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New Year Greeting

To our readers and patrons whoever and wherever they may be we wish a Happy New Year. May the coming twelve months be full of happiness and prosperity to them; may the past year which has been unfortunately fraught with many perplexities and annoyances be forever forgotten, and may the joys of the future be limited only by the sky above and as far as the North, East, West and South extend. Let us all hope that the prosperity in sight will continue for many decades, and that the dawn of a new era will not be broken in its expansion by interrupting shadows.

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Track Labor in Winter

There is an increasing sentiment in the engineering departments of our railroads in favor of maintaining section forces as nearly as possible at the same working strength the year round. The arguments involved have been stated and re-stated until it is only necessary to touch briefly the important points in presenting the case for such a policy.

Track labor has entered the classification of skilled labor. No experienced roadmaster will defend the theory that an untrained man in a section force is worth as much as a man of several seasons' experience. When a man's experience at any kind of work becomes a determining factor in his value for that kind of work he enters the class of skilled labor. The tamping of ballast evenly, to give a smooth-riding track surface; the tightening of joint bolts-tight enough to hold the joint, yet with enough elasticity to allow for expansion and contraction of the rails; the adzing of a rail seat or tie-plate seat to give a bearing on which the rail will maintain line, gauge and surface; the proper sloping of drains to minimize pocketing and stoppage; the fastest possible results in switch and crossing installation or renewals to prevent delays to traffic; all of these parts of the section laborer's work offer opport anities for the experienced man, the skilled laborer, to save time and money for his railroad.

A skilled laborer must maintain his skill by practice. The man who, by not getting steady employment at his regular work is forced to seek other employment, loses his value to himself, and he loses his value to his employers. A skilled track laborer is of no greater value to a farmer for his experience at track work, and the reverse holds true. The versatility of the jack-of-alltrades has lost its commercial value both to the man and to his employer in this age of specialization. An experienced track laborer at \$2 a day is a better investment for a railroad than an inexperienced laborer at \$1.50. The data compiled by a number of careful roadmasters proves this beyond question. In addition to this disadvantage of employing unskilled track labor, there is the fact that at the usual time of increasing section forces in the spring, the market is the keenest for unskilled labor; farm work, building construction, road construction, municipal improvements, all enter the labor market on a competitive basis, and the unskilled laborer reaps the benefit of this competition by a higher wage than his lack of experience warrants.

The railroad fiscal year, with its inevitable attempts to curtail expenses during the spring months, in anticipation of the annual report has been held largely to blame for the present undesirable condition.

Another factor of perhaps equal moment is the idea that there is not much for track men to do in the winter months, making the saving effected by reducing forces in winter compensate for the higher expense involved in summer work with inexperienced labor. This need not be so. Track men who have given the matter much thought have devised plans for employing section forces in winter in such ways as to reduce the amount of summer work to a point where the winter force will suffice. Distribution of material; care of track and drains during freezing and thawing weather; repairing of tools; cleaning and thawing of switches and interlocking plants; repair work on buildings are all legitimate winter activities by which some roadmasters are utilizing forces of four men throughout the year, rather than two men in winter and six for spring, summer and fall.

To these winter activities can be added increased track inspection, for the broken rail is almost wholly a winter problem, and the care of snow around station buildings, where the patrons of the road can be very satisfactorily impressed by dry, clear platforms and approaches. Wet feet in boarding a train, resulting from wet or slushy platforms are not only a source of annoyance, but often of ill-health to the passengers.

Another solution of the problem of equalizing summer and winter work for track forces is suggested, which provides that section men recruited from the outlying sections be used for the winter work around terminals and classification yards.

Year round employment for track men is the goal. When this can be accomplished, men can be held year after year, giving the road the results of their experience in the form of skilled labor, and obviating the necessity of competing in the labor markets for unskilled labor at the time when wages are the highest.

The increasing use of the electric current on railways for the movement of locomotives, motor cars, shop machinery, signals, etc., as well as for lighting shops, cars, lamps, and for the production of heat, has introduced a new form of danger to menace the unwary. This is the possibility of receiving an electric shock. These shocks may be either permanent or temporary in their effects. If the former, death takes place, usually instantaneously, as as far as we can judge, without any pain. The temporary effects of electric shock produce complete unconsciousness, which, if the victim be not restored, will result in death.

The immediate significance of this fact lies in its bearing on every day conditions. Many of our large railways are electrified on various sections. As this application of electricity is comparatively new, there is necessarily a good deal of misconception, or perhaps ignorance on the part of section men and others who work on the right-of-way as to the nature and power of the current that flows in third rail or overhead wire. It constitutes a menace to safety, and where want of knowledge exists loss of life may result. If one of these men should be struck down or overcome by contact with the electric conductor he appears at once to be beyond the reach of help, although this is not necessarily the case by any means.

The temporary effect has all the appearance of death, and the beholder has no alternative but at once to resort to restorative measures. Medical aid should be summoned without any delay and the witness of the accident should at once begin to produce artificial respiration, and persist in it for hours if necessary in order that life may be saved. The rule of action may be very simply stated. It is, that the sufferer from electric shock should at once be treated as one partially drowned. In any case, the victim can do nothing for himself, he appears to be dead and will certainly die, if not effectively cared for, without loss of time.

At first sight the reason for the same restorative measures being applicable alike to cases of apparent drowning and electric shock does not appear. A man apparently drowned has his lungs filled with water. This liquid is too heavy to be expelled in the respiratory process, the principle one of which is the diaphragm.

The diaphragm is the muscular partition in the body separating the heart and lungs from the abdominal vicera, such as the stomach, liver, spleen, intestines, etc. In the case of a man apparently drowned, the diaphragm is unable to act and respiration ceases. Artificial respiration and the consequent emptying out of the water from the lungs is essential. In a case of electric shock the lungs are full of air, but the "stroke" or the flow of electric current acts on what physicians call the medulla oblongata, and affects the nerves from it so as to inhibit or stop the movement of the diaphragm. The medulla oblongata is at the base of the brain and is the part at the back, low down, near the neck. A man buttoning his back collar stud can by raising his hand up to the head, touch the place where this division of the brain is located. This region is the origin of the nerves which control involuntary action, such as the nerves which govern the action of the heart and of the diaphragm, which latter is most largely the cause of respiratory action.

The partially drowned man, and the man electrically "shocked" both have the diaphragm action stopped. In the first case it is like a clock whose pendulum becomes stationary because the hands are jammed. The second is as if the mechanism of the clock was free, but the pendulum had been arbitrarily stopped. In either case the pendulum must be made to swing again. In the human frame artificial respiration brings back the normal action of the diaphragm and the process of resuscitation goes on.

A pamphlet issued some years ago by the United Gas Improvement Co. of Philadelphia sets forth the procedure to be followed in case of electric shock. In it the patient is represented as placed upon his back. This is the supine position. In a treatise lately published by John Wiley & Sons, of this city, by Dr. Lauffer, the patient is placed face down. This is the prone position. Both methods have their advocates and both are effective.

The imperative necessity for prompt action by the man who would render first aid, becomes apparent when we remember that human beings have been able to live without food for forty days, and to subsist two days without water, but no one can be without air for more than two minutes without most seriously endangering his life. In these cases the victim is absolutely helpless, the friend who attempts to render help cannot take time to telephone or hunt up a physician, he must get to work on the instant. If he is fortunate enough to send for assistance, well and good, but in any case he must work, steadily, perseveringly and without cessation in the interest of his fellow man.

In all this the man who works unfalteringly must not measure his time nor his endurance. He must put success before him as the one, only, and paramount consideration. He must encourage himself in his efforts by the assurance of success, he must not stop to doubt. Who may say that the influence of his persistence and his will may not evoke a faint response in the helpless and stricken but still living friend to whom he ministers? The effects of individual rage or fright in a mob of people reveal themselves in the actions of many who do not see or hear the frenzied man, and may it not be that the action of what has been called "mob psychology," applied in a particular case, to a being who appears not to see or hear, yet may turn the scale or at least give him the full benefit of what power there is in resolute effort backed by the kindly thought.



A Glaring Menace

We call attention to the article on highway crossings in this issue, which will be followed by others on the same subject. We shall be glad to have comments or papers from our readers at any time relating to this present-day engrossing theme. The grade crossing, besides being a menace to vehicular traffic and the peaceful citizen who has a right to go that way, is unfortunately an invitation to the tramp and others who like the ties for a sidewalk, to invade the right of way, perhaps meeting death in the end or suffering serious injuries. The elimination of such crossings, for the latter reason alone, then, is of vital consequence. The trespass evil will to a large extent be thereby overcome, and that evil is today a public misfortune, as we all know.

Five thousand four hundred seventy-one trespassers on railroad property were killed in this country last year and 6,354 were injured. On the average, 16 trespassers are killed every day and 17 are injured-not all of them on account of invasions at the grade crossings. but a very large number of them. We referred to this evil and the suppressing of it at some length in our August issue of 1915, and in our November and December issues discussed the subject, especially referring to the separation of grades by the New York Central at Buffalo and by both the New York Central and the Pennsylvania roads at Erie, Penn. The stupendous work and expense involved in the elimination of grade crossings in Buffalo were apportioned by agreement between the New York Central and the city, and resulted in the separation of twenty-three streets. The whole operation was begun and finished within five years. This resulted in doing away with every heretofore dangerous crossing in the city, with the exception of two, so far as the New York Central was concerned, and this was a momentous accomplishment. At Erie an agreement has been consummated between the city, the New York Central and the Pennsylvania whereby, at an expense involving some \$2,000,000 or more, twelve streets will be taken care of by eliminating grade intersections.

It will thus be seen that this matter is a live one and well worthy of consideration, from more than one point of view.

Comparisons Are Odious

That famous news sheet, the Springfield (Mass.) Republican, not long ago brought forth some interesting information regarding railroad speed, as far back as 1851. It mentioned that a contest was arranged, under stipulations as to load, fuel and steam pressure, to take place in October of that year. A half dozen locomotives were entered in this contest. The distance to be covered in the competition was nine miles.

A locomotive bearing the name of Addison Gilmore covered the distance in eleven minutes and twenty-nine seconds and won the prize. The achievement was referred to, in that day, as something performed in "hairraising" time. The other five engines trailed along, respectively, in this trial of speed, in 12 minutes and 50 seconds, 13 minutes and 26 seconds, 14 minutes and 7 seconds, 14 minutes and 35 seconds, and 14 minutes and 58 seconds. It certainly was hair-raising speed for those days, but special runs today and special portions of track, on regular runs, are covered with heavy loads behind the locomotive at rates of speed so far superior to the speed with small loads, attained in 1851, that we smile at the comparison, but sixty-four years hence results will undoubtedly show such comparisons with the present day speed that people living in that generation will have a chance to smile—too.

The Merchants Association of New York

This association has done a good many public spirited things the past year besides encouraging and advancing business affairs within its own particular circle. It has gone abroad in the cause of the railroads of the country in a way to merit more than ordinary commendation and in pressing the claim that the railroads are and have been grossly treated in the matter of compensation for carrying the mails they have stirred up an interest on this subject in pretty much every city of consequence in the land.

The resolutions adopted by the Merchants Association in this all-important matter have substantially been imitated, in addition to many others which have already taken action, by the Chambers of Conmerce of Philadelphia, San Francisco, the State of Connecticut, Spokane, Washington; Eugene, Oregon; Zanesville, Ohio, and Springfield, Ohio. The good work is still going on. Associations like the Merchants Association of New York are of wonderful assistance, not only in promoting affairs of local interest, but in improving and instituting many matters of national importance. The railroad companies certainly owe this association a vote of thanks.

Electrolysis Mitigation

A paper giving a brief general statement regarding electrolysis and corrosion and presenting a detailed discussion of the various methods of electrolysis mitigation that have been proposed or tried for protecting underground structures has just been issued by the Bureau of Standards, Department of Commerce, Washington, D. C. There is no charge for this paper. Methods of mitigation are treated under two heads, namely, those applicable to pipes and those applicable to the railway return system. The conclusion is drawn that while certain of the methods applicable to pipes, particularly pipe drainage and insulating joints, are often valuable, they should in general be used as auxiliary measures only, the chief reliance being placed on reducing potential drops in the railway return to reasonably low values. Where return feeds are necessary for accomplishing this, insulated feeders are preferable because they are more economical.



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Lift Bridge Over the Thomson River at Kamloops

Thirteen Deck-Plate Girder Spans, with Lift Span at Channel, Giving 57 Ft. Vertical Clearance Above Maximum High Water

The lift bridge over the Thomson river at Kamloops, B. C., Canada, is in type like the famous Tower bridge in London, which was built from a fund held by the Bridge House Estates, an old institution which derived its original revenue from the sale of the properties and rights which once existed when the bridges entering any large town had shops built on them so as to secure traffic from travelers in and out of the city.

This type of bridge, applied to railway uses, has a moveable floor which carries the tracks of the road, and when in place in its lowest position forms one part of a long continuous bridge. The lift floor can be raised deck level so that the operator has a clear view of the river both up and down stream.

The bridge was designed and construction supervised by Waddell & Harrington, consulting engineers, Kansas City, Mo. The cost to the railway company of the bridge complete was about \$250,000.

The lift span is counterweighted like an elevator in an apartment house or public building and when down in its lowest position it rests on the piers, and the weight of the train when crossing is carried on the permanent supports, like the rest of the bridge. When raised, the lift span is light and nothing more comes



Distant View of Thompson River Bridge, in British Columbia

by suitable machinery and engines from the lower level position to a height sufficient to permit the passage of boats and steamers below it.

The Thomson river flows through hard sand and rock at this point and is in what is known as the grazing region of British Columbia. The river is navigable some distance below Kamloops and for a considerable distance above the bridge, so that the government requires navigation rights to be respected. The Thomson has two branches which join at Kamloops, one branch being known as the North Thomson and the other the Thomson. The North Thomson comes down through deep, impassable canyons, while the Thomson drains a series of mountain lakes.

The bridge is on the line of the Canadian Northern Railway, and consists of 13 deck plate girder spans 93 ft. center to center of piers. A movable span of the vertical lift type is provided at the channel and gives a horizontal clearance of 80 ft. and a vertical clearance of 57 ft. above maximum high water.

The lift span is operated by a 12-horsepower gasoline engine which opens or closes the span in a hundred seconds, that is, 1 minute and 40 seconds. The operating machine is located between the main girders, and below the deck. A small operator's cabin is located on the on the chains, gear, brakes, etc., than the unbalanced weight of the girders themselves. In this way the work of the hoisting engines is not excessive, and wear of parts is practically nil. For the kind of service to be performed, this style of bridge is eminently suitable, and its maintenance charge is not large.

Trust and Savings Fund for Employes

In line with railroad relief associations which we have heretofore mentioned, we find that the Westinghouse Electric and Manufacturing Company has recently established a savings fund, which offers facilities to its employes for the handling of their savings accounts. It encourages a spirit of thrift among the employes and cannot help but be of great benefit. The example of the Westinghouse Company is most commendable. The fund is open to any employe of the company, wherever he may be located, and he may become a depositor at any time and discontinue at any time. The amount of the deposit cannot be less than 10 cents and may be any multiple thereof, and the deposits must be made from each regular pay. The deposit, however, is limited to one account, the amount of which





Lift Bridge Over the Thompson River, Canadian Northern Railway

in any one year cannot exceed \$500. The idea of this is that the plan is intended as a method of encouraging the employe to save his earnings and when he has been successful up to this point, allow him to handle his own finances. Interest is paid on the deposit at the rate of $4\frac{1}{2}$ per cent., which is credited semi-annually.

An interesting feature of this fund is that the Westinghouse Electric and Manufacturing Company acts as a trustee and guarantees the deposits and the interest. The rules provide that an amount of \$100 or less may be withdrawn, without notice, but an interval of two weeks must elapse before a subsequent withdrawal can be made and for withdrawals of more than \$100 notice of one week must be given. An auditing committee, not to exceed seven persons, is to be elected by the depositors from among their own number, which committee shall be given an opportunity to examine the condition of accounts at semi-annual interest periods, the findings of which shall be published.

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Outline Drawing of Spans 7, 8 and 9, Thompson River Bridge

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The Magnolia Cut-Off on the Baltimore & Ohio Railroad

Lower Grades and Reduced Mileage Save Expense in Haulage. More than 3,200,000 Cubic Yards of Material Removed

On the eastern division of the Baltimore & Ohio Railroad the right of way is through a hilly formation for nearly 100 miles east of Cumberland, Md. To reduce the grade on a section where the up grade had such an incline that helper locomotives had to be placed in service to haul the freight up this incline, the engineers of the company planned and built a cut-off 11 miles in length which saves the expense of extra power for hauling, and adds more track-way for train movement. This route is known locally as the Magnolia Cut-off, and involves removing more than 3,200,-000 cu. yds. of excavation, over 90 per cent of which is rock; the driving of four double-track tunnels with a combined length of 7,225 ft.; also the construction of two crossings over the Potomac river, with a total length of 2,054 ft., and the building of 5,200 lineal feet of concrete retaining walls.

In driving the tunnels drills operated by compressed air were used, the compressor or plants being contiguous to the work. The drilling in the Doe Gully cut was done by compressed air power drills. The three excaon the banks, in revolving mixers, and the major portion was delivered to the towers by derricks and tramways, elevated, and deposited into the various units through chutes. The steel was erected without falsework, from the shore with a 50-ton derrick car, which loaded the material from the low level and placed it in position, moving outward as the work progressed. The field riveting was done with compressed air hammers. The average length of the girders was 100-ft. deck plate type, with 90 and 80-ft. lengths on the approaches, and where the Kessler bridge crossed the present line, it was necessary to use through girders, with ballast deck; the rest of the bridge being open floor. The dimensions of the piers were 8 by 35 under the coping. No floating plant was used for the work. Approximately 26,000 yds. of concrete were placed in the river bridges and 48,000 yds. in the retaining walls west of Kessler's and west of Paw Paw. All of this concrete was mixed in revolving mixers, one part cement, three parts sand, and five parts broken stone. The coffer dams were placed on the rock bottom of the river and



Cut which Eliminates Tunnel on the Baltimore & Ohio at Doe Gully

vators ranging from 60 to 70 c. yds. capacity in ten hours, were of the Bucyrus, Marion, Osgood-Marion type with operating dipper bucket shovels $3\frac{1}{2}$ cu. yds. capacity.

The rock to be taken out of the open cuts as well as from the tunnels, was of a hard formation, necessitating the use of 40 per cent dynamite cartridges, inserted in holes bored by steam drills in the tunnel formation and by well drills in the open cuts, where the rock wall inclined from 45 to 60 degs. from horizontal. Thus the rock was shattered, to be removed by the excavators.

In constructing the bridges, the concrete was mixed

carried to the height of ordinary high water. Ordinary sheathing was used with clay puddling. The reinforcement consisted of $\frac{3}{4}$ -in. round rods with triangular mesh near the surface.

This work is estimated to cost fully \$10,000,000, or \$500,000 per mile, and will eliminate 5.95 miles of distance, and 377 deg. of curvature. It will also reduce the maximum grade against eastbound traffic from 0.5 per cent to 0.1 per cent, eliminating a grade 2.8 miles long, and releasing two pusher engines.

Starting from a connection with the old route a short distance west of Orleans Road, the new route ascends on a 0.4 per cent grade to the west end of the present Doe Gully tunnel, and is being built as a four-track road to reduce the existing 0.55 per cent grade westbound. At Doe Gully tunnel the new route leaves the old and extends west generally parallel to it, but on a 0.1 per cent descending grade, for two miles to Hansrote, and is located on a bench adjacent to but considerably above the operated tracks.

At Hansrote the new route turns abruptly into the hill and after passing through Stuart tunnel crosses the present route and the Potomac river, passes through Graham tunnel, and again crosses over the river and the existing line. It then continues parallel to the present road for over a mile, but on a bench about 40 ft. above it. It passes through the southerly limits of the town of Paw Paw, and joins the old route at Little Cacapon; the 0.1 per cent grade being almost continuous from the summit at Doe Gully.

At Doe Gully a double-track tunnel was replaced by a four-track open cut, with a maximum depth on center line of 195 ft., and requiring the removal of 1,350,000



The Magnolia Bridge-Eleven Spans

cu. yds. of material, nearly all of which is rock, lying in strata tilted sharply on end. In addition to the amount and character of the material to be removed, the excavation of this cut was complicated by the necessity of keeping the present double-track tunnel in continuous service.

As shown in one of the illustrations, the material on the west side of the cut and over the tunnel was excavated by steam shovels to within 10 ft. of the roof of the tunnel. A vertical ledge of 16 ft. wide was then left west of the west wall, and the west half of the cut was taken out approximately to grade. A temporary double-track line was then laid through this cut for emergency use, in case the tunnel should be blocked during its removal. Because of the depth of the cut and the character of the material the slope on the west side has been benched at intervals of 50 ft. vertically, while the opposite slope will be treated in the same manner after the tunnel has been removed. These benches are designed to afford drainage and to prevent slides, and have been built on grades of 3.2 and $1\frac{1}{2}$ per cent on the upper, middle and lower levels, respectively. The material from these benches was wasted at the elevation of the benches at the ends of the cut.

Immediately west of Doe Gully the new route passes through a hill by means of a tunnel 1,025 ft. long, known as Randolph tunnel. This tunnel is located on a 4 deg. curve. Here a top heading 9 by 16 ft. was first driven. Following this a model 20 Marion air-operated shovel widened the heading to the full arch section. The bench was then removed by a large shovel. The arch was lined with timber as the excavation progressed, and this was replaced with the permanent concrete lining as soon as the steam shovels had completed their work.

The standard lining consists of concrete up to the 25 deg. line, faced with one course of brick above this



Three Engines Working in Cut on Magnolia Cut-Off

point. To secure a bond with the concrete, every fifth brick was made a header. Blaw steel forms were used. Refuge niches were inserted on each side at intervals of 100 ft., and cable and switch boxes were placed 300 ft. apart.

One of the most interesting portions of the work is that from the tunnel southerly $1\frac{1}{2}$ miles to Hansrote. Between these points the new route is closely adjacent to the exisiting route and on a bench above it. Because of this close proximity it was decided to shatter the formation with explosives where the material is not being excavated by steam shovels, forming benches not to exceed 8 ft. in depth, and the waste was dumped into ravines at the level of the different lifts. A considerable amount was so placed on the river side of the present tracks to permit these tracks to be extended laterally at certain locations, in this way reducing the



Magnolia Cut-Off Looking East from Present Tracks, Showing Smith McCormick's Wall

maximum degree of curvature from 5 degs. to 3 degs. At Hansrote the new route leaves the old and turns abruptly into the hill, crossing the mountain divide through Stuart tunnel 3,600 ft. long. The east approach to this tunnel required the removal of 205,000 cu. yds. of rock. About 90,000 cu. yds. of similar material was removed from the west approach. At the latter point considerable difficulty has also been encountered in establishing the portal, because of the sharply inclined and badly broken strata. This tunnel is constructed on a tangent, except for 371 ft. of spiral within the east portal.

This tunnel was driven from two shafts 117 and 40 ft. deep, also from the west portal, the east approach cut not being completed in time to enable a heading to



be driven from the east portal. As in the Randolph tunnel, 9 by 16 ft. center headings were first driven, working in this instance from five points. These headings were widened to full section by hand, except for the first 1,000 ft. in the west heading, where a 20-Marion shovel was also used.

With this shovel it was possible to widen and timber 60 to 70 lineal feet of the arch section per week, as compared with 45 by hand work. The shovel also removed 6 ft. of the bench at the same time, to secure the necessary working clearance. The bench was then taken out with the large shovels. Because of the difficulty encountered in establishing the portal at the west end and the uncertain character of the material at the east portal, the center heading was driven from the shaft to within 72 ft. of the east portal, at which point it opens into two wall plate drifts. The entire arch The route of the cut-off west of Kessler's bridge required a concrete retaining wall along the shore of the river between tracks. This wall is of gravity section, non-reinforced, and with a maximum height above the footing of 31 ft. The elevation of the top of footing is 3 ft. below the top of the rail of the lower line. The construction of this footing has been a difficult engineering problem, as in some cases it has been necessary to go as much as 14 ft. below the top of the footing to secure a proper foundation, while in other cases it has been necessary to remove a 40-ft. rock face to secure sufficient bench. The top of the wall is 4 ft. above the elevation of sub-grade of the new route.

This wall required the placing of 22,000 cu. yds. of concrete, deposited by means of a movable traveler spanning the two main tracks. The traveler was of steel construction with a horizontal clearance of 32 ft.



View of Construction Work on the Magnolia Cut-Off, on the B. & O.

section was then removed for 30 ft., after which the wall plate drifts alone were driven, leaving the center support for the roof for 42 ft. in from the portal, until the portal was turned. Both steel and timber centers were used in this tunnel, the steel being used where especially loose rock formation was encountered, while the wooden centers were employed elsewhere.

A short distance west of Stuart tunnel this new route crosses the old, at Magnolia station, continuing across the Potomac river, passing through a point in a tunnel 1,600 ft. long, and then recrossing the river and the operated line, all in a distance slightly over one-half mile.

The bridge at Magnolia consists of six 100-ft., three 80-ft., and two 75-ft. deck plate girder spans on concrete piers, with the new grade 50 ft. above the old route and 60 ft. above the water. The viaduct at Kessler's curve consists of four 100-ft., and six 75-ft. deck plate girder spans with three skew girder spans over the old route, with a combined length of 202 ft., 6 ins. Both structures are designed for Cooper's E 60 loading.

The piers for both structures are founded on rock about 5 ft. below the river bed, and one of the views we give shows clearly the different steps in their construction. 9 ins., and a minimum vertical clearance of 23 ft. 3 ins. above the high rail on curves. Two derricks with 50-ft. booms and two boilers and hoisting engines were placed on the upper platform. In this way all excavation for the wall footing and the depositing of the concrete was handled by the derrick without interfering with the main track and without any material crossing the tracks at grade. The forward derrick conveyed the excavation ahead of the wall, while the other one deposited the concrete. When removed from one section of the wall to the next, the forms were lifted free of the completed work. The traveler moved on two rails, supported on timber blocking. The wall was built in 50-ft. sections, and a section could be completed in two days.

A short distance west of this wall the new route passes through the southerly limits of the town of Paw Paw. Shortly after leaving the main line the new railroad passes through Carothers tunnel, 1,000 ft. long. The material encountered here and the methods of driving are similar to those described as used at the other tunnels. One of the largest cuts on the line was at Paw Paw, where over 500,000 cu. yds. of material, largely earth, was removed. The maximum depth of the cut at this point was 96 ft.

This material was hauled west to a point where the



old route is to go towards the river, and be graded to allow space for a four-track line, and at the same time to raise the grade of the old line above high water. A portion of this new fill extends into the river, and to protect it from being washed out by flood current, another retaining wall, similar to that east of



End of Retaining Wall, West of Kessler's Bridge

Paw Paw, was constructed for a distance of 3,300 ft. This wall has an average height of 24 ft. and was built in the same general manner as the wall previously described, but here, as it was not necessary to span any tracks, a wooden traveler was provided to carry the forms only, and the concrete was deposited with a locomotive crane. Two sets of steel forms were provided for 30-ft. sections and these were used alternately. About 25,000 cu. yds. were required for this wall.

This illustration of engineering ability in perform-



Middle Bench of Doe Gully Cut

ing a very difficult work, was planned by the chief engineer, Mr. Francis Lee Stuart. It was carried out by Mr. John T. Wilson, district engineer, and Messrs. Errett M. Graham, T. C. Marshall, and Tazewell Ellett, Jr., resident engineers. The total force employed was approximately 2,500 men, and the total cu. yds. excavated was 3,300,000.

Temperature Influence on Concrete

Some very interesting and informative tests on how far temperature may influence the attainment of strength in concrete were carried out a short time ago at the University of Illinois. Three groups of tests were made, the first on forty-five cylinders 6x6 ins. The second group was on fifty-one 6-in. cubes and the third on cylinders 8x16 ins. The quality of the materials are considered as typical of that used in first-class concrete work in the Middle West. The cement taken was Universal Portland cement, which passed the standard specifications of the American Society for Testing Materials. The sand used was from a deposit of glacial drift near the Wabash river at Attica, Ind. The stone

was crushed limestone from Kankakee, Ill. It had been carefully graded and screened over a $\frac{1}{4}$ -in. mesh before use. It contained 10 per cent of material smaller than one-quarter of an inch.

The concrete tested consisted of one part cement, two parts sand, and four parts of broken stone, and is represented by the figures 1, 2, 4. The materials were weighed separately and then mixed on the floor with shovels. The test specimens of Group 1 were weighed measured, their bearing surfaces coated with plaster of paris and left in the testing room for 20 hours in a temperature of 70 degs. F. Group 2 were tested an hour after being brought from storage in a temperature of 70 degs. F. Group 3 were similarly treated. In group 2 two specimens were subjected to special treatment. In standardizing the strength of specimens the observed values of cubes and cylinders were brought to what may be considered equivalent values, such as would be obtained from cylinders with height equal to twice their diameter. The observed values were multiplied by 0.73, which is the ratio of strength of prisms to cubes as determined by the Committee on Specifications and Methods of Test for Concrete Materials, of the American Concrete Institute.

The bulletin of the university, which is No. 81, thus summarizes the general conclusions which it is thought to be justifiable from the mass of data secured, the tables compiled and the curves plotted as a result of the experiments. It may, however, be pointed out that groups 1 and 3 were tests of cylinders 6 and 8 ins. in diameter, and 6 and 16 ins. high, respectively. Group 2 was concerned with cubes 6 ins. a side. The report states that owing to the effect of the restraint of the pressing surfaces of the testing machine, the results of these tests were not considered. It is therefore on the information secured by the testing of the cylinders that the value of the conclusions rest.

The report says in effect that under uniform temperature conditions, there was an increase of strength with age within the limits of the tests. For any temperature the rate of increase decreases with the age of the specimen; and this rate of increase is less correspondingly at the lower temperature conditions. For the specimens tested, under normal hardending temperature conditions of from 60 to 70 degs. F., the compressive strength of the concrete subjected to a uniform temperature at the ages of 7, 14, and 21 days may be taken as approximately 50 per cent, 75 per cent, and 90 per cent of the strength at 28 days, respectively. For lower temperatures the percentage values are less; and for higher temperatures the percentages are higher. The relation between the percentage values at the ages of 7, 14, 21, and 28 days is nearly the same for temperature conditions from 30 to 70 degs. F. The values for the lower temperatures should be used with caution. Concrete which is maintained at a temperature of 60 to 70 degs. F. will at the age of one week have practically double the strength of the same material which is kept at a temperature of 32 to 40 degs. F.

The figures given in the report as Nos. 15 and 16, it is stated, may be used to determine the representative strength of concrete similar to that used in these tests, for various temperature conditions and for ages up to 28 days. It should be noted that generally in this investigation the specimens were stored under temperatures which were nearly uniform during the whole storage period. In a particular set, designated as F, the variations in temperature include a number of alternations above and below the freezing point and the specimens were seriously injured. The results accord with the well-known effect of freezing and thawing upon green concrete.



Formation and Prevention of Pockets and Soft Places

By C. A. DAVIS

The Importance of Attention to Drainage in the Early Construction of Railroads and in Track Maintenance Work from Year to Year

There are three important things to be considered on the subject of pockets and soft places: 1st, the cause; 2d, to prevent, and 3d, to check them after once formed. The statement in your editorial in the July issue, is true, that improper construction and placing of material in the first place, gives a start for pocket formation and soft places that may not become fully developed for a number of years and yet be the direct cause of what has cost railroads millions of dollars and many deaths, and loss and damage caused by wrecks. Years may have elapsed since the construction work was first done, but this defect can be readily traced back to where it started. The smaller the fault the longer period will elapse before it can produce noticeable trouble.

In order to confirm this statement it becomes necessary to show the oversight or erroneous theoretical belief adhered to, while the construction of the road bed was going on. The theory demands most rigid investigation, in order to right the theory and also overcome many of these soft pocket places, by preventing their first formation. I can safely say that a large number of pockets and soft places are the direct cause of poor grading and the way the grade was finished, although part was the fault of bad track laying and surfacing, but most of the pockets were not formed when grading was started. Grading and ballasting are done in accordance with theoretical instructions more than the placing of material. This I cannot call anything but defective theory that soon develops into trouble and it takes thousands of dollars to maintain a passable track but rarely a safe one, at all times.

On all grade work stakes are set and the work completed and accepted before permission is given for track laying. It is well known that the crown of the grade varies but is invariably made level on top, this being one of the greatest causes of future soft spot and pocket formation together with the grade and class of earth put in. The kind of earth has the largest part chargeable to it, on account of the flat finish. It is evident that earth with large lumps will be more open and after a few rains become soft, and the clods will soon pack and cause a lower place in the grade than where the earth was more fine and loose. This produces an uneven surface and makes places that may only retain a small quantity of water, yet this will be enough to start a soft place and instead of becoming smaller it will increase until it becomes of troublesome and, by improper repairing, soon develop into a serious pocket formation.

These troubles could in a great measure be prevented if only a practicable result was considered, regardless of theory in finishing the grade. If all grades were finished with a rolling top it would cause water to run off, leaving the crown dry after all rains, which would prevent any formation that would hold water for a pocketstarter. There cannot be any practical and observing track-man but will back up my statement that a large per cent of these pockets and soft places could have been prevented if the grade had been so finished that these pockets could not have got a start. To further condemn the flat-top finish it is only necessary to state that when the track is laid as near the center of the grade as is practicable, there is an enormous weight on about 8 ft., while there is from 4 to 6 ft. without any additional weight extending from the end of the ties each way to the edge of the grade on fill and in cuts. This will cause a much faster settling under that part covered by the track than that out at each side, thus forming a trough instead of a shed as should have been done.

This defect is not so prominent that an official passing along would observe, if it was anything out of the ordinary, but any practical man who is looking for cause and effect can see this condition, and ofttimes tries to remedy it by cutting down the shoulder and casting the earth off to give better drainage. This succeeds to a certain extent and gives some relief, but it does not always accomplish what is desired. As grades are made over an undulating section, this trough is formed, and water accumulates. It follows down a descending grade and where there is a raise it will so accumulate in front of it and form a regular boggy soft place that if not properly handled will require tiling or course stone so placed that the water can escape, but this will only give partial relief, for the trough still exists and causes a disturbance after each wet spell.

It is not an uncommon thing to see on newly made grades before the track is laid, where water has run for some distance before leaving the surface and when it does, will wash the earth in the cut ditches or off the edge of fills, then how can any better results be expected after the track has been put down and the lowered condition caused by this additional weight. The only noticeable difference is that the water has to zigzag under and around the ties, thus covering a greater surface and making a much wider wet place than when running without meandering among the ties and permitting much more water to settle in the ground, leaving no visible trace, but the track will get out of surface and line.

Thus we find the first and original starting of what in later years will develop into troublesome pockets and soft places which could have been prevented had theory been sidetracked. This would not have cost one penny more at that time and would have saved many thousands of dollars later on and give a much better track and one that could have been maintained at a much less cost. This is not an opinion of my own, but the result of close observation on many miles of new track that I have had charge of from the first start in grading through track laying and ballasting, not at any one place but in four different States-with the same result in each. Most if not all these conditions could have been prevented had the grade been finished with a raise of about 6 ins. descending to the outer edge, and by being positive that there is no place where water could accumulate and stand before the track is laid.

After the track is laid and settled we have the proper drainage as the shoulders will be sufficiently low to give a perfect drainage from the end of the ties if they are properly laid and surfaced. I can give over fifty different locations where track was rushed on new grade with the same result and almost all soft pocket places had the same origination. I will give the reason for

their formation; namely, the placing of crooked ties with the bow down, especially if a pole tie made from a young tree just large enough to make one tie. When these are laid bow down there is no possible way to prevent water from gathering at the center, and it is bound to produce a softer point than at other places. A split tie may be bowed to a certain degree, but if the heart side is put down it will invariably become straight as soon as the weight is put upon it, and cause no bad results.

The first surfacing has a lot to be charged to the soft spot, but it is not noticeable at first. That is by tamping up the end of the ties and filling in and dressing up regardless of whether there is anything under the center of the ties or not. This to a certain extent is the result of too much rush work and a desire to make a record. Track surface made in this hasty way will soon fill with water and soften the center so that it will cause untold trouble before it is overcome. If track is properly laid and surfaced, a large percentage of the defect chargeable to construction would be overcome, and it would cost but a trifle more, if any, at that time, which would make a large saving later on. The track should have about 4 ins. raise, and every tie should be tamped and filled underneath and then filled in and so dressed that water will run off, and if all surplus earth that is on the shoulders is not utilized it should be cut away and thrown out so that there would be a drain at all places.

There cannot be too much attention paid to the first surfacing filling and dressing of new track if good and lasting results are to be obtained, which is the desire and expectation of every one who has the permanent maintenance to look after. This is the effect, cause and remedy for the principal part of the soft pocket formation.

We now proceed to the next cause and effect brought about in applying ballast. I will say that there are far more pockets and soft places made while applying ballast than many believe, yet it is nevertheless true, that by strict attention and careful watching for developments after a track has been put up on ballast in first class shape, that it becomes apparent. Stakes are set and instruction given as to how high to raise and what work must be done in preparing track for ballast, and right here in the preparing I have found the main cause, and have seen, to my sorrow, the effect, after a piece of track has been put up on ballast and dressed and looks perfect, and should be satisfactory in every way for years to come, but faults will soon develop and give an endless lot of trouble. Now the instruction is to throw out all earth from between the ties before ballast is unloaded, and as a general rule it is done, but right here arises the question with what future results? Let us take an observation as to how it is done and see what is hidden when ballast is distributed. It is very easy to get the earth from between the ties inside the rails, but from under the rail is more difficult, and is entirely too often left, with only a small portion, if any, taken out. Now if the rest was only taken out as low as the bottom of the ties it would still leave a ridge under each rail, forming a trough; but this is not the worst. Almost invariably the earth is dug out below the tie bed in the center, for several inches, thus forming a small receptacle for water to stand, and the ballast completely hides it from view; but later years will develop a pocket or soft place, with no other cause than this preparing for ballast.

I have seen miles of this kind of work done, and later on had charge of this division and examined and fought hard to overcome the trouble, which I did to a certain extent; but not what should have been done, as it was so costly that I could not get the material and help that was required.

At the time this track was being ballasted I had charge of another division, and was given all the ballast that I considered necessary, and permited to make just what raise I considered necessary to give a permanent piece of track without having a grade stake set, or any instruction as to how the work had to be done. Instead of casting out the earth, as theory said, I distributed the ballast after cleaning off the shoulders and gave the track a good raise, tamping the ends with ballast, and then pushing the earth in the track down in the old tie beds and to the center of the track, which made it something like 4 ins. higher than out at the end of the ties. Then I unloaded more ballast and gave not less than 8 ins. raise at any place, and using a spot board brought up the rest of track to these points, with the result that there were no weak spots. There was 40 miles of this work, and I can say that for three years after, while in my charge, and for years following there had not been any pockets or soft places develop. The foreman on the adjoining division had the earth thrown out, and he had pockets and soft places develop all over the division.

But of these facts are there enough to prove or disprove these statements? There is no foreman that ever put up ballast but will say that after throwing out the earth and raising the track that there are old tie beds that are much deeper than the rest of the earth. and when ties are spaced this old bed often comes entirely out from under or at most partially comes out from under a tie which makes an uneven bed of gravel, permitting the tie to cant and work toward the weakest place, and at the same time this old bed being packed down solid will retain water almost like a pot or pan. This being the true condition, how can there help being soft and pocket places form, and instead of diminishing they grow gradually larger after each rain until they become so enlarged that it takes work, material, and a large outlay of money to overcome them so as not to develop in later years.

There is a mixture of ballast, mud and water several feet deep and if on a level tract of land this new formation is far below the surrounding surface of the land. To get relief from places like this it is frequently necessary to tile for several hundred feet to get a drainage to carry off the water.

To further present a proof where improper preparation was at fault, although done strictly in accord with stakes and theoretical instruction, we will take a 40-mile road, now a main line of the A., T. & S. F., but at that time was not owned by them. There were eight work trains widening cuts, making ditches and shaping up fills preparatory for crushed stone ballast. At all places the earth was left or placed so that it would be level with the top of the ties, the earth in the track shoveled off and ballast put in. Now it can readily be seen that where the old ties had lain that there was a receptacle for water as large as the tie, and this being in gumbo the ability of such earth to hold is well known.

The track was given a good raise, ties spaced, a all additional ties necessary to make a good substantia road were applied, but what was the result? In lesthan 18 months there was almost as soft and rough track as it was previous to ballasting, and for years there was not a mile out of this forty that could be called good track, being filled with pockets and soft places the entire length. All this was for no other reason than the manner in which the preparation and applying of the ballast had been done.

There are only two ways to check soft or pocket places and that is to make such drains as will carry off



all water, or to seal with some material so that water cannot penetrate. Coarse ballast will never give lasting results, but on the other hand will make a continual demand for more, and the cost of applying the same is heavy. A great many pockets can be filled by throwing out all the ballast during dry weather and filling in earth until the defect is as high or higher than at the sides, then placing the ballast back; but this takes time and careful work and watching to get permanent relief, yet it can be done.

The work of overcoming soft places and pockets is entirely governed by the locality, but first of all drainage must be made so that water cannot stand at these places, and when that is done the greatest obstacle is removed.

The most important thing is to know the cause or origin of the soft spot and then see that it does not exist, as prevention is better than cure.

The Significance of the Overlap

A Discussion of the Overlap from the Standpoint of Safe Operation

In automatic block signaling there is an important arrangement of track circuit which is known as the "overlap." When a train enters a block it makes the home and distant signals at the entrance of the block assume the danger and the caution position, respectively. The distant signal so standing does not go to clear when the block is vacated, because it works in unison with and duplicates the action of the home signal next ahead.

To be more specific, when a train enters block A, both home and distant signals at the entrance of this block go to the stop and caution positions. When the train leaves block A and enters block B the home signal at A goes to clear, but not so the distant at A. This signal remains at caution as long as the home at B is at danger, and clears only when the home at B clears. The entrance of the train into block A puts the distant at A at caution, but the train must actually be in block C before the distant or caution signal at A will go clear.

This provides important information for the enginemen as they enter block A. The signals say to them, the block at A is open to you for the home signal 18 clear. It also informs them of the condition of block B, according to whether the distant at A is found, as they enter block A, to be clear or in the caution position. With this knowledge supplied to them by the operation of an automatic device they must govern themselves and decide on their behavior.

The overlap is, as we have said, an arrangement of the track circuit, and it is designed for a special purpose. On entering block A both home and distant signals assume the position "against" a following train. If the train in question pulls into block B, say 50 ft., it is protected as far as mere semaphore blades and lights are concerned. Suppose the train stops there for some reason. If there was no overlap the home at A would clear, through the distant at A would remain at caution.

It is possible under these circumstances for an engineman to make a mistake or miscalculate and enter block A, observing the cautioning distant signal at A, and yet travel at such speed that the home signal at B might be seen or its indication acted on too late to avoid a rear collision. Such a thing ought not to happen, and the rules provide that it shall not happen, but on a railway, as we know it, there is always the possibility of some one going wrong, and it is that ever present menace to safety which causes the use of auto-

matic appliances, and the constant and laudable endeavor of the officers of a railway to keep up the moral tone of the employees by a conscientious regard for the life of others. In this it is only fair to say the rank and file of railroad employees heartily and ably cooperate.

The overlap is so arranged that if the train stopped, say, a few feet inside block B, the home signal at A would not clear. The overlap is designed to cover some appreciable distance, say 600 ft. or over, according to grade, curvature, or other physical peculiarities of the track. The whole arrangement is practically equivalent to saying that the influence governing the home signal at A overlaps block B for 600 ft. or more. A train entering block B runs say 600 ft. past the home signal at B before the home signal at A will clear.

In practical everyday life on a modern railway the overlap has the advantage of thus being an important safety device. It is true that the rules provide for there being no rear collision, but the question may fairly be asked, Would you feel perfectly safe and contented if you sat in the rear Pullman on a train stopped just inside block B, with the signals almost over your head at "stop" and the home at A clear, permitting a fast train to enter the block you had just left?

The engineman on the following train is warned by the distant signal A, and was told as plainly as railway semaphores can say it,—"The home signal at B is against you, prepare to stop now." He thus has one whole block to provide for the many possibilities and contingencies that may and do constantly arise—wet or dry or greasy rail, variation in the holding power of brakes, obscuration of the lights at night, adverse and fitful weather conditions. All this is contemplated in the rules and they should be implicitly, faultlessly and vigorously obeyed. The overlap does not supersede the rules, nor does it modify their absolute and binding character of their announcement. No amount of false reasoning can substitute right for wrong, and special pleading can not make black look white.

The signals stand for certain things, neither more nor less, they do not beg nor plead. They state facts. Yet while human nature remains what it is, the overlap constitutes additional security which will give a man one more last chance for safety in the happily remote case that he has miscalculated or has been momentarily distracted or has been slow of action. Signaling is one of the most supremely important branches of railroad work, and although the ingenuity of the engineer has brought it to a high state of mechanical excellence, it devolves upon the signal engineer and his staff and the road master and his staff where they have the maintenance of the signal system, or are even remotely related thereto, to thoroughly grasp the meaning and the significance of each detail, so that they may know, when derangement or failure of the mechanism occurs, what serious consequences it involves and thus intelligently apply their knowledge and ability to the work of adjustment and repair to that commanding appliance upon which the lives of others are so directly and specially dependent.

American Concrete Pipe Association

The annual convention for 1916 of the American Concrete Pipe Association will be held in Chicago, February 17 and 18, during the week of the cement show. A programme of unusual interest has been prepared, covering different topics of importance relative to the manufacture and sale of concrete sewer pipe and drain tile. Among the speakers will be Hon. A. O. Eberhart, ex-Governor of Minnesota.



Up-Grade Signals on the Delaware Lackawanna & Western

New Method of Dealing With Permissive Signaling Involving "Discretionary Obedience" by Which Delay to Traffic is Eliminated

The Black Rock Branch on the Buffalo Division of the Delaware, Lackawanna & Western Railroad has been signalled with semaphores worked on what may be called the permissive system. The semaphores, both home and distant, on the masts of up-grade signals are painted yellow; and the night indications are also given in yellow. This of course, permits an engineman to proceed under caution, to the next block, otherwise,



Permissive Signals, D., L. & W.

if a red day or night indication is given, the engineer would be obliged to stop, and in doing this on a grade of anywhere from 45 to 70 ft. to the mile, it would be difficult to start the train again without the aid of a pusher, hence the desirability of using the yellow or up-grade signals on this portion of the road.

There is on this line about 30 miles of such signalling, and the maximum grade is 79 ft. to the mile. A copy of the bulletin for the guidance of the enginemen and others when putting these up-grade signals in service has been issued and the circular reads as follows: "Eastward home and distant signal K-4134, located just east of the Erie and Black Rock crossing, and westward single arm home signal K-4125, located 8-10 mile east of the same crossing, will display a yellow or caution home blade by day and a yellow light by night. When the blade is in the horizontal position or a yellow light is displayed, enginemen may proceed under absolute control, to the next block ahead, without stopping at the signal. "Enginemen of any train entering a block under this restrictive indication, as provided by the rules, will be held responsible in case of any accident on account of the block being occupied. These signals will be operated in accordance with rules governing use and operation of automatic block and interlocking signals, which became effective December 16, 1900. The placing of the blades on the signal masts will indicate that they are in service."

The principle here involved is one in which practical expediency has provided a method of working; under the circumstances. The blades of the semaphores both painted yellow, the "home" being square on the end and the "distant" having the usual fish-tail. No red signal day or night is used, because a stop is not required. This does not require an engineman to pass or disregard the red, imperative, stop signal.

We have before now alluded to the fact that a "home" signal is not of necessity and of itself an order



Permissive Block on Grade, D., L. & W.

to the engineman to stop. Custom and what is considered good practice require the stop, hence the red color used, and it is quite right that it should be so under normal conditions, but the fundamental point as indicated in this installment is that the signal is an "information giver" upon which the engineman is expected to act with common sense and due regard for conditions. To stop a heavy train on an up-grade might entail

delay and more or less extra work by a pusher. The



engineman is therefore permitted to proceed with the warning given by the horizontal yellow signal blade or yellow light at night. Such a condition may not involve danger or accident and depends largely on how faithfully duty is performed and how fully responsibility is accepted. The signal system here described covers a special territory and is designed for extranormal conditions, yet at the same time it recognizes the fact that enginemen are capable of accepting responsibility and acting with the idea of "safety first" always before them. In this their performance approximates to what in other lines of activity has been called "discretionary obedience."

Simple Concrete Steps

Method of Constructing Forms and Pouring Concrete for Inexpensive Steps

Steps are not only subject to hard usage, but when made of wood with the lower part in contact with the ground and subject to alternate wetting and drying, brings on decay very rapidly, making it unsafe and dangerous. A simple method of making them is shown in our illustration. The three forms consist merely of that many boxes open at top and bottom and also at the end adjoining the door-sill.

A rise of 8 ins. and a tread of 10 ins. will be found convenient. For this reason the height of each box should be 8 ins., since every box will form a step. All of the boxes should be of the same width, but each one is 10 ins. shorter than the one beneath it, thus forming the tread of the step. If the steps are few in number



Simple forms for Constructing Concrete Steps

and not too wide, 1-in. boards will be stiff enough to hold the concrete without bulging, but if there is any doubt about this it is better to use 2-in. plank. The concrete for the steps should be mixed in the proportion of 1 bag of Portland cement to $2\frac{1}{2}$ cu. ft. clean coarse sand to 4 cu. ft. of crushed rock or pebbles. The earth beneath the steps should be excavated to a depth of 6 ins. below the surface, the excavation being the exact size of the bottom of the steps. The earth should be level and compact at the bottom of the excavation.

Place the largest box in position around the edge of the excavation, staking it in place at two or three points to prevent shifting. Level the first box very carefully by means of a carpenter's spirit level. The concrete, mixed rather dry, should be deposited in the box and thoroughly tamped and compacted until moisture rises to the surface. Work the concrete thoroughly along the

sides of the forms so as to produce a smooth surface. At the front end of the box, where the concrete becomes the tread, the surface of the concrete must be carefully leveled off and smoothed with a trowel for a distance of about 12 ins. from the outer edge. Immediately after this is done the second and smaller box is placed on top of the first one, being fastened thereto by a few nails through the upright cleats shown in our illustration. The nails must not be so long as to project through the forms and into the concrete. Fill the second box with concrete immediately, being careful that no dirt or other foreign matter collects on the surface of the first batch of concrete, as this would prevent a good bond between the two layers. Finish this step in exactly the same manner as described for the first step. The last or third step is constructed in exactly the same manner as those previously described.

The brace between the two back cleats is for the purpose of preventing the boards from spreading at the side next to the wall. The outer surface of the top step is carefully leveled off with a straight-edge and finished by troweling to a smooth surface. Not more than a half hour should elapse between placing the concrete for each step so that the concrete first deposited will not harden and set before the next form is filled. After the steps are about a week old, the forms may be removed and the steps used. After the forms are removed any roughness or irregularities may be smoothed down and the surface of the entire steps be finally finished by rubbing with a piece of emery wheel and water or carborundum and water. Where the work includes many steps, a hollow space is generally left under the main body of the steps to effect a saving in materials. Where this is done the platform and steps are reinforced with steel rods or heavy wire mesh to prevent cracking. Steps such as these are useful on railways, at office and shop doors, etc.

Accelerator for Hardening Concrete

Experiments have been made by the United States Bureau of Standards, says a recent commerce report, to develop a method for accelerating the hardening of concrete, in order that the material might be used in revetment work in place of the willow mats that have been used in the past along the Mississippi River. The Bureau finds that 4 per cent of calcium chloride added to the mixing water increases the strength of the concrete at the age of one day 100 per cent or more. In some cases the strength of the concrete in which the calcium chloride was used at the age of two days equaled 75 per cent or more of the strength normally attained in one month. The Bureau of Standards believes that the findings of this investigation will be of appreciable value in concrete construction. Further information may be had on application to the Bureau at Washington, D. C.

Railroad to Argentine-Bolivian Frontier

In order to act in harmony with the Bolivian Government, says a recent commerce report, the President of Argentina has authorized the construction firm, Vezin & Co., to prolong northward, as far as the Argentine-Bolivian frontier, the line of the Central Northern Railway, and to place a bridge over the River La Quiaca. This work must be carried on under control of the general administration of national highways (of Argentina), which will place at the disposal of the constructing company all facilities possible to bring the work to a speedy and satisfactory conclusion.

In any discussion of this subject there is little progress to be made by simple statements of what the practice may be by any particular road, unless some conditions are stated as to the reasons why such practice is adopted, giving wheel bases of rolling stock, both for passenger and freight service, and for freight cars and passenger cars, four or six wheel trucks, also for locomotives in each kind of service, giving number of pairs connected and whether flanged tires are used on all wheels or only on front and back, or other pairs.

So far as the writer's experience goes, after many years of riding on locomotives and coaches, there can be no doubt that side swing on coaches is a very definite source of trouble from bad riding, and in fact, some special instances of such trouble were promptly cured by reducing the lateral play on the axles. In the same way, with freight cars, some heavily loaded coal cars were watched carefully on curves, and showed plainly an enormous increase of resistance to curving when the side bearings came into play, and the flanges of the wheels ground very hard in compelling the trucks to come round to the curve. In one particular instance where the traffic of a yard was seriously delayed by the inability of the power to make the necessary movements in the time at disposal, an inquiry was arranged between the officers of the different departments, and it was shown that the power could not make the time, but on investigation, the track which was a reverse curve had been widened to enable the locomotives to get around, to such an extent that the freight car trucks skewed until the flanges of the wheels were cutting the rail heads, and slivers of the rail were picked up which were hot and had been just produced in that way. When the tracks were closed in to gauge and a suitable locomotive put on the service, there was no further trouble, and one engine did the work satisfactorily which two were unable to perform before.

On another occasion, trouble was reported in main line service, that the rail heads on curves were being cut away on the outer rail, and the cause was attributed to the length of wheel base on the locomotive, but after watching carefully for some time it was found that the wheels on four wheel trucks were showing cut flanges, and in one instance the flange was found to be exactly one-half the original thickness. The curves on this division were, as far as the writer's memory serves, widened about $\frac{1}{8}$ in. per two degrees of curvature with a limit of curvature of about 4 ft. $9\frac{1}{4}$ ins.

If, therefore, we discuss the question from the standpoint of "Why should the gauge be widened," we may certainly decide at once that no four-wheel truck requires any widening of gauge for any curve that is operated in main line service, and further, that any widening done for other reasons is very detrimental to the haulage of freight trains, entailing as it does, not only increased wear and tear of rails, wheels and trucks, but also increases the horsepower to be developed by the locomotive.

The next point to notice is that six wheel trucks, being longer in the wheel base, do not assume so much angularity for a given amount of increase in width of gauge, and therefore are less affected by it. On the other hand, the center pair of wheels require to move over to suit the curve, but if we take a truck with say 13 ft. wheel base, we find that on a 10 deg. curve, the center ordinate or versed sine is less than half an inch, so as there is plenty of play in the journals it does not affect the trucks at all. Consequently, so far as cars and coaches are concerned, it is a mistake to widen the gauge at all up to 10 degs., and, indeed, it would be beneficial not to do so.

This brings up the gist of the question. If a curve is to be widened it must be because it is deemed desirable or necessary to suit the locomotive. As it is obvious that a straight locomotive cannot be put on a curved track, some compromise or adaptation is compulsory. During the past fifteen years, or thereabouts, there has been a practice very largely adopted of flanging all driving wheels, apparently originally having been evolved out of an idea of having increased safety in the minds of those responsible. At the same time there has been an enormous increase in the size and weight and wheelbase of the locomotives used, especially in freight service. Driving tires have been set in on the front and back pairs of drivers to conform in some very slight degree to the curvature of the outer rail, and decrease the pressure of the middle set or sets of wheels against the inner rail, which is all right as far as it goes, and which is very little, as a wheel base of 16 ft., which is common, requires an offset of 11/16 ins. to fit the curve, consequently the difference, or about $\frac{1}{2}$ in. has to be very largely obtained by the bending of the rail heads out to suit. The argument to meet this is that $\frac{3}{4}$ in. play is allowed between the flanges of the driving wheels and rail heads, that is $\frac{3}{8}$ in. on each side. If a pair of tire templets are fixed on a bar in the correct position and placed on a pair of rails correctly set, it will show that the side play is largely taken up by the curve at the root of the flanges and this view is borne out by the fact that the wear at that point in service is extremely heavy. To confirm this it is only necessary to say that the writer has seen new engines only four months in service, which required to be taken into shop to have tires turned down $\frac{1}{4}$ in. in order to get good flanges again. Now, if this destruction takes place on the driving tires, which are not less hard than the rails, there has been as much or more destruction of rail heads from this cause alone. There is no information to show what the widening on curves was on the road where this took place, but from the writer's knowledge there was no reason to doubt that the common practice of widening was in service.

There has been considerable discussion in the last few years about broken rails, and enormous damage has been caused by wrecks from that cause. Of course, the increased size and weight of the locomotive has been met by the increased size and weight of rail, but would any engineer care to see the top chord of a bridge span deflected 15 or 20 degs. to one side while under the limit load calculated and considered safe when in a vertical position.

The logical conclusion is that only bald tires should be be used on the middle wheels of engines with more than two pairs of driving wheels, both in the interest of safety and economy. Atlantic Type locomotives have been operated for years with bald tires on the main wheels, as formerly were used on ten-wheeled engines, and up to speeds of 90 miles an hour were perfectly safe, showing no indication of the slightest undue wear on flanges, and no evidence of nosing at any speed, while nosing is quite observable with ten-wheel engines having all flanged tires and the front and back tires set in.

The wear of flunges, and of course, of rail heads has been largely diminished by the use of flange lubricators, but there can be no doubt that the movement of bending of the rail heads outward is facilitated by that lubrication.

The Chief Cause of Rail Creeping

By JOE RODMAN Comparison of the Effects of the Causes and Remedies of Rail Creeping

Engineers ascribe the creeping of rail to various contributary causes, and though those cited have long been definitely established, there is yet considerable difference as to the relative importance of each.

Theoretically, it would seem that low joints and worn fixtures are the primary causes of rail creeping, and that opinion is very generally accepted. Mr. La Bach, in his excellent article in a late issue of Railway Engineering and Maintenance of Way, strongly supports this theory, though he minutizes more fully on the collateral influence of wave-motion, which he ranks as the secondary cause.

During the past few years several noticeable cases have fallen under the notice of the writer which tend to demonstrate that under ordinary conditions wavemotion alone is a stronger incentive to rail creeping than all other causes combined.

On coal-chutes, beet-dumps, etc., where the loads are pushed upward ahead of the locomotive, creeping is more noticeable than on level track where the traffic stress is more evenly regulated, and the creeping in such cases is invariably upward—or in the direction in which the loads are pushed—notwithstanding the counteractive influence of gravity, the "kick" of drivers, and the invariable descent under brakes, all of which are accepted as causes of rail creeping. Naturally, such structures are subject to less undulation than unsecured track, yet the surface variation is sufficient to cause a greater movement of steel, and in less time, than is usual on more normal track.

The locomotive being at the tail of the train, the kick or back stress of the drivers is insufficient to force the rail from under the weight of the advancing loads; though the returning empties and locomotive no doubt cause the steel to run slightly in the opposite direction, it is the difference in weight, and consequently wavemotion, rather than gravity or other causes from which steel is supposed to run.

As wrinkles are ironed from a cloth, increasing its length in the operation, or as mud "squashes" from beneath the forward tread of a wagon-wheel, so the track, retained immovably by the after weight, must advance in proportion to its resiliency and its length be increased by the depression of the advancing arch due to its elasticity. The greater the grade, the greater the arch to be depressed by the advancing load. That principle may also explain the frequent tendency of steel to climb a grade under apparently average conditions of traffic.

Many instances in busy yards will also tend to demonstrate that the greater amount of creeping is in the track on which the loads are more often pushed ahead of the locomotive. In larger yards this effect is the most noticeable owing to regular procedure of switching.

A landslide having demolished part of a coal-branch on a western road, a temporary switchback was built to replace the former spiral curve and the grade percentage slightly increased. On the grade approaching the switch, the loads were pushed ahead of the locomotive. During the three months of summer weather in which the switchback expedient was employed, the steel climbed the hill nearly three feet within less than one mile of track. At the spur end they impinged against a granite cliff and the last quarter of a mile was kinked so badly that the foreman in charge declared, "Sure, it looks like it wor built of gyar-r-rd rails." There is little doubt that, notwithstanding the tension from the down-hill thrust of the reverse branch at the switchback—which crept downward—and the return locomotives and empty cars under brakes, the abnormal creeping was almost entirely due to the ironing out of the track before the advancing loads, or what is more commonly known as wave-motion.

Where the loads are pulled instead of pushed, the drivers pull an amount of the slack backward on the wave-motion, and, consequently, the creeping tendency is counteracted. Often on worn track or track with spikes and bolts loosened, it can be noticed that the joint will close slightly under the first driver. Careful measurements on such track will often show a decided creeping toward the advancing train instead of from it,

Though the impact against the rise following a low joint or other surface depression in track doubtless results in some of the "slack" being driven forward, and in the higher quarter being depressed and urged forward as in the ironing out of wave-motion, a careful comparison of track of good surface and one of poor surface, where the traffic is one way only on each, usually will show but a very slight difference between the forward movement of the two, while a track, level or inclined, where the loads are pushed ahead of the locomotive will show a great increase in creeping over the track subjected to merely normal or reverse traffic under the same conditions in other phases. Expanded joints, of course, conduce to creeping through impact though in lesser degree.

Rail anti-creepers are serviceable but expensive. In coarse rock-ballast the observant foreman can secure excellent results without the anti-creepers by seeing that all angle-bars are properly slot-spiked to good ties and that several ties ahead—in the direction of the creeping—are spaced with spawls selected to wedge the ties firmly apart, and so distribute and partly nullify the stress of any of the causes of rail-creeping, even the almost irresistable wave-motion.

On earth, sand, or gravel ballast, careful slot-spiking in the same manner and the use of one anti-creeper to the rail of 33 ft. or less in length will often reduce creeping to an almost imperceptible degree if several ties ahead of joint ties and creepered ties are spaced by sawed sections of old ties, bricks or stone pavingblocks immediately under the rail and concealed beneath the ballast. Where earth track is dressed lightly they may be placed far enough inside the rail to effectually conceal them if the ties are of sufficient strength to withstand the consequent shearing stress.

Another simple expedient is to smear with crude oil all angle-bars or continuous-joint plates as they are applied. The oil delays the rust-bonding and allows the rail more readily to expand and contract within its own length.

Often an experienced or well-instructed trackwalker or laborer can alone accomplish much during the warmest weather by carefully searching out the tightest places, loosening the bolts in the more open joints, and tapping with a maul until the rail closes the open space. At times even a half-inch of expansion will prevent a serious "kick-out."

In spite of all precautions, rail will continue to creep until a change is made in the very nature of steel; but very simple precautions will go far toward reducing the movement. Paved track is almost immune, paving being a poor conductor of heat, and an open track, even under the most unfavorable conditions, it can be greatly checked unless the trackman in charge is himself subject to creeping.



Nicholson Tunnel on the Deleware, Lackawanna & Western

Two shafts sunk; work carried on simultaneously at six points; rock at one end and soft earth at the other.

In making the change of line between Scranton and Binghamton the Delaware, Lackawanna & Western Railroad were compelled to drive a tunnel which is popularly known as the Nicholson tunnel between Clarks Summit and Hallstead. It is 3,630 ft. long. In it two vertical shafts were sunk. These were so placed as to divide the tunnel into three approximately equal parts. One shaft was placed one-third of the distance from the east portal and the other was located one-third of the distance from the west portal, thus dividing the tunnel into three. These two shafts, 34 x 54 ft. in horizontal section, were used for excavation purposes.

No. 1. Where the material was poor No. 2 was not excavated until the advance headings were joined and timbering was carried up immediately behind this excavation. When excavations Nos. 1 and 2 (Fig. 2) east from shaft No. 1 encountered earth, about 300 ft. from the east portal, work in this heading was temporarily discontinued. Section No. 3 (Fig. 2) was excavated just far enough ahead of No. 4 to permit the drilling of Nos. 4 and 3, and the material was thrown by hand into the shovel pit.

The west portal cut was excavated to grade in November, 1913, and a shovel started to excavate sec-



They are lined with concrete and will remain as permanent ventilating shafts with a horizontal section 30 x 50 ft. The excavation of these shafts began September, 1912, and reached wall-plate grade as illustrated in one of our line cuts at a depth of about 115 ft. in April, 1913. Headings No. 1 shown in Fig. 2 were started in both directions from both shafts, with an average progress of 8 ft. per 10-hour shift. Heading No. 1 started from west portal cut September, 1913.

Where the roof would stand, without danger of falls, sections No. 2 (Fig. 2), were excavated close behind

Nicholson Tunnel on the Delaware, Lackawanna & Western Railroad, Showing Brick Walls and Arched Brick Roof

tions Nos. 3 and 4 (Fig. 2) at the west portal on November, 22, 1913. The shovel reached shaft No. 1 in July. 1914, and as the contractor was using steam locomotives it became necessary to provide air circulation between shaft No. 1 and some point near the east portal. In this the contractor, Mr. D. W. Flickwir, stated that his progress with steam locomotive was greater than could be obtained with electrical equipment.

The east portal cut had been excavated to within 58 ft. of the grade at this time and an 8 x 10 ft. shaft was


sunk from this elevation at a point on the portal slope about 80 ft. west of the actual portal. A top center heading (No. 1, Fig. 3) was driven, and temporarily timbered, to meet the heading which had been discontinued, as described. This work was completed just



previous to the shovel reaching shaft No. 1. The 8×10 ft. shaft was then carried down to the spring line of the arch and the excavation of section No. 2 (Fig. 3) started and the wall-plate was put in place. This was followed immediately by the excavation of No. 3 and the placing of the timber. After this excavation and



Fig. 2

timbering had joined the timbering already in place in the rock section the shaft was sunk to grade (Sec. No. 5, Fig. 3) excavated, and mud sills and plumb posts were placed. Section No. 6 was excavated by the shovel. This same process, with the exception of heading No. 1, was followed from the 8 x 10 ft. shaft east to the east portal. The shovel dug out at the east portal on November 7, 1914.

The rock encountered was blue and gray sandstone, horizontally stratafied. The strata varied in thickness from about 3 ft. down to a formation resembling shale, and these strata were frequently separated by mud seams up to $\frac{1}{2}$ or $\frac{3}{4}$ of an inch in thickness. The earth was a dense yellow clay and gravel with some sand seams and were uniformly dry. The entire tunnel was timbered, as shown in Fig. 4, and is lined with hard burned brick arch and side walls laid with a 1 to 2 portland cement mortar. The side walls rest on a concrete footing, and a concrete ditch and curb are provided. Complete details are shown in Fig. 4. Concrete footings were started July 27 and were completed December 6, 1914. The brick lining was started September 14, 1914, and was completed in May, 1915.

For constructing the brick arch the contractor provided three sets of movable centers, each 64 ft. long. Two of these centers were started midway between shaft No. 2 and the west portal and worked each way from this point. The other was started at shaft No. 2



Fig 3

and worked toward shaft No. 1. When the portion between shaft No. 2 and the west portal was completed the centers between the shafts Nos. 1 and 2, and the set, which was at shaft No. 2, were moved to the midpoint between shaft No. 1 and the east portal and worked both ways from this point. The set at the west



portal was moved between shafts Nos. 1 and 2. The total tunnel excavation was 147,000 cubic yards.

Our half-tone illustrations show the west portal as it appeared in the course of construction. We also show the interior of the tunnel with roof timbered and sides of rock, the stratafication of the rock being clearly visible. A temporary work track runs through the excavation. A view of the tunnel in course of construction gives an idea of the permanent brick lining of walls and roof, and shows the temporary support used in placing the brick arch. The whole of the work has



Tunnel, Showing Timbered Roof

been carried out, without drawback, to successful completion under the direct supervision of Mr. G. J. Ray, the chief engineer of the D. L. & W. Railroad.

The Size, Design, Quality and Service of Rais The Importance of Investigation Along the Lines of Material and Structure of Rails

Speaking of rails at a recent meeting of the St. Louis Railway Club, Mr. E. A. Hadley, chief engineer of the Missouri Pacific, said in the latter part of his address, of which we here give a brief abstract, that the rails of the heavier sections of the A. S. C. E. design (from 80 lbs. a yard and up) have not in recent years given the service that was expected of them. The fault may be in improper methods of manufacture or it may be in the design of the rail itself, which, while suitable twenty years ago, may be unfited for the heavier loads of today. Three principal reasons have been advanced as to the probable cause of the poor service of these later rails:

It has been said that the wheel loads were exceeding the limits of strength of the steel in the rail, and without costly methods of manufacture, the rails could not be made to carry the loads with a proper degree of safety. Standard sections then in use were those of A. S. C. E. design. These were said by the manufacturers to be impossible to roll in the heavier weights then being demanded by the railroads. Railway engineers, while admitting that the rails would not stand the heavier wheel loads, claimed that the steel was of poorer quality than that used in the lighter rails previously turned out.

The making of steel rails for use under a high-speed passenger train service is something more than a mere commercial proposition, and both the producer and user have great responsibilities in the matter. Neither can lay them aside nor shift them one upon the other. Realizing the importance of the question, the American Railway Association appointed a Committee on Standard Rail and Wheel Sections to consider the subject. This committee, by a sub-committee on which the manufacturers were represented, presented a report October 1, 1907, which recommended the use of proposed standard rail sctions known as ARA Series A and Series B. The A type is characterized by a shallow head, wide base, thin flanges and a greater height than Series B. The 90-lb. type A rail is now used as standard by very many western roads, and the type B section is used on the coal roads in Maryland and Virginia, and seems to be preferred by the eastern roads, especially those with crooked track, probably on account of the greater amount of metal in the head to resist curve wear. At the present time both types appear to be giving good service.

The proper length of rail has received considerable attention and 33 ft. now seems to be the length most in favor. The use of much longer rails is limited by the difficulty of straightening at the mill, the cost of manufacture, the difficulties of transportation, expansion and contraction in track, and the labor and cost of handling.

The controversy over the most satisfactory rail joint has been going on for years, and there are now a number of very good patented rail joints on the market. The cheapest joint giving good service is the angle bar, and it has the advantage over most other joints in that it is easy to put in and can be applied without respacing the ties at the time of rail laying. Its strength, however, is computed as not over 70 per cent of the strength of the unbroken rail, whereas some of the patented joints have a strength of over 100 per cent of the unbroken rail. Careful tests of the angle bar and a number of patented joints applied to 85-lb. rail failed to develop sufficient economy of maintenance, all things being considered, to make it possible to say definitely that the angle bar was not the most economical joint. With light sections of rail the angle bar is decidedly inferior to a number of patented joints, but with the heavier weights of rail and the greater height from base to head of the rail with the angle bar made to suit, shows that it is efficient and satisfactory.

The present general practice for turnouts is to use the split switch and a spring-rail frog where the traffic over one line is much heavier than over the other line, and where speed is high on one and low on the other line. The stiff frog is generally used for yard tracks. Of late years the use of manganese steel for crossing frogs and switch points which are subjected to heavy traffic is coming largely into use and giving excellent results. It secures several times the life of the ordinary carbon steel frog and point at a reasonable increase in first cost.

Economy of train service has become so important that there will be no return to lighter loads. The tendency is and will continue to be in the direction of heavier loads. The track is, as a matter of fact, a continuous girder, connecting the terminals of a railroad, over which pass the same loads, at the same speed, as pass over the bridges. The importance, therefore, of giving to the design and construction of the track the same careful investigation and study which are considered necessary in the design and construction of a bridge, cannot be overestimated.

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Spiking Tie-Plates to Rails

When discussing the matter of track construction at a meeting of the St. Louis Railway Club, Mr. H. J. Pfeifer, Eng. M. of W. T. R. R. A. of St. Louis, Mo., said that the track question is of the greatest importance to the railroads, and also to the street railways. Referring to the question of screw spikes he held that the ordinary cut spike which is in use today is, under present conditions, more economical, and holds the rail just as well as the screw spike would. With reference to saving the tie, it was his opinion better to lengthen the tie-plate, place hooked shoulders on it to hold the rail, and then spike the tie-plate to the tie without having the spike engage the rail. This does away with a great deal of the cutting of ties, resulting from heavy traffic, and materially increases the life of the tie.



FAX MALE TH

Electrification on the Pennsylvania Railroad

Current Received at 13,200 Volts, Transmitted at 44,000 Volts, Stepped Down to 11,000 Volts, Single Phase For Catenary System.

The electrification of the suburban service of the Pennsylvania Railroad between Broad Street Station and Paoli is the first electrification undertaken by this company in the vicinity of Philadelphia, and its primary purpose is to increase the capacity of Broad Street Station and thus to relieve what congestion it can at that terminal. In addition to the through passenger train service accommodated at the station, there is an extensive suburban service extending over six different routes. The possibilities of electric traction were examined into by committees consisting of operating officials of the road and their analysis indicated that during rush hours the relief which would be secured by electrification would be equivalent to greatly increasing the station capacity. It is estimated that under electric operation there is a sufficient saving in operating costs as compared with steam to pay interest on the investat a substation on the westerly bank of the Schuylkill River opposite the main generating station, the connection between the power house and the substation consists of armored submarine cables under the river. It is delivered at 13,200 volts, and is stepped up to 44,000 volts and, by means of duplicate single-phase overhead transmission circuits, then transmitted to the stepdown substation. While the present service is on one phase only of the power company's three-phase generating system, the plan is to supply the succeeding or future electrification power requirements from the remaining phases. Power at 25 cycles and 13,200 volts is transmitted from the electric power house to the Arsenal Bridge substation over four 350,000 c.m., 3-conductor submarine cables. On the west bank of the river the submarine cables are connected to paper-insulated, leadcovered cables, installed in clay ducts. From the Ar-



View of Pennsylvania Railroad, Showing Catenary Suspension System as Applied to Curves

ment. Analysis of service conditions and cost estimates covering various electric systems led to the conclusion that one having a very high voltage overhead contact wire and one which eliminates moving machinery in substations for the supply of power, is the most suitable and also the most economical from the standpoint of both first and operating costs. In arriving at this conclusion, primary importance was attached to the feature of possible long distance operation over the entire divisions rather than to the requirements for present short suburban electric service. In this case 11,000 volt, singlephase 25-cycle power is supplied directly to the trains from the overhead catenary trolley system.

Power for traction purposes is purchased from the Philadelphia Electric Co. It is delivered to the railroad senal Bridge substation there are four 44,000-volt singlephase transmission lines to the West Philadelphia substation. The four transmission lines are carried on brackets on the side of the elevated structure between the Arsenal Bridge substation and the West Philadelphia substation. Beyond the West Philadelphia substation the lines are carried on the catenary supporting structures. Along the right-of-way the lines are carried on both sides of the tracks. Horn gap switches for sectionalizing are installed on the roofs of the three substations and lightning arresters on the roofs of all substations.

The transmission lines are 2/0-7 strand, hard-drawn copper wires. Wires are spaced 5 ft. apart where the two wires of a single-phase feeder are on the same cross arm and where there is more than one circuit on a pole the vertical spacing is 3 ft. 6 ins. The lines are protected by a 3/8-in. steel ground wire on the top of the poles. Where the transmission lines pass under highway bridges, the ground wire is dead-ended on the bridge structure and the wires carried on post type insulators. At the Arsenal Bridge substation the lines are protected by relays which operate on overload and on an unbalanced load in either leg caused by a ground. In the other substations the relays operate differentially only, and in case of a ground between substations the circuit on which the trouble occurred would be cut out first in three of the substations and finally at the Arsenal Bridge substation. Overload relays are provided in the 13,200 volt lines at the Philadelphia company's power station and reverse current relays in these feeders in the Arsenal Bridge Substation. After erection the transmission lines were tested out at a potential of 66,000 volts, or three times the working pressure, to ground.

In order to try the various types of structures and details, an experimental four-track section about a mile long was completely equipped in the fall of 1913. An examination and study of this led to the adoption of what is called the "tubular cross-catenary bridge" for carrying the catenary trolley wires. On either side of the tracks a tubular steel pole is set and grouted into a concrete foundation. Each pole has a double guy, anchoring the pole away from the tracks and spanning the tracks between the poles are the two cross wires forming the cross catenary bridge which carries the longitudinal wires. The tubular poles are built up of various lengths, sizes and weights of steel pipe welded together as required. The guys are solid steel rods with a heavy turnbuckle near the ground end to permit of adjustment. The cross wires are of extra high tension galvanized steel strand, the upper strand usually being 3/4 in. and the lower one $\frac{1}{2}$ in. in diameter. Both are socketed at each end and at one side a turnbuckle is installed to permit of adjustment. The top and bottom cross wires are joined by means of a vertical $\frac{3}{4}$ in. rod and suitable malleable iron clamps at the points where insulators carrying the longitudinal wires are placed. Each insulator consists of three suspension type units, the porcelain being 8 ins. in diameter, the flashover value of the three being many times that of the line voltage. The cross wire bridges are about 300 ft. apart on tangents, but are closer on curves, the exact spacing depending upon the degree of curvature. After the bridges are erected, insulators are suspended approximately over the center of each track; they are over the center of the track on tangents, but are offset towards the outside of the curve on curved track. Every 15 ft. on curved track and 30 ft. on tangents, a hanger supports the lower two wires from the "messenger" wire.

On the Terminal Division, where the steam locomotive traffic is very dense, and there are smoke and corrosive gases, a non-corrodible tube hanger is used. The hanger tube, which is 9/16 in. outside diameter and No. 18 gauge, being fastened to a casting at each end. Some of the tube is Monel metal, while the balance is a bronze mixture containing 90 per cent copper. On the Philadelphia Division, where there is relatively less steam traffic, wrought iron strap hangers 1 in. wide by 3/16 in. thick are used. The main messenger cable, at the hanger clip, is protected from corrosion by a collar of zinc. The flat strap hangers which have a quarter turn in them to minimize the area exposed to the wind in the direction crosswise with the tracks and to better resist bending when placed on curves, are bolted to the castings clamping the auxiliary messenger and trolley wires. On tangents, the castings at the bottom of the

hangers hold the auxiliary messenger only and the trolley wire is, in turn, supported from this auxiliary messenger every 15 ft. at points equidistant from the hanger. This is intended to insure a flexible trolley wire. On curves the two lower wires do not hang directly beneath the messenger, but the whole system swings into a curved plane until a balance is reached between its weight and the tension in the wires. The tensions in both the auxiliary, messenger, and trolley wires, are selected so that in extreme hot weather there will be enough tension to prevent sagging and yet in extreme cold weather the contraction will not cause stresses beyond the elastic limit.

The catenary system over each of the four main tracks is separated electrically from those over the other tracks, and trolley sectionalizing points with switches are provided at all crossovers, so that sections of the line may be temporarily cut out of service for repairs.



Close View of P. R. R. Signal Bridge

On the main running tracks sectionalizing is of the "airbreak" type, the trolley wire being divided into two wires which are spread apart and each wire is lifted up at a different point; insulators are placed in each wire where it hangs above contact with the pantagraphthat is, while the pantagraph is making contact with one wire the other is lifted up and sectionalized. At crossovers and in yards, the trolley wires are sectionalized by means of wood stick insulators, having runners or gliders on each side so arranged that while the pantagraph always makes contact with at least one of the runners they are separated electriclly. The switches are of the disconnecting knife type, mounted on top of the wood section insulators, and are operated from the ground by means of a long, impregnated wooden switch stick. An interesting detail in the erection of this catenary work was the use of cars the top platforms of which could be readily raised or lowered by means of chain hoists. The cars were equipped with removable outriggers so that in the four-track section

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the work could be completely erected over one of a pair of tracks without in any way interfering with the regular steam traffic on this track.

The electrified route is crossed in many places by overhead highway bridges, some of which are not high enough above the tracks to permit the trolleys being carried at the normal height of 22 ft. In such cases and where it was impracticable to raise the highway bridge, the trolley wires gradually dip and go under the bridges at a less height than 22 ft. The catenary bridges are so located that these highway bridges come in the center of a span where, due to the sag in the messenger, the F. A. Molitor refers to the custom of burying the ties, of earth ballasted track, stating that there seemed to be no good reason for it, and that this method resulted in poor drainage.

In the Argentine, Uruguay and Paraguay, this custom is well nigh universal, particularly in those regions where the only material available for surfacing is the rich gumbo-like soil which is splendid for agriculture, but about the worst possible material for track. Unless the ties are completely covered and a hard unbroken shell-like surface formed, covering them entirely, the heavy rains work down alongside the ties to



Typical Signal Bridge of P. R. R., Showing Position Signals for Day and Night

vertical height necessary to clear the catenary system is a minimum. As it passes under the highway bridges each catenary system is steadied by being held with post type insulators, supported by brackets on the bridge structure. The transmission wires on either side of the main line tracks are also carried down underneath the bridge and supported from the bridge structure by the insulators. At each bridge the metallic brackets carrying the insulators are carefully bonded together and earthed by means of ground plates. To prevent pedestrians on the bridges from contact or interference with the wires solid wooden fences, either vertical or inclined, and of sufficient height to shut out all view of the wires have been erected. In order to fully protect the trainmen, general orders have been issued that no men are allowed on top of any car in the electrified zone.

BURYING TIES IN EARTH

Editor Railway Engineering and Maintenance of Way: Sir—In the brief but interesting account of the railways of Brazil in your issue of December, 1915, Mr. the soil on which they rest, they begin to "pump" and in a short time the track is gone.

There is a tendency to form a hollow or ditch between the rails where there is considerable pedestrian travel on the track as is the case in some instances, but it is more usual on well maintained track to keep the dirt slightly crowned between the rails, and drain the space by depressions under the rail at every fourth tie on alternate sides.

In covering the ties or "boxing in" the track as it is called, care is taken to get a smooth surface, which gradually gets baked hard and which if carefully put on and maintained, sheds the water and keeps it from getting under the ties. The principal object is not so much protection of the ties from decay as providing a means of surface drainage and of keeping the soil underneath dry. In the Argentine where ballast is available, or where material is used which will drain, the type of track construction is practically the same as our own. F. CAIRS.

New York, N. Y.



Methods of Securing Track Maintenance Laborers

Arrangements adopted by a number of Roads for Securing Adequate Forces for Section and Construction Work and the Policies Involved

ON THE CINCINNATI, HAMILTON AND DAYTON By F. D. Batchellor, Dist. Engineer M. of W.

Trackmen on C. H. and D. Ry. of the Toledo division are obtained from Cincinnati and Toledo with the exception of a few section men, who are obtained locally on outlying sections. In the Indianapolis and Wellston divisions section men are obtained locally. These men are not hired through company or private labor agencies, except extra gang men, who are sometimes obtained through labor agents at Cincinnati and Toledo. We do not have an employee at private labor agencies, nor have we any labor bureau, as we have not had much trouble in getting men.

As far as possible we try to keep trackmen permanently employed, although it is necessary in winter months to reduce the force. Where other than natives are employed we build shelters for them to live in, old box cars usually being used for this, cars being set off trucks. The men board themselves. We have no special inducement to offer men to stay in our employ other than chances for promotion. Men are always promoted from the ranks if they are capable.

We have found that we have obtained good results by having an extra gang of about fifteen men in charge of an assistant foreman, who is moved from section to section where there is work to do, the assistant foreman reporting to and working under the direction of section foreman. This enables us to get much better work out of extra gangs than we do in cases of where gangs are placed in charge of extra gang foreman, and this plan also reduces the cost of doing the work, as the section foreman takes more interest in work done on his section than an extra gang foreman does.

In placing gravel ballast, instead of having extra gang in charge of this work, we have increased our section gangs and find much better results are obtained and track put in much better shape than could be done by extra gangs.

Another method we have tried which has resulted in the saving of labor and reducing the cost of work is in the rail laying gang. In this we have a three-man track laying machine, which enables us to dispense with nine men in handling rails, and also does away with the danger of injury to the men in handling rails in the old way. We have found that rail can be laid in this manner much more economically and quickly than by the old method.

We have a number of cases where our tracks pass through towns where the ballast has become in bad condition and where we are not able to raise our tracks, thus making it necessary that the old material be dug out from tracks and new material placed under the ties. In this case we have used the American ditcher with a clam shell, digging out material between tracks and loading it on cars and then shovel out by hand the material from between the ties and filling up holes dug out between tracks, new gravel then being distributed. This is handled by a small force and as a result there is considerable saving in labor and work train service.

We have run over our territory a McCann spreader, which has a wing the shape of the roadbed. This machine has been run from one end of our road to the other and has dressed up all of the ballast and shaped the roadbed. In order to get rid of the shoulders which are thrown up by the first wing, a second spreader is also run behind the first. This has enabled us to maintain our track a great deal cheaper than we could have done otherwise, as it has helped drainage conditions materially.

There was an old abandoned gravel pit at North Dayton, out of which gravel had been taken to the water level. As we were badly in need of gravel and had no other pit available, we placed a whirley with a clam shell in this pit, getting out gravel below the water level. This has given us a good supply of washed gravel very economically as it is not necessary to have a spotting engine to spot cars.

ON THE MICHIGAN CENTRAL

By J. J. Bernet, V. P. in Charge of Operation

The majority of our laborers for extra gangs doing work of rail laying, ballasting, spacing ties and construction work are obtained through private labor agencies in the cities of Hamilton, Ontario; Detroit, Michigan; Chicago, Illinois, and Toledo, Ohio. Laborers for regular sections, yards or small permanent extra gangs are usually hired in the towns or villages nearest the points where they are to be worked. This company has no company labor agency, and no representative at the agency to accept them.

An attempt is made to keep track laborers on regular sections, yards or small permanent extra gangs continually employed, though it is often necessary to reduce these forces during the winter season. Endeavor is also made to give extra gangs as much work as possible during the winter months by allowing them to remain in living cars and use them whenever occasion demands to clean up snow and ice and to pack ice during the ice harvesting season.

Cars containing berths, stoves, lamps and fuel are furnished foreign laborers. Extra gangs are housed in trains operated by a contract boarding concern which insures the men good sleeping and boarding accommodations at reasonable rates. Laborers for sections, yards and permanent extra gangs are usually recruited and worked in the territory in which they live, and provide their own living quarters and board.

The laborer in each section gang showing most promise is made first man and he relieves the foreman in case of sickness or absence for other causes, and the first man most eligible to assume a foreman's duties is appointed section foreman when vacancy in such position occurs.

ON THE CHICAGO, BURLINGTON AND QUINCY By H. E. Byram, Vice-President

We obtain the greater number of our laborers from Chicago, St. Louis, Kansas City and Omaha, through either private or company labor agencies. There are several company agencies but no labor bureau.

It is found necessary to reduce the force in the winter and therefore impossible to keep all the section men permanently employed.

Each section is furnished a house in which section laborers can live. Extra gangs are furnished with bunk cars and commissary, except foreigners, who provide their own commissary.



Freight Terminal on the Clover Leaf Valuable Property Acquired and Constructive Management Have Made this Terminal Successful

After its reorganization in 1900 the Toledo, St. Louis and Western-known the country over as the "Clover Leaf"-needed, among other facilities, suitable freight terminal yards at Toledo. This road is one of the Central West important lines, which, starting as a "pirate" many years ago, has developed into a property which has to be reckoned with in these days by all the lines in that territory. Oftentimes the criminal is set on his feet after years of probation and becomes a citizen of the highest respectability. The Clover Leaf stands in that position today, even though it is operated under a receiver, whose control was ushered in by most unfortunate financial operations, for which the road as a once successful enterprise was in no way to blame. Unwise and unnecessary acquirements were the cause of its downfall.

Enthusiastic and money-chasing fiscal agents, encouraged by a few individuals in power, are as a rule to blame nowadays for the misfortunes of many a railroad property, which, if unhampered, would reward those interested in its securities handsomely. The 451 miles of road between Toledo and St. Louis runs through a most productive and interesting country. Added to this is the Detroit & Toledo Shore Line, owned jointly by the Grand Trunk and the "Clover Leaf," which gives the latter road an excellent Detroit entrance and furnishes a large amount of both East and West bound traffic. For a dozen years after its reorganization the "Clover Leaf" enjoyed unusual prosperity and was on the high road toward permanent dividends and an absolutely sound financial standing, when its misfortunes began under unwise handling.

which the "Clover Leaf" is a part owner, it furnishes direct service to and from every industry in this, at present, rapidly growing community. The general office building, which occupies an important corner at Erie and Krause Sts., is immediately connected with the commodious freight house, which is most necessary for prompt transaction of business between the local freight



Freight Terminal on the Clover Leaf at Toledo

agent and his assistants and the officers at the head of the traffic department.

The arrangement of the tracks in the freight yard is most convenient, as shown by the accompanying drawing, while the approach to industries provides ample facilities. The whole system of tracks and yards is directly connected with the main line, so that incoming and outgoing trains are handled to the best advantage. This property, which was "picked up" piece-meal at figures absurdly low, could not be secured today except at a fabulous price. It is an example of forethought



Layout of Tracks and Property owned in Toledo, O., by the Toledo, St. Louis & Western

Some day, like other properties under similar conditions, it will come forth from its unwarranted financial disturbances and resume its course as an institution of the first class. In the past fifteen years it has never lost its reputation for respectability at all events and serves the country through which it runs well. The property known as the "Erie St. purchase," in Toledo, was acquired in parcels, from time to time, without a beating of drums or a blowing of horns, in 1902 and 1903, and that, with other acquisitions and rights, now furnishes the company with the best terminal facilities of any road running into Toledo today. It provides a close touch with many important industries, and in connection with the Toledo Railway and Terminal Co., of worthy of imitation by many roads which as a rule are generally short of facilities which eventually they have to provide at tremendous cost.

You want to be a popular, progressive, successful man. You perhaps feel that you have done everything in your power to that end. You have worked early and late with but small or medium returns, and have seen others make a brilliant record with seemingly little effort. Do you think it is "luck"? They have simply discovered their possibilities. You can very likely outstrip them when you find yourself.—Geo. H. Knox.



A Study of Electricity

By REGINALD GORDON

Magnetic Effects of Electricity Explained and Simple Experiments Suggested

Under this title in a previous issue an outline was given of the uses and applications of electricity in railroad service. The following table gives the uses to which railroads put the silent power

RAILROADS USE ELECTRICITY FOR	POWER	 Locomotives Motor Cars Shop Machinery Turn Tables and Drawbridges Telegraph Circuits Signals
	LIGHT	{ Locomotive Headlights Car Lights Signal Lights
	HEAT	Shop Work—Welding Heating of Motor Car Trains
	CHEMICAL ACTION	Charging Storage Batteries for Car Lights, Signal Motors, etc.

Electricity may be generated or developed in several ways, but only two of these methods are of interest to



The Mariners' Compass.

railroad men, these are batteries and power-driven generators. Batteries depend upon chemical affinity or attraction for their action and are used for a variety of purposes on railroads. Power-driven generators are of two principal classes—magneto-electric and dynamoelectric generators.

Magneto-electric machines are used for furnishing electric ignition for gasoline-driven automobiles and



North and South Poles of Magnet.

railroad motor cars, as well as for the ringing current on some telephone systems. Dynamo-electric generators are used for all large power, lighting and chemical purposes, such as power for operating railroad locomotives and cars, for furnishing light and heat for stations and cars, and power for operating signals, as well as for charging storage batteries.

Electricity and magnetism are terms commonly used in connection with each other, which while expressing two closely related ideas are not always interchangeable. Many persons are familiar with the use of the magnetic compass shown in Fig. 1 for indicating direction, and most of those who have used it have learned that its behavior is dependent upon the magnetism of the earth. The "needle" of the compass is a straight piece of magnetized steel supported so that it can swing freely in a horizontal plane. It comes to rest with its longest axis in the north and south line because the earth itself is a magnet and by its unseen force exerts a steady pull that causes any magnets that are free to move to arrange themselves in a particular direction in any particular place. The relation between electricity and magnetism can be shown by many experiments. One of the simplest, and one that can be made with simple apparatus is shown in Fig. 2, where a single battery cell, com-



Electric Action Shown by Compass.

monly known as a dry cell, such as is used for electric bells, spark coils, etc., is shown with a piece of wire attached to its terminals. When this wire is held near the compass in the position shown the magnetic needle



Electric Action Exemplified by Coil and Compass.

turns away from its north and south position because the electric current in the conducting wire produces magnetism around it, and this magnetism being stronger than that of the earth, pulls the needle away from its natural position. By winding this wire into a compact coil of many turns, as shown in Fig. 3, its effect on the



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needle is greatly intensified. The effect of the current upon the magnet is approximately proportioned to the number of turns of the conductor forming the coil. The current develops a magnetic effect around it that influences the needle and produces the observed effects. The space around a magnet or conductor conveying electricity and throughout which its influence is exerted is called its "field." Whenever a magnet, or a magnetic substance, such as a piece of iron or steel, is brought into this field it is influenced by it. If the magnetic substance can move freely it will assume some position in the field where it offers the least resistance to the flow of the magnetic lines through it. Fig. 4 illustrates this principle and shows that there is attraction between unlike named, and repulsion between likenamed, magnetic poles.

In order to render this clear there are shown in Fig. 5 three cases illustrating the condition of the space around or near a magnet. These show the position assumed by fine iron filings that have been scattered on a piece of cardboard placed on top of a bar magnet and a horseshoe-shaped magnet, respectively. The experimenter will find that when the iron filings are sprinkled evenly on the cardboard and the latter is gently tapped, they will arrange themselves end to end in certain distinct lines. Each particle of iron becomes a magnet and is forced to assume a position where it offers the least resistance to magnetic force. The lines in which the small pieces of iron arrange themselves are called lines of force or lines of magnetic flux. While we do not know with any certainty what magnetic force is, it is usual to regard it as a form of energy which is always flowing in a closed circuit and in a definite direction. The direction of this flux or flow in the compass needle is through it from one end to the other, and we call the



Lines of Force from Permanent Magnet.

end at which the earth's magnetic flux enters the compass needle the south pole, and at the end at which it leaves, the north pole. This is only a conventional designation, just as are the names north and south, as applied to those regions of the earth at which its magnetic force seems to be concentrated and to have its origin.

For the purposes shown in Figs. 1-5, permanent magnets are used, made of hard steel, a metal rather difficult to magnetize to any great degree of strength, but having the advantage, when once magnetized. of retaining its magnetic strength for a long time. Wrought iron is very much more susceptible to magnetism than cast iron or steel. Certain grades of soft steel containing a low percentage of carbon are equally susceptible with wrought iron; and in general throughout the range of iron and steel of various degrees of hardness, the harder the metal the more difficult it is to magnetize it, but the better it retains its magnetism. It may be stated, however, that the magnetic properties of any grade of iron or steel depend largely upon the chemical



Coils About Soft Iron Cone of Electro-Magnet.

composition of the iron. For this reason most electromagnetic devices, such as generators, motors, etc., are made with electro-magnet cores of soft iron or mild steel, because a given amount of electricity in the conductor wound around the core produces the maximum amount of magnetism in it. Furthermore, up to what is called the limit of saturation, or all that it will take without any escaping, the amount of magnetism that can be produced in a given piece of iron or steel depends on the amount of electricity that can be sent around it through the windings of the conductor. Thus it may be seen that while "permanent" magnets are quite limited in their power, electro-magnets made of iron and coils of insulated copper wire can be made of any capacity desired.

The limit of magnetic strength with permanent steel magnets is soon reached. All large magnets are made by winding an iron core with many turns of insulated wire, as shown in the diagram Fig. 6. As intimated in the last paragraph the capacity of these depends upon the size of the core and the amount of electricity that can be forced through the coil surrounding it. As any one who has worked with large electro-magnets is aware, the field of a magnet of this kind can be made so strong as to pull large pieces of iron from the grasp of a person holding them in front of it. Another instance of the same power is that made use of in lifting magnets which are employed on cranes used for handling large masses of iron and steel.

In order to understand more clearly the action of an electric generator or motor a few experiments with simple apparatus will be described later. It may be stated in advance that generators and motors consist essentially of two parts, a fixed part and a movable part. These are often referred to as the stator and the rotor.

The Southern Pacific is planning to build two large freight steamships to be used in coastwise traffic between New York and the Gulf of Mexico. At present this company is using in this service eight extra steamships chartered from other lines.



Valuable Light on the Cost of Eliminating Grade Crossings; and on the Cost of Maintaining "Protected" Crossings.

In the early days of railroading, when all railroads intersected the public highways at grade, the legal talent of the common carriers deemed that responsibility for accidents ended when a large sign was extended across the highways at such points, announcing plainly: "Look out for the engine while the bell rings!" All that the railroad company had to do then was to provide bells for the locomotives and direct the engineers to ring their bells on approaching and going by these crossings. If the bell did not ring at the proper time,



Rockaway Avenue Crossing Before Grade Separation, L. I. R. R.

the company, in case of an accident, was liable; otherwise the foot passenger or driver of a vehicle shouldered the blame and could not recover for his inadvertence. This may, in a measure, be the substance of the law today, but railroad companies are required to do more than this, on occasion, depending upon location and conditions generally. The freedom with which real estate syndicates have laid out streets and thoroughfares across the railroads in growing sections has added further menace to the situation, with no chance, as a rule, for successful opposition, on the part of the railroad companies, to the danger.



Rockaway Avenue Crossing After Grade Separation, L. I. R. R.

Accident after accident has occurred; suits at law to recover damages have crowded the court calendars, and settlements in large amounts have been made, until the grade crossing subject has become a theme for violent discussion in the daily papers and among the people of towns and municipalities throughout the land. The day of grade crossings, therefore, is gradually disappearing, and some railroad companies are already in position to declare that there are now no such crossings on their lines, the New Haven and the New York, Westchester and Boston claiming that distinction. These are wonderful accomplishments, resulting in an absolute

protection of the public, as well as the railroads, at points which were formerly the scenes of many disasters, costing many lives and many thousands of dollars in damages. The outlays involved in this modern safeguard have also cost many millions, in which the railroads and municipalities have joined in many instances, according to law, but all these vast expenditures have been warranted in view of established safety and the fact that the interest charges on account of this betterment will be inconsiderable in the end as against the former annual outgo in damage payments and for other claims.



Ornamental Deck Girder Elevated Crossing on Cencrete Piers, L. I. R. R.

In the neighborhood of New York City the Long Island Railroad Company has been among the foremost, of late years, to recognize the importance of such improvements and has already constructed many over or under-grade crossings, and is still engaged in this direction, at tremendous expense because the Long Island country, as a rule, is flat and offers no easy solution of this great problem.

On the Long Island Railroad today there are 953 intersecting highways, 305 of which are absolutely protected either by an elevated or depressed crossing (118 elevated and 187 depressed); 193 are protected by gates, 46 by flagmen or guards, and 72 by other methods, such as bells or other mechanical devices. On a system whose line of railroad is but 400 miles, with unusually frequent train service, the number of highway intersections is much larger and the menace greater than the average. Of this number, then, 616 are protected and 337, which might be called unimportant, at present, are not protected.

The average cost of protecting crossings, in the several ways mentioned, on Long Island is shown as follows:

By elevation\$	200,000.00
By depression	200,000.00
Cost of installing gates	350.00
Cost of maintaining gates, per annum	38.60
Cost of installing bells, DC	912.50
Cost of installing bells, AC	1,824.50
Cost of maintaining bells, per annum	78.05
Cost for crossing men at crossings not	
equipped with gates, per annum	548.44
Cost for crossing men at crossings equipped	
with gates, per annum	557.12

27

355 men are employed at crossings equipped with gates and 58 men are employed at crossings not equipped with gates.

During the past five years approximately 12 grade crossings have been eliminated each year.

Payments made for personal injury claims for accidents occurring at these grade crossings are charged to "Injuries to Persons—Transportation." For the past five years these charges have been as follows:

1910	171,136
1911	192,330
1912	173,513
1913	222,783
1914	162,317

However, payments on account of claims for other accidents are charged to this same account, and it may not, just now, be possible to establish any exact proportion between the increase of protected crossings and the decrease of damage claims.

The present division in the expense of protecting grade crossings in New York State appears to be as fair as the railroads could expect.



Mill Neck Road Crossing, L. I. R. R.

The Long Island railroad in view of all the circumstances and conditions under which these great improvements have been and are being made is entitled to great credit and consideration.

One of the large railway systems in the West which links Chicago, St. Louis and Kansas City, has devoted much consideration to this important subject of highway crossings. When this line was built between Chicago and St. Louis, 50 years ago, there were barely 100 grade crossings on the line. To-day there are 963, besides a large number where the grades have been separated at great expense. When this railroad was originally constructed the Chicago city limits were at Twelfth street, Since then they have been extended more than 7 miles beyond and there have been opened 110 city streets, at grade, where the railroad intersected. For more than three-quarters of this distance the tracks have been elevated so that the street crossings are now undergrade and the entire expense of this improvement has been borne by the railroad company in spite of the fact that all this territory had been taken into the city limits long after the railroad was constructed and put in operation. The question of fairness in this matter is left to the judgment of every unprejudiced person who considers it.

At present this company has 990 unprotected crossings throughout its system and 315 protected—39 overhead and 87 depressed, 43 by gates, 58 by flagmen or guards, and 88 by bells. The average cost for elevated crossings, based upon the expenditures for track elevation in the city of Chicago has been \$44,303.46. Gate protection at present averages \$32.50 per month for wages and \$600 each covering the initial expense for installation. Protection by flagmen, alone, averages \$30 per month, and the average cost for the installation of electric bells is \$300.



Reinforced Concrete Highway Bridge Over Tracks, L. I. R. R.

In the past five years 5 grade crossings have been eliminated. The extreme hard times have prevented expenditures in this direction beyond this. All the railroads in the country have struggled with poverty and its consequences for a long time and the hope arises now that the future has in store better things. Affairs, absolutely necessary, have required rigid attention in spite of needs both public and private, as we all know.

When it comes to the question of an honest division of expense when grade crossings are to be eliminated we come in contact with something regarding which there are many opinions. In the early days, referring to this company's experience, in Chicago, the public and the city authorities, naturally, were of one mind and the railroads shouldered such expenses entirely because they were obliged to do it. Any opposition on their part was hopeless, while the public in a large measure enjoyed the benefit. Sentiment has changed somewhat of late years and the adjustment of expenses for these public improvements has been established in some States upon a percentage basis by law, depending upon circumstances now and then.



Deck Girder Highway Crossing Over Electrified Track, L. I. R. R.

In Pennsylvania, for instance, the court judge, after reviewing the history of the construction of the railroad and the opening of the highway and all the attendant circumstances, determines the percentage of cost which each of the parties in interest shall bear.

Until very recent years, when any grade seperation was ordered by the city or State authorities in Ohio, the cost was divided equally between the railroad company and the municipality. Now the railroad company

in that State is obliged to stand 65 per cent of the expenditure and the public assumes 35 per cent. This is an arbitrary arrangement. In a case involving the separation of grades along a prominent highway in one of the counties of Missouri, the court decided that it would be inequitable to assess the entire expense upon the railroad company and eventually the matter was adjusted by charging the county with 40 per cent and the railroad company with 60 per cent.

Heretofore, in Illinois, the railroads have been obliged to assume the entire expense in such cases. Quite recently, however, in a case wherein two railroads intersected in a growing city and the highway on which was a street railroad intervened, as a factor, the Public Utilities Commission apportioned the expense on a basis of one-third to the steam railroads, 25 per cent of the balance to the street car company, 10 per cent to the municipality and the balance to the State. Under the law in Illinois today no highway crossing can be laid out to cross a railroad until the matter has been approved by the Public Utilities Commission. The question naturally arises, admitting that the common carriers as well as the public, benefit by the growth of the communities through which they operate, what percentage of the



Coney Island Avenue Highway Crossing Over Tracks, . L. I. R. R.

cost of grade separation should honestly be borne by them. This is a burning question today. The public demands protection, the railroads are quite in sympathy with the movement, but as both are permanently benefited by such improvements, it would seem only fair that the railroad company should not be called upon to pay more than half the expense in any case. In many circumstances they should be assessed at very much less than this. Absolute protection throughout the country is still a long way off, but the day will be celebrated eventually when the grade crossing menace becomes ancient history.

Handling a Peculiar Drainage Situation By ALBERT MARPLE

Unusual Culvert Construction to Carry Torrential Flow of Water Safely Under Tracks

A somewhat unusual drainage situation exists on a road in the West, and the manner in which this problem was handled by the engineers of the company is of interest. For possibly half a mile on either side of the bridge we show in our illustration as well as for about a mile away from the tracks the roadways have a gradual descent to this particular point, where they cross the tracks and continue on. On account of this unusual grade situation the water from a large territory east of the tracks, which collects at this point, where, if nothing had been done, it would have simply run over the tracks, probably taking tracks, foundation, etc., along with it. But when this line was constructed a culvert, which the engineers felt sure would take care of this drain water problem for all time, was provided and thus far it has "stood up" under the most severe of storms.

As may be seen in the illustrations this culvert is



End view of culvert

made of concrete. It is 60 ft. in length and 30 ft. wide. As it was necessary for this culvert to accommodate a considerable volume of water the drain openings were made quite large. There are two of them, and each is 8 ft. in width and 2 ft. in height. They are separated by a concrete support which is 10 ins. in thickness and which runs the entire width of the culvert. The concrete floors of these openings have been made 6 ins. thick and at the upper side an "apron" has been run for about three yards back into the earth so as to eliminate any danger of the floor undermining the culvert.

At either side of the culvert and outside the tracks a sort of "walk" effect 4 ft. in width has been laid, while on the surface the section occupied by the tracks is of gravel and sand. Beneath this sandy surface, however, the concrete of the culvert serves as a foundation for the tracks. At the outside of these "walk" sections is a railing made of 2-in. iron pipe, the posts of which are buried in a raised section of concrete which is 6 ins. wide and 4 ins. high.



Side view of culvert

In the construction of this bridge the lower section or base was poured first. This consisted of the floor of the water-openings and the support, as well as the solid concrete sections on either side of the drain openings.. After this had hardened sufficiently, the T-rails, which serve as a support for the roofs of the drain opening were placed in position. The forms were placed, then, for the upper half of the culvert, and the concrete of that section was poured. The concrete which serves as a foundation for the surface rails comes 2 or 3 ins. above the rails which constitute the support of the roofs of the water openings. These T-rails have been placed side by side, so as to form a continuous roof across the entire culvert. The standard mixture of 1-2-4, one part cement, two parts sand, four parts broken rock, was used in the construction of this culvert. This concrete work has been given a smooth plaster finish.





The T. W. Snow Construction Co., 537 South Dearborn St., Chicago, have recently adapted their Seaverns Patent Car Unloader to meet the requirements of small railroad coaling plants. The car unloader is of the bucket chain type, with the chain operating from a counterbalanced beam above, so that the operating height is easily varied from the top of the load to the



Bucket Chain Unloading Car of Sand

bottom of the empty car. This beam is provided with lateral motion sufficient to carry the bucket chain from one side of the car to the other, and the whole car unloader can be mounted to travel on a track, the length of the car.

The great flexibility of the unloader enables it to operate cleanly and quickly-90 per cent. of the material is removed by the bucket chain, and the remainder is shoveled into the buckets by the attendant.

In adapting the car unloader to coaling station serv-



ice, a 50-ton coal storage bin is provided at suitable height, and the unloader carries the coal to a hopper from which a second bucket chain conveyor lifts it to the storage bin. The buckets will handle coal from 6-in. lump down to screenings, and with a 7-hopsepower electric motor, or gas or oil engine, as is most convenjent, and one man as operator, the plant can unload a 50-ton car per hour. A niggerhead and switch rope can be used to haul the loaded cars up to the machine, and the empties away. The relative positions of car, unloader, conveyor and storage bin are shown in the second illustration.

If the unloading track is laid between two coaling tracks, and flexible spouts are provided, the station can deliver coal on both tracks, as indicated in the third illustration. The plant will operate at a very low cost per ton, and it is claimed that the results are as economical as are obtained in the largest plants.



End Elevation of Coaling Plant

The initial cost of the plant is much reduced by the fact that no excavation or pit is required, as would be necessary with a balanced bucket coaling station. In speed and economy of operation this plant quite equals the results of plants of other types which for outlying stations would be prohibitively expensive.

Mudge & Company, Railway Exchange building, Chicago, have recently introduced to the railway engineering department the Smith Motor Wheel, for application to track speeders. This wheel is now in use attached to bicycles throughout the United States, and its adaptation to track cars places this form of power at the disposal of track men.

Investigation has shown that direct application of engines to the thousands of hand speeders now in service has been found impracticable. The light frame construction of a speeder will not adequately support its own motor and a troublesome and unnecessary expensive "makeshift" has been the reward for many operators who have tried to rebuild their speeders into motor cars.

With the Smith Motor Wheel the man with the "Old Armstrong" can now fit himself out with a motor driven car which will release him from laborious pumping and his slow method of getting over the ground.

The motor wheel which is the entire power plant within itself, is hitched behind the velocipede and employed as a pusher. Special appliances for attaching are, of course, necessary and these are built and furnished free in accordance with certain dimensions given by the speeder owner. The engine is the four-cycle, air cooled type, $2\frac{3}{8}$ -in. bore by $2\frac{1}{2}$ -in. stroke, and develops $1\frac{1}{2}$ horsepower. It is magneto equipped and is throttle governed by means of a flexible tubing control fastened to handle bars or conveniently on seat board. Any

speed from four to twenty-five miles an hour can be set and maintained.

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Some idea of the capacity of this motor wheel can be gained from the fact that for a test two of them applied to the rear of a seven-passenger Franklin automobile easily propelled it on a several mile run. The wheel complete weighs but fifty pounds and with its heavy rubber tire gives ample tractive power to carry one, and under favorable conditions, two men on a speeder. It is quickly attached and detached and can be taken off



The Smith Motor Wheel attached to track speeder

at night and locked up if it is desired to leave the speeder out of doors. When not in operation it is hooked up to the frame of the speeder about an inch over the rail so that the handle bars can be used if desired.

The Carborundum Company, Niagara Falls, N. Y., are introducing a new hand power grinder, especially adapted to the requirements of railroad section gangs and construction gangs. This grinder was designed after consultation with a number of prominent railroad engineers and has a number of features which merit attention. The size and strength of the malleable



The Carborundum Company's new hand-power grinder for section work

iron clamps make it possible to attach this machine to a hand car or the sill of a car or any other convenient place where the thickness of platform does not exceed 5 ins. The size and length of the handle gives ample power; the length of the bearings and the size of the spindle insure minimum maintenance; the hand tool rest can be adjusted to any angle or position on the wheel that can be required, and the quick and easy method of fastening the attachments by means of wing nuts and keyed bolt ends saves time in making adjustments. Attachments can be furnished suitable for grinding all of the principal tools used by construction gangs and maintenance of way gangs, including twist and flat drill attachments; chisel attachment; scythe attachment, and trueing attachment.



Attachment for properly grinding twist drills

The flat drill grinding attachment makes it possible to grind a flat drill to an oval edge similar to the edge obtained on a twist drill, is understood to be the most desirable edge. At the same time if a flat edge is preferred it can be ground.

The twist drill and flat drill attachments are equipped



Attachment for grinding oval edge on flat drill

with a ratchet feed dial having a major and minor adjustment, allowing of a feed of .006 in. on the drill being ground, and either attachment will grind drills from $\frac{1}{4}$ in. to $\frac{1}{2}$ in., and will also grind small drills with large shanks and large drills with small shanks, or



Attachment for grinding scythe

drills with tapered shanks. These two attachments allow of lateral motions across the face of the wheel and also up and down to give the oval edge. All attachments are simple in design and made of malleable iron to provide the necessary strength to bear the work for which they are intended.





American Blower Company, Detroit, Mich., have issued a 44-page illustrated book on "The Commercial Value of Washed Air," in which are described, by noted authorities, the advantages to employer and employee of using washed and tempered air. The remainder of the book is given to a description of the construction and operation of the "Sirocco" purifying and ventilating system and the sizes and capacities of various types of various installations.

The American Lighting Co., 617 Jackson blvd., Chisago, have recently issued a 6-page illustrated circular describing the Sunlight Flood incandescent lamp for outdoor and indoor flood lighting, operating on D. C. or A. C. current, burning 1,000 watts, lighting 8,00 0sq. ft.

The American Steel & Wire Co., 30 Church St., New York City, have issued a 64-page book on railroad fences, gates and steel fence posts, in which the service of a railroad fence is analyzed and the qualities of their products which meet this service are described. Free building instructions for setting up fence under all railroad conditions are a feature of the book.

The Dake Engine Company, Grand Haven, Mich., have issued their 48-page illustrated catalogue for 1915-1916, covering their line of air and steam motors for jib cranes and hoists, swinging gears, hoisting engines, derrick crabs, pneumatic chain and wire hoists, drilling hoists, boiler test pumps, steam feeds for saw-mill carriages, etc. In addition to illustrating this line of material the catalogue gives piece-part names and numbers for replacements and current price-list.

The Fairmount Gas Engine and Railway Motor Car Co., Fairmount, Minn., have issued a 20-page illustrated catalogue, describing the manufacture and uses of their line of motor cars from engine outfits to be installed on existing speeders to extra gang cars which will haul loaded trailers carrying an extra gang of a hundred men —or six or eight tons of construction material.

The Frost-Superior Fence Company, Cleveland, Ohio, have issued a 48-page illustrated catalogue on galvanized woven wire railroad fence, woven wire gates, coiled spring wire and fence builders' supplies and tools. Instructions for stretching fence and hanging gates are included as well as data in regard to weight and strength of various sizes of fence.

Gerdes & Company, 30 Church St., New York City, has issued an illustrated mailing card describing the Gerdes hygienic method of direct forced draft ventilation, applicable to machine shops with or without balconies and to general building construction.

The Hatfield Rail Joint Manufacturing Company, Macon, Ga., have issued a 6-page illustrated circular describing the Hatfield Rail Joint. The circular contains an analysis of the forces to be met by a rail fastening and shows how the Hatfield Rail Joint fulfills these requirements.

The Industrial Works, Bay City, Mich., have issued a 90-page illustrated book No. 107, on their complete line of cranes, illustrating and describing portable and stationery cranes on many different types and capacities designed for railroad and construction purposes, pile drivers, portable rail saws, transfer tables and various accessories. Cranes are shown operated by steam, electric and hand power. The completeness of the apparatus illustrated and the frankness with which the capacities and uses of the various types and sizes are stated, is a valuable part of the book.

The Ingersoll-Rand Co., 11 Broadway, New York, have issued an 80-page illustrated catalogue on equipment for lifting water by compressed air, describing the theoretical and practical principles involved, and giving tables of sizes of equipment necessary to produce various rates of flow, and various lifts in feet.

The Kernchen Company, McCormick Bldg., Chicago, Ill., have issued a 16-page illustrated bulletin on the Kernchen Siphonage Ventilator, including descriptions of installations, records and data with regard to tests and some matter on the theory of ventilation. A list of sizes and capacities of ventilators is included.

The Link Belt Company, Chicago, Ill., have just issued a 576-page, illustrated, general catalogue, containing views and descriptions of the links and attachments for their various types of link-belt and chains, as well as bearings, brackets and hangers, take-ups, buckets, screw conveyors, weight boxes, car unloaders and coaling station elevators, and special equipment.

The Monroe Calculating Machine Co., Woolworth building, New York, have issued an illustrated circular describing the uses of the Monroe Calculating Machine in engineering and contracting offices. The machine will add, subtract, multiply, divide or combine these processes in any way desired.

The National Roofing Company, Tonawanda, N. Y., have issued a 16-page illustrated book on the use of "Hydrolox"—a water-proofing for Portland cement. A discussion of the principles of water-proofing is presented, and then more specifically, the integral and the plaster-coat systems of water-proofing are discussed. The results of tests are included.

H. A. Rogers Company, 87 Walker St., New York City, have issued a 20-page illustrated catalogue on the Heintz steam trap for steam heating systems. The book contains a discussion of condensation and the means for dealing with condensation as well as instruction for setting up the apparatus.

The Star Headlight and Lantern Co., Rochester, N. Y., have recently issued a 136-page illustrated catalogue describing in detail their complete line of electric, acetylene gas and oil headlights, and signal, switch, water gauge and cab lamps for steam railway service.

The Western Wheeled Scraper Co., Aurora, Ill., have issued a 16-page illustrated bulletin on the Western Automatic Air Dump Car, describing the standard Western dump cars with a new air dumping device, which tilts the bed of the car and raises the side with one movement. The construction and operation of the car are illustrated as well as different types of service to which it can be put.

Westinghouse, Church, Kerr & Company, 37 Wall St., New York, have issued a 12-page illustrated bulletin, No. 20, on the lay-out and equipment of the locomotive repair shops of the Chicago & Alton Railroad, at Bloomington, Ill. The bulletin discusses the theory of building a shop around a predetermined machine lay-out, rather than attempting to advantageously lay out machines after the shop building has been completed.

Westinghouse Electric Manufacturing Company, East Pittsburgh, Pa., have issued a 16-page illustrated reprint of a paper presented at a meeting of the Railway Club of Pittsburgh, by E. M. Herr, president of that company. The paper deals with electric power development through successive sizes of generating units with relation to industrial and railway electrification projects.

Personal Items for Railroad Men

W. H. Holt, recently appointed supervisor of the Norfolk Southern Ry. at Star, N. C., succeeds F. L. Lilley.

R. R. Sheetes, recently appointed signal inspector of the Chicago & Northwestern, succeeds W. H. Hometh.

C. J. Dixon, recently appointed roadmaster of the Seaboard Air Line at Athens, Ga., succeeds J. Landrum.

M. C. Manney has been recently appointed signal inspector of the Chicago and Northwestern Ry. at Chicago, Ill.

I. S. Lhoyd, recently appointed chief engineer of the Tellsmere R. R. at Tellsmere, Fla., succeeds W. A. James.

J. Landrum, recently appointed division engineer of the Seaboard Air Line at Atlanta, Ga., succeeds J. L. Kirby.

J. L. Kirby, recently appointed division engineer of the Seaboard Air Line at Hamlet, N. C., succeeds A. O. Wilson.

R. G. Henley, recently appointed foreman of the Nirfolk & Western at East Radford, Va., succeeds there W. Buddwell.

L. D. Fisher, recently appointed roadmaster of the Detroit, Toledo & Ironton R. R. at Adrian, Mich., succeeds O. Climer.

L. Vogland, recently appointed assistant roadmaster of the Great Northern Ry. at St. Cloud, Minn., succeeds L. Kiloran.

A. Eckstrom, recently appointed assistant roadmaster of the Great Northern Ry. at Great Falls, Mont., succeeds A. Kemp.

James A. West, recently appointed roadmaster of the Chicago, Rock Island & Gulf Ry. at Dalhart, Tex., succeeds C. B. Lane.

L. J. Gilmore, recently appointed assistant roadmaster of the Great Northern Ry. at Kelley Lake, Minn., succeeds Fred Graba.

J. J. McCarthy, recently appointed assistant roadmasmaster of the Eastern Texas R. R. at Lufkin, Tex., succeeds H. L. Pirkle.

A. G. Savage, recently appointed roadmaster of the Texas & New Orleans R. R., at Jacksonville, Tex., succeeds A. H. Maher.

H. Wilburne, recently appointed roadmaster of the Galveston, Harrisburg & San Antonio at Victoria, Tex., succeeds H. J. Gordon.

W. H. Maxwell, recently appointed roadmaster of the Montreal & Southern Counties Ry. at St. Lambert, Que., succeeds H. B. Fleshman.

B. G. Womack, recently appointed roadmaster of the Galveston, Harrisburg & San Antonio at San Antonio, Tex., succeeds P. Sweeney.

Edw. M. Boggs, recently appointed chief engineer of the San Francisco-Oakland Terminal Rys. at Oakland, Cal., succeeds C. H. Rinkley. J. M. Romney, recently appointed supervisor of bridges and buildings on the Guantanamo Ry., at Guantanamo, Cuba, succeeds P. Desjaigne.

I. T. Phillips, recently appointed general foreman of bridges and buildings of the Norfolk Southern Ry. at Norfolk, Va., has been serving as supervisor at Wilson, N. C.

S. L. McClanerhan, recently appointed division engineer of the Chicago, Rock Island & Pacific at Good Land, Kan., has been serving as assistant engineer at Colorado Springs.

W. D. Brown, recently appointed general manager of the Mineral Point & Northern Ry. at Mineral Point, Wis., has been serving that road in the capacity of assistant general manager.

N. F. Shipley, recently appointed foreman of Section 52, Glassport yard of the Pittsburgh & Lake Erie Railroad, was in 1915 promoted from track walker to assistant foreman of work train, and later to extra gang foreman, before his recent promotion.

J. W. McCraw, recently appointed roadmaster of the Third District of the Western Division of the El Paso & Southwestern System, at Tucson, Ariz., succeeding O. G. Horton, transferred, has spent the last three years as section foreman in the Tucson yards.

R. L. Mason, who has been connected with Hubbard & Company, manufacturers of railway track tools, for the past 14 years in the capacity of manager of the railroad department, has left that firm to form a railroad supply company of his own at 1501 Oliver building, Pittsburgh, Pa.

J. H. Minton, recently appointed assistant engineer in the maintenance of way department of the Nortswest System of the Pennsylvania Lines West, succeeding D. M. Craig, resigned, has been continuously in the service of the construction and maintenance of way departments of that road since 1907.

F. A. Benz, recently appointed division engineer on the Buffalo, Rochester & Pittsburgh Railway at Rochester, N. Y., with jurisdiction over Divisions 1 and 2, and the Erie Division, entered the service of that road in 1906, and was promoted from the position of assistant engineer, to succeed John P. Reynolds, deceased.

E. R. Lewis, assistant to the general manager of the Duluth, South Shore and Atlantic Ry. at Duluth, Minn., has had his jurisdiction extended to include all matters pertaining to engineering, maintenance-of-way and structures, and also valuation work of the Duluth, South Shore & Atlantic Ry. and the Mineral Range R. R.

R. C. Emmett, recently appointed roadmaster of the New Mexico Division of the Atchison, Topeka & Sante Fe R. R. at East Las Vegas, N. M., succeeding L. Lenehan, deceased, entered the employ of that road in 1898, and has served continuously since, as extra gang and section foreman on the Chicago Division.



C. L. Bartholome, recently appointed signal supervisor of the Vandalia Railroad at Terre Haute, Ind., succeeding C. W. Hixson, transferred, has been in the service of the Pennsylvania Lines West since 1905, as signal repair man, draftsman, wireman, signal inspector, signal foreman, signal supervisor, before being transferred to Terre Haute.

F. J. Blauvelt, recently appointed division engineer of the Lehigh Valley Railroad at Auburn, N. Y., entered the service of that road in 1903 as stenographer and a few months later entered the engineering department as rodman, and serving in various capacities until early in 1915, he was promoted from assistant engineer to supervisor of track at Cortland, where he remained until his present appointment.

John T. Bealor has recently been appointed by the Homestead Valve Manufacturing Co., Pittsburgh to have charge of their new department in which they have the eastern territory for the Taylor Steam Specialty Company of Battle Creek, Mich. Mr. Bealor is in a position to render expert advice and service on matters pertaining to vacuum exhaust steam heating systems, and to returning condensation from exhaust steam to boilers.

F. D. Cosner, recently appointed engineer maintenance of way, succeeding R. H. Pembroke, resigned, on the Coal and Coke Ry., at Elkins, W. Va., served from 1903 to 1905 in the U.S. Corps of Engineers in the Philippine Islands. In 1905 he started work in the location and construction of the Coal and Coke Ry. In 1906 he was location engineer for the R. & P. S. Ry. and the T. & N. C. Ry. In 1907 he was appointed resident engineer on the Albemarle Sound bridge on the N. & S. Ry. This bridge is five miles long over a single bed of water. In 1908 Mr. Cosner was appointed location engineer of the R. & N. Ry., and in 1910 had charge of the building of a bridge for the C. & C. In 1910 he did construction work in Arizona for the E. P. & S. W. System, and in 1912 went to South America to work on the Pan American Ry. at Durozua, Uruguay. In 1913 he was appointed assistant engineer in the Bureau of Engineering Statistics of the J. G. White Co., which position he held until the announcement of his present appointment on the Coal and Coke Ry.

L. W. Turner, recently appointed roadmaster of the Second Division of the Georgia & Florida Railway at Vidalia, Ga., started railroad work in 1899 as section laborer on the A. K. & N. Ry., at the age of 14 years, and in 1899 was appointed night yard foreman of the D. S. C. & I. In 1901 he was made foreman of the Mineral Bluff section of the A. K. & N. and in 1902 took charge of the construction of the yards of the Tennessee Copper Co. at Copperfield, Tenn. Following this work, he was engaged in contracting and railroad operating work until in 1906 he had charge of building the Snow Bird R. R. from Andrews, N. C., to the Little Snow Bird River. After this work was completed Mr. Turner held a number of positions in the engineering and transportation departments of railroads in that section, and in 1911 was appointed supervisor of the North Division of the G. & F. In 1912 he was made roadmaster, and in 1913 assistant general roadmaster, where he remained until the road was divided into two roadmasters' divisions, when he received his present appointment. Mr. Turner has been identified in his eighteen years' railroad work with some very interesting construction work, including having charge of the construction of the Smoky Mountain loop at Farmer, Tenn., and of the largest sulphuric acid plant in the south, at Copperhill, Tenn.

Trygve D. Yensen, for his success in development

of alloys of iron possessing remarkable electrical properties, has been promoted, effective January 1, to be Research Assistant Professor of Electrical Engineering of the University of Illinois. Mr. Yensen has not only duplicated what other investigators have done, but he has produced metal, the magnetic permeability of which is many times greater than any that has before been produced. It is understood also that he has not only done this once, but his procedures have been so systematic that he can duplicate with certainty any result which has thus far been obtained. His work has attracted wide attention, and visitors to his laboratory have come from every part of this and other countries. Mr. Yensen's results have been obtained through the melting of metals in vacuo by the use of an electric furnace. He is the author of a considerable number

of scientific papers and of the following bulletins of the Illinois Engineering Experiment Station: No. 55. "Starting Currents of Transformers with Special Reference to Transformers with Silicon Steel Cores." No. 72, "Magnetic and Other Properties of Electrolytic Iron Melted in Vacuo." No. 77, "The Effect of Boron upon the Magnetic and Other Properties of Electrolytic Iron Melted in Vacuo." No. 83, (in press) "The Magnetic and Other Properties of Iron-Silicon Alloys Melted in Vacuo."

Obituary

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John I. Johnson, general superintendent of the Central of Georgia Railway, died at Savannah, Ga., Sept. 21, last. He was not only popular, but able. He was in every sense a self-made man, commencing as a trainman and advancing steadily until he became general superintendent. Mr. Johnson was 53 years old and was born in Hanover county, Virginia. In his death the Central of Georgia loses an executive of the highest class. It is a source of extreme regret that he should pass away in the midst of his usefulness and activity.

Association of American Portland oement Manufacturers

At the annual meeting of the Association of American Portland Cement Manufacturers, held in New York on December 15, 1915, the following officers were elected:

President—B. F. Affleck, president Universal Portland Cement Co.

First Vice-President—F. W. Kelley, president Helderberg Cement Co.

Second Vice-President—Richard Hardy, president Dixie Portland Cement Co.

Treasurer—G. B. Brown, president Alpha Portland Cement Co.

Assistant Treasurer—John J. Matthew, treasurer Alpha Portland Cement Co.

Assistant Secretary-L. R. Ferguson.

Percy H. Wilson, who has served as secretary for a number of years, resigned and J. P. Beck was elected general manager of the association. The association unanimously approved of a comprehensive plan for enlarging the activities of the organization submitted by Mr. Beck, and by resolution the executive committee was instructed to carry into operation the proposals in the report.

The Savannah & Northwestern, C. E. Gay, Jr., general manager, Savannah, Ga., are in the market for several miles of relaying rail.

RAILWAY ENGINEERING AND MAINTENANCE OF WAY

WITH WHICH IS INCORPORATED ROADMASTER AND FOREMAN

New Series Vol. XII Established 1884 NEW YORK, FEBRUARY, 1916 Copyright 1916 No. 2

Lessons Which Mean Something

We never know what we can do until we have been compelled to act. These past years of forced economy have taught railroad managers many things. The efficiency which has been exercised here, there and everywhere on the railroads has brought about marvellous results and decidedly beneficial ones, too. Things have been accomplished which, heretofore, were deemed nothing but dreams. When circumstances demanded real ingenuity in operating methods it was promptly forthcoming. Like the husband-man whose income is meagre; but who has a family to support and supports it, the railroad managers have employed all the methods of economy known to the science of railroading; have introduced successfully many new ideas and under the rigid tutelage of want have acquired habits which will serve them well for all time.

These nice lessons in the care of material; the running of trains and in other directions will be the means, later on of saving many a railroad, to the end that dividends may be assured and the interest on its bonds be promptly met. The past eight years full of so many struggles have without doubt been blessingsin disguise, perhaps-at the time, but, now, quite understood. There is no reason why the average railroad should not be handled exactly as any business usually is. As the science of railroading grows more exact we can readily perceive the trend of affairs. There is no business which involves so many details, as the railroad business, and there is no field which presents so many satisfactory results, as this business does, when true rules of care and economy are put in vogue, under rigid discipline, and followed. We have yet to find a man who has selected railroading as his profession who is not thoroughly interested in it. as he moves upward. This is one of the fundamentals which usually invites success not only for the man but also for the company which gives him employment.

Scarcity of Track Labor

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The track labor situation, as far as may be forecast from present conditions, bears every indication of a shortage, not alone for this spring but for some time to come.

The factories of the east are calling for common labor, the governments of Europe have recalled what men they could for soldiers, and the winter's supply of new labor from Europe has been very much less than usual. These considerations all suggest that the big cities will not furnish the usual amount of track labor when the call for the spring increase in maintainance forces is sounded.

Much of the labor has found not only more profitable employment, but all year round rather than seasonal or casual employment. The new labor, which does not appreciate that much track work in this country is temporary employment, have, on account of the embargo on emigration enforced by the belligerent countries of Europe, not put in their appearance.

Engineering officials who do not want to be seriously embarrassed by shortage of labor can profit by the example of one official in the middle west who now has a small force of men engaged on extra work, and is planning his inspection and distribution of material, clearing of drains, etc., to keep that gang at work for the rest of the winter. He has reached the conclusion that even with this small force on hand, with the experience they will gain between now and then, he will have an advantage when spring work starts. And further, that by beginning the spring work early and keeping at it, it will cost less to hold these men than it would to find new ones when the time comes and the better grades of labor for this work are scarce on a competing labor market.

This official's immediate problem does not differ from general conditions to such an extent that similar foresight to his would help to solve the general track labor problem.

The Interstate Commerce Commission has reported and shows comparative figures relating to train accidents covering the period from the year 1902 down to the close of June 30, 1915. In 1902 there were 8,675 train accidents reported to the Commission, 5,042 of which were caused by collisions and 3,633 were due to derailments. In 1908 collisions had materially decreased, but derailments had increased so that in number the causes practically matched each other. In 1915 the number of derailments had increased to 6,849, while collisions had decreased to only 3,538. The Commission having investigated the causes of derailment during 1915, in 40 different instances found that 11 of them were due to "bad track." Bad track, of course, is due to either lack of attention or faulty material, and perhaps to both. Exercise of extreme economy is more often the cause, and there have been occasions, unfortunately, to go to extremes more than often in the past several years. As a rule, when orders go out from



headquarters to reduce expenses the track department suffers; men are lopped off all along the line and supervisors and roadmasters are forced to meet the call as best they can. As the track is the fundamental basis of all the business this presumably economical move is more frequently in the direction of trouble than otherwise, and we have all seen what unfortunate results are likely to follow. One derailment on account of a badly maintained track may result in damage so large that all the supposed economy put in vogue on 200 or more miles of a system is wiped out in a moment with something left, perhaps to apply on the best part of another 200 miles. High speed, too, as occasion often seems to require, is another cause; but this can be more easily overcome. Let the track be good or bad, some managements are especially wise when they limit the speed of all trains and hold to it under all circumstances. Rails fail now and then. Heavy trains and more powerful locomotives and equipment are operated over some lines where the rails hardly warrant it and unless they are properly tied there is usually but one result in the end. If, however, the matter of derailments is run down to its most vital features it will be found that the reason lies largely in economy badly exercised in the first instance; unwarranted excessive speed in the second, and rail failures in the third. In every case it is largely a question of management, and if the railroads are setting out to fathom this interesting subject of derailments as they should they will save money by remembering that by being penny wise they will unexpectedly learn that they have been more than one pound foolish. When it comes to establishing rules of economy let the track alone in economy orders; keep it up to a top standard at all times, regardless of everything. A poor equipment will run on a good track, but neither good nor bad equipment can be handled successfully on a bad track. 4

Making the Convention Pay

When the doors of the Coliseum open, Monday morning, March 20, there will be gathered in Chicago a host of railroad and railroad supply men from all over the country. The railroad men have spent time in preparing papers and discussions for their association meetings, as well as in arranging their work so that they can be absent. The supply men have spent time and money, not only in preparing their exhibits, for their spaces, but in the research and experiments, and service tests that have developed the devices they exhibit, and by calling in their sales force to attend the convention, and explain details of the appliances there.

All this effort must be considered an investment, if it is to continue, year after year, and we must look to the results to determine its value. The results we look for are the spreading of information from railroad man to railroad man, from supply man to railroad man, and from railroad man to supply man. In every one of these cases the value of the information secured will depend to a great extent on the time and care spent in its preparation.

Before our readers come to the convention, they are urged to study the list of exhibitors at the convention, and make notes of the subjects that are of greatest interest to them. Then when they arrive at the Coliseum they can arrange a systematic plan for covering the exhibits in which they are interested, with the least possible lost motion or lost time.

It is worth while to avoid the busiest hours, as salesmen then are likely to have their attention diverted to such an extent that much time is lost. It is worth while to make a preliminary survey of the booth, from the aisle, and determine as far as possible the most interesting features of the exhibit, before taking them up in detail one by one. It is worth while to have a note book very handy, and it is no reflection on any man that he is unable to remember and assimilate the vast amount of information offered him during the convention, unless he will transfer the burden of figures and details from his memory to his notebook. It is worth while to waste as little time as possible in getting over the features of a device to the limit of your present knowledge-to where you can begin to gather facts that will extend your information; it wastes both your time and a salesman's time for you to listen to facts with which you are already familiar. It is worth while to get what descriptive matter you can, and to wait until you are back from the convention to read it over, with your notes on that subject, to get the best possible grasp of the subject. It is worth while to make a note or get a card of the man you talk with, for any questions that may come up later can be profitably referred to him, with the knowledge that he can tell how far the subject is clear to you.

There are two extreme courses to be avoided, in studying the exhibits; first, to treat each exhibit as equally important to the next, and so devote no more time to the subjects in your own special field that you do to subjects of little except general interest to you. The second is to confine all of your attention to your own field, and not take advantage of the exceptional facilities offered to familiarize yourself in a general way with the advances made in related fields of work.

Between these two lies the proper course, and every man will have to hold himself responsible for the most advantageous distribution of his time. It is not out of place to suggest that when the booths you are most interested in are crowded, you cannot fare worse in booths of less specific interest to you, for all the information wanted from them can often be secured from the aisle, whether the booth is crowded or not. Mornings are the best time for the concentrated work in your own department, as every exhibit will be set in order, and more freedom is possible in comparing devices than later, when the attendance increases.

The subject of how best to make the convention serve you and through you, your work and your railroad is worth painstaking study. All the thinking and planning that can be done beforehand will result not only in more time available for the purposes of the convention, but in a more advantageous use of that time.

Grade Separation at Crossings

The movement to eliminate grade crossings in main line track is gathering momentum with each passing year to such an extent that some roads are now making a practice of avoiding such crossings on all new construction.

In the engineering departments of railroads whose experience in grade separation has extended over a number of years, there has become available a considerable amount of data from which it is possible to determine the most advantageous method of separation to recommend for the solution of any specific problem which is referred to the departments.

The article on grade separation appearing elsewhere in this issue was prepared with this idea in mind: to furnish in compact form, for reference, a comparison of the various methods of grade separation and of the conditions for which each is best adapted. The comparisons are made from the standpoints of engineering practice and initial and operating or maintenance costs.

Such roads as have not had these conditions to meet will find the material authoritative. No attempt is made to prescribe a definite design for any individual conditions, nor to present cost estimates except for purposes of comparison. However, a tentative estimate on a given project could be facilitated and checked to a certain extent by reference to the data given for general cases.

Watching the Rail at Work

The explanation of the compression of the rail under the wheel load, as outlined some years ago by Prof. Johnson, still holds good. In this explanation, the minute "flow" of metal under pressure is taken for granted, or at least accepted as a fact. Metal compressed very heavily on a small area, as a wheel standing on a rail, is productive of a definite effect. The metal at and below the point of contact sinks down as a result of the pressure, and its displacement brings about a lateral "flow" of the metal below, which seeks relief by the upward movement of the metal surrounding the point of contact.

It must be remembered that Prof. Johnson's analysis of the "flow" of metal under these conditions is envisaged only by the eye of science. In the language of ordinary thought it represents little more than a tendency. Yet as there is no effect without a cause, so it is manifestly impossible to escape the conclusion that the pressure of a wheel on a rail produces a "flow" of metal, however slight it may actually be.

Viewed with the eye of science, a driving wheel standing on a rail is really in the centre of a shallow depression. The area of contact is dependent upon the load carried. Some experiments made by the U. S. Ordnance Department on this subject showed that a wheel loaded to 15,000 lbs. stood on an area of approximately 0.2 of a square inch, and that when this wheel sustained a weight of 60,000 lbs., the area became nearly 0.7 of a square inch. From this it seems fair to suppose that the resulting hollow-and-hill condition of the rail was more marked in the latter than in the former case.

A locomotive standing on a pair of rails rests in a number of minute depressions, with a raised ring around each; the number of depressions corresponding to the number of its wheels, and the depth proportional to the load on each. This would present an aspect very like what might be seen through a microscope, where the surface film of water would be slightly depressed under each foot of a water-spider. The movement of a locomotive along such track would be to make it constantly run uphill and draw behind it cars doing the same thing. The rise and depression of the rail in front of and under the locomotive would always be there, and would be somewhat similar to the catenary wave, which on a suspension bridge precedes the load.

The total energy expended in thus surmounting the minute hills in front of an engine and cars is not great for any one train. Its power-consuming quality only becomes apparent when considered in the aggregate, where all trains and a series of years is considered. The individual effects of load, whatever they may amount to, are augmented at two points in the revolution of the driving wheels where they reach a maximum. These are when the pull down and the push up of the connecting rod throws a greater weight on the rail than that due to the static load. This effect is partly, though not wholly, done away with by the action of the counterbalances.

The heavy stiff rail is, other things being equal, not only an engineering requisite, but it operates to the advantage of the mechanical department as well by eliminating destructive shocks to rolling stock. The more flexible the smaller rail, as expressed in the langauge of the prize ring, it receives severer punishment, which causes more or less rapid deterioration of the road-bed, and it adversely affects the rail itself. It constantly uses up power which could be more profitably employed in pulling the paying load.

The whole subject opens up a wide field of systematic and scientific investigation. We have not now at our disposal all the data which can and will be brought to light, in the future. Our researches along the lines of chemical composition, heat treatment, rail rolling, and rail form, have progressed far enough to teach us some very valuable lessons, but more remains to be done. The other line of investigation, that of "watching the rail at work," is still in the earlier stages of its existence, and there is likelihood that it will be proceeded with further than it has been so far. There is no doubt that a most instructive and useful mass of facts await the explorers who carry on the line of work already begun by Prof. Johnson, Dr. Dudley, the U. S. Government, the C., B. & Q., and others, who have directed attention to how the rail carries its load, the "why" of its section, its supports and its relation to moving locomotives and cars, and in fact to its position not only in the laboratory, but out in the open, in railroad use, as a contributing factor in the science of transportation.



Martins Creek Viaduct, Delaware, Lackawanna & Western

Three-Track Reinforced Concrete Structure; Arches Built in Two Ribs Pierced with Openings for Inspection; Refuge Balconies for Men and Handcars

In our issue of November, 1915, we described and illustrated the great Tunkhannock Creek Viaduct recently completed by the Delaware, Lackawanna & Western Railroad on the new forty-mile re-location of the main line between Clark Summit, Pa., seven miles west of Scranton, Pa., and Hallstead, Pa., fourteen miles east of Binghamton, N. Y. This viaduct is the largest concrete railroad viaduct of its kind in the world. It is an interesting fact that the second largest concrete structure of this type, the Martins Creek Viaduct, although somewhat dwarfed by the gigantic proportions of the Tunkhannock Creek Viaduct, was built on this same change of alignment.

The Martins Creek Viaduct is a three-track structure 47 ft. wide, 1,611 ft. long and 150 ft. above the creek. The piers are carried to rock, 25 ft. below the bed of stream, giving the structure a maximum height of 175 ft. It consists of seven 150-ft., three-centered, arches with a rise of 59 ft.; two 100-ft. full-centered, arches, one of which is an abutment arch and cannot be seen in our illustration, since it is buried in the approach fill on the left or west end. There are two 50-ft. fullcentered, arches on the west end that give the necessary length, which prevents the approach fill encroaching on the tracks of the old line that pass under the fourth arch from that end. arch, but does not reach the back of the last main arch. The pressure exerted by this high embankment on the pier assists materially in reducing the eccentricity of the resultant thrust of the 150-ft. and the 100-ft. arch spans. The entire floor is waterproofed with three plies of Minwax saturated cloth, laid in Minwax hard waterproofing and protected by a $1\frac{1}{2}$ -in. layer of asphalt mastic furnished by the Johns-Manville Co. The tracks are laid on stone ballast 3 ft. deep, and are enclosed between massive parapet walls, 3 ft. thick and 3 ft. 6 ins. high above the top of the rail. The walls are substantially reinforced, insuring a large factor of safety in the event of a derailment.

The architectural treatment is commendable. The main arch with its graceful curve, approximating to an eclipse has been set at such a height as to give the proper balance between the sub-structure and the super-structure. Grace and utility have been combined in the design of the overhanging pilasters. This feature of the architectural treatment is built in the form of a balcony, or refuge niche, into which the trackmen working on the bridge can place a handcar to clear passing trains.

The contractor, anxious for the best results, cooperated with the engineering department of the railroad in an endeavor to obtain the best possible finish



Martins Creek Concrete Viaduct on the Delaware, Lackawanna & Western Railway

The main arches are built in two ribs, each 17 ft. 6 ins. wide and 12 ft. apart. The depth of the arch ring is 6 ft. at the crown and 12 ft. at the haunch. They are surmounted by solid transverse spandrel walls 12 ft. 6 ins. apart that support the floor arches and the parapet walls. The floor has a depth of 2 ft. at the crown, and is reinforced with 1-in. square bars placed 7 ins., centre to centre. The top of the floor is ramped 3 ins. from the crown of each arch to the spandrel walls through which the drainage is carried in 6-in. cast iron pipes to the opening between the main arch ribs. A floor system similar to that over the main arches is continued to the crown of the 100-ft. abutment arch. The heavy approach fill slopes through the hollow superstructure and completely buries the two ribs of this of the concrete without resorting to surface treatment. This was accomplished by the construction of heavy timber-formed units, lined with stout galvanized iron plates, and by giving careful attention to the spading of the concrete against the forms, to keep the aggregate away from the surface. The lining of the forms proved to be economical as well, since the metal preserved the timber and permitted the repeated use of the units.

The piers are 20 ft. wide at the springing line, and 10 ft. below the springing line they are increased to 28 ft. in order to form a ledge 4 ft. wide on either side of the pier. On this the structural steel centers for the main arch rings was supported. This ledge is cancealed by an ornamental belt of steps, built after the removal of the center. The 12-ft. opening between the

arch ribs facilitated the moving of the center. The piers of the main arches are solid for 17 ft. below the springing line and below that elevation they are divided into two legs 23 by 28 ft., separated by a 12-ft. opening. Strips of moulding were placed at 5-ft. intervals on inner faces of the pier forms to make the construction joints and the horizontal scorings around the pier. In this manner the unsightly construction joints so often in evidence in this kind of work, are hidden by the scoring.

The excavation for the foundation varied from 10 to 60 ft. below the surface of the ground. This was made in open caissons, built of Lackawanna steel sheet piling. The viaduct contains 78,000 cu. yds. of concrete and 1,000,000 lbs. of reinforcing steel.

A series of openings in the walls of the piers just above the lower arches, enables the top side of these arches to be inspected as well as the pier walls and underside of the upper arches. A man may climb up to the top of the lower arches on a ladder at one of the abutments and make a tour of the entire structure without being compelled to leave it. The discolored portion of the viaduct, as seen in our illustration, was caused by the drippings from the contractor's outfit, but will later on be entirely cleaned off. The viaduct is an artistic piece of work and serves to enhance the beauty of the rolling landscape at this point on Martins Creek.

Mr. G. J. Ray, chief engineer of the D. L. & W., had direct supervision of the design and the construction of the viaduct. Mr. A. B. Cohen, concrete engineer of the road, had charge of the design. The construction was supervised by Mr. F. L. Wheaton, and Mr. W. L. Lozier, resident engineer, was in charge of the work.

The contract was awarded in June, 1912, to F. M. Talbot Company of New York City, of which Mr. F. M. Talbot is president and Mr. E. J. Mailady is secretary and treasurer. The viaduct was completed six months and 15 days ahead of the contract time.

Programme of Section Work for Gangs By W. KIRCHBAUM

This outline is intended mainly for roads using gravel, cinder or slag ballast, as stone ballast may be handled in a different manner during wet weather.

Early spring track work should be commenced before the frost is out of the ground. The entire section should be gone over, paying close attention to spreading places in the track and where this is caused by the rail being canted, the ties should be properly adzed and rails spiked in proper positions. Bolts should be inspected carefully and loose ones tightened. All scrap that has been snowed under during the winter should be gathered and placed in scrap bin at the car house.

Any accumulation that has lodged in sewers and waterways should be cleaned out so as to allow the early spring rainfalls to run off without doing any damage.

If any joints are observed that are churning and which cannot yet be tamped they should be shimmed to prevent the rail from breaking. I do not believe in doing much tamping at this season of the year before the frost is entirely out of the road bed, as otherwise there may be some very high places left in the track when the frost goes out. Ballast that is worked when wet will soon get worn out and will not handle nicely when summer comes.

At this season of the year the section gang is usually composed of a foreman and 2 or 3 men and it is surprising what such a gang can do in the way of little jobs when proper system is followed. It is very important that minor repairs to track tools be made at this season of the year. This can be done on rainy days when the weather is too bad to work outside. The car house can be converted into a shop and all grinding of adzes, axes, etc., done, spike maules should be rehung and in fact any work done that will put the summer tools in first class condition.

After the frost gets out of the ground and roadbed, track should be worked from end to end of the section, taking out all the shims that have been put in during the winter months, tamping up any places that require it and always keeping a good line. While making the first trip over the section and doing all this work the bolts should again be inspected and tightened where necessary, for a loose joint gets low very quickly. The next thing to look after is the right of way fences which should be put in order so that they will require no more attention during the summer. It will be easy at this time to see just which fields the farmers are going to use for pasturing and which fences must be put in the best shape to prevent stock getting on to the right of way.

Digging holes for fence posts is the most easily done in the spring when the ground is soft and in addition there is no high grass to contend with. And when a stretch of woven wire fence is properly put up at this season it will hold a more even expansion during the entire year, as you are putting it in during the period of medium temperature. Five or six men can in a few days go over an entire section and put the fences in shape to carry them over until the following spring. By the time the fences are fixed it will be time to start tie renewal. These should be made as quickly as possible consistent with good work the ties having been unloaded and placed in piles convenient to the places they are to be put in during the fall and winter. Under heavy traffic it is well to keep the new ties tamped and spiked as fast as they are placed, thus eliminating any danger of broken rails or track spreading. It seems best to have each pair of men do the entire work on the ties, pulling them out and putting in the new ones and tamping them. This keeps the track safe for trains much better than if the gang is split up, part of them digging out, others pulling out, others putting in ties and still others tamp-The foreman should help out wherever ing them. needed.

After the tieing has been completed and the old ties piled and burned and the right of way given a general cleaning up, a few days should be spent in cleaning up the ballast from weeds and grass. The best article for this work is a scuffer, made from a piece of an old crosscut saw 12-in. long. The teeth are cut off and two holes punched in the center to which a small iron rod is attached as a rake handle is moulded. The back of the saw should be used for cutting edge. This can be filed from time to time and this tool allows a man to stand in a working position which allows him to do much work without tiring him, and with this tool one laborer can cut as much grass as three laborers can with ordinary shovels. A man should be provided with a common garden rake to rake off the grass and weeds that have been cut so as to leave the grass line and gravel line in a very neat condition. The scuffers provided already made up I have found to be too light and not as serviceable as the home made one.

After the ties are in and the weeding done the track should be put in good surface and line and given a very neat appearance. This should be done completely by starting at one end of the section and working toward the other. Section gangs usually do not do heavy sur-



facing, the extra gangs being put on to do this work, but these do not do as permanent work as the section gang. The laborers do not care for results but simply work to get in their time. The result is that track ballasted by such a gang will ride all right for six months or a year and then will get badly out of surface because it becomes center bound. A section gang of 6 to 8 men should be employed to do the heavy surfacing instead of letting the extra gangs do it. Then the work can be started at one end of the section and giving a lift of one or two inches as you have ballast and in the meantime if a raise of one inch is given, the inside or the center of the tie should be tamped only a shovel length from the rail on each end. If two inches raise is given the center should be tamped about two shovel lengths from the rail. The part of the tie underneath the rail should be well tamped with a bar or tamping pick. The raising should be started in the morning, the men tamping only the ends of the ties with the exception of the joints where the insides should be tamped, and this work can be pushed along that way until dinner time. Then the gang can drop back and tamp the centers and line and trim up the track raised in the morning. The bolts should then be tightened and after the men have become accustomed to this system it is surprising how much ground can be covered each day. After the general surfacing of the whole section is completed the gang can run over the track quickly and pick up the few little spots which have developed. Broken ties should at the same time be replaced with new ones, the ballast line polished up and all public and private crossings put in a good condition and then grass and weeds should be cut and burned from the right of way.

After the above work has been done on the main line the side tracks should be given some attention. They may need some new ties and perhaps some of them will need complete surfacing. This should all be done before the fall rains and bad weather sets in. The foreman after doing this work should look after the waterways and sewers and get them properly cleaned out for fall rains and winter snows. At this time the forces will probably be reduced to a winter basis and unless full preparation has been made the foreman will have a hard time during the winter. The gang will probably consist of only two or three men and special attention should be given to switches, frogs and crossings, cleaning out from under the moving rails so that they may be easily cleaned of snow in the winter time.

During the winter a very careful and painstaking inspection must be kept up on the track. Switches, frogs and guard rails should be examined frequently, and also ice removed from them so that they will work easily. Plates on which points move should be oiled at least once a week and a few drops of oil should be put on the pipe that works the derails.

Rail rests should be made during this time if they will be required anywhere on the section and the ones which are on the section should be inspected and put in good shape, being sure that good rails are placed on them in every case.

Fence material should be arranged for and other little jobs that will shorten the summer work should be done. A great deal of shimming is sometimes necessary and care should be exercised to leave the track spiked solidly where this is done, especially where the shimming is so high that an ordinary spike will not hold the track to gauge. In this case rail braces of some sort should be used. The foreman should carefully watch the different parts of this section at this season of the year to determine the quality of his ballast and spot the places where - 4-----

Conclusions from Rail Failure Statistics Compilation of Sources of Rail Failures from Railroad Statistics

A report on the subject of rail failures compiled for the year ending October, 1914, was presented to the American Railway Engineering Association by Mr. M. H. Wickhorst, engineer of tests, rail committee, a brief resume of which is here presented. The statistics were furnished by the railroads which are members of this association. The failures were divided into, head, web, base and "broken."

The tonnage of rails given in the data sent in by the various roads shows kind of steel, year rolled, and the total tonnage in each year:

1909	514,302	935,512
1910	842,895	1,402,603
1911	630,694	863,954
1912 95.666	997,078	1,092,744
1913 72.496	1,202,060	1,274,556
1914 20,779	672,564	693,343

Lots less than 1,000 tons in any one year were not placed in the tables. The method of compiling the statistics was to make prints of the reports sent in by the railroads, then cutting them up along horizontal lines. These strips showed the units in the tables, and after sorting in suitable order and collecting into the desired groups, the information was made up into tables, from which cuts were made. The tabulation this year is limited to a classification by mills. For the same reason the committee continued to use failures per 10,000 tons as the unit of comparison.

The detail tabulations by mills and years rolled and a condensed table showing the failures of each year's rolling mill has been compiled. It is interesting to note the comparative performance of Bessemer and Open-Hearth rails for the several years' rollings. Figuring the failures per 10,000 tons of Open-Hearth rails as 100 for each of the years 1909, 1910, 1911 and 1912, the relative number of failures of Bessemer rails, together with the failures per 10,000 tons, is shown below:

19095	141.7	268.7	100	190
19104	76.3	158.5	100	208
19113	58.5	113.4	100	193
19122	20.1	44.4	100	221

The rails for 1913 and 1914 are not included in this comparison, as they are probably too young for reliable comparison. It will be noted that the failures per 10,000 tons of Bessemer rails were about twice those of Open-Hearth rails.

The records are closed for the 1908 and 1909 rollings. The 1909 rails showed as a general average for all mills, a lower rate of failures than the 1908 rails, and it is gratifying to note that the later rollings also show a tendency toward continued improvement as a general average.

A comparison with last year's statistics indicates, as a general average of all the mills, a gradual decrease in the rate of rail failures of rollings for the successive years since 1908, the year with which the records began. As a general average, the failures per 10,000 tons of Bessimer rails were about twice as much as those of Open-Hearth rails.

Railways of the Republic of Colombia, South America

By JOSE M. ROSALES, Commissioner of Colombia to the United States

Description of Railroad Situation in Colombia Dealing with Topography of the Country and the Location of Existing Roads

The Republic of Colombia lies in the northwest corner, as it were, of South America and has the Caribmean Sea on the north, Venezuela and Brazil on the east, Ecuador, Peru and Brazil on the south, and the Pacific Ocean on the west.

The area of the Republic is 505,000 square miles, and there is a coast line of about 2,000 miles on both oceans. From north to south it is longer than from St. Paul to New Orleans, and from east to west, in places, it is wider than from New York City to Chicago. Its area is equal to that of the New England States, New York, New Jersey, Rhode Island, Ohio, Indiana, Vermont, West Virginia, Delaware, Maryland, Kentucky, Tennessee and North Carolina. It is larger than France, Germany, Belgium and Holland combined, but a large part of the territory is still uninhabited. The population today is just 6,000,000. Colombia is consequently the third South American State in area and population, Brazil and Argentina ranking first and second respectively.

Topographically, the Colombian territory may be treated under two great divisions: a mountainous one on the west and a level district on the east; the former, 20,000 feet, and Hervea, 18,000 feet. All of these have, of course, icy tops, as the snow limit in the tropics is 13,000 feet. Tolima is covered with nearly 6,000 feet of snow from the summit down.

The relief map plainly shows the topography of this wonderful country and explains why the building and operation of railroads therein are confronted with difficulties in the extreme. To complete the connection of Bogota, the capital, with the Pacific Coast—now under way—it is necessary to cross the three mighty ranges already alluded to, which is a great engineering feat. As to the construction of railways along side the Andean valleys of the Atrato and Magdalena Rivers, especially in their lower course, is more than a serious task on account of the marshes and extensive lagoons of the lowlands, where the tropical vegetation is most luxuriant.

The mining interests of the country as well as the agricultural resources and the other industries require better railroad facilities. In fact, it is what Colombia needs in order to be able to assume its place among the progressive nations of Latin America. We have an



The Magdalena River District in the Republic of Colombia

with its elevated ranges and intermediate deep valleys, constitutes the Andean region. The immense eastern dominions, almost uninhabited and watered by such fine navigable rivers as the Arauco, Meta, Caqueta, Guaviare and Putumayo, consist of great plains on the north and dense forests on the south.

The great chain of the Andes on entering Colombia divides into three ranges that run in a northerly direction and end upon the shores of the Caribbean Sea. On the Central range, the most imposing of the three, the highest peaks of the Andes north of the Equator may be found: Huila, 18,000 feet; Ruiz, 17,000 feet; Tolima, annual output of gold to the extent of 40,000 lbs.; of platinum we export 2,000 lbs. annually; we have iron, petroleum and coal in abundance and the copper mines of Sierra Nevada, when properly worked will yield more mineral than those of Chile.

The last year we exported 120,000,000 pounds of coffee. Colombia is the second coffee exporter after Brazil, but I must say that ours is the better of the two, as we have plenty of humidity and shade in the Cordilleras, more than in any other South American country. The exportation of bananas amounts to 350,000 bunches monthly.

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Tunnel on the Girardot Railroad

As the industrial resources of the republic have grown, and now that the political affairs have become settled and conditions generally are normal, railroad activities are shaping toward the building of a complete national system, to which will belong all the different sections of railroad lines now scattered here and there throughout the republic.

To-day there are 14 different lines constructed and in full operation with extensions and connections pro-



Railroad Bridge on the Antioquia

jected which will eventually bring about the national railroad system intended. Bogota, a flourishing city of 150,000 inhabitants, is the great centre from which everything in the republic radiates. The city was built by the Spaniards in 1538 and still keeps that dignified character and peculiar charm of the old Spanish capitals. It lies 8,600 feet above sea level upon a wide



Scene on the Girardot Railroad

plateau of the eastern range, while the Magdalena River is the great artery of traffic, occupying the valley between this range and the central one and flows north to the Caribbean Sea. This river, one of the largest in South America, is navigable for about 480 miles, from Baranquilla at the mouth of the river to Neiva, although the navigation is stopped just once by the Honda rapids.

The railway lines now in operation logically lead to this great river and naturally depend upon it to reach the northern coast. The general plan of the Colombian



Sketch Map of Colombian Railroad

Government to-day is to establish by a union of the present lines three complete systems of railroads to give impulse to all agricultural and mining resources of the country and to establish positive unity in all its commercial activities. The most important of these systems is the railway from Bogota to the Pacific coast. Upon this, as well as the improvement of the sanitary conditions of Buenaventura and our Pacific ports, all the energies of the government and the financial resources of the country are bent.

To reach the lower Magdalena River it is necessary to complete the line from Bogota north as indicated on the accompanying map, which shows the Magdalena River district, and to reach the same district farther north the line from Cucuta must be extended forward. From Bogota towards the Pacific coast the line has already been constructed to Girardot on the Magdalena, at a point 1,000 feet above the sea level, and on from there almost to the foothills of the Central Cordillera, while from the Pacific at Buenaventura eastward the line has already surmounted the western range of mountains and is at present crossing the Cauca River valley to meet the Bogota line. It can readily be imagined what



engineering problems are presented in this great work and what enormous expense is involved. To cross the central range the line must go over a pass 9,000 ft. high, while on both sides of the pass rise the snowy peaks mentioned before. But it is a glorious task which will eventually be crowned with success.

The Cucuta line is also a very important one, since all the coffee and other native products of the soil are grown in that district, and when the line is completed to the Magdalena the entire output of crops will seek the river and thence north to Barranquilla, the most consequential port on the Caribbean Sea. This route, too, for all merchandise imported, will save the custom duties now paid to Venezuela, making possible increased importations at great saving to the consumers.

On account of the heavy grades encountered the standard gauge generally adopted is that of 3 ft. It is true that the railways of the Bogota plateau have a 3-ft. 6-in. gauge, but as the Girardot line, as well as La Dorada has 3 ft. and the same gauge has been decided for the Cauca and Antioquia lines, this gauge will meet all the requirements and become the standard all through the country.

The fourteen different lines heretofore mentioned and which will be finally put together to make the three systems projected are:

The R. R. of Antioquia, 102 miles The R. R. of Barranquilla, 18 miles. The R. R. of Cartagena, 65 miles. The R. R. of Cucuta, 45 miles. The R. R. of Pacifico, 105 miles. The R. R. of Girardot, 82 miles. The R. R. of La Dorado, 73 miles. The R. R. of La Dorado, 73 miles. The R. R. of La Sabana (Bogota), 25 miles. The R. R. of del Norte (Bogota), 40 miles. The R. R. of del Sur (Bogota), 25 miles. The R. R. of Santamarta (Bogota), 92 miles. The R. R. of Santamarta (Bogota), 92 miles. The R. R. of Tolima, 30 miles. The R. R. of Amaga, 30 miles.

The total mileage amounts to 740 miles, but with the chain complete there will be in the republic about 1,450 miles of railroad which will serve the country thor-



Relief Map of Colombia



Tropical Forest in Colombia

oughly and be the means of exploiting the natural wealth of the soil and developing the industrial activities of the people. In view of the attention now being directed toward the South American countries, here is a field well worthy of consideration on the part of capitalists, engineers and those engaged in the manufacture and sale of supplies.

Chesapeake & Ohio Railroad

The Chesapeake & Ohio seems to be developing into a remarkable property. In the month of November last its net earnings were \$600,886.19 as against \$21,876.08 for the corresponding month in 1914; an increase of \$579,010.11. From July 1 last-the beginning of the fiscal year-down to and including the month of November the net earnings show an increase of 155 per cent over the five months from July 1 to November 30, 1914. The gross earnings of the system for the first five months of the present fiscal year were \$19,632.-688.50, compared with \$16,583,243.91 in the same period of 1914, an increase of 18 per cent, or \$3,129,718.96. This shows that a vast volume of new business was developed and that conditions generally throughout the territory which this well-maintained property serves have improved to a wonderful extent. The Chesapeake & Ohio is well on its way toward more than remarkable success. It is an excellent example of highly efficient railroading.



A Novel Railway Waiting Station By ALBERT MARPLE Artistic Suburban Station Shelters, Constructed of Concrete, with Tile Roofs

One of the most attractive of the smaller railroad waiting stations to make its appearance in Southern California is a structure, built on a combination of Mission Spanish lines, shown in the accompanying illustrations. This attractive little station is directly opposite a boulevard from the old Spanish mission at San Fernando, known as the San Fernando Mission. This is one of the very old structures that are still standing and which was used by Spanish padres years



View Looking Out from Waiting Station

ago when the territory, now California, was still in the possession of Spain.

This modern open air waiting room is, with the exception of the red (Spanish) tile roof, made entirely of concrete, the walls and seats being solid. It is 16×28 ft. in size. In both the front and the rear there are two arches, each 9 ft. in width, through which an excellent view of the mission may be obtained from the interior of the room. The walls are 12 ins. thick, and the building has, both inside and out, been given a finish of rough sand. A pleasing feature is the arched windows above the seats at either side. On each side there are three of these windows, each window being



Exterior View of Waiting Station

3 ft. in width at the bottom. The roof, all round the building, has an overhang of about 4 ft. and is equipped with water gutters. The red tile roof contrasts nicely with the white plaster finish of the cement, and at each of the four ridges of the roof there is a little dome, out of which rises a short flag pole.

Along each of the two closed sides of this room there is a comfortable rest bench. The seat section of the bench is 18 ins. in width, 2 ft. in height, while the back section, which is raised from the wall behind, is about 30 ins. high. Although this bench appears as though it might be a separate feature, it is in reality a part of the building itself, having been constructed at the same time as the walls.

Another practical feature is the sanitary drinking fountain, made of glazed cement, which is in the center of the room. The water for this fountain has been piped underground from the old fountain at the Mission, about a hundred yards away. An interesting point about this modern station is that, so far as was practicable, it was built on lines which harmonized with those of the Mission near which it stands. In other words, Spanish and Mission styles were used in its design and construction.

Locomotive Cranes for Track Work New Method of Laying and Relaying Rail on the Lehigh Valley

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The Lehigh Valley Railroad has just announced the purchase of six new locomotive cranes. Aside from the purpose for which they were originally designed, the management and engineers of the Lehigh Valley have found these cranes a good asset in laying rail



Locomotive Cranes on the Lehigh Valley

for new tracks and in picking up old rail. Recently during the congestion at the port terminals, the cranes have also been used with great advantage in the unloading of heavy freight. The Lehigh Valley now has as many as thirty-two of these cranes at work.

During the past year the Lehigh Valley Railroad has made some remarkable records in the loading and unloading of rail by the use of these cranes. The best record was made on a stretch of line between Gilbert and a point east of Lodi, N. Y., when 4.07 miles of track were laid with new 100-lb. rail in remarkably short time. Four locomotive cranes were used. The work was begun at 6.23 A. M., and the last new rail



Rail-laying Train on the Lehigh Valley

was laid at 12.51 P. M., and the track was entirely completed and the old rail and material picked up and loaded on cars at 6:30 p. m. This was done without any interruption to traffic. Our illustrations give a good idea of three of these cranes at work. The work train has a business-like appearance and lives up to its appearance.

A Study of Grade Crossing Elimination in Cities

Digest of Paper Read before Western Society of Engineers by C. N. Bainbridge, Assoc. M. W. S. E., Containing Valuable Tables and Original Information, Constituting a Comprhensive Survey of Grade Separation Work

In general, grade crossings can be eliminated in two ways only, by carrying the tracks over the street, or the street over the tracks. The tracks may be carried across the streets by depressing the streets and leaving the tracks at their original elevation, or by elevating the tracks and leaving the streets at their original elevation, or by a partial elevation of the tracks and a partial depression of the streets. The streets may be carried over the tracks by a full elevation of the streets or by a full depression of the tracks, or by a partial elevation of the streets and a partial depression of the tracks.

In the following discussion, track elevation refers to the case where the tracks are carried across the streets, and track depression refers to the case where the streets are carried over the tracks.

Probably the biggest factor entering into a question of grade crossing elimination is the cost, this being the most vital to the railroads, who generally bear the greater burden of the expense. Practically all questions which arise, where two or more plans present themselves, are determined from this standpoint.

The geological character and topography of the country and the effect on the grade of the railroad are also big factors in selecting a plan for any grade separation project. In a flat low district situated as is Chicago, there is, however, little choice in selecting the method of separation. Track depression would be out of the question on account of difficulties which would be encountered by water and interference with the sewer system which would make the expense prohibitive. This leaves the alternative of track elevation, or partial elevation. Chicago, however, is only one city in many where grade separation is being carried on, and at other places where the tracks are at the summit of an ascending grade, the natural selection would be depression. unless this proved to be too expensive. There are still other places where the ground is high above water and the present tracks nearly level. In such cases either track elevation or track depression could be adopted without excessive gradients.

Numerous elements are involved in the study of a project of this nature and for convenience they will be considered in the following order:

Excavation or fill. Clearances. Bridges. Right of way and retaining walls. Changes in streets. Conclusions.

Excavation or Fill

To carry the tracks over the street requires a vertical separation of grades of from 15 ft. 6 in. to 17 ft. 6 in., allowing from 3 ft. 6 in. to 4 ft. for floor depth and 12 ft. to 13 ft. 6 in. for headroom. To carry the streets over the tracks requires a vertical separation of grades of from 21 ft. 6 in. to 26 ft. 6 in., allowing from 18 to 22 ft. for clearance and from 3 ft. 6 in. to 4 ft. 6 in. for floor depth. The difference of from 5 to 11 ft. in the amount of vertical separation of grade, required for complete elevation and complete depression, together with the increased width of roadbed required for track depression over that required for track elevation, in order to provide for drainage, makes the amount of excavation, in the case of track depression, considerably more than the amount of fill required for track elevation. Fig. 1 shows typical cross-sections required for track elevation, and track depression and illustrates the above statement for one and two-track projects. From inspection, it is seen that the excess in yardage of track depression projects increases as the number of tracks increase.



Fig. 1

What appears at first glance to be a decided advantage for track elevation, may, on further study and consideration be an advantage for track depression. This depends largely on the source of material for fill, in the case of track elevation, and the distance it has to be hauled, and where material excavated—in the case of track depression—can be disposed of. Other things being equal, material can be excavated as cheaply in a cut for track depression as in the borrow pit for track elevation; but usually the cost of dumping material for fill will exceed the cost of wasting material from the cut, due to the fact that material for fill is usually dumped from a trestle, and the cost of the trestle is chargeable to the fill. The additional cost of a trestle will go a long way toward balancing the cost of additional yardage required in the project of track depression. This may be best illustrated by an example: Assuming that but one track is to be elevated or depressed, leaving the street in its original position and that the right of way is sufficiently wide so as not to require walls, the cross-sections required are shown in Fig. 1. Assuming further that the cost of material for fill per cu. yd. exclusive of cost of borrow pit and haul, and cost of handling traffic, is as follows:

Loading and shifting track at pit	\$.10
Unloading and distributing from trestle	.06
Frestle at \$6 per lin. ft. $600/26$.23

Cost per cu. yd. for fill in place, exclusive of cost of borrow pit and haul and cost of handling traffic

Assuming that the cost of material excavated in the depression per cu. yd. exclusive of haul and cost of land to waste on and cost of handling traffic is as follows:

.39

.20

Loading and shifting track in cut	\$.10
Unloading and distributing	.10

Cost per cu. yd. of material removed from excavation exclusive of haul and cost of land to waste on and cost of handling traffic....

From the foregoing it is noted that the cost of 1 cu. yd. of material for fill, exclusive of the items indi-



cated above, is practically twice the cost of 1 cu. yd. of material from the depression, but from Fig. 1, it is noted that the quantity of material from 1 lin. ft. of depression is slightly in excess of twice the quantity of material for 1 lin. ft. of fill, thus making the cost for 1 lin. ft. of depression and 1 lin. ft. of fill approximately the same, exclusive of haul, cost of borrow pit and land on which to waste material, and cost of handling traffic.

Assuming further that the cost of haul is five mills per ton mile and that material weighs 2,500 lb. per cu. yd., the cost of haul per cu. yd. of material would be 0.625 cents per mile.

The cost of hauling material for 1 lin. ft. of

embankment one mile 26 x .00625...... \$.1625 The cost of hauling material for 1 lin. ft. of

depression one mile $60 \times .00625....$.375

These figures indicate that, when the length of haul for material for fill is approximately equal to, or less than, twice the length of haul necessary to waste material from the depression, track elevation is cheaper.

For a two-track proposition the same reasoning holds, and figures indicate that for equal hauls, track elevation is the cheaper if one trestle is used in making the fill, but when two trestles are used, track depression is the cheaper.

It has been assumed in the foregoing comparison that the cost of borrow pit and cost of land to waste material on would be approximately equal and would not enter into the above comparison. This, however, may not always be the case, and the cost of such land should be pro-rated to the estimated yardage for fill and excavation, and the value of the land, after the work is completed, credited to same. It is sometimes the case that a project of grade crossing elimination is carried on to advantage in conjunction with some other project, such as the construction of freight or storage yards, where considerable grading is necessary and material may be borrowed or wasted as the case may be, to good advantage and at small expense.

Further examples could be given, but the ones already cited will illustrate that the question of the source of material to be borrowed and place of disposition of material to be wasted is vital and should be considered for any project. Other items, such as difference in cost of bridges and walls, number of tracks, and cost of maintaining traffic, changes to sewers, and nature of material to be excavated, and depth of depression and amount of elevation will tend to throw the balance either one way or another for any particular case.

Clearances

In recent years numerous state legislatures have passed various laws regarding vertical and side clearances. In some cases the requirements of these laws are more rigid than the present standard clearances of 22 ft. vertical and 7 ft. lateral, maintained by the majority of the railroads. The Minnesota law, one of the most recent ones, requires new tracks to be 14 ft. centers, 1 ft. greater than the present practice, and a side clearance of 8 ft. measured from the center line of track at the base of rail. This is 1 ft. greater than the present bridge clearance standards, 2 ft. 6 in. above the top of rail, and 3 ft. greater at top of rail. The clearance over tracks is fixed at 21 ft., which is not quite as great as the present railroad standard bridge clearance. This is typical of the laws being passed by various legislatures, although some specify but 7 ft. above the highest car for vertical clearance, which would reduce the clearance to about 20 ft. 6 in. In most cases, however, there is a provision in such laws which

allows this clearance to be reduced in special cases, if approved by the city or railroad commission. For track depression projects the overhead clearance generally adopted is between 18 and 22 ft., but in some instances where passenger traffic alone is handled on the lines this is reduced to 16 ft., although this latter figure is somewhat scant if electrification is contemplated at some future date.

Where the tracks are elevated, the clearances of the bridge over the street varies in different localities, the usual clearances being 12 to 13 ft. for streets without street cars, and 13 ft. 6 in. to 14 ft. 6 in. for streets with street cars.

The following brief table gives the vertical clearances which have been used in the past for bridges over the tracks and for bridges over the streets in different localities under various conditions. For proposed work there is little variation from the clearances shown for bridges over streets, but there is a strong tendency, as indicated by recent legislation, to increase the clearances under bridges over the track to 21 or 22 ft. wherever possible, unless the railway commission or some other competent authority permits a reduction in special cases.

CLEARAN BRIDGE	CES IN FI S OVER ST	EET OF REET	CLEARANCE BRIDGES	S IN FE OVER TRA	ET OF ACKS
Location. S	its. without St. Cars.	Sts. with St. Cars.	Location. C	learances.	Clearance. Side
Chicago	12 to 13	13.5	Chicago	16 to 18	• • • •
Philadelphia.	14	14	Philadelphia	20	• • • •
			Rhode Island	18	• • • •
Num Vork	14	1	Connecticut	18	• • • •
New TOLK	14, USUAL, 1 and 19	T			
	special	14	New York City	7 16 to 18	
			N. Y. State	21	
D			Massachusetts	18	••••
Випаю	13	14	Buffalo	15 to 18	
Evanston	12 to 13	13.5	Minneapolis	18 to 18.5	• • • •
••			North Dakota	21	8
Kansas City	13	14.5	Canada	22.5	• • • •
Cloudand	10		Kentucky	22	
Cieveiand	13	14.5	Cleveland	16.25	• • • •
Detroit	19	14	New Hampsnire	21	••••
Milwaukoo	19	19 5	Minnesoto	18	
MANNAUNCE	1-	10.0	Vormont	41 99	2
			Indiana	22	1.0
			Indiana	<i>4</i> 1	1

If legislation governing clearance must come, national legislation is preferable to state legislation. A railroad passing through six or eight states would not then have to conform to as many different laws for clearances, and trainmen would have some knowledge of what to expect in the way of clearances.

Bridges

Bridges for track elevation or track depression projects are in practically all instances of a permanent nature and are constructed of either structural steel or reinforced concrete; or a combination of both. A few of the roads are adopting concrete, wherever possible, to the exclusion of steel in structures of this class, as the first cost is the same as or less than steel, the maintenance is less, and it can be treated aesthetically to better advantage where such treatment is warranted by the nature of the district through which the road passes, such as across boulevards and in residence districts. The same may be said for bridges crossing a depression of the tracks, although the need for aesthetic treatment is probably not so great, because fewer people will view the bridge from close range.

Bridges for track elevation can be divided into four types:

Type A.—Structures spanning the full width of street with single spans.

Type B.—Structures spanning the full width of street with two spans, supports being placed in the center of the street. Type C.—Structures spanning the full width of street with three spans, supports being placed at the curb lines.

Type D.—Structures spanning the full width of street with four spans, supports being placed at the curb lines and at the center of roadway.

In practically all types it is desirable to:

1st.—Keep the floor of the bridge as thin as possible. 2nd.—Avoid any projections above the top of rail, which might be a menace to safety.

3rd.—Select a type of bridge which can be readily altered to provide for additional tracks.

Bridges of types A, B, and C, except in cases of narrow streets where comparatively short spans can be



employed, have no alternative, except the use of steel girders, although they have been used to some extent by resorting to a combination of structural steel and reinforced concrete, but not to the exclusion of the deep side girders. These types, however, have the first qualification of thin floors, but cannot in all cases meet the second qualification of no projections above the top of rail, nor do they meet the third provision for taking care of additional tracks without considerable alteration and expense.

Fig. 2 illustrates how the projections above the bridge floor are a menace to safety, unless sufficient side clearance is maintained by spreading the track which, although an advantage, will increase the cost of the bridge and embankment. Fig. 3 illustrates conditions prevailing when deck type structure of type "D" is permitted.

Bridges of types "B" and "D" have the objection that the roadway is obstructed by the supports in the center of the street, but, with the possible exception of structures spanning boulevards, there is no serious disadvantage in this, provided the roadway on each side of the center supports is of sufficient width to allow two vehicles going in the same direction to pass each other. This objection would be even less for structures spanning streets with double street car tracks, although it requires the spreading of the car tracks. The car tracks themselves form a natural barrier in the center of the street, there being little occasion for traffic across the car tracks from one to the other, especially in the short distance occupied by the bridges.

Bridges of type "D" meet the three requirements of thin floors, no projections above top of rail and ease of alteration to provide for additional tracks. Due to the comparatively short spans, this type is well adapted to be constructed of either steel or concrete. It has been recognized by practically all parties interested that tight floors are a necessity in bridges crossing city streets, not only to prevent grease, dirt and water from dropping through, but also to deaden the noise of trains passing at high speed across the bridges. Numerous types of floors have been used to accomplish these results, but only two types of floors, i. e., steel I-beams and concrete slabs for steel bridges and the solid slab for concrete bridges, will be considered here. There are numerous modifications of or variations from these selections which might be adopted, the various roads using the one with which they have had the better success, but in all probability floors as used in concrete bridges of type "D" will remain the cheaper.

Structures spanning 60-ft., 66-ft. and 80-ft. streets are compared, these being the usual width of streets in cities.

The relative economy of the various types is shown in the estimates in Figs. 4 to 13.

These relative comparisons for track elevation bridges are on the basis of two track structures for Cooper's E-50 loading with track and girders 13 ft. 0 in. on centers. The depth of floor for the steel structures is 3 ft. 6 in., and for concrete structures 3 ft. 10 in. No account has been taken of the additional cost chargeable to the concrete structure due to the difference in thickness of floors. This would vary, depending on the distance between structures, and whether retaining walls were required to retain the fill between structures. On the other hand, no account has been taken of the additional cost to maintain the steel bridges; it being assumed that the additional cost of maintenance of the steel structure, if capitalized, would offset the cost of the additional fill and walls. Paving and sidewalks have been figured on the basis of the right of way being 100 ft. wide. This may be wider than the majority of right of way, but there will be



few crossings where at least this amount of paving and sidewalk will not have to be restored. Abutments and pier footings have been figured on the basis that the foundation is good for a load of from 2 to 2.5 tons per sq. ft.

The estimates are intended to represent only the comparative cost of a structure as illustrated. Numerous items, such as rails, ties, ballast, and drainage of subways being common to all structures have not been included, it being assumed that they would vary with the location and conditions under which a structure is built, but that there would be little difference due to the type of structure built.



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TYPE A. Steel Structures spanning full Width of Street with Single Span Fig. 4

Bridges for track depression projects may be divided in two main types:

Type E.—Bridges spanning the tracks with clear spans.

Type F.—Bridges spanning the tracks with two or more spans with intermediate supports.

In bridges for track depression as well as for track elevation it is desirable to observe the same conditions, namely:

1st.—Keep the floor of the bridges as thin as possible. 2nd.—Avoid any obstructions between tracks.

3rd.—Select a type of bridge which can readily be altered to provide for additional tracks.

Bridges of type "E" (bridges with clear spans) meet the first of these requirements, but in most cases not to as good advantage as structures of type "F" with supports between tracks. For streets with narrow roadways and short spans, not exceeding three tracks, a deck type structure of either concrete or steel can be adopted. For longer spans and wide roadways, however, the deck type must give way to the through type with girders projecting above the roadway, and reinforced concrete cannot be used to advantage; but a combination of structural steel and concrete may be used. For narrow roadways but two lines of girders need project above the roadway, one on either side at the curbs; but for wide roadways center girders are required. This is a disadvantage, the same as the center piers in bridges of type "D" (structure spanning the



Width of Street with Two Spans

street in four spans with supports at the center of street and at the curbs) for track elevation, but is not serious. Structures of type "E" spanning the tracks with a single span do not lend themselves well to the third requirement, that of additional tracks. Either additional tracks must be provided for when the structure is built, or considerable expense must be incurred to lengthen the bridge to provide for them.

Bridges of type "F" (bridges spanning the track with two or more spans) meet the first requirement of thin floors and the third requirement of providing for additional tracks, but do not meet the second requirement of no obstructions between tracks. This can be overcome by spacing the tracks in pairs at 13 and 18 ft. centers respectively where more than two tracks are used, which will give the required clearances, but will add an item of expense for additional excavation, and, where the right of way is narrow, an item for additional right of way or higher walls. This type of bridge is also well adapted to the use of concrete.

The comparative economy of the various types to meet different conditions is shown in the foregoing estimates:

The foregoing comparisons for track depression bridges are on the basis of 20 ft. 0 in. clearance over tracks at 13 ft. 0 in. centers, except in bridges of type "F" (bridges of two or more spans with intermediate supports) where alternate tracks are widened to 18 ft.

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340

30

40

5

360

40

5

50



0 in. centers to provide adequate side clearance. A 24-ton concentrated load on two axles 10 ft. centers and 5 ft. gauge and two 40-ton street cars were assumed as the bridge loads, with 150 lb. per sq. ft. on the portion of the sidewalks and roadway not occupied by the concentrated load and street cars. As it is not a common practice to carry the full width of the street across the depression where the streets are 80 ft. wide, no estimates are shown for this width of street. It is usual for 80-ft. streets to carry only the roadway and two amply wide sidewalks across the depression, reducing the width of street by the amount otherwise occupied by parking. As in the case of the track elevation bridges, paving and sidewalks off the bridge have been figured on the basis of 100 ft. right of way. The estimates are intended to be comparative only, and the same items were omitted as in the case of track elevation bridges.

Fig. 6

Ignoring property damages, and, in the case of track elevation, the excavation required for depressing the streets, and in the case of track depression the excavation required for depressing the tracks and the fill required for the street approaches, the cost of a particular type of structure across an assumed 100 ft. right of way remains practically constant, regardless of the elevation to which the tracks are elevated or depressed; i. e., structures of type "D" (bridge spanning the street in four spans) will cost practically the same, ignoring the above item, whether the tracks be elevated 2 ft. or 10 ft. The same is true for any of the other types.

930

37/0

340

1280

2600

5.500

5500

1030

3710

70

1590

380

1380

Toto

.1240

3710

370

80

1590

450

1600

3140

ARR

\$12 70

25 10

325 1300

154 360

20 340

31 5050

\$100 340

25 30

\$ 80 340

25 10

15 330

34 5700

\$18

\$700

\$100 340

\$800

25 30

\$ 12

25 10

154 540





From an examination of the estimates it can be seen that for a two or three track proposition there is little difference between the cost of bridges for elevation and those for track depression. Concrete bridges of type "D" (bridges with supports at curbs and at center of roadway) are the cheapest type for track elevation and concrete bridges of type "E" (bridges spanning tracks with clear spans) are the cheapest for track depression. As the number of tracks increase, however, bridges of type "F" (bridges spanning tracks with two or more spans with intermediate supports) for track depression show a saving over other types of bridges. If the distance between adjacent bridges be great, this may be more than offset by the cost of the additional excavation or higher walls required, by having the tracks spaced at 18 ft. centers to provide sufficient side clearance where supports are located between tracks. The estimates show further that the first cost of concrete bridges, although requiring a slightly deeper floor, are cheaper than steel spans with concrete slabs. It might be said here, that if timber floors were used in place of the concrete slabs for the depression bridges, the cost of such bridges would be reduced below those of reinforced concrete, but on the other hand, if the steel bridges are encased, the difference in cost between the two will be still greater in favor of the concrete bridges.

In track depression bridges of type "E" (bridge spanning tracks with clear span) there is a manifest sav-



TYPE D Concrete Structures Spanning full Nidth of Street with Four Spans

Fig. 8

ing, by using the center girder, of between \$20 and \$30 per linear foot of bridge besides the saving either in the cost of excavation in the cut and reduction in heights of walls where used, or in the amount of fill, paving, etc., on the approaches, depending on whether the tracks are depressed one foot less or the street raised one foot less, due to the decrease in the floor depth.

All of the foregoing figures for both track elevation and track depression bridges are applicable only when the tracks cross the streets at right angles, or when they cross at an angle which will not materially increase the span lengths.

For track elevation bridges, where the tracks cross the streets obliquely, or cross at the intersection of two streets, it is desirable, although in some instances difficult without resorting to unsymmetrical and complicated construction, to space the supports so that they line up in the direction of both streets.

Right-of-Way and Retaining Walls

In general, for the same number of tracks in each case, track depression will require a greater width of right of way than track elevation, even where the tracks occupy the full width of right of way and where retaining walls are resorted to.

It is seen from Fig. 1 that the amount of additional right of way required for track depression over that

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110

2.5

185

\$ 20

\$109

1325

154

182

20%

6

\$120

26

25

20% 2500

Total

159

540

45



TYPEE2- STRUCTURES SPANNING 2 TRACKS WITH SINGLE SPAN TYPE E3-STRUCTURES SPANNING 3 TRACKS WITH SINGLE SPAN

Fig. 9

required for track elevation, if no retaining walls are used, depends on the amount of elevation and depression of the tracks.

In cases where the entire right of way is occupied by tracks retaining walls would be required for both track elevation and track depression. In such cases it is seen from Fig. 14 that it is necessary to acquire additional right of way to accommodate the same number of tracks in depression as in elevation, or else eliminate one track to allow room for the retaining walls, which must be built on railroad property. The loss due to the elimination of one track to the railroad company is impossible to determine. An order of any city or commission calling for track depression under such circumstances, in the face of the railroad's opposition, amounts to confiscation of railroad property without compensation and without due process of law, and it is doubtful if it would be upheld in the courts.

Both of these conditions are serious handicaps for track depression, for in the majority of cases the districts where grade separation is required are usually thickly settled and the tracks are lined with industries or other improvements, making the acquisition of additional right of way out of the question on account of the value of adjacent property, and leaves the building of retaining walls the only alternative. This would very often be the governing factor in the selection of a plan were the choice made entirely from the economic standpoint, unless the cost of walls be offset by the saving in the cost of track depression bridges over those for track elevation, and in some cases by the saving in the cost of excavating the material for the cut over the cost of filling the embankment.

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TYPE E4-STEEL STRUCTURES SPANNING FOUR TRACKS WITH SINGLE SPAN Fig. 10

520 195 S.Y.

145 880 S.F.

2720

16400

630 195 S.Y.

\$21,700

130 880 5.F. 3570 630

130

19600

520 160 S.Y.

145 960 S.F.

2950

\$17,800

160 SY

960 S.F.

3.25

15

20%

There may, however, be instances where the tracks run through a strictly residence district, where land values would not be excessive and additional right of way could be acquired for a nominal figure, but this condition would be the exception rather than the rule.

Any one of numerous types of retaining walls may be adopted on any project, economy being the prime factor in the selection.

Much literature has been published regarding the economy of various types of walls, and this phase of the subject will not be discussed further than to state that for walls of the height required for track elevation and track depression a gravity wall will, under ordinary conditions, be cheaper than the reinforced concrete types. The following curves, Fig. 15, will serve to indicate the comparative costs per linear foot for various heights of wall for track elevation and track depression for various distances of track from right of way lines.

In compiling these curves, the most severe case has been assumed, in that all walls have been figured to be wholly within the right of way. Some economy can be gained, especially in the high wall where a toe is allowed to extend beyond the right of way, as is generally permitted where there is a street or alley parallel to and adjacent to the right of way. The unit prices assumed are indicated in the figure.

Figure 16 will serve to indicate comparative costs, per linear foot of right of way, of fill and walls for va-



MATERIAL	COST	60:0" Street 36:0" Roodwou		60-0 St 36-0 Ro	reet odwoy	66-0" 5h 44-0" Roc	reet	66-0" Street 44-0" Roodway		
		Quantity	Cost	Quantity	Cast	Quantity	Cost	Quantity	Cost	
Structural Steel	0.034	300,000*	9,750	240,000	7.800	410,000*	13320	3240001	0.530	
Concrete Side walk on Bridge	0.40	1,800 sp#	720	1,800	720	1.5843	630	1.584	630	
Concrete Slobs	20.00	100 cy	2,000	110 cu	2,200	117 cu	2.340	124.	2 480	
Renforced Conc. Abutment	10.00	540CY	5,400	540CY	5400	580CY.	5,800	580CX	5.800	
Exc. for Abut.	1.00	620cy	620	620cy	620	680cu	680	680.00	680	
Bock Fill	,60	750cy	450	750cu	450	830 cu	500	830cu	500	
Handrail	1.50	200 hft	300	200 haft	300	200 Inft	300	200 ht	300	
Poving on Br	225	360sq4	810	33050	740	43030	970	400	900	
Poving on Rol IV. but of Bridge	3.25	4	45	14	45	59 .	191	59 .	191	
Sidewolk on R of W, but dif Br.	15	240 .4	35	240-H	35	528-ft	79	52B · H	79	
Eng. & Cont	20%		4070		3690		4990		4410	
Totals			24200		22,000		29800		26500	

TYPE**E6**-STEEL STRUCTURES SPANINING SIX TRACKS WITH SINGLE SPAN

Fig. 11

rious heights of track elevation, and of excavation and walls for various depths of track depression, for one, two, three, and four tracks on 60, 66, and 100 ft. rights of way, under the following assumptions:

For track elevation it was assumed that fill would be made up to 9 ft. in height by raising the track by depositing material along either side of the track and jacking it a foot or so at a time and tamping the material under the tracks. For heights above 9 ft. it was assumed that but one trestle would be built whether one or more tracks are elevated. The limit of 9 ft. was obtained in the following manner: It was assumed that the ordinary city block is approximately 300 ft. long; this would allow the tracks to be raised 9 ft., by using a 3 per cent grade, without crossing any of the streets. At the streets it was assumed that trestles would be so built as to later permit the construction of bridges without blocking traffic. If the tracks were raised to heights above 9 ft. in short blocks, it would mean that one or more streets would have to be blocked while the tracks were being raised, either by cribbing or filling, and then after the tracks were at the final elevation the fill or cribbing would be removed and a trestle built. This, however, would cause double work at each street, the expense of which would in all probability pay for the additional cost of building the trestle the entire length of the elevation.

For track depression it was assumed that the shovel would remove the earth within the dotted lines indi-





TYPE F - CONCRETE STRUCTURES SPANNING 24 & 6 TRACKS WITH THREE SPANS Fig. 12

cated on the figure and the remainder would be removed at the time, or after the walls are built.

The unit prices used for excavation, fill and trestle are as indicated in the figure; the unit prices for walls are the same as those shown on Fig. 15 for comparative cost of walls. No item has been included to take care of the traffic, which would depend on the density and location.

Change in Grade of Streets

So far only complete elevation and complete depression of the tracks have been considered, which require very little change in the grades of the streets. The question immediately arises as to whether or not a partial elevation of the tracks with a partial depression of the street, or a partial depression of the tracks with a partial elevation of the streets, would not be the plan to adopt. It might be said here that on practically all projects for complete track elevation or depression the plans usually provide for at least a slight change in grade of the street, varying from 1 ft. to 3 ft., which change can readily be made without incurring excessive expense or property damage. It may also be said that to change the grade of the street entirely without changing the railroad track, except in the case of isolated crossings or in country districts is unusual.

To change the street grade any appreciable amount brings up a number of questions: namely, allowable grades on streets, economy, drainage and interference



	Cost	60-0" Street 36-0" Roodway		66-0° Street 44-0 Roodway		60'-0" Street 36'-0" Roadway		660 Street 44-0 Roadmay		60-0"Street 36-0"Roodway		66'0". 44'0'k	Street
		Quantity	Cost	Quantity	Cast	Quantity	Cast	Quantity	Cost	Quantity	Cast	quantit	Gast
Struct Steel	.031	215000	6990	315000	10240	21,5000	6.990	31,5000	10240	21,5000	6990	21.500	102.40
conc. Sidewalk	40	2400 SH	960	22005/	880	24005	960	220051	880	2,400SE	960	220051	880
Conc Slab	22.	100 CY	2200	165G)	3630	1000	2,200	165CY.	3630	IDOCY	2200	KSCY	3630
Conc.Col. Footigs	8	40CX	320	5000	400	4007	320	SOCY.	400	400	320	5000	400
Reinf Conc Abut.	10.					3300)	3300	3600	3600	474CY	4740	5/764	5170
Plain Conc Abut	7.	ZIOCY	1470	230GY	1610					1	4.45	U.I.G.	
Exc. For Abut. = Col Footgs	1.	110002	1100	12400	1240	13800	1380	1540CY	1540	7300	730	840G	840
Backfill	.60	5000	300	55000	330	11000	660	1200 CY.	720	13800	830	15000	900
Poving on Br.	2.25	380SY	855	4605	1030	3805	855	4605Y	1030	3805Y	855	densy	1030
Poving on Rain but off Br.	325	2051	65	502	100	20 SY	65	30 5.Y	100	2054	65	3054	100
Sidewalk on Roth but off Br.	.15	132S.F.	20	120SE	20	132.S.F	20	120 SF.	20	132 SF.	20	120SF	20
Handrail	150	ZOOLE	300	200LF.	300	ZOOLF	300	ZOOLF	300	ZODLE	300	ZOOLE	300
Eng & Cont.	20%		2,920		3920	-	3,450		4.540		3590		4590
Totals			17500		123700		\$20,500		\$27000		\$21600	-	22200

TYPE F3- STEEL STRUCTURES SPANNING 2.446 TRACKS WITH THREE SPANS

Fig. 13

with sewers, gas and water mains, and property damages.

Considerable discussion always arises as to what maximum grades are allowable where the grade of the street is changed. Chicago, where probably more money has been expended for grade separation work than any other city in the country, has fixed by ordinance a maximum grade of 3 per cent. To adopt this grade, however, in all cities would be unquestionably in error, especially so in a hilly city, where existing street grades of from 6 to 8 per cent are not uncommon.

Although most cities try to limit the allowable grades to 3 per cent or 4 per cent, the following table gives some of the grades which have been used on work of this nature in various cities:

Maximum Grade. Location. Chicago $\dots 3\frac{1}{2}\%$, usual 3%Buffalo4% Joliet, Ill.... $3\frac{1}{2}\%$ Evanston $\ldots 3\frac{1}{2}\%$ or 3%Milwaukee4% Minneapolis ..5%, 4%, usual 3% Cleveland 6%, usual 4%Detroit4%, usual 3% Philadelphia $.5\frac{1}{2}$, usual 3%Indianapolis ...4½, usual 3% Lynn, Mass ..3%, 4%, and 5%Washington ..9%, 8%, 6%, usual 3%, 4% Newton, Mass.9%, 8½%, 7½%, 6%, usual 3% and 5% Digitized by Google



Curves Showing comparative cost of Walls of various heights for track elevation and track depression with various distances of track from R of M Line.

Fig. 14

The most rational manner of determining grades to be used would be to take the maximum existing street grade of the thoroughfare of which the street to be changed is a part, or in the case of comparatively flat country, adopt a minimum grade of 3 per cent to 4 per cent, depending on the character of traffic frequenting the streets, and the length of approaches. In special cases exceptions could be made and a slightly steeper grade than ordinarily used could be permitted for a short distance, in order to avoid interfering with the grade of adjacent intersecting streets. This would often materially reduce the construction cost and obviate considerable property damages, and the slight increase in grade for the short distance would not seriously affect teaming.

The level portion of the street where carried under the tracks should extend far enough beyond the portal of the subway so that loads of maximum height will not encroach on the vertical clearances when starting up the approaches. Where the rate of change in grade exceeds 6 ins. in 100 ft., vertical curves extending 15 or 20 ft. on each side of the intersection should be adopted

Where the street is to be carried over the tracks, the sidewalk and roadway must be elevated the same amount, but where the street is carried under the tracks the roadway is sometimes depressed 4 or 5 ft. further than the sidewalk at the deepest part. This has the disadvantage of having high curbs, but where wagons would back up to property adjacent to right of way



Fig. 15

for loading or unloading it would be an advantage. It also has the additional advantage of producing a smaller actual damage to property, as very often the sidewalks can be left at their original level and the streets depressed 4 or 5 ft. and the tracks elevated the remainder. If, however, this method is carried to extremes and the elevation of sidewalk and street differ to any great extent at the adjacent cross streets, steps are required to get from the street to the sidewalk, which is a decided disadvantage.

At first glance it would be natural in most projects to say that the less the grade of the tracks is changed the less the project will cost. This, however, is not always the case. Streets may occur with such frequency that the cost of excavation or filling streets, the cost of repaying streets and sidewalks, alterations to sewers and water pipes, and property damaged, will be equal to or greater than the cost of excavating or filling the embankment for track elevation or depression.

Wherever streets are depressed adequate provision should be made for drainage. In some cases where proper provisions have not been made, the streets are flooded and traffic blocked. Catch basins with proper connections to sewers should be placed some distance outside of the portal of the bridge so that in winter or spring time, when the thaw starts, they will not be


in the shadow of the bridge and remain frozen. Similar provision and precaution to provide for drainage should be exercised in the cut in the case of track depression.

In cases where the streets or tracks are depressed to such an extent as to interfere with sewers, the problem is much more complicated. Either new sewers must be constructed at a lower level or else the sewerage will have to be siphoned. Both of these schemes entail considerable expense and are serious handicaps to track depression.

Interference with the water and gas mains is a less serious objection, the question of gradients there being



- TYPICAL CROSS SECTIONS OF 660° R OF W. FOR TRACK ELEVATION AND TRACK DEPRESSION WHERE FULL WIDTH OF R OF W IS UTILIZED Fig. 16

a secondary consideration. Although it adds quite an item to construction cost, provision can be made to carry them across the bridge or floor, or depress them under the cut.

The question of property damage is one for which it is impossible to lay down any set rule. There are many things both imaginary and real for which property owners claim damages when a project of this nature is being executed. In making allowance for this phase of the question, each problem will have to be handled separately, the damages estimated and an amount allowed which would be sufficient to put the property back into as good a condition or perhaps better condition than previously existed. It will be found, in a good many cases where damages are settled out of court, that considerable saving can be effected by buying the property damaged and selling again after the work is completed.

Conclusions

It has not been the writer's intention that this paper should represent a technical study of the grade separation question. Although portions of it deal purely with the engineering side of the question, the primary object has been to set forth, in a general way, some of the questions which will arise in considering a problem of this nature. The question is of such magnitude that it is impossible to cover fully and completely all the questions which arise; no two projects are alike; all have peculiarities of their own, and special features must be dealt with as they arise. From the foregoing considerations, however, it may be said in a general way that track elevation is more satisfactory than track depression, both to the railroads and to the industries having side track connections located along the right of way. and at the same time the former possesses many advantages to the city. With the possible exception of cases where the tracks pass through a high

class residence district where the aesthetic appearance is of such importance as to outweigh the other factors, track elevation would appear to be the best solution of the problem.

Securing Maintenance Labor on M., K. & T. By L. F. LONNBLADH, Chief Engineer

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The greater number of our laborers are obtained from local points along the lines but for extra gangs we receive a large number from Kansas City and St. Louis, also Mexican labor from Houston and San Antonio.

These men are hired through private labor agencies, except where obtained locally. No company man is kept at the private labor agencies to accept shipments of men.

A certain number of the track men are employed permanently and the forces increased as work may require. Section houses or boarding cars are furnished the men as required.

In promotion the efficiency of the particular man is what governs our choice. Generally the laborers who are efficient and take interest in the work are promoted to foremen.

I believe that maintenance could be bettered by having an apprentice on every section and paying him a slight increase in wages above that paid the ordinary track laborer. Then in case of vacancy in the foremanship the position should be filled from these apprentices, seniority and qualifications governing.

In connection with this outline I wish to say a few words about the class of labor which is very aggravating to a foreman in a great many cases, but some foremen make their conditions far worse than they should be. A foreman should do the best he can with what he has to do it with, and I know many of them that will get good results from foreigners where others can accomplish nothing. A foreman should be firm in his discipline to his men and yet be loyal to them, and he should be a very good judge of mankind. What can be said to one man with profit cannot be said to another and a foreman should take all this into consideration. In this way he will get the very best results from the efforts of each man.

Any roadmaster or supervisor knows when he gets a first class corps of section foremen, and his troubles are diminished to quite an extent by so doing. A foreman should study his men and acquaint each one with the particular kind of work to which he is fitted and insist that he systematize his work so as to keep his section in as near as possible perfect shape.

---+---First Aid Saved Limb

The value of first aid instruction in big industrial plants has already been demonstrated. An accident on the Grand Trunk Railway resulted in one of the men having his right leg broken in two places. The case was handled by the G. T. R. first aid class, and on the patient reaching the hospital the surgeons called in the whole nursing and student staff to see the manner in which the splints and bandages had been applied. The doctors stated that if the man had been moved without this expert care there would have been a very serious chance of his losing the limb or of his becoming lame for life.

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The article on page 10 of our January issue on the "Formation and Prevention of Pockets and Soft Places" was credited to C. A. Davis in error. It should have been Mr. D. C. Davis.



Principles of Railway Block and Interlocking Signals

The Safety Factor in Signal Design. Interlocking as an Aid to Traffic and to Increasing the Capacity of a Railroad

The important and interesting subject of Railway Signaling has recently been very fully and instructively dealt with by Mr. Harold McCready of New York in a paper presented to the Richmond Railroad Club. In it he disclaimed any intention of minutely covering the entire subject, but described briefly the principles which are involved in correct signaling, and he described apparatus which is considered as standard in this country.

Safety First has been the watchword of the signal designer, and the accomplishment of this arrange-

looked the fact that the signal engineer has often to sacrifice good designs in order to obtain maximum safety.

A first class signal system must aid traffic and not impede it. The frequent failure of the signal apparatus, even if the semaphore blade assumes the stop position, does not get trains over the road. Delays result, and a want of confidence in the efficacy of the system is engendererd. Signals are designed first for safety and second to keep trains moving. They also contribute to the maximum use of track, and so con-



Example of Power Interlocking Plant on the New York, Westchester & Boston Railroad

ment is made so that if any part of the apparatus fails or breaks or if the wires become disconnected or broken, the signal goes to "danger." Those not familiar with the mechanism or with the conditions to be met, are apt to consider the whole system unnecessarily complicated. Telephone engineers have pointed out what were to them obvious improvements in the parts of the mechanism. They have intimated that the signal relays might be made cheaper, but in so doing they have oversiderably increase the volume of traffic that can be moved.

Signaling on railways naturally divides itself into two main branches. These are interlocking signals and automatic block signals. The American Railway Association defines the interlocking system as "An arrangement of switch, block and signal appliances so interconnected that their movements must succeed each other in predetermined order." An interlocking machine

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consists of a group of levers concentrated at a central point for operating certain switches and signals and so arranged as to interlock such levers as to make it impossible to give clear signals for conflicting routes.

Interlocking plants are installed, for example, where tracks converge, as at a "Y," and they are intended to prevent a clear signal being given for an obstructed track. They prevent false moves. In the example of the "Y" suppose the vertical leg to represent the main line, and the arms of the letter the converging tracks. On each of the two converging tracks, a signal is placed to govern movements of trains to the main track, or vertical leg of the "Y." A two-arm signal placed on that main track governs a movement from the main line into one or other of the branches. The upper arm of this signal governs admission to, say, the right hand branch track, while the lower arm controls admission to the left hand branch track from the main line. It is necessary that, before one of the signals on a branch track may be cleared, the signal on the other branch track must be at "danger," because otherwise two trains might converge simultaneously on the main from the two arms of the "Y." Finally, neither of the signals on the branch tracks should be cleared until the switch at the crotch of the "Y," where the main and two sidetracks join, has been set in the right position.

The interlocking machine is the device which governs and protects train movements under such circumstances. In purely mechanical interlockings, the machine is provided with a number of levers, from which operate the various switches and signals, and these levers are so interlocked with each other as to prevent conflicting routes both showing clear by signals being thrown to the clear position at the same time. The interlocking of the levers is such as to require the switches to be in the correct position before signals governing them may be cleared.

In general, a separate lever is provided for actuating each signal switch. In interlocking plants the normal position of all signals is stop, the semaphore arm projecting horizontally from the signal mast. When the arm is pulled down or allowed to go up so as to project at an angle from the mast, it indicates clear and the train may proceed.

Before the signal may be pulled clear, the switches which it governs must all be thrown to the right position, and they must be locked. The movement of the switch lever to throw the switch to the normal position or the main track does not release the signal lever; that is only half the operation. A second lever is provided for each switch to lock it. This second lever actuates a detector bar. This is a flat bar lying close along the rail and rising above the top of the rail during the time occupied in shifting the lever. When the lever is put home the detector bar sinks below the rail level again. The object of the detector bar is to prevent the switch lever being used while a train is passing over switch. If it was not for this it would be possible for the towerman to move the switch and so "split" the train with disastrous results. In placing the switch it is first unlocked by the lock lever, it is then thrown by the actuating lever. It is then locked and the signal lever completes the operation by indicating the route. These levers cannot be moved indiscriminately, they must follow in regular order, so that the sequence of events may be preserved.

Such a plant as this is described as mechanical interlocking. In it switches and signals are moved by levers. After a switch is thrown to the normal or to the reverse position it is locked by a simple plunger locking arrangement. The signals in a mechanical interlocking plant may be operated by pipe or wire connection, between the lever and the signal itself. If the signals were, say, 2,000 ft. distant, the operation of a long pipe would present serious difficulties on account of friction.

Mechanical interlocking plants for simple track layouts are undoubtedly the simplest and cheapest, and the best for that kind of work. For example, where there is an ordinary crossing of two single track roads, simple hand pulled signals are provided governing movements in either direction on each road, there being two signals on each line. In order to allow a train to pass over the crossing on one track, the corresponding signal is cleared for that track, and the pulling of that signal lever automatically locks the levers controlling the signals on the other track and the opposing signal on the same track, so that only one and not all four signals can be cleared at a time.

If a large and complicated terminal track layout is concerned, involving 20 or 30 tracks, a mechanical interlocking plant is inadequate; because one lever would have to be provided for moving each switch, and another lever would be required for locking the switch. In a track layout of 100 single switches, there would be 200 levers, and if, in addition, there were 100 signals, 300 levers in all would be required. These levers are usually spaced 5 ins. centers and a 300-lever machine would be 125 ft. long. It is plain that a mechanical interlocking system for complicated layouts is an impossibility. It is impossible because it is imprac-The interlocking machine would require a ticable. long cabin to house it in, and at a complicated terminal space is precious. Several men would be required to run up and down in front of this long machine throwing the levers in the rush hours of night and morning. Another most important reason is that the complicated network of pipes and wires from the cabin to the various switches and signals to be operated would be excessive; the space to be occupied by these pipes and cranks and wires would necessitate several acres in itself and the apparatus would be most difficult to maintain.

In the case of complicated and busy track layouts, it is necessary to move the switches and signals by means of power. Power interlocking plants have come into general use during the last 15 or 20 years for the operation of all layouts that are complicated. In all large terminals, such as the Pennsylvania Terminal and Grand Central Terminals in New York, the Washington Terminal, the St. Louis Terminal, and the Broad Street Station, at Philadelphia, the switches and signals are operated by power.

Power interlocking does not differ in the protection it affords, or in the general principles involved, from the smaller and mechanically operated interlocking plants. Power interlocking systems have the advantage of being free from hand labor. The movement of a switch is accomplished by some kind of motor mechanism situated close to the switch point. The towerman moves a small, easily operated little crank, but it is not the strength of his arm which operates the signal or the switch. The small crank in the tower moves an electric circuit closing device which permits the flow of electricity along the wires leading from the tower to the motor device at switch or signal. The wires are laid all together in cable form placed in a wooden conduit along the right-of-way, and wires branch out from the cable opposite the switch or signal to be operated. In this way the pipes, cranks, large levers and wires of the mechanical system are eliminated.

The power interlocking machine occupies compara-

tively little space on account of the smallness of the levers and the compactness of the parts. The levers are just large enough to permit a man to grasp them. As an example, one may mention the electro-pneumatic interlocking installation at the St. Louis Terminal. The layout consists of 44 double slip switches, with moveable point frogs, 65 single switches and 145 signals. The machine itself has 215 levers, but the machine is only 44 ft. long. As many as 33 levers are not in use, having been provided for future extensions.

If a mechanical interlocking machine had been used to do the work of this power machine, it would have required 528 levers, and would have been 245 ft. long. If 55 ft. were further required at this machine, one may imagine the "100-yard dash" a towerman would have to make in order to throw two levers at opposite ends of the machine. Generally speaking, a power plant requires one or two men to operate it, while a mechanical interlocking machine to do the same work would require six or seven men.

Power-operated switches are quicker in action than mechanical operated switches. The power switch throws the movement over very rapidly, which is a matter of considerable importance in a busy terminal where trains are being run back and forth in great numbers. Summarizing, the four principal advantages of power interlocking over mechanical plants we find that they are: first, economy in cabin space; second, they require a less number of men to operate them; third, the movements are quicker in their operation; and fourth, power interlocking is the only thing possible where a complicated layout is concerned.

There are two kinds of power interlockings. The older of the two systems is the Electro-Pneumatic System, which is in service in all the great terminals in this country, with two exceptions, viz: the Grand Central Terminal in New York and the Chicago & Northwestern Terminal in Chicago. All the other great terminals, including Boston South Station, Pennsylvania Terminal in New York, Broad Street Station Terminal in Philadelphia, several large plants in Chicago, St. Louis, Kansas City, and others almost as well known, operate on the Electro-Pneumatic principle.

In the Electro-Pneumatic system, the power used for the direct operation of the switches and signals is compressed air at a pressure varying between 80 and. 100 lbs. In the case of switch movements, a cylinder with a 5-in. piston stroke and having a diameter of from 4 to 7 ins., depending on the weight of the switch to be moved, is provided, and is operated by air being admitted to one side or the other, the switch points being actuated by a simple escapement crank driven from the piston. The cylinder is placed directly at the switch points and its piston drives the crank arrangement in such a manner that when air is admitted to one end of the cylinder, it forces the points one way, and when admitted to the other end it forces the points the other way. Thus, the actual power for moving the switch is compressed air.

The admission of the air to the cylinder is controlled by an electric valve. This electric valve is simply an electro-magnet whose armature controls a pin valve allowing the air to pass from the main air line to the cylinder. It is, of course, understood that the interlocking plant is provided with one large air main from $2\frac{1}{2}$ to 3 ins. in diameter, extending from one end of the plant to the other, and provided with small branches to each point to be operated. The admission of the air from the main line to the switch cylinder is controlled by the electric valves. Electric current for the control of the valve is secured by the interlocking lever in the cabin. In other words, when the towerman moves a lever, he closes a circuit which energizes an electromagnet at the appropriate switch, no matter how far away. He can throw the switch either way he desires because a valve magnet is situated at either end of the cylinder. The movement of the signal blades is similar in principle. An air cylinder governs the movement, and the flow of air to one end of the signal cylinder is electrically governed in the same way the switches are. Each signal is operated by one electro-magnet, and to clear the signal the towerman moves his lever to the corresponding position and this causes air to rush into one end of the cylinder and effect the movement of the signal blade. When the signal is to be put in the stop position, it is only necessary to cut off the electric cur-



Typical Installation in Signal Tower

rent and the signal "falls" to stop by gravity, the semaphore being counterweighted for that purpose. If a wire breaks, the electro-magnet is de-energiezd, air is cut off from the cylinder and the signal falls to stop by gravity. If the air fails, or the electric current ceases to flow, the signal falls to stop by gravity, and all such failures are on the side of safety. The electro-pneumatic system was invented by George Westinghouse about 1880.

In the purely Electric Interlocking System the movements of switches and signals are accomplished by an electric motor, placed directly at the switch or at the signal. The power for the operation of this motor is carried over wires from the contact on the interlocking machine lever to the motor to be operated. The interlocking machine used in the Electric system is practically the same as that in the Electro-Pneumatic. The lever has simply to be large enough to carry the contacts which close the various circuits. All the power for the motors is controlled directly by lever contacts. In order not to waste too much power through heat losses in the wire which is laid between the lever and the motor, the voltage on these wires has to be made commensurate.

The electric interlocking system, besides the electric motor, requires certain circuit controllers. The elec-



tric motor operates at considerable speed, so the switch operating crank has to be driven through a system of gear such as is used in an automobile transmission. Therefore, the electric system, while somewhat more economical than the Electro-Pneumatic system, is more difficult to maintain. It involves motors, gears, circuit controllers, etc., requiring the attention of a man who is familiar with both electrical and mechanical appliances.

However, the electric system has an important advantage for small interlocking plants. In the Electro-Pneumatic system, a supply of compressed air must be available. In the case of an isolated interlocking which is too large for a mechanical interlocking plant, it may not be advisable to put in an Electro-Pneumatic system, on account of the apparatus required for compressing air. In such a situation an electric plant will be the cheaper. In an important terminal an air compressor is usually provided for car cleaning, and this may be utilized to furnish air to operate the signals and switches. Mechanical systems are suitable for unimportant layouts involving only a few switches, and where train movements are relatively infrequent. Power interlockings are generally used at all congested points where there are frequent train movements. Power interlocking plants are divided into two classes, viz: the Electro-Pneumatic system which compressed air moves the switches and signals. This compressed air is governed by magnets controlled from the tower. The other system is the Electric Interlocking System, where the devices are actuated entirely by electric motors.

Waterproofing Concrete Roof of Pier By J. B. GARDINER

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Ass. Mem. Soc. C. E., Secretary Minwax Co.

The waterproofing of concrete for building and roofing operations has assumed such an importance in recent years that it can safely be assumed that where an unusually difficult problem has been solved, the methods and reasons for their adoption will be of service in making plans for new work.

The roof of the Recreation Pier at the foot of Broadway, Baltimore, was designed in its main elements, similar to those of the solid floor deck girder of railroad bridges-not only to sustain the dead load incident to general roof construction, but the live load of hundreds of children running over it. There are two longitudinal girders running the full length of the roof, supported at suitable intervals by channel columns. These girders in turn carry a series of I-beams, one every forty feet, running transversely. On these I-beams is a 1-2-4 reinforced concrete slab 5 ins. thick. In order to get proper drainage, both to the sides and to the free end of the pier, a layer of cinder concrete was placed on the slab, tapering from an inch on the sides to 5 ins. in the center. The entire deck is surrounded by an iron railing, supported on posts resting on base plates and fastened to the deck by means of bolts cast in the concrete slab. The continuity of the concrete surface is further broken by eighteen metal columns supporting electric lights, and by one hundred and twenty metal sockets, regularly spaced and protruding 6 ins. above the surface, designed to receive the standards for an awning which is used in hot weather. The two sides and one end of the roof, which is 304 ft. long by 135 ft. wide, are free, while the other end abuts against a building. There were no expansion joints provided, either longitudinal or transverse.

These are the main structural elements of the roof as it was when it was first turned over to the waterproofing company for waterproofing. The original specification called for an asphalt mastic, an inch to $1\frac{1}{2}$ ins. in thickness, and the usual construction and maintenance bond was required of the contractor.

After a few months cracks began to develop in the mastic sheet, and in a short time it was literally check-



Fig. 1. Detail of Transverse Expansion Joints

ered with small openings running in all directions. Naturally, leaks developed wherever the cracks appeared, the water dripping through on to the merchandise beneath, and also running over and corroding the steel frame work. Attempts were made to repair the waterproofing by filling the cracks with asphalt, but no sooner were the existing cracks closed than new ones developed. It may be said in passing that this was not surprising, bcause it has been found that an asphalt mastic covering alone has seldom proved to be a satisfactory method of waterproofing. Shrinkage or temperature cracks almost always occur. Particularly is this the case where the area is large and the sheet continuous. The writer had occasion a short time ago to inspect some new concrete bridges on a railroad construction project near New York which had been waterproofed by the membrane method. A protection or armor coat of $1\frac{1}{2}$ ins. thick of mastic had been placed. Although the spans were not more than from 50 to 100 ft., and the width of the mastic sheet was not more than



Fig. 2. Detail of Flashing Around Socket Pipes

15 ft., transverse cracks had developed, and in some cases they were nearly an inch in width.

To return to the work under discussion, when it became evident that further attempts at repair would be ineffectual, the contractor was called upon to make good his guarantee. The contractor, however, proved that a chemical analysis and physical test of the materials he used had complied with the architect's specifications, and that if the specifications did not produce a waterproof result, the fault was a fault of design, and not chargeable against the waterproofing contractor.

Aside from the question of the legal responsibility, there is another question of vital importance to engineers using waterproofing materials. The manufacture of waterproofing and its installation are both technical subjects, and must go hand in hand. Every manu-



facturer should know what conditions his material will have to meet and what it will not have to meet. It will reflect little glory on the reputation of a manufacturer who proves that the material he furnishes meets imperfect specifications, unless he can also prove that he made an attempt to have the specifications revised to a basis where fulfilling them would have given satisfaction.

It was necessary to have the roof waterproof, and it was decided to have the entire work done over again, and bids were taken. The new plans and specifications were in a measure tentative, and the various bidders were privileged to submit revised plans of their own, and to bid on the use of materials adapted either to their plans or to the plans drawn by the architect. After a hearing, at which each of the bidders was given every opportunity to discuss his methods and his materials, the contract was awarded on the following specification for materials, although the bid was over \$3,000 higher than the lowest bid on the same plans.

The specification was as follows:

"The waterproofing course was to consist of two layers or plies of saturated cotton fabric, laid in and cemented with an asphaltic bitumen. The materials were to fulfill the following specification:

"The cloth to be a woven fabric of diagonal weave, to give it maximum elasticity; to be delivered on the work thoroughly impregnated with an asphaltic bitumen, entirely by pressure and without the use of oils, petroleum residues or bitumen solvents to liquefy the bitumen in order to produce this saturation. No wood pulp, talc or other substance which will prevent close permanent adhesion between successive plies shall be used on this cloth. The cloth shall be elastic, stretching at least 10 per cent in any direction without fracture, and shall be of the following strength:

"A one-inch strip, when tested by a Kompagraf or other standard machine, shall show a tensile strength of at least 100 lbs. to the inch. The cloth must be proof against puncture to the extent of 90 lbs. to the inch, when tested by a standard paper testing machine. It shall be thoroughly flexible, so as to conform readily to the surface to which it is applied, and to permit of close snug flashing.

"The bitumen with which this cloth is applied shall be a tough naturally occurring asphaltic bitumen, having a melting point between 175 and 200 deg. F. It shall have a penetration of at least 30 centimeters when tested with a No. 2 cambric needle at 77 deg. F., and the penetration shall not be reduced more than 20 per cent by heating for seven hours at 325 deg. F. The loss in weight, after heating for seven hours at 325 deg. F. shall not be greater than one-half of one per cent. The bitumen shall be flexible and ductile between 15 and 130 deg. F., and shall form a close mechanical bond not only to the membrane and the concrete to which it is applied, but also to the concrete which is cast against it."

The details of the waterproofing involved some very interesting and unusual features. First, it was deemed advisable, because of the length of the structure, to provide expansion joints. Accordingly, seven transverse joints were cut through both the mastic and the concrete, clear through the slab to the steel, the joints coming over the center line of the flange of the I-beams. Although the deck is 134 ft. wide, it was not deemed necessary to cut any longitudinal joints through the concrete, as both sides were unobstructed, and the concrete could, without danger, expand indefinitely. To prevent the mastic cover from moving, joints were cut through the mastic, but only to the concrete. All joints were one inch in width, and were cut with a compressed air tool. The principal features of the waterproofing are the waterproofing of the expansion joints, the flashing around the awning pole sockets and the flashing along the line of juncture of the building and the pier.

In Fig. 1 are shown the details of the method used in waterproofing the expansion joints. The transverse joints, from the steel beams to the top of the concrete, were first filled with an expansion joint cement. The waterproofing, consisting of two plies of saturated fabric, which conformed with the specification and was laid in and cemented with an asphaltic wax. It was carried down into the joint as shown, so that should further contraction occur than that provided for by the width of the joint, the waterproofing course would be subjected to no tensile strain. The remaining portion of the "U," thus formed, was then filled with an expansion joint cement.



Fig. 3. Detail of Flashing Against Building

The method used in flashing around the sockets is shown in Fig. 2. The mastic was cut away 3 in. around each socket. One layer of cloth was then carried over the mastic, and down over the surface of the concrete that had been exposed by cutting away the mastic. An iron washer with a 3-in. flange was then slipped over the socket, the waterproofing course proper, consisting of the two-ply blanket, was laid over the one-ply previously put down, over the washer and up to the socket. In casting the wearing surface a circular wedgedshaped form was placed around the socket, and the space left after this form was drawn, was filled with expansion joint cement. This class of material was selected because of its great adhesive and elastic qualities.

Illustration Fig. 3 is the method used in flashing against the base of the building. As a means of flashing, where the railing posts rested on the concrete, the base plates were unbolted and raised, and the waterproofing slipped under them. They were then bolted back in place. This formed a very secure joint.

The wearing surface was $1\frac{1}{2}$ to 1 cement mortar, reinforced with poultry netting, trowelled to a sidewalk finish, and tooled to give a good foothold. It was cast in 10-ft. squares, a joint of $\frac{1}{2}$ in. being left between abutting edges of successive squares. This joint was filled with an expansion joint cement. The entire wearing surface was then given two thorough coats of a concrete hardener to prevent dusting of the cement. Complete cost data has not been compiled, but will soon be available for those who are interested.



Principles and Operation of Speed Control Mechanism

Automatic Brake Application If Stop Indication is Overrun. Speed [Controlled If Motorman Ignores Caution Signal. Auxiliary Indications Given. Overlap Not Necessary

A speed control and signal system has been developed in which a cab signal may, at the discretion of the using company, be made the sole indication for the motorman on electrified lines, or if desired, the fixed automatic signal by the side of the track, may be used; but in any case the cab signal is an essential part of the apparatus. It does away with the outside stop arrangement operated by a trip or other device, and for this it substitutes a short ramp placed between the rails, and this ramp is electrically energized from the track circuit or is de-energized by the presence of a



End View of Car with Contact Ramp

train in the block. Interlocking fixed signals are of course used.

The cab signal is so designed as to give information as to when to apply brakes, also when to resume normal speed, also the permissible speed, and practically to indicate the available braking distance. Each car is equipped with a speed-control, which automatically applies the brakes if the motorman fails to obey the cab signal. The system is arranged to compel a stop at fixed interlocking signals by automatically applying the emergency brakes if a train should attempt to go on, when the signal shows "stop."

Cab signals are placed at both ends of each motor car and indications are given by two lights. A green light indicating "proceed" if the two blocks next ahead are clear; and a yellow light shows "caution" when the next block ahead is clear and the second block ahead is occupied or is governed by an interlocked signal at "stop."

The audible signal in the cab is so connected with the speed-control mechanism, that it sounds earlier than the automatic speed-control application of the brakes takes place and permits the motorman to slow down sufficiently to avoid the application of the brakes. An indication is given in the cab to show the maximum allowable speed and the distance within which, after a caution signal has been met and passed, the speed of the train must be reduced to avoid the automatic application of the brakes.

The speed-control mechanism is so arranged to act, that when a train runs into an unsignaled section a distinctive indication is given in the cab, and the cab signals and speed-control equipment are automatically put out of service. They automatically return to service again when the train enters a signal section. The speed-control equipment does not interfere with the operation of the train so long as the motorman runs according to the cab signal indications, but if he fails to obey the "caution" signal shown in the cab right in front of him, the apparatus enforces compliance by applying the brake, but only if the speed exceeds that which is prescribed.

When a train, moving at a speed below the prescribed minimum, approaches a clear block, its speed-control apparatus is, previously, automatically reset so as to permit the train to accelerate. If a clear block is succeeded by one with a train in it the following train may accelerate, slowing down if the speed thus acquired exceeds that established by physical conditions. If a clear block is succeeded by another clear block, the train is permitted to run at normal speed.

In the event of the failure of the speed-control mechanism it may be cut out of service, but this does not interfere with the operation of the apparatus on the remaining cars of the train.

The speed-control and cab-signal equipment is actuated by means of ramps adjacent to the tracks so as to insure full track capacity and facility of operation.

The cab signals are practically block signals and indicate the condition of the blocks ahead. At crossings, junction-points, terminals, etc., fixed signals of the light type are used to show the route set up. The indications of interlocking signals are given by one light, green for the high speed route, yellow for the diverging route, and red for stop.

The operation of the speed-control mechanism depends on a governor. A bevel gear attached to the axle carries motion from the revolving axle and gives it to a worm. This worm is constantly in motion as the car



Side View of Car with Contact Shoe on Ramp

moves and its speed of revolution varies with that of the car. By means of a magnet de-energized, this worm, jointed appropriately, is permitted to fall by gravity and mesh with a toothed sector, or it is drawn up and away from the sector when the magnet becomes energized. The action of this magnet, and the glowing of the cab signals is controlled from the ramp, which is energized or not, according to whether a block is empty or occupied.

The energized ramp holds the signals and the control mechanism normal. But when the ramp is deenergized by the presence of a train in the block, an appropriate signal glows brightly before the motorman's eyes, and the worm drops into the toothed sector and begins to move it, so that in a predetermined time it will set the brakes. When the worm begins to act, a caution signal glows, and the motorman may then, if he obey it, apply the brakes and slow down. If he fails to do this the time interval, always consistent with safety, elapses, and an automatic brake action follows:

If, however, the motorman at once applies the brake, he consequently reduces the speed of the train, the wheels turn less fast and the action of the worm on the toothed sector becomes slower, and the time interval is necessarily lengthened as the train comes to the required pace. At the next ramp, if the block is clear, the ramp is energized and by acting on the magnet, lifts the worm away from the toothed sector and things become normal again. The action of the ramp puts the automatic brake-applying apparatus to work at once, but the worm and toothed sector, (which latter in its final position applies the brakes) is like the delay-action fuse on a high-power projectile which holds back the explosion until the shell has buried itself in the object of attack.

The selector and selector ramp placed between the rails are used for giving more detailed information in the form of a displayed word, such as when to apply brakes, when to resume speed, permissible speed, available braking distance and such other information as may be deemed necessary to properly control the train speed. Such information is given independently of the speed-control mechanism and the position of the selector ramps on any railway is governed by experience or the physical configuration of the road.

The automatic application of the brakes takes place at varying distances from the end of the block, depending upon the speed on account of the toothed sector being moved quickly or slowly by the worm connected to the axle, and this fast or slow action of the sector depends on train speed. This is one of the strong points of the system. The usual system with automatic stops has an overlap, the length of which is based on maximum speed. Failure to obey a stop indication would cause an emergency application at the same spot for any train, regardless of speed. This requires that trains be kept apart a distance equal to the length of the overlap, which is usually a full block. With the speedcontrol system, trains can close up, provided the speed has been reduced. In the speed-control system this important facility is provided by the fact that trains can close up instead of being spaced a full block apart. They thus may come nearer each other slowly and under control.

The system is handled by the General Railway Signal Company of Rochester, N. Y., under the Simmens patents for speed control. This equipment is used on the cars of the New York Municipal Corporation.

Contract for Steel Bridge in Canada

The contract for building the superstructure of the railway bridge over Smoky River, Alberta, for the Dominion, Dunvegan & British Columbia Railway has been awarded to the Dominion Bridge Co., Ltd. The material will be fabricated in this company's Winnipeg establishment. The bridge will consist of two 86-ft. deck plate girder approach spans, six 120-ft. deck spans, and one 125-ft. through truss span which will cross the main channel of the river, the steel in the superstructure will probably weigh nearly 1,200 tons.

Principles of Dynamo-Electric Machinery By REGINALD GORDON

Induction, Magnetic Field, and Electro Motive Force Defined and Simple Demonstrations Illustrated

In order to clearly understand the action of a dynamo or electric generator, and its counterpart an electric motor, the following experiments with simple apparatus will serve to make the matter plain. In the first illustration, Fig. 1, a coil of wire having an iron core is shown connected with an indicator or galvanometer. The latter is a coil of many turns of fine wire, at the centre of which is a magnetic needle, whose motions



Galvanoneter or Indicator

Fig. 1. Indicator Showing Development of an Electric Current by Movement of Magnet

show the direction and strength of the magnetic field produced by a current in the coil. There is no battery in this circuit, yet when the large magnet shown is brought near or moved away from the end of the coil,



Fig. 2. Coil Moving Through Horseshoe Magnet

the indicator shows the existence of an electric current through its windings. The indicator swings one way on the approach of the magnet, and in the opposite direction on its withdrawal. The same effect is produced whether the coil or the magnet is moved.

In the next diagram, Fig. 2, the same principle is shown by representing a coil of wire rotated in the field produced by the two poles of a magnet similar to those of the common type of magneto-generator.

Before going any farther, however, it is necessary to remind the reader that in speaking of energy, whether in large or small amounts, one must distinguish between quantity and pressure. The amount of power developed by a water wheel, for instance, is known definitely only when the number of gallons per minute and the height through which the water falls are known. So with electric energy, the quantity is expressed by the unit Ampere and the height or head or pressure or electromotive force is designated by the unit called the Volt. These are distinctly different ideas or concepts and unless clearly registered in mind may lead to confusion.

Referring again to the second diagram, the coil is shown in the magnetic field in front of the pole N. When the coil is rotated in the direction shown by the arrow, an electro-motive force (abbreviated e.m.f.) is at once set up in it, which decreases in intensity until it is zero when it reaches the position indicated by k, midway between the two poles. As soon as the coil passes the point k, this e.m.f. begins again and becomes stronger in the same sense, as the coil moves around until the latter reaches the point f, where it is a maximum and where it suddenly reverses, decreasing to zero as it moves from f to t and again increasing in the same sense in approaching the pole N at h. In other words, a conductor rotated through a bi-polar field such as that shown in Fig. 2, has a current of electricity generated in it that is reversed in direction twice during each revolution. This is usually shown by the conventional diagram of the third illustration, Fig. 3, where the height of the curve above or below the line N S repre-



Fig. 3.—Curve Showing Intensity and Direction of Electro-Motive Force

sents the values of the voltage developed at any point during one rotation of the coil from t to t.

The points h and f of the curve indicate the two points of reversal of the e.m.f. in front of the two poles respectively. The point k indicates the zero value of the e.m.f. on passing beyond the influence of pole N and coming nearer the pole S, and the dropping of the curve below the line NS indicates a change in the direction or sense of the e.m.f., but shows its development in the same manner with reference to the poles as in the first half of the revolution. Incidentally, this curve will help to explain the distinction between alternating current and direct or continuous current, as the latter is sometimes called. In the last experiment the electric current is in the same sense in passing through onehalf of a revolution of the coil and in the opposite sense in passing through the other half. The rotation of the coil in the magnetic field under these conditions gives rise then to a pulsating or alternating current and the sequence of events during one-half of a complete revolution, and shown by the curve above and below the



Fig. 4.—Commutator Attached to Rotating Conductor, Generating Direct Current

line NS from h to h constitutes what is called one complete "cycle." Each half of this cycle is called a "phase." The electric current generated in the coil during the first half of the revolution is in one phase and pulsating. The next illustration, Fig. 4, shows a single conductor, for the sake of clearness, in a magnetic field arranged to avoid the reversal of the e.m.f. just described. The commutator shown allows the current generated in one part of the conductor when passing the reversing point in front of a pole, to be disconnected from the terminal or brush to which electricity had been passing. A moment later the same part of the conductor is connected to the other brush, thus sending current in the opposite sense into the external circuit. This arrangement furnishes a pulsating current, but direct in the sense of not suffering reversal. Generators are built with a large number of conducting coils on the armature or rotor so as to give as many impulses as possible for each revolution. In all that has been said, the field has been produced by a permanent magnet. constituting a magneto-electric generator. A dynamoelectric generator is so constructed that the current developed in the armature is wholly or in part utilized to create the magnetic field.

The Buffalo Chamber of Commerce gave a luncheon recently in honor of the completion of the first part of its terminal facilities. For more than 25 years Buffalo has been troubled with the terminal problem. In the last few years the Terminal Commission has had the matter in hand with the work of the Chamber of Commerce and the city administration, and definite results have now been accomplished. The first to be completed is the freight terminals of the Lehigh Valley R. R., including an office building and a freight shed 600 ft. long, with extensive yards, team tracks, etc.

Efficiency and Standardization in Track Maintenance Work

System of Determining the Efficiency of Track Gangs. Standardization of Methods in Maintenance Work. Bonus to Track Gangs Above Minimum of Efficiency.

A problem in efficiency, and also in the standardization of work, in which something like the Taylor theory of efficiency is involved, was explained by Mr. S. L. Conner to the members of the New England Railroad Club at a recent meeting. Mr. Conner, although a professor of railroad engineering at Tufts College, Boston, yet as a special piece of work performed the duties of assistant supervisor on the B. & O. Railroad. He expressed wonder that the principles he saw exemplified there were not more generally adopted in railroad work.

He spoke first of the labor problem. Track men are recruited from the least intelligent class, and are men who usually cannot gain employment in other fields. It has become common practice to hire these men through labor agencies and by so doing securing an undesirable class at wages ranging from \$1.25 to \$1.75 per day. All of us are aware of the responsible character of the work done by these men, since the lives of millions of passengers are annually dependent upon the proper performance of the work, under competent supervision.

All of us expect the full measure of ox-like performance in muscular effort on the part of these men, and some of us realize that a certain degree of mental effort is necessary, even though it may be in the placing of a tie plate, or the renewing of a rail joint. The men work industriously, and it is a singular thing that passing strangers hold little of interest to the man occupied with his work.

At the outset it is proper to indicate that this method of track work efficiency has for its basic idea an incentive to the man, in the shape of a premium or bonus, and thus we are dealing with a bonus or premium system. Thus the method affords a stimulus at the very beginning, and an increased performance is secured, and a more uniform result is attained.

There were under this supervisor ten regular or section gangs, three extra work gangs, and one fence gang. The total number of men employed daily was between 150 and 200 men.

It is obvious that under such a system as this the supervisor must be always on the alert, and be in constant touch with the whole of his sub-division, and constantly patrolling it. The work of planning constitutes a considerable part of his time. It was the practice of the supervisor to make regular visits. Work orders were used which tabulate all forms of scheduled work, and are, therefore, possible of comparison as regards relative efficiency. There is another kind of work that appears in the maintenance service of all roads, which is called unscheduled work, for lack of a better term. Work that is unscheduled work consists of such items as clearing wrecks, cutting rail for expansion. Items other than those here appearing may be mentioned; patrolling track is clearly "dead" work, since safety precautions cannot be susceptible to measurement; cleaning ashes from passing tracks where freight trains stand is another of these items; cleaning toilets at stations, mowing right-of-way, etc.

An attempt, however, is made to reduce the number of these items to measurable conditions, which until standards can be established, is tentatively accomplished thus, as for example—mowing right of way. This item of work is a variable one, since it may be a full mowing, or it may be an attempt to cut down the high growth only. The latter condition was one that arose this summer, and the writer was informed that the first day's work under observation might be considered as 67 per cent. efficiency, and that any future performance on that particular assignment might be graded above or below this mark as the performance was better or poorer.

The kind of work on the form is all scheduled work, and was as follows: Renewing 36 W. O. ties in E. B. Main in 60 hours' actual performance, and in the outside columns of the form 45 hrs. of standard performance. Replacing 18 ties in E. B. Main in 20 hrs. actual work, and in the outside column 15 hrs. standard performance. Installing 80 tie-plates in E. B. Main in 10 hrs. actual work, which should have been done in 8 hrs. standard performance. Surfacing ties in E. B. Main 20 hrs. actual work, set down as 15 hrs. standard performance.

In order to understand how the standard performance is determined, the first item was that of renewing 36 W. O. ties, and is considered for that condition where the tie is "in face," or in other words where the track is not raised. Referring to a detailed work sheet, there may be found the detail study of the items involved in this performance. They are the usual motions involved, that of digging the balast from around the old tie, drawing the spikes, removing the old tie, preparing the new bed, carrying the new tie from the pile, placing the new tie in position, spiking it to gauge and tamping it solidly in position, after which, the ballast having been cleared, is returned to the crib, and the old tie removed for burning.

The standard of measurement for 100 per cent. efficiency under these conditions is 8 ties per 10 hours, and since the report called for renewing 36 ties, the actual time for 100 per cent. efficiency is determined by dividing 36 divided by 8 and the result multiplied by 10, thus giving as a result 45 hours. While the tamping involved in this work may be more efficiently done by use of tamping machines, it is interesting to note that these are being considered by this company for use on this work, as has been recently indicated. By referring to one of the late editions of Tratman's Railway Track and Track Work there may be found the statement that the renewing of 8 ties in stone ballast in a day of 10 hours in an average performance for one gang, so there seems to be no injustice done to the man where such a performance is considered 100 per cent. efficiency.

Men work in pairs, each starting at end of crib and digging the ballast out of the cribs adjacent to the tie to facilitate its removal. Spikes are then drawn, the old tie is moved sidewise into open crib and is then removed. A peculiar feature is that here in this operation the men are allowed to drive the picks into face of the fie and are not permitted to do so when putting in new ties. The new bed is prepared and the new tie slipped into place with tongs. One man then holds up the tie close to the rail with a bar, and the other spikes. Each man then thoroughly tamps both sides of each end of the tie outside the rail, and for a distance of 18 ins. inside the rail. After tamping, ballast is thorough-



ly cleaned, returned to the cribs, and the shoulder redressed. Not less than two weeks after renewals, the ties should again be tamped.

An item for respacing bunched ties usually accompanies the work of renewals. The several motions are, digging out the ballast from between the ties, drawing spikes, driving tie to place, spiking to gauge, tamping and finally cleaning the ballast and redressing the shoulder. Respacing 12 ties in 10 hours is considered 100 per cent. efficiency.

As many as 18 ties were respaced in 20 hrs., and it is now easy to determine the standard time by dividing 18 by 12, which gives 15 hrs. as the standard. For respacing ties, cribs are cleaned out, ballast well loosened under ties, spikes drawn or cracked up considerably. On tie to be respaced and the two adjacent ties the rail is raised with bars, tie driven to position with wooden mauls. The use of wooden mauls is along the lines of economy. Their use has resulted from time studies. If the tie to be respaced is next a joint tie or one firmly embedded, good work is often done by moving it with a jack. After ties are respaced they are spiked to the rail, at the same time one man holding the tie close to the rail, and the other spiking. After spiking, each man tamps the tie, one at each end, as in tie renewals, the ballast is cleaned, returned to crib, and the shoulder redressed.

Next comes installing of tie plates and the study of the motions performed. They are, distributing material, spike pulling and adjusting tie, lifting rail and placing tie-plates, driving first and second spikes. In this study the measurement for standard performance is 100 tie-plates in 10 hours. Our report showed that there were 80 tie-plates installed in 10 hours. The measurement for standard performance or 100 per cent. efficiency required only 8 hours.

This study presupposes that the plates have already been distributed by work-train and are either strung out or placed in convenient piles. There is a standard of measurement for handling and distributing the material so that this part of the work has already been measured. The motion study was based on a performance of a gang of ten men and foreman.

The performance of the work in detail is as follows: two men keep about 14 ties ahead of the rest of the gang drawing spikes and adjusting. After these come two men, one holding up the rail with clawbar, using spike as a fulcrum, the other completes the adjusting and slips plate into place. The working foreman in a condition such as this, with his men close at hand, may fill in several gaps at opportune times, and thus increase the efficiency of his gang. Two men now follow up, spiking every other tie to gauge, and are in turn followed by two men who complete the spiking. These last two men keep well in the rear, and not only spike ties left unspiked, but also hammer down all spikes that may need it as result of trains passing over the track during the work. Necessary plates, spikes, and tieplugs should have been distributed for each tie. A decided advantage in this method, using no jack, is that there is no necessity for men running back and forth for heavy tools, the men are not overburdened, as they have with them only the tools they are continually using. The method here described is where common hook spikes are used.

The next and last piece of work on our daily report was that of surfacing, and the items in its performance of picking up low joints, centers and quarters is as follows: raising low spot with jack, cribbing out the ballast, tamping both ends of tie on the receiving face and on the leaving face, cribs are then filled in and ballast redressed. The standard performance requires that 48 ties shall be surfaced in 10 hrs. as 100 per cent efficiency. It was stated that 72 ties were reported as being surfaced in 20 hrs., and by dividing 72 by 48 we find that the time for standard performance should have been 15 hours as against 20 reported.

In this work, that the grading may be simplified, each end of a tie is considered as a full tie. This was also done to simplify the divisions of the motion study. The method is, previous to surfacing water should be drained from the cribs, rails brought to gauge, spikes tightened. After ballast has been removed from cribs, the low spot in the rail is raised by a jack, the foreman sighting the surface to the desired height. After this the other rail is raised and adjusted by the level board. Men work in pairs, tamping inside and outside of the receiving face of the tie, and also on the leaving face. This is why each end of a tie is counted as one tie. After tamping, the cribs are filled with cleaned ballast and the shoulders are redressed. Ballast screens are used by the B. & O. for cleaning ballast on long stretches. They are the invention of Mr. A. G. Zepp, supervisor on this road.

The scheme is to set up the screens so that a maximum amount may be handled with a minimum of effort. A bag is placed under the screen to catch the falling earth. These bags after being filled are then placed along the outside of the rail or in the center between tracks where they are loaded on cars for shipment to dump. It is claimed that cleaning of ballast has been justified where only one cubic yard of stone can be recovered in a distance of 8.1 lineal feet of double track road. Formerly, in tracks that had deteriorated by presence of dirt and cinders in the voids of the stone, they were restored to condition by a wholesale removal of dirt and ballast, which was a wasteful extravagance. but in the employment of these screens a decided economy, it is claimed, has been effected. Aside from this economical feature, the practice of screening ballast, instead of putting the track up on new ballast, admits of maintaining the surface without disturbing the roadbed under the ties, a vital point in track maintenance. In addition, it is claimed that the screen method is more thorough and is quicker than the other usual ballast fork method, and laborers do not tire so easily.

After the relative values of standard performance have been determined, the record of both the actual time and the standard time is transferable to a sheet called "daily record sheet." One of these is reserved for the performance of each gang, and is filled out in full. Headings are provided for the usual work performed on maintenance work and are gauging, surfacing, etc. Vacant columns show any new schedule work. The column for patrolling track is one of "dead" work, and has no measurement in extra performance. In this column, "general miscellaneous" which is "dead" work, is reported in actual hours, and as it is 67 per cent work, no standard is available. The report shows this time was spent in clearing cinders, pulling weeds, watering, cleaning toilets, etc.

A column is headed "detention," and 10 per cent of the scheduled hours is allowed as detention. For example, if there are 10 hrs. of scheduled work, there is an allowance of one hour for detention.

In the first column is shown the standard scheduled hours and next the actual scheduled hours, which results are obtained by adding up each day's efficiency measurement and the actual hours taken. Next the summation of the total scheduled hours is made. In the total columns of one sheet were 1,751 hrs, of dispatched work and 1,796 hrs. of actual work. By divid-

ing 1,751 by 1,796 we have 98 per cent. The relative efficiency of the gang was 81 per cent, and as 67 per cent (mentioned above) was the limit for a bonus, these men exceeded the average rate of work by 14 per cent.

It is of interest to know how the 67 per cent value was determined as the lowest limit in measuring efficiency. After careful observations by the maintenance officials they agreed that for every \$1.50 expended in wages the company should receive \$1.00 in return where there was no attempt to bring pressure to bear upon the men for increased output. Thus they determined that the men actually give two-thirds of value.

At the end of the second half of the month a record similar to the one already mentioned is made out and the efficiency value of the several gangs reported to the division engineer. All these records of performances are collected and are set upon a final form. This is known as the monthly efficiency record. The headings on this form are similar to those on the daily record sheet. Upon this form and in the several columns are shown the total performance of each gang on each particular piece of work. From the summation of the figures the relative efficiency of the sub-division as a whole is established and copies of each supervisor's report, together with any comments by the officials, is sent to the several sub-divisions. This affords a contrast and adds a stimulus for better effort on the part of each supervisor. Each division report is in turn contrasted with those of the other divisions on the system, so that each maintenance officer will know how he stands. It is natural that competition is keen, which is a desirable state of affairs, as healthy rivalry always is. While there may be merits and demerits in the whole plan, it is a step in the right direction, and out of its experiences better conditions may, no doubt, be developed.

Construction of Roadbed and Track

Relations of Ties to Ballast and Ballast to Subgrade

The function of roadbed and track is to carry the load which rolls over it. Its capacity to stand the wear and tear which this implies depends very largely on the conditions of the materials in the sub-grades, the kind of ballast and its amount and the size and number of the ties used, and the quality and dimensions of the rail. These in effect were the points first presented to the St. Louis Railway Club by Mr. E. A. Hadley, chief engineer of the Missouri Pacific Railway at a recent meeting of the club.

The entire load, the speaker continued, must be ultimately carried by the sub-grade, and care and study should be given to it, because a great deal of money is spent on track maintenance, which money is wasted because of improper or incomplete work done on the subgrade at the time of its construction. The sub-grade is usually composed of soil found in the immediate vicinity of the railroad, and most soils are compressible to a greater or less degree.

Two things can be done to make the sub-grade properly sustain the load: First, by increasing its carrying power per square foot. This done by having good drainage, for drainage is most important because the carrying power of dry soil is higher than that of wet. The second thing is to distribute the load from each wheel over as many square feet of sub-grade as possible. This is secured by the ballast, as the greater the depth of the ballast the greater the area over which the pressure is distributed. The closer the ties are spaced in the track, the greater the number to take the press-

ure from the rail. This result can also be secured by increasing the length and size of ties, and the heavier and stiffer the rail is the greater the number of ties made to support the load from a wheel.

The standard roadbed for a first-class single track is usually considered to be about 20 ft. in width, the edges of the slopes being about 16 ins. below the bottom of the ties and the slope about $1\frac{1}{2}$ to 1. The ballast provides material that can be worked in wet weather and will not be materially softened or otherwise affected by rain, and which will permit the track to be maintained in a practically uniform condition.

When the sub-grade is soft the ballast is continually being forced down into the sub-grade, and the track must be surfaced quite often. The economy of ballast which permits being surfaced quickly and cheaply is increased.

The principal kinds of ballast generally used today are earth, cinders, gravel, chatts, burnt clay, furnace slag and broken stone. Dirt ballast or earth is easily worked in dry weather, but it is difficult to keep up the track with it in wet weather, and it also has a heavy growth of grass and weeds. It is dusty in dry weather and it reduces the life of the ties by decay at the ground line and causes broken ties in the winter by the earth heaving. Gravel is a ballast which increases the life of the tie and makes it possible to maintain good track. It is comparatively free from weeds, especially washed gravel from streams. It is also free fairly from dust. Chatt ballast is the refuse from lead and zinc mines from which the metal has been extracted, and is really finely crushed stone. It almost entirely destroys vegetation, and if not too fine is practically dustless. It is easily worked and gives a neat appearance to the track.

Burnt clay is not used extensively. It pulverizes rapidly and the growth of weeds is heavy. It is usually a rather coarse material and should not be used except where cost of other ballast is high. Granulated slag ballast is molten slag run into water. It forms a fair ballast for yard and side-tracks. The coarse slag is practically crushed rock. It is hard, black and has very sharp projections, which cut into the ties, making renewals difficult, but is free from dust and weeds. Broken stone ballast can be worked the year around and is not easily displaced by running water and is practically dustless It is expensive in first cost and makes tie renewals difficult.

The heavier the traffic the more economical stone ballast becomes, but it is not so for light traffic. On a comparatively solid sub-grade a stone-ballasted track will remain in good condition longer than a gravelballasted track. Stone ballast, after being in use for some years, becomes filled with earth from the subgrade and with cinders and other foreign material, so that it does not properly drain off the water. It must be removed and cleaned with ballast forks to remove the dirt and then replaced with 10 to 20 per cent of new material.

The most common material used for ties is wood, but some consideration has been given other materials, and more consideration must be given in the future. Granite ties were among the earliest substitutes offered, and were used for some time in Ireland and on the old Boston & Lowell Railroad. As late as 1910 these old granite ties were still dug out of the roadbed on the Boston & Lowell. In recent years some concrete ties have been made, and steel ties have been used extensively on the Bessemer & Lake Erie with considerable success. The Pennsylvania Lines have also used some steel ties. The Mexican Railway System, about 360 miles, is practically all laid with steel ties, which seem to have given excel-



lent service. The Pennsylvania Lines have tried concrete ties in stone ballast, but the ties failed under the heavy and high speed traffic and were taken out within three years. The Chicago & Alton and the Pittsburg & Lake Erie have tried concrete ties with only moderate success. The steel ties are more promising, but most of the railroads are using wood. Two things which can be done in this connection, reduce the amount of timber by the use of other materials and, by preserving the wood, decrease the annual renewals. Adopt forestry methods for the forests still standing and cultivate new plantations. The practice of sawing ties from logs should be encouraged as the old idea that a sawed tie is inferior to a hewn tie disappears. To a chemically treated tie it makes no difference whether it has been sawed or hewn.

The general tendency is toward the use of tie plates, and, with the greater use of treated ties it must be extended in order to get full value from the treatment by preventing the rail cutting into the tie. In this country the ordinary nail spike is generally used for fastening the rail to a wooden tie. There are some objections to this, but on account of their comparatively low cost and ease of handling, it is probable that they will continue to be used. The French railways were about the first in Europe to use the screw spike, and it is today universally employed by the large systems on the continent. The use of the screw spike in Great Britain is almost as rare as in the United States.

With the increase in density of traffic there is a tendency of the rail to creep in the direction of traffic, and on account of the joint ties being spiked through the slotted holes these ties move with the rail and cause bunching and rough track. To overcome creeping there have been numerous appliances devised for anchoring the rails to the ties. They are generally fastened to the base of the rail and bear against the side of the tie. The first rails used, both in this country and in Europe, were made of iron, and an iron rail, even when manufactured in the best manner, was little more than a bundle of rods. Under the heavy pounding of the locomotive the top of these rails had a tendency to spread sideways and become laminated. It is significant that during the twenty years preceding 1868 the price of iron rails had been gradually reduced to one-third of their original cost. The reduction in price accompanied an inferior quality of iron. In Europe and in England the use of steel rails was begun about 1861, and in the United States about 1864, when the Chicago & Northwestern, the Philadelphia, Wilmington & Baltimore, and the Old Colony & Newport each laid portions of track with this metal supplied from Europe. The first Bessemer steel rails made in America were rolled at the North Chicago Rolling Mill on May 24, 1865. The first steel rails rolled in the United States upon order were made at the Cambria Iron Co., Johnstown, Pa., August, 1867.

The adoption of an improved section was very slow, and as late as 1881 there were 119 patterns of steel rails of 27 different weights per yard and 180 older patterns in use, or a total of about 300 patterns. In 1893 the American Society of Civil Engineers brought out designs of rail sections, which were adopted and used by many railroads, so that in a few years about twothirds of the output of the rail mills conformed to these designs.

Much of our reasoning is performed in order to justify our feelings, or to find proofs for the position dictated by our desires, feelings, sympathies, prejudices or sentiments. It has been said that men seek not reasons but excuses for their actions.—W. W. Atkinson.

Rail and Tie Fastenings

Editor Railway Engineering and Maintenance of Way.

Sir—In your January, 1916, issue, on page 19, there is a brief mention made of a discussion which took place at the St. Louis Railway Club on the question of rail and tie fastenings. From a mechanical point of view there can be no doubt as to the desirability of fastening the rail to the tie-plate in such a manner that it interferes as little as possible with the fastening of the tie-plate to the tie.

As a matter of fact neither screw spikes nor drive spikes can be expected to accomplish all that is desired of them when certain loads are carried by the rail. The reason for this is that the stresses in the wood of the tie itself exceed the elastic limit for that material. The pulling action due to the wave motion of the rail is largely responsible for this, and naturally can never be eliminated. The number of repetitions of the load



The LaBach Design of Tie-plate and Fastening

and the amount they exceed elastic working conditions will be the governing factors in length of service. There is also a pulling on inside spikes due to the overturning tendency of the rail itself.

If the fastenings are separated the overturning effect will be lessened in much the same manner as if the rail base had been increased in width.

By the use of clips to fasten the rail to the tie-plate a small space may be left for the vertical working of the rail. Spring clips may also be used on spring washers as shown in drawing attached.

It must be borne in mind, however, that when rails are secured in this manner precautions must be taken against creeping.

A couple of years ago the writer attempted to design a tie-plate which could be rolled; the accompanying print shows the result. It is a shoulder plate to vary in thickness between $\frac{1}{2}$ in. and $\frac{7}{8}$ in.

It would be interesting to secure a discussion of the problem and some completed designs showing how the problem had been solved in different cases.

Chicago, Ill.

Paul M. LaBach, Asst. Engineer, C. R. I. & P.

Las Tanos, New Mex.

Limiting Individual Judgment

Editor Railway Engineering and Maintenance of Way: Sir—An editorial in a recent railway journal inspires me to give you my opinion on a few items of our maintenance of way work, which I claim should be standardized. It is generally conceded that in unity is strength, and standardization to me spells the same.

First, we should have a standard templet or guage, similar to that used by mechanical departments on wheel flanges, to test ball on rails to determine just when a rail is worn sufficiently to be removed from track.

Tie standards should be for new work, unload and pile 30 ties at every tenth joint or every second pole; for renewals, 3 ties for every 33 ft. rail each year in fine ballast, or 10 ties per rail every four years for stone ballast, on account of the destruction to the ballast bed by renewing a few ties under a rail each year.

Worn down frog wings should receive the same consideration that hollow worn driving wheels get, that is, remove them from track when worn down $\frac{3}{6}$ of an inch.

Last but not least a standard pay for maintenance of way employes in the United States and Canada would eliminate the very great amount of friction that exists on account of the irregularity of wages paid for similar service; and, when the conditions justify an increase of pay on the railways of the country, there would then be a standard by which to proportion the increase according to service. Yours truly,

J. HEALY,

Supervisor Hocking Valley Railway, Logan, Ohio.

Handling Bridge Approach Embankments

Editor Railway Engineering and Maintenance of Way: Sir—Several years ago the writer had considerable trouble by a roadbed moving and pushing bulkhead boards forward at the approaches of a bridge. The strain was so strong that it broke some of the bulkhead boards. Being on a down grade of about 1½ per cent, I could see only one remedy, and that was to release all the bulkhead boards from the bottom up, as far as where the cap rests on the piling.



Arrangement of Bridge Approach Embankments

After bulkhead boards were released, I increased the width of the embankment at the approach of bridge to 15 ft. from the rail, filled in with earth from the edge of the embankment, clean around underneath of bridge extending 5 ft. ahead of the bridge, as high up as where the cap rests on the piling and thus allowed the roadbed its freedom to move and adjust itself, and I had no more trouble after that. The upper four bulkhead boards remained in their proper position.

If railway companies would increase the width of embankments at the approaches of bridges to 15 ft., the approaches of the bridges would keep better surface, and if the companies would discontinue putting bulkhead boards down to bottom of embankment, it would be an improvement. As stated in this letter, there would be less trouble of maintenance on both bridge and track, and besides a saving would be affected by using less lumber. I cannot see the necessity for using more than from 3 to 4 upper bulkhead boards.

You will find enclosed diagram shows the proper position of the embankment, properly widened out at the approach of the bridge. Kindly let the letter appear in print in your Railway Engineering, as this theory or idea may be, and likely is, of interest to many of your readers.

> HENRY KOCH, Section Foreman, El Paso & SouthWestern Ry.

Book Reviews

The Mechanical World—Pocket Dairy and Year Book for 1916. This is the twenty-ninth year of its publication. Emmott & Co., Manchester and London, England; The Norman Remington Co., Baltimore, U. S. A., and the Marnzea Kabushhiki-Kaisha, Japan. Price, 30 cents, postpaid.

It is a collection of useful Engineering Notes, Rules, Tables and Data. It is truly a pocket diary readily carried so as to be consulted at any time most conveniently. It is virtually all the "world of mechanics," snugged up for quick and oft needed information.

Conversion Chart and the W-PVT Chart, by Merl Wolfard, S. B. and M. M. E., and Charles K. Carpenter, M. E. John Willey & Sons, Inc., New York.

The Conversion Chart, 12 in. by 34 in., represents more than 40 complete conversion tables, including power, speed, linear, surface and volumetric conversions by means of a novel of logarithmic co-ordinate paper.

The W-PVT Chart, 24 by 38 ins., is divided into two quadrants by use of a heavy diagonal line bringing the PV quadrants close to the TV quadrant, so that pressure temperature and volume relations throughout any gas engine or air compressor cycle may be easily determined. The chart may be entered directly in any units of pressure, temperature or volume, and cube or cube root and the 3/2 or 5/2 power or root of any number may be obtained.

The chart is printed on accurately divided logarithmic co-ordinate paper and all plotted scales are open enough to insure a high degree of accuracy.

Resuscitation from Electric Shock, Drowning and Asphyxiation. By Charles A. Lauffer, A.M., M.D. Published by John Wiley & Sons, Inc., New York, 1915. Price 50 cents.

This book is one of ninety pages, illustrated, bound in cloth, and is pocket size, $4x6\frac{1}{2}$ ins. It deals in a scientific, yet easily understood style, with causes, the physical effects of this class of accident, which temporarily suspends animation, and in which prompt and intelligent aid must be given without loss of time. There is always danger from such accidents on railways, and no man who comes in contact with his fellowmen in this modern day should be without a knowledge of an effective method of resuscitation which he is liable to need at any moment.

The book not only gives full and practical information as to what to do and how to do it, but also what not to do, which is frequently just as important. It is written in concise language and is therefore short and to the point, and the methods explained here have been the means of saving human life.



In this new edition forty-two pages have been added dealing with chemical manifestations of illuminating gas poisoning, commercial devices for artificial respiration, resuscitation by means of the prone pressure method, with examples of its success, and by means of artificial respiration. The full contents follows:

Instruction in Resuscitation. Forethought. Successful Results. Types of Cases Requiring Resuscitation. Mechanism of Respiration. The Method. I. Position of Patient. II. Posture of Operator. III. Mode of Operation. IV. Rate Per Minute and Duration of Operation. Supplemental Assistance. Mechanical Resuscitation. Prof. Schaefer on the Prone Pressure Method. Clinical Manifestations of Illuminating Gas Poisoning. Commercial Devices for Artificial Respiration. Resuscitation by Means of the Prone Pressure Method. Resuscitation from Electric Shock. Drowning and Asphyxiation by Means of Artificial Respiration. Successes of the Prone Pressure Method. Hero Medal Recommended.

Maintenance of Way and Structures. By William C. Willard, C.E., M.S. Published by McGraw-Hill Book Co., Inc., 239 West 39th St., New York, and 6 Bouverie St., London. Price, \$4.00.

There is very little if anything on the subject of maintenance of way and structures which this work does not fully consider. The matter is arranged and treated in an interesting and instructive way and is something which the practical engineer as well as the student will enjoy and profit by. Altogether it is an up-to-date discussion of all the problems and matters which confront the construction department of a railroad and that all important maintenance of way department. The roadway, fastenings, tieplates, signs, fences, highway crossings, bridges and trestles, switches and frogs, tools, supplies, records and accounts are all taken in hand and discussed in a masterly fashion. It is full of drawings, illustrations and plans all of use to the maintenance of way engineer.



The Allis-Chalmers Manufacturing Co., Milwaukee, Wis., has recently issued a 36-page illustrated booklet on wood-preserving equipment and methods. Photographs of typical plants and tables containing valuable data on the subject are included. The various processes of timber preservation and plant construction are compared.

The American Conduit Mfg. Co., Pittsburgh, Pa., have recently issued two illustrated circulars, one on Eagle Brand Lead-Zinc coated conduit for electric wiring, describing the resistance of this conduit to the action of wet slag, wet cinders, wet mortar, concrete, etc. The second circular describes their flexible Wireduct.

The American Shop Equipment Co., Chicago, Ill., have recently issued a 36-page illustrated catalogue covering shop furnaces which have been equipped with an improved type of combustion chamber. A number of the furnaces are built with a layer of insulation brick between the fire brick and the plates, to reduce fuel consumption, maintain a more uniform temperature in the furnace and maintain a cooler temperature outside for the operator. Furnaces are described for forging, welding, hammer, bulldozer, spring fitting.

The Brown Hoisting Machinery Co., Cleveland, Ohio, have recently issued a 32-page illustrated catalogue describing the various types of Brownhoist Transfer Cars and Larries. The rates of speed at which material can be moved and placed with this equipment are carefully determined and sufficient data presented to be of great value in selecting the proper type of equipment to meet given conditions.

The Bryant Electric Co., Bridgeport, Conn., have rerectly issued an illustrated catalogue comprehensively describing their wiring devices, including switches, fuses, plugs, etc.

The Chicago Pneumatic Tool Co., 1010 Fisher Bldg., Chicago, have recently issued a 16-page illustrated booklet giving a brief survey of the variety of types of compressors and oil engines which they manufacture. Some twenty-four represented types selected from over 300 are illustrated and the classes of service for which they are most advantageous are described.

The Minwax Co., Inc., 18 E. 41st St., New York City, have recently issued a 12-page illustrated bulletin No. 3, describing floor treatments. The bulletin discussed the use of Winwax floor filler and finish for cement, composition, terrazzo, tile and marble floors and gives specifications for these and other wood floors as well as illustrating a number of typical installations.

The Newport Culvert Co., Newport, Ky., have issued a 16-page illustrated folder on "Genuine Open Hearth Iron" (Newport iron) Culverts describing the advantages of pure iron in resisting rust, and their line of corrugated pipe for culverts.

The P. & M. Co., Chicago, Ill., have recently issued an illustrated booklet on the construction and installation of their bond wire protectors for use in connection with the different types of rail joints.

The Trussed Concrete Steel Co., Youngstown, Ohio, has recently issued a 32-page illustrated book describing portable steel buildings for railroad and contractors' use. The book shows the forms of construction and various buildings in service.

The Vanadium-Alloys Steel Co., of Pittsburgh, Pa., have recently issued a 4-page illustrated reprint of an article by Roy C. McKenna, president of that company, on "Mining Tungsten Ores in Colorado." The article deals with changed conditions in the sources of supply of this important alloy owing to imports being cut off from the belligerent countries of Europe.

Westinghouse, Church, Kerr & Co., 37 Wall street, New York city, have recently issued a very attractive folder, dealing with the advantages of having reinforced concrete work designed and constructed by the same organization. Three typical examples of Westinghouse Church Kerr work are illustrated.

Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., have issued a 16-page illustrated reprint of a paper presented at a meeting of the Railway Club of Pittsburgh, by E. M. Herr, president of that company. The paper deals with electric power development, through successive sizes of generating units with relation to industrial and railway electrification projects.

C-A-Wood Preserver Co., Inc., St. Louis, Mo., have recently issued a 40-page illustrated catalogue on wood preservation. The book deals with the comparative advantages of surface treatment and impregnation for wood preservation with respect to ties, sills, platforms, wood blocks and wood floors, as well as structural timbers. Methods of using the C-A-Wood Preserver and typical projects where it has been used successfully.





National Railway Appliances Association

Arrangements for the forthcoming exhibition of the National Railway Appliances Association in Chicago, March 20-23, inclusive, in connection with the meeting of the American Railway Engineering Association; Railway Signal Association, and the Association of Railway Telegraph Superintendents, are nearing completion.

A recent report from C. W. Kelley, secretary and treasurer, states that all of the space in the coliseum and annex have been sold with the exception of a very few small spaces.

Appended is a list of the members of the National Railway Appliances Association for this year and the representative character of the companies listed insure an interesting and instructive exhibition.

Acme Supply Co., Chicago, Ill. Adams & Westlake Co., The, Chicago, Ill. Adams Motor & Manufacturing Co., Chicago, Ill. Ajax Rail Anchor Co., Chicago, Ill. Allith-Prouty Co., Danville, Ill. American Guard Rail Fastener Co., Philadelphia, Pa. American Hoist & Derrick So., St. Paul, Minn. American Kron Scale Co., New York, N. Y. American Steel & Wire Co., Chicago, Ill. American Valve & Meter Co., Cincinnati, Ohio. American Vulcanized Fibre Co., Wilmington, Del. Anchor Company, Chicago, Ill. Armco Iron Culvert Manufacturers, Middletown, O. Asphalt Ready Roofing Co., New York, N. Y. Associated M'n'f'rs of Malleable Iron, Cleveland, O. Ayer & Lord Tie Co., Inc., Chicago, Ill. Ballow Safety Rail Joint Co., Roanoke, Va. Barrett Manufacturing Co., New York, N. Y. Bausch & Lomb Optical Co., Chicago, Ill. Boss Nut Company, Chicago, Ill. Brach Supply Co., L. S., Newark, N. J. Bryant Zinc Co., Chicago, Ill. Buda Co., The, Chicago, Ill. Carnegie Steel Co., Pittsburgh, Pa. Chicago Bridge & Iron Works, Chicago, Ill. Chicago Flag & Decorating Co., The, Chicago, Ill. Chicago Malleable Castings Co., Chicago, Ill. Chicago Pneumatic Tool Co., Chicago, Ill. Chicago Railway Signal & Supply Co., Chicago, Ill. Cleveland Frog & Crossing Co., Cleveland, Ohio. Clyde Iron Works, Chicago, Ill. Commercial Acetylene Ry. Lt. & Sig. Co., N. Y. City. Concrete Mixing & Placing Co., Chicago, Ill. Creepcheck Co., The, Inc., New York, N. Y. Crerar-Adams & Co., Chicago, Ill. Cornell Wood Products Co., Chicago, Ill. Daniels Safety Device Co., Chicago, Ill. D. & A. Post Mold Co., Three Rivers, Mich. Detroit Graphite Co., Detroit, Mich. Dickinson, Paul, Inc., Chicago, Ill. Dillworth-Porter & Co., Ltd., Pittsburgh, Pa. Dixon Crucible Co., Joseph, Jersey City, N. J. Duff Manufacturing Co., The, Pittsburgh, Pa. Edison, Thos. A., Inc., Bloomfield, N. J. Edison Storage Battery Co., Orange, N. J. Electric Storage Battery Co., The, Philadelphia, Pa.

Electric Railway Improvement Co., Cleveland, Ohio. Empire Railway Appliance Corp., New York. Eymon Continuous Crossing Co., Marion, Ohio. Fairbanks, Morse & Co., Chicago, Ill. Fairmont Gas Eng. & Ry. M. C. Co., Fairmont, Minn. Fargo Manufacturing Co., Inc., New York, N. Y. Federal Signal Co., Albany, N. Y. Fibre Conduit Co., The, Chicago, Ill. Frictionless Rail, The, Boston, Mass. Galena Signal Oil Co., Franklin, Pa. General Electric Co., Schenectady, N. Y. General Railway Signal Co., Rochester, N. Y. Gurley, W. & L. E., Troy, N. Y. Hall Switch & Signal Co., New York, N. Y. Hatfield Rail Joint Manufacturing Co., Macon, Ga. Hayes Track Appliance Co., Richmond, Ind. Hazard Manufacturing Co., Wilkes-Barre, Pa. Hoeschen Manufacturing Co., Omaha, Neb. Hubbard & Co., Pittsburgh, Pa. Indianapolis Switch & Frog Co., The, Springfield, O. Ingersoll-Rand Co., New York, N. Y. International Steel Tie Co., The, Cleveland, Ohio. Johns-Manville Co., H. W., New York, N. Y. Jordan Co., O. F., The, Chicago, Ill. Joyce-Cridland Co., The, Dayton, Ohio. Julian-Beggs Signal Co., Terre Haute, Ind. Kalamazoo Railway Supply Co., Kalamazoo, Mich. Kellogg Switchboard & Supply Co., Chicago, Ill. Kelly-Derby Company, Chicago, Ill. Keppler Glass Constructions, Inc., New York, N. Y. Kerite Insulated Wire & Cable Co., The, N. Y. City. Keystone Grinder & Mfg. Co., Pittsburgh, Pa. Kilbourne & Jacobs Manufacturing Co., Columbus, O. Lackawanna Steel Co., Lackawanna, N. Y. Lansing Company, Lansing, Mich. Lehon Co., The, Chicago, Ill. Lidgerwood Manufacturing Co., New York, N. Y. Louisiana Red Cypress Co., New Orleans, La. Lumber Manufacturers Agency, Centralia, Wash. Lundie, John, New York, N. Y. Lufkin Rule Co., Saginaw, Mich. M. W. Supply Co., Philadelphia, Pa. MacRae's Blue Book Co., Chicago, Ill. Madden Co., The, Chicago, Ill. Massey Co., C. F., Chicago, Ill. Miller Train Control Corporation, Danville, Ill. Morden Frog & Crossing Works, Chicago, Ill. Mudge & Co., Chicago, Ill. National Carbon Co., Cleveland, Ohio. National Concrete Machinery Co., Madison, Wis. National Indicator Co., Long Island City, N. Y. National Lead Co., New York, N. Y. National Lock Washer Co., Newark, N. J. National Malleable Castings Co., Cleveland, Ohio. National Standard Co., Niles, Mich. Nichols, Geo. P. & Bro., Chicago, Ill. Northwestern Motor Co., Eau Claire, Wis. Ogle Construction Co., Chicago, Ill. Okonite Co., The, New York, N. Y. O'Malley Beare Valve Co., Chicago, Ill. Otley Paint Manufacturing Co., Chicago, Ill. P. & M. Company, Chicago, Ill.

Patterson Co., W. W., Pittsburgh, Pa. Pennsylvania Steel Co., Philadelphia, Pa. Pittsburgh-Des Moines Steel Co., Pittsburgh, Pa. Pocket List of Railroad Officials, New York, N. Y. Positive Rail Anchor Co., Louisville, Ky. Protective Signal Mfg. Co., The, Denver, Colo. Pyrene Manufacturing Co., New York, N. Y. Q. & C. Co., The, New York, N. Y. Rail Joint Co., The, New York, N. Y. Railroad Supply Co., The, Chicago, Ill. Railroad Water & Coal Handling Co., Inc., Chicago. Railway Periodicals Co., Inc., New York, N. Y. Railway Review, Chicago, Ill. Ramapo Iron Works, Hillburn, N. Y. Reading Specialties Co., Reading, Pa. Roadmasters & M. of W. Association, Sterling, Ill. Roberts & Schaefer Co., Chicago, Ill. Safety Rail Joint Co., Not Inc., Centralia, Ill. Sanitary Bunk Co., Indianapolis, Ind. Sellers Manufacturing Co., Chicago, Ill Signal Accessories Co., New York, N. Y. Simmen Automatic Railway Signal Co., Buffalo, N. Y. Simmons-Boardman Pub. Co., New York and Chicago. Snow, T. W., Construction Co., Chicago, Ill. Standard Asphalt & Rubber Co., Chicago, Ill. Standard Oil Co., Chicago, Ill. Standard Underground Cable Co., Pittsburgh, Pa. Staple Post Mold Co., Westerville, Ohio. Southern Pine Association, New Orleans, La. Templeton Kenley & Cc., Ltd., Chicago, Ill. Titanium Alloy Mfg. Co., Niagara Falls, N. Y. Track Specialties Co., New York, N. Y. Tyler Underground Heating System, Pittsburgh, Pa. Union Switch & Signal Co., Swissvale, Pa. U. S. Wind Engine & Pump Co., Batavia, Ill. Verona Tool Works, Pittsburgh, Pa. Walker, Wm. T., Rail Bender Co., Chicago, Ill. Wayne Oil Tank & Pump Co., Fort Wayne, Ind. Western Electric Co., New York, N. Y. Wharton, Wm., Jr., & Co., Inc., Philadelphia, Pa. Whall Co., C. H., Boston, Mass.

William Edward Ballentine, general railway sales manager of the Willard Storage Battery Co., Cleveland, Ohio, died January 11, after an illness of four days. Mr. Ballentine was first associated with the Fort Scott & Memphis R. R., then with the Pullman Co., and later was head of the electrical department of the Rock Island. In 1909 he was appointed manager of the western territory of the Willard Storage Battery Co., and in 1913 was appointed general railway sales manager of that company. The success of the Willard Storage Battery Co. in the train lighting field is greatly due to his efforts.

The Bailey Meter Co., 141 Milk street, Boston, Mass., has recently been incorporated to manufacture and sell the complete line of recording meters and instruments, for power plant use, that has been developed during the last six years in the mechanical engineering department of the Fuel Testing Co., of Boston. E. G. Bailey expects to devote his energies to the new company while W. B. Calkins, who has been associated with him in the Fuel Testing Co., will continue in the work of that company. The Bailey meters are designed to accurately record the measurements of steam, water, air and gases under all conditions of pressure, temperature and capacity.

C. N. Beckner, recently appointed superintendent of construction for the Federal Signal Co. with headquarters in Chicago, entered signal work in 1902 as helper in a signal construction gang on the Norfolk & Western. In 1905 he was appointed signal foreman on the Santa Fe and in 1906 returned to the Norfolk & Western as signal supervisor on the Norfolk division. In 1910 he was appointed signal foreman of the Louisville and Nashville at Louisville, and in 1912 was made signal supervisor of the Louisville, Cincinnati & Lexington division, the Kentucky division and the Louisville Terminal. In 1914 he was appointed assistant signal engineer, where he remained until his recent resignation to accept his new position.

E. H. Bell has recently been elected president of the Railroad Supply Co., of Chicago, succeeding the late Henry S. Hawley. Mr. Bell has been vice-president of that company for some years.

The Chicago Railway Signal & Supply Co., Chicago, have recently announced the appointment of G. O. Bates as their southern representative, with headquarters at Chattanooga, Tenn.

William Andrew Conner, vice-president of the Standard Underground Cable Co., Pittsburgh, Pa., died recently in his office at Perth Amboy, N. J. In 1885 he took charge of the first plant the company built, at Pittsburgh, and from that time has been the manufacturing head of the concern.

The Duntley Product Sales Co., 810 Fisher Bldg., Chicago, Ill., has organized a railway department under the management of W. F. Caspert, formerly connected with the Monarch Steel Castings Co., of Detroit. The W. O. Duntley interests are represented by C. A. Duntley, who will be actively connected with the management of the new department.

The Economy Devices Corporation has recently announced the opening of a Chicago office in the McCormick building under the management of Joseph Sinkler.

The Kay & Ess Co. have announced the appointment of H. N. Turner, formerly eastern representative, as sales manager, with headquarters at Dayton, Ohio.

DeWitt V. Moore, recently division engineer, Central District, division of valuation, Interstate Commerce Commission, Chicago, has resigned and will take up a consulting practice in Chicago. Mr. Moore's experience includes engineering work on the Pennsylvania and a consulting practice at Indianapolis covering twenty years. He will specialize in valuation matters, particularly with the smaller railroads.

The Q. & C. Co., of New York city, have announced the acquisition of the National Railway Materials Co., and will in the future conduct the business of that company in the name of the Q. & C. Co.

The J. C. Russell Shovel Co., Pittsburgh, Pa., announce that they have made an arrangement with R. L. Mason, 1501 Oliver Bldg., Pittsburgh, Pa., to act as special representative in the railway field. Mr. Mason will have charge of railroad sales on track shovels and locomotive scoops and his broad experience in the last fourteen years especially qualifies him to be of service.

A. E. Schafer, who has for the past two years been vice-president and general sales manager of the Flint Varnish Works at Flint, Mich., has severed his relations with that company.

The Western Electric Co., Inc., of New York, has recently been formed and has taken over the assets of the Western Electric Co. of Illinois No changes in the personnel of the organization or in the policy operations and management of the company will be made.





Cyclodial Wier for Water Meter

The Kennicott Co., Chicago, Ill., have recently placed on the market a water meter embodying a wier with a cycloidal notch. The thought of a wier calls to mind the wiers of "V" notches and rectangular notches now in general use, and all the experience that has been secured in their operation lies back of the design of the new cycloidal notch.

Water flowing from a round hole in the bottom of the container, or wier, passes out at a rate varying in proportion to the square root of the head. The rectangular notch in the side of the wier permits the water to flow at a rate proportional to the 3/2 power of the head. The "V" notch changes this ratio to the 5/2 power of the head.

For a constant head, these ratios would any of them be sufficiently convenient for use, for once the rate of flow had been established, the mathematician could devote his time to other duties. Or, were the head to vary, and only an occasional reading be desired these ratios of rate of flow to head can be used.

It is when a record is to be kept of the water flow that these fractional exponents in the proportion com-



Cycloidal Notch Wiers.

plicate matters. A continuous recording device capable of recording the square root of the cube of the continuously varying reading of a rectangular notch wier is not a simple mechanism, nor is a similar device for recording the square root of the fifth power.

With these facts in mind, the Kennicott Co. began experimenting to find what shape of notch would permit the water to flow at a rate proportional to the head, with no intermediate computations. Starting with a rectangular slot in the bottom of the wier, experiments were made to determine how long the slot would need to be at each height for the water to flow at a rate proportional to the height or head. These lengths of slots, when plotted into a curve, formed the basis for the construction of a wier box with a curved end and a rectangular slot, shown in the sketch Fig. 1. Exhaustive tests confirmed the results of the experiment.

After the perfecting of this form of wier a mathematical investigation of the curve demonstrated it to be a right cycloid, that is, a curve generated by a point on the circumference of a circle rolling on a straight line in the same plane with the circle.

Having developed this form of wier and thoroughly

tested its dependability the Kennicott Co. has incorporated it in its new cycloid wier meter, used in connection with that company's water softening and storage apparatus, the form of notch used being indicated in sketch Fig. 2. This device makes possible much more accurate measurement of water by simpler means than have hitherto been employed. Though an astonishingly rational development and one perfectly reducible by mathematical computation, no previous investigators or experimenters appear to have attempted this result at any rate, basic patents covering the principle have been allowed the inventors by the United States patent office.

New Nut Lock and Bolt for Hollow Work

The Columbia Nut and Bolt Co., Inc., Bridgeport, Conn., have just placed on the market the Columbia Jib Nut Lock, a three-thread lock made either square or hexagon, as illustrated, which has several advantages. The threads are cut straight through the nut which can, therefore, be applied up to the holding nut with fingers and a wrench is only required to set it tight.



Columbia Jib Nut Locks

The bent edges of the nut being on opposite sides, it can be applied either side up, and owing to its shape it does not injure or mar the threads of the bolt in any way. The bent edge of the jib nut comes in contact with the surface of the holding nut, tipping the jib nut over at an agle and forcing its threads into the threads of the bolt, making a jam. These bolts are made in all sizes from $\frac{3}{8}$ in. up to and including 2 ins. and both square and hexagon threads.

The Kling bolt has been designed in such a way that the head will pass through a hole of the same diameter



as the stem of the bolt and will give a firm anchorage for the head on the opposite side, making it available for all hollow construction work. The bolt is split in order that the head may be passed through a hole the size of the bolt stem. This splitting does not reduce the area of the metal nor affect the tensile strength of the bolt. The

area of the metal at the head is greater than the area of metal where the thread is cut.



Personal Items for Railroad Men

Markensking in the solution of a beneficient of a state of the solution of the

H. E. Astley, recently appointed division engineer of the New York, New Haven & Hartford at Waterbury, Conn., succeeding Paul Sterling, has been serving in that capacity at Hartford, Conn.

Claude L. Van Auken, recently appointed assistant engineer on the valuation of the Chicago Terminals for the Chicago, Rock Island & Pacific Railway, was formerly in the valuation department of the Chicago, Milwaukee & St. Paul Railway.

F. H. Bagley, recently appointed assistant signal engineer of the Louisville & Nashville, entered the employ of the Union Switch & Signal Co. in 1907 and after over three years of experience in all lines of work of their engineering department, he was appointed in 1910 as special assistant to the supervisor of signals on the New York division of the Pennsylvania R. R. Here for a year he conducted a school for signal maintainers on that division. Returning to the Union Switch & Signal Co., Mr. Bagley spent the next year in development work on alternating current signal, and in 1911 was a ppointed signal inspector on the Louisville & Nashville. In 1912 he was appointed signal inspector on the Louisville & Nashville and later supervisor of signals on the Cincinnati division, Kentucky division and Louisiana Terminals for that road. In 1914 he was appointed by the Interstate Commerce Commission as senior signal engineer in the division of valuation with headquarters at Chattanooga, Tenn., where he remained until his recent appointment.

C. N. Becker, recently appointed superintendent of construction for the Federal Signal Co. with headquarters at Chicago, has recently resigned as assistant signal engineer of the Louisville & Nashville.

F. T. Beckett has recently been appointed engineer of maintenance of way of the second district of the Chicago, Rock Island & Pacific at El Reno, Okla. The third district has been abolished.

G. W. Belew, recently appointed supervisor on the Louisburg Division of the Louisville & Nashville, succeeding W. C. Mahoney, resigned to accept a position with the N. C. & St. L., entering the service of the L. & N. as a track man in 1907 and later that year was made apprentice foreman. In 1908 he was made storekeeper of the track supply department at Columbia, Tenn., and in 1911 was appointed section foreman, which position he held until his recent appointment.

R. W. E. Bowler, recently appointed supervisor at South Fork, Pa., on the Pittsburgh division of the Pennsylvania R. R., entered the service of that road in 1905 as rodman and in 1908 was appointed transitman at Altoona. In 1909 he was made assistant supervisor on the Media division and after being transferred to Columbia, Pa., in 1910 and to Harrisburg, Pa., in 1912, nas now been promoted to supervisor at South Fork, Pa.

J. S. Brown, recently appointed assistant to the engineer of maintenance of way with office duties on the New York, New Haven & Hartford, at New Haven, Conn., has been serving as assistant engineer. George W. Caye, recently appointed general purchasing agent of the Grand Trunk Ry. system at Montreal, succeeds J. H. Guess, resigned.

Frank D. Cooner, recently appointed transitman in the office of the engineer of maintenance of way, entered the service of that road in 1910 as rodman and was transferred to different parts of the system before his recent promotion.

Albert Darrow has recently been appointed signal supervisor on the Buffalo, Rochester & Pittsburgh, with offices at Salamanca, N. Y.

K. B. Duncan, recently appointed to the newly-created office of valuation engineer of the Atchison, Topeka & Santa Fe, has been until his recent appointment acting engineer on the Gulf, Colorado & Santa Fe.

F. T. Fisk, recently appointed assistant supervisor on the middle division of the Pennsylvania R. R., entered the service of that road in 1910 as rodman on the Buffalo division. In 1915 he was appointed transitman in the office of the engineer of maintenance of way at Philadelphia, where he remained until his recent promotion.

S. F. Gates, recently appointed assistant supervisor at Huntington, Pa., on the middle division of the Pennsylvania R. R., was transferred from a similar position at Jamesburg, N. J.

J. V. Givney, recently appointed assistant supervisor in the office of the valuation engineer of the Pennsylvania R. R. at Philadelphia, entered the service of that company in 1910 as rodman in the construction department. In 1915 he was appointed transitman in the office of engineer of maintenance of way, where he remained until his recent promotion.

F. B. Jamieson, recently appointed transitman in the office of the engineer of maintenance of way, entered the service of the Pennsylvania R. R. in 1909 as chairman of the Pittsburgh division. In 1910 he was appointed rodman on the same division, where he remained until his recent promotion.

Zeno N. Kent, recently appointed assistant supervisor at Millville, N. J., for the West Jersey & Seashore and was appointed transitman in the office of the engi-R. R., entered the service of the Pennslyvania in 1910 neer of maintenance of way in 1915, where he remained until his recent promotion.

W. G. Massenburg, recently appointed acting engineer of the Gulf, Colorado & Santa Fe, succeeding K. B. Duncan, has been serving as division engineer at Beaumont, Tex.

J. E. McIntyre has recently been appointed supervisor on the middle division of the Pennsylvania R. R. at Mifflin, Pa., and was transferred from South Fork, Pa.

Charles W. Newell, recently appointed assistant supervisor at Jamesburg, N. J., on the Trenton division of the Pennsylvania R. R., was transferred from similar work in the office of the valuation engineer.



W. H. Park, recently appointed roadmaster on the Missouri Pacific at Conway Springs, Ark., served as roadmaster on that road from 1910 to 1912, at which time there was a redistribution of territory, and Mr. Park was appointed division roadmaster on the M. K. & T. Ry. at Atoka, Okla. Returning in 1913 to the Missouri Pacific, he has served as extra gang foreman until the announcement of his recent appointment.

C. D. Perkins, recently appointed assistant to the engineer of maintenance of way with field duties, of the New York, New Haven & Hartford, at New Haven, Conn., has been serving as division engineer at Harlem River, N. Y.

W. H. Petersen, engineer maintenance of way of the First District of the Chicago, Rock Island & Pacific at Des Moines, Ia., has recently has his jurisdiction increased to include the Nebraska and Colorado divisions of that road.

L. St. Claire Pie, recently appointed assistant supervisor on the Philadelphia division of the Pennsylvania R. R., was transferred from a similar position on the West Jersey & Seashore R. R. at Woodbury, N. J.

J. S. Ruff, recently appointed division engineer of the Central New England Ry. at Poughkeepsie, N. Y., succeeding G. F. Yardley, has been serving as supervisor at South Braintree, Mass.

Edward Sheffield, recently appointed acting supervisor of signals of the Houston & Texas Central, through the leave of absence of Mr. L. H. Feldlake, has been serving as assistant signal supervisor.

A. R. Smiley, Jr., recently appointed transitman in the office of the engineer of maintenance of way of the Pennsylvania R. R., entered the service of that road in 1910 as rodman on the Trenton division.

Earle C. Smith, recently appointed acting supervisor at Titusville, Pa., on the Buffalo division of the Pennsylvania R. R., entered the service of that road in 1905 as rodman and in 1909 was made transitman. In 1910 he was made assistant supervisor in Philadelphia and has been transferred in the capacity of assistant supervisor to Haddonfield, N. J., Blairsville, Pa., Huntington, Pa., successively.

Paul Sterling, recently appointed division engineer of the New York division of the New York, New Haven & Hartford at Harlem River, N. Y., succeeding C. D. Perkins, has been transferred from division engineer at Waterbury, Conn.

A. M. Williams, recently appointed supervisor in the office of the division engineer of the Buffalo division of the Pennsylvania R. R., was transferred from Titusville.

G. F. Yardley, recently appointed division engineer of the New York, New Haven & Hartford at Hartford, Conn., succeeding H. E. Astley, has been serving as division engineer of the Central New England Ry.

-----Obituary

William Claffin Andrews, advertising manager of the Edison Storage Battery Co., Orange, N. J., died recently in New York city. Mr. Andrews was first employed as sales engineer of the Stanley Instrument Co. of Great Barrington, Mass., and was later connected with the General Electric Co. in Schenectady, N. Y., and Harrison, N. J. Subsequently he was for two years secretary of the Rae Company, New York city, and in 1913 became advertising manager of the Edison Storage Battery Co., holding that position until his death. **Frederick Hebert Eaton** died on January 27. By it the industrial world has lost one of its foremost captains. He was born in Berwick, Pa., April 15, 1863, and was descended from early Colonial stock.

Mr. Eaton had been for many years a commanding figure in the car manufacturing industry and had been engaged therein practically all his life. He obtained his early experience as chief clerk in the office of the Berwick Rolling Mill Company, then a subsidiary of the old Jackson & Woodin Car Manufacturing Company. From 1892 to 1899 he was successively secretary, vicepresident and president of the Jackson & Woodin Company at Berwick. In 1899 he was an important factor



Frederick Hebert Eaton

in the formation of the American Car and Foundry Company, a consolidation of many car building companies in the United States, and which is one of the largest industrial organizations in the country today. Mr. Eaton was president and a member of the executive committee of the American Car and Foundry Company from 1901 to the time of his death. In 1906 Mr. Eaton was presidential elector on the McKinley-Hobart ticket. for his native state of Pennsylvania.

Mr. Eaton was a director of the American Agricultural Chemical Company, American Beet Sugar Company, Columbia Trust Company, Hoyt & Woodin Manufacturing Company, National Surety Company, Seaboard National Bank and Sligo & Eastern Railroad Company; chairman of the board of directors of American Car and Foundry Export Company, and was a trustee of the Mutual Life Insurance Company of New York.

He was also a member of the New York Chamber of Commerce, the Pennsylvania Society in New York, the Society of Colonial Wars, Sons of the Revolution, Economic Club, American Geographical Society, American Society of Political and Social Science, Academy of Political Science, Peace Society of New York, Navy League of U. S., New York Genealogical and Biographical Society.

Mr. Eaton was also a member of many clubs. He is survived by his widow, Elizabeth Furman Eaton, and a daughter, Mae Eaton Crispin of Berwick. His city residence was Alwyn Court, 182 West 58th street, and his country place "Maibenfritz," Allenhurst, N. J.



John Alexander Hill, whose death occurred last week, has been a unique figure in the ranks of technical journalists, and the president and founder of the Hill Publishing Company. He was born on February 22, 1858, at Sandgate, Vermont, but early removed to Wisconsin, where he was educated. His start in life, at the age of fourteen, was in a small printing office, in which he became foreman at seventeen. His love for machinery, which was gratified in the printing office, led him to seek its further expansion in railroad life.

He took the position of fireman on the Denver & Rio Grande, and shortly afterward became a locomotive engineer. It was his practical experience on the road which enabled him later on to write those inimitable sketches entitled "Jim Skeever's Object Lessons," which faithfully portrayed the actual railroad man as he is on the real railway. Leaving active railroad life, his printing house training enabled him to found the "Daily Press" of Pueblo, Col. He edited this paper for about a year, but again turned his attention to railroad work, at which he remained until 1887. During these years he was a frequent contributor to the "American Machinist." Many of his writings appeared under the simple name of John Alexander.

In 1891 Mr. Hill formed a partnership with Angus Sinclair, another D. & R. G. locomotive engineer, and together they acquired the "Locomotive Engineer,"



John Alexander Hill

They changed its name to include the science, and made it "Locomotive Engineering." In 1885 they bought the "American Machinist," and later, when the partnership was dissolved, Mr. Hill took the "American Machinist." Under his guiding hand the property advanced in standing and in value, and its success enabled Mr. Hill to form a company which acquired not only the "American Machinist," but "Power," "The Engineering and Mining Journal," "The Engineering News" and established the "Coal Age."

In acquiring these technical publications, Mr. Hill was able to give tangible form to his enlightened ideas of the printer's life and his art. He did not see any good reason why printers should work surrounded by disorder and amid printing ink, oily rags and waste paper. He believed a printing office might be as bright and clean as any other establishment where work is done, and he made this belief a reality in his building at Tenth avenue and 36th street, New York. This building is painted white inside, and even the machinery is of the same color. It contains a tablet put up by the employes some years ago with the inscription, "Within this monument to independent truth and service in engineering journalism, the employes of the Hill Publishing Company have placed this tablet, as an appreciation of the man and employer, John A. Hill."

There was in this no idle flattery, for all had confidence in his justice and fair dealing. He is credited with many practical improvements in printing machinery and practice. He stood squarely behind his editors and never allowed the hope of advertising patronage to warp judgment or to bind honest opinion or stifle its expression. His wish was to die in harness and the grim reaper found him at his post.

Albert H. Scherzer, president and chief engineer of the Scherzer Rolling Lift Bridge Co., of Chicago, died recently as a result of injuries received in an elevator accident. In 1892 he engaged in the practice of law and on the death of his brother William, the inventor of the rolling lift bridge, he became president and chief engineer of the company. Mr. Scherzer designed a number of important railway bridges, both in the United States and abroad, and invented many improvements in bridge design.

A. W. Swanitz, formerly chief engineer and manager of the Alaska Northern Ry., died recently at Alameda, Cal. Before entering the service of the Alaska Northern Mr. Swanitz was active in the construction of a number of railroads in various parts of the country.

Method Used in Quenching Steel Discussed

At a recent meeting of the Huddersfield Engineering Society, says a recent commerce report, Mr. Shipley N. Brayshaw lectured on "The Quenching of Steel." The lecturer discussed the properties which determined the value of any liquid as a quenching medium, and pointed out that the main items of consideration in this direction were specific gravity, specific heat, boiling point, conductivity, and fluidity, and gave some interesting information in connection with experiments which he had carried out in the hardening of tools in various ways, and by means of various quenchers.

He described the effects of stirring the quenching medium, and also the use of jets for throwing a strong stream against the articles to be cooled. He referred to the use of brine and a freezing mixture of snow and salt. He pointed out that the age of water had a great deal to do with its quenching powers, and instanced the carrying away of water in barrels from the River Don, in Sheffield, even as far as the United States for this purpose, owing to some peculiar property which it possessed.

The uses of oil, mercury, fusible oils, and fusible salts as quenching media were dealt with, and the lecturer laid down as the ideal medium for quenching, one which was from fluid at 100 degs. C., at a high boiling point of practically 800 degs. C., fairly high specific gravity, and of fairly good specific heat. This would give a glass-like hardness to the tools, but the quenching should be carried out at such a temperature that the heat left would prevent breakage.

RAILWAY ENGINEERING AND MAINTENANCE OF WAY

WITH WHICH IS INCORPORATED ROADMASTER AND FOREMAN

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The Growth of the Convention Idea

The history of conventions of railroad and railroad supply men in this country is a history of accomplishment and progress. In the early days, the social feature of the meetings of railway associations seems to have predominated. Gradually the power of the association toward standardizing the varying practices in separated parts of the country was recognized, and the value of some of this work is second in importance only to such measures as adopting standard gauge. The serious work done by the associations has entitled them to the respect and influence which they enjoy. This respect and influence, once earned, has reacted to make the subject matter and discussions at their meetings of increasing pertinence and value.

Just as there has been progress among the railway associations, there has been an appreciable movement among the associations of railway supply men toward serious accomplishment. The beginnings of all the representative associations of railway supply men can be traced to entertainment of railroad men attending railroad men's conventions. The early forms of exhibit—models in the parlors of hotels where railroad men met—were the beginning of the educational idea, which has been fostered, until in its present proportions it is a mighty force in the advancement of the science of transportation.

The educational value of a convention which brings together working models of the most improved appliances entering into the work of a single department of railroad activity has been recognized. The convenience and economy of collecting under one roof tangible and demonstrable evidences of the scattered pioneer work of each year, where they may be examined and considered, has been admitted. The advantages of having these exhibits demonstrated and explained by qualified experts has been considered. The cost in dollars and in time of preparing and concentrating the exhibits and of assembling the railroad men and supply men has been estimated and appreciated.

The railroad and railroad supply men who attend the conventions know that a high degree of application and perseverance is necessary if full advantage is to be taken of the opportunities afforded by the convention. The subject of "Making the Convention Pay" has been considered recently in these columns. The preparation for the convention by both railroad and supply men has been discussed. To the men who attend the convention there remains less to be said than to the railroad men who do not attend; to the men who remain on the job, keeping the wheels going 'round, while their associates or subordinates, as the case may be, are delegated to attend the convention, absorb and assimilate the information it offers, and bring back, to the extent of their ability, the convention itself.

No. 3

It is unfair to the men who are sent to attend a convention to even imply that such a trip partakes of the nature of a vacation. True, it brings a change of work, which might ordinarily be considered as more or less refreshing; but in reality it places under such a strain the man who takes seriously his responsibilities in representing his department at the convention that any restful effects resulting from changed surroundings are more than overcome by the concentration required, the long and irregular hours imposed, and the unnatural mental and physical stimulation incident to these conditions. A man's attendance at a convention must be regarded as seriously as any other trip of investigation on behalf of his railroad, if the man is to feel the sense of responsibility that is necessary to the fullest realization of the benefits of the convention.

In this connection, a word in behalf of the railroad supply companies is not out of place. Only such railroads as have themselves gone through the experience of preparing an exhibit for their own purposes are in a position to intelligently appreciate the effort and expense involved in preparing suitable exhibit material, and bringing together the corps of experts necessary to adequately describe and demonstrate the material exhibited. In return for the convenience afforded by this gathering together of men and material, the exhibitors deserve systematic and serious consideration of their exhibits. Only by such earnest of appreciation are they warranted in making their present efforts to be of service in this way.

The March conventions in Chicago afford the best present example of the combination of serious work done by railroad associations, serious preparation of exhibits of pertinent railway supplies, and serious attention given by the railroad men to the appliances of the supply men. The sentiment in favor of this attitude toward all technical conventions is reaching gratifying proportions. It is within the power of every man who takes the trip to Chicago this year to add to the value and importance of the convention idea by adopting the proper attitude toward his work at the convention.



What-Some Railroad Necessities Cost

The New York Central has recently prepared some interesting data relating to its own lines and service which will apply in a general way to many other systems. The practically stationary rates, both passenger and freight, and the steady increase in the cost of operation are the basis for the preparation of these interesting figures.

In the past ten years the New York Central has expended \$400,000,000 for new stations; electrification; the separation of grade at highway crossings; safety devices of all kinds; rock ballasting; heavier bridges; heavier locomotives; coaches and equipment of various sorts, and all this in the interest of the public good. Wages of train employes alone have advanced 45 per cent in the last decade. Supplies of all kinds have steadily increased in prices in the same time. In the matter of equipment alone there have been some tremendous increases. Steam locomotives formerly costing on the average \$17,300 each, are now to be had at \$25,000, while electric locomotives have gone up in price from \$30,000 to \$50,000. Seven years ago steel passenger coaches could be purchased for \$12,000 each. Today \$16,000 is the standard figure, and within three years the price of a steel baggage car has advanced from \$8,000 to \$8,800-an increase of 10 per cent. Additional heavier equipment has forced the company to rebuild its roadbed; construct more substantial bridges and culverts and lay heavier steel rails, while the consumption of fuel has greatly increased on account of the larger engines in service.

Eight years ago steel rails cost \$29.30 per ton. In 1914 the price was advanced to \$30.02 and today it would be impossible to secure them at this figure. The standard weight of rails, of a few years ago-85 lbs, to the yard-has been abandoned, so that now requirements call for a 105-lb. pattern, or, as in many instances for a 140-lb., in order to safely handle the increased weight of equipment. By the M feet, ties cost \$21.64 in 1910. Today the price for the same class of material is \$24.64 per M feet. The vast quantities of stone ballast required, formerly purchased at 60 cents per yard, now cost 65 cents. The cry for "safety first" and efficiency has resulted, too, in enormous expenditures in the way of improved signal systems. What are classed as "current improvements" have increased \$4,000,000 since 1910. Not including the vast outlay in the Grand Central terminal, these current improvements aggregate \$39,000,000 for the past five years. Electrification work beginning in 1903 has involved an outlay of \$24,000,000. These are all most interesting facts, not to mention an increase in taxes of more than \$1,250,000 since 1910.

It is no wonder that a desire for better rates is encouraged on the part of this and other great railroad systems. The New York Central refers to the present rates as "ancient" and most of them truly are. All outgo and no income is much harder on a railroad than overwork on the boy who does not remember that "all work and no play makes Jack a dull boy."

Extra Professional Duties of an Engineer

As a general definition of the word engineer it has been said that he is a man who has helped to bring about many wonderful developments in utilizing the forces of Nature and by so doing he has increased the efficiency of each worker many fold. It might be added that he has added to the material comfort of millions and has given to life a wider and more satisfying outlook. It has been said that an engineer is a "dreamer whose dreams come true."

In presenting a paper to the A. S. M. E. not long ago, Mr. F. H. Newall drew the generally accepted and conventional picture of the engineer when he described him as one who, to the ordinary public, appears as a man seated in his office, perhaps removed from interruption, absorbed in abstruse calculations, and unaware of the changes going on outside in other lines of endeavor. If this is true, as no doubt it is, in part at least, the engineer fails to receive the recognition from the public to which he is justly entitled. He is a conscientious worker and usually possesses a great deal of modesty, so much so that he does not concern himself with the task of enlightening the public. He may regard that as the legitimate work of others, but by not telling his own story a lack of recognition is his meed.

The engineer, unlike men in other professions, has to deal with elemental physical conditions. His success does not depend on convincing an audience, nor on directing or even leading the thoughts of his fellow men, whose opinion and belief are transitory. The engineer's work must be judged by higher and more rigidly exacting standards, for he deals with the forces of nature, which do not lie and cannot be deceived; he may not flatter, and he would browbeat them but in vain.

It has been said that the work of an engineer should speak for itself, but much of his best work is not visible, and even if it is conspicuous, it is often unobserved and seldom understood. Foundations of stupendous and imposing structures are buried deep. Tunnels, water works, sewers, processes, methods and appliances and many of the essentials of life produced by the engineer are out of sight. The information concerning these things may be read in the technical press or in the transactions of professional societies and clubs, but the man in the street does not read these accounts. Mr. Newell further charges that much that appears in the periodic press of the professions is highly technical. and is often only within the mental grasp of a few experts. Many of the technical papers read at society meetings are not presented so as to be readily taken in by the practical railway man, on whom rests the bulk of the actual performance of railway work.

It is true that to the technically educated man it is easier to write so as to reach the trained and well-informed few, but the necessity for simplication exists if the profession is to do all that is expected of it. Years ago Huxley, who was a trained and expert biologist, took up the cause of organic evolution as set forth by Darwin, and brought the subject to the level of the ordinary intelligence, so that in the end his devotees practically embraced all who could read or think. Indeed, so completely was the difficult task of reaching so vast an audience accomplished that at the twenty-first anniversary of Darwin's book Huxley said that the theory of evolution had been so widely and completely accepted that a little healthy opposition would do it good.

Mr. Newell very rightly advocates the formation of local societies of engineers, and the vigorous prosecution of the work supposed to be done by them. In the railway world we have special societies, associations and clubs each of which publish proceedings, and the technical press of the country is doing much good work in spreading abroad the information gathered by experts in the various engineering lines.

It is not, however, only the presentation of ascertained facts, good as they are, that is all important. Facts pure and simple are like the tempting viands on the table, their enjoyment is another thing, but their assimilation produces the results upon which growth depend. The exchange of ideas, and the comments of an experimenter or worker, on the experience of another is one of the most potent factors in the progress of railroad men. Meetings such as are to be held in Chicago this month, with the exhibition of railroad appliances and the demonstration of their utility, must occupy a high place in the estimation of the railroad man as a means of acquainting himself with the most recent progress which has been made in the science of transportation, in which he is vitally interested and with the success of which he himself is intimately concerned. He does not have to study behind closed doors, but may mingle with his fellows and in the open; see, observe and make the labors and the industry of others his own. ____**L**__

Bridge Floors and Guard Rails

A very great source of danger to the floor of a bridge, and indeed to the whole structure itself, is that which may arise at any time by the derailment of a pair of wheels or a truck, on the bridge or before an approaching train reaches a bridge It is possible for a derailed truck under a car to be hauled safely across the whole length of a bridge, in spite of the very well-known tendency of the truck to become slewed. This, however, is not a chance one who has the care of the bridge would care to take.

A common form of protection is the placing of a couple of wooden stringers parallel to the rails and between them. Each stringer is placed a few inches from the gauge side of the rails, and is bolted through the bridge ties at short intervals. These longitudinal stringers are generally notched or gained so as to fit down over each bridge tie. This prevents what is called the "bunching" of ties in case a wheel became wedged between ties without a guard, and pushed the first tie and those in front of it, along, leaving a gaping hole behind and perhaps causing the pushed ties to mount on one another. Sometimes this guard stringer is shod on the wheel side with an angle-iron to protect the wood of the stringer. The wooden stringer is open to the objection that it weathers like all exposed pieces of timber, and in time splits or develops cracks.

A more effective protection against a derailed truck is afforded by a rail of lighter weight than the track rail and placed approximately where the wooden stringer is usually placed. This inside guard rail has been found to be effective in dealing with wheels which are off the track. It is usual to carry this pair of guard rails a suitable distance off the bridge, in the direction of train approach and to join their ends in a curved angle, something in outline like a long high gothic church door. The point can be made from an old frog, and the point is often depressed, and indeed it is desirable to do this, so as not to present a raised obstruction in case a brake rod, sand plank or other piece of the running gear had fallen and was dragging.

The distance to which the "shore" end of the guard rail should be carried depends on circumstances. The probable approach speed of the trains, the presence or absence of a curve at the approach, an ascending or descending grade, etc., are matters which have to be decided on the ground for each particular bridge. The pointed guard rails when properly placed are spiked to the track ties and to the bridge floor ties, and with smooth and unobstructed joints, are capable of guiding derailed wheels across a bridge with minimum damage to the bridge floor.

The guard rails perhaps do their best work when track rail and guard rail are each spiked to the same tie-plate on each tie. This necessitates the use of a long tieplate, but the advantages secured are worth the cost. The standard gauge of track is 4 ft. 8½ ins. Rule No. 83 of the Master Car Builders' Code of Interchange Rules prescribes a distance of 4 ft. 5 3-32 ins. between the backs of car wheel flanges. That is, anything less than this, on wheels cast after 1908 are considered to be out of gauge. If the guard rails were placed 10 ins. or less if possible from the track rail, with a tie-plate under track and guard rail, and if the tie-plate measured, say, 25 ins. long, the derailed wheel between track and guard rails would roll over the tie-plates or probably run along the flange of the guard rail, with back of wheel against ball of guard rail, and have no tendency to slew.

The other wheel which had dropped down outside the track rail would be carried over each tie on the outside end of the long tie-plate, without any tendency to cut into the wood of the track ties. The size of the tieplate to be used, and the weight of the guard rail per yard, and the position of the tie-plate, that is how far it was advisable to extend it outside the track rail, would all have to be decided by the engineer in charge, but this method of bridge protection against the effects of derailed wheels has in it the elements of at least one satisfactory solution of the problem, though its details would have to be adapted to the special conditions imposed on the engineer in charge.

The Largest Cantilever Bridge in the World

C. P. R. & N. T. R. Bridge Over St. Lawrence River, Piers 1,800 Feet Apart, Central Span 640 Feet Long. Weight of Bridge Approximately 65,000 Tons

The Canadian Government railway bridge near the city of Quebec, in Canada, when completed may be said to be the largest cantilever bridge in the world. The piers are 1,800 ft. apart and the suspended span is 640 ft. long. The bridge is expected to be in operation before the close of the present year. The work of spanning the St. Lawrence river at Quebec was begun about eight years ago and was a Government undertaking. It was conceived under the administration of the Liberal Cabinet, of which the Rt. Hon. Sir Wilfred Laurier was Premier. The first Government guarantee was for cantilever. These high members can be built out from the piers member by member on one side and then on the other, so as to keep the weight of the growing span properly balanced on the supporting pier. No scaffolding or false work is necessary where this method is followed and the navigation of the stream is not obstructed.

In many positions this system is the simplest and most economical method of bridging, and is often used for spans of greater length than where independent girders are used. The shore ends of the long cantilever



View of St. Lawrence River, Showing Work Done by End of 1915. North to the Left.

\$6,000,000. This amount was then estimated to be sufficient.

During the construction of the bridge thus begun, the structure gave way, entailing the loss of life of about ninety persons. The present bridge will cost \$17,000,000 and will be the greatest example of the cantilever principle ever applied to any bridge. This form of bridge involves the construction of two long spans with piers under their centres and not at the ends, as in other types of bridges. A central or connecting span is hung between the free ends of each spans are anchored down to piers or abutments, as the case may be, but the object of thus securing them is principally for the purpose of sustaining the weight of the rolling load when it comes upon the outer end of the cantilevers and where a suspended or connecting truss hangs to the free ends of each cantilever, the anchored shore ends will support the weight of the central span.

In the Quebec bridge the distance covered by two cantilever spans and the connecting span is 1,800 ft. These figures at once call to the mind the stupendous





Ten Bridge Members Concentrated on the Shoe, the Reaction on Shoe Being About 55,000,000 lbs.

structure erected over the Frith of Forth by Sir Benjamin Baker. The Forth bridge has one tower on the island of Inchgarvie and it is 260 ft. wide. The distance between adjacent faces of the supporting piers is 1,710 ft., and this distance is exceeded in the Quebec bridge by 90 ft. The Canadian structure is being financed by the government and the C. P. R. will of course have running rights over it and also the government road, the National Transcontinental Railway. So closely do the anchor or shore end and the free end balance each other on the pier that there is only about 1,000 tons difference between them, the free end weighing about 24,000,000 lbs. and the shore end 26,000,000 lbs.

Here follows an account of the progress of erection of Quebec bridge up to and during season of 1915, by H. P. Borden, the assistant to the chief engineer of the bridge: When work on the Quebec bridge closed down in 1914, the north anchor arm was completed out to the main pier with the exception of two panels of the upper web members and top chord. On the south side no steel at all had been erected between the main and anchor piers.

About the middle of April, 1915, a start was again made on the erection of the steel on the north shore, and on May 3 of the same year the erection of the main posts was begun. These posts rest on the main shoes over the main pier and are the largest single members in the bridge, being 310 ft. high centre to centre of pins, and approximately 10 ft. square. As the four posts required for the bridge weigh approximately 6,000 tons, costing in the neighborhood of one

million dollars, or considerably more than the entire cost of many important bridges, some idea of the magnitude of these members may be obtained. Each of these members is composed of four separate columns latticed together in four directions, terminated by a tapered solid section at both top and bottom. In order to facilitate shipment and handling, each of these members was shipped in twenty-six separate sections and spliced together in the field. It was expected that serious difficulty might be encountered in the erection of these sections as they had to be put in place with splice plates attached to the ends and lowered with extreme precision to allow the webs and flanges of the adjoining section to be entered between the various plates and angles forming the splice. The efficiency of the electrically controlled hoists on the erection traveler, however, was such that this work was carried out with remarkable rapidity, both posts on the north side being erected and riveted sufficiently to allow the traveler to be moved ahead within one month from the time a start was made. Enough riveting was done on these members to take care of all erection stresses before any further steel was erected or the traveler moved ahead. This riveting was considered highly advisable rather than filling the holes with bolts and drift pins and riveting later as the work progressed, as it was found from past experience that once a strain was applied to a drifted joint it was absolutely impossible to remove these drifts except by drilling. The cramped space in the interior of these members also made riveting somewhat difficult, but with the use of specially designed jam riveters, which could work in a space

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View Showing Anchor and Cantilever Arms at North End



Progress of South Anchor Arm. Traveler Finishing South Main Post

March, 1916



down to 14 in., very satisfactory work was obtained. While in some cases the heads of inside rivets were not perfect, yet, in all cases, tight rivets were obtained.

When the erection of the main post had proceeded to the desired stage, the traveler was moved ahead and the erection of the first panel of the cantilever arm was started. As the bottom chords have a field splice between main panel points, it was necessary to devise drillings getting in between the web plates of the member. When the splice was taken apart, care was taken to clean out all drillings that might be found to exist between any parts of the splice material.

By the middle of November, 1915, the cantilever arm was completely erected, being quite up to the programme laid out by the bridge company at the beginning of the season. The work of the traveler having



Map Showing Position of Quebec Bridge Over the St. Lawrence River

some support for these members for riveting this splice before it could be connected to the main panel point. This was accomplished by means of a "flying bridge" or heavy steel platform extending for one full panel length and for the width of the bridge. On this "flying bridge," which was supported by links to the structure above, the bottom chords were assembled and jacked up into their proper alignment, and the centre splices fully riveted up. As each panel was completed the "flying bridge" was moved forward to the next panel. This work went ahead very rapidly, as all field splices and connections had previously been reamed out in place at the shop, thus avoiding any shop errors or the necessity of making any alterations or changes in the field. As each panel was erected, accurate measurements were taken to see that the alignment was correct. Owing to the extreme accuracy with which this work was manufactured and inspected in the shop, no difficulty of this nature was encountered, the alignment of both the anchor and cantilever arms throughout their entire length being absolutely correct.

Members on both sides of the bridge were erected simultaneously by the traveling cranes and stiff-leg booms, and as the traveler moved ahead the sway bracing was put in position by the rear booms. Practically all splices in web members were riveted up complete before moving ahead, or at least sufficiently riveted, to carry the full erection stress.

Remarkably good records were made in riveting, the percentage of rivets to be cut out being very low. In one case over 4,000 rivets were driven in the splices of the bottom chords, and only one loose rivet was found by the inspectors. This extraordinary record was due, naturally, to the experienced riveters employed on the work, but also to the fact that in reaming out the splices in the shop from 25 to 50 per cent of bolts were used in bolting up the splice material, thus preventing been completed on this side of the river, it is now being taken down and will be re-erected at the site where the suspended span will be erected this year.

On the south shore the erection of the falsework to support the anchor arm was started about the middle of last April, this falsework being taken from the north



Workmen Riveting Members at Bottom Chord

shore where it had been used to support the north anchor arm. The erection of the anchor arm started on July 7, 1915, and, owing to the experience gained on the north side, it was erected much more rapidly, a gain of over six weeks being made in the completion of this work. By the middle of November, 1915, the entire anchor arm had been erected, including the main posts, with the exception of a certain amount of riveting, which will be completed this year.

During the past season about 30,000 tons of steel



March, 1916

were erected. In all about 45,000 tons have been erected out of the 65,000 tons, the estimated total weight of the bridge.

The record day's tonnage in 1915 was 670 tons for the south shore traveler, although there were several days in which over 600 tons were erected by this traveler. An average of 350 tons per day was made in the erection of the south main post.

Next season the south cantilever arm will be erected, and it is expected that this work will be finished early in September, 1916. The suspended span will also be erected at Sillery Cove, a point some three miles below the bridge site. When completed it will be floated to the site on six pontoons 160 ft. long and 32 ft. wide, each having a working draft of 8 ft. This span, which is 640 ft. long, 110 ft. high at the centre, 88 ft. wide, and weighing about 5,000 tons, will then be attached to



Flying Bridge Being Shifted

long hangers from the ends of the cantilever arms and jacked into place by means of heavy jacks placed on the erection girders at each corner of the cantilever arm. This operation should not take over twenty-four hours if everything works smoothly.

By the end of 1916 practically all the steel work of this bridge should be in place, and it will be possible for working trains to cross the river at this point.

The work is under the supervision of the board of engineers, Quebec Bridge, composed of Mr. C. N. Monsarrat, chairman and chief engineer, and Mr. Ralph Modjeski of Chicago. Mr. C. C. Schneider, a former member, is now deceased.

It may be mentioned that Mr. Monsarrat designed and constructed the Lethbridge viaduct, which is believed to be the longest and highest bridge in the world. It is on the line of the Canadian Pacific Railway.

The contract is being carried out by the St. Lawrence Bridge Co., Ltd., of which Mr. George F. Porter is engineer of construction; Mr. W. B. Fortune, superintendent, and Mr. S. P. Mitchell, consulting engineer of erection.

The New German Railway Station at Leipzig

Railway Terminal of Sand Stone with Huge Iron Roof Nearly Half of Which is Skylight

U. S. Consul W. P. Kent, at Leipzig, has lately reported to the Board of Commerce at Washington that the large railway station was completed and put in service on December 1, 1915.

The total cost of the construction of the Leipzig station was \$32,130,000. In meeting this expense, the amounts to be contributed are: By the Kingdom of Saxony, \$14,280,000; by the Kingdom of Prussia, \$12,614,-000; by the city of Leipzig, \$4,046,000; by the Imperial Postal Department, \$1,190,000.

The main building, erected upon a symmetrical basis, has a front of 984.25 ft., and each one of the side wings measures 295 ft. The area covered by this main building is 167.918 sq. ft. The passenger platforms behind the main building are covered by an iron roofing of a length of 784.4 ft., and of a surface of 710,424 sq. ft. Of this roof surface, 301,392 sq. ft. are built as skylights. Above the passenger platforms are erected, side by side, six big arched trainways of a length of 787.4 ft. each.

The two outside halls have a breadth of 139.44 ft. each, while the four inside halls have, each, one of 147.64 ft. Each outside hall adjoins a smaller one of a breadth of 49.21 ft. Each of the first six halls is 65.62 ft. high, while the two smaller outside halls are only 32.8 ft. high. The total area covered by the main building and the passenger platform halls is 882,648 sq. ft.

The material used for the front of the building is a yellow-colored, hard sandstone from the quarries of Schona on the Elbe. The rear, and the walls of the big entrance halls, are built of sandstone of the Cotta quarries. The roofing is of tiles. The building was started in May, 1909. The cost, including that for the foundation work, amounted to \$1,694,600.

As a connection between the main building and the passenger platforms, a cross hall has been established along the rear front, having a breadth of 114 ft. This cross hall again is adjoining toward the passenger platform by a cross platform of a breadth of 78.7 ft., thus enabling the passengers to pass from one platform to another without being hindered by the entering or outgoing of other travelers.

From the square in front of the building two big entrance halls, 85.3 ft. high and covering each a floor space of 18,083 sq. ft., lead over staircases 33 ft. in breadth to the cross hall above the street level.

Cement and Concrete Specifications for Chile

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A recent Commerce Report says that a set of standards and specifications for the cement and reinforced concrete used in Chile has been received by the Bureau of Foreign and Domestic Commerce. The standards for cement were compiled by a committee of technical experts and scientific men, who stipulated that the first requisite for the acceptance of any cement by the Government should be a certificate of approval from the testing laboratory at the University of Chile. Besides being subjected to chemical analysis at this laboratory, the cement is tested for weight, fineness and holding and resisting qualities. The specifications for concrete represent the application of scientific principles in the determination of dimensions of walls, beams, floors, etc. The complete set of specifications (in Spanish) will be loaned upon request at the Bureau or its district offices. Refer to file No. 1088.

New Stations on the Lackawanna and New York Central By REGINALD GORDON

Steel and Concrete Used Together with Brick in Station Construction. Facilities for Railroad and Conveniences for Public Important Factors

The Delaware, Lackawanna & Western Railroad completed a few months ago a station at South Orange, N. J., 15 miles, and has another under construction at Madison, N. J., 27 miles, from New York. Both of these stations comprise part of an improvement begun several years ago on the Morris and Essex division of this road, and at both places the grade of the tracks was raised in order to eliminate a number of street crossings. At South Orange the grade was raised 12 ft., the entire change in this respect being carried out over a distance of three-quarters of a mile, doing away with five important street crossings at grade. The design of the new station is in simple style combined with solidity. The tracks are carried over the street crossings on reinforced concrete arches. The building is constructed of dark tapestry brick with a roof of greenish tile. The railings and balustrades at the edges of the platforms are also of reinforced concrete of a simple yet pleasing design. One detail, small in itself, yet which adds greatly to the appearance of the finished station at all times of the day or night, is the design of the lighting fixtures that are placed on posts at intervals along the balustrade. Each standard is painted black and carries a glass lantern of soft amber color, thus avoiding any bright spots of light, and still being in harmony with the tawny caution light of the signal service. The fixtures are sufficiently numerous and so spaced that ample illumination and a good quality of light is se-

At Madison, a station of unusual design is now under construction, Gothic in detail and of the later form of that style, is executed in granite of pinkish gray color. This improvement, in addition to the rise of grade for the purpose of elevating the tracks above the street level, has altered the position of the freight yard and entailed a change of grade as well as of location of the line for more than a mile. As this division of the Lackawanna is a very old one, built more than sixty years ago, the grades and curvature put severe limitations on the train loads. The design of this structure is entirely different from that of other new stations on the road, the modified Gothic being quite unusual for most railroad buildings. The roof of gray and dull red slate color makes a pleasing contrast with the stone of the main building as well as with the concrete of the posts and arches of the platform shelters. A large porte-cochere on the main facade of the building will afford convenient access in bad weather and also serve to neutralize the somewhat eccesiastical effect of the architectural treatment of the structure. Facing the main entrance a corridor leads directly to wide stairways which give access to both the east and west bound train platforms, the station being placed on the east bound track, since most of the traffic consists of commuters doing business in New York and Newark. The diagram of this building, which we show, illustrates the general arrangement of waiting, baggage and toilet



Beacon Station with Shelters on Island Platforms. New York Central Lines

cured. Although that part of the building fronting the street is 125 ft. long by only 23 ft. deep, it is continued transversely under the tracks 77 ft., thus providing large space for waiting rooms, ticket office, toilet rooms, telephone booths and express office, all on the street level floor. The platforms are extended to a considerable distance east and west of the shelters shown in the illustration, and have stairways leading directly into the station, as well as at the farther ends to the street. rooms, etc. Another illustration shows the stage of construction in the early part of February of this year.

In connection with the general improvement work and four-tracking begun on the Hudson division of the New York Central more than four years ago, the two stations, views of which are reproduced, have been recently completed. At Beacon, 58 miles from the Grand Central station, there stood an old station, built of wood, which had long since become obsolete. In



Architects' Drawing of Madison Station on the Delaware, Lackawanna & Western

planning a new station, a site for it was selected that would secure better alignment for the road. The former main tracks were on a short tangent at the station, and reverse curves both north and south of it made a re-



South Orange Station. D., L. & W.

location necessary. In laying out the plan for four tracks, the engineers, in order to do away with these

curves, made a new location which involved filling in several hundred feet outside the old river bank for a



Rhinecliff Station. New York Central Lines

distance of three-quarters of a mile, also extending a large sewer and moving the ferry slip for the Newburgh-Beacon ferry out into the river more than 300 ft. farther, where a new waiting room and new slips were

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Plan of General Arrangement, Madison Station. Delaware, Lackawanna & Western

constructed. The highway was raised to a new grade. This public road had a street railway track running down the steep hill from the town, east of the railroad right-of-way and crossing the railway by an overhead bridge, to reach the waiting rooms of the station and the ferry. The new station has been built on a site west of the right-of-way. Subways give access to the train platforms for passengers, and baggage elevators at con-



Shelter Brackets at Madison Station. D., L. & W.

venient points are provided. The main waiting room is 47 ft. 10 ins. square, of ample size for the community using it, totaling nearly 40,000 persons, as a large number of passengers to and from Newburgh pass through this station. The building is of granite on the lower courses, while dark tapestry brick is used for the main structure. The roof is of tile, harmonizing well with the surroundings.

At Rhinecliff, 88 miles from New York, in addition to the necessity of furnishing a more commodious and



Platform Shelter, South Orange. D., L. & W.

ornamental station, it was important to make a more convenient approach from the village street, and to do away with a dangerous crossing formerly necessary to reach the south bound track and Rondout ferry. The new station has been located north of the old, and the main waiting rooms, ticket offices, etc., on the east side of the right-of-way, and an overhead bridge and driveway for reaching the southbound track and water front, has been provided. The limitations of the site at this point made it necessary to make the stairways from the overhead bridge to the platform unusually steep.

The stations shown in other illustrations are only a few of the new structures that these two roads have built within the last few years. Thus the Lackawanna finished one at Mountain Station, one in Orange, N. J. (illustrated), as well as at Chatham, Convent, Morristown and Morris Plains; while the New York Central structures at Utica and Rochester, N. Y., have attracted the attention of many travelers.

It is a world we need be careful how we libel, Heaven forgive us, for it is a world of sacred mysteries, and its Creator only knows what lies beneath the surface of His lightest image.—The Battle of Life.

- H-

Housing Competition and Public Exhibition

Announcement of Plans for Bringieg Together Best Thoughts on Subject of Housing Labor

Prizes aggregating \$2,100 are offered for plans, sketches, grouping and arrangement, for the housing of immigrants in industrial towns. The competition is conducted under the auspices of the National Americanization Committee, with the co-operation of the various societies and institutes of architects and engineers. The contest closes May 1. The prizes are divided into two groups.

The first group covers plans for the housing of workmen in industrial communities not exceeding a population of 35,000. Entries in this class include plans for (1) single family houses; (2) combined family and lodging houses, which will permit separation of the family from the lodgers; and (3) boarding houses or community dwellings for numbers of single men or of single women. The first prize for this class is \$1,000, the second \$500, the third, fourth and fifth \$100 each. In the first group the committee has in mind a new community produced by a new industry, with the consequent need of supplying dwellings for a large number of employes. A considerable proportion of these employes will be needed permanently; the rest, as the construction gangs, from two to five years only. In the statement of the conditions of the contest, which is being issued to competitors, it is pointed out that these two important considerations are the welfare of the tenant and the cost. The wages of the employes for whom the houses are designed are to be from \$2 a day to \$20 a week.

In the second group a first prize of \$200 and a second of \$100 is offered for a satisfactory substitute for the unused and side-tracked freight cars now used to nouse construction gangs on railways. In announcing the competition the committee calls attention to the fact that new communities clustered around new industries are being produced in this country with phenomenal rapidity. It is the small industrial town at present, not the large city, in which the "congestion" problem of the country is centered. Men flock by thousands to places where there are plenty of jobs-but no dwellings. In one New England town families are being "evicted," not because they cannot pay rent, but because they cannot get houses for the rent they can pay. A large percentage of these workmen are immigrants who have no way of creating American standards of living for themselves. If such standards are not provided for them, and insisted upon, groups of immigrant workmen are bound to follow various Southern European standards of living and customs, vitally affecting social health and prosperity. The community that results from these conditions cannot be truly American.

The aim of the contest is therefore to arouse interest in the subject, and to produce carefully worked out and entirely practicable housing plans and standards which it will be possible for employers and workmen and communities alike to demand and insist upon. In order that the result of the competition may be made immediately available, and may be drawn to the attention of those persons most interested or concerned, the competition will be followed by public exhibits not only of the results of the competition but also of any plans now in existence, or in process of execution, which architects, engineers, employers or corporations may care to submit. Inquiries concerning the competition may be addressed to the National Americanization Committee, 20 W. 34th St., New York.

Letters to the Editor

General Suggestions for Track Men

Editor Railway Engineering and Maintenance of Way.

Sir—First line your track, then surface it; then alternately line and surface it until it is true. In lining track, the outside rail of a curve ought to be selected as the "line" rail. On the tangent following this curve keep the same rail as the "line" rail. If the following curve is in the same direction as the previous one, the same rail should still continue to be the "line" rail. If the following curve is in the opposite direction to the previous one, continue the "line" rail for only about two rail lengths from the beginning of the curve; then transfer the lining to the outside rail of the curve and continue using this rail as the "line" rail until the curve is again reversed.

Follow closely the rules laid down by your company, as to allowance for expansion at the joints; noting this expansion under varying traffic, climate, temperature and other conditions, for the information of the engineer in charge.

After spiking the "line" rail, be careful to use the track gauge systematically between the heads of the rails, in spiking the "gauge" rail. Gauging between the bases of the rails in a track may produce unfortunate results, owing to varying heights of rails and widths of bases.

Unless you have standards laid out by your division engineer, widen the gauge on curves 1/16 of an inch for each degree of curvature by steps of $\frac{1}{8}$ of an inch. The foreman should watch all gauging carefully; proper provision for varying widths of gauge being made in his track tools. The gauge would then be as follows:

From	tangen	t to 2	degs.,	4 ft.	81⁄2	ins.
From	2 degs	. to 4	degs.,	4 ft.	85⁄8	ins.
From	4 degs	. to 6	degs.,	4 ft.	8¾	ins.
From	6 degs	. to 8	degs.,	4 ft.	81⁄8	ins.
From	8 degs	. to 1	0 degs.	. 4 ft	. 9	ins.

If you do not widen the gauge on curves the traffic will do so, by the grinding of the wheel flanges on the rail, to the detriment of both. To measure the degree of curvature, stretch 44 ft. of a tape line or cord, with three knots on it, 22 ft. apart, on the inside of the curved rail. The distance of the rail from the middle of the cord in half inches gives the degree of curvature.

If your company has no specific standard for superelevation of outer rail on curves the following may be adopted as representing good practice: For track within the outer switch points in yards and terminals, no super-elevation; gauge widening is more important here. For road track on which speeds correspond to ordinary freight train running; $\frac{1}{2}$ in. per deg. For high speed passenger track; 1 in. per deg.

In the matter of tie-plates, it may be said that the tendency is toward increasing their use. With treated ties the necessity becomes more apparent, as it is desirable to protect the wood in some way from the wear of the rail, because other things being equal, the treated tie has a longer prospective life than the untreated tie has. Tie-plates were originally made with the idea of being anchored to the tie. One of the first objections to the tie-plate was that if it became loose it not only did not protect the tie but actually facilitated the cutting and breaking of the fibers of the wood.

As a result of this idea, we have a great variety of

tie-plate designs with spines, prongs, flanges or steps, which are intended to bed into the tie and make tie and tie-plate practically one piece upon which the rail may move, if any movement does take place, but which will not affect the intimate connection of tieplate and tie.

On our leading roads some general instructions regarding the application of tie-plates have been issued for the guidance of trackmen.

One road recommends that tie-plates be used on all ties in high speed tracks on curves of two degs. radius, or over; on all ties in track subjected to heavy service; on all switch-ties, and ties on turntables, ash-pits, bridges and trestles; at water stations and at tracktroughs, and through all road crossings and station platforms. Tie-plates should be used on all soft wood ties and on all ties that have been treated. Tie-plates should be applied according to standard plans and care taken that the shoulder will have full bearing against base of the rail.

Another road prescribes that in laying tie-plates before ties are placed in the track, the "line" side of the tie be marked and the plates put on, the other plate being then put on in its proper position by gauging it from the line plate. Tie-plates on new ties should be driven home with a proper appliance. If put on after rails are laid, the tie should be carefully adzed the full length of the plate, all spike holes plugged, the rail lifted, the plate slipped in and be settled into the tie with some proper appliance.

Sellew points out in his writing on the subject that the various designs of tie-plates on the market indicate a difference of opinion among engineers as to the form that is most effective. Besides the variation in the form of the plate there is some difference of opinion concerning dimensions for a given weight of rail.

The thickness of plates varies usually between $\frac{3}{8}$ and $\frac{7}{8}$ ins. and the width between 5 and 8 ins., the length between 8 and 11 ins. These dimensions include flat and flanged plates. Some plates are made the same thickness throughout, others are heavier at the shoulder than at the ends, but as a general thing it is evident that in many designs there is no need for a continuation of the same thickness throughout the length of the plate.

This brings us to a contemplation of European practice which is to incline the rail. Some of our leading roads are experimenting with a tie-plate so made as to tilt the head of the rail inward in order to approximate to the coning of the standard wheel tread. One evidence of the sentiment favorable to these experiments is the practice, prevalent to some extent, of inclining the rails on curves where the wear on the rails has been found to be very heavy.

There have been two ways of securing the inclination desired by some engineers. Ties may be adzed, but this method is open to the objection that the mechanical wear of the base of the rail or the tie-plate on the tie soon alters the angle of inclination. The other method involves the use of a special tie-plate, which will give the desired inclination without adzing the tie at an angle, and without the tendency to wear down the tie, which results from adzing at an angle. Where such work is being carried out on American railroads some few general instructions on the subject may be found to be of service.

In passing from the upright to the inclined rail, or



vice versa, the transition can be made within the elastic limit of the rail, in about a quarter of a rail length, by lightly adzing about four ties and dapping in the plates. In replacing flat tie-plates by inclined plates under intermittent traffic, the following method of operation should appeal to the track man.

Have a supply of wedge shims ready for temporary adjustment of the track. Pull the spikes on such a stretch of track as can rapidly be made safe without delaying train movement. Remove all obstructions on this stretch of track. Clean the tie under the rail, by slight adzing or otherwise. Fill all spike holes with soft wood plugs, not too tight fitting. Slip in the special plates from the outside of the rail. Spike the "line" rail on the inside first; bringing the shoulder of the plate against the base of the rail. Using the track gauge carefully, tap the shoulder of the plate under the gauge rail against the outside of the base of the rail; then spike the inside first. Hold passable flat plates for use in replacement of incidental worn flat plates elsewhere, if they seem desirable. Tap your spikes down from time to time, as the plates seat themselves under traffic.

TRACKMAN.

How to Maintain Track

Editor, Railway Engineering and Maintenance of Way:

Sir—Railway track is designed and built for the purpose of carrying the traveling public and freight over it in the form of moving trains. A railway track receives its attention, according to the allowance made for its maintenance. There is, therefore, opportunity for the display of executive, of skill and judgment in distributing work to advantage for a railway company. Owing to the fact that the poorer the track in relation to the traffic, the greater the expense for maintenance and renewals, more money has to be spent.

The writer has seen on quite a number of sections where he has been employed as section foreman, and especially when assistant foreman in construction gangs, that in hundreds of cases money has been spent over and over again by some section foreman on the same stretch of track and no improvement could be seen after the work had been done; it amounted to merely patchwork.

Good track, in normal conditions, requires skill, judgment and executive ability. There is a growing recognition of the fact that no foreman can maintain track up to normal, unless the following things are to be had: First, good gangs. Second, good surface. Third, good alignment. If one of the three items is absent, trouble begins.

A method of keeping good track remains a secret to many track foremen. A foreman in charge of work is merely an instrument, if he fail to use his full powers rightly, if he has all the good intentions of the world, he is liable to fall short in the discharge of his duty. We have all reached the conclusion that success of a mechanic rests upon his judgment, therefore, he should be educated. How can anyone become a successful mechanic without it? It has been proved that the promotion anyone receives rests in large measure on his education.

We must admit that a good many of our railways have favored a more enlightened policy. It is the necessity for the general improvement of a section foreman so that he may be able to maintain the track in proper relation to the increasing traffic which heavy loads impose upon it. Financial conditions often compel rail-

ways to conduct their maintenance with very limited means, yet the track must be made to carry the traffic, and this being so, the track foreman must make every minute count.

Allow me space to mention that nothing looks any better than a neat line. When I was employed as assistant foreman in construction gangs I always figured true alignment of track to be an important economy of maintenance, for the easy and safe running of trains. Too much time and labor cannot be spent for true alignment. Money spent for true alignment is well spent and will be repaid many times over in lessened repairs. I have realized on some sections a thorough and complete realignment was necessary. I have never seen a successful track liner unless he was 400 to 450 ft. behind his lineman. Anyone doing track work will agree that the opportunity to learn the true worth of the business only comes to a man who has worked in a construction gang.

I would be glad to see letters appear in print from other brother track foremen. I think Railway Engineering and Maintenance of Way will be of permanent service to railways and to their employes.

HENRY KOCH,

Foreman, Sec. 31, E. P. & S. W.

Las Tanas, N. M.

Operation of Section Motor Cars

Editor, Railway Engineering and Maintenance of Way:

Sir:—In regard to this subject I would like to say that I have made a careful study of this part of our maintenance of way. For the benefit of those who have not had the experience with section motor cars, I would like to say that we have used motor cars on thirty sections of our road for the past five years with the best results. We are using the No. 26 and No. 32 styles of the Fairbanks-Morse cars. These cars are better adapted to our work on account of their speed and weight. Our sections are 12 miles long and we have one foreman and six laborers to each section.

Recently the price of gasoline advanced to the point to where it was almost prohibitive; in fact, it increased the cost of motor car operation to the point where it was almost necessary to go back to the lever car. To meet this emergency it was necessary to reduce the cost in a very short time and to reduce the cost to as low a point as possible.

After experimenting for 10 days with different mixtures of gasoline oil and kerosene, I found that we got the best results from a mixture of half gasoline, half kerosene with one-quarter pint gas engine oil to each gallon of the above mixture. I made the test on three sections where foremen had taken an interest in this and where the conditions were not so favorable as on other sections. I have a heavy inspection car of the 32 type of Fairbanks-Morse cars, and I also made several tests on this car. The results with the new mixture proved even more satisfactory than the old mixtures of gasoline and oil. Instructions have been issued from the general manager's office to all foremen to put this new mixture in practice and with instructions as to manner of handling to avoid waste.

I would like to state further that we had up to the time we commenced to use the new mixture all kinds of engine and spark plug trouble. Piston rings would become imbedded in carbon, which caused a great loss of power as well as heat in the engines. This took place to such an extent that cars would not pull over the heaviest grade until the engines were cooled down.



Spark plugs were always giving trouble on account of getting so dirty that they would become short circuited.

All this trouble has stopped and every day I hear section foremen say that they are getting to and from their work without any trouble whatever, as the new mixture affords better lubrication. No change of adjustment of carburetor is necessary, as it only takes the usual amount of fuels, but in some cases less, where a change of adjustment has been made, it has invariably been to increase the air and reduce the gas.

If this appeals to those who use the motor cars for section use, I will be glad to give them a comparative report showing the exact saving, which is in excess of 40 per cent. L. W. TURNER,

Roadmaster, G. & F. Ry.

Vidalia, Ga.

Dynamo-Electric Machinery_for, Railroads By REGINALDIGORDON

4

Generating and Transforming Units Described and their Operation Explained

The art of designing electric generating machinery has advanced so rapidly and so far that units of 30,000 kilowatts, equivalent to 40,000 horse power, are becoming common in railway generating stations. The term "generating unit" is applied to any combination of steam engine, or steam turbine, or water wheel that drives a dynamo; prime mover and generator commonly being set on the same base, or foundation. Generators in railway power houses are usually built to furnish alternating current, abbreviated to the letters A. C. Sometimes direct current, abbreviated, D. C., machines are used, but chiefly for shop motors and lights, or for street and interurban railways where the energy is not transmitted more than a few miles. In railway substations, a type of machine called a rotary converter is installed, which runs as a motor driven by A. C. power, and at the same time generates D. C. power which is fed into the third rail or trolley wire.

Generally speaking, generators may be classed either as self-excited or separately-excited. The diagrams used here show this distinction for machines having only two poles in the field, but the principle can be extended to include any number of poles. Alternating current generators supplying power to railways are almost always separately excited. The exciting generator or "exciter" as it is called, is sometimes beltdriven from a pulley on the shaft of the main generator, or mounted directly on that shaft. Its output is D. C. energy that goes through the coils of the field magnets of the large machine, and is regulated in amount according to the demand for power from the latter. All

D. C. generators must have a commutator, or device for collecting all the positive currents in the armature circuits, and connecting them with the positive terminal; and collecting all the negative currents, and connecting them with the negative terminal of the machine, whence they are distributed by the leads or bus-bars to the switchboard. This commutator is made up of a large number of segments or narrow pieces of copper, each insulated from those next it by narrow strips of mica, bakelite or other approved insulation. This fact limits the voltage or electro-motive force that can be generated in one D. C. dynamo; so, when power must be transmitted at high voltages, it is almost always done with alternating, and not with direct current. If D. C. power must be obtained for lomotives or for shop motors from a distant power plant, the A. C. current must be transformed to D. C., at points where it is to be used or locally distributed.

For electric locomotives or motor cars either direct or alternating curent may be used. It has never yet been definitely settled by electrical engineers which is the better system for railway work under all conditions of distance, grades, speed, train load, density of traffic, etc. The two systems are being used about equally. The Pennsylvania Railroad has both, employing 600 volt D. C. locomotives for its New York terminal electric service, and 11,000-volt A. C. for the motor coaches used on the Philadelphia-Paoli electrification described in the January, 1916, issue of Railway Engineering and Maintenance of Way. Both systems are alike in óne respect. They both generate alternating current energy in the power houses and transmit it at high tension to various points on the electrified division. On the roads using D. C. this alternating current must be transformed to direct, and thence transmitted to the third rail or overhead conductor. On the other hand. roads equipped for A. C. operation with the energy transmitted from the power station may be fed directly into the conductor from which locomotives and cars draw their supply.

Where power must be transmitted long distances, A. C. energy must be supplied, not only because the amount of power that can be distributed through a wire circuit increases almost in proportion to the rise in voltage at the source, but also because, as before mentioned, it is not practicable to build D. C. generators so well insulated as to stand the strain of high tension between adjoining commutator bars and armature circuits. For these reasons the common practice is to install steam turbine-driven A. C. generators, transmit the 13,200volt A. C. energy to sub-stations located 12 to 20 miles apart along the road, and at each sub-station convert A. C. power into low tension D. C. power at 650 volts.

Where A. C. energy is to be transmitted at a voltage higher than that for which it is practicable to design a generator, the output of the latter is raised by a transformer to the desired value, and lowered at the sub-station in a similar manner.

A transformer (called also a static transformer, because it is stationary and does not move, nor has it



Diagram of Typical Power House, Transmission Line, and Sub-station

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any moving parts) is an electro-magnetic device for alternating current, consisting of an iron core, or frame, on which is wound two circuits. One of these consists of a few turns of thick wire, and the other of a large number of turns of fine wire wound close together, but insulated from each other; the thick wire being connected to the generator and the fine wire to the line. Every alternation of current through the winding connected to the generator induces a current in that connected to the line; but the voltage in the line coil, or secondary, is higher than that in the primary, in proportion as the number of turns of the fine wire is greater than that of the thick wire.

Thus a dynamo giving alternating current at 13,200 volts is conected to a transformer that "steps up" the voltage to 44,000 volts, at which pressure it is transmitted along the railroad to a sub-station where another transformer is situated, by which the pressure is "stepped down" to 11,000 volts. At this voltage it is fed into the overhead conductor for use with A. C. locomotives and motor cars. If these, on the other hand, are designed for D. C. power, the transformer at the receiving station must be supplemented by a rotary converter, referred to in the first part of this article. Rotary converters usually have an armature, or rotor, having two entirely separate systems of circuits, one of which connects with collector rings on the A. C. side and the other with a commutator and brushes, from which direct current power is taken off for the third rail or overhead wire.

According to local governing conditions, some roads use one system and some the other. Thus the New



Self-Excited Direct Current Generator

York Central and Pennsylvania distribute A. C. energy from the power stations at 13,200 volts and convert it at sub-stations to 650 volts D. C. The New Haven distributes A. C. at 22,000 volts, and by the use of special transformers supplies it at 11,000 volts to the locomotives.

The Chicago, Milwaukee & St. Paul receives A. C. energy at 100,000 volts at the sub-stations, which then distributes it as D. C. current at 3,000 volts to the overhead wire. It must be remembered that in every transformer of energy, say from 13,000 volts to 44,000, or from 2,200 to 110, no energy is created or brought into being. It is simply changed in voltage, or transformed from one voltage to another, but the energy before or after the change remains the same. A current of 200 amperes at 13,000 volts, if transformed up to 52,000 volts, is correspondingly diminished in quantity to 50



Separately-Excited Direct Current Generator

amperes, or less. This latter quantity, however, can be distributed by a smaller wire than the former in the ratio of 1 to 4. This smaller wire is the secret of success of high-tension A. C. transmission.

Railways in Colombia, South America

Following the article in our February issue by Mr. Rosales on the Colombian railways, it may be of interest to observe that consul Isaac A. Manning at Barranguilla has recently reported to the Department of Commerce at Washington what the Colombian government is doing in regard to the construction of the railway from Cucuta to the Magdalena river. An amendment to the law of 1912 which provided for the building of this line stipulates that the government shall now contract therefor; receiving bids for the work within 120 days of publication of the call in Colombia and abroad. The invitation for such bids shall include the specifications and conditions of construction in accord with the surveys made by the commission established for the purpose. The Colombian government has been authorized to secure a loan for the needed funds. As soon as the loan has been arranged the contract will be awarded and the necessary bonds will be issued. This will doubtless be of moment to such of our own countrymen as are interested either in railroad supplies or in the construction of railroads.

In Belgium there are 48 miles of railroad for every 100 square miles of land. Railroad mileage is densest in that country, Saxony coming next with 34 miles to every 100 miles of land. All Germany has but 19 miles, so calculated, while Great Britain barely exceeds that, having 19 3/10 miles. The United States, as a whole, can boast of but 7 miles to every 100 square miles of land; but New Jersey has $30\frac{3}{4}$ miles; Massachusetts more than 25 miles; Pennsylvania about $25\frac{3}{4}$ miles; Ohio $22\frac{1}{2}$ miles and Illinois about $21\frac{1}{2}$ miles. Taking the United States as a whole, considering the population, we have 26 miles of railroad for every 10,000 inhabitants and Europe, as a whole, has but 5 miles for every 10,000 inhabitants.

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Highway Crossing Elimination on the D. & H. and the C. & A.

Examples of Structures used for Raising and Depressing Tracks in Efforts to Prevent Crossing Accidents

Some one has well said that it is harder to change human nature than it is to abolish grade crossings, and this statement was based on results obtained by one of the large railway systems of the country, after a thorough investigation by its representatives of what the people are in the habit of doing when they come to a railway crossing at grade. The actions of more than 17,000 drivers of motor vehicles were observed, practically 12,000 of whom, or more than 69 per cent, looked neither to the right nor left before crossing the rails. Less than 3 per cent of the whole number looked one way only, and about 28 per cent looked both ways; 3,300, or about 19 per cent, crossed at a reckless speed, and only 35 of the total number came to a full stop before going on. More than 4,800 drivers of horses were included in the investigation, and 39 per cent of them looked in neither direction on approaching the crossings,

under-grade construction, costing on the average \$57,-283.54, which was divided as follows: Delaware & Hudson, \$27,108.29; individuals and other companies, \$30,-175.25. The average cost for installing crossing gates has been \$700.00; the expense of flagmen has averaged \$600.00 each per annum, and the cost for installing signal bells and other devices has averaged \$500.00 each.

Personal injury claims paid on account of grade crossing accidents have amounted in each of the past five years to:

1911	• • • • • • • • • • • • • • • • • • • •	\$34,749.00
1912	•••••	20,394.32
1913	•••••	55,787.95
1914		12,259.92
1915	•••••	21,610.85

The total amounting to \$144,802.04



Highway Overcrossing D. & H. near Bainbridge, N. Y.

while 8 per cent looked one way only and 52 per cent looked both ways. We can readily see, then, that carelessness of the public is the underlying cause of accidents at the standard menace known as the grade crossing. The good work of elimination and furnishing other means of protection is still meeting with careful consideration.

The Delaware & Hudson Company has on its system 566 crossings which are unprotected at present, and 290 protected. Of the protected crossings, 37 are treated by the elevation of tracks, 78 by depression, 107 by gates, 93 by flagmen, and 90 by signals or crossing bells. In the past five years six grade crossings have been eliminated, which is most creditable. One of these six was an overhead crossing installed at a cost of \$15,238.06, the Delaware & Hudson assuming \$7,851.22 of this amount and the balance being divided between various individuals and companies. The other five were of

In the state of New York the law governing the elimination of grade crossings requires the railway to meet 50 per cent of the total expense, while the state and the municipality interested share equally in the balance. It would seem from a careful consideration of the whole matter that an equitable adjustment of such expenditures would result should the total amount be equally divided among all parties in interest. The situation as to crossings varies on the different railways, depending upon circumstances—such as the density of population, frequency of traffic, and the public demands. On the Detroit, Toledo & Ironton, a representative line of the class where circumstances are not what might be called insistent, there are no grade crossings in process of elimination at present, nor have any such crossings been eliminated in the past five years. This line today is burdened with 259 crossings at grade, of which 19 are protected and 240 unprotected. Gates are in service at



Overhead Crossing, D. & H., at Greenwich Junction, N. Y.



Inner Grade Crossing, D. & H.

7 of the so-called protected crossings. At 9 of them flagmen are in regular service, and 3 are provided with suitable alarm bells.

The cost for installing gate protection has averaged \$475, to which is added a 10 per cent depreciation charge per annum. Gatemen and flagmen receive each \$30 per month, and the average cost for installing alarm bells has been \$300. As there have been no expenditures to separate the rails and the highway, the Detroit, Toledo & Ironton has had no occasion to come within the law which provides for a 50 per cent charge against the



Overcrossing, D. & H., at Rupert, Vt.



California Avenue Overhead on the Chicago & Alton in Chicago



carrier, the balance to be adjusted equally between the state and the municipality interested.

Shifting the scene of operations from the Central West, there is one of the large Eastern systems, of more than years has been \$28,000, not including a heavy expenditure of more than \$1,500,000 in one of the busy, thriving towns on the line. As there is no definite data covering the work of depressing tracks the figures given



Albany Avenue Crossing on the Chicago & Alton, Chicago

2,000 miles, which has to contend with a total of 1,947 highway crossings, 813 of which are protected and 1,134 not protected. In addition, there are 450 overhead structures and 332 cases treated by a depression of tracks. Elimination is still in vogue, and much work in this direction is being accomplished. Of the protected represent the cost of elevation only. To erect gates has, on the average, cost \$800 and to man them \$740 each annually. At crossings protected by flagmen only the annual expense is also \$740 each. Crossing bells come in at \$545 for the installation with an annual maintenance charge of \$100 for each bell. The aver-



An Excellent Example of an Overhead Crossing on the Chicago & Alton, at Chicago

crossings at grade, 355 are provided with gates and 293 are made as safe as circumstances will permit by flagmen, while 165 are furnished with bells or so-called automatic flagmen and bells. In the matter of eliminating grade crossings the average cost the past five age cost of installing automatic flagmen is \$600 each, with a maintenance charge of \$100 annually.

In the past five years seven grade crossings have been eliminated each year on the average.

The amounts paid for personal injuries at highway

crossings in the five calendar years ending with 1914 are as follows:

1910	•••••	\$41,995.17
1911	•••••	69,859.33
1912		27,394.04
1913		54,970.29
1914	• • • • • • • • • • • • • • • • • • • •	89.964.76

Even with more protection it would seem that the personal injury question is not an easy one to solve, pre-



Under Crossing, Castleton, Vt. D. & H.

sumably because at crossings which are protected either by gates or flagmen automobile drivers, particularly, exercise no care as a rule, and as the use of these machines becomes more common the danger of accidents increases. Until grade crossings are still further eliminated it will not be possible to secure data which will be reliable for comparisons between the cost of installing absolute protection and the saving thereby and the results arising from grade crossings, protected by gates or otherwise. The three examples of superb reinforced concrete construction on the Chicago and Alton which appear in this article show what substantial protection is afforded in the city of Chicago.

Mechanical Elimination of Seams in Steel Rails

Increased weight of rolling stock and speed of traffic have led to increase in size of rail sections, requiring changes in the methods of rail manufacture. It is not surprising that new and unexpected physical weaknesses should develop in the heavier rails. One of the chief troubles has been failures through crescentshaped pieces breaking out of the rail flanges, followed by at least one, and in many cases several, ruptures across the whole section of the rail. This statement was made by Mr. Robert W. Hunt a short time ago when speaking to the members of the A.S.M.E. Investigation shows that in practically each case of rail failure there was a more or less pronounced seam running longitudinally in the bottom of the rail near its center. This seam was at the top of the curve of the crescent-shaped break and is undoubtedly the point at which the fracture starts.

As a result of an investigation, Mr. T. H. Mathias, assistant general superintendent of the Lackawanna Steel Co., determined that the most certain way of getting rid of seams was to remove that portion of the metal which contained them. He believed the primary causes of seams existed in the ingots and were caused in the casting of the ingots. The surfaces of ingots display disk-like apertures, due to entrapped air, which in rolling can easily become elongated into a dangerous

seam. It was clear that the surfaces of the ingots are decarburized to the extent of eight to ten points carbon and to a depth of 5/16 in.

The removal of the surface metal is effected by a hot sawing, or milling operation during the process of rolling. The ingot is reduced to a point where the product is 75 per cent finished, in the form of a partially shaped bar 60 ft. long, when it is entered between two pinch rolls with the flange side up and forced between two milling saws. A second set of rolls pulls on the bar and aids in holding it in line for the milling operation. The milling saws are 5 ft. in diameter with an 8-in. face and revolve at a peripheral speed of 2,500 ft. per min. Metal is removed from the top and bottom of the bar the main object being to eliminate the seams from the central portion of the bottom of the rail which has been the starting point of the moonshaped cracks, and from the top or bearing surface of the head of the rail. ·+-

Food for Careful Consideration

The supervisor of station service of the Baltimore & Ohio has recently made some startling estimates which are well worthy of more than ordinary attention. He has put into pamphlet form, for general distribution, data on the possibilities for economy in railroad service covering office administration, heating and lighting, car cleaning, maintenance, use of fuel, ice, brooms, mops, in fact every phase of effort connected with the science of transportation.

In discussing the use of material, supplies and facilities generally he goes on to say:

"If one incandescent electric light were left burning an hour unnecessarily at each of the 2,500 agencies on the Baltimore & Ohio, the loss of electric current would amount to 125,000 watts, or sufficient electricity to supply the average home with illumination for 18 months," He also points out that the economies within the possibility of the employes of an average railroad system, if rigidly adhered to during a year would result in a saving equal to the purchase price of 1,548 homes, 8,601 steel gondola cars or 225 passenger locomotives of largest design.

This is food for consideration by railroad employes as well as general officers who have the interests of the great railroad companies which they serve at heart. The pamphlet should have a wide circulation and thereby produce wonderful results.

International Engineering Congress, 1915

The Committee of Management, International Engineering Congress, 1915, announces that the volume on mechanical engineering is ready for distribution and the members who have subscribed for this volume will soon receive it. The other volumes will be issued as rapidly as possible. Owing to the large amount of material to be reprinted and the thousands of copies to be bound, the work cannot be carried on with greater speed. However, it is hoped that within two months the entire set will be completed.

Members who did not send in their final selections may be disappointed in not securing all the volumes they might have had in mind, and at this date the committee has decided to close the lists for certain volumes which have been sent to the press. It may be possible to supply members who would apply at this late hour with copies of volumes which have not gone to press. This notice is signed by W. A. Cattell, secretary, 425 Foxcroft building, San Francisco, Cal.



The Principles of Railway Signaling

Description of the Elements of Automatic Block Signal System, Showing Types of Semaphore Signals Used

The purpose of Mr. Harold McCreedy in addressing the Richmond Railroad Club was not to discuss the technical details of signaling, as that subject would occupy very many books. It was his intention, he said, to deal with general principles, and to describe, briefly, appliances which are standard in America.

The slogan in the signal world, as in other branches of railroad work, is, "Safety First." Signals would not be useful if their indications could not be relied on. In the designing of signal apparatus, the element of safety is the primary one which the designer takes into consideration and keeps as a guide all the time. If any part of the apparatus fails or if any part of it breaks, provision is made so that the signal arm assumes the stop position automatically. All the electric circuits



Example of Automatic Block Signals on the Southern Pacific

are designed so as to fail on the side of safety. This may cause delay, but not disaster.

Signaling may be divided into two great branches. The first is the interlocking branch, which deals with the control of train movements at terminals and crossings. The second branch concerns block signaling. The American Railway Association has some definitions for block signal work which are of interest and are here stated.

"A block is a length of track of defined limits, the use of which by trains is controlled by fixed signals.

"A block signal is a fixed signal controlling the use of a block. The word 'fixed' refers to location only."

Block signals may be classified in three ways: 1st. As to manner in which their day indications are displayed. 2nd. As to the manner in which they are controlled and operated. 3rd. As to what they control. Under the first classification there are: (a) Banner signals, the indications being displayed by a revolving banner. (b) Disc signals, the indications being displayed by a movable disc in front of a fixed background. (c) Semaphore signals, the indications being displayed by the position of an arm moving in a plane at right angles to the track. In all types under class No. 1 the night indications are given by colored lights.

Under the second classification there are: (a) Manual, the signal being controlled and operated by man power. (b) Controlled manual, the signal being operated manually and constructed so as to require the cooperation of the signalman at both ends of the block. (c) Automatic, the signal being operated by power which is controlled entirely by the presence or absence of a train in the block, or the conditions of the track.

Under the third classification there are: (a) Home block signal, a fixed signal at the entrance of a block to control trains in entering and using the block. The indications displayed by a home signal are "stop" and "proceed," or in some cases "stop," "caution" and "proceed." (b) Distant block signal, a fixed signal used in connection with a home block signal to regulate the approach thereto. An absolute block system is one which never allows more than one train in the same block at the same time. A permissive block system is one which may allow more than one train in the same block at the same time, provided the trains are moving in the same direction and the second train has been warned by signal that another train is in the block.

In the home and distant block system, the home signal, situated at the entrance of the block, controls trains entering the block; the home block signal is placed at the top of the signal mast. This home semaphore is a two-position signal, one in which the signal blade has but two positions.

In the last two years, however, the three-position signal has come into general use. Normally, with a train in the block directly ahead, the semaphore arm stands out horizontally; with the block directly ahead clear but the second block ahead occupied, the arm occupies the 45 deg. position up in the air; with two blocks directly ahead unoccupied, the signal occupies the straight upward or vertical position.

A clear home signal as used in the home and distant system, indicates that the block directly ahead is clear or unoccupied. However, the use of a home signal alone would not be sufficient for the rapid operation of trains, for the enginemen would always have to be prepared to stop right at the signal if there were a train in the block ahead. A second signal is provided; the distant signal, at the entrance of the first block back, to give the enginemen an indication as to the condition of the home signal next ahead so that he can be ready to stop, if necessary, when he gets to that home signal; and in the meantime, he can keep on going.

In the three-position system, there is but one arm on each signal mast. The arm is always in one of three positions. At horizontal it indicates that the block directly ahead is occupied; when the signal arm is in the 45-deg. position, it means that the first block ahead is clear but the second block ahead is occupied, and that, therefore, the enginemen must proceed under control so as to be able to stop at the next signal ahead. When the arm is straight up, parallel with the mast, or in other words, when it is vertical, it indicates that two blocks ahead are clear. During the last two or three years, the Pennsylvania Railroad has adopted a system for giving the enginemen information with regard to three blocks ahead. This involves a signal with two arms. The upper arm operates in three positions and the lower arm operates in two positions.

Speaking generally the block system is a system whose primary object is the facilitation of train movements, to enable one to put on a given stretch of track the maximum number of trains and keep the trains moving, and still prevent them from getting too close to each other. The block idea involves the division of the track into sections of a certain length. If the traffic is very dense, it is necessary to make the blocks very short so that the trains can be brought closer together. On the other hand, if the traffic is not so dense as to require very close spacing of trains, the blocks may be made longer. On the Southern Pacific some blocks are two miles long, that is over ten thousand feet. On certain interurban electric roads there are blocks five miles long. On the other hand, there are blocks 600 ft. long. In the New York Subway, for example, the average length of block is 800 ft., the trains running with a minute and a half headway; this is as close as the trains can be spaced with the present braking equipment. The length of blocks is. therefore, governed solely by the number of trains to be run in a given time.



Example of Three-Position Signal on One Mast

There are two kinds of block signaling. The first is the manual system, where, at block towers placed at intervals along the line, the signals, which are of the mechanical type, are moved by hand by the towerman.

This man receives word by telegraph or telephone from the towerman in the block stations on either side of him, so that before a train passes a tower the towerman communicates with the man ahead in the next tower, to see whether the block between them is clear. If the block is clear, the train enters, the towerman places his signal to danger and thus the train is protected. That



Example of Signals Protecting the Hackensack Bridge

is why the manual system is sometimes called the telegraph block. There is also the controlled manual system, employing what is known as the track circuit. In this scheme, whenever a train enters the block, it throws the signal automatically to stop; moreover, the towerman cannot pull his signal to the proceed position, unless the block is actually unoccupied.

The most important branch in this field, however, is that of automatic block signaling, where the signals are absolutely independent of manual control and are power operated, generally by electric motors. This motor may be operated from a set of batteries, or it may be fed from an alternating current power transmission line strung along the right-of-way. The power for running the motor is carried over the contacts of a relay, which contacts are not closed to permit power to pass to clear the signal until the block directly ahead is unoccupied. When a train enters the block, it causes the relay to open its contact and this throws the signal to stop, by gravity. It is impossible for the signal to be clear when a train is in the block. The track relay control is the keystone of the whole system of automatic block signaling.

Automatic block signaling is considered by some, who have not carefully investigated the matter, as too costly to warrant its installation, but those who have had experience with it know that it will soon pay for itself, not necessarily from the standpoint of safety alone, though, of course, the saving of one wreck may pay for two or three block systems, but principally because it enables the operating department to get the maximum carrying capacity for trains out of the track with safety and facility. The installation of an automatic



block signal system will often so increase the train capacity of a stretch of track as to render unnecessary the installation of another track.

The power for operating automatic block signaling systems, as has been said, may be obtained either from batteries located directly at the signals, or from a power transmission system running along the right-ofway. The battery system has been in vogue until about the last five years; these batteries, consisting of sixteen cells at each signal, require a good deal of attention in that the signal maintainer must examine the batteries periodically, clean them out and renew their contents. In this system, batteries are also provided for the operation of the track circuit which controls the track relay and these batteries have to be constantly attended to. The electric current fed to the track circuits is direct current, and with trolley roads in the vicinity, current leaking from the trolley return rails may interfere with the track relay controlling the steam railroad's signals. The signal may, therefore, stand in the proceed position falsely.

For these reasons, there has been an increasing use of the alternating current in signaling systems, and it is considered standard for all important installations. It has the advantage that it is entirely free from battery and foreign current troubles. Hence, aside from the increased safety, the actual expense for maintaining an alternating current system is less than in the case of the direct current system. There are cases where one man takes care of from 30 to 50 miles of alternating current automatic signals and two or three small interlocking plants in addition. The alternating current system has come into general use, because it is safer than the direct current system, and because it is cheaper to maintain.

One of the most recent developments in the signaling field is the use of light signals for day as well as for night indication. There are certain signal engineers who believe that the next ten years will see the general adoption of light signals in place of semaphore signals.

The light signal consists of a sheet iron or cast iron case carried on a pole and having two or three colored lenses illuminated by incandescent lamps behind them. When, for example, the red lens is illuminated, it indicates that the block immediately ahead is occupied. When the yellow lens is illuminated, it indicates that the first block in advance is clear, but that the second block in advance is occupied. When the green lens is illuminated, it indicates that both blocks ahead are clear. Such a light signal corresponds exactly to a three-position semaphore.

There is another system of light signaling in which a steel background, fastened on a signal mast, acts as a background for three rows of electric lights. One row projects horizontally, another in a line 45 degs. from the horizontal, and the third vertically, all radiating from a common point. By means of a three-contact track relay, such as is used in the ordinary semaphore block system, the horizontal row of lights may be illuminated to indicate stop, the 45-deg. row may be illuminated to indicate caution, and, when the vertical row is illuminated, it indicates that two blocks ahead are clear, and that the enginemen may go ahead at full speed.

In all light signals, the indication is given by day and by night with lights alone. Light signals have the obvious advantage that there are no moving parts or complicated mechanisms involved. They consist merely of a cast iron or sheet iron case with lenses, and back of those lenses are electric lights. There are no motors, and no moving parts to wear out. In certain locations, light signals actually have an advantage over semaphore signals, as in the case of electric roads where there is a network of overhead wires; in such cases, semaphore indications may not be entirely satisfactory, because the view of the semaphore blade may be obstructed by this overhead work. On the other hand, the light signal shows up well. In general the feeling in this country to-day is that the light signal has very distinct advantages, but it remains to be seen whether it will meet all conditions.

Finally, as to automatic stops. A great deal of work has been done and a great deal has been written, and more has been said, about automatic stops. An automatic stop is a device to automatically stop an engine, both by shutting off steam from the throttle and by applying the brakes, in case the engineman, for any reason, tries to run past a danger signal. Many impracticable schemes have been suggested for automatic stops, but no fully satisfactory one for all the varying conditions on steam railroads has yet been found. The patent office is full of plans for automatic stops. Nearly everybody who thinks of an idea plans to patent it. Most of these patents are not worth very mucn.

These things make it appear to Mr. Harold McCready (the author of the paper from which this short resume is taken) that when it comes to the spending of money on stop signals, the wiser course appears to him to be to expend it on some already known and tried system, on the ground that there are thousands of miles of railroad track which are not now protected in any way.

The Difficult Maintenance of Beach Track By JOE RODMAN Conditions Met in Maintaining Track on

Sand and Methods Used Successfully

In addition to the various ills to which track under normal conditions is subject, the trackman in charge of beach track has to deal with shifting sand, high tides, and the rapid deterioration of steel and fixtures from the erosive action of fogs, damp salt-air, and the salt-impregnated beach-sand that cannot be prevented from drifting over, and covering the base of the rail, the spikes and the tie-plates.

When the sand is in a dry state, a wind of not more than 6 miles an hour velocity is sufficient to set it in motion, though so slowly and gradually that a small force of laborers may easily prevent it drifting over the ball of the rail. During the spring and autumn months the worst winds prevail, and the sand being dryer, drifts much more rapidly than at other times. During the heavier and more protracted wind-storms each train is accompanied by a gang of shovelers who ride on the front end ready to remove the drifts if they interfere.

The most troublesome drifts are those that form between the higher dunes, especially when there is one on each side of the track about in line with the course of the wind. Not only does the first obstruction break the current of the wind and cause the floating sand to swirl and eddy into spits over the nearer track or rail but the air in the intervening space being static, the drift forms over the entire quiescent area between the two dunes covering both rails, or both tracks, equally.

The dunes themselves are continually varying in size, form and position. A salt weed springs from a stray seed in the flat, and the sand piles around it as it grows. As the growing weed branches out and gains in height, the sand dune increases in diameter and height until often a small mound is formed, which, if near enough, persistently encroaches on the track. However, as a measure of compensation, the wind will at times most unaccountably attack a dune that has long withstood its forces and, seeming to concentrate a spiteful en-



A "Tumble" Weed Starting a Drift

ergy on it alone, will steadily remove its drying surface until not a vestige remains on the spot.

Of the several lines laid in the sand wastes of the Southern California coast, the Pacific Electric has by far the most difficulty with the shifting sand owing to its greater mileage along the beach, its proximity to the ocean, and its more frequent service. Often, during the more severe storms, its otherwise good service has been interrupted for several days at a time, the trains being able to make not more than five miles an hour through the drifting sand. In shoveling the trains through, the sand is cleared only to the ball of the rail; and frequently before the train can get up to the shovelers, the rail becomes again covered enough to "ground" the motor, after which it is necessary to make a contact by holding a shovel or other metal tool between the rail and one wheel until a stretch of naked rail is reached.

Various schemes for plowing the sand were tried but without success until V. B. Radcliff, a roadmaster on this railway, perfected a simple plow of a bridge stringer and a pair of ballast shoes, which, like most simple and effective expedients, was tried only after more com-



Track Buried in Drifted Sand

plicated schemes had failed or were discarded because of their impracticability. The accompanying illustrations show the simplicity of the plow construction and the "before and after taking" conditions of the track.

Like an ice flanger, it is necessary to lift the plow over switches, catile guards, etc., and that necessitates a small gang of laborers to make the various adjustments; but compared to the former cost of removing sand from the track by hand after each storm, the small cost of the few laborers, motor and crew is inconsequential. It has been roughly estimated that the plow and motor accomplish more at a cost not exceeding twenty-five dollars than could be done by one hundred and fifty shovelers in a full working day.

The action of drifting sand resembles that of snow in that the fills are swept bare while the cuts are filled accordingly as their banks break the air currents. Various plans of obstruction after the manner of snow fences were tried but with little effect save to form new dunes extending nearer the track and causing the sand to fill the faster. Often, in the course of one sand storm, a "tumble weed" becoming lodged near the track will cause the formation of a new dune, as in the illustration showing the tip of a weed protruding from a newly-formed drift in the track.

Dirt, stone waste or a coating of crude oil placed on the shoulders of the fills will prevent undermining; but no remedy has so far been found for sand in the cuts save to fight it until the storm subsides. Raising the track has been proposed; but as the sand promptly rises to meet the level of any obstructioin, the increased elevation would afford only temporary relief.

Tide experts declare that a shell no larger than a pea



A Switch Cleaned After a Sand Storm

may change an ocean current. However that may be, it is none the less enigmatic to the beach trackman that the ocean will suddenly cease its attack on an almost vanquished embankment and transfer its forces to a place previously immune and consequently unprepared, but probably making some amends by refilling the weakened spot.

"The sea recedes; force triumphs over force;

Crumbles the shore; the waves their vict'ry chant." Like the poet, the trackman applies some very descriptive language to the same theme, and the same intensity of his feelings directs him to remand it to a place where, if popular belief be true, it would be enthusiastically welcomed.

Less than three years earlier the track shown in another illustration was fully two hundred feet from the actual beach, and the sand dunes, which at that time intervened, were in places fifteen feet higher than the track grade. Apparently about the same amount of sand washed from this spot was deposited about two miles farther along, making safe a previously weakened spot, that is, safe until a reverse change takes place.

After a great deal of inconvenience, expense and delay to traffic, the difficulty was solved by a section foreman who, before his installation on that section, had never so much as seen the ocean. Instead of following the usual method and placing orders for carloads of heavy stone, he, at a very small expense, graded



the readily available sand into a long, gentle slope inclining toward the breakers. After each high tide he would rebuild the toe of his slope, leaving no breast for the next tide to undermine; for, as he picturesquely expressed it, "How's she going to bite anything off when she can't do nothing but fall back on herself?"

After several months of high tides and ground swells mounting his slope, and falling gently backward, spent and harmless, his track is intact. So far, "she ain't bit anything off."

Gauging and re-spiking require a great deal of the beach trackmen's time. Pockets or slots, in places, an inch in width are rusted from the sand-covered base of the rail at the point of spike contact. At the same time, the spike is rusting away; and when the flanges thrust the rail it is gradually opened or pushed outward to a



The Sand Plow Bucking a Light Drift

new contact. It was probably under such circumstances that the traditional foreman wrote to his roadmaster for "a gauge that would fit the track"; for, certainly 4 ft. $8\frac{1}{2}$ in. seems entirely too narrow for long stretches of sand track.

Frequently a spike is withdrawn so rusted that when tapped with a maul or beaten over the rail it will scale away until a core of solid material not thicker than a telephone wire remains. The old-style ribbed tie-plates last barely three years, after which only a few thin strands, remaining where the ribs were formerly imbedded, are held in place by the rail.

To remove a track bolt after the first year of service, it is necessary to break it with a maul or cut the burr, which is so tightly "rust-welded" to the bolt that they





Front View and Plan of Sand Plow

are as one piece. In releasing old angle-bars, frequently they are bent into the shape of a horseshoe before they lose their grip on the rail.

Ties, on the contrary, seem to gain in length of life. Untreated redwood ties that have been covered in the sand for a dozen years or more, with remarkably few exceptions, seem to be as serviceable as when they were applied. What few tie renewals that have been necessary have been almost entirely due to the tie plate hav-

ing rusted away, allowing the rail flanges to cut into the tie and weaken it so that the end became broken off at the point of stress.

With the exception of the upper parts of the switch stands they are never oiled on the beach track because



Side View of Sand Plow

of the certainty of their gumming from the mixture of oil and sand. The slide plates and other fixtures are at intervals "scaled" with a chisel in much the same manner that rust is removed from the sides of a steel ship when docked for painting.

Besides actual shelter the only protection against rust for angle bars, continuous joints, tie plates and other extra material on hand is to paint it lightly with crude oil which, with the finer sand that adheres to it, forms a hard and stable film that will protect the metal for a year or more. All supplies of the same nature are also piled cup downward so that they retain as little moisture as possible from the frequent fogs, rains and blowing spray. Even with the precautions taken, often the plates or continuous joints must be heated slightly and beaten clear of rust before they can be made to fit the rail.

For heavy rail beach-sand is splendid ballast, as the stiffness of heavy steel prevents it from surface-bending while its resiliency is sufficient to insure its automat-



"So Far She Ain't Bit Anything Off"

ically tamping itself after each slight depression from traffic stress; and the sand packing but little below the ball of the rail tends to retain it in fair alignment. On steel sixty pounds to the rail and lighter, the general surface is not difficult to maintain, but the dry, powdery sand "pumping" beneath the joint-ties allows the lighter rail quickly to surface-bend from quarter to joints which, despite frequent raising, retain a bad surface from the downward thrust of the bent rails and angle bars; and, of course, where surface is irregular a good alignment cannot be maintained.

In short, any rail too heavy and rigid to bend under the traffic stress will retain good surface and line on beach sand while a rail light enough to surface-bend under the same conditions will thrust the rounded and uniform grains of sand outward and away from the synclinal in ratio to the angle of its dip. Naturally the surface-bent joints become steadily worse and impossible to surface by ordinary methods. How the diffi-

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culty was finally overcome is a subject worthy of treatment in a separate article.

With all the extra work essential to the maintenance of beach-track there are also reciprocating conditions. Save where an embryo sand-dune is beginning to form around the nucleus of a weed, there is no weed cutting;



High Tide Undermining Beach

the native sand-ballast being instantly permeable, no elaborate drainage precautions are required; and the dressings of track for either service or appearance is futile and, consequently, not considered necessary.

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Methods of Creosoting Douglas Fir Effect on Strength of Timbers of the Temperature and Pressure Used in Treating

In some experiments made by Mr. O. P. M. Goss, while in charge of the Seattle Timber Testing Laboratory it was found bridge stringers, treated by the boiling and steaming process, lost from 33 to 35 per cent of their original strength. In an endeavor to eliminate this result and yet retain the preservative features produced, a large number of experiments have been made, with this end in view. There are two general classes of structural timber. Those that must retain their full strength after treatment, and those where protection is of primary importance and strength is secondary.

Mr. Goss, who is connected with the Forest Service, has offered some observations on this question at a recent meeting of the American Wood Preservers' Association. He says in substance:

No difficulty has been experienced in handling the second class of material, that where strength is secondary. The trouble has been entirely with the first class. It has been possible to secure a good oil penetration by both the steaming and boiling processes. From experiments which have been made it has been shown that high temperatures and high pressures in these treatments are largely responsible for the loss in strength of the wood. The treatments used in the past have been applied, something as follows:

In the boiling process the timbers were placed in a retort in green condition, and boiled in creosote oil under atmospheric pressure for 22 to 24 hrs. at a temperature ranging from 230 to 260 degs. Fahr. This boiling period was used to season the timber and prepare it for receiving the oil. After the boiling period, pressure was applied, rising from zero to as high as 145 to 185 lbs. per sq. in. The pressure was continued over a period of 4 to 6 hrs., at a temperature of approximately 180 to 230 degs. Fahr. By this method, 10 to 14 lbs. of oil per cu. ft. were injected into the wood.

In the steaming process the timbers were placed in the retort in a thoroughly green condition and steamed at 90 lbs. pressure per sq. in. for 4 to 7 hrs., at a temperature of approximately 325 to 335 degs. Fahr. A vacuum of approximately 20 ins. was then applied for 18 to 20 hrs. while the temperature ranged above 220 degs. Fahr. At the end of the vacuum period creosote oil was introduced and pressure applied, rising from zero up to 160 lbs. per sq. in. This pressure period continued for 2 to 4 hrs., at a temperature of approximately 208 degs. Fahr. Ten to 14 lbs. of oil per cu. ft. of wood were usually injected into the timber by this process.

In both these processes high temperatures were applied. The temperature used in boiling was lower than that used in steaming, but was applied for a longer time.

In recent experiments both temperatures and pressures have been reduced and the vacuum made to take a more important part in the process. The most successful treatment yet devised for treating bridge stringers and similar forms without loss in strength is that of boiling in vacuum. When green timbers are creosoted by this method the treatment requires approximately 26 hrs.

When boiled in vacuo the timbers are placed in the retort and creosote oil introduced at a temperature of 160 to 180 degs. Fahr. Heat is applied, and the temperature of the oil gradually raised to 190 degs. Fahr. and held at that temperature for 5 to 6 hrs., which is a sufficient length of time to warm the timbers through.

When the timbers are thoroughly warmed, a vacuum of 24 to 27 ins. is produced on the oil, still holding a temperature of 190 degs. Fahr., this vacuum formed through an overhead pipe extending from the top of the retort for 36 ft. vertically into the air and returning to the condenser. The purpose of this pipe is to prevent the creosote oil from passing over into the condenser while boiling under vacuum. This vacuum begins at 16 to 18 ins. and as the timber seasons it is gradually raised to 24 to 27 ins. The full period for which the vacuum is applied is 12 to 16 hrs. It is continued until the rate of seasoning of the timber is 0.1 lb. of water per cu. ft. of wood per hour. After this finished rate of seasoning is reached, the vacuum is broken and pressure on the oil is started, which rises as high as 120 to 135 lbs. per sq. in. and continues over a period of 4 to 6 hrs. The temperature of the oil during the pressure period drops from 190 to 180 degs. Fahr. By this process 10 to 14 lbs. of oil per cu. ft. may be pressed into the wood.

This method of treatment is a modification of the Boulton process, and at the low temperatures used seasons the wood even better than the old boiling process which employed much higher temperatures. Timbers treated by the method are noticeably easier to press than timbers treated under the old boiling process. The edges of the checks which develop, due to seasoning, are very sharp, showing that the wood is not burned at all.

In order to carry the test still further, and to determine the effect of this treatment upon the strength of Douglas fir bridge stringers, two shipments of full sized stringers were selected, and treated in four different charges at the plant of the St. Helens Creosoting Co. These stringers were of three sizes, 7×14 ins. $\times 28$ ft., 7×16 ins. $\times 30$ ft. and 10×14 ins. $\times 28$ ft. They were carefully selected so that the two halves were of equal quality, cut in the center, and one-half creosoted and tested, and the other half tested in its natural green condition. The 7×14 in. and the 10×14 in. stringers



were tested on a 13-ft. span, and the 7×16 in. stringers were tested on a 14-ft. span.

All stringers were tested under one-third point loading. The strength tests were made on the treated material within approximately 10 days after date of treatment. The untreated stringers were tested in a green condition. All tests were made by the Bureau of Standards, Portland, Ore., in accordance with United States Forest Service standard methods, and a complete report rendered on the tests.

The 7 x 14 in. stringers, based on the modulus of rupture, showed the average strength of the timbers treated to be 101.2 per cent that of the natural. In three sets of these stringers the treated showed less than the natural, while in six tests the treated showed greater strength than the natural.

As regards the modulus of rupture, the fiber stresses at elastic limit, and the modulus of elasticity, the results of the experiments show that treated and natural stringers are very close together for these factors. The results as set down in this paper prove that Douglas fir bridge stringers can be effectively creosoted without injury to their strength, a fact which is particularly interesting to the railroads as well as consumers of structural timber.

The Psychology of the Crossing Road Aparatus Used at Highway Crossings by the C. & N. W., the Long Island, the Southern Pacific and Others

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Railroad companies have been menaced from their earliest days with the possibility of the road-crossing accident, and many ways have been tried in the effort to prevent injuries and loss of life. The most effective way has been to depress the highway or elevate the railroad track. Where this has not been feasible or has been too expensive, other means have been adopted; among these is the electric alarm bell and the roadcrossing watchman.

On the Chicago & Northwestern the watchman has



New York Central. Highway Crossing Lamp

been supplied with a round disc painted white with the word "Stop" in black upon it. The watchmen have been advanced to the rank of railroad policemen and are therefore empowered to make arrests. The Long Island Railroad uses striped gates, and banks of earth and clumps of trees which obscured the track have been leveled and cut down so that automobilists and others have no excuse for asserting that a concealed crossing was in their path.

The New York Central not only use the discs as stop



Crossing Watchman with Disc. N. Y. C.

signals for warning automobilists, but they are now trying a form of lamp for the same purpose at night. The whole matter with them, as with others, is in the experimental state, and they do not feel that they are committed to any particular form or color in the way of warning signals. The advantage of the watchman's disc over the usual flag is that it cannot be fluttered in the wind, and can never appear "on edge" to the driver of a vehicle, and is not likely to attract the eye of enginemen or emphasize to them the stop indication.

The lamp is a combination of an ordinary standard railroad lantern, which if broken or defective can be removed from the long case, which is intended to re-



N. Y. C. Automobile Signalled at Crossing

strict rather than concentrate the light. At present the N. Y. C. are using a red glass with the word "Stop" upon it, but the objection to red is that it might unintentionally be shown to an engineman, with the result that an unnecessary application of brakes might take place. This road in the person of its general safety agent, Mr. Marcus A. Dow, is making what might be called a working test in order to arrive at a trustworthy conclusion as to the most suitable devices and colors and the most effective methods for reducing the casualties at highway crossings. It is an honest endeavor, carried out intelligently and with care, having the almost paternal quality of endeavoring to protect a user of the highway against himself.

The Southern Pacific Company have with the personal supervision of Mr. W. R. Scott, vice-president and general manager at San Francisco, Cal., devised

and put in operation a distant signal for automobilists for use at highway crossings. The signal is placed some distance from the actual crossing and is designed to give anyone approaching advance information as



Front View

Side View

to whether or not the train is coming. The red light, which is inside the cylinder-like portion of the signal, is lit up when a train is within about 2,000 ft. of the crossing, and approaching automobilists would therefore not necessarily stop at the signal, but would have positive knowledge that a train was approaching and would, in the majority of instances, go on up to the crossing itself before stopping.

This railway has been endeavoring to accumulate



Southern Pacific Crossing Warning Device

definite information as to the benefits derived from the use of the signal, and while they are sure that it is a great help, yet are unable to furnish any statistical information as to the extent of such benefits for the reason that the actions of the automobilists and others passing the apparatus would depend largely on whether or not the individual is thoroughly familiar with the crossing. For instance: a stranger would, upon seeing the signal, probably slow up and take such heed of it as would be noticeable to an observer, while one familiar with the signal and its location would pass it with a glance, the one watching his behavior would be unable to determine whether it was even seen. The approximate cost of the apparatus is \$40. Other roads, as we said, use an electric alarm bell at crossings.

The signal here described is a good example of the painstaking and scientific effort to apply an adequate remedy to what is a serious menace to human life. The whole question is as yet in an indeterminate state and the railways are compelled to approach it with the heavy handicap that the law is of questionable assistance to them, and they are without means of applying any discipline to even wanton offenders, as they might, if there own employes were involved. It is said that the municipal law of Paris holds that in an automobile accident it is considered to be prima facie evidence of the carelessness on the part of the foot passenger, if he is hurt. This has very greatly reduced the number of such accidents in the streets of Paris. A person injured by an automobile when crossing the



S. P. Co. Highway Crossing Warning Signal

street cannot succeed in an action in court unless he is able to establish, beyond peradventure, that he was run down by the most flagrant and, one might almost say, malignant carelessness of a chauffeur. The law gives the road to the automobile and the sidewalk to the pedestrian, and while the right to cross is not denied to the walker, he must do so largely, if not wholly, at his own risk.

The root of the crossing evil, especially in this country, is psychological to a far greater extent than is generally recognized. The numerous epithets hurled at automobilists who try to cross railroad tracks are more or less wide of the mark. We are here confronted not by a theory, but by a condition. The railroad companies who are endeavoring to combat the evil have got to the point where they recognize the condition and are doing the best that can be done in approaching the subject, with what means they can command.

When the psychological aspect of the matter is considered, it must be remembered that this does not involve any of the comparatively meaningless speculations which were dependent on philosophical or theological modes of thought which had no relation to the ordinary affairs of daily life. The modern science no longer wanders in the labyrinth of speculation about the soul. Applied psychology will more and more be compelled to place its experiments and state its views to the expectant world of industry and commerce. The concrete case before us does not involve a knowledge,



however fragmentary, of Kent's categorical imperative or the postulates of experience. What everyone would like to know is why the simple knowledge of a railway track in front of a chauffuer does not operate to produce any evidence of caution on his part, and further, why with gates, signals, watchmen, the risk of accident is not only not eliminated, but only partly reduced.

No explanation that leaves out the psychology of the phenomenon can hope to reach a definite and final result. The words careless, reckless, speed-fiend, irresponsible motorist, and others of like import, do not either express what actually exists, but they tend to produce only an empty, though wordy, outburst between the parties. Help may be gained in throwing some light on the subject, if the efforts of the modern, practical theory of experimental and applied psychology are brought to bear upon the case. There is no abnormal action, and no accident in industrial life, whether on or off a railway, which is not within the scope of this newly developed science, and to ignore it is but to set back the hands of the clock.

The love of what we call reckless speed in the joy rider may have had a perfectly legitimate origin in the long-past days which saw the early genesis of the race. Bergson points out that in the very dawn of life the animal and plant divided on the necessity to move, and the ability to stand still and live. The development of movement went on in animal life until complete differentiation of the animal and vegetable kingdoms was complete. Mobility was gaining headway, when a serious halt occurred. The animal was compelled to resort to all kinds of heavy defensive armor to resist attack, of which the shells of molusks, the heavy, tough skin of the saurians, the carpace of the glyptodons and their allied species, and the hard, bony case of ganoid fishes are all examples of the method of defense which checked the mobility of the animal without destroying its slowly acting and eventually triumphant instinct and desire for rapid motion and the joy of speed. The primal instinct is thus revealed. Its fulfillment is today. The desire in some form persists.

In more modern times the influence of mental interference has been studied and throws a certain light on the whole matter. We are told that we cannot ignore the many side influences which hasten or delay, improve or disturb the acquisition of industrial skill. It seems to be detrimental in some way to the enjoyment of the gratified instinct for rapid motion to submit it to an interruption. Such an interruption is clearly in view at a railway crossing and instances have been noted where drivers have approached a crossing with gates down and red flag and light displayed and have preferred to make a detour over rough ground and go around the end of the lowered gate and gain the road beyond with a brief margin for safety, rather than undergo the mental exertion involved in a halt, a pause, and a fresh start. Any interruption presupposes a special effort and this is distinctly irksome, if by constant driving and practice a chauffeur has been able to reduce his work on a motor car to the almost automatic act of steering while gliding along a smooth road at a rapid pace.

We have not, by these remarks, sought to exonerate the driver of a machine, but rather to emphasize the handicap to effective advance which weighs down the railway in its laudable effort to preserve life and property and to protect a man against himself. Suppose the gates, the flag and the lights are seen. How long will they consciously act on the observer? There is no settled state of consciousness, any more than there is no place where an arrow is when it flies. The attention of the driver subject to distraction must be arrested and held. How best to do this is the problem. The question of taking risk is perhaps to the chauffeur the deepest question that can ever be asked of him, and the reply cannot be couched in words, it must and can only be answered by the dumb turning of the will, followed by the necessary and saving act.

Railway Signal Association Program Reports of Committees

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For Discussion at Stated Meeting, Auditorium Hotel, Chicago, Ill., March 20, 1916

Time of Meeting

Morning session—9:30 a. m. to 1 p. m.

Afternoon session-2 p. m. to 5:30 p. m.

List of Subjects

Committee I—Signaling Practice.

Exposition of the Three Schemes of Signaling. Committee II—Mechanical Interlocking.

- Requirements for the Protection of Traffic at Movable Bridges.
- Revision of Specifications for Mechanical Interlocking.
- Drawing 1400—Leadaways—Turn in Pipe Run with Cranks.
- Drawing 1401—Leadaways—Turn in Pipe Run with Deflectors.

Drawing 1402—Leadaways—Turns in Main Pipe Run. Committee III—Power Interlocking.

Typical Drawings for Electro-Pneumatic Interlocking as follows:

1147-Single Switch with Electric Detector Bar.

1148-Three-arm Selected Signal.

- 1158—Single Switch Circuit.
- 1159-One-arm Signal Circuit with Line Control for Distant Signal.
- 1160-Section Locking for Crossover.
- 1161—One-arm Signal Circuit with Polarized Control for Distant Signal.
- 1162—Section Locking for Single Switch.
- 1163—Signal Circuit, showing Selection through
- Switch Levers and S. S. Indicators.

Committee VI—Standard Designs.

Revised Drawings

- 1035—Signal Masts.
- 1059-Clamp for Base of Ground-mast Signals.
- 1073-Details of Transverse Pipe Carriers.
- 1197—Two-lever Wall Machine.

1226-Stuffing Box for Wire.

1236-Two-way Single-Lamp Signal.

- 1360-Tang Ends with Screw Jaws.
- 1397-Two-lever Wall Machine.

New Drawings

- 1235-Semaphore Spectacle-Design "C."
- 1355-Crank Bearings and Clamps.

1356-Double Spectacle Bearing and Lamp Bracket.

1357-Ladders for Two-way Single-lamp Signal.

1399—Low Target Stand.

- Committee IX—Wires and Cables.
 - Definitions of principle terms used in Wire and Cable Specifications.
 - Specifications for Steel Cored Aluminum Stranded Aerial Cable.
- Committee X—Storage Battery and Charging Equipment.
 - Specifications for Lead Type Portable Storage Battery.



Specifications for Composite Stationary Storage Battery.

Drawing 1175—Hydrometer and Thermometer.

Drawing 1248—Portable Storage Battery.

Special Committee—Electrical Testing.

Method of Testing Apparatus for Circuits—Progress Report.

Drawing-R. S. A. 4-Track Circuit Test Chart.

Drawing-R. S. A. 5-Test Chart for Insulated Joints. Special Committee-Lightning Protection.

Requisites for Ground Connections for Lightning Arresters.

Requisites for Applying Ground Apparatus.

Harmonizing Committee—General Provisions of Specifications for Signal Installations.

American Railway Engineering Association Program Seventeenth Annual Convention

Order may be changed by a two-thirds vote of convention, or by time required for consideration of reports. Morning session, 9:30 a.m. to 12:30 p.m.; afternoon session, 2 p.m. to 5 p.m.; evening session, 7:30 p.m.

First Day-Tuesday, March 21st.

President's address.

Reports of Secretary and Treasurer.

Reports of Standing and Special Committees.

X. Signals and Interlocking.....Bulletin 181

IX. Signs, Fences and Crossings....Bulletin 181

XIII. Water ServiceBulletins 181, 183

XV. Iron and Steel Structures...Bulls. 178, 181, 183

- VII. Wooden Bridges and Trestles....Bulletin 182
- VIII. MasonryBulletin 182

Evening Session

Illustrated paper on "The Nick and Break Test in the Inspection of Steel Rails," by Robt. W. Hunt.

Illustrated paper on "Test of Douglas Fir Bridge Stringers," by H. B. MacFarland.

Second Day-Wednesday, March 22d

111.	Ties
XIX.	Conservation of Natural ResourcesBull. 182
XIV.	Yards and TerminalsBulletin 182
Special.	Uniform General Contract FormsBull. 182
Special.	Stresses in Railroad TrackBulletin 182
XII.	Rules and OrganizationBulletin 184
I.	RoadwayBulletin 183
II.	BallastBulletin 183
	Annual Dinner at 6:30 p.m.
	This Day Thursday Marsh 094

Third Day-Thursday, March 23d

V.	Track	Bulletin 183
VI.	Buildings	Bulletin 183
XVIII.	Electricity	Bulletin 183
Special.	Grading of Lumber	Bulletins 174, 183
- XI.	Records and Accounts	Bulletin 183
XVII.	Wood Preservation	Bulletin 184
IV.	Rails	Bulletins 179, 184
XVI.	Economics in Railway Loc	ationBulletin 184
	New business.	
	Election and installation o	of officers.
	Adjournment.	

Members are requested to register on arrival in Room 1166 of the Congress Hotel, and receive a badge, program and other convention literature.

Members are also requested to bring the Bulletins containing committee reports to the convention, as the supply of extra copies is limited. Additional copies of Bulletins containing committee reports may be procured by members during the convention in Room 1166 at cost.

Reservations for the annual dinner can be made beginning Tuesday noon, on the second floor of the Congress Hotel.

Railway Telegraph Superintendents Meeting

The Western division of the Association of Railway Telegraph Superintendents will hold their March meeting in Chicago, Wednesday, March 22, 1916, in the Red Room on the nineteenth floor of Hotel LaSalle, at La-Salle and Madison Sts. The meeting will be called to order at 9:30 a.m. and at 12:30 a luncheon will be served. The subject matter announced for the meeting includes preliminary and informal reports from several chairmen of standing committees; a discussion of experiences and preventive measures dealing with the interruptions to telegraph and telephone service resulting from recent sleet storms and cold waves; a discussion of other sources of current supply than gravity batteries, and a question box for subjects apropro and of interest, which may be mailed or handed to the secretary before the meeting. An afternoon session will be held if considered advisable. Any further information may be secured from the secretary, R. W. Potts.

The Creepage of Electricity

In describing the motors used on the C. M. & S. P. electrification, the company pointed out that the "creepage" distance was exceptionally large. In explanation of this word "creepage" when used in connection with electrical installations we may say that the voltage of electric power is analogous to pressure. This voltage, or pressure, is at all times tending to "break down" the electric conductors or circuits and return, completing its circuit without passing through the electrical apparatus such as machinery, light, heating coils, etc. This voltage will actually "break down" the atmosphere, and if two points, such as metal conductors, are brought sufficiently close together the electric currents will jump across the distance between these points, depending on the voltage used. The voltage must be comparatively high, for instance 11,000 volts will jump something like $\frac{1}{4}$ in. However, the creepage distance is a great deal more than this $\frac{1}{4}$ in., that is, the voltage on the conductors, if the conductors are in contact with surfaces such as wood, glass, tape or any similar material, will creep along from conductor to conductor over the surface of the material, the distance depending a great deal on the condition of the material, such as moisture or dirt. It is, therefore, necessary in the design of all electrical apparatus where there are conductors, such as the commutator of a motor with voltage impressed on it, that sufficient creepage distance between these copper conductors and the ground be allowed (in this case the frame of the motor), so that the current will not creep across, even although the material such as glass, wood, tape, etc., may be covered with moisture and dirt.

Reference to the creepage of the motors being spoken of as extraordinarily large simply means that these distances are probably greater than the standard allowance so that there will be practically no chance of creepage to ground and thus flashovers of the motors often with considerable damage to motors, machinery or cars, which would occur if the creepage distance was too small.



March, 1916

Supply Trade News

Directory of Exhibitors at the N. R. A. A. Convention, 1916

Enrollment Booth, National Railway Appliances Association, located on the north side of the Wabash avenue entrance of the Coliseum, in charge of the enrollment committee; J. L. Hench, Lackawanna Steel Co., Chicago, Ill., chairman; A. H. Kuerst, Detroit Graphite Co., Chicago, Ill.; A. R. Sutter, The P. & M. Co., Chicago, Ill.; Hubert Van Zant, Carnegie Steel Co., Chicago, Ill.; L. M. Mathews, Fairbanks, Morse & Co., Chicago, Ill.

Numbered badges will be used as last year and on the promptness with which the individual members of the association register and procure their badges depends to a considerable degree the value of the printed list of members with their badge numbers and hotel addresses, which will be issued Tuesday, including all names registered Monday.

Information Booth, National Railway Appliance Association, in the secretary's office on the south side of the Wabash avenue entrance of the Coliseum, will be maintained not only during the week of the exhibition but prior to and during the installation and dismantling of the exhibits. During this entire time there will be a competent person in attendance to give any necessary information to members.

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South Half of Coliseum

Acme Supply Co., Chicago Ill.—Space No. 191. Exhibit: Gosso sanitary bed for bunk and construction cars, Acme steel diaphragm, Acme vestibule curtain outfit, Acme duplex weatherproof window, Kass safety step tread, Acme safety step box, Acme anti-pinch door shield, Acme crown curtain fixture, Acme protected groove curtain fixture, Regal revolving shade box, Chanarch steel flooring, Acme steel passenger car doors. Representatives: H. H. Schroyer, H. U. Morton, S. W. Midgley, R. C. Munro, E. B. Van Patten, W. J. Koons, A. E. Gosso, R. M. Smith, J. B. Smouse.

Adams Motor and Manufacturing Co., Chicago, Ill.— Space Nos. 218, 219. Exhibit: Railway Inspection Motor Cars. Representatives: W. E. Adams, N. W. Adams.

The Adams & Westlake Co., Chicago, Ill.—Space Nos. 83, 84, 102. Exhibit: Signal lamps, lanterns, long-time burners, Adlake center-core long-time burner wicks, switch locks, etc. Representatives: G. L. Walters, A. S. Anderson, C. B. Carson, J. F. Stender, H. G. Turney, Wm. J. Piersen.

Ajax Rail Anchor Co., Chicago, Ill.—Space No. 14. Exhibit: Ajax double grip rail anchors. Representatives: F. B. Bradley, H. G. Eefbarg, B. Hoffmann, G. N. Holmberg, G. F. Weiss.

Allith-Prouty Co., Danville, Ill.—Space No. 187. Exhibit: Door hangers, spring hinges, rolling store ladders, overhead carriers, fire door hardware, hardware specialties. Representatives: H. R. Maxwell, A. V. Martin, F. B. Coates, H. C. Smith, D. E. Willard.

American Guard Rail Fastener Co., Philadelphia, Pa. —Space No. 119. Exhibit: Guard rail clamps, tie plate guard rail fasteners, rail anchors. Representatives: D. F. Vaughan, D. L. Vaughan.

American Hoist and Derrick Co., St. Paul, Minn.— Space No. 67. Exhibit: Large pictures of the "American" railroad ditcher. Representatives: F. J. Johnson, W. O. Washburn, W. L. Manson, C. C. Austin, D. L. O'Brien, Harold Washburn, J. L. Hickey.

American Kron Scale Co., New York City—Space No. 223. Exhibit: Kron automatic dial scales. Representatives: W. W. Camp, Ernst Ohnell, C. Larson, M. E. Fitzgerald, J. Kirk Rowell, E. M. Abramson.

American Steel and Wire Co., Chicago, Ill.—Space Nos. 51, 70. Exhibit: Railway right-of-way fences and

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North Half of Coliseum

gates, steel fence posts, wire rope, rail bonds, telegraph and telephone wire, signal wire, electrical wires and cables. Representatives: L. P. Shanahan, B. H. Ryder, F. A. Keyes, C. S. Wright, Jr.

American Valve and Meter Co., Cincinnati, O.—Space Nos. 130, 131, 132. Exhibit: Poage water columns; Fenner drop spouts; Anderson economy switch stands; Anderson quick repair switch stands; Anderson interlocking switch stands; Anderson safety switch locks. Representatives: J. T. McGarry, F. C. Anderson.

American Vulcanized Fibre Co., Wilmington, Del.— Space No. 126. Exhibit: Vul-Cot fibre for rail joints, steel cross tie, bridge and switch insulation, and fibre specialties. Representatives: C. C. Bell, Wm. Maxwell, H. P. Weldon, W. A. Jordan, H. E. Winn, John Barron.

Anchor Co., Chicago, Ill.—Space No. 165. Exhibit: Efficiency rail anchor. Representatives: T. B. Bowman, C. P. Williams.

Anchor Post Iron Works, New York City—Space No. 171½. Exhibit: Inter-track railing with special extra "D" channel rails; inter-track railing with rails and pickets electrically welded; right-of-way fence with extra "D" channel rails; right-of-way fence with rails and pickets electrically welded; right-of-way fence which can be graded or adjusted in the field to suit any slope; galvanized anchor posts and samples of chain link woven fabric, photographs and blue-prints. Representative: George W. Forster.

Armco Iron Culvert Manufacturers, Middletowp, O.— Space Nos. 99, 100. Exhibit: Culverts, "Armco" iron railway products. Representatives: G. F. Ahlbrandt, B. G. Marshall, Howard See, John S. Roney.

Asphalt Ready Roofing Co., New York City.—Space No. 170. Exhibit: "Hudson" asphalt shingles, "Protection" brand roofing, "Arrow" brand roofing, red, green and gray "Rockland" roofing. Representatives: H. H. Huested, C. A. Sparrowhawk.

Associated Manufacturers of Malleable Iron, Cleveland, O.—Space Nos. 216, 217. Exhibit: Malleable iron castings and testing machines. Representatives: S. H. Standish, Frank M. Robbins, Mr. Fulton.

Automatic Electric Co., Chicago, Ill.—Space No. 165½. Exhibit: Train dispatching exhibit; automatic telephone switchboard in operation; supplies, lamps, cords, wire, etc. Representatives: W. N. Curtiss, W. N. Furthman, J. H. Finley.

Ayer & Lord Tie Co., Inc., Chicago, Ill.—Space No. 224. Exhibit: Interior creosoted wood blocks for shop floors, creosoted wood paving blocks, creosoted timbers, treated railroad ties, etc. Representatives: A. H. Noyes, B. S. McConnell, W. H. Blythe, F. W. Maechler.

Ballow Safety Rail Joint Co., Roanoke, Va.—Space No. 192. Exhibit: Non-frictional insulated rail joint; elongated nuts applied to the common bolt on ordinary rail joint, using a plain splice bar; frog equipped with the elongated nut; section of railway crossing using elongated nuts on standard bolts, in full size, 85 and 100-lb. steel rail; an insulated joint and bolts and a plain joint and bolts that have stood service. Representatives: C. E. Ballou, H. B. Rockhill.

The Barrett Co., New York City. Space Nos. 107, 108. Exhibit: Roofing (Barrett specification roofs), tar-rok sub-floor construction for wooden floors in machine shops, mill buildings and freight houses; bridge waterproofing, waterproofing and damp-proofing for masonry, wood preservatives, plastic cement, metal paints for cars and buildings and locomotives. Representatives:

E. H. Poetter, W. S. Babcock, E. J. Caldwell, H. B. Nicholas, J. J. Ross.

Bausch & Lomb Optical Co., Chicago, Ill.—Space No. 47. Exhibit: Engineering instruments. Representatives: B. H. Witherspoon, C. A. Bengston.

Boss Nut Co., Chicago, Ill.—Space No. 13. Exhibit: Boss lock nuts. Representatives: J. A. MacLean, W. G. Willcoxson, M. C. Beymer, J. W. Fogg.

L. S. Brach Supply Co., Newark, N. J.—Space No. 2. Exhibit: Lightning arresters, automatic flagman, crossing bells, signal accessories. Representatives: A. G. Brach, Geo. Gaunt, Godfrey Gort.

Bryant Zinc Co., Chicago, Ill.—Space Nos. 153, 154, 155, 156. Exhibit: Highway crossing material; relays; batteries; battery supplies; bells; signal supplies. Representatives: Stanley C. Bryant, Harry F. Worden, Jerry Costigan, Otto S. Flath.

The Buda Co., Chicago, Ill.—Space Nos. 86, 87, 88, 89. Exhibit: Buda gasoline section motor cars, Buda gasoline motor velocipedes, Buda gasoline inspection cars, Buda electric storage battery trucks, Buda-Wilson (new type) bonding drill, Buda "Hyduty" Paulus track drill, Buda car replacers, Buda bumping posts, Buda ballbearing and cone-bearing "Postop" jacks, Buda ratchet jacks, Buda "Hyduty" tool grinders, Buda ground throw switch stands, Buda electric crossing gates. Representatives: J. L. Artmaier, H. C. Beebe, C. H. Bull, W. C. Dyer, J. J. Gard, G. A. Glasford, W. F. Hebard, R. C. Horton, E. Johnson, W. Krause, N. C. Study, T. H. Wheeler, E. J. Porter.

Carbic Manufacturing Co., Duluth, Minn.—Space No. 169. Exhibit: Flare lights, and welding and cutting equipment. Representative: Gordon Paterson.

Carnegie Steel Co., Pittsburgh, Pa.—Space Nos. 52, 53, 71, 72. Exhibit: Steel cross ties, new; also ties after eleven years' service; "Braddock" insulated joints; "Duquesne" rail joints; reinforced angle bars; steel sheet piling; locomotive piston; rolled steel automobile flywheels; automatic stereopticon, showing views of installation of material. Representatives from general offices, Pittsburgh, Pa., and from Chicago sales office.

Chicago Bridge and Iron Works, Chicago, Ill.—Space Nos. 65, 66. Exhibit: Models of steel water tanks; enlarged photographs. Representatives: G. T. Horton, Merle J. Trees, Robert H. Murray, Horace B. Horton, Hiram T. Horton, C. S. Pillsbury, C. M. Ladd, F. L. Cook, H. J. Trum, E. G. Ladd, K. I. Small, R. Green, H. C. Brown, J. L. Zeller, H. B. Murphey.

Chicago Flag and Decorating Co., Chicago, Ill.— Space No. 189. Exhibit: Railway signal flags, manufacture demonstrated. Representatives: Geo. L. Glendon, L. G. Magnussen.

Chicago Malleable Castings Co., Chicago, Ill.—Space No. 180. Exhibit: The Thomas rail anchor tie plate, the Thomas guard rail. Representatives: Fred F. Bennett, Wm. H. Kofmehl, John W. Thomas.

Chicago Pneumatic Tool Co., Chicago, Ill.—Space Nos. 115, 116. Exhibit: Giant fuel oil engine class AO, size 9 x 8 in.; single tandem fuel oil-driven compressor, class N SO, size 9 x 8 in.; rock drills, consisting of type A 66, B 66 and C 66 Hummer drills, pneumatic tools; electric tools; speed recorder. Representatives: J. R. McFarland, J. W. Lowell, A. E. Swanson, C. E. Walker, J. F. Canby, J. C. Campbell, C. B. Coates, Ed. Aplin.

Chicago Railway Signal and Supply Co., Chicago, Ill. ---Space Nos. 96, 97, 98. Exhibit: Mechanical signals and signaling devices; electrical signals and acces-

sories, relays, annunciators, indicators, highway crossing alarms and signal maintenance accessories. Representatives: C. N. Suhr, W. C. Martin, P. P. Williams, E. W. Vogel, W. M. McClintock, H. C. McNeil, F. L. Rainbow, Arthur C. Dunne.

Cleveland Frog & Crossing Co., Cleveland, O.—Space No. 91. Exhibit: Frogs, crossings, switches, switch stands. Representatives: G. C. Lucas, Geo. Stanton, L. G. Parker.

Clyde Iron Works, Chicago, Ill.—Space No. 182. Exhibit: One 8¼ x 10 double-cylinder double-drum four independent winch-head special railroad erector's engine, adapted to work on double track main line right of way. Representatives: E. S. Quinn, G. P. Miller, J. H. Crawford.

Commercial Acetylene Railway Light & Signal Co., Inc., New York City—Space Nos. 135, 136. Exhibit: Commercial acetylene and Aga flash light as applied to railroad signals, commercial acetylene as applied to locomotive headlights, commercial acetylene for oxyacetylene welding and cutting. Representatives: C. E. Lee, O. F. Ostby, E. T. Sawyer, H. G. Doran, C. A. McCune.

Concrete Mixing and Placing Co., Chicago, Ill.— Space No. 172. Exhibit: Pneumatic concrete mixer and conveyor for tunnel lining work. Representatives: H. B. Kirkland, Edward Wray.

Cornell Wood Products Co., Chicago, Ill.—Space No. 164¹/₂. Exhibit: Cornell-wood-board. Representatives: C. O. Frisbie, E. W. Cowell, C. W. Litsey, P. A. Short.

The Creepcheck Co., Inc., New York City—Space No. 193. Exhibit: Anti-creeping devices. Representatives: A. Dinklage, O. Metcalf, M. A. Sheehan, C. Genscher.

Crerar, Adams & Co., Chicago, Ill.—Space No. 28. Exhibit: Jacks, drills, carbic lights. Representatives: J. A. Marbin, W. I. Clock, G. D. Bassett, C. W. Gregory, R. M. Bullard.

Daniels Safety Device Co., Chicago, Ill.—Space No. 149. Exhibit: Bulldog nut, bullpup nut, automatic tapping machine, boltless rail joint. Representatives: T. M. Daniels, W. D. Collins, W. E. Killen, C. C. Wood, Jr., M. Somsel.

Detroit Graphite Co., Detroit, Mich.—Space No. 106. Exhibit: Paints for bridges, buildings, water tanks, Sta-White for interior use, Anti-Aqua for damp-proofing. Representatives: Tom R. Wyles, L. D. Mitchell, J. J. Hogan, A. H. Kuerst, W. D. Waugh, E. Randolph, G. H. Varney, E. Booth, DeWitt C. Smith.

Paul Dickinson, Inc., Chicago, Ill.—Space No. 101. Exhibit: Smoke jacks, ventilators, chimneys, cast iron buildings. Representatives: J. A. Meaden, A. J. Filkins, W. A. Dayton, F. C. Webb.

Dilworth, Porter & Co., Ltd., Pittsburgh, Pa.—Space No. 27. Exhibit: Railroad spikes and tie plates. Representatives: C. Stein, W. F. Schleiter, Joseph Dilworth.

Joseph Dixon Crucible Co., Jersey City, N. J.—Space No. 117. Exhibit: Dixon's Silica-Graphite paint, boiler graphite, lubricating graphite, graphite greases, pipe joint compound, solid belt dressings, graphite brushes. Representatives: H. W. Chase, R. R. Belleville, J. E. Simpson.

The Duff Mfg. Co., Pittsburgh, Pa.—Space No. 167. Exhibit: Barrett track jacks, Duff ball-bearing screw jacks, Duff-Bethlehem hydraulic jacks. Representatives: E. A. Johnson, C. N. Thulin, C. A. Methfessel.

D. & A. Post Mold Co., Three Rivers, Mich.—Space No. 168. Exhibit: "D. & A." cement fence post machines; specimen posts; steel reinforcements; spacers; tie wire fence fasteners. Representatives: G. H. Dougherty, O. Dougherty, L. A. Dougherty, L. W. Dougherty.

Thomas A. Edison, Inc., Bloomfield, N. J.—Space Nos. 20, 21. Exhibit: Signal cells, demonstration board for track circuit work, automatic signal operated and lighted by Edison batteries. Representatives: E. E. Hudson, F. J. Lepreau, P. A. Garrity, E. W. Brown, P. B. Hyde.

Edison Storage Battery Co., Orange, N. J.—Space Nos. 21½, 22. Exhibit: Edison storage batteries. Representatives: H. G. Thompson, F. V. McGinness, H. M. Roberts, W. F. Bauer, C. A. Luckey, H. J. Butler.

The Electric Railway Improvement Co., Cleveland O. —Space No. 221. Exhibit: Rail bonds and equipment for their installation. Representative: G. Howatt.

The Electric Storage Battery Co., Philadelphia, Pa.— Space No. 1. Exhibit: Storage batteries. Representatives: G. H. Atkin, G. H. Groce, W. Borroughs, H. M. Beels, T. Milton.

Empire Railway Appliances Corporation, New York City—Space No. 27. Exhibit: Tieplate anti-creeper. Representatives: E. B. Powers, D. L. Braine.

The Eymon Continuous Crossing Co., Marion, O.— Space No. 169½. Exhibit: The Eymon continuous crossing. Representatives: Byron E. Wilson, Edward P. Dorward, A. W. Nyquist, J. H. Eymon.

Fairbanks, Morse & Co., Chicago, Ill.— Space Nos. 73, 74, 75. 76, 92, 93, 94, 95. Exhibit: 15 h. p. semi-Diesel engine, direct connected to a 10 k. w. generator in operation, $3\frac{1}{2}$ h. p. motor, direct connected to $2\frac{1}{2}$ in. centrifugal pump in operation, 7x10 power pump, 12x7x12steam pump, deep well power head, locomotive water crane, electric motors, ball bearing and internal starter types, scales, motor cars. Representatives: Geo. J. Akers, K. P. Brown, F. M. Condit, F. P. Drinker, E. A. Elder, E. C. Golladay, C. T. Fugitt, D. J. Higgins, G. Howard, J. G. Jones, J. L. Jones, T. C. Kennedy, D. K. Lee, L. H. Matthews, C. W. Pank, E. E. Pendray, F. V. Roy, A. A. Taylor, H. E. Vergosen, F. N. Whitesell, C. H. Wilson.

Fairmont Gas Engine and Railway Motor Car Co., Fairmont, Minn.—Space Nos. 125, 144. Exhibit: Motor car mowing machines; motor car disc weeding machines; featherweight auto speeder; 8 h. p. heavy duty motor car engine with cone clutch for chain drive; 4 h. p. hand car engine. Representatives: H. E. Wade, W. F. Kasper, R. I. Sawyer.

Federal Signal Co., Albany, N. Y.—Space Nos. 36, 37, 55, 56. Exhibit: Alternating and direct current interlocking appliances, low volt switch machine, low volt signals, A. C. light signals, A. C. semaphore signals, A. C. relays, A. C. transformers, D. C. relays, interlocking relays, highway crossing signals, electro-mechanical interlocker, clock-work time releases, switch guard, bridge circuit controllers, battery charging switches, impedance bonds, electric locks. Representatives: A. H. Renshaw, John T. Cade, Carl Henze, W. H. Reichard, J. W. Hackett, H. G. Thompson, Paul Renshaw, J. J. Hubbard, H. P. Ober, J. W. Kelly, H. C. Ware, C. N. Beckner, S. J. Turreff, Casper Herringer.

The Frictionless Rail, Boston, Mass.—Space Nos. 133, 134. Exhibit: Frictionless rail. Representatives: F. A. Barbey, S. W. Simonds, G. H. Bryant, T. F. Dwyer, Jr.

The Fibre Conduit Co., Chicago, Ill.—Space No. 159. Exhibit: Fibre conduit for underground cables, fibre conduit and fittings for signal trunking, fibre conduit



and fittings for roundhouse wiring. Representatives: W. W. Smythe, Jr., F. C. Smith, D. E. Crum.

General Electric Co., Schenectady, N. Y.—Space Nos. 150, 151. Exhibit: Penn Dell automatic sub-station for maintaining power on a transmission line or service for two or more sources of electric supply, standard section type switch board for train lighting, baggage-truck and general battery charging, vacuum tube lightning arresters, enameled resistance units, indoor and outdoor type air-cooled transformers for low-voltage signal lighting, portable testing instruments. Representatives: W. O. Kellogg, W. J. Clark, W. H. Sigourney, C. C. Bailey, H. M. Jacobs, J. Roberts, B. F. Bilsland, S. W. McCune, L. W. Shugg.

General Railway Signal Co., Rochester, N. Y.-Space Nos. 38, 39, 40, 57, 58, 59. Exhibit: Electric Interlocking (dynamic indication): 16-lever model 2. unit-levertype electric interlocking machine equipped with rotary circuit controllers, lever lights, lever locks and mechanical time release; operating switchboard; two-arm model 2A 110-volt non-automatic top-of-mast signal; model 2A 110-volt semi-automatic signal; 110-volt model 5 switch machine; relays and indicators; Mechanical Interlocking: adjustable deflecting bar, self-cleaning switch adjustment, low-voltage power signals, relays and indicators, model 2B electric lock and switch circuit controllers; electro-Mechanical Interlocking: eight-lever, model 2B electro-mechanical interlocking machine with rotary circuit controllers; Direct Current Automatic Block Signaling: 10-volt model 2A top-of-mast signal, 10-volt model 2A base-of-mast signal, three position motor relay, track and line relays, "copper-cup" ground plate, model 1B lightning arrester, model 1A adjustable resistance units, R. S. A. terminals, "Plagraphite" relay contacts; AlternatingCurrentBlock Signaling: model 2A base-of-mast signal equipped with 110volt 60-cycle induction motor, light signals, line and secondary transformers, track and line relays, stub pole equipped with line transformer, plug cut-outs, lightning arresters and connections, resistance and impedance units; Selective Signaling System: Selector equipment, including selectors, bells, call keys, relays and silencer, R. S. A. "Take Siding" signal actuated by 10-volt model 2A signal mechanism; miniature track for demonstration of the "OS" arrangement, and an answer-back selector; model 5 low-voltage switch machine (for operation of outlying switches) operating in connection with a twoarm 10-volt model 2A signal and controlled by hand switch and indicator group; colored photographic enlargements showing views of several steam and electric railway signaling installations; electrical devices connected to energy and may be operated as under service conditions. Representatives: A. T. Carter, W. W. Coleman, S. M. Day, C. M. Deardorff, L. E. Dodge, F. L. Dodgson, M. F. Geer, W. S. Henry, W. K. Howe, S. Johnson, F. H. Jones, R. F. Kelly, H. W. Lucia, F. W. Moffett, G. D. Morgan, C. O. Poor, F. W. Rizer, F. B. Rosencrans, O. A. Ross, W. W. Salmon, V. I. Smart, H. M. Sperry, J. E. Stephenson, H. B. Taylor, L. Thomas, J. W. White, S. N. Wight, J. R. Willis, W. P. Woodruff, M. Wuerpel, W. R. Young.

W. & L. E. Gurley, Troy, N. Y.—Space No. 137. Exhibit: Engineering and surveying instruments, Gurley railroad transits with one piece truss standard and other improved features, transits, levels, leveling rods, stadia rods, compasses, current meters, sketching cases, tapes, etc. Representatives: H. M. Dibert, L. C. Higbee.

Hall Switch and Signal Co., New York City-Space Nos. 77, 78, 79, 80. Exhibit: Electric interlocking, automatic signals and equipment, highway crossing signals, telephone and telegraph selectors and equipment. Representatives: W. J. Gillingham, H. W. Wolff, O. B. Frink, H. L. Hollister, M. H. Beekman, R. Connell, J. A. Ritter, D. R. Day, B. A. Hinman.

The Hatfield Rail Joint Mfg. Co., Macon, Ga.—Space No. 166. Exhibit: Hatfield rail joints and crossing fastenings: Representatives: T. B. Bowman, M. R. Hatfield, Walter T. Johnson, C. P. Williams.

Hayes Track Appliance Co., Richmond, Va.—Space Nos. 140, 141. Exhibit: Hayes Derails: Model C, size 5, right with operating stand; Model E, size 5, right with target stand; Model EX, size 5, with repair track target stand; Model HXP, size 5, with lever; Model H, size 5, right with lever. Representatives: Stanley W. Hayes, W. Harding Davis, E. L. Ruby, E. W. Brown, R. W. Slautterback.

Hazard Manufacturing Co., Wilkes-Barre, Pa.—Space No. 3. Exhibit: Rubber-covered signal wire. Representatives: A. W. Gabriel, E. L. Willson, Thomas Keffe, L. W. Allen, George P. Cady, H. G. Gabriel, C. B. Semple.

Hoeschen Mfg. Co., Omaha, Neb.—Space No. 183. Exhibit: Hoeschen batteryless crossing signals, Hoeschen style "M" selective magneto generator, Hoeschen batteryless train drop annunciators. Representatives: F. K. Davis, R. A. Fry.

Hubbard & Co., Pittsburgh, Pa.—Space Nos. 142, 143. Exhibit: Track tools; claw bars, wrenches, mauls, shovels, scoops, etc. Representatives: Joseph V. Smith, O. W. Youngquist, G. H. McCammon, A. H. Handlan, Jr.

The Indianapolis Switch & Frog Co., Springfield, O.— Space Nos. 49, 50. Exhibit: Manganese frogs, switches, mates, crossings, switch points, unit drilled built-up construction, portable electric welders, electric welded joints; special trolley device for operating electric welders, grinders, track drills and cluster lights, allow ing electric cars to pass without removing from trolley wire. Representatives: J. C. Jameson, E. C. Price, H. E. Freeman, W. H. Thomas, J. A. Foulks.

Ingersoll-Rand Co., New York City—Space Nos. 207, 208, 209, 210. Exhibit: "Imperial" pneumatic tie tampers, "Imperial" portable air compressor cars, a complete line of "Little David" pneumatic tools suitable for track work. Representatives: W. H. Armstrong, D. H. Seeley, Chas. Dougherty.

International Steel Tie Co., Cleveland, O.—Space Nos. 198, 199. Exhibit: Full size section of steel crossing foundation with crossing section in place on it, steel twin ties for paved street track. Representatives: Wm. P. Day, J. J. O'Donnell, W. C. Mahon, L. C. Shank.

Jaeger Machine Co., Columbus, Ohio.—Space No. 172¹/₂.

H. W. Johns-Manville Co., New York City—Space Nos. 174, 175, 176, 177. Exhibit: Asbestos and magnesia railroad supplies, smoke jacks, asbestos roofings, corrugated asbestos roofing, transite asbestos shingles, rubber type roofings, high and low pressure pipe coverings, sheet, ring, spiral, coil and rope packings for high and low pressure work, J-M steam traps, J-M fire extinguishers, lighting fixtures, NoArk enclosed fuse devices, electrical materials, underground fibre conduit for electric wiring, underground conduit for steam pipes, boiler laggings, tapes for all services, high temperature and insulating cements. Representatives: J. E. Meek, J. C. Younglove, G. A. Nicol, P. C. Jacobs, F. X. Connolly, F. J. Horne, H. B. Sewell, Geo. Christenton, D. L. Jennings, E. T. Wade, F. W. Doty, H. L. Leach,

H. A. Waldron, C. D. Folsom, J. H. Trent, E. H. Willard, R. A. Hamaker, H. T. Morris, L. E. Hassman, C. E. Murphy, W. J. Hennessy, H. G. Newman.

The O. F. Jordan Co., Chicago, Ill.—Space No. 222. Exhibit: Model of railroad spreader, pictures, etc. Representatives: Walter J. Riley, J. P. McNally, C. A. Levey, Wm. J. Tangerman, R. E. Bressler.

The Joyce Cridland Co., Dayton, O.—Space No. 29. Exhibit: Lifting jacks for railway service. Representatives: G. W. Llewellyn, W. I. Clock, C. D. Derby.

Julian-Beggs Signal Co., Terre Haute, Ind.—Space No. 163, 164. Exhibit: Railway train control and speed control: Representatives: Steven Smith, Thomas E. Clark, M. H. Hovey, B. K. Read.

Kalamazoo Railway Supply Co., Kalamazoo, Mich.— Space Nos. 23, 24, 25. Exhibit: Hand, push and velocipede cars, motor cars, track drills, track jacks, track levels and gauges, drill bit grinders, cattle guards, etc. Representatives: J. McKinnon, D. A. Stewart, W. N. Sidnam, H. R. Miller, F. E. McAllister, W. C. Irwin, M. Babcock, H. N. Whipple, W. Winterle, H. Bosma.

Kellogg Switchboard and Supply Co., Chicago, Ill.— Space No. 184. Exhibit: Train dispatching telephone apparatus, selective signaling equipment, "Head in" signals for electric and steam roads, telephone apparatus in general. Representatives: W. O. Collins, A. J. Porter, E. A. Woodward.

Kelly-Derby Co., Chicago, Ill.—Space No. 11. Exhibit: Latest styles of two and four wheel all steel warehouse trucks. Representatives: C. W. Kelly, W. B. Holcomb, J. E. Angell.

Keppler Gas Constructions, Inc., 101 Park Avenue, New York City—Space No. 228. Exhibit: Keppler skylight construction for train sheds, stations, roundhouses, etc. Representatives: F. L. Keppler, M. H. Foley.

The Kerite Insulated Wire and Cable Co., New York City—Space Nos. 44, 63. Exhibit: Wire and cables. Representatives: Azel Ames, P. W. Miller, J. W. Young, J. A. Renton, B. L. Winchell, Jr., G. A. Graber, W. H. Fenley, J. A. Hamilton.

Keuffel & Esser Co., New York City—Space No. 168½. Exhibit: Drawing materials, surveying instruments, measuring tapes. Representatives: H. Huster, J. Lamb, E. Veasey.

Keystone Grinder and Manufacturing Co., Pittsburgh, Pa.—Space No. 194. Exhibit: Keystone hand and foot power railroad tool grinders. Representatives: H. C. Holloway, D. L. Braine, James C. Barr, W. Harding Davis, James C. Dolan, Georgia Supply Co., J. C. Kirby, Frank D. Nauman.

The Kilbourne and Jacobs Mfg. Co., Columbus, Ohio. --Space No. 190. Exhibit: K & J all-steel automatic air dump cars. Representative: David Green.

Lackawanna Steel Co., Lackawanna, Pa.—Space Nos. 31, 32, 33, 34. Exhibit: Standard and special shapes rail and angle bar sections, joint plates, tie plates, steel sheet piling, spikes and bolts. Representatives: C. R. Robinson, E. Armstrong, F. E. Abbott, A. P. Van Schaick, C. H. Hobbs, J. N. Hench, A. H. Weston.

Lansing Company, Lansing Mich.—Space Nos. 213, 214. Exhibit: Lansing electric freight house tractor; Lansing electric freight house hoist; Lansing freight house trucks; Reynolds' freight house trucks. Representatives: H. W. Woodward, Stowell C. Stebbins, Fred Schultz, H. H. Ames, J. T. Birney, A. C. Buck.

The Lehon Co., Chicago, Ill.—Space No. 148. Exhibit: Roofing for buildings, car roofing, waterproof insulating and refrigerator papers, saturated burlaps, saturated cotton fabrics, asphalt shingles, canvas passenger and coach roofing, damp-tite paints. Representatives: Tom Lehon, D. B. Wright, J. W. Shoop, E. A. Magurn.

Louisiana Red Cypress Co., New Orleans, La.—Space Nos. 200, 215. Exhibit: Louisiana red cypress. Representatives: Frank N. Snell, C. A. Nesom, H. P. Altman.

The Lufkin Rule Co., Saginaw, Mich.—Space No. 121. Exhibit: Measuring tapes and rules of all descriptions. Representatives: Theodore Huss, S. B. McGee, F. G. Brown.

Lumber Mfrs. Agency, Centralia, Wash.—Space No. 220. Exhibit: Fir lumber. Representatives: J. J. Jennelle, Jr., D. H. Davis.

John Lundie, New York City—Space No. 161½. Exhibit: Lundie tie plates. Representatives: John Lundie, Wallace Bigelow.

MacRae's Blue Book Co., Chicago, Ill.—Space No. 9. Exhibit: MacRae's Blue Book, the Railway Supply Index Catalogue. Representatives: E. B. Cooke, T. H. MacRae, L. R. Rollins, Lloyd Simonson.

The Madden Co., Chicago, Ill.—Space No. 195. Exhibit: Madden track layer, Richter blue flag derail, Wagner switch point straightener, Blair tie spacer, Suggitt reversible side ballast plow, the Brown rail loader. Representatives: H. C. Holloway, Thomas D. Crowley, V. L. Walker.

C. F. Massey Co., Chicago, Ill.—Space Nos. 35, 54. Exhibit: Reinforced concrete watchmen's houses, shelter station, cattle pass pipe, whistle, mile and sign posts. Representatives: C. F. Massey, F. S. Peabody, R. J. Collins, A. Christ, Jr.; D. A. Hultgren, F. E. Richert, Chas. Gilman, R. A. McDonald.

Miller Train Control Corp., Danville, Ill.—Space No. 197. Exhibit: A full size Atlantic type boiler head with all instruments showing the application of the Miller train control to the engineer's air brake valve, also the attachment to the throttle, giving the size, position and application of the control as applied to locomotives; automatic signal, parts of the shoe and control; Westinghouse electric pumps and necessary apparatus to furnish air for the operation of the control and the engineer's air brake valve. Representatives: W. B. Murray, H. B. Miller, J. N. Garber, C. A. Crowell, J. R. McSherry.

Morden Frog and Crossing Works, Chicago, Ill.— Space Nos. 90, 109. Exhibit: Solid manganese rigid frog No. 9, manganese guard rail, standard 11-ft. guard rail with Morden adjustable clamp and adjustable end blocks; switch stand for facing point switch, operating switch and point lock; G. L. M. malleable yard switch stand; point lock attachment for high main line stand. Representatives: Arthur C. Smith, W. J. Morden, W. Homer Hartz, B. T. Gibbs.

Mudge & Co., Chicago, Ill.—Space Nos. 127, 128, 146, 147. Exhibit: Mudge motor cars, classes E-3 inspection, E-6 inspection, GS-1 section, GS-2 section, F-1 section, GQ-2 handcar equipment, Smith motor wheel applied to hand velocipede. Representatives: Burton W. Mudge, Robert D. Sinclair, George W. Bender, Sherman C. Amsden, Blake C. Howard, W. D. Jenkins, Royal D. Hawley, C. M. Mudge, C. P. Benning, Clive Hastings, F. A. Ingalls.

M. W. Supply Co., Philadelphia, Pa.—Space No. 138. Exhibit: Vaughan rail anchor, Vaughan track indicator. Representative: David L. Vaughan.

National Carbon Co., Cleveland, O.—Space No. 152. Exhibit: Primary signal and track batteries, Columbia



dry batteries, Columbia Multiple and Hot-Shot batteries, storage batteries, flashlight batteries, carbon brushes, arc light carbons, welding carbons, carbon telephone specialties, special forms in carbons of all kinds. Representatives: Chas. S. Pflasterer, W. H. Arkenburgh, E. L. Marshall, J. M. Spangler, Walter R. Pflasterer, C. W. Wilkins, L. W. Fischer.

National Concrete Machinery Co., Madison, Wis.— Space No. 227. Exhibit: The National power fence post machine, including concrete mixer having a capacity of a fence post per minute of running time, National sheet steel molds for line and corner fence posts, ring and whistle posts, mile posts, etc.; National woven steel wire reinforcements for various types of posts; photographs of plants in railway service, showing process of manufacture, method of handling posts, etc., and posts in right-of-way fences. Representatives: J. B. Evans, V. E. Rogers, W. G. Clark, E. A. Everett, W. M. McClintock, B. K. Read.

National Lead Co., New York City.—Space No. 188. Exhibit: Dutch Boy red lead-in-oil, Dutch Boy white lead, Dutch Boy linseed oil, solder. Representatives: Charles Barr Field, Professor A. H. Sabin.

The National Lock Washer Co., Newark, N. J.—Space Nos. 201, 202. Exhibit: Hipower nut locks, parallel plain spiral nut locks for railroad track joint bolts. Representatives: John B. Seymour, R. L. Cairncross, A. T. Thompson, J. T. Patterson, Jesse Hough.

The National Malleable Castings Co., Cleveland, Ohio. Space No. 105. Exhibit: Rail anchors, malleable rail braces, malleable tie plates, malleable spools and washers. Representatives: James A. Slater, T. W. Aishton, C. H. McCrea, J. J. Byers.

National Standard Co., Niles, Mich.—Space No. 185. Exhibit: Magic tool grinders with attachments, Cook's improved bonding drills, Climax track drills, standard jacks. Representatives: C. R. Wescott, R. L. Brown, F. A. Buckley, W. H. Parkin, W. F. Harrah, Guy Hayman.

Geo. P. Nichols & Bro., Chicago, Ill.—Space No. 173. Exhibit: Electric turntable tractors. Representatives: George P. Nichols, S. F. Nichols, Henry Fries, Nicholas Fries.

Northwestern Motor Co., Eau Claire, Wis.—Space No. 196. Exhibit: Railroad gasoline motor cars. Representatives: R. R. Rosholt, K. Rosholt.

Ogle Construction Co., Chicago, Ill.—Space Nos. 12, 31. Exhibit: Automatic coaling station. Representatives: M. W. Powell, R. A. Ogle, C. F. Bledsoe, L. S. Murphy.

The Okonite Co., New York City—Space Nos. 16, 17. Exhibit: Okonite insulated wires and cables of every description for every kind of electrical service, Candee potheads, Okonite and Manson tapes, etc. Representatives: Lewis G. Martin, J. D. Underhill, W. T. Kyle.

O'Malley Beare Valve Co., Chicago, Ill.—Space No. 114. Exhibit: Globe valves, angle, check, locomotive and blow-off valves. Representatives: Edward O'Malley, Thomas O'Malley, William Leighton, Blake C. Hooper, H. M. Newell.

Otley Paint Mfg. Co., Chicago, Ill.—Space No. 10. Exhibit: "Eureka Brand" railway locomotive paints, cements, specialties. Representatives: B. F. Otley, James J. Otley, Walter A. Otley.

W. W. Patterson Co., Pittsburgh, Pa.—Space No. 145. Exhibit: Tackle blocks—high grade, hand made, double extra heavy. Representative: W. W. Patterson, Jr. The Pennsylvania Steel Co., Philadelphia, Pa.—Space No. 30. Exhibit: Frogs, switches, switch stands, etc. Representatives: R. W. Gillispie, G. S. Vickery, R. L. Gillispie, Stanley H. Smith, Fred H. Ogden, J. F. Hennessey, K. C. Banks.

The Peyton Safety Rail Joint Co., Centralia, Ill.---Space No. 226. Exhibit: Rail joint. Representative: Warren Perry.

Pittsburgh-Des Moines Steel Co., Pittsburgh, Pa.---Space No. 103. Exhibit: Steel tanks, stand pipes, coaling stations, sanding stations, pictures, plans and models. Representatives: W. W. Hendrik, A. C. Pearsall, H. J. Klurzing, J. E. O'Leary, C. L. Todd, G. A. Smith, W. H. Jackson.

Pocket List of Railroad Officials, New York City.— Space No. 26.

Positive Rail Anchor Co., Louisville, Ky.—Space Nos. 178, 179. Exhibit: Positive rail anchors, Betts tie plates, Economy guard rails, Economy switch points. Representatives: W. M. Mitchell, Frank M. Robbins, John C. Haswell, L. C. Ferguson, J. A. Shoulty, L. C. Ryan, A. H. Told, W. M. Mitchell, Jr.; W. A. Wallace, C. J. Webb, W. Harding Davis.

The Protective Signal Mfg. Co., Denver, Colo.—Space No. 158. Exhibit: Highway crossing signal complete, including wig wag bell, relays, track instruments, masts, relay box; type "C" oscillators: time relay units; alternating and direct current signal devices; automatic thermo time units, highway crossing bells. Representatives: D. R. Morris, W. C. Neahr, A. M. Adams.

Pyrene Mfg. Co., New York City—Space No. 186. Exhibit: Pyrene fire extinguisher, safety cans, oily waste cans, $2\frac{1}{2}$ -gal. soda and acid extinguisher, 40-gal. chemical tanks, fire hose, fire buckets, fire axes, water and sand. Representatives: J. D. Cole, R. G. Henderson, H. B. Boykin, E. L. Kent, G. C. Breidert, W. B. Paulson.

The P. & M. Co., Chicago, Ill.—Space Nos. 122, 123. Exhibit: P. & M. rail anti-creepers (or rail anchors), bond wire protectors. Representatives: F. A. Poor, P. W. Moore, F. A. Preston, A. R. Sutter, G. E. Johnson, D. T. Hallberg, R. W. J. Harris, H. G. Warr, F. N. Baylies, R. D. Hawley, A. B. Griggs, W. C. Lynch, L. S. Walker, R. J. Mercur, F. C. Webb, G. A. Macpherson, J. W. Dodge, R. H. Johnson, J. E. Mahoney, J. Ritchie, W. W. Glosser, J. Reagan, C. J. Duggan, P. V. Samuelson.

The Q. & C. Co., New York City—Space Nos. 120, 139. Exhibit: Bonzano rail joints, rolled steel step joints, insulated joints, guard rail clamps, guard rail bracers, Samson rail benders, portable rail saws (hand and power), derails (adjustable), Vaughan rail anchor, Peffers air brake hose protector, magnetic wig-wag crossing signal. Representatives: L. T. Burwell, H. A. Hawes, W. W. Hoit, A. R. Horn, F. F. Kister, E. R. Packer, G. T. Pool, C. F. Quincy, Edmund Quincy, A. Robertson, Edgar M. Smith, J. V. Wescott.

The Rail Joint Co., New York City.—Space Nos. 81, 82. Exhibit: Continuous, Weber, Wolhaupter and 100-Percent rail joints. Representatives: L. F. Braine, Percy Holbrook, Benjamin Wolhaupter, W. Paton Thomson, McLeod Thomson, G. C. Isbester, E. A. Condit, Jr.; R. W. Payne, J. G. Miller, E. L. Van Dresar, J. C. Barr, F. C. Webb, V. C. Armstrong.

The Railroad Supply Co., Chicago, Ill.—Space Nos. 85, 104. Exhibit: Chicago derailer, rolled steel tie plates, automatic flagman or wig-wag, electric highway crossing bells (gong and locomotive type), trolley contactors, interlocking relays for steam and trolley road service, channel pins, resistance units and other signal accessories, battery and relay housings. Representatives: E. H. Bell, G. M. Kenyon, H. G. Van Nostrand, H. M. Buck, G. W. Nibbe, Geo. T. Cook, R. S. Prentice, F. C. Webb, J. M. Fitzgerald, A. H. Smith.

Railway Age Gazette, New York, N. Y.—Space No. 45. Exhibit: Railway Age-Gazette, Maintenance of Way Daily, Railway Signal Engineer, Railway Electrical Engineer, Railway Mechanical Engineer, The Signal Dictionary. Representatives: Edw. A. Simmons, Samuel O. Dunn, Lucius B. Sherman, Henry Lee, E. T. Howson, C. R. Mills, F. H. Thompson, H. H. Marsh, H. F. Lane, R. E. Thayer, H. H. Simmons, Frank S. Dinsmore, W. S. Lacher, J. M. Rutherford, G. L. Lacher, John N. Reynolds, A. F. Ashbacker, B. W. Matthews, John H. Cross, M. S. Foote, T. E. Crossman.

Railway Periodicals Co., Inc., New York City—Space No. 185½. Exhibit: Railway Engineering and Maintenance of Way, Railway Master Mechanic, The Monthly Official Railway List. Representatives: Ernest C. Brown, J. A. Kucera, C. S. Myers, J. W. Barbour, L. A. Horswell.

Railway Review, Chicago Ill.—Space No. 64. Exhibit: Railway Review. Representatives: Willard A. Smith, Harold A. Smith, W. M. Camp, Charles S. Bates, J. E. Gougeon.

Ramapo Iron Works, Hillburn, N. Y.—Space No. 110. Exhibit: Track work, automatic safety switch stands, manganese reinforced switch points, rolled shoulder switch riser plates, manganese insert frog, guard rail clamps, etc. Representatives: W. C. Kidd, Thomas E. Akers, J. Edgar Davidson, Arthur Gemunder, James B. Strong.

Reading Specialties Co., Reading, Pa.—Space Nos. 7, 8. Exhibit: Rail benders, car replacers, guard rail clamps, tie spacers, compromise joints. Representatives: J. Turner Moore, M. G. Moore, B. J. Buell, Henry G. Fennell, Daniel H. Fowler, A. S. Flowers, Atkinson & Uteck, the Herr-Rubincam Supply Co.

Roberts & Schaeffer Co., Chicago, Ill.—Space No. 48. Exhibit: "RandS" measuring loader for locomotive coal, Beamer patent steam sand dryer, photographs and diagrammatic drawings of standard counter-balanced bucket locomotive coaling plants and "RandS" gravity sand plants. Representatives: Clyde P. Ross, H. S. Shimizu, E. E. Barrett.

Sanitary Bunk Co., Indianapolis, Ind.—Space No. 205.

Sellers Mfg. Co., Chicago, Ill.—Space No. 124. Exhibit: Tie plates. Representatives: George M. Hogan, R. A. Van Houten.

Signal Accessories Co., New York City—Space No. 118. Exhibit: Triplelock switch machines, Bossert switch adjustments, SACO enameled steel signal blades, Welday adjustable rail braces, triplepath lighting arresters, black brand signal friction tape, P-L rounded protectors, Rapp foundation extensions, Ziegler relays, electric light automatic cut-in relays, resistance units, general signal accessories. Representative: F. C. Lavarack.

Simmen Automatic Railway Signal Co., Buffalo, N. Y. —Space Nos. 5, 6. Exhibit: Simmen dispatcher's table for controlling signals on moving trains and for recording the movement of trains in the dispatcher's office, model of the Simmen cab signal in operation. Representatives: P. J. Simmen, C. E. Chatfield, L. Ringer, G. P. Simmen, W. H. Crawford.

T. W. Snow Construction Co., Chicago, Ill.—Space No. 46. Exhibit: Water columns, oil columns, tank hoops, etc. Representatives: T. W. Snow, Barton Snow, W. A. Lathrop.

Southern Pine Association, New Orleans, La., Space Nos. 203, 204, 211, 212. Exhibit: Samples of pine illustrating new density rule; examples of service tests of creosoted piling; fence posts, bridge timbers, crossarms, etc.; samples of new creosoted material, track sections showing modern methods of using creosoted yellow pine for track purposes, including standards of the P. & L. E. and the D. L. & W.; samples illustrating improper uses of longleaf pine and pine, leading to failure; samples illustrating service tests with creosoted wood block paving for both outdoor and shop purposes; representatives, Arnold Von Schrenk, J. C. Valadie, Mr. Pendleton.

Willis C. Squire & Co., Chicago, Ill.—Space No. 160½. Exhibit: Stop and waste hydrants and hydrant valves; switch and water service thawing outfits; portable oil burners. Representatives: Willis C. Squire, E. P. Cogswell, G. A. Nelson.

Standard Asphalt and Rubber Co., Chicago, Ill.— Space Nos. 161, 162. Exhibit: Waterproofing, mineral rubber floors, insulation, roadways. Representatives: Robert F. Trumbull, R. E. Kartack.

Standard Underground Cable Co., Pittsburgh, Pa.; Space, No. 18; Exhibit, Wires and cables for electrical purposes and cable terminals; cable junction boxes, etc. Representatives:

Staple Post Mold Co., Westerville, O.—Space No. 160. Exhibit: Molds for the manufacture of concrete posts, accessories. Representatives: H. L. Pettit, R. B. Bennett.

Templeton, Kenly & Co., Ltd.—Space No. 113. Exhibit: Simplex jacks for cars and tracks; Simplex emergency jacks; Simplex pole jacks. Representatives: W. B. Templeton, J. H. Hummel, A. C. Mills.

The Titanium Alloy Mfg. Co., Niagara Falls, N. Y.— Space No. 15. Exhibit: Ferro carbon-titanium, titanium aluminum bronze castings, bronze castings: Representatives: H. H. Cook, A. C. Hawley.

Track Specialties Co., New York City.—Space No. 206. Exhibit: "Superior" rail joints, "Superior" compromise joints. "Trasco" insulated joints, "Superior" derailer, "Trasco" guard rail clamp, "Trasco" guard rail brace, "Superior" padded tie plate, "Superior" rail benders. Representatives: W. B. Lee, John A. Bodkin, W. M. Osborn, R. L. Mason.

Tyler Underground Heating System, Pittsburgh, Pa. —Space No. 181. Exhibit: Section concrete tunnel piped for steam and hot water; section 1, pipe ditch construction for steam or hot water; section 2, pipe (steam and return) ditch construction for steam, anchors, expansion joints with bored guide and support for follower, wall brackets to hold one, two or three pipes, samples ditch casing one inch to twenty-four inches, samples tunnel and outdoor casing, condensation meters, steam traps. Representatives: E. B. Tyler, E. M. Hatheway, C. E. Stewart, J. W. Copeland, W. T. White.

The Union Switch & Signal Co., Swissvale, Pa. Space Nos. 41, 42, 43, 60, 61, 62. Exhibit: Interlocking Machines: type "F," model 14, electro-mechanical type "P-4," two-unit push-button machines;—Ground Signals, top post styles "T-2" A.C. three position, "T-2" D.C. 3 position upper quadrant signal, electro-pneumatic, three position, ground signals, style "B," A.C. 11-volt 60-cycle left-hand upper quadrant, traction type, style "S" D.C. with case, instruments and interior wir-



ing;-Position Light Signals: A.C. model 14, with instruments and internal wiring, dwarf with adjustable reflectors;-Switch and Lock Movements: electro-pneumatic, rack and pinion type, model 13-A, 110-volt D. C. with de-energized and point circuit controllers, model 13-A D.C. 20 volts, type "G" with post lock, electropneumatic direct acting, controlled from two-unit pushbutton machine;-Switch Circuit Controllers: Universal, two and three positions, and vertical rotary;-Circuit Controller, interlocked, 3-unit; Keystone insulated rail point; automatic regulator for alternating current track circuits; phase meter, for measuring phase angles on alternating current track circuits-Relays: model 12 A.C. polyphase track two position, model 12 A.C. polyphase track three position, radial polyphase A.C. track three position, model 16 A.C. line, model 15 A.C. three position vane type, model 16 vane type interlocking 4 front and 2 back contacts each side, A.C. standard vane track for steam roads, galvanometer A.C. track two position, model 16 brakeless centrifugal, model 12 D.C. polarized, model 13 D.C. four point, model 13 D.C. two point high voltage contacts, model 12 D.C. interlocking; 75 and 200 volt ampere track transformer, air-cooled, enclosed type-Impedance Coils: electric road type 600-volt amperes, steam road types 100 and 300-volt amperes—Adjustable Track Resistances; Electric Locks, model 12 A.C. and D.C.; Clock Work Time Release; Tower Indicators, A.C. "Z" armature semaphore type, A.C. "Z" armature disc type, model 11 D.C. with three front and two back contacts, model 11 D.C. with five front and four back contacts. model 11 D.C. with eight front and two back contacts-Forgings: railway signal appliances, automobile parts, aeroplanes, general forgings-Keystone insulated rail joint, model 14. Representatives: W. D. Uptegraff, T. W. Siemon, J. S. Hobson, C. E. Denney, G. A. Blackmore, W. H. Cadwallader, Aaron Dean, J. P. Coleman, H. W. Griffin, J. J. Cozzens, C. O. Harrington, H. R. Sheene, H. A. Wallace, R. P. Tuttle, L. F. Howard, J. E. Saunders, W. Zabel, W. W. Talbert, S. E. Gillespie, J. D. Roett, George Marloff, H. A. Hamilton, J. F. Talbert, J. L. Loucks, J. T. Mallanny, J. H. Deming.

U. S. Wind Engine and Pump Co., Batavia, Ill.—Space Nos. 111, 112. Exhibit: Curtis double acting pumps, deep well working barrel or cylinder, ground switch stands, low semaphore switch stands, foot latch for switch stand, model windmill pumping outfit, model of tank and tower outfit, model of 12 post railroad tank structure with tank and outlet fixtures, round, halfround and flat tank hoops, water column with telescopic spout, positive and hydraulic water column valves, samples of pine, fir and cypress tank lumber. Representatives: L. E. Wolcott, C. E. Ward, G. E. Vermilyer, J. P. Prindle, Jr., F. E. Pearson.

Verona Tool Works, Pittsburgh, Pa.—Space No. 129. Exhibit: Track tools, gauges, levels, jacks, nut locks, rail anchors. Representatives: H. S. Paul, H. Fischer, E. Woodings, H. C. Mull.

Wayne Oil Tank and Pump Co., Fort Wayne, Ind.— Space No. 171. Exhibit: Self-measuring oil pumps and tanks for storage in connection with railroads. Representatives: B. F. Geyer, J. B. Beall.

Western Electric Co., New York City—Space Nos. 4, 19. Exhibit: Complete train dispatching telephone equipment; typical samples of incandescent lamps and maintenance apparatus pertinent to telephone work, such as cross-arms, poles, glass insulators, etc. Representatives: G. H. Porter and G. K. Heyer. Wm. Wharton, Jr., & Co., Inc., Easton, Pa.—Space Nos. 68, 69. Exhibit: Tisco manganese steel frog, of solid and insert designs, W-J switch stands, guard rail clamps, split switch with Tisco manganese steel tips and equipped with Wharton-O'Brien insulated lock and pulling rods, adjustable rail braces and several styles of regular braces, Wharton-O'Brien insulated pulling and lock rods for double slip switches. Representatives: Arthur S. Partridge, H. F. McDermott, S. G. Llewellyn, Robert C. McCloy, D. L. Swank.

Yale & Towne Mfg. Co., New York City—Space No. 157. Exhibit: Triplex hoists, railway padlocks, switch locks, signal box locks, cabinet locks, night latches, door closers, station hardware. Representatives: Wm. J. Nahrwald, W. C. Bigelow, J. H. Bricker, R. J. Kleinsmid, W. A. Lockwood.

Architecture in Railroad Engineering Work Development of Stations from Purely Utilitarian to Artistic and Convenient Public Building

Architecture in railroad work as here presented is not intended to be a discussion of ethics of architecture, nor of the merits of any one designer as compared with the merits of any other designer, but is intended to be more in the nature of a history of the development of architecture in railroad work and of the efforts of architects to design railroad buildings, for whatever use they were intended, that should be economical from a constructive point of view, having low maintenance expense as well as long life, and with all an artistic exterior, and interior as well, that is in keeping with the locality within which the building is placed and that is best adapted to serve the purpose for which it is intended.

These were the opening remarks of Mr. F. M. Davidson, architect of the Boston & Albany, at a recent meeting of the New England Railroad Club. We are able to present a brief review, as follows. He said among other things:

"There are records in the B. & A. files which show that architectural services were rendered as far back as 1840, but apparently this was only in the design of an occasional station. It may be noted here that the development of architecture in this direction has been coincident with the development of the railroad. When the first railroad was completed from Boston to Worcester the prime object of the road was traffic, and the stations were modest wooden affiairs of relatively cheap construction; but as business grew and the importance of the railroad increased the necessity for increased facilities for handling the business became apparent and the services of the architect were sought with ever increasing frequency. But even then the stations were as a rule built of wood, with now and then one of brick.

"Some old stations now in use as freight houses, for instance, Auburndale, was built in 1850, West Newton in 1850, East Brookfield and West Brookfield somewhere between 1841 and 1846, Rochdale 1838, West Brimfield probably in the early 'forties' and Brighton at a later date, 1858. Cottage Farms was built so long ago that nobody remembers. In 1864 a new station at Foster St., Albany, for joint occupation was built by the Boston & Worcester, the Norwich & Worcester and the Worcester & Nassau. Later a new station was built, a part of which is now standing. When this station was erected, it was considered from an architectural point of view as one of the show stations of the country. The lines of the tower were so good that it became a land mark. The railroad, owing to the wishes of the citizens of Boston kept a portion of the head house and the tower, when the new station was built.

At this time many railroad stations were built of which there had been no plans, but only a rough sketch. As an example one may mention the case where a rough sketch made by a foreman carpenter to show to the general superintendent, was all there was. Now every railroad has its standard stations, freight houses, engine houses, and other buildings are to-day built from standard plans. Up to fifteen years ago no buildings except stations on the B. & A. were designed by architects, and these were commissions given to regular practising architects, who designed the station and supervised the construction.

Owing to the advent of the important work of grade crossing elimination at important points, and the development of facilities on the water-front, involving the alteration of large and expensive buildings and the construction of many new buildings it was decided to try the experiment of having an architect on the pay-roll of the construction department, and the speaker was engaged in February, 1901, as the experiment, being told at the time that it was an experiment and might be good for one week or for life. Since 1901 practically every building erected on this railroad has been designed and the construction supervised by the railroad forces. As to the success or failure of the experiment it can only be said: that it has been demonstrated time and time again that the road is saving money, that is in salaries as compared with architects commissions.

There is no man in the profession who has a greater variety of structures to deal with than the railroad architect, and the number of complex situations having to be met is multitudinous. Railroad men know that the architect has to please the president, the vice-president, the general superintendent, the general manager, probably the chief engineer, and the signal engineer and all the other officers of the road as well as the public.

Railroad buildings should be economical from a constructive point of view, having low maintenance expense, etc. The principle that the best is the cheapest in the long run, and also that cheapness is not necessarily economy, is the view taken. Of course, a flagman's shanty on a cross road out a hundred miles in the woods, may be cheap and probably unattractive, but a building for the accommodation of the American Express Company on a principal street in Worcester, Mass., must be as nearly fireproof as possible and in keeping with the other buildings in the vicinity, and as expensive as the conditions warrant.

The majority of the B. & A. buildings were made to be fire resisting as far as possible, at least on the exterior. Reinforced concrete is a predominant part of station buildings and on Mr. Davidson's road he reported it to be as satisfactory a structuray material as any. The company, however, built an interlocking signal tower of concrete, but discontinued the subsequent use of this material, as the problem of building extension did not seem to be solved by the use of a monolithic structure. Brick was found to be better suited to requirements of the case.

Great improvements have been made in the matter of heating, lighting and ventilation of buildings. The old style hot air furnace, like the car stove, has practically disappeared. If used at all, the registers are placed at such a height as to be above a man's head, in the walls of the building. Steam for heating and electricity for lighting are installed in their latest forms wherever it can be done.

In the discussion that followed, Mr. Murphy pointed out that architectural development has kept pace with that in the other lines of railroad work. It is very interesting to study the gradual progress from the purely theoretical design of a station apparent in the first buildings after the 1840 crop, which were the first designed by architects. These were evidently built after an architect drew a perspective and then fitted the interior to it. If the station was dark, the architecture was good; if the plumbing was not very good, the building looked well from the outside; if the heating was not very good, it could be remedied later. As things kept growing, the architect began to realize more and more that the object of the station was to please the public, not only as to outward appearance, but also as to convenience. The use of more elaborate heating systems and electricity brought in new problems, and the mechanical engineer became a very great help and an important factor in the design and construction of stations. We have now come to the point where a station is designed by planning the facilities first and drawing the perspective later. The result has been very good. We have stations that have plenty of natural light, that are well ventilated, that are well illuminated, that are well heated, and that are so built that the maintenance costs have come down considerably.

It might be well to say a word about the low platform arrangement. On the New York Central some high platforms are used, but the question has been carefully studied and the lifting of baggage to the high level platform has been considered. Platforms are now made on this road, one foot above the tie, and the distance from the center track to the edge of the platform has been so determined that while the platform does not encroach on the largest coaches, it is near enough to the steps of a car not to endanger a woman or even a child falling between car and platform when stepping aboard.

Following, Mr. Pearson said it is a difficult matter for any architect to design a station that will suit everybody. In one station the large arch was designed by Mr. Richardson, designer of Trinity Church, who was considered one of the foremost architects of this country. Another station was designed by Bradford L. Gilbert, who was considered a very fine architect. To design a station that will accommodate every one, so that you can get your baggage checked, buy your ticket, catch your train in three minutes is almost impossible. One of the recent stations that we constructed was by request of the local people designed to accommodate them and to carry out their wishes. The result was it was built between two public streets, with a granolithic sidewalk 900 ft. long connecting the two streets, and the principal features they insisted on and that afterwards proved to be of great help, were, first, that the toilet rooms should be handy to one entrance and the drinking fountain should be handy to the exit, the idea being that people would go in one door, use all the facilities and pass on.

H. S. Norris has recently been engaged by the C. A. Willey Co., Long Island City, N. Y., as manager of railway sales. He will have charge of their line of railway paint specialties. His resignation from the U. S. Metal & Manufacturing Co., New York, takes effect Feb. 15.

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The National Indicator Co., 852 Vernon avenue, Long Island City, N. Y., whose factory was recently destroyed by fire and whose models, in preparation for the National Railway Appliance Association convention, were destroyed at that time, reports that very satisfactory progress is being made in rebuilding their factory. More light and better manufacturing facilities will be a great advantage in making their specialties. A new apparatus is being installed for applying a rustproof coating to all machines. It is expected that the plant will be in operation by April 1st.





Pneumatic Tie Tampering Machine

The Ingersoll-Rand Co., 11 Broadway, New York, have recently placed on the market the "Imperial" pneumatic tamping machine which has proven the means of materially reducing the cost of track ballasting and main-



"Imperial" Compressor Mounted on Section Car

tenance. The replacement of hand labor with machines has become the fixed policy of nearly every upto-date railway company. In the coming season, with the abnormal shortage of unskilled labor, due to present conditions, this will be brought out more strongly than ever.

These tampers are operated in pairs, one on each side



Operating "Imperial" Pneumatic Tie-Tamper in Close Quarters Around Switch

of the tie as shown in the first illustration. The operation of the tool is a rapid hammer action on the tamping bar which in turn compacts the ballast and forces it down and under the tie. It is the practice to tamp each tie a distance of about 16 to 18 ins. either side of the rail. Observations made on a railroad where new track was being raised from 2 to 3 ins. on stone ballast, showed an average of 240 ties tamped per nine-hour day, at a total cost of 2 cents per tie. One of the particular advantages in the use of pneumatic tampers is the ease with which they operate in cramped quarters such as switches, frogs and crossovers. These are all places where hand tamping, to be well done, is a very difficult and in some cases a practically impossible task.

For operating these tie tampers the Ingersoll-Rand Co. builds a special "Imperial" compressor unit in two styles. The ordinary outfit used is the gasoline motor driven type. This consists of a handcar mounted vertical air compressor with reservoir cooling system direct conected to a gasoline motor. Suitable air receiver and piping are included. This compressor is designed to operate two tamping machines. A larger size capable of operating four tampers has recently been brought out. Both of these compressor cars are self-propelled and capable of transporting the section gang to and from their work.

An electric motor driven type is built for service where electric current is more convenient. The tamping machines are very economical in air consumption and it has been found practicable to operate them from switch and signal service air lines without interfering with the operation of signals, etc.

The manufacturers state that track tamped with "Imperial" tie tampers will be more evenly ballasted, that the ballast will be more finely packed and that the settlement of trackage will be much less and far more uniform than with hand tamping. The machines handle stone, cinder or other ballast with equal effectiveness.

Fairmont Gas Engine and Motor Car Co., Fairmont, Minn., have placed on the market a mowing machine, No. 24, for cutting weeds along the right of way. The illustration shows the machine cutting a heavy growth



Fairmount Mowing Machine No. 24 Cutting South Dakota Sunflowers

of Kansas sunflowers. The machine mows weeds and grass on both sides of the track at the same time, cutting a 6-ft. strip outside the weed line, at a rate of three miles per hour. Varying slope of the grade makes no difference. One man on each side of the machine operating two levers can easily raise or lower or vary



the angles of the cutter-bars so that they will follow the ground perfectly, while the machine cuts right along without stopping. The bars can be very quickly raised to avoid obstructions. With the cutter bars raised the machine will travel 15 miles per hour in high gear. During portions of the year when there is no grass to cut the engine can be removed and installed on an ordinary section car. One of these cars will take care of the weed cutting on 500 miles of track.

Time Element Relay

The Union Switch and Signal Co., Swissvale, Pa., have recently developed a time element relay which recognizes the importance of train speed as a factor in determining whether certain train movements may safely be made, and which makes the signal aspect dependent upon the speed of the approaching train as it enters the block governed by the signal, by measuring the time required to traverse the length of block. This idea has been proven highly advantageous as a means for safely facilitating traffic under certain conditions of traffic congestion.



Time Element Relay

This "time element" relay comprises an operating movement consisting of an induction motor type line relay of rugged construction, and a retarding device connected between the operating movement and the relay contacts, so constructed that a definite time interval is interposed between the time that the energy is applied to the relay and the time that the relay closes its front or opens its back contacts. This time element may be adjusted without opening the case to any value up to 30 seconds. The retarding device is so designed it is almost wholly immune to variation due to changes in external conditions, and operates in a uniform time irrespective of variation in the voltage or frequency applied to the relay.

----*---Vane Type Interlocking Relay

The Union Switch and Signal Co., Swissvale, Pa., has developed a new alternating current interlocking relay possessing many features, which give it a wide application. This relay embodies all the well-known operating

characteristics of the Union Co.'s standard direct current interlocking relay, having substituted for the D. C. magnets the simple A. C. vane operating elements. In the case of simultaneous de-energization of both sides of the relay, both sets of back contacts cannot be held open on account of the special locking construction.



Mechanism of Vane Type Interlocking Relay

The new Model 16 Vane type interlocking relay is positive in the operation of the contacts and is free from any possibility of the locking arms being improperly released. The construction of the vane operating elements is essentially that of the standard Union single element vane relay, which does not respond to direct current. The vertical position of the air gap between pole faces and vane insures against the collection of dust or small foreign particles which might obstruct



Contacts of Vane Type Relay

the moving element. This relay is provided with a top plate of insulating material which carries the locking device, the two vane elements and the terminal posts. The terminal posts are non-turning and conform to R. S. A. requirements. Each side of the relay can be

provided with four front and two back graphite to graphite, metal to metal, or metal to graphite contacts, as required.

Either or both sides of this relay can be wound for operation on any of the usual frequencies and for any potential up to 220 volts. This makes it suitable for use on either electric or steam road track circuits or for control from line circuits. The coils are formwound and especially insulated. They will withstand a ground test in excess of R. S. A. requirements.

In brief, this relay with its adaptability, simplicity of construction, unresponsiveness to direct current, and reliability of operation should produce a highly satisfactory alternating current interlocking relay.

Low Voltage Switch Movements

The Union Switch and Signal Co., Swissvale, Pa., have presented a solution of the problem of properly protecting the switch at the entrance of a passing siding by some means other than by the use of handoperated switches and electric locks. A hand-operated switch necessitates the stopping of the train so that the trainmen may open the switch. This stop, together with that incidental to the closing of the switch on leaving the siding, keeps the train on a given section several minutes longer than would be necessary if some



Low Voltage Switch Movement

means of power operation of the switch were provided, to say nothing of the resultant wear on apparatus and waste of coal. The installation of a high voltage D. C. switch movement is not to be considered on account of the cost of installing and maintaining the necessary storage battery.

These difficulties have been overcome by the use of a low voltage switch movement, one of which is on exhibition at the Coliseum. This machine is designed to operate on 20 volts storage or primary battery and may be controlled from the lever of any kind of interlocking machine or by a simple double throw knife switch.

The control used requires only three wires between the tower and the switch for the control of the switch movement and the three signals that are necessary for the protection of traffic over the switch. The switch cannot be thrown unless all signals are in the full stop position and the track unoccupied. A signal cannot be cleared unless both the switch movement and the relay controlling it are in such a position as to insure safe movement of trains over the route governed by the signal; that is, they obtain complete S. S. control which for a long time has been recognized as one of the safest principles of power interlocking.

An indicator in the tower conveys to the tower man all necessary information in regard to the operation of the switch and signals and indicates the acceptance of a signal by a train or the departure of a train from the section. The switch movement itself is in keeping with very high standards of design, material and workmanship. The motor is rugged in construction and can be left blocked indefinitely without injury on 32 cells of primary battery. This condition might exist in case the switch became jammed in mid-stroke. Another attractive feature is the terminal board near the wire inlet. This feature is common to all of the Union's Model 13A switch movements. With this arrangement all of the internal wiring is done before the movement leaves the factory so that all connection at time of installation is made to terminal posts near the wire inlet.



L. M. Booth Co., New York, have recently issued a 16-page illustrated bulletin, S-15, on their Type F Water Softener. The bulletin illustrates a number of installations of Booth Continuous Type Water Softeners, which automatically furnish a complete daily measurement record of the water purified, the chemicals used, etc. The construction and operation of typical plants and the method of determining the proper type of installation is considered.

Chicago Pneumatic Tool Co., Chicago, Ill., have recently issued a four-page bulletin describing the Duntley Universal Electric Hammer Drill, which will operate interchangeably on direct or alternating current. The hammer blow, which is delivered by a piston on the drill or chisel, is produced by pneumatic impact and is very effective. Suitable tools for use in the hammer are also described.

The Columbia Nut & Bolt Co., Bridgeport, Conn., have recently issued a 24-page illustrated booklet describing, in addition to their original Columbia Lock Nut and Improved Columbia Lock Nut, their new Columbia Jib Nut Lock and Kling Bolt. The jib nut lock is a threethread nut with a bent edge on each side, made either square or hexagon. The Kling bolt has a divided head, which permits the head to be put through a hole the size of the bolt and lock, where only one side of a sheet, to which something must be bolted, is accessible.

The D & A Post Mold Co., Three Rivers, Mich., have issued for the convention an illustrated folder describing the equipment and supplies for manufacturing "D & A" reinforced cement fence posts for railway service.

Thomas A. Edison, Inc., has issued through the Primary a Battery Division, at Bloomfield, N. J., a 20-page illustrated catalogue, No. 3043, on primary cells, renewals and parts, giving, with details of construction and prices, the component parts of primary batteries and battery systems, as well as information on which to base the proper selection of the type of battery best adapted to any given requirements of service.

The Fibre Conduit Co., Orangeburg, N. Y., have recently issued an 84-page illustrated catalogue describing in detail the advantages, construction and installation of Orangeburg fibre conduits.

The Hatfield Rail Joint Manufacturing Co., Macon, Ga., have issued for the convention a 6-page illustrated bulletin on the Hatfield rail joint, rail joint fasteners, and crossing and frog fastenings, which describes the Hatfield method of using high tension heavy coil springs with a vibration bar and reinforced angle bar.

The National Metal Molding Co., Pittsburgh, Pa., have issued an illustrated linen-backed wall chart showing conduit charts as adopted by the National Electrical Contractors' Association, showing sizes of conduit required by the National Electric Code.

T. W. Snow Construction Co., Chicago, Ill., have issued for the convention a four-page illustrated circular on Rivetless Tank Hoop Lugs, which describes lugs for oval and flat hoops, held by two bolts, and which illustrates the types and their applications.

Standard Oil Co. (of Ind.), Chicago, Ill., have recently issued a 16-page booklet dealing with the composition, characteristics and service-giving qualities of their new Fortnite Long Time Burner Oil for signal burners. Some data from tests is included and considerable information in regard to the economy that can be effected both in oil and maintenance labor by the use of this grade of signal oil.

The Track Specialties Co., 29 Broadway, N. Y. City, have recently issued a 16-page booklet containing an article by Wellington B. Lee, M. Am. Soc. C. E., giving simple and accurate rules for the computation of shortened switch leads and some information on the subject of derailers.

Tyler Underground Heating System, Pittsburgh, Pa., have recently issued an architect's and engineer's data sheet containing a number of sectional drawings, diagrams and tables of value in laying out and constructing underground heating systems. The sheet is divided into 61 detail drawings and tables and contains a wealth of valuable information on their system.

Book Reviews

The Civil Engineer's Pocket Book, by John C. Trautwine, C.E.; revised by John C. Trautwine, Jr., and John C. Trautwine, 3rd, C. Es.; 19th edition; third issue. Published by Trautwine Co., Philadelphia, Pa. Price, \$5.

The Trautwine Civil Engineer's Pocket Book holds an old and honorable place in the engineering world. It has grown with the passing years, and now has 1,257 pages of condensed and valuable matter, covering every phase of the requirements of the profession. The books is about $6\frac{3}{4} \times 4\frac{1}{2}$ ins., bound in Morocco leather, gilt edge, and is thumb-indexed, so that any one of sixteen subjects can readily be found without practically opening the book. The first edition appeared in 1872. The index at the end of the book is compiled with a view of being thoroughly comprehensive, and embraces 47 pages.

Among the easily found general heads are: The theory of mathematics and geometry, weights and measures, surveying, physics, statics, strength of materials and hydraulics. Practice deals with engineering operations, such as dredging, building, structures, etc. -in short, doing work in the open. The letters W. W. refer to water works, such as dams, reservoirs, pipes. hydrants, etc. Trusses take in bridges of all kinds and

neat little line illustrations of bridge types tell this story at a glance. Railroad work is handled exhaustively with tables, illustrations and figures. Material comprises characteristics of iron and steel, shapes, tests, tables, etc. Under the head of costs is an indication of average prices and business directory, in which the various kinds of materials and the representative names of supply houses, a bibliography or list of books intended to be usefully suggestive to the civil engineer closes that department. A very full and complete line of information on the important subject of concrete occupies 126 pages, and is a matter not always to be had in as full and complete form. The matter is necessarily new, as the art is comparatively young and accurate data is not readily accessible.

This brief survey of the work is of course incomplete and fragmentary, as the only real description of the book is the book itself. In the introduction to "Engineer's Field Manual," prepared under the direction of the Chief Engineers, U. S. Army, reference to the book before us is made among the list of authorities. The reference is to "a single work seems to deserve further mention, and that is the incomparable 'Trautwine,' the indebtedness to which is too obvious to require mention, but too important to permit it to be dispensed with." Not only are the formal topics fully treated, but all through information is available which gives internal evidence that the authors have left no stone unturned in their search for full, reliable and authentic evidence of their facts and figures.

Engineering as a Career. This is a series of papers by well-known engineers, and the book has been edited by F. N. Newell, Professor of Civil Engineering in the University of Illinois, and C. E. Draper, Secretary the Cleveland Engineering Society. Published by D. Van Nostrand Co., New York. Price \$1.00 net.

This work is a guide for young men and a reference book, as it were, for those of experience. The separate articles, which are short and to the point, are by representative men who have been successful in the engineering field. Frequent requests for such a work is the reason for its publication. It therefore meets a want. It is really a book of experiences, and in each article we see how the writers gained the success which was their original aim. It is an interesting book to have at hand always.

Concrete. By John C. Trautwine, Jr., and John C. Trautwine, 3rd, civil engineers. First Edition, 1916. Trautwine Co., Publishers. Price, \$1.00.

This book on concrete is reprinted in convenient form from Trautwine's Civil Engineer's Pocket Book and contains not only the specific part on concrete, but kindred and allied topics from the Pocket Book have been incorporated in "Concrete." Some of these are strength of materials, mortar and cement mortar, experiments, specifications, cost, price list, business directory, bibliography and index. The whole subject of concrete is very fully dealt with, not in the narrative style, divided into chapters, as in ordinary books on the subject, but in the Pocket Book style, and it has been said of this book that it is believed to contain a more complete and more conveniently classified presentation of modern practice in concrete, both plain and reinforced, than is to be found elsewhere in equal space. This book appeals to the engineer who is especially devoted to concrete structures or has concrete work to do on railways. It is a "concrete" pocketbook in condensed and convenient form, and ought to be of great use to the profession



Personal Items for Railroad Men

A. Astle, recently appointed roadmaster of the Moncton and New Castle division of the Intercolonial Railway at New Castle, N. B., entered the service of the Canada Eastern in 1893 as a sectionman. In 1895 he was appointed section foreman and in 1904, when the Canada Eastern was taken over by the Intercolonial Railway, he was put in charge of large gangs making extensive repairs to the road. In 1911 he was appointed roadmaster and remained on that division until has recent appointment, succeeding A. P. Giles, superan-

F. V. Berkey, recently appointed assistant engineer

of the Indianapolis Terminal and Vincennes division of the Vandalia Railroad at Indianapolis, entered the service of the Pennsylvania Lines west in 1903 as assistant in the engineering corps in the Logansport division and later served in a similar capacity on other divisions. In 1914 he was appointed assistant division engineer of the Zanesville division from which he was promoted to his present appointment, in which he succeeds H. B. Kester, transferred to the St. Louis division of the Vandalia Railroad.

R. A. Black, recently appointed resident engineer of maintenance district No. 2 of the Canadian Government Railways at Campbellton, N. B., commenced railroad work with the Canadian Northern on their first location service southeast of Winnipeg. In 1898 he was appointed roadmaster on location work for the Canadian Pacific and served in various capacities until his appointment in 1902 as resident engineer of construction. In 109 he was appointed locating engineer for the National Transcontinental Railway. In 1910 he was made division engineer of construction and in 1913 assistant district engineer of District B, which position he held until 1915. In that time he was appointed resident engineer of District No. 5 of the Canadian Government Railways, where he remained until his recent transfer to District No. 2.

S. C. Grizzle, recently appointed roadmaster of the International and Great Northern Railway at Italy, Tex., entered the employ of that road in 1904 as section foreman. In 1905 he was made yard foreman and in 1908 was made extra gang foreman. In 1911 he was made general foreman of the Houston terminals, where he remained until his recent appointment, where he succeeds M. Kerr, who has left railroad service to engage in other business.

A. H. R. Howe, recently appointed division engineer of the Illinois division of the Baltimore and Ohio Railroad at Flora, Ill., entered the service of the Boston and Albany in 1903 and served successively as rodman, level man, inspector and transitman. In 1906 he entered the service of the Baltimore and Ohio in the chief engineer's office and in 1909 entered the government employ on the Isthmus of Panama as chief draughtsman on the Pacific division. In 1911 he took up his work again with the Baltimore and Ohio and later that year was appointed assistant division engineer of the Ohio division. In 1913 he was made division engineer of the Cincinnati Terminal division, and when that division was abolished in 1914 he was appointed master carpenter of the Ohio division, where he remained until in his present appointment he succeeds H. R. Gibson, promoted to the division engineer of the Indiana division. nuated.

William McNab has recently been appointed valuation engineer of the Grand Trunk Railway system at Montreal.

F. J. Meyer has recently been appointed roadmaster of sub-division No. 2 of the main line of the New York, Ontario and Western Railway.

J. S. Patrick, recently appointed roadmaster on the Minneapolis, St. Paul and Sault Ste Marie at Moose Lake, Minn., entered railroad service as a section laborer for his father, who is at present section foreman at Silver Lake, holding the record of 33 years of continual service. In 1910 Mr. Patrick entered the service of this road as assistant foreman and in 1911 was made extra gang foreman in charge of construction on new lines and terminal work, including the track and switch work of the Minneapolis, St. Paul and Sault Ste Marie elevated freight terminal in Chicago in 1913, and the rearranging and enlarging of the track lay-out in the Great Northern station in Minneapolis.

George V. Sneden, engineer maintenance of way of the New York & Long Branch R. R., at Long Branch, N. J., died recently at his home in Red Bank, N. J.

Ross Shaul, recently appointed supervisor of track for the Cleveland, Cincinnati, Chicago and St. Louis Railway, at Springfield, Ohio, had been previous to this promotion extra gang foreman for about three years, and before that timekeeper in the engineering force for some time.

H. E. Stafford, recently appointed general roadmaster of the Duluth, South Shore and Atlantic Railway at Marquette, Mich., was appointed roadmaster on the Nebraska division of the Chicago and Northwestern in 1886 and in 1890 was made roadmaster on the Duluth, South Shore and Atlantic. In 1907 he was appointed assistant superintendent, as the track department on that road was included in the organization of the transportation department. Recently a reorganization has placed the track department under the jurisdiction of the engineering department of the road, the position of assistant superintendent has been abolished and Mr. Stafford has been appointed general roadmaster.

A. O. Swift, recently appointed signal supervisor for the Chicago district of the Chicago, Milwaukee and St. Paul, entered the service of that road in 1898 in the bridge and building department. In 1906 he was transferred to the signal department and in 1909 appointed assistant signal foreman of the Chicago district. In 1910 he was appointed district signal foreman for the Chicago district, and when the Chicago district was recently made a supervisor district Mr. Swift was appointed signal supervisor.

RAILWAY ENGINEERING AND MAINTENANCE OF WAY WITH WHICH IS INCORPORATED ROADMASTER AND FOREMAN

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No. 4

Appreciation of the Conventions

The conventions are over and we can take stock of what has been accomplished. Perhaps more important than the concrete figures of attendance and the specific recommendations of committees is the atmosphere of co-operation that is fostered by such gatherings. Ours is a tremendously big country, and to maintain progress in various pursuits, as a unit, it is necessary that men come together to represent all of the sections, in forming policies which are to be national rather than local or provincial.

When one technically trained man from the extreme West, and another from the extreme East, bring their experiences to the same convention floor; when with them are associated hundreds of other keen minds from points between, all bent on the solution of some common problem, the diversity of their experience, and hence of their viewpoints, expedites the accomplishment of their purpose. The ideas and plans of the creative genius are matured under the guiding conservatism of the equally gifted analyst of experience.

The amount of really hard work done by the various committees in the preparation of their reports is not apparent when one glances at the finished product as it is presented to the association. Not only is the gathering of suitable and pertinent material a more or less difficult task, but the sorting, placing and appraising of its value is a slow and laborious performance, which taxes the abilities of the committeemen and takes up a good deal of time.

The work, however, when properly and efficiently done, creates a permanent value for the use of the every-day railway man, which he could never get were it not for the co-ordinated effort of the association as a whole. The thanks of the railway world is in reality tendered to the workers in many fields, as they place before the members the description of devices and methods and the explanation of how work is done, and the many difficulties encountered and overcome by men having the same end in view, but working in different parts of the country, and amid a variety of circumstances which is a powerful modifying factor in the result sought for.

The fruit of this labor of the few is made available to the many, and opportunity is afforded for question and explanation in arriving at a complete understanding. There is this business aspect to it, it is part of a healthy and pleasant experience. It is really education, but taken in under, one might say, most enjoyable circumstances, and knowledge so acquired, is retained.

Creosoting Railroad[®]Ties

In considering this important subject one has a better chance to understood it by taking what might be called a microscopic view of the structure of the tie, and this can be done by the exercise of what Tyndall called the "scientific imagination," which enables one to see in the mind's eye that which is not visible to the organ of physical sight. By Tyndall's process the tie reveals itself as composed of woody fiber separated by an immense number of minute pores or small, more or less circular passages parallel to the long, horizontal axis of the tie.

To the microscope the tie appears to be honey-combed with a series of channels like the cartridge case of an ordinary revolver or like the parallel barrels in the now obsolete French field piece, the mitrailleuse. This simile is not strictly accurate, because the barrels of the gun and the cartridge case of the revolver are machine-made, and these channels do not meet or intersect or run one into another. In red oak the channels may run continuously for long distances. In many species there are no continuous open channels or pores. The tie generally contains a multitude of approximately parallel channels, which during the life of the tree from which the tie was cut were the capillary tubes up which the nourishing sap of the tree was able to flow.

A tie cut from such a tree is more or less damp along these internal tubes and before the process of drying is completed it is likely to be attacked from within by some form of fungoid growth. Fungus is well known to be vegetable matter and germinates from a minute organism which always enters from without. One of the peculiarities of this plant-like growth is that it can live and multiply without any necessity for sunlight. Fungus is destitute of chlorophyll, or green coloring matter, so familiar to us in the verdure of the leaves and foliage of trees, flowers, shrubs and weeds. This green coloring matter, in the presence of sunlight, is able to separate the carbon from the carbonic acid of the air and apply carbon to the building up of its own tissues.

The absence of chlorophyll in the fungus prevents it from doing this, and restricts it to the absorbtion of the carbon from other organisms which have already assimilated it. A fungus is therefore compelled to live on matter in which the assimilation of carbon has already taken place, and an ordinary railroad tie affords it the very kind of sustenance it requires. The decay of timber is thus caused by the presence of some form of fungoid growth, which produces the condition which we call rot, and indeed other forms of decay may take place under appropriate circumstances.

The usual method of preventing this form of decomposition is by coating the internal surfaces of the pores of the wood with the oil of creosote. This is one of the important coal-tar products, and is a powerful antiseptic. The presence of creosote not only kills the minute organism from which the fungus grows but generally renders the dead wood of the tie entirely unfit for vegetable or animal life. From this fact it is easy to see that although the wood is saturated, as we say, with the oil of creosote, the physical fact is that the internal walls of the capillary tubes or pores of the wood are in reality "painted" over with a film of creosote. This is practically what takes place in the "empty-cell" creosote treatment. The "full-cell" treatment supplies enough creosote to entirely fill each pore of the treated wood.

The creosoting treatment may be very briefly described as subjecting the wood to a process which empties the ends and to a certain distance the pores, of the air contained in them, and in filling these minute spaces with the antiseptic, coal-tar product. The ties to be treated are placed in a large air-tight cylinder or tank and the air is then pumped out. So completely is the progress carried on that the air imprisoned in the pores of the wood escapes. The oil of creosote warmed or even made hot is then introduced into the air-exhausted receptacle containing the ties until it is quite full and the warm liquid readily impregnates the wood at the ends, and at least approximate, saturation is assured by afterwards pumping air into the tank and leaving the timber soaking in the oil of creosote under a pressure of perhaps from 100, 120 or 150 lbs. to the square inch.

Prof. Raphael Meldola, F. R. S., tells us that one cubic foot of wood absorbs about a gallon of oil. The actual quantity, of course, varies with the structure of timber which is treated and depends on the number and size of the pores in any species of tree and also depends on the method used for treating.

A process not unlike this is resorted to with pipes intended for water mains, where the coating of their internal surfaces is effected by dipping them into tar or asphaltum. The whole problem of tie preservation is thus seen to be the application of science in combating the tireless effort of Nature to provide for the perpetuation of even the lower and least developed forms of life. We cannot hope to outstrip Nature, but for industrial and economic reasons we may at least restrict her activity or partially delay for our own purposes the natural and inevitable deterioration of the timber which plays such an important part in the transportation systems we have devised. It is as if we had halted the flowing reel in a moving-picture machine and were rewarded by seeing only the immobile faces and figures of the actors held in unwonted but effective repose.

National Ownership of the Railroads

It would seem that there are at least three classes who are inclined to be in favor of public ownership of the railroads; the stockholders who would rather have government bonds in place of capital stock; well meaning individuals of socialistic ideas who believe that under government ownership better service, at less cost, will result and those who are of the notion that, on general principles, the government ought to own the railroads. This last class includes the active politicians who see visions of a great machine created for their especial benefit.

Whether any or all of these views are just or unjust we will not undertake to determine; but we will present the picture of a government owned railroad, as it might appear.

We observe the railroad with all its branches, completely built and in operation, at the moment the government has acquired it and has undertaken to make it pay, continuing its operation in the interest of the public. Its affairs are in the hands of a new cabinet secretary. Clamoring politicians beset him to provide places for faithful supporters who may not know much of railroad business; but they are willing to learn if they have the chance. The secretary supplies the places as rapidly as he can, consistent with his duty and allegiance to his party. The patronage must be dealt out depending upon all the sections through which the railroad runs and every section has its political foreman, upon whom a good deal rests, as we know. If there are not places enough they will have to be created, in time. Where one man was formerly sufficient, two or more seem to be necessary now. Pay rolls are increasing; supply bills in consequence are growing and where two tracks, formerly, more than answered every purpose, four seem to be required. As time goes on, the railroad, from a political viewpoint, does not appear to be doing its share toward the support of the party in power. Extensions must therefore be built. All these additions and improvements require bond issues from time to time and they are freely floated to meet the demands, while the railroads' deficit each year is rapidly increasing. Train service in the hands of incompetents is gradually growing worse, and the shipper and consignee have now abandoned all hope that goods will be transported and delivered promptly. With affairs going from bad to worse the only remedy to meet the deficits and pay interest is a more general income tax and mostly all classes of wage earners will submit to it with the assurance that eventually the railroad will be a financial success in which the whole country will share. Meantime the people who once called the railroad a "menace" and begged loudly for governmental ownership talk in violent terms the other way and ask "for what good was all this?"

The effort—based largely upon political greed—not only with a semblance of keeping abreast of the times, but ahead of them, is constantly forcing extravagances in operation and other useless expenditures which a critical public finally awakens to. Tax budgets call on the people to make good these supposed needs. They shoulder a burden (of which they can never be relieved), not only to their detriment in the matter of service, but the cost of maintenance and support as well. This in a very general way is the picture of a railroad under government ownership as we see it. The appearance of things changes from time to time. What is indistinct in some lights may develop into a definite object at other hours, so that if the picture from our viewpoint does not meet with the approval of some of our readers, who may be loudly advocating government ownership of the railroads we shall be glad to have another rendition of it as they see it: or. if they prefer, let them investigate what municipal ownership of public utilities has accomplished in some notable instances and what the results have been in other countries, where these steel highways are owned and operated by the government.

As one forceful example, we might mention that Lord Claud Hamilton, in England, in a recent address at the annual meeting of the Great Eastern Railway Co., said: "Does it not strike you how marked is the contrast of the smooth and successful working of the gigantic task imposed upon the Committee of General Railway Managers with the reckless and haphazard manner in which much of the work under, or partially under, government control has been administered? The reason of this difference is obvious: In the one case the work has been performed by practical, trained business men; in the other case, the preponderance of politicians, lawyers and government officials-in many instances without any real business experience-has been the cause of a terrible waste of public money, of inefficiency and of unpardonable delay. These mistakes are, I am glad to say, being gradually rectified. But the war has been in progress for one year and seven months, and it seems a grave reflection upon our system of government that such maladministration should have been possible, and in the best interests of the country it is greatly to be deplored."

Leakage from Rails and Efficiency of Bonds

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A study of the problems connected with the leakage of electric current from railway rails has recently been completed by the Bureau of Standards, Department of Commerce, and the results have just been published in Technologic Paper No. 63. The theory of the leakage of current from railway tracks has been developed .mathematically, and curves were plotted to aid in the interpretation of the results. The conclusions to be drawn from the formulas and curves are discussed with special reference to practical problems in electrolysis. It is shown how the escape of electricity from the rails is affected by increasing the track conductivity, as by careful bonding of all joints; by the use of a high resistance roadbed; and by shortening the distance over which a power house or sub-station furnishes power.

The paper is intended primarily for electric railway engineers, but steam railway engineers will find it most useful, and also others who are familiar with electrolysis problems. Copies may be obtained free. The Bureau of Standards have also embodied information regarding Modern Practice in the Construction and Maintenance of Rail Joints and Bonds in Technologic Paper No. 62, just issued. The paper is largely a compilation of information in the nature of data and opinions submitted by forty-two companies who answered inquiries sent out by the Bureau. Analysis of the data shows that soldered bonds have been demonstrated to be unsuccessful and are now practically obsolete, while all other types of standard bonds are capable of giving good results, but only when carefully installed.

Loose rail joints are shown to be the most prevalent cause of bond failures. The adoption of various types of welded joints to take the place of the common bolted joint appears to be more frequently used. The whole problem of track bonding is shown to be in a state of evolution owing to new inventions and recent improvements in methods of construction, and as a result complete standardization of these practices cannot be expected at present. Copies of the publication will be sent free to those interested who apply to the Bureau of Standards, Washington, D. C.

Examples of Excellent Discipline

To determine how well train regulations and signal rules were observed the Pennsylvania management made 4,364,519 tests during 1915. For every 1,110 trials only one error occurred-99.9 per cent of perfection. In four sets of tests, which included obedience to so-called "Stop" signals, there were no failures whatever; 68,941 observations relating to the shifting of trains were made, resulting in but 17 errors. Out of 342.991 tests for obedience to safety rules covering track workmen, 73 only showed a disregard, or one error in 4,699 trials. The percentage of accidents to employes decreased by 11 per cent. In 62,934 tests relating to rules governing watchmen employed at grade crossing there were but eight failures. These are wonderful showings, indicating a system of superb discipline, reflecting great credit on the Pennsylvania management and tending to prove that railroad business is reaching the position of an exact science.

The Cuban Railroads

Our minister at Havana, Cuba, has informed the State Department at Washington that the President of Cuba has signed a decree, dated February 17 last, appointing a commission to consider the question of nationalizing the railroads of Cuba. A report from this committee will be forthcoming within the next few months. It is probable that it will be interesting and instructive.



Railroad Bridge of Steel and Concrete

By M. ROBERT CONOVER

A very interesting structure is the bridge of the New York & Long Branch Railroad, over the Shrewsbury river at Red Bank, N. J. This bridge, recently completed at a cost of about \$250,000, is a double-tracked structure, replacing an old double-tracked wooden bridge structure which was condemned after many years of use.

The building of the new bridge was accomplished in precisely the same place as the old one had been and without interruption of traffic other than the use of but one track at different stages of the work and the slowing down of trains.

The concrete work was executed by G. B. Spearin of Spearin & Preston, contractors, New York City, and The American Bridge Co. of New York City had charge of the steel work.

The bridge is of the girder type of construction. There are 20 supports, each support consisting of 4 piers, each resting upon its own foundation of concrete. These concrete foundations, shaped like frustums of a pyramid, are 12 ft. high, 5 ft. square at the top and 14 by 11 ft. at the bottom. Each rests upon a tons estimated, and each group would sustain a load of 420 tons.

The piling used were 4-in. tongued and grooved sheet piling driven with a small steam hammer. It was difficult to place the piling directly under the old trestle, but it was accomplished by hanging the hammer on the end of the derrick boom, thus enabling it to work at an angle.

The concrete foundation rests upon this piling below water. Thus the piling, being under water at all times, is practically everlasting. Extreme care was taken during the work to get the foundations as good and well placed as modern methods of construction render possible. When the steel was erected, there was absolutely no trouble experienced with either the placing of the anchor bolts of the separate piers or with the spacing of the pairs of piers in either direction.

The plant used for the construction of the foundations was designed especially for this job and was one of the most efficient yet devised.

Water for the concrete was obtained from a well driven through the river bed and the proportions of the



Steel and Concrete Bridge Over the Shrewsbury River, on the New York & Long Branch

sub-foundation of 28 piles driven to hard bottom and penetrating the river bottom to an average depth of 40 ft. The hard bottom of the river here is sharply "V" shape. Over this is a layer of silt and shells. The silt extends up to low water in some places lying bare at low tide. This material is so soft as to be easily pumped to a certain depth where it hardens to a compact mass of shells.

About each set of piling a cofferdam is built. The usual system of walling was employed. The mud and water were pumped out to a depth of 10 ft. below the river bottom. Each pile is capable of sustaining 15

ingredients for the concrete were 1:2:4 or one part cement, two parts sand and four parts gravel.

Measuring center distances, the bridge is 25 ft. across; and lengthwise, 25 ft. between the foundation piers and 50 ft. between each set of piers from center to center.

The broader sides of the concrete foundations extend across the bridge space, thus strengthening it against the lateral stress from rapidly moving heavy trains.

The grade of the new bridge is 2 ft. higher than the old structure, which makes it less susceptible to shock from trains coming upon it from the north or toward the town. The old structure suffered so much from





Sectional View, N. Y. & L. B. Bridge

this stress that its supporting timbers were forced one foot out of plumb.

The fact that the present structure has a heavy system of lateral bracing which enables it to absorb the lateral stresses caused by trains entering and crossing it; that being of steel, it is capable of transmitting and distributing stresses more evenly and conforming more closely to calculations, and the superiority of rivetted joints of the steel structure to the bolted joints of the old wooden bridge give the new work strength to resist the racking strain of heavy express trains which no wooden structure can equal.

The piers are tied at their bases by lateral and lengthwise girders and also at their upper parts where the transverse braces terminate. Brackets crosswise of the bridge distribute the weight of the superstructure and



the section of the superstructure immediately under each roadbed is strongly braced by transverse braces.

The life of this bridge is estimated at thirty, forty or more years depending upon its care, painting, etc.

During the construction of the new bridge, the old bridge had to be made perfectly safe for the daily



Concrete and Steel Used on N. Y. & L. B. Ry.

traffic to and from New York. As previously mentioned the old wooden structure had been forced out of plumb by the stress of heavy traffic during its years of service. By means of hydraulic jacks—small and insignificant looking affairs in themselves—this heavy structure was shoved back to its proper position in a few minutes after the jacks were put to work. The old structure was then



Perspective View of Bridge Over Shrewsbury River

braced and sustained the weight of trains during the progress of the work.

A narrow railroad track near to the water's edge was used to deliver the concrete for the foundations at the various points needed. Cable cars were run upon this to carry the materials.

Maintaining the Track Force

Reasons for and Recults Anticipated from Maintenance of the Track Force for the Entire Year

The question of maintaining the track force the year round or reducing it in the fall was the subject of a recommendation by Sub-Committee No. 1 in their report presented at the last meeting of the Roadmasters and Maintenance of Way Association.

Without endeavoring to reproduce the exact words of the committee report the substance of the recommendation for the maintenance of the track force was substantially as follows:

A sub-division should have floating gang, foreman and crew of picked men, compensation to be slightly more than the regular section men and the size of the floating gang to be determined by circumstances. This gang should be equipped with portable camp and tools for various track work. This crew should be used to do various special jobs, such as building new side tracks, transferring cars, handling snow and various other jobs. At times when special work is slack it should assist some foreman in doing heavy work and give the foreman who is behind in his work a helping hand.

The sub-committee expressed agreement with Mr. Costello, roadmaster on the Santa Fe, when he stated that a section crew must be able to see some progress or it will not become interested; because work, if going along smoothly, accumulates momentum.

A floating gang of this kind would tend to encourage section crews and so increase their efficiency. The special work done by these men in time will qualify them to fill positions of assistant foreman and foreman as they will get more experience than regular track men. The committee recommend that section forces be maintained the year round because the practice of reducing forces to the minimum in early fall does not appear to be the best, for with certain limitations a force more nearly uniform throughout the year is economical for reasons that follow:

It helps to secure a better grade of laborers. Such men will enter and remain in service and be satisfied with a lesser wage if assured of work all the year round. If in a climate that will permit, such work as relaying rail, gauging track, rebuilding fences should or supervisor, would come nearer, by the process of repairing, to getting the full life out of each tool or appliance for the reason that he would be getting suggestions from the men who use these things and could go more into detail with him as to their defects. In other words these men have to "live with" and operate the appliances, and it is a vital matter to them to have the tools not only in good condition, but fixed up so as to suit the practical circumstances which these men daily encounter in their work.

The committee also recommended the employment of two carpenters to relieve the section men.

Magnolia Cut-off on the B. & O.

An article published in the January issue of this magazine has brought requests from a number of our readers for more information, which has been secured from the construction engineers.

Regarding the Baltimore & Ohio Railroad, Magnolia



Map of the Magnolia Cut-Off on the Baltimore & Ohio

be done in the late fall and early spring and much other miscellaneous and necessary work can be carried on throughout the entire winter. There is much less work to be done during the summer than in cases where the force is reduced below a reasonable number early in the fall, and consequently a less number of men may accomplish the season's work, thus greatly reducing the necessity for large extra gangs or floating gangs.

The abnormal demand for laborers now so apparent, with consequent increases of wages, and reduced efficiency, always incidental to supply being less than demand, would not be an annual occurrence with unknown but certainly considerable loss to the railway. Steady work brings to railways a better class of laborers and means that the available supply of efficient track foremen will also increase. This, in turn, means Cut-off, a comparison of physical features new and old lines, is of interest. Grades E. B. old line, 0.8 U. C.; new line 0.10 C.; grades W. B. 0.55 U. C. old line; 0.40 C. new line. Distance—miles 16.86 old line; 11.08 new line; distance saving for the 5.78 new line. Curvature—degrees 1,680 old line; 803 new line; curvature saving 877 in favor of the new line. Maximum curve, 9 degs. old line; 5 degs. new line. Tunnels—No. 1, old line; 4 new line. Tunnels, length in feet, 1,331 old line; 6,900 new line.

Construction—placing equipment, 2 months, Magnolia Cut-off work, 17 months; total number men employed, 2,500; equipment, power shovels, 22; locomotives, 55; locomotive cranes, 2; dump cars, 550; concrete plants, 6; traveler, 1; air and steam drills, 116. Direct savings per annum, elimination of helper en-



Profile of Baltimore & Ohio Railroad at Magnolia Cut-Off

less waste of labor, better care of material, little loss of scrap, less accidents, and more safety.

A blacksmith on each sub-division to repair tools, make light repairs to section cars, etc., was also part of the recommendation, because it is believed that such a man, working under the direction of the roadmaster gines, \$40,000; eliminate overtime, \$20,000; mileage, wages, tonnage, etc., \$140,000; other estimated savings, \$300,000; total, \$500,000. Density of traffic, 130,000 tons per mile of road, 20 per cent increase in five years. Mikado or 2-8-2 locomotives used—tractive power, 54,-600 lbs. Tonnage rating E. B. 6,500 tons.

American Railway Engineering Association

The seventeenth annual convention of the American Railway Engineering Association was called to order at 9:30 a.m., Tuesday, March 31st, at the Congress Hotel, Chicago, by President Robert Trimble. The report of the secretary, Mr. E. H. Fritch, gave the membership of the association as 1,336, an increase of 100 during the year. Since the 1915 meeting of the association ten members have died. The association was reported to have a cash balance of \$13,880.40.

Report on Signals and Interlocking.—Committee X

The report of Committee X on Signals and Interlocking, of which Mr. C. C. Anthony was chairman, was substantially as follows: No revision of the Manual was recommended. In 1914 the committee submitted a preliminary report. Since that time the committee has given the subject further study and here submitted a report embodying the conclusion at which the committee had arrived. In the preliminary report it was stated that signal work draws men from every class of mechanics. Any of these different classes can be developed into general signal men, but, in the present state of the art, a training along electrical lines is almost universally essential.

In all branches of engineering activities there are specialties which can only be learned by experience. The track circuit with its relay is one of these specialties in signal work. It is a combination which is not found in any other activity and must be studied as a part of signal work. Because of the necessity for the display of correct signal indications, the circuits must be studied from an entirely different standpoint from those found in other branches of electrical engineering; and the demand for fool-proof apparatus and its maintenance creates a demand for men especially educated in a practical way to think and act correctly in emergency. Many of the operations can be carried on by untrained men. A large share of the work involves very little knowledge; but if men are used for these duties in connection with others of the same general attainments as in other activities, there seems no way by which they can progress or learn the things that will fit them properly to inspect and maintain the more complicated parts of the installations, except through practical experience which, in turn, must involve a general force devoting its entire time to signal work or closely allied activities. Because the main controlling power of signal apparatus is electrical and because of the special training required, they did not recommend, as a means of obtaining economy and efficiency, a combination of signal and track forces.

The subject of the capacity of a single track was assigned at the outset to a sub-committee, consisting of Messrs. Peabody (chairman), Ames, Denney, Eck and Patenall, to which Messrs, Dodgson, Ingalls and Scott have since been added. The same subject is assigned by the Railway Signal Association to its committee on Signaling Practice and the work is carried on jointly.

This year the sub-committee was fortunate in securing the co-operation of Mr. F. L. Dodgson, consulting engineer, General Railway Signal Company. Mr. Dodgson has contributed an analysis of the effect of passingsiding location on the capacity of single track to secure the maximum. In considering the effect of passingsiding locations on the capacity of single-track railroad, it would seem to be the most logical thing to first determine, if possible, what rule or rules, if any, must be followed in order to so locate the sidings that maximum capacity of the road will be obtained. The committee recommended that the matter on Capacity of Single Track be accepted as a progress report.

Discussion.—The report on Capacity of Single Track was accepted as a progress report. The list of matters acted upon by the Railway Signal Association, at its 1915 meeting and adopted by letter ballot in 1916, including certain revised titles, was received for publication in the Manual for the information of members of the American Railway Engineering Association. The subject of requisites for switch indicators has not yet been crystalized in satisfactory form, and was accepted as a progress report.

Report on Signs, Fences and Crossing—Committee IX

Committee IX, of which Mr. W. F. Strouse was chairman, made a report on Signs, Fences and Crossings, which is briefly as follows: Last year the committee made a very exhaustive study of the subject-matter in the Manual; it now made no recommendations for changes this year in any portion of the Manual. The subject of track construction and flangeway at paved street crossings had been carefully considered, and without a thorough review, it was considered unwise to suggest changes.

When the conclusions were recommended for inclusion in the Manual strong opposition developed, which seemed to center particularly about recommending the use of 141-lb. 9-in. girder rail. Two distinct conditions are implied, namely, a style of construction suitable for use at paved street crossings, and one suitable for tracks laid in paved streets. The report seemed to indicate that it referred to tracks in paved streets rather than at paved street crossings. Separate conclusions are necessary to cover each condition, as implied in the outline.

If the vehicular traffic on these streets is heavy and they are paved with standard granite blocks of an average depth of 6 ins., the ordinary T-rail is not deep enough to provide a proper sand cushion over the ties. This has brought about the very general use of the 141-lb. 9-in. girder rail with flangeway, although a slightly shallower rail might prove just as satisfactory. If the vehicular traffic is light and other conditions are favorable to the use of sheet asphalt, asphalt, wood or vitrified blocks, the regular T-rail construction is not only possible but preferable.

If the subgrade is perfectly dry and the street is paved with sheet asphalt or grouted blocks on a substantial concrete base, the matter of drainage is not so important, as conditions tend to improve with age. If the subgrade is wet, the question of drainage is important.

In growing cities and towns, especially in the West, the demands for carrying the standard street pavement across tracks at street intersections have become so frequent and insistent that it is of great importance to the railroads. In many cases the municipalities require a concrete base under and between the ties. This form of construction has not always proved satisfactory under heavy railroad traffic; hence the results have not warranted the expense. The use of ballast under high-speed tracks seems to be more satisfactory.

The fundamental principle underlying the design is that the street paving adjacent should in no way be connected to or be dependent upon the track, thus giv-


ing it a chance to slightly change its position vertically without disturbing the surface of the crossing or that of the adjacent street paving.

For flangeways rails have been used of a lighter section set upright on blocks to provide proper elevation and bolted to the running rail at intervals of 6 ft., the proper flangeway being maintained by the use of fillers or separators.

In the report of this committee three years ago attention was called to the fact that street car companies seemed to pay more attention to the details of construction of their tracks in paved streets than had been done by steam roads. Attention was called to the details



Illinois Central Standard Construction

of construction of tracks by the Montreal Tramways Company.

After a careful study of the plans received and of construction with which the committee is familiar, it had reached the conclusion that two distinct conditions are to be met and that three distinct forms of construction are desirable.

For paved street crossings, where the general direction of traffic is at right angles to the track, the regular standard track construction of the several railroads should be used, and the space occupied by the track or tracks planked over. The flangeway should be formed by using a rail laid upon its side and properly secured to the ties or set upright and bolted to the running rail.

For tracks in paved streets, subject to heavy traffic, requiring granite block paving, the construction should consist of stone or gravel ballast not less than 12 ins. deep, treated ties and 141-lb. 9-in. girder rail.

For tracks located in streets subjected to light traffic only, the construction should consist of standard track construction, using treated ties, stone or gravel ballast. A form of flangeway in general use is that provided by laying a rail upon its side with the head resting against the web of the running rail and the base against the edge of the adjacent planking or other paving material.

A serious objection to this flangeway is the fact that it cannot be used at joints in the running rail without cutting out the head opposite the angle bar or eliminating the flangeway entirely at the joints, which is frequently done. Another form of flangeway quite common in plank crossings is either to leave sufficient space between the gauge line and the adjacent planks or to bevel them to fit. This is somewhat dangerous for horses.

Another method is to fit one of the various forms of paving blocks against the web of the rail between the head and base. This form of flangeway would probably be satisfactory in tracks where the speed is low, but could not be recommended for use in highspeed tracks. The form of flangeway which most nearly meets all requirements, and at a moderate cost, is that provided by the girder rail now extensively used. In the matter of flangeways for tracks laid in paved streets, the committee feels that the most satisfactory construction is that obtained by the use of the 141-lb. 9-in. girder rail with flangeway. This construction is cheaper in first cost than where a relaying T-rail is used with the main rail to form the flangeway. It will permit the use of any kind of paving; provides a flangeway for the wheels; leaves no openings in which animals can get trapped; provides a shoulder against which to place the paving and requires no maintenance as long as the rail lasts.

Railway signs naturally fall under two divisions or classes: One applying to the general public, the other to the employes of the railroad companies. Of the former, the principal signs are public and private road crossing and trespass signs. Under the latter may be mentioned whistle and ring boards, clearance and mile posts, right-of-way monuments, bridge and trestle numbers, etc.

The laws of about 75 per cent of the states reported are more or less specific as to what shall constitute a legal highway crossing sign, that is, the general design, the wording of the inscription, size of letters, etc. In no case, however, do the laws respecting trespassing state what inscription shall appear on trespass signs.

In most cases, certain illegal acts are specified, but no style of warning is suggested, it being left to the civil authorities to make arrests and inflict such punishment as the laws of the various states provide, usually fines or imprisonment, or both, at the discretion of the court.

The committee has made a study of the laws relating to the class of signs applying to employes and finds



Proposed Form of Construction

the only signs covered by laws, and that only by implication, are whistle and ring boards. These signs are covered by a quite common provision in the laws of the different states.

We have all no doubt at some time wondered what prompted or inspired the wording on the various signs and warnings which have from time to time been brought to our notice. In some states, "Look Out for the Engine," in others "Look Out for the Locomotive," while in the majority of the states the public is warned to "Look Out for the Cars." As the locomotive usually precedes the cars the natural inference would be that either the other styles of warning would be adopted. Various stories have gone the rounds respecting the origin of the warning "Stop, Look, Listen." In its investigation the committee found that it was adopted by the Philadelphia & Reading Railway July 23, 1891. About that time this company acquired the Gettysburg & Harrisburg Railroad, and on an inspection trip over that road several officials of the Philadelphia & Reading Railway noticed that sign at a number of crossings. This sign has since been adopted by a number of roads.

As concrete fence posts had been so fully studied during the past four years, the committee felt somewhat at a loss to know what feature of the subject could be studied with profit this year. The feature which appealed especially to the chairman was the change in sentiment which has developed in regard to the manufacture of concrete fence posts during the past ten or twelve years.

Discussion.—The only subject presented for adoption for the Manual by this committee was a plan for street crossings. The discussion showed several points on which members of the association disagreed with the committee, and the plan was referred back to the committee for further consideration.

Report on Water Service—Committee XIII

The report on this important subject was presented by Committee XIII, of which Mr. J. L. Campbell was chairman. The report in brief is as follows: In its report to the sixteenth annual convention in March, 1915, the committee submitted for approval a number of important changes in the subject-matter embodied in the Manual under the heading of "Water Service."

The committee formulated and the secretary of the association sent to the railroads various questions on the subject. On account of lack of uniformity and incompleteness of the replies received, it would not be wise to attempt general or specific deductions from the data given. The inquiry has undoubtedly brought together considerable information of some value, but the committee raised the question whether or not an investigation of this kind results in any general substantial advance in the state of the art, especially when it involves so many diverse conditions having no general application such as are found in pumping the water for American railways.

Those who have given some attention to the details of the subject generally agree that the cost of pumping water at a water station frequently has little relation to the cost of pumping at another station and gives no basis on which the cost of pumping at another station could be deduced even on the same railroad. The wide variations in cost of pumping are in many cases the result of conditions other than the character and efficiency of the pumping apparatus and substantially unamenable to correction. The committee is of the opinion that the principal value of an investigation of this kind is its direction of the attention of the roads to what they are individually doing and doubtless such investigations of the different phases of the general transportation problem do result in more or less improvement in operating conditions.

Of the sources of water supply reported, about 30 per cent are deep wells of small diameter. The roads are, therefore, securing a large part of their water supply under the most adverse conditions for economical pumping. A good deep-well centrifugal pump offers some important advantages over the old deep-well working barrel in the matter of maintenance, capacity of well and cost of pumping.

The committee on the subject of protection against

freezing formulated a set of thirty or more questions, which were sent to forty-four railroads in the United States and Canada, requesting information concerning practice, the troubles encountered due to freezing of the water stations and the remedies employed to correct the troubles. These questions pertained to pipe lines, pumphouses and machinery, tanks and water columns. Answers were received from forty roads.

The minimum temperatures to which the water stations are exposed vary from about 18 degs. above zero in the Gulf States to 50 degs. below zero at some Canadian stations. Some of the mountain roads in the United States report temperature conditions fully as troublesome as the Canadian roads, and roads in the Southern States report low temperatures of short duration.

The penetration of frost is reported as one inch in Louisiana, and three inches, six inches and ten inches in some of the other Southern States. In the Central and Plains States, it is reported variously from 2 to 6 ft. In Canada it varies from 3 ft. in southern Ontario to 6 ft. in Manitoba. Some of the mountain roads in the United States report 6, 7 and even 8 ft. The depth of the frost does not always vary directly with the temperature. Earth well covered with snow freezes to a much less depth than when the snow covering does not exist or is very light. Frost penetrates to a greater depth in gravel or loose rock than in clay; therefore, in the laying of pipe lines, the local conditions must be considered as well as the temperature.

Pipe lines may be laid on the surface without cover in the extreme Southern States. In the central districts the minimum cover is variously reported as being from 2 to 7 ft., and 3 ft. of cover is sufficient in the southern parts of Canada; and at other stations 7 ft. 6 in. is reported as the practice. The size of pipe, amount of water discharged and local conditions will have a bearing on the minimum depth of cover and no inflexible rules can be made governing this depth. Of the forty roads reporting, four report trouble with the pipe cover in use. In Dakota a pipe line froze with 5 ft. 4 ins. cover. One mountain road had trouble in rocky soil. Another had trouble when the cover was less than 4 ft.

When pipe lines cannot be drained, protection is provided in various ways. Sometimes the circulation of the water in the pipe is sufficient, or the pipe may be wrapped with hair felt covered with tarred paper and boxed. The number of layers of hair felt, paper and boxing depend on the length and size of pipe, temperature, etc. When steam is available a steam pipe may be enclosed with the water pipe. A common method is to enclose the pipe in a wooden box and pack the box with sawdust. This method should only be used in the more moderate temperatures. A favorite method, used where the cold is extreme, is air-space insulation -two or more air spaces being built around the pipe and lined with building paper. One road in Canada uses a four-foot square box with four thicknesses of lumber, four thicknesses of 10-ounce felt and four airspaces. It is important that all boxes of pipe coverings be as air-tight as practicable, and waterproof.

For long lengths of exposed pipe, alternate layers of hair felt and tar paper protected by an outer layer of metal or heavy roofing paper may be used. Four layers each of hair felt and tar paper are used by one road exposed to a temperature of 20 degs. Heavy canvas, painted, is also used for the outer covering without boxing.

Valves should be below frost line where possible. Large valves may be buried and valve stem protected by cast-iron valve box extending to surface of the



ground. Valves which require frequent inspection may be placed in pits, which, in the colder climates, must be provided with double cover. If the covers are air-tight, or nearly so, the air space between them forms an excellent insulation, otherwise the space should be filled with sawdust, manure or other good insulating material. When the frost penetration is deep, it is not ordinarily possible to place the lower cover below the frost line, and in some instances the side walls of the pits are built with air space between outer and inner walls.

Where water is pumped directly from shallow streams or reservoirs, and it is possible to place the suction pipe below the frost line, it may be protected by carrying it out to deep water beneath an earth dike covered with sod. The better practice is to construct an intake well fed by gravity from the stream, the end of the suction pipe being installed in the well. Suction pipes subject to freezing should be arranged so that they will drain after using. The use of intake wells is generally recommended. The warmth of the earth is a factor in preventing the freezing of the water in the wells, and it is generally only necessary to place a single wooden cover over the wells. In colder climates, double covers are resorted to, with air space between, or else a single cover is used and covered with snow, which forms a first-class protection.

The necessity for special construction of pump houses in order to prevent the freezing of the machinery and piping will depend on the power used for pumping and whether the plant is operated frequently or infrequently.

Where steam is used for power, and night and day pumping is done and circulation of water is constant, the heat from the boiler will ordinarily be sufficient to keep all piping and machinery from freezing without special frost protection. In the colder climates the construction of pump houses must provide better protection against cold than further south.

The roof protection consists sometimes of one layer of matched boards—sometimes two layers. The Canadian lines ceil their houses on the inside and doublesheath them on the outside, using building paper between the two layers of sheathing.

The freezing of water jackets and piping on internal combustion engines is experienced by a number of the roads, because they are not properly drained by the attendant and it is either necessary to avoid carelessness or neglect at these places or else see that heat be provided at all times. Few roads have any printed rules regarding the care of water stations to prevent freezing. It would seem desirable that rules for the care of water stations be incorporated in Maintenance of Way Book of Rules.

Tanks infrequently used are subject to more trouble from freezing than those in frequent service. Tanks supplied from ice-cold streams will cause more trouble than those supplied with the warmer ground waters from wells. The troubles due to freezing are generally as follows: The rods operating the outlet valve become inoperative due to the ice forming in top of tank and holding the rod and tank valve shut. After the rods become inoperative, and the pumps are started, the sheet of ice in top of tank acts as a float and raises the rods, thus opening the tank valve, allowing the water to drain out of tank and flood track and vicinity. Outlet valves freeze in shut position. This is frequently due to leaky condition of the valve. Valves in tank bottoms flush with the floor give more trouble than those elevated above the floor of tank and above the frost box. The number of air spaces required vary with the temperatures encountered.

In the Gulf States and in some of the Southwestern States, the use of roofs over tank is not generally necessary to prevent freezing. In colder climates a roof of sheathing laid tight and covered with prepared roofing is common, and in still colder climates the formation of ice on the surface of the water in the tank and the prevention of the valve rods freezing up will be largely overcome if a frostproof floor of matched lumber and paper is built at the level of the top of the staves. Canadian roads find it necessary to entirely surround their wooden tanks with a separate house, tarred felt being applied to both sides of studs and covered on one side by shiplap and on the other with drop siding. The floor over top of tub consists of joist with the under side ceiled with shiplap, the upper side being ceiled with two layers of shiplap with tarred paper between.

The freezing trouble in steel tanks is found to be practically the same as in wood tanks. That is, the rods operating the valve are held by the ice forming in top of tank, the valves freeze when used infrequently and ice forms more quickly if ice cold water from streams is pumped into tank. While wood is a better non-conductor than steel, and the ice accumulation is somewhat greater in steel tanks than in wood, it is not apparent that steel tanks cause any more trouble than wood.

On some Canadian roads steam or hot water coils are used in the bottom of the down leg or mud drum of the steel tanks. A more successful method consists of a stove beneath the mud drum with stovepipe extending up through mud drum and tank near inlet and outlet pipe. No trouble is reported when this was done. Keeping tanks full, or nearly so, at all times during winter will result in less accumulation of ice.

Most roads in territory subject to freezing report trouble with water columns. The operating rods and other operating parts freeze, due to accumulation of ice. The valve rods stick where they pass through the stuffing boxes or where they pass through the flange of the lower upright. The valves and pits freeze, due to insufficient protection. To remedy the above conditions, burning coal oil or kerosene lamps are sometimes placed in the pits or the frozen parts are thawed by means of steam hose where available or by building a fire of oily waste, or thawing by hot water or turning exhaust steam into pit.

All columns should be designed so that they may be drained. The usual arrangement is a valve at base of column, which may be so turned in warm wether that the column will not drain. In cold weather this valve should be turned so that the column will drain into the pit.

Discussion.—No recommendations were made by the committee, the report being submitted for information.

Iron and Steel Structures-Committee XV

The report of committee XV on the subject of Iron and Steel Structures is practically made up of a number of appendices on related matters. The report and the additions by sub-committees is in substance as follows: Mr. A. J. Himes was chairman of the committee. Appendix A on the methods of protection of iron and steel structures against corrosion was in charge of subcommittee A; it is continuing its investigation of common practice in shop painting. The idea of the subcommittee is to obtain accurate information as to the common practice in shop painting.

During the year a new method for coating with metals has been observed. This is the so-called Schoop Metal Spraying Process, by which surfaces may be



coated with easily fusible metals such as lead, tin, zinc, aluminum, copper, brass, etc. The process involves an apparatus called a "pistol" which is a mechanism which feeds wire, of the metal to be deposited, into a blast flame of combined oxygen, reducing gas and compressed air, which results in the issuance from the nozzle of a spray of fused metal. This spray, when directed upon a surface, coats it with the metal. Iron and steel surfaces are readily coated after cleaning by the sand blast. It is claimed that a coating of zinc or lead can be applied at a cost of only a few cents per square foot of surface including the preliminary sandblasting.

The sub-committee on Columns had not, at present, very much information beyond what was published in the last report. Twenty-four columns will be tested. The bureau to do the work, was asked to proceed as promptly as possible. The tests have been discussed a good deal with members of the American Society Committee and some apparent anomalies have arisen in the test results which, if verified, may be interesting to bring to the attention of the Committee.

Sub-committee C, on the Design, Length and Operation of Turntables, submitted the following report on phosphor bronzes, as information. A test of the hardness of the bronze was provided for in the specifications. Hardness, as distinguished from compressive strength, is one of the primary qualities. It is expected that a systematic record of the results of hardness tests on bronzes of the qualities here required will result in hardness limits which may be specified. There are two methods of determining hardness in common use: the Shore's scleroscope and the Brinell ball method.

The scleroscope is a measure of resilience. The Brinell method consists in applying to a finished plane surface of the metal a hardened steel ball 10 mm. in diameter loaded with a weight varying from 500 to 3,000 kg. for a period of 30 seconds. Dividing the applied weight by the area of the indentation gives the hardness number.

Bearing metals are used for the purpose of reducing friction and wear between parts of machinery in sliding contact. The simplest form of application of this principle of using different metals in contact is in the use of cast-iron bearings under rolled or forged wrought-iron or steel shafts. There is no tendency to heat and "seize" under moderate speeds; the friction is little, but, on account of the small difference between the metals, the wear is considerable and the use of such bearings is limited to the crudest kind of machinery. Cast-iron may then be said to be the primitive bearing metal.

In 1839 Isaac Babbitt discovered the alloy known as Babbitt's Metal which has become a standard bearing metal for use in machinery the world over. Bronze and brass came next in order of development of bearing metals. Being harder than Babbitt Metal the friction and wear are less, but the fit of the bearings must be more nearly perfect. Bronze is an alloy of copper and tin; brass is an alloy of copper and zinc, the copper preponderating in both. Phosphor bronze is a bronze to which phosphorus has been added for the purpose of cleansing and deoxidizing the metal. Most of the phosphorus passes off with the impurities and little remains in the metal. Manganese bronze is a bronze in which manganese has been used for the same purpose. Aluminum, vanadium, titanium have been used in alloys with bronze. Their effect is to add to the strength and homogeniety of the metal, but their development is in the proprietary stage.

For machinery bearings with low pressure and high

speeds, under constant operation, the strength of the bronze is less important than its anti-friction and wearing qualities. For bearings of movable bridge trunnions and discs, turntable discs, and similar slowmoving parts operated infrequently and carrying heavy pressure, the bronze must be hard enough and strong enough in compression to reduce friction to a minimum and not to flow under pressure. For worms, gears, nuts, etc., the bronze must have tenacity and hardness as well as anti-friction and wear-resisting qualities. The hardness and strength of bronze increase with the amount of tin. The introduction of lead improves the wearing qualities and softens the metal besides cheaping the product. Zinc increases the tensile strength but is injurious to the alloy for bearing purposes. It should not be used except in bronze for the third purpose mentioned and then only in small quantities, as too much causes a segregation of the tin and the formation of hard "tin spots."

Until 1887 the standard bearing alloy was seven parts copper and one part tin. Some time before 1887 Dicks, of England, patented the introduction of lead and phosphorus into the copper-tin alloy, and the resulting metal became known as the "S Brand." This alloy was adopted by the Pennsylvania Railroad.

About 1876, F. J. Clamer made and sold a metal known as Ajax Metal, containing more lead and less copper than the "S" Brand. It was used largely for engine bearings. Dr. C. B. Dudley, of the Pennsylvania Railroad, began a series of experiments and tests of phosphorus and lead in bronze. He made experiments of increasing the lead and decreasing the tin, which resulted in his "Ex B Metal." G. H. Clamer experimented with increasing amounts of lead and by decreasing the tin and using only pure metals produced successfully "Plastic Bronze." This metal is suitable for light bearings and resists wear well but is too soft for bearings under heavy pressure.

The necessity for a harder bearing metal for heavy pressures has developed a series of formulas containing upwards of 20 per cent tin and no lead. The metal produced has an elastic limit in compression of from 24,000 to 40,000 lbs., and the permanent set is from 1/16in. to 1/10 in.

A considerable number of engineers believe in specifying the physical properties only and leave the chemical composition to the maker. Others modify this course by stipulating certain control over the formula but making the physical requirements the criterion for acceptance. The third class of bronze, that requiring high tensile strength, is best secured by the introduction of from one to two per cent of zinc. This constitutes gun-metal. For this purpose the ultimate tensile strength and percentage of elongation seem to be more proper physical requirements than the compression characteristics.

There are two ways of introducing the phosphorus into the copper-tin alloy: first, by adding it direct to the molten metal; second, by the use of phosphor-tin for a part of the tin content. The first method results in the loss of a considerable part of the phosphorus. The second method gives better results and probably makes for more uniform crystallization of the tin by the phosphorus.

The so-called Manganese Bronze, being primarily a copper-zinc alloy, is not bronze, but brass. The same is true of Tensilite Bronze. These alloys are designed for tensile strength and not for bearing metals, although they are so used. Manganese bronze is considered unsuitable for high pressure bearing purposes because of its fibrous structure.

The committee submitted a report on the "Require-



ments for the Protection of Traffic on Movable Bridges," which had been prepared in connection with Committee No. 2 of the Railway Signal Association. This report was adopted for printing in the Manual, and will be found as part of the report of Committee No. 2 of the Railway Signal Association, elsewhere in this issue.

Discussion.—A. F. Robinson, of the committee, described three 100-ft. turntables on the Santa Fe.

Report on Wooden Bridges and Trestles—Committee VII

The report of committee VII on wooden bridges and trestles, of which Mr. E. A. Frink was chairman, is in effect what follows:

The committee was divided into three sub-committees, which have worked during the year on the subjects assigned. During the year a communication was received from a firm manufacturing cypress lumber, suggesting the advisability of formulating a specification for cypress bridge and trestle timber.

Sub-committee No. 1 on "Design of Docks and Wharves" submitted the following progress report for information:

A circular letter was sent to certain members of the association, who were in a position to furnish data and plans concerning the latest and best practice in the construction of freight-handling docks. Much information and many plans were received showing a great diversity of design adapted to the many varying conditions that are met on our sea-coast cities and Great Lakes ports. This is the day of permanent improvements in most of the territory covered by the railroads represented in this association, and it is pertinent to ask if it is worth while to confine investigation to strictly wooden structures.

In considering the general plan for a dock or a wharf, the character of the service to be rendered is of importance. If the structure is to accommodate passenger service, its arrangement, as to safety and convenience, should be given careful attention. If the structure is to accommodate freight service, there are even more questions arising that will have a very important bearing on the design. The character of the floating equipment is of importance.

The height of a structure is often determined by its location on a shore line, subject to rise and fall of the water due to tides or other causes. On most of our harbors conditions imposed by the general layout of government harbor lines affect the general shape of the work.

The business and economic conditions governing construction of this kind have a most important bearing. For instance, a lumber dock built in a country where the timber business will last only ten or fifteen years, will suggest a cheap first cost, while a structure to handle package or bulk freight serving ocean liners and permanent railroad lines would naturally suggest structures of permanent design. The fire hazard and insurance rate on property is very important. Often the facility of approach of the railroad tracks, complications of manufacturing and improved properties, general layout of the ground over which the approaching railroads are to be operated, may materially alter the general design.

By far the greater number of all docks yet built or being built in this country are designed with wooden piling to carry their loads. In many cases these are being surmounted above water line by concrete piers, either with or without timber grillage. Some structures are surrounded by timber sheet piling well-anchored back with steel rods and the dock then filled to the

required height. The natural conditions have very important bearing on the foundation design. In soft earth piling must be long and driven until a secure bearing is found, but if the bottom is of rock formation, timber cribs designed to fit more or less the uneven rock bottom may be sunk in place and filled up to the proper level. It is becoming more and more the practice to use treated timber and treated piling in all work subject to destruction by the teredo or other form of marine borers. During the past a great many docks have been constructed of timber cribs sunk along the dock line without placing under them piling or other permanent form of support. These structures have been very unsatisfactory. Where the improvement will warrant the expenditure, the use of some form of steel sheet piling is very satisfactory. Where piling is driven in very deep water and future plans contemplate permanent filling of the dock, it is often good practice to fill in around the piling to a certain depth with rubble stone.

One of the most common causes of failure and perhaps the most common defect in dock foundation construction is the improper spacing of the supporting piling. The tendency is to space piling more or less uniformly throughout the structure with utter disregard of the unequal distribution of load. The superstructures of many docks and wharves constructed during the past few years are of a composite character. Timber, concrete and steel are used in various combinations, and there seems to be great diversity of opinion as to the best practice. In the past few years some designers have placed concrete decks on timber structures, others have used concrete with asphalt wearing surface. It would seem that either of these methods of construction were hardly satisfactory.

The superstructures of many wharves is of very simple construction, being principally a more or less extensive roof supported upon posts from the dock foundation. The danger of fires to wharves and their contents has been a factor in producing a permanent form of construction. The constant rise in prices of timber in all forms and the lower prices of steel and concrete is making it more feasible to put up fireproof structures of permanent design. Plans for proper distribution of electric current for light and power, water pipes for drinking purposes and sanitary uses and fire mains, together with fire alarm and hose storage points, are all questions to be carefully considered in designing superstructures.

Since the subject assigned viz.: comparative merits of ballast deck and reinforced concrete trestles to the committee seems to encroach on that of the masonry committee. Inquiries have been transmitted to about seventy-five of the more important railways in the United States and Canada, aggregating 225,550 miles of line. To these inquiries forty-seven of the lines have responded. The questions submitted and a very brief abstract of answers to a portion thereof appear below.

Many of the attendant questions and problems of which disposition must be made, are not susceptible of mathematical solution, and while the committee can report the work well in hand and progressing satisfactorily, though slowly, it begs a continuation of the time for work on report until next year.

During the year 1914 the committee on lag screws began the investigation of their use to fasten guard timbers to ties on wooden and metal bridges. A goodly number of replies were received to a circular which was sent to the various roads throughout the country. In a later circular one of the queries was whether the road would be willing to give lag screws a trial on

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some of its bridges on the recommendation of the committee. Thirty-three roads indicated their willingness to make this trial, and the committee recommended that the trial be made. The work for this year has been to formulate plans and methods of procedure for further investigation. A plan was prepared illustrating the practice of several of the railway systems having had success in the use of lag screws. There is also shown on a plan the general ideas of the committee relative to such construction. A circular was prepared and a copy of the plan attached. This was sent to the thirty-three roads indicating their willingness to make a trial of lag screws. Replies to a later communication indicate that four roads have already begun the experiment and fourteen others expect to make the experiment soon.

In spite of the very general satisfaction expressed by the roads using lag screws, and in view of the fact that comparatively few roads have used them, and that a few of the roads using them report adversely and have abandoned their use, the committee does not yet feel justified in recommending the adoption of lag screws for fastening outer guard timbers as good practice.

The committee recommended that the report be received as a progress report and that the subject be continued for another year.

Report on Masonry—Committee VIII

The report on masonry made by committee VIII, of which Mr. F. E. Schall was chairman, summarized briefly is as follows:

The committee on masonry, during the past year, held one meeting of the whole committee. Meetings of the various sub-committees were held at different points. Sub-committees were appointed to deal with the subjects assigned by the board of directors.

The sub-committee on Cost and Method of Constructing Concrete Piles made further study of the data collected and presented a report.

The committee on Appearance, Wearing Qualities and Cost of Surface Finish of Concrete presented a final report and submitted general specifications for different surface finishes of concrete used in general railroad construction.

The committee on Design of Foundations for Piers, Abutments, Retaining Walls and Arches in Various Soils and Depth of Water, Not Considered Pneumatic Foundations, confined its activity to the searching of records as to the general practice of investigating the carrying capacity of foundation soils. A number of questions relative to the method of testing foundations in general were submitted to members of the association and others; the answers to the questions are presented in a progress report.

The Joint Committee on Specifications for Cement held several meetings during the past year.

The report of the Joint Conference, appointed to reconcile differences between the specifications of the American Society for Testing Materials and the United States Government specifications for cement, presented its report. The report was very complete. The sub-Committee on Accelerated Tests of Cement held one meeting during the past year, and decided that until such tests have received a more complete investigation the existing requirements as to constancy of volume of cement should govern.

The Joint Committee on Concrete and Reinforced Concrete held several meetings during the year, at which the members from the Masonry Committee participated.

The committee, in its progress report last year, presented typical designs for concrete piles and tables showing the cost and use of such piles. No further information being requested from the membership of the Association on this subject, the committee confined its work to further study of the data presented last year. The typical designs for concrete piles, illustrated in last year's proceedings, furnish, in the opinion of the committee, a sufficient variation to give information in regard to designs of piles that may be suitable for certain classes of work. The load which a concrete pile is to carry, the nature of the soil into which it is to be driven, whether the pile will act as a column on the hard bottom or whether the pile receives support from the soil through skin friction, are factors that enter into the question as to size, design and amount of steel reinforcement required.

The question as to whether square, octagon or hexagon shaped concrete piles should be used depends upon the style of the structure the piles are to carry; the question as to whether tapered or straight concrete piles should be used depends upon the soil in which they are to be driven, and whether the piles act as a simple column or whether skin friction may be obtained. The hexagon-shaped pile, either tapered or straight, seems to present the most suitable shape for general conditions.

Concrete piles, to obtain good results, should be seasoned not less than 30 to 40 days before handling and driving, depending upon the amount of driving expected and the season of the year when the piles are made.

Where it is not possible to drive concrete piles to plan cut-off, it is necessary to remove a portion of the pile above this point, and, unless otherwise specified, a variation of 4 in. will be allowed above the plan cutoff for the inequalities of the tops of the piles. All shaken or loosened parts of the head of cut-off piles should be removed. Where reinforcement has to be cut off it should be done by a hack-saw or oxy-acetylene torch.

The durability of a finish depends mainly upon the resistance of the surface of the concrete to the penetration of moisture. A skin of mortar is produced against the form, and the more non-absorbent the form material the richer in cement will this outside coating be, and therefore the more impervious to moisture.

The following methods are those generally used for finishing concrete surfaces. As the concrete is deposited the coarse aggregate is carefully worked back from the forms into the mass of the concrete with spades, fine stone-forks or other tools, leaving only mortar next to the forms. All holes or voids appearing after the removal of the forms should be filled with mortar made of the same proportion of cement and sand as the mortar of the concrete, and rubbed smooth and even with the surface with a wooden float.

After the forms are removed, a wash, usually of one part cement and one part sand, is applied to the surface with a brush. This fills up the pores, covers the small inequalities and wood-grain marks and produces a smooth and more even finish and color. The film of mortar thus put on usually develops checks and haircracks and later scales and flakes off.

The method of rubbing consists of smoothing the surface of the concrete to the desired degree of smoothness with carborundum bricks, cement bricks or with wooden floats. The rubbing smooth, fills the pores and small cavities and forms a surface of uniform finish and appearance that does not flake or scale.

The surface layer is washed with acid and scrubbed; commercial hydrochloric or nitric acids are used, di-



luted usually one part to two or three parts of water, according to the age of the concrete, as determined by experiment on the work. Great care must be taken to remove completely all traces of the acid, otherwise its action will continue and the surface be permanently discolored. Removing the mortar with sand blast has not generally proved successful, because of the varying density or hardness of ordinary concrete and consequent difficulty in removing the mortar to a uniform depth.

Concrete may be cut or dressed similar to natural stone, with a crandall, bush hammer rotary or other tools. This treatment, carried to the extent of cutting slightly into the aggregate, produces attractive surfaces, and bush hammering is considered by many to give the best possible appearance at a reasonable cost. The effect of courses can be produced by placing "V"shaped battens, properly arranged, horizontally on the inside face of the forms.

Concrete floors do not stand hard trucking without considerable wear and dust. The wearing surface should be mortar mixed with carborundum, granite grit or other hard aggregate, and troweled hard. Some patented combinations of sal-ammoniac and finely divided iron have proved fairly durable.

Very little reliable data on the cost of the various kinds of finish have been found available. Rubbing with carborundum or wood floats, 1c. to 4c. per sq. ft.; sand blast, 2c. per sq. ft.; bush hammering or tooling, 3c. to 10c. per sq. ft.

The committee confined itself to the collection of information bearing on the methods of design of foundations as reported by various railroad companies. The bearing power of soil for the support of structures is a subject that has not been as thoroughly investigated as the determination of the strength of materials composing structures which are placed on the soil. The work of the committee embraced this difficult and lengthy problem, and it is incumbent upon every member of the American Railway Engineering Association, in making investigations and tests of the carrying capacity of soils for specific structures, to keep an accurate account of such investigations, their results and determinations, and furnish such information to the Masonry Committee.

The weight for which a foundation soil can permanently and safely be used depends upon the strength of the material encountered. The same pressure which is imposed upon the foundation soil is naturally also sustained by the underside of the material used in the construction of the foundations; therefore, the load upon the foundation soil will never exceed the strength of the building material placed upon it.

Discussion.—The main part of the discussion was the report of this committee on the subject of finishing by means of wash of cement, and most of the experiences cited by members were unfavorable to including this method in the recommendations. It was finally decided to refer the specifications back to the committee for further consideration and presentation at the next meeting.

Mr. T. L. Condron next presented to the association questions in regard to the use of steel reinforcing bars rolled from steel rails. There was some considerable difference of opinion in this discussion, as to whether or not this material was suitable for reinforcing bars, and the question was referred back to the committee, to be decided by expert knowledge and test rather than by vote of the association.

Report on Railroad Ties—Committee III

The committee III on railroad ties, of which Mr. L. A. Downs was chairman, reported substantially as follows:

The data collected shows that the practice of the railroads is anything but uniform; the fact is that the methods of properly protecting the tie are going through rapid changes, which make it difficult for the railroads to say definitely as to the effect on the tie of any particular part of the design. A study of the situation leads to the conclusion that it is one of the important problems for the maintenance engineer today. It is felt that no definite practice can be presented to the association as having been developed to such an extent that it should be adopted, and the present purpose of the committee is to illustrate tendencies of good practice and to call particular attention to the necessity of reducing or elminating, if possible, movement between the tie plate and the tie.

The primary purpose or function of the tie plate is to protect the tie from mechanical wear and all other functions should be subordinated to this. Assuming that the tie plate will be of sufficient area to properly distribute the loads imposed, and that it is of sufficient thickness so that it will not buckle, it is necessary that the movement between the plate and the tie be reduced to a minimum or eliminated, if possible. If this is not done this movement will defeat the purpose of the plate. Of the different methods in use to accomplish this the following are illustrated:

First, by using cut spikes independent of those that secure the rail, as shown in Fig. 1. Second, by using screw spikes or lag screws independent of the fastenings securing the rail. Fig. 2 shows cut spikes used to secure the rail and lag or screw spikes to secure the plate. In Fig. 3, screw spikes secure the rail while lag screws secure the plate, and in Fig. 4 the plate is secured to the tie by screw spikes, and the rail is secured by a hook on the plate on one side and by a screw or cut spike on the other. Third, by using a flat plate bolted through the tie, as is shown by the experiment illustrated in Fig. 5. Another method to reduce the movement between the tie and the plate is to provide for more or less movement between the fastenings and the rail, as shown in Fig. 3; the free distance being about 1/16-inch.

The general tendency at the present time seems to be towards a flat-bottom plate, or at least plates that have no deep ribs or projections on the bottom.

At the first meeting the year's procedure was outlined and a request made that the association secretary send a circular letter to railway companies asking for copies of their cross- and switch-tie specifications.

Specifications were received from some seventy-five railway companies, most of which sent copies of both cross- and switch-tie specifications. These were tabulated alphabetically as to the more important stipulations as reference to current practice; and used as a basis for revision of the association's cross-tie specifications, as well as a basis from which to formulate switch-tie specifications.

Information was also collected on the subject of various woods used for ties, notably Douglas fir and tamarack, with a view to criticism of lists of woods to be used treated and untreated in manufacture of ties.

List of "Woods to be used untreated" and "Woods to be treated" being under discussion, it was decided to delete the terms "Walnut" and "Black Cherry" from the list, because few railway ties of these woods are now available. "Birch" was added, because ties of this wood are available in considerable numbers for treatment.

"Pines other than longleaf, strict heart yellow pine" is inserted instead of "Loblolly, etc.," because of the multiplicity of local names of the various varieties.



Fig. 1. Standard Tie Plate, P. R. R.

"Douglas Fir" is substituted for "Red Fir" as a better term.

There is a great deal of misunderstanding about Douglas fir, due principally to the various names it goes under in the different localities where it is found. The most common of these names and the states in which they are used are:

Douglas fir-Utah, Oregon, Colorado, Montana.

Red fir—Oregon, Washington, Idaho, Utah, Montana, Colorado.

Douglas spruce-California, Colorado, Montana.





Yellow fir—Oregon, Montana, Idaho, Washington. Spruce—Montana.

Oregon pine—California, Washington, Oregon. Fir—Montana.

Red pine—Utah, Colorado, Idaho. Puget Sound pine—Washington. The name Douglas fir has been adopted by the forest service and by various trade and technical associations and is coming into general commercial use.

The Douglas fir is in reality not of the Fir family, but is what is known as a pseudotsuga, or false hemlock, so-called on account of the resemblance its leaf stems, habits and character its cones bear to the hemlock.

The wood varies widely in character and grain, which may be very coarse, medium or fine. Coarse-grained wood is generally of a distinct reddish brown color from which it derived the name of red fir. The finegrained wood is of a yellowish brown color, from which it derived the name of yellow fir. The botanical characters of trees furnishing these two qualities of wood are the same, and there is no foundation for the popular belief that these woods come from two different varieties or species of trees. The two grades are sometimes found in the same tree.

After investigation it is decided to leave unaltered the term "Tamarack." Though in common with all conifers the heartwood of tamarack is exceedingly refractory and practically impossible to penetrate, unless subjected to severe steaming, yet treatment of



Fig. 3. Screw Spike Tie Plate, D., L. & W.

the sapwood and tie ends seems desirable, as a life of fifteen years is indicated as thus obtainable.

The term "flatted" as synonymous with "pole," as applied to the railway tie, is inserted because of its wide use by railway companies and tie contractors.

Discussion.—In the discussion, it was brought out by Mr. W. A. Courtney that longleaf strict-heart yellow pine will last about three times as long when treated with preservative as when not treated. Some data was submitted on the use of metal, composite and concrete ties, and this was accepted as information.

Report Conservation of Natural Resources—Committee XIX

The report of committee XIX was on the conservation of natural resources. A brief abstract of this paper is here presented. Mr. C. H. Fisk was chairman. The committee refers to the last two reports, partic-

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FIG. 4. HOOK SHOULDER THE PLATE FOR 516 RATL BASE, D. L. & W. R. R.



Figs. 4 and 5. Hook-Shoulder Tie Plate, D., L. & W.

ularly the 1915 report, showing success of the Illinois Central and other railways in practical forestry. Dr. B. Fernow's Canadian report deserves credit for information furnished.

Success has followed forest planting on the sand hills of Nebraska. Jack pines planted by the United States Government Forest Service ten years since now have a height of 15 ft. and a diameter of over 4 ins. The U.S. Forest Service shows that on third-quality soil, 50,000 ft. B. M. per acre of white pine can be grown in 80 years, and one-half more on best quality soil, while stumpage values actually obtained for inferior second growth average \$280 per acre for 70year-old wood, while raising the crop including all items of expense averages \$140 per acre, leaving a net return of \$140 from land valued at \$5 per acre. Even 35 to 40-year-old wood can be profitably marketed. H. R. MacMillan, chief forester in British Columbia, reports that about 69 per cent of the area of Canada south of the sixtieth parallel is unsuited for agriculture, but a large proportion is suitable for the production of merchantable timber, and forest products will



Morgan Tie in Service

always be an important industry, as they furnish 12 per cent of the foreign trade, 16 per cent of the railway traffic and equals in value the annual wheat crop. Care of the young forest on these is not only a duty to posterity, but an insurance of timber industries



Morgan Steel Tie, New Design

affecting Canada's prosperity. The one great obstacle in the way of proper preservation of young forest growth, as well as of mature timber, is the annual recurrence of forest fires.

The U. S. Forest Service reports that an average of 10,000,000 acres is annually burned over, causing a loss of \$25,000,000. These fires destroy the soil covering in a forest, causing rapid runoff on steep slopes and the erosion and irregularity of stream flow with loss



Cross-Section of Running Rail Adjacent to Morgan Tie

of navigability, hence, the necessity of continued state and national co-operation to secure protection from forest fires, which destroy annually 12,000,000 board feet of timber. It is stated that nature has taken 10,000 years to form a foot of soil, hence, waste should be avoided by proper drainage.

The annual consumption is three times as great as

the annual growth, the forests are being harvested three times as fast as they grow, and this compels economy in the use of wood. Forty cu. ft. of wood per acre are used, and only twelve cu. ft. is produced by the natural growth. We use 260 ft. per capita, France 25, Great Britain 14. Dr. Swain estimates the total waste of mineral products at one million dollars daily, or more than one-sixth of the production, besides the waste of lives. The deplorable feature of this waste is its permanent loss to national resources.

Millions of dollars' worth of by-products from coke production are literally thrown away annually in the United States through the continued use of the obsolete beehive-oven process, according to reports of the United States Geological Survey. The loss by that method last year is estimated at \$40,000,000. Conserve fuel as we will, fuel supplies are absolutely limited in quantity, which makes a serious problem if we depend entirely upon steam for power. Any power development, not dependent on a decreasing natural resource, must become increasingly valuable. The electric age requires cheap power to maintain its growth, so as water will always be raised by the sun, precipitated on the land and descend into the ocean; this gives the needed source of energy, 70,000,000,000,000 cu. ft. of water run off to the sea annually, enough to generate 250,000 H.P. for every foot of fall between the place of precipitation and the ocean. The commercial developable power is about 37,000,000 H.P., of which 30,000,000 H.P. are wasted.

The value of the wasted water powers in New York state has been estimated at \$15,000,000 annually. The development and use of less than 25 per cent of California's available water powers would stop all wood, oil and coal-burning for power purposes in that state. The same is true for nearly all of the western states, also many of the eastern and southern states. If all the water powers could be developed and their output substituted for steam, the available coal supply could be husbanded and used for other purposes, for which there is no other equal substitute. Use of water power to furnish motive power for railways saves an equivalent amount of coal. Its conservation is then a double conservation as it involves a non-renewable resource of a limited supply, and this is of greater importance than that of any other of our material resources; if not used, water power is continually wasting with no good results.

In Canada, in 1914, the total water-power developed was approximately 1,500,000 H.P. Assuming that under average conditions 1 horsepower hour can be produced in a steam plant from three pounds of coal, this amount, calculated on a 12-hour basis and taking a load factor of 50 per cent, which is a conservative allowance, represents a saving of 4,050,000 tons of coal per year.

Electric locomotives can successfully replace the heaviest type of steam engine on mountain grade divisions of main steam roads if the daily tonnage is sufficiently heavy to justify the first cost of electrification.

The Chicago, Milwaukee & St. Paul railway has recently made elaborate tests on its Edmont grade of 1.66 per cent over the Rocky Mountains east of Butte, to show the tonnage its electric locomotives would haul and the application of regenerative braking. Two electric locomotives pulled a trailing load of 48 cars, 3,000 tons, over the range at a speed of 16 miles per hour. A steam train of 37 cars, 2,100 tons, followed, drawn by two of the heaviest road engines and a Mallet pusher at a speed of 9 miles per hour. The new locomotives pull a load thirty-eight per cent heavier than those now pulled between Butte and Anaconda, freight engines being geared to a maximum of 35 m. p. h., while passenger engines will be expected to make 65 m. p. h.; 113 miles of the proposed 440.5 miles of main track and 141 miles of side and yard tracks to be electrified have been completed, and work will continue at rate of 100 miles per year until finished.

The committee offers the above as a progress report and requests that it be received as information, and recommends continuing the study of the relation of railways to the different conservation projects, reviewing work done by each up to the present time, and to recommend such policies as may appear desirable for railways to follow.

Discussion.—The discussion of this report dealt chiefly with attempts at reforestation. L. A. Downs spoke discouragingly of the results of reforestation as practiced on railroads in this country up to date.

Report on Yards and Terminals—Committee XIV

The report of the committee on yards and terminals presented by committee XIV, of which Mr. E. B. Temple was chairman, was in substance as follows:

The section of the Manual applicable to yards and terminals was discussed in 1914, and the recommendations appear in the Bulletin for February, 1915.

The sub-committee on handling freight in double track freight houses and cost of operation of same, pursued its labors and it was suggested that consideration be also given to the advisability of constructing and operating storage warehouses in large cities in connection with inbound houses. A number of railroad companies have built and are now building some structures of this kind.

Three methods for studying the working capacity of station and approach tracks were referred to in the report for 1912, and work during the current year pertaining to passenger stations has been devoted principally to an observation of the results obtained by the use of two of the methods then discussed, viz., that used by the Pennsylvania in analyzing the capacity of Broad street station in Philadelphia, and the coordinate train diagram and track-occupancy diagram.

In 1910 and 1911 the track layout of the station and approaches at Broad street station, Philadelphia, of the Pennsylvania Railroad Co., were seriously congested, and a board of engineers and a transportation committee devised a method showing occupation of the tracks during the peak-load periods, also the relief afforded by the multiple-unit system of electrification. One of the lines—Broad street station to Paoli—has since been electrified. The results so far have come up to expectations.

Three classification yards were selected for study two hump and one flat. Details of the cost and results of operation for the month of August, 1915, for the hump yards, and September, 1915, for the flat yard are available. In case members of the association desire to make further study of these costs the names of the railways operating the yards will be supplied by the secretary.

The committee has conferred with a committee of the American railway electrical engineers in reference to the question of yard lighting and track spacing in order to make typical layout plans with proper yard lighting and without dangerous side or overhead obstructions. A sub-committee has also been working on the proper grade over track scales on the hump, including the grade on each side of the scale, but no definite conclusions have as yet been reached.

Unit costs on the operation of three hump yards and



April, 1916

three flat, exist. They say: "If we were to rearrange and rebuild yards we would seriously consider making the classification tracks in all yards of sufficient length to hold 150 cars, which would enable us to take care of maximum trains, with a little room for expansion. This condition would be governed entirely by the trainload hauled on the division which the yard is intended to serve; the receiving tracks to hold 130 cars. This would also be governed by the trainload of the division taking the cars from the yard. In the receiving yard the grade between the receiving end and dispatching end, toward the hump, to the 150 to 175; this would enable one engine to shove the trains out of the receiving yard with considerably less damage than at present."

The committee has been working on specifications for track scales for two or three years. They submitted recomendations to show progress, stating that the American Railway Association is contemplating a revision of its "Track Scale Specifications and Rules."

Sub-committee inspected installation by the Pennsylvania railroad at East Tyrone, and were very much pleased with its action and think it has possibilities for the future.

The following recommendations concerning the Design, Construction, Maintenance and Operation of Railroad Track Scales were made with the view of setting an ultimate standard to which railroads may work, but are not intended to condemn scales, methods of installation or reinstallations now in service which come within the sensibility and tolerance prescribed. These are not intended to cover installations for special weighing, such as twin loads, etc.

The most essential features of a good track scale are the design, capacity and length, and in the selection and installation of such a scale the following must be given careful consideration:

Maximum loads to be moved over scale for weighing or otherwise, considering the spacing of and concentration of weight on axles; length of wheel base of cars or other equipment to be weighed; whether cars are to be weighed spotted or in motion; location with respect to yard work and grade; character of foundations; method of installation; drainage, lighting, heating and ventilation. In addition to this a daily test should be made on each scale equipped with an automatic attachment, by weighing a car spotted on the trip end of the scale with beam, also in motion with the automatic attachment connected. A book record of this and other tests is to be kept by weighmaster.

Efficient automatic weighing and recording devices may be used where desired. There has been in the past, and may be at present, an impression that the automatic weigher and recorder will overcome all outside influence and give correct results regardless of scale and track conditions and the speed at which the cars are handled over the scale. This is an erroneous impression and it is absolutely necessary that the scale and the automatic device be in first-class condition with properly maintained approach tracks, and cars must be run at a slow rate of speed, with particular attention to steadiness of motion, if the best results are to be obtained.

This report was accepted as a progress report.

Special Report on Uniform General Contract Forms

The special committee report, here condensed, on uniform general contract forms, was presented by Mr. H. E. Lee, chairman. Three sub-committees were formed to deal with the (1) Critical Review; (2) Industry Track Agreements; and (3) Interlocking Agreement and Railway Crossing Agreement.

Sub-committee 1 received suggestions from members, and recommended a bond, reading: The contractor shall, at the time of the execution and delivery of this contract, and before the taking effect of the same in other respects, furnish and deliver to the company, a written bond of indemnity to the amount of....... doilars, in form and substance and with surety thereon satisfactory and acceptable to the company, to insure the faithful performance by the contractor of all the covenants and agreements on the part of the contractor contained in this contract.

This bond shall remain in force and effect for the full amount or such smaller sum as may at any time be specified by the chief engineer.

They also recommended forms for Timely Demand for Points and Instructions, Inspection, Insurance, Intoxicating Liquors Prohibited, and Annulment.

Sub-committee 2 requested members to furnish copies of agreements for industry tracks used by their companies. This request met with a gratifying response. The forms indicate widely differing conditions. Track elevation or depression and the presence of streets, buildings and other improvements greatly complicate matters. The attitude of the courts and regulating bodies further complicates conditions.

In the preparation of the form of Agreement for Industry Track submitted, the committee was guided by the majority practice of railroads. The committee felt that while the Standard Form of Agreement for Industry Tracks may not be widely adopted, it will be of value as a compilation and adaptation of what are regarded as the more important provisions required.

Sub-committee 3, on Form for Interlocking and Railway Crossing Agreement, requested members of the association to submit forms of agreement for interlocking, and for railroad crossings used by their companies. The sub-committee had been able to complete the work of tabulating and comparing these agreements, and therefore the preparation of uniform contract forms had to be held over.

Discussion.—The report of this committee was discussed at considerable length, and it was decided to refer the matter back to the committee and ask that discussion be submitted to the committee in written form for guidance in its future work.

Special Committee on Stresses in Railroad Track

The report of the special committee of which Mr. A. N. Talbot was chairman, having in charge Stresses in Railroad Track, substantially reported that the experimental work on this subject has progressed. Much effort has been expended in developing instruments for making tests. The problem is a complicated one and the difficulties in the way are many, so that satisfactory instruments for determining stresses could only be had after long and patient trials.

This was especially true concerning instruments for measuring strains in the rail under moving loads. It was important that these instruments should make a continuous record of the action of the rail under and between the wheel loads of the moving load. It was found essential that the stresses on both sides of the rail be measured simultaneously. A method of finding the depression of the track under moving load by photographic methods had to be developed. The measurement of stresses under static loads was not found to be difficult.

The field tests were conducted on the main line of the Illinois Central Railroad north of Champaign. Only the general character of these tests can be outlined. Data were taken to determine (1) the distribution of

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stresses and moments along the rails for a given loading, (2) the division of vertical load among adjacent ties for a given loading, (3) the distribution of vertical pressures among the ties, through the ballast, and over the roadbed, (4) the depression, compressibility or stiffness of the track, (5) the effect of wheel spacing of some types of locomotives and also the effect of single and double concentrated loads, (6) the effect of speed upon most of the foregoing items. Tests were conducted at speeds as high as 65 m.p.h.

Among the variables of the track were three weights of rail, two sizes of ties, and three depths of ballast. In addition to tests on standard track, minor tests were made where uneven tie spacing or worn or decayed ties might affect the stresses. The Illinois Central provided the locomotives and crew. The calculation and compilation of the results required a great deal of time. The data are being put in shape and it is expected the results will soon be ready. The results appear to give fairly definite quantitative values for stresses in the rails and for the general distribution of loads and pressure under the various conditions of the test. The committee believes that it will be able to determine the general action of the track under moving loads. The committee plans to continue the tests during the coming season

This report was presented and accepted as a progress report.

Report on Rules and Organization—Committee XII

The report of Committee XII was presented by the chairman, Mr. G. D. Brooke. A number of revisions in the Manual was presented by this committee and approved by the association.

Report on Roadway—Committee I

The report of the committee I, on roadway, of which Mr. W. M. Dawley was chairman, is substantially as follows:

In apportioning the work of the committee among the members it was decided to assign the subject to two sub-committees, on revision of Manual, including increased width of roadbed sections to provide for increased depth of ballast; the other, on steam, electric and air shovels, dragline excavating machinery and locomotive cranes, general specifications for, method of handling and blank forms used.

A circular letter requesting standard roadbed crosssections was sent out and thirty-eight replies had been received. From an inspection of the sections so far received it does not seem that it is necessary to increase present recommended widths of roadbed to cover current practice. The ballast committee will stand by their recommendation of 24 ins. of ballast for Class A track to secure an approximately uniform distribution of load over the subgrade, and in case this depth is adopted by the association, a width of subgrade of approximately 26 ft. will be necessary to accommodate the increased spread of the ballast.

In further explanation of the subject of Haul and Overhaul discussed in last year's report, and to incorporate in the proceedings an illustrated method of determining the proper distribution of excavated material in the construction of the roadbed, the following monographs, entitled "The Profile of Quantities," by S. B. Fisher, and "The Overhaul and Distribution Diagram," by . R. W. Ambrose, were submitted.

Some further work has been done by the sub-committee looking toward a classification of soils, but the information so far obtained is not sufficient to justify the adoption of any one classification to the exclusion of others. A classification designed for identification of soils subject to pressure of engineering structures must necessarily deal with soils as found in their natural state, as in the case of the roadbed, as modified by the excavation, transportation and deposition. The object of the committee is to determine and adopt a classification which by the application of a simple field or laboratory test, preferably the former, will enable the locating or maintenance engineer to identify the soils of which it is proposed to define and limit the bearing power.

An effort has been made by the committee to cooperate with similar committees of other societies. Mr. R. A. Cummings, chairman of the soils committee of the American Society of Civil Engineers, advises that the forthcoming report of that committee contains a proposed classification for all kinds of soil and an appendix of the scientific work which is being done by the bureau of standards. Some work has been done by the joint committee on stresses in railroad tracks toward the determination of the distribution and amount of stress communicated to the roadbed through ballast of different depths, but it has not progressed far enough to enable this committee to base any conclusion as to units pressures allowable.

The sub-committee on the prevention of water pockets had on hand a large amount of correspondence not as yet thoroughly digested. It has been deemed advisable to delay drawing conclusions until the efficacy of the remedies adopted have been clearly demonstrated. The committee hopes to be able to conclude this subject next year.

The committee reported that the data it had gathered was not in shape to be presented as finished work, and its report was accepted as a progress report.

Committee II—on BaHast

The report on ballast was presented by committee II, of which Mr. H. E. Hale was chairman. The report is briefly presented in what follows:

The question of efficiency of stone ballast is largely covered and determined by the "physical tests of stone for ballast," which was thoroughly investigated by the committee several years ago and the tests which were approved by the association are specified in the manual.

The committee in its discussions has felt that the old specifications for gravel ballast, "30 to 35 per cent sand," was not sufficient and that some further specifications as to the proportion of various sizes of gravel should be made. Stretches of track have been selected where the results from the use of the ballast were known, and samples of the ballast have been tested to determine the per cent of various sizes of gravel used in the ballast.

The committee recommends that other ballast materials should be in the following order of efficiency: Stone, broken slag (not granulated), gravel, chatts, burnt clay or gumbo, cinders.

The efficiency of gravel for ballast, in the opinion of the committee is much improved by washing, because washing removes clay, dust and other undesirable materials. If the washing plant is properly arranged the desired per cent of each size of gravel can be placed in the ballast during the process of washing.

The committee obtained a very complete report made in 1913 of the Brookhaven ballast washing plant, which is a very efficient plant, and the committee was fortunate to have this report checked and revised in 1915. A copy of this report, including sketches of the general layout and detailed sketches of the method of washing, has been printed by the committee (appendix C.).



One part of particular interest in this washing plant is the method of separating the clay (appearing in considerable quantities in certain strata) from the sand and gravel without the loss of sand or gravel and permitting considerable profit from the sale of clean sand and gravel of various sizes.

In the matter of tamping the difference in cost by the mechanical tamper as reported in one of the tests is probably due to different methods of accounting, but the comparative figures taken from each test separately are of much interest.

The photographs show various views of the mechanical tampers illustrating the size of the tamper and the method of using it.

With the data now available in the tests herein the committee feels unwilling to make any definite recommendations in regard to the mechanical tie tamper, but trusts that further development and tests of the mechanical tamper will place the committee in a position to make a more detailed report and more definite recommendations.

The following is a report of the ballast formers used on the Santa Fe, together with photographs illustrating method of operating. Fig. 1 shows the devices fastened up for handling on the road. This arrangement consists of a regular ballast plow ahead of a shaping board, there being on the front end of the car a 4,000-gallon



Tamping Ties in Under-River Tubes

capacity tank. About 2,000 gals. of water is carried in this tank for weighting the car down. Just behind the shaping board there is a sprinkler pipe which is used to sprinkle the ballast. Fig. 2 shows ballast spreader and former in operation. Fig. 3 shows track skeletonized ready for dropping ballast. Fig. 4 shows track after ballast has been dropped and Cafferty-Markle device has passed over it. Fig. 5 shows the ballast after having been dressed. The appliances are handled by air. The shaping wings are raised and folded back for transporting.



Electrically Driven Tie Tamper

The committee is of the opinion that the use of "formers" to shape the shoulder of the ballast, and also to a large extent, the path adjoining the ballast, results in considerable economy.

Ballast has been applied by contract on several roads. The Michigan Central Railroad has applied ballast by contract. The Missouri Pacific Railway in 1909 to 1911 applied quite a large amount of ballast by contract.

The committee has had considerable difficulty in obtaining good comparative figures on the cost of ballasting by railroad forces, and by contract, due to the dif-



Resurfacing with Pneumatic Tampers Digitized by GOOSIC

bal-

ferent track and other conditions existing where ballasting has been done. They feel, however, that ballasting by contract under certain conditions has given very satisfactory results, and under certain conditions is more economical than ballasting by railroad forces.

As regards efficiency, taking into account the three classes of roads, and their experience with the depths now standard with them, the chairman of the sub-committee took up with various roads, widely distributed as to geographical location, the question as to their present practice relative to ballast depths. In nearly every case the depth of ballasting materials given for class "A" roads is at least equal to the 24 ins. recom-



Fig. 1. Ballast Spreader and Former, with Plow

mended by the committee. In several cases a much greater depth has been found.

Taking into account the tests made in the past, etc., the committee cannot do otherwise than reaffirm the conclusion that a combination of ballasting materials, approximately 24 ins. in depth in the aggregate, is necessary to insure uniform distribution of the load on the roadbed. Some roads do not require uniform distribution of the pressure; others require an almost absolutely uniform distribution in order to avoid excessive distortion. First may be cited the roadbed through a rock cut, where only sufficient ballast is necessary to



Fig. 2. Ballast Spreader and Former in Operation

provide drainage and allow of track maintenance work; second is the extremely soft clay or muck roadbed requiring the most uniform distribution possible.

Investigations now being carried on by the field parties of the division of valuation indicate that there is a much greater depth of ballast actually existing in track than has previously been supposed and that while many standard plans of trunk line railroads show 12 ins. of ballast, the actual depth existing in their main lines is much greater.

Recommendations of ballast committee, covering depth of ballast of class "A" track, should be changed to read as follows: "On fills on roadbed material, subject to deformation, by the application of live load, the minimum depth of ballast, under bottom of tie, should be 24 ins. Through rock-cuts or on material which will not be de-



Fig. 3. Track Skeletonized, Ready for Ballast

formed by application of live load, the minimum depth of ballast under bottom of tie should be 12 ins., this 12 ins. to serve as a cushion and not for the purpose of distributing the load transmitted from tie to roadbed uniformity."



Fig. 4. Track After Ballast Has Been Dropped and After Spreader Has Gone Over It

The conclusions of this committee were, after considerable discussion, accepted as information.

Report on Track—Committee V

The committee V, on track, of which Mr. J. B. Jenkins was chairman, reported substantially as follows: Meetings of the whole committee were held in Chicago as well as the meetings held by the various sub-committees. In addition to the seven subjects assigned by the Board of Direction at the beginning of the



Fig. 5. Track with Ballast After It Has Been Dressed Digitized by GOOG C

year, the committee was requested by the president to co-operate with Mr. Hegel of the Chicago Junction Railway in making tests of tie plates subject to action of brine drippings.

The committee has made a critical examination of the subject-matter of the chapter on track in the Manual, and considers, in view of the thorough and comprehensive revision which was made last year, that no further changes should be recommended until after the new edition of the Manual has been published.

This report is necessarily one of progress only. The work which the committee has done this year may be briefly stated as follows: It has received from eighteen railroads good data in the form of records of tests sections, which data has now extended over a period of twelve months. The sub-committee sent out a further appeal to not only the railroads which had signified their intention of co-operating, and which have kept the desired record for a year, but to a number of other roads. The sub-committee prepared a chart, outlining a suggested method of analyzing results of track sections. This chart enabled a relationship to be established between units of labor performed and the physical characteristics.

It is felt that the first step to be taken in analyzing the test section records would be to establish the values of certain physical characteristics of labor or man-hours. The next step would be the application of these results to the subject of adjusting section lengths. Out of this second subject will naturally spring a study of the situation for the purpose of establishing, on a broader basis, a method of apportioning maintenance of way expenses with reference to larger districts, special attention being given to the matter of attempting to work out values with reference to traffic and climatic conditions.

One of the railroads, represented on the sub-committee, has undertaken to make a systematic study of establishing proper lengths of sections, by making allowance for the various things which influence expenditure of labor. Certain assumptions were made in this particular instance. The application of them will certainly yield some result in the way of a more equitable distribution of labor between the various sections.

The subject assigned to sub-committee No. 3 was "Study the relation between worn flanges and worn switch points with a view to correcting the causes and decreasing the number of derailments due to the combination of worn switch points and worn flanges on wheels." The committee has been conducting some investigations since this work was assigned, and during the period up to date they have examined at least a thousand switch points, in order to determine if the proposed rule suggested by the committee last year was adaptable to the conditions, and would result in determining whether a switch point had reached the condition where it should be removed from the track. The rule as suggested was as follows:

A switch point should be removed when it is so worn that the greatest distance from the worn switch point to a straight line 24 ins. long from any point on the gauge line of the switch rail to a point on gauge line of the stock rail equals $\frac{1}{2}$ in.

This rule has been applied to a number of badly worn switch points, which had reached the condition or removal. In no single case had the application of the rule indicated that it was necessary to remove these points from the track. As a matter of fact, the condition reached was that it would have been undesirable to allow these points to remain in service any longer. An alternative rule proposed by Mr. Leighty read as follows: When the line of wear makes an angle with the gauge line projected, equal to, or greater than, "A" = $\frac{1}{2}$ -in., "B" = 8 in., the point shall be removed. The application of Mr. Leighty's rule works out no better than that suggested by the committee.

Generally, track conditions and certain contributary defects of equipment, not practicable to eliminate for the time being at least, must, to an undefined point, be taken into practical account in determining the limit of wear. As observed, the switch point is in a sense a fixed object, subject to frequent and easy inspection, while passing wheels are moving objects, subject to long trips over home or foreign roads, and subject also to insufficient or perhaps indifferent examination and liability of worn or sharp flanges, imperfect tram, bent axles, or stiffly rotating or rigid trucks, all of which points have a bearing upon the car safely passing over the switch point.

The M. C. B.'s rule fixes within certain limits the permissible flange wear, as well as the gauge of wheels, and the combination of a partly worn wheel and a partly worn point, with or without a modifying or contributing condition may or may not result in a derailment. It is fair to assume that generally, where a switch point approaches the limit of permissible wear, the balance of the switch lead or main track portion thereof is measurably worn, and that factor such as gauge of track, gauge of wheels, wheel centers, track centers, or rigid wheel base, wheel load, condition of loading, freedom of rotary motion of the track or trucks, curvature, superelevation, etc., tending to increase or decrease the side pressure of the flanges or the vertical loading, also contribute in assisting the wheels to mount the point. This may be further modified by the speed of the car, train or engine, the stiffness of the rail and the nature of the service the switch is supposed to perform.

In fact, there does not seem to be any theoretical basis upon which a definite rule could be established, and the practical tentative rule of a $\frac{1}{2}$ -in ordinate, in 24-in. chord, as the limit in any position throughout the lead along the gauge line seems sufficiently general and practical to cover ordinary conditions. On the other hand, there are ample cases where even this limit would not be permissible, and certain conditions where the limit might be safely increased. It makes a very great difference whether the switch lead is from a straight main track or from the high side, or to the low side of the curve, as well as the degree of curve and the switch angle and frog angle. Also whether switch leads from a lateral track or from a base line or yard track.

It might be safe for the service intended and generally used in a yard, but not safe for certain classes of road engines which may never be called upon to use the switch, owing to condition of curvature or clearances. In high-speed tracks no element of risk may be taken nor made, nor is economy considered, while for laterals or yard tracks under slow speed, more reasonable wear, without undue risk, may be obtained, taking consideration of the nature and frequency of the service, intricacy of track system, power employed, etc.

In the opinion of the committee that it is going to be impossible to formulate any rule that will, even in a remote sense, cover the conditions aimed at. As in the past, it is going to be necessary to rely upon the judgment of the track foreman and supervisor to determine when a switch point in a given location has

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reached the point where it must be removed from the track.

The subject assigned to this committee No. 4 was "Review specifications and present designs for cutand screw-spikes," and a circular letter was sent to roads represented in the association to ascertain the extent to which the association's specifications have been used in the purchase of the spikes, and for the further purpose of securing information as to recommended changes in the specifications and designs for both cut- and screw-spikes and data concerning dimensions and specifications of screw-spikes now in use. Two or three of the roads reporting are using the American Railway Engineering Association specification for cut-spikes.

The head of the cut-spike is designed to take the blow of the hammer directly over the axis of the spike and thus minimize the damage to spikeheads and danger of breaking the head off during very cold temperatures. The tilting downward of the nose gives a stronger, more rugged construction, and assists in giving an easier clearance in the spike machine. It also permits the pulling of the spike more readily with the clawbar. The reinforcement is symmetrical; that on the back of the neck of the spike, having been used originally as it now is with many roads to force the spike forward against the base of the rail when driving.

From the replies received from the members of the association, and from our study of the specifications for screw-spikes formerly adopted, we do not feel warranted in recommending any changes whatever in the present specifications. We submit herewith a design for a screw-spike which we believe the association will be warranted in adopting as a standard. This form of spike is now in use by two or three roads making more or less use of screw-spikes and, so far as information is available, they have given satisfactory results. The distance from the underside of the head to the beginning of the thread is variable. This distance will vary with the thickness of the tie plate and rail base.

It is well known by all concerned that the use of the screw-spike is very limited at the present time. The committee feels that now is the time to adopt a standard form of screw-spike so as to eliminate, as far as possible, the different forms of thread which are sure to be used as the use of screw-spikes becomes prevalent.

The two subjects, "Report on guard rails and flangeways and effect of increase of $\frac{1}{8}$ -in. thickness of wheel flanges," and "Continue the study of the design of manganese frogs and crossings," were assigned to a single sub-committee No. 5, for the reason that there was danger of some conflict in the requirements of the design of manganese frogs and crossings and in the flangeway requirements for thicker wheel flanges. The committee has no recommendations to make at this time excepting that these two subjects be reassigned.

The committee have designed a double switch lug. It is their opinion that with this lug, a switch may be operated safely by using either rod as a throw rod and the other as a lock rod. This lug is so designed that it will not be necessary to have rights and lefts and it will reinforce the point sufficiently to prevent locking of switch with any obstruction, of sufficient size to be dangerous, behind the point. The spacing of bolt holes for this lug corresponds to that already adopted and published in the Manual. The use of this switch lug will permit throwing the switch by either rod with equal safety and give sufficient space between to minimize trouble from snow and ice. For the present year the sub-committee have prepared drawings of typical layouts of double crossovers or scissors for 15-ft. track centers, which were made to conform as nearly as possible with those for 13-ft. track centers. In all of the above plans the frogs, switches and turnouts already adopted have been followed as closely as possible.

For the present year the sub-committee have revised the plans of double slip crossings. The changes are in the location of the insulated joints and removing of all joints from a 10-ft. section at the center. All double-slip crossings of either design may be operated by hand or by interlocking, as may be desired. In the prepared plans they followed closely as possible the plans of frogs, switches and turnouts that have been adopted. The double lug has not been taken into consideration on these plans, as it has not been adopted, but should it be, it could be applied with a few minor changes.

The committee has compiled data of present practice as to dimensions of frog guard rails and offers a definition and specifications for frog guard rails. A rail or other device is required to guide the wheel flange so that it is kept clear of the point of frog. Rail braces may be used in place of clamps. Length of guard rail: For all new work, 11-ft. guard rails are recommended for frogs up to and including No. 10; $16\frac{1}{2}$ -ft. guard rails for No. 11 frogs and over.

Mr. G. W. Hegel, chief engineer, Chicago Junction Railway, advised the president of the American Railway Engineering Association that he was contemplating making a careful test of the resistance of tie plates to brine drippings and offered to co-operate with this association in making these tests. This subject was accordingly referred to the track committee, and subcommittee No. 7 was organized to co-operate with Mr. Hegel, who afterward became a member of the track committee and of this sub-committee.

The track on which the tests will be conducted is in the yards of the Chicago Junction Railway, Union Stock Yards, Chicago. This track is subjected to the almost continual movement of refrigerator cars and the resulting corrosion of track fastenings is especially severe. Preparations are now being made for the installation of tie plates of rolled steel, wrought-iron, malleable iron and American ingot iron. As the test is not primarily to determine the merits of the relative designs of tie plates, but rather of materials, only one design of each metal will be installed. With the exception of the American ingot iron plates, all tie plates are being purchased in the open market.

A certain proportion of each type of plate will be dipped in oil and will be oiled at regular intervals during the tests. Another portion will be dipped in hot tar before placing in the track, while the remainder will be inserted without preparation of any kind.

With one or two slight modifications, the conclusions recommended by the committee were adopted for publication in the Manual, with the exception of a design for a screw spike, which was criticized in the discussion and withdrawn by the committee for further consideration.

Report on Buildings-Committee VI

The committee VI report on buildings is here condensed. Mr. M. A. Long was chairman of the committee.

The only item in the Manual that was recommended to be changed was the item under "Engine Houses." The following was suggested.

"When there is an engine house without turntable and no 'Y' track or other means of turning provided, Digitized by GOOGLE such engine house should preferably be equipped with smoke jacks at each end of each stall."

The weighing of package freight at freight houses is very important from a revenue standpoint, and railroads are installing a greater number of scales, and giving consideration to the weighing of all package freight. There are some points where practically all the freight handled is of standard package freight, and at such houses very few scales are needed. There are three classes of freight terminals, the largest being where both inbound and outbound houses are arranged in the same layout. At such points the following arrangement of scales is recommended: In outbound houses it is desirable to have a scale at every second door opening, or a maximum of 75 ft. between scales, these to be located on the team side. In inbound houses it is desirable to have scales placed 100 ft. centers as the maximum and on the team side.

In layouts where one house handles both inbound and outbound freight and where the business is heavy and diversified, the scales should be located preferably at every third door opening, or a maximum of 75 ft. apart. Scales should be on the team side of the house.

At small outlying stations, where there is a combination baggage and freight room, one dormant scale, approximately two tons capacity, placed preferably at one side of the door nearest the team side, is recommended, as at this point it will be less liable to damage from trunks or large packages. In large houses, scale platforms should be as small as practicable to accommodate the trucks used, and usually not over 6 by 8 ft.. except at certain localities, where one or two large scales are necessary to handle freight that is especially bulky. Scales for houses handling freight only should have a minimum capacity of 4 tons. Higher capacity scales cost very little more and are economical from an operating and maintenance standpoint, as they will stand up better to their work. Dial scale, properly maintained, has a great many advantages over the beam type.

The ashpit is the most expensive structure on a railroad, from a maintenance standpoint. The usual procedure at an ashpit is to drop the hot ashes into the pit and this heats up the walls and other parts of the structure. Then cold water is thrown on the ashes to cool them. This rapid cooling causes contraction in the material of the structure, and when repeated many times, weakens and sometimes destroys the structure. Another destructive element is the sulphuric acid produced by the water and sulphur in the ashes. This destroys the steel parts coming in contact with it at a rapid rate. Most ashpits are built of concrete, in which limestone is a principal ingredient. Hot ashes cause this limestone to swell and disintegrate, and in a short time the concrete is damaged. Firebrick facing has been used, but on account of the nature of the work and the tools used, experience shows that they are soon knocked off. Slag has been used in place of stone, and makes a good substitute. Gravel also makes a good substitute, and if trap rock is available, it is better than either of the above materials.

At outlying districts, where few engines are handled, cast-iron ties, approximately 12 ins. high, are used to prevent burning wood ties (Fig. 1). These should be on the spur tracks. The pit should be between the track rails, approximately 3 ft. deep (Fig. 2), and its length made to suit the business handled. In some instances these pits are fitted with buckets, which are handled by pillar crane, and a traveling or gantry crane is often used. Pit similar to that shown in Fig. 2, one side open, pit 3 ft. deep, with depressed track along-

side, is shown in Fig. 3, the top of car approximately level with base of rail on the cinder track. The depressed pit filled with water (Fig. 4), into which the cinders are dropped, one feature being to design the pit so that cinders will drop directly into the water and reach the main body of the pit freely, another feature is the easy removal of the cinders by grab bucket operated either by a gantry or locomotive crane. Pit equipped with bucket or car located under the track (Fig. 5) and hoisted by mechanical means, the cinder bucket or car running on rails placed on an incline, car being run high enough to dump in a car located on a track parallel to and approximately 25 ft. centers from ash track.

All types of pits should be equipped with water supply to wet down the hot cinders. The available records are not kept in such shape that it is possible to determine the relative economy of various types of pits, but where a large number of engines are handled, the water type pit, with locomotive or gantry crane with grab bucket, is recommended.

The committee had no additional information to offer on coaling stations, the report last year being as complete as could then be made. The committee recommends this subject be continued for another year, and that they be instructed to consider the storing and handling of stored coal.

Discussion.—Recommendation of the committee that an engine-house without turntable or other means of turning an engine should preferably be equipped with smoke-jackets at each end of each stall, was adopted for publication in the Manual. The conclusions presented by the committee in regard to freight-house signals was accepted as information and referred back to the committee for further consideration.

Report on Electricity—Committee XVIII

The committee XVIII on electricity, of which Mr. Geo. W. Kittridge was chairman, reported substantially as follows:

The sub-committee on clearances brought their work up-to-date regarding overhead clearances on various electrified roads in the United States, also data regarding third rail clearance on various electrified roads.

Messrs. R. D. Coombs, G. A. Harwood and E. B. Katte have continued serving as representatives of the A. R. E. A. on the National joint committee on overhead and underground line construction. This joint committee had not yet completed its work on the revision of the crossing specifications, nor completed any other new specification.

Association delegates were actively engaged with the joint committee on preparation of the revised specifications for crossings, when the progress of the National joint committee's work was arrested by the fact that the United States Bureau of Standards was about to issue a safety code which included specifications for crossings. No definite report will be made by the National joint committee until the safety code is issued and subjected to study by the National joint committee.

Messrs. Brumley, Katte and Murray have continued as association representatives on the National joint committee on electrolysis, and report that they have no report to make to the committee on electricity until the preparation of a report by the National joint committee on electrolysis.

No meeting of the National joint committee on electrolysis was held during 1915, but sub-committees have been at work preparing various sections of the report, and it is expected the report will be ready for final check very soon.



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The committee recommends that the revised data regarding overhead and third rail clearances be received as information, also the committee recommends that representatives continue to serve on the National joint committee on electrolysis and the National joint committee on overhead and underground line construction, and that the statistical data furnished by the subcommittee on clearances be kept up-to-date. The committee also recommends that during the coming year the subject of report on water power for electrical railway operation be taken up. That consideration be given any new information that may develop in reference to maintenance organization and relation to track structures, and asked for such other instructions as seem necessary or desirable.

The report of this committee was received as information and referred to the committee for further consideration.

Special Report on Grading of Lumber

The special committee on the grading of lumber, of which Dr. H. von Schrenk was chairman, in effect reported that last year they called attention to the practical difficulties of distinguishing between various species of southern yellow pine, and to the fact that it has been generally recognized that it makes little practical difference from what species of pine a structural timber is cut so long as certain density requirements are met, in addition to the usual heart and sap requirements.

During the past year, after exhaustive investigations, a rule was adopted establishing two classes of southern yellow pine, called "dense" pine and "sound" pine. By this two classes of southern yellow pine are established —dense pine and sound pine. These terms replace the botanical designations hitherto used, namely, longleaf and shortleaf pines.

In the report a series of definitions of southern yellow pine are given; also the grading of hemlock; specifications for bridge timbers to be creosoted; and proposed specifications for southern yellow pine bridge and trestle timbers to be treated, follow. In summarizing their work, the committee recommended that the definition given for quality of southern yellow pine be adopted as standard; that the grading rules for hemlock lumber, as printed in Bulletin 174, be adopted as standard, with an ommission indicated.

The definition for southern yellow pine presented by the committee was adopted. The specifications for southern yellow pine, bridge and trestle timber to be treated, was received by the association as information.

Report on Records and Accounts-Committee XI

The report of the committee XI on accounts, of which Mr. W. A. Christian was chairman, was practically as below:

The committee reports progress on use of small



Fig. 1. Cast-Iron Tie Pit

Fig. 2. Track Pit

forms on cardboard, and hopes to be able to make a report thereon next year.

Methods for Reproducing Maps and Profiles on Drawing Linen for Permanent Record and the best known reproductions of tracings are as follows: Ferro Prussiate—White line on Blue ground. Pellet— Blue lines on White ground. Ferro-gallic—Black lines on White ground. Brown—White lines on Brown ground. The photographic process. The hectograph process. The planograph process. The lithographic process.

The first four are too well known to need any explanation. The photographic process is quite varied,



but the one most generally used is where the photograph is made positive on paper without the use of the so-called negative. The hectographic process is one where the various colors of inks are used, and when applied to pads the ink being absorbed therein. The planograph process is one where the image is reproduced negatively on a coated plate and treated in chemical baths, allowing the high and low lights to stand in relief. This plate may be used in a printing



Fig. 4. Water Pit, with Gantry Crane

press. The lithographic process is the latest in this country, and on account of its cheapness it is used for the reproduction of original tracings. It being a dry process throughout, the reproductions are naturally true to scale of the original.

In explaining this latter process, it might be said that a plate of any smooth substance, such as metal, glass or linoleum, is coated with a gelatine in which are placed certain chemicals after the gelatine is melted. To apply this gelatine the plate is placed in an inclined position and covered with the gelatine. After the plate is entirely covered, it is put in a horizontal position and allowed to cool. The original tracing is put in a vacuum frame and a print is made similar to a blueprint. This print then is applied to the gelatine plate, it being removed as fast as applied. There appears on the gelatine the image of the original in dark blue lines caused by the action of the chemical of the print



and gelatine. Ink is then applied to the gelatine and adheres is proportion to the density of the lines of the original. This is the most important thing in this process. In other words, the reproductions are only good if the lines of the original are opaque. This process should be worked in a cool temperature. Reproductions by this process may be made on any material. Any portion of the original not wanted in the reproduction can be removed either on the so-called blueprint or plate. Any additions may be made in sections by making another print of same and pasting it on original blueprint before applying to pad.

Where originals, as in railroad alinement maps, are very long and wide, it is possible to reproduce these in any desired width or length. It is quite common on right-of-way sheets to reproduce the land schedules in their proper places, originals having been made on a type-writer using a black ribbon and having a black carbon reversed on the back of the original, thereby making letters opaque.

The report of this committee was submitted and received as information.

Report on Wood Preservation—Committee XVII

The report of Committee XVII on wood preservation, of which Mr. Earl Stimson was chairman, summarized



Fig. 5. Track Pit, with Bucket Power-Operated

is as follows: During the past year the committee has given attention to developing a standard method for determining the percentage of water in creosote oil when shipped in tank cars. After much consideration, the committee decided to carry on a series of tests. These tests were under the auspices of the committee with the co-operation of similar committees of the American Society for Testing Materials and the American Wood Preservers' Association.

Samples were taken by various means and afterwards divided into three sets. One set of samples was tested in the laboratory of von Schrenk and Kammerer, another in the laboratory of the Port Reading Creosoting Plant, and the third in the laboratory of the Barrett Manufacturing Company.

In accordance with the prearranged plan, one car was loaded with substantially dry oil, and a measured volume of water added to the car from a separate source, and the other car was loaded with oil containing about 7 per cent of water. The two cars each had a marked capacity of 8,043 gallons, and inside shell diameter of 82 ins. Four hundred and fifty-two gallons of water were run in by gravity from a measuring drum having an exact capacity of 113 gallons into car 4480. The water entered through a 2-in. pipe directed so that the stream of water mingled with the stream of oil.

The results obtained from car 4480, which contained

dry oil to which water was deliberately added, varied widely, but on the other hand, the tests on wet oil contained in car 52 are uniform. The committee observed that the water separated rapidly from the oil in car 4480, so that indeed there was more free water on the surface of the oil within two hours after loading than there was at the time of unloading. Evidently the water and oil had become mixed during transit and the water did not again separate so rapidly from the oil. With car 52, there was no apparent separation of water and oil, even though this oil contained more water than the other. It is obvious, of course, that the partial separation of oil and water, such as took place in car 4480, makes sampling more difficult than when the water is uniformly distributed throughout the oil.

The following conclusions have been drawn by the committee: That for accurate determination of water in a tank car of creosote, a system of sampling from several zones in a car is necessary. There must be at least three zones, the top, the middle and the bottom of the car.

That the cross-section tube frequently used for taking samples from tank cars is of little value.

The so-called thief (1915 Proceedings, American Railway Engineering Association, Vol. 16, page 831) has been found incorrect in theory, and results confirm this.

That the taking of a dipper or bucket sample from the running stream cars while discharging does not give reliable results, and that this method should not be used.

That the bottle method, meaning the use of a small stoppered vessel from which the cork can be withdrawn at any desired level, is a convenient apparatus for taking zone samples.

That efforts be made to construct an improved form of the sampler, provided further tests warrant a definite recommendation for its use.

That for ordinary purposes the taking of three zone samples of the apparatus referred to or by means of a bottle device, is recommended.

That the tests described this year be considered preliminary. Care should be taken to make such tests to include both summer and winter shipments.

Regarding Tests of Treated Ties

Relation of amount of preservative and depth of penetration to resistance of the material against decay, taken as a subject, is new as regards its investigation by the committee. The value of an established relation between the amount and depth of preservatives to the resistance of the timber against decay is apparent, and this determination must be based on service tests. It was found that service records give the amount of preservative, while the depth of penetration is not recorded. Ties or timbers treated with a given amount of oil show wide variations in the depth of penetration, due to the percentage of sapwood, the moisture contents of the stick, etc.

The records of timbers that were not exposed to mechanical wear and in which the impregnated wood extends from one-half to two inches on the outside, indicate that complete penetration is not necessary if the outer protective ring remains unbroken, and the ends are likewise protected. A very definite record of creosoted ties on the Norfolk Southern in 1896 resisted decay until abrasion under the rail cut through the treated portion. Then decay commenced at the unprotected point, and necessitated the removal of many ties which otherwise were in good condition.

Records definitely show that comparatively heavy in-

jections of creosote are an absolute protection, and the point remaining to be determined is to what extent these injections can be reduced and still give protection which is in proportion to the reduced cost.

The committee presented this report to the association as information. In doing so it desired to especially call attention to the subject matter under "Water Sampling in Creosote Oil."

The report of this committee was received as a progress report.

Report on Rail—Committee IV

The report of committee IV on rail, of which Mr. J. A. Atwood was chairman, reported in substance as follows: First, as to the revision of the Manual, no recommendations were made. The main part of the report dealing with Rail Failures, Statistics and Conclusions, stated that the statistics covering rail failures for the period ending October 31, 1914, had been issued in Bulletin 179 for September, 1915. They show a decrease in the number of failures of rails rolled in successive years since 1908, as indicated by the figures showing the failures of open-hearth rails rolled by all the mills, expressed as number of failures per 10,000 tons of rail laid.

Year Rolled	Years of Service of Rail					
	0 Year	1 Year	2 Years	3 Years	4 Yerrs	5 Years
1908	• • •		• • •	• • •	• • •	268.9
1909		• • •	• • •		109.0	141.7
1910			•••	57.6	76.3	• • •
1911		• • •	37.4	58.8		
1912	•••	18.4	20.1	·		
1913	1.2	7.9				
1914	0.8		• • •	•••		• • •

The final basis of comparison is the number of failures per 10,000 tons for five years' service, but when this age has not been reached for the later rollings, a comparison can be made in the meantime on a less number of years' service, and a study of this table indicates an improvement for the successive years' rollings as compared with the rollings of previous years.

The statistics for the year 1915 are in process of compilation. The basis of comparison has also been changed from "failures per 10,000 tons of rail laid" to "failures per 100 track miles of rail laid," and the next report will be on this basis.

In dealing with the Effect on Rails of Defective Equipment and Improper Maintenance the subject was assigned with the object of determining the effect of bad spots in wheels, on rails with a view to having the allowable defects in wheels changed if found to be necessary, and experiments in that line are being considered. The committee were unable to make any definite report until the joint committee on stresses in railroad track can go extensively into the matter of making experiments to develop what the effect of bad flat spots on wheels is on the rail.

Special Investigations of Rails for the year have been presented to the rail committee as follows:

No. 49. Segregation and Sponginess in Ladle Test Ingots. By Robert W. Hunt & Co. (Bulletin 179.)

No. 50. Influence on Rails of Method of Blooming. By M. H. Wickhorst. (Bulletin 179.)

No. 51. American Rail Mill Practice. By Sub-Committee on Mill Practice, Charles S. Churchill, Chairman. (Bulletin 183.)

No. 52. Internal Fissures in Rails. By Sub-Committee, W. C. Cushing, Chairman. (Bulletin 184.)

No. 53. Some Causes of Rail Failures. By W. C. Cushing. (Bulletin 185.)

No. 54. The Nick and Break Test in the Inspection of Steel Rails. By Robt. W. Hunt and C. W. Gennet, Jr.

The paper on Ladle Test Ingots calls attention to the importance of obtaining the test ingots free from sponginess. A spongy test ingot is apt to be of heterogeneous composition, and aluminum is suggested as a desirable addition to the test ingot to prevent sponginess.

The paper on Methods of Blooming is a study by the experimental method, of the influence of various methods of rolling the bloom, on the properties of the rails and the production of seams. A large proportion of the rail failures originate from seams in the base of the rail or from low transverse ductility in the base. This will require a great amount of experimental work, but improvement of rails in this respect can be expected to reduce rail breakages.

The paper on Rail Mill Practice covers a report of a sub-committee that visited rail mills. Brief descriptions are given of the several rail plants; representative analyses of the materials were made; comparisons of each of the stages of manufacture were instituted; attention is called to changes and improvements, and finally a discussion is given of the relation of mill practice to rail failures.

The paper on Internal Fissures in Rails covers a report of a sub-committee concerning the state of information on this subject. The different types of internal fissure are discussed. From the study of chemical examinations by the Altoona laboratory it appeared that transverse fissures occur indiscriminately in the several rails of the ingot and that segregation is not an important factor in causing the fissures.

Mr. Cushing's paper on Causes of Rail Failures presents a large number of illustrations of the different types of failures and a discussion of the causes.

The paper by Messrs. Hunt and Gennet gives the results of experience with the inspection of rails by the "nick and break test" of a rail from each ingot, and in which segregation is judged by the appearance of the fracture. It is concluded that this method of inspection insures greater protection to the purchaser and better conserves the interests of the maker.

Track Bolts and Nut Locks has had the attention of the committee, and they submitted specifications for "Medium Carbon Steel Track Bolts with Nuts," and specifications for "Quenched Carbon and Quenched Alloy Steel Track Bolts with Nuts." These specifications are recommended to supersede those in the Manual. Attention has been given to the matter of specifications for spiral spring nut locks or spring washers for track bolts.

The Manual now contains "Specifications for Heat Treated, Oil Quenched, Steel Joint Bars," which should be revised for bars made of alloy steel, and it submitted such specifications.

The report of this committee forms a part of a study of rail failures during a service period of five years, and was submitted as information and not to be acted upon this year. Specifications were submitted for a number of types of steel, which were received as information.

Report on Economics of Railway Location—Committee XVI

The report of the committee XVI on the economics of railway location, of which Mr. John G. Sullivan was chairman, made a progress report, for as was stated in the report (an abstract of which we give), the committee was not able to submit conclusions or recom-



mendations, and therefore a report of progress was put forward.

Sub-committee No. 4, under Prof. E. C. Schmidt as chairman, did some work and sent out a circular, but is not in position at present to present information from which any conclusions can be drawn. Sub-committee No. 5, under Chairman P. M. LaBach, made a study and submitted the result of freight locomotive tests on the Logansport division of the Pennsylvania lines made in 1912. This shows results for special conditions and is instructive. It was thought advisable not to publish this report now.

The chairman of the committee made a careful study of the statistics of coal consumption in freight service on the western lines of the Canadian Pacific railway for the past eight years. These studies have convinced him that instead of attempting to base coal consumption directly on the amount of work done, that it is better to divide the coal into two factors, one varying directly with the amount of work done and the other varying with the engine miles run. As a result of these studies, the following formulæ have been adopted for western lines on the Canadian Pacific railway: Single-Track Operation.-Fairly busy lines, 3.5 lbs. coal per calculated horsepower hour, plus 70 lbs. coal per engine miles run. Double-Track Operation.-3 lbs. coal per calculated horsepower hour, plus 60 lbs. coal per engine miles run.

The above figures are an average for the year, for conditions on the C. P. R. western lines, using engines equipped with superheaters and having drawbar pull varying from 36,000 to 42,000 lbs. each. The calculated horsepower is the work done overcoming resistance, lifting loads from a lower to a higher level and overcoming curve resistance. Acceleration and work done running air pumps being indeterminate, was not taken into account in the calculated horsepower hours. The amount of coal per engine miles run, covered the above mentioned work, besides coal used in keeping steam up in locomotives, or burned at sidetracks or wasted at roundhouses.

Inasmuch as no conclusions or recommendations were submitted, the report was received as a progress report.

Annual Election of Officers

The election of officers resulted as follows: President—A. S. Baldwin, Illinois Central R. R. Vice-President—C. A. Morse, C., R. I. & P. Ry. Secretary—E. H. Fritch (re-elected).

Treasurer—George H. Bremner. Directors—R. N. Begien, B. & O. R. R.; C. E. Lindsay, New York Central Lines; W. D. Pence, Interstate Commerce Commission.

Nominating Committee—A. M. Burt, Northern Pacific Ry.; A. F. Robinson, A., T. & S. F. Ry.; E. B. Temple, Pennsylvania R. R.; M. A. Long, B. & O. R. R., and W. K. Hatt, Purdue University.

Improvements on the Railroads of Argentine

Extensions of various parts of the Argentine railway system and further improvements are authorized by executive decree. A branch line from Aymogast, on the Argentine Northern, to Aming is projected, to cost \$42,460. Pipe lines are to be installed at Cebollar to furnish the necessary water supply, and on the Central Northern line switching connections and signal apparatus are to be installed at Laguna River, General Pinedo and Urundel.

Concrete Freight Piers—Lehigh Valley Railroad

By M. W. LATIMER

The Lehigh Valley Railroad has just completed a freight pier at the foot of Rector street, New York, that is not only unusually well designed and equipped for the rapid handling of freight, but also is unique in being constructed of reinforced concrete. This replaces two old piers, Nos. 8 and 9, the new one being designated as Hudson River Pier No. 8. Almost two years were required to accomplish the removal of the old piers and the building of the new. A large amount of work incidental to these operations was encountered, and the total cost is reliably stated to have been more than \$1,000,000. The pier is 730 ft. long and 75 ft. wide, constructed of reinforced concrete and steel and resting upon a concrete sub-structure bedded on piles. The number and spacing of the piling was designed to provide ample support for the reinforced concrete substructure and its load, and the elevation was chosen at such a height that all piling and clamping timbers would be below water line. The sub-structure consists of a series of concrete bases tied together by arches, on which are built the main supports for the deck of the pier, which is designed for a static load of 500 lbs. per sq. ft. The thickness of the concrete floor or deck is at no point less than 8 inches, and ample provision is made to allow for changes of length in such a long structure by three transverse expansion joints, covered with steel floor strips and so fitted that there is no actual connection between the abutting sections.

An unusual feature of this latest improvement to New York's water front is the massive concrete sea



Lehigh Valley Pier-West Street Front

wall running along the bulkhead of this and the adjoining pier, which, when completed, will be disignated No. 9 and will be occupied by the Central Railroad of New Jersey. This wall is constructed of solid concrete blocks resting on a pile foundation. Each block is pyramidal in shape, about 7 by 8 ft square on the base, 15 ft. high, and weighing 85 tons. The blocks were cast separately and lowered into place. It is the only concrete sea wall in or about New York Cicy, and is likely to influence the future design of such structures to a notable degree. The operations incident to its construction and that of the pier structure involved the rebuilding of a large main sewer and the replacement of the street surface over a considerable area back of the bulkhead. The former method of building Hudson River piers was to place a number of timber cribs filled with stone back of the piling, with no protection for the original river bank; so that at periods of unusually high or spring tides the banks were over-



flowed and cellars on West Street flooded. The new pier is of solid construction, designed not only to remain rigidly fixed without the sagging so commonly observable in old works of this kind, but also capable of withstanding the ramming it occasionally must receive from tugboats and lighters. It is carried out into the river to the limit of pier-head line set by the engineers of the New York City Department of Docks.

The main superstructure of this Lehigh Valley pier is a steel frame, with corrugated metal siding and steel trusses supporting a wooden roof covered with Johns-



Lehigh Valley Pier-Car Float Being Warped Alongside

Manville 4-ply built-up asbestos and felt roofing. A substantial fire wall is built across the pier at a point about half way to the end, with a metal automatic fire door of ample width. This door is hung in such a manner that it is held open by a steel wire having a fusible metal link in it over the doorway. The melting of this link by the heat of a fire starting in the vicinity of the door will release weights that in falling will pull the door to the closed position. While no sprinkler system has been installed as yet, it is the intention of the company to add this feature of fire protection to the otherwise well-protected structure. The steel work of the pier shed is independent on either side of the fire wall, so that while a destructive fire might cause complete collapse of the building on one side of the wall, it is unlikely that its effects would be felt on the other side. The sides and ends are closed by Kinnear rolling steel doors, easily opened or closed by hand,

thus giving access from a boat at any point for convenient shipment. The bulkhead structure is two stories high, with the exterior of the West street facade sheathed with copper. Two driveways of ample width give access to the pier, and between them there is a cashier's office and a large room for the accommodation of the United States custom officials. The rest of the building will be occupied by Lehigh Valley offices, furnishing desk room for a large number of clerks. Tubular elevators communicate between this department and the cashier's office on the ground floor. On the second floor, in addition to the agent's office, toilet rooms, etc., there is a large record room built of fire-resisting materials for the storage of valuable documents. Windows are provided on both the West street and river fronts, giving plenty of light and air in any part of the offices.

On the inner end of the pier are the boiler room, meter room for water-supply main, toilet rooms and general store room. Coal for the boiler room will be delivered from boatloads at the pier directly through a window over the bins. As time spent in billing and checking outgoing freight is so vitally important, great care has been taken in the design of the arrangements of this part of the pier. Two offices are built on the driveways for the weigh-masters and their assistants. The hand-truck scale platforms are located in front of these offices, and the weights are shown on direct-reading dials about 3 ft. in diameter, enabling both the freight-handler and weigh-master to see the weight of a shipment simultaneously and within the shortest possible time, giving the man his weight check, thus facilitating the operations of loading. Platform scales are installed in several other convenient locations. There is a large fire-proof room for the storage of valuable, inflammable or explosive shipments, built as a separate unit from the main superstructure. For the convenient handling of heavy articles, there is a hand-operated traveling crane of ten tons capacity traversing the full width of the pier and capable of swinging outboard far enough to load and unload lighters.

Readiness of access to cars on floats lying at the pier has been especially considered in the general design. Numerous gangway bridges are provided on each side,



L. V. R. R. Pier-Arrow Shows Position of Fire Wall

and thus cars can be loaded or unloaded without difficulty, no matter what the stage of the tide may be. In addition to this, at the bulkhead and facing out into the stream, are three bridges for loading car-float gangways from the end, giving a total capacity of the pier of 5 floats carrying 23 cars each, or 115 cars in all.

The light from the windows in the monitor and upper part of the building is very evenly diffused, thus facilitating the rapid handling and checking of freight. This is a simple device in itself, and one that always increases the output of shops and factories.



Spring Meeting of the Railway Signal Association

Report of March 1916 Meeting

The spring meeting of the Railway Signal Association was called to order at 9:30 a.m., Monday, March 20th, in the Auditorium Hotel, by President W. J. Eck, signal and electrical engineer of the Southern Railway.

Committee No. 7, on Direct-Current Relays (chairman, E. W. Kolb), reported progress in its investigations.

Committee No. 4, on Automatic Block Signaling (W. M. Vandersluis, chairman), reported that progress had been made on specifications for trunking and other matters, and that a report would be ready for the annual meeting.

The Committee on Maintenance and Operation (G. S. Pflasterer, chairman), reported progress.

Committee on Committees of the Board of Direction (C. A. Dunham, chairman), reported on the organization and possibilities of the regional committees.

Report on Wires and Cables-Committee IX

The committee IX on wires and cables, of which Mr. W. H. Elliott was chairman, reported briefly as follows:

The committee on wires and cables presented here its report on the subjects of preparing standard definitions of principal terms used in wire and cable specifications and of preparing specifications for steel core aluminum stranded aerial wire, and asked that the matter be given consideration, with a view of having them approved at the next annual convention for submission to letter ballot. Definitions of principal terms used in wire and cable specifications. Specifications for aerial aluminum cable steel reinforced.

The definitions submitted and the illustration of the use of the terms recommended are taken from Circular No. 37, Electric Wire and Cable Terminology, of the Bureau of Standards of the Department of Commerce and Labor. These definitions were prepared by the Bureau of Standards in co-operation with representatives of the standards committee of the American Institute of Electrical Engineers, together with other engineers, representatives of railroads and manufacturers.

Of the definitions submitted, greatest variations existed in the use of the words "strand" and "cable." The word "strand" signifies a component part of a larger unit. A strand is one of the component parts of a cable, each part being either a single wire or a combination of wires.

Wire. A slender rod or filament of drawn metal.

Conductor. A wire or combination of wires not insulated from one another, suitable for carrying a single electric current.

Stranded conductor. A conductor composed of a group of wires or any combination of groups of wires.

Cable. (1) A stranded conductor (single-conductor cable); or (2) a combination of conductors insulated from one another (multiple-conductor cable).

Strand. One of the wires or groups of wires of any stranded conductor.

Stranded wire. A group of small wires, used as a single wire.

Cord. A small cable, very flexible and substantially insulated to withstand wear.

Concentric strand. A strand composed of a central core surrounded by one or more layers of helically laid wires or groups of wires.

Concentric-lay cable. A single-conductor cable composed of a central core surrounded by one or more layers of helically laid wires.

Rope-lay cable. A single-conductor cable composed of a central core surrounded by one or more layers of helically laid groups of wires.

N-conductor cable. A combination of N conductors insulated from one another.

N-conductor concentric cable. A cable composed of an insulated central conducting core with (N-1) tubular stranded conductors laid over it concentrically and separated by layers of insulation.

Duplex cable. Two insulated single-conductor cables twisted together.

Twin cable. Two insulated single-conductor cables laid parallel, having a common covering.

Triplex cable. Three insulated single-conductor cables twisted together.

Twisted pair. Two small insulated conductors twisted together, without a common covering.

Twin wire. Two small insulated conductors laid parallel, having a common covering.

In order to illustrate the proper use of the terms, the following discussion is submitted as information:

The use of a cable in the transmission of a single current is in general restricted to the cases where the current is large. This requires a large conductor, which for practical reasons is stranded. When one of the strands of a conductor is composed of more than one wire, each element of the strand is also called a strand. Stranded conductors are very commonly formed of concentric strands, which consist of a central core surrounded by one or more layers of helically laid wires. If used as a completed cable, such a conductor is called a concentric lay cable.

Discussion.-It was voted to accept the definitions and the principal terms used in wire and cable specifications as reported by the committee. C. C. Anthony made the suggestion that instead of printing these definitions in the Manual, a note be printed in the Manual referring to the places where these difinitions might be found in the proceedings of the association. This suggestion was accepted by the chairman of the committee. The chairman, however, submitted for adoption and submission to letter ballot specifications for aerial aluminum cable, steel reinforced. E. G. Hawkins suggested that the clause on conductivity of aluminum wire be made to read: "The conductivity of the aluminum wire shall be not less than 60% of the annealed copper, standard centigrade." This suggestion was made in order to prevent any confusion with the percentages of conductivity used in the Matthiessen standard scale. The committee accepted this suggestion, and the motion to submit to letter ballot was carried.

Report on Mechanical Interlocking—Committee II

Committee II on mechanical interlocking, of which Mr. C. J. Kelloway was chairman, reported briefly as below, giving an outline of their work, which was to prepare specifications for apparatus and materials used in mechanical interlocking; also to prepare standard plans for leadaways and layouts for slip switches, movable point frogs and derails, and specifications for apparatus and materials used in electro-mechanical inter-



locking; further, as to interlocking and operation of drawbridges, and lastly, recommend methods for mechanically locking switches at interlocking plants.

The committee on mechanical interlocking presented its report on subjects—specifications for apparatus, plans, etc., for slip switches, and interlocking at drawbridges—with the request that the same be given consideration. The committee presented for discussion and acceptance revised specifications for mechanical interlocking. The committee presented for discussion and acceptance drawings of leadaways and turns in pipe lines. The chairman submitted final report, "Requirements for protection of traffic at movable bridges," which has been agreed upon by the committee appointed by the association and Committee XV of the A. R. E. A. for acceptance.

The committee is prepared to submit complete specifications for electro-mechanical interlocking. The committee has also carefully considered methods for me-'chanically locking switches at interlocking plants; much time and discussion has been devoted to this subject.

The committee, in presenting proposed revisions of certain sections and paragraphs in existing specifications, has, for convenience in comparison, given the proposed wording for the new schedule.

Building foundations—The foundation for interlocking station and leadout supports shall be furnished in place by the ——, and shall be in accordance with R. S. A. drawings specified. Interlocking station— When fireproof buildings are erected a special chase for electric conductors shall be provided by the erector of the buildings. Lighting for buildings—The number, kind, size and distribution of electric lights, when used, were described. Machine—Levers shall be numbered and in accordance with drawings specified.

Other items in the specification were levers, locking, cranks, rocking shafts and fittings, pipe and pipe lines, stuffing boxes, pipe carriers, compensators, jaws, lugs and pipe adjustments.

The protective appliances at drawbridges consist in devices for insuring that the bridge is in proper position, and the track in condition for the passage of trains over draw, or for reduction to a minimum of the damage in case of trains not stopping when track is not in condition for passage of same over draw; also the usual devices for protection against damage in case of derailment.

The protective devices may be classified under the headings: Interlocking power and bridge devices; bridge surfacing, aligning and fastening devices; railend connections; signaling and interlocking; guard rails.

Interlocking the drawbridge devices so that their movements must follow in a predetermined order to protect the drawbridge machinery.

Drawbridges should be equipped with proper mechanism to surface and align them accurately and fasten them securely in position. This condition can be secured by the use of efficient end lifts in case of swing bridges, and by proper end locks in case of lift bridges.

Rail ends may be mitered or cut square. Mitered rails where lapped should retain the full thickness of the web to the points. The points should be trailing to normal traffic where possible; on single track bridges the points should be trailing to traffic entering the movable span. Where rail ends are cut square or mitered and not lapped, they should be connected by sliding sleeve or joint bar or by easer rails to carry the wheels over the opening between the end of bridge and approach rails. If trains are to proceed over drawbridges which are in service, without first stopping, interlocking should be installed which will provide that the drawspan, tracks and switches within the limits of the plant are locked in the proper position.

This will require locking drawbridge devices; locking providing for the proper order of operation of signaling devices, such as signals, switches and derails.

This interlocking will require the following order of operation: Before opening a drawbridge—(1) display stop signals; (2) unlock rail and bridge devices. Before operating trains over drawbridge—(1) lock bridge and rail devices; (2) display clear signals.

Since there are various types and designs of drawbridges and various drawbridge devices for each of the types, and also various designs and types of signaling devices, as well as various locations from which they all may be interlocked and operated, a typical example only of the detail order of operations is given, viz., a swingbridge with all its devices operated from one location on the drawspan, having home and distant signals, derails, etc.

To open drawbridge: (1) Display stop signals; (2) unlock derails; (3) open derails; (4) uncouple interlocking connections; (5) unlock rail-end connections; (6) unlock bridge surfacing, aligning and fastening devices; (7) operate power-controlling device to position permitting application of power to bridge machinery; (8) withdraw rail-end connections; (9) withdraw bridge surfacing, aligning and fastening devices; (10) open bridge. To pass trains over drawbridge: (1) Close bridge; (2) insert bridge surfacing, aligning and fastening devices; (3) insert rail-end connections; (4) operate power-controlling device to position preventing application of power to bridge machinery; (5) lock bridge surfacing, aligning and fastening devices; (6) lock rail-end connections; (7) couple interlocking connections; (8) close derails; (9) lock derails; (10) display clear signals.

The above example of order of operation includes derailing switches, but their use is not recommended in all cases. Each situation must be given special study with respect to the use of derails, smash boards or similar devices; their location with respect to drawspan, and the use and length of guard rails.

Guard rails should be provided as for fixed bridges, except for the necessary breaks at the ends of the movable span. Obstructions to derailed wheels which are guided by the guard rails should be reduced to a minimum. The rails and attachments should be separated from the metallic structure so track circuits may be successfully operated the entire length of the bridge. The various bridge devices should be so designed that Railway Signal Association interlocking apparatus may be used. Electric and time locking apparatus is regarded as adjuncts.

Discussion.—In discussing the committee's proposition to eliminate specifications for wire-connected signals, several members questioned whether this could be done on account of the fact that a number of roads are using wire-connected distant signals. Mr. Elliott, in discussing this matter, questioned whether the added expense of maintenance of wire-connected signals did not overcome any advantage of less expensive initial installation that could be advanced. It was suggested that any road could look back in the Manual for wireconnected signal specifications when occasion arose. Mr. C. C. Anthony moved that a notation be made as to the number of roads using wire-connected signals, with the following results: 30 members stated that they are installing only pipe-connected or power-operated signals; 38 members expected to install only pipe-connected or power-operated signals in the future; 1 member stated that his road expected to continue the in-



stallation of wire-connected signals, and explained that on some branch lines only two trains a day were operated, and that in high-speed service his road expected to install only pipe-connected signals; 44 members stated that they are now using wire-connected signals to some extent, and no one stated that he was using no such signals. A number of other changes were recommended on the first two subjects reported by the committee, and these were referred to the committee to be presented at the May meeting. The committee's final report on "Requirements for Protection of Traffic at Movable Bridges" was accepted by the association.

Report on Storage Battery and Charging Equipment— Committee X

The report of committee X, of which Mr. R. B. Elsworth was chairman, was substantially as follows:

Under subject of preparing specifications for apparatus and material used in storage battery installation, the committee submitted to the association for discussion two specifications for batteries, and a drawing showing a proposed standard hydrometer and thermometer for storage battery work. These specifications have been worked up in conjunction with the manufacturers and as far as was practicable, in accordance with their suggestions.

The specifications for lead type portable storage battery have been under investigation by this committee during the past four years. Tentative specifications have been submitted to the association for discussion on two or three previous occasions. The committee have submitted specifications which eliminate the optional features which are objectionable. It is the recommendation of the committee that these specifications be discussed and if they meet with approval the committee will recommend that final action be taken.

The proposed specification for composite type stationary storage battery has also been under consideration by the committee for the past couple of years. The specification has been prepared for the use of those roads who do not wish to purchase pure lead type battery but still wish a R. S. A. specification upon which to purchase material. The committee recommends that these specifications be discussed.

A proposed standard hydrometer which has been designed and submitted by the committee with the idea of getting a substantial instrument with the largest possible scale and still be able to use the hydrometer for the smallest standard stationary storage batteries. This instrument can be purchased economically and, in the opinion of the committee, should be adopted by the association. The thermometer is of the flat type and has been marked to show the corrections to be made in hydrometer readings at the various temperatures. The committee has also been working on a combined hydrometer and thermometer, using the flat section of the hydrometer for the purpose of the thermometer scale.

The committee has also been doing work preparing plans and specifications for switchboards, and hopes to have a switchboard specification and additional plans for discussion of the association at the May meeting.

Discussion.—After some discussion, in which Mr. H. M. Beck, of the Electric Storage Battery Co., took part, it was decided to approve the specifications for opposite type stationary battery for signaling for submission at the annual meeting. The committee's plans for standard hydrometer and thermometer for portable storage batteries were received as information, as the committee wished to make some alterations before they were submitted at the May meeting.

Special Committee on Lightning Protection

The special committee on lightning protection of which Mr. E. G. Hawkins was chairman, practically reported as follows: In the matter of made ground connections, they said that ground apparatus should be designed to provide the best electrical connection with the earth. and with the lowest practicable impedance to discharges from lightning arresters, and also that it have sufficient capacity to handle discharges from the lightning arresters, and be designed with a factor of safety sufficient to insure the apparatus against damage from these discharges. It should be designed and made of the materials best suited to withstand the physical and chemical actions and be fastened as to prevent loosening and be easy of inspection. The terminal connections and ground apparatus be so aligned as to provide a direct path for the discharges.

Ground leads from lightning arresters to ground apparatus should be designed with the lowest practical impedance to discharges from lightning arresters. Ground leads have sufficient capacity and sufficient strength to withstand ordinary mechanical injuries.

Ground apparatus to be installed as near as practicable to lightning arresters, and at a sufficient depth to insure the least resistance practicable and to run as directly as practicable from the lightning arresters to the ground apparatus, and be placed where they are the least liable to injury, and so located as to provide sufficient clearance to prevent contact with operating circuits. The recommendations of the committee were accepted.

Report of Special Committee on Electrical Testing

The special committee on electrical testing, of which Mr. W. N. Manuel was chairman, reported among other things, as follows: Forty-two letters were sent out and twenty-eight replies were received. Sixteen replies indicated the practice of making systematic inspections and tests as frequently as practicable. No special methods or instructions are in use. Ten replies were brief acknowledgments.

There seems to be a growing need of frequent, periodical tests of insulation resistance, conductivity of conductors and contacts, drop-away and pick-up of electro magnetic apparatus, lightning arresters. grounds, etc. At present, only a limited number of men are capable of making such tests, and usually cover a large territory at infrequent intervals. In one instance, a relay repair car covers the system, changing out, recalibrating and repairing en route, all defective relays. An analysis of the data collected indicates the desirability of recommending the preparation of adequate instructions for making, at frequent intervals, routine inspection and tests of all apparatus and circuits, to educate maintainers along this line so they they may ultimately take necessary measurements, record the result on suitable forms. For a time such tests would necessarily be conducted under the direction of inspectors.

(a) As to methods of testing apparatus and circuits, 28 replies to 42 requests for information brought out the fact that at present comparatively few men had a right to test apparatus, and these seem in present practice to make as frequent trips over the road as possible, testing, repairing and renewing apparatus as necessary. There seems to be an opportunity for a recommendation that routine inspections and tests of



all apparatus and circuits be made at frequent intervals, with a view of educating maintainers to do this work.

(b) In regard to minimum insulation resistances allowable, the committee reported progress.

(c) In regard to ranges and scales for electrical instruments, recommendations were presented for consideration.

(d) In regard to preparing forms for recording the results of tests, a track-circuit test chart and an insulated joint test chart were presented as a progress report.

(e) In regard to specifications for adjustable resistances for testing, the committee reports progress in the development of a unit for universal use in signal testing.

(f) In regard to a standard marking or numbering of relay posts, the committee recommends the marking of binding posts on all signal apparatus, and duplicate marking of all wires connected thereto, to assure the re-establishing of proper connections when apparatus is changed out. Suitable constructive criticism was offered in the discussion, and the committee hopes to be able to present complete reports at the May meeting.

Report on Standard Designs—Committee VI

The committee VI on standard designs presented the following report which we give in a brief summary. Mr. F. P. Patenall was chairman of the committee:

The committee on standard designs presented thirteen drawings, five of which are new and eight are revisions of previous issues. On five of the eight revised drawings the changes are of such character that they do not affect the designs; these drawings were presented for the information of the members.

The revised drawings are as follows:

Signal Masts. Clamp for Base of Ground-mast Signals. Details of Transverse Pipe Carriers. Two-lever Wall Machine. Stuffing Box for Wire. Two-way Single-lamp Signal. Tang Ends with Screw Jaws. Two-lever Wall Machine, Details. Low Target Stand.

At various intervals in the past, the committee received requests and suggestions to design a switchlamp support which would provide a separate lamp attachment at hand-operated switches where ordinary throw-over levers are used. The plan submitted meets the requirements, and provides the means of adjustment so that the rotating of the lamp to its proper angle may be kept in strict alignment.

Discussion.—The plans submitted by the committee were, after some discussion, approved. R. E. Trout reported for a sub-committee that work done had resulted in a suggestion that the number of sizes of roundels could be reduced from the present practice of 16 for red, 12 for yellow, 17 for green, 7 for purple and 7 for blue, to two standard sizes, $8\frac{3}{8}$ in. in diameter for high signals and $5\frac{3}{8}$ ins. for dwarf signals. The sub-committee further suggested that all lenses be $5\frac{3}{8}$ ins. in diameter, with the exception of the red lens of rear-end marker lamps, $6\frac{3}{8}$ ins., and rear-end platform lamps, $8\frac{3}{8}$ ins. The president announced that the matter of lenses would be discussed further at the May meeting.

Report of Special Committee on Harmonizing Specifications

The special committee on the harmonizing of specifications, of which Mr. H. S. Balliet was chairman, reported substantially as follows: After giving this subject considerable study it seemed advisable to the special committee to make the various sections, comprising the general specifications, meet all the specifications for signal installations, and in order to do this it was found necessary to revise and rearrange the existing sections, as well as to add some additional matter.

After outlining the policy of eliminating the general provisions from seven specifications, the special committee revised and rearranged the sections and paragraphs, as finally decided on by the committee.

Discussion.—The committee suggested that the matter be submitted to letter ballot. The request of this committee was received as a progress report.

Report on Signaling Practice—Committee I

The report of Committee I on the exposition of the three schemes of signaling is substantially as follows: Mr. C. C. Anthony was chairman of the committee. There were three schemes presented. To begin, Scheme No. 1 provides but one limiting indication, proceed with caution; this indication must be given when conditions are such that a train may pass the signal but, at and beyond the signal, must be run at restricted speed or so that it can be stopped at any point. In such cases any signal in the rear, operated in connection with the one in question, should also be at caution.

In the case of a home interlocking signal it is assumed that there is a distant or automatic block signal in the rear and an automatic or other advance signal stopping distance in advance. The mechanical or electrical control of the home signal would be such that it could be set at caution, but not at proceed, with any facing switch reversed. The distant or automatic signal in



the rear would then also be at caution. The engineman of a train approaching the home signal with caution, in accordance with the indication of the signal in the rear, would take any action required by the conditions; and among these would be the existence, at fixed locations, of the one or more facing switches, any one of which might be reversed. The engineman, then, finding a certain route set up, might proceed at low speed over a turnout or crossover into a siding, to the main track of a branch or to a main track against the current traffic;

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or, if conditions required, he should move at still lower speed; or, again, if it were evident that the route set up was not the right one for his train, he should stop before getting into any difficulty. With similar effect the home and distant might be at caution for a closing-in movement of one train following another between the home and advance. On the other hand, if the advance signal were at stop, the switches set for the main track and the track clear, the home would be at caution and the distant clear.

In the case of a diverging route, operated under the permissive manual block system, it would be practically necessary to provide an advance signal, the proceed indication of which, when the block was clear, would leave a train free to proceed without signal restriction after clearing the junction or crossovers. In the absence of an advance signal the caution indication of the home signal would require a train to proceed with caution throughout the block. On a road operated under the absolute block system, however, the territory covered by a caution signal on a main track diverging beyond it might very well be defined as extending to the advance, where one exists, and through the interlocking limits where there is no advance signal. A train turning off to a branch or other main track would then be restricted until clear of the interlocking and would be free to proceed unrestrictedly through the block.

What has been said of low speed applies to Scheme No. 1, although this scheme contains no specific speed indication. The difference between Scheme No. 1 and the other schemes in this respect is that, in connection with Scheme No. 2 or Scheme No. 3, the actual rate of speed called low speed and not to be exceeded under low-speed indications, must be specified by rule; whereas, in the application of Scheme No. 1, a similar speed limit, arrived at in the same way, must be prescribed by rule as the limit not to be exceeded by a train already proceeding with caution when it passes a caution signal, unless any facing switches beyond the signal are right; or by a train moving over a turnout or crossover on the indication of a fixed signal. Under this rule, when the switches are right and other conditions are favorable. the speed may be higher so long as it is such that the train can be stopped within range of vision-as when the train is entering an occupied block with a good view or is approaching an advance signal located some distance beyond the switches. If preferred, however, the speed limit may be prescribed for all movements past caution signals by trains already proceeding with caution, to be observed even though the switches are right and equally where there are no facing switches. It would doubtless be well also to make the same speed limit apply to turnouts and crossovers, movements over which are not governed by fixed signals; this is true as well of the rate specified as low speed where either of the other schemes is applied.

In terminal territory, particularly at and near a large passenger station, and in some other similar situations, where the speed of all movements is restricted by rule to a rate at which trains may run over the turnouts and crossovers, proceed indications may be given by either dwarf or high signals for movements over the turnouts and crossovers as well as movements on the straight or continuous tracks. Where block operation, or equivalent control of the signals, is maintained through the territory, a signal should not be at proceed unless the route set up is clear and the signal in advance is at proceed, or at caution with the route beyond it clear. The caution indication should be given when the route is occupied and when the signal in advance is at stop, or at caution for a closing-in movement; also to govern movements into spur or other tracks not used by road

trains. In any event a signal should not be at proceed when the signal in advance, on the route set up, gives the stop indication.

Scheme No. 2 is a development of Scheme No. 1 primarily for the purpose of providing for medium-speed movements, by an additional indication, although it includes a second additional indication, proceed at low speed, which may be used under certain conditions under which the caution indication is given in Scheme No. 1.

To illustrate applications of the low-speed indication some of the diagrams for Scheme No. 1 are referred to; it is to be understood in each case that the low-speed, instead of the caution, aspect would be displayed at the home signal.

The action required by this indication is that the train, when passing and proceeding beyond the signal,



Second Scheme Signal Arrangement

move at such low rate of speed as conditions may require but not exceeding through the low-speed territory the rate fixed by the rules as the maximum for lowspeed movements. Beyond that territory the speed must continue to be governed by the conditions. Practically, then, the low-speed indication is the caution indication with a low speed limit added. Some of the uses of the indication make this guite clear.

On a road signaled in accordance with Scheme No. 2, where two-arm signals were installed the low-speed indication would be given at a home interlocking signal for movement into a siding.

When a signal gives the low-speed indication, its distant signal must be at caution. The distant signal should evidently not be at proceed, because a train might reach the low-speed signal unchecked and, as its speed could not instantly be reduced, it would pass the signal at a higher speed than that prescribed. For a similar reason the medium-speed indication should not be given at the signal in the rear. In the absence of a distant or equivalent signal all trains would have to approach as though a caution indication had been re-

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ceived at a signal in the rear, as in the case of a home signal without a distant, referred to in the remarks on the caution indication. It is obvious that, under certain conditions, the caution indication is given in Scheme No. 1 to a train proceeding with caution when it approaches the signal, while, under the same conditions, the low-speed indication may be given in Scheme No. 2.

The action required by the proceed at medium speed indication is that the train, when passing and proceeding beyond the signal, move at a rate of speed not exceeding that defined by the rules as medium speed. The force of the indication is primarily to limit the speed to the prescribed rate and it goes without saying that, in a particular case, lower speed might be required by conditions having nothing to do with the signals.

As in the case of the proceed indication, clear track is not invariably a condition that must exist when the medium-speed indication is given. This indication may, for example, govern to a branch not operated under the block system. When a train is to move over a mediumspeed route with a signal in advance at stop or the block occupied, or under any other conditions requiring further reduction of speed or a stop on or beyond that route, the low-speed indication may be given. A practical reason for so doing is found in the convenient operation of the signal in case conditions change so that the medium-speed indication can be given before the train arrives. The only signal operation necessary in that case is the movement of the bottom arm from the diagonal to the vertical position. The practice as to speed indications governing to an advance signal at caution, in permissive blocking and possible track-circuit control. When a signal gives the medium-speed indication the distant or equivalent signal in the rear must give the caution indication so that a train, which must not exceed medium speed when passing the medium-speed signal, will not reach that signal unchecked.

Quite frequently there is but one route for movements over which the medium-speed indication is given at a particular signal. The indication is then, practically, also a route indication.

In Scheme No. 3 four types of high signals are provided for use as circumstances may require. (1) A onearm signal to be used, in general, where no speed indications are to be given; (2) a two-arm signal with arms of equal length at the usual spacing—7 ft. being the adopted standard of the associations—to be used, chiefly for block and distant signals, where indication No. 8, but no low-speed indication is to be given; (3) a twoarm signal with the bottom arm shorter than the top arm and at a greater distance from it than on signals of type 2, to be used where low-speed, but no mediumspeed, indications are to be given; (4) a three-arm signal with the bottom arm shorter than the others, to be used where both low-speed and medium-speed indications are to be given.

Two-arm or three-arm signals may, however, be used uniformly for certain purposes, such as interlocking home signals, certain arms on individual signals being inoperative where there is no occasion to give the indications for which they provide.

In Scheme No. 3 the purpose is to provide two indications in connection with each speed, one requiring a train to proceed with caution and at the same time not exceed the specified speed; the other restricting the movement in no way except as to speed. It was found that the necessary distinction could be made and four similarly worded indications could be formulated by expressing the general restriction or absence of such restriction in the familiar terms "Proceed with caution" and "Proceed," and adding the words "on low-speed route" or "on medium-speed route," which make it clear that, where the train is to go, the speed is limited to low speed or medium speed. This wording is entirely appropriate in view of the fact that speed signal indications were developed primarily as a means of consistently signaling movements over routes differing from one another in the character of the turnouts or crossovers forming part of them, and that, in the majority of cases, the character of the route determines the speed indication to be given.

This indication is of the same effect as the low-speed indication of Scheme No. 2. It is only used, however, under part of the conditions mentioned in connection with that indication—to govern movements over lowspeed routes to main tracks with the current of traffic, when conditions do not permit the indication, proceed on low-speed route, to be given; to govern movements



Arrangement of Signals in Third Scheme

to sidings and to main tracks against the current of traffic, and to govern closing-in or permissive movements.

This indication provides for low-speed movements with no restriction by signal other than that of speed. The action required is that, at the signal and through the low-speed territory, the rate specified as low speed be not exceeded; so far as the signal is concerned, the train is free to maintain that rate of speed. Therefore the indication should not be given when conditions affecting the signals are such that lower speed or a stop may be necessary; as when the track beyond the signal is occupied or a signal in advance is at stop. Under this indication the speed may be increased as soon as the train is through the territory covered by the indication. When a signal gives either of the lowspeed route indications, the distant or equivalent signal in the rear, if there is one, should be at caution.

The action required by this indication is that the train, while not exceeding medium speed through the territory covered by the speed indication, proceed with caution through the territory covered by a caution indication on the track reached by the medium-speed



route. The train may pass the signal at, but not above, medium speed if the conditions permit such speed under the caution indication.

This indication is of exactly the same effect and is to be given under the same conditions as the mediumspeed indication in Scheme No. 2. It may govern to a signal in advance giving the indication proceed with caution on medium-speed route, when the conditions beyond are such that a train may maintain medium speed up to that signal.

The action required by this indication is that the speed of the train, if it is higher than medium speed, be reduced to that speed after the signal is passed and at least by the time the next signal is reached if the distance between signals is sufficient. Ordinarily the indication is given as a "medium-speed distant indication" when the signal in advance is giving one of the medium-speed route indications. Under these circumstances the distance between the signal giving the reduce-speed indication and the one giving the mediumspeed route indication, should be sufficient for the speed of the fastest train to be reduced to the specified rate. Occasionally three successive signals must be so spaced that there is not sufficient distance for reduction to medium speed between the second and third nor between the first and second, although the distance between the first and third is sufficient. In that case, when the third signal gives a medium-speed route indication, the reduced-speed indication must be given at the first and should be repeated at the second.

Where the lengths of automatic blocks or the distances between several successive semi-automatic signals are less than stopping distance for the fastest trains, the reduce-speed indication may be given at one signal when the next is at caution and the signal beyond that is at stop. Then a fast train, reducing speed after passing the first signal and passing the second at approximately medium speed, can readily be stopped at the third; while a slow train may continue at its moderate speed from the first signal to the second and make its entire reduction of speed to a stop at the third signal after passing the second. When an automatic block signal is provided with two arms, so that the reduced-speed indication can be given, the diagonal arrangement of lights, distinguishing the signal as an automatic, S8, may be secured by the use of a spectacle of design A on the top arm and one of design B on the bottom arm. The red marker light then becomes an active light; when the bottom arm is vertical its green light appears at the left of the mast. However, the diagonal arrangement of the two lights at that time is of no significance.

Discussion.—The report of the committee was accepted, with a unanimous vote of thanks to Mr. Anthony for the preparations of the exhibition.

Committee No. 3, on Power Interlocking, did not present its report on account of the absence of the chairman, Mr. F. B. Wiegand. The report was held over for discussion at the May meeting.

There were registered 159 active members of the association, 14 junior members, and 59 associate members.

The officers of the Railway Signal Association for 1916 are:

President—W. J. Eck, signal and electric engineer, Southern Ry., Washington, D. C.

Vice-Presidents—Charles A. Dunham, signal engineer, Great Northern Ry., St. Paul, Minn.; and W. H. Elliott, signal engineer, New York Central Lines, Albany, N. Y. Secretary-Treasurer—C. C. Rosenberg, Bethlehem, Pa. Directors—T. S. Stevens, F. P. Patenall, B. H. Mann, F. B. Wiegand, J. C. Mill, M. M. Vanderslius, A. H. Yocum, W. M. Manuel, Charles W. Parker, J. M. Waldron, C. J. Kelloway.

Government Railways in Japan Interesting Information Regarding Operations, Wages and General Conditions

U. S. Consul M. D. Kirjassoff, Yokohama, makes a highly interesting report on the Japanese railways to the Bureau of Commerce at Washington. The report covers operations for the year ending March 31, 1915. Conditions required the exercise of economy in that year, resulting in a reduction of the number of shops and the number of employes. The total capital of the Government Railways expressed in our money for the ber of employes totaled 114,966. The total route mileyear 1914-15 was \$501,477,698, an increase over the previous year of more than \$16,000,000, while the numage of the entire system is 5,686, and the track mileage amounts to 8,611. 75 new stations were constructed in 1915, making the full number of stations 1,604. 2,611 locomotives were in service, 43,702 freight cars and 6,693 passenger cars and 47 ships with a gross tonnage of 21,515. The number of passengers carried was 166,092,421. The profits for the year amounted to \$27,385,682. The average wages paid per day per capita was in round figures but 36 cents. The total traffic receipts were \$55,860,469, and the ratio of expenses to gross receipts was less than 50 per cent. Conditions in Japan are materially different from those prevailing in the United States, but the operations of the Japanese railways are attended by the exercise of well-directed economy.

Bascule Bridge for the Southern Pacific

Preliminary steps to abolish the old swing bridges across Oakland's inner harbor from Oakland to Alameda have been taken by the chambers of commerce of Oakland, Berkeley and Alameda and by the city councils of the three municipalities. The authorities are seriously considering the erection of bridges of the bascule type to care for the rapidly increasing traffic over the present bridges and which also will do away with the slow-moving swings that are now a great hindrance to the water traffic in the inner harbor.

At present there are two swing bridges, one used exclusively for the Southern Pacific suburban and the other caring for all other traffic, including trolleys. The time required to open the swings not only causes long delays in street traffic, but also holds up the shipping to so great an extent that vessel men say they are a menace to navigation.

The Delaware & Hudson

In spite of the general business depression which prevailed in the year 1915, the Delaware & Hudson Company made the following showing for the period ending December 31, last, covering its railroad department: Total operating revenue, \$23,787,519; total expenses (operating), \$14,823,625.67; net revenues, \$8,-963,893.33. This was a net increase, over the previous year, of \$1,429,782.70, while the operating expenses decreased 4.52 per cent, making the percentage of expenses to earnings, 62.32 in 1915 as against 66.84 in 1914.

The yearly dividend of 9 per cent was continued.

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New Methods and Appliances

Duntley Universal Electric Hammer Drill

The Chicago Pneumatic Tool Co., Chicago, Ill., have recently placed on the market an electric hammer drill for drilling stone and concrete. The tool is equipped with a universal motor, and will operate interchangeably on direct or alternating current. The hammer blow, which is delivered by a piston on the drill steel or chisel, is produced by pneumatic impact and is very effective. At the instant the blow is struck the piston is running free of all mechanical parts, and therefore no shock or vibration is transmitted to the electrical parts of the tool. This means that there is no tendency for the electrical wires or connection to be crystallized due to incessant jarring. The tool is well balanced. and when held loosely in the hand the line of the center of gravity falls between the third and middle fingers of the hand, and lies within the barrel of the tool, allowing



Electric Hammer Drill

the tool to hang vertically. A thumb-switch conveniently located in the handle for the control of the electric circuit is manipulated the same as in the wellknown pneumatic hammers. All bearings are of the ball type, provision being made for the lubrication of all revolving and reciprocating parts. The gears and those portions of the moving parts subject to wear are all hardened. When drilling holes in stone or concrete in a downward position the powdered cuttings collect rapidly and not only absorb and waste much of the force of the blow, but tend to choke up the hole, making it difficult to remove the drill bit. A special feature of the Duntley electric hammer drill is the live air device for clearing the hole of the cuttings while drilling. This makes it possible not only to deliver the full force of the blow on the solid stone or concrete, but the removal of the drill bit is accomplished without difficulty, as there are no cuttings left in the hole to interfere. Hollow steels for this purpose can be furnished.

Right-of-Way Gates

The Iowa Gate Co., Cedar Falls, Iowa, have recently adapted to right-of-way use some of the features of construction that have made their gates for other pur-



Fig. 1. Locomotive Boiler Flues as Received from Railroads and the Machine for Cutting Them

poses efficient and economical. The most important feature of these gates is the use of 2 or $2\frac{1}{4}$ -in. rejected locomotive flues in place of new tubing.

It has been found by experiment that rejected locomotive flues of this size are equal in strength for this purpose to tubing of $1\frac{5}{8}$ -in. outside diameter. The tubes are received from railroad companies in even lengths as they are taken from service, and Fig. 1



Fig. 2. Locomotive Boiler Flues Cut to Proper Length and Stocked

shows the portable pipe-cutting outfit which is used to saw the tubes of lengths used in making the gates. Before this operation, the tubes are rumbled, and after they have been trimmed to stock length they are stored as shown in Fig. 2. After the gates are fabricated they are stocked in standard sizes, and shipment can be made on very short notice. In Fig. 3 is shown a stock





Fig. 3. Gate, in Right-of-Way Fence, Made of Locomotive Boiler-Flue Frame and Woven Wire

gate in right-of-way fence, Chicago, Rock Island & Pacific tracks, near Cedar Falls, Ia.

The use of rejected locomotive boiler flues makes possible a saving to the railroads of about one-third the



Fig. 4. Adjustable Feature of Gate for Sloping or Uneven Ground

cost of the gates. Another feature of advantage, illustrated in Fig. 4, is the adjustability of the style "H" gate, which can be raised on uneven ground to prevent dragging.



The Anchor Co., Railway Exchange Bldg., Chicago, Ill., have recently issued a 12-page illustrated booklet on the Efficiency One-Piece Rail-Anchor, which employs a $\frac{1}{4}$ -in. cotter pin through the anchor and the neutral axis web of the rail to secure a positive grip.

The Anchor Post Iron Works, 165 Broadway, New York City, have recently issued an 8-page catalog on Anchor Post Railroad Fences, which are suitable for inter-track or right-of-way fencing. One of the features of this fencing is the method of securing pickets to rails by means of an electric weld.

The A. S. Cameron Steam Pump Works, New York City, have recently issued a 36-page illustrated bulletin, No. 110, describing their line of duplex pumps. The bulletin describes the details of the design and construction of the pumps as well as the complete line of machines, and includes tables of capacities and instructions for installing and maintaining.

Franklin Railway Supply Co., New York City, have recently issued a 24-page illustrated catalogue on Mc-Laughin Flexible Conduit, Franklin Bolt Joints and the Franklin Single Water Joint. The catalogue illustrates by photographs and sections the construction, application and repaired parts of the devices named. The Tyler Underground Heating System, Pittsburgh, Pa., has recently issued a large sheet containing 61 diagrams, cross sections and tables, describing in detail the Tyler specialties for use on ditch and tunnel piping for every purpose, also the Tyler boiler feed water weighing machines, meters and traps. The information condensed on this sheet is the equivalent of a volume of considerable bulk and gives in compact form a tremendous amount of data for the use of engineers in laying out ditch and tunnel piping.

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	Supply Trade Not	tes
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Walter H. Bentley has recently been appointed assistant to Burton W. Mudge, president of Mudge & Co., Chicago, Ill. Mr. Bentley entered the service of the Chicago & Northwestern Railway in 1903, in the storekeeping department. In 1909 he served for a time as locomotive fireman on the Duluth & Iron Range, returning to the Chicago & Northwestern, where he filled



Walter H. Bentley

various positions in the engineering and purchasing departments. In 1912 he joined the Chicago sales force of the Baldwin Locomotive Works, and the Standard Steel Works, and in 1914 was appointed western representative of the Curtain Supply Co., of Chicago, where he remained until the announcement of his recent connection with Mudge & Co.

The Russell Engineering Co., St. Louis, Mo., has recently announced the resignation of F. G. Curfman from their staff and the addition to their sales force of C. H. Fritsch, who has had 15 years' experience in gas bench construction work.

W. G. Willcoxson has severed his connection with the Garrett-Callahan Co. and accepted a position with the Boss Nut Co. of Chicago.

If you entertain the supposition that any real success, in great things or in small, ever was or could be . . . wrested from Fortune by fits and starts, leave that wrong idea here.—Mr. Jarndyce.





Lee Barnes, recently appointed acting roadmaster for the Northern Pacific Ry. at Little Falls, Minn., succeeds Austin Grimes, roadmaster.

J. E. Bishop, recently appointed foreman of section P-1 of the Pittsburgh and Lake Erie at Pittsburgh, Pa., has been serving in a similar capacity on the Pennslvania lines east of Pittsburgh.

B. M. Cheney, recently appointed general inspector of permanent way and structures of the Chicago, Burlington & Quincy at Chicago, entered the service of the Burlington, Cedar Rapids & Northern in 1900 as rodman on location. In 1902 he was appointed resident engineer of the Des Moines, Iowa Falls & Northern. In 1903 he joined the forces of the Illinois Central and in 1904 he was appointed assistant engineer and later assistant chief engineer on construction of the Inter-Urban Railway at Des Moines, Ia. In 1906 he was appointed assistant engineer on construction and maintenance for the Chicago, Burlington & Quincy and in 1914 he was appointed assistant to the general inspector of permanent way and structures, serving in this capacity until his recent appointment.

A. Crumpton has recently been appointed assistant valuation engineer on the Grand Trunk Railway System at Montreal, Can.

Charles H. Ewing, recently appointed general manager of the Philadelphia & Reading Ry., at Philadelphia, succeeding Agnew T. Dice, entered the service of that road in 1883 as rodman in the engineering corps. In 1885 he was made transitman, and in 1886 assistant enigneer on construction and maintenance; in 1889 he was appointed roadmaster, and in 1892 division engineer. In 1893 he was appointed chief engineer of the Central New England Ry., and in 1902 returned to the Philadelphia & Reading as division engineer on the Reading and Lebanon divisions, and in 1905 was appointed engineer of maintenance of way. In 1910 Mr. Ewing was made superintendent of the Atlantic City R. R., and in 1913 he was appointed general superintendent of the Philadelphia & Reading, where he remained until his recent appointment as general manager.

Samuel Fisher, recently appointed general foreman of track on the Pittsburgh & Lake Erie, succeeding E. J. Laughlin, has been foreman of section P-1 at Pittsburgh, Pa.

J. E. Kissell, recently appointed acting engineer of maintenance of the Peoria & Eastern, succeeds A. M. Turner, assigned to other duties.

E. J. Laughlin, recently appointed supervisor of track for the Claiston Steel Works at Claiston, Pa., has been for the past 17 years on the Pittsburgh & Lake Erie, where he has resigned the position of general foreman of track.

B. W. Lee, recently appointed engineer of the Aransas Harbor Terminal Ry., at Aransas Pass, Tex., entered the service of that road in 1913 as draughtsman, and was shortly made assistant engineer. His appointment as engineer followed the death of J. C. Moore, vicepresident and chief engineer of that road.

E. H. McGovern has recently been appointed resident engineer for the Cleveland, Cincinnati, Chicago & St. Louis Ry. at Columbus, Ohio.

W. J. Mahoney, recently appointed acting supervisor of bridges and buildings on the Louisville & Nashville at Etowah, Tenn., is serving during the absence on account of sickness of S. Long. Mr. Mahoney has been bridge foreman on that division since 1905.

B. D. Marburger, recently appointed roadmaster of division No. 6 of the San Antonio & Aransas Pass Ry., began railroad work in 1905 on the Sunset Central lines and after two years' work as a student, which included some experience as draughtsman, instrumentman and timekeeper, he was transferred to the maintenance department where he was successively made assistant section foreman of the Houston yard, assistant roadmaster and roadmaster on the main line at Hearne, Tex. In 1913 he joined the staff of the St. Louis, Brownsville & Mexico Ry. and was given charge of a party making a re-survey for valuation work. It was on the completion of this work that he was given his present appointment, where he succeeds Charles Watkins, who has been made extra gang foreman on the Wabash R. R.

G. U. Middleton, recently appointed assistant division engineer on the Zanesville division of the Pennsylvania Lines west at Zanesville, Ohio, entered the service of the Chesapeake & Ohio as assistant on the engineering corps on the Richmond and later the Indianapolis divisions. In 1915 he was appointed pilot engineer in the department of valuation, where he remained until in his present appointment he succeeds F. V. Berkey, transferred to the Indianapolis terminal division.

A. L. Morrison, recently appointed foreman of section 57 on the Pittsburgh & Lake Erie, has resigned his position as supervisor of the Western Maryland Railroad at Confluence, Pa.

C. P. Noland, recently appointed roadmaster of the Birmingham Southern R. R. at Fairfield, Ala., succeeds J. F. Vance, promoted.

H. B. Pflasterer, recently appointed signal inspector of the Nashville, Chattanooga & St. Louis Ry., at Nashville, Tenn., entered the service of the C. & E. I. at Danville, Ill., in 1898 and after some work in a bridge construction gang became signal helper and worked his way up through the signal department there. In 1901 he was made signal maintainer and in 1904 was appointed fitter in the signal construction gang of the Nashville, Chattanoga & St. Louis at Nashville, Tenn. Later that year he was appointed signal foreman and in 1908 general signal foreman. In 1915 he was appointed supervisor of signals and has now been made general signal inspector.

Guy Pinner, recently appointed bridge engineer of the Seaboard Air Line, at Norfolk, Va., succeeds W. O. Scheuerman, assistant bridge engineer, resigned.



C. C. Ramsdell, recently appointed assistant general roadmaster on the Kansas division of the Union Pacific R. R. at Salina, Kan., was, previous to that appointment, roadmaster at Northport, Nebr.

M. J. Scott, recently appointed roadmaster of the Nebraska division of the Union Pacific at Northport, Nebr., worked as track laborer and section foreman for the Central of New Jersey from 1907 until 1913, when he joined the forces of the Union Pacific as extra gang foreman. In his recent appointment he succeeds C. C. Ramsdell, appointed assistant general roadmaster at Salina, Kan.

W. W. K. Sparrow, recently appointed valuation engineer of the Chicago, Burlington & Quincy at Chicago, entered railroad service in Ireland in 1898 and after service there and in Africa was employed in 1909 by Waddell & Harrington, consulting engineers at Kansas City. He was later associated with H. von Unwerth, and in 1913 he was made assistant chief engineer of the Missouri State Public Service Commission, where he remained until his recent appointment.

H. T. Sympson, recently appointed division engineer of the Western division of the Pennsylvania Lines west of Pittsburgh, began railroad work in 1903, with the Yazoo & Mississippi Valley R. R. at Vicksburg, Miss., serving one year as track apprentice. In 1904 he was made assistant engineer with the Alabama & Vicksburgh and Vicksburgh, Shreveport & Pacific Rys. at Vicksburgh, Miss. He entered the service of the Vandalia R. R. as assistant on engineer corps, chief engineer's department, in 1905, and served in that capacity until 1906, when he was made assistant engineer on construction work. From 1908 to 1911 he was in the chief engineers' office at St. Louis, having been transferred on the latter date to the Michigan division of the Vandalia as assistant division engineer. He was transferred to the St. Louis division of the Vandalia as assistant engineer in 1912. He now succeeds Harvey Hall, appointed assistant division engineer of the Western division, P. F. W. & C. Ry.

J. B. Thalken, recently appointed roadmaster on the Union Pacific R. R. at Laramie, Wyo., entered the service of that road in 1894 as a track laborer on the third district and in 1900 was appointed section foreman on the Wyoming division. He was later given charge of extra gangs at various points and in 1908 appointed foreman of the Buford gravel pit. In 1912 he was made foreman of the Cheyenne terminal yards and held that position until the announcement of his recent appointment.

A. M. Turner has recently been appointed district engineer in charge of track elevation on the Cleveland, Cincinnati, Chicago & St. Louis Ry. at Columbus, Ohio.

W. M. Vandersluis, signal engineer of the Illinois Central Railroad, has been appointed consulting signal engineer of the Central of Georgia Railway.

Charles M. Wheeler, recently appointed supervisor of signals of the Pennsylvania Railroad at Baltimore, Md., has been promoted from assistant inspector of signals at Philadelphia.

F. N. White, recently appointed supervisor of the Mobile & Ohio Ry. at Corinth, Miss., entered the service of the Mobile & Ohio in 1880 as laborer, was made apprentice in 1881, foreman in 1883, extra gang foreman in 1892 and in 1911 assistant supervisor, which position he held until his recent appointment.

Obituary

Theodore Voorhees, president of the Philadelphia & Reading Railway Co., died on March 12 last. The railroad world has lost an able executive. Mr. Voorhees was born in New York on June 4, 1847, and had therefore nearly reached man's alloted span of life. After graduating in 1869 from the Renssaeler Polytechnic Institute he joined the engineering staff of the Delaware, Lackawanna & Western and remained in that service for four



Theodore Voorhees

years, when he was appointed superintendent of the Syracuse, Binghamton & New York Railway. Following this service he was made superintendent of the Champlain division of the Delaware & Hudson system, which position he held until he was appointed assistant general superintendent of the New York Central, later becoming general superintendent. He was selected in 1893 as vice-president of the Philadelphia & Reading, in charge of operation. He filled this office until 1914, when he was elected president of that road to succeed Mr. Baer. Mr. Voorhees was a man of rare qualities and experience and was a member of many societies. His life was both busy and successful.

------Book Review

Railroad Field Manual for Civil Engineers. By William G. Raymond, C.E., L.L.D., Professor Civil Engineering and Dean of the College of Applied Science in the State University of Iowa. A first edition, published by John Wiley & Sons, Inc., New York, and Chapman & Hall, Limited, London. Price, \$3.00.

This book is for use in the field, although adapted to both field and office use. It is replete with interesting subjects and the necessary tables for use in connection with these subjects. It treats of compound and simple curves, as well as the spiral. There is a chapter on Logarithms and other chapters on Location, Estimates, Turnouts and Crossovers, Adjustment of Instruments, Azimuth, Latitude and Time and Sexagesimal Trigonometrical functions. The author sends it forth hoping that it will meet with approval in some places; tried in other places and prove to be a work of value and not the outcome of fads or fancies. It seems to be a book worth having in such a collection of works as an enterprising railroad man requires. It is a sort of pocket edition easily carried; is well bound and therefore serviceable.

April, 1916





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WALTER S. LACHER, Associate Editor IIAROLD F. LANE, Associate Editor

Entered at the Post Office at Chicago, Ill., as mail matter of the second class. Subscription price, including the twelve regular monthly issues of the *Railway Maintenance Engineer* and the four daily issues of the *Railway Age Gazette*, published in connection with the annual convention of the American Railway Engineering Association: United States, Canada and Mexico, \$1.00; foreign countries (excepting daily editions), \$2.00.

WE GUARANTEE that of this issue 5,137 copies were printed; that of these 5,137 copies, 4,012 were mailed to regular paid subscribers, 53 were mailed to advertisers, exchanges and correspondents, and 1,072 were provided for new subscribers, copies lost in the mails and office use. The *Railway Maintenance Engineer* has applied for membership in the Audit Bureau of Circulations.

Three passenger trains were derailed recently on important roads because of the weakening of the track at

Protection Against

Accidents

se of the weakening of the track at points where the renewal of rails or other repair work was under way. It is to the credit of the maintenance of way department that accidents of this nature are as rare as they are.

At the same time, every such occurrence is one too many, and supervisors must be alert to see that safety is placed ahead of every other consideration in the conduct of their work. As it is impossible for them to be on the ground continually where work affecting the safety of trains is in progress, it is necessary that they keep constantly before their foremen the fact that they can afford to take no chances involving the safety of travel. The problem is becoming more serious each year with the increasing necessity of employing inexperienced men in the gangs, and the difficulty of securing an adequate number of competent, experienced foremen to fill vacancies as they occur.

It has been the universal practice to measure the thoroughness of the treatment of timber in terms of the

Measuring the Penetration of Preservatives pounds of oil injected per cubic foot of timber. As pointed out by Lowrie Smith in another column, this may lead to highly inaccurate results with structural timber. As a

remedy he suggests measuring the penetration on the basis of the pounds of oil injected per square foot of superficial area. This method has such evident merit that it is surprising that it has not been adopted before, particularly in view of the very general discussion of the penetration necessary for this class of timber. Owing to CONTENTS

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the variation in the density of timbers and their relative susceptibility to treatment, the amount of oil actually injected will vary with any two sticks of timber. However, it is necessary to select an average figure as a basis for comparison which is sufficiently accurate for practical purposes. As the vital consideration in the treatment is the depth of penetration of the oil from the surface, and as the proposed rule gives this more accurately than the old one, it should meet with ready adoption.

The present shortage in the supply of labor for track work is forcing the railways to adopt a number of ex-

Tendencies Toward

Contract Work

railways to adopt a number of expedients in order to complete the large amount of work proposed for this season. One method which is being adopted on a number of roads is to contract a considerable

amount of maintenance of way work heretofore performed by company forces. In general this is not the result of any decision to adopt this practice permanently, but in many cases it has been resorted to locally to get the task done. It is the natural desire of the roads to conserve the limited amount of labor which they can secure for work on the track, turning over to small contractors that which can be done by other forces. A small contractor possesses a number of inherent advantages over a large railway organization. He can organize his forces directly for the task in hand, pay the wages necessary to secure the desired number of men and vary the wage rate from day to day if necessary to meet fluctuations in the labor market. With a limited number of men under his direction and with the incentive of personal gain resulting from the efficiency of his forces, he will exert closer supervision and secure more work from his



men than the average railway. Several roads have experimented with the contracting of maintenance of way on a large scale. Many railway men believe that a large part of what is now done by company forces will ultimately be turned over to contractors as a practical way of increasing the efficiency of these forces.

THE RECLAMATION OF SCRAP

THE recent statement of a vice-president of an impor-tant eastern road that he tant eastern road that he was not as much interested in the amount of money his road earned as in the amount it saved, deserves special emphasis. Largely as a result of the depression through which the railways were passing until recently, the incentive to economize has been very strong. This has led to the adoption of many methods and practices not emphasized previously. One of the developments to which greatly increased attention has been given is the systematic reclamation of scrap materials. Over \$250,000,000 is spent annually for new materials for the maintenance of way department. A considerable part of this amount goes for ties and other materials for which there is little or no salvage value after their serviceable life is exhausted. However, a much larger amount is expended for materials which have a definite and considerable value after their removal from the track and structures. The easiest way to realize on these materials is to sell them as scrap, just as they are received from outlying points. But this is not in most cases the most profitable way, although followed on a large number of roads.

During recent years a number of roads have studied their scrap piles with surprising and highly profitable results. In a number of instances they have found that materials were reaching the scrap dock which were fit for further use and they have adopted measures to prevent such material being sent in. In other instances they have found that with slight expense a considerable portion of the material sent in as unfit for further use could be repaired and returned to service. They have also found that with many tools and built-up materials, parts of worn out units can be used to repair others with economy. Also in the handling of materials properly included as scrap, considerably higher prices have been secured through systematic sorting and preparation to comply with standard market classifications. All these measures and others have resulted in very considerable economies.

The manner of handling maintenance of way scrap varies widely after its collection out on the road and shipment to central points. On many roads the mechanical department has charge of the disposal of all scrap. On others, the maintenance of way department collects and handles its own scrap. On still others, the mechanical department assumes charge of the reclamation of maintenance of way scrap under the direction of employees of the latter department.

The possibilities for economy in the handling of roadway scrap are sufficient to justify a careful investigation of this subject by the maintenance of way department of every line. On those roads on which this subject has been given close attention surprisingly profitable returns have been secured. At the same time the systematic handling of these materials by men familiar with them is far less general than it should be.

In order to stimulate interest in the subject and to present accurate information concerning the results which are possible, we announce a contest on The Reclamation of Maintenance of Way Materials. This contest will include discussions of the manner of handling, sorting and disposing of scrap materials, the keeping of usable materials out of the scrap pile and the reclamation of materials for further service, either directly or through repairs, and the extent to which such repairs are justifiable. In addition to a discussion of this subject, special attention will be given to papers describing methods actually in force and the results secured, with detailed descriptions, and cost figures showing the expense of conducting this work, and the savings resulting. Photographs will also be valuable. We will pay \$25 and \$15 for the two best papers received in this contest, and our regular space rates for all others accepted and published. All contributions should be sent to the editor of the Railway Maintenance Engineer, Transportation Building, Chicago, and must reach him not later than July 15, to be considered by the judges.

STUDIES IN ORGANIZATION

•ONDITIONS in the maintenance of way department are changing rapidly. Traffic has increased continuously, wheel loads are heavier and the service demanded of the track and structures has become increasingly severe. At the same time higher and more exacting standards of maintenance are required than ever before. With these conditions on the one hand the railways have been confronted on the other with a changing and rapidly deteriorating supply of unskilled labor, and with new problems in the use of materials, following the transition from Bessemer to open hearth steel rails, from hard wood ties to those of softer and less durable timber, etc., all of which have tended to increase the cost of maintenance of way work.

These conflicting conditions of more exacting service and the rising cost of labor and materials require increased supervision and the concentration of trained men on the solution of these problems from day to day. Good track and uniformly high standards of maintenance alone are not positive proofs of the highest degree of efficiency, for some roads are spending more than is necessary to secure these standards. Rather, efficiency in maintenance of way operations should be measured by the standards of maintenance secured per unit of expenditure, local conditions considered. A number of roads have realized the necessity for close supervision of this work and have placed it under the direct charge of men qualified by training and practical experience to direct it and devote their entire time to it. Other roads have not given the subject the attention thus far which the large expenditures warrant and as a consequence they are not, in many instances, securing the best results possible.

This condition has led to the preparation of a series of articles describing the organization of the maintenance of way department as it has been developed on a number of roads which have given this subject special attention. In some instances this organization is strictly divisional in character, in others departmental and in still others a combination of the two. In addition to discussing the form of organization, the articles will also describe methods which are being followed on these roads to effect economies in so far as they are not commonly adopted. The first article in this series describes the organization of the maintenance of way department of the Lehigh Valley and a number of the methods which have been developed on that road.

The days when the "old man ran the road" are gone. This is the age of specialization in all industries and in all branches of railway service as well. The universal realization of this fact will mean much for the maintenance of way department and for the efficiency with which its work is handled, for once it is recognized and

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the necessary measures taken, improvements in other conditions will come as a matter of course.

THE RAILWAY MAINTENANCE ENGINEER

WITH this issue the Railway Maintenance Engi-neer makes its initial neer makes its initial appearance. It is not, however, a stranger to the maintenance of way field, for it has been formed by a consolidation of the Maintenance of Way section of the Railway Age Gazette, which has appeared regularly in the third issue of each month of that paper for the past five years, and of Railway Engineering and Maintenance of Way, which we have acquired, and with which was consolidated the Roadmaster and Foreman about five years ago. While the weekly issues of the Railway Age Gazette will continue to present information concerning maintenance of way problems of interest to railway men in all departments and will aim to give them the data which they as broad railway men will require, the Railway Maintenance Engineer will devote its entire attention to the problems of this department and will present information of interest and value to those engaged in the upkeep and improvement of the track, structures and other fixed physical properties.

More attention is being paid to maintenance of way work to-day than ever before and the progress being made in the development of materials and methods is correspondingly rapid. More exact and scientific methods are being demanded under the necessity of securing the maximum return for every dollar expended. Rapidly changing conditions with respect to labor and materials and the increasing severity of the demands made on the track and structures combine to present new problems which must be solved. No one group of men can work out these problems unaided. The greatest progress can only be made through the co-operation of a large number of men and the free exchange of information and ideas. It will be the aim of the Railway Maintenance Engineer to assist in the dissemination of this information which will aid in the conduct of the work in this department. Descriptions of new methods and materials will be presented from month to month for the information of the more experienced as well as the education of the younger men in the field. Particular attention will be devoted to the presentation of information which will assist employees of the maintenance of way department, whether chief engineers or section foremen, to handle their work more economically and efficiently.

Special attention will also be given to the development of a comprehensive news department, in which will be chronicled changes, promotions and transfers among railway and supply men in this field, improvement and construction work authorized, etc. We solicit for the Railway Maintenance Engineer the co-operation of men interested in this department of railway activity in advising us of new developments, changes in personnel, and other information which will be of interest to our readers, in order that the Railway Maintenance Engineer may be made thoroughly representative of the activities in the maintenance of way field, and be of the greatest value to our readers and to the railways who employ them.

PRESSURE OF WET CONCRETE.—Further tests on the lateral pressure of concrete on forms were made recently at the University of Illinois, both in the laboratory and on actual construction. These tests tend to confirm earlier ones. The pressure corresponds to the hydrostatic pressure of wet concrete until the concrete has partly set. It is also influenced by the rate of pouring.

LETTERS TO THE EDITOR

EXPERIENCED FOREMEN WANTED

To the Editor:

WELLINGTON, ILL.

A trackman's work is skilled labor; untrained men are useless and do inferior work. We must have trained and practical trackmen for leaders whose work is the result of years of experience. There is an army of 45,000 foremen and 340,000 trackmen in the United States, and yet we need all the trained men we can get, for only well-trained men can do first-class track work. One trained man is worth three untrained. I believe experiience should be made a condition of promotion for foremen. It is not what one does, but how one does it that is the test of capacity. Nothing is so costly as ignorance. The best railroad requires constant supervision, skillfully planned to keep the track in good order. The foreman should know from actual inspection that the track is in order so that nothing likely to cause accidents or delay may occur. The responsibility for safe track is in the hands of the foreman, and his pay should be good. There should be two trained men in each gang, the foreman and an assistant. JOHN MITCHELL.

TIGHTENING TRACK BOLTS

ST. BERNARD, O.

TO THE EDITOR:

The article by Earl Stimson, published on page 317 in the issue of the Railway Age Gazette of February 18, relative to track bolts and track wrenches contained much useful information, but I believe that the idea of track bolts being stretched until they give poor service, as well as the idea of the proper length of track wrench to be used as expressed in this article, are wrong. Evidently the testing machine which was used or some of the figures which were secured have misled the author, for he claims that the average track laborer is liable to overdraw a 1-in. bolt with a wrench 42 in. long.

If this is tried in the track instead of on paper and a testing machine it will be found that a man cannot tighten a new well-oiled 1-in. bolt enough to cause it to stretch under heavy wheel loads, with a wrench 54 in. long. New, well-oiled 1-in. bolts can be tightened with a wrench 42 in. long or even 36 in. long, provided the nuts do not fit very tight, but among old bolts that are somewhat rusty many will be found that cannot be properly tightened with a wrench of that length even after they have been oiled. As long as the old bolts taken out of the track do not show any indication of having been stretched there is no need of one becoming alarmed and cutting the wrenches so short that they cannot be tightened properly. The poor service that track bolts are giving is not due to their being overdrawn and stretched, but because they are not kept tightened properly. The use of shorter wrenches will surely increase rather than remedy this trouble.

The loosening of the bolts is not caused by the nuts coming off, as is often believed, but it is due to the friction caused by the expansion and contraction of the rail and the vibration of passing trains, which causes the rail splices to work deeper into the rail, leaving the bolts loose. Other trouble results from the fact that two or three bolts will break at a joint and the rail run apart, leaving the joint open. For this the bolts are not to be


blamed, as it usually is the running of the rail that cuts them off. Sometimes a bolt will break of its own accord, but this is very rare. The threads are stripped off a bolt or nut only where the nut does not fit properly, or where the bolt is so short that the nut will go on only a few threads. Nuts come off only where they fit too loosely. Another trouble with track bolts and one that seems to be much misunderstood, is that many break when they This are tightened after being in service a few years. is because of the fact that the nuts fit tight on the bolts and when they become rusted the bolts will break rather than tighten. On a number of railroads where this breakage was noticed it was believed to be due to trackmen overdrawing the bolts so that they broke and the wrenches were shortened so that they could not be broken. While this was effective in stopping the breaking of bolts it made it impossible to tighten a large percentage of the loose bolts. As a result bolts were often neglected or instructions were disregarded and an extension put on the wrenches. In this case the proper remedy is to oil the bolts a few days before tightening them and then to turn the nut backwards a little before tightening it, rather than in cutting the wrenches so short that the bolts cannot be tightened properly.

E. F. PETRY, Track Foreman, Baltimore & Ohio South Western.

EIGHT-HOUR DAY ON CONSTRUCTION WORK

TO THE EDITOR:

If the so-called eight-hour day, for which the railway orders are contending, becomes effective, it will have a marked effect on the cost of work-train service on construction and maintenance work, and engineers who are the summer he would, very likely, have enough left of the \$1,973.72 he had received for his seven months' work so that he could take a short vacation.

In nearly all classes of railway construction work, the cost of work-train service is an important item of expense, and in some classes of work, such as driving piles on the main line, and spotting cars in a gravel pit, the wages of the trainmen and enginemen constitute about 25 per cent of the cost. This is also an important item in the expense of unloading ballast and track material, unloading concrete bridge and culvert material, and handling steel erection derricks.

To anyone familiar with railway construction work the attitude of the men as to a real eight-hour day is well known. The work is easy, the hours regular and the men are out for the money.

I recall the complaints that arose and the threats to quit the work-train service, where men held rights for regular trains, when an order limiting work trains to 12 hours per day was proposed.

Is the increase demanded by the train service men justifiable as compared with the salaries paid to other classes of railway employees? On the construction work mentioned above, under the present schedule, the locomotive engineer receives more per month than the assistant engineer in charge of grading and bridge work on 50 to 80 miles of line, or the roadmaster in charge of the tracklaying and ballasting. The conductor receives more per month than the resident engineer in charge of 10 to 15 miles of construction, and the fireman and the brakemen each receive more per month than the instrumentmen, inspectors or draftsmen.

The cost of living has increased alike for the organized and the unorganized employees of the railways, while the increase in compensation has been more favorable to

Present	SCHEDULE-10	HOURS' PAY	FOR 8 HOURS'	WORK, 11/2	TIME AFTER	8 Hours		
	Present	Wages			Proposed	l Wages	T	D
For	Day	Month	Per	For	Day	Month	Per	Cent of
10 Hou	rs 13 Hours	28 Days	Hour	8 Hours	13 Hours	28 Days	Month	Increase
Engineer\$ 5.20) \$ 6.76	\$189.28	\$ 0.65	\$ 5.20	\$10.07	\$281.96	\$ 92.68	48.96
Fireman 3.25	4.225	118 .3 0	.40625	3 .25	6. 3 0	176.40	58.10	49.11
Conductor 4.18	3 5. 43 4	152.15	.5225	4.18	8.10	226.80	74.65	49.06
Brakeman 2.78	3.614	101.19	.3475	2.78	5. 3 86	150.81	49.62	49.03
Brakeman 2.78	3 .614	101.19	.3475	2.78	5. 3 86	150.81	49.62	49.0 3
Entire Crew\$18.19	\$23.647	\$662.11	\$2.27375	\$18.19	\$35.242	\$986.78	\$324.67	49.04

CHICAGO, ILL.

engaged in this class of work will no doubt be interested in knowing what this will mean in dollars.

When bridge and track crews work 10 hours per day it has been found that it is necessary for the work-train crews to work about 13 hours per day. This is one class of train service where it will not be possible to reduce the time to an actual eight-hour day. It is necessary for work trains to tie up at some point where coal and water are available, and as this often means a run of 25 to 50 miles, night and morning, it is necessary for the train crew to put in two to four hours more per day than the bridge or track crews they serve.

To show what the increase would mean in dollars, I show here the present rates of pay on one of the roads in the middle West, and also the rates that would have to be paid under the demand for ten hours' pay for eight hours' work, with time and one-half pay for overtime.

It will be noted that at the new rate the engineer would receive \$281.96 per month, or \$3,383.52 per year if he worked the entire time, but as the construction season lasts only about seven months it would probably be necessary for him to go back to firing. He would then receive only \$150 to \$175 per month, according to the amount of overtime he succeeded in getting in, or if he did not spend too much on picture shows, etc., during organized labor, and I think there is a feeling among the unorganized forces that every increase granted to organized labor makes it harder for other employees to secure merited advances in wages. I recall a case of a locomotive engineer being appointed trainmaster, who, after a six-month trial, went back to his engine, saying, "there was too much grief for the money with no limit to the hours and no overtime for a trainmaster."

CONSTRUCTION ENGINEER.

NEW BOOKS

The Practical Design of Steel Framed Sheds. By Albert S. Spencer. 157 pages, 6 in. by 9 in. Bound in cloth. Illustrated. Published by D. Van Nostrand Company, New York. Price \$3.50.

This book is very largely a compilation of tables of complete designs for the roof trusses and columns of frame shed buildings of 40 to 100-ft. spans. The methods used in arriving at these designs are given in detail, together with 12 plates showing graphic methods. The last two chapters in the book are devoted to external coverings, gutters, pipes, ventilation, etc. While entirely general as to theory, the treatment is essentially English as to practice and in scope is limited to a single type of structure, namely, a plain rectangular building with a flat gable roof.





Unloading 199 Cars of Cinders with One Train in One Day

HE Lehigh Valley has made marked progress in the development of efficient methods in the maintenance of way department during the past few years. The standards to which the property has been maintained have been raised materially while the expenditures for upkeep have been moderate. This has been made possible primarily by the close attention given to the details of this work by trained men devoting their entire time to the work of this department. Because of the concentrated attention given to the work of this department this road has been a pioneer in a number of practices leading to important economies, which are attracting much attention from railway men throughout the country to-day. It is the purpose of this article to discuss the organization which has been developed on this road and to point out some of these methods not commonly known or followed.

The Lehigh Valley comprises 1,442 miles of road, about half of which is classified as branch lines. The main line extends from Jersey City to Buffalo and Suspension Bridge, with a number of branches in the anthracite coal fields near Wilkes-Barre and Hazleton, Pa., and in the lake region of western New York. Including the main line a total of 595 miles has two or more tracks. The revenue freight traffic density for the fiscal year ending June 30, 1915, was 3,689,820 ton miles per mile of road and the passenger density 149,403 passenger miles per mile of road. Slightly over one-half the freight traffic consists of coal, moving in heavy trains eastward from Wilkes-Barre and Hazleton coal regions to tidewater and also westward to the great lakes. For operating purposes the road is divided into seven divisions.

THE FORM OF ORGANIZATION

The organization of the maintenance of way department of the Lehigh Valley is strictly divisional in character. The engineer maintenance of way, with office at the operating headquarters at South Bethlehem, Pa., is in charge of all work in this department, reporting to the general manager. All engineering work incident to maintenance operations is handled through this office as is all construction work carried on with company forces. The road owns two steam shovels, 100 air dump

cars and other auxiliary equipment in addition to two ditchers, 35 locomotive cranes, etc. The construction equipment is employed to a large extent in doing small grading work for side track extension and minor track changes. It is also the practice of this company to build some of the smaller stations and other buildings with company forces.

All construction work for new lines, large structures and important improvements is handled by an entirely separate organization under the direction of the chief engineer located at the executive headquarters at New York and reporting to the operating vice-president. All work done by contract is likewise handled through this same office.

The engineer maintenance of way has a staff of assistants, including an inspector maintenance of way, a hydraulic engineer and a signal engineer. The inspector maintenance of way gives special attention to the details of track work. The hydraulic engineer has charge of water service and of the operation of all water stations, while the signal engineer is responsible for the construction and maintenance of signals and other work commonly incident to that position.

The engineer maintenance of way and his staff handle all matters with subordinate officers through the regular division organization. Each division has a division engineer in charge of maintenance of way matters reporting to the division superintendent, and he in turn reports to the engineer maintenance of way on such work. Each division engineer in turn has a complete maintenance of way organization with assistant engineers, supervisors of track, bridges and buildings, and signals. A telegraph lineman is also assigned to each division reporting to the division engineer and handling local repair work. Telegraph line work of any magnitude is handled by floating gangs reporting to the superintendent of telegraph, who, in turn reports direct to the general manager. Water service work on the division is under the charge of the supervisor of bridges and buildings. Each signal supervisor has the usual corps of maintainers with their assistants and also has a construction gang for the heavier work on the division. Each division engineer also has a small engineering corps, which does all the survey work 163



incident to the routine maintenance of way problems. In the maintenance of bond wires and insulated joints there is a close relationship between the forces of the supervisors of track and of signals, the section forces being required to maintain these bond wires and joints while the signal maintainers are required to inspect them, and both forces are held responsible for failures.

The division engineers are promoted from the assistant engineers in the maintenance of way corps or from



Organization Chart of the Maintenance of Way Department

supervisors; the supervisors come from the ranks of the foremen and the engineering corps. On the busy mainline divisions a supervisor's territory covers about 50 miles of line.

The standard sections of rail used on main line are the A. R. A. type A 100-lb., and the Lehigh Valley 110lb. sections, the latter having practically the same dimensions as the 100-lb. rail except that more metal is added in the head. The 110-lb. section was designed primarily for use on those divisions of heavy curvature. This road is now laying 2,500 tons of 136-lb. rail. A straight angle bar is used with the 100-lb. and 136-lb. rail, and one with a reinforced head on the outside with the 110-lb. rail. Approximately 85 per cent of the ties used are creosoted. Between 15 and 20 per cent are secured locally along the line. Twenty ties are laid per 33-ft. panel. All ties on curves and all treated ties on tangents are tie plated.

No. 15 turnouts, with 21-ft. switches, are standard on main line except for high-speed movements where No. 20 frogs, with 30-ft. switches are employed. Manganese frogs and crossings are used exclusively on main lines and on busy switching leads in yards. On lighter traffic tracks, open hearth frogs are used, while many frogs removed from main tracks because of wear are also relaid in these yard tracks.

Section Work

In any maintenance of way organization the majority of the employees are in the section gaugs and much of the success of the department depends on the efficiency of these men. In common with other eastern roads the Lehigh Valley has a large number of foreign section foremen, mainly Italians, and the laborers are to a very large extent foreign. About 40 per cent of the track laborers are employed throughout the year. Practically all of these are in the regular section gangs, although a few men in extra gangs remain in their cars on the line during the winter to assist in the renewal of rail. However, in most instances, rail is removed with forces organized by combining several regular winter section gangs.

Special attention is given to the problem of making the surroundings attractive for the men as a means of holding them in the service. At a number of places new and modern section houses have been built for the foremen and also for the men in the gang. The laborers are also encouraged to start gardens on unoccupied land on the right of way which the company gives them the use of. In a number of instances measures such as these have been found to hold the men on the Lehigh Valley when higher wages have been paid on neighboring lines.

The average length of section on double track is 4 miles and on four-track lines 3 miles. The normal summer section force is 7 men and the winter force 3 men, the gangs being increased as local conditions demand.

One of the most important innovations which have been introduced has been the reorganization of the program of section work whereby one-third of each section is overhauled thoroughly each season, so that it will require the minimum amount of attention during the intervening two years. When overhauling the track in this way, the old ballast is cleaned to the bottom of the ties and extensive tie renewals are made while the track is given a light raise, sufficient to give the ties a new bearing and filled in and dressed with new ballast. The work is done thoroughly and carefully, so that the track will require only the routine attention for some time. By going over a portion of each section each year in this way, it is possible to maintain the ballast and the ties in good condition without disturbing the entire track each year as is customary when the ties are "spotted in" indiscriminately and light surfacing done here and there over the entire section. In renewing switch ties on main lines "spotting in" is likewise discouraged and they are renewed only in entire sets. Any ties removed which are good for further service are then relaid in yard turnouts.

To handle the work in this manner the section gangs are assisted by extra gangs, whose duty it is to raise the track for the section gangs while leaving the final surfacing for the permanent forces. An extra gang raises enough track on each of several sections to keep the regular gangs busy with the surfacing for four or five days. They are provided with motor cars, and after raising the desired amount of track on one section they go to the next. Their work is so arranged that by the time the sec-



LAYING RAILS WITH A LOCOMOTIVE CRANE

tion gangs catch up with them, the extra gangs have covered all the sections on which they are co-operating in this manner. They then return to the first section and repeat the performance. In this way they expedite the work of the section gangs materially while leaving to them the more accurate and careful finishing details and placing the responsibility for thorough work on the forces who will have to maintain the track in the future. As the formation of large gangs is discouraged, these extra



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gangs are limited to about 15 men. When on a section they are not consolidated with the regular gangs, but work separately, preserving the identity of each force.

As fast as practicable, hand cars are being replaced with motor cars for section gangs. No more hand cars are being purchased, but as fast as new cars are required the section and extra gangs are being supplied with motor cars on main and branch lines alike. There are 289 sections on the Lehigh Valley. At the present time the road owns 182 motor cars.

In spite of the fact that a large mileage of the line is very crooked, and it is impossible for trains to be seen any considerable distance in many places, it has been found that the number of accidents has not increased, but, if anything, has decreased, following the installation of motor cars. This is accounted for in large 1910 except where changing to a standard of 20 ties per panel.

As a logical result of this step it was decided to lay the rail during the winter when the interference with other maintenance operation was less and labor conditions are more satisfactory. During the last six years practically all rail has been laid during the winter without spacing joint ties. In this period a total of 179,300 tons or 1,125 track miles of new 90-lb., 100-lb. and 110-lb. rail has been placed in track in this manner, in addition to 129,700 tons or 1,037 track miles of rail relaid in secondary or branch lines. The results of this practice have been observed very closely and although rail laid in this manner has been in service for varying periods up to six years, no detrimental effect has been observed.

Rail anchors are applied to the new rail on the same



A SECTION OF TRACK WITH SHOULDERS WIDENED WITH CINDERS

measure by the fact that the men have learned to take advantage of the normal danger automatic signals, which give them an advance indication of trains coming up behind them.

When the motor cars were first installed, a system inspector was employed to keep them in repair. Now an experienced mechanic on each division travels over the division inspecting the cars, adjusting them and making minor repairs on the ground. The cars are sent to the local division shops for heavy repairs, which are made by this same man. With this system it is seldom that over two or three cars are out of service on the entire line at a time.

LAYING RAIL WITHOUT SPACING JOINT TIES

Another practice in which the Lehigh Valley has been a pioneer is that of laying rail without spacing ties. After careful consideration the officers of the road came to the conclusion that the uniform spacing of ties throughout the rail length was more important than the arbitrary spacing at the joints to conform to some standards, resulting in many instances in throwing the joint ties onto a new bed. As a result the respacing of the ties when they are otherwise evenly distributed was discontinued in day that it is laid, their application being a part of the rail renewal. These anchors are applied in sufficient number to hold the rail from creeping as conditions require. No attempt is made to prevent creeping through spiking the slots in joints.

In addition to permitting this work to be carried on during an otherwise dull season, an immediate saving of over \$350 per mile has been made, by eliminating the spacing of ties and the later surfacing which would be necessary because of the shifting of the joint ties onto new beds. The forces employed in laying the rail at this season consist mainly of section gangs combined for this work. In this way productive work is secured during a season when a certain force is required for emergencies, but is not otherwise employed on constructive work at all times. By employing the men in this way greater value is secured for the money expended for this labor.

At the time the advisability of eliminating the respacing of joint ties was under consideration the causes of the deterioration of rails were studied carefully and the conclusion was reached that the primary conditions leading to battered rails were loose bolts and excessive expansion. As a result a system was inaugurated to insure



the maintenance of tight bolts. A bolt inspector was employed, reporting direct to the office of the engineer maintenance of way to devote his entire time to checking the number of loose bolts found on the different sections over the system. Working under instructions from the general office this inspector goes from place to place tapping every bolt in a mile or in multiples of a mile, and recording the number of loose, slightly loose and missing



A MACADAM HIGHWAY CROSSING

bolts per mile of track. He also notes and reports any rail anchors loose or missing. This man reports directly to the engineer maintenance of way on each mile of track checked and copies of this report are forwarded by the engineer maintenance of way through the division superintendent to the division engineer and supervisor. After a short interval this inspector again goes over the same territory and makes another check. If any unsatisfactory conditions reported on the first inspection have not been remedied, disciplinary measures are applied.

To insure that the foremen are giving this subject the proper attention, each supervisor has a bolt inspector, who devotes the larger part of his time to the same work. As a result of this campaign, which started six years ago, it is seldom that over 25 or 30 loose bolts per mile of track are now found as compared with 900 to 1,000 frequently reported when the campaign was first inaugurated.

Track bolts are also oiled twice each year by the track walker alone or assisted by the regular section forces. Two or three weeks before rail is to be relaid, the bolts are again oiled to permit them to be removed readily. As a result of this practice it is necessary to cut very few bolts and at least 95 per cent of those removed are forwarded with the rail for re-use.

LABOR-SAVING EQUIPMENT

Special attention has been given to the use of machanical equipment to replace manual labor for much of the heavier work. The Lehigh Valley owns 35 locomotive cranes in addition to 8 light steam derricks and two double-end and two single-end, air-operated hoists. Fourteen of these locomotive cranes, the steam derricks and all of the air hoists are regularly assigned to the maintenance of way department and are distributed on the different divisions. In handling large jobs, requiring several cranes, it is also possible to secure temporarily those assigned to ash pits, coaling stations, etc.

For the past six years the loading and unloading of rail by manual labor has been entirely eliminated and power equipment employed. Frequently, where a large amount of material is to be distributed or picked up, several cranes or derricks are placed in one train. Thus one work train with 9 loading machines, each provided with an operator, a fireman and four laborers, loaded 115,817 lineal ft. of 90-lb. rail or nearly 11 track miles on the main line of the Wyoming division between 6:30 a. m. and 3:55 p. m., April 5, 1915. These rails were numbered and loaded in proper order in 37 cars, so that they could be unloaded and relaid in the same order in which they came out of the track. This record was made without interruption to trains on this heavy traffic main line.

In June, 1915, one work train, with several machines, loaded 149,466 lineal ft. of 90-lb. rail with fastenings, or 14.15 track miles, on the Seneca division, in one day. This comprised 2,002 tons of rails and was loaded at a cost of 15.6 cents per ton. Similar records have been made in unloading rail, one work train with seven machines distributing 85,494 lineal ft. of 100-lb. rail in one day.

During the past year locomotive cranes have been employed very successfully in place of tong men to place the rail in position in the track in relaying operations. In this work it has been found that a foremen with six men, a locomotive crane and an operator is able to throw out the old and lay the new rail much faster than men could do it. In addition all the heavy lifting is eliminated in this way. On July 12, 1915, 4.07 track miles of 100-lb. rail, including four turnouts, was relaid in the main line between Gilbert, N. Y., and Lodi, and all the released material was picked up, the new material being distributed beforehand. Four locomotive cranes and crews were employed, two starting at each end and one relaying each rail. The first crane started work at 6:23 a. m., and the last rail was in place at 12:51 noon. The cranes then turned back and assisted the air loaders to pick up the material released, the last of which was loaded in proper order for shipment at 6:30 p.m. Including all delays, the four cranes laid an average of 64 rails each per hour for the entire period they were working. As a result of these trials it is now the standard practice to organize so as to unload the rails and fastenings ahead of the cranes the day they are relaid, in this way reducing the interference with traffic still further and concentrating all the work in one day. While this requires special organization beforehand and the assembling of a relatively large force for one or two days, it is possible in-



UNLOADING CINDERS FROM DUMP CARS

this way to select those days on which the traffic is lightest and the resulting interference with train movement is least, a consideration of much weight on a busy line. The rivalry created between various portions of a force such as this also increases materially the amount of work done by the gangs.

Locomotive cranes have also been employed advantageously in renewing bridge ties. Late last summer 1,522 8-in. by 12-in. by 12-ft. ties, amounting with elevation blocks to over 160,000 ft. B. M. of timber, were renewed in one track on a bridge across the Susquehanna river at Towanda, Pa., in 12 hours' working time with the assistance of two locomotive cranes. Each crane hauled behind it a flat car on which the new ties were piled in groups of 12, which were dropped onto the top of the deck girder spans ahead as fast as the old ties were removed and stacked on this same car. The track was laid with 100-lb. rails with 90-lb. guard rails and the new ties were tieplated solidly as laid. All ties had been framed in advance and elevation blocks attached. The cost of this work, including the installation of two temporary crossovers, was 46 cents per tie, and it is believed that this would have been reduced to 31 cents if the work had not been delayed seriously by a storm. In another instance, 365 ties were renewed by a similar method on a single-track bridge at a cost of 20.4 cents per tie.

Another class of work in the handling of which unusual records have been made has been the unloading of cinders. About 120 cars of cinders are made daily on the Lehigh Valley. Up to a few years ago they were considered a source of expense and were wasted to a large extent. Now, however, they are distributed systematically to the branch lines for ballast purposes and are also used for widening shoulders. A sufficient quantity is secured for all branch-line ballast requirements and in some instances to take out small sags in the grade line. The cinders are loaded into hopper bottom cars at the terminals and are sent out onto the line under the instructions of the engineer maintenance of way. As the cars arrive at the point of use, they are held on convenient side tracks until a sufficient number are on hand to require a work train for a full day. A heavy road engine is then sent out, which takes as many cars as it can handle conveniently to the point of unloading. Five or six cars are opened at a time, properly spaced through the train to distribute the cinders to the required depth, and they are then leveled off with ties placed in front of the truck of each car being unloaded. As fast as a train is unloaded, the cars are set out and another string se-cured. In this way 199 cars were unloaded on the Mahanov & Hazleton division before 3 p. m. one day last summer. These cinders are placed under the track on the branch-line sections by the regular section forces in the same manner as stone ballast is put under on the main line.

Similar records have been made in unloading ties. As many as 128 cars, containing 28,000 ties, have been unloaded and distributed from coal cars by one work train in a day.

In making records such as this, as in other work, a large part of the results has followed the creation of a spirit of rivalry between divisions, supervisors and gangs. This spirit has been cultivated judiciously. The good performances of one division are made known to the others with information concerning the manner in which they were made. At the first opportunity other supervisors naturally try to excel the previous records.

supervisors naturally try to excel the previous records. Another measure to reduce labor is the loading of coal for the outlying pumping stations in 12-yd. air dump cars. These cars are forwarded in local freight trains and are dumped at the water stations with practically no delay, and without the necessity of sending a gang of men to unload the coal by hand. A considerable quantity of cinders is also loaded in these cars in the winter and unloaded along the line to widen banks.

By organizing especially for the work requiring the services of work trains and doing as much as possible when a train is employed, it has been possible to reduce the number of trains required materially. Previously, each supervisor operated one work train regularly and others as occasion demanded. Frequently as many as 20 such trains were out on various parts of the system at one time. This condition has been done away with and trains are now ordered only as required. A greater attempt is made to house the gangs on the work and to provide them with motor cars, as a result of which no trains are now required to haul the men over the road. Also, as when unloading rails, cinders or ties, an effort is made to secure the maximum amount of work from a train when it is ordered. As a result the average number of work trains employed on the system is now about 1 2/3 daily.

This same principle has been employed when one track on double-track lines is taken out of service because of maintenance operations as when relaying rail. Instead of ordering out a pilot engine to precede trains moving over the single-track section, a motor car is run back and forth with a trainmaster in charge, effecting a material saving over the cost of an engine and crew.

Pneumatic tie tampers are now being experimented with and in all of the large yards where air pipes are in-



BRANCH LINE BALLASTED WITH CINDERS

stalled the pneumatic tie tampers are used. In addition to this, seven portable four-machine air tampers are in use with a view to eventually supplanting manual labor for tie tamping with power.

HANDLING MATERIAL

As far as possible, all work for the year is included in an annual program prepared at the beginning of each fiscal year. This estimate includes all materials such as ties, rails, track fastenings, tie plates, switches, etc. After it is approved, the auditor charges out one-twelfth of the account on the books monthly. The labor item is, therefore, the only charge affected by business conditions and subject to fluctuation.

After this system budget has been approved the engineer maintenance of way gives each division a monthly appropriation. These appropriations are in turn distributed by the division engineer between the different supervisors under the direction of the engineer maintenance of way. Similar appropriations are made monthly for special work not included in the regular maintenance of way budget.

To insure the proper accounting for all labor and material, two accountants are assigned to the office of the engineer maintenance of way, who visit the offices of the various supervisors, check their material and labor accounts and make test inventories from time to time. In



this way it is possible to detect errors while fresh in mind which would otherwise accumulate and become difficult to discover later. This practice has been found to result in a great improvement in the records.

Close attention is given to the handling of new and scrap materials. Each track, bridge and signal supervisor has a small storehouse at his headquarters, where he keeps one month's stock of materials used in his department. Supplies are sent to these local storehouses by the general storekeeper on requisitions approved by the engineer maintenance of way, after being compared with the supplies reported on surplus material reports made monthly. As far as possible the requisitions are filled by transferring material from other divisions rather than by ordering from the storekeeper. Once each year a committee composed of the general storekeeper, the engineer maintenance of way and the superintendent of motive power make a detailed inspection of the system, checking all supplies on hand, collecting surplus and obsolete material and preventing the unnecessary accumulation of supplies out on the line.

Two principal scrap platforms are maintained at Sayre, Pa., and Packerton, both of which are operated by the stores department. All small scrap is shipped direct to these points. The maintenance of way department has a man stationed at each of these scrap platforms, who reclaims all usable track materials sent in as scrap. All such material reclaimed is held for the inspection of the supervisor who sent it in. As a result of this plan very little usable material is sent in as scrap.

All frog and switch materials taken out of track are sent to Weatherly, Pa., where a frog and switch shop is operated by the mechanical department for the manufacture and repair of frogs, switches, and other special track work. The normal requirements of the road for these materials are filled here for all but manganese construction, which is purchased from the manufacturers. Switch stands and similar material are also repaired here, but track tools are repaired at the local shops on each division.

BRIDGE MAINTENANCE

A bridge inspector is assigned to each division, reporting to the supervisor of bridges and the division engineer, who spends his entire time inspecting bridges and large roofs on his territory. A general bridge inspector inspects all large bridges on the system. Each fall the general bridge inspector makes a careful inspection of all structures, accompanied by the division engineer, bridge supervisor and local bridge inspector. Based upon the information secured at this time, the program of repairs for the following season is made up.

All painting is done by local division forces. A foreman painter is employed permanently on each division, who builds up his gang each spring. In the same way a mason foreman and gang handle the work of this nature on each division.

All bridge deck timbers and ties are creosoted, special care being taken to see that the timbers are treated uniformly with no excess oil on the surface, to create a fire hazard. To prevent the prevalent low spots at the ends of bridges, six 10-ft. ties are placed at each end of each structure to give increased bearing at those points.

A form of special equipment which is yielding good returns is a portable saw mill. This was first secured to reclaim a large amount of lumber from a coal storage building, which was being dismantled at Perth Amboy a year ago. Since that time it has been moved from place to place over the road to reclaim bridge timbers and to saw up timber cut along the right of way.

A practice which has been working out very satisfac-

torily during the last two years has been the replacement of plank street and highway crossings with macadam as fast as they require renewal, except at certain crossings of very heavy traffic. When placing this type of crossing, the track rails are first cleaned and painted with asphaltum. The ballast next to and under the rail is also thoroughly mixed with this material to prevent the loss of current from the signal circuits. The remainder of the track is then filled almost to grade with the regular stone ballast and is covered with screenings. In this way the cost of maintenance is materially reduced, the danger of the planks being forced up by the frost or ice in the winter is eliminated and smoother crossings are provided for the highway traffic. Practically the same construction has been adopted for platforms at a number of the smaller stations. An additional safeguard to highway traffic has been the installation of Hall disc signals released from main line service, at obscure points to warn highway traffic of approaching trains.

STAFF MEETINGS AND INSPECTIONS

Regular meetings of the men in this department are held regularly to discuss current problems. Every two months a meeting of the general manager, superintendent of transportation, engineer maintenance of way, superintendent of motive power and all division superintendents is held to discuss operating matters of common interest to these departments. Similar meetings of the engineer maintenance of way, inspector maintenance of way, hydraulic engineer, signal engineer and division engineers are held regularly. The supervisors of bridges and buildings compose a committee which meets every two months. Each division superintendent also holds a meeting with his staff every two weeks.

Each fall an annual inspection is made over the main line, passing over both main tracks. This inspection is conducted by the general manager, accompanied by the engineer maintenance of way, all division superintendents, division engineers and supervisors and four of the older track foremen selected from different sections from year to year. Frequently general officers from other departments accompany the inspection, making a party of about 40 men. Each division and section is rated and the results announced but no prizes are awarded.

By this and similar measures the efficiency of this department has been increased, the standards of maintenance have been raised, more work has been done and the expense per unit of work done has decreased.

We are indebted to G. L. Moore, engineer maintenance of way, for the opportunity to collect the information contained in this article.

TRACK SCALE SPECIFICATIONS

T HE United States Bureau of Standards has issued a 28-page circular containing a proposed new specification for track scales. The specifications are much longer and go into much more detail than those of the American Railway Association.

The major portion of the circular is devoted to a method for determining the capacity rating, concerning which there is much confusion at present. This method follows the general principles used in the design and investigation of truss bridges whereby the position of the load for the maximum effect on each individual part of the structure is determined, and having found this position, the stress in the particular part is calculated. An attempt is made to reduce this to formulæ giving the relation between the loads and the stresses. The methods given purport to reduce these to tables and diagrams eliminating nearly all actual calculations.

HOLDING LABOR ON RAILROAD WORK

Discussions of the Present Situation—Means of Alleviating the Shortage by Making Conditions More Attractive

THE railways are now facing the most serious labor shortage in recent years and the indications are that it will become more acute as the season develops. This has forced maintenance of way officers to give much attention to this subject and will undoubtedly lead to a marked improvement in working conditions which will retard if not prevent similar recurrence in the future. The discussions presented below point out some of the ways in which railway conditions can be made more attractive to labor.

ALLEVIATING THE LABOR SHORTAGE

By E. R. Lewis

Assistant to General Manager, Duluth, South Shore & Atlantic

The railway labor problem for 1916 presents more than ordinary difficulties to the intended employer. We have become accustomed to expect the labor market to fluctuate with the local supply and demand. When times are hard, when industrial concerns are doing little, and railway maintenance is being held to a minimum, labor is comparatively cheap and sufficient. The opposite of these conditions results in like changes in the price and supply of labor. But the world's war has stimulated many manufactures and has created new fields of employment. The mandates of war have drawn many thousands of toilers away from the country to the trenches and to employment in war industries abroad. There is therefore a real shortage of labor in America at the present time.

But the present "plight of capital" has been more largely brought about by anticipation than by reality. There has been a nationwide advertisement by press and by word of mouth of an impending scarcity of labor, ever since war was declared. Our newspapers and our magazines, our writers and our readers, our manufacturers and our laborers have spread the dire predictions of a labor famine with persistence and with conviction, until the ghost is flesh and blood, the man of straw is endowed with life, and the labor bugaboo has become a real labor scarcity. It pays to advertise, especially when the world freely advertises for you. I say advertise, for that has been the effect, though not the intent, of the written and oral predictions of a labor famine in 1916. The gratuitous advertising has resulted in placing labor in its enviable present-day position.

No doubt there are less laborers in America to-day than when the world war began, but rumor has lengthened the shadow of the labor famine beyond all semblance of its real proportions.

Employers of railway labor began before winter ended to lay plans for an unusually early start at maintenance work in the spring, on the theory of "first come, first served." There were organized many maintenance gangs which were allowed to mark time by shoveling snow till the frost went out, in order to retain the organizations against efforts of later entries into the field to hire the men away by the lure of higher wages. The late bidders' prices were often met by the first employers in order to hold the men, with the result that wages have soared and labor has become more arrogant. These early sparrings for an opening have led to the ruin of the labor situation. There will be "eight hours' work for ten hours' pay" this year as the ultimate result of these runs to cover of the captains of industry, frightened by the shadow of impending labor famine.

But money is fortunately not everything in this world. There are other considerations of value both to the man you hire and to the man up higher. These other considerations depend on the points of view of those directly interested. The kind of labor hired has much to do with the case. The conditions under which the laborer labors often mean as much to him as the wage he earns.

In order to meet the labor situation successfully each employer must studiously consider his own individual problems. He must make a detailed survey of the labor markets within his reach, of the total supply of labor in each district, of the demands upon that supply, of the wages paid and of the inducements offered by competing employers. Knowing his source of supply and his competition, the employer must know his employees and be prepared to so treat them as to retain their services after he gets them. Men of different nationalities differ as do classes and individuals. Each kind of labor demands a special treatment to obtain the best results. A thorough understanding of type is the key to the situation. The employer must get to the bottom of this question and solve it himself. It is no abstruse problem, but it requires close attention and a keen insight into human nature. The men of northern Italy differ markedly from those of southern Italy. Scandinavian laborers are not all "Dutch," nor are Japanese and Chinese alike. Men of these various nationalities require treatment to fit their several needs.

The employer must understand his men, their wants, their objects in seeking his employ, their customs, preferences and opinions. It is possible even through an interpreter to gain the understanding, confidence, respect and good will of any body of workmen. But it takes time and attention to begin with, and periodical study thereafter to bring about and to retain that perfect understanding which is necessary to get the best mutual re-sults to labor and to capital. Put yourself in the laborer's place. What would you think of the proposition from his standpoint? The foreman and the assistant foreman are his direct superiors. What do you think of them? What would you think of them as your superiors? Do they understand the laborer? If not, change them for men who do understand him and who will treat him properly. Consider the men's food, customs and home life. The first is by long odds most important. Men of all classes are alike in this respect. Feed them well, house them well, organize them well, and officer them well. You then will invariably have a better class of men, better satisfied men, and harder working men than your competitors, who pay as much, or possibly more, than yourself.

Nothing demoralizes an organization quicker than idleness. It is noteworthy that an army in waiting is a difficult proposition. Hard work makes, as idleness unmakes men in all walks of life. Provide, then, for the rainy day. Provide work to keep the men busy—work that counts—work that the men know to be worth while.

The very careful training in these matters of the foremen and assistant foremen will usually produce the desired results, provided they are the right kind of men. It is relatively as important to hire foremen with executive ability and brain power as to engage system officers



with like qualities. Then give your foremen requisite authority to handle the situation properly. There are many cases where the food question may be given over to the men themselves, the buying and preparation being done by one or more of the workmen's representatives. In military parlance, they are permitted to run their own mess.

The practice on some roads of hiring and paying cooks for bridge and other small gangs and letting the food be bought by the foreman and the costs charged and collected by him against each man according to his proportion of the total cost per month, has met with marked success. It is well known that boarding contractors cannot make ends meet if they have only a few boarders. Both parties are early dissatisfied; the men with the food and the contractor with the finances. For this reason the co-operative plan is advisable for gangs of 15 men or less.

It is of primary importance to provide comfortable and cleanly quarters for all laborers. It is no less important to make the men keep the quarters clean, to keep themselves free from vermin and to take individual pride in the conditions about their camps. It is well to have the foreman and assistant foreman eat with the men, to allow no favoritism as to special dishes, to taboo free meals absolutely, to insist on promptness, on wise selection of foods and on proper variety and alternation in menu.

The fault is that too often there is no one of proper caliber to consider and insist on these camp comforts which mean so much more than the casual observer might think.

When a railway company has an established reputation for hiring good men, paying a fair wage, providing good quarters, working the men to the best advantage, maintaining good discipline, and giving fair treatment to all, the foreman can pick and choose. The gangs will weed themselves. Cleanly camps will not permit uncleanly men to remain. A sober gang will not tolerate disorderly laborers. There is no real difficulty about retaining labor. Understand the men, give them the consideration due them, be just to them, give their problems intelligent attention, feed and house them in cleanly and reasonable comfort. The cost of supervision necessary to these ends will be returned many fold.

IMPROVING LABOR CONDITIONS

By ROADMASTER

The serious shortage of labor with which the railways are now confronted is not a temporary condition; therefore, remedies should be adopted at an early date. Prompt action is necessary to avoid the serious deterioration in the physical condition of much track. Those lines which have been maintained in good condition in recent years can stand a reduction of forces for a time, but a postponement of improvement work even on such lines only means greater effort later.

One of the necessary measures to meet the present situation is a wage that will enable a railroad to compete with other industries in occupations where no more skill is required than in track work. Permanent employment in so far as it can be adopted economically will also assist materially in the solution of this problem. I find that at the present time our forces are limited to the number of men employed during the late winter, although we have made every effort to increase our regular section forces and have raised the wages 25 cents per day since March 15. However, wages alone will not solve the present difficulty, although with a rate more nearly equal to that paid by factories and other industries a

sufficient force can be secured locally in many instances where the roads are now short of men.

More supervision of track work is necessary. The adoption of every possible labor-saving device is also essential, effecting in this way a reduction in the number of men necessary.

The adoption of cut-throat methods, such as making unreasonable concessions to foreign laborers, ought to be avoided in a season such as this. Fair treatment should be accorded track laborers and full efficiency should be required of them.

The most important improvement which can be made is the distributing of maintenance work throughout the year. A number of roads are now endeavoring to get their heavy improvement work completed early in the season so that they may be able to assign the available forces later to the work of preparing the track for the coming winter.

I believe that the conditions confronting American railways at the present time will lead to important changes in the methods of conducting work in the maintenance of way department. This will include the more general contracting of such work as can be done that way, the organization of special gangs for fence repairing, renewal of plank crossings, etc., enabling the track forces to work exclusively on the track.

PRACTICAL SUGGESTIONS

By Track Man

Industrial districts are now experiencing one of the busiest periods of activity in history. Mills, factories, mines and railroads are being worked to capacity, and large extensions of plants are being made. As a result common labor is at a premium. This in connection with the fact that a great many laborers have returned to Europe has created a demand much beyond the available supply. The shortage is particularly noticeable on railroad work for the following reasons:

1. The Italian was generally employed on many roads until a year ago, being preferred because he adapted himself more easily to the living and working conditions than did men of other nationalities. A large percentage of the Italians have returned to Europe, so that the departure of this particular nationality has been more serious as far as the railroads are concerned than it would have been had it been confined to some other nationality.

2. The conditions under which men must work and live on railroad work do not suit the men now available as well as do the conditions and mode of living in industrial towns. This is especially true of the Austrian, Slav and Greek.

3. Wages on railroad work are lower than those paid in other industries.

4. Railroad work has in the past been a seasonal occupation and so has not offered permanent employment.

Heretofore there has usually been an adequate supply of labor and during a large part of the time there has been a surplus, the result being that little serious study has been given to the securing and holding of men. As a matter of fact, the problem has been to get authority to put on as large a force as those in immediate charge of maintenance work considered necessary. Now the conditions are reversed and serious attention is being given to the problem of holding and conserving what labor is to be had.

The laborers are keenly alive to this condition and as a result they are less efficient and are moving from place to place, attempting to secure higher wages and concessions as to conditions of living and hours, creating a general spirit of indifference and unrest. Again many roads are turning to the professional employment agent for help and many of these agents are simply exploiting both the roads and the men.

Railroads cannot hope to compete with the manufacturers or contractors on wages. While it is believed that some advance in wages is necessary in order to hold anything like an adeqate force, it seems that there is a much more profitable field in bettering the conditions under which the men live and work. To do this one must understand the habits and characteristics of the different classes or nationalities used and meet the mode of living which these different groups demand as nearly as possible. In the past the men have had to put up with conditions they were not used to and did not like. At present they are in a position to choose, so that the road that studies those features and most nearly meets the desires of the men will be the most successful in holding them under present conditions.

In the past very little if any distinction has been made between the different classes of men that should be used on section and extra gang work. The general run of Slavs, Austrians and Greeks prefer and at the present time insist on working or at least living in large gangs. It is a waste of time and effort to try to split up large gangs. Special effort must therefore be made to get men on the sections. For this men must be secured who are willing to work in small gangs and to provide and cook their own food. In order to accomplish this, living quarters must be provided as convenient and comfortable as possible and section headquarters should be established in villages and towns.

There are several reasons why men prefer to be in large gangs. For instance, the Austrian and Slav do not want to cook for themselves. They want, and, in fact, usually insist, on having their meals cooked for them. Again, they are meat eaters and want fresh meat every day. This means that quarters must be provided for women, or a man cook must be employed, and this can only be done when a sufficient number of men are together to justify employing a cook and arranging for fresh meat and other food.

The men are usually directed by a gang leader who controls 40 to 50 men and it is practically impossible to separate these men from him. With the hobo and to a certain extent the Greek, a commissary run either by a commissary company, the railroad or by the men themselves is necessary. In these commissaries the men are charged so much a meal and something for bedding and other service. It is simply a waste of time to send out from a large center a gang of men who usually have no clothes but those they wear, no money and no bed clothes, unload them at some small station, crowd them into cars or buildings in which there is nothing but a few stoves and wooden bunks and expect them to go to work. Provision must be made for food, bedding and credit until they are paid. It is the neglect of these obvious necessities that accounts for the inability of some roads to keep their forces.

It is the usual practice to house men in camp cars. It would be difficult to devise a more uncomfortable, unsanitary, inconvenient method (as far as the men are concerned) of housing men than this. While it is recognized that cars offer some advantages in that the men can be moved quickly from place to place, it is believed that this kind of shelter is not only unsuited for the purpose except under special conditions, but is also more expensive than buildings. While it may be necessary to have some forces in cars, a large part of the men can be located in buildings in selected locations.

The common box car is poorly lighted, it cannot be

ventilated, it is hard to heat in winter and is hot in summer, it will only hold eight men without crowding, it is usually set near or alongside a main track or yard, a dangerous place for the men; it is liable to be involved in a derailment, it is frequently moved so that men and contents are disturbed and is often placed where rest cannot be had day or night. A box car is usually fitted up with bunks for 16 men and contains about 2,100 cu. ft. or 130 cu. ft. per man. In connection with the small windows and the location of the doors the lack of ventilation is obvious. A minimum of 200 cu. ft. per man with reasonably good means of ventilation should be provided.

A 16-ft. by 40-ft. building, housing 24 men, will provide 5,500 cu. ft. and the openings can be spaced so that ample light and ventilation are secured. Such a building will cost \$600 or \$25 per man. A box car is worth at least \$200 for scrap and if fit for revenue service \$500, or an average of \$320, or \$20 per man. If the number of men is reduced to eight, the cost is \$40 per man. These figures for the box cars are probably low, showing that there is no economy in their use. With the serious objections to the box car mentioned above it is believed that they should not be used unless it is absolutely impossible to use buildings.

If a building is provided the following conditions should be met:

1. The camp site should be carefully selected, having in mind good drainage, a location that is not noisy, that can be reached by wagons so that supplies can be hauled in, and easy of access so that the men can get to and from work conveniently. The location should be near a town if possible so that the men may have whatever advantages the town offers in the way of picture shows or other means of entertainment. If not located near a town, it should be near a station so that train service is available.

2. The building or buildings should be amply large to take care of the men. Overcrowding is one of the worst features of railroad camps. The buildings should be well lighted and ventilated, and built in such a manner that they will be warm in winter and reasonably cool in summer. If wood bunks are used they should be built two high, each stand accommodating two men. The bunks should be built separate, not attached to the building, so that they can be moved out when the building is cleaned and fumigated (which should be done regularly). There should be at least 30 in. between each set of bunks. Plenty of stoves and a separate building for cooking and eating should be provided.

3. An ample supply of good water must be had at the camp. It is not safe to depend on springs, and usually the water supply is too far from the camp. A drilled well is much better if it is possible to get water in this way.

4. No liquor should be allowed in the camp openly. Of course, some of the men will drink, but a large part of the drinking is due to the assumption on the part of foremen and railroad officers that the men must have liquor and nothing is done to discourage it. As a matter of fact, the men are being exploited by commissary men and liquor agents and a large part of the drinking can be done away with if reasonable attention is given to this feature.

One very important matter bearing on the inability of railroads to hold men is the attitude of contempt on the part of foreman and others in authority towards the foreigner. The men are usually treated in an overbearing manner, called hunkies, dagoes, etc., and as a result are resentful and sullen. A man will measure up very



largely as to what you expect from him. If little is expected and he is treated with contempt it is unlikely that he will do more than is expected.

Summing up, to hold forces under present conditions, the following changes are necessary:

1. Provide better living quarters, using box cars as little as possible.

2. Provide permanent employment.

3. Select men for large or small gangs as the case may be—using men who are willing to cook for themselves in small gangs.

4. Grant a moderate increase in wages.

5. Work out at each camp a method of running a commissary, either in charge of a cook or a commissary company, or preferably by the railroad company.

6. Track foremen and others who come in direct contact with the men should treat them fairly with patience and consideration.

7. Discontinue the very general practice of paying

men overtime they do not make. A number of roads are paying eleven hours for ten hours' work to avoid raising the rate per hour. This is dishonest and unfair both to the men and to the railroad company. It creates dishonest foremen and stores up trouble for the future.

8. Do not work men for an unreasonable length of time. Frequently at wrecks or emergencies it is common practice to work them from 18 to 30 hours and usually no provision for food is made. This is unfair. It should be possible to arrange for food on any road if the men are out overtime, and in any case a relief should be on the ground after the men have worked 16 hours.

9. Do not send men unreasonable distances by hand car. If necessary to move them more than two miles, use a work train or motor cars.

10. Do not expect the men to pump a hand-car to or from work on their own time. It is real work and should be paid for.

The Principal Causes of Rail Failures*

BY W. C. CUSHING

Chief Engineer Maintenance of Way, Pennsylvania Lines, Southwest System

F ROM January 26, 1909, to December 16, 1912, there were 4,330 rail failures in 1,790 miles of single main track, being 60 failures for each 100 miles of track per annum. These were not all *broken* rails, but represent the sum total of all kinds of failures.

It is not practicable to make a complete survey of the chemical condition and physical properties of every rail which fails, when they are so numerous, and therefore it has been our custom to select at random rails which have failed in the different ways indicated by the "classificaout of 286, or 71 per cent. Furthermore, 96, or one third of the fractures, occurred within the limits of the joint. If there was no fault to be found with the material, this would be a clear indication that the margin of safety of the rail under ordinary service conditions was quite small, because when the conditions became unusually severe, as in the case of a long-continued frozen roadbed, the rails immediately began to break, and, to a considerable extent, at the weakest point, namely, the joint.

In the case of 12 breakages in the joint only does one

STATEMENT OF RAIL FAILURES FROM JANUARY 26, 1909, TO DECEMBER 16, 1912, CLASSIFIED AS TO KIND OF FAILURE. SECTION. PROCESS AND WEIGHT

Pennsylvania Lines West of Pittsburgh-South West System

					Kind of	Failure			
				Flow of	Crushed	Split	Broken	Split	Total
Wt.	Section	Process 1	Broken	Metal	Head	Head	Web	Base	Failures
100	A. S. C. E	. Bessemer	100	4	59	156	13	3	335
100	P. S	.Bessemer	51	29	23	94	12		209
100	P. S	O. HA	3	• • •	1		1		5
100	P. S	O. HB	5	1	• • •	6	5		17
100	A. R. AA	Bessemer	3		4	113	10		130
85	P. R. R	.Bessemer	43	6	3 5	3 15	17	7	423
85	A. S. C. E	.Bessemer	373	67	3 66	1279	129	87	2301
85	P. S	.Bessemer	202	12	211	326	73	35	859
85	P. S	O. HA		7	18				25
85	P. S	O. HB	2	2	5	10	1	1	21
85	P. S	.OH Mayari	5		•••				5
Total			787	128	722	2299	261	133	4330

tion." For the purpose of this study there has been surveyed the following number of each classification:

1.	Broken
2.	Flow of Metal 15
3.	Crushed Head 19
ŀ.	Split Head 153
	Split Web 18
	Broken Base 42
	Damaged (without fracture) 2
	Worn out in service
	T . (
	Lotal

One is struck with the large number of rails which have broken at a time when the roadbed was frozen, 203

*Abstracted from Bulletin No. 185, American Railway Engineering Association.

fail to account for the additional weakness at that point by defective material. In 21 of the rails, slag was present. As 19 of these were of the P. S. section, which was introduced with the year 1908, it would appear that the methods used by the mills for pouring ingots are not as good as those formerly used, or there is increased carelessness on the part of the workmen.

In the great majority of the rails studied, the fracture has been a simple one, that is, the rail broke into two parts and no accident resulted on account of being discovered in sufficient time by the trackmen. Occasionally, however, a rail flies into many pieces, and it is usually the cause of a train wreck. Such failures are the most dangerous and the most to be dreaded.

A few rails which broke shortly after a broken wheel

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passed over them were examined in order to ascertain if such fractures occurred only when the metal was of poor quality, or whether the fractures occurred because of the additional punishment by the broken wheel when the metal was of fairly good quality. While in all of the examples the roadbed was frozen at the time, yet the material was reasonably satisfactory except in one case, which was above the average of hardness and had a rolling seam in the base.

The rails classified as "flow of metal," "crushed head," "split head" and "split web" are treated under the heading "Defective Heads," because what appears to be one defect is often another when cut open and examined. It is also rather difficult at times to distinguish between "flow of metal" and "crushed head."

It will be noticed from the table that "defective heads" were very numerous during the period in question, 3,410, and that 2,299 of them were classified as "split heads." Of the total, 205 were examined, or surveyed, and the results are tabulated. The first thing noticeable in examining the tabulation was that scarcely any of the failures have occurred in the joints, and the condition of the roadbed has no important bearing on the problem. Segregation, however, is an almost invariable companion of the defective head and web, and that is nearly always accompanied by one or both of the other defects, brittleness and hardness. Sometimes slag is present and sometimes foreign steel, due to the cutting or protection of the ingot mold stool, but an examination of a rail with a bad head will nearly always disclose segregation, brittleness and hardness. One or two of them is sometimes absent. A split head, however, very rarely occurs without the accompaniment of one or more of the defects, which is pretty positive proof that the metal will stand up under the load if it is homogeneous and free from defects. It is the general custom now to have the rails stamped with letters to designate their location in the ingot, with the object of tracing defects back to the ingot in the study to bring about improved mill practice. The rails are stamped "A," "B," "C," etc., beginning with the top. The foreign steel is, therefore, usually found in the rails, from the lower part of the ingot. Sometimes old scrap tieplates were used for stool protection, and the shape of the plate was still discernible in the rail section. These discoveries brought about the discontinuance of the practice.

The results of the examination of so many "split head" rails seem to show that they are nearly always found in segregated rails having hard, unsound metal in the interior and softer metal at the surface. The flow of the softer metal develops a split in the harder unsound and less ductile metal in the interior of a badly segregated rail, resulting in a split head. The remedy seems to be to reduce segregation by making sounder and more homogeneous ingots, which can be done by the use of a sink head, as advocated by Sir Robert Hadfield.

The sources of trouble are not ended with the production of a sound ingot. Greater care should be exercised in blooming and rolling, and improved methods should be introduced. Previous studies indicate that the large and heavy reduction in the blooming rolls is injurious to the finished product, as it initiates the cracks which result later on in seams, which have been responsible for many failures, especially broken bases. The remedy seems to be lighter reductions. Base breakages have been practically eliminated by the heavy base of the 100-lb. P. S. section, but that is not the correct way to remove the defect, which still exists in the case of the 85-lb. P. S. section, which has a heavier base than was customary in former practice. These heavier bases were introduced

primarily to make the rolling conditions better by equalizing more nearly the areas of metal in head and base. The rails come out straighter on the cooling beds, and thus the amount of "gagging" has been reduced.

These cases of long service rails and rails worn out in the tracks seem to show that high carbon is not the only consideration for more durable material, as rails with low carbon have lasted longer under the same conditions than rails with higher carbon, though this is by no means always the case. The temperature of rolling is undoubtedly a very strong if not the strongest factor in producing homogeneous and durable material.

PENETRATION OF PRESERVATIVES

By LOWRIE SMITH

Superintendent of Treating Plants, Northern Pacific, Brainerd, Minn.

THE unit of measurement employed for designating the amount of creosote used in treating sawed structural material, which consists almost entirely of the heart portion of conifers, and in which the penetration of the preservative is limited to a comparatively shallow depth, is considered unsatisfactory by many. It is not based on any scientific reasoning and is apparently an arbitrary unit that was adopted for lack of anything better.

In the treatment of material of this kind the question of first importance in deciding the amount of preservative to be used is the amount of surface exposed to

Size	12-in. by 16-in. 16 ft.	2-in. by 6-in. 16 ft.
Volume in cu. ft	. 21.30	1.33
Superficial area in sq. ft.	. 77.4	21.4
Ratio of area to volume.	. 3.54	16.15
Total oil injected in lbs.	. 170	11
Lbs. of oil per sq. ft	. 2.20	0.51
Depth of oil in ins	0.41	0.09

treatment and the protection desired, not the cubical contents. The practicable penetration being limited to a comparatively shallow depth, that portion of the timber beyond this treatable zone should not be considered.

The great variation of the ratio of the superficial area to the volume of pieces of timber of different cross sections has never been realized or given due consideration. Feeling that more information along this line would be of interest to the producers and users of creosoted material, the accompanying table was prepared, the intention of which is to give a comparison of the treatments of timbers of different cross sections with the same, and also different amounts of creosote oil per cubic foot of volume.

An example of its use may be shown by taking two extremes, a 12-in. by 16-in. 16-ft. timber and a 2-in. by 6-in. 16-ft. timber, given the same treatment of 8 lb. of oil per cubic foot. While both sticks are given the same amount of oil per cubic foot, the larger has about 4.5 times as much per square foot of superficial area and that the depth of this oil is about 4.5 times greater than in the smaller. By following across the table horizontally on the 2 by 6 line it will be seen that even with a treatment of 25 lb. per cu. ft., which is the practicable limit, it is impossible to get more than 1.49 lb. per sq. ft., or 68 per cent of that obtained with 8 lb. on the larger size. Also, the average treatment given a charge made up of timbers of varying cross sections receiving a specified amount of oil per cubic foot, can be computed by dividing the total amount of oil required, in pounds, by the total square feet of superficial area, which will give the pounds per square foot. Reference to the table will show that this amount per square foot is a certain depth, and will indicate whether or not by that treatment it is reasonable to expect certain required results. This same information may be obtained by multiplying the pounds per square foot by the factor 0.1833, which is the depth of a pound of oil over a square foot of surface.

The table was not prepared with the intention of trying to establish any definite criterion for judging the penetration to be obtained from a given treatment, the impossibility of this being very apparent to anyone All things being equal, the depth of penetration of a given amount of oil per unit of volume would vary inversely with the ratio of the superficial area to the volume, and that the penetration of a given amount of oil over a given area would vary directly with the amount.

In formulating the rule and compiling the table the variations of the density of the oil throughout the limits of penetration, and the lap of penetration on the corners and edges, were ignored; the depth of a given amount of

Size	Lgth.	Rt.B.M.	Vol. Cu. Pt.	Perimeter	End Aren Sq. Pt.	aperficial Area So. Pt.	Aroa Aroa O Volume.	In con Hottor Column of Sup	umn a fig a mag	mark gures rkol roz.	ed " ini "in"	lbs" icute indi	top you cato	figur nds of s dep	th of	ndica 1 por f this mds F	er C	otal ft. ount	veig of 3 of 0	ht of up. a il ov	oil reu. er or	in ti e sq.	ft.		
				In. Pt.		in.	14	-	2	10	-	12	-	1	4	16	-	1.8		20	-	22			4
								Lbs.	In.	.bs.	In.	20.0	In.	Lbs.	In.	508.	in.	the.	Ja.	_Ls.	Za.	bs.	!n.	Lbs.	In.
16 X 12	16	256	21.30	56 4.67	1.33	77.4	3.54	2.20.	.41	2.75	.51	3.31	.61	3.65	.71	4.41	.81	4.95	.91	5.57	1.01	5.26	1.11	6.62	1.21
14 X 12		224	18.65	52 4.33	1.17	71.6	3.84	2.08	.38	2.63	.48	3.15	.57	3.55	.67	4.16	.76	4.70	.88	5.21	.30	5.73	1.05	6.23	1.14
12 X 12	"	192	16.00	43 4.00	1.00	66.0	4.13	128	.35	2.45	.45	2.01	.53	3.40	.62	3.33	.71	4.35	.80	4.85	.39	5.54	.90	5.82	1.07
10 X 12		160	13.33	44 3.66	.83	60.2	4.52	105	.32	2.22	.41	2.66	.49	3.11	.57	3.54	.05	3.99	.73	4.44	.31	4.07	.89	5.33	.98
8 X 12	. "	128	10.68	40 3.33	.65	54.6	5.12	85 1.56	.29	1.96	.36	2.34	.43	2.75	.50	3.14	.58	3.52	.65	3.92	.72	4.30	.79	4.70	.86
6 X 12		96	8.00	36 3.00	.50	49.0	6.15	1.30	.24	80	.30	1.96	.36	2.29	.42	2.61	.48	2.94	.54	160	.60	176	.66	192 3.92	.72
4 X 12	"	64	5.33	32 2.66	.33	43.2	8.17	43	.18	53	.23	1.51	.28	75	.32	35	.36	2.23	.41	106	.45	117	.50	128	.55
3 X 12		48	4.00	30 2.50	.25	40.5	10.15	32	.14	.99	.19	48	.22	1.38	.25	64	.29	72	.33	. 80	.30	88	.40	2.37	.44
2 X 12	"	32	2.66	28 2.33	.16	37.6	14.15	.57	.10	.71	.13	.05	.16	.90	.18	43	.21	48	.23	53	.26	59	.29	.64	.31
16 X'10	"	213	17.75	52 4.33	1.11	71.5	4.03	142	.36	178	.46	212	.54	247	.63	282	.72	318	.82	353	.91	369 5.43	1.00	425 5.95	1.09
14 X 10	n	187	15.57	48 4.00	.97	65.9	4.23	125 1.90	.35	156	.43	187	.52	219	.61	249	.69	280	.73	311-4.72	.86	342	.95	374 5.68	1.04
10 X 10	54	133	11.10	40 3.33	.75	54.7	4.92	89 1.63	.30	111	.37	133	.45	155	. 52	177	.59	200	.67	222	.75	244	.82	266	.89
8 X 10		107	8.93	36 3.01	.56	49.1	5.50	71 1.45	.27	89	.33	107	.40	125	.47	143	. 53	161	.60	179	.67	196	.73	214 4.37	.80
6 X 10	19	80	6.65	32 2.66	.42	43.4	6.55	53 1.25	.22	67	.28	80	.34	93	.39	106	.45	120	.51	133	.56	146	.62	160 3.70	.68
.4 X 10	"	53	4.42	28 2.33	.28	37.9	8.60	35	.17	1.17	.21	53	.26	62	.30	71	.35	79	.38	88	.43	97	.47	106	.51
3 X 10	н	40	5.33	26 2.16	.21	35:0	10.55	27	. 14	.95	.17	40	.21	47	.25	53	. 28	60	.32	67	.35	73	.38	08.2	.42
2 X 10	н	27	2.25	24 2.00	.14	32.3	14.35	18	.10	23	.13	27	.15	32	.18	36	.20	41	.23	45	.26	49	.28	.54	.31
16 Z 8	Ĥ	171	14.23	48 4.01	.89	05.8	4.63	114	.32	142	.40	171	.40	199	.55	3.46	.63	256	.71	234	.79	313	.87	341	.95
14 X 8	"	140	12.45	44 3.66	.78	60.1	4.83	99 1.65	. 30	2.07	. 38	150	.45	174	.53	190	. 61	224	.68	849	.76	274	.84	299	.91
8 X 8	u	35	7.08	32 2.56	.45	43.5	6.13	57	.24	71	.30	35	. 36	00	.42	113	.48	127	.54	142	.62	156	.66	170	.79
·6 X 8	u	64	5.33	28 2.33	.33	38.0	7.15	43	.21	53	.26	1.59	.31	75	.36	2.94	.41	96	.46	177	.52	117	.57	128	.62
4 X 8	u	43.	3.58	24 2.00	.22	32.4	9.05	29	.16	36		43	.54	50	. 28	57	32	64	. 36	72	.41	2.44	.45	86	.49
3 X 8		52	2.66	22 1.83	.17	29.6	11.13	21	13	27	16	32	.20	37	. 25	43	27	48	.30	53	.35	58	.36	64	.40
2 % 8	"	21	1.75	20 1.67	.11	26.9	15.35	14	/10	17	10	21	12	25	17	23	10	32	22	35		59	.97	42	.20
16 X 6	**	128	10.65	44 3.66	.67	59.9	5.63	. 85 1 49/	. 26	1.75	. 32	123	50	149	.45	17)	52	102	.50	213	.65	234	.72	256	.76
14 X 6		112	9.35	40 3.33	.58	54.5	5.83	75	05	93	51	112	30	131		149	- 20	169	50	187	63	206	60	224	.75
6 X 6		48	4.00	24 2.00	.25	32.5	8.13	32		40	.01	-48	.00	56	. 19	64		72	.04	80	.00	88	.00	96	. 54
4 X 6		32	2.66	20 1.67	.17	27.1	10.15	.99	.10	27	.23	32	,27	37	.36	43	.20	48	-91	53	de.	59	.00	64	.44
3 % 6	. 11	24	2.00	18 1.50	.13	24.3	12.15	.78	.14	20	.18	24	.86	28	.20	32	.29	36	.00	40	.00	44	.40	48	.36
8 X 6	.41	16	1.33	16 1.33	.08	21.4	16.15	.66	.12	.82	.15	16	.10	1.15	.21	21	10	24	.87	27	.00	29	.00	32	.27
These figu 1 pound= 2 1/16 = .06 1/8 = .12 3/16 = .18 1/4 = .25	ares bas 26.4 cu. 225 5/1 250 3/6 280 7/1 500 1/1	aed on oi in. or . 16 = .312 3 = .375 16 = .437 2 = .500	l having S 1833 inch 5 9/16 = 0 5/8 = 5 11/16 = 0 3/4 =	50. Gr. of 1. over one sq. .5625 13/16 .6250 7/8 .6875 15/16 .7500	.05 at 38 .ft.of su 5 = .8125 = .8750 5 = .9375	°C=8.7	5 lb.per	gel					123	In tal thi is lic us giv a g	form ble, rough igno guid the re so giver	nulati the v bored, over table one kin n amou	ng t aria he l the a gi and c int c	the diniti dept: iven a l'rul of an of oi	of s of h of idea idea l und	rules the de penet a git being re in t of t der co	and insit ireti ireti isen q i use tende tende thut	comp y of on on uanti d as d sim to ex n con	uting the so corne ty of a basi ply to pect f aition	il rs s rom s.	a black

TABLE SHOWING PENETRATION AND AMOUNT OF OIL INJECTED INTO TIMBERS OF VARIOUS SIZES WITH DIFFERENT TREATMENTS

familiar with the treatment of timber, when the variations of refractoriness of wood in the same stick are considered, but simply to show the relation between the variables and give a rough idea as to what to expect. It would seem reasonable, however, to say that the average minimum depth of penetration of a given amount of oil per square foot of area can be assumed to be as shown in the columns marked "In," as this is simply the depth of a given quantity of oil over a given area without any consideration being given to the increased depth caused by the volume of the wood in which it is distributed.

The information developed by this table indicates that a rough rule for penetration would be: oil over a given area being used as a basis, as it was intended simply to give some kind of an idea of what to expect from a given amount of oil under certain conditions. The table in its present form was made to cover as many variables as possible for individual conditions; it can be greatly condensed and simplified by the use of curves.

GASOLINE.—George A. Burrell, of the Pittsburgh station of the Federal Bureau of Mines, estimates that in 1909 the consumption of gasoline in this country was 11,000,000 barrels. In 1916 he estimates the amount will be 38,000,000 barrels.





F^{IVE} contributions were received in the contest on the Handling of Construction Equipment in Maintenance of Way Work, which closed March 10. These papers were turned over to C. G. Delo, chief engineer, Chicago Great Western, and W. H. Penfield, assistant to vice-president, Chicago, Milwaukee and St. Paul, who awarded the first prize to F. F. Hanly, assistant engineer, Baltimore & Ohio, Baltimore, Md., and the second prize to S. J. Evans, Central California Traction Company, Sheldon, Cal. The other contributors to this contest included O. W. Duffy, superintendent of construction equipment, Chicago, Burlington & Quincy, Galesburg, Ill.; P. H. Hamilton, St. Louis & San Francisco, Memphis, Tenn., and L. M. Gunstead, supervisor, Illinois Central, Waterloo, Iowa. The two prize winning papers are published below and other contributions will appear in an early issue of this paper.

FIRST PRIZE—THE HANDLING OF EQUIPMENT ON THE BALTIMORE & OHIO

By F. F. HANLY

Assistant Engineer, Baltimore & Ohio, Baltimore, Md.

The character of work coming within the scope of the Maintenance of Way department ordinarily requires the employment of a large complement of special equipment. For the prompt and economical handling of emergencies, improvement work and maintenance renewals, this is indispensable, yet, notwithstanding this, its misdirected use frequently becomes expensive, and the only effective means of governing this expense seems to lie in a wellorganized system of centralized control.

An adequate supply of maintenance equipment requires a large capital investment which is justified by the facilities it offers for the prompt handling of emergencies, and since the same equipment is suitable for ordinary maintenance renewals, repairs and improvements, the overhead expense, applied against an individual emergency, is greatly reduced by employing it continuously on such work during the interval between emergencies. Frequently, during certain seasons of the year, demands arise simultaneously on several divisions of a road for the same kind of equipment and the need of it at that time seems so urgent as to warrant procuring new or additional equipment to handle the work properly. This tendency very often leads to an overstock of expensive equipment, most of which must lie idle for several months after the season's work is completed and the overhead must be absorbed in a relatively low output for each machine or car. The fault is not so much the result of the fluctuating nature of maintenance work as it is the lack of a well-regulated system of planning the work for which the equipment is adapted and for directing the work from a central office according to a definite program.

On the Baltimore & Ohio the use of all maintenance of way special equipment comes under the direction and control of the engineer maintenance of way. A program is prepared each year embracing all work over the system for which the various machines are suitable. The equipment is then assigned to the divisions and placed under the supervision and care of the division engineer. As soon as the work at one location is completed and before the equipment is moved, the engineer maintenance of way is notified and his office record of the change in location is revised accordingly. In this way he is informed each day of the location and condition of the equipment, whether in use or idle and the kind of work being done, and the responsibility for its use and maintenance is placed in the hands of the division engineers, whereas its movement from one division to another lies within the direction of the engineer maintenance of wav.

The equipment facilities comprise the following:

8	pile drivers.
15	steam shovels.
12	steam ditchers.
14	spreaders.
17	unloading plows.
9	Lidgerwood unloaders.
5	ballast plows.
25	rail unloaders.
2	rail curvers.
3	locomotive cranes.
13	ditching cars.
10	concrete mixers.
10	hoisting engines.
4	air compressors and riveting outfits.
948	camp cars.
6	emergency camp trains.

There are not enough units to distribute one complete outfit to each division, nor is it desirable that such distribution should be made. There are divisions, for instance, which seldom need a pile driver, while others, which suf-fer from washouts, require them frequently. Relatively few pile drivers will take care of the needs adequately by moving them from place to place as they are required; by keeping a daily record of their location, they will be available for an emergency at any point. Likewise the amount of concrete work is not sufficient to justify assigning a mixer permanently to each division. While such equipment as rail unloaders and camp cars are more or less essential for every-day use, they are usually assigned to all divisions, but the general run of work can be carried on satisfactorily with only a few pieces of each kind of equipment, properly distributed according to the knowledge which a general supervising officer has of all requirements. This practice reduces the amount of lost time from idle equipment to a mini-



mum and insures an equitable distribution to the divisions requiring it most urgently.

The care of all equipment is in charge of the division engineer. The outfits assigned to the division or transferred to it for temporary use are kept clean and in repair by the divisional forces. As soon as the work is completed at one location and before the equipment is removed to another, it is cleaned, repaired and restored in good order. Repairs that cannot be made in the field are handled at the maintenance of way shops at Martinsburg, W. Va., where facilities are provided, not only for making repairs, but for the rebuilding of badly damaged or wornout equipment. The organization for handling the work is large enough to insure prompt repairs so that the equipment is held out of service the minimum length of time. The shop is an important adjunct in the scheme of maintaining a minimum amount of equipment. Since it is operated under the direction of the engineer maintenance of way, he is able to exercise such control over the handling of repairs as to insure the return of the equipment to service promptly.

With the exception of pile drivers, steam ditchers and shovels, no equipment has assigned crews. Regularly employed maintenance of way forces are selected on each division to operate it when assigned or transferred to the division. These employes are otherwise usually engaged in carpenter, bridge, track or tunnel gangs, etc. The pile drivers are in charge of regularly assigned crews who go with the outfits wherever they are used. The complete plant consists of the pile driver, one camp car and one tool car. The crew consists of one foreman, one engineer, one fireman and two helpers to man the leads. This force is augmented by the carpenter force employed on the same work. The pile driver work is scheduled ahead far enough to keep the crew and outfit employed continuously, but a driver is moved from one point to another only when sanctioned by the engineer maintenance of way, except in cases of emergency. The steam shovels likewise have regularly assigned crews. However, as steam shovel work is more or less intermittent, the crews are otherwise employed in the maintenance department during the interval. The regular crew consists of one engineer, one fireman, one craneman and one watchman, but no camp provision is made for these men. Consequently, the equipment is left in charge of a watchmin over night and during interruptions to the work.

The steam ditchers are operated by a hoisting engineer and one helper, who is selected from the division organization to act as fireman. A ditcher is ordinarily used in connection with a work train and under the supervision of a track or extra gang foreman. A sufficient force of labor is employed to load and unload the cars and dress the roadbed behind the machine. An effort is made to train the men operating the various machines so that they are gualified to substitute, in the absence of any member, and ultimately gain promotion in the regular order.

As the season of heaviest maintenance work approaches, it becomes a problem of vital importance to house the additional labor force properly. The work is usually so scattered over the road that the only means of providing adequate, convenient quarters for the extra gangs is the use of camp cars. With nearly 1,000 cars fitted up for camp service, it is imperative that they serve all needs as far as possible and avoid the necessity of diverting more cars from revenue service. It requires their distribution in a way that will avoid overcrowding on one division and part utilization on another. Weekly reports are sent to the engineer maintenance of way from each division showing the total number of cars on hand,

their capacity and the number of men occupying them. This makes possible an intelligent comparison of the situation on each division and such readjustments and transfers as seem necessary to accommodate the demands where congestion occurs. Without this control the available equipment would often become inadequate without being fully utilized and create the tendency toward building bunk houses or fitting up other suitable buildings and additional cars at considerable expense.

In addition to the ordinary camp cars, emergency camp trains accommodating from 60 to 70 men are established at six centrally located points over the system. Thev consist each of four bunk cars, two dining cars, a kitchen car and a foreman's car, and are maintained intact, completely stocked with track tools, bedding, cooking utensils and provisions so as to be available immediately for use at washouts, land slides and other emergencies. They are permitted to be used for emergencies only upon authority of the engineer maintenance of way. Each division on which such a camp is located is responsible for its condition and regular inspections are made by the division engineer to insure that it is being maintained in proper order.

In order that the central office may have an accurate record of the equipment situation at all times, each division makes the following reports on standard forms:

- Daily report, on pile drivers, steam shovels and ditchers. 1.
- Weekly report, on all equipment except camp cars. Monthly report, on camp cars.
- 3.

For the sake of convenient reference by the engineer maintenance of way, the daily reports received from the divisions are abstracted and condensed on separate forms. one for pile drivers, one for steam shovels, and one for steam ditchers. The weekly reports cover all equipment except camp cars. The monthly reports cover camp cars or cars in non-revenue service.

It requires only 7 per cent of one clerk's time to prepare the condensed forms in the central office. When completed they give a concise record of the equipment situation for use of the engineer maintenance of way and serve as an excellent guide in familiarizing him with the progress of the work at all points. The forms contain a complete list of all equipment numbers which serve as a guide for the clerk in checking any failure by the divisions to report.

Summarizing briefly, the salient features in the practice of handling equipment on the Baltimore & Ohio are control by a central office, operation and maintenance by the division organization, equitable distribution to the most urgent work and continuous use, resulting in low unit costs. It is felt that all work is handled more promptly, and the equipment is utilized to greater advantage under this practice than could be attained under any other plan.

SECOND PRIZE-ORGANIZING AND HANDLING CREWS FOR BALLAST WORK

By S. J. Evans

Central California Traction Company, Sheldon, Cal.

After the question of the location of the gravel pit is settled, the steam shovel is the next item that should be given consideration. If the shovel is not new, no matter how little it had been used since it was purchased, it should be given a thorough overhauling at the division shops. This should be done under the supervision of the steam-shovel engineer, as many defects which may be ignored or overlooked by the shop employees will cause serious delays after the shovel has been put into service.

Duplicate shovel parts that receive hard usage, such as

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dipper teeth, circle cables, etc., should be furnished and stored in the tool car. As soon as those in service have become worn and must be replaced, others should be forwarded by the supply department upon telegraphic requisition, copies of which should be sent to the roadmaster and superintendent for their files. It should be understood that these "wire" requisitions must not be ignored or held up when they do not conform with the ruling of the supply department. The requisitions should be considered as emergency and should be treated as such, for should the circle cable break a serious delay would result.

All cars which are to go into this service should be taken to the repair shop and overhauled. Particular care should be taken to have the plow cars in good working order. Flat cars if used in connection with Lidgerwood unloaders should be equipped on one end with hinged aprons made of iron or steel plates and it should be understood that when these cars are made up in a train, the aprons must be on the ends of the cars nearest the unloader, so that the plow point cannot lift and tear the aprons from the hinges. The cars should be equipped with steel stakes made of pieces of old rails, a supply of which should be kept on hand at the pit to replace those lost in transit.

Rodger ballast cars should be made tight to avoid leakage of material in transit. The dumping gears should be overhauled and tested to have them working perfectly while dumping with the cars in motion. Side dump cars should be used only to load refuse, such as gravel that contains a large amount of loam or clay. This refuse material is generally used to strengthen embankments and to fill in trestles and can be handled by this class of equipment to good advantage, thus releasing the other classes of ballast cars for the service of ballast distribution.

Hart convertible ballast can be used for side dumping if it is decided that the Lidgerwood must be used, but most roadmasters prefer to have the gravel dumped in the center of the track, so the Hart convertible cars will be considered as center dump cars.

It is essential to select a general foreman who is familiar with every phase of the work. He should be a trackman who has had an extensive experience in handling the unloading and loading of earth, gravel and other material for filling and ballasting. He should have charge of all forces at the pit, including the shovel engineer, pit track foreman, pit engine crew, and car repairers. The shovel engineer should be in direct charge of the shovel. The craneman, fireman and the four, or if the shovel is extra large, six pit men should be placed under his direction. The pit track foreman should be furnished with enough laborers to keep the pit tracks in good condition. These tracks, as a rule, are considered unimportant, as they are temporary tracks, but when consideration is given to the rough usage to which they are subjected, it is clear that these tracks, especially the loading track, must be in good alinement and surface to prevent derailments.

Where the shovel is working but one shift in 24 hrs., a watchman should be provided for the night hours. He should be required, also, to coal up the pit engine and the steam shovel. The coal car should be spotted on the loading track at the rear end of the engine tank and opposite the shovel coal bin and a water tank car should be coupled to the coal car with a hose long enough to reach the water tank of the shovel. A hand or steam pump should be placed either on the shovel tank or on the water car. If the locomotive and shovel are equipped to burn crude oil, instead of coal, the oil car should be fitted with an oil pump stationed on a flat car next to the engine. In fact, both the oil and water pumps could be set up on a flat car and fitted with steam pipes and kept

as part of the equipment. This arrangement will enable the watchman to have everything in readiness in the morning for the shovel to begin operation without delay. At noon the water and pump car can be spotted and the water can be pumped into the shovel tank by either the engine or shovel fireman.

Two car repairers should be stationed at the pit to make all light repairs to cars; those that are in such bad order as to occupy these car repairers for too long a time should be tagged and sent to the division repair shops.

It is important to have a telegraph operator stationed at the pit, so that the general foreman can be called upon for any information that is required at the division or district offices. The operator can compile the yard reports, instead of the agent nearest to the pit, as is done when there is no operator at the pit. A train crew should be stationed at the pit and should not be allowed to leave the pit to unload a few cars of gravel out on the main line during the working hours of the shovel. This practice causes delays which result in a diminution of the day's output by the shovel and should not be countenanced by the division superintendent.

One of the duties of the general foreman is to make telegraphic reports each evening to roadmasters and division offices covering the number and class of cars loaded during the day and of empty and loaded cars on hand at the close of the day. He should also make a record of every loaded car that has left the pit storage tracks during the preceding 24 hours. The operator takes a record of the yard at 7 a. m. and the general foreman's report should date from 7 a. m. of the preceding day to 7 a. m. of the date of record. This should be sent to the roadmaster's office, giving in detail the number of cars, and the class, with the initials and car numbers.

As the first requirement at the pit is a loading track, this should be laid in advance of the arrival of the shovel so that the latter can be cut in at once upon its arrival. There should be enough rails and ties on hand to lay a second track immediately behind the shovel. If there is room enough, a switch should be installed in the loading track as close to the main line as possible to allow the shovel to begin loading from this second track, thus avoiding the cutting and the throwing of the pit track to install the shovel, which works off from the short spur behind the frog onto its own track rails.

As the shovel progresses from day to day the pit track gang can lay the second track close behind the shovel. This can be used for the storage of empty cars until the shovel has reached the end of the pit. When the shovel moves back to start a new cut, this track is cleared of empty cars and is in readiness for use as a loading track. The loading track that has just been abandoned may be taken up from time to time as the shovel progresses with the new cut, and laid behind it. This method avoids the delay of half a day or more throwing track each time the shovel is moved back.

No matter how trivial, a report of every delay should be made to the roadmaster, recording the exact time the shovel has been out of service and also giving in full the cause of the delay. By doing this, in every case, it will put the causes of all delays where they rightly belong and will be an incentive for more efficient service.

One point that should be watched very closely is to have all cars loaded to capacity. It is common practice to load light and report the cars as having a full load, thereby making a record for the shovel that is not justified.

Enough storage tracks should be built convenient to the pit to permit empties to be set out and loads picked up without interfering with the pit service. When the train hauls are 75 miles or more in length or extend onto an-



other district or division, a distributing train should be provided to do the unloading.

Where the gravel runs freely, a foreman and four laborers will be sufficient to handle the unloading of the ballast. If the cars are of the Hart convertible type, two men should be worked upon the ground. One uses a piece of iron pipe about four feet in length as an extension for the dumping lever and holds the bottom doors closed when the other man releases the latches. By the use of this extension of the levers the doors are kept from flying open and covering both rails with gravel, thereby derailing one or more cars. The other two men should be stationed, one on each end of the car, working the gravel out of the corners with a shovel. This gang should be kept continuously in this service throughout the season and should be recruited from the track forces, selecting those who are seeking advancement and are willing to work for it. Additional help, when needed, should be given by the foreman of the section upon which the gravel is being unloaded.

Upon some railroads, the unloading is done under the supervision of the conductor of the train, who is given section men to do the dumping. This system is radically wrong, for in no place is a foreman of keen insight or judgment needed more than in charge of the distribution of ballast material.

The arrangement of cars for greater safety as well as economy is important. Where Hart convertible cars are in use as center dump cars, the dumping is handled from the ground and these cars should be switched or turned to have the dumping levers all on one side of the train, preferably on the side of the prevailing winds. This places the lever men and brakemen out of the dust and in a clear position to give signals. The engineman should be on the same side also. It makes little difference whether the engine is backing up or going forward, but the instant of time required for the fireman to relay a signal cannot always be spared in case of an accident.

THE SOUTHERN FOREST SITUATION

THE United States Department of Agriculture has issued bulletin No. 364, entitled, "Forest Conservation for States in the Southern Pine Region," by J. Girvin Peters, chief of state co-operation. This bulletin points out the situation which arises from the removal of the pine and hard wood forests without proper provision for restocking the cutover areas or the prevention of fires. One result has been an increase in the erosion of streams, the silting up of channels in the lower reaches, with much damage by floods.

The solution suggested is adequate forest legislation by the individual states to secure a non-partisan department of forestry, a technically trained forester in charge, a forest fire protective system, co-operation with private owners and towns in the management of timber lands and for tree planting, state-owned forests by gift or purchase and an adequate appropriation of funds. It is also suggested that the individual states investigate the stateowned lands with a view to withdrawing from sale those chiefly valuable for timber production.

Special attention is drawn to the importance of the lumber industry to the southern states, with an annual cut having an estimated value of about \$275,000,000. At the present rate of cutting the existing stand of timber is estimated to last 35 years.

STANDARD CROSSING SIGNAL.—The American Railway Association has adopted a circular disc with the word "STOP" painted thereon as the standard signal for highway crossings, and will take steps to secure its adoption.

THE SAFE LOCK SWITCH MACHINE

THE simultaneous throwing of both switches of a crossover removes the possibility of trainmen, or others, setting one of the switches for movement through the crossover, while the other is set for the straight track. Furthermore, with this method, the chance of having a light engine on a crossover with one or both the switches set for a conflicting movement is remote as the occasion



THE INDICATORS

for such handling on the part of trainmen is removed. The desirability of having both switches of a crossover open before a train starts to make a crossover movement and the movement completed before either switch is restored to its normal position is obvious. The Safe Lock switch machine has been designed in an effort to fulfill these conditions in a safe and practical method, while at the same time facilitating the work of the trainmen.

One of the first steps in this development was to locate a switch and lock movement at one switch and connect it by a single pipe line to the throwing stand at the other switch. This method was found unsatisfactory because sufficient stroke is not provided by the ordinary switch stand to operate a switch and lock movement in a reliable manner, and the throwing lever could be forced into place with little extra effort without the switch-and-



CONNECTIONS AT THE SWITCH POINT

lock movement completing its stroke and locking the switch, and without the condition being detected by the switchman. Another method was to connect the switches together directly by cranks, leaving out the switch-andlock movement. This also proved undesirable for the reason that the points of the pipe-operated switch could be held open to a dangerous extent by an obstruction, and the condition not be discovered by the switchman.

These experiments demonstrated that there were two

Switch

essential points to be covered before the throwing of both switches from one stand simultaneously could be accomplished in a practical and satisfactory way; first, sufficient stroke must be secured at the throwing stand to operate a switch removed a distance equal to the length of an ordinary crossover; and, second, reliable means must be provided whereby a switchman could be sure that the switch points of both switches had moved into place. The two-lever ground stand, located midway between the switches on double-track and near the main cations. The Safe Lock switch machine is placed midway of the crossover on double track and at the main track switch on single track. Only one lever is required, thus removing the objection of confusing trainmen, or the necessity of special training on their part to properly operate the stand. The first movement of the lever through 60 deg. unlocks the switches; the movement through the next 60 deg. throws them, and the movement through the last 60 deg. locks them in the new position.

With the Safe Lock switch machine the switches are locked in both normal and reverse positions by the fac-



PLAN OF TRACK LAYOUT WITH THE SAFE LOCK SWITCH MACHINE

track switch on single-track, partially covered these requirements. In this scheme both the switches are equipped with standard interlocking connections and facing point locks; the switches being operated by one of the levers and locked in the normal position by the facing point locks operated by the other lever.

The first installation of this kind was made on the Cincinnati, New Orleans & Texas Pacific on April 4, 1911, and several similar installations have been made since. They are still in service and have given little, if any, trouble from adjustments, renewals, etc., but several objections to the arrangement have arisen. First, the switches are only locked in the normal position by the



THE FOUR POSITIONS OF THE LEVER

facing point locks. Second, it is more or less confusing to trainmen to have to operate two levers, and in a few instances they have left the switches in the normal position and unlocked, failing to restore the lock lever to its normal position. Third, if the points are not properly in place for the crossover movement, no reliable means is provided for a switchman to detect this condition.

It was to overcome these objections that the Safe Lock switch machine was designed. The switches are equipped with standard facing point locks, the connections being installed in accordance with standard interlocking specifiing point locks, and failure of either of the switches to go to its proper place in either position is indicated to the switchman in an unmistakable way, as he would have to buckle the lock operating connections a distance of five inches to get the lever down on either side. He can tell readily if the points have responded to the lever by looking at the targets on the switches; the facing point locks then insure the points fitting up.

In designing the machine, strength and simplicity of parts have been given particular attention. The weight of the machine is approximately 400 lb., and there are only three operating parts exclusive of the lever and two operating pins and rollers. Mounted on a concrete foundation, it is rigid and positive in operation. A stroke of $6\frac{1}{4}$ in. is provided for throwing the switches.

The first Safe Lock switch machine was installed on the Cincinnati, New Orleans & Texas Pacific on March 22, 1913, and it is reported to have given excellent service with no repairs, and with only ordinary attention, since that time. After the first installation had been in service about one year the use of this device was extended gradually over all the districts on the Cincinnati, New Orleans & Texas Pacific and Alabama Great Southern with uniformly good results. At present there are 50 crossovers equipped with the facing point lock layouts, 12 being operated by two-lever ground stands and 38 by Safe Lock switch machines. These machines are being placed on the market by Chas. F. Jones, Lexington, Ky.

EUROPEAN TIMBER-TREATING PLANTS.—All the Belgian plants were taken over by the Germans. There are about six plants which were owned partly by private and partly by government interests. In times of peace the government plants were managed by the German authorities. One of the largest creosoting plants in northeastern France is that of Amagne, which was captured by the Germans. The 150,000 ties found in this plant have been used by German troops for repair and other work, and the plant is not now in operation. Serbia had one small plant at Chichewash, near Nish, and it is now being used as a magazine for the German troops.



PROTECTING TRACK FROM DRIFTING SAND



Southern Pacific Track Along the Pacific Ocean Near Surf. Cal.

FOR a considerable distance north of Santa Barbara, Cal., the Coast division of the Southern Pacific lies immediately adjacent to the Pacific ocean. The track is located on a bench considerably above the elevation of the water and passes through a considerable area of sand dunes. This sand is continually drifting back and forth, moving at times seaward and again shoreward. These conditions were particularly serious between Surf, Cal., and Honda, a distance of five miles. In many places between these points the track is located only a stone's throw from the ocean, lying from 150 to 186 ft. above the water, with the sand dunes rising 100 ft. to 200 ft. higher.

These conditions created serious elements of danger for train operation. Although watchmen were employed to patrol the track constantly this protection was subject to two serious dangers. While the wind might not appear excessive at the points where the employees happened to be, sand might be drifting badly at other points nearby. Strangely enough such storms are the most dangerous, as the sand does not then fill the air to warn those who approach of its presence, but moves along close to the ground and frequently covers the rail on one side of the track only. This is sufficient, however, to derail a locomotive or car coming upon it. Also, watchmen assigned to the patroling of the track to detect drifting sand become very unreliable after long periods of immunity, and frequently do not detect a local flurry covering the rails during a couple of hours' inattention or during the night.

It was, therefore, necessary to adopt some permanent means of relief. About 1898 sand fences were established, but these were soon discarded, as it was found that they had the tendency to build the hills up to an even greater height. The experiment was also tried of spreading large quantities of adobe over the surface of the sand adjacent to the track. Extensive experiments were conducted with the planting of native grasses and weeds, but it was found that the plants failed or died for lack of nutrition. While certain weeds came up well, the sand blasts cut and destroyed the tender growth and no progress was made along these lines. The peach apple, or mesembryantheum, flourishes and abounds at points a few miles from this vicinity. It was therefore quite natural that much should be expected of this plant, but as it was short and in the nature of a carpet, and as the carpet was not complete, but lying more or less loosely, after being transplanted it was uprooted and entirely destroyed by severe storms before becoming set.

In the spring of 1908 about 1,000 plants of the species of grass called bent grass (Amophila Arenaria), used in reclaiming sand dunes at the Cliff House and in Golden Gate Park, San Francisco, were sent for planting in the Honda dunes. An exposed and prominent site was chosen for this experiment, and such good results were obtained that future efforts were confined for three years to extending its growth over the entire area, selecting the most troublesome spots first. As the plants had to be obtained in San Francisco and hauled from the park to the depot the day after digging, shipped 300 miles to the nearest station and then hauled by push car to the site of the planting, a considerable loss at first resulted, over 25 per cent of the grass failing. In three years, however, a sufficiently heavy stand developed so that the plants were obtained from the first and second year's planting. Of these no loss occurred from failure to take hold and throw out roots, the only loss being on exposed slopes during exceptionally heavy storms, where the wind cut in and uprooted small patches here and there to an amount not exceeding 2 per cent. The expense of handling the reclamation also decreased greatly when plants were obtained from fields adjacent to the work, the cost of planting per acre with grass from Golden Gate Park, San Francisco, being \$49.56, as compared with \$26.45 per acre at present. On one hill, where in times past the sand covered the rail to the depth of from 5 to 30 ft., no trouble has occurred for five severe seasons. Steam shovel and hand work and watchmen amounted each year to many times the cost of planting this area of 40 acres and safety is now assured.

The method of handling this reclamation is as follows: A gang of 30 men moves on the ground as soon as sufficient rain has fallen to moisten the sand on top and pulls





Conditions Before Work was Undertaken Planting in Progress, with an Unplanted Area in the Center A Closer View of the Method of Planting An Area on Which the Grass Has Grown



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the grass from thrifty tufts in an established field. The grass pulled is 24 in. to 30 in. long and the tops are cut off, reducing the length to 18 in. It is done up in handy bundles, bound with grass, and transported to the point of planting. The grass is planted in rows spaced two feet apart, and the plants are placed at intervals of two feet in the rows. When placing them in the ground a vertical opening is made in the sand with a shovel and a plant is dropped into the opening before withdrawing the shovel. After the shovel is withdrawn, the foot is pressed on the side of the opening from which the shovel came to close the sand firmly about the roots.

A field completely planted in this manner presents to the wind a broom of grass eight to ten inches high and so breaks and interferes with it that only in rare cases, as on steep slopes, does it obtain a hold upon the sand sufficient to raise it. The dry broom left standing above the sand protects the field until the roots are formed and green shoots appear of sufficient strength to withstand the wind.

Among the grass may be planted seeds of the Blue Lupin, which in time becomes a strong brush. The grass protects these, and all other young tender shoots, which will thrive under such protection in the sand. The Acacia Latifolio flourishes in the sand and may be planted at intervals of 12 ft. in rows 12 ft. apart, becoming a dense thicket in three years. The coast division of the Southern Pacific now has 140 acres planted to bent grass with ten acres of it reinforced with acacia and lupin.

As an experiment 200 young African Cedar trees are being grown from cuttings obtained near Keeler on the Sale Lake division, in 1913. The nursery at Goleta, Cal., also propagates pine, cypress and gum trees that are planted in the reclaimed area; 20,000 acacias, 200 pines, 700 cypress and 1,000 gum trees have been planted, of which all but the pine are doing well.

We are indebted to W. R. Scott, vice-president and general manager of the Southern Pacific, for the above information.

ENLARGING A DEEP WELL

THE capacity of a deep well on the Chicago, Milwaukee & St. Paul was doubled recently by reaming out the upper 255 ft. to permit the use of a larger pump pipe and cylinder. The experience with this well included also a number of other interesting features.

The well is located at Mannheim, Ill., and was drilled in 1911. Commencing at the top, it consists of a 55-ft. drift cased with 12-in. pipe, 926 ft. of 8-in. hole and 842 ft. of 6-in. hole. It was the intention to drill an 8-in. hole for the full depth, but when the drilling had reached a depth of 981 ft., a stratum of shale a short distance above commenced to cave, making it necessary to insert a section of 6-in. casing for the entire depth of the stratum of shale and one of lime stone just below it, which was full of crevices. The rest of the well obviously had to be drilled with a 6-in. bit.

Water was encountered in quantity in several strata, but it was all too hard for use in boilers except that obtained from a 108-ft. stratum of white sand at the bottom of the well. To exclude all the other water it was necessary to case the well to the depth of the lowest of the other water-bearing strata, which being in the 6-in. portion of the well necessitated the use of 288 ft. of $4\frac{1}{2}$ in. pipe at the lower end of the casing, with 908 ft. of 6-in. casing above it.

The well was equipped with an air lift consisting of 321 ft. of air pipe in 338 ft. of 4-in. discharge pipe. Air was supplied by a 10-in. by 10-in. air compressor, belt

driven by a 40 h.p. Nash gas engine. A pressure of 121 lb. per sq. in. was necessary to start the water and the normal pressure while the water was running was 97 lb. A discharge of 110 gal. per min. was developed with this equipment, requiring the consumption of 5 gal. of gasoline per hour.

The air lift plant was later replaced by a Downey double-acting deep-well pump, furnished by the Keystone Driller Company, Beaver Falls, Pa., belt driven by a Stover fuel oil engine. The pump cylinder was $4\frac{3}{4}$ in. in diameter placed 150 ft. below the surface. This pump delivered 100 gal. per min. with a consumption of fuel (kerosene) of $1\frac{1}{4}$ gal. per hr., a great saving over the previous arrangement.

Since the well was installed there has been a gradual increase in the consumption of water at this station, leading about the first of this year to a study for increasing the capacity of the plant. In view of the location of the water-bearing strata at the bottom of the well and the relatively small drop in head, accompanying a discharge



SKETCH SHOWING METHOD OF ENLARGING WELL

of 100 gal. per min., it was concluded that the capacity of the well was sufficient to supply water for a material increase in the pumping capacity, which was limited under the circumstances to the discharge obtainable with a $4\frac{3}{4}$ in. pump cylinder.

Accordingly, it was decided to increase the diameter of the well for a sufficient depth to permit the installation of a larger pump cylinder and a contract was let for enlarging the well to a 12-in. diameter for a depth of 255 ft. The 6-in. casing was cut off at that depth and pulled. The end of the pipe was then plugged temporarily and the 8-in. hole was reamed out to a diameter of 12 in. as far as the end of the 6-in. pipe.

It was the intention to line this 12-in. hole with a 10-in. casing, but it was found that the reaming tools used by the contractor formed a hole that was so crooked that it was impossible to lower more than a relatively short length of 10-in. pipe into it without binding. In consequence it was necessary to use an 8-in. pipe and instead of sealing the connection with the 6-in. pipe by putting the new pipe over the one already in position, it



was necessary to make the connection with the 6-in. pipe by means of a 6-ft. length of $4\frac{1}{2}$ -in. pipe as shown in the accompanying drawing. This detail was devised by A. D. Beesley, chief carpenter.

The upper end of the $4\frac{1}{2}$ -in. pipe was connected by means of a flush, threaded bushing to the working barrel of a deep-well pump, which was in turn connected to the 8-in. pipe which served as the discharge line. The new pump is of the same type as the one which it replaced, except that it has a $7\frac{3}{4}$ -in. cylinder. It is belt operated by a Fairbanks, Morse type "Y" crude oil engine of 20 hp. operating at 350 r.p.m. This plant on test discharged 200 gal. of water per minute on 7 qt. of kerosene and $\frac{1}{4}$ pt. of lubricating oil per hour. This fuel consumption is considerably more than double that for the discharge of 100 gal. per min. with the same type of pump, and is accounted for, partly by the increased friction resulting from the higher velocity through the two sections of $4\frac{1}{2}$ -in. pipe, which circumstances made it necessary to install in the well and also by the greater drop in head required to obtain the greater discharge from the well.

The contract price for increasing the size of the well for the depth of 255 ft. was 1,200. The increased capacity has been found of material advantage. All the water necessary can be pumped each day in an average of 18 hrs. Formerly the pump was in practically continuous operation and there were runs of 140 to 192 hrs. without stops. The alterations to the well were carried on under the direction of A. Yappen, district carpenter, Chicago, Milwaukee & St. Paul, Chicago, Ill.

A HAND-CAR ENGINE OUTFIT

A S a means of holding men and securing more efficient work, many section foremen have equipped their old hand cars for gas engine propulsion at their own expense rather than wait until the railroad company could furnish them with new motor cars. These engines are ordinarily installed on the cars by the section foremen themselves, who provide the necessary housing, seats, etc. In order to reduce this work to the simplest possible form, Mudge & Co., Chicago, have introduced a motor engine outfit complete in a single unit. The frame which supports the engine serves also as a seat for the crew



THE ENGINE OUTFIT READY TO INSTALL

and houses the battery box as well. Everything is completely assembled, ready to run, except for the transmission to the car axle. The work of installing it on the car is a simple matter. The frame is bolted to the floor of the car, a hole is cut in the floor for the passage of the drive belt and a split steel pulley is attached to one of the car axles.

The engine has a horizontal cylinder of $4\frac{1}{2}$ -in. bore by 5-in. stroke and develops six horsepower at 600 r. p. m. A special effort has been made to insure simplicity and the use of a minimum number of parts. This is true also of the carburetor, which is automatic with but

a single adjustment. The engine may be equipped also to burn either kerosene or gasoline, with provision for the use of gasoline to start the engine.

Lubrication is provided by mixing lubricating oil with the kerosene or gasoline, by means of a sight feed lubricator on the cylinder and grease cups on the crank shaft bearings. The seat is 25 in. by 68 in. and the complete frame with all parts in place weighs 300 lb.

LUMBER STATISTICS FOR 1915

THE Forest Service of the United States estimates that 37,013,294,000 board feet of lumber was cut in 1915, by 29,941 mills. These figures are based on a total of 30,985,473,000 board feet reported by 16,248 mills. The following tables give the total cuts by states and also the total production of the various kinds of the principal woods as far as the figures are available to date. The cut for yellow pine is the largest, being 14,-



CURVE OF LUMBER PRODUCTION AND SHIPMENTS

700,000,000 board feet, and that for Douglas fir comes next with 4,413,000,000 board feet.

Since the beginning of February there has been a marked increase in both the shipment and production of lumber in this country. In March, 1916, 951,800,000 feet were cut, as compared with 797,500,000 in March, 1915, and 899,100,000 were shipped in March, 1916, as compared with 748,500,000 in the same month in 1915.

1915 PRODUCTION OF YELLOW PINE

State Louisiana Mississippi Texas North Carolina Alabama Alabama Arkansas Florida Georgia Georgia	Number of Mills Report- ing 201 460 229 1.024 557 350 181 832 481 356	Production of Mills Reporting M Ft. 2,868,402 1,630,354 1,544,210 1,078,077 1,004,499 1,067,853 823,270 493,332 523,498 565 910	Estimated Total No. Active Mills 300 975 350 2,500 1,250 600 360 1,650 1,400 750	Estimated Total Production M Ft. 2,950,000 1,850,000 1,650,000 1,350,000 1,350,000 1,190,000 950,000 1,000,000 890,000 750,000
South Carolina Oklahoma	356	565,910 160,406	750 90	750,000 170,000
Reported total . Other States	4.713	11,759,811	1,555	250,000
Estimated total.			11,780	14,700,000

1915 PRODUCTION OF DOUGLAS FIR

	Production	Estimated
	of Mills	Total
	Reporting	Production
State	M Ft.	M Ft.
Washington	. 2.754,179	2,920,747
Oregon	. 1,119,395	1,254,125
California	. 117,951	119,000
Idaho	. 76.283	76,700
Montana	. 41,464	42,400
	4,109,272	4,412,972

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PRELIMINARY 1915 FIGURES FOR OTHER WOODS

Hemlock		White Pine
Wisconsin	446,584 M	Minnesota 884,252 M
Michigan	362,973 M	Idaho 201,858 M
Washington	306,570 M	Wisconsin 188,274 M
Pennsylvania	256,170 M	
West Virginia	132,346 M	1,374,126 M
New York	93,014 M	Western Pine
Maine	68,631 M	Calif. and Nevada 389,991 M
Oregon	61,96 3 M	Idaho 301,600 M
		Oregon 189,203 M
1	,728,251 M	Washington 130,507 M
Cypress		Montana 118.920 M
Louisiana	559,8 3 0 M	Arizona 75.843 M
Florida	147,079 M	New Mexico 61,466 M
Georgia	47,261 M	
South Carolina	30,034 M	1,167,788 M
Arkansas	24,554 M	Redwood
Mississippi	23,679 M	California 418.821 M
Missouri	23,639 M	
		Sugar Pine
	856,076 M	California 114,494 M

A NOVEL ERECTION METHOD

By H. S. COWELL

Erection Engineer, Virginia Bridge and Iron Company, Roanoke, Va.

A HIGH steel viaduct was recently completed for the transportation of coal mine cars in Wyoming County, West Virginia, which presented some unusual features in erection. The United Pocahontas Coal Company arranged to lease 1,200 acres of No. 3 Pocahontas seam coal in a mountain situated on the north side of Pinnacle creek and to the north of the present mines of the Zenith and Indian Ridge coal companies, but to reach this new



ERECTION VIEW, SHOWING THE STEEL STRUTS

field and transport the coal to the tipples of the old coal mines, it was necessary to extend one of the present Zenith drifts northward to the face of the mountain and then bridge the valley. Owing to the inaccessibility of the proposed viaduct all of the members for it had to be hauled on mine cars about one mile through the old drift, which was in some places only four feet high in the clear and with frequent sharp curves, and this was a governing factor in the design.

The design adopted provided a viaduct 680 ft. long and about 170 ft. high in the center, made up of one 30-ft. beam span, four 102-ft. spans, and one 92-ft. riveted

deck truss span, supported on five towers of 30-ft. span, and weighing about 340 tons. As the erection equipment had to be brought to the bridge site through the old mine, and as the pieces to be handled were comparatively light and short, it was decided to use a light timber traveler. This necessitated the use of a scheme of erection whereby the truss spans could be erected one piece at a time. As the cost of falsework for this would be very high, a pair of inclined steel struts or booms were made, the lower ends of which were pin connected to temporary wing plates bolted to the columns and the top ends of which were held in position to receive the bottom chords of the truss span by two 1¹/₄-in. diameter wire rope cables. These cables were fastened to turn buckles with a 24-in. takeup, which were in turn fastened to the head of the second column back with heavy chains.

After the erection struts were in place the truss span was built up on them to a point a little beyond the center, after which the traveler was moved forward to the center of the span and the next tower was built up, followed by the remainder of the span. The traveler was then backed off the span and was used to remove the erection struts, transferring them ahead to the completed tower and placing them in position for the next span. These struts were made long enough to give the proper camber to the truss span and no difficulty whatever was encountered in placing the last sections of the top chord.

The actual time of erection was 34 working days with an average of 34 men. The steel for this viaduct was designed, fabricated and erected by the Virginia Bridge and Iron Company, Roanoke, Va.

RECENT DERAILMENTS

O N February 2, passenger train No. 44 of the Pennsylvania R. R. was derailed near Seward, Pa., while running at 65 miles per hour, five of its eight cars being derailed, and 44 passengers and 3 employees being slightly injured. The derailment was caused by the weakening of the track, following the removal of the spikes from two out of every three ties for a distance of 1,000 ft., preparatory to the renewal of rails. The foreman in charge of the track work was a man of 13 years' experience.

An extra train consisting of an engine and two cars was derailed on the Coal & Coke Ry. near Milliken, W. Va., on February 7, overturning the tender and injuring one trainman. The derailment was caused by weakened track following a heavy rain.

Louisville & Nashville train No. 94 was derailed at Henderson, Ky., on March 3, by frozen mud in the flangeway at a public crossing, killing the fireman.

A southbound passenger train broke through a bridge on the South Dakota Central near Watertown, S. D., killing 2 passengers and injuring 13. The bridge had been weakened by a fire, believed to have been set by a preceding train.

A work train was derailed on the Central of New Jersey near Edison, N. J., on March 10, by snow in the flangeway of a highway crossing, killing the engineer.

The "Katy Flyer" of the Missouri, Kansas & Texas was derailed near Itasca, Tex., on March 20, 3 cars leaving the track, and 5 passengers being slightly injured. The cause of the derailment was weakened track at a point where rails were being renewed.

An engineer was killed and a fireman seriously scalded in the derailment of a Baltimore & Ohio passenger train at Flora, Ill., the locomotive being overturned and three coaches leaving the track. The derailment was caused by weakened track at a point where repairs were being made.



A NEW TRACK FASTENING

JUNE, 1916

A TRACK fastening that will maintain a resilient but firm contact between the parts it joins together under service conditions is greatly to be desired. Such a fastening will reduce to a minimum the wear between parts, especially of the tie plate into the tie, and so reduce one of the largest of maintenance expenses. The fastening here described has been designed with a view to providing a practical means of maintaining this principle.

By reference to the accompanying drawing it will be observed that the rail is held to the tie plate by clamps. These clamps have inclined fingers which permit of a strong clamping effect and also, by reason of their in-



PLAN AND SECTION OF THE FASTENING

clined fingers, adjust themselves to any ordinary imperfections of commercially rolled rails and tie plates. Back of the clamps and engaging them and the screw spikes are steel springs so shaped that they drop freely into place before the screw spikes are inserted. As the screws are turned down these springs flatten out and, by an action similar to that of a toggle joint, press the clamps securely into place. These springs have a range of adjustment sufficient to compensate for any ordinary irregularities in the other parts. The upper portions of the springs also act as spring washers between the screw spike heads and the tie plate. The tie plate is similar to the ordinary shoulder plate except that inclined grooves are formed in its under side to receive the lower fingers of the clamps. The screw spikes are the same as those used with rail clips. Bolts through the tie or driven spikes may be used instead of the screw spikes if desired.

Six of these fastenings have been tried out experimentally for a period of one year in a track laid with 100-lb. A. R. A. type A rail, carrying about 10,000,000 tons annually. They were applied to ties which had been previously adzed down considerably on account of wear under $7\frac{1}{2}$ -in. by $10\frac{1}{2}$ -in. by $5\frac{4}{8}$ -in. plates and ordinary driven spikes. The ties have not shown any further wear during the period of the experiment.

The main advantage to be expected of the fastening

is due to the principle first mentioned of maintaining an unbroken resilient contact between the parts, but in addition to the resulting reduction in the wear of the tie plate into the tie, the fastening, by maintaining an unbroken contact between the parts, will reduce rail creeping. The rail and tie plate are clamped together, making the tie plate in effect a part of the rail and providing a broad base, which adds to the stability of the rail against overturning.

The full holding power of the screw spikes, bolts or driven spikes is developed by reason of the upward thrust from the rail being delivered on at least the two opposite sides of their heads. Also as this force must be transmitted through the springs, no sudden blow can result. This device has been patented by H. E. Van Ness, assistant engineer, Central Railroad of New Jersey, New York, N. Y.

NEW ROCK ISLAND ANGLE BAR

BY J. G. WISHART

Office Engineer, Rock Island Lines, Chicago

THE accompanying design of angle bar is one which will be used with new 100-lb. A. R. A. type A section open hearth steel rails on the Rock Island Lines during the coming summer. A similar section has been prepared for 90-lb. rails. These sections were designed in the chief engineer's office under the direction of C. A. Morse, chief engineer, and are modifications of sections used in preceding years. These modifications consist mainly in the design of a larger head or upper flange and a thicker web. Metal has been added in the head by increasing its thickness on the inner face and adding



THE NEW ROCK ISLAND ANGLE BAR

the longitudinal ridge on the outer face above the bolt holes, this ridge being designed for the use of ¼-in. spring washers. In addition to giving added strength to the bar, the heavy upper flange and thick web have a moral effect on the trackman in that they show their strength and thus appeal to his natural instinct. This is considered a benefit as it will impress him with its effectiveness and gain his attention in seeing that it is properly applied.

These bars are heat-treated and quenched in oil and are of steel with 0.42 to 0.55 carbon. They will be applied with 1-in. heat-treated track bolts and spring washers. Rock Island standard tie plates and $\frac{5}{8}$ -in. by 6-in. track spikes, instead of the ordinary 9-16-in. by $5\frac{1}{2}$ -in. spikes will be placed on all joint ties.

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A UNIVERSAL SAND TESTER.

By Cloyd M. Chapman

Engineer of Tests, Westinghouse Church Kerr & Co., New York, N. Y.

A NY method which will determine quickly and with reasonable accuracy whether the granularmetric analyses of the sand shipments received agree with the analysis of the sample tested when the suitability of the sand was determined, will serve to check the quality of the sand as it is used on the job. A method which seems to solve the problem and to provide a quick, easy, accurate record of the size analysis of sand without requiring an expert operator or laboratory equipment is by means of a sand tester recently put on the market for this particular purpose. This consists of a box of sheet copper in which



SAND TESTER AND SAMPLE RECORD SHEET

are soldered a series of wire screens placed at an angle of about 45 deg. with the narrow sides of the box. The accompanying photograph shows one of these instruments constructed with glass sides to show the internal arrangement of screens.

There are five of these screens which divide the box into six compartments. Each of these compartments opens into a chamber attached to one side of the box and into each of these side chambers is screwed a glass cylindrical measuring receptacle. One end of the main box is provided with a round opening and a rubber plug for closing the opening. On one side of the box are two rods on which slide a platen holding a record sheet and also an index finger. Both the platen and the index finger slide freely along the rods the full length of the

box and both are easily removable by springing the slide clips off the rods.

To make a sand test with this instruments a small measuring cup is filled from the sand pile and emptied into the box. Water is added until the box is nearly full. The rubber stopper is inserted in the end of the box and holding the instrument in an inclined position with the glass receptacles uppermost the sand is washed down through the sieves by shaking the instrument in all directions. The glass receptacles, being inverted, do not fill with water while the sand is being shaken down through the screens. The instrument is next turned slowly over 180 deg. about its longitudinal axis and then turned on end, with the receptacles upright, and the sand is washed into them.

The depth of the sand in each receptacle is proportional to the quantity of each size of sand. The platen carrying the record sheet is now clipped on the slide rods and the index finger is snapped into position on the same rods. The form of record sheet generally used is shown in the accompanying drawing. It provides a variable length scale of one hundred parts on which percentage of the total sample may be read directly, even though the total volume of the sample may vary between rather wide limits.

The bottom line of the record sheet is placed opposite the bottom of the sand in the lowest receptacle and the index finger is moved along until it is in line with the top of the sand in the bottom receptacle. A line is then drawn with a pencil across the record sheet, using the lower edge of the index as a straight edge. The index is then moved up until it is opposite the bottom of the sand in the next receptacle. The platen is moved up until the pencil line just drawn coincides with the lower edge of the index. The index is then moved up to the top of the sand in the second receptacle and another line drawn across the record sheet along the lower edge of the index. By repeating this procedure there are produced on the record sheet a series of horizontal lines whose distances apart are equal to the depths of the sand in the six receptacles. The top line will cut the top diagonal line of the record sheet at some point depending upon the size and grading of the sample. At this point of intersection, representing 100 per cent, or all of the sand, a vertical line is drawn on the record sheet. This vertical line will intersect all the horizontal lines previously drawn. At this point of intersection may be read to the right the per cent retained on and to the left the per cent passing the various screens in the box.

The shaded bands on the accompanying record slip show the results of a standard analysis for a particular sand, allowing a two per cent variation from the mean. With such a diagram in his possession an inspector can tell at once whether the sand tested varies materially from the standard analysis established for that particular sand.

The time required to make a test with the instrument is about ten minutes on the average, including taking the sample, making the separation, drawing the record diagram, and cleaning out the instrument for another test. As compared with any other known method, this is very rapid.

EARLY RAILWAY TRAVEL IN ENGLAND.—Rule (1). Any person desiring to travel from Liverpool to Manchester, or vice versa, or any portion of the journey thereof, must twenty-four hours beforehand, make application to the station agent at the place of departure, giving his name, address, place of birth, age, occupation and reason for desiring to travel.



^{*}Abstracted from a paper presented before the American Concrete Institute, Feb. 17, 1916.

GENERAL NEWS DEPARTMENT

ALL SECTION FOREMEN of the Duluth, South Shore & Atlantic were granted an increase in pay of \$2.50 per month, effective May 1.

THE STATISTICAL STATEMENT issued by the American Railway Association for May 1 showed a total surplus of 59,657 cars, as compared with 52,274 for April 1 and 292,269 for May 1, 1915.

THE SENATE COMMITTEE ON INTERSTATE COMMERCE has acted favorably on the bill to increase the number of Interstate Commerce commissioners from seven to nine. Similar action was taken in the House of Representatives some time ago.

THE BUREAU OF FOREIGN AND DOMESTIC COMMERCE held examinations in various cities on May 19, for a special agent to investigate the markets for railway supplies in South America and for a similar agent to visit Africa, Australasia and the Far East.

THE CLEVELAND, CINCINNATI, CHICAGO & ST. LOUIS has issued a small card for distribution in cities along its line showing the number of heads of families employed, the number of persons dependent upon these employees and the total monthly pay roll for these cities.

THE COLLEGE OF MECHANICAL AND ELECTRICAL ENGINEERING of the State University of Kentucky, Lexington, dedicated a monument to early American railroading on May 30. The monument is in the shape of a 25-ft. section of the original track of the Lexington & Ohio Railroad, the first railroad built west of the Allegheny Mountains.

THE OLD GUARD of the Nashville, Chattanooga & St. Louis, an association of employes and officials of the road who have been in the service since the Civil War, held its ninth annual meeting in Nashville recently, and decided to enlarge the membership by admitting anyone who had been in the employment of the road 35 years.

DURING A DISCUSSION in the House of Commons of the Canadian Parliament recently, the acting minister of railways stated that the expenditure on the Quebec bridge to date amounts to \$18,257,621, of which \$10,473,046 has been on the new bridge. The total cost of the structure, including the amount expended for the old bridge, is estimated at \$27,000,000.

THE LONG ISLAND RAILROAD has issued a poster, printed in three colors, announcing that it will continue its campaign introduced last year against reckless driving of automobiles over grade crossings. It calls attention to the efforts made last year which were rewarded by the absence of a single fatal accident, and requests the assistance of the public for the coming season.

OF THE RECENT ORDER of 125,000 tons of rails ordered by the Pennsylvania for the lines east of Pittsburgh, all but 5,000 tons will be rolled to a 130-lb. section. This section is identical with the 125-lb. section adopted two years ago, with the exception that 1/8-in. of metal is added to the top of the head. The Bessemer & Lake Erie has also ordered a considerable tonnage of this same section.

THE SOUTHERN PACIFIC will discontinue the use of the name Sunset-Central Lines as the official designation of this group of railroads in Texas, and these roads will be known in the future as the Southern Pacific Lines. The Sunset-Central Lines include the Houston & Texas Central, the Galveston, Harrisburg & San Antonio, the Texas & New Orleans, the Houston, East & West Texas and the Houston & Shreveport. Similar action is contemplated with reference to the Sunset-Central Lines in Louisiana.

WITH THE OBJECT of placing in convenient and accessible form before those in the United States interested in or responsible for railway materials, the Bureau of Standards, Department of Commerce, in connection with its investigation of failures of railway material, has obtained copies of specifications for rails, axles, wheels and tires used in several European countries. These specifications are given in full, together with a digest and discussion, in Technologic Paper No. 61, "Foreign Specifications for Railway Material," just issued. The available data concerning the types and weights of foreign railway equipment, together with those concerning derailments and accidents abroad, are also included in the publication.

AMONG THE SIX EMPLOYEES of the Pennsylvania Railroad retired from active service on April 1 was Daniel Sullivan, crossing watchman at Titusville, Pa. He entered the service of the Pennsylvania as a brakeman in May, 1864, and was transferred to duty as crossing watchman at Titusville, in November, 1877.

F. D. UNDERWOOD, president of the Erie, has announced that any employees of the road called upon for military duty of any kind in the militia shall enjoy leave of absence with full pay, and that this time shall not be deducted from the regular vacation periods and shall not affect continuous service records. This order applies to all employees paid by the day, week or month, but not those paid by the piece, by the hour or by mileage.

A TRACK-REPAIR LABORER came in contact with poison ivy while mowing grass on a right of way, resulting in his sickness. While in bed, owing to his reduced power of resistance to disease, he contracted bronchitis, of which he died. The New York Appellate Division, in a proceeding under the Workmen's Compensation Act, held that his death was accidental within the meaning of the act, and not the result of an occupational disease and that compensation could be properly awarded.

A PRELIMINARY STATEMENT of the general results of the 1914 census of manufactures with respect to steel works and rolling mills has been issued by Sam L. Rogers, director of the Bureau of the Census, Department of Commerce. The statistics for 1914 covered a period of marked depression. The output of rails in the later year, not including rerolled or renewed rails, was 1,842,041 tons, valued at \$54,009,918, as compared with 2,858,599 tons, valued at \$81,128,295, in 1909. The production of rerolled or renewed rails decreased from 106,352 tons, in 1909, to 63,671 tons, in 1914, and of rail fastenings—splice bars, tie-plates, etc.—from 396,911 tons, in 1909, to 348,947 tons, in 1914.

THE TENNESSEE SUPREME COURT has held that a railroad is not liable for injury to a member of a section crew riding on a hand car in charge of the foreman who permitted it to run at high speed, the man being injured by the foreman's negligence in applying the brake suddenly. The court held that the foreman was not specially required to use the brake and that any of the men on the car might have used it. If the man had been different. The railroad, having provided a safe roadbed, a hand car in good condition and having exercised due care in the selection of servants to operate it, was not liable for the neglect of the servants in such operation.

PLANS ARE DEVELOPING RAPIDLY for the annual convention of the Roadmasters' and Maintenance of Way Association, which will be held at the McAlpin Hotel, New York, on September 19 to 22 inclusive. The twenty-fourth floor of this hotel has been reserved for the convention and the exhibit of the Track Supply Association. While the program for the convention has not yet been completed, the annual banquet will be held on Thursday evening with several prominent railway men as speakers. Arrangements have also been made for a special train to convey the members of the association and their guests on an inspection trip over the lines of the Long Island Railroad on Thursday afternoon preceding the banquet.

CORRECTION

IN THE DESCRIPTION of the improved Buda-Wilson Bonding Drill published in the Maintenance of Way Section of the *Railway Age Gazette*, for April 21, page 915, the statement was made that this drill supersedes the "Hy-Duty" Wilson Drill. This is incorrect, as the Buda Company is prepared to furnish either drill according to the preference of the user.



PERSONAL MENTION

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GENERAL

F. W. SMITH, JR., division engineer of the New York division of the Pennsylvania Railroad, has been appointed assistant superintendent of the New York division, effective May 1.

THEODORE SPEIDEN, JR., who has been appointed assistant general manager of the Nashville, Chattanooga & St. Louis, with headquarters at Nashville, Tenn., began railway work in May, 1899, in the engineering department of the Louisville & Nashville. He subsequently became roadmaster of the Nashville division, and while in that position had charge of the construction work done by company forces on the Lewisburg & Northern. He entered the service of the Nashville, Chattanooga & St. Louis as assistant superintendent of the Chattanooga division in 1914. On February 1, 1916, he was made superintendent of the Chattanooga and Nashville divisions.

R. L. GEBHARDT, division engineer of the New Jersey and Lehigh division of the Lehigh Valley, has been appointed trainmaster of the Seneca division with headquarters at Sayre, Pa. He was born at Easton on Sept. 9, 1882. After graduating from Lafayette College, he entered the service of the Lehigh Valley during the summer of 1908 as a draftsman on the engineering corps at Easton and was promoted to assistant engineer on the New Jersey & Lehigh division at Easton in 1909. He was again promoted to assistant division engineer at Easton in 1910. In 1911 he was appointed division engineer of the Auburn division at Auburn and in 1912 was returned to Easton as division engineer of the New Jersey & Lehigh division, which position he held up to April 15, 1916, the date of his latest appointment.

ELISHA LEE, who was appointed assistant general manager of the Pennsylvania Railroad, with headquarters at Philadelphia, Pa., on May 1, graduated from the Massachusetts Institute of Technology in 1892, and entered the service of the Pennsylvania in November of the same year as a rodman in the office of the division engineer of the Tyrone division. From August, 1895, to October, 1897, he was on leave of absence. In April, 1899, he was appointed assistant supervisor, and two years later was promoted to supervisor. In August, 1903, he was appointed assistant engineer in the maintenance of way department, and in April, 1907, he was promoted to principal assistant engineer on the Philadelphia, Baltimore & Washington. On March 24, 1909, he was appointed superintendent of the New York, Philadelphia & Norfolk, since which time he has been in the operating department.

CHARLES S. KRICK, who was appointed general superintendent of the New Jersey division of the Pennsylvania Railroad on May 1, graduated from Lafayette College in June, 1887, and entered the service of the Pennsylvania as a rodman on the Schuylkill division the following month. On December 14, 1890, he was appointed assistant supervisor on the Tyrone division and was transferred to the Philadelphia division in April, 1892. He was appointed acting supervisor about three years later and was promoted to supervisor in June, 1896. On January 1, 1903, he was made assistant engineer of the Erie and Susquehanna divisions and was later transferred to the Philadelphia division. He became principal assistant engineer of the Philadelphia, Baltimore & Washington, in January, 1906. In April, 1907, he was appointed superintendent of the New York Terminal division, since which time he has been in the operating department.

E. F. MITCHELL was appointed group engineer of the western group of the presidents' conference committee on federal valuation of railroads, with office at Chicago, III., effective May 1. He was born in July, 1864, and was educated in private schools. He entered railway service in 1882, as an employee of the construction department of the Pennsylvania. He remained with this road in various capacities in both the construction and maintenance departments until 1887. From 1887 to 1890, he was division engineer maintenance of way of the Norfolk & Western, and from 1890 to 1892, assistant engineer in charge of surveys and track construction and draftsman for the Denver & Rio Grande. He was engaged in private civil and mining engineering practice in Colorado until 1900, when he returned to the Denver & Rio Grande as assistant engineer. From 1901 to 1904 he was chief engineer of the San Luis Valley Land & Mining Company in Colorado, and from 1905 to 1912 was engineer of construction and chief engineer of the Missouri Pacific. For the past four years he has been engaged in private practice as consulting engineer.

GAMBLE LATROBE, who has been appointed general superintendent of the Philadelphia, Baltimore & Washington, was born at Baltimore, Md., on January 21, 1866, and began railway work on April 4, 1884, as a rodman on construction on the Philadelphia division of the Baltimore & Ohio. In August, 1887, he became a levelman on the Pennsylvania R. R. and in May of the following year entered the service of the Philadelphia & Reading at Williamsport, Pa. On October 2, 1889, he returned to the service of the Pennsylvania R. R. at Altoona, and was appointed assistant supervisor in February, 1890. From January, 1895, to April, 1902, he was supervisor, and from that date to March, 1908, he was division engineer of the Baltimore division. At that time he was appointed general agent and superintendent at Baltimore, since which date he has been in the operating department. He has recently been superintendent of the Baltimore division of the Northern Central with headquarters at Baltimore.

ENGINEERING

J. H. HARRIS, division engineer of the Manhattan division of the Pennsylvania Railroad has been appointed division engineer of the newly created New York division.

J. F. DONOVAN, division engineer of the Mahanoy & Hazleton division of the Lehigh Valley at Hazleton, Pa., has been appointed division engineer of the New Jersey & Lehigh division at Easton, Pa., succeeding R. L. Gebhardt, appointed trainmaster.

H. O. KELLEV, assistant engineer of the Evansville & Indianapolis, has been appointed division engineer, with office at Terre Haute, Ind. He was born at Lebanon, Ind., on July 17, 1890, and graduated from the Rose Polytechnic Institute in 1913. He entered railway service with the Chicago & Eastern Illinois in July of that year, and continued with that road until March 1, 1916, when, on the separation of the Evansville & Indianapolis from the Chicago & Eastern Illinois, he went with the latter property.

W. S. MOORE has been appointed engineer maintenance of way of the Louisville, Henderson & St. Louis, with headquarters at Louisville, Ky. He was born in Fresno, Cal., in 1886, and graduated from Vanderbilt University in 1907. He entered the employ of the Louisville & Nashville the following year as a rodman on the Memphis division. He was appointed engineer of terminals at Louisville in 1911, and assistant engineer, Pensacola, Fla., in 1912. He was appointed engineer maintenance of way of the Louisville & Atlantic (Louisville & Nashville) in 1913. He went to the Louisville, Henderson & St. Louis in November, 1915, on special work and was appointed to the newly created office of engineer of maintenance of way on April 17, 1916.

FRANK STRONG has been appointed division engineer maintenance of way of the San Pedro, Los Angeles & Salt Lake, with office at Salt Lake City, Utah, vice R. K. Brown, promoted. Mr. Strong was born at Philadelphia, Pa., on December 29, 1879, and graduated from Norwich University, Vermont, in 1902, as a civil engineer. He entered railway service in March, 1903, with the Pennsylvania. He was employed in the construction department of this road until 1909, during which time he was identified with the construction of the Pittsburgh terminal facilities, the Brilliant cut-off, and the New York tunnel and terminal work. In 1909 he joined the engineering staff of the Salt Lake Route. He has been engaged in location, construction, maintenance and valuation work for that road since that time.



R. K. BROWN was appointed engineer maintenance of way of the San Pedro, Los Angeles & Salt Lake, with headquarters at Los Angeles, Cal., on May 1. He was born in Cincinnati, Ohio, in 1876. When 16 years of age he entered the employ of the Pensylvania Lines West of Pittsburgh, as a rodman. During intervals between periods of employment he attended the Rens-

ment he attended the Rensselaer Polytechnnc Institute at Troy, N. Y., from which he received his degree. After returning to the Pennsylvania Lines he was advanced to division engineer, with headquarters at Richmond, Ind. In 1902 he left the Pennsylvania Lines and went to Los Angeles, Cal., to become division engineer of the San Pedro, Los Angeles & Salt Lake. In the following year, when the Salt Lake route reached Salt Lake City, Utah, he was transferred to the latter



R. K. Brown

city as division engineer maintenance of way of the Salt Lake division, which position he held until his recent promotion.

C. R. ANDERSON has been appointed division engineer of the Mahanoy & Hazleton division of the Lehigh Valley with headquarters at Hazleton, Pa. He was graduated from the Civil

Engineering department of Lafavette College in 1907. In that year he entered the service of A. Pardee & Company, coal mining operators at Hazleton, as an assistant engineer. In 1908 he accepted a position in the engineering department of J. S. McIlvaine & Company, bridge contractors and erectors, Chambers-burg, Pa., and in the next year entered the service of the Lehigh Valley as a transitman in the engineering department of the Mahanoy & Hazleton division. After serving as transitman for nearly two years, he was promoted to draftsman, which position he held for two years. In 1913 Mr. Anderson was promoted to the position of assistant



C. R. Anderson

the position of assistant division engineer. The early part of this year he was promoted to the position of supervisor of track on subdivision No. 2 of the Mahanoy & Hazleton division and served in that capacity until his recent promotion.

F. L. WHEATON, engineer of construction of the Delaware, Lackawanna & Western, was appointed division engineer at Binghamton, N. Y., on April 19, succeeding Charles E. Wickham, deceased. After graduating from Thayer School of Engineering, Dartmouth College, in 1886, Mr. Wheaton entered railway service in August of that year as division engineer of construction with the Chicago, Rock Island & Pacific. From 1889 to 1891 he was assistant engineer of construction for the Lehigh Valley at Geneva, N. Y., from which time he was in private practice at Jersey City, N. J., until 1899. Following a year as resident engineer for the Chicago & Northwestern at Mason City, Iowa, he went with the Lackawanna in 1900, as assistant engineer, since which time he has been in charge of the construction of the New Bergen tunnel; the Hoboken terminal; the Hopatcong-Slateford cut-off and the Clark's Summit-Hallstead cut-off recently completed. JOHN R. SEXTON, recently appointed division engineer of the Erie with headquarters at Meadville, Pa., was born January 18, 1889, at Long Branch, N. J. He was graduated from Rutgers College in 1911. He first entered railway service in the summer of 1910, when he served as a rodman on the Lehigh Valley. From August 1, 1911, to October 12, 1913, he was successively rodman, transitman and inspector on the New York Central & Hudson River. Upon leaving the latter road he went to Cleveland, Ohio, as resident engineer of the Erie, and was transferred later to Weehawken, N. J., in the same capacity. On April 1, 1915, he was appointed assistant division engineer of the Mahoning division, with office at Youngstown. Ohio. On May 1, 1916, he was promoted to division engineer of the Meadville division with office at Meadville, Pa., vice C. Bucholtz, promoted.

TRACK

WILLIAM STANCE KAMINSKI has been appointed roadmaster of the Northern Pacific, with headquarters at Duluth, Minn.

J. HOLLONQUIST, roadmaster of the Canadian Pacific, at Moose Jaw, Sask., has been transferred to Mission, B. C., vice J. Esslemont, deceased.

JOHN BOXFORD was appointed acting roadmaster of the fourth district of the Panhandle & Santa Fe, with headquarters at Slaton, Tex., on May 1, succeeding D. O'Connell, transferred.

J. H. BROWN has been appointed roadmaster of the Atchison, Topeka & Santa Fe, at Topeka, Kan., succeeding A. E. Hansen, deceased. Mr. Brown was formerly with the Union Pacific.

F. M. LEWIS has been appointed assistant supervisor on the Philadelphia division of the Pennsylvania Railroad, with headquarters at Enola, Pa., succeeding H. H. Kauffman, transferred.

JOHN MERRY, roadmaster on the Rocky Mountain division of the Northern Pacific, with headquarters at Missoula, Mont., has been transferred to the Yellowstone division, with office at Glendive, Mont.

C. S. ROZZELLE has been appointed assistant supervisor of the Illinois division of the Baltimore & Ohio Southwestern at Carlyle, Ill., in charge of track between East St. Louis and Xenia, effective May 1.

A. G. ARMSTRONG has been appointed assistant supervisor of the Indiana division of the Baltimore & Ohio Southwestern at North Vernon, Ind., in charge of the line between Seymour, Ind., and Jeffersonville, effective May 1.

J. M. COTTER has been appointed roadmaster and E. F. Kelley, master carpenter of the Spokane, Portland & Scattle, with headquarters at Vancouver, Wash., following the re-establishment of division headquarters at this point.

M. D. MORGAN has been appointed roadmaster of the Chicago, Rock Island & Pacific, with headquarters at Fairbury, Neb., vice F. Bokenkroger, C. C. Cunningham has been appointed roadmaster with headquarters at Liberal, Kan., vice A. Shumate.

CHARLES EWALD, yard foreman of the Cleveland, Cincinnati, Chicago & St. Louis at Hillsboro, Ill., has been appointed acting supervisor of District No. 2 of the St. Louis division, with headquarters at Mattoon, Ill., relieving John Barth, injured in a motor-car accident several weeks ago.

GEORGE B. SCHROYER has been appointed assistant supervisor on the New York division of the Pennsylvania Railroad with headquarters at Jersey City, N. J. George F. Walter has been appointed assistant supervisor on the Delaware division at Clayton, Del. Joshua F. Hunter has been appointed assistant supervisor of subdivision No. 3 on the Maryland division.

H. B. WELSH, supervisor of the Pennsylvania Railroad at York, Pa., was appointed supervisor at Reading, Pa., on May 10, succeeding T. E. Lightfoot, transferred. F. E. Putney, supervisor at Freeport, Pa., succeeds H. B. Welsh. W. B. Carpenter, supervisor at Reynoldsville, Pa., has been transferred to Earnest, Pa., succeeding W. S. Springer, transferred. E. L. Hoopes has been appointed supervisor at Osceola Mill, Pa., succeeding F. M. Robb, transferred.

CHARLES C. CUNNINGHAM, recently appointed roadmaster of the Chicago, Rock Island & Pacific, with headquarters at Liberal, Kan., was born in 1887 at Washington, Iowa. He gradu-



ated from Yale in 1909, and entered the service of the Rock Island in August, 1909, as a rodman. He was later transitman, and successively assistant engineer at Topeka, Kan., Kansas City, Mo., and Dalhart, Tex. He was appointed roadmaster at Liberal, Kan., on April 26, 1916, vice A. Shumate, who resigned to accept service with another company.

J. D. ALBRIGHT has been appointed acting roadmaster on the Western division of the Duluth, South Shore & Atlantic at Ewen, Mich., with jurisdiction between Nestoria, Mich., and Superior, Wis., succeeding August Mase, resigned. Mr. Albright entered the employ of the Duluth, South Shore & Atlantic as section laborer on February 17, 1892, two years later he was promoted to section foreman and on June 1, 1911, he was appointed roadmaster of the Western division. He resigned this position on May 1, 1915, and was reappointed on April 1, 1916, as noted above.

W. P. ABBOTT has been appointed assistant supervisor on that part of the Ohio division of the Baltimore & Ohio Southwestern, between Madisonville, Ohio and Chillicothe, effective May 1. J. Hewes, Jr. has been appointed assistant supervisor at Chillicothe, Ohio, with jurisdiction between Chillicothe, Ohio, and Portsmouth. D. Hubbard has been appointed assistant supervisor at Athens, Ohio, in charge of track between Hamden, Ohio, and Belpre. C. E. Newhouse has been appointed assistant supervisor at Blanchester, Ohio, with jurisdiction over the line between Blanchester, Ohio and Columbus, including the Hillsboro branch.

PURCHASING

R. O. Woods has been appointed division storekeeper of the Mobile & Ohio, with office at Meridan, Miss., vice M. R. Ducey, resigned to accept service with another company.

SAMUEL WILSON SAYE has been appointed purchasing agent of the Georgia & Florida, with headquarters at Augusta, Ga., succeeding J. H. Conley, assistant auditor. He was born at Athens, Ga., on August 4, 1893. On January 8, 1912, he began railway work as a stenographer on the Southern at Columbia. S. C. The following April he entered the service of the Georgia & Florida as a stenographer in the accounting department, and three months later he became secretary to the general manager. On February 1, 1916, he was appointed commercial agent, with headquarters at Vidalia, Ga., which position he held at the time of his recent appointment as purchasing agent at Augusta of the same road.

OBITUARY

A. E. HANSEN, roadmaster, Atchison, Topeka & San Fe, Topeka, Kan., died on April 19. Mr. Hansen had been a roadmaster on the Santa Fe for a number of years. He had also been prominent in the Roadmasters' and Maintenance of Way Association, being president of that organization several years ago.

HENRY ROHWER, a pioneer engineer of the West, died at St. Louis, Mo., on May 5, at the age of 68 years. He was born in Germany and came to this country in 1869. He held various engineering positions with the Burlington, the Oregon Short Line, the Omaha Belt and other roads. From March 1, 1901, to January 1, 1905, he was chief engineer of the Missouri Pacific. Since that time he was engaged in private practice as consulting engineer.

CHARLES E. WICKHAM, division engineer of the Delaware, Lackawanna & Western at Binghamton, N. Y., died April 16. after a lingering illness. He was born at Southampton, England, on July 21, 1863, and was educated at the State University of Iowa. He entered railway service as a chainman on the Burlington, Cedar Rapids & Northern, in 1884. In 1887 he was appointed office engineer of the Kansas & Colorado, after which he was employed with the Chicago, Rock Island & Pacific, and on the Mexican Southern. He was appointed superintendent of construction of the Peoria Terminal Ry. in 1892, becoming roadmaster of the Chicago, Rock Island & Pacific in 1893 and division engineer of this same road in 1897. On January 1, 1901, he was made general roadmaster in charge of lines east of the Missouri river, from which position he went to that of division engineer of the Delaware, Lackawanna & Western.

CONSTRUCTION NEWS

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THE ANTHONY & NORTHERN will soon commence the construction of a branch north from Larned, Kan., an indefinite distance.

THE ATLANTIC NORTHERN has awarded a contract to Campen & Company to rebuild 20 pile trestle bridges having a total length of about 1,625 lineal feet. Company forces are also at work retieing, ditching and ballasting the road.

THE ATCHISON, TOPEKA & SANTA FE has completed plans for a passenger station to be built at Colorado Springs, Colo. The structure will be a two-story building, 90 ft. by 301 ft., with brick exterior stone trimmings, tile roof and tile interior. It will include a depot, baggage room, lunch room and dining room on the first floor and railroad offices on the second floor. The entire first floor will have tile flooring, except the baggage room, which will have a mastic flooring. The cost is estimated at \$175,000.

The Atchison, Topeka & Santa Fe will spend about \$330,000 on improvements at Las Vegas, New Mex., which will include a 34-stall reinforced concrete roundhouse, a brick power house, 35 ft. by 70 ft., a 600-ton coal storage and service plant, a lavatory building, 24 ft. by 120 ft., a 100-ft. concrete cinder pit and incidental track changes.

The Atchison, Topeka & Santa Fe is making a survey for a branch line from Lubbock, Tex., west for an indefinite distance.

THE ATLANTIC COAST LINE has submitted a proposition to residents of Orangeburg, S. C., to build a new passenger station there at an estimated cost of \$11,000. The railroad also proposes to move the present passenger station to a suitable place for future use as a freight house.

THE BALTIMORE & OHIO will build a new freight house at Bellaire, Ohio. The proposed structure is to be 40 ft. by 160 ft., with a covered platform 16 ft. by 80 ft. and an open platform 16 ft. by 190 ft. The company also plans to build a two-story brick office building, 40 ft. by 40 ft., at this point.

THE BOSTON & ALBANY is planning to build at Worcester, Mass., a new freight house 450 ft. long and 30 ft. wide, which will be used exclusively for outbound freight.

THE CENTRAL OF NEW JERSEY has asked for bids on June 1 for the construction of a new terminal station on Broad street. Newark, N. J. The proposed structure is to be 67 ft. high, 300 ft. wide, including a concourse 166 ft. long, and station and platforms 1,040 ft. in length and of steel frame construction, with brick and terra cotta walls on concrete foundations.

THE CHARLESTON & WESTERN is planning to build a new brick freight station at Anderson, S. C., by company forces.

THE CHICAGO & NORTHWESTERN has received bids for moving, remodeling and constructing additions to the present passenger station at Fond du Lac, Wis. The estimated cost of these improvements with track changes is about \$68,000.

The Chicago & Northwestern and the Chicago, St. Paul, Minneapolis & Omaha have jointly appropriated about \$130,000 for improvements to their shops at Sioux City. The work will include the installation of four 300-hp. boilers, a boiler washing plant for a 38-stall engine house, and the construction of a cinder pit and approach. Part of the above appropriation will be used for the purchase of new tools.

THE CHICAGO. BURLINGTON & QUINCY has awarded to Westinghouse, Church, Kerr & Co., New York, a general contract for the erection of additional shop buildings at West Burlington, Iowa. The work will be done jointly by this company and the Burlington's own forces.

The Chicago, Burlington & Quincy has awarded a contract to the Railroad Water & Coal Handling Company, Chicago, III., for the construction of a water station at Yates City, III., which will involve the laying of 13,000 ft. of 8-in. cast-iron pipe and a 30-h.p. oil engine directly connected to a triplex pump.

THE CHICAGO GREAT WESTERN has completed a survey for a line between Rochester, Minn., and Mantorville, which, if con-

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structed, will save about 25 miles in the distance between Rochester and St. Paul.

THE CHICAGO, INDIANAPOLIS & LOUISVILLE is preparing plans for a stone depot to be built at Monon, Ind., at a cost of from \$15,000 to \$20,000.

THE CHICAGO, MILWAUKEE & ST. PAUL has awarded a contract for ballasting and bank widening between Alamo, S. D., and Aberdeen to the Peter Nelson Company, Minneapolis, Minn.

The Chicago, Milwaukee & St. Paul will build a new passenger and freight station at Kimball, S. D., by company forces at a cost of about \$6,000.

The Chicago, Milwaukee & St. Paul, the Chicago, Burlington & Quincy and the Davenport, Rock Island & Northwestern have jointly agreed to construct a union passenger station, a new freight house and yards, depress the main-line tracks and remove switching tracks from the river front at Davenport, Iowa. Work on the freight house and yards will be begun about July 1, with the prospect of their completion this year. The union depot will be built in 1917, and the subway the following year. The total cost of these improvements has been estimated at \$500,000.

The Chicago, Milwaukee & St. Paul is resurveying its line from Blackfoot Junction, Mont., east, and expects to ask for bids on the work some time in June.

THE CHICAGO, ST. PAUL, MINNEAPOLIS & OMAHA has awarded a contract to A. Guthrie & Co., St. Paul, Minn., to erect an 800-ft. bridge across the Chippewa River at Chippewa Falls, Wis.

The Chicago, St. Paul, Minneapolis & Omaha has awarded a contract to the La Crosse Dredging Company, Minneapolis, Minn., to fill the trestle approaches to its bridge over the Mississippi River at St. Paul, Minn., requiring the deposit of 60,000 cu. yd. of material.

The Chicago, St. Paul, Minneapolis & Omaha has awarded a contract to the George A. Fuller Company, St. Paul, Minn., for the erection of a new office building on the site of the present offices, involving the construction of an eight-story fireproof steel-frame building, 128 ft. by 99 ft. The building will be faced with Bedford stone for the first story and with brick for the other stories, and will cost about \$400,000.

THE DELAWARE & HUDSON has awarded a contract to the C. P. Boland Company, Albany, N. Y., for an extension to its present office building on the Plaza at Albany, N. Y. The structure will be 50 ft. by 184 ft. in area and four stories high, including an attic, and will be built of granite, steel and concrete at an estimated cost of \$260,000.

THE ERIE has awarded a contract to Kidder & McCourt for the grading for a new yard at Akron, requiring the handling of 72,000 cu. yd. of material.

The Erie has received bids for the construction of a roundhouse at County Road on the Jersey meadows, Jersey City, N. J. The structure is to have from 35 to 40 stalls and is to be of frame construction.

THE FLORIDA EAST COAST is constructing division terminal facilities at Buena Vista, Fla., to remove the present facilities from the center of the city of Miami. The work includes the laying of $11\frac{1}{2}$ miles of track, and the erection of a 10-stall roundhouse with an 85-ft. turntable, a small machine shop and other auxiliary division shop buildings. The total cost of the work is estimated at \$200,000. All work is being done by company forces.

THE GREAT NORTHERN contemplates making improvements at Whitefish, Mont., at an estimated cost of \$35,000, which will include the construction of a 15-stall. 116-ft. frame extension to the roundhouse, an extension to the boiler house and cinder pit, and some additional track work.

The Great Northern has awarded a contract for the construction of timber snowsheds on the east slope of the Cascade mountains to the W. J. Hoy Company, St. Paul, Minn., on the west slope to Grant Smith & Company. A contract was also let to Henry & McFee, Seattle, Wash., for concrete sheds on the west slope.

The Great Northern has awardede a contract for the construction of 25 miles of new line from Lambert, Mont., west, to A. Guthrie & Co. THE GULF COAST RAILWAY has awarded a contract to E. B. Duncan, Ocala, Fla., to build 28.5 miles of new line from Venice, Fla., on the Seaboard Air Line southeast to Placida on the Charlotte Harbor & Northern, and work is now under way. The company was organized last year by some of the officers of the Southern Investment Company, Richmond, Va., L. M. Williams, Richmond, being president.

THE GULF, COLORADO & SANTA FE will build a new station at Bay City, Tex., at an estimated cost of \$15,000.

THE HOCKING VALLEY has awarded a contract to Fritz, Rumer, Cooke, Grant & Co., to build a 15-stall brick engine house with wooden roof, at South Parsons avenue, Columbus, Ohio.

THE MICHIGAN CENTRAL has awarded a contract to the Wallbridge-Aldinger Company, Detroit, Mich., for the construction of a roundhouse, an oil house, a small machine shop and a coal chute at Montrose, Ont. The buildings will be of concrete and brick construction.

THE MINNEAPOLIS & ST. LOUIS and the Chicago, Milwaukee & St. Paul will jointly erect a viaduct, about 1,700 ft. long, over the tracks on West Lake street, Minneapolis, Minn.

THE NEW ORLEANS, MOBILE & CHICAGO, W. F. Owen, receiver, has been authorized by Judge Toumlin in the Federal District Court at Mobile, Ala., to start the construction of a 34-mile extension from Middletown, Tenn., north to Jackson, the estimated cost being between \$700,000 and \$800,000.

THE NEW YORK CENTRAL has received bids for the construction of a new passenger station and facilities at Poughkeepsie, N. Y., at an estimated cost of \$250,000.

THE NORFOLK & WESTERN has let a contract to W. W. Boxley & Co., Roanoke, Va., for the construction of 3 miles of second track between Joe, W. Va., and Alnwick. This work will consist of approximately 131,000 cu. yd. of excavation, of which 71,000 cu. yd. is borrow; also from 800 to 1,200 cu. yd. of class "A" masonry.

THE NORTHERN PACIFIC has awarded contracts to A. Guthrie & Co., St. Paul, Minn., for the extension of the Sunnyside branch from Grand View, Wash., 12 miles to Gibbons, and of the Sincoe branch 9 miles to White Swan, Wash.

THE OREGON-WASHINGTON RAILROAD & NAVIGATION COMPANY is receiving bids for the construction of a frame, nine-stall roundhouse with brick exterior at La Grande, Ore. The structure will cost about \$30,000.

THE PENNSYLVANIA LINES are constructing an eastbound running track between Marion, Ohio, and Harvey, a distance of five miles, reducing the grade from 0.5 per cent to 0.3 per cent, and requiring the handling of 50,000 cu. yd. of earth and 5,000 cu. yd. of rock. The grading contract has been awarded to P. T. Clifford & Son, Valparaiso, Ind., and the track work is being done by company forces.

THE PERE MARQUETTE contemplates the construction of an additional freight yard at Flint, Mich., which will contain about seven miles of new track, a coal dock, water station and four-stall engine house, at an estimated cost of \$100,000.

THE PITTSBURGH & LAKE ERIE is double tracking about two miles of its line between Fayette City, Pa., and Newell.

THE SEABOARD AIR LINE and the ATLANTIC COAST LINE will build a joint passenger station of tapestry brick trimmed with Indiana limestone, at Ocala, Fla., with umbrella sheds 250 ft. long along each railway and connected to the main roof of the station.

THE ST. LOUIS & SAN FRANCISCO and the Missouri, Kansas & Texas have jointly let a contract to H. E. McCart, Durant, Okla., to build a brick passenger station with stone trimmings, 122 ft. by 79 ft., at Durant, the estimated cost being \$30,000.

RAILS

THE MAINE CENTRAL has recently placed orders for 7,500 tons of rails.

THE VIRGINIAN has ordered 8,000 tons of rails from the Pennsylvania Steel Company.

THE PERE MARQUETTE has ordered 15,000 tons of rails from the Algoma Steel Corporation.

THE WESTERN MARYLAND has ordered 2,000 tons of rails from the Pennsylvania Steel Company.

THE HAVANA CENTRAL has ordered 5,000 tons of rails from the United States Steel Corporation.

THE CHESAPEAKE & OHIO has ordered 10,000 tons of rails from the Pennsylvania Steel Company.

THE NORFOLK & WESTERN has ordered 18,000 tons of rails from the United States Steel Corporation.

THE NEW YORK, NEW HAVEN & HARTFORD has ordered 20,000 tons of rails from the Bethlehem Steel Company.

THE CINCINNATI, HAMILTON & DAYTON has ordered 5,000 tons of rails from the United States Steel Corporation.

THE ERIE has ordered 25,000 tons of rails from the United States Steel Corporation in addition to orders previously reported.

THE MINNEAPOLIS, ST. PAUL & SAULT STE. MARIE has ordered 14,000 tons of rails for 1917 delivery from the Illinois Steel Company.

THE ANN ARBOR has ordered 1,500 tons of 85-lb. rail from the Lackawanna Steel Company for delivery in May, June and July, 1917.

THE BOSTON & MAINE has ordered 8,000 tons of rails from the Pennsylvania Steel Company and 10,000 tons from other companies.

THE TEXAS & PACIFIC has ordered 14,000 tons of open-hearth rails from the Tennessee Coal, Iron & Railroad Company for 1917 delivery.

THE CHICAGO GREAT WESTERN has ordered 4,000 tons of openhearth rails and 4,450 tons of Bessemer rails from the Illinois Steel Company.

THE CHICAGO & EASTERN ILLINOIS has arranged with the Illinois Steel Company for the delivery of 10.000 tons of 90-lb. rails in the spring of 1917.

THE PHILADELPHIA & READING has divided an order for 25,000 tons of 100-lb. rails for 1917 delivery between the Bethlehem Steel Company, the Carnegie Steel Company, the Lackawanna Steel Company and the Pennsylvania Steel Company.

THE LAKE SUPERIOR & ISHPEMING has ordered 3,500 tons of rails from the Illinois Steel Company. It has also placed orders with the Lackawanna Steel Company for May, 1917, delivery for 3,500 tons of 85-lb. rails, 9,800 pairs of angle bars, 9,800 Abbott joint plates, 1,300 kegs of spikes and 350 kegs of bolts.

STRUCTURAL STEEL

THE WESTERN MARYLAND has ordered 1,200 tons of bridge material from the McClintic-Marshall Company.

THE CHICAGO UNION STATION COMPANY has ordered 148 tons of 1-beams from the Scully Steel & Iron Company.

THE BALTIMORE & OHIO has ordered 600 tons of steel for coal pockets near Baltimore from the Hedden Iron Construction Company.

THE MAINE CENTRAL has divided an order for 550 tons of bridge material between the American Bridge Company and other shops.

THE DULUTH & IRON RANGE has ordered 601 tons of steel from the American Bridge Company for an ore car repair shop at Two Harbors, Minn.

THE MISSOURI PACIFIC has placed orders with the American Bridge Company for 234 tons of steel for three 90-ft. turntables and 432 tons for various bridges.

THE SOUTHERN RAILWAY has ordered 1,750 tons of bridge steel from the American Bridge Company, 500 tons from the Fort Pitt Bridge Works, and 450 tons from L. F. Shoemaker & Co.

THE CHICAGO, MILWAUKEE & ST. PAUL has ordered 108 tons of steel from the Fort Bridge Works for widening the Ashland avenue subway, Chicago, for a third track, and 126 tons of steel from the Jones & Laughlin Steel Company for a bridge over tracks at West Lake street, Minneapolis, Minn.

SUPPLY TRADE NEWS

C. J. BLAIR, president of the Kennicott Company, Chicago, died in that city on May 10. He was born at Michigan City, Ind., on April 6, 1845, and had been active in the commercial life of Chicago, being senior vice-president of the Corn Exchange National Bank, Chicago, for 13 years preceding his death.

THE BARRETT COMPANY, having been convinced that with the workmanship properly safeguarded a Barrett specification roof will last for a minimum period of 20 years without repairs, will henceforth give a twenty-year surety bond guaranty without charge on all Barrett specification roofs of 50 squares or more in the United States and Canada, in towns of 25,000 and over, and in smaller centers where its inspection service is available, provided the roof is laid by a roofing contractor satisfactory to it and in strict accordance with the Barrett specifications dated May 1, 1916, and subject to the inspection and approval of the Barrett Company. This surety bond will be issued by the U. S. Fidelity & Guaranty Company of Baltimore.

THE Q. & C. COMPANY, New York, has issued the following announcement relative to Bonzano rail joint patents: "In answer to numerous inquiries regarding possible infringement of the so-called Thompson patents by several recent designs of Bonzano rail joints, we herewith give notice that after careful investigation and through advice of counsel, we have taken, from the owners of the Thompson-Thompson patents, a license for the exclusive manufacture and sale of Bonzano rail joints with reinforced heads...covered by the Thompson-Thompson patents. In view of the above, our customers need have no further consideration as to any possible infringement on account of the reinforcing of the heads of our Bonzano joints. The Bonzano joints, which include the Thompson features of reinforcement of the head, will hereafter be known as the "Bonzano-Thompson rail joints."

TRADE PUBLICATIONS

BUILDING MATERIALS.—E. M. Long & Sons, Cadiz, Ohio, have issued an attractive 24-page booklet describing their lumber and other products, including O. G. fir gutters used extensively on railway buildings.

WHEELBARROWS.—The Kilbourne and Jacobs Manufacturing Company has issued a 30-page catalog, No. 41, describing its line of steel and wood wheelbarrows, concrete carts, drag and wheel scrapers, dump gars and plows.

CONCRETE POSTS.—The Ohio Post Mold Company, Toledo, Ohio, has issued a 24-page pamphlet describing the uses and advantages of posts made in the Ohio post molds and machines. These posts are of a "T" shape with a rod in each corner.

GASOLENE HOISTS.—The Lidgerwood Manufacturing Company has issued Bulletin No. 16, illustrating and describing its hoists operated by gasolene engines. These hoists are designed for use where electric current is not available, and where coal and water suitable for boiler use are difficult to obtain.

FENCE POSTS.—The National Concrete Machinery Company, Madison, Wis., has issued a 16-page illustrated pamphlet describing the use and manufacture of concrete fence posts for railroads. The National power mixer and fence post machine is described and the forms and reinforcement used and method of manufacture are explained in detail.

TIE TAMPING OUTFITS.—The Ingersoll-Rand Company has issued a bulletin on the use of the pneumatic tie tamper on steam and electric railways. The first 12 pages are devoted to a description of the methods and results obtained with these tie tampers on various roads with numerous illustrations showing exactly how the machines are handled. The remaining 12 pages are devoted to a description of the equipment, including the tie tamper, hose, the two-tool and four-tool gasoline engine compressor cars, the two-tool electric compressor car and miscellaneous equipment.

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class class. Subscription price, including the twelve regular monthly issues of the Railway Maintenance Engineer and the four daily issues of the Railway Age Gazette, published in connection with the annual convention of the American Railway Engineering Association: United States, Canada and Mexico, \$1.00; foreign countries (excepting daily editions), \$2.00.

WE GUARANTEE that of this issue 5,200 copies were printed; that of these 5,200 copies, 4,035 were mailed to regular paid subscribers, 69 were mailed to advertisers, exchanges and correspondents, and 1,069 were provided for new subscribers, copies lost in the mails and office use. The *Railway Maintenance Engineer* has applied for membership in the Audit Bureau of Circulations.

While the great increase in the consumption of gasoline is a matter of common knowledge, few have considered

Economical
Use of
Gasoline

the effect of this increase, as reflected in higher prices, on the cost of railway operation. A brief consideration will lead to a realization of its

very general employment for a wide variety of purposes in railway work. The rapid increase in the adoption of motor cars and the transition from steam to gasoline-operated pumping plants and small power plants are examples of the growing use of this fuel. This has resulted in the demand for it on the railways increasing rapidly and with advancing prices, the total expenditure has increased still more rapidly. It is therefore important that the users of gasoline see that it is employed economically. The present conditions also furnish a strong incentive for the adoption of cheaper oils wherever conditions will permit.

During recent years the large passenger terminal has received much attention from railway men and the public

The Small Passenger Station

in general, to the detriment of the smaller station, although, considering the number of people who use terminals of the two classes, the smaller structure is probably of

equal importance with the larger. Until recently it was the common practice on most roads to build at outlying points, small frame stations, which were of sufficient size for the needs of the companies, but which had little or no claim to attractiveness of appearance. In view of the large amounts expanded to provide terminals of attractive design at the larger cities, this policy has become manifestly inconsistent. A number of roads are now giv-

ing closer attention to the smaller stations, and are designing structures primarily for utilitarian purposes, but also with regard to their attractiveness. As each station presents a problem in itself in design, in the selection of materials and in construction details, increased study and supervision are necessary, but the results fully compen-

Because of the importance of the reclamation of way scrap, we desire to call attention to the contest on this

Reclamation
of Scrap
Materials

sate for this increased attention.

subject which is now being conducted and to solicit the co-operation of students of the problem in order that the greatest amount of valuable information may be brought

out. No field offers greater opportunity in proportion for economy on the average road to-day than the scrap pile. Much material is commonly sent in as scrap which is suitable for further use in its present condition. Other material unfit for further use as it is sent in, can be repaired and reclaimed at small cost, while still other materials which can be considered only as scrap, can be sorted in accordance with the market classifications in order to secure the highest prices. Further opportunities for economics exist in the methods of collecting and handling these large quantities of materials. As already announced, we are conducting a contest on The Reclamation of Maintenance of Way Scrap to include all phases of the problem from the assembling and collection of the material out on the line to its final disposal. Special attention will be given to papers describing methods actually in use and the results secured with detailed descriptions and cost figures. Photographs will also be valuable. Prizes of \$25 and \$15 will be paid for

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the two best papers received, while all others accepted and published will be paid for at our regular space rates. All contributions should be sent to the Editor of the *Railway Maintenance Engineer*, Transportation Building, Chicago, and must be received not later than July 15 to be considered by the judges.

THE "EIGHT-HOUR DAY"

ONE of the biggest and most complicated of the many problems now facing the railways is that created by the demand of the organizations of trainmen and enginemen for an eight-hour basic day and time and onehalf for overtime in all train and yard service, except passenger service. It is estimated by the managers that to accede to the proposals would increase their payrolls by about \$100,000,000 a year. Such an important question as is raised by a demand of this magnitude, backed by a threat to strike unless the railroads comply, is naturally of great interest to all railroad men.

If the railroads should have to accede to the demands in the form in which they have been presented, the effect would be felt with especial force in work train service on construction and maintenance work, where the hours of employment of the train crews are necessarily long, but where their work is comparatively easy. Actual figures from the payroll of a large western road show that to pay the present day's wage for eight hours' work and a rate 50 per cent higher for the additional hours would increase the earnings of the work train crews by nearly 50 per cent. And this is in spite of the fact that this class of service is not subject to most of the conditions regarding which the brotherhoods complain in attempting to justify their demands, and that work train assignments are usually eagerly sought by the train employees in exercising their seniority rights.

As the expense of work trains is a very important item in both construction and maintenance work, an increase of nearly 50 per cent in the wages of the crews would add very materially to the expense of the upkeep and improvement of a railroad. The facts that it would be extremely impracticable to reduce the hours in work train service to eight hours, and that the employees now choose these runs because of the high pay that goes with the long hours, is one of the best indications that the purpose of the demands is to increase wages rather than to establish an eight-hour day.

The amount of the increases asked appears especially unreasonable when the present earnings of the train crews are contrasted with those of the other men concerned in maintenance work. The average wage of all the train employees, about \$1,253 per year, not only shows an unjust discrepancy as compared with the average pay of a section foreman, about \$765 a year, but even as compared with the technically trained engineers who are in charge of the work. The average locomotive engineer earns about \$1,772 a year; firemen, \$1,037; conductors, \$1,533 and other trainmen, \$1,023 a year. In work train service the wages considerably exceed these averages.

The controversy created by the demands of the trainmen's organizations is not one that concerns merely the men directly involved and the managements. To grant any large increase in wages to the class of railroad employees that have for many years been most successful in obtaining higher pay would render it even more difficult for the railroads to improve the condition of their other employes. The controversy is therefore of especial significance to the 80 per cent of railway men, most of whom receive considerably less pay than the train employees.

PROGRESS IN WATER SOFTENING

"HE present situation regarding water treating plants is unusual. Few additional plants have been built in recent years, while a number of old plants have been abandoned. When this state of affairs was investigated two years ago by the water service committee of the American Railway Engineering Association, nothing was learned that would indicate any defect in the basic principles of water treatment. There was ample evidence, however, that the seeming failure of the water softeners had resulted almost entirely from neglect on the part of the railroads to provide a form of organization which would insure the proper operation and maintenance of the plants as well as the intelligent use of the treated water. A few cases were encountered where the facilities were of poor design or of inadequate capacity or where the installation was apparently ill-advised.

A common source of trouble is the failure to provide an adequate check on the treatment by a competent chemist. It cannot be expected that the pumpers who commonly operate these plants will fully appreciate the object of water treatment or that they will always follow instructions conscientiously. Difficulties have also arisen from divided authority. There are cases where the water softeners are operated by the mechanical department and maintained by the bridge and building forces, thus becoming a sort of step-child in which neither department takes any particular interest.

A refreshing contrast to such conditions is seen in the results recently obtained on the Missouri Pacific, described elsewhere in this issue, with water-softening plants built some 10 years ago. The reasons for success in this case are obvious. The plants were installed under the direction of a superintendent of water service whose sole interest lay in the production of an adequate supply of boiler water of good quality. Having obtained the necessary appropriation for water-softening plants, he and his department were responsible for an adequate return on the investment. The operation of the plants was not, as in some cases, intrusted to the tender mercies of some other officer, who might or might not be in sympathy with water treatment. It is not to be inferred that this is an isolated case of successful water treatment, for similar measures have produced good results on other roads. While reports like the one appearing in this issue are rather rare at this time, repeated demonstrations of the advantages to be secured were given considerable publicity some years ago. At the present time many roads are suffering from the effects of bad boiler waters where it would seem that a thorough study of the conditions should demonstrate the justifiability of a considerable investment in water-treating plants. For the benefit of those who must make the necessary investigations, it is to be hoped that more new data will be made available showing results secured with existing installations.

Few roads are giving water service the attention it deserves. As a result, uneconomical practices have been allowed to develop. This condition has risen from lack of concentrated attention being given to this subject. If the maintenance of bridges was left to a roadmaster as incidental to his main duty of supervising the track as the water service on most roads is left to the supervisor of bridges, similar shortcomings would soon develop here.

The elimination of encrusting matter from the water is not the only means of economy, for while the quality of the water on the Missouri Pacific was greatly improved, the cost of pumping it was reduced at the same time. A recent comparison of the cost of providing water on the basis of 1,000 ton miles, on nine western roads, showed a variation from 31-3 cents to 7 cents, the lowest figure being for a road with a well-organized water service department operating in the same general territory as the road with the highest figure. Local conditions alone do not account for the fact that the water cost twice as much on one road as on the other. The installation of economical pumping units, the use of the most economical fuels and the proper supervision of pumpers all enter into these costs. A third opportunity for economy arises from the maintenance of water stations. While the amount spent at any individual outlying station may be relatively small, when a railway system, as a whole, is considered, a large amount of money is expended yearly in the maintenance of these stations. With the cost of operation and maintenance of the water stations on the average railroad of this country amounting to almost \$100 per mile of line annually, it would seem evident that the average railway could well afford to organize a special department with direct supervision over this service.

THE USE OF WOOD

N comparison with wood used for building purposes, steel is a comparatively young structural material. The wonderful development of its use in bridges and buildings, fostered during an age of scientific endeavor, has resulted quite naturally in delegating the arrangement of the structural steel pieces to form columns, girders and trusses to skilled designers thoroughly trained in the mathematics of design. This accounts also for the strict application of the results of tests showing the physical qualities of the material. This policy is carried out even to the most careful scientific study of the minutest details of the work. With wood the situation is entirely different. The carpenters' trade is as old as civilization, and practices developed through the ages have been passed down to the present with little change. It is true that in the design of most trusses, and of pile and timber trestles and other large timber structures of a like character, thorough use is made of the best information available regarding the strength of timber, but in minor structures and almost entirely in building construction the smaller details are left to the carpenter. While trade knowledge does take some account of stress action, it is frequently wide of the mark, for instance, in bearing across the grain. The selection and use of wood has been the subject of research by various laboratories throughout the country for some time, and much valuable information is being disseminated not only as to the strength of wood, and the methods of preservation, but also regarding the general application of wood to the various uses in a manner that will insure the longest life. The importance of ventilation, drainage and security against infection from decayed pieces has been given special attention, and evidences of the rapid deterioration of timber structures from improper practices in this respect are frequently brought to light. As an example of the movement for better education along these lines attention may be called to the course of lectures recently announced by the University of Wisconsin to be given by the staff of the Forest Products Laboratory. Railroads will continue for many years to use timber exclusively for many purposes, including buildings, platforms, signs, gates, etc., for timber has certain qualities which make it preferable for many uses over any other material, irrespective of price, but with the increasing cost of lumber, it is essential to secure full returns for the money expended in its purchase and it becomes more and more necessary that its use be subjected to scientific supervision. When the knowledge of timber becomes universal, many of the present destructive practices will disappear.

LETTERS TO THE EDITOR

Haileyville, Okla.

To the Editor: In spite of all that has been written and said regarding the importance of maintenance of way work, it is still evident that the transportation department, on which the maintenance of way department must rely for much assistance in the handling of materials, frequently fails to give it the support required. When a roadmaster desires a work train he calls upon the superintendent, who, if he approves, may give him the train with a small engine. If he does not think that a train is necessary the superintendent will probably tell the roadmaster to ask the chief despatcher to arrange for a passing train to unload the material. At the same time the chief despatcher will probably hold instructions from the superintendent that local trains, or those moving in the direction of prevailing tonnage, must not be used for this work. After considerable delay the chief despatcher will probably be able to arrange to do the work while the section gangs will have lost enough time meeting other trains to have more than paid for the cost of a special work train.

Frequently when a train is promised it will be arranged for the local crew to do the work on Sunday, and the roadmaster is asked to have his forces lined up ready to begin work at seven o'clock. In the meantime the local train crew is delayed in reaching its terminal on Saturday and its rest period does not expire until late Sunday forenoon. When ready the train will probably be further delayed in getting out of the yard by the necessity of allowing passenger or other trains to pass. As a result it does not get out on the line ready to distribute the material until noon. Late in the afternoon the conductor advises the despatcher that he has unloaded a few cars of material and has a considerable number remaining. He will then probably be instructed to remain as long as the men will work and unload as many more cars as possible. Without previous preparation for night work insufficient lanterns are available, the work is delayed and possibly injuries are incurred. In any event, only about one-third of a day's work is done at a cost three times that under normal conditions.

Closer co-operation between the transportation and the maintenance of way departments will eliminate such conditions. It is not reasonable for the transportation department to expect a roadmaster to require his men to work on Sunday (frequently at time and one-half rates), when the work can be arranged more conveniently during the week. There is no economy in postponing work from day to day for a better opportunity. Slow orders are frequently maintained over bridges or soft spots in track for weeks at a time because of delay in unloading the required materials. The transportation department maintains correctly that all trains should be run with full tonnage and that such trains earn the revenue. This is true, but it is equally important to keep the cost of the maintenance of way down, as the money saved in both departments goes into the same fund. Train despatchers can assist materially in the handling of material by watching their trains closely and knowing where supplies are to be unloaded. They can then arrange to do the work economically without interfering materially with the handling of their traffic. J. L. Coss.

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RAIL EXPANSION AND BREAKAGE

COLORADO CITY, COLO.

To the Editor:

The writer has for a number of years battled with the track problem on one of the most difficult mountain railroads of the country, made up principally of 3 and 4 per cent grades and 16-deg. curves. It has been his observation that the failure to maintain proper allowance for the expansion and contraction of each individual rail is responsible for a large percentage of the rail breakages. It is a well known fact that a curve, no matter how light, will, in a measure, act as an anchor against the running or dragging of the rails and that the heavier the curvature is the more solid is the anchor. For illustration: we have one mile of tangent track between two 16-deg. curves located on a grade of 3 per cent. A close inspection of the track discloses the fact that, for about one-half of the distance, starting with the curve at the lower point, the expansion is closed, while the joints for the other half are open as much as the conditions will permit. This is evidence that heavy trains descending the grade with the brakes constantly in use, drag the rails against the anchor formed by the curve at the lower point. The curve at the higher point acts also as an anchor against the longitudinal movement of the rails thereon.

Here we have two equally dangerous conditions. During the summer months the hot sun strikes this track and the rails must expand, while in the winter they must contract. The great difference in temperature between the night and the day in this locality, as in many others, causes rails to expand and contract to a considerable extent each 24 hr. With these conditions the stress in the rail during the heat of the day, with no allowance for expansion, is enormous, often shoving the track out on the curves and requiring the removal of a portion of a rail before the curve can again be lined. However, allowing that the track on the curve remains in place, imagine the stress created in it by the expansion of the metal with no allowance made for it. Then picture the movement of this rail under a large locomotive hauling a train of heavily loaded cars. Is it any wonder an occasional rail gives way under this strain?

We have a similar condition over the other one-half of this track. In severely cold weather the expansion is open; each individual rail is tugging at the joint; there is no allowance for contraction and we find the same stress here as outlined above—only in one instance it is created by the expansion, while in the other it is caused by contraction that greatly reduces our rail efficiency. It has been our observation that the rail breakage, of which we have considerable, usually occurs in the summer months when expansion has closed the joints and during the winter months when rail joints are open sufficiently to prevent further contraction.

Those who were in charge of track maintenance prior to the advent of the power brake for train control will readily recall that in those days accidents chargeable to rail breakage were less frequent than to-day. To be sure, there are many who are all too ready to place the responsibility on the rail manufacturer. We frequently hear the remark, "If we could only get the quality of steel that we furnished in years gone by we would have less trouble." In our opinion, this is a great injustice to the present manufacturers of steel rails. Prior to the advent of the power brake the running or dragging of rails to any considerable extent was unknown, for the very good reason that the old method of stopping a train by the use of hand brakes was very much slower and a sufficient number of brakes could not be applied at one time to cause the dragging of the rail, thereby destroying the allowance for expansion and contraction.

When we devise means whereby we can maintain this allowance, and then exercise proper care in the laying of the rail so that each individual rail will act separately, expanding and contracting within itself, we will have solved the problem of 100 per cent track efficiency by eliminating the greater per cent of the rail breakage, the churning of an occasional cross tie in the ballast, thereby causing an uneven track surface, and the kinking of an individual rail or the throwing out of line of an entire section of track. M. L. PHELPS,

Superintendent, Colorado Midland.

NEW BOOKS

Proceedings of the American Wood-Preservers' Association, 432 pages, 6 in, by 9 in. Illustrated. Bound in cloth. Published by the American Wood-Preservers' Association, F. J. Angier, secretary-treasurer, Mt. Royal Station, Baltimore, Md. Price, cloth, \$3.50; paper, \$2.50.

This is a complete account of the twelfth annual convention of the American Wood Preservers' Association, which was held in Chicago January 18-20, 1916. A most interesting and valuable feature of this book is the statistical section which gives detailed data as to the consumption of wood preservatives and the amount of timber treated, itemized as to kind, uses and territorial distribution. It also gives a list of the timber treating plants in operation, a list of patents referring to wood preservation and an extensive bibliography of wood boring crustaceans. Extensive records are also given of the service of railway cross-ties and wood block flooring.

Modern Framed Structures. By J. B. Johnson, C. W. Bryan and F. E. Turneaure. Part Three, Design, rewritten by F. E. Turneaure, dean of the College of Engineering, University of Wisconsin, and W. S. Kinne, associate professor of structural engineering, University of Wisconsin. 486 pages. Illustrated, 6 in. by 9 in. Bound in cloth. Published by John Wiley & Sons, New York. Price \$4.00.

This is the third of a series of three volumes constituting a complete rewriting of the well-known "Modern Framed Structures," published in 1893. Volume One of the new edition has the title, "Simple Structures," and vol-ume Two, "Statistically Indeterminate Structures and Secondary Stresses." This volume is a revision of those chapters of the original book devoted to the subject of detailed design and unit stresses, but contains much material that was not given in the earlier edition. There is no better measure of the progress of bridge design in the last 20 years than that to be obtained by a careful comparison of this book with the original edition in the treatment of secondary stresses, impact, provision for future loading, etc. Although there is no actual physical sub-division in the book, it is in reality composed of two distinct parts. One is an analytical exposition, comprising the several chapters on stresses, and those on riveted joints, plate girder bridges and truss bridges. The other part is a manual for the student and designer and consists of the chapters containing complete outlines of the design of a plate girder bridge, pin-connected and riveted truss spans, a highway bridge and a roof truss. An insert plate containing a drawing of the structure under consideration accompanies each one of these chapters. Forty-six pages of the book are devoted to appendices. Appendix A contains the specifications for steel railway bridges of the American Railway Engineering Association, Appendix B some tables of detailing information, and Appendix C a treatment of the subject of bending in planes at oblique angles with the principal axes of the structural members.

SEASONS WORK SUMMARIZED

"Just a little sunshine, hel-av-alot of rain, More than 40 washouts; winter time again."



Boiler Scale from Untreated Water

URING 1915, 604,470,000 gal. of water were treated by softening plants on the Missouri Pacific, removing from this water 1,816,837 lb. of scale-forming solids. There are 33 water-treating plants in operation on the main and branch lines between St. Louis, Mo., and Pueblo, Colo., which have been in service from 5 to 10 years, and represent a total investment of \$70,450. On the basis of a saving of 7 cents per pound for incrusting matter kept from entering the engine boilers, as outlined by the water service committee of the American Railway Engineering Association in 1914, the total saving to the railway from the removal of this scaling material amounted to \$127,171. From this must be deducted \$26,717 for the cost of treatment, including additional labor, chemicals, maintenance, and 10 per cent to cover interest and depreciation in the treating facilities, leaving a net saving of \$100,454.

In arriving at the figure of 7 cents per pound for incrusting matter removed, the committee realized that the benefits derived from water treatment are numerous, but usually of an intangible nature. However, values were placed on four of them—loss of fuel resulting from the insulating effect of the scale, renewal of flues, repair work on flues and boilers in the roundhouse, and the loss of engine time during repairs. On account of its intangible nature and the difference in the relation on the various districts, the reduction of engine failures was not considered in determining the above figure. It has been found that the average cost per engine failure, exclusive of labor and material for repairs, amounts to \$17, and on one division the engine failures resulting from boiler troubles were cut down over 1,000 per year by the treatment of the water, thereby giving a saving in this one item alone of \$17,000. From this it is seen that 7 cents is very conservative.

The accompanying table shows the character and source of supply, the amount of water treated, the amount of incrustants removed, the cost of plant, and the cost of operaion of the 33 plants during the year 1915. The amount of scale removed was derived by checking the raw water hardness against the incrusting solids still remaining in the water after treatment.

Of the 33 plants on the Missouri Pacific, 16 are of the intermittent, and 17 of the continuous type of various

designs. The majority were installed by company forces under the supervision of the superintendent of water service, and each one was designed to fit the individual station with a view to providing for the maximum use of the existing facilities. Material changes have been necessary in some of the first plants installed, but all have paid for themselves many times over, and after several years of service are still yielding 142.5 per cent on the investment.

Many of the stations were equipped for softening the water at a remarkably small expense. Intermittent plants were provided by placing a second tank beside the old one and equipping each with air-agitating pipes, each serving alternately as a storage and a treating tank. Where penstocks are used, the pumper manipulates the valves into the discharge line so that the proper tank is connected at all times. Where engines take water direct from the tank, each one is equipped with a spout, the operator placing a white flag on the tank from which water is to be taken.

The most inexpensive plant is built inside a roadside tank and consists of a shallow box placed under the roof of the tank to act as a mixing basin for the chemicals and water. The mixture then flows down through a large discharge pipe to the bottom of a small inside tank about 10 or 12 ft. in diameter, from which it is discharged at the top through an 18-in. excelsior filter into the tank proper, which serves as a storage compartment. At small stations where the rate of pumping does not exceed 4,000 or 5,000 gal. per hour, this plant has proven very successful and economical, but where the rate of upward flow of the water requires it to pass the filter in less than three hours, there is a strong tendency for the sludge to be carried over, resulting in milky water, which induces foaming. The chemicals are put in with a small simple displacement plunger pump and the mixture is regulated by the chemist's instructions of so many inches from the chemical vat per foot of water in the storage tank.

A continuous plant for larger capacities has given very good service. In this case the chemicals and water mix in a small box at the top of the tank, and because of the large volume of water going through a small space very thorough agitation is secured. The mixture then goes down through an inside steel tube 6 ft. in 197
diameter, which quiets all eddies and comes up in an outside storage tank with no filter. By proper treatment of the water a good, clear effluent is obtained at the height of 18 ft. in a tank 30 ft. in diameter, pumping at the rate of 25,000 gal. per hour. The amount of chemicals is regulated and supplied by a small plunger pump, as in the other style of plant.

The water-treating plants are operated by pumpmen under the supervision of the division water service fore-

Station	Source of Supply	Rew Cater Bardness in Grams Per Gal.	Annual Consumption fn Gallons	Pounds of Scale Removed	Original Cost of Treating Facilities	Total Additional Cost for Treatment	Total Saving
Auburn, Sob.	z ell	30	28,867,950	\$6,330	\$ 7,500	\$ 2,156	\$ 5,973
Berlin, Seb.	Tell	28	3,170,400	10,463	1,500	243	732
Brownell, Ean.	3e11	12.5	15,990,000	23,965	750	296	1,679
Bushton, Kan.	3011	16.0	11,640,755	20,370	750	234	1,426
Caney, Man.	Creek	12 - 28	3,648,000	7,276	1,500	424	509
Cedarvale, Man.	Creek	12 - 18	3,316,600	4,975	750	295	348
Concordia, Kan.	Well	\$5.0	10,164,300	40,738	2,300	645	2,852
Downs, Zan.	¥011	16.0	11,137,000	16,707	6,500	824	1,170
Bads, Colo.	W 11	23.0	8,470,000	15,246	2,000	385	1,067
Greenleaf, Xan.	Tell	24 - 40	10,593,387	37,076	5,000	801	2,596
Gypoum City,Zan.	Creek	12 - 40	12,194,000	36,582	3,000	686	2,562
Haswell, Colo.	Tell	27.0	15,270,000	46,445	000, ۲	560	3, 261
Herington, Kan.	Creek	20 - 65	8,149,000	40,745	3,000	366	2,852
Solsington, Ian.	2011	16 - 18	61,940,000	123,880	5,000	1,236	8,672
Holton, Kan.	1011	36.0	3,318,030	14,931	2,000	448	1,045
Jamestown, Ean.	3011	18 - 22	7,245,280	14,490	750	145	1,014
La Flotte, Mab.	Creek	10 - 19	13,655,000	31,406	750	207	2,198
Le Noy, Kan.	Creek	10 - 20	18,027,000	27,040	3,000	620	1,095
Lenora, Kan.	Tell	20.0	2,746,000	8,492	360	102	384
Marquette, Esn.	Tell	18 - 30	\$1,581,450	64,744	750	567	4,632
Oak Kills, Kan.	7011	27.5	5,977,500	13,150	1,600	393	921
Olcott, Kan.	5011	18.0	1,963,000	3,926	800	153	275
Ordway, Colo.	Reservoir	25 - 45	18,167,000	90,835	3,000	1,216	6,368
Tasblo, Colo.	7011	18 - 30	31,800,000	95,400	2,500	942	6,678
Roper, Zan.	Creek	10 - 18	9,490,800	14,256	\$00	227	996
Scott City, Kan.	Tell	11.6	19,855,000	19,855	2,000	580	1,390
Sedalia, Mo.	Well	18.0	18,250,000	36,500	1,500	234	2,556
Seneca, Kan.	Tell	22.0	5,098,800	13,257	2,000	409	928
Union, Nob.	Creek	6 - 18	21,405,000	21,405	z,000	50 0	1,498
Geoping Later, Seb.	Creek	6 - 18	8,376,400	8,376	2,000	374	686
Fichits, Ean.	8011	50.0	\$6,158,000	\$30,790	750	3,237	23,155
Tinfield, Zan.	Creek	12 - 25	4,501,500	300,6	1,500	597	630
Kansas City, No.	City Tater	35.0 8 - 22	187,310,000	492,105	10,000	6,42]	34,447
	TOTALS		604,468,087	1,816,837	\$70,450	*26 ,717	\$127,171

CONDITIONS AT THE TREATING PLANTS

man. The treatment is regulated by a chemist stationed at Kansas City, the most central location. Samples of both the raw and treated water are sent to him from each plant twice a week. Formulæ are changed and any failures are investigated by him, and he is directly responsible for the results secured. Any corrections or changes found necessary are made by the division forces. Reports of the semi-weekly tests are furnished the general and division offices. A content of not more than 6 grains of incrusting solids per gallon in the treated water has been made a standard and any failure to meet this requires an investigation and explanation.

The treatment in general is gaged by the direct effect on the locomotive boilers. During his inspection trips the chemist consults the master mechanic, foremen and head boilermakers at the engine terminals as to the results obtained and checks leaky failures through daily reports. For many points where a softening plant will be located eventually on account of the hardness of the water, the scaling effect is overcome to a large extent by over-treatment at the nearest adjacent treating plant. Tests of the water taken from engine boilers on the various districts are frequently made and the treatment is adjusted as far as possible to give an excess of caustic alkalinity from sodium hydrate in the boilers at all times. Where it has been impossible to do this with the present treating facilities, excellent success has been obtained by the introduction of soda ash direct into the engine boilers through the washout holes after each washout, in amounts determined by the chemist. On account of the large amount of sludge and mud formed in the boilers, foaming conditions result, but this has been kept at a minimum and no serious trouble has been experienced. An anti-foaming compound prepared by the company chemist is used to take care of this feature. Before soda ash was used in this manner the engine failures on one division from boiler troubles were 19.1 per 100,000 engine miles, but they were reduced to 9.1 in 1915, when the soda ash treatment was in effect. Only five failures due to foaming occurred during the same year, a lack of compound being responsible for three of the five. Records show that continuous improvement is being made with the increased familiarity in handling the changed conditions.

From the figures shown it is not difficult to determine the advantages secured. The life of flues has been increased from 50 to 300 per cent. Engine failures on one division have been decreased from 1,435 in 1910 to 202 in 1915, resulting almost entirely from the decrease in boiler failures in consequence of the use of soda ash and treated water. On the same division the boilermaker force has been reduced from 17 to 7 at the terminal roundhouse, a saving of \$15,000 per year in this item alone.

At the Sedalia, Mo., power plant, where the water is treated for five Babcock and Wilcox double-deck water tube boilers of 275 hp. each, 715 of the 840 four-inch tubes have been in continuous service for the past eleven years on treated water. On account of the shortage of boiler capacity and the unavoidable heavy duty, there has been insufficient time to shut down these boilers for washing out and two of them ran for five years between washouts, at the end of which time the scale on the tubes was less than 1-16 in. thick. With the use of the raw water, tube failures were frequent and the scale heavy.

The photographs at the head of this article show some samples of boiler scale, illustrating the difference between treated and untreated water. The one at the left shows a piece of scale $1\frac{1}{2}$ in. thick, taken from a front flue sheet brace after 10 months' service. The one in the center shows a sample of sulphate scale $\frac{1}{4}$ in. thick, which put a boiler out of commission after three months' service. The one at the right shows a specimen of scale



SCALE FROM TREATED WATER

entirely clogging up the space between boiler flues after 8 months' service. The other photograph shows small fragments taken from locomotive boiler tubes after two years' service on the same district after the installation of treating plants and use of treated water. The pieces are less than 1-16 in. thick.

Over 5,000,000 telegrams and 3,000,000 letters are transmitted by the railways annually in tracing freight, involving an expense to the roads of over \$100,000.

SAWING BATTERED RELAYING RAIL

A Discussion of the Advisability of This Practice and a Description of a Mill Recently Completed

THE sawing of rail released from main tracks to remove the battered ends and thereby improve its riding qualities, before relaying it in secondary lines, is practiced on a number of roads. On others it is not considered practical. For this reason we present below a discussion of this practice as worked out on a road which has long followed this practice and also a description of a mill recently completed on a western road.

THE RECLAMATION OF OLD RAILS

By John Reinehr

Foreman of Rail Mill, Chicago, Milwaukee & St. Paul, Savanna, Ill.

The value of scrap relative to that of serviceable second-hand rail is the determining factor in deciding whether old rails are worth reclaiming. It is fair to assume that the value of second-hand serviceable rail removed from the track is at least two-thirds that of new rail (assuming an average for all rail replaced by new No road wants to sell serviceable rails as scrap, and all of them do reuse selected second-hand rails in patchwork or in the relaying of branches without reclaiming other than sorting. This is likely to be more profitable than selling the second-hand rails, but without straightening and sawing off the ends of battered rails, or those with worn fishing, results in the track are not satisfactory, and the second or third service life is materially reduced.

It is a safe assumption that during any service period, 10 per cent of the rails become in such condition that they cannot be relaid without sawing, or cannot be sold for relayers, owing to badly battered or broken ends, or worn fishing. Without means for reclaiming, such rails would have to be sold as scrap.

Assume a case of the relaying of 100 miles of 75-lb. rail:

Total rails recovered	11,800 tons
Rails fit for relaying	10,620 tons
Rails fit only for scrap without sawing	1,180 tons



INTERIOR VIEW OF NEW CHICAGO & EASTERN ILLINOIS RAIL MILL

and second-hand rail on a large system annually), or approximately \$21 per ton.

While scrap value is at present at a fair figure, for a number of years prior to August, 1915, it did not average above \$12 per ton, and whatever rails have been reclaimed from scrap through means of conservation and have been made serviceable, have gained in value the difference between \$12 and \$21 per ton.

^{*}Presented before the convention of the Railway Storekeepers' Association, Detroit, Mich., May 15-17, 1916.

Scrap (7 per cent), 83 tons at \$12
Serviceable (93 per cent), 1,097 tons at \$21 23,03
Total value recovered\$24,03
Value of 1,180 tons of scrap at \$12 13,160
Gross gain\$10,873
Less the cost of straightening, sawing, drilling and
reloading the entire 11,800 tons at \$0.70 per ton 8260
Net demonstrable profit from the whole operation .\$ 2.61.

Cost of sawing 1,180 tons at \$0.70\$ 826

Rails recovered from 1,180 tons sawed :



There is an additional value in rails sawed over those relayed without sawing in that they make better track, more permanent joints and will wear materially longer, but there are no data available from which this value could be estimated or demonstrated in dollars and cents.

The foregoing is a fair demonstration of the value of reclaiming rails. Because of the great difference between the value of scrap and serviceable rails, the salvage is very large, and a small recovery in tonnage compensates for a good deal of handling.

A considerable portion of the sawed rails, depending upon local conditions, when properly graded, sorted, and equipped with well-fitting joints, will make as good track as new rails of equal length and are fit to lay anywhere within their section limits. The poorer grades can be used on branch lines and side tracks. The ultimate recovery from the redistribution will, of course, be scrap and must be sold. The probable effect of dumping second-hand rails on the market in large quantities, either as scrap or relayers, upon the price of new, second-hand, or scrap rails is a factor to be considered.

The most economical means for conserving the rails on a system to the fullest extent is to have a central point for storing and handling, or, in the case of a great distance between extreme terminals, several points to minimize the transportation cost. This central point should have sufficient storage space and be provided with tracks, track scales, skidways, overhead runways on which are mounted hoists (either pneumatic or electric), and a 25ton locomotive crane for yard service, for use in unloading, sorting, piling and reloading rails. It should be equipped with a plant consisting of a rail straightening machine, a friction saw, drill presses and suitable skidways and rollers.

To secure the greatest economy, sufficient storage space, tracks, and mechanical handling facilities are essential to permit sorting on cars, so that material may be permanently placed for storage, re-shipment, or sawing as desired, directly off the cars on which it is received. The rails requiring sawing should go into the plant, and, with a continuous forward movement, should be straightened, classified, sawed, drilled and put in the stock piles for which they are intended, ready for shipment on requisition.

Proper classifying and sorting are of much value in getting good track service out of sawed rails. In the plant under the writer's jurisdiction 85-lb. rails and heavier are sorted into six different grades—main track rail, No. 1 second quality rail, second quality rail, No. 1 side track rail, side track rail and curve-worn main track rail. Sections under 85 lb. are graded—main track rail, second quality rail and side track rail.

On all main track the rails are sorted and piled in accordance with a gage number obtained by calipering the depth or thickness of the rail head. The rails piled together are of nearly uniform thickness of head and make good riding track. The main track rails are of practically full section and free from other than ordinary surface wear or distortion. The second quality rails are as substantial and safe as are the main track rails, but are not of such uniform and even surface, as they may be slightly curve worn, or overflowed, or of slightly uneven surface. The side track rails are badly worn or overflowed, the No. 1 being the least worn or overflowed. The curve-worn main track rails are outside curve rails worn not to exceed 7/16 in. at the top. The gage is applied to them and they are numbered and piled, each number by itself, and so shipped on requisition. They are used on branch line main tracks and make a good substitute for frictionless rail on the inside of curves.

In connection with the plant, it is essential to have

facilities for handling and sorting joint fastenings and tie plates. While the greater portion of the second-hand fastenings recovered at this time is of very inferior quality, judicious sorting will produce many joints in firstclass condition, and enough somewhat inferior joints to satisfy all demands for all minor purposes, as on side tracks. Full joint fastenings for all rails furnished from this plant should accompany the rails except on large orders for main track rail, where new joint fastenings are to be applied, in which case it is probably economical to furnish the joints direct from the mill, to the point where rails are to be laid.

Second-hand tie plates recovered from track should be handled at this plant. They should be sorted for rail section and condition and be properly piled to permit ready checking of the stock. A suitable punch and shears will permit the reclaiming of the plates from obsolete stock, or their repunching for other rails than those they were originally intended for. A drop hammer operated by compressed air, mounted over a suitable anvil and die, will permit the rapid straightening of tie plates bent in service.

A PLANT FOR SAWING RELAY RAIL

By W. H. HAUSER

Mechanical Engineer, Chicago & Eastern Illinois

The sawing of relay rail by the hot or friction saw is by no means a new operation. Work of this kind was performed in past years when wrought iron rail was used and when the angle bar bolt holes could be punched with the standard heavy-duty punch. Plants for sawing rail, however, are not so numerous but that an explanation of the work performed and an explanation of the results obtained may be of interest to men in maintenance of way service.

The Chicago & Eastern Illinois has just completed a very compact and complete plant at Danville, Ill., for the sawing of relay rail. Rail taken up and intended for re-



UNSAWED AND SAWED RAILS

lay purposes is shipped to this plant, where bent or twisted rail is straightened by a hydraulic press, worn or battered ends are sawed off, new angle bar holes are drilled and the reworked rails are reloaded and shipped to the division on which they are to be relaid or are placed in the storage yard.

The two accompanying photographs show the difference in the results obtained from cut and uncut relay

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rail. These photographs are made from the short ends of rails cut at the plant. The first photograph shows several groups of battered ends singly and matched together as would probably be the case were the old rail relaid as it came from the track. Some sorting would be possible, but the best that could be expected would be battered, chipped or splintered ends, poor joints, fins on the ends, elongated bolt holes and irregularity in rail connections. Such rail if relaid without being sawed would be difficult to maintain and with the best of maintenance would hardly give good results in service. The second photograph shows these rails reversed; that is, located over the track. The rails are skidded from the tracks onto a 24-in. roller conveyor in the building. They are passed through a hydraulic press and straightened of all kinks or bends. From the conveyor the rails are skidded to a storage rack and from this rack to the saw table.

The operations necessary in the sawing are controlled by one man standing back of, and to the left of the saw. By means of a simple system of levers and with air clamps and cylinders and a belt-driven roller rail feed he moves the rails to position. Hand-operated stops, located on each side of the saw, are provided to regulate



FLOOR PLAN OF THE DANVILLE RAIL MILL

bringing the sawed ends together. The difference is very apparent.

In sawing a varying amount of fin is left on the sawed end of the rail, which is chipped off by men equipped with light air hammers, who also clean the head of the rail of any bent or rough pieces which might interfere with the application of angle bars.

After leaving the drill presses the rail is inspected and graded by means of a gage which measures the wear to 1-32 in. This gage is slipped over the head of a rail and the wear observed. Rails showing 1-32 in. of wear are marked one, those showing 2-32 in. are marked two, and so on. A gage is provided for each weight of rail.

After grading, the rail is moved out of the building by means of a roller conveyor and loaded on flat cars for shipment, or placed in the storage yard. The storage yard is provided with an overhead air hoist for placing the rails in the proper piles, according to grade. A layout of the plant and yard is shown in the accompanying drawing.

The rails are delivered to the plant on flat cars and are unloaded and placed on the receiving tracks, accommodating 400 to 500 rails, by means of a double air hoist the length of the cut-off. When in proper position the rail is clamped to the table swung against the saw, and the cut made. The table is returned to position, the rail released from the clamp and moved along the table to the proper position for the second cut and the operation repeated. The rail is then skidded off the saw table to the drill press where the bolt holes are drilled. It has been found advisable to drill one end of the rails at a time.

The output of the rail-sawing plant varies but slightly, depending entirely on supply. An average day's run of 10 hours on 80-lb. rail is 220 full rails or 90 tons, unloaded, sawed, drilled, straightened and loaded. The actual sawing of one 80-lb. rail end requires from 14 to 21 seconds. A rail is handled onto the table, both ends sawed, and the rail is off the table in about 1 minute and 45 seconds. The drill presses are built and operated to equal the capacity of the saw.

The saw runs in a water bath and is built on a stationary base, while the table is designed to swing the rail against it. The plant is built on the ground with all the large, heavy-duty shafting set on a concrete foundation. The journals are oil-and-forced-feed-water lubricated.



The plant operates continuously, with no delays or mechanical troubles of any kind except such as can be handled by one machinist permanently located at the plant.

The plant was built and is operated as part of the maintenance of way organization. Its machinery, equipment and installation cost complete, ready for service, was about \$9,000. The organization necessary to operate consists of 17 men, divided as follows:

1 Foreman

- 1 Machinist and assistant to foreman
- 1 Combination engineer and fireman
- 2 Rail saw attendants
- 2 Drill press men

1 Hydraulic press operator 1 Night watchman 7 Laborers

In the above list the first three men must be capable of handling any special work required of them. The remainder are men taken from the various section gangs, who are taught to handle the work assigned to them and who are returned to section-gang service whenever the plant is closed down.

Figuring all overhead and actual charges due to the operation of the plant, deducting the loss of rail due to sawing 12 in. off of each end and including the salvage value of sawed ends, scrap rail and drillings, the expenditure per ton for the operation of the plant amounts to an average of about \$0.70 per ton.

The Selection of Cross-Ties

THE renewal of ties has been placed on a strictly mathematical basis on the Baltimore & Ohio through the preparation of a general circular by the timber preservation department, giving explicit instructions for the selection of ties for renewals in all

The selection given in the schedule, which provides from one to three choices as to classes and grades of ties in each case, is based on a determination of the most economical tie for each condition of track as determined by two factors, namely, the cost in track complete and

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Items of Cost	Cla	ss A— Grade	81'	Cla	iss A—8 Grade	1	Cla	Grad	$-8\frac{1}{2}'$ le	Clas	ss B– Grade	-8'	Class Gr	$C - \frac{81}{2}'$ ade		E- Gra	$8\frac{1}{2}'$
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Purchase price Inspection Treatment. Freight—	\$.800 .010	\$.680 .010	\$.250 .010	\$.700	\$.580 \$.010	.250	\$	500 \$ 010	.350	\$.40	00\$. 10\$.	250 010	\$.610 .010 .220	\$.510 .010 .200	\$.	570 010 220	\$.470 .010 .200
80 miles for non-treatment. 380 miles for treated. Work train service.	.018	.018 .010	.018 .010	.018 .010	.018 .010	.018		018	.018 .010	.01	 18 . 10 .	018 010	.090	.070		.090 010	.070
(a)	\$.838	\$.718	\$.288	\$.738	\$.618 \$.288	\$.	538 \$. 388	\$.43	38\$.	288	\$.940	\$.800	\$.	900	\$.760
Handling and installing. Two tie plates. Interest on (a)—	. 190 . 240	. 160 . 120	. 160 . 120	. 190 . 240	. 160 . 120	. 160 . 120		160 120	. 160 . 120	. 10	50 . 20 .	160 120	. 190 . 240	. 160		190 240	. 160
6 months on untreated, 12 months on treated. Supervision	\$.025 .066	\$.022 .066	\$.009 .066	\$.022 .066	\$.019 .066	.009	\$.	016 \$ 066	.012	\$.01	13 \$. 56 .	009 066	\$.056 .066	\$.048	\$	054	\$.046 .066
(b)	\$1.359	\$1.086	\$.643	\$1.256	\$.983 \$.643	\$.	900 \$.746	\$.79	97 \$.	643	\$.492	\$1.194	\$1	.450	\$1.152
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Annual cost per tie with annual	\$1.279	\$1.046	\$.603	\$1.176	\$.943	.603	\$.	860 \$. 706	\$.7	57\$.	603	\$1.412	\$1.154	\$1.	.370	\$1.112
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THE COSTS OF VARIOUS GRADES OF TIES

tracks and on all divisions. The object of this schedule is as follows:

- 1. To define the most economical tie for every condition of track and traffic.
- 2. To assist in the most economical distribution of ties and to locate the producing districts where purchase may be extended with advantage.
- 3. To locate and define those track districts where, on account of the combination of curves, grades and traffic, treated ties ought not to be used.

the assumed life in years. The method by which this determination is made is explained in a key or supplement to the general circular.

For the purpose of selection, the ties are divided into five classes. Class A includes white oak, burr oak, chestnut or rock oak, cherry, mulberry, black walnut and locust. Class B covers chestnut only. Class C covers red oak, black oak, scarlet oak, spanish oak, pin oak, shingle and laurel oak, honey locust, beech and hard or

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sugar maple. Class D includes silver, soft or white maple, red, soft or swamp maple, red or river birch, sweet or black birch, white elm, rock elm and red elm. Class E includes only shortleaf pine, loblolly pine and sap longleaf pine. Each class is subdivided into two or three grades determined by the dimensions of the tie.

The assumptions as to the life of different classes and grades of ties under varying traffic are the result of an extended investigation in which the experience and opinThis schedule has been prepared on the basis of using tie plates with all treated ties. Where an economy in comparative cost is shown in the use of tie plates on untreated ties it has been indicated in the schedule by adding the words "Tie Plated." The question of the use of ties obtained locally rather than treated ties shipped in from the plant has also been carefully considered, taking into account such factors as the conditions of traffic and the economy of shipping the local

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Yard and Industrial	Heavy power and traffic Moderate weight, power and traffic			9	7	8	6			8	6 8	7	5	10	7	9	6	9	6	8	5		15		13
Repair, temporary and storage	Light power and traffic			9	9 9	9 9	9			9 9	9 9	8 8	8	12	10	12 12	10 10	12 12	9 10	11 12	8 10		16 16		15

LIFE OF TIES UNDER DIFFERENT CONDITIONS

ion of 58 engineers and trackmen were utilized. They are all men of responsibility and judgment in matters concerning track and ties, most of them being Baltimore & Ohio officers. The cost per year is the unit of comparison used, being the total cost of the tie in track. The cost and life of the ties as affected by the location relative to the supply, the character and extent of the traffic, etc., have been estimated on the basis of data accumulated as to the following items:

- 1. Annual tie consumption and tie supply, present and anticipated.
- The relative quality of the same class of ties grown in different districts.
 The most economical tie, first, second and third
- The most economical tie, first, second and third choice.
 Minimum haul.

The district where grades curve and traffic conditions combine to make derailments likely, or to cause frequent rail changes from regaging, respiking, etc., have been determined by inspection on the ground, according to the weight of the locomotives used, by examination of profiles and by questioning track and operating officers. ties to points more remote from the treating plant with the use of treated ties locally.

Tables are given herewith to show the estimated life of ties under various conditions of traffic and the comparative annual cost of different classes and grades of ties with different length of life.

HIGHWAY SIGNALS.—The Public Utilities Commission of Colorado, in an order dated June 15, has directed the Atchison, Topeka & Santa Fe, and the Denver & Rio Grande, to install automatic signals at the twenty highway crossings on their lines between Denver and Pueblo. The commission, in its report, says that heretofore the public did not appreciate the usefulness of crossing signals, but is now co-operating with the carriers; a large majority of the drivers of vehicles stop when they see a "wigwag signal" begin to move. Heretofore the commission has ordered the installation of electric bells at crossings, but it is now of the opinion that where traffic is heavy there should be both an audible and a visual warning. The new signals must be installed within 60 days, and must be of a design approved by the commission.





New Station at Siloam Springs, Ark.

REBUILDING SMALL PASSENGER STATIONS

A Description of the Design and Construction of These Facilities on the Kansas City Southern

BY H. F. HAAG,

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THE Kansas City Southern was constructed between 1886 and 1897. During the latter part of this period most of the passenger and freight depots were built, the majority having been constructed from 1895 to 1897. Owing to the fact that, when first built, the road was located through a sparsely settled country, most of these passenger stations were originally of frame construction with shingle roofs and timber foundations, being about the average usually found on a new line in this part of the country.

As the country has rapidly settled and also as many of these stations have become dilapidated with 20 or more years of service, it was decided that the rehabilitation of a considerable number of such structures, necessitating more commodious buildings, was necessary. Where conditions did not demand a larger or better building, it was renewed with the same type, such structures being of frame with composition roofs and placed on pile head foundations. The platforms were of shell, cinders or chats, the layout including a small freight platform, a water closet and a coal bin. This class of facility, with the building 20 ft. by 60 ft. in size, and the grading nominal, cost on an average \$1.46 per sq. ft. of depot floor space, the depot proper averaging about \$1 per sq. ft.

The next improvement in the type of passenger or combination depot consisted in adding a concrete foundation with concrete walls up to the window sills, a slate or a composition roof and drop siding or stucco above the window sill line. Such buildings, however, cost from \$4,000 to \$6,000, averaging from \$1.78 per sq. ft. for drop siding and a composition roof to \$2.10 for stucco siding and a slate roof, these figures including the cost of platforms and outhouses. It was felt that, although the result was a substantial, fairly attractive looking building, the expenditure of an additional amount of money would result in a building with a longer life, which would compare very favorably with the better class of passenger depot, and would be capable, if necessary, of being enlarged to care for an increase of traffic that could not be foreseen when the plans were prepared.

With this in mind, the company has prepared and is now working on a comprehensive program which covers the renewal and rehabilitation of practically all of its passenger depots. This program calls for an expenditure of \$80,000 per year for the next five years. This, together with over \$50,000 spent last year and the expenditures for 1912 to 1914, means a total cost for such structures of over \$750,000. The buildings to be so rehabilitated vary from small shelter buildings at \$750 to pretentious layouts costing \$75,000. Among the facilities so provided in the last few years may be mentioned those at Fort Smith, Ark., which, together with tracks, real estate, etc., cost upwards of \$200,000, the Union Station at Joplin, Mo. (the Kansas City Southern Company being one-fourth owner of the Joplin Union Depot Company), the improvements at Kansas City, Mo., and many smaller projects.

A type of building costing from \$10,000 to \$15,000 and averaging about \$12,000, which has been erected during the last year at Anderson, Mo., Siloam Springs, Ark., Stilwell, Okla., and Sallisaw, Okla., has given excellent satisfaction and has created such favorable comment that it is with this type of building that this article deals

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primarily. Incidentally, it may be stated that a station of this type is now being built at Spiro, Okla., and plans are being prepared for one at Leesville, La.

The plans for these structures are prepared in the office of the chief engineer, except at such times as several are under way at one time, in which case it is sometimes necessary to have them prepared by outside architects. It is the company's experience that the cost of the preparation of the plans and specifications, including the preliminary studies, together with changes and modifications, averages from 20 to 35 man days. The superintendence varies, depending upon the length of time of construction, but averages about \$175 per month, which makes the engineering and superintendence, including field engineering, average about $7\frac{1}{2}$ per cent.

When plans for a new depot are to be prepared, information is received from various sources. The division engineer furnishes a corrected station plat showing all tracks, buildings, street improvements, sewers, water lines, gas supply, electric light lines, and other data that might affect the design or layout. He also furnishes cross-sections of the depot and platform site, and a top of main rail profile, together with any suggested changes in the present layout. The operating officers are called upon to furnish data as to the square feet of floor area they recommend for various facilities, the number of passengers handled, the number of pieces of baggage handled, the present population with the rate of increase, the amount of money the business will warrant spending, etc.

As an example of how the space is assigned for waiting rooms, baggage rooms, etc., the following outline made for one of the larger stations will answer: The number of passengers handled from October, 1912, to September, 1913, totaled 145,397, of which 67,377 were outbound and 78,060 inbound, a monthly average of 12,-116, and a daily average of 398. The largest number handled in any one day was 2,017, but on account of certain local conditions, this figure was ignored and the average was used. The ticket sales in 5 years were \$541,-991.94, a monthly average of \$9,599.89, which, upon analysis, showed a yearly increase of 4.2 per cent. The life of the building was assumed as 30 years, but it was decided that it would be necessary to provide only for 20 years' growth, which, assumed at the same rate for the previous 5 years, gave 84 per cent as the increase that because of certain peculiar local conditions. Two through trains arrived between 7:30 and 9 p. m. and two through trains between 8:30 and 9:30 a. m. If one of the trains should be late and encroach on the time of the other, the number of passengers to be handled at one time would approximate one-half of the 75 per cent of the passengers, or 275. To this was added the number of trainmen, attendants, visitors, etc., assumed as one-third, which gave a total of 360 people. The proportion of



NEW STATION AT SALLISAW, OKLA.

negro travelers was one-fourth, or about 90 negroes and 270 whites. Allowing 12 sq. ft. per colored individual, it would require 1,080 sq. ft. for the negro waiting room. This amount per individual is conservative, but investigation showed that owing to climatic conditions, the majority stayed outside the building, except in inclement weather, so that it was felt the space assigned would be adequate. The number of white passengers who would stay in the depot for any length of time was determined as 15 per cent, for whom smoking room and rest room should be provided. At 20 sq. ft. per individual, it re-quired about 400 sq. ft. each for a smoking room and a ladies' rest room. This left 229 white people, of whom one-third passed directly through the building, leaving 153 to be accommodated in the general waiting room. At the rate of 15 sq. ft. per individual, 2,295 sq. ft. was required. During 1913 there were handled an average of 2,466 pieces of baggage per month, or 81 per The same rate of increase would give an average day. of 149 pieces per day at the end of 20 years. Assuming that two-thirds would be housed at one time and that the space required for each piece would be $2\frac{1}{2}$ ft. by 21/2 ft., it would require 625 sq. ft. of space for storage,



FLOOR PLAN OF A TYPICAL STATION

had to be provided for. On this basis it was figured that in 20 years there would be handled 339 outbound passengers and 394 inbound, or a total of 733, per day. There were four through and four local trains and investigations showed that the local trains handled about 25 per cent of the traffic. This local traffic was of such a character that it was felt that it should be disregarded or in reality one-half of this area, if it is assumed that pieces would be piled on top of another, but that baggage for two trains would have to be handled at one time. This area should be doubled on account of trucking space, scales, counter, etc., which required 938 sq. ft.

This method is, of course, approximate, but has given results close enough so that plans could be prepared with-



out guessing at what was required or going to the other extreme of making too costly and lengthy an investigation.

In the construction of the depots built in 1915, an inspector was appointed whose duty it was to handle all details of the work from the time the contract was let until final payment was made. Every two weeks he transmitted a progress report, an illustration of which is shown, which report was accompanied by two or three photographs. When the job was completed these progress reports were attached, together with a completion report, to the A. F. E., or work order, thus giving a complete record of every stage of construction. This manner of making such comprehensive reports and of keeping accurate cost data is one of the reasons why the engineering costs on these jobs are comparatively high.

In providing a new depot in the country traversed by the Kansas City Southern, some conditions are met with that are not common to other localities. Misuse of toilet ing is a 13-in. brick wall, which acts as a fire wall, although the door from the freight into the baggage room is of wood.

Where the ground surrounding the building is at about the same level as the tracks, the freight room floor is elevated 2 ft. 10 in., so that it is at the same elevation as the body of a wagon or the floor of a car. There is also a 6-ft. platform in the freight room end of the baggage room, so that trunks can be left for storage without having to lift them up or down from the baggage trucks. Of course, when the tracks are somewhat higher than the adjoining ground, all the floors in the building are on the same elevation. The baggage room, office and negro waiting room floors have a 5-in. concrete floor on a 12-in. cinder fill. The freight room floor is of shiplap on creosoted sleepers in a cinder fill, which type of floor has given excellent service, although it is somewhat hard to renew. In the bay in the office a wood floor is used, as it is found that it gives better service and is bet-



NEW STATION AT STILWELL, OKLA.

facilities, for instance, in some sections is so common that these conveniences are only installed inside the building under unusual conditions. High ceilings must be provided in the South on account of the heat. An excessive amount of express as compared with passenger traffic must be provided for, because of the very heavy express business handled. Waiting rooms for the races must be provided and cannot adjoin each other.

In the new buildings constructed last year, experiments were made with different roof pitches. At Anderson, Mo., the pitch is 9 in 12, while at the other stations it is somewhat flatter. For appearance alone this pitch seems desirable, as it eliminates the squatty appearance which is prevalent with depot buildings. The roofs are all of first-class red tile with one exception, where some slate that was on hand was used with a red tile ridge and hip roll.

The foundations are of concrete carried to a good footing and extending to the platform elevation. The concrete, a 1:3:5 mixture, is reinforced only at the corners and offsets.

The walls are of a rough surfaced, dark red brick, costing about \$13.50 per thousand. All walls are 13 in. thick and are carried up for roof rafters to rest upon. The brick are all laid with a flat recessed joint. The wall between the freight room and the rest of the buildter liked by the operator. The floor in the white waiting room is of marble terrazzo with a base of the same, having a 2-in. cove.

The freight rooms and the baggage room are whitewashed; the office and negro waiting room are ceiled above the chair rail and the white waiting room is plastered above the chair rail. The interior walls in the white waiting room are a smooth brick veneer up to the chair rail, which permits of the room being flushed.

Except where absolutely necessary, sanitary toilets are not installed because of the nuisance committed therein by the lawless element. It may seem surprising to hear that in one town where a new depot was constructed in which sanitary toilets were provided, the privilege was abused a number of times in the first week the new building was opened. In this same town another road has a monthly expense of \$50 to keep its toilets in proper condition. Where toilets are not placed in the buildings, a separate building is constructed several hundred feet away, which is screened and provided with metal dry boxes.

In all the depots plenty of shelving and cupboard space is provided for the storage of records, stationery, etc. This is an item that is very often overlooked, especially in combination depots. Another convenience for the agent is a slop sink, where he can wet his copying cloths and do other similar work which requires running water.

Steam heat is supplied only at the largest stations. In all cases, except where gas is available, coal stoves are used. Coal is stored in a 6 or 8-ton coal storage house located adjacent to the house track. Where electricity for lighting is not available, oil lamps are used. When this is necessary, oil boxes are placed at the ends of the platform. These boxes are about the size of a tool box, are lined with metal and are kept locked. All oil must be stored therein and it is required that the filling and cleaning of lamps be done away from the building proper.

Platforms are made of brick and are 450 ft. long and

so good a foothold as brick and require more labor to keep them clean.

The freight room, as before stated, sometimes has an elevated floor. It is equipped with a 4-ton capacity warehouse scale placed on a concrete foundation. Doors are provided in the front, rear and end of the room.

The latest type of pipe-connected train order semaphore is provided, working in the upper quadrant, with an iron pole set in concrete. The table lever is placed on the right hand side of the bay, 14 in. from the side wall, which makes it accessible and at the same time it does not interfere with the telegraph instruments.

Telegraph, telephone and electric light wires are carried into the building in an underground conduit, the end of



A TYPICAL PROGRESS CHART

16 ft. wide at the ends, the depot being placed 24 ft. back from the center of the main track. The brick are laid in herringbone fashion on a 2-in. sand cushion. The curb is of concrete 6 in. thick with a batter on the outer side and 18-in. footings. The platform is placed 5 in. above the top of rail at the curb, 5 ft. from the center of the track and has a 2-in. crown to shed water. In front of the depot the platform has a straight slope of $4\frac{1}{2}$ in. from the curb to the building line. At the less important stations the platform is made of cinders, shell or chats with curbing made of old bridge stringers. At a station where there is a water supply, a 50,000-gal. capacity steel tank equipped with a spout is placed at one end of the platform, while a 10-in crane supplied by a 12-in. line is located at the other end, which permits an engine to take water while a train is stopping to receive or discharge passengers and baggage. No type of concrete platform has been found satisfactory owing to the fact that it is impossible to keep them from cracking or chipping when heavy articles are dropped on them. They do not offer the conduit curving upward and terminating at the chair rail. Batteries are placed in cupboards and all wires are run through conduits concealed in the walls. Battery cupboards are placed under the ticket window shelves.

In order to facilitate the handling of business with the agent, the door between the office and the white waiting room is cut through the center, making what is commonly called a "Dutch" door, the lower half having a shelf covered with sheet iron. This serves as a counter and at the same time keeps the public out of the office. Depending upon local conditions, either a drinking fountain or a water cooler is installed. An oak bulletin board having a glass cover and a train bulletin board are also a part of the new equipment. In the average size station a seating capacity for 72 people is provided. These settees are of solid oak, costing about \$2 per foot, with their backs just high enough to fit in under the chair rail. The accompanying illustrations give a fair idea of the appearance of the stations, although they cannot do justice to the color effects that have been secured.



Furniture and fixtures:

Following are some detailed costs on two of the new depots erected:

depots erected :				100.00	110.00
Ande	erson Mo	Sallisaw Okla	Lighting fixtures	65.15	164.36
(Non-c	omnetitive)	(Compatitive)	Scales	99.00	102.00
C Noil-C	ompetitive)	(Competitive)	Building :		
Population	1,600	3,500	Roof	802.00	1,205.00
Average number of passengers per			Floors	600.00	(Wood floors in-
train	42	52			cluded in brick
Average number of pieces of baggage					and frame work)
per train	8	12	Wiring	249.00	220.00
Sq. ft. of floor space in the building.	2,880	3,692	Plumbing	75.00	665.00
Cost per sq. ft. of building (all items)	\$6.09		(0	utside to	ilets)
Cost per sq. ft. of building (building	•		Foundation and fill	435.00	823.00
and platform only)	\$3.34	\$3.27	Mill work	805.00	868.50
Cost per so, ft, of brick platform	\$0.18	\$0.22	Painting	190.00	251.67
···· • • • • • • • • • • • • • • • • •	(includes	(includes hand	Plastering and stucco.	180.00	347.00
	curbing)	rail and 6-ft	Hardware and iron work	250.00	253.00
	cursing,	retaining wall)	Brick and frame work	2 542 73	2 755 00
So ft of waiting room oppose por		· · · · · · · · · · · · · · · · · · ·	Drinking fountains and cooler	2.0 12.70	101 50
Sq. II. of waiting room space per	20	20	Track surfacing	• • • • • •	40 47
passenger	20	20	Grading and road crossing	••••	221 73
Sq. ft. of baggage room space per			Freight charges	347 42	436 50
piece of baggage	55	44	Engineering and supervision	708.67	1 160 24
-			Other items necessary on account of	790.07	1,109.24
Detailed Cost of Facilities:			new depot such as new stock		
Passenger platform	1 560.00	\$ 1 \$45.00	new depot, such as new stock		
Freight and baggage platforms	170.00	φ 1,043.00 154.00	drivoways paving sta	7 019 20	
Telegraph and telephone lines	225 55	100 32	unveways, paving, etc	7,910.29	
Semanhore	80.00	-90.02	Crand total	17 544 01	¢12.090.42
	00.00	00.00		17,544.81	\$12,080.43

The Gasoline Situation

BY M. E. CARROLL

THE abnormal industrial conditions which have existed throughout this country for several months past have created many interesting, and sometimes perplexing, problems for the railroads. Owing to the interruption in our customary channels of supply through importation, many articles formerly in daily use have become quite scarce and difficult to obtain. On the other hand, a stimulation in our exports of other items has resulted in a scarcity in the home market, and resultant rise in prices.

Of the many commodities in general use which have been affected by the changed conditions, resulting in a price increase of about 100 per cent during the past year, is one considered to be a daily necessity, viz., gasoline. The price of gasoline in the early part of 1915 was about 8 cents per gallon for tank wagon delivery through the Middle West, 10.5 cents in Chicago, and 15 cents in New York, while by the end of the year it had risen to 16.5 cents per gallon in Chicago and 21 cents per gallon in New York. In 1916 further increase has been witnessed.

There are many reasons for this advance in price. The first and greatest is the unprecedented increase in the number of automobiles in service. Those informed in the automobile trade estimate that in 1910 there were about 350,000 automobiles in service in the United States, while at the beginning of this year there were 2,250,000, this number being added to at the rate of 4,000 new machines per day. Presuming that every new automobile tank receives 10 gallons of gasoline for the first trip, this would represent a daily increase in gasoline consumption of 40,000 gal. There are also to be considered the farm tractors coming into general use throughout the central and western states, and the motor trucks, which are rapidly replacing horses on city streets. Several thousand motor trucks have been exported for war purposes, and our exports of gasoline have grown accordingly. We are now exporting 300,000,000 gal. of gasoline per year, which is greater than the entire amount used in this country only a few years ago.

In the face of this increased demand, the production of petroleum has failed to increase accordingly. The principal new petroleum fields are producing crude oil which is low in gasoline. California produces about 100,-000,000 bbl. of petroleum a year, the best of which has only about 5 per cent gasoline. The famous Cushing field, which some time ago produced 300,000 bbl. of petroleum a day, containing 30 per cent gasoline, has fallen off to 100,000 bbl. a day in production.

During the period while these developments and changes were in progress, the railroads were increasing each year their demand for gasoline. Many steam pumping stations and the uncertain wind-driven pumps have been superseded by gasoline-driven pumps. The labor conditions on track work have changed, and with this has come the gradual change from hand cars to gasoline-driven motor cars for section use. That these and other conditions have affected the gasoline situation is shown by the total purchase of gasoline for any large railroad system. One road of 6,000 miles in the central west purchased 132,000 gal. of gasoline during 1912, while in 1915 its annual consumption had increased to a total of 428,000 gal. During the same period the average purchase price on this road increased from 10.5 cents to 16.5 cents.

Not only has the first cost of gasoline increased, but the railroads are put to more expense than formerly in handling and caring for it. Gasoline is to-day just as staple an article of domestic use as sugar or bread, and when distributed over the greater part of a railroad's territory, must be protected against loss in other ways than through evaporation. This necessitates additional expenditure for the construction of suitable storage stations for the gasoline supply, and a careful checking system of receipts and disbursements to know that the losses are not unnecessarily great.

There is scarcely a railroad in the central or western portion of the country that does not average about 1 gasoline motor car for every 10 miles of main track, and as few of these cars will operate on less than 4 gal. of gasoline per hundred miles, the total consumption of any one road is considerable. Considering the length of a section to be 10 miles and the standard practice to go over the track on hand car or motor cars once each day.

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this would mean, together with such side trips as going for water, tools, trips to the telegraph office, etc., enough miles each day to consume one gallon of gasoline for fuel. If there is no waste or improper use of gasoline, we would have an addition to what we have considered our normal expenses of at least 10 cents a day for each motor car operated. This appears like a small sum, but when comparing our expenses with those for some previous period it represents a clear waste because we do not get any greater results from a gallon of gasoline now than we did years ago. This means on the average main line division an additional expense of \$4 or \$5 per day, and on an average railroad having one gasoline-propelled car for every 10 miles of main track, an increase in expenses of about \$21,000 per annum. Some roads have made a reduction in the gasoline consumption on these cars by placing a small feed tank for gasoline on each car and filling the main tank with kerosene of good quality. The motor car is started with gasoline and after running a short distance, the cylinders become warm. The gasoline supply is then shut off and the car operated for the balance of the trip with kerosene as fuel.

Many pumping stations and train yard air compressors formerly operated by means of gasoline engines have been changed over to fuel oil or distillate engines at small expense, with a resultant saving in expense for fuel. The expense of operating pumping stations by gasoline varies widely between different railroads, but the average road in the middle west is using about one gallon of gasoline for this purpose to every two gallons used on motor cars, and additional costs through increase in gasoline prices can be computed accordingly. The expense of changing a gasoline pumping engine or electric generator engine for charging signal department storage batteries so fuel oil or distillate may be used instead of gasoline is about \$96, including a suitable storage tank for the new kind of fuel.

It is very easy to waste gasoline, and the present high cost of this commodity emphasizes more than ever the need of taking care of the supply and instructing employees in regard to its proper use. Gasoline is wasted by evaporation when stored in tanks or cans which are not air tight; by improper use when stored at places where unauthorized persons can help themselves to the supply for their personal use; by extravagance in operation of gasoline engines of all kinds through failure to control the supply of gasoline to the carburetor, thus allowing more gasoline to be burned in the cylinders than is necessary to procure a proper explosion; by leakage in handling through failure to furnish a proper measuring can, funnel, etc., much gasoline being wasted while supply is being put into tank and into the feed reservoir of the engine, because of careless handling.

When an annual consumption of 400,000 gal. or more for any given railroad is considered, and the price of gasoline has doubled, while it is costing four times as much per gallon as fuel oil or distillate, and three times as much as good quality kerosene, it is obvious that a little study on the part of division officers in charge of gasoline operation should effect a considerable saving on each division where gasoline engines of various kinds are in general use.

Wood Preservation Statistics

THE proceedings of the American Wood Preservers' Association contain some valuable statistics on the quantity of wood preservatives consumed and the amount of wood treated by wood-preserving plants in the United States in 1915. These are compiled by the association in co-operation with the forest service of the United States Department of Agriculture. The following information is abstracted from this report:

In 1915, the 102 wood-preserving plants operating in the United States during the year treated about 141,858,-963 cu. ft. of timber. In 1914 with 8 less plants operating 17,723,676 cu. ft. more timber was treated. In spite of this decrease in the total output, there was an

TABLE 1.—CONSUMPTION OF WOOD PRESERVATIVES BY THE TREAT-ING PLANTS IN THE UNITED STATES, 1909-1915

	Number		Zinc	Other				
	of	Creosote	Chloride,	Preservatives,				
Year	Plants	Gallons	Pounds	Gallons*				
1909	64	51.431.212	16.215.109	†				
1910	71	63.266.271	16.802.532	2.333.707				
1911	80	73.027.335	16.359.797	1.000.000				
1912	84	83.666.490	20.751.711	3.072.462				
1913	93	108.373.359	26.466.803	3.885.738				
1914	94	79,334,606	27,212,259	{ 9,429,444 ‡ 2,486,6 3 7				
1915	102	80,859,442	33,269,604	3,205,563‡				
*Includes crude oil, coke oven-tar, refined coal-tar and car								

bolineum oils. †Statistics not available.

‡"Paving oil."

increase of 1,986,286 cu. ft. in the amount of construction timber treated. The number of cross-ties subjected to treatment in 1915 was 37,085,585, a reduction of 6,761,402 from the figures of 1914. The amount of wood block paving increased 319,467 sq. yd., or 11 per cent, and the preservation of piling aggregated 9,308,419 lin. ft., an amount less than that reported in 1914 by 2,612,-182 lin. ft.

Table 1 shows the consumption of wood preservatives used by the treating plants by years and by kinds. The consumption of zinc chloride exceeded that of any previous year and the amount of creosote used was slightly more than the amount used in 1914, which was a decrease of about 27 per cent from the quantity used in 1913. As seen in the accompanying diagram, for the first time since the active development of the wood preservation industry in the United States, the consump-



tion of domestic creosote exceeded that of the imported oil, and would tend to show a gradually decreasing dependence upon the foreign supply for American consumption. The price of domestic creosote in 1914 was approximately $8\frac{1}{2}$ cents per gallon, f. o. b. plant, and that for zinc chloride 3 cents per pound. Owing to the un-



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certainty of foreign shipments and the total lack of them at times during the past two years, the prices of both kinds of preservatives have practically doubled since that time.

Table 2 shows the number of cross-ties treated by kinds of wood and kinds of preservatives in 1915. The number of ties treated in 1915 was less by 6,761,402 than in 1914. This decrease was greater for hewed than for sawed ties, the total quantity reported being 25,831,204 hewed and 11,254,381 sawed. Oak ties again take the lead in the number treated and constitute 45.53 per cent of the total number of all species. Yellow pine ties are second and constitute 23.03 per cent. The number of ties

treated with miscellaneous preservatives was only 6,520 in 1915, as compared with 2,625,681 in 1914.

FLAT SLAB TESTS.—Bulletin No. 84, recently issued by the Experiment Station of the University of Illinois contains an account of an elaborate series of tests on flat slab structures built according to various systems and in a number of different buildings, including the Soo terminal at Chicago, where the slab carries railroad loading. While it is not pretended that these tests will clear up the cloud of misunderstanding which now surrounds flat slab design, they are of material value because of the manner in which the tests were conducted, because of the num-

	Yellow	Douglas	Western	,		Tamar-				Other	
Preservative Oak	Pine	Fir	Pine	Beech	Gum	ack	Maple	Birch	Elm	Species	Total
Creosote 7,365,6	73 5,243,516	787.247	301,581	2,469.202	1,650	390,017	36,626	173,916		307,641	17,077,069
Zinc Chloride 7,954.4	92 3,257,565	2,760 952	1,702,167	100,000	204,65 3	449,660	316	55	50,846	1, 33 8,578	17,819,284
Zinc Chloride and			. ,	•							
Creosote 1,565,3	52 40,122		3,861	364,535	71,583	91,496				45,763	2,182,712
Miscellaneous		5,655			• • • • • • •	865	• • • • •			• • • • • • • • •	6,520
Total	17 8,541,203	3,553,854	2,007.609	2,933,737	277,886	932,038	36,942	173,971	50,846	1,691,982	37,085,585
Per cent of total											
needed 45.	53 23.03	9.58	5.42	7.91	0.75	2.51	0.10	0.47	0.14	4.56	100.00

TABLE 3.—COMPARATIVE STATEMENT OF MATERIAL TREATED IN THE UNITED STATES, 1909-1915, INCLUSIVE

								TOLAT
Preservatives. Ye	Cross Ties. ar Cu. Ft.	Piling. Cu. Ft. 4 421 726	Poles. Cu. Ft.	Paving Blocks, Cu. Ft. 2 004 200	Construction Timbers. Cu. Ft.	Cross- Arms. Cu. Ft. 41 764	Lumber and Miscellaneous. Cu. Ft. 417 787	Material Treated. Cu. Ft.
Creosote	10 44,525,229 11 49,532,163 12 57,461,515 13 75,998,307 14 67,774,329 15 51,231,207	5,219,254 4,937,363 7,624,939 7,630,328 7,804,657 6,288,238	255.597 106.213 1,169,981 2,367,769 1,188,511 2,336,318	4,692,453 10,145,724 7,091,658 6,810,308 3,127,506 1,174,319	7,801,272 7,417,105 6,892,493 10,308,883 8,389,158 9,264,164	41,704 88,069 71,961 1,643,128 1,813,010 395,403 87,373	2,687,713 2,499,995 2,841,195 1,853,993 1,348,566 981,028	65,269,587 74,710,524 84,724,909 106,782,598 90,027,630 85,115,647
Zinc Chloride 19 19 19 19 19 19 19 19 19 19	9 24,153,162 10 27,587,583 11 28,337,883 12 28,532,874 13 36,051,816 14 50,020,755 15 53,457,852	4,726	18,246 47,996	······································	320,891 541,514 1,043,851 259,972 585,756 1,317,925 2,406,150	·····	2.333 71.060 119.931 20.092 7.670 4.355 275.279	24,476,386 28,200.157 29,501.665 28,831,184 36,693,238 51,343,035 56,144,007
Zinc Creosote	9 8,095,794 0 6,354,219 1 7,312,374 12 8,214,303 13 6,938,838 14 5,868,834 15 6,548,136	38,392 97,874 327,594 2,320		······································	62,918 181,143 560,613 758,989 140,718 40,396	······	43,699 30,646 99,367 53,628 4,822	8,202,411 6,604,400 7,312,374 8,972,157 8,079,049 6,009,552 6,705,894
All Preservatives 19 19 19 19 19 19 19 19 19 19	09 62,079,036 0 78,467,031 1 85,182,420 12 97,183,009 13 120,781,248 14 131,540,961 15 111,256,755	4,421,726 5,257,646 4,937,363 7,737,035 7,957,922 8,061,902 6,295,284	659,664 255,597 106,213 1,188,579 2,500,420 1,482,407 2,512,780	2,994,290 4,692,453 10,145,724 7,397,095 6,856,293 6,869,370 7,707,971	5,286,120 8,523,929 8,460,956 7,793,524 11,653,628 9,847,801 11,834,087	41,764 88,069 71,961 1.643,128 1.824,719 417,914 90,627	463,819 2,789,419 2,619,926 2,988,686 2,039,658 1,362,284 1,161,459	75,946.419 100,074.144 111.524,563 125,931,056 153,613,888 159,582,639 141,858,963

CONVERTING FACTORS

To obtain the number of cross-ties, divide figures shown by 3. To obtain the number of lineal feet of piling, divide the figures shown by .6763.

To obtain the number of lineal feet of poles, divide the figures shown by .5868. To obtain the number of square yards of paving blocks, divide

treated with creosote and zinc chloride form 46 and 48 per cent, respectively, of the total number treated. This is quite a change from the proportion in 1914, when 51.5 per cent of the ties were treated with creosote and only 38 per cent with zinc chloride. The number of ties treated by zinc chloride and creosote in combination was 2,625,681, over 50 per cent of which were oak. In using zinc chloride for treatment the average injection of preservative was 0.5 lb. per cu. ft. and with creosote oil an average of 8.5 lb. per cu. ft. The number of ties the figures shown by 2.625.

To obtain the number of board feet of construction timbers, multiply the figures shown by 12.

To obtain the number of cross-arms, divide the figures by .6198. To obtain the number of board feet of lumber and miscellaneous material, multiply the figures shown by 12.

ber of types of floor brought into comparison and because, unlike most other tests of this kind, they have not been made for the purpose of exploiting any single type. One of the conclusions reached in these tests is that there is need of others on structures built for test only. Results to be obtained with complex structures built for commercial purposes leave much to be desired because of the elements of strength which the component parts of the structures impart to each other. These should be eliminated in future tests.





Settlement of an Abutment Near North McGregor, Iowa

THE location of a railroad and the proportioning of the bridges and culverts which are required in its construction always give rise to conjecture as to the justification of provisions for the unusual or occasional storm or flood and it is commonly held that security against all possible contingencies cannot be justified. To provide for such storms as occur only at long intervals would in most cases result in such an increase in the fixed charges as to place an undue burden on the business of the railroad. This being accepted, each unusual occurrence must be disposed of when it takes place, as a problem by itself.

A condition of this kind presented itself on the night of June 1 in a wind and rain storm which passed across eastern Iowa in a southeasterly direction into southern Wisconsin and northern Illinois, the equal of which had not occurred in 20 years. A number of railroads in the path of this storm suffered heavily. Rock Island train No. 2, running north from Cedar Rapids, Iowa, encountered a weakened embankment at the approach to a bridge near Packard, Iowa, which, through a series of peculiar circumstances, caused the wreck of both the train and the bridge and resulted in the death of several persons. Further east along the Iowa and Dakota division of the Chicago, Milwaukee & St. Paul the storm caused many washouts, particularly in the 14 miles just west of North McGregor, Iowa, where the railroad follows the course of Giard creek in making the descent to the Mississippi river bottoms. Crossing over into Wisconsin, the storm resulted in washouts on the Burlington which interrupted train service for some time between La Crosse, Wis., and Savanna, Ill., while at Sauneman, Ill., Wabash train No. 17 was blown off the track by what was apparently a small tornado.

The bridge on the Rock Island and many of the structures affected on the Chicago, Milwaukee & St. Paul had been in place for 20 years, proving adequate for all storms which had occurred in that time. Many of the bridges along Giard creek on the St. Paul, replaced structures which were destroyed by a flood on May 24, 1896, their proportions and details having been determined after a careful study of the information presented by the earlier storm.

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girder spans. The abutments were of the pier or buried type with the spill of the ends of the embankment completely surrounding them. The piers were of somewhat unusual design, consisting each of two masonry pedestals on a concrete footing with pile foundation and surmounted, about five or six feet above the bed of the stream, by a brick pier with a stone masonry bridge seat and a brick arch between the two pedestals. These piers were reinforced at the elevation of the arch by two steel rods, one on each side, with a plate across each end.

The sub-structure was built in 1896 and the steel was put on in 1897. From that time until the flood that caused the wreck, no trouble had ever been experienced with high water. The storm and flood of the night of June 1 were the greatest of which there is any record in the vicinity.

The cause of the accident as described hereafter is based upon a study of the situation on the ground after the accident and from the testimony of persons on the train. It was dark when the accident occurred and little could be seen until daylight. A work train had been sent over the track about 40 min. ahead of the passenger train as a precautionary measure and an inspection of the bridge at that time indicated that no damage had been done by the flood water. However, in the time intervening before the passenger train arrived the embankment behind the south abutment was weakened to such an extent by scour at the toe of the upstream slope that it gave way under the weight of the train. The engineer reported feeling the track go down under him, although the engine, tender, mail car and baggage car went across the bridge safely on the rails. By the time the smoker crossed this depressed portion of the embankment, it had settled to such an extent that the car struck the back wall of the abutment with sufficient force to drive the girders of all three spans north longitudinally three feet, pushing back the parapet wall of the north abutment. As the girders were anchored to the piers, they carried the tops of the piers with them, breaking the bond between the masonry pedestals and the brick work. As a result the tops of the piers were forced about three feet out of plumb.

The smoking car was apparently derailed at the south The Rock Island bridge consisted of three 42-ft. deck end of the bridge and went across on the ties, bunching all those in the last span. The chair car following the smoker fell into the river when it reached this span. The first sleeper stopped with its north end just over the south pier and the south end on the embankment, the girder span dropping down underneath it, as shown in one of the accompanying photographs.

It is supposed that the hammering of the trucks of the several cars on the south abutment as they passed over it onto the bridge beat it down so that at the time the first. sleeping car passed over it the abutment collapsed.

The embankment washed out behind the south abutment for about 30 ft. No farther damage was done to the bridge by the action of the flood water. It is apparent from this that the failure of the bridge was really caused by the derailment of the train behind the south abutment. The people who lost their lives in this accident were drowned in the chair car, one end of which was completely submerged in the stream.

THE GIARD CREEK FLOOD

The location of the Iowa and Dakota division of the Chicago, Milwaukee & St. Paul for the 14 miles along Giard creek is one that would naturally be subject to flood conditions in case of a heavy storm. The valley is narrow and winding with steep sides and a water grade of about one per cent. The railroad crosses the creek many times in this distance with bridges varying from 50 to 150 ft. in length. As the valley approaches the Mississippi river it widens out, affording space for the village of North McGregor and a freight and engine terminal for the railroad which includes a considerable yard layout and a 17-stall roundhouse.

Combining the topographic layout of the valley with a storm traveling in the direction of the flow and the fact that no freshets had occurred in a long time to carry away accumulations of rubbish, the conditions were especially favorable for serious destruction of property in the valley. That the storm was especially severe at this point is evidenced by the fact that three branch lines of the St. Paul in this vicinity also suffered interruption of train service because of washouts.

Practically all the highway bridges in the valley were destroyed. Of 30 railroad bridges in the 14 miles between North McGregor and Valdora, two had superstructures washed off the masonry by the flood and drift; one lost a pier, thereby dropping two girder spans into the stream, four others suffered more or less serious damage to their sub-structures through settlement and erosion, and practically all of the other bridges were isolated through the washing out of the embankment behind the abutments. Nearly a mile of main track was washed out in the 14 miles of line. In one case, three double track girder spans, 50 ft. long, were carried 500 ft. away from the bridge site. In another case a 130-ft. through truss span was lifted off its abutment and swung around parallel to the stream.

Although the valley of the creek is much wider in the vicinity of North McGregor, the volume of the water was sufficient to cover the freight yard to a depth of from six to eight feet, washing out much of the track. There were 300 cars in the yard at the time, 65 of which were tipped over or carried some distance when the tracks were displaced. About 60 cars containing merchandise were submerged from two to five feet above the floor level, causing a heavy loss to the lading.

As shown in one of the accompanying photographs the roundhouse was badly wrecked, part of the roof being torn off by the high wind and a part of the walls being caved in by the pressure of the water and the impact of the drift which it carried. The 11 engines which were in the house at the time were covered with debris,

a foot of mud covered the floor and the turn-table pit was filled with mud. Two boiler stacks were blown down by the heavy wind and did considerable damage to the portion of the roof on which they fell. The oil house was washed away and an ice house in the vicinity was also damaged.

RESTORING THE LINE

The storm moved from west to east. It struck Emmetsburg, 200 miles west of the Mississippi, at 2 p. m., and between 3 o'clock and 5 it was raging at Mason City, with heavy rain and hail. It did not reach North Mc-Gregor until 7 and lasted until about 10 p. m. By 8:40, before the storm was over at North McGregor, a work train had started east from Mason City to commence repairing the damage. The telegraph wires were down for long distances and the lack of telegraphic communication interfered seriously in the task of organizing the repair work. In fact, it was necessary to carry on the work independently from each end of the damaged district.

Men and equipment were moved in from all available points. Extra gangs at work on several adjacent divisions were assembled and together with all section gangs in the immediate vicinity, they totaled over 600 men. Material for pile trestles was immediately sent in from all storage points within a reasonable distance, and as soon as a reconnoissance could be made to determine the amount of trestle required, the estimate was checked up against the material as fast as it was delivered and requisitions were made for whatever additional material was required. Several pile drivers were sent in, but as only one could be used at each end of the break, the others were held for emergency use. The drivers actually used were kept at work continually by crews working in two shifts.

In the 100 miles between Mason City and Valdora, 14 miles west of North McGregor, the destruction wrought was not particularly serious. The repair work in this territory was carried on quickly, and the line was open from the west as far as Beulah (nine miles west of North McGregor) by June 5, but nearly a week longer was occupied in opening the line on the remaining 9 miles. The track was restored where possible, without building trestles, by blocking it up sufficiently to permit the drivers to pass to the next serious break. In all, 1,500 ft. of pile trestle was built in the 14 miles.

As soon as the progress with the drivers permitted, work was commenced on the filling in of the trestles and the repairing of the track where it had been blocked up temporarily. To expedite this work a steam shovel was transferred from Waukesha, Wis., to a pit 5 miles east of North McGregor on the Wisconsin side, where it started work on June 5. Later another shovel was installed in a pit at Plymouth, Iowa, 130 miles west of the Mississippi. It is estimated that 35,000 to 40,000 cu. yd. of filling will be required to restore this line.

PROVISION FOR FLOODS

No storm of a severity approaching that of June 1 had occurred in this region since the flood of 1896, which carried away many of the bridges and resulted in the loss of several lives. Many of the present structures on this line were built at that time to replace the structures then destroyed, after a careful study of the flood conditions to determine what reasonable measures could be taken to prevent a repetition of the damage at some later date. Considerable interest naturally attaches to the present situation with respect to measures which might possibly have been taken to avoid the damage recently done.

By far the greatest damage was done by the washing out of embankments. The flood water virtually filled the



Photograph No. 4-Rock Island Bridge Near Packard, Iowa; Others of St. Paul Line West of North McGregor, Iowa. Fig. 3 Shows Girders Carried 500 Ft. to Position at Left of Photograph



valley from side to side, covering the track for long distances. A relocation of the line to keep the grade above the flood level would have required heavy construction and an investment of many times the cost of repairing the damage done by the flood.

With the line on its present location and the embankment subject to overflow, the question arises as to the security of the bridges. In only two structures was the superstructure carried away or displaced from the masonry by the flow of water or pressure of the drift material, although the water was over the tracks on a great many of the bridges. In four of the structures out of the 30 the sub-structures suffered more or less serious settlement or disintegration and in one case the pier was carried entirely away.

The security of the sub-structure is a matter of foundations and workman-hip and an examination since the storm di-closes the excellent character of the masonry, most of which was a-hlar stone, built just preceding the general introduction of concrete for railroad masonry, on natural cement footings with natural cement mortar for laying the stone work and Portland cement mortar for the copings. In several cases heavy overhangings of masonry are supported merely by the tensile strength of the mortar. With the advantage of monolithic structures now possible in concrete construction, the security of the abutments and piers under similar conditions would no doubt have been considerably better.

The foundations for these bridges were a serious problem, the underlying material being a hardpan in which it was impossible to drive piles. Excavation in this was expensive because all of the material had to be loosened with picks before it could be removed. Under such circumstances the depth of foundations was purely a matter of the best possible judgment.

A SMALL-RAISE TRACK JACK

A NEW small-raise track jack has just recently been introduced to meet the demands of the maintenance officers of some railroads for a track jack that gives only a small raise and which is also sufficiently light to permit



BARRETT JACK.

it to be carried easily by one man. It is known as the No. 227 10-ton track surfacing jack and is made by the Duff Manufacturing Company, Pittsburgh. It is $9\frac{1}{2}$ in. tall over all with a $5\frac{1}{2}$ -in. runout and weighs 35 lb. The jack is so low that when tripped it can be left in position under the rail while trains pass. The base of the jack is of a new Barrett type, reinforced with ribs.

It also has a carrying handle. The rack and the toe forging are of special carbon steel, the teeth are machine cut and the fulcrum pin is of chrome nickel steel.

AN AUTOMATIC ALTITUDE VALVE

VALVES designed for the automatic control of the water level in tanks or for the regulation of pressure have received extended use in connection with the water service layouts at engine terminals and other railway installations. The Golden-Anderson Valve Specialty Company, Pittsburgh, which manufactures valves of this type, has introduced improvements from time to time which are designed to make these valves applicable under various conditions of service. Among these special applications may be mentioned an electric solenoid at-



IMPROVED CONTROLLING VALVE

tachment for use where remote control is desired. Another modification provides for cutting the tank out of service when a higher pressure is applied to the supply line as in case of fire.

The device in its simplest form is shown in the accompanying drawing which is a sectional view of the main valve in the closed position. If water is drawn from a tank, standpipe or reservoir, the pressure is removed from the top of the diaphragm "R," through the pipe "T" which connects into the outlet side of the valve. This causes the valve spindle "K" to rise, allowing the high pressure auxiliary valve "H" to close, while the exhaust valve "I" is opened, permitting the water above the piston or valve "B" to escape through the passages "M" out of the port "N." The pressure above the valve being removed, the water underneath the piston "B" forces it open.

When the water in the tank reaches the desired height, the pressure, entering through the small pipe "T," is distributed on the top of diaphragm "R," closing the exhause valve "I" and opening the high pressure valve "H." This allows the initial pressure to come on the valve "B," through the ports "L" and "M." Because there is a greater area on the top of the valve "B" it is forced to its seat, shutting off all the water.

AN AUTOMATIC CROSSING GATE

A N automatic gate for grade crossing protection has been in experimental service on the Chicago & Eastern Illinois at Hoopeston, Ill., since September 25, 1915. In the first six months of service the gate was operated nearly 8,000 times with seven failures, the majority of which occurred during the first few days after the gate was installed. The highway at this point crosses three tracks, two of which form the double-track main line, the third being a passing siding. A recent typical daily report sheet showed 52 train movements for which gate operations were necessary, and 46 vehicles using the crossing.

The mechanism is controlled by setting sections in the track, the circuits on the main line tracks being arranged on the open circuit principle, and on the passing track on a closed circuit. Either arrangement can be used, as desired. On the main line, three rails in each track are insulated for setting sections, one at the crossing and one 1,500 ft., in each direction from it. A track instrument located 2,000 ft. from the crossing on each of the main tracks in the direction from which trains normally approach closes a circuit through a bell mechanism, giving a warning some time before the gates are operated. The bell continues to ring until the train has reached the crossing. It requires from 8 to 10 seconds after the train passes the setting section, 1,500 ft. from the crossing, for the gate to operate to the closed position. If in spite of the bell warning, a vehicle should be caught on the tracks between the gates, the same procedure is possible as with



THE GATES RAISED

ordinary gates, either to drive through them or raise them by hand. The gates are accurately counter-weighted, making the latter action easy. It is also feasible to place the gates far enough back to allow room for a vehicle caught on the crossing to stand between the track and the gate. In addition to the bell, a red light is displayed on the gate at night. The light circuit is connected through an operating clock arranged to throw the light in service at a definite time in the evening, and to cut it out at a definite time in the morning.

The gate-operating mechanism is located in enclosed cases on each side of the track on which the gates are mounted. Each of these cases supports two gates, one on each side of the track being operated by each of the mechanism units. The operation of the arm across the tracks from the mechanism is accomplished by means of shafts located below the ties.

The control circuits are said to take care of all conditions arising at this crossing, such as trains moving against the current of traffic; long freight trains approaching the crossing, stopping in the circuit, leaving part of the train in the circuit and passing over the crossing into the yard for some time; trains backing into the circuit and never reaching the crossing; and trains on all three tracks at the same time.

The gates are motor-operated through gearing, the



GATES IN LOWERED POSITION

power being supplied by 30-volt, 50-a.h. storage batteries. The operating circuits are broken through circuit breakers actuated by the movement of the gate.

The mechanism has been maintained by the signal organization and has required no more care than would be expected from equipment in an experimental stage. The storage batteries are recharged every 35 to 50 days. The annual cost of maintenance, aside from breakage, is estimated at \$75 to \$100 a year. The initial cost would be about the same as the annual cost for the protection of a dangerous crossing by watchmen, both day and night. The gate is patented by Jay Briggs, Hoopeston, Ill.

INCREASING COSTS OF MATERIALS

IN a circular issued by the St. Louis & San Francisco on June 1, it is stated that materials and supplies at the current prices of March 13, 1916, had advanced 53.6 per cent over the 1915 prices, and on June 1, 1916, the prices of these same materials and supplies, excluding fuel, rails and ties had made a further advance of 10.1 per cent, or a total increase of 63.7 per cent over 1915 prices.

The following amended list of articles and the percentages of increases over 1915 prices will be of interest to maintenance of way officials:

Article	Per Cent
Track bolts	112
Steel bridges	187.4
Drills	241.7
Gasoline	172.6
Galvanized iron	93.2
Square and hexagon nuts	
Track spikes	117
Metal tie plates	146
Portland cement	
Track frogs	18
Rail joints	37.5
Paints	27 7
Sand	40
Shovels	35

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THE ROADMASTERS' CONVENTION

PLANS for the next annual convention of the Roadmasters and Maintenance of Way Association are developing rapidly. At a meeting of the entertainment committee, held on June 17, the general outline of the program was adopted.

The convention will be called to order at the McAlpin Hotel, New York, at nine o'clock on Tuesday, September 19. The entire day, with an evening session, will be devoted to the routine business of the association and to the discussion of committee reports. The consideration of reports will be continued on Wednesday forenoon. In the afternoon an inspection of the western end of the Long Island Railway will be made by special train, the party returning in time for a business session in the evening. Thursday morning will be devoted to the further consideration of committee reports, while in the afternoon a special train will conduct the members and guests over the main line of the New York, New Haven & Hart-ford between Grand Central Terminal, New York, and Stamford, Conn. On Thursday evening the Track Supply Association will give a banquet for the members of the association and a theater party for the ladies. Friday morning will be devoted to a business session of the association and an inspection of the exhibits of the Track Supply Association. In the afternoon the Central Rail-road of New Jersey will give the members and guests a trip by boat and rail down the Hudson river through New York harbor to Sandy Hook and Atlantic Hylands, thence by train to Asbury Park and returning to New York.

The outlook for a large and instructive exhibit for the Track Supply Association is excellent. At the present time applications have been received from 46 firms, a larger number than at this date, on any previous year. The following firms have made application for space up to June 20:

Ajax Rail Anchor Co., Chicago, Ill.
Ajax Forge Company, Chicago, Ill.
American Hoist & Derrick Co., St. Paul, Minn.
American Steel & Wire Company, Chicago, Ill.
American Steel & Wire Company, Chicago, Ill.
American Steel Co., Pittsburgh, Pa.
Crerar Adams & Co., Chicago, Ill.
Creepcheck Co., New York City.
Duff Mfg. Company, Pittsburgh, Pa.
Elliott Frog & Switch Co., East St. Louis, Ill.
Empire Railway Appliance Corporation, New York City.
Fairbanks Morse & Company, Chicago, Ill.
Frictionless Rail, Boston, Mass.
Hayes Track Appliance Co., Richmond, Ind.
Hauek Manufacturing Co., Brooklyn, N. Y.
Indianapolis Switch & Frog Co., Springfield, Ohio.
Ingersoll Rand Co., New York City.
John Lundie, New York City.
John Lundie, New York City.
Madden Company, Chicago, Ill.
Mitchell Rail Anchor Co., Louisville, Ky.
Morden Frog & Crossing Works, Chicago, Ill.
Mudge & Company, Chicago, Ill.
National Lock Washer Co., Chicago, Ill.
National Lock Washer Co., Chicago, Ill.
National Lock Washer Co., Marso., Pittsburgh, Ohio.
Norton Company, Worcester, Mass.
P. & M. Company, Chicago, Ill.
Positive Rail Anchor Co., Marion, Ind.
Pocket List of Railroad Officials, New York City.
Q. & C. Company, New York City.
Rail Joint Company, New York City.
Raily Joint Company, New York City.
Raily Specialties Co., Reading, Pa.
Sellers Mfg. Company, Chicago, Ill.
Simmons Boardman Publishing Co., New York City.

Southern Railway Supply Co., St. Louis, Mo. Templeton, Kenly & Co., Chicago, Ill. Track Specialties Company, New York City. Union Switch & Signal Company, New York City. Verona Tool Works, Chicago, Ill. Wyoming Shovel Works, Wyoming, Pa.

BRANDING LUMBER AT THE MILL

A FTER a number of years, a growing sentiment on the part of the lumber manufacturers in favor of the trade-marking of lumber has crystallized into definite action. The Southern Cypress Manufacturers' Association has adopted this practice and other lumber associations are either formulating plans for carrying it into effect or have the matter under serious consideration. In addition to this a few manufacturers have commenced to mark lumber as individuals and it is expected that others will follow their example.

The trade-marking of lumber is one method that will be used by the lumber manufacturers in their campaign to secure the proper recognition of their product for those purposes for which it is best suited and to establish a reputation for fair dealing and standardized products. As carried out by the Cypress Manufacturers' Association each piece will bear the name of the association and a number designating the mill where the stick originated. By bringing the name of the association or individual manufacturer to the notice of the user a closer relation between them is brought about which will encourage the user to bring to the manufacturer's notice any irregularities from which he has suffered.

In the case of the association mark, each mill is identified and any objectionable practice by the mill or by the jobber can be quickly run down. A strict compliance with the association regulations will soon create a reputation for the trade-marked lumber which will mean a return to the manufacturer far in excess of the expense entailed in marking.

One advantage of this system lies in the fact that it will mean as much to the small producer as to the larg-



THE BOGALUSA BRAND

est. Any mill which will conform to the regulations of the association can share in the reputation which the marked lumber will enjoy. A few of the larger manufacturers have recently begun the practice of branding their product with individual trade-marks, thus establishing reputations for the individual manufacturers rath-



er than the associations. Trade-marks of this kind are shown in the accompanying photographs.

There have been cases in the past where the producer and user have suffered alike from irregular practices on the part of the middleman, who has sold lumber as belonging to a higher grade than it classified according to the manufacturers' grading rules. It is apparent from this that the marking of the grade of the lumber would be a desirable addition to the brand. It has, however,



THE NEWMAN BRAND

been found impossible thus far to work out any practicable scheme for doing this. The rules for grading are not uniform in all localities and much lumber is used for purposes requiring special gradings or selections. Another objection arises from the possibility of some change in the grading of individual sticks after they have been graded at the mill because of the disappearance of some defects and the appearance of new ones, through changes of temperature, humidity or other causes while the material is en route.

However, with the trade-mark clearly shown on the stick the purchaser can readily trace down any irregularities in the grading. It is also entirely possible that select structural material classed as dense southern yellow pine according to the recently adopted classification, will be placed on the market branded as to grade.

The accompanying photographs show two schemes for branding the lumber: one on the side and the other on the end. The latter is the favored practice and is executed automatically by a machine as the lumber leaves the trimmer table, the marks being a combination of an impression in the fibres and an ink mark. When the prices are branded on both ends the ink is commonly used on one end only. Marking the sticks on both ends simplifies the process and has the advantages that the piece is still identified after one end has been cut off and when the lumber is piled the marks will always be visible on the ends of all the sticks exposed on any side. The minimum size which it has been found practicable to mark is 1 in. by 3 in.

The trade-marking of lumber will work to the advantage of the reputable dealers and to the disadvantages of the unscrupulous. With this impetus to fair dealing the gain to the purchaser should be great, particularly to a large purchaser such as a railroad, whose requirements are not only diversified but exacting.

AN ENLARGED TIE TAMPING OUTFIT

THE Ingersoll-Rand Company, New York, has recently placed a compressor car on the market designed to provide air for four Imperial tie tampers. It is similar in make-up and detail to the two-tool car previously introduced, except that it has a 20-hp. engine with a compressor capacity of 88 cu. ft. of free air per minute instead of a 12-hp. engine and a compressor capacity of 45 cu. ft. of free air per minute, provided in the smaller car. The car complete is also about 50 per cent heavier. The car has a width of 5 ft. 10 in and a longth of 11

The car has a width of 5 ft. 10 in. and a length of 11 ft. 6 in. The direct-connected engine and compressor



THE ENLARGED TIE TAMPING OUTFIT

are housed in a closed box with removable sides, placed in the center of the car and leaving ample platform space on both ends to carry the tools and the crew. The car is self-propelled through the medium of a lever-controlled clutch on the engine. Both the engine and the compressor are lubricated automatically by means of a splash system. The compressor is cooled by water from the engine radiator. To facilitate moving the car on or off the track, a set of cross trucks is provided.

Aside from the car, the complete outfit includes four of the pneumatic tie tampers, each fitted with a tamping bar and two 300-ft. hose units. A set of lifting jacks is also furnished to assist in removing the car from the track and replacing it.

A HOME-MADE RAIL LOCK INDICATOR

THE accompanying drawing shows a home-made switch for a rail lock indicator on a draw span, which was made and installed on a bridge after it was in service, no indicator having been provided when the bridge was built. The draw span is 400 ft. long, and the



DIAGRAM OF INDICATOR

operating cab is suspended above the tracks in the center of the span, so that the rail locks are 200 ft. away from the operator. While each end of the draw is illuminated with a 100-watt lamp; during dark nights, especially in bad weather, the operator cannot see readily if the rails are in line when the bridge is being closed.



The various functions of closing and opening the bridge are not interlocked to insure proper sequence of operation and the completion of each function before commencing the next one, but light indicators were provided in the operator's cab to show when the end jacks are in or out. As there is no indicator for the end latch, it is possible for the operator to extend the jacks when closing the bridge without having the bridge and rails properly lined up.

To overcome this, the switch shown in the drawing was designed and mounted horizontally between the track rails, parallel to the center line of the track, the rail locks working horizontally. It consists of a cast iron case containing a movable rod on which a contact disc is mounted between two springs. On one end of this rod, projecting outside of the casing is an adjustable head separated from the casing by a coiled spring. This head is placed so that it is moved to the left when the rail locks are thrown into position, compressing the spring and forcing the contact disc against the terminals B. This completes a circuit and lights a green indicator lamp in the operator's cab. When the rail locks are opened the adjustable head is released and forced to the right by the spring, bringing the contact disc in contact with the terminals C. This completes the circuit to light a red indicator lamp in the operator's cab. Springs are provided in the inside of the case to permit overrun of the operating rod, in case the adjustment of the contact head is not accurate.

We are indebted for this information to J. G. Koppel, Sault Ste. Marie, Mich.

A QUICK-REPAIR SWITCH STAND

SWITCH which has been run through is always a A source of annoyance because of the expense involved in bent rails or broken stands and because it ties up the traffic until repairs can be made. This difficulty is overcome in the Anderson quick-repair switch stand which is provided with a single easily-breakable part which



THE ANDERSON SWITCH STAND.

will be destroyed quickly when the switch is run through, thereby preventing damage to any other parts. It provides also for quick renewal of the broken part so that the switch need be out of service only a very short time.

This switch is of the parallel throw type and is equipped with a crank pin, which is necked down at the point where it passes from the hole in the crank to the one in the crank rod, so that it is easily broken when a

pressure is applied on the crank rod and the throwing lever is locked. A new pin can be placed in five minutes by any track laborer at a cost of 15 cents for the new pin. Each switch stand is sent out with two pins, the extra one being held in a small lug on the back of the crank, where it is always ready for use. This crank pin is self-locking, being provided with a small lug on one side of the lower end, which is tapered to permit its ready entrance into the holes in the crank and the crank rod, but which prevents its removal. As the end of the connecting rod is under the switch stand housing, it is held down so that it is impossible for the rod and arm to become disconnected unless the crank pin is broken.

Another feature of this switch stand is the throwing lever, which is forged in one piece with the pinion shaft. The housing is designed to afford protection from dirt, ice and snow. This switch stand is made by the American Valve & Meter Company, Cincinnati, Ohio, and has been used on a number of important railroads.

A NEW SHEET PILING

A improvement of the common Wakefield sheet pil-ing has been devised which provides a positive interlock like steel sheet piling. As shown in the accompanying drawing, the two outside members of each unit are milled or grooved longitudinally on the inside of the mortise to receive projecting lugs on the tenon of the middle piece. Sufficient clearance is provided to prevent binding, but the fit is close enough to insure a watertight cofferdam. The drawing also shows the detail of the corner units.

This sheet piling has been used on government levee work in the South. A typical installation on the fourth levee district on the Mississippi river involved 857 lineal feet of bulkhead, with a total cost of \$4,309.76, of which



METHOD OF TURNING CORNER.

\$1,328.27 represented the cost of driving. These piles were all heart long leaf yellow pine, and were $5\frac{1}{2}$ in. thick by 20 ft. long, and were driven full length by a 2,350-lb. drop hammer, with a fall of 12 ft., at an average of 80 blows per pile. No difficulty was experienced, except where a few buried logs were encountered.

These piles were used recently by the Louisiana Railroad & Navigation Company for a water-tight bulkhead 250 ft. long at New Orleans. The piles were 41/2 in. net thickness and 24 ft. long, with a 16-ft. penetration. For a distance of 150 ft. the piles were driven through the remains of an old barge without drifting, shattering or otherwise injuring them. The accompanying photograph shows a pile driver at work on the cofferdam for a bridge pier at New Orleans. The sheet piles were $5\frac{1}{2}$ in. thick by 30 ft. long.

This sheet piling is made of long leaf yellow pine by the J. J. Newman Lumber Company, Hattiesburg, Miss., and is known as the Martinez interlock sheet piling. The piles are furnished knocked down. One cent per lineal foot of pile is said to cover the cost of labor and nails to assemble them.



GENERAL NEWS DEPARTMENT

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The Kentucky Court of Appeals holds that a section hand assumes the risk of falling off a hand car because of its being overcrowded, where the conditions are open and obvious, he being aware of them when boarding it, not complaining and not being directed by the foremen to board the car in spite of its condition.

SEC:SEC

In a damage suit for \$34,000 brought against the Chicago, Milwaukee & St. Paul by a conductor who had been dismissed from service when it was found he used intoxicants, Judge A. Van Valkenburgh of the United States District Court at Kansas City declared that, "it is the duty of a railroad to the public it serves to protect its patrons by discharging men who use intoxicants."

According to a statement issued by Thomas W. Hulme, general secretary of the Presidents' Conference Committee on the federal valuation of the railroads, 64,793 miles of line of road and track have been inspected and inventoried up to May 31, 1916. The federal parties had also covered the bridges on 40,112 miles of line and had inspected "adjacent similar lands" on 29,495 miles of line previous to that date.

In a case against the Chicago, Milwaukee & St. Paul, the Wisconsin Supreme Court has decided that the work of preparing articles for interstate commerce is not a part of such commerce within the meaning of the federal employers' liability act. In the case under consideration an employee of the railroad was killed at Tomah. Wis., by a pile of lumber falling upon him, the lumber being used in the manufacture of articles used by the road.

The Boston & Maine has granted an increase of five per cent in wages to such of its employees outside of the "Big Four" brotherhoods who have not had advances recently, and who are not being paid more than the prevailing wages for similar work in eastern New England. The increase will add about \$800,000 a year to the Boston & Maine payrolls. It has been accepted by several of the unions that have taken strike votes to enforce recent demands upon the road.

The Texas Court or Civil Appeals holds that the custom of the railroads to make deductions from the wages of its employees in favor of persons having claims against them in accordance with a statement in a time book, constituting an order upon the company and signed by the employees, which action was taken for the accommodation of the employees and without consideration, does not constitute an assumption of primary liability by the railroad for goods sold to a section gang at the request of a section foreman.

The Norfolk & Western has notified employees that, except where important interests of the company interfere, anyone wishing to take his vacation this year at Camp Oglethorpe, Ga., for military training will be allowed a month with pay. This is an experiment as the company believes that large employers of men ought to encourage military training. An officer of the company states that only two employees took advantage of the company's offer for the May encampment; one a man from the general office, and the other a conductor on the Norfolk division.

On Sunday, June 4, the officers of the Bangor & Aroostook invited about 1,500 of the employees to attend a "good-will meeting" at Houlton, Me., special trains being run from all of the divisions of the road. Before the meeting was called, the brakemen and the telegraphers, who belong to brotherhoods. held meetings of their own organizations. At the general meeting Percy R. Todd, president of the road, announced that a cash bonus of four per cent of the wages received during the 12 months ending June 1, 1916. would be paid at once to each employee receiving less than \$2,000 a year. The enginemen and firemen of this road are non-union, nearly the whole force having been recruited since January, 1913, when the brotherhood men declared a strike. Most of the shopmen and clerks are also non-union, while the conductors, brakemen, station men

and section men belong to the unions. It is said that none of the employees of this road are taking part in the present movement for an eight-hour day, though president Todd in his address took occasion to repeat his former declaration that the company is not opposed to labor unions.

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The Mississippi Supreme Court holds that, where a railroad company properly acquired a parcel of land for a right of way, and the contour of the land rendered a cut necessary, the road is not liable to the grantee of the owner of the land for injuries caused by the slipping of the land into the cut, the lateral support being removed. The original grant of the right of way necessarily included a right to make the cut and remove the lateral support. When a right of way is condenined or bought, it is held that the right to do any and all things necessary and proper in the use of it is presumed to have been paid for.

The Nebraska Supreme Court holds that, where a section foreman has notice of the railroad's rules requiring him to send a man ahead to look out for a train when approaching a sharp curve in a deep cut on a hand car, the failure of trainmen to give warning of their approach before the presence of the section men is discoverable, is not negligence in the absence of a statute or rule requiring them to do so. The trainmen may assume until the contrary appears, that section men will obey reasonable known rules promulgated for the safety of themselves and others and that where a foreman breaks the rules and is killed on failing to jump from the car before being struck, no recovery can be had for his death.

In an action of mandamus by a landowner to compel a railroad company whose line ran through his land to construct an undercrossing in place of the existing grade crossing, the railroad claimed that at no place could a crossing of any character be constructed without making the grade so steep that it could not be traveled in any manner; and that to construct an undercrossing where the plaintiff wanted it, even at an unreasonable grade, would cost more than \$8,000. The Iowa Supreme Court holds that, on the question whether a grade crossing with proper gates and guards is adequate, the consideration of cost is not a defense, but is a circumstance properly to be considered and neither the expense nor the convenience or profit to the landowner taken alone is necessarily ground for making or refusing an order for an undercrossing. A landowner is entitled not to the most convenient or profitable means of crossing, but to an "adequate crossing," the location and character of which must be determined with due regard for all the interests involved in its construction and maintenance. The court refused to order an underground crossing, but ordered that the railroad place a gate at the existing grade crossing and cut down an embankment to enable an approaching train to be seen.

The labor leaders have secured favorable action by the House Committee at Washington on a bill to make more stringent the hours-of-labor law as effecting signalmen, and to bring within its provisions signalmen at interlocking towers even where they do not send or receive train orders; and the bill is now on the House calendar awaiting action. The bill bears the name of Representative Cullop of Indiana and the House committee has made a favorable report on it. In night-and-day offices the working time-limit is reduced from 9 hours to 8, and the 8-hour term must be one continuous period. On the completion of the 8-hour period the employee must not be required or permitted to go on duty again until the expiration of 16 hours. The provision taking in levermen, which is effective only in towers, stations, etc., which are operated continuously, applies to men who operate "signals or switches or similar mechanical devices controlling, pertaining to, or effecting the movement of trains." Exception is made in the case of accidents, etc., where the telephone must be used to obtain orders, and the law does not apply to railroads where there are not more than two passenger trains daily. On such roads of light traffic, signalmen may work 10 hours in each 24-hour period.



PERSONAL MENTION

GENERAL

G. A. HARWOOD has been appointed engineering assistant to the vice-president in charge of operation of the New York Central, with duties assigned and headquarters at New York. He was formerly chief engineer of electric zone improvements.

ARTHUR D. PETERS, who has recently been appointed division superintendent of the Lake Erie & Western, with headquarters at Lima, Ohio, was born at Springport, Mich., on March 19, 1879. He graduated from the engineering department of the Michigan Agricultural College in 1903, and entered railway service with the Lake Shore & Michigan Southern as a draftsman on February 22, 1906. From September, 1906, until July, 1907, he was in the land and tax department, after which he was real estate agent of the Lake Erie & Western until August, 1903, since which time he has been special engineer.

RICHARD H. AISHTON, who has recently been elected president of the Chicago & Northwestern, was born at Evanston, Ill., on June 2, 1860. He entered the service of the Northwestern in 1878 as an axman in the engineering corps and has been in the employ of this road continuously since that date, advancing through the positions of rodman, levelman, assistant engineer, superintendent of bridges and buildings and division engineer, until June 1, 1895, when he was appointed assistant superintendent. Since that date he has been in the operating department, being appointed general manager in January, 1906, and vice-president in charge of operation and maintenance in November, 1910.

ENGINEERING

SAMUEL MURRAY has been appointed chief engineer of the Oregon-Washington Railroad & Navigation Company, with headquarters at Portland, Ore. Mr. Murray has been acting chief engineer since September 14, 1915, succeeding J. R. Holman, who was granted an indefinite leave of absence at that time.

HENRY C. COSAND has been appointed division engineer and master carpenter of the Chicago, Rock Island & Pacific, with headquarters at Eldon, Mo. Mr. Cosand was born at New

Castle, Ind., on September 7, 1877, and graduated from Purdue University in 1904. He entered the service of the Rock Island in the same year as a rodman and instrument man, with headquarters at Topeka, Kan. In 1906, he worked as a draftsman in the Topeka office of the same road. In 1907 and 1908 he was assistant en- . gineer in charge of construction at the Armourdale Yards, Kansas City, Kan. In 1909 he was assistant engineer in the office of the engineer of maintenance of way at Topeka, Kan. He was engineer in charge of construction of new terminal facilities at North St. Louis,



HENRY C. COSAND

Mo., in 1910, and from 1911 to 1914, was office engineer in the office of the engineer of maintenance of way at Topeka. In 1915 he was appointed pilot engineer on government valuation work in Missouri, Kansas and Colorado. He was made division engineer of the St. Louis division on January 1, 1916, and on May 21 was also appointed master carpenter. His entire railroad experience has been with the Rock Island.

J. A. GILLIES has been appointed engineer of the southern district of the Atchison, Topeka & Santa Fe, western lines, with headquarters at Amarillo. Tex.

S. W. BRADY, who has been temporarily engaged in federal valuation work, has resumed his duties as engineer of the Beaumont division of the Gulf, Colorado & Santa Fe, with headquarters at Beaumont, Tex., taking the place of G. A. Knapp, who has been acting in that capacity.

TRACK

R. M. BARRETT, supervisor of the Wellsville & Buffalo at Arcade, N. Y., has been appointed roadmaster, with headquarters at the same point.

J. W. THOMAS has been appointed roadmaster of the Norfolk & Western, with headquarters at Wilcoe, W. Va., succeeding J. B. McConnell, transferred.

C. B. M. LONG has been appointed track supervisor of the Baltimore & Ohio, with headquarters at Holloway, Ohio, in place of W. A. Hennen, transferred.

I. J. KILBURN has been appointed roadmaster of the Colorado division of the Atchison, Topeka & Santa Fe, with headquarters at Pueblo, Colo., succeeding J. P. Costello, promoted.

PAUL KIRKBRIDE has been appointed assistant roadmaster of the Norfolk & Western, with headquarters at Williamson, W. Va., succeeding C. P. Yost, assigned to other duties.

CHARLES SAXON has been appointed roadmaster on the Peninsular division of the Chicago & Northwestern, with headquarters at Iron Mountain, Mich., vice George Mathiason, resigned.

J. P. COSTELLO, roadmaster of the Colorado division of the Atchison, Topeka & Santa Fe, with headquarters at Pueblo, Colo., has been promoted to inspector of track, western lines, with headquarters at La Junta, Colo.

G. W. HUFFMAN has been appointed supervisor of the Baltimore & Ohio at Ravenna, Ohio, vice F. C. Green, transferred. E. Landis has been appointed supervisor at Rowlesburg, W. Va., vice G. W. Huffman, transferred.

EDWIN L. HOOPES, who was recently promoted to supervisor on the Tyrone division of the Pennsylvania Railroad at Osceola Mills, Pa., was born September 2, 1882, and after graduating from Princeton, entered the service of the Pennsylvania on June 12, 1905, as chainman. In April, 1910, he was appointed assistant supervisor at Verona, Pa., being transferred on July 1, 1912, to Mt. Holly, N. J., and on July 1, 1913, to Perryville, Md.

T. H. HICKEY has been appointed track inspector of the Michigan Central, with headquarters at Detroit, Mich. He was born in Ireland on October 2, 1852, and first entered railway service in 1872, with the Ft. Wayne & Jackson. In 1881 he entered the employ of the Michigan Central as an extra gang foreman and one year later was promoted to assistant road-master on the Eastern division. He was promoted to division roadmaster in 1884, and in 1892 was transferred in the same capacity to the Canadian division, with headquarters at St. Thomas, Ont.

GEORGE M. BALL, JR., supervisor of the Pennsylvania Railroad at Jersey City, N. J., has been transferred to Washington, D. C., succeeding Robert Faries, transferred to Baltimore. Jerry Bergan, supervisor at Elmira, N. Y., has been transferred to the office of the division engineer at that point. F. J. Potter, supervisor at Bordentown, N. J., has been transferred to the office of division engineer at Trenton, N. J. W. W. Springer, supervisor at Earnest, Pa., has been transferred to Baltimore. A. E. Preble, supervisor of the Camden Terminal division and the West Jersey and Seashore, with headquarters at Camden, N. J., has been transferred to Bordentown, being succeeded at Camden by Joseph H. Reading, supervisor at Baltimore. Thomas E. Lightfoot, supervisor at Reading, Pa., has been transferred to Erie. W. D. Cornwell, supervisor at York, Pa., has been transferred to Elmira, N. Y. F. M. Robb, supervisor at Osceola Mills, Pa., has been transferred to Oil City, succeeding Harold J. Davall, transferred to Jamesburg, N. J. Wm. P. Critchfield, supervisor at Kittanning. Pa., has been trans-



ferred to Freeport. R. S. Stewart, supervisor at Trenton, N. J., has been transferred to Kittanning, Pa.

CLARENCE L. FRY, assistant supervisor of the Pennsylvania Railroad at West Brownsville, Pa., has been transferred to Baltimore, succeeding Wendell G. McNees, transferred to West Brownsville, Pa. Herbert H. Kaufman, assistant supervisor on the Philadelphia division, has been transferred to York, Pa. Raymond Swenk, assistant supervisor of the Delaware division, has been transferred to the Camden Terminal division and the West Jersey and Seashore, with headquarters at Camden, N. J., succeeding Joshua F. Hunter, transferred to the Maryland division.

JAMES McCoy, who was promoted to supervisor of the New York division of the Pennsylvania Railroad at Jersey City, N. J., on May 15, was born at Susquehanna, Pa., September 26, 1862, and entered the service of the Pennsylvania on May 25, 1884, as sub-foreman on the New York division. On December 1 of that year he was advanced to track foreman, and on February 1, 1909, he was promoted to the position of general track foreman of the Manhattan division. He was appointed assistant supervisor, Manhattan division on November 1, 1912, which position he held until his recent appointment.

J. B. MCCONNELL has been appointed roadmaster of the Norfolk & Western, with headquarters at Portsmouth, Ohio, vice J. D. McNamara, appointed yard foreman at that point. Mr. McConnell was born at Gate City, Va., in October, 1887, and entered railway service as a section laborer on the Norfolk & Western in January, 1904. In March, 1905, he was made assistant foreman of an extra gang and remained in that position until January, 1911, when he was promoted to extra gang foreman. On June 28, 1915, he was appointed roadmaster, with headquarters at Wilcoe, W. Va., and on May 24, 1916, was transferred in the same capacity to the Scioto division, with headquarters at Portsmouth, Ohio.

WILLIAM JOSEPH AGER has been appointed roadmaster of the Northern Pacific, with headquarters at Tacoma, Wash., vice C. W. Fee, promoted to trainmaster at the same place. He was born at Dublin, Ireland, on May 16, 1864, and first entered railway service as a general foreman with the Oregon-Washington Railroad & Navigation Company on June 10, 1902. From September 14, 1903, to March, 1908, he was superintendent of construction of the Spokane Traction Company at Spokane. Wash. He then returned to the service of the O.-W. R. & N. Co. as a roadmaster, remaining in that position until June, 1912. In December, 1912, he entered the employ of the Northern Pacific as an extra gang foreman, and in December, 1915, was made a section foreman on the same road. He was promoted to roadmaster on May 12, 1916, with headquarters at Tacoma, Wash.

BRIDGE

WALTER SCHLINKERT has been appointed supervisor of scales of the Illinois Central, with headquarters at Centralia, Ill., vice Fred Schlinkert, deceased.

CHARLES F. NYE has been appointed supervisor of water service of the Wheeling & Lake Erie, with headquarters at Brewster, Ohio, succeeding Adam Nye, deceased.

W. E. WHITE has been appointed assistant general foreman of the bridge and building department of the Atchison, Topeka & Santa Fe, with headquarters at Chanute, Kan.

J. O. BUTLER has been appointed acting general foreman of the bridge and building department of the Atchison, Topeka & Santa Fe, with headuqarters at Wellington, Kan., vice Ed Mc-Cann, who has been pensioned.

CHARLES R. KNOWLES, general foreman of waterworks of the Illinois Central and the Yazoo & Mississippi Valley, has been appointed superintendent water service of these roads, with headquarters at Chicago, Ill., effective June 23.

WILLIAM D. SIGEL has been appointed master carpenter of the Pittsburgh, Cincinnati, Chicago & St. Louis, with headquarers at Xenia, Ohio, vice S. H. Deacon, retired on account of old age. Mr. Sigel was born at Cherry Grove, Hamilton County, Ohio, on August 29, 1864, and attended Normal University at Lebanon, Ohio, in 1880 and 1881. He entered railway service as a carpenter in the maintenance of way department on the Cincinnati division of the Pittsburgh, Cincinnati, Chicago & St. Louis on May 20, 1891. In September, 1900, he was promoted to carpenter foreman on the same division, and on June 1, 1916, he was appointed master carpenter, with headquarters at Xenia, Ohio.

BENJAMIN H. MCNAMARA, recently appointed master carpenter of the Chicago, Rock Island & Pacific at Dalhart, Tex., was born at Marietta, Ohio, on April 20, 1860. He had a common and high school education and entered railway service in the bridge and building department of the St. Louis & San Francisco on May 20, 1890. He was a division foreman in this department until February 1, 1902, when he left the Frisco to become general foreman in the bridge and building department of the St. Louis, Kansas City & Colorado, now a part of the Rock Island. He continued in the same position until October 10, 1912, when he was promoted to master carpenter of the St. Louis division of the Rock Island, with headquarters at Eldon, Mo. On May 22, 1916, he was transferred as master carpenter to the El Paso division, with headquarters at Dalhart, Tex., vice J. M. Beaty, transferred to Fairbury, Neb.

PURCHASING

E. W. THORNLEY, district storekeeper of the Pittsburgh division of the Baltimore & Ohio, has been appointed assistant general storekeeper.

R. A. JACOBS, formerly inspector of stores of the St. Louis & San Francisco, at Springfield, Mo., has been appointed superintendent of the reclamation plant, with headquarters at Springfield, succeeding R. F. Whalen, resigned.

H. J. McQUADE, recently appointed purchasing agent of the Lehigh Valley, with headquarters at New York, entered the service of the Lehigh Valley as a clerk in the local offices in Philadelphia when a boy, 29 years ago. On February 3, 1902, he was transferred to the general bookkeeping department, and on December 23, 1903, was appointed chief clerk to the general auditor, which position he held until January 20, 1909, when he was elected assistant treasurer, remaining there until June 1, 1910, when he left the service of the Lehigh Valley to assume other duties. He now returns to the Lehigh Valley as purchasing agent of that road.

OBITUARY

CHARLES HOPKINS CARTLIDGE, bridge engineer of the Chicago, Burlington & Quincy, died at his home in Hinsdale (Chicago), on June 14, after a brief attack of pneumonia. He was born at Hannibal, Mo., on April



CHARLES H. CARTLIDGE

and the Nashville, Chattanooga & St. Louis, organized to build a 12-mile connection between Metropolis, Ill., and Paducah, Ky., including a double-track bridge across the Ohio River. In his work as bridge engineer he was a pioneer in the development of reinforced concrete trestle and culvert construction, using these types largely on work built under his direction.

29, 1869. After receiving a grammar and high school education he entered railway work on the Kansas City, Memphis & Birmingham on July 18, 1886. He was engaged on construction work with this road from November, 1886, to June, 1888, from which time he was employed on land surveys and municipal engineering work at St. Joseph, Mo., until June 26, 1890. On this date he entered the bridge department of the Burlington as a draftsman, being appointed bridge engineer on June 16, 1902. He was also chief engineer of the Paducah & Illinois, a subsidiary of the Burlington,





THE BALTIMORE & OH10 has been asking for bids for the construction of a new open pier at the company's export terminal at Locust Point, Baltimore, the estimated cost being \$650,000. The new pier will be 1,000 ft. long and 150 ft. wide, with a water depth of 35 ft. and will have a double track in the center, with a single track on the east side.

The Baltimore & Ohio will soon award the contract for the erection of a steel-frame freight house, 350 ft. long by 35 ft. wide, at Thirty-third street, Pittsburgh.

The Baltimore & Ohio has made plans for new freight facilities to be constructed at Parkersburg, W. Va., at a cost of \$300,000. The improvements consist of a modern freight station, transfer platform, team tracks and offices for the division freight and the agency forces. The building will be of brick construction, 500 ft. long by 35 ft. wide, with the office portion of the building occupying the second floor.

The Baltimore & Ohio has received bids for the construction of the Long Fork Railroad in northeastern Kentucky, extending from a junction with the Chesapeake & Ohio Railroad at the forks of Beaver Creek, Floyd County, in a southerly direction to Weeksbury, Knott County, a distance of 26 miles. The line will involve five tunnels from 140 feet to 775 feet in length. The new line will be built to reach a large area of coal lands on which development has been started.

THE BESSEMER & LAKE ERIE will build a large concrete ore dock at Conneaut, Ohio, and has made application to the government for the establishment of a new harbor line.

THE CANADIAN NORTHERN PACIFIC will erect a \$1,000,000 freight and passenger terminal at Vancouver, B. C., a freight shed, 800 ft. by 40 ft., and a roundhouse, and will lay approximately 130,000 ft. of track. The grading work, which involves the handling of 4,000,000 cu. yd. of material, is well advanced, and bids for the construction work will be called for soon.

THE CHICAGO & EASTERN ILLINOIS is doing preliminary work on a new passenger station at Danville, III., including trackage and sheds, at an approximate cost of \$175,000. It is also completing car shops partially built in 1913 at a cost of about \$100,000.

THE CHICAGO GREAT WESTERN has awarded a contract to Joseph T. Nelson & Sons, Chicago, for the erection of two buildings at Oelwein, Iowa, to be used as a rail reclamation plant. They will be one-story frame buildings, 34 ft. by 70 ft. and 40 ft. by 96 ft. respectively. The following machinery recently purchased will be installed: One Ryerson No. 3 high speed motordriven section saw, one drill press, three spindle rail drilling machines with motor drive, one No. 11 Boudry Champion power hammer, one motor drive reverse planer outfit. The buildings with equipment will cost about \$8,000.

THE CHICAGO, MILWAUKEE & ST. PAUL is constructing a 500ft. by 175-ft. extension to its docks at Tacoma, Wash., at an estimated cost of \$200,000. The extension is a timber structure with a roof covering and the work is being done by company forces.

THE DETROIT, BAY CITY & WESTERN is building an extension southeasterly from Peck, Mich., its present terminal, to Pt. Huron, 32 miles, to include the construction of one 700-ft. trestle, and 12 small bridges varying from 12 ft. to 30 ft. in length. A depot and a roundhouse are contemplated at Pt. Huron and a new terminal depot at Bay City to cost about \$60,000.

THE DULUTH & IRON RANGE has let contracts for the erection of a car repair shop at Two Harbors, Minn., which will be a one-story, steel-frame structure, 275 ft. by 310 ft., with concrete block walls. Strom Brothers of Two Harbors, Minn., have the contract for the foundation work, and the steel work has been ordered from the American Bridge Company. No contract has yet been awarded for the erection of the superstructure. THE GREAT NORTHERN has awarded a contract to Grant, Smith & Company, Seattle, Wash., for the construction of a 20-stall brick roundhouse, a powerhouse and a 100-ft. turntable at Great Falls, Mont., and a contract to the Howlett Construction Company, Moline, 111., for a 500-ton coal chute, work now being under way.

THE ILLINOIS CENTRAL is preparing plans for a two-story, brick and concrete passenger station, with tile roof, at Mattoon, 111., 36 ft. by 150 ft., to cost about \$50,000.

The Illinois Central is preparing plans and specifications for a brick freight house at East St. Louis, Ill., 1,050 ft. by 40 ft., 400 ft. of which will have two stories.

THE INDIANAPOLIS UNION has awarded a \$125,000 contract to the Ketler-Elliott Erection Company, Chicago, for part of the steel work in connection with the elevation of tracks through the business district of Indianapolis.

THE LEHIGH VALLEY is making improvements at Manchester, N. Y., which include a 30-stall roundhouse, the construction of a machine shop, boiler, engine and oil houses, an office building, a concrete and steel water ash pit, a gravity coal trestle and a 100-ft. turntable. Special electrical apparatus will be installed to operate all of the machinery and light in the yards, and a large compressor layout will be provided for supplying air throughout the yards for testing purposes. Westinghouse, Church, Kerr & Company, New York, have the contract for this work.

The Lehigh Valley will make terminal improvements at Niagara Falls, N. Y., consisting of a 15-stall roundhouse, machine shop, storehouse, engine, boiler and oil house, an office building and a freight house having concrete platforms on either side. An extensive addition to the yard tracks will be necessary, which will include a car repair yard, shops, storehouses, drop pits, a washout system for cleaning engines, a concrete and steel coal pit and water ash pit. The new freight station and the necessary yards will be built near Suspension Bridge.

THE McCONNELLSBURG & FORT LOUDON desires to receive bids for the building of a railroad from McConnellsburg. Pa., to Fort Loudon, about 11 miles, the plans calling for about 100,000 cu. yd. of excavation work. The maximum grade is $6\frac{1}{2}$ per cent and the maximum curvature 18 deg.

THE MISSOURI, KANSAS & TEXAS is replacing the light spans of its bridge over the Arkansas river at Muskogee, Okla., with heavier ones and is constructing four new piers, the J. W. Mc-Murry Construction Company, Kansas City, Mo., having the contract for the pier construction. The cost of the improvement is estimated at \$62,000.

THE NEW YORK CENTRAL AND THE ERIE are now engaged in the elimination of grade crossings at Niagara Falls, N. Y., at an estimated cost of \$600,000. Solid-floor steel bridges are to be erected on concrete masonry. A contract has been let to the Fort Pitt Bridge Works for the fabrication of the steel and contracts are to be let by the city of Niagara Falls for the sub-structure and grading work, and also for the paving of the streets.

THE OREGON-WASHINGTON RAILROAD & NAVIGATION COMPANY, together with the street railway company of Portland, Ore., have been assessed 60 per cent of the cost of the plans which have been filed with the city authorities, providing for the elimination of grade crossings on the Oregon-Washington Railroad & Navigation Company's line in Sullivan Gulch, which includes the construction of seven permanent and three temporary viaducts. The estimated cost of the structures is \$520,000, and of the entire project \$600,000. Legal procedure does not permit the asking of bids before the latter part of September or the first of October.

THE PENNSYLVANIA LINES have awarded a contract to Henkel & Sullivan, Cincinnati, Ohio, for the masonry and street work in connection with track elevation between Delta and Stanley avenues, Cincinnati.

THE PHILADELPHIA & READING has awarded a contract to the Atlantic, Gulf & Pacific Company, New York, for the dredging and embankment work for an additional pier at Port Reading, N. J., to facilitate the unloading of coal from cars, while the McMyler-Interstate Company, Cleveland, has the contract for

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the car-unloading machinery. A contract has also been let to the Surety Engineering Company, Inc., New York, to build a thawing plant with a capacity of 44 cars at Port Reading.

THE PITTSBURGH, CINCINNATI, CHICAGO & ST. LOUIS has awarded a contract to Dunn & McCarthey, Chicago, Ill., to construct a new freight terminal at Indianapolis, Ind., which includes the laying of 55 miles of track and the construction of a roundhouse, coaling plant, water station, inspection pits, ash pits, sandhouse, oilhouse, powerhouse, yard office, scales and interlocking towers.

THE SALINA NORTHERN is building an extension 55 miles long from Lincoln Center, Kan., northwest, involving 850,000 cu. yd. of fill, 285,000 cu. yd. of cut, 25,000 cu. yd. of rock excavation, the erection of one 55-ft. deck girder span, three 67-ft. girder spans and four 120-ft. pin-connected truss bridges, the placing of 2,500 cu. yd. of masonry and the erection of 6,400 lineal ft. of trestles.

THE WHEELING & LAKE ERIE will build a three-story, reinforced concrete freight house, 40 ft. by 360 ft., at Canton, O., at an estimated cost of \$90,000, and will lay about $1\frac{1}{2}$ miles of track, involving the erection of three bridges. J. C. Carland & Company, Toledo, O., have the contract for the track work.

TRACK MATERIALS

THE CHICAGO, INDIANAPOLIS & LOUISVILLE is making inquiries for 1.000 kegs of spikes.

THE CHICAGO GREAT WESTERN has ordered an additional 1,000 tons of rails from the Illinois Steel Company.

THE ILLINOIS CENTRAL has ordered the following track specialties for its requirements during the ensuing year: 20,000 tons of tie plates, 30,000 pairs of angle bars, 20,000 kegs of track spikes and 45,000 kegs of track bolts.

STRUCTURAL STEEL

THE CHICAGO, MILWAUKEE & ST. PAUL has ordered 111 tons of steel from the Wisconsin Bridge & Iron Co., Milwaukee, for use in the Lake street and South Water street subways, Milwaukee.

THE CENTRAL OF NEW JERSEY has ordered 400 tons of bridge steel from the McClintic-Marshall Company.

THE LEHIGH VALLEY has ordered 1,600 tons of structural steel from the Phoenix Bridge Company.

THE NEW YORK CENTRAL has ordered 850 tons of steel from the Fort Pitt Bridge Works for grade crossing elimination work at Niagara Falls, N. Y.

The New York Central has ordered 300 tons of steel from Terry & Tench for a viaduct on Vanderbilt avenue, between Forty-eighth and Forty-ninth streets, New York.

THE PENNSYLVANIA RAILROAD has ordered 1,200 tons of bridge work from the Pennsylvania Steel Company.

The Pennsylvania Railroad has ordered 150 tons of steel from Lewis F. Shoemaker & Company, and will soon place orders for 350 tons of steel for six bridges and 300 tons for a subway connection at the New York station.

The Pennsylvania Railroad has ordered 2,600 tons of bridge steel from the Fort Pitt Bridge Works and 1,800 tons from the Phoenix Bridge Company.

THE PHILADELPHIA & READING has ordered 200 tons of steel for a bridge at Pottstown, Pa., from the American Bridge Company.

THE SOUTHERN RAILWAY has ordered 500 tons of steel from the McClintic-Marshall Company for an office building at Washington, D. C.

ACCORDING to current reports, the Russian Government is negotiating for over 300,000 tons of steel rails for delivery late in 1916 and early in 1917. It is understood that approximately one-half of this order has already been taken by the United States Steel Corporation.

THE WABASH has ordered 266 tons of steel for three girder bridges to be built at Attica, Ind., and Toledo, Ohio, from the American Bridge Co.

SUPPLY TRADE NEWS

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WILLIAM P. HARPER, chief of the purchasing department of the Allis-Chalmers Manufacturing Company and president of the Northwestern Manufacturing Company, Milwaukee, died of apoplexy on May 27.

JAMES A. NOLAN has accepted a position as superintendent of the track tool department of the Oliver Plow Company, Hamilton, Ontario. For several years he held a similar position with Hubbard & Co., Pittsburgh, Pa.

R. E. WILLIAMS, formerly auditor of the International & Great Northern and the Texas & Pacific, has joined the railway sales department of the Patton Paint Co., Milwaukee, Wis., and, in conjunction with W. E. Kelley, will have charge of the business of the Patton Paint Co. in the Southwest.

W. A. PHILLIS has been appointed advertising manager of the Borden Company, Warren, Ohio, in charge of the publicity and advertising of Beaver square-end pipe cutters and easyworking die stocks. Mr. Phillis was previously connected with the metallurgical and advertising department of the National Tube Company, Pittsburgh, Pa.

CHARLES A. GROSS, formerly assistant sales manager, structural steel department, of the Bethlehem Steel Company at New York, has resigned to join the Harris-Silvers-Baker Company, New York, engaged in the fabrication and erection of steel structures, which company is being reorganized. It is understood that Mr. Gross will be secretary of the new company.

JAMES T. HALL, president of the National Surface Guard Company, Chicago, died at that city on May 18, aged 81. He was born at Newport, Herkimer County, New York, in Feb-



JAMES T. HALL

WARD B. PERLEY has been elected vice-president and general manager of the Canadian Steel Corporation, a subsidiary of the United States Steel Corporation, organized to build the new Canadian works at Ojibiway. Ont. The first announcement The first announcement that the steel corporation would build a Canadian works was made several years ago, but the announcement of the new corporation indicates that work will be begun at once on the new plant. Mr. Perley has long been identified with the steel industry, beginning work with the Franklin Iron Works Company at Columbus, Ohio. In 1899, when the National Steel Company was formed, he was made assistant to the vice-president in charge of the operating department. He became connected with the Steel Corporation in 1901, and in 1911 became assistant to the president, having charge of the distribution of raw materials other than iron, ore and coke, which position he held until his recent appointment.

ruary, 1835, and when a young man engaged in the lumber business at St. Louis, Mich., and Alma. Later he was superintendent of the Chicago, Saginaw & Canada, now a part of the Pere Marquette, and when the Toledo, Ann Arbor & Northern was being built from St. Louis north about 40 miles, he had charge of the construction work. Twenty-seven years ago he went to Chicago, where he invented the first steel cattle guard and organized the National Surface Guard Company, becoming president. He held this position from that date until the time of his death as noted above.



P. J. Ford, for years buyer and department manager for Crerar, Adams & Company, Chinago, has organized the P. J. Ford Company, with office and store at 619-621 West Washington street. Chinago, which company has the selling agency for the Ford Chain Block and Manufacturing Company. Philadelphia, the Indiana Foundry Company, Indiana, Penn, and several heavy hardware specialties in the railroad supply field. Mr. Ford has had many years' experience in the railway supply field, having entered the employ of Crerar, Adams & Company on June 26, 1893, as an assistant shipping clerk, from which position he advanced to shipping clerk, city buyer and hyper and department manager of that company.

GENERAL

THE CEMENT-GUN CONSTRUCTION COMPANY, Chicago, has taken larger offices in the Karpen building, 900 South Michigan avenue.

THE TEXAS STEEL COMPANY, Beaumont, Tex., has been incorporated in Texas for \$2.50000. A suitable site for a steel plant has been secured at Beaumont and the iron ores of Cass, Marion and Up-bur counties of that state will be used.

DAVID LUPTON'S SONS COMPANY, Philadelphia, Pa., manufacturers of special construction for light and ventilation in fireproof buildings, has opened a direct sales office at 1150 Oliver building, 141 Milk street, Boston, Mass., with Harry Wolf in charge as sales engineer. H. R. Wilkinson, the company's New York manager, now has general supervision of New England sales, and the direct Lupton service is extended through New England.

THE AMERICAN MANGANESE STEEL COMPANY, Chicago, has announced the purchase of the Brylgon Steel Casting Company's plant at New Castle, Del., which is a large, up-to-date steel foundry having a monthly capacity of approximately 400 tons of steel castings. This plant is rapidly being converted into a manganese steel foundry and is expected to be in operation by July 15. The American Manganese Steel Company now has two plants at New Castle, Del., and one at Chicago Heights, III.

THE FRANKLIN INSTITUTE has awarded its Elliott Cresson gold model to Dr. Robert Gans of Pankow, near Berlin, Germany, for Permutit, which is a gray colored, flaky substance, prepared by fusing together alumina, silica and an alkali carbonate, and is used for softening water. When the Permutit has been exhausted of its sodium, it may be regenerated with a solution of sodium chloride (common salt). The Permutit filters are widely used in Germany and France and are coming into use in England and the United States.

THE A. M. BYERS COMPANY, Pittsburgh, manufacturer of genuine wrought iron pipe, has leased for a term of years the plant of the Susquehanna Iron Company at Columbia, Pa., comprising the Columbia works and the Susquehanna works. The Susquehanna works consist of a puddle mill with 32 single furnaces and equipment of squeezers and muck bar mill, and the Columbia mill contains a puddling plant of 28 single furnaces and an 18-in, and a 10-in, skelp mill. Forge iron for these puddling plants will be furnished from the Byers blast furnace at Girard, Ohio.

CHARLES R. SHEPLEY AND WILLIAM L. JOHNSON have formed the firm of Shepley & Johnson, general contractors and engineers, with offices in the Pioneer building, St. Paul, Minn. Mr. Shepley was formerly chief engineer of the George J. Grant Construction Company of St. Paul and of the Emerson-Brantinghan Company. Mr. Johnson is vice-president and general manager of the American Dump Car Company of St. Paul, having formerly been associated with the Winston Bros. Comyany, railway contractors, of Minneapolis, and for the past three years having been a member of the firm of Hoy & Johnson of St. Paul.

THE RAILROAD WATER AND COAL HANDLING COMPANY, Chicago, Ill., has been awarded contracts by the Illinois Central for water station improvements at Effingham, Ill., and Kentwood, La. At Effingham the work includes the installation of 4.800 ft. of 6-in. pipe line and 50 ft. of 4-in. pipe line with valves and hydrants, and the building of the foundation for a water tank. The improvements at Kentwood include a 10,000-gal. fuel oil tank, 100 ft. of 8-in. pipe line, 100 ft. of 12-in. pipe line and the construction of a brick pump house 20 ft. by 28 ft., to contain 2 complete pumping units, each consisting of a Morris centrifugal pump with a capacity of 500 gal per minute and a 25 hp. Stover fuel oil engine.

AT THE ANNUAL MEETING of the directors of Fairbanks. Morse & Co., Chicago, C. H. Morse, Sr., was elected chairman of the board and C. H. Morse, Jr., was re-elected president. The following have been elected directors of E. & T. Fairbanks & Co., St. Johnsbury, Vt., recently acquired by Fairbanks. Morse & Co.: C. H. Morse, Jr., W. E. Miller and W. S. Hovey of Chicago, Thomas McMillan of Montreal, H. J. Fuller of New York, succeeding Henry C. Ide, Charles A. B. Pratt of New York and Joseph Fairbanks, A. H. McLeod and C. L. Harpham of St. Johnsbury, Vt. Officers were elected as follows: Frank H. Brooks, president: C. H. Morse, Jr., vice-president; John C. Clark, secretary, and Fred C. Beck, treasurer.

AFTER A DECLINE in the use and production of natural cement to a point where it has become an almost negligible factor in masonry construction, one of the oldest companies, the Utica Hydraulic Cement Company of Utica, Ill., is now making a campaign to re-establish a legitimate place among construction materials for this product. The natural cement industry enjoyed an extended and steady growth until about 20 years ago. when the rapid development of the manufacture of Portland cement in this country, combined with a steady decline in the price of that material, effected a competition with which the natural cement manufacturers were unable to cope. The older material suffered also from the failures of natural cement structures in which its use had been ill-advised, combined with the coincident existence of a wide-spread educational campaign on the proper use of Portland cement, no equivalent of which was attempted by the natural cement manufacturers. Natural cement was in extensive use at a time when concrete construction was in its infancy and the improper practices in design and construction which were common at the time reacted to the disadvantage of natural cement. On the other hand, the subsequent investigations of concrete and the wide-spread discussion of design and construction have been contemporaneous with the growth of the Portland cement industry, which has profited materially therefrom. It is the object of the campaign now under way to show the extent to which natural cement has been used successfully for certain purposes, as in the mortar for brick sewers and other brick and masonry construction, in the concrete bases for pavements, in foundations and other places where it is not exposed to the atmosphere. Attention is also being called to the relative economy of natural and Portland cement for those purposes where natural cement has a legitimate place.

TRADE PUBLICATIONS

PRESSED STEEL CONSTRUCTION.—The Trussed Concrete Steel Company. Youngstown, Ohio, has issued a 24-page booklet describing Kahn pressed steel products for use in building construction. The booklet describes in detail the forms of construction for which these materials are applicable and their method of installation. A number of excellent photographs showing the use of these materials are also included.

BUMPING POSTS.—The Railway and Traction Supply Company, Chicago, has issued a 56-page catalogue illustrating installations of the Hercules steel bumping post, the Little Giant bumping post, the Weatherson nut lock and the Wyoming vacuum track sander. An interesting feature is the account of the special Hercules bumping posts installed on the Panama Canal locks for the towing locomotives.

PAINT.—The Sherwin-Williams Company, Cleveland, O., has issued an interesting booklet of 52 pages in commemoration of the company's fiftieth year of business, compiled as a record of the important events in the company's history. It contains articles by many of the officers of the company and is illustrated with photographs of the officers and of the plants at various stages.

PIPE CUTTERS.—The Borden Company, Warren, Ohio, has just issued a 16-page booklet concerning its die stocks and squareend pipe cutters. These tools are described in detail with unusually clear illustrations, giving a comprehensive idea of their construction and operation.



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When visiting his gangs the average supervisor ordinarily devotes practically all of his attention to the methods

The Proper Use of Tools

of conducting the work and little or none to the kind and condition of the tools the men are using. While the consideration of methods is essential, the importance of the equip-

ment of the gangs should not be overlooked as, especially under the present unusual conditions existing in the steel industry, the amount of money involved in tools is large. For this reason every effort should be made to secure full results from them. This involves a knowledge of their limitations and of the proper methods of using them. It is in this respect that most employees are deficient. It is nearly always easier to use a tool correctly than incorrectly, and most of the abuse results from ignorance. Careful attention to the training of the men in the proper ways of using the different tools and in the results of abuse will do much to reduce the expense of this item and will contribute largely to a decrease in personal injuries.

Because of the ever-increasing difficulty in holding experienced men in the maintenance of way department,

The Discipline of Maintenance

of Way Forces

any step which will help overcome this condition is of general interest. For years it has been common practice for supervisors or foremen to summarily dismiss subordinates

from the service without the formality of a hearing and the men have frequently suffered from the spleen of employing officers whose only limitation in the matter of dismissals has been their ability to obtain substitutes.

To correct the abuses of this system and to instil in the minds of the men a sense of security in their positions, the chief engineer of the Buffalo, Rochester & Pittsburgh has put into effect a plan whereby a man in the permanent employ of the company cannot be discharged without a full investigation. The order and its application, which are described elsewhere in these columns, guarantee fair treatment to the men of the engineering and maintenance of way department, and make it impossible to remove men from the service permanently without the sanction of the chief engineer. The plan further prescribes that for minor offenses discipline is applied by record and that the men are given an opportunity to clear their records. The system is similar to that followed successfully for the men in the train service on a number of roads and places the men of the engineering department more nearly on a plane with those who are organized and protected from summary dismissal by their agreements with the railroads on which they are working.

The recent narrow escape of a passenger train from serious accident resulting from a derailment caused by

Laying Rail Without Expansion

track which had buckled on account of the heat on an important main line, brings to attention the rapidly increasing practice of materially reducing, and in some instances of en-

tirely eliminating, the allowance for expansion in laying rail. Starting four or five years ago, a considerable number of roads have very materially reduced the allowance for expansion formerly provided, depending upon the heavier sections of rail to absorb the expansion stresses created by the heat. Not all the roads which have taken



this action have anchored their rail adequately and it has run considerably in some instances under traffic. As a result, the combined stresses created by the running of the rail and by expansion frequently become very high and it is not surprising that the track buckles, particularly if the bolts are so tight that the rail cannot adjust in the joints. The reduction of the allowance for expansion to the lowest practicable limit is desirable as a means of conserving the rail, and this limit can safely be set lower with track well anchored than with unanchored track. At the same time, the entire elimination of all expansion without the adoption of means to keep the rail from moving under traffic is open to serious question. It would at least seem advisable to adopt a conservative policy on those lines having high speed passenger traffic until the safety of this practice has been demonstrated on freight lines or on tracks handling passenger trains only at moderate speeds.

ECONOMICAL WATER SERVICE

ONE common result of inadequate attention to water service is blind adherence to standard equipment without a realization of the fact that a type of plant well adapted to certain conditions may be entirely uneconomical at other points. While it is much easier and does not require any special knowledge to specify a certain standard type of equipment for all water stations, the failure to consider local conditions in this manner cannot help but result in the installation of inefficient plants in a large proportion of the places.

As an example of the lack of realization of this fact, only a short time ago an officer of a large road was asked for his recommendation regarding the type of pump which should be made standard on that road. To arrive at his recommendation he ascertained the cost per thousand gallons of water pumped at each station on the road equipped with each of the several pumps under consideration, averaged these costs for each type of pump and recommended the one showing the lowest cost without giving any consideration to the local conditions under which the different pumps were working. In marked contrast with this condition is the practice on an adjoining road where a detailed study is made at each station at which improvements are contemplated and every request for an expenditure must be accompanied by a carefully prepared estimate of the savings in operation which this expenditure will create. A study of this fact led to the recent installation of a 25-hp. plant at one station which has made possible the pumping of all the water required in 4 hours per day as compared with 10 to 12 hours' operation previously, saving about \$40 per month in the pumper's salary alone. Savings of this nature when multiplied many times over a system exert an important effect on the total cost of this branch of railway operation.

However, the installation of the proper type of equipment alone is not enough. One road which has failed to give the water service department the same particular attention recently that it gave it some years ago, has found that the cost of pumping the water has practically doubled within the last few years because of the discontinuance of the supervision over the operation of these plants. Continued trained supervision, both in the selection and installation of new equipment and of its operation, is necessary if the most economical results are to be secured. While the total expenditures are not so large as in a number of other branches of railway operation, they are of sufficient size to deserve attention and the proportion of the total expenditures which it is possible to save is as large as can be secured elsewhere.

ADEQUATE SUPERVISION

ONE fact which stands out prominently in the maintenance of way organization of the Buffalo, Rochester & Pittsburgh, described in another column, and which was also noticeable in the Lehigh Valley organization, described two months ago, is the detailed supervision which these forces receive. The problem of providing adequate supervision for men scattered over every mile of a line is a difficult one, but this very condition makes added supervision necessary.

The amount of money spent annually under the direction of the average section foreman exceeds \$5,000 and that under a roadmaster's jurisdiction varies from \$150,-000 to \$200,000. In spite of these relatively large amounts involved, frequently a foreman does not see his superior officer except on the rear end of a passing train for weeks at a time, likewise on many lines a roadmaster is left largely to himself so far as supervision is concerned, reporting to an officer less experienced in track matters than he is.

One of the greatest handicaps in the economical conduct of maintenance of way work is the lack of super- vision all the way down the line. The chief engineer or other officer in charge of maintenance of way on a system of 8,000 to 10,000 miles is not able to study details and he is not given a sufficient number of assistants to enable any of them to concentrate on these relatively detailed but, nevertheless, important problems. This condition prevails throughout the entire organization. A roadmaster is given charge of 150 to 250 miles of busy main line or an even greater mileage of branch line, making it impossible for him to visit each foreman as he should to discuss the work with him and to give the foreman the benefit of his broader experience. While it is true that the Buffalo, Rochester & Pittsburgh and the Lehigh Valley are both roads of relatively limited mileage, if this close supervision is worth while there, it will be of even greater value on roads of larger mileage. It is only when we secure more nearly adequate supervision that we have truly efficient and economical maintenance.

CONCRETE MATERIALS

CURRENT literature in the technical journals, the proceedings of the engineering societies and the reports of experiments contain a wealth of information on the influence of the character of the sands and coarser aggregates on the strength and durability of concrete. The need of clean, hard, durable materials for the production of good concrete has long been appreciated, and for a decade or more there has been a common understanding that the relative density of the concrete, as affected by the grading of the particles used, bears a more or less definite relation to the strength. However, it is only in recent years that this subject has received the attention it deserves and a multitude of experiments have disclosed the complexity of the subject, although bringing us ever closer to the truth.

We are now beginning to understand upon how many conditions the strength of the concrete is dependent. Notwithstanding this fact, it is still the practice, particularly in railroad work, to specify definite proportions for the ingredients of the concrete by relying on a more or less definite specification for the sands and coarser aggregates to obtain materials of a sufficiently standard character to insure good concrete, the proportions of the ingredients being sufficiently generous to insure a concrete of sufficient strength no matter how much the volumetric make-up of the sand and gravel may vary from that necessary to produce concrete of the maximum strength. In the case of concrete placed by company forces it is possible to sail somewhat closer to the wind with the proportions, depending upon the experience and judgment of the foreman, who varies them when he detects by observation of the mixed concrete that they are not what they should be.

Such methods are approximate and uneconomical at best, and, as pointed out in an article on another page of this issue in contract work they place a premium on the use of the poorest material which will pass the specification. If, instead, an attempt is made to determine by actual tests the proportions necessary to obtain just the strength of concrete required for a given class of work with the materials at hand, it will frequently be possible to make use of the materials most readily available which would otherwise be eliminated by a regular specification, while, on the other hand, with the best of sands and coarse aggregate it will be possible to obtain the desired results with a smaller proportion of cement.

THE SEASON OF CONVENTIONS

WITH the season for the maintenance of way conventions, other than that of the American Railway Engineering Association, drawing near, it is well to consider the opportunities they offer for the promotion of modern methods of conducting work. The Roadmasters and Maintenance of Way Association will meet at New York on September 19 to 22. The American Railway Bridge and Building Association will hold its convention at New Orleans on October 17 to 19 and the Maintenance of Way Master Painters' Association will convene at Philadelphia the same week. These three associations cover all the major activities of the maintenance of way department from the standpoint of the The first two mentioned conventions are field forces. each attended by 300 to 400 men interested in their respective branches of work, the Master Painters' Associa-tion being somewhat smaller. These men spend three to four days in active discussion of live problems connected with their duties and exchange much practical information. It is self-evident that the free exchange of ideas by men of long experience, employed on a large number of roads in all parts of the country will bring out a great deal of valuable information. There is also much to be gained from the enthusiasm which a meeting of a large number of men with common interests creates. The standards of work of each of these associations has been raised materially within the past few years until they are now attended by a considerable number of higher engineering and maintenance of way officers who find the information brought out in the discussions and reports of practical value to them. This has been particularly true of recent conventions of the Bridge and Building Association.

Many roads arrange for their supervisors and engineers to attend these conventions regularly and some general officers write their men urging them to go. Some roads pay the expenses of their men to these conventions, feeling that the increased efficiency and enthusiasm of the men make such expenditures a good investment for the road. In this day when more scientific methods are being developed rapidly, when increased demands are being made upon the track and structures and when the scarcity and decreasing efficiency of labor are so acute an officer in charge of maintenance of way should have all the information available and should be able to benefit fully from the experiences of other roads in order to perform his work for his road to the best advantage. If it is at all possible for a supervisor or an engineer to get away from his division for a few days he will find the time spent at these conventions well worth while, for he will gain many practical ideas.

LETTERS TO THE EDITOR

A TRIBUTE TO THE ROADMASTER

TO THE EDITOR:

HILLBURN, N. Y.

BALTIMORE, MD.

For many years one has seen volumes written regarding the duty well done of public servants and individuals in almost every walk of life. Only a short time ago glowing tributes were paid to a master mind in railroad building. We have also read many articles regarding different organizations in the railroad service, but one has seldom seen a line written which has done justice to a class of men who are constantly giving their entire thought and devoting all their energies to their dutythe roadmasters and supervisors. Possibly this is because they are unassuming and firmly believe that the work set before them must be done and that no credit is due them. It may also be because they consider themselves part and parcel of the railroad organization to which they belong.

Let us look for a moment at their record and see what they are called upon to perform from day to day, week to week and so on throughout the years. The duty of a roadmaster or supervisor is to oversee the division of which he has charge. He must know that the roadbed under his care is in perfect condition, and sometimes he keeps it so when little material is forthcoming for the purpose of maintaining his track. In stormy weather he must be ever alert and watchful. There are times during the winter months when for days he never enters his home. Sometimes we find trouble along the line in other branches than the maintenance of way department, but one will always find the roadmaster faithful to his trust.

Presidents of railroads have risen from roadmasters and supervisors. We have many general managers and hundreds of superintendents who have risen from that rank, another proof of the caliber required in a roadmaster to oversee and maintain tracks over which millions of tons of freight and hundreds of thousands of passengers are carried in safety. W. C. K.

UNIT COSTS

TO THE EDITOR:

One of the effective devices by which present day manufacturers keep in touch with the situation in their plants is to require a daily or monthly record of the unit costs of the various parts which go to make up the finished product. A comparison of the results for two periods will indicate at a glance a gain, a loss or no change.

It may be claimed that maintenance of way work can in no wise be compared to manufacturing. It is perfectly true that maintenance as a whole is never completed and there has never been devised a unit of comparison such as the cost to maintain one mile of track which can logically be used to compare one year with another to show the real economy of maintenance. This difficulty seems to have effectually postponed the development of comparative cost systems for track work. On the other hand, manufacturers have been forced for selfpreservation to develop cost systems for single products and the parts and operations going into those products. Certainly most railways also have found it necessary to economize in track work, and the writer believes that to do so intelligently the practice of recording the cost



of applying the various elements of track furnishes the first essential.

The principal track maintenance operations are: Applying ties, rails, ballast, frogs, switches, guard rails, tie plates and anti-creepers; surfacing, gaging, lining, cleaning ballast, respacing ties, tightening bolts and unloading cinders and refuse. It is not far wrong to say that varying with the season the above items will cover from 60 to 90 per cent of the total hours. Hence a record of all or even a part of these operations will enable the management to keep a good check on performance and to call on this section or that division to produce a better output.

The simplest method of comparison is in terms of hours, which overcomes the objection that different rates may be paid in different districts, or that rates may be varied from time to time. An illustration of this would be a report from a foreman that on May 10, 64 ties were installed in stone ballast in 80 hrs., or at the rate of 8 per 10 hrs. The factor of varying density of traffic and different distances to travel from the tool house to work may be conveniently covered by allowing a different credit percentage for each section.

It is not supposed that records like this can be kept without any cost. By using daily reports with printed headings for the principal track operations, the foreman would furnish the basis of the records and some person would be required to tabulate them in the roadmaster's or division engineer's office. It is not difficult for foremen to keep the time of performing the various kinds of work. Omitting yard sections, the usual foreman's daily time report contains from two to four entries for work done.

Even if the cost of such records was much greater than experience has shown it to be, it would be better to expend the money than to operate in the dark and merely trust that the roadmasters are getting the best performance possible. The difference in unit costs, frequently found to be the result of more economical methods on certain districts, would point the way to further economies.

If maintenance of way work had in the past been done for profit on a competitive basis it seems probable that such unit costs would have been developed some time ago. The complaints of additional clerical work and red tape are largely a case of "crying before being hurt," for with modern office methods using computing machines, slide rules, duplicating machines and patent indexes, office work is made vastly cheaper.

Surfacing may be reported as ties tamped, each end of a tie being reported as one tie, while separate headings may be used for surfacing low joints and surfacing out of face. Gaging and shimming may be reported the same way, each end of a tie to count as one tie. Applying anticreepers and tie plates may be reported as the number applied and the hours spent.

Maintenance of way men often say that such records may readily be kept in machine shops, but that track work is different and therefore detail comparative records are impossible. This is hardly the case. Even in machine shops such records are not easily kept, but are recognized to be of value and are kept in spite of this difficulty. Briefly, some of the features making the accumulation of these records difficult are: The varying overhead expense in different departments; similar variations in the cost of power used; the cost of spoiled and rejected parts; variations in the quantity manufactured, and sequence of operations performed on different machines at different rates of pay.

It is common to see maintenance of way expense given

per mile of all tracks or per mile of main tracks or per million revenue ton miles. In each case only one side of the transaction is covered, viz., the cost, while the amount of work performed, a factor equally important, is lacking. The nature of track renewal work, therefore, is such that to measure the real economy of performance it is necessary to know the number of each of the principal items of work and the time or cost required to perform them. W. C. NISBET,

Baltimore & Ohio.

NEW BOOKS

Rail Failures. By A. L. Davis, office engineer, Illinois Central. Bound in board. 155 pages, 4 in. by 6½ in. Illustrated. Published by Hall-Stockton Printing Company, Chicago. Price \$1.00.

This book was prepared primarily to assist trackmen in making reports of rail failures, such as are made on the standard form prepared by the rail committee of the American Railway Engineering Association. The first 11 chapters are devoted to a brief description of the properties of steel as influenced by the various ingredients and impurities and the processes used, and to the manufacture of iron and steel, with special reference to rails. The practice of typical rail mills is treated at some length. Chapters 12 to 19, inclusive, are devoted to descriptions of the various kinds of rail failures as they have been classified, with explanations of the causes of each as they are now understood, including outlines of the several theories for the causes of transverse fissures. The remainder of the book is devoted to the specifications of the American Railway Engineering Association for both Bessemer and open-hearth rail and modifications of these specifications to include the chemical analysis of finished rail and the nick and break test, as well as an account of tolerances and the practice of various mills as to branding and stamping. The book is written in non-technical language and will prove valuable not only The book is written in in its primary object, but as a source of general information on the subject of rail manufacture and failures. An appendix is devoted to tables of the dimensions of various rail sections.

Structural Timber Hand Book on Pacific Coast Woods. By O. P. M. Goss, consulting timber engineer. 290 pages. 5½ in. by 8 in. Bound in leather. Published by the West Coast Lumberman's Association, 1016 White building, Scattle, Wash. Price \$1.00.

With the rapidly increasing use of Douglas fir, western red cedar, western hemlock and Sitka spruce, there has arisen a demand for accurate information concerning these timbers and their physical characteristics. This book has been prepared to supply the information required by users of these classes of timber in construction work in addition to a large amount of tabular data of value in designing work. The book is well prepared and edited and contains much information concerning these Western timbers and the work for which they are suitable, either in their original state or treated. The book opens with a description of the various botanical species of Pacific coast woods, followed by tables giving a summary of the mechanical and physical properties, taken from the United States Forest Service publications. The grading rules are given, with an explanation of the relation between strength and density of Douglas fir. Several pages are devoted to a review of the latest data on the methods and effect of treating this wood with creosote oil. Nearly 200 pages are devoted to tables of safe loads on beams and columns, covering all ordinary sizes of sticks, span lengths, etc. The last few pages are devoted to miscellaneous uses for timber with some cost data. This is a valuable work, which should be on the desk of every engineer engaged in the design of structures involving the use of timber.





Station Grounds at East Salamanca, N. Y.

A LTHOUGH a road of relatively small mileage in a highly competitive territory, the Buffalo, Rochester & Pittsburgh is maintained to unusually high standards and with more than the ordinary degree of efficiency. This is accomplished primarily by close, systematic supervision of all details of the work by the general and local maintenance of way officers. In contrast with the divisional form of organization employed successfully on the Lehigh Valley and described in the June issue, the departmental organization is in effect on the Buffalo, Rochester & Pittsburgh with similarly satisfactory results.

This road operates 586 miles of line with 208 miles of second main track and 1,168 miles of all tracks and extends from Buffalo and Rochester, N. Y., south to But-ler, Pa., with connections into Pittsburgh and New Castle, Pa., over the Baltimore & Ohio and with branches into the bituminous coal fields south of Punxsutawney. The freight traffic density is approximately 3,250,000 ton miles per mile of line, and the passenger traffic density approximately 100,000 passenger miles per mile of line. Approximately two-thirds of the freight traffic consists of coal moving north to Buffalo and Rochester, a con-siderable part of which crosses Lake Ontario by car ferry into Canada. With the exception of about 700,-000 tons of iron ore moving southward from Buffalo, the remainder of the freight business consists of high class merchandise of various kinds. For operating purposes the road is divided into two divisions in addition to the terminal divisions at Buffalo, Rochester and New Castle.

THE ENGINEERING DEPARTMENT

The chief engineer is in charge of all maintenance of way and construction work, reporting directly to the president. All subordinate officers in this department report directly to the chief engineer or his assistants without reference to the local division operating organization. All problems originating in the engineering department of common interest to two or more departments are referred to the chief engineer who handles them direct with the head of the other department concerned.

Assisting the chief engineer are the engineer of construction, the engineer maintenance of way, the signal engineer and the office engineer. The superintendent of the timber preserving plant, the master mason and a special assistant also report directly to him. Reporting to the engineer maintenance of way are two division engineers, to whom report the roadmasters and supervisors of bridges and buildings. Each division engineer is also given an engineering corps of sufficient size to handle the routine engineering work other than on new construction of magnitude which is handled directly by the engineer of construction and his forces. The supervisor of water service reports directly to the engineer maintenance of way, independent of the division engineers, although cooperating with them. This is also true of the master mason, whose gangs report directly to him; he in turn reports directly to the chief engineer as noted above. With these exceptions, all maintenance of way forces report to the division engineer on whose territory they are working. The work in connection with Federal valuation is in direct charge of an assistant engineer, reporting directly to the chief engineer through the office engineer. A special office and field force is assigned to this work.

As an aid to the efficient conduct of work out on the line, close attention has been given to the office organization. One common file is maintained for the chief engineer and his staff. Two carbon copies are made of each letter written, one on white and one on yellow paper. The white carbon copies are attached to the file correspondence, while all the yellow carbons for each day are bound together and passed to the chief engineer, the engineer maintenance of way, the signal engineer, the office engineer, and the chief clerk, who read them and check each letter with their distinctive colors. In this way the heads of these subsidiary departments are kept fully informed regarding the work being done in the entire engineering department, much inter-department correspondence is eliminated and departmental lines are kept down.

An important unit in the office organization is the office engineer and his staff, who have charge of all office records, the preparation of plans for new work, etc. Special attention is given to the maintenance of accurate map records in the general office. As any improvement work in the field is finished the officer in charge is required to make a complete report, accompanied by a blue print of the plan, corrected to show the work as actually



built. The office tracings are then revised accordingly. Large maps to a scale of 30 ft. to 1 in. have been made for all terminals showing the water systems, blue prints of which are framed and placed in the principal shop buildings and offices for ready reference; smaller maps of each water station, showing all physical features such

project. The handling of the accounting in this office also gives the engineering department an opportunity to prepare cost data which are valuable for estimating purposes, and also in the economical conduct of later work. To insure uniformity of practice in the collection and distribution of these charges, all division maintenance of



THE ORGANIZATION OF THE ENGINEERING DEPARTMENT.

as tanks, standpipes, piping, etc., are provided, complete sets of which are furnished in blue print form to interested officers. Complete records are also kept of all sidings, main track rail, ballast, drain tile and fences, and the maps and charts are revised monthly, all division and general officers having complete revised sets of these prints. All right of way records are kept in the chief engineer's office, although purchases and sales are negotiated by a right of way agent acting in conjunction with the engineering department but reporting direct to the president.

All accounting for engineering department expenditures is done in the chief engineer's office. All time books are sent through the division engineer's offices to the chief engineer, and all payrolls are made up there. The distribution of all charges is made in the manner and the detail required by the auditing department, and only the totals for the different items are given to the auditor. way officers and their clerks meet with the engineering accountant every three months to discuss methods, new rulings, etc.

In connection with the Federal valuation of the property, a resurvey of the entire line is being made, at which time the original center lines and all property lines are run out and established. Concrete monuments are being placed in the present center line of the track in single track territory and midway between tracks in double track territory, at the beginning and end of all curves and at intervals of 1,000 ft. on tangents, and all surveys are referenced to this monumented base line. Monuments are also placed at all right of way line intersections, concrete monuments being used through cities, villages, etc., and treated timber stakes through outlying territory.

Close attention is paid to the appearance of the property, particularly about station grounds. By the exercise



A Tool House.

ONE OF THE RESERVOIRS

ATTRACTIVE STATION GROUNDS.

From the direct knowledge of the manner in which the work was handled in the field, the engineering department is able to distribute the charges to their proper accounts more accurately and also to do the work quicker. It is seldom that all the charges for a piece of work are not in and distributed within 30 days of the completion of the

of care in designing the buildings and in laying out the grounds in harmony with them, unusually attractive effects have been secured with slight additional expense. Practically all of the newer stations are of brick or concrete construction. The maintenance of station grounds is in charge of the roadmaster, the master mason, how-

c

ever, handling all landscape gardening work. Beyond the station grounds, similar attention is paid to the removal of all debris and waste materials. The foundations of all signals and signs are graded and dressed to standard dimensions, paved with cobble stones and the slopes sodded. Metal and concrete roadway signs are used almost entirely.

STANDARDS

Few roads have prepared as complete a set of standards of design and construction as well as of methods of performing work as the Buffalo, Rochester & Pittsburgh. With the idea that the trained officer of wide experience is better able to determine the best way to perform work and to develop economical methods than the foremen on the job, the chief engineer and his staff devote a great deal of time to this subject. They have prepared unusually complete standards for much of the it is believed that they are encouraged to become more economical in their use. All foremen are also provided with speed tables enabling them to check accurately the speed of trains as a curb against reckless running. In addition, men from the engineering department are sent out at intervals during the winter to check the speed of trains. All instances of excess speed reported are taken up with the transportation department for action.

Approximately one-half of the foremen and nearly all of the laborers are foreign. A few apprentice foremen are also employed. These men are recruited from the gangs and also from the outside. They are placed under the more capable foremen for instruction and are paid 20 cents per hour for the first three months of service, \$55 per month for the next three months, and \$60 per month thereafter until such time as they are placed in charge of sections.



STANDARD MAIN LINE TRACK AND ROADBED CONSTRUCTION.

routine work while every plan for reconstruction work involving special problems contains a detailed schedule of operations which is worked out carefully for the guidance of the foremen in the conduct of the work. The standards are printed on sheets of uniform size for convenience in binding and filing. Each foreman is provided with a complete set of the standards for all work coming under his direction and he is held responsible for the performance of his work according to them. These standards are revised annually to keep them up-to-date.

All foremen are also provided with books, in which they file for reference all circulars received by them. To insure that these books are kept up-to-date, the foremen are required to send them to their superior officers every two months, where they are checked. The file copies in these offices are in turn sent to the general offices for checking at similar intervals. These books do not become the personal property of the foremen, but a man is required to hand his copy over to his successor. To insure familiarity with the instructions, the men are examined on them at frequent intervals.

All foremen are also provided with books showing the prices of all materials used by them. By informing the men in this way on the costs of materials they are using,

The track is laid with 90-tb. and 100-tb. A. S. C. E. rail placed with the brand out. Insert type manganese frogs are employed in busy yard tracks and in all but the highest speed main tracks with manganese switch points on the turnout side. All rail is thoroughly anchored as laid and the ties are spaced. A heavy renewal of ties is made at the time rail is laid to avoid the disturbance of the track the following year. At other times the ties are spotted in as their condition demands. Stone ballast is applied wherever new rail is laid, the track is brought up to grade, and heavy Goldie shoulder tie plates are applied to all ties at the same time. All new ties are also provided with tie plates when inserted. In addition all turnouts are tie plated and the old plates released from main tracks, are used in yard and side tracks. It is the plan to have all the ties in main tracks, on both curves and tangents, fully plated. Switch ties are "spotted in" unless 50 per cent or more of the ties in a set require renewal, when the entire set is replaced.

As fast as possible all cuts are being under-drained. From 40 to 50 miles of 6-in. drain tile is being laid each year, preference being given locations at which ballasting work is planned. The tile is being laid 4 ft. below the surface and is supported on boards to hold it in line, the



trenches being back filled with coarse cinders above the tile.

With highly-developed standards of materials, it is natural to expect a systematic program of work. As far as possible all work is handled according to a definite schedule and is undertaken on all sections simultaneously. This program is established by circulars issued from time



CONCRETE SIGNAL TOWER CONSTRUCTION.

to time, and, in addition to promoting uniformity, has been found to give a measure of performance for the different sections. In brief the program provides that, as soon as the frost leaves the ground, the forces begin clearing up the property, opening ditches, removing shims, surfacing and lining, and putting the track in good riding condition. They then oil and tighten all bolts and drive down the spikes over the entire section, after which they take up the heavier track work. About July 1 they begin weeding and mowing. Later in the fall the bolts are again oiled and tightened as the track is prepared for time burners are used, the men are required to examine the lamps daily and to report to their foreman any that are burning improperly, being disciplined for failure to make such reports. The foremen transmit these reports to the roadmasters, who keep book records of them. The roadmasters and signal supervisors are also required to ride over their territories at night once every two weeks to note that the lamps are burning and to report any failures. A comparative statement of lamp failures by divisions is made monthly to encourage their proper maintenance. By these measures the number of lamp failures has been reduced 90 per cent in recent years.

All ties are purchased directly by the superintendent of the timber preserving plant, who has three inspectors stationed in the producing areas, reporting directly to him. About 80 per cent of the ties received are beech and maple. All main track ties are treated before being placed in the track and are grouped before treatment, beech being treated to refusal and other woods except pine being given 12 lb. of oil per cu. ft. of timber. Pine is given 10 lb. of oil per cu. ft. All ties are thoroughly air-seasoned before treatment. At the present time about 650,000 ties, or 47 per cent of all those in the main track, are treated. Every tram of ties is weighed before and after treatment to ascertain the amount of oil injected. As a further check on the thoroughness of treatment, one tie of each class of timber is sawed in two and two are bored with an increment borer every week and the samples sent to the chief engineer.

The ties are laid in the track with the sap side up, and to insure this being done, a nail with a letter depressed in its head indicating the kind of wood is driven in the sap side of the tie at the treating plant. A dating nail bearing the year in depressed figures is driven in each treated tie by the trackmen when it is placed in the track. An independent inventory of the ties on hand at the treating plant and stored along the line is made by the chief engineer's office every three months to keep a close check on the supply.



A STANDARD TRACK-WALKER'S OUTFIT. STANDARD PRACTICE IN RENEWING TIES.

the winter. Where the regular foreman is capable, he is given sufficient men to handle the heavier work, other than rail renewal and ballasting, on his section. On other sections extra gangs are sent in.

METHODS OF WORK.

The track-walkers are held responsible for the maintenance of all switch and signal lamps. Although longTo secure uniformity of practice and to prevent their removal from the track prematurely, while at the same time insuring the removal of all decayed ties, they are examined by inspectors, who indicate those which are to come out each season. Four inspectors, selected from the more experienced foremen and reporting to the division engineers, are assigned to definite territories and



work back and forth on the track throughout the season, not only indicating the ties which are to be removed, but also noting and reporting any improper practices in the conduct of track work.

As soon as the frost is out of the ground in the spring these inspectors go over one mile of track on each section carefully, to indicate the ties to be renewed so that the foremen can get started on tie renewals. After going over their entire territories in this way they drop back and complete their inspection of the main tracks and sidings. The section foremen accompany the inspectors over their respective sections, calling to their attention any ties which they may have missed and which the foremen believe should be renewed. Where track is to be ballasted heavier renewals are made, the inspectors being advised beforehand where such work will be done. must submit his recommendation to the chief engineer for approval and final decision. In this way a foreman or other employee has a security of position until his case has been passed on by higher officers, removing the danger of unwise or hasty action being taken by a local officer because of petty personal differences. For minor offenses discipline is applied by record without suspension, as far as possible, and employees are given an opportunity to clear their records by efficient service. A discipline bulletin is issued monthly and mailed to every foreman and higher officer. A copy is also posted in every tool and pump house along the line for the information of the men.

All accidents in the engineering department are subjected to special investigation and are also bulletined. A comparative statement of the injuries incurred by divi-



Unloading a Frog with a Magnet.

Section foremen are required to fill out cards daily showing the number and kind of treated ties placed in each mile, and also indicating the tracks in which they were placed.

In taking treated ties out of the track the section foremen are required to fill out cards daily showing the number, character and age of the ties, the points from which they were removed and the reasons for their removal. After these cards are approved by the roadmaster they are forwarded to the chief engineer for his records. Goldie tie plates and pointed spikes are used exclusively. All ties are adzed to templates when relaying rail before the new rail is applied and the exposed surfaces are given a brush treatment with creosote.

To establish uniform practice and to insure fair treatment for all employees, no man on the permanent forces, whether paid by the day or month, may be discharged or reduced in rank or pay (reductions in force, insubordination, intoxication or other causes requiring prompt action excluded) before a full report is made to the superior officer, with a complete statement of the employee's record. Before taking final action this officer

A PILE DRIVER AT WORK.

sions is issued monthly. Likewise all derailments are investigated by a committee consisting of one representative each from the maintenance of way, mechanical and operating departments, who are able to determine the cause for nearly all accidents of this character and to recommend the proper remedy.

For the past two seasons tents equipped with steel bunks have been substituted for camp cars for the extra gangs with very satisfactory results. These tents are more sanitary and more easily moved from place to place as the work progresses than are cars. In general it is possible to establish a camp immediately adjacent to the This arrangement also permits a more flexible work. camp layout to accommodate gangs of different sizes. The tents have met with the general approval of the men, particularly because they are cooler on hot nights. Standard outfit cars, equipped with steel bunks, are provided for mason, track, bridge, signal and water service gangs. These cars and also all hand and tool cars, tool boxes and tools are distinguished by distinctive color boards to indicate their assignment to the mason, track, bridge, or water service divisions of the department.


While the construction of extensions is generally contracted, practically all improvement work along the operated lines is handled with company forces. For this purpose the road owns 2 steam shovels, 3 Lidgerwood unloaders with a complement of unloading plows, 1 Jordan spreader, 2 pile drivers, 3 locomotive cranes, 2 American ditchers and 100 specially-designed steel under-frame flat cars. Each roadmaster, supervisor of bridges and buildings, and master mason also has a steam derrick for the handling of rail and other materials, the throwing of rail onto the ground being strictly prohibited. During the summer working season each roadmaster has an assigned work train, with others as the occasion demands. During the winter months work trains are ordered only as required.

The road is now engaged in a comprehensive program of replacement of timber structures with those of steel and reinforced concrete, designed for Coopers E-60 loading. For many of the structures concrete slabs are

is carefully graded, drained and paved. Every three years the steel hoops are removed from all wooden tanks and are scraped, examined, repaired if necessary and painted. At the same time the tubs are painted. By this plan the tanks are inspected and painted regularly, their life is increased, and the danger of failure is practically eliminated.

About 56 per cent of the main line mileage is equipped with automatic block signals and the entire system with telephone despatching circuits. Starting with the maintenance of this equipment, the signal forces have now taken over all electric service, including electric light and power equipment, and their inspection and maintenance is now handled directly by the regular forces. The signal lamps are maintained by the track-walker, who is also held responsible for the detection of broken bond wires. The track-walker, maintainer and battery man are all held jointly responsible for the proper bonding of the track.



THE CONCRETE PIPE PLANT AT EAST SALAMANCA.

erected on concrete piers. Four years ago there were over 300 timber structures on the northern divisions, practically all of which have now been replaced. Concrete decks are being applied to practically all structures up to about 110-ft. spans. All concrete work is placed by company forces.

A complete concrete post and pipe plant is operated at East Salamanca under the direction of the master mason. At this point all concrete culvert pipe, fence posts and similar materials required on the line are made. Telephone booths for use at outlying points, signal bases, etc., are also cast here as required.

During the last few years careful attention has been given to the development of adequate water supplies by the construction of large reservoirs formed by the building of earth and masonry dams across ravines. In addition to securing an ample supply of water at points where shortages have been encountered previously, the quality is improved, for much of the water through the oil and coal mining regions is unsatisfactory for boiler use. All these reservoirs have been built entirely with company forces.

The standard roadside tanks are of steel on steel posts for 100,000 gal. capacity and of wood on steel substructures for 50,000 gal. capacity. The ground below all tanks A signal supervisor is located on each division with a corps of maintainers and battery men. The battery men make a daily report of all battery renewals, giving the location of each one renewed. A record is kept of renewals of all track, line and operating batteries and of all materials used in them. Counters are also attached to all signals and readings are taken at the end of each month, from which the number of operations per avoidable interruption is ascertained. A monthly bulletin containing these performances by divisions is then issued to encourage rivalry between the supervisors.

The maintainers are required to inspect everything in their charge every two weeks, making all repairs at the time of inspection, and to make out detailed reports in duplicate. As far as possible the supervisors accompany the maintainers on these inspections and sign the reports with them as an encouragement to thorough inspection.

As a means of instruction of the men, meetings of the foremen, battery men and maintainers and track-walkers, respectively, are held at intervals to discuss their problems and the methods of performing their work. The meetings of the section foremen are held at different points on the roadmaster's districts to give the men an opportunity to see the other men's track. During the summer when it is difficult for many of the men to leave their work lists of 20 to 25 questions are sent to them monthly to answer. The replies are forwarded to the chief engineer's office, where they are corrected and any errors called to the attention of the men. In this way they become more familiar with the standards of the road and with the methods of conducting work. A book of rules prepared in conversational form and containing about 4,000 questions and answers relating to all branches of maintenance of way work is now being completed. This book will be distributed to all the officers, foremen, crossing watchmen and flagmen, who will then be examined on it at intervals.

HANDLING MATERIALS.

A monthly requisition meeting is held at a central point, attended by all division officers, to discuss the materials needed during the next month, the possibilities of transfers, etc. The requisitions are brought to the meeting in pencil form and are discussed in detail, the purpose being to encourage the division officers to do their own ordering carefully, rather than to have the general officers cut down the requisitions later. After the meeting the division officers make out their revised requisitions and forward them through the division engineers' offices to the chief engineer for approval.

All materials, except timber and concrete, are carried in stock by the stores department, which is provided by each year, traveling by motor cars, and covering about 20 miles of line per day. This inspection is made in great detail, and their problems are discussed with the different foremen along the line.

From the above it can be seen that one of the most important reasons for the high standards of maintenance found on this property is the close supervision given to details and the thorough system of inspection which has been developed. By concentrating attention on a road with limited mileage the officers are able to keep in close touch with the various activities. The detailed and regular system of inspection which has been built up detects the deficiencies and the chief engineer's office then follows them up closely until proper repairs have been made. In this way the men in the field are impressed with the importance of preventing bad conditions and of repairing them promptly when found.

We are indebted to E. F. Robinson, chief engineer, for the opportunity to collect the information contained in the above article.

SLOW ORDERS AND HAND SIGNALS

A^T a recent staff meeting on the Frisco, inspectors spoke of the necessity of men being very careful when working at a bridge where there is a slow order, not to wave at an engineer on a passing train and not



ONE OF THE CONCRETE SLAB BRIDGES RECENTLY BUILT.

the engineering department, with a detailed list of all supplies it is expected to carry. Timber and concrete materials are carried directly by the engineering department at Bradford and East Salamanca, respectively. A supply car is run over the line each month accompanied by the division officers, which distributes the small materials necessary for the following month. All small scrap and obsolete materials are picked up at the same time and forwarded to Du Bois for sorting and reclaiming. An "inquest" is held by the engineering department on all frogs, crossings and special track work sent in, to determine whether they should be scrapped or repaired. All maintenance of way tools are repaired by employees of this department at East Salamanca and Punxatawney. Every three months a detailed inspection of all the materials on hand is made by the general officers. As the supply car goes over the line all tool and pump houses and all station buildings are also inspected.

A system of pensions is in force for the employees of this department in common with those of other departments of the Buffalo, Rochester & Pittsburgh. Under this arrangement employees 70 years of age, with 20 years of continuous service, are entitled to a pension equal to 2 per cent of their average salary for the last ten years, multiplied by the number of years in service. Under these provisions, one roadmaster, one supervisor of bridges and buildings and about 20 foremen and laborers are now carried on the pension roll.

An inspection of the entire road is made by the chief engineer with his staff and the division officers twice to make any signal with the hands, as the engineer is liable to mistake it for a "high ball" and not reduce speed across the bridge. Cases were cited in the past where the engineer approaching with his train to where men were working waved with his hand at the foreman in charge, who returned the salute by waving his hand; and the engineer thought, or pretended he thought, it was the proceed signal, and did not slacken speed; an accident resulted and the foreman received the blame.

It was decided that if the engineer waves or signals to the foreman and the foreman feels that he must acknowledge the courtesy, the best thing to do is to nod the head; but in any case he should keep the hands down so that nothing can be construed as a signal to continue at regular speed. In case of an accident where slow orders have been disregarded, if the foreman has waved or signaled in any way to the engineer, the engineer can easily lay all blame on the foreman.

TRESPASSING.—"Are you to be one of the unfortunate 13" is the title of a leaflet which is now being distributed among employees of the St. Louis and San Francisco who come in contact with that portion of the public which uses the railroad tracks as a highway. This leaflet emphasizes the fact that an average of 13 persons are killed every day on the railroads of the United States because they use the railroad tracks as a highway. The trespasser is seldom injured, but is usually killed. It contains the striking statement "they didn't expect to get hurt any more than you," and is signed Your Friend.



A SUGGESTED PROGRAM FOR TRACK WORK

The Importance of Planning Carefully in Advance for the

Various Duties To Secure the Proper Results

BY W. F. RENCH

Supervisor, Pennsylvania Railroad, Perryville, Md.

THE tabular figures shown below are the readings taken in one direction over a sub-division 33 miles long in tests immediately preceding and following the past calendar year. The single direction is given because the speed, which was the same in the two cases, was at the rather high average rate of 58 miles per hour. The resultant was obtained by adding together the spills and vibrations and dividing successively by the distance traversed in miles and the rate of speed used in miles per hour. It is seen that in the later test there was an entire absence of spills and that the resultant was improved more than one-half. This result for a single year's work was unquestionably attained by rigid adherence to a definite program of work.

Test of December		Test of January
1, 1914	Feature	10, 1916
3	Spills	0
1209	Horizontals	397
341	Verticals	211
5.3	Pedometers	43
35	Time	35
0.84	Resultant	0.34

The importance of system as well as method in track work has been recognized by many roads for a number of years. The engineer maintenance of way of one of the largest trunk lines ascribed the improvement made last year on his road to the particular attention devoted to systematic work. Several recent discussions have emphasized the advantage of standardizing maintenance of way work and of placing the organization upon a permanent basis throughout the year.

The program in use on the sub-division referred to is given below. The various percentages and the detailed items of work were adopted by the supervisor after a careful study of the repairs through several typical years. Care was taken to develop a schedule with alternating periods of intensive repair and entire suspension of renewals. The time between December 1 and September 20 was divided into six periods of seven weeks each, and the dates defining these periods were established as points of peak excellence in maintenance of line and surface. The first three weeks of the long period following September 20 is employed mainly in general policing of the road to attain as finished and attractive an appearance as possible, and such work is regarded as an integral part of the season's repair program.

Throughout the year it is the practice to precede each established date with a three weeks' period of general lining and surfacing. During this period a test is made every ten days with a track instrument and water spiller, in which the spills and vibrations are recorded for each section and the exact times are noted in minutes and seconds. Readings are also taken over certain portions of the sections when thought desirable, and the deficiencies indicated by the record are indicated to the different foremen. A resultant is calculated for each section and from these a rank is given, the complete figures being communicated to all concerned. When there are any special features that operate to handicap the section, a proper notation is made. These tests inspire considerable rivalry, especially as the final standing determines the supervisor's recommendation for the awarding of the several foremen's prizes.

The program of work takes advantage of seasonable distribution of track work fully into account. It provides especially for making such renewals in winter as may be done practically in the closed season, to the end that forces may be kept uniform throughout the year. By extending the more active renewal of ties over six months of the year assurance is obtained that good riding will not be sacrificed to a too rapid progress in repairs. The periodical suspension of tie renewals enables the supervisor to clear the road of accumulated dirt and old ties and to distribute the material required for use in the succeeding period systematically.

It is fully understood that the program is not merely an ideal scheme to be vaguely followed, but a schedule that should be met substantially month by month. As will be noted in the accompanying table, a blank column is provided in which to enter the progress made in the three special items. The percentages of completed work are computed from the material reports and are entered upon the program at the end of each month. The supervisor is able to keep informed constantly of his progress through the daily material reports, or lacking that system, at least through the weekly statements from his foremen of ties, ballast and rail applied in main tracks. Observations are made to detect lack of compliance with the program in policing, tightening of bolts, cleaning of bridge seats, and in the manner of making tie renewals. The suggested program employs but three items for detailed recording, these being such as are of universal application. It might happen that the ditching program planned for the year would be of such definite scope as to form an additional item, and still other items might be added.

A sound condition of the ties is recognized as an essential element in the maintenance of a main running track. Lacking an ample repair in this particular, no track is adequate for the severe operating requirements of today. It thus becomes of the highest consequence to prosecute the renewals steadily and persistently until the required number have been applied. The estimated guantities are obtained by different methods on the several roads. When these are found to be not entirely reliable recourse may be had to an empirical rule. Records have been kept to such good purpose that upon any well-maintained road the requirements for a certain class of track can be approximated by a simple calculation. These records determine the life of the tie in main track, and while it may vary considerably through diverse climatic conditions and unequal traffic burden, and the extensive use of treated ties and of tie plates will cause the figures to increase progressively, it supplies a sufficiently accurate basis for checking the progress of repairs.

The ballast program is in the main coincident with the tie program, for in surfacing the road light lifts are made which consume the ballast chargeable to maintenance expenses, the larger reballasting operations having no part in the repair program. The main advantage in thus regulating the flow of ballast is that the tie renewals are followed closely and the fine line and surface do not deteriorate through insufficient back filling. This sequence also tends toward the preservation of a neat appearance during the period of repairs. A definite

Month	Per cent of ties to be renewed in main tracks at end of month.	Progress.	Per cent of ballasting to be completed at end of month.	Progress	Per cent of rail re- newals to be com- pleted at end of month.	Progress	Work To Be Engaged In
January					15		Laying new rail, constructing standard ditches, removing snow and ice, surfacing, shimming and gaging.
February					30		Laying new rail, constructing standard ditches, removing snow and ice.
March					45		Mainly surfacing, continuing rail renewals, starting tie renewals, policing the road, installing under drainage.
April	27		25		50		First half, laying rail, putting in ties, raising track where tie renewals were made; second half, surfacing track.
May	46		35		65		Vigorous prosecution of tie renewals, rail renewals and track raising, with as much policing as possible.
June	57		50		70		First three weeks, surfacing, including track raising; last week, continuing rail and tie renewals. Mow the right of way about the middle of the month.
July	72		68		85		First half, continuing rail and tie renewals; second half, lining and surfacing and gaging.
August	90		78		90		Vigorous prosecution of tie renewals, track raising, rail repairs, with as ample policing as possible.
September	95		90		95		First half, surfacing and lining; second half, general policing of roadway, ballast border and ditches, with rail and tie renewals in sidings. Mow the right of way the second week in this month.
October	100		100		100		Final policing of the road for the division inspection along with necessary lining, surfacing and gaging and repairing crossings.
November							Surfacing and lining in order to enter upon the closed period in the best shape possible.
December		·					Cleaning snow and ice, keeping ditches open, making standard ditches where possible.

Saturday, to be devoted to policing, cleaning up scrap, pulling grass and weeds. Between June and September, two days each month to be devoted to tightening bolts. Last_working day each month, bridge seats to be cleaned thoroughly.

When making tie renewals, 3½ days to be devoted to putting in ties, 1½ days to surfacing or raising the stretch renewed.

progress in ballasting is important because when the back filling is deferred until fall the material may not be obtainable and the tracks will thus remain empty through the winter, a condition which strongly contributes to trouble from heaving.

In the item of rail renewal there is a possibility of divergence because the material may not be supplied promptly, but it is believed the program can be substantially complied with under normal conditions. It will be noted that a large percentage of the rail is scheduled to be applied in the winter and early spring. This is rendered practicable by the increasing use of plain base splices and the ability to postpone for a time the spacing of the ties. The program co-ordinates the laying of rail to some extent with the several periods, because such work necessarily requires attention from the section forces, and there might otherwise be interference with the surfacing program.

The advantage of having a definite program for the lesser items of maintenance work is quite tangible. It is vastly easier to regulate the conduct of the sub-division if all the section forces are engaged in substantially the same kind of work. The matter of mowing the right-ofway is important enough to have a specific date set for the two mowings. By having this work completed at one time the full benefit from improved appearance is realized. The indicated plan for policing the road has been

found to give excellent results. It is well known that unless a regular time is designated for doing this important work it is liable to be left undone. The tightening of bolts is a similar item which is apt to be neglected unless a set time is regularly employed. The benefit from the attention to this item is noticeable not alone in the increased safety of the joints and the greater freedom from noise, but in the improved riding of the track. Tests have shown that the vibrations are increased over track which contains a large percentage of loose bolts.

THE MADDEN RAIL LAYER

N a season such as this when the shortage of track labor is universal, appliances which reduce the number of men required for any important operation are of special interest. For this reason the Madden rail layer, made by the Madden Company, Chicago, is now attracting much attention from railway men because of the records it is making on several roads in the relaying of rail with a limited number of men.

This machine was first developed by P. Madden, roadmaster of the Chicago, Milwaukee & St. Paul at Sparta, Wis., about four years ago, since which time it has been used on over 40 roads. At present several lines, including the Northwestern, the St. Paul and the Great Northern relay practically all of their rail with this machine.



It was described in the Maintenance of Way Section of the Railway Age Gazette of September 19, 1913, page 525, but since that time several improvements have been introduced. One is the substitution of a barket arrangement in place of a fixed counterweight to enable the amount of counterweight to be adjusted to the weight of the rail being handled. Another improvement is the addition of a light rail on which the car can be moved forward or backward when laying rail which is not distributed accurately. This rail, which is 20 ft. long and weighs 100 lb., is carried forward with the car when moving from one rail to the next by means of hooks suspended from the frame of the car. When carrying rail inaccurately distributed forward or backward to "heel it in" the small wheels of the car run on this rail.

This car weighs 750 lb. It can be lifted from the track readily to allow trains to pass without the necessity of running to the nearest siding. Five men are required to operate it to best advantage, two at the hoist, one with the rail tongs at the center and one at each end. As one man is required to heel the rail in with any form of organization for comparative purposes, four men are re-



THE IMPROVED MADDEN RAIL LAYER.

quired to place the rail with this machine in contrast with 12 to 20 men with tongs.

In addition to this immediate reduction in the number of men required, more rail can be relaid with this machine than with tong men. In a recent instance, 19 men, including 2 flagmen, relaid and fully bolted and spiked 2,700 ft. of track in a day, closing four times to allow trains to pass. On the Louisville & Nashville, 30 men have relaid 2,400 ft. of track per day, including full bolting and spiking. Tests have shown that the machine is capable of laying rail under ordinary conditions as fast as 125 men can throw out the old rail ahead and fully bolt and spike behind it. A gang of 120 men on the Northwestern laid 12,000 ft. of track in this way with one machine in one day last summer. One roadmaster, on the same road, using one of these machines, relaid 32 miles of track last year at an average cost per mile of \$297.07, including the unloading of new rail and the loading of the old, the application of tie plates, etc., a material reduction from previous costs.

A particular advantage of this machine during a season such as this is the flexibility of operation which is possible, as five men can place the rail as fast as a large gang can do the other work, while it can also be used with small gangs. The Rock Island has used one of these machines successfully recently with a gang of only 12 men at a point where more labor could not be secured at the time.

COMING CONVENTIONS

PLANS for the convention of the Roadmasters and Maintenance of Way Association, which will be held at the McAlpin Hotel, New York, on September 19 to 22, inclusive, are developing rapidly. The detailed program is as follows:

Tuesday, September 19, 9:30 a. m.—Convention called to order by president. Addresses of welcome, reception to new members, etc.

2:30 p. m.-Papers, reports and discussions.

7:30 p. m.-Reports and discussions.

Wednesday, September 20, 10 a. m.—Reports and discussions. Paper by Geo. Rex, manager treating plants, Atchison, Topeka & Santa Fe.

2 p. m.-Trip over the electrified zone of the Long Island.

7:30 p. m.—Papers, reports and discussions.

Thursday, September 21, 9:30 a. m.-Election of officers, reports and discussions.

2:30 p. m.—Trip over the terminals of the New York Central and the New York, New Haven & Hartford to Stamford, Conn. 8 p. m.—Annual banquet of the Track Supply Association.

Friday, September 22, 10 a. m.—Installation of officers and closing business, adjourning at 11 a. m. to visit the exhibit of the Track Supply Association.

the Track Supply Association. 12:30 p. m.—Trip by steamer of the Central Railroad of New Jersey to Atlantic Highlands, then by rail to Asbury Park, returning to Jersey City by rail.

At the opening session on Tuesday morning, Mayor Mitchel of New York City and James A. McCrea, general manager of the Long Island, will welcome the members. At the banquet on Thursday evening, Ralph Peters, president of the Long Island; A. S. Thompkins, judge of the New York Supreme Court, and Fred D. Underwood, president of the Erie, will address the members and guests.

Arrangements are being made for a special train leaving Chicago on Sunday afternoon, September 17, over the New York Central Lines, for the members of the Roadmasters and Supply associations from that city or west.

In addition to the list of 46 firms who have made reservations for space in the exhibit of the Track Supply Association, published last month, the following firms have also applied. The exhibit promises to be one of the largest and most complete ever held:

Bowman, T. B., Chicago, III. Carbic Manufacturing Co., New York City. Chicago Malleable Castings Co., West Pullman, III. Cleveland Frog & Crossing Co., Cleveland, Ohio. Dressel Railway Lamp Works, New York City. Eymon Continuous Crossing Co., Marion, Ohio. Hatfield Rail Joint Mfg. Co., The, Boston, Mass. Hussey-Binns Shovel Co., Pittsburgh, Pa. O. F. Jordan Co., Chicago, III. Seltite Co., Inc., Westchester, N. Y. Wharton, Jr., & Co., Inc., Philadelphia, Pa.

BRIDGE AND BUILDING CONVENTION

The American Railway Bridge and Building Association will hold its annual convention at the Gruenwald hotel, New Orleans, on October 17 to 19, inclusive. Arrangements are being made for a special train over the Illinois Central from Chicago, leaving on Sunday, October 15, and stopping at the National Cemetery at Vicksburg, Miss., en route. On the Friday following the close of the convention it is expected that a trip will be made by special train to the Pontchartrain trestle on the New Orleans & North Eastern, thence to Slidell, La., where the plant of the American Creosoting Company will be visited. The party will then go over the New Orleans Great Northern to Bogalusa, La., visiting the saw mill of the Great Southern Lumber Company. A trip is also planned by steamer and train over the New Orleans harbor and over the Public Belt Railway to afford the members an opportunity to study the dock construction.





THE two prize-winning papers in the contest on the Handling of Construction Equipment Used in Maintenance of Way Work were published in the Railway Maintenance Engineer for June, page 175. The following contributions received at the same time cover other phases of this problem of interest to railway men concerned with the distribution, operation and maintenance of the various kinds of equipment used for this class of work.

THE MAINTENANCE OF EQUIPMENT By P. H. Hamilton

St. Louis & San Francisco, Memphis, Tenn.

A number of railroads do not give the maintenance and operation of work equipment the necessary consideration, and as a result much money is wasted in the use of dilapidated or inefficient machines and cars. Instead of repairing equipment after it has been ordered out to a job, it should be overhauled immediately after it has been released from work, thereby getting it into shape for the next work, which may come up on short notice.

When a maintenance of way officer receives authority to do some work he immediately advises his superior as to the special equipment he will need. The road is canvassed, the best of the available equipment is sent and reaches him in the same condition as when released from the previous job. The steam shovel has worn-out chains, the gear wheels need traming, the throttles and water tank leak, etc. The Lidgerwood shows up apparently in first-class shape; but the cable is shorter than desired. The center plow is apparently in good shape. The dirt cars arrive in good running condition, but otherwise in bad shape. The side dumping equipment is out of order, and the sides are held shut by stakes.

When the first train of dirt is loaded and hauled out it is found that the plow runs to one side, and the sides are torn from some of the cars. Every possible means of adjustment is tried to make it drag on center, but without success. On account of the heavy load, the pressure against one side of the cars is too great, and it is necessary to cut down the loads. Measurement finally shows that the plow is constructed off center; that is, one side of the nose is considerably longer. This makes no difference when the cars are loaded light, but it prevents heavy loading. The air pump on the locomotive is bad, the train line is leaking, and it is necessary to stand on the main line an extra length of time pumping up the air to operate the spreader.

When work equipment is released from a job those in charge should be required to make statements covering the condition of each machine or car, giving recommendations as to improvements. These reports should be sent to some designated officer, who will give them con-

sideration and, being an expert, he will act on the suggestions as he sees fit. The reports should be made a part of the equipment record. Most roads arrange for reports from division officers, showing the location and condition of special work equipment on the division. The entries in these reports, under the heading "Condition," generally specify "Good," "Fair," or "Bad." "Fair" or "Good" give little information, and when some equipment is needed a man must be sent to the station where it is stored to get the necessary information, but he will not catch the minor defects which will show up in operation.

A shortage of equipment is expensive, and on large jobs auxiliary equipment should be provided. It is often expedient to rent or lease machines from other roads, or from jobbers or manufacturers for auxiliary use, instead of investing money in additional plant. If a steam shovel is placed in first-class shape it should go through a season safely. However, on emergency work an auxiliary shovel may be justified as insurance against delay in the work. Extra cars should be on hand, as cars are continually in need of repairs. Two 50-ton jacks should be available for use in wrecking. Two or more channel irons often come in handy in pulling trucks out of holes. Clamps, swivels, melting furnaces, babbitt metal for splicing cables, etc., should be available. A good blacksmith and one or more car repairers will help keep the cars in service and on a job of any magnitude there is always plenty of work for blacksmiths and carpenters.

No matter how thorough the preparation, and how efficient the organization, there are many opportunities for the exercise of ingenuity and initiative in keeping the work in progress. Situations arise which must be met promptly.

During cold weather machines should not be put under load until thoroughly warmed up. In winter it is best to keep the plow on an empty car to prevent it from freezing fast over night. In selecting cars for handling earth or ballast, for handling rail or bridge material, or for handling ties, those which can be loaded to fullest capacity should be taken.

The dump cars commonly used by contractors are best for handling dirt, but they are not always available. More or less delay is often experienced, trying to dislodge sticky earth from them. It is sometimes economical to cover the floors of the cars with sheet zinc. Earth will not stick to this, and any metal will clean itself more readily than wood. Steel frame, convertible cars with flat bottoms and swinging sides are best for use with center and side plows. These steel frame cars are built for handling heavy loads, and plows can be run over them with little damage to them. When using a spreader it should be located at the rear of the train; that is, farthest from the engine. While the cars are being opened up the wings should be lowered and made ready for



work. As the train moves ahead it spreads the dirt being unloaded. Where equipment is operated by air, the train line should be kept in first-class shape. Sometimes it is expedient to have an auxiliary water tank with a work engine to prevent the loss of time running for water.

HANDLING CONSTRUCTION EQUIPMENT

By O. W. Duffy

Superintendent of Construction Equipment, Chicago, Burlington & Quincy, Galesburg, 111.

A great many railroads at the close of the construction season sidetrack all construction equipment, and give it no attention other than to make repairs, until the spring work opens up. The result is that the money invested does not produce any returns during the winter.

On a well-organized railroad all construction equipment should be in the care of one man, who should work in close touch with the general manager, the engineer maintenance of way and the general superintendents. Before the work is started in the spring it should be gone over and a decision should be reached as to the equipment necessary to handle this work to the best advantage. When a superintendent is ready to commence his work he should advise the man in charge of construction equipment to furnish the necessary outfit on a given date and it should be the duty of the latter to have the machinery, cars and other equipment on the job with competent men to operate them, ready to commence the work on the date set. Every man in that organization should know his place and be there to carry out his part. In this way all delays in starting the work and perfecting the organization are eliminated. The man in charge of the equipment must understand the handling of all the different machines used, and should be held responsible for the work they do.

The construction equipment department should receive a telegraphic report every day from each outfit, showing just what work has been performed and the extent and nature of the delays. A weekly report should also be made by the steam shovel and ditcher engineers, giving a list of all the machines in service and their condition. By doing this, the equipment superintendent keeps in close touch with his men and the machinery, and any defects that show up can be corrected before the machines are put out of commission.

As soon as a steam shovel or ditcher finishes any work, the division superintendent notifies the equipment superintendent, who, being in close touch with the general manager and chief engineer, can arrange to move the outfit to some other work. Unless properly controlled, many divisions will hold more equipment than is needed, while other divisions are short of it.

A stock of repairs should be carried at some central location and when any material or supplies are needed for the outfits, they can be furnished quickly. All requisitions for construction equipment and supplies should go through the equipment department office, as many of the requirements of construction work can be filled with supplies released from some other place, instead of buying new material.

After the season's work is completed, there is considerable work done by hand that should be done with the construction machinery. For instance, by using two small drums in place of one large one, a steam shovel will handle a $1\frac{1}{2}$ -cu. yd. clam-shell bucket, and do the work of a locomotive crane, storing coal, loading coal from stock piles, handling cinders at pits, coaling engines where emergency coaling stations are found necessary in cold weather, cleaning up cinders and doing miscellan-

eous work which is ordinarily done by hand at a much higher cost. The disinfection of stock cars can be accomplished with economy by placing an air pump on a steam shovel and coupling up the injector to a steam hose to furnish hot water.

When ice is being loaded and unloaded at an ice house the cars can be spotted by equipping a steam shovel with 1,000 ft. of $\frac{3}{4}$ -in. cable and cutting it out near the ice house, so that the machine can pull the cars. Where there is light ditching to do a wing of the desired shape on a Jordan spreader can do a lot of work quickly at small expense, that is now done by hand or teams.

In conclusion, the equipment department should make a weekly report to the general manager and engineer maintenance of way, showing all the equipment, its condition, where located and whether or not in service. This report can be kept up to date only with the co-operation of the superintendents in keeping the equipment department advised as to when and where any of the outfits are moved. The head of this department should work under the superintendent of motive power and be carried on his roll. as much of his work in keeping the equipment in good condition will come under the jurisdiction of the mechanical department.

METHODS OF GRAVEL PIT OPERATION

By L. M. GUNSTEAD

Supervisor, Illinois Central, Waterloo, Iowa.

The first thing that is necessary after a gravel pit has been located is to start a gang of about 20 teams removing the top soil that is not fit for ballast, but which can be loaded on cars by the shovel and used for widening banks and filling openings.

A gang of about 30 men should then be started laying temporary pit tracks, one storage track for loads and one for empty gravel cars, each 1,500 ft. long and connected with tracks leading to the main line. A track 200 ft. long, where cars can be placed for light repairs, is also required. It will be necessary to have another track of the same length for engines, this track to be provided with a temporary cinder pit. In some locations water can be provided by digging a hole 10 to 12 ft. deep, thus enabling engines to syphon water. This, of course, is intended for locations where regular water stations are not near enough and serious delay to the pit work would result from running to the nearest water station.

The next thing is to arrange work trains and equipment to handle the output. This is governed by the length of the haul. For instance, if it is necessary to haul the gravel from 20 to 75 miles or more, three work trains will be required, consisting of 25 or 30 Haskell & Barker side dump gravel cars or the number that engines can handle over the division. A Lidgerwood unloader with a gravel plow and cable is also required. The movement of these work trains can be so arranged that the one Lidgerwood and plow can unload for all three trains by arranging to have the last train using them turn them over to the next train of loads at the meeting point when returning with empties. It will require one engine at the pit to spot cars for the shovel and switch them out to the load storage track.

It will take two men, in addition to the regular engineman, craneman and fireman, on the shovel, to lay track for the shovel and cave down steep gravel banks when necessary. An experienced man will be required to run the Lidgerwood.

The output from one steam shovel will require three track surfacing gangs of 30 men each. They should be located at three different points on the work, as the three gangs so located can accomplish more than is possible where the same number of men are used in one gang. Local section gangs can be used for throwing pit tracks when necessary.

One car repair man should be furnished to inspect, oil and make necessary light repairs on the cars at the pit. It should be the duty of the gravel pit foreman to keep the time of the men employed at the pit, check the number of cars loaded and direct the conductors of work trains where to unload gravel. He in turn should receive his instructions from his supervisor or road master. The equipment for a steam shovel ditching outfit should consist of a work train and crew, a mud plow, a bank leveler and 10 flat cars, full staked. It will require one foreman and 6 laborers to slope the bank and handle the bank leveler. As only 2 men are required to handle the leveler, the remaining 4 men and the foreman can remain at the ditch while the train is unloading. An experienced conductor should be assigned to this work, as most of it is handled on the main line, and much time can be saved by handling the trains properly.

Quick Work Prevents Flood Damage

THE erection of the Athabasca river bridge of the Edmonton, Dunvegan & British Columbia about 100 miles north of Edmonton, Alberta, was interrupted by an unlooked-for and serious rise of the river, which caused an accumulation of drift wood that threatened to carry away one of the spans. The bridge was saved by a quick decision of the erection foreman to use a rather unusual means to solve the difficulty.

The bridge is a symmetrical structure built for a single track. It has a 175-ft. through truss span in the middle with two 150-ft. deck truss spans and one 70-ft. deck plate girder span on either side. The total weight of the steel erected is 1,127 tons. All five trusses are of the riveted type and were erected on falsework in the ordinary manner with a double boom derrick car, working from the east end of the bridge. The through span is sup-



THE MANNER OF MAKING THE CONNECTION.

ported on structural steel posts, riveted to and forming a part of the adjoining deck truss spans. The lower end of each of these posts was field-connected to the gusset plates above the bearings, these gussets being shop riveted to the bottom chords of the flanking spans. This was the layout adopted by the consulting designing engineer of the railway and necessitated the erection of the first length of bottom chord of the third deck span from falsework under the through span before the vertical posts supporting the latter could be placed.

Almost immediately after the completion of the channel span and the removal of the falsework upon which it had been erected, the river rose very rapidly and the tops of the piers were soon under water, while the bottom chords of the deck spans were clear of the water surface by only a very few inches. The flood water carried a large amount of drift wood, much of which became lodged around the pier supporting the west end of the through span. The conditions were aggravated by the presence so close to the water of the end sections of the bottom chords of the third deck span. In a short



THE COMPLETED BRIDGE.

time the accumulation of timber at this point, some of the pieces being logs of very large dimensions, was offering such resistance to the flow of the water that the steel bent was being pushed down stream at the rate of one-half inch a minute.



DEBRIS LODGED IN THE BRIDGE.

The quick decision of the erection foreman undoubtedly saved the span, coupled with the fortunate presence of a Lidgerwood unloader near the bridge. Leav-



ing the Lidgerwood on the east bank of the river, a line was run out over the bridge and hitches were taken on the outer ends of the two projecting sections of the bottom chords of the third span. The derrick car was placed in position on the outer end of the through span to load the pier members and provide as much frictional resistance as possible against any tendency of the vertical posts to kick under. The Lidgerwood then hauled in its line, thereby deliberately bending up the two bottom chord members a sufficient amount to release the jamming logs. After the level of the river had fallen, the chords were straightened again and the points where the bends had been introduced were well reinforced. The erection then proceeded in the normal manner.

We are indebted for the above information to P. L. Pratley, designing engineer of the Dominion Bridge Company, Montreal, which company fabricated and erected this bridge.

Simplifying Section Foremen's Reports

BY KENNETH L. VAN AUKEN

MANY foremen have little education along clerical lines, and are not able to make up an elaborate monthly time book accurately. It is difficult for them to balance the time and distribution of labor with the total hours worked. Furthermore, when they wait unThe Delaware and Hudson recently investigated this subject and decided that a daily report on time, distribution, material and tools would solve most of these difficulties. With the monthly system the records showing the time of the laborers and the distribution of the work,



BOTH SIDES OF THE DELAWARE & HUDSON DAILY TIME SHEET.

til the end of the month to enter up the time and distribution, many errors are likely to occur. In like manner it is difficult for most track foremen to make out complicated monthly material statements, with the result that the roadmaster or his clerk usually has to put in considerable time correcting them. the material used, recovered, received or shipped, and the report of the tools on hand must all be made at the end of the month, necessitating much overtime work on the part of the foreman. With the daily reports adopted by this road, the entire report on time, distribution, tools and materials is made at the close of the day.

The advantages cited are that the facts are fresh in the trackman's memory, and he is then able to relieve his mind of further responsibility; the possibility of padding the payroll is reduced; accurate reports covering the character of the work performed are secured; more accurate reports are obtained of material used and it is easier to credit the cost of a given job with the value of second-hand or scrap material; the delivery of material is established within 24 hours; the roadmasters are in possession of all facts covering the performance of section gangs within 24 hours; they are better able to control the immediate force allotment; the possibility of performing work for outside concerns, without compensation, is reduced since section foremen, when reporting monthly, quite frequently overlook this feature; a comparison of labor items with a report of material used for the same day is available, and the daily report gives an accurate determination of unit costs for renewals.

The form which has been developed by the Delaware and Hudson makes it possible to get on a single sheet all the desired information regarding the time and its distribution and material. On one side, the names of the laborers are entered. The check numbers are shown in the second column, hours worked in the next to the last, and the rate of pay in the last column. At the lower part of the sheet the foreman enters the different kinds of work done, together with the hours worked by the gang on each kind of work. The hours are further separated under main-track, side-track and job-order headings. On the opposite side of the blank are given spaces for entering the material used and taken from the track, the material received or shipped away, and below, a space in which the foreman may report cars received and shipped, request material to be rushed, or mention any other matters of interest to the roadmaster.

This makes it unnecessary for the foreman to handle more than one kind of report, and its simplicity makes his work much easier. He writes in the kind of work done during the day, and in a similar manner writes in the materials used, taken from track, received or shipped. It is not necessary to have a large number of lines in order to include every item of material or distribution that is encountered in a single day's work. Compared with some of the voluminous books and reports required on some roads, these reports have been simplified enormously.

ALARGE ROADSIDE TANK

By C. R. KNOWLES

General Superintendent of Water Service, Illinois Central, Chicago, Ill.

THE 200,000-gal. steel tank recently constructed by the Illinois Central to supply water to road locomotives at Obion, Tenn., marks an important step in railway water tank construction, as it is the largest roadside railway water tank ever constructed for locomotive supply. The tank is a standard conical bottom steel railway water tank with settling drum. The tank proper is 36 ft. in diameter by 18 ft. high and is constructed of $\frac{3}{6}$ -in. and $\frac{5}{16}$ -in. plates. The bottom forms a cone connecting the shell of the tank proper to the mud drum and is 36 ft. in diameter at the top and 10 ft. at the bottom. The total depth of this bottom from the shell to the mud drum is 15 ft. The plates forming the shell are $\frac{7}{16}$ -in. thick.

The mud drum is 20 ft. high, 10 ft. in diameter at the top and 6 ft. at the bottom. The capacity of the tank is figured from the top of the mud drum, leaving ample space for the precipitation of suspended matter. The mud drum is equipped with a 6-in. washout valve

for cleaning the tank while in service. The roof is conical with a pitch of $4\frac{3}{8}$ in 12, constructed of $\frac{1}{6}$ -in. plates secured to the top of tank by means of angles riveted to both tank and roof. A 12-in. cast iron finial surmounts the apex of the roof.

The height of tank over all above foundations is 60 ft. The tower consists of six posts, each constructed of two 12-in. 25-lb. channels with a $14\frac{1}{2}$ -in. cover plate and lacing bars 2 in. by $\frac{3}{8}$ in., $145\frac{4}{8}$ in. center to center. The foundation contains 122 cu. yd. of concrete and consists of six outside piers, 10 ft. 6 in. square at the bottom and 3 ft. 4 in. at the top, and one central pier 11 ft. square at the bottom, the total bearing on the soil being 131.25 sq. ft.

The total weight of tank and tower is 117,000 lb., distributed as follows: Tank 78,000 lb., mud drum 9,000



THE 200,000-GAL. TANK AT OBION, TENN.

lb., tower 30,000 lb. The weight of the water alone when the tank is full is 1,749,300 lb., making a total weight on foundation of 1,771,000 lb. The tank was constructed by the Chicago Bridge and Iron Works and cost complete, including foundation, \$6,786.40.

The pumping equipment supplying water to the tank is installed in duplicate units, consisting of centrifugal pumps driven by oil engines, each pumping unit having a capacity of 500 gal. per min. The maximum daily pumping capacity is 700,000 gal. This quantity of water may be pumped at a cost of less than $\frac{1}{2}$ cent per 1,000 gal. Water is delivered to locomotives through 1,200 ft. of 14-in. cast iron pipe and two 12-in. penstocks serving the north and south bound tracks.

This tank and water station were constructed to take the place of water stations formerly located at Rives and Newbern and forms a part of the scheme of rearrangement of water stations between Fulton and Memphis



made necessary on account of double track construction. The distance to Fulton, the first water station north of Obion is 24.87 miles and to Dyersburg the first station south 20.09 miles. With the completion of the new water station at Curve 37.30 miles south of Obion, it will be possible for through freights to run by Dyersburg, taking water at Curve and Obion. By constructing a tank of this capacity it was possible to dispense with the services of a night pumper and handle the work with one man. This saving is in excess of the additional cost for the tank and also guards against possibility of failure of the supply owing to breakdowns.

A NEW USE FOR A TRACK JACK

THE accompanying photograph illustrates a new use for a track jack. By the help of two attachments known respectively as a "universal tie spacer" and a "jack attachment," sold by the Reading Specialties Company, Reading, Pa., the track jack is made to act in a horizontal position to space ties. The tie spacer is an iron yoke made to fit over the head of the rail with an arm on one side to take the thrust of the jack. The jack attachment is a small casting made to fit over the head of



THE TRACK JACK AND TIE SPACER.

the jack and provided with a saddle to bear against the yoke. With the foot of the jack against the side of a tie and the yoke in position over the top of the rail, the "raising" of the jack causes the yoke to grip the rail and it is thus possible to exert a high pressure against the side of the tie.

The yoke can be used alone in conjunction with a lining bar to accomplish the same purpose in a somewhat less effective manner in gravel or cinder ballast. When used with the jack and jack attachment, it is possible to space ties easily in heavy stone or slag ballast. It is not necessary to crib out in front of the ties except in the case of the first tie to be moved. With all subsequent ties the cribs can be pushed ahead of them. It is not necessary to detach the jack attachment from the tie spacer, nor the jack from the jack attachment when moving the device from one tie to the next. As the yoke fits loosely over the rail it can be removed quickly as soon as the jack is released. The removal of the jack can be accomplished in much less time than is possible in the case of a jack in position under a rail.

The yokes are made in three different sizes. Size 1 fits all weights of rails from 55 to 80-lb., inclusive. Size 2 is for rails from 85 to 100-lb., inclusive, except the

100-lb. P. R. R. section, and size 3 fits all the larger sizes of rails. Owing to the simplicity of this device and the ease with which the men can be taught to use it, it is said to result in very material economy in the work of spacing ties. It has received extended use on the Baltimore & Ohio and other roads.

CUTTING BRUSH AND WEEDS

BY E. F. PETRY,

Track Foreman, Baltimore & Ohio Southwestern, St. Bernard, O.

A LL grass and weeds growing in the ballast should be cut at least once a year, and in some parts of the country more than once. Some railroads prefer to keep the track free of grass and weeds at all times and others allow them to grow until fall on account of the dust in the summer months. The practice to be followed depends largely upon the climate, the kind of ballast used and the financial condition of the road. However, all weeds should be cut before the plants go to seed. The weeds and brush on the right-of-way also should be cut at least once a year, the weeds before going to seed, and the brush when the sap rises the second time.

The right time to cut brush is in August when the sap is rising the second time. If brush is cut at this period much of it will be destroyed, as it will lose much of its sap and there will not be sufficient growing weather remaining for it to recuperate, causing much of it to die before the next spring. If it is cut later in the season much of the sap will be in the roots, ready to shoot up from the old stumps the next spring, while if cut earlier, even if much of its strength is lost, there will still be enough good growing weather for it to recover fully before autumn.

Shovels are generally used to cut the grass and weeds in the ballast, and they make good weed cutters, although in fine gravel, sand, cinder and dirt ballast a weed cutter with a long handle, or a hoe is used to some extent, and where the grass and weeds are not too hard and tough or the ballast too coarse much more work can be done than with a shovel, and it is not so tiresome. Whether a shovel, weed cutter or hoe is used, it should be kept sharp. A flat file is a very good thing to use for that purpose. Some trackmen do not favor the idea of sharpening tools, as they will get dull again, but if one will watch the results obtained by using a dull, as compared with a sharp shovel, he will soon be convinced that sharpening tools is a time-saving proposition. A tool will not last as long when kept sharp, but the greater amount of work done will offset many times the wear of it. If a man does only 10 per cent more work with a sharp shovel than with a dull one, this will pay for a new shovel in less than 3 days.

The most common practice when cutting grass and weeds out of the ballast is to let each man throw out by hand the grass he has cut. This is slow work. A better way to do is to have the men cut the grass and weeds and one man follow with a garden rake, raking out all the larger weeds without picking up every little blade of grass. By this method a gang of men will cut from 25 to 50 per cent more grass and weeds in a day. On some roads picks are used to loosen the grass and weeds, which are then pulled and thrown out by hand. This is slow work and should only be done in stone ballast.

On some roads it is the practice to send one or two men to cut the brush or do the right-of-way mowing to avoid furnishing tools for all the men. This is a poor way to economize, as the men away from the foreman are liable to make such work last as long as possible. As a result the greater amount of labor required will generally reach several times the price of the extra tools.



Track Put Up On Crushed Gravel

Crushed Gravel Ballast on the Rock Island

HE availability for use as ballast of a deposit of gravel depends principally upon the relative proportions of the various sizes of particles and the content of clay or loam. If the amount of fine sand or foreign matter is high the gravel will give a dusty ballast and one that drains improperly. If, on the other hand, the gravel contains a considerable amount of particles or boulders which will not pass through a 2 or 3-in. screen, it will be troublesome and expensive to handle in the track. The first objection can be overcome by washing the gravel and this has been done in certain pits during the past eight years or more. The other difficulty can be overcome by passing the gravel through a rock crusher and this is now being done, in combination with washing, in a pit serving the Chicago, Rock Island & Pacific at Rockdale, near Joliet, Ill. The success of either of these remedies depends, of course, upon the economy with which they can be carried out, as affected by the physical condition or situation of the pit.

Except for the fact that a considerable portion of the stone is too large for use in track, the gravel at Rockdale would be an excellent natural ballast; at the same time the pit presents physical characteristics which are most favorable for economical operation. The face of the pit is 13/4 miles long and 65 ft. high above a general ground level, which can readily be drained, while there is a considerable deposit of material below this level which affords possibilities of future development by dredging. The content of clay or loam is small and the stripping is so thin that with the use of the washing process no attempt is made to strip. The sand contains only a small amount of the extremely fine particles. The pit is owned and operated by the Chicago Gravel Company and the output is used commercially as well as for railroad ballast.

The gravel is excavated with a 175-B Bucyrus turntable steam shovel with a 65-ft. boom and a $3\frac{1}{2}$ -cu. yd. dipper. This machine has a capacity of 3,500 cu. yd. in nine hours. The gravel is hauled to the crushers over standard gage tracks in two trains consisting of two Roger ballast cars of 40 cu. yd. capacity each, handled by 40-ton, 4-wheel switch engines. The crushing plant consists of four No. 6 Allis-Chalmers gyratory crushers with a capacity of 300 cu. yd. per hour. Two Symons Brothers disc crushers are provided to recrush all stone which fails to pass through the largest size screen. A grizzly is provided under the hopper over the four primary crushers in order to by-pass as much as possible of the fine material to avoid the possibility of choking up the crushers. The rock is transmitted from the track hopper to the crushers and from the crushers to screens, etc., on heavy conveyor belts.

The screening and washing plant consists of seven steel tanks 19 ft. in diameter and of varying heights, to a maximum of 48 ft. and seven rows of four screens each arranged in two banks by which the material is separated into six different sizes. In one bank the sizes of the mesh in the screens are in order, 2 in., $1\frac{1}{4}$ in., $\frac{3}{8}$ in. and $\frac{1}{4}$ in., and they separate the stone respectively into what are known as 2-in. stone, 1-in. stone, roofing gravel and torpedo sand. In the other bank the sizes are $2\frac{1}{2}$ in., $1\frac{1}{2}$ in. and $\frac{1}{4}$ in.

The process of screening is the direct opposite of the usual method in that the material passes over the largest size screen first, all the material retained on the screen being passed directly to a bin while that which passes through the screen is carried to the next smaller screen. Fifteen hundred gallons of water per minute is used for washing, a stream of water being played on each screen. The separation of the clay and loam takes place in a box under the last screen, where a tilting device periodically pours off the water containing the suspended matter and permits the sand to drop into a bin.

Bins are provided for each of the sizes enumerated above and in addition there is one bin for ballast which consists of the run of the pit for the material retained on the $1\frac{1}{4}$ -in., $\frac{3}{8}$ -in. and $\frac{1}{4}$ -in. screens plus 10 per cent of the torpedo sand. The run of the pit for the three larger sizes consists approximately of one-fourth roofing gravel, one-fourth 1-in. stone and one-half 2-in. stone. Ten per cent of torpedo sand is added because it has been found



that this amount of sand facilitates the handling of the ballast in track.

Gravel from this pit was first used on the Rock Island for ballast in 1912, the gravel being crushed to a 2-in. size without washing. This gave a fairly satisfactory ballast, but some tendency toward churning of track was noted and it was finally concluded that it was not entirely suitable for the standard of track desired for the main lines of the Rock Island. As a result, the washing feature was added in 1913 and has been carried on for the three last seasons, according to the arrangement described above. The ballast has been used on the main line of the Illinois division between Chicago and Rock Island, and on the main line of the Missouri division between Rock Island and Eldon, Iowa. During the past season the average daily output has been about 65 cars, about 35 cars of which has been used for concrete on track elevation in Chicago, and ordinary commercial purposes. The rest is being used as ballast in a general improvement of the tracks over the district mentioned above, including a raise out of face and extensive tie and rail renewals.

A special effort is made not to mix the new ballast with the old. In general no new ballast is delivered until all the old ballast has been removed to the level of the bottom of the ties, either by raising the tracks or by using it to widen the shoulders. Ordinarily the ballast was unloaded in two portions: first, a sufficient amount for making the lift with skeleton track, and later the amount necessary for dressing to the standard ballast section. The track was raised by shovel tamping and then left for a period of about two weeks, when it was gone over again and all low spots were raised with the use of tamping picks.

This crushed and washed gravel costs approximately two-thirds the average cost of crushed stone ballast available in the same general territory, and with the experience had thus far the results obtained have been entirely satisfactory. It is much easier to handle in track than rock ballast. In fact, it can be worked almost exactly the same as gravel, shovels being used for most of the tamping as mentioned above. Owing to the fact that a considerable portion of the stone has passed through a crusher, a large portion of the particles are angular in shape rather than round, a fact which adds materially to the holding power of the material as a ballast and there is not the tendency to roll which has sometimes been experienced with washed gravel which has not been crushed. The ballast looks very much like rock ballast in track and is equally clean and free from dust.

Reducing Track Tool Expenses

BY M. E. CARROLL

I F a newly-appointed roadmaster, making his first trip over his division, found three section men sitting in the shade of a tree smoking their pipes, and upon his return trip the next day found them still sitting there, without question he would start a vigorous inquiry into the cause of this condition. If from this inquiry he learned that this practice was regularly authorized and that he must carry the expense of these three men for the entire season, he would certainly consider that he was being imposed upon, and doubtless would spend some time and energy in planning a means of eliminating this unusual charge. Yet a roadmaster on an average main line division is incurring an equivalent expense through the increase in the cost of his track tools without being nearly as much disturbed over it.

The gigantic war being waged in Europe has had a powerful and far-reaching influence over American manufactures. One of the results of the interruption of our imports was a shortage of tungsten used in the manufacture of high-speed steel. In a few months the price of this commodity advanced several hundred per cent, causing such an increase in the price of high-speed drill bits as to render their use almost prohibitive.

Partly in sympathy with the high-speed steel situation and partly because of the demand for export purposes, the price of crucible steel, of which many of the bestgrade track tools are made, has also experienced a sharp rise. This, together with the scarcity of labor in all manufacturing lines, has resulted in a general increase in the cost of all tools used in track maintenance, amounting to nearly 20 per cent.

In recent years the flat drill bit of high-speed steel has come into general use for rail-drilling. The cost of these drill bits has risen from \$0.70 to \$3.10 each in a little more than a year, and on many lines the use of carbon steel drill bits has been resumed. Unfortunately, it has not been the practice to call the attention of the trackmen to this change in the quality of the steel, and they discover the difference by trying to make the carbon

steel drill bit do the same work which they have been doing with the high-speed drill bit. The result is a broken bit and a waste of labor and material. Unless complete instructions are given trackmen in the use of drilling machines and the handling of bits much time will be lost in drilling rails and many bits damaged.

There are two features in connection with the drillbit situation which will bear close attention on any railroad. It is of the utmost importance to watch the disposition of the old high-speed drill bits when discarded by trackmen. These scrap bits are worth more than the new ones cost two years ago. Each one should be carefully saved, sent to the roadmaster's office by registered package, and turned over to an expert tool man at the shops for reworking. Usually drill bits of this kind can be reground and put to further use, or reduced to the next smaller size and used in the shop drill presses.

The other point deserving attention is the disposition of obsolete high-speed steel. Dealers have offered very attractive prices for the odd sizes of steel which have accumulated in storehouses owing to past changes in shop practices. One railroad system found that, by making an inexpensive set of dies, most of this valuable high-speed steel of obsolete sizes could be worked up into drill bits, thus saving the cost of new ones. After this stock was exhausted the same dies were used in making drill bits of carbon steel. These were marked with a small white paint dot and trackmen were cautioned that drill bits so marked must not extend very far from the drill chuck and must be handled carefully when starting the hole and when the drill bit comes through the rail. In this manner very good success has been had in drilling with carbon steel drill bits, which cost only \$0.14 each to make.

Another thing which receives considerable abuse in the hands of trackmen is the track chisel. This tool should be made only of crucible steel and should be of best quality. An ordinary operating division of three hundred miles will use 200 to 300 chisels per month during the summer season. Every chisel failure means a delay to work and may even result in personal injury. Track chisels should be of good quality, and the tendency of purchasing departments to order the cheaper quality of track tools at the present time in an effort to offset the rise in prices does not always result in economy to the railroad. The accompanying illustration shows a track chisel which has seen many months of hard service and has been kept in shape for use by occasional grinding. With it is shown a comparatively new track chisel of cheaper quality, which broke under the hammer during the first half-hour of use and must be sent to the blacksmith shop for redressing.

Track chisels should be handled carefully when in use. The men should be instructed to hold them accurately in the cut and in an upright position, perpendicular to the rail surface. A 12-lb. to 15-lb. sledge should be kept with the tool outfit and used in striking the chisels, designed and will take hold of any ordinary track spike without being driven on with a maul. If the rail has cut into the tie an adz should first be used, or the wood removed by chipping with the sharpened end of the clawbar. The price of an ordinary claw-bar has increased \$0.75 during the past year, and the illustration shows what happens to a tool of cheap quality if it is abused in service.

A great deal can be accomplished in effecting economy in the use of track tools if a thoroughly-understood system of ordering and supplying new tools and caring for the tools in service, both while in use and when idle, is in effect. Foremen should make requisitions at regular intervals for their supplies of new tools, stating on the requisitions if the old tools will be available in exchange. Roadmasters should carefully scrutinize these requisitions and if the old tools are not available, suitable inquiry should be made. Supply cars should be fully



A COMPARISON OF TOOLS IMPROPERLY AND CORRECTLY USED.

rather than using a spike maul. A maul is too light for striking track chisels, and its small face renders it difficult to strike an accurate blow on the chisel head.

Adzes are frequently misused by trackmen. In the haste to prepare the ties ahead of a rail-laying gang the men frequently neglect to sweep the gravel off the ties before using the adz. Also one inexperienced in the use of this tool is very liable to strike the edge against a track spike or the rail flange. A tool of first-class quality will stand moderate abuse of this sort, but the cheaper tools, which the purchasing department is tempted to buy during this season will become nicked after a few minutes of use. The illustration shows the difference between a tool of good quality which has seen a great amount of service and a new tool of cheaper quality which became nicked in the first 15 min. of hard service.

It is a difficult matter to teach trackmen the proper manner of using a claw-bar. The average section man or spike puller in a rail gang does not think of attempting to use a claw-bar unless there is another man ready to strike it with a spike maul. Claw-bars are scientifically stocked so that approved requisitions will be filled without shortage, and supply car clerks should be fully instructed in the importance of obtaining every old tool which the requisitions show will be available for exchange for the new ones specified on the orders. The responsibility for the failure to turn in the old tools in place of the new ones should rest with the roadmaster and not with the supply car clerks.

In thus gathering up an old tool for every new one furnished an opportunity is given to inspect the old tools and to form an opinion as to where they have given proper service and where they have received proper usage. It also affords the opportunity of assembling these tools at one place on the system where a sufficient quantity is thus brought together each month to warrant the employment of an expert tool repairer, who can work over the old tools and turn them out the equivalent of new ones. If the old tools are sent to each nearby shop point the repairs are treated as an odd job and are indifferently made, causing the trackmen to become prejudiced against the use of repaired tools.



On the section, and especially on extra rail and ballast gangs, one employee should be delegated to the care of tools. It should be his duty to see that they are properly stored so as to be available when wanted, to see that edged tools are kept properly ground so as to always be in condition for service, and to see that tools are not scattered on the work and lost, but are kept ready for use and gathered up at the close of the day's work.

The annual expense for tools on a large railroad system ranges from \$12,000 to \$20,000 per month and is worthy of close attention at all times. This is especially true during this period of high prices.

SPECIFICATIONS FOR CONCRETE AGGREGATES*

BY CLOYD M. CHAPMAN,

Engineer of Tests, Westinghouse, Church, Kerr & Co., New York, N. Y.

ONCRETE is a cheap building material because it is composed largely of inexpensive aggregates, and for economic reasons these aggregates should be secured from deposits in the vicinity of the point of use. Whatever materials are locally available for aggregates must be used in the great majority of cases, for aggregates which must be transported long distances are no longer inexpensive. The material at hand capable of making concrete of fair quality will generally be used in preference to a better material which must be brought from a distance at considerable cost for transportation.

It is generally true that even a very poor sand, that is, one which compares very unfavorably with standard Ottawa sand when tested in 1 : 3 mixtures with cement, will give a suitable compressive strength if sufficient cement is used. When the only available sand is of such a quality it is necessary to increase the proportion of cement until the required strength is obtained. Our present specifications for sand require that it shall, when tested as prescribed, show a compressive strength approximately equal to that obtained with standard Ottawa sand. A rigid adherence to these specifications would mean that in many sections of the country no concrete work could be done without importing aggregates from a distance. The result is that the specifications are ignored in those localities and the work done without them.

On the other hand, where most excellent materials are available, the present specifications for sand do not permit of a variation of the proportions used, no matter how good the materials may be. For instance, some wellgraded sands show strengths 40 per cent higher than that obtained with Ottawa sand in 1 : 3 mortar, and in $1:3\frac{1}{2}$ or even 1 : 4 mortar show compressive strengths equal to that obtained with Ottawa sand in the proportion of 1 : 3. Yet this sand receives no credit for quality under the present form of specifications.

In order to cover and include all materials which are capable of producing concrete of the quality required for the particular service it is to perform it is only necessary to specify the result required instead of specifying the materials used. By specifying the results required and permitting the use of such materials as will produce these results when tested under specified and standardized conditions, it is possible not only to properly safeguard the product, but to permit the use of such materials as are available in each locality.

It is also true that in many cases the local materials are of such poor quality and would require such a large proportion of cement to fulfill the specifications that it would be economical to bring in better material even from a considerable distance, the saving in cement paying the freight. Specifications of this kind might take some such form as the following, in which all figures are purely arbitrary and in no sense proposed as a standard to be followed:

"The materials used shall be of such quality, and shall be used in such proportions as to produce a concrete which shall show a compressive strength of 2,500 (or 2,000 or 1,500 lb. per sq. in. at the age of 28 days, when tested in accordance with the standard methods of testing."

This form of specification is obviously susceptible to modification to cover varying conditions and qualities. For instance, to insure against a material which sets or hardens slowly, and consequently requires forms being kept in place an unusual length of time, the specifications may require a certain minimum strength to be attained in three days. When compressive strength is not the prime requisite, as for instance, in sea wall or tunnel work, the requirements as to impermeability or density may be inserted, either in place of, or in addition to, the strength requirement.

It would probably be desirable to add some further qualifying clauses to the specifications, such as the limit of size of particles, the character of the materials composing the aggregates, freedom from constituents liable to cause deterioration, etc.

The method at present most commonly employed, except in the cases of some of the railroads and on government work where aggregates, particularly the sand, are systematically tested, is practically to ignore the quality of materials, except the cement, and to specify, arbitrarily, proportions that will give good enough results with almost any aggregates. Wherein lies the incentive to a contractor or builder to use any better materials than the cheapest, if he is compelled by the specifications to use a certain arbitrary mix regardless of quality or material?

Any specifications for concrete aggregates which are to be used all over this country must be so drawn that any material which will make concrete of the required quality will be included. In operating under such specifications, it is of great importance that specimens of the concrete produced on the job be regularly made and tested. It is also of the greatest importance that a close day-to-day check be maintained on the quality of the materials used, to insure a reasonable uniformity, and to know that these materials are at least equal in quality to the materials used in arriving at the proportions required to give the quality of concrete called for in the specifications governing the work.

When the materials used on the job are from the same sources as those tested and from which tests the proportions to be used were determined, it is a simple matter to check up their qualities. Sand and stone from the same source do not vary much in quality, except in so far as quality is influenced by size of particles. Having once established by test the suitability of sand and stone for any grade of concrete and having determined the proper proportions in which to use them to attain a certain desired result, it is only necessary thereafter to see that the size, grading and proportions of these materials are reasonably constant to insure uniform quality of concrete. This fact is based on the well-established principle that, other things being equal, the aggregate whose granulometric-analysis curve most nearly approaches the line of maximum density will produce the best concrete. This makes it possible to determine with reasonable certainty which of two sands of the same kind and from the same source, but differing only in fineness. will make the better concrete.

[&]quot;Abstracted from a paper presented before the convention of the American Society for Testing Materials at Atlantic City, N. J., June 27-30.

GENERAL NEWS DEPARTMENT

A COURT at Jamaica, N. Y., sentenced Michael Halleran, a crossing flagman of the Long Island Railroad to six months' imprisonment on July 11, for being intoxicated on duty.

THE SOUTHERN PACIFIC has announced an increase of wages of 25 cents per day for all section laborers except Mexicans and Chinese, employed on its lines in California, Nevada, New Mexico and Arizona.

THE UNION PACIFIC has converted a dining car into an experimental wireless telegraph station and has built other stations at Omaha, Neb., and Grand Island, with another one proposed at North Platte.

THE SOUTHERN PACIFIC has issued a notice that, owing to the Mexican situation, all of its lines south of the international border are closed and that the company is not in a position to accept shipments for points in Mexico via Nogales or Naco.

THE PENNSYLVANIA LINES have increased the average loading of cars carrying miscellaneous freight from 8,500 to 18,000 fbs. during the past four years by giving special attention to this subject. It is estimated that 1,693,847 cars have been saved in this period.

THE WESTERN RAILROADS moved 507.917,000 bushels of grain to primary markets in the six months ending June 30. This is the largest amount of this class of traffic ever handled and is an increase of 77,583,000 bushels, or 18 per cent over the amount handled in 1913, the previous high record.

THE NEW YORK, NEW HAVEN & HARTFORD placed an extensive embargo, effective at midnight June 29 and extending until midnight July 12, on all carload and less-than-carload traffic coming from connecting lines via Harlem River, N. Y., and Maybrook, because of heavy passenger business owing to troop movements and Fourth of July travel.

SERIOUS FLOODS during the last two weeks have interfered materially with the operation of the Southern, the Seaboard Air Line, the Carolina, Clinchfield & Ohio and other railways in North Carolina and adjoining states. The Southern suffered particularly in the vicinity of Asheville, N. C., a number of lines being closed for several days.

THE CHICAGO, BURLINGTON & QUINCY ran a special train from St. Paul to Chicago recently, which was completely equipped with telephones in every car and in every berth. The train comprised 12 cars, including a diner and a car equipped for band concerts. The telephones installed were of the automatic type. The train carried a party of Shriners to a convention at Buffalo.

THE AMERICAN SOCIETY FOR TESTING MATERIALS at its annual convention held at Atlantic City, N. J., June 27 to 30, adopted specifications for steel tie plates, track spikes, and screw spikes. While similar in many details to the specifications for the same material adopted by the American Railway Engineering Association three years ago, they vary from the original specifications in several important details.

THE BALTIMORE & OHIO uses a mailing envelope 5 in. by $11\frac{1}{2}$ in. for railway business, which has 23 lines for addresses on each side, enabling it to be used 46 times. Each address is scratched out after being used. The Atchison, Topeka & Santa Fe uses a similar envelope with an open window, the letters being folded so as to show the address after they are placed in the envelope and requiring no address on the outside.

GOVERNMENT OWNERSHIP OF RAILWAYS IN CANADA, as reflected by the management of the Intercolonial and the Prince Edward Island railways, shows some interesting results. In the 47 years in which the Intercolonial has been operated by the Dominion government its earnings have exceeded its operating expenses in 22 years, the total combined net earnings for these years being \$1,967,000. In the other 25 years its operating expenses have exceeded its earnings, and its combined deficits have been over \$11,500,000, leaving a net deficit of \$9,500,000, without allowing anything for taxes or interest. The total operating deficit of the Prince Edward from 1875 to 1914 amounted to \$3,280,000, or a total for the two roads of approximately \$12,800,000. If taxes and interest on the investment were allowed at the same rate that a privately owned railway has to pay this deficit would become much larger.

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THE INDIANA APPELLATE COURT holds that an action for benefits against a railway employees' relief association is void under the Indiana statute of 1907, prohibiting railways from maintaining any relief association the rules of which require an employee to waive personal injury claims on becoming a member.

THE MINISTER OF WAYS OF COMMUNICATION in Russia has proposed that women be installed as assistant station masters in fourth-class stations and sidings because of the shortage of men, and the satisfactory results which have followed the employment of women elsewhere. The necessary conditions of such employment are that the women should be properly trained in a railway traffic school and should not be under 25 years.

THE PENNSYLVANIA RAILROAD has received responses to the call issued by S. C. Long, general manager, indicating that at least 50,000 of the employees are ready for special duty to prevent interruption in service in case of a strike among the engineers, firemen, conductors and trainmen. Included among these are some of the train service employees, a majority of the shop employees and many of the pension employees.

THE PENNSYLVANNIA RAILROAD has authorized an appropriation of not to exceed \$100,000 to be expended for the relief of the dependent families of employees who have enlisted in the army or navy through membership in the National Guard or otherwise, and who have been called into active service. Each case will be considered on its own merits and this fund will be directed into channels where there is an established necessity for its application.

THE ERIE has ordered three triplex articulated locomotives for use in pusher service on the Susquehanna Hill of the same design as one purchased recently, which has given satisfactory service. Each of these locomotives weighs 860,350 lb., with the wreight on drivers 766,350 tb. They are equipped with three sets of eight driving wheels, one set being placed under the tender, and they exert a tractive force of 160,000 tb. They are the largest engines built up to this time.

THE ATCHISON, TOPEKA AND SANTA FE has adopted a death benefit for its employees, effective July 1. By the terms outlined, it proposes to pay to the beneficiaries of each employee dying while in the company's service, and who has been in its employ continuously for two or more years. a sum equal to 5 per cent of the pay received by him during the 12 months preceding his death, multiplied by the number of years of continuous service. In no case, however, will a benefit exceed \$3,000 or be less than \$250.

THE ACCOUNTING OFFICERS' ASSOCIATION has ascertained that the executive officers in charge of 85.3 per cent of the mileage of the country favor a change in the end of the present fiscal year from June 30 to December 31, as compared with 14.7 per cent opposing such a change. Of 31 state railway commissions of whom inquiries have been made, 20 favored the change, 6 will make the change if the Interstate Commerce Commission and other state commissions do likewise, 2 are opposed and 2 are non-committal.

THE INTERSTATE COMMERCE COMMISSION has issued its preliminary abstract of steam railroad statistics for the year ending June 30, 1915, covering the operations on 257,569.32 miles of line, including 11,279.64 miles operated under trackage rights, and a total mileage of all tracks of 391,141.51. This is an increase of 1,022.22 miles of line and 3,933.20 miles of track during the year. The roads report 65,099 locomotives, 55,705 passenger cars, 2.356,-338 freight cars and 95,934 cars in company service. The average number of employees for the year was 1,409,342 and their total compensation \$1,164,844,430.



1876, at Montclair, N. J.,

and was educated in the

Montclair high school and

later attended Rutgers Col-

lege, New Brunswick, N. J.

In 1898 he began railway

work as a draftsman in the

tax agent's office of the

Central Railroad of New

Jersey at New York, and

has been in the continuous

service of that road ever

since. In August, 1899, he

was transferred to the chief

engineer's office as a rod-

man, and the following November was appointed as-

sistant engineer at Mauch

Chunk, Pa. He was trans-

ferred in the same capacity to Jersey City in 1901, re-

maining in that position until January, 1907, when he

PERSONAL MENTION

GENERAL

E. V. SMITH, district engineer maintenance of way of the Baltimore & Ohio at Wheeling, West Va, has been appointed assistant division superintendent at New Castle, Pa.

J. G. BLOOM, division engineer of the Chicago. Rock Island & Pacific at Little Rock, Ark., has been appointed superintendent of the Amarillo division, with headquarters at Amarillo, Texas.

A. W. THOMPSON, formerly chief engineer of the Baltimore & Ohio and more recently vice-president in charge of operation, has been promoted to the position of vice-president in charge of traffic and commercial development of the Baltimore & Ohio System, with headquarters at Baltimore, Md.

ERNEST STENGER, who has been appointed general superintendent of the Union Pacific, with headquarters at Omaha, Nebr., was born at Colmar, Alsace. in 1865 and graduated from the University of Michigan in 1886. He entered railway service as a rodman with the Burlington & Missouri River in the same year. He was a draftsman with the Atchison, Topeka & Santa Fe from 1888 to 1890 and was assistant engineer with the Missouri Pacific for the next 10 years. From 1900 to 1907 he was a division engineer, assistant superintendent and division superintendent of the Union Pacific. He was then general superintendent of the Rio Grande Western until March, 1911, from which date until his recent appointment he was general manager of the St. Joseph & Grand Island at St. Joseph, Mo.

L. B. ALLEN, who has been appointed general superintendent of the Central general division of the Chesapeake & Ohio, entered railway service as a rodman on the Southern Railway in 1899 after graduating from Kentucky State College. From Aug. 1, 1899, to January 1, 1904, he was employed on location and construction on the Chesapeake & Ohio. He spent the following year in the office of the engineer maintenance of way, and from January 1, 1905, to January 1, 1910, he was division engineer of the Kentucky division, with headquarters at Ashland, Ky. On the latter date he was appointed engineer maintenance of way of the Kentucky general division and of the Chesapeake & Ohio of Indiana, with headquarters at Covington, Ky. He was appointed division superintendent at Huntington, W. Va., on January, 1914, which position he held until his recent promotion to general superintendent.

ENGINEERING

G. L. MARICK was appointed assistant office engineer of the Gulf, Colorado & Santa Fe on July 1, with headquarters at Galveston, Texas, this position being a newly created one.

H. O. KELLEY, division engineer of the Evansville & Indianapolis, with headquarters at Indianapolis, Ind., has been appointed engineer maintenance of way with headquarters at the same point.

DANIEL W. THROWER, district engineer of the Yazoo & Mississippi Valley, with office at Memphis, Tenn., has been appointed assistant valuation engineer of the Illinois Central and the Yazoo & Mississippi Valley, with headquarters at Chicago, Ill.

B. B. SHAW, assistant engineer of the Chicago, Rock Island & Pacific at Haileyville, Okla., has been appointed division engineer of the Arkansas division with headquarters at Little Rock, succeeding J. G. Bloom, appointed division superintendent at Amarillo.

WILLIAM TRAPNELL, division engineer maintenance of way of the Baltimore & Ohio at Cumberland, has been appointed district engineer maintenance of way at Wheeling, W. Va., succeeding E. V. Smith, who has been appointed assistant superintendent at Newcastle, Pa.

FRED TAPLEY has resigned as assistant engineer of the Canadian Pacific to accept a similar position with the Canadian Government Railways (Intercolonial), at Moncton, N. B. H. R. Miles, resident engineer at Sudbury, Ont., succeeds Mr. Tapley, and V. T. Boughton, resident engineer at Chapleau, Ont., succeeds Mr. Miles at Sudbury.

CHARLES F. HINCHMAN, assistant engineer. maintenance of way of the Cleveland, Cincinnati, Chicago & St. Louis at Mt. Carmel, Ill., has been appointed engineer maintenance of way of the newly created Indianapolis terminal division, with headquarters at Indianapolis. Ind. Mr. Hinchman was born at Detroit, Mich., on December 21, 1882, and graduated from the University of Michigan in 1904. He first entered railway service on November 11, 1908, as assistant on the engineering corps of the Big Four. From 1909 to 1911, he was a laborer on interlocking and bridge gangs of the same road, and on the latter date again became assistant on the engineering corps. He was appointed assistant engineer maintenance of way, with headquarters at Mt. Carmel, Ill., on January 1, 1914. His appointment as engineer maintenance of way of the Indianapolis terminal division was effective on July 1, 1916.

ARTHUR E. OWEN has been appointed chief engineer of the Central Railroad of New Jersey, with headquarters at New York, succeeding Jos. Osgood, deceased. He was born on January 19,



ARTHUR E. OWEN

was appointed principal assistant engineer.

MILTON B. MORGAN, assistant engineer maintenance of way of the Illinois Central and the Yazoo & Mississippi Valley, with office at Chicago, was appointed district engineer of the Yazoo & Mississippi Valley, with office at Memphis, Tenn., in place of Daniel W. Thrower, appointed assistant valuation engineer, effective July 15. Mr. Morgan was born at Alden Station, Luzerne County, Pa., on June 26, 1872, and graduated from Pennsylvania State College in 1898. He first entered railway service in August, 1898, in the maintenance of way department of the Illinois Central. From August, 1899, to June, 1911, he was employed in the construction department of the Illinois Central and the Yazoo & Mississippi Valley. From June, 1911, to June, 1912, he was assistant roadmaster of the Birmingham district of the Illinois Central, with headquarters at Corinth, Miss. On the latter date he was appointed roadmaster of the Tennessee division, with headquarters at Fulton, Ky. From November, 1913, to July 15, 1916, he was assistant engineer maintenance of way, with headquarters at Chicago, Ill.

SAMUEL MURRAY, whose appointment as chief engineer of the Oregon-Washington Railroad & Navigation Company, with headquarters at Portland, Ore., was announced in the last issue, was born at San Francisco, Cal., on June 20, 1880. He graduated from the University of California in 1902, and entered railway service with the Southern Pacific in August, 1902, after a short period of employment with the American Bridge Company. He was a draftsman and laborer on bridge construction for the Southern Pacific until 1906, when he was appointed chief draftsman in the office of the consulting engineer of the Harriman lines. In 1907 and 1908 he was bridge engineer of the San Pedro, Los Angeles & Salt Lake, and in 1909 he was appointed bridge engineer of the Oregon & Washington, with headquarters at Seattle. Wash. He continued to hold this position after this

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road was merged with the Oregon-Washington Railroad & Navigation Company. Following the temporary retirement of J. R. Holman in September, 1915, he was made acting chief engineer, and upon Mr. Holman's permanent retirement he was appointed chief engineer, effective July 1, 1916.

R. N. BEGIEN has been appointed chief engineer of the Baltimore & Ohio System, with headquarters at Baltimore. Md., succeeding Francis Lee Stuart, resigned to engage in private prac-

tice. He was born in Boston, Mass., on March 15, 1875, and graduated from the engineering course at Harvard University in 1897. After leaving school he served for over three years as a member of the Nicaraguan Canal Commission, after which he spent a year in railway engineering work in Ecuador. He entered the employ of the Baltimore & Ohio on August 1, 1902. as assistant engineer at Somerset, Pa., and was appointed division engineer at Philadelphia in June, 1908. On May 1, 1910, he became assistant to A. W. Thompson, then chief engineer of the Baltimore & Ohio, continuing as his assistant when Mr. Thompson be-



R. N. BEGIEN

being associated with im-

portant public, as well as

railway projects. He was

born at Camden, S. C., on

December 3, 1866, and grad-

uated from Emerson Insti-

tute, Washington D. C., in

June, 1884. He entered

railway service in the office of the consulting engineer

of the Baltimore & Ohio in

the same year, remaining with the road until 1887.

After a varied experience

in general engineering work

he was assistant engineer

with the Nicaraguan Canal

Commission from Decem-

ber, 1897, to July, 1899, and

later was division engineer with the Isthmian Canal

Commission. In February,

1900, he returned to the

came general manager and later third vice-president on May 1, 1912. In December, 1912, he was appointed assistant general superintendent at Baltimore. He was promoted to general superintendent of the Baltimore & Ohio Southwestern at Cincinnati, O., in July, 1913.

FRANCIS LEE STUART, chief engineer of the Baltimore & Ohio System, resigned, effective July 10, to engage in private practice in New York. He has had a wide experience in engineering work,



FRANCIS LEE STUART.

Baltimore & Ohio as assistant engineer on location, being appointed district engineer in June, 1903. and engineer of surveys in March, 1904. One year later he was appointed chief engineer of the Erie, remaining in this position until January 1, 1911, when he was appointed chief engineer of the Baltimore & Ohio System, including the Cincinnati, Hamilton & Dayton. During the last five years the rehabilitation of a large part of the Baltimore & Ohio, including the construction of the Magnolia cut-off and the tunnels at Sand Patch, Pa., and Kingwood, W. Va., were under his direction. Mr. Stuart will devote his attention to the promotion of several patents for conveying machinery, some of which will be installed in the new export pier which the Baltimore & Ohio is now building at Curtis Bay, Baltimore. F. F. HANLY, assistant engineer in the office of the engineer maintenance of way of the Baltimore & Ohio, at Baltimore, Md., has been appointed division engineer of the Cumberland division,

with headquarters at Cumberland, Md. Mr. Hanly was born at Shelbina, Mo., on November 21, 1886, and graduated from the University of Missouri. Previous to entering railway service he was employed by the United States government as recorder on a drill boat locating locks and dams on the Ohio river. In September, 1909, he entered the service of the Baltimore & Ohio Southwestern as an assistant on the corps of the maintenance of way department. From September, 1911, to December, 1914, he was assistant engineer in the office of the engineer maintenance of way of the Baltimore & Ohio at Balti-



F. F. HANLY.

more, Md. From the latter date until September, 1915, he was assistant division engineer of the Baltimore division, with office at Baltimore. From September, 1915, until June 1, 1916, he was again assistant engineer in the office of the engineer maintenance of way at Baltimore.

W. R. ARMSTRONG, general manager and chief engineer of the Salt Lake & Utah, has been appointed engineer maintenance of way of the Union Pacific, with office at Omaha, Neb., effective



August 1. Mr. Armstrong has had 25 years of railroad experience, both as an engineer in charge of construction and maintenance of way and as an operating officer. Prior to coming to the Oregon Short Line in 1905, he was connected with various lines in the Middle West. During his first year with the Oregon Short Line he was engaged in special engineering work. In the following year he was placed in charge of the construction of the Yellowstone Park branch. He was also in charge of the extension from Huntington, Ore., down the Snake River canvon, to Homestead. In 1908 Mr. Armstrong was

made superintendent of the Montana division, which position he held until 1913, when he was appointed general manager and chief engineer of the Salt Lake & Utah, then under construction.

WILLIAM G. ARN, roadmaster of the Indiana division of the Illinois Central, has been promoted to assistant engineer maintenance of way of the Illinois Central and the Yazoo & Mississippi Valley, with office at Chicago, to succeed Milton B. Morgan, promoted, effective July 15. Mr. Arn was born at Terre Haute, Ind., in 1877, and graduated from Rose Polytechnic Institute in 1897. His first railway experience was with the Louisville & Nashville as building inspector during the construction of the Nashville union station and terminal. In November, 1900, he was appointed assistant division engineer of the same road, with headquarters at Montgomery, Ala., and later he was made assistant engineer at New Orleans, La., in charge of second-track construction and terminal improvements. Later he was made acting roadmaster of the New Orleans and Pensacola divisions and subsequently roadmaster of the Cumberland Valley division. He then entered the service of the Missouri Pacific. After working for a short time as assistant engineer in the general offices



of the Missouri Pacific at St. Louis, Mo., he entered the employ of the Illinois Central in March, 1907, as assistant engineer in charge of the construction of terminals at Birmingham, Ala. From April, 1908, to August, 1909, he was assistant engineer of the Birmingham division, and on the latter date was placed in charge of the reconstruction of passenger terminals at Louisville, Ky. From June, 1910, to August, 1912, he was engaged in miscellaneous work in the general offices at Chicago, after which he was given charge of the construction of the Grand Central station and track elevation at Memphis, Tenn. From November, 1913, to July 15, 1916, he was roadmaster of the Indiana division at Mattoon, Ill.

TRACK

JOHN CALLOWAY has temporarily succeeded John Y. Burke, deceased, as roadmaster on the Texas & Pacific.

M. P. Fox has been appointed supervisor of the Baltimore & Ohio at Washington, Pa., in place of T. S. Pattison, promoted.

D. V. O'CONNELL has been appointed roadmaster of the Chicago & Northwestern at Tracy, Minn., to succeed Frank Thiewes, effective July 12.

T. J. JOYNER, general roadmaster of the Atlantic Coast Line at Jacksonville, Fla., has transferred his headquarters to Lakeland, Fla., effective July 1.

R. C. VIOLETT, roadmaster of the Chicago, Burlington & Quincy at Aurora, Ill., has been appointed roadmaster and assistant trainmaster, with headquarters at Streator, Ill.

P. D. FITZPATRICK, valuation engineer of the Central Vermont at St. Albans, Vt., has been appointed general roadmaster, in addition to his other duties, succeeding W. P. Elrod, resigned.

H. S. BADDERS has been appointed master carpenter of the North Carolina division of the Seaboard Air Line, with headquarters at Hamlet, N. C., in place of W. J. Galloway, resigned.

FRED B. OREN, superintendent of the New Orleans division of the Yazoo & Mississippi Valley, with office at Vicksburg, Miss., has been appointed roadmaster of the Indiana division of the Illinois Central, with office at Mattoon, Ill., succeeding William G. Arn, promoted, effective July 15.

T. B. KENNEDY, assistant roadmaster of the Norfolk & Western at East Radford, Va., has been transferred to Pulaski, Va., with jurisdiction over the line from New River to Bristol and the North Carolina branch, with headquarters at Pulaski, Va. T. S. Faulkner has been appointed assistant roadmaster between Roanoke and Bluefield, with headqurters at East Radford, Va., succeeding T. B. Kennedy.

J. W. THOMAS, whose appointment as roadmaster of the Norfolk & Western, with headquarters at Wilcoe, W. Va., was announced in the July issue, was born at Lebanon. Va., on December 28, 1888. He received a high school education at Lebanon and entered railway service on June 1, 1904, as a section and extra-gang laborer on the Norfolk & Western. On March 1. 1906, he was made section foreman, and on September 1, 1908, was promoted to assistant extra-gang foreman. He was later made extra-gang foreman, and on May 24, 1916, was promoted to roadmaster at Wilcoe, W. Va.

J. P. COSTELLO, whose appointment as inspector of track, western lines, Atchison, Topeka & Santa Fe. with headquarters at La Junta, Colo., was announced in the last issue, was born at Osborne, Ohio, on March 3, 1882. He was educated at Osborne high school and at Purdue University, where he took the course in civil engineering. He first entered railway service in March, 1898, as a section hand on the Erie. In March, 1903, he was appointed section foreman on the same railroad. In 1905 he entered the employ of the Cleveland, Cincinnati, Chicago & St. Louis as foreman on second-track construction. In the following year he was made extra gang foreman, and from 1909 to 1910 he was rodman for that road. He was transitman on the Big Four from 1910 until 1912, when he was appointed rail inspector of the New York Central lines, with headquarters at Gary, Ind. From June, 1912, to December, 1912, he was assistant supervisor on the Baltimore & Ohio, and from the latter date until August, 1913, supervisor. From 1913 up to the time of his recent appointment as track inspector, he was roadmaster of the Atchison, Topeka & Santa Fe at Pueblo, Colo.

BRIDGE

J. H. GROGG has been appointed assistant master carpenter on the Norfolk division of the Norfolk & Western, with headquarters at Lynchburg, Va.

GUSTAV A. HAGGANDER has been appointed bridge engineer of the Chicago, Burlington & Quincy, with headquarters at Chicago, succeeding C. H. Cartlidge, deceased. He was born at Sioux City, Iowa, on Janu-

ary 30, 1885. He obtained his technical education at the Armour Institute of Technology, Chicago, from which he graduated in 1907. Following graduation he en-Burlington as a draftsman in the office of the bridge engineer, later being a concrete inspector and a designer until June 10, 1910. when he was made office engineer. From July, 1912, to July 1, 1916, he was assistant bridge engineer of the lines east of the Missouri river, with office at Chicago, Ill. As bridge enginer of the Burlington System he will continue to have his headquarters at Chicago.



G. A. HAGGANDER

WALTER SCHLINKERT, whose appointment as supervisor of scales of the Illinois Central, with headquarters at Centralia, Ill., was announced in the July issue, was born at Centralia on June 8, 1885. He was educated in the public schools of his native city and first entered railway service on May 19, 1902, as a scale machinist apprentice. On May 19, 1906, he was made scale inspector and remained in that position until December, 1913, when he was promoted to assistant supervisor of scales. On June 1, 1916, he was appointed supervisor of scales, succeeding Fred Schlinkert, deceased.

CHARLES RICHARD KNOWLES, whose appointment as superintendent of water service of the Illinois Central and the Yazoo & Mississippi Valley was announced in the last issue,



on July 7, 1879. He was educated in private schools and entered railway service on January 1, 1900, as assistant foreman of water service of the Kentucky division of the Illinois Central. From March 1, 1902, to July 1, 1906, he was foreman of water service on various divisions of the Illinois Central. On the latter date he was appointed inspector of water service of the Illinois Central and the Yazoo & Mississippi Valley, with office at Chicago, Ill., and continued to hold that position until April 1, 1912, when he was appointed general foreman of water works. On June 16, 1916, he was promoted to super-

was born at La Porte, Ind.,

CHARLES RICHARD KNOWLES

intendent of water service, with headquarters at Chicago, Ill. FRANK C. WORBS has been appointed assistant engineer in charge of bridge and building work of the Wheeling & Lake Erie, with headquarters at Cleveland, Ohio. He was born at Medina, Ohio, on October 23, 1887, and graduated from the Case School of Applied Science in 1911. He entered railway service in the bridge department of the Wheeling & Lake Erie on February 18, 1913. After 19 months with the Wheeling & Lake Erie, he took charge of field work on the Brooklyn-Brighton bridge, a reinforced concrete arch structure, with a total length of 1,726 ft., built in Cleveland by Cuyahoga County. After the completion of this work he re-entered the service of the Wheeling & Lake Erie, taking the place of E. U. Smith, assistant engineer, resigned to become associated with the Samuel Austin Sons Company, contractors.

ROBERT FARNHAM JR., assistant to the engineer of bridges and buildings of the Pennsylvania R. R. at Philadelphia, Pa., has been appointed assistant engineer of bridges and buildings, and his former position has been abolished. He entered the service of the Pennsylvania in 1903 as transitman and later in the year became assistant engineer of construction in charge of the grade-crossing elimination work in Washington, D. C. In 1910 he was transferred to Broad Street Station, Philadelphia, and in 1913 he was appointed assistant to the engineer of bridges and buildings.

ARTHUR ENGH has been appointed assistant bridge engineer of the Chicago, Burlington & Quincy lines east of the Missouri river. He was born at Chicago, Ill., on June 9, 1885. Prior to entering railway service he was employed by Ralph Modjeski and the American Bridge Company. From August, 1905, to 1908, he did detailing and designing work in the bridge department of the Burlington. He was then made office engineer, being temporarily relieved of these duties in 1914 to become office engineer of the Paducah & Illinois, in charge of the design of the Metropolis (Ill.) bridge across the Ohio river. In 1915 he again became office engineer of the Burlington, in charge of the design and preparation of plans for a double-track bridge across the Missouri river at Kansas City. As assistant bridge engineer he will have headquarters, as heretofore, at Chicago, Ill.

PURCHASING

R. H. ADAMS has been appointed assistant purchasing agent of the San Pedro, Los Angeles & Salt Lake.

E. A. PAUL has been appointed purchasing agent of the New Orleans Great Northern, with office at New Orleans, La.

WILLIAM G. O'FALLON has been appointed purchasing agent of the Terminal Railroad Association of St. Lous, succeeding J. E. Williams, Jr., assigned to other duties.

ISAAC B. THOMAS has been appointed assistant purchasing agent of the Pennsylvania Railroad, with office at Philadelphia, Pa. He was born at West Chester, Pa., on June 26, 1872, and graduated from Sheffield Scientific School, Yale University, in 1892. Later in the same year he entered the service of the Pennsylvania Railroad as an apprentice at the Altoona shops. Since that time he has held various positions in the mechanical department, being appointed superintendent of motive power of the Erie division and of the Northern Central at Williamsport. Pa., on May 1, 1911, which position he held at the time of his recent appointment as assistant purchasing agent.

OBITUARY

JOHN Y. BURKE, roadmaster on the Texas & Pacific, died on June 25.

THOMAS TROY, supervisor of the Chicago & Alton at Springfield, Ill., was killed on July 18, near Lexington, Ill., while riding on a motor car.

FRED H. WHITE, purchasing agent of the Duluth, Missabe & Northern, with office at Duluth, Minn., died at that city on July 17, after an illness of two weeks following an operation for carbuncles.

ALEXANDER DOIG, a pioneer master carpenter of the Chicago & Northwestern, died at his home in Winona, July 22, at the age of 77 years. Mr. Doig was born in Dundee, Scotland, on June 19, 1839, and came to the United States in 1855. He began work with the Chicago & Northwestern in 1865 and was appointed assistant superintendent of bridges between Mankato, Minn., and Marshall in 1874. He was made superintendent of bridges and buildings on the Minnesota division in February, 1877, and in 1901 his jurisdiction was extended over the Dakota division. He retired from active service about seven years ago. During his long connection with the Minnesota division of the Northwestern he had charge of the construction of practically all of the existing structures between Winona, Minn., and Watertown and Huron, S. D. DON JUAN WHITTEMORE, consulting engineer of the Chicago. Milwaukee & St. Paul and for nearly 50 years its chief engineer, died at his home in Milwaukee, Wis., on July 16, at the age of

86 years. He was born at Milton, Vt., in 1830, and was educated at Bakersfield Academy in the same state. He entered railway service in 1847, in the engineering corps of the Vermont & Canada. In 1849 he was appointed assistant to the chief engineer in charge of the construction of this line between Swanton, Vt., and Rouse's Point, N. Y. Upon the completion of this road he was appointed assistant engineer in charge of a division of the Great Western of Canada, and in 1852 left that road to become contractor's engineer in building the Central Ohio between Zanesville, Ohio, and Wheeling, W. Va. From July,



DON JUAN WHITTEMORE

1853, to 1857, he was assistant chief engineer of the La Crosse & Milwaukee, and from the latter date until 1860 was chief engineer and director of the Southern Minnesota. In the winter of 1860-1861, he was chief assistant engineer of the Ferrocarril Del Oeste in Cuba. He then reëntered the service of the La Crosse & Milwaukee as chief assistant to the chief engineer, and in 1863, when the La Crosse & Milwaukee was merged into the Chicago, Milwaukee & St. Paul he was made chief engineer of the St. Paul, in which capacity he served actively until December 6, 1910, when he retired. Since 1910, he has continued to serve the St. Paul in a consulting capacity.

JOSEPH O. OSGOOD, chief engineer of the Central of New Jersey, died suddenly in the Broad street station, Newark, N. J., on June 28. He was born at Cohasset, Mass., on December 28, 1848, and attended Massa-



chusetts Institute of Technology. He began railway work in July, 1865, as a rodman on the construction of the Eastern Shore Railroad, now a part of the New York, Philadelphia & Norfolk. From 1874 to 1878 he was engaged in engineering work with the Massachusetts Board of Harbor Commissioners at Boston. For the next three years he was employed on construction work by the Atchison, Topeka & Santa Fe in Colorado and New Mexico. He went to San Diego, Cal., in September, 1881, where he was engaged in the construction of the California Southern for two years. From 1883 to

1884 he was chief engineer of the Boston, Hoosac Tunnel & Western, after which he was out of railway work for about one year. He was appointed chief engineer of the Toledo, St. Louis & Kansas City, now a part of the Toledo, St. Louis & Western, in April, 1886, serving subsequently as a director of that road. While with this line he was in charge of the work of changing it from narrow to standard gage. In January, 1888, he was appointed chief engineer of the Lake Shore & Michigan Southern, resigning in March, 1889, to engage in consulting railway engineering work in New York. On July 17, 1901, he was appointed chief engineer of the Central Railroad of New Jersey, which position he held until his death, as noted above.



Vol. 12, No. 3

CONSTRUCTION NEWS

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THE ATCHISON, TOPEKA & SANTA FE is planning to construct a passenger and freight station at Carrollton, Mo., to cost about \$25,000. The structure will be 190 ft. by 30 ft., and will have a brick exterior, tile roof and concrete floor.

THE CHICAGO & NORTHWESTERN has awarded a contract to Leyden & Ortseifen, Chicago, for the construction of a brick depot at Menominee, Mich., to cost about \$14.000.

THE CLEVELAND, CINCINNATI, CHICAGO & ST. LOUIS will soon open bids for a brick and concrete station and office building 40 ft. by 150 ft., two stories in height, to be built at Mattoon, Ill.

This road has awarded a contract to the Walsh Construction Company, Davenport, Iowa, for the elimination of four street crossings between First avenue and Seventeenth avenue, Columbus, Ohio. The project involves about 180,000 cu. yd. of embankment and 10,000 cu. yd. of concrete work. The tracks will be elevated an average of six feet and the streets will be depressed. Four steel through girder bridges with solid floors will be erected.

THE CHICAGO, MILWAUKEE & Sr. PAUL is checking up original surveys made in 1914 on an extension from Grassrange, Mont., to Winnett, about 20 miles, and expects to begin construction work this summer.

The St. Paul has started the construction of extensive new terminal facilities at North McGregor, Iowa. The work includes a 22-stall roundhouse, a 90-ft. turntable, a 100,000-gal. water tank, a 154-ft. cinder pit, a sandhouse, a coaling station, a powerhouse 50 ft. by 63 ft., a blacksmith and machine shop 40 ft. by 60 ft., a car repair building 40 ft. by 80 ft., and an entirely new yard layout, involving 15 miles of track. The project also involves an extensive channel change of Giard creek and the raising of the yards above the flood level. Outside of part of the grading which has been contracted to Morris. Shepherd & Dougherty, St. Paul, Minn., all of the work is to be done by company forces.

THE COLORADO, KANSAS & OKLAHOMA contemplates the extension of its line south across western Kansas to Forgan, Okla.

THE DELAWARE, LACKAWANNA & WESTERN is carrying out improvements between Brick Church, N. J., and Mountain Station, on the Morristown line, to eliminate 26 grade crossings through the city of Orange. The work includes the construction of 23 reinforced concrete flat-slab bridges, one steel bridge, a new brick station at Orange and one at Highland avenue, and the elimination of two grade crossings at Milburn. When these improvements are completed, the company will have three tracks from Newark to Milburn, with no grade crossings between Newark and Summit, with the exception of the section through East Orange, on which 12 grade crossings are yet to be eliminated.

THE DULUTH, MISSABE & NORTHERN has awarded a contract to Macleod & Smith for the construction of a 100-ft. reinforced concrete roundhouse, designed for 60 stalls, one-half of which is now being built.

THE EAGLE PASS & ARANSAS PASS is a new company which has been organized at Aransas Pass, Tex., to build a line between Aransas Pass, Tex., and Eagle Pass, a distance of about 250 miles. The proposed route is through a ranch region that of late years has undergone considerable agricultural development. Bonuses aggregating \$50,000 in cash and considerable land have been pledged in aid of the project.

THE FT. SMITH, SUBIACO & EASTERN will extend its line from Scranton, Logan County, Ark., to Dardanelle, a distance of about 15 miles. The work will be done by company's forces, and the contracts for rail and other material have already been made.

THE GREAT NORTHERN is building 36 miles of new line from Wildrose, N. D., west to the Montana border.

This road has awarded a contract to Morris. Shepherd & Dougherty, St. Paul, Minn., to build an extension from Wildrose, N. D., to Grenora, 36 miles, at an estimated cost of \$675,000. About 5 per cent of the work has been completed. THE MISSOURI, KANSAS & TEXAS has awarded a contract to the American Construction Company, Houston, Tex., for the erection of a reinforced concrete cotton platform at Houston, to cost about \$50,000.

THE MISSOURI PACIFIC expects to begin work within 30 days on the construction of passenger and freight stations at Joplin, Mo. The freight house will be of brick construction and the passenger station will have a stone and brick exterior with a tile roof. The cost of the work is estimated at about \$50,000.

This road has awarded a contract to the List & Gifford Construction Company, Kansas City, Mo., for from 60.000 to 80,000 cu. yd. of bank widening work between Dupo, Ill., and Roots, on the Illinois division, a distance of about 45 miles. The work has been sub-let to the List & Bagwell Construction Company, which concern now has it under way.

It is preparing plans for the construction of a brick passenger station at Bismarck, Mo., to cost approximately \$15,000, and one at De Soto, Mo., to cost \$17,000. A new passenger station has been started by this road at Clarksville, Ark., which will cost about \$15,000. These plans include the rearrangement of tracks and the construction of the necessary platforms.

THE MONTANA EASTERN, a subsidiary of the Great Northern, has awarded a contract to A. Guthrie & Co., St. Paul, Minn., for the completion of a line between Lewistown, Mont., and Higgins, 25 miles. About half of the line was constructed in 1913.

THE NEW YORK, NEW HAVEN & HARTFORD has submitted plans for approval to the Boston authorities for the enlargement of the cut leading to the freight terminals at Boston to provide for four tracks instead of two tracks. The estimated cost of this work is \$829,000.

THE NORTHERN PACIFIC has authorized the construction of a branch line from Dixon, Mont., to Polson, 33.75 miles in length, involving about 23,000 cu. yd. of material per mile, and the building of a few small timber bridges. The work has not been started, nor have bids been asked for.

THE OREGON SHORT LINE will complete an extension from Marshfield, Idaho, to Idahome. a distance of 19 miles, track-laying work to be done by company forces. Grading of this line was completed in 1911.

THE PENNSYLVANIA LINES will relocate their line adjacent to the north bank of the Ohio river from a point a short distance east of Glen Osborne station, Pa., through Sewickley and Edgeworth Boroughs to a point west of Shields station, a distance of 2.7 miles. This will be a four-track line and will involve about 550,000 cu. yd. of fill and 105,000 cu. yd. of excavation. It will have a maximum curve of 1 deg. 45 min. and maximum grades of 0.112 per cent east bound and 10 per cent west bound. There will be five undergrade street crossings and five passenger station subways, involving the placing of 13,000 cu. yd. of concrete and the erection of 18,000 sq. ft. of steel solid-floor bridges. A new freight and passenger station layout will be constructed at Sewickley.

THE PORT BOLIVAR IRON ORE RAILWAY is locating a route for an extension from Big Cypress Bridge, three miles north of Ore City, Tex., to Avinger, a distance of 10 miles. The road will connect with the Missouri, Kansas & Texas at Avinger.

THE ST. LOUIS & SAN FRANCISCO will build a frame roundhouse, a car repair shed and other buildings at West Tulsa, Okla., which, together with a 100-ft. turntable, other mechanical facilities and yard tracks, will cost over \$200,000.

This road also contemplates the construction of a ten-stall roundhouse, a 100-ft. turntable, mechanical department buildings and yard tracks at Oklahoma City, Okla., to cost about \$200,000.

THE SOUTHERN is receiving bids for the masonry work on the bridge over the south channel of the James river, near Richmond, Va. The present bridge, which consists of five through pin-connected spans, is to be replaced by ten through girder spans, with new intermedate piers. A contract for the bridge proper will be let as soon as the piers are ready.

THE SOUTHERN PACIFIC is preparing plans for a 10-story office building to be constructed at the corner of Market and Spear streets, San Francisco, Cal.

This road has completed the work on a line from Hoover, Ore., southeasterly along the north fork of the Santian river for a

ð

2250



distance of 11 miles. It it not known when the line will be completed.

THE WHEELING & LAKE ERIE is constructing a belt line $3\frac{1}{2}$ miles long at Canton, Ohio, to reach the new furnaces of the United Furnace Company. This line will cross Tuscarawas street with a double track under-grade crossing, to be constructed of reinforced concrete and steel beams. J. C. Carland, Toledo, Ohio, has the contract for the work, which is now practically 50 per cent completed.

THE WISCONSIN & NORTHERN is extending its main line from Shawano, Wis., to Black Creek, 24 miles. The contract for the grading has been awarded to P. W. O'Connor & Co., Grand Rapids, Mich. The track laying and the erection of bridges will be done by company forces. About 10,000 cu. yd. of material is being handled per mile, and about 300 cu. yd. of concrete will be placed in the construction of culverts. The maximum curvature is 2 deg. and the grade, southbound, 0.6 per cent, and northbound, 0.8 per cent. Three pile trestles totaling about 300 ft. in length will be constructed.

THE YAZOO & MISSISSIPPI VALLEY is preparing to raise the grade of its tracks from three to six feet for about 12 miles between Vicksburg, Miss., and the Yazoo river. The work will be done by company forces and will involve the handling of about 250,000 cu. yd. of materials. The company is also raising its grade for a distance of about 17 miles, south of Vicksburg, 14 miles of which will be on an entirely new line, including a new crossing over the Big Black river, and the handling of about 500,000 cu. yd. of material. H. W. Nelson Company, Chicago, Ill., have the contract for the grading.

STRUCTURAL STEEL

THE CHICAGO & WESTERN INDIANA has ordered 219 tons of steel from the American Bridge Company for an over-crossing with its own track at 87th street, Chicago.

THE ILLINOIS CENTRAL has ordered 465 tons of steel from the American Bridge Company for track elevation bridges in Chicago.

THE LEHIGH VALLEY has ordered 400 tons of bridge work from the American Bridge Company and 325 tons from another company for use at Waverly, N. Y., in addition to 400 tons from the Pennsylvania Steel Company for use at Sayre, Pa.

THE PENNSYLVANIA LINES have ordered 4,000 tons of steel from the American Bridge Company for a bridge across the Beaver river at Rochester, Pa.

THE PENNSYLVANIA RAILROAD has ordered 2,300 tons of bridge steel for 21 spans from the American Bridge Company and 1,200 tons for 17 spans from the Pennsylvania Steel Company.

THE SOUTHERN has ordered 500 tons of steel from the Mc-Clintic-Marshall Company for a bridge over the James river, in Virginia.

TRACK MATERIALS

THE FRENCH GOVERNMENT has ordered 14,000 tons of rails from the United States Steel Corporation.

THE HARRIMAN LINES have ordered 6,000 tons of tie plates.

THE RUSSIAN GOVERNMENT RAILWAYS are now negotiating for 50,000 kegs of track spikes.

THE RUSSIAN GOVERNMENT RAILWAYS have ordered from 425,-000 to 450,000 tons of 67½-1b. rails and accessories from the mills of this country. Of this amount the United States Steel Corporation will roll about 200,000 tons, the Cambria Steel Company 165,000 tons, and the Lackawanna Steel Company 75,000 tons. This is probably the largest single rail order ever placed in this country, involving a total expenditure of between \$22,000,000 and \$23,000,000. The rails are to be delivered by July, 1917.

THE SEABOARD AIR LINE is in the market for 5,000 to 10,000 kegs of spikes.

THE SOUTHERN PACIFIC has ordered 80,000 tons of rails from the Tennessee Coal, Iron & Railway Co. for delivery during the second and third quarters during 1917.

THE WESTERN MARYLAND has ordered 2,250 kegs of track spikes.

SUPPLY TRADE NEWS

D. E. GARRISON, president of the Corrugated Bar Company, of St. Louis and Buffalo, died on July 4, at his home in St. Louis, Mo., at the age of 77.

E. R. MARKER, district manager of the T. L. Smith Company, has opened new quarters at 609 Wells street, Milwaukee, Wis., where he has taken charge of the business of the company as Wisconsin representative.

WILLIAM M. HENDERSON, until recently assistant to the superintendent of the frog, switch and signal department of the Pennsylvania Steel Company at Harrisburg, Pa., has been appointed assistant works manager of William Wharton Jr. & Co., Easton, Pa.

HENRY FISCHER, sales agent at Chicago for the Verona Tool Works, of Pittsburgh, Pa., has been appointed general sales



manager of the company. with headquarters at Pittsburgh, Pa. Mr. Fischer was born in Brooklyn, N. Y., on June 4, 1880. He was employed by the Shutt Improvement Company, railroad contractors, at St. Louis, Mo., from 1901 to 1903. From 1904 to 1911 he was in the engineering department of the Cleveland, Cincinnati, Chicago & St. Louis, at Cincinnati, Ohio, during the last three years of which time he was chief clerk to the chief engineer. From 1911 until July 1, 1916, he was sales agent of the Verona Tool Works at Chicago, in charge of the western territory, from which position he was promoted as noted above.

HENRY FISCHER

JOSEPH THAYER GILMAN, first vice-president of the Goodwin Car Company, New York, died on June 11 at the age of 52 years. He was born at Framingham, Mass., in 1864. When 20 years

of age he went to India with C. H. Bailey & Company, importers of goat skins, returning in 1897 because of ill health. The following year he again went to India, this time to open a house for the Keen Sutterlee Co., Ltd. Upon his return from this trip he became associated with John M. Goodwin of the Goodwin Car Company. In 1898, however, he went back to India, opening a house in Calcutta for Burk Brothers of Philadelphia, manufacturers of Morocco. He returned to the United States and in 1903 again became associated with the Goodwin Car Company, becoming second vice-president and later first vice-president. At



JOSEPH THAYER GILMAN

the time of his death he was in charge of the design and construction of the Goodwin car and made all contracts for their lease and sale.



WILLARD WILSON, assistant manager of sales of the Tennessee Coal, Iron & Railroad Company, has been appointed general manager of sales of the company, succeeding F. A. Burr, who resigned to become general manager of sales of the Ætna Explosives Company.

HENRY ALDEN SHERWIN, chairman of the board of directors of the Sherwin-Williams Company, died of heart failure on June 26. at his country place, near Cleveland, Ohio. Mr. Sherwin was

born at Baltimore, Vt., on September 27, 1842, and began his business career at the age of 13. In 1862 he went to Cleveland, where he secured a position as a clerk and bookkeeper with a dry goods company. In July, 1866, he left this business to organize Dunham & Co., the name of which was changed to Sherwin, Williams & Co., in 1870, when E. T. Williams was taken into the firm. In 1884, this company was incorporated as the Sherwin-Williams Company. For the past few years he was chairman of the board of directors of the company, although not as active in the affairs of the organization as in former years. Mr. Sherwin



HENRY ALDEN SHERWIN

Signal Company, which has

recently acquired the rail-

way light and signal busi-

ness of the Commercial

Acetylene Railway Light & Signal Company, as noted

elsewhere in these columns,

Mr. Derickson was born at Meadville, Pa., in 1866. He

served an apprenticeship in the Erie Shops at Mead-

ville. Pa., but later studied

civil engineering and was

for a time employed in the

engineering department of

the Erie. Subsequently he engaged in railroad and

land surveys in the south,

being at one time general

manager of the Lookout In-

cline Railway at Lookout Mountain. He was later

sales manager of the Cham-

was well known to the older men of the railway supply field. He began his career as a salesman by selling to the railroads. Mr. Sherwin established the first factory lunchroom to provide noon-hour lunches for employees, a plan which has since been adopted by many other industrial firms.

THOMAS M. DERICKSON, general manager of the F. B. Zieg Manufacturing Company, Frederickstown, Ohio, has been appointed general sales manager of the A. G. A. Railway Light &



THOMAS M. DERICKSON

pion Iron Works, after which he became general manager of the Memphis district of the Bell Telephone Company, and subsequently general sales manager of the Galion Iron Works, Galion, Ohio. Since that time he has been general manager of the F. B. Zieg Manufacturing Company, as noted above.

WILLIAM H. YETMAN, for the past two years in charge of the western railroad department of the Pyrene Manufacturing Company, New York, has been appointed railroad sales manager of the company for the entire United States, with headquarters at Chicago. He succeeds E. L. Kent, who has resigned to become vice-president of the Metal Hose & Tubing Company. Mr. Yetman was formerly hydraulic engineer for the Bethlehem Steel Corporation. William D. Dorry will be in charge of railway sales in the territory east of Pittsburgh, with headquarters at New York.

GENERAL

THE LIDGERWOOD MANUFACTURING COMPANY, New York, moved its office at Seattle, Wash., from 807-809 Western avenue to new quarters at 63-65 Columbia street, on July 1.

THE RENSSALAER POLYTECHNIC INSTITUTE, at the recent commencement exercises, conferred the degree of Doctor of Engineering upon Robert W. Hunt, who has been a trustee of the institute since 1886, and has done much to further the interests of the school. At the same time a portrait of Mr. Hunt by Lewis Betts was presented to the institute. Mr. Hunt has contributed largely to the erection of some of the institute's new dormitories.

THE KENNICOTT COMPANY, of Chicago, Ill., was placed in the hands of receivers on July 12, and the Central Trust Company of Illinois was appointed receiver. Chauncey J. Blair, late president of the company, it is understood, was trying to float a bond issue for the purpose of obtaining more working capital at the time of his death last May. Further efforts to effect this purpose were unsuccessful and the receivership followed.

THE COMMERCIAL ACETYLENE RAILWAY LIGHT & SIGNAL COM-PANY has sold out its railway light and signal business to the A. G. A. Railway Light & Signal Company and will confine its efforts to the sale of acetylene, changing the company's name to the Commercial Acetylene Welding Company, with offices at 80 Broadway, New York. The officers of the new company are: E. C. Benedict, president; F. S. Hastings, vice-president; M. J. Quinn, secretary and treasurer, and G. Mayer, assistant secretary and assistant treasurer. The directors include these officers, as well as Edward Beers, Robert S. Sharp, and A. V. Conover. M. M. Smith has been promoted to general manager.

THE BETHLEHEM STEEL COMPANY has announced the acquisition of the Pennsylvania Steel Company and the Maryland Steel Company, and their operation in the future under lease by the Bethlehem Steel Company. The general sales offices of these companies have been consolidated with those of the Bethlehem Steel Company. R. W. Gillispie, general manager of sales for the Pennsylvania and Maryland Steel companies at Philadelphia, and Paul Mackall, sales agent for the Bethlehem Steel Company in the Pittsburgh district and west, have been appointed assistant general sales agents at So. Bethlehem, Pa. Edward S. Knisely is general sales agent. R. E. Belknap, district sales manager of the Pennsylvania Steel Company at New York, has been transferred to Chicago as sales agent, and J. M. Price, sales agent in Chicago has been transferred to St. Louis.

TRADE PUBLICATIONS

LOCOMOTIVE CRANES.—The Brown Hoisting Machinery Company, Cleveland, Ohio, has issued a 64-page booklet describing in detail and illustrating the essential features of its locomotive cranes and special attachments. A large portion of the booklet is devoted to photographs of cranes engaged in a wide variety of operations. The book is instructive to present and prospective users of this type of equipment, particularly as it suggests many uses to which a crane may be put.

CABLE WAYS.—The Lidgerwood Manufacturing Company, New York, has issued an attractive 14-page booklet describing and illustrating its cable ways. The first 6 pages are devoted to a description of the cable ways and their development, with illustrations of special features. In the remaining 8 pages, illustrated descriptions are given of various construction jobs where they have been utilized.

DU PONT PRODUCTS.—The Du Pont companies have recently issued a 111-page book, 5 in. by 8 in. in size, giving a complete list of the products made by E. I. Du Pont de Nemours & Co., the Du Pont Fabrikoid Company, the Du Pont Chemical Company and the Arlington Company. The book contains a list of products arranged under the following heads: High explosives; low explosives; black blasting powder; sporting powders; explosives for military uses; miscellaneous commodities, blasting supplies, Fabrikoid; chemicals; Pyralin; special products and byproducts. In each case a brief description of the commodity is given, followed by a list of its users and also its uses.





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EDWARD A. SIMMONS, President. LUCIUS B. SHERMAN, Vice-President. HENRY LEE, Vice-President and Treas. W. H. WIUM, Secretary	PREVENTING CONSIDERATION RAILWAY E
ELMER T. HOWSON, Editor.	SIMPLE MET
WALTER S. LACHER. Associate Editor JOHN G. LITTLE, Associate Editor	Two Ballas
Entered at the Post Office at Chicago, Ill., as mail matter of the second class. Subscription price, including the twelve regular monthly issues of the <i>Railway Maintenance Engineer</i> and the four daily issues of the <i>Railway Age Gasette</i> , published in connection with the annual convention of the American Railway Engineering Association: United States, Canada and Mexico, \$1.00; foreign countries (excepting daily editions), \$2.00.	COMPARATIVE A MACHINE SYSTEM IN A PORTABLE A POWER-O RENEWING T
WE GUARANTEE that of this issue 5,942 copies were printed; that of these 5,942 copies, 5,218 were mailed to regular paid subscribers, 74 were mailed to advertisers, exchanges and correspondents, and 650 were provided for new subscribers, copies lost in the mails and office use. The Raitway Maintenance Engineer has applied for membership in the Audit Bureau of Circulations.	OBSERVATION Woods Usei An Improve Determinin General Ni

Safety is the first consideration in all branches of railway service. This statement is emphasized so frequently

Protecting
Weakened
Track

in the abstract that it is well to consider its application to the actual details of the various operations involved in the routine conduct of work. The discussion of track ob-

structions in another column points out some of the more important precautions which should be observed in the conduct of maintenance of way work. Because of the rapid change in the personnel of the forces and the great difficulty of holding experienced men in the service, increased attention to their proper instruction is neces-sary. So much of the work of the track and bridge departments involves the safety of train movements that it is a primary duty of the supervisors in charge to pay careful attention to the instruction of the men in this subject. One road is inaugurating a series of surprise tests to satisfy itself that the men understand the rules and follow them under all conditions.

The section foreman comes in closer contact with the property owners adjacent to the line than any other em-

The	Railway
	as a
N	eighbor

ployee of the railway. His relations with them are largely those of a neighbor. One problem in which their interests are common is that of preventing fires along or adjacent to

While one will find an occasional the right of way. farmer who makes no effort to co-operate with the railway in these matters and who regards a road as a source of revenue through the payment of claims, a foreman will generally find that his efforts to provide fire guards of

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one kind or another meet with approval and that he can secure the co-operation of adjacent property owners in this protective work. By employing tact and diligence and by exercising reasonable care for the protection of the farmers' property he can generally secure their cooperation also in the maintenance of fences, in the handling of drainage and in similar problems which rise from time to time. The efforts to establish and maintain friendly relations with the farmers along the line form a very important means of protecting the revenue of a railway.

The suggestion made in another column by W. E. Schott that the characteristics of the different classes of labor

Studying Our Labor

should be studied and living conditions made to conform to their habits as far as practicable, if the best results are to be obtained, deserves special emphasis. It must be recognized that

the American hobo, the Italian, the Mexican, the southern negro and the other races employed in track work vary radically in their racial characteristics, and that the same methods of organization and of conducting work which are applicable with one class are not necessarily equally successful with other nationalities. The methods of feeding the men and the character of the food itself also differ widely. In a year such as this, when many roads are finding it necessary to employ nationalities with which they are unfamiliar, close study can well be given to these racial characteristics in order to work the men most effectively. With the expenditure for wages alone for a floating gang reaching \$100 or more per day and with this multiplied many times over a system, the im-



portance of securing the maximum returns is evident. The recent decision of one large Eastern road to undertake a careful investigation of the characteristics, methods of work and habits of living of the various nationalities which it now employs or may employ in the future, can well be followed elsewhere.

Although it was at one time the universal practice to mix concrete in large quantities with no other equipment than

a few shovels and hoes, the machine Concrete Mixmixing of concrete for even the smallest jobs is now generally acers for Maincepted as the most economical methtenance Work od. In fact, the hand mixing of concrete is frowned upon in some circles and specifications often definitely prohibit it. A justification of this attitude is to be found in the recently reported tests of the United States Bureau of Standards on concrete and mortars made of sands and coarse aggregates selected from various parts of the country. Compression tests made on concrete cylinders, hand mixed by three contractors, showed materially less strength than duplicate specimens made of machine-mixed concrete by the same organizations, the methods followed in each case conforming in every way to actual commercial practice. Notwithstanding the common acceptance of these facts, we still find that small amounts of concrete placed by the division forces on railways are frequently hand mixed, the excuse being that there is not a sufficient yardage in these isolated jobs to justify the moving and setting up of a mixer plant and that the preparatory operations constitute a large portion of the labor charge. In refutation of this idea it is only necessary to call attention to the large variety of styles and sizes of mixers on the market which include some suited to the most diminutive of concrete operations and which can be set up and operated easily by two or three men. The size of mixer most suitable for each organization depends upon the variety and character of work which it is expected to do. Another solution for the machine mixing of small concrete jobs may be found in the adaptation of the mixer car idea as used by some railroads on the larger concrete construction work now being done by company forces in various parts of the country.

THE STRIKE SITUATION

ONE of the most encouraging developments in the controversy between the railways and the four brotherhoods of train service employees has been the manner in which the men in the other branches of railway service have indicated their loyalty to their companies. Only last week a petition signed by approximately 100,-000 unorganized railway employees was presented to President Wilson urging that he oppose the demands of the four brotherhoods.

The maintenance of way department, employing the largest group of men in the railway service aside from those involved in the present controversy, has long been noted for its loyalty. In this instance the men in this department realize that the roads, in opposing a raid on their treasury by a group comprising only 18 per cent of the employees (and those the highest paid in the railway service), are fighting the battle of their unorganized employees. The frequent demands of the men in train service in recent years have made impossible adequate wage increases for the men in other departments whom the officers have felt were more deserving. The roads have recently passed through several years of business depression and greatly decreased earnings, forcing a large mileage into the hands of receivers. Now for the first

time in several years the earnings have been more satisfactory and many of the roads have taken this opportunity to increase the wages of the deserving men in the unorganized branches of the service.

At this time, when the members of the four brotherhoods have made their exorbitant demands, backed by the threat of a strike, the railways must look to the employees in the other branches of service for support in the crisis they are facing. It would have been the easy thing for the managers to have complied with the demands of the brotherhoods, particularly after President Wilson became their open ally, but to have done so would have meant the sacrifice by the roads of the interests of the other employees. At the time of going to press the danger of a strike is great. If it comes it is to be hoped that the employees of the maintenance of way department will extend to the railways the full support which the managers are relying upon, based upon their knowledge of the long-standing loyalty of these men. After all, the fight of the managers is their fight.

CENTRAL REPAIR SHOPS

L ARGE as the direct cost of repairing maintenance of way tools is, this is only a part of the total expense involved. The cost of exchanging tools, particularly if they have been improperly repaired and the service life shortened, the reserve stock which must be maintained, the danger of accidents resulting from improperly repaired tools and the cost of transportation to and from the repair shops, all contribute to the ultimate cost of this work. Too often only the direct expense in the shops is considered and these other large contributing factors are lost sight of. However, well-thought-out plans for the systematic repair of tools must take all of these conditions into account.

No one of the plans described in another column is applicable to all roads. Local conditions of labor, shop location and equipment and the mileage and location of the lines may render impractical on one road a plan eminently suited to another. At the same time, certain characteristics are common to most roads. These point to the economy of a central shop for the repair of maintenance of way tools and equipment. The objection most commonly raised are those of increased haul of tools and the consequent delay. With the proper location of the shop on the average system, it will not be necessary to resort to long hauls, while the delay in repairing tools at a central shop properly administered is less than in the average local shop with its divided supervision.

The most evident advantage of a central shop is the concentration of a sufficient amount of work at one point to enable men to be employed constantly on it and to become proficient in the particular duties. The tempering of tools and their sharpening require knowledge and experience above that of the average blacksmith. The belief prevalent on some roads that any blacksmith can repair tools sufficiently well for all practical purposes is a source of heavy loss and of frequent accidents. A large proportion of the tools returned to service to-day are improperly repaired and do not give the service which they should after passing through the shop. It is for this reason that some of the manufacturers have added repair departments and are offering to repair in their own shops the tools which they make in order that they may render the proper service.

With the concentration of this work for a considerable mileage of lines in one shop, preferably under the direction of the maintenance of way department to eliminate divided responsibility, the improper repair of tools can be detected promptly and measures taken to improve ณ์ ที่

the practice. While this problem is a minor one from the standpoint of the money involved, its ultimate effect, as evidenced not only in the direct cost of making repairs, but in conserving the time of the men and in reducing injuries, is such as to warrant its careful investigation. It is significant that on the lines where the closest attention has been paid to this subject, the central shop has been very generally adopted.

A HIGHER WAGE RATE

THE serious shortage of track laborers experienced this year is causing many railway men to cast about for ways to avoid a similar recurrence of this difficulty in the future. In the fields of organized labor the problem presented to the railways is that of meeting the united demands of employees without reference to the competition for men by outside industries. In the maintenance of way department the difficulty is that of establishing a wage which will attract men from other employment in sufficient numbers to meet the demands of the roads. The latter is the simpler problem, for it is purely a competitive one.

There is an increasing sentiment among railway men that the labor in the track department must be placed upon a more permanent basis by paying a wage sufficient to attract the desired class of men in the service and to induce them to remain as they become experienced employees. One road which has given this subject careful consideration is now working out an interesting experiment. Early last spring it established a wage rate considerably above that on neighboring railways. Before this went into effect the section foremen were advised that this rate would be justified only if they filled out their gangs with native men from the surrounding coun-Although located in one of the most highly develtry. oped industrial districts in the United States, with one or two exceptions the foremen were able to secure sufficient local men to fill out at least half of each gang. It was soon evident that the extra wage was more than offset by the increased amount of work performed. In addition, these men who lived in the communities did not require cars to live in, transportation to and from the labor centers, freight on foodstuffs and other concessions commonly granted to foreign employees, none of which are included in the wage rate, but all of which cost the company money. Also of great importance in a year such as this is the increased security against strikes as compared with forces composed largely or entirely of foreigners who are easily led by an agitator from their own ranks.

There is naturally some question as to the effect such a plan would have on the labor market of the country if applied universally on all roads. With the large number of men employed on the sections many railway men believe that it is impractical to secure them in sufficient numbers to fill the permanent forces, and because of this they feel that the native track laborer has disappeared permanently from the railway field. Also, there is reason to understand why an executive officer in charge of a large system would hesitate to authorize an increase in the wage rate sufficient to attract a sufficient number of men to fill out the desired forces on his entire line. On the other hand, the advantages are so evident and the situation is so extreme that the plan is worthy of careful trial on one or two divisions of any large system. Obviously it would not be practical at the present time to extend this plan to other than the permanent forces. The laborers for floating gangs are required in such large numbers and for only a few months of each year that other conditions aside from the wage rate will prevent high grade native laborers from accepting such work.

LETTERS TO THE EDITOR

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THE LABOR PROBLEM

TO THE EDITOR:

The present period of prosperity and the consequent demand for labor of all classes has brought the track labor problem to an acute stage. It is with difficulty that labor of any kind is now obtained in sufficient quantity for maintenance of way work and the quality of the average force is very low. The work is hard and exacting. The demand for labor in other classes of work where rates are more flexible and follow supply and demand more closely has attracted the better class of men and has left for railroad work, on the floating gangs at least, only those who are below par in intelligence, initiative and ability.

There is, also, at the present time a very noticeable unrest in all classes of labor, which further complicates the problem. If the present business conditions continue, and nothing occurs to change the trend of thought among laboring classes, there is no doubt that the railroads will have to make a radical change in their policy toward labor in the maintenance of way department, if adequate forces are to be obtained to carry on the work.

It is my opinion that the fundamental reason for the existence of a labor problem in the maintenance of way department, is the classification of section forces as unskilled labor, and the payment and handling of these forces on this basis. Track work is a trade. A good section man is not made in a day. True, it does not require the same degree of skill and knowledge to tamp a tie correctly as it does to operate a machine, but it does require some skill and knowledge. The same is true of rail laying, tie renewals, switch work and the other primary duties of the track forces.

Trackmen should be classed as semi-skilled laborers and should be paid accordingly. Instead of allowing the increases in rates paid for other classes of work to force trailing increases to trackmen, leaving for the track forces the unfit, it would appear more logical to set the standard higher and pay for it.

Every trackman knows that proper tamping is absolutely essential to economical track maintenance, and, given a force of skilled men who are physically and mentally fit, it stands to reason that economy will be effected in the amount of work done and the thoroughness with which it is done. And that as much can be accomplished with a smaller force of competent, skilled men as with a larger gang of the rejects.

Granted a rate that will class track forces as semiskilled labor, the question of permanence or steadiness of employment is the leading factor in the labor problem of this department. Under the present practice the forces are largely increased during the spring and summer, and are cut to the lowest safe minimum during the colder months. This practice makes the work unattractive as a means of livelihood. In the extreme North this practice is perhaps unavoidable, but in the central and southern portions of the country there is really no reason why a great deal of the work that is rushed through with increased forces during the spring and summer cannot as well be handled in the colder months, reducing the labor requirements for the summer and permitting a more nearly uniform number of men to be employed the year round.

True, a great deal of time would be lost by these men

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during the winter on account of unfavorable weather, but it is probable that these conditions would similarly affect other classes of semi-skilled labor, so that the status would remain relatively the same. In any case, for a man to make only half time is preferable to being laid off entirely, and the man who is kept on the pay roll during the winter is much more likely to stay during the summer than one who is laid off all winter. I do not wish to be understood as advocating carrying men when the full value of their wages cannot be obtained, but with the proper arrangement of seasonal work much can be found that can be handled to advantage during the winter months, and the force need not be cut to the minimum required to keep the track safe.

Is it not possible that the solution of the track labor problem lies in smaller gangs of more efficient men, permanently employed, and paid a rate that will compare favorably with the prevailing rates for other classes of semi-skilled labor? From such gangs really capable assistant foremen and apprentices can be selected, and a long step would thus be made toward the solution of the foreman problem, also.

A satisfactory substitute for hand labor on track work has not yet been found, and if we want good labor we will have to pay good prices for it. The day of good common labor has passed. Common labor is no longer good, but is largely made up of the unfit. Track work cannot be handled satisfactorily with the drifting, shiftless class of men who now largely make up track gangs. The track labor problem is really a question as to whether the job is to be made a good job for the good laborer or a common job for the common laborer.

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THE INTELLIGENT USE OF TRACK LABOR

To the Editor:

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SAN MIGUEL, CAL.

The construction of railway roadbed and track and their maintenance afterwards have always called for an army of men, and the demand for labor has usually been greater than the supply. Until about 15 years ago most of the track men were Irish, but in late years this nationality has almost disappeared from the service, and Austrians, Italians, Greeks, Mexicans, Japanese and other nationalities have taken their place. In view of the wide difference of opinion regarding the relative efficiency of men of the various nationalities and the large amount of money spent for labor, it is surprising that the haphazard methods followed to-day in the selection of men have been allowed to continue.

If a piece of work is authorized and extra laborers are needed at a time when men are scarce and those of the nationalities previously used cannot be secured, a railway will hire laborers of other nationalities as an experiment. These men are commonly sent out on the line to foremen who have never handled that class of labor before. From the first it is generally seen that the work is far below standard in quantity as well as in quality. Some of the men soon quit, others are discharged and in perhaps a month or two only a few are left. As the foremen are known as capable men, the result is, in most cases, that the men are considered to be inefficient, notwithstanding the fact that frequently the same nationality has given good results on neighboring lines.

Since track work does not require a large amount of physical strength or a high decree of intelligence, there is no reason why one laborer, if satisfied with the conditions of employment, should not be as satisfactory as another, irrespective of nationality, and it would seem advisable

to ascertain the reason for this apparent failure. To condemn an entire group of laborers collectively for such reasons seems unwise.

Except in an unusual year, such as the present one, cheap labor can be found if a careful search is made for it. For instance, the Southern Pacific has employed Mexican laborers almost exclusively on its line extending from El Paso, Texas, west almost 1,000 miles to Santa Barbara, Cal., with splendid results and at a considerably reduced cost. Here, as on several other roads in the West, the maintenance of way department has made a study of this problem and has created living conditions satisfactory for the class of labor employed. The men are permitted to live in comfortable quarters and to have their families with them and they are perfectly contented with their \$1.25 to \$1.50 per day.

To eliminate the continuous search for suitable track men the following suggestions are made: Decide on some kind of labor of which a sufficient supply is available, considering the climatic conditions in the locality where such labor is to be employed; then carefully investigate the habits and customs of this nationality and make every effort to enable the men to adhere to them as much as possible. Adopt a uniform wage scale with perhaps a slight increase for long service. Treat the men well and see that they are handled fairly. Pay for intelligent foremen and train them to handle such labor properly. These methods will do much to improve labor conditions. W. E. Schott.

A MODERN BOARDING CAR

S OME time ago the Bessemer and Lake Erie purchased five 12-section Pullman sleeping cars of wood con-struction with steel underframes. Two of these cars struction with steel underframes. have been remodeled at the company shops for the use of floating carpenter gangs, who are required by the nature of their work to live away from their homes. As far as possible the interior decorations and finish of the cars were not disturbed. The floor of the entire car was covered with inlaid linoleum.

The smoking room was converted into a kitchen and furnished with a first-class four-plate range, white enamel sink and cupboard for dishes and cooking utensils. A refrigerator with a capacity for 200 lb. of ice is set just outside the kitchen door on the platform of the vestibule. Seats were removed from the four sections adjoining the kitchen and the space used as a dining-room. A dining-table 32 in. by 50 in. with a 48-in. extension, and eight chairs, all of which match the interior of the car. comprise the dining-room furniture, together with a seat of sufficient width to be used as a sofa built along one side of the room. The dining-room is fully equipped with dishes and linen. The remaining eight sections provide sleeping quarters for 16 men and are furnished with the necessary bedding. The stateroom was left untouched and is used by the foreman for an office, where he can make out his reports undisturbed.

Water for cooking and toilet purposes is stored in a tank underneath the car and circulation is caused by compressed air supplied by a hand-operated pump. Heat is supplied by Baker heaters, which also heat the water. Oil lamps are used for lighting.

Two more of these cars are being used by gangs for sleeping quarters only, the kitchen and dining-room facilities being in a converted box car placed at one end of the Pullman. This arrangement allows the use of all twelve sections as sleeping quarters. We are indebted to H. T. Porter, chief engineer,

Bessemer & Lake Erie, for the above information.

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Tools Repaired and in Need of Repairs.

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THE determination of the proper method of making repairs to track tools is a problem that is deserving of the close attention of maintenance of way men. While the charges to this item, when viewed locally, may appear to be of little consequence, in the aggregate the annual cost of the 295,000 miles of line operated by the railroads of the United States and Canada closely approximates \$1,750,000, on the basis of an average cost of approximately \$5.75 per mile of line.

While it is too often the case that this money is spent without any definite knowledge on the part of various roads as to the cost of the methods they are using, it is a fact that a number of roads are now making careful efforts to analyze the expense of their methods and to compare the costs and results with those on roads following other plans. In preparing this article the practice of 35 roads, operating approximately 110,000 miles of line, have been studied, and of this total, roads operating 26,000 miles of line are now carrying on independent investigations in an effort to determine the best methods of making tool repairs.

Before determining on any system of making repairs it is advisable that the point at which tools should be scrapped rather than repaired should be determined carefully. On one important railway the chief engineer has issued instructions that sample tools be gathered and that definite limits of wear be set beyond which the tools should be scrapped rather than repaired. For example, a new track shovel measures about 1134 in. on the blade. It will shovel as well when it is worn down to 6 in. or 8 in. as when new, but, of course, will not enable the man handling it to do more than half as much work. The limits which have been established take into consideration the value of a new tool and the decrease in the amount of work a man can do with a worn tool. Where one has been so worn as to decrease its efficiency and make it more profitable to scrap it than to repair it, it will be scrapped. For example, it has been decided that a track shovel worn to less than 10 in. in length on the blade should not be reissued for track work, but should be utilized in some other manner.

THE COLLECTION OF TOOLS

The collection of tools in need of repair and the returning of them to the men or the issuance of others in their stead is preliminary to the actual repair. This operation is generally made under one of two general plans, some roads shipping the tools to the repair shop by the most ready channel, while on other roads supply cars are run over the line at regular intervals. This latter method is employed with many variations.

On the Central Railroad of New Jersey all tools are properly tagged as to the ownership and are moved to the shops by work train, passenger train, or freight train, as may be most convenient. The repairs are made at the shop and the tools are returned through the most ready channel.

On the Pennsylvania Railroad the tools to be repaired and the repaired tools are handled under both methods. Generally they are handled by supply cars making weekly trips over certain prescribed districts, and the practice is to exchange new or repaired tools for an equivalent number of the same class of tools in need of repairs. This exchange is covered by a shop order, and the most satisfactory way is to have this order go direct from the superviser to the shop, without following a roundabout way through a number of higher officers. At other points the tools are shipped back and forth by local freight.

On the Baltimore & Ohio the tools are collected monthly by supply trains and are shipped to central points, where the repairs are made. The tools are then returned to stock at a price which covers the cost of handling and repairing and are then reissued on requisition through the regular channels. On the Missouri Pacific supply cars are run in local freight trains that stop at each section headquarters. New or repaired tools are issued from the cars only in return for broken or parts of broken tools, thus insuring that tools are not being lost by the men. A foreman accompanies the car and inspects all tool houses to see that no reserve stock accumulates over the standard allowance. From one to three weeks is required to cover the assigned territory. On the conclusion of the supply car trip the material collected is shipped to one of the three central plants, where it is separated into reclaimable tools, parts for repair use and scrap.

On the Southern Railway the practice is varied. All broken tools are sent to the supervisor monthly by the foremen. The supervisor is furnished with a large box in which these tools are placed and in which they are sent by him to the roadway shop. The shop foreman replaces the tools received with an equal number of the same kind of either new or repaired tools and returns



them, in the box, to the supervisor. The supervisor then sends them out to the foremen along the line. This method takes out of the hands of the foreman the question of scrapping tools and further requires care in the accounting for tools, as new ones are only issued in exchange for those sent in. Any request for additional tools must be accompanied by a satisfactory explanation.

It may be seen from the above that the method of collecting and returning tools is largely dependent upon local conditions. This is doubly true in adopting methods for making the repairs. Because of this difficulty in formulating any standard method that will cover the various conditions encountered, many roads have not adopted any single system of handling repair work. However, the great majority are following one of the several methods systematically.

METHOD OF MAKING REPAIRS

There are four distinct methods used by the roads in making repairs to track tools. The facilities of the division motive power shops are utilized by a number of roads and the repairs are made by men in the employ of that department. Foreign facilities are utilized by other



SHOVELS AND BALLAST FORKS AWAITING REPAIRS

roads, and under this plan the tools in need of repair are sent to the manufacturers, or local outside blacksmiths are employed. Other roads have adopted the division maintenance of way blacksmith plan, under which the repairs are made in a blacksmith shop operated under the direction of the local supervisor or roadmaster. A fourth plan is the organization of a central plant where the tools in need of repair are accumulated at one or more centrally located points, where the repairs are made by men especially trained in this line of work and generally under the supervision of the maintenance of way department.

On the Chicago, Milwaukee & St. Paul there is no definite system used. All tools are handled through the storekeeper, and, when once issued to the men, the manner of making the repairs is left to the judgment of the different roadmasters. On the Lackawanna an effort is made to centralize maintenance of way repairs at Dover, N. J., but it is not considered economical to send the tools from outlying divisions to this central shop, and in many cases the facilities of the motive power department are used. At Elmira, N. Y., a maintenance of way blacksmith shop is maintained where repairs are made to the tools used on the line for a distance of 50 to 60 miles each way.

The Pennsylvania Railroad is employing all four methods on different parts of its line. The total annual cost of repairs on this road exceeds \$100,000, while the cost per year for each man employed varies from a minimum of \$3.30 on one division to a maximum of \$20 on another, with the average cost slightly more than \$7. These variations are due to both local conditions and to the methods employed.

MOTIVE POWER SHOPS

On many roads the facilities of the division motive power shop are utilized. This plan has the advantage over others that the repairs can be made without the installation of special equipment or the hiring of additional forces. It is especially adaptable to roads where the accumulation of work of this nature is small in relation to the miles of line operated and on the outlying divisions of any road where the distances are great to any central point where the repairs might be made.

The disadvantages of the plan are numerous. Probably the greatest is the natural disposition of the mechanical department to slight the work of another department in favor of its own. Moreover, where two departments are involved, as under this plan, there is a division of responsibility which is always unsatisfactory. Disputes between the trackmen and the tool dressers arise with the trackmen claiming that the tools are not properly repaired and the tool dressers claiming that they are improperly used. It is difficult to judge fairly between the two departments, but it is a fact that tool repairing is incidental to the work of the mechanical department and the men rarely become expert in it. It is also a fact that when two departments are involved a wide difference of opinion as to charges is likely to occur. It has happened in many cases where tools are repaired by the mechanical department that the maintenance of way department has felt that it has been discriminated against in the matter of charges, 27 per cent of the tool repair charges on one division being found by investigation to be overhead charges.

REPAIRS BY MANUFACTURERS

The practice of sending tools to manufacturing plants has the advantage over other plans that the repairs are made by expert tool makers, who devote their entire attention to one highly specialized class of work in shops where the best of equipment is provided for carrying on the work, thus insuring good results and a proper temper. The tempering of tools is an art in itself and can be done successfully only by experts. Improper heating when tempering results in breakage and failures later.

The manufacturers who have undertaken to repair the tools have done this in support of their sales department rather than as a commercial project, for they feel that by making the repairs in their own shops the full life of the tools will be realized, a result not always possible where repairs are made by men who are not skilled in this line of work. It is urged as an argument against this plan that the freight charges run the cost up to a prohibitive point, but investigation will show that this is generally over-estimated, as the average cost is less than one cent per tool for a haul of 600 miles. Another argument against the plan has been that a surplus stock of tools must be kept on hand if the repairs were made at tool works, because of the time required for shipment to and from the factory, but experience has shown that these repairs are now being made by the manufacturers and the tools returned to the points from which they came within three weeks of the date of the original shipment, within a 500-mile limit.

To obtain the best results from this method the tools to be repaired should be thoroughly inspected by employees of the road at the point of shipment and those too badly worn for repair thrown out. However, if this is not done by the shipper, in some cases arrangements are made for it to be done at the plant, and an allowance is made to the railroad for the scrap value of the rejected



tools or they are held for the inspection of the proper railroad official. Because of the fact that these repair branches are not operated as a separate commercial project, the cost to the roads is low and compares favorably with that under other plans with the insurance of the best workmanship.

The Rock Island is sending about 50 per cent of its track tool repair work to manufacturers and is repairing the remainder at central shops. The tools that are sent to the manufacturers are collected at Silvis, Ill., and are shipped from and returned to this point in carload lots. The Louisville & Nashville has abandoned the repair of its tools at motive power shops and has entered into an agreement with a manufacturer to make these repairs. Under the method employed by this road each roadmaster assembles the tools in need of repair on his district and ships them direct by freight to the manufacturer. At the same time he forwards a requisition for the repairs to the superintendent for approval. The approved requisition is then sent to the purchasing agent, who places the order for the repairs.

On one superintendent's division of the Pennsylvania Railroad, conveniently located to a commercial tool manufacturing plant, all tools in need of repair are sent to the storekeeper and they are then forwarded by him to the tool works. The repaired tools are returned to the storekeeper and are sent out along the line, according to the shop order. The Pennsylvania is also employing local outside blacksmiths to repair the tools on some of the smaller outlying divisions.

DIVISION MAINTENANCE OF WAY SHOPS

In making repairs at division maintenance of way blacksmith shops the advantages of small stock are secured owing to the short haul and the personal supervision of the roadmaster or supervisor in seeing that the tools are not allowed to accumulate in the shop. An added advantage is that the same men are constantly engaged in tool repairing and become more expert in this line of work. A disadvantage of this method is the relatively expensive organization. The Central Railroad of New Jersey, which abandoned the use of motive power shops to establish small maintenance of way blacksmith shops, has overcome this disadvantage, in a measure, by employing the men in the mechanical floating gangs of the maintenance of way department ordinarily engaged in making repairs at drawbridges, etc., in these shops when not otherwise engaged. By utilizing these men in the shops while they are waiting for trains or for quitting time, it is possible to turn out a considerable amount of work which the blacksmiths regularly employed could not do. Also where a maintenance of way shop is in operation small steel parts may be fabricated, parts of machines made or any of the special appliances that the maintenance of way department may be especially in need of may be prepared. If this work were done by the mechanical department more detailed plans would have to be prepared and a large amount of correspondence would be necessary, occasioning much delay.

The Philadelphia & Reading is also using division maintenance of way blacksmith shops. Each supervisor is allowed the necessary blacksmith and helpers to carry on the work properly. The shops are equipped with power to operate fans, grindstones, drill presses, carborundum tool grinders, and, in some cases, a steam hammer.

The New York Central, east of Buffalo, is also employing this method, and allows each supervisor a blacksmith and helper and a carpenter. The wood-working repairs are taken care of by the carpenter, while the blacksmith and his helper make the tool repairs.

CENTRAL REPAIR SHOPS

The use of the central plant is growing in favor. One of the advantages of this plan is the readiness with which it may be operated in connection with the supply and reclamation departments. By operating these plants in connection with the supply department the transferring of material from the shop to the storehouse is done away with, and, furthermore, the proper distribution of tools is assumed without a scarcity on one division and a surplus on another, as often happens when the repairs are handled locally. Such a shop also lends itself readily to operation in connection with frog and switch shops.

The plan has the advantage, in a greater degree than in the division maintenance of way blacksmith shop, that the men become expert in this line of work, owing to the fact that a sufficient amount of it is accumulated to keep them constantly engaged in the same class of work. In this respect this plan equals the utilizing of the facilities of manufacturing plants, and has the advantage that the shops are more convenienly located on the line. It is also possible to send the men working on these tools out on the line occasionally with the foremen, using them



REPAIRED TRACK JACKS

as an aid in preparing the tools for the service required of them.

Another advantage of this method is that, because of the large quantities of tools collected at one point, it is possible to make a careful inspection of them and to detect tools that have not given proper service. While this is possible to a limited extent in local shops, the assembling of the tools at one point enables one to ascertain quickly the results they are giving over the system. It is also possible to detect tools that have failed through improper use and to correct the abuses by giving the proper instructions to the men.

The objections most commonly urged against this plan are the long freight hauls and the length of time required for the return of the tools with the consequent necessity of carrying a larger reserve stock in the storerooms. While, because of this delay in rush times during the summer working season, it may be best to send some of the work to division shops, the possibilities of a central plant for the repair of surplus tools during the winter months has special merit. Some roads are now operating in this manner, as the haul in the winter months, when the tools are not required, is not an argument against the central plant. The plan is best adapted to roads with branch lines radiating from ceneral points, where a maximum mileage of lines can be served by a central plant with a comparatively short haul from any portion of the district served.

The Baltimore & Ohio has abandoned the practice of division maintenance of way blacksmith shops in favor of central shops, as the former scheme was not considered satisfactory from several standpoints. Frequently it was not possible to get a good, skilled blacksmith at a local shop, with the result that a poor quality of work was turned out, and in some cases the cost ran high. This method also led to a surplus accumulation of tools on one division whereas on another there would be a scarcity. As the matter was handled locally it was difficult to get the surplus stock back in circulation. To avoid these difficulties two central plants are now operated, one at Martinsburg, W. Va., and one at Zanesville, Ohio. The economy of the new method was apparent during last year, the total charge against the account being the lowest in ten years.

On the Missouri Pacific the work is handled in connection with the supply department and the reclamation work. Three plants are operated. The supply department maintains a force of mechanics at the central shops, independent of the mechanical department forces, who are experienced or are in training for this particular class of work. The work of reclaiming track materials, such as frogs, switch stands, lamps, etc., is carried on in conjunction with the work on tools and other supplies.

Where tools are collected in sufficient quantities, as at central plants, it is sometimes possible to carry on the repair work on a piece-work basis. This plan has been adopted by the Norfolk & Western at its Roanoke shops, where the following prices prevail:

Dress and straighten lining bar	. \$0.06
Repair and temper track chisel	07
Repair and temper track hammer	15
Dress and temper clay pick (per end)	04
Re-steel and temper pick (per end)	125
Dress and temper tamping pick (per end)	08
ke-steel and temper tamping pick (per end)	15
Re-dress and shape claw bar	30

As a detailed example of the central plant and its operation in connection with the reclamation and supply departments, J. T. Bowser, chief clerk in the roadmaster's office of the Cincinnati, New Orleans & Texas Pacific, at Danville, Ky., submits the following:

OPERATION OF A CENTRAL PLANT

The Cincinnati, New Orleans & Texas Pacific extends from Cincinnati, Ohio, to Chattanooga, Tenn., a distance of 338 miles, and is a part of the Queen & Crescent Route. Prior to 1908, repairs to tamping picks, track chisels and other small tools used in the maintenance of way department of this road were made in the shops of the mechanical department at such times as the forces in that department could be put on this work. Little was done in the way of repairs to frogs, switches and switch stands prior to that time.

The arrangement was found to be not satisfactory because of the delays in getting out work. Moreover, it was thought that a great deal could be done in the way of reclaiming material which could not be done under the arrangement then in effect. In 1908, therefore, the employment of a maintenance of way blacksmith and two helpers was authorized, and a small building, convenient to the maintenance of way storeroom and near the main shop at Ferguson shops, Kentucky, which is centrally located, was equipped with the necessary tools and machines for the repair of frogs, switches, switch stands and other material and maintenance of way tools.

The organization for handling material, classifying scrap and reclaiming and repairing second-hand material and tools consists of a maintenance of way department storekeeper, a blacksmith and two helpers, and a machinist and apprentice. A section gang is used for handling and classifying material and scrap. The foreman of this gang reports to the supervisor in all matters pertaining to maintenance of track, but is subject to the call of the storekeeper for handling material in the scrap yard. The storekeeper, to whom orders for repairs or material are given, and who is directly responsible for maintenance of way material in the storeroom, is necessarily the head of the organization. Under his general supervision the blacksmith has charge of the shop, and directs the work so as to supply the material for which the storekeeper has orders.

The plant consists of a maintenance of way department storeroom, material yards and sheds, scrap bins and tracks, and the repair shops. The shop is a frame building about 20 ft. by 60 ft. in size, situated adjacent to a track on which cars are placed for convenience in handling heavy material to and from the shop.

The shop equipment consists of planer, drills, cut-off saw, forges and chain hoist. An air hoist for handling the heavy material off and on cars is located on the side of the building, adjacent to the track. A stock of repair parts for switch stands, switches, track jacks, etc., is kept on hand by the storekeeper.

All maintenance of way scrap and second-hand material from the entire road, with the exception of scrap rail over six feet long, which is shipped direct to scrap dealers, is shipped to Ferguson shops. The greater part of this material is collected along the line of the road in cars operated in the local freight trains on the first Monday of each month. During the month the section gangs accumulate the scrap at a central point on their respective sections, and the foreman has sufficient men on hand on the day the "scrap car" goes over the line to load scrap without unnecessarily delaying the train. At yards scrap and second-hand material is allowed to accumulate until a carload is on hand, when the car is forwarded to Ferguson shops. On arrival at the shop the cars are placed on the track adjacent to the scrap bins, and the material is unloaded and classified by the section gang. The secondhand material is separated from the scrap, and, if no repairs are needed, it is placed in the storeroom, or, if repairs are required, is delivered at the shop.

The storekeeper is required to make monthly reports of the cost of repairing frogs, tools, etc., so that comparisons of the cost of making repairs of different kinds can be made for each month. The cost of labor for the forces employed in the repair shop averages about \$310 per month, including the machinist and apprentice. The cost of labor for the section gang varies widely with the amount of material to be handled and no accurate estimate can be made of this expense.

It is hardly possible to arrive at a definite figure showing the actual saving effected in dollars and cents, for the reason that no record was kept of material that might have been reclaimed before the maintenance of way repair shop was put in operation and the work of reclaiming such material started. Since the system has been in effect a complete record of all material reclaimed has been kept, and a brief outline of what has been and is being done gives a good idea of the saving effected.

Since the shop has been in operation it has not been necessary to purchase any common rail frogs for ordinary maintenance purposes, the only frogs ordered through the purchasing agent being solid manganese or other special frogs, and those required for laying new rail and for additions and betterments. In fact, in a number of instances, frogs have been furnished from the maintenance of way repair shop for these latter purposes. The reconstructed frogs are found to wear as long as new frogs. Practically all switch points 18 ft. and longer which, before the repair shop was started, were scrapped when they became too badly worn at the point for further use are now planed down to be used as shorter points. Also with the occasional assistance of a tinner or carpenter, lamps, lanterns, oil cans and water buckets are repaired, shovels rehandled, gages repaired and levels fitted with new glasses and plates.

At the scrap bins good parts are taken off broken or

worn material or appliances and are used in repairing other appliances of the same kind. The scrap shipments are carefully watched for good spikes and bolts, or other material, and these are re-issued from the storeroom.

A Novel Method of Ditching a Cut

BY H. M. CHURCH,

Division Engineer, Baltimore & Ohio, Baltimore, Md.

RADICAL departure from the customary method of sloping and ditching was experimented with on the Baltimore division of the Baltimore & Ohio during the past season, and, although there seem to be no authentic unit costs for other methods, this method appears to be reasonably cheap. Between Contee, Md., and Muirkirk, on the Washington branch, the tracks pass through a deep cut known locally as Muirkirk cut. The formation at this point is red and yellow clay and an inferior grade of iron ore, which is smelted in a small blast furnace at Muirkirk, the product being charcoal iron. For a number of years the program of work on the Washington branch has included a large amount of sloping in several cuts. The south side of Muirkirk cut was sloped and covered with street dirt during the season of 1913 and 1914, with a rented contractor's dinkey engine and narrow-gage dump cars. Here the work progressed slowly, as it was necessary to employ a switchback to obtain suitable dumping ground. In addition to this, continual trouble was experienced with derailments and the heavy grades on the dinkey track also had a tendency to impede the progress and run up the cost of the work.

The north side, which had never been sloped, was bare of vegetation and very much weathered with deep gullies. Owing to the clay formation, the ditches became obstructed by sediment which was washed down by rains or rolled or slid down when loosened by the thawing of the ground. This condition not only presented an unsightly appearance to the traveling public as compared with the neat appearance of the southern slope, but caused rough and "pumping" track, owing to the choked ditches and standing water, with mud and clay working up into the stone ballast.

The comparatively flat ground at the top of the slope at this point offered an opportunity to introduce an original method of ditching. A heavy timber truck was built



FINISHING THE SLOPE

and erected on a section of broad-gage track on the flat top of the slope. On the truck was an ordinary stationary double-drum, double-acting 15-hp. hoisting engine with boiler, and also a small 5-hp. reversing engine for swinging the boom. At one corner of the truck a 12-ft. mast was erected, braced by stiffeners. This mast operated a 29-ft. boom. Large, open-end wooden boxes of about 0.6-cu. yd. capacity were construced with two fixed chains and one detachable chain on the open end for dumping. A large rope was also provided with each box to guide it up the slope and to drag it down to position when empty. Being large and flat, these boxes could be set anywhere on the slope and loaded by the men. When a box was loaded it was dragged up the slope by the derrick (one man steadying it with a hand rope), and it was swung out to the rear of the machine, where it was tripped by



WORKING ON THE SLOPE

another man, whose duty it was also to spread out this waste dirt and count the boxes. About four or five of these boxes were used at once, empty ones being loaded on the slope or in the ditch by laborers while the engine was busy hauling up and emptying the full ones. As the work proceeded the track was removed from behind the engine and built ahead, moves of about 15 or 20 ft. being made at a time.

This waste material was deposited at the top of the slope about 5 ft. back from the edge and formed a dam about 2 to 3 ft. deep and about 15 ft. wide. This dam not only performs the same service as a top ditch and thereby saves the cost of building one, but served also as a driveway for the teams hauling street dirt with which to cover the slope. It also afforded a convenient and cheap method of disposing of the waste material.

The working organization was as follows:

- 1 engineer.
- 1 foreman.
- 1 cart and driver hauling water and coal.
- 1 water boy (also assisted in hauling water to the engine).
- 1 man tripping boxes at the top.
- 2 men building track and clearing ahead.
- 1 or 2 men taking the boxes up the slope and dragging them down to position.
- 1 night watchman (who also had steam up in the morning).
- 16 men sloping and loading boxes (or enough men to load 400 boxes in 10 hr. (Capacity of box, 0.6 cu. yd.)

Total, 26 men.



The working capacity of this plant was 400 boxes in 10 hr., working at 100 per cent efficiency. Work was begun on September 11 and was stopped on December 4, during which time 2,100 ft. of cut was sloped and ditched with about 400 ft. still remaining to be done in the spring. Below is the detailed cost of the equipment and handling material:

ESTIMATED VALUE OF PLANT

Estimated present value of 15-hp. double-drum, double-	
acting stationary engine and boiler\$	600.00
Nine boxes at \$25	225.00
Track and derrick	175.00

Total\$1,000.00 COST OF SLOPING AND DITCHING

Depreciation of equipment	; 100.00
Rental of swinging engine at \$20 per month	50.00
Assembling plant on ground	42.98
Operating engine and derrick	183.27
Watching engine	155.31
Unloading coal for engine	4.92
Repairing derrick	19.68
Team hire hauling water and coal	224.00
Labor sloping and ditching 11,300 hr. at \$0.164	1,853.20
Estimated cost of taking down and shipping equipment.	75.00

Total cost\$2,708.36



SKETCH OF THE MACHINE AND BOXES

The estimated total yardage handled (with allowance for shrinkage) was 4,650 cu. yd., which gives a unit cost of \$0.58 per cu. yd., as compared to a bid of \$0.90 submitted by contractors. At one point it was necessary to cross a gully with the engine. This gully is about 50 ft. wide by 15 ft. deep and the cost was as follows:

Seams	2.00
Grading	0.02
nstalling pipe 1	1.48

\$83.50

The above unit cost per cubic yard for sloping does not include the cost of covering with street dirt.

COMING CONVENTIONS

"HE program for the convention of the Roadmasters' Association, which will be held at the McAlpin Hotel, New York, from September 19 to 22, was published on page 228 of the issue of last month. Since that time some other features have been added to the program, including a paper on the operation and maintenance of electrified terminals by F. Boardman, division engineer, electric division, New York Central, which will be presented on Thursday morning.

Reservations are being made rapidly for the special train which will run over the New York Central lines from Chicago. This train will consist of standard sleeping, dining and observation cars. The train will leave Chicago at 6 o'clock Sunday evening, September 17. It will leave Buffalo at 8:05 Monday morning (Eastern time); Syracuse at 11:25 a. m. and Albany 12:45 p. m. and will arrive at New York at 6:25 p.m.

BRIDGE AND BUILDING CONVENTION

The program for the convention of the American Bridge and Building Association, which will be held at the Gruenwald hotel, New Orleans, on October 17 to 19, inclusive, is approaching completion. The convention will open at ten o'clock Tuesday morning with addresses by representatives of the city of New Orleans and by the president of the Association. The annual dinner will be held on Wednesday evening. On Thursday afternoon it is planned to make a tour of the terminals of New Orleans. On Friday, a special train will convey the members and their guests to Slidell, La., where the plant of the American Creosoting Company will be visited. The party will then go to Bogalusa, La., to visit the sawmill of the Great Southern Lumber Company. It is expected that the members from north and west of Chicago will leave Chicago on Sunday morning, October 15, by special train, stopping en route at the Vicksburg National Cemetery and reaching New Orleans Monday evening.

PAINTERS' ASSOCIATION

The thirteenth annual convention of the Maintenance of Way Master Painters' Association of the United States and Canada will be held at the Hotel Walton, Philadelphia, on October 17, 18 and 19, 1916. The detailed program is as follows:

Tuesday, October 17, meeting called to order at 9:45 a.m. Address of welcome by Thomas B. Smith, mayor of Philadel-phia, and by Howard B. French, president of the Philadelphia Chamber of Commerce; President's address; Secretary-treas-urer's report; Preservative Coatings for Iron and Steel by Leo

urer's report; Preservative Coatings for Iron and Steel by Leo P. Nemzck, John Lucas & Co. Tuesday, 2:00 p. m.—Application of Fire Resisting Paints, H. J. Barklay, master painter, Illinois Central; Fire Resisting Paints, W. A. Clapp; Reducing the Fire Loss, G. F. Johnston, Pyroline Products Company; Safety First, M. F. Ebel, master painter, Cincinnati, Hamilton & Dayton. Wednesday, October 18, 9:45 a. m.—Illustrated lecture on paint, H. A. Gardner, Institute of Industrial Research; Organiza-tion and Administration of the Maintenance Painting of Bailroad

tion and Administration of the Maintenance Painting of Railroad tion and Administration of the Maintenance Fairing of Fair one Bridges, by W. S. Lacher, Railway Maintenance Engineer: The Sanitary Value of Paint, E. W. Lutes, The Sherwin-Williams Company; What This Association Has Accomplished for the Difference of the Paintee Paintee New York Central Railways, A. B. Phelps, master painter, New York Central.

2:00 p. m.-The Master Painter's Position in Relation to the 2:00 p. m.— The Master Painter's Position in Relation to the Corporation and His Men, H. E. Conrad, master painter, Penn-sylvania Railroad: The Influence of Pigment on Paint Perma-nency, Malcolm McNaughton, Joseph Dixon Crucible Company; Benefit the Railways Received from This Association, Ole Stub-sted, master painter, Chicago & Northwestern. Open discussion on The Accounting of Labor and Material, Finishing Each Job Complete, The Advantage of Motor Cars Over Hand Cars, The Treatment of Cast Iron Radiators, Stancile in the Field

Stencils in the Field.

Thursday, October 19, 9:45 a. m.—Open discussion; an exhibit of photographs of difficult and interesting work; business meeting, election of officers.

2:00 p. m.-Visits to places of historic interest in and about Philadelphia.

Fred C. Rieboldt. master painter, Chicago, Milwaukee & St. Paul, Milwaukee, Wis., is president and F. W. Hagar, master painter, Ft. Worth & Denver, Ft. Worth, Tex., is secretary.

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T this time of the year all employees of the maintenance of way department on most railroads must be on the alert to discover and put out fires on the right of way or adjacent thereto. In some parts of the country these fires become a source of considerable anxiety, while in other localities the situation is not so serious. However, the precautions taken to prevent fires, the measures adopted to discover those which have started and the means used to put them out are of general interest to railway men. A discussion of the subject by E. R. Lewis is followed by a review of the practices pursued on railroads in various parts of the country.

RAILWAY FIRE PREVENTION

By E. R. Lewis

Assistant to General Manager, Duluth. South Shore & Atlantic, Duluth, Minn.

Fire prevention is a matter for universal consideration. Fire is the common enemy, for property destroyed by fire is a real loss. It can be replaced only at the expense of the losers. No one gains anything by a fire loss. If the property burned is uninsured, the owner is commonly the loser. If insured, the insurance company may be called on to make good the loss. The insurance company exists by virtue of premiums paid in advance for fire protection and only a percentage of the loss is recoverable. If a third party is responsible for the loss, he must pay the claim. Lawsuits only result in additional cost to the contestants and a placing of responsibility for payment. Therefore, any organization which has for its object the prevention of fire along a railway right-ofway should include residents within the territory to be protected, as well as employees of the railway company whose lines traverse the territory.

State and Federal authorities are valuable allies in the organization and in the real work of fire prevention. The government forestry department is especially interested and active in lending skilled assistance. The preparations must, of course, begin with the forming of the best possible organization.

It is known that the most favorable start at fire prevention for a railway company is to have a special officer or officers who give their time to organizing those individuals in the different communities who are most interested in fire prevention, and in making arrangements which will best assist those interested persons in bringing others to a realization of the great importance of this movement to the whole community.

Fires are usually caused through carelessness, rarely by viciousness, almost always through ignorance. Education is, therefore, a prime necessity. Naturally, property owners are most vitally interested. The railway companies are large property owners. Their trains must travel by day and by night through districts in which vegetation is often so dry that fires may easily start from a spark from the locomotive smoke stack, from a live coal from the fire-box, from a lighted cigar or cigarette stub, or even from the sun's rays on the curved surface of an empty bottle, or other bit of glass. Tramps and other trespassers on railway property are very often responsible for setting fires.

Enforcement of existing laws against trespass would undoubtedly result in preventing a large percentage of the fire loss. Not only tramps, but hunters, campers and children are frequently careless in lighting and neglecting fires, which spread and cause much damage. An organization for the prevention of fire along railway rights-of-way may be perfected in much the same way as the "safety first" organization. The employees of every department should be interested and their minds kept alive to the importance of this kind of safety. The necessity for faithfulness in carrying out instructions, for being ever on the alert, for keen observation and for prompt action all along the line by all members of the organization is evident.

Operating, mechanical and track department employees and officers of railways are often able to detect and assist in stopping fires. Bridge and building department officers and employees also may have much to do with fire prevention. All employees riding on trains and on inspection cars may at times do valuable service in observing and reporting fires and inflammable material which may cause fires. In most cases freight and passenger trainmen are able to tell when locomotives are setting fires. It is easy to distinguish between fires starting by sparks from the smoke stack and those starting from live coals from the fire-box of a locomotive, especially when looking from the rear of a train. The nettings in stacks should be inspected after each trip of a locomotive. The dampers of fire-boxes should be watched and the shaking of locomotive fires properly controlled. There are certain steep grades on nearly every railway where the danger from fire resulting from locomotives working with ports open is especially grave. These localities should be marked for special treatment by all concerned.

Most railway right-of-way is 50 ft. wide on each side of the center of the single main track. If there is more than one track the right-of-way between the track and the boundaries is even more restricted. Fire cannot ordinarily gain much headway in the 20 to 40 ft. between the grass line and the right-of-way limit. Therefore, it is a wise precaution to clear or plow suitable fire paths at the right-of-way boundaries. This work involves considerable initial expense, but the expense of maintenance is not great after the first year. A path 6 ft. wide is considered reasonably safe. Where plowing is possible it is effective and comparatively cheap. In some places the grass must be hoed or shoveled away. Vegetation-destroying liquids are sometimes used to keep fire paths clear of grass and weeds, with good results.

Some state laws demanding the mowing of grass and weeds on railway right-of-way are unfair and illogical, and indirectly cause many railway grass fires. It is almost impossible to rake grass clean from the stubble after mowing. It is suggested that if these laws were changed to include only the cutting of noxious weeds and the mowing and back-firing from 6-ft. strips along the shoulders of banks and cuts and along right-of-way boundaries, the best results might be obtained. Growing grass is less inflammable than stubble and wisps of dry hay. Trackmen know this and they ordinarily mow inside the fence lines first. As soon as this grass is dry it is fired where it lays, with the first favorable wind. With the wind blowing toward the track there is no trouble nor danger in thus providing with little expense an effective fire path which will last for a season. Plowing and back-firing are methods of fire protection known to and practised by settlers since the earliest days of western emigration, and now extensively practised by the government forestry department. High winds during protracted seasons of hot, dry weather are conditions most to be feared. Track patrol at such times by night and by day is effective and desirable. The shovel is the fire fighters' best weapon. Earth or sand thrown on the flames is very effective in stopping an advancing grass or forest fire, when water is not available.

It is possible and necessary to remove most inflammable material from railway premises. Chips, grass, refuse timber, driftwood, oily waste and all other refuse should be cleaned from the foundations of bridges, especially wooden structures. Ballast floors and fireproof paint on bridges are fire preventives. Water barrels should be kept filled and fire buckets provided wherever needed at bridges and buildings. Hand grenades and fire extinguishers in trains are often of service in quenching fires along the line.

The practise of placing water barrels on the roofs of buildings is considered wrong, for most fires do not start at the top of a house, but at the base. The water barrel is better placed on the ground near the building and at the foot of a ladder leading to the roof as a better point from which to quench a fire. The ladder should be placed at an easy angle for use. Water-soaked blankets, jackets or any heavy cloth articles are valuable to smother a fire.

Locomotive fire apparatus is especially valuable. A locomotive equipped with 50 ft. of hose and a suitable nozzle may be used effectively to fight forest fires. Many locomotives are so equipped on logging railways, where the slashings formed by woodsmen who leave felled tree tops in the woods cause many fires.

Every railway employee should be always on the lookout for fires. Every smoke should be investigated. Section and extra gangs and crews of logging trains, work trains and way freights should be instructed to assist and co-operate actively in fighting fires, not only on the right-of-way, but in the immediate neighborhood where conditions permit.

If railway employees help residents to fight fires, the residents usually reciprocate to their mutual benefit. During times of special fire danger, lookout towers at favorable locations are valuable. Signal masts frequently serve this purpose for section foremen, who should then

patrol their sections both morning and evening. Warnings in trains and stations against the careless throwing away of matches and lighted cigars and cigarettes and glass; bulletins and rules against the opening of grates and the use of locomotive fire shakers while running. will help prevent fires. All observers should note in writing the date, time of day, place, direction of wind and the relative location of fire and railway property, as soon as a fire or distant smoke is seen; for many fires are blamed on railway locomotives which in reality start far off the railway property and from other causes. A wetted finger held up will give the exact direction of the wind to a person standing still. It takes but a few moments to jot down the observations. The value of such notes, promptly forwarded to the proper officer, is often of great importance. These written records frequently are of use in lawsuits arising from fire claims, months after the occurrence. When it is generally known that a railway company requires such records kept, the number of fire claims will dwindle perceptibly.

When a fire occurs in spite of all precautions, prompt investigation with disinterested witnesses is of the utmost importance. Many suits against railway companies are lost by the railways because of lack of prompt investigation and proper witnesses. All officers and employees who observe fires or danger of fires and who are not able to do active service in remedial work on account of other duties should immediately report the observation to the nearest section foreman and operator. It should be the operator's duty to report at once to the chief despatcher. It is the section foreman's duty to get to the fire or danger with his men, car and tools as quickly as he can, whether on his section or the adjoining section.

Night fire patrols result in much benefit in times of stress. Extra gangs may work a certain number of men at night, with train and extra train crew to good advantage. Night track walkers are frequently necessary on account of fire danger.

Old ties should not be burned in dry weather. No more than 40 to 50 ties should be piled together for burning, nor should any such fire be allowed to burn after night. To this end all tie fires should be lighted early in the morning and quenched with earth or otherwise in the afternoon.

Close watching, well organized and faithfully carried out is more than half the battle.

THE PRACTICE ON THE VARIOUS RAILROADS

That "an ounce of prevention is worth a pound of cure" is an axiom which cannot be improved upon, when considering the subject of fire prevention, and it is the practice of railroads generally to take precautions which will tend to prevent the starting of fires from the sparks from locomotives, abandoned fires on the right-of-way, discarded cigarettes, etc. On many roads the measures taken are outlined in printed circulars. In some cases it has been found advantageous during periods of dry weather, to send out these circulars repeatedly, warning the section foremen of the precautions which the dry weather makes especially necessary. On the Illinois Central inspections are made semi-annually by a fire inspector and various maintenance officers.

Vigilance in fire prevention must be directed toward two definite ends, one to eliminate as far as possible all sparks or other sources of fires, second to put the rightof-way and its contents in such condition that they offer a poor field for the starting of a fire from any source.

To eliminate sparks, every effort must be made to keep front-end screens in good condition and to enforce strict rules for the operation of ash pans. The condition of spark arrestors on the Bangor & Aroostook is checked by requiring the section foreman to include in his fire report message the words "examine ash pan of engine" or "examine netting on engine," in any case where he believes that the fire was started from either of these sources. Roads in the southwest find that the fire hazard is very much less in the case of locomotives burning oil as a fuel. On 485 miles of main track on the Canadian Pacific operated by oil-consuming locomotives, in no case has a fire been attributed to the locomotives.

The most favorable condition for the starting of fires from sparks or other sources is obtained when the grass and other vegetation on the right-of-way is dry enough to burn. From this follows the general practice of cutting or burning the vegetation on the right-of-way just as soon as it becomes dry enough to make it necessary or desirable. On the Chicago & North Western it has been found expedient to mow the right-of-way at about the time that the small grains mature in the adjoining fields.

On the Union Pacific it is customary to require the track laborers to remove the shocks of grain to a distance of at least 250 ft. from the tracks during the time that the grain is being cut. Weeds on the right of way are cut, beginning about the middle of June, the work being done by the track forces, assisted by teams and men hired in the locality. As soon as the weeds are dried sufficiently they are burned whenever the direction of the wind permits.

Fires in the vicinity of wooden bridges or trestles are especially dangerous because of the opportunity for the destruction of the bridge. This makes it imperative to keep all weeds, brush and rubbish away from the supports for such structures. It is, of course, a univer-al rule to provide water barrels and keep them full.

OUTSIDE ASSISTANCE

The railroads must not only organize to obtain the requisite vigilance on the part of their employees, but a certain amount of co-operation with the adjoining property owners and governmental authorities is also requisite to secure the desired end. As the sparks from locomotives may be oftentimes carried beyond the rightof-way, the burning of grass inside the fence line does not always suffice. For this reason some roads have endeavored to obtain permission from the farmers to burn grass or plow furrows in the adjoining fields at a sufficient distance from the track to prevent fires. Occasionally it is possible to get the farmers to do a portion of this work themselves. Sometimes they are given old ties suitable for firewood as payment for this work. This co-operation is not always readily secured, for, in the words of one railway officer, "there are some owners of property adjacent to railroad track who will not agree to anything which would reduce the value of their holdings as sources of claims for damage alleged to have been caused by locomotive operation."

STATE REGULATION

Some states have laws which are designed to assist the railroads in their efforts to prevent fires. Such a law was passed in the state of New Jersey in 1909, which required that a strip 10 ft. wide and 100 ft. from the nearest rail must have every particle of vegetation of inflammable nature removed, and that between this safety belt and the railroad the ground was to be cleared of grass and brush by mowing or burning or both, while trees were to be trimmed of branches six feet above the ground. Unfortunately this law was declared unconstitutional, but the Pennsylvania Railroad continues to carry out the spirit of this law wherever it can obtain the voluntary co-operation of the property owners.

The laws of New Jersey also require that a permit be

issued by a fire warden to burn old ties, grass, etc., on the right of way. For the sake of convenience in applying this law the Lackawanna has had its section foremen appointed fire wardens to serve in that capacity without any additional compensation.

The Dominion of Canada has very extensive regulations governing matters such as the use of fire protective appliances on locomotives, the regulation of fuel, the construction and maintenance of fire guards, the clearing of right of way, and the establishment of a special patrol of the railway lines in the forest sections from April 1 to November 1, as specified by the chief fire in-spector of the Board of Railway Commissioners. Each year the chief fire inspector of the board issues a circular prescribing the fire guard requirements in the prairie provinces and also issues a statement setting forth the fire patrol required. The government has inspectors on duty to see that these requirements are complied with. The regulations also cover the manner in which a track in forest sections shall be patrolled, but the inspectors have the power to waive the patrol when the conditions make it unnecessary.

The state of Maine has a law providing for the appointment of chief fire wardens and deputy wardens, some of the latter being assigned to patrol the tracks of all the railroads in the state the salaries of such wardens being paid by the railroad companies. The Bangor & Aroostook has been able to increase the efficiency of this system through a plan whereby the railroad hires these men subject to the approval of the deputy fire warden, the men being employed in the section gangs at such time as there is no danger of fire. It is the duty of these deputy fire wardens to patrol the railway track and watch for fires which they fight, whenever discovered, with the assistance of track forces.

FIRE FIGHTING

Having taken every precaution to prevent the starting of fires, the next important provision is for the discovery of the fire at the earliest possible moment after it starts. This is carried out by patroling the track by special officers as in the case of the state of Maine or by the regular track forces. Ordinarily this work is necessary only at such times or periods when the vegetation is in a condition to ignite readily. The train and engine crews are commonly enlisted in this work by instructing them to notify the section foremen as they pass by of any fires that they have noticed in coming over a section. On some roads this is facilitated by furnishing the engine and train crews with what are known as fire cards which are thrown off to the section crews or station agents, with blanks filled out to show the location of the fire.

The actual fire fighting must be done by the track forces except in such cases where the fire is sufficiently close to engine terminals or shops to permit the mechanical forces to be called out. Section foremen are always instructed to disregard their section limits in cases of fire and to send their crews on to adjoining sections whenever necessary.

Water ordinarily not being available, the fires must be extinguished by beating with limbs of brush or wet sacks tied to the end of a shovel. Where the vegetation is thin, it is often possible to throw sand or dirt on the fire. On the Pennsylvania Railroad ballast forks are found to be effective in the pine woods of the Delaware sand plains, while water alone is effective among the rocks of the Pennsylvania hills. Whenever a fire assumes dangerous proportions it may be necessary to plow a furrow at the head of it and burn back on the windward side of the furrow.


In Canada each patrolman in fire inspection service is required to have one shovel and one canvas bucket. Patrolmen equipped with velocipedes or power cars are required to have two shovels, two buckets and one ax, and in addition each regular section gang must be equipped with an ax, two mattocks and four buckets, to be stored in the tool house.

On the lines of the Southern Pacific in the Sierra Nevada mountains, where it is necessary to protect the snow sheds, four special fire trains are maintained fully manned and always under steam. All switch engines of this company are equipped with fire hose and either pumps or inspirators, and it is the practice to keep tank cars filled with water at a number of central points to be used in connection with the switch engines.

Administration of Claims

As claims are almost invariably presented against the railroad company for a fire which takes place within any reasonable distance of the right of way, it is necessary that the claim department be furnished with all available information relative to the nature of the fire, the circumstances surrounding its occurrence which would throw any possible light on its cause and a thorough inventory of the extent of the damage. To this end the section foremen are required to make out reports of fires on blank forms designed to guide them in giving the necessary information. In some of these reports, aside from calling for all possible evidence as to the cause of the fire and the extent of the damage, an opportunity is given for the foreman to give his personal opinion as to these questions. At the same time the foremen are usually cautioned not to give out any information particularly as to the cause of the fire to unauthorized persons.

On the Pennsylvania Railroad more expert data is obtained in the case of forest fires by requiring the forester to appraise the damage. This results in a forest survey for the purpose of ascertaining the composition of the wood with figures on the rate of growth, volume and yield in material and money. If a settlement is not made the man who made the appraisal may be called upon to testify as an expert in any suit leading from the damage claims.

On the Union Pacific the precaution is taken to measure and locate all hay and grain stacks within $\frac{1}{2}$ mile of the track on both sides of the right of way. Thus accurate information is available in advance of any fires. On the Canadian Pacific a rough sketch of the general location of fires accompanies the evidence gathered. If it is concluded that the company's liability is clear, steps are taken to ascertain if the claimant carried any insurance and the amount of compensation recoverable from the company is reduced by the amount of insurance carried. The value of the property lost is also estimated very closely, taking into account the market price in the case of grain and deducting the cost of cutting, thrashing and marketing. The Southern Pacific maintains a very close account of fire losses. Out of a total of 214 occurring during 1914 the company was charged with having caused 64 per cent and credited with extinguishing and assisting to extinguish 83 per cent. Of the total loss from these fires, 71 per cent fell upon the company in the form of claims paid or from the destruction of fences, ties and other company property.

Considerations in Guard Rail Design

BY JAMES G. WISHART,

Office Engineer, Chicago, Rock Island & Pacific, Chicago, Ill.

THE diversified details and dimensions of frogs, switches, guard rails, etc., adopted by different railroads or advocated by the various manufacturers, have resulted in a direct increase in the cost of these articles to the railroads and in delays in deliveries. These delays are especially noticeable when orders are placed during rush periods in the manufacturer's shop. This variation in design is specially prominent in the standard plans of guard rails which have been adopted by the various railroads. Lengths varying from 7 ft. 6 in. to 25 ft. are in actual use at the present time. The 15-ft. length has been the most commonly used, with the 10 and 11-ft. lengths gaining in favor since the adoption of 33-ft. rails. The shorter lengths of 7 ft. 6 in. and 8 ft. 3 in., while of comparatively recent design, are proving equally as efficient in the track as the longer ones. Their cost is a third less and a greater number are obtainable from the same quantity of rail. The method of fastening the guard rail in its proper position also varies to a great extent. Combinations of from four to eight bolts with solid or adjustable fillers and with the addition in some cases of one or two guard rail clamps, are in common use.

There is apparently no good reason for such a wide divergence of practice. The principal reason is probably personal equation, or possibly a desire for individuality, on the part of those responsible for the plans on the different railroads. It would appear as a reasonable assumption that a track appliance which proves itself satisfactory for one railroad whose equipment and volume of traffic are above the average, should serve equally well on any other road in the same section of the country.

A guard rail is defined by the track committee of the American Railway Engineering Association as "A rail or other device to guide the wheel flange so that it is kept clear of the point of frog." This describes briefly and definitely the principal function of this appliance. The frog point itself is protected by the straight portion, generally placed in the center of the guard rail, the wheel flanges being drawn gradually to the proper position, relative to the frog point, by the flared portion at each end. The wheel flange should also be guided across the diverging throatways immediately ahead of the point. Therefore, the distance from the point of frog across this diverging throatway to the point where the flangeway is of normal width is what governs the length of the straight portion in the center of the guard rail.

This distance varies from $13\frac{1}{2}$ in. in a No. 6 frog to 45 in. in a No. 20 frog. As very few frogs of a flatter angle than No. 11 are in general use, it would appear that a guard rail with a straight center portion 30 in. in length is ample to protect all frogs up to a No. 11, and one with a straight center portion 39 in. in length for all frogs up to a No. 16. As frogs of an angle flatter than a No. 16 are more or less of a special character and are used only in very high speed turnouts; they should be protected by specially designed guard rails.

The flare ends should be straight, not curved, and the angle of divergence as flat as practical. The distance of

4 in. between the heads of running and guard rails at the end of the guard rail is ample to give proper and safe clearance for the wheel flange when entering the guard rail flangeway and a length of 2 ft. 6 in. along the flare produces a rate of divergence of approximately 1-16 in. in 1 in. The straight flare end offers less resistance to the moving wheel flange than a curved one and consequently makes a smoother riding guard rail. The 2-ft. 6-in. flare ends with a 30 or 39-in. center straight portion provide a guard rail that will give ample protection and is an economical length.

The accompanying plans of guard rails have been designed with the above objects in view, the lengths being such that 4 of the 8-ft. 3-in. lengths may be cut from a 33-ft. rail and 4 of the 7-ft. 6-in. lengths from a 30-ft. rail. This, of course, will not work out in every instance as shorter length rails may at times, for special reasons, be more desirable for this purpose. Assuming that 33-ft. rails are of the heavier sections and consequently in use in main tracks where there is a heavy traffic, the 8-ft. 3in. guard rail shown was designed with an adjustable center filler and heavy yoke or clamp. By means of the adjustable filler, 11/8 in. of side wear on the head of the guard rail can be taken up or the flangeway can be widened where turnouts are installed on sharp curves and the curvature is carried by the frog point and the gage is widened.

The clamp as a guard rail fastening is rapidly gaining in favor, every year adding to the number of additional companies who approve its use. The strength of these clamps is such that bolts at the center of the guard rail or rail braces are unnecessary except in extreme cases. The heavy yoke of heat-treated steel or refined iron as designed at the present time, gives a maximum strength at the point where the greatest holding power is required. An extremely low percentage of clamp failures has been recorded since the introduction of the modern designs. The lateral thrust of the wheels tends to overturn the guard rail and to overcome this with bolted guard rails the rail brace is often resorted to with indifferent success. The clamp overcomes this difficulty without the aid of rail braces.

The ease with which guard rails with clamps are installed is another point in their favor. The design shown is applied with the drilling of but two holes in the main rail, a pair being applied easily in one-half hour by three men. The proper method of applying the clamp should



THE 7-FT. 6-IN. GUARD RAIL

be strongly impressed on the trackman, as this appliance is not fool-proof, although its proper application is simple. The points to be observed are: first, its position relative to the frog point, that is, 10 in. ahead of it or toward the toe of the frog; second, its position with relation to the running rail, that is, at an angle of 90 deg. to the gage line, and third, to see that all fillers are tight, this being accomplished by driving the wedge filler in firmly and inserting the fastening to prevent retroaction. The end fillers are of cast iron and are designed to serve as foot guards as well as separators. The bolts through these fillers should be of the diameter shown in the table and to withstand the excessive stresses caused by blows from wheel flanges traveling at high rates of speed, should have a tensile strength of not less than 100,000 lb. per sq. in. and be made of a special alloy or heat-treated steel.

The 7-ft. 6-in. guard rail shown is designed on the theory that 30-ft. rails are of the lighter sections and are



consequently used in a majority of cases where the traffic is comparatively light, principally in side tracks. For this class of service the two bolts at the center are generally satisfactory and efficient as a means of holding the guard rail to gage and at a lower cost than the clamp. These bolts as well as those at the end should be made under the same specifications as those for the 8-ft. 3-in. guard rail. The solid center filler does not allow of any variation in the width of the flangeway and in cases where such adjustments are necessary, the clamp and adjustable filler should be used. In cases of heavy traffic the clamp should be applied in place of the center bolts.

Plates $\frac{5}{6}$ in. thick and 8 in. wide should be used on all ties with both of the designs shown. These plates are a material aid in holding the rails to proper gage as well as protecting the switch ties.

The standard distance between backs of wheels as adopted by the Master Car Builders' Association is 4 ft. $5\frac{1}{8}$ in. The distance from the gage of the running rail to the back of the wheel, when in normal position, is 1 11-16 in. Allowing 3-16 in. for the clearance between the back of the wheel and the inside face of the guard rail, a flangeway of 17% in. is required. This makes the distance between inside faces of guard rails 4 ft. 434 in., and this distance must be maintained in all cases. If the track gage is widened at the frog point, the full amount of widening must be added to the guard rail flangeway, as the flangeway in the frog cannot be altered. If this is not done derailments will occur. Many trackmen do not appreciate the importance of this rule and it should be strongly impressed on them when the adjustable fillers are adopted.

The designs presented herewith are thought to be economical, both in construction, installation and maintenance, and to fulfill all requirements.

Uniform standards for frogs, switches, guard rails and other track appurtenances if adopted by all the railroads of the country, or even by groups of railroads purchasing track material at a common market, will result eventually in material economies both for themselves and for the manufacturers.

"Hopping" Trams—Through its safety committee, the Nashville, Chattanooga & St. Louis has inaugurated a campaign against "train hopping." Within the past two weeks two boys have been crippled while trying to catch rides on freight trains of this railroad. Arrests have proved only a temporary preventative.



RAILWAY ENGINEERING ASSOCIATION WORK

The Subjects Assigned to the Committees for Investigation This Year with the Chairmen of Committees

THE work outlined for the various committees of the American Railway Engineering Association for the ensuing year, together with the chairmen of the different committees, is given below. Although this schedule has just been announced in its entirety, the different committees were advised of the subjects assigned to them for investigation some time ago and they are now actively engaged in their work. As will be noted, a number of these subjects will necessarily be continued over more than one year and it is not expected that complete reports will be presented upon all of them at the approaching convention.

1. ROADWAY

W. M. DAWLEY, assistant engineer, Erie, New York, N. Y.

Continue the study of unit pressures allowable on roadbeds of different materials, co-operating with the special committee on Stresses in Railroad Track.

Report on the prevention and cure of water pockets in roadbed. Report on advisable slopes for high rock cuts 40 ft. in height or more.

Report on advisable width for newly-constructed roadbeds on high embankments of 50 ft. or more.

Report on the advantages and disadvantages of track elevation and track depression in cities where many street crossings make it necessary to change the grade of the railway.

Report on the advantages and disadvantages in depressing or elevating streets where a few crossings are to be eliminated with but slight changes in the grade of the tracks.

Report on the effect of fast trains on the cost of maintenance of way and maintenance of equipment.

2. BALLAST

H. E. HALE, group engineer, Presidents' Conference Committee on Valuation, New York City.

Report on ballast sections, with particular reference to the use of sub- and top-ballast.

Define sub- and top-ballast.

Report on the proper depth of ballast of various kinds to in-sure uniform distribution of loads on the roadway, conferring with the special committee on Stresses in Railroad Track and the committee on Roadway.

Report on methods and cost of applying ballast, with especial reference to the following plans: (a) Organization of the most economical ballast gang of railway company forces. (b) Use and limitations of mechanical tools, such as the pneumatic tamper and spreader for forming shoulder and path. (c) Application by contract.

Report on the comparative merits of different stones and gravel and other materials for ballast.

3. Ties

L. A. Downs, general superintendent, Illinois Central, New Orleans, La.

Continue the study of the effect of the design of tie-plates and track spikes on the durability of cross-tics. Submit specifications for cross- and switch-ties:

(a) When used without preservative treatment. (b) When to be used with a preservative liquid. Report on trials of metal, composite and concrete cross-ties,

and give results to date.

Report on future timber supply for ties, both domestic and foreign.

4. RAIL

JOHN D. ISAACS, consulting engineer, Southern Pacific, New York City.

Submit definite recommendations for changes in the Manual, giving special attention to the rail designs recently adopted, and

to the specifications for carbon steel rails and joint bars Present annual statistics of rail failures and draw conclusions

therefrom. Report on the effect on rails of defective equipment and im-

proper maintenance.

Continue the special investigation of rails.

Report on track bolts and nutlocks.

Report on details of manufacture and mill practice as they affect rail quality.

Make a critical study of joint bars from the standpoint of design and material, together with laboratory tests, including strain gage measurements, after having established a uniform method for comparative testing.

Report on the relative values of material for joint bars, quenched only versus quenched and tempered, and whether it is most advantageous to quench in oil or water.

Report on the rational relation between the intensity of pressure due to wheel loads and the resistance of rail steel to crushing and deformation.

Continue the investigation and development of methods of inspection.

Report on federal and state commission rulings.

5. Track

G. J. RAY, chief engineer, Delaware, Lackawanna & Western, Hoboken, N. J.

Continue the study of the economics of track labor.

Report on specifications and submit designs for cut- and screw-spikes.

Report on guard rails and flangeways and the effect of an increase of 1/8 in. thickness of wheel flanges.

Report on typical plans of turnouts, crossovers, slip switches and double crossovers, and prepare detail plans for such work, including such incidentals as the plates, rail braces, riser plates, etc., conferring with the committee on Signals and Interlocking.

Report on the design of and specifications for manganese frogs and crossings.

Report on the reduction of taper of tread of wheels to 1 in 38 and on canting the rail inward.

Confer with the committee of the Master Car Builders' Association with a view of reducing the present allowable limit for flat spots on freight car wheels.

Report on the test of tie plates subject to brine drippings.

Report on the limit of wear on the rail head on curves.

Report on specifications for relayer rail for various uses.

Report to the extent the frog and switch designs recommended by the Association are being used by railways. Report on definition of "main track."

6. Buildings

M. A. Long, assistant to chief engineer, Baltimore & Ohio. Baltimore, Md.

Report on coaling stations. Report on freight house and passenger station scales.

Report on ash pits.

Report on a classification of buildings on the basis of "Speci-fication-Types" and upon the use of the "cubic foot," "square foot," and "bill of particulars" methods for ascertaining the approximate cost of new construction.

Report on safety tread devices for stations exposed to the elements.

Report on the general subject of roadway buildings.

Report on the design and merits of high and low platforms at passenger stations.

Report on the design of shop buildings. Report on comparison of "umbrella" versus "butterfly" sheds at through stations.

7. WOODEN BRIDGES AND TRESTLES

E. A. FRINK, principal assistant engineer, Seaboard Air Line, Norfolk, Va.

Report on the design of docks and wharves, including floors; likewise coal and ore wharves.

Report on the comparative merits of ballast deck and reinforced concrete trestles, taking into consideration the design of ballast floors for timber trestles.

Continue the study of the use of lag screws in trestle construction.

Report on the classification of wooden bridges.

Report on the merits of galvanized iron fastenings for timber trestles as compared with plain iron and steel fastenings. especially in relation to their use on creosoted structures.

8. Masonry

F. L. THOMPSON, assistant chief engineer, Illinois Central, Chicago, Ill.

Report on the cost and method of constructing concrete piles, and make recommendations on how and where to be used. Present additional typical designs for concrete piles for different loading and rules for driving under various conditions and load-

ing. Report on the cost, appearance, and wearing qualities of various methods of surface finish for concrete.

Report on typical designs of foundations for piers, abutments, retaining walls, and arches in various soils and depth of water (not including pneumatic foundations)

Report on principles of design of plain and reinforced retaining walls and abutments.

Report results of work with the joint committee on Standard Specifications for Cement.

Report results of work with the joint committee on Concrete and Reinforced Concrete.

Report upon the wisdom of the use of blast furnace slag in reinforced concrete work, taking into especial consideration its probable duration.

9. SIGNS, FENCES AND CROSSINGS

W. F. STROUSE, assistant engineer, Baltimore & Ohio, Baltimore, Md.

Report on the subject of "Signs" and the principles of design and rules for their use.

Report on the concrete fence posts.

Report on the reduction of the number of roadway signs and the adoption of a standard sign for general use as far as possible. Study in this connection, in collaboration with the committee on Signals and Interlocking, the design of suitable day and night (if necessary) markers or signs for switch signals, derail switches, stop posts, slow posts, resume-speed posts, water station and track-pan markers, highway crossing signals, etc. Also consider the location of signs, having in mind the matter of safety of employes obliged to use the roadway.

Report on legal requirements relative to the provision of fences for right-of-way and of stock-guards.

Report on the classifications of fences into "types." Make a comprehensive study of crossings: (a) Grade crossings: Crossing gates, crossing signal bells, warning signals, watch houses.

(b) Overgrade and undergrade crossings: Study the laws of the various states which affect the distribution and cost between the carrier and the public. Study the economic design of overhead bridges to meet the requirements of public service commissions and other governmental bodies.

10. SIGNALS AND INTERLOCKING

C. C. ANTHONY, assistant signal engineer, Pennsylvania Railroad, Philadelphia, Pa.

Continue the study of economics of labor in signal maintenance.

Report on the problem of signaling single track roads with reference to the effect of signaling and the proper location of passing sidings on the capacity of the line. Report on specifications adopted by the Railway Signal Asso-

ciation, which, in the judgment of the committee, warrant con-sideration, conferring with the committee on Track on any appliances affecting track.

Report on requisites for switch indicators, including method of conveying information as to the condition of the block to the conductor and engineman.

Report on the desirability of having an overlap in automatic signaling; if so, is it best to have two stop indications between trains or two caution indications instead, or the latter in special cases only, such as on downgrade tracks?

Report on the various methods of giving signal indications other than by means of the semaphore (this includes the light signal for day and night indications).

Report on the feasibility of separating into distinct types of their own (1) the signals for train operation, and (2) the markers or signs which indicate the location or position, or both, of information signs and switch signals for conveying information to trainmen. The semaphore is now almost universally used for governing train operation, therefore design suitable day and night (if necessary) markers or signs for switch signals, derail switches, stop posts, slow posts, resume-speed posts, water station and track-pan markers, highway crossings, signals, etc., conferring with the committee on Signs, Fences and Crossings.

Analyze the signal schemes which have been presented to the Association. State specifically for what purpose each aspect and indication shall be used and what action on the part of the engineman is required.

Report on automatic train control.

Report on the comparative merits in various locations of alternating current and direct current for operation of automatic signals.

Report on applications of aspect for instructions to trains to take siding at a non-interlocked switch.

11. Records and Accounts

W. A. CHRISTIAN, senior civil engineer, Division of Valuation, Interstate Commerce Commission, Chicago, Ill. Report on the use of small forms on cardboard or other suit-

able material for use of field men in making daily reports, to the end that supervision may be facilitated and efficiency encouraged.

Report on the Interstate Commerce Classification of "Invest-ment in Road and Equipment" and "Operating Expenses" and report on any desirable changes.

Report on the various methods of reproducing maps and profiles on tracing linen for permanent record.

Report on the problem of recording and reporting the cost of additions and betterments.

Submit specifications for maps and profiles, co-ordinating with previous work of the Association.

Report on the valuation forms now in use and recommend forms for both field and office use.

12. Rules and Organization

C. DOUGHERTY, chief engineer, Queen & Crescent, Cincinnati, Ohio.

Prepare a "Manual of Instructions for the Guidance of Engineering Field Parties.

Continue the study of the science of organization. Prepare a "Manual of Rules for the Guidance of Employes of the Maintenance of Way Department."

13. WATER SERVICE

A. F. DORLEY, engineer maintenance of way, Missouri Pacific, St. Louis, Mo.

Make a final report on the design and relative economy of track pans from an operating standpoint.

Report on methods for rejuvenating driven wells and the cost and success, as compared with driving new wells. Report on the various types of well strainers in use and the

service secured from each type.

Report on methods for complying with Federal regulations in regard to purity of drinking water supplied to the public and employes on interstate trains.

Report on designs of impounding reservoirs, and the conditions under which they are economical.

Report on the relative merits of continuous and intermittent water softeners.

Report on rules or examination questions for the care of boilers in pumping stations.

14. YARDS AND TERMINALS

E. B. TEMPLE, assistant chief engineer, Pennsylvania Railroad, Philadelphia, Pa.

Report on the handling of freight in double-deck freight houses and the cost of operation.

Continue a study of typical situation plans for passenger stations and approaches and on methods of their operation.

Report on classification yards.

Make a final report on track scale specifications.

Report on a suitable profile for hump yards.

IRON AND STEEL STRUCTURES 15.

A. J. HIMES, engineer grade crossing elimination, New York, Chicago & St. Louis, Cleveland, Ohio.

Report on methods for the protection of iron and steel structures against corrosion.

Report on the relative economy of various types of movable bridges.

Report on secondary stresses and impact.

Report on column tests.

Report on the design, length and operation of turntables.

Report the present practice in construction of ballast-floor bridges and methods in use for waterproofing the same.

16. ECONOMICS OF RAILWAY LOCATION

JOHN G. SULLIVAN, chief engineer, western lines, Canadian Pacific, Winnipeg, Man., Can.

Report on the resistance of trains running between 35 and 75 miles per hour.

Report on the effect of curvature on the cost of maintenance of way and of the maintenance of equipment.

Report on the effect of train resistance on the amount of fuel consumed.

After the study of the effect of the various physical characteristics of railroad locations upon their economy of maintenance and operation has been made, if it is possible to do so, state the conclusions derived from these studies in a formula, or series of formulas, which can be used by engineers in determining the relative efficiency of various locations.

Report on the entire question of economics of location as effected by the introduction of electric locomotives.



Report on the extent the locating engineer is justified in making additional expenditures in getting nearer to medium-size centers of population already in existence in the territory where the road is to be built.

17. WOOD PRESERVATION

EARL STIMSON, engineer maintenance of way, Baltimore & Ohio, Baltimore, Md.

Report on water in creosote.

Report on the relation of the amount of preservative and the depth of penetration to the resistance of materials against decay, and also the penetration of preservatives.

Report service test records, extending them to include structural timbers.

Report on the drying process in wood preservation.

Report on methods of accurately determining the absorption of creosote, and upon the temperatures used in the creosoting process.

Report on the results of the exposure tests of material treated with water gas tar.

18. Electricity

GEORGE W. KITTREDGE, chief engineer, New York Central, East of Buffalo, New York, N. Y.

Report on the subject of clearances of third rail and overhead structures, conferring with other committees.

Report on the study of electrolysis and insulation and its effect upon reinforced concrete structures.

Report on the study of maintenance organization, and relation to track structures.

Report on the proper type of overhead catenary construction, with particular reference to the consideration of providing clear vision for signals, co-operating with committee on Signals and Interlocking.

Report on water power for electrical railway operation, in collaboration with committee on Conservation of Natural Resources. Report recommended practice for eliminating, as far as is

practicable, the interference with telephone and telegraph cir-cuits caused by the use of 25-cycle propulsion circuit.

Report on the interference with telegraph and telephone circuits caused by the use of a direct-current propulsion circuit and methods of eliminating this effect as far as is practicable.

Continue co-operation with national joint committee on Electrolysis and the national joint committee on Overhead and Underground Line Construction.

> CONSERVATION OF NATURAL RESOURCES 19.

R. C. YOUNG, chief engineer, Lake Superior & Ishpeming, Marquette, Mich.

Continue the study of tree planting and general reforestation. Report on developments in methods of lumbering and forestry tending to prolong the timber supply.

Collect statistics on extent of use of treated timber and of permanent materials to replace untreated timber and bare steel. Report on the conservation and utilization of water power for

railway purposes, conferring with Committee on Electricity. Report on the study of coal, fuel-oil, timber, iron and steel resources

Report on the relation of railways to the different conservation projects, reviewing work that has been done by each company up to the present time, and make recommendations on policies economical for railways to follow.

UNIFORM GENERAL CONTRACT FORMS

E. H. LEE, vice-president and chief engineer, Chicago & West-

ern Indiana, Chicago, Ill. Report on forms of agreements for industry tracks. Report on forms of agreements for interlocking and railway crossings, conferring with the committee on Signals and Interlocking, including the rights and obligations of the interested companies.

Report on a form of agreement embodying rules governing the construction of undercrossings of railways with electrical conductors, conduits, pipe lines and drains, conferring with the committee on Roadway and the committee on Electricity.

Report on a form of lease agreement for industrial site.

21. GRADING OF LUMBER

DR. HERMANN VON SCHRENK, consulting timber engineer, St. Louis, Mo.

Report on classification and grading rules for all lumber and timber used in the construction and maintenance of way departments of railways.

Report on specifications for construction timbers and building lumber.

From these studies draw up in a unified form a set of specifications for construction timbers and building lumber for use on railways, showing each kind and quality of lumber or timber which is suitable for each of the different classes of work on a railway.

Report on specifications for timber which is to be treated with preservative substance, co-operating with the committee on Wood Preservation.

22. STRESSES IN TRACK

A. N. TALBOT, professor of municipal and sanitary engineering. University of Illinois, Urbana, Ill.

Simple Methods of Collecting Scrap

BY J. B. BAKER,

Supervisor, Pennsylvania Railroad, Philadelphia, Pa.

CCELERATION in all lines of business means an increase in worn-out materials for the scrap bins, and in no industry is this more marked than in railroad maintenance. Shop and maintenance scrap is generally centralized at points where electro-magnets



FIG. 1. LOADING SCRAP WITH SHOVELS

may be used to advantage, but to handle scrap at outlying points some means more economical than a magnet is desirable.

The customary procedure, as shown in Fig. 1, is to concentrate the discarded material in piles near mile posts, whistle boards or other distinctive locations, to be picked up by work-train gangs, who use ballast forks for small scrap and carry the larger pieces. It required three minutes from stop to start of the train for 17 laborers to load a ton of scrap in this manner.

On one of the main line divisions of the Pennsylvania Railroad a derrick, shown in Fig. 2, has supplanted this procedure. The derrick is a No. 3 American rail loader. operated by an air cylinder connected to the main reservoir of the locomotive. The safe capacity of the machine is about 4,000 lb. at a 26-ft. radius, which permits operation over an intervening track. The boxes to contain dirt or other material were made of 134-in. plank and are 4 ft. by $4\frac{1}{2}$ ft., with two sides and a back 10 in. in height. One end is left open for ease in dumping when the ring which holds the finger of the front hook is struck upward, thereby releasing the single chain and causing the box to swing from the two chains hooked to rings in the ends of the reinforcing strap irons with which the boxes are bound. The contents having been emptied into a car, the box is swung back to its location on the ground and the chains released. To pick up a ton of



scrap in this way three laborers are necessary, though four may be used advantageously under certain conditions, as, for example, when loading from the low side of a curve. A ton or more of material may be loaded easily in two minutes' time from stop to start of a train. The comparative labor cost by these two methods is as i

follows: By hand, 3 min. for 17 laborers @ 20 ct...\$0.17 per ton By boxes, 2 min. for 4 laborers @ 20 ct... 0.026 ""

Or a saving in labor of\$0.144 per ton

These figures do not include the cost of the compressed air furnished by the locomotive, or the cost of upkeep of the derrick. Interest charges on a machine already in use should not be considered in this service. The boxes were made from lumber previously used in concrete forms and cost \$3.25 each, complete.

Ordinarily a derrick or rail loader is used almost exclusively for handling rail, and is therefore idle the greater part of the time, but is included in every-day work-train equipment for the purpose of delivering and picking up repair and wornout rail in small quantities. Therefore, comparative costs of handling scrap on the division by hand and by the use of a rail loader and boxes resolve into a comparison of the cost of labor and



FIG. 2. LOADING SCRAP WITH A BOX

of air supply. As already shown, there is a difference of 14.4 ct. per ton in favor of the box method, based simply on the saving of labor hours required. This in itself should be sufficient recommendation for the addition of boxes and a chain where a rail loader is already in use. If, as observation seems to indicate, an actual reduction in time is to be expected in the loading of each pile of scrap, then the time of the work train engaged in this service will be reduced and a further saving accomplished.

Other uses for these boxes readily suggest themselves, and we shall mention but one, which has proved very satisfactory. In cleaning the ditches through a cut, the boxes were placed at the proper interval to accommodate the dirt immediately adjacent thereto, and when filled by the ditch gang were picked up by a derrick and piled on a car. Empty boxes replaced the loaded ones removed, and, when opportunity offered, the loaded boxes were emptied where additional fill was needed. In this particular case, with the easily-tripped chain, it was possible to deposit this dirt at a greater distance from the track than could have been done by men in one handling.

The pictures showing the handling of rough stone by the use of large tongs attached to the rail loader are easily understood, and suggest the advantages to be derived when handling one and two-man stone for riprap and protection from scouring around bridge piers and abutments. Many bridges have hand railings, and at other points features such as interlocking connections, terra cotta pipe, neat ditches and sod preclude the usual method of lifting the stone to the top of the car sides and letting it fall to the ground or into the water. Therefore, it may be necessary to resort to some such scheme as sliding the stones or other material down planks, probably requiring a man on either side to control their course. The



FIG. 3. LOADING STONE BY HAND

use of hooks, which may be tripped with the load hanging over the water will show a marked saving in the cost of handling fairly large rough stone. To some the greatest appeal of this method will be made through the safety feature, which is self-evident upon an examination of the picture showing four men lifting one stone into a flat car, and the thought of what might happen if the hands of one should slip or be pinched. The result of an accident when sliding stones down a plank from



FIG. 4. PICKING UP STONE WITH A DERRICK

the height of a gondola car is likely to be more serious on account of the stone being above the men during part of its travel.

Machines such as the derrick shown in the pictures must come into pretty general use, owing to the rapidly increasing weight of track material and for other reasons. They are expensive, and, to show interest on the investment, should be kept in economical use and should not be allowed to remain idle awaiting the next railhandling job.





The Crusher at Pearl, Ill.

THE Chicago & Alton has recently made extensive changes in its stone ballast plant at Pearl, Ill. The old crushing plant has been entirely rebuilt and extensive modifications have been made in the track arrangement in the quarry, with the result that a much more economical layout has been obtained than formerly existed. The purchase of about 20 acres of additional quarry land has added materially to the value of the quarry. Within 30 miles of this site a gravel ballast pit is being operated in the bed of a small stream, the method of operation being such as to obtain a considerable yardage of ballast at small cost. The layout and operation of these two plants embody a number of interesting features.

The rock at Pearl is a hard limestone, and, as developed at present, it presents a face about one-quarter mile long, with a maximum height of 125 ft. at the center, tapering off toward each end. The stripping is about 12 ft. deep at the center, decreasing to practically nothing at each end of the face. The limestone stratum is underlaid by a blue shale, which forms a suitable floor for the quarrying operations, the top of this shale being at an elevation of about 20 ft. above the grade of the Chicago & Alton main tracks, which pass by the nose of the hill in which the quarry is situated.

Advantage of this situation was taken in the location of the original crusher house by building it against the slope of the ground between the floor of the quarry and the track level, and this feature has been retained in the new layout. By placing the bins for the storage of the crushed stone only a sufficient elevation above the track level to obtain an efficient discharge of the stone into the cars, the vertical distance which it is necessary to elevate the stone from the crushers to the screens is approximately 20 ft. less than that which would have been required if the floor of the quarry and the tracks were on the same level. This arrangement is clearly seen in the photograph showing the crusher plant from the side of the loading tracks.

This is practically the only feature in which the old layout resembles the new one. In the old installation end-dump quarry cars were used, which approached the plant on a stub track leading to an incline, which elevated the cars to a tipple, where the rock was dumped into the crusher hoppers. The crushers were at a sufficient elevation to discharge by gravity into the screens over the bins. With this arrangement, power was expended for elevating the cars as well as the stone, and it also involved a hoisting engine with a man to operate it. In the new layout the crushers are placed at a sufficient elevation below the quarry tracks so that side-dump cars can unload the rock directly into the crusher hoppers, the rock alone being elevated to the screens by an Allis-Chalmers bucket elevator belt.

There are two crushers, each of which is placed in position to receive rock from the quarry cars, but ordinarily only one of them, a No. 6 Gates gyratory crusher, receives stone from these cars, a No. 5 crusher of the same make serving as a tailing crusher to which the rejects from the screen are spouted. The rock from the crusher is elevated, as previously noted, and passed through an Allis-Chalmers cylindrical screen 20 ft. long by 48 in. in diameter, which is divided into three sections having holes $1\frac{1}{4}$ in., $1\frac{3}{4}$ in. and $2\frac{1}{2}$ in. in diameter, respectively. The section with the smallest holes is surrounded by a dust screen seven feet long having holes 3% in. in diameter The material passing this dust screen is collected in a small dust bin, while three large bins are provided for the storage of the stone passing the 11/4, 13/4 and $2\frac{1}{2}$ in. holes, respectively. The power plant contains two 125-hp. locomotive boilers, a two-stage air compressor and a 35-hp. steam engine.

The arrangement of the tracks at the crusher can be seen in the photograph showing a birdseye view of the plant. The cars pass around a loop in going by the crusher dump, this loop being connected with the tracks of the quarry so that the cars always pass the crusher in the same direction. Twenty spur tracks are provided along the face for the collection of the stone which is loaded into 2 1-16 cu. yd. side-dump cars built for 3-ft. gage tracks.

About 80 men are normally employed in the quarry, the force being divided into two groups: the car loaders, who are employed on a piece work basis, and a plant force on a daily or monthly basis. The force is as follows:

	superintendent\$89.0	0 per	month
	timekeeper 53 (0 per	month
•	engineer 75.0	0 per	month



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L	fireman	57.00	per	month
l	coal passer	1.75	per	day
2	feeders and 1 machine man	2.10	per	day
l	ballast car loader	2.10	per	day
l	car loader's helper	1.75	per	dav
L	powder man	2.40	per	day
l	powder man's helper	1.75	per	day
l	night watchman	1.75	per	day
l	car dumper	2.10	per	day
2	air drillers	2.40	per	day
2	drillers' helpers	1.75	per	day
l	plug drill man	2.10	per	day
l	"yardmaster"	2.10	per	day
l	switch boy	1.50	per	day
l	water boy	1.50	per	day
2	track men and 6 laborers to clean ledges.	1.75	per	day
l	quarry car repairer	2.50	per	dav

In addition to this force, 40 men are employed loading stone into the quarry cars at $16\frac{1}{2}$ cents per cu. yd. The quarry was reopened about June 10, and the average output since that date has been about 350 cu. yd. per day. It is anticipated that this will be increased to about 450 cu. yd. as soon as the work can be properly organized.

The rock is shot down from holes drilled along the face about 5 or 6 ft. apart with an average depth of about 32 ft., the distance from the face varying with the conditions. A typical charge for one hole is 50 lb. of 60 per cent dynamite, 75 lb. of black powder and two 30-ft. electric exploders. A considerable portion of the rock comes down in pieces too large to handle, so that it is necessary to shatter them by charges placed in holes drilled with a plug drill or by "adobe shooting." About 5,000 lb. of dynamite, 150 cans of black powder and 300 electric exploders are used each month for the ledge shooting, and about 100 lb. of dynamite and 100 caps and 150 ft. of fuse are used for shattering the large stones.

The output of this quarry is ordinarily divided into three grades—dust, concrete stone and ballast. The balThe concrete stone is also used occasionally in ballast by mixing it with the ballast stone. The plant has not been in operation a sufficient length of time to determine over just what territory the stone will be used. It will serve all of the Western division of the Alton and will probably be used extensively also in the direction



THE CRUSHER FROM THE TRACK SIDE.

of Bloomington, Ill., and St. Louis, Mo., east and south of Roodhouse, Ill., respectively.

THE GRAVEL BALLAST PLANT

The gravel pit is located about five miles west of Louisiana, Mo., on Noix creek. At the site of the pit the water gradient is relatively flat, but further up stream the



THE FACE OF THE QUARRY.

last is made by mixing the stone from the $1\frac{3}{4}$ and $2\frac{1}{2}$ in. screens. The concrete stone is that passing the $1\frac{1}{4}$ in. screen and the dust is that passing the dust ring. The latter is used for station platforms, foot paths, etc., and a considerable amount is sold for fertilizing purposes. creek comes out of the hills where the water grade is steep and the flow rapid. Whenever a heavy rain storm causes the runoff of a large quantity of water, gravel picked up in the hills by the rapid flow of the water is deposited in the lower reaches of the stream where the



flow is less rapid. As a result the material removed by the pit operations is replaced from time to time by storms.

The development of the pit is simple. Two tracks are laid side by side on the creek bed, the track on the side next to the excavation being occupied by a Browning locomotive crane and its tender, and the other track by a string of cars to be loaded with gravel, 100,000-lb. capacity coal cars being generally used in this service. The locomotive crane picks up the gravel with a clam-shell bucket and loads the cars, the crane moving back and forth along its track as the cars are loaded. The operating force consists simply of the crane engineer and his helper. The loaded cars are pulled out and the empties set in by the crew of a pusher engine stationed at Louisiana to assist trains up the Bowling Green hill. The loads are picked up and the empties are set out on side tracks at Louisiana by the local freight crews. Whenever the operations in the gravel pit necessitate the throwing of track or their extension further up the creek, a track gang of about 20 men is employed to do this work, but the men are used in the pit only when there is some-

COMPARATIVE WATER SERVICE COSTS

By P. M. LA BACH

Assistant Engineer, Rock Island Lines, Chicago, Ill.

7 ARIOUS units have been proposed from time to time as a means of comparing the relative costs of the water service of different railroads. The unit most frequently utilized has been the freight ton mile, which is a convenient figure, as it is found in the published statistics of the Interstate Commerce Commission. However, it ignores the question of passenger tonnage. The ratio of the latter to the former varies widely and in addition the amount of water needed to haul a passenger ton one mile exceeds that for a freight ton anywhere from 50 to 150 per cent. It is evident that any figures which have for a common divisor only a part of the work done must necessarily be in error.

The cost of operating a pumping plant, exclusive of fixed charges, involves a constant and two variables. The constant is the pumper's wages and the variables,



LOADING GRAVEL NEAR LOUISIANA, MO.

thing for them to do, being employed as an extra gang on the main line at other times.

The bed of the gravel in the pit varies from $1\frac{1}{2}$ to 8 ft. in thickness, and is ordinarily in condition for immediate removal, although occasionally stripping of a foot or more must be done to remove clay or silt. Because of the irregularity of the deposit the output varies from 7 to 13 cars per day, depending upon how the material runs. The load per car is 32 cu. yd. when the 100,000-lb. capacity cars are used.

The floods which supply the gravel, as previously explained, have occasionally caused considerable damage to the track layout, putting the pit out of service for several days and requiring considerable additional work by the track force. This gravel pit has been in operation under the present arrangement during this season and last. In six months last year 58,240 cu. yd. of ballast were removed. Most of the material has been used in the immediate vicinity of the pit, or between Mexico, Mo., and Clark, where it has been found to be particularly suitable for the soft sub-grade conditions encountered.

ITALIAN RAILWAYS.—The Italian army has constructed over 500 miles of railway track in the vicinity of the Austrian front since the war begun.

the cost of fuel and the cost of repairs. To express it mathematically:

- Let K = pumper's wages.

Let K = pumper's wages. Let $G = \cos f$ fuel per 1,000 gal. pumped. Let $R = \cos f$ frepairs per 1,000 gal. pumped. Let N = number of 1,000 gal. Then the total cost per month equals K + (G + R) N. Assigning units which are frequently found in practice, we have: K = \$50 per month.

- G + R = \$0.01N = 500.
- \$50 + 5 = \$55.

Cost of pumping 1,000 gal. = \$0.11.

- K = \$50 per month.G + R = \$0.01.
- N = 1,000.

Cost of pumping 1,000 gal. = \$0.06.

K = \$50 per month.

G + R =\$0.01. N - 3.000 = 3.000.

Cost of pumping 1,000 gal. == \$0.027.

Where larger amounts are pumped it is frequently found that another pumper is employed. This fact has a direct bearing on statistical studies of this nature. It is important to know how much water the stations furnish as units. The quantity of water used is in direct ratio to the amount of work done by the locomotives taking water at that particular station. Also water stations

are spaced as far apart as the tender tanks will permit and are usually constant in number for an engine district. If under these conditions the traffic is doubled the amount of water needed will be doubled, but the cost does not vary in the same ratio. In comparison, therefore, some allowance must be made for density of traffic. This may appear to be hypothetical, but there are many divisions of light traffic on which the pumper's wages exceed the cost of fuel, while on others with more trains the reverse is true. Another factor entering into the question is the question of grades. A railroad having light grades will perhaps haul twice as many tons per unit of water consumed as another with heavy grades.

In looking for another unit attention has been called to the fact that a locomotive develops about the same average horse power mile after mile. For instance, a consolidation engine of 1,200 hp. will be used to its limit, except on descending grades, no matter what load the ruling grade permits. Assuming that the rated horse power of locomotives will average about the same on the various railroads, the locomotive mileage could be used as a unit except for the fact that passenger locomotives use about half as much water per mile as freight locomotives. To overcome this difficulty the use of what may be called constructive engine mileage is suggested; that is, one made up of the total freight engine miles plus onehalf of the passenger engine miles.

For the purpose of comparing units, the table given herewith has been prepared to show the cost of water on 21 railroads with reference to three units, namely, "mile of road," "1,000 ton miles," and "constructive engine miles." The cost in terms of miles of road gives high values for the line with heavy traffic. The cost per ton mile has the objections enumerated heretofore, while the constructive engine mileage gives relatively higher values for the road with the heavier average train loading. None is, therefore, entirely satisfactory.

Also any calculations for cost of water on a railroad, no matter what the unit, which include all water expenses are manifestly unfair to those roads which are treating a considerable portion of their water in watersoftening plants. Railroads in a large part of the United States can afford to add considerable amounts to their water service costs by treating the water. While this will result in large economies, unfortunately they will not be reflected in water service costs. The same may be said of track pans. They save costs in fuel and overtime, but add to the cost of water service itself.

In view of this we can never expect to have any true comparison of the efficiency of water service on the various railroads until some means is developed for taking all of these items into account. It might be simpler to subtract the cost of these items from the total water service cost in order that a comparison might be made between figures that give only the cost of pumping the water. On many railroads the cost of water is too high, principally because the water service is without direct supervision by anyone familiar with the problems involved. In consequence a unit for the cost of water on railroads, which will permit of a fair comparision, is sorely needed and an organized effort should be made to obtain one.

DATA ON THE COST OF WATER ON 21 RAILROADS OVER 950 MILES LONG.

	Per Mile of Road		Cost of Water		
	Freight Ton Miles	Construc- tive Engine Miles	Per Mile of Road	Per 1,000 Ton Miles	Per Con- structive Engine Mile
	5,430,286	13,586	\$282.10	\$0.052	\$2.08
	2,788.075	9,970	128.10	.046	1.28
Eastern)	2,997,966	8,422	91.80	.031	1.09
Roads	4,255,513	12,975	142.70	.033	1.11
	3,223,935	8,679	96.60	. 030	1.11
l	3,011,617	5,022	67.70	.022	1.34
Southan	1,116,491	4,955	43.60	0.039	0.88
Boade	651,835	3,702	37.00	.057	1.00
noaus	1,633,461	5,424	55.30	. 034	1.02
l	677, 129	4.519	48.40	.071	1.07
(834,338	3,229	41.20	0.049	1.28
Middle	942,339	3,000	33.20	. 035	1.11
Western	639,184	3,165	43.70	.068	1.38
Roade	1,417,388	5,038	95,10	.067	1.88
noaus	911,648	3,149	41.80	.046	1.32
l	609,465	2,642	50.30	.082	1.90
ĺ	706,150	3,090	70.90	0.100	2 27
Western	732,032	3,871	63.00	.086	1.63
Roade	788,895	2,516	81.40	. 103	3.23
noaus	1,051,899	3,836	72.60	.069	1.89
	531,952	2,989	46.60	.087	1 56

A Machine To Oil Track Fastenings

D^{URING} the past 10 years railroad maintenance engineers have been confronted with the problem of overcoming the corrosive action of salt brine drippings from refrigerator cars on steel rails and fastenings. This problem has become more acute with the general use of high carbon steel in tie plates, screw spikes, bolts, etc., owing to the freer action of acids on steel as compared with iron. To overcome this action, A. J. Neafie, principal assistant engineer of the Delaware, Lackawanna & Western, has developed a machine for spraying oil on the rails, angle bars, bolts, tie plates and screw spikes.

The machine was constructed at the company's shops and is simple in design. A standard flat car is used to carry the necessary equipment, consisting of an air pump driven by steam from the locomotive, an air reservoir with pressure gages and reducing valves, oil and air pipes, a sand box and air sanders, two leather rail wipers, operating levers and a tool box. The flat car is handled on the head-end of the train and the operating levers are located on the forward end of the car, while the movable spraying device is attached to the car in front of the forward truck, so that the operator can see the entire mechanism. The spraying device is counterbalanced so that it can be raised and lowered with ease. A 2-in. oil line with a screening device is attached to the side of the car and is connected by a flexible hose to the center of the



THE OIL SPRAYING CAR.

spraying device. The outlets, which discharge at the sides of the rails, are equipped with round adjustable nozzles for distributing the oil under the heads of the rails and over the tie plates. A $\frac{1}{2}$ -in. air line is connected to the reservoir and discharges inside of the oil lines about 5 in. from the ends of the nozzles.

The oil car is tapped by a 2-in. oil line at the outlets, and by a $\frac{1}{2}$ -in. air line at the dome with flexible hose between the cars. The 2-in. oil line is attached by clamps



THE SPRAYING NOZZLES.

to the running board of the car. The steam coils are connected either to the main steam line from the engine or to the exhaust of the air pump. All lines have valves at each connection so that oil can be taken from, or heat applied to, any desired number of cars in the train. After making several tests with different kinds of oil, it was found that a comparatively heavy oil was best adapted for spraying purposes. Experiments demonstrated that Road Oil No. 45, furnished by the Texas Oil Company, had the desired adhesive quality. This oil was used in oiling and spraying some 800 miles of track in October, 1915. The oil was heated to 150 deg. F. and an air pressure of 30 to 40 lb. per sq. in. was applied through the domes of the cars from which oil was being used. A like pressure was maintained on the $\frac{1}{2}$ in. line to the nozzles to break up the oil and spray it over the proper area. The best results were obtained when the train was running between 20 and 25 miles per hour and using 100 gal. of oil per mile of track. At this rate an average of 80 miles per day can be sprayed, allowing for delays caused by regular passenger and freight traffic.

The cost of spraying based on using 100 gal. per mile and spraying 80 miles per day, is as follows:

3,000 gal. of oil at 31/2 cents per gal\$	280
Engine and crew	30
Material and supplies	5
Total cost per day	320
Total cost per mile	4

The economy of spraying the rail and rail fastenings has shown itself in a number of instances, as in stopping the rust scale on the web of rails and on the angle bars and bolts. The bolts are preserved by having oil on the thread line and can be taken off or tightened without destroying them. The corrosion of the tie plates, screw spikes and metal fixtures has been almost eliminated by one application of oil and there is no doubt that the oil which is sprayed on the ties preserves them at their vital points.

System in Keeping Track Bolts Tight

BY E. D. SWIFT,

Assistant Engineer, Belt Railway of Chicago

THAT splice bolts should be kept tight to perform their functions properly is a generally recognized fundamental of good track. Nevertheless, there is a lack of uniformity in the efforts to attain this desirable condition and an attitude of tolerance toward indifferent performance. One is led to believe that, owing to an almost universal prevalence of these difficulties over a long period of time, the thought on the subject is largely superficial, and that the really far-reaching illeffects of loose bolts on the entire track structure and even on rolling equipment is not fully appreciated.

Discussion of this subject with men of long experience in responsible charge of track work discloses a general feeling that looseness in a considerable percentage of bolts is inherent in a way to normal conditions-an undesirable condition, but one impracticable of avoidance. In other instances, where the importance of the situation is more fully appreciated, a heavy renewal of bolts is considered as an essential to proper maintenance. There can be no doubt that the economies resulting from tight bolts fully justify frequent replacements if this produces the best results, or if the condition sought is impracticable of attainment by a less costly method. In a study of the situation in his work extending over a number of years, the writer has found that the frequent renewal of bolts is not only unnecessary but undesirable, in that it precludes more favorable results in the use of labor and ma-

terial and more continuously effective service obtainable by other methods.

It has been found that the bolts replaced in ordinary maintenance are largely confined to those which have been loose for a sufficient time to permit the threads beyond the nut becoming damaged by corrosion or in vibration against other parts of the splice. Some of these fail in wrenching, while others are cut out. In either case, the failure is in the refusal of the nut to turn on the bolt on account of defective threads. So it is readily seen that neglect to re-tighten in time not only causes increased expense for labor and material, but of greater consequence, loose bolts being ineffective, it induces a condition of extraordinary and rapidly growing deterioration in all parts of the track in the vicinity of the joint.

Experience seems to prove that the method responsible for large renewals is that in which the work is executed in a considerable degree of thoroughness at the different times when it is performed, but that such times are limited to certain intervals. These may be established by a set rule, but are more often determined by someone on the ground from the apparent needs of the situation when bolt tightening is treated as a special order of the day and indulged in by all or a considerable part of the section crew. With other matters pressing for attention, there is naturally a tendency to stretch the intervals, with the result that they are often so far apart that looseness is developed in a considerable percentage of the bolts before attention is attracted. Cutting out or breaking those that cannot be tightened is then in order.

The method the writer has found most satisfactory is daily inspection with re-tightening at the first indication of looseness. Thus the deterioration that is the result of looseness is arrested before actual harm is done. The work is delegated to the track-walkers, and its importance is impressed upon them. There is a greater incentive for these men to perform their work thoroughly than with gang work. The responsibility is undivided and they soon learn that procrastination results in additional work. In other words, they learn to appreciate the need for and also apply the "stitch in time."

To some it may appear that bolt tightening on a large section is a heavy assignment for a track-walker in addition to his other duties. As a matter of fact, bolts attended to in this manner require but little work on any one day.

Another cause for bolt trouble is that the actual work of tightening is at times performed in a superficial manner. Merely to screw up the nuts until all apparent looseness is taken up is insufficient. It is very important that the different parts of the splice are in proper adjustment and firmly placed. This may be accomplished as follows: After an initial tightening-which should be sufficient only to take up all slackness quite firmly-the splice-bar should be struck several sharp blows with a spike hammer along the base. The object of this is to insure that the splice-bars are not "cocked" in their position on the rail, to take out any "lagging" due to friction between splice and rail or by reason of the track spikes holding the bar and to destroy or drive out any grit or scale obstruction to a good metal-to-metal contact beween the splice-bars and the rail. After this is done, it is of the highest importance that the nuts be run home very firmly. On the latter feature the writer finds his experience somewhat at variance with a prevailing idea to the effect that bolts are often stressed beyond the elastic limit in wrenching and that this condition is a contributing influence in much bolt trouble.

It is appreciated that many bolts are broken in wrenching, but that these are almost invariably loose bolts on which the nut is bound, may be determined by an examination of the fractures, which will show twist. Obviously a bolt could not be twisted in wrenching if the nut was free to turn in the threads; and, conversely, the nut would have to turn to stretch the bolt.

It is the writer's practice to require bolts (smaller than $\frac{7}{8}$ in. not considered) to be tightened practically to refusal, using wrenches about 40 in. in length. The $\frac{7}{8}$ -in. carbon steel bolts so treated are probably stressed more than is ordinarily regarded as good practice. The results obtained, however, through a term of several years have been uniformly satisfactory, as evidenced by a general elimination of battered rail ends. However, to bring out more detailed information of the effect of these methods on the bolts themselves, a test has been undertaken, which has now progressed sufficiently to be of some value.

In October, 1914, 80 4-hole angle bar joints in new 80-lb. A. S. C. E. rail, on track carrying a heavy freight service handled by locomotives of 50,000-lb. axle loading, were equipped with marked bolts 7_8 in. x 41_4 in., half carbon steel and half heat-treated steel. An inspection made in April, 1916, after a service of 18 months, shows but two replacements and these were in the carbon steel. The balance were all in good and effective condition.

A PORTABLE FRAMING MACHINE

THE accompanying illustration shows an ingenious application of a motor car to auxiliary operations, such as the framing of timbers. The scheme may be applied, however, by mounting a small gas engine on a car without the necessity of power operation of the car itself.

The device consists essentially of an arm made of two flat bars about four feet long attached to the frame of the engine, with a cast iron block at the outer end of the arm, bored to carry a short piece of shafting, parallel to the engine shaft, from which power is transmitted by means of a belt and pulleys. On this shaft at the end of the arm may be mounted such tools as a circle saw or a grinding stone, but in particular a cutter for dapping timbers. The arm is pivoted at its attachment to the engine, so that it may be raised or lowered by means of a vertical screw shaft, equipped with a hand wheel at



ARRANGEMENT FOR FRAMING TIES.

the top and passing through a threaded block secured between the two bars forming the arm. This shaft bears on a plate attached to the body of the car and serves to move the arm up or down when the hand wheel is turned.

Longitudinal movement of the cutting tool is obtained by moving the car backward or forward bodily on its wheels. This movement is controlled as shown in the accompanying photograph by a lever, secured to one of the wheels of the car, which can be attached or detached quickly as desired. By means of this lever very small movements of the cutter are easily obtained.

A machine of this kind has been in use on the Pere Marquette for a year with satisfactory results on about 2,000 ties and a considerable amount of heavy timber. Ties can be framed at the rate of one per minute, the speed being governed by the rate at which they can be placed on the carriage rather than by the speed of the tool. It has also been used for sawing planks and timbers and for grinding tools.

The method of procedure in using this machine for dapping or framing timbers as developed by experience is as follows: The car is put off on rails, at right angles to the main track or siding, and the timber to be framed is passed to the machine on a push car standing on the main track or siding, or if desirable to keep these tracks clear, on two rails laid for the purpose. The cutting tool for drapping makes a cut three inches wide for each



pass. As soon as one cut is made the car is moved ahead three inches to start a second cut. This operation is repeated until the desired width has been obtained.

Aside from the speed with which the work can be carried on and the accuracy of the operations when repeated on a large number of pieces, the machine has the advantage that it eliminates the need of skilled adzemen.

This device is being placed on the market by J. E. Toohey, Grand Rapids, Mich. It is equipped with a six horsepower engine and may be obtained, if desired, on a standard-gage, self-propelling motor car or on a two-foot gage car built for framing only.

A Power-Operated Bar Bender

POWER-OPERATED bar-bending machine is being used by the track-elevation forces of the Chicago, Milwaukee & St. Paul at Chicago in a material yard where, aside from the storage of all surplus construction materials, it is the practice to carry on all preparatory operations on the materials and deliver them to the site of the construction work in the exact quanti-



THE BAR-BENDING MACHINE.

ties required, thereby decreasing the congestion incident to a restricted right-of-way. In the case of the bars used in the reinforced concrete work, this consists in delivering them cut to length and bent according to the details and bills on the plans.

As shown in one of the accompanying photographs, the machine for bending the bars consists of a pyramidalshaped frame made of structural steel angles supported



BENDING THE BARS.

on a concrete foundation. This frame supports a 3-in. vertical shaft, fitted at the top with a cast-steel block arranged in such a manner that a rod placed between the shaft and this block is securely held when the shaft is given a rotary motion, thereby causing the rod to be bent around the shaft. At the bottom of the shaft, just above the ground surface, a 30-in. sheave is provided. Two wire cables which have their ends attached to this sheave at a point on its circumference pass around the groove on opposite sides and lead to two drums on a small hoisting engine, as shown on the accompanying drawing. Thus the sheave, with its vertical shaft, may be rotated about 270 deg. in either direction by pulling one or the other of the two cables.

The hoist consists of two drums, which are mounted on a shaft, connected by two clutches to two pullleys belted to a 6-hp. gas engine. Each clutch is operated by means of a long rod connected to a lever located conveniently at the bender. The arrangement of the clutches and transmission is such that one drum unwinds its cable while the other one is winding up, and vice versa. Thus when one clutch is thrown in, the bar bender is turned in one direction, while the other clutch causes it to run in the other direction. The cable used to pull the shaft in the direction for bending the bars is $\frac{3}{4}$ in. in diameter, while the reverse movement is made with a



SKETCH OF THE LAYOUT.

 $\frac{1}{2}$ -in. cable. To preclude any possibility of an overrun of the cables, blocks are secured to each of them in positions where they come in contact with arms attached to the lever rods just before the limit of travel of the cable is reached, with the result that the lever is automatically pushed back into the inoperative position before the cable can run too far. In other words, the limit block on the bending cable will stop the machine just as the 180-deg. bend is completed, while the block on the reverse cable will automatically stop the reverse movement in the correct initial position ready to make another bend. For intermediate bends, of say, 45 deg., which are the most common, a second block is placed on the bend cable to stop the machine when a 45-deg. turn is completed, special provision being provided to make this block inoperative in case a 180-deg. angle is desired.

The bending machine is located under an open shed at one end of a long table equipped with rollers to facilitate the handling of the bars. The operating cables and the clutch rods are carried under this table so that they do not interfere with the movements of the workmen. One of the accompanying photographs shows a pipe railing placed in front of the machine at a radius of about 8 ft., which serves as a support for the outer end of a bar when bends are required at a considerable distance from the end. For bars having bends near each end only, it is more convenient to turn the bar end for end after the bends on one end have been completed. This operation is facilitated by means of an overhead trolley suspended from the ceiling.

The bending of bars with the power is much faster than when the bars are bent by hand. The speed at which the work can be done or the tonnage handled per day depends upon the number of bends to be made. A one-inch bar 20 ft. long, having 8 bends, can be finished at the rate of one every three or four minutes, and it is possible to turn out three or four tons in a day of 10 hours. Before the power machine was installed six men were employed at this work. Now three men can bend about 3 times as many bars per day as were formerly bent by six.

The operation of this yard requires the employment of about 35 men, of whom 3 are employed on the bar bender and 2 on a bar shears, located at the opposite end of the shed from the bar bender. This is a Slater, Marsden & Whittemore shears, on which from 3 to 8 bars may be cut at one stroke, depending upon the size of the bar. The arrangement of the plant is such that they pass progressively from the stock piles by the shears and finally to the bender. The men not employed cutting or bending are required for loading and unloading the bars, lumber, hardware and other material stored in the yard.

The bar-bending machine was developed by the trackelevation forces of the Chicago, Milwaukee & St. Paul, who are under the general direction of C. F. Loweth, chief engineer, and the immedate direction of C. H. Buford, assistant engineer.

RENEWING TIES BY CONTRACT

PROMPTED by the scarcity of labor and the large amount of work to be done this season, the Chicago, Burlington & Quincy is experimenting with the renewal of ties by contract on the Aurora division. Early in the spring a contract was let, covering two gangs of not to exceed 20 men each. The contractor hires the men and keeps the gang full, being paid a unit price per tie renewed. The work is supervised, inspected and accepted by the regular foremen of the respective sections. The railroad furnishes the tools and the cars in which the men live. The men board themselves in the manner common to foreign laborers.

This gang is moved from section to section, being sent to those points where a sufficient number of men cannot be secured for the regular gangs and where no general surfacing is contemplated, the tie renewals being made in conjunction with the surfacing when the track is given a general raise. Preceding the gang, the section foreman in charge of the track on which the work is being done marks on the web of the rail over the center of the tie, each tie which is to be removed. The contract gang then starts at one end of the section and renews all the ties which are to come out on the entire section, after which it is transferred to another point. In this way this gang retied 11 sections between May 18 and July 4.

The contract provides that the road distribute the new ties and that the men renewing them restore the track to its original condition, including the placing of tie plates, dressing the ballast shoulder, etc., and pile the old ties on the right-of-way ready for loading or burning. In carrying on the work the foreman divides the gang of eight men into pairs and assigns to each pair a rail, marking the men's initials on one end. This serves to identify the men with the number of ties renewed in the panel as a basis for payment and also locates definitely any poor work. A separate record is kept of the ties renewed by each two men and they are paid individually on a piecework basis.

The immediate effect of this plan has been to increase the amount of work done per man, about 50 per cent more ties being renewed with this gang of eight men than with the average section gang of the same size on adjacent sections. The men also work longer hours, starting about 5:30 a. m. and working about 11 hours per day. They appear to be pleased with the arrangement, as they are earning about \$2.35 per day as compared with \$1.65 on the section work. From the standpoint of the railway the work is being expedited, although increased supervision is necessary. Because of the limited extent to which this plan is being tried it is still regarded as in the experimental stage.

OBSERVATIONS ON RAIL JOINT WEAR

By G. A. de Haseth,

Chief Engineer, Puget Sound Electric Ry., Tacoma, Wash.

THE accompanying photographs show two joints which had been in use about seven years under a service approximating 600,000 wheels. They were imbedded in a plastic soil, the cohesive nature of which accentuated an interesting condition which at its incipiency would otherwise hardly be noticeable. In the first illustration the undisturbed condition of the soil at the bear-



FIG. 1. CLOSE CONTACT BETWEEN RAIL AND ANGLE BAR.

ing line of the rails and the end portions of the angles shows a substantial intregality of the parts at these points. There is, however, a well-defined line of cleavage between the rail ends and the middle portion of the angle bars which indicates clearly the existence of a movement between the tip ends of the rails and the angle bars. The condition of the soil around the nuts proves them to be tight upon their bolts and that no movement



FIG. 2. Showing Loosening Between Angle Bar and Rail

between the bolts and the angle bars has taken place. It is therefore apparent that this relative movement of rail ends is not the result of any diminution of bolt pressure either through the stretching of the bolts or the loosening of the nuts.

Relative motion in a rail joint causes abrasion that



means loss of metal which, in the present instance, although small, is important, for the function of the angle bar is to produce an efficient junction of the rails. From the above it is obvious that, abrasion having set in, the tightening of the bolts cannot restore a rail joint of this type to its original effectiveness. In other words, such a structure is inherently deficient since it cannot prevent the relative movement of rail ends except under initial conditions.

In examining Fig. 2 a complete loosening of the grip between the angle bars and the right-hand rail ends is noted. This joint is identical with No. 1 as to construction, installation and traffic conditions. The more pronounced deterioration apparent in this case would point to some contributory factor not present in the joint shown in Fig. 1. It is known that in rolling, rails cannot be produced with such accuracy of dimensions as to insure a uniformly equal grip of the angle bars against both of the rails, the rail which is slightly smaller limiting the final seating of the angles. In consequence one rail head will engage the angle bars with less pressure than the other and abrasion will set in at such points at a comparatively early date.

Apparently there are two different and independent forces which tend to produce abrasion between rail ends and angle bars-wave motion and lateral thrust. The writer's observation is that the latter is by far the more important contributory factor. The bending strains introduced into a rail joint by the passage of a wheel over it, commonly described as a load wave, unquestionably tend to disturb the intimate contact between the rails and the angle bars at identically the same points of bearing that looseness appears in the illustration. Observation shows that abrasion of the same kind develops also, although not so rapidly, in joints that are not subject to a load wave movement of any appreciable magnitude, such as when located in track laid upon concrete and firmly imbedded in pavement. Hence the word lateral thrust is used to designate that force caused by the surging of a truck or the wedging action of a wheel flange fillet, which, with each passing wheel, exerts a side thrust on each rail end independently, and in rapid succession. Abrasion, therefore, sets in as a result of this lateral relative movement of rail ends and angles, very slightly at first, but eventually developing to such an extent or into such loss of metal as to permit noticeable vertical relative movement between the ends of the rails and the joints. As a remedy for this wear it is the opinion of the writer that a structure affording that firm union of rail and angle bars must be attained which will permanently prevent the slightest degree of relative movement of the extreme rail ends.

*WOODS USED BY THE RAILROADS

BY HOWARD F. WEISS

Director, Forest Products Laboratory, Madison, Wis.

THERE has existed for some time a rather common belief that our timber supply has become so scarce that it is now almost impossible to secure timber of good quality. This impression is quite misleading. The United States Department of Commerce estimates the amount of standing timber in the United States at approximately 2,900,000,000,000 ft. B. M. The present total annual consumption of timber in this country approximates 52,000,000,000 ft. B. M., which would indicate that our present stands of virgin timber will last approximately 55 years if the rate of exploitation continues as at present. When we add to this the amount of timber being pro-

*Abstracted from a paper read before the St. Louis Railway Club, May 12, 1916.

duced annually, due to new growth, it, of course, very materially lengthens the theoretical period of exhaustion. A consumer can secure just as good timber now as formerly, and, in view of the fact that we now have grading rules based upon accurate scientific data, a customer can secure structural timber which will run even better than timber secured in years gone by when no such grading rules existed. Of course, the price of timber has advanced, just as has the price of many other products, and with the steady cutting of our virgin supply, it will undoubtedly continue to advance.

The improved conditions under which timber is now being used in the United States are making it possible to secure from it a much greater service than was secured in the past. This is excellently illustrated in the wooden cross-tie. Only a few years ago the number of ties impregnated with wood preservatives in this country was comparatively small, but within the last decade the percentage has very rapidly increased, and is continuing to do so. Thus by means of artificially prolonging the life of the natural wood, we are able not only to secure a much greater service from the woods originally used for ties, but it has been found possible to use for the manufacture of cross-ties many woods which were hereto-fore of little or no value. It is perhaps not far from the truth to say that the average life of untreated crossties in the United States is 7 years, and that our total annual consumption of ties for renewal purposes alone is around 100,000,000. From the results which have been secured in prolonging the life of wooden ties from decay, there is every reason to expect that with proper treatment an average service of about 17 years can be secured. Should this prove to be true, it will more than cut in half our present annual consumption of cross-ties for replacement purposes.

About 9 per cent of our total annual consumption of 52,000,000,000 feet B. M. of timber goes into the manufacture of ties, and about $2\frac{1}{2}$ per cent is used in car construction. In addition to these two items, a very large amount of timber is used annually by the railroads in the construction of bridges, stations, and other structures. For this reason I believe it would be good policy for them to insure for themselves a plentiful supply of suitable timbers tributary to their property.

Much improvement can undoubtedly be made in present methods of inspecting timbers for railroad consumption. In fact, present methods result in much needless confusion and waste. In an attempt to improve this condition, our laboratory has just prepared a bulletin called "The Tie Guide Book," which explains in simple language and with suitable pictures how the different kinds of timber cut for ties can be identified.

A method for classifying structural timbers according to their density by mechanical tests is one of the most interesting and valuable recent results of our investigations. It is found the strength of the wood bears a direct relation to its dry weight or density; that is to say, the denser the wood the greater the strength. For example, a piece of longleaf pine, which has a specific gravity of about .40, has a modulus of rupture of about 4,600 lb. per sq. in., whereas identically the same kind of wood, but with a specific gravity of .60, has a modulus of rupture of about 10,000 lb. per sq. in. From these mechanical tests and observations certain definite mathematical equations for determining the strength of structural vellow pine timbers have been formulated. Progress has so far advanced that practical grading rules have been developed, and these have recently been adopted by the American Society for Testing Materials, the Southern Pine Association, and the American Railway Engineering Association.



AN IMPROVED EMERSON PUMP

SEPTEMBER, 1916

A N improvement has been made on the Emerson standard steam pump by the substitution of a new form of steam valve, which adds greatly to the economy and adaptability of this type of pump. The Emerson pump operates by the utilization of the vacuum produced by condensing a quantity of steam with a jet of cold water. As seen in the accompanying drawing, the pump consists of two vertical chambers connected at the bottom where they are equipped with suction valves opening upward. Discharge ports are also located in the bottom of each cyclinder, equipped with valves leading into the discharge pipe. Each chamber communicates at the top with a steam valve operated by a small 3-cylinder rotary engine, which admits steam alternately and positively, first into one chamber and then the other. The condenser



THE EMERSON PUMP

nozzles screwed into the wall of each chamber and connected with the bottom of the opposite ones, complete the apparatus.

The operation of the pump is simple, one chamber filing with water while the other one is discharging. As soon as one chamber is filled with water, the valve at the top automatically turns the steam into the chamber, forcing the water to discharge through the discharge ports at the bottom. A cushion of air over the surface of the water prevents contact between the steam and the water, and thereby precludes condensation of steam, while the chamber is emptying. Meanwhile the opposing chamber is filling with water, causing a jet of water to spray out of the condenser nozzle in the empty chamber. This condenses the steam, and the steam port at the top having been closed meanwhile, a vacuum results, and the chamber is again quickly refilled through the suction valve at the bottom. The cycle is then repeated.

Until recently the steam valve at the top was of the flat rotary slide valve type. This has now been superceded by an occilating type of valve, which has a number of advantages over the old form. The valve is balanced against steam pressure and practically eliminates friction so that no lubrication is required. It is said that the 3-cylinder engine will operate the new valve with a steam pressure of only $\frac{1}{2}$ lb. per sq. in. Another advantage is the elimination of seven wearing parts required in the old valves.

Because the need of lubrication is avoided, the pumps do not require the lubricators formerly furnished, and may now be used for such service as drinking water, dye vats, etc., where the slight contamination of the water by the oil would have been objectionable.

These pumps are manufactured by the Emerson Pump and Valve Company, Alexandria, Va., and have been used extensively on railroad construction work, both by contractors and by the railroads themselves.

DETERMINING THE PURITY OF CREOSOTE

T. H. DAVIS has recently described a simple abpresence in creosote oil of tar, free carbon or dirt as follows: "Allow six drops of a sample of creosote oil to fall upon the surface of clean, white blotting paper. If carbon, tar or dirt is present it is observed very readily, as it segregates quickly at the center. The paper should be laid away in a flat position for a few hours in a place free from dust. If then examined, foreign matter will be observed in a distinct zone at the center of the spot; the outer zone indicates the character of the oil."

Homer Cloukey of the Forest Products Laboratory, Madison, Wis., has run a series of tests to verify the Davis "absorption spot test" and to obtain some idea of the sensitiveness of the test for tar, carbon or dirt. In order to make it fairly quantitative, a series of spots were made from carbon-free creosote oil to which free carbon in the form of lampblack had been added in definite graduated amounts. The series comprised six mixtures of creosote and lampblack with percentages of lampblack of 0.0, 0.005, 0.01, 0.05, 0.10 and 0.50.

The results showed an increasing gradation in the density of the free-carbon ring at the center and indicated that 0.005 per cent is easily shown by this test. In heavier percentages than 0.5 per cent the amount in an unknown sample would be difficult to estimate by comparison. The admixture of tar to creosote can be determined roughly from the size of the inner zone and the general character of the spot. The heavy tar does not diffuse with the speed of the lighter creosote oil.

The presence of dirt, tar or free carbon in creosote in very minute quantities is indicated by this test. If the creosote spot shows a dense black center it will probably be necessary to run a free carbon specification. When pure, high-gravity distillate oil is specified and the spot test is used in the preliminary examination of the oil the slightest adulteration with coal tar can be detected instantly.

It will be noted from the determinations made by Mr. Cloukey that percentages of free carbon greater than 0.05 per cent can be estimated only with difficulty. It is apparent that in order to secure a pure creosote of the quality of No. 1 maintenance of way oil or a pure, highgrade distillate oil the spot test is practically essential in the preliminary examination.

St. Paul, Minn., adopted the spot test some time ago and made it a part of the city's specifications for a pure distillate oil for the treatment of its wood paving blocks. The spot test has also been adopted by the Diesel Engine Users' Association of England for the examination of the fuel oils used in this type of engine.



GENERAL NEWS DEPARTMENT

THE PRESIDENT OF CUBA has signed a bill providing for a commission to study the question of government ownership of railroads in Cuba.

THE MISSOURI PACIFIC has increased the wages of its section men an average of six per cent and of section foremen \$5 per month, effective August 1.

THE EL PASO & SOUTHWESTERN is reported to have given a voluntary increase of $7\frac{1}{2}$ per cent in rate of wages of shopmen, section foremen, clerks, telegraphers and train despatchers.

THE CHICAGO, BURLINGTON & QUINCY is equipping its new lounging cars for its Chicago-Denver, Chicago-Omaha and Chicago-St. Paul trains with soda fountains, similar to those used in drug stores, from which passengers may be served at any time of the day or night.

THE BUFFALO, ROCHESTER & PITTSBURGH has placed its name in conspicuous lettering on all overhead bridges where state highways cross the railroad for the purpose of giving people in automobiles a convenient landmark and to make the name of the road familiar to everybody.

AN ARMORED CAR has recently been completed by the Standard Steel Car Company for the United States Army. This is the first car of this kind ever constructed for this army. It is to be equipped with a three-inch rapid fire field gun and has 20 port holes for machine guns or small arms.

THE QUEBEC BRIDGE across the St. Lawrence river is rapidly approaching completion. The south cantilever arm was completed on July 25, the north arm having been completed late last year. It is expected that the suspended span will be floated into place early in September, completing the erection of the steel.

P. H. DUDLEY, consulting engineer, New York Central Lines, has recently made a statement that no transverse fissures have been found in basic open-hearth rails rolled according to the specifications of the New York Central Lines and from reheated blooms. He advocates the reheating of all blooms as a means of eliminating this serious cause of failure.

THE PRESIDENT'S CONFERENCE COMMITTEE ON VALUATION has published a summary of the Federal valuation reports on the Texas Midland, the Atlanta, Birmingham & Atlantic, the Norfolk Southern, the San Pedro, Los Angeles & Salt Lake and the Elgin, Joliet & Eastern. These are the first properties on which the government has completed its valuations.

THE PENNSYLVANIA RAILROAD reports that in the first six months of the present year 92,380,184 passengers were carried on the company's lines without the loss of the life of a single one in a train accident. This completes two and one-half years in which no passenger has been killed in a train accident on any part of the Pennsylvania System, either east or west of Pittsburgh.

THE NATIONAL CONFERENCE COMMITTEE OF THE RAILWAYS met with the representatives of the four brotherhoods of train service employees in New York on Tuesday, August 8, to receive the returns from the strike vote and to renew negotiations leading to the settlement of the wage controversy. On the following day the roads requested the aid of the United States Board of Mediation and Conciliation in the settlement of the controversy, but this failing, President Wilson asked the representatives of the railways and the employees to confer with him on Monday, August 14. It soon became evident that President Wilson had accepted in large part the demands of the employees. In his conference with the railway officers he recommended the concession by the railways of the 8-hour basic day, and urged that the demands for extra pay for overtime and the contingent proposals of the railways should be postponed pending an investigation by a special commission. Failing to secure the approval of his plan from the committee representing the railways, he summoned over fifty leading railway executives to Washington

on the following Sunday and presented the matter before them. These men supported the action of their committee, and in a statement presented to the President on Monday, August 28, again urged their desire for arbitration of the entire issue.

THE PUBLIC SERVICE COMMISSION for the First District of New York has issued an order to various railroads and rapid transit lines operating in New York City directing them to furnish reports of the condition of all bridges and elevated structures within 30 days after the end of each calendar year. These reports must contain statements to the effect that the bridges have been inspected by competent officers or employees of the respective companies and if found safe the reports must so state. If they are found to be not thoroughly safe, the reports must further state what steps have been taken to place them in safe condition.

THE PENNSYLVANIA RAILROAD has given orders for the adoption of the green-yellow-red scheme for night signal indications on its lines. The order includes not only fixed signals, but markers on the rear of trains, switch lamps, markers for track tanks, slow signs, resume speed signs, hand lamps at interlocking and block signal stations and lights at public crossings. Lights at highway crossings will be red instead of green as at present. It is expected that the change will require some little time for its accomplishment, as the number of glasses to be changed runs into the hundreds of thousands, and because of present industrial conditions, deliveries of material may be slow.

THE NATIONAL ASSOCIATION OF RAILROAD COMMISSIONERS, the American Railway Association and the American Automobile Association conferred at New York City through their representatives relative to joint action by the three associations concerning the promotion of safety at grade crossings. It was agreed to ask the American Railway Association to call together a committee of railroad counsel to draft bills covering the question of regulation of traffic at grade crossings, with a view to the prevention of accidents, these bills to be submitted to the Public Service Commissions of the several states and to the Automobile Association for criticism. It is then proposed to have a further conference in Washington prior to the annual convention of the National Association of Railway Commissioners.

THE SOUTHERN PACIFIC is conducting a school on wheels for the children of the men employed in an extra gang on the Los Angeles division. More than 25 children belonging to the families of the 50 men employed in this gang attend and they are being taught in a box car fitted up with benches. A teacher is employed who instructs them daily in English and Spanish and in primary work. The car is moved from place to place with the gang so that the children do not miss a day's schooling. Arrangements are now being made to replace the car with an old passenger coach which will be fitted with benches and blackboards and will be easier to heat. The results from the school have not only been satisfactory, but the class of men retained in the gang is high. It is also planned to fit up a hospital car for the women and children in the camp who may become ill.

THE SUPREME COURT of the State of Washington holds that a person inspecting the main track of a railroad engaged in intrastate and interstate commerce is engaged in interstate commerce within the act. The rules of a railroad required section men to keep a lookout for trains. An employee, who was killed while inspecting the track on a speeder, was held to be guilty of negligence in not maintaining a lookout for trains, regular or irregular, particularly as he wore a cap which covered his ears so as to affect his hearing, and his negligence was at least equal to that of the railroad in running an engine backwards without maintaining a proper lookout. The action was tried without a jury, and the trial court made no deduction for the deceased's contributory negligence. It was held that the Supreme Court might make such deduction from the award and affirm the judgment.



PERSONAL MENTION

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GENERAL

P. J. LANDERS, engineer maintenance of way and acting superintendent of the Indianapolis Union Railway, was appointed superintendent on August 1, succeeding A. A. Zion, who was granted a leave of absence several months ago and who has since retired on a pension.

A. W. JOHNSTON, who has been appointed assistant to the president of the New York, Chicago & St. Louis, with headquarters at Cleveland, Ohio, entered railway service as a draftsman in the office of the general superintendent of the Pittsburgh, Cincinnati, Chicago & St. Louis in 1875, after graduation from the Massachusetts Institute of Technology. He entered the employ of the New York, Chicago & St. Louis as division engineer in April, 1884, being made division superintendent on October 1, 1893. He was appointed general manager on February 1, 1906, which position he held until the time of his recent promotion.

ENGINEERING

E. G. LANE, district engineer maintenance of way of the Baltimore & Ohio Southwestern, has been promoted to engineer maintenance of way of the Baltimore & Ohio Lines West, and



E. G. LANE

and of the Cincinnati, Hamilton & Dayton, with office at Cincinnati, Ohio. Mr. Lane was born in 1869, and after a preliminary education attended Northern Ohio University and later took a special course at Cornell University. He first entered railway service on May 1, 1888, as a levelman on the Valley Railway (Ohio), now the Cleveland division of the Baltimore & Ohio. On January 11, 1899, he entered the service of the Baltimore & Ohio, and from that time until January, 1905, he was successively assistant engineer on the Cleyeland, Cumberland and Pittsburgh divisions. He was then made division engineer of

the New Castle division and on January 1. 1907, was promoted to district engineer maintenance of way at Pittsburgh, Pa. He remained in that position until November 10, 1911, when he was made assistant engineer of operation in the office of the vice-president at Baltimore. Md. From March, 1914, to July, 1916, he was district engineer maintenance of way of the Baltimore & Ohio Southwestern, with office at Cincanniti, Ohio. As engineer maintenance of way of the Baltimore & Ohio Lines West and of the Cincinnati, Hamilton & Dayton he will continue to have headquarters at Cincinnati.

EDGAR J. CORRELL, division engineer of the Baltimore & Ohio Southwestern at Chillicothe, Ohio, was appointed district engineer maintenance of way of the Southwest district of the Baltimore & Ohio, Lines West, with headquarters at Cincinnati, Ohio, effective August 20. He was born at Canton, Ohio, on October 23, 1871, and received his education in the public schools of that city and in Ohio Northern University. He began railway service as a rodman with the Baltimore & Ohio Southwestern in September, 1896. In January, 1898, he was promoted to transitman and in May, 1901. to assistant division engineer, with headquarters at Chillicothe, Ohio. The following year he was made assistant engineer and transferred to Cincinnati, Ohio, and in May, 1902, again was appointed assistant division engineer, with office at Washington, Ind., remaining in this position until April, 1903. He was division engineer of the Ohio division at Chillicothe, Ohio, from April, 1903, to May, 1908, when he left the Baltimore & Ohio System to become engineer maintenance of way of the Missouri Pacific at Little Rock, Ark. He returned to the Baltimore & Ohio in August, 1911, as division engineer at Chillicothe, Ohio, which position he held until the time of his recent promotion.

FRANCIS DANIEL BATCHELLOR, district engineer maintenance of way of the Cincinnati, Hamilton & Dayton, has had his jurisdiction extended over the Northwest district of the Balti-



more & Ohio Lines West, with headquarters, as heretofore, at Cincinnati, Ohio. Mr. Batchellor was born at Liverpool, Eng., on September 15, 1878, and received his education from a manual training school at Philadelphia Pa. and the International Correspondence Schools at Scranton, Pa. He began railway work in 1898, in the office of the supervisor of the Pennsylvania Railroad at Tacony, Pa. From 1900 to 1903 he was an assistant in the engineering corps of the Pittsburgh, Cincinnati, Chicago & St. Louis, with headquarters at Cincinnati, Ohio, and from July, 1903, to September, 1907, was employed in the same ca-

F. D. BATCHELLOR

pacity on the Baltimore & Ohio Southwestern. He was assistant division engineer of the Indiana division of the Baltimore & Ohio Southwestern from September, 1907, to September, 1910, when he was promoted to assistant engineer maintenance of way. In March, 1911, he became division engineer of the Indiana division of the same railroad and retained this position until December, 1912, when he was appointed assistant to the general superintendent of the Baltimore & Ohio Southwestern and the Cincinnati, Hamilton & Dayton. In June, 1913, he was appointed assistant superintendent of the Toledo division of the Cincinnati, Hamilton & Dayton, and remained in this connection until July 1, 1913, when he was promoted to district engineer maintenance of way of the Cincinnati, Hamilton & Dayton, with office at Cincinnati.

M. P. NORTHAM, office engineer of the Southern Railway, Washington, D. C., has been appointed supervising engineer, maintenance of way department, with headquarters at Washington.

T. R. RATCLIFF has been appointed engineer maintenance of way of the Indianapolis Union Railway, with headquarters at Indianapolis, Ind., succeeding P. J. Landers, appointed superintendent.

TRACK

N. T. BLACKWELL, roadmaster on the St. Louis division of the Chicago Rock Island & Pacific, has transferred his headquarters from Windsor, Mo., to Eldon.

J. L. CONOVER has been appointed assistant supervisor of subdivision 32 on the Philadelphia division of the Pennsylvania Railroad, succeeding E. D. Flad, transferred.

GEORGE MATHIASEN has been appointed roadmaster of the Chicago & Northwestern at Montfort, Wis., to succeed D. Manning, assigned to other service, effective August 11.

CLIFFORD JOHNSON has been appointed roadmaster of the Chicago-Aurora division of the Chicago. Burlington & Quincy, with headquarters at Aurora, Ill., succeeding Roy C. Violett, transferred.

C. GREISHEIMER, acting supervisor and master carpenter of the Cincinnati, Hamilton & Dayton, between Dayton, Ohio, and Dean, has been appointed master carpenter in charge of the Delphos division.

JOHN TRUITNER, roadmaster on the Rocky Mountain district of the New Mexico division of the Atchison, Topeka & Santa Fe, with headquarters at Raton, N. M., has been transferred to



pereverences and the second the Third district. J. E. Truitt, extra gang foreman, has been appointed roadmaster at Raton, N. M., succeeding Mr. Truitner, effective August 20.

M. H. BEARD has been appointed supervisor of the Cincinnati, Hamilton & Dayton in charge of the Findlay-Ft. Wayne branch of the Delphos division, with headquarters at Ottawa, Ohio, in place of Simon Baker, assigned to other duties.

CHARLES JEROME MEYERS has been appointed supervisor of the Cincinnati, Hamilton & Dayton, with jurisdiction over the lines between Dayton, Ohio, and Dean, in place of C. Greisheimer, assigned to other duties. Mr. Meyers was born on April 25, 1874, at Pittsburgh, Pa. He graduated from Wittenberg College and from the Case School of Applied Science. His railway career commenced in September, 1902, when he was employed as an extra gang foreman by the Union Pacific. He remained in this connection until March 1, 1904, when he went to the Chicago & Northwestern as general foreman of construction. In June, 1907, he took employment on the Pennsylvania Lines as steel foreman. He entered the service of the Chesapeake & Ohio in October, 1911, as yard gang foreman and in April, 1913, was made assistant steel gang foreman on the Cleveland, Cincin-nati, Chicago & St. Louis. In December, 1915, he was appointed steel gang foreman on the Cincinnati, Hamilton & Dayton and retained this position until his present appointment, which became effective August 1. His headquarters are at Chillicothe, Ohio.

BRIDGE

ROBERT FARNHAM, JR., whose appointment as assistant engineer of bridges and buildings of the Pennsylvania Railroad, with headquarters at Philadelphia, Pa., was announced in the



ROBERT FARNHAM, JR.

issue of last month, was born at Washington, D. C., on December 19, 1877. He was educated at private schools and at the Preparatory School of Columbia University, Washington, D. C., after which he graduated from the civil engineering course of Lehigh University in 1899. He entered the employ of the bridge department of the District of Columbia in July of that year. From July, 1902, to March, 1903, he was engaged in the design of steel buildings with J. H. Gray & Company of New York City. On this latter date he entered the service of the Pennsylvania Railroad as a transitman at

Washington, D. C. In August of the same year he was appointed assistant engineer of construction and was placed in charge of the elimination of grade crossings at Washington. He was transferred to the office of the engineer of bridges and buildings at Philadelphia in March, 1910, and was appointed assistant to the engineer of bridges and buildings on August 1, 1913. He was appointed assistant engineer of bridges and buildings in July, 1916, as noted above.

H. S. BADDERS has been appointed master carpenter of the Seaboard Air Line, with headquarters at Hamlet, N. C., in place of W. J. Galloway, resigned. He was born at Baltimore, Md., on December 10, 1863, and first entered railroad service on July 28, 1914, as carpenter foreman on the Georgia division of the Seaboard Air Line.

C. W. LENTZ, supervisor of bridges and buildings of the Illinois Central at Dubuque, Iowa, has been appointed bridge inspector, with jurisdiction over the system south of the Ohio river. John Morphew, bridge foreman, has been appointed bridge inspector, with jurisdiction over the system north of the Ohio river. Hugh Callahan, bridge foreman on the Minnesota division, succeeds C. W. Lentz as supervisor of bridges and buildings at Dubuque.

CONSTRUCTION NEWS

THE ATCHISON, TOPEKA & SANTA FE has filed articles of incorporation for the construction of a line 70 miles southwest from Lubbock, Texas, to a point near Seminole.

This road has awarded a contract to Sharp & Fellows, Los Angeles, Cal., to erect a passenger station at Colorado Springs, Colo., at an estimated cost of \$175,000.

THE ATLANTIC COAST LINE has awarded a contract to Wade. Clower & Wade, Jacksonville, Fla., to build the extension of the Haines City branch from the present southern terminus at Sebring, Fla., south via Venus, Palmdale and Hall City to Immokalee, 80 miles, with a branch to Moorehaven, 20 miles. The maximum grade will be 0.4 per cent compensated and the maximum curvature 4 deg. A drawbridge will be built over the Caloosahatchee river. The company expects to develop a traffic in citrus fruits, vegetables and lumber.

THE BALTIMORE & OHIO has awarded a contract to the Bates & Rogers Construction Company, Chicago, for grading, tunneling and masonry work on the Long Fork Railroad in northeastern Kentucky, at an estimated cost of \$500,000. This line is to be built from a junction with the Chesapeake & Ohio at the forks of Beaver creek to Weeksbury, Knott county, a distance of 26 miles. The work involves 450,000 cu. vd. of excavation and embankment, the construction of five tunnels from 140 ft. to 775 ft. in length, and 10,000 cu. yd. of masonry work. The maximum curvature is 10 deg. and the maximum grade with the traffic 1.9 per cent.

This road is elevating its tracks for about a mile through Defiance, Ohio. The work involves the laving of a second track, closing the last remaining gap on the east end of the Chicago division, the construction of bridges over the Auglaize river and the W. & E. canal, the construction of subways at Jefferson. Wayne, Clinton and Summit streets and the reconstruction of subways at Washington and Francis streets. New passenger and freight facilities are also being provided. The total cost of all improvements is estimated at \$530,000. The North American Railway Construction Company, Chicago, has the contract for the subway masonry, grading and paving; the Pittsburgh Construction Company has the contract for the false work in the river, and the Carmichael-Dryder Company, St. Louis, Mo., the contract for the bridge masonry.

THE CANADIAN NORTHERN has let a contract for a line from Kamloops, B. C., to Kelowa. Work on a new bridge over the Thompson river has already been commenced, as well as for the grading southwest from Vernon, B. C.

THE CHICAGO & EASTERN ILLINOIS plans to erect a passenger station at Danville, Ill., at an approximate cost of \$95,000. The structure will have concrete foundations, brick walls with stone and terra cotta trimmings and a hollow tile roof. The Clarke Construction Company, Danville, Ill., has the contract for the train sheds. The structural steel will be furnished by A. Bolter's Sons, Chicago.

THE CHICAGO & NORTH WESTERN, the Chicago, Burlington & Quincy, the Minneapolis & St. Louis and the City of Peoria (Illinois) have jointly awarded a contract to the Widell Company, Mankota, Minn., for the construction at Peoria, Ill., of a reinforced concrete viaduct to carry Adams street over the tracks of the above railroads. The structure will be approximately 1,100 ft. long between abutments, and will rest on 29 piers. The cost of the work is estimated at \$100,000, which will be shared by the city and the railroads.

THE CHICAGO, MILWAUKEE & ST. PAUL plans terminal improvements at South Beloit, Ill., which will cost about \$65,000.

This road is also planning the construction of terminal facilities at Atkins, Iowa, to cost about \$614,000. The improvements will include a 26-stall roundhouse, a 90-ft. turntable, a 154-ft. cinder pit, a coal-handling plant, a power house 50 ft. by 80 ft., a blacksmith and machine shop 50 ft. by 90 ft., a storehouse 50 ft. by 100 ft., an ice house and other buildings, as well as a modern yard for handling increased traffic. The concrete work will probably be done by company forces, and bids have been asked for in connection with the grading.

THE ERIE is making improvements on County Road, Secaucus, N. J., which include the construction of a 36-stall roundhouse to have 115-ft. stalls and a 100-ft. turntable, a machine shop, a power house, a storehouse and a complete engine terminal. The foundations of the buildings will be of concrete, while the superstructures of the roundhouse and machine shop will be of frame construction and the power house of tile. The Robert Grace Contracting Company, Pittsburgh, Pa., has the contract for the work, which is estimated to cost \$650,000.

THE GRAND TRUNK has started work on new repair shops at Port Huron, Mich., which will cost approximately \$700,000. There will be eight buildings in the group, which are intended to accommodate 30 passenger and 75 freight cars at one time. About 15,000 ft. of new trackage will be required.

THE ILLINOIS CENTRAL has awarded a contract to the Lynch Construction Company, Monmouth, Ill., for the raising of the tracks at five points on the St. Louis division, totaling about five miles. Work has also been started on a change of line and grade between Evers, Ill., and Effingham, five miles, for which the above company has the contract.

THE JACKSONVILLE TERMINAL COMPANY has started condemnation proceedings in the Circuit Court to acquire land necessary for the site of the proposed new passenger station and tracks in Jacksonville, Fla. This is the first legal step taken in the construction of a \$2,000,000 project. Plans for the station building, which will cost about \$1,000,000, are now being completed by New York architects. Engineers are already on the ground planning the preliminary work which will begin soon.

THE KANSAS CITY TERMINAL will make terminal improvements at Kansas City, Kan., at an approximate cost of \$4,-000,000, which include the erection of two \$100,000-passenger stations, two freight stations, a double-deck, double-track bridge and a long double-track steel viaduct over the Kaw river and the laying of five miles of new track. The work involves the use of 17,000 tons of steel and 40,000 cu. yd. of masonry. A contract has been let to the American Bridge Company for the fabrication of the 17,000 tons of steel required for the bridge and viaduct.

THE LOUISIANA RAILWAY & NAVIGATION COMPANY will build a passenger station at Rampart street, New Orleans, La., which will be 36 ft. high, 50 ft. wide and 250 ft. long, of brick and concrete construction with a granite front. Work will be started about September 1. Freight facilities will also be improved. The total cost of this work is estimated to reach \$350,000 to \$500,000.

THE MISSOURI, KANSAS & TEXAS has awarded a contract to widen its roadbed between Osage, Okla., and Wybark, which involves approximately 168,000 cu. yd. of excavation.

THE NEW YORK CENTRAL, in connection with the Pennsylvania, has commenced the elimination of grade crossings with six of the principal streets in Erie, Pa. The work will extend over a period of about five years, and in connection therewith a modern passenger station will be constructed.

THE NEW YORK, NEW HAVEN & HARTFORD will spend about \$250,000 in improvements to freight and passenger terminals at New Haven, Conn., although definite plans are not yet made.

THE NORTHERN PACIFIC has awarded a contract to Siems, Wickham & Company, St. Paul, Minn., to grade a branch line from Dixon, Mont., to Polson, a distance of 33.75 miles.

THE PENNSYLVANIA LINES WEST have awarded a contract to the C. R. Cummins Company, Chicago, to build double track from Columbus, Ohio, to Lewis Center, 15 miles, and the work is now under way.

THE PENNSYLVANIA RAILROAD has awarded a contract to W. F. Trimble & Sons Company, Pittsburgh, to construct a 14-stall roundhouse at Derry, Pa. The structure will be of brick and wood with a wood-block floor, wooden rolling doors and built-up roofing, and will cost about \$75,000.

This road has also awarded a contract to Warren, Moore & Company of Philadelphia to build two freight houses at Harrisburg, Pa., at an approximate cost of \$350,000. Both buildings will be of reinforced concrete, the inbound house being 44 ft. long by 50 ft. wide and four stories high, while the outbound house is 470 ft. long by 20 ft. wide and one story high.

THE SEABOARD AIR LINE has awarded a contract to the Vaughan Construction Company, Shawville, Va., for the con-

struction of a portion of the 10 miles of line between Hamlet, N. C., and Gibson. This work is part of a plan to establish a low-grade line from Hamlet, N. C., to Savannah, Ga., via Charleston.

THE SOUTHERN PACIFIC will build a 10-story steel-frame, brick and concrete office building on Market street, between Stewart and Spear streets, San Francisco, Cal., which will be 275 ft. wide by 290 ft. long. Over 2,000 115-ft. piles will be driven to furnish a foundation for the building. The eight top floors will be used for general office purposes by the Southern Pacific, and all of the first two floors, except space on the first floor for the district freight agent, will be rented to the public. The estimated cost of the building is \$1,750,000. Bliss & Fayville are the architects.

THE WASHINGTON-NEWFORT NEWS SHORT LINE has filed applications with the War Department at Washington for the approval of its plans for bridges over the Potomac, Rappahannock and York rivers. This company was chartered in Virginia last January to build a railroad from Newport News, Va., to Washington, D. C.

THE WHEELING COAL RAILROAD, a subsidiary of the Pennsylvania Railroad, has been incorporated in West Virginia and has adopted a location for a railroad from a point on the Pennsylvania-West Virginia state line, near Majorsville, to a junction with the Wheeling Terminal Railway at Wheeling, in Wheeling Creek valley. The survey has been made for that part of the line in Pennsylvania, which will extend from a point on the Pennsylvania-West Virginia state line near Majorsville east to Marianna, where a connection is proposed with the Millsboro branch of the Pennsylvania Railroad. Application has been made for a certificate of public convenience covering the construction of the line in Pennsylvania, and after that has been granted a company will be organized and a location for the route adopted.

STRUCTURAL STEEL

THE BALTIMORE & OH10 has ordered 300 tons of bridge steel from the American Bridge Company.

THE BOSTON & MAINE has divided an order for 200 tons of bridge steel between the American Bridge Company and the Fort Pitt Bridge Works.

THE CHICAGO, BURLINGTON & QUINCY has ordered 1,478 tons of bridge steel from the American Bridge Company.

THE CINCINNATI, HAMILTON & DAYTON has ordered 300 tons of bridge work from the American Bridge Company for bridges in Ohio.

THE DENVER & RIO GRANDE has ordered 288 tons of bridge steel from the American Bridge Company for bridges in Colorado and Utah.

THE DULUTH, MISSABE & NORTHERN has ordered 201 tons of steel from the American Bridge Company for a bridge over the White Face river at Kelsey, Minn., and 115 tons of steel from the same company for a bridge over the St. Louis river at Forbes, Minn.

THE LEHIGH VALLEY has ordered 400 tons of steel from the Pennsylvania Steel Company for a bridge at Rochester, N. Y.

THE NEW YORK CENTRAL has ordered 700 tons of steel from the American Bridge Company for a bridge in Youngstown, Ohio.

THE ST. LOUIS SOUTHWESTERN has ordered 267 tons of bridge steel from the American Bridge Company for 2 single-track pony truss spans.

THE SEABOARD AIR LINE has ordered 2 bridges, aggregating 800 tons of steel, from the American Bridge Company to repair flood damage.

THE SOUTHERN RAILWAY has ordered 8 bridges, with a total of 700 tons of steel, from the Virginia Bridge & Iron Company, Roanoke, Va., for flood repair work.

TRACK MATERIALS

THE CANADIAN NORTHERN has ordered 15,000 tons of rails from the United States Steel Corporation.

THE HAVANA CENTRAL has placed orders with the U. S. Steel Corporation for 10,000 tons of steel rails, which will be rolled at Chicago.

THE CANADIAN PACIFIC has placed an order for 10,000 tons of steel rails with the United States Steel Corporation.



SUPPLY TRADE NEWS

PERSONAL

C. FURNESS HATELY has been elected president of the National Surface Guard Company, Chicago, succeeding the late James T. Hall.

WALTER D. THOMAS, for many years representative in the southeastern states for the Rodger Car Company, Chicago, died July 10.

T. F. FLANAGAN, assistant sales manager of the Pyrene Manufacturing Company, New York, has been appointed general sales and advertising manager.

JAMES A. MCINTOSH, a member of the contracting firm of McIntosh Brothers, died in Milwaukee on July 28, at the age of 71 years. Among other work, Mr. McIntosh constructed a considerable part of the Pacific Coast extension of the Chicago, Milwaukee & St. Paul.

J. L. TERRY has become associated with the sales department of the Q. & C. Company, New York. Mr. Terry was formerly with the Denver & Rio Grande, was later purchasing agent of the Denver, Laramie & Northwestern, and subsequently served as superintendent and general manager.

A. C. GARRISON has been elected president of the Corrugated Bar Company, St. Louis, Mo., to succeed his father, D. E. Garrison, deceased. A. L. Johnson has been appointed vicepresident and general manager, and W. H. Kennedy, vicepresident and treasurer. W. M. Armstrong, vice-president and sales manager, has resigned.

THOMAS J. DRUMMOND, president of the Lake Superior Corporation, the Canadian Iron Corporation, and the Algoma Steel Corporation, Ltd., died suddenly August 6 at his summer home in Castine, Me. Mr. Drummond was born in Tawley, Ireland, September 26, 1860, and received his education in the public schools of Montreal. In 1882 he became a partner in the firm of Drummond, McCall & Co., of Montreal, manufacturers of iron and steel, and in this connection aided in the founding of the Montreal Car Wheel Company, the Canadian Iron Furnace Company, the Radnor Forges and the Drummond-McCall Pipe Foundry. He was also president of the Algoma Central Railway, and held directorships in the Canadian Car & Foundry Company, the Cockshutt Plow Company and the American Iron and Steel Institute.

GENERAL

THE SQUIRE-COGSWELL COMPANY has been incorporated in Chicago and will take over the railway supply business formerly carried on under the name of Willis C. Squire & Company.

THE BETHLEHEM STEEL BRIDGE COMPANY of Delaware has been organized to take over the business of the Pennsylvania Steel Company with headquarters at Steelton, Pa. The officers of the new company are G. H. Blakeley, president; Thomas Earle, vice-president; B. H. Jones, secretary and treasurer, and F. A. Shick, controller.

THE RAIL JOINT COMPANY, NEW YORK, has made the following announcement: "The Bonzano Rail Joint Company, as well as the Q. & C. Company, by advice of their counsel after investigation of the Thomson and Thomson rail joint patents owned by the Rail Joint Company, have recognized the utility and validity thereof, and have taken a license thereunder in order to utilize the Thomson and Thomson novel system of metal distribution, for head reinforcement, in connection with their Bonzano types of splice bars. Accordingly, notice is given by the Rail Joint Company that the aforesaid companies are authorized under the Thomson and Thomson patents in the manufacture and sale of the Bonzano type of splice bars having the Thomson and Thomson system of metal distribution for head reinforcement."

AMERICAN RAILWAY EQUIPMENT IN THE FAR EAST

Continued interest in the markets of the far east, Australia and South Africa has led the Bureau of Foreign and Domestic Commerce, of the Department of Commerce, to undertake an investigation of the field for American railway equipment and supplies in that section of the world. Frank Rhea, of the division of valuations of the Interstate Commerce Commission, has been appointed special agent to make the investigation, and is already engaged in making arrangements for conferences with manufacturers, contractors and selling agents, which will be held during a preliminary trip to the principal manufacturing centers in this country. This preliminary trip will be made in September.

When the special agent has learned what information the manufacturers in this country want concerning railway conditions across the Pacific, he will go abroad and make a careful study on the ground of the conditions as they affect railway construction, equipment, traffic, the probable extension or reconstruction of railways, tramways, etc. While all specific opportunities for securing orders will be promptly reported, the real purpose of the investigation is to gather together the fundamental facts and conditions that will enable the American manufacturer to consider intelligently the different fields, and to determine whether it is to his advantage to enter any of them.

Manufacturers and others who wish to get in touch with Mr. Rhea before he leaves this country should address the Division and Commercial Agents, Bureau of Foreign and Domestic Commerce, Custom House, New York.

TRADE PUBLICATIONS

Wood CONSTRUCTION AND FIRE LOSSES.—The National Lumber Manufacturers' Association, Chicago, has issued a 15-page booklet pointing out some of the errors in the commonly accepted ideas regarding the large fire losses resulting from timber construction and presenting a large amount of data regarding actual and accurate comparison. This book contains a large amount of information of value to those interested in wood construction from the standpoint of the fire hazard.

MORTAR.—The Hydrated Lime Bureau of the National Lime Manufacturers' Association has issued a 32-page booklet describing a series of tests conducted by J. S. Macgregor, professor of civil engineering, Columbia University, on the effect of adding hydrated lime to cement mortar used in brick work. This booklet contains a large amount of interesting information regarding these tests, showing that the use of hydrated line results in a greater strength at a less expense for materials.

STEAM HAMMERS.—The National Hoisting Engine Company, Harrison, N. J., has issued a 20-page catalogue describing the National steam pile hammer. The booklet contains tables giving the dimensions and other characteristics of the five sizes of these hammers and is illustrated with photographs showing the hammers in use on various kinds of construction work. A 12page pamphlet has also been issued describing steam hammers No. 6 and No. 7, weighing 650 and 150 lb., respectively, which are designed especially for use in driving wood and steel sheet piling.

STEEL POLES.—The Bates Expanded Steel Truss Company, Chicago, has issued a 48-page pamphlet describing the onepiece steel poles formed by shearing and expanding special steel Jsections, which are rolled to five different sizes. The book describes the method of manufacture. It gives complete data on the properties of the poles, on the methods by which they are installed and the various fittings, such as cross-arms, lamp and trolley wire brackets, caps, etc., which are used with these poles. Several pages are devoted to handbook data particularly applicable to this product.

VALUATION STUDIES.—The railways entering Chicago have formed a committee to study the highly specialized problems involved in the valuation of large terminals. The complicated network of tracks in this city makes advisabble their consideration as a whole. In collecting construction costs, much benefit will be secured from the exchange of data between the different carriers. The committee consists of one man from each road.



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WE GUARANTEE that of this issue 6,877 copies were printed; that of these 6,877 copies, 5,749 were mailed to regular paid subscribers, 78 were mailed to advertisers, exchanges and correspondents, and 1,050 were provided for new subscribers, copies lost in the mails and office use. The *Railway Maintenance Engineer* has applied for membership in the Audit Bureau of Circulations.

The account given on another page of this issue of the reconstruction of an old bridge, while it relates to a struc-

Economical Bridge Renewals

ture of modest proportions and involves well-known construction methods, deserves serious consideration as illustrating the economies to be obtained by the intelligent use of

reinforced concrete in bridge repair and reconstruction. While it would have been possible to underpin and jacket the old masonry piers with plain concrete or stone masonry, it would have been a much more expensive and awkward piece of work. The abutments of this bridge deserve still more attention, and to those interested it would be time well spent to make estimates comparing the cost of the abutments used with mass abutments carried down through the embankment or with high wing abutments placed in the position of the two piers. It would also be of interest to consider the use of creosoted piles in place of the reinforced concrete piles.

The Roadmasters' Association is to be commended for the uniformly high grade of the committee reports pre-

Excellent Committee Reports

sented at the convention this year. Increased interest has been shown in the work of this association and these results are reflected in all of the association's activities. The first

step in the preparation of these reports was the selection of live subjects for study. No topics of more direct interest to track men could have been selected than those on the possibilities of maintaining a uniform track force throughout the year, the non-spacing of joint ties, and the equating of track values. All of these problems

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are of direct interest, concerning which there is a wide difference of opinion at the present time. Therefore, very frank discussion on the floor of the convention by a large number of practical track men cannot help but be beneficial. Of particular note this year is the evident care given the preparation of the reports. They not only reflect credit on the officers and committees for this year, but set a new high mark which succeeding administrations will have difficulty in surpassing.

The per diem on a car is as sure as death and taxes, and woe unto him who unnecessarily delays the release of

Releasing
Cars
Promptly

a car, particularly if it has been used in non-revenue service. With the menace of a car shortage throughout the country not many months ahead, the pressure to secure the release of cars is much heavier at the present time than

it has been for a long time in the past. It is a well-known fact that men engaged in the ad-

ministration of maintenance or construction work on railroads are compelled to spend a considerable portion of their time and energy in securing the prompt release of the cars consigned to them with company material. It is only at times of great financial depression, when there is an enormous car surplus, that this situation is relieved.

The rental of a car, whether expressed in per diem on a foreign car or calculated as the fixed charges against a car owned by the home road, or in terms of its potential earnings in revenue service, is a tangible quantity, and unless close attention is given to the matter, enormous charges may pile up.

It is entirely possible, however, that under certain cir-



cumstances the zealous efforts to secure the release of cars promptly may result in additional expenses of another kind that will more than offset the savings in car rental. An additional work train may be called out to "clean up the road" when the car rental saved may not be sufficient to pay for the cost of the extra train service. Similarly a large part of the time of a gang of laborers may be wasted by moving them a long distance to unload a car when, if delayed a day or two, it might be possible to do the unloading at a much smaller expense. It is also possible that in a rush to release a car its contents may be unloaded in such a position as to require the rehandling of the material a few days later. Examples such as these all represent definite waste of time and money, but as compared with the per diem on a car they are decidedly intangible when it comes to making the inevitable explanation for delay. Rules may be inflexible and explanations hard to drive home, but a dollar is a dollar whether in terms of car rental or wages of men, and it is the duty of the maintenance officer to decide in each case what action will result in the greatest net economy and then to act in accordance with this conclusion if within his power to do so.

REMEMBERING LOYALTY

DURING the recent controversy with the four brotherhoods of train service employees, the railways called upon their men in other branches of the service for assistance in the threatened crisis, and it was a source of much satisfaction to observe the manner in which these other employees rallied to the aid of the roads. There is no question but that the loyalty of these men would have assisted greatly in defeating a strike had one been called. In this contest the men, particularly in the unorganized branches of the service, felt that the stand of the employers was in their interest, as they knew that any money forced from the roads by the four brotherhoods (whose members are already the highest paid men in railway service) left that much less to be distributed among the others.

Now that the entire matter has been deferred until January 1, and it is probable that the Adamson eighthour law, which was enacted hurriedly under a threat of the brotherhood leaders, will be contested in the courts, it is hoped that the roads will not lose sight of their other employees and of their relative claims for consideration for increases in pay.

The largest group of employees, aside from those involved in the controversy, consists of those in the maintenance of way department. A class of particularly deserving men are the foremen, and especially the section foremen, who comprise an army of approximately 45,000 men in the United States. Their responsibility is equal to that of any train conductor. They must insure the safety of the track day and night throughout the year, regardless of weather conditions. The risk of accident they know is as great as that incurred in the train service, their work being particularly hazardous in the busy terminal with its almost continuous train movement. Their loyalty is notable, and was strikingly illustrated by a recent incident on a western road. Agitators had led the foremen on one division to organize a union, to present demands for increased pay and to strike when these demands were refused. A few days later, while these men were out on a strike, a storm of unusual severity washed out the line in a number of places and train operation was seriously interfered with. That night, regardless of the strike, these foremen were found back on the track patrolling their sections. This contrast

with the spirit manifested in the brotherhoods of train service employees deserves recognition.

Efficient, loyal track foremen are absolutely essential to safe operation. Lack of attention to this group of men in the past has resulted in many cases in less efficient employees taking the places of those of the older school, as they have retired from the service. With this condition existing and with the rewards of organization held up before them, it may only be a few years, unless the policy of the managements is changed, until the men of the track department are thoroughly organized, their efficiency reduced and the difficulties and cost of maintenance of way materially increased, while at the same time the roads will be forced to grant the men the increases which they now hesitate to authorize. We will then have an enlarged payroll with these other disadvantages which can be avoided if the loyalty and efficient service of the track foremen are properly recognized at the present time.

THE RECLAMATION OF SCRAP

ONE of the judges who examined the contributions received in the contest which closed recently on The Reclamation of Maintenance of Way Scrap Materials, has called attention to the fact that nearly all of them were prepared by men in the stores department, and almost none by employees of the maintenance of way department, which is most directly concerned. He stated, further, that this harmonized with his observations regarding the relative interest shown in this work by the men in the two departments; that the maintenance of way department on most roads had paid very little attention to this subject, and that the special interest which has been created in this work during the last few years has resulted almost entirely from the efforts of the stores department.

Unfortunately, his observations are largely correct. While it is to the credit of the stores department that it has seen and grasped this opportunity to save money and has proceeded to effect important economies, it is unfortunate that the maintenance of way department, to whose credit many of these savings go, has not taken a more active part in the conduct of this important and constructive campaign.

The maintenance of way department uses over \$250,-000,000 worth of materials annually, or nearly \$1,000,-000 on each working day, and its opportunities to effect economies are correspondingly great. In a large measure the means of doing this are within its own control. One reason for the absence of interest in this subject is a lack of appreciation of the money value of the materials on the part of the men of all ranks in the department. While the purchasing and stores departments have before them continually the materials used in terms of dollars, the maintenance of way department has not emphasized this sufficiently. As a result, the men are more extravagant with tools and materials than they would be if they had a proper realization of their value. It is only very recently and on a few roads that the men have been advised of the cost of the supplies they are using, and, in general, they have handled them without giving any consideration to their value. This has not necessarily led to waste and extravagance, but it has permitted opportunities to effect economies such as the one referred to here to pass by unnoticed.

The maintenance of way department should give this subject more attention, for it is just as much to its interest to reduce the cost of operation by effecting economies in the reclamation of materials as in the relaying of rail or the painting of buildings. The stores department cannot do the best reclamation work unaided. Some men have stated that more money has been spent in reclaiming certain tools than they were worth, but they have seldom offered the stores department the benefit of their constructive criticisms and determined for them the maximum economical limit of expenditure. Others have objected to the use of second-hand materials as inferior for certain work, but they have not co-operated to ascertain where they can be employed to the best advantage. If the stores department is to continue in charge of the reclamation of maintenance of way materials, it is essential that the maintenance of way department extend it full co-operation, for the latter should be as much interested as the former in effecting a reduction in the cost of operation.

When one studies this subject surprisingly large economies are found to be possible. The maintenance of way department of one road, which has followed an active policy of scrap reclamation for a number of years, found recently that it could reclaim enough track bolts this year to fill its entire demands, an important saving in view of the present high prices. This is indicative of a wide variety of opportunities for the efficient use of maintenance of way materials.

LECISLATION AVERTS STRIKE

THE wage controversy between the railways and the four brotherhoods of train service employees, which has been in progress throughout most of the year and which has occupied a large share of public attention for several weeks, has been temporarily, although by no means permanently, settled by the action of Congress in passing the so-called "eight-hour" day. This requires the railways to pay 10 hours' wages for eight hours of work, and overtime at pro rata rates, pending an investigation by a commission.

Of course, it is perfectly well understood that this step was taken by Congress under strong pressure both from the labor brotherhoods and from the President, and in the effort to meet the emergency created by the threat of a strike on September 4, Congress itself had little intention of doing more than postpone the issue until after election. It lacked both the time and the courage necessary to adopt either a more comprehensive or a more drastic program for the purpose of making such a situation impossible in the future, although it well understands that it will have to face the issue in another form next winter.

While most people have reason to be glad that a disastrous strike has been averted, those who have been at all familiar with the relations between the railroad managements and the organizations of train employees in recent years and with the way in which this particular settlement was brought about, will naturally regret that it was made in such an unsatisfactory and inconclusive manner, and many railroad officers will feel that as a substitute for arbitration of such controversies, politics has few advantages as compared with the method of settlement by force.

The speeches in which members of Congress have placed themselves on record on the subject for campaign purposes indicate that a large number of those who voted for the bill were by no means deceived into thinking that they were passing a real eight-hour law. They knew that on its face the bill provided rather for an increase in wages for a majority of the highest paid employees of the railroads than for any reduction in hours, and they knew that in either reducing hours or increasing wages for these employees they would be discriminating against

most other railroad workers, but, as one Senator expressed it, the purpose was merely to "bridge the chasm" until after election. This was the democratic view. Republicans said that Congress was being coerced into passing unconsidered legislation "at the point of a gun."

But whatever view be taken of the matter, it appears certain that the entire question is to be taken up again this winter in Congress. The Newlands investigating committee has decided to make the subject a part of its inquiry, and there is some possibility that the ultimate result will be a regulation of some of the phases of the labor problem which need regulation as much as any other phase of the transportation problem ever did. President Wilson has stated that the plan is to take up his entire comprehensive plan for dealing with the question, which includes provision for compulsory investigation before a strike may be lawfully declared, as well as provision for an increase in freight rates if made necessary by increases in wages.

The fact that Congress was compelled to jump through a hoop at the behest of the labor organizations in such a public manner may give the public some idea of the pressure that the railroads have been subjected to for some years, and the effect of this object lesson in the end may be valuable.

Having passed a law that will relieve the fatigue to which the members of the four brotherhoods are subjected because of long hours by providing them with two more hours of overtime pay and an increase of 25 per cent in the hourly rate, the President and Congress have now gone on a much needed vacation. The legislation was justified on the ground that "the idea of the eight-hour day was fundamentally sound," although the sponsors of the law, for well-known reasons, were interested in its application to only a certain group of railway employees. No concern seems to have been felt as to any fatigue on the part of the maintenance of way men or other railway employees, and as a result there will be no change in the working schedules in this department. Roadmasters will continue to climb on to the rear end of "number six" as she leaves at seven a. m., and their office hours will be as heretofore, from eight p. m. to ten p. m., The master carpenter, the foreman of water or later. service and the maintenance engineering party will conform to their habits of the past and spend at least half of their nights on the small of their backs in "the smoker" or on the settees of a way station waiting for daylight. Section foremen will follow past conventions as to the patrol of tracks on stormy nights. No strike for an extension of the eight-hour basic day to maintenance of way is anticipated in the near future.

Meantime, the 82 per cent of railway employees not involved in the recent controversy should recognize the fact that by passing a law expressly to raise the already very high wages of the 18 per cent of the employees who were involved in it, Congress and President Wilson have made it much harder than it otherwise would have been for the railway managements to give the 82 per cent of employees what they are entitled to. The great majority of railway employees have the strongest reason for regarding with dissatisfaction and disgust the recent proceedings at Washington in behalf of the "big four" brotherhoods, especially in view of the fact that circumstances indicate strongly that they were a direct result of a political frameup. And the 82 per cent of railway employees have every reason to be discontented and disgusted with the course adopted by President Wilson and Congress, and they will have about five and one-half times as many votes to cast on election day as the mem-bers of the "big four" brotherhoods.



TO THE EDITOR:



HOLDING TRACK LABOR

FAYETTEVILLE, TENN.

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TO THE EDITOR:

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In so far as the South is concerned, I have learned from actual experience that the best way to retain good section labor is to distribute the work as near uniformly throughout the year as possible, thus using practically the same number of men the year round, and to furnish them with comfortable houses to live in and sufficient fuel for winter use. In some classes of track work one trained man can do more than three untrained ones, and he is also safer. Green men are liable to get hurt, to injure someone else, or to cause accidents which may result in loss of life and the destruction of property.

Because men are commonly laid off in the fall of the year, it is frequently impossible to obtain a sufficient number of trained men in the spring to do the season's work. Consequently it is necessary to depend upon such labor as the farmers do not want, with the result that the section forces cannot complete the scheduled program and it is necessary to do a considerable portion of the work with extra gangs. This, of course, is a more expensive method.

To anyone who is not familiar with the method, questions naturally arise as to the economy of distributing the work uniformly throughout the year. The system, however, has had a fair trial in the South. While the days are shorter in winter than they are in summer, men will do much more work while the weather is cool than when it is hot. Again, work is not delayed during cold weather on account of buckling track, which is one of the most dangerous conditions with which a section foreman has to deal. It is true that there is some rough weather in the South during the summer months, but this does not seriously interfere with the work.

When the entire year's work is done during the summer season there is not enough work to be done during the winter months to employ the men which must be retained for emergency work, with the result that there is considerable waste of labor. If the work was distributed throughout the year there would be sufficient for the men to do during the winter months as well as to take care of emergencies that might occur.

The completion of all work during a limited period in the summer frequently calls for a rush that makes it impossible to do all of the work with sufficient thoroughness. A piece of newly-surfaced track cannot stand properly unless the cuts are ditched and the embankments are properly shouldered, and there is not always time to do these things in a short working season.

Although section foremen are poorly paid, they are in a position to make friends for the railroad, especially among the farmers. If the section foreman conducts himself as a gentleman, every farmer along the line will regard him as a neighbor and friend. This will constitute an asset which will go a long way toward the settlement of stock and fire claims and other controversies which frequently arise between the farmers and the railroad. Even where matters must be carried to court, the standing of the section foreman and his men in the community will be of material benefit to the railway company. The fact that the foreman is regarded as a good citizen makes him worth just as much to the company on the witness stand as an employee who is better paid. In

view of these considerations, it is to the railroads' interest to offer the best possible inducement to retain men of good morals and living habits on the sections. Such inducements could include good houses, fuel and ground for gardens, chicken coops, pig pens, etc.

R. A. EASLEY, Track Supervisor, Nashville, Chattanooga & St. Louis.

THE INSPIRED INVENTOR

CHICAGO, ILL.

Attention has been called at different times to the able assistance given by the public to the managements of the various railroads in developing new ideas for devices which will cheapen transportation. The Patent Office has freely encouraged and ably assisted the inventors in bringing forth many new contrivances of which no railroad man had ever heard before, but which will save the railroads millions. No further experience or familiarity with railroads seem to be necessary than that to be obtained by an occasional ride on a train. An interesting example of an invention fostered by this sentiment is illustrated in the following letter from a man who has discovered a new use for the extra rails and rail rests along the right-of-way, which he had observed in his travels:

"I have been granted patent No. —— on the improved nut-locks.

"I also have noticed that at intervals all along your right-of-way you have sets of three posts sunk into the ground and carrying a rail held in a horizontal position which is the grade of the road at that point or a reference which you can refer to when need be, I suppose.

"The nut-lock that I have been granted a patent on is adjustable to :-1/200 of an inch. Now, if you set the rail spoken of on three sets of two (each) iron wedges, set together points on and drawn together and held by means of a bolt (see drawing) which had a number of holes in the body of the bolt proper, so as to allow further adjusting, you would have an easy and permanent means of setting the grade reference rail, and resetting if need be.



THE WEDGE TO SUPPORT THE RAIL

"I wish that you would look over this matter and inform me the best price that you can pay for the same for all railroad purposes.

"Most respectfully yours,"

I am curious to know if the inventor ever saw a rail rest carrying two rails, and to know what reason he might have assigned for the presence of the second rail, unless there were two or more tracks.

PAUL M. LA BACH, Assistant Engineer, Chicago, Rock Island & Pacific.





The New and the Old Ways of Handling Rails.

■ LEVEN contributions were received in the contest on the Reclamation of Scrap Maintenance of Way ▲ Materials. These papers were turned over to A. S. Baldwin, chief engineer of the Illinois Central, and E. J. Roth, purchasing agent of the Monon, who awarded the first prize to J. G. Kirk, district storekeeper, Chicago, Rock Island & Pacific, Silvis, Ill., and the second prize to Andrew Graham, assistant general foreman of the reclamation plant, Atchison, Topeka & Santa Fe, Corwith, Ill. The other contributors in this contest included John Reinehr, foreman rail saw mill, Chicago, Milwaukee & St. Paul, Savanna, Ill.; F. B. Grant, foreman scrap dock, Chicago Great Western, Oelwein, Ia.; I. G. Stutsman, superintendent track and switch shops, Chicago, Milwaukee & St. Paul, Tomah, Wis.; H. E. Rouse, general storekeeper, Chicago Great Western, Oelwein, Ia.; J. G. Talbot, foreman of reclamation plant, Seaboard Air Line, Portsmouth, Va.; W. M. Jeffers, general manager, Union Pacific, Omaha, Neb.; D. G. Curtis, inspector of stores, Chicago, Burlington & Quincy, Chicago, Ill.; J. E. Conroy, district storekeeper, Chicago & Northwestern, Missouri Valley, Ia.; Charles Williams, supervisor, Kanawha & Michigan, Quincy, W. Va.

RECLAMATION ON THE ROCK ISLAND By J. G. Kirk

District Storekeeper, Chicago, Rock Island & Pacific, Silvis, Ill.

The reclaiming of material from scrap, while not a new subject, is one that is receiving more and more attention on all American railroads, and with the increasing prices on new material, it becomes more and more important that the maximum results along these lines be obtained.

The Rock Island began to enlarge on its scrap-handling facilities and reclamation plants in 1906, so as to handle scrap and reclaim material more systematically. At that time a new scrap dock was erected at Silvis, Ill., where the general shops and general stores are located. The structure was made from second-hand bridge lumber, and all of the handling of scrap at that time was done by men with wheelbarrows. In 1908 a four-ton gantry cantilever-type crane was purchased and installed; in 1911 a second crane of the same type, but of ten tons capacity, was purchased and installed, and at the same time the dock was extended to double its capacity. With the completion of the new facilities orders were issued that all the scrap from the railroad should be sent to Silvis, where, with the plant provided and with the organization which has been built up, men thoroughly trained in the handling and reclamation of scrap go over every piece received, properly classifying the material for sale and reclaiming that fit for further use. In 1913 a five-ton gantry crane was purchased for the handling of maintenance of way material, such as frogs, switches, boilers, pumps, concrete bars, etc., also to handle the scrap rail. These facilities are all the Rock Island has today, although further extensions and improvements are contemplated and will be made as early as practicable.

In the reclaiming of material on any railroad, it is of prime importance that handling of the scrap and the reclaiming of good material from the scrap should be done as economically as possible, otherwise the maximum saving cannot be realized. To illustrate what can be done along these lines, the following figures show what has been accomplished on the Rock Island. They are based on the tons handled in and out:

Year.		Tons Handled.	Cost of Handling.	Cost per Ton.
1906*		. 2.598	\$ 679.59	\$0.261
1907		20,325	4,993.09	.245
1908		47,780	7,002.00	.148
1909		34,877	4,275.99	.122
1910		53,953	4,954.09	.091
1911		74,710	6,189.93	.082
1912		73,080	5,789.25	.079
1913		92,234	7,732.52	.083
1914		88,210	7,179.52	.0813
1915		103,460	7,951. 3 6	.0768
- 17	1 100/ 1	• • • •	.11	

*Figures for 1906 are for last three months only.

It will be noted that the installation of machinery to handle the scrap resulted immediately in economies in handling. Had the cost of handling scrap in 1915 been as high as in 1906 it would have cost the Rock Island \$19,049.33 more to handle its scrap. While the above figures show in dollars and cents what has been saved along this line the pictures at the head of this article and in Figs. 1 and 2 show the new and old ways of handling scrap and scrap rail, and illustrate more graphically how this economy has been brought about.

It may be thought by some not thoroughly versed in the plan of handling in use on the Rock Island that on account of the low cost some of the features of reclaiming material may have been sacrificed to reduce this cost. This, however, is not true, as the economy in handling has been brought about almost entirely by a reduction in the costs of unloading and loading. The cost of sorting does not offer as great a possibility for economy as the



other two operations, for the reason that every piece of material has to be handled by hand and carefully scrutinized to get it into its correct scrap classification or to reclaim it. The picture shown in Fig. 3 illustrates more clearly how the sorting is done. It will be noted from the photograph that the men have no running



FIG. 1. HANDLING SCRAP WITH A MAGNET.

around to do to sort their material. It is unloaded from the cars into the center of the sorting bin with the crane, and the sorters then throw one piece at a time into the various small bins provided for scrap and reclaimed material. As soon as the small bins are full they are emptied by the cranes with magnets either into cars being loaded out or into the larger storage bins.

During 1915 the Rock Island reclaimed \$655,842 of material of all classes. These figures include material for both mechanical and roadway departments. However, as this article deals with roadway materials only, those items of reclamation pertaining to that department will be used.

To begin with, the reclaiming of material on the line is encouraged and an effort is made to save as much of it locally as possible, as it is realized that the handling of this material and the unnecessary haul occasioned by sending all of it, whether serviceable or not, to a central station for reclamation and return, costs considerable



FIG. 2. HANDLING SCRAP BY HAND.

money on account of the extra labor and haul occasioned as well as the necessity for a larger investment in unapplied material because of the greater length of time it is kept out of service. No particular good is accomplished by sending all second-hand serviceable material to a central reclaiming station other than to pile up a large paper showing of material reclaimed, while if the material is reclaimed locally where practicable and returned at once to service (although the figures as to the material reclaimed may not be available), the railroad will receive a greater real benefit on account of the greater economy in handling in this way. The standard section house and scrap dock in use on the Rock Island is an example of what can be accomplished along this line and is shown in Fig. 4. The construction of these docks, may at first thought appear to be unnecessary, but it has been found that they go a long way to establish system by providing a place for everything and keeping everything in its place, and they can be cheaply con-structed from second-hand lumber. Scrap, as soon as made, is picked up and such articles as track spikes, track bolts, rail anchors, etc., which can be used again are reclaimed and placed in the section house to protect them properly, and any material which cannot be repaired or used locally is placed in the scrap bin for shipment to the central reclaiming station.

It is important that the scrap be kept moving as rapidly as possible, in order that the revenue to be derived from its sale be obtained as early as possible, also so that the usable material may be returned at once to service. With the idea of expediting the movement of scrap, and at the same time avoiding accumulation, there is in force on this road a regular loading schedule for each division, one division loading its scrap on the first, another on the third of the month, and so on. By following this schedule the divisions are cleaned up at least once each month.

After all the reclamation which can be economically handled in the field is taken care of, the scrap moves to



FIG. 3. SORTING THE SCRAP.

the central station, where it receives the final inspection. Among the items which are being reclaimed at the Silvis plant are track shovels. This is a simple procedure, requiring only the use of an anvil and vise and such tools as hammers, chisels, etc. The operation consists of removing good handles of shovels from broken blades and vice versa, and attaching the good blades and handles so reclaimed together. Thus good, serviceable shovels are obtained with the purchase of practically no new material, with the exception of a few rivets. During 1915, 2,577 track shovels were repaired in this way at a saving of \$824.57.

The guard rail in Fig. 5 was made from rail reclaimed from the scrap. These are being manufactured at a cost of approximately 35 per cent of the purchase price of new ones, and their service in track will be as long as new material. On roads the size of the Rock Island a saving of \$4,200 yearly should be realized in this item alone.

The switch point 11 ft. long shown in Fig. 6 has been cut back from an old 15-ft. or 16½-ft. point standard for main line. These 11-ft. points are used for yard



and side tracks only. The old points are cut off and new points planed onto them at a cost of from 60 to 65 per cent of what the longer points formerly used to cost. A saving of approximately \$3,000 yearly can be made in this way. On roads not possessing a frog shop arrangements can no doubt be made with the various frog manufacturers to take care of these repairs at a considerable saving over the purchase of new material.

The track tools in Fig. 7 were sent in for repairs. During 1915, 15,270 track tools of various kinds were reclaimed and repaired at a saving of \$4,787.94. These repairs can be made in any ordinary blacksmith shop.



FIG. 4. SCRAP DOCK AT A SECTION HOUSE.

The roadway signs, flanger, stop, whistle, slow and release signs in Fig. 8 were made in the shops from flues and iron and sheet steel reclaimed from scrap. During 1915, 112 flanger, 1,020 whistle, and 431 temporary slow and release signs were made up in this way at a saving of \$608.

During 1915 the following material was reclaimed:

		Saving.
47	derail stands	\$ 10.43
31	derails	232.15
49	head rods	98.20
17	connection rods	18.11
58,706	tb. plates	. 433.23
3,713	rail braces	. 420.23
2.375	rail anchors	346.96
44,050	tb. track spikes	. 402.19
53	hand-car wheels	
325	the boat spikes	4.36
4,230	tb. screw spikes	75.70
163	slide plate braces	20.64
3	sets slide plates	29.17
26	sets heel block plates	21.76
Т	otal	\$2 236 90
	Jai	φ2,200.90

The following are some of the items that were repaired and returned to stock during 1915:

	Saving.
588 switch stands	\$ 4,098.27
108 frogs	1,434.09
8 roller rail benders	898.65
3 jim crow benders	49.27
258 pieces switch material	256.83
203 11-ft. switch points	407.09
993 hand and push cars	16,275.08
15,270 track tools	4,787.94
810 track jacks	2,833.74
109 velocipedes	2,000.98
18 motor cars	2,318.69
	A15 2(0 (2
1 otal	\$35,360.63

The central reclaiming station should also carefully watch the service being given by various articles of material purchased by the railroad and report any that fails to give satisfactory service as indicated by the scrap articles received. Any items purchased subject to guarantee and failing to fulfill the terms of the guarantee should be placed at one side and held for free replacement. From \$3,000 to \$5,000 per year can be saved in this way on maintenance of way material alone.



FIG. 5. A RECLAIMED GUARD RAIL. FIG. 6. A SWITCH POINT RECOVERED FROM SCRAP.

In the handling of reclamation on the Rock Island we have given careful attention to the feature of safety, and every item reclaimed has been put in perfect condition for all practical purposes. Great progress has been made in the past, and with the ever-increasing interest which is being shown in all departments, greater progress is expected for the future. A reclamation committee has been appointed, consisting of the chief engineer, general mechanical superintendent and general storekeeper, and sub-committees have been appointed on each division, consisting of the division engineer, master mechanic and storekeeper. These committees have meetings at least once each month and new items of reclamation are discussed and reported on. Splendid results are being



FIG. 7. TRACK TOOLS AWAITING REPAIRS (at left). FIG. 8. SIGNS MADE FROM SCRAP MATERIALS (at right).

obtained, as every member is trying to suggest some new item which can be reclaimed economically.

RAILWAY MATERIAL FOR JAPAN.—The Japanese Diet has appointed a committee to investigate the question of substituting broad gage for the present narrow gage on the government railways. It is expected that recommendations in favor of the work will be adopted in the next fiscal year's budget. The work of reconstruction would be started on the trunk line on the main island, with treasury funds amounting to \$10,000,000, the deficit to be covered from the railway funds.



The Selection of Culvert Pipes

A Discussion of the Relative Merits of Each Class of Materials for Use Under Different Conditions

BY L. W. DUFFEE.

Locating Engineer, New Orleans, Mobile & Chicago, Walnut, Miss.

A FTER the drainage area of a waterway has been determined, and the corresponding length or depth of the opening has been fixed, it remains to decide the type of structure to be used, whether a truss or a girder, or, in the case of concrete, whether a full center or a segmental arch. Perhaps it has not occurred to every engineer that the determination of the size, type, quality and strength of ordinary culvert pipes deserves a proportionate amount of his time and a study of the subject. Aside from discussions of the requisite area of waterways, and plans and specifications for standard masonry structures, there seems to have been little written on the subject of these smaller drains, whose needs can be supplied by simple pipe or box culverts, in spite of the fact that thousands of dollars are spent annually in their purchase.

In former days, and during the period of the greatest activity in railroad construction, the choice of small waterways was confined to brick or stone arches, timber or stone box culverts and vitrified clay and cast iron pipes. Stone was generally used in rocky country, and timber where rock was not at hand, the timber being replaced later with something more permanent. In each case the problem was to get the culvert that could be placed the quickest and most conveniently.

At the present time, when new construction is much more limited than formerly, the engineer usually has not only more time to choose the best, but has a much wider range of materials and types to choose from, and much better transportation facilities. More local factories have also sprung up. In the last decade or so there have been put on the market a number of new styles of pipes, in cast iron, steel, thin corrugated metal and concrete, and the more extensive use of creosote has brought back the use of timber—now placed in a different class, because of the protection given it.

The purpose of this article is not to lay down any fixed rules, but rather to emphasize the necessity and economy of a thorough study of each particular situation before making a definite choice. The writer does not think that any one style of pipe should be adopted for general use on any work of much size, but that several varieties should be adopted, in line with the several conditions that exist. If we compare vitrified clay, concrete, corrugated iron, lightweight lock joint cast iron and standard heavyweight cast iron water pipe from the standpoint of cost and durability, the clay pipe is the cheapest in 12-in., 18in. and 24-in. sizes, and plain concrete next; but in the larger diameters, corrugated iron leads in low cost. Reinforced concrete and corrugated iron compare favorably in the smaller diameters. After these, we find the lightweight cast iron, which shows a considerable jump in cost, followed by the standard cast iron pipe, which, being heavier, is naturally more expensive.

With the exception of possible frost damage, vitrified clay and concrete would ordinarily stand the test of time better than the others, provided they were, or could be, laid and maintained in the ideal manner, with prepared beds and well-built head-walls and aprons. Practical experience, however, goes to show that ideal conditions are not always possible to attain or maintain, and that uneven displacements occur which subject such pipes to stresses and destructive agents which they cannot always resist. Here is where a longer-jointed, or a lock-jointed pipe, even though less resistive to chemical deterioration, may actually prove the more durable, on a long test. Cast iron has some wonderful records along this line. Corrugated metal depends on its location, the chemical composition of the soil in which it rests, care in handling, laying and jointing, and protection afterwards, for its durability rather than on the resistance it shows to sulphuric acid in a laboratory test. This new product deserves careful consideration.

Perhaps any pipe now on the market will meet the requirements of a dead load, equivalent to the weight of the embankment above, if carefully placed. Unfortunately, this is a small portion of the many tests to which the pipe is subjected before it finds its resting place in the embankment. Plain concrete and vitrified clay, being brittle, get their edges knocked off in handling, or suffer more serious damage. Complete loss sometimes occurs in breakage, which must be charged into the cost of those that survive; weaknesses may develop which may not show until the pipe is laid. In the case of fills made by dumping from temporary trestles, or cableways, the culverts receive great impact which it is impossible to prevent entirely, not to mention loose clods or boulders which roll down the slopes and damage the uncovered ends. Under such conditions a joint is often displaced by the uneven settling, even if it escapes otherwise, weakening the remainder of the line. Corrugated metal, though having longer joints, is not usually designed to withstand such attacks.

Where the fill is high, and the stresses great, no chances should be taken, and only the strongest types should be used. Reinforced concrete, or heavy cast iron pipe would then be advisable. We might safely say that the heavy cast iron water pipe would answer any condition, but it is, of course, most expensive. One manufacturer makes cast iron pipes in three weights—"standard," "heavy" and "double heavy"—to meet the varying requirements of high and very high fills, especially when made by the above-mentioned method. Much economy can be practiced by selecting one that would be safe, but not unnecessarily so.

The requisite of weight resolves itself into cost, but means even more, for as the weight increases, the cost of freight and handling increases, and may demand special equipment to handle it, which is not otherwise justified. Especially is this true on new construction, where the material must needs be hauled by wagon across country, and, more often than otherwise, over bad roads. This will often equal one-half the initial cost of the pipe. In cases of long haul, we must look for the lightest pipe that meets the other requirements. Corrugated metal is only about one-fourth the weight of the next heavier. Whether nestable, or in tube form, it is decidedly the easiest and cheapest to handle, and it is thus worth straining a point to use it in the more isolated quarters. Its very lightness, however, makes it subject to washouts, especially

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at the ends, which are liable to be floated upward out of position, even if the remainder stays in place. The corrugations help to offset this to some extent, and if end walls are used, a very satisfactory culvert can be made with them.

Next to corrugated pipe, the lightweight cast iron is easiest to handle, as to weight, and is not subject to breakage or damage in transit. The standard cast iron water pipe, vitrified clay and concrete, are all about the same weight per foot, and heavier than the others. Another important item to be remembered is the weight per unit of joint, as one must take into consideration the means whereby this material is to be handled in its several movements. Thus the corrugated metal is made in approximately 10 and 20-ft. lengths, plain concrete and vitrified clay in 2-ft. lengths, lightweight cast iron in 3ft. lengths, and the standard cast iron water pipe in 12-ft. lengths. A comparison of these units for, say, a 36-in. diameter will show the 10-ft. length of corrugated pipe to weigh 500 lb.; the 2-ft. joint of concrete or clay pipe, 750 lb.; the 3-ft. joint of lightweight cast iron, 900 lb., and the 12-ft. joint of cast iron about 5,000 lb. This should all be duly considered.

Some general conclusions may be deduced. In placing any pipe, consideration should be given the probable cost of replacing it, in event of failure, destruction or natural deterioration. If any experiments are to be made, they should be tried only on low embankments. In cases of unusually high fills, no chances should be taken, but only the best material from every standpoint should be used. Owing to the excessive cost of replacing culverts, espe-. cially on busy lines, more attention should be given to their upkeep than has been done in the past. It is not uncommon to meet section foremen who have not even been told that the keeping of culverts free of obstructions is a part of their duties. Delinquency in this regard is probably most common on newly constructed roads, where much more attention is needed than later when the banks have settled.

In view of these and other reasons, the writer thinks that no pipe less than 18 in. in diameter should be placed under fills of 5 ft. and over; and that 36 in. should be considered the maximum diameter for a single line. Owing to the circular shape of pipes, when larger diameters are used in flat drainage basins, the water has to rise too high against the embankment before the full benefit of the opening is made available. Two lines of smaller pipe, being close to the ground, will get the water off much more quickly. This does not apply to ravines, ditches, etc., in which the run-off is confined to an area much the shape of the pipe itself. When replacing pipes on operated lines, the element of weight can be disregarded, as equipment will usually be available for handling the otherwise unwieldy sections.

Handling Track in a Gravel Pit*

BY KENNETH L. VAN AUKEN

T seems hardly necessary to state that the steam shovel is the most essential part of the gravel ballast pit equipment. When a steam shovel is loading from two to three cubic yards at each swing it is making money and making it fast. In the same way, when a shovel is held up and is not loading ballast, it is losing money. Furthermore, the overhead expenses, including the wages of the employees on the steam shovel and on track work, the cost of operating the locomotives and cars, the wages of the locomotive and train crews, and interest on the investment-continue whether the shovel is working or not. This indicates the great importance of a steam shovel being kept continuously at work. It hardly seems necessary to call attention to this seemingly obvious fact; but the writer has seen many articles on gravel-pit operation in which little was said concerning the handling of the track work in such a manner that the steam shovel will not be delayed.

There are a number of factors which influence the time that the shovel is actually loading ballast, but the principal requirements are a shovel that will stand hard knocks and which requires little repairs; and the handling of the track work in such a manner that the steam shovel will have its nose in the bank 24 hours a day, if necessary.

In the first place, the loading and storage tracks should be so arranged that empty cars may be handled expeditiously, and so that, if possible, there will be no delay in waiting for empties. This requires also that the train work be well planned and handled. Then, again, the loading tracks must be kept in sufficiently good surface and line to keep the cars on the track.

Nothing will run up the cost of getting out ballast as quickly as stub-end tracks. Outlets at both ends are absolutely necessary for efficient operation. If, on account of a desire to hasten the work, the shovel is stopped before completing the first cut, each succeeding cut will be shorter, and when the shovel approaches the end of the stub track it is only possible for the locomotive to spot one car so the shovel can reach it. Since each succeeding cut made by the steam shovel is shorter, the capacity of the pit constantly decreases while the cost of operation constantly increases.

It is advisable to keep both the loading track and the shovel on a line as nearly straight as possible, as curves increase the cost of pit operation excessively. Where a pit is being worked in which there are curves, the track should be gradually straightened out by taking the maximum cut in the bank at bulged points, and the minimum width at indented points.

After a cut has been excavated to the desired depth the steam-shovel engineer should make an effort to keep the bottom level, and also to keep the bank straight so that the loading track can be kept straight. Trouble is



FIG. 1. TRACK LAYOUT TO CUT SHOVEL IN WITHOUT DELAY.

frequently experienced and much delay occasioned by cars being derailed on curves in pit tracks, or because of irregularities in the surface.

It is in the handling of the shovel after it has completed a cut and while it is being moved back to start a new cut that most of the time is wasted in gravel-pit operation. Frequently this requires from three or four hours to a whole day, and materially increases the cost of loading.



^{*}Copyright, 1916, by Kenneth L. Van Auken.

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The old way of handling a shovel in a gravel pit was to wait until it had completed one cut and then to line over the loading track for a new loading track, "spur-in" the shovel and move it back on the same track. This meant a delay of a day or so while the track was being lined over and the shovel moved back. The extra cost of handling the work in this manner will justify the investment in many miles of track material.



FIG. 2. TRACK LAYOUT WHERE ROOM IS LIMITED AT PIT ENTRANCE.

There are several typical layouts which can be used to advantage in operating a pit, depending on the amount of track and switch material available. Under no circumstances should such a small amount of track material be reserved that there will not be enough to follow up the steam shovel with a new track while the old loading track is in use. Fig. 1 illustrates an efficient method of handling a gravel pit where it is impossible to obtain switches for use at either end of the track. The new loading track is kept built up behind the shovel and is surfaced and lined ready for use. After the shovel has completed the cut and while it is backing up, the connection between the old loading track and the new one is made by lining over and connecting at B.

The new loading track should be built originally in such a manner that no connection rails will have to be cut. This can be done by holding a tape line at the point (x), where the foreman will have to start lining the track over, with the opposite end at (y), the joint which is to be cut; then by swinging the end of the tape line at (y) over, a couple of stakes may be set approximately where the joint will come after the track is lined over. The first rails should be laid a couple of inches ahead of these stakes so that if they are forced back a little as the track is set up they will not be too long to make the connection. Of course, if they are too long they can usually be driven ahead by a gang of 12 to 16 men with a heavy rail.

Where there is not sufficient room to spur the shovel in and secure a straight cut at the beginning of the bank, a tail track (Fig. 2) should be built, the steam shovel run back onto it and then headed from it into the face of the bank. A more efficient method is possible if one switch is available at A, making it unnecessary to line the track over at that point when spurring the shovel in for the next cut. While the shovel is being moved back the connection is made at B. After the shovel is at work the switch may be taken out under traffic.

The most efficient method, possibly, is to use two switches, one at A and one at B (Fig. 1). Then when the shovel has been moved back, all that is necessary is to throw switch A to let the shovel in, and then to line up switches A and B for the new loading track; when both the shovel and the loading track are ready for immediate work.

Sometimes it is necessary to use more than one shovel in one bank on account of the large quantity of ballast desired for immediate use. In this case, a second shovel can be started in, pointed in the same direction as the first shovel, but never opposing it. The loading track for the second shovel will then be the stub-end track which is being built behind the first shovel. With a pit with entrance tracks at each end, this gives an entrance track for each shovel and prevents interference. If the shovels are pointed toward each other there will be constantly increasing interference as they approach each other. While with two shovels in a long bank, one following the other, the work can be handled to good advantage, though of course not so well as if each shovel had a double-ended track.

Line and surface are often neglected as not essential to the loading track. They are, however, very essential not that the track should be kept in as good condition as a main line, but that it may be good for the service demanded. Humps and curves not only make it more difficult to handle the loading train and thus cut down the number of cars that can be handled by one locomotive, but they are apt to cause derailments which result in costly delays.

Another thing which should be emphasized in the operation of the gravel pit is that the shovel should be headed for each cut so that it will get the full reach in the bank at the beginning. If the shovel is not started back far enough and does not load a full width at the beginning or end of the cut, the bank will become curved and cause a jog in the tracks as well as in the bank.

The illustrations and discussions herein have been of one end of the pit only. In general, the opposite end of the pit should be handled in whichever manner the available material suggests.

IMPROVED WEED EXTERMINATION EQUIPMENT

THE Atlas Preservative Company of America, New York City, has recently made important improvements in its equipment for the distribution of the chemicals which it employs in the extermination of weeds. With the equipment used previously it was necessary to equip the locomotive which pushed the train with additional air pumps to force the liquid forward to the



THE IMPROVED DISTRIBUTING CAR.

sprinklers. This arrangement was unsatisfactory, because of the inability to maintain a uniform pressure, which resulted in an uneven distribution of the chemicals on the vegetation. As an example, while results were perhaps satisfactory on an ascending grade, they might not be on a descending grade, owing to the higher speed of the locomotive. On roads where several hundred miles of line were to be treated, this arrangement was also



unsatisfactory from a railway viewpoint, for either one locomotive had to make the entire trip or it was necessary to fit up an engine on each division.

In the new equipment the amount of liquid applied to the track is under the control of the operator, and is not dependent upon the speed of the locomotive. This control allows the treatment to be applied as best suited to the condition of the vegetation. It also permits greater not fenced. A centrifugal pump located at the rear of the flat car and driven by a gasoline engine draws the liquid forward through the main to the sprinklers. The sprinkling head is carried on the front end of the flat car and is sectionally divided into five parts, each controlled by butterfly valves with extension handles reaching to a quadrant or by a quick opening valve on the 6-in. line, which completely shuts off the flow from the spray line.



A SKETCH OF THE DISTRIBUTING CAR.

speed in operation and an average of 100 miles of line can now be treated per day.

A sprinkling train for extensive work now consists of 5 or 6 tank cars discharging into a common main and a flat car carrying the sprinkler equipment. The locomotive pushes the train from the rear and can pull a special car for sprinkling an odorous compound to render the vegetation repellent to cattle, where the right of way is The operator sits in front of the quadrant and, by means of the butterfly valves, controls the flow as required by the condition of the vegetation. When crossing streams or bridges or when passing through station grounds, the flow can be completely shut off for any length of time without stopping the engine. A meter is placed beside the operator, so that he may know at all times the gallons of liquid applied per mile.

The Maintenance of Insulated Rail Joints

BY E. F. SCHERMERHORN, The Rail Joint Company, New York, N. Y.

HE use of insulated joints in track was forced by the adoption of track circuits. In the early days when track circuits were few, and rolling stock comparatively light, it was deemed sufficient to use the simplest form of insulated joint, i. e., a pair of wooden splice-bars, and the resulting weak spots in the track were considered to be a necessary evil connected with the use of track circuits. With the increase in the weight and speed of trains and the number of insulated joints in service, the insufficiency of this device was demonstrated. Improvements were made, looking to the increase of strength as a track joint, without impairing the efficiency as an insulating medium, and down to the present time, all improvements to all types of insulated joints have been made with this twofold object in view-efficiency as insulation and as a fastening and supporting device for the rail-ends.

This line of thought leads directly to the source of much of the trouble now experienced with insulated joints—a division of work and a division of responsibility. The average track man considers the insulated joint to be primarily a signal device, and consequently more or less out of his jurisdiction, while the signal man is interested only in the insulation afforded by the joint, and leaves its upkeep to the trackman. This division of responsibility leads to the neglect of insulated joints, and this neglect results in serious trouble and unwarranted expense.

Some roads have taken active steps to secure harmony and co-operation between the track and signal departments, with particular reference to the use of insulated joints, and these roads have fully demonstrated the beneficient results to be obtained through such a course, by decreasing the signal failures and maintenance expenses, as well as improving the morale through the removal of a source of continual irritation between departments. In view of the fact that any large road has thousands of insulated joints in its tracks, the cost of repairs and renewals as well as the signal failures due to improper application and maintenance of joints are worthy of the consideration of any operating officer who desires the greatest efficiency at the least expense.

It requires only momentary consideration to realize that an insulated joint cannot be made as durable as an all-steel joint, for with the introduction of insulating material between the parts of the joint structure, the durability of the joint is reduced to the basis of the durability of the insulating material, and no known material of this class suitable for rail joints can be compared with steel as to durability. But insulated joints can be made and are now in use, which, as track fastenings, are fully as strong and secure, and can be maintained to



fully as good alinement and surface as the ordinary allsteel joint. However, this joint must not only have all the care and attention which is necessary to properly maintain an all-steel joint, but this care and attention must be given much more frequently, in order to preserve the insulation from wear. For instance, it is a recognized fact that all joint bolts must be tightened frequently, in order to preserve the joint bars and rail-ends from wear; and in insulated joints where comparatively soft insulating material is used, and the wear is greater, the bolts must be tightened more frequently than in an all-steel joint, to take up this wear. Again it is known that joint ties must be tamped more frequently than intermediate ties, and it is reasonable to admit that both shoulder and joint ties under insulated joints must be tamped still more frequently, on account of the comparatively yielding nature of the insulating material.

Many a good device is prevented from doing its work properly through careless and improper application or installation, and this is particularly true of insulated joints. It has been the custom of many track men to slap in the rails and bolt them up hurriedly without paying particular attention to the fit, and this is being done with many insulated joints, to their great detriment. It is a great mistake to apply carelessly any kind of rail joint, for its efficiency depends upon securing full and complete bearing on all bearing surfaces. Owing to the design of rails now in use, the bearing surface on top of the joint bar is small and consequently the insulating material introduced at this place is subjected to heavy loads on a small area, and it is necessary to apply the joint so as to obtain all of this bearing, in order to secure good results. If the bar is applied in a cocked or inclined position, the bearing surface will be reduced to a minimum, resulting in all of the load being concentrated on a small area, and the insulating material is soon cut out.

In order to relieve the top insulation from the necessity of carrying the whole load on such a small surface, many insulated joints are made with steel and insulating base-members underlying and supporting the rail base. The object of the base-members is to help carry the load on their broad surfaces, thus distributing the load and wear on greater areas of insulation, and relieving the top insulations proportionately. Yet in spite of this evident object, many joints of this type can be found in track with their upper portions "cocked" and drawn in close to the rail web, and their base-members flaring out and down from the rail base, affording little or no support. Trackmen should realize the necessity of driving these plates in at the base so as to get full bearing and support, and yet it is surprising to find how often they fail to do so until told.

The following general rules may be suggested:

1. Before applying a joint, remove all scale, dirt and other foreign matter from the rail ends and joint parts. Clean, smooth bearing surfaces are necessary to obtain a good fit and durability.

2. Remove from the rail ends all burrs, lips and rough edges which might cut into the insulation. By cutting or filing these off before the joint is applied, time and trouble will be saved later on, through avoiding renewals of damaged insulation.

3. Never apply an insulated joint on a cut rail end. The rough and sharp surfaces will damage the insulation, and if bolt holes are inaccurately drilled, undue strain will be placed upon the insulating bushings. The rails can be passed by each other so as to place the cut end in the adjoining all-steel joint, and a good rail end in the insulated joint. Do not apply an insulated joint on battered rail ends, as the fiber will be crushed out quickly. It is usually possible to turn the rails, or pass them by each other, so as to place good rail ends in the insulated joints.

4. Do not attempt to apply an insulated joint when the opening between rails is too great. Close up the opening until it is filled by the end post; otherwise the bolts and insulating bushings will be damaged.

5. Never drive a bolt through an insulating bushing, as the latter will surely be damaged. The bolts can be inserted easily by hand, if the rails and joint parts are in proper position.

 $\hat{6}$. If the rail is worn, the insulating end posts will project above the rail head. This projection should be trimmed off flush with the rail head before the first train goes over; otherwise, the end post will be mashed and opened to the weather.

7. Tighten nuts alternately and equally, keeping the center bolts in the lead, and tap the bolt heads frequently while tightening. If the joint is of the base-supported type, it is important to drive in the base frequently while tightening bolts, so as to obtain the full base-bearing.

8. Support each end of the joint equally on good ties and keep the joint ties and shoulder ties well tamped at all times. When a joint gets low, the wear on the insulation increases. Provide good drainage for the ballast, so as to prevent churning joint ties.

9. If necessary, adze the ties carefully to give the joint a solid and even support.

10. Keep all bolts tight at all times. In a loose joint the insulation is quickly destroyed.

11. If the track creeps so as to reduce or increase the opening between rail-ends, the rail should be driven back and anchored with anti-creepers, so as to avoid cutting out the insulation. If the rails run together, the end post is crushed, and if they pull apart the bushings are crushed. Do not force rail ends apart with a chisel, as it will damage them and leave rough edges which will destroy the fiber.

12. Tighten all nuts several times during the first two weeks, until the joint parts get firmly set.

13. Keep all joints dry and clean when not in track. Dampness ruins fiber when not held tightly in compression, and dirt and cinders on joint parts interfere with their proper fit.

It may seem to some that the above directions are the essence of refinement in track work, but it has been fully demonstrated by the roads which follow these methods that the time and trouble expended in such operations are saved many times over by the increased durability and efficiency of the joint, and the infrequency of renewals and repairs.

A number of leading railroads have issued, in their standard blueprint form, detailed instructions for applying insulated joints, with drawings of the particular type of joint used, and the different parts of same. These are sent out to trackmen and signalmen as official instructions, and the resulting betterment of insulated joint conditions has demonstrated the advantage of such action.

THE SUEZ CANAL.—The tonnage passing through the Suez Canal last year decreased to 4,143,340 tons, as compared with 4,767,729 tons in 1914. The revenue collected declined from \$25,000,000 in 1913 to \$24,000,000 in 1914 and \$17,000,000 in 1915. The number of ships which passed through the canal last year was 3,708 or 904 less than in 1914. The number of British vessels which used the canal in 1914 was 3,078, of an aggregate of 12,910,-278 tons; in 1913, 2,736 vessels, aggregating 11,656,038 tons, passed through the waterway.





THE EARLY DAYS OF THE PENNSYLVANIA

Interesting Details of the Construction and Operation of One of the First Lines Built in This Country

> BY W. F. RENCH Supervisor, Pennsylvania Railroad, Perryville, Md.

THE Columbia and Philadelphia Railroad, the antecedent of the Pennsylvania, was one of the very first railroads built in this country. It was constructed by the State of Pennsylvania, and the work was authorized in 1828 previous to the opening of the Liverpool and Manchester railway in England. It began at Broad and Vine streets, Philadelphia, and terminated at Columbia on the Susquehanna river, 81.6 miles west.

It was completed as a single track line in 1833 and was at first operated by horses. Passing tracks 200 ft. long in the clear were built about $1\frac{1}{2}$ miles apart. The question as to which one should back to the siding when opposing teamsters met was a frequent source of contention. The controversy was usually settled by a fight, which was frequently very bloody. To stop these battles the road was double-tracked in 1834. About that time locomotives were introduced.

The first engines burned wood, and this continued to be the practice until 1853. All kinds of wood were used, and the fuel was fed to the fire box in half lengths of cord stock. A supply for a locomotive leaving each fuel station was two cords. Columbia, Lancaster, Parkesburg, Downington, Paoli and Philadelphia were designated places for taking on fuel.

The most prominent feature of the first locomotive was the stack. By reason of the scant clearance of the many overhead structures, the lowering of the stack was of frequent recurrence. The bell was also an important accessory, especially to the trackman, since its ring was depended upon to announce the low spots in the track.

During the first 20 years locomotives were distinguished only by name. One of the earliest was "Black Hawk." It was nearly square and resembled somewhat a large stove box. The cylinders were inclined about 30 deg. with the horizontal. This class was without injectors. When it became necessary to fill the boiler the train was stopped, four screw jacks were set at the corners, the engine was lifted clear of the rails and it was then operated as a pumping engine until the required supply of water was obtained.

The "Baldwin" engine succeeded the "Black Hawk" type and it had a frame of wood covered with sheet iron. It was equipped with an injector besides a hand pump on the running board for use in emergency. The engine

was still without housing and the engineer rode at the front, standing up during the entire trip. This class of locomotive had six driving wheels and no truck. The "Atlas" was the typical engine of this class. The "Lewiston" and "Chester" were two others. They were mainly used in drawing freight trains, but the "Atlas" was also used to run the "accommodation" between Columbia and Lancaster. This train was in reality an accommodation, since a signal to take on a passenger was honored at any highway crossing or even a fence corner.

The "Rogers" type came next, the first of the eightwheel locomotives. The "George Washington" weighed about seven tons and could draw 22 cars with a total weight, including lading of 119 tons. A trial trip with this engine one summer day in 1836 with a single eightwheel coach, carrying a party of about 40 people, showed the latent possibilities of this type. The run from Lancaster to Philadelphia, 67 miles, was made in 3 hr. 11 min. or at the rate of 21 miles per hour. The tourists caustically scored the unfortunate location with its frequent short curves. It was noted that the "locomotive bowed its chimney most respectfully at all the bridges.' The dense volume of smoke, impregnated with glowing sparks from the wood fuel, rendered the discomfort of riding outside very great. In the fall of 1837 this type of engine drew 35 cars with a total weight, including lading of 190 tons, at an average rate of 10 miles per hour.

The cars were the property of individuals and companies, while the motive power and the road belonged to the state. The average length of the cars was 14 ft. and their capacity about 3 tons. They were nearly all of the four-wheel type. A fixed rate of tolls was exacted by the state for the use of the road and equipment and a uniform passenger and freight tariff was observed. The cost of passenger travel was 4 cents per mile and the freight rate on merchandise 9.14 cents per ton per mile. The principal commodities carried were coal and lumber. The direction of loaded traffic was mainly eastward.

Two rival passenger lines, the "Eagle" and the "Phœnix," operated over the C. & P. in its early days. Each had its coach in the four trains that were scheduled in the two directions, the "Eagle" coach being known by its yellow color, and the "Phœnix" by its blue color. Each car had its own conductor. It is supposed the occupation of conductor was a lucrative one, since fares were mostly paid in cash. The morning train left Columbia about 8:30 and the evening train about 4:30. The night train arrived there about daylight and the day train



^{*}Abstracted from a paper by W. H. Wilson, presented before the Franklin Institute, Philadelphia, in 1840, supplemented by information secured from three men now living, of an average age of 85 years.

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about 4 p. m. The trip between Columbia and Philadelphia at first required 10 hours, but this was soon reduced to less than half that time.

The trip from Philadelphia to Pittsburgh in 1834 was made by train to Columbia, thence to Hollidaysburg by steam packet through the canal which ran along the east bank of the Susquehanna, and crossing over, skirted the south bank of the Juniata; thence over the inclined planes of the Old Portage to Johnstown; thence again by steam packet down the Kiskiminetas and the Allegheny to Pittsburgh. The trip from Columbia to Pittsburgh consumed $4\frac{1}{2}$ days.

TRACK CONSTRUCTION

Early track was designed for vertical rather than horizontal stability. The greater part of the new road was of stone blocks and edge rails held to gage by cross



AN EARLY "COALING" STATION.

sills or by ties at intervals. The blocks were almost entirely of sandstone from 20 in. to 24 in. long and 16 in. thick, and were undressed, except that the seats for the chairs were made smooth. The two holes side by side near the middle of the stone were 2 in. in diameter and were 6 in. apart on centers. Into these holes were driven locust or cedar plugs, which received the round spikes which held the chairs in place.

The bed for the stones was formed by depositing a layer of broken stone well rammed into two parallel trenches 28 in. wide and 22 in. deep below the finished grade. When the chairs and rails were placed and the stones brought to a good surface the trench was entirely back-filled with ballast. The stones were set 18 in. apart longitudinally, or a little over 3 ft. between centers.

The edge rails were of iron and weighed 41¼ lb. per yard. At first they were 15 ft. long, but later on an 18-ft. length was adopted for curves. The head was not unlike that of the present rail. The base was similar to the head, but smaller. The rails were held in place in cast iron chairs by iron keys. These frequently worked loose, and it was necessary to reset them constantly. Workmen with a regular patrol were assigned to the task of keeping them tight. The chairs weighed about 15 lb., those for the joints having a rib in the center which prevented the rails from moving endwise.

The total length of the double track line was 81.6 miles. Six miles of the track was laid with granite blocks, plated with flat iron bars; 18 miles was laid with wooden string pieces similarly plated, and the remainder, excepting short stretches over new embankments was built with stone blocks and edge rails, hav-

ing either ties at intervals or cross blocks of stone every 15 ft., to maintain the gage. On a few of the embankments wooden stringers and cross sills were employed. There was soon found to be a tendency of the blocks and edge rails to spread apart and ties were added on about 5-ft. centers. At first these were 7 ft. 6 in. long, but the size was then as now, 7 in. by 7 in.

The inclined plane at Columbia, which rose 90 ft. in 1,800 ft., was straight and uniform in gradient throughout. It carried two tracks and two loaded cars were drawn up while four empty cars were being let down. It was operated by a 40-hp. engine. The endless rope was of hemp $3\frac{1}{2}$ in. in diameter, with short hausers 10 or 12 ft. in length to attach the cars. One end contained an eyelet and the other had loose strands, by which it was tied to the power rope after a half hitch had been made. Display of the white side of a large disc in place of the red one was the signal from either end that cars were attached and ready for the power rope to be started.

The distance from the foot of the inclined place to the basin of the canal was one mile and the cars were handled over this section by horses long after locomotives came into use on the road proper. About 1840 the Columbia plane was replaced by a six-mile stretch of new road.

The Philadelphia plane, which was located just west of the Schuylkill river, was 2,805 ft. in length and rose 187 ft. It was operated by a stationary engine of 60 hp. The three miles of road between the foot of the Schuylkill plane and the terminal of the line at Broad and Vine streets was operated by two locomotives.

The C. & P. railroad was designed for a maximum gradient of 30 ft. per mile and the sharpest curve had a radius of 631 ft. The predominant curves were 5 deg. and 6 deg. About 70 per cent of the line was tangent. There were 22 bridges on the line, the ruling type having stone abutments and piers and wooden trusses, generally of the Burr type. The width of the roadbed was 25 ft., both in cuttings and on embankments.

PREPARING STEEL SURFACES FOR PAINTING

THE preparation of a steel or iron surface for painting should be such as will secure proper adhesion of paint to that surface. It is improbable that paint ever acts chemically on these metals; and the persistence of paint on iron is primarily a matter of adhesion, which may be lessened or destroyed by any unsatisfactory surface, and by the entrance or intrusion of solid or fluid material between the paint film and the metal.

Recently-rolled steel or iron is covered with a mill scale of anhydrous oxide, and, if painted at once, the paint never touches the metal, but is applied to the mill scale. If this mill scale ever comes off the paint comes with it, sometimes in scales. If the metal begins to rust by access of air and moisture, the rust penetrates under the mill scale and loosens it. Ordinary rust is hydrated oxide and stimulates further corrosion, but the anhydrous mill scale does not, and it is objectionable because it may crack off by unequal expansion or from other causes.

In addition to mill scale and rust, other objectionable surface coatings which are frequently encountered are dirt, grease, oil, water and frost.

In considering methods for preparing these surfaces for painting it is well to take account of the methods used to secure the adhesion of substances other than paint to iron or steel. Such cases are, for example, the

^{*}Abstracted from a committee report presented before the convention of the American Society for Testing Materials at Atlantic City, N. J., June 27-30.

electrodeposition of copper or other metals; the plating of iron by molten metal; the coating of steel or iron with a vitreous enamel, which is practiced in making enameled vessels for cooking and the like; and the application of varnish enamels, such as are used on bicycles and many other metal surfaces. In all these processes it is essential that the adhesion should be perfect; that is, that the coating should wear off from the outside, not peel off from the metal; and this is what is desired with paint. In all these cases it is universally believed to be necessary that the coating material should come in actual contact on all parts of the surface with the actual metallic surface of the iron or steel; the latter must be freed from all dirt and grease, and from all scale and rust, before the coating is applied. This is done by cleaning the surface with chemically active liquid, such as sulphuric acid, by the sandblast, and by other mechanical means, such as filing or polishing with an emery belt, and the like. Unless this is done it is found that the superimposed coating is likely to scale or flake off.

The thorough methods of cleaning by sand-blasting and pickling can be and sometimes are applied to structural and car steel for painting and for repainting, and undoubtedly are the best methods known for the purpose. They are, however, much more expensive than the ordinary method, which consists in scraping, wire-brushing and wiping spots of grease and oil with gasoline or benzine.

The sand-blasting method has the advantage over the pickling method in that it is more general of application, the pickling method being confined to the shop and generally to the material before assembling. It may, however, be of interest to know that good authorities maintain that iron or steel cleaned by pickling holds a coating more securely than that which is sand-blasted, and that this is owing to the rougher surface, viewed with a microscope, of the acid-etched metal.

The scraper and wire brush do not remove the firmlyadhering mill scale, in consequence of which most of the structural and freight-car steel is painted over mill scale. It must be remembered that all platers and enamelers insist absolutely on the complete removal of mill scale; therefore it must not be regarded as harmless, but it certainly is less dangerous than ordinary rust.

Builders of ships for service in sea waters have frequently required the pickling or sand-blasting of the steel parts which are to be submerged, in order to remove the mill scale, and it is the common practice to do likewise for steel passenger-car bodies. The removal of mill scale at the expense of incipient rusting is also sometimes attempted by the erection of steel structures without paint and allowing them to stand exposed to the weather for several months before painting.

In addition to cleanliness of surface, freedom from dampness, severe cold and frost is considered essential to the proper adhesion of paint. This may be accomplished by painting outdoors only in warm, dry weather, or by keeping the material under cover in warm dry air during the process of cleaning and painting. Heating of surfaces is also resorted to.

While for some purposes, such as sea-going ships and passenger-car bodies, there seems to be little question as to the final economy of incurring the additional first cost of the more thorough methods of cleaning, the economy of such methods for ordinary steel structures and freight cars is not so certain.

Reconstructing an Old Bridge

IN replacing the superstructure of a plate girder bridge on the Wheeling and Lake Erie it was found necessary to underpin the piers and provide two new abutments. The old bridge, as shown in one of the accompanying photographs, consisted of one deck girder span about 45



THE OLD BRIDGE

ft. long on cut stone masonry piers with approaches on either end, each consisting of a combination of a girder span supported by a pile pier at the outer end and several spans of pile trestle. The new superstructure consists of a new middle span 44 ft. 4 in. long and two approach spans each 65 ft. 7 in. long. The girders are of uniform depth, 6 ft. $6\frac{1}{4}$ in. back to back of angles.

Upon inspection the old masonry was found to be in good condition, supported on oak piling and timber grillages. The grillage in each case is 3 ft. deep with timbers 2 ft. center to center and with concrete filling the spaces between. The top of the first course of masonry is at the normal water level, making the bottom of the footing 4 ft. 6 in. below water level, the depth of the stream being approximately 7 ft.

To provide adequately for the Cooper's E-60 loading used in the design of the girders, it was necessary to increase the bearing area of the piers. This was accomplished by surrounding the footing of each pier with a new concrete footing supported on two rows of piles, bringing the new concrete up to the third course of stone



EXCAVATION COMPLETED FOR ONE OF THE PIERS


and carrying it 4 ft. below the bottom of the existing grillage. Thus the old foundation was completely encased, eliminating any possibility of scour and increasing the area of the base. The new footing was calculated to take the entire weight of the pier in the event of any



THE FOOTING REINFORCEMENT

slight settlement of the old foundation. It was reinforced with one-inch rods placed horizontally in both directions to insure that the new concrete would serve as a ring around the old footing and to enable it to support the pier. Short lengths of old rails were also used.

The extreme ends of the approach girder spans are supported in new pocket abutments, each carried on 15 reinforced concrete piles driven into the end of the old



THE ABUTMENT UNCOVERED

embankment. These abutments consist simply of a slab of reinforced concrete built monolithic with the back wall and side walls, the reinforcement providing adequately for the distribution of the load over the piles. Provision was also made for future second track in the design of these abutments. One of the accompanying photographs shows the excavation for the jacket for one of the pier footings when ready for the concrete. Quicksand was encountered in the work, making it somewhat difficult, but requiring no change in the method outlined. Notches were cut in the sides of the old footing to insure a better joint with the new concrete.

The concrete piles for the abutments are 16 in. in diameter and 40 ft. long, of uniform section from butt to point with a cast steel pilot on the point to facilitate driving. They were furnished by the Great Lakes Dredge and Dock Company from its plant at Cleveland, Ohio. The reinforcement consists of eight $\frac{1}{2}$ -in. diameter vertical rods with $\frac{1}{4}$ -in. rings, 16 in. center to center, each ring being wrapped once around each vertical rod. The piles were driven by company forces at a cost of 15 cents per lineal foot. The equipment consisted of an Ohio locomotive crane with a three-ton Vulcan steam hammer working 85 blows per minute. The piles were driven to refusal, most of them going the full 40 ft. through clay, gravel and quicksand.

The new girders were fabricated by the King Bridge Company, Cleveland, Ohio, and erected by the Ferro Construction Company, Chicago, sub-contractors, using a derrick car which lifted out the old girders and set in the new ones, working progressively from one end of the structure.

After the structure was completed, the abutments were back-filled with granulated slag. Owing to the fact that the under side of the west abutment was clear for some distance above the sloping surface of the old embankment, the slag filling was packed around the piles and also up under the abutment to avoid subsequent settlement of the filling behind the back wall. This was not necessary in the case of the east abutment, as some excavation was required to permit its construction.

The reconstruction of this bridge was planned and carried out under the direction of W. L. Rohbock, chief engineer of the Wheeling and Lake Erie. We are indebted to Edward U. Smith, formerly assistant engineer, for the information given above.

DRAINAGE ON LIGHT TRAFFIC LINES By Joe Rodman

TRACK drainage consists in affording opportunity for water to flow down hill. Consequently, the labor involved is ditching, grading, and the removal of obstructions, with the small variations of procedure necessitated by exigent track requirements. On non-swelling soils, small irregularities are of little importance, that class of soil being usually alluvial, which readily washes to a uniform grade or surface. Heavy clay, "gumbo," or adobe soils, on the other hand, swell to a troublesome degree as they absorb water. It is with these that careful observation and attention to detail will save a great deal of subsequent surfacing. Openings should be made for every puddle, however small, by shaving the crown from the rises on the lower sides and placing the surplus soil in the depressions. This should be done while the water is still standing, for there is no better indicator of irregularity than water itself. Ties should be "bled," by trimming the slope to an

Ties should be "bled," by trimming the slope to an even grade as indicated by the escaping water. On earth-ballasted track much future labor may be saved if the slope is cut about $\frac{1}{2}$ in. below the ends of the ties. This prevents the formation of other pockets by allowing for the increased swelling of the soil and the settling of the track on the water softened bed.

An important though simple expedient in the trimming of earth track is to instruct the laborers to cut the dirt to a shallow trough between the ends of the ties, as shown in Fig. 1. This allows the water to form a central rivulet as it drains from the raised portion between the rails and keeps it from working along the sides of the ties.

Pools formed in stone, gravel or slag ballast can often be drained by thrusting a lining bar deep into the subgrade and shaking it until the water finds a sub-ballast passage. Often in restoring scattered ballast a toe line of clay or other impermeable material will be formed, which, unless discovered and corrected in time, will retain water and keep the base saturated and soft. This is frequently the cause of depressed track at points where good ballast is present.

As a rule, drain boxes are too few and too small. Their scarcity causes the water to follow the track for long distances between outlets and their insufficient capacity often causes the back water to surmount the berm and flood the subgrade. A perfect system of track drainage implies surface boxes and flumes in plenty located to drain the greatest possible volume of water in the shortest space of time.

Notwithstanding standard specifications as to depth, track ditches should be graded to carry the water as rapidly as possible. For example: if the standard calls for a six-inch depth that should be considered an average, and instead of conforming to it throughout, the excavation should be decreased at the head of the ditch and increased gradually as the proportion of tributary water is received or according to the distance to the point of discharge, where it may be much more than the specified depth.

Undoubtedly the V-shaped ditches give the greatest amount of service for the least amount of labor. Not only do their shoulder lines remain sharp and clear for future cleaning, but the cleaning itself is minimized because the shape tends to concentrate the variable quantity of water in a central current that rakes the mud and debris from the ditch and drains to the last trickle. Beside the straight lines and tidy appearance of the Vditch, they are easily and cheaply excavated.

The lines for both sides may be measured and marked by a simple method. On a 1-in. by 6-in. board nail two sharpened cleats. Measure the desired distance from



A TEMPLET FOR DITCH CONSTRUCTION

the rail, then affix a shoulder guide on each side for the rail head, as shown in the drawing. As the template is moved along the rail the pointed stakes mark the straight lines of the ditch. To correct for variations of depth or water grade, one stake can be tacked to an ordinary track level with its length below the level corresponding to the vertical distance required between the bottom of the ditch and the top of the rail.

Five cents' worth of crude oil, thoroughly kneaded with a mixture of sand and clay dust, tamped around the head of an insecure drain box, may save many dollars in washout repairs. A few cents' worth of Portland cement mixed with clean, sharp sand will better accomplish the same end. A ditch excavated through sandy or "made" ground will retain its shape better if lined with a well-packed apron of dirt and crude oil. This mixture is almost impervious if tamped into place and subjected to a period of dry, hot weather.

Experimental Track in Holland

BY K. DEN TEX Utrecht, Netherlands

GREAT obstacle to the use of a reinforced concrete tie is its weight. Many of the designs which have been found too weak and sufficient strength has been secured only by adding material. But as the ties are already heavy, additional weight is objectionable. One way out of this difficulty is to cut the tie in two.

A tie fulfills a double function. It provides the necessary base to support the load on the roadbed, and it holds the rails to gage. As a support on the roadbed, reinforced concrete serves very well, but to limit the weight the lateral dimensions must be small. In fact, a round slab or foot placed underneath the junction of the rail and the tie would be the ideal solution. The other function, to hold the rails to gage, can be entrusted to a light tie of steel or wood, which materials, owing to their elasticity, are well adapted to that purpose.

A trial track based on these principles has been installed on the Netherlands state railways. This is shown in the accompanying photographs, one of which shows the stretch of track with the ballast removed. The length of this experimental section of track is 120 ft. It contains 30 steel ties of channel section, laid flat, reposing on 60 concrete slabs, with the intermedium of an equal number of wooden wedges. This track was built in December, 1914, in the main line from Utrecht to Amsterdam, which carries a traffic of 50 trains a day. The speed at this location is not



THE EXPERIMENTAL TRACK WITH BALLAST REMOVED

fast, as the distance from Utrecht, at which all trains stop, is only a mile. After a service of $1\frac{1}{2}$ years, the track is still practically as good as it was when installed.



One of the most important observations of this experiment is that the wedges do not work loose. The entire combination of the rails, ties, wedges and reinforced concrete slabs is strongly bound together by V-shaped bolts, which are hooked into the reinforcement of the



SECTION THROUGH A CONCRETE PEDESTAL

slabs. The wedges are of hard wood and have an inclination of 1 in 10.

The surface of the track is regulated by adjusting the wedges, the V-bolts being loosened in advance. The track has required very little maintenance work. The ties near the joints, which are laid opposite, have settled about $\frac{3}{4}$ in. more than the other. Although it was not yet necessary, the pair of slabs under one of these ties was lifted on a layer of gravel which was shoved under them. The tamping of the ballast under the concrete is dangerous for this material and has been avoided.

The concrete has been sufficiently protected against the shocks of the traffic by the wooden wedges and the tight attachments. It does not crumble, but on some



PEDESTAL AT A RAIL JOINT

of the slabs cracks may be seen across the bottoms of the center openings. The great feature of the track is its rigidity. Its weight, including the ballast reposing on the slabs amounts to 1,500 lb. per yard against 600 lb. calculated for the standard track of the Netherlands state railways, consisting of wooden ties and flat cast iron chairs. The weight of one slab is 440 lb. The cost of the track, calculated from normal prices before the war, is 6.15 per yard as compared with 5.70 for the standard track.

To keep the cost down to this reasonable amount the spacing of ties has been increased 4 ft. with a 2-ft. spacing of the joint ties. It is judged that rails weighing 92 lb. per yard are strong enough for this spacing if well supported. In fact, as the rail is subjected by the traffic to two systems of pressures, one from above and the other from the reaction of the supports below, there is no reason why the distance of the last-named supports should be so much closer together than the others, represented by the axles of the train.

By exact measurement the strain has been determined in the base of the rail between the supports and it has been found that, although the distance of the supports in the trial track was more than double that in the standard track, the strain was only about 50 per cent in excess.

It is not necessary to carry the concentration of support and attachments as far as it has been done with this trial track. The principal features of the trial are the employment of the wooden wedges and separate slabs under the rails and the depth of the bases of these slabs.

Durability and an easy, but thorough, maintenance of the track can be procured by this system. Ballast of inferior quality may prove sufficient. The laying of the track and the surfacing when the wedges have reached their limit of life is difficult, compared with the ordinary track on wooden ties, but the difference is not sufficient to be of any importance.

OCTOBER CONVENTIONS

THE twenty-sixth annual convention of the American Railway Bridge and Building Association will be held at the Gruenwald Hotel, New Orleans, from October 17 to 20, inclusive. From present indications the attendance and interest will exceed that of any previous convention. A large number of the members are planning to leave Chicago on Sunday morning, October 15, on a special train via the Illinois Central, stopping at Vicksburg National Cemetery en route and reaching New Orleans about six o'clock Monday evening.

The convention will open with an informal reception in the parlors of the hotel on Monday evening. The remainder of the program is as follows:

TUESDAY MORNING

Convention called to order ten o'clock. Address of welcome by city and railroad officials.

Reports of officers.

Appointment of special committees.

Election of new members. President's address.

AFTERNOON SESSION

Reading and discussion of reports on Water Supply, Floors for Shops, Round Houses, etc., Paint and Its Application to Railway Structures and Modern Methods of Driving Piles.

EVENING SESSION

Reading and discussion of report on Caring for and Handling Creosoted Materials. This report will be followed by an illustrated lecture by Dr. Herman Von Schrenk, consulting timber engineer, St. Louis, on Practical Considerations in the Handling of Timber.

Progress reports will also be submitted on Blank Forms for the Bridge and Building Departments' Use and Fireproofing Roofs of Wooden Buildings.

WEDNESDAY MORNING

Reports of nominating and auditing committees.

Reading of reports and discussion on Efficient Methods of Handling Work and Men. Station Buildings for Passenger Service Only and Economical Handling of Concrete on Small Jobs.



The afternoon will be devoted to an excursion on the Mississippi river, inspecting the water front terminals between the Stuyvesant and Chalmette docks.

EVENING SESSION

A banquet will be given at the Gruenwald Hotel.

THURSDAY MORNING

Report and discussion on Small Coaling Stations.

Unfinished business.

New business

Election of officers.

Selection of meeting place for 1917.

Closing business.

AFTERNOON SESSION

On Thursday afternoon a 38-mile automobile trip will be provided, covering the interesting features of New Orleans.

EVENING SESSION

The annual association dinner will be held.

FRIDAY

Friday will be devoted to an all-day trip by special train through the southern pine belt to Bogalusa, La., over the New Orleans, Great Northern and the New Orleans, Northeastern railways. The train will stop to enable an inspection to be made of the six-mile creosoted trestle over Lake Ponchartrain and also at Slidell to permit a visit to the Southern Creosoting Works. At Bogalusa the party will visit the saw mill of the Great Southern Lumber Company and a complimentary dinner will be provided at the Pine Tree Inn.

Indications point to an unusually large and interesting supply exhibit. The number of firms will show an increase of over 20 per cent, as compared with that of last year. Ample space will be provided for all exhibitors in a hall immediately adjoining the convention hall, and it is urged that any firm which has not yet made application should communicate with P. C. Jacobs, secretary of the Bridge and Building Supply Men's Association, care of H. W. Johns-Manville Company, Chicago. The following firms have already arranged to exhibit.

American Hoist & Derrick Co., St. Paul, Minn. American Valve & Meter Co., New York. American Valve & Meter Co., Cincinnati, Ohio. Barrett Mfg. Co., New York. Bird & Son, East Walpole, Mass. Philip Carey Co., Cincinnati, Ohio. Chicago Bridge & Iron Works, Chicago. Chicago Bridge & Iron Works, Chicago. Chicago Pneumatic Tool Co., Chicago. Jos. Dixon Crucible Co., Jersey City. Detroit Graphite Co., Detroit, Mich. Paul Dickinson, Inc., Chicago. Fairbanks, Morse & Co., Chicago. Heath & Milligan Mfg. Co., Chicago. H. W. Johns-Manville Co., New York. The Lehon Co., Chicago. C. F. Massey Co., Chicago. National Roofing Co., Tonawanda, N. Y. Geo. P. Nichols & Bro. Chicago.

Geo. P. Nichols & Bro., Chicago. Q. & C. Company, New York. Sinumons-Boardman Publishing Co., New York. T. W. Snow Construction Co., Chicago. Standard Asphalt & Rubber Co., Chicago.

The Texas Co., Houston, Tex. Toch Brothers, New York. U. S. Wind Engine & Pump Co., Batavia, Ill.

MASTER PAINTERS' ASSOCIATION

The plans for the thirteenth annual convention of the Maintenance of Way Master Painters' Association of the United States and Canada are complete. The meeting is to be held at the Hotel Walton, Philadelphia, on October 17 to 19, inclusive. The program, which was published in full in the September issue of the RAILWAY MAINTE-NANCE ENGINEER, consists of papers by railway master painters and paint experts on various topics related to the painting of railway bridges and buildings. A well-attended and enthusiastic meeting is anticipated.

The History of a Water Station

BY C. R. KNOWLES

General Superintendent of Water Service, Illinois Central, Chicago, Ill.

COMPILATION of the figures showing the consumption of water at Centralia, Ill., for 23 years Abrings to mind the enormous increase in the consumption of water by the railroads within the last quarter of a century. According to these figures, the consumption has practically doubled every 10 years. The amount used at Centralia in 1895 was 72,000,000 gal., while in 1905 it had increased to 141,404,000 gal., and in 1915 to 238,630,000 gal. It may be said in passing that the consumption in 1915 was 42,000,000 gal. less than that in 1914, because of a campaign against water waste. Except for this the amount used in 1915 would have been fully double that of 1905. While these figures as to the rate of increase may not apply to outlying stations they would certainly appear to apply to main line terminals. They are taken from actual meter readings throughout the entire period.

The first water supply at Centralia was secured from Shop creek and was barely sufficient for the few engines running into Centralia at the time the road was constructed in 1852. The additions to the motive power were very rapid during the first few years after the road was built and the demand for water soon outgrew the supply from the creek. A new water station was therefore established about two miles north of Centralia early in 1855 at a stream known as Crooked creek. The supply was apparently ample and there being but little contamination, the quality of the water was fairly good. This

pumping station was operated by horse power, the first pump being operated by one horse, and later as the consumption increased by two horses. The first steam plant was not erected until about 1858. During flood periods it was impossible to operate the horse power and an auxiliary tank and hand pumps were located high enough to be used when the stream was high. The tanks were located at the Crooked creek station and it was necessary to bring the engines out from Centralia for water. The supply for the shops at Centralia was secured from a well in the roundhouse, 12 ft. in diameter and 40 ft. deep. Locomotives were also supplied from this well when the supply was low at the creek. This well was dug in 1855 and was used for drinking water and shop supply for over 40 years. A well was drilled at the shops in 1857 to a depth of 1,500 ft. in an effort to secure artesian water, but with no success.

In 1859 the consumption of water had increased to such an extent that it was found necessary to build a dam across Crooked creek, forming a reservoir for the storage of water during the dry seasons. A 300,000-gal. reservoir was also constructed at the shops and walled with stone and the water station was enlarged and rebuilt, involving a 2¹/₄-mile pipe line of 4-in. cast iron pipe from the creek to the shops.

Another effort was made to secure a more convenient and satisfactory water supply in the vicinity of the shops in 1861 when a well 8 ft. square and 50 ft. deep was



sunk, with galleries running out 50 ft. on each of the four sides of the shaft. This well did not meet expectations, as it afforded only a limited supply.

As the old pumping station was destroyed by fire in 1865, it was replaced by a new brick pump house with a 40-ft. brick stack. A Weldon pump from the old Weldon shops, Chicago, was installed and two 40,000-gal. tanks were erected. A year later a second Weldon pump was added, a large intake sump was constructed at the river and new suction lines were laid. The four-inch pipe became inadequate for the supply in 1867. It was found heavily incrusted and was cleaned and part of the line was relaid with cleanout boxes every 100 ft. This proved only a temporary relief and 5,000 ft. of the four-inch pipe was taken up and relaid with eight-inch pipe in 1868. This pipe is cast iron and is still in service after being in the ground 48 years.

The history of the station for the next few years is incomplete, but it seems that the old Weldon pumps remained in service until the early eighties, when more modern pumping machinery was installed. The pumping equipment in 1885 consisted of a locomotive boiler and two 4-in. by 7-in. by 10-in. Worthington duplex pumps. The water was pumped through 12,240 ft. of pipe, 5,500 ft. of which was 8 in. and 6,740 ft. 6-in. pipe. There were two tanks, a 12-ft. by 12-ft. tank at the north yard and a 16-ft. by 22-ft. tank at the shops. The overflow from the tank at the shops was piped to the reservoir. Another pump at the shops pumped water from this reservoir for washing boilers and for fire protection.

In 1891 a contract was executed with the city of Centralia covering the joint use of Crooked creek reservoir. The consumption of water by the city and railroad outgrew the pumping equipment in 1903 when the city constructed its own plant. It was apparent shortly after this that Crooked creek was becoming inadequate for the demand, and it acquired a reputation for pollution.

In 1908 the supply failed and the city was practically out of water for over three months, the shortage of water causing an enormous amount of trouble and expense to the railroad. A temporary station was established at a small artificial lake about two miles south of Centralia. An additional pump and boiler was also installed at the Little Muddy water station 20 miles south of Centralia, a temporary station was established at Grand Tower 81 miles south of Centralia, and the hauling of water was begun. The water trains consisted of 20 large tank cars with a capacity each of from 8,000 to 10,000 gal., each train hauling about 200,000 gal. of water. In spite of the most rigid economy it required at least two trains a day to maintain the supply. The unloading tracks were converted into watertight troughs, additional troughs were laid to a reservoir and the water was repumped to the tank. It was necessary to haul water from October 30, 1908, until February 6, 1909, during which time 4,450 cars of water were handled at a cost of \$16,993.41.

Because of the total failure of the water supply, a committee of seven citizens was given authority in the summer of 1909 to devise and execute plans for an adequate supply. The Illinois Central gave this committee full support by agreeing to a substantial increase in water rates. A bond issue of \$50,000 was voted and the remainder of the \$158,000, which represented the cost of the new reservoir and pumping station, was guaranteed by citizens.

The new reservoir was formed by constructing a 650ft. dam across a valley about 8 miles east of and upstream from the Crooked creek pumping station. The submerged area is approximately 250 acres and the watershed is about 8 square miles with a capacity of the reservoir of nearly 1,000,000,000 gal. The water flows by gravity through a 20-in. wood stave main to the pumping station, which is located near the original site of the Crooked creek station.

A REVERSIBLE RAIL BENDER

A MONG track devices of comparatively recent introduction is a reversible rail bender placed on the market by the Reading Specialties Company, Reading, Pa. The bender is made right and left hand by the use of a removable hook, which can be taken out and reversed. With this bender it is possible to bend any section of rail to within 10 in. of the end without adding splice bars or another section of rail. Thus it is readily used for kinking stock rails at switch points without removing the points. The frame is made of heat-treated



THE RAIL BENDER.

cast steel having an elastic limit of 45,500 lb. per sq. in. and an ultimate strength of 78,000 lb. per sq. in. The screw is of special cold rolled steel and the bushing of special bronze. The screw is protected against bending action by placing the bushing in a trunnion so that the screw can change its position as the bending of the rail takes place. This reversible bender is being used by the New Haven, the New York Central Lines, the Louisville & Nashville, the Reading, the Erie, the Wheeling & Lake Erie and the Pennsylvania.

CONCRETING IN COLD WEATHER.—Sand and pebbles or broken stone used must be free from frost or lumps of frozen material. If these materials contain frost or frozen lumps, thaw them out before using. Mixing water should always be heated. Although adding common salt to mixing water will prevent freezing of concrete that has not hardened, there is a limit to the quantity of salt which may be added if the final strength of the concrete is not to be affected.

Sand and pebbles or broken stone and mixing water must be heated so that the concrete when placed shall have a temperature of from 75 to 80 deg. F. Some sands are injured by too much heat. The same applies to certain varieties of pebbles and broken stone. A temperature not exceeding 150 deg. F. will generally prove most satisfactory.

Warm metal forms and reinforcing before placing concrete. Be careful to remove ice and frozen concrete remaining on the forms from preceding work. Forms can be warmed by turning a jet of steam against them or by wetting with hot water.—Portland Cement Association.





The Banquet on Thursday Evening

THE thirty-fourth annual convention of the Roadmasters' and Maintenance of Way Association was held at the Hotel McAlpin, New York, on Sep-tember 19 to 22. The convention exceeded all previous records in attendance, over 250 members registering. An important feature contributing to this large attendance was the placing of a special train at the disposal of the western members by the New York Central, about 175 roadmasters and supply men and members of their families coming from Chicago on an all-steel train consisting of eight sleeping cars, an observation car, a club car and two dining cars. This train left Chicago at 6 o'clock Sunday evening and arrived at New York at 7 o'clock Monday evening. Officers of the maintenance of way department of the New York Central accompanied the train over their respective districts east of Buffalo, pointing out to the members those features of interest along the route.

The convention was characterized by unusual interest in the discussions and in the various activities. Although it was at first feared that the unusual labor conditions existing this year and the resulting delay in the completion of the season's work would prevent many roadmasters from attending the convention, they were present from points as far remote as California, Arizona and Montana. Over 150 roadmasters came from points west of Chicago.

The officers of the association during the past year were': President, Coleman King, supervisor of the Long Island Railroad, Jamaica, N. Y.; vice-president, M. Burke, roadmaster, Chicago, Milwaukee & St. Paul, Chicago, Ill.; second vice-president, A. Grills, general roadmaster, Grand Trunk, St. Thomas, Ont.; secretary, P. J. McAndrews, roadmaster, Chicago & Northwestern, Sterling, Ill.; treasurer, W. H. Kofmehl, roadmaster, Chicago, Milwaukee & St. Paul, Elgin, Ill.

OPENING BUSINESS

The convention was called to order at 10 o'clock Tuesday morning, by President King, who introduced J. M. Rice, general secretary of the railroad Y. M. C. A., New York, who opened the convention with prayer.

Ralph Peters, president of the Long Island Railroad,

welcomed the convention to New York on behalf of the railways." After paying a tribute to the loyalty and efficiency of the roadmasters as a class, and citing numerous experiences arising from his personal contact with them as an operating officer, he said in part as follows: "Let me suggest that you consider among other subjects how to restore the old-time loyalty and faith of the mass of employees, as well as of the public, in the integrity and honesty of those conducting railway business. You roadmasters, through your section foremen, and your general organization, are close to the farmers and to the local population along the lines of your respective roads. You know that your executive officers as well as your operating and maintenance officers are striving at all times to upbuild their properties, to give good service and to increase the traffic. You know how we are bowed down by rigid laws and regulations, especially in the manner of accounting for all the work that we do so that proper charges may be made for depreciation, for property abandoned, for Additions and Betterments and all the numerous details that have in recent years been placed upon the maintenance department, so that to-day practically every section foreman must have a clerk to keep his time and distribution books, while a supervisor or roadmaster must have a large force to make out all the reports required of him by the Commission.

"These things are the result of a lack of appreciation by the general public of the constructive work and upbuilding that is being done by the railroads. You men, by the force of example, as well as by word of mouth can make friends for your companies, can make the people along the lines of your road understand definitely what the real facts are concerning the railroads, and the railroad managements.

"The officers responsible for your work are just as devoted and faithful in their efforts to get successful results as you men are individually. Trust in your officers and join with them in trying to put the railroads in proper light before the people of the country in order that those who are elected to the legislature, to congress or to higher positions may stop the foolish, unreasonable multiplication of laws affecting every branch of the



railroad service; laws that are depriving men of the individual rights guaranteed to them by the constitution. We all know your loyalty. We all know and appreciate your honesty, sincerity and fidelity as displayed in your everyday work. Let the people that you come in contact with everywhere know that every man in the railroad service is loyal and faithful in the discharge of his duties and is entitled to the respect of the community in which he lives. This will help the whole railroad situation more than anything else I can think of."

James Burke, superintendent, Erie Railroad, Chicago, one of the pioneer members of this association, replied to Mr. Peters on its behalf. He was followed by E. T. Howson, editor of the Railway Maintenance Engineer, who spoke on The Objects and Ideals of the Association.

Marcus M. Marks, president of the Borough of Manhattan, welcomed the association to the city of New York on behalf of the public. He was followed by W. M. Camp, editor of the Railway Review, who spoke on The Roadmaster, and by Robert Black, president of the

The Roadmaster, and by Robert association in 1894, who spoke on early reminiscences of this association before the formation of the American Railway Engineering Association, the Railway Signal Association, and the other organizations now existing in this branch of railway activities, and by J. V. Neubert, engineer of track, New York Central, who emphasized particularly the importance of the section foreman to a railway.

In his presidential address, Coleman King reviewed the activities of the past year. He stated that the number of new members received was larger than in any previous year in the history of the association. He referred at some length to the financial condition of the bulletin of the association, and to the fact that he ascertained early in his administration that it was not self-sustaining. As a result the contract with the publishing company was canceled and the

bulletin is now issued directly by the association. He urged close attention to the sessions of the convention and participation in the discussion of the reports presented.

The report of the treasurer showed a balance of \$714.55 in the treasury, a material increase over last year.

SEASONABLE DISTRIBUTION OF FORCES

In general the committee is of the opinion that all regular section work can be carried upon a practically uniform basis without regard to geographical locations or climatic conditions. The actual time of year, however, to start and finish work must depend upon the local conditions of the particular section or line.

The committee is in favor of a monthly payroll allowance and a yearly material allowance. A monthly payroll allowance gives a chances for quick curtailment in expenses which invariably affects the maintenance department first and at the same time gives maintenance officers opportunity to keep their payroll expenses well in hand. Heavy maintenance work often shows up quickly which cannot be foreseen and provided for in a yearly allowance. A yearly material allowance permits the company to purchase material at advantageous prices.

The committee is not in favor of standard maintenance forces the year around. It is necessary to take care of the heavy section work in from five to eight months. It is impossible in the northern half of the United States and Canada to spread this work out over the entire year. To carry the summer force, which would be required to take care of this work, the balance of the year when section work is light would result in a needless expense for the company. No heavy main line section should have less than five men in winter, and light branch lines less than three men. Replacing broken rails with proper flagging require at least this force.

A winter section force should be on the basis of 0.3 to 0.6 men per equivalent mile of track and on the summer basis of 0.7 to 1.2 men per equivalent mile of track. If section work could be distributed throughout the year there is no question but that a uniform force would be

desirable and efficient, but on account of the impracticability of so doing there would be no advantage in a force of this kind.

From November 1 to April 1 the weather is such upon the eastern, northern and central lines that track work cannot be handled with any assurance of economy. During this period the minimum "winter force" should be used, outside of handling snow and ice, in regaging and rolling rails, tightening spikes and bolts, repairing rightof-way fences, shimming, clean-ing up right-of-way and ditching. In the late fall or early spring all ties for the next year's renewals should be distributed by work trains upon sections along the line of road where they are to be applied. As soon as the frost is out of the ground, the entire section should be gone over, taking out shims, lining track and surfacing up bad spots. The full allowance of summer

forces to take care of heavy section work should be put on about April 1. Tie renewals would start about this time in main tracks and be completed not later than July 1. At the completion of the tie renewals in the main tracks, these tracks should be surfaced out of face, and the alinement corrected where necessary. Following main track work in the late summer, come the tie renewals and other work on sidings, including the renewal of switch timber. Track work should be discontinued a sufficient time in the latter part of August to permit the mowing and cleaning up of the right of way. The right of way should be burned over after mowing and kept free from dead vegetation and unsightly rubbish at all times.

The regular section force should not be required to lay new rail or take care of new ballast. This work ought to be handled by extra gangs. The size of gangs should be determined by the amount of work to be taken care of. At least half a day per week, preferably Saturday afternoon, should be devoted to cleaning up around station grounds, freight driveways and station buildings.

The final work of the season is the shaping up of shoulders, widening ditches, trimming grass lines and



President, the Roadmasters' Association.

going over the track for any poor surface or line which may have developed after the heavy summer travel.

The committee recommends a monthly payroll allowance; a yearly material allowance, and that the size of ance; a yearly material allowance.

M. P. Condon, N. Y. N. H. & H. (chairman); John Shea, roadmaster, D. & I. R.; J. B. Oatman, div. eng. B. K. & P.; J. Daugherty, roadmaster, St. L. & S. F.; D. McCooe, superintendent track, G. T.; F. N. Hanson, supervisor, C. & A.; N. McNabb, roadmaster, M. C.; J. B. Kelly, roadmaster, M. St. P. & S. S. M.; W. Cummings, roadmaster, D. L. & W.

INDIVIDUAL COMMENTS

The following individual comments were added by members of the committee: J. B. KELLY—The proposal for uniform forces throughout the year is worthy of consideration, but does not appear practicable for our northern territory. The adoption of such a plan where possible would aid in producing efficiency in our labor, and relieve us from the continued uncertainty of labor. I believe the open season in my territory is too short to



M. BURKE First Vice-President.

take care of the necessary work with the number of men that would be an average for all the year, based on the present summer and winter allowances for labor, and that the snow and ice conditions prevent an economical use in winter of the necessary summer force.

J. B. OATMAN—Forces can be better organized and become more efficient if the foremen are allowed a certain number of men the year around, so that it would not be necessary to lay off men in the fall and pick up new men in the spring. If one can secure the necessary supply of new ballast, a gang should be organized ready for work by April 25, this gang to consist of not less than 200 laborers in charge of a gentral foreman and enough assistants to properly handle the work; the gang to be placed in cars, tents or portable buildings so they can be changed rapidly from one location to another. This gang should place all the new ballast on two or three roadmasters' or supervisors' divisions.

The advantages secured by handling work in this manner are (1) Better supervision, as one foreman is in direct charge of all the work. (2) Better labor supply, as it will be easier to supply men for one large gang than for several small ones scattered over 200 or 300 miles of territory. (3) The work accomplished is nearer to standard, as the men are working only on one class of work. (4) Better results are obtained in handling supplies for one gang than for several. (5) It avoids a shortage of ballast where four or five gangs are working, as shipments would be made to one point. (6) A better handling of the setting of top of rail and center stakes. (7) A reduction in the number of slow orders, as it is only necessary to maintain slow orders in the territory where the gang is working. (8) The work will all be completed before the men are moved to a new location, not leaving a large amount of work to be finished by the section forces. (9) A decrease in the cost of work train service, as it is necessary to look after but one gang. (10) Accurate cost reports can be kept for one large gang better than for several small ones. (11) A decrease in the cost per mile over the present method.

An extra gang for relaying rail should consist of a general foreman, with the necessary assistants and from 75 to 80 laborers, to be located in camp cars cut out where rail is to be laid to avoid the use of a work train moving men to and from work. These laborers should be paid a higher rate or a bonus, depending upon the amount of work done. The gang should lay all new rail on several roadmasters' or supervisors' divisions, getting the work started and carrying it on ahead of the ballasting gang.

The benefits derived from handling work in this manner include (1) Better supervision. Work is all done by one gang instead of by several small gangs under foremen who are not thoroughly familiar with this class of work. (2) An increased amount of work accomplished per day per man. (3) A better distribution of material. Instead of unloading rail and fastenings at a number of places weeks in advance, the material can be distributed just before the men are moved to the job. Better results can be obtained by keeping all material properly picked up, sorted and disposed of. 4) A reduction in the cost of work train service. (5) A reduction in the number of slow orders. (6) A reduction in the cost of laying rail per mile. (7) Proper records of cost can be kept in different localities. As all material handled on a foreman's section goes through his hands, the foreman in charge of the section should handle and check all new material received. In the same manner all old material taken out of track, laid and shipped should be handled by him.

It would be impossible for a rail-laying gang to distribute material before they were placed on the work, as it would perhaps be moved from one roadmaster's or supervisor's division to another and all material should be handled before the gang is moved. This can be done by the roadmaster or supervisor, the general and section foremen co-operating with each other. All heavy track material should be handled with a rail derrick, locomotive crane or ditching machine, as one of these machines with 4 laborers can handle more track material in a

day than a gang of 40 men by hand.

J. DAUGHERTY — The practice recently originating on the Frisco, and which I think is a good scheme, is for extra gangs to work in Missouri and Kansas from April to November, then ship south to work in Oklahoma, Texas, Mississippi and Alabama during the winter months. In this way good gangs with good boarding outfits are well organized and it is only a matter of moving to the work and transferring them from one roadmaster's territory to another. By having the ex-

A. GRILLS Second Vice-President.

tra gangs in one territory the general superintendent and general manager can keep in close touch with the work being done, the material is followed up, ties are all inserted and surfacing is done. About September the ditching and bank widening should be given preferred attention in order to get the best results out of the work done during the summer.

The Frisco works a foreman and four men on main line and a foreman and three men on branches, on an



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average of $5\frac{1}{2}$ miles to the section on main line and 7 miles on branches. We find this is as small a force as should be kept and that this number can be used to good advantage.

From March 15 to April 15 the force should be increased to a double force and the roughest spots surfaced first and ties put in the places surfaced. After April 15 more force work should be done in the way of tie renewals and surface and line. Fences should be

built where needed, bolts tightened, and ballasting and rail laying will be in order. Both of the latter should be done with extra gangs.

SUGGESTIONS FOR DISCUS-SION

Economy of uniform track forces. Can we keep more men busy in winter doing work than has usually been done in summer?

Effect on the labor market and wages following the adoption of the uniform force plan where economical. Would it tend toward a better supply of better laborers?

Would it make more

stable the rate of wages and stop the usual step rate advance of summer?

Would it make unnecessary the employment of many floating and extra gangs on maintenance work and thus eliminate the evils of using interpreters and stop the sometimes seeming necessity of granting many concessions to foreign labor?

Would uniform forces aid in the problem of proper housing of labor and advance the laborers toward the desired standard for American citizens?

In your territory can you economically employ large gangs in winter to relay rail?

Does the system on which you are an officer occupy a territory favorable to shifting of track relaying and ballasting forces and if so, do you favor a shifting of these extra forces from division to division with a view of reducing the total number of men employed under the present system of doing all the work at one season?

DISCUSSION

That part of the report relating to the maintenance of uniform forces throughout the year created a great deal of discussion and evidenced a strong division of opinion, although the majority were in favor of a more uniform force than is now allowed. A number of members told of their troubles in securing a sufficient number of men to handle the ordinary section work during the past summer. They did not believe that the assurance of winter work would hold men when higher wages were offered elsewhere. P. J. McAndrews (C. & N. W.) advocated latitude rather than arbitrary practices in the building up of winter forces. He did not believe that an excessively large force should be retained throughout the winter, but that it was possible to arrive at a practical mean. Almost all supervisors want more men during the winter than they are now permitted to retain, and if they secure them they can find sufficient productive work to keep them busy. He did not believe that any capable supervisor would advocate employing



P. J. MCANDREWS Secretary.

more men than the work then in hand actually required.

Coleman King (L. I.) took issue with the committee on its conclusion disproving of a uniform force and strongly advocated permanent section gangs. This system has been employed on his line during the last four years and as a result he has been able to effect a considerable reduction in the number of men employed because of their increased efficiency. The road is now in better condition than when the system was inaugurated, in spite of the fact that a smaller number of men are now employed. During the present year, when most of the roads have been suffering from a severe shortage of labor, this condition has been evident only to a slight degree on the Long Island. He believed that a road is ahead at the end of the year, even if the company pays for some unproductive time during the winter, because of the increased efficiency secured from the experienced men during the summer.

C. T. Kimbrough (I. H. B.) stated that he had been able to hold practically all of his men this summer to whom he had given employment last winter, although adjoining roads were very short of labor, and he was in a busy industrial district.

W. Shea (C. M. & St. P.) stated that he believed the sole cause of a shortage of track labor rested with the section foreman. This man is the only one who comes in direct contact with the track laborer. Mr. Shea stated that he does not have a single foreign laborer on his line, but that by careful attention the foremen are able to secure all the native labor they desire. He advocated maintaining the position of section foreman such that he will be on an equality with other artisans in the community in which he lives and that his family will be able to enjoy the same privileges enjoyed by those of similar rank.

J. B. Oatman (B. R. & P.) strongly advocated a permanent force. He now has only 75 per cent of his full force, but of the men remaining in his employ practically all are those with one year of service or more. He has



lost practically none of the men held during last winter, even though contractors and others have offered higher wages. He advocated taking good care of the men, protecting them in their tenure of employment and seeing that the company provides comfortable and well-maintained houses for them to live in. He believed that six men employed the year round will do more work than four employed in the winter and eight in the summer.

F. Barnoski (C. M. & St. P.) stated that one experi-

enced man is worth two in-

W. H. KOFMEHL Treasurer.

experienced ones and that for this reason he favored a thorough trial of the system whereby permanent forces are maintained.

After further discussion the report was amended to read that the association favors going towards the plan of more uniform maintenance forces, wherever possible and entirely, where practical. To be consistent, the association then voted to eliminate those portions of the report immediately following referring to the seasons at which various kinds of work should be performed.



P. J. McAndrews advocated transferring extra gangs from one division to another, in order to distribute the work over a longer season, secure experienced men and reduce the number of men required, For instance, at present, on many systems, the rail is laid on practically all divisions at the same time, while it could be distributed over a longer season. He advocated permanent employment for extra gangs as far as practicable, in this way holding in the service for a longer season men who became familiar with rail laying operations, etc. With the total number of men who can be secured limited as is the case this year, the supply of labor is conserved in this way. It is probable that this shortage of labor will be felt in succeeding seasons, making the subject of this report one of special interest and value.

A recommendation of the committee favoring a yearly material allowance created further discussion. W. Shea (C. M. & St. P.) opposed a yearly allowance of material because of the inability of a road to determine the amount of work it could undertake so far in advance, because of variations in earnings. Henry Ferguson (G. T.) stated that he has been working on monthly and yearly allowances for some time and has found that they are of considerable advantage in normal seasons. In a year such as this, when both materials and labor are difficult to secure, the amount of work which it is possible to do is governed more by the amount of material and the number of men which can be secured than by the amount of money which is available. However, in other years, definite allowances of labor and material enable a roadmaster to plan his season's work more intelligently and to work to better advantage. Knowing the money he will be allowed to spend, he can organize his forces on a more permanent basis and can undertake his work more systematically than when dependent on the receipt of special authority for each job.

ANCHORING TRACK

Tracks creep in the direction of heaviest tonnage, fastest speed and descending grades on single track and in the direction of traffic on multiple tracks, the creeping conditions in either case being aggravated by a soft or springy condition of the roadbed, often found in low or wet districts. The creeping of rails and ties causes track to become rough, and shortens the life of the rails through a disturbance of an equal and proper expansion at the joints, which open at the points of least resistance (as, for example, outside of frogs and switches) and close entirely where the creeping tendency is resisted, as at switches, railroad crossings and curves.

Where light ballast is used it is noticeable that the outside rail of double track creeps more rapidly than the inside rail, which causes joint ties when spiked in slots to slew across the track at more or less of an angle, this condition causing bad alinement and uneven gage and contributing very much to poor riding and in a limited way to unsafe track conditions. The correction of these conditions entails a large expenditure for labor and is damaging to ties through frequent spacing. The disturbance of the ballast by shifting of ties keeps track loose and as the track is continually creeping it is necessary to offset this action by "driving" or "bumping" back the rails and spacing the ties, followed always in turn by the necessary surfacing of the track.

A most dangerous track condition resulting from creeping, is the shoving out of line and misplacement of railroad crossings, disturbances of line and especially of gage at cross-over switches (which in numerous instances have contributed to derailments) and sun kinking of track on portions of the line where expansion closes during cool weather. As rail will seldom "back up" any great distance, this results in a kink in hot weather.

Many and varied have been the efforts put forth to prevent the creeping of track, the most common of all being the spiking of slots in angle bars; or—antedating the use of angle bars—spiking in the slot formed at the joint by a $\frac{1}{2}$ -in. notch or slot left in the ends of rail base, thus making a 1-in. slot where two rails came together at joints. In this slot a spike was driven "facing" out or away from rail. Some of the rails also had a slot cut out of base at quarters and centers, and to make the anchoring more efficient by communicating the strain to adjoining ties, short blocks of wood were cut the required length and driven between several ties in the direction of creeping; this helped some, while the slot spike held.

When rails did not come from mills with slots cut out of quarters and centers, they were quite often provided on the ground, and in addition (after the adoption of angle bar joint fastenings) holes were drilled in the web of the rail and either an entire or more often a half angle bar was bolted to the rail at centers so that the slots could be spiked for anchorage, which served very well until the corners wore off the slots or partly cut the spikes so that the angle bar worked by, or often pushed out of line or gage trying to get away from the anchor. If this was not done, the tie was crowded out of place, a wide space being made behind such a tie and bunching occurring ahead of it.

Under the conditions described, it is not surprising that some one started to design a separate appliance to prevent rails from creeping. Persistent effort was finally rewarded and for a number of years rail anchors or anticreepers have been available that will anchor track, and which, if properly applied in quantities commensurate with the traffic conditions, will effectually hold the rails where originally laid.

THE USE OF RAIL ANCHORS

Very little argument should be required to convince the most skeptical as to the saving resulting from the use of efficient rail anchors. An annual saving approximates \$250 to \$400 per mile in extreme cases which is otherwise spent in driving back rail, squaring up slewed ties, renewing ties which have had their service shortened by former spacing, and surfacing tracks that might have served in a satisfactory manner with a little and comparatively cheap smoothing up if the roadbed were not disturbed by creeping and by driving back the rail and in spacing ties.

No set rule as to the number of rail anchors to use per mile can me made, as local conditions, such as swamps, undulating subgrade, descending grades, heavy braking districts, etc., govern this. It is our judgment, however, that, under favorable conditions, with stone ballast and heavy section rail, not less than four anchors per 33-ft. rail should be used. These should be placed without any reference to joints, but in every case opposite each other and against the same tie, one pair preferably in each quarter rail length.

The cost of rail anchors in place is estimated below:

Total\$221.44

It is apparent from this that the cost of material and labor in the application of this number of anchors costs less per mile than one readjusting of track affected by creeping. Assuming that the anchors will prevent creep-



ing, there can be no consistent argument against their general use where necessary.

UNIFORM SPACING OF TIES

Cross ties in main track should be evenly spaced, a uniform distance being maintained between the edges of ties instead of spacing them a uniform distance center to center. With the common practice of using 7-in. by 9-in. squared ties and 20 ties per 33-ft. rail, a distance slightly more than 11 in. between the edges of ties is provided, while with ties having an 8-in. face, and using the same number per rail, the space between ties will be 13.8 in.

Ties should be spaced regardless of joints, which can be done where no reinforcement extends below the base of rail or the top of tie. Where the spacing is uniform and with ties having a nine-inch face the portion of rails within the joint fastening will either be bearing on two sides or the ends of rails will be directly on one tie, thus insuring at all times either a suspended or supported joint, which is considered satisfactory by most track engineers.

This method of tie spacing will give a more even bearing on the roadbed and an even working of the track under trains. After careful consideration, we have reached the conclusion that uniform spacing of ties throughout the entire track structure is more important than the arbitrary spacing at joints.

Re-spacing the joint ties in connection with the relaying of rail throws that portion of the track on a softer roadbed than the rest of the track, and even with the most careful handling of the work it is necessary to surface the track immediately. This could often be avoided if the ties were spaced without regard to joints.

From information furnished by a large number of roadmasters and supervisors in various parts of the country, we estimate the average cost of respacing joint ties and surfacing track (on account of respacing) to approximate \$350 per mile on a stone ballasted line where rails are laid with staggered joints. The adoption of the uniform spacing of ties and the elimination of special spacing at joints, therefore, means a large annual saving to our railways.

It is claimed that ties should be specially spaced under joints to give the rails extra support at the ends, but the committee is of the opinion that by the use of a good type of angle bar, rail laid with proper expansion, good track bolts and proper maintenance at the joints, special spacing is unnecessary, and that deterioration of rails at joints, poor surface and general bad track conditions have been the result of creeping rails, loose bolts and the consequent excessive expansion. These conditions often came about through a shortage of labor, but we believe that by the uniform spacing of ties and the application of sufficient rail anchors, a noticeable reduction in track labor requirements can be brought about and better track maintained.

ELIMINATION OF SLOT SPIKING

The principal reason that joint fastenings were slotted for spiking was to prevent rail creeping. This, we know, was not effective and we believe that the use of joint fastenings as rail anchors was imposing an additional burden on the joint, which has always been the weakest part of the track structure.

The result of this anchoring at joints was and is apparent in several ways, which tend to weaken track and increase maintenance expense. Joint ties were slewed out of proper position, slots in angle bars became worthless with the stripping off of the bases of bars by the

strain of resisting the rail creeping, an extra strain was placed on track bolts, which caused much of the stretching so often blamed on the ignorant track laborer.

To maintain good track under any ordinary conditions it is not necessary to have joints slotted for spiking, and we believe that the elimination of slots and punch holes in joint fastenings adds much to the strength and life of the joint, reduces maintenance costs through avoiding disturbances of track at the joints, and that track will be more satisfactory with the non-slotted joint than when a slotted and spiked joint is used for anchorage. This, however, is only feasible where rail anchors are used in sufficient numbers to keep the rail from creeping, and we believe that in some instances rail anchors have been condemned as worthless because some one tried to hold bad creeping track with too small a number of anchors.

We, therefore, believe that track creeping can be prevented by the use of rail anchors at a reasonable cost, and that a considerable saving can be made in maintenance costs by the use of these appliances. We believe that all ties should be uniformly spaced throughout the main track structure, and that no special spacing with reference to length or style of angle bar should be required. We believe that angle bars or other joint fastenings should not be slotted for spiking and that all anchoring of the track should be done by the use of rail anchors.

SUGGESTIONS FOR DISCUSSION

Anchoring of single track—in one direction only—in both directions.

Anchoring of double tracks in light ballast—number of anchors necessary.

Cost of driving back rail—respacing and surfacing track, in various kinds of ballast—applying anchors.

Spacing of ties. Your practice as to the space center to center or between edges of ties. Size of ties. Cost of spacing joint ties alone after relaying rails.

Will the elimination of slot spiking weaken the track structure in any way? Does the slot spiking at joints and use of rail anchors combined make a better track structure than either alone?

P. M. Dinan, supervisor, Lehigh Valley (chairman); J. G. Hutchinson, roadmaster, C. R. I. & P.; G. A. De More, supervisor, N. Y. N. H. & H.; W. E. Davin, supervisor, P. & L. E.; M. J. Connerton, roadmaster, C. N. O. & T. P.; L. Coffel, supervisor, C. & E. I.; A. M. Clough, supervisor, N. Y. C.; F. E. Crabbs, roadmaster, C. & N. W.

DISCUSSION

T. Donahoe (B. & O.) thought that the figures given in the report, of \$250 to \$400 necessary to correct conditions created by the creeping of rails, was too high in many instances. P. J. McAndrews (C. & N. W.) thought that this figure was correct in many cases if the loss of material as well as of labor was considered. Driving rails back results in damage to the rail, and to bolts and other track materials.

The question of the advisability of anchoring single tracks created considerable discussion. J. V. Neubert (N. Y. C.) stated that his road has applied more anchors on single track than on multiple track lines. The instructions are that anchors shall be used wherever needed on all main tracks. E. Keough (C. P. R.) stated that he has applied anchors to hold the track from moving in each direction on many single track lines, particularly in the muskeg country.

T. Hickey (M. C.) emphasized the necessity of applying anchors in the vicinity of interlocking plants, drawbridges, and other points where the results of rail creeping are particularly serious. He advocated the use of at least two anchors per panel on all double track roads and





The Special Train and Party at Utica, N. Y.

Officers of the Roadmasters' Association Officers of the Track Supply Association On the Way to the Beach at Long Beach (Left). Making Good Use of the Observation Platform on the Special Train (Center). On the Beach at Long Beach (Right).

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as many as six per panel where necessary to restrain the movement of the rails. He has also found that the creeping of rails seriously affects the maintenance of insulated joints. All anchoring should be done at the point of origin of the movement rather than at the point where its serious results are noted. If anchors are applied only at the point of noticeable movement trouble may follow. Only a close inspection of the track will determine the proper number of anchors required.

At the close of the discussion on this subject, J. V. Neubert presented an analysis of 25,550 derailments on main and side tracks in which it was found that 32.5 per cent were due to defects of equipment, 51.9 per cent to operating causes, 11.4 per cent to unavoidable causes, and 4.2 per cent to defects of maintenance of way.

EQUATING TRACK VALUES

The primary purpose of a study of Equating Track .Values is to determine how the proper standard of maintenance may be obtained best and most economically and at the same time assign equal or equivalent duties to all trackmen. The constantly increasing cost of labor and material required to maintain track in proper condition to handle the present exceedingly heavy modern trains, is now one of the most serious questions before the railroads. It is therefore of vital importance that the cost of track work should be subjected to careful analysis.

It is the opinion of the committee that this investigation should be conducted in the following manner: (a) Classification of railroads on the basis of traffic handled. (b) Determination of the proper standard of maintenance for main track, sidings, switches, etc., and the relative amounts of work required to attain same. (c) The selection of special test sections from which accurate records of the distribution of labor shall be kept in order to obtain the above information. The committee has adopted forms showing the manner in which the distribution of labor is to be kept, and is now collecting data from test sections on eight different railroads. These forms are being filled out each month and will be summarized and the results analyzed at the end of the year.

In addition to the statistics on labor the committee is also collecting information in regard to the general characteristics of the test sections; that is, mileages, the number of switches, weight of rail, kind of ballast, ties, drainage, subgrade, curvature, gradients, weather conditions, etc., all of which are of vital importance in determining the final equating values.

From present available data the committee has prepared the attached table of Equated Track Values for practical application, realizing that these figures may be more or less modified by the results obtained from actual tests:

	CLA	SS		Force, 1 Foreman and	Equiv. Mileage or sect.	Men per mile with Foreman	Men per mile with- out Foreman	Miles per man with Foreman.	Miles per man without Foreman
A.	Double	Track	S	6 men	9	0.78	0.67	1.29	1.50
	Lines		W	3 men		0.44	0.33	2.25	3.00
A.	Single	Track	S	4 men	6	0.8 3	0.66	1.20	1.50
	Lines		W	3 men		0.66	0.50	1.50	2.00
B.	Single	Track	S	4 men	7	0.71	0.57	1.40	1.75
	Lines		W	2 men		0.57	0.43	1.75	2.33
C.	Single	Track	S	3 men	8	0.50	0.37	2.00	2.67
	Lines		W	2 men		0.37	0.25	2.67	4.00
		-							

Each supervisor should have a permanent extra gang on his district on the following percentage of the actual main line and siding mileage (not equated):

Class A-Summer, 10 per cent; winter, 5 per cent.

Class B and C-Summer, 6 per cent; winter, 3 per cent.

PROPOSED EQUATED TRACK MILEAGE VALUE

2 miles of passing track equals 1 mile of main track.

- 2 miles of passing track equals 1 mile of main track.
 2¹/₂ miles all other sidings equals 1 mile of main track.
 15 switches equals 1 mile of main track.
 24 single derails connected with tower or switch stand equal 1 mile of main track.
- 12 single track railway crossings equal 1 mile of main track.
- 15 single highway crossings (public roads) equal 1 mile of main track.
- 10 single highway crossings (city streets) equal 1 mile of main track.

CLASSIFICATION OF TRACK

Class A railways are those having more than one track, or a single track with the following traffic per mile: Freight cars per year equal 150,000, or 5,000,000 tons.

Passenger cars per year equal 10,000. Maximum passenger speed of 50 miles per hour.

Class B roads are those single-track lines having the following traffic per mile:

reight cars per year equal 50,000, or 1,670,000 tons.

Passenger cars per year equal 5,000.

Maximum passenger speed of 40 miles per hour.

Class C lines are single-track lines not meeting the minimum requirements of Class B.

SUGGESTIONS FOR DISCUSSION

It is thought that in some instances the lowering grade of track labor, and higher standards of maintenance de-sired have resulted in "robbing" many important terminal freight yards and passing sidings of the labor necessary for proper maintenance. Is it a fact?

There is no measure now for the determination of the efficiency of track forces except the judgment of supervising officers. Is there a beter method?

Would the equation of track values place all sections on a nearly equal basis and place the foreman with a large number of switches, crossings, etc., in a relatively better position to maintain yard facilities? How does the committee's table of track values and labor allowed compare with your present practice?

A. Grills, general roadmaster, G. T. (chairman); W. Shea, roadmaster, C. M. & St. P.; C. I. Coon, engineer of track, N. Y. C. E. Irwin, roadmaster, A. C. L.; P. J. McAndrews, roadmaster, C. & N. W.; M. Donohue, general roadmaster, C. & A.; Geo. Beckingham, superintendent of track, G. T.

DISCUSSION

M. Burke (C. M. & St. P.) believed that this investigation should be carried on in all parts of the country, for conditions in the north and south vary widely. It is possible to get more out of men in the south and

the labor is more easily retained. P. J. McAndrews (C. & N. W.) urged a campaign to get the section foreman to keep better and more complete records to aid in the proper distribution of costs. Charges are not now made correctly, the tendency being to charge work largely to the main lines and to neglect to charge properly the time spent elsewhere, as when repairing fences, etc. With the increase in the number of automobiles more good crossings are required and the charges to this item are not increasing as they should. There are sections now where 100 per cent more time is spent on crossings than five years ago. He suggested that all roadmasters and supervisors start equating their sections on their own account. At present the number of men employed is left entirely to the judgment of the supervisor and if a section is not kept up more men are employed without any other investigation.

CROSS TIES

George E. Rex, manager of treating plants, Atchison, Topeka & Santa Fe System, delivered an illustrated lecture on The Use and Abuse of Cross Ties before the convention on Wednesday morning, of which the following is an extract:

From a monetary standpoint ties rank second in importance in the maintenance of way department only to labor. Accurate statistics of tie consumption are difficult to obtain, but the last official statement of the census bureau (1911) shows 401,653 miles of railway tracks with an annual renewal of 135,053,000 ties, or an average of 336 ties per mile of track, which gives an average life of somewhat less than nine years. Of these ties only 23 per cent were treated.

As the white oak tie is the best representative of untreated timber used in this country, and as almost every white oak tie is used untreated, this average of nine years' service is as much as one can expect for this type of timber without treatment. In the west white oak has become almost a negligible quantity and the roads have had to resort to the use of inferior woods such as loblolly, short leaf and mountain pine.

The Santa Fe has practically no timber supply on its line, so that it was one of the earliest roads in the United States to undertake the preservation of ties from decay. It has been treating its tie supply continually since 1885, until to-day of the 30,422,416 ties in the tracks of the parent system covering 9,552 miles, over 80 per cent of the ties are treated, and as far as possible every tie that goes into the track, including white oak, is treated now. The result of this practice is shown by the statement that, while an average of 336 ties are renewed per mile of track annually in this country, we have reduced our renewal to considerably less than 200 ties per mile, which indicates an average life of 15 years.

Of recent years the treatment of ties has made such rapid strides in affording protection to inferior timbers that if their mechanical protection could be controlled as it should be, ties should be treated in such a manner that the railroads could be absolutely assured of 20 years life from them. Treatment alone cannot accomplish this result, although it is the largest single factor in doing so. In treating ties one should be sure that the sap wood is thoroughly impregnated, the heart wood will then last if the treated area is sufficient to compel every bit of moisture in the timber to pass through the treated layer of wood, and be thoroughly sterilized.

The modern way to get the full life of ties renders the four following steps advisable: (1) Insure a sound interior condition of the tie. (2) Bore a hole for the spike so that it does not break down the fiber. This also assures treatment around the spike hole. (3) Make two parallel bearings for the rail, by adzing the tie before treatment. (4) Stamp the tie with the date of treatment, the kind of wood and the weight of rail for which it is bored.

In conclusion treatment and mechanical protection of ties cost money, but if these methods were put in general practice, the average life of ties as shown by the census in 1911 can be more than doubled, which will mean a large saving in dollars.

ELECTRIFIED TRACK MAINTENANCE

Francis Boardman, division engineer, electric division, New York Central, New York, described the special maintenance problems presented by the electrification of the tracks under his jurisdiction. He pointed out particularly the opportunity to secure power for all classes of track work from the third rail, immediately adjacent to the track and the possibility of installing power-driven track tools. He stated that he has twelve electric tie tampers and several electric drills in service on his territory. Electric grinders are also employed to chip off stock rails, sharpen tools and true up the points of frogs. All switch lamps and slow signs are lighted by electricity, while night work is illuminated in the same way, greatly increasing the efficiency of men.

He pointed out the fact that the third rail attached to the track makes a heavier track, which is harder to line. This makes necessary the organization of larger track gangs. An estimate was made of the amount of additional labor required to insert ties along third-rail track last year, during the preparation of which it was found that little additional work was required in open territory, but that in congested territory with multiple track lines, the work was materially increased. As an average figure for the New York division, it was estimated that the third rail required 10 per cent more men.

CLOSING BUSINESS

The annual election of officers for the ensuing year was held on Thursday morning. The following was the selection: President, M. Burke, roadmaster, C. M. & St. P., Chicago; first vice-president, A. Grills, general roadmaster, G. T., St. Thomas, Ont.; second vice-president, J. B. Oatman, roadmaster, B. R. & P., Punxsutawney, Pa.; secretary, P. J. McAndrews, roadmaster, C. & N. W., Sterling, Ill.; treasurer, W. H. Kofmehl, roadmaster, C. M. & St. P., Elgin, Ill.; member of executive committee, J. W. Powers, supervisor, New York Central, Oswego, N. Y.

Chicago was selected as the location for the next annual convention, which will be held on September 18-21, 1917.

ENTERTAINMENT FEATURES

The association held long evening sessions on Tuesday and Wednesday evenings to permit inspections of terminals and tracks in the vicinity of New York to be made during the afternoons. On Wednesday afternoon over 450 members and guests made an inspection trip over the lines of the Long Island railway between the Pennsylvania Terminal in New York and Long Beach, returning via Far Rockaway. On the way to Long Beach the train passed through the recently completed Jamaica Terminal, with its comprehensive grade separation system. At Long Beach the party witnessed a demonstration of the pneumatic tie tamping machine.

On Thursday afternoon an inspection of the Grand Central Terminal and the electrified portion of the New York, New Haven & Hartford Railway between New York City and Stamford, Conn., was made by special train. On Friday afternoon, after the close of the convention, the members were the guests of the Central Railroad of New Jersey on a boat trip down New York harbor to Asbury Park, returning to Jersey City over the railway of that company.

THE BANQUET

The fifth annual banquet of the Roadmasters' and Maintenance of Way Association and the Track Supply Association was held in the McAlpin Hotel on Thursday evening, with 290 railway and supply men present. F. A. Preston, president of the Track Supply Association, presided, and introduced James A. McCrea, general manager of the Long Island, who spoke in part as follows:

"I believe that much good results from these meetings. The roadmaster is constantly on duty 24 hours a day. Generally, he works the year around without vacation, except for these conventions, which are both a vacation for him and an inspiration.

"The roadmasters, the supervisors and, in fact, the

section foremen are diplomats in their own territory. Often by the use of tact they heal the old sores of their road, keep on good terms with their neighbors and, moreover, are successfully coping with labor shortage.

"What I especially desire to emphasize to-night is the roadmasters' connection with road crossing accidents. I especially urge all you men here to-night to consider the improvement that you can make on your respective sections by proper attention to the clearing of the right of way in the vicinity of crossings of weeds, trees or bushes that obstruct the view. Secondly, I wish to call to your attention the advisability of revising grades approaching crossings. Often the approaches are steep and an inefficient driver of an automobile may stall his engine in such a manner that an accident is very liable to occur. I think it is entirely possible that with very little expense the grades approaching highway crossings can be revised in such shape to make them very nearly fool proof.

"There is a third fact that I am desirous of placing in your minds to-night, and that is standard legislation. I want every one of the men here present to go home and use his influence with his friends and neighbors to the end that the laws in all states will be similar."

JUDGE TOMPKINS' ADDRESS

W. C. Kidd, secretary of the Track Supply Association, then introduced A. S. Tompkins, judge of the Supreme Court of New York, who spoke in part as follows:

"The greatest force and the most effective agency in the upbuilding of our country, in our material development and in our commercial growth and general prosperity have been and are our railroads, and the energy, genius and enterprise, the courage, optimism and faith of the pioneers in railroad building have made possible the wonderful development and prosperity of our country. Those men and their successors, the men of yesterday and the men of to-day, most of whom have been trained and equipped in the hard but effective school of service and experience, have given this country its splendid transportation facilities, the best, the most comfortable, the most efficient, the most gigantic in the world.

These railroads, their builders, their owners, their officers and their operators deserve better treatment than they sometimes receive. Instead of criticism, abuse and condemnation they deserve credit and praise and commendation. It seems to be the common notion, at least it is the notion among a good many people, that the railroads are the common enemy of mankind, and they are the favorite target for the demagogue, the lawless, the idle and the worthless. They are the great arteries of our country through which flows the life blood of the nation, making us great and rich and powerful and keeping us prosperous and happy. In this great public business none occupy more important places, none have a more important duty to perform than the men who are charged with the maintenance of way and the tracks. Their vigilance, experience, efficiency and faithfulness make it safe for the public to use these great arteries of travel and transportation and make railroading safe and successful.

"I have always felt that there is no class of men in all the commercial life of the state and the nation, that there is no body of men in any walk of life, or in any department of business who deserve so much credit, so much consideration and so much praise as railroad employees of all classes and grades, because of the natural hazards of their employment, because of the risks and the dangers incident to their work, because of the tremendous responsibility that rests upon them, and because of their general fidelity to duty. They are the guardians of us all as we in repose and confidence and with a sense of absolute safety and security place our lives in their keeping and they ought to be well paid. From president down to track-walker and gate-tender, every railroad employee ought to be liberally paid and ought to have reasonable hours for his labor, but I think that the most ardent supporter of the rights of labor and the most earnest defender of railway policies and management, and all good Americans view with apprehension the growing tendency of the times toward government and legislative dictation and control of matters that ought to be the subject of individual agreement and contract.

The federal government and the state have the right to protect the public health by regulating the hours of labor, but never in the history of organized government has it been contemplated that the government should fix wages or regulate the terms of employment between master and servant. It is contrary to our free American institutions and contrary to the fundamental law of the land, and that tendency ought to be resisted by employee as well as by employer, because it is a rule that will work both ways. It is a two-edged sword. If the government can force a railroad to pay higher wages, it can permit a railroad to pay low wages. If the government can force a railroad company to employ a man at a certain wage, it can, by its great power, force labor to take what it fixes as compensation and take away from the laboring man the right to negotiate and make a contract for himself.

"It is repugnant to American institutions and American liberties and American ideals. Let the men fix their wages with their employers, or, better still, let the union, through its officers, negotiate with the employer and fix the wages, but the government has no right to interfere.

"These great arteries that give life and energy to the nation and serve alike the comfort, convenience and necessities of all classes and all conditions, and that are so indispensable to our happiness and prosperity, ought to be protected by the public against unreasonable demands, ought to be guarded against the attack of the demagogue, the professional agitator, the lazy and the worthless and ought not to be the subject of hasty, ill-considered, illadvised and immature legislation.

"What we need most in this country is not more laws, but more respect for the law and more respect for the natural rights of men and women. What we need most is more of the spirit of fraternity and brotherhood and charity and humanity to inspire the hearts and dictate the thoughts and control the actions of men, employees and employers, individuals and corporations. We shall not have settlement between capital and labor, we shall not have perfect unity and concord between these two classes; the economic, industrial and social problems that are confronting us, will not be settled right, or permanently settled, until the hearts of men are regenerated, until men everywhere learn and practice and live by the golden rule.

"It cannot be done by legislation or by judicial decrees, but when men learn to apply to the every-day affairs of life the spirit of fraternity and brotherhood and do unto others as they would have others do unto them, then our problems will all be solved, and our troubles will all be over, and then we shall have no more strikes, or graft, or greed, or oppression, or corruption, or selfishness."

THE TRACK SUPPLY ASSOCIATION

The fifth annual exhibit of the Track Supply Association was held in a room adjoining the convention hall. Over 60 firms exhibited their devices here, a larger number than at any previous convention. Special attention was given to the appearance of the exhibit hall, and as a result the display was more attractive than in any previous year.

The officers of the Track Supply Association for the past year were: President, F. A. Preston, the P. & M. Company, Chicago; vice-president, R. A. Van Houton, Sellers Manufacturing Co., Chicago; secretary-treasurer, W. C. Kidd, Ramapo Iron Works, Hillburn, N. Y. Mem-bers of executive committee, E. M. Fisher, Fairbanks, Morse & Co., Chicago, Ill.; E. T. Howson, *Railway Main*tenance Engineer, Chicago, and J. J. Cozzens, Union Switch & Signal Co., New York.

The firms exhibiting, with the names of their representatives and their exhibits, are given below:

LIST OF EXHIBITORS

Ajax Rail Anchor Co., Chicago, Ill.—Ajax Rail Anchors H. G. Elfborg, Paul Hoffman, G. N. Holmberg. American Hoist & Derrick Co., St. Paul, Minn.—Transparent

Photographs of the American Ditcher. Edward Coleman, Frank W. Hatten.

- W. Hatten. American Steel & Wire Co., Chicago, Ill.—Woven Wire Fenc-ing and Steel Posts. A. W. Fronde. American Valve & Meter Co., Cincinnati, Ohio.—Anderson Economy Switch Stand, The Anderson Interlocking Switch Stand and Switch Lock. J. T. McGarry, F. C. Anderson. Call Switch Co., New York, N. Y.—Operating Model of Call Switch. Ira A. Call, Harry A. Pike, R. V. Call, J. J. Lytton. Carbic Mfg. Co., Duluth, Minn.—Portable Carbic Lights, Carbic Cakes. G. B. Van Buren, S. K. Ferris. The Carborundum Co., Niagara Falls, N. Y.—Track Grinder. H. P. Frost.

- H. P. Frost.
- Carnegie Steel Co., Pittsburgh, Pa.-Braddock Insulated Rail Joint. Norman Hench.
- Chicago Malleable Castings Co., Chicago, Ill.—Thomas Rail Anchor Tie Plates. J. W. Thomas, Warren Osborn. The Creepcheck Co., New York, N. Y.—Anticreepers. C. H.
- Geuscher.
- Crerar, Adams & Co., Chicago, Ill.—Track and Bonding Drills, Track Jacks, Emerson Rail Benders, Die Starters. Russell Wallace, W. I. Clock.
- Dressel Railway Lamp Works, New York, N. Y.—Dressel Railway Lamps, F. W. Dressel, Robt. Black, F. W. Edmonds. The Duff Mfg. Co., Pittsburgh, Pa.—Track Jacks. C. E. Hale, C. A. Methfessel, E. A. Johnson.

- Empire Railway Appliance Corporation, New York, N. Y.— Combined Rail Anchor and Tie Plate. D. L. Braine. Engineering News, New York, N. Y.—Elmer E. Smith, Wm. Buxman, Win G. Conley, H. K. Hottenstein, L. E. Ives, J. E. Sample.
- Sample. Equipment Improvement Co., New York, N. Y.—Davis Ad-justable Track Gage. C. W. Cross. Fairbanks, Morse & Co., Chicago, Ill.—A. A. Taylor, F. M. Condit, J. L. Jones, G. Howard, C. T. Fugitt. The Frictionless Rail, Boston, Mass.—Frictionless Rail. F. A. Barbey, J. W. McManama, T. F. Dwyer, Jr. Hatfield Rail Joint Mfg. Co., Macon, Ga.—Hatfield Rail Joint. U. R. Hatfield

- U. R. Hatfield.

- U. R. Hatfield. Hauck Mfg. Co., Brooklyn, N. Y.—Portable Oil Burners and Torches, Thawing Outfit. G. A. Nelson. Hayes Track Appliance Company, Richmond, Ind.—Hayes De-rail. E. L. Ruby. Robert W. Hunt & Co., Chicago, Ill.--Samples of Special In-spection Sheets and Photographs. C. W. Gennet, Jr. Hyatt Roller Bearing Co., Newark. N. J.—Hyatt Roller Bear-ings for Motor Cars. C. M. Day, C. A. Sloan, I. M. Mooney, Walter R. Bylund, R. A. Hulme, G. J. Helmstaedter. Indianapolis Switch & Frog Co., Springfield, Ohio.—"R-N-R" solid manganese frog. J. A. Foulks. Ingersoll-Rand Co., New York, N. Y.—Imperial Tamping Out-fits. Transparent Photographs of Imperial Pneumatic Tampers at work, W. H. Armstrong, Chas. Dougherty, D. H. Seeley. Interlocking Rail Joint Co., New York, N. Y.—Rail Joints. E. W. Coughlin. E. W. Coughlin.
- The O. F. Jordan Company, East Chicago, Ind.—The Jordan Spreader, Ballast Shaper, Bank Builder and Snow Plow. J. P. McNally.
- Keystone Grinder & Mfg. Co., Pittsburgh, Pa.—Keystone Portable Tool Grinders. John S. Wincrantz. Lackawanna Steel Co., Buffalo, N. Y.—Joint Plates, Tie Plates, Improved Angle Bars. A. H. Weston. John Lundie, New York, N. Y. The Lundie Tie Plate. Wal-here Pierdow Lehr Lundie
- lace Bigelow, John Lundie.
- The Madden Co., Chicago, Ill.-Richter Blue Flag Derail,

- The Alexander Milburn Co., Baltimore, Md.—Milburn Port-able Lights, Oxy-Acetylene Cutting Apparatus, Track Walkers' Hand Lamp. C. L. Pollard. W. M. Mitchell Co., Louisville, Ky.—Mitchell Rail Anchor, Betts Safety Guard Rail. L. C. Ryan. Mudge & Co., Chicago, Ill.—Motor Car Literature. C. W.
- Cross.
- National Lock Washer Co., Newark, N. J.—Hipower Nut Locks. F. B. Archibald, R. F. Horsey, J. H. Horn. The National Malleable Castings Co., Cleveland, Ohio.—Rail
- Anchors, Malleable Rail Braces, Malleable Tie Plates. J. J. Byers.
- P. & M. Co., Chicago, Ill.—Vaughan Rail Anchor, P. & M.
 Rail Anchor. Fred A. Preston, R. W. J. Harris, L. S. Walker,
 W. W. Glosser, E. T. Hallberg, G. E. Johnson, F. H. Bayliss.
 Pocket List of Railroad Officials, New York, N. Y.—Copies

- Pocket List of Railroad Officials, New York, N. Y.—Copies of Pocket List. J. Alexander Brown, Harold A. Brown. Positive Rail Anchor Co., Marion, Ind.—Positive Rail Anchor and Guard Rail Brace. Frank M. Robbins.
 Q. & C. Co., New York, N. Y.—Bonzano Rail Joint, Rolled Steel Step Joint, Adjustable Derail, Guard Rail Clamps, Fewing's Car Retracker, Magnetic Wig-wag and Whitman Adjustable Rail Brace. C. F. Quincy, E. R. Packer, W. W. Hoyt, J. L. Terry, E. M. Smith, L. C. Burwell, Edmund Quincy. The Rail Joint Co., New York, N. Y.—Rail Joints. V. C. Armstrong.
- Armstrong.

- Armstrong.
 Railroad Supply Co., Chicago, Ill.—Tie Plates and Derailer.
 H. M. Buck, G. W. Daves, A. H. Smith.
 Railway Review, Chicago, Ill.—Copies of Paper. W. M.
 Camp, A. E. Hooven, L. A. Collier.
 Ramapo Iron Works, Hillburn, N. Y.—Guard Rail Clamp,
 Slide Plate, Automatic Switch Stand. W. C. Kidd, Thomas
 Akers, Arthur Gemunder, Edward Banker, E. C. Bigelow,
 James B. Strong.
 Reading Specialties Co., Reading Pa.—Guard Rail Clamp, Rail
 Bender. Semi-universal Tie Spacer, Reading Rerailer and
 Clamp, Reading Compromise Joints. Leonard Schuetz.
 Roller Lock Nut Co., Inc., New York, N. Y.—Lock Nuts and
 Literature. H. L. C. Wenk.
 Sellers Mfg. Co., Chicago, Ill.—Tie Plates. R. A. Van Houten,

- Sellers Mfg. Co., Chicago, Ill.-Tie Plates. R. A. Van Houten, Geo. M. Hogan.
- The Seltite Co., New York, N. Y.—Seltite Self-Tightening Washer. J. Morris Butler, Charles M. Young. Silver Steel Tie Co., Salt Lake City, Utah.—Silver Steel Tie.
- Jos. A. Silver.
- Simmons-Boardman Publishing Co., New York, N. Y.—Rail-way Maintenance Engineer, Railway Age Gazette, E. T. How-son, Henry Lee, C. R. Mills, J. H. Cross, J. G. Little, F. C. Koch, H. H. Beardsley.
- Southern Railway Supply & Equipment Co., St. Louis, Mo .-
- Southern Railway Supply & Eduplitent Co., St. Duts, Mo.– Saunders Car Stopper. W. D. Achuff, Laurance Boswell. Templeton-Kenly & Co., Ltd., Chicago, Ill.–Simplex Track, Pole and Emergency Jacks. H. W. Finnel, A. C. Mills. Track Specialties Co., New York, N. Y.–Trasco Guard Rail Clamp, Superior Compromise Joint, Derailer, Rail Joint, Rail Durder Conset Beil Brace Tie Diete The Better Bedted Tie Clamp, Suberlor Compromise Joint, Deraher, Kall Joint, Kall Bender, Guard Rail Brace, Rail Brace, Tie Plate, Padded Tie Plates. W. B. Lee, J. A. Bodkin. Union Switch & Signal Co., Swissvale, Pa.—Keystone Insulated Rail Joint, Model 14. J. J. Cozzens, J. C. Donaldson. Verona Tool Works, Pittsburgh, Pa.—Lining Bars, Track Wrenches, Picks and Other Tools. Harry Fischer, H. S. Paul. Wm Wheater In Score Forter De Switch Stend Lord

- Wm. Wharton, Jr., & Co., Easton. Pa.-Switch Stand, Insulated Gage Rod and Switch Rod. G. R. Lyman, Thomas O'Brien, Wyoming Shovel Works, Wyoming, Pa.—Track Shovels.
- H. T. Potter.
- The following firms were members of the Track Supply Association, but did not exhibit:

- Ajax Forge Co., Chicago, Ill. Elliott Frog & Switch Co., E. St. Louis, Ill. Morden Frog & Crossing Works, Chicago, Ill.
- Cleveland Frog & Crossing Co., Cleveland, O. L. S. Brach Supply Co., Newark, N. J.
- H. M. Brown.

The annual meeting of the Track Supply Association was held on Thursday morning. At this meeting the reports of the retiring officers were read and approved and the following officers were elected for the ensuing year: President, R. A. Van Houton, Sellers Mfg. Co., Chicago; vice-president, E. T. Howson, editor, Railway Maintenance Engineer, Chicago; secretary-treasurer, W. C. Kidd, Ramapo Iron Works, Hillburn, N. Y.; director, F. A. Barbey, the Frictionless Rail Co., Boston, Mass.

GENERAL NEWS DEPARTMENT

THE CHICAGO GREAT WESTERN has made a general study of crossing-bell protection at highway grade crossings on its system, as a result of which it has installed 79 additional crossing signals. With those previously in service, there will be a total of 140 highway crossings provided with crossing bells at the end of this year.

THE BALTIMORE & OHIO is making a detailed inspection of every grade crossing on the system. Under the plan outlined, the officers will approach each crossing on foot from the public highway, as well as along the right-of-way, to ascertain the range of vision on both lines of travel. Based upon the information secured in this way, measures will be adopted to correct unsatisfactory conditions.

THE BALTIMORE & OHIO EMPLOYEES' MAGAZINE contained an article in a recent number indicating the manner in which employees can assist the valuation department in the collection of data, particularly with reference to hidden quantities and the methods of handling work in the earlier days, for which the records are now incomplete. The article gave a detailed list of examples of the character of information that was desired.

THE MICHIGAN SUPREME COURT has reversed a decision for the plaintiff in an action against a railroad for setting fire to a barn, holding that the original verdict was contrary to the great weight of the evidence, where it was shown that the barn was located a comparatively great distance from the track, there had been frequent showers the day before the fire, no other fires had been set in the vicinity, and the locomotive in question had never before been charged with setting a fire.

THE UNITED STATES CIVIL SERVICE COMMISSION announces examinations October 4 for the following positions in the division of valuation, Interstate Commerce Commission: Junior civil engineer, grade 1; junior civil engineer, grade 2; junior mechanical engineer, grades 1 and 2; junior structural engineer, grades 1 and 2. Salaries range from \$720 to \$1,080 for secondgrade positions, and \$1,200 to \$1,680 for first-grade positions. Applicants must be between 21 and 36 years old.

THE PHILIPPINE LEGISLATURE has approved an act providing for the purchase by the government of the Philippine Islands of the stock of the Manila Railroad. This company operates about 500 miles of lines on the Philippine Islands. The operation has been unremunerative and a receivership was threatened. The Philippine government decided to take over the lines to insure their continued operation because of the importance of transportation to the development of the Islands.

THE CHICAGO, MILWAUKEE & ST. PAUL is installing light signals for both day and night indications and eliminating semaphores entirely on the 440 miles of its main line between Harlowtown, Mont., and Avery, Idaho, which is now being electrified. The only exception is a 38-mile section of line in the Bitter Root mountains where the staff system now in service will be retained. A red, a green and a white light will be provided for each signal and the trains will be governed by the color indication.

THE AMERICAN STEEL & WIRE COMPANY, calling attention to the Interstate Commerce Commission's statement of August 10, concerning an impending car shortage, has asked its customers to co-operate with the carriers in order that delays and losses may, so far as possible, be avoided. "Inability to ship," says the circular, will, at this season, with the shortage of iron and steel material in every direction, "be very injurious to your interests. We hope, therefore, that you will take every possible means to unload cars very promptly."

THE ALABAMA SUPREME COURT has held that where a fire is communicated from a railroad right-of-way in consequence of a burning building or of a burning car standing on the track, the same rule applies as in the case of any other owner of property; that where such owner sets a fire on his own premises for his own purpose and in a proper manner without negligence, or where the fire accidentally starts without his fault, he is not liable for damages caused by its being communicated to the property of another party unless he is thereafter guilty of negligence in failing to control or extinguish the fire as it spreads. This decision arose from an action to recover damages for the destruction of a pile of lumber placed on the right-of-way for shipment and burned by a fire starting in a camp or commissary car occupied by section men and standing on an adjacent side track.

THE PRESIDENT'S Conference Committee on the Federal Valuation of the Railroads has issued a statement of the progress of the government field parties in making an inventory of the railway properties up to July 31. This statement shows that 73,478 miles of line have been inventoried with respect to road and track, 49,544 miles with respect to bridges, 47,294 miles with resepct to buildings, 49,884 miles with respect to signals, 77,987 miles with respect to telephone and telegraph lines and 27,648 miles with respect to land.

THE PENNSYLVANIA RAILROAD has issued a statement that the total amount paid out in pensions was \$13,108,780 up to August 1. On the same date 50 employees were placed upon the "roll of honor," as the pension list is termed. The oldest of these men in point of service was James McLaughlin, a track laborer, who retired after a continuous service of 56 years 7 months. He entered the employ of the Pennsylvania as a water boy on the Camden & Amboy, now a part of the Pennsylvania Railroad, in 1860, and has been in continuous service since that date.

THE ARKANSAS SUPREME COURT holds that a bridgeman employed by a railroad engaged in interstate commerce and fatally injured through the negligence of fellow-employees while a member of the gang engaged in removing old bridges and while removing the bolts from old caps lying clear of the rails was "engaged in interstate commerce," since the repairing of the bridge could only be done by removing the bridge timbers a sufficient distance from the track so that their presence would not materially injure the operation of trains or increase the danger of fire from passing trains.

THE WISCONSIN SUPREME COURT has held that a road was not liable for the death of a 16-year-old boy, who had entered upon a railroad's unfenced right-of-way, boarded a moving freight train and had been killed while attempting to leave the train while in motion, after having ridden several miles, although the Wisconsin fencing statute holds liable a railroad which does not fence its road bed for damages "occasioned by the want of a fence." In this decision the court stated that the voluntary action of the boy in jumping off a moving train was entirely unrelated to the company's omission of a fence, and the latter could not be considered as causing his death.

THE JOINT CONGRESSIONAL COMMITTEE recently appointed to investigate the subject of railway regulation has decided to hold hearings in Washington, beginning November 20, at which meeting it will be decided whether hearings will be held in other cities. The investigation will also include the hours and wages of labor. The committee will invite to its hearings railway officers and employees, shippers, bankers, representatives of state and interstate commissions and commercial bodies. Frank Healy, secretary to Senator Newlands, has been elected secretary to the joint committee.

THE SOUTHERN PACIFIC has allotted 78 gold watch fobs, suitably engraved and bearing the company's safety emblem, to those employees who did the most toward furthering "safety first" work during the past year. Ten and one-half points are granted for each safety suggestion made, involving a change in standard practice to correct a defect, the practical working out of which requires actual labor and indicates the thoughtful attention of the employee. Five points are awarded for each suggestion which warrants the issuance of instructions to employees, but does not involve physical labor in its application. One credit is granted for each suggestion not involving actual labor in its application, and which has been covered heretofore by instructions. C. H. Rippon, piecework inspector at Sacramento, Cal., headed the list of employees with 1,293 points.



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PERSONAL MENTION

GENERAL

ROBERT S. PARSONS, chief engineer of the Erie, with headquarters at New York, has been appointed also assistant to the president.

J. H. NUELLE, acting general superintendent and chief engineer of the New York, Ontario & Western, has been appointed general superintendent, with headquarters at Middletown, N. Y. He began railway work with the engineering department of the Pennsylvania Lines at Chicago, Ill., in June, 1906, going to the New York, Ontario & Western as assistant engineer the following year. He was appointed engineer maintenance of way in January, 1912, and chief engineer in July, 1913.

R. J. PARKER, general superintendent of the Eastern division of the Atchison, Topeka & Santa Fe, Topeka, Kan., who has been appointed general manager of the Western lines at Amarillo, Tex., was a roadmaster on this road from 1887 to 1892, after which he was general roadmaster of the Eastern division, with headquarters at Topeka, Kan., until January 1, 1897, when he was appointed division superintendent at Newton, Kan. Since that time he has been in the operating department, being appointed general superintendent at Topeka on October 1, 1910.

EDWARD RAYMOND, who was recently appointed general superintendent of the eastern district, eastern lines, of the Atchison, Topeka & Santa Fe, with headquarters at Topeka, Kan., began his railway career in the maintenance of way department. Mr. Raymond was born on May 31, 1858, at Kendall Corners, Orleans County, New York, and was educated at the country district school. He entered railway service on November 14, 1877, with the Atchison, Topeka & Santa Fe as a track laborer. Later he became consecutively section foreman, roadmaster, trainmaster, assistant superintendent, division superintendent and general superintendent, western district, eastern lines, which position he held until his recent appointment.

Ross MILLER, who has been appointed engineer of the South Dakota Railway Commission, with headquarters at Pierre, S. D., was born at Greenwood, Wis., August 6, 1883. He received his early education in the common and high schools of his native city and later entered Lawrence University, whence he graduated in 1904. He entered railway service immediately, securing employment in the engineering corps of the Chicago & Northwestern, working on location, construction and valuation up until 1907, when he was made an instrument man in the maintenance of way department. In 1908 he was made assistant engineer, maintenance of way, and held this position up to the time his present appointment became effective.

ABRAHAM TRACY HARDING, vice-president of the New York Central, who has been promoted to the position of assistant to the president with jurisdiction over all departments of the New York Central, entered the service of this road in the maintenance of way department. He was born in 1868 in South Carolina and graduated from the University of South Carolina in 1894. Previous to graduation he had been a telegraph operator, an agent and a stenographer, respectively, on the Richmond & Danville. He entered the maintenance of way department of the Southern immediately after graduation, going to the New York Central & Hudson River in 1898 as supervisor, being promoted later to division engineer. In 1903 he was advanced to engineer maintenance of way, and later to assistant to the general manager. In 1906 he became assistant general manager and six years later assistant vice-president, becoming vice-president in 1913. He was made vice-president in charge of operation in 1915, which position he held at the time of the appointment announced above.

ENGINEERING

W. F. FOURRIER has been appointed assistant engineer on the Atchison, Topeka & Santa Fe Coast Lines at Needles, Cal., succeeding B. H. Quinham, resigned.

H. E. STEVENS, engineer of bridges, Northern Pacific, has been appointed chief engineer with office at St. Paul, Minn., succeeding W. L. Darling, resigned. B. V. SOMERVILLE, formerly principal assistant engineer, has been appointed resident engineer of the Pennsylvania Lines, with headquarters at Detroit, Mich., a newly-created position. S. D. MOSES has been appointed resident engineer of the Southern Railway, with headquarters at Spartanburg, S. C., succeeding L. G. Wallis, recently resigned to accept service with another company.

C. M. McVAY, engineer maintenance of way of the Kanawha & Michigan, has also been appointed engineer maintenance of way of the Kanawha & West Virginia, recently acquired by the former road.

H. A. LANE, who has been promoted to assistant chief engineer of the Baltimore & Ohio, began engineering work in 1895 as a rodman with the New York, New Haven & Hartford, and in 1901 was made assistant engineer in charge of a part of the grade separation work done by that road at Fall River, Mass. In December, 1902, he entered the employ of the Baltimore & Ohio in the office of the assistant engineer of surveys, and in 1907 was given charge of operations for freight terminal betterments. In 1910, he was made assistant engineer of surveys, which position he held until his recent promotion.

C. H. R. Howe, who has been appointed division engineer of the Baltimore & Ohio Southwestern, with headquarters at Chillicothe, Ohio, was born February 12, 1886, at Worcester, Mass. He graduated from Worcester Academy in 1897, and later entered Dartmouth College, completing his course there in 1901. He first entered railway service in February, 1903, with the Boston & Albany, being successively up to 1906, rodman, level man, inspector and transit man. On February 1, 1906, he accepted employment with the Baltimore & Ohio in the chief engineer's office, where he remained until 1909. In February of that year he entered the service of the United States Government as chief draftsman with the Isthmian Canal Commission at Panama. On October 1, 1911, he returned to the chief engineer's office of the Baltimore & Ohio. From January 1, 1912, to May 15, 1913, he was assistant division engineer of the Ohio division. From May 15 to June 15, 1913, he was division engineer of the Indianapolis division of the Cincinnati, Hamilton & Dayton, and from the latter date to March, 1914, division engineer of the Terminal division at Cincinnati, Ohio, having jurisdiction over both the Cincinnati, Hamilton & Dayton and the Baltimore & Ohio. During the following two years he was master carpenter of the Ohio division of the Baltimore & Ohio. following which he was appointed division engineer of the Illinois division, effective February, 1916. On July 20, 1916, he was appointed division engineer of the Ohio division, succeeding E. J. Correll, promoted to district engineer.

TRACK

L. H. BELL has been appointed roadmaster on the Pere Marquette, with office at Saginaw, Mich., succeeding F. D. Harrigan, transferred.

J. D. REID has been appointed assistant supervisor on the Chicago division of the Baltimore & Ohio, with headquarters at Defiance, Ohio, effective September 4.

MARTIN J. FAYRAM has been appointed roadmaster of the Chicago & North Western, with headquarters at Manlius. Ill., succeeding K. O. Eck, assigned to other duties.

FRED LEMON has been appointed roadmaster of the Alliance division of the New York Central Lines West of Buffalo, with office at Alliance, Ohio, succeeding G. H. Jedlle, transferred.

ERNEST A. TITUS has been appointed acting roadmaster on the St. Paul division of the Northern Pacific, with office at St. Paul, Minn., vice H. J. McCall, granted leave of absence.

W. A. MARSHALL, supervisor of the Kanawha & Michigan, has had his jurisdiction extended over the Kanawha & West Virginia, which was recently acquired by the Kanawha & Michigan.

G. DUFFY, roadmaster on the Hearst sub-division of the National Transcontinental, has been transferred to the Cochrane sub-division at Cochrane, Ont., succeeding M. J. Sheridan, transferred to Grant, Ont.

F. D. HARRIGAN, roadmaster of the Ludington line and branches of the Pere Marquette, has been transferred to the Toledo line and terminals, with office at Saginaw, Mich., succeeding W. F. Bushroe, deceased.



F. A. WRIGHT, assistant division engineer of the Chattanooga division of the Nashville, Chattanooga & St. Louis, has been appointed supervisor of the Sequatchie Valley, Orome and Tracy City branches, with headquarters at Bridgeport, Ala., succeeding W. H. Hutton, assigned to other duties.

W. L. Fox, supervisor of the Huntsville division of the Nashville, Chattanooga & St. Louis at Sparta, Tenn., has been transferred to the Atlanta division, with headquarters at Kingston, Ga., succeeding J. T. Fox, resigned. M. C. Stone has been appointed supervisor at Sparta, succeeding W. L. Fox.

B. C. DOUGHERTY, roadmaster of the Chicago, Milwaukee & St. Paul at Beloit, Wis., has been transferred to Chicago, Ill., succeeding David Mav, roadmaster at Chicago, Ill., transferred to Libertyville, Ill. M. Gaylord, roadmaster at Savanna, Ill., has been transferred to Beloit, Wis. He has been succeeded at Savanna, Ill., by E. Cush, formerly at Libertyville, Ill.

L. BERCER, roadmaster on the Canadian Pacific at Brownville Junction, Me., has been transferred to the Smiths Falls subdivision of the Eastern division, with office at Smiths Falls, Ont. J. H. Guthrie, roadmaster on district No. 2 of the Atlantic division at Aroostook Junction, N. B., has been transferred to Brownville, succeeding L. Berger. W. H. McGann has been appointed roadmaster of the Edmondson, Aroostook, Tobique sub-division of the Atlantic division at Aroostook, N. B., succeeding Mr. Guthrie. W. J. Craig has been appointed acting roadmaster at Aroostook, succeeding Mr. McGann.

EARL E. CROWLEY, whose appointment as roadmaster on the Panhandle & Santa Fe, with office at Canadian, Tex., was recently announced, was born May 18, 1889, at Belle Plaine, Iowa. He received his education in the grammar and high schools of Milwaukee, Wis., and upon graduation entered railway service with the Chicago & North Western in June, 1905, as a timekeeper. After several minor promotions he was made acting section foreman and then extra gang foreman. He was in charge of extra gangs for a period of three years on the Galena division of this same company and in May, 1913, was promoted to be assistant roadmaster, which position he resigned in November, 1915. His present appointment became effective when he relieved C. E. Bruce, resigned.

BRIDGE

PAUL EBERST, foreman of bridges and buildings of the Kanawha & Michigan, has also been appointed foreman of bridges and buildings of the Kanawha & West Virginia, control of which was recently secured by the Kanawha & Michigan.

J. W. Woon has been appointed general foreman of bridges and buildings on the Valley division of the Atchison, Topeka & Santa Fe with headquarters at Fresno, Cal., succeeding D. A. Shope, resigned. He has been succeeded at Needles, Cal., by L. F. Seeley.

CHARLES F. NYE, who has been appointed supervisor of water supply of the Wheeling & Lake Erie, with headquarters at Brewster, Ohio, was born in Canton, Ohio. July 24, 1892. He received his preliminary education in the schools of this city and entered railway service in June, 1908, taking employment in the water supply department of the Wheeling & Lake Erie. In 1913 he was promoted to water gang foreman and retained this connection until his present appointment became effective, September 1, succeeding his father, A. Nye, deceased.

JOHN R. MORPHEW, whose appointment as bridge inspector of the Illinois Central was announced in the last issue, was born in Nora Springs, Iowa, December 29, 1873. He received his early education in the common schools of Nora Springs and entered railway service with the Illinois Central in February, 1895. From that time he has been continuously in the employment of this company, passing successively through the grades of bridgeman, hoisting engineer, assistant foreman and foreman of erection, which latter position he held for 13 years, up to the time his present appointment became effective. The position is a new one and his jurisdiction will embrace all lines of the Illinois Central north of the Ohio river.

LEWIS T. SEELEY, bridge foreman of the Arizona division of the Atchison, Topeka & Santa Fe Coast Lines, has been promoted to general foreman of the bridge and building department and of water service, in place of J. W. Wood, transferred to the Valley division at Fresno, Cal., in place of D. A. Shope, resigned, effective August 1. Mr. Seeley was born in Genesee County, Michigan, on August 21, 1868, and first entered railway service with the Atchison, Topeka & Santa Fe in 1899. From November 27, 1899, to March 5, 1902, he was bridge carpenter on the Albuquerque division and from the latter date until August 10, 1906, he was foreman carpenter at the shop at Winslow, Ariz. For the ensuing ten years up to the time of his recent appointment as general foreman of the bridge and building and water service department at Needles, Cal., he was bridge foreman of the Arizona division.

CHARLES WILLIAM LENTZ, who was recently appointed bridge inspector on the Southern Lines of the Illinois Central, with office at Memphis, Tenn., was born at Wetang, Ill., January 3, 1878. He attended the common and high schools of his native city, leaving the latter in 1896. In May of this same year he entered the service of the Illinois Central as a section hand and remained in this capacity until June, 1897, when he became a bridge and building carpenter. In 1902 to 1904 he was assistant bridge and building foreman, and from 1904 to 1906 he was a foreman. He was a pile driver foreman from 1906 to 1908, and a foreman of masonry from 1908 to 1909. From 1909 to 1915 he was general foreman of bridges and buildings, and from January, 1913, he was advanced to supervisor of bridges and buildings on the Minnesota division, with office at Dubuque, Iowa. His present position is a new one, having just recently been created.

PURCHASING

F. J. O'CONNER has been appointed general storekeeper of the Chicago, Milwaukee & St. Paul, to succeed G. G. Allen, resigned.

J. F. PRATT has been appointed general storekeeper of the Great Northern, with office at St. Paul, Minn., succeeding John Opheim, transferred.

O. H. Wood has been appointed assistant purchasing agent of the Great Northern, with office at Seattle, Wash., succeeding C. L. Bankson, resigned.

Hugh Greenfield has been appointed purchasing agent of the Duluth, Missabe & Northern, with headquarters at Duluth, Minn., succeeding Fred H. White, deceased.

R. BARNWELL, general tie agent of the Western lines of the Canadian Pacific, has been appointed assistant purchasing agent of the Western lines and his former position has been abolished.

OBITUARY

M. T. MURPHY, supervisor of the Terminal Railroad of St. Louis, died suddenly of heart failure, on the street, in New York, on Monday afternoon, September 18. He had just arrived in that city to attend the convention of the Roadmasters and Maintenance of Way Association.

ANNUAL INSPECTION.—The Pennsylvania Railroad will hold its forty-fourth annual track inspection on October 3 and 4. S. C. Long, general manager, will go over the main line from Pittsburgh to New York, accompanied by some 300 operating officers. Every year, on the occasion of this inspection, prizes to the amount of \$5,400 are awarded to the supervisors and their assistants, who have maintained their sections of the roadbed in the best condition during the year. The awards for 1916 will be announced upon the arrival of the inspection party at Harrisburg on the evening of October 3.

PENSIONS.—The Great Northern has set aside \$1,000.000 to endow a pension fund for veteran employees. The new plan went into effect on September 16, the anniversary of the birth of the late James J. Hill. The appropriation will be invested in bonds, interest on which will be used for pensions, but if the fund thus created proves insufficient, the deficit will be paid out of earnings and included in operating expenses. Employees are to be retired at the age of 70, but may voluntarily quit at 65 and receive pensions. The system will take in those employees who have been continuously in service for 20 years or more. For each year of service an allowance of one per cent of the average monthly pay received for the 10 years preceding retirement will be paid, but in no case will the payment be less than \$20 a month nor more than \$75.

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CONSTRUCTION NEWS

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THE ALABAMA GREAT SOUTHERN is planning to construct a concrete coal chute and sand house at Birmingham, Ala., to provide modern facilities for supplying coal and sand to locomotives. Other improvements will also be made, which include a water station at Pratt yard and a 50-ft., 150-ton track scale at the Twenty-second street yard.

THE BELLE FOURCHE & NORTHWESTERN is making surveys for a new line to be called the Belle Fourche & Northwestern, to run from Belle Fourche, S. D., to Miles City, Mont., a distance of 204 miles.

THE BOSTON & MAINE has awarded a contract to the H. Wales Lines Company, Meriden, Conn., to build a locomotive shop at East Deerfield, Mass. The building will be of brick and steel construction, 40 ft. high, 170 ft. wide and 200 ft. long, and will cost approximately \$80,000.

THE CHICAGO & ALTON is developing plans for an entirely new freight terminal east of their existing station at Harrison street, Chicago, Ill., made necessary by the vacation of the old station to make room for the new Union station. The new development will be located largely between the present station and the Chicago river.

THE CHICAGO & NORTHWESTERN has let contracts to the Grant Smith Company of St. Paul, Minn., for the erection of ore dock No. 3 at Ashland, Wis. This third dock will have 200 pockets of a total capacity of 50,000 tons, and will cost approximately \$1,500,000.

THE GULF, COLORADO & SANTA FE is planning to construct two large water storage reservoirs and pumping plants in Texas. One will be located near Brownwood and will have a capacity of 300.000,000 gal. and the other will be near Sweetwater with a capacity of 290,450,000 gal.

THE ILLINOIS CENTRAL will build a new freight house at East St. Louis, III. The building will be of timber construction, 1,050 ft. long by 32 ft. wide. About 486 ft. will be two stories high to provide for additional office space and the rest will be one story high. There will be a transfer platform 12 ft. wide running the entire length of the shed and a heavy freight platform 170 ft. long and 27 ft. wide. The approximate cost of this undertaking is \$150,000.

THE MINNEAPOLIS, ST. PAUL & SAULT STE. MARIE is building a new freight and passenger station at Grand Rapids, Wis., which will cost approximately \$45,000. The W. A. Hansen Construction Company, Chippewa Falls, Wis., has the contract for the work.

THE NEW YORK CENTRAL is building, with company forces, a pile and timber car ferry slip with a protecting stone crib on the St. Lawrence river at Ogdensburg, N. Y. The slip will be 40 ft. wide, 215 ft. long, and will cost approximately \$22,000.

This road has let a contract to The Wells Brothers Company, New York, for the building of a passenger station and express building at a point north of Main street, in Poughkeepsie. The building will have an elevation of 46 ft. on the east and 72 ft. on the west. It will be 63 ft. wide and 161 ft. long, with an express wing 25 ft. by 79 ft., and will be of steel, concrete, brick and stone construction, with tile roof.

THE OREGON SHORT LINE is enlarging several engine houses. Besides an 18-stall addition at Pocatello, Idaho, construction work is progressing rapidly on 5-stall additions to other engine houses at Salt Lake City, Utah; Montpelier, Idaho, and at Glenn's Ferry, Idaho, and 4 stalls at Dubois, Idaho. New facilities at Nampa, Idaho, including a 6-stall engine house and machine shop annex, are also nearing completion.

THE PENNSYLVANIA LINES are planning to extend their lines from Toledo, Ohio, to a point near the city limits of Detroit, Mich., where connection will be made with the Pere Marquette, over which it will run into the Fort street depot. Approximately \$40,000,000 will be used to build this line and a belt road for freight purposes which will parallel the line of the Detroit terminal. THE PENNSYLVANIA RAILROAD will build a new outbound freight house at Buffalo. It will have standing room for 120 cars and will be so constructed that it can be enlarged in the future. Contracts for the work have not yet been let. The company will use the present freight station at Louisiana street for the inbound freight house.

THE PUBLIC BELT RAILROAD COMPANY will be given authority to construct a bridge or tunnel to connect the east and west banks of the Mississippi river at New Orleans, if the constitutional amendment authorizing this work, which will be submitted to the voters of Louisiana on November 7, is carried. The Public Belt Railroad would like to hear from engineering firms who want to submit applications for contracts in connection with the work.

THE ST. LOUIS-SAN FRANCISCO will construct a ten-stall roundhouse with engine pits and drop pits, at Oklahoma, Okla., to cost approximately \$52,000. In addition to this it will install a cinder pit to be operated with a locomotive crane, a machine shop, boiler house and blacksmith shop, car repair shed and a storehouse, to cost in the neighborhood of \$58,000, exclusive of machinery, which will involve another \$36,000. It will also install a 50-ft., 150-ton track scale and lay about 45,000 lineal ft. of track. To complete these improvements, which will be done entirely by the company's own forces, will require an expenditure of \$250,000.

THE SOUTHERN RAILWAY will make improvements at Alexandria, Va., which will provide for modern engine terminal facilities, consisting of a 20-stall roundhouse and a 100-ft. turntable capable of handling the heaviest locomotives, a mechanical coalhandling plant, electrically-operated cinder pits, water tank, sand plant, a small shop for running repairs, a storehouse for oil and other supplies, wash and locker room for employees. These structures, together with the necessary tracks, are to be located on property owned by the company just south of the National Cemetery. J. P. Pettyjohn & Co., Lynchburg, Va., have the contract for the foundation work for the roundhouse and turntable.

THE SOUTHERN RAILWAY and the Mobile & Ohio have awarded a contract to A. H. Patrick, Corinth, Miss., to build a station for their joint use at Corinth. The structure will be of brick, two stories high, 50 ft. wide and 256 ft. long, and will cost about \$25,000.

STRUCTURAL STEEL

THE BALTIMORE & OHIO has ordered 250 tons of bridge steel from the American Bridge Company.

It has also ordered 275 tons of steel from the American Bridge Company for a bridge at Defiance, Ohio.

THE BOSTON & MAINE has ordered 325 tons of steel from the American Bridge Company for shops at East Deerfield, Mass. It has also ordered 150 tons of bridge work from the Phœnix Bridge Works.

THE CHICAGO, MILWAUKEE & ST. PAUL has ordered 226 tons of steel from the American Bridge Company for a bridge over Bay street, Tacoma, Wash.

THE DENVER & R10 GRANDE has ordered three steel turntables weighing 202 tons, from the American Bridge Company. which will be installed at Denver, Colo., and at Pueblo.

THE MINNEAPOLIS, ST. PAUL & SAULT STE. MARIE has ordered 375 tons of steel from the Minneapolis Steel & Machinery Company for the approaches to the Ashland ore dock.

THE PITTSBURGH & LAKE ERIE has ordered 700 tons of steel from the American Bridge Company.

THE SOUTHERN RAILWAY has ordered 1,500 tons of steel from the McClintic-Marshall Company for its Seneca river bridge.

TRACK MATERIALS

THE CHICAGO & ALTON is now contracting for its miscellaneous track and specialty supplies for 1917.

THE ATCHISON, TOPEKA & SANTA FE has purchased approximately 7,000 tons of tie plates at Chicago. It has also purchased 1,500 tons of tie plates from the Railroad Supply Co., Chicago. for delivery at Pueblo, Colo., and has bought angle bars for 90 miles of track for April 1 delivery from the Illinois Steel Co.



SUPPLY TRADE NEWS

GENERAL

THE CHICAGO BRIDGE & IRON WORKS has opened an office in Jacksonville, Fla., with Elwood G. Ladd in charge, who will handle the company's sales in Georgia, Florida and Alabama.

THE RAILWAY MOTOR CAR COMPANY OF AMERICA, Chicago, is about to begin the manufacture of power work cars in a 13-acre plant at Hammond, Ind., recently acquired by this company. These cars will be made under patents owned by the company and will be different in transmission and construction from any cars now in use. It is stated that the section car will constitute a self-contained power plant available for all sorts of track repairs. Later the company will produce unit passenger cars and locomotives, using the same principle of construction. F. A. Lester is vice-president and sales manager with office at Chicago.

PERSONAL

D. R. McVAy has been appointed railway sales representative of the Barrett Company, New York City, with headquarters at Cincinnati, Ohio.

WARREN S. CORNING has been appointed general sales agent of the Fox River Iron Company, Aurora, 111., with headquarters in the Transportation building, Chicago.

BURTON W. MUDGE, president of Mudge & Co., Chicago, dealers in railway supplies, has also been elected president of the Safety First Manufacturing Company, Chicago.

HARRY FLANAGAN, formerly with the Grip Nut Company, will represent the railroad department of the H. W. Johns-Manville Company, New York, in its Twin City territory.

B. H. FORSYTHE, formerly with the Hale & Kilburn Company, has entered the sales department of the Grip Nut Company, with offices in the McCormick building, Chicago, Ill.

C. FURNESS HATELY has been elected president of the National Surface Guard Company, Chicago, succeeding the late James T. Hall. Mr. Hately was born at Brantford, Ont., in January, 1876. He received his early edu-

cation at Sidcut School,

England, attending this

school from 1886 to 1889. Later he attended Trinity

College, Port Hope, Canada,

from 1889 to 1893, and

Shattuck School, Faribault,

Minn., from 1894 to 1896.

He then entered the bank-

ing business, engaging in

this line of work until 1912,

when he became interested

in railway building in North

Dakota. Later he became connected with the Midland

Continental, remaining with

that road until February,

1915, when he resigned. Mr.

Hately plans to expand the

business of the National

Surface Guard Company

tracts for the construction



C. FURNESS HATELY.

and has already let conof buildings which will permit the output to be increased to about three times its present capacity.

W. L. HAYES, formerly assistant manager of the Cleveland, Ohio, district of the American Steel & Wire Company, has been appointed manager of the Chicago district, to succeeded F. C. Gedge, deceased. W. C. Stone, formerly assistant manager of the Chicago district, succeeds Mr. Hayes at Cleveland.

HOWARD H. HIBBARD has been elected vice-president of the Grip Nut Company, Chicago, succeeding W. E. Sharp, who has recently been elected president of the company. Mr. Hibbard is the son of Edward R. Hibbard, who is retiring from the presidency to make his home in California. Immediately on leaving school he began his work in the company's plant at South Whitley, Ind., where he has made a careful study of the details of engineering and manufacturing of the devices handled by the company.

W. E. SHARP has been elected president of the Grip Nut Company, Chicago, Ill., succeeding Edward R. Hibbard, who has retired from business. Mr. Sharp began his railway career as



W. E. SHARP.

an apprentice in the car department of the Erie in April, 1889. In October, 1892, he was promoted to general foreman of the car and locomotive department of the same road, with headquarters at Chicago. He left this position in 1898 to accept service with the Armour Car Lines as assistant superintendent, which position he held until April, 1901, when he became the superintendent of this line. In 1911 he resigned this position to enter the railway supply business, becoming vice-president of the Grip Nut Company, which office he continued to fill until his election to the presidency, as announced above.

D. E. CAIN, western manager of the Dearborn Chemical Works, whose death at Denver, Colo., was recently announced, was born September, 1862, in Chicago, Ill., where he received his early education. He first entered railway service with the Chicago & Northwestern, and in 1881 became connected with the Atchison. Topeka & Santa Fe, holding various positions with that road in the mechanical department. He was general superintendent at La Junta, Colo., and Topeka, Kan., from 1902 to 1905. In 1905 he was appointed general manager of the Southwestern and Choctaw districts of the Chicago, Rock Island & Pacific, holding that position until December, 1906, when he became identified with the Dearborn Chemical Works as western manager, with headquarters at Denver, Colo. He remained with this concern until two years ago, when he retired from business because of ill health.

TRADE PUBLICATIONS

HYDRATED LIME.—The Hydrated Lime Bureau of the National Lime Manufacturers' Association, Pittsburgh, Pa., has issued bulletin A2, which is an exposition of the influence of hydrated lime on the workability, segregation, uniformity, strength and permeability of concrete. Particular reference is made to the use of the hydrated lime as an integral waterproofing compound and to its advantages in concrete that is to be spouted because of the increased plasticity obtained.

STEAM HAMMERS.—The National Hoisting Engine Company. Harrison, N. J., has issued a 20-page catalogue describing the National steam pile hammer. It contains tables giving dimensions and other characteristics of the five sizes of these hammers and is illustrated with photographs showing the hammers in use on various kinds of construction work. A 12-page pamphlet has also been issued describing the steam hammers No. 6 and No. 7, weighing 650 and 150 fb., respectively, which are designed especially for use in driving wood and steel sheet piling.

STRUCTURAL WATERPROOFING.—The Trus-Con Laboratories, Detroit, Mich., have issued a 52-page pamphlet explaining the nature and advantages of Trus-Con Waterproofing Paste (concentrated), which has been put on the market as an integral waterproofing for concrete structures. It is obtained in the form of a paste, which is mixed with the water to be used in making the concrete. Detailed instructions and specifications for the use of this material under various circumstances are given as well as a large number of photographs of structures in which the material has been used. The last half of the booklet is devoted to five papers discussing various phases of waterproofing and dampproofing in carrying out the integral process.





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WE GUARANTEE that of this issue 6,938 copies were printed; that of these 6,938 copies, 5,805 were mailed to regular paid subscribers, 83 were mailed to advertisers, exchanges and correspondents, and 1,050 were provided for new subscribers, copies lost in the mails and office use. The Railway Maintenance Engineer has applied for membership in the Audit Bureau of Circulations.	ELEM A THE GENE

The National capital has become in recent years an increasingly important source of news relating to every

Opening a Washington Office

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nt source of news relating to every phase of the railway industry. The desirability of permanent editorial representation in Washington has been felt for some time by the Simmons-Boardman Publishing Com-

pany, which, in addition to the Railway Maintenance Engineer, publishes the Railway Age Gazette, the Railway Mechanical Engineer, the Railway Signal Engineer, and the Railway Electrical Engineer. It is only recently, however, that the opening of such an office has been financially possible through the broadening of this company's activities, and still more recently that the move could be consummated, as it was first necessary to find the proper man and relieve him of other duties. An editorial office for all these publications has now been opened in Rooms 64 and 65, Home Life building, Washington, D. C. It is in charge of Harold F. Lane, who has had a long and valuable experience in railway newspaper work, and in addition to a thorough knowledge of railway economic matters has a good working knowledge of the more technical departments of the railway business.

The season now drawing to a close has been an unusual one in many ways from the standpoint of the main-

	tenance of way department. For the
Closing the	first time in several years the earn-
Season's	ings have been sufficiently large to
Work	warrant the authorization of many
MUL	deferred improvements. Early in
spring, howev	er, when plans were being made
take advantag	e of this condition, it became

CONTENTS W FLOORING CTING AGAINST TRACK OBSTRUCTIONS; W. F. RENCH....339 ENTS OF GANG ORGANIZATION; KENNETH L. VAN

evident, that, in spite of the fact that the money was available, even less than a normal amount of work could be completed because of a shortage of labor and delay in the delivery of materials. As a result the general condition of the track is probably no better now than at the same time a year ago, while in some localities it has deteriorated because of the shortage of labor. This places an added responsibility upon those in charge of its maintenance. Within a few weeks frost will prevent further extensive surfacing and similar work. It is, therefore, absolutely essential that every effort be made during the short time remaining to place the track in the best possible condition for the heavy traffic which now appears to be in prospect for the winter. Hours spent in placing the track in perfect condition before it freezes will save days in maintaining it during the winter. Incidentally, the lesson of this year points to the importance of beginning now to prepare for next season's work in order that it may be possible to undertake it actively as soon as the frost leaves the ground in the spring.

The necessity for keeping small passenger stations in a sanitary and presentable condition emphasizes the im-

Station Building Construction portance of substantial construction. Too many station buildings have been built that look shabby within a few months of their completion, and in five years look older and offer

more justification for criticism on the part of the public than other station buildings four times as old. Permanent construction cannot be justified in many classes of railway structures because they will frequently outlast their



usefulness, changing conditions making them obsolete or ill-adapted to their intended purpose before their physical conditions are such as to require their replacement. This is true of the passenger stations of our large cities. Because of the rapid growth in population they generally become inadequate and by reason of the rapid advancement in methods and facilities for handling traffic, they become obsolete before their normal life has expired. However, this argument in general does not apply to the passenger stations in smaller towns. Census statistics show that the smaller cities and towns, particularly in the agricultural regions of the east and middle west, are increasing but very little if at all in population, and, barring changes of line which require the moving of the station building to a new site, there is no reason why a well-designed, properly-built structure should not serve a small community indefinitely. To fulfill this requirement it must be designed and built to last. The design must be one that will wear well in the eyes of the traveling public. The fantastic designs grow tiresome, while one following the dignified lines will look as well at the end of 30 years as when it is built. From the standpoint of wear the requirements of the passenger station are unusually severe, and construction details that are entirely proper in a dwelling, for instance, will not serve the purpose in a building which must bear up under the careless usage of the public. A little more money spent for better or more serviceable materials will frequently add greatly to the life of the building and delay the time when the numerous evidences of wear and hard usage will give it the shabby appearance which is so largely responsible for the demands of the townspeople for a new building long before the station has really outlived its usefulness as a railway structure.

REORGANIZING THE GANGS

THE gang is the unit of the maintenance of way organization. While it may vary in size from a foreman and three or four men for a section or a small bridge gang to 75 or more men for a rail-relaying gang, the output of work is equally dependent upon the manner in which the gang is organized. It is commonly acknowledged that the personnel of the gangs has changed very rapidly in recent years. It has not been so generally realized that changed conditions frequently require the revision of methods and that it is possible that the present difficulties in retaining experienced employees in the service may arise from the continued application of the methods of a generation ago, which are perhaps antiquated and unsuited to the conditions of to-day.

Not many years ago wages in the maintenance of way department were fairly comparable with those in other industries with which the roads compete for men and an ample supply of efficient native labor was available. As the wages paid in these other industries have risen in recent years, those received by the men in the maintenance of way department have lagged behind, with the result that to-day many of the more capable men have gone into the other industries which have offered greater wages and the railways have been forced to go to the labor agencies and to take from them any labor which they might secure. At the same time the old practice has prevailed of paying all the men in a gang a uniform rate, with the result that these low wages have filled the gangs entirely with those of an inferior grade and have left the roads with few men that may be classed as potential foremen. With such a condition at the present time, the problem will become worse as the ranks of the efficient foremen are depleted.

Only in a relatively few instances has the possibility

of the reorganization of the maintenance of way gangs been considered as a means of solving this problem. At the present time it is probably impracticable to raise the wages of all of the laborers to a point sufficiently high to attract a sufficient number from other industries to fill the gangs with men of the desired grade. It is not so impracticable to place a few skilled workmen in each gang paying them a wage sufficient to hold them and then to fill out the remainder of the gang with laborers, or helpers, as they are commonly termed in other trades where similar methods are in vogue. Such a method, if carefully worked out, need not increase the total expenditure materially and in many cases not at all. At the same time it will provide a nucleus of experienced men in each gang who will set the pace for the rest and thereby tend to increase the output of the entire gang. It will also provide a supply of material from which foremen can be created as the demand arises, while the abolition of the uniform rate will provide an incentive for the more ambitious and capable men to prepare themselves for promotion to positions as skilled laborers as vacancies in these ranks occur.

One of the greatest handicaps in the employment of labor in the track department to-day is the fact that one man is considered as good as another and there is no opportunity to differentiate between those of different ability and habits of work. As the wage rate is largely based upon the performance of the least efficient the only opportunity for an ambitious man to better his condition is to go into other work, for the promotion from the position of laborer to that of foreman is slow.

It is true that a plan of this general character has been tried to a limited extent on a few roads by the creation of the position of track apprentice, but it has not received the attention in any comprehensive manner that its success in other industries would appear to justify. It is frequently the case that a higher wage rate results in a decreased unit cost owing to the greater efficiency secured from the men. If the raising of the wages of one or two men in each gang to the point where skilled laborers can be secured and retained in the service after they have become experiencd and the ultimate cost of performing the work is thereby reduced the railroad as well as the men are gainers. The difficulty in recent years has been that railway managements have been prone to scrutinize wage rates so closely that they have lost sight of the ultimate cost of the work, when, as a matter of fact, the wage rate is secondary so long as the cost of performing the work is reasonable.

MAINTENANCE EXPENDITURES

NE of the most difficult and at the same time one of the most important problems with which an officer in general charge of maintenance of way work is confronted is the determination of the proper standards of maintenance to be followed and the expenditures to be authorized for various lines of different traffic densities and earnings. As a basis from which to start, each line should be expected to contribute its proportion to the net earnings of the system, and money should not be spent on one line which must be derived from the earnings of another. This rule is, of course, subject to many important modifications. For instance, the expenditures for maintenance do not increase in direct proportion to the traffic, and there is a wider margin between gross and net earnings on lines of heavy business than on branch lines with only a few trains. Also, on lines of very light traffic, expenditures for maintenance cannot be reduced below the point where the safety of operation is endangered, although the business does not



justify even this expenditure. Again, frequently a road will feel warranted in maintaining a branch line to higher standards than the immediate business will justify in order to preserve relatively high standards over a system. However, these and similar deviations are made purposely and with a full knowledge of conditions.

Of greater consequence are the expenditures made because of a lack of a definite determination of the justifiable amount which may be spent. It is seldom that a roadmaster or a superintendent is criticized by the higher officers because his track is too good. On the other hand, when criticizing track which is not in the best condition, few men consider the amount of money which has been spent, the fact that the track may be as good as the traffic justifies or that excellent results may have been secured for the actual money expended. As a result, the local officers usually spend all the money they can secure on their respective lines, and endeavor to bring them up to the best possible condition without reference to earnings. Their only curb is the supervision given by the higher officers, and, instead of working with their superiors to ascertain the amount the road is justified in expending on the different minor lines and then limiting the expenditures to this amount, the local men enter into a contest with their superiors to persuade them to authorize as large an appropriation as possible.

This condition is responsible for the spending of much money, which is not justified by sound business princi-The inherent defect and the principal cause for ples. this condition is the failure to consider the amount of money spent when praising or condemning the condition of a line. When a roadmaster receives more praise for work well done in maintaining a branch line with an expenditure of \$800 per mile if this is all that is justified, than if he had expended \$1,000 per mile and was maintaining track better than conditions warranted, this problem will be largely solved. It is easy to recognize good track and difficult to detect full value received from definite expenditures. This difficulty should not prevent a road from endeavoring to correct extravagance wherever it is found to exist. Such correction of extravagance is only one step in the promotion of a uniform, rational distribution of expenditures based on the needs of the property.

THE STEEL MARKET

T HE present war in Europe defies comparison with any other conflict in the world's history. With millions of men withdrawn from productive employment in order that they may give their entire energies to the organized and wholesale destruction of life and property, and with neutral nations enjoying the unnatural prosperity engendered by the manufacture and sale of war materials, it is obvious that markets throughout the world must be in an abnormal condition. The steel industry, because of its close association to modern warfare, is affected relatively more than other commercial undertakings, although what is true regarding the price of high speed steel drills is essentially true also of the price of potatoes. The difference is one of degree only.

The prices of steel products at the beginning of this year bore such a sharp contrast to those of the depression of the winter of 1914 and 1915 that those who were compelled to buy these commodities could not bring themselves to believe that such prices could be maintained for any length of time. The representatives of the steel industry, on the other hand, predicted even higher prices, and the passing months have shown them to be the true prophets. While prices in general have not experienced any repetition of the rapid advances of the previ-

ous year, the steel market during 1916 has been characterized by marked stability, accompanied by small but steady increases. Structural shapes advanced between March, 1915, and March, 1916, from \$1.15 per 100 lb. to \$2.25. The price at present is in the neighborhood of \$2.75. Track spikes, which were worth \$1.35 in March, 1915, and had advanced to \$2.50 in March, 1916, are now worth from \$2.65 to \$2.90. Similarly, carbon steel track bolts advanced from \$1.85 to \$2.50, and are now quoted at \$3.25 to \$3.50.

The steel mills are enjoying what seems to be an unlimited supply of new orders, and there is apparently no hope of any immediate improvement in deliveries. The unfilled orders of the United States Steel Corporation aggregated 9,522,584 tons at the end of September. This is a decrease of 137,775 tons from the corresponding figure at the close of August and less by 347,750 tons than the maximum on May 31, 1916, but a more definite comparison is obtained by recalling that the unfilled orders of the corporation in November, 1914, totaled only 3,324,-592 tons.

This demand for steel comes from various sources. Besides the orders from the allies for strictly war materials, there have been calls for steel to be used in shipbuilding and for building and equipping railways. Shipbuilding has created a demand for plates, which, together with the car orders, explains the difference between the price of plates and that of shapes. A factor recently introduced is the naval program of the United States Government, including four battleships and a large number of smaller crafts. The requirements of the government alone for the next twelve months are estimated at from 250,000 to 275,000 tons.

In anticipation of the difficulties of delivery, most of the railways of this country have arranged for their rail requirements much farther in advance than is the usual custom. Those roads which failed to take this precaution are now in serious difficulty. One road which recently found it necessary to place an additional order for 25,000 tons was required to accept Bessemer rails in order to obtain delivery in the second half of 1917. The Canadian rail mills, which, under the Underwood tariff, gave the American roads an alternative market, have been of no avail in later months and only recently the Canadian government announced the preparation of plans for the assistance of the Canadian railways in overcoming the existing rail shortage consequent to the diversion of Canadian mills to war manufactures.

The status of the structural steel fabricator has not changed materially in the last six months, except in so far as the intervening time has served to use up the stocks that had been purchased on speculation early in 1915. The fabricating shops are not sharing in the prosperity of the war industry. The high prices have served to restrict structural steel projects, both as to steel frame buildings and bridges. As a result the shops are not working to capacity, although they have about as much to do as labor conditions and deliveries will permit. Orders at the present time, as shown by the statistics of the Bridge Builders and Structural Society, represent about two-thirds of the shop capacity.

On the whole, the situation presents a discouraging aspect to the railways which desire to show a reasonable return on any project involving the use of iron and steel in any quantity. However, the situation may as well be faced squarely, for, barring any sudden change in the policy of the warring nations in the near future, there seems little hope for any chance for any immediate improvement in the market from the standpoint of the purchaser.



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LETTERS TO THE EDITOR

DANVILLE, KY.

We hear a great deal about the section foreman problem, but the discussion seems to concern itself chiefly with the obtaining of new foremen, and little attention seems to be given to the conservation and raising to the highest state of efficiency of the existing organization. The retention of the men now in the service, the raising of their efficiency and the increasing of their ability, is a matter of supervision and the problem falls squarely on the track supervisor or roadmaster. Supervision of track does not consist merely of riding over one's district, looking for bad places in the track, detecting the foreman who is not handling his work properly, and reprimanding him more or less severely. This method may have been satisfactory when the demands on track were not so exacting, and when men were plentiful and jobs were scarce. Conditions have changed. There are too many places where a man may make a living and retain his self-respect, for a foreman to stand for much of the old-fashioned "jacking-up."

The track supervisor or roadmaster of today must handle his men more tactfully, not only because men are not so readily available, but because more is demanded of them, better training is required and a higher degree of intelligence and ability is necessary. These qualifications are largely a matter of training and intelligent direction of effort. Even the most experienced men require constant instruction if they are to meet the changing conditions.

The division engineer, the roadmaster and the track supervisor not only have the advantage of a wider field of experience to enable them to grasp quickly the need or desirability of new methods or better practice, but the various associations to which large numbers of them belong place at their disposal the experience of hundreds of their fellows. The foreman has no such advantages and must look to these officials for instruction. The training of the young foreman is both more difficult and easier than that of the more experienced man. He has more to learn, but he is frequently more open-minded than an older man. His ideas and methods are not so firmly fixed, and he more readily appreciates his need of instruction, while the older man, with his more firmly fixed ideas, does not see the value of new methods so readily, and, unless properly handled, is likely to adopt a change because he has to, and not because it appeals to him. This does not make for the best work.

Proper instruction implies a careful study of the individual foreman, for, save in the broader principles of handling men, there is no such thing as a fixed method. The method must vary with the man and must be individual in character.

A great deal of time must be spent on the ground with the foremen. Is a man not handling his work properly? Is he getting full value for the labor expended? The only way to get at the bottom of his difficulty is to work with him. Three or four days or a week spent in this way will not be wasted time. When the trouble is found, show him the why as well as the how. If he still fails to improve, be sure he understands, then talk the matter over with him, man to man, and warn him of discipline or discharge before going to that step. Anger and abuse

cause sullenness or loss of confidence, and no man does good work when in either of those conditions.

A fair, manly attitude toward the men breeds a mutual respect between supervisor and foreman and a selfrespect and self-confidence in the foreman, and it increases loyalty and produces contentment. These make for open-mindedness, intelligent and constructive thought, and real efficiency.

J. T. Bowser,

Maintenance of Way Department, Queen & Crescent Route.

NEW BOOKS

Proceedings of the American Railway Engineering Association. 6 in. by 9 in., 1,400 pages. Illustrated. Bound in half morocco, cloth or paper. Published by the American Railway Engineering Association, Karpen Building, Chicago. Price, half morocco, \$7.00; cloth, \$6.50; paper, \$6.00.

The volume this year contains fewer pages by 172 than last year, but owing to the larger number of inserts and the necessity for using heavy paper for a large number of plates it is actually thicker than the preceding one. Of the total number of pages, 780 are devoted to re-ports, 144 to discussions and 467 to monographs. Extensive work was done by all of the committees, but owing to the custom of continuing the work from year to year, the reports of a number of the committees were in the form of progress statements that did not indicate the true value of the work being done. In the case of the committee on iron and steel structures, on the other hand, the report given this year represents a digest of the work extending over a long period and for that reason constitutes one of the most valuable portions of the proceedings. Definite recommendations are made relative to secondary stresses, impact and working stresses based upon the results of tests and other investigations. The most important action taken by the association in its convention last March was the adoption of the report of the committee on rules and organization covering the standard clearances for bridges and other structures. The large amount of discussion which this entailed is particularly interesting. The reports of the committee on rail contain the usual annual review of the rail failure statistics, a report on internal transverse fissures, a study of 108 rail failures by W. C. Cushing involving a large number of illustrations, and an account of the nick and break test in the inspection of steel rails by Robert W. Hunt and C. W. Gennet, Jr.

The report of the water service committee gives an interesting account of the practice in protecting water stations from freezing. The report on masonry includes extensive notes on the appearance, wearing qualities and cost of surface finishes for concrete. Stone ballast by contract forms an important part of the report of the committee on ballast and is amplified by discussion on the floor of the convention.

Among the more comprehensive treatments in Part 2, covering the personal monographs, may be mentioned a report on special steels by W. C. Cushing; one on ballast tampers by George W. Vaughan, and two reports by Earl Stimson on the standardizing of maintenance of way work and a test of track bolts and wrenches.

À report on tests of treated and untreated Douglas Fir stringers by H. B. MacFarland includes extensive tables and diagrams. Two shorter reports were included: "Rise and Fall," by C. P. Howard, and "An Exceptional Flood," by J. L. Campbell. The book this year contains several series of unusually good illustrations, particularly those given with the reports on causes of rail failures, the nick and brick test, special steels, and the testing of Douglas fir stringers. These add materially to the value of the Proceedings.

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To the Editor:



Piles of Reclaimed Materials at the Seaboard Air Line Reclamation Plant

THE prize-winning paper in the contest on the Reclamation of Maintenance of Way Scrap Materials was published in the *Railway Maintenance* Engineer for October. The paper winning the second prize is published below, followed by two other contributions treating of somewhat different phases of the problem, which were received at the same time.

THE SANTA FE SCRAP YARD

By Andrew Graham

Assistant General Foreman, Reclamation Plant, Atchison, Topeka & Santa Fe, Corwith, Ill.

Not many years ago a Santa Fe blacksmith, repairing tools and doing various odd jobs in his line of work in a box car in odd moments began repairing track tools for the section foreman. To replace broken parts of these tools he went through the scrap cars to find good parts. This man secured enthusiastic support in his repairing work from the general purchasing agent, who moved the scrap yards from Topeka, Kan., to Corwith, Ill., about this time. Scrap from all over the system was sent to this yard to be disposed of. The classification of scrap was constantly changing and Chicago afforded the only market, so greater efficiency was expected from direct contact with the scrap material by the consumer.

The movement for gathering in one central place the scrap of the 11,000 miles of road gave birth to the thought of reclaiming all the useful material. The result has been far beyond expectations. Formerly with scrap sorted at several points or sold in carload lots the real loss was not realized.

A shop was built with about 3,000 sq. ft. of floor space for blacksmiths to repair track tools and work over old bolts and round iron. The shop had to be enlarged within a year. The next year two more shops were built and the old one was enlarged. Each year for seven years the floor space was increased. At present 50,000 sq. ft. of floor space is in use and a new steel building is now under construction, adding 17,500 sq. ft. for the operation of a five-stand rolling mill.

The personal supervision of this department by the general purchasing agent has made this a distinct department. Because of this separate organization, the overhead charge is cut and new and raw materials are more quickly procured from manufacturers.

In any new departure, the proof of its efficiency lies in results. This growing department of scrap reclamation has consistently justified the expenditure of \$100,000

SHOP ORDER STATEMENT, CORWITH SCRAP YARD, A. T. & S. F. RY. CO.

First Three Months, 1916.

Numb	er Material	·	Shop Expense	— •	Value	Net
Article. Repaire	ed. Used.	Labor	Supervision.	Total	New.	Saving.
Track Shovels 1,665	5 \$ 86.04	\$153.48	\$ 4.20	\$ 243.72	\$ 965.70	\$ 722.18
Ballast Forks 252	7 6.14	18.86	.84	25.54	173.66	277.72
Scoop Shovels 196	5 43.09	15.79	.47	59.35	74.01	14.66
Track Spikes-Kegs &	3 86.60	23.00	9.79	119.39	290.00	170.61
Star Switch Stands 65	5 82.14	39.48	15.78	137.40	677.44	540.04
Ground-Throw Switch Stands	2 26.19	25.65	12.39	64.23	450.63	38 6.40
Rail Tongs	4 6.87	1 6 .61	7.51	30.99	114.68	83.69
Track Drills 170	5 178.64	61.82	28.87	269.33	1,289.95	1,020.62
Clawbars 546	6 3 76.40	96.26	47.50	520.16	775.32	255.11
Lining and Timber Bars 342	7 43.80	62.18	32.21	138.19	142.90	174.71
Tamping Picks 5,02	0 813.00	63 8.86	322.83	1.774.69	2,697.94	923.25
Dirt Picks 54	4 29.52	51.98	29.05	110.60	195.84	85.24
Norton Jacks	4 233.35	60.23	30.23	323.81	1,531.90	1,208.09
Barrett Jacks 192	2 226.64	73.60	36.33	296.57	851.43	554.86
Track Chisels 48	3 15.57	58.43	27.94	101.95	262.66	160.71
Spike Mauls 66	1 30.66	70.72	33.83	135.21	413.21	268.00
Tamping Bars 33	4 172.78	62.87	25.53	261.18	377.42	115.24

for the machinery now in operation. The total figures in the recapitulation of the monthly shop orders for the calendar year of 1915 are as follows: Material used, which includes the scrap value of the old material as well



RAIL AND FROG STORAGE

as the cost of the new material used, \$624,085.52; labor expended, \$88,598.88; shop expense and supervision, \$38,-143.60; total cost of repairs, \$750,828, value as new, \$1,047,209.51, making net profit of \$296,381.51, or \$1,000 for every working day.

The maintenance of way scrap reclaimed has been holding its own with the mechanical and that from other scrap departments as a revenue producer. The accompanying table gives an idea of the cost of the repairs and the saving made on different track tools repaired the first three months of this year.



REPAIRED TRACK JACKS

In addition to the items given in the table 10,000 tie plates are reclaimed each month and put back into service; 1,000 rail joints and angle bars are reclaimed each month, and tinware, such as water buckets, dippers, oil cans, sprinklers, etc., used by the section men are made out of second-hand galvanized iron car roofing. This department clears \$500 net each month. Track bolts rendered useless on account of rust are worked over, oiled, sorted and issued back on requisitions. Slow signs are made out of scrap sheet iron and scrap pipe. Milepost signs, bridge signs, etc., are manufactured from scrap pipe and sheet iron. Bridge bolts and drift bolts are all made of scrap rods. Drain pipes for crossings and culverts are picked out of scrap. Snow and cane brooms are made at this plant, using the old handles. Bumping-post rails are made from scrap rails. In fact, everything that can possibly be manufactured from scrap is made at the yard, requisitions being sent here before the material is purchased and experts selected from the different departments of the railroad go over them, picking out the items they can reclaim or make from scrap.

The Santa Fe rail mill is located at Newton, Kan., where frogs, switches and guard rails are repaired. Scrap rail is shipped in from all over the line and sorted for different uses, such as relaying, sidings, frog and switch material, guard rails and scrap. A scrap frog is taken apart and credit allowed to the division from which it came, for good serviceable parts. Frogs that can be repaired at a small cost are taken in at the price of new and the division scrapping them is charged with the material and labor expended for repairs. The frog then is



PILES OF RECLAIMED RAILS

issued to the line at the price of new. Frogs are also made from second-hand rail and the serviceable parts taken from scrap frogs.

At the present time the entire output of the shop is devoted to the repair and making of frogs. There were 1,436 frogs repaired during 1915 and 196 bridge points were made. The value of the new material used amounted to 3,260.70, the amount spent on labor was 8,912.06, and the overhead expense 2,148.94, making a total cost of 14,321.70. The cost, if purchased new, would have



REPAIRED TRACK DRILLS

been \$50,178.13. This makes a net saving to the company of \$35,856.43.

The assembling of scrap metal at one point might be advantageously done by some other roads for several

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reasons. When tools break on a section they are thrown in a scrap car and forgotten. The accumulation from thousands of miles of line with the opportunity for inspection to ascertain the possibility of repairs, or of defects or weak places, is surprising. Representatives of railway supply houses visit the yard daily and examine their own products after they have gone through weeks or months of service. Not long ago 867 tamping picks were replaced by a manufacturer because of a defect in one spot. Oftentimes a change of design results in an improvement which is participated in by all railroads.

Repeated handling of tools makes men expert in repairing them. Tools repaired at different points show inferior workmanship. A blacksmith not used to handling tool steel each day gets out of practice. Tools repaired at each division point only afford a blacksmith about one day's work per month, while at the reclamation plant one man works continually on picks, another on clawbars and another on chisels, etc. Suggestions from roadmasters and section foremen regarding their requirements are more readily given and received at one central point. These men may meet at such a point and profit by what others are doing along the road, as well as give ideas of reclaiming this scrap material.

The maintenance of way scrap is handled very conveniently by a supply car covering a given territory. The car is loaded with tools and supplies which are issued to the different sections upon the return of the old tools with requisitions for the new ones. The old tools are taken to the nearest storehouse by the car and from there shipped to the reclamation plant. Thus they are kept in circulation. Officials and workmen like the plan and work in harmony to promote the new-found science of saving.

THE PRINCIPLES OF RECLAMATION

By J. G. Talbot

Foreman, Reclamation Plant, Seaboard Air Line, Portsmouth, Va There should be no distinction between the reclama tion of the maintenance of way material and that of any the scrap systematically and regularly. The supply train offers the only practical service. The assembling and reclamation plant should be organized on broad enough lines to take care of all operations, including the sorting and handling of the scrap. The track layout should be such as to avoid all unnecessary handling. The reclamation tools should be arranged in sequence. For the same



KEGS FOR SORTING BOLTS AND NUTS

reason the reclaimed material should be stored and shipped, or delivered, directly from the plant.

An accurate record of the unit cost of the work must be kept which must take into consideration the salvage value of the material, all expense connected therewith, and its proper proportion of overhead, so that it may be known at all times what the unit actually costs. This is necessary in order that the reclamation of any article may be discontinued promptly when it is shown that it



ONE PART OF THE SEABOARD RECLAMATION PLANT

other department. Theoretically, reclamation should begin with the user and be refined upward. In practice, it begins at the assembling point and is refined downward.

The first requisite is to install a method of assembling

costs more than it can be purchased for new, less the salvage.

Sufficient and modern tools should be installed and proper supervision must be maintained to do the work



well and cheaply, and develop it. Reclamation work will develop every day in proportion to the perfection of the organization and the intelligence of the supervision. The gradual refining of this work will have the effect of lessening the amount of reclamation, and the men on the sections, in the shops and elsewhere will gradually learn by forcible lessons, and discipline if necessary, the need of closer supervision and care in the use of materials, for



STRAIGHTENING SPIKES

it is recognized that the real service consists in obtaining the fullest service from the material before it is removed. The conditions under which men work will make it impossible for them ever to overcome losses in this way entirely, and it will always make it necessary to have a general assembling point where material can be carefully analyzed and salvaged.

A supply train is used for picking up all scrap and surplus and obsolete material to be worked over. This train operates over the different divisions on a prearranged schedule, giving a 60-day service. Section foremen and their men meet the train and obtain from it the necessary supplies, and at the same time loading all scrap and surplus. Roadmasters accompany this train and know whether or not the supplies delivered are in the required amount and if the scrap and tools turned over have served their purpose. On the first trip of the supply train on three divisions, there was picked up as surplus tools and tools needing repairs, 2,022 picks, 525 clawbars, 386 track chisels and 133 track jacks. By picking up scrap at regular intervals congestion is avoided at the reclamation plant and the loss of many tools and much scrap is obviated.

Regardless of the fact that foremen have instructions to use all serviceable spikes, almost any large road can pick out and straighten 75 to 100 kegs of spikes per month. These when rattled make serviceable spikes for side track use. Bolts can be picked out and soaked in crude oil and many kegs reclaimed per month.

Rail is one of the expensive items on the railroad and very little attention has been given to its reclamation. A properly laid out yard equipped with a friction saw, rail drill and straightening machine will make many tons of rail serviceable, either for selling or for use on side tracks. The best short pieces of rail can be saved out and used for frogs or guard rails.

Roadway scrap, if carefully sorted, will be found to yield astonishing amounts of good angle bars, tie plates, braces, joints, etc., many of which can be used again, and if there is a surplus they can be sold to many small users. The assembling of scrap as far as possible at one point will justify the purchase of cranes and magnets to do the work properly and economically. Scrap can be handled by cranes and magnets for one-fourth the cost of doing it by hand.

While it is felt a great deal has been done in the reclamation of material, actually the surface has only been scratched, as far as opportunity is concerned, but what we have done has been done with full knowledge of the principles involved and the plan has been laid out in an economical and practical manner and is capable of being largely extended as conditions will warrant.

The following list of equipment will give an idea of the work the Seaboard Air Line is doing along this line:

Spike-straightening machine. Rattler for spikes. Vats for soaking bolts and nuts. Rail saw Rail drill. Rail straightener. Facilities for repairing jacks, drills, rehandling shovels, etc. Magnetic brass separator. Brake beam repair shop. Spring reclaiming plant. Nut tappers. Bolt threaders. Bolt shears. Bolt-straightening hammers. Large alligator shears. Large hammer for general work. Washer machine.

Acetylene cutting and welding apparatus. Cranes and magnet.

RE-USING WORN MATERIALS

By Charles Williams

Supervisor, Kanawha & Michigan, Quincy, W. Va.

A scrap car is run over the division on the local freight on the first Tuesday of each month. All section foremen



SCALE TRACK SIGNAL MADE FROM SCRAP

have standing instructions to bring the scrap in each evening to the scrap bins located at tool houses, and to be on hand each scrap day to load their accumulations into the scrap car, together with any other material taken out of the main line and sidings that they have no immediate use for. The loaded scrap cars are shipped to the scrap yard, where the mechanical department as well as the maintenance of way department scrap is sorted. All



spikes that are fit for further use are straightened. The good wings of frogs are saved and used to repair other frogs. Frogs that are not fit for main line use are used in sidings and mine tracks, where, after being bolted new throughout, they give a number of years' service.

The manganese tip switch points that break where the manganese connects with the point are repaired by taking a bridle rod out of the scrap and drilling it to fit the holes in the switch point. The bridle rod is then bolted to the point with 34-in. bolts, which makes the point as good as new at a cost of \$0.35. We have eight points repaired in this manner, and two have been in use over one year on the ladder track of the load yard, where an average of 400 cars per day pass over them. In addition, all the engines use this track in going to and from the roundhouse.

The defective rails removed from the main line are turned and used in house and mine tracks, and the light rails recovered are sold to coal companies for motor tracks at the relay price. The scrap rails over six feet long are piled, and when enough are accumulated are sold on sales order, the same being done with rails under six feet long.

Damaged and worn switch stands are taken apart and the good pieces are saved and used for repairs. The Ramapo switch stands that become damaged or worn are repaired by purchasing the necessary pieces from the makers. The accompanying picture shows a scale track signal that was made from a piece of scrap floor beam from a bridge, and four staffs of high-target switch stands that were recovered from scrap. This signal is used in the receiving yard to indicate which tracks are blocked, and eliminates the danger of heading a train onto a blocked track. This signal was made at a labor cost of \$5.25.

Scrap frog points are used at the ends of guard rails on bridges. Tie plates that are worn and unfit for the main line are drilled to fit smaller rails and are used on yard tracks and branches. Tie plates are drilled in the shops at a cost of $1\frac{1}{2}$ cents per plate, and, considering the cost of new plates and the length of service obtained under light rail, a large saving is made.

Rail Failure Statistics for 1915

THE annual analysis of the statistics of rail failures prepared by M. H. Wickhorst, engineer of tests for the Rail Committee of the American Railway Engineering Association, appear in bulletin No. 188, which has just been issued. This report includes the statistics of rail failures for the year ending October 31, 1915, and is based upon information furnished by the railways of the United States and Canada in response to a circular sent out by the American Railway Association. The report covers the rollings for 1910 and succeeding years. The tonnage included in this report amounts to 7,397,699 tons of rails, of which 1,384,858 tons is of Bessemer rails and 6,012,841 tons is open-hearth rails. As is to be expected, the Bessemer rails show a continually decreasing proportion of the total tonnage. The following data is abstracted from the report:

It is interesting to note the comparative performance of Bessemer and open-hearth rails for the several years' rollings. Figuring the failures per 100 track miles of open-hearth rails as 100 for each of the years 1910, 1911, 1912 and 1913, the relative failures of the Bessemer rails, together with the failures per 100 track miles, is shown below:

FAILURES OF OPEN-HEARTH AND BESSEMER COMPARED

Year Rolled	Years' Service	Failu per 100 Tra	ires ack Miles	Comparative	Failures
		Open-Hearth	Bessemer	Open-Hearth	Bessemer
1910	5	153.1	236.9	100	154
1911	4	115.5	178.8	100	155
1912	3	46.0	66.9	100	143
1913	2	24.8	35.2	100	142

It will be noted that the Bessemer failures per 100 track miles were about 50 per cent greater than those of the open-hearth rails. It is probably also true that the open-hearth rails were, in general, in more severe service, so that the actual difference under the same conditions may have been greater.

The comparison between open-hearth and Bessemer rails as obtained from the statistics in the 1913 and 1914 reports and this report are collected together below. The original comparisons in the 1913 and 1914 reports compared the failures per 10,000 tons, but below the comparison is on the basis of failures per 100 track miles, although the difference is small.

Bessemer Failures Compared with Open-Hearth Failures Taken as 100

Year Rolle	d												_		2	2	_	-	-	-	-	Y	egg	a	r	s'		Se	el		4	c	e	-	_	-	-	-		5		_	
1908		,																																		-			1	12	2	-	-
1909												Ŀ						5									.			1	9	5							18	38	3		
1910												L										2	23	30)					2	20	7	1						1	54	ł.		
1911														2	4	9						2	29)1						1	5	5										ł,	
1912							í.	į						2	21	9						1	4	13													ĺ.		0			1	C
1913														1	4	2																											

In order to show more conveniently the relative number of failures from each of the mills and to show the ranking of the mills as regards the failure performance of the rails rolled by them, one of the accompanying tables has been prepared. Taking the average number of failures per 100 track miles of all the mills in each group (Bes-

COMPARISON OF FAILURES FOR THE DIFFERENT MILLS, USING 100 AS THE AVERAGE OF FAILURES OF ALL MILLS FOR EACH YEAR'S ROLLINGS

	191	0	191	1	1912	2	1913	2
			101	<u>.</u>	1014		1010	
Mill	Relative Failures	Rank	Relative Failures	Rank	Relative Failures	Rank	Relative Failures	Rank
		BES	SEMER					
Illinois	86.9	2	99.4	3	81.9	1	79.0	13
Maryland	77.3	1	35.9	1	97.0	$\overline{2}$	165.3	5
Lackawanna	92.6	3	155.0	5	151.7	3	74.4	2
Cambria	171.2	4	138.2	4	188.8	4	57.1	Ī
Carnegie	203.5	5	88.8	2	212.1	5	84.7	4
	0	PEN	HEAR	гн				
Tennessee	35.8	1	36.7	1	95.4	5	66.5	2
Colorado	39.8	2	47.3	2	120.9	7	44.4	Ī
Pennsylvania	80.9	4	107.0	6	59.8	2	84.7	4
Carnegie	66.0	3	110.7	7	120.2	6	78.2	3
Illinois	134.7	8	96.8	4	85.3	3	88.3	5
Lackawanna	97.2	5	97.7	5	86.1	4	126.7	7
Maryland	106.3	6	52.6	3	39.3	1	298.8	9
Bethlehem	216.1	9	226.4	9	113.3	8	108.5	6
Cambria	131.3	7	204.8	8	161.5	9	199.6	8



semer and open-hearth), in any year's rolling as 100, the relative number of failures of each of the mills is shown for the years 1910, 1911, 1912 and 1913. The later rollings are not included because of being too recent. The rank of each mill is also shown for each year's rolling.

One important purpose of these statistics is to enable comparisons to be made of the performance of rails rolled from year to year. The final comparison is made on the basis of five years' service, but before closing the record of any one year's rolling, a comparison can be made on the performance of a less number of years in service. The records are closed for the 1908, 1909 and 1910 rollings and it is noted that both the Bessemer and open-hearth rails showed reductions in the number of failures in the successive years.

The average number of failures per 100 track miles of the rollings for the several years, including both the Bessemer and open-hearth rails, is given in the following table:

Year Rolled	-	 	(0		 -		_		1	 	-	 - \ 2	ŕ	9E	ır	s	,	\mathbf{s}	e	r١	vi 3	C(e	 - -	 	4	ł			_	-		_		5	;	_		-
1908 1909 1910 1911 1912 1913	- - - -		•	2		 • • • • •	- - -	 	2	· · · · · · · · · · · · · · · · · · ·	 	 		· · · 732	· · · 725		· · · ·			•	12 10 4	24		0 4 3		2	24 52 33	1. 2. 3.	173		•		•	321	979	-878		185.	- - -	- - -
1914 1915			(0	. 2					8	 2		 			 				•	••••		•	•	 .	•			•	•	•	•	•	•	•	•	•	•	•	•

A study of the results shows that the 1908, 1909 and 1910 rollings have successively decreased numbers of failures compared on a basis of five years' service and the later rollings also show successive reductions in failures when compared on a less number of years' service. This is due partly to the gradual replacement of Bessemer by open-hearth rails, and partly to the improvement in both the Bessemer and open-hearth records.

1 12-ft. by 14-ft. tent for the cooks, commissary clerk, etc. 1 16-ft. by 20-ft. portable steel building for the commissary.

A 16-ft. by 24-ft. tent equipped with six double deck

Camp Equipment for Extra Gangs

HE Buffalo, Rochester & Pittsburgh is replacing box cars with tents for the housing of its extra gangs engaged in track work with excellent results. The standard equipment for a gang of 150 men consists of:

2 16-ft. by 24-ft. tents for bakery and kitchen. 4 16-ft. by 24-ft. tents for dining quarters.

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steel bunks, a stove, a lamp and a table provides comfortable sleeping quarters for 12 men. A tent of the same size will provide a dining-room for 48 men, while one of this size is adequate as a kitchen and bakery for



A TYPICAL CAMP ALONG THE TRACK

13 16-ft. by 24-ft. tents for sleeping quarters. 1 16-ft. by 24-ft. tent for the foreman and timekeeper, for sleeping quarters and office. 1 10-ft. by 12-ft. dining tent for the foreman. 1 10-ft. by 12-ft. tent.

a gang of 50 to 60 men. The kitchen is equipped with a large cooking range of a size depending upon the number of men in the camp. All of the tents have sectional floors to facilitate moving. The railway provides all



INTERIORS OF THE BUNK, DINING AND KITCHEN TENTS

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equipment except the kitchen utensils, dishes, mattresses, blankets, lamps and the kitchen range. Each camp is equipped with an ice box, ice being furnished by the company two or three times a week.

The cook and all the kitchen and dining-room employees are furnished by the labor agent and work under the direction of the commissary clerk. The railway furnishes one man at each camp who is responsible to the foreman for sanitary conditions. The sleeping tents are swept daily and the floors are scrubbed twice each week. The floors in the kitchen tents are scrubbed each day and in the dining tents every second day. The foreman and the commissary clerk exact cleanliness from the laborers, neglect in this matter being sufficient cause for The use of steel bunks has been found to dismissal. result in materially improved sanitary conditions as compared with those existing in the camp cars and wooden buildings formerly used, which it was practically impossible to keep clean and free from vermin.

Where foreign gangs are employed no cook or dining tents are furnished, as these men prefer to do their own cooking out of doors. The location of a camp is given the personal attention of the labor agent and the roadmaster, who consider each site from the standpoints of proper sanitation and an ample supply of pure spring water.

A NEW ACETYLENE LIGHT

THE Alexander Milburn Company, Baltimore, Md., has introduced a new acetylene gas lamp for use on construction work, known as Milburn Light No. 22, which has a support.

which has a capacity of 100 cp. for a period of eight hours without recharging. The special feature of this lamp is the arrangement for varying the position of the The flame. lamp may be ordered with a simple burner set at 45 deg., with or without a wind shield, or it may be provided with a movable burner, which may be set at any angle from horizontal to vertical. This is a convenience where it is especially desirable to direct the light to secure a certain distribution or intensity of light at a given point. This burner may be used



THE ACETYLENE LANTERN

with or without a reflector. The wind shield, which is useful in outdoor work in the case of high wind, is made of transparent mica, with metal protecting edges and ribs. It is easily attached or removed from the burner.

The lamp consists of a plain cylinder, 6 in. in diameter, made of seamless steel stampings with fittings of steel and malleable iron. The total height of the lamp over the bail is 11 in., and it weighs eight pounds when loaded. The carbide charge is one pound. The water feed is automatic, generating the gas only when needed, and is controlled by a needle valve on top. The carbide chamber is arranged for easy charging and dumping, and the water chamber has a funnel at the top to facilitate filling.

SCHOOLS FOR TRACK LABORERS' CHILDREN

THERE are many localities along the railroads in the Southwest, where sparse population and undesirable physical conditions produce very unsatisfactory living conditions for the men located at way stations along the line. Public instruction is frequently not available for the children of such employees. Realizing that these con-



AN EXTERIOR VIEW OF THE CAR

ditions are not conducive to efficient, steady and satisfied employees, the Southern Pacific has made a consistent effort to provide ways and means of improving the conditions as much as possible. Living quarters are made attractive, shade trees are planted, water is provided in abundance and provision is made for the schools wherever practicable. In a number of cases school buildings have been built at the expense of the railroad company and telegraph operators have been granted overtime for trips made on motor cars twice a day to convey children to and from the schools.

The Mexican labor commonly used in the track forces has introduced a further problem, because even when organized in extra gangs these men move their families with them. The children in these gangs are deprived ordinarily of any educational opportunities.



THE INTERIOR OF THE CAR

This has been overcome in one gang by establishing the school car shown in the accompanying photographs. The interior of the car is made as attractive as the equipment in bunk car service will permit. The teacher is generally the wife of the timekeeper in the extra gang, special pains being taken to select a timekeeper who has a wife who is competent to carry on this work. The



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shifting of the extra gang from point to point does not interfere in any way with the continuity of the instruction, as the school car is moved with the rest of the camp equipment.

It has been found that the Mexicans respond immediately to this treatment and the company has been amply repaid in more efficient work and longer terms of service on the part of the men. The laborers have manifested their appreciation particularly of the opportunity for educating their children. In a number of instances, daughters of laborers have graduated from high schools.

W. H. Whalen, superintendent of the Los Angeles division on which this car is operated, has made arrangements to obtain an old passenger coach which will be fitted up with benches and blackboards and which will be easier to heat, expecting in this way to improve materially the conditions in this unique school room. He has, furthermore, arranged to fit up a hospital car for the women and children in the camp who become ill.

THE BETTS GUARD RAIL

THE accompanying photographs show two views of one end of a Betts safety guard rail, which comprises construction details that differ materially from most other designs. The particular feature is the type of holder used, which combines the idea of a tie plate with the principle of a clamp, no bolts or independent clamps being used to connect the main and the guard rails. The two holders at the ends of the guard rail with-



Two Views of the Guard Rail

in the limits of the flare are of either malleable iron or cast steel. The intermediate holders are forged from rolled plates. Although entirely different in construction the principle is the same in the two types. The guard rail is secured at its base between a track spike on the outside and a lip on the holder on the inside, and the latter in turn is held down in place by the main rail and the load it carries. Consequently, the guard rail cannot lift up or roll without lifting the main rail. In the case of the intermediate wrought holders which are made in two pieces, any turning thrust of the guard rail is transmitted directly to the underside of the main rail head.

Another feature of the guard rail is a malleable iron foot guard. This can be applied quickly after the guard rail has been spiked in place. It is slid in from the end, after which the key shown in the photograph is driven down behind a lug forming a part of the base of the end holder. It is removed just as readily by driving the key upward and sliding the foot guard out.

These guard rails have been used extensively by the Big Four and on the Terminal Railroad Association of St. Louis. They are also being used experimentally on a number of other roads in the Middle West. In recent investigations of several of these guard rails in use for over two years at frogs, they were to be found to have been unimpaired by the service. There had been no change in the opening between the heads of the rails, nor in the gage between the running rail and the point of frog. It was also reported that there had been no charge for maintenance against these guard rails since they have been installed. The forged guard rail holders used on the intermediate ties opposite frogs are also being used with guard rails on sharp curves, some of them having seen three years of service. These guard rails and holders are being placed on the market by the W. M. Mitchell Co., Louisville, Ky.

A NEW FLOORING

A NEW flooring, consisting of small wood blocks $1\frac{1}{2}$ in. by $3\frac{1}{2}$ in. in section set on end and dovetailed to a baseboard, is being put on the market under the name, "Bloxonend." It can be laid exactly like ordinary wood flooring—it can be laid directly on joints or over old floors, no special foundation being required. The sections are grooved for splines and can be joined easily and tightly. Bloxonend comes in strips about eight feet



Construction of the Block

long, and is manufactured in several standard combinations. The "two-over-one" section is a combination of two-inch blocks on a one-inch baseboard. It can be made in special sizes with a thicker base, if required, for floors carrying extra heavy weight, built for heavy trucking. For mill construction it comes in laminated flooring up to 16 ft. with the blocks on the top edge, thus doing away with the necessity of laying a hardwood floor on top.

The purpose of this flooring is to combine the rapidlaying advantage of the tongue-and-groove type of floor-



METHOD OF LAYING THE FLOOR

ing with the good qualities of wood block flooring as to durability, smoothness, quietness and resilience.

It is claimed that this floor is suitable for a variety of purposes, applying in the case of railway installation to freight houses, station platforms, shops, etc. Bloxonend is the invention of C. J. Carter, and is handled by the Marsh & Truman Lumber Company, Chicago.



B Y elaborating the rule somewhat, a track obstruction in so far as it relates to a maintenance condition, may be defined as any work which will not permit the passage of a train at full speed with an ample margin of safety. The provision expressed in italics is especially important by reason of the transition occurring in track practice. It is a well-known fact that conditions are sometimes found to exist which would be pronounced inadequate if gaged by the standard of a definite factor of safety. It is not enough that trains "get over all right;" they must be passed with such absolute assurance of safety that no single element of doubt is present. If the safety of a situation admits of argument a flag should be sent out at once against trains.

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To meet the changing conditions in track construction it is essential that limits be determined for the various operations. The problem of applying the heavier sections of new rail is alone a serious question. The declining quality of the laboring forces, the frequency with which they change from place to place, and the loss of the native and experienced labor formerly counted upon, have made a new situation which must be met. Although the exact conditions that require protection will vary somewhat with the standards of maintenance of the road, it is thought that rules designed for use on a trunk line of high standards in maintenance will supply helpful suggestions in such determination.

A prime requisite for the efficient protection of traffic is a rigid requirement that the track forces shall have close at hand the proper appliances for conveying stop signals quickly in the event that a suddent emergency should require it. Whenever such a circumstance arises men with red flags or red lanterns are sent in each direction a sufficient distance to stop a train before it reaches the point of obstruction. They should also be equipped with torpedoes to be used in the manner prescribed by the rules. At the immediate place of danger a red flag or lamp is placed within constant sight of the men on the ground. In automatic signal territory a shunt rod should be used to set the nearest signal in the stop position. Information is also given the despatcher promptly so that notice of the obstruction can be delivered to trains.

It should be the first duty of every foreman to select with the utmost care and train with thoroughness men upon whom full reliance can be placed to supply unfailing protection. He must instruct them to flag every train until called in. The practice of allowing a flagman to pass certain trains while protecting is wrong and should never be permitted. While some loss of time may be suffered if he is called in and again sent out, the matter of safety far outweighs any other consideration. It is essential that the flagman shall be able to speak English intelligibly, as it is necessary for him to inform the engineer why he is being flagged. This information conveyed in broken English may lead to misunderstandings and a consequent accident. The specific conditions which have been determined by careful study to exceed the limits of permissible departure from the ideal are given categorically. It is believed that adherence to these standards will always conserve safety without unnecessarily restricting maintenance operations. In the relaying of rail the following features are considered to introduce an obstruction to safe movement: A greater number of spikes withdrawn from a single line of rail than at every other tie; less than one bolt in either half of any joint or these not tightened; a poorly applied connection joint, introducing an offset in the gage line or a step from the higher to the lower rail; the loosening of all the spikes along the inside line of the rail through any part of the stretch to be relaid.

It is further required that the ties at the point of renewal shall be in the sound condition that should at all times be present in main line tracks. If the ties are not sufficiently sound, proper replacement should be made before the relaying of rail is attempted. The drawing of spikes is limited to a single line of rail because there is the possibility that the alternate spikes might be withdrawn from a different series of ties for the two rails and no protection against spreading of the rails be afforded. Accidents have occurred through such a condition being overlooked in the hurry of renewal.

It is required that two bolts be in place, one in each half of the joint, to assure that the rail will not pull apart while a train is passing over it. Wherever possible the difference in height of the two rails or the offset in the gage at a compromise joint should be no more than $\frac{1}{16}$ in. The raising of the spikes is necessary where a rail section with a heavier base is being applied. While this lifting may be done in advance upon the outside line of the rail, it may not be done upon the inside line until the last train has passed. The laying of rail on the road under consideration is regarded as of such importance that this work on the main line is always directly in charge of an assistant supervisor; thus an officer of the company is responsible for the safety of operation.

A condition that is unsafe may be introduced by an improper manner of making tie renewals. The removal of two or more ties together, or the removal of more than four ties in any 33-ft. section of track, or the lack of full spiking or tamping at the ties adjacent to those removed, constitutes an obstruction requiring protection. The weight of rail in the track is the principal element in determining the permissible space between bearing surfaces. With 100-lb. rail where maintenance is good it is believed no obstruction will exist when the span is not greater than 27 in., or, for very short periods, while one tie is removed in renewal, when the span is no greater than 48 in. Such a condition should not extend beyond a few train movements and should never be left over night. It is preferable that the spaces should be maintained as far as possible within 18 in. The limiting maximum span should be reduced for less weights



of rail than 100 lb. in the ratio of the squares of the respective weights to the square of 100 lb., and may be similarly increased for heavier weights.

In raising track under high speed operation lifts greater than 2 in., requiring a measurable time to apply a runoff at least as moderate as 5% in. in 33 ft., or in any service, the use of the track jack within the rails, or a change of elevation greater than 11/2 in., in 33 ft., constitutes an obstruction. Tests with the newer and stiffer equipment have shown that the side bearings will foul at the diagonally opposite corners when the rate of the run-off is greater than $1\frac{1}{2}$ in. in 33 ft. In any maintenance operations a margin of practical working variation must be assumed, and it seems fair to propose $\frac{1}{2}$ in. as the limit to which irregularity of elevation might go. If this limit is adopted the run-off may be established at a rate of 1 in. to 33 ft. If 3/4 in. low joints might occur, a rate of 3/4 in. to 33 ft. should not be exceeded. The rate where a speed above 45 miles per hour is permitted should not exceed $\frac{1}{2}$ in. to 33 ft. These restrictions apply whether the change in elevation is at the approach to a curve, or a neglected depression in the grade, or the run-off when a single rail is being raised. To avoid this menace it is customary to raise both rails together and for greater comfort to the passenger the raising is made toward the traffic.

An obstruction in gaging track exists when the spikes are removed from more than every other tie on one side of the rail and removed or lifted from more than four adjacent ties on the other side of the rail at the same time. If, in spike lining, the gage should be tightened to less than 4 ft. 81% in., or widened to more than 4 ft. 914 in., an unsafe condition would be introduced which would require flagging. From the fact that gaging must generally be done by laborers working in twos and threes, without the supervision of the foreman, this rule is important and should be carefully impressed upon those to whom this responsibility is entrusted. The condition stated may develop from rail running or track spreading out and the rule should be likewise impressed upon the track walker.

A track obstruction exists when both splice bars at a joint are broken entirely through, and similarly, when renewal is made of both splices at the same time. This work should always be delegated to two men so that one can supply the necessary protection. Any operation in lining in which the throwing exceeds that usually done in ordinary maintenance is an obstruction. It is not necessary, except in special cases, to do the lining in a manner to cause an obstruction. It should always be done gradually so as not to introduce any menace to the traffic.

The matter of working to the exact standards set for the various processes is of such consequence that several roads now require efficiency tests to be made regularly to determine compliance with the rules. These tests are made by the supervisor and also by the members of the safety committee. The results of the tests are recorded and violations of the rules are adequately punished. Tests are made by the division engineer when rail-laying is in progress to determine that the supervisor or assistant supervisor is in charge of the work. The renewing of ties is strictly the work of the foreman and this item is specially observed. The tests are made by surprise and the aim is to try each foreman once a month. The other items of work, such as gaging, changing splices, raising track and lining are occasional and tests are made as opportunity presents. If the records show a foreman failing persistently he is demoted and a more careful man placed in his stead.

A NEW TYPE OF FALSEWORK

A N excavation under a track either for a small pipe trench or for a bridge of considerable proportions, calls almost invariably for the conventional falsework with its span of bridge stringers supported on mud sills or—if the requirements are still more severe—on pile bents. This form of construction necessitates the disturbance of the ballast for the full length of the stringers with still deeper excavations into the roadbed to place



THE SUPPORTING SADDLE

the mud sills or caps. The result is that the track is disturbed for a much greater distance than is called for by the excavation for the pipe or other structure which is to be passed underneath.

The operating requirements of practically all side and yard tracks and of a large proportion of the main tracks in this country are such that the track ties on either side of any small excavation can be relied upon as the support for the load carried across the opening, providing the rails can be properly reinforced or supported. The problem has been to provide a means for carrying the rail load without going underneath the ties. This is solved in the Bohannan Excavation Rails, shown in the accompanying photographs. The running rails are reinforced by auxiliary rails placed on top of the ties at either side and the load of the running rail is transmitted to the



THE RAILS IN POSITION

auxiliary rails by the use of one or more clamps of such design that the entire structure can be applied without disturbing the beds of any of the ties.

The character of the clamp is illustrated in detail in one of the photographs. It consists of two yokes which are placed over the auxiliary rails and to which the load



of the running rail is transferred by means of a saddle block which spans between them. All parts are firmly secured by means of two keys that are driven home after the construction has been assembled.

The device is simple and capable of ready mathematical analysis and as the weight of the auxiliary rails may be varied from 60-lb. to 100-lb., the number of separate clamps used being optional, and as the limiting span lengths may be changed as desired, it is possible to ad-



TOP VIEW OF THE CONSTRUCTION

just the construction as found necessary to provide adequately for the character of the traffic on various classes of tracks. Any rails available may be used, but it is preferable to provide special rails with the heads bent down at the ends as shown in the photographs.

This device has been used by a number of railroads and large industrial companies, particularly in yards. Among the railroads may be mentioned the Elgin, Joliet & Eastern and the Duluth & Iron Range. The device is being sold by the Bohannan Easer Joint Company, Ensley, Ala.

A NEW GUARD RAIL CLAMP

THE Reading swing or flexible guard rail clamp is designed to permit the placing of the guard rail without the need of pulling the spikes or moving the guard rail. It also has a flexible bearing which eliminates much of the stress which ordinarily results from the binding or bending taking place as wheels pass over the track. The clamp consists of five pieces, a yoke, two filler blocks, one outside block and a wedge block, all of which are of cast



THE GUARD RAIL CLAMP

steel, thus permitting the distribution of the metal to the points of greatest stress.

These clamps are manufactured in three sizes, namely, the LC size for the 100-lb. A. S. C. E. section and all others up to and including 135 lb., the MC size for all sections from 70 to 100 lb. inclusive, except the 100-lb. A. S. C. E. and the SC size or all sections up to and including 65-lb. rails. Filler blocks are furnished according to the section of rail to be used. These clamps are now in use on the Pennsylvania Railroad, the Reading, the Baltimore & Ohio and the Southern. They are made by the Reading Specialties Company, Reading, Pa.

STEP-SPLICES FOR WORN RAILS

By E. D. Swift

Assistant Engineer, Belt Railway of Chicago

I T is often necessary in track work to join a new or full section rail with a rail of the same pattern that has been reduced in height by wear. If, as is the usual custom, no provision is made to adjust the two heights of rail to a uniform surface, a step or abrupt change in surface is established that causes excessive deterioration. Not only are the ends of the rails battered, but the shock of wheels passing from one elevation to the other sets up strains in the splice bars and bolts that make the proper maintenance of the joint impracticable. Furthermore, the shocks encountered by rolling equipment, particularly locomotives, in passing over such joints, must be very detrimental.

As a means of eliminating such undesirable joinings, step splices, readily converted from the standard splice bars, have been used with much success by the Belt Railway of Chicago. A pair of splice bars are bolted to two short pieces of rail of the different heights to be joined, and then brought to a sufficient heat for easy bending. With a plate of a thickness equal to the difference in heights under the base of the low rail, and close up to the joint, the joint is put under a power hammer, or press, head up, and the desired offset put in the splice bars by forcing the high rail to an even surface with the low one.

A POWER-OPERATED RAIL-LAYING CAR

THE Chicago, Burlington & Quincy has recently built at its Aurora, Ill., shops, and is now using a poweroperated rail-laying car for the handling of rails in relaying operations. The car consists of a steel frame supporting a platform 12 ft. long with a boom 18 ft. long extending out in front. This boom, which is built of 4in. channels placed back to back, carries a $\frac{1}{2}$ -in. cable over an 8-in. wheel at the forward end of the boom with



THE RAIL-LAYING CAR

a rail clamp at the end of the cable. The boom is supported by a connecting rod to the vertical post at its rear end, which is in turn anchored to the platform of the car by 4 rods. The cable itself passes over the wheel at the forward end of the boom to a drum mounted on the platform of the car, which drum is operated by a 30-hp. Buda gasoline engine mounted near the rear of the car. A seat is provided on the car for an operator who controls the operation of the drum and the cable by means of a hand lever and a foot brake. The car is employed in


lifting the new rail from the shoulder of the embankment and lowering it into place on the ties. In addition to the operator one tong man is required to place the tongs on the rail and two men (one at each end) guide it into position. As soon as the rail is placed, the car, which is self-propelled, is run onto the new rail and the operation repeated. Other men follow behind, bolting and spiking the rail into place. The center of the rail is marked in advance and it is picked up by the clamp about 6 in. back of the center in order to raise the front end and lower the rear end to facilitate "heeling it in." While in the air the tong man strikes the rail with a steel bar to knock off any dirt and rust which may have collected on the base. The drum on which the cable is wound is provided with hand levers for use in case of an engine failure. Heavy rails are also placed on outriggers at the sides to counter-balance the car when picking a rail up from the shoulder.

The car is self-propelled and is capable of running at a speed of 10 miles per hour on the main line. When at work on a main track it is run onto the nearest siding under its own power to clear trains. Its purpose is to replace the tong men when relaying rail. In a recent performance 216 100-lb. rails were laid between one o'clock and 4:30 with a gang of 48 men. It has been found possible to lay a maximum of 100 rails per hour if there is a sufficiently large gang present to keep up with the bolting and spiking. The car is provided with a shelter for the protection of the operator, the canvas sides of which can be dropped to protect the engine from the weather.

Tests of Rail Joints

BY H. B. MACFARLAND

Engineer of Tests, Atchison, Topeka & Santa Fe, Chicago, Ill.

THE object of the test was to study the effects on the strength and rigidity of rail joints, resulting from the following conditions: (1) The effect of various percentages of carbon on the physical properties of untreated angle bars, as compared with bars of similar composition and section that had been quenched; (2)



THE TESTING MACHINE

the influence on the strength of the joint, resulting from the use of oil quenched, medium carbon steel track bolts as compared with the untreated, low carbon steel track bolts.

Forty-eight pairs of bars were received for this test, 42 of which were Santa Fe experimental angles of different carbon range, and six were Illinois Central medium carbon, quenched bars. The Santa Fe bars were manufactured by the Colorado Fuel & Iron Company, Pueblo, Colo., for use with 90-lb. Santa Fe section rails. Six pairs of bars from each of the seven heats were used for test. The remaining bars were applied in service under various conditions. These bars were fitted with both untreated, low carbon steel track bolts and oil quenched, medium carbon steel track bolts manufactured by the Illinois Steel Company at Joliet, Ill. These bolts were 434 in. long under the head; from 7%-in-stock; with

*Abstracted from a paper in Bulletin No. 188 of the American Railway Engineering Association.

rolled threads, measuring 15-16-in. in diameter over the threads.

The Illinois Central joint bars were manufactured by the Cambria Steel Company for 90-lb. A. R. A. type A rails. Six pairs of these quenched, medium carbon steel bars complete with bolts and lock washers were furnished for test. These bars were fitted with oil-quenched, medium carbon steel track bolts, manufactured by the Illinois Steel Company at Joliet, Ill. The bolts were $5\frac{1}{4}$ in. long under the head, from 15/16-in. stock, with hot rolled threads measuring one inch in diameter over the threads.

Thirty-eight pairs of these bars were subjected to either static or dynamic tests, the remainder being held in reserve for special investigation.

For static tests the angle bars were bolted to two 90lb. Fanta Fe rail sections, about three feet long, which were supported by heavy knife edges set 30 in. apart on the bed of the 200,000-lb. Olsen testing machine. The



MEDIUM CARBON OIL-QUENCHED BOLTS

Low Carbon Untreated Bolts

load was applied at the center of the bars by means of another knife edge and a suitable block to simulate wheel pressure. The bars were bolted together so as to allow $\frac{1}{8}$ in. between the rail ends, the bolts being stressed to approximately 20,000 lb. load in applying.

For the drop tests the bars for these tests were bolted to 90-lb. Santa Fe rail sections as in the static tests. The joint was placed on the supports of an M. C. B. drop



test machine using a 36-in. span. A 2,000-lb. tup was used with a fall of 8 ft. 6 in., which is one-half the height required by American Railway Engineering Association specifications for a 90-lb- rail.

The bars were given a succession of drops on the head or base until failure resulted. The bars were deflected on the first drop to an extent that the rail ends were usually together at the top and slightly over an inch apart at the bottom. After the rails had been deflected so that the ends came together at the top, the bars would tend to shear the bolts on being deflected further.

The greatest distortion of the bars at the center also occurred on the first drop after which the distortion per drop became less. The ends of the bars tended to spread out from the rail, as shown in one of the accompanying photographs.

The bolts in this test were under a stress which tended to shear and stretch them. The amount that the bolt was bent out of line, due to shearing for each drop, was not determined, but the elongation was measured. It was observed that in some cases the bolts were badly bent out of line, but did not show any great elongation.

Some of the bolts in these tests did not elongate in the first drop and in some cases they did not elongate in

ONE OF THE JOINTS AFTER THE TEST

the second drop. The two center bolts showed a greater elongation than the two outside bolts. The slip of the bar on the rail was less in the case of loading on the base than of loading on the head of the rail.

In drop tests the low carbon steel bolts were elongated more than the oil-quenched bolts for the same number of drops. The deflection of the bars was less in three of the four cases where the oil-quenched bolts were used than for the low carbon steel bolts.

The amount the bolts were bent in this test was indicated by the amount of slip of the bar on the rail. This slip showed that the oil-quenched bolts were not bent as much as the untreated, low carbon steel bolts, which is shown in an accompanying photograph. The bars were distorted more in every case for the untreated low carbon steel bolts than for the oil-quenched bolts. The data showed that the deflection and distortion of the bars in the drop tests were dependent on the elongation and rigidity of the bolts.

For the low carbon steel bolts three of the four joints failed by shearing the bolts, all failing on the third drop. For the oil-quenched bolts two of the four joints failed by shearing the bolts. These two joints each failed on the fourth drop. These data show that the oil-quenched bolts offer greater resistance to shear than the untreated low carbon steel bolts.

From a study of the data obtained in these tests, as shown by the curves and the comparative tables, the following facts are evident:

1. The strength and rigidity of the track joint are dependent on the strength of the joint bar.

2. The strength of material varies with the carbon content when other elements are constant, and the material is handled in the same manner regarding heat treatment and quenching.

3. Proper quenching of the material raises both the yield point and the ultimate strength of the steel, and results in a stronger joint.

4. The strength and rigidity of the joint are influenced to a slight extent by the strength of the bolt, both in static and dynamic tests, showing in favor of the oilquenched, medium carbon steel bolt over the untreated, low carbon steel bolt.

UNNECESSARY INJURIES TO TRACK MEN*

By Isaiah Hale

Commissioner of Safety, Atchison, Topeka & Santa Fe

JUDGING from the way reports are coming in, this summer is to be an "open season" for personal injuries to track employees. It is inconceivable how or why some men do the things they do or how or why some foremen will permit them to be done. Very few of these injuries came from doing an unnecessary and dangerous thing the *first* time. If the foremen would eliminate these uncalled for and unjustifiable acts *the first time* they are tried many accidents and injuries would probably not occur. If you don't believe this is true, how do you explain the fact that there are scores of foremen on this system who have been here for from 10 to 30 years and never yet have had one of their men seriously injured?

Don't delude yourself into thinking that "luck" will follow a man hour after hour, day after day, year after year, and never desert him. There's more than luck; there's interest in his work; there's supervision that is supervision.

Another railway system makes frequent use of the expression: "The average accident might be prevented in less time than it takes to make a written report of it," and with much less embarrassment.

Get it out of your mind that the safety advice and warnings turned in your direction from time to time are not intended for you, but are meant for someone else. The one thing which, more than another, has contributed to the disappointing showing in our safety work is the fact that practically every man thinks he is immune from personal injury, and generally the first man to get hurt is the one who is so sure of his ability to take care of himself that he does not regard it necessary for *him* to remember that "Eternal vigilance is the price of safety."

The pipe crossbar handle on a certain handcar was loose, due to a nut being off the bolt. When the car was running too fast the handle slipped off the rocker frame and one man fell under the car and was run over. (The foreman who does not give his equipment close enough supervision to detect a defect like this, or, knowing it, does not make it safe, is contributing to an accident that will probably follow.)

A section man was injured when a lining bar fell off the motor car, one end striking the ground and the other

*From the Santa Fe Magazine for July.







end flying up and striking the man on the leg. (It was pretty thoroughly proven that the injury was due to the improper placing of tools on the motor car.)

A trackman was stooping to put on angle bars. Another man, spiking a tie or two away, struck a glancing blow and the spike flew out and struck the first man on the head. (A little care in such cases would prevent similar accidents.)

A section man stood too close to the track and was struck on the head by a chunk of coal that fell from a passing train. (During last summer every section foreman and every section laborer on the system was warned of the danger of standing too close to passing trains. It was the foreman's duty to see that his men got back a safe distance.)

A trackman was tightening bolts when his wrench slipped, causing him to fall backward and injure his spine. (No man ever should throw his weight against a track wrench without "setting" himself so that if the wrench does slip off the nut, he can save himself.)

Two handcars loaded with section laborers were coming in at night, the foreman in charge of the head car and the assistant foreman in charge of the second car. Entirely ignoring his instructions to keep moving handcars a certain distance apart, the assistant foreman ran his car so close to the head car that, when the latter stopped, the hind car crashed into it, killing one man and injuring others. (Our rules are very plain on this point, and, if lived up to, there should be no handcar accidents of this kind. The time to break up the practice of running cars too close together and too fast is before, not after, an accident happens.)

ELEMENTS OF GANG ORGANIZATION

By Kenneth L. Van Auken

M UCH has been written and said on the subject of gang organization, but very little has been printed defining exactly what is meant by this term. If the men are working promiscuously here and there, and the work is conducted in such a way that parts of it are skipped as the gang goes along, the gang cannot be said to be organized.

Gang organization consists of five distinct steps: (1) Assigning each man definitely to a particular kind of work; (2) arranging the men in twos, threes, fours, fives or sixes, or the number required for a particular part of the work; (3) placing all the men in the gang in proper positions relative to each other; (4) picking out for each place the man best adapted to that particular work; (5) teaching and developing inexperienced men; (6) experimenting to find where fewer men can be used on any part of the work without decreasing the amount done.

It is not enough for the foreman to tell his men to "get tools for putting in a switch," or to assign his men to the work of putting in a switch, in the same manner. Each man should be designated as a spiker or a bolter, etc., so that he will be sure to understand exactly what he is to do.

Even if only three men are required for a piece of work, there is a chance to organize them by pairing off the two men who will work best together and using the third to assist them. The three men working separately might accomplish very little, but working together they can accomplish much. For instance, in spiking, two spikers should be paired off and a nipper assigned to them. Just enough men should be assigned to each part of the work to enable them to keep up with the rest of the gang.

Many trackmen prefer to have both spikers righthanded men, but the spikers themselves like to pair off a right-handed man with a left-handed man, so that both of them will walk and face forward. With good spikers, and a proper supervision to insure that the men do not move the ties when spiking them, there is no objection to pairing off a right-hand with a left-hand spiker, and they are likely to go along faster and be better satisfied. Another example which might be given to show the necessity for having the right number of men at each part of the work is in raising track with a large gang. The crew for each jack should consist of one man placing the jack blocks in the holes ahead of the jack men, two jack men, two tampers and at least one "swamper." If the men are not arranged in this or a similar way which is equally efficient, the work of the entire gang is likely to be held up.

Placing the gang so that all the men are at their proper places implies that each subdivision can just handle its work and keep ahead of the other parts of the gang, that the work is done systematically and that it is completed without the necessity for part of the gang running back to finish up. For instance, in arranging the end tampers in surfacing with three gangs on each side of the track: the head gang of tampers on each side should tamp every third tie, leaving the remaining two ties for the two following gangs. The ends will then be tamped completely as the gang goes along, and there will be no necessity for the laborers to pass each other in doing their particular parts of the work, nor for any laborers to go back to tamp ties which have been skipped.

In picking out for each place the man adapted to that particular work, the man's experience and his natural bent should be considered. A man who is worthless at one part of the work may be well adapted to some other part. There are places where green men may be started more satisfactorily than others; for instance, in tightening bolts or bolting behind the strappers in a track-laying gang. The work required of these men is not difficult, and it can be handled very well by almost any laborer who is trying to do what is right. In a surfacing gang there may be men who make good tampers, and yet who are poor at handling a shovel for filling in and dressing off. On the other hand, there may be men who will never make first-class tampers, and yet who are able to handle a lot of material when filling in and dressing up.

In teaching and developing new men, two methods may be followed: The foreman may taken hold of the tool to show a man exactly how to do the work, or he may pair off the green men with the experienced men and have the experienced men teach the others. When teaching the men by means of example, the foreman should perform each operation exactly, exaggerating the motions and making them very slowly. It is necessary to do a good deal of teaching in almost any gang to fill the places when experienced men leave the job. Frequently by pairing off a green man with an experienced man almost as much work can be done as if two experienced men were available.

There is often a chance to cut down the number of men in a particular part of a gang because the number originally provided is such that the men are not working to capacity. By taking some of the men from that particular work and assigning them to other squads the total output may be increased. There is also a chance to cut down some parts of the gang temporarily where conditions make their work lighter and transfer them to other duties.

When it is considered that a "poor gang well organized will do more and better work than a good gang poorly organized," the importance of these fundamental principles is realized.



The Dinner on Wednesday Evening.

THE twenty-sixth annual convention of the American Railway Bridge and Building Association was held at the Grunewald Hotel, New Orleans, La., on October 17 to 19. It was one of the largest in point of attendance in the history of the association, over 160 members registering. With members of their families and supply men, the total attendance exceeded 375.

A feature contributing to the large attendance was the operation of a special train consisting of seven sleeping cars, an observation sleeping car, two dining cars and a club car from Chicago to New Orleans by the Illinois Central and the Yazoo & Mississippi Valley. This train left Chicago on Sunday morning, stopped four hours at Vicksburg, Miss., to enable the party to visit the National Park, and reached New Orleans at 7 o'clock Monday evening. Approximately 200 people came on this train.

The officers for the past year were: president, Geo. W. Rear, general bridge inspector, Southern Pacific, San Francisco, Cal.; first vice-president, C. E. Smith, consulting engineer, St. Louis, Mo.; second vice-president, E. B. Ashby, chief engineer, Lehigh Valley, New York City; third vice-president, S. C. Tanner, master carpenter, Baltimore & Ohio, Baltimore, Md.; fourth vice-president, Lee Jutton, division engineer, Chicago & Northwestern, Madison, Wis.; secretary-treasurer, C. A. Lichty, purchasing department, Chicago & Northwestern, Chicago, Ill.

The convention was called to order by President Rear at 10 o'clock Tuesday morning and was opened with prayer by C. A. Lichty. In the absence of Mayor Behrman, City Commissioner Newman welcomed the Association to the city on behalf of the public, while L. A. Downs, general superintendent of the Illinois Central at New Orleans, welcomed it on behalf of the railways. C. E. Smith replied to these addresses of welcome on behalf of the association.

In his annual address, President Rear referred to the great development which has taken place in bridge work during the quarter century the association has existed. He also referred to the growing chasm between the rail-

ways and some of their organized employes and to the contrast between the attitudes of these men and the employees of the bridge and building department.

The report of the secretary-treasurer showed a balance of \$1,403.47 in the treasury. During the past year 58 new members were received.

Eight committee reports were presented and discussed, abstracts of which follow:

A-INTAKES AND INTAKE LINES

The purpose of an intake is to provide an uninterrupted supply of water to the pumps. Also, if properly designed and constructed, it should prevent debris or rubbish carried by the water from entering the intake or the suction pipe and interfering with the operation of the pumps.

In considering the matter carried in water as affecting the operation of pumps a division may be made into two general classes: that having a specific gravity greater than water, such as mud, sand, gravel and cinders; and that having a specific gravity less than water, such as fish, leaves, small sticks and twigs, and vegetable matter. Certain classes of cinders also come under this classification. The first class may usually be taken care of by settling basins of proper design, while those in the second class require a strainer. Any one or a combination of all the above troubles may be encountered, with slush ice, anchor ice and snow as important factors for trouble during the winter months in the northern states. An intake which will prevent trouble from one cause will probably be ineffectual with another. Rarely are two problems of this kind found to be alike, for, given the same quantity and character of debris or rubbish, the current velocity or direction of flow may exert different influences.

Where the bed of the stream and the bed load is composed of coarse sand and gravel with but little silt or mud a fine strainer such as a well screen may be buried in the stream with good results. Where silt, mud and fine sand are carried in the water it is necessary to provide the well or sump with two or more compart-



ments where the water may be brought to rest and the heavy matter allowed to settle.

Where the water is clear and there is but little debris a foot valve with a strainer will answer the purpose, always providing the foot valve is readily accessible and of ample area. The straining area of a foot valve should be at least three times the displacement of the pump and preferably more, as with insufficient straining area the velocity of the water through the strainer is increased, and the debris accumulates more rapidly.

On some intakes it is the practice to use screens of large area and varying mesh, according to the size of the matter in the water, placing these screens beyond the mouth of the intake pipe. Various arrangements of these screens are employed for removing the foreign matter

from the water, but the method usually adopted is to have the screen so arranged that a clean one may be inserted behind the dirty one, so that the latter may be removed for cleaning. It is therefore very essential that screens be readily accessible, and they can not be used where the height of water varies greatly or other conditions prevent ready access to them.

Where no foot valve is used the end of the suction pipe is sometimes plugged and perforated for several feet, thus forming a strainer. This method permits turning the pressure back from the tank where a bypass is provided and flushing out the strainer. This is not desirable, however, where there is much foreign matter in the water, as it interrupts the operation of the pumps and wastes a great deal of water.

Where the water is taken direct from the source of supply without any intake pump the "twin" or "multiple" strainer is

undoubtedly more effective than any other type. As the name would imply, these strainers consist of two or more compartments, any one of which may be cut out of service and cleaned without shutting down the pump. A 10-in. strainer of this type has been in use in a railroad pumping station in Chicago, pumping from Lake Michigan for seven years. There have been times when this strainer has been cleaned at intervals of 20 min. for 10 hr. at a time without shutting down the pumps. This type of strainer is usually located in the pump house at a point near the pump for convenience, but it may be located anywhere in the suction line.

A common trouble with lake intakes and sometimes with northern rivers is the formation of anchor ice in needles and in thin flakes. This anchor ice usually forms in moving water, and is carried below the surface by currents where it adheres to the intake, forming a heavy mass that soon shuts out the water and is very difficult to remove. Steam jets are sometimes used to keep anchor ice away, but the most effective methods of guarding intakes from this defect is to either locate the intake in quiet water or to create a zone of quiet water by driving piling.

SUCTION LINES

While in common practice a suction lift of 24 to 26 ft. is sometimes possible, a pump should rarely be placed more than 20 ft. above the lowest water and wherever practical just as close to the water as possible. Suction pipes should be made as short and direct as possible, avoiding all unnecessary bends or elbows. The size of the suction pipe will be controlled to a large extent by the permissible loss of suction head. If the suction line is of any considerable length it will be necessary to increase the size of the pipe to cut down the velocity and reduce the friction loss. In any event a suction line longer than 50 ft. or with more than two elbows should be at least one size larger than called for by the maximum delivery of the pump. Long suction lines and those with high lifts should be provided with vacuum chambers to take up the irregularities of flow due to the action of the pump. Suction lines are subject to more or less

vibration owing to the action of the pump and the importance of keeping such lines tight necessitates the use of threaded or flanged pipe, except in cases where excessive corrosion oc-The pipe should be of curs. first-class material, preferably of genuine wrought iron pipe. Many suction lines show conclusively upon examination that deterioration and decay often occur after only a few years' service. No definite prediction can be made of the life of a suction line, the rate of deterioration depending upon a number of special conditions.

B—FUELS FOR INTERNAL COMBUSTION ENGINES

Three distinct grades of engine-burning oil have been developed from the crude oil, which are designated as light, medium and heavy distillates. The following table gives the products of crude oil of interest in connection with oil engines:

Solar oil

Gas oil

Residues

Cvlinder oil

Light distillates Light benzine Gasoline Heavy benzine Medium distillates Kerosene

Medium distillates Kerosene Engine oil Pitch and asphalt The light distillates in the above table are suitable for a gasoline engine and may be burned readily through a carburetor or mixing valve. Kerosene and distillates of 39 deg. Baume and over with a flash point of 230 deg. and under, and a burning point of 280 deg. and under may be burned readily in a gasoline engine equipped with a generator for preheating the oil before it enters the cylinder. The remaining distillates of 26 deg. Baume and over may be burned readily in the hot bulb type of oil engine. It may be mentioned that the specific gravity

spray and lift pumps. The main points in purchasing fuel oil for internal combustion engines are as follows: There should be only a trace of earthy matter, such as dirt, etc., in the oil, and not more than one per cent of water. Of coke residue there should not be more than a trace, as any appreciable amount will cause trouble in the plugging of the cylinders. There should not be more than a trace of free carbon in the oil. The sulphur content should

is of minor importance, but a certain limit of low specific

gravity is necessary in order to get the oil through the





not be more than 0.8 per cent, as a greater proportion may attack the cylinder walls and tend to cause pitting. The oil should contain no free ammonia, alkalies or mineral acids because of their pitting effect on the surfaces exposed to combustion. The oil should not contain more than 0.05 per cent of non-combustible mineral matter. A paraffin content of more than 15 per cent may cause trouble, as a large quantity of oxygen is necessary for complete combustion. The oil should con-

tain not less than 10 per cent of hydrogen and should have a heating value of about 18,000 B. t. u. per pound. The tar content should not exceed 0.4 per cent. Oil containing creosote will cause incomplete combustion and gives trouble by coking.

In selecting a fuel for an engine its composition as affecting combustion is most important. For proper combustion the fuel should be mobile and volatile, clean and free from water, solid particles and grit. In general the specific gravtiy of an oil rises directly as the vapor density. The boiling point and the amount of



C. E. SMITH, Vice-President.

air necessary for combustion vary inversely with the volatility, and the greater the volatility of the fuel the better the ignition and combustion. Petroleum benzines require approximately 40 volumes of air, whereas the heavy petroleum products require approximately 100 volumes of air for complete combustion.

In order to utilize the existing equipment many of the gasoline engines now in service have been converted to kerosene and distillate engines by the addition of attachments for pre-heating the oil to (or near) the flashing point before it enters the cylinder. These attachments consist of generators or mixing chambers wherein the oil is heated by the exhaust of the engine. They are made in various sizes and types, both for throttling and for hit-and-miss governors. With these attachments the engine is generally started on gasoline and is allowed to run on this fuel until the cylinder and generator are heated when the oil is cut in. On other types a retort is provided where the oil is converted into a vapor or gas by heating the retort with a blow torch. Either method requires from five to ten minutes to start an engine running on oil. Electric ignition is used as with gasoline engines. Very little carbon trouble is experienced with the use of these attachments and the lubrication required is about the same as with a gasoline engine.

The heavy-oil engine is a comparatively recent development and is being extensively used in railway water stations, as well as for other service The most popular engine of this type is the two-cycle oil engine constructed in units of 50 hp. and under using heavy oil as fuel. This type of engine is very often confused with highcompression engines operating on the Diesel principle or with the converted gasoline engines using kerosene and distillates through a carburetor or mixing valve.

Intelligent lubrication is essential to the proper operation of the oil engine. Improper lubrication contributes largely to oil-engine trouble. The high speeds and temperatures at which these engines work necessitates a continuous and skillful use of good oil. Engines of this type are liable to suffer from carbon trouble and resultant deterioration owing to the fact that an excess of oil injected into the cylinder breaks up into volatile compounds, such as the naphthas, heavy tar-like oils and free carbon. Overloading the engine also will cause carbon trouble. When an engine is working up to its maximum power a momentary overload will cause an excess of oil and the resultant accumulation of carbon owing to the fact that the oil engine is not flexible enough to adjust itself instantly to the varying loads as does a steam engine or pump.

Though the oil engine can not yet be considered as fully developed, it has passed the experimental stage, and while it is perhaps not as reliable under all conditions as a steam engine or pump, much of the prejudice against it is undoubtedly due to lack of experience in handling. With the present imperfect knowledge of what the engine is capable of doing and of which particular oils may be burned in it, one can not speak conclusively, but there is no doubt that the future of the engine is assured.

C. R. Knowles (I. C.), chairman; C. A. Lichty (C. & N. W.), J. Dupree (C. T. H. & S. E.), J. J. Murphy (S. P.).

DISCUSSION.

That part of the report relative to suction lines created a large amount of discussion. A. Montzheimer (E. J. & E.) stated that he has secured the best results when he has lowered a pump to within 2 or 3 feet of the surface of the water; in some instances he has permitted the water to flow directly into a pump. C. R. Knowles stated that this is especially true with a worn pump. It is also more economical in maintenance and in cost of operation. A pump will also deliver more water as the suction head is decreased. G. W. Rear called attention to the fact that as the length of suction line and the lift are decreased, the troubles from leakage, etc., diminish.



B. F. Pickering (B. & M.) described a 1,300-ft. suction line with an 8-ft. lift and an undulating grade line where he has encountered a large amount of trouble with air pockets at the high points. He has found no way to avoid these pockets.

James Dupree (C., T. H. & S. E.) urged the construction of suction lines of screwed pipes, as it is impossible to maintain a tight line with leaded joints. R. H. Reid (N. Y. C.) stated that the difficulty with air pockets arises largely from the fact that a certain amount of air is in the water, and that as

S. C. TANNER, Vice-President.

the pressure decreases this air is released and collects at the high points.

L. D. Hadwen (C., M. & St. P.) called attention to some intakes supported by floats which have recently been constructed by the St. Paul in settling basins at Mobridge, S. D., where the water passes through small reservoirs to permit the sediment to be deposited. These floating intakes enable the water to be withdrawn from the upper part of the basin.

W. M. Clark (B. & O.) emphasized the necessity of



individual study and design for each local water station and described a number of installations which were entirely unsuited to conditions other than those for which they were designed.

In discussing the report on fuels for internal combustion engines, C. R. Knowles stated that conditions are changing so rapidly with reference to the oil supply that data which may be entirely correct today will probably be out of date tomorrow.. The entire subject is passing

through a very rapid transformation, making it necessary for one to keep closely in touch with the more recent developments.

ENGINE HOUSE, SHOP AND FREIGHT HOUSE FLOORS

ENGINE HOUSES

Plank floors were formerly in common use, but since timber has become scarce and the cheaper grades of such poor quality, it is not considered economical to use all-plank floors for the less important houses. In the middle western territory hard maple, which may yet be



LEE JUTTON, Vice-President.

secured at a reasonable figure, is the best available material for a plank floor, but where a considerable amount of water is used for washing out engines, etc., the planking is liable to curl up or swell, which is decidedly objectionable. Unless the planks are not less than 3 or 4 in. in thickness the floors are easily damaged and require frequent repairs.

Cinders, because of their low cost and cheap maintenance, are almost universally used and make a good floor for small outlying engine houses. Such floors should be well crowned and kept well rolled and tamped, as they are liable to be carried away by the water released when washing out engines. An improvement over the ordinary cinder floor is to place upon a cinder bed a coating of about 5 in. of limestone screenings, tamped to a smooth surface. An ordinary cinder floor costs about \$0.50 per sq. yd., while one with a top of screenings costs about \$0.75 per sq. yd.

Where the first cost is limited and engines are housed mainly for protection from the weather, an economical floor can be constructed of wooden blocks sawed from second-hand pine or fir bridge timbers, such as ties, stringers, etc., and laid on end on a cinder cushion. Such floors are of low first cost and are easily kept in repair. Floors of this description are still in fairly good condition after 15 or 16 years of service with no repairs. The blocks should be of a uniform depth, but the other dimensions may vary. Round cedar blocks have not proven satisfactory. The cost of wooden-block floors, as above described, ranges from about \$0.90 to \$1.00 per sq. yd.

Concrete has been used quite extensively with varying success. A very acceptable floor is built with 6 in. of concrete with a 1-in. neat cement finish. This does not require the use of hardeners or water-proofing materials. The concrete is stopped a sufficient distance from the edge of the engine pit to admit placing a jacking plank and to permit access to the wall plates and rail plates when it becomes necessary to remove them. Vitrified brick laid flat on a well-tamped gravel or puddled sand foundation 5 or 6 in. thick and with sandfilled joints can be laid at a cost of about \$1.25 per sq. yd. Clay, loam and other such materials can be used for filling. The committee is of the opinion that a brick floor, laid on a concrete foundation and costing \$2 to \$2.25 or more per sq. yd., is not to be recommended because of the cost.

Creosoted wood blocks, with the grain vertical, laid on a 2-in. sand cushion on a well-puddled and rolled gravel bed with a 4-in. crown at the center, between tracks, have been extensively used and have given good satisfaction. Hot sand should be used to fill the joints. The blocks may vary from 4 in. by 3 in. to 4 in. by 6 in. in size. The depth of the blocks should be uniform and from 4 to 8 in., the greater depths naturally holding better surface. This type of floor costs from \$1.25 to \$2.50 per sq. yd., depending on the thickness and local conditions. The same kind of floor laid on a 6-in. concrete foundation asphalt filler will cost about \$3.25 per sq. yd. This is an ideal engine-house floor, as it is not so hable to damage as one constructed of harder materials when subject to falling objects, and it is almost impervious to water.

An asphalt mastic top $1\frac{1}{2}$ in. to 2 in. thick on a concrete base has been in use for some time, and, as far as the committee has been able to learn, has given very good results. Such a floor can be built for about the same cost as creosoted blocks on a concrete base, as above described.

MACHINE AND BOILER SHOPS

The materials commonly used for floors in machine and boiler shops, listed in the order of their longest use, are plank, concrete, brick, creosoted blocks and mastic. The price of all these floors runs about the same as in engine houses, except that a concrete floor should be laid heavier to jack on, and should be not less than 5 in., and preferably 7 in., thick and laid on a slag or gravel foundation with a 1-in. float. It is better if the float has a

face.

mixture of some first-

class waterproofing com-

pound to make it im-

pervious to water. This

type of floor costs about

\$2.50 per sq. yd. The concrete should be thor-

oughly troweled to a

smooth, hard, even sur-

Asphalt mastic on a

concrete base is an ideal

shop or engine-room floor.

In this case the concrete

should not be less than 5

in. thick, with a slip of

felt saturated in asphalt

next to the concrete. The

asphalt mastic should be

from $1\frac{1}{2}$ in. to 2 in. thick,



C. A. LICHTY Secretary-Treasurer.

and as hard as possible on account of the grease that is liable to drop on it in such buildings.

Some of the members of the committee are of the opinion that creosoted wood blocks, with the blocks 4 in. thick and with an asphalt filler on a concrete foundation, practically the same as recommended for engine houses, make a good floor and can be used in machine or boiler shops. The blocks should be rectangular in shape, of uniform length and free from any irregularities, so as to prevent unevenness, as the floor wears under constant.

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heavy use. The committee has recommended asphalt filler entirely instead of other tar products, as the others soften under different degrees of temperature.

WAREHOUSE AND TRUCKING FLOORS

The committee has knowledge of an untreated wooden floor, made of 2-in. D. & M. maple laid on 3-in. pine subplanking on sand or gravel filling, that has been in use under heavy trucking for 19 years and is still good. This floor was subject to heavy freight trucking.

For certain classes of floors a concrete surface is good, as it costs \$0.80 to \$1 per sq. yd. less than a floor with a mastic top. However, there are several objections to this class of floor for trucking purposes, among which may be mentioned dampness, dusting and slipperyness resulting from frost or some foreign substance on the surface. Truckers object to them, as they are cold to the feet.

It is the opinion of the committee that the best trucking floor is made with a concrete base and an asphalt mastic surface from $1\frac{1}{2}$ in. to 2 in. thick; this mastic to be well troweled, but not hard enough to destroy its elasticity. Particular care should be exercised in getting mastic of the consistency to withstand various changes in temperature. In the south the floors can be made very much harder than in the north. The mastic should not be so soft as to flow when subjected to the trucking load.

A new wood floor is being put on the market so constructed that the wearing surface is on the ends of $1\frac{1}{2}$ in. by $3\frac{1}{2}$ -in. blocks 2 in. in depth, dovetailed onto a base of either 1-in. or 2-in. plank. This floor can be laid the same as other plank floors, with a wearing surface on the ends of the blocks.

Committee: D. Rounseville (C. & N. W.), Chairman; J. S. Robinson (C. & N. W.), G. A. Mitchell (G. T.), R. M. Bowman (L. E. & W.).

DISCUSSION

In presenting the report, Chairman Rounseville stated that all prices quoted in the report were taken from actual work and included the cost of placing the filling necessary to support the floors; therefore, they could not be applied directly to other work without a full knowledge of local conditions.

J. P. Wood (P. M.) disagreed with the recommendation of the committee advocating a 1-in. neat cement top on a roundhouse floor. He found that this surface scaled off under heavy service, and has secured better results by puddling the concrete well when placing it and then floating it thoroughly. L. D. Hadwen (C., M. & St. P.) has reinforced that part of the concrete floor adjacent to the pits which has to carry the jacking load in a roundhouse. This and other special details affect the unit cost to an important degree. Lee Jutton (C. & N. W.) stated that he has used brick in roundhouse floors with good results, finding this form of construction particularly applicable where there is a possibility of a floor being opened from time to time to repair underground piping, etc. He has found that a concrete floor wears rapidly at the expansion joints.

E. C. Morrison (S. P.) described a mastic top which he placed on a concrete foundation in six freight houses 800 ft. long by 60 ft. wide in San Francisco. While this type of floor cost 15 per cent more than wood, it has required no repairs in the two years it has been in service. W. M. Clark (B. & O.) advocated the use of creosoted wood blocks on a concrete base with a $\frac{1}{2}$ -in. sand cushion, having secured favorable service from this form of construction. He reported difficulty with maple floors rotting from below because of poor ventilation.

J. Spencer (G. T.) recently placed 2,000 sq. ft. of creosoted wood-block flooring in an erecting shop, the first 10 bays of which were laid on a gravel foundation with a 1-in. sand cushion and the remainder on cinders, well compacted. He found that the latter form of support gives the better service.

J. B. Sheldon (N. Y., N. H. & H.) reported difficulty with concrete floors disintegrating in freight-house service. C. H. Fake (M. R. & B. T.) has found that concrete floors will give good satisfaction in small freight houses where there is little trucking, but that they are not so satisfactory at larger stations. L. D. Hadwen (C., M. & St. P.) stated that concrete floors have been used in a number of freight houses on his road without any trouble.

J. Gratto (S. P.) placed an asphalt macadam top on an untreated plank deck on a wharf at San Pedro, California, about 12 years ago. This wharf is subjected to heavy cart trucking and a timber floor lasted only a short time. The asphalt top was applied at a cost of $9\frac{1}{2}$ cents per sq. ft. and has given such good satisfaction that it is planned to add it on a large amount of other wharves.

A. S. Markley (C. & E. I.) stated that he has secured good results from roundhouse floors on a sand fill laid with brick, with the joints grouted where the floors had given trouble from settlement before being grouted.

HANDLING CREOSOTED TIMBER

Timber has been and will continue to be one of the principal materials of construction employed in the bridge and building department. In spite of the inroads which steel and concrete have made in recent years, there are many forms of construction for which timber is eminently superior to any other materials. Its principal handicap is its limited resistance to decay, and this has been overcome in large measure by the use of creosote oil, zinc chloride and other preservatives. The protection of timber afforded by these preservatives has introduced new problems for the bridge and building workmen, the importance of which is not fully realized. Only sound timber should be treated. Large quanti-

Only sound timber should be treated. Large quantities of timber have been treated in past years, and, to a lesser extent, are still being treated to-day, in which the decay is well advanced. It is only fair to state that this condition exists only because of the inability of those in charge of the timber-treating plants to detect such forms of decay rather than because of deliberate intent. It is only within the past few years that this condition has begun to be realized and many reported failures of creosoted timbers are not properly chargeable to the failure of the treatment, but are rather the result of the treating of timber which was entirely unsound before the preservative was injected. For this reason some of the railways have installed cut-off saws by means of which $\frac{1}{2}$ in. of timber is sawed from the ends of each tie before it is treated, as a check on the inspection.

With sound timber properly seasoned the treatment should be sufficient to insure the complete penetration of all sapwood and some entrance into the heartwood. If the heartwood is entirely sealed with preservative there need be little fear of decay. In general, piling and bridge timber should be treated to refusal.

After going to the expense of treating timber it would appear to be self-evident that it should receive no unnecessary abuse that would tend to render the treatment ineffective. Yet largely as a result of ignorance and carelessness one sees treated timber handled with hooks and cut unnecessarily on nearly every railroad. If the character of construction is such as to warrant the use



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of treated timber, precautions certainly should be taken to avoid all unnecessary penetration of the protective surface To gouge or tear this surface so as to expose the untreated timber, even at one minor point, may be sufficient to start decay within the stick and lead to early failure of the entire piece. Notwithstanding this, only two or three roads have prepared any instructions for the guidance of workmen handling treated timber.

The problem is primarily one of education-Few workmen are so minded that they will deliberately destroy



A TREATED TIMBER BOX WITH TWO UNTREATED PLANKS AT THE TOP WHICH FAILED AFTER FOUR YEARS' SERVICE.

the property of their employers if this can be avoided readily. If the injury resulting from the cutting of treated timber is pointed out to them and they are shown how to avoid this damage, most men will co-operate in eliminating this unnecessary destruction. Such measures, coupled with disciplinary action for the men who will not respond to educational measures, will eliminate a large part of the mutilation of treated timber found to-day.

The problem is not alone one for the men to solve, however. The timber must come to them in a condition requiring the minimum practicable amount of framing in the field. This has led to the framing of a large amount of timber before treatment, a practice which is receiving serious consideration on several roads today. At the Gautier, Miss., timber-treating plant of the Louisville & Nashville, which treats bridge timbers only, a carpenter shop has been installed at which all timbers are fully framed before they are treated. As a result the cutting of the timber after treatment is reduced to the minimum. Similarly on the Santa Fe, where large numbers of treated timber box drains and culverts are used, the timber is framed and sawed to the length desired before being treated.

Even with the most careful precautions it frequently becomes necessary to bore into timber or to cut it when using it in the field. The problem then is to protect it and to duplicate the original treatment as far as possible. It is the quite general practice to fill all bored holes with hot creosote and to apply coal tar, or, preferably, hot creosote to all cut surfaces. This treatment should be applied to all surfaces which have been cut,

whether they show untreated wood or not. On one or two roads a coat of hot pitch is applied after the creosote as a seal. The importance of protecting all cut surfaces should be thoroughly impressed on the workmen.

Care should also be taken to avoid the use of treated and untreated material in the same structure. Instances are frequent where a workman runs short of treated material and thoughtlessly fills out with untreated timber, or applies a brush treatment to sufficient timber to complete the structure. The usual result of this action is to reduce the life of the adjoining treated timber, if not of the entire structure, almost to that of the untreated or partially treated timber by affording lodgment for the fungi in the unprotected wood, from which they spread to the adjoining treated sticks. This is forcibly illustrated by the accompanying photograph of a creosoted drain box, in which the center of the top was filled in with two untreated planks which supported a luxurious growth of fungi. To make matters worse, the treated timber had been sawed after treatment and these fungi came directly in contact with the untreated ends of the treated timber. It is not, therefore, surprising that this box failed after four years. This condtiion was only brought to light by the reported failure of the treated timber.

Piling requires special treatment, according to the con-ditions under which it is to be used. Where they are to be used in water infested with marine borers, special attention should be given to see that they do not contain pitch knots or other blemishes which will retard the penetration of the oil. Care must also be taken to see that the surface is not injured in handling.

For the same reason that it is advisable to apply a brush coat to all cut surfaces of stringers and framed timbers, pile heads should be protected after being cut off. The inconsistency of leaving the head of a pile unprotected after treating the stick carefully is so evident as to require no argument.

The Atlantic Coast Line applies a paste of coal tar and lime to the exposed tops of piles handled by company forces, while the specification inserted in contracts for the building of structures by other than company forces reads as follows: "If untreated wood is exposed on any piece of creosoted timber or piling in framing, boring bolt holes, etc., the untreated part must be painted, when dry, with at least two coats of warm creosote. In addition, piling cut-offs must be covered with a paste of coal tar and lime." The Southern requires the heads of the piles to be coated with hot creosote, followed by an application of coal-tar pitch of such consistency that it will remain



Misuse OF TREATED TIM-BER BASE.

elastic at the lowest temperatures encountered.

In addition to the avoidance of all unnecessary cutting into treated timber, care should be taken in handling it to and from cars to avoid abrasions that would penetrate the treated surface. Heavy timbers should not be thrown from a car, as this tends to split and break them. Neither should they be handled with sharppointed grab-hooks or peavies. A number of roads use skids to transfer such timbers from pile to pile and to and from cars. Heavy slings are also used in place of grab-hooks. While this may require some special attention at first, after such practices become standard and the men become accustomed to them, little, if any, additional time or exertion is required.

When stored along the line it should be piled solidly, so that it will not dry out too rapidly, and should be covered with a light layer of dirt for the same reason and as a protection from sparks from passing locomotives. All grass and other combustible materials should be kept cleared away from the piles. Piling intended for use in water infested with marine borers should not be piled in the sun for any length of time, as the oil evaporates and the resistance of the pile to the borers is decreased. In one instance treated piles left on the bank for two winters and one summer before driving were destroyed by marine borers in less than five years, while others of the same kind and treatment which were driven soon after being treated were attacked but slightly. This also probably explains the fact that the marine borers frequently attack one side of a pile more severely than the other.

Closely allied with the adoption of methods to secure full service from treated timber is the investigation of all failures to ascertain their cause in order that similar conditions may be avoided in the future. While the scientific investigation of these failures will in most cases be made by the engineer in charge of timber preservation for the system, he must depend on the local supervisors of bridges for notice of failures and for data regarding the service rendered and any conditions leading to failure. Too frequently treated timber which has failed to give satisfactory service is removed from a structure and destroyed without an examination being made to ascertain the cause. The result of a multiplication of such instances is a prejudice against all treated material and perhaps the discontinuance of its use. Treated timber has been used successfully too long to justify its condemnation because of any isolated failures, and the road which takes such action does so to its own detriment. On those roads on which no timber is destroyed until the reasons for its failure have been ascertained, the number of such failures reported has decreased very materially. It has been the experience that a very large proportion of those reported have been found to be due to other causes than the treatment, and in numerous instances the timber reported as treated timber was never treated at all. It is only by such investigations that the reasons leading to premature failures may be ascertained and the contributing conditions corrected.

E. T. Howson (Railway Maintenance Engineer), Chairman; J. S. Lemond (Sou.), F. D. Mattos (S. P.).

DISCUSSION

There was a difference of opinion regarding the extent to which the framing of timber before treatment is practical. C. R. Knowles (I. C.) uses creosoted timber in the supports for wooden water tanks, all of which is framed in advance at the treating plant. He has found that it is rarely necessary to bore a hole in the timber after it has been treated. J. Gratto (S. P.) reported a considerable amount of trouble with the failure of treated piles from interior decay. This was explained by other members as probably due to improper seasoning and the fact that the timber may have been unsound when treated.

MODERN METHODS OF DRIVING PILES

This report is confined to the consideration of methods of driving wooden piles. Track pile drivers are of two general types: turntable drivers and boom drivers. In some locomotive crane drivers these features are combined. Turntable drivers are in more common use, but the boom driver has a number of advantages.

In the early days of railroad pile driving drivers were frequently built in company shops. Today, there is less of this and machines are more commonly purchased from manufacturers. In general they are of standard allsteel construction and are equipped with air pumps and brakes for operation separately or as part of a train. They are self-propelled, power being supplied from the engines through shaft and gear connections to the car wheels. They can run at speeds of from 8 to 25 miles an hour and some can haul several cars. The turntable is turned or shifted and the leads raised and lowered by steam power under the control of the engineer. The leads may be battered in two or three directions, usually by hand-operated mechanism, and either a steam or a drop hammer may be used in them. Idlers are required at one end when moving these cars in trains.

There are many desirable features on these modern cars, but probably the self-propelling device is as valuable as any. With a car so equipped it is possible in many situations to dispense with the use of a locomotive. On busy lines it is usual to confine independent movement to short distances—say, one-half mile—and frequently short side tracks are laid near construction jobs to accommodate the driver. On light traffic lines, it would appear that the propeller might be used for greater distances. Use can be made of such a driver in material yards for shifting cars and the boom type of driver is especially valuable for this work.

Some drivers have a very long reach. One that will reach a second bent ahead is a great aid in emergency driving after a fire or washout. A wide side reach is valuable on three and four-track lines and for such use those drivers which have little overhang at the rear are advantageous.

The ability to operate the turntable mechanism and raise and lower the leads by hand as well as by power is a feature of some machines. A boom supported at the foot of the leads when raised, or on the hammer, is a handy contrivance for lifting bridge timbers, and electric lights for night driving are desirable. These have been applied by the Union Pacific to one of its drivers.

For driving piles in foundations beyond the reach of the track driver the most common practice is the use of the ordinary land or creeper driver, which consists of upright leads placed at the end of a pair of sills with a hoisting engine and boiler mounted on a platform at the opposite end of the same sills. In some cases power is furnished from a track driver and occasionally horse power is used. The driver is mounted on wheels or rollers, or hickory skids may be attached to the under side of the sills. The size of the machine varies with the nature of the work to be done and the weight of the hammer used is generally less than on track drivers.

Other methods employed for driving foundation piles are the suspension of leads from the boom of a track derrick, or of a stiff-leg or guy derrick placed on the ground or on barges; the extension of the leads of a track driver to reach the foundation pit; or leads may be suspended from the superstructure.

As with foundation piling the kind of equipment used for marine work depends on the nature of the work and the number and length of the piles to be driven. For heavy work fixed leads mounted on barges of from about 20 ft. by 50 ft. to 30 ft. by 60 ft. in plan, and 5 or 6 ft. deep are used. The engine, boiler and housing are located on the barge to properly balance the leads and hammer. Power winches should be provided to hold the barge in proper position. If battered piles are to be



driven the leads may be suspended near the top from a fixed A frame. Some roads use, in place of the fixed leads, a land driver similar to that described above mounted on a barge, and one of the Committee's correspondents expresses a preference for this type when it is not necessary to pull any piles.

For lighter work smaller barges which may be shipped on flat cars are convenient. Where conditions permit one may follow the practice of the Detroit & Mackinac and drive piles for docks and pier protection with a land driver resting on the ice.

Steam hammers are in use and are recommended for certain classes of work on 31 of the 52 lines answering the Committee's inquiry. A decided preference is shown for medium-weight steam hammers. It does not seem that there can be much difference of opinion about this. The heaviest hammers are more difficult to handle and when near the top of the leads increase the tendency of a driver to overturn. In addition, there are not many situations in railroad practice where a medium-weight hammer will not handle the work.

The minimum weight of drop hammers on track drivers is about 2,000 tb. In general, railroad companies are using hammers weighing from 2,800 lb. to 3,500 tb., although seven of the roads reporting to the Committee are using heavier hammers for some of their work, mention being made in one case of a hammer weighing 4,500 fb. As a rule heavier drop hammers are used on floating drivers of permanent construction than on track drivers, and lighter hammers are in use on land drivers.

The usual method of attaching a rope pile line to the pile is by means of a short piece of chain with a hook at the free end. When a wire cable is used as a pile line the chain is sometimes dispensed with, the hook being attached directly to the cable. Care should be used in placing and fastening the chain around the pile, particularly when handling freshly creosoted piles. The Boston & Albany uses a snatch block at the lower end of the lead, through which the pile line is passed when the piles are some distance from the track, thus preventing a side pull against the top of the leads.

Practice in regard to the assignment of drivers to divisions or to the whole line is not uniform. For the most part drivers are assigned to the whole line, although on some of the larger roads a driver is assigned to each division, but is moved to near-by divisions if there is occasion for it. In addition to the division drivers, there are sometimes additional drivers which are assigned to the whole line and used where there is a large amount of work, or on construction jobs.

Where drivers are assigned to divisions the pile driver crew is more or less permanent, but where assigned to the whole line the more common method is for the engineer only to accompany the driver. It is claimed by some that better driving results from this arrangement--presumably local pride has an effect.

The minimum depth of penetration for piles in trestles is usually considered to be about 15 ft., but there are numberless situations where piles stopped at this depth will not sustain the load. The determination of the proper stopping place is largely a matter of judgment and experience. Formulæ or rules have been devised to assist the judgment and a summary of the methods used by a number of railroad companies may be of interest:

Foreman's judgment without formulæ	14 roads
As long as the pile will drive without damage	6 roads
Practical refusal	13 roads
Engineering News formula	4 roads
Special instructions based on investigation and	
tests	3 roads

Records showing the total penetration are quite generally kept. Blank forms on which a variety of information is shown are used on many lines.

The water jet is in successful use under proper conditions on about 50 per cent of the railroads reporting. Some use it only with concrete piles, others for foundation piles or with a marine driver only. But one failure is reported and that is ascribed to the small size of the pump. Favorable conditions for the use of the jet are sandy soil, or gravel, and deep penetration. The practice is fairly uniform.

Jet pipes vary in size from 21/2 in. to 11/4 in. and nozzles from no contraction on a 2-in. pipe to 1/2 in. at the end of a 1¹/₄ in. pipe. On the Southern Pacific, the jet pipe is drawn out to a rectangular shape about 1/4 in. by 2 or $2\frac{1}{2}$ in. Some advantage is claimed for this shape when used in stiff material. Two jet pipes are occasionally used, as it is somewhat easier to guide a pile to correct position in this manner. The water pressure used varies from 100 fb. to 225 fb. per sq. in. and pumps with 3 or 4-in. discharge pipes are generally used. A large volume of water at moderate pressure gives the best results. Prof. Jacoby, in his book referred to previously, states that from 50 gal. to 250 gal. of water is required per min., but other authorities place the quantity at from 250 gal. to 500 gal. per min. A water jet may also be employed for loosening piles which are to be pulled.

A somewhat different type of jet wherein steam takes the place of water is in use on the Chicago, St. Paul, Minneapolis & Omaha and is described as follows: "We use a steam jet on a track driver when jetting is advisable and have found it practical and economical to bore the piles and insert the jet pipe so the full force of the jet is applied at the center of the point of the pile. A hole of proper size is bored in the center of the point and at an angle such that it comes out the side of the pile about two feet above the point. The nozzle of the jet is inserted in this hole and allowed to go down with the pile. This method has been used and found very satisfactory where it was desired to drive falsework piles down to rock to support two heavy spans while piers were being rebuilt."

In view of the large amount of attention given to the matter of safety during the last few years, an effort has been made to bring out descriptions of features which have been adopted for this reason and a list is presented herewith which it is believed will prove interesting and profitable. Some of the suggestions have already been adopted by practically everybody:

Rail clamps when driving on the side.

Cable guards to protect leads when driving on high elevations. Steel pile cap.

Steam power for operating leads and car brakes. Driver so constructed that no idler car is required when in a

train. Covering for all moving parts of machinery.

Stops for holding the hammer while a pile is being set in place

Cables run along the main tension braces on a land driver and fastened to the main members to prevent the collapse of the frame in case of bolt failures.

Hand railing around the driver and tank at about the floor level.

The steam hammer.

Careful design. Competent men

Careful inspection of lines and keeping the driver in good repair.

Provision for throwing the propelling mechanism in and out of gear from the side of the car. Painting white the side of the hammer nearest the engineer so that he may readily see it.

The use of a blue lantern to signal the engineer when working at night to avoid confusion with train signals.





VIEWS IN AND ABOUT THE CONVENTION

PANORAMIC PHOTOGRAPH OF THE CONVENTION PARTY AT NEW ORLEANS: (1) THE SPECIAL TRAIN LEAVING VICKS-BURG. (2) AT THE ILLINOIS MONUMENT IN THE NATIONAL CEMETERY, VICKSBURG. (3) ON THE OBSERVATION PLATFORM LEAVING VICKSBURG. (4) EXAMINING THE CREOSOTED TRESTLE ACROSS LAKE PONTCHARTRAIN ON THE N. O. & N. E. (5) TWO OF THE VETERAN MEMBERS. (6) ON THE STATION PLATFORM AT VICKSBURG. (7) PART OF THE NORTHWESTERN MEN AT BOGALUSA. (8) GOING THROUGH THE SAWMILL OF THE GREAT SOUTHERN LUM-BER COMPANY, BOGALUSA, LA. (9) AN EARLY MORNING INSPECTION OF ONE OF THE NEW ORLEANS DOCKS.



Special precautions to insure protection by flagmen as well as by train orders.

Metallic steam hose from the boiler to the hammer.

Foot boards on the front end.

Pile and hammer cables carried under the floor of the car; two extra running sheaves are required to accomplish this.

The Chesapeake & Ohio and the Western Maryland report piles driven by contract except in emergency cases. This, of course, is common practice in the case of foundation piles, but is somewhat unusual for trestle renewals.

Maro Johnson (I. C.), chairman; J. P. Canty (B. & M.), R. H. Reid (N. Y. C.), J. P. Wood (P. M.), O. F. Dalstrom (C. & N. W.),

Discussion

Several members spoke of their difficulty in securing satisfactory service from the steam hose used with steam hammers, although A. S. Markley (C. & E. I.) stated that he had been able to drvie 3,500 lin. ft. of piling with one set of hose. E. K. Barrett (F. E. C.) and others reported difficulty with all types of hose which they had used. R. H. Reid (N. Y. C.) stated that he has used plain, armored and double-armored hose and has found that while the plain hose will not stand the abuse that the other types will, it will open up after being jammed, while the armored hose will not.

A. Montzheimer (E. J. & E.) urged the importance of the keeping of full penetration records of all piles driven because of their importance in valuation matters, not only as proof of the penetration secured, but also as a means of securing data regarding the wastage from the cut-off. A. S. Markley stated that such a record which he has kept since 1881 was consulted freely by the valuation department of his road when the government forces were making their inventory. G. W. Rear (S. P.) pointed out the fact that, within reasonable limits, it costs as much to drive a pile of one length as of another, and that for this reason unit costs prepared on the basis of the lineal feet of piling driven are misleading and of little real value.

L. D. Hadwen (C., M. & St. P.) referred to the increasingly common practice of using steel cables with drop hammers in place of manila rope. E. K. Barrett (F. E. C.) stated that he has used $\frac{3}{4}$ -in, wire cable for this purpose for 15 years and that he has driven as many as 1,300 piles with one cable without a break. Wire cable costs less than rope. R. H. Reid (N. Y. C.) uses both manila and wire rope for both hammer and pile lines. He has found that the wire rope wears the sheaves faster than manila, but the latter is more flexible and more easily manipulated. He uses a 20-in. sheave at the top of the leaders and 18-in. sheaves at other points. B. F. Pickering (B. & M.) reported the use of fourstrand lubricated manila rope, which lasts as long as wire cable and costs about the same.

While discussing the relative merits of steam and drop hammers, G. W. Rear stated that 50 per cent of the piles are overdriven and that a steam hammer will ordinarily secure all the penetration a pile requires, this conclusion being based on an observation of many broomed piles.

PASSENGER STATIONS OF MODERATE SIZE

Stations should be designed with simple, wide overhangings and with broad platforms, preferably on all sides of the structure. Attention should be given to the driveway approaches and paths, and, where there is sufficient ground, shrubbery should be planted that will be effective, not only through the growing season but through the winter months as well.

There is no set rule by which the size of a station suitable for any town or city may be determined. The rev-

enue from ticket sales is an index of the passenger business originating at a station, but it might be misleading as to the kind of a station required, for some towns originate very little passenger business and yet are called upon to handle heavy traffic. The amount of transfer business must also be considered, and, where there is much of it, comfortable and commodious quarters must be provided. Many railroads have standard designs for the smaller stations, but these cannot be adhered to very closely because every location has different conditions that require modifications.

The station proper should have a general waiting room, and leading off from this a women's retiring room, with toilet, and also a men's smoking room and toilet. On the opposite side of the room there should be a ticket and telegraph office, and a baggage and express room. In addition to the ticket window there should be a window between the general waiting room and the baggage room so that passengers can check baggage without going out of the station.

With the maintenance cost in mind, the committee recommends the use of brick, stucco or concrete, because the first cost is very little higher than that of a frame structure. At some points stone costs about the same as brick. It makes a very good building material and gives a neat appearance. If brick is used it should be re-pressed or vitrified because a soft brick will result in a damp building. Rough texture bricks are being used extensively, and are more pleasing in appearance than smooth brick. In the matter of maintenance the painting of wooden buildings amounts to considerable. This is eliminated with brick, stone and concrete structures.

The roofs of stations require careful consideration. The plainer the roof lines are the cheaper is the upkeep, but appearance should not be sacrificed altogether for this item. The better buildings are roofed with tile or slate, and these materials should be used for slopes of 6 in. per ft. or over. Care should be exercised in securing the proper grades of materials. The best grade of slate is considered expensive, but for length of service it exceeds that of any other roofing material. The difference in price between a good and a poor quality of slate is not very great.

Several companies manufacturing roofing tile are willing to place it on a roof under a guarantee. While tile costs more than slate, the color adds a great deal to the appearance of the building. Ordinary sheathing paper is satisfactory under a slate roof, but a layer of composition roofing should be used under a tile roof. Composition roofs, asbestos shingles and tin are used to a limited extent, but they are not recommended for the better class of structures.

The interior of the station is usually of wood frame because it is cheaper and there is little danger of fire in a structure of this character. Brick or hollow tile makes a more substantial and fireproof interior, but the cost is not often justified. Walls are generally plastered and usually the lower five or six feet are covered with a wood wainscot in the waiting rooms, with tile in the toilet rooms. In many stations the walls are finished with a light-colored brick. This gives a finished surface that lightens the dark rooms and is very satisfactory from the standpoint of wear, but it is much more expensive than plaster.

One of the principal problems in a station is the floor surface. Wood holds and absorbs the dirt, while varnish is soon scratched and worn off by the cinders carried in by the passengers. Where wood is used it should be either maple or edge-grain pine. Composition floors are used extensively; they give a hard, impervious sur-



face, but their wearing qualities are not altogether satisfactory. Some tile floors have given good results, but others have worn badly, because the cinders are ground into them, causing the surface to craze and discolor. Floor tile should be vitrified to wear satisfactorily. Ticket offices should have wood floors, while vitrified brick floors give the best wearing surface for baggage rooms.

In the smaller stations, stoves are generally used for heating, but they are not to be recommended, except in very small stations. Hot water heating plants are more satisfactory than steam, but are recommended only where there is an attendant on duty for the full 24 hours. A low pressure steam plant is very satisfactory and is to be recommended where an attendant is not on duty the full 24 hours, as there is less likelihood of it freezing. There is practically no more danger than with a hot water system. Damper regulators are recommended for either hot water or low pressure steam heating systems.

Platforms should be not less than 10 ft. wide. In front of the station building they should be not less than 16 ft. wide and as much more as can be consistently Vitrified brick is quite generally used, but allowed. many roads prefer concrete. One feature in favor of a brick platform is that if settlement occurs or if any of the brick become broken they can be repaired more easily than if the platform is built of concrete.

DISCUSSION

R. H. Reid (N. Y. C.) emphasized the importance of improved lighting conditions in small stations. L. D. Hadwen (C., M. & St. P.) deprecated the use of timber floors in otherwise attractive stations, favoring some type of composition floor which, although requiring expert workmanship in laying, is more sanitary. E. C. Morrison (S. P.) stated that he has placed tile or concrete floors in small stations whenever it has been necessary to remove timber floors, preferring tile floors.

In reply to a question, J. S. Robinson (C. & N. W.) stated that he has used asbestos and asphalt shingles with satisfactory results, but that he has found that the asbestos shingles discolor more, particularly from the drip from wires crossing overhead. He has also found that it is difficult to keep clean the concrete floors in small stations, which do not have janitor service unless they have been well-troweled when laid.

HANDLING CONCRETE ON SMALL JOBS

It was decided that only such work should be considered as did not exceed 200 cu. yd. in volume and which would not warrant the installation of a special plant. Replies to a circular letter asking for information regarding their practices were received from 41 different railroads, representing a total of 127,500 miles and covering practically all the different railroad conditions that would be encountered in North America.

A summary of the replies shows that 31 roads, representing a mileage of 100,280, handle their small concrete work with their own forces in general, while two roads, with 2,839 miles, handle such work exclusively by contract. Six roads with a mileage of 24,403 use both methods, being governed by the nature of the work, its volume and the convenience in handling, the question of labor supply playing an important part in the method used. On small jobs of this character, contractors are often not in a good position to compete, as the work is connected with operating features and has to be adjusted to suit them rather than to suit the convenience and economy of its conduct. The question of safety and the desire to have the company's own employees handle construction under operated tracks or in the yards and has an important influence in eliminating contract work in many instances.

In considering the relative economy of handling work of this character by contract or by company forces, the fact that the contract price does not cover all the incidentals in connection with the work should not be overlooked. Company work is often conducted at a disadvantage from the point of economy in order to facilitate the work of other departments and delays which company forces may experience would result on contract work in large bills of extras which do not appear in the contract price.

Of the replies received, 31 indicate that they are able to organize the work so as to admit of a regular program through the season, while 5 are unable to do so. Three handle work of this kind by means of regular floating gangs. In most cases a program is mapped out in the spring and forces are organized to cover the season's work, though it is sometimes necessary to organize to take care of individual jobs. A desirable way of taking care of such small jobs would be to have a crew organized under the district authority to take care of the work on each district or division where the volume makes this justifiable. Some roads keep a regular gang all the year handling this class of work and moving from one division to another. This method is used on the Chicago, Burlington & Quincy, floating gangs moving from one division to the other and cleaning up all work as they go. On the Chicago, Rock Island & Pacific, regular bridge gangs are used for small work.

No very complete lists of the tools considered essential for a small concrete outfit were given. The following, which is typical of an outfit on small work on the C., M. & St. P., may be taken as an example:

1

- Concrete mixer
- 10 Wheelbarrows
- Cant hook
- 50 ft. 1-in. water hose
- Small track jack
- Combination vise
- Hand axe
- Double-bit axe
- Sheet pile pounder
- Timber bar
- Cross-cut saw
- No. 4 sand screen
- 12 D. H. S. P. No. 2 shovels
- pr. knee boots D. H. spade
- 8-tb. sledge
- 16-lb. sledge
- 8-ft. straight edge Grindstone and frame com-1
- plete
- Claw hammers
- pr. carrying hooks 4
- Heavy mortar hoes
- 2 7/8-in. bridge augers
- The outfit should be adjusted, as far as possible, to the character of work the crew will be called upon to do and the hauling of all excess equipment and surplus secondhand lumber, etc., from other jobs should be avoided. Nearly all roads favor the use of a small mixer in any concrete outfit. In most cases the carpenters are required to furnish their own tools, but it is economy to have a liberal supply of hammers, saws, etc., on hand in an outfit so that laborers can be pressed into service, sheeting up the forms, etc., when they would otherwise be waiting. For crews making frequent moves, a tool car will save much handling, as small amounts of cement and lumber can be carried along with the outfit and only such tools as are necessary for the job in hand need be unloaded.

The size of the mixer recommended shows consider-

Single-bit axe 2 Water barrels 6 Heavy galv. water pails 1 Gaso. driven diaphragm

Tubular lanterns

- pu**mp** Pinch bar 1
- Combination nail pullers 12 D. H. R. P. No. 2 shovels
- 1 Measuring box
- Tool box 1
- 1 Steel broom
- 3 Common brooms
- Stonemason trowel 1
- 16-ft. straight edge 1
- 1 Plasterer's trowel
- 2 pr. wire pliers 200 ft. of 1-in. line
- 6 Track chisels
- 2 12-in. monkey wrenches
 - 2 18-in. pipe wrenches 1 set 8-in. double blocks for
 - 1-in. line.

able variation, evidently, larger work being considered in some instances in the replies. Only 6 prefer hand mixing for small work. Sixteen recommend mixers with from 6 to 9 cu. ft. capacity of the unmixed charge. This corresponds to a 1-sack batch mixer. Eight prefer a halfyard or 2-sack batch mixer and two use 3/4-yd. machines.

The opinions as to the minimum sized job on which the use of a mixer is justifiable vary widely. Four roads recommend using some form of mixer for quantities as small as 5 cu. yd. Six would use one where the quantities are from not less than 10 to 30 yd., 5 set 50 yd. as the limit and 6 consider 100 yd. a minimum.

L. D. Hadwen (C., M. & St. P.), Chairman; J. W. Wood (P. M.), C. F. Green (S. P.), G. H. Stewart (B. R. & P.).

Discussion

C. E. Smith described the former practice of the Missouri Pacific of contracting all concrete work, which practice he found unsatisfactory. When organizing to handle this work with company forces, gangs were assigned to the local divisions and the quality of the work was materially improved. After the organization had been perfected and the necessary equipment secured, it was found that the number of requests for the replacement of timber bridges with concrete construction increased very rapidly. Between 1910 and 1915, 25 miles of timber bridges similar to those which had previously been renewed in kind were replaced with concrete culverts and embankments. The installation of company work enabled unit prices to be reduced 25 per cent. Up to one year ago no concrete work had been contracted for the last four years.

SMALL COALING STATIONS

There are certain general features of small coaling stations which are objectionable and which should be given careful consideration before any particular type of plant is installed. Some types of small plants require a trestle immediately over the coaling track at such a height as to just clear a high car. This condition is dangerous and objectionable, especially if the coaling is done on the main line. If that part directly over the tracks is of steel, the maintenance will be high, for the metal will be eaten away rapidly by the gases from locomotive stacks. If the overhead structure is of wood there is danger from fire, and also the trouble from the wood decaying quickly on account of the moisture from the exhaust steam.

With a timber structure there are always heavy maintenance charges when it gets old. The fire risk must also be considered. It is a serious matter to lose a coaling station by fire, even though it is a small one, for, owing to the location and the number and character of the trains served, a small station may be just as important to the operation of a railroad as a larger one.

Air-hoist bucket plants are used on many western roads for small stations. The trackage necessary is not great and the maintenance of such a plant is not high when the small amount of coal used is considered. The frame supporting the hoist is usually built over the coaling track, but some of the railroads use an air hoist having a derrick which swings out over the coaling track and avoids placing an obstruction over the coaling track.

A number of stations on the Southern consist of a high platform built alongside the coaling track at the proper height to permit shoveling coal from the platform to the engine. Above this platform and farther back from the coaling track is an elevated trestle up which cars of coal are pushed on a 5 per cent grade, and from which the c-al is dumped to the platform. The cost of such a

coaling station naturally varies, depending upon the size of the platform and the amount of track necessary to serve the plant. The cost of operation is high on account of the large amount of labor required in moving the coal. The cost of maintenance is also fairly high.

The Union Pacific employs mechanical plants almost exclusively, even where the consumption is small. On the Chicago & Alton the gravity type of coal chute is used, where the cars are taken up a high trestle and the coal is dumped by gravity into bins, and thence by gravity on to the engine. This type is preferred for the larger stations, but this road is using mechanical plants at less important stations and where the space is restricted.

The Western Maryland uses a small coaling station in which the loaded cars are pushed up an inclined trestle to the proper height above the coaling track. The coal is dumped from cars about 8 or 10 ft. to the platform and is then shoveled into small narrow-gage cars. These cars are then pushed out over a locomotive standing on the coaling track and dumped. This is another type of plant where the topography must be favorable in order to get the cheapest installation. It has the objectionable feature of an obstruction over the main track. The operation is a little high, but the maintenance is about normal.

In the small coaling stations on the Santa Fe the coal cars are pushed up onto a trestle and the coal is shoveled into pockets alongside the trestle, from which it flows by gravity to the locomotives. On the Chicago & Northwestern the gravity-pocket and the air hoist-bucket types are used. The gravity-pocket type, used where the consumption is small, is the same as that employed on the Santa Fe. For the air-hoist-bucket type a derrick is erected, the coal is shoveled from cars onto a platform and then into one-half-ton buckets, and it is then delivered to the engine by means of the derrick, the coal being dumped by opening the bottom of the buckets. Air from the locomotive is used in operating the derrick while the engine is being coaled. The derrick is also equipped for hand operation for moving the buckets around while they are being filled. The operation of these plants is rather high on account of the labor needed; the maintenance, however, is low.

A coaling station where the consumption is small should be as inexpensive as possible, that is, it is preferable to have a plant in which the cost of operation may be high rather than an expensive plant on which the operation may be comparatively low. In deciding on the construction of a coaling station the interest on the investment must be considered, and this may more than offset the higher cost of operation of a cheaper plant. Another thing to be considered is that small plants are more liable to be moved than larger ones.

Mention has been made of the growing tendency to use locomotive cranes for coaling stations. However, the cranes now in use are large machines having a capacity of from 15 to 20 tons. These cranes cost from 60,000 to \$8,000, and if they are used in connection with elevated bins they result in rather expensive coaling stations. One company has worked up a design for a small crane having a capacity of 4,000 th. at a 20-ft. radius, which will cost about \$3,000. The only thing necessary to equip a small coaling station in addition to this crane is 400 or 500 ft. of trackage. The labor for operating such a plant will not require more than two men, and it will undoubtedly prove to be economical both in operation and maintenance.

L. Jutton (C. & N. W.), Chairman: W. F. Strouse (B. & O.), J. H. Nuelle (N. Y. O. & W.), G. W. Kinney (L. A. & S. L.). The report was accepted without discussion.

OTHER REPORTS

A comprehensive report on Paint and Its Application to Railway Structures was presented in abstract by C. E. Smith, chairman. This report reviewed the tests of paints made during recent years by the American Society for Testing Materials, and the reports on painting made to the American Railway Engineering Association two years ago. It closed with a statement of the results which have been secured from the coating of a large amount of steel work with the cement gun on the Kansas City Terminal.

A report of Efficient Methods of Handling Work and Men, presented by F. E. Weise (C., M. & St. P.), chairman, described the methods of handling five special problems economically. These have been described previously in the Maintenance of Way section of the Railway Age Gazette and the Railway Maintenance Engineer.

DR. VON SCHRENK'S TALK

At the session on Thursday morning Dr. Herman von Schrenk, consulting timber engineer, St. Louis, gave an instructive talk on timber, its uses in railway work, its failures, and precautions which may be taken to avoid them. After discussing briefly the prevalent waste of timber in this country, particularly when compared with European practices, he pointed out means of securing the most economical use of timber in those places for which it is particularly suited. He described the density rule for southern yellow pine, which is being adopted rapidly by the railways, and pointed out its advantages over previous standards. The principal part of his address was devoted to means of protecting timber from unnecessary exposure to the agents of decay and from improper handling. He pointed out those defects most commonly encountered, using lantern slides freely to show unfavorable conditions, as well as those more satisfactory. The sanitation of lumber yards was particularly emphasized, and the statement was made that one yard which has given the subject special attention recently has reduced its losses from an average of 5 to 10 per cent annually to practically nil.

SUBJECTS FOR COMMITTEE WORK

The following subjects were selected for investigation and report at the next convention:

- 1. Organization of the water service department. Eco-
- nomical delivery of water to locomotives.
- The construction of shop buildings
- 3. Erection of plate girder spans with the least interference with traffic.
- Roof drainage of railway buildings.
- Repairing and strengthening old masonry.
- Hand-operated devices for lifting, pulling and hoist-6. ing.
- 7. Paint and its application to the exterior of railway buildings.
- Fireproofing the roofs of railway buildings. 8
- 0 Blank forms for water service records.
- 10. Snow sheds (an individual paper).
- 11. Efficient methods of handling work and men.

BUSINESS SESSION

Following recent agitation by members of the American Railway Bridge and Building Association and the Maintenance of Way Master Painters' Association for the consolidation of the two organizations, the former association invited the Painters' association to consolidate with it. The latter association, however, declined the invitation, believing that the proper time for this consolidation has not yet arrived.

At the annual election of officers on Thursday morn-

ing, the following were selected: president, C. E. Smith, consulting engineer, St. Louis, Mo.; first vice-president, E. B. Ashby, chief engineer, Lehigh Valley, New York; second vice-president, S. C. Tanner, master carpenter, Baltimore & Ohio, Baltimore, Md.; third vice-president, Lee Jutton, division engineer, Chicago & Northwestern, Madison, Wis.; fourth vice-president, F. E. Weise, chief clerk to chief engineer, Chicago, Milwaukee & St. Paul, Chicago, Ill.; secretary-treasurer, C. A. Lichty, general inspector, purchasing department, Chicago & Northwestern, Chicago, Ill. D. C. Zook, master carpenter, Pennsylvania Lines, Ft. Wayne, Ind., was elected a member of the executive committee.

St. Paul was selected as the location for the next annual convention.

ENTERTAINMENT

A three-hour business session was held on Tuesday evening to permit the members and their families to take an automobile ride about New Orleans on Thursday afternoon. A number of the members made an inspection tour of the docks along the river front on the same afternoon. On Friday about 275 members and guests went to Bogalusa, La., on a special train provided by the New Orleans & Northeastern and the New Orleans Great Northern railways to visit the sawmill of the Great Southern Lumber Company. Stops were made en route at the north end of the New Orleans & Northeastern trestle across Lake Pontchartrain to enable the members to examine this structure, and at Slidell, La., to visit the plant of the Southern Creosoting Works.

The Bridge and Building Supply Men's Association gave a banquet to the members of the Bridge and Building Association and their families in the Grunewald hotel on Wednesday evening, about 350 being present. On Thursday evening the annual Association dinner was held in the same building.

THE SUPPLY ASSOCIATION

The Bridge and Building Supply Men's Association held an attractive exhibit in rooms adjoining the convention hall, 30 firms, with 69 representatives, taking part. This exhibit was the largest ever held, both in the number of firms participating and in the number of men present. The exhibits consisted largely of photographs and blue prints, literature and samples of products.

The officers of this association for the past year were: President, D. A. Bonitz, National Roofing Co., Tonawanda, N. Y.; vice-president, J. A. Nealley, Joseph Dixon Crucible Co., Jersey City, N. J.; treasurer, L. D. Mitchell, Detroit Graphite Co., Detroit, Mich.; secretary, P. C. Jacobs, H. W. Johns-Manville Co., Chicago, Ill.

The firms exhibiting, with the character of their exhibits and the names of their representatives, are given helow:

American Hoist & Derrick Co., St. Paul, Minn. Illuminated transparent photographs of railway ditchers. Represented by F. J. Johnson and W. O. Washburn. American Tar Products Co., Chicago, Ill. Represented by

J. L. Spell.

American Valve & Meter Co., Cincinnati, Ohio. Catalogs of the Poage automatic water column. Represented by J. T. Mc-Garry.

Barber Asphalt Paving Co., Chicago, Ill. Represented by Ar-thur T. Cavey and Robert M. Jordon. The Barrett Co., New York. Built-up and prepared roofing

materials, coal tar products, creosote oil, iron and steel paints and the Holt roof connection. Represented by E. J. Caldwell, C. F. Ames, S. Day, G. R. McVay, W. Wamsley and E. H. Poetter.

Chicago Bridge & Iron Works, Chicago, Ill. Photographs and catalogs of steel water tanks. Represented by M. J. Trees, H. C. Brown and H. B. Murphy.



Chicago Pneumatic Tool Co., Chicago, Ill. Pneumatic tools and hose couplings. Represented by C. E. Walker, J. N. Steb-bins and J. W. Lowell.

Detroit Graphite Co., Detroit, Mich. Represented by L. D. Mitchell, J. L. Hogan and W. D. Waugh.

Joseph Dixon Crucible Co., Jersey City, N. J. Photographs and catalogs of graphite paints. Represented by H. A. Nealley and H. A. Van Derslice.

Fairbanks, Morse & Co., Chicago, Ill. Represented by A. A. Taylor, D. K. Lee, J. George Jones, L. D. Matthews, C. H. Wilson and U. C. Kalar.

Grip Nut Co., Chicago, Ill. Grip nuts. Represented by J. E. Weatherford.

H. W. Johns-Manville Co., New York. Asbestos roofing, in-sulating shingles, steam traps and fire extinguishers. Repre-sented by P. C. Jacobs, J. H. Trent, L. E. Hassman and H. G. Newman.

Newman. The Lehon Co., Chicago, Ill. Roofing and insulating materials. Represented by Tom Lehon and D. B. Wright. C. F. Massey Co., Chicago, Ill. Photographs, blue prints and catalogs of reinforced concrete culverts, pile trestles, portable houses, sewer pipe, etc. Represented by C. F. Massey, C. Gilman and H. E. Burns. National Roofing Company. Tonawanda, N. Y. Security Wide-Wold catalogs and H. Jacker and Hudgele materiascone Represented Wold catalogs.

Weld asphalt roofing and Hydrolx waterproofing. Represented by D. A. Bonitz and B. A. Flanders.

Otley Paint Mfg. Co., Chicago. Ill. Samples of railway bridge steel, refrigerator, car and building paints. Represented by Benj. F. Otley and W. A. Otley. Patent Vulcanite Roofing Co., Chicago. Ill. Samples of felt,

asphalt and ornamental roofing and asphalt shingles. Represented by A. J. Van Page.

sented by A. J. Van Page. The Patterson-Sargent Co., St. Louis, Mo. Represented by Jos. K. Patterson and W. H. McBride. Philip Carev Co., Cincinnati, Ohio. Represented by G. L. Cockrell and A. Donaldson. Pyrene Mfg. Co., New York. Fire fighting appliances. Rep-resented by F. P. Murphy and E. J. Putzel. The O. & C. Co., New York. Derails and tie spacers. Repre-sented by R. B. Quincy and J. V. Wescott. The Shepherd Automatic Switch Co., Montgomery, Ala. Model of the Shepherd Automatic Switch. Represented by M. L. Shepherd. Shepherd.

Simmons-Boardman Publishing Co., New York. Copies of the Railway Maintenance Engineer and the Railway Age Gazette. Represented by E. T. Howson and F. H. Thompson.

T. W. Snow Construction Co., Chicago, Ill. Represented by T. W. Snow. Southern Pine Association, New Orleans. Examples of the correct and incorrect treatment of ties and piling. Illustration of the U. S. Forest Service—density rules for yellow pine. Rep-resented by J. C. Valadie and Dr. Herman von Schrenk. Standard Asphalt & Rubber Co., Chicago, Ill. Photographs and catalogs of mineral rubber floors, asphalt, etc. Represented

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Mansfield and U. S. water columns and Curtis pumps. Repre-sented by C. E. Ward.

At the annual election on Thursday morning the following officers were selected for the ensuing year: President, H. A. Nealley, Joseph Dixon Crucible Company, Jersey City, N. J.; vice-president, L. D. Mitchell, Detroit Graphite Company, Detroit, Mich.; treasurer, P. C. Jacobs, H. W. Johns-Manville Company, Chicago, Ill.; secretary, Tom Lehon, The Lehon Company, Chicago. Executive committee—C. E. Ward. U. S. Wind Engine & Pump Company, Batavia, Ill.; W. H. Pratt. Heath & Milligan Mfg. Company, Chicago, Ill.: M. J. Trees, Chicago Bridge & Iron Works, Chicago, Ill.: A. A. Tavlor, Fairbanks, Morse & Co., Chicago; C. H. Cockrell, Philip Carey Company, Cincinnati; C. F. Massey, C. F. Massey Company, Chicago, Ill.

THE OLDEST EMPLOYEE.—The October number of the Maize, the Chicago Great Western employees' magazine, presented the photograph of John C. Brown, section foreman at Waterloo, Ia., as the oldest employee in continuous service on the road. Although Mr. Brown is only 47 years old, he has worked for the road 33 years.

CONVENTION OF MAINTENANCE OF WAY MASTER PAINTERS

"HE thirteenth annual convention of the Maintenance I of Way Master Painters' Association of the United States and Canada was held at the Hotel Walton, Philadelphia, October 17 to 19, inclusive, with an attendance of about 40 members, together with representatives of a number of paint manufacturers. The meetings showed a marked improvement over last year's convention, both as to the attendance and the scope of the program.

L. P. Nemzek (John Lucas & Company) presented a paper on "Preservative Coatings for Iron and Steel," in which he recommended and gave reasons for the advantages of basic lead chromate in place of the commonly used oxide, red lead. H. A. Gardner (Institute of Industrial Research) gave an illustrated lecture on "Physical Characteristics of Pigments and Paints," which included reference to the possibilities of kukin oil, the oil of the soya bean and perilla and china wood oils. Pigments were considered from the standpoint of hiding power, oil absorption, opaqueness, suspension, etc. He prefers red lead containing 15 per cent of litharge. In commenting on this, A. H. Sabin (National Lead Company) stated that this amount of litharge was an advantage in a paint to resist water because the film was necessarily thicker.

Three papers were presented which covered the subject of fire resisting properties of paint, one by W. A. Clapp (Clapp Fire Resisting Paint Company) on "Fire Resisting Paints," another by G. F. Johnston (Pyroline Products Company), entitled "Reducing Fire Losses," and a third by H. J. Barkley (I. C.) on the "Application of Fire Resisting Paints." In discussion of these papers, H. A. Gardner expressed the view that any good paint containing a mineral pigment has fire resisting properties, since after the oil is driven off by the heat the surface is covered with a coating of purely mineral sub-E. H. Brown (Painters' Magazine) stated stances. that he had found a heavy coat of lime whitewash, when protected from the weather, to be a good resistant. A number of the members spoke of their experience with various formulæ containing whitewash as the principal ingredient.

W. S. Lacher (Railway Maintenance Engineer) presented a summary of the organization and administration methods as carried out on American railways in the repainting of bridges. M. F. Ebel (C. H. & D.) told of the precautions to be taken to safeguard the lives of men in railway painting. The position of the master painter in relation to his men and to the railroad was discussed at some length following an outline presented by H. E. Conrad (P. R. R.).

Papers were also presented on the following subjects: "What the Association Has Done for the Railroads," by A. B. Phelps (N. Y. C.); "The Influence of Pigments on Paint Permanency," by Malcolm McNaughton (Joseph Dixon Crucible Company); "Sanitary Value of Paints," by E. W. Lutes (Sherwin-Williams Company); "The Selection of Brushes," by A. G. Pruett (C. & O.), and "Benefit of the Association to the Railroads," by O. Stubstad

All officers of the association were re-elected for the coming year and include F. C. Rieboldt, president (C., M. & St. P.), Milwaukee, Wis.; H. E. Conrad, first vice-president (P. R. R.), Huntington, Pa.; A. E. Wilson, second vice-president (N. Y. N. H. & H.), Hartford, Conn.; F. W. Hager, secretary-treasurer (Ft. W. & D.), Fort Worth, Texas. The next convention will be held at Cleveland, Ohio, on October 16 to 18, inclusive.

GENERAL NEWS DEPARTMENT

THE DEPARTMENT OF COMMERCE has issued a statement advising that the exports of railroad supplies from the United States for the seven months ending with July amounted to \$36,215,000, as compared with \$9,465,000 for the same period of the preceding year.

THE PUBLIC SERVICE COMMISSION OF PENNSYLVANIA has adopted a resolution fixing the fiscal year for reports made to the Commission to end December 31. All companies are notified, however, to file the usual annual report for the fiscal year ending June 30, 1916.

THE SUPREME COURT of the state of Washington holds that the driver of an automobile who drove up a 12 per cent incline to a crossing on intermediate gear at a speed of 10 to 15 miles an hour, under which circumstances the car could have been stopped in from 3 to 5 feet, but failed to stop though there was an approaching train in view not more than 300 ft. away, was negligent, as matter of law, in attempting to cross in front of the train.

THE CANADIAN GOVERNMENT officially announces that an arrangement has been made with regard to supplying rails required by the railways, which will temporarily satisfy their urgent requirements. Owing to the fact that the steel companies have latterly devoted their principal attention to the making of war munitions, there has arisen a great shortage of rails, the railways being unable to obtain those needed for track maintenance. The exact line of policy to be pursued in order to relieve the situation is not indicated, but jt is understood that the customs duties on rails will be temporarily suspended.

THE FORESTY EXHIBIT to be shown at the International Soil Products Exposition, El Paso, Tex., while intended primarily for the farmers, contains features which will be of interest to maintenance of way men. The exhibit will contain actual working models of two types of post-treating plants suitable for use in treating fence posts and other timbers. The system of fire protection for the national forest will also be shown, by a miniature of a typical lookout tower, from which the forest guard watches for signs of fire, together with telephone lines and firefighting tools with which the fire-fighting force is provided.

THE LEHIGH VALLEY, inconvenienced by the scarcity of vessels available for the transportation of ties from the South, and the high rates charged, lately used in that traffic its own sea-going tug, "Perth Amboy," which ordinarily takes coal to New England. The tug was sent south with three steel barges used for carrying coal, these being placed at Brunswick, Ga., and Jacksonville, Fla., where ties are easily concentrated. and a load of 50,000 ties was quickly obtained. The tug experienced no difficulty in bringing the tow back to Perth Amboy (New York harbor) and the experiment is regarded as a complete success, as there was a large saving in the cost, and the company was able to bring a large quantity of ties to its line promptly.

J. M. DAVIS, OPERATING VICE-PRESIDENT of the Baltimore & Ohio, returning from a recent inspection trip over the eastern lines of the company, said, "If all the idle men who have no visible means of support were forced to go to work, there would be no shortage of labor in the United States. There is a very serious shortage of labor in the Pittsburgh district, but in a few hours' daylight ride through this section I counted over 100 able-bodied men beating their way on Baltimore & Ohio freight trains in both directions in and out of Pittsburgh. It is not only in connection with the present scarcity of labor that I am interested in the subject, but I have felt for some time that this question is inseparably linked with the trespassing problem."

THE TENTH ANNUAL CHICAGO CEMENT SHOW will be held in the Coliseum from Wednesday, February 7, to Thursday, February 17, 1917, inclusive. The exhibits will be concentrated this year in the Coliseum with the balcony and annex, without the First Regiment Armory, which was used last year. While this space will be devoted to the exhibit, it will be concentrated in a manner to make it more accessible to visitors. During the same week the National Builders' Supply Association will hold its annual convention at the Hotel Sherman, on February 11 and 12, while the Illinois Lumber and Builders' Supply Dealers' Association will meet at the same hotel on the two following days. It is also probable that the American Concrete Institute will meet at the same time.

THE BALTIMORE & OHIO has distributed to every employee whose duties are in any way hazardous a booklet, entitled "Safety and Sanitation Rules," embracing precautionary practices it has found necessary to enforce in conducting the operation of its trains, tracks and shops. Although the year 1915 showed an increase of 56 per cent for fatalities and 18 per cent for injuries in the reduction of accidents to employees over 1913, the railroad management expects to obtain further reductions in accidents through the influence of this booklet. The preface to this book consists of a letter from J. M. Davis, operating vicepresident, who states that "Safety must be the first consideration of every department of the service and that compliance with the rules and the co-operation of each employee is imperative."

THE ILLINOIS CENTRAL and the Yazoo & Mississippi Valley, through the general manager, T. J. Foley, has issued an appeal to motorists to "Stop, look and listen" at highway crossings. According to Mr. Foley, during the ninety days preceding September 26, 18 persons were killed and 36 persons injured in automobile grade crossing accidents on the Illinois Central. Mr. Foley further states that statistics prove that crossings which are used extensively, and therefore are considered the most dangerous, are really the safest. The great majority of accidents occur at outlying crossings which are the least used. He calls attention to the fact that there are 8,000 grade crossings on the Illinois Central system and that to separate the grade at these crossings would cost \$215,408,020, which is nearly twice as much as the capital stock of the company.

THE PENNSYLVANIA RAILROAD annual track inspection was made by S. C. Long, general manager, and a party of about 400 operating officers on October 3 and 4. This inspection covered the main lines between New York and Pittsburgh and between Philadelphia and Washington, and \$5,400 in prizes were awarded to the supervisors and their assistants for excellence in track maintenance during the past year. The first, or "Klondyke" prize of \$1,200, divided on the basis of \$800 for the supervisor and \$400 for the assistant, is an award for the best maintained subdivision throughout the year, and was presented to C. M. Wisman, supervisor, and H. M. Grimm, assistant supervisor, who have charge of the track from east of Liddonfield. Pa., to west of Plainsboro, N. J. Four prizes of \$800 each, of which \$600 was for the supervisor and \$200 for the assistant, were awarded for the subdivisions having the best line and surface on each of four main-line divisions. These prizes went to C. Z. Moore, supervisor, and L. R. Fleming, assistant supervisor, in charge of track between Harrisburg and Dillerville; W. R. Hanly, supervisor, and B. M. Frymire, assistant supervisor, in charge of track from east of Thompsontown, Pa., to west of Marysville; W. E. Brown, supervisor, and G. H. Stewart, assistant supervisor, in charge of track between New Florence, Pa., and Donohoe; W. F. Rench, supervisor, and A. G. Andrew, assistant supervisor, in charge of track between Perryville, Md., and Back River bridge, north of Baltimore. A special "Improvement" prize of \$1,000, \$700 to the supervisor and \$300 to the assistant, for the greatest improvement made in the line and surface of a supervisor's section of track was awarded to J. E. McIntyre, supervisor, and W. W. Portser, assistant supervisor, who have charge of the track from Anderson, Pa., to east of Thompsontown. These awards were made upon the basis of frequent inspections during the past year by a special committee. appointed for the year, composed of W. G. Coughlin, engineer of maintenance of way; A. B. Clark, assistant engineer of mainte-nance of way; L. W. Allibone, superintendent Sunbury division, and J. K. Johnston, superintendent, Tyrone division.



PERSONAL MENTION

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General

CARL BUCHOLTZ, formerly division engineer of the Erie, and more recently trainmaster at Huntington, Ind., has been promoted to the position of assistant superintendent at Kent, Ohio.

H. G. SPARKS, division engineer of the Chicago & Eastern Illinois at Salem, Ill., has been appointed assistant superintendent of the Chicago division, with office at Brazil, Ind., succeeding S. S. Huffman, promoted.

L. W. BALDWIN, formerly engineer maintenance of way of the Illinois Central, and more recently general manager of the Central of Georgia, has been elected vice-president and general manager of the latter road, with headquarters at Savannah, Ga.

BENJAMIN N. HUDSON, general foreman of bridges and buildings of the Trinity & Brazos Valley, was appointed assistant superintendent, with office at Teague, Tex., effective October 1. He entered railway service with a company at Little Rock, Ark., which is now a part of the St. Louis, Iron Mountain & Southern, and for several years was employed with a bridge construction crew. About 1900 he became connected with the bridge and building department of the Texarkana & Ft. Smith, and when this company was taken over by the Kansas City Southern he held the position of general foreman of bridges and buildings. He was later appointed master carpenter of a Texas subsidiary of the Chicago, Rock Island & Pacific at Fort Worth, Tex., being appointed roadmaster of this same road in 1910 and transferred to Amarillo, Tex. In 1911 he went to the Trinity & Brazos Valley as general foreman of bridges and buildings.

ARTHUR B. CLARK, assistant engineer of maintenance of way of the Pennsylvania Railroad, in charge of roadway and track at Philadelphia, Pa., has been appointed superintendent of the Renovo division, with headquarters at Renova, Pa., succeeding J. M. James, deceased. Mr. Clark was born on October 1, 1867, at Green Village, Pa., and was educated at Mercersburg College, and in 1891 graduated from Lafayette College with the degree of C. E. He commenced work on the Pennsylvania Railroad in 1889 and advanced through the maintenance department. He was made assistant engineer of the Middle and Western divisions of the Philadelphia & Erie, on December 15, 1905, and was subsequently transferred in the same capacity to the West Jersey & Seashore, and later to the Maryland division of the Philadelphia, Baltimore & Washington. In January, 1910, he was appointed principal assistant engineer of the same road, with office at Wilmington, Del., and in June, 1913. he became assistant engineer of maintenance of way of the Pennsylvania Railroad, in charge of roadway and track, which position he held at the time of his recent appointment mentioned above.

ENGINEERING

A. W. WHITE, office engineer of the Chicago & Eastern Illinois, at Chicago, Ill., has been appointed division engineer with office at Salem, Ill., succeeding H. G. Sparks, promoted, as noted elsewhere.

WILLIAM A. DUFF, engineer of bridges on the Canadian Government Railways at Moncton, N. B., has been appointed assistant chief engineer, effective October 1, 1916. He will continue to perform the duties devolving upon the engineer of bridges, but will also have charge of the Halifax Ocean Terminals, and will perform such special work as may be assigned to him by the chief engineer.

IN CONNECTION WITH THE APPOINTMENT of T. H. Niemeyer, division engineer, Pittsburgh division of the Pennsylvania Railroad, to the position of assistant engineer of maintenance of way in charge of roadway and track, the following appointments and transfers have been made, which became effective September 27, 1916: J. B. Hutchinson, Jr., division engineer of the Monongahela division, was transferred to the Pittsburgh division, with headquarters at Pittsburgh; C. E. Brinser, division engineer at Williamsport, was transferred to the Monongahela division, with headquarters at Pittsburgh; A. W. McClellan, division engineer of the Trenton division, was transferred to Williamsport, and Elmer Irving, supervisor at Lancaster, Pa., was promoted to the position of division engineer of the Trenton division.

J. S. MCBRIDE, valuation engineer of the Chicago & Eastern Illinois, has been appointed principal assistant engineer, with office at Chicago, Ill. He will still perform the duties connected with his former office as valuation engineer, this latter office having been combined with that of his present position. He was born at Louisville, Ky., where he received his early education. Later he graduated in civil engineering from the Rose Polytechnic Institute. In 1905 he entered railway service with the Chicago & Eastern Illinois as instrument man on construction and maintenance, since which time he has been continuously in the employ of this company. In 1908 he was appointed assistant engineer on the Illinois division at Salem, Ill., and in 1914 was promoted to valuation engineer at Chicago, Ill., which position he held until his recent appointment as principal assistant engineer.

ELMER IRVING, supervisor on the Pennsylvania Railroad at Lancaster, Pa., who was promoted to division engineer of the Trenton division on September 28, with headquarters at Camden,



N. J., as noted elsewhere. was born at Trenton, N. J., in April, 1878, and entered the services of the Pennsvlvania Railroad as a rodman in the office of the assistant engineer in New York in June, 1895. Later he enrolled in Cooper Institute and graduated from that institution in 1900. Īn April, 1902, he was advanced to the position of transitman under the principal assistant engineer at Altoona, Pa. On January 1, 1903, he was promoted to the grade of assistant supervisor, with headquarters at Haddonfield, N. J. He was transferred to New Florence, Pa., in 1904 and to Osceola Mills in 1905. On December 1, 1908, he

ELMER IRVING.

was promoted to the position of supervisor, with headquarters at Earnest, Pa., being transferred to Lancaster, Pa., in 1912, where he was located at the time of his recent appointment.

J. D. ELDER has been appointed division engineer of the Western division of the Michigan Central, with headquarters at Niles, Mich., succeeding C. C. Hill, transferred to the valuation department. John Evans, division engineer of the Detroit division, has been appointed division engineer of the Detroit Terminal and Toledo division, with headquarters at Detroit, and E. C. Wurzer has been appointed division engineer of the Detroit division, with headquarters at Detroit. These two latter changes follow the division of the Detroit divisions.

EDWARD C. WURZER, whose appointment as division engineer of the Michigan Central at Detroit is announced elsewhere in these columns, was born in April, 1880, at Detroit, Mich. After obtaining a preliminary education in his native city he entered the University of Notre Dame, leaving in 1903 to accept employment with the Michigan Central as rodman. He has been continuously in the service of this company since that time, being promoted to transit man in 1904 and to assistant engineer in the division engineer's office at Detroit, Mich., in 1906. In 1907 he was transferred to the bridge department as a draftsman and in 1909 he was promoted to bridge inspector. From June, 1912, to July, 1914, he was assistant engineer on construction on the connecting railroad and hump yard then being built at Detroit, Mich. From July 15, 1914, to September 1. 1914, he was acting division engineer, with office at Jackson, Mich., and from September 1, 1914, to October 1, 1916, he was assistant field engineer in the valuation department. His appointment as di-



vision engineer of the Detroit division became effective on October 1, 1916.

H. E. STEVENS, engineer of bridges on the Northern Pacific, with office in St. Paul, Minn., has been appointed chief engineer, succeeding W. L. Darling, resigned. Mr. Stevens was born March 8, 1874, at Bluehill, Maine. After attending the common and high schools

of his native community, he

entered the University of Maine, from which he

graduated in 1897, after

completing the engineering

course. Immediately upon

leaving the university he

took up his engineering practice. About three years

later he became associated

with Ralph Modjeski of

Chicago, Ill., with whom he

remained up until the early

part of 1904. In May of this year he entered the

services of the Northern Pa-

cific, being assigned to the

three years he was engaged

in bridge construction along

For

bridge department.



H. E. STEVENS.

various parts of the system, and in 1907 he was appointed engineer of bridges, which position he was holding at the time his present appointment became effective, October 1, 1916. He will have his headquarters at St. Paul, Minn.

W. L. DARLING, chief engineer of the Northern Pacific, with office at St. Paul, Minn., whose resignation has just been accepted, was born March 26, 1856. at Oxford, Mass., where he received

his early education. His technical education was obtained at Worcester Polytechnic Institute, and, upon graduating, he entered the engineering department of the Northern Pacific. From June, 1879, to August, 1883, he was resident engineer and later locating engineer on that road. From August, 1883, to February, 1884, he was resident engineer on the St. Paul & Northern Pacific, and from April to July, 1884, he was locating engineer on the Chicago, Burlington & Quincy, going to the Florida Railway in December, 1884, as locating engineer. In August, 1885, he was appointed engineer in charge of terminals on the Chicago, Burlington &



W. L. DARLING.

Northern, which position he held until May, 1887, and from May to December of this same year he was chief engineer of the Duluth. Watertown & Pacific, From December, 1887, to January, 1889, he was assistant engineer of the St. Paul, Minneapolis & Manitoba, and from January, 1889, to March, 1891, he was assistant engineer on the Northern Pacific, being promoted to principal assistant engineer, a position he held until July, 1898, when he was appointed assistant chief engineer. He became chief engineer in 1901, but resigned in August, 1902, to become chief engineer of the Chicago, Rock Island & Pacific, with office at Chicago, Ill., a position he held until October, 1905, when he was appointed chief engineer of the Pacific Railway, with office at Seattle, Wash. He resigned in January, 1906, to become chief engineer of the Northern Pacific. During the years 1906 to 1909, inclusive, he was, in addition to his duties as chief engineer of this latter road, also consulting engineer in active charge of construction of the Spokane, Portland & Seattle. In May of this present year he sent in

his resignation, to take effect October 1, 1916. He retires to engage in private engineering practice.

CARL H. NIEMEYER, division engineer of the Pittsburgh division of the Pennsylvania Railroad, was appointed assistant engineer maintenance of way in charge of track work on September 28, succeeding A. B.



C. H. NIEMEYER.

April 1, 1894, being transfered later to St. Marys, Lewistown and Harrisburg. On January 1, 1900, he was promoted to supervisor of the Trenton cutoff of the Philadelphia division, serving in the same capacity later at Harrisburg and Pitcairn. Mr. Niemeyer was promoted to division engineer of the Sunbury division in Scptember, 1905, being transferred to the Conemaugh division in April, 1907, and to the Pittsburgh division in March, 1911, where he remained until his promotion referred to above.

JOHN D. ELDER, assistant engineer of the Michigan Central, has been appointed division engineer, with headquarters at Niles, Mich., succeeding C. C. Hill, transferred to the valuation department, effective October

He was born at Elder Ridge, Pa., in September, 1880, where he received his early education. In 1900 he entered Pennsylvania State College, completing a four years' course. In June, 1908, he took employwith the Detroit Terminal Company, ment River a subsidiary of the Michigan Central, organized for the construction of a tunnel under the Detroit river and the building of yards in connection therewith, being made an inspector on thirdrail and interlocking con-From March, struction. 1911, to March, 1913, he was connected with the engineering department of the Kansas City Terminal, and



JOHN D. ELDER.

from March, 1913, to March, 1915, he was assistant construction engineer with the Detroit River Terminal Company, working on the extension of the yards in connection with the new Michigan Central passenger station. While engaged on this undertaking he was practically in charge of the electrification and interlocking work. From March, 1915, to October, 1916, he was associated with the valuation department as assistant engineer in charge of costs.

TRACK

M. DODD has been appointed assistant roadmaster on the Bay City division of the Michigan Central, with office at Vassar, Mich. Herman Wichert has been appointed assistant roadmas-

he

Clark, promoted to the posi-

tion of superintendent of

the Renovo division. He was born in Williamsport.

Pa., in 1869, attended the

public schools of that city

and graduated from Cornell

University in 1891. After a

few months as levelman on an engineering corps, lay-

ing out logging roads in

entered the service of the

Pennsylvania Railroad as a

draftsman in the office of the division engineer of the

Eastern and Susquehanna

division of the P. & E. and

the Northern Central in

January, 1892. He was ap-

pointed assistant supervisor

at Millersburg, Pa., on

central Pennsylvania,



ter of the Detroit Terminal division, with headquarters at Detroit, Mich.

HARRY C. RUPPLE has been appointed roadmaster of the First district of the Pasco division of the Northern Pacific, with office at Pasco, Wash.

HARRY C. RUPPLE, roadmaster on the Third district of the Pasco division of the Northern Pacific, has been transferred to the First district, with headquarters at Pasco, Wash.

F. H. CARPENTER has been appointed roadmaster of the Atchison, Topeka & Santa Fe, with headquarters at Hutchinson, Kan., succeeding J. R. McGovern, who relieved V. H. Shore as roadmaster at Dodge City, Kan.

G. G. AUSTIN, formerly with the Union Pacific, has been appointed roadmaster of the Chicago Junction Railway at Chicago, Ill., succeeding Michael Murphy, granted an extended leave of absence on account of continued ill health.

JOHN BRET, extra gang foreman on the Kansas division of the Union Pacific, has been appointed roadmaster at Manhattan, Kan., in charge of track from Manhattan, Kan., to Beatrice, Neb., and from Junction City, Kan., to Belleville, succeeding J. P. Hopkins, transferred to Kansas City, Mo., with jurisdiction over the Kansas City Terminals and the line west to Topeka, in place of W. M. Kilgore, granted a leave of absence because of sickness.

J. C. POFFENBERGER, recently advanced to the position of assistant supervisor on the Pennsylvania Railroad, at Phillipsburg, N. J., was born at Harrisburg, Pa., in 1888. He graduated from the course in civil engineering at Lehigh University in 1911, and entered the services of the railway company shortly afterward as a rodman. In March, 1916, he was advanced to transitman, and in September of the same year he was promoted to assistant supervisor at Phillipsburg, N. J.

M. SLATTERV, roadmaster on the south end of the Mackinaw division of the Michigan Central at Bay City, Mich., has been transferred to the Saginaw division, with headquarters at West Bay City, succeeding Dennis C. Shea, deceased. E. Sargeant, roadmaster on the northern end of the Mackinaw division, with headquarters at Cheboygan, Mich., has been transferred to Bay City, succeeding Mr. Slattery. J. E. Crowley, assistant roadmaster at Cheboygan, has been promoted to the position of roadmaster, with headquarters at the same point. E. Gibbon, section foreman, succeeds Mr. Crowley as assistant roadmaster at Cheboygan.

J. D. ARCHIBALD, who was recently appointed supervisor on the Pennsylvania Railroad at Barnesboro, Pa., was born April 30, 1883. He graduated from the N. E. Manual Training School and entered the services of the Pennsylvania as a rodman on the New York division on October 11, 1902. On January 1, 1906, he was promoted to draftsman on the same division, a position he held for three years, when he was promoted to transitman in the office of the engineer maintenance of way. He became assistant supervisor at Baltimore in March, 1910, and was transferred to Lamokin, Pa., on June 16, 1913, where he remained until his recent advancement to the grade of supervisor.

LAWRENCE H. BELL, whose promotion to roadmaster of the Pere Marquette, with office at Saginaw, Mich., was recently announced, was born February 8, 1888, at Belmont, Ohio. After receiving a preliminary education in his home community, he took a technical course at the Ohio State University, from which he graduated in 1905. He entered railway employment in June, 1912, with the Erie as a rodman, being promoted later to transit man on construction work. He remained in the engineering department of this road until April, 1913, when he resigned to take the position as assistant engineer on the Pere Marquette. His present appointment to roadmaster became effective September 1, 1916.

F. W. L. SCHNEIDER, supervisor of the Pennsylvania Railroad at Tyrone, Pa., was transferred to the same position at Lancaster, Pa.; S. L. Church, supervisor at Dravosburg, Pa., was transferred to Tyrone; H. A. Gass, supervisor at Wilkes-Barre, was transferred to Dravosburg; F. D. Davis, supervisor at Barnesboro, Pa., was transferred to Wilkes-Barre; J. D. Archibald, assistant supervisor at Lamokin, Pa., was promoted to the position of supervisor, with headquarters at Barnesboro; R. L. Kell, assistant supervisor at Altoona, Pa., was transferred to Lamokin; H. H. Kauffman, assistant supervisor at York, Pa., was transferred to Altoona; R. P. Graham, assistant supervisor at

Freeport, Pa., was transferred to York; E. B. Gallow, assistant supervisor at Phillipsburg, N. J., was transferred to Freeport; J. G. Poffenberger, transitman in the office of engineer maintenance of way, was promoted to the position of assistant supervisor, with headquarters at Phillipsburg, N. J. These appointments were effective September 28.

BRIDGE

R. W. SMITH has been appointed general foreman of bridges and buildings of the Trinity & Brazos Valley, with headquarters at Teague, Tex., succeeding B. M. Hudson, promoted.

OBITUARY

VIRGIL GAY BOGUE, consulting civil engineer, New York, died on October 14 on a steamship on which he was returning from Mexico. He was born at Norfolk, N. Y., on July 20, 1846, and



Virgil G. Bogue.

rison to investigate methods of improving the navigation of the Columbia river and afterwards was consulting engineer for the Governor of New Zealand for three years in the selection of a route for a proposed railway across the South Island. He later served as consulting engineer of the Western Maryland. He was vice-president and chief engineer of the Western Pacific during the period of its construction, from 1905 to 1909.

DENNIS C. SHEA, roadmaster of the Saginaw division of the Michigan Central, died in Bay City, Mich., on August 24. He was born on November 14, 1855, and entered the service of the Michigan Central as a laborer in April, 1870. He was appointed section foreman at Leslie, Mich., in October, 1878, and served in this capacity at different points until June, 1892, when he was promoted to assistant roadmaster. He was again promoted to the position of roadmaster September, 1898, which position he occupied until his death. His entire service was with the Michigan Central.

TIE CUTTING.—An interesting method of producing railroad ties is now being tried by James Bradley of Evansville, Ind., who has recently received a contract to produce 150,000 ties from the Hobart-Lee Tie Company of Springfield, Mo. About 1,500 acres of land near Ozark, Mo., was purchased, and as experienced tie makers were scarce small portable gasoline saw mills have been installed at which ties are being produced at the rate of 1,500 per day.

How ONE ROAD DOES IT.—In the maintenance of way department, this plan has been adopted. Every morning when the section foreman takes out his Italians, Greeks, Austrians or other foreigners, who compose most of our section gangs, he tells them to be careful, to look out for trains and for the avoidance of all manner of injuries, such as getting their fingers pinched or dropping rails or ties on their feet. Periodically the division engineer meets the section foremen and gives them a talk on safety, especially in regard to the proper loading and unloading and handling tools, jacks, rails, ties and other materials, looking out for teams and the proper practice on their approach, and all other questions.—The Maize.

graduated from Rensselaer

Polytechnic Institute in

1868. One year after grad-

uation he went to Peru,

where he was engaged in

railway construction and operation for several years.

Returning to the United

States on the outbreak of

hostilities between Peru

and Chile, he was engaged

in the location and construction of the western

extension of the Northern

Pacific across Idaho and

vember, 1886 until 1891, he

was chief engineer of the

Union Pacific, resigning on

the latter date to engage in

consulting engineering in

New York. He was a mem-

ber of the commission ap-

pointed by President Har-

From No-

Washington.



CONSTRUCTION NEWS

THE BALTIMORE & OHIO has given a contract to J. J. Walsh & Sons, Baltimore, Md., for the construction of new freight facilities at Parkersburg, W. Va., at a cost of \$300,000.

THE CANADIAN NORTHERN is erecting a warehouse 86 ft. long, 48 ft. wide and two stories high at Edmonton, Alta., Canada. It will have concrete foundations and brick walls, and is estimated to cost \$90,000.

THE CHESAPEAKE & OHIO has let a contract to Ballard, Herring & Severs, Inc., Yancy Mills, Va., for the construction of a line from Man, W. Va., south along Guyan river. to Gilbert, 13 miles. The line has no adverse grade against loaded traffic and a 0.5 per cent grade against empty traffic. The maximum curvature is 12 deg. The construction involves about 36,000 cu. yd. of material per mile, with one-deck girder bridge.

THE CHICAGO, BURLINGTON & QUINCY plans to build two large freight terminal buildings at Chicago, Ill., to replace structure to be removed to make way for the new Union station. The freight houses will be three stories high, 65 ft. wide and 800 ft. long. The materials to be used will be brick, steel and reinforced concrete. It is expected that bids will be asked about December 1.

THE CHICAGO, WEST PULLMAN & SOUTHERN is erecting a combination engine house and machine shop at Chicago, Ill. The building will have concrete foundations and brick walls; it will be one story high, 125 ft. long and 175 ft. wide and is estimated to cost about \$40,000.

THE LOS ÅNGELES & SALT LAKE will build a new line from Pico, Cal., through Whittier, Fullerton and Anaheim to Santa Anna, a distance of about 25 miles. The contract for the grading work will soon be awarded. Four combination freight and passenger stations will be built. Both steam and gasolineelectric motive power will be used on the new line.

THE MARENGO, LAKE GENEVA & NORTHERN has awarded a contract to the Cortlandt Engineering Company, New York, to complete its line from Marengo, Wis., to Delavan.

THE MISSOURI PACIFIC will undertake a grade separation project at Omaha, Neb., involving the elimination of grade crossings at Dodge, Douglas and Farnam streets. The work will involve the construction of three concrete-covered steel viaducts to carry the streets over the tracks and will also include about 300,000 cu. yd. of embankment in the approaches. The work will be done by company forces and is estimated to cost \$200,000.

THE MITCHELL & NORTHWESTERN has been granted a permit by the railroad commission of South Dakota to build a line from Mitchell, S. D., northwest about 100 miles to Highmore.

THE NEW YORK CENTRAL has let a contract to Manion Brothers for a new freight house at Lockport, N. Y., to be located about one mile west of the existing station in that city. The new building will be 40 ft. wide and 400 ft. long, with an office building 2 stories high at the east end for a length of 60 ft. The building will be of ordinary construction with concrete foundation.

THE NORFOLK SOUTHERN has opened bids for the construction of a combined passenger and freight station at Asheboro, N. C. The structure will be 30 ft. wide and 125 ft. long, with concrete foundations, brick walls and a metal or asbestos shingle roof.

THE NORTHERN PACIFIC will call for bids about November 1 for a line between Laurel, Mont., and the Lake Basin district, a distance of about 35 miles.

THE OREGON-WASHINGTON RAILROAD & NAVIGATION COMPANY has awarded a contract to Muir & McClelland, Portland, Ore., for the construction of new additions to the Albuia shops in Portland at an estimated cost of about \$25,000.

This road has also awarded contract to Twohy Bros., Portland, Ore., for the construction of an extension 10 miles long from the mouth of Beaver Creek to the head of Carbon Creek. Camps have been erected and active work was commenced, October 1. About 125,000 cu. yd. of grading will be necessary, as well as some clearing and grubbing. A number of small bridges and culverts will e constructed. The approximate cost of this work will be close to \$200,000.

THE PENNSYLVANIA LINES WEST are rebuilding with company forces two miles of the Wellsburg & State Line Railroad, which includes some grading, new ties and 307 lin. ft. of bridge superstructure.

This road has also awarded a contract to Ferguson & Edmundson, Pittsburgh, Pa., to build part of a new 12-mile line from Chester, W. Va., along the south bank of the Ohio river east to the mouth of Raccoon creek, about three miles below Beaver, Pa.

THE PENNSYLVANIA RAILROAD will enlarge its yard at Morrisville, Pa., at a cost of about \$650,000.

THE PHILADELPHIA, BALTIMORE & WASHINGTON is constructing second track on the Delaware division, from Greenwood, Del., to Harrington, 7.44 miles; Greenwood to Bridgeville, 6.05 miles, and Seaford to Broad Creck, 3.34 miles.

THE PHILADELPHIA & READING has awarded contracts for a bridge to be built over Pennypack creek at Bryn Athyn, Pa. The J. E. Brenneman Company has the contract for the substructure, the McClintic-Marshall Company for the superstructure and the Benjamin Foster Company for the waterproofing of the bridge. The bridge is to be a two-span, single-track, through-plate girder bridge, each span being 54 ft. 3 in. clear. It is being built for the Philadelphia, Newtown & New York Railroad to replace a through wooden truss which was destroyed by fire.

THE SOUTHERN is enlarging its facilities for repairing cars at Spencer, N. C. The improvements consist of a new all-steel car shed, 109 ft. by 600 ft., with a shop 50 ft. by 100 ft., the shed being equipped with overhead cranes for handling car bodies and materials. Additional track room will also be provided.

This road has let contracts for the construction of a new concrete and steel bridge across the Catawba river, near Belmont, N. C., to take the place of the temporary structure, erected after the destruction of the old bridge by a flood in July. The contract for the steel work has been awarded to the Virginia Bridge & Iron Company, Roanoke, Va., and for the masonry and approaches to Robert Russell. The new bridge will be located about 40 ft. north of the site of the old bridge. It will be 900 ft. long and will consist of nine 100-ft. deck plate girders, supported on concrete piers.

This road has also awarded a contract to James L. Marshall, Washington, D. C., for the construction of a new office building, 120 ft. by 90 ft. in area and 9 stories high, at an estimated cost of \$400,000. The building is expected to be completed by April 1, 1917.

THE ST. LOUIS SOUTHWESTERN is building a 15-stall roundhouse at Pine Bluff, Ark., with company forces, the approximate cost of which is \$30,000.

THE WESTERN MARYLAND has given a contract to the Price Concrete Construction Company, Baltimore, Md., for the construction of an office building on Pt. Covington street, Baltimore. The building will be 40 ft. wide, 76 ft. long and 2 stories in height and will cost about \$12,500.

STRUCTURAL STEEL

THE BALTIMORE & OHIO has ordered 700 tons of bridge steel from the Fort Pitt Bridge Works, 100 tons from the Toledo-Massillon Bridge Company and 550 tons from other shops.

THE CHICAGO & NORTHWESTERN has ordered 1.076 tons of steel for ore spouts for No. 3 dock at Ashland, Wis., from the American Bridge Company.

THE GREAT NORTHERN is in the market for 3 65.000-gal. steel tanks with 30-ft. steel towers, 1 28,500-gal. steel tank with a 13-ft. steel tower and 2 10,000-gal. steel tanks.

THE MINNEAPOLIS, ST. PAUL & SAULT STE. MARIE has ordered 478 tons of steel from the American Bridge Company for use in an extension to ore docks at Superior, Wis.

THE OGDEN, LOGAN & IDAHO has ordered 146 tons of steel for pony through trusses for bridges at Ogden, Utah, from the Ogden-Salt Lake Company.

THE VANDALIA has ordered 778 tons of steel for three riveted truss spans and one plate girder span for the Indianapolis & Frankfort Railway.



SUPPLY TRADE NEWS

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STANLEY H. SMITH of the sales department of the Bethlehem Steel Company, Chicago, Ill., has been appointed sales agent of the Cleveland district, with office at Cleveland, Ohio.

G. A. WHITE, metallurgist of the American Sheet & Tin Plate Company, has been appointed to the same position with the Titanium Alloy Manufacturing Company, Niagara Falls, N. Y.

HARRY A. PIKE, secretary of the Clifton Porcelain Tile Company, Inc., Newark, N. J., has also been made assistant to the president of the Call Switch Company, Inc., New York, and the executive offices which have been located at Denver, Colo., have been transferred to the Singer building, New York.

ROBERT C. CLIFFORD, who for the past four years has been district sales manager for the United States Cast Iron Pipe & Foundry Company, in charge of its St. Louis and Kansas City offices, is now associated with the Walter A. Zelnicker Supply Company, St. Louis, in charge of its rail department.

GEORGE A. KYLE has been engaged as engineer in charge of location and construction of the railways to be built in China by the American International Corporation, New York City, and the Siems-Carey Railway and Canal Company, St. Paul, Minn. He will work with officials of the Chinese government in deciding upon the lines to be built. Mr. Kyle has worked in both hemispheres, north and south of the equator, and was associated with John Hays Hammond in the Rand in South Africa. In Alaska he built over 600 miles of line, including the line fron Seward to the Matanuska coal fields and a line to Fairbanks. Recently he has been engineer in charge of location and construction for the Northern Pacific.

HARRY W. FINNELL, general manager of the Henry Giessel Company, Chicago, has been elected vice-president in charge of sales of Templeton, Kenly & Company, Ltd., Chicago, manu-

facturers of Simplex jacks. Mr. Finnell started his business career in the rolling mills of the National Tube Company, at McKeesport, Pa., in 1889. Later he became connected with the sales department of this firm, but left the company in 1901 to become connected with the Wheeling Steel & Iron Company, rising to the position of assistant sales manager. In 1906 he entered the sales department of the Chicago Railway Equipment Company. In 1909 he was appointed assistant sales manager of the Carbon Steel Company, later being made sales manager and then assistant to the president, and at the same time president of the



HARRY W. FINNELL.

Mosher Water Tube Boiler Company. He was general manager of the Henry Giessel Company at the time of his appointment noted above.

WILLIAM F. LEAKE, secretary and treasurer of T. S. Leake & Co., general contractors, and also secretary and treasurer of the Railroad Water & Coal Handling Co., Chicago, Ill., died at his home in this city, October, of pneumonia after a brief illness. He was born in June, 1858, at Ottawa, Ill., where he received his early education. In his boyhood he took up the carpenter's trade, obtaining his first employment with the Sanders Bros. Mfg. Co. of that city. After a few years he entered the service of the Illinois Central, later being made general foreman of carpenters for the entire system. After several years with this

company he became general superintendent of George B. Swift & Co., general contractors. In 1907 he and his brother, T. S. Leake, organized the contracting firm of T. S. Leake & Co., of which he became secretary and treasurer. In 1914 he also became interested in the Railroad Water & Coal Handling Co., Chicago, Ill.

MARVIN A. NEELAND, assistant to the vice-president and chief engineer of the United States Steel Corporation, has resigned to accept the position of consulting engineer of the American International Corporation, New York. He is succeeded by John Hulst, chief engineer of the Carnegie Steel Company.

W. P. BARBA, vice-president of the Midvale Steel Company, Worth Brothers Company and the Wilmington Steel Company, has resigned and his duties will be assumed by E. E. Slick, vicepresident of the Cambria Steel Company. Mr. Barba entered the employ of the Midvale Company as a boy in 1880 and advanced through the positions of chief chemist, departmental superintendent, general manager of sales, general superintendent and general manager to that of vice-president.

GENERAL

THE H. W. JOHNS-MANVILLE COMPANY, New York, has opened a new branch office at Great Falls, Mont., in charge of J. H. Roe. This company now has 55 branch offices.

R. W. HUNT & Co., Chicago, has been awarded the contract for the inspection of all the rails and fastenings, aggregating over 400.000 tons, which have been ordered recently from the steel mills of this country by the Russian government railways.

THE CARNEGIE STEEL COMPANY and other large steel companies in the Pittsburgh district have notified their customers that steel orders from the United States government will be given precedence over other orders for steel early in 1917, providing the government needs the steel to carry out its naval program as an aid to preparedness, especially in the delivery of steel plates and shapes for new naval vessels.

According to E. J. Buffington and G. G. Thorpe, presidents, respectively, of the Illinois Steel Company and the Indiana Steel Company, five additional blast furnaces are to be erected at the Gary, Ind., plant. This will make 17 stacks in all, the largest single group in America. New construction now under way at the plant will cost between \$15,000,000 and \$20,000,000, and employment will be given to several thousand men on its completion next year. The National Tube Company plans call for four blast furnaces, several ore docks, a Bessemer mill and auxiliary facilities. Plans are also under way for the American Car & Foundry Company, both of which are to be located at Gary.

TRADE PUBLICATIONS

SIMPLEX JACKS.—Templeton, Kenly & Co., Ltd., Chicago, has issued a 32-page pamphlet illustrating and describing the various types of jacks now on the market under the above name. Maintenance men will be interested in the several designs of track jacks, bridge jacks and jacks especially designed for handling telegraph or telephone poles.

WATER TREATMENT. The Dearborn Chemical Company, Chicago, has issued a booklet, entitled "Incrustation, Corrosion, Foaming and Other Effects of Water Used in Steam Making and Methods of Prevention." After pointing out that this company does not supply a "cure-all" and that it is not a "boiler compound house," the book discusses the subjects of corrosion, foaming and other boiler troubles and then describes how this company makes analyses, works out formulae and compounds the proper remedies for individual conditions.

ASBESTOS BUILDING MATERIALS.—The H. W. Johns-Manville Company, New York, has issued two 32-page pamphlets covering transite asbestos shingles and corrugated asbestos roofing, respectively. The pamphlets are illustrated with views of buildings of all kinds in various parts of this country in which these materials have been used. Several pages are also devoted to data of size, shape, weight, etc., to facilitate estimating. The pamphlet on corrugated roofing is especially complete as to this feature and contains a number of sketches of construction details for the use of this material on steel frame shop buildings.

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WALTER S. LACHER, Associate Editor Subscription price, including the twelve regular monthly issues of the Railway Maintenance Engineer and the four daily issues of the Railway Maintenance Engineer and the four daily issues of the Railway Maintenance Engineer and the four daily issues of the Railway Maintenance Engineer and the four daily issues of the Railway Mexico, \$1.00; foreign countries (excepting daily editions), \$2.00.
WE GUARANTEE that of this issue 6,740 copies were printed; that of these 6,740 copies, 6,007 were mailed to regular paid subscribers, 93 were mailed to advertisers, exchanges and correspondents, and 550 were provided for new subscribers, copies lost in the mails and office use. The Railway Maintenance Engineer has applied for membership in the Audit Bureau of Circulations.

For the second time within less than a year, the price of steel rails has been advanced \$5 per ton, so that they are

The Railroads and Rail Manufacture advanced \$5 per ton, so that they are now quoted at \$38 and \$40 per ton for Bessemer and open hearth steels, respectively. To make matters worse, it is impossible to secure rails, even at these prices, for delivery hs. Thus at one stroke the railways

within 6 or 8 months. Thus at one stroke the railways have received an added burden of \$15,000,000 in operating expenses the second time within one year and must also take their turn in line, regardless of their needs. The position of the steel manufacturers bears a sharp contrast to that of the railways, who, confronted with a similar influx of business and subjected to a greatly increased cost of operation, not only cannot raise the price for which their product is sold, but are loudly criticized when they are unable to furnish cars for a few days or weeks at the most.

With the serious shortage of labor during the past season, much track work has necessarily remained undone.

Cold Weather and Broken Rails The high prices and delayed deliveries of rails have also resulted in a considerable amount of old rails being carried over in track until next year. As the past few years have

been characterized by a large number of rail failures under even more favorable conditions, increased trouble from rail breakage may be expected this winter. It will require special vigilance on the part of all maintenance of way employees to insure that all such rails are detected and removed before they cause accidents. Supervisors can, therefore, well afford to discuss this matter

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fully with each of their foremen to impress the importance of attention to this work upon them and to instruct them regarding means of identifying dangerous rails. The foremen in turn should not only give this subject special attention themselves, but it is necessary that they in turn see that their track walkers and the men in their gangs co-operate in this work in order that traffic may be carried safely through the winter.

We have devoted a considerable amount of space in preceding issues to discussions of the reclamation of

Reclaiming Bridge Materials track materials. The reclamation of bridge and building materials is also of much importance, although the railways have been slow to realize the opportunities to effect savings here.

The possibilities for the resawing of timber released from one use for further service in another place are surprisingly large if the subject is considered carefully. One road which sends all timber released to central points for reclamation finds that it can fill many of its requisitions from the material secured in this way, practically all of which would otherwise be burned or left on the ground. Likewise there is an opportunity frequently to use old steel bridge spans too light for use under present day trains, for highway spans or in building construction. One road recently built the supports for the runway for an overhead crane in a car shop from old bridge posts. Another used bridge trusses to support the roof of a large shop building. To develop the experiences of those who have reclaimed timber or steel bridge and building materials, we announce a contest on The Reclamation of Bridge and Building Materials. As far as possible con-



tributions should describe practices which have been developed and proposed modifications for other improvements. They should include as much detailed information regarding the methods followed, the amount and character of the material reclaimed and the savings effected as possible. If photographs are available they will also be of value. Prizes of \$25 and \$15 will be paid for the two best papers presented, based upon the practicability of their methods and their general application. Other papers accepted and published will be paid for at our regular space rates. All contributions should be sent to the editor of the *Railway Maintenance Engineer*, Transportation Building, Chicago, and must be received not later than January 10, 1917.

CONVENTION ENTERTAINMENT

"HE problem regarding the proper amount and character of entertainment to provide at a convention and the relations which the supply associations should bear to the entertainment of the railway men have always been difficult to solve satisfactorily and permanently. While not so aggravated in the maintenance of way associations as in those in some other branches of railway service, these questions have nevertheless required attention from time to time. The impression prevails in some quarters that the primary purpose of a convention is to afford an opportunity for the members to relax and to enjoy the hospitality of the supply men and that the technical work of the association is made secondary. Largely for this reason some roads discourage attendance at conventions on the part of their employees. While this impression is by no means general, attention may well be called at this time to the marked improvement in the character of the entertainment provided at the maintenance of way conventions in recent years and to the relations existing between this and the more serious work of the associations.

From its organization the American Railway Engineering Association has always discouraged all forms of entertainment by supply men and the only relaxation from serious work during the three days' session is the banquet on Wednesday evening given by the association itself. While the National Railway Appliances Association presents its exhibit simultaneously with the convention, this is a thorough businesslike display of materials presented for demonstration solely on their merits and without any attempt at organized or unorganized entertainment or interference with the work of the engineering association.

The Roadmasters' Association has had the most serious problem to contend with. Previous to the organization of the Track Supply Association a few years ago entertainment was entirely unorganized with the abuses that such conditions always lead to. The Track Supply Association has taken this matter in hand and has worked closely in co-operation with the officers of the Roadmasters' Association until the convention is now on as high a plane as that of any other railway association. At the recent convention in New York the entertainment by the Supply Association was confined to the banquet on Thursday evening. On the two preceding evenings the convention held long night sessions for the discussion of committee reports in order to enable the members to make inspection trips over the terminals and tracks of roads in the vicinity of New York on two afternoons, which trips were provided by the railways and were a source of much instruction to the members of the association, many of whom had not previously had an opportunity to study track maintenance under such intensive traffic conditions.

The conventions of the Bridge and Building Associa-

tion are conducted upon an equally high plane. At the New Orleans convention all of the entertainment, except a banquet, was provided by the members themselves or by the railways and consisted largely of visits to points of technical interest and instruction to the members.

With the conduct of these meetings upon as high a plane as now exists these associations deserve the hearty support of the railways, particularly in encouraging their men to affiliate with the respective associations, to attend the conventions and to participate in the collection and dissemination of information of value to the railways in promoting efficient maintenance of way practices. The frequent interchange of ideas on problems of general interest on the floor of a convention cannot help but broaden the viewpoint of those in attendance and serve to extend improved methods beyond the limits of the roads on which they originate.

A PLEA FOR STANDARDIZATION

N contrasting American and German industrial methods, Dr. Chas. P. Steinmetz recently characterized the tendencies of this country as strongly individualistic, with each one preparing standards to suit his own peculiar conditions and fancies, while the Germans follow more general standards which, while not, perhaps, so well adapted to each individual installation, tend towards greatly decreased costs of production and resultant economy and promote industrial efficiency. While the railways are not worse offenders than other American industries, it must be admitted that there is much merit in this criticism as applied to them. In spite of the fact that the American Railway Engineering Association and other organizations have done excellent work in preparing standards for various materials, designed to harmonize different views and practices, these standards have not been generally adopted, the diversity continues to exist and in some ways it has shown a tendency toward greater extension. No one standard of rail section, for instance, is applicable to all conditions and a certain limited variety of standards is therefore advisable, or at least not seriously objectionable. No one will maintain, however, that the 12 or 15 different sections of 100-lb. rail in use to-day are necessary or advisable. When it is realized that this lack of uniformity extends through the joints. tie plates and almost all other details of construction, it is evident that the result is tremendously expensive in the aggregate.

A multiplicity of standards is objectionable for a number of reasons. In the first place, it increases the cost of production, for which the consumer must pay, through the necessity of making and keeping different rolls, patterns, etc. One manufacturer of special track work has over \$100,000 tied up in a stock of different sections of rails alone. Not only must he carry the interest on this investment, but as a certain amount of the material becomes obsolete from time to time it must be sold at little better than scrap prices. Likewise this duplication of standards reduces the quantity of the output, again increasing the unit cost and at the same time delaying delivery. It is also not practicable for a shop to proceed with the manufacture of this class of materials during dull times in advance of orders because of this same condition. Another serious objection to a variety of standards is the increased amount of stock which each road must keep on hand to meet its requirements. When all of these losses are combined, the aggregate is enormous and the railways pay for all of it.

The principal reason for this condition is the unwillingness of the individual to subordinate his opinion to



TO THE EDITOR:

that of the majority and to co-operate in the preparation of a common standard which will best serve the needs of all. Frequently the deviation is only in details which are of minor consequence, but they defeat the advantage of the standard, and it has not been uncommon for these departures to be actual detriments to the design as a whole. This is in decided contrast with the policy of one small railroad of adhering to the standards of the larger systems rather than to add to the already complicated maze of standards.

There never was a more propitious time than now to consider seriously the folly of our present lack of standardization, for not only is the necessity for economy in the purchase of materials great at the present high prices, but anything which will promote increased output and hasten deliveries is greatly to be desired. It is to be hoped that the present waste because of this condition can be eliminated. This can be done at once and will be done whenever those charged with the preparation of standards grasp the broader view of the problem and cooperate for the common good.

THE EFFECT OF HIGH PRICES

THE current high prices of labor and material and the shortage of both have brought about a more or less general policy of deferring the renewal or reconstruction of railway bridges and other structures in all cases where this can be done without encroaching on the limits of safety. This policy has resulted in many cases in placing an increased burden on the bridge maintenance forces who are compelled to exercise increased vigilance and ingenuity in making possible the continued use of structures which would have been replaced under normal conditions.

The influence of the present state of the labor and material market, particularly the latter, has also been noted in the occasional deviation from the usual types of construction. For example, concrete and timber structures are being built where steel would ordinarily have been used. Second-hand steel rails have been used as reinforcement in concrete arches when, under normal price conditions, it would have been more economical to use reinforcing bars which could then be secured within a reasonable time of delivery. For the same reason mass concrete structures have been used when conditions at normal times would point to the economy of reinforced concrete. Because of this, it is entirely possible that structures built or repaired at this time will be subject to adverse criticism at some time in the future when the conditions which led to the use of extraordinary designs or materials will be overlooked or forgotten. It is also more than likely that in the absence of records the cost of structures now being built will then be greatly underestimated.

A consideration of these facts points to the great opportunity for underestimates in the Federal valuation now in progress, in the absence of the direct testimony of those personally engaged in a given project or of records much more complete than those kept in the past, the unusual conditions or unforeseen contingencies are readily overlooked and the cost of the work as estimated will be based on average or normal conditions rather than those actually obtaining.

VESSELS BUILDING.—Builders' returns to the bureau of navigation, department of commerce, show that steel merchant vessels building or under contract to be built in private American ship yards on November 1 numbered 417, of 1,479,946 gross tons, an increase of 25,676 tons over the returns from October 1. LETTERS TO THE EDITOR

TIE PLUGS

CONCORAN, CAL.

In the early days of track maintenance tie plugs were rarely used except occasionally around frogs and switches as it was considered that they were hardly worth the trouble and time required to make them by hand. As new tie material has become scarcer and more expensive and treated ties have been more generally used, the use of the plugs has grown in favor, and machines have been invented to turn them out by the thousands.

Before the use of tie plates became general the plugs in their present form answered very well, and when applied, one blow of the sledge would drive them flush with the top of the tie, but with the introduction and general use of heavy shoulder tie plates the plug, in its present shape, has proved to be unsatisfactory. The shoulder, or head, left on the plug by the machine causes it to jam in the hole of the tie plate and it often requires the use of a track punch to properly seat the plug. The punch also frequently jams during the operation, causing more delay.

My idea of a tie plug for use under present conditions is one that will fit easily in the hole, can be placed by hand and will seat itself with the first tap of the maul on the spike that follows the plug. Also why should not a soft wood plug be used in a soft wood tie. I have seen old soft wood ties that, when released, had as many as six hardwood plugs strung in a line, where if soft wood plugs had been used they would have flattened from the pressure of the spike and would have held the spike more firmly.

> G. REILLY, Atchison, Topeka & Santa Fe.

> > TAMAQUA, PA.

THE COST OF WATER

To the Editor:

P. M. LaBach, in the September issue, page 278, demonstrates that it is impracticable to arrive at any true comparison of the efficiency of the water service department on the various railroads. Conceding this and recognizing the wide range of conditions it is difficult to see what benefit can be secured by attempting to establish unit costs for water service. Improved practices and proper supervision may be conducive to efficiency, but the present tendency is towards greater expenditures for water in order to supply a better quality of boiler water, to ensure an ample supply for all requirements and to deliver the water at such locations as will contribute to efficiency of operation as a whole. Any attempt to make a feature of the unit cost of such relatively insignificant items as water and oil may draw attention from such larger items as fuel, train crews, engine repairs, etc.

The writer recalls a recent instance where a desire to reduce the cost of water led to the abandonment of water treatment where the scale-forming material was close to the low limits recommended for treatment. A few months' trial showed a material increase in scale and a test of fuel conducted by the officer recommending the abandonment, showed such results as to bring urgent action for a return to treatment.

It may also be noted that the great supply of the Pennsylvania Railroad in the Pitsburgh district was not



installed to reduce the unit cost of water, but to facilitate the handling of freight, and there is no question that the benefits secured by this supply so greatly improved operating conditions along the old line that little has since been heard of the development of a new freight line north of Pittsburgh. An ample supply of water for railroads and manufacturers at Syracuse and Rochester, N. Y., are examples of increased efficiency secured by increasing the unit cost of water.

Let us give proper consideration to the smaller items of operating cost, but not at the expense of such major items as fuel consumption, train speed, tonnage or engine maintenance. E. T. REISLER.

HOW SOME FOREMEN STUDY THEIR SECTIONS

TO THE EDITOR:

St. Johns, Kan.

The most important detail in the maintenance of surface on rock-ballasted track is the preparation of the The uniformity of sub-grade to receive the ballast. width of fills is one of the most important considerations in the preparation of the roadbed, a minimum width of 20 ft. being advisable where from 8 to 12 in. of ballast is placed under the track. If a fill is irregular in width the track will be hard to maintain as it will settle more where the bank is narrow and if one side is wider than the other for any considerable distance it will be difficult to maintain the track to cross level. After one side becomes low the track will also go out of line from the increased thrust of the traffic on the low rail. Where curves are located on fills these same conditions will retard the maintenance of the proper uniform superelevation and line.

Where track regularly becomes low at certain times I have always made it a practice to investigate those places, endeavor to ascertain the cause and apply the remedy after bringing the track back to proper surface and line. On fills I have found that many of these low places result from a weak or narrow shoulder and I have been able to overcome this difficulty by strengthening the shoulder to the uniform width.

However, all rough track on fills is not attributable to the lack of uniform width, for a considerable percentage results from the character of the material composing the embankment. This can only be remedied by construction forces and after an embankment is built the only relief is to adopt measures to overcome the difficulty as far as possible. A roadbed is often seriously disturbed by small burrowing animals, particularly in sandy soil. They can be eliminated by the use of poison. Some fills contain water pockets which can be drained by driving a small pipe into the side of the embankment with the outer end low enough to drain the water out. If the pipe is plugged at the inner end when being driven into the bank and the plug is then forced out the water will escape readily.

Another cause of the settlement of banks is the presence of water along the side of a fill for considerable intervals. In most instances this can be removed by the installation of culverts, drainage pipes or ditches. While it takes some time for standing water to affect the surface of the track it usually leaks into the bottom of the embankment and gives trouble sooner or later.

As it is impossible to maintain good surface and line with loose bolts all the bolts should be kept tightened. In general they should be tested and tightened twice each year while the track forces should also tighten any found loose when working over the section during the season. When spotting up and lining track all bad ties should

also be changed out as new ties can be inserted at much less cost at this time and they will aid materially in keeping the track in good surface and line.

V. H. SHORE, Section Foreman, A. T. & S. F.

NEW BOOKS

The Preservation of Structural Timber (Second Edition). By Howard F. Weiss, Director United States Forest Products Laboratory, Maison, Wis, 352 pages, 90 illustrations, 6 in. by 9 in. Bound in cloth. Published by the McGraw-Hill Book Co., New York. Price \$3.

From his position in charge of the Forest Products Laboratory at Madison, Wis., the author has an unequaled opportunity to accumulate accurate information regarding the latest developments in the field of timber and of its uses. The first edition of this book, which appeared two years ago, was received as a distinct edition to engineering literature, treating of a subject of which there was little authentic information in book form at that time. In this second edition the author has added a considerable amount of new data, particularly with reference to the durability of treated and untreated timber and has amplified that section relating to the art of rendering wood fire resistant. With the increased attention given to timber and its uses during the last two or three years this book should be of value to engineers interested in this form of construction.

Handbook of Rock Excavation. By Halbert P. Gillette. 809 pages, 200 illustrations, 4¼ in. by 7 in. Bound in leather. Published by the Clark Book Co., New York. Price \$5.00.

During recent years when the importance of the cost of handling work has been emphasized more than previously there has been an increased demand for cost data compiled under various conditions. Recognizing the value of such information the author of this book has performed a distinct service to engineers through his books and other writings on the cost of handling work. This handbook on Rock Excavation is a companion book to a similar volume on Earth Excavation which will be published soon and to a third book on Tunnels and Shafts, which is now in course of preparation. In the book on Rock Excavation the author gives a large amount of information concerning the tools and other equipment required for this class of work and the conditions under which they are of greatest advantage. Accompanying voluminous data on the cost of handling work are descriptions of different methods followed and the equipment used, enabling a student to analyze the figures and apply them to his local conditions. In some instances certain essential details are lacking, but the author stated that he thought it best not to exclude reliable records of actual cost merely because certain items were lacking, especially if those items could be supplied through the natural deduction of the experienced and competent reader.

Among the more important chapters in the book are those on Methods and Cost of Hand Drilling; Machine Drills and Their Use; the Cost of Machine Drilling; Cable Drills, Well Drills, Augers and Cost Data; Core Drills; Loading and Transporting Rock; Railroad Rock Excavation and Boulder Blasting; and Subaqueous Rock Excavation.

The book is prepared in the form of a handbook rather than a textbook with the expectation that it will find its greatest use by engineers and contractors in the field, although it will also be found useful as a text because of the valuable information which it contains.

IT PAYS.—One never can tell when a courtesy or a kindness will result in good both to the employee and to the road.—Santa Fe Magazine.



C TEAM railroads are recognizing more and more the importance of a good grade of special track work, including under this term switches, frogs, guard rails, crossings (either rigid or with movable points), single and double slips, crossovers, turn-outs, curves and complex layouts and their parts. New installations and renewals of special work represent an expenditure for material alone, without the labor cost of installation, of from \$12,000,000 to \$15,-000,000 annually. The subject therefore would appear to be an important one. The maintenance of special track work is also necessarily expensive, and the condition of these parts of the track structure largely affects the smooth riding of the trains and the life of the rolling stock. The railroads and the

The railroads and the manufacturers are continually bringing out new designs with the object of reducing the cost of maintenance and insuring a good track for the running of trains. Individual designers try to attain the object in different ways, the

THIS IS THE FIRST OF A SERIES OF ARTICLES ON THE DESIGN OF SPECIAL TRACK WORK. THESE ARTICLES WILL DISCUSS THE ESSENTIAL ELEMENTS IN THE DESIGN OF THESE COMPLICATED BUT NEC-ESSARY DETAILS OF TRACK CONSTRUCTION. THEY WILL POINT OUT THE EXTENT AND CHARACTER OF THE INFORMATION WHICH A MANUFACTURER MUST RECEIVE FROM A RAILROAD BEFORE IT CAN UNDERTAKE CONSTRUCTION. THEY WILL ALSO COMPARE THE GOOD AND THE BAD FEATURES OF DIFFERENT DESIGNS AND POINT OUT THE RELATIVE POINTS OF MERIT AND THE DISADVANTAGES. SPE-CIAL EMPHASIS WILL BE LAID UPON THE PRESENT UNNECESSARY AND HIGHLY EXPENSIVE DUPLICA-TION OF STANDARDS, PARTICULARLY IN POINTS OF MINOR IMPORTANCE WHICH ADD TO THE COST OF PRODUCTION BY THE MANUFACTURER, AND FOR Тне WHICH THE ROADS MUST AND DO PAY. MAGNITUDE OF THE AMOUNTS EXPENDED BECAUSE OF THESE VARIATIONS IN STANDARDS IS NOT GEN-ERALLY REALIZED.

The author of these articles has been directly engaged in the design and manufacture of special track work for the past 10 years, first as a draftsman in a designing office, then as an engineer in the shops and in the field, and more recently as chief estimator with one of the large manufacturers of this class of materials. In his present position he not only sees all new designs of this manufacturer, but all plans submitted to this company by the railroads pass through his hands, giving him an unusual opportunity to study a wide variety of standards at first hand and to observe their points of merit and their disadvantages. work and the larger special track work manufacturers have also spent considerable time, labor and money in standardizing manganese track work, their findings having been endorsed by the American Railway Engineering Association. Yet relatively few roads have adopted these recommendations.

It seems that every time a railway issues a new set of standard plans new details appear which cause extra expense. It often happens that designs requiring special patterns, special forgings or different methods of planing are incorporated on drawings, and the question naturally arises as to the advisability of the various associations and committees making special studies of these problems whem the railroads are not recognizing their value and the advantages to be gained from their use.

Taking steel sockets as an example, special track work manufacturers have dies for certain sockets. A railroad prepares its own detailed drawings on which all dimensions are given. If any one of the dimen-

differences often being, however, in particulars relatively unimportant. The various and differing designs are multiplying so rapidly that there has been a growing necessity for the standardization of steam railroad work in such a way that the roads will adopt for their own the various standards recommended by different railway associations and by reputable special track work manufacturers.

THE VARIETY OF STANDARDS

A committee of the American Railway Engineering Association has been working for years to standardize track

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sions differs from the manufacturers' standards, the existing dies for forging the sockets cannot be used, with the resultant increase in the cost of manufacture of the socket. Special sizes of materials, as, for example, special bolts, bolt heads or nuts, special threads or any other unusual requirements as to sizes are the cause of much trouble and expense. This is especially true at the present time when materials are difficult to get under any circumstances, and it is almost impossible to secure materials of special sizes.

The subject of rail sections has been an absorbing one for the engineer, the rail mills and special track work



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manufacturers ever since the tee rail came into general Here again various associations, including the use. American Society of Civil Engineers and the American Railway Association, have been at work designing sections from which it would seem that a section suitable for any special conditions could be selected. Nevertheless, there are now in active use nearly a dozen different sections of 100-lb. rail (Fig. 1) and to these should be added several more sections weighing practically 100 lb. per yd., in which a little metal has been added to the head or to the base of the regular 100-lb. rail section. Figure 2 shows three popular sections in which the exceedingly small differences are apparent and yet one section cannot be substituted for the other in the manufacture of frogs and switches.

In the manufacture of special track work this great variety of rail sections creates the constant necessity of keeping on hand a stock of all these different rails amounting to many tons and involving a large investment, with the added danger of some of this stock becoming be kept as nearly alike as possible, and should preferably follow the existing best practices.

In manganese steel work the Manganese Track Society has embodied in its standards for frogs the experience of years in the manufacture of these materials and of the manganese steel castings themselves to get the best results. The railroads can do no better than to profit by this experience, and the adoption of these standards will in hardly any case interfere with existing general standards, such as the length of the frogs. Detailed plans for such frogs, gotten out by some railroads often differ only in minor details, the dimensions frequently only differ by a few inches, but they necessitate new sets of patterns. Engineers not entirely familiar with the foundry practice necessary in the making and treating of manganese steel castings are further apt to proportion the castings called for by the design in such a way that the best results both as to service and safety cannot be obtained.

The same principles apply to manganese steel cross-



obsolete or otherwise unfit for use before it is worked up and so reducing its value to scrap. It further means, also, almost countless different patterns and different fittings of all kinds to suit each rail section and design for frogs, switches and crossings, which must be kept on hand or be specially manufactured. This means expense that somebody has to pay for and often means delay in turning out the special track work needed by the railroads.

IMPORTANCE OF UNIFORM STANDARDS

Any railroad should follow some standard. The switches or frogs which it uses should be alike and interchangeable as far as possible. The road should know when it sends out inquiries on certain material, exactly what it desires the special track work manufacturer to figure on and not leave the designs to him, for it frequently happens that a manufacturer may make a price on a considerably less substantial switch than was intended. Again a railroad may order from one special track work manufacturer at one time, and from another at another time, and unless the company follows a certain standard, it may get entirely different articles. For instance, one company may furnish 5-in. slide plates and another 6-in. slide plates, one pressed steel braces and another malleable iron braces, etc. The material should

ings. The Manganese Track Society has gone into the details of various styles of crossings thoroughly, and it has recommended certain types for certain angle limits. It is a simple matter for a railroad when ordering crossings to give the angle of the crossing and the degree of curve, and to specify "to be according to Manganese Track Society Standards." The company will then know exactly what it can expect, and the manufacturer will know exactly what the railroad company wants.

The determination as to when to use manganese steel is largely a matter of opinion, and depends a great deal on conditions. On track where there is severe traffic it is unquestionably the cheapest construction in the long run and quite a few of the larger roads use manganese steel frogs on main line traffic altogether. From the point of view of a trackman it is much the best construction, both in regard to ultimate service and economy in maintenance.

Perhaps the greatest number of delays in filling orders for special track work is caused by unnecessary correspondence, owing to the fact that the manufacturer is not given enough information when the order is first received to enable him to proceed with the construction. It happens all too frequently that the order does not state the rail section, the rail drilling or even the style of construction for the work required. In subse-



quent articles the information required by a special track work manufacturer to build a switch, a frog, or a crossing will be given. Curves in special pieces should be eliminated as far as possible. First of all, the pieces having curves are not interchangeable with standard pieces, and secondly, they cost considerably more than straight pieces.

INSPECTION

All of the large special track work manufacturers have their own corps of inspectors who inspect every piece before it leaves the shop. Every slip switch is set up in order to check the dimensions and the fit of the various parts. All rigid, movable, single and double slip crossings are similarly assembled complete before shipment. In addition to this, many roads send their own inspectors to see that the work is strictly in accordance with the designs of the railroad, and that the material is up to specification. There are differences of opinion among railroad inspectors as to the deviations allowable from drawings and specifications in given dimensions, accuracy of workmanship, etc. The character, class and nature of the pieces also have a bearing upon the degree of accuracy to be expected or the variations allowable, and it would be difficult to set fixed rules to cover all The matter must be left largely to the judgment cases. of the inspector.

The question of gage is a very important one, and almost every engineer has his own views in regard to it. The American Railway Engineering Association has recommended that 8 deg. curves and under should be maintained to standard gage, and that the gage should be widened $\frac{1}{8}$ in. for each 2 deg. or fraction thereof over 8 deg. to a maximum of 4 ft. 9¹/₄ in. Where frogs occur on the inside of curves the gage at the frog should be standard or the flangeway should be widened to compensate for the increased gage. The clear width of standard flangeway for all frogs, and between main rails and guard rails, should be $1\frac{3}{4}$ in. measured at the gage line, for all tracks of 4 ft. $8\frac{1}{2}$ in. gage.

There are many appliances for the maintaining of gage. Their use depends entirely on conditions. Within proper limits a slight variation from standard gage is not seriously objectionable, provided the variation is uniform and constant over long distances. Wide gage due to worn rail need not be corrected until the excess over the proper gage is equal



special track work manufacturer from whom they order. A good foundation is one of the most important items in connection with good track work, for the best track construction will not give good

results on a poor

to $\frac{1}{2}$ in. Railroads which follow a dif-

ferent practice from

the above as to gage

of their work should

have a clear under-

standing with the

ould be widened to compensate for frequently requires the premature renewal of the struc-The clear width of standard flange- ture.

The Improvement of an Old Line

BY B. B. SHAW,

Division Engineer, Chicago, Rock Island & Pacific, Little Rock, Ark.

THE Choctaw, Oklahoma & Gulf was built across western Arkansas and eastern Oklahoma in 1899, and was acquired by the Rock Island in 1903. Previous to 13 years ago that portion of the country through which the line passes was practically undeveloped, but following the opening of the Indian lands in Oklahoma in 1903, the settlement of this country has proceeded rapidly. As a result, in 1914, an average of four passenger and 10.3 freight trains passed over the section of track under consideration daily and the freight traffic density for this year was 3,211,951 gross tons per mile of line.

Until recently consolidation locomotives were employed in freight service with a total weight of 161,870 lb. This type of engine has recently been replaced by one weighing 206,000 lb., and when the work of strengthening the bridges for Cooper's E-55 loading is completed, Mikado locomotives with a total weight of 320,000 lb. will be used. The largest freight equipment now employed consists of 50-ton cars weighing with overload a total of 77 tons. The operation of this equipment has made necessary the replacement of the old 65-lb. rails with new 90lb. rails. For the adequate protection of the heavier rail, additional ballast was required, which in turn made necessary the widening of the existing embankments.

The roadbed was built originally with a 16-ft. crown

on embankments with $1\frac{1}{2}$ to 1 side slopes, and a 12-ft. crown in cuts with 1 to 1 side slopes, and a 4-ft. ditch on each side. Owing to weathering, the embankments have sloughed off to a width of approximately 14 ft. In improving the line the standard roadway section was increased to 20 ft. with $1\frac{1}{2}$ to 1 slopes on embankments and 5-ft. ditches on each side in cuts, and 8 in. of ballast was placed under the ties.

foundation. A good foundation eliminates many items of

maintenance. This is especially true of crossings. A roadbed which, for instance, is not properly drained, gradu-

ally allows the crossings to sag and creep badly. The re-

sult is that the bolts become loose and some part breaks. This not only causes unnecessary maintenance cost, but

The contract for bank widening was let to one contractor, who in turn sublet the work to ten sub-contractors. Owing to the small yardage, ten-team outfits secured the best results. To create a spirit of competition such an outfit was placed on each mile, with the stronger and weaker outfits alternating. All work was completed out of face. The soil handled was classified as 81.04 per cent earth, 10.97 per cent loose rock and 7.99 per cent solid rock. The loose and solid rock consisted of bituminous shale, argillaceous sandstone and limestone. While it was necessary to blast the shale and sandstone, they disintegrated on exposure to the elements. The limestone was also blasted, but care was taken not to shatter it, and it was piled for convenient loading for use later as riprap.

The following table shows the average cost per mile of bank widening:

Earth, 2,134 cu. yd., at \$0.23\$	502.32
Loose rock, 296 cu. yd., at \$0.40	118.40
Solid rock, 215 cu. yd., at \$0.80	172.00



^{*}Abstracted from a thesis presented at the University of Illinois, June, 1916.

4.80

Clearing, 0.4 miles, at \$12.00 Force account, actual cost plus 10 per cent, cleaning

\$1.009.35

(The average cost of all material moved was 29.4 cents per cu. yd., and the cost of engineering 3.62 per cent of the labor charges.)

The first item of force account was for cleaning out pockets of gumbo soil. The second item covers the cost of moving rails which had been distributed for relaying.

Overhaul was not allowed, and excavation that could not be used for widening embankments within the 500-ft. free haul limits, was wasted on false berms, along surface ditches or below sub-grade along embankments. A total of 79.8 per cent of the cost of this work was chargeable to Additions and Betterments.

The original 65-lb. A. S. C. E. rail was replaced by 90-lb. open hearth A. R. A. Type A rail, 33 ft. long. The rail laying was done with company forces, the gang consisting of a foreman, timekeeper and 40 to 70 laborers. The organization varied from day to day, according to the work.

From the following tables showing the cost of relaying with 90-lb. rail, the value of the material recovered, and the estimated cost of relaying with 65 and 67-lb. rail, the cost of Additions and Betterments for one mile is derived:

NEW 90-LB. MATERIAL

Labor	\$ 569.02
Work train	89.32
Tools and supplies	16.28
90-lb. rail. 10.716 ft., at .41067	4,400.74
90-lb. angle bars. 3 pr., at 1.08	3.25
90-1b. continuous joints, 325 pr., at 1.56839	509.73
Track bolts. 2.264 lb., at 2.20 cwt	49.81
Nut locks. 1.311 pcs., at 5.20 M	6.82
Spikes, 3.097 lb., at 1.80 cwt.	55.75
Tie plugs, 9.932 pcs., at .76415 M	7.59
Tie plates, 6.369 pcs., at .10393	661.93
No. 10 spring rail frogs, 90-1b., 0.9 pcs., at 58.54	52.69
Complete switches, 0.9 pcs., at 49.56	44.60
Complete guard rails, 1.8 prs., at 15.17	27.31
Turnout plates, 0.9 sets, at 3.39	3.05
90 to 65-lb. off-set joints, 1.6 prs., at 2.40	3.84
90 to 85-1b. off-set joints, 0.18 prs., at 3.04	.55
90 to 80-lb. off-set joints, 0.05 prs., at 3.04	.15
Rail anchors. 400 pr., at .16	64.00
Engineering	7.23

Total cost material and labor (one mile).....\$6,573.66 MATERIAL RECOVERED

65-lb. rail, 10,598 ft., at .213	\$2,257.37
67-lb. rail, 118 ft., at .219	25.84
65-lb. angle bars, 354 prs., at .30	106.20
67-lb. angle bars, 4 prs., at .30	1.20
65-lb. tie plates, 61 pcs., at .05	3.05
No. 10 spring rail frog, 65-lb., 0.9 pcs., at 20.25	18.23
Complete switches, 0.9 pcs., at 17.15	15.44
Complete guard rails, 1.8 pcs., at 4.90	8.82
Scrap bolts and spikes, 1.99 tons, at 12.00	23.88

ESTIMATED COST TO RELAY WITH 05- AND 0/-LB. RAI	L
65-1b. rail, 10,598 ft., at .29659\$3,	143.26
67-lb. rail, 118 ft., at .30572	36.07
65-lb. angle bars, 354 pr., at .56	198.24
67-lb. angle bars, 4 pr., at .59	2.36
Track bolts, 1,013 lbs., at 2.20 cwt	32.29
Nut locks, 1,311 pcs., at 4.80 M	6.29
Spikes, 3.097 lb., at 1.80 cwt.	55.75
Tie plugs, 9.932 pcs., at .78415 M	7.59
Tie plates, 61 pcs., at .087	5.31

No. 10 spring rail frogs, 65-1b., 0.9 pcs., at 45.65	41.09
Complete switches, 0.9 pcs., at 41.36	37.32
Complete guard rails, 1.8 pcs., at 8.34	15.01
85 to 65-lb, off-set joints, 0.18 pcs., at 3.28,	.59
80 to 65-lb. off-set joints, 0.05 pcs., at 3.05	.15
\$3	3,571.32
Add 10 per cent for superintendence contingencies	

Total cost to relay with 65- and 67-lb. rail (one mile)\$3,928.34

From the table covering the cost of the 90-lb. material, the items of labor, work train, tools and supplies and engineering amounting to \$681.85, being straight operation, were deducted, leaving an Addition and Betterment charge of \$1,963.47, an operating charge of \$2,150.16 and a stock charge of \$2,460.03.

The track was originally ballasted with cinders, burnt gumbo, hand-broken stone and earth. Blue trap diabase rock, machine-crushed, and screened over a $\frac{1}{4}$ -in. mesh and through a $2\frac{1}{2}$ -in. mesh, as specified, was the new ballast. The ballasting was performed by company forces, consisting of a foreman, timekeeper, 3 flagmen, 1 waterboy, 12 raisers, 7 men gaging, lining and surfacing, 12 tampers and 6 floaters.

The table of labor and material for ballasting reduced to a one-mile unit is as follows:

Ballast used, 2,518 cu. yds., at 70c	\$1,762.60
Ballast inspector	40.10
Work train	. 111.55
Unloading	68.76
Applying	. 784.19
Raising bridges and cattle guards	25.67
Skeletonizing	. 115.95
Engineering	. 32.75

The items "raising bridges and cattle guards" and "skeletonizing," plus the cost of replacing the original ballast, give the operation charges, which, reduced to a percentage basis, are 15.024 per cent of the total, leaving the Addition and Betterment percentage as 84.976. These percentages, applied to the preceding table, give the operating charges of \$562.29 and the cost of Additions and Betterments as \$2,379.28 per mile.

The total cost of improving one mile of line was:

Bank widening Rail laying Ballasting	Fotal Cost .\$1,009.35 . 4,113.63 . 2,941.57	Additions and Betterments \$ 664.50 1,983.47 3,379.28
Charge to operation	\$8,064.55	\$5,007.25 \$3.057.30
(Total cost of engineering 0.94 per	cent of to	stal labor and

(Total cost of engineering, 0.94 per cent of total labor and material charges.)

Previous to the improvement, the yearly maintenance of one mile of track was approximately \$800, not including bridge and building charges. The Addition and Betterment charge of \$5,007.25, capitalized at 6 per cent, costs \$300.44 per year. The yearly saving made by the reduction of sections and labor alike is \$306. Before the improvement, the track was divided into five and six-mile sections, with a foreman and four to six laborers on each; now a section covers seven miles, one section having been eliminated, and the labor is reduced to a foreman and three men. When the work is completed as authorized, another section will be eliminated.

Before the improvement the cost of tie renewals was 40 per cent of the total maintenance; now with the better drainage conditions and the reduction of mechanical wear, the life of the ties is lengthened.



L. & N. TIMBER TREATING PLANT

This Layout Has Been Entirely Rebuilt Because of a Disastrous Fire. A Number of Interesting Features

THE Louisville & Nashville has recently completed the rebuilding of its creosoting plant at Gautier, Miss., which was burned on August 13, 1915. This plant was one of the first built in this country and is the oldest in the United States in point of continuous operation.

The main line of the Louisville & Nashville from Mobile to New Orleans includes several long trestles across indentations of the Gulf of Mexico, the timbers in some of which are subjected to severe attack of marine borers. These borers soon showed the necessity for the treatment of all piling and an open tank plant was at once installed. In 1876, this open tank plant was changed over into a one cylinder pressure plant. On May 1, 1880, the Louisville & Nashville R. R. acquired active control of the New Orleans & Mobile, as the line west of Mobile was known. Two cylinders were added to this plant by the L. & N. at different dates previous to 1902, when all three cylinders and the remainder of the layout were destroyed by fire.



Cylinder House and Boiler Room

The plant was at once rebuilt with the buildings of timber construction covered with galvanized iron, housing three cylinders, each 6 ft. in diameter and 115 ft. long. It was this plant which was destroyed by a second fire last year, caused by an explosion of gas which had collected in the top of the cylinder room. In this later fire one cylinder was entirely destroyed, parts of another were reclaimed, while a third was in such condition that it could be used with only slight repairs. This cylinder was turned end for end, moved on new foundations and placed in service with a delay of only one week.

The Gautier plant treats bridge timbers and piling ex-



Cylinder House and Oil Storage Tanks

clusively, employing the full cell treatment and supplying the bridge material for the entire system. The Louisville & Nashville operates a second timber treating plant at Guthrie, Ky., at which only ties are treated, which are used on the lines north of Birmingham, Ala., untreated cypress ties being used south of that point. In addition to the large amount of timber bridging on the Gulf division, ballasted deck construction is now standard for trestles on all parts of the system except this division, where open deck construction is used. Only creosoted timber is used in wooden bridges. About 10,000 piles and about 6,000,000 ft. B. M. of timber are treated annually at Gautier. Because of the depth of water encountered at a number of the bridges on the Gulf division a large amount of the piling treated is of long dimensions. All of the dimension timber except the bracing is framed before treatment.

With the exception of the bracing all of the material treated is long leaf yellow pine, which is secured from



PLAN OF THE PLANT AND TRACK LAYOUT

y, Ala. The Gautier plant larger cylinder is

points south of Montgomery, Ala. The Gautier plant is located on the shore of an inlet of the Gulf into which three streams enter at the upper end. This makes it possible to deliver 65 per cent of the piling to the plant by water. About 25 per cent of the timber also comes to the plant by water in the form of logs and is sawed to the required dimensions at this point. The remainder of the piling and dimension timber is received by rail.

All timber is treated green as it comes from the water, although, as much of it has been in the water for periods



INTERIOR OF THE OPERATING ROOM

ranging from 6 weeks to 3 months, it is fairly well seasoned in this way. Good penetration is secured in the treatment although a longer time is required, from 21 to 30 hours being necessary to treat this timber, depending upon the condition of the material.

As far as practicable the material recovered from the old plant was used in the reconstruction. This accounts for the difference in the size of the two working tanks and the use of three small oil storage tanks instead of one larger one. The boilers and a considerable portion of the original power plant have also been used in the revised layout. The use of this older material has also influenced the arrangement of the plant since it was necessary to locate the new buildings and other facilities to fit the location of that part of the equipment of the old plant which was utilized. Thus the arrangement of the present plant is entirely different from that which would probably have been provided had the designers been free to adopt the most desirable arrangements.

In so far as the plant has been designed new, it is similar in general details to that built at Guthrie, Ky., in 1913. In both of these plants particular attention was paid to the detailed design of pipe fittings and connections in order to reduce fuel consumption and to prevent the leakage of water into the oil. Before completing the plans for each of these plants a visit was made to most of the larger and more modern installations in this country in order to secure the best ideas of each.

It was necessary to construct all the new buildings and install the equipment without interfering with the operation of the cylinder recovered intact from the fire. The new buildings are of fireproof construction, with steel frames and 6 in. concrete curtain walls 8 ft. high with $2\frac{1}{2}$ in. stucco on metal lath above. Concrete floors are used throughout.

The retort house is 153 ft. long and 24 ft. wide. It opens directly into an engine room 45 ft. long and 25 ft. wide in which are located the pumps and operating equipment. In that retort room are two cylinders, one of which is 7 ft. in diameter and 133 ft. long and the other is 6 ft. in diameter and the same length. The

larger cylinder is new throughout. The larger diameter was determined on as a desirable size for tie plant operation. If the amount of bridge timber to be treated decreases in the near future it is proposed to transfer this larger cylinder to a new tie plant, the construction of which is now under consideration. The 6 ft. cylinder is composed in part of material recovered from the old plant, 68 ft. of the shell being cut from a cylinder which was installed in this plant four years ago and was still in serviceable condition after the fire. A third cylinder which was recovered from the fire and quickly placed in operation is located outside the retort house, where it will be operated for 3 or 4 years, or as long as it is serviceable.

Two 50,000 gal. measuring tanks were uninjured by the fire and were returned to service without alterations. The oil in these tanks is heated by live steam which passes through six $\frac{1}{2}$ in. pipes enclosed in 2 in. pipes, the steam entering the coils through the smaller pipes and returning with the condensation to the feed water heater through the larger one. In this way it is possible to raise the oil to a high temperature in two hours. The oil passes from these tanks to the cylinders by gravity through a 10 in. pipe line and it is pumped back through the same line. The pressure pump operates through a 4 in. pipe line. Gage boards in the operating room indicate the amount of oil in the measuring tanks at any time.

In emptying the cylinders, the oil can either be pumped back directly into the measuring tanks or drained into an underground tank from which it can be pumped into the storage tanks by means of a 12 in. by 12 in. by 12 in. Worthington pump, set in a depressed pit in the engine room. In filling the cylinders, an electric contact rings a bell and turns on a light when the oil touches the top of the cylinder. The oil pressure pumps are equipped with regulating valves to maintain the pressure at 125 lb. In a similar way the steam header is equipped with a regulating valve to limit the steam pressure in the oil storage tanks or in the cylinders to 45 lb., preventing too high pressure in the heating pipes.

The vacuum is secured and maintained by means of



THE YARD AND DERRICKS

two vacuum pumps recovered from the fire. The vacuum is drawn from the top, enabling all water accumulating during the steaming process to be drained out to a sap drum under the cylinder.

All valves are located under a false steel floor at one side of the engine room, adjacent to the cylinders. The valves are arranged to enable oil to be pumped to any tank or cylinder in the plant. The high pressure valves are equipped with by-passes to permit the pressure to be released before these valves are opened. A complete



drainage system has been built underground, carrying the water to an outlet at one end and the oil escaping from the ends of the cylinders to an underground storage tank at the other end.

All 10-in. oil pipes under floors are laid in 24-in. by 24-in. concrete tunnels to enable them to be withdrawn readily for alterations or repairs. As a protection against fires a 50,000-gal. water tank on a 50-ft. tower is provided, also a 12-in. by $8\frac{1}{2}$ -in. by 10-in. Laidlaw-Dunn-Gordon fire pump, both connected to 6-in. and 4-in. underground pipe lines about the yard. Electric lights are used throughout the plant and yard, power being provided from a small generator in the engine room.

A boiler house and a small shop are located in a separate building a short distance from the cylinder house. Two sets of boilers which were recovered from the old plant burn either wood or coal and are equipped with a Cookson feed water heater. Coal is delivered into a pit at the door of the boiler house from a track extending along side. The machine shop is equipped with an air compressor, a 14 in. lathe and a few other tools sufficient to handle the ordinary repair work around the plant.

One of the interesting features of this installation is a saw mill located at the water's edge. This mill was installed primarily to frame all bridge timber except braces, before treatment, but its activities have been extended to include the sawing direct from the logs of about 25 per cent of the dimension timbers required. A planing mill is operated in connection with it. The saw mill employes 25 men and has a capacity of about 15,000 ft. B. M. of timber daily. All waste slabs and refuse from this mill are carried to the boiler room by a continuous belt conveyor and are dumped opposite the fire doors where they are used as fuel.

Practically all material in this yard is handled mechanically. A stiff leg derrick on a fixed support loads the material from the saw mill onto trams for the cylinders. After treatment the material is transferred from the trams into cars by a guyed stationary American derrick at the other end of the yard. In addition a Brownhoist locomotive crane with a 50-ft. boom loads the piling directly from the water onto cars and performs such other work about the yard as may be necessary. All material is loaded for shipment as fast as it is treated, to the extent that cars are available and none is stored permanently at the plant.

This plant has been built and is being operated under the direction of W. H. Courtenay, chief engineer of the Louisville & Nashville, with John B. Lindsay, superintendent of timber treating plants, and P. T. Vaughan, assistant superintendent, directly in charge. The buildings were erected by the Meacham Contracting Company, Hopkinsville, Ky., while the piping was installed by J. M. Foley, Birmingham, Ala. The Power and Mining Machinery Co., Cudahy, Wis., furnished the new 133-ft. cylinder and the new section of the 6-ft. cylinder, while the tram cars were manufactured by the Allis-Chalmers Mfg. Co. of Milwaukee, Wis.

PERE MARQUETTE TRACK INSPECTION

A S a result of the annual track inspection on the Pere Marquette, the Detroit-Canadian division, J. J. Corcoran, superintendent, and W. J. Long, division engineer, received the highest division rating, although the Chicago-Petoskey division was only $2\frac{1}{2}$ points behind. The track on the Detroit-Canadian division is in charge of William Meier, roadmaster at Grand Ledge, Mich., and Harry Morris, roadmaster at Walkerville, Ont. Roadmaster William Meier also received the highest rating (92.6) among the roadmasters, while L. Seger, section foreman at Brighton, Mich., received the highest rating for a section foreman, this being the second year he has won this recognition. The special prize awarded to the roadmaster whose territory showed the greatest improvement went to F. J. Meier, roadmaster on the Chicago division at Benton Harbor, Mich.

The following section foremen also received the highest ratings on their respective roadmasters' districts: L. Seger, Brighton, Mich.; William Krajewski, Wyoming, Mich.; William Harris, Fennville, Mich.; William Chadley, Mecosta, Mich.; Wm. F. Bailey, Montague, Mich.; L. Lawrence, Freeland, Mich.; J. Mentel, Erie, Mich.; C. Sexton, Bellaire, Mich.; Wm. Moulton, Hemlock, Mich.; Wm. Ebmeyer, Baldwin, Mich.; Richard Morgan, Carsonville, Mich., and Lewis Wilmott, Dresden, Ont.

A RAIL CALIPER

THE accompanying photographs show a gage or caliper which has been adopted at the rail-reclaiming plant of the Chicago, Milwaukee & St. Paul at Savanna, Ill., during the past year to measure accurately the height of relaying rails preliminary to sorting them according to the depth of the head, to secure uniform surface at the joints and easy riding track. Until recently a gage



Two Views of the Rail Caliper

was used which calipered the rail over all, but it was found that owing to the accumulation of dirt and rust and to abrasion on the base of the rail this method was inaccurate, particularly when the instrument was handled by an inexperienced or careless workman. In designing this recent instrument it was desired to secure measurements at a point removed from the end of a newlysawed rail, where it would not come in contact with any burr raised by the saw and not properly removed by the chippers and to secure contact with the clean solid metal of the head of the rail. As the fishing height is uniform in sawed rails after the splice wear has been removed by cropping the ends the abutting surfaces on rails of uniform thickness of head will be even after applying the splice.

This instrument can be used on any section of rail by simply inserting the proper blades. This is accomplished by the removal of two screws and the blade. The gage is used at the Savanna plant to sort all sawed rails selected for use in main track into four different groups, varying 1/32 in. in the thickness of the head, from full section down to the minimum considered permissible for rails to be used in main track. We are indebted to John Reinehr, foreman of the rail mill at Savanna, Ill., for this information.



NOVEL METHOD OF SUPPORTING ARCH CENTERS

S a part of the improvements now under way on its Α Morris and Essex division, the Delaware, Lackawanna & Western is completing a reinforced concrete arch bridge over its tracks at Millburn, N. J., that is of interest because of the manner in which an unobstructed clearance was maintained for trains during construction. As the line, which is three-tracked at this point, carries a very heavy commuter traffic in the morning and even-



THE GIRDERS SUPPORTING THE CENTERS

ing, it was not practical to take any of the tracks out of service during construction in order to place the usual falsework posts. As a further complication the vertical distance available between the top of rail and the highway grade was too small to permit the use of steel arch centers without reducing the top clearance to an undesirable extent. To meet this situation it was decided as a matter of economy to suspend the arch centers from old plate girders rather than from steel ribs embedded in concrete, a practice which had been adopted previously.

The details of construction which were worked out as



END VIEW OF THE GIRDERS IN POSITION

the design was made, provided for building the abutments, together with portions of the arch ring constructed at These cantilever sections were built out cantilevers. from the abutment to the limit of the side clearance on segmental forms supported on falsework bents, placed parallel to the tracks and, when completed, left an intervening 45-ft. span between the arms of the cantilevers where it was necessary to suspend the centering.

On the completion of the abutments and the cantilever arms, four plate girders, each 60 ft. long and 6 ft. deep, were brought in and placed. The outside girders were supported on blocking placed on the sidewalls of the abutments and the inner two on concrete piers erected for this purpose on the slope of the abutments. The steel floor beams were then bolted to the girders as in ordinary bridge construction. Between the center girders timber crossbeams were used instead of steel. This floor system supported the 12-in. by 12-in. stringers that carried the centering which consisted of 3-in. by 3-in angles that ran lengthwise of the bridge and conform to the curve of the arch. The centering was suspended from



THE GIRDERS AND SUPPORTING CONNECTIONS

the stringers by 3/4-in. rods placed 3 ft., center to center, and provided with adjusting screws at the top so that the proper curve might be maintained. These rods were placed in pipes so that they might be removed from the finished work readily.

In similar structures previously erected by this railroad it has been the custom to suspend the arch centers from steel ribs embedded in concrete, but with the present high cost of steel it was found that the use of the girders was economical. While some difficulty was experienced in concreting because of the small clearance between the tops of the ribs and the suspension girders the method proved very successful.

The bridge was designed and constructed under the general supervision of G. J. Ray, chief engineer of the Lackawanna and George T. Hand, division engineer. G. B. Barackman, assistant engineer, was in charge of construction and A. B. Cohen was the designing engineer.

COMMITTEES OF ROADMASTERS' ASSOCIATION

T a meeting of the executive committee of the Roadmasters' and Maintenance of Way Association, held in Chicago on October 21, the following subjects were selected for consideration at the next annual convention, with the chairmen of the committees as follows:

Methods of Securing and Retaining Track Laborers. A. M. Clough, supervisor, New York Central, Batavia, N. Y. Recommended Methods for the Inspection of Ties in Track

and the Most Efficient Plan for Making Renewals. J. B. Oat-man, roadmaster, Buffalo. Rochester & Pittsburgh, DuBois. Pa. The Proper Method of Maintaining Track Surface. J. E.

McNeil, inspector of track and roadway, Atchison, Topeka &

Santa Fe, Los Angeles, Cal. Equating Track Values. A. Grills, general roadmaster, Grand Trunk, St. Thomas, Ont.

Methods of Snow Removal from Switches and Tracks and Recommended Types of Brooms, Thawing Appliances and Tools. Thompson, roadmaster, Atchison, Topeka & Santa Fe, Joliet, I11.

Individual papers will also be presented on the following:

Some of the Difficulties of Maintaining Tracks in Large Termi-

nals, by C. J. Coon, New York Central, New York. The Oiling of Rails and Fastenings to Protect Them from Corrosion, by E. T. Howson, *Railway Maintenance Engineer*. Economical Methods of Maintaining Street and Highway Crossings, by M. Griffin, supervisor, Central Railroad of New Jersey, Jersey City, N. J.



TRAINING YOUNG MEN FOR PROMOTION

The Application to the Maintenance Department of Principles Employed Successfully in the Mechanical Field

THE demand for trained, efficient foremen is a universal and pressing one in all branches of the maintenance of way department to-day. There is almost an equal dearth of material from which to create supervisors and roadmasters. The outlook for the future is even more discouraging for the class of men now being drawn into the ranks as laborers does not offer a promising field from which to recruit foremen. This condition is arising at a time when the demands which are being made on the maintenance of way department are more exacting than ever before and when the work requires a higher degree of intelligence and concentration than at any previous period.

With this shortage of foremen existing in a department employing one-fourth of all the men engaged in railway service, the need of some method of training is plainly evident. It would seem to be only a matter of sound business procedure to provide some means whereby this condition will be relieved and men eligible for promotion and trained in the methods of the company will be waiting for these positions. The most logical way to provide such a corps of men is through an apprentice course or school of training. Up to the present time no road has established any such system in the maintenance of way department in any comprehensive manner. It is true that plans have been started in a minor way but they have not been tried sufficiently long or on a large enough scale to demonstrate their practicability and have been discontinued before the results could be ascertained.

A similar shortage of trained men exists to a lesser degree in the mechanical department where the officers have been more prompt to realize the condition and the apprentice system has received greater attention. One of the roads which has developed this system most successfully in the mechanical department is the Atchison, Topeka & Santa Fe. The methods developed on that road were described in detail in a paper read before the New York Railway Club on October 20 by F. W. Thomas, supervisor of apprentices on the Santa Fe. While this paper relates directly to the work being done in the mechanical department the parallel between this branch of the service and the maintenance of way department is so close that we publish an abstract of this paper below in the belief that our readers will see the application of these methods to their own department and endeavor to determine for themselves the extent to which similar methods are practical in the maintenance of way department.

The fundamental principles which have been applied here are equally well adapted to the maintenance of way department, the modifications necessary consisting almost entirely in details of administration. If young men can be secured as shop apprentices at wages ranging from \$1 to \$1.35 per day they can be secured equally well for out-of-door work in the maintenance of way department, where the unskilled laborers' rates the past season have ranged from \$1.85 to \$2.25. The opportunity to collect the men for instruction at a shop exists also in terminals where track apprentices may be divided between different gangs in one terminal or concentrated in one gang under a competent foreman. At the completion of a four-year course the men should be capable of becoming assistant foremen in large gangs or section foremen at salaries equal to those of machinists. The opportunity for promotion would likewise be open to them the same as to the machinists with corresponding increases in pay.

That this plan is not an idle dream is indicated by the fact that at least one large road is now working upon a definite form of organization and is planning to install the apprentice system on a large scale. When railway officers realize the importance of the economy of training young men according to their own standards, not only for minor positions in the maintenance of way department but for advancement to the higher positions as well, the shortage of capable foremen and supervisors will become a thing of the past and the economical and intelligent conduct of the work will be materially increased.

THE SANTA FE PLAN

By F. W. Thomas

The training of young men for positions of responsibility involves two considerations; the foundation upon which to build and the material with which you are to build. The solution of both of these by the Santa Fe requires a little explanation of the preparation of the raw material from which we may select the stones for the building. Our apprentice system was organized nine years ago.

Briefly, our scheme for training boys for our shops, is as follows: We take a boy who has completed grammar school or better and examine him as to his mental make-up. A series of simple arithmetical problems, coupled with the manner of filling out his formal application blank, and a personal interview, give us some idea of the boy's accuracy, industry and alertness. He then goes out in the shop to run the gauntlet of our shop instructors. They find out why he wants to be a machinist instead of a lawyer, or a boiler maker instead of an editor or a preacher, if some friend or parent sent him to us on account of the good wages paid mechanics, or if he is making application simply because his father was a machinist. We want to find out as much as possible about the boy from the boy himself. We do not ask any letters of reference. We do, however, strongly endeavor to get boys of good, honest parentage. If he passes the shop instructors he next goes to our surgeons and passes a physical examination. We are taking these young fellows in our service for life, and it is well that young men sound in body and mind should be selected.

If the doctor passes him the boy goes to the office of the superintendent of shops, filling out the regular indenture papers and minor's release, is given a letter to the shop foreman, who gives him a shop number, etc., and he is told to be on hand by the time the whistle blows in the morning. He enters the shop next morning.

The apprentice in the shop is constantly under the eye of the shop instructors and is taught how to perform each operation or step of the trade he has been indentured to learn. An exact account is kept of each job performed and the time required to perform it. His shop work is correlated with useful instruction in the apprentice school room. We teach him mechanical and free hand drawing, the elements of mechanics, shop arithmetic, and some other subjects, closely related to his actual shop work. A boiler maker apprentice, for instance, will have acquired a working knowledge of plane and descriptive geometry. He is familiar with the Fed-
eral rules as to the inspection and maintenance of boilers. He can quickly make you a sketch or a working drawing of a boiler, can lay out, flange, stay and build a boiler. At 21 years of age he is the equal of a boiler maker of 50 years. Throughout his four years apprenticeship he is hourly watched by general and shop foremen, by shop and school instructors. His weak points are strengthened, his strong features are exercised. Personal characteristic blanks are filled out from time to time which give the supervisor's office a graphic personal record. While the boy is serving his apprenticeship we find out his particular fitness, firmly convinced that the boy, now a man, will perform his duties better when his heart is in the work; if he can be placed on a class of work which he loves, he will certainly do better than if engaged on some work which he does not like.

RECRUITS FOR PROMOTION

The best worker will not necessarily make the best foreman, this we have long since learned. Those who have given evidence of possessing talent for leadership are selected for development. Possibly and very probably not all deserving ones are selected, but we are pretty sure that only those are selected who have given evidence of such ability. This is our first source of supply. The second is from our special apprentices, who are graduates of engineering schools.

Special apprentices are selected only upon a personal interview. We require these specials to work one year on machines, and one year on the erecting floor, then we decide whether or not he shall pursue our course for the development for positions of responsibility.

We now have the boy from the public schools, who has served his four years' journeyman apprenticeship and has become a first-class mechanic, and the college man who has engaged in practical shop work for two years; the pick of two sources for development into our future officers. They must, during their apprenticeship, have been quick to learn, industrious, prompt, honest, readily and effectively amenable to discipline, steady under fire, and popular with officers and associates, and then have some distinctive qualities of leadership.

TRAINING FOR FUTURE RESPONSIBILITY

We offer each of them the following opportunity: He must serve two months in the boiler shop, familiarizing himself with tubes, stays, patches, front ends, Federal laws, etc., pursuing a course of reading and study of boilers and appurtenances. He next goes to our freight car shop and serves two months on trucks, draft gears, body, doors, roof, air brakes and inspection, also pursuing a course of reading and study on car work, M. C. B. rules, etc. Then we send him to a busy roundhouse for four months. He may previously have had roundhouse work but he is now taught the operation of an engine house from the time a locomotive reaches the ash pit until it is headed out on the "ready to serve" track. Here he reads or studies some good books on locomotives. We next find him with the traveling engineer, studying fuel economics, learning to fire, to inspect and operate the engine, to make out the usual road foreman's report, accompanied by an individual study of parts of the machinery, the construction and operation of injectors, lubricators, safety valves, air brakes, valve motion, etc. He also familiarizes himself with the Federal and company rules for the inspection and care of locomotives. We next find him at the front door of our back shops or a large roundhouse, for thirty days engaged in inspecting incoming locomotives and thirty days inspecting outgoing locomotives. Once a month he has written a letter covering the work he has done, explaining the operation of certain features, offering suggestions as to shop management or methods, and criticizing local existing conditions when he can offer some remedy. In each branch of the above he must answer 150 questions bearing on the work in hand.

This is called our Special Course for Graduate Apprentices, and it keeps them very busy. We have so made this course that it is a trying and severe one, but it is certainly a developing one. A few break down under it or throw it up, but 80 per cent or over pursue it to the end.

OPPORTUNITY FOR OUTSIDE TRAINING

To prevent any possibility of our growing stale, we pick a number from this list of special course men and send them east. One year ago we brought six machinists and one boiler maker to the Baldwin Locomotive Works for a period of six months, where they were made assistant department foremen. They were given as much responsibility as they could carry and were changed from one department to another every two months. They acquired a general and detailed knowledge of the plant, executive and operative, from the time the material for a locomotive was ordered and received and on through the plant until it left the works a finished locomotive. They had an opportunity to note the practices of nearly all the roads in this country and many foreign nations. They were given, through the liberality of the Baldwin Locomotive Works, an opportunity of visiting a steel mill and studying the manufacture of steel. They were likewise treated with two half days at the Master Mechanics' convention at Atlantic City. Every two months the speaker was required to visit these young men in Philadelphia. These young men are back home again. They were not spoiled; they went back to their trade in the shop, but for a few days only. One is foreman of our Dallas terminal, one a roundhouse foreman in Kansas, one in Arizona, one machine foreman in Topeka, one welding engineer in charge of gas and electric welding and one machine foreman in California, all doing well. Seven more have taken their places at Baldwin's.

In like manner we sent four graduate apprentice passenger car men to the Pullman shops to catch on to the latest and best in steel car construction, two young painters to the Pullman shops to acquire the newest and best in painting, graining and decorating steel passenger cars. Four young fellows are at the Westinghouse Air Brake Company, mastering the manufacture of air brake equipment.

Each of the above young men was required twice a month to write me a letter giving in detail their observations and work during the past two weeks. These letters were remarkably interesting and will be of untold benefit to the young men in after years. The training this letter writing gave them could not be obtained so effectively in any other way. It required from two to five days a month for the author to thoroughly read and criticise these letters. The young fellows meet once a week and the letters are read over and discussed by them before sending. No changes are made in the original, though a postscript may be written. It gives each an opportunity of knowing what the other is doing, how he expresses himself, etc.

The law is laid down to us that we must not go outside for a mechanical officer. We must promote those who are now in service. The prize is hanging out to them and only when they fail us will we let outsiders enter the race. With this practice in vogue it would be very shortsighted to wait until the job was open to find a man. We believe in having a man ready for the job. We can't have a man ready at a moment's notice unless we are prudent enough to go into the matter a sufficient time ahead.

KNOW YOUR MEN

The weakness, or fitness, of a boy is not left to the judgment of one man. It is the result of four years of individual instruction. There is no such thing in our regular scheme as classes. There is no huddling together boys of all kinds, of all the various dispositions, capacity and intelligence, each boy from the moment he makes his application until the day we graduate him into manhood as a mechanic, is a class unto himself, is treated as a unit, and all the instruction we give him in shop and in school room is individual. We go further. We have a governing body known as the apprentice board, composed of our general foreman, department foremen, gang foremen, shop and school instructors, who meet as a trial court to pass on each boy eight times during his apprenticeship. This board is as fair and honest and equally as anxious to mete out real justice as any court or body of men that ever assembled to pass judgment on a fellow man. If the boy is fit they pass him. If he is a misfit he goes, and no power can save him. Like our courts, he may get a new trial. His case may be deferred. but justice will find him. That board is even more anxious in removing the illfitted and talentless boy than it is to encourage and help the genius. It is deemed a crime against the railroad, a crime against society, a crime against the boy's young life to require him to stay and attempt to learn a trade when all his talent and all his ambition lies in other channels. When a boy completes his apprenticeship we know him and his capabilities. He may not be a leader, he may not be a world beater, but we know what he can do and where best to use him.

We have in our apprentice regulations of 22 articles, only two dont's for the boy. He must not smoke cigarettes, as the tendency of this practice is towards dishonesty. We say he must not drink, for who wants a booze fighter? The other 20 articles are there to safeguard the boy.

When we graduate an apprentice we continue a watchful supervision over him. If he remains at his graduating shop the local instructors keep an eye on him, helping and advising him when necessary. If we transfer him to a distant shop his "follow-up" card is sent ahead to the instructor, who aids him in getting located and in securing a good boarding place, etc. If he leaves the road, we still follow him. It may cost us a few postage stamps but the information is worth the stamps. So we have pretty nearly a perfect record of all our graduates. The location of 150 who have left us is as follows: On adjacent or connecting roads, 57; on distant roads, 14; in Canada, 4; "Somewhere in France," 2; in Panama assisting in operating the canal, 2; in garages, 37; in contract shops, 14; in business for themselves, 12; in the navy, 8.

The first position after leaving the ranks is the most trying of the young man's life. It is here he needs counsel and advice from old heads. We are prone, when entering on a new job, to try to do too much, to turn too many things upside down, to make a record the first month. Right here is where the young man is liable to fail, and a steady, guiding hand is needed to balance him. A master mechanic who had promoted a young fellow to a roundhouse foremanship at an important terminal, told me that for one solid week he spent eight of the ten hours per day in that house. That week made the young man one of the best roundhouse foremen on the system.

Has the game been worth the candle? Let me briefly recount the benefits we have enjoyed. From our apprentice system we have graduated over 900 first-class, skilled mechanics into our shop forces, trained and educated for Santa Fe work in Santa Fe ways, who in skillfulness, in general intelligence, in resourcefulness, in loyalty, are the superior of any equal body in similar vocations from any railroad or corporation of any place or any time. The present apprenticeship system has improved the whole moral tone of our shops. It has been the means of abolishing rawhiding and mule-driving. The use of profanity by officers to men has practically ceased, and the violation of Rule G is rare.

Of the graduates 72 per cent are in service to-day. When you think of the fact that the average turnover of men in the shops and manufacturing plants in the country is three and one-half years this is a flattering showing. Of the 72 per cent who have remained with us, over 100, or 15 per cent, have been promoted to some position of responsibility and we have others ready and waiting. The past year has been one of unusual activity, the biggest year in our history; yet we have not employed a mechanic from the outside for more than 12 months, and at our principal shops, Topeka, Kan., no skilled mechanic has been employed for over two years. These are the fruits of our recruiting and training system.

THE FIRST VALUATION REPORTS

THE Interstate Commerce Commission has issued tentative reports on the valuation of the Atlanta, Birmingham & Atlantic and the Texas & Midland as of June 30, 1914. These are the first reports to be issued in accordance with the valuation act of 1913. The tentative valuation of the Atlanta, Birmingham & Atlantic is stated as follows:

COMMON CARRIER PPOPERTY

. Cost of	f Reproduction	
of Road	and Equipment,	Present
Exclu	iding Lands.	Value.
New. L	ess Depreciation.	of Lands.
Owned by A. B. & A\$22,716,886	\$18,071,950	\$1,091,886
Leased to others 170,754	111,366	13.668
Used by A. B. & A., owned 22,546,132	17,960,584	1.078.218
Used, leased from others. 1,608,866	1,448,226	1,213,195
Total used by A. B. & A. 24,154,998	19,408,810	2,291,413

The value of the property used by the Atlanta, Birmingham & Atlantic is allocated to states as follows:

_	Georgia.	Alab ama .
Cost of reproduction, new	.\$12,383,707	\$6,852,881
Cost of reproduction, less depreciation	. 10,184,690	6,195,360
Present value of lands	. 1,545,347	746,066

The value not allocated to states, including the equipment, is placed at \$4,918,410 for the cost of reproduction, new, and \$3,028,760 for the cost of reproduction, less depreciation.

The valuation of non-carrier lands, present value including improvements, is stated as follows:

Georgia Alabama	•		•	•		•	• •			•	•	•			•	•	 •	•	•	•	• •	• •	•••		•	•	•	•	•	•	•	•••	•	•	•	•	•	\$ 14	41 3	, 7 1,4	78 12	22	;
Total					•								•																								•	\$ 14	45	5.2	20)3	

The original cost of the property could not be ascertained. The Atlanta, Birmingham & Atlantic was in the hands of receivers at the date of the report. The mileage owned at that time was 633.5 and its total outstanding capital liabilities amounted to \$54,571,176.14 in addition to receivers' certificates amounting to \$4,994,000. The property investment as shown by the books at that time was \$53,325,751.58, of which the Interstate Commerce Commission took exception to \$25,290,710.

These figures and those given below are based on the minimum valuation, all matters in dispute being omitted and left to the Interstate Commerce Commission for decision.



The tentative valuation on the property of the Texas Midland was stated as follows:

COMMON CARRIER PROPERTY		
Road and equipment, exclusive of lands: Road wholly owned		
Cost of reproduction new \$	2 601 280	
Cost of reproduction, less depreciation.	2,007,708	
Cost of reproduction, new	21.951	
Cost of reproduction, less depreciation.	18,208	
Equipment—	,	
Cost of reproduction, new	582,071	
Cost of reproduction, less depreciation	362,940	
General expenses-		
Cost of reproduction, new	176,693	
Cost of reproduction, less depreciation	138,561	
Total cost of reproduction, new	ation	\$3,382,004
acpreent and a second acpreent		

Land :

1,862.52 acres owned and used for transportation

The original cost of this road could not be found. The original cost of equipment now in existence was stated as \$528,874.59; of 1,369.91 acres of land purchased as \$68,232.41 and of 492.61 acres donated (cost to the donors) as \$43,103.75. The capitalization of the Texas Midland on June 30, 1914, was \$2,112,000. It owned 111 miles of line.

Notices of these tentative valuations have been served on the attorney-general of the United States, the governors and the state commissions of the states in which the properties are located and the railroads. Each party is allowed 30 days from November 1 in which to file a protest with the commission. If no protest is made the tentative values will be considered as final. It is required that each protest filed shall include a specification setting forth in detail the particular items against which the protest is directed.

A NEW POLE JACK

T HE difficulties attending the plumbing or pulling of telegraph, telephone or signal poles are being materially reduced with the introduction and use of a jack especially designed to facilitate these operations. The Simplex pole jack follows the general lines of the track jack, but gains its special adaptability through several modifications from ordinary construction and by the aid of a few accessories.

The head of the jack is given the form of a blunt, twopronged tooth, which has the two-fold purpose of supplying two teeth to bite into the pole when straightening it and also provide a notch or groove with which to hold a chain (furnished with the jack) when lifting or pulling a pole. The most radical departure from ordinary design is the pivoting of the base of the jack so that the body of the jack may be placed in an inclined position as when straightening a pole, while the base remains horizontal. The efficiency of this feature is carried a step further by providing a section of 10-in. 25-lb. iron I-beam 2 ft. long to serve as a spread foundation for the jacks. It has the further advantage that when the flanges of the beam are pressed into the ground it offers a strong resistance against slipping when the jack is used in the inclined position.

Another convenient addition to the appliance is a twoposition lever socket whereby the lever handle may be kept in a convenient working position for either the inclined or the vertical positions of the jack. The lever handle is a five-foot steel bar designed to serve also as a pinch bar.

This jack has a capacity of 15 tons and a total height of 39 in., affording a lift of 24 in. The total weight of



STRAIGHTENING A POLE

the equipment is 189 lb., but the jack itself without the accessories weighs only 90 lb.

The use of this jack is said to result in economy and increased safety when pulling poles. It also claimed that poles can be straightened readily with the use of this



RAISING A POLE

jack by one man. The jack will hold a pole in position so that a workman can step aside to ascertain if it has been properly lined up. These jacks are manufactured by Templeton, Kenly & Company, Limited, Chicago.





THE thirteenth annual convention of the Maintenance of Way Master Painters' Association of the United States and Canada was held at the Hotel Walton, Philadelphia, on October 17 to 19, inclusive, as reported briefly in the *Railway Maintenance Engineer* for November. About 40 members were in attendance and a healthy interest was displayed in the proceedings of the various sessions.

The officers of the association during the past year were: President, F. C. Rieboldt, master painter, Chicago, Milwaukee & St. Paul, Milwaukee, Wis.; first vice-president, H. E. Conrad, master painter, Pennsylvania Railroad, Huntington, Pa.; second vice-president, A. E. Wilson, master painter, New York, New Haven & Hartford, Hartford, Conn.; secretary-treasurer, F. W. Hager, master painter, Fort Worth & Denver, Fort Worth, Tex. All of these officers were re-elected for the coming year. The next convention will be held at Cleveland, Ohio, on October 16 to 18, inclusive, 1917.

Thomas B. Smith, mayor of Philadelphia, and Charles E. Tryon, representing the Philadelphia Chamber of Commerce, welcomed the convention to Philadelphia at its opening session. In his presidential address, F. E. Rieboldt recommended certain changes in the constitution and by-laws which would expedite the business of the Association. He also referred to a movement on foot to bring about an amalgamation with the American Railway Bridge and Building Association, a matter which was brought to a head later when a telegram was received from the latter association, then in convention at New Orleans, La., in which the members of the Maintenance of Way Master Painters' Association were invited to become members of the Bridge and Building Association and suggesting the formation of a joint committee to facilitate negotiations. After considerable discussion of the subject, the convention in session at Philadelphia notified the Bridge and Building Association of its appreciation of the invitation, but declined to accept the offer at the present time.

L. P. Nemzek (John Lucas & Company), Gibbsboro, N. J., presented a paper on "Preservative Coatings for Iron and Steel," in which he recommended and gave reasons for the advantages of basic lead chromate in place of the commonly used oxide, red lead. H. A. Gardner (Institute of Industrial Research, Washington, D. C.) gave an illustrated lecture on "Physical Characteristics of Pigments and Paints," which included reference to the possibilities of kukin oil, the oil of the soya bean and perilla and china wood oils. Pigments were considered from the standpoint of hiding power, oil absorption, opaqueness, suspension, etc. He prefers red lead containing 15 per cent of litharge. In commenting on this, A. H. Sabin, National Lead Company, New York, stated that an addition of 10 per cent of litharge to a strictly high grade red lead containing originally less than two per cent (PbO) would give a harder film and produce better results for the interior of a water tank. On the other hand, freedom from litharge is important for the

weather exposure on the outside of the same tank as on other general work.

A. B. Phelps, master painter, New York Central Lines West of Buffalo, in a paper entitled, "What This Associa-tion Has Done for the Railroads," reviewed the experiences of the roads of this country with brine drippings from refrigerator cars which have caused incalculable damage to rails, fastenings and steel bridges. He called attention to the fact that the Maintenance of Way Master Painters' Association at its convention in 1909 passed a resolution recommending that all refrigerator cars be provided with containers which would eliminate the dripping of brine while in transit. The initiative thus taken led to discussions by other railway organizations, resulting finally in an interchange rule effective October 1, 1916, which requires the equipment of refrigerator cars in this manner. He stated further that he believed it was the duty of the members of this association to keep a close watch on the practical working of this rule and to call attention to any laxity in its enforcement.

A paper by Malcolm McNaughton (Joseph Dixon Crucible Company) entitled "The Influence of Pigment on Paint Permanency," gave a review of the various properties of a pigment necessary to produce a permanent paint and described the action of graphite with respect to the various requirements imposed. "The Sanitary Value of Paint" was the subject of a paper by E. W. Lutes (Sherwin-Williams Company, Cleveland, Ohio), in which he called attention to the psychological value of paint in encouraging neatness on the part of the employees and the general public.

H. E. Conrad, master painter, Pennsylvania Railroad, Huntingdon, Pa., presented a brief manual of instructions for the master painter under the title, "The Master Painter and His Relation to the Corporation." This covered such matters as the records of material, prevention of waste, safety, co-operation, and treatment of the men with respect to discipline and welfare. The discussion of this paper dwelt particularly on the welfare feature, with special reference to the encouragement of athletics as carried out on the Pennsylvania Railroad. There was also considerable discussion with reference to records and accounts. The subject was considered of sufficient importance for presentation at another convention. "The Benefits the Railways Receive from This Association Through Its Members" was the subject of a paper presented by Ole Stubstad, master painter, Chicago & Northwestern, Winona, Minn. In addition to the discussion of the formal papers presented, considerable discussion was given informally to a number of assigned subjects, which included the painting of mahogany wood, both in matching old wood with new and genuine mahogany with birch, baywood and others; methods for reaching the tops of stacks to be painted; economy of the use of motor cars, and the use of ladder jacks suitable for reaching difficult or awkward positions. The entertainment features of the convention included a smoker, a banquet and a tour of the city of Philadelphia to points



of general and historic interest, which were tendered the membership by the representatives of the supply companies.

The following are abstracts of other papers presented:

MAINTENANCE PAINTING OF BRIDGES

By W. S. Lacher

Associate Editor, Railway Maintenance Engineer

Most discussions relative to the painting of steel bridges have been restricted to a comparison of the various classes of paints or to a consideration of the conditions affecting the shop and field coats of new bridges. Little has been said or written concerning their repainting. A single important exception to be noted is the report of the committee on Iron and Steel Structures of the American Railway Engineering Association for 1915. This gives in tabular form replies from 47 roads to

eight questions and refers particularly to the kinds of paint, the equipment used and the results obtained. This report does not cover the manner or organization for determining the need of painting or the methods actually used in carrying out the work, and as the economy and effectiveness of the painting are very largely dependent upon these factors, they have been taken as the subject of this paper.

An investigation discloses a wide variation in practice, particularly as to the classes of men employed, and the organization and methods for conducting this work, part of which may be accounted for by variations in local conditions, the personnel or the general scheme of organization in effect on the several roads. The reasons for some of the other differences, however, are not so clear.

Administration

From replies received by the committee on Iron and Steel Structures, mentioned above, it is apparent that

the length of the intervals between repainting is governed by no definite law. One road reports the interval as 1, 2 or 4 years; another 8 or 10 years, and a third 5 to 15 years. Climatic conditions have a large influence. Bridges in arid or semi-arid regions do not need as frequent attention as those in humid districts or those in locations where the air is heavily laden with furnace gases or where they are subject to salt fogs, or are partly submerged at high tide.

Another cause for the variation is the difference in the amount of attention given the bridges. On some roads, unfortunately, bridges are not repainted until the previous coat has almost disappeared. On other lines, the complete repainting is deferred at a material saving by the systematic touching up from time to time of the parts subject to the quickest deterioration. On the Santa Fe it is the practice to repaint or retouch a bridge whenever the weather coat has deteriorated sufficiently to expose the body coat underneath, the idea being to avoid if possible the removal of the body coat. The expense of cleaning off rust is thus avoided very largely.

The failure to repaint railroad bridges can almost always be accounted for by a lack of the necessary funds. When a reduction in earnings makes a reduction in main-



tenance expenses imperative the painting schedule is one of the first to be cut because the failure to paint a bridge when the new coat is needed has no immediate effect upon the efficient operation of trains. The work is put off for this reason, although the maintenance officers realize that it will result in a greater expenditure at some later date.

The decision to repaint a bridge is determined almost universally by the condition of the structure rather than by the interval since the last painting, the condition being determined by inspection as carried out according to various schedules. These inspections are usually made individually or jointly by master carpenters, engineers maintenance of way, bridge inspectors, or bridge engineers, at least once each year. On the Canadian Pacific the division superintendents and the division engineers inspect all bridges in the fall, while the resident engineers and the master carpenters give all truss bridges and high via-

ducts an additional inspection in the spring. On the Chicago & North Western, independent inspections and recommendations are made by the general bridge inspector or his assistants, and the division maintenance officers, the two sets of recommendations being checked against each other in determining the work to be authorized. On the Burlington, all steel bridges of any importance are inspected personally by the bridge engineer.

As a rule, the repainting of a bridge is authorized as a part of the annual bridge maintenance budget, which gives authority in detail for the individual structures. A less common practice is to provide a sum for bridge painting by divisions, leaving the detailed distribution to the division engineer maintenance of way or the master carpenter, subject no doubt in most cases to the recommendations of the master painter.

Most roads do maintenance bridge painting with company forces, gen-

erally under the direction of the division master painter. The work is usually done by a division paint gang, which paints all classes of structures, as there is rarely enough work within the limits of the district ordinarily covered by a single division organization to keep a gang of bridge painters constantly at work on steel bridges. There are several disadvantages to this plan. House painters do not like bridge painting, particularly the work of cleaning off rust. They are not as skillful as the regular bridge painters in swinging staging or moving around on high structures. To obtain the latter class of men, some roads organize temporary bridge painting gangs every season, a reliable, experienced man usually being kept on the permanent force to hire the men and supervise the work.

On the Chicago & Alton, a combination of the two schemes is used, a special steel paint gang being organized only when there is a considerable amount of this work to be done. The Michigan Central maintains two permanent bridge-painting gangs, consisting of a foreman and eight men each, one gang working in the United States and the other in Canada. They are under the direct supervision of the bridge engineer. The New York Central has general paint gangs on branches where the





bridge and building work is under the direction of one supervisor, and separate steel paint gangs on main lines where the bridges and buildings are generally handled by separate supervisors. On the Pennsylvania Railroad, painters from the locomotive repair shops are occasionally used on bridges.

Whenever repair work is done on steel bridges, it is common to have the iron bridge men do any touching

up or spot painting that The may be necessary. Chicago & North Western has used iron bridge successfully men on complete repainting jobs. These men are more agile and skillful in moving about in high places and are said to work faster. The Baltimore & Ohio lays particular emphasis on these qualifications in the selection of bridge painters.

Several roads contract all or a part of their maintenance bridge painting. This does away with the need of an organization for that purpose, the nucleus of which must be held over



H. E. CONRAD Vice-President

during the slack period. The same influences have been felt on this work which have caused the tendency towards contract work in other branches of the maintenance of way department, chief among which is the greater latitude allowed a contractor in the payment and selection of his men. Probably the most important reason for this has been the difficulty in obtaining capable foremen. The requirements are exacting. A foreman must not only be able to handle men, organize a new force each year, teach green men how to apply paint correctly and understand the safe swinging of scaffolds on high structures, but he must also be able to turn his hand during slack seasons to almost any other class of painting, including high grade interior work. Men of these qualifications are not always available.

The Chicago & North Western does a large part of the bridge painting by contract, the contracts being let by the engineer maintenance of way in units of a season's work for one division. The division engineer appoints an inspector, who is kept on the work constantly and the work is also given considerable attention by the division engineer and the master carpenter. This arrangement has given good satisfaction. The contractor furnishes the labor and equipment and the railroad company supplies the paint.

On the Canadian Pacific, repainting is contracted occasionally, depending upon the location, steel tonnage, nature of the structures, etc. In doing this work by contract, the railway supplies the paint at the nearest station and the contractor furnishes all labor and equipment. The contract usually provides one price per ton for painting and another for cleaning and scraping.

The Chicago Great Western has had a contract in effect for the last six years which is to be continued indefinitely until canceled at the option of the railroad or the contractor. Under this arrangement the contractor is required to paint any steel structure whenever the repainting is authorized, at an established price, which is on a tonnage basis for bridges and on a square foot basis for sheet metal work, such as coaling stations. The price includes a guarantee to maintain the paint on each structure for a period of 10 years from the date of painting it, the necessity for repainting or touching up to be determined by the railway maintenance officers. To establish the guarantee, a definite lump sum surety bond was required at the outset, and in addition the railroad company withholds for the 10 years 20 per cent of the funds due to the contractor on each job. After these deductions amounted to a specified sum, the surety bond was released. There is a further clause which specifies the maximum amount which the railway company can withhold. The contractor furnishes all labor and equipment as well as the paint.

Workmanship

As the work is now conducted on most railways, the economy and quality of the painting depends very largely upon the judgment, experience and general reliability of the paint foremen, supplemented by occasional inspection and general supervision by their superior officers. On the Michigan Central, the Frisco and the Burlington, standard instructions have been issued which specify the manner in which all the details of the work shall be carried out. In view of the frequent use on this work of men who do not possess the trade knowledge of the skilled painter, the benefits of such instructions cannot be doubted.

The importance of thorough cleaning cannot be emphasized too strongly. Cleaning is dirty, arduous, monotonous work, which it is difficult to get men to do properly. The work includes brushing of loose, light scale, the scraping of tight rust, the chipping of heavy scale and the removal of the resulting dust with a painters' duster. All scale and rust, and loose, blistered or checked paint must be removed, but good paint surfaces should not be disturbed. Heavy coats of paint in a checked or cracked condition may be softened by the use of lye. Some roads specify how this shall be done. The Burlington instructions are as follows: "The lye, in the proportion of 1 lb. per $7\frac{1}{2}$ gal. of



over the old work, allowed to stand till the paint is softened, and then brushed and washed off with water liberally applied. It will be necessary to use a hand force pump and hose for this, to remove every trace of lye from the old work." A blow torch may also be used for this purpose, while spots of oil should be removed with gasolene. On the Frisco, scrapers are made out of old flat files, and pean hammers are used for heavy scale. The sand blast seems

water, should be brushed

Vice-President

to have had a very limited use in cleaning bridges, although a number of roads report favorable results. While this equipment affords the simplest means for securing an absolutely clean surface and while there are conditions under which its use will result in a material economy, it is at a disadvantage on bridge work because of the loss of the sand after it has been used. The removal of heavy scale with a sand



blast should not be attempted, as it requires the expenditure of an excessive amount of time and sand, and there is danger that the removal of the scale will be accompanied by the removal of an undue amount of sound steel from adjacent portions of the surface. Its primary object is the removal of the thin tight sticking coating of rust and the thorough cleaning of the surface. For this purpose no other method can equal it. Owing to the rapidity with which a thin film of rust will be formed, surfaces cleaned by the sand blast should be painted immediately. The use of the sand blast has been found valuable under certain circumstances, and several roads have purchased a number of outfits, which are transferred from division to division, as conditions arise demanding their use. One objection which has been raised to the use of the sand blast is that it necessitates the spur-



F. W. HAGAR Secretary-Treasurer

ring out of a compressor car, an item that will add an expensive charge to a small job. However, there are now on the m a r k e t compressors mounted on skids that can be unloaded at the site of the bridge with small effort or loss of time.

The greater susceptibility of certain parts of a bridge to agencies tending to shorten the life of the paint, point to the economy of frequent repainting of those portions as, for instance, the floor system, or the touching up or spot p a in t in g of affected parts. Another practice

is the double coating of portions in the poorest condition. This is accomplished by cleaning all rusty parts and spot painting them with a body paint. After this has dried thoroughly, the bridge is given a complete new weather coat.

A difference exists as to the practice on special features, as, for instance, the top flange of stringers. The usual practice is to leave the ties undisturbed, painting the stringers between them and to leave the parts covered by the ties to be painted by the bridge carpenters whenever the ties are renewed. On the other hand, at least one road requires its painters to jack up the ties so that the tops of the stringers may be painted completely at one time.

SPECIAL CONDITIONS

Many roads, particularly lines handling solid trains of refrigerator cars, have suffered for years from the effect of brine drippings and various remedies have been suggested and applied from time to time. The covering of the top flanges of floor beams and stringers with felt or paper treated with hot bitumen compounds, advocated some years ago, has been abandoned. Most engineers offer no solution other than to repaint the affected parts frequently or to provide some means to deflect or shed the brine so that it will not come in contact with the steel. The Michigan Central has used wood strips between the ties for this purpose, while the Frisco has used old galvanized iron sheets. A number of experiments are now in progress which involve the use of coatings or protections of various kinds, none of which have been adopted

thus far as standard practice. The Burlington is using a coal tar paint and the Michigan Central is filling up the corners on the tops of bottom flanges with cement mortar, first cleaning the surface and coating it with asphalt primer or tar cement paint. The New York Central has experimented with special paint, coatings of coal tar and cement mixtures.

The paint on the under side of bridges, subject to the action of smoke and cinders from engines passing underneath, deteriorates very rapidly, being subject to wellknown destructive agents, corrosive gases and cinder blast. The latter is effective only where the smoke stacks are but a few feet below the metal surface.

That the influence of gas is severe is indicated by the fact that the constructions designed to eliminate paint have not always been a success. Even concrete-encased I-beam spans have shown serious deterioration, although, as in the case of the painted steel work, it is not clear whether the gas alone caused the trouble, or whether poor design and workmanship were partly to blame. It suffices to say that good drainage is absolutely essential for either the concrete or the steel bridge. The action of the gases is not nearly as severe where moisture is not present. Ventilation should also be obtained if possible. These difficulties have led to the use of reinforced con-crete wherever possible. The application of a relatively thin layer of concrete to the steel surfaces by means of the cement gun has also been used extensively. The New York Central reports favorably on the use of bitumen coating applied hot, stating that it resists the chemical action of the gases much better than ordinary paint.

The action of cinder blast is an entirely different problem. Where the conditions are severe, no paint, or even a concrete protection, can resist it. The only satisfactory solution would seem to be the introduction of a shield, which may be replaced as soon as it has been worn through. Steel and cast iron plates, asbestos lumber and even wooden boards have been used for this purpose. For the sake of economy and to avoid excessive interference with the ventilation, these shields are made only of sufficient width to receive all of the cinder blast of the stack.

DISCUSSION

A. H. Sabin stated that he believed it to be the duty of the railway master painters to make inspections of the highway bridges along the line of the railways and call the attention of citizens and public officers to the need of the proper care of such bridges. It was the consensus of opinion that the members could be of valuable assistance to the public in this way and that the railways would be glad to have them make an effort to enter into the public affairs of the communities in which they live, thereby furthering amicable relations between the public and the railways. The paper also brought forth some discussions of the spraying of paint on structural steel. H. E. Conrad stated that he had experienced no difficulty in carrying out the work by this process if the necessary pressure was available. He did not recommend the practice, however, as he believed that thorough brushing was necessary to obtain good results, although spraying proves of value where the work is inaccessible as in box girders, trough floors and the like. J. P. Lewis (Wabash) questioned the practicability of passing a heavy body paint through the spray. E. H. Brown called attention to the fact that carbon dioxide can be used to furnish the pressure for the spray and that compressed carbon dioxide is ready available in pressure tanks supplied to the trade for soda fountains and various other purposes. H. B. Wilson stated that he did not believe it

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was desirable to brush down paint thin on places that were subject to considerable abrasion. This led to considerable discussion of the practice in applying paint to structural steel.

SAFETY FIRST

By M. F. Ebel

Master Painter, Cincinnati, Hamilton & Dayton, Hamilton, Ohio

In painting the interior of water softener tanks, care should be taken to provide ventilation so that all fumes from the paint can escape. Steel water tanks should be treated in the same way. Open lights or torches should be kept away from any material of a volatile nature. This applies also to cars containing paint materials and where possible a keg of sand should be kept in a convenient place, with a scoop that can be used readily to cover a fire with the sand.

All ropes, hooks, planks and ladders should be inspected from time to time, particularly at the time of taking them from the car. There is always a chance that something may have been injured, cracked or broken in moving it from the preceding job.

In washing interior walls and woodwork in station or other buildings that are wired for electric light, it is always well to turn off the current before starting the work, especially around sockets or connections. The use of a wet sponge in such a place may give a man a sufficient shock to throw him off a scaffold.

As in the case of all other railway employees, caution must be exercised in the use of hand, motor or push cars on the main tracks. Whenever there is any question as to the safety of the use of the car, as when handling a loaded push car, it must be protected both front and rear by flags.

APPLICATION OF FIRE RESISTING PAINT

BY H. J. BARKLEY

Master Painter, Illinois Central, Carbondale, Ill.

Generally speaking, fire-resisting paints are divided into two general classes, one with a coal tar base and the other with a linseed oil base. A class by itself is the socalled water glass and common whitewash which was for years put on the insides of covered wooden bridges, a type of bridge that has almost ceased to exist.

The St. Louis division of the Illinois Central has a large number of open deck wooden trestles on branch lines, which we started to coat with fire-resisting paint in 1913. Both types of paint have been used since, and not a single dollar has since been lost by fire on any of the structures so treated. Previous to that time fires on such structures were frequent, causing a loss in time, traffic and money.

We found the best tool to be a half-worn four-inch wall brush made into a hatchet brush with a diagonal handle about four feet long. The coal tar product has to be heated, which is done in a 50-gal. iron kettle on the bank at the end of the bridge. Only the top and two sides of the guard rail and ties, the tops of stringers, caps and sub-sills where they are not covered with sheet metal, are coated. After a three years' trial we find that both types of paint have their advantages both as to covering capacity, permanency, and to actual fire-resisting qualities, for which we have tested them both in several ways.

Generally speaking, one gallon is figured for every four lineal feet of bridge. The temperature will affect the amount of material to some extent, as will also the size of the ties and whether they are surfaced or not.

The term "fire resisting" is often misused. A government report says that "There is no known way of making wood absolutely fireproof," but it is a fact that we can reduce the fire hazard to a great extent, as has been proved by demonstrations and by actual use. We know absolutely that coals of fire from a locomotive ash pan have caused countless fires and we also know that we can stop that kind of loss. A heavy timber structure in flames is another matter, but is a condition seldom encountered. In other words, fire-resisting paints seem to be a preventive rather than a cure.

It is my prediction that a greater amount of fire-resisting paints will be used in the future on timber bridges, coal chutes and like structures, not only on railroads, but in factories and the home.

DISCUSSION

Two other papers were presented which also covered the general subject of fire-resisting properties of paint, one by W. A. Clapp (Clapp Fire-Resisting Paint Company) on "Fire-Resisting Paints," and the other by G. F. Johnston (Pyroline Products Company), entitled "Reducing Fire Losses." In discussion of these papers, H. A. Gardner expressed the view that any good paint containing a mineral pigment has fire-resisting properties, since after the oil is driven off by the heat the surface is covered with a coating of purely mineral substances. E. H. Brown (Painters' Magazine) stated that he had found a heavy coat of lime whitewash, when protected from the weather, to be a good resistant. A number of the members spoke of their experiences with various formulæ containing whitewash as the principal ingredient.

ECONOMY OF SELECTING GOOD BRUSHES

By A. G. Pruett

Foreman Painter, Chesapeake & Ohio, Richmond, Va.

Undoubtedly, the best brush to use is the round brush. In the hands of a skilled mechanic, the elastic round brush will spread and brush in paint better than any other. However, the lack of good mechanics who understand how to bridle and break in round brushes has led to the adoption by most painters of oval or flat brushes of various sizes. Set in rubber or cement, a good leatherbound, flat brush, size No. 30, is a good all-round brush for railroad work. A good oval brush is very good for painting bridges. A $1\frac{1}{2}$ -in. brush set in rubber makes a good sash tool.

The precaution taken by some painters to test the quality of the brushes they buy would seem decidedly worth while. The safest course is to buy only good quality brushes from reputable firms. Examine the brushes carefully and make tests that will indicate the presence of imitation bristles. The quality of the bristles determines almost entirely the quality of the brush. Good bristles taper, are split at the end and curl when burned, but do not flame. Imitation bristles burn like cotton. Horse hair does not taper, but has square ends and lacks the spring of the genuine bristles. It makes a flabby brush. Sometimes four or five different lengths of bristles are used in a high grade brush. Besides giving the proper spring and stiffness, the shorter bristles prevent the brush from becoming stubby after a little use. As the brush wears down, this shorter stock with its flag ends comes into service and the brush wears down evenly and maintains the proper working level.

For kalsomine work a No. 7 kalsomine brush with bristles $5\frac{1}{2}$ in. long is desirable. One should see that there is not too much short stock in the center, nor imitation bristles in the brush. For varnishing, most painters prefer brushes that are set in rubber with metal ferrules. They are oval in shape and chisel edged. Great



care should be taken that no imitation bristles are present, as breaking bristles on a varnish job make serious trouble. Stippling brushes should be about $3\frac{1}{2}$ in. wide by 9 in. long, the bristles should be stiff and strong with no short stock. For cleaning out filler from moldings or ornaments and for rubbing with pumice stone and oil or water, rubbing brushes are time and labor savers. They are more economical than burlap and other similar devices. They are made similar to dusters with tough bristles about an inch long.

A good flat duster is more desirable than a round one, especially on bridges over water, as the round ones are more apt to roll off. Flowing brushes, made of bear hair and ox hair, are time and money savers and give excellent results on special jobs. In painting radiators they flow the bronze on without leaving any brush marks, give a better luster to the bronze, spread the paint thinner and make it go farther. These brushes are thin and mounted on rather long handles, making it easy to paint the inside coils of the radiators.

Floor-waxing brushes are made very much like the rubing brushes, except that they are larger, about six or eight inches, have a long handle and are weighted to about 25 lb. Stencil brushes should be short, round and stubby. A good stencil brush can be made out of a round brush, bound short, though any round brush with good, even, springy bristles will serve the purpose. Where rust must be removed wire brushes of various shapes and sizes are required.

DISCUSSION

E. H. Brown commended the paper, but stated that the information it contained was of little use to the painter at the present time because of the impossibility of getting good bristle brushes under the existing market conditions. Before the beginning of the European war practically all high-grade bristles used in brushes came from Russia. These bristles were sold every year at the Nigni Novgorod fair, most of them going to Leipsig, where there was an extensive industry in the sorting and cleaning of these bristles preparatory to their use in brushes. Since the war, this commerce has been interrupted and nothing has been arranged that definitely takes its place. He also stated that bristles are produced in quantities in China, but this market is at present in an unsettled state on account of the activity of the Japanese in obtaining control of it.

A Concrete Post Plant on the Lackawanna

A Small Force Is Enabled to Produce a Considerable Output by Utilizing By-products of Ballast Crushing Plant

THE Delaware, Lackawanna & Western operates a concrete fence post plant at Hog Mountain quarry, about two miles east of Boonton, N. J., where the road has a crushing plant for the production of broken stone ballast. The stone is an excellent grade of granite and the material passing a ¾-in. screen, which is not used for ballast, is employed in the manufacture of the concrete posts.

THE PLANT

The plant consists of a seasoning room, a mixing room and a cement storage house. The seasoning room is 40 ft. wide by 50 ft. long, and is equipped with racks on which to place the molds during the seasoning of the posts. It also contains a 15-hp. upright boiler, located in the center of the room, for heating during the winter season when the crushing plant is idle. The mixing room



PILE OF COMPLETED POSTS

is 16 ft. wide and 20 ft. long and is adjacent to one end of the seasoning room. It contains a $\frac{1}{2}$ -cu. yd. Smith mixer, with an upright engine to drive it, and also a small engine to drive the conveyor, which handles the stone from the crushers to storage bins which hold about 30 cu. yd. of stone. The room also contains benches for cleaning, oiling and filling the molds. The cement storage house and the sand bins are located convenient to the mixing room.

In the operation of this plant the stone passes from the bins through a gate to measuring boxes which empty directly into the mixer, avoiding all manual handling of



the stone. The sand and cement are handled from the cement house and sand bins to the mixer by hand. Metal molds furnished by the D. & A. Post Mold Company, Three Rivers, Mich., have been used in this plant since 1910. These molds are carefully cleaned and thoroughly oiled just before using them each time, to insure a smooth surface for the finished post and to prevent the concrete from sticking to the molds. After cleaning and oiling they are passed to the shaker rack of the molding machine, where the reinforcement is placed and the concrete is poured. This shaker rack will handle 8 molds at a time, and is provided with a longitudinal shaking motion which serves to shake and settle the concrete in the molds and insure proper density and a smooth, weatherproof surface. After adequate shaking the posts are transferred to the seasoning room in the molds in which they are allowed to remain for a period of 30 to 60 hours. depending upon the weather conditions. After the seasoning they are placed on a car and transferred to the storage ground, some 300 ft. from the plant, where they are unloaded and stored on end in piles ready for shipment.

During the summer season the plant is operated at the rate of 200 posts per day. In the winter the force is reduced and the output is 100 posts per day. The winter force consists of a foreman, who also runs the engine and feeds the mixer, one man to clean and oil the molds and two men to fill the molds, place the reinforcements and transfer the molds to the seasoning racks in the seasoning room. During the summer season this force is augmented by four men who rack and load posts on cars and unload all material received.

DETAILS OF THE POSTS

Four types of posts are manufactured, as shown on the accompanying drawing, viz.: A standard line post, an anchor brace or corner post, an iron fence post and a barbed wire special post. The line post is made in a "U" shape mold, 7 ft. 6 in. long, tapering from $3\frac{1}{2}$ in. at



IRON FENCE AND BARBED WIRE POSTS

the top to $5\frac{1}{2}$ in. at the bottom. Wire fence connections are made by looping a tie wire around the posts, Western Union style. These posts each contain 0.16 bags of cement, 0.31 cu. ft. of sand and 0.6 cu. ft. of $3\frac{1}{4}$ -in. stone. The cost of the post, including material and labor, is 19 cents. The corner post is 8 ft. long, of square section tapering from 7 in. to 5 in., and costs 38 cents.

The post used for iron fences is of the same shape and size as the corner post, but is reinforced with an iron bar, $\frac{3}{8}$ in. by $\frac{11}{2}$ in. in section, 5 ft. 6 in. long, located in the center of the post and to which are riveted short cross pieces of the same section of sufficient length to project beyond the faces of the post and serve as convenient connections for the horizontals of an iron railing. These posts cost 94 cents each. A further modification of the corner post is the "barbed wire special" for use in locations on the right of way where it is desired to offer the maximum obstacle to climbing over the fence. The reinforcement of this post is identical with that of the corner post (four bars), except that a $\frac{3}{4}$ -in. square bar is set in the top of the post with a projection of about 14 in., bent at an angle of 45 deg. with the axis of the post and punched with $\frac{1}{4}$ -in. holes for fastening barbed wire. Posts of this type cost 69 cents each.

EXPERIENCE WITH THE POSTS

Part of the first year's operation in the manufacture of the posts was along experimental lines, special attention being given the various kinds of reinforcement. The first reinforcement used consisted of flat bars of hoop steel $\frac{5}{8}$ in. wide and No. 18 gage, using four pieces of this reinforcement to the post, uniformly spaced about $\frac{1}{2}$ in. inside of the surface. A large number of posts were manufactured with this type of reinforcement and proved entirely satisfactory. Later round rods were substituted for the flat bars and are used at the present time.

In the standard post this reinforcement consists of one 5/16-in. rod in the bottom of the mold and two $\frac{1}{4}$ -in. rods near the top of the mold; that is, on the flat side of the post near each corner. A third $\frac{1}{4}$ -in. rod, half the length of the others is placed in the face of the post so as to project about 24 in. above the ground level, and thus increase the strength of the lower portion of the post.

The posts were first made with a mixture of stone dust with stone passing a $\frac{3}{4}$ -in. ring and held on a $\frac{1}{4}$ -in. screen, thus using practically the entire by-product of the crushing plant and eliminating the use of sand. This proved unsatisfactory, however, as the stone dust contained a considerable portion of clay and dirt. As a result of this experience the standard mixture is now one part cement, two parts washed sand and four parts stone, passing a $\frac{3}{4}$ -in. ring and retained on a $\frac{1}{4}$ -in. screen.

In loading the posts in cars it is the practice to pack them in wood shavings and clippings from the adzing and boring plant. This reduces the breakages to a minimum.

Since opening the plant in August, 1910, 100,000 posts have been manufactured, of which 75,000 are the standard line posts, the rest consisting of the various special posts. This plant is operated under the direction of A. J. Neafie, principal assistant engineer, Delaware, Lackawanna & Western, to whom we are indebted for the above information.

SPECIAL RAIL INSPECTION

N 1912 a special inspection service for rails supplementary to that previously employed was inaugurated by Robert W. Hunt & Company, Chicago, since which time it has been applied to over 4,500,000 tons of rails. While the ordinary inspection made by this and other testing companies is confined primarily to an examination of the finished rail, this special inspection provides for the stationing of additional inspectors throughout the mill where they can observe the important steps in the manufacture of rails. As this service has now been in effect for four years it is possible to give some idea of its merits and of the results it is accomplishing. The November Employees' Bulletin of Robert W. Hunt & Company contains an analysis of the statistics prepared by the rail committee of the American Railway Engineering Association for the year ending October 31, 1915, showing the number of failures reported from rails rolled under the special inspection as compared with those not subjected to it. This study shows that there were 19.6 failures reported per 100 track miles of rails rolled under this special inspection as compared with 26.4 failures



reported for those to which this inspection did not apply, or that the number of failures was 40 per cent less with rails subjected to the special inspection.

A NEW 90-LB. RAIL SECTION

THE Chicago & Northwestern has designed a new 90-lb. rail section for use in its 1917 rolling, which embodies a number of features of interest. Before designing this section careful consideration was given to the probable necessity for increasing the weight of rail in the future and the conclusion was reached that the 90-lb. and 100-lb. sections will be sufficiently heavy for the traffic of the Northwestern for many years. A new 100-lb. section was designed two years ago and has been used since that time with very satisfactory results. The new 90-lb. section has been designed for main line use with that section. While not the governing principle in the design of the new rail, advantage was taken of the opportunity to adapt it to the 100-lb. joint to enable the same angle bars to be used with both sections of rail. Also the same joints and intermediate tie plates may be



NEW C. & N. W. 90-lb. Rail

used for both the new 90 and 100-lb. sections, although the width of the base differs slightly. This uniformity of fastenings will not only prevent confusion, but will result in very material economies in the amount of material held in stock.

In designing the new section an endeavor was made to secure a sufficient fishing depth to enable a joint of the requisite strength to be used and also to secure a thicker base than previously employed. As a result the new section is a compromise between the American Railway Association, A and B sections. The rail has the same thickness of flange as the B section (1 1-32 in.), but has a fishing depth of $\overline{2}$ 31-32 in. as compared with 3 5-32 in. for the A. R. A. type A section and 2 5% in. for the B section. As a result, the moment of inertia approaches that of the A section, being 36.72 as compared with 38.70 for the A section and 32.3 for the B section. To secure the desired distribution of metal, the head and the web are 1-16 in. narrower than the American Railway Association section. Thirty-eight per cent of the metal is in the head of this section, as compared with 36.2 per cent in the A section and 40.1 per cent in the B section. This rail has been designed under the direction of W. H. Finlay, chief engineer.

STEEL BUNKS FOR CARS AND TENTS

'ITH the growing scarcity and increased cost of labor and the greater degree of attention given to secure the maximum efficiency of the labor output, railroads are giving increased attention to the comfortable housing of the men in construction or maintenance camps. One evidence of this has been the substitution of old passenger coaches and sleepers and canvas tents or bunk houses for the conventional bunk car. The accompanying photograph shows a passenger car in bunk car service in which sanitary steel bunks replace the boxed or wooden bunks commonly used. The bunks shown are double-deck angle bunks standing on four legs, independent of any support from the car structure. Other bunks may be had which are supported by chains and hooks from the sides of the car in one, two or three tiers. Instead of supporting them from the sides of the car, iron pipe standees secured to the floor and ceiling may be used.

One feature of this type of bunk is the provision for the easy removal by unhooking from the supporting chains. At the same time the bunks are secure against unhooking when in use. These bunks may be fitted with either wire fabric or canvas bottoms; the former are said to give the best results. These bunks are known as the



CAR EQUIPPED WITH ROMELINK BUNKS

Romelink bunks or berths, and are manufactured by the Southern-Rome Company, Baltimore, Md. They are said to be much cheaper than wooden bunks, while offering much less opportunity for the accumulation of filth and vermin. An installation of these bunks is in use on the Baltimore & Ohio.

A ONE-MAN RAILWAY.—A new use has been found for an abandoned railroad. The Idaho Southern Railway, built and in active service while the great irrigation projects of the Twin Falls country were under construction, was later abandoned by the owners. An enterprising Idaho man saw an opportunity, so he leased the track, ordered built for him a sixteen-passenger high-powered automobile, fitted with flange wheels, put it on the track with two light trailers for freight and express. He operates his auto train on a regular schedule and has the only one-man railroad in existence so far as known. The line extends from Jerome to Gooding and is reported to be doing a good business, considering the capacity of the equipment operated.



CREATING A FRIENDLY SPIRIT TOWARD THE ROADS

Two Discussions of the Opportunities for Section Foremen to Promote the Interests of Their Employers

N their endeavor to cultivate favorable public opinion the railroads have generally overlooked the opportunities their section foremen possess to promote friendly relations with the residents of the smaller communities along the line. In many instances these men can be of material assistance to their employers in this campaign by handling efficiently those details of their work which bring them in contact with the public. Many of the railways have not realized the extent to which the occasional lack of attention to maintenance of highway and farm crossings, of drainage ditches and of fences has contributed to the general antagonism through the agricultural communities. For this reason the two articles following are published to emphasize the opportunities which the railways and the section foremen possess to remove this feeling.

THE RAILWAY AS A NEIGHBOR

By Track Man

The section foremen, from the nature of their duties, are the custodians of the railway right of way. They are, therefore, the representatives of the railways with whom the adjacent land owners, particularly in the agricultural communities, come most in contact and they are responsible more than any other group of employees for the sentiment which the farmers bear towards the railroads. The roads have been subjected to a large amount of adverse and restrictive legislation in recent years, particularly in the middle western agricultural states. This condition has resulted from a general feeling that a railroad is a foreign corporation without any interest in local conditions and from direct antagonism because of the multiplication of numerous instances of neglect and the assumption on the part of some roads of an attitude of indifference towards the local communities. More recently the roads have given a large amount of attention to means to overcome this feeling on the part of the public. They have not, however, in general realized the important place the section foremen hold in this campaign of education nor have the foremen themselves fully grasped the opportunity to further the interests of their employers by combating this spirit of antagonism on the part of those residents along the line with whom they come in contact in the course of their regular duties.

In many communities the section foreman and the agent are the only representatives of the company and the attitude of the railroad as seen by the citizens depends largely upon the relations which these men bear to the community. The agent comes in contact directly with the residents of the village and the patrons of the road, while the section foreman meets the adjacent property owners more directly and the road is popular largely to the extent that the dealings with these men is satisfactory. Each in his sphere can and does exert an important influence on the standing which the road which employs them enjoys in their respective communities. This does not mean that a foreman should leave other duties to undertake a campaign of education, for he now has all the work he can handle successfully. Rather the results desired will be secured by the proper performance of the duties coming within his regular activities.

As the owner of its right of way a railway becomes a

neighbor with the adjacent owners of land and their tenants, with many of the relations this situation commonly presents. They have numerous interests in common, including the maintenance of fences, highway and farm crossings, drainage ditches, etc. While these have been the subject of legislation defining the duties and rights of each they cannot be settled satisfactorily entirely upon this basis. A railroad is required by law to maintain proper fences and to provide farm crossings under certain conditions for the use of the farmer. It is also prevented from interfering with the natural drainage of the land. There is, however, a wide difference between the maintenance of fences, for instance, in a manner which comes within the law and that which is commonly regarded as satisfactory. The indifferent manner in which this work may be handled may not result directly in damages to the road because of the fact that a farmer is not willing to incur the expense involved in a lawsuit, but it is no indication that he does not feel resentment and will not take the first opportunity to attack the road. On the other hand, a farmer is frequently careless in

the handling of gates at farm crossings, since the railroad is required to install and maintain them while he may make no effort to prevent stock from getting out on the track and being killed, the railroad paying for it. Likewise, during the harvest season some farmers make a practice of stacking their grain close to the fence, thereby increasing the fire hazard and the liability for claims later.

While all claims, or even all unfair ones, cannot be eliminated, many can and will be if the section foreman secures the confidence of the farmers along the right of way and impresses them with the desire of the railroad to be fair. Investigations will usually show that claims are most frequent on those lines where the farmers are most hostile to the railroads. When the average farmer realizes that the road is doing its full share to maintain the fences and to protect his stock, to keep the drains open, and the farm crossings in repair he will be far less desirous of taking every opportunity to file claims. It is in this way that attention to the proper maintenance of these facilities by the section foremen will promote friendly relations with the farmers and pay direct returns to the railroads.

There is also an indirect but nevertheless an important return from the traffic standpoint, particularly at competitive points. The farmers are producers of large quantities of live stock and grain which they are themselves shipping more generally each year and which they will naturally route over the road towards which they are most favorably inclined. Fair consideration of the rights of the farmers on the part of the section foremen is a very effective means of traffic solicitation under such conditions. A still further effect of a friendly attitude on the part of the farmers will be reflected in the nature of the demands made on the railroads by highway commissioners and other local authorities. There is almost continual contact between the railways and the public authorities which may become a source of considerable discord and difficulty if not properly handled. The value of a friendly board of highway or street commissioners is particularly evident when a railway has improvements in view for which it desires changes in grade or in the location of roads or similar improvements.

While the values which accrue to a railroad from the cultivation of friendly relations along the line are more or less intangible they are nevertheless real in the aggregate. The section foremen have an opportunity to perform a distinct service for their railroads while adding practically no additional duties on themselves. In fact, in many instances their duties will be lightened by the co-operation which they will secure from the farmers in maintaining fences, in driving stock off the right of way, etc., while the continued criticism and the necessity for explanation of complaints will largely disappear.

THE TRACK MAN AND THE PUBLIC

BY E. R. LEWIS

Assistant to General Manager, Duluth, South Shore & Atlantic

Public opinion, as it concerns railway companies, is molded to a great extent from the personal contact of individuals; from the experiences of patrons of the railway companies with their officers and employes, and from verbal and printed reports of the dealings of these individuals with each other on the business of patron and railway, of public and of corporation.

The importance, therefore, of the impressions made by the railways' representatives, on those persons with whom they come into contact, cannot be overestimated, but is too often unheeded or underestimated. Men of affairs have ever recognized the value of courtesy in all dealings with each other. Railway managements are by no means remiss in this particular, as is evidenced by instructions issued and placards displayed for the benefit of officers and employees.

The section foreman is selected to police the company's property. He is instructed to prevent trespass; to resist encroachments; to take charge of property found and stock killed or injured on the right of way; to preserve property posts, boundary fences and land line monuments; to keep waterways open and to be informed on all alterations to drainage proposed or carried out in the neighborhood of the company's property, which might affect the safety of the roadbed. The section foreman is charged with insisting that farm gates be kept closed. He is first appealed to for farm and highway crossings. He is asked for help to prevent and stop fires. He must cut the brush from about right-of-way fences and to fell or trim trees which endanger telegraph and telephone lines, and which may fall across tracks. He must set up snow fences, keep crossings clear of snow and ice, prevent persons from icing crossings for sleighs in winter, take care of fallen telegraph and telephone wires, and take responsibility for the maintenance of cattle guards, wing fences, signs and warning bells.

In all these duties and others, the section foreman comes into contact with the public, with those whose property adjoins that of the railway company, with owners and tenants, and lessors; with residents and tramps; with farmers, townsmen, tradesmen; with automobilists and teamsters; with truckers and pedestrians. These persons are the railway company's neighbors and patrons. They claim, one and all, the right to express their opinions, to voice their complaints, to make their claims, to argue their cases and to enforce their demands. They are naturally most likely to appeal first to the most accessible of the railway company's representatives. If satisfaction is not readily forthcoming, the company is blamed. Now, the section foremen is, or should be, one of the representatives most accessible to the public in these cases, and he must be prepared to rise to the occasion.

Railway men in the maintenance of way departments too often err in paying attention too strictly to their own particular line of work, to the exclusion of everything outside those limits. A section foreman frequently is, and should always be, a man among men in his community. He should make his influence felt when occasion arises. He should be as keen to get business and to preserve good will for his company as are the general manager, the freight and passenger traffic managers, agents or others who represent the company. The section foreman can do a great deal for his employers along these lines. He is often in court as a witness and as a juryman. He is often a householder and a taxpayer, nearly always a voter, frequently a highway commissioner or member of a school board.

Though the responsibilities of his position are heavy and his hours of service long, yet the section foreman may and should be a leader among men in his community. His opportunities to make his influence felt among his neighbors for the company's good and his own are plainly many. The danger is that the section foreman himself may not realize, and so neglect, to take advantage of his opportunities in this extended sphere of influence. Railway companies need worthy, hard-headed representatives in every department and community. Their influence should be felt throughout the land in favor of their companies, on all questions of the day, for of such is the kingdom of earth.

It is therefore the duty of the roadmasters, the supervisors and their assistants, to bring section foremen to a lively realization of their influence for the public weal and for the increase of their companies' business. The section foreman should know the residents along his section. The roadmaster should know the owners and tenants of property adjoining the railway. Requests, however seemingly absurd, from patrons of the company should receive respectful and prompt acknowledgment and attention.

The company's interests demand that every officer and employee shall give his best efforts toward getting and keeping business. The business of a railway company is the sale of transportation. Section foremen often hear of people wanting information on freight and passenger routing and rates. It is easy to recommend their own company's route and to put the inquirer into communication with the proper officer to supply the details and place the business. Foremen can do much to prevent claims for damage and to minimize those which cannot be prevented. Many claims are presented as the result of inattention. Many large claims are paid through the courts which might have been settled as very small items if promptly handled. Delay is annoying to the average railway patron, and delay has more to do with that dissatisfaction which has placed railways in disfavor than any other one factor. If a foreman or roadmaster can expedite settlement of any question opened by his company's patrons, he will be doing a service to the whole railway world.

The maintenance department should be organized not only as a machine to care for track, but as a body of men capable of leading men in any public enterprise, of influencing the public to understand and insist on fair dealings with and for railway companies. The leaders of these trackmen are the roadmasters. To them we must look for the necessary leadership.

A CHECK ON RECKLESS DRIVING.—To check the speed of automobiles before passing grade crossings, the city of Los Angeles has installed "humps" in the pavement on each side of the tracks for a short distance.

GENERAL NEWS DEPARTMENT

THE GRAND TRUNK has accepted an award, made by the governmental Board of Conciliation, increasing the pay of track repair laborers 25 cents a day, and advancing the pay of track foremen 20 cents a day.

THE INTERSTATE PASSENGER BUSINESS of the Atchison, Topeka & Santa Fe in the state of Kansas, according to the figures submitted to the Kansas Public Utilities Commission, yields a return of only 1.489 per cent.

THE PENNSYLVANIA RAILROAD has spent over \$40,000,000 for the removal of grade crossings on the lines east of Pittsburgh since 1902. While a large number of crossings have been eliminated a much larger number still remain.

THE UNITED STATES STEEL CORPORATION and other steel companies have announced a further increase of \$5 per ton in the price of rails. This makes the price of open-hearth rails \$40 a ton and Bessemer rails \$38, an increase of \$10 per ton since last spring.

THE SOUTHERN has painted "barber pole" signs at all of its crossing gates, in accordance with the standard recommended by the American Railway Association. The stripes are alternate black and white, eight inches wide, running at an angle of 45 deg.

THE UNITED STATES STEEL CORPORATION has announced an increase of 10 per cent in the wages of the employes of its steel and iron companies, effective December 15 next. The increase affects in all about 200,000 employes, and adds nearly \$20,000,000 to the corporation's annual pay roll.

THE CHICAGO, MILWAUKEE & ST. PAUL placed in service its third electrified district, extending from Deer Lodge, Mont., to Alberton, a distance of 110 miles, on November 1. This road now has 336 miles of line under electric operation, extending from Harlowton, Mont., to Alberton, and will place the fourth and last district from Alberton to Avery, Idaho, in service about January 1.

THE PENNSYLVANIA RAILROAD reported that in the eight months ending September 1, 13 people lost their lives and 104 were injured at grade crossings on the system. Out of this number no less than 23 drivers of motor cars smashed their machines into the sides of trains that were actually part way over the crossings, causing 4 persons to be killed and 51 injured. Six motorcycles, 2 bicycles and 4 horse-drawn vehicles were similarly driven into the sides of trains.

THE AMERICAN RAILWAY ASSOCIATION statement of freight car surpluses and shortages for November 1 showed a net shortage of 108,010 cars, the largest since these figures have been compiled. This is an increase from a net shortage of 60,697 cars on September 30 and is in contrast with the conditions for the eight years preceding August, 1916, when there was a continuous net surplus except for one month in 1909, three months in 1912, one month in 1913 and the month of March, 1916.

MEXICAN railway employees are not allowed to strike as a body in Mexico, as a result of which, the men in the repair shops along the northeastern Mexican roads recently hit upon the idea of striking in small groups at a time until everybody was out. The chief grievance of the men, it is said, is that they were paid in paper notes. As this currency fluctuates greatly, the men insisted upon being paid in gold. Their demands were refused by the Carranza authorities and the strike ensued.

THE GRAND TRUNK will issue annual passes to employees having been 15 years in the service on January 1, 1917. If a man is married the pass will include his wife. Each pass will be good over either the Eastern Ontario or Western lines, according to the territory on which the man is employed. Employees having been 20 years in the service will receive annual passes for themselves and wives, good over the entire system. Former employees now on the pension or superannuation rolls will be considered, with reference to length of service, as employees and will be accorded the same pass privileges.

THE CHICAGO, MILWAUKEE & ST. PAUL ROADMASTERS' ASSO-CIATION held its tenth annual meeting at the Republican House, Milwaukee, Wis., on November 1 to 3, inclusive, with about 30 roadmasters present. Reports were presented on The Oiling of Track Appliances to Prevent Corrosion and the Causes of Our Present Labor Conditions and the Remedies. A. M. Anderson, roadmaster at Milwaukee, Wis., presided. The officers selected for the next year were R. Whitty, president, Horicon, Wis.; Dave Mau, vice-president, Chicago, Ill.; W. H. Kofmehl, secretary-treasurer, Elgin, Ill. Milwaukee was selected as the location for the next meeting.

THE LEHIGH VALLEY has stationed a complete emergency train at Easton, Pa., to house and feed workmen at out-of-the-way places on occasions of important repairs or serious troubles due to washouts, etc. The company bought two sleeping cars from the Pullman Company and fitted up two coaches as additional hunk cars, while another car was stripped of seats and a metal trough placed along either side at waist height for convenience in washing. Two additional coaches have been equipped with longitudinal tables and two rows of seats for use as a dining car. Between them is the kitchen car, made over from an old dining car. This kitchen car is equipped with an additional range, steam-tables and a refrigerator.

WILLIAM C. EDES, chairman of the Alaskan Engineering Commission, reports that much progress has been made on the construction of the government railroad. Forty-nine miles of track have been laid from Anchorage, which, with the 71 miles of the old Alaskan Northern now in operation as far as Kern Creek, makes 130 miles of the 470 needed to connect Seward with Fairbanks. The tracks so far laid from Anchorage comprise about 6 miles southward toward Seward, 38 miles of main line northward to Fairbanks and 15 miles on the Matanuska branch and into the coal fields near by. Rail will be laid in the near future as far as Potter Creek, 15 miles from Anchorage, from which point the rock excavation work will be undertaken during the coming winter.

PRESIDENT WILSON has prepared a preliminary draft of his message to Congress, in which he recommends legislation along the lines proposed at the time the Adamson law was passed, but upon which no action was taken at that time. The measures advocated include provision for the enlargement and administrative reorganization of the Interstate Commerce Commission, explicit approval by Congress of the consideration by the Interstate Commerce Commission of an increase in freight rates to counterbalance additional expenditures by the railroads because of the eight-hour law, a compulsory arbitration measure, and a law providing for the government use of the railways in times of military necessity. Needless to say, organized labor is bitterly opposed to the contemplated compulsory arbitration measure, and at a meeting held in Baltimore by leaders of the American Federation of Labor and the four railroad brotherhoods a frenzied demonstration followed a most radical speech by Samuel Gompers, who denounced the proposed legislation bitterly.

THE WEST VIRGINIA SUPREME COURT has held that when, by agreement with the adjoining land owner and for adequate consideration, a railroad rightfully turned the course of a stream, and in the absence of a contract to do so, the railroad is not liable, therefore, to observe the action of the water and to protect the banks or take other timely measures to prevent its encroachment on the adjoining land. It is the owners duty to protect his property and if he suffers damage by erosion he cannot recover from the railroad. The bridge originally built by the railroad over such a water course had decayed or been washed away by high waters, and because of the owner's negligence in failing to protect the bank on his land, the channel of the stream had been greatly deepened and widened. It was held that the whole burden of rebuilding the bridge and approaches thereto would not be enjoined on the railroad, but it might be required to build and maintain the crossing and bridge as if the conditions were the same as when it built the original crossing and bridge over the water course and right of way.

last issue, was born at Hamilton, Ont., on April

from the University of To-

ronto in 1901, entering

railway service the same

year as draftsman and act-

ing resident engineer of

construction on the Van-

couver, Victoria & Eastern,

in British Columbia. In

1902 he was appointed as-

Grand Trunk at Hamilton, Ont., and the following

year went to the Kenwood

Bridge Company, Chicago,

Ill., as draftsman. He remained with this company

until 1905, when he went in

the same capacity to the Canadian Bridge Company

at Walkerville, Ont. Dur-

sistant engineer

He graduated

on the

20, 1877.



GENERAL

M. C. SELDON, division engineer of the Chesapeake & Ohio at Richmond, Va., has been appointed trainmaster of the Rivanna district at Charlottesville, Va.

JAMES E. TURK, general superintendent and formerly supervisor of track and division engineer of the Philadelphia & Reading, has been appointed assistant to the general manager.

E. F. ROBINSON, chief engineer of the Buffalo, Rochester & Pittsburgh, has been promoted to the position of general manager, with headquarters at Rochester, N. Y. He will continue to administer the duties of chief engineer. Mr. Robinson was born at Earlington, Ky., on March 16, 1874, and graduated from Rose Polytechnic Institute, Terre Haute, Ind., in 1894. He entered railway work as a masonry inspector with the Cleveland, Cincinnati, Chicago & St. Louis at Mattoon, Ill., in December, 1895. He was appointed assistant roadmaster of the New York Central & Hudson River at Lyons, N. Y., on October, 1898, and became roadmaster on Chicago, St. Paul, Minneapolis & Omaha at Worthington, Minn., on September, 1899, which position he held until his appointment as superintendent of maintenance of the Butte, Anaconda & Pacific at Anaconda, Mont., on October, 1901. One year later he became engineer of track of the Buffalo, Rochester & Pittsburgh, with office in New York. He was appointed chief engineer in November, 1907.

ENGINEERING

R. G. WYMAN has been appointed division engineer of the Atchison, Topeka & Santa Fe, eastern lines, with office at Amarillo, Tex., succeeding J. W. Walter.

CHARLES A. LEMMON, chief engineer of the Butte, Anaconda & Pacific, has resigned to become assistant to the general manager of the Anaconda Copper Mining Company, Anaconda, Mont.

A. LECKIE, assistant engineer of the Arkansas Western, with headquarters at Pittsburg, Kan., has been appointed division engineer of the Kansas City Southern, with headquarters at Kansas City, Mo. He succeeds E. M. Basye, assigned to other duties.

E. G. LANG has been appointed division engineer of the Missouri, Kansas & Texas, with headquarters at Oklahoma City, succeeding G. H. Cravens, resigned to engage in private engineering practice. Mr. Lang was formerly roadmaster at Parsons, Kan.

W. C. PEARCE has been appointed division engineer of the Chesapeake & Ohio with headquarters at Richmond, Va., succeeding M. C. Seldon. F. D. Beale has been appointed acting division engineer at Clifton Forge, Va. J. W. Gleason has been appointed acting division engineer at Ashland, Ky., and H. A. Bertram has been appointed acting division engineer at Peru, Ind.

H. H. JOHNTZ, office engineer in the maintenance of way department of the Missouri, Kansas & Texas, has been appointed assistant engineer on general maintenance and construction work, with headquarters at Parsons, Kan. W. P. Christie, formerly assistant engineer with the Union Pacific at Castle Rock, Utah, has also been appointed assistant engineer in the office of the engineer maintenance of way at Parsons, Kan. L. E. Willis, transitman, has been promoted to the position of assistant engineer in the same office.

WILLIAM H. VANCE was appointed chief engineer of the Louisiana & Arkansas, with headquarters at Stamps, Ark., on November 1. He was born at Effingham, Ill., on November 6, 1876, and graduated from the University of Illinois in 1899. On March 1, 1902, he entered railway service with the Peoria & Eastern as assistant engineer, remaining in that position until March, 1905, when he was appointed assistant division engineer of the Missouri division of the St. Louis, Iron Mountain & Southern. He went to the Louisiana & Arkansas on June 1, 1906, as division engineer, remaining in that position until October 20, 1909, when he was appointed engineer maintenance of way, which position he held until his recent promotion.

J. S. MCBRIDE, recently promoted from valuation engineer to principal assistant engineer of the Chicago & Eastern Illinois, with office at Chicago, Ill., was born at Louisville, Ky., and graduated from the Rose Polytechnic Institute, in civil engineering. In 1905, he entered railway service with the Chicago & Eastern Illinois as instrument man on construction and maintenance, since which time he has been continuously in the employ of that road. In 1908, he was appointed assistant engineer of the Illinois division at Salem, Ill., and in 1914, was promoted to valuation engineer at Chicago, Ill. As principal assistant engineer, he will continue to have charge of the federal valuation work in addition to taking care of his new duties.

WILLIAM A. DUFF, the announcement of whose appointment as assistant chief engineer of the Canadian Government Railways, with headquarters at Moncton, N. B., was made in the



WILLIAM A. DUFF

ing 1907 and 1908 he was chief draftsman in the bridge department of the Transcontinental Railway at Ottawa, Ont., being promoted to assistant engineer of the same road, which position he held until 1913, when he was appointed engineer of bridges of the Canadian Government Railways at Moncton, N. B. He held this latter position when appointed assistant chief engineer as noted above.

GEORGE W. CORRIGAN, roadmaster of the Southern Pacific at Hornbrook, Cal., has been appointed division engineer of the Stockton division, with office at Stockton, Cal. He was born at Harrisonville, Mo., in September, 1876. He graduated from the engineering department of the Missouri University at Columbia, Mo., in 1900, and immediately entered railway service with the Union Pacific as a rodman, later becoming an instrumentman on location and construction. From January, 1901, to November, 1907, he was employed by the Missouri Pacific, first as assistant engineer and then as division engineer, engaged chiefly on location and construction. From May, 1908, to March, 1911, he was assistant engineer maintenance of way on the Southern Pacific, and from March, 1911, to September 15, 1916, roadmaster with this same company. He succeeded L. Beauman, resigned.

ELMER H. BROWN, roadmaster of the Northern Pacific at Dilworth, Minn., has been appointed supervisor of bridges and buildings, with office at Minneapolis, Minn., effective November 1. He was born at Buffalo, N. D., on November 25, 1886. Upon graduating from Olivet College, Olivet, Mich., he entered the United States Reclamation Service, and the following year, 1909, took employment with the Northern Pacific in the construction department. During 1911 and 1912 he was assistant engineer in the valuation division of this same company, and was then appointed assistant engineer in the maintenance of way department, which connection he held until 1914. At that time he was made roadmaster at Dilworth, Minn., and now becomes supervisor of bridges and buildings, succeeding Dennison Fairchild, resigned to go into the contracting business.



private interests. Mr. Bur-

ton has been in the service of the Southern Pacific since May, 1900, when he

took a position as rodman

on the western division of

that road in the office of the

resident engineer at Oakland Pier, Cal. In August.

1902, he was placed in

charge of right-of-way and station ground leases and

later became draftsman in the same office, where he remained until September,

1905, when he was trans-

ferred to the general office

at San Francisco, where he

was employed as a drafts-

man under the chief engi-

neer. In November, 1906.

he was transferred to the

office of the consulting engi-

R. B. BURTON, who has been senior assistant to John D. Isaacs, consulting engineer of the Southern Pacific, since February, 1912, has resigned, effective December 1, to accept a position with



R. B. BURTON

neer of the Union Pacific and the Southern Pacific in Chicago and served as draftsman in this office until June, 1907, when he became chief clerk. In August, 1909, he became assistant to Mr. Isaacs and in February, 1912, when the Union Pacific and the Southern Pacific were separated, he was made senior assistant to the consulting engineer of the Southern Pacific.

TRACK

DAVID PETERS, extra gang foreman on the Illinois Central, has been appointed supervisor, with office at Freeport, Ill., succeeding C. G. Byran.

FRED J. CHALLONER has been appointed roadmaster of the Northern Pacific, with office at Dilworth, Minn., succeeding Elmer H. Brown, promoted.

J. A. ROBERTS has been appointed supervisor of the Baltimore & Ohio, with headquarters at New Martinsville, W. Va., succeeding C. B. M. Long, transferred,

J. H. WINTERMEYER has been appointed supervisor on the Baltimore & Ohio, with headquarters at Wheeling, W. Va., succeeding T. C. Stonecipher, furloughed.

J. E. CONNOLLY has been appointed acting roadmaster of the Marysville district of the Southern Pacific, with headquarters at Marysville, Cal., succeeding B. O. Thistle, who has been appointed roadmaster of the Placerville district, with headquarters at Sacramento, Cal., vice F. L. Milne, assigned to other duties.

C. G. STEWART has been appointed assistant supervisor on the Chicago division of the Baltimore & Ohio, with headquarters at Walkerton, Ind. John K. Waite has been appointed assistant supervisor on the Illinois division, with headquarters at Vincennes, Ind. Wm. T. Haight has been appointed assistant supervisor of the Indiana division at North Vernon, Ind.

EGBERT I. ROGERS, assistant roadmaster of the Iowa division of the Illinois Central at Ft. Dodge, Ia., was appointed roadmaster, with the same headquarters, on November 1, succeeding H. Gileas, retired. He was born August 3, 1876, at St. Joseph, Mo., where he received his early education in the common schools. Later he entered the engineering department of the Missouri State University at Columbia, Mo., from which he graduated in June, 1897. He entered railway service with the Illinois Central the following month as a track apprentice. From January, 1898, to July, 1901, he was instrument man and assistant engineer in charge of surveys and new construction in the Mississippi delta, after which he was engaged in construction work until September, 1911, including double tracking and grade reduction in Mississippi, Louisiana, Kentucky, Tennessee and Illinois and new freight terminals at New Orleans, La. From September, 1911, to June, 1912, he was roadmaster of the New Orleans division of the Yazoo & Mississippi Valley, with headquarters at Vicksburg, Miss. During June and July, 1912, he was a special engineer on the Missouri, Oklahoma & Gulf, in Oklahoma. From July, 1912, to July, 1914, he was chief engineer of the Lorimer & Gallagher Construction Company on construction work in connection with the Southern Traction Company at East St. Louis, Ill., and from July, 1914, to July, 1915, he was engaged in private work in Kentucky and Texas. In August, 1915, he was appointed chief engineer of the Texas City Terminals at Texas City, Tex., which connection he held until February, 1916, when he was made assistant engineer in the valuation department of the Illinois Central. In August of the present year he was made assistant roadmaster at Ft. Dodge, Ia.

JAMES EDWARD CROWLEY, the announcement of whose promotion from assistant roadmaster to roadmaster on the Michigan Central, with office at Grayling, Mich., was announced in the



last issue, was born August 18, 1873, at Leslie, Mich. He received a common school education in this community and then entered the Leslie high school, from which he graduated in April, 1889. He took employment immediately with the Michigan Central as a section hand, and several years later was promoted to a foremanship. During 1902 and 1903 he was foreman of the Saginaw yards for this same company, and was granted an indefinite leave of absence about this time to enter the employ of a contracting concern then building a new electric line between Saginaw, Mich., and Flint as superintendent of construction. In 1906 he

JAMES EDWARD CROWLEY

returned to the Michigan Central as a section foreman, and in June, 1907, was promoted to extra gang foreman on the Mackinaw division. On October 1, 1907, he was appointed assistant roadmaster, which position he held until his present appointment became effective on September 1, 1916.

BRIDGE

E. H. BROWN, roadmaster of the Northern Pacific, at Dilworth, Minn., has been appointed supervisor of bridges and buildings, with office at Minneapolis, Minn., effective November 1, 1916.

MELVILLE FISK CLEMENTS, assistant engineer on the Northern Pacific, has been appointed bridge engineer, effective November 6, with office at St. Paul, Minn., succeeding H. E. Stevens, pro-



MELVILLE FISK CLEMENTS

since which time he has been engaged chiefly on new construction and grade separation. During the last two years he has been in charge of grade separation work at Spokane.

moted to the position of chief engineer, as announced in the last issue. He was born in March, 1875, at What Cheer, Iowa. and graduated from the state university at Iowa City, Iowa, in 1899. The same year he entered railway service in the engineering department of the Burlington, Cedar Rapids & Northern. From June, 1902, to May, 1906, he held various engineering positions with the Chicago, Rock Island & Pacific, and from the latter date to August, 1907, he was engineer for the Clinton Bridge & Iron Works at Clinton, Iowa. In August, 1907, he was appointed assistant engineer on the Northern Pacific.



H. H. FREEDLE, division bridge foreman on the Kansas City division of the Missouri, Kansas & Texas, has been appointed concrete inspector in the office of the engineer maintenance of way of the Missouri, Kansas & Texas, with headquarters at Parsons, Kan., with particular jurisdiction at present over concrete work on the St. Louis division.

PURCHASING

C. D. CLAPP has been appointed purchasing agent of the Mississippi Central, with headquarters at Hattiesburgh, Miss.

P. J. SHEA has been appointed general storekceper of the Boston & Albany, with headquarters at West Springfield. Mass., succeeding E. B. Rockwood, resigned.

J. P. HARRISON, assistant purchasing agent of the Louisville & Nashville, at Louisville, Ky., has been appointed purchasing agent, succeeding P. P. Huston, retired. H. T. Shanks has been appointed assistant purchasing agent.

M. E. TOWNER, special representative of the Whitman & Barnes Manufacturing Company at St. Louis. Mo., has been appointed purchasing agent of the Western Maryland, with office at Baltimore, Md., succeeding H. M. Burgan.

GEORGE W. HAYDEN, assistant to the chief purchasing officer of the St. Louis—San Francisco, with office at St. Louis, Mo., has resigned to accept employment with the New York, New Haven & Hartford as supervisor of materials and supplies, with headquarters at New Haven, Conn.

OBITUARY

CHARLES W. HOTCHKISS, chairman of the board of directors of the Virginian Railway and president of the Chicago Tunnel Company and the Rail Joint Company, died at Battle Creek,



CHARLES W. HOTCHKISS

organic heart trouble. He was born at Unadilla Forks, N. Y., on June 19, 1863. He entered railway service with the New York, West Shore & Buffalo at Newburgh, N. Y., as a rodman. He was assistant engineer on the Michigan Central from August, 1886, until May, 1896, from which date he was chief engineer of the Chicago Junction to January, 1899. On this date he was appointed chief engineer of the Chicago Transfer and Clearing Company and in June, 1900, he was elected president of the Indiana Harbor Railroad and built the Indiana Harbor Belt and the Chicago, Indiana & Southern. When

Mich., on October 28, of

the New York Central took over these lines in October, 1905, he was made general manager of the Chicago, Indiana & Southern. In May, 1912, he was elected president of the Chicago Tunnel Company, Chicago, Ill. In February, 1915, he was also elected to the chairmanship of the executive committee of the Virginian Railway and president of the Rail Joint Company of America.

CIGARETTE SMOKING.—On the Texas & Pacific a rule has been promulgated prohibiting the smoking of cigarettes by employees on duty.

HEROISM.—Jerry Fountain, crossing watchman on the Alabama Great Southern. Bessemer, Ala., has been awarded a Carnegie medal for heroism in rescuing an aged pedestrian from being killed by a freight train on the afternoon of May 1 last. Watchman Fountain, who has but one arm, succeeded in pulling the old man from the track but not before the engine had struck them both. He was badly bruised, but the wayfarer, 94 years old, was not injured.

CONSTRUCTION NEWS

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THE ALABAMA GREAT SOUTHERN plans to construct at once a new freight station at Bessemer, Ala. The building will be of reinforced concrete and brick, 33 ft. by 205 ft., having a platform 350 ft. long served by the necessary tracks.

THE ATCHISON, TOPEKA & SANTA FE is considering plans for an entrance into St. Louis. A cut-off from some point on its line near Carrollton, Mo., to Mexico, Mo., on the Chicago, Burlington & Quincy is proposed, using the tracks of the Burlington from that point to St. Louis. This line will also give the Burlington a new short line to Kansas City.

This road also plans to construct a new line from Caney, Kan., through Pawhuski, Okla., to Ralston, a distance of about 60 miles. Although surveys are being made, no actual construction will be started until the details in connection with the securing of the right of way are completed.

THE BALTIMORE & OHIO has started improvement work with company forces at the Garrett, Ind., freight yards on its Chicago line, which will cost approximately \$75,000. The yards are being enlarged to increase the capacity of eight tracks in the westbound yard and four tracks in the eastbound yard to 100 cars each.

This road has also let contracts and work is in progress on construction of double track from Milford, Ind., to La Paz, a distance of 24 miles. This work will include 7 new steel bridges with concrete substructures. On the completion of this work this system will have double track from Philadelphia to Chicago.

THE CANADIAN NORTHERN plans to extend its line from Easton, Alta., Can., to a point about 35 miles west, though as yet no contracts have been awarded and work has not been started.

THE CENTRAL RAILROAD OF NEW JERSEY has awarded a contract to F. D. Hyde, New York, to build a new passenger station at Newark, N. J. The building will be 45 ft. high and 60 ft. wide in front and 266 ft. in the rear, the length varying from 86 ft. to 400 ft. The structure will have concrete foundations, steel frame, brick and terra cotta walls and a wooden and concrete roof, with built-up roofing. The building proper will cost \$500,000 and the track changes \$50,000 additional.

THE ILLINOIS CENTRAL has awarded a contract to A. W. Stoolman, Champaign, Ill., for the erection of a new passenger station at Mattoon, Ill. The building will be two stories high, 160 ft. long and 36 ft. wide, and will cost approximately \$75,000.

THE KANSAS CITY TERMINAL has awarded a contract to the Arkansas Bridge Company of Kansas City, Mo., for the erection of a steel bridge over the Kaw river and actual construction has just commenced. The bridge will require about 25,000 tons of steel and will cost approximately \$3,000,000. There will be two 300-ft. and one 135-ft. spans over the Kaw river and one 117-ft. and one 147-ft. span over various railway tracks. There will also be girder viaduct approaches totaling 7,700 lineal feet.

THE MICHIGAN CENTRAL and the Michigan State Highways Commission have asked for bids on or about January 1 for the construction of a reinforced concrete bridge 620 ft. long in Ann Arbor, Mich. The estimated cost is about \$45,000.

THE MISSOURI, KANSAS & TEXAS will ercct a new passenger station at San Antonio, Tex., which will be one story high, 245 ft. long and 77 ft. wide. The structure will be fireproof throughout with stucco on brick, built in the mission style with mission towers, and will cost approximately \$125,000. The platforms along the passenger tracks will be 850 ft. in length and covered with umbrella sheds.

THE MISSOURI PACIFIC intends to begin work in the early spring on the elevation of its tracks at Dodge, Douglas and Farnam Streets, Omaha, Neb. For this purpose Judge Hook of the Federal Court at St. Louis, Mo., has authorized B. F. Bush, receiver, to expend \$200,000. It is the intention ultimately to elevate the Belt Line tracks for a considerable distance beyond the point mentioned, but at present only the work outlined above will be undertaken.

THE NORTH TEXAS & SANTA FE contemplates building a line from Hannaford, Tex., to Shattuck, Okla., a distance of about į



85 miles. Surveys have been completed and the final details in securing the right of way are being completed. About one-half of the construction will be through a fairly level prairie country, while the other half will offer heavy work. Engineering headquarters have been established at Shattuck, Okla., and much material for the undertaking has already been delivered at that point. It is understood that the Atchison, Topeka & Santa Fe will assume control of this road on its completion.

THE PENNSYLVANIA RAILROAD has awarded a contract to H. L. Kreusler, Pittsburgh, Pa., to build a 40-ft. extension to the single-story combined freight warehouse and office building at Greensburg, Pa. The extension will have a concrete foundation, will be of brick construction with slate roof and will cost about \$50,000.

This road also plans to build an outbound freight house 30 ft. wide and 240 ft. long at Rochester, N. Y., at an approximate cost of \$50,000. The present freight house will be used as an inbound receiving station and additional tracks to hold 40 cars will be constructed between the two stations.

It has also authorized work at its West Morrisville, Pa., yards, on the New York division, which consists of the construction of an eastbound receiving and a westbound departure yard and an eastbound and westbound main running track. The work involves from 350,000 to 400,000 cu. yd. of grading, the construction of 3,000 cu. yd. of concrete masonry and about 2,500 sq. yd. of macadam paving.

THE SOUTHERN has completed plans for the enlargement of its yard at Pomona, east of Greensboro, N. C., which consist of the extension of the present yard tracks, and the addition of 13 new yard tracks and 3 repair tracks. The yard proper will have a capacity of 1,084 cars and the repair tracks 104 cars, a total of 1,188 cars which is an increase of 829 cars over the present facilities. A new engine terminal will also be built at Pomona Junction, with a modern 18-stall roundhouse, a 100-ft. turntable, a mechanical coaling station, machine shop and auxiliary buildings. Bids for the construction and heating of the roundhouse have been asked for.

STRUCTURAL STEEL

THE CHICAGO, BURLINGTON & QUINCY has ordered 3,000 tons of structural steel from the American Bridge Company for a freight house at Chicago, to be built in connection with the Chicago passenger terminal improvements.

THE DELAWARE & HUDSON has ordered 400 tons of bridge work from the Phoenix Bridge Company.

THE GREAT NORTHERN has ordered 305 tons of steel from the Minneapolis Steel & Machinery Company for an extension to its mail and express building at Minneapolis.

THE KANSAS CITY TERMINAL has given an order to the American Bridge Company to fabricate 25,000 tons of structural steel for a bridge over the Kaw river and approaches at Kansas City, Mo.

THE NEW YORK & LONG BRANCH has ordered 1,000 tons of steel from the McClintic-Marshall Company for a bridge over the Manasquan river.

THE PENNSYLVANIA RAILROAD has ordered 1,000 tons of bridge steel from the McClintic-Marshall Company.

THE SOUTHERN has ordered 500 tons of steel from the Virginia Bridge & Iron Works for car repair shops at Spencer, N. C.

TRACK MATERIALS

THE ANN ARBOR is reported to have ordered 1,500 tons of rails from the Illinois Steel Company.

THE CHICAGO, BURLINGTON & QUINCY has ordered 25,000 tons of rails for 1917 delivery from the Illinois Steel Company.

THE FRENCH GOVERNMENT is reported as having ordered 50,-000 tons of rails from the Bethlehem Steel Corporation.

THE GREAT NORTHERN has ordered 30,000 tons of rails with fastenings from the Illinois Steel Company for 1918 delivery.

THE RUSSIAN GOVERNMENT is reported having ordered 50,000 tons of rails from the Bethlehem Steel Corporation for the Trans-Siberian Railway.

THE ST. LOUIS-SAN FRANCISCO will purchase 56,000 tons of rails.

SUPPLY TRADE NEWS

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PERSONAL

EXUM M. HASS, western editorial representative 'of the Electric Railway Journal, has been appointed manager of sales of the International Steel Tie Company, Cleveland, Ohio, ef-



fective on November 1. He graduated in civil engineering from Purdue Univer-sity, 1905. Previous to his college course and during vacations he served in the engineering corps of the Baltimore & Ohio and the Chesapeake & Ohio. After graduation he was made resident engineer for the Chicago & Eastern Illinois in the construction of a freight yard at Dalton, Ill. In 1906 he was appointed assistant engineer maintenance of way of the Illinois Traction System, where he helped organize a maintenance of way department. In 1907 he was appointed locating and constructing engineer for the company, in charge of building extensions to the system. In

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Exum M. Hass.

1909, when work on the track extensions had practically ceased, his title was changed to superintendent of bridges and buildings, and while serving in this capacity most of this company's standard way stations and sub-stations, as well as the terminal buildings in St. Louis, Mo., were built. In November, 1912, he joined the editorial staff of the Electric Railway Journal and has since served as western editorial representative.

D. P. LAMEROUN has been appointed general manager of the Pratt & Letchworth Company, Ltd., Brantford, Ont. He was born in Mayville, Wis., December 12, 1873, and took a course in civil engineering at the

University of Wisconsin, in the class of 1895. After leaving college he spent two years in the maintenance of way departments of the Milwaukee Northern and the California-Oregon and the following three years as private secretary to the commissioner of the general land office at Washington, D. C. In 1900 he became associated with the Beaver Dam Malleable Iron Company, working his way up through that organization until he became general manager, and remaining with this concern until 1913. During this period he was also on the legislative committee of the Wisconsin Manufacturers' Association



D. P. LAMEROUX

and for three years a regent of the University of Wisconsin. In this year he entered the railway supply business in Chicago, being connected with the Cleveland Steel Company and the Trumbull Steel Company. In his new duties he will act as general manager of the various malleable plants of the Canadian Car & Foundry Company, Ltd., including the Pratt & Letchworth Company's plant at Brantford and the malleable iron plant at Amherst.



ROBERT D. SINCLAIR, first vice-president of Mudge & Company, Chicago, has been elected vice-president in charge of all departments. He was born at Chicago, Ill., on April 12,



ROBERT D. SINCLAIR

1878, and entered railway service in the auditing department of the Chicago & Eastern Illinois in 1892. The following year he accepted a position with the operating department of the Columbian Intramural Railway at the Chicago World's Fair. At the close of this exposition he entered the service of the Union National Bank of Chicago, and remained with it until its consolidation with the First National Bank in 1900. When he went with the larger bank, remaining until September 1, 1910, when he became secretary and treasurer of Mudge & Company. On June 9, 1912, he was elected second vice-president of

this concern, later being made first vice-president. On November 1, 1916, he was elected vice-president in charge of the sales, manufacturing and operating departments of the company as noted before.

EDWARD THOMAS HENDEE, secretary of Joseph T. Ryerson & Son, Chicago, died suddenly at Minneapolis, Minn., November 12, 1916. He was born at Claremont, N. H., on February 22,

1880, and graduated from the New York University in 1900. From 1901 to 1902 he was assistant professor mechanical engineering of at New York University, and on the latter date became associated with Joseph T. Ryerson & Son, as advertising manager. In this capacity he built up and became manager of the machinery department, and in this connection he was particularly successful in developing the domestic and foreign machinery business and the railway supply business of his company. In 1911 he was made assistant to the president and in 1913 was given charge of the railway supply department. In the same year he was



EDWARD T. HENDEE

elected secretary of Joseph T. Ryerson & Son, which position he held at the time of his death. Mr. Hendee was also vicepresident and director of the Lennox Machine Company and director of the American-Glyco Metal Company.

GENERAL

THE KIRBY LUMBER COMPANY, Houston, Tex., has announced that its sales will be handled exclusively by the Kirby-Bonner Lumber Company.

THE JONES & LAUGHLIN STEEL COMPANY, Pittsburgh, Pa., plans to establish a large warehouse in St. Paul, Minn., to handle its northwest business.

THE HESS-BRIGHT MANUFACTURING COMPANY makes the following announcement to correct misleading rumors and statements: "A group of bankers, including Frank A. Vanderlip, Philip W. Henry, Thatcher M. Brown and Franklin B. Kirkbride of New York and Marcus Wallenberg of Stockholm, have recently acquired from the American group of stockholders a controlling interest in the Hess-Bright Manufacturing Company. This group of bankers also owns a substantial interest in the S. K. F. Ball Bearing Company of Hartford, Conn. The two companies will be operated independently of each other. The former policy of the Hess-Bright Manufacturing Company will be increased somewhat more rapidly to meet the constantlygrowing demand for its product. B. D. Gray, who retains his former stock holdings, will continue to manage the business as president. F. E. Bright retires from active participation in the company's affairs, but remains identified with the company as chairman of the board. Aside from these two changes, the organization remains as before.

TRADE PUBLICATIONS

POLE JACK.—Templeton. Kenly & Company, Ltd., Chicago, has issued an eight-page folder describing its new pole jack for pulling, straightening and reinforcing telegraph and other poles. The pamphlet is illustrated with photographs of this jack in service showing the numerous uses for which it is adapted.

A TEST FOR CREOSOTE OILS.—The Republic Creosoting Company, Indianapolis, Ind., has issued a folder describing the Davis spot test for the determination of the presence of tar, free carbon or dirt in creosote oil with colored illustrations of the results of these tests. This test was described in the *Railway Maintenance Engineer* for September, page 285.

"PECKY" CYPRESS.—The Southern Cypress Manufacturers' Association, New Orleans, La., has issued a small 44-page booklet describing "Pecky" Cypress, which contains a large amount of information regarding this peculiar timber, its development and its uses. This book is prepared in an unusually interesting manner and is well illustrated with photographs of this timber and its uses.

PAINT GUNS.—The Spray Engineering Company, Boston, Mass., has issued a bulletin describing its "Spraco" paint gun, a hand tool for use in applying all kinds of liquid coatings. The equipment is adapted for use in the shop or field and may be adjusted for spraying the highest grade of varnishes and lacquers, as well as heavy asphaltum and structural paints, producing finely finished surfaces without streaks or brush marks. It is also adapted to applying heavy durable coatings to rough structures.

CONCRETE THROUGH THE AGES.—The Pennsylvania Cement Company, New York, has issued a 28-page book with the subtitle, "Looking Backward Twenty Centuries on Concrete Construction." It is not a matter of general information that the first extensive use of concrete construction came during the early Roman period and that the Roman people carried it to an extraordinary development as early as in the first century B. C. The distinguishing feature of this book is a series of six color drawings showing the Pantheon at Rome, the Pont du Gard at Nimes, the Pons Fabricus, the Via Appia or Appian Way, the Amplitheater at Pompeii and an unnamed view of Roman ruins, in the first five of which concrete played an important part.

REINFORCED CONCRETE DESIGN.—The Portland Cement Association, Chicago, has published a 20-page pamphlet containing a lecture prepared by Earnest McCullough, chief engineer of the Fire Proof Construction Bureau of that association, for a short course for teachers held at Lewis Institute, Chicago, to expound the principles of reinforced concrete design with the fewest words and in the simplest possible form. The standard symbols are given and the usual formulæ are derived, introducing a number of diagrams designed to illustrate the principles of flexture, bond, shear, etc., to those not familiar with the subject. The pamphlet is limited in its scope to the simple column and beam with a section on the reinforcing of a circular tank.

THE CHANNEL TUNNEL.—It appears that the London press is favorable to the English Channel tunnel project. Late in August it was announced in Paris that France had taken all the necessary steps to enter into negotiations with England for the joint construction of the tunnel. Plans were outlined by M. Sartiaux, chief engineer of the Nord Railway Company, who stated that the tunnel would cost £16,000,000. It is stated that the English Tunnel Company controls the right to construct tubes.—Canadian Engineer.





lume 12

CHICAGO: Transportation Building NEW YORK: Woolworth Building NOVEMBER, 1916

CLEVELAND: Citizens' Building WASHINGTON: Home Life Building Number 11

The Portable Railway Saw Mill Plant



- A Portable Saw-mill Plant—composed of a sawmill, a cut-off saw, and power of some kind really gives a railroad a movable lumber yard, to be transported anywhere on the system that it can be used.
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- Where an Old Dock is Being Dismantled, take the saw-mill outfit there and saw the timbers into usable sizes, to be stocked at some convenient point ready for use along the line.
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