



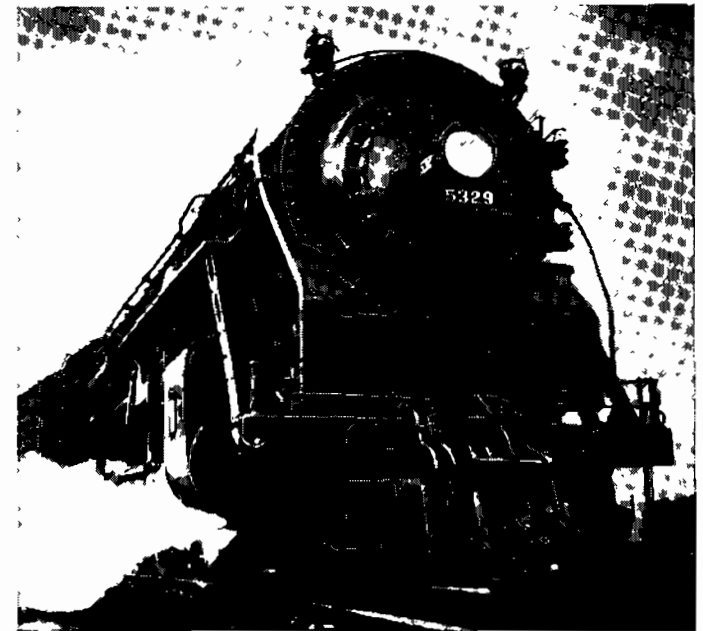
INTERNATIONAL CORRESPONDENCE SCHOOLS, SCRANTON 9, PA.

**TRAINING  
TO GET AHEAD**  
*on the*



**RAILROAD**

**Looking Ahead  
and  
Getting Ahead  
in  
RAILROADING**



**International Correspondence Schools, Scranton 9, Pa.  
International Correspondence Schools Canadian, Ltd.,  
Montreal, Quebec, Canada**

## Meeting the Needs of Railroads and of Railroad Men

*"The problem of railroads . . . is to offer the most efficient service of any form of transportation, and at rates capable of attracting business. Broadly speaking, they are doing this today."*

This statement by the president of a great railroad, sums up the task and the challenge facing the railroads and railroad men.

To provide this efficient transportation service is not the responsibility of management alone, or of the employees alone, or of any one department of any railroad. It's a job that calls for the coordinated effort of all railroad employees, from the guards at the grade crossings all the way up to the president himself. For anyone to "fall down" on his particular job is to put the entire operation in danger. Efficient railroading depends on each member of a crew out on a run as well as on the dispatcher who signs the orders; it depends on the flagman, the brakeman, fireman, engineer, conductor, yard-man, station agent, shop man, the office worker. *Good railroading is teamwork—all along the line.*

When you stop to consider, there are very few organizations in which teamwork is as necessary as it is in railroading. And there are few in which failure due to carelessness or ignorance is

more quickly noticed, or in which know-how and efficiency are more quickly recognized.

The modern railroad has become a very complex organization of departments. Each of these is so closely geared to all the others that the whole organization is affected if one of these "gears" fails to perform as it should. Each department, too, is an organization that is made up of individuals—men and women—with definite responsibilities. Those responsibilities—those jobs—are also "geared" very closely, so that the efficiency of the department depends on the ability of *each member* of it. So *the efficiency and the success of the road depends upon each and every employee who is on the payroll.*

So, it's quite clear that how you do *your* work—whether or not you know it thoroughly and do it well—*does* matter a very great deal. Whether you stand still or go ahead depends on what you know and how you apply your knowledge. That's fact, for nowhere does ability and good work, or ignorance and poor work, stand out more conspicuously than it does in the modern railroad organization.



*The general offices  
—The great Service  
Department and  
Printery.*



*The Administration  
Building and In-  
struction Depart-  
ments.*

## How Thousands Have Advanced in Railroading

The "boomer" was a colorful figure in the early days of railroading. He served his purpose and went his way as railroading grew up. Rough and strong, he wouldn't care much for railroading as it is today with its heavy trains, high speed, safety and economy in operation. Safety, speed, reliability and economy—these were the services that shippers and travellers wanted—and the service they got. To provide this service called for rules and regulations which became laws. In order to meet these requirements railroad men *had to know more*. So, it happened that away back in those "growing up days" railroad managements and railroad workers themselves, turned to International Correspondence Schools for the knowledge that they had to have.

Through I.C.S. courses and instruction the knowledge that railroad men required was provided in those early days—and through all the succeeding days, right up to this present time. *Through these courses men can stay on the job and study in their spare time*. They can learn while they earn—and thousands of them are doing it this very day, just as they have done throughout the years. This record of service to railroad men is something of which I.C.S. is very proud. It's a long, unbroken record that extends away back to 1898 when the I.C.S. Railroad School was first organized.

Locomotive engineers, firemen, air-brake men and others found that first course exactly what they had been wanting for so long. It met their needs so exactly that a demand arose for other courses, modeled along similar lines, for other railroad men.

Today, almost any railroad employee who wants to get ahead, may choose from a variety of courses—courses for locomotive engineers, firemen, air-brake service and repair men, shop men, car builders, signal men, roadmasters, section foremen, bridge and building foremen, rate clerks and traffic employees, office workers, apprentices. In fact, there are courses for practically everyone, no matter what his duties or how technical his work may be.

I.C.S. courses are practical and are easy to understand. So, as you learn, you can go to your work and put your newly-acquired knowledge into use—right on the job. You can demonstrate to yourself and to others that you *know*. It is this that helps I.C.S. men to get ahead—is helping them every day.

## What Happens When Railroad Officials are Interested in Employees Who Study?

No one better realizes the importance of the individual worker to the department than do railroad officials themselves. Because of this, officials, years ago, took the initiative in directing the attention of employees to I.C.S. courses. The result has been that training arrangements have long been in effect between I.C.S. and many railroads. In fact, such arrangements are now in effect with more than 250 railroads including some of the largest systems. Some of these arrangements have been in effect for many years.

These railroad officials—like executives in other businesses and industries—are very definitely interested in men who study in order to make themselves more capable and efficient. This is indicated by the interest these officials express in the study records of employees. Officials of railroads which have training arrangements with I.C.S. *insist* that we send monthly reports that include the names of *every employee* who is enrolled with I.C.S., together with his progress and standing as a student.

## What is This I.C.S. System? What Can You Profit by It?

I.C.S. courses are planned for busy men. Most I.C.S. students are employed and want to get ahead. They must learn in their spare time and these courses are designed for this very purpose. *All the principles, methods and practices are explained in clear, simple terms so that even those of limited education can learn, and can apply what they learn because they understand it*. It means that the man who studies today can go out and apply his new-found knowledge on the job tomorrow.

The lessons of I.C.S. courses are written by practical men. Each of these men is a specialist in his particular subject. Many of them are employed by famous industrial concerns that make railroad supplies and equipment; others are outstanding railroad men. What these men write is edited by the skilled I.C.S. staff and much of the actual teaching is written *into the text itself*. This "instruction in the text" is supplemented by the teaching which the trained, experienced I.C.S. faculty provides as they guide, advise and direct you.

## Distinctive Features of I.C.S. Service

### Lecture and Demonstration Cars

Another distinctive feature of I.C.S. service is the instruction cars that are run over the railroads that have training arrangements with I.C.S. These cars are equipped with air-brake and other apparatus for demonstration purposes, and many men visit the cars to benefit by the free lectures on engines, firing, combustion, air brakes and other subjects.

These I.C.S. instruction cars and the instructors in charge supplement in a very practical way the instruction carried on direct from Scranton. Such cooperation means that the railroad man who is studying in this way becomes better satisfied in the work he is doing, and happier in it because he is able to do it better. This I.C.S. service supplements and makes more effective the railroad's own educational program.

It is largely because everything is explained so clearly, and because the teaching is conducted with such understanding, that so very many of the railroads of the United States and Canada have entered into these training arrangements with I.C.S. for the benefit of their employees. This, so far as we are able to learn, is a greater tribute than has ever been conferred upon any educational institution.

### Training to Use on the Job Every Day

The benefits of an I.C.S. Railroad Course are well expressed by Robert W. Neff of Kansas City, Missouri, who says: "The course enabled me to detect defects more easily in the equipment that I am handling daily. It has helped me in instructing firemen for the promotion examination which I have already passed. The course enables one to grasp all the finer points of both mechanical and air-brake equipment, starting from the bottom detail and working up to the most important."

The I.C.S. cars are well equipped with demonstration apparatus and staffed by able men.



Railroad men welcome the I.C.S. instruction car with its demonstration equipment and the able men who travel with it. These cars operate on railroads which have agreements with I.C.S.

### Charts That Show—Models That Explain

Seeing what takes place in a brake valve, compressor, or in other parts of the air brake equipment is to have a clear understanding of it. A model or chart is often more helpful than it would be to have the actual apparatus itself. You know that the apparatus works, that the brakes go on when air is applied, and they go off when the air is released. But you can't *see* what goes on inside the equipment—the valves working ports being opened or closed. Explanation of how it works will help you to understand, but clear explanation *in connection with the I.C.S. charts* will make it all wonderfully clear—and easily and quickly, too.

By the use of a color scheme of pressures on I.C.S. charts the flow of air is made clear. In this way you can see *how* the apparatus works and what takes place when air is applied or released. Because of this your understanding is clear.

A great deal of time, thought, and money have been spent making these very effective charts. This is another reason why railroad men are so enthusiastic about their I.C.S. courses.



For convenience in recording and shipping, packages containing instruction texts, models and charts relating to Locomotive and other Air Brake Courses have been prepared. These packages, called Forms, are designated by numbers, and their contents are as follows:

**Form 56:**

Model of Piston and Piston Valve.

**Form 102C:**

MODEL—54 Plain Triple Valve.

CHARTS—13 charts, No. 6 ET Locomotive Brake Equipment.

14 charts, No. 8 ET Locomotive Brake Equipment.

All these models and charts are in one box with six instruction texts: Air Brake Compressors, A-1 Engine Equipment, No. 6 ET Locomotive Brake Equipment, No. 8 ET Locomotive Brake Equipment.

**Form 8 ET:**

14 charts, No. 8 ET Locomotive Brake Equipment and instruction texts on this subject.

**Form 5702X:**

14 charts, No. 8 EL Diesel Freight-Locomotive Brake Equipment and instruction texts on the subject.

**Form 103:**

6 Steam Distribution Charts, with reference pamphlet on the subject. This form is designed to make clear the distribution of the steam to the cylinders by the valves.

**Form 104:**

13 charts on the U.C. Valve Westinghouse Air Brake, known as U-12-BC and UEA-12, and instruction text "U.C. Passenger-Car Brake Equipment."

**Form 5464A:**

11 plates of the D-22-P Passenger-Car Brake Equipment.

8 plates of the "HSC" Brake Equipment as applied to passenger-train cars and Diesel Locomotives.

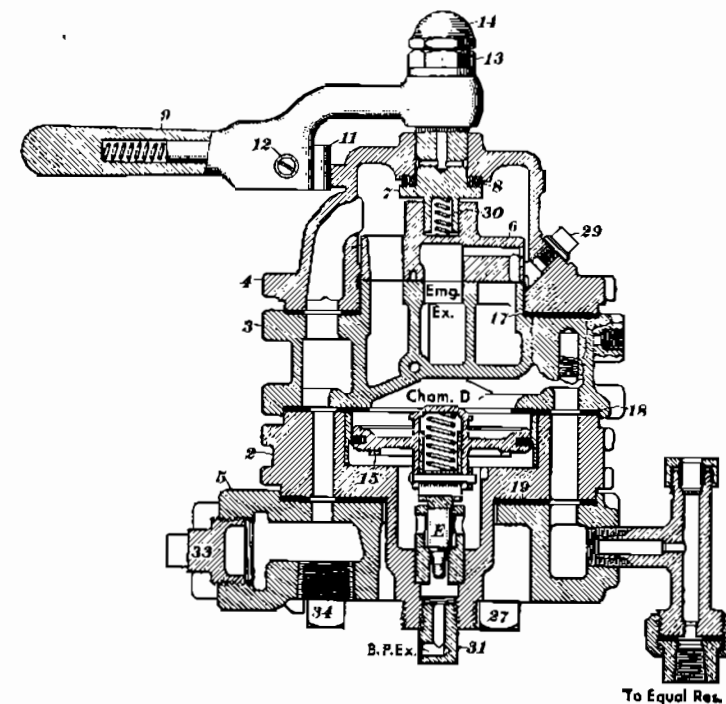
**Form 1087:**

Locomotive Lubrication Chart.

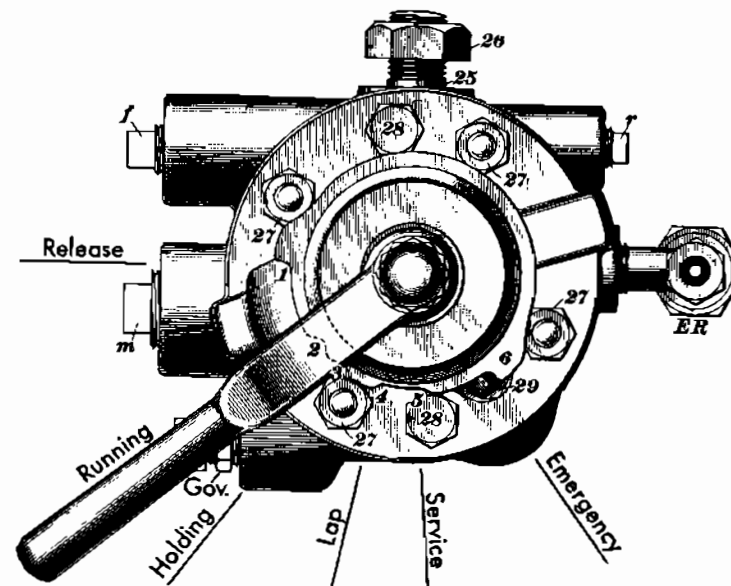
Locomotive and Tender Defect Chart.

**Form 2508X:**

10 charts of the Pneumatic Equipment of the Union Switch and Signal Company's Automatic Train-Control System.



*Typical illustrations from an I.C.S. lesson on air brakes.*



## **Other Advantages of I.C.S. to Railroad Men**

### **1. *You Study Where You Please.***

You do not have to leave home to secure an education; the education comes to you.

### **2. *No Time Lost From Work.***

You can keep right on with your work, and can study during spare hours. I.C.S. courses turn odd moments into profit.

### **3. *You Study When it is Convenient.***

Our Schools never close. You can begin to study when you please, using the spare hours that are ordinarily wasted, making progress as rapidly as your time and ability permit.

### **4. *We Teach Wherever the Mails Reach.***

You can move from place to place while studying. We have students in many countries, and on the seas.

### **5. *No Books to Buy.***

You have no extra textbooks to buy. We furnish *all* Instruction Texts and Question Papers, return envelopes and information blanks. We prepay postage on all mail sent from the Schools. Except for the paper on which you write your answers to the examination questions and the postage on the mail you send us, you have nothing else to buy.

### **6. *Specially Prepared Instruction Texts.***

The lessons of your course come to you in convenient pamphlet form. They fit into your pocket. Each of them has been written specially for the I.C.S. system of instruction, by men who are expert in the theory and practice of the particular subjects about which they write.

### **7. *Education and Experience Combined.***

Under the I.C.S. system of training you are able to combine education and experience by immediately using in daily work the knowledge gained through your studies. There can be no more practical educational system than this.

### **8. *Courses Comprehensive.***

I.C.S. courses begin at the beginning and each gives you comprehensive knowledge in its line. In this way they are adapted to the needs of men of limited education as well as those who may be technical graduates.

### **9. *The Cost is Slight.***

Although these courses are specially prepared and specially illustrated, for the man who must study in his spare time, the cost is far lower than one would ordinarily expect. Many wonder how we can deliver so much for the price we charge.

### **10. *Instruction is Private.***

Your instruction will be conducted privately. No one need know what questions you ask, what help you receive. These are matters between you alone and your teachers.

### **11. *Only Spare Time Required.***

Progress, advancement, requires knowledge. To get the knowledge calls for study. It means work, and some social engagements will have to be given up at times. However, there is no system under which you are so free to arrange your time as you are with I.C.S. You can enjoy business and social life as you could not possibly do if attending night schools or other class instruction.

### **12. *Written Explanations.***

The instruction and explanations which you receive from I.C.S. are always written, so you can refer to them often (and you probably will). This is not possible with oral instruction.

### **13. *Each Student is a Class by Himself.***

With I.C.S. you are a class by yourself. You do all the "reciting" that is required and you get all the instruction. You will find that you are encouraged, guided, counseled and taught at every step. You can ask questions and there is no "class" to embarrass you. You can go ahead with your course as rapidly as your time and ability permit, or you may take as much time as necessary in order to understand. There's no one to hold you back; no one to hurry you.

### **14. *Instruction is Thorough.***

The written answers to questions in connection with an I.C.S. course make it possible for your teacher to detect any weak points and to give proper help when it is necessary.

### **15. *Success Follows Study.***

When a student enrolls we require that he be able to read and write and that he will study as we direct. We expect him to do his part—and we shall surely do ours. As a result of this teamwork some truly remarkable achievements have been made possible. On the successful completion of the course a diploma is awarded. Back of that diploma is a record of requirements met under high standards, and the prestige of a great educational institution.

### **16. *The Slow to Learn are Helped.***

We take great interest in students who do not learn easily. Many of our best friends are those who required the most assistance. (And it is assistance that is always given gladly.)

### **17. *I.C.S. Students Prepared for Examinations.***

I.C.S. courses prepare for examinations because they are thorough and comprehensive. Anyone studying with I.C.S. learns to express himself clearly in writing, and he remembers what he writes. No other system does this so well.

### **18. *Our Schools are Open to All.***

Our Schools are open to all. Age, race, religion, politics—these do not matter. Do you really want to learn and get ahead? This is all that matters with us.

### **19. *Moral Advantages.***

The habits acquired by systematic study and the money saved by staying home and putting in time on self-improvement will prove the making of any man.

## Leading Railroads Endorse I.C.S.

Perhaps the best evidence of all as to the superiority of I.C.S. instruction and the unequalled success of the I.C.S. Railroad Department is the fact that railroad companies, controlling almost one-third of the steam-railway mileage of the United States, and nearly all of the mileage of Canada, have made special arrangements with International Correspondence Schools for the education and special training of their employees.

The following list tells the story:

### A

Aberdeen & Rockfish  
Abilene & Southern  
Ahnapee & Western  
Akron, Canton & Youngstown  
Alabama Great Southern  
Algoma Central & Hudson Bay  
Alton  
Alton & Southern  
Angelina & Neches River  
Ann Arbor  
Apalachicola Northern  
Asherton & Gulf  
Asphalt Belt  
Atchison, Topeka & Santa Fe  
Atchison, Topeka & Santa Fe—Coast  
Lines  
Atlantic & East Carolina

### B

Baltimore & Ohio  
Baltimore & Ohio, Chicago Terminal  
Bangor & Aroostook  
Beaumont, Sour Lake & Western  
Bingham & Garfield  
Birmingham & Southeastern  
Birmingham Belt  
Blue Ridge  
Buffalo Creek & Gauley  
Burlington-Rock Island  
Butte, Anaconda & Pacific

### C

California Western Railroad and Navigation Co.  
Camas Prairie  
Canadian Government  
Canada & Gulf Terminal  
Canadian National Railways  
Canadian Pacific  
Carolina & Northwestern  
Carolina, Clinchfield & Ohio  
C. C. & O. of S. C.  
Central of Georgia

Central Indiana  
Central Vermont  
Cherry River Boom and Lumber Co.  
Cherry River Paper Co.  
Chesapeake & Ohio  
Chicago & Erie  
Chicago, Burlington & Quincy  
Chicago, Rock Island & Pacific  
Chicago Short Line  
Chicago, St. Paul, Minneapolis & Omaha  
Chicago, West Pullman & Southern  
Cincinnati, Burnside & Cumberland  
River  
Cincinnati, N. O. & Texas Pacific  
Cincinnati Union Terminal Co.  
Cisco & Northeastern  
Clinchfield  
Colorado & Southern  
Columbus & Greenville  
Copper Range  
Cumberland & Manchester

### D

Danville & Western  
Delaware & Hudson  
Delaware, Lackawanna & Western  
Denison & Pacific Suburban  
Denver & Rio Grande Western  
Denver & Salt Lake  
DeQueen & Eastern  
Detroit, Caro & Sandusky  
Detroit Terminal  
Detroit & Toledo Shore Line  
Dominion Atlantic  
Doniphan, Kensett & Searcy  
Duluth, South Shore & Atlantic  
Duluth, Winnipeg & Pacific  
Durham & Southern

### E

East Jordan & Southern  
East Tennessee & Western N. C.  
Elk River Coal & Lumber Co.  
Erie  
Esquimalt & Nanaimo

### F

Florida East Coast  
Fort Worth & Denver City  
Fredericton & Grand Lake Coal and  
Railway

### G

Galveston, Houston & Henderson  
Georgia & Florida  
Georgia, Florida & Alabama  
Georgia Northern  
Georgia Southern & Florida  
Georgia, Southwestern & Gulf  
Grand River  
Grand Trunk Western  
Great Northern  
Green Bay & Western  
Gulf Coast Lines  
Gulf & Ship Island  
Gulf, Colorado & Santa Fe  
Gulf, Mobile & Ohio

### H

Harbor Belt Line  
Harriman & Northeastern  
High Point, Randleman, Asheboro &  
Southern  
Holtan Inter-Urban  
Houston & Brazos Valley  
Houston Belt & Terminal

### I

Illinois Northern  
Illinois Terminal  
International Great Northern  
Interstate

### J

Jacksonville, Gainesville & Gulf

### K

Kansas City, Mexico & Orient—P.&S.F.  
Kansas City Southern  
Kansas City Terminal  
Kansas, Oklahoma & Gulf  
Kentucky & Indiana Terminal  
Kentucky & Tennessee  
Keweenaw, Green Bay & Western

### L

Lake Erie & Northern  
Lake Superior & Ishpeming  
Lancaster & Chester  
Lenoir Car Works, Lenoir City, Tenn.

Litchfield & Madison  
Los Angeles & Salt Lake  
Louisiana & Arkansas  
Louisiana & Pine Bluff  
Louisville & Nashville  
Louisville, Henderson & St. Louis

### M

Macon, Dublin & Savannah  
Maine Central  
Manistee & Northeastern  
Manistique & Lake Superior  
Manitou & Pike's Peak  
Marianna & Blountstown  
Maryland & Pennsylvania  
McCloud River  
Mexico Northwestern  
Middleton & Unionville  
Midland Terminal  
Midland Valley  
Mineral Range  
Minneapolis & St. Louis  
Minnesota & International  
Minneapolis, St. Paul & S. S. Marie  
Minnesota Transfer  
Mississippi Central  
Missouri-Illinois  
Missouri, Kansas & Texas R. R. Co.  
(Katy)  
Missouri, Kansas & Texas R. R. Co.,  
of Texas  
Missouri Pacific  
Montreal & Southern Counties  
Muscle Shoals, Birmingham & Pensacola

### N

Nacozari  
Nashville, Chattanooga & St. Louis  
Natchez & Southern  
Nevada Co. Narrow Gauge  
New Brunswick Coal & Railroad  
New Iberia & Northern  
New Jersey & New York  
New Orleans & Lower Coast  
New Orleans & North Eastern  
New Orleans Terminal  
New Orleans, Texas & Mexico  
New York, New Haven & Hartford  
New York, Ontario & Western  
New York, Susquehanna & Western  
Niagara, St. Catharines & Toronto  
Norfolk & Portsmouth Belt Line  
Norfolk Southern  
Northeast Oklahoma  
Northern Alberta  
Northern Pacific



Northern Pacific Terminal Co. of  
Oregon  
North Louisiana & Gulf  
Northwestern Pacific  
Northwestern Terminal Co.

## O

Ogden Union Railroad & Depot Co.  
Oklahoma City-Ada-Atoka  
Oncida & Western  
Orange & Northwestern  
Oregon, California & Eastern  
Oregon Electric  
Oregon Short Line  
Oregon Trunk  
Oregon-Washington Railroad & Navigation Co. (U. Pac.)  
Ouachita & North Western

## P

Pacific Great Eastern  
Panhandle & Santa Fe  
Pearl River Valley  
Pecos Valley Southern  
Pere Marquette  
Petaluma & Santa Rosa  
Pittsburgh & Shawmut  
Pittsburgh, Shawmut & Northern  
Portland Terminal  
Prince Rupert Dry Dock Co.

## Q

Quana, Acme & Pacific  
Quebec Central

## R

Rio Bravo Oil Co., Houston, Tex.  
(So. Pac.)  
Rio Grande City  
Rio Grande Southern  
Roberval-Saguenay  
Rock Island Southern  
Rutland

## S

St. John's River Terminal  
St. Joseph & Grand Island (U. Pac.)  
St. Louis, Brownsville & Mexico  
St. Louis & Hannibal (U. Pac.)  
St. Louis Electric Terminal  
St. Louis & San Francisco (Frisco)  
St. Louis, San Francisco & Texas  
St. Paul Union Depot Company  
Sacramento Northern  
San Antonio, Uvalde & Gulf

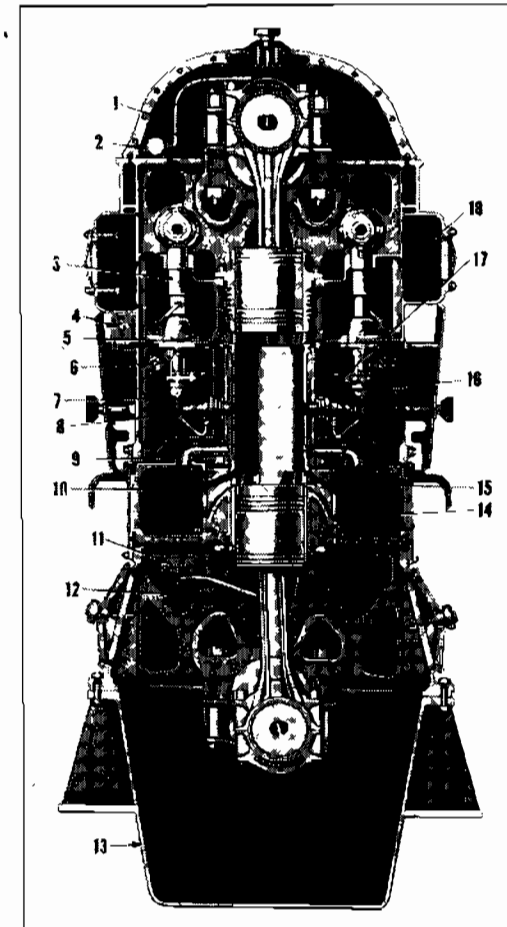
San Benito & Rio Grande Valley  
San Diego & Arizona Eastern  
Santa Maria Valley  
Savannah & Atlanta  
Seaboard Air Line  
Sierra  
South Georgia  
Southern  
Southern Pacific  
Southern Pacific Golden Gate Ferries,  
Ltd.  
Spokane, Coeur D'Alene & Palouse  
Railway  
Spokane International  
Spokane, Portland & Seattle  
Staten Island Rapid Transit  
State University Railroad  
Sugar Land  
Sunset Route

## T

Tallulah Falls  
Tavares & Gulf  
Temiskaming & Northern Ontario  
Tennessee, Alabama & Georgia  
Terminal Railroad Association, St.  
Louis, Mo.  
Texas & New Orleans  
Texas-New Mexico  
Texas, Oklahoma & Eastern  
Texas Pacific  
Texas Pacific-Missouri Pacific Ter-  
minal  
Texas Short Line  
Texas State  
Tijuana & Tecate  
Toledo Terminal  
Tonopah & Goldfield  
Toronto, Hamilton & Buffalo  
Toronto Terminals  
Tremont & Gulf

## U-V-W-Y

Union Pacific  
Union R. R. Co., Memphis, Tenn.  
Union Railroad of Oregon  
Utah  
Utah, Idaho Central  
Virginian  
Waco, Beaumont, Trinity & Sabine  
Weatherford, Mineral Wells & North-  
western  
Western Maryland  
Western Pacific  
Yadkin  
Yosemite Valley



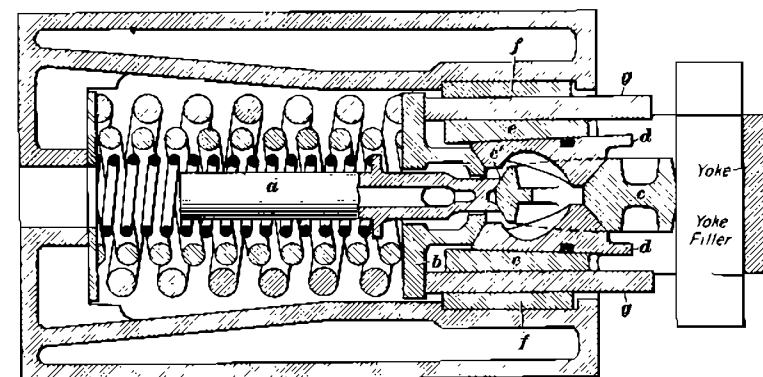
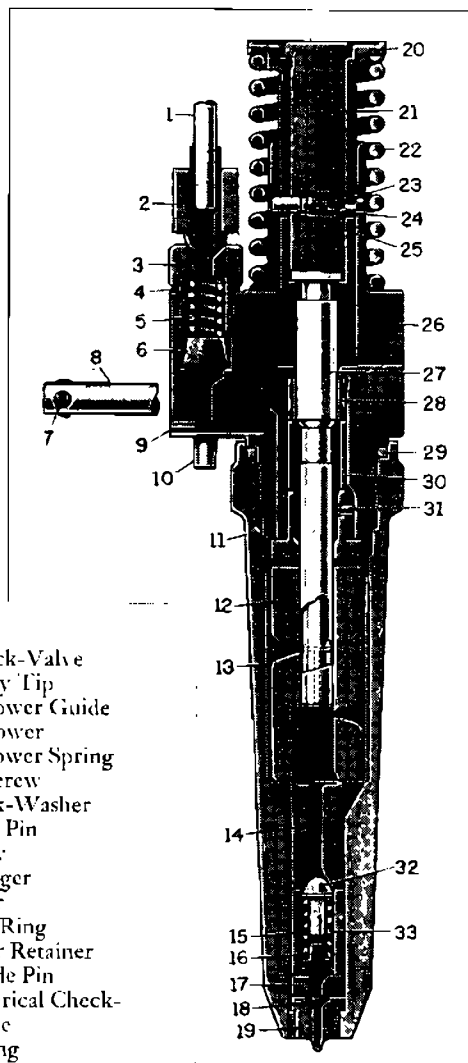
- |                                  |                             |
|----------------------------------|-----------------------------|
| 1—Upper Crankcase Compartment    | 10—Exhaust Manifold         |
| 2—Upper Lubricating-Oil Header   | 11—Lower Oil Header         |
| 3—Injection-Pump Tappet Assembly | 12—Lower Crankcase          |
| 4—Water Return Header            | 13—Sub-Base and Oil Pan     |
| 5—Scavenging-Air Inlet Ports     | 14—Exhaust Deck             |
| 6—Fuel-Control Rod               | 15—Exhaust Ports            |
| 7—Injection-Nozzle Compartment   | 16—Cylinder Liner           |
| 8—Injection Nozzle               | 17—Fuel-Supply Header       |
| 9—Water-Inlet Elbow              | 18—Air-Receiver Compartment |

*This illustration from the I.C.S. lesson unit "Fairbanks-Morse Diesel Locomotive Engine" shows a transverse cross-section of this engine. A great many other illustrations (both halftones and carefully-detailed line drawings) help to make this engine and its operation clear. This unit of the course is typical of all others in clear explanation and helpful illustration.*

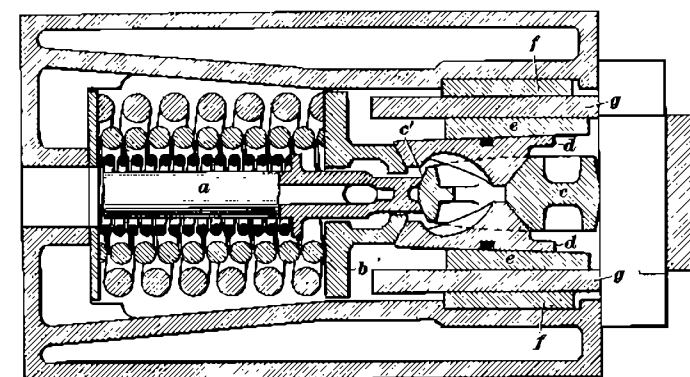
## Hundreds of Pictures Help I.C.S. Students to Understand

- 1—Fuel Line
- 2—Fuel Connection
- 3—Filter Cap
- 4—Gasket
- 5—Filter Spring
- 6—Filter
- 7—Rack Control Pin
- 8—Control Rack
- 9—Plug
- 10—Locating Dowel
- 11—Nut
- 12—Bushing
- 13—Spill Deflector
- 14—Check-Valve Seat
- 15—Spring Cage
- 16—Check-Valve Stop
- 17—Spacer

- 18—Check-Valve
- 19—Spray Tip
- 20—Follower Guide
- 21—Follower
- 22—Follower Spring
- 23—Setscrew
- 24—Lock-Washer
- 25—Stop Pin
- 26—Body
- 27—Plunger
- 28—Gear
- 29—Seal Ring
- 30—Gear Retainer
- 31—Guide Pin
- 32—Spherical Check-Valve
- 33—Spring



Neutral Position  
(a)



Compressed Position  
(b)

These illustrations show vertical sectional views of the NY-11-F draft gear when used with a horizontal yoke. They are from the lesson unit "Draft Gears." No matter what I.C.S. course you choose, or what subject you study, we believe you will be surprised and pleased with the way in which everything is presented through explanation and illustration so you can learn easily and apply what you learn, on the job.

It is because of clear explanation, pictures that explain, and the help of I.C.S. teachers that I.C.S. courses have been popular with railroad men ever since 1898 when the I.C.S. Railroad School was organized. Engineers, firemen, air-brake men, brakemen, car repairers and builders, conductors and others are finding I.C.S. courses a sure way to realization of their aims.

This illustration of a cross-section of a unit injector is from the I.C.S. instruction text "Two-Cycle Diesel Locomotive Engines." Many other remarkable illustrations lead to understanding of these engines, their various parts and the operation of these parts in the functioning of the engine as a mighty power unit. With the great increase in the use of such engines, training of this nature is becoming more and more necessary for railroad men.

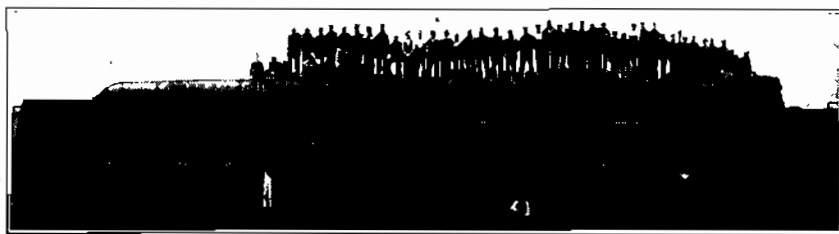
## Training That Clears the Way for Men Who Want to Go Ahead

The requirements for engineers are necessarily rigid. The examinations which one must take, *and pass*, call for a thorough knowledge of the engine, the boiler and steam-making equipment, the air brakes and control apparatus, care of the engine, and how to get it over the road safely, economically and *on scheduled time*.

The fireman who is confronted with an examination on fuel economy, and on boiler and engine operation, will find the knowledge gained from an I.C.S. course invaluable.

The air-brake expert, the roundhouse man, the conductor, and the trainman can acquire clear understanding of his work through these courses. Each will find a course that is specially designed to meet his needs. The operation of engine and train apparatus is explained so clearly that any man, even though his education may be limited, may grasp and understand the subject. With such understanding, I.C.S. students pass examinations for higher positions more readily and apply their knowledge to better advantage in every day work.

It is largely because everything is explained so clearly and because the teaching is conducted with such understanding that so very many railroads in the United States and Canada have entered into arrangements with these Schools for the further training of their employees. This, so far as we have been able to learn, is a greater tribute than has ever been conferred upon any educational institution by the railroads. It is evidence of confidence in what these Schools can do for the man who wants to get ahead and who will study in order to do it.



Railroads for many years have devoted much attention to adequate apprentice training. Many of them have long profited by I.C.S. cooperation. Here is a typical apprentice group.

## Locomotive Engineer's Course

This is a course of broad scope for firemen and engineers who desire practical knowledge of the locomotive and of the care and operation of locomotive equipment. Prepared especially for firemen who wish to pass their examinations, the course is broad enough to meet the needs of any engineer wishing to increase his technical knowledge, or who is in line for promotion to an official position.

The mechanical section provides a clear understanding of the locomotive, of locomotive operation, of all locomotive appliances, and of breakdowns. The description of the locomotive is complete, and all parts of the assembly are described fully.

All details of the boiler are explained, as well as the Association of American Railroads' new standard method of drafting of steam locomotives, and the calculation of the strength of boiler joints, fire box stresses, and the bursting pressure. Other subjects deal with valves and valve gears, stokers, the booster, feedwater heaters and exhaust-steam injectors, lubricators, hand firing, and oil burning. Locomotive appliances such as water columns, sanders, bell ringers, power reverse gears, fire doors, grate shakers, the valve pilot, low-water alarm, and the foam meter are explained in detail.

Air brakes are covered in a very comprehensive way, not only in lessons that are clear, but also with the aid of unique and very practical charts and models. In fact the Air Brake section of the course explains the air-brake equipments, as applied to the locomotive and to cars, disorders, remedies, and repairs.

The following Forms are furnished with this course: (See page 8) Form 1087, Form 102C, and Form 104.

Enrollments for this course will be accepted only from locomotive engineers, firemen, hostlers, and hostler helpers who hold seniority rights in the firemen's or engineering service; or who have at some time in the past held such rights. The applications must be accompanied by a certificate signed by an official of the railroad to the effect that the applicant for the course is, or has been, so employed.

If desired, the student may, on request, begin with a study of the air brake subjects before taking up the study of the mechanical subjects.

## SUBJECTS COVERED

Locomotive Boilers, 2 Parts  
Hand Firing of Locomotives  
(Optional)  
Oil-Burning Locomotives (Optional)  
Type D Duplex Stoker (Optional)  
Locomotive Stokers  
Locomotive Injectors  
Locomotive Feedwater Heating  
Equipments  
Heat and Superheaters  
Locomotive Appliances, 2 Parts  
Locomotive Lubricators  
The Steam Locomotive, 2 Parts  
Locomotive Valves (Accompanied by  
Model 56—Piston—and Piston Valves)  
Stephenson Valve Gear (Optional)  
Baker Locomotive Valve Gear  
Walschaert Valve Gear, 2 Parts  
Type C-2 Locomotive Booster  
Locomotive Management (Accom-  
panied by Form 1087)  
Locomotive Breakdowns  
Locomotive Headlights

Train Rules, 2 Parts (Optional)  
Form 107-C containing:  
Air Brake Compressors  
A-1 Engine Equipment (Optional)  
No. 6 ET Locomotive Brake Equip-  
ment, 2 Parts (13 Charts)  
No. 8 ET Locomotive Brake Equip-  
ment, 2 Parts (14 Charts)  
Brake Equipments for High-Speed  
Trains (Accompanied by Form  
5464A containing 19 Plates)  
Air-Brake Troubles  
Automatic Train Control (Accom-  
panied by Form 2508X) (Optional)  
Foundation Brake Rigging, 2 Parts  
Type K Freight-Car Brake Equipment  
Type AB Freight Brake Equipment  
PM and LN Passenger Brake Equip-  
ment (Optional)  
UC Passenger-Car Brake Equipment  
(Accompanied by Form 104)  
LT Automatic Control Equipment  
(Optional)

## Locomotive Engineer's-Mechanical Course

This is a course for locomotive engineers who desire instruction on the locomotive and its appliances, but not on the air brake. In this course, no instruction is included on the air brake, and no models or charts are furnished. In other respects, the course is the same as the Locomotive Engineer's Course.

To enroll for this course, one must be a locomotive engineer, fire-  
man, hostler or hostler's helper, holding seniority rights in the fireman's  
or engineer's service, or must have at some time held such ratings.

## SUBJECTS COVERED

Locomotive Boilers, 2 Parts  
The Steam Locomotive, 2 Parts  
Locomotive Valves (Accompanied by  
Model 56—Piston and Piston Valve)  
Stephenson Valve Gear  
Walschaert Valve Gear, 2 Parts  
Baker Locomotive Valve Gear  
Type C-2 Locomotive Booster  
Locomotive Valve Setting (Optional)  
Southern Locomotive Valve Gear  
(Optional)  
Locomotive Appliances, 2 Parts  
Hand Firing of Locomotives

Oil-Burning Locomotives  
Type D Duplex Stoker (Optional)  
Locomotive Stokers (Optional)  
Locomotive Injectors  
Locomotive Feedwater Heating  
Equipments  
Locomotive Lubricators  
Heat and Superheaters  
Locomotive Management  
(With Form 1087)  
Locomotive Breakdowns  
Locomotive Headlights  
Train Rules, 2 Parts

## Steam Locomotive Brake Equipment Course

Engineers, who need more information on the action, use, and effective handling of locomotive brakes, including compressors, will find this course helpful. The following forms, including charts and models, are furnished with the course: Form 5464A, Form 102C. (See page 8.)

## SUBJECTS COVERED

Air-Brake Compressors  
A-1 Engine Equipment  
No. 6 ET Locomotive Brake Equip-  
ment, 2 Parts (13 Charts)  
No. 8 ET Locomotive Brake Equip-  
ment, 2 Parts (14 Charts)

Brake Equipments for High-Speed  
Trains (With Form 5464A)  
Air-Brake Troubles (Optional)  
LT Automatic Control Equipment  
(Optional)



*Special types of locomotives for special purposes are seldom better illustrated than in this picture of these Norfolk and Western Company's engines. Any of these is decided contrast to the engines of a generation ago, and it stands to reason that in the years to come, these will be superseded by still other engines even more efficient. The search for a machine to utilize every last ounce of energy in fuel is going on constantly. While the railroad man of today may know equipment thoroughly, it is necessary to keep up-to-date all the time as engines, brakes, and train equipment change. Men, as well as equipment, can get out of date and thousands of alert railroad men are keeping up with the times through study of I.C.S. courses.*

## Locomotive Firemen's Course

The instruction covers boilers, firing, injectors, and lubricators. The aim throughout is to prepare firemen to pass the first year progressive examinations and it's a good course for this purpose. Anyone wishing to prepare for the second- and third-year examinations, however, should enroll for the Locomotive Engineer's course which was prepared for that purpose.

Anyone enrolling for this Locomotive Firemen's Course must be a railroad employee, a prospective fireman, and the application for enrollment must be approved by an official of the Mechanical Department of his railroad. In this way we are assured that any student of this course may have an opportunity at some time to learn the road, or otherwise to qualify as a locomotive fireman.

### SUBJECTS COVERED

Locomotive Boilers, 2 Parts  
The Steam Locomotive, 2 Parts  
Locomotive Appliances, 2 Parts  
Locomotive Injectors  
Hand Firing of Locomotives  
Locomotive Feedwater Heating  
Equipments

Locomotive Lubricators  
Train Rules, 2 Parts  
Type "D" Duplex Stoker (Optional)  
Locomotive Stokers (Optional)  
Oil Burning Locomotive (Optional)  
Elements of Arithmetic, 4 Parts  
(Optional)



Interior of an I.C.S. Instruction Car Showing Air-Brake Equipment and Other Apparatus. The Instructor is Ready to Begin His Lecture and Instruction on Combustion of Coal.

## Air Brake Course

To use air properly requires a knowledge of the complete brake mechanism all the way from the compressor on the engine to the last car on the train. So that such understanding may be possible, this course explains all the principles clearly and goes into careful details concerning the operation of compressors, train control, engine equipment, air brake troubles, brake rigging, brake equipment on locomotives, brake equipment for high-speed trains.

The following forms, including charts and models, are included in this course: Form 5464A, Form 102C, Form 104, Form 2508X, Form 5702X, Form 5815X.

To enroll, one must be a locomotive engineer, fireman, hostler or hostler's helper, maintenance man on electric or diesel locomotives, locomotive mechanic or helper, locomotive or special apprentice, electrician or electrician's helper, or electrician apprentice, who is employed in the Mechanical Department of the railroad, an I. C. C. locomotive inspector, roundhouse foreman, assistant roundhouse foreman, shop or general foreman, or a higher officer of the Mechanical Department. The course will also be helpful to those engaged in designing diesel and electric locomotives. A statement should accompany the application for enrollment. This should be signed by an authorized officer of the railroad stating that the applicant is so employed.

### SUBJECTS COVERED

Air-Brake Compressors (With Form 102C)  
A-1 Engine Equipment  
No. 6 ET Locomotive Brake Equipment, 2 Parts (13 Charts)  
No. 8 FT Locomotive Brake Equipment, 2 Parts (14 Charts)  
No. 8 EL Diesel Brake Equipment, 2 Parts (With Form 5702X) (in preparation)  
Brake Equipments for High Speed Trains (With Form 5464A, 19 Charts)  
No. 24 RL Brake Equipment, 2 Parts (With Form 5815X containing 16 Charts)

Air Brake Troubles  
Automatic Train Control (With Form 2508X)  
Locomotive Appliances, 2 Parts  
Foundation Brake Rigging, 2 Parts  
Type K Freight-Car Brake Equipment  
Type AB Freight Brake Equipment  
PM and LN Passenger Brake Equipment  
UC Passenger-Car Brake Equipment (With Form 104)  
LT Automatic Control Equipment (Optional)  
Arithmetic, 4 Parts (Optional)

## Universal Control Valve Course

This is a course for those who wish instruction in the construction and the operation of UC Passenger Car Brake Equipment. The course consists of an instruction text on this brake, and 13 large cardboard charts with the operative parts in color. Students find that these charts are very helpful in learning and understanding this equipment.



## Diesel Locomotive Course

This is a thoroughly modern course prepared primarily to give locomotive engineers and firemen instruction in the operation of Diesel Locomotives. With the rapid growth of diesel power, many other railroad men will find that this course will open the way to opportunity and advancement. Everything is explained very clearly, and scores of illustrations help to make it easy to understand Diesel-locomotives and their equipment.

The course deals with the various working parts of diesel locomotives—engines, generators and accessories, traction motors and trucks, and the braking equipment. One soon becomes familiar with power control, problems of braking, engine operation and procedures necessary to meet various conditions and situations. In fact, the thoroughness of the course is increasingly apparent as one proceeds to learn about the various apparatus, from the draft rigging and trucks, motors, engines, generators and accessories right up to the controls in the cab.

With the course is also furnished:

Form 5702X—which includes lessons on the 8 EL Diesel Brake Equipment with 16 Charts on this equipment.

### SUBJECTS COVERED

Principles of Diesel Engines  
Fundamental Electricity  
Diesel-Electric Locomotives  
Diesel-Locomotive Trucks and Draft Rigging

Two-Cycle Diesel Locomotive Engines, 4 Parts  
Fairbanks-Morse Diesel Locomotive Engines

Four-Cycle Diesel Locomotive Engines, 2 Parts  
Electrical Equipment of Diesel Locomotives, 4 Parts  
Diesel-Locomotive Auxiliaries, 2 Parts  
Operation of Diesel Switching Locomotives  
Operation of Diesel Freight Locomotives  
Operation of Diesel Passenger Locomotives  
Steam Generators for Diesel Locomotives

Alco-GE Diesel Road Locomotives  
EMD F3-F7 Diesel Road Locomotives  
Automatic Train Control (Optional) (Accompanied by 10 Charts)  
No. 8 EL Diesel Brake Equipment, 2 Parts (Accompanied by 16 Charts)  
Brake Equipment for High-Speed Trains (With Form 5464A)  
No. 24 RL Brake Equipment, 2 Parts (With Form 5815X, containing 16 Charts)  
Train Rules, 2 Parts (Optional)

## Steam and Diesel Locomotive Engineer's Course

This is a combined steam, diesel and air-brake course for firemen and engineers who may be required to operate both steam and diesel locomotives. A thorough study of the lessons of this course will enable firemen to prepare for their first-, second-, and third-year examinations.

### SUBJECTS COVERED

#### SECTION A—STEAM LOCOMOTIVES

Locomotive Boilers, 2 Parts  
Hand Firing of Locomotives  
Oil-Burning Locomotives  
Locomotive Stokers  
Locomotive Injectors  
Locomotive Feedwater Heating Equipments  
Locomotive Appliances, 2 Parts  
Locomotive Lubricators  
The Steam Locomotive, 2 Parts  
Locomotive Valves  
(Accompanied by Model 56—Piston and Piston Valve)  
Baker Locomotive Valve Gear  
Walschaert Valve Gear, 2 Parts  
Locomotive Management  
(With Locomotive Lubrication Chart, Locomotive and Tender Defect Chart)

#### SECTION B—DIESEL LOCOMOTIVES

Principles of Diesel Engines  
Fundamental Electricity  
Diesel Electric Locomotives  
Diesel Locomotive Trucks and Draft Rigging  
Two-Cycle Diesel Locomotive Engines, 2 Parts  
Fairbanks-Morse Diesel Locomotive Engine

Four-Cycle Diesel Locomotive Engines, 2 Parts  
Electrical Equipment of Diesel Locomotives, 4 Parts  
Diesel Locomotive Auxiliaries, 2 Parts  
Operation of Diesel Freight Locomotives  
Steam Generators for Diesel Locomotives  
EMD F3 Diesel Road Locomotives (Accompanied by Bulletin "The Woodward Governor")  
Alco-GE Diesel Road Locomotives

#### SECTION C—AIR-BRAKE EQUIPMENTS

Air-Brake Compressors  
A-1 Engine Equipment (Optional)  
No. 6 ET Locomotive Brake Equipment, 2 Parts (13 Charts)  
No. 8 ET Locomotive Brake Equipment, 2 Parts (14 Charts)  
Brake Equipments for High Speed Trains (19 Charts)  
No. 8 FL Diesel Brake Equipment, 2 Parts (14 Charts) (Optional)  
No. 24 RL Brake Equipment, 2 Parts (16 Charts)  
Air-Brake Troubles  
The AB Freight Brake Equipment



## Car Inspector and Air Brake Course

In these days of high-speeds, heavy loads, and long hauls, the necessity of inspection of cars and brakes is of extreme importance.

Here's full information on the operation and disorders of the Westinghouse Freight and Passenger Brake Equipment, also on the air signal system, foundation brake rigging, trainyard inspection, air conditioning and car lighting.

The following forms, with charts and models, are furnished with this course: Form 5464A, Form 104.

### SUBJECTS COVERED

#### Westinghouse Air Brake

##### Booklets:

U. S. Safety Appliances (For Reference)  
Code of Rules for Interchange of Traffic (For Reference)  
Wheel and Axle Manual (For Reference)  
Foundation Brake Rigging, 2 Parts  
PM and LN Passenger Brake Equipment  
Type K Freight-Car Brake Equipment  
Type AB Freight Brake Equipment  
Air-Signal System

UC Passenger Car Brake Equipment (With Form 104)  
Brake Equipment for High-Speed Trains (With Form 5464A)  
Principles of Air Conditioning  
Air Conditioning of Railway Cars, 6 Parts, Including: Pullman System, Carrier Safety, Steam-Jet System, York System, G. E. System, Waukesha System, Frigidaire System (Optional)  
Railway Car Lighting, 3 Parts  
Car Heating  
Yard Inspection of Trains  
Arithmetic, 5 Parts (Optional)

## Railway Conductor's Course

Because the conductor has such a variety of responsibilities it is necessary that his knowledge of the equipment in his charge should be varied and as complete as possible. It is with this thought in mind that this course is designed. The course will also be very helpful to yardmasters, trainmen, brakemen, flagmen, and switchmen.

Form 104—UC Passenger-Car Brake Equipment and 13 charts on the UC Valve Westinghouse Air Brake, known as U-12-BC and UEA-12 accompanies the course.

### SUBJECTS COVERED

Arithmetic, 7 Parts  
Commercial Calculations, 2 Parts (Optional)  
Westinghouse Air Brake (Accompanied by booklet "U. S. Safety Appliances")  
PM and LN Passenger Brake Equipment  
Air-Signal System  
Type K Freight-Car Brake Equipment  
Type AB Freight Brake Equipment

UC Passenger-Car Brake Equipment (With Form 104)  
Train Rules, 2 Parts  
Principles of Air Conditioning  
Air Conditioning of Railway Cars, 6 Parts (Optional)  
Brake Equipment for High-Speed Trains (With Form 5464A)  
Railway Car Lighting, 3 Parts  
Car Heating  
Spelling, 2 Parts (Optional)

## Locomotive Machinist's Course

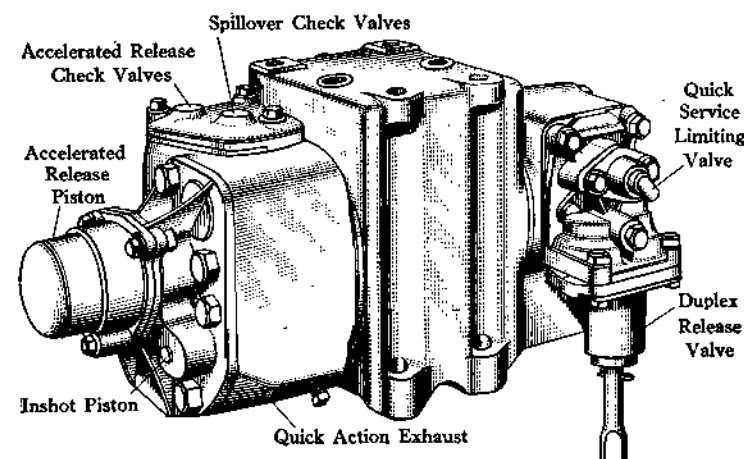
Since the railroad shop presents so many problems not found in any other place, highly specialized knowledge is required of the railroad shop machinist, as well as of the shop machinist, shop apprentices, helpers, roundhouse foremen, gang foremen, and others who need thorough knowledge of all phases of locomotive shop work.

So that anyone may have the specialized knowledge necessary for success and advancement, instruction is provided on the locomotive, on valves, valve gears, valve setting, locomotive rod, wheel, and pin work, and on frames. There is also instruction on shop equipment.

### SUBJECTS COVERED

The Steam Locomotive, 2 Parts  
Locomotive Valves (With Model 56—Piston and Piston Valve)  
Stephenson Valve Gear  
Walschaert Valve Gear, 2 Parts  
Baker Locomotive Valve Gear  
Type C-2 Locomotive Booster  
Locomotive Valve Setting  
Elements of Blueprint Reading  
Laying Off Locomotive Frames  
Machining Frame Cross Ties  
Locomotive Cylinder and Erecting Work  
Cylinder, Guide and Crosshead Repair Work  
Laying Off Shoes and Wedges  
Locomotive Rod, Wheel, and Pin Work

Locomotive Steam-Pipe and Spring Work  
Type D Duplex Stoker (Optional)  
Locomotive Stokers (Optional)  
Locomotive Appliances, 2 Parts  
Locomotive Injectors  
Locomotive Lubricators  
Locomotive Feedwater Heating Equipments  
Lathes  
Lathe Tools  
Lathe Thread Cutting  
Shaper and Slotter Work  
Planers  
Planer Practice  
Arithmetic, 4 Parts (Optional)



*This illustration from an I.C.S. instruction text is typical of the hundreds that make it possible for I.C.S. students to have a clear understanding of every principle—and to do it easier.*

## Railroad Car Repairer's Course

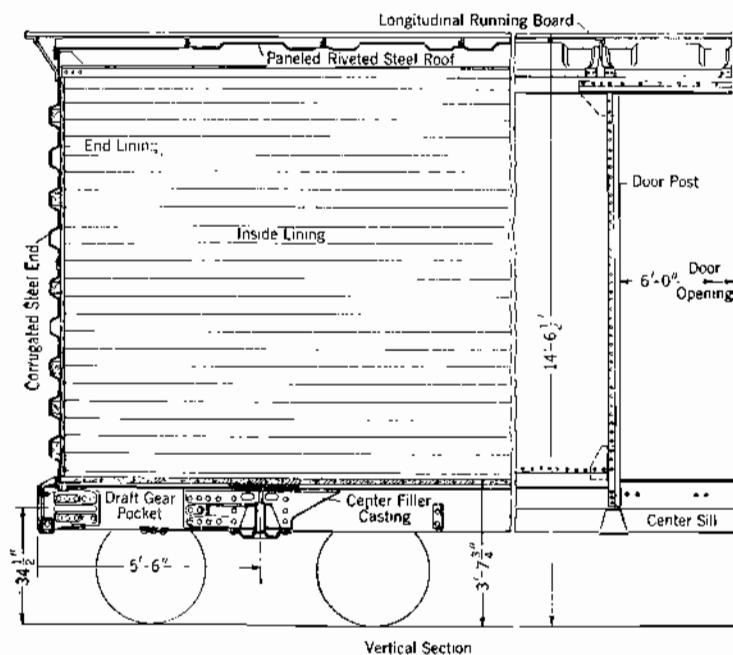
First written by an experienced car foreman, this course has been revised to cover instruction on recent developments and now reports the latest practice in this phase of railroad work. The construction and repairs of various types of freight cars, both wood and steel, are explained fully. The instruction also covers the draft rigging and trucks.

The section of the course relating to repairs is thoroughly in accord with modern practice. Three pamphlets of the American Railway Association are included for reference.

### SUBJECTS COVERED

Freight-Car Trucks, 2 Parts (With 3 Booklets: "U. S. Safety Appliances," "Rules for Interchange of Traffic," and "Wheel and Axle Manual")  
Draft-Gear Attachments  
Draft Gears  
Box Cars  
Stock Cars, Refrigerators, and Caboosees, 2 Parts  
Steel-Frame Flat Cars  
Steel Gondola and Hopper Cars, 2 Parts  
Tank Cars

Steel-Car Repairs, 2 Parts  
Passenger-Train Car Repairs  
Passenger-Car Truck Repairs  
Car-Shop Millwork  
Gas-Welding Equipment (Optional)  
Gas Welding of Carbon Steel (Optional)  
Gas Welding of Cast Iron and Alloy Steels (Optional)  
Gas Cutting (Optional)  
Arithmetic, 3 Parts (Optional)



Typical illustration from an I.C.S. instruction text.

## Boilermakers' Course

Boilermakers, apprentice boilermakers, helpers, layersout, flangers, and all others interested in heavy sheet metal work will find in this course the information which the expert must have. Training is provided which is necessary in building boilers, tanks, stacks, and similar work in shops.

The instruction covers projection drawing, triangulation, development of surfaces, bending and flanging plates, boiler design, and the properties entering into boiler construction. The proportioning of boiler parts and the calculations by which the strength of boiler parts is determined are taught.

The course is arranged in two divisions. The student enrolls first in Division 1. When work on all the subjects of this division has been completed, the student then enrolls for Division 2. When work on all the subjects in both divisions has been completed, the student qualifies for a diploma from the entire course.

### SUBJECTS COVERED

#### Division 1—Mathematics and Drafting

Arithmetic, 7 Lessons  
Formulas  
Geometrical Drawing  
Elements of Projection Drawing  
Development of Surfaces  
Practical Laying-Out Problems

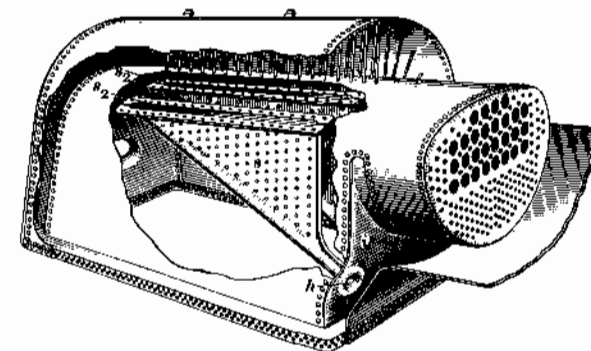
Drawings for Welded Parts  
Elements of Mechanics, 2 Parts  
Types of Steam Boilers  
Boiler Mountings  
Boiler Details, 2 Parts

#### Division 2—Boiler Construction

Elements of Fluid Mechanics  
Heat  
Steam (with Steam Tables)  
Pipes and Pipe Fittings  
Boiler Furnaces, Settings, and Chimneys

Boilermaking, 5 Parts  
Boiler Repairs, 2 Parts  
Boiler Inspection  
Properties of Materials  
Riveted Joints  
Steam Boiler Design, 2 Parts

Another illustration from an I.C.S. lesson. This one shows the installation of two thermosyphons installed in a modern locomotive boiler—a subject of interest to all engine men and to boiler makers in particular.



## Air Conditioning of Railroad Cars Course

Air conditioning on railroad cars has become so general that many who are responsible for the operation of the air-conditioning apparatus on cars find need for a great deal of information on the subject in order to meet the requirements of the job. It is for these that this course is offered. It is not the purpose to teach the *design* of air conditioning systems, nor to go intensively into the fundamentals of the science.

Through this study you can become well informed on the construction and operation of the equipment used to clean air, to heat it or to cool it, and to govern the humidity for the comfort of passengers in Pullmans, diners, club cars and other cars equipped with air conditioning apparatus. Under the subject "*Air Conditioning of Railway Cars*" special attention is given the Carrier-Safety Steam-Jet System, the Frigidaire System, the G. E. System, the Pullman System, the Waukesha System, and the York System. Thorough treatment is also given the application of air conditioning principles to the cooling of railway cars.

### SUBJECTS COVERED

Arithmetic, 3 Parts  
Fundamental Electrical Instruction  
Direct-Current Generators and Motors  
Storage Batteries, 2 Parts  
Principles of Air Conditioning  
Alternating-Current Generators,  
Transformers, and Rectifiers  
A-C Motors and Control  
Electrical Measuring Devices

Slow-Speed Protective Relays  
Heating and Cooling of Cars  
Air Conditioning of Railway Cars, 6  
Parts, Including: Pullman System;  
Carrier Safety Steam-Jet System;  
General Electric System; York System;  
Waukesha System; Frigidaire System

## Railroad Signalmen's Course

Men who are engaged in any kind of railroad signal work find this course ideally adapted to their needs for sound technical training.

A sound understanding of fundamentals is given at the beginning and this is followed by thoroughly technical instruction on various types of automatic railway signals, of both the semaphore and light types, and the circuits involved; highway crossing protection systems, and instruction on maintenance. Other subjects deal with centralized traffic control, switching and interlocking apparatus, and car-retarder systems. The subject *Automatic Train Control*, with charts, is also furnished for reference.

### SUBJECTS COVERED

Arithmetic, 7 Parts  
Formulas  
Trigonometry and Graphs (For Reference)  
Elements of Mechanics, 2 Parts  
Elementary Electrical Principles

Electrostatics and Magnetism  
Theory and Construction of Direct-Current Machines  
Alternating-Current Generators, Transformers, and Rectifiers  
A-C Motors and Control

(Continued on page 31)

### SUBJECTS COVERED—Continued

Switchgear, 2 Parts  
Electrical Measuring Devices  
Practical Electrical Measurements  
Storage Batteries, 2 Parts  
Glossary of Railway Signaling Terms  
(For Reference)  
Track Circuits

Automatic Railway Signaling, 2 Parts  
Railroad Mechanical Interlocking  
Railway Electrical Interlocking, 2 Parts  
Railway Electropneumatic Interlocking  
Railway Car-Retarder Systems  
Centralized Traffic Control Systems  
Automatic Train Control (Optional)  
(With Form 2508X)

## Section Foreman's Course

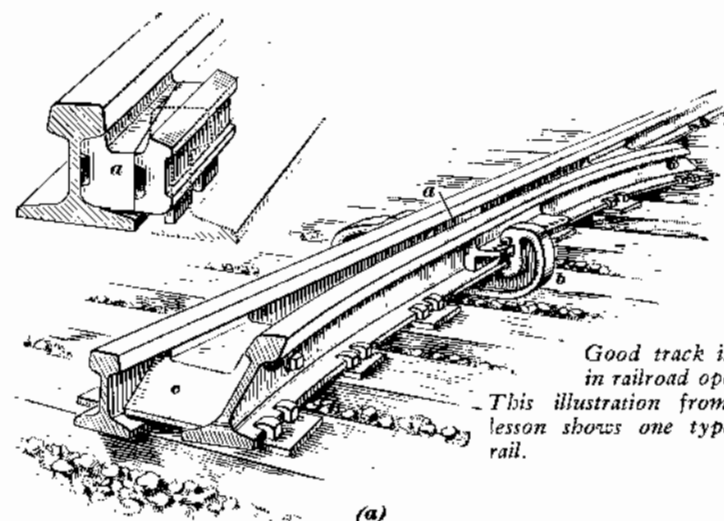
The duties and responsibilities of the section foreman are covered in a very thorough, yet easily understood way. The principles of track work with which a section foreman should be familiar are taught, as well as methods of ditching, ballasting, lining and surfacing track, renewing ties and rails, and placing turnouts.

Instruction is also included in arithmetic and in the elements of blueprint reading. Spelling and letter writing are other subjects which help the foreman to express himself clearly and correctly in his communications and reports. By means of this instruction, men who are employed as assistant foremen on track maintenance work are trained to qualify for the position of section foreman, and section foremen are helped to qualify for advancement to higher positions.

### SUBJECTS COVERED

Arithmetic, 4 Lessons  
Elements of Mensuration  
Railway Drawings, Blueprints, and Sketches  
Elements of Trackwork, 2 Parts  
The Section Foreman and His Work

Maintenance of Track, 3 Parts  
String Lining of Track  
Spelling, Part 1  
Planning and Writing the Letter  
Mechanics of the Letter  
Routine and Adjustment Letters



Good track is important in railroad operation. This illustration from an I.C.S. lesson shows one type of guard rail.

## Roadmaster's Course

This course provides the knowledge of trackwork, engineering principles and other subjects which is expected of the roadmaster or the track supervisor. Following the subjects of arithmetic and trackwork, there are others on the elements of railway organization and operation, and the duties and work of the roadmaster. This is followed by a more liberal education in engineering mathematics, on general and railroad surveying, materials and methods of engineering construction, and in elementary bookkeeping and letter writing.

The course is arranged in two divisions. The student enrolls first in Division 1. When work on all the subjects of this division has been completed, the student then enrolls for Division 2. When work on all the subjects in both divisions has been completed, the student qualifies for a diploma from the entire course.

### SUBJECTS COVERED

#### Division 1—Trackwork and Construction

Elements of Arithmetic, 6 Parts  
Elements of Algebra, 4 Parts  
Elements of Mensuration  
Railway Drawings, Blueprints, and Sketches  
Elements of Trackwork, 2 Parts  
The Section Foreman and His Work  
Maintenance of Track, 3 Parts  
Railway Organization and Operation  
The Roadmaster and His Work, 2 Parts  
String Lining of Track

#### Division 2—Surveying and Business

Logarithms  
Geometry, 2 Parts  
Plane Trigonometry, 2 Parts, with Trigonometric Tables  
The Slide Rule (Optional)  
Chain Surveying  
Leveling  
Compass Surveying  
Transit Surveying  
Office Work in Angular Surveying  
Circular and Parabolic Curves, 2 Parts

General Properties of Materials, 2 Parts  
Elementary Chemistry  
Materials of Structural Engineering, 2 Parts  
Cement, Concrete, and Mortar  
Field Methods in Concrete Construction  
Reinforced Concrete Construction  
Stone and Brick Masonry  
Railway Structures and Terminals  
Agreements and Specifications

Spiral Easement Curve  
Earthwork  
Railroad Location  
Trackwork, Part 2  
Introductory Accounting, Part 1, 3 Lessons (Accompanied by Work Books)  
Planning and Writing the Letter  
The Mechanics of the Letter  
Routine and Adjustment Letters

## Bridge and Building Foreman's Course

Instruction is given on subjects which a bridge foreman or a building foreman should know. This training will be valuable to any man who has anything to do with constructing, repairing, and maintaining bridges, buildings, and other structures of the railroad.

### SUBJECTS COVERED

Arithmetic, 6 Parts  
Railway Drawings, Blueprints, and Sketches  
Formulas  
Geometry and Mensuration, 2 Parts  
Materials of Structural Engineering, Part 1  
Carpentry, 3 Lessons  
The Steel Square, 2 Parts (Optional)  
General Properties of Materials, Part 1  
Materials of Structural Engineering, Part 2  
Elementary Chemistry  
Cement, Concrete, and Mortar  
Reinforced-Concrete Construction  
Forms and Centering, 2 Parts

Field Work in Concrete Construction, 3 Parts  
Piling  
Foundations  
Stone and Brick Masonry  
Waterproofing of Concrete  
Roofing, 2 Parts  
Fireproofing  
Reading Structural Steel Blueprints, 2 Parts  
Reading Concrete Blueprints, 2 Parts  
Surveying for Building Construction  
Elements of Trackwork, 2 Parts  
Railway Structures and Terminals  
Agreements and Specifications  
Erection of Steel Building Frames



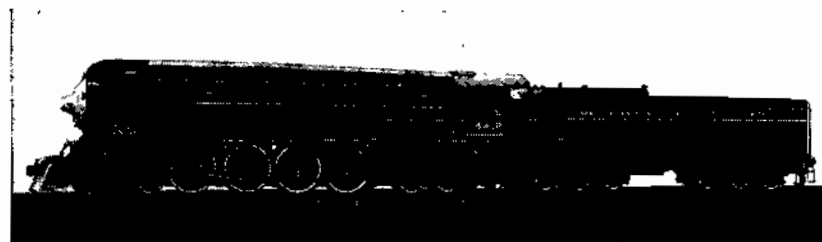
## Backbone of Transportation

Railroads made possible the development of the North American Continent. Great cities sprang up at strategic places, vast areas were opened to cultivation. The products of mines, forests, manufacturing industries, and the products of our natural resources were made available to all the people.

When war came the railroads faced a tremendous task of transporting millions of tons of vital materials—and they did it fast—day after day, month after month. Cars kept going, engines kept running, men kept on working.

Since the days of war, railroads have spent millions in improving rights-of-way, in buying new cars and thousands of locomotives.

In an organization so great and so complex as a railroad every piece of equipment, every individual is important. Each must be as ideally suited to a purpose as possible. Every man, from the call boy to the president is important in his place. Each must know what to do and how to do it. The safety of all depends on such knowledge. Service to passengers and to shippers depends upon it, too. This is why training is so important to every railroad man—from the call boy to the president.



## Subjects That Prepare for Success in Railroading

Would you have training that is both practical and thorough because it is based on the practical experience of railroad men—and is taught by men with railroad experience?

Would you have information that is so practical and usable that experienced railroad men profit by it, yet is so clearly explained that the beginner who knows little or nothing about a subject can understand it?

As you read the descriptions of subjects that follow note how thoroughly each goes into detail, how well they are illustrated and the thorough treatment given to each. These descriptions illustrate the thoroughness of all I.C.S. instruction texts. These are arranged in alphabetical order for your convenience.

### A-1 ENGINE EQUIPMENT

61 Pages, 29 Illustrations

Names and Arrangement of Parts; Air-Brake Terms. Plain Triple Valve. G-6 Automatic Brake Valve. Operation of Governor. Slide-Valve Feed-Valve; Combined Automatic and Straight-Air Locomotive Brake Equipment.

### AIR-BRAKE COMPRESSORS

80 Pages, 44 Illustrations

Arrangement and Operation of the Air Brake; The 9½" x 9½" x 10" Air Compressor. Operation of Steam Cylinder; Operation of Air Cylinder; The 11" x 11" x 12" Air Compressor; The 8½-inch, 150 Cross-Compound Air Compressor. Operating a Compressor; Lubrication. New 8½-inch 150 Compressor; Reconditioning the Compressor.

### AIR-BRAKE TROUBLES

62 Pages, 21 Illustrations

Disorders and Tests of Air-Brake Apparatus; 9½-inch and 11-inch Compressor; Type G-6 and H-6 Brake Valves; Disorders; C-6 Independent Brake Valve; Testing and Oiling. Straight-Air Brake Valve; Disorders; The Feed-Valve; Disorders. Main-

tenance of Air-Brake and Air-Signal Equipment on Locomotives; Rules Adopted Jointly by the Bureau of Safety of the I. C. C. and the Safety Appliance Committee of the A. R. A.

### AIR CONDITIONING OF RAILWAY CARS

6 Lessons, 371 Pages, 179 Illustrations

Each lesson provides information and instruction on the Air Conditioning of Railway Cars by means of the systems made by six different manufacturers. These are: Carrier-Safety Steam-Jet System; Frigidaire System; G. F. System; Pullman System; Waukesha System.

### AIR-SIGNAL SYSTEM

21 Pages, 7 Illustrations

General Arrangement of Apparatus; The Signal Whistle; Reducing Valve (Old Style and Improved); Car Discharge Valve; the Signal Valve; Signaling.

### ALCO-GE DIESEL ROAD LOCOMOTIVES

70 Pages, 32 Illustrations

Freight and Passenger Units; Description of Diesel Engine; Fuel Oil

System; Lubricating Oil System; Engine Cooling Water System; Pressure Air System; Power Plant Regulating System; Locomotive and Engine Controls; Preparing Locomotive for Operation; Position of Controls; Starting and Stopping Engine; Operation of Locomotive; Action of Safety Features; Changing Operating Ends; Emergency Engine Shutdown; Dynamic Braking.

### ARITHMETIC

7 Lessons

Elements of Arithmetic; Fractions; Decimals; Weights and Measures; Ratio and Proportion; Powers and Roots; Mensuration.

### AUTOMATIC TRAIN CONTROL

90 Pages, 44 Illustrations

Types of Automatic Train Control; Union Switch and Signal Company's Two-Speed Train Control; Three-Speed Automatic Train Control; Union Switch and Signal Company's Pneumatic Equipments. General Railway Signal Company's Pneumatic Equipment. Charts 2508X.

### BAKER LOCOMOTIVE VALVE GEAR

57 Pages, 47 Illustrations

Names of Parts; Details of Parts. Operation; Principle of Reverse Arrangement.

### BRAKE EQUIPMENTS FOR HIGH-SPEED TRAINS

102 Pages, 26 Illustrations, 19 Charts

Arrangement and General Operation of D-22-P Passenger-Car Brake Equipment. D-22-AR Control Valve. Purpose of Parts: Continuous Quick Service Valve; Relay Valve; Operation; HSC High-Speed Passenger-Car Brake Equipment; Electric Equipment; 21-B Magnet Valve; Energizing Low-Speed Medium-Speed and High-Speed Magnets; Operation of Speed Governor Control Equipment; HSC High-Speed Brake Equipment for Diesel Electric Locomotives; MS-40

Automatic Brake Valve; S-40-C Independent Brake Valve; Operating Instructions; HSC Locomotive Brake Equipment with L-8-PC and M-36 Brake Valves.

### CAR HEATING

50 Pages, 38 Illustrations

Vapor Car Heating Company's Systems; Arrangement and Operation of Manual, Automatic Temperature Control, and Zone Systems of Car Heating; Locomotive Equipment; Operation of Vapor Regulators, Reducing Valves, Vapor Cut-Out Valves, and Constant Pressure Valves; Single-Tube Adjustable Thermostat; Operating Instructions; Enginemen's and Trainmen's Duties.

### CODE OF RULES FOR INTERCHANGE OF TRAFFIC

304 Pages, Many Illustrations

The contents of this book are indicated by its full title, which is: Code of Rules (M. C. B.) Governing the Condition of and Repairs to Freight and Passenger Cars for the Interchange of Traffic, Adopted by the Association of American Railroads.

### COMMERCIAL CALCULATIONS

2 Parts, 99 Pages

Rapid Addition; Special Method of Subtraction; Special Methods of Multiplication; Special Methods in Division; Short Method of Division; Percentage; Commission and Brokerage; Insurance; Interest; Applications of Percentage; Profit and Loss; Taxes, Promissory Notes; Bank Discount; Partial Payments and Exact Interest; Merchant's Rule; Compound Interest; Present Worth; Stocks and Bonds; Exchanges—Foreign and Domestic; Duties; Equation of Payments; Equation of Accounts.

### CYLINDER, GUIDE, AND CROSSHEAD REPAIR WORK

59 Pages, 31 Illustrations

Back-Shop Repairs; Cylinder Work; Cylinder Bushings; Reboring the Cylinders; Application of Bushing; Lo-

cating Steam Edges of Ports; Grinding In of the Heads; Guide Work; Piston Work; Piston-Rod Work; Crosshead Work; Fitting the Shoes; Machining New Crossheads; Piston-Ring Work; Lining Up Crosshead Guides.

#### DIESEL-ELECTRIC LOCOMOTIVE

55 Pages, 17 Illustrations

Development and Classification; Description of Diesel-Electric Locomotive; Traction Motor; Power Control; Speed Ratio; Switching Locomotive; Arrangement of Equipment; Passenger Locomotive; General Features; Arrangement of Equipment; Freight Locomotives; Arrangement of Equipment; Rating of Locomotives; Effect of Gear Ratio; Tonnage Rating; Drawbar Pull; Dynamic Brake; Comparison of Steam and Diesel.

#### DIESEL-LOCOMOTIVE AUXILIARIES

2 Parts, 154 Pages, 77 Illustrations

Electro-Motive Locomotives—Mechanical Auxiliaries, Air Compressors; Freight and Switching Locomotive Types; Passenger Locomotive Type. Air-Compressor Governor; Water-Cooling Fan Drives; Fuel-Oil Filters; Fuel-Oil Pumps; Fuel-Oil Relief Valves and Sight Gages; Lubricating-Oil Filters; Lubricating-Oil Cooler and Tank; Lubricating-Oil Engine Shut-Down Devices; Lubricating-Oil Engine Shut-Down Alarms.

Electrical Auxiliaries. Auxiliary Generators. Main Generators: Passenger and Switcher Type; Freight-Locomotive Type. Traction Motors; Fuel-Pump and Car-Heater Motor; Cab-Heater Motor; Dynamic-Brake Blower Motor; Head-Light Dyna-

motor; Battery-Charging Contactors; Engine-Starting Contactor; Generator Battery-Field Contactor; Generator Shunt-Field Contactor; Traction-Motor Field-Shunting Contactor; Traction-Motor Series-Parallel Contactors; Dynamic Braking Contactors; Dynamic-Brake Warning Relay; Ground Protective Relay; Reverse-Current Relay; Time-Delay Relay; Transition Relay; Wheel-Slip Relay; Oil-Pressure Relay; Voltage Regulator; Load Regulator; Reverser; Reverser; Cam-Switch.

#### DIESEL-LOCOMOTIVE TRUCKS AND DRAFT RIGGING

67 Pages, 29 Illustrations

Classes of Trucks; Six-Wheel Passenger-Locomotive Truck; General Description; Truck Frame; Truck Bolster; Body and Truck Connection; Spring Plank; Truck Springs; Characteristics of Springs; Journal Boxes and Bearings; Hyatt Roller Bearing; Care of Journal Boxes; Wheels and Axles; Motor Drive; Details of Drive; Freight-Locomotive Trucks; Switcher Trucks; Service Instructions; Brake-Rigging Adjustment; Raising Locomotive; Removing Springs; Truck Removal.

#### ELECTRICAL EQUIPMENT OF DIESEL LOCOMOTIVE

2 Parts, 241 Pages, 115 Illustrations

Traction Equipment; Systems of Power Transmission; Traction Motors; Motor Requirements; Gear Ratio; Traction-Motor Heating; Cooling Devices; Current-Voltage-Speed Relations; Limits for Diesel-Engine Power; Field Shunting; Effects of Loose Connections; Reversing Direction of Rota-

tion; Traction-Motor Operating as Generator; Motors in Parallel. Dynamic Braking.

Generator Equipment: Factors Influencing Generator Design; Method of Determining Load; Automatic Field Adjustment; Field-Strength Curves. Field-Excitation Control Systems: General Electric Split-Pole Exciter; Exciter Bridge Circuits; Westinghouse Six-Pole Exciter; Compound Differential Exciter. General Motors Generator-Load Control; Load Regulator; Oil-Motor Control; Plunger-Type Load Regulator; Pilot Valve. General Electric Speed Switch. Westinghouse Carbonstat Regulator. Current Range of Generator and Motor: Motors in Series and Parallel; Transition. Power Circuits. Commutation. Mechanical and Electrical Construction.

Control Equipment: Remote Control; Switching Requirements. Relays; Setting Relays. Arc Quenching; Blow-out Coils; General Electric Speed Switch: Contactor Arrangement; Sequence of Operation. Reversers. General Motor Passenger Locomotive Control Circuit. Contactor-Control Circuits and Engine-Control Circuits for General Motors Locomotive with General Electric Equipment. Freight-Unit Control Circuit with Cam Switch: Freight-Unit Circuit without Cam Switch. American Locomotive Company Passenger Locomotive Control System. Alco Switcher. Baldwin Switcher. General Electric 44-Ton Switcher. Whitcomb and Davenport-Besler Switcher. Auxiliary Equipment. Troubles in Diesel Locomotive Circuits: Cutting Out Traction Motors; Determining Nature of Trouble; Failure of Power Plant; Short Circuits and Grounds.

#### ELEMENTS OF BLUEPRINT READING

65 Pages, 56 Illustrations

Representation of Objects: Perspective Drawings; Mechanical Drawings; Blueprints; Kinds of Views; Arrangement of Views; Relation of Views; Projection Drawing; Planes of Projection; Reading Drawings; Lines Used on Drawings; Shading on Drawings; Sectional Views; Forms of Section Lining; Conventional Sections; Breaks; Sections of Adjacent Parts; Abbreviations and Notations on Drawings; Scales; Dimensions on Drawings; Representation of Various Details; Interpretation of Drawings; Examples of Blueprint Reading.

#### EL DIESEL

#### BRAKE

#### EQUIPMENT, NO. 8

2 Parts, 130 Pages, 34 Illustrations, 16 Charts

Brake Equipment on Units; Equipment on A Unit; Equipment on B Unit; Parts of Equipment; KS-8-PA Pedestal Brake Valve; Pipes Connected to Pedestal; Lower Rotary Valve and Seat; Upper Rotary Valve and Seat; Charging Valve and Exhaust Valve; Cut-Off Valves; S-8-A Independent Brake Valve; Application Valve Portion; Recapture Valve Assembly; Train-Control and Safety-Control Cock; Suppression-Valve Portion; M-3-A Feed-Valve; No. 8 Distributing Valve; Timing Valve; Differential Cut-Off Valve; H-1 Relay Air Valve; Safety-Control Feature; Centrifugal Governor; Train-Control Reservoirs; KM Brake-Pipe Vent Valve; B Relay Valve; Automatic Brake Operation; Full Release; Running; Service; Lap;

Some unimaginative dolt said one time, "Experience is the best teacher." Soon, almost everybody was saying it, and they passed it on to their children and to their children's children. Experience is a wonderful teacher. But, anyone attempting to fit himself for a top place in life without study, and through the "learn-by-experience" school will find that he cannot acquire in a whole lifetime, as much as he could in a few months' study of a course which includes the accumulated experience of many.

One Student says: "I particularly like I.C.S. because, regardless of the subject I am studying, I.C.S. teachers correct errors in English or punctuation, and give clear instruction. I like I.C.S. because I can set my own pace of study. I went to night school at one time. Then our children came and I couldn't get to classes every night. If I missed a session it was just too bad. I.C.S. avoids this drawback. I like this because I can work by day and study at night, and what I learn ties in with my work."



First Service; Emergency; Control Brake Operation in Running and Lap Positions; Suppression of Train-Control Brake Applications in Service and First Service Positions; Permanent Suppression; Operating Instructions; Broken Pipes.

#### FMD F3 DIESEL ROAD LOCOMOTIVES

90 Pages, 25 Illustrations

Description of Locomotive; Description of Equipment; Diesel Engine; Alternator and Main Generator; Cooling-Fan Motors; Traction-Blower Motors; Operating Controls; Engine Controls; Miscellaneous Controls; Engine Governor; Locomotive Operation; Safety Devices; Engine Water System; Lubricating Oil System; Fuel Oil System; Electrical Equipment; Air System.

#### ET LOCOMOTIVE BRAKE EQUIPMENT, NO. 6

2 Parts, 120 Pages, 53 Illustrations, With 13 Charts of the Equipment

Parts of the No. 6 ET Equipment; General Arrangement of Apparatus; Operating Instructions; No. 6 Distributing Valve; H-6 Automatic Brake Valve; S-6 Independent Brake Valve; Construction; Arrangement of SD and SF Governors with ET Equipment; B-6 Feed Valve; G-6 Reducing Valve; No. 4 Pneumatic Brake-Pipe Vent Valve; The M-3 and the M-3-A Feed Valves; Emergency Relay Valve; Aftercooler; Super Compressor Governors; Pedestal-Type Brake Valve. Automatic Operation of the No. 6 ET Locomotive Brake; Independent Operation of the No. 6 ET Locomotive Brake; No. 14 EL Locomotive Brake Equipment; Air Signal System.

#### ET LOCOMOTIVE BRAKE EQUIPMENT, NO. 8

2 Parts, 100 Pages, 39 Illustrations With 14 Charts of the Equipment

Development; Manipulation of Equipment; General Arrangement; Brake Valve; Distributing Valve; Steam Throttle Valve; Feed Valve; Super-Governor; Operation of Equipment. Broken Pipes; Instructions for Making Stops.

#### FAIRBANKS-MORSE DIESEL LOCOMOTIVE ENGINES

100 Pages, 45 Illustrations

Engine Construction and Maintenance. Operating Cycle; Engine Timing; Engine Specifications; Cylinder Block and Liners; Engine Crankshafts and Vertical Drive; Barring Device; Upper Crankshaft Removal; Checking Backlash in Vertical Drive Assembly. Main Bearing Replacement; Removal of Upper and Lower Connecting Rods and Pistons; Piston-Ring Maintenance; Piston-Head Clearance. Cam Shafts, Bearings and Timing Chains. Scavenging-Air Blower. Removal and Overhaul of Blower; Checking Blower Backlash; Oil-Separator Maintenance. Engine Systems. Exhaust System. Engine Lubricating Oil System. Cooling System; Fuel-Oil Supply Pump; Fuel Injection Pump; Replacement of Pump Parts; Injection-Nozzle Testing and Maintenance; Balancing Load on Cylinder; Fuel Injection Timing; Injection Pump Troubles; Engine Water-Cooling System. Engine Air-Cooling Systems. Engine Control-Autoload System. Differential-Field Exciter; Woodward SI Governor; Emergency Stop Control; Low Lubricating-Oil Pressure Control.

#### FOUNDATION BRAKE RIGGING

2 Parts, 94 Pages, 49 Illustrations

Levers; General Rule for Calculating Levers; Friction; Coefficient of Friction; Nominal and Actual Braking Force; Standing and Running Piston Travel; The American Automatic Slack Adjuster; Brake-Rigging Calculations; Calculating the Braking Ratio; Calculations Involving Air Pressures; Calculating Length of Stop; Hand Brakes. Description and Calculation of Force.

#### FOUR-CYCLE DIESEL LOCOMOTIVE ENGINES

2 Parts, 154 Pages, 67 Illustrations

Baldwin-Westinghouse Diesel Locomotive Engine. Engine Construction; General Diesel-Engine Data; Engine Lubricating System; Engine Fuel-

Oil Systems; Fuel-Oil Purifications; Fuel-Injection Pumps; Fuel Injectors; Automatic Shutdown Device; Engine Governor; Overspeed Stop; Actuator; Engine Cooling System; Cooling-Water Treatment; Engine Operation and Maintenance; Starting, Running, and Stopping; Inspection; Valve Maintenance; Zero-Lash Units; Chain Drives; Fuel-Pump Timing; Valve Timing; Engine Troubles and Remedies.

Alco-GE Diesel Locomotive Engine. Principal Engine Parts; Engine Data; Electric Circuits; Engine Lubricating System; Engine-Cooling System. Overheating of Cooling Water; Operation in Cold Weather; Leakage From Water System. Engine Fuel-Oil System. Fuel Injection Pumps; Fuel-Oil Strainer; Engine Governor. Governor Dump Valve. Engine-Air System. Pressure Air; Control Air; Ventilating-Air System; Radiator Cooling Air; Traction Motor Blowers; Engine-Compartment Ventilation. Turbo-charger. Fuel and Boiler Water-Level Gages; Alarm Signals; Low Lubricating-Oil Pressure Switches; High Temperature Switch; Engine Overspeed Trip. Engine Operation. Starting and Stopping. Inspection. Bearing Maintenance; Piston Maintenance; Cylinder-Head Maintenance; Fuel Nozzle Maintenance; Valve Mechanism Maintenance; Gear Train Overhaul.

#### FUNDAMENTAL ELECTRICITY

56 Pages, 32 Illustrations

Electron Theory, Protons and Electrons; Ions and Ionization; Conductors and Insulators; Electromotive Force; Electric Current; Electric Resistance. Types of Circuits. Ohm's Law. Electric Power: Units of Electric Energy. Storage Batteries. Magnetism and Electromagnetism: Magnets; Magnetic Fields; Electromagnets; Ampere Turns; Relay; Generator and Motor Electro-

magnets; Self Induction. D-C Generators: Commutation; Construction Features; Voltage Control. D-C Motors: Counter Electromotive Force; Speed Adjustment of D-C Motors; Manual Starter; Safety Features; Panel Controllers.

#### HAND FIRING OF LOCOMOTIVES

68 Pages, 4 Illustrations

Coals and Their Combustion; Coal Loss Through Unburned Gases; Smoke-Forming Constituents of Coal; Conditions for Economical Combustion; Draft of Locomotives; Cooperation of Engineer and Fireman. Details of Firing; Preparing Fire for Start; Method of Firing; Firing Poor-Steam Engines. Combustion. Chemical Elements and Compounds.

#### HEAT AND SUPERHEATERS

62 Pages, 30 Illustrations

Measurement of Temperature; Thermometers; Absolute Temperature; British Thermal Unit; Heat Units in Fuel; Transmission of Heat; Relation Between Heat and Work; Steam; Difference Between Saturated and Superheated Steam; Steam Tables; Superheated Steam Table; Locomotive Superheaters. Pyrometer.

#### LATHES

77 Pages, 68 Illustrations

Use of Lathes; Types, Requirements; Feature of Production Lathes; Tool-room Lathes; Friction Clutches; Size of Lathe; Carriage Stops, Spacing Attachments; Lathe Centers; Face Plates. Adjustable Jaws and Clamps; Air-Operated, Magnetic, Revolving Jaw; Draw-In Collets; Step Chuck; Solid Mandrel, Cast-Iron Solid Mandrel, Mandrel Press; Special Mandrels; Common and Safety Lathe Dogs; Maintenance of Lathes; Installing and

Since 1891, now way past a half century, more than 5 million men and women have enrolled for I.C.S. courses. You can hardly go into any city, any business organization, industrial establishment, office, even a crossroads' village, that you do not find those who have advanced to high places as a result of studying I.C.S. courses. This is proof that education is progress.

Testing New Lathes; Lathe Lubrication; Special Forms of Lathes; Details of Change Gearing and Countershaft.

## LATHE THREAD CUTTING

82 Pages, 67 Illustrations

Forms of Screw Threads; Threading Tools; Threading Practice; Threading Tapers; Measuring Threads; Scales; Gages; Comparator; Wires; Errors of Threads; Change Gear Systems; Comparison of Pitches.

## LATHE TOOLS

46 Pages, 53 Illustrations

Lathe-Tool Shapes and Materials; Theory of Cutting Tools; Tool Angles; Materials for Lathe Tools; Turning Tools; Forged and Ground Roughing and Finishing Tools; Tool Holders; Tipped Tools.

## LAYING OFF LOCOMOTIVE FRAMES

48 Pages, 27 Illustrations including copies of the shop blueprints of the frames.

Description; Frame Specifications; Casting the Frames; Planning the Frames; Laying Off Frames; Position for Laying Off; Locating Centers of Pedestal Jaws; Slotting the Frames; Laying Off for Drilling; Drilling the Frames.

Texts for each I.C.S. course are the work of many engineers and executives who are best qualified to deal with specific subjects. They set down the facts about the latest approved developments in their own special lines. Unique, too, is the I.C.S. method of presenting information. Staff experts, skilled in correspondence technique, build into the texts the explanations which capable teachers provide in classrooms.

These teachers guide and direct your progress with sympathetic understanding of your problems and your aims. But to learn will require study. It calls for concentration and work on your part. We have made it as easy as we know how, but there is no "royal road to learning" by which you can become educated, skilled, well informed and capable without putting serious effort into it.

## LAYING OFF SHOES AND WEDGES

66 Pages, 47 Illustrations

Correct Relation of Driving Axles to Main Frames; Squaring Frames by Fish Tram Method; Temporary and Permanent Centers; Handling Trams; Marking Shoes of Wedges; Proof Lines and Methods of Transfer; Alternative Methods of Laying Off Machining Shoes and Wedges; Roundhouse Work on Shoes and Wedges.

## LOCOMOTIVE APPLIANCES

2 Parts, 131 Pages, 96 Illustrations

Water Gages; Disorders and Testing; Water Columns; Whistle; Steam Gages; Fire Doors; Sanders; Bell Ringers; Grate Shakers; Franklin Power Reverse Gears; Operation and Disorders; Reverse Gears; Barco Reverse Gears; Electromatic Foam Collapsing Blow-Off System; Loco Valve Pilot; Back-Pressure Gages; Barco Low-Water Alarm.

## LOCOMOTIVE BOILERS

2 Parts, 154 Pages, 80 Illustrations

Description; Construction of Boiler Shell; Smokebox Details; Finding Height of Table Plate; Finding Diameter of Nozzle; Description of Fire-

box; Staying Firebox to Boiler Shell; Renewal of Firebox; Expansion of Firebox Sheets; Report of Committee on Locomotive Construction; Association of American Railroads, on Drafting of Steam Locomotives.

Firebox Appliances; Tubes and Flues; The Steam Dome; Boiler Evaporation; Firebox Evaporation; Tube and Flue Evaporation; Leaks. Washing Out Boilers. Testing of Boilers; Calculating Strength of Boiler Joints; Summary of Rules; Abstract of Federal Rules.

## LOCOMOTIVE BREAKDOWNS

40 Pages, 25 Illustrations

Procedure in Event of Breakdowns. Failures That May Occur; Burst Tube; Broken Cylinder Head; Blocking of Valves; Broken Frame; Leaky Throttle Packing; Defective Piston Valve. Removing Side Rods; Taking Down Main Rod; Broken Driving-Box Brass; Broken Main Crankpin; Raising a Driving Wheel Clear of Rail; Broken Tires; Broken Axles; Breakdown of Four-Wheel Trailing Truck.

## LOCOMOTIVE CYLINDER AND ERECTING WORK

72 Pages, 41 Illustrations

Lay-Off Operations; Trail Lay-Off of Splice and Frame Fit; Final Lay-Off; Machining the Cylinders; Laying Off for Drilling; Matching the Cylinders; Drilling and Reaming; Erecting Work; Leveling the Frames; Application of Cylinders; Lining Up Frames; Application of Boiler to Frame.

## LOCOMOTIVE FEEDWATER HEATING EQUIPMENTS

76 Pages, 54 Illustrations

Heating Feedwater; Elesco Feedwater Heating Equipment; Worthing-

ton Type BL Feedwater Heating Equipment; Worthington Type S. Equipment; Worthington Type SA Feedwater Heating Equipment; Coffin Feedwater Heating Equipment; Exhaust Steam Injectors; Elesco SFX Exhaust Steam Injector; Sellers Exhaust Feedwater Heating Equipment.

## LOCOMOTIVE HEADLIGHTS

70 Pages, 44 Illustrations

Parts of Equipment; Principle of Steam Turbine; Electrical Principles; Electrical Units; Pyle National Equipment; K-240 Two-Pole Turbine Generator; Wheel and Nozzle Details; Governor Assembly; Sunbeam RE-3 Two-Pole Turbine Generator; MO-6 Four-Pole Turbine Generator; Headlights; Frames and Reflectors; Installation and Operation; Wiring and Control Equipment; Maintenance and Inspection; Care of Commutator.

## LOCOMOTIVE INJECTORS

76 Pages, 44 Illustrations

General Operation of Injectors; Sellers Class N Improved Lifting Injectors; Sellers Class K Non-Lifting Injectors; Nathan Simplex Lifting Injector; Nathan Non-Lifting Injector; Ohio Lifting Injector; Ohio Non-Lifting Injector; Double-Jet Injectors; Hancock Lifting Inspirator; Hancock Non-Lifting Inspirator; Disorders.

## LOCOMOTIVE LUBRICATORS

89 Pages, 64 Illustrations

Detroit, Nathan and Chicago Hydrostatic Lubricators; Detroit, Nathan and King Mechanical Lubricators; Detroit and Nathan Oil Feed Dividers; Chassis Lubrication; King Air Compressor Lubricator; Flange Oilers.

Do you wish your study progress reported to your employer? We will gladly do this. Letters are reaching us constantly from students telling of the value of this service and the promotions that have come as a result of it. Employers also write to thank us for the service and to express interest in the employee who is interested enough in himself and his job to study and to make his services more worth while.

**LOCOMOTIVE MANAGEMENT**  
92 Pages, 41 Illustrations, with I. C. C. Defect Chart and Locomotive Lubrication Chart.

Inspection Before Attaching to Trains; Inspection at End of Run; Work Reports; Overheated Journals and Crankpins; Carbonization in Cylinders; Starting the Train; Proper Operation of Throttle and Reverse Lever when Running; Fuel Economy; Handling Engines in Cold Weather; Priming; Theory of Foaming; Causes for Uneven Exhaust; Blows, Explanation of Wheel Defect Gauge; Federal Inspection Rules.

**LOCOMOTIVE ROD, WHEEL, AND PIN WORK**

99 Pages, 54 Illustrations

Main-Rod Work; Laying Off Main Rod; Front-End Arrangement. Side-Rod Work; Application of Rods; Axle Work; Crank Axle for Three-Cylinder Locomotive; Crankpin Work; Tire Work; Mounting the Tires; Turning the Tires; Counter-balancing Driving Wheels; Driving-Box Work.

**LOCOMOTIVE STEAM-PIPE AND SPRING WORK**

78 Pages, 53 Illustrations

Steam Conveying System; Inside and Outside Dry Pipes; Steam Pipe Rings; Principle of Ball Joint; Inside and Outside Throttle Valves; Repairs to Steam Conveying System; Spring Work; Theory of Spring Arrangement; Explanation of Three-Point Suspension; Finding Center of Gravity; Calculating Rear Points of Suspension.

**LOCOMOTIVE STOKERS**

45 Pages, 37 Illustrations

Standard Type HT Stoker; Names and Description of Units; Operating

Instructions; Standard Type BK Stoker; Standard MB Stoker; Hanna Locomotive Stoker Types S-F and H-4; Operation of Hanna Stokers; Stoker Firing.

**LOCOMOTIVE VALVES**

77 Pages, 51 Illustrations

Modern Locomotive Valves; Arrangement of Passages in Cylinder Saddle With Outside and Inside Admission Valves. Piston Valve; Cylinder and Steam Chest; Names of Parts; Valve Terms Used in Valve Movement. Valve Events; Definition of Cylinder Events; Events for One Stroke; Position of Piston When Events Occur; Movement of Both Valves; Order of Valve Events for One Turn of Driving Wheels.

**LOCOMOTIVE VALVE SETTING**

96 Pages, 53 Illustrations

Object of Valve Setting; Importance of Correct Steam Distribution; Setting Valves with Walschaert Valve Gear; Setting the Valves With Baker Valve Gear; First Method; Alternative Method of Setting; Setting the Valves with Stephenson Valve Gear; Trailing Method of Valve Setting; Setting Valves of Three-Cylinder Locomotives.

**LT AUTOMATIC CONTROL EQUIPMENT**

86 Pages, 72 Illustrations

Arrangement of Piping; Description and Operation of Type L Automatic Brake Valve; Straight-Air Brake Valve; 37 RV Safety Valve; Double-Pressure Feed-Valve; Single-Pressure Feed-Valve; Duplex Pump Governor; DS Strainer and Check-Valve; F-3 and F-4 Feed-Valves; No. 5B Compressor.

**MACHINING FRAME CROSSTIES**

46 Pages, 31 Illustrations, including perspective and copies of the prints and crossties.

Purpose of Frame Crossties; Guide Yoke Crosstie, Machining the Crosstie, General Principles of Laying Off; Reverse-Shaft Crosstie; Laying Off for Drilling; Bumper Bracket; Method of Laying Off; Machining the Bracket; Laying Off for Center-Pin Hole; Frame Filling; Frame Crosstie; Planning; Laying Off for Drilling.

**OIL BURNING LOCOMOTIVES**

63 Pages, 32 Illustrations

Use of Oil as a Fuel; Oil Burning Equipment; One-Burner System; Vertical-Draft System; Horizontal-Draft System; Types of Burners; Adjustment of Burners. Two-Burner Systems; Operation of Oil Burning Locomotives; Roundhouse Inspection.

**OPERATION OF DIESEL FREIGHT LOCOMOTIVES**

69 Pages, 15 Illustrations

Arrangement of Units; Engine-Room Control Equipment; Engineer's Control Station. Starting and Handling of Trains; Manual Transition; Traction-Motor Connections; Transition-Meter Dial; Wheel-Slip Indications; Backward Transition; Dynamic Braking; Locomotive Reverse; Control-Station Interlocks; Trailing an A Unit; Towing of Locomotive; Isolating a Power Plant; Operating Section on Three Traction Motors; Preparing of Engine for Layover; Engine Starting Troubles; Faulty Locomotive Operation; Dead-Heading; Care; Operation of Steam Generator; Operation of Fan Clutch; Care of Lubricating System; Operation of Fuel-Oil System; Operation of Controller and Reverser;

Care of Locomotive Battery; Sanding Precautions.

**OPERATION OF DIESEL PASSENGER LOCOMOTIVE**

51 Pages, 15 Illustrations

General Description: Arrangement of Engine; Low-Voltage Cabinet; High-Voltage Cabinet; Engine Controls; Engineer's Control Station. Starting Train; Operating Precautions; Stopping Engine for Maintenance; Cutting Out Engine; Engine Trouble; Locomotive Starting Troubles; Standing Time; Safety Devices; Operation of Cooling System; Operation of Lubricating-Oil System; Care of Fuel-Oil System; Use of Hand Brake.

**OPERATION OF DIESEL SWITCHING LOCOMOTIVES**

40 Pages, 12 Illustrations

General Description: Diesel-Engine Controls; Engineer's Controls. Starting Engine; Moving of Locomotive; Forward Transition; Backward Transition; Starting Troubles; Stopping of Engine; Cold Starting; Lack of Power; Dead-Heading; Isolating Trucks; Cooling System; Cab Heating; Freezing-Weather Precautions; Operation of Boilers; Lubricating System; Lubrication Troubles; Fuel-Oil System.

**PLANERS**

58 Pages, 57 Illustrations

The Types of Planers in General Use; Planer Details; Planer Motions; Planer Drives; Variable-Speed Devices; Feed Mechanisms; Planer Adjustments; Lubrication and Care of Planers; Planer Equipment Such as Chucks, Parallels, V Blocks, Screw Plugs, Clamps, Toe Dogs, Jacks and Centers.

I.C.S. instruction texts have been called "the best illustrated textbooks in the world." Perhaps they are. Certain it is that from the very beginning I.C.S. texts have been specially prepared—and specially illustrated—so that every principle and every important detail may be easy to grasp. Illustrations have always played a major part in I.C.S. teaching, so it may be that "the best illustrated textbooks in the world" is not an undeserved or over-stated compliment.

With I.C.S. you study, relaxed in the quiet of your own home, free from confusion of classroom or shop. You can reread, think, understand—and you can ask questions of I.C.S. teachers, knowing that you will receive understanding answers.

## PLANNER PRACTICE

59 Pages, 55 Illustrations

Planner Tools and Operations; Roughing and Finishing Tools; Grinding Planner Tools; Setting Tools; Tool Holders; Cutting Speeds; Setting and Holding Planner Work; Cuts and Feeds; Planing Slots; Undercuts, Curved Surfaces, Bevels, and Large Work Such as Engine Beds and Lathe Beds; Lubricants and Coolants in Planing.

## PM AND LN PASSENGER BRAKE EQUIPMENT

47 Pages, 34 Illustrations

The PM Passenger Brake Equipment; Description of Parts; Operation of High-Speed Reducing Valves; Service Operation; Emergency Operation.

The LN Passenger Brake Equipment; Operating the Brake; Mixed LN and PM Equipments; Full Service; Lap; Release and Recharge.

## PRINCIPLES OF AIR CONDITIONING

76 Pages, 16 Illustrations

Physical Measurements; Measurements of Energy; Measurement of Electricity; Measurement of Heat and Temperature; Definition of Heat; Sources of Heat; Measurement of Heat Transmitted; Methods of Heat Transmission; Factors Affecting Heat Transmission; Measurement of Air Velocities; Control of Temperature, Humidity and Motion of Air; Comfort Zones; Comfort Chart; Apparatus for Air Conditioning; Equipment for Refrigeration; Cycle of Operation; Air Cleaning Devices; Computation Involved in Air Conditioning; Heat Transfer Through Barriers; Calculation of Over-all Transmission; Infiltration Loss; Description of Psychrometric Table; Relation of Temperatures to Relative Humidity.

Progress brings change and as changes come and new developments take place, I.C.S. instruction texts are revised to keep them current with technical and business progress.

## PRINCIPLES OF DIESEL ENGINES

40 Pages, 7 Illustrations

Principles of Combustion; Heat Energy of Fuels; Principle of Operation. Cycles of Operation; Two-and-Four-Stroke Cycles; Intake, Compression, Expansion and Exhaust Strokes; Application of Two-Cycle Principle; Four-Cycle Diesel Engines. General Features; Crankshaft Designs; Firing Orders; Valve Timing; Individual Pump System; Injection Timing; Lubrication of Engines; Engine Cooling; Air Cleaning; Power and Efficiency.

## RAILWAY CAR LIGHTING

3 Parts, 212 Pages, 130 Illustrations

Fundamental Principles; General Features of Axle-Generator Systems; Gould Simplex System; Electric Storage-Battery Car-Lighting System; Safety Car Lighting Systems; Stone-Franklin Car Lighting System.

## RL BRAKE EQUIPMENT NO. 24

100 Pages, 15 Illustrations, 16 Charts

Names and Purposes of Parts of "A" Unit; DSE-24-H Brake Valve; S-40-D Independent Brake Valve; K-2-A Rotair Air Valve; D-24 Control Valve; Electric Pneumatic Master Controller; 21-B Magnet; Names and Purposes of Parts of "B" Unit; Description of Brake Valve; Views of Rotary Valve and Seat; Description of D-24 Control Valve; FS-1864 Relay Valve; Wiring Diagram.

Operation of Equipment; Release and Charging Position; Running Position; Automatic Service Position; Service Lap Position; Graduated Release Lap; First Service Position; Emergency Position; Speed Governor Control; Independent Brake Operation; Electro-Pneumatic Brake Operation; Dynamic Interlock; Operating Instructions.

## SHAPER AND SLOTTER WORK

66 Pages, 64 Illustrations

Shapers; Cutting Tools and Speeds; Shaper Equipment; Shaper Operations; Shaper Attachments; Slotter; Slotter Operation; Keyway Cutters. Broaching; Broaching Machines; Broaching Tools and Attachments; Preparing Work for Broaching; Broaching Operations; Lubricants for Broaching; Hydraulic Shaper.

## SOUTHERN LOCOMOTIVE VALVE GEAR

22 Pages, 17 Illustrations

Construction; Movement Imparted by Eccentric Crank; Ratio of Eccentric Rod; Reversing Arrangement. Breakdowns.

## SPELLING

2 Parts, 175 Pages

One should be able to spell correctly if he wishes to create the most favorable impression in the minds of others. These lessons are interesting and the information to be gained from them will help one in writing letters, making out reports, etc.

## STEAM GENERATORS FOR DIESEL LOCOMOTIVES

54 Pages, 22 Illustrations

Vapor-Clarkson Types CFK 4225; Steam Generating Unit; Water and Steam Pressure Gages; Coil Blowdown Valve; Soot Blower Valves; Steam Separator; Heat Exchanger; Steam Trap; Safety Valves; Water Pump; Water Treatment Tank; Fuel Control; Rotary Converter; Spark Plug and Face Plate Assembly; Air Pressure Reducing Valve; Atomizing Air Control Switch; Combustion-Air Blower; Operating Switches; Motor; Automatic Control Switches; General Operation of Steam Generator. Water System; Fuel System; Atomizing Air System; Ignition System; Combustion System; Control System. Operating Instructions. Operating Troubles and Their Remedies.

## STEAM LOCOMOTIVE, THE

2 Parts, 274 Pages, 183 Illustrations

Views of a Locomotive; General Operation; Types of Frames; Cylinders;

Arrangement of Steam Passages; Casting the Cylinders; Machine Work on Cylinders; Erecting Work; By-Pass Valves; Relief Valves; Steam Conveying System; Engine Trucks; Underlying Principles; Trailing Trucks; Underlying Principles; Alco and Commonwealth Trucks; Lima Four-Wheel Articulated Trailing Trucks.

Driving Box; Bearings; Franklin Adjustable Wedge; Piston Rod; Rod Packing; Crosshead; Guides; Main Rod; Side Rod; Driving Axle; Driving Wheels; Lateral Motion; Tires; Counterbalance; Cross Counterbalancing; Spring Rigging; Three-Point Suspension; Mechanics of the Steam Locomotive; Angularity of Main Rod; Performance of Locomotives.

## STEPHENSON VALVE GEAR

61 Pages, 31 Illustrations

Details and Action of Gear; Determining Position of Eccentrics.

## TRAIN RULES

2 Parts, 140 Pages, 27 Illustrations

Purpose of Train Rules; Duties of Employees; Definitions; Time Table; General Explanation; Rule 4; Explanation of Other Rules on Standard Code; Explanation of Train Orders.

## TWO-CYCLE DIESEL LOCOMOTIVE ENGINES

2 Parts, 119 Pages, 73 Illustrations

Control of Locomotive; Efficiency of Diesel Engines; Cylinder Heads, Pistons, Connecting-Rods and Bearings; Rocker-Arm and Valve Springs; Maintenance; Removal of Heads; Removal of Valve Springs; Replacing Valves; Piston Removal; Locating Exhaust-Valve Leakage; Inserting Piston; Accessory Drive, Oil Pump, Water Pump, and Governor Drive; Lubricating and Cooling Pump.

Cam-Shaft and Blower Drive; Over-speed Trip; Replacing Cam-Shaft Bearings; Locating Dead Center; Checking Timing; Resetting and Ad-

justing Over-speed Trip; Lubricating-Oil System; Cooling System and Fuel-Oil System; Filling Cooling System; Care of Injector; Governor Control; Governor; Governor Linkage; Injector Linkage; Internal Adjustment of Governor Control; Governor Repair; G. M. Model 567 Engine.

#### TYPE AB FREIGHT BRAKE EQUIPMENT

65 Pages, 21 Illustrations, 14 Charts

Reason for Development; Special Features; Description of AB Valve; Type "AB-10" Empty and Load Equipment; "AB-1B" Brake Equipment for Fast Freight Service; A. A. R. Rules for Maintenance of Air-Brake Equipment on Cars.

#### TYPE C-2 LOCOMOTIVE BOOSTER

36 Pages, 21 Illustrations

General Operation of Booster; Booster Control System; Arrangement at Reverse Lever; Preliminary Throttle Valve; Domic Pilot Valve; Booster Throttle Valve; Cutting in the Booster; Cutting Out the Booster; The Tender Boosters; Disorders.

#### TYPE D DUPLEX STOKER

60 Pages, 39 Illustrations

General Arrangement and Operation of Stoker; Distribution of Coal; Arrangement of Stoker on Tender; Arrangement of Locomotive; The Conveyor System; The Elevating System; The Distributing, or Spreading System; The Driving Engine; Preparation for Trip; Operating the Stoker; Duties of Fireman at End of Trip; Stoker Disorders.

#### TYPE K FREIGHT-CAR BRAKE EQUIPMENT

36 Pages, 20 Illustrations

Piping Diagrams of Type-K Equipment; Type-K Triple Valve; Auxiliary Reservoir and Brake Cylinder; Operation of Type-K Freight-Car Brake Equipment; Disorders; Maximum Number of Cutout Brakes; A. A. R. Rules for Maintenance of Air-Brake Equipment.

#### US PASSENGER-CAR BRAKE EQUIPMENT

78 Pages, 44 Illustrations, and Form 104 including 14 cardboard charts in color.

Arrangement of Equipment; U-12-BC Universal Valve; Quick-Action Portion; High-Pressure Cap; Pipe Bracket; Charging the Brake System; Service Position With Quick Service Feature; Service Lap; Release; Graduated Release and Quick Recharge; Emergency; Release After Emergency; Blows; Cleaning and Lubrication; Electro-Pneumatic Brake Equipment With UEA-12-BC Universal Valve.

#### UNITED STATES SAFETY APPLIANCES FOR ALL CLASSES FOR CARS AND LOCOMOTIVES

This is a publication issued by the Association of American Railroads and contains the specifications of the Interstate Commerce Commission for safety appliances to be used on cars and locomotives.

#### USE OF TRIGONOMETRIC TABLES

44 Pages, 16 Illustrations

Functions of Angles; Explanation of Use of Trigonometric Tables. Prac-

tical Trigonometric Calculations. Table of Natural Sines, Cosines, Tangents, and Cotangents.

#### WALSCHAERT VALVE GEAR

2 Parts, 100 Pages, 61 Illustrations

Action of Gear; General Description; Names and Arrangement of Parts; Changing the Lead; Break-downs.

#### WESTINGHOUSE AIR BRAKE

48 Pages, 8 Illustrations

General Arrangement of Brake; Auxiliary Reservoir; Brake Cylinder; Triple Valve.

#### WHEEL AND AXLE MANUAL

220 Pages, 132 Illustrations

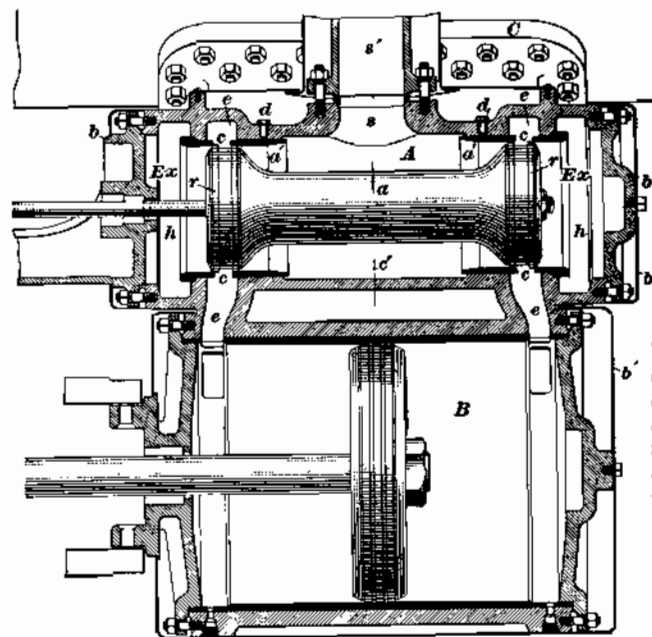
This is a book issued by the Mechanical Division of the Association

of American Railroads. It gives the specifications for various kinds of car wheels and axles, and describes the recommended practice in wheel and axle work and inspection.

#### YARD INSPECTION OF TRAINS

57 Pages, 12 Illustrations

Duties of Car Inspectors; Necessary Qualifications; Tools; Blue Signal Rule; Marking and Carding; Safety Appliances; Inspection of Arriving Trains; Inspection of Car Ends; Inspection of Trucks; Inspection of Car Centers; Inspection of Trains of Miscellaneous Cars; Inspection for Commodity Loading; Inspection of Out-bound Train; Interchange Car Inspectors.



This and other illustrations, make it easy to understand all about locomotive valves. Whenever an illustration will help to make a point clear one is used in I.C.S. lesson texts.

From start to finish, you will have the cooperation of I.C.S. teachers. The work you submit for correction is examined very carefully by a teacher who gives full time to your work while it is before him. Every point in the lesson is gone over. If there is a part you do not understand, sometimes a two- or three-page letter of individual and specific instruction is written. All of the I.C.S. teacher's time on every working day is used to instruct 12 students, on the average. This ratio is one of the lowest existing in any educational system.

No one can ever say, "I don't need to study, to learn any more. I know it all." What one can learn in a single lifetime is only an infinitesimal part of all the knowledge in the world. Even the greatest engineer, physician, lawyer, scientist must keep on studying, because progress advances rapidly. New things, new developments, new methods in every trade, art and profession come to the fore so rapidly that no one can ever say his education is finished.

## What It Means To Enroll

*If there is one thing more than any other in all the world that will increase your chances to get ahead, to have the recognition and respect of those above you; if there is one thing more than any other that will mean advancement and more money, it is preparation for the job you have and for the bigger position ahead.*

Standing still, inaction, failing to develop one's natural abilities to the highest possible degree is one of the greatest crimes a man can commit against himself.

And it is so easy to prepare for the bigger position when once you've made the start.

### Answers To Your Questions

*Do I have any books to buy? What does the course include?*

All the books you will need are included with the course. You will receive practical lessons on the subject you want to learn, the help of expert teachers, the benefit of our Service Department, your employer will be notified of your progress—everything a reasonable man might expect will be done to bring about your greater success. The course includes all this. No, there are no extra books to buy.

*How do I get my lessons?*

Several lessons in handy pamphlet form are sent as soon as your enrollment reaches us and others are sent as you proceed with your course. They are just the right size to slip into your pocket out of the way until you have a spare moment to study. You always have plenty of lessons on hand so that there will be no delay and no waiting.

*Will I have to come to Scranton?*

No. You will study right in your own home, during the spare time at noon-hour—whenever you wish, and you will not lose a single day from work. Our students right here in Scranton study their lessons and write out the answers to their examinations in their own homes just the same as students in far distant places. You won't have to lose a minute's time off the job to "go to

school." You study in spare time, you learn, you see how to use your knowledge every day. Thousands of railroad men have learned—and are learning—this way. They have found the I.C.S. way a good way to get ready for examinations—and to get ahead.

*How long will it take me to finish the course?*

A thorough understanding of every subject is the most important thing to consider. The length of time required to finish a course depends upon the time at your disposal, the diligence with which you study, your adaptability, etc. You can put your training into practice from day to day and thus derive benefit from the course at once. In this way, many find themselves qualified for bigger positions and promotion comes even before they have their diplomas.

*Suppose I need help?*

In that case, by all means write us. I.C.S. lessons explain everything so clearly and are so well illustrated that the man studying as we direct seldom finds it necessary to ask for help, but when help is needed we gladly give it. In fact, we furnish special Information Blanks for this purpose. Your success is our first consideration. That's the thing we work for.

*Will I have individual instruction?*

Yes, indeed! You will have the advantage of knowing that you will be called upon to prepare work on every lesson. You will have the individual instruction of expert teachers. As an I.C.S. student you are really a class by yourself. There is no one to hurry you over important points more rapidly than you should go and, on the other hand, there are no slow students to hold you back. We will do everything we can to help you. The progress you make is up to you, and the time you are willing to spend in studying for advancement.

*Will a course really mean an investment for me?*

The answer to this question is found in the letters we are constantly receiving from our students and graduates. There is space



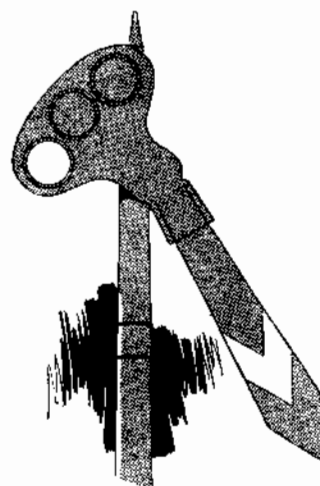
in this booklet for only a few of these letters. Read some of them again. They have been written by ordinary, every-day men who were filling very ordinary positions when they enrolled. Many of them did not have the education and other advantages that you have had. But they have advanced. They are making good. They are earning bigger incomes. They have won the recognition and respect of business men and railroad officials. You will have identically the same instruction, service, and help they received, so isn't it reasonable to assume that, with your advantages, you will succeed as they have, or perhaps to an even greater extent?

*Do railroad officials care any more for the man who studies than for the man who does not?*

The futures, the fortunes, and the success of railroad officials, department heads, superintendents, and others depend upon the success of the road. Trained men make a road more successful. You may be sure that your officials are intensely interested in trained employees—in men who care enough to study. The officials of nearly 300 railroads, including some of the greatest systems in the world, have even gone so far as to make special arrangements with us for the instruction of their employees. They insist that we keep them informed of the names and the progress of their employees who study—conclusive proof that officials *are* interested.

*Can I afford the time and money for a course?*

Your spare time is your own. On your road, in the shop where you work, in the office—wherever you are—you probably know of men who are filling second-rate positions because they never took the trouble to become first-rate men. *Can you afford to take chances with your success all the rest of your life with your present mental equipment?* You should face this question squarely. It's your problem. You certainly cannot hope to advance and to get very far ahead in the world now, to earn a bigger income, until you have invested some of your time and money in preparing for the things ahead. In order to reap, you must sow. In order to profit, you must invest. *In order to succeed, you must prepare.*



## **I.C.S. Clears the Way for Railroad Men**

*WHAT OTHER MEN SAY HAS WEIGHT. Not that you'll be influenced entirely by the opinions of others, but after all, what they have done and are doing is a rather accurate measure of the worth of I.C.S. instruction. Our space is limited, so we can present only a few typical letters which set forth interesting evidence. These letters come from men who have studied I.C.S. courses and have found that the knowledge they have acquired has opened the way to many opportunities. The man who knows has the kind of power that gets the green light.*

*The same courses that have cleared the track ahead for many other railroad men are available for you. It will mean study and effort on your part, but you'll be a man who is ever so much more capable because of it. If you are willing to do your part you'll find us sincerely willing to do ours. And the result should certainly be greater success for you.*

### **PREPARED IN SHORT TIME TO BECOME ENGINEER**

Thanks to I.C.S. I am engaged in work that I have always wanted and am earning a good salary.

When about to take my final examination with the Atlantic Coast Line Railroad, I realized that I had insufficient training; that I was not ready. Having only five months in which to prepare I was desperate. Your representative, however, offered me a plan by which I could prepare myself. On his advice I enrolled

immediately in the Locomotive Engineer's Course and started a program of study. Although I had very little time to study I used every minute I could.

When the examination came up five months later, I stood among the leaders. I.C.S. lessons are so simple and plain that I recommend your course for a beginner as well as for review by the experienced engineer.

Foster M. Stone  
Florence, South Carolina

#### THINKS ANY RAILROAD MAN SHOULD TAKE AN I.C.S. COURSE

I am a graduate of the Locomotive Engineer's Course and am glad to tell you of the advancement I have had from the position as fireman, at the time of my enrollment, to that of engineer which is my present position.

I am glad to mention the fact that this course has helped me to know a locomotive from A to Z. I do think that any man who expects to work on a railroad should take the I.C.S. course which I have just finished.

Edward J. Barnes  
Saginaw, Michigan

#### ROCK ISLAND ENGINEER APPRECIATES HIS I.C.S. TRAINING

The course I took with I.C.S. set me straight on a number of things. It showed me that a number of things I was attempting to do were not being done correctly. Without the scientific training which the course provided I could never have accomplished anything much. I always keep in mind the things learned from the course, and shall be glad to recommend I.C.S. as the best.

It may interest you to know that I am now a locomotive engineer with the Burlington Rock Island Railroad Company. At the time of my enrollment for the Locomotive Engineer's Course I was a fireman. I have finished the course and am now earning about \$85 a month more than I was at the time I enrolled.

Grover Cleveland Cully  
Teague, Texas

#### AIR-BRAKE INSPECTOR TELLS OF STUDY BENEFITS

I am glad to write concerning the benefit I have received as a result of my Car Inspector and Air Brake Course. I am very proud of my diploma.

The study of this course has given me increased knowledge of my work as an air-brake inspector. I have been called on more often for overtime work than those inspectors who have not studied the air brake thoroughly. I have also been consulted often about air brakes and car inspection.

While I was studying you brought that fact to the attention of my employer. I am certain that this was interesting to him. Recently the foreman of car inspectors told me that I was doing good work and that he was hearing excellent reports about me.

Jay D. Gehrett  
Harrisburg, Pennsylvania

#### SPEDILY ADVANCES TO RANK WITH EXPERIENCED MEN

It is with pleasure and pride that I advise you that I have been awarded further promotion at the engine house where I am employed. Following a 60-day period of probation I have been promoted to the position of air-brake inspector on running power during the afternoon trick. This I know is the direct result of my study on the Air Brake Course as directed by your very efficient faculty.

I am very proud to have been able to attain this position in such a remarkably short time, and rank with men who have been at the business 20 years or more. The realization that my rapid progress is due directly to the splendid instruction and whole-hearted cooperation which was extended to me by I.C.S. prompts me to inform you of my good fortune.

I am sure that the early success that has rewarded my efforts under your expert guidance can be repeated by anyone and everyone who makes use of the advantages so freely offered by the International Correspondence Schools.

George Sutton  
Cambridge, Massachusetts

#### SOUTHERN PACIFIC FIREMAN SEES GREEN LIGHT AHEAD

I am a fireman on the Southern Pacific Railroad and have already completed most of the lessons of the I.C.S. Locomotive Engineer's Course. Before taking this course I did not know anything about the steam locomotive. Since I work on them every day it is absolutely necessary that I do know them. Now, due to your excellent course and advice I have complete confidence, whereas before I did not.

In order to secure a promotion to the position of locomotive engineer the company must know whether or not I am able to qualify for the responsibility. Your letters to them and their letters to me concerning the course, tell me that they are keeping check on me. The further I progress with my course the more I am convinced that I could never have spent my money for a better purpose.

Floyd W. Patterson  
Roseburg, Oregon

#### HOW THE AIR BRAKE COURSE HELPS A MAN

I am a graduate of the Air Brake Course. The study of this course has given me a broader and more intimate knowledge of the construction and operational functions of the entire air brake system. It has helped me very extensively in my work as I am now readily able to locate trouble, to adjust, repair, and instruct on the air brake equipment. It has brought me the satisfaction of more confidence in myself and my work. As Assistant Engine House Foreman I have been able to gain experience along the line of my course. It has been very valuable.

Idus R. Rupert  
Nazareth, Pennsylvania

## FIREMAN BECOMES ENGINEER

At the time of my enrollment for the I.C.S. Locomotive Engineer's Course I was employed as a fireman by the Southern Pacific Railroad. My advancement has been to locomotive engineer.

The promotion to engineer came after I had been working as fireman for only two years and three months. I found the course invaluable as it enabled me to pass the examination on which my company is very strict in every detail. Without this course I know I couldn't have passed with so much ease.

A. J. Burns  
Houston, Texas

## PASSES ENGINEER'S EXAMINATION WITH HIGH RATING

I first enrolled with I.C.S. for the Air Brake Course. When I enrolled I was a locomotive fireman, and have since been promoted to engineer. I passed my air brake examination with a grade of 99.9 per cent, which to a great extent, was due to my I.C.S. training.

I wish to thank International Correspondence Schools for the knowledge and assistance I have derived through my studies with them. This has been of so much help to me that I am now planning on taking additional work that will be of direct help in the diesel engine line.

Homer E. Wells  
Marion, Ohio

## FIREMAN PLANS FOR SONS TO ENROLL

I am certainly proud to have completed my Locomotive Engineer's Course. I am a fireman and the Master Mechanic told me he was glad to hear that I was interested in my job and trying to get all I can for the examination for engineer when it comes—which will be soon as I am next in line for promotion.

I have two sons in high school and when they are through and decide on the line of work they are going to take up I intend to have them take courses in those lines with I.C.S. I only wish that I had started sooner than I did.

Arthur S. Brandt  
Lebanon, Pennsylvania

## "A FIREMAN CAN WORK HIS HEART OUT IF HE DOESN'T KNOW WHAT HE'S DOING"

I am a locomotive fireman on the Baltimore & Ohio Railroad. Three years ago I enrolled for the Locomotive Engineer's Course to prepare myself for a promotion. About six months ago I took my first and second years examinations on Machinery and Air and made 97 per cent on it.

I would not take anything for the knowledge I have gained from my I.C.S. course as I feel that it is responsible for my high marks, and I have a good understanding of the workings of a locomotive. This has made my work as a fireman much easier and has given me confidence. A fireman can sure work his heart out on a locomotive if he doesn't know what he is doing and why he is doing it. Many firemen complain about the complications of the "AB" freight brake and

I almost dreaded that lesson before I came to it, but after I got started on it I became so interested that I could not stop until I had finished it, and I found that it isn't so complicated after all. Everything is explained so clearly the I.C.S. way that anyone can understand it. The I.C.S. is the best thing that ever happened to me.

James L. Dorrough  
Washington, D. C.

## DIESEL MECHANIC SAYS COURSE WORTH MANY TIMES ITS COST

Although I had four years practical experience in diesel-engine work I could see that if I was to get the deeper things I would have to study. That is why I enrolled with I.C.S. Now that I have completed my Diesel Course I can say that it is aiding me every day in many ways. First, it has helped me to gain promotion from an Assistant Engineer to a Diesel Machinist with *over \$100 a month increase* in salary.

It has also taught me what to do and what not to do. I am now a Diesel Mechanic with the Illinois Central Railroad. The course has been worth many times the price I paid for it, and I would suggest that any man who is interested in advancing, take a course along the line of the work he does.

Thomas E. Fields  
Chicago, Illinois

## SEES FUTURE AHEAD OF HIMSELF IN DIESEL

I have reached the point in my Diesel Engines Course where I am getting definite results. I am a high school graduate and have had two years of night classes in college, but I consider this the most concise study I have ever taken.

I am now employed as a machinist with the Mechanical Department of the Union Railroad where diesel represents 13 per cent of the total motive power. With this splendid background I expect to "go places." I strongly advise anyone who is interested in this line of work to take up a course with I.C.S.

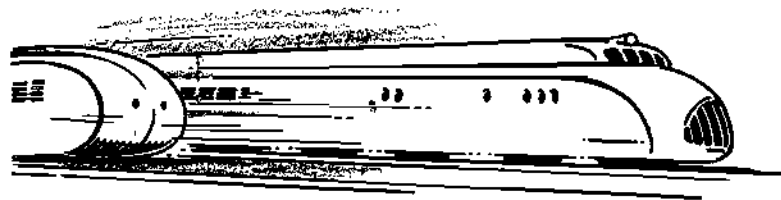
C. F. Brandfass  
Turtle Creek, Pennsylvania

## I.C.S. SHORTENS THE WAY TO PROMOTION

Although I have not yet completed half of my course on Air Brakes I feel that the small amount I paid for it has been well returned by the great wealth of information I have obtained. I was a machinist's helper on the Boston & Maine Railroad when I enrolled seven months ago and I have already qualified as an air brake inspector—thanks to the I.C.S. course.

The lessons are so easy to understand that they have made it easily possible for me to discern the defects of the air brake equipment on one of our locomotives in much shorter time than I did before. If I had to learn this by just working on the equipment it would have taken me at least two years to qualify for the position I now have. I would recommend this course to anyone.

Edwin S. Montgomery  
Roxbury, Massachusetts



## The Road Ahead

For all you know, some roadmaster, shop superintendent, division superintendent, department head, or an official even higher up, may have his eye on you—watching you work and your attitude, considering your present abilities and your fitness for the bigger job ahead. This may be happening without your ever dreaming that it is so, for railroad officials have a way of searching the ranks for men of initiative and ability. We, at I.C.S., know this is so, for officials are constantly asking us for the records of their men, who study our courses.

*Men, who study I.C.S. courses, are invariably good men to select for promotion.* Railroad officials know that such men can meet the requirements—that they pass examinations—that they know their work. Because the study records of I.C.S. students are watched closely, they are the men who are so often kept in mind when promotions come.

So, even today, someone higher up may be watching you—considering your training for the position higher up—or wondering if you are going to do anything about getting the training that is necessary.

I.C.S. can get you ready for promotion, if you will enroll and do your part. We say this positively, because we have been training men for advancement for many years, and it will bear remembering that many others whom we have trained have advanced.

You have the privilege, though, of writing your own running orders. Whether you choose to have a clear track on the main line or to spend your life on switches and side tracks, is up to you. No one can compel you to enroll for a good practical course or to study it, in order to, fit yourself for a better position than you have now. That is entirely up to you. A year from today will you be fitted for something better? A month from now will you be able to look back on something worthwhile that you have started? Think it over.

You can never reach the end of a good run by standing still.

Make your start now. Ask us to report your enrollment and you study progress to your employer, and in this way become "A man he keeps in mind."