INSTRUCTION PAMPHLET
NO. 5050-4
MAY, 1936

THE UC PASSENGER CAR BRAKE EQUIPMENT

WITH

QUICK SERVICE FEATURE

THE NEW YORK AIR BRAKE COMPANY
420 LEXINGTON AVENUE
NEW YORK, N.Y.

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Passenger Car Brake Equipment
with
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INDEX

HOW TO STUDY THE AIR BRAKE

Because the air brake is a means of *train control*, a thorough understanding of its elementary functions and principles of operation on the part of railroad men who have anything to do with train handling, either directly or indirectly, is not only the most important information that can be acquired, but absolutely essential to the largest factor of safety and economy in the handling of freight and passenger traffic with minimum loss of life or damage to railroad rolling stock and lading.

A great deal of misapprehension and confusion of mind exists, however, in regard to the kind of practical air brake information *most essential* for different classes of railroad employes.

Practical operating and mechanical railroad officials in recent years have approved the following fundamental basis of approach to the subject of air brake education as most nearly meeting actual operating conditions and service requirements.

Enginemen, Firemen, Conductors, Brakemen, and Train Crews Generally in Actual Charge of Trains on the Road

For this class of employes the *first* essential is the ability to skillfully *manipulate* the brake system as a whole, which involves merely a general knowledge of the functions and features obtainable in a given system, how to make preliminary train tests before starting out, and how to operate the brake valve to secure best results in

train control under the different conditions that exist on any given road. It is of secondary and relatively minor importance that operating employes of this class should know the internal workings of the various individual devices which make up the brake system or be familiar with the movement of parts and the detailed intricacies of various air pressures in different chambers, ports, passages, etc. Of course, the more comprehensive the air brake education of the employe, the more valuable his services to his road, but for the engineman, for example, the ability to manipulate the brake valve with skill and judgment is of primary importance always. This class of information is covered by our Publication 9037, Passenger Train Handling Instructions, which will be gladly furnished upon application.

Air Brake Foremen, Repairmen, and Test Rack Operators

For this class of employes who have to do primarily with internal construction, operation and proper functioning of moving parts of individual air brake devices, the study of ports, passages, chambers, air pressures and the whys and wherefores of internal operation is of first importance and a knowledge of manipulation secondary although desirable, of course, and to be encouraged so far as time and opportunity permit. The matter covering description, etc., beginning with page 53, is, therefore, intended primarily for this class of railroad employes.

Air Brake Instructors, Inspectors, Road Foremen of Engines, Train Masters, and Officials in Charge of Air Brake Operation and Instruction Generally

This class of railroad officials and employes must understand the functions and features available in each type of locomotive, passenger car, and freight car brake equipment; should be familiar with our general recommendations as to manipulation and the specific instructions thereon as formulated and officially approved for a given road including a thorough understanding of the conditions which produce break-in-two's, slid flat wheels, excessive shocks and stresses in train handling, or other damage to rolling stock and lading; should know the internal operation and functioning of individual devices; the maintenance of the apparatus in service; train tests for brake efficiency; tests for individual devices in repair shops; and, in general, approved methods of organization and instruction for different classes of railroad employes in order to secure the largest possible practical results for the railroad.

This Instruction Pamphlet has, therefore, been made sufficiently comprehensive throughout to meet all normal requirements of this class of officials. We feel very strongly that for those most concerned no effort is of greater practical benefit to the road served than that spent in the proper kind of air brake education and we are ready and willing, at all times, to assist in promoting these processes of education along practical lines in every way possible.

Price of this Instruction Pamphlet, single copies, 50 cents.

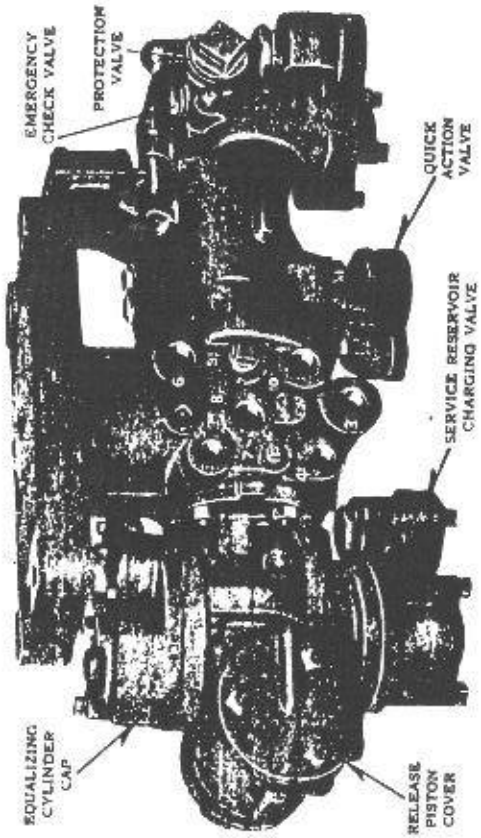


Fig. 1. View of U-12-BD Universal Valve, Showing the Pipe Connections

The UC
Passenger Car Brake Equipment
with Quick Service Feature

Passenger train operating conditions have become so severe during recent years as to demand a more efficient and effective brake than has heretofore been available. The rapid development of motive power and rolling stock has imposed such stringent requirements, as can only be met by the best possible means of train control.

Many changes have taken place, chief among them being, heavier cars, longer trains, higher speeds and faster schedules,—all tending to render the heretofore standard brake equipment less satisfactory and efficient.

Heavier Cars have necessitated the development of a higher braking force, involving larger cylinders with their accompanying large reservoirs, which has accentuated difficulties heretofore less vital to brake operation.

The inevitable losses which tend to reduce overall brake efficiency are much more serious factors than formerly; the large cylinders intensify the harmful effects of false travel, because of greater piston displacement, and increase the possibilities of piston packing leakage; the heavy foundation brake rigging, made necessary by the high forces developed, absorbs more of the cylinder effort; and the work imposed upon the brake shoes is greater because of a higher unit pressure combined with speed and length of stop, which means a lowering of the co-efficient of friction and consequently a reduced average retarding force.

The large reservoirs so increase the volume to be charged from the brake pipe as to render less effective, the function of the quick recharge feature of the previous equipment to conserve brake pipe pressure, with the consequently delayed and uncertain release on the rear of a train, due to the slow rise of brake pipe pressure.

Longer Trains, involving a greater number of brake equipments in series, also have aggravated the trouble regarding uncertain release, as well as intensified the effects of serial brake application.

Higher Speeds have greatly increased the energy which must be dissipated in bringing the train to a stop as well as made the time element in getting the brake applied much more manifest, since every second's delay has proportionately greater effect on the length of the stop.

Faster Schedules have reduced the margin of safety in train operation and created the demand for a greater reserve braking force.

In addition to these general considerations there are certain inherent characteristics of the usual type of brake equipment which have rendered it inadequate for modern conditions such as—lack of "service stability"—in that inevitable fluctuations of brake pipe pressure often cause the brakes to "creep on", and that it is possible to make such a light reduction as to render release uncertain due to inability to build up sufficient differential; the graduated release, quick recharge and high emergency pressure features are so combined that if the former is eliminated by cutting out the supplementary

reservoir, the others are also lost; possibility of undesired quick action due to abnormal slide valve friction; inability to obtain an emergency application, after a heavy service application, which is very desirable and often *necessary* if accident is to be averted.

In view of the above, the demand for a brake of greater capacity and effectiveness has been recognized, and in order to provide for safety, comfort of passengers and economy in time under modern severe traffic conditions, the Universal Valve has been developed. This valve is the principal part of the Universal Pneumatic Brake Equipment (Schedule UC), so called because it admits of universal application to all classes and conditions of passenger train service.

The new and improved functional characteristics of the Universal Valve which make adequate control of modern passenger trains possible, are as follows:—

1. CERTAINTY AND UNIFORMITY OF SERVICE ACTION.

The feed groove is closed on the slightest brake pipe reduction, a movement of the piston only being required. The design is such as to then require the necessary and proper differential to be built up to move the parts to service position as the reduction is continued. This means that all brakes will apply and apply alike.

2. MAXIMUM SERVICE STABILITY AND RELEASE SENSITIVENESS.

The ports and cavities in the equalizing graduating valve, slide valve and slide valve seat are so arranged as to provide for the *maximum permissible* resistance

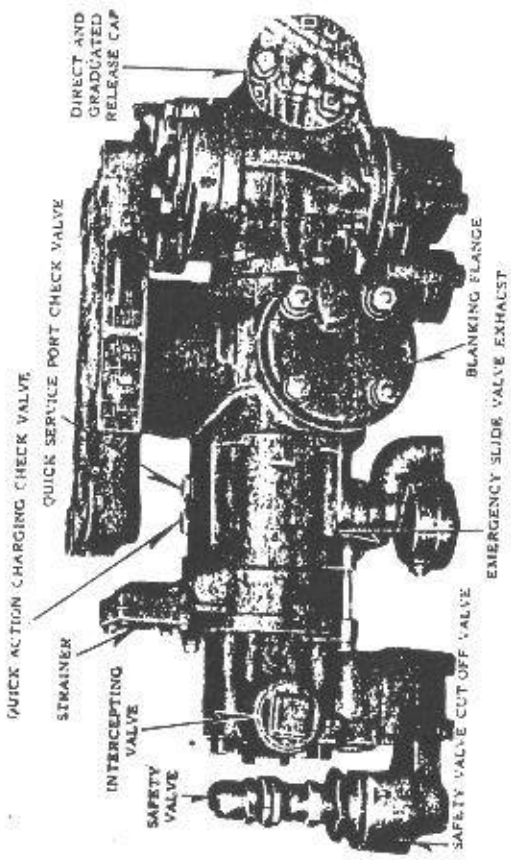


Fig. 2. View of the U-12-BD Universal Valve, Showing Various Details

before application and the *minimum possible* resistance before release. The advantage of this arrangement is two-fold.

(a) It prevents the brakes from creeping on due to inevitable fluctuations of brake pipe pressure, and the engineman from making such light reductions as to render a release difficult.

(b) It insures that the valves will be responsive to an increase in brake pipe pressure and makes a release more certain.

3. Quick Service Feature.

Effective brake application is provided by this feature which operates to produce very nearly simultaneous brake application on all cars of a train. Resultant uniform retardation eliminates slack action.

4. Improved Quick Recharge and Graduated Release Features.

The auxiliary reservoir volume consists of two units, a small Auxiliary Reservoir, of fixed size except for the two cylinder installation (as hereinafter explained), and a service reservoir of a size proportional to the brake cylinder. When the graduated release is cut in (by means of an adjustable cap for the purpose) the Auxiliary Reservoir is recharged from the Emergency Reservoir to within a few pounds of the normal brake pipe pressure, during which time practically no air is being drawn from the brake pipe. When graduated release is cut out the Auxiliary Reservoir only is recharged from the brake pipe, while the Service Reservoir is recharged from the Emergency Reservoir. It will be evident then that:

through leakage, careless manipulation or other cause to such a value that the effectiveness of the brake will be seriously impaired.

9. FACILITY FOR ADAPTING THE EQUIPMENT TO ANY SET OF SERVICE CONDITIONS.

This is by reason of the unit system of construction of the Universal Valve which permits any combination of operating parts necessary to produce the desired results.*

It should be further stated that all the functions mentioned have been so combined that the requirements of interchangeability with existing equipments are fully satisfied.

*NOTE—See note page 21.

PARTS OF THE EQUIPMENT

The following is a list of the parts which make up the equipment, with a short description of each.

1. A *Universal Valve, Type U-12-BD*, which corresponds in a general way to the triple valve previously in common use. It operates to control the admission of air to and exhaust from the brake cylinder and to charge the reservoirs.

2. *A *Brake Cylinder* with piston and rod so connected through the brake levers and rods to the brake shoes that when the piston is forced outward by the air pressure, this force is transmitted through the rods and levers to the brake shoes and applies them to the wheels.

3. *Three supply or storage reservoirs*, designated as the auxiliary, service and emergency reservoirs. The *auxiliary* and *service* reservoirs combined form the reservoir volume for the brake cylinder in service applications. All three reservoirs form the reservoir volume for emergency applications. The *emergency* reservoir also assists in obtaining quick recharge, and graduated release (if the Direct and Graduated Release Cap on the universal valve is set for graduated release).

4. A *conductor's valve* placed inside each car, by means of which the brakes may be applied by the conductor in case of accident or emergency.

*NOTE—When the light weight of a car exceeds the maximum limit of the largest (18"x12") single brake cylinder, a two cylinder installation may be used, one cylinder being employed for the brakes on each truck with one universal valve for both cylinders. Brake cylinders are installed directly on trucks on later design cars in order to simplify brake rigging and increase braking efficiency, one or more cylinders per truck depending on the truck design.

5. A *centrifugal dirt collector* is connected in the branch pipe between the brake pipe and universal valve as near the universal valve as circumstances will permit, as illustrated in Fig. 33, and is for the purpose of preventing pipe scale, sand, cinders or foreign particles of any kind from reaching the universal valve.

6. A *branch pipe tee, various cut-out cocks, angle cocks, hose couplings, dummy couplings, etc.*, the location and uses of which will be readily understood from the isometric view of the equipment, Fig. 33, and the descriptions which follow.

7. The *Automatic Slack Adjuster* is a simple mechanism by means of which a predetermined piston travel and consequently a uniform cylinder pressure is constantly maintained, compelling the brakes on each car to do their full share of work, thus securing the highest efficiency and reducing the danger of flat wheels which are likely to accompany a wide range of piston travel. This device establishes the running piston travel; that is, the piston travel occurring when the brakes are applied while the car is in motion; and since this is the time during which the brakes perform their work, the running travel is most important.

8. A *pressure retaining valve* is used on roads having heavy grade service. This valve is connected by piping to the brake cylinder exhaust connection on the universal valve and when the handle is placed in retaining position it retards the rate of brake cylinder exhaust while the engineman is recharging the auxiliary and service reservoirs, and when brake cylinder pressure has been reduced to a certain predetermined amount, retains that pressure in the brake cylinder. (If retaining valve with

While the graduated release and quick recharge features of the universal valve enable the engineman to perform manually to a large degree the functions performed automatically by the pressure retaining valve it is usually found that, for heavy grade service, the use of a retaining valve is desirable on account of the additional safety and economy in air consumption thereby secured.

Where a pressure retaining valve is required, it should be of the 10-lb. type.

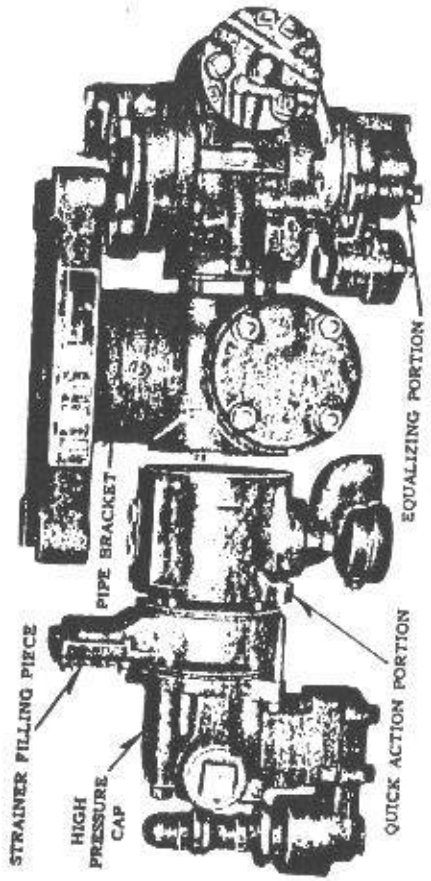


Fig. 3. View of the U-12-BD Universal Valve, Showing the Different Portions

DESCRIPTION OF THE PARTS

U-12-BD Universal Valve

Figs. 1 and 2 are photographic views of the U-12-BD universal valve showing the location of some of the different parts. Fig. 3 is a photographic view with the portions separated from each other to show their relative location and Fig. 26 shows the location of the various exhaust ports.

The valve consists of the following portions:

(1) *Three-face Pipe Bracket,* to which are bolted the quick-action and equalizing portions, the third face being covered by a blanking flange.* The bracket is bolted to the underframing of the car, all pipe connections being made permanently to this bracket, so that none need to be disturbed in the removal or replacement of any operating portions of the universal valve. This bracket contains two chambers, the quick-action chamber and the quick-action closing chamber.

(2) The *Equalizing Portion,* which controls (either directly or indirectly through the medium of the other portions of the universal valve) the desired charging of the reservoirs, the application of the brakes, whether in service or in emergency, and the release of the brakes.

(3) The *Quick-Action Portion,* which includes the various parts controlling the quick-action and high pressure functions.

*Note—Where service requirements justify the addition of electric control to the pneumatic brake, this may be accomplished by removing the blanking flange and attaching to the third face of the pipe bracket the necessary electric parts. This converts the U-12-BD universal valve into a "UE-12-BD" universal valve. The system of operation then becomes "electro-pneumatic", in which the electric and pneumatic control are so combined that the electric is ordinarily employed but if this should fail for any reason the brakes would operate pneumatically and without requiring any different manipulation of the brake valve.

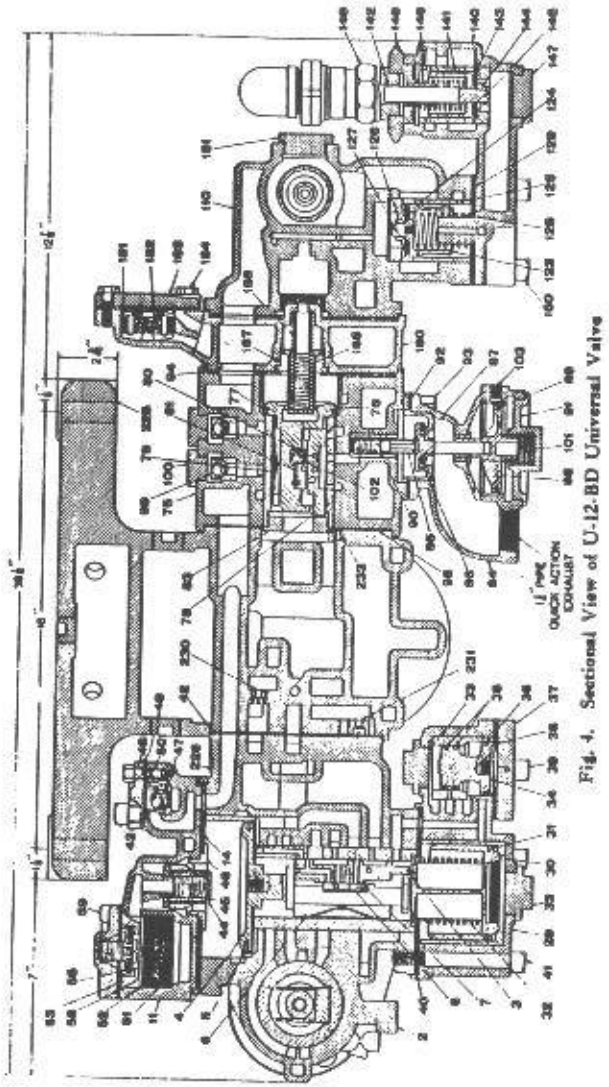


Fig. 4. Sectional View of U-12-BD Universal Valve

(4) A *Strainer Filling Piece*, interposed between the quick action portion and the high pressure cap, prevents the passage of dirt in the air supply to the quick action portion.

These different portions contain parts which are as follows (see Figs. 4 and 5):

1. PIPE BRACKET.

The pipe bracket 225 contains the quick-action and quick-action closing chambers, which supply pressure to control the emergency piston and open the quick-action exhaust in emergency applications. The quick-action closing chamber also supplies the pressure to keep the quick-action exhaust open for a definite length of time. The service choke plug 230 and exhaust choke plug 231 are located in the equalizing portion face of this bracket. Their purposes are explained on pages 65 and 69. (See tabulation below for sizes used with the various cylinders).

Service and Exhaust Choke Schedule

Brake Cyl.		Service Choke		Exhaust Choke	
No.	Size	Size	Pc. No.	Size	Pc. No.
1	14"x12"	.12"	78367	3/32"	78371
1	16"x12"	.136"	78368	7/64"	78372
1	18"x12"	9/64"	78369	1/8"	78373
2	14"x12"	.18"	78370	11/64"	78374
2	16"x12"	Omitted		13/64"	78375

The quick service choke plug is located in the quick-action face of the bracket. The purpose of this choke is explained on page 63. Size of choke varies according to

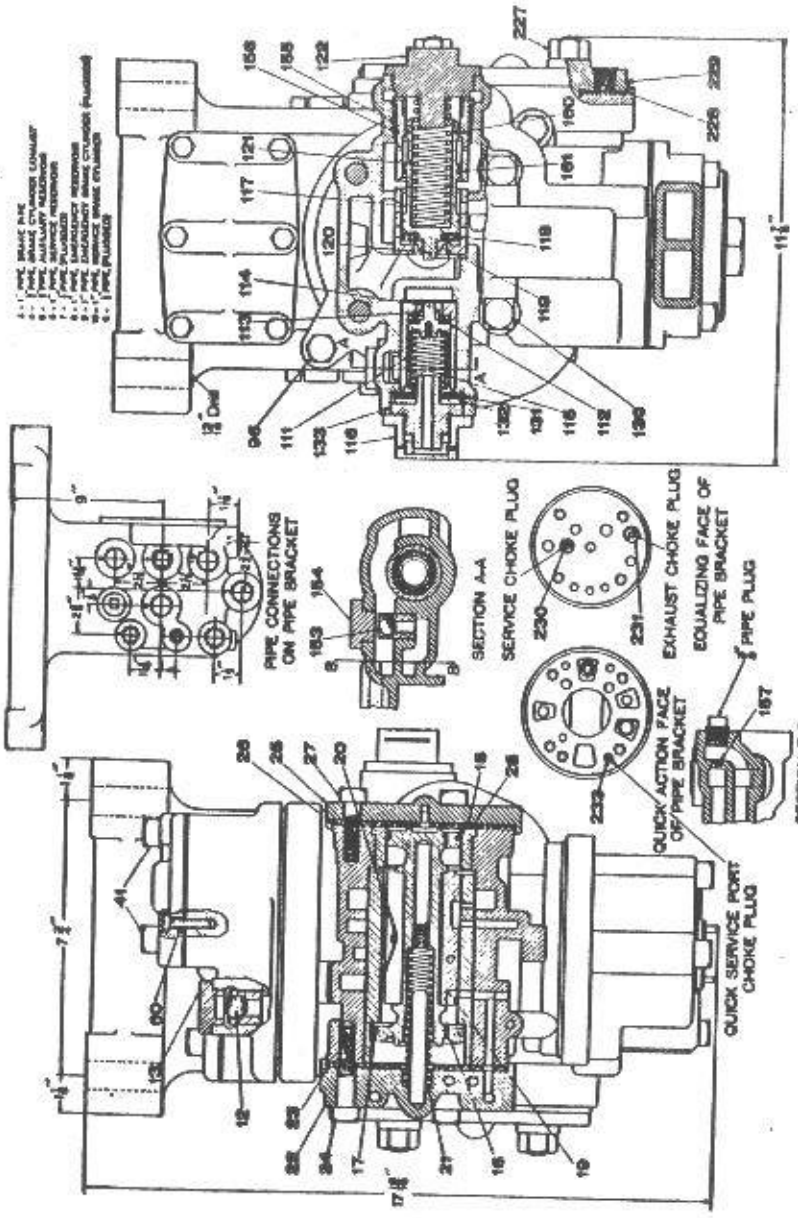


Fig. 5. Views of U-12-BD Universal Valve from Assembly Drawing

the total volume of brake pipe of the car as tabulated below.

Quick Service Port Chokes

Brake Pipe Volume	Size of Choke	Pc. No.
600 to 900 cu. in.	$\frac{1}{8}$"	63688
900 to 1200 cu. in.	$\frac{5}{32}$"	48458
1200 to 1500 cu. in.	.136 (No. 29 Drill)	84742
Over 1500 cu. in.	No choke	

The cubic inch brake pipe volume for any given car is the sum of the lineal feet of each size of pipe, forming the brake pipe and its branches, multiplied by the following cubic inch volume per lineal foot.

Pipe Size	Standard	Extra Strong
$\frac{1}{2}$"	3.60	2.76
$\frac{3}{4}$"	6.36	5.16
1"	10.32	8.52
1$\frac{1}{4}$"	18.00	15.24

2. EQUALIZING PORTION.

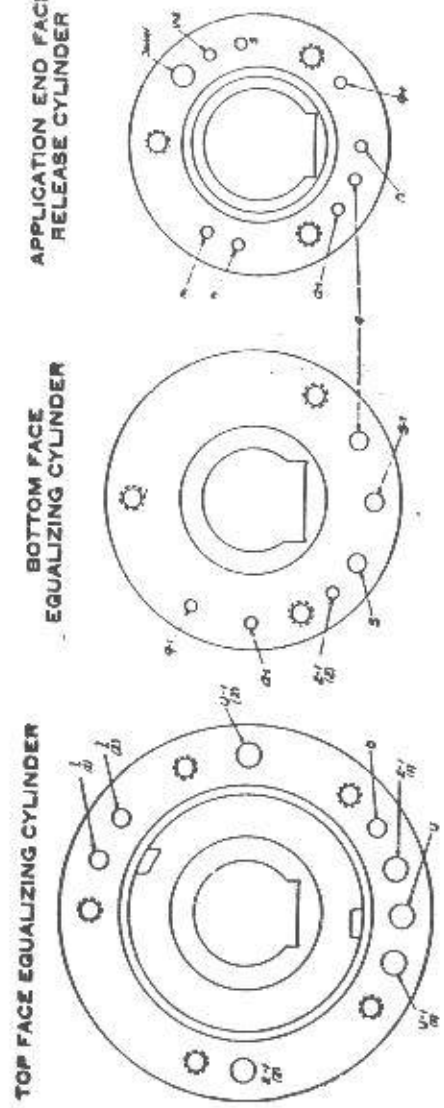
The equalizing portion contains:

(a) The *equalizing piston 4* which moves the equalizing graduating and slide valves when the brake pipe pressure is varied.

(b) The *equalizing graduating valve 7*, which controls the flow of air:

(1) From the auxiliary reservoir to the resistance increasing cavities T (Fig. 28), and from these cavities through the equalizing slide valve 3 to the atmosphere.

(2) From the end chambers of the release piston 16 through the equalizing slide valve 3 to atmosphere.



b —to Pipe Bracket Face, ports b and P.1. a-1
(1)—to Equalizing Piston Chamber. q
(2)—to Release Slide Valve Chamber.
—to Pipe Bracket Face.
e-1 —to Equalizing Slide Valve Seat. q-1
b-1 (1)—to Release Slide Valve Seat.
e-1 (2)—to Pipe Bracket Face.
e-1 (1)—to Bottom Face and also to e
(2)—Equalizing Slide Valve Seat service port.

NOTE.—You will note on referring to the diagrammatics that the port designations, a-1 and a-1 each represent two ports. In order to distinguish between different ports having the same designation we have used the suffixes—"(1)" and "(2)", as you will note above. "(1)" indicates the first port and "(2)" the second port as shown on the diagrammatics, and reading from left to right.

—to Release Cylinder Application End Face. a-1
—to Release Slide Valve Seat and Release Cylinder Application End Face. b
—to Release Cylinder Application End Face. m
—to Release Slide Valve Seat and Release Cylinder Application End Face. n
—to Equalising Slide Valve Chamber. q
(2)—to Equalising Cylinder Top Face and Equalising Slide Valve Seat. q-1
e
v-2

—to Equalizing Cylinder Bottom Face.
—to Equalizing Slide Valve Seat.
—to Equalizing Slide Valve Chamber, Equalizing Slide Valve Seat and Pipe Bracket Face.
—to Release Slide Valve Seat.
—to Release Slide Valve Seat and Equalising Cylinder Bottom Face.
—to Equalizing Cylinder Bottom Face.
—to Release Slide Valve Seat and Equalizing Cylinder Bottom Face.
—to Release Slide Valve Chamber and Pipe Bracket Face.

(3) From the auxiliary reservoir through the equalizing slide valve 3 to the brake cylinder.

(4) From the auxiliary reservoir through the equalizing slide valve 3 and release slide valve 19 to atmosphere.

(c) The *equalizing slide valve 3* which controls the flow of air:

(1) From the end chambers of the release piston 16 through the equalizing graduating valve 7 to atmosphere.

(2) From the auxiliary reservoir by the equalizing graduating valve 7 to the brake cylinder.

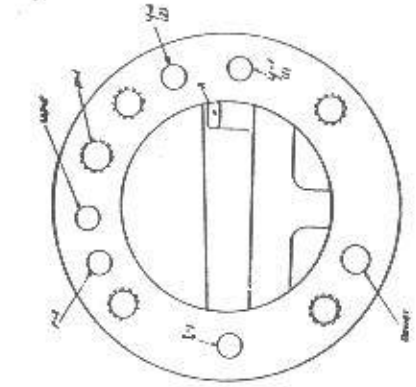
(3) From the auxiliary reservoir, through the equalizing graduating valve 7 and release slide valve 19 to atmosphere.

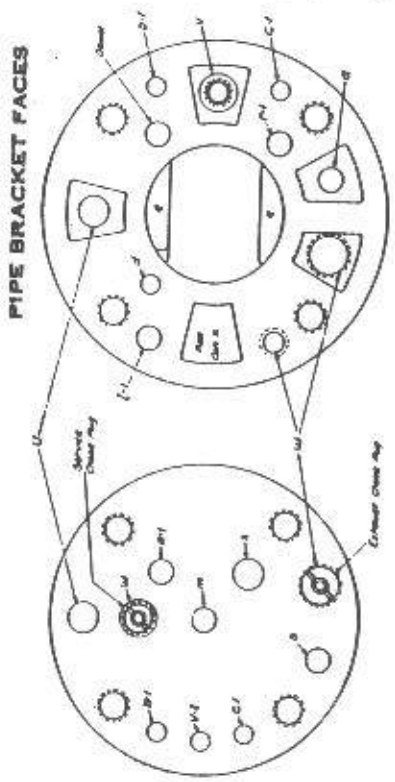
(d) The *equalising piston stop 44 and spring 45*, which force the equalizing piston 4 slightly away from the cylinder cap gasket following a service application and thereby cause the graduating valve to lap.

(e) The *service port check valve 12*, which prevents the flow of high pressure air from the brake cylinder to the equalizing piston chamber G (Fig. 32) (auxiliary reservoir) during an emergency application.

(f) The *emergency reservoir charging check valve 12'* which prevents the flow of air from the emergency reservoir to the brake pipe or the equalizing piston chamber C (Fig. 26) during a service or emergency application.

(g) The *service reservoir check valve 12"*, which prevents the flow of air from the auxiliary reservoir to the service reservoir.





PIPE BRACKET FACES

EQUALIZING FACE

b —to Brake Pipe and Quick Action Face (port a).
b-1 —to Quick Action Face.
c-1 —to Quick Action Face.
m —to Auxiliary Reservoir.
p-1 —to Magnet Face.
u —to Service Reservoir and Quick Action Face.
v-2 —to Emergency Reservoir, Quick Action Face (port v) and Pipe Connection 7.
w —(Exhaust Choke Plug) to Brake Cylinder, and to Service and Quick Service Choke Plugs.
w-2 —(Service Choke Plug) to Brake Cylinder and Exhaust Choke Plug, also to Magnet Face.
x —to Magnet Face.

QUICK ACTION FACE

a —to Brake Pipe and Equalising Face (port b).
b-1 —to Equalising Face.
c-1 —to Equalising Face.
d —to Quick Action Closing Chamber.
e —to Quick Action Chamber.
f-1 —to Magnet Face.
v-1 —to Magnet Face.
u —to Service Reservoir and Equalising Face.
v —to Emergency Reservoir Equalising Face (port v-2) and Pipe Connection 7. In original installations this port was closed by a plug which is no longer used, except in special cases (where it is necessary to separate the emergency from the graduated release and quick recharge function).
w —(lower)—to Brake Cylinder and Equalising Face.
w-1 —(upper)—(Quick Service Choke Plug to Brake Cylinder.

MAGNET FACE

f-1 —to Quick Action Face.
p-1 —to Equalising Face.
r-1 —to Quick Action Face.
w-2 —to Brake Cylinder through Service Choke Plug and to Equalising Face.
x —to Equalising Face.
y-1 —to Brake Cylinder Exhaust Pipe Connection.

(h) The *graduated release piston 30*, which holds the equalizing slide valve 3 in graduated release position when making a graduated release with the cap set in the required position.

(i) The *charging valve 34* which provides for the recharging of the service reservoir without drawing any air from the brake pipe until all the brakes start to release.

(j) The *release piston 16* (differential type) which causes movement of the release slide valve 19.

(k) The *release slide valve 19* which controls the flow of air:

(1) From the emergency reservoir around the charging valve 34 to the service reservoir.

(2) From the emergency reservoir to the auxiliary reservoir (only with graduated release cap in graduated release position).

(3) From the emergency reservoir to the back of the high pressure valve 123.

(4) From the back of the high pressure valve 123 through the emergency slide valve 78 to atmosphere.

(5) From the auxiliary reservoir, through the graduating and equalizing slide valves, 7 and 3 to atmosphere.

(6) From the brake cylinder to atmosphere.

(m) The *Direct and Graduated Release Cap 22*, (Application Piston Cover), which controls the type of release (as hereinafter explained). The words "graduated," and "direct" are cast on the flange of the cap and the word "release" is cast on the body. Large letters G

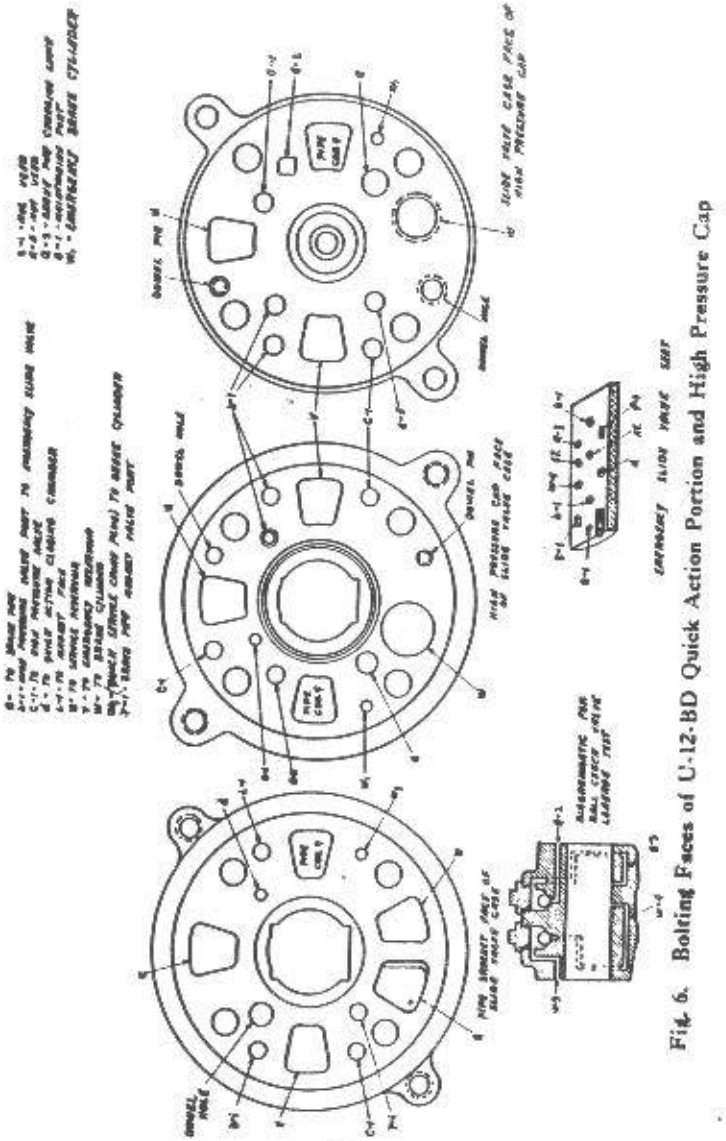


Fig. 6. Bolting Faces of U-12-BD Quick Action Portion and High Pressure Cap

and D are cast on the face of the cap, coinciding with the words on the flange. To change the position of the cap, turn it until the proper letter coincides with the arrow on the equalizing portion body in which position the flange wording also gives the proper register. Thus, the setting is always in full view from the side of the car. Figs. 21 and 22 illustrate the two settings.

(n) The *equalizing cylinder cap strainer 51*, which collects the fine dust particles from the air, not previously removed by the dirt collector, thus protecting the equalizing piston and slide valve.

(o) The *charging by-pass check valve 54'*, which opens and by-passes the air around the strainer in case the latter becomes restricted.

(p) The *application by-pass check valve 54*, which insures normal valve operation in case of strainer restriction, by unseating and by-passing air around the strainer.

3. Quick-Action Portion.

The Quick-action portion contains:

(a) The *quick-action chamber charging check valve 99'*, the ball check farthest from the pipe bracket, which prevents the flow of quick-action chamber and quick-action closing chamber air to the brake pipe during a service application.

(b) The *quick service port check valve 99* the ball check, next to the pipe bracket, which prevents backflow from the brake cylinder to the brake pipe whenever cylinder pressure is higher than that of the brake pipe or quick-action chamber (slide valve chamber).

(c) The *emergency piston 76*, which moves the emergency graduating valve 80 when a service rate of brake pipe reduction is made and also slide valve 78 when an emergency rate of reduction is created.

(d) The *emergency graduating valve 80*, with ball charging choke 102, which controls the flow of air;

(1) From quick action and quick action closing chambers to atmosphere during service applications.

(2) From brake pipe to brake cylinder during service applications (quick service feature).

(3) From quick action and quick action closing chambers to quick action piston 88 during emergency applications.

(4) From brake pipe to quick action and quick action closing chambers during charging operation. The charging rate is governed by the ball charging choke 102, by means of the clearance between the ball and the walls of its cavity. The ball charging choke also serves to prevent the graduating valve from blowing off its seat during charging.

(e) The *emergency slide valve 78*, which controls the flow of air:

(1) From the quick-action chamber, through the emergency graduating valve 80 to atmosphere.

(2) From the quick-action and quick-action closing chambers to the quick-action piston 88.

(3) From the back of the high pressure valve 123 through the release slide valve 19 to atmosphere.

(4) From the top of the high pressure valve 123 and bottom of cut-off valve 141 to atmosphere.

(5) From the brake cylinder to the quick-action chamber (in emergency application).

(f) The *quick-action piston 88 and valve 85*, which vent brake pipe air to atmosphere during an emergency application.

4. Strainer Filling Piece.

The Strainer Filling Piece contains:

(a) A *flat, cartridge type, hair strainer 181*, which protects the parts by preventing passage of fine dust particles with the air passing to the quick action portion.

(b) The *emergency piston stop 185 and spring 186*, which increase the differential required to move the emergency piston 76 from service to emergency position.

5. The High-Pressure Cap.

The high pressure cap contains:

(a) The *protection valve 111*, which vents brake pipe to atmosphere, causing an emergency application, when the brake pipe pressure has fallen to approximately 35 lbs.

(b) The *intercepting valve 117*, which, during an emergency application, causes the service reservoir to equalize with the brake cylinder and then cuts off the service reservoir and permits the emergency reservoir air to equalize with the brake cylinder.

(c) The *high pressure valve 123*, which separates the emergency reservoir from the brake cylinder except in an emergency application.

(d) The *safety valve 149*, which limits the service brake cylinder pressure.

(e) The *cut-off valve 141*, which cuts off the safety valve 149 from the brake during emergency applications.

(f) The *emergency check valve 153*, which prevents the sudden admission of air from the brake pipe to the emergency piston chamber but permits unrestricted flow of air from this chamber during emergency applications.

(g) The *emergency piston chamber charging choke 157*, which restricts the flow of brake pipe pressure to the face of the emergency piston thus avoiding a sudden build up of pressure in this chamber which might slam the piston to its release position.

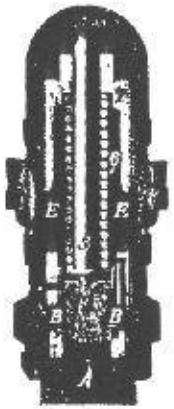


Fig. 7. Sectional View of E-7 Safety Valve

E-7 Safety Valve

The E-7 safety valve, Fig. 7, is unlike the ordinary type of safety valve, because within certain limits the closing pressure can be regulated as well as the pressure at which the valve will open; moreover its valve opens and closes with a "pop" action, permitting air to escape to the atmosphere quickly when opening and causing the valve to seat promptly and firmly when closing.

When the pressure in cavity A under valve 4 is sufficient to overcome the pressure exerted by the tension of spring 6, valve 4 is raised from its seat, which upward movement closes the upper end of port *d* in the valve bushing and opens port C, permitting air to flow from cavity A through chamber B and port C to the atmosphere. As the pressure below valve 4 decreases, the tension of spring 6 forces valve 4 downward, which restricts the opening through port C to the atmosphere and opens the upper end of port *d* to the spring chamber E. Although chamber E is open to the atmosphere at all times, the connecting ports *f* in the body are sufficiently small to restrict the exhaust, so that the pressure builds up very rapidly in chamber E and assists spring 6 in forcing valve 4 quickly to its seat.

To adjust the safety valve for the maximum or opening pressure, which in the case of the UC Equipment is 63 pounds, remove the cap nut 3 and screw down or back off regulating nut 7, as required, after which replace the cap nut. The minimum or closing pressure for the safety valve, used with the equipment referred to, is 60 pounds, and can be adjusted by changing the size of ports *f*, using regulating nut 8 for the purpose. After adjustment, screw down jam nut 9.

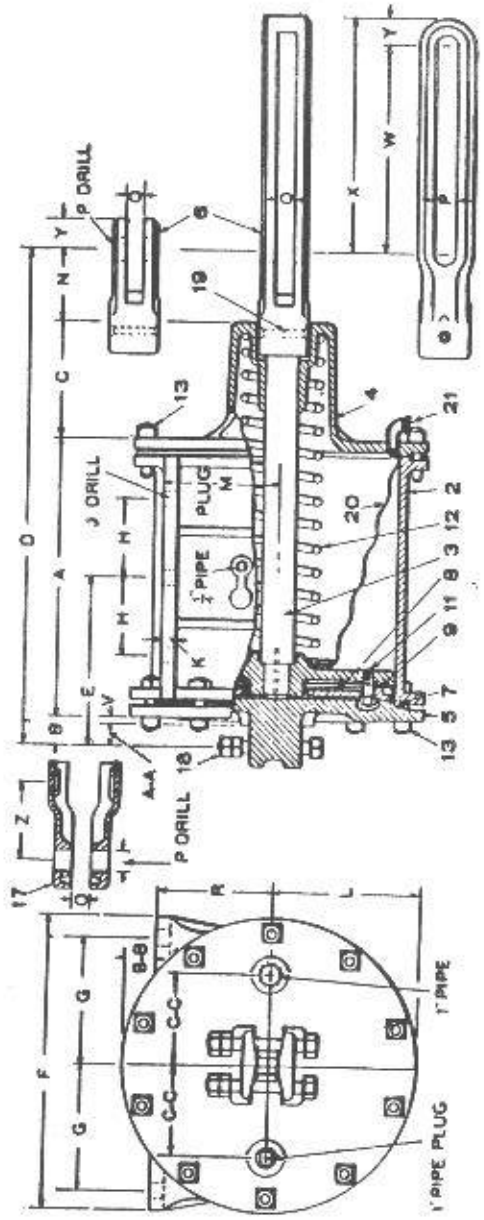


Fig. 8. Type Q Brake Cylinder

Brake Cylinder

Fig. 8 illustrates the section and exterior of the Q type of brake cylinder. The piston has a solid push rod 3 which is attached to the levers of the foundation brake rigging; 12 is a release spring which forces the piston to release position when air pressure is exhausted from the opposite end of the cylinder; the packing cup 9 presses against the cylinder wall and prevents the escape of air past the piston. The pressure head 5 will be provided with detachable lever brackets 17 unless otherwise specified. These can be easily removed to allow the application of the automatic slack adjuster, thus obviating the necessity for changing the head.

Hand brake rigging should be designed to work in harmony with the air brake system. The solid cross head is normally furnished, in which case the brake cylinder release spring returns the brake rigging to release position. The slotted cross head requiring a separate release spring, may be used if desired.

Brake Cylinder Protectors

The brake cylinder protector is a recommended device which has been developed to protect the cylinder wall and piston packing from dirt, thereby assuring normal functioning of the cylinder for extended periods without the necessity of frequent inspection or cleaning.

The protector is a conical cloth hood, flanged on the large end, this flange bolting between the non-pressure head and cylinder body, while the piston end of the hood

is held between two circular steel plates. The release spring holds the small end of the protector against the piston while the flanged end is held like a gasket between the non-pressure head and cylinder body. The hood collapses and distends with application and release of the piston.

Protectors are waterproof, so that any dirt or water entering from the non-pressure end of a cylinder is collected within the hood and discharged through a street ell drain at the bottom of the non-pressure head.

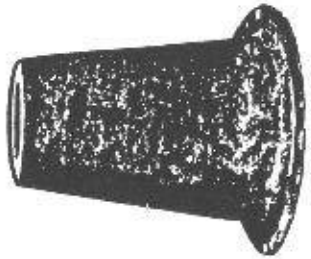


Fig. 9. Photographic View of Brake Cylinder Protector (Ref. 20 in Fig. 8)

Consequently, dirt never comes in contact with the cylinder walls or packing, so there is no undue wear. Not only is the brake cylinder maintained in an efficient working condition, but also the service life is prolonged without the frequent necessity of inspection, cleaning, or renewal of packing.

Care should be taken to avoid allowing the piston to strike the non-pressure head—as in testing with the cylinder rod detached from the cylinder lever—else the protector may be damaged.

Reservoirs

Enameled reservoirs are now strongly recommended on account of their durability and protection against corrosion, oxidation, etc., preserving a greater factor of safety than does the plain unenameled type. These reservoirs are enameled both inside and out by a special process.

Each reservoir is provided with a drain cock for the purpose of draining off any water which may collect as well as bleeding air from the reservoirs when necessary.

Following is a list of the standard reservoirs used with the various sizes of brake cylinders:

SIZE OF RESERVOIR	CAPACITY Cu. In.	CYLINDERS USED WITH and No. REQ'D.				
		1–14	1–16	1–18	2–14	2–16
AUXILIARY						
10″x33″	2125	1	1	1	.....	.....
12″x27″	2450	.....	.....	.....	1	.....
12″x33″	3088	.....	.....	.....	.....	1
SERVICE						
12″x33″	3088	1	.....	.....	.....	.....
14″x33″	4476	.....	1	.....	.....	.....
16″x33″	5724	.....	.....	1	.....	.....
16″x42″	7436	.....	.....	.....	1	.....
16″x48″	8577	.....	.....	.....	.....	1
EMERGENCY						
18½″x42″	10014	1	.....	.....	.....	.....
20½″x42″	12082	.....	1	.....	.....	.....
20½″x48″	14003	.....	.....	.....	.....	2
22½″x48″	16661	.....	.....	1	.....	.....
22½″x60″	21223	.....	.....	.....	1	.....

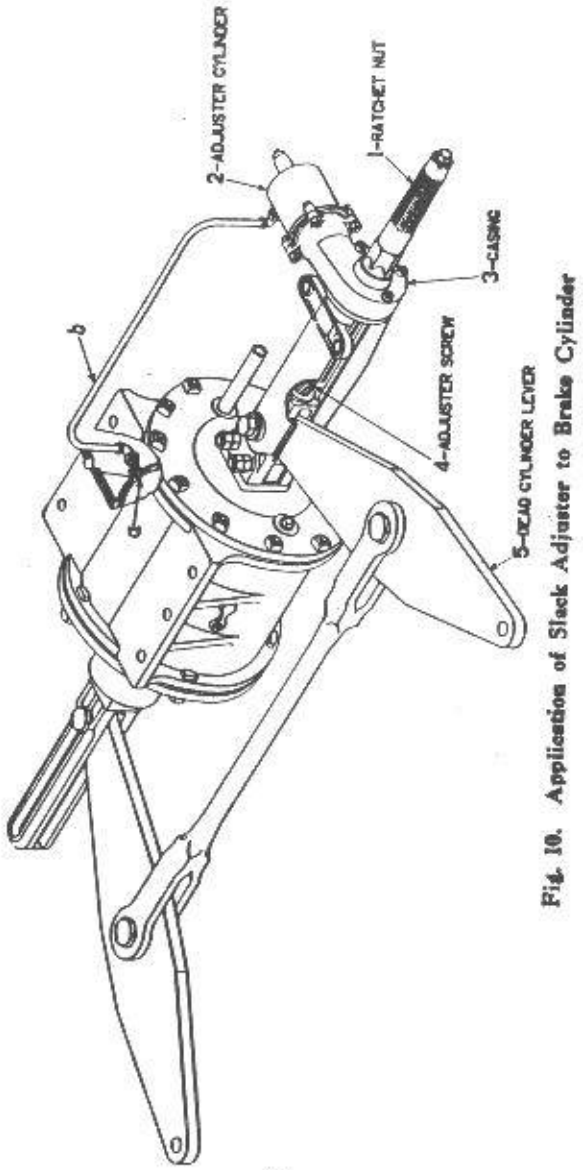


Fig. 10. Application of Slack Adjuster to Brake Cylinder

The Automatic Slack Adjuster

The automatic slack adjuster is illustrated in Figs. 10 and 11. The brake cylinder piston and packing act as a valve to control the admission and release of brake cylinder pressure to and from pipe *b*, Fig. 10, through port *a* ip the cylinder, this port being so located that the piston packing uncovers it when the predetermined piston travel is exceeded. Whenever port *a* is so uncovered, brake cylinder air flows through pipe *b* into slack adjuster cylinder 2 where the small piston 19, Fig. 11, is forced outward, compressing spring 21. Attached to piston stem 23 is a pawl extending into casing 24, which engages ratchet wheel 27, mounted within casing 24 upon screw 4, Fig. 10.

When the brake is released and the brake cylinder piston returns to its normal position, the air pressure in cylinder 2 escapes to the atmosphere through pipe *b*, port *a* and the non-pressure head of the brake cylinder, thus permitting spring 21 to force the small piston to its normal position. In so doing, the pawl turns the ratchet wheel upon screw 4 and thereby draws lever 5 slightly in the direction of the slack adjuster cylinder, thus shortening the brake cylinder piston travel and forcing the brake shoes nearer the wheels. As the pawl is drawn back to its normal position, a lug on the lever side strikes projection *a*, Fig. 11, on the cylinder, thus raising the outer end of the pawl, disengaging it from the ratchet wheel and permitting the screw to be turned by hand if desired.

To apply new shoes, turn casing 1 to the left, thus moving lever 5 toward the position shown in Fig. 10, until sufficient slack is introduced in the brake rigging. To

bring the shoes closer to the wheels and shorten the piston travel, turn casing 1 to the right. When the piston travel is less than 7" or more than 8", the slack adjuster should be adjusted so that the piston travel is 7½" with 60 lbs. brake cylinder pressure and safety valve blowing.

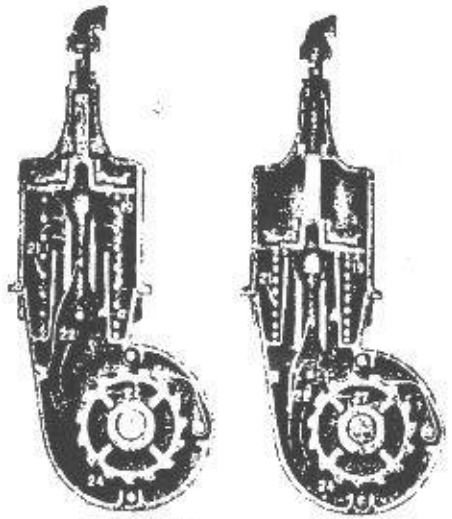


Fig. 11. Automatic Slack Adjuster Cylinder

The screw mechanism is so proportioned that the brake shoe wear is compensated for at the rate of about ⅛ of an inch for each operation of the adjuster, thereby removing the danger of *unduly* taking up false travel which would result in the shoes binding on the wheels.

If the adjuster crosshead is allowed to work out to the outer end of the adjuster body it will become locked. To

release, loosen the stop screw in the end of ratchet nut 1 about one half turn, rotate ratchet nut one eighth turn to the right to free the pawl, then turn to the left to let out the required slack. Be sure that the stop screw is re-tightened.

As stated in connection with "Brake Cylinder," to avoid the necessity of a bracket to support the adjuster, a special cylinder head, provided with a suitable lug, has been designed for that purpose and is now furnished with passenger car cylinders, unless other styles be specified.

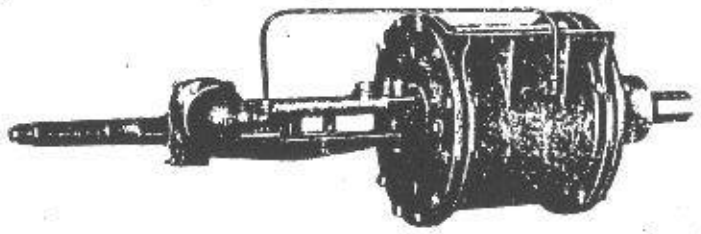


Fig. 12. Slack Adjuster Applied to a Type "Q" Brake Cylinder

The best results are obtained by the use of copper pipe from the brake cylinder to the adjuster cylinder, since this pipe is more flexible and does not corrode. It should always be firmly secured.

The slack adjuster cylinder should be cleaned and lubricated, and all other adjusting parts carefully inspected and given necessary attention each time the brake cylinder is cleaned.

Pressure Retaining Valve with By-Pass Choke

The Retaining Valve recommended for passenger service by the A.A.R. is the standard 10 pound single pressure type modified by drilling a by-pass choke port through the closing valve, the size of the choke to vary with the size of the brake cylinder with which the retaining valve is used.

The release rate is not affected by the by-pass port until brake cylinder pressure has been reduced within a pound or two of the closing point. Below the closing point value, the brake cylinder air is more gradually blown down, which provides that the brake is not entirely released

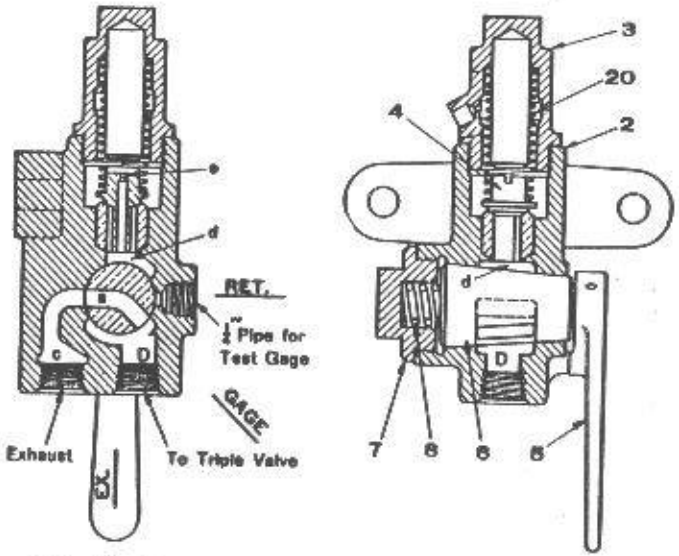


Fig. 13. Pressure Retaining Valve with By-Pass Choke

while recharging and also conserves the air supply by preventing movement of the brake cylinder piston to release during the recharge period.

The following table specifies the drill size for the by-pass choke through the closing valve to provide the proper blow down rate with the different brake cylinder sizes.

Brake Cylinders	Choke Drill Size
One 12"	.0520" (No. 55)
One 14"	.0635" (No. 52)
Two 14"	.0860" (No. 44)
One 16"	.0700" (No. 50)
Two 16"	.0960" (No. 41)
One 18"	.078125" ($\frac{5}{64}$")

Operation. The cock key 6 has three outlets, one to atmosphere through the exhaust port *c*, one to the closing valve 4 (passage *d*) and one to the ¼" tap marked "¼" pipe for test gage." The closing valve 4 is normally held to its seat by spring 20, closing passage *d*. When the handle is turned down, Fig. 13, passage *a* in the cock key connects chamber D (which is connected to the universal valve exhaust) to the exhaust passage *c* and the atmosphere.

When the handle is turned up to horizontal position, passage *a* connects chamber D below the cock key with passage *d* so that when the brake is released, brake cylinder air flows to the retaining valve chamber D and through passage *a* to passage *d* underneath the closing valve 4 which it must lift against the pressure of spring 20 in order to flow to atmosphere through the vent port in

the cap nut 3. Spring 20 is capable of retaining a pressure of 10 pounds in the brake cylinder. As long as the brake cylinder pressure is greater than this, valve 4 is unseated and air exhausts to atmosphere through the vent port which, being small, makes the release much slower than when the retaining valve is not used. When the pressure has been reduced to 10 pounds, it is no longer able to hold valve 4 open and the remaining 10 pounds blows down at a slower rate through the by-pass choke in the closing valve.

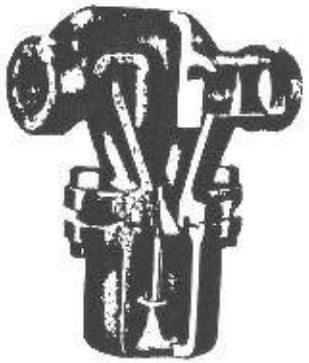


Fig. 14. Centrifugal Dirt Collector

Centrifugal Dirt Collector

The *centrifugal dirt collector* is located in the branch pipe in order to protect the universal valve against the entrance of pipe scale, sand, cinders, dirt, or foreign substances of any kind.

Fig. 14 is a sectioned view of the standard "Check Valve Type" in which the detachable enlarged dirt chamber and the check valve are the outstanding features.

This design comprises two separate portions; the upper or body portion to which the pipe connections are made, and the lower or dirt chamber portion which contains the brass umbrella shaped check valve. The two portions are bolted together and the joint between is protected by means of a rubber gasket.

The detachable dirt chamber provides for easier cleaning, and the increased capacity permits of longer time between cleaning periods (may be the same as for universal valve and brake cylinder).

The purpose of the check valve is to hold in the dirt chamber the collected dirt under all conditions of air brake operation. The body portion has a machined seat against which the check valve seats when a heavy reduction in pressure occurs above it, such as that during an emergency application or recharging an empty equipment, thereby shutting off communication between the dirt chamber and the dirt collector outlet. The check valve is so designed and placed on the valve stem as to permit of a rocking motion whereby any fine dust which may collect on top of the check valve will be shaken off into the dirt chamber.

CONDUCTOR'S VALVE

The conductor's valve may be located at any convenient point in the car, preferably with a cord attached to its handle and running the length of the car. However, one valve may be placed at each end, which will obviate the necessity of the cord. When this valve is opened, the

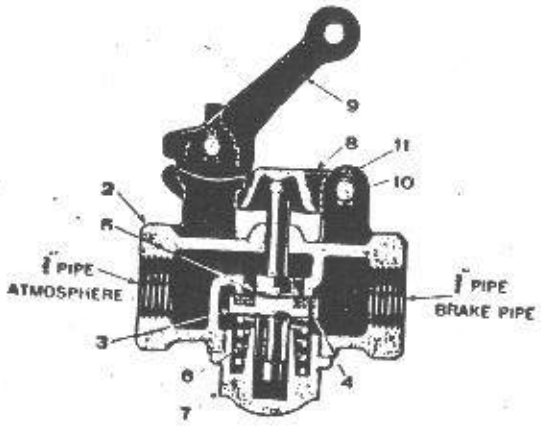


Fig. 15. B-3-A Conductor's Valve

air from the brake pipe flows directly through it to the atmosphere, setting the brakes in emergency. It should therefore be used only in case of actual danger and should then be opened as wide as possible and left open until the train stops.

PIPE FIXTURES

The purpose of the *Branch Pipe Tee* is to prevent moisture that may be deposited in the brake pipe, from any cause, draining into the branch pipe connection and from thence into the universal valve. While the centrifugal dirt collector has proven very efficient in collecting moisture and dirt from the piping of the air brake system, thereby protecting the universal valve, the use of the branch pipe tee illustrated in Fig. 16, will materially assist in preventing the *excessive* deposit of moisture in the branch pipe sometimes occasioned in charging and testing trains from poorly designed yard

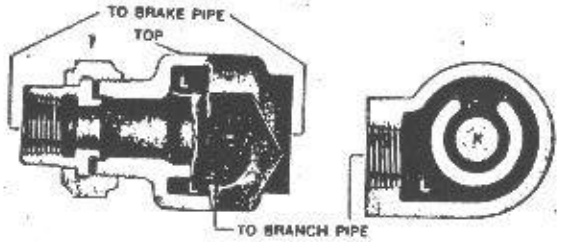


Fig. 16. Branch Pipe Tee

plants, or because the locomotive has insufficient reservoir capacity or cooling pipe to insure precipitation of the water before passing to the brake system. This fiting has the interior coring so designed that the outlet from the brake pipe to the branch pipe is at the top. Thus, as air enters at K from the brake pipe it flows upward into chamber L and thence through the pipe opening at the side to the branch pipe, the moisture and heavy particles of dirt passing on through the brake pipe.

These fittings are made in two forms, one having the branch pipe connection at the side and the other having the connection at the bottom. Unless otherwise specified the former, as illustrated in Fig. 16, will be furnished.

Cut-out Cock, Fig. 17, of which there are two (1-inch), one in the branch pipe and one in the brake cylinder pipe. The cock in the branch pipe when closed cuts off communication between the brake pipe and universal valve. The cock in the brake cylinder pipe has a

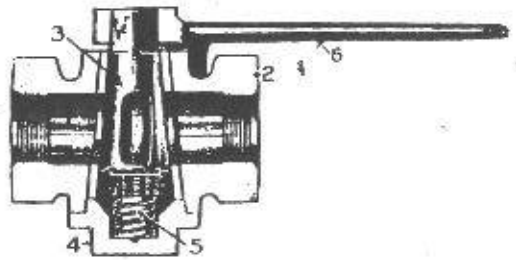


Fig. 17. Cut-Out Cock

side vent which, when the cock is closed, vents brake cylinder pressure to the atmosphere, thus providing a much quicker and more convenient method of releasing brake cylinder pressure (as is often necessary in order to replace shoes or make quick repairs to brake rigging) than draining and recharging the reservoirs. To avoid a brake failure the cock should be opened again when this work is finished.

These cocks should be placed where they can be easily reached but protected from accidental closing. The handle should be in such position that, as affected by vibration, it would tend to jar open instead of shut.

Improved Angle Cock

Figs. 18 and 19 illustrate the angle cock which was recently modified to provide for an improved method of installation and simplified handle removal.

An extension with a U bolt groove to the brake pipe end of the angle cock serves to support the brake pipe entering the angle cock while the groove in the extension permits the angle cock to be positively attached to the hanger bracket.

The handle may be removed independent of the socket. After driving out the hinge pin, the handle may be easily removed by first depressing it and then sliding it forward to permit the web to clear the socket lugs.

The handle, of course, locks in both open and closed positions. When so locked, it is necessary to slightly raise the handle before it can be turned, thus insuring against accidental opening or closing by being stepped upon, flying missiles or loose rods and chains.

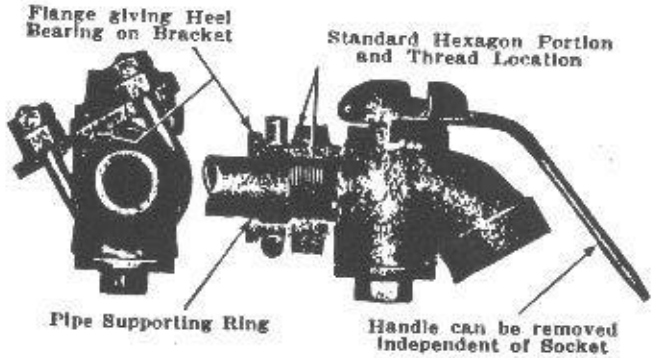


Fig. 18. View Showing Angle Cock Improvements

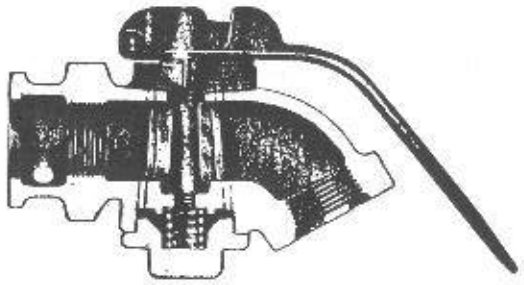


Fig. 19. End and Sectional Views of the Improved Angle Cock

Hose Connections, Fig. 20, make the brake pipe continuous throughout the train. When cars are being separated, as in switching, the hose should be uncoupled by hand, to prevent rupture or damage.

Fig. 20. Hose Connection

Dummy Couplings, Fig. 21, are provided at each end of the car to which the hose couplings should be attached when not coupled up, to protect against injury to the hose couplings or dirt entering the pipes.

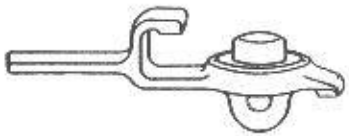


Fig. 21
Dummy Coupling

OPERATION OF THE EQUIPMENT

As it is impossible to show all the ports and connecting passages in the various valves by any single section taken through the universal valve, Figs. 28 to 32 have been made to show in a purely diagrammatic way the relations of the various ports.

The actual proportions and mechanical construction of the parts have been disregarded where necessary to make the connections and operation more easily understood.

On the folder with the first diagrammatic view, Fig. 28, is shown an isometric view of the graduating valves and slide valves and their seats, the operative positions of the diagrammatic and the isometric views corresponding

Port Connections

EQUALIZING SLIDE VALVE SEAT—Port *g* connects to the small end of the release piston; *h* to the large end of this piston; *d-1* to the release slide valve seat; *z-1* is the service port; *m* connects to the auxiliary reservoir; *u-1* connects to the service reservoir; *s-1* connects to the large end of the charging valve chamber H.

RELEASE SLIDE VALVE SEAT—Port *q* connects to the chamber between the ends of the charging valve; *l* leads to the equalizing piston chamber C, (emergency reservoir charging port); *n* connects to the auxiliary reservoir

(quick recharge port); *c-1* leads to the back of the high pressure valve; *b-1* leads to the emergency slide valve seat; *u-1* connects to the underside of check valve 12"; *s* leads to the chamber between the ends of the charging valve; *d-1* connects to the equalizing slide valve seat; *x* is the brake cylinder exhaust; *w* connects to the brake cylinder.

EMERGENCY SLIDE VALVE SEAT—Port *o* leads to the front of the high pressure valve; *o-1* connects to port *o*; *t-1* is blanked by the high pressure cap; *f-1* connects to the quick-action piston; *b-1* leads to the release slide valve seat; *d* connects to the quick-action closing chamber; *a-3* connects to brake pipe; *w-4* connects to brake cylinder.

CHARGING THE SYSTEM (Fig. 28)

To charge the brake system the engineman's brake valve is first placed in *Release* position to permit a rapid charging, and then in *Running* position. Air at main reservoir or feed valve pressure, as the case may be, flows through the brake valve into the brake pipe and thus throughout the train, passing through each branch pipe to the universal valve on that car. The brake pipe air enters the universal valve through passage *a* and flows in two directions—to the Quick Action Portion and to the Equalizing Portion.

Charging Quick Action Portion

Brake pipe air, entering through passage *a*, flows to the upper side of the quick action valve 85 which is then held seated by air pressure as well as by the tension of spring 90. The air flow continues through passage *a* to the strainer 181 in the quick action portion strainer filling piece and through the hair strainer and passage *a* to protection valve 111 in the high pressure cap. The protection valve 111 will be on its brake pipe (lower) seat when there is no air in the system. When the brake pipe pressure reaches approximately 45 lbs. this valve will be forced from its brake pipe seat to its atmospheric (upper) seat, allowing brake pipe air to flow through passage *a-2*. Ball check 153 prevents direct flow to chamber *A* in front emergency piston 76 so that pressure build up in this chamber must be through choke 157 into port *a-5* and thence to chamber *A* through the filling piece. This prevents such a sudden build up of pressure in chamber *A* as would "slam" the emergency piston 76 to its release position.

Brake pipe pressure also flows around the protection valve to the left, through passage *a-2*, past ball check 99′, through passage *a-3*, port *a-4* in the emergency slide valve 78, and past the ball charging choke 102 in the emergency graduating valve, thus charging the emergency slide valve chamber *B*. The quick-action chamber is charged to brake pipe pressure from chamber *B* through passage *e*, and the quick-action closing chamber through cavity *e-1* in the slide valve and passage *d* in the slide valve seat. Ball charging choke 102, by virtue of the clearance between it and the walls of its cavity, governs the rate of charge for slide valve chamber *B*, the quick-action chamber and the quick-action closing chamber.

Charging Equalizing Portion

Brake pipe air flows through passage *b* to the cavity beneath the strainer, through *b*-4 beneath charging by-pass valve 54′, and through *b*-2 to the top of application by-pass valve 54 where in conjunction with spring 57, it keeps the valve 54 seated. Normally, pressure passes through the strainer to *b*-5, thence to equalizing piston chamber *C*; and through passage *b*-3 to the cavity above charging by-pass valve 54′ where spring 57′ assists to keep valve 54′ on its seat. Should the strainer be restricted, build up through passage *b*-3 will be retarded so that pressure in passage *b*-4 unseats valve 54′ and passes via *b*-3 and *b*-5 to chamber *C*. This by-pass feature operates if the dirt restriction causes a two-pound differential across the strainer and the charging by-pass check valve. Consequently there is no interference to normal charging due to the strainer.

In the absence of pressure in the slide valve chamber *G*, the equalizing piston 4, with graduating valve 7 and slide valve 3, are forced to full release position as shown in Fig. 28, the graduated release piston 30 being held to its lower position by spring 32. The release piston 16 is held in its release position by spring 21. The lower end of this piston (inner seal) is connected to the exhaust through passage *g*, port *f*, cavity *D* in the graduating valve and cavity *E* in the slide valve. Port *h* leading to the upper end of the release piston is blanked by the equalizing slide valve. The release slide valve 19 now connects the brake cylinder passage *w* to the exhaust passage *x* through cavity *k-1*, and also opens the various charging ports as explained later.

Brake pipe air can flow from the equalizing piston chamber *C* in two directions:

(1) through the feed groove *k* to the slide valve chamber *G*, and thence through passage *m* to the auxiliary reservoir, thus charging it, and through passage *s-1* to the bottom face of the charging valve 34 which is thus forced upward connecting passages *r* and *s*. The resistance increasing cavities T in the face of the equalizing slide valve are also connected to auxiliary reservoir pressure.

(2) through passage *l* past ball check 12′ to the release slide valve chamber *I*. From this chamber air flows through passages *v-2* and *v* to the emergency reservoir, thus charging it. Air also flows from this same chamber through passages *p*, *q* and *r*, around charging valve, thence through passage *s*, port *t* in the release slide valve, passage *u-1* and under ball check 12″, into passage *u* to the service reservoir, thus charging it.

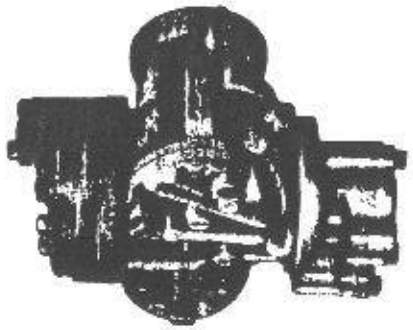


Fig. 23. Graduated Release Cap in *Direct Release* Position

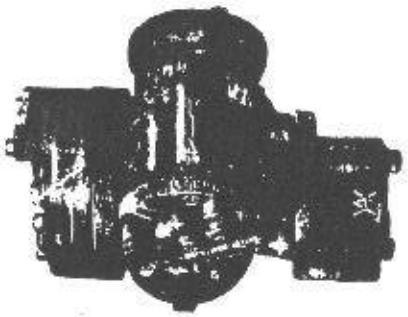


Fig. 22. Graduated Release Cap in *Graduated Release* Position

Chamber *L* below graduated release piston 30 is connected to chamber *I*, which in turn is connected to the emergency reservoir. Passages *p* and *q* connect chamber *I* with the cavity *r* of the charging valve. The top face of the charging valve is connected to service reservoir pressure from passage *s* through passage *q-1*.

Air can also flow from the release slide valve chamber through passages *c-2* and *c-1* to the back of the high pressure valve 123 and then through passage *m-1* to the back of the intercepting valve 117, the middle cavity of which is in direct communication with the emergency reservoir through passages *v-1* and *v*. The inner face of the intercepting valve 117 is connected to the service reservoir through passages *u-2* and *u*. This valve will then be held seated by the spring 121. The face of the high pressure valve 123 is connected to the atmosphere through passage *o* and cavity *N* in the emergency slide valve 78. The cut off valve 141 is held to its lower seat by the spring 146.

The initial charging operation is the same regardless of whether the Graduated Release Cap is in direct or graduated release position.

RECHARGING AFTER AN APPLICATION

With Graduated Release Cap Set in Graduated Release Position

With the graduated release cap set in graduated release position, the auxiliary reservoir is recharged from the brake pipe through feed groove *k* and from the emergency reservoir, which is connected to release slide valve chamber I through ports *v* and *v-2*, and this chamber in turn is connected to auxiliary reservoir through port *n*-1

in the release slide valve, port *n*, through the graduated release cap, and thence through passage *m*, leading to the auxiliary reservoir. Since the emergency reservoir is fully charged, the auxiliary is mainly recharged from this source.

As emergency reservoir pressure is decreased during recharge and the auxiliary reservoir pressure increased above that in the service reservoir, the charging valve will be moved up and service reservoir will be recharged from the emergency reservoir by way of port *p* in the release slide valve, passage *q* to cavity *r* in the charging valve, passage *s*, cavity *t* in the release slide valve, passage *u-1* under ball check 12″ and passage *u*.

Passage *r* at the left of the charging valve 34 is connected to the emergency reservoir (passage *q*, port *p*, chamber *I* and passage *v-2*, and passage *s* at the right is connected to the service reservoir (cavity *t* and passages *u-1* and *u*). Consequently when these two passages have been connected together by the lifting of the charging valve, the service reservoir is recharged from the emergency reservoir at approximately the same rate as the auxiliary is being recharged. Since the emergency reservoir has been depleted in recharging the auxiliary and service reservoirs, it is recharged from the brake pipe as in the initial charging, as soon as the brake pipe pressure becomes higher than emergency reservoir pressure.

RECHARGING AFTER AN APPLICATION

With Graduated Release Cap in Direct Release Position

With Graduated Release Cap in direct release position, the auxiliary reservoir recharges directly from the brake pipe through feed groove *k*, port *n* leading from chamber *I* (emergency reservoir pressure) to the auxiliary reservoir being blanked by the graduated release cap.

The charging of the service reservoir is controlled by the charging valve.

In direct release the charging of the service reservoir must not be at a more rapid rate than that of the auxiliary reservoir or an excessive amount of brake cylinder pressure would be obtained when it is necessary to reapply the brakes before fully recharged, as for the second application of a two-application stop. This is controlled by the charging valve moving up and down as the auxiliary reservoir is charged, cutting off the flow of pressure from the emergency reservoir to service reservoir when the latter is charged to approximately the same pressure as that in the auxiliary reservoir and again opening the connection from the emergency reservoir to the service reservoir when the pressure in the latter is slightly less than that in the auxiliary reservoir.

The quick-action and quick-action closing chambers are charged in the same manner as initially and after an application.

QUICK SERVICE (Fig. 29)

To apply the brakes on the train, a suitable brake pipe reduction is made with the engineman's brake valve.

This reduces the pressure in passage *a* leading to the emergency portion, thence through passage *a-2* to the top of ball check 153, which is momentarily lifted by greater pressure beneath it, thereby reducing pressure in chamber *A* on the face of the emergency piston.

The differential across the emergency piston thus created, causes the piston to move, carrying the graduating valve to quick service position, where cavity *w-6* establishes connection between the two slide valve ports *a-4* and *w-5*. Brake pipe pressure from passage *a-2* now lifts ball check 99′ and flows through passage *a-3*, port *a-4*, cavity *w-6*, port *w-5*, passage *w-4* past ball check 99 into passage *w-3*, thence through choke 233 into passage *w* to brake cylinder.

A light reduction of brake pipe pressure is required to obtain the foregoing operation because the emergency piston moves only the graduating valve. This quick service function causes a practically simultaneous reduction of brake pipe pressure on each car of the train, resulting in the brakes applying uniformly and preventing harsh slack action.

In quick service position the quick-action chamber air is connected to atmosphere through a vent port in the graduating valve and port *j-1* in the emergency slide valve, thereby reducing quick-action chamber pressure at the same rate as brake pipe pressure is being reduced. The vent port in the graduating valve is of such a size that a movement of the emergency slide valve to emergency position will not occur until brake pipe pressure is reduced at an emergency rate.

Ball check 99 prevents back flow from the brake cylinder to brake pipe in the event brake pipe pressure should become lower than brake cylinder pressure.

Ball check 99′ prevents the quick-action and the quick-action closing chamber volumes being added to brake pipe volume during the service reduction.

The quick service choke 233 is inserted in brake cylinder passage *w-3* for the purpose of controlling quick service activity. This choke must be the proper size to suit the brake pipe volume on the car as listed on page 23.

SERVICE (Fig. 29)

Coincident with the quick service previously described, the initial reduction also reduces the pressure in chamber *C* on the brake pipe side of the equalizing piston 4 below that in the auxiliary reservoir, acting on the opposite side of the piston in chamber *G*.

Pressure is withdrawn through passage *b*-5 thence through the strainer and out passage *b* to atmosphere. Normally, application by-pass valve 54 remains seated as the pressure in passage *b*-2 is reduced at the same rate as flow through the strainer. However if the strainer should be restricted sufficiently to create a two-pound differential between pressures above and beneath the valve, the spring will be overcome and the valve 54 will unseat, thus passing pressure through passage *b*-2, at a normal reduction rate.

The slightest differential pressure created first causes the equalizing piston only to move upward and close the feed groove *k* and charging port *l*. (This reduces to a minimum the back flow of air from the auxiliary reservoir to the brake pipe through the feed groove; and prevents air flowing from the emergency reservoir into chamber *C* if charging check valve 12′ is leaking. This insures that the brake pipe reduction will be more effective in accomplishing what is obviously desired).

Following this, as the reduction continues, the graduating valve 7 is moved upward by the piston, connecting cavities *T* in the slide valve to the atmosphere through cavity *D* in the graduating valve. This increases the force holding the slide valve to its seat and insures that a very light reduction will not apply the brakes, thus giving the valve needed stability. The resistance cavities *T* are now made so that the resistance to movement during application is less than with the U-12 Universal Valve. When the differential acting on the piston reaches the predetermined desired value, the slide valve 3 is moved upward to its service position as shown in Fig. 29.

The release piston 16 has been held in release position by spring 21 and because the inner area of the lower end of the piston was connected to the atmosphere through passages *g* and *f* and cavity *D*. With the equalizing slide valve now in service position, passage *g* is blanked and passage *h* leading to the upper end of the release piston is open to the atmosphere through cavity *E*.

It will be noted that emergency reservoir pressure is always in chamber *I*, and that the upper end of piston 16 is larger than the lower end. The force tending to hold the piston in release position is therefore spring pressure plus emergency reservoir pressure acting on the area of the lower piston inside of the seal, while the force tending to move the piston upward is emergency reservoir pressure acting over the whole area of the upper end. Consequently there is sufficient differential built up to force the release piston to its upper seat, or into service position. (Emergency reservoir air will then equalize into passage *g* through the small port in the lower end of the piston).

It should be noted that a movement of the equalizing slide valve was required to actuate the release piston. This insures against the possibility of the piston and graduating valve "floating" over and causing the release piston and slide valve to close the exhaust port, which might cause trouble should the brakes creep on due to leakage. With the release slide valve now in service position the B. C. exhaust port is closed as well as the service reservoir charging port *u-1* and the quick recharge port *n*.

The equalizing slide valve now being in service position, the service reservoir is in communication with slide valve chamber *G* through passage *u-1* and past service reservoir check valve 12', the auxiliary reservoir being always in communication with this chamber. Air can now flow from the combined volume of these reservoirs by way of chamber *G* through passages *z* and *z-1* past the service port check valve 12 and through passage *w* to the brake cylinder and thus apply the brakes. The brake cylinder is in communication with the safety valve through passages *w* and *w-1* which limits the brake cylinder pressure to 63 lbs. in service applications. (With the cap set for graduated release the graduated release piston 30 will be moved into the position shown, against its upper seat, when a service application is made, since the auxiliary reservoir pressure acting on the upper side is reduced while the pressure in chamber *L* at the bottom, emergency reservoir remains at its initial value).

A choke fitting 230 is inserted in the service port, the size of which is so proportioned as to give the proper rate of increase in brake cylinder pressure, thus making it possible to use the same valve with various sizes of cyl-

inders simply by changing the choke. The service and exhaust chokes used with the universal valve and listed on page 23 will cause the brakes on very short trains, having the smaller brake cylinder sizes, to apply and release somewhat more slowly than the chokes formerly supplied with the U-12 valve, this being for the purpose of obtaining a more uniform application and release of brakes throughout a train, regardless of length.

It will be noted that cavity *S* in the face of the equalizing piston slide valve has performed no function thus far. Should there be an excessive amount of friction between the graduating valve and the slide valve such as to prevent the graduating valve moving on the slide valve, both valves would move together and it will be evident that while the slide valve might be in service position, yet the service port *z* would be blanked by the graduating valve.

In such event cavity *S* connects chamber *G* to the brake cylinder passage *z-1* through port *m*, thus insuring against a possible brake failure from this cause.

SERVICE LAP (Fig. 30)

To hold the brakes applied the engineman's brake valve is moved to lap position in which further escape of air from the brake pipe is prevented; neither is there an increase of pressure. When the flow of air from the auxiliary and service reservoir to the brake cylinder has reduced the pressure in chamber *G* slightly below that remaining in chamber *C*, the differential pressure will move the equalizing piston and graduating valve down to *Service Lap* position. In this position port *z* is blanked,

and flow of air to the brake cylinder is thereby stopped. Further movement is prevented by the shoulder of the piston stem striking the end of the slide valve 3. The slight difference of pressure which was sufficient to move the piston and graduating valve is unable to overcome the added resistance of the slide valve, hence there is no further movement.

As described under the heading "Quick Service", emergency slide valve chamber pressure is reduced through port *j-1* at the same rate as pressure is removed from the face of the piston. When pressure in chamber *B* has been reduced slightly below brake pipe pressure in front of the emergency piston, the piston and graduating valve are moved to the left, preventing further flow of quick action chamber air to atmosphere and of brake pipe air to brake cylinder.

It will be noted that the equalizing slide valve 3 remains in *Service* position, a movement of the piston and graduating valve only being required to lap the valve. Consequently when in this position, but a slight reduction in brake pipe pressure is required to again bring the piston and graduating valve into *Service* position. In this manner the brakes may be applied in a series of steps, or as is usually stated, "graduated on."

If more than a full service reduction is made before the brake valve is lapped, air will pass from the auxiliary and service reservoirs to the brake cylinder and to the atmosphere through the safety valve until the pressures in the three volumes have become equalized at the safety valve setting. Such an over reduction is obviously only a waste of air. If continued below the protection

valve setting, an emergency application will result, as explained under the heading *Emergency*.

RELEASE (Fig. 28)

To release the brakes, the brake valve handle is placed in *Release* or *Running* position, according to results desired.

An increase in brake pipe pressure causes the pressure in chamber *C* above the equalizing piston to increase. As the pressure in chamber *G* does not change, sufficient force is exerted upon the piston to move it downward. The first movement of the graduating valve toward lap position, as just described, has connected resistance increasing cavities T to the slide valve chamber *G*, so that while these cavities increase the slide valve resistance when an application is made, they decrease the resistance to release. When the pressure in chamber *C* has sufficiently increased, the slide valve is moved downward toward release position.

It will eventually go all the way to release in all cases, as shown in Fig. 28, or *immediately* if the cap is set for direct release, since piston 30 is balanced (auxiliary reservoir pressure above and below) and held seated as in Fig. 28. If the cap is set for graduated release, the slide valve is halted in graduated release position by piston 30, which is then in the position shown in Fig. 24, due to there being full emergency pressure below and reduced auxiliary reservoir pressure above. In either event, the lower end of the release piston 16 is connected to the atmosphere through passages *g*, *f*, and cavity *D* in the graduating valve, and passage *h* leading to the upper end is blanked by the graduating valve in former case and

by the slide valve in the latter. The force now tending to hold the release slide valve in service position is emergency reservoir pressure acting on the area of the upper piston inside of the seal while the force tending to move the piston downward is emergency reservoir pressure acting over the whole area of the lower piston plus the tension of the spring 21. Consequently there is sufficient differential to force the release piston downward to its lower seal, or to release position, (emergency reservoir air will then equalize into passage *h* through the small port in the end of the piston)

Brake cylinder air will then exhaust to the atmosphere through passage *w*, cavity *k-1*, and ports *x* and *y-1*, thus releasing the brakes.

A choke fitting 231 is inserted in the exhaust port, the size of which is so proportioned as to give the proper rate of decrease in brake cylinder pressure, thus making it possible to use the same valve with various sizes of cylinders simply by changing the choke. The various sizes of these fittings and the cylinders with which they are used are shown in table on page 23.

The movement to full release position is made positive by momentarily connecting chamber *G* below the equalizing piston to atmosphere, so that after the release movement has commenced it is certain to be completed. The equalizing piston moves from service to release position before the release piston moves correspondingly. When the equalizing slide valve is approaching release position, passage *F* registers with port *d-1*, connecting chamber *G* to atmosphere through passages *j*, *F*, *d-1* and cavity *k-1*. This connection is not broken until the release slide valve moves to its release position, which only

occurs after the equalizing slide valve has moved to its full release position. This feature prevents the creation of such an equilibrium of pressures as to cause the parts to halt in "cracked port" position with the feed groove and exhaust port barely open, and insures a positive and unrestricted release.

At the same time the parts are in release position, the system is being recharged, as explained in detail under the heading of RECHARGING AFTER AN APPLICATION. It should be noted that during this operation the pressures on the brake pipe and auxiliary reservoir sides of the

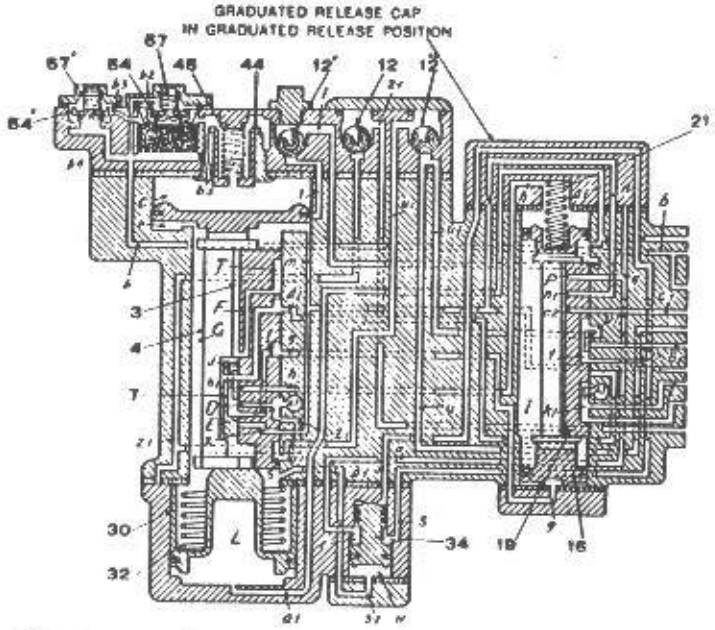


Fig. 24. Diagrammatic View of the Universal Valve Equalizing Portion. *Graduated Release* Position

equalizing piston are always in balance. This insures a quick response of the brakes to any reduction or increase of brake pipe pressure, irrespective of what operation may have occurred just preceding, so that as many applications and releases in quick succession as may be desired, can be made without depleting the system. If the brake valve handle is placed in *Running* position and left there the brake pipe pressure is fully restored and the valve parts remain in *Release* position, the brakes being thereby fully released.

GRADUATED RELEASE (Fig. 24)

If it is desired to reduce the brake cylinder pressure in steps or to "graduate it off," the graduated release cap must be in graduated release position and the brake valve must be returned to lap position before the brake pipe pressure has been restored to normal. In other words, the brakes will be entirely released if the brake pipe pressure is fully restored, but if the pressure is only partially restored, the brakes will only partially release.

After the brake pipe pressure has been increased so that the equalizing slide valve starts toward release position it is stopped in graduated release position by the graduated release piston 30, which, during a service application, is thrust forward into the equalizing piston chamber because the pressure above it (auxiliary reservoir) decreases while that below (emergency reservoir) remains unchanged. The release piston and slide valve will then be moved to release position, permitting the exhaust of brake cylinder air, as explained on page 68.

While the pressure above the equalizing piston does not increase after the brake valve is lapped, the pressure below the piston does increase because emergency res-

ervoir air is flowing into chamber *G* from chamber *I* through passages *n-1*, *n* and *m*. The pressure below the piston consequently becomes greater than that above, causing it to move upward with the graduating valve, until the lost motion between the piston stem and slide valve is taken up, into Graduated Release Lap position, Fig. 25.

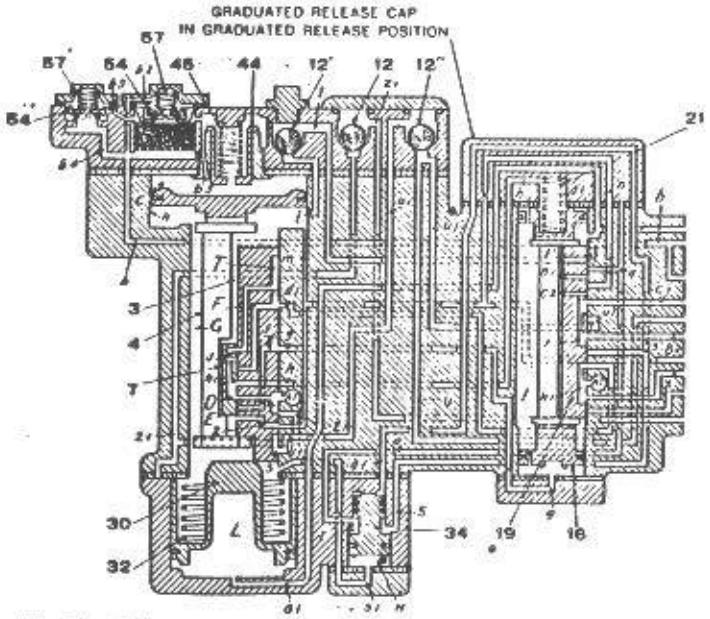


Fig. 25. Diagrammatic View of the Universal Valve Equalizing Portion. *Graduated Release Lap* Position

The application end of the release piston is then connected to atmosphere and the release end connection is blanked, so that the release slide valve is moved from release to service position as explained under SERVICE.

In service position the exhaust port connecting the brake cylinder to the atmosphere is blanked and the air remaining in the cylinder is retained. The brake cylinder pressure can thus be released in successive steps.

When the auxiliary reservoir has equalized with the emergency reservoir, the graduated release piston 30 will be returned to normal position by the spring, permitting the return of the equalizing piston and slide valves to their full release position. No further graduation can now be made, the brake pipe pressure becoming fully restored, and the exhaust of air from the brake cylinder completed.

The amount of reduction in brake cylinder pressure for any given "Graduation" depends upon the amount of air pressure which has been restored in the brake pipe.

Furthermore, the graduated release function can be eliminated and although quick recharge of the auxiliary reservoir is also lost, a quick recharge of the service reservoir is effected which makes possible more prompt reapplications at short intervals.

It will be noted from what has been said regarding the release operation that there are two release positions of the equalizing slide valve—graduated and full release. This is so that the graduating valve may control the movement of the release piston when it is desired to graduate the release without endangering an unintended closing of the exhaust port, such as might be possible if the graduating valve controlled the release piston at all times. As it is arranged, a movement of the slide valve must be effected to actuate the release piston when the parts are in full release position.

EMERGENCY (Fig. 31)

Any reduction in brake pipe pressure faster than a predetermined rate causes an emergency application of the brakes throughout the train, obtaining a high cylinder pressure in a very short time.

The equalizing portion operates the same in emergency as it does in service operation, so that the description need apply to the emergency portion only. When the brake pipe pressure is suddenly reduced, the pressure in chamber *A* in front of the emergency piston is also reduced, since this chamber is connected to the brake pipe through holes in the spring stop 185, passage *a-5*, past the emergency check valve 153 into passage *a-2* and past the protection valve 111 to passage *a*. The pressure on the emergency piston is therefore unbalanced, causing it to move to emergency position, carrying with it the graduating valve 80 and slide valve 78. In passing to emergency position, and before the slide valve has moved, the graduating valve uncovers port *R* in the slide valve. Air is thus admitted from the quick-action and quick-action closing chambers through passages *R* and *f-1* to the underside of quick-action piston 88 forcing this piston upward, opening the quick-action valve 85, and venting brake pipe air to the atmosphere. This venting which is thus initiated very quickly, serves to shorten the time required to transmit quick-action throughout the train.

When the emergency slide valve has moved into emergency position, the quick-action chamber is cut off and the quick-action closing chamber is connected to the underside of the quick-action piston 88 through passages *d*, *e-1* and *f-1*, so that this volume of air causes the quick-action piston to remain open a definite time until

the pressure is reduced to a certain value through the small hole in the quick-action piston. The purpose of this is twofold—first to insure transmission of quick-action, and second to insure closure of the exhaust so that the brake pipe pressure can be restored when desired.

The emergency slide valve has connected the back of the high pressure valve 123 to the atmosphere through passage *c-1*, cavity *t* in the release slide valve, passage *b-1*, and cavitiy *N* in the emergency slide valve. As the back of the intercepting valve 117 is connected to the back of the high pressure valve by passage *m-1*, the pressure back of the former becomes atmospheric momentarily. Service reservoir pressure, present upon the front of the intercepting valve moves it to the right, so that air from this reservoir can flow from ports *u*, and *u-2* to port *x-1*, open the high pressure valve 123, lift the cut-off valve 141 to its upper seat, and flow through passages *w-1* and *w* to the brake cylinder.

This causes a quick drop of service reservoir pressure acting on the left of the intercepting valve and as brake cylinder pressure is present on the right of this valve, the pressures acting on the valve, equalize and spring 121 then moves the valve to the left and prevents further flow of pressure from the service reservoir.

Auxiliary reservoir pressure flows to brake cylinder through the service port in the same manner as during a service application but does not flow as quickly as service reservoir pressure and therefore, does not equalize with brake cylinder until after the service reservoir is cut off by the intercepting valve. Consequently, auxiliary reservoir pressure is higher than service reservoir

pressure but is prevented from flowing into the service reservoir by ball check 12″.

With the intercepting valve to the left, Fig. 32, emergency reservoir pressure, present in passage *v-1*, flows through the cavity in the intercepting valve to passage *x-1* and on to brake cylinder. As brake cylinder pressure increases above that in the auxiliary reservoir it is prevented from flowing into the auxiliary reservoir by ball check 12.

As the cut-off valve renders the safety valve inoperative, a high pressure is secured in the brake cylinder and, due to large passages it is secured in a very short time.

In order to insure the brake cylinder exhaust being closed before the emergency parts function, the release slide valve moves to service position before pressure is vented from behind the high pressure valve.

The quick action chamber is connected to the brake cylinder through port *o-2* in the emergency slide valve, passages *o-1*, *o*, past cut-off valve 141, thence through passage *w-1* to *w*. This is to maintain the pressure in this chamber against possible leakage and insure that the emergency piston and valves remain in emergency position.

The protection valve 111 causes an emergency application when the brake pipe pressure falls below 35 lbs. Normally this valve is held to its atmospheric seat, but when the brake pipe pressure becomes less than the predetermined minimum, the spring 115 moves the valve to its brake pipe seat (as shown in Fig. 32), connecting passage *a-2* to the atmosphere through the vent in the protection valve cap. This produces an emergency rate of reduction so that the emergency piston is actuated with the results as just described.

RELEASE AFTER EMERGENCY

When the brake pipe pressure is being restored after an emergency application, the protection valve 111 will be the first to go back to normal position, this taking place when the pressure has reached approximately 45 lbs. Brake pipe air will then be admitted to chamber *A*, through passage *a* but since the quick action chamber pressure is maintained equal to that in the brake cylinder, the brake pipe pressure is as yet insufficient to move the emergency piston to release position. When the brake pipe pressure acting on the face of the equalizing piston has been built up slightly higher than that remaining in the auxiliary reservoir, from the first stage of the equalization, this piston with its valves will be returned to release position which will in turn cause the release piston and slide valve to return to their release position in the manner previously described. This permits air to flow from chamber *I* through port *c-2* and passage *c-1* to the back of the high pressure valve 123 which will be thus balanced and returned to its normal position by the spring 128, cutting off communication between passage *x-1* and the passage leading to the lower side of the cut-off valve and consequently between the brake cylinders and the emergency reservoir. During this time air has been exhausting from the brake cylinder through port *w*, cavity *k-1* in the release slide valve and through passages *x* and *y-1*.

When the pressure in the emergency slide valve chamber *B* has thus been reduced to a point where the brake pipe air in chamber *A* (combined with spring 186) has the balance of power, the emergency piston will return the slide valve to release position. An additional exhaust is then provided for brake cylinder air through passages *w-1* and *o*, and cavity *N* in the emergency slide valve seat, until the cut-off valve 141 closes, after which the remaining air escapes through the usual exhaust passages.

The reservoirs and chambers will then be recharged in the usual manner.

INSTALLATION AND MAINTENANCE

For more complete specifications for installation see our publication No. 2502.

All the pipe connections are permanently made to the universal valve pipe bracket and no pipes need be disconnected to remove the operating portions of the valve, loosening the bolts which hold them in place being all that is required. The bracket should be installed as near the brake pipe as possible so that the branch pipe may be short; short bends in the piping should also be avoided. Care should be taken in locating the valve to have it free from obstructions which would render inspection or removal difficult. The universal valve should be placed above the general level of the piping and the piping itself so arranged as to avoid pockets in which moisture may collect. If this point does not receive proper attention, trouble may be experienced in cold weather from the freezing of water in the pipes or even in the valve.

Before installing the universal valve, all the piping should be thoroughly hammered and blown out, in order to loosen and remove all scale or foreign matter. This is especially important in new installations. A suitable compound to make a tight joint should be applied on the male threaded portion only, and never in the socket. Do not use red or white lead. After the piping is complete, all the joints should be thoroughly tested under pressure with soapsuds and made air-tight.

Never remove the operating parts of the universal valve while on the car. If one of the portions of the valve is not working properly, or needs cleaning and lubricating, take it down and replace by a portion in good condition. All cleaning and lubricating should be done at a bench, by a competent man, where the liability of damage to the internal parts of the valve is least. Any attempt to remove the moving parts of the valve while still on the car is almost sure to result in a large percentage of valves being injured by careless handling or dirt getting inside the pipes or valve.

LUBRICATION

Brake Cylinder

Close the brake cylinder cut-out cock. Remove the nuts from non-pressure head bolts, then remove non-pressure head, release spring and piston from the cylinder.

CLEANING CYLINDERS. Scrape the old lubricant from the cylinder wall and leakage groove and wipe these surfaces clean and dry. Kerosene may be used for assisting in cylinder cleaning but must be completely removed. If the cylinder wall is rusted, the rust should be removed with sand paper.

CLEANING PISTON AND PACKING CUP. Scrape old lubricant from the metal part and packing cup using a dull-edge round-end scraper (like a case knife), and wipe all surfaces clean and dry. The packing cup should be carefully examined and should be renewed if brittle, thin at any point, cut, cracked, or otherwise defective. Examine piston and follower plate for cracks and tighten up follower plate nuts.

APPLYING NEW PACKING CUPS. Examine follower studs for tightness in the piston. Locate the packing cup centrally on the piston. Place the follower in position and apply the nuts, bringing them in contact with the follower without tightening. Then draw them down uniformly.

Illustration Showing Initial Step in Fitting Piston Packing Cup Into the Brake Cylinder

APPLICATION OF LUBRICANT. Apply a coating of brake cylinder lubricant to the wall of the cylinder and to the outside of the packing cup with a brush.

ASSEMBLING. The initial step in fitting the piston with packing cup into the cylinder is illustrated on page 82. To prevent possible damage from the sharp edges of the cylinder, the packing cup should be pressed inward at the points of contact as shown in the illustration. With the piston in this position, enter it into the cylinder. The sleeve or rod should then be slowly raised and the piston moved into the cylinder until the upper portion of the packing cup engages the cylinder wall. Form this portion into the cylinder, while the sleeve or rod is being gradually raised, taking special care not to crimp or otherwise damage the packing cup. Then pull upward and outward on the sleeve or rod until it is in horizontal position and push the piston to its release position.

When assembling pistons in brake cylinders in other than the customary location below the underframe, the methods employed must be changed as required to produce similar results.

Universal Valve

The proper interval for cleaning and lubricating the universal valve is best determined for each particular case by a careful inspection and trial. Where conditions are severe and the valve exposed to extremes of weather, dirt and so on, relatively frequent inspections will, no doubt, be found necessary. Where the valve is protected and not subjected to hard usage the interval may, obviously, be lengthened.

LUBRICATION OF SLIDE VALVES AND SEATS AND GRADUATING VALVES. All oil, gum or grease should be thoroughly removed from the slide valve and its seat in the bush and the face of the graduating valve. Use benzine or gasoline to insure this.

The face of the graduating valve, both upper and lower surfaces of the slide valve on which a graduating valve is used, the slide valve seat and the upper portion of the bushing where the slide valve spring bears should be lubricated with a high grade of very fine, dry, pure graphite, rubbing it in until the slide valve and seat show a dark copper color.

To apply the graphite, use a stick in the shape of a paddle about 8 inches long and having a small piece of chamois glued to one end. Put a small amount on the chamois skin and rub on the surfaces specified. Leave no free graphite on the slide valve or seat. When the work is completed, the slide valve and its seat must be entirely free from oil or grease. Care should be taken when handling the parts after lubricating that the hands do not come in contact with the lubricated parts as the thin coating of graphite is easily removed.

EQUALIZING, RELEASE AND EMERGENCY PISTONS. The piston rings and the bushing in which they work should be sparingly lubricated by first pushing the piston to release position and applying a drop or two of oil to the circumference of the piston bushing, spreading it over the surface as uniformly as possible and then moving the piston back and forth several times to insure proper distribution of this oil on the wall of the cylinder. After this, the surplus oil should be removed from the outer end of the cylinder.

Care should be taken not to permit any oil to get upon the gaskets.

EQUALIZING PISTON STOP. The equalizing piston stop should be lubricated with a drop or two of oil.

CHARGING AND HIGH PRESSURE VALVES. Lubricate these valves with oil in the same manner as described above for the pistons.

No lubricant should be used on the quick action piston, intercepting valve, protection valve or cut-off valve.

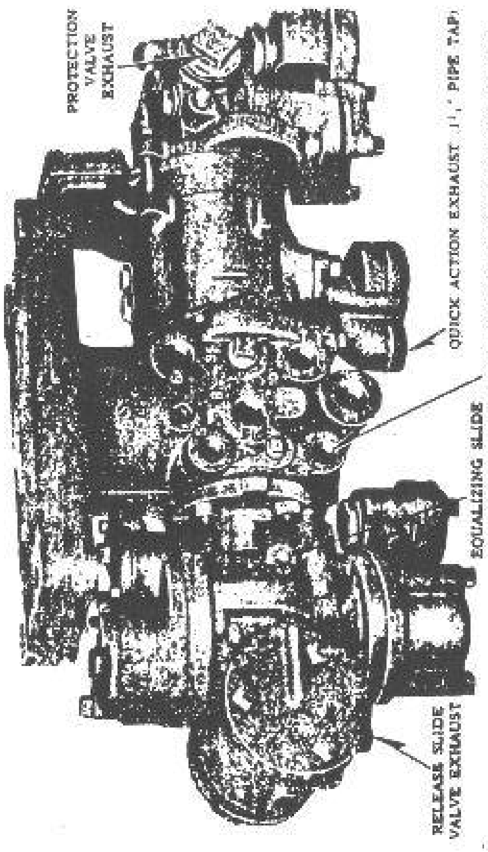
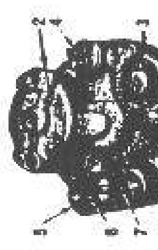


Fig. 26. View of U-12-BD Universal Valve, Showing Location of Exhaust Ports, and Details of Equalizing Cylinder Cap

Equalizing Cylinder Cap



2—Application By-Pass Check Valve

3—Charging By-Pass Check Valve

4—Emergency Reservoir Check Valve

5—Check Valve Cover under which are located:

6—Service Port Ball Check

7—Service Res. Ball Check

GENERAL HINTS

Cutting Out Defective Brake

When it is found necessary to cut out the brake, close the branch pipe cut-out cock and bleed all reservoirs.

With the double equipment, having independent brake rigging for each truck, if any of the truck rigging members fail, the brake on the end of the car affected may be cut out by closing the brake cylinder cut-out cock on that end of the car.

Locating Defects

Cause of Blowing at Various Exhaust Ports of Universal Valves

The following tabulation lists in detail under the heading of the particular exhaust port being considered, the various causes which may result in a blow of air from these ports with the equipment in various positions.

Release Position

Equalizing Slide Valve Exhaust Port. Leaky equalizing slide valve or graduating valve, or release end of release piston.

Release Slide Valve Exhaust Port. Leaky release slide valve.

Emergency Slide Valve Exhaust Port. Leaky emergency slide valve and graduating valve, or high pressure valve.

Brake Cylinder Exhaust Port. Leaky release slide valve, leaky equalizing slide valve and graduating valve, or release piston seal.

Protection Valve Exhaust Port. Leaky atmospheric seat of protection valve.

Quick Action Exhaust Port. Leaky quick action valve, emergency slide valve and graduating valve.

Service Lap Position

EQUALIZING SLIDE VALVE EXHAUST PORT. Leaky equalizing slide valve and graduating valve, or application end of release piston.

RELEASE SLIDE VALVE EXHAUST PORT. Leaky equalizing slide valve or release slide valve.

EMERGENCY SLIDE VALVE EXHAUST PORT. Leaky emergency slide valve and graduating valve, high pressure valve or cut-off valve.

BRAKE CYLINDER EXHAUST PORT. Leaky release slide valve or equalizing slide valve.

PROTECTION VALVE EXHAUST PORT. Leaky atmospheric seat of protection valve.

QUICK ACTION EXHAUST PORT. Leaky quick action valve, emergency slide valve and graduating valve.

Emergency Position

EQUALIZING SLIDE VALVE EXHAUST PORT. Leaky equalizing slide valve and graduating valve, or application end of release piston.

RELEASE SLIDE VALVE EXHAUST PORT. Leaky equalizing slide valve or release slide valve.

EMERGENCY SLIDE VALVE EXHAUST PORT. Leaky emergency slide valve, release slide valve, or high pressure valve.

BRAKE CYLINDER EXHAUST PORT. Leaky release slide valve or equalizing slide valve.

PROTECTION VALVE EXHAUST PORT. Leaky emergency piston seal.

QUICK ACTION EXHAUST PORT. Leaky emergency slide valve.

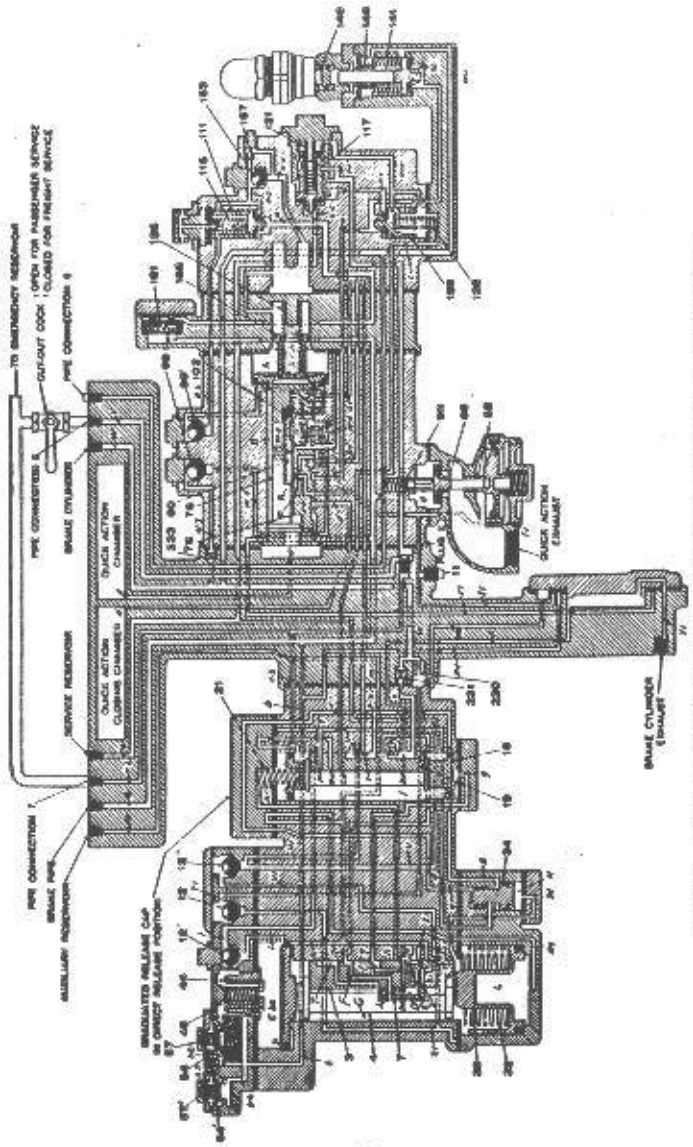


Fig. 27. Diagrammatic View of the U-12-BD Universal Valve arranged for use in both Freight and Passenger Service

UC Equipment for Cars used in both Freight and Passenger Service

Fig. 27 is a diagrammatic view of the U-12-BD universal valve arranged for use in both freight and passenger service, and Fig. 34 is a piping diagram of the UC equipment modified for the same purpose.

The necessary changes consist of the insertion of plug "X" in port *v-2* in the pipe bracket quick action face, connecting pipe connection No. 7 to the emergency reservoir and placing a cut-out cock in the pipe from emergency reservoir to pipe bracket connection No. 8.

In passenger service, with the cut-out cock open, the operation of the universal valve will be the same as already described in this pamphlet.

In freight service, however, the cut-out cock should be closed and the graduated release cap placed in *direct release* position. This arrangement continuously provides the pressure needed in the equalizing portion to secure proper operation while the high pressure feature in emergency is eliminated, by reason of the cut-out cock and plug "X" cutting off emergency reservoir supply to the quick action portion. With the graduated release cap in *direct release* position, graduated release operation is avoided under the relatively slow brake pipe pressure increase rates common in freight service. Piston travel should be not less than 7", preferably 8".

When transferring cars from freight to passenger service, the cut-out cock should be *opened* and the graduated release cap returned to *graduated release* position.

Illustrations

Illustrations (Continued)