Supplement No. 1 to No. 99-A-2

The Air Brake and Train Air Signal

The "AB" Freight Brake Equipment

1935

THE PENNSYLVANIA RAILROAD

Supplement No. 1
to
No. 99-A-2

The Air Brake and Train Air Signal

Operation of "AB" Car Equipment

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Approved
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Chief of Motive Power

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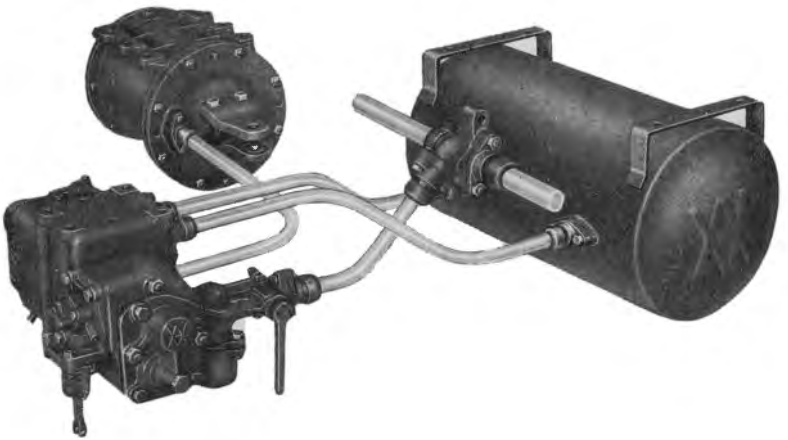


Fig. 1 View of the "AB" Freight Brake Assembly with Steel Reservoir

The "AB" Freight Car Brake Equipment

The new "AB" freight brake, which was developed to keep pace with other major improvements, overcomes limitations of the heretofore standard equipment and fulfills present day operating requirements. The new brake assures fast, positive and effective brake operation, simplifies inspection and maintenance, and anticipates future transportation development.

The proved, good operating features of the former standard brake have been retained, and other valuable features have been added. Notable among these additions are forms of construction designed for economical maintenance and protective devices to exclude dirt. The entire equipment is arranged for installation on the car with maximum insurance against leakage and for convenience in inspecting, cleaning, etc.

The following paragraphs cover new features of interest in the study of the new "AB" freight brake equipment. The detail operation of these features is described later in the pamphlet under "Operation."

Improved Quick Service—Two stages of quick service provide a prompt and positive brake application on all cars of long modern trains. The first stage insures prompt starting of the brake application on all cars of the train. The second stage positively develops brake cylinder pressure of moderate amount on all cars, which, combined with the fast and positive application through the train, provides for smooth train slack control. All quick service activity is then ended and full control of brake cylinder pressure beyond this point is in the hands of the engineman except as directly influenced by improper and undesired brake pipe leakage. The use of pressure retaining valves in grade operation modifies the quick service function by automatically cutting out the second stage. The first stage alone then functions to insure a prompt and positive re-application of all brakes. Protection is provided against undesired service applications.

Improved Release—In case of excessive slide valve friction that might delay release (or cause a "stuck brake"), a release insuring valve automatically releases the brake by reducing auxiliary reservoir pressure. A rapid increase of brake pipe pressure is obtained when release is started by using the emergency reservoir (which remains fully charged during a service application) to initially recharge the auxiliary reservoir instead of drawing on the brake pipe supply. This with restricted

recharge of head brakes insures a prompt and certain release of all brakes. Uniform restricted release on all cars is provided to permit adjustment of train slack gradually without shock when releasing brakes on long trains. After emergency, the rate of build-up of brake pipe pressure is hastened by discharging (during a fixed period of the release operation) brake cylinder and auxiliary reservoir pressure into the brake pipe, the partial restoration of brake pipe pressure from this source assisting materially in the accomplishment of a prompt and positive release.

Improved Emergency—Undesired emergency during service application is eliminated by separation of the parts controlling the service and the emergency operations. Protection against undesired emergency during release is assured by preventing overcharge of the quick action chamber. Emergency quick action can be obtained at any time regardless of the state of service application or release. Emergency brake cylinder pressure is approximately 20% higher than that obtainable from a full service brake application. The speed of emergency quick action through the train is approximately 40% faster than with former standard freight equipment. Development of emergency brake cylinder pressure in steps and at a controlled rate prevents damaging shocks.

General Features ' ' ' *A removable hair strainer* (with by-pass valve protection against stoppage) in each "AB" valve provides lengthened intervals between cleanings, minimum maintenance cost and long life by preventing the passage of dust particles (too fine to be

Fig. 2. View of the "AB" Valve showing the Pipe Connections

1 Brake Pipe
2 Emergency Reservoir
3 Brake Cylinder
5 Auxiliary Reservoir
10 Retaining Valve

caught by the dirt collector) to the operating parts of the valve and to the brake cylinder. ' ' ' *A duplex release valve* of large capacity (which can be operated from any angle) is provided for bleeding the auxiliary and emergency reservoirs, and the construction is such that both reservoirs can be discharged at the same time or the auxiliary reservoir alone. ' ' ' ' *A pipe bracket*, which is permanently mounted on the car, carries the valve portions and the pipe connections so that no pipe joints need be broken when removing the valve portions. ' ' ' *Pipe connections* are of the reinforced flanged union type which support the pipe and thereby prevent pipe breakage and loosening of joints. ' ' ' *The branch pipe tee* is provided with flanged union connections and a bolting lug for securely anchoring to the car body. ' ' ' *The auxiliary reservoir and the emergency reservoir* are combined into a two compartment reservoir of ample strength to withstand maximum operating pressures. ' ' ' *The brake cylinder* is fitted with an improved packing which does not require a follower plate and therefore simplifies replacement and eliminates leakage from this source; has means for continuous lubrication of the cylinder walls without opening the cylinder; the piston rod can be lubricated and is protected against damage; and the cylinder is protected against the entrance of dirt. ' ' ' ' *Provision is made for the addition of parts* to the equipment for use on cars exceeding in weight the capacity of the standard ten inch brake cylinder, without change in the "AB" valve operating portions or the two compartment reservoir.

Parts of the Equipment

The following is a list of the parts which make up the "AB" freight car brake equipment.

An "AB" Valve which corresponds in a general way to the triple valve as used with former standard equipment. It operates to control the admission of air to, and exhaust from, the brake cylinder and to charge the reservoirs.

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 air pressure, this force is transmitted through the rods and levers to the brake shoes and applies them to the wheels.

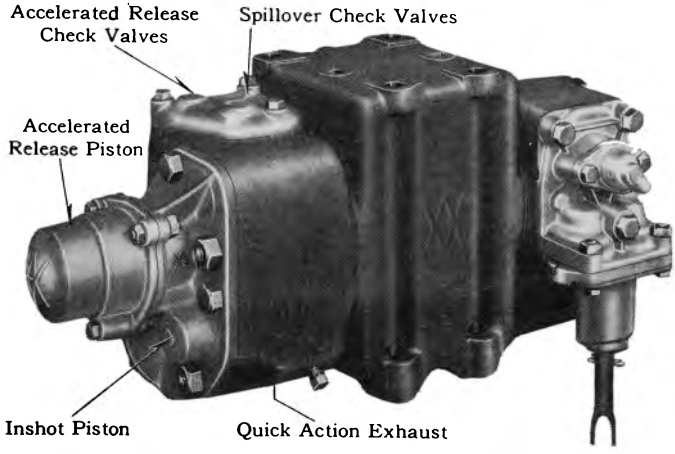


Fig. 2A. Front View of the "AB" Valve showing location of some Emergency Portion Details

A Two Compartment Reservoir which combines the auxiliary and emergency reservoir volumes. The auxiliary volume supplies air for service brake applications, and both volumes supply air for emergency applications. The emergency volume also assists in the recharge of the auxiliary volume.

A Combined Dirt Collector and Cut-out Cock is mounted on the "AB" valve pipe bracket. The purpose of the dirt collector is to prevent entrance into the "AB" valve of pipe scale, sand, cinders, or foreign particles of any kind. The cut-out provides a means of closing the pipe connections between the "AB" valve and the brake pipe.

A Branch Pipe Tee which is bolted to the car underframe by means of a bolting lug. The purpose of the branch pipe tee is to prevent the passage of excessive moisture from the brake pipe into the branch pipe fittings.

A Pressure Retaining Valve which is connected by piping to the "AB" valve exhaust. Its purpose, when the handle is placed in retaining position, is to retard the rate of brake cylinder exhaust while recharging the equipment and when brake cylinder pressure has been reduced to a certain predetermined amount, to retain that pressure in the brake cylinder.

An Angle Cock at each end of the brake pipe and also Hose Connections with Couplings which provide a means of flexible connection between the brake pipe on adjoining cars.

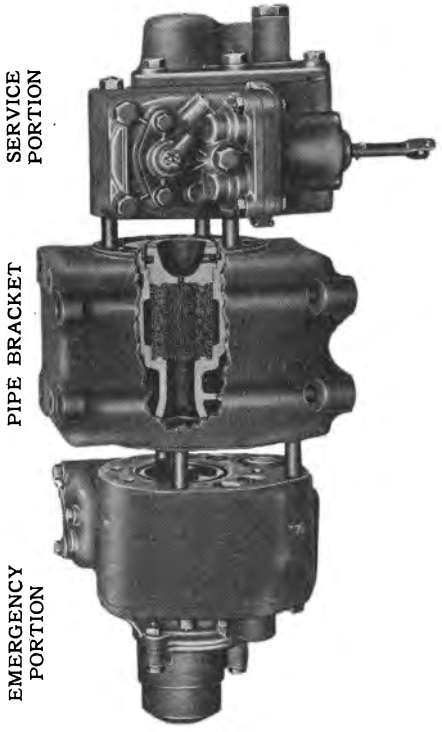


Fig. 3. View of "AB" Valve showing the Operating Portions, Pipe Bracket sectioned to show Strainer

Description of the Parts

The "AB" Valve

This valve consists of three portions as follows:

1—A Two Face Pipe Bracket to which are bolted the service and emergency portions. The bracket is bolted to the car underframing, all pipe connections being made permanently to the bracket by means of reinforced flanged unions so that no pipe joints need be disturbed when removing or replacing the operating portions of the "AB" valve. This bracket contains a removable hair strainer and the quick action chamber.

2—The Service Portion, which controls (either directly or through the medium of the emergency portion) the desired charging of the reservoirs and the service application and release of the brakes.

3—The Emergency Portion, which controls the quick action feature, controlled high brake cylinder pressure and the accelerated emergency release function.

The SERVICE PORTION contains the following parts:

(a) *The service piston 33*, which moves the service graduating and slide valves when the brake pipe pressure is varied.

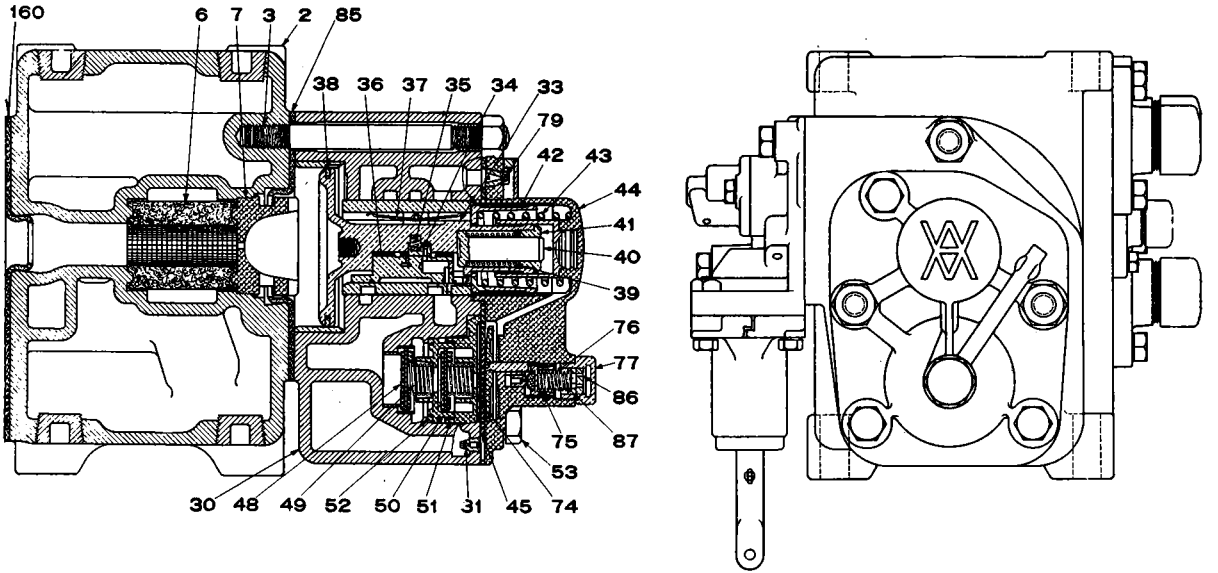


Fig. 4 Sectional and End Views of the Pipe Bracket and Service Portion

(b) *The service graduating valve 34*, which opens and closes the passages:

(1) Between the auxiliary and emergency reservoirs with the slide valve in release positions.

(2) From brake pipe to quick service volume with the slide valve in full release position.

(3) From auxiliary reservoir to brake cylinder with the slide valve in service position.

(c) *The service slide valve 36*, which opens and closes ports and passages:

(1) Between the auxiliary (service slide valve chamber) and emergency reservoirs past the graduating valve.

(2) From brake pipe to quick service volume through the graduating valve.

(3) From brake pipe through the limiting valve to brake cylinder.

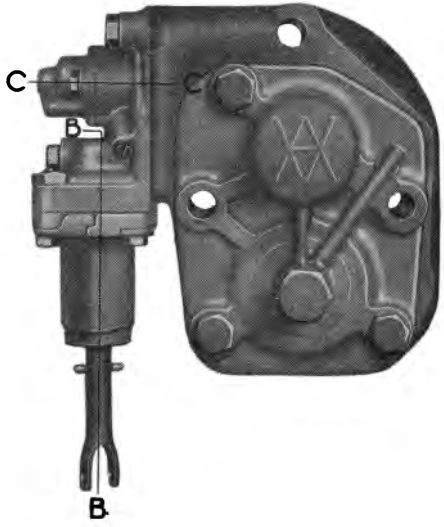
(4) From brake cylinder to pressure retaining valve (exhaust).

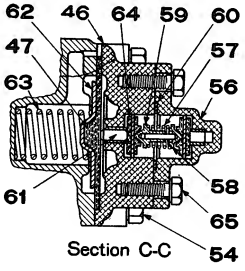
(5) From auxiliary reservoir past the graduating valve to brake cylinder.

(6) From auxiliary reservoir to inner area of release insuring valve.

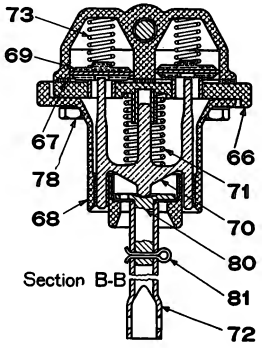
(7) From inner area of release insuring valve to pressure retaining valve (exhaust).

(d) *The service piston return spring 43, and cage 42*, which prevent movement of the service piston to retarded recharge position unless brake pipe pressure is about three pounds higher than auxiliary reservoir.





Quick Service Limiting Valve



Duplex Release Valve

Fig. 5. End View and Partial Sections of Service Portion

(e) *The stabilizing spring 39 and the spring guide 40*, which provide stability of quick service activity by preventing movement of the service piston to preliminary quick service position until a predetermined difference in pressure between the brake pipe and the auxiliary reservoir is attained.

(f) *The release insuring valve 75*, which insures return of the service piston to release position in case of excessive slide valve friction, by exhausting auxiliary reservoir pressure to atmosphere.

(g) *The limiting valve check* 64a *and diaphragm 47*, which terminates secondary quick service when a predetermined brake cylinder pressure is developed.

(h) *The back flow check 64*, which serves to prevent flow of brake cylinder pressure into the brake pipe, such as during emergency when brake cylinder pressure is higher than brake pipe.

(i) *The duplex release valve*, handle *72* of which controls the opening of auxiliary reservoir release valve 69 and emergency reservoir release valve 69a, permitting manual reduction or draining of auxiliary reservoir pressure alone or both reservoirs together.

(j) *The quick service volume*, into which brake pipe air flows to initiate preliminary quick service.

(k) *The preliminary quick service choke plug 31*, which restricts the continuous exhaust of quick service volume air to the atmosphere.

(l) *The secondary quick service choke plug 32*, which restricts the rate of air flow from brake pipe to brake cylinder during secondary quick service.

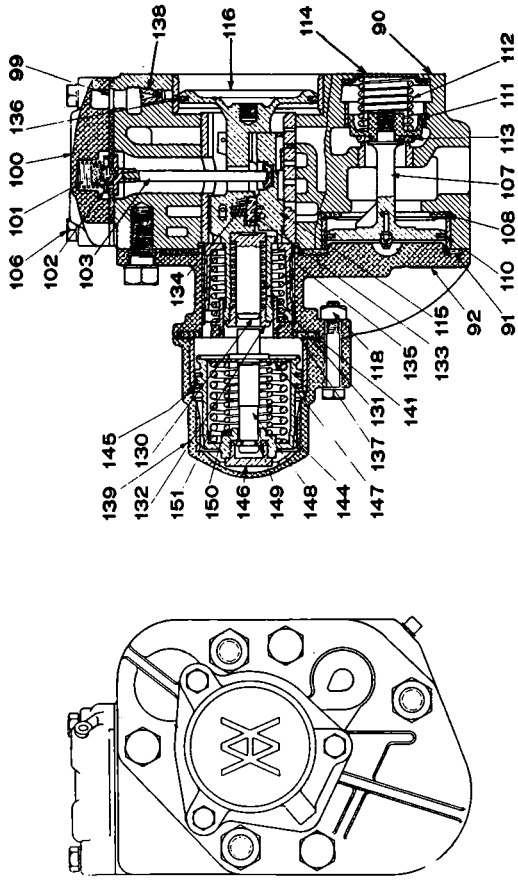


Fig. 6. End and Sectional Views of the Emergency Portion

(m) *The release insuring choke plug 79*, which serves to restrict the rate of auxiliary reservoir reduction at such time as the release insuring valve functions to reduce this pressure.

(n) *The release and application by-pass check valves 48a and 48*, which by-pass brake pipe air around the strainer in case of strainer restriction.

The EMERGENCY PORTION contains the following parts:

(a) *The emergency piston 116*, which moves the graduating valve 133 when a service rate of brake pipe reduction is made and also slide valve *115* when an emergency rate of reduction is created.

(b) *The emergency graduating valve 133*, which controls the flow of air:

(1) From quick action chamber to atmosphere during service applications.

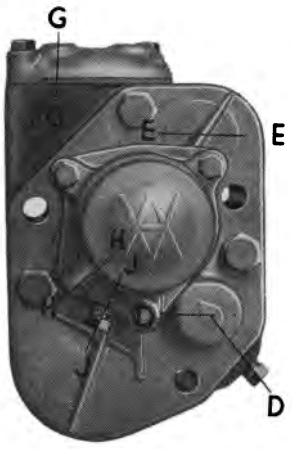
(2) From quick action chamber to the vent valve piston 107 during emergency applications.

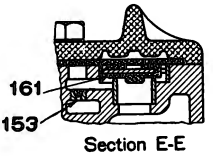
(c) *The emergency slide valve 115*, which controls the flow of air:

(1) From quick action chamber, through the graduating valve, to atmosphere during service applications.

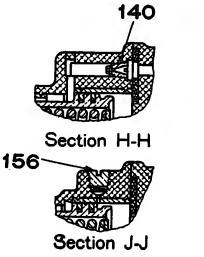
(2) From quick action chamber to vent valve piston 107 during emergency applications.

(3) From quick action chamber to the outer face of accelerated release piston *144* except during emergency applications.

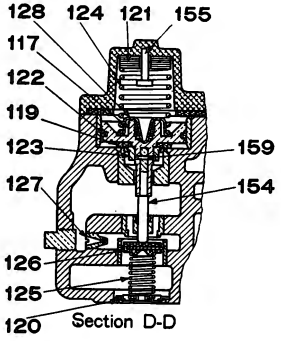




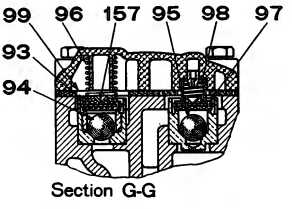
Timing Valve



Accelerated Release Cap



Inshot Piston and Valve



Accelerated Release and Spillover Check Valves

Fig. 7. End View and Partial Sections of the Emergency Portion

(4) From emergency reservoir to the outer face of accelerated release piston *144* during emergency applications.

(5) From emergency reservoir to the brake cylinder during emergency applications.

(6) From the brake cylinder, past check valves *93* and *94*, to the brake pipe during release after emergency.

(7) From the brake cylinder, through inshot piston volume to the outer face of inshot piston 117 except during emergency.

(d) *Piston 107 and vent valve 111*, which vent brake pipe air to atmosphere during an emergency application.

(e) *The emergency piston return spring 137, and cage 135*, which during release cycles return the emergency piston from accelerated release to normal release position when quick action chamber pressure recharges to approximately brake pipe pressure.

(f) *The emergency piston spring 131, and spring guide 130*, which stabilize the emergency portion against undesired emergency.

(g) *The accelerated release piston 144 with springs and stem 148*, which prevent return of the emergency piston to release until a predetermined brake pipe pressure has been restored.

(h) *The spillover check valve 97 and ball check 95*, which provide against overcharge of the quick action chamber.

(i) *The accelerated release check valve 93 and ball check 94*, which provide the initial build-up of brake pipe pressure (after emergency) from the combined volumes of the auxiliary reservoir and the brake cylinder when the slide valve moves to accelerated release position.

(j) *The diaphragm spring 101 and slide valve strut 103*, which serve to keep the slide valve seated in the absence of quick action chamber pressure.

(k) *The inshot piston 117 and the inshot valve 126*, which control the first stage of emergency brake cylinder pressure development.

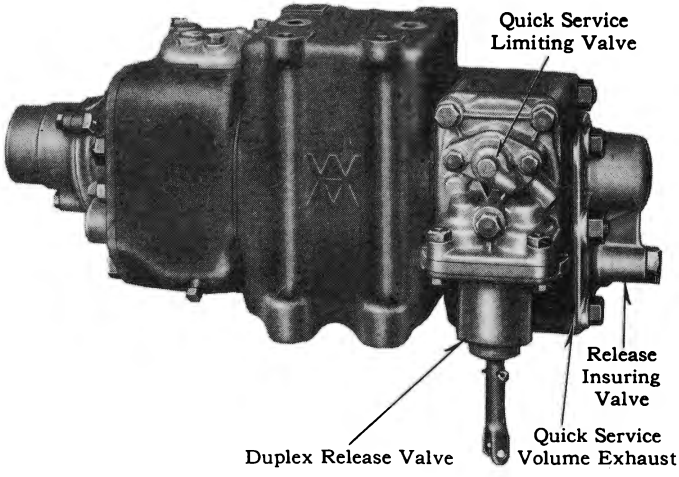


Fig. 8. Front View of the "AB" Valve showing Location of Service Portion Details

(l) *The delay choke plug 127*, which provides the delayed build-up of brake cylinder pressure during the second stage of emergency brake cylinder pressure development.

(m) *The timing valve 161*, which starts the final stage of emergency brake cylinder pressure development.

(n) *The timing choke plug 153*, which restricts the rate of flow to the brake cylinder through the additional port opened by the timing valve during the final stage of emergency brake cylinder pressure development.

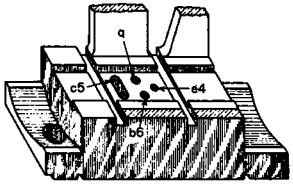
(o) *The inshot piston volume*, which serves to annul the controlled brake cylinder pressure development during a service brake application and modifies the controlled build-up when service precedes an emergency application.

(p) *The choke plug 140*, in the accelerated release cap which serves to prevent "slamming" of the accelerated release piston to its innermost position, (extreme left,) by restricting the flow of air displaced by this piston.

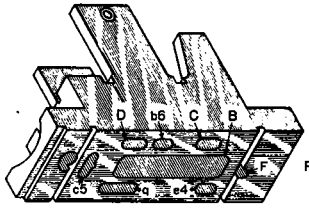
(q) *The charging choke plug 138*, which restricts the rate of flow from the brake pipe to the quick action chamber.

(r) *The choke plug 109*, in vent piston 107, which controls the rate of exhaust of quick action chamber air during emergency.

Graduating Valve

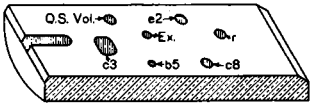


Plan of Slide Valve



Piston End

Face of Slide Valve



Slide Valve Seat

Fig. 9. Service Graduating Valve, Slide Valve and Seat

PORT CONNECTIONS

Service Slide Valve Seat

b5—To brake pipe passage *b2*.

c3—To brake cylinder through pipe bracket and emergency portion, also connects to limiting valve diaphragm passage *c4*.

c8—To back flow check through choke plug.

e2—To emergency reservoir release check valve, and through pipe bracket to emergency reservoir passage *e* and to emergency portion passage *e3*.

Ex.—Exhaust passage through pipe bracket to retaining valve.

Q.S.Vol.—To the quick service volume.

r—To release insuring valve through choke plug, and to passage *m*.

Service Slide Valve

B—Cavity in slide valve.

b6—Port through slide valve.

C—Cavity connection to cavity *D*.

c5—Service port through slide valve.

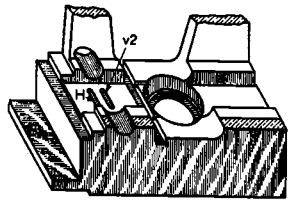
D—Cavity connecting to cavity *C*.

e4—Emergency Reservoir port through slide valve.

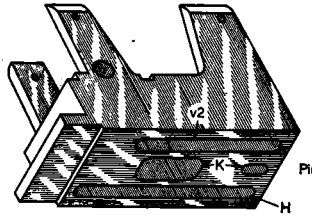
F—Cavity and port through slide valve.

q—Port through slide valve.

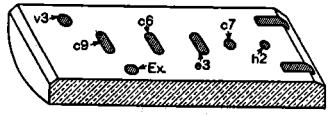
Graduating Valve



Plan of Slide Valve



Face of Slide Valve



Slide Valve Seat

Fig. 10. Emergency Graduating Valve, Slide Valve and Seat

PORT CONNECTIONS

Emergency Slide Valve Seat

c6—To timing valve, and passages *c2* and *c3* in the pipe bracket.

c7—To inshot piston volume.

c9—To accelerated release check valves.

e3—To emergency reservoir passage *e* in pipe bracket and service portion passage *e2*, and passage *e5* leading to spillover check valves and strut diaphragm.

Ex.—Quick action pressure exhaust.

h2—To accelerated release piston.

v3—To vent valve piston.

Emergency Slide Valve

H—Cavity in face of slide valve with port connection to top.

K—Two connected cavities in face of slide valve.

v2—Cavity in face of slide valve with port connection to top.

Fig. 11. Exterior View of the Improved Brake Cylinder

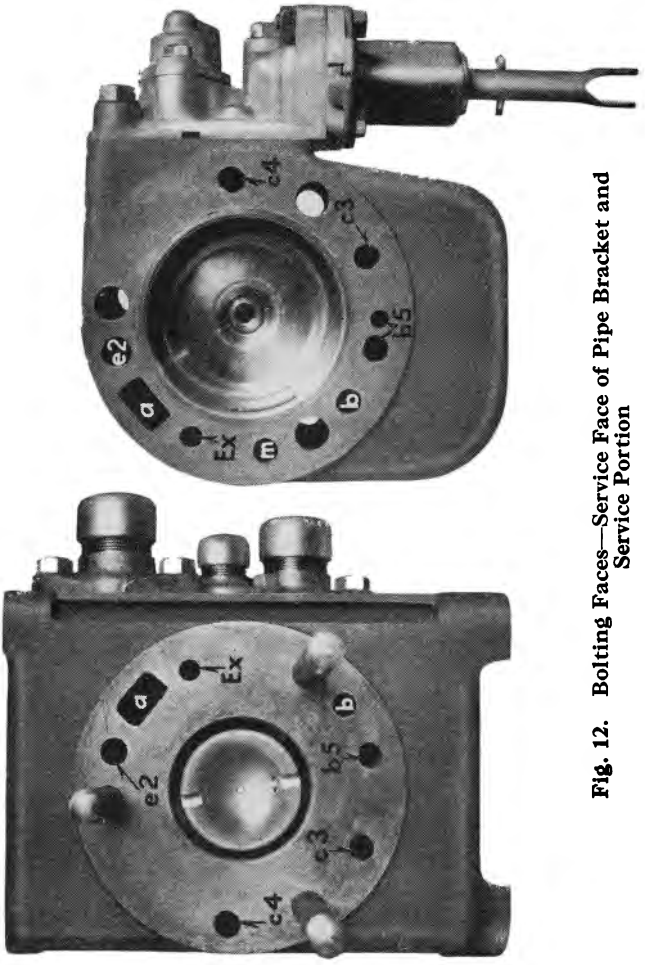


Fig. 12. Bolting Faces—Service Face of Pipe Bracket and Service Portion

BOLTING FACES—PORT IDENTIFICATION

Service Portion

a—To slide valve chamber and to auxiliary reservoir release check.

b—To inner side of strainer by-pass checks.

b5—To slide valve seat and outer side of by-pass checks.

c3—To slide valve seat.

c4—To limiting valve diaphragm.

e2—To slide valve seat and to emergency reservoir release check.

Ex.—To slide valve seat.

m—To slide valve seat.

Pipe Bracket—Service Face

a—To auxiliary reservoir.

b—To brake pipe and branch *b4*, also to strainer.

b5—To strainer chamber.

c3—To emergency face and branches *c2* and *c4*.

c4—To passage *c3*.

e2—To emergency reservoir and to emergency face.

Ex.—To retaining valve.

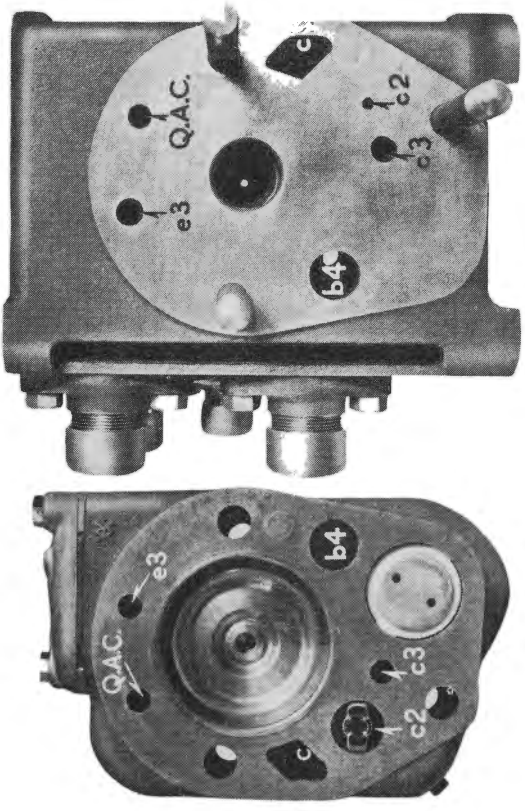


Fig. 13. Bolting Faces—Emergency Portion and Pipe Bracket Emergency Face

BOLTING FACES—PORT IDENTIFICATION

Emergency Portion

b4—To vent valve and to accelerated release check.

c—To chamber between inshot valve and piston, and to timing valve outer area.

c2—To the inshot valve.

c3—To slide valve seat and to timing valve inner area.

e3—To slide valve chamber and to chamber above spillover checks and strut diaphragm.

Q.A.C.—To slide valve chamber.

Pipe Bracket—Emergency Face

b4—To brake pipe passage *b*.

c—To brake cylinder.

c2—To passage *c3*.

c3—To service face and branch ports *c2* and *c4*.

e3—To emergency reservoir and service face.

Q.A.C.—To quick action chamber.

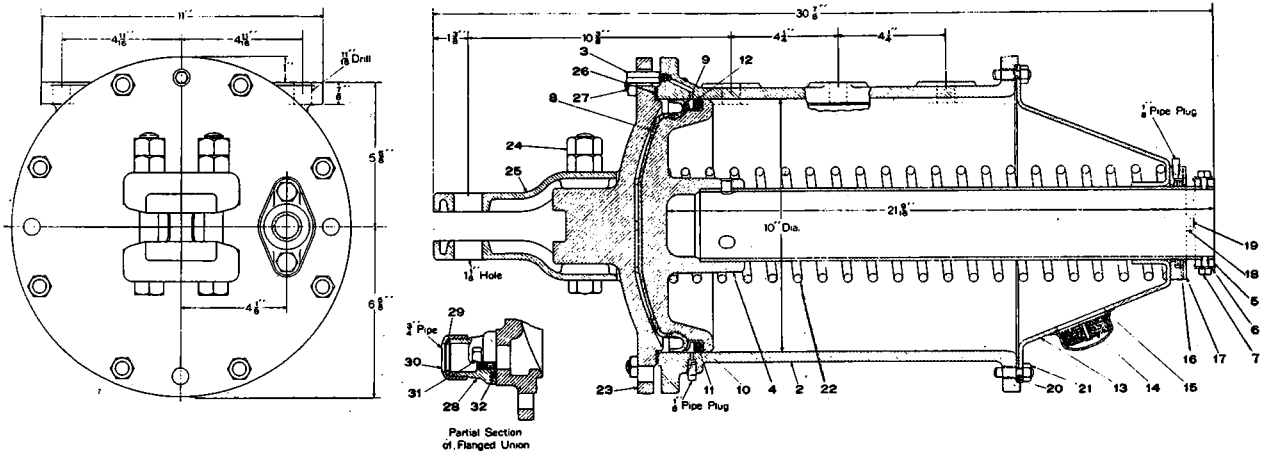


Fig. 14. Catalog Assembly View of the Brake Cylinder with Lever Brackets

Brake Cylinder

Fig. 14 illustrates a sectional view of the 10 x 12″ brake cylinder with lever brackets and arranged for pipe connection at the side of the lever bracket lug by means of a ¾″ reinforced flanged union. The brake cylinder is also supplied with a plain pressure head having the pipe connection in the center, see Fig. 15. The piston 4 has a hollow sleeve which provides for a loose push rod that is attached to the levers and rods of the foundation brake rigging; spring *22* is a release spring which returns the piston to release position when air is exhausted from the pressure end of the cylinder; the packing cup presses against the cylinder wall and prevents escape of air past the piston.

The brake cylinder is designed to prevent the entrance of dirt, and the construction is such as to permit the lubrication of moving parts without removal of the piston or opening of the cylinder.

To prevent the entrance of dirt, the piston rod is ground true as to diameter and surface, and the non-pressure head *13* is fitted with three metallic packing rings 16, which are designed to form a seal against atmospheric dirt at all times. A tapped opening in the non-pressure head provides a means of lubrication of the piston sleeve and rings.

Since atmospheric air must enter the non-pressure end of the cylinder during the release movement, the non-pressure head is fitted with a curled hair strainer *14*. This strainer is of the cartridge type held in place

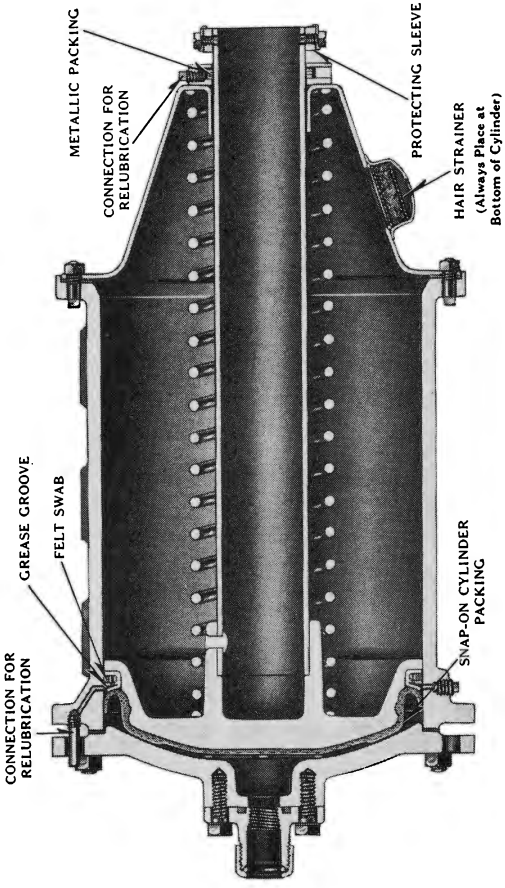


Fig. 15. Sectional View of the Improved Brake Cylinder

by a breather cover which prevents flying dirt and water contacting directly with the strainer.

Lubrication of the piston and cylinder is provided for by tapped openings which are normally plugged. These plugs are located at the pressure end (top and bottom), as shown by Fig. 15. These ports in the cylinder are so located as to deliver lubricant into a groove in the piston, which is formed behind the packing cup and in front of a felt swab.

The felt swab serves a double purpose; it prevents overflow from the groove to the non-pressure side of the piston when introducing the lubricant and, as it becomes saturated with lubricant, results in the cylinder surface being relubricated with each application and release movement of the piston.

A special WABCO "Snap-on" packing cup, formed to fit the piston (and not cut out in the center), lays flat against the face of the piston, no follower plate being required to hold the cup in place as with present standard brake cylinders. The circumference (or perimeter) of the piston is machined to form a shoulder over which the packing cup is fitted, and a groove back of this shoulder provides for a felt packing ring (or swab).

As already explained, the space back of the heel of the WABCO packing cup and in front of the felt packing ring (or swab) provides a groove around the piston which, when filled from the outside with lubricant, serves to spread the lubricant over the cylinder wall with each movement of the piston.

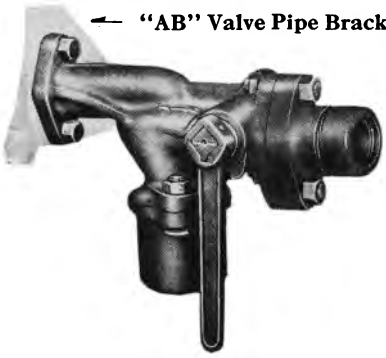


Fig. 16. Combined Dirt Collector and Cut-out Cock with Reinforced Flanged Union

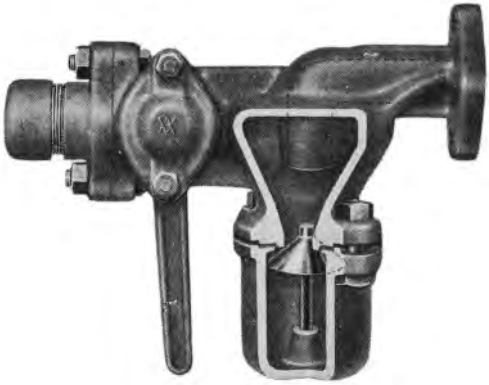


Fig. 17. View showing section through the Dirt Collector portion

Combined Dirt Collector and Cut-out Cock

This device is a combination of two of the branch pipe fittings—the centrifugal dirt collector which protects the "AB" valve against entrance of dirt, and the cut-out cock which opens (handle vertical) or closes (handle horizontal) communication between the "AB" valve and the brake pipe. Bolting flanges are provided for both pipe connections, the flange on the dirt collector end bolting direct to the "AB" valve pipe bracket while the flange on the cock end is provided with a reinforced flange union.

The dirt collector is the standard check valve type with the detachable dirt chamber. It is only necessary to remove two nuts to drop the dirt chamber for cleaning.

The purpose of the umbrella shaped 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, 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.

Two Compartment Reservoir

The auxiliary and emergency reservoirs are combined into one reservoir which is divided into two compartments, one of which serves as storage for auxiliary reservoir pressure and the other for emergency reservoir pressure. The volume of the auxiliary reservoir compartment is such that with the brake system charged to 70 pounds, a full service application will result in equalization of auxiliary reservoir and brake cylinder pressures

Fig. 18. Steel Two Compartment Reservoir

Fig. 19. Cast Metal Two Compartment Reservoir

at approximately 50 pounds. The emergency reservoir compartment is of such volume that with the equipment charged to 70 pounds, both reservoir volumes and brake cylinder will equalize at approximately 60 pounds during an emergency application.

Two types of reservoirs have been designed, one of welded steel construction and one of cast metal, either of which may be used with this equipment. Both reservoirs are fitted with reinforced flanged unions for $\frac{3}{4}''$ pipe connection to each compartment.

The welded steel reservoir, as illustrated by Fig. 18, is provided with mounting brackets at the top and the interior is treated for rust prevention by the NO-OX-ID process.

The cast metal reservoir, as illustrated by Fig. 19, is made up of three castings—a separation plate and two flanged chambers which are identical except that one is provided with a single supporting lug and the other with two. The position of the separation plate between the chambers when assembling determines which chamber is the auxiliary reservoir volume and which is emergency reservoir volume as indicated by letters cast on a lug projecting from the separation plate between the two pipe connections. The letters "AUX" on one side of the lug indicate that the compartment on that side is auxiliary reservoir volume, and letters "EMERG" on the other side of the lug indicate that the emergency reservoir volume is on that side.

Fig. 20. Branch Pipe Tee

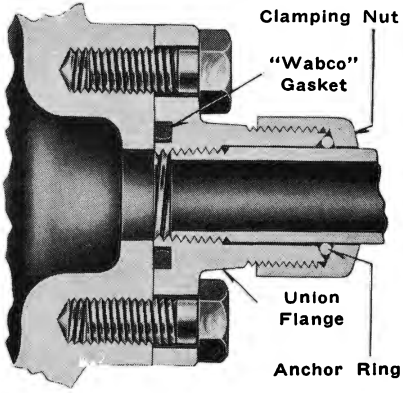


Fig. 21. Flanged Union Connection as used on "AB" Valve, Brake Cylinder, Reservoir, Dirt Collector and Branch Pipe Tee

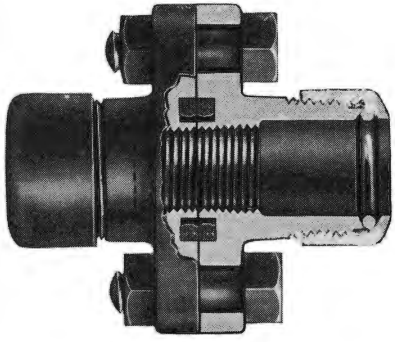


Fig. 22. Flanged Pipe Union

Branch Pipe Tee

The branch pipe tee is a fitting used to connect the branch pipe to the brake pipe and its purpose is to prevent excessive moisture that may be deposited in the brake pipe, from any cause, passing into the branch pipe and thence into the "AB" valve. While the centrifugal dirt collector effectively collects dirt and moisture from the branch pipe, the use of the branch pipe tee will materially assist in preventing excessive deposit of moisture in this pipe sometimes occasioned in charging and testing trains from poorly designed yard plants, or because the locomotive has insufficient reservoir capacity or cooling pipe to insure precipitation of the water before passing to the brake system.

The interior is such that the passage leading to the branch pipe comes out of the top of the brake pipe, air from this pipe flowing upward into the branch pipe while the moisture and heavy particles of dirt pass on through the brake pipe. Pipe connections are made by means of reinforced flanged unions and a supporting lug is provided for bolting to the car underframing.

Reinforced Flanged Union Fittings

Tightening the clamping nut will cause the anchor ring to close in and grip the pipe firmly so that all bending strains are removed from its weakest point and concentrated at its strongest point.

The gasket is under an initial strain, but it is not subject to any subsequent movement because the union flange is drawn up solid, metal to metal.

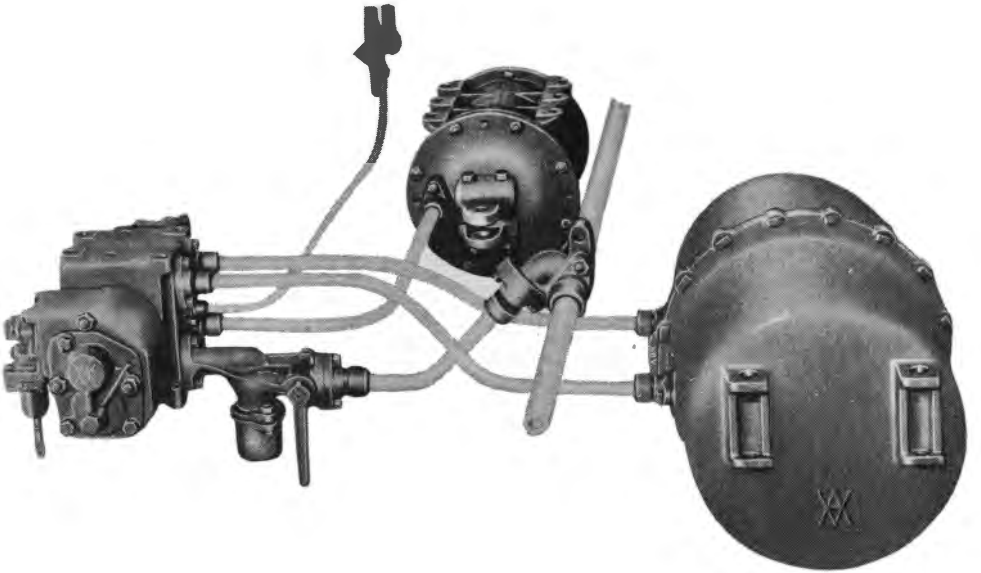


Fig. 28. Assembly View of the "AB" Equipment with Cast Metal Reservoir

OPERATION OF THE EQUIPMENT

As it is impossible to show all the ports and connecting passageways by any single section taken through the "AB" valves, Plates 1 to 10 inclusive have been made to show in a purely diagrammatic way the relation of the various parts to each other, for the different operating positions. The actual proportions and mechanical construction of the parts have been disregarded where necessary in order to make the connections and operation more easily understood.

Full Release and Charging Position

Plate 1

Brake pipe air passes through the combined branch pipe cut-out cock and dirt collector into passage *b* and thence through curled hair strainer *6* to the faces of service piston *33* and emergency piston *116*. Passage *b* also continues around the strainer to the space between by-pass check valves *48* and *48a*. The purpose of these check valves is to insure the application and release of the brake in the event that the hair strainer *6* becomes clogged with dirt due to improper maintenance. Check *48a* will open to allow brake pipe air to flow to the face of the service piston when releasing, and check valve *48* will open to allow brake pipe air to flow from the face of the service piston when applying the brake, upon the development of approximately two pounds differential (difference in pressure) across the strainer.

Brake pipe air on the face of service piston *33* passes through two feed grooves to the slide valve side of the piston and through passage *a* and pipe to the auxiliary reservoir. In this position of the service piston both feed grooves are fully open, permitting maximum charging flow to the auxiliary reservoir.

The emergency reservoir is charged with air flowing from the auxiliary reservoir by way of the service slide valve chamber, through restricted port *e4* in the slide valve at the left end of the graduating valve, to passages *e2* and *e* thence through pipe to the emergency reservoir.

Brake pipe air on the face of emergency piston *116* flows through the charging choke *138* to the slide valve side of the piston and to the quick action chamber.

Emergency reservoir air is connected to the underside of the emergency slide valve *115* by passages *e* and *e3*. In order to prevent the slide valve *115* being unseated when the quick action chamber is not charged, the slide valve is balanced by spring *101* and diaphragm loaded strut *103*. Emergency reservoir air is connected to the upper side of diaphragm *99* through passage *e5* and port *e6*, and exerts pressure in a downward direction to keep the slide valve seated when there is no air pressure above the slide valve. When the quick action chamber is charged, the pressure in the emergency slide valve chamber holds the slide valve to its seat and the pressure on both sides of the strut diaphragm *99* is the same; consequently the stem is balanced, removing downward strut pressure except that of the light spring *101* which does not increase slide valve friction materially.

A branch *b4* from brake pipe passage *b* leads to the right of quick action vent valve *111*.

The brake cylinder is connected to atmosphere through passage *c*, past inshot valve *126*, passages *c2* and *c3*, cavity *B* in the service slide valve and passage *Ex*. to the retainer.

The inshot piston volume is connected through port *c7* to cavity *K* in the emergency slide valve, thence through port *c6* and passage *c3* to the service slide valve cavity *B*, which is open to the retainer through exhaust passage *Ex*., as above explained.

Emergency reservoir air is connected through passages *e*, *e3* and *e5* to the spring chamber above the spillover check valves, ball check *95* and rubber seated valve *97*. The underside of ball check *95* is connected by a choked passage to the emergency slide valve chamber and quick action chamber.

In the event of the quick action chamber becoming overcharged, as might occur on the head end of a long train by reason of improper use of release position of the automatic brake valve, when quick action chamber pressure becomes a small amount higher than emergency reservoir pressure, as determined by the check valve spring *98*, ball check *95* and the spring loaded check valve *97* will be unseated, permitting the overcharge in the quick action chamber to flow to the emergency reservoir and thus prevent emergency application through undesired operation of the emergency portion. The use of the spring loaded check valve *97* and ball check *95* provides double protection against the quick action chamber charging from the emergency reservoir.

Quick action chamber air is connected through port *h* in the emergency slide valve to passage *h2* leading to the left of accelerated release piston *144*. The right of the accelerated release piston is also exposed to quick action chamber pressure and, therefore, the piston is in a balanced condition and remains in this position to the extreme left, out of contact with the emergency piston except when an emergency application has been made as described under "Emergency."

Uniform Release

Front End Retarded Recharge

Plate 2

When during release the brake pipe pressure is more than approximately three pounds higher than auxiliary reservoir pressure, the return spring *43* at the end of the service piston stem is compressed and the service piston *33*, slide valve *36* and its graduating valve *34* are moved to their extreme right hand position, as shown.

This piston movement closes one of the feed grooves in the piston bush, thus reducing the rate of air flow from brake pipe to auxiliary reservoir by restricting it to one feed groove (the upper groove on Plate 2). As only front end brakes assume retarded recharge position, brake pipe air flow to auxiliary reservoirs is restricted on the front end of the train while brake pipe and auxiliary reservoir pressures are built up on the rear portion of the train at an increased rate, thus providing a sufficiently uniform recharge.

The brake cylinder is connected to exhaust in this position as described under "Full Release Position," the rate of brake cylinder release being the same in both positions.

The slide valve *36* blanks the quick service port *b5*, cutting off flow to the graduating valve to prevent the latter being unseated during initial charging of the equipment.

On head end cars the emergency piston *116* and slide valve *115* may assume "Accelerated Release" position by reason of brake pipe pressure being enough higher than quick action chamber pressure to compress return spring *137*, but this will have no effect as brake pipe pressure will be higher than brake cylinder pressure except when an emergency application has been made as covered under "Release after Emergency Application."

Preliminary Quick Service Position

Plate 3

When a service brake pipe reduction is started, the service piston *33* first moves to the left far enough for the spring guide *40* at the end of the piston stem to engage the slide valve when spring *39* is slightly compressed and the piston closes the feed grooves.

The piston spring *39* and guide *40* stabilize the preliminary quick service so that a predetermined differential of auxiliary reservoir and brake pipe pressures is required to move the service piston and graduating valve to preliminary quick service position. Undesired quick

service activity which might otherwise occur, due to moderate fluctuations of brake pipe pressure, is thereby prevented.

As the brake pipe pressure reduction continues, enough differential is created to compress the piston spring *39* and move the piston and graduating valve until cavity *G* in the graduating valve connects slide valve ports *b6* and *q*. Since seat port *b5* containing brake pipe air now registers with slide valve port *b6*, and a port in the seat leading to the quick service volume registers with slide valve port *q* (quick service port), communication is established between the brake pipe and the quick service volume resulting in a local reduction of brake pipe pressure.

This preliminary local reduction of brake pipe pressure, controlled by the graduating valve, results in rapid quick service action throughout the train.

The quick service volume is permanently connected to atmosphere through choke *31* and by this means local brake pipe reduction is continued until the slide valve moves. After the quick service volume has been cut off by the movement of the slide valve, remaining air pressure in this volume is exhausted through choke *31*.

During preliminary quick service, the emergency piston *116* and graduating valve assume service position as described under "Service Position."

Service Position

Plate 4

When the slide valve *36* is in service position, brake pipe air flows at a restricted rate through the limiting valve to the brake cylinder until a moderate pressure of predetermined amount is developed.

Brake pipe air in passage *b5* flows through port *C* and cavity *D* in the service slide valve thence through passage *c8* and choke *32*, lifts back flow check *64* and flows past limiting valve check *64a* to the underside of the limiting diaphragm *47* to passages *c4*, *c3*, *c2*, past unseated inshot valve *126*, to passage *c* and to the brake cylinder.

At the same time auxiliary reservoir air in the service slide valve chamber is flowing past the right end of the graduating valve, through slide valve service port *c5* to passage *c3* in the seat. In the emergency portion, branch *c6* leads through cavity *K* in the emergency slide valve to passage *c7* to the inshot piston volume and to the left of inshot piston *117*. Therefore, brake cylinder pressure is acting on both sides of inshot piston *117* and as the spring *124* on the left of this piston is stronger than the spring *125* on the right of inshot valve *126*, the piston and valve are held in open position and allow a direct build-up of brake cylinder pressure.

As pressure is built up in the brake cylinder, it also increases under quick service limiting diaphragm *47*. When the pressure reaches approximately nine pounds, the diaphragm is deflected upward against the force of spring *63*, allowing spring *57* under limiting valve check *64a* to move this check valve up to closed position as

shown by separate view entitled Limiting Valve, Second Stage Service. This cuts off the flow of brake pipe air to the brake cylinder, and ends all quick service activity.

When cycling on descending grades and the brake is reapplied with the retainer in holding position, the first stage only of quick service is obtained, as covered under "Preliminary Quick Service." The additional quick service, brake pipe air flow to brake cylinder, always obtained with an initial brake application, is cut off by the quick service limiting valve when ten pounds or more brake cylinder pressure is retained.

When a service rate reduction of brake pipe pressure causes the pressure on the face of emergency piston *116* to become slightly lower than quick action chamber pressure on the slide valve side of the piston, the piston and graduating valve move to the right until the emergency piston spring guide *130* strikes the left end of the emergency slide valve. In this position the piston closes the charging choke *138*, and the vent port *v* through the graduating valve registers with port *v2* in the slide valve. Port *v2* is connected to the exhaust port in the slide valve seat, thereby reducing quick action chamber pressure, back of the piston, at the same rate as brake pipe pressure is being reduced on the face of the piston. This action keeps quick action chamber pressure from attaining a differential over brake pipe pressure sufficient to compress the emergency piston spring *131* enough to cause the graduating valve to uncover port *H*, which would cause emergency application.

By this means the valve is stabilized against undesired emergency, and emergency application is made available at any time, as described under "Emergency."

Service Lap Position
Plate 5

When the desired amount of brake pipe reduction has been made and auxiliary reservoir pressure is reduced slightly below brake pipe pressure, the service piston *33* and its graduating valve move to the right until the piston stem engages the slide valve, in which position the graduating valve blanks service port *c5* in the slide valve and cuts off further flow of auxiliary reservoir air to the brake cylinder.

The emergency piston *116* and graduating valve return to charging position, blanking port *v2* in the slide valve and thereby preventing further flow of quick action chamber pressure to the exhaust port.

Release and Recharge After Service Application

During a service brake application, the emergency reservoir remains at the pressure charged previous to the brake application. When the service slide valve returns to release position, Plate 1, release of brake cylinder pressure and recharge of the brake system is accomplished as described under "Full Release and Charging Position" except that now pressure from the emergency reservoir flows through passages *e* and *e2* and restricted port *e4* through the slide valve to the service slide valve chamber and auxiliary reservoir.

This provides the quick recharge feature and also more positive and prompt release of all brakes by recharging the auxiliary reservoirs from emergency reservoirs during initial release, and permitting a quicker build-up of brake pipe pressure throughout the train than possible if all recharge were from the brake pipe.

Emergency Position

First Stage—Plate 6

When an emergency rate brake pipe reduction takes place from any cause, quick action chamber pressure cannot reduce through the vent port *v* in the graduating valve *133* and port *v2* in the emergency slide valve to atmosphere at the same rate; therefore, sufficient differential is built up across the emergency piston to compress spring *131* and allow the graduating valve *133* to move far enough on the slide valve to uncover port *H* in the slide valve which registers with port *v3* in the seat, allowing quick action chamber air to flow to the left of vent valve piston *107*. The resulting movement of this piston unseats the vent valve *111*, opening a large and direct passage from brake pipe passage *b4* to atmosphere. The rapid venting of brake pipe air causes an emergency reduction rate of brake pipe pressure to pass serially and rapidly through the train due to the same operation of connected valves, and insures the prompt movement of valves on other cars to emergency position.

The rapid reduction of brake pipe pressure causes the emergency piston and slide valve to move to the extreme

right position which carries slide valve port *H* out of register with seat port *v3*, but this port is now uncovered by the slide valve so that quick action chamber pressure remains connected to the vent valve piston.

The emergency slide valve now connects emergency reservoir air from passage *e3* through the slide valve cavity *K* to passage *c6* whence it flows through passages *c3* and *c2*. Meanwhile, the emergency rate of reduction in brake pipe pressure has caused the service piston and slide valve to move to the extreme left position where the graduating valve uncovers the service port *c5* through which auxiliary reservoir air flows through passage *c3* to passage *c2*, combining with the flow from emergency reservoir. The combined air pressures now flow past the unseated inshot valve *126* to passage *c* and to the brake cylinder.

The emergency slide valve has blanked port *c7* leading to the inshot piston volume and the spring side of inshot piston *117*. The inshot piston spring *124* holds the inshot valve *126* open to allow air to flow at an unrestricted rate to the brake cylinder until approximately *15* pounds brake cylinder pressure is developed, when the force of the inshot piston spring *124* is overcome and the piston moves to the left, allowing spring *125* to close the inshot valve *126*.

Emergency Position

Second Stage—Delayed Build-Up

Plate 7

With the inshot valve *126* now closed, brake cylinder pressure build-up continues at a slower rate through the delay choke *127*.

The duration of this delayed build-up of brake cylinder pressure is continued until the timing valve *161* is unseated by the increasing brake cylinder pressure, which begins the third or final stage in the development of emergency brake cylinder pressure.

Emergency Position

Third Stage—Final Build-Up

Plate 8

Quick action chamber pressure is on the left of timing valve *161* while brake cylinder pressure is connected to the right of this valve. Brake cylinder pressure is increasing while quick action chamber pressure is being reduced through the vent valve piston choke *109* to atmosphere. When quick action chamber pressure has reduced to a certain relation to brake cylinder pressure, timing valve *161* will be unseated and air can flow to the brake cylinder through choke *153* in addition to choke *127*, producing a faster rate of final brake cylinder build-up.

This three stage operation just described provides an initial inshot of pressure from the combined emergency and auxiliary reservoirs to the brake cylinder of limited amount but at an unrestricted rate, followed by a delayed build-up and finally a fast rate to equalization.

This controlled brake cylinder pressure development is modified when a partial service brake application precedes an emergency application and is completely annulled when the service brake application has developed thirty pounds brake cylinder pressure (or more)

before the emergency application is made. The amount of inshot pressure and delay time before final build-up is dependent upon the amount of brake cylinder pressure in the inshot piston volume and on the left of inshot piston *117* at the time emergency takes place.

As both the emergency reservoir and the auxiliary reservoir equalize into the brake cylinder during emergency, a higher brake cylinder pressure is obtained than is possible from a full service application.

Movement of the emergency slide valve to emergency position blanks port *h* at the slide valve seat thereby cutting off the chamber at the left of accelerated release piston *144* from quick action chamber pressure. Cavity *K* in the slide valve now establishes connection between passages *h2* and *e3*, and emergency reservoir air, which is also brake cylinder air at this time, flows to the back of the accelerated release piston *144*. Quick action chamber pressure on the right of the accelerated release piston is gradually depleted to zero (by way of the choke *109* in the vent valve piston *107*) following an emergency application and, therefore, emergency reservoir pressure on the left of the accelerated release piston moves it to the right.

While quick action chamber air is reducing through the choke in vent valve piston *107*, the rate of exhaust is such that the vent valve will remain open a definite time (about 60 to 70 seconds) until the pressure is reduced to a certain value when spring *112* will reseat the vent valve. The purpose of this is threefold—first to insure transmission of quick action, second to prevent release of an emergency brake application before the

train is at rest (in order to avoid possible damage to the train), and third to insure closure of the exhaust so that the brake pipe pressure can be restored when desired.

Release After Emergency Application

Plate 9

When brake pipe pressure on the face of the emergency piston is restored after emergency application, the piston is prevented from returning to release as the accelerated release piston *144* was moved to the right during the preceding emergency application. The emergency piston spring guide *130* now comes in contact with the stem *148* of the accelerated release piston, thereby arresting further movement of the emergency piston until approximately 20 pounds brake pipe pressure has been built up on the face of the emergency piston. At this pressure springs *150* and *151* are compressed and the emergency piston and slide valve start to move toward release position. Movement of the slide valve first cuts off the connection between passages *e3* and *h2*. (See Plate 8) and then establishes connection between passage *h2* and port *h* in the slide valve (see Plate 9). Quick action chamber pressure is now acting on both faces of the accelerated release piston, putting the latter in balance. The twenty pound release differential previously established causes the emergency piston to move positively to the extreme left (Accelerated Release Position) compressing emergency piston return spring *137* and returning the accelerated release piston *144* to its left hand position.

Accelerated Emergency Release

Plate 10

The emergency piston is now in Accelerated Release position, the slide valve blanking emergency reservoir port *e3* in the seat, which bottles up this volume and provides that no further change (after emergency application) takes place in emergency reservoir pressure until the service slide valve moves to release and connects it to the auxiliary reservoir. The brake cylinder is now connected to the under side of ball check *94* and rubber seated check *93* through passage *c*, past inshot valve *126*, through passages *c2*, *c3* and *c6*, cavity *K* in the emergency slide valve and seat passage *c9* leading to these check valves. Since the brake cylinder and the auxiliary reservoir are connected, through port *c5* in the service slide valve (which is still in service position), the pressure of these combined volumes under check valves *94* and *93* is greater than brake pipe pressure above from passage *b4*. Both check valves are therefore unseated and brake cylinder and auxiliary reservoir air is permitted to flow through passage *b4* into the brake pipe until these pressures are within about ten pounds of equalization, thus providing a quick, serial initial build-up of brake pipe pressure.

See Plate 6

Since auxiliary reservoir pressure is being partially reduced while the brake pipe pressure is being initially built up throughout the train, the development of that brake pipe pressure needed to release the brakes is accomplished much sooner than it would be by raising brake pipe pressure through the brake valve alone and,

therefore, a very prompt and positive release of the brake is accomplished.

The quick action chamber is being charged through the charging choke *138*. Return spring *137* will move the emergency piston and slide valve from Accelerated Release to charging position as soon as the pressures on both sides of the emergency piston become substantially equal. This slide valve movement blanks port *c9* in the seat thereby preventing further flow of brake cylinder air past the accelerated release check valves to the brake pipe.

When brake pipe pressure becomes slightly in excess of auxiliary reservoir pressure the service piston and slide valve are moved to either retarded recharge or full recharge position and the brake will be released and reservoirs recharged as previously described under "Release and Recharge After Service Application."

Release Insuring

A release insuring feature functions to accomplish the release of each brake if excessive friction of operating parts prevents normal release.

Referring to Plate 4, when brake pipe pressure on the left of release insuring diaphragm *45* exceeds by approximately one and one-half pounds the pressure in the auxiliary reservoir on the right of the diaphragm, the latter will be deflected to the right and unseat release insuring valve *75*, which will allow auxiliary reservoir air to flow through passage *r* and choke *79* to cavity *B* in the service slide valve and through the exhaust

passage *Ex.* to the retainer. This will reduce auxiliary reservoir pressure until enough differential is created across the service piston to move it and the slide valve to release and charging position. As the service piston moves back toward release position, passage *r* is disconnected from the exhaust passage and when release position is reached (see Plate 2), passage *r* is connected with auxiliary reservoir pressure through port *F* in the slide valve, therefore, further reduction of auxiliary reservoir pressure by means of the release insuring valve is prevented.

Duplex Release Valve

Plate 1

A duplex release valve is attached to the service portion by means of which the auxiliary reservoir air may be drained alone or both auxiliary and emergency reservoir air may be drained at the same time.

The release valve handle *72* may be moved in any direction to open the release checks. The plunger *70* has two stems which are lifted to unseat the release checks *69* and *69a* when the handle *72* is moved. There is less clearance between auxiliary release check *69* and its plunger stem than between emergency reservoir release check *69a* and its stem. Therefore, if handle *72* is moved part way the auxiliary reservoir release check *69* is lifted from its seat and the reservoir is drained without opening the emergency reservoir release check *69a*. If handle *72* is moved its full travel both release checks are unseated and both reservoirs drained.

General

Accelerated Release check valves *93* and *94* in the emergency portion prevent brake pipe air flowing to the brake cylinder if for any reason the emergency slide valve is forced to Accelerated Release position when brake cylinder pressure is lower than brake pipe pressure. In normal charging position of the emergency piston, port *c9* in the seat (leading to the check valves) is blanked by the slide valve.

Back Flow Check *64* in the quick service limiting valve of the service portion prevents air flowing from the brake cylinder when brake pipe pressure is less than brake cylinder pressure, as during an over reduction or an emergency brake application.

The port *m* in the service portion body is for the purpose of providing auxiliary reservoir air to the transfer valve which is used with the 4-12 brake equipment.

General Hints

In releasing an individual brake by means of the duplex release valve on the service portion of the "AB" valve, the brake pipe being charged, pull the handle only far enough to open the auxiliary reservoir check but not far enough to open the emergency reservoir check, and then permit auxiliary reservoir pressure to drain only until the brake cylinder exhaust is heard to start.

When there is no air in the brake pipe, drain both auxiliary and emergency reservoirs by pulling the duplex release valve handle its full travel and holding both check valves open until all pressure is drained.

When it is found necessary to cut out a brake, close the branch pipe cut-out cock and drain both auxiliary and emergency reservoirs by pulling the duplex release valve handle its full travel and holding until the pressure is exhausted.

Because of the use of an emergency reservoir with the "AB" equipment in addition to the auxiliary reservoir, approximately twice as long is required to charge the brake system as compared with the "K" equipment. This should be considered when "picking up" a car on the road having "AB" equipment as the brake may fail to apply during the road test of brakes unless sufficient time is allowed for charging.

After an emergency brake application, the vent valve remains open a definite period and there is a slight exhaust at the main exhaust port of the emergency portion for at least one minute. The brake should not be

considered defective due to a leak at this exhaust port unless the blow continues longer than two minutes.

ILLUSTRATIONS

List of Diagrammatic Views shown on Folders

Plate 1—Full Release and Charging Position

Plate 2—Retarded Recharge Position

Plate 3—Preliminary Quick Service Position

Plate 4—Service Position

Plate 5—Service Lap Position

Plate 6—Emergency Position—First Stage

Plate 7—Emergency Position—Second Stage (Delayed Build-up)

Plate 8—Emergency Position—Third Stage (Final Build-up)

Plate 9—Release after Emergency Application

Plate 10—Accelerated Emergency Release

Plate 11—Piping Diagram of the "AB" Equipment

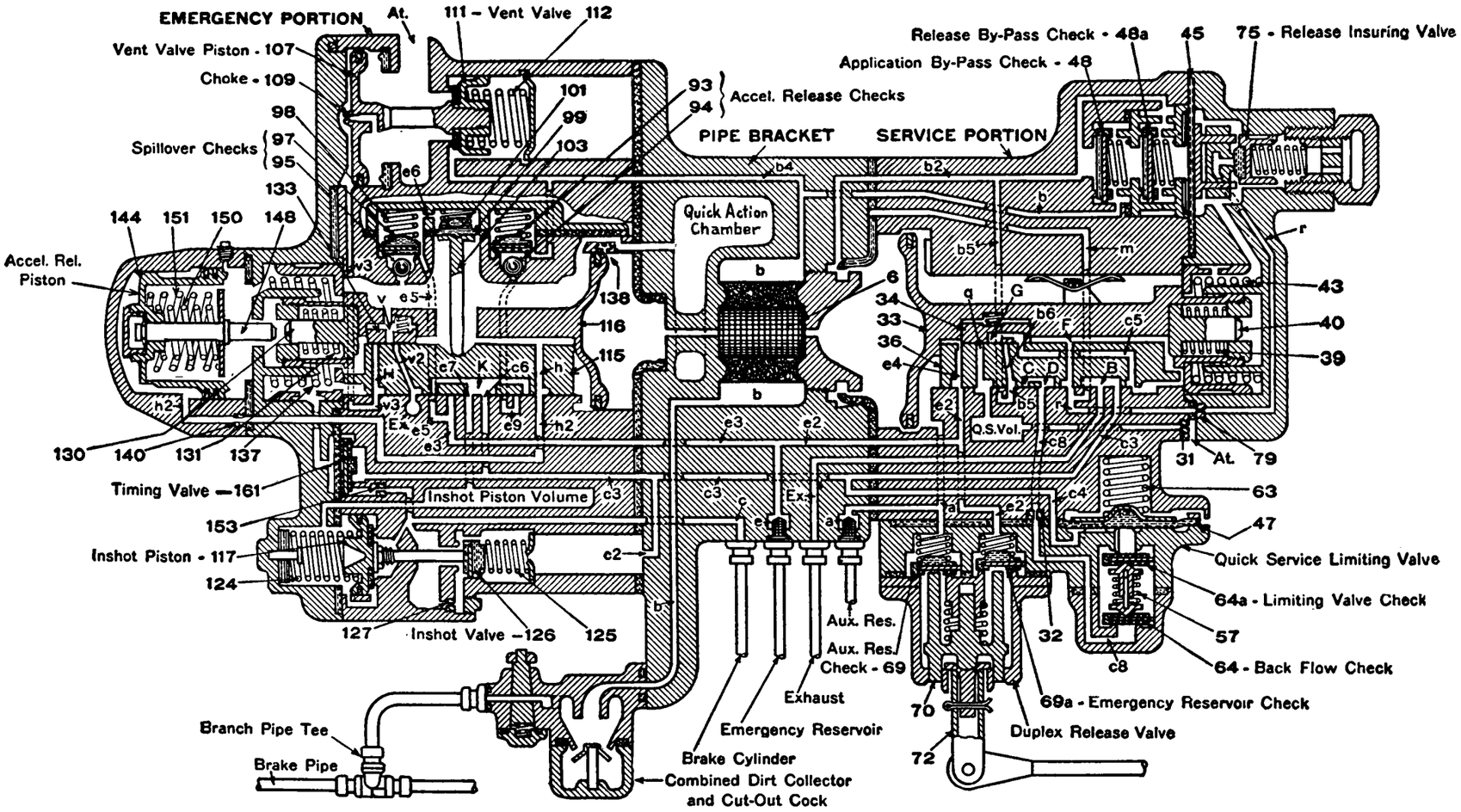


Plate 1 Full Release and Charging Position—"AB" Valve—Diagrammatic

Plate 1 Full Release and Charging Position—"AB" Valve—Diagrammatic

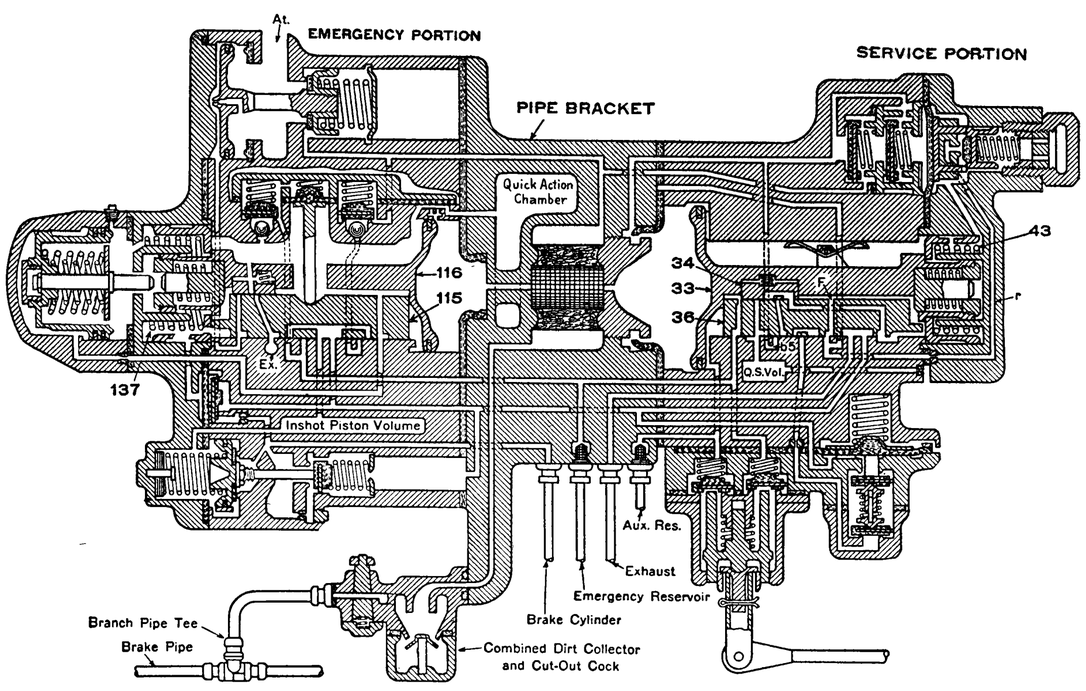


Plate 2 Retarded Recharge Position—"AB" Valve—Diagrammatic

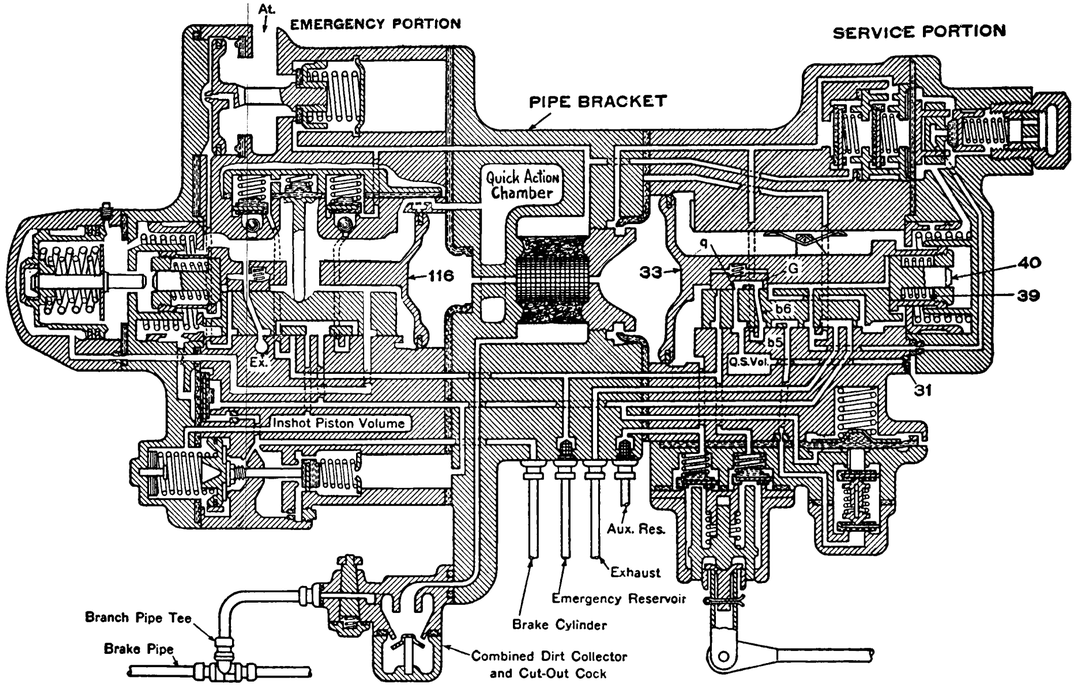


Plate 3 Preliminary Quick Service Position—"AB" Valve—Diagrammatic

Plate 2 Retarded Recharge Position—"AB" Valve—Diagrammatic

Plate 3 Preliminary Quick Service Position—"AB" Valve—Diagrammatic

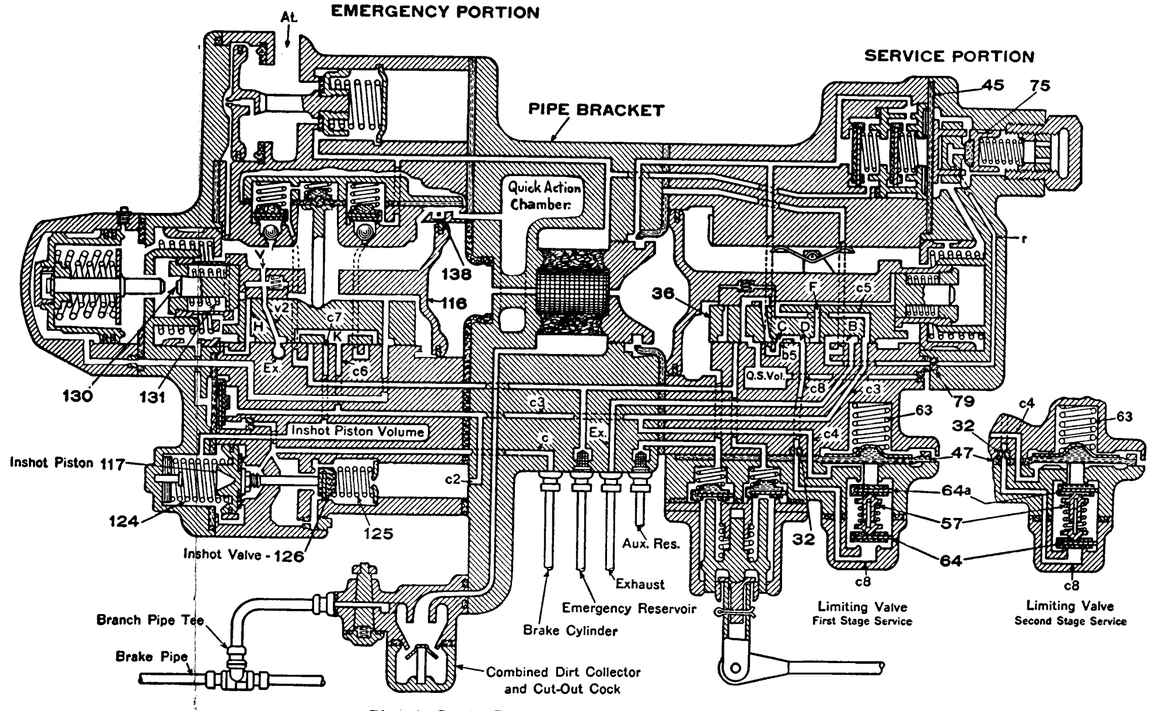


Plate 4 Service Position—"AB" Valve—Diagrammatic

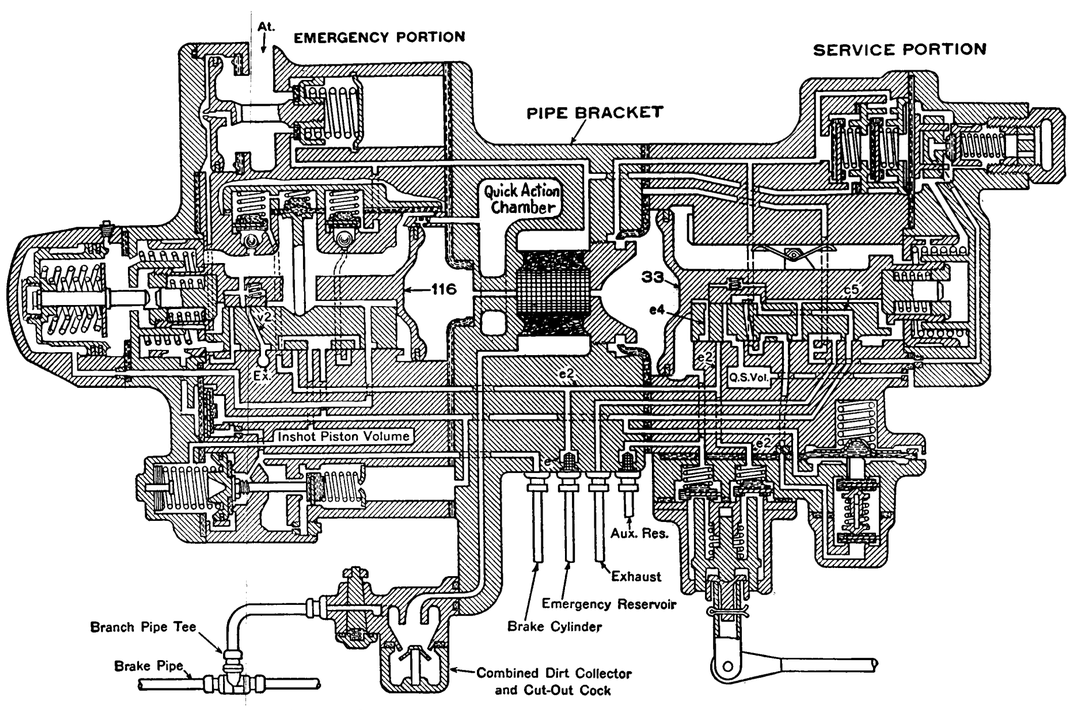


Plate 5 Service Lap Position—"AB" Valve—Diagrammatic

Plate 4 Service Position—"AB" Valve—Diagrammatic

Plate 5 Service Lap Position—"AB" Valve—Diagrammatic

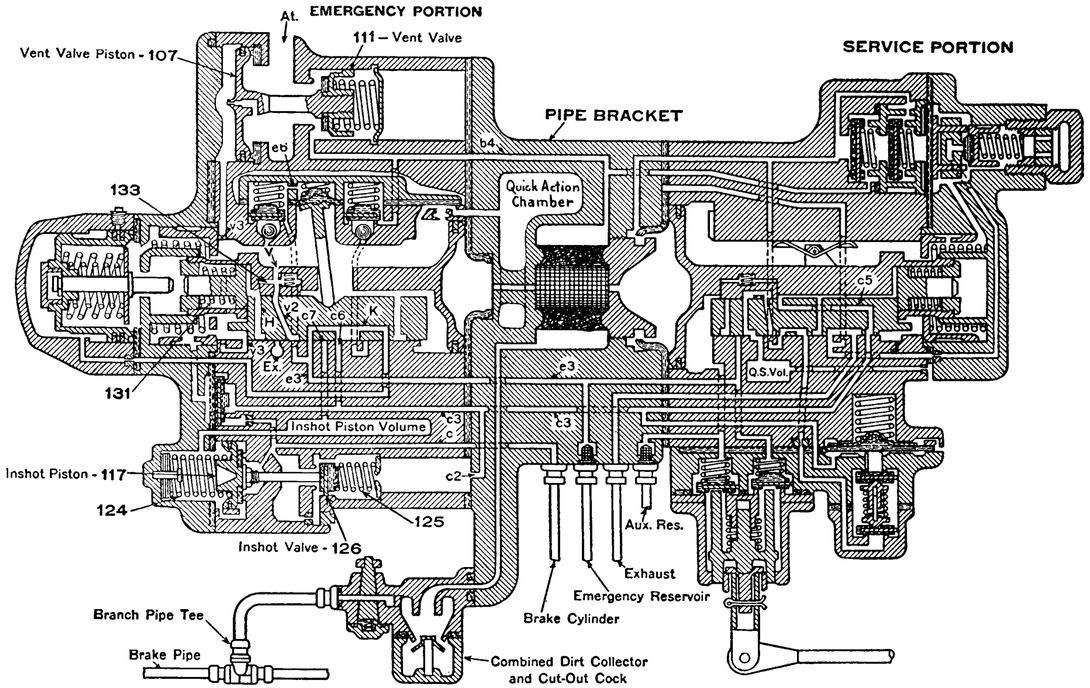


Plate 6 Emergency Position (First Stage)—"AB" Valve—Diagrammatic

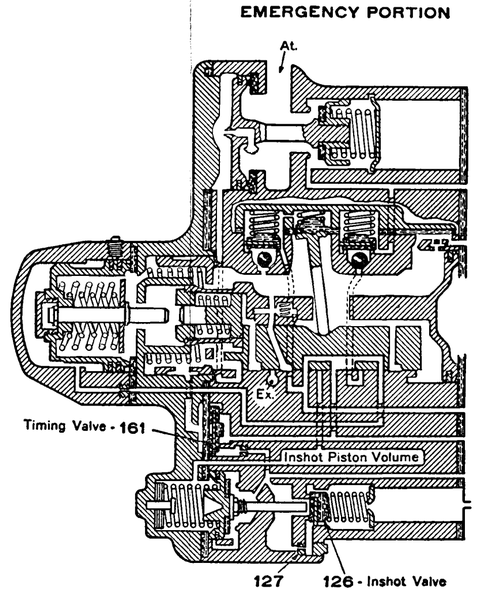


Plate 7 Second Stage Emergency Position—"AB" Valve Emergency Portion—Diagrammatic

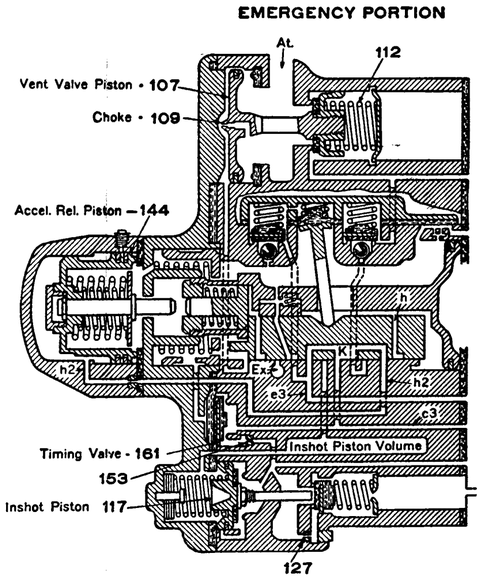


Plate 8 Third Stage Emergency Position (Final Build-up) "AB" Valve Emergency Portion—Diagrammatic

Plate 6 Emergency Position (First Stage)—"AB" Valve—Diagrammatic

Plate 7 Second Stage Emergency Position—"AB" Valve Emergency Portion—Diagrammatic

Plate 8 Third Stage Emergency Position (Final Build-up) "AB" Valve Emergency Portion—Diagrammatic

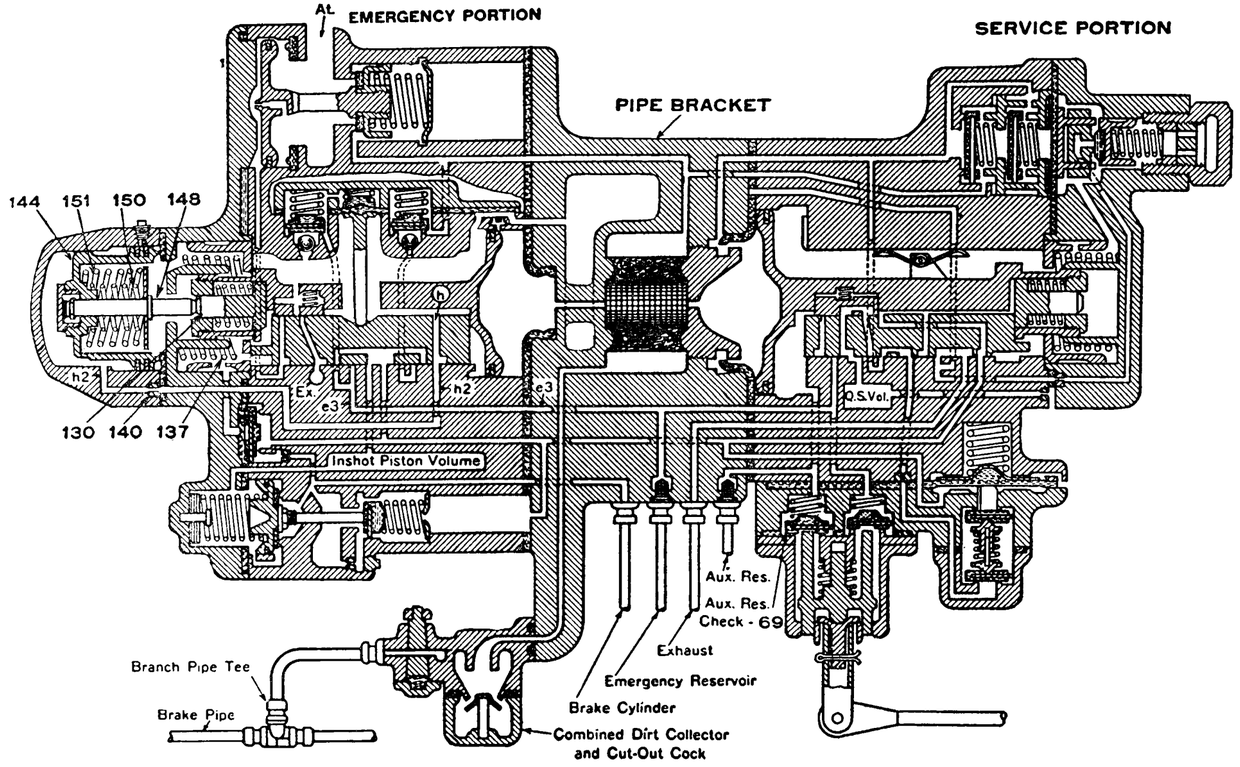


Plate 9 Release after Emergency Application—"AB" Valve—Diagrammatic

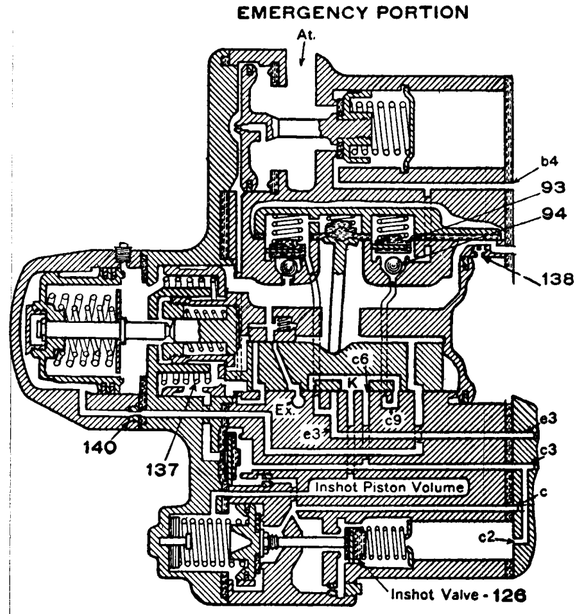


Plate 10 Accelerated Emergency Release—"AB" Valve Emergency Portion—Diagrammatic

Plate 9 Release after Emergency Application—"AB" Valve—Diagrammatic

Plate 10 Accelerated Emergency Release—"AB" Valve Emergency Portion—Diagrammatic

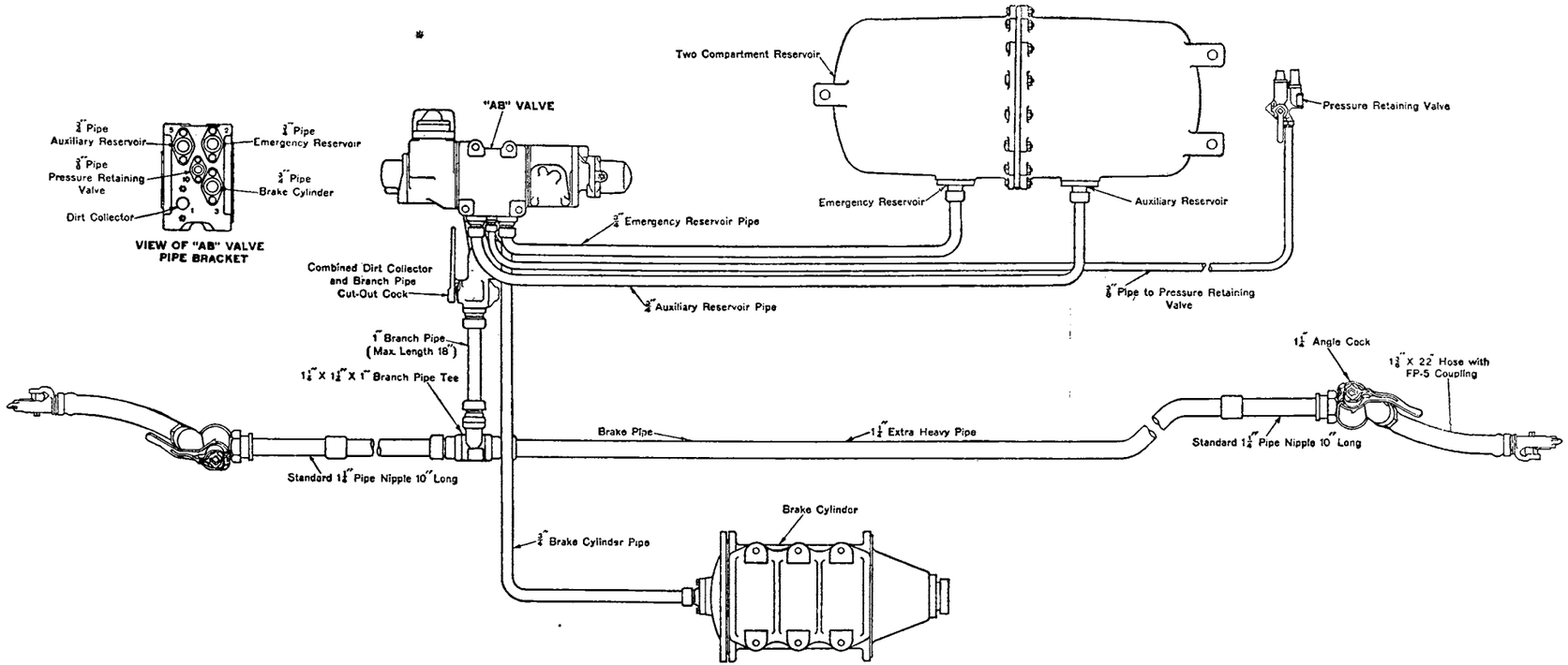


Plate 11 Piping Diagram of the Complete "AB" Freight Car Brake Equipment

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