WABCO
WESTINGHOUSE AIR BRAKE CO.
a subsidiary of
AMERICAN-STANDARD

No. 14-EL BRAKE EQUIPMENT FOR DIESEL-ELECTRIC SWITCHING LOCOMOTIVES

INSTRUCTION PAMPHLET

WESTINGHOUSE AIR BRAKE DIVISION
WILMERDING, PENNSYLVANIA

CONTENTS

MAY, 1953

(Superseding Issue of February, 1945)

THE EQUIPMENT

The No. 14-EL Brake Equipment as described in this pamphlet is an adaptation of the well known No. 6-ET Equipment (as applied to steam locomotives) to the Diesel-Electric Locomotive which is a comparatively light weight locomotive generally used in switching service.

The important features of the No. 14-EL equipment, as described in this pamphlet, are:

1. Locomotive brakes may be applied or released independently of, or in conjunction with, the train brakes, affording a range of control of the train unit not otherwise possible.
2. Absolute flexibility in the control of the brake cylinder pressures between the maximum and minimum possible.
3. Brake cylinder pressure on the locomotive maintained regardless of leakage or variation in piston travel.
4. Both locomotive and train brakes may be graduated on or off at will.
5. Maximum braking force in emergency, insuring shortest possible stop distances.
6. Extreme flexibility in service operation, insuring smooth handling of train and avoiding damage to the rolling stock and lading.

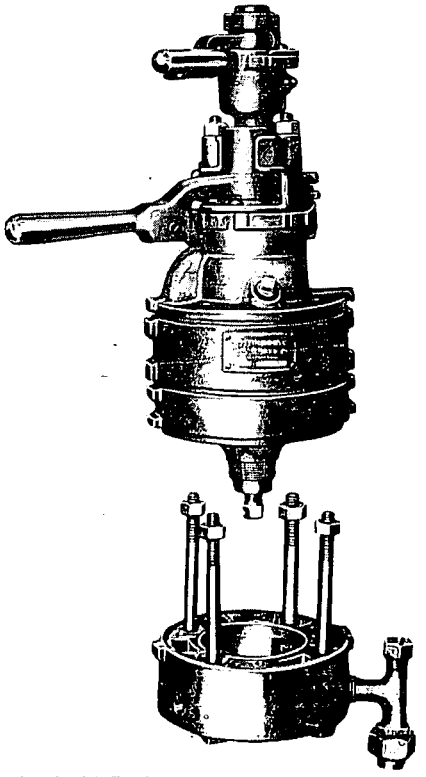


Fig. 1. K-14 Brake Valve removed from Pipe Bracket

PARTS OF THE EQUIPMENT

The following is a list of the operating parts which make up the single-end equipment, with a short description of each (for difference between parts of single-end and double-end equipment, see page 93.)

1. An *air compressor or compressors* driven either by electric motor or directly from the engine furnish the compressed air for use in brake system and auxiliaries.
2. A *compressor governor* which automatically controls the operation of the compressors between predetermined minimum and maximum pressures.
3. Two *main reservoirs* to which the compressed air is delivered from the air compressors where it is cooled to atmospheric temperature and stored for use in charging the brake system.
4. A *safety valve,* which protects against excessive main reservoir pressure in case the Governor for any reason fails to stop the compressors.
5. A *feed valve* which automatically maintains a predetermined normal pressure in the brake system.
6. A *reducing valve* which reduces main reservoir pressure for straight air operation, and for the air signal system when used.
7. Two *duplex air gages,* one of which indicates equalizing reservoir and main reservoir pressures, and the other brake pipe and locomotive brake cylinder pressures.
8. A *brake valve,* on the operating end of the locomotive, consisting of an Automatic and an Independent portion. The Automatic portion controls the operation of the locomotive and train brakes; the Independent portion controls the operation of the locomotive brakes only. By proper movements of the automatic brake valve handle (the lower and larger one) the engineman is able to charge the entire system on the locomotive and train, apply the brakes and hold them applied, release the brakes on the locomotive and train, or hold the locomotive brakes applied while releasing the train brakes and recharging the entire system. By proper movement of the independent brake valve handle (the upper and smaller one) the locomotive brakes can be operated independently of the train brakes at any and all times.
9. An *equalizing reservoir* which adds volume to the space above the equalizing piston in the brake valve so that reductions in brake pipe pressure may be properly made during service applications of the brakes.
10. A *distributing valve* which automatically controls the flow of air from the main reservoirs to the locomotive brake cylinders when applying the brakes;

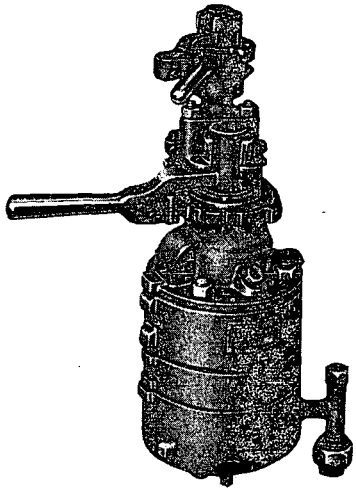


Fig. 2. K-14 Brake Valve

from the brake cylinders to the atmosphere when releasing the brakes; and automatically maintains locomotive brake cylinder pressure against leakage, keeping it constant when holding the brakes applied. The distributing valve, therefore, bears a similar relation to the brakes on the locomotive that the triple valve bears to those on the car, besides performing additional functions.

11. *Brake cylinders* with pistons and rods so connected through the brake levers to the brake shoes that when pistons are forced outward by air pressure this force is transmitted through the rods and levers to the brake shoes and applies them to the wheels.

12. Three *centrifugal dirt collectors*, two for the protection of the distributing valve and the other for protection of the feed valve and reducing valve. The dirt collector is for the purpose of preventing pipe scale, cinders or foreign particles of any kind from reaching the devices above mentioned.

13. Two *Quick Release Valves* which provide direct release of brake cylinder pressure during the release operation.

14. A *combined strainer and check valve* which, together with a *cut-out cock*, constitutes the dead engine fixtures, enabling the brakes on a locomotive being hauled dead in a train to be operated like those of any car on the train.

15. Various *cut-out cocks, hose, couplings, dummy couplings, etc.*, the location and uses of which will be readily understood from the diagram of the equipment, Plate 13, and the descriptions which follow.

16. While not a part of the air brake apparatus proper, the locomotive is usually equipped with two *air alarm whistles or horns*, one at each end of the locomotive, to be used as a warning of approach, with the necessary *whistle valves and cut-out cocks.*

The brake system requires two lines of *pipe,—Main Reservoir Pipe* and *Brake Pipe*, the latter being continuous throughout the train.

The *Main Reservoir Pipe* has branches leading as follows: to the *distributing valve;* to the *feed valve;* to the *reducing valve;* to one *duplex air gage;* and to the *brake valve.*

The *Brake Pipe* leads from the brake valve throughout the length of the locomotive and train, having branches connecting the *distributing valve* on the locomotive and to the *operating valve* on each car. It forms the means of communication by which the engineman, by proper manipulation of the brake valve handle, can operate the brakes on the entire train. A branch from the brake pipe leads to one *duplex air gage.*

DESCRIPTION OF THE PARTS

Air Compressors and Governors

The operation and maintenance of the air compressors and governors for the Diesel-electric locomotive are fully described in Instruction Pamphlet No. 5002-5.

E-7-A Safety Valve

The purpose of the safety valve is to vent pressure at a predetermined point in order to prevent excessive main reservoir pressure on the locomotive.

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* past valve *4* and through 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 should be 10 pounds above the governor cutting out point, 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 can be adjusted by changing the size of ports *f*, using regulating nut *8* for the purpose. After adjustment, screw down jam nut *9*.

E-7-B Safety Valve

The purpose of the safety valve is to vent pressure at a predetermined point in order to prevent excessive main reservoir pressure on the locomotive.

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. The air pressure

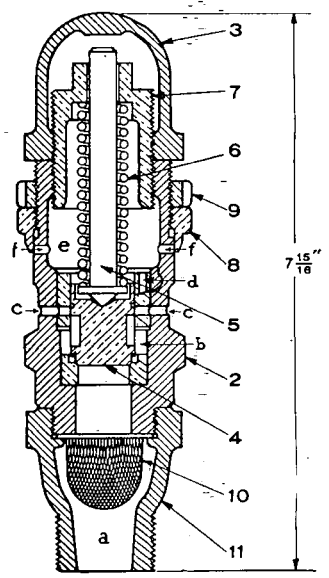


Fig. 3. E-7-A Safety Valve

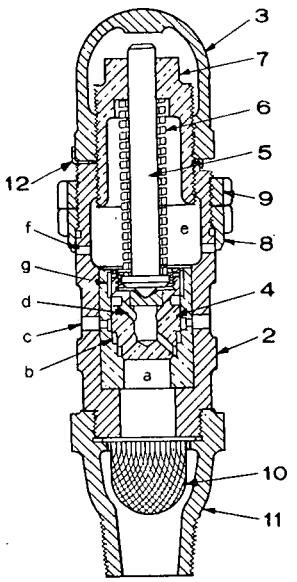


Fig. 4. E-7-B Safety Valve

then is exerted in cavity *b* over the full diameter of the valve *4* which provides sufficient extra force to continue the valve moving against spring *6*. Air then flows past the valve and to the atmosphere through port *c*. While in the open position, the upper end of valve *4* closes off communication from chamber *g* to the chamber *e* so that air cannot flow through bypass port *d* to the chamber *e*. As the pressure below valve *4* decreases, the tension of spring *6* forces the valve downwardly. This restricts the opening of ports *c* and at one stage in the movement opens chamber *a* to chamber *g* and to chamber *e*. Although the ports *f* are open to the atmosphere, they may be so restricted by the ring *8* as to allow the pressure to build up rapidly in chamber *e*, assisting the spring *6* in closing the valve *4* to its seat.

The adapter *11* and strainer *10* provide a large capacity pipe connection and a replaceable screen for keeping pipe scale and other large foreign particles from the valve seat.

To adjust the safety valve for the maximum or opening pressure, which in this case is 150 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 is 145 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*.

Main Reservoirs

Main reservoirs are used to store and cool the compressed air furnished by the air compressor and to collect water and dirt. Each reservoir is provided with a drain cock by means of which all residue may be drawn off at frequent intervals, as water or oil collecting will soon materially decrease the air storage capacity.

All main reservoirs are numbered serially before leaving the factory and a certificate is furnished, setting forth in detail the design, material, construction and tests with a detachable portion covering the specific information which the Interstate Commerce Commission now requires all Interstate Carriers to file.

Enameled reservoirs are 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 by a special process both inside and out.

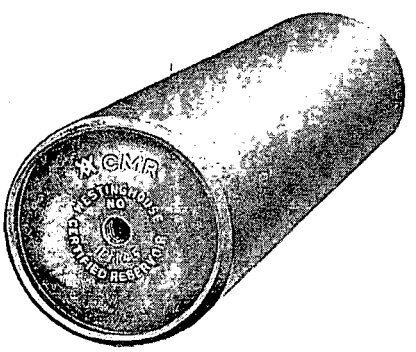


Fig. 5. View showing Certified Main Reservoir Marking

Wabcotite Union Fittings For Main Reservoirs

Fig. 6 illustrates a main reservoir fitted with a Wabcotite Flanged Union. The application of this fitting to main reservoirs extends to this vital pipe connection the maximum available protection against pipe or fitting breakage.

As shown in the section below, a forged steel flange is set into and welded to the head, and the reinforced fitting with copper gasket applied to it by four cap screws. The welded flange is suitable for 2″ flanged connection for 1½″, 1¼″ or 1″ iron pipe as required. The reinforced fittings are available in both straight and elbow types.

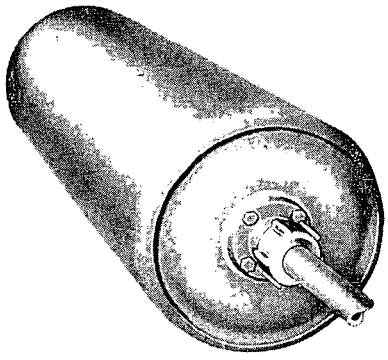


Fig. 6. View of Main Reservoir with Wabcotite Flanged Union

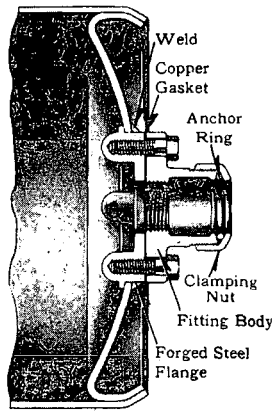


Fig. 7. Wacotite Flanged Union as Applied to a Main Reservoir

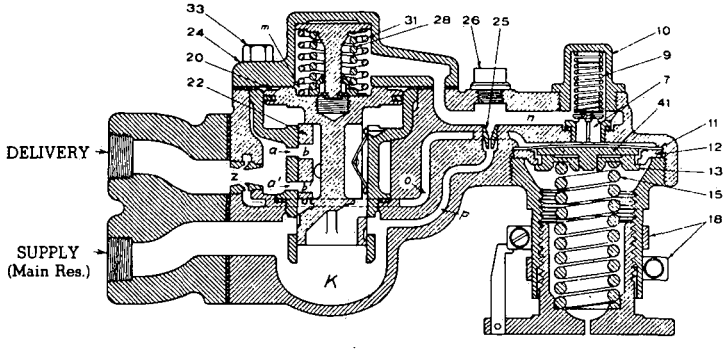


Fig. 8. Diagrammatic View of the M-3-A Feed Valve in OPEN Position

Type M Feed Valves

The M-3-A Feed Valve regulates the pressure in the brake pipe with the automatic brake valve in *Running* or *Holding* positions, and the M-3 reduces main reservoir pressure for use in independent brake operation and the train air signal system. The M-3-A and M-3 feed valves are identical except that the M-3-A is provided with adjustable stops for double pressure control. The following description of operation applies equally to the M-3-A and M-3 feed valves.

The diagrammatic views, Figs. 8 and 9, picture the valve with all parts in one plane in order to facilitate description. Main reservoir pressure is connected to both sides of piston 20, the underside through slide valve chamber and chamber k, and chamber m on top through passage n, by-pass choke 25, passage p and chamber k. Passage n also leads to the top of regulating valve 7 while the diaphragm chamber under this valve is always in communication with feed valve pipe pressure through passage o.

Opening

Air pressure enters the feed valve opening marked "Supply" and flows to chamber k and the slide valve chamber under piston 20. Above the piston is spring pressure and feed valve pipe pressure combined which, however, is less than the main reservoir pressure in the slide valve chamber under the piston. Consequently, the piston and slide valve will move up to the position shown in Fig. 8 and main reservoir air will flow to the feed valve pipe through ports b and b' in slide valve 22 and ports a and a' in the seat.

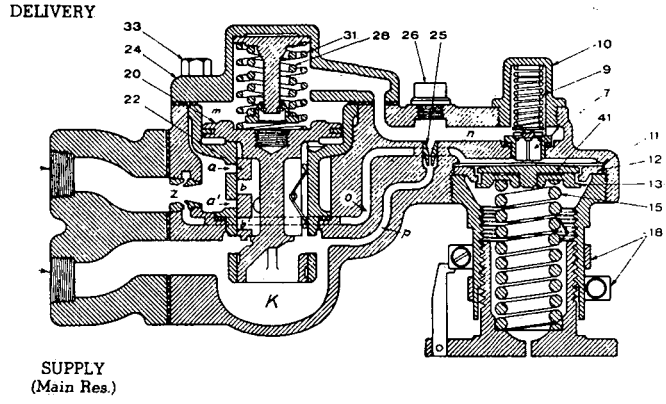


Fig. 9. Diagrammatic View of the M-3-A Feed Valve in CLOSED Position

Main reservoir air also flows from chamber k through port p and by-pass choke 25 to passage n and above the piston. Passage n is connected to regulating valve 7 (held open at this time by regulating spring 15 under diaphragm 11) so that pressure passing through the by-pass choke is free to flow past the regulating valve and through passage o to the feed valve pipe. Consequently, so long as the regulating valve is open, the pressure above piston 20 will be less than that underneath and the piston and attached slide valve will remain in open position as illustrated.

It will be noted that there are two ports through the slide valve and the slide valve seat. When feed valve pipe pressure has been reduced a considerable amount below the adjustment of regulating spring 15, regulating valve 7 will be fully open and piston 20 will move upward to its extreme position opening both ports in the slide valve, as the by-pass choke so restricts the flow of main reservoir air that pressure cannot build up in the chamber above piston 20 as long as valve 7 is fully unseated. If a limited reduction of feed valve pipe pressure has been made, the regulating valve will not be fully

opened and air flowing through the by-pass choke will result in a lower differential acting on piston 20 which will move upward only far enough for port *b* in the slide valve to register with port *a in the seat.*

Closing

When feed valve pipe pressure above diaphragm 11 (connected through port *o*) becomes greater than spring pressure acting under the diaphragm, the diaphragm will move downward permitting spring 9 to seat the regulating valve 7. Main reservoir air flowing through by-pass choke 25 to chamber *m* above piston 20 will quickly equalize with the pressure underneath, and springs 28 and 31 will force the piston and slide valve downward to closed position, Fig. 9, thus cutting off the flow of main reservoir air to the feed valve pipe through the slide valve.

The parts will remain in this position until feed valve pipe pressure above diaphragm 11 becomes less than the tension of regulating spring 15 when the diaphragm will move upward, unseating the regulating valve and again connecting the top of piston 20 to feed valve pipe pressure. The piston and slide valve will then be moved upward to open position by reason of the higher main reservoir pressure under the piston as compared to the lower feed valve pipe pressure above in chamber *m*.

Venturi Tube Action

The function of venturi tube z is to obtain a sustained air delivery flow from the main reservoir to the feed valve pipe up to the point of pressure for which the feed valve is adjusted. Its operation is on the same principle as a steam injector. The main reservoir air in flowing through the venturi tube to the lower pressure in the feed valve pipe develops an increased velocity at the small section of the venturi tube with a corresponding decrease in pressure at this point. Passage *o* leads into the venturi tube at this small section, or throat, which causes the pressure to be reduced in the diaphragm chamber below the feed valve pipe pressure and permits the regulating spring 15 to open the regulating valve 7 more fully, thus allowing a greater flow of air with consequently greater reduction of pressure on the face of supply piston 20.

As the feed valve pipe pressure approaches the pressure for which the Feed Valve is adjusted, the velocity of flow through the venturi tube diminishes. Therefore, its effect of reducing the pressure in the diaphragm chamber becomes proportionately less, thus permitting accumulation of pressure in the diaphragm chamber, which tends to close the regulating valve at its true setting.

Adjustment

The M-3 is adjusted by turning up, or backing off, the regulating nut.

The M-3-A has two adjustable stops 18 encircling the spring box, split through the lugs and closed with a machine screw. When setting the valve, set the valve at the low brake pipe setting, loosen the machine screw and move the lower stop 18 against the stop pin which is a part of the regulating nut and tighten the machine screw. Then, set the valve at high pressure and set the upper stop 18 to hit the stop pin in the same manner. Thereafter by turning the regulating nut until the pin hits either stop, the Feed Valve is regulated from high to low pressure.

The M-3 reducing valve should be set to supply 45 pounds pressure for the independent brake and the signal system, and the M-3-A feed valve adjustable stops should be placed to give 110 pounds high (or 90 pounds, depending upon class of service or local conditions), and 70 pounds low brake pipe pressures.

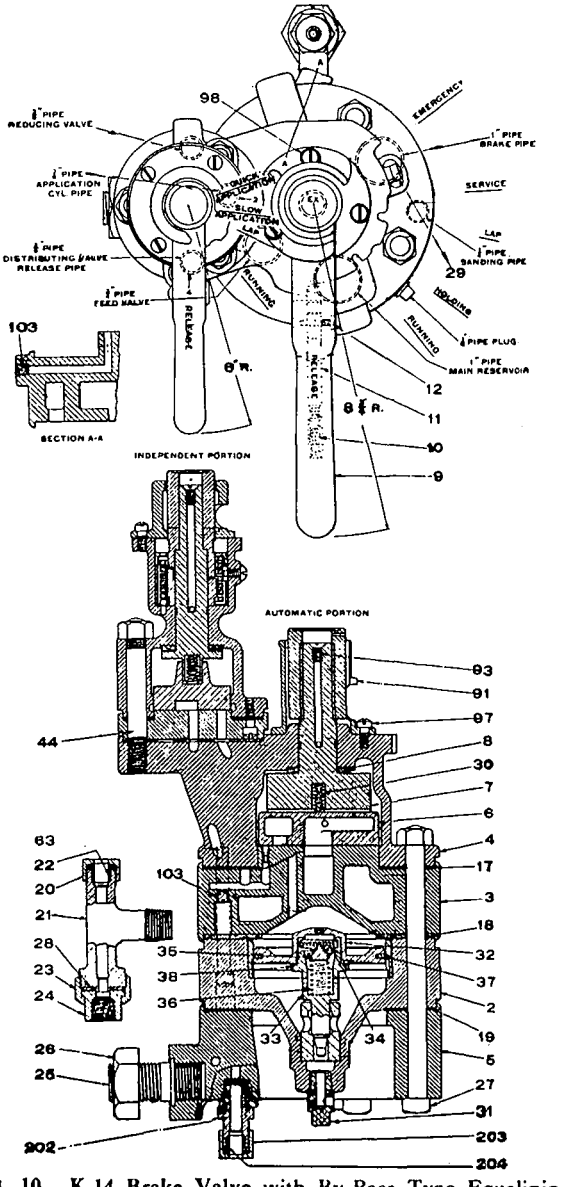


Fig. 10. K-14 Brake Valve with By-Pass Type Equalizing Piston, Top and Sectional Views

Brake Valves

The automatic and independent brake valves are combined into one structure and mounted on a bracket to which all pipe connections are made, so that the brake valve portion may be removed from the bracket without breaking any pipe joints. The handle of the automatic brake valve is removable in Lap position, and the handle of the independent brake valve in Running position. Pipe connections to the bracket portion are provided for as follows:

¾″ feed valve pipe (marked "FV").
⅜″ application cylinder pipe (marked "2").
⅜″ distributing valve release pipe (marked "4").
1″ brake pipe (marked "BP").
1″ main reservoir pipe (marked "MR").
⅜″ reducing valve pipe (marked "RV").
¼″ sand pipe (plugged).
Union tee for gage and equalizing reservoir connections.

The brake valve portion may be removed from the pipe bracket by backing off the nuts from the four bolts 27. First, however, the double heading cock should be closed, the automatic brake handle placed in Release position and the main reservoir cut-out cock closed (in order to prevent lifting from their seats the slide valve of the feed valve and the rotary valve of the automatic brake valve). The independent brake only may be removed by backing off the nuts from the three studs 44.

Substantially the same pressure in the brake pipe and equalizing reservoir *during charging operations* are insured by the by-pass equalizing piston. This feature makes it possible when releasing the brake to make a re-application more promptly than is possible with the solid type piston. The collapsible type equalizing piston performs the same function with earlier type brake valves and is interchangeable with the *by-pass type* equalizing piston. Both types are described below.

The *by-pass type* of equalizing piston consists of a piston 32 and piston stem 33 screwed together and held by lock washer 38. The stem contains a light spring 36 which centers on spring seat 35 and normally holds a "Wabco" check valve 34 on a beaded seat formed on the inside face of the piston. With brake pipe pressure below the piston and equalizing reservoir pressure above the piston equal, the spring holds the by-pass 34 seated. Whenever the equalizing reservoir pressure is raised higher than brake pipe pressure, as generally occurs during release of the brakes owing to the rapid charging of the small equalizing reservoir volume compared to brake pipe volume, the excess pressure moves the check valve from its seat, permitting equalizing reservoir air to flow through a connecting port at the top of the piston, past the check valve to the spring cavity, thence through drilled holes in the valve stem to the brake pipe. When the pressures equalize, the spring seats the valve thereby closing the by-pass. This serves to keep brake pipe and equalizing reservoir pressures approximately equalized.

The *collapsible type* of equalizing piston consists of the piston with hollow stem and the equalizing discharge valve. The equalizing discharge valve slides in the hollow stem of the piston, being held in normal relative position by a spring in the hollow stem. Whenever the equalizing reservoir pressure is raised slightly higher than brake pipe pressure, the excess pressure on the top of the equalizing piston compresses the spring and forces the equalizing piston down to a position in which the by-pass grooves in its bushing are uncovered, thereby permitting the pressure in the equalizing reservoir and brake pipe to equalize.

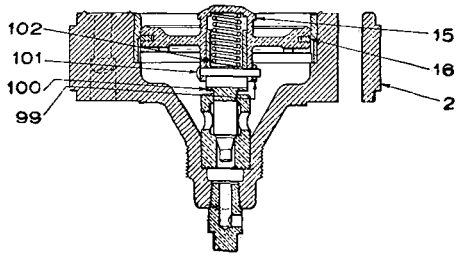


Fig. 11. Collapsible Type Equalizing Piston

The six positions of the automatic brake valve handle are, beginning at the extreme left: *Release, Running, Holding, Lap, Service, and Emergency.*

In the following paragraphs the positions are taken up in the order in which they are most generally used rather than in their regular order as mentioned above.

Release Position. The purpose of this position is to provide a large and direct passage from the main reservoir to the brake pipe, to permit a rapid flow of air into the latter to (a) charge the train brake system; (b) quickly release; but (c) *not* release locomotive brakes, if they are applied.

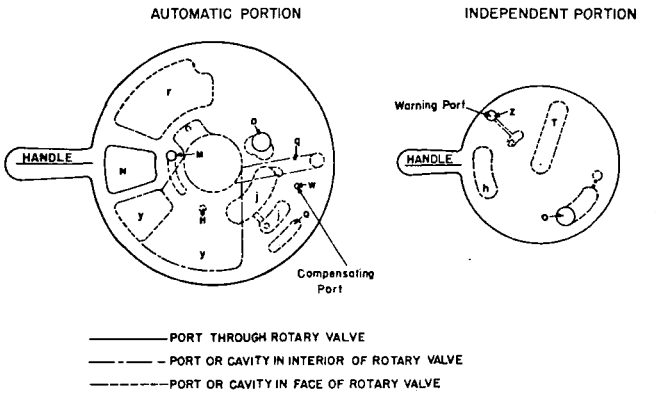


Fig. 12. Rotary Valves, K-14-A Brake Valve. K-14-B Automatic Rotary Valve does not have Compensating Port "w".

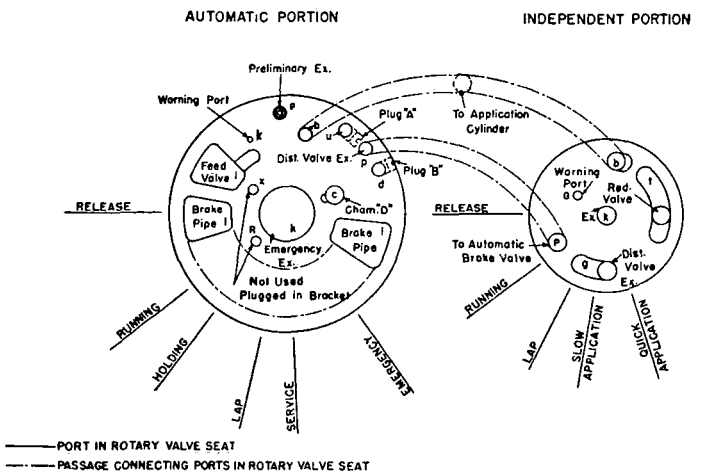


Fig. 13. Rotary Valve Seats, K-14-A and K-14-B Brake Valve

If the handle were allowed to remain in this position, the brake system would be charged to main reservoir pressure. To avoid this, the handle must be moved to *Running* or *Holding* position. To prevent the engineman from forgetting this, a small port discharges feed valve pipe air to the atmosphere in release position with sufficient noise to attract attention to the handle position.

Running Position. This is the proper position of the handle (a) when the brakes are charged and ready for use; (b) when the brakes are not being operated; and (c) to release the locomotive brakes. In this position a large direct passage is opened from the feed valve pipe to the brake pipe, so that the latter will charge as rapidly as the feed valve can supply the air, but cannot attain a pressure above that for which the feed valve is adjusted. The equalizing reservoir charges uniformly with the brake pipe, keeping the pressure on the two sides of the equalizing piston equal. The distributing valve release pipe is connected with the atmosphere.

Service Position. This position gives a gradual reduction of brake pipe pressure to cause a service application. The gradual reduction is to prevent quick action. The brake pipe discharge is also gradually stopped to prevent the pressure at the head end of the brake pipe being built up by the air flowing from the rear, which might cause some of the head brakes to "kick off."

Lap Position. This position is used while holding the brakes applied after a service application until it is desired either to make a further brake pipe reduction or to release them. All ports are closed. The removal of a plug in the rotary valve seat permits release of the locomotive brakes in case it is desired to hold *train brakes only* in this position. This plug is designated as "Plug B," Fig 13, in port *d* which connects the distributing valve release pipe to atmosphere. With the equalizing slide valve of the Distributing Valve in lap, the brake on the locomotive is held applied with the train. When the brake valve handle is moved to release or running and returned to lap with graduated release equipment, the train brakes remain applied, but the locomotive brakes are released if "Plug B" is removed.

Release Position. This position, which is used for releasing the train brakes after an application, without releasing the locomotive brakes, has already been described under RELEASE.

Main reservoir air is admitted to the brake pipe, raising the pressure in the latter, thereby causing the car operating valves and equalizing portion of the distributing valve to go to release position, which releases the train brakes and recharges the auxiliary reservoirs and the pressure chamber in the distributing valve. When the brake pipe pressure has been increased sufficiently to cause this, the handle of the brake valve should be moved to either *Running* or *Holding* position; the former when it is desired to release the locomotive brakes, and the latter when they are to be still held applied.

Holding Position. This position is so named because the locomotive brakes are held applied while the train brakes are being released and their auxiliary reservoirs recharged to feed valve pressure. In case the use of this position is not desired, the removal of a plug in the rotary valve seat causes the brake valve to function the same in *Holding* as in *Running* position. This plug is designated as "Plug A," and is located in the passage between port u and distributing valve release pipe, see Fig. 13.

Emergency Position. This position is used when a very quick and heavy application of the brakes is required. A large and direct communication is made between the brake pipe and atmosphere. This direct passage makes a sudden and heavy discharge of brake pipe air, causing the valves on the cars and distributing valve on the locomotive to move to emergency position and give

maximum braking force in the shortest possible time. In this position also, locomotive brake cylinder pressure is maintained against leakage, and main reservoir air is permitted to flow into the sand pipe in case air sanders are connected to the brake valve or to the emergency relay valve where used.

Plan views of the rotary valve and the rotary valve seat are shown by Figs. 12 and 13. *Full lines* denote port openings in the *top* of the rotary valve and *in the rotary valve seat;* dotted lines denote ports and cavities in the face of the rotary valve; and *dot-and-dash lines* indicate ports in the *interior* of both valve and seat.

The Offset Type independent brake valve handle is illustrated by Fig. 14. This handle is designed so that in *Full Release* position it is parallel to the cab wall, and at right angles to cab wall in *Quick Application* position. This handle is slightly longer than the straight handle.

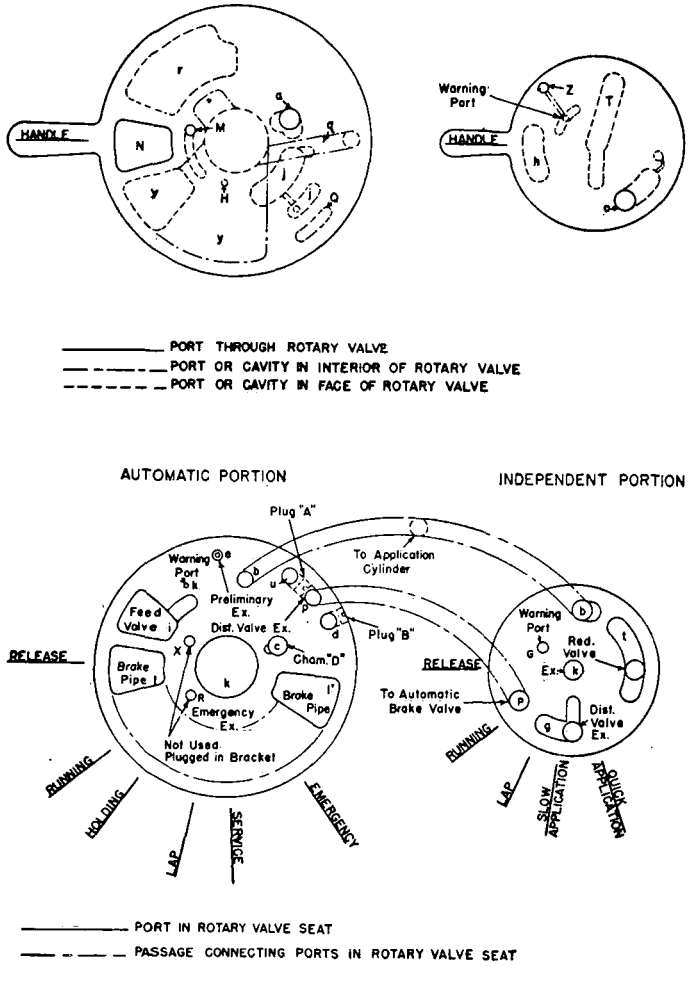


Fig. 14. Rotary Valve and Rotary Valve Seats, K-14-F Brake Valve

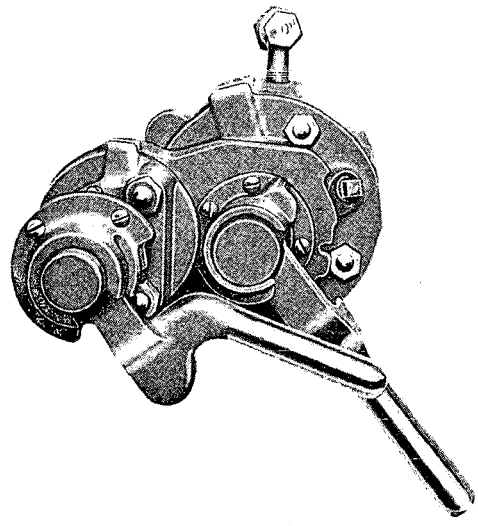


Fig. 15. Top View of the K-14 Brake Valve with Off-Set Independent Handle.

The positions of the *independent brake* valve handle, in order from the left, are:

Release position. This position is used to release the locomotive brakes when the automatic brake valve handle is not in *Running* position. It also may be used to release locomotive brakes after an independent application at a faster rate than obtainable in *Running* position. The independent portion of the brake valve is provided with a return spring which automatically moves the handle from *Release* to *Running* position as soon as the engineman releases his hold on it, the purpose being to prevent the handle from being left in *Release* position and thereby making it impossible to operate the locomotive brakes with the automatic brake valve handle. As a warning to the engineman in case of a broken return spring, air from the reducing valve is allowed to escape to the atmosphere in *Release* position.

Running position. In this position communication is established through the distributing valve release pipe, between the application cylinder of the distributing valve and a port in the automatic portion of the brake valve so that the distributing valve can be released by the latter. It will also be noted that if the handle of the automatic portion is in *Running* position and the locomotive brakes are being operated, they can be released by simply returning the independent brake valve handle to *Running* position.

Lap position. This position is used to hold the independent brake applied after the desired cylinder pressure is obtained, at which time all communication between operating ports is closed.

Slow Application position. Locomotive Brakes are applied slowly in this position.

Quick Application position. This position gives a quick application of locomotive brakes. The same spring that automatically returns the handle from *Release* to

Running position also returns it from *Quick Application* to *Slow Application* position when the engineman releases his hold on it. The action of the spring between these two latter positions serves to make *Quick Application* position more prominent, so that in rapid movement of the handle the engineman is less likely to unintentionally pass over to *Quick Application* position, thereby obtaining a heavy application of the locomotive brakes when only a light one is desired.

K-14-B and K-14-F Brake Valves

The No. 14-EL brake equipment is furnished with either the K-14-B or K-14-F brake valve which is optional, and the equipment is operated in the same manner with either brake valve. The K-14-F brake valve differs from the K-14-B only in the rotary valve and seat of the independent portion, as shown in Fig. 13 and 15. In the K-14-F brake valve, Fig. 15, the independent portion rotary valve seat exhaust port *g* is larger than in the K-14-B. Further, the K-14-F brake valve has an additional port *Z* in the independent rotary valve, and the connecting cavity *T* is longer than its corresponding cavity in the K-14-B.

In independent release position of the K-14-F brake valve, Plate 13, the elongated cavity *T* in the independent rotary valve 6 connects the enlarged distributing valve release pipe port *g* to the exhaust port *k*, in addition to connecting port *b* to port *k* as in the K-14-B brake valve, Plate 12. This provides two passages for venting of the air from the distributing valve application chamber with the K-14-F brake valve, see Plate 10 for position of the distributing valve for releasing after an independent application.

In independent quick application position of the K-14-B brake valve, Plate 9, reducing valve air is connected to the distributing valve application chamber through port *o* in rotary valve 6, port *b* in the rotary valve seat and the application cylinder pipe. With the K-14-F brake valve, Plate 10, the port *Z* in the independent rotary valve 6 connects reducing valve air to port *g*, which flows to the distributing valve release pipe thence to the distributing valve application chamber. Reducing valve air is also connected to the application chamber through port *o* in the independent brake valve rotary valve 6, port *b* in the rotary valve seat and the application cylinder pipe. Thus two passages connect air to the distributing valve application chamber with the K-14-F brake valve in quick application position.

Distributing Valve

The distributing valve is the automatic valve mechanism which controls the operation of the brakes on the

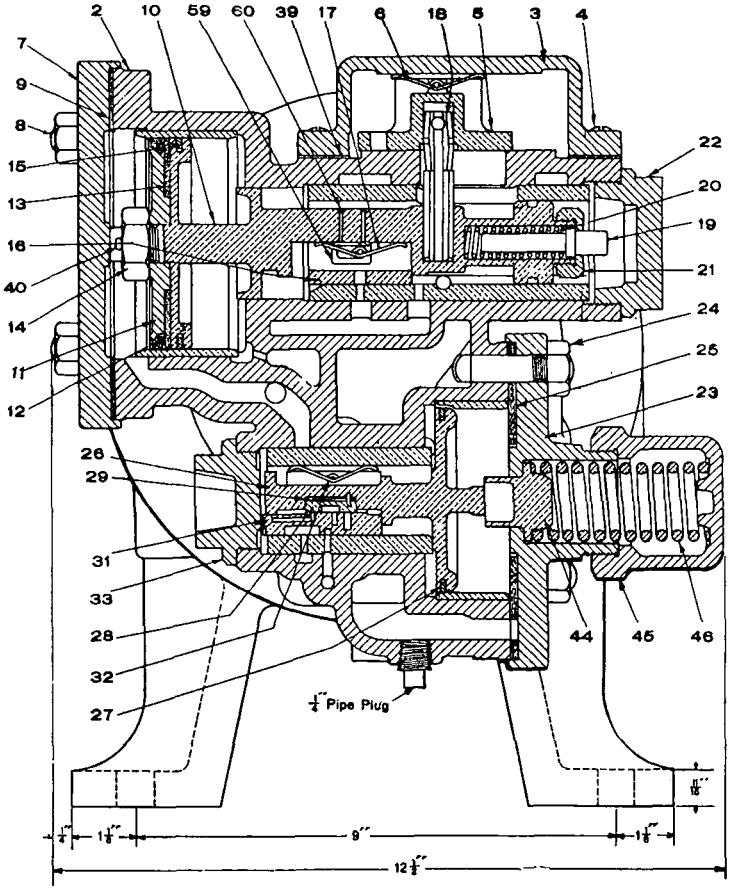


Fig. 16. No. 6-E Distributing Valve, Actual Section

locomotive in accordance with the movements of the automatic and independent brake valve handles.

The distributing valve has five pipe connections, made through the end of the double-chamber reservoir, three on the left, and two on the right. Of the three on the left, the upper (MR) is the supply from the main reservoir; the intermediate (2) is the application-cylinder pipe, leading to the independent and automatic brake valves; and the lower (4) is the distributing valve release pipe, leading through the independent brake valve, when the handle is in *Running* position, to the automatic brake valve. Of the two on the right, the lower (BP) is the brake pipe branch connection, and the upper (BC) is the brake cylinder pipe, branching to all brake cylinders on the locomotive.

The distributing valve consists of two portions called the "equalizing portion" and "application portion." It is connected to a "double-chamber reservoir," the two chambers of which are called respectively the "pressure chamber" and the "application chamber." The latter is ordinarily connected to the application portion of the distributing valve in such a way as to enlarge the volume of that part of it called the "application cylinder," (Fig. 17).

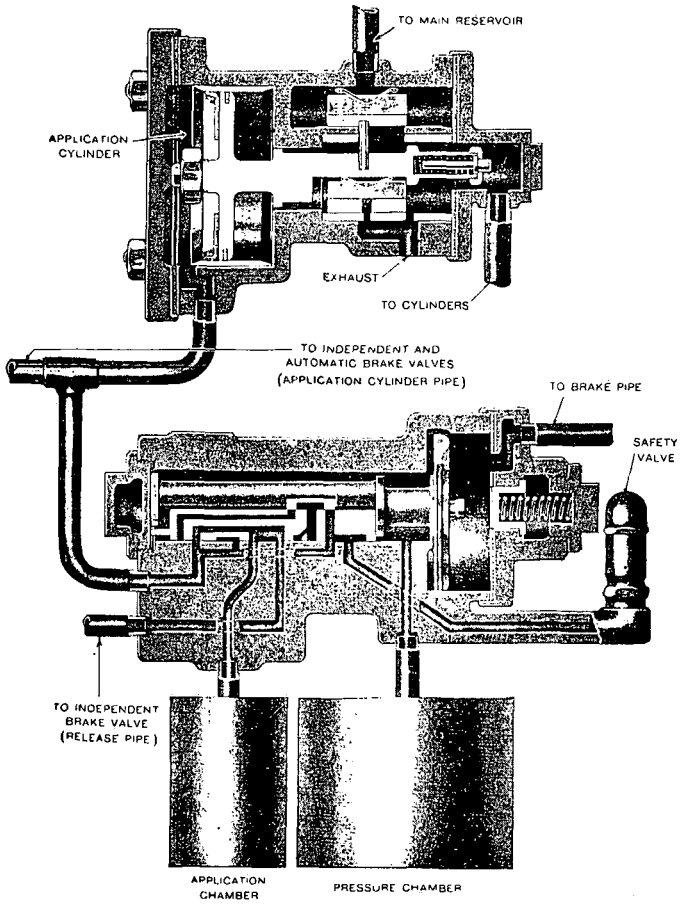


Fig. 17. Diagrammatic View of the Essential Parts of the Distributing Valve and Double-Chamber Reservoir

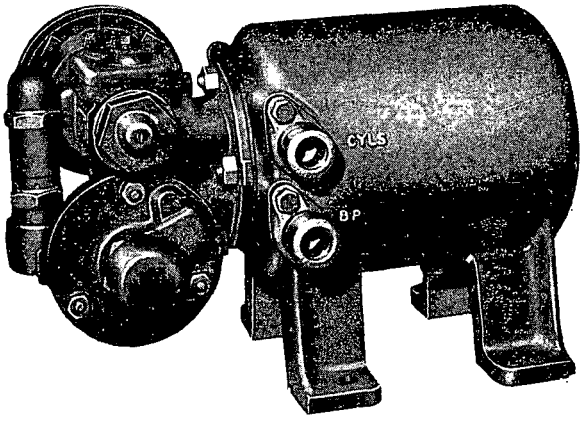
The connections between these parts as well as their operation, may be compared with that of a miniature brake set—the equalizing portion representing the triple valve; the pressure chamber, the auxiliary reservoir; the application portion always having practically the same pressure in its cylinder as that in the brake cylinders. This is shown by the diagrammatic illustration in Fig. 17. For convenience, compactness and security they are combined in one device as illustrated.

The equalizing portion and pressure chamber are used in automatic applications only; reductions of brake-pipe pressure cause the equalizing slide valve to connect the pressure chamber to the application chamber and cylinder, allowing air to flow from the former to the latter.

With the No. 6-E Type Distributing Valve, the upper slide valve (attached to the piston rod of the application piston) admits air to the brake cylinders and is called the "application valve," while the lower one releases the air from the brake cylinders and is called the "exhaust valve."

The No. 6-KR Type Distributing Valve incorporates a "duplex poppet type application valve." Referring to Fig. 18, *Application valve* 54 and *pilot valve* 57 are operated by the application piston to supply air from the main reservoir to the brake cylinders. During an application, the end of the application piston first engages and unseats the pilot valve, allowing air from the spring chamber to flow to the brake cylinders.

The opening of the pilot valve quickly drops the pressure on the spring side of the application valve 54 inasmuch as the choke restricts the supply of air to this chamber. Thus, the main reservoir pressure acting over the outer annular area of the brake cylinder side of valve 54 is able to partially overcome the spring tension and reduced air pressure in the spring chamber, with the result that a small differential acting on the application piston opens application valve 54. *Springs* 63 and 64 promptly close the pilot and application valves when the application piston moves to lap after required brake



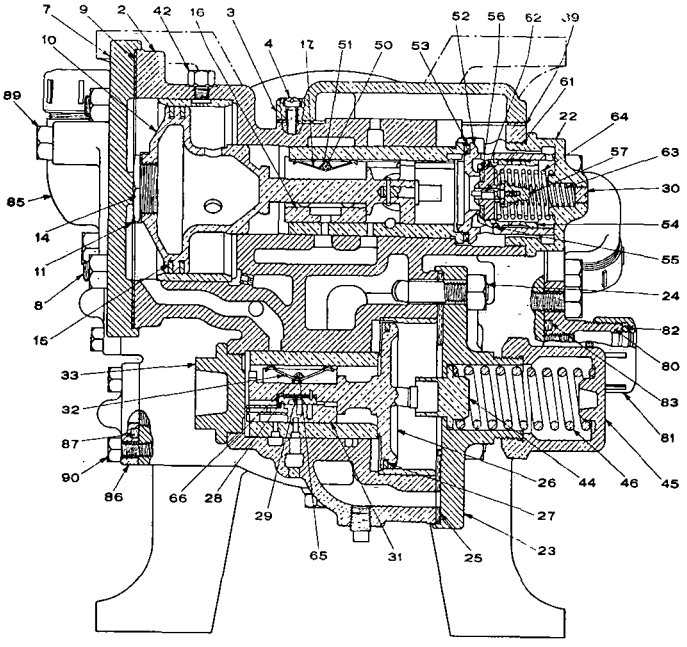


Fig. 18. Photographic and Sectional View of the No. 6-KR Distributing Valve

cylinder pressure is obtained. Because of the large diameter of the application piston, a very light differential is required to move it and the exhaust slide valve to release position.

As the air admitted to the brake cylinders comes directly from the main reservoirs, the supply is practically unlimited. Any pressure in the application cylinder will force the application piston to close the exhaust valve, open the application valve and admit air from the main reservoirs to the locomotive brake cylinders until their pressure equals, or slightly exceeds, that in the application cylinder; whereupon the application piston and valve will be returned to lap position, closing the application valve. Also any variation of application cylinder pressure will be exactly duplicated in the locomotive brake cylinders, and the resulting pressure maintained regardless of any brake cylinder leakage.

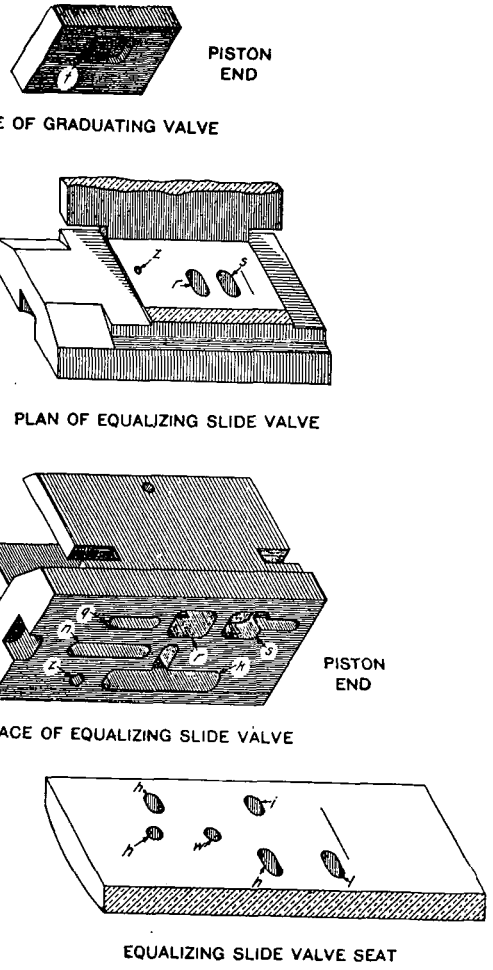


Fig. 19. Isometric View of Equalizing Slide Valve and Seat, and Graduating Valve

The operation of this locomotive brake, therefore, depends upon the admitting of air to and the releasing of air from the application cylinder; in independent applications, directly by means of the independent brake valve; in automatic applications, by means of the equalizing portion and the air pressure stored in the pressure chamber.

In all emergency applications the application chamber is cut off from the application cylinder. The pressure chamber then equalizes with this reduced volume at a higher pressure than in service applications with the result that a correspondingly higher cylinder pressure is obtained.

Referring to the isometric views of the slide valve seat, Fig. 19, the ports are as follows:

h leads to the Application Cylinder, Automatic Brake Valve and Independent Brake Valve.

w leads to the Application Chamber.

i leads to the Distributing Valve Release Pipe.

l leads to the Safety Valve.

The operation of the distributing valve is described later under "Operation of the Equipment."

E-6 Safety Valve

Fig. 20 is a sectional view of the safety valve which is an essential part of the distributing valve.

The safety valve is adjusted by removing cap nut 3, and screwing up or down the adjusting nut 7. After the proper adjustment is made, cap nut 3 must be replaced and securely tightened, and the valve operated a few times. Particular attention must be given to see that the holes in the valve body are always open, and that they are *not changed in size,* especially the two upper holes.

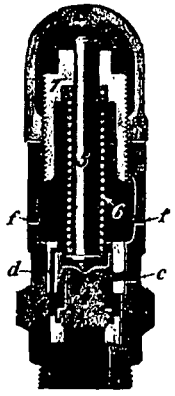


Fig. 20. E-6 Safety Valve

This safety valve should be adjusted for 68 *pounds.* Like all adjustable devices, the safety valve is most easily and accurately adjusted when the work is done on a shop testing rack.

Duplex Air Gages

There are two duplex air gages, each of which has two pipe connections. One gage is connected to the main reservoir (red hand) and equalizing reservoir (white hand), while the other gage has connections to the locomotive brake cylinders (red hand) and the brake pipe (white hand).

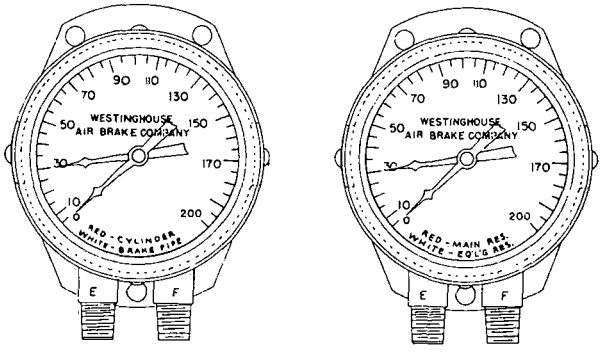


Fig. 21. 3½" Duplex Air Gages

The gages should be installed in the direct line of vision of the engineman while running over the road and where they will not be obscured in any way by intervening objects, or too strong a light back of or near them.

Duplex Brake Cylinder

Fig. 22 illustrates a sectional view of the duplex brake cylinder, four of which are installed on each locomotive. As illustrated, this type of brake cylinder consists of a cylinder with a non-pressure head on each end, and contains two pistons which work in opposite directions when air pressure is applied to the central chamber between the two pistons. Each 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 cylinder; the packing cup presses against the cylinder wall and prevents escape of air past the piston.

The duplex 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 pistons or opening of the cylinder.

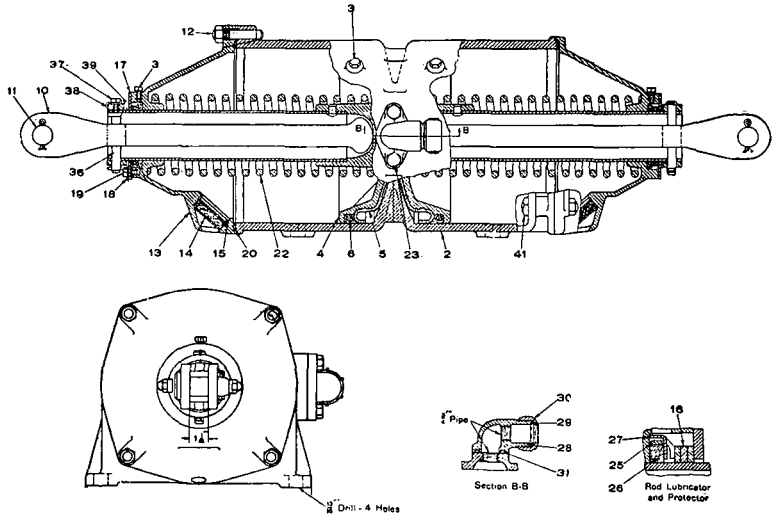


Fig. 22. Duplex Brake Cylinder

To prevent the entrance of dirt, each piston rod is ground true as to diameter and surface, and each non-pressure head 13 is fitted with a piston rod lubricator and protector consisting of a felt swab and three bronze rings, which are packed in grease and serve to lubricate the piston rods as well as to seal the interior of the cylinder against dirt and moisture. A tapped opening in each non-pressure head provides a means of lubrication of the piston sleeve and rings.

Since atmospheric air must enter the non-pressure ends of the cylinder during the release movement, each non-pressure head is fitted with a curled hair strainer 14. This strainer is of the cartridge type held in place by a breather cover which prevents flying dirt and water contacting directly with the strainer.

Lubrication of the pistons and cylinder is provided for by tapped openings which are normally plugged.

The plugs 3 are located as shown by Fig. 22, and the ports in the cylinder are so located as to deliver lubricant into a groove in each 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.

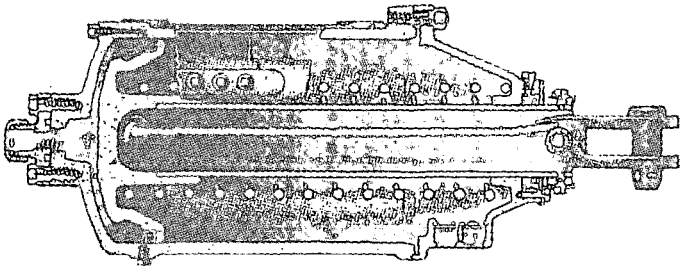


Fig. 23. Type "U" Brake Cylinder

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. 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.

Type U Brake Cylinder

This type of brake cylinder is shown in Fig. 23. It is the same as the duplex brake cylinder except it has a single piston.

Types B and D Brake Cylinders

The type of brake cylinder used depends on the installation conditions. The type "B" and 'D" brake cylinders are similar except that the type "B" cylinders do not have lever bracket 19, Fig. 24. Where a lever bracket is required the type "D" cylinders are furnished.

The piston 3 has a hollow sleeve in which is the push rod 14, attached to the front lever of the brake rigging. The pin 16 is attached to the push rod holder 9 which is in turn fastened to the hollow piston rod so that the push rod 14 moves in and out with the piston.

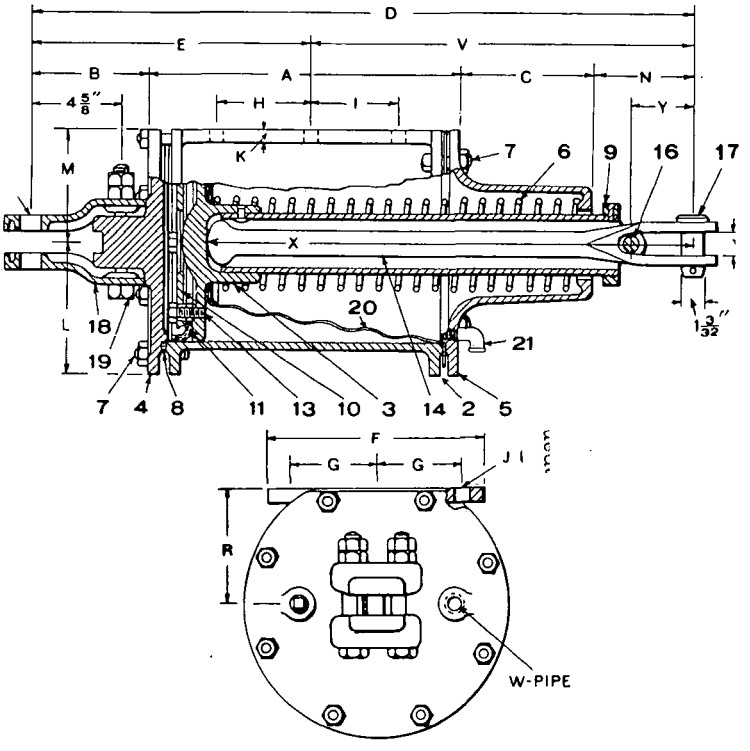


Fig. 24. Type D Brake Cylinder with Dirt Protector

This arrangement gives the necessary flexibility between the push rod and the front lever arm of the foundation brake. The release spring 6 forces piston 3 to release position when the air pressure is exhausted from the opposite end of the cylinder; the packing cup 11 presses against the cylinder wall and prevents the escape of air past the piston.

The brake cylinder protector 20 protects 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 5 and cylinder body 2, while the piston end of the hood is held between two circular steel plates. The release spring 6 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 21 at the bottom of the non-pressure head. Consequently, dirt never comes in contact with the cylinder walls or packing, so there is no undue wear.

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.

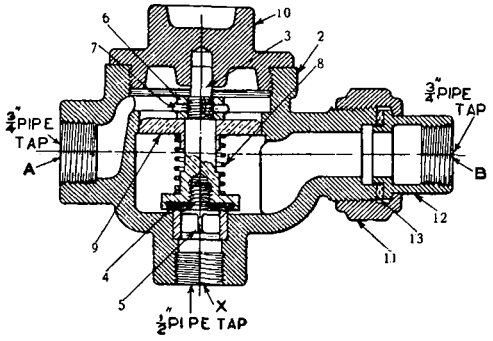


Fig. 25. Sectional View of the Quick Release Valve

Quick Release Valve

Two quick release valves are installed in the brake cylinder pipe (one for the front brake cylinders and one for the rear), and functions to provide fast release of the locomotive brake. The ¾" pipe taps "A" and "B" (Fig. 25) are connected to the distributing valve and to the brake cylinders respectively. Piston 9 is a sliding fit on vent stem 3 and is normally held in the position shown by spring 8, separating the distributing valve and the brake cylinders.

During a brake application, air pressure from the distributing valve above piston 9 forces this piston downward, which opens a passageway between pipe connections "A" and "B", permitting pressure from the distributing valve to pass to the brake cylinders. The vent valve 4 is held seated at this time by both air and spring pressure.

When the brake is released, reduced air pressure above the piston allows brake cylinder pressure underneath to lift the piston to its extreme upper position, the piston contacting vent valve stem nut 6 and unseating the vent valve. The passage between the pipe connections is now closed by the piston, and brake cylinder pressure is free to flow past the vent valve to the atmosphere through the ½" pipe tap "x". When the brake cylinder pressure is exhausted, the piston drops to normal position and seats the vent valve.

Centrifugal Dirt Collectors

Three Centrifugal Dirt Collectors are used with the equipment as shown on the piping diagram of Plate 13. One is installed in the branch pipe between the brake pipe and the distributing valve, as near the latter as circumstances will permit; one, with a drain cock between the distributing valve cut-out cock (main reservoir branch) and the distributing valve; and one, with a drain cock, is placed in the main reservoir pipe, between the main reservoir cut-out cock and the main reservoir branch pipes.

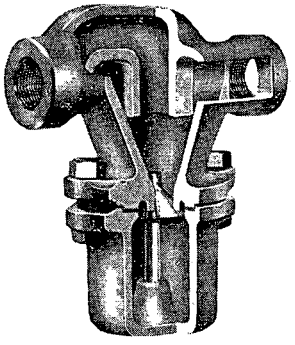


Fig. 26. Sectional View of "Check Valve Type" Centrifugal Dirt Collector

Fig. 26 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 easy cleaning, and the large capacity permits time between cleaning periods to be the same as for the distributing valve and brake cylinders.

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.

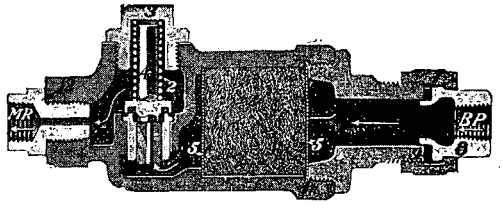


Fig. 27. Combined Air Strainer and Check Valve

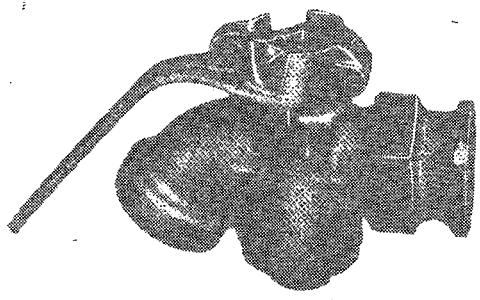


Fig. 28. Photographic View of the Angle Cock

Combined Air Strainer and Check Valve

The "Dead Engine" feature shown in the diagrammatic views and the piping diagram, is for the operation of the locomotive brakes when the compressor on a locomotive in a train is inoperative from any cause. Fig. 27 shows the combined strainer, check valve, and choke. As these parts are not required at other times, a cut-out cock is provided. This cock should be kept closed except under the conditions just mentioned. The air for operating the brakes on such a locomotive must then be supplied through the brake pipe from the locomotive operating the train brakes.

With the cut-out cock open, air from the brake pipe enters at BP, passes through the curled hair strainer, lifts check valve 4, held to its seat by a strong spring 2, passes through the choke bushing, and out at MR to the main reservoir, thus providing pressure for operating the brakes on this locomotive.

The strainer protects the check valve and choke from dirt. Spring 2 over the check valve insures this valve seating and, while assuring an ample pressure to operate the locomotive brakes, keeps the main reservoir pressure somewhat lower than the brake pipe pressure, thereby reducing any leakage from the former. The choke prevents a sudden drop in brake pipe pressure and the application of the train brakes, which would otherwise occur with an uncharged main reservoir cut in to a charged brake pipe.

Angle Cock

Fig. 28 illustrates the angle cock, one of which is installed at each end of the brake pipe. The cock is open with the handle parallel to the pipe line, as illustrated, and closed with the handle crosswise or at right angles to the pipe line.

The handle may be removed independently 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.

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. A split type socket is used and the rivet pin hole for locking the socket to the key is drilled through the split portion, engaging a notched-out cavity in the square of the key.

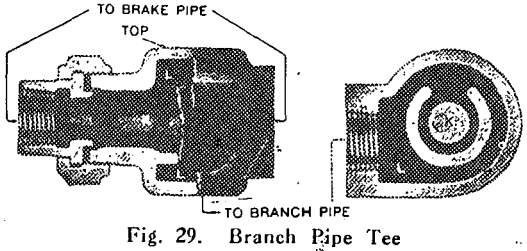


Fig. 29. Branch Pipe Tee

Branch Pipe Tee

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 valves.

Pipe Fixtures

The *Main Reservoir Cut-out Cock* is to cut off and vent the air from the main reservoir pipe when removing the brake valve, feed valve, reducing valve, etc. Before this cock is closed the double-heading cock should be

closed and the brake valve handle placed in *Release* position. This is to prevent the slide valve of the feed valve and the rotary valve of the brake valve being lifted from their seats.

The *Double-Heading Cock* is located in the brake pipe underneath the brake valve. In double-heading service, this cock must be closed on the second locomotive and the handles of the automatic and independent brake valves placed in *Running* position. The brakes on this locomotive can then be completely controlled from the head locomotive. However, the engineman on the second locomotive can apply or release his brakes independently of the train brakes by proper manipulation of the independent brake valve handle.

Cut-out Cocks are placed in the brake cylinder piping for cutting out the brake cylinders when necessary, and one is also placed in the branch pipe from the main reservoir pipe to the distributing valve.

Operation of the Equipment

It should be clearly understood that the diagrams of the equipment, Plates 1 to 14, are not intended to show the actual construction of the operative devices comprising the equipment but are distorted and drawn so as to make the connections and operation more easily understood.

AUTOMATIC OPERATION

The operation of the apparatus for the different positions of the automatic brake valve handle (assuming that the handle of the independent portion is carried in *Running* position) is as follows:

Charging the System—Plate 1

With the main reservoirs charged and the handle of the automatic portion of the brake valve in *Release* position, air flows from the main reservoir pipe through port A to chamber A above the rotary valve 6 of the automatic portion of the brake valve, thence through port N in the rotary valve and port *l* in the seat to the brake pipe, charging the entire system. Main reservoir air from chamber A also flows through ports *a* and *c* to chamber D above the equalizing piston and thence to the equalizing reservoir and air gage through passage s.

Main reservoir air flows through the brake pipe to chamber *p* of the distributing valve, thence through feed groove *v* over the top of equalizing piston 26 into the equalizing slide valve chamber above equalizing slide valve 31 and through port *o* to the pressure chamber.

If the brake valve handle were allowed to remain in *Release* position, the brake system would be charged to the same pressure as in the main reservoirs, and to prevent the engineman from forgetting this, cavity *r* in the rotary valve connects port *i* with the warning port *k* in the seat, allowing air from the feed valve to escape to the atmosphere with sufficient noise to attract the engineman's attention to the position of the handle.

Running—Plate 2

With the automatic and independent handles of the brake valve in *Running* position, Plate 2, cavity *r* in the automatic rotary valve connects ports *l* and *i* in the valve seat, affording a large direct passage from the feed valve pipe to the brake pipe, so that the latter will charge up as rapidly as the feed valve can supply the air, but cannot attain a pressure above that for which the feed valve is adjusted. From port *l* it also flows through port *l'*, cavity *j* and port *c* to chamber D above the equalizing piston. Chamber D is connected through port *s* and pipe connections, as shown, to the equalizing reservoir and gage. The purpose of the equalizing piston and reservoir will be described later, under "Service Application."

Port *l*, mentioned above, has a branch *v* which leads to the underside of the equalizing piston. Therefore, with the brake valve handle in *Running* position, the feed valve maintains a practically constant pressure (70 lbs. or 110 lbs. as the case may be) in the brake pipe and on the underside of the equalizing piston and the same pressure in the equalizing reservoir and chamber D on the opposite side of the piston.

The end of the equalizing piston stem is called the "equalizing discharge valve," which, when open, allows air from the brake pipe to flow through port *m*, past the equalizing discharge valve and through port *n* to the service exhaust fitting and atmosphere at EXHAUST. This valve is held to its seat during the time the brake pipe is being charged as above, as well as at all times when the air pressure (in pounds per square inch) is the same on the under and upper sides of the piston, because the pressure of the air above the piston acts on the entire area of the piston, while that below it acts on an area which is less than that above by the amount of the area of the piston stem. This makes the total pressure on the top of the piston slightly higher than that below, thus holding the piston down and the equalizing discharge valve on its seat.

Air entering the brake pipe at *l*, flows through this pipe and the branch pipe to chamber *p* of the equalizing portion of the distributing valve. Brake pipe air then flows through feed groove *v* over the top of piston 26 into the chamber above equalizing slide valve 31, and through port *o* to the pressure chamber, until the pressures on both sides of the piston are equal. The application chamber is connected through port *w*, cavity *k* (in the equalizing slide valve), port *i* and the distributing valve release pipe to EX in the brake valve through port *g*, cavity *h*, port *p*, cavity *q* and port *k*. The brake cylinder pipe is connected to the distributing valve exhaust and the atmosphere through ports *c*, *d* and *e*.

Service Application—Plate 3

The system being charged, as has been described, say to 70 lbs. brake pipe pressure, and the automatic brake valve handle is moved to Service position, port e, called the *preliminary exhaust port*, leading to chamber D and the equalizing reservoir is opened. This permits air to escape from above the equalizing piston through port *e* in the rotary valve seat, cavity *q* in the rotary valve and port *k* to the atmosphere. This at once reduces the pressure of the air on the top of the equalizing piston below that in the brake pipe under the piston, and the higher pressure forces the piston upward, raising the attached equalizing discharge valve from its seat and allowing air from the brake pipe to flow through open-

ing *m*, past the valve, and through passage *n* and the service exhaust fitting to the atmosphere.

It will now be clear that the purpose of the equalizing reservoir is to add volume to the chamber D above the equalizing piston. Without the equalizing reservoir this volume is so small that, with the brake valve handle in *Service* position, its pressure would drop to zero almost instantly and it would consequently be very difficult to make a moderate brake pipe reduction and practically impossible to obtain the exact amount of reduction desired in any given case.

When the pressure in chamber D is reduced to the desired amount, the handle is moved to *Lap* position, thus stopping any further reduction in that chamber. Whether the flow of air from the brake pipe ceases at once or continues for a period of time after the handle is placed in *Lap* position depends upon whether the train is a long or short one. With a short train the total volume of air in the brake pipe is not very great, so that it escapes through the service exhaust nearly as fast as the air in chamber D and the equalizing reservoir air is flowing out through the preliminary exhaust port *e;* thus the pressure below the equalizing piston is falling about the same rate as that above.

In such a case, as soon as the pressure in chamber D ceases to fall, the brake pipe pressure below the equalizing piston becomes slightly less than that above the piston and the higher pressure forces the piston downward, seating the equalizing discharge valve and preventing further flow of air from the brake pipe.

On a long train, however, the total volume of air in the brake pipe is large, so that it takes very much longer for sufficient air to escape through the service exhaust fitting to reduce its pressure, and the pressure below the equalizing piston, therefore, falls at a much slower rate than that above it. In such a case, air continues to escape from the brake pipe after the handle has been placed in *Lap* position for a period of time, depending upon the length of the train, until the brake pipe pressure has been reduced slightly below that in chamber D, when the equalizing piston is forced downward and the service exhaust opening closed as explained. It will be seen that the equalizing piston and valve automatically measure the amount of air which must be discharged from the brake pipe in order to obtain the desired reduction and govern the rate of its discharge, according to the length of the train, to a degree which would be impossible were the flow of air from the brake pipe to the atmosphere directly controlled by the brake valve handle. The equalizing piston, by closing slowly as the pressure falls, prevents a surge of air to the head end of the brake pipe which, if the opening were closed quickly, might cause some of the head brakes to release.

As the brake pipe is connected to chamber *p* of the distributing valve, a reduction in brake pipe pressure, as described, will lower the pressure on the brake pipe side of the equalizing piston 26 below that of the opposite side of the piston, which results in the piston moving toward the right. The first movement of the piston closes the feed groove *v*, and at the same time moves the graduating valve 28 until it uncovers the upper end of port *z* in the equalizing slide valve 31. As the piston continues its movement, the shoulder on the end of its stem engages the equalizing slide valve which is then also moved to the right until the piston strikes the graduating stem 44 of the cylinder cap, preventing further movement. Port *z* in the equalizing slide valve then registers with port *h* in the seat, and cavity *n* in the equalizing slide valve connects ports *h* and *w* in the seat. As the equalizing slide valve chamber is always in communication with the pressure chamber, air can now flow from the latter to both the application cylinder *g* and application chamber.

As pressure builds up in chamber *g* on the left of application piston 10, of the No. 6-KR Distributing Valve, the piston and attached exhaust slide valve 16 are moved to the right, cutting off the exhaust ports from slide valve chamber *b*. As the piston continues its movement, the end of its stem contacts application pilot valve 57, forcing the latter from its seat, allowing main reservoir air in chamber *a* to flow to the slide valve chamber *b*, thence through passage *c* to the brake cylinder pipe.

With the pilot valve unseated, pressure is reduced in chamber *a* faster than it can be restored from main reservoir pressure through choke *a2;* therefore, the application valve 54 approaches a balanced condition in which it is unseated by a slight excess of application cylinder pressure on the left of the application piston (chamber *g*) over brake cylinder pressure on the right of the piston. With application valve 54 unseated, main reservoir air in chamber *b* is free to flow to the brake cylinders through a large capacity opening. This provides an adequate rate of brake cylinder build-up for the large brake cylinder volume used on modern locomotives, with a very light differential across the application piston.

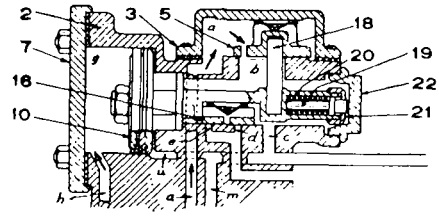


Fig. 30. Application Portion of the No. 6-E Distributing Valve in Service Position

In the No. 6-E Distributing Valve, the pressure in the application chamber forces application piston 10 to the right, causing exhaust slide valve 16 to close exhaust ports *e* and *d*, and to compress application piston graduating spring 20; also causing application valve 5, by its connection with the piston stem through the pin, to open its port and allow air from the main reservoirs to flow into chamber *b*, and through passage *c* to the brake cylinder pipe and thence to the brake cylinders, forcing their pistons outward and applying the brakes.

Quick release valves are interposed in the pipes to the front and rear brake cylinders. Air entering the chamber above piston 9 of the quick release valve forces this piston downward until it strikes a collar on the vent valve stem, clearing the valve body sufficiently to make a direct opening, thereby allowing air to flow from the brake cylinder pipe to the brake cylinders.

During the movement just described, cavity *t* in the graduating valve connects ports *r* and *s* in the equalizing slide valve, and by the same movements ports *r* and *s* are brought to register with ports *h* and *l* in the seat. This establishes communication between the application cylinder and the safety valve.

Service Lap—Plate 4

After the desired brake pipe reduction has been made, the automatic brake valve handle is returned from *Service* to *Lap* position, Plate 4. As has already been described, in this position of the brake valve the brakes are held applied throughout the train until a further application or release is made.

When the brake pipe reduction is not sufficient to cause a full service application, the conditions described above with reference to the distributing valve continue until the pressure in the pressure chamber is reduced enough below that in the brake pipe and chamber *p* to cause piston 26 to force graduating valve 28 to the left until stopped by the shoulder on the piston stem striking the right hand end of equalizing slide valve 31, the position known as *Service Lap*. In this position, graduating valve 28 blanks port *z* so that no more air can flow from the pressure chamber to the application cylinder and application chamber. It has closed port *s*, cutting off communication to the safety valve, so that any possible leak in the latter cannot reduce the application cylinder pressure, and thus similarly affect the pressure in the brake cylinders.

In the No. 6-KR Distributing Valve the flow of main reservoir air past application valve 54 to the brake cylinders continues until pressure at the right of application piston 10 slightly exceeds application cylinder pressure at the left of the piston, when the piston will move to the left. Springs then close application valve 54 and pilot valve 57, preventing further flow of air to the brake cylinders.

A greater differential of pressure on application piston 10 is required to move the piston and exhaust slide valve than to move the piston alone; therefore, the piston stops when it comes into contact with the slide valve. Here the exhaust slide valve 16 still blanks the exhaust ports *Ex*. In this lap position the pressures on both sides of the piston are balanced. Under this condition, if brake cylinder pressure should be reduced by leakage, the piston will move to the right, open the pilot valve or application valve far enough to restore brake cylinder pressure to approximately that of the application cylinder, when the piston will again be moved to lap position. This constitutes the brake cylinder *pressure maintaining feature*.

With the No. 6-E Distributing Valve, the flow of air past application valve 5 to the brake cylinder pipe continues until brake cylinder pressure slightly exceeds that in the application cylinder when the higher pressure and application piston graduating spring together force piston 10 to the left to the position illustrated, thereby closing the application port. Further movement is prevented by the resistance of exhaust valve 16, and the application piston graduating spring having expanded to its normal position. The brake cylinder pressure is then practically the same as that in the application cylinder and chamber.

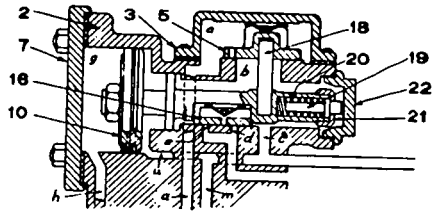


Fig. 31. Application Portion of the No. 6-E Distributing Valve in Service Lap Position

From the above description it will be seen that application piston 10 has application cylinder pressure on one side, *g*, and brake cylinder pressure on the other. When either pressure varies, the piston will move toward the lower.. Consequently, if that in chamber *b* is reduced by brake cylinder leakage, the pressure maintained in the application cylinder *g* will force piston 10 to the right, opening the application valve and again admitting air from the main reservoirs to the brake cylinders until the pressure in chamber *b* is again slightly above that in the application cylinder *g*, when the piston again moves back to *Lap* position. In this way the brake cylinder pressure is always maintained equal with that in the application cylinder. This is the *pressure maintaining* feature.

Release and Recharge—Plate 5

In *Release* position, air from the main reservoirs flows through port A to chamber A above the rotary valve, then through port N in the rotary valve to port *l* and thence directly into the brake pipe. At the same time air in chamber A also flows through ports *a* and *c* to chamber D above the equalizing piston and to the equalizing reservoir. While in this position, air from the feed valve pipe also flows through the warning port *r* in the rotary valve to port *k* and the atmosphere, with considerable noise. This indicates to the engineman that the handle is in *Release* position and attracts his attention if the handle is left there by mistake.

Main reservoir air that is admitted to the brake pipe through port *l* in the brake valve flows to the distributing valve chamber *p*, increasing the pressure therein above that in the pressure chamber, causing equalizing piston 26 to move to the left, carrying with it equalizing slide valve 31 and graduating valve 28 to the position shown. The feed groove *v* now being open permits the pressure in the pressure chamber to increase until it is equal to that in the brake pipe, as before described. This action does not release the locomotive brakes because it does not discharge application cylinder pressure. The release pipe is closed by the rotary valve of the automatic portion of the brake valve, and the application cylinder pipe is closed by the rotary valves of both portions.

To release the locomotive brakes, the handle of the automatic portion of the brake valve must be moved to *Running* position, Plate 2. The release pipe is then connected by the rotary valves to the atmosphere through port *g*, cavity *h* in the rotary valve of the independent portion of the brake valve, port *p*, cavity *q* in the rotary valve of the automatic portion, and port *k* to EX and the atmosphere. As cavity *k* in the equalizing slide valve 31 of the distributing valve connects ports *i*, *w* and *h* in the valve seat, the air in the application cylinder and chamber will escape through the distributing valve release pipe to the atmosphere. As this pressure reduces, the brake cylinder pressure will force application piston 10 to the left until exhaust valve 16 uncovers exhaust ports *d* and *e*, allowing brake cylinder pressure to escape, or in case of graduated release, to reduce in like amount to the reduction in application cylinder pressure.

As soon as pressure in the brake cylinder pipe is reduced by the distributing valve, the quick release valves function to make a like reduction in brake cylinder pressure. With the chamber above piston 9 connected to the distributing valve exhaust, brake cylinder pressure underneath will force the piston upward until the piston stem nut contacts the cap nut, when vent valve 4 will be unseated, permitting brake cylinder pressure to flow past the vent valve direct to the atmosphere.

Running position also closes the warning port, stops the direct flow of air from the main reservoir to the brake pipe, chamber D and the equalizing reservoir, and opens the supply of air to these parts through the feed valve, in which position the brake pipe, chamber D and the equalizing reservoir are charged and maintained at the standard pressure to be carried by the feed valve, as fully explained under "Running."

Holding After Automatic Service—Plate 6

To hold locomotive brakes applied while the train brakes are being released and the brake pipe recharged to feed valve pressure, the handle of the automatic portion of the brake valve is moved to *Holding* position. All ports register as in *Running* position with the exception that port *p*, which leads to the release pipe and application cylinder, is closed. Any air pressure which may be in the application cylinder from a previous service application is then held bottled there, preventing the air from releasing from the locomotive brake cylinders. Therefore, the only difference between *Running* and *Holding* positions is that in the former the locomotive brakes are released, while in the latter they are held applied.

Emergency—Plate 7

When it is desired to make the shortest possible stop, the brake valve handle is placed in *Emergency* position. This opens the brake pipe directly to the atmosphere through the large ports *l* and *l'*, cavity *y* and port *k*, causing an emergency rate reduction of brake pipe pressure. Cavity *y* also connects port *c* to the exhaust port *k*, thus allowing the air in chamber D and the equalizing reservoir to escape to the atmosphere. The reduction in brake pipe pressure thus caused takes place so much more rapidly than during a service application of the brakes that the air pressure in the pressure chamber of the distributing valve forces the equalizing piston 26 quickly to its extreme position at the right, sealing against the gasket and compressing equalizing piston graduating spring 46.

The movement of the equalizing piston to the right causes equalizing slide valve 31 to uncover port *h* in the seat, making a direct opening from the pressure chamber to the *application cylinder only*, so that they quickly become equalized. The application cylinder volume, being small, and connected with that of the pressure chamber at 70 lbs. pressure (low pressure service), equalizes at about 65 lbs. The application cylinder is now connected to the safety valve through port *h* in the seat, cavity *q* and port *r* in the equalizing slide valve, and port *l* in the seat. Cavity *q* and port *r* in the equalizing slide valve

are connected by a small port, the size of which is so proportioned to the size of the maintaining port in the automatic brake valve that air flowing from the main reservoir to the application cylinder will escape through the safety valve at a rate which will limit brake cylinder pressure, so that while it will be considerably higher than that obtained from a full service brake application, it will be less than main reservoir pressure.

As a result of the rapid, direct equalization of pressure chamber and application cylinder pressures, application piston 10 of the No. 6-KR Distributing valve is moved promptly to the right, opening the application valve 54 fully, which then produces a fast build-up of brake cylinder pressure as described under "Automatic Service."

In the No. 6-E Distributing Valve, when the application piston moves to the right, main reservoir air is permitted to flow from chamber *a* through the port in the application valve to chamber *b* and thence through port *c* to the locomotive brake cylinders as explained under Service Application.

The movable parts of the distributing valve remain in the position shown until the brake cylinder pressure slightly exceeds the application cylinder pressure, when the application piston 10 and the application valve move back to position known as *Emergency Lap*, as shown on Plate 8. (See Fig. 31 for position of No. 6-E Distributing Valve application portion parts).

The release after an emergency is brought about by the same manipulation of the automatic brake valve as that following service application, but the effect on the distributing valve is somewhat different. When the equalizing piston 26, equalizing slide valve 31, and graduating valve 28 are forced to the *Release* position by the increased brake pipe pressure in chamber *p*, the application chamber pressure which was cut off, is connected to the application cylinder, Plate 1, having emergency pressure therein, through port *w*, cavity *k*, and port *h*. The pressure in the application cylinder at once expands into the application chamber until these pressures are equal, which results in the release of brake cylinder pressure until it is slightly less than that in application cylinder and chamber. Consequently, in releasing after an emergency (using the *Release* position of the automatic portion of the brake valve), the brake cylinder pressure will automatically reduce to about 15 lbs., where it will remain until the handle is moved to *Running* position.

When piston 26 is moved back to its normal position, spring 46 forces graduating stem 44 back to the position shown on Plate 1.

If an Emergency Application is made by a conductor's valve, a burst hose, or parting of train, the operation will be as above described. The handle of the automatic portion of the brake valve should be immediately moved to *Lap* position, to prevent a loss of main reservoir pressure.

INDEPENDENT BRAKE OPERATION

As previously mentioned, the No. 14-EL brake equipment is operated in the same manner with either the K-14-B or K-14-F brake valve, and that the only difference is in the rotary valve and seat of the independent portion. In the K-14-F brake valve independent quick application position, two passages connect reducing valve air to the distributing valve application chamber, and one passage with the K-14-B. In independent release after independent application, the K-14-F provides two passages to vent the distributing valve application chamber air, and one is provided in the K-14-B. Plates 9 and 10 show the two brake valves diagrammatically in quick application position and Plates 12 and 13 show them in independent release position, where the above mentioned differences are clearly shown and later described.

The function of the application portion of the distributing valve is to control the flow of air to and from the locomotive brake cylinders, as described under automatic operation. The movement of the application piston, which actuates the exhaust and application valves, depends upon the variation of air pressure in the application cylinder, which pressure may be indirectly controlled by the automatic portion of the brake valve, through the movement of the equalizing piston and its slide valve and graduating valve, or directly by the *independent portion* of the brake valve. Therefore, when considering the use of the independent portion of the brake valve for locomotive brake manipulation, the equalizing portion of the distributing valve may be disregarded altogether, and the application piston considered as being moved by the air in the application cylinder, controlled directly by the independent portion of the brake valve.

The operation of the equipment for the different positions of the handle of the independent portion of the brake valve is as follows:

Running—Plate 2

This is the position in which the handle of the independent portion of the brake valve should be carried at all times when the independent brake is not in use. Cavity *h* in the rotary valve connects ports *g* and *p* in the seat, thus establishing communication through the Distributing Valve Release Pipe, between the applica-

tion cylinder of the distributing valve and EX of the automatic portion of the brake valve. The locomotive brake cylinder pipe is open to the atmosphere through ports *c*, *d* and *e*, to exhaust in the distributing valve.

Slow Application

The only operative difference between *Slow Application* position and *Quick Application* position, which is fully described below, is in the size of the opening in the rotary valve through which air is admitted to the application cylinder pipe and for that reason no diagrammatic is shown of the complete equipment with the handle of the independent portion in *Slow Application* position and the handle of the automatic portion in *Running* position. However, by referring to the independent portion of the brake valve shown on Plate 14, it will be seen that port *o* registers with port *t*, allowing main reservoir air that has been reduced to 45 lbs. (by passing through the reducing valve) to flow through ports *t*, *o* and the restricted tail-port to port *b*; thence through the application cylinder pipe to the application cylinder of the distributing valve, moving the application piston to the right and thereby permitting main reservoir air to flow to the brake cylinders, building up the pressure therein at the same rate as the application cylinder pressure is being increased. This flow will continue until the pressure in the brake cylinders slightly exceeds that in the application cylinder as described under "Service Lap."

Since the supply pressure to the distributing valve is fixed by the regulation of the reducing valve to 45 lbs. this is the maximum cylinder pressure that can be obtained.

Lap—Plate 11

Lap position, is used to hold the independent brake applied after the desired cylinder pressure is obtained, at which time port *b* leading to the application cylinder pipe and port *g* leading to the distributing valve release pipe are blanked by the rotary valves of the independent portion of the brake valve, and the application piston of the distributing valve moves to *Lap* position, as previously described. The brakes are thus held applied until a further application or a release is made. (As stated above, after a brake cylinder pressure of 45 lbs. is obtained no further application can be made with this portion of the brake valve.)

Release—Plate 2

To release the locomotive brakes the K-14-B or K-14-F brake valve handle of the independent portion of the brake valve is placed in *Running* position. This opens the distributing valve release pipe through port *g*, cavity *h* of the rotary valve of the independent portion of the brake valve, port *p*, cavity *q* of the rotary valve of the automatic portion and pork *k* to EX and the atmosphere, allowing air to escape from application cylinder *g* of the distributing valve to the atmosphere. The greater pressure (brake cylinder pressure) on the other face then forces the application piston to *Release* position, as shown. In this position the air in the brake cylinder pipe escapes to the atmosphere through ports *c*, *d* and *e* and the distributing valve exhaust. The quick release valves function, as already explained, to exhaust pressure in the brake cylinders direct to the atmosphere.

With the K-14-F brake valve a release of locomotive brake can be obtained by moving the independent brake valve handle to *Release* position. As shown on Plate 13, in this position cavity T in the independent rotary valve 6 connects seat ports *g* and *b* to the exhaust port k. This opens both the application cylinder pipe and the distributing valve release pipe to exhaust. Air from application cylinder *g* and passage *h* flows through the application cylinder pipe to the independent brake valve exhaust. Also, with the equalizing piston and slide valve 31 of the distributing valve in release position, Plate 2, cavity *K connects* passages *h* and *i*, permitting application cylinder air to flow through the distributing valve release pipe to the independent brake valve exhaust. Thus the air is exhausted more quickly from the application cylinder pipe than in *Running* position. The application piston then makes a corresponding release of brake cylinder pressure.

If the handle is returned to *Lap* position before all of the application cylinder pressure has escaped, the application piston 10 will return to *Independent Lap* position, Plate 11, as soon as the brake cylinder pressure is reduced a little below that remaining in the application cylinder, thus closing exhaust ports *e* and *d*, and holding the remaining pressure in the brake cylinders. In this way the independent release may be graduated as desired.

Quick Application—Plates 9 and 10

To obtain a quick application of the independent brake with the K-14-B brake valve, the handle of the independent portion of the brake valve is moved to *Quick Application* position Plate 9. The opening between ports *o* and *b* is larger than in *Slow Application* position, allowing supply air at 45 lbs. to flow rapidly from the reducing valve pipe to the application cylinder piston 10 to the right as shown. The distributing valve now operates as described under "Slow Application."

With the K-14-F brake valve a quick application of the independent brake is obtained in the same manner as with the K-14-B brake valve, except that in addition, warning port *z* in the rotary valve registers with port *g* in the rotary valve seat, Plate 10, permitting reducing valve air from rotary valve chamber F to flow through the distributing valve release pipe to the distributing valve, thence through passage *i* slide valve cavity *k* and passage *h* to the application chamber and application

cylinder *g*. The two channels of flow provide a build-up of application cylinder pressure which operates the application piston to produce a fast build-up of brake cylinder pressure as described under "Slow Application."

Independent Release After Automatic Service Application—Plate 12

If the brakes have been applied throughout the train by means of the automatic portion of the brake valve, as described under "Service Application," and it is desired to release the locomotive brakes, the handle of the independent portion of the brake valve is placed in *Release* position. This opens the application cylinder pipe to the atmosphere through port *b*, cavity *T* in the rotary valve, port *k* in the seat and EXHAUST. The air in the application cylinder *g* is then free to flow to the atmosphere through port *h* of the distributing valve and the application cylinder pipe. Brake cylinder pressure in chamber *b* forces the application piston from *Lap* position, Plate 11, to *Release* position, permitting air in the brake cylinder pipe to escape through port *c* to chamber *b* and thence to exhaust and the atmosphere through ports *d* and *e*, thus releasing the locomotive brakes. None of these operations change the conditions in either the pressure chamber or brake pipe; consequently, the equalizing piston does not move until release is made by the automatic brake valve.

It will be noted that ports *t* and G in the seat of the independent portion of the brake valve are connected through the rotary valve, thus allowing air from the reducing valve pipe to escape to the atmosphere in *Release* position. This acts as a warning to the engineman in case the return spring is broken and fails to return the handle to *Running* position.

Independent Application after an Independent Release—Automatic Brakes Applied—Plate 14

If it is desired now to re-apply the locomotive brakes after a release, the train brakes remaining applied, the handle of the independent portion of the brake valve is placed in *Slow* or *Quick Application* position. The locomotive brakes are then re-applied as already described under "Slow Application."

EQUIPMENT WITH INDEPENDENT BRAKE CONTROL OF LOCOMOTIVES IN DOUBLE HEADING SERVICE

This equipment is the same as that already described except that a No. 6-DKR Distributing Valve is substituted for the No. 6-KR; a three position Brake Pipe Cut-out Cock is substituted for the brake pipe cut-out cock under the brake valve: and, in addition to the

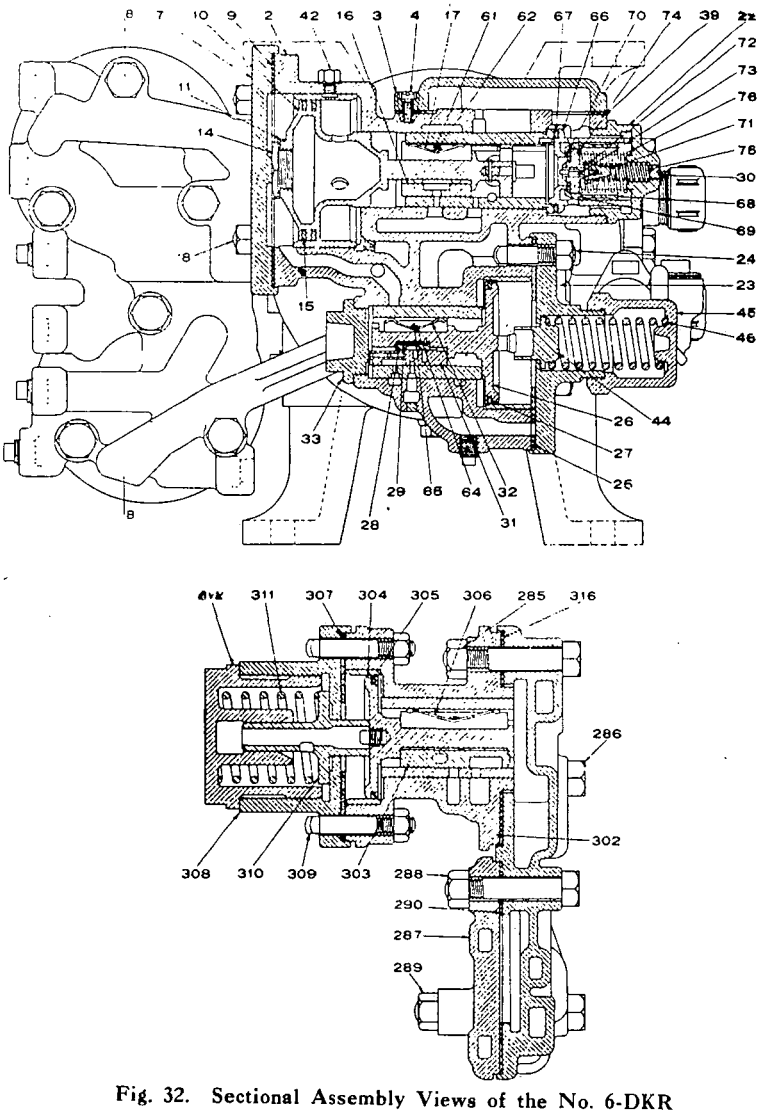


Fig. 32. Sectional Assembly Views of the No. 6-DKR

brake pipe and the main reservoir pipe, a third pipe, the Equalizing Pipe, runs throughout the length of the locomotive. See plate 17 for typical piping diagram of the equipment.

The No. 6-DKR Distributing Valve is the same as the No. 6-KR except that a Filling Piece is inserted between the valve and reservoir portions, to which is bolted a Transfer Valve portion and a Dead Engine Fixture.

The Transfer Valve serves to relay in double heading the operation of the distributing valve on the first or controlling locomotive to that on the second locomotive, and thus provides independent brake control on both locomotives.

The Dead Engine Fixture performs the same function as the cut-out cock and combined strainer and check valve described on Page 53.

The Brake Pipe Cut-out Cock under the brake valve controls the usual brake pipe connection to the brake valve and also the main reservoir pipe connection to the transfer valve piston chamber.

The Equalizing Pipe serves as the connection between the distributing valve (of locomotives in double heading service), which provides control of the independent brake on both locomotives by connecting brake cylinder pressure developed on the first (or controlling) locomotive to the application cylinder pipe connection of the distributing valve on the second locomotive.

A Brake Pipe Vent Valve is used to insure the transmission of quick action, originating on either locomotive, to the train and vice versa, when operating in road service.

Transfer Valve

The Transfer Valve, Fig. 32 (Section B-B), consists of a piston and slide valve, and is attached to a filling piece to which all pipe connections are made except the brake pipe and the brake cylinder pipe. The slide valve chamber is connected to main reservoir pressure, while the piston chamber is connected to main reservoir pressure or to atmosphere, depending upon the position of the double cut-out cock.

The transfer valve, see diagrammatic view, Plate 18. has port connections as follows:

To Cut-out Cock.

To Main Reservoir Supply Pipe.

To Brake Cylinder Pipe.

To Equalizing Pipe.

To Application Cylinder and Equalizing Slide Valve Seat.

To Application Cylinder Pipe.

When the piston and slide valve are in forward position (piston chamber open to atmosphere), the Application Cylinder Pipe is open through the slide valve so that connections between the brake valve and the distributing valve are the same as with the standard No. 6-KR, the only difference being that the transfer slide valve connects the brake cylinder pipe to the equalizing pipe.

With the piston and slide valve in forward position (main reservoir pressure in piston chamber), the application cylinder is cut off from the brake valve and connected to the equalizing pipe so that the operation of the distributing valve on the controlling locomotive will be relayed to the second locomotive through the equalizing pipe, that is, the distributing valve on the second locomotive will function to duplicate the brake cylinder pressure developed on the controlling locomotive.

Three Position Cut-out Cock

The Cut-out Cock under the brake valve serves as the usual brake pipe cut-out cock in addition to other

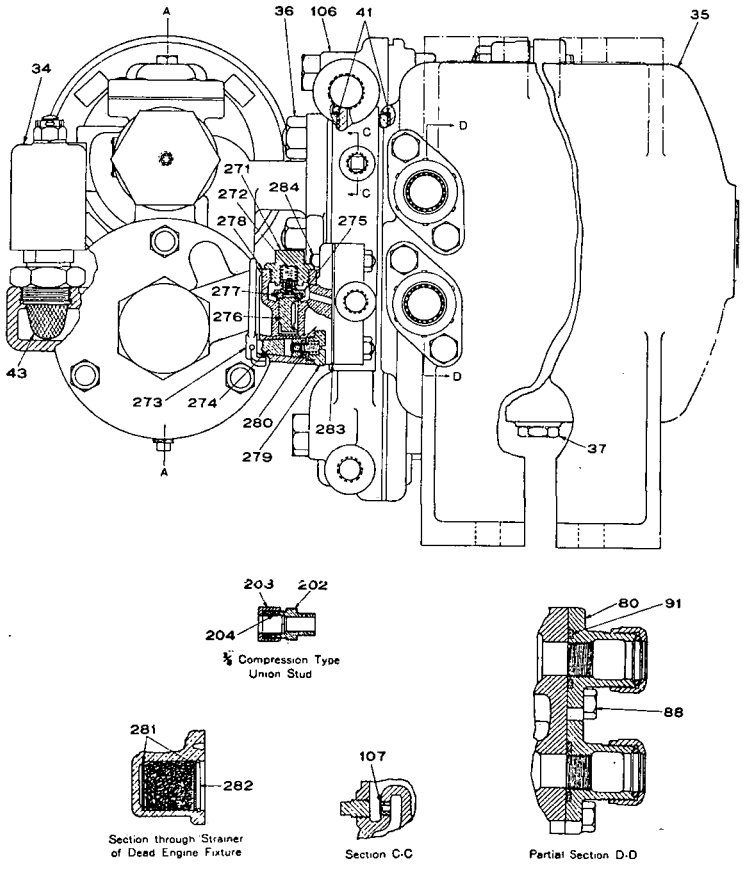


Fig. 33. Outline and Details of No. 6-DKR Distributing Valve (Dead Engine Fixture Shown Includes Refs. 271 to 283)

functions. This cock Fig. 34 has three operative positions:—position No. 1 with handle horizontal or crosswise of the pipe; position No. 2 with handle upward (parallel with pipe); and position No. 3 slightly beyond position No. 2. Pipe connections (See Plate 17) are as follows: brake valve (1); brake pipe (2); transfer valve operating pipe (4); main reservoir pipe (5); main reservoir (cock seating pipe) (6).

Provision is made so that the handle cannot be accidentally placed in No. 3 position. The body is provided with stop lugs for position No. 1 and 2, and with a stop lug for No. 3, in a higher plane. There is a stop pin 8 in the handle instead of the usual plug. Normally the handle can be freely moved between position No. 1 and 2, but to move it into position No. 3, requires that the stop pin 8 be raised against the tension of spring 7, so that it will pass over the lug for position No. 2.

When the locomotive is operated as a single unit, or as No. 1 in double heading, the cut-out cock will be in position No. 1, opening the brake pipe connection to the brake valve and connecting the piston chamber of the transfer valve to the atmosphere.

On a locomotive operating as the second unit in double heading the cut-out cock will be in position No. 2, closing the brake pipe connection to the brake valve and connecting the transfer valve piston chamber to main reservoir pressure.

When a locomotive is hauled "dead" in a train the handles of the brake valve should be in *Running* position—then the cock under this brake valve should be in position No. 3 (same as position No. 1 except the brake pipe connection is closed), (it is understood, of course, that the dead engine cock should be opened the same as with the No. 6-ET equipment).

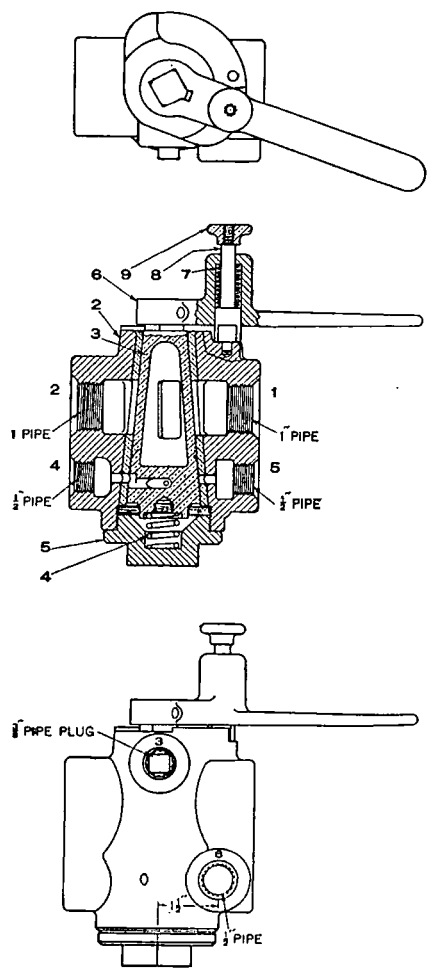


Fig. 34. Three Position Cut-out Cock

When a locomotive is used as a pusher the cut-out cock should be placed in the same position as for a "dead" engine operation, but the dead engine cock should remain closed.

Operation of Equipment with No. 6-DKR Distributing Valves

The operation of this equipment, see diagrammatic view on *Plate* 18, is the same as that already described except as follows:

Independent Application

With the handle of the independent brake valve in either Slow or Quick Application positions, reducing valve air instead of flowing direct to application cylinder *g* of the distributing valve, now flows to the filling piece and through passages 4, K, 4a to cavity b in the transfer valve slide valve 303 and thence through passage 4b to the application cylinder. Brake cylinder pressure flows to the equalizing pipe through passage BC and cavity c in slide valve 303. In double heading service, brake cylinder air in the equalizing pipe flows to cavity b in slide valve 303 of the transfer valve on the second locomotive and thence through 4b to the application cylinder, which causes the application portion of this distributing valve to function in the same manner as that on the operating locomotive.

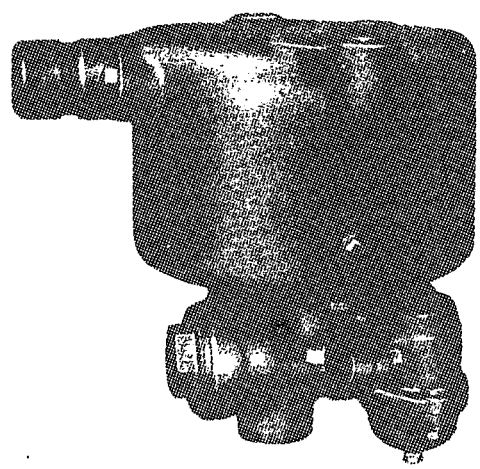


Fig. 35. Exterior View of No. 4-B Brake Pipe Vent Valve

Independent Release

In *Running position* of the independent brake valve, air from the application cylinder of the distributing valve instead of passing direct from passage *i* into the release pipe now flows through passage 1a, H and 1 in the filling piece, and thence through the release pipe to the brake valve exhaust.

As the brake cylinder pressure is reduced, the equalizing pipe pressure is also thereby reduced (through the transfer valve) and causes the release of the brake on the second locomotive, the application cylinder of its distributing valve being connected to the equalizing pipe through the transfer valve.

Multiple Unit Operation

When two locomotives are coupled together, the brake pipe, main reservoir pipe and equalizing pipe hose must be coupled up between the two locomotives and their cocks opened.

Where there are two or more locomotives in a train, the instructions already given remain unchanged so far as the leading locomotive, or the locomotive from which the brakes are being operated, is concerned.

On the second locomotive, operating as a multiple unit, the brake pipe cut-out cock is moved to position No. 2, closing the brake pipe connection to the brake valve and connecting the transfer valve piston chamber to main reservoir pressure. Move the handle of the automatic brake valve to Lap position and the independent brake valve handle to Running; after which remove both the brake valve handles. The brake of the second locomotive is then operated from the first locomotive the same as on the first locomotive.

No. 4-B Brake Pipe Vent Valve

The purpose of the Brake Pipe Vent Valve is to provide a means of propagating quick action (emergency application) from the locomotive to the cars in the train or vice versa. It is connected to a branch pipe from the brake pipe at fitting 42, Fig. 36. Fig. 36 shows a sectional and Fig. 35 an exterior view of the No. 4-B Brake Pipe Vent Valve. This device comprises an emergency piston 2, with its slide valve 3, a quick action valve 4 and quick action piston 5, and an actuating volume called the quick action chamber. Strainer 37 protects the piston and slide valve from dirt.

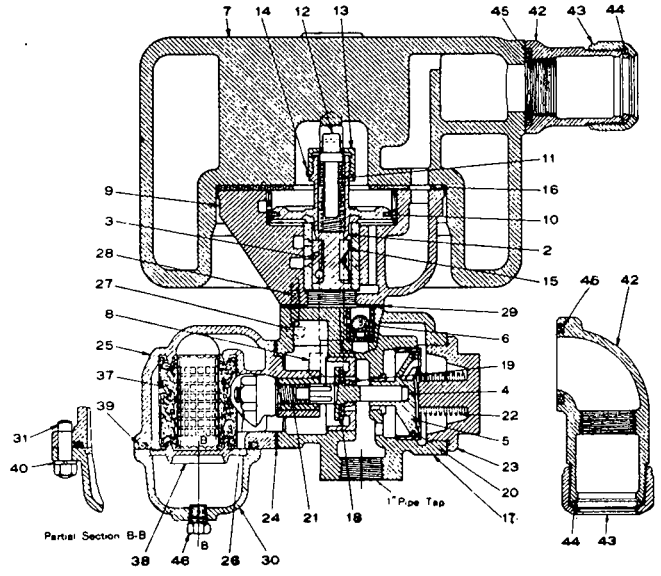


Fig. 36. Sectional View of No. 4-B Brake Pipe Vent Valve

Brake pipe air entering the Vent Valve, Fig 37, flows through passage *a* to chamber *E* at the left of quick action valve 4 and thence through strainer 37 and passage *b* to chamber *A* above the emergency piston 2, forcing the piston to its lowest position. This opens charging port *c* in the piston bush, permitting brake pipe air to flow past ball check valve 6 and through passage *c2* to the slide valve chamber *B* and thence through passage *d* to the quick action chamber, charging the latter to brake pipe pressure.

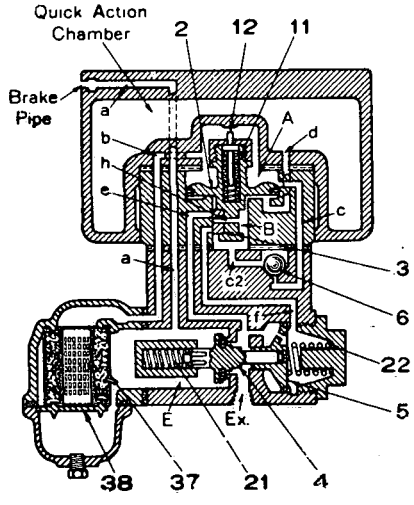


Fig. 37. Brake Pipe Vent Valve in Normal Position

The reduction in brake pipe pressure during a service application takes place at the Vent Valve also, and the air flows from the piston chamber *A*, Fig. 38, through passage *b*, and strainer 37, to chamber *E*, thence through passage *a* to the brake pipe. The pressures on the emergency piston 2 are unbalanced and it moves upward until its piston stop 12 strikes the cap where spring 11 prevents further travel of the piston. The charging port *c* is now closed by the piston and the slide valve chamber *B* is

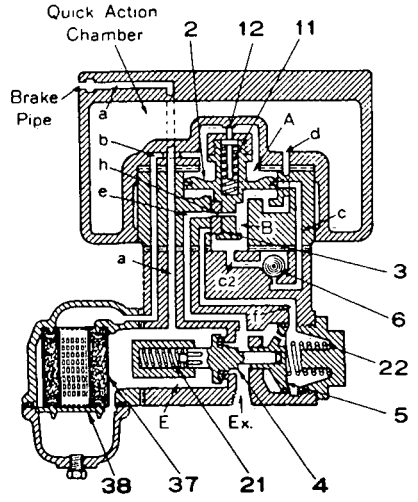


Fig. 38. Brake Pipe Vent Valve in Service Position

connected through the slide valve port *h* to the exhaust passage *e*. This permits quick action chamber pressure to reduce in pressure at the same rate as the brake pipe pressure, thus preventing operation of the quick action valve during service applications. (When the brakes are released, the quick action chamber is again charged as previously described under "Release and Charging.")

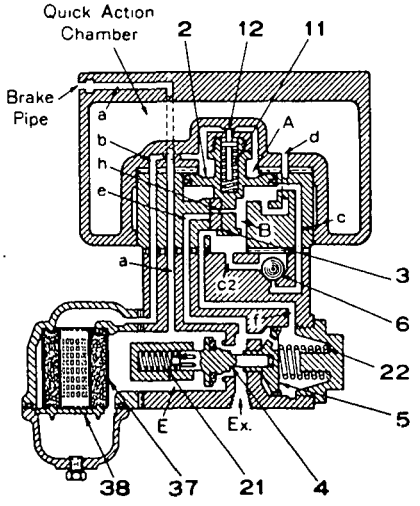


Fig. 39. Brake Pipe Vent Valve in Emergency Position

An emergency rate of brake pipe reduction also occurs at the Vent Valve. With the sudden pressure drop in chamber *A*, the higher Quick Action Chamber pressure in chamber *B* forces the piston upward, compressing spring 11, and carrying slide 3 to its limit of travel, which uncovers port *f*, Fig. 39. Quick action chamber air in chamber *B* then flows through passage *f* to the outer face of quick action piston 5, and since there is no air pressure on the opposite face of the piston, it is moved to the left, unseating quick action valve 4. This creates a direct opening from chamber *E* to the atmosphere and accomplishes a rapid venting of brake pipe air from passage *a* and the brake pipe, thus propagating quick action to adjacent locomotive and cars.

A small vent port through the quick action piston allows quick action chamber air to bleed down until spring 21 can force both the valve and piston to their normal position, thus closing the outlet to the atmosphere and permitting the brake pipe (and quick action chamber) to be recharged when desired, as already explained.

DOUBLE END EQUIPMENT

Plate 19

For double end locomotive equipment, the K-14-A Brake Valve and No. 14-KR Distributing Valve are used instead of the K-14-B Brake Valve and No. 6-KR (or 6-E) Distributing Valve as described on preceding pages. The long distributing valve release and application cylinder pipes between the two brake valves of a double end equipment add considerable volume to the application chamber and, therefore, result in a lower application chamber pressure. To offset this effect, the No. 14-KR distributing valve and the K-14-A brake valve are provided with compensating ports, which is the only difference between these valves and those already described with the single end equipment. Compensating ports are unnecessary with single end equipment because of the short piping between the brake valve and the distributing valve.

In the rotary valve of the K-14-A Automatic Brake Valve, a compensating port *w*, Fig. 13, supplies main reservoir air to the application cylinder pipe in Automatic Service position, and to the brake pipe in *Release* position. The air supplied to the application cylinder pipe during a service application passes to the distributing valve where it has access to both the application cylinder and the application chamber. This offsets the effect of a long application cylinder pipe which would tend to increase the volume of the application cylinder, and hence decrease the pressure obtained in the brake cylinders for any given brake pipe reduction.

Compensating ports in the distributing valve permit brake pipe air to flow into the distributing valve release pipe during an automatic service application. This serves as a quick service feature in that it causes a slight reduction in brake pipe pressure in the distributing valve, and also prevents any drop in application chamber pressure (and, therefore, in brake cylinder pressure) when the automatic brake valve handle is returned to *Holding* position after an automatic service application.

The "Dead Engine Fixtures" (cut-out cock and combined strainer and check valve) are omitted since this feature is incorporated with the "F-1" brake application valve, as described under the "Safety Control Feature."

The remainder of the details of the equipment is the same as that for single end locomotives as listed under "Parts of the Equipment," with the exception that *two* each of the following items are required instead of *one*: *equalizing reservoir; double heading cock; set of duplex air gages, and brake valve.*

SAFETY CONTROL FEATURE

The safety control feature, as incorporated with the No. 14-EL brake equipment, functions only in case the engineman fails to hold the foot pedal down, without first making a brake application.

Unless a service brake application has first been made, or a straight-air application resulting in about 35 pounds brake cylinder pressure, an emergency application of the brake will occur, if the foot valve pedal is not held down.

The safety control feature as installed with the Brake Equipment consists of apparatus as described on the following pages.

Type "F" Brake Application Valve

The brake application valve, Figs. 40 and 41, consists of a pipe bracket 20 to which all pipe connections are made, an application valve 2 which incorporates the cut-off valve 49 and the cut-out cock 16, and the "dead engine" feature 29. The application valve portion and the dead engine fixture portion are bolted to the pipe bracket and may be removed without breaking any pipe joints. Taps in the pipe bracket provide for pipe connections as follows:

M.R. —1″ pipe to main reservoirs.
B.P. —1″ pipe to brake pipe.
Ex. —1″ exhaust pipe.
F.V. —¾″ pipe to feed valve.
F-1 —⅜″ pipe to foot valve on one end.
F-2 —⅜″ pipe to foot valve on other end.
B.C. —⅜″ pipe to brake cylinder pipe.

A *double check valve* 24, which is incorporated in the pipe bracket, serves to open communication between the brake application valve and the operating foot valve, and to cut-off communication with the non-operating foot valve. The double check valve is readily accessible upon removal of the cover plate 26.

The application piston 3 of the *brake application valve* is held in normal, or release, position by the action of spring 8 on the piston stop 7, and the slide valve 6 makes connections as follows: (a) main reservoir pressure in the slide valve chamber to feed valve supply pipe; (b) brake cylinder pipe to the cut-off valve. In application position of the slide valve 6, the brake pipe is connected to the exhaust port, the air supply to the feed valve is cut off; the port leading to the brake cylinder pipe is blanked, and the passage leading to the cut-off valve is vented to atmosphere.

By sealing pressure in the chamber on the face of piston 3 when the brake is applied, the *cut-off valve* permits removal of foot from the operating foot valve pedal without causing the movement of piston 3 or slide valve 6 to application position. Brake cylinder pressure on top of diaphragm 48 deflects it downward, causing the small diaphragm 43 to seal the passage leading to the face of the application piston.

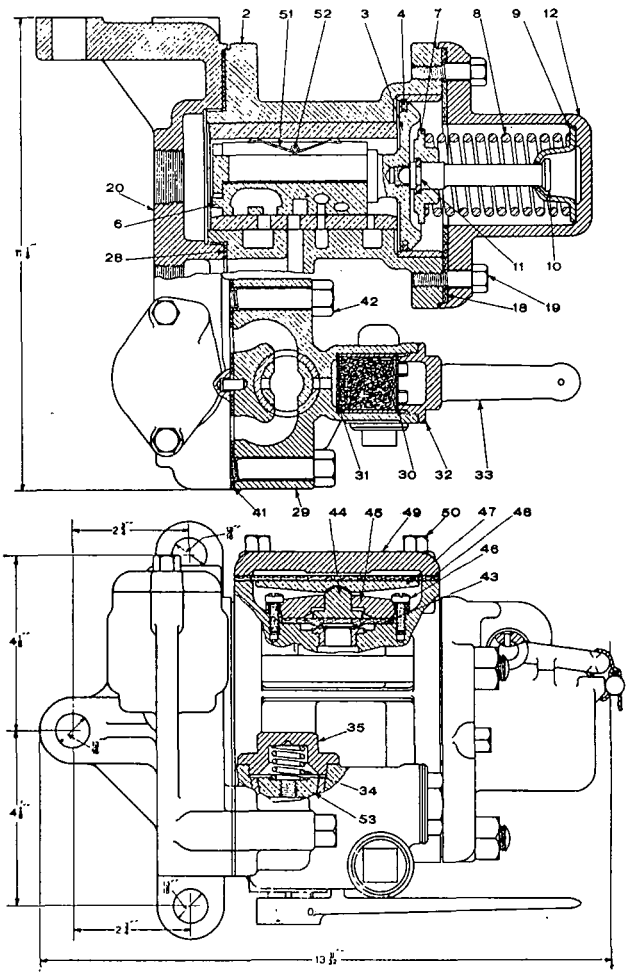


Fig 40. Outline and Sectional Views of the Type "F" Brake Application Valve

The *cut-out cock* 15, incorporated in the cylinder cap 12, permits cutting out the safety control feature by by-passing main reservoir pressure in the application piston slide valve chamber around to the face of the piston, and cutting off communication with the foot valve. The handle 16 of this cut-out cock is provided with a sealing arrangement to hold it in cut-in position, so that it is necessary to break the seal to cut out the safety control feature.

The *"dead engine" feature* is composed of a cut-out cock 33, a strainer 30 and a check valve 36 combined into a single device which provides the same function as the cut-out cock and the combined strainer and check valve standard with the No. 6-ET equipment.

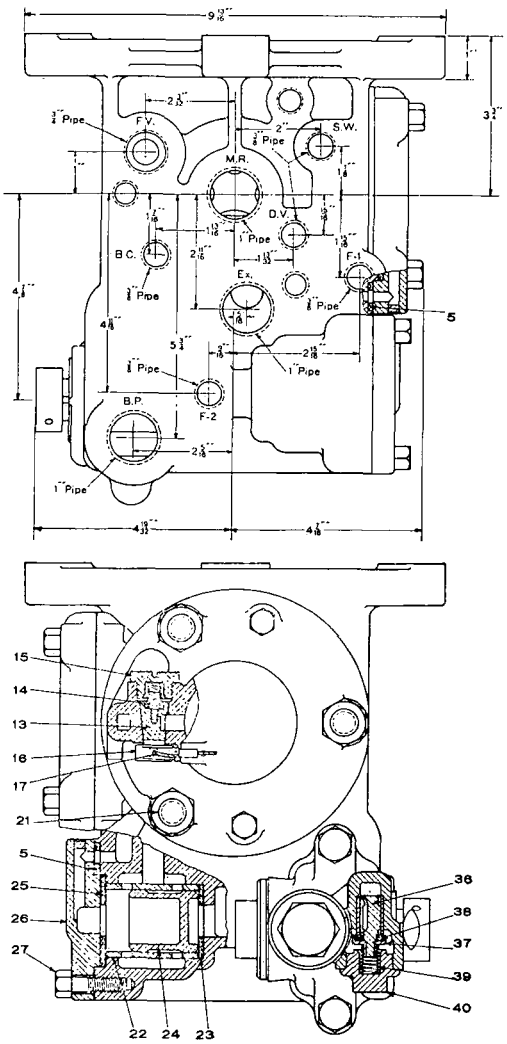


Fig. 41. Outline and Sectional Views of the Type "F" Brake Application Valve

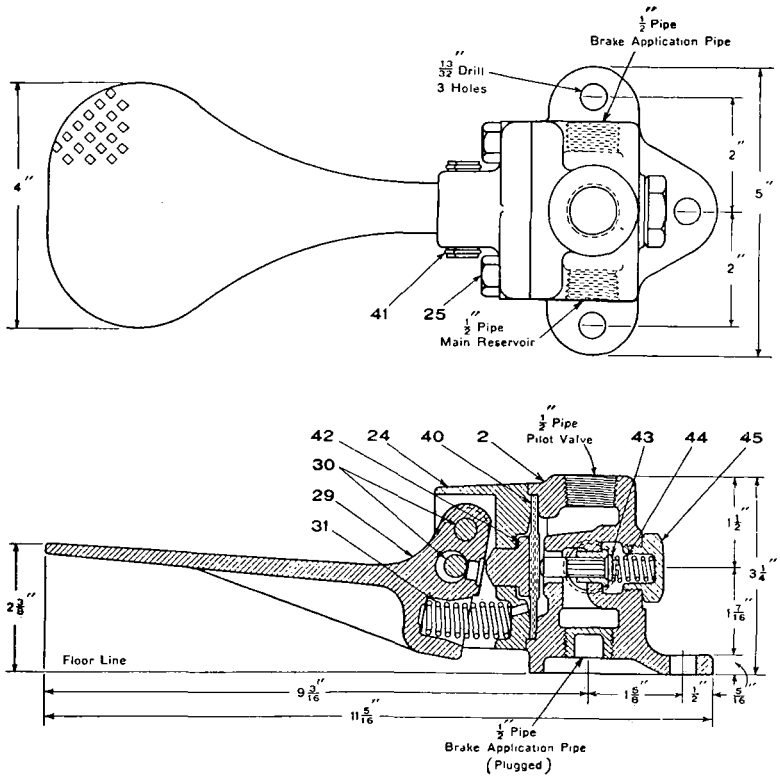


Fig. 42. Plan and Sectional Views of the Diaphragm Foot Valve

Diaphragm Foot Valve

The diaphragm foot valve is conveniently located in each control cab, as the foot valve pedal in the operating end must be held depressed at all times to prevent an emergency brake application unless a service application has first been initiated and sufficient pressure built up in the brake cylinders to render the brake application valve inoperative. Three ½" pipe taps are provided; one in the top to atmosphere, one side for connection to main reservoir pressure, and the other side for connection to the brake application valve.

The principal parts of the diaphragm foot valve, Fig. 42, are: the diaphragm 40, follower 42, foot pedal 29 and spring 31, valve 43 and spring 44. Normally (without pressure on the foot pedal) the diaphragm is unseated, connecting the brake application valve (double check valve) to the atmosphere, and valve 43 is seated preventing passage of main reservoir pressure to the atmosphere. Downward pressure on the foot pedal compresses spring 31 and contact with the follower 42 transmits the pedal movement to diaphragm 40, causing the seating of the diaphragm which cuts off the atmospheric connection to the brake application valve.

Valve 43 is normally held seated by spring 44 and main reservoir pressure which is always present in the spring chamber. When the diaphragm is deflected by foot pedal pressure as explained above, however, the diaphragm contacts with the valve stem and unseats the valve with the result that main reservoir pressure is free to flow past valve 43 to the brake application valve where its presence insures against an emergency brake application being initiated by that device.

Safety Control Feature Operation
Plate 20

The safety control feature consists of the brake application valve and two foot valves, one at each end of the locomotive. It is necessary to hold the foot valve pedal depressed on the operating end, unless there is a predetermined amount of brake cylinder pressure, in order to prevent an emergency application of the brakes.

With the foot valve pedal depressed, diaphragm 40 is held against its seat and valve 43 is unseated, so that main reservoir pressure can pass by valve 43 and through pipe F-1 to one side of double check valve 24 in the brake application valve. This pressure will force double

check valve 24 to a position which will cut off the foot valve on the non-operating end, and main reservoir air can then pass through passage f-3 to the diaphragm seat of the cut-off portion of the brake application valve. With no brake cylinder pressure above diaphragm 48 of the cut-off valve, diaphragm 43 will be unseated, and main reservoir air can pass through passage f-4 to chamber B on the left of application piston 3.

Main reservoir pressure is present at all times on the right of application piston 3, consequently pressures on this piston will be equalized and spring 8 on the left will move the piston and its slide valve 6 to release position, as shown by Plate 20. In this position, main reservoir pressure is connected past the left end of application slide valve 6, through a passage, to pipe FV leading to the feed valve. Brake cylinder pressure is connected through cavity *d* in slide valve 6 to passages which lead to the chamber above cut-off diaphragm 48.

If, for any reason, pressure is relieved from the foot valve pedal, valve 43 of the foot valve will close and cut off the supply of main reservoir pressure to the left of application piston 3 of the brake application valve, and at the same time diahragm 40 of the foot valve will be unseated, allowing pressure in pipe F-1 to flow to atmosphere through the foot valve exhaust. This will cause a reduction of pressure on the left of application piston 3 of the brake application valve, and main reservoir pressure on the right of this piston will then move the piston and slide valve to the left (application position).

In application position of slide valve 6, the supply of main reservoir air to the feed valve is cut off, and cavity *b* in the slide valve connects brake pipe pressure to the brake application valve exhaust. As the exhaust ports are of sufficient size to vent brake pipe pressure at an emergency rate of reduction, the distributing valve will function to make an emergency brake application as described under "Emergency Position." The flow of brake cylinder air to the chamber above diaphragm 48 is cut off by the slide valve 6, and the chamber is connected to atmosphere through slide valve cavity *a* in order that the cut-off valve will remain open and make possible the release of the brake.

The safety control feature will not function when the brake has been applied and there is a predetermined pressure built up in the brake cylinders. Diaphragm 43 of the cut-off valve will be seated, due to brake cylinder pressure acting on diaphragm 48, and pressure may be relieved from the foot valve pedal without affecting the brake application valve. The reason for this condition is that, while pressure will be vented from passage f-3, the pressure between diaphragm 43 and the chamber to the left of piston 3 will not be disturbed.

With cock 16 closed, pressure from the slide valve chamber is by-passed around the piston, and connection between pipe F-1 and chamber B to the left of piston 3 is closed so that the safety control feature will be inoperative.

Release After Safety Control Application

The brakes cannot be released until the pedal of the foot valve is again depressed, so that main reservoir air can flow through the foot valve to the application valve, causing the piston and slide valve to move back to release position as soon as the combined spring and air pressures in chamber B are able to overcome the main reservoir pressure in slide valve chamber A back of the application piston. The feed valve port in the seat is again uncovered by the slide valve, and main reservoir air is free to flow to the feed valve where it is reduced to brake pipe pressure and flows through the feed valve pipe to the brake valve. As the brake pipe port in the seat of the application slide valve is blanked by the slide valve, the brake pipe can be recharged and the brakes released.

The handle of the automatic brake valve should be in *Running* position.

WARNING—The handle of the automatic brake valve should never be placed in *Release* position when the locomotive is running over the road. To avoid this possibility, it is recommended that automatic brake valve handles be fitted with Full Release Position Nullifiers.

Dead Engine Feature

The "dead engine feature" portion of the brake application valve provides for operation of the brakes on a locomotive with an inoperative air compressor when such locomotive is hauled as part of a train. As brake cylinder pressure is supplied from the main reservoirs with this type of equipment, it is necessary to have available a supply of main reservoir pressure in order to operate the brakes.

A diagrammatic view of the dead engine feature, which is attached to the pipe bracket of the brake application valve, is shown in cut-out position (for normal brake operation) by Plate 20. To cut in this feature, the dead engine cock 33 is turned up to vertical position, in which brake pipe air is disconnected from the application slide valve and connected to the main reservoirs, through slide valve chamber A, which are thus charged to a pressure less than brake pipe as governed by the check valve spring 39. In this position, air from the brake pipe flows through the cock and strainer and past spring loaded check valve 36 into the slide valve chamber A, which is always in communication with the main reservoirs through pipe MR.

Small ports restrict the passage of brake pipe air through the dead engine fixture and thereby prevent a sudden drop in brake pipe pressure and application of the train brakes, which otherwise would occur with uncharged main reservoirs cut in to a charged brake pipe.

The strainer protects check valve 36 from dirt, and a strong spring underneath insures seating of this valve and, while assuring ample pressure to apply the locomotive brakes, keeps the main reservoir pressure lower than brake pipe, thereby preventing any back-flow from the main reservoirs into the brake pipe.

With the dead engine feature cut in, the double heading cocks should be closed, the safety control cock 16 turned up to cut-out position and both brake valve handles carried in *Running* position. If for any reason it is desired to apply or release the locomotive brakes, it can now be accomplished by means of the independent brake valve.

Rules for Operating

The following instructions are intended to cover in a general way the proper method of handling the No. 14-EL equipment in service, and do not apply rigidly to all individual cases or conditions. Specific instructions are usually issued by each railroad to cover its own recommended practice in accordance with the local operating conditions, and the representatives of the Westinghouse Air Brake Company (see list of offices on last page) will be glad to co-operate, with this object in view.

Charging

Before starting the air compressor (the locomotive not being coupled to the train), *close* the drain cocks in the reservoirs; the brake pipe cut-out cocks (or angle cocks), at each end of the locomotive; the cut-out cock under the alarm whistle not to be used and the double heading cock under the brake valve not to be operated (double-end equipment only); also the dead engine cut-out cock. See that all the following cocks are *open*: main reservoir cut-out cock; brake cylinder cut-out cocks; cut-out cock under alarm whistle to be operated; double heading cock under the brake valve to be operated; distributing valve cut-out cock; all brake pipe cut-out or angle cocks between cars and locomotive.

See that all hand brakes are fully released.

Place the handles on the brake valve to be operated (the cut-out cock underneath it being open) and move them to *Running* position.

Do not attempt to move the train (or locomotive) until the brake pipe gage hand shows full brake pipe pressure, and it is known that the brakes are cut in and operating properly.

The instructions for manipulating the EL equipment are practically the same as those given for the No. 6-ET Equipment which is standard for use on steam locomotives; therefore, no radical departure from present methods of brake manipulation is required to get the desired results.

AUTOMATIC BRAKE

Running

When not in use, carry both brake valve handles in *Running* position.

Service

To apply the brakes in service, move the handle of the automatic brake valve to the *Service* position, making the required brake pipe reduction, then back to *Lap* position which is the one for holding all the brakes applied.

Release

It is, as a rule, safest to come to a stop before releasing the brakes on a freight train, especially a long one, rather than attempt to release at low speed. However, if conditions permit the release while in motion, the brake valve handle should be moved to *Release* position and held there long enough to move as many of the triple valves to release position as possible without overcharging the head end of the train (the time in *Release* position should be governed by the length of train, amount of reduction made, etc.) then return to *Running* position to release the locomotive brakes and complete the recharging of the auxiliary reservoirs. A few seconds after such a release, particularly on long trains, it is necessary to again move the handle to *Release* position and quickly back to *Running* position to "kick off" any brakes at the head end of the train that may have reapplied due to their auxiliary reservoirs having been slightly overcharged.

Holding Locomotive Brakes Applied

If, when releasing as explained above, it is desired to hold the locomotive brakes applied after the other brakes release, move the handle from *Release* back to *Holding* instead of *Running* position, then releasing the locomotive brakes fully by moving the handle to *Running* position and leaving it there, or graduating them off, as circumstances require, by short successive movements between *Holding* and *Running* positions.

Emergency

To apply the brakes in emergency, move the handle of the automatic brake valve quickly to *Emergency* position and leave it there until the train stops and the danger is past.

INDEPENDENT BRAKE

When using *the independent brake only,* the handle of the automatic brake valve should be carried in *Running* position. The independent application may be released by moving the independent brake valve handle to *Running* or *Release* position.

When all brakes are applied automatically, to graduate off or entirely release the *locomotive brakes only,* use *Release* position of the independent brake valve.

The red hand of one air gage will show at all times the pressure in the locomotive brake cylinders, and this hand should be watched in brake manipulation.

Release position of the Independent Brake Valve will quickly release the locomotive brakes under any and all conditions.

If, when the locomotive is coupled to a train, the locomotive brake re-applies after being released, make a "kick off" with the automatic brake valve by moving the handle quickly from *Running position* to *Release* and return to *Running*. The reason for the re-application is that the pressure chamber of the distributing valve being charged higher than the brake pipe and causing the equalizing slide valve to move into service and then service lap position, closing the release pipe and preventing the release of application cylinder pressure with the brake valves in *Running position*. Releasing with the independent brake valve in *Release position* under these conditions will release the locomotive brake but will not insure against a re-application.

GENERAL

The train brakes should invariably be released before detaching the locomotive, holding with hand brakes where necessary. This is especially important on a grade, as there is otherwise no assurance that the car, cars, or train so detached will not start when the air brakes leak off, as they may in a short time where there is considerable leakage.

The automatic brakes should never be used to hold a locomotive or a train while standing even where the locomotive is not detached, for longer than ten minutes, and not for such time if the grade is very steep or the condition of the brakes is not good. The safest method is to hold with hand brakes only and keep the auxiliary reservoirs fully charged, so as to guard against a start from brakes leaking off, and to be ready to obtain any part of full braking force immediately on starting.

The independent brake is a very important safety feature in this connection, as it will hold a locomotive or quite a heavy train on a fairly steep grade if, as the automatic brakes are released, the slack is prevented from running in or out, (depending on the tendency of the grade) and giving the locomotive a start.

When leaving the locomotive, while doing work about it, or when it is standing, always leave the independent brake valve handle in *Application* position.

After an emergency application of the brakes while running over the road due to any cause other than intended by the operating engineman, move the brake valve handle to *Lap* position to prevent loss of main reservoir pressure. After the train stops, the cause of the application should be located and remedied before proceeding.

Before leaving the round house, the engineman should try the brakes with both brake valves, and see that no serious leaks exist. The pipes between the distributing valve and the brake valve should be absolutely tight.

The safety valve operation and adjustment should invariably be tested at this time, also on arrival at terminal, and any needed adjustment made. Otherwise a necessary emergency application may give too little or too much holding force. To determine adjustment of the safety valve, place the automatic brake valve handle in *Emergency* position and note on the brake cylinder gage the pressure at which the safety valve opens, which should be between 65 and 70 pounds. Return the brake valve handle to *Lap* position and note the pressure at which the safety valve closes. The safety valve should be adjusted to 68 pounds. It is assumed that this test will always be made on the locomotive alone, that is, before the brake pipe is connected to the train.

Changing Ends

In changing from one end of the locomotive to the other, first apply the brakes by the automatic brake valve and then move to *Lap* position, after which close the double heading cock in the brake pipe underneath the brake valve, remove the handles, place them on the brake valve at the other end and open the double heading cock underneath the brake valve to be operated. Always close the double heading cock before removing the brake valve handles and place the handles on the brake valve before opening this cock.

Double Heading

When two locomotives are coupled together, the brake pipe (main reservoir, signal pipe and equalizing pipe if used) hose must be coupled up between the two locomotives and their cut-out cocks open

Where there are two or more locomotives in a train, the instructions already given remain unchanged so far as the leading locomotive, or the locomotive from which the brakes are being operated, is concerned.

On the second locomotive (not having transfer valves) close the double heading cock under each brake valve and place the handle of one automatic brake valve in *Running* position, also cut out the safety control feature, if used. The brakes of the second locomotive can then be operated from the first locomotive the same as those in the train. But if the engineman on the second locomotive finds it necessary, he can prevent the application of the brakes

on the second locomotive by placing the independent brake valve handle in *Release* position. Also, if the brakes on the second locomotive are applied and there is danger of overheating the tires, or the drivers should slide, the brakes can be released by moving independent brake valve handle to *Release* position, reapplying later, if necessary, by using the independent brake valve handle in the usual way, provided the handles of the independent and automatic brake valve on the second locomotive are, as before, left in *Running* position after the operation. This does not in any way interfere with the brakes on the second locomotive being afterwards released from the first locomotive in the usual way. The pressure in the brake cylinders on the second locomotive should never be thus reduced, however, except where absolutely necessary.

Dead Heading

When the locomotive is to be hauled dead in the train place the handle of one automatic and one independent brake valve in *Running* position, close the double heading cock under each brake valve, and open the dead engine cock, also cut out safety control feature, if used. The locomotive brakes will then operate like those of a car in the train.

If, for any reason, it is desirable to keep the maximum braking power of such a locomotive lower than the standard, this can be accomplished by reducing the adjustment of the safety valve on the distributing valve. It can also be reduced at will by the independent brake valve.

NO. 14-EL BRAKE EQUIPMENT ARRANGED FOR MULTIPLE UNIT OPERATION WITH H-5-B or H-5-BR RELAYAIR® VALVE

The equipment is the same as that which includes the 6-DKR Distributing Valve except for the installation of an H-5-B or H-5-BR RELAYAIR Valve in the equalizing pipe as shown in Fig. 44. Functionally, the H-5-B and H-5-BR Cut-Off Valves, as they are commonly called, are identical. The H-5-B, however, has tapped pipe connections. The H-5-BR has flanged fittings.

The purpose of the cut-off valve is to provide a simple but positive break-in-two protection. It does this by closing the connection between the brake cylinder pipe and the equalizing pipe. When the two units break apart, the main reservoir pipe is opened to atmosphere. Main reservoir air pressure on diaphragm 10 of the cut-off valve reduces rapidly. Spring 19 returns valve 15 to its seat,

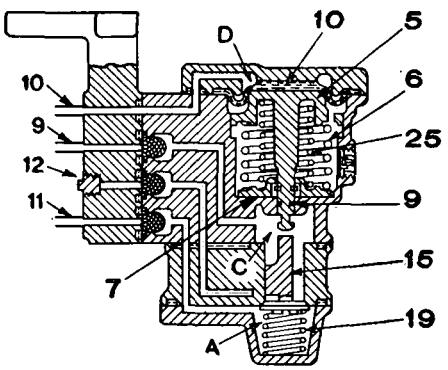


Fig. 43 Diagrammatic

closing the brake cylinder pipe from the equalizing pipe. Thus an automatic brake application resulting from a break-in-two will be retained on both units.

The check valve and choke shown in Fig. 44 permits an unrestricted flow of air from the main reservoir system of one unit to the main reservoir system of another unit when the compressor on the latter is inoperative. During a break-in-two, the choke controls the rate of loss of air from the first main reservoir. It also prevents build-up of air on the cut-off diaphragm, increasing the valve's efficiency and speed of operation.

NO. 14-EL EQUIPMENT ARRANGED FOR MULTIPLE UNIT OPERATION WITH H-6-B RELAYAIR VALVE UNIT

This equipment responds to the same controls and performs the same functions as the multiple unit equipment with the 6-DKR Distributing Valve and H-5-B or H-5-BR RELAYAIR Valve.

The H-6-B RELAYAIR Valve Unit, used in conjunction with the 6-KR Distributing Valve, consists of a

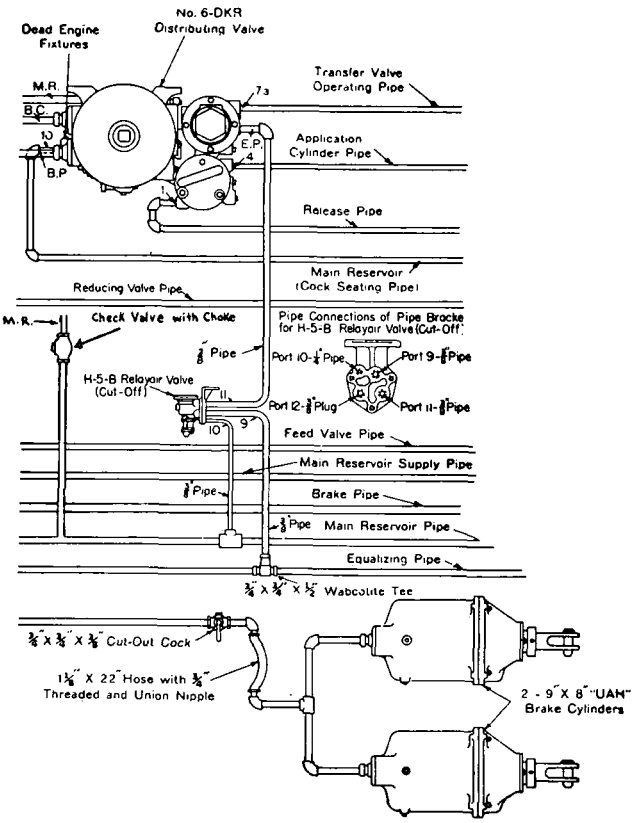


Fig. 44 Partial Piping Diagram showing H-5-B RELAYAIR Valve

pipe bracket which mounts two RELAYAIR portions known as the transfer valve and the cut-off valve. A third mounting face is covered with a blanking pad. The transfer valve has spring arrangements providing a 25 psi operating pressure above the diaphragm. The operating pressure of the cut-off valve is 50 psi.

The transfer valve performs the transfer functions, between lead and trailing units, incorporated previously in the transfer valve portion of the 6-DKR Distributing Valve. The cut-off valve closes the brake cylinder connection to the equalizing pipe when a break-in-two occurs between units.

The brake pipe cut-out cock controls the usual brake pipe connection to the brake valve. It also controls the main reservoir pipe connection to the transfer valve diaphragm chamber.

LEAD UNIT The brakes on the lead unit, with brake pipe cut-out cock set in No. 1 position, operate like those of a locomotive having only the basic equipment. In this position, the brake pipe cut-out cock vents to atmosphere the transfer pipe and chamber D of the transfer valve. With no pressure on diaphragm 10 of the transfer valve, valve 17 is held off its seat by spring 6. This connects the brake cylinder pipe with passage 13. At the same time, main reservoir air forces downward diaphragm 10 of the cut-off valve, unseating valve 15.

This connects the equalizing pipe, through passage 13, to the brake cylinder pipe. Brake cylinder air pressure, therefore, is maintained in the equalizing pipe.

TRAILING UNIT The brakes of the trailing unit can be controlled from the cab of the lead unit by:

1. Placing the automatic brake valve handle in Lap position.
2. Placing the independent brake valve handle in Running Position.
3. Setting the brake pipe cut-out cock in No. 2 position.

The automatic brake valve handle is placed in Lap position to close the exhaust passage of the release pipe through the independent brake valve and the rotary valve of the automatic brake valve.

The brake pipe cut-out cock in No. 2 position connects the main reservoir equalizing pipe to the transfer pipe. Main reservoir air pressure forces downward diaphragm 10 of the transfer valve, seating valve 17 and unseating valve 15. The application cylinder pipe is now connected to passage 13. Since the diaphragm of the cut-off valve is also down, the equalizing pipe and the application cylinder pipe are connected. This insures that brake cylinder pressure on the trailing unit is identical to that on the lead unit because it places equalizing pipe air pressure in chamber *g* of the application cylinder regardless of the position of the equalizing piston and slide valve.

In No. 2 position, the brake pipe cut-out cock seals off the connection between the brake valve and the brake pipe. Thus the brake pipe pressure on the trailing unit is controlled entirely by the brake valve of the lead unit.

MULTIPLE UNIT OPERATION AND DYNAMIC INTERLOCK WITH K-14-Q BRAKE VALVE, H-6-A RELAYAIR VALVE UNIT, AND 6-IKR DISTRIBUTING VALVE

This equipment performs the multiple unit functions in the same manner as that previously described. In addition, a dynamic interlock arrangement insures that any air brake application on the locomotive, except one made by the independent brake valve, will be released and held off during dynamic braking. To provide this feature, a K-14-Q Brake Valve, an H-6-A RELAYAIR Valve Unit, and a 6-IKR Distributing Valve are used.

NOTE. The dynamic interlock feature can be arranged for single unit operation. This is done by removing the H-6-A RELAYAIR Valve Unit and by substituting a two-position brake pipe cut-out cock for the three-position cock. The distributing valve release pipe with its two distributing valve connections is piped directly to the brake valve.

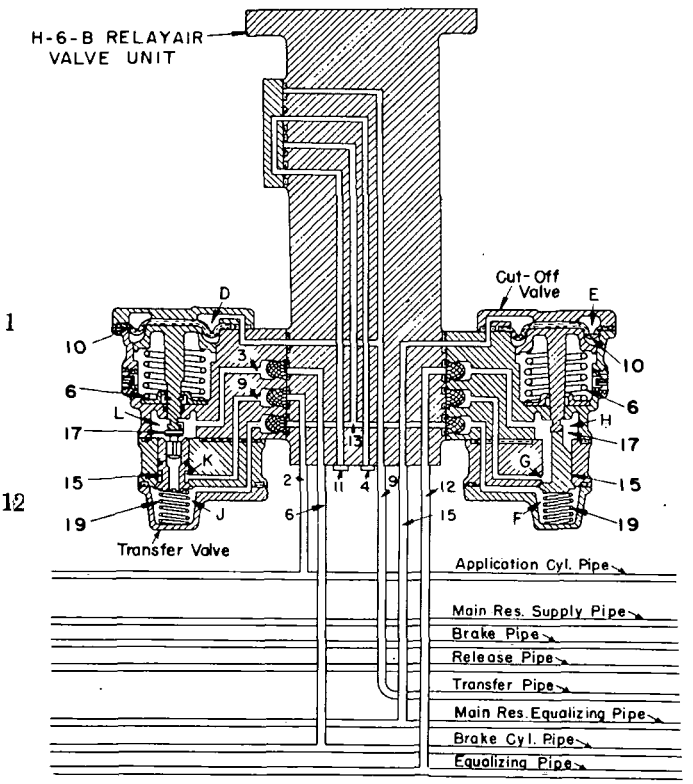


Fig. 45 Diagrammatic

The K-14-Q Brake Valve is the same as related K-14 brake valves except for an atmospheric vent in passage *p* of the independent brake valve. This vent provides an exhaust port through which any air brake application except one made by the independent brake valve, is released on the locomotive during dynamic braking. It should be noted that this vent also nullifies the "holding" feature in Holding position and graduated release of the locomotive brake by automatic brake valve manipulation.

The H-6-A RELAYAIR Valve Unit is the same as the H-6-B described previously except that the blanking plate is replaced by a RELAYAIR portion identical to the transfer valve. This added portion is known as the dynamic valve.

The 6-IKR Distributing Valve is a standard 6-KR Distributing Valve with the application cylinder cover replaced by a filling piece mounting an FA-4 Magnet Valve portion. The FA-4 Magnet Valve is a double-beat valve arranged so that chambers *b* and *a* are connected when the magnet coil is de-energized (normal position). When it is energized (dynamic braking position), chambers *b* and *c* are connected.

OPERATION OF THE EQUIPMENT

The transfer valve and cut-off valve of the H-6-A RELAYAIR Valve Unit operate in the same way as the

like portions on the H-6-B RELAYAIR Valve Unit. The dynamic valve, like the transfer valve, is controlled through the transfer pipe by the brake pipe cut-out cock. With the latter in No. 2 position, the dynamic valve connects the release pipe from the distributing valve through passages 11 and 13, the cut-off valve, and pipe 12 to the equalizing pipe.

On a lead or dead unit with dynamic brake released, normal air brake operation is the same as that of the basic equipment. This is because the positions of the H-6-A RELAYAIR Valve Unit and FA-4 Magnet Valve are such that the pipe connections between brake valve and distributing valve are functionally the same.

When a dynamic brake application is made on top of an automatic brake application, the magnet valve becomes energized. Passages *h* and *hl* and chamber *g* are connected through chambers *b* and *c* to the release pipe. From the release pipe, connection is made through the RELAYAIR Valve Unit to brake valve connection 4, and from there to atmosphere through passage *p* and the vent at the side of the brake valve. With chamber *g* connected to exhaust, the air brake on the locomotive is released.

The preceding covers the operation with a choke, which is standard on this equipment. The choke is located in the passage which connects the passages from chambers *a* and *b* of the magnet valve to each other and to chamber *g* of the application cylinder. When the dynamic interlock feature takes the automatic brake off, application chamber air flows through this choke and, along with chamber *g* air, exhausts through the magnet valve into the release pipe. When the magnet valve is de-energized, the locomotive brake will not re-apply until a reduction in brake pipe pressure is made, again placing air in the application chamber. The choke slows the rush of application chamber air into the small-capacity magnet valve chambers and chamber *g*. By eliminating a pressure build-up, it eliminates a possible air brake application while the dynamic brake is applied.

A pipe plug, optional on this equipment, can be used in place of the choke. In such a case, air remains in the application chamber when the dynamic interlock feature takes the automatic brake off. When the magnet valve becomes de-energized, it allows application chamber air to enter chamber *g* and the automatic brake will reapply.

As mentioned before, an independent brake application can be made on top of a dynamic brake application. When the independent brake valve is moved to either Slow or Fast Application position, reducing valve air in chamber F is connected to both the application cylinder pipe and the release pipe. The two channels of flow provide a fast build-up of application cylinder pressure with a corresponding fast build-up of brake cylinder pressure. On the trailing unit, equalizing pipe air, at brake cylinder pressure, flows through the H-6-A RELAYAIR Valve Unit to the application cylinder via the application pipe and the release pipe.

LUBRICATION

Brake Cylinder

The duplex cylinder, Fig. 22, can be lubricated without opening as follows:

Remove upper ⅛" pipe plugs from the center portion of the cylinder. Attach an approved pressure gun to each connection and inject about 2½ cubic inches of brake cylinder lubricant. Replace the ⅛" pipe plugs.

Remove the ⅛" pipe plugs at the outer end of each non-pressure head. Attach pressure gun and inject about 1¼ cubic inches of brake cylinder lubricant. This will lubricate the piston rod bearing and dirt protection seal in the non-pressure head. Replace the ⅛" pipe plugs.

When a cylinder has been re-lubricated and check tests show objectionable leakage, the cylinder must be dismantled and the fault determined and remedied. Each piston should be removed from the non-pressure end of the cylinder.

This brake cylinder does not have a follower bolted to the piston. The WABCO packing covers the entire piston head and is arranged so that it snaps on the piston and is held in place by a bead on the piston which fits into the non-pressure side of the packing.

When the cylinder is dismantled the packing must be removed, cleaned and inspected. If there are any cracks or deep scratches on the packing bearing surface, or if the packing is worn too much to hold a proper bearing on the cylinder wall, it should be replaced.

Before new packings are applied, the felt swabs on the pistons must be carefully cleaned, re-lubricated and adjusted so that they will have full contact with the cylinder wall when the pistons are replaced. The cylinder must also be cleaned so as to remove all dirt and old lubricant, and the walls re-lubricated with an approved brake cylinder lubricant.

While the cylinder is dismantled, release springs must be inspected and, if necessary, cleaned so as to remove any rust or dirt which might later find its way to the cylinder walls. If springs show any rust spots, they should be covered with an approved rust preventive after cleaning.

The hair strainer and the piston rod seal in each non-pressure head must be dismantled and inspected. The strainer can be removed from the inside of the head for inspection. It is held in place by a wire spring. By closing the ends of the spring, the strainer parts are released for removal. The strainer should be replaced by a clean one and the dirty strainer taken to the shop for inspection, cleaning and reconditioning, if necessary.

If seal rings are not tight on the piston rods, they must be replaced.

The re-assembly of the dismantled brake cylinder must be done with special care to insure that no dirt or other foreign substance can get inside the cylinder before it is closed.

Brake Valves

A good grade of graphite grease is recommended for use on the brake valve rotary valves whenever it can be conveniently applied, as when assembling the device after overhauling, repairs, etc. However, as graphite grease cannot be used conveniently for lubricating the valve after it is assembled, a good grade of oil should be used in such cases. Whatever lubricant is used should be applied very sparingly.

The equalizing piston should be removed and the bushing thoroughly cleaned with a cloth saturated with a good grade of lubricating oil, filling the pores of the metal with oil, then wipe out with a clean cloth. The piston with ring should be immersed in clean gasoline, then blown off with air and wiped dry with a clean cloth. Before the cleaned piston is replaced in the bushing, three drops of approved oil must be placed in the groove and the ring moved around to distribute the oil. Insert the piston to its innermost position in the bushing and lubricate the bushing sparingly, move the piston back and forth several times, after which remove the surplus oil from the outer edge of the bushing.

If the brake valve cannot be conveniently removed for lubrication, a hard working handle may be remedied by closing first the double heading cut-out cock and then the main reservoir cut-out cock and (after the pressure has blown off) removing the oil plug in the valve body and filling the oil hole with good oil, then moving the handle a few times between release and emergency positions to give the oil a chance to work in between the rotary valve and its seat. After this operation, again fill the oil hole and replace the oil plug. Next remove the cap nut from the rotary valve key, fill the oil hole and push down on the key, then fill the oil hole again after moving the handle a few times, and replace the cap nut.

If the independent brake valve handle works hard, it should be similarly treated at this time (before opening the main reservoir and brake valve cut-out cocks).

Distributing Valve

Never remove movable parts of the distributing valve while it is on the locomotive. If the valve portion is not working properly, or needs cleaning and oiling, remove it from the reservoir portion and replace it with a valve portion in good condition. All cleaning and oiling 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 take the valve portion apart while it is still on the locomotive is almost sure to result in a large percentage of valves being injured by careless handling or dirt getting inside the valve. If repairs are necessary, such valves should be returned to our shops for that purpose. Our facilities for doing this work and of maintaining standards are of the best. We can, therefore, do it more quickly, accurately and guarantee better satisfaction than where it is handled by other shops not so well equipped. Furthermore, it is of the utmost importance that the manufacturer's standards be not departed from if the parts of the apparatus are to be perfectly interchangeable.

The proper specified cleaning period of the distributing valve is best determined for each particular case by careful inspection and trial. Where conditions are severe and the distributing valve exposed to extremes of weather, dirt and so on, the cleaning, oiling and testing will require shorter intervals than where conditions are more favorable, but under the most severe conditions this interval should not be longer than three months.

The following is the method of lubricating the distributing valve:

EQUALIZING PORTION.—The equalizing slide valve and graduating valve and their seats should be lubricated with dry graphite. After the bearing surfaces have been properly rubbed in by a free use of oil, they should be wiped clean with a soft cloth or some soft material. All oil, gum or grease should be thoroughly removed from the valves and their seats.

Before replacing the equalizing piston, the piston with ring should be immersed in clean gasoline, then thoroughly blown off with air and wiped dry with a clean cloth. The piston bushing should be thoroughly cleaned with a cloth saturated with a good grade of lubricating oil, filling the pores of the metal with oil, and then wiped out with a clean cloth. Before the cleaned pistons are replaced in the piston bushings, three drops of approved oil must be placed in the groove and the ring moved around to distribute the oil. Insert the piston and slide valve in the body, leaving them in the innermost position, then lubricate the piston bush sparingly and move the piston back and forth several times, after which remove the surplus oil from the outer edge of the bush.

The face of the graduating valve, both upper and lower faces of the equalizing valve, the equalizing valve seat, and the upper portion of the bushing where the equalizing valve spring bears should be lubricated with a high grade of very fine, dry, pure graphite, rubbing it in until the parts 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 of graphite on the chamois skin and rub on the surface specified. Leave no free graphite on these surfaces. When the work is completed, the graduating and equalizing valves and seats 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.

APPLICATION PORTION.—The exhaust valve and seat and application valve and seat of the No. 6-E of the application portion should be cleaned, rubbed in and sparingly lubricated with graphite grease. The poppet type application valves of the No. 6-KR Distributing Valve should be cleaned and seats replaced if defective.

Before applying the piston to the application portion, clean the application cylinder and piston. Lubricate the walls of the cylinder and piston ring, using a good grade of lubricant specially prepared for the purpose.

Feed Valve and Reducing Valve

The only part of the feed valve and reducing valve requiring lubrication is the slide valve which should be lubricated with dry graphite.

Type F Brake Application Valve

The piston and slide valve should be cleaned and lubricated in the same manner as that described for the equalizing portion of the distributing valve. Diaphragms should be inspected and replaced if found defective. The strainer unit of the dead engine feature should be clean-

ed, also the double check valve. If double check valve end seals are defective, they should be replaced.

TESTING LOCOMOTIVE BRAKES

In preparing the locomotive for service and before making the following tests, follow carefully the rules for operating given under the heading "Charging."

Test No. 1. When the system is charged and the governor stops the compressor, note whether a leak occurs at the service exhaust port of the automatic portion of the brake valve when the handle is in *Release, Running, Holding* or *Lap* positions. Leakage at this point indicates that the equalizing discharge valve is leaking. If this leakage is due to foreign matter on the valve seat, it can usually be displaced by closing the cut-out cock underneath the brake valve, then making a heavy service application and returning the handle to *Release* position. The heavy blow caused at the exhaust fitting usually removes the obstacle and allows the equalizing piston valve to seat.

Test No. 2. Place the handle of the automatic portion of the brake valve in *Service* application and allow it to remain there until brake pipe pressure is entirely exhausted as indicated by the gage hand, after which place the handle in *Lap* position and note if there is leakage at the rotary valve, which will be indicated as follows: increase of brake pipe pressure will cause a blow at the service exhaust fitting; increase of equalizing reservoir pressure will cause the equalizing reservoir gage to so register; increase of pressure in the application chamber of the distributing valve will cause an increase in brake cylinder pressure or an intermittent blow at the safety valve.

Test No. 3. Make a partial *Service* application with the independent portion of the brake valve, then *lap* the valve. If brake cylinder pressure increases up to the amount for which the reducing valve is adjusted, it indicates leakage of the independent rotary valve. If brake cylinder pressure increases to brake pipe pressure it indicates leakage of the distributing valve equalizing slide valve.

Test No. 4. If after a *Service* application, the locomotive brakes release, air is leaking from the application cylinder or the application cylinder pipe. Leakage at the brake cylinder exhaust port of the distributing valve when the locomotive brakes are applied indicates a leaky exhaust valve, while an increase of pressure above that put into the brake cylinder at the time of an application or blowing of a safety valve indicates that the application valve is leaking. Should there be a blow at the exhaust port of the automatic portion of the brake valve when both handles are in *Running* position, it indicates leakage past the equalizing slide valve.

A leaky graduating valve may be detected by increase in brake cylinder pressure when the handle of the automatic portion of the brake valve is in *Lap* position after an ordinary service application, provided the reduction is not sufficient to give equalization between pressure chamber and application chamber and application cylinder.

TROUBLES AND REMEDIES

Broken Pipes

MAIN RESERVOIR PIPES:—If the main reservoir pipe breaks between the reservoir and the branch to the distributing valve in such a way that it cannot be repaired, the locomotive brake cannot be applied by either brake valve. If the break is between the brake valve and the branch pipe leading to the distributing valve, both sides of the main reservoir pipe should be plugged and the locomotive brakes can be operated in the usual manner with the independent brake valve.

MAIN RESERVOIR BRANCH PIPES:—If the branch pipe from the *main reservoir pipe to the distributing valve* breaks between the main reservoir pipe and the cut-out cock, plug the main reservoir side of the break and close the branch pipe cut-out cock. The locomotive brakes are then inoperative. The train brakes can be operated in the usual manner.

If the *branch pipe leading to the feed valve and reducing valve* breaks, both sides must be plugged. This cuts out the independent brake valve, and the use of *Running* (for releasing and recharging the train brakes) and *Holding* positions of the automatic brake valve. As there would be no pressure on top of the independent rotary valve to hold the valve to its seat, it would be impossible to secure an automatic application of the locomotive brakes. To remedy this, move the independent brake valve handle to *Slow Application* position before applying the brakes and leave it there until it is desired to again release the locomotive brakes. When the automatic brakes are released, return the independent brake valve handle to *Running* position. The train brakes are released and recharged with the automatic brake valve handle in *Release* position. The locomotive brakes can be released by moving the handle of the automatic brake valve to *Running* position or by *Release* position of the independent brake valve.

To prevent too high a brake pipe pressure with the

automatic brake valve handle in *Release* position, the compressors must be stopped by means of the control switch.

If the break occurs *between the reducing valve and the branch pipe leading to the feed valve,* plug both sides of the pipe. This cuts out the independent brake valve but does not interfere with the handling of the locomotive and train brakes with the automatic brake valve except that the independent brake valve must be manipulated as described in the preceding paragraph.

When the pipe is broken *beyond the feed valve or reducing valve,* it is not necessary to plug the pipe leading from these valves as the same result can be accomplished by turning the adjusting nut sufficiently to loosen the regulating spring and cause the blow of main reservoir air to cease.

Another remedy in case the pipe is broken beyond the reducing valve is to slack off the reducing valve adjusting nut, as just described, plug the broken pipe toward the independent brake valve and plug the exhaust port in the bottom of this brake valve. The independent brake valve handle should then be kept in *Running* position. The locomotive brakes can then be operated by the automatic brake valve.

BRAKE PIPE:—In case of a broken brake pipe branch to the distributing valve, plug the end leading from the brake pipe. The train brakes may then be operated in the usual manner. The locomotive brake can be operated by the independent brake valve in the ordinary way except that *Release* position must always be used to release it.

If the break is *ahead of the branch pipe to the distributing valve,* the distributing valve side of the break may be plugged without affecting brake operation.

If the break occurs *between the branch pipe to the distributing valve and the branch to the automatic brake valve,* plug the pipe as above. It will be impossible to apply and release the brakes by the automatic brake valve but they may be applied and released by the independent brake valve.

BRAKE CYLINDER PIPE:—A broken brake cylinder pipe permits escape of main reservoir air when the brake is applied and may cause the release of one or more of the locomotive brake cylinders, depending upon where the break occurs. If the break cannot be repaired, close the cut-out cock in the pipe leading to the broken pipe. If the break occurs next to the distributing valve reservoir, close the cut-out cock in the main reservoir supply pipe to the distributing valve.

APPLICATION CYLINDER PIPE:—If the application cylinder pipe breaks, plug the pipe on the distributing valve side of the break. If the break occurs *between the distributing valve and the tee to the independent and automatic brake valves,* the locomotive brakes cannot be applied with the independent brake valve, and the emergency maintaining feature is lost; the locomotive brakes can, however, be applied as usual by the automatic brake valve and released by the valve in *Running* position. If the break is *between the automatic valve and the tee,* the independent brake can be applied and released in the usual way but the emergency maintaining feature is lost. If the break occurs *between the tee and the independent brake valve,* the locomotive brakes cannot be applied by the independent brake valve, but the emergency maintaining feature is retained.

DISTRIBUTING VALVE RELEASE PIPE:—If the release pipe breaks, the holding feature is lost and it is also impossible to keep the locomotive brakes fully applied with the independent brake valve unless the opening from the distributing valve side of the break is closed. This should not be done except possibly in switching service, where the independent brake valve is mostly used, and it is then necessary to use the *Release* position of the independent brake valve *at all times* when it is desired to release the locomotive brakes. On road locomotives, the distributing valve side of the break should be left open and the brakes controlled by the automatic brake valve until repairs can be made.

EQUALIZING RESERVOIR PIPE:—In case of breakage of the equalizing reservoir pipe, plug this pipe at the brake valve union and also plug the brake pipe service exhaust. Then to apply the brakes, move the handle of the automatic brake valve gradually toward *Emergency* position, making the desired brake pipe service reduction gradual and direct, then return the handle gradually to *Lap* position.

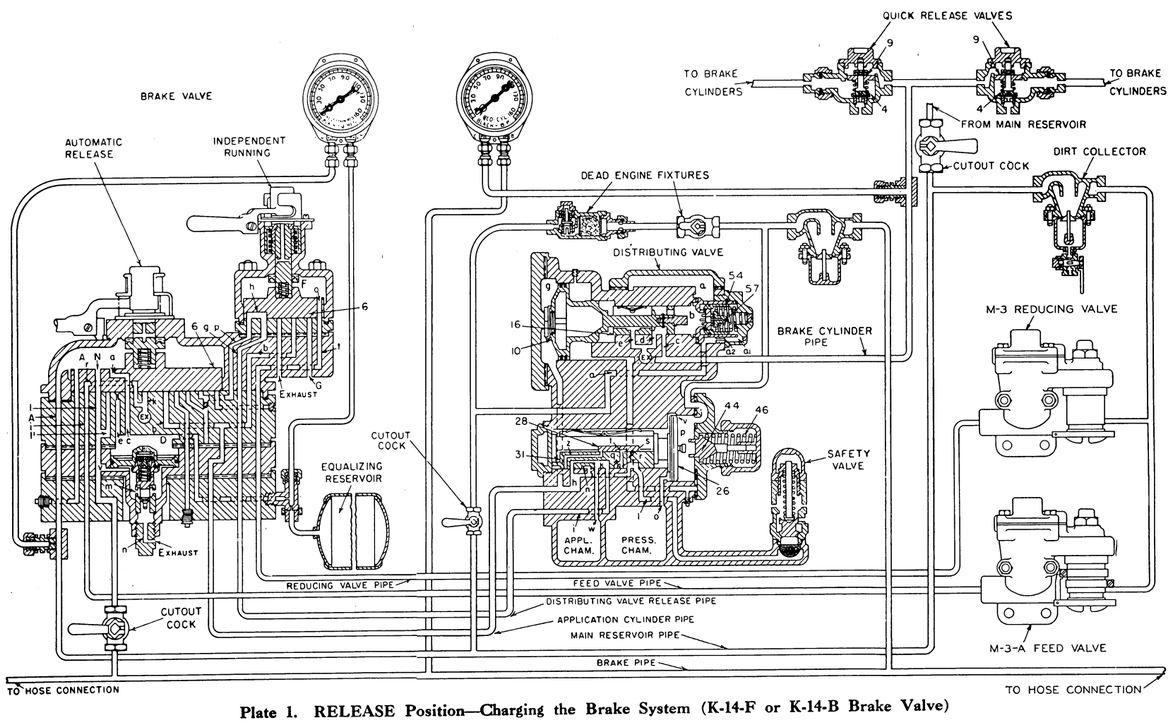


Plate 1. RELEASE Position—Charging the Brake System (K-14-F or K-14-B Brake Valve)

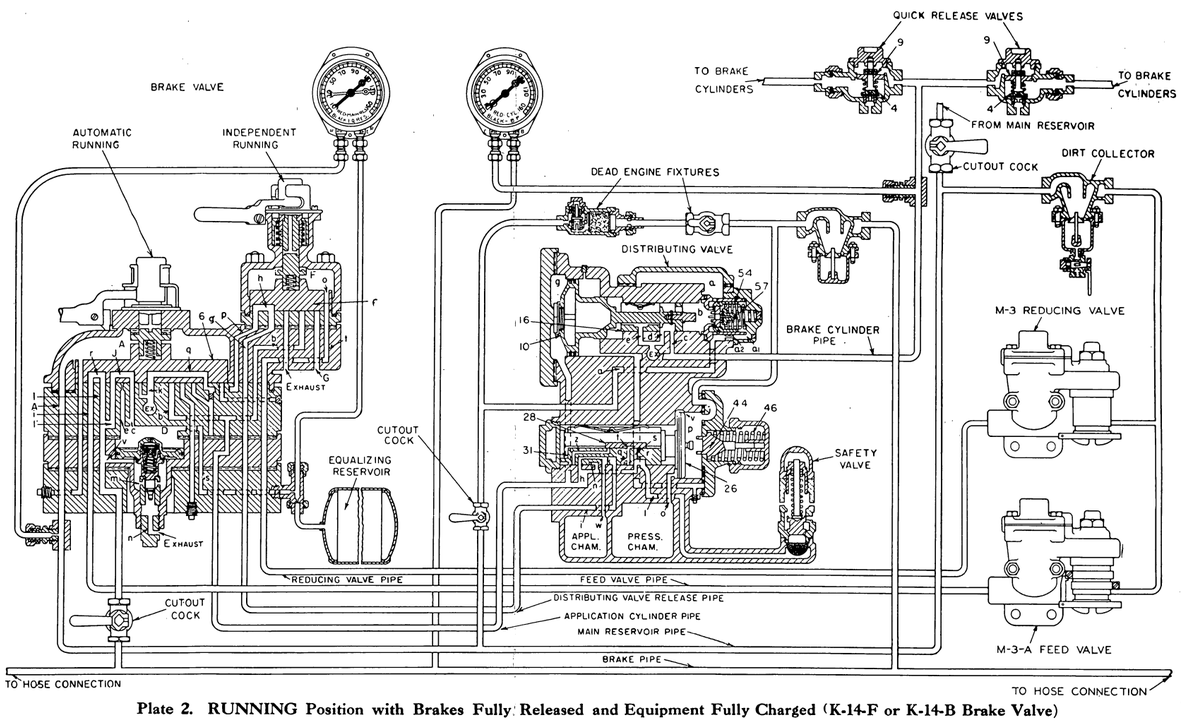


Plate 2. RUNNING Position with Brakes Fully Released and Equipment Fully Charged (K-14-F or K-14-B Brake Valve)

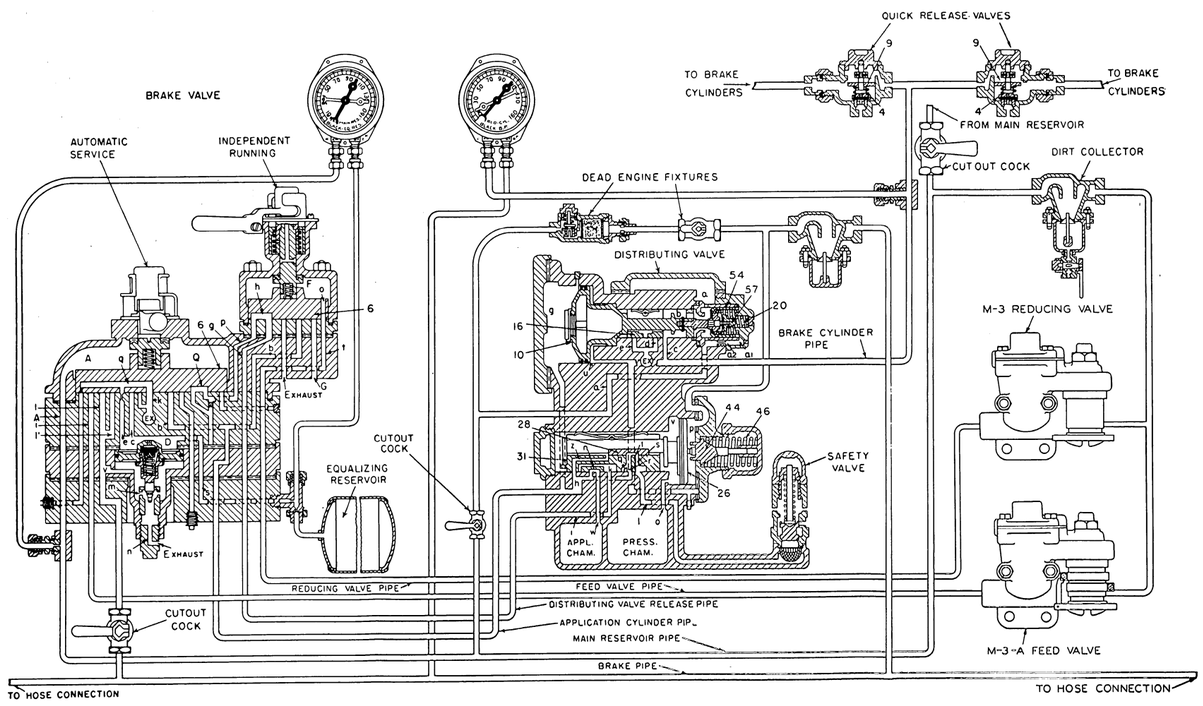


Plate 3. AUTOMATIC SERVICE Position (K-14-F or K-14-B Brake Valve)

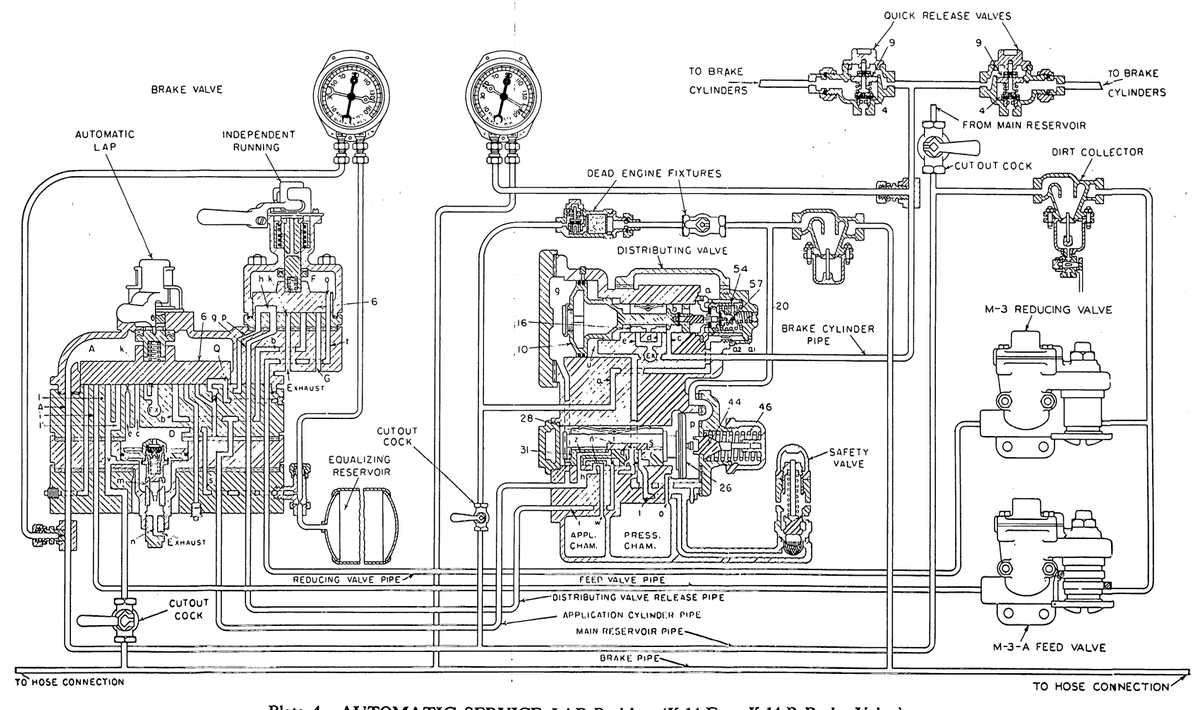


Plate 4. AUTOMATIC SERVICE LAP Position (K-14-F or K-14-B Brake Valve)

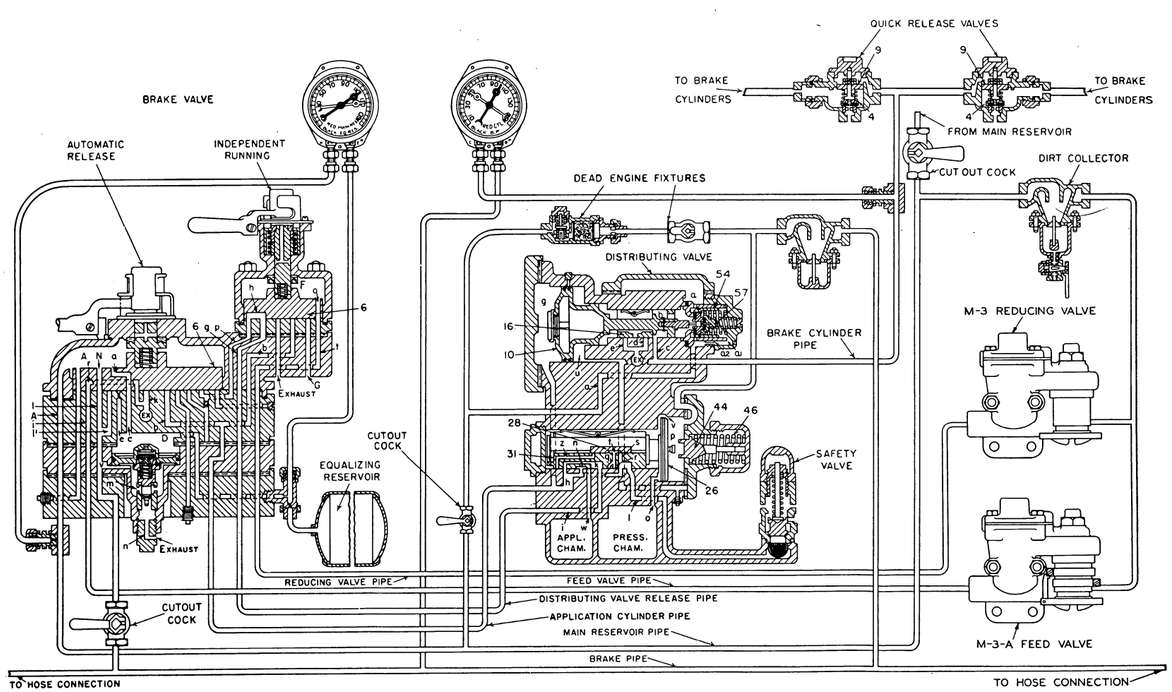


Plate 5. RELEASE after Automatic Service (K-14-F or K-14-B Brake Valve)

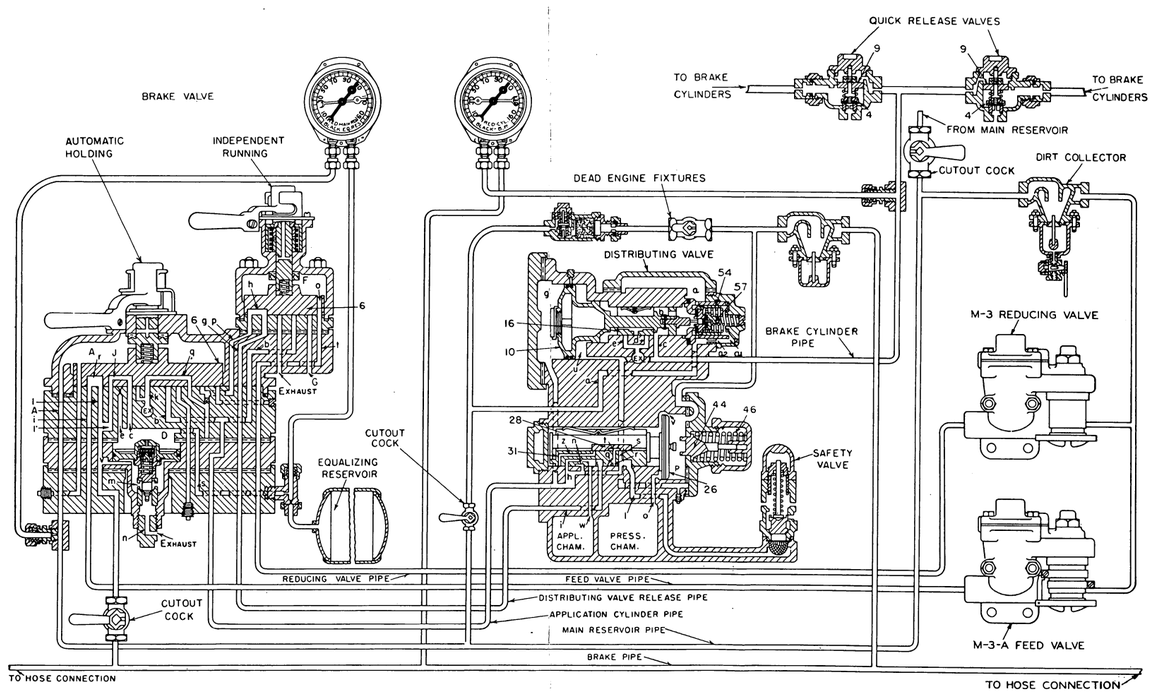


Plate 6. HOLDING after Automatic Release (K-14-F or K-14-B Brake Valve)

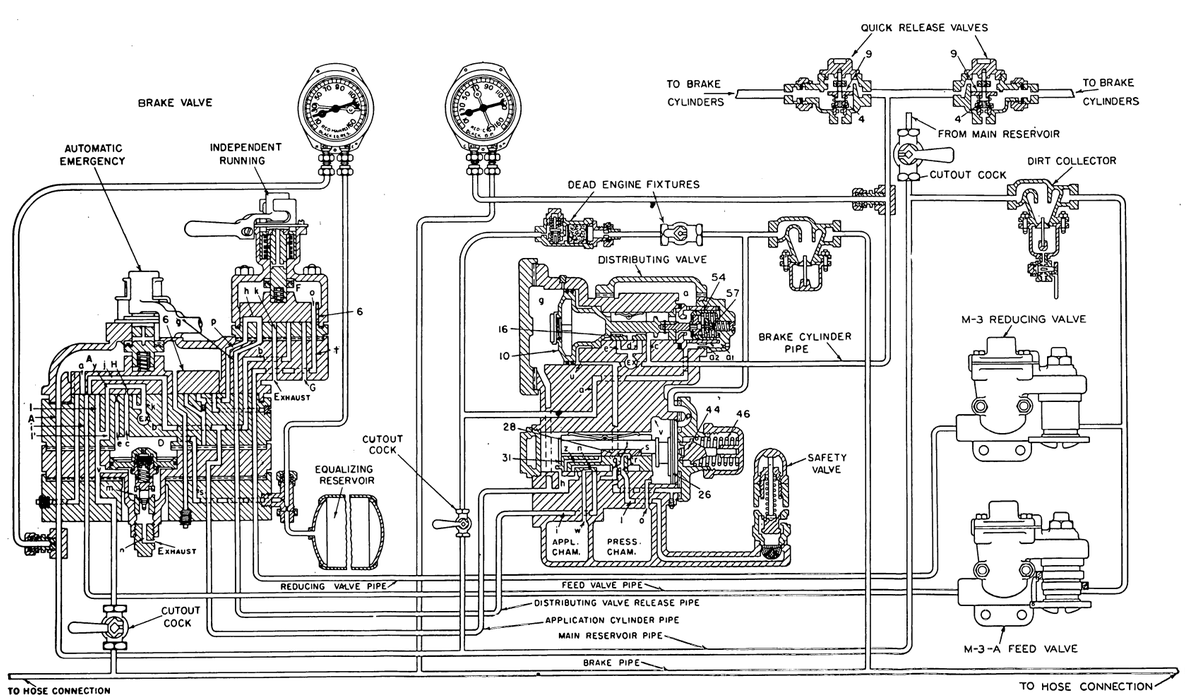


Plate 7. EMERGENCY Position (K-14-F or K-14-B Brake Valve)

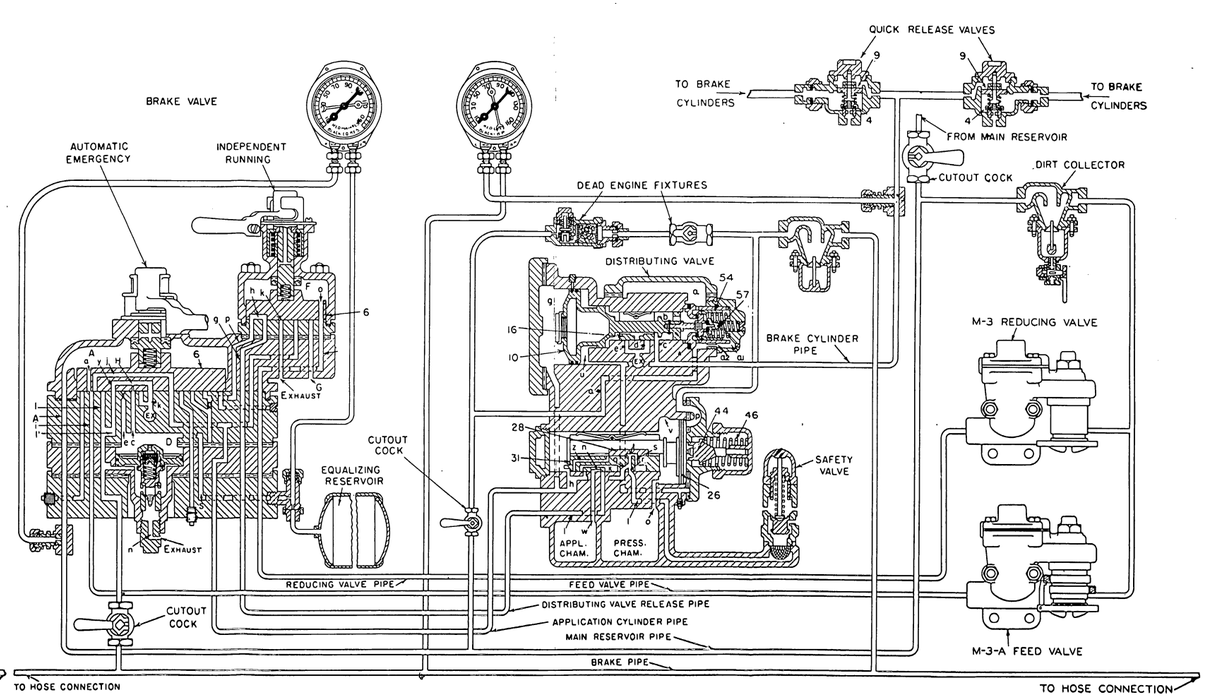


Plate 8. EMERGENCY LAP (K-14-F or K-14-B Brake Valve)

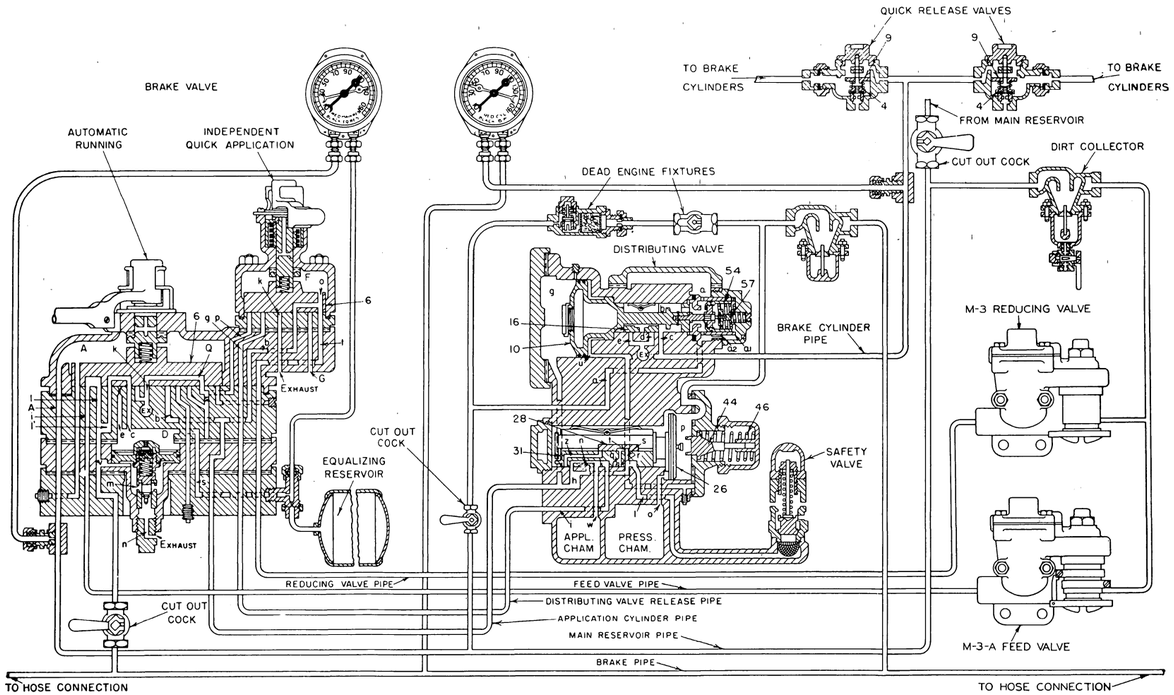


Plate 9. INDEPENDENT APPLICATION Position (K-14-B Brake Valve)

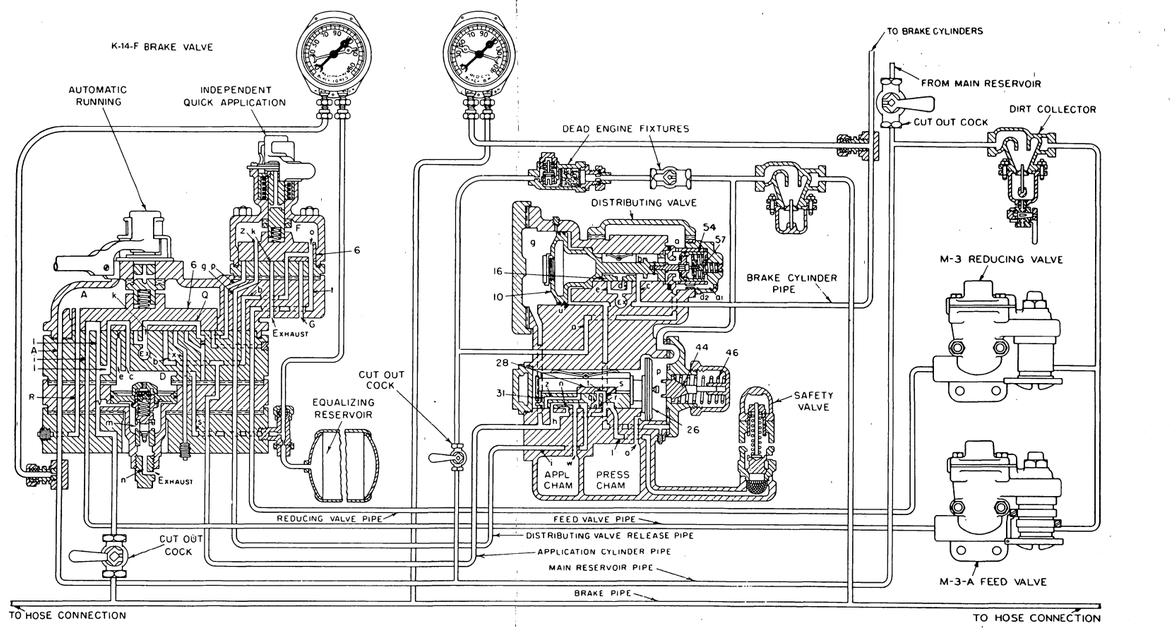


Plate 10. INDEPENDENT APPLICATION Position (K-14-F Brake Valve)

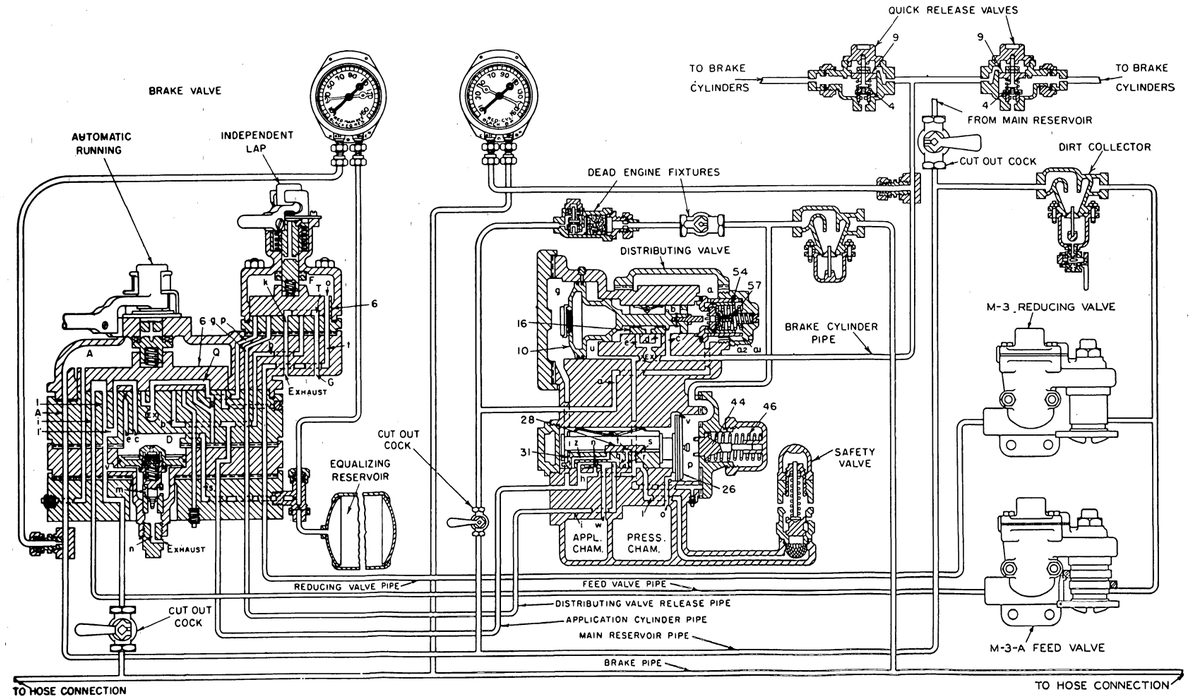


Plate 11. INDEPENDENT LAP Position (K-14-F or K-14-B Brake Valve)

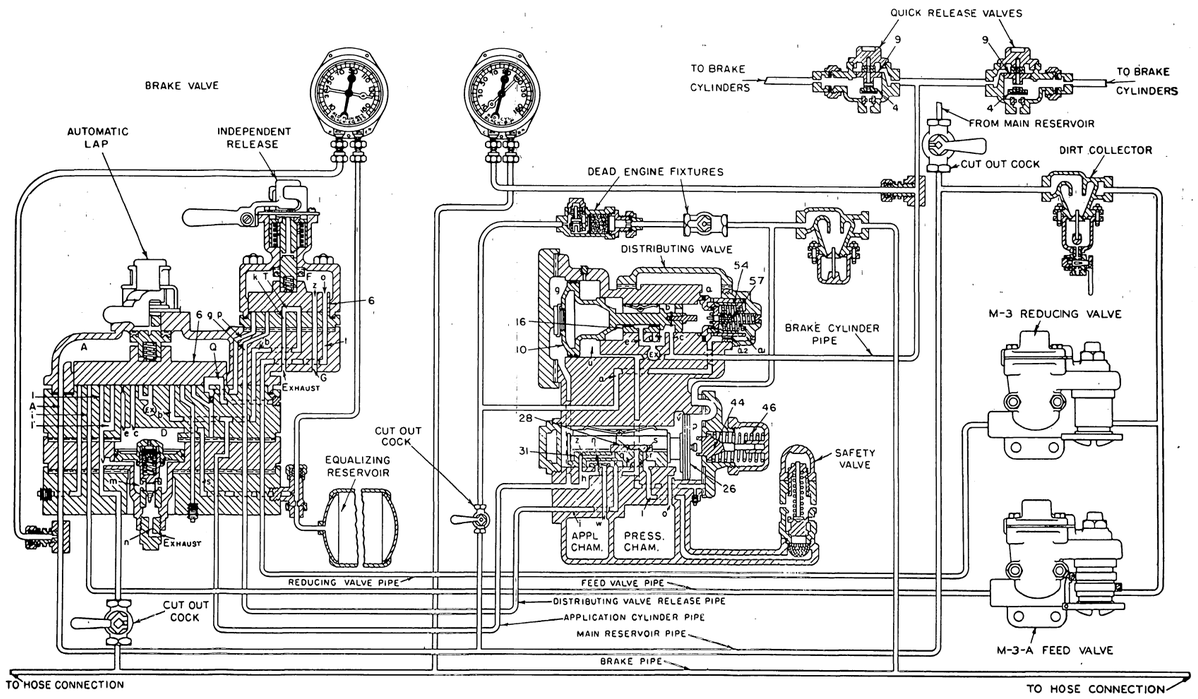


Plate 12. INDEPENDENT RELEASE Position after Automatic Service (K-14-B Brake Valve)

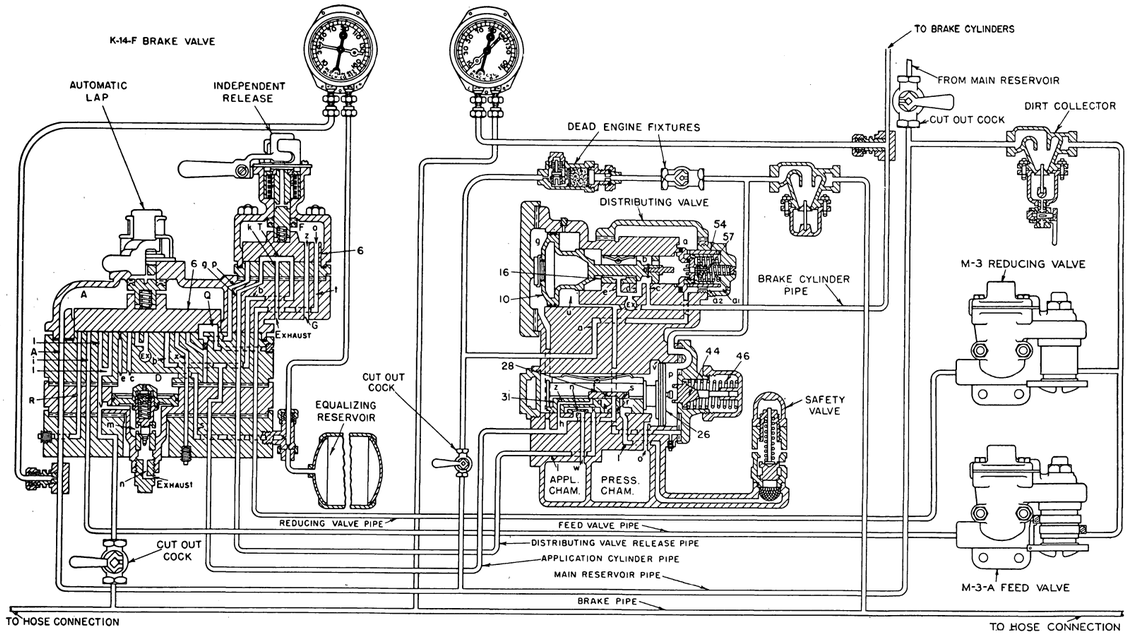


Plate 13. INDEPENDENT RELEASE Position after Automatic Service (K-14-F Brake Valve)

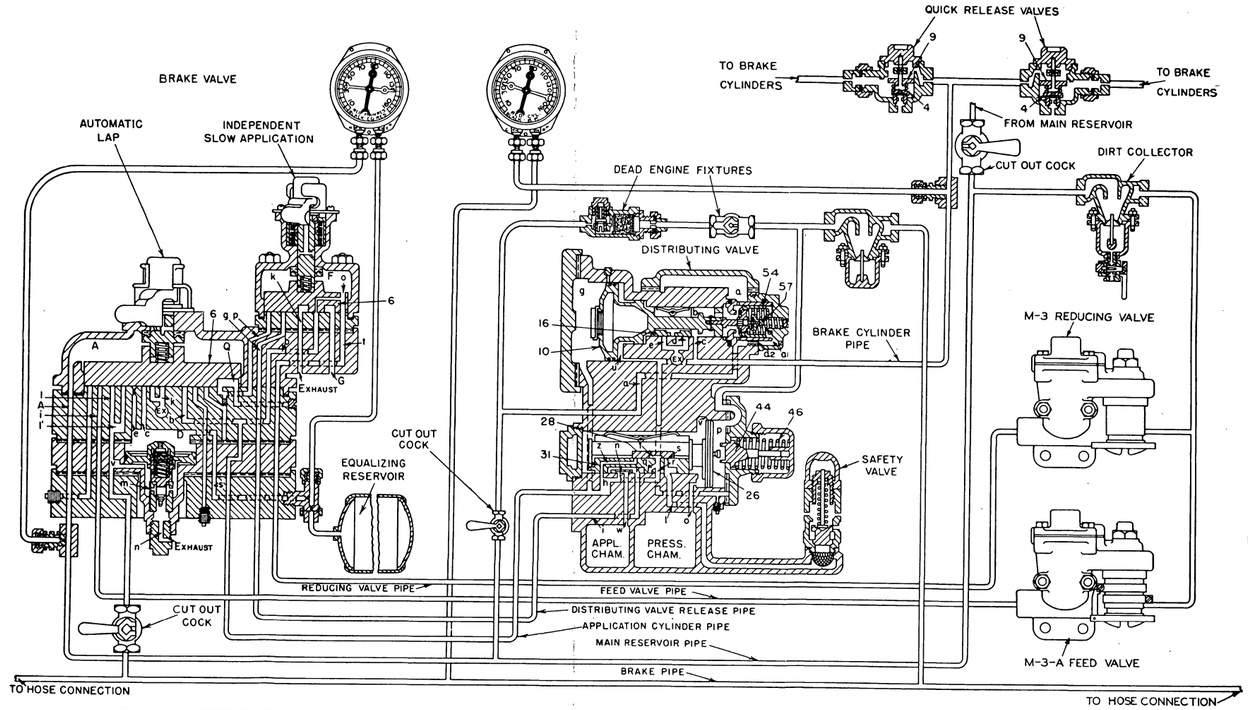


Plate 14. INDEPENDENT APPLICATION after Independent Release—Automatic Brake applied (K-14-B or K-14-F Brake Valve)

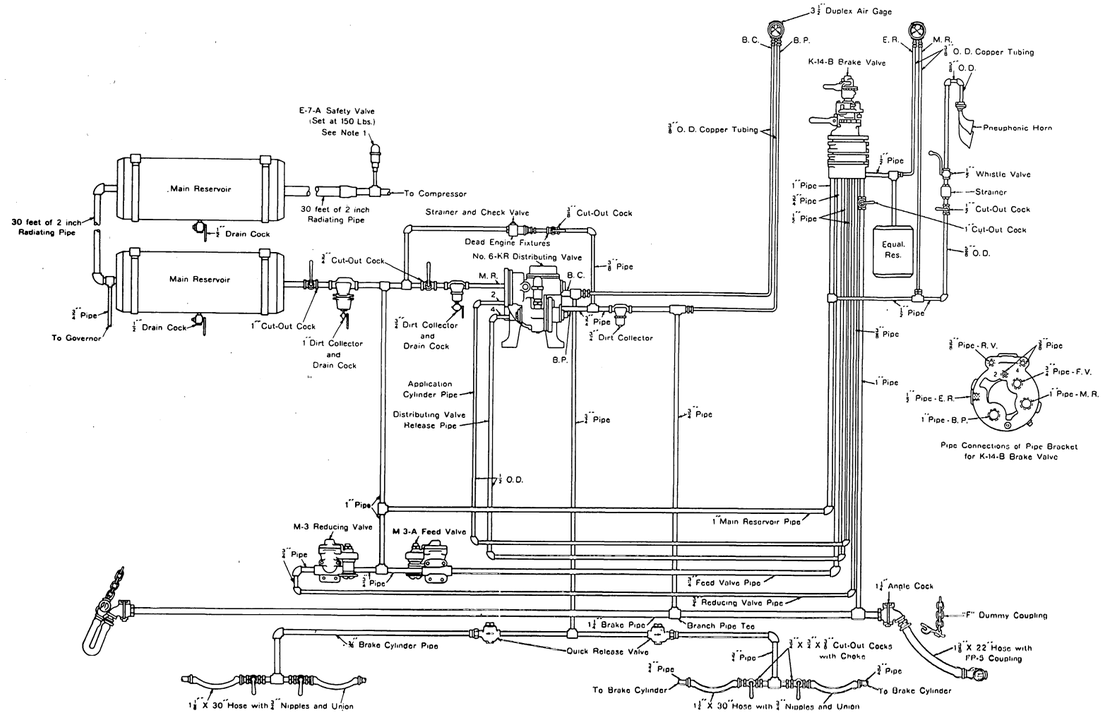


Plate 15. Piping Diagram of Single-End No. 14-EL Locomotive Brake Equipment with K-14-B Brake Valve and Quick Release Valves

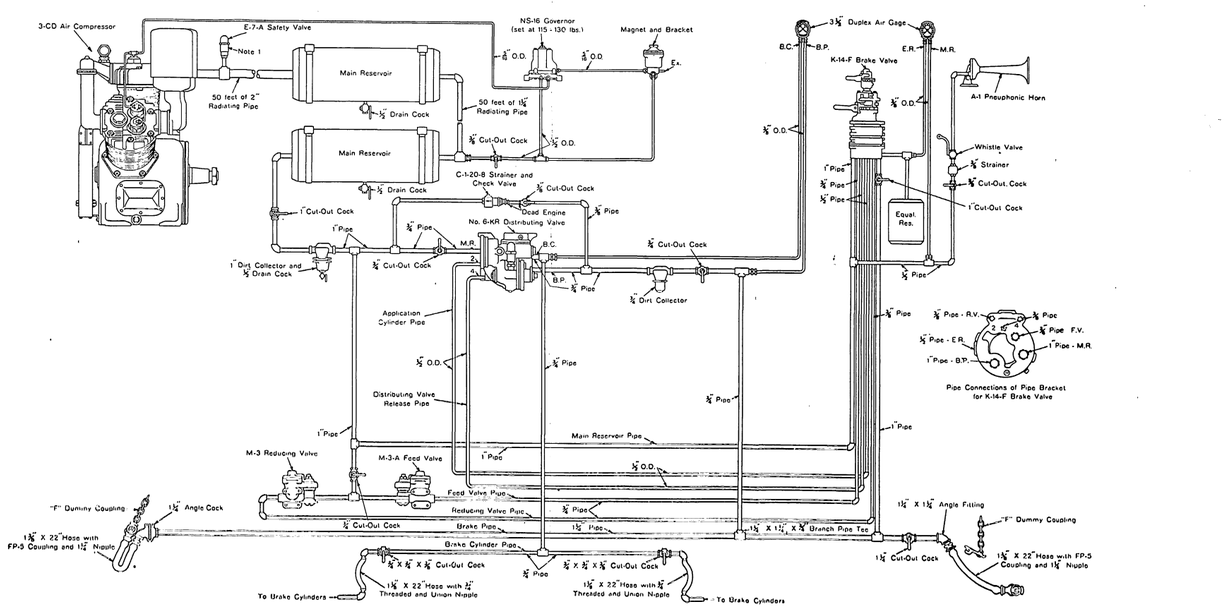


Plate 16. Piping Diagram of Single-End No. 14-EL Locomotive Brake Equipment with K-14-F Brake Valve

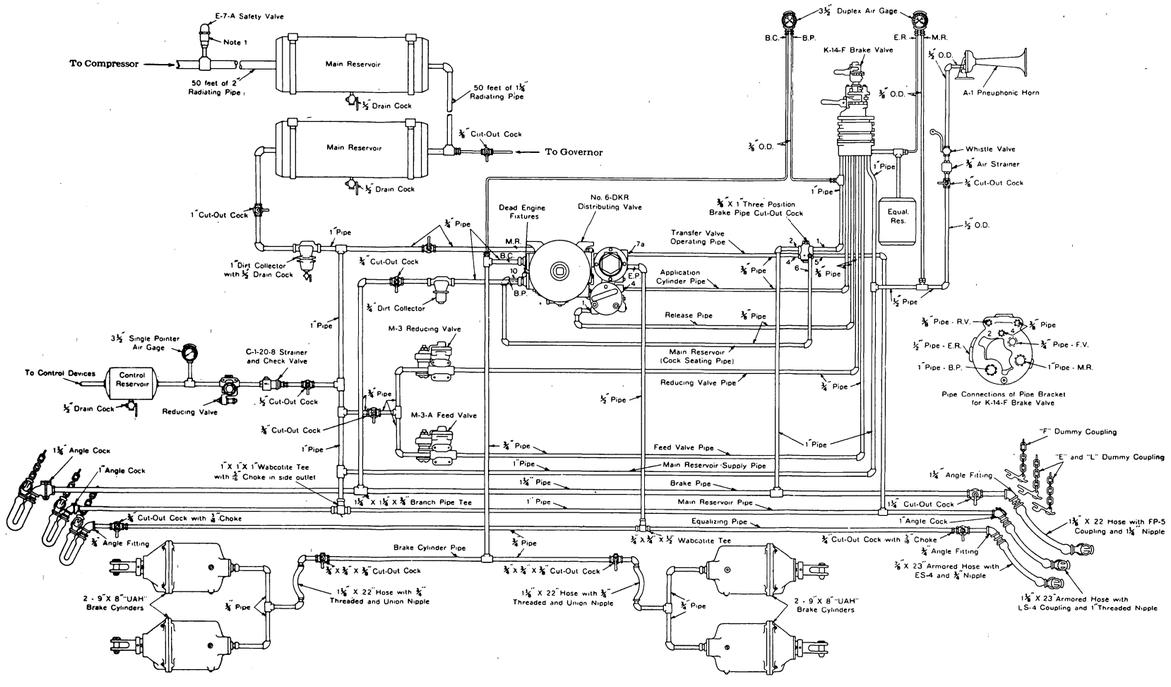


Plate 17. Typical Diagram of 14-EL Equipment with No. 6-DKR Distributing Valve

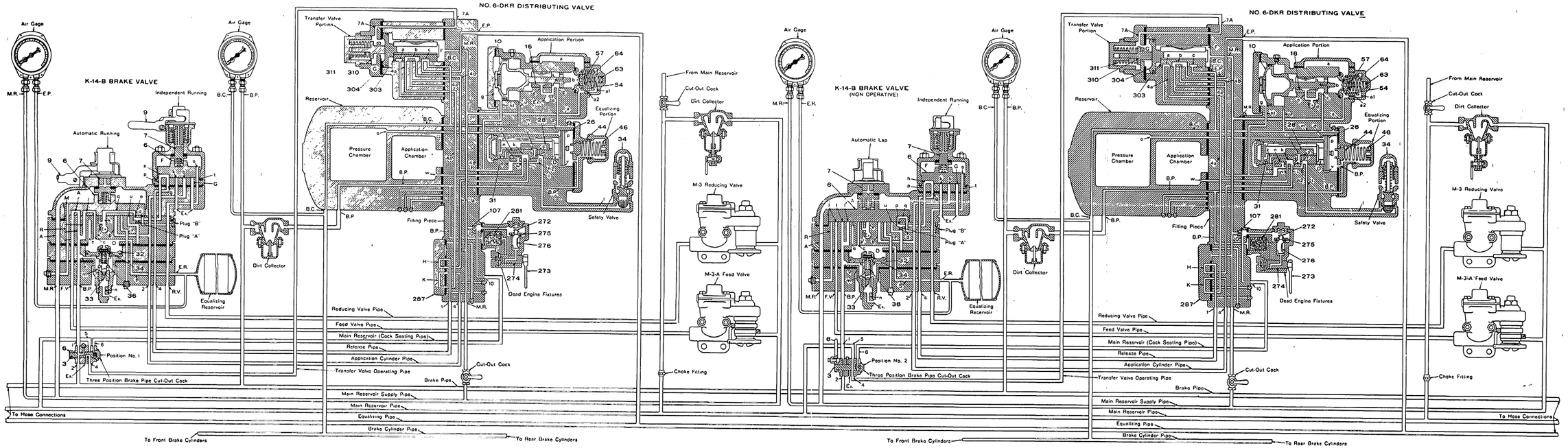


Plate 18. Diagrammatic View of 14-EL Equipment with No. 6-DKR Distributing Valves showing arrangement for Two Locomotives in Double Heading Service

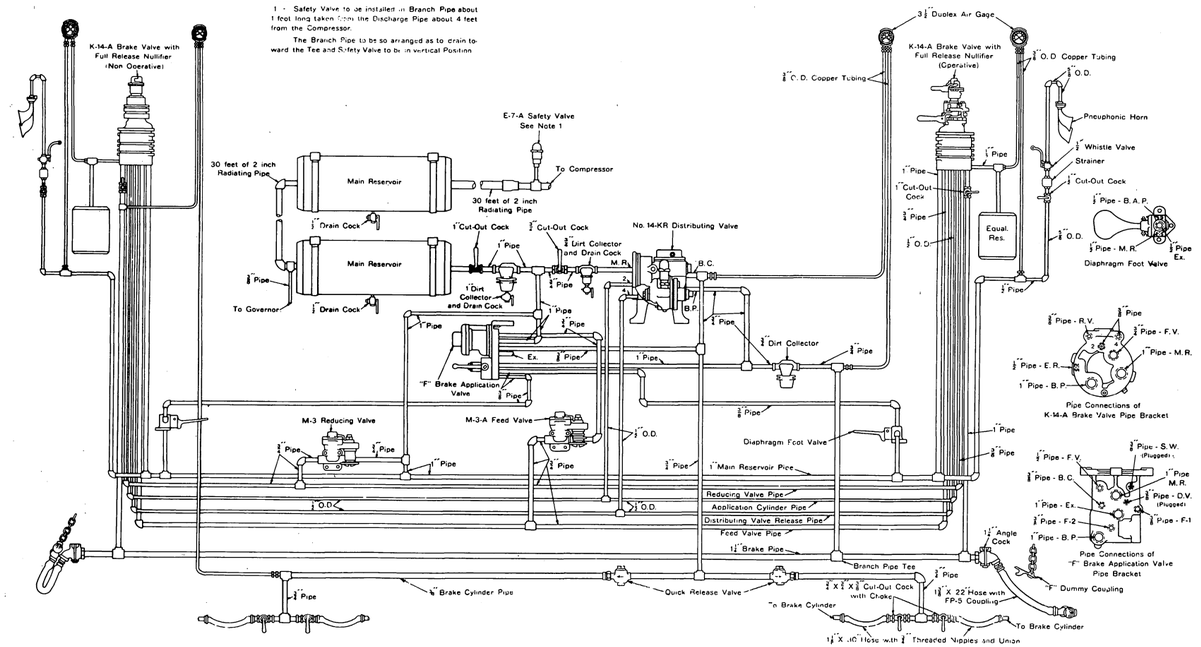


Plate 19. Piping Diagram of Double-End No. 14-EL Locomotive Brake Equipment with Safety Control Feature

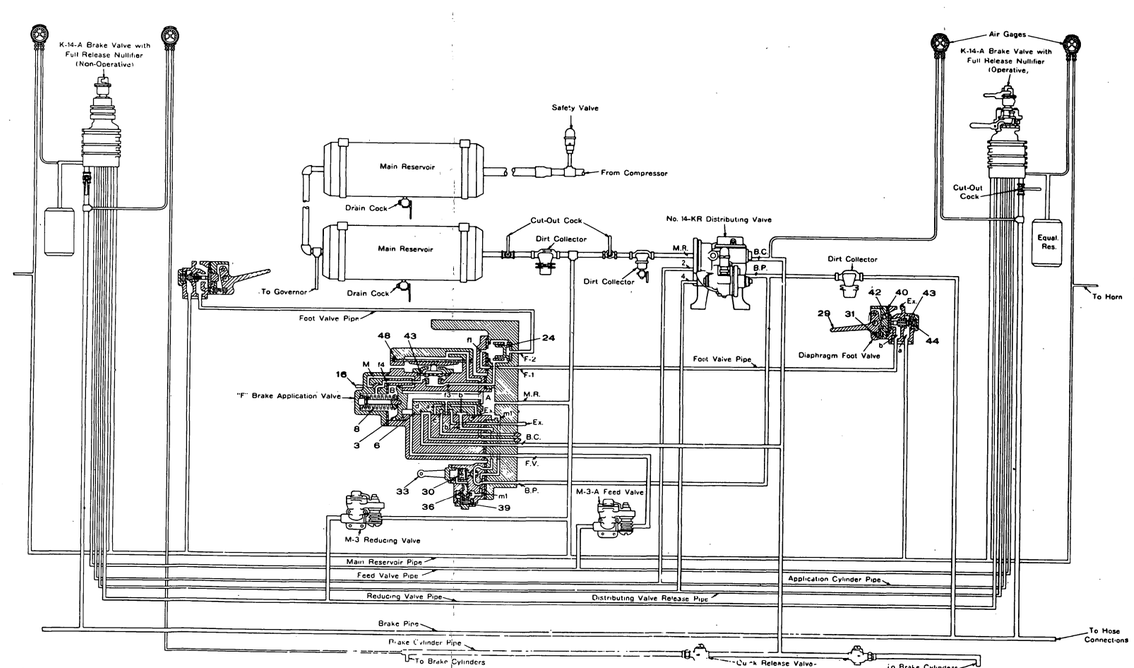


Plate 20. Diagrammatic View of Safety Control Feature as applied to No. 14-EL Double-End Locomotive Brake Equipment

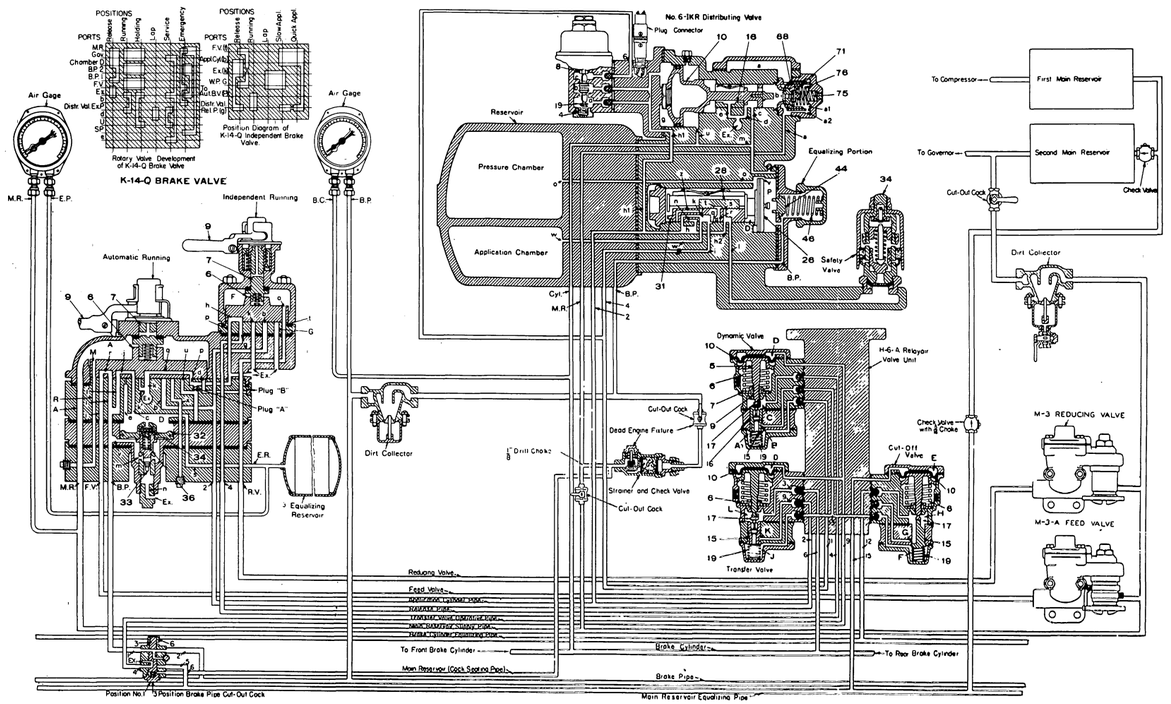


Plate A Diagrammatic - Multiple Unit Operation with Dynamic Interlock using H-6-A RELAYAIR Valve Unit