NO. 6-SL BRAKE EQUIPMENT

FOR

DIESEL-ELECTRIC YARD SWITCHING LOCOMOTIVES

INSTRUCTION PAMPHLET NO. 5046-15

JUNE - 1950

WESTINGHOUSE AIR BRAKE COMPANY

WILMERDING, PENNSYLVANIA

C-45108

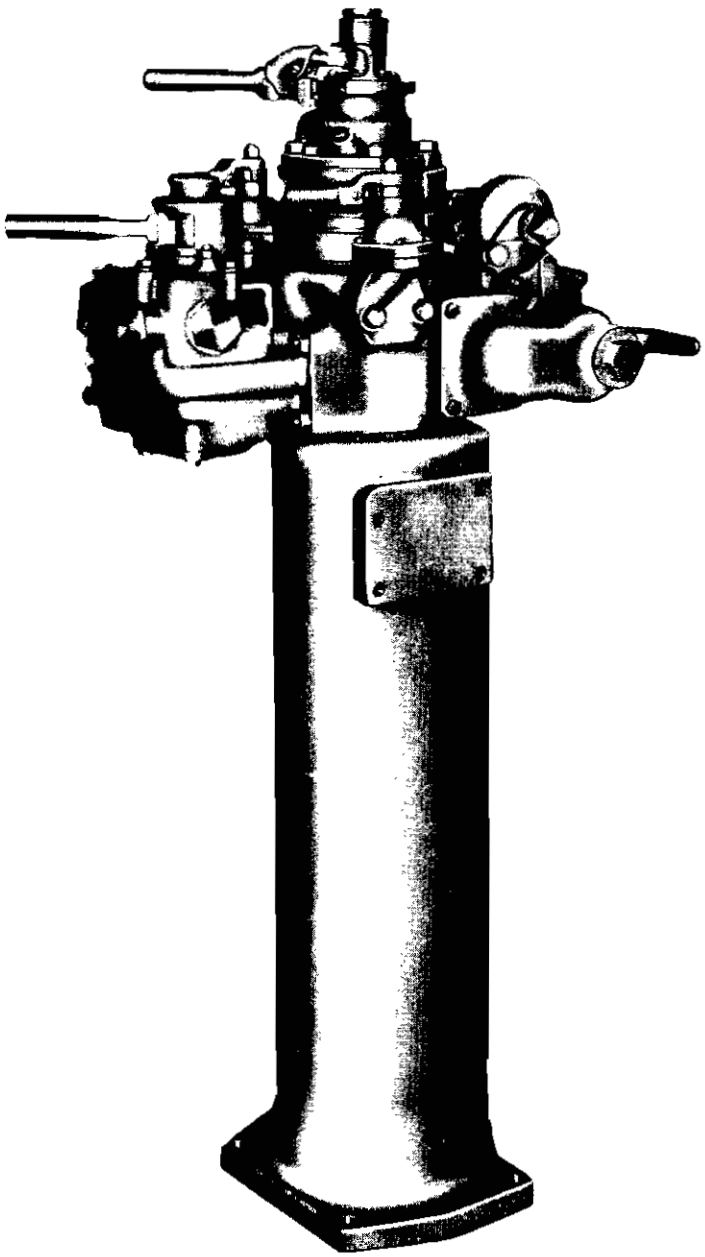


Fig. 1. KH-6-P Brake Valve

THE EQUIPMENT

In design the 6-SL brake equipment for modern switching locomotives follows the same general principles employed in predecessor switcher equipments. As switcher horsepower and utility increased, braking requirements were amplified, necessitating additional features to meet expanding services. The 6-SL brake equipment provides for every switching requirement covering the entire yard switching field.

The important features of the 6-SL brake equipment as described in this pamphlet are:

1. Locomotive brake may be applied with any desired pressure between the minimum and maximum and this pressure will be automatically maintained in the locomotive brake cylinders regardless of leakage from them and of variation in piston travel, until released by the brake valve.

2. The locomotive brake can be graduated on and off with either the automatic or the independent brake valves.

3. It is always possible to release the locomotive brake with the independent brake, even when automatically applied.

4. Maximum braking force in emergency, insuring shortest possible stop distances.

5. Rail sanding for forward or reverse operation by manual control of the brake valve sander valve.

6. Bell ringing by manual control of brake valve bell ringer valve.

7. Multiple Unit operation.

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.

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. One aftercooler located in the pipe between the first and second main reservoir is used to insure proper cooling of main reservoir air.

5. Two automatic drain valves, one located on the first main reservoir which discharges precipitated water from the first main reservoir and another drain valve located in the pipe between the aftercooler and the second main reservoir which discharges moisture from the aftercooler.

6. Two safety valves, which protect against excessive main reservoir pressure.

7. A Pedestal, situtated in the cab, on which the following devices are located:

   An Automatic Brake Valve Portion, to control the operation of the train and locomotive brakes. By proper movements of the automatic brake valve handle the engineman is able to charge the entire air brake equipment on the locomotive and train, apply the brakes and hold them applied, release the brakes on the locomotive and train, or hold the locomotive brake applied while releasing the train brakes and recharging the entire air brake equipment.

   An Independent Brake Valve Portion, to control the operation of the independent brake

on the locomotive. By proper movement of the independent brake valve handle the locomotive brake can be operated independently of the train brakes at any and all times.

A Feed Valve, which automatically maintains a predetermined normal air pressure in the brake system.

A Two Position Cock, by means of which the automatic brake valve is cut-out on the second locomotive when double-heading.

A Bell Ringer Valve which operates the locomotive bell to provide a warning of approach.

A Sander Valve which provides forward or reverse sanding to the locomotive wheels depending on the position of the sander valve handle.

8. 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.

9. A distributing valve which automatically controls the flow of air from the main reservoirs to the locomotive brake cylinders when applying the brakes; 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 operating valve bears to those on the car, besides performing additional functions.

10. Two duplex air gages, one of which indicates equalizing reservoir and main reservoir pressures, and the other brake pipe and locomotive brake cylinder pressures.

11. "UAH" 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. A 1-1/4" emergency-brake valve located in the brake pipe enables the operator to apply the brakes if necessary.

13. A centrifugal dirt collector, for the protection of the distributing valve. The dirt collector is for the purpose of preventing pipe scale, cinders or foreign particles of any kind from reaching the device above mentioned.

14. An "H" air filter in the main reservoir pipe to the equipment is used to prevent the entrance of dirt and moisture into the air brake devices. A cock at the bottom of the air filter is used to drain off all residue.

15. 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.

16. 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 10, and the descriptions which follow.

17. While not a part of the air brake apparatus proper, the locomotive is usually equipped with an air horn, at the head end of the locomotive, to be used as a warning of approach. The necessary whistle valves and cut-out cocks are included.

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 dead engine fixtures; and to the brake valve.

The Brake Pipe leads from the brake valve throughout the length of the locomotive

and train, having branches connecting to 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.

DESCRIPTION OF THE PARTS

Motor Driven Air Compressors

The operation and maintenance of the 3-CD motor driven air compressor is fully described in Instruction Pamphlet No. 5002-5.

Compressor Governor

The S-16 compressor governor is of the pneumatic double "Safety Valve" type and is fully described in Instruction Pamphlet No. 5042-1.

Reservoirs

The main reservoirs, Fig. 2, are used to store and cool the compressed air furnished by the air compressor, and also assist in depositing moisture, oil or other foreign matter, allowing only clean dry air to pass on to the brake system. To assist in this, the piping should be so installed as to drain into the reservoirs.

As an accumulation of water or other foreign matter is not only injurious to the reservoirs, but is liable to seriously reduce the capacity, the reservoirs should be drained at regular intervals by means of drain cocks provided for that purpose.

E-7-B Safety Valve

The purpose of the safety valve, Fig. 3, 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 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, 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 can be adjusted by changing the size of ports f, using regulating nut 8 for the purpose. After adjustment, screw down jam nut 9.

KH-6-P Pedestal Brake Valve

The KH-6-P pedestal brake valve furnished with a straight type pedestal has an automatic brake valve portion with a rotary type valve for control of the train and locomotive brakes, and an independent brake valve portion of the self-lapping type which provides independent and flexible control of the locomotive brake.

Four bolt holes in the base of the pedestal are provided for installation purposes. All the pipe connections are made to the pipe bracket face, beneath the floor sheet, by means of Wabcotite fittings. The only piping in the cab is the copper tubing for gage and governor connections which are connected to the upper portion of the pedestal. This arrangement provides a compact brake valve installation that occupies minimum space and eliminates practically all heavy air piping from the cab. When heavy locomotive repairs are made, it is only necessary to break the pipe connections and lift the complete pedestal from the cab. Located on the pedestal and brake valve body are the following portions:

The Automatic Brake Valve portion.

The Independent Brake Valve portion.

The Bell Ringer Valve.

The Sander Valve.

The Two Position Cut-Out Cock.

The Feed Valve.

The pipe connections to the pipe bracket are designated numerically and so marked on the bracket.

3/8" Equalizing Reservoir Pipe (marked "5").
3/8" Application Cylinder Pipe (marked "2").
3/8" Distributing Valve Release Pipe (marked "4").
1" Brake Pipe (marked "1").

1" Main Reservoir Pipe (marked "7").
3/8" Bell Ringer Pipe (marked "10").
3/8" Forward Sanding Pipe (marked "11").
3/8" Reverse Sanding Pipe (marked "13").
3/8" Automatic Sanding Pipe (marked "21").

The automatic brake valve portion may be removed from the pedestal by backing off the nuts 3 from the four studs, Fig. 6. First, however, the two position cock should be closed, the automatic brake handle placed in emergency position and the main reservoir cut-out cock closed (in order to prevent lifting from their seats of the feed valve slide valve and the rotary valve of the automatic brake valve). The independent brake valve portion only may be removed by backing off the nuts from the four studs 19.

Substantially the same pressure in the brake pipe and equalizing reservoir during charging operations is insured by the by-pass equalizing piston. This feature makes it possible when releasing the brake to make a re-application promptly.

The by-pass type of equalizing piston consists of a piston 41 and piston stem 42 screwed together and held by the lock washer. The stem contains a light spring 45 which centers on spring seat 44 and normally holds a "Wabco" check valve 43 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 43 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 five positions of the automatic brake valve handle are, beginning at the extreme left: 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.

Running Position. This is the proper position of the handle (a) to charge the train brake system; (b) when the brakes are charged and ready for use; (c) when the brakes are not being operated; and (d) to release the locomotive and train brakes. In this position

a large direct passage is opened from the feed valve to the brake pipe, so that the latter will charge as rapidly as the brake equipment can take 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.

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.

Movement of the brake valve handle to running before returning to lap, moves distributing valve equalizing piston 26 and slide valve 31 to release position. This connects the application cylinder to the distributing valve release pipe.

Holding Position. This position is so named because the locomotive brake is 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 19a and distributing valve release pipe, see Fig. 7.

Emergency Position. This position is used when the most prompt and heavy application of the brakes is required. A large and direct opening is made between the brake pipe and atmosphere. This direct passage makes a sudden and heavy discharge of brake pipe air, causing the operating valves and distributing valve 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.

Plan views of the rotary valve and the rotary valve seat are shown by Fig. 7. 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 independent brake valve portion of the KH-6-P brake valve is shown in Fig. 6 and Plate 1. It consists of a body 72, Fig. 5, in which are assembled independent quick release valve 97. Plate 1 shows the independent exhaust valve 97a, independent application check valve 97b, and cam and shaft 76. Attached to the brake valve body are the self-lapping unit 118, Fig. 6, and housing 88 for the brake valve handle 109, Fig. 5. The independent brake valve portion may be removed from the pedestal by backing off the nuts from the four studs 19.

The functions of the independent brake valve portions follow:

Independent brake valve inlet valve 122, Fig. 6, supplies air for controlling the locomotive brake when actuated by the cam on shaft 76, Fig. 5.

Independent quick release valve 97, Fig. 5, provides for a quick release of the locomotive brake, applied by the automatic brake valve, by depressing the independent brake valve handle 109 in running position. This unseats release valve 97 to quickly vent application cylinder pipe air and thus release the locomotive brake. Either a full or partial release is available depending how much application cylinder pipe air is vented.

Independent exhaust valve 97a, Plate 1, provides an atmospheric opening for self-lapping exhaust valve 134 during operation of the independent brake. In running position spring 98a seats the valve, closing the exhaust opening (Ex in the body) to the atmosphere. With the brake valve handle in the application zone exhaust valve pawl 94 contacts the exhaust valve plunger and unseats exhaust valve 97a.

Independent application check valve 97b prevents back flow from the application cylinder pipe to the control chamber of the independent brake valve with the automatic brake applied.

The handle positions of the independent self-lapping brake valve which provide independent control of the locomotive brake are: (1) Running, (2) Brake Application Zone. Release of an automatic brake application can be made by depressing the handle in Running position.

Running Position. This position is used to release the independent locomotive brake. When the automatic brake valve handle is in Running position independent release is obtained by moving the independent brake valve handle to Running. This establishes communication through the distributing valve release pipe, between the application cylinder of the distributing valve and the exhaust port of the automatic brake valve. To obtain a fast release of the locomotive brake the handle is depressed in running position. Quick release of the locomotive brake takes place since communication is established through the application cylinder pipe, between the application cylinder of the distributing valve and the quick release valve exhaust port of the independent brake valve.

To release the locomotive brake after an automatic brake application when the automatic brake valve handle is not in Running position, the independent brake valve handle is depressed in Running position. The locomotive brake is quickly released

because communication is established through the application cylinder pipe, between the application cylinder of the distributing valve and the quick release valve port in the independent brake valve.

Application Position. This position gives a quick application of the locomotive brake. Main reservoir air is connected to the distributing valve application portion where air is relayed to the brake cylinders. The amount of brake application is determined by the amount of brake valve handle movement into the application zone. No fanning of the brake valve handle is necessary as the brake valve automatically builds up the application pressure to the amount corresponding to the handle position and then laps off. Thus, the application pressure is increased simply by moving the handle 109 to the right and decreased by moving to the left.

Shaft 76 with the plunger collar 84, Fig. 5, exhaust valve pawl 94 and cam, Fig. 6, operates the various valves in the independent brake valve as the independent brake valve handle is moved between Running and Full Application positions as previously explained.

The sander valve and bell ringer valve, Fig. 6, section C-C, are similar each having an operating handle 187, rotary valve key 180, rotary valve 179 and both valves are housed in a similar body. The bodies of these valves are held attached to the brake valve pedestal by four studs and nuts 193.

The Sander Valve has three handle positions, beginning at the extreme left: Reverse Sanding, Neutral and Forwarding Sanding. The handle has a spring loaded latch which locates the handle in position and which passes over the quadrant shoulders during handle movement. In Neutral position the ports from the forward and reverse sanding pipes are connected to the exhaust port of the valve body by the sander valve rotary valve ports. In Forward Sanding position the rotary valve ports connect the reverse sanding pipe port to the exhaust port of the sander valve body and main reservoir air from above the rotary valve to the forward sanding pipe port, thus supplying air pressure for forward sanding. In Reverse Sanding position the rotary valve ports connect the forward sanding pipe port to the exhaust port in the sander valve body and main reservoir air from above the rotary valve to the reverse sanding pipe port, thus supplying air pressure for reverse sanding. In both forward and reverse sanding a choked port in the sander valve rotary valve connects main reservoir air to the exhaust port, thus sounding a warning as long as the sander valve handle remains in either sanding position.

The Bell Ringer valve has two handle positions: Bell Ringing position at the extreme left and Neutral to the right. A notched quadrant into which the handle latch fits is used as the location for the handle when moved to the desired position. In Neutral position the port from the bell ringer pipe is connected to the exhaust port in the valve body by the bell ringer valve rotary valve port. In Bell Ringing

position the rotary valve port connects main reservoir air from above the rotary valve to the bell ringer pipe port, thus supplying air pressure for operation of the bell ringer.

A Two-Position Brake Pipe Cock 164, Fig. 6, located on the side of the brake valve body is used to open or close the passage between the brake valve and brake pipe. In Double Heading Service, or where more than one locomotive is used in a train such as helpers and pushers, the two-position cock must be closed and the handles of the automatic and independent brake valves placed in running position on all locomotives except the one controlling the train brakes. The brakes on such locomotives can then be controlled from the locomotive controlling the train brakes. However, the enginemen on the locomotive not in control of the train brakes can apply or release his brake independently of the train brakes by proper manipulation of the independent brake valve handle.

The M-3-A Feed Valve attached to the brake valve body, regulates the pressure in the brake pipe with the automatic brake valve in Running or Holding positions. The feed valve is provided with adjustable stops for double pressure control.

The diagrammatic views, Figs. 9 and 10, picture the valve with all parts in one plane in order to facilitate description. Main reservoir air 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 delivery pressure through passage o.

Opening

Main reservoir air 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 delivery 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. 9 and main reservoir air will flow to the delivery passage through ports b and b' in slide valve 22 and ports a and a' in the seat.

Main reservoir air also flows from chamber k through port p and 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 air passing through the choke is free to flow past the regulating valve and through passage o to the delivery passage. 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 delivery passage 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 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 delivery pressure has been made, the regulating valve will not be fully opened and air flowing through the 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 a port a in the seat.

Closing

When delivery 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 choke 25 to chamber m above piston 20 will quickly equalize with the pressure underneath, and spring 31 will move the piston and slide valve downward to closed position, Fig. 10, thus cutting off the flow of main reservoir air to the delivery passage through the slide valve.

The parts will remain in this position until delivery pressure above diaphragm 11 becomes less than the value of regulating spring 15 when the diaphragm will move upward, unseating the regulating valve and again connecting the top of piston 20 to the delivery air 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 delivery 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 delivery passage 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 delivery passage 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 delivery pressure and permits the regulating spring 15 to open the regulating valve 7 more, thus allowing a greater flow of air with consequently greater reduction of pressure on the face of supply piston 20.

As the delivery 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-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 screw 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 may be regulated for either high or low pressure.

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.

Distributing Valve

The distributing valve is the automatic valve mechanism which operates the brakes on the 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 for 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.

The connections between these parts as well as their

operations, may be compared with that of a miniature brake set,--the equalizing portion representing the service portion; the pressure chamber, the auxiliary reservoir; the application portion always having practically the same pressure in its cylinders as that in the brake cylinders.

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.

The No. 6-KR Type Distributing Valve incorporates a duplex poppet type application valve. Referring to Fig. 12, 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 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 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 cylinder comes directly from the main reservoirs, the supply is practically unlimited. Any pressure in the application cylinder will move 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 or piston travel.

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 application, by means of the equalizing portion and the air 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 appli-

cations with the result that a correspondingly higher cylinder pressure is obtained.

Referring to the isometric views of the slide valve seat, Fig. 13, the ports are as follows:

h leads to passage 2.
2 leads to the Application Cylinder, Automatic Brake Valve and Independent Brake Valve.
w leads to the Application Chamber.
4 leads to the Distributing Valve Release Pipe.
1 leads to the Safety Valve.

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

Type "A" Safety Valve

The purpose of the safety valve, Fig. 14, is to vent pressure at a predetermined point in order to prevent excessive brake cylinder pressure on the locomotive.

When the pressure in cavity A under valve 3 is sufficient to overcome the tension of spring 5, valve 3 is lifted from its seat. This upward movement opens ports c, permitting air to flow from cavity A through chamber B and ports c to the atmosphere. At the same time, a part of the air from cavity A flows through valve ports x into spring chamber D, then through ports y (in body 2) into chamber E, between body 2 and shell 17, thence through filter 16 to the atmosphere. As the pressure below valve 3 decreases, spring 5 forces valve 3 downward, restricting the opening to the atmosphere through ports c but permitting air flow through valve ports x to continue into spring chamber D. Although chamber D is open to the atmosphere at all times, the connecting ports y in the body are sufficiently small to restrict the exhaust, so that pressure builds up very rapidly in chamber D and assists spring 5 in forcing valve 3 quickly to its seat.

To adjust the safety valve for the maximum or opening pressure, in this case 68 pounds, remove cotter 20, nut 19, lock washer 18 and shell 17, then remove cap nut 13 and screw down or back off adjusting nut 6 as required, finally replacing the cap nut. The minimum or closing pressure can be adjusted by changing the size of ports y, using throttling ring 7 for this purpose. After adjustment, screw down locking ring 8, then replace shell, lock, washer, castle nut and cotter pin.

"UAH" Brake Cylinder

The illustration on Fig. 15 is a sectional view of the "UAH"

improved brake cylinder which is made in sizes to meet all operating requirements and which incorporates features contributing towards satisfactory operation and economical maintenance. This brake cylinder is designed to prevent the entrance of dirt.

The cylinder body and pressure head are combined into a single casting 2 which is provided with a bolting flange for mounting and a Wabcotite mounting for the pipe connection. The piston 4 has a hollow rod which provides for a loose push rod 10 that is attached to the levers and rods of the brake rigging, and a push rod holder 39 is attached to the outer end of the piston rod.

A solid WABCO packing cup 5 snaps onto the pressure face of the piston. 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 contains a piston lubricator. The space back of the heel of the packing cup and in front of the lubricator swab provides a groove around the piston which, when filled with lubricant, serves to spread the lubricant over the cylinder wall with each movement of the piston.

To prevent the entrance of dirt, the piston hollow rod is ground true as to diameter and surface, and the non-pressure head 13 is fitted with a hollow rod lubricator packing seal 63 held in place by spring seat 64 which is packed in grease and serves to lubricate the hollow rod as well as seal the interior of the cylinder against dirt and moisture.

Since atmospheric air must enter the non-pressure end of the cylinder during the release movement, the non-pressure head is fitted with a curled hair strainer 14. This strainer is of the cartridge type held in place by a strainer retaining ring 15 which prevents flying dirt and water contacting directly with the strainer.

Type "H" Air Filter

The type "H" air filter, Fig. 16, is used to prevent the passage of dirt and moisture with the air flowing from the main reservoirs into the equipment. The air filter is used and located in the main reservoir pipe leaving the last reservoir.

This type of filter consists of a cover, a dirt chamber and a baffle portion from which the filter unit is supported. The cover is fitted with unions and two tapped lugs for supporting brackets. A raised arrow cast on the top indicates direction of the air flow. The baffle has a spiral rib which imparts a swirling movement to the air flow, which aids in removing dirt and moisture and depositing in the dirt chamber. The pipe taps in the dirt chamber provide that the drain cock may be placed either at the side or bottom and the other tap plugged.

The filter unit is formed of wire screen covered by felt which is pleated around and supported on a central perforated metal tube. Felt sealing pads are applied at top and bottom. This deep-seated method of folding the felt concentrates within a small space a large filtering area -- several times greater than the inlet or outlet. Air entering the annular intake is diffused downward between the baffle and dirt chamber and passes through the filter unit and out the central opening at the top.

The dirt chamber is detached by removing the nuts from the cover studs, after which the filter unit is released by backing off the castle nut on the lower end of the tie bolt.

Centrifugal Dirt Collectors

Centrifugal Dirt Collectors are used with this equipment, see the piping diagrams, Plate 10. The dirt collectors are used to prevent pipe scales, cinders and other foreign matter from reaching the distributing valve and brake valve.

Fig. 17 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 a rocking motion whereby any fine dust which may collect on top of the check valve will be shaken off into the dirt chamber.

Duplex Air Gages

There are two duplex air gages, Fig. 18, 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).

1-1/4" Emergency-Brake Valve

The 1-1/4" emergency-brake valve, Fig. 19, provides a means of venting the brake pipe and obtaining an emergency brake application. The emergency-brake valve consists of a body 2 in which are housed the vent valve 3, vent valve spring 8 and valve nut 6. Valve lever 10 is attached to body 2 by rivet 11 and operating lever 9 by a similar rivet.

Normally when the brake pipe is charged the brake pipe air is prevented from being vented by seated vent valve 3. When the operating lever 9 is pulled, valve lever 10 is moved downward which unseats vent valve 3, thus permitting brake pipe air to vent to atmosphere and insure an emergency brake application. When the operating lever 9 is released, spring 8 seats the vent valve 3 preventing further loss of brake pipe air.

Pipe Fixtures

A Branch Pipe Tee, Fig. 20, is located in the distributing valve branch to the brake pipe. Its purpose is to prevent moisture that may be deposited in the brake pipe, from any cause, draining into the branch pipe connection and thence into the distributing valve.

This fitting has the interior coring so designed that the outlet from the brake pipe to the branch pipe is at the top. Thus, as air enters from the brake pipe it flows upward through the pipe opening at the side to the branch pipe, the moisture and heavy particles of dirt passing on through the brake pipe.

The Main Reservoir Cut-out Cock, Fig. 21, is to cut off and vent the air from the main reservoir pipe when removing the brake valve, feed valve, etc. Before this cock is closed the brake valve cock should be closed and the brake valve handle placed in Emergency 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.

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

Hose and Couplings, Fig. 22, make the brake pipe connections throughout the train. When cars are being separated, as in switching, the hose should be uncoupled by hand, to prevent rupture or damage.

Dummy Couplings, Fig. 23, are provided at each end of the locomotive to which the hose couplings should be attached when not coupled, to protect against injury to the hose couplings or dirt entering the pipes.

Combined Air Strainer and Check Valve

The "Dead Engine" feature shown in the diagrammatic views and the piping diagram, Plates 1 to 12, is for the operation of the locomotive brakes when the compressor on a locomotive in a train is inoperative from any cause. Fig. 24 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.

OPERATION OF THE EQUIPMENT

It should be clearly understood that the diagrams of the equipment, Plates 1 to 9, 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 BRAKE OPERATION

Release and Running Position

The functions of charging and releasing the brakes can be accomplished by using either both Release and Running positions of the brake valve or the Running position only. A "Full" Release Nullifier is available for the handle of the automatic brake valve when it is desired to nullify Release position.

The use of Running position for releasing train brakes instead of Release position is found to have the advantage of avoiding stuck brakes (many times) on account of the liability of overcharging on locomotive and cars nearest the locomotive. Where Release position is used, the length of time that the automatic brake valve is in Release position must be carefully determined, as brakes will likely reapply on light overcharges when the brake valve handle is returned to Running position.

Release and Charging Position

Plate 1

With main reservoirs charged and the handle 55 of the automatic brake valve in Release position, air flows through the dirt collector in the main reservoir pipe to the brake valve and the distributing valve. Entering the brake valve through port 7, main reservoir flows through passage 7 to chamber A above rotary valve 36, thence through the rotary valve port (Not shown in this diagrammatic) and ports 1a and 1 to the brake pipe charging the entire system. At the same time port j in the rotary valve registers with the equalizing port C in the valve seat permitting air at main reservoir pressure to enter chamber D above equalizing piston 41 and the equalizing reservoir.

As the equalizing piston chamber P in the 6-KR distributing valve is connected to the brake pipe, brake pipe air flows through the feed groove v past piston 26 into the chamber about the equalizing slide valve 31 and through port o to the pressure chamber, until the pressures on both sides of piston 26 are equal.

If the brake valve handles were allowed to remain in Release position, the brake system would be charged to main reservoir pressure. To avoid this the handle 55 must be moved to Running or Holding position. To prevent the engineman from forgetting this a small port discharges feed valve air to atmosphere in release. A cavity in the rotary valve 36 connects port 20 with warning port WP in the seat and allows a small quantity of air to escape into the exhaust cavity "EX" which makes sufficient noise to attract the engineman's attention to the position of the handle.

Running - Plate 1

With the automatic and independent handles of the brake valve in Running position, Plate 1, cavity r in the automatic rotary valve connects port 20 to port 1a in the valve seat, affording a large direct passage from the feed valve to the brake pipe, so that the latter will charge the entire system 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 1a it also flows through cavity j and port C to chamber D above the equalizing piston 41. Chamber D is connected through port 5 and pipe connections, as shown, to the equalizing reservoir (E.R.) and gage. The purpose of the equalizing piston and reservoir will be described later, under "Service Application".

Port 1a, 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 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 pedestal connection 1, flows through this pipe and the branch pipe to the B.P. connection of the distributing valve, thence to chamber P of the equalizing portion. Brake pipe air then flows through feed groove v past 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 to Ex in the brake valve through port w, cavity k in the equalizing slide valve, port i and the distributing valve

release pipe to connection 4 in the brake valve pedestal through port 4, past independent brake valve exhaust valve 134, port 19, cavity q and the exhaust port.

The brake cylinder pipe is connected to the distributing valve exhaust and the atmosphere through ports c, d and e.

Service Application - Plate 2

The system being charged, as has been described, say to 70 lbs. brake pipe pressure and the automatic brake valve handle 55 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 the exhaust port to the atmosphere. This at once reduces the pressure of the air on the top of the equalizing piston 41 below that in the brake pipe under the piston, and the higher pressure moves the piston upward, raising the attached equalizing discharge valve from its seat and allowing air from the brake pipe to flow through opening 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 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 moves 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 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 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 moved 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 10 and attached exhaust slide valve 16 are moved to the right, cutting off the exhaust ports d and e from slide valve chamber b. As the piston continues its movement, the end of its stem contacts application pilot valve 71, moving the latter from its seat, allowing main reservoir air in chamber a1 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 a1 faster than it can be restored from the main reservoir pressure through choke a2; therefore, the application valve 68 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 68 unseated, main reservoir air in chamber a 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, with a very light differential across the application piston.

During the movement just described, cavity t in the graduating valve 28 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 h2 and l in the seat. This establishes communication between the application cylinder g and the safety valve.

Service Lap - Plate 3

After the desired brake pipe reduction has been made, the automatic brake valve handle is returned from Service to Lap position, Plate 3. As has already been described, in this position of the brake valve the brakes are held applied throughout the train until a further brake pipe reduction 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 move 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 g 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 68 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 68 and pilot valve 71, 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.

Release and Recharge - Plate 1

To release the brakes after a brake application the automatic brake valve handle is moved to Running position. In this position, air from the feed valve flows through port 20 to cavity r in the rotary valve, then to ports 1a and 1 thence directly into the brake pipe. At the same time air from passage 1a also flows through cavity j and port C to chamber D above the equalizing piston 41 and through port 5 to the equalizing reservoir.

Feed valve air that is admitted to the brake pipe through port 1 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 be restored until it is equal to that in the brake pipe, as before described. The distributing valve release pipe is connected to atmosphere through port 4, exhaust valve 134 of the independent brake valve, port 19, cavity q in the rotary valve of the automatic portion, and the exhaust port EX to the atmosphere. As cavity k in the equalizing slide valve 31 of the 6-KR Distributing Valve connects ports 4, i, w and h in the valve seat, the air in the application cylinder g and chamber will escape through the distributing valve release pipe to the atmosphere. As this pressure reduces, the brake cylinder pressure will move application piston 10 to the left until exhaust valve 16 uncovers exhaust ports d and e, allowing brake cylinder air to escape, or in case of graduated release, to reduce in like amount to the reduction in application cylinder pressure.

Holding During Automatic Release - Plate 4

To hold locomotive brake 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 19, which leads to the distributing valve 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 brake is released, while in the latter it is held applied.

Emergency - Plate 5

When it is desired to make the shortest possible stop, the brake valve handle 55 is placed in Emergency position. This opens the brake pipe directly to the atmosphere through large port 1a, cavity y and the exhaust port, causing an emergency rate reduction of brake pipe pressure. Cavity y also connects ports C and h to the exhaust port, 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 moves 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, and to insure the equalizing piston being held in Emergency position, main reservoir air is permitted to flow through a restricted opening by way of port a and cavity j in the rotary valve of the automatic portion of the brake valve and port 2 in the seat into the application cylinder pipe and into the application cylinder g. 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 g is now connected to the safety valve through port h2 in the seat, cavity q and port r in the equalizing slide valve and port 1 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 pressure 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-DKR Distributing Valve is moved promptly to the right, opening the application valve 68 fully, which then produces a fast build-up of brake cylinder pressure as described under "Automatic Service".

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 lap.

The release after an emergency is brought about by the same manipulation of the automatic brake valve as that following service application, and is explained under "Release and Recharge".

If an Emergency Application is made by an emergency-brake 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 before mentioned, the function of the application portion of the distributing valve is to control the flow of air to and from the locomotive brake cylinders. The movement of the application piston 10, 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 chamber, controlled directly by the independent portion of the brake valve.

The operation of the equipment with the independent brake valve follows:

Running - Plate 1

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. Exhaust valve 134 in the independent brake valve is open, connecting ports 19 and 4 thus establishing communication through the Distributing Valve Release Pipe, between the application cylinder g 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.

Application, First Stage - Plate 6

To obtain an application of the locomotive brake, the independent brake valve handle 55 is moved to the right. The farther the movement of the handle, the greater the amount of application. As the handle is moved to the right the cam on shaft 76 moves dog 144, pusher pin 139 and attached levers, the ends of which are positioned on inlet valve 122 and exhaust valve 134. Spring pressure plus air pressure acting to hold inlet valve 122 closed is heavier than spring 148 acting

to hold exhaust valve 134 open; therefore, the first movement of the handle cam to move the balancing levers causes the exhaust valve 134 to close, cutting off the brake valve exhaust. Further movement of the brake valve handle to the right causes additional movement of the balancing levers, which now fulcrum on the closed exhaust valve 134 and open inlet valve 122. This permits main reservoir air from passage 7 to flow into the brake valve chamber F supplying application air past check valve 97b and through passage 2 to the application cylinder pipe. At the same time application air also flows from chamber F to passage 4 and the distributing valve release pipe.

At the distributing valve, air from application cylinder pipe 2 flows through passage 2 to application cylinder 3 and to cavity k and port w to the application chamber; and air from the distributing valve release pipe flows through passage 4 and i, cavity k in the equalizing slide valve to port w and the application chamber. The two channels of flow provide a fast build-up of application cylinder pressure which quickly moves application piston 10 to right, opening application valve 68 fully. This permits main reservoir air to flow to the brake cylinders, building up pressure therein at the same rate as the application pressure is being increased. This flow will continue until the pressure in the brake cylinders exceeds that in the application cylinder when the application piston moves to the final application stage.

When the independent brake valve handle 55 is moved out of running into application position exhaust valve pawl 94 on shaft 76 contacts the exhaust valve plunger and lifts exhaust valve 97a from its seat. Thus passage 19 from the self-lapping exhaust valve 134 is provided with an opening to atmosphere regardless of the automatic brake valve handle position. This insures the proper operation of the self-lapping portion of the brake valve.

Independent Application, Final Stage - Plate 7

As pressure builds up in brake valve chamber F, it acts upon spring loaded piston 127 which forms the exhaust valve seat, and moves piston 127 and exhaust valve 134 compressing spring 148, the exhaust valve thus remaining closed. The exhaust valve end of floating lever 138 moves with the exhaust valve and piston so that, as the lever fulcrums on the handle cam, the application valve end of the lever moves away from the inlet valve after which valve 122 is closed by spring 123. In this manner the self-lapping unit operates to quickly and accurately build up pressure in the distributing valve release pipe and application cylinder pipe corresponding to the position of the brake valve handle.

In the application portion of the distributing valve application piston 10 moves to the left as shown in independent application final stage. Application valve 68 and pilot valve 71

are closed by springs 75 and 76 respectively, preventing further flow of air to the brake cylinders and slide valve 16 laps ports e and d preventing loss of brake cylinder air. The brakes are thus held applied until a further application or a release is made.

Independent Release After Independent Application
Plate 1

To release the locomotive brake the handle of the independent brake valve is moved to Running position. As the brake valve handle is moved toward running position, the handle cam moves away from balancing lever pusher pin 139 of the self-lapping unit. The lever 138 then fulcrums on closed inlet valve 122 and spring 148 moves exhaust valve 134 from its seat. This permits distributing valve release pipe air to flow to atmosphere past exhaust valve 134, passage 19, cavity q, the exhaust port and brake valve exhaust Ex. If the brake valve handle is moved only part way toward running, distributing valve release pipe air in brake valve chamber F, and acting on the piston type exhaust valve seat 127, will only be reduced in pressure and the piston spring 148 will move seat 127 into contact with exhaust valve 134 and prevent further flow of air from the distributing valve release pipe. With the brake valve handle in running position, the handle cam is moved away from the balancing levers and the exhaust valve spring 148 holds valve 134 open to vent all air pressure from the distributing valve release pipe. Thus the distributing valve release pipe pressure is decreased in small graduations, or entirely, as desired.

Venting of distributing valve release pipe air permits air to flow from application cylinder g of the distributing valve through passage h1, 2, cavity k in the distributing valve slide valve 31, passage i, 4, and through distributing valve release pipe 4 as previously described. The greater brake cylinder pressure on the other face then moves the application piston to release position, as shown. In this position the air in the brake cylinder pipe flows to the atmosphere through ports c, d and e and the distributing valve exhaust.

Independent Release - Automatic Brake Applied
Plate 8

If the brakes have been applied throughout the train by means of the automatic brake valve, as described under "Service Application", and it is desired to release the locomotive brake, the independent brake valve handle in Running position is depressed. When handle 55 is depressed it moves actuating plunger 82 and the attached plunger collar down to contact and depress quick release valve operating arm 90. This moves plunger 93 to the right to unseat quick release valve 97. Thus air from distributing valve application cylinder g flows through passage h1, 2, application cylinder pipe, passages 2 and 2a in the brake valve, past unseated quick release valve 97 and through the independent brake valve Ex. opening to atmosphere. Brake cylinder air in chamber b moves application piston 10 from Lap position

to Release position, permitting air in the brake cylinder pipe to flow through port c to chamber b and thence to exhaust and the atmosphere through port d and e, thus releasing the locomotive brake. 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.

If a graduated release is desired, quick release valve 97 must be closed before all of the application cylinder pressure is lost. To do this handle 55 is returned to its upper position permitting spring 83 to move plunger 82 upward away from operating arm 90. The anchor pin spring 92 then moves arm 90 away from plunger 93 and spring 98 closes quick release valve 97. In this way the independent release may be graduated as desired.

Independent Application after an Independent Release - Automatic Brakes Applied
Plate 9

If it is desired to re-apply the locomotive brake after a release, the train brakes remaining applied, the handle of the independent brake valve is moved to application position. The locomotive brake is then re-applied as previously described, except that the application air from independent brake valve chamber F through passage 4 and the distributing valve release pipe is cut off from application cylinder g by slide valve 31 in the distributing valve after an automatic application. Application air flow from independent brake valve control chamber F to the distributing valve application cylinder g and application chamber is past application check valve 97b, passage 2, application cylinder pipe and passage 2 and h1 in the distributing valve. One branch of passage 2 leads to application chamber by way of cavity n and passage w.

Independent Application after an Automatic Application
Plate 9

If it is desired to increase the locomotive braking pressure after an automatic brake application of less than full service, independent brake valve handle 55 is moved to the right to application position. This closes exhaust valve 134 and opens inlet valve 122 permitting main reservoir air from passage 7 to flow to control chamber F and unseat application check valve 97b. Application air can then flow through passage 2 and the application cylinder pipe to the distributing valve application chamber and application cylinder g to operate the application piston 10 and increase the locomotive brake cylinder air pressure in the same manner as previously described under "Application - First Stage".

KH-6-P Pedestal Brake Valve
Sander Valve Operation

The Sander valve located on the side of the brake valve and shown diagrammatically on Plate 1, provides sanding of the locomotive wheels in forward or reverse operation.

In reverse operation sanding is provided by moving the sander valve handle 187 to the extreme left position. As shown in the view of Plate 1, main reservoir air from chamber B is connected through a port in rotary valve 179 to port 11 and the reverse sanding pipe. At the same time main reservoir air flows through a choked warning port to the exhaust opening to sound a warning as long as the handle is in sanding position.

Sanding in forward operation is provided by moving the sander valve handle to the extreme right position, Plate 1. In this position main reservoir air is connected through a port in rotary valve 179 to port 13 and the forward sanding pipe. Main reservoir air also flows through a choked warning port in the rotary valve to the exhaust opening to sound a warning as long as the handle remains in sanding position.

In Neutral position, Plate 1, midway between forward and reverse, main reservoir air is cut off from both sanding pipes by the rotary valve. The sanding pipe ports 11 and 13 are connected to the exhaust port through rotary valve 179.

Bell Ringer Valve Operation

To operate the bell ringer valve the lower valve handle 187a is moved to the left out of neutral, Plate 1. In this position main reservoir air from chamber C is connected through the port in rotary valve 179a to port 10 and the bell ringer pipe. When the handle 187a is moved to Neutral, Plate 1, port 10 from the bell ringer pipe is disconnected from the main reservoir supply and connected through the rotary valve to the exhaust port, thus stopping the bell ringing.

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 two position brake pipe cut-out cock on the brake valve; and, in addition to the brake pipe and the main reservoir pipe, a third pipe, the Equalizing Pipe, runs throughout the length of the locomotive. See plates 11 and 12 for typical diagrammatic piping diagram of the equipment.

The No. 6-DKR Distributing Valve, Fig. 25, is the same as the

No. 6-KR except that a Filling Piece 106 is inserted between the valve and reservoir portions, to which is bolted a Transfer Valve portion 308 and a Dead Engine Fixture 278.

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 previously described and shown on Fig. 24.

The Brake Pipe Cut-out Cock on 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. 25 (Section B-B), consists of a piston 304 and slide valve 203, 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 brake valve brake pipe cut-out cock.

The Transfer valve, see diagrammatic view, Plate 11, has port connections as follows:

To Brake Valve Cut-out Cock (7A).
To Main Reservoir Supply Pipe (MR).
To Brake Cylinder Pipe (BC).
To Equalizing Pipe (EP).
To Application Cylinder and Equalizing Slide Valve Seat (4b).
To Application Cylinder Pipe (4a).

When the piston 304 and slide valve 303 are in forward position (piston chamber G open to atmosphere), Fig. 26, the

Application Cylinder Pipe is open through the slide valve 303 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 303 connects the brake cylinder pipe to the equalizing pipe.

With the piston and slide valve in forward position (main reservoir pressure in piston chamber G), Fig. 27, the application cylinder g is cut off from the brake valve and connected to the equalizing pipe EP 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.

The three position cut-out cock on the brake valve, Plate 11, serves as the usual brake pipe cut-out cock in addition to other functions. 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 port 1 to the brake valve port 1a and connecting the transfer valve piston chamber port 9 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 port 1 to the brake valve port 1a and connecting the transfer valve piston chamber port 9 to main reservoir port 15.

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 port 1 is closed), (it is understood, of course, that the distributing valve dead engine cock should be opened).

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 11, is the same as that already described except as follows:

Independent Application

With the handle of the independent brake valve in application position, main reservoir air instead of flowing direct to application cylinder g of the distributing valve, now flows to the filling piece 287 and through passages 4, K, 4a to cavity b in the transfer valve slide valve 303 and thence through passage 4b and h1 to the application cylinder. Brake cylinder pressure flows to the equalizing pipe EP

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, Fig. 27, 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.

Independent Release

In Running position of the independent brake valve, Plate 11, air from the application cylinder g 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 valve three position 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.

Type "KM" Vent Valve

The "KM" vent valve, Fig. 28, provides a means of insuring propagation of quick action through a train when the brake pipe is vented to make an emergency brake application.

This valve, Fig. 29, consists of an upper housing 2 which is bolted to a bracket 29, and a lower case 3 which is

bolted to the bottom of housing 2 and supports slip bushing 5 in which moves a piston 9. The lower case is seated to the upper housing by a gasket 13. The piston shank is guided by an extension on the lower end of the bushing. Bushing 5 is formed with a seat on which seals a gasket 11 on the underside of piston 9 when the pressure differential across the piston becomes great enough. Drilled ports through the piston stem and the piston between the gasket 11 and the piston ring provide a stabilizing passage. Flow through this passage and leakage past the ring are limited by gasket 11 when it seals on its seat. The stabilizing passage and a drilled port in the bushing furnishes a direct but accurately restricted communication across the piston 9. Three unseating pins firmly secured to the piston project upward through drilled passages in housing 2 and are shouldered at two points to engage valves 24 and 21. The latter seats on a bushing pressed into a large exhaust core in the body, and the former seats on a small seat formed on the upper side of valve assembly 21. A spring 20, guided in a bushing enclosed in cap 4, urges both valves to their seats. Gasket 19 seals the cap to the housing.

As the piston moves upward, the unseating pins first lift valve 24 off its seat and then valve 21 off its seat, exposing a very large exhaust port. A strainer 27 prevents the entrance of large particles of foreign material, and the level of the entrance to the drilled passages for the unseating pins is high enough so that loose water collected in chamber A will flow back into the pipe before it can get to the operating parts.

The piston stem is drilled out to receive a felt packing 37 which is saturated with light oil. Breathing through a small port in the stem under changes of pressure in chamber C supplies a film of lubricant for the stem fit with the bushing over long periods of time.

Brake pipe air entering the "KM" vent valve, Fig. 30, flows through strainer 27 into chamber A surrounding the discharge valves and above the piston 9. The latter is moved downward until the end of the stem engages the spring cup 7, and since the rate of brake pipe pressure development is high on a locomotive with the brake valve handle in Running position, the spring 8 will be compressed until the gasket 11 seals on its seat. Air flows through stabilizing ports a and b into chamber C beneath the piston, charging it to brake pipe pressure at a low enough rate to afford adequate protection against overcharges. Valves 24 and 21 are held tightly to their seats by the combined load of pipe pressure and spring 20.

When an emergency rate of brake pipe reduction occurs at the "KM" vent valve, Fig. 31, the capacity of stabilizing ports a and b is not sufficient to prevent a high differential pressure to be quickly developed across the piston 9, with the result that the piston moves upward with ample force to unseat valve 24 against the load of the tension of spring 20 and the brake pipe pressure on the seat area. As soon as valve 24 is unseated, brake pipe air flows through the opened

exhaust port, and greatly increases the rate of brake pipe reduction. The added increase in pressure differential across the piston creates the force necessary to cause the lower shoulders on the pins 99 to pick up and unseat the large exhaust valve 21. Thus the vent valve responds to the comparatively light differential required to lift a valve of small diameter but almost instantly develops a very large venting capacity. When fully open these two valves provide an exhaust capacity equal to the internal diameters of a standard 1-1/4" pipe. Piston 9 is limited in its travel by a stop boss on the lower face of the housing. Stabilizing ports a and b allow chamber C to bleed down until spring 20 and the weight of the operating parts can move both exhaust valves to their seats, closing the outlet to the brake pipe and permitting it to be recharged when desired.

RULES FOR OPERATING

The following instructions are intended to cover in a general way the proper method of handling the No. 6-SL brake 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 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 end cocks at each end of the locomotive; 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 air horn; the brake valve cock located on the side of the brake valve body and distributing valve cut-out cock.

The handles of the brake valve should be in "Service" position. (These handles are not removable).

Do not attempt to move the train (or locomotive) until the brake equipment is charged to pressure required by company rules.

The instructions for manipulating the 6-SL Brake equipment are practically the same as those given for other equipment, therefore, no radical departure from present method 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

The brake valve handle should be moved to Running position to release and recharge.

Holding Locomotive Brake Applied

If, when releasing it is desired to hold the locomotive brake applied after the train brakes release, move the handle to Holding instead of Running position, then releasing the locomotive brake 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 position.

When all brakes are applied automatically, to graduate off or entirely release the locomotive brake only, depress the independent brake valve handle in Running position.

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.

Depressing the independent brake valve handle when in Running position will quickly release the locomotive brake under any and all conditions.

This brake valve has the improved self-lapping feature so that the locomotive brake may be controlled on and off with great flexibility.

Double Heading

When two locomotives are coupled together, the brake pipe hose must be coupled between the two locomotives and the cut-out 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 close the brake valve two position cut-out cock and place the handles of both brake valves in Running position. The brake 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 brake on the second locomotive by depressing the independent brake valve handle in Running position. Also, if the brake on the second locomotive is applied and there is danger of overheating the tires, or the drivers should slide, the brake can be released by depressing the independent brake valve handle in Running position, re-applying later, if necessary, by using the independent brake valve handle in the usual way, provided the handles on 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 brake 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 Engine

When the locomotive is to be hauled dead in the train, place the handles of both brake valves in Running position, close the brake valve cut-out cock and open the dead engine cock. The locomotive brake will then operate like that 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.

LUBRICATION

Type "U" Brake Cylinder

Dismantling of Brake Cylinders

Disconnect and remove the brake cylinder push rod. To avoid personal injury which may occur if the non-pressure head assembly is not secured by the hollow rod collar, examine the collar to determine that it will hold securely, then remove the piston, release spring, and non-pressure head complete. These parts must be transported to a suitable shop for re-conditioning. The piston and non-pressure head assembly must be handled at the locomotive and while being transported to and from the locomotive, so that the piston packing cup, lubricator swab assembly and other parts will be effectively protected against damage and contact with any kind of dirt. It will be the responsibility of individual railroads to provide such adequate protective means.

If the non-pressure head gasket is not broken and in condition to provide a tight seal, do not remove it. If not, remove the gasket, clean its seat when cleaning the brake cylinder and apply a new gasket when assembling the cylinder. Thoroughly clean the brake cylinder by

first using a dull rounded scraper for removal of all grease and any dirt, using an approved solvent, if necessary, to soften gummy deposits and remove rust spots, then wipe dry and clean with rags. When the cylinder is clean, unless the cleaner is prepared to immediately apply a re-conditioned piston and non-pressure head assembly, the cylinder should be covered to protect it from dust and dirt. New lubricant should be applied to the cylinder just before the cleaned and lubricated piston is installed.

Re-Conditioning of Piston and Non-Pressure Head Assembly

After the assembly has been taken to a suitable shop, place the piston and non-pressure head assembly in a holding fixture which will hold a release spring partially compressed and proceed as follows:

(a) Remove the hollow rod collar, the non-pressure head, the hollow rod felt packing seal, the spring seat and release spring.

(b) Blow all dirt out of the non-pressure head and at the same time blow any loose dirt from the strainer. 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. If found to be in good condition, re-install it, otherwise the strainer must be replaced by a clean one and the dirty strainer, if otherwise in good condition, may be cleaned and re-conditioned, if necessary.

(c) Using a suitable file, break any sharp edges from the ends of the opening in the non-pressure head which guides the hollow rod.

(d) Examine the release spring. If rust spots are found, clean them with emery cloth and coat the spring with a rust preventive.

(e) Re-condition the hollow rod felt packing seal by soaking it in a solvent to dissolve the grease and brush it to remove the surface dirt. If damaged or worn so that the spring seat cannot close it firmly on the hollow rod, apply a new one. Soak the hollow rod felt packing seal in oil specified below, and hang up to drain. It is ready for use after the oil ceases to drip.

(f) Clean the piston and hollow rod, removing any rust or rough surfaces, using emery cloth if necessary.

Remove the packing cup by using a wooden tool about 1" wide and 3/32" thick, or equivalent, with rounded edges to prevent damage to packing cup and piston lubricator. Thoroughly clean the packing cup with an approved solvent to aid in removing the oil, grease and dirt.

The packing cup should be carefully examined and should be renewed if brittle, thin at any point, cut, or otherwise defective.

Remove and clean the piston lubricator as follows:

Without removing the lubricator swab from the piston lubricator, submerge in a tank of an approved solvent for a few minutes then loosen the lubricator swab in its groove with a thin, rounded edge blade, after which return to the solvent tank for a time sufficient to dissolve the grease from the lubricator swab. Brushing the outer surface of the lubricator swab with an ordinary hand brush will aid in removing the old grease and clean the surface. The lubricator swab should then be dried with a jet of air.

When the lubricator swab of the piston lubricator is damaged, worn out, or in such a condition that it cannot be loosened and raised in its groove so as to make a full contact against the cylinder wall, the lubricator swab must be removed and one in good condition applied.

Submerge the clean piston lubricator in a tank of oil, using oil as per specification below. Soak the assembly in the oil for at least 10 minutes and allow same to drain for about 10 minutes (the purpose of this operation is to saturate the lubricator swab and thereby prevent it from absorbing oil from the brake cylinder lubricant.

Re-Assembly of Piston and
Non-Pressure Head

After completely coating the hollow rod with lubricating oil as per specification below, place the piston and hollow rod in

the holding fixture used while dismantling. Apply the release spring, then place the packing seal assembly sleeve on the end of the hollow piston rod, next place the spring seat and then the felt packing seal on the release spring. Force the non-pressure head under this arrangement of parts. Use the locking mechanism of the holding fixture to hold the release spring partly compressed while fastening the hollow rod collar.

Assemble the piston cup to the piston, then protect the entire assembly with a suitable cover from dirt or damage while being stored or transported to the locomotive.

Brake Cylinder Assembly

Using a suitable brush, coat the cylinder wall completely but sparingly with brake cylinder lubricant (current A.A.R. Spec. M-914) place the non-pressure head gasket in correct position in the recess of the cylinder flange. Coat the cylinder wall bearing surface of the packing cup and fill the grease groove of the swab retainer with brake cylinder lubricant and immediately apply these parts to the cylinder and tighten the non-pressure head bolts. Apply and connect the push rods.

Check the cylinder for loose supporting bolts and nuts and if missing or loose, they must be renewed or tightened. Tighten solidly all flange fittings.

Lubricating Oil Specification

The oil employed for soaking the lubricator swabs of the piston and hollow rod lubricators, as specified in the foregoing paragraphs, must be a paraffin base oil per the following specification:

Flash point	400 Degrees F. Min.
Fire point	450 Degrees F. Min.
Pour point	5 Degrees F. Max.
Viscosity at 100° F.	550 to 700 Seconds
Viscosity index	100 Min.
No fatty oil	
Neutralization No.	.05 Max.

Brake Valves

A good grade of graphite grease is recommended for use on the automatic brake valve rotary valve 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 lubricating oil (current A.A.R. Spec. M-912) 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 a cleaning solvent, 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 brake valve 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 approved lubricating 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 up the oil hole again after moving the handle a few times, and replace the cap nut.

At regular inspection periods plugs 121 of the oil ports in the independent brake valve self-lapping portion, which lead to the felt expander 128, should be removed and the passages filled with approved lubricating oil. The oil plugs should then be securely replaced. At regular shopping intervals the brake valve should be dismantled, cleaned, and lubricated. Piston packing cup 130 should be lubricated with brake cylinder lubricant and the moving parts with lubricating oil. All valves and seats should be cleaned to insure proper seating. The complete independent brake valve unit can be removed from the pedestal by removal of stud nuts 19, and taken to the shop where the cleaning and lubricating can best be done.

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 pipe bracket 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 six 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 approved lubricating oil. All oil, gum or grease should be thoroughly removed from the valves and their seats before the lubricating oil is applied.

Before replacing the equalizing piston, the piston with ring should be immersed in a cleaning solvent, 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 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 lubricating 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 lubricating oil.

Application Portion - The ring 55 on application valve piston 54 should be sparingly lubricated with one drop of lubricating oil and the ring moved around to distribute the oil. The bushing should be wiped with a clean cloth saturated with oil and then wiped with a clean cloth. The seat 56 should be wiped with a clean cloth to insure that it is free of oil or grease before the lubricating oil is applied.

Before applying the piston to the application portion, clean the application cylinder and piston. Lubricate the walls of the cylinder

and piston ring, using the same lubricating oil.

Feed Valve

The slide valve face, the slide valve seat and the upper portion of the bushing should be glazed with the best grade of very fine pure dry graphite.

The piston ring groove should be lubricated with two drops of lubricating oil and the ring moved to distribute the oil. Also place three drops of oil in the piston bush.

TESTING LOCOMOTIVE BRAKE

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 fully charged note whether a leak occurs at the service exhaust port of the automatic portion of the brake valve when the handle is in Running, Holding or Lap positions. Leakage at this point indicates that the equalizing piston 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 on the brake valve, then making a heavy service application and returning the handle to Running position. The heavy blow caused at the exhaust fitting usually removes the obstacle and allows the equalizing piston valve to seat.

Test No. 2. With brake valve gaskets known to be in good condition, make a 20 pound service reduction from pressure to be carried, close the brake valve cut-out cock, place the handle in Lap position and note if there is leakage at the rotary valve; it will be indicated as follows: increase of brake pipe pressure will cause a blow at the service exhaust fittings; increase of 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 application with the independent brake valve. If brake cylinder pressure increases up to the amount for which the distributing valve safety valve is adjusted, it indicates leakage of the independent self-lapping unit inlet 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 an automatic 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 only when the locomotive brakes are applied indicates a leaky exhaust valve.

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 may be leakage past the equalizing slide valve, or past the independent brake valve inlet 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.

Note: For more complete tests see Instruction Pamphlet 5048.

TROUBLE AND REMEDIES

Broken Pipes

Main Reservoir Pipes - If the main reservoir pipe breaks between the reservoir and the brake valve pedestal in such a way that it cannot be repaired, the locomotive brake cannot be applied by either 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 brake is then inoperative. The train brakes can be operated in the usual manner.

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, but the locomotive brake cannot be operated by the automatic brake valve. The locomotive brake can be operated by the independent brake valve in the ordinary way except that the independent brake valve must be depressed in Running to release it.

If the break occurs between the branch pipe to the distributing valve and the branch to the automatic brake valve, plug the distributing valve side of the pipe. 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, 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. The

locomotive brake cannot be applied with the independent brake valve, and the emergency maintaining feature is lost; the locomotive brake can, however, be applied as usual by the automatic brake valve and released by that valve in Running position.

Distributing Valve Release Pipe - If the release pipe breaks, the holding feature is lost and it is also impossible to keep the locomotive brake 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 depress the independent brake valve handle to Running at all times when it is desired to release the locomotive brake. 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.

Printed in U.S.A.
Ji

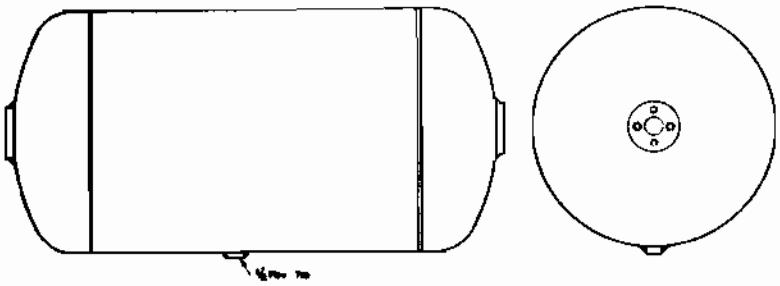


Fig. 2. Main Reservoir

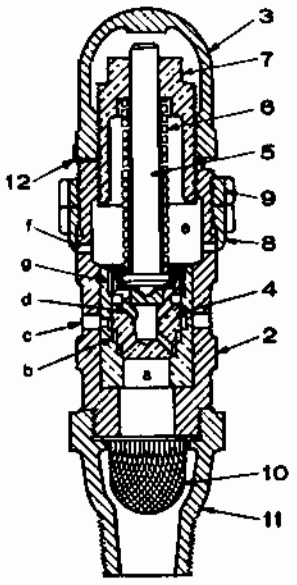


Fig. 3. E-7-B Safety Valve

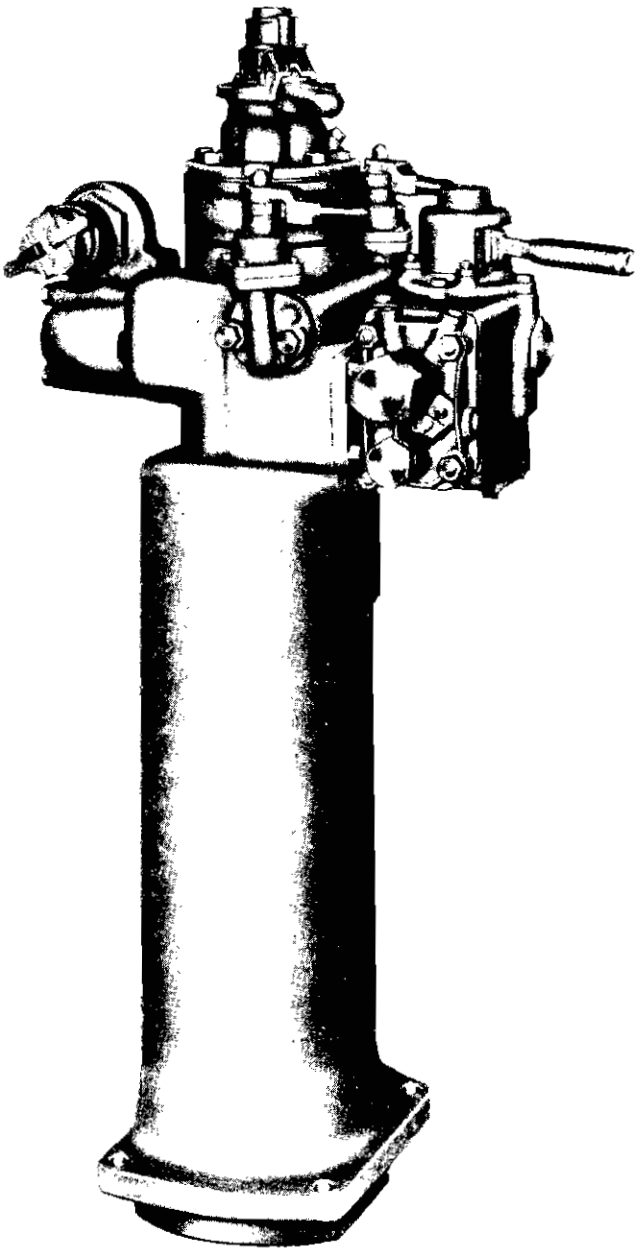


Fig. 4. KH-6-P Brake Valve

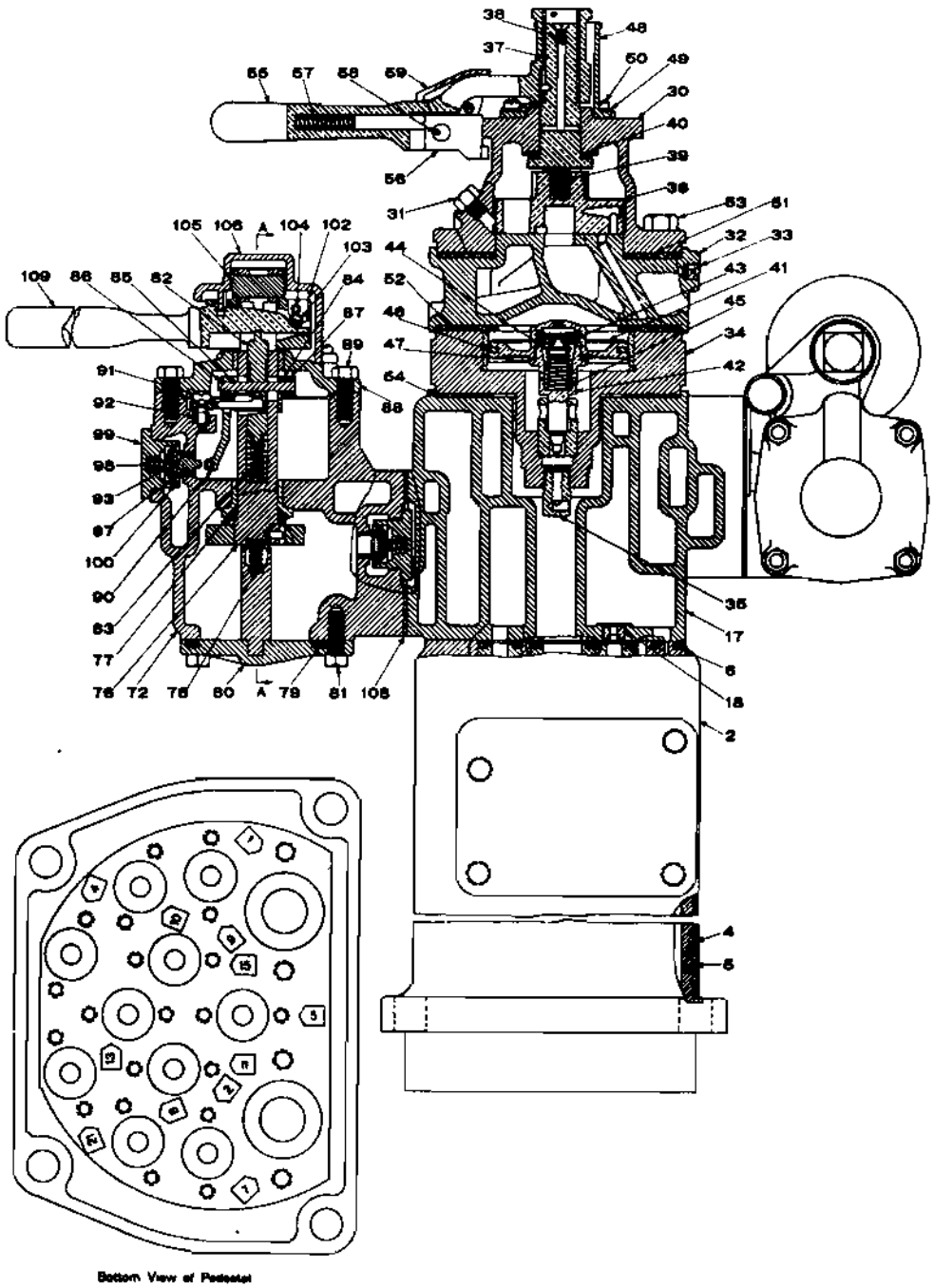


Fig. 5. KH-6-P Brake Valve
Sectional and Outline Views
Bottom View Showing Pipe Connections

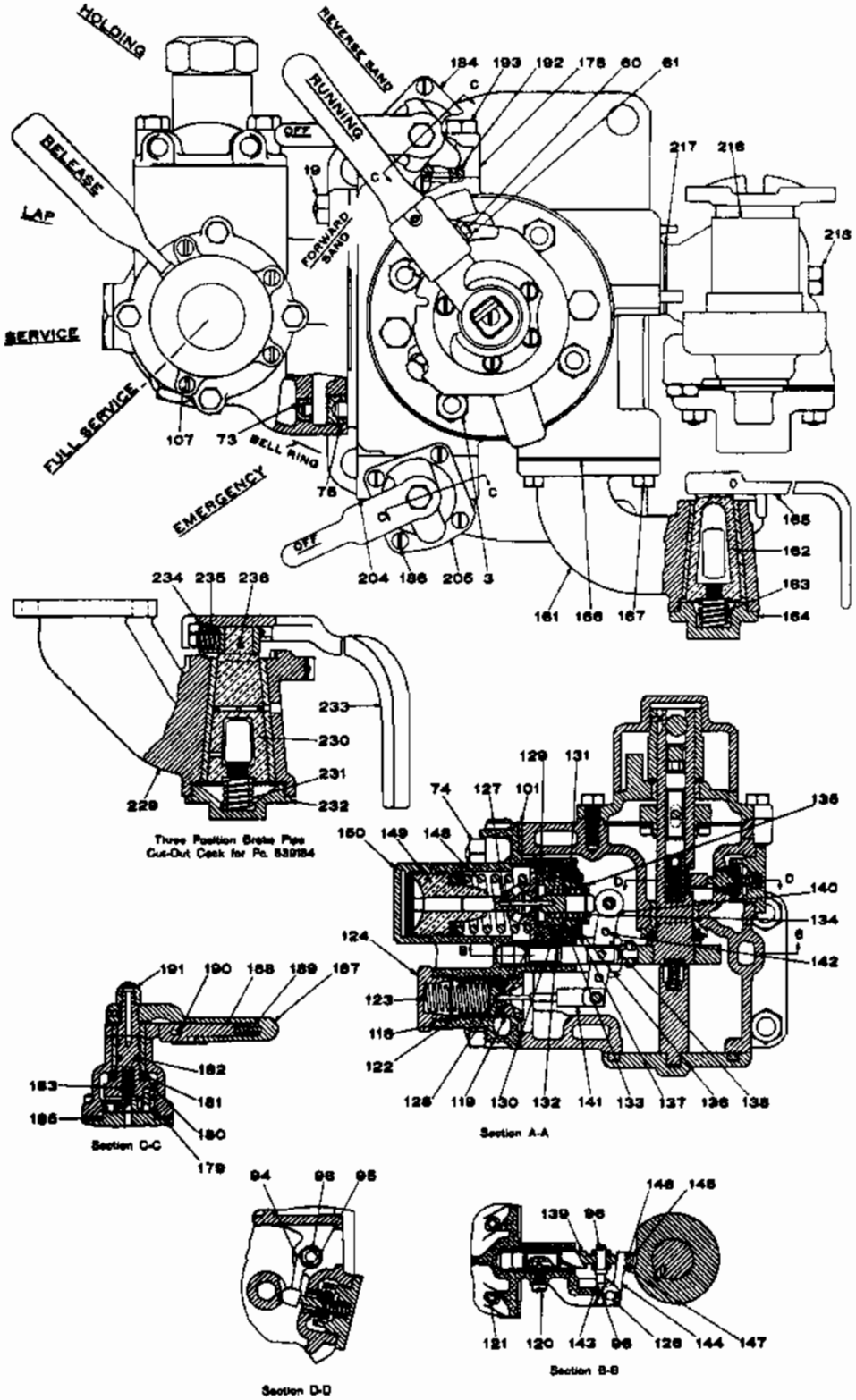


Fig. 6. KH-6-P Brake Valve - Top and Sectional Views

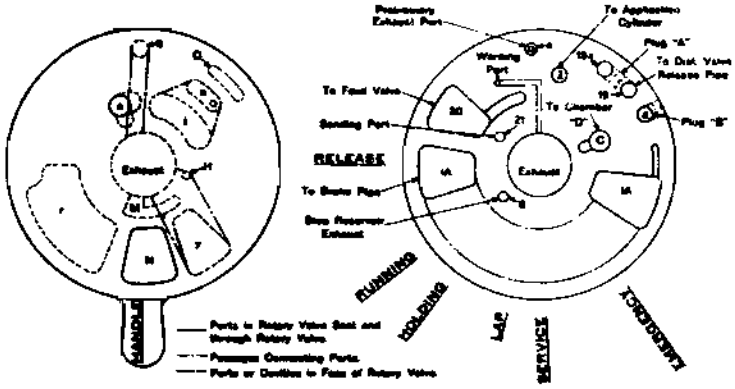


Fig. 7. Rotary Valve and Seat, KH-6-P Brake Valve

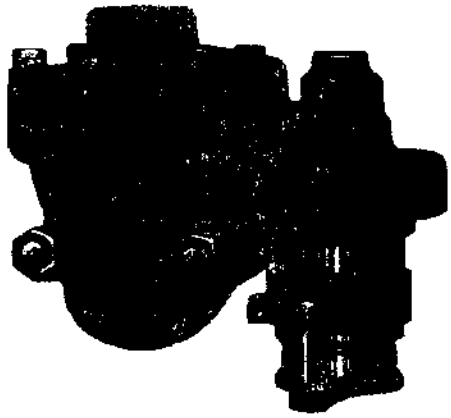


Fig. 8. Type "M-3-A" Feed Valve

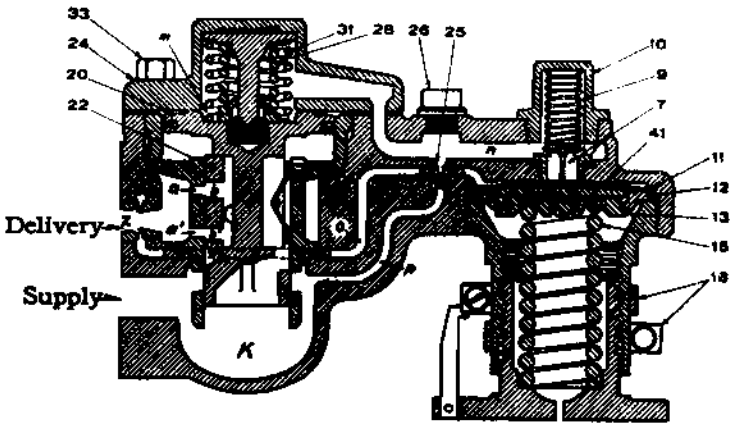


Fig. 9. Diagrammatic View of the M-3-A Feed Valve in OPEN Position

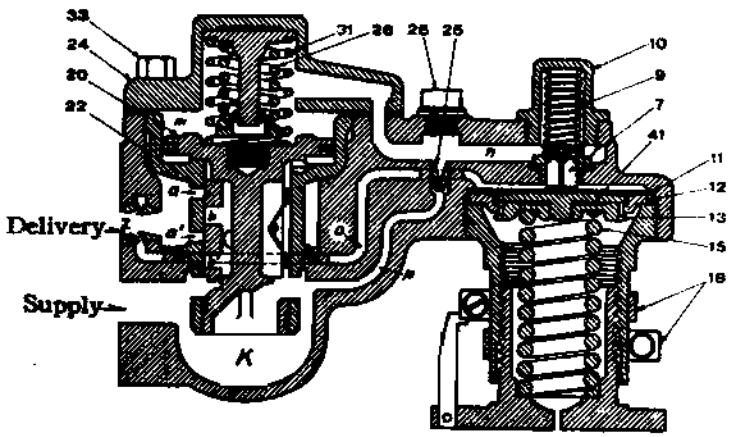


Fig. 10. Diagrammatic View of the M-3-A Feed Valve in CLOSED Position

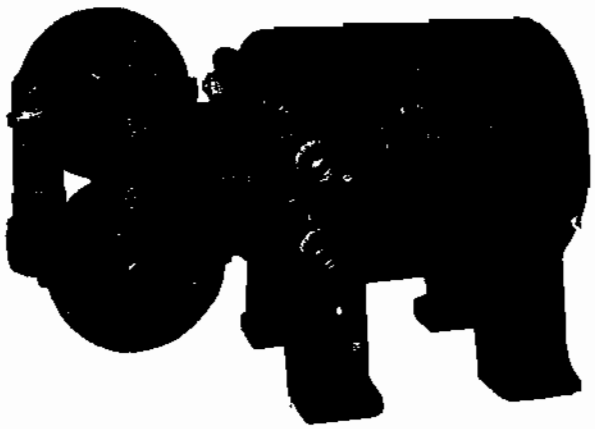


Fig. 11. No. 6-KR Distributing Valve

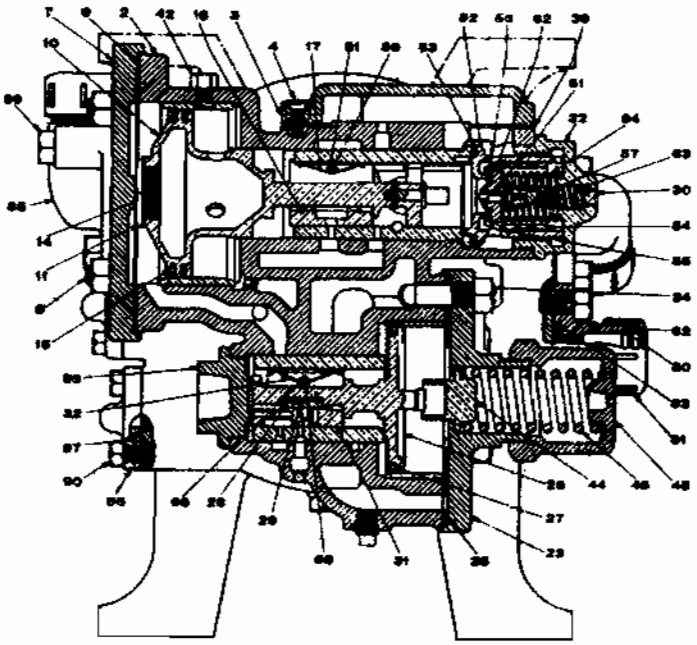


Fig. 12. Sectional View of the No. 6-KR Distributing Valve

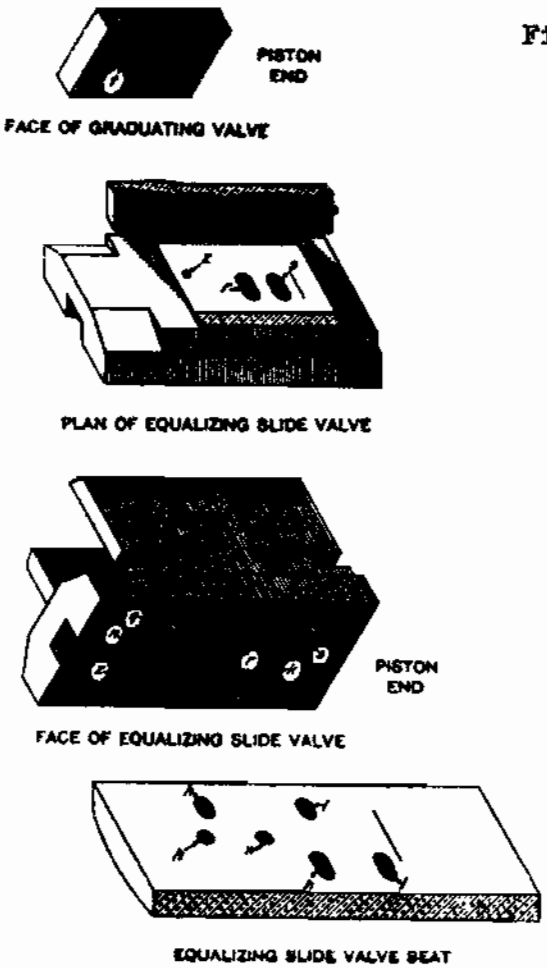


Fig. 13. Isometric View of Equalizing Slide Valve and Seat and Graduating Valve

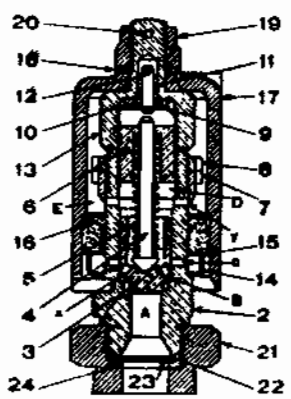


Fig. 14. Sectional View of the "A" Safety Valve

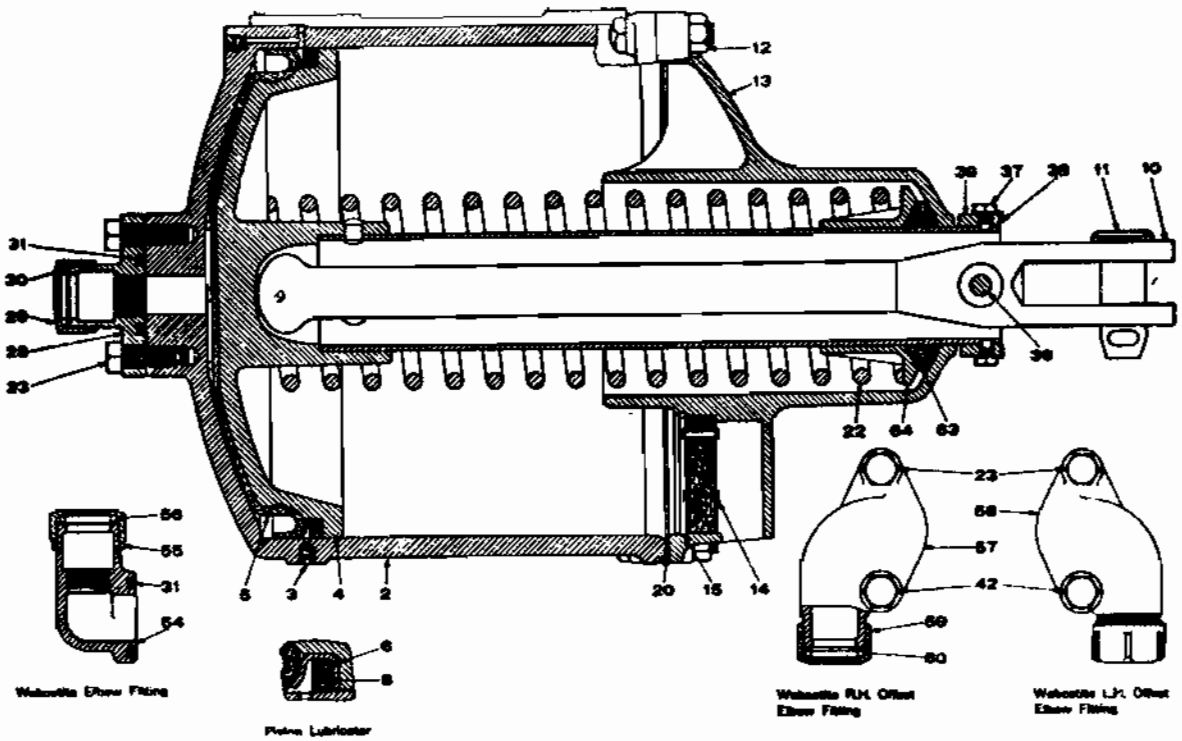
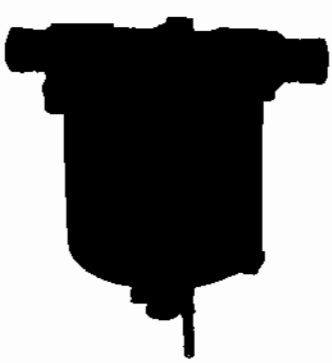


Fig. 15. UAH Brake Cylinder



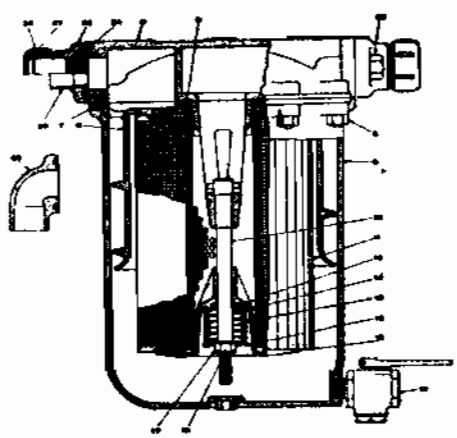


Fig. 16. Type "H" Air Filter

Fig. 17. Sectional View of "Check Valve Type" Centrifugal Dirt Collector

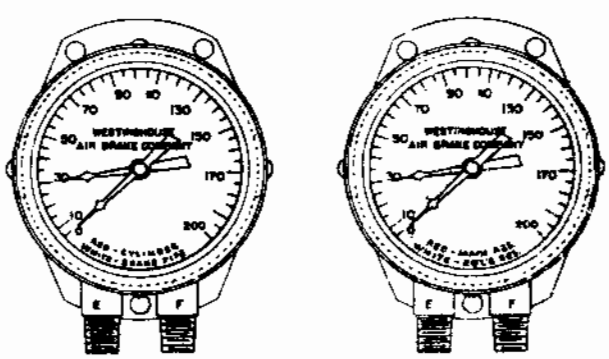
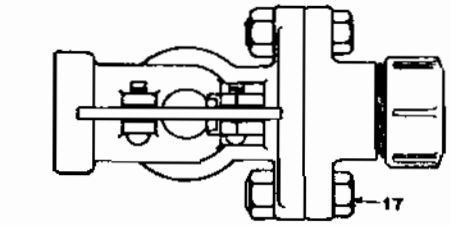


Fig. 18. 3-1/2" Duplex Air Gages



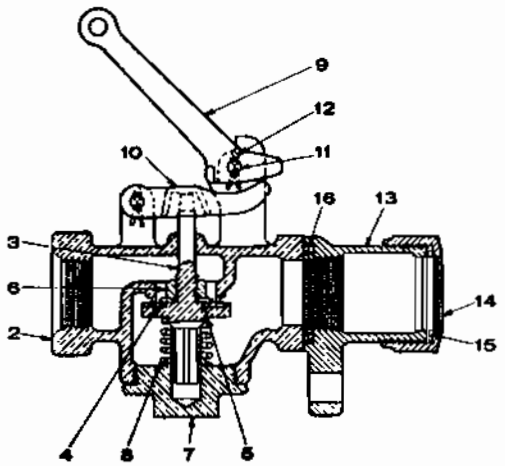
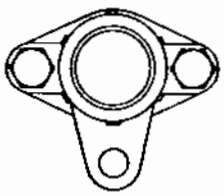
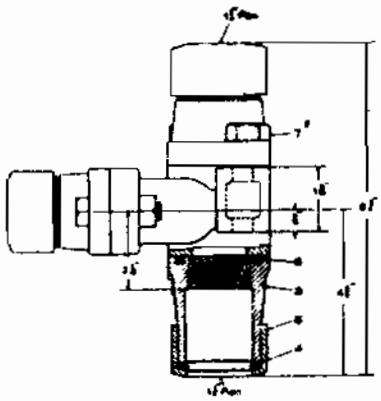


Fig. 19. 1-1/4" Emergency-Brake Valve





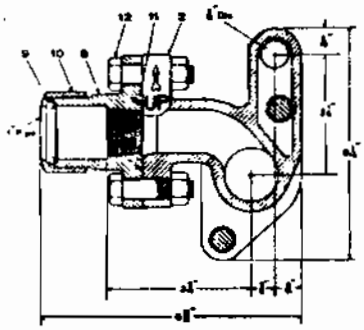


Fig. 20. Branch Pipe Tee

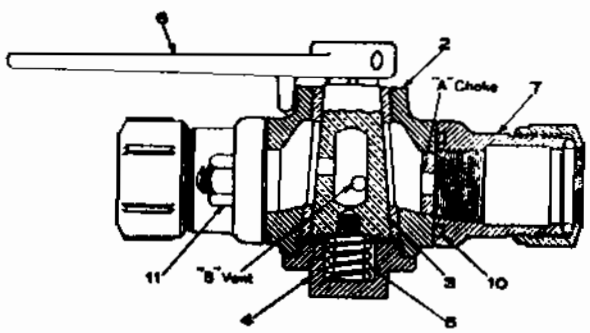


Fig. 21. Sectional View of Main Reservoir Cut-Out Cock

Fig. 22. Hose Connection

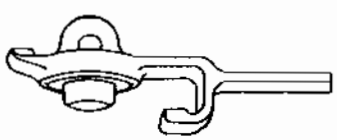


Fig. 23. Dummy Coupling

Fig. 24. Combined Air Strainer and Check Valve

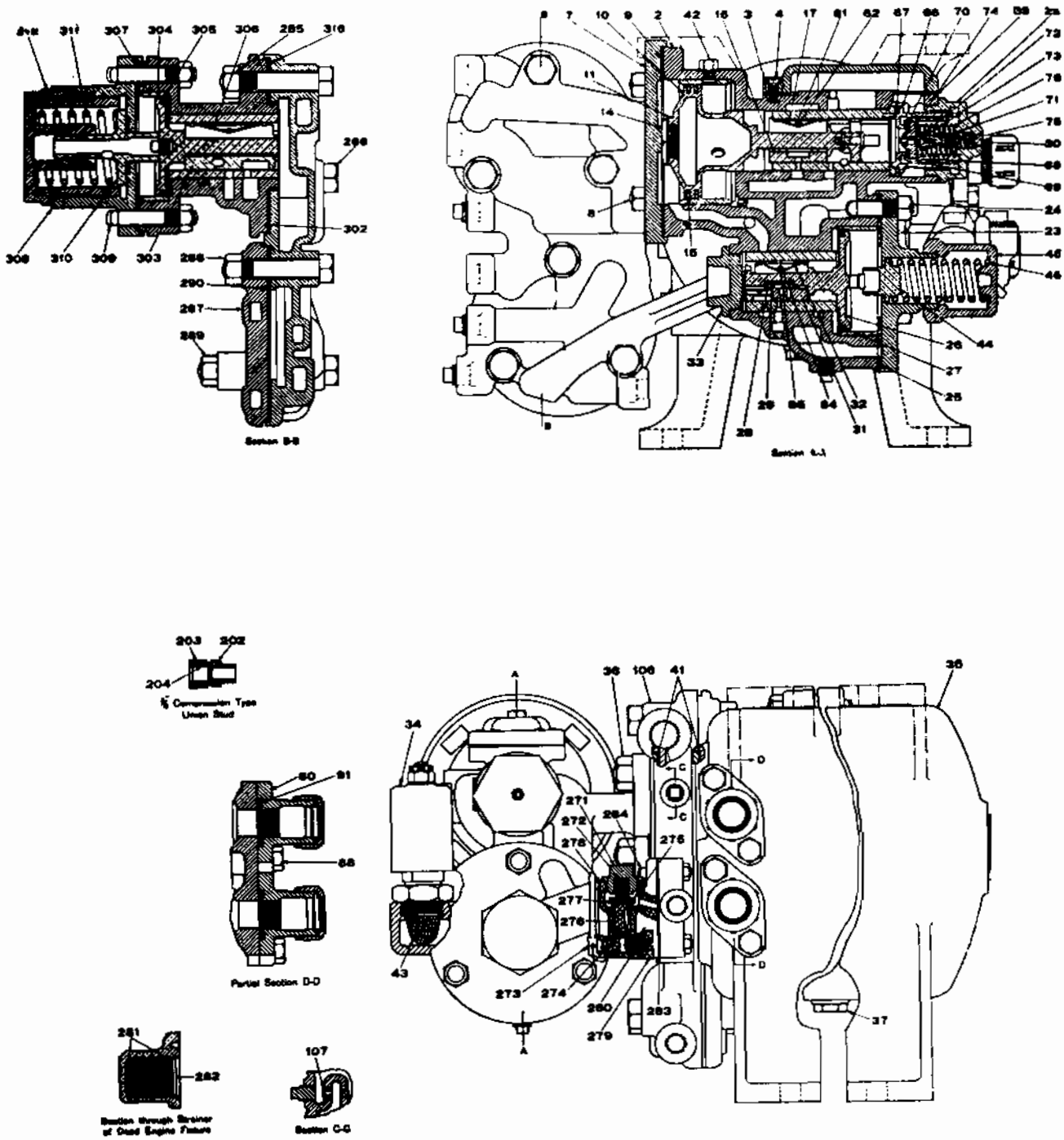


Fig. 25. Sectional and Outline Views of No. 6-DKR Distributing Valve

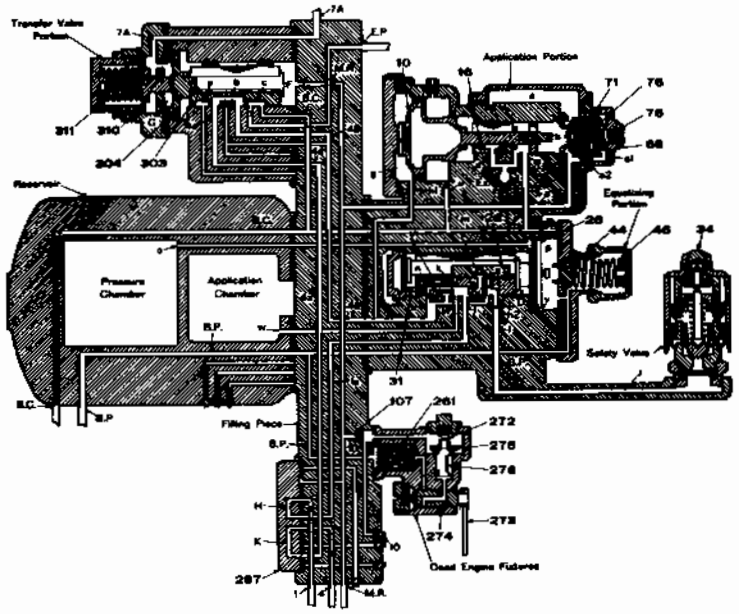


Fig. 26. Diagrammatic Section of Distributing Valve—Running Position Transfer Valve Portion as set on lead unit for multiple unit control.

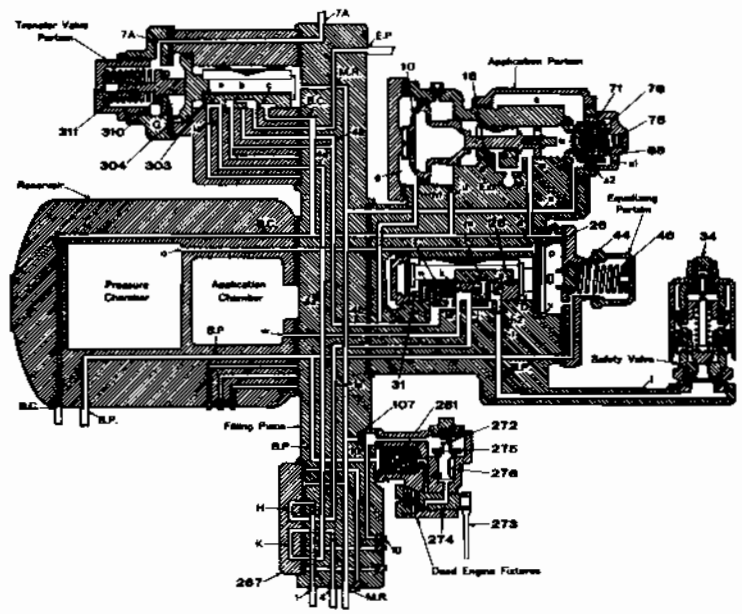


Fig. 27. Diagrammatic Section of Distributing Valve—Running Position Transfer Valve Portion as set on trailing unit permitting control of independent brake from the lead unit.

Fig. 28. Type "KM" Brake Pipe Vent Valve with Long Mounting Bracket

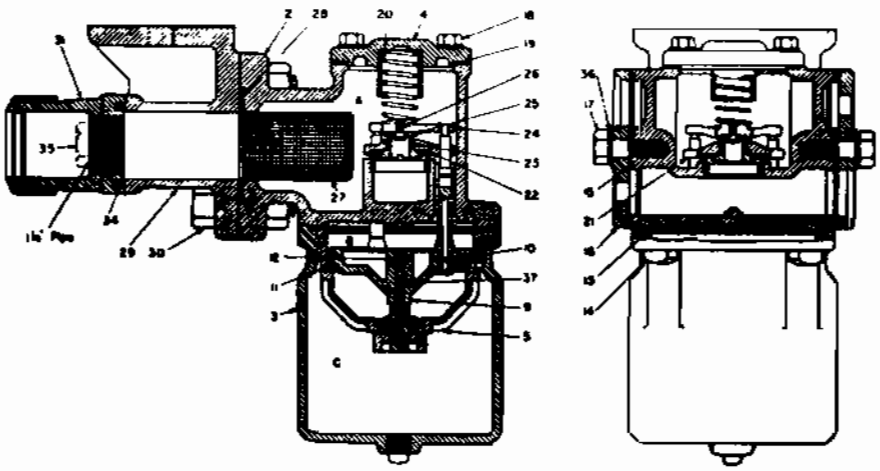


Fig. 29. Sectional Views of "KM" Vent Valve with Short Mounting Bracket

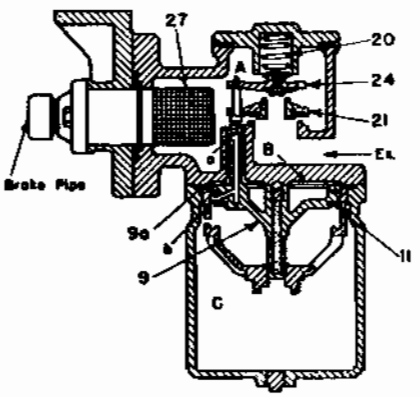


Fig. 30. "KM" Vent Valve in Charging Position

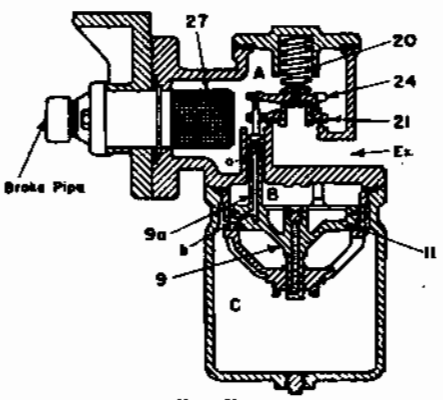


Fig. 31. "KM" Vent Valve in Emergency Position

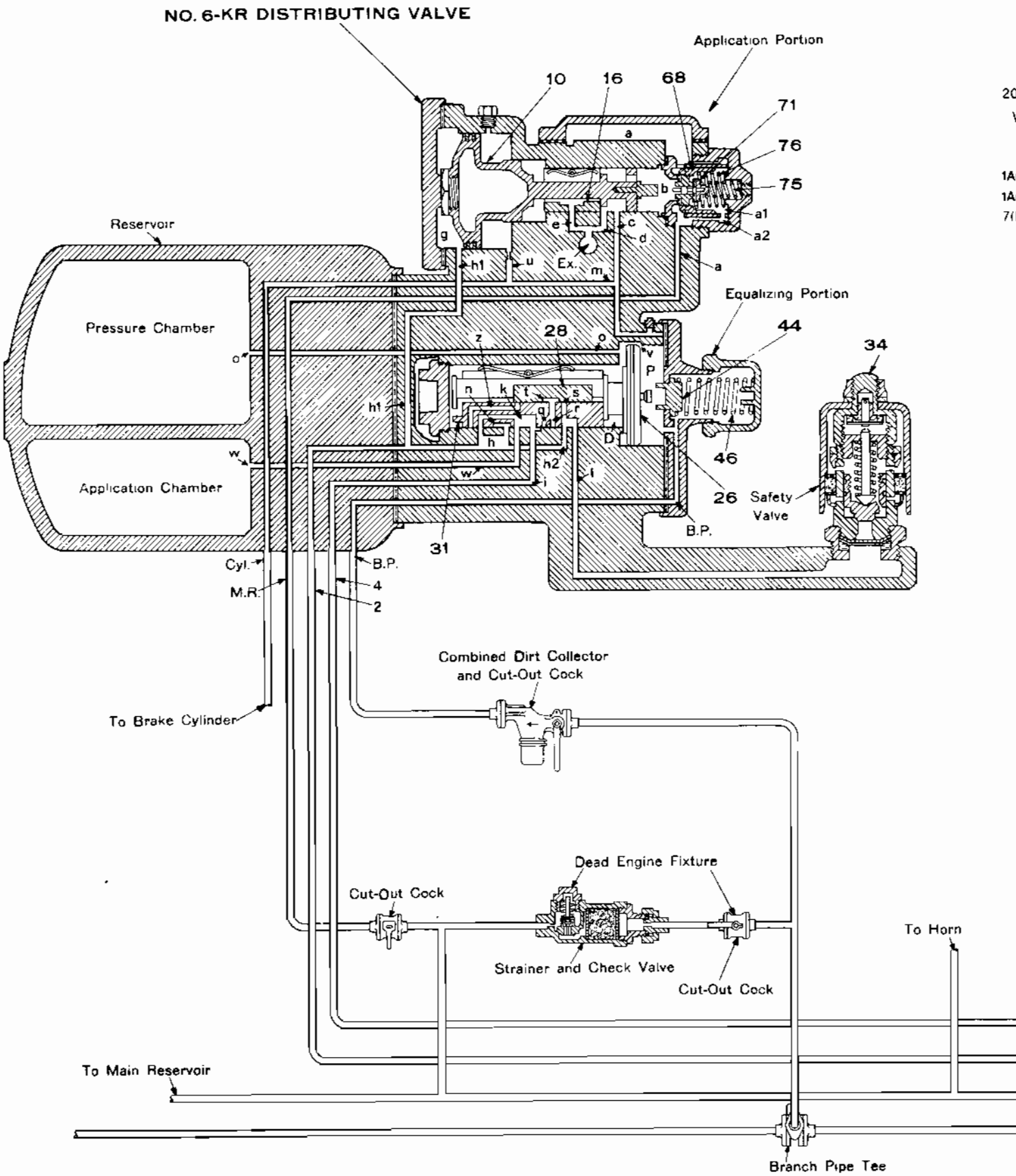


Plate 1. Running Position with E

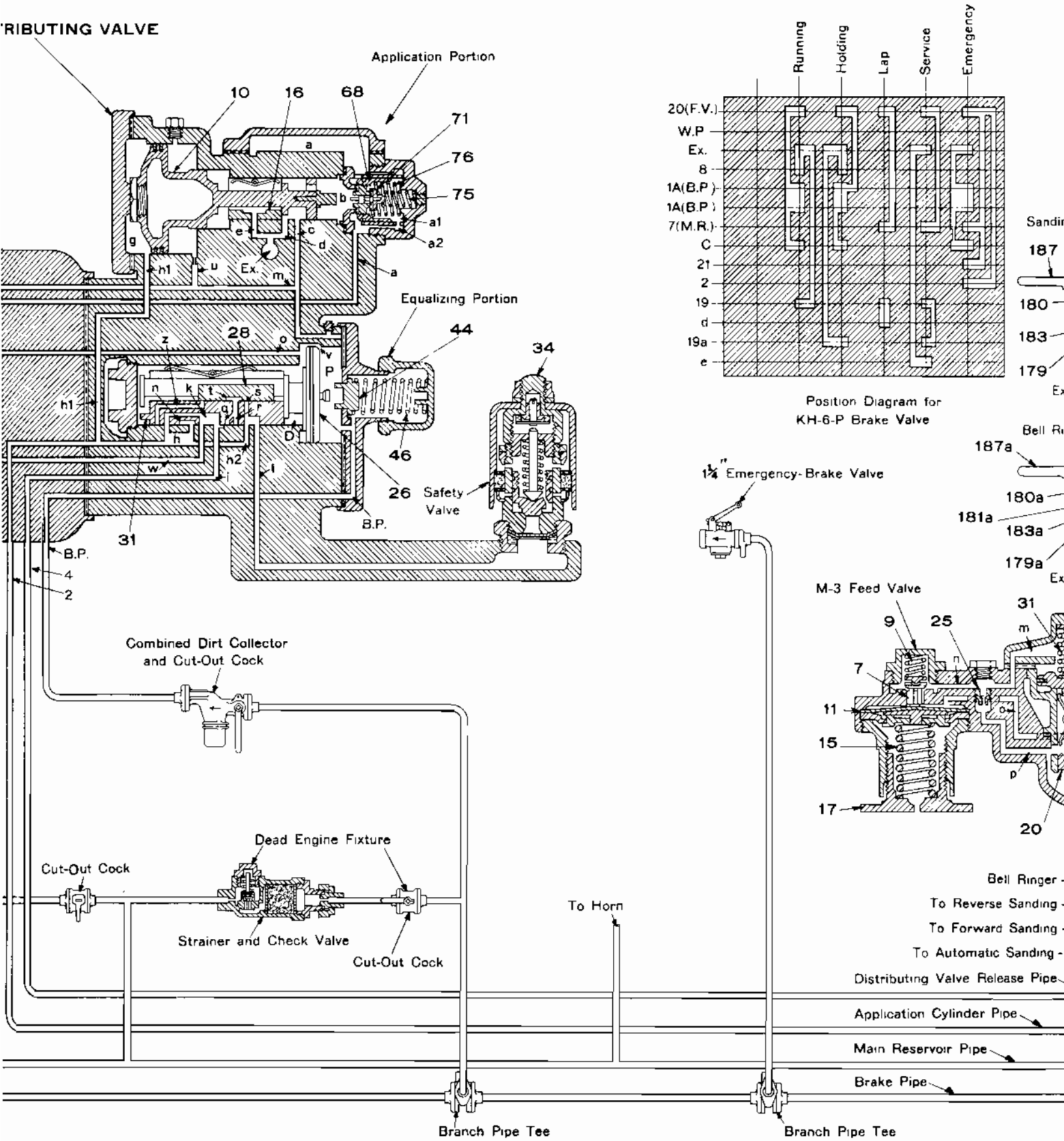
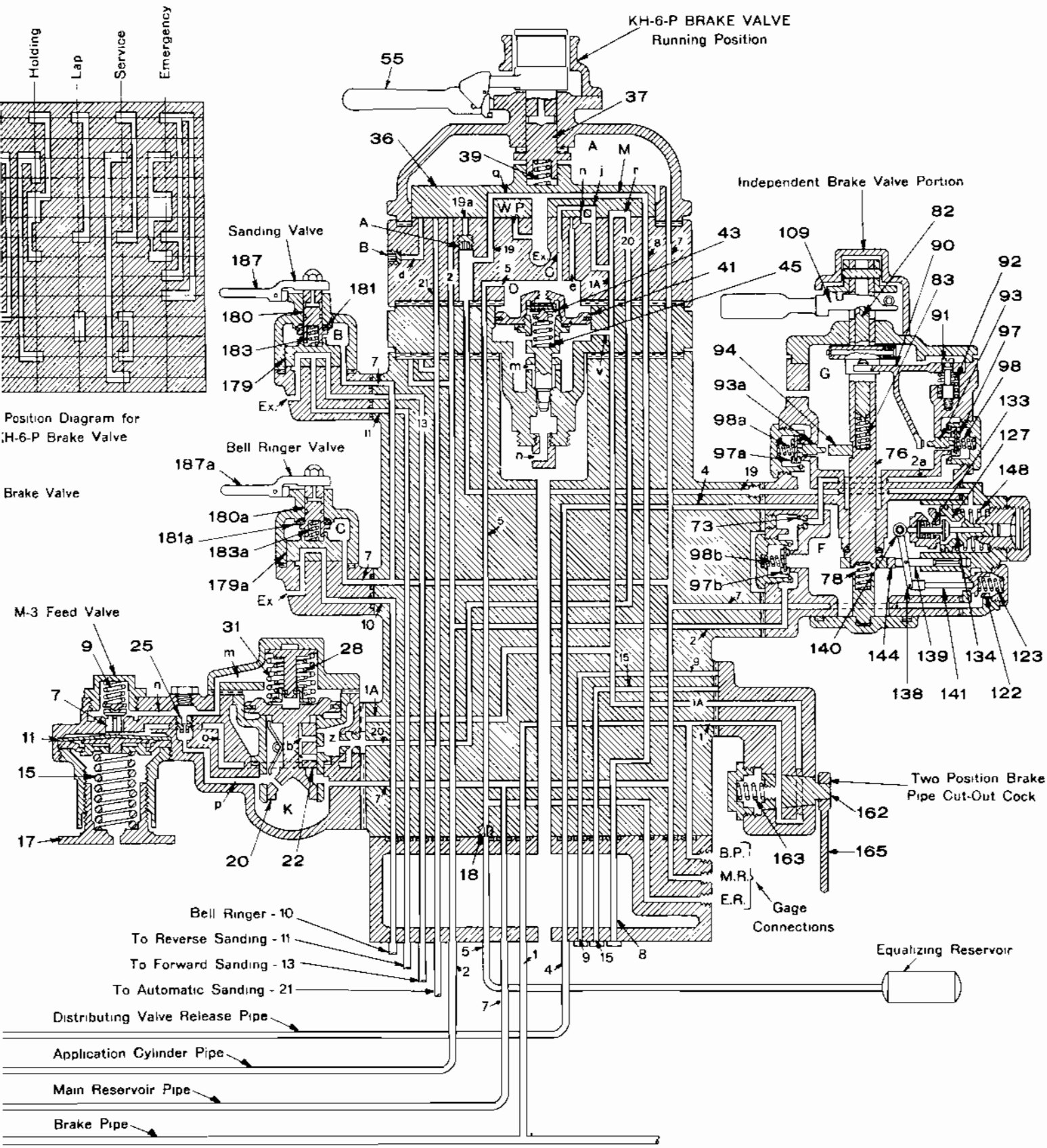


Plate 1. Running Position with Brakes Fully Released and Equipment Fully C

E-45152



eleased and Equipment Fully Charged

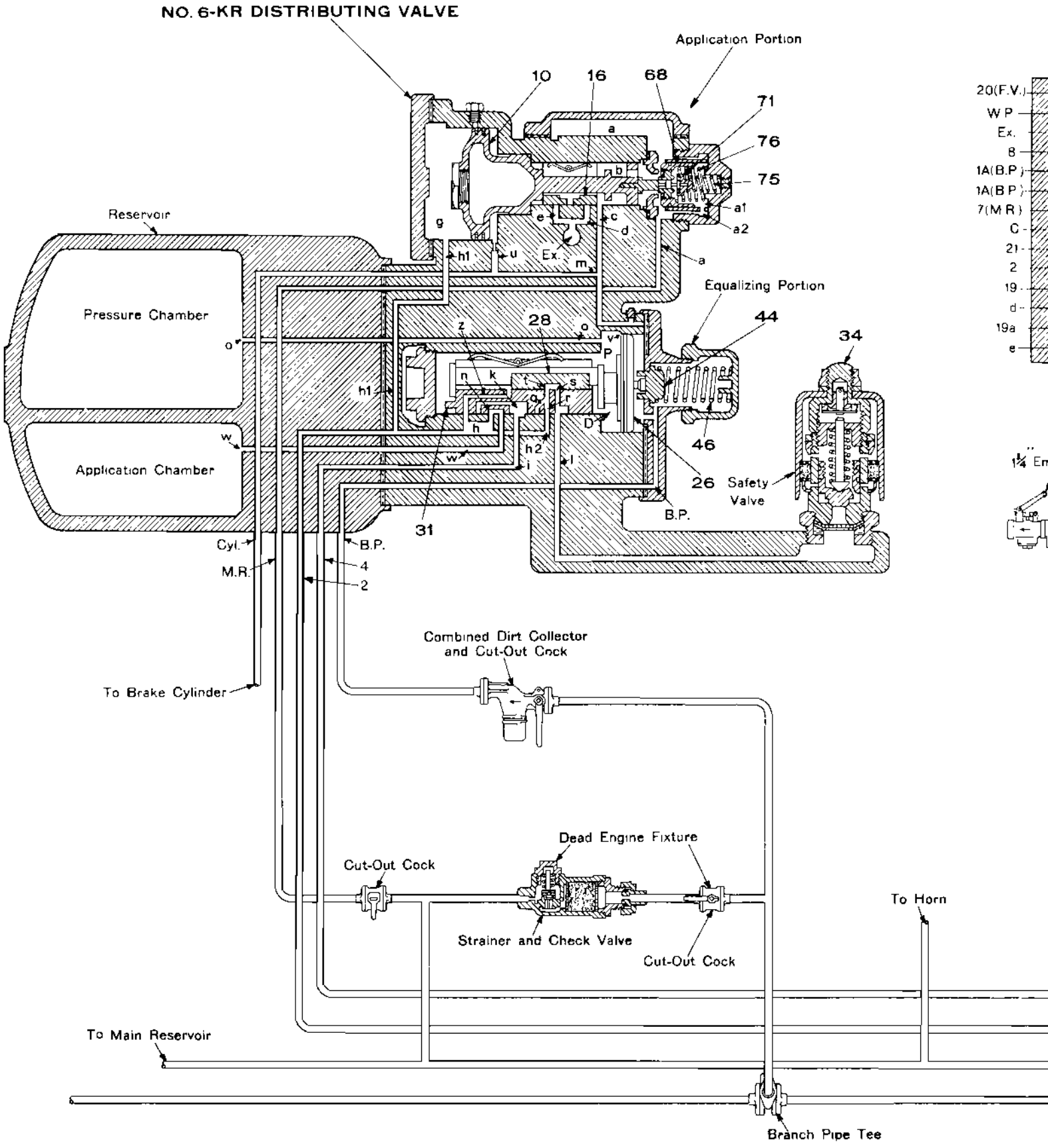


Plate 2. Autom

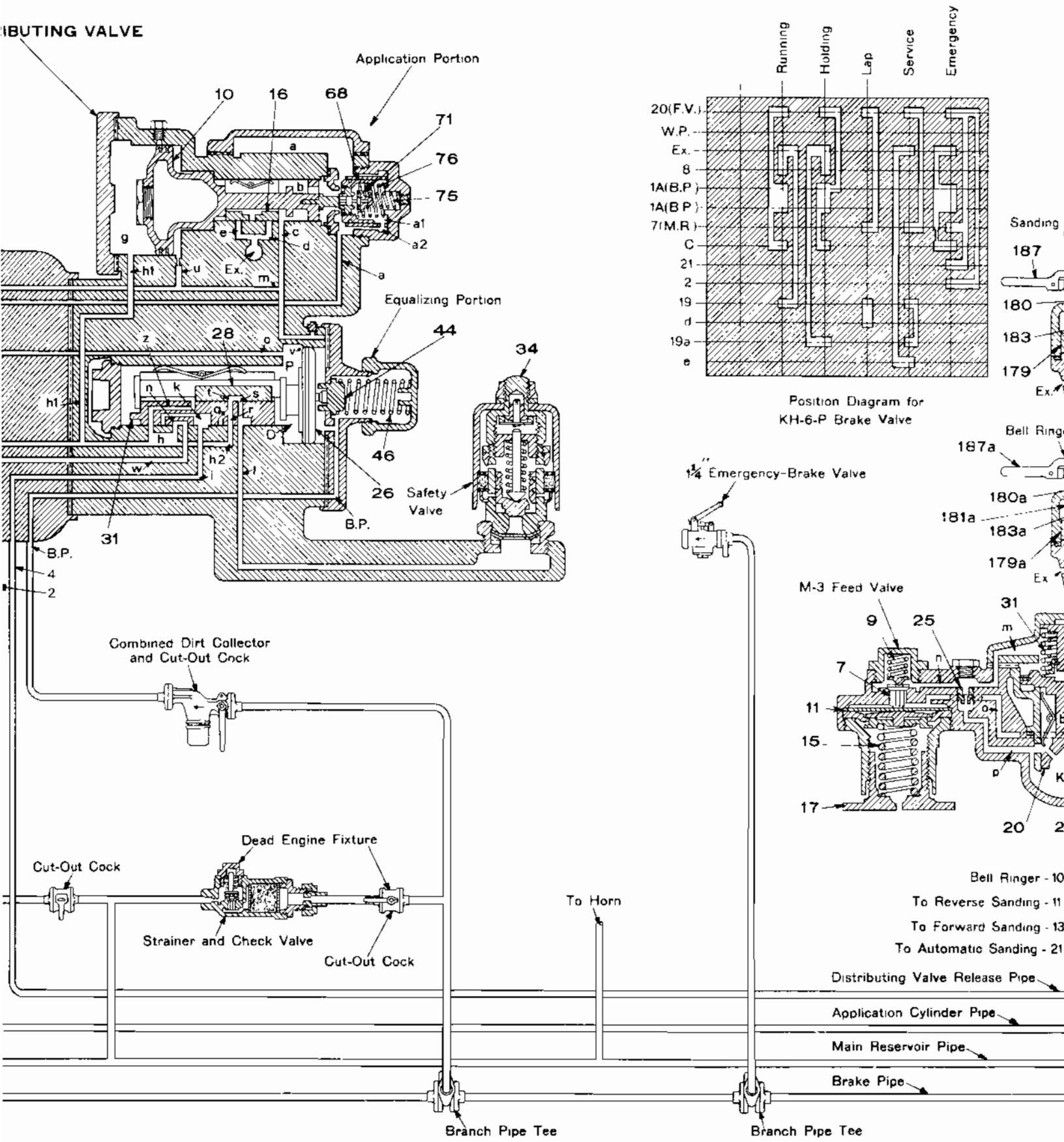
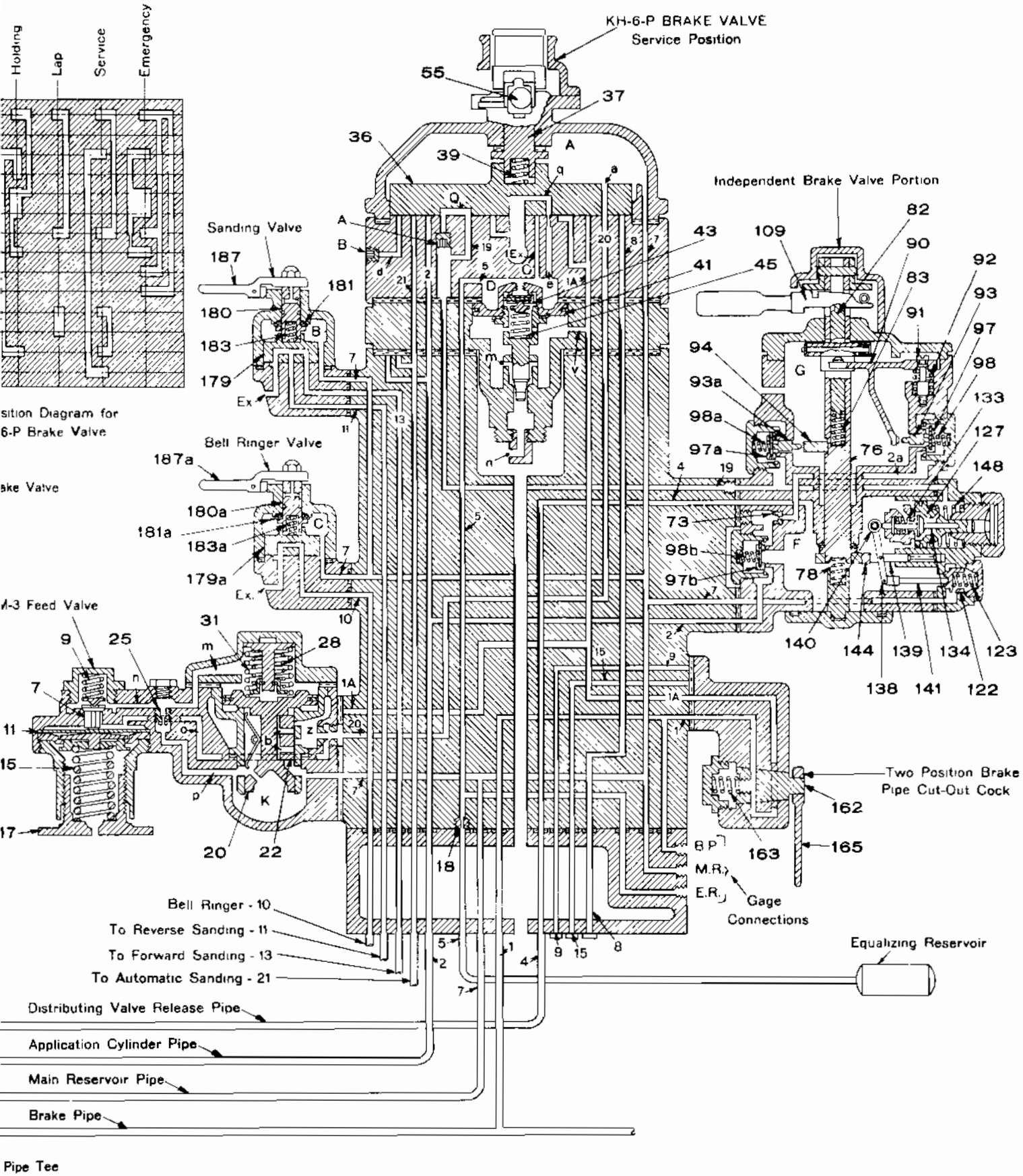


Plate 2. Automatic Service Position

E-45149



ice Position

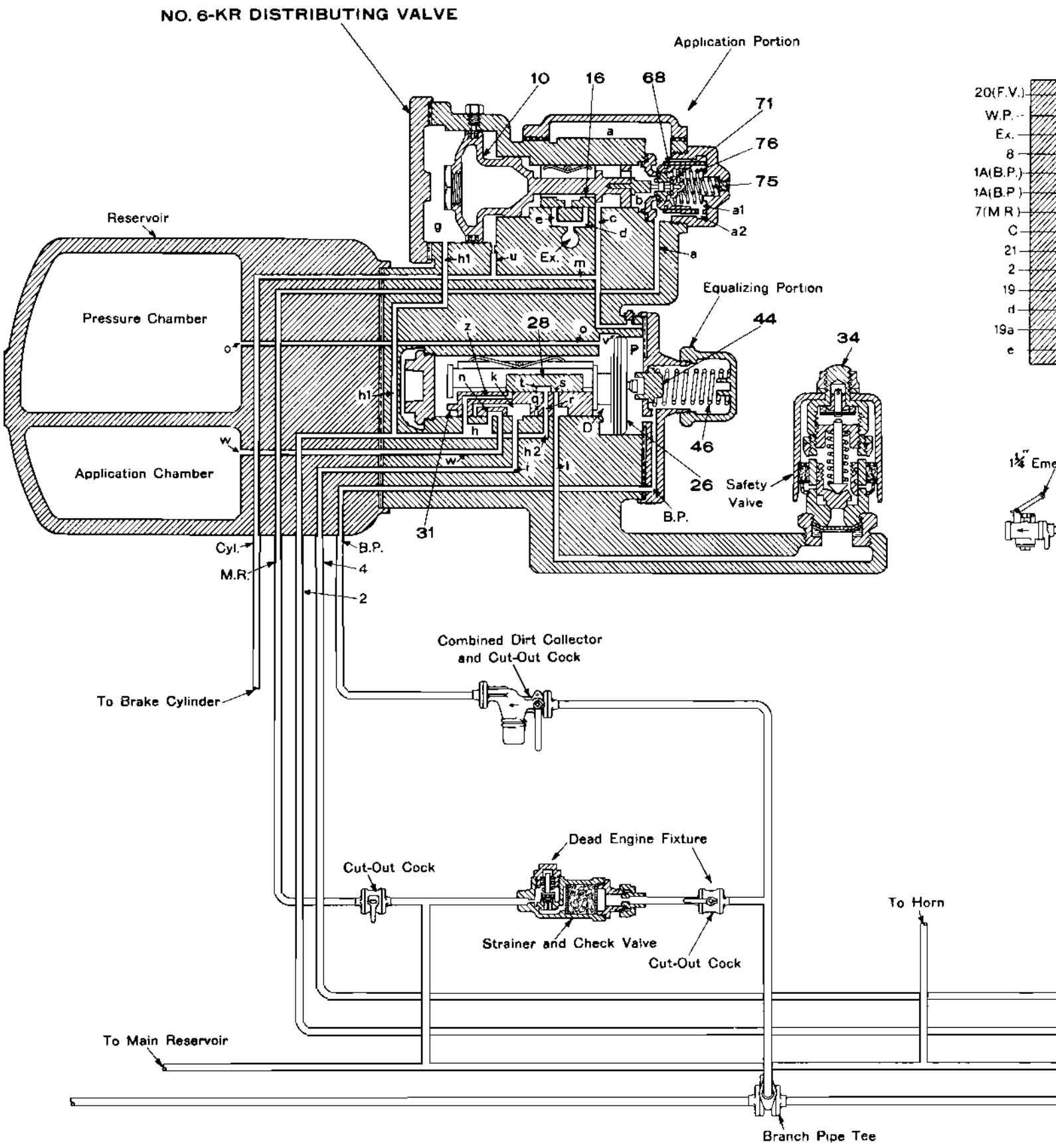


Plate 3. Automatic

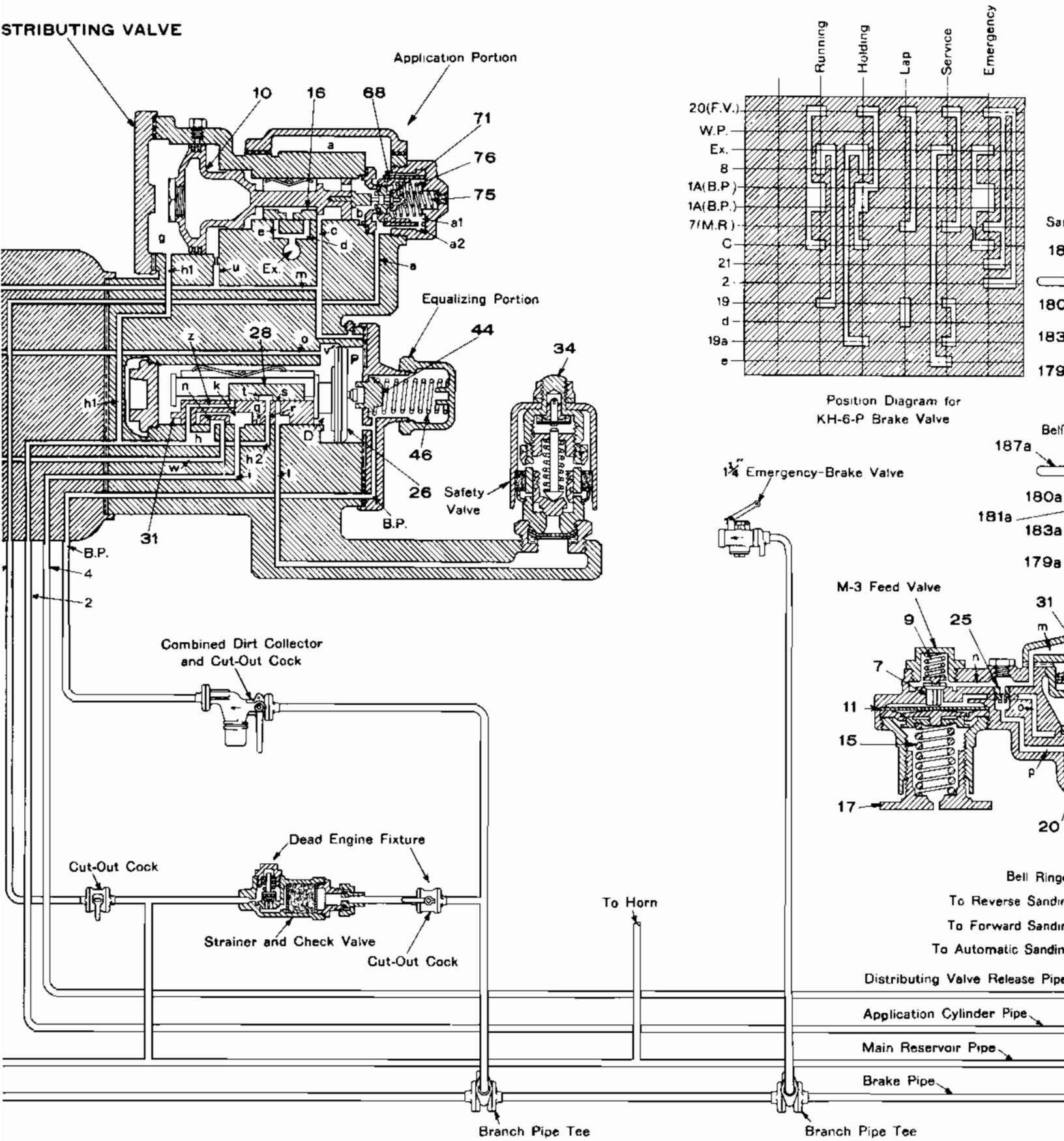
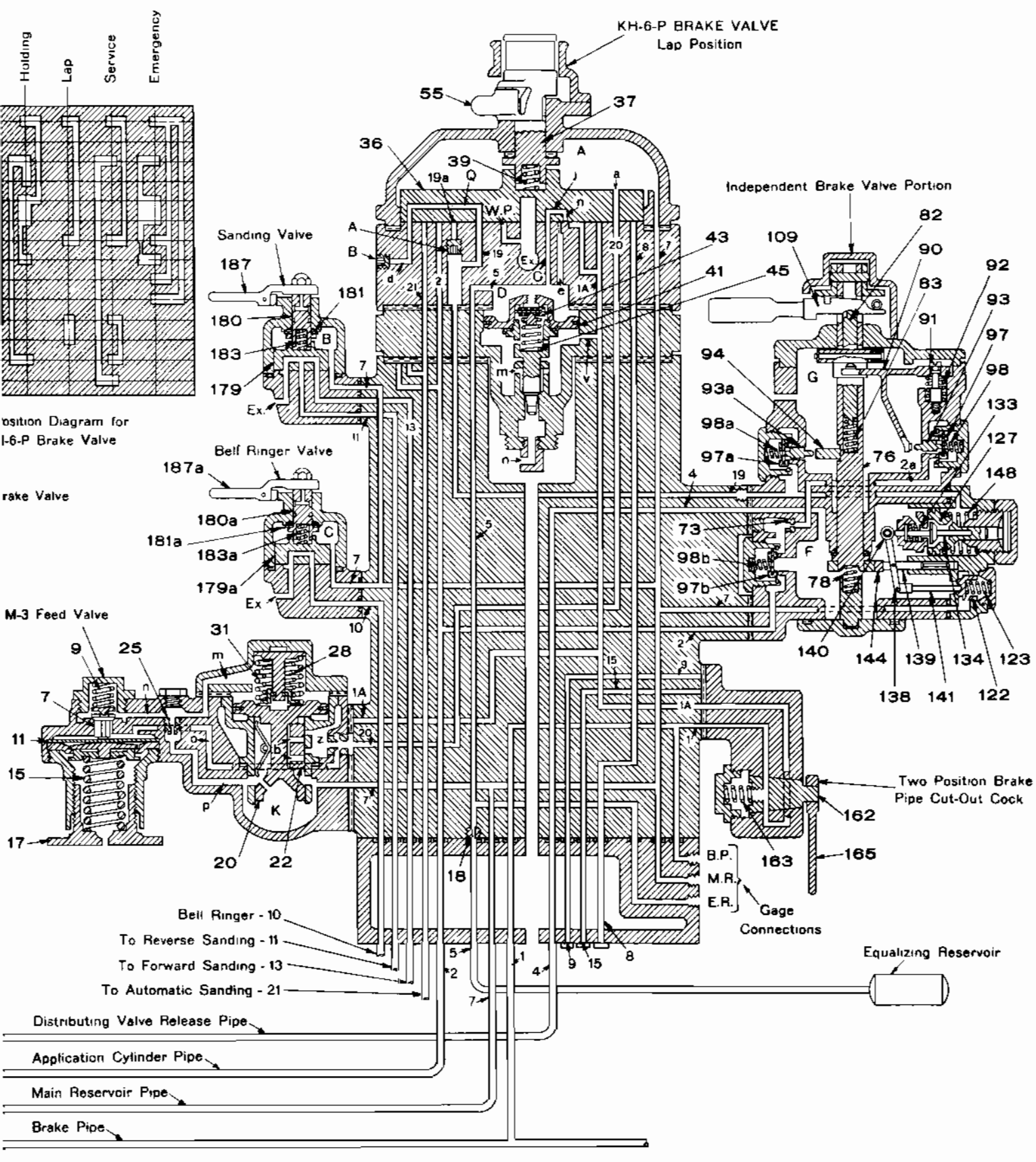


Plate 3. Automatic Service Lap Position



osition Diagram for
I-6-P Brake Valve

rake Valve

ıch Pipe Tee

e Lap Position

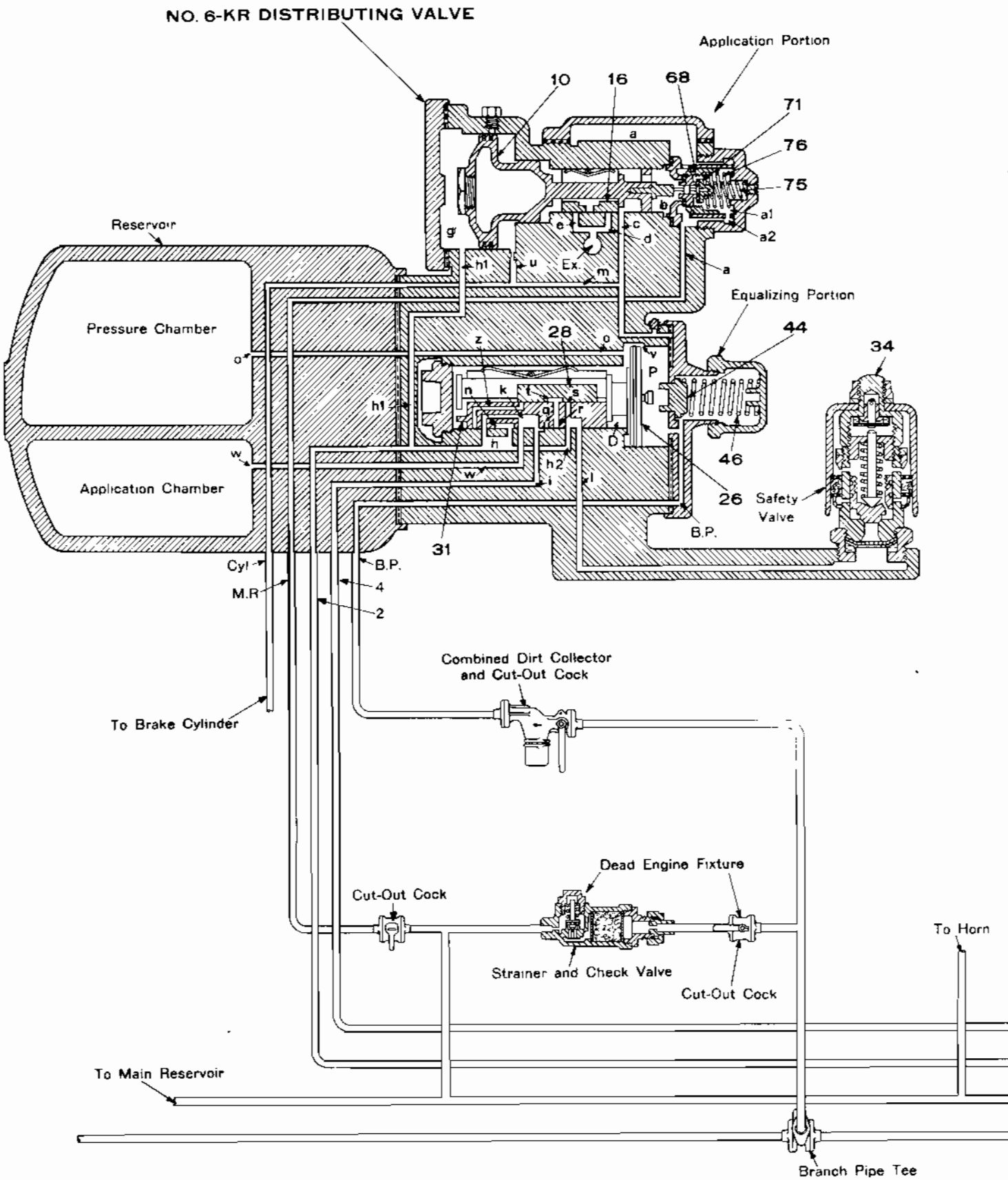

NO. 6-KR DISTRIBUTING VALVE
Application Portion
10
16
68
71
76
75
a
a1
a2
b
c
d
e
g
h1
u
Ex.
m
a
Reservoir
Pressure Chamber
o
Equalizing Portion
44
34
28
z
o
v
P
n
k
t
s
q
r
h1
h
D
46
w
Application Chamber
h2
i
l
26
Safety Valve
B.P.
31
Cyl
M.R
B.P.
4
2
Combined Dirt Collector and Cut-Out Cock
To Brake Cylinder
Dead Engine Fixture
Cut-Out Cock
To Horn
Strainer and Check Valve
Cut-Out Cock
To Main Reservoir
Branch Pipe Tee

Plate 4. H

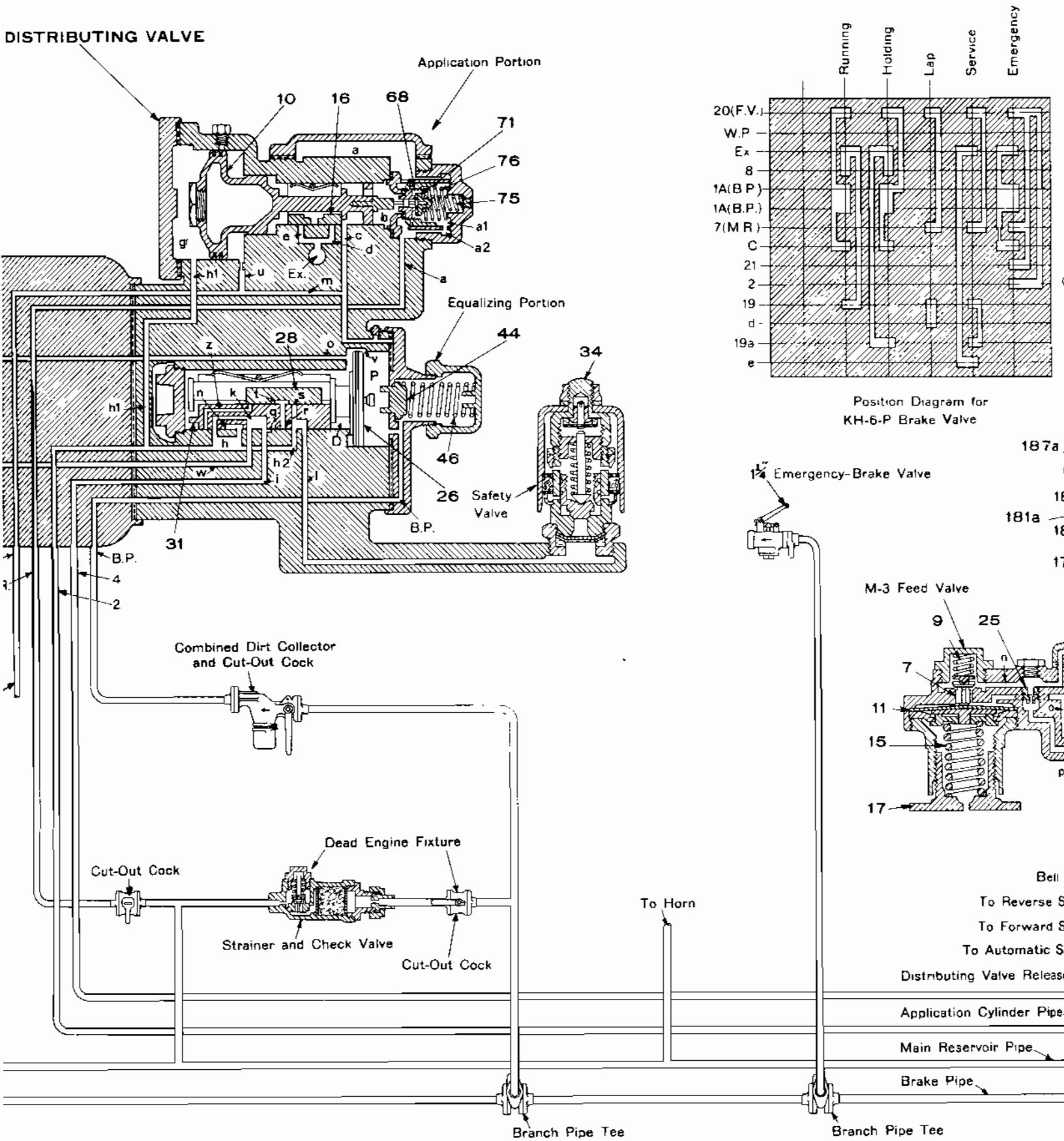
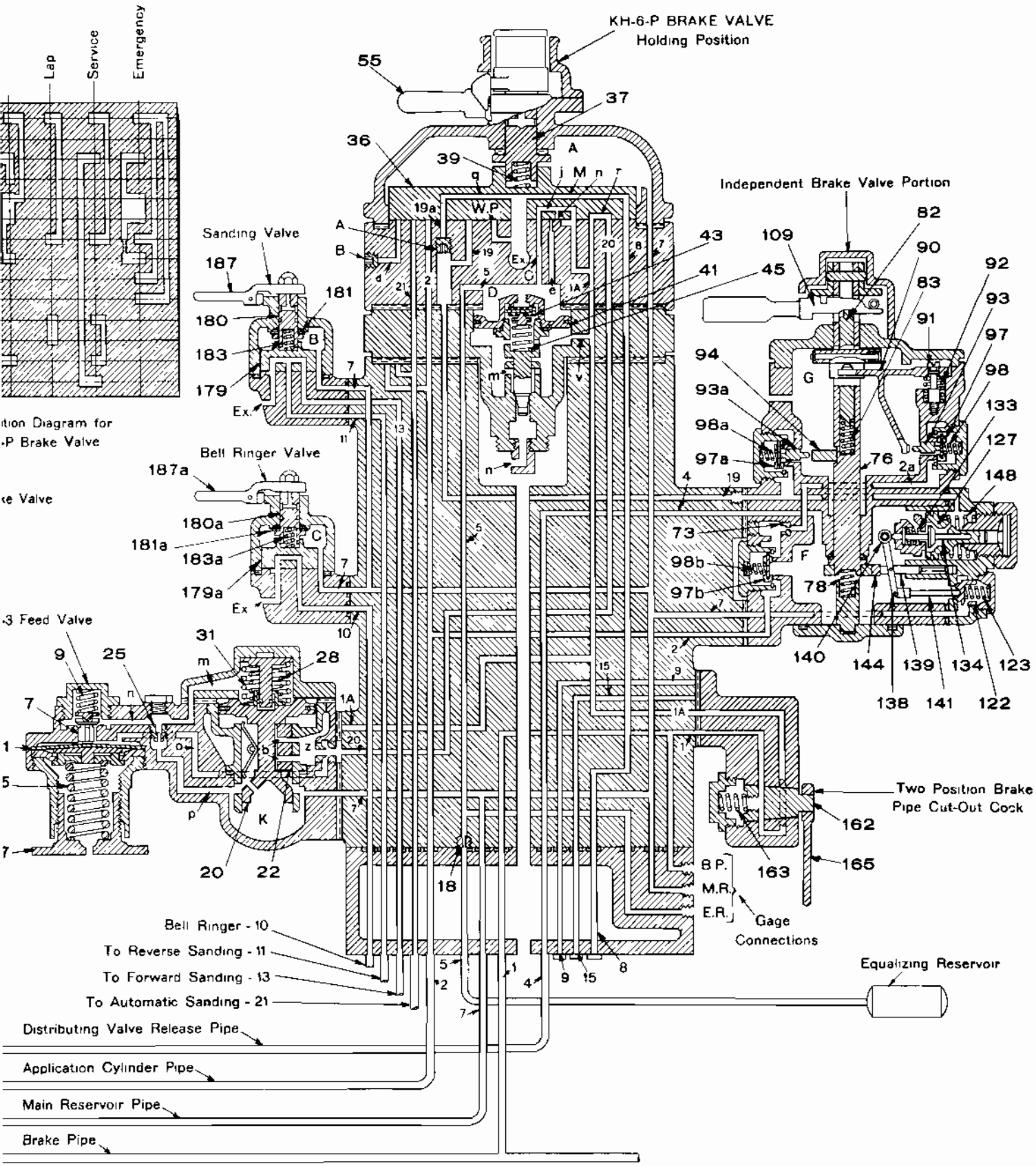
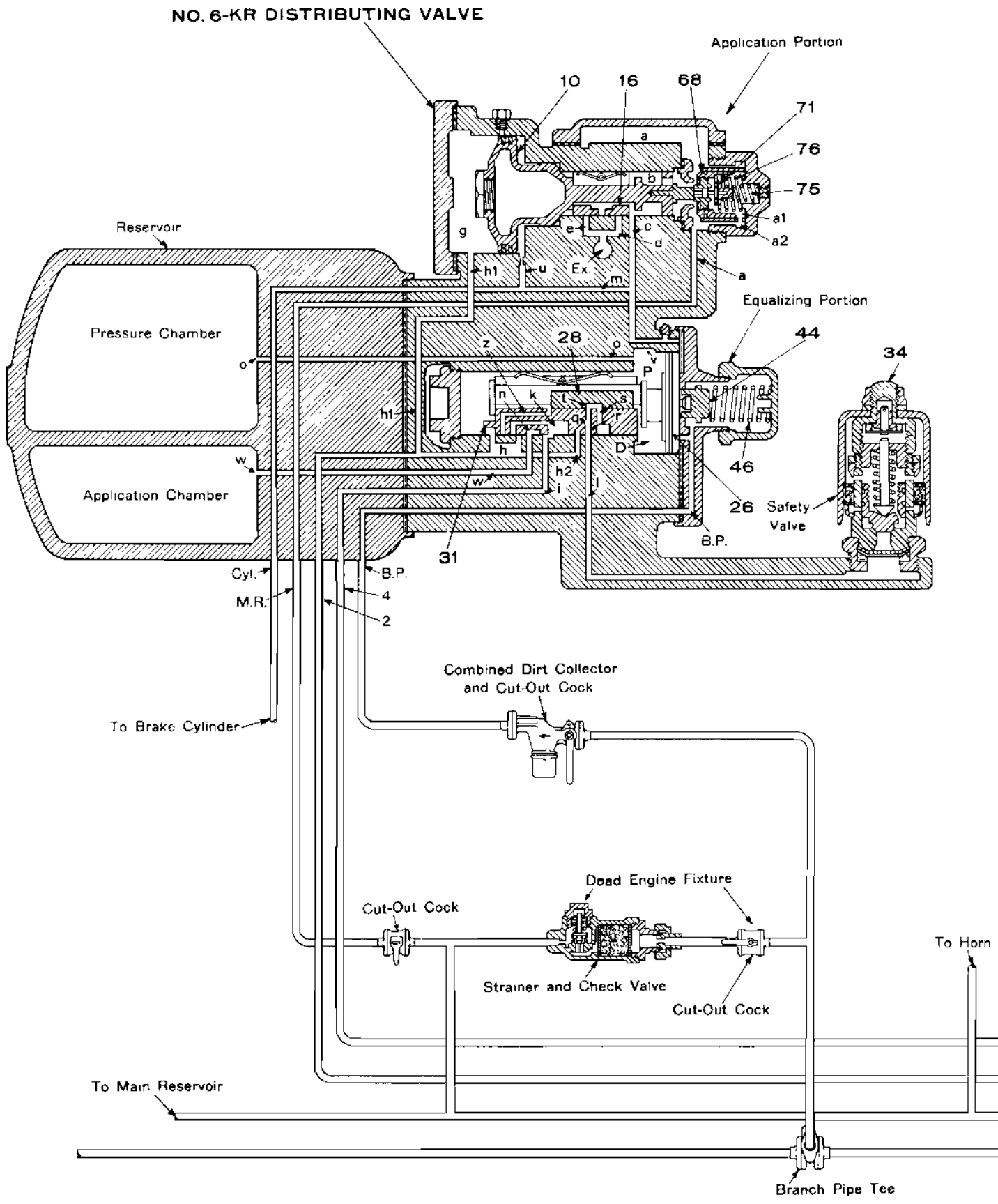


Plate 4. Holding during Automatic Release



matic Release


NO. 6-KR DISTRIBUTING VALVE
Application Portion
10
16
68
71
76
75
a
b
a1
a2
Reservoir
g
e
c
d
h1
u
Ex.
m
a
Equalizing Portion
Pressure Chamber
44
34
z
28
o
v
P
o
n
k
t
s
r
q
h1
h
D
46
w
Application Chamber
h2
i
j
26
Safety
Valve
B.P.
31
Cyl.
B.P.
M.R.
4
2
Combined Dirt Collector
and Cut-Out Cock
To Brake Cylinder
Dead Engine Fixture
Cut-Out Cock
To Horn
Strainer and Check Valve
Cut-Out Cock
To Main Reservoir
Branch Pipe Tee

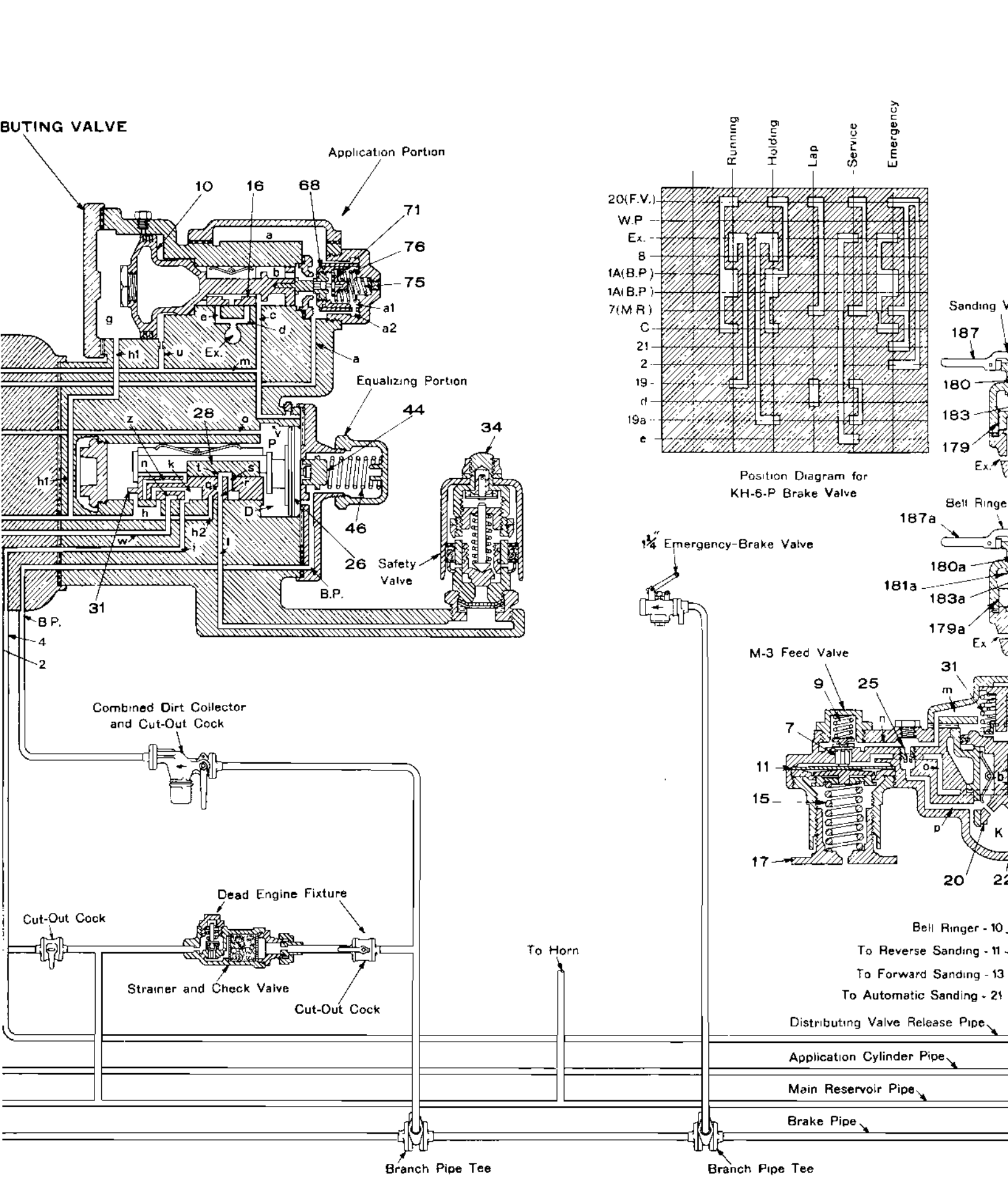
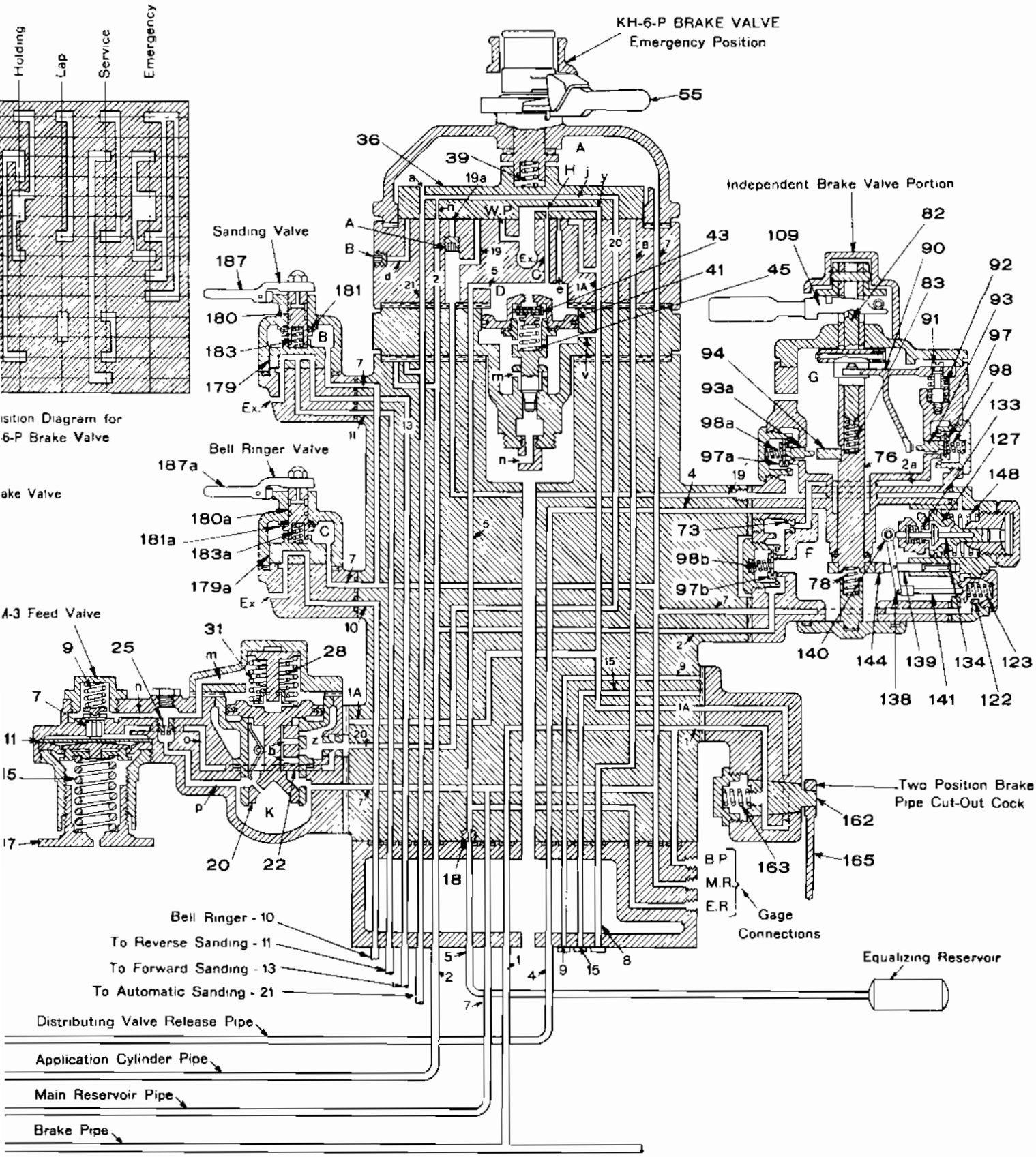


Plate 5. Emergency Position


Holding
Lap
Service
Emergency
KH-6-P BRAKE VALVE
Emergency Position
55
36
39
19a
A
H
j
y
W.P.
Independent Brake Valve Portion
Sanding Valve
187
180
183
179
181
B
Ex.
43
41
45
109
82
90
92
83
93
91
97
94
98
93a
133
98a
127
97a
76
148
73
98b
97b
78
140
144
139
134
123
138
141
122
Bell Ringer Valve
187a
180a
181a
183a
179a
C
M-3 Feed Valve
9
25
31
28
7
11
15
17
20
22
18
Two Position Brake
Pipe Cut-Out Cock
162
163
165
B P
M.R.
E.R
Gage
Connections
Equalizing Reservoir
Bell Ringer - 10
To Reverse Sanding - 11
To Forward Sanding - 13
To Automatic Sanding - 21
Distributing Valve Release Pipe
Application Cylinder Pipe
Main Reservoir Pipe
Brake Pipe
Pipe Tee

osition

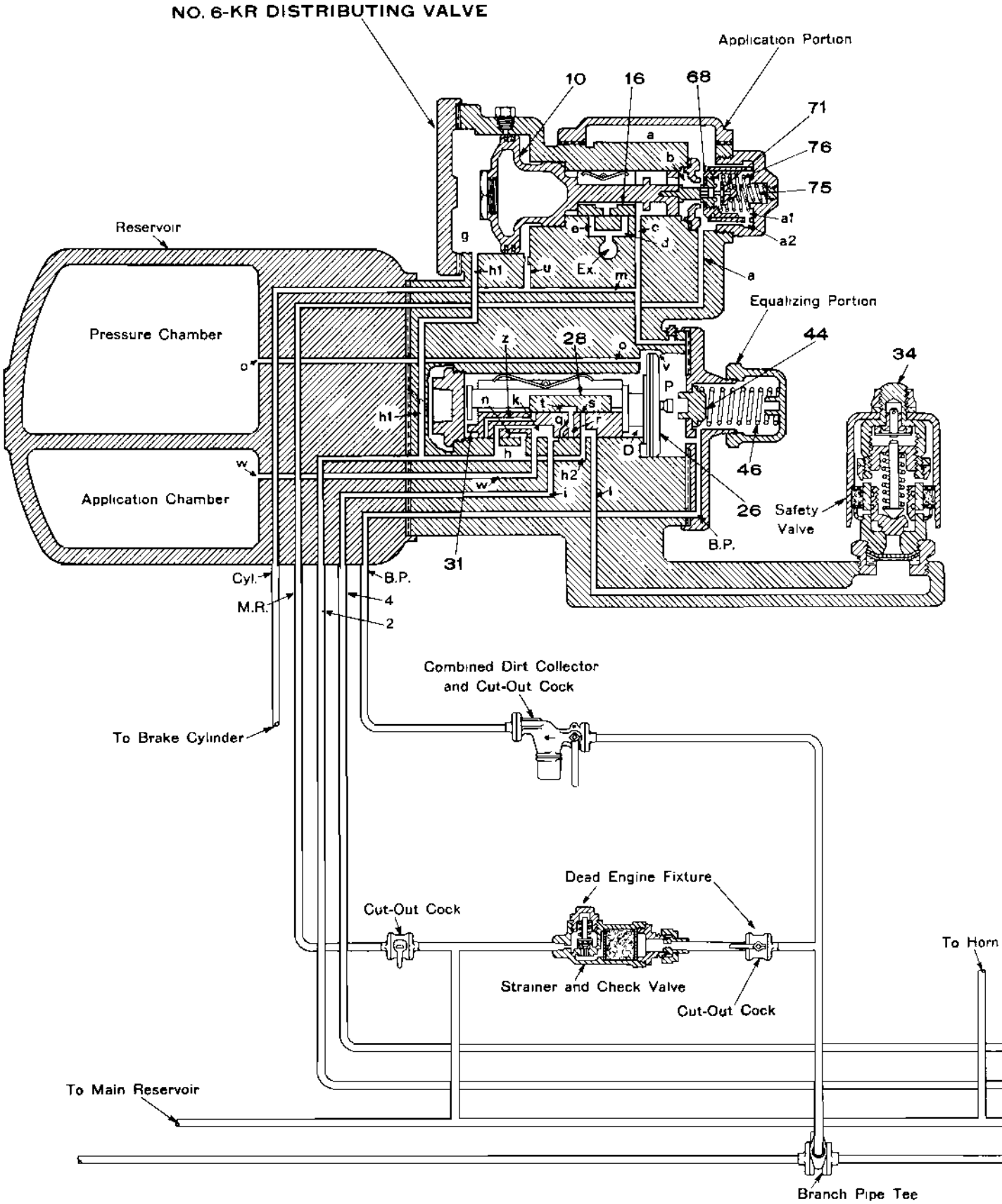

NO. 6-KR DISTRIBUTING VALVE
Application Portion
10
16
68
71
76
75
a
b
a1
a2
Reservoir
g
e
c
d
h1
u
Ex.
m
a
Equalizing Portion
Pressure Chamber
z
28
o
44
34
v
P
n
k
i
s
q
r
h1
h
D
46
w
h2
i
l
26
Safety Valve
Application Chamber
B.P.
31
Cyl.
B.P.
M.R.
4
2
Combined Dirt Collector and Cut-Out Cock
To Brake Cylinder
Dead Engine Fixture
Cut-Out Cock
To Horn
Strainer and Check Valve
Cut-Out Cock
To Main Reservoir
Branch Pipe Tee

Plate 6.

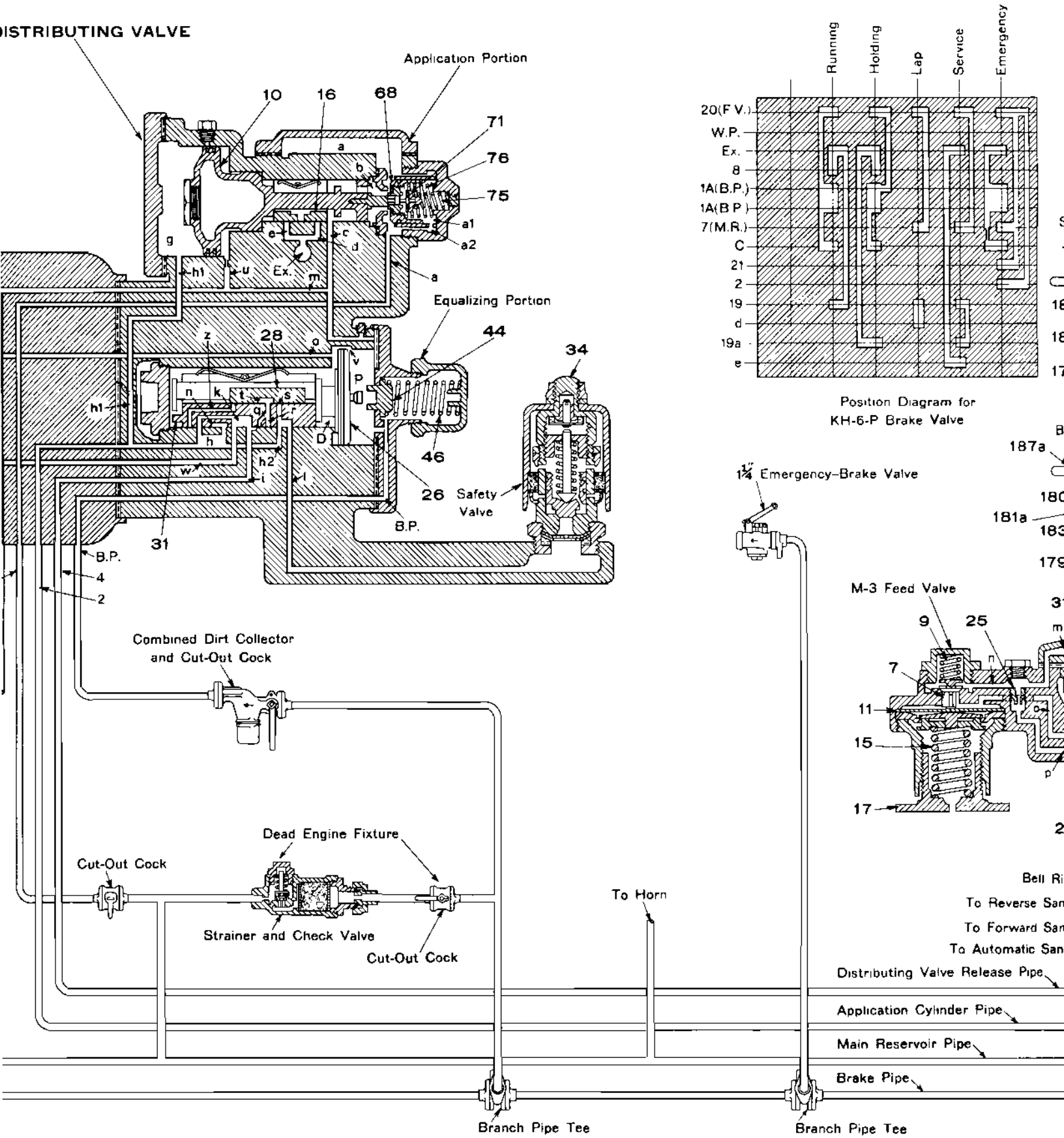
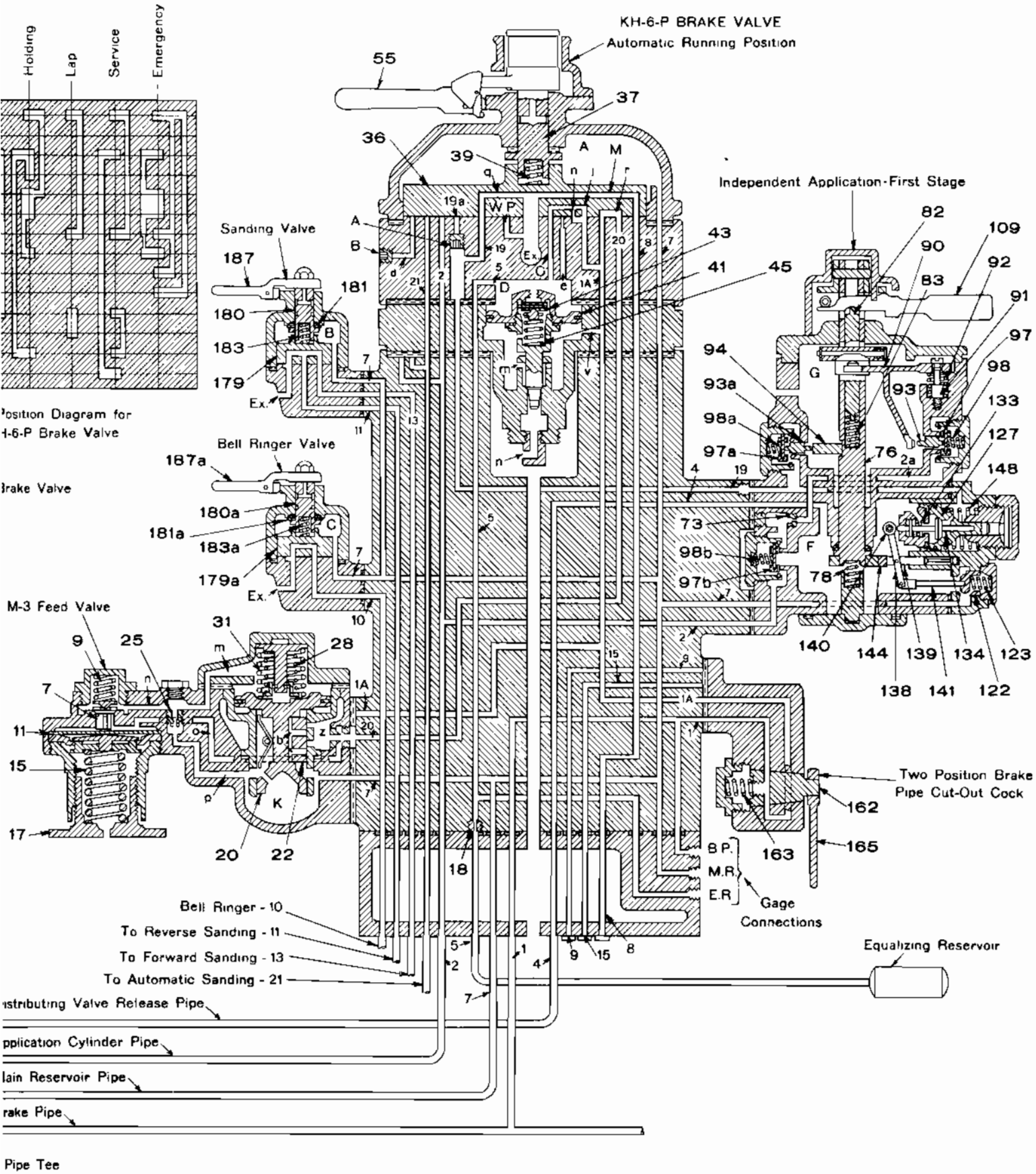


Plate 6. Independent Application—First Stage



ition—First Stage

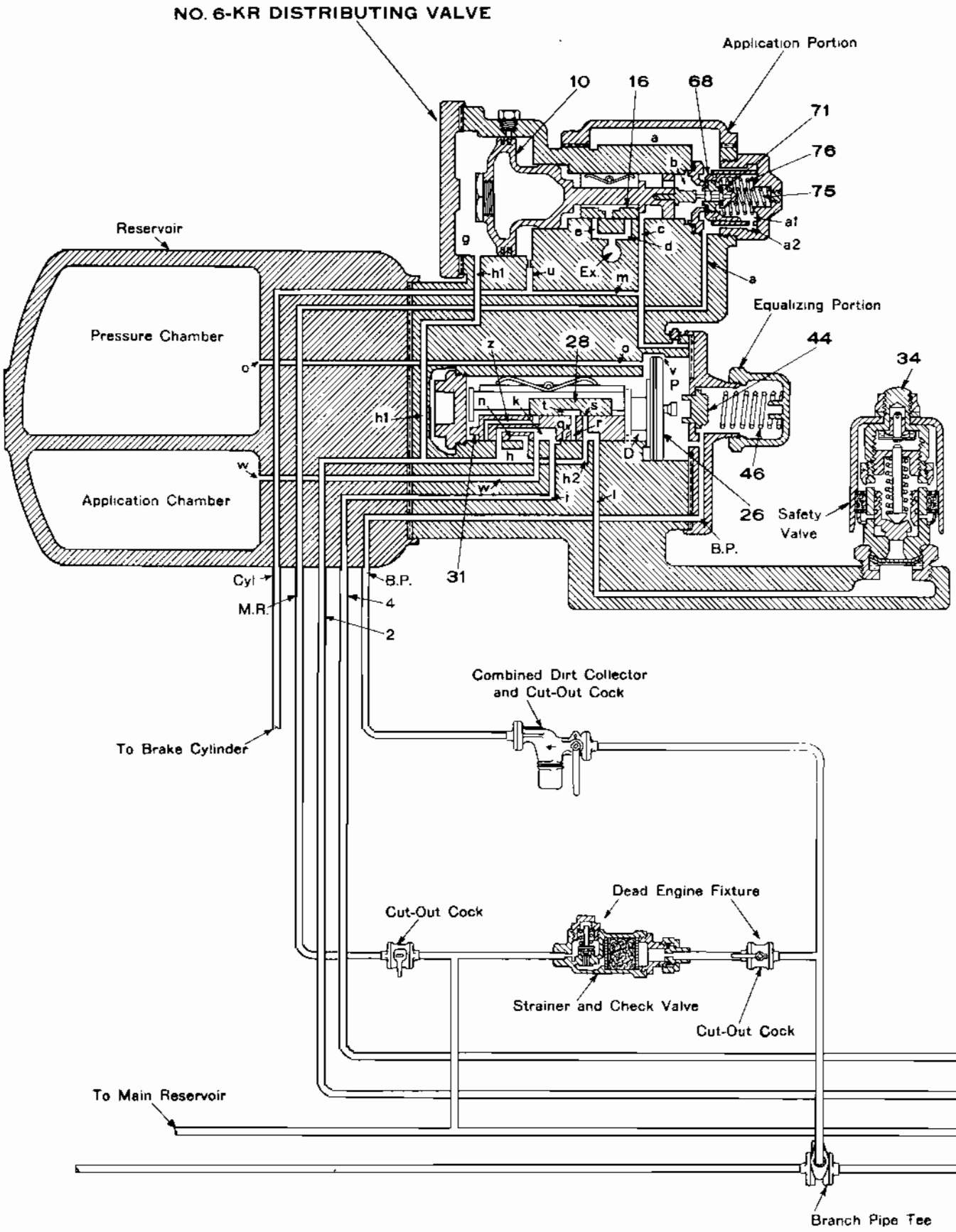

NO. 6-KR DISTRIBUTING VALVE
Application Portion
10
16
68
71
76
75
a
b
a1
a2
c
d
e
g
h1
u
Ex.
m
a
Reservoir
Pressure Chamber
o
Equalizing Portion
44
34
28
z
o
v
P
n
k
t
s
r
q
h1
h
h2
w
i
l
D
46
26
Safety Valve
B.P.
w
Application Chamber
Cyl
M.R.
B.P.
31
4
2
Combined Dirt Collector and Cut-Out Cock
To Brake Cylinder
Dead Engine Fixture
Cut-Out Cock
Strainer and Check Valve
Cut-Out Cock
To H
To Main Reservoir
Branch Pipe Tee

Plate 7.

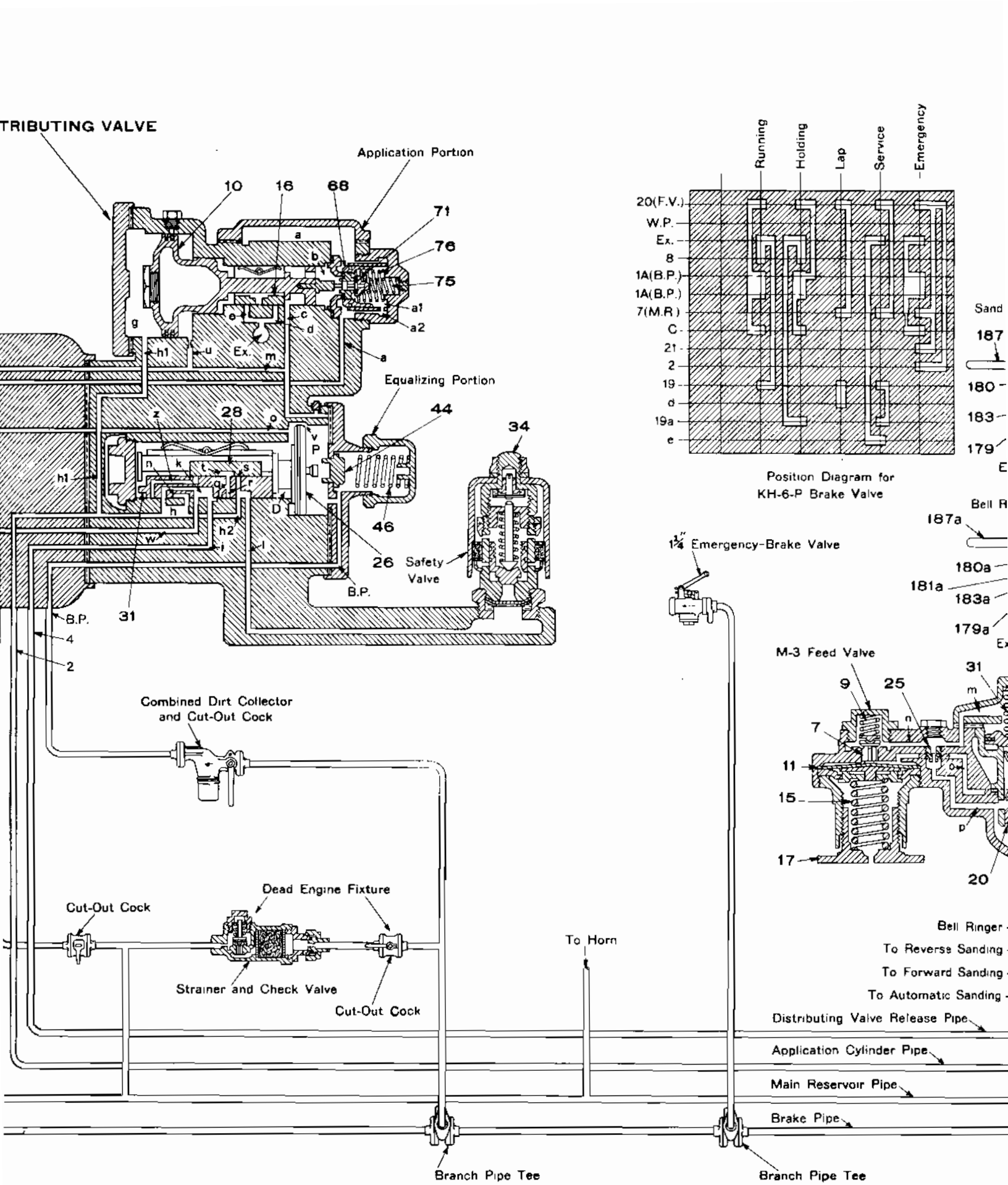
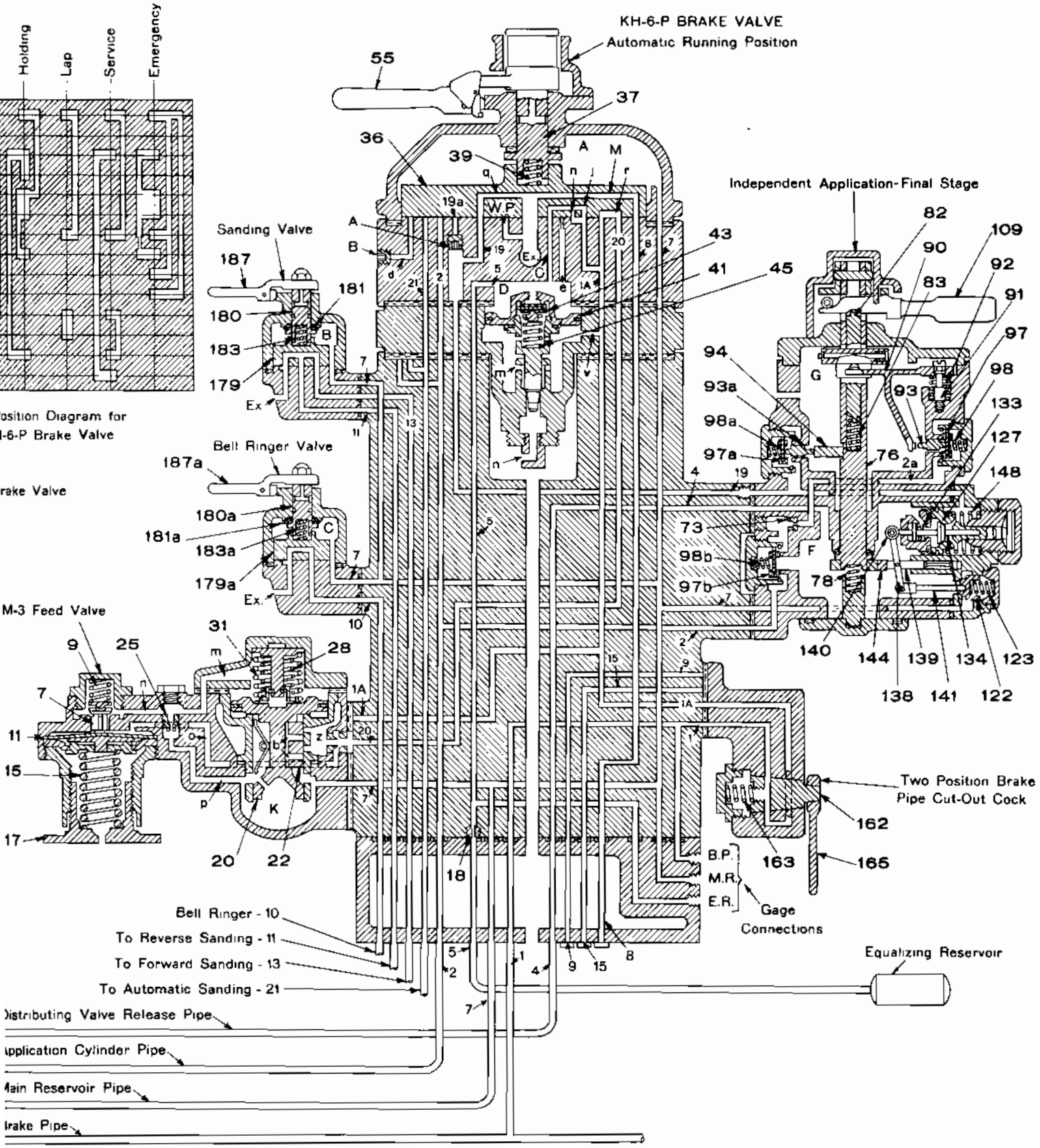


Plate 7. Independent Application—Final Stage



osition Diagram for
-6-P Brake Valve

rake Valve

tion—Final Stage

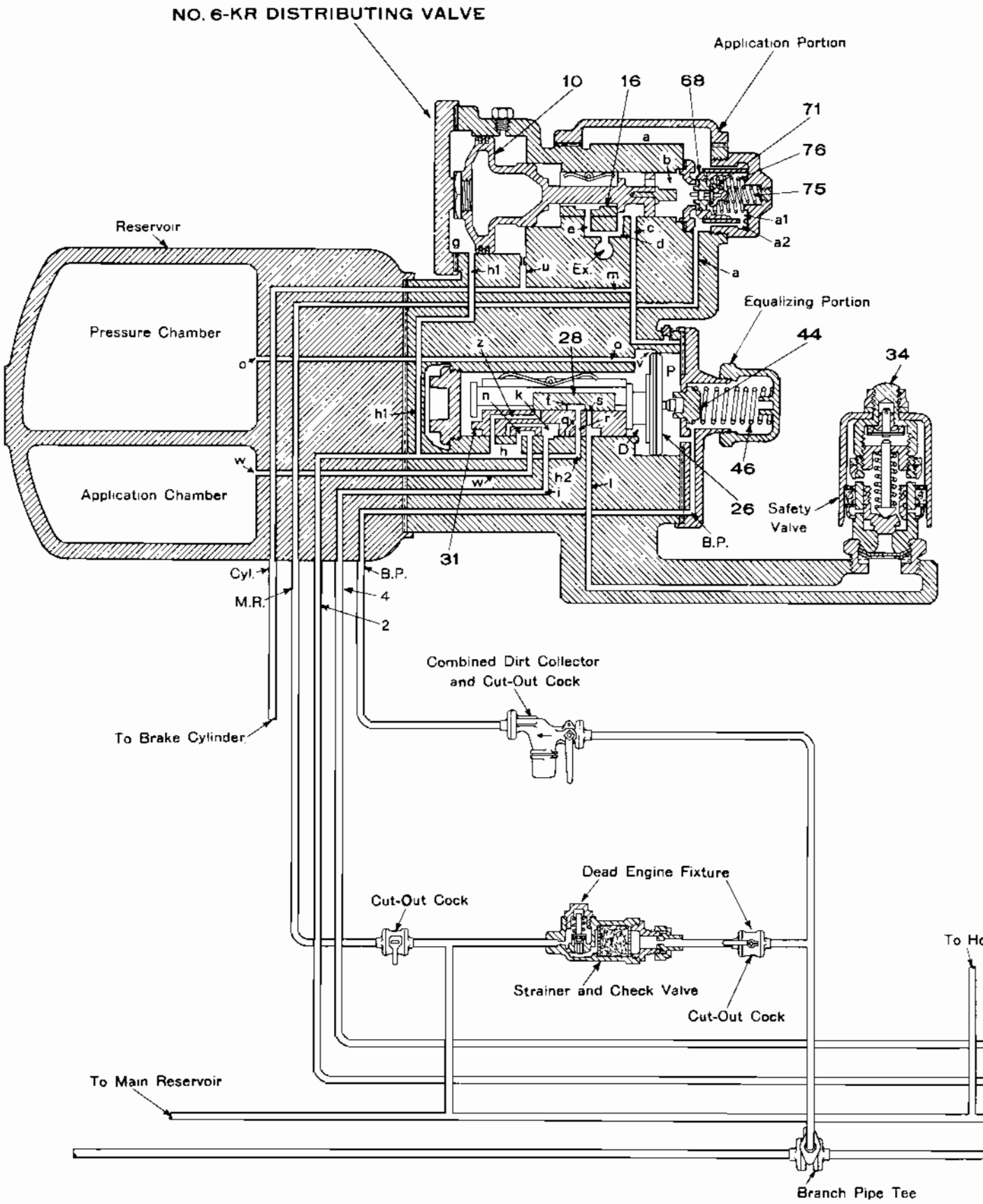

NO. 6-KR DISTRIBUTING VALVE
Application Portion
10
16
68
71
76
75
a
b
a1
a2
Reservoir
e
c
d
g
h1
u
Ex.
m
a
Equalizing Portion
44
34
Pressure Chamber
o
z
28
o
v
P
n
k
f
s
h1
q
r
h
D
w
h2
i
l
46
Application Chamber
26
Safety Valve
B.P.
31
Cyl.
B.P.
M.R.
4
2
Combined Dirt Collector and Cut-Out Cock
To Brake Cylinder
Dead Engine Fixture
Cut-Out Cock
Strainer and Check Valve
Cut-Out Cock
To Main Reservoir
Branch Pipe Tee

Plate 8. Ind

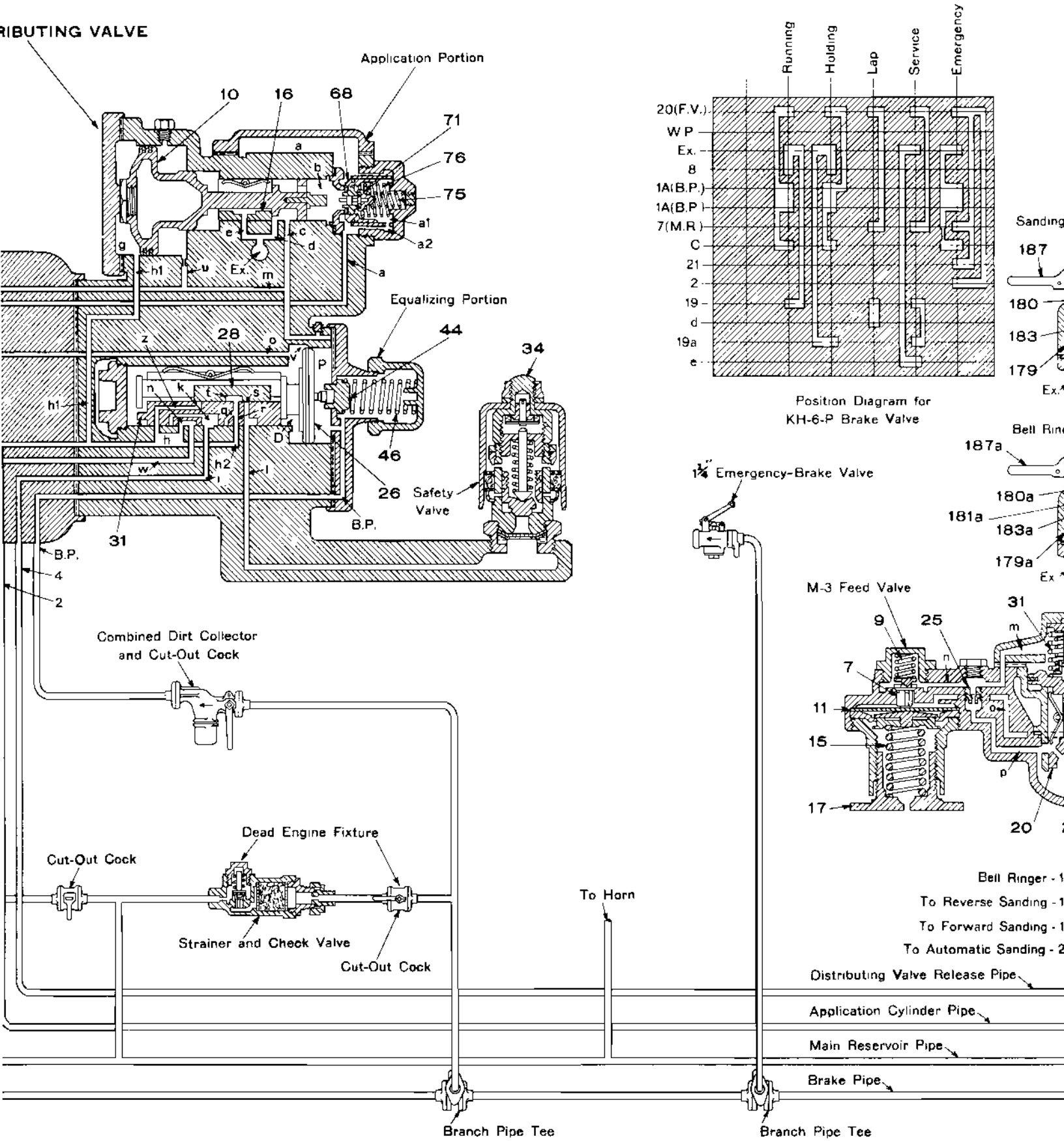
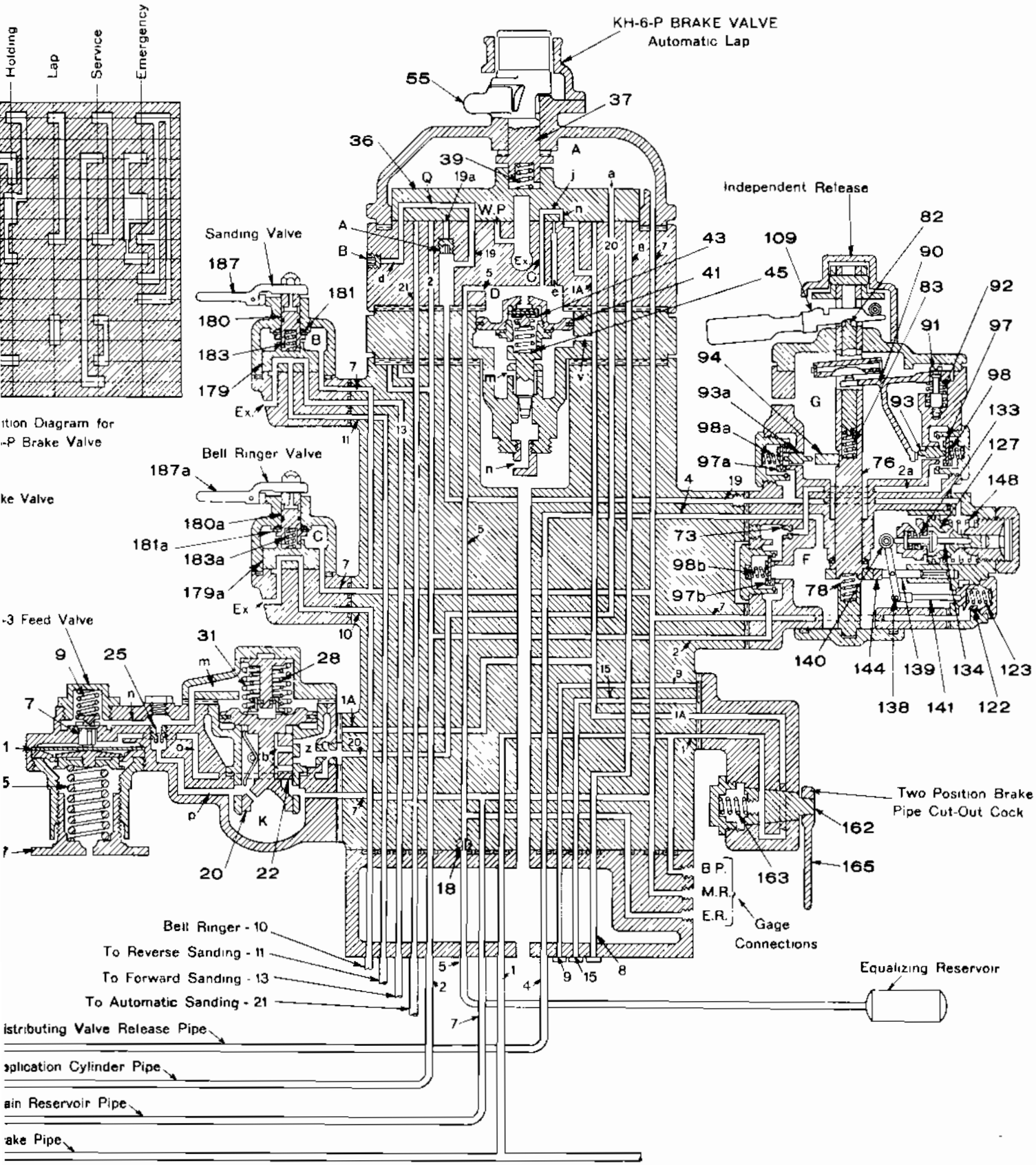


Plate 8. Independent Release—after Automatic Service



Automatic Service

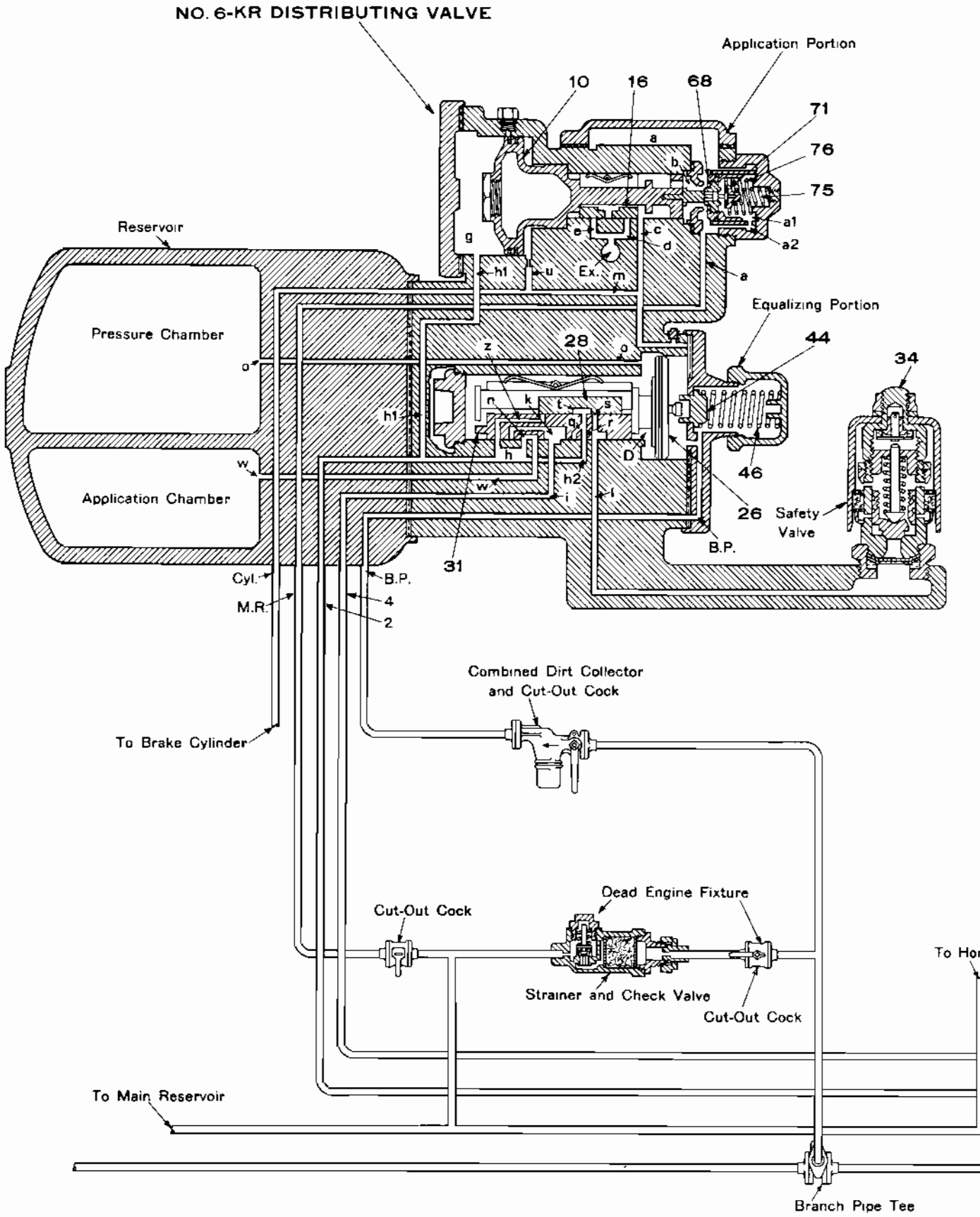


Plate 9. Independent Appl

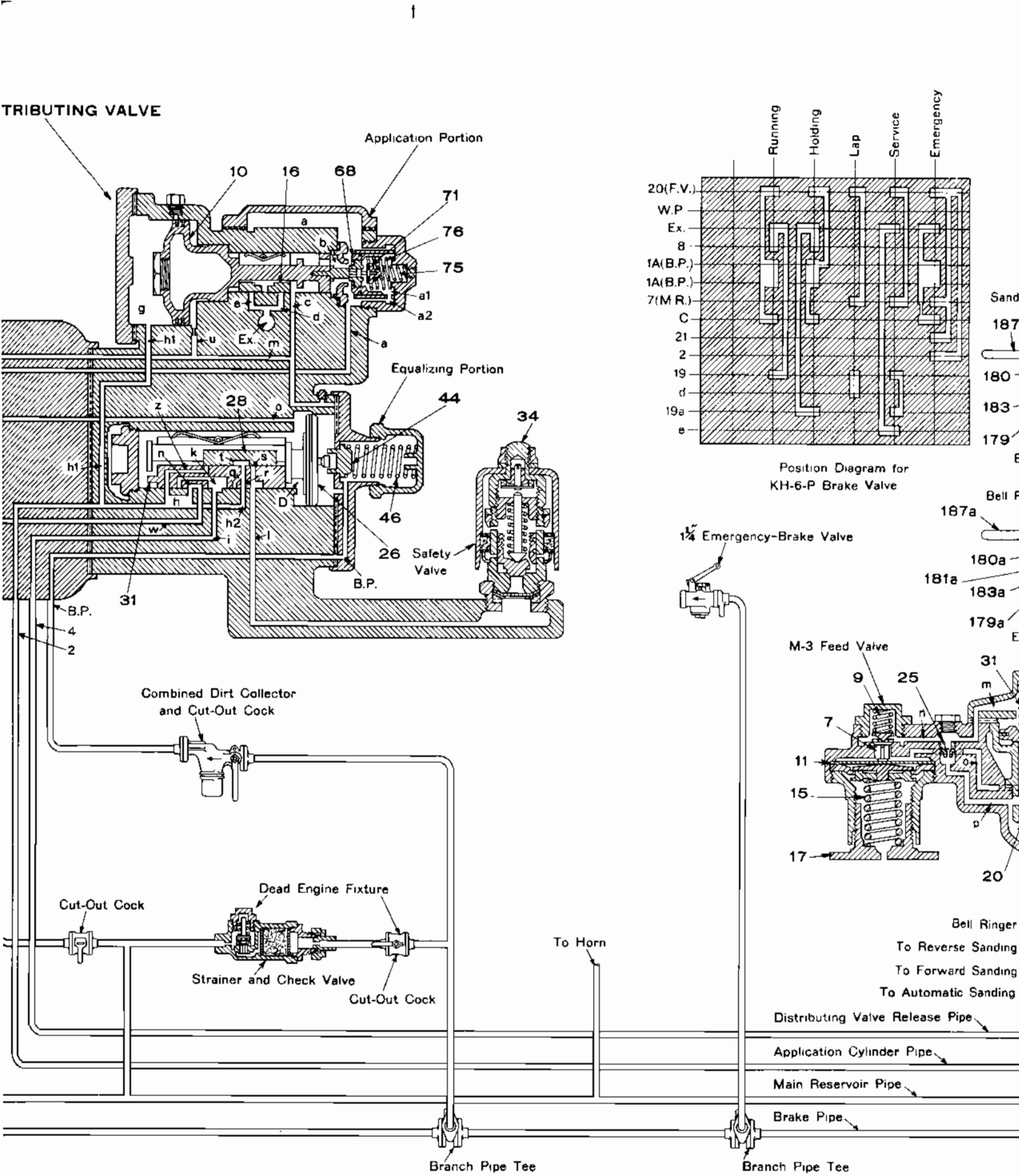
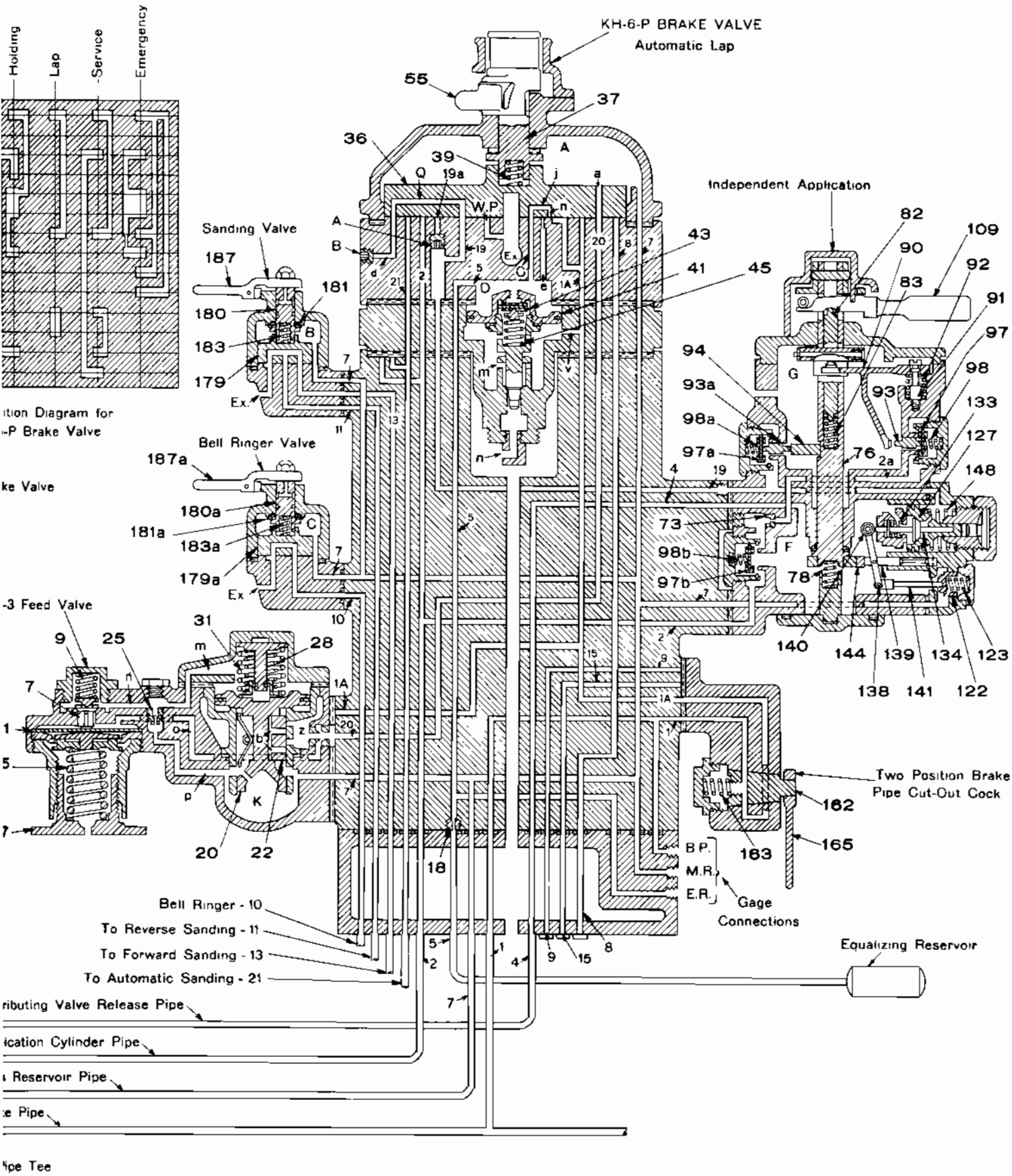
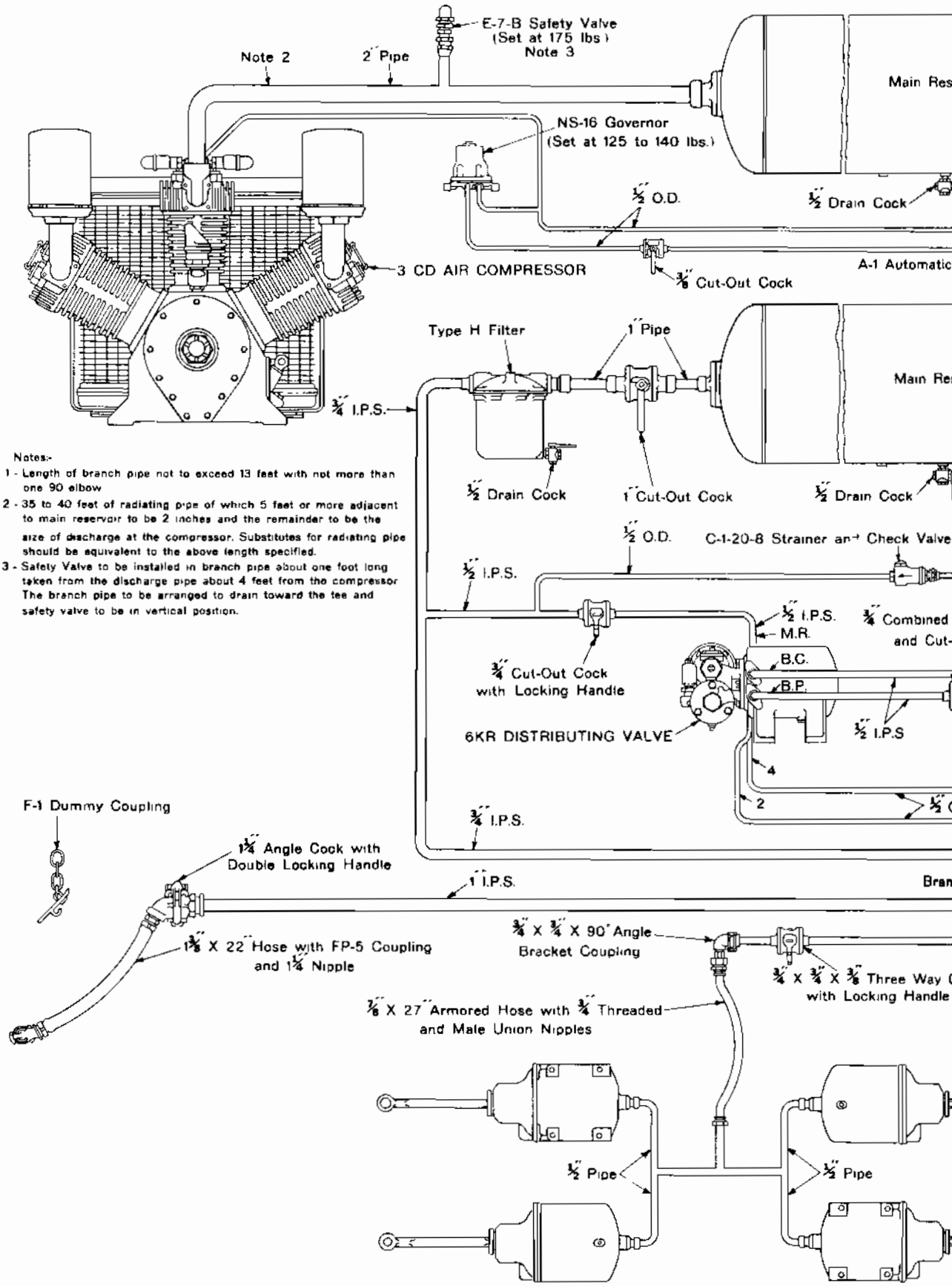


Plate 9. Independent Application after Independent Release—Automatic Brake



Release—Automatic Brake Applied



Notes:-

1 - Length of branch pipe not to exceed 13 feet with not more than one 90 elbow

2 - 35 to 40 feet of radiating pipe of which 5 feet or more adjacent to main reservoir to be 2 inches and the remainder to be the size of discharge at the compressor. Substitutes for radiating pipe should be equivalent to the above length specified.

3 - Safety Valve to be installed in branch pipe about one foot long taken from the discharge pipe about 4 feet from the compressor. The branch pipe to be arranged to drain toward the tee and safety valve to be in vertical position.

Plate 10. Piping Diag

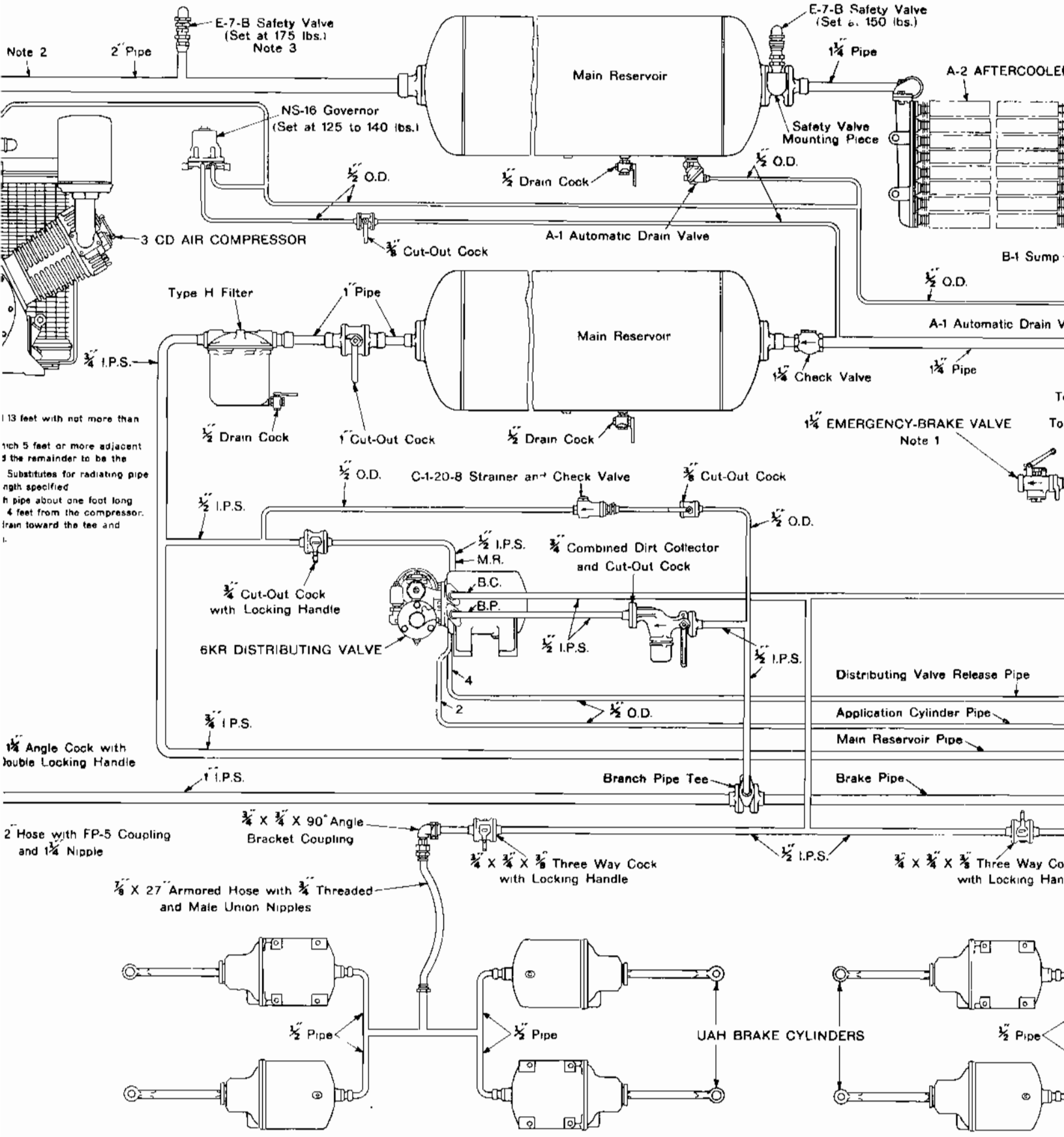
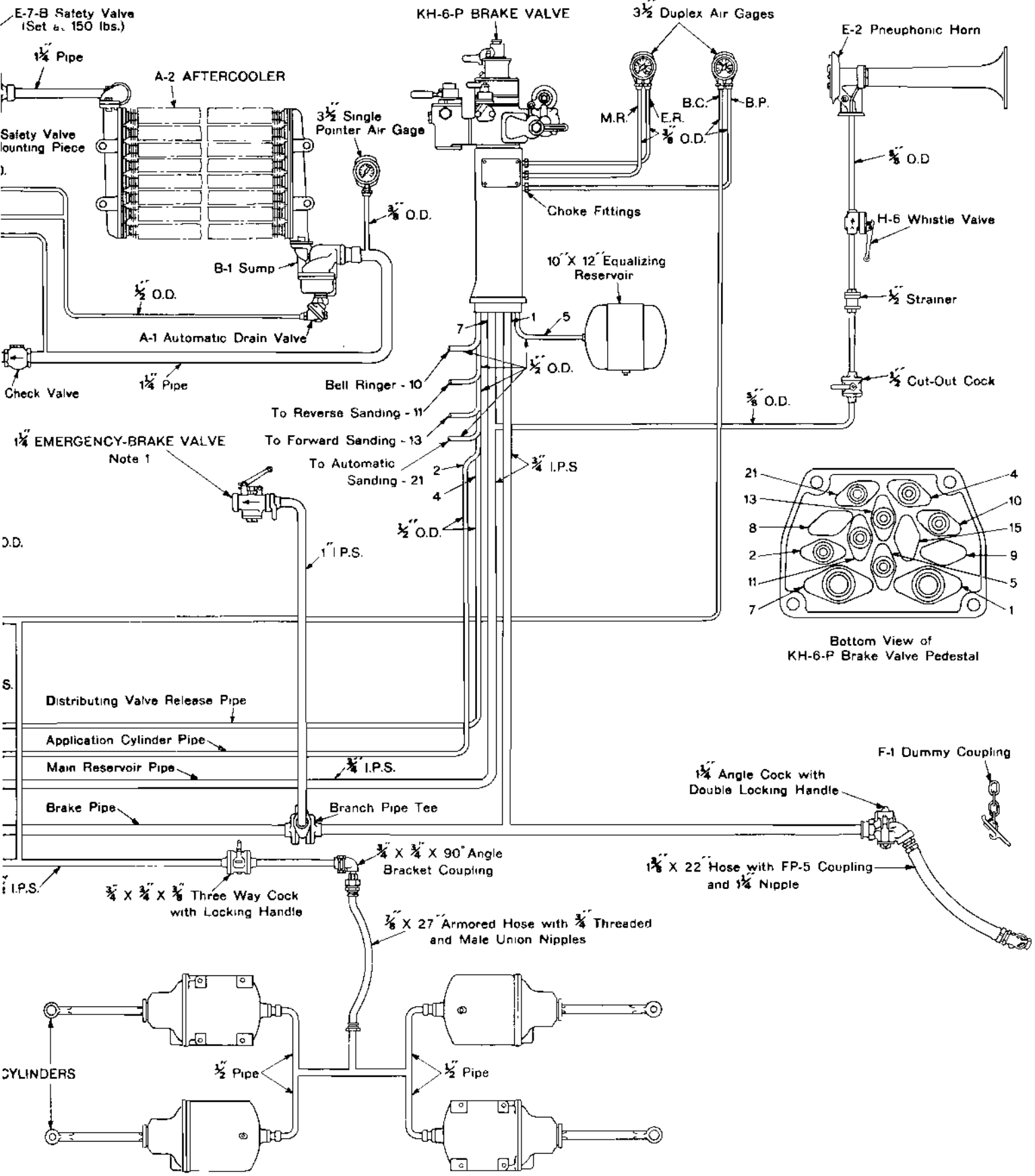


Plate 10. Piping Diagram of Single End No. 6-SL Locomotive Brake Equi



No. 6-SL Locomotive Brake Equipment

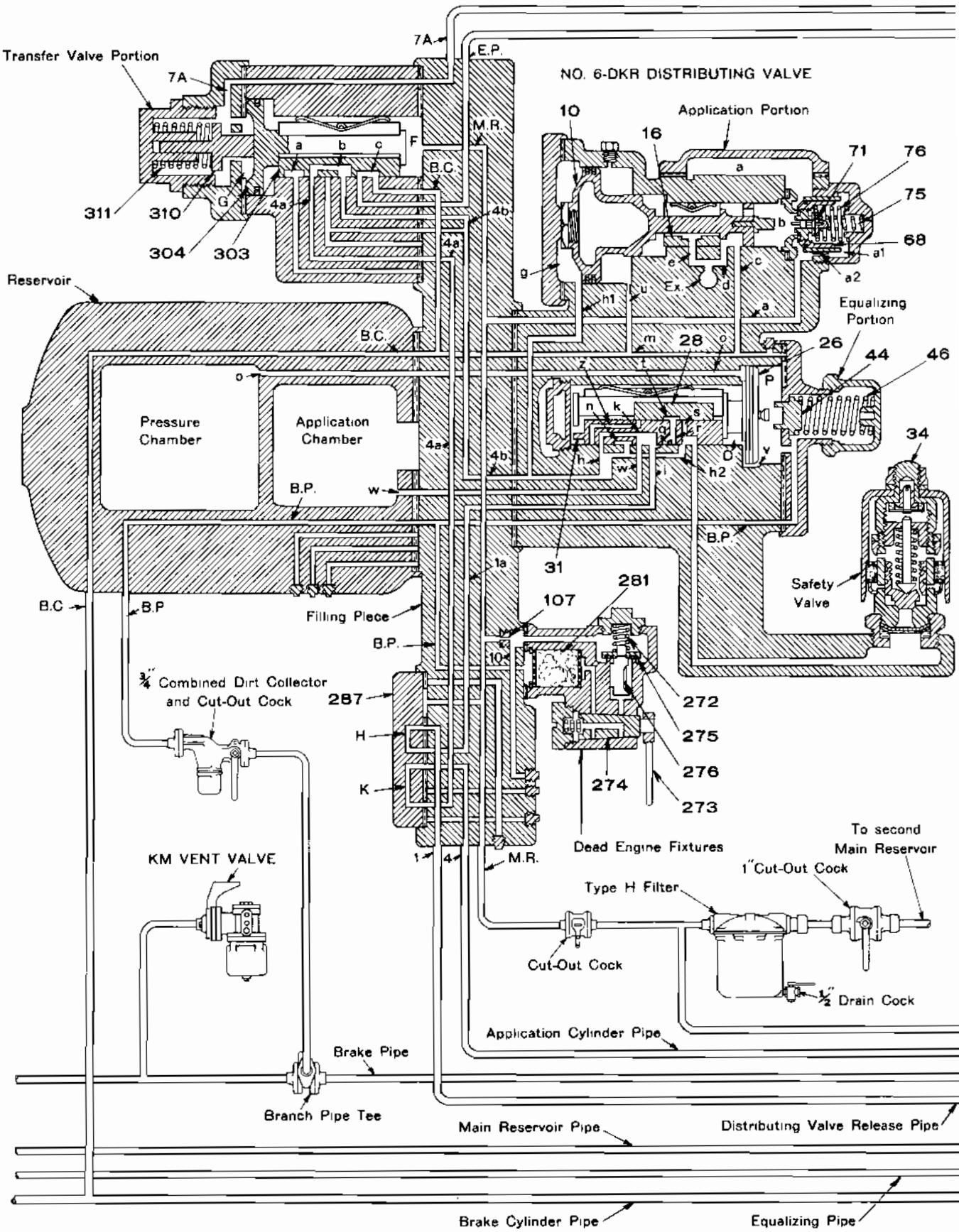


Plate 11. Diagrammatic Vie

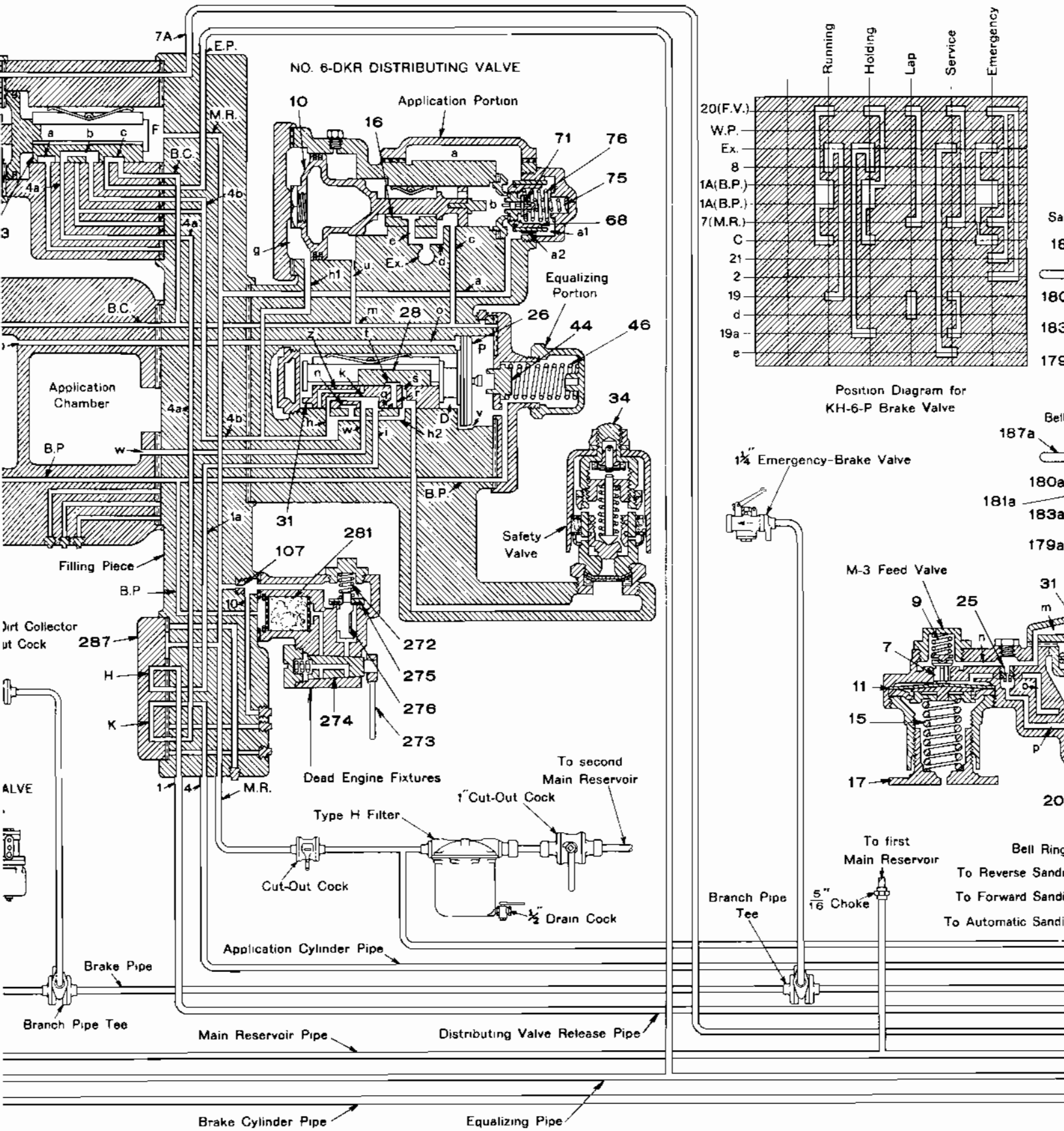
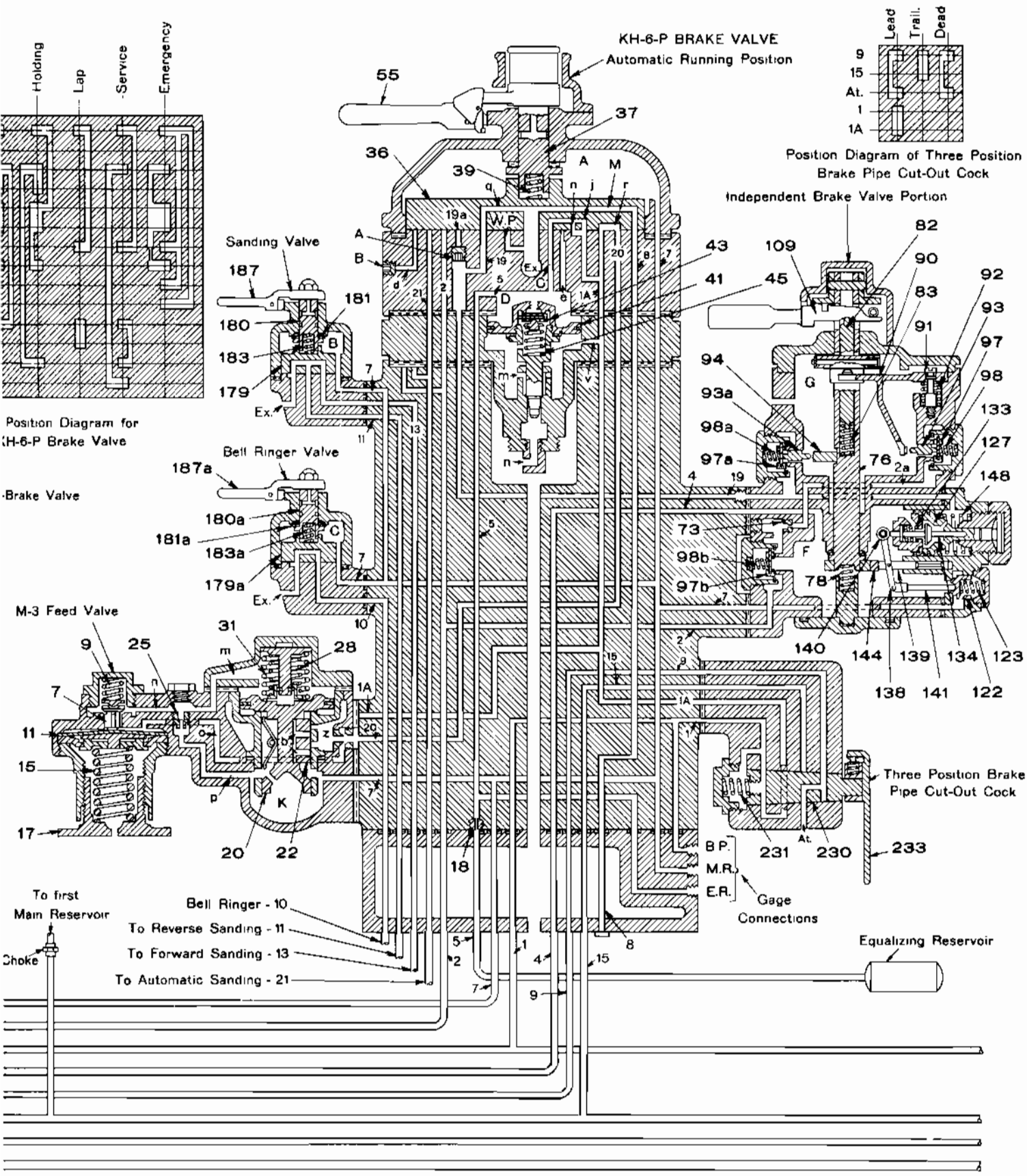


Plate 11. Diagrammatic View of 6-SL Equipment with No. 6-DKR Distributi
Running Position

E-45143



it with No. 6-DKR Distributing Valve
ion

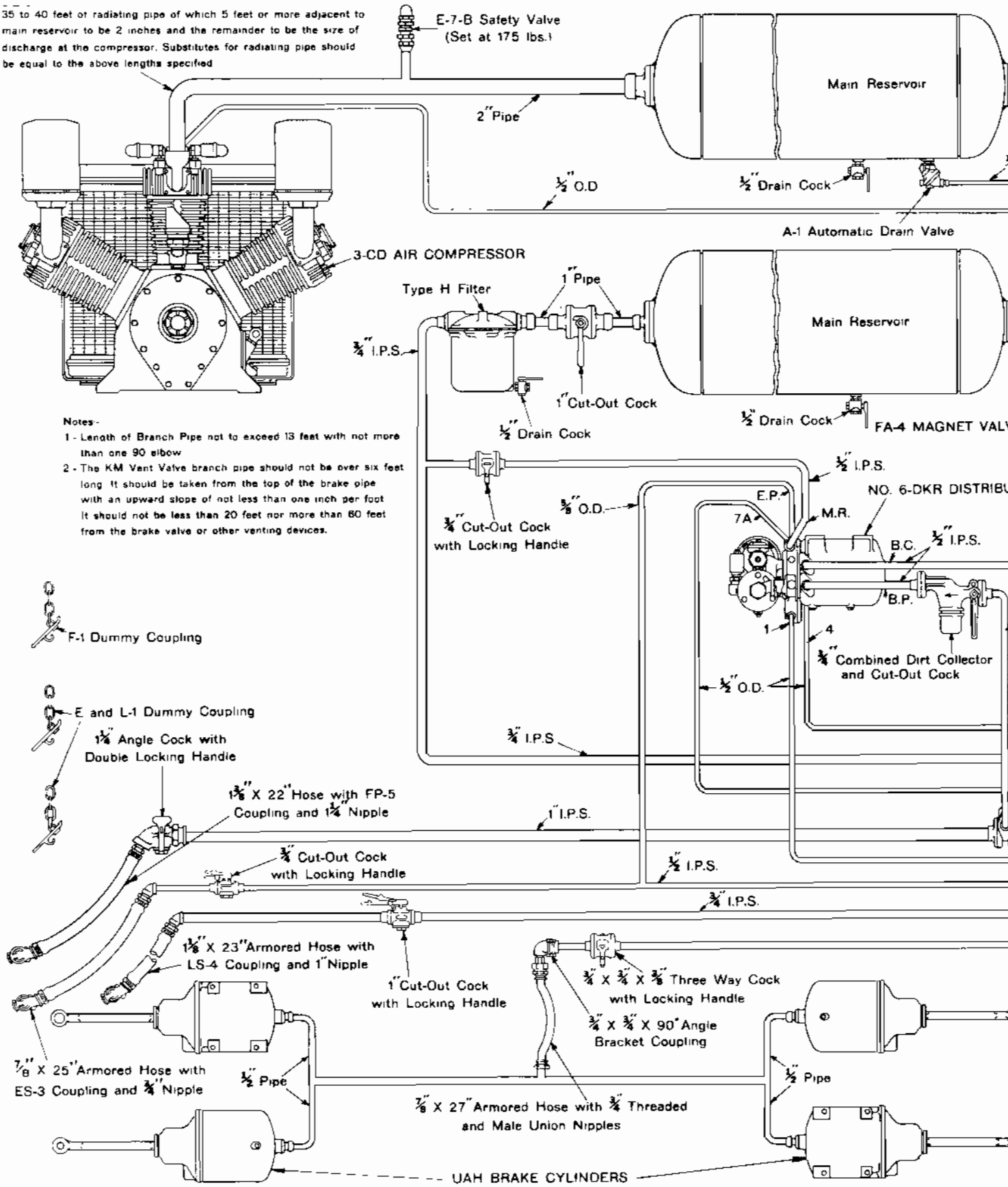


Plate 12. Piping Diagram of 6-SL Ec

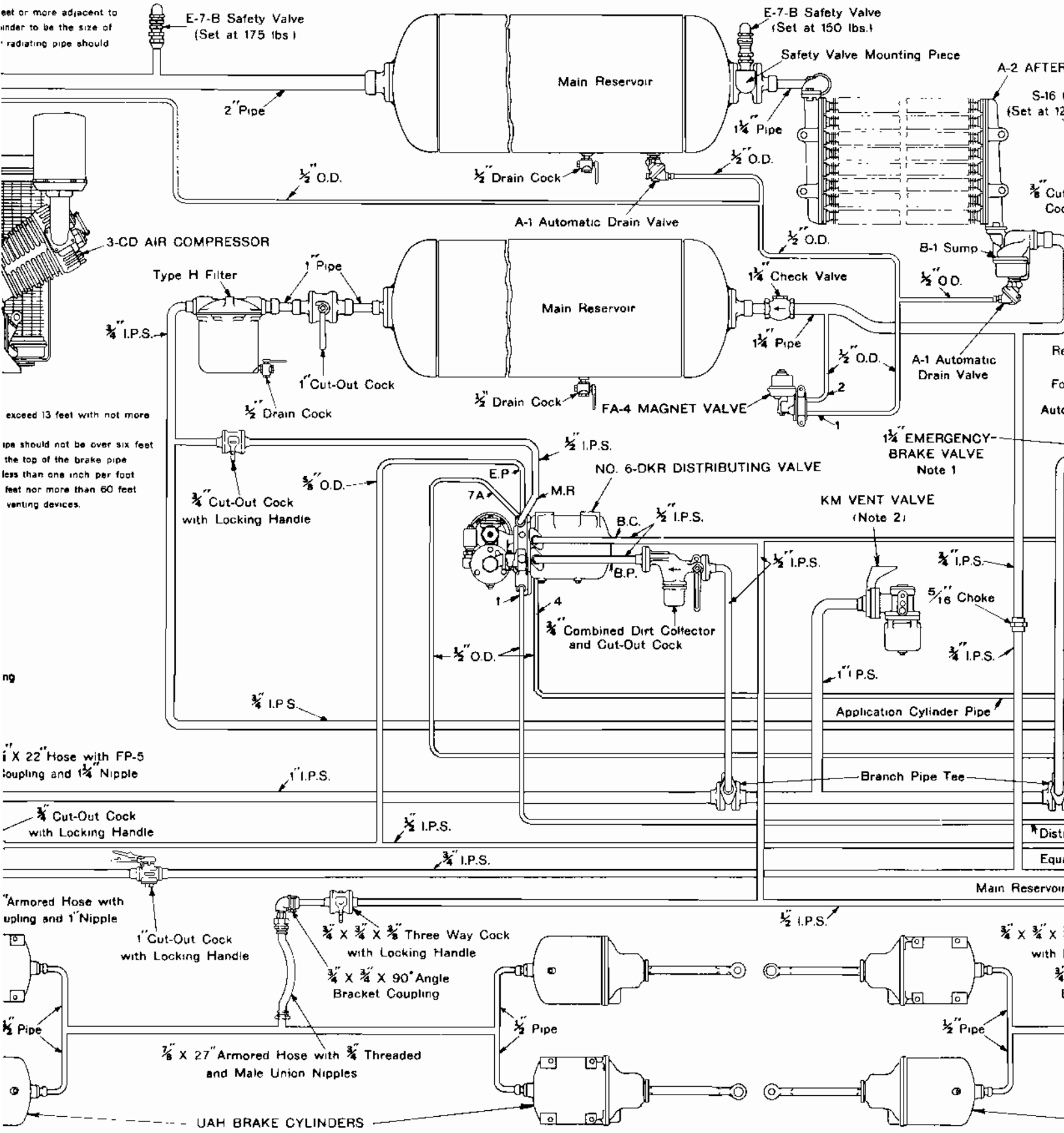
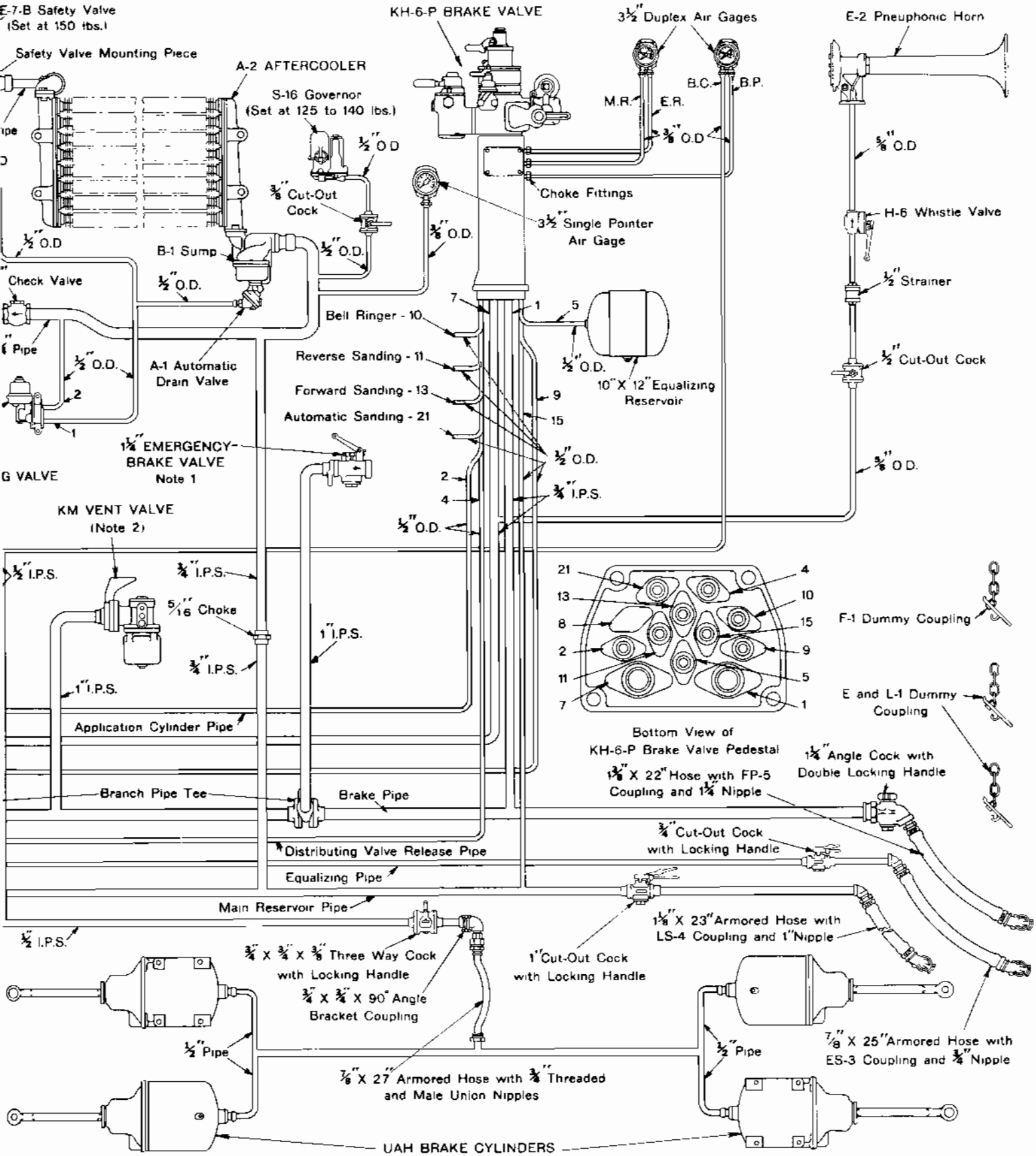


Plate 12. Piping Diagram of 6-SL Equipment with No. 6-DKR Distributing



ıment with No. 6-DKR Distributing Valve