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EMBODYING DESCRIPTIONS AND INSTRUCTIONS FOR THE MANIPULATION OF

THE WESTINGHOUSE No. 6 "E T" ENGINE AND TENDER BRAKE EQUIPMENT, TOGETHER WITH QUESTIONS AND ANSWERS RELATIVE TO THE PRACTICAL OPERATION THEREOF; THE NEW YORK B-3 LOCOMOTIVE BRAKE EQUIPMENT; NEW YORK DUPLEX AIR PUMPS AND PUMP GOVERNORS; AND THE DUKESMITH E. C. EQUIPMENT No. 6 AND CAR CONTROL VALVE

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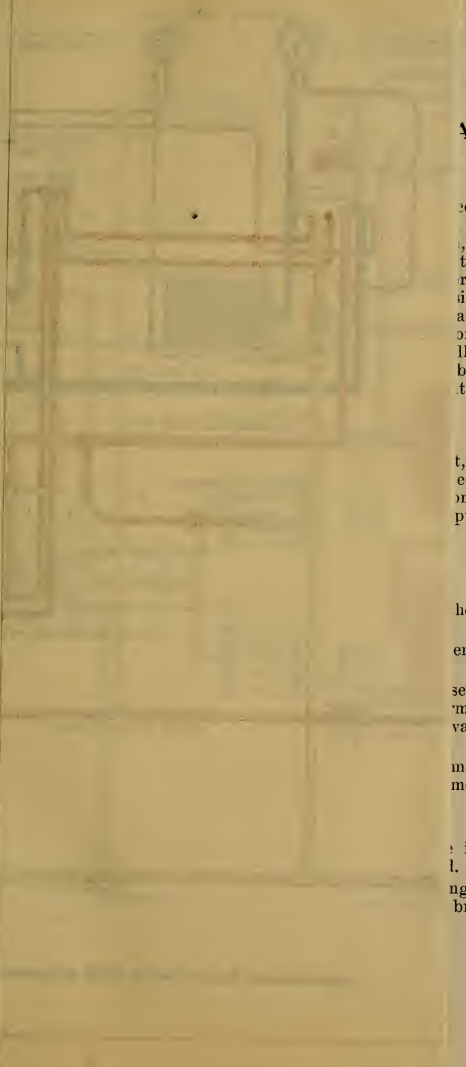
THE NO. 6 "E. T." LOCOMOTIVE BRAKE EQUIPMENT.



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PRESSURES

REDUCING VALVE PIPE

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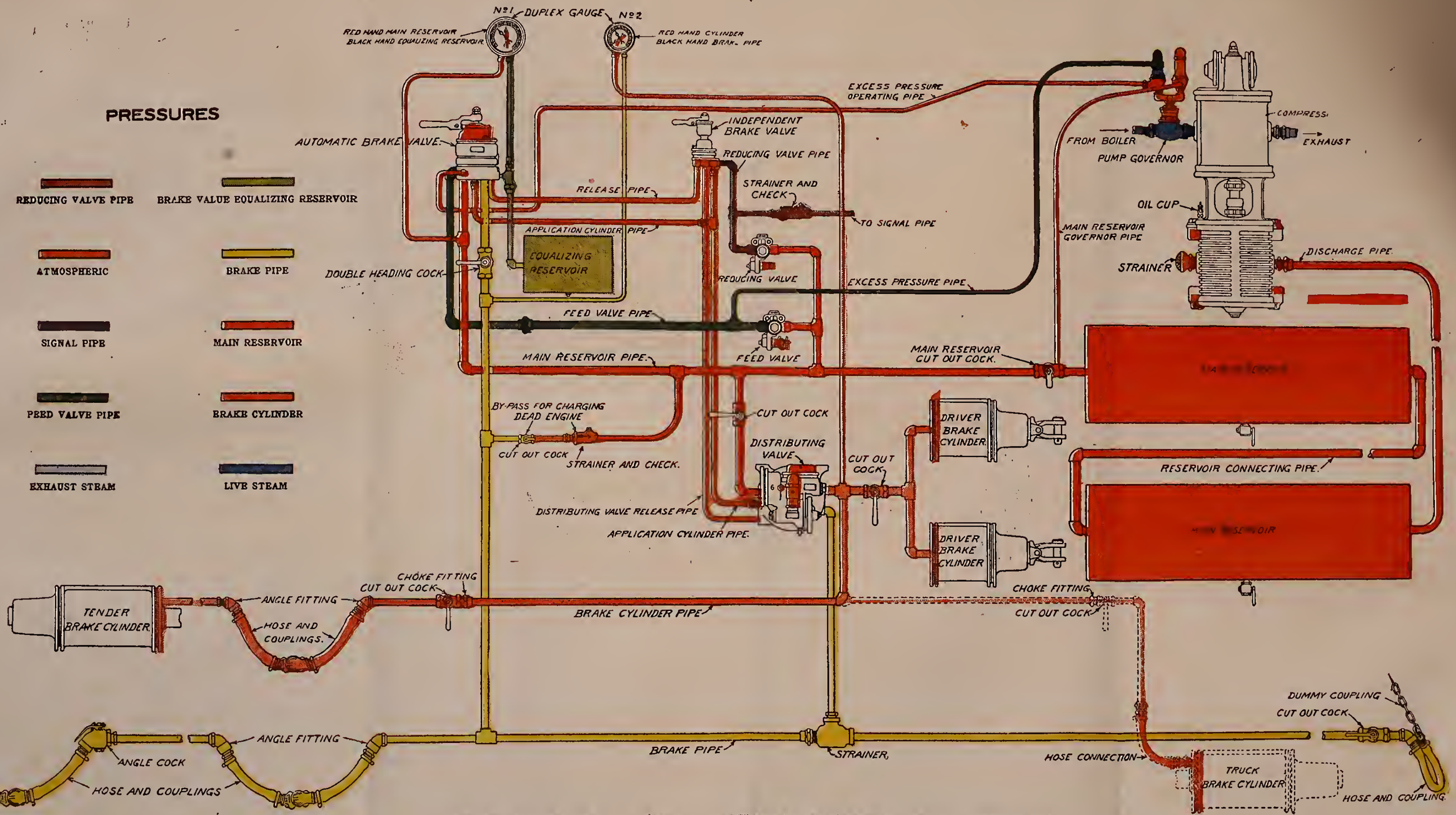


INSTRUCTION DIAGRAM. No. 6 ET LOCOMOTIVE BRAKE EQUIPMENT.—PIPING CONNECTIONS.

THE NO. 6 "E. T." LOCOMOTIVE BRAKE EQUIPMENT.

The "E. T." Locomotive Brake equipment was introduced in 1905 and is now known as the "No. 5" E. T. Equipment. The "No. 6" E. T. Equipment, illustrated and described herein, is a modification of the No. 5, to accomplish the same results by simpler means, as well as to embody certain additional operative advantages which railroad men suggested as valuable and desirable in a locomotive brake apparatus. The only difference in manipulation between No. 5 and No. 6 "E. T." equipment is that on the second engine in double heading, the No. 6 brake-valve handle remains in *running position*, as with the old standard G-6 brake-valve, instead of in *lap position*, as with the No. 5 equipment.

ARRANGEMENT OF APPARATUS.

Fig. 1-A is a diagram of the No. 6 "E. T." equipment, giving the necessary instructions for correctly piping up the equipment; Fig. 1-B is a similar diagram giving the designations of apparatus and piping as referred to in the following description:

PARTS OF THE EQUIPMENT.

1. The Air Pump to compress the air.

2. The Main Reservoirs, in which to store and cool the air and collect water and dirt.

3. A Duplex Pump Governor to control the pump when the pressures are attained for which it is regulated.

4. A Distributing Valve, and small double-chamber reservoir to which it is attached, placed on the locomotive to perform the functions of triple valves, auxiliary reservoirs, double check valves, high-speed reducing valves, etc.

5. Two Brake Valves, the Automatic to operate locomotive and train brakes, and the Independent to operate locomotive brakes only.

6. A Feed Valve to regulate the brake-pipe pressure.

7. A Reducing Valve to reduce the pressure for the independent brake valve and for the air-signal system when used.

8. Two Duplex Air Gauges; one, to indicate equalizing-reservoir and main-reservoir pressures; the other, to indicate brake-pipe and locomotive brake-cylinder pressures.

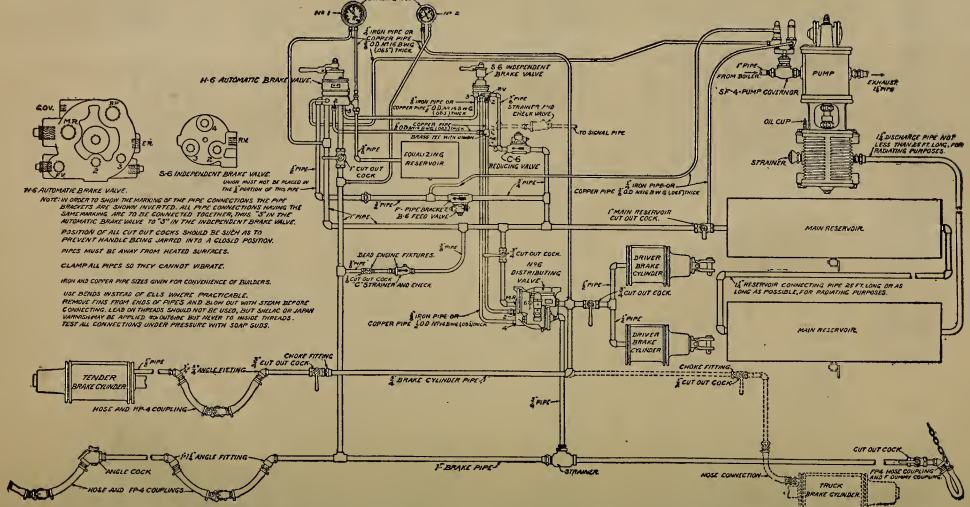


FIG. 1-A. PIPING DIAGRAM OF THE NO. 6 "E. T." EQUIPMENT.

9. Driver, Tender, and Truck-Brake Cylinders, Cut-Out Cocks, Air Strainers, Hose Couplings, Fittings, etc., incidental to the piping, for purposes readily understood.

NAMES OF PIPING (Refer to Fig. 1-B).

D—Discharge Pipe: Connects the Air Pump to the first Main Reservoir.

C—Connecting Pipe: Connects the two Main Reservoirs.

MR—Main-Reservoir Pipe: Connects the second main reservoir to the Automatic Brake Valve, Distributing Valve, Feed Valve, Reducing Valve, and Pump Governor.

FV—Feed-Valve Pipe: Connects the Feed Valve to the Automatic Brake Valve.

E—Excess-Pressure Governor Pipe: Connects the Feed-Valve Pipe to the Excess-Pressure Head of the Pump Governor.

RV—Reducing-Valve Pipe: Connects the Reducing Valve to the Independent Brake Valve, and to the Signal System, when used.

BP—Brake Pipe: Connects the Automatic Brake Valve with the Distributing Valve and all Triple Valves on the cars in the train.

BC—Brake-Cylinder Pipe: Connects the Distributing Valve with the Driver, Tender and Truck-Brake Cylinders.

H—Application-Cylinder Pipe: Connects the Application Cylinder of the Distributing Valve to the Independent and Automatic Brake Valves.

I—Distributing-Valve Release Pipe: Connects the Application Cylinder exhaust port of the Distributing Valve to the Automatic Brake Valve through the Independent Brake Valve.

Referring to Fig. 1-B, air compressed by the pump passes through pipes D and C as usual to the main reservoirs and the main-reservoir pipe, MR. The main-reservoir cut-out cock, W, is to cut off and vent the air from the main-reservoir pipe, when removing any of the apparatus except the governor. The end toward the main reservoir is tapped for a pipe connection, G, to the Pump Governor. Before this cock is closed the double-heading cock, X, should be closed, and the brake-valve handle placed in release position. This is to prevent the slide valve of the feed valve, and the rotary valve of the brake valve, being lifted from their seats.

Beyond the main-reservoir cut-out cock, the main-reservoir pipe has four branches, one of which runs to the automatic brake valve, one to the feed valve, one to the reducing valve, and one to the distributing valve. As a result, the automatic brake valve receives air from the main reservoirs in two ways, one direct and the other through the Feed Valve.

The Feed-Valve Pipe, FV, from the feed valve to the automatic

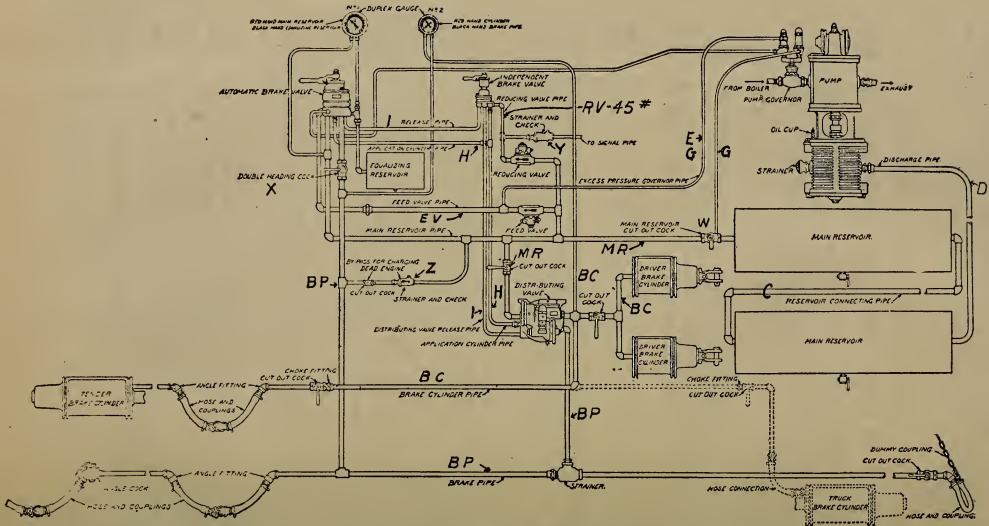


FIG. 1-B. INSTRUCTION DIAGRAM OF THE NO. 6 "E. T." EQUIPMENT.

brake valve has a branch, EG, to the top of the excess-pressure head of the duplex pump governor.

The third branch of the main-reservoir pipe connects with the reducing valve. Air at the pressure for which this valve is set (45 pounds) is supplied to the independent brake valve through the reducing-valve pipe RV. When the air-signal system is installed, it is connected to the reducing-valve pipe, in which case the reducing valve also takes the place of the signal reducing valve formerly employed. In the branch pipe supplying the air-signal system is placed a combined strainer, check-valve, and choke fitting, Y. The strainer prevents any dirt from reaching the check valve and choke fitting. The check valve prevents air from flowing back from the signal pipe when the independent brake is applied. The choke fitting prevents the reducing valve from raising the signal-pipe pressure so quickly as to destroy the operation of the signal.

LARGE DUPLEX AIR GAUGE (No. 1).

SMALL DUPLEX AIR GAUGE (No 2).

The distributing valve has five pipe connections, made through the end of the double-chamber reservoir, three on the left and two on the right. Of the three on the left, the upper, MR, is the supply from the main reservoir; the intermediate, H, is the application-cylinder pipe, leading to the independent and automatic brake valves; and the lower, I, 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 engine and tender. In this pipe are placed cocks for cutting out the brake cylinders when necessary, and in the engine truck and tender brake-cylinder cut-out cocks are placed choke fittings to prevent serious loss of main-reservoir air and the release

of the other locomotive brakes during a stop, in case of burst brake-cylinder hose.

The two Duplex Air Gauges are connected as follows: Gauge No. 1; Red Hand, to main-reservoir pipe under the automatic brake valve; Black Hand, to gauge-pipe tee of the automatic brake valve. Gauge No. 2; Red Hand, to the brake-cylinder pipe; Black Hand, to the brake pipe below the double-heading cock.

The amount of reduction made during an automatic application is indicated by the black hand of Gauge No. 1. The black hand of Gauge 2 is to show the brake-pipe pressure when the engine is second in double heading, or a helper.

The automatic-brake-valve connections, other than already mentioned, are the brake-pipe, the main-reservoir, the equalizing reservoir, and the lower connection to the excess-pressure head of the pump governor.

PRINCIPLES OF OPERATION.

Before taking up the description of each part of this equipment, we wish to emphasize that the principles governing the operation of it are just the same as those of previous automatic air brake equipments. The difference consists in the means for supplying the air pressure to the brake cylinders. Instead of a triple valve and auxiliary reservoir for each of the engine and tender equipments, the distributing valve is made to supply all brake cylinders. The distributing valve consists of two portions called the "equalizing portion" and "application portion." It is connected to a "double-chamber reservoir," the two chambers of which are called respectively the "pressure chamber" and the "application chamber." The latter is ordinarily connected to the application portion of the distributing valve in such a way as to enlarge the volume of that part of it called the "application cylinder" (Fig. 2). The connections between these parts as well as their operation, may be compared with that of a *miniature brake set*—the equalizing portion representing the dummy triple valve; the pressure chamber, the dummy auxiliary reservoir; and the application portion (dummy cylinders) always having practically the same pressure in its cylinder as that in the real brake cylinders. This is shown by the diagrammatic illustration in Fig. 2. For convenience, compactness and security they are combined in one device as shown in Figs. 3, 4 and 5. The equalizing portion (dummy triple) and pressure chamber (dummy auxiliary) are used in automatic applications only; reductions of brake-pipe pressure cause the equalizing valve to connect the pressure chamber dummy auxiliary to the dummy cylinder, allowing air to flow from the former to the latter. The upper slide valve connected to the piston rod of the application portion, admits air to the brake cylinders and is called the "application valve," while the lower one releases the air from the brake cylinders and is called

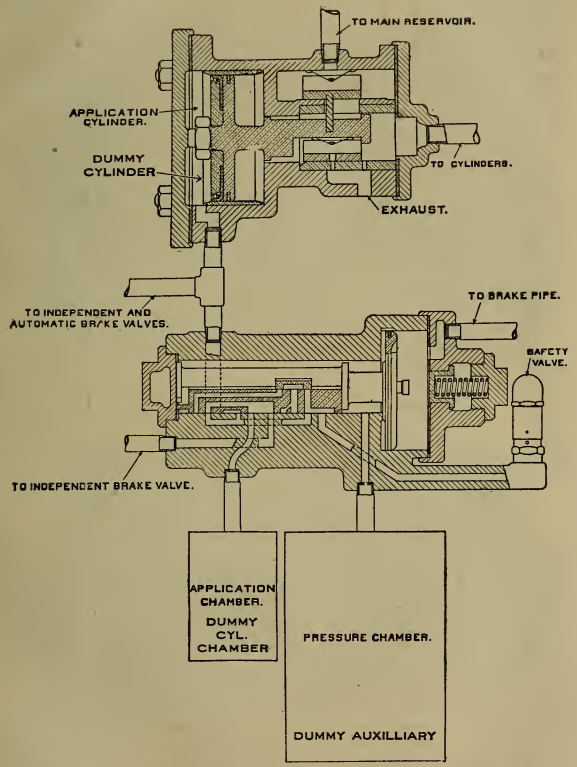


FIG. 2. DIAGRAMMATIC VIEW OF THE ESSENTIAL PARTS OF THE DISTRIBUTING VALVE, AND DOUBLE-CHAMBER RESERVOIR.

the "exhaust valve." As the air admitted to the brake cylinders comes directly from the main reservoirs, the supply is practically unlimited. Any pressure in the dummy cylinder will force the application piston to close the exhaust valve, open the application valve and admit air from the main-reservoirs to the locomotive brake cylinders until their pressure equals that in the dummy cylinder; any variation of this (dummy) cylinder pressure will be exactly duplicated in the locomotive brake cylinders, and the resulting pressure maintained regardless of any brake-cylinder leakage. The whole operation of this locomotive brake, therefore, consists in admitting and releasing air pressure into or out of the dummy cylinder, in independent applications directly through the independent brake valve; in automatic applications, by means of the equalizing (dummy triple valve) portion and the air pressure stored in the pressure chamber (dummy auxiliary).

The well known principle embodied in the quick-action triple valve, by which it gives a high braking power in emergency applications, and a sufficiently lower one in full service applications, to provide a desired protection against wheel sliding, is embodied in the No. 6 distributing valve. This is accomplished by cutting off the application chamber from the application cylinder in all emergency applications. In such applications, the pressure chamber has to fill the small volume of the application cylinder only, thus giving a high equalization, and a correspondingly high brake-cylinder pressure. In service applications, it must fill the same volume combined with that of the application chamber, thus giving a lower equalization and correspondingly lower brake-cylinder pressure.

The following description gives the operation in detail.

THE NO. 6 DISTRIBUTING VALVE.

This valve is the important feature of the "E. T." equipment. Fig. 3 shows photographic views of the valve and its double-chamber reservoir. The pipe connections, as previously referred to, are plainly shown. Fig. 4 shows the two chambers of the reservoir. The safety valve, 34, is an essential part of the distributing valve, and is described under the heading "E-6 Safety Valve."

Referring to Figs. 4 and 5, the names of parts of this apparatus are as follows: 2, Body; 3, Application-Valve Cover; 4, Cover Screw; 5, Application Valve; 6, Application-Valve Spring; 7, Application-Cylinder Cover; 8, Cylinder-Cover Bolt and Nut; 9, Cylinder-Cover Gasket; 10, Application Piston; 11, Piston Follower; 12, Packing-Leather Expander; 13, Packing Leather; 14, Application-Piston Nut; 15, Application-Piston Packing Ring; 16, Exhaust Valve; 17, Exhaust-Valve Spring; 18, Application-Valve Pin; 19, Application-Piston Graduating Stem; 20, Application-Piston Graduating Spring; 21, Graduating-Stem Nut; 22, Upper

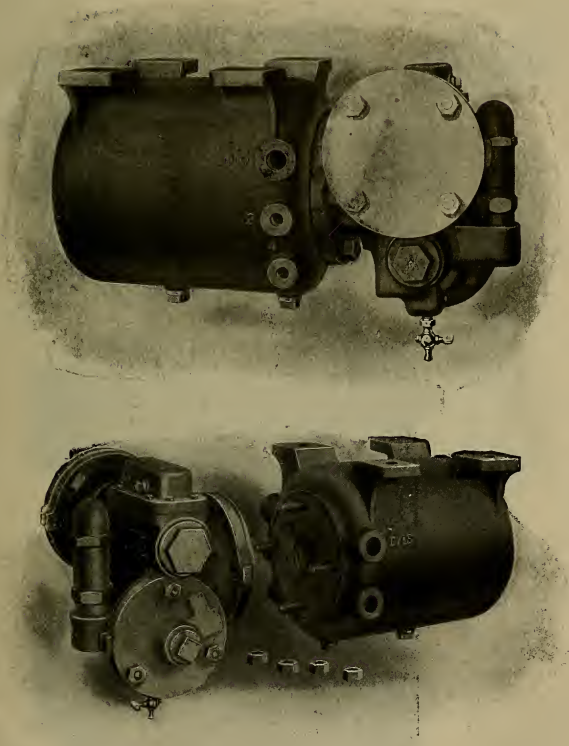


FIG. 3. NO. 6 DISTRIBUTING VALVE AND DOUBLE CHAMBER RESERVOIR.

Connections: MR—Main-Reservoir Pipe; 4—Distributing-Valve Release Pipe; 2—Application-Cylinder Pipe; CYLS—Brake-Cylinder Pipe; BP—Brake Pipe.

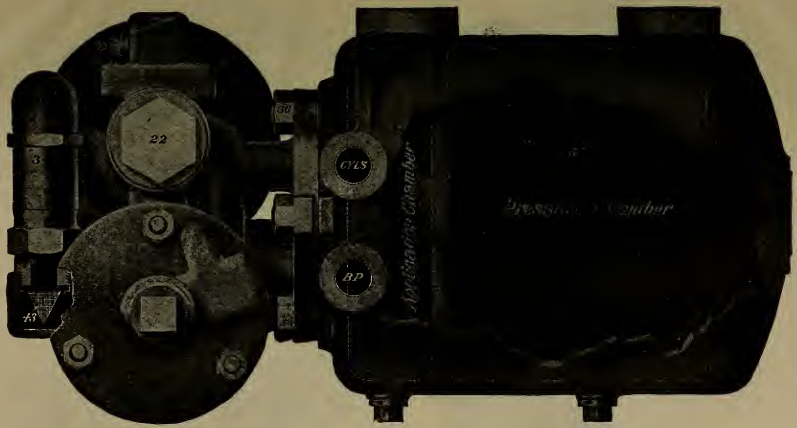


FIG. 4. NO. 6 DISTRIBUTING VALVE AND DOUBLE-CHAMBER RESERVOIR.

Pipe Connections: CYLS—Brake-Cylinders Pipe; BP—Brake Pipe.

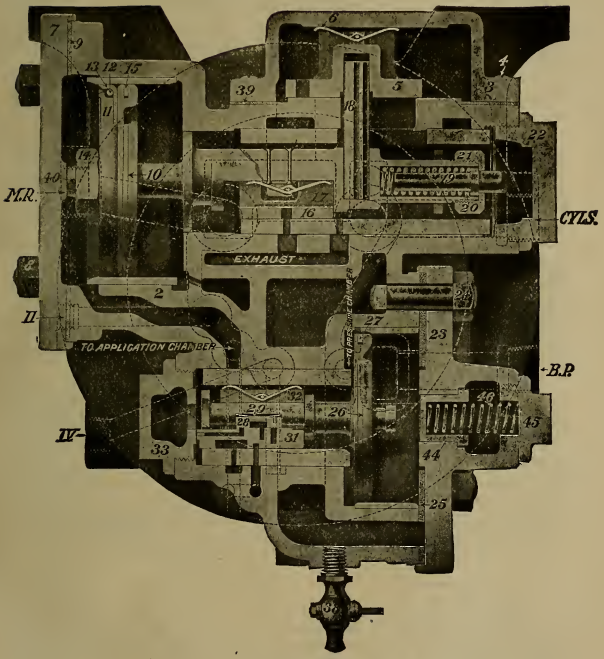


FIG. 5. NO. 6 DISTRIBUTING VALVE.

Connections: MR—Main-Reservoir Pipe; IV—Distributing-Valve Release Pipe; II—Application-Cylinder Pipe; CYLS—Brake-Cylinder Pipe; BP—Brake Pipe.

Cap Nut; 23, Equalizing-Cylinder Cap; 24, Cylinder-Cap Bolt and Nut; 25, Cylinder-Cap Gasket; 26, Equalizing Piston; 27, Equalizing-Piston Packing Ring; 28, Graduating Valve; 29, Graduating-Valve Spring; 31, Equalizing Valve; 32, Equalizing-Valve Spring; 33, Lower Cap Nut; 34, Safety Valve; 35, Double-Chamber Reservoir; 36, Reservoir Stud and Nut; 37, Reservoir Drain Plug; 38, Distributing-Valve Drain Cock; 39, Application-Valve-Cover Gasket; 40, Application-Piston Cotter; 41, Distributing-Valve Gasket (not shown); 42, Oil Plug; 43, Safety-Valve Air Strainer; 44, Equanzing-Piston Graduating Sleeve; 45, Equalizing-Piston Graduating-Spring Nut; 46, Equalizing-Piston Graduating Spring.

To simplify the tracing of the ports and connections, the various positions of this valve are illustrated in nine diagrammatic views; that is, the valve is distorted to show the parts differently than actually constructed with the object of explaining the operation clearly instead of showing exactly how they are designed. The chambers of the reservoir are for convenience indicated at the bottom as a portion of the valve itself. In Fig. 5, equalizing piston 26, graduating valve 28, and equalizing slide valve 31, are shown as actually constructed. But as there are ports in the valves which cannot thus be clearly indicated, the diagrammatic illustrations show each slide valve considerably elongated so as to make all the ports appear in one plane, with similar treatment of the equalizing-valve seat. Fig. 6 shows the correct location of these ports.

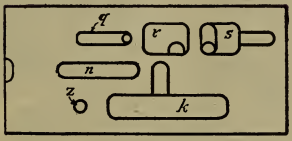
Referring to Fig. 7 it will be seen that main-reservoir pressure is always present in the chamber surrounding application valve 5 by its connection through passage *a*, *a*, to the main-reservoir pipe. Chamber *b* to the right of application piston 10 are always in free communication with the brake cylinders, through passage *c* and the brake-cylinder pipe. Application cylinder *g* at the left of application piston 10 is connected by passage *h* with the equalizing valve seat, and to the brake valves through the application-cylinder pipe.

AUTOMATIC OPERATION.

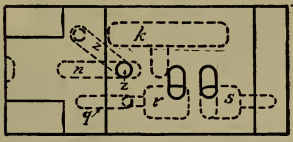
Charging. Referring to Fig. 7, which shows the movable parts of the valve in the release position, it will be seen that as chamber *p* is connected to the brake pipe, brake-pipe air flows through the feed groove *v* around the top of piston 26 into the chamber above equalizing valve 31, and through port *o* to the pressure chamber, until the pressures on both sides of the piston are equal.

Service. When a service application is made with the automatic brake valve, the brake-pipe pressure in chamber *p* is reduced, causing a difference in pressure on the two sides of this piston, which results in the piston moving toward the right. The first movement of the piston closes the feed groove, and at the same time moves the graduating valve until it uncovers the upper

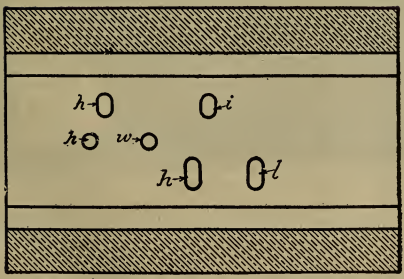
PLAN OF
GRADUATING VALVE.



FACE OF SLIDE VALVE.



PLAN OF SLIDE VALVE.



PLAN OF SLIDE VALVE SEAT.

FIG. 6. GRADUATING VALVE, EQUALIZING VALVE, AND EQUALIZING VALVE SEAT OF NO. 6 DISTRIBUTING VALVE.

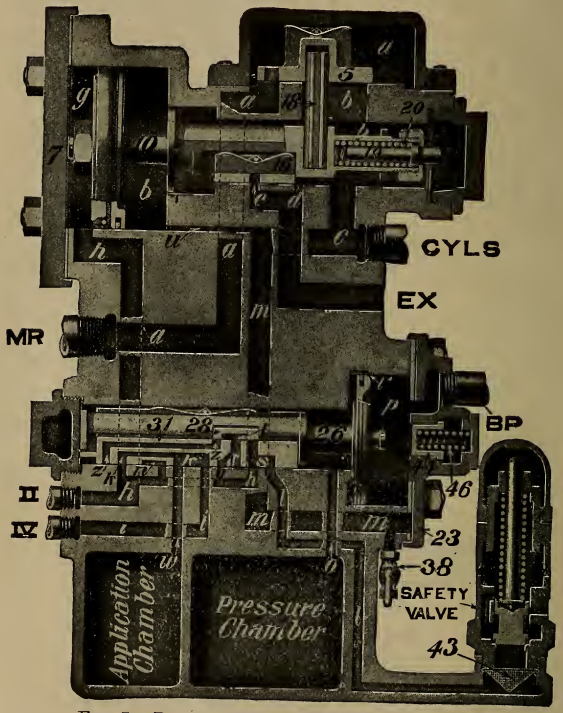
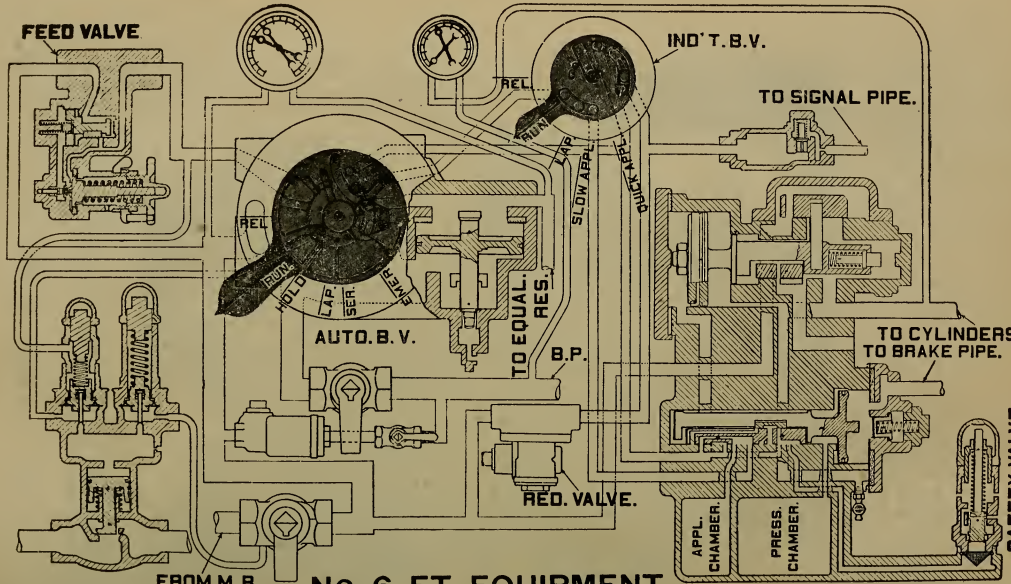


FIG. 7. RELEASE, AUTOMATIC OR INDEPENDENT.

Connections: MR—Main-Reservoir Pipe; IV—Distributing-Valve Release Pipe; II—Application-Cylinder Pipe; CYLS—Brake-Cylinder Pipe; BP—Brake Pipe.



No. 6 ET EQUIPMENT.

RUNNING POSITION WITH FEED VALVE
SUPPLYING BRAKE PIPE LEAKS

end of port *z* in the equalizing valve 31. As the piston continues its movement, the shoulder on the end of its stem engages the equalizing valve, which is then also moved to the right until the piston strikes equalizing-piston graduating sleeve 44, graduating spring 46 preventing further movement; port *z* in the equalizing valve then registers with port *h* in the seat, and cavity *n* in the equalizing valve connects ports *h* and *w* in the seat. As the equalizing-valve chamber is always in communication with the pressure chamber, air can now flow from the latter to both the application cylinder and application chamber. This pressure forces application piston 10 to the right, as shown in Fig. 8, causing exhaust valve 16 to close exhaust ports *e* and *d*, and to compress application-piston graduating spring 20; also causing application valve 5, by its connection with the piston stem through pin 18, to open its port and allow air from the main-reservoirs to flow into chambers *b*, *b* and through passage *c* to the brake cylinders.

During the movement just described, cavity *t* in the graduating valve connects ports *r* and *s* in the equalizing valve, and by the same movement ports *r* and *s* are brought into register with ports *h* and *l* in the seat, thus establishing a communication from the application cylinder to the safety-valve, which being set at 68 pounds, limits the brake-cylinder pressure to this amount, which is 3 pounds above the maximum obtained in emergency application from original 70 pounds.

The amount of pressure resulting in the application cylinder for a certain brake-pipe service reduction, depends on the comparative volumes of the pressure chamber, application cylinder and its chamber. These volumes are such that with 70 pounds in the pressure chamber and nothing in the application cylinder and chamber, if they are allowed to equalize, for an example, as with a 20-pound brake pipe reduction, they will show about 50 pounds.

Service Lap. When the brake-pipe reduction is not sufficient to cause a full service application, the conditions described above continue until the pressure in the pressure chamber is reduced enough below that in the brake pipe to cause piston 26 to force graduating valve 28 to the left until stopped by the shoulder on the piston stem striking the right-hand end of equalizing valve 31, the position indicated in Fig. 9, and shown as SERVICE LAP. In this position, graduating valve 28 has closed port *z* so that no more air can flow from the pressure chamber to the application cylinder and chamber. It also 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. The flow of air past application valve 5 to the brake cylinders continues until their pressure slightly exceeds that in the application cylinder when the higher pressure and application-piston graduating spring together force piston 10 to the left to the position shown in Fig. 9, thereby closing port *b*. Further movement is prevented by the

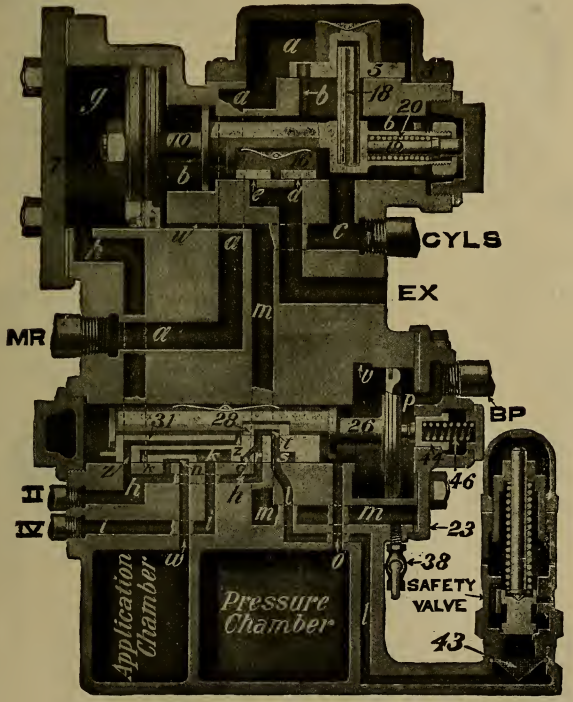
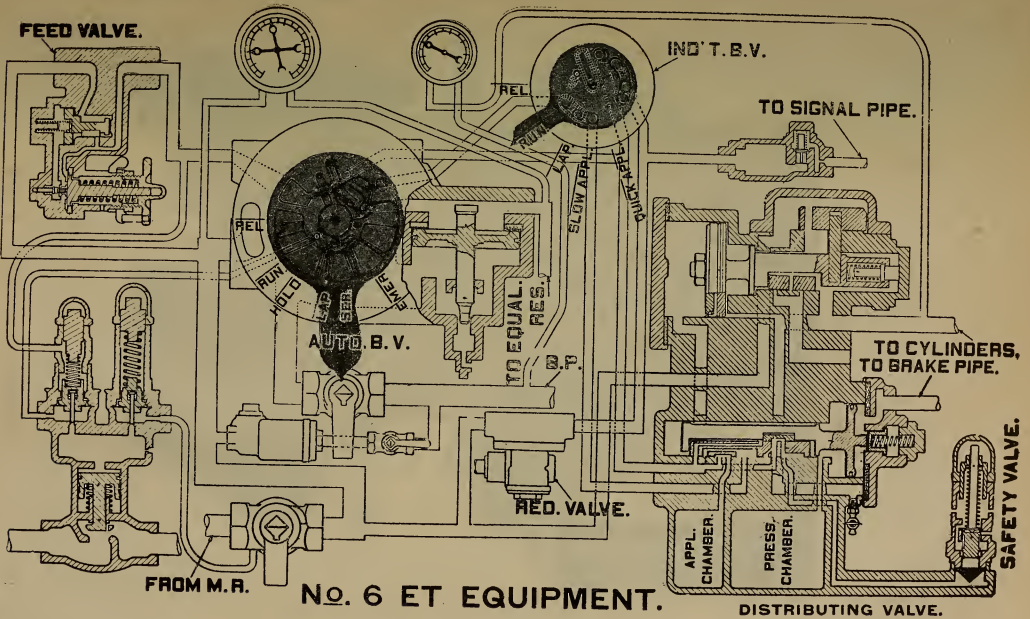


FIG. 8. AUTOMATIC SERVICE.



No. 6 ET EQUIPMENT.

AUTOMATIC SERVICE POSITION

resistance of exhaust valve 16, and the application-piston graduating spring having expanded to its normal position. The brake-cylinder pressure is then practically the same as that in the application cylinder and chamber.

From the above description it will be seen that application piston 10 has application-cylinder pressure on one side and brake-cylinder pressure on the other. When either pressure varies, the piston will move toward the lower. Consequently if that in chamber *b* is reduced, by brake-cylinder leakage, the pressure maintained in the application cylinder will force piston 10 to the right, opening application valve 5 and again admitting air from the main-reservoirs to the brake cylinders until the pressure in chamber *b* is again slightly above that in the application cylinder when the piston again moves back to lap position. In this way the brake-cylinder pressure is always maintained equal with that in the application cylinder. This is the *pressure-maintaining* feature.

Automatic Release. When the automatic brake valve is placed in release position, and the brake-pipe pressure in chamber *p* is thereby increased above that in the pressure chamber, equalizing piston 26 moves to the left, carrying with it equalizing valve 31 and graduating valve 28 to the position shown in Fig. 7. The feed grove *v* now being open permits the pressure in the pressure chamber to feed up until it is equal with that in the brake pipe as before described. This action does not release the locomotive brakes because it does not discharge application-cylinder pressure. The release pipe is closed by the rotary valve of the automatic brake valve, and the application-cylinder pipe is closed by the rotary valves of both brake valves. To release the locomotive brakes, the automatic brake valve must be moved to running position. The release pipe is then connected by the rotary valve to the atmosphere, and as exhaust cavity *k* in the equalizing valve 31 connects ports *i*, *w* and *h* in the valve seat, application-cylinder and chamber pressure will escape. As this pressure reduces, the brake-cylinder pressure will force application piston 10 to the left until exhaust valve 16 uncovers exhaust ports *d* and *e*, allowing brake-cylinder pressure to escape (See Fig. 7), or in case of graduated release, to reduce in like amount to the reduction in the application-cylinder pressure.

Emergency. When a sudden and heavy brake-pipe reduction is made, as in an emergency application, the air in the pressure chamber forces equalizing piston 26 to the right with sufficient force to compress equalizing-piston graduating spring 46, so that the piston moves until it strikes against the leather gasket beneath cap 23 as shown in Fig. 10. This movement causes equalizing valve 31 to uncover port *h* in the bush without opening port *w*, making a direct opening from the pressure chamber to the *application cylinder only*, so that they quickly become equal-

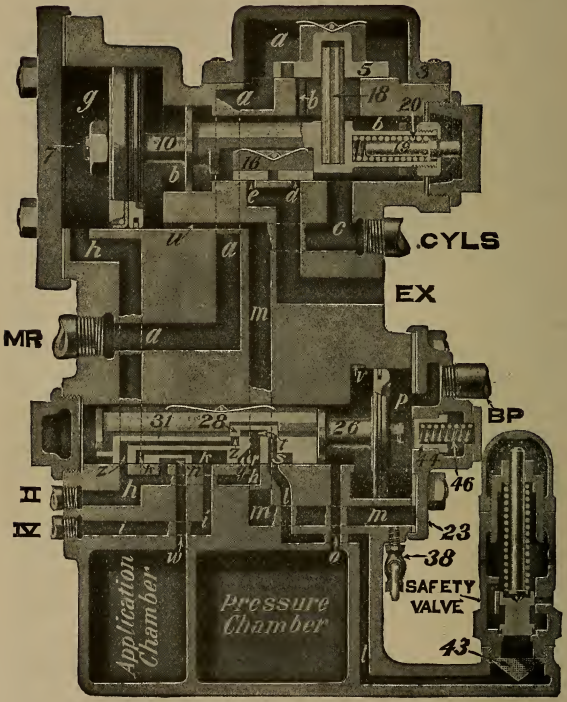
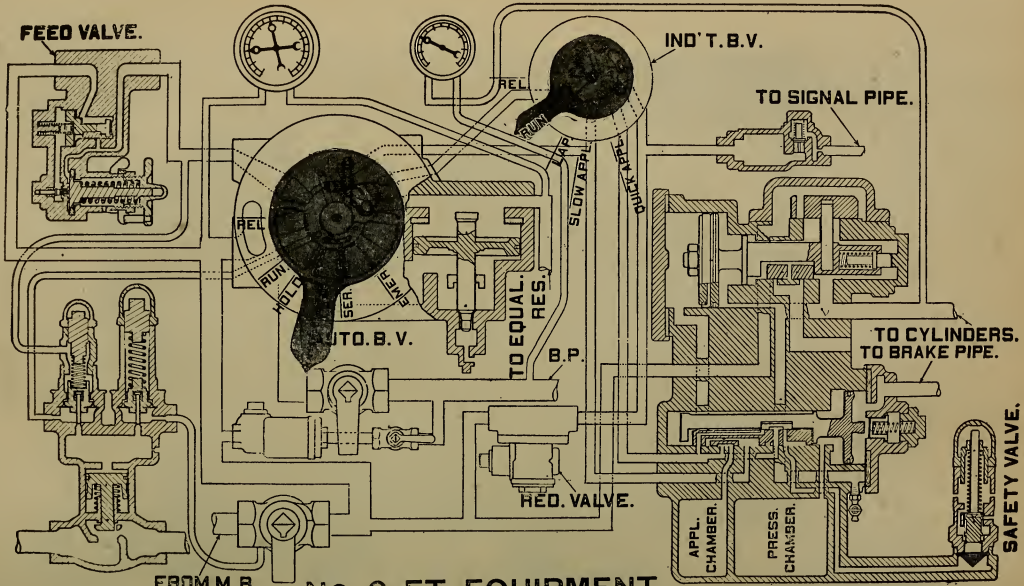


FIG. 9. SERVICE LAP.



AUTOMATIC SERVICE LAP POSITION

ized. This cylinder volume, being small, and connected with that of the pressure chamber at 70-pounds pressure, equalizes at about 65 pounds. Also in this position of the automatic brake valve, a small port in the rotary valve allows air from the main-reservoirs to feed into the application-cylinder pipe, and thus to the application cylinder. The application cylinder is now connected to the safety valve through port *h* in the seat, cavity *q* and port *r* in the equalizing valve, and port *z* in the seat. Cavity *q* and port *r* in the equalizing valve are connected by a small port, the size of which permits the air in the application cylinder to escape through the safety valve at the same rate that the air from the main-reservoirs, feeding through the rotary valve of the automatic brake valve, can supply it, preventing the pressure from rising above the adjustment of the safety valve.

In High-Speed Brake Service, the feed valve is regulated for 110-pounds brake-pipe pressure instead of 70, and main-reservoir pressure is 130 or 140 pounds. Under these conditions an emergency application raises the application-cylinder pressure to about 93 pounds, but the passage between cavity *q* and port *r* is so small that the flow of application-cylinder pressure to the safety valve is just enough greater than the supply through the brake valve, to decrease that pressure in practically the same time and manner as is done by the high-speed reducing valve, until it is approximately 75 pounds. The reason why the pressure in the application cylinder, pressure chamber and brake cylinders does not fall to 68 pounds, to which pressure the safety-valve is adjusted, is because the inflow of air through the brake valve with the high main-reservoir pressure used in high-speed service is equal, at 75 pounds, to the outflow through the small opening to the safety valve. This is done to get a shorter stop in emergency. The application portion of the distributing valve operates similarly, but more quickly than in service application.

Emergency Lap. The movable parts of the valve remain in the position shown in Fig. 10 until the brake-cylinder pressure slightly exceeds the application-cylinder pressure, when the application piston and application valve move back to the position known as *Emergency Lap* as shown in Fig. 11.

The release after an emergency is brought about by the same manipulation of the automatic brake valve as that following service application, but the effect on the distributing valve is somewhat different. When the equalizing piston, valve, and graduating valve are forced to the release position by the increased brake-pipe pressure in chamber *p*, the application chamber, with no pressure in, is connected to the application cylinder, with the emergency pressure in, through port *w*, cavity *k*, and port *h*. The pressure in the application cylinder at once expands into the application chamber until these pressures are equal, which results in the release of brake-cylinder pressure until it is slightly less than that in application cylinder and

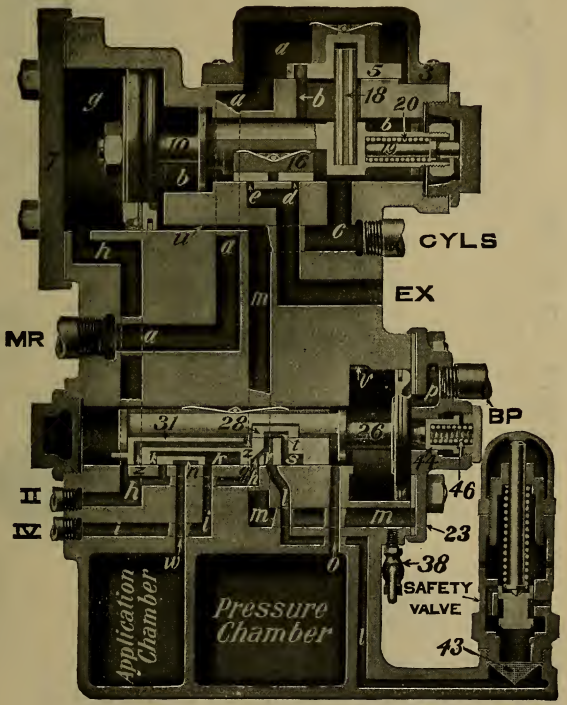
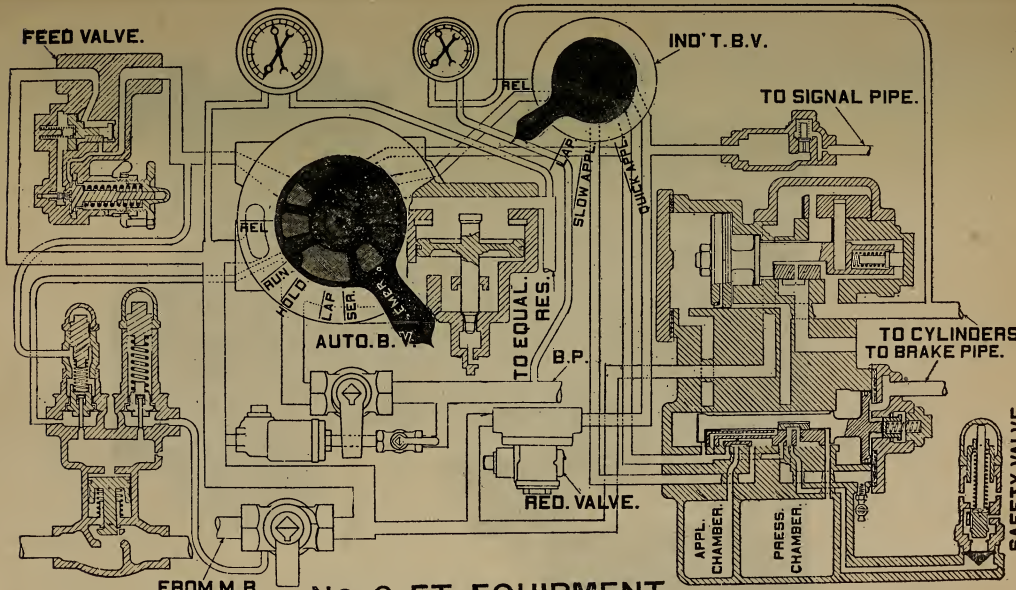


FIG. 10. EMERGENCY.



No. 6 ET EQUIPMENT.

EMERGENCY POSITION

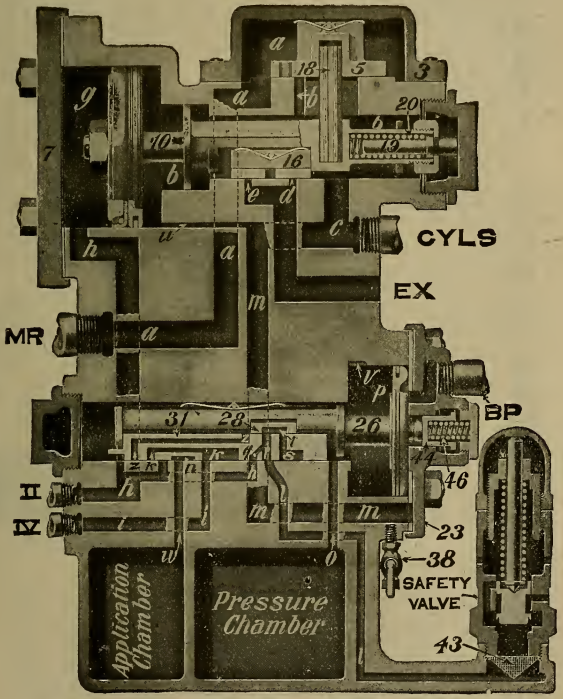
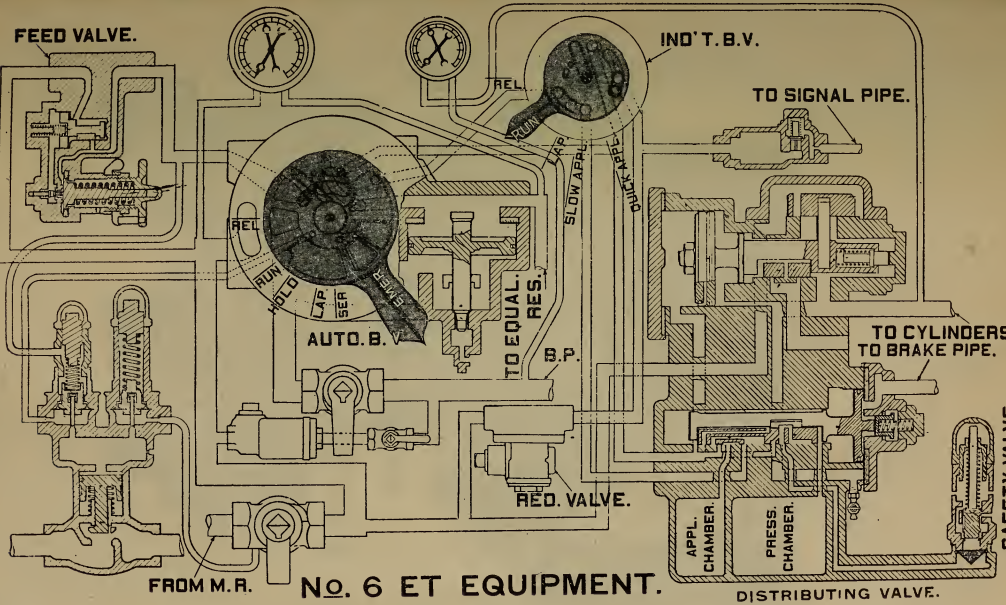


FIG. 11. EMERGENCY LAP.



EMERGENCY LAP POSITION

chamber. Consequently, in releasing after an emergency, the brake-cylinder pressure will *automatically* reduce to about 15 pounds, which will remain until the automatic-brake-valve handle is moved to running position.

If the brakes are applied by a conductor's valve, a burst hose, or parting of train, the movement of equalizing valve 31 breaks the connection between ports *h* and *i* through cavity *k*, so that the brakes will apply and remain applied until the brake-pipe pressure is restored. The handle of the automatic brake valve should be moved to lap position to prevent a loss of main-reservoir pressure.

INDEPENDENT BRAKE OPERATION.

Independent Application. When the handle of the Independent Brake Valve is moved to either application position, air from the main reservoir, limited by the reducing valve to a maximum of 45 pounds, is allowed to flow to the application cylinder, forcing application piston 10 to the right as shown in Fig. 12. This movement causes application valve 5 to open its port and allow air from the main-reservoirs to flow into chambers *b*, *b* and through passage *c* to the brake cylinders, as in an automatic application, until the pressure slightly exceeds that in the application-cylinder. The application-piston graduating spring and higher pressure then force application piston 10 to the left until application valve 5 closes its port. Further movement is prevented by the resistance of exhaust valve 16, and the application-piston graduating spring having expanded to its normal position. This position, shown in Fig. 13, is known as *Independent Lap.*

It will be seen that whatever pressure exists in the application cylinder will be maintained in the brake cylinders by the "pressure maintaining" feature already described under the heading "SERVICE LAP," and indicated in Fig. 9.

Independent Release. When the handle of the independent brake valve is moved to release position, a direct opening is made from the application cylinder to the atmosphere. As the application-cylinder pressure escapes, brake-cylinder pressure in chambers *b* moves application piston 10 to the left, causing exhaust valve 16 to open exhaust ports *e* and *d* as shown in Fig. 7, thereby allowing brake-cylinder pressure to discharge to the atmosphere.

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

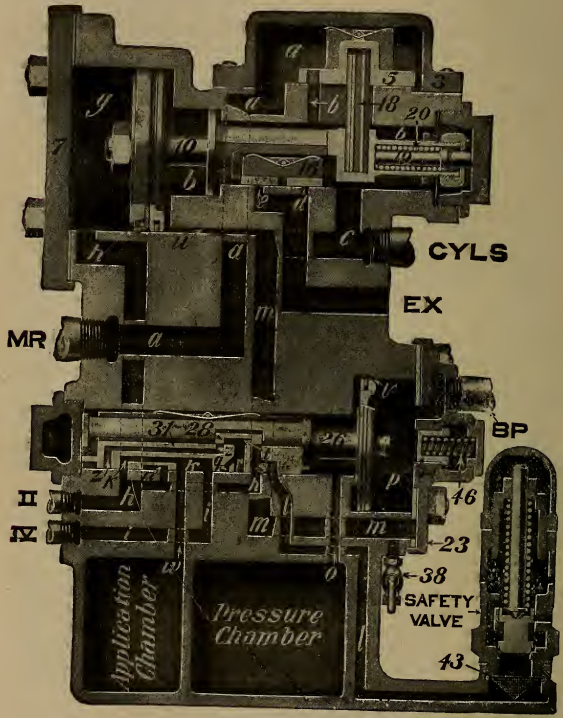
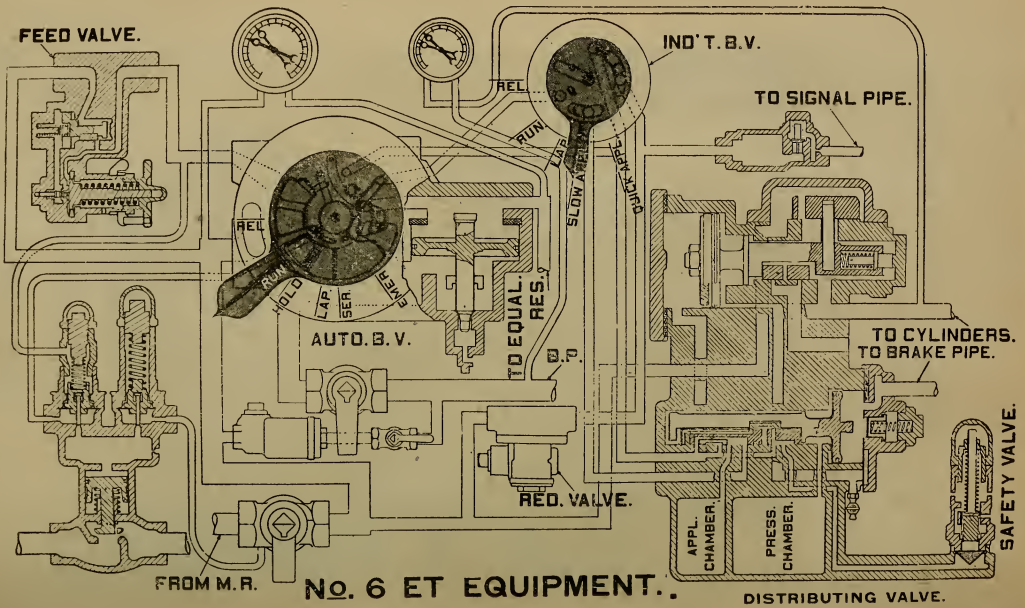


FIG. 12. INDEPENDENT APPLICATION.



INDEPENDENT APPLICATION POSITION SLOW

This equipment has all the flexibility and ease of manipulation possessed by the combined automatic and straight air equipment, with much less apparatus and complication, besides the other important features of pressure maintaining, equal pressures in all brake cylinders, and the fact that it is *always* possible to release the locomotive brakes with the independent-brake valve, even when automatically applied. In connection with this last mentioned feature, Fig. 14 shows the position the distributing-valve parts will assume, if the locomotive brakes are released by the independent brake valve after an automatic application has been made. This results in the application portion going to release position without changing the conditions in either the pressure-chamber or brake pipe; consequently, the equalizing portion does not move until release is made by the automatic brake valve.

An independent release of locomotive brakes may also be made in the same manner, after an emergency application by the automatic brake valve. However, owing to the fact that, in this position, the automatic brake valve will be supplying the application cylinder through the maintaining port in the rotary valve, the handle of the independent brake valve must be *held* in release position to prevent the locomotive brakes from reapplying, so long as the handle of the automatic brake valve remains in emergency position. The equalizing portion of the distributing valve will remain in the position shown in Figs. 10 and 11, while the application portion will assume the position shown in Fig. 14.

Double Heading. When there are two or more locomotives in a train, the handles of both brake valves on each locomotive except the one from which the brakes are being operated, should be carried in *running* position. The release pipe is then open to the atmosphere at the automatic brake valve, and the operation of the distributing valve is the same as that described during automatic-brake applications. In double heading, therefore, the application and the release of the distributing valve on each helper locomotive is similar to that of the triple valves on the train. But in case an engineer on a helper finds it necessary to apply or to release his brakes independently of the train, he can do so by using the independent brake valve, without moving the handle of the automatic valve.

Port *u* drains the application cylinder of any moisture precipitated from the air in chambers *b;* such moisture passes to the lower part of the distributing valve through port *m*, where it may be drawn off by drain cock 38.

To remove piston 10 and slide valve 16, it is absolutely necessary to *first* remove cover 3, application valve 5 and valve pin 18.

THE QUICK-ACTION CYLINDER CAP.

The equalizing portion of the distributing valve, as already

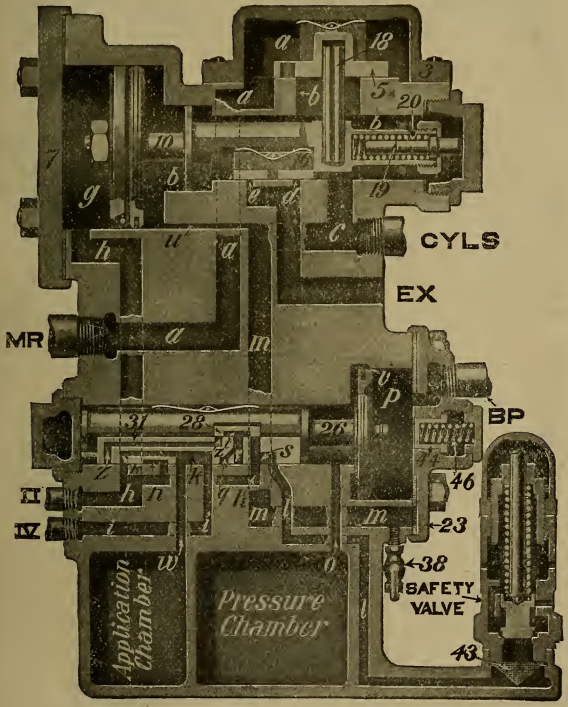
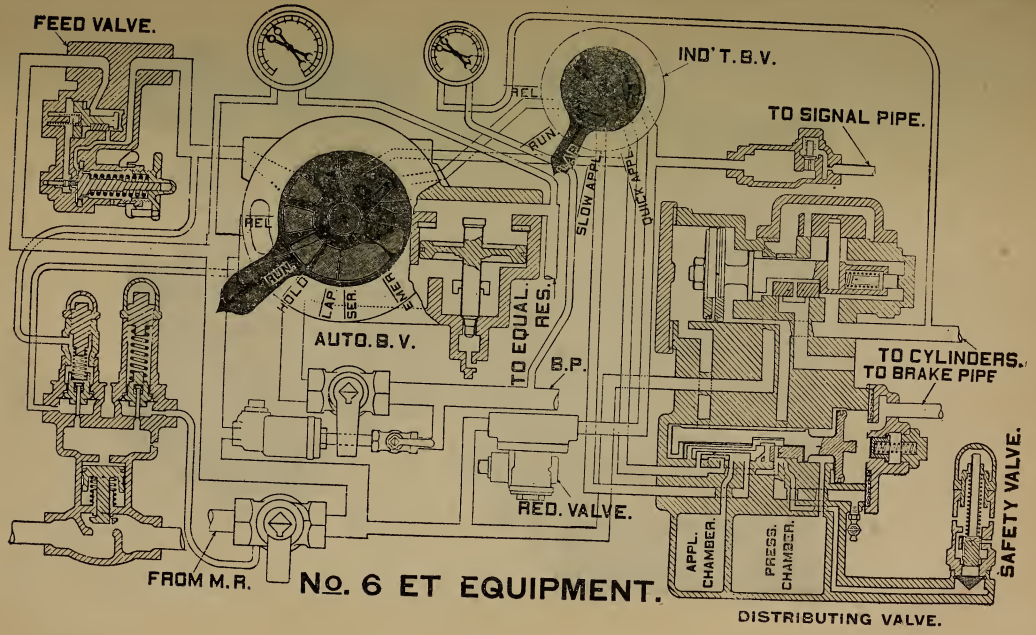


FIG. 13. INDEPENDENT LAP.



INDEPENDENT LAP POSITION

described, corresponds to the plain triple valve of the old standard locomotive brake equipments. There are, however, conditions under which it is advisable to have it correspond to a quick-action triple; that is,—vent brake-pipe air into the brake cylinders in an emergency application. To obtain this, the cylinder cap 23, Fig. 5, is replaced by the "Quick-Action Cylinder Cap," illustrated in Fig. 15.

In an emergency application, as equalizing piston 26 moves to the right and seals against the gasket (Fig. 16) the knob on the piston strikes the graduating stem 50, causing it to compress equalizing-piston graduating spring 55, and move slide valve 48 to the right, opening port *j*. Brake-pipe pressure in chamber *p* flows to chamber X, pushes down check valve 53, and passes to the brake cylinders through port *m* in the cap and distributing-valve body. When the brake cylinders and brake pipe equalize, check valve 53 is forced to its seat by spring 54, thus preventing air in the brake-cylinders from flowing back into the brake pipe. When a release of the brakes occurs and piston 26 is moved back to its normal position (Fig. 7), spring 55 forces graduating stem 50 and slide-valve 48 back to the position shown in Fig. 15.

In all other respects, the operation of a distributing valve having this cap is exactly as described before.

E-6 SAFETY VALVE.

Fig. 17 is a sectional view of the safety valve which is an essential part of the distributing valve. It is unlike the ordinary safety valve, as its construction is such as to cause it to close quickly with a "pop" action, insuring its seating firmly. It is sensitive in operation and responds to slight differences of pressure.

The names of the parts are 2, Body; 3, Cap Nut; 4, Valve; 5, Valve Stem; 6, Adjusting Spring; 7, Adjusting Nut.

Valve 4 is held to its seat by the compression of spring 6 between the stem and adjusting nut 7. When the pressure below valve 4 is greater than the force exerted by the spring, it rises, and as a larger area is then exposed, its movement upward is very quick, being guided by the brass bush in the body 2. Two ports are drilled in this bush upward to the spring chamber; and two outward through the body to the atmosphere, although only one of each of these is shown in the cut. As the valve moves upward, its lift is determined by the stem 5 striking cap nut 3. It closes the two vertical ports in the bush connecting the valve and spring chambers, and opens the lower ports to the atmosphere. As the air pressure below valve 4 decreases, and the compression of the spring forces the stem and valve downward, the valve restricts the lower ports to the atmosphere and opens those between the valve and spring chambers. The discharge air pressure then has access to the spring chamber. This chamber is

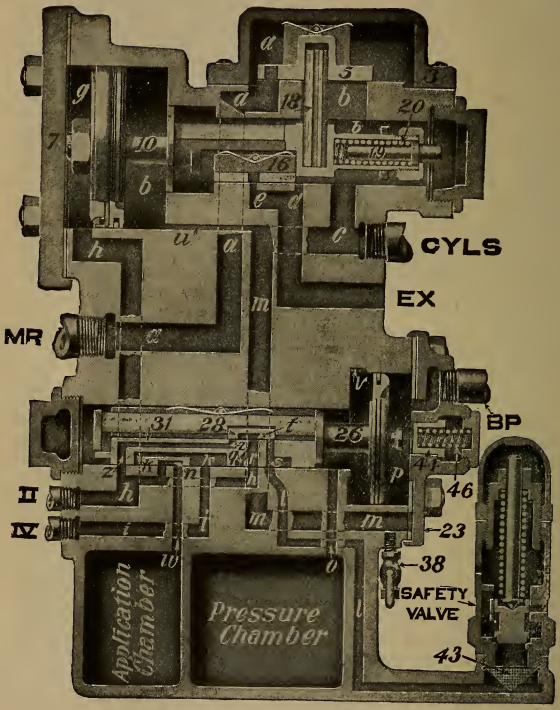
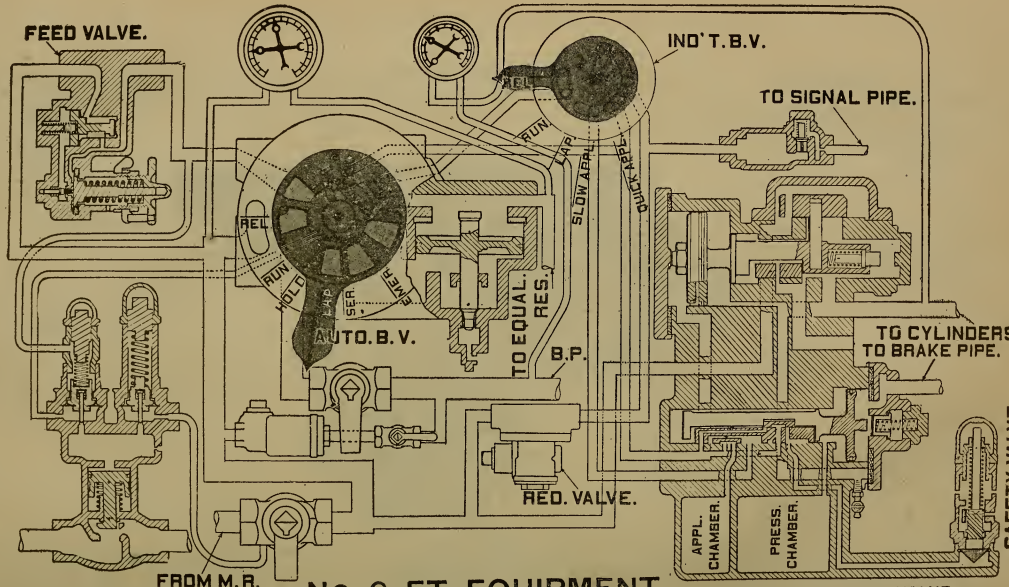


FIG. 14. RELEASE POSITION.
When Locomotive Brake is released by Independent Brake Valve After an Automatic Application.



No. 6 ET EQUIPMENT.

INDEPENDENT RELEASE AFTER AUTOMATIC SERVICE APPLICATION

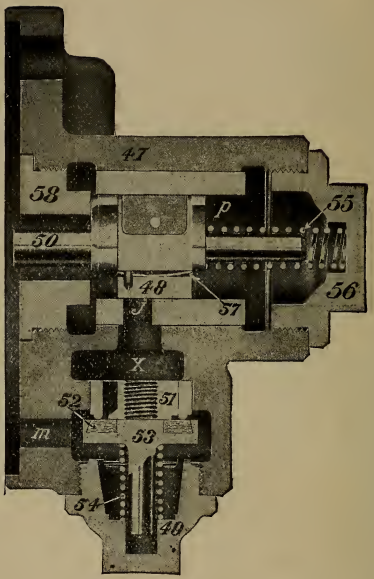
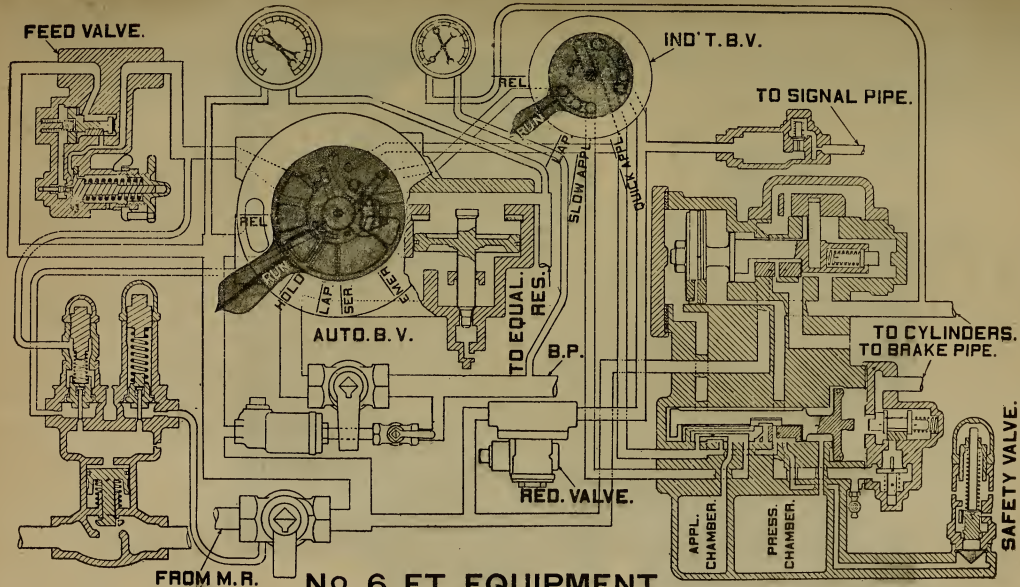


FIG. 15. THE QUICK-ACTION CYLINDER CAP FOR NO. 6 DISTRIBUTING VALVE.



No. 6 ET EQUIPMENT.

RELEASE POSITION QUICK ACTION CAP

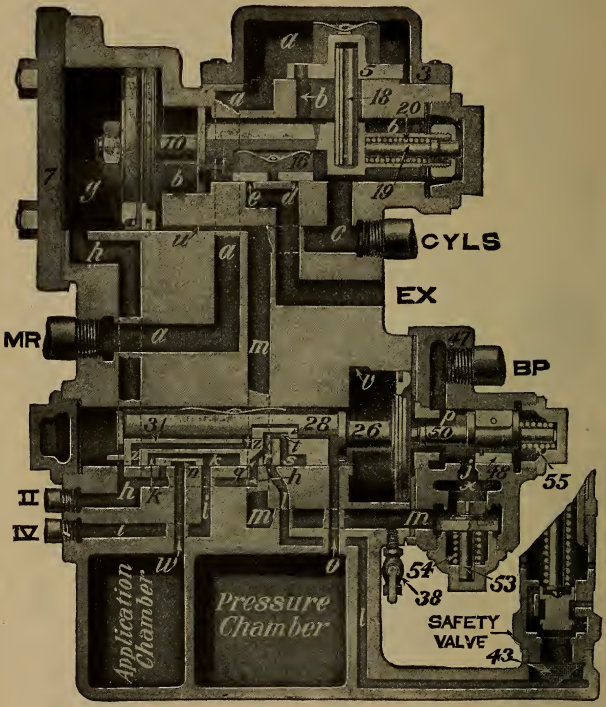


FIG. 16. EMERGENCY POSITION OF NO. 6 DISTRIBUTING VALVE WITH QUICK-ACTION CAP.

No. 6 ET EQUIPMENT.

EMERGENCY POSITION QUICK ACTION CAP

always connected to the atmosphere by two small holes through the body, 2; the air from the valve chamber enters more rapidly than it can escape through these holes, causing pressure to accumulate above the valve and assist the spring to close it with the "pop" action before mentioned.

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

This safety valve should be adjusted for 68 pounds. The safety valve, as are all adjustable devices, is more easily and accurately adjusted when done on a shop testing rack.

THE H-6 AUTOMATIC BRAKE VALVE.

This Brake Valve, although modelled to a considerable extent upon the principles of previous valves, is necessarily different in detail, since it not only performs all the functions of such types but also those absolutely necessary to obtain all the desirable operating features of the No. 6 Distributing Valve.

Fig. 18 is taken from a photograph of this brake valve, while Fig. 19 shows two views, the upper one being a plain view with section through the rotary-valve chamber, the rotary valve being removed; the lower one a vertical section. In these views the pipe connections are indicated.

Fig. 20 shows two views of this valve similar to those of Fig. 19, with the addition of a plan or top view of the rotary valve. The six positions of the brake-valve handle are, beginning at the extreme left, Release, Running, Holding, Lap, Service, and Emergency. The names of the parts are as follows: 2, Bottom Case; 3, Rotary-Valve Seat; 4, Top Case; 5, Pipe Bracket; 6, Rotary Valve; 7, Rotary-Valve Key; 8, Key Washer; 9, Handle; 10, Handle-Latch Spring; 11, Handle Latch; 12, Handle-Latch Screw; 13, Handle Nut; 14, Handle Lock Nut; 15, Equalizing Piston; 16, Equalizing-Piston Packing Ring; 17, Valve-Seat Upper Gasket; 18, Valve-Seat Lower Gasket; 19, Pipe-Bracket Gasket; 20, Small Union Nut; 21, Brake-Valve Tee; 22, Small Union Swivel; 23, Large Union Nut; 24, Large Union Swivel; 25, Bracket Stud; 26, Bracket-Stud Nut; 27, Bolt and Nut; 28, Cap Screw; 29, Oil Plug; 30, Rotary-Valve Spring; 31, Service-Exhaust Fitting.

Referring to the rotary valve, *a*, *j* and *s* are ports extending directly through it, the latter connecting with a groove in the face; *f* and *k* are cavities in the valve face; *o* is the exhaust cavity; *x* is a port in the face of the valve connecting by a cored passage with *o*; *h* is a port extending from the face over cavity *k*

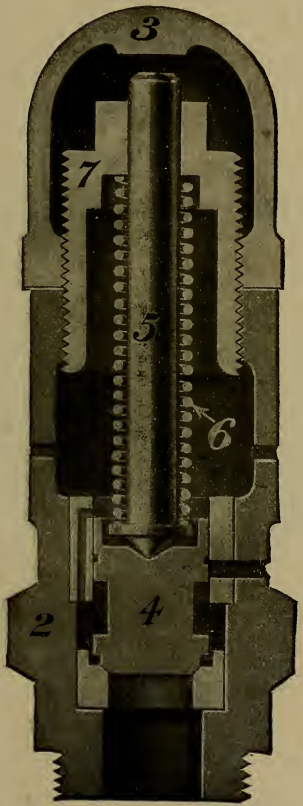


FIG. 17. E-6 SAFETY VALVE.

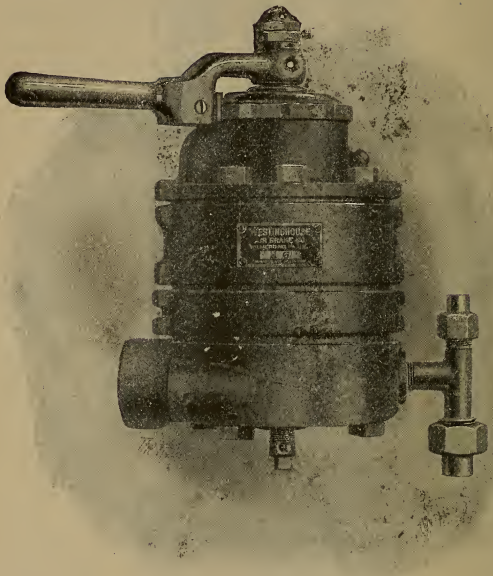


FIG. 18. H-6 AUTOMATIC BRAKE VALVE.

and connecting with exhaust cavity *o*; *n* is a groove in the face having a small port which connects through a cavity in the valve with cavity *k*. Referring to the ports in the rotary-valve seat, *d* leads to the feed-valve pipe; *b* and *c* lead to the brake pipe; *g* leads to chamber D; EX is the exhaust opening leading out at the back of the valve; *e* is the preliminary exhaust port leading to chamber D; *r* is the warning port leading to the exhaust; *p* is the port leading to the pump governor; *l* leads to the distributing-valve release pipe; *u* leads to the application-cylinder pipe.

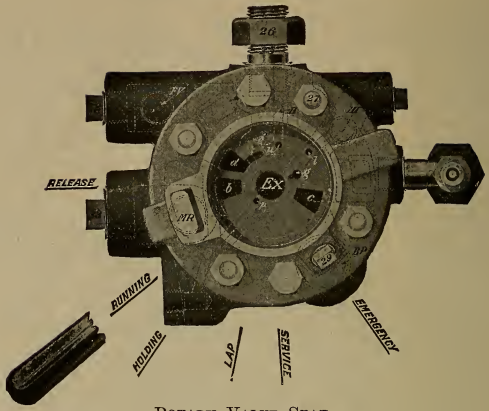
In describing the operation of the brake valve, it will be more readily understood if the positions are taken up in the order in which they are most generally used, rather than their regular order as mentioned previously.

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

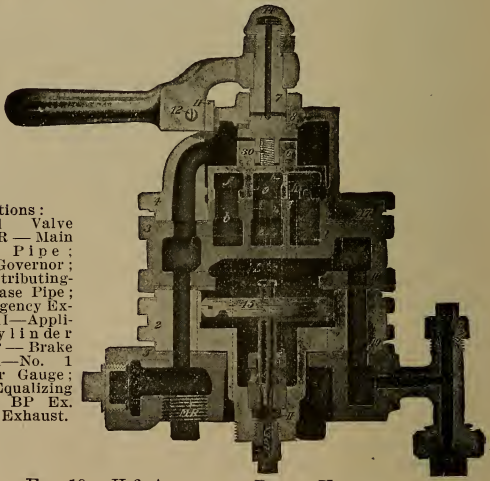
Air at main-reservoir pressure flows through port *a* in the rotary valve and port *b* in the valve seat to the brake pipe. At the same time, port *j* in the rotary valve registers with equalizing port *g* in the valve seat, permitting main-reservoir pressure to enter chamber D above the equalizing piston.

If the handle were allowed to remain in this position, the brake system would be charged to main-reservoir pressure. To avoid this, the handle must be moved to Running or Holding position. To prevent the engineer from forgetting this, a small port discharges feed-valve pipe air to the atmosphere in release position. Cavity *f* in the rotary valve connects port *d* with warning port *r* in the seat and allows a small quantity of air to escape into the exhaust cavity EX, which makes sufficient noise to attract the engineer's attention to the position in which the valve handle is standing. The small groove in the face of the rotary valve which connects with port *s*, extends to port *p* in the valve seat, allowing main-reservoir pressure to flow to the excess-pressure head of the pump governor.

Running Position. This is the proper position of the handle (a) when the brakes are charged and ready for use; (b) when the brakes are not being operated, and (c) to release the locomotive brakes. In this position, cavity *f* in the rotary valve connects ports *b* and *d* in the valve seat, affording a large direct passage from the feed-valve pipe to the brake pipe, so that the latter will charge up as rapidly as the feed valve can supply the air, but cannot attain a pressure above that for which the feed valve is adjusted. Cavity *k* in the rotary valve connects ports *c* and *g* in the valve seat, so that chamber D and the equalizing reservoir charge uniformly with the brake pipe, keeping the pressure on the two sides of the equalizing piston equal. Port *s* in the rotary valve



ROTARY VALVE SEAT.



Connections: FV — Feed Valve Pipe; MR — Main Reservoir Pipe; GO—To Governor; III — Distributing-Valve Release Pipe; EX—Emergency Exhaust; II—Application cylinder Pipe; BP — Brake Pipe; GA—No. 1 Duplex Air Gauge; ER — Equalizing Reservoir; BP Ex. —Service Exhaust.

FIG. 19. H-6 AUTOMATIC BRAKE VALVE.

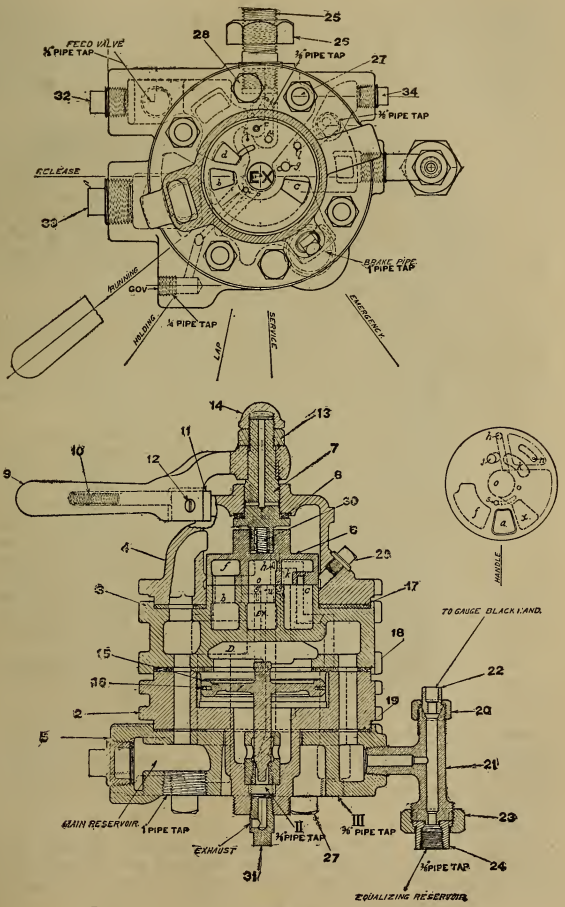


FIG. 20. THE H-6 AUTOMATIC BRAKE VALVE.

registers with port *p* in the valve seat, permitting main-reservoir pressure, which is present at all times above the rotary valve, to pass to the excess-pressure head of the pump governor. Port *h* in the rotary valve registers with port *l* in the seat, connecting the distributing-valve-release pipe through the exhaust cavity EX with the atmosphere.

If the brake valve is in running position when uncharged cars are cut in, or if, after a heavy brake application and release, the handle of the automatic brake valve is returned to running position too soon, the governor will stop the pump until the difference between the hands on gauge No. 1 is less than 20 pounds. The pump stopping from this cause, calls the engineer's attention to the seriously wrong operation on his part, as running position results in delay in charging, and is liable to cause some brakes to stick. Release position should be used until all brakes are released and nearly charged.

Service Position. This position gives a gradual reduction of brake-pipe pressure to cause a service application. Port *h* in the rotary valve registers with port *e* in the valve seat, allowing air from Chamber D and the equalizing reservoir to escape to the atmosphere through cavities *o* in the rotary valve and EX in the valve seat. Port *e* is restricted so as to make the pressure in the equalizing reservoir and chamber D fall gradually.

As all other ports are closed, the fall of pressure in chamber D allows the brake-pipe pressure under the equalizing piston to raise it, and unseat its valve, allowing brake-pipe air to flow to the atmosphere gradually through the opening marked BP Ex. When the pressure in chamber D is reduced the desired amount, the handle is moved to *lap position*, thus stopping any further reduction in that chamber. Air will continue to discharge from the brake-pipe until its pressure has fallen to an amount a trifle less than that retained in chamber D, permitting the pressure in this chamber to force the piston downward gradually and stop the discharge of brake-pipe air. It will be seen, therefore, that the amount of reduction in the equalizing reservoir determines that in the brake pipe, regardless of the length of the train.

The gradual reduction of brake-pipe pressure is to prevent quick action, and the gradual stopping of this discharge is to prevent the premature release of head brakes.

Lap Position. This position is used (a), 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; and (b) to prevent loss of main-reservoir pressure in the event of a burst hose, a break-in-two, or the opening of the conductor's valve. All ports are closed.

Release Position. This position, which is used for releasing the train brakes after an application, without releasing the locomotive brakes, is described under *Charging and Release.* The air flowing from the main-reservoir-pipe connection through

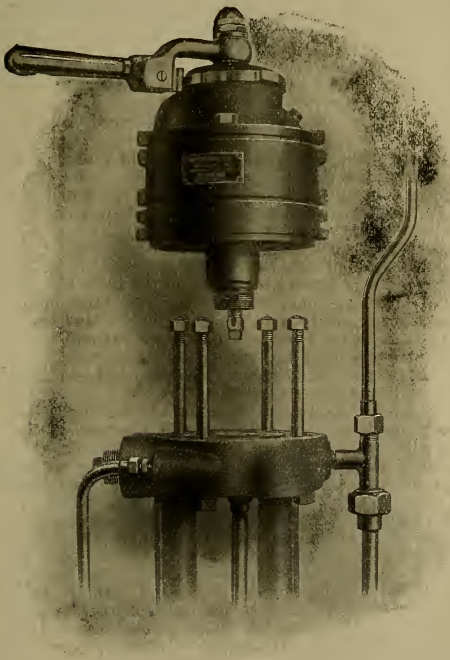


FIG. 21. H-6 AUTOMATIC BRAKE VALVE REMOVED FROM ITS PIPE BRACKET.

port *a* in the rotary valve and port *b* in the valve seat to the brake pipe, raises the pressure in the latter, thereby causing the triple valves and equalizing portion of the distributing valve to go to release position, which releases the train brakes and recharges the auxiliary reservoirs and the pressure chamber in the distributing valve. When the brake-pipe pressure has been increased sufficiently to cause this, the handle of the brake valve should be moved to either *Running* or *Holding* position; the former when it is desired to release locomotive brakes, and the latter when they are to be still held applied.

Holding Position. This position is so named because the locomotive brakes are held applied while the train brakes recharge to feed-valve pressure. All ports register as in running position, except port *l*, which is closed.

Therefore, the only difference between *Running* and *Holding* Positions is that in the former the locomotive brakes are released, while in the latter they are held applied.

Emergency Position. This position is used when the most prompt and heavy application of the brakes is required. Port *x* in the rotary valve registers with port *c* in the valve seat, making a large and direct communication between the brake pipe and atmosphere through cavity *o* in the rotary valve and EX in the valve seat. This direct passage makes a sudden and heavy discharge of brake-pipe pressure, causing the triple valves and distributing valve to go to the emergency position and give maximum braking power in the shortest possible time.

In this position main-reservoir air flows to the application cylinder through port *j*, which registers with a groove in the seat connecting with cavity *k*; thence through ports *n* in the valve and *u* in the seat to the application-cylinder pipe, thereby maintaining application-cylinder pressure as already described and shown in Fig. 10.

The oil plug 29 is placed in the top case 4, at a point to fix the level of an oil bath in which the rotary valve operates. The position of this oil hole is such that it is impossible to pour oil into the valves in excess of the amount required. This arrangement furnishes thorough lubrication. Valve oil should be used. Leather washer 8 prevents air in the rotary-valve chamber from leaking past the rotary-valve key to the atmosphere. Spring 30 keeps the rotary valve key firmly pressed against washer 8 when no main-reservoir pressure is present. The handle 9 contains latch 11, which fits into notches in the quadrant of the top case, so located as to indicate the different positions of the brake-valve handle. Handle-latch spring 10 forces the latch against the quadrant with sufficient pressure to indicate each position.

To remove the brake valve, close the cocks, as previously explained, and take off nuts 27. (See Fig. 21.) To take the valve proper apart, remove cap screws 28.

The brake valve should be located so that the engineer can

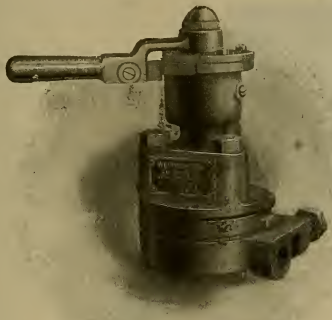


FIG. 22. VALVE, COMPLETE.

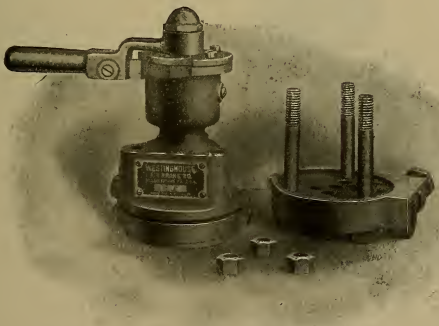


FIG. 23. REMOVED FROM PIPE BRACKET.

S-6 INDEPENDENT BRAKE VALVE.

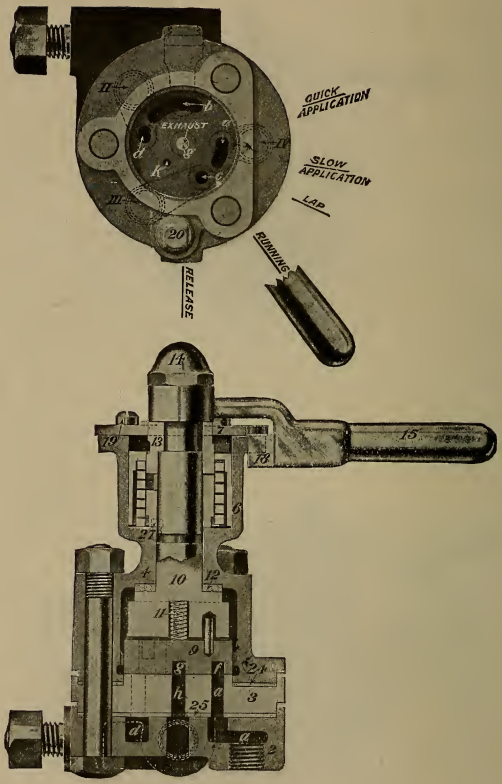


FIG. 24. THE S-6 INDEPENDENT BRAKE VALVE.

Connections: RV—Reducing Valve Pipe; EX—Exhaust; IV—Distributing-Valve Release Pipe to the Distributing Valve; III—Distributing-Valve Release Pipe to the Automatic Brake Valve; II—Application-Clyinder Pipe.

operate it conveniently from his usual position, while looking forward or back out of the side cab window.

THE S-6 INDEPENDENT BRAKE VALVE.

Fig. 22 and 23 illustrate this valve, which is of the rotary type. Fig. 24 shows a vertical section through the center of the valve, and a horizontal section through the valve body, with the rotary valve removed, showing the rotary valve seat. Fig. 25 shows this valve similarly to Fig. 24, with the addition of a top view of the rotary valve. In these views the pipe connections and positions of the handle are indicated. Referring to Fig. 25, the names of parts are as follows:

2, Pipe Bracket; 3, Rotary-Valve Seat; 4, Valve Body; 5, Return-Spring Casing; 6, Return Spring; 7, Cover; 8, Casing Screw; 9, Rotary Valve; 10, Rotary-Valve Key; 11, Rotary-Valve Spring; 12, Key Washer; 13, Upper Clutch; 14, Handle Nut; 15, Handle; 16, Latch Spring; 17, Latch Screw; 18, Latch; 19, Cover Screw; 20, Oil Plug; 21, Bolt and Nut; 22, Bracket Stud; 23, Bracket-Stud Nut; 24, Upper Gasket; 25, Lower Gasket; 26, Lower Clutch; 27, Return-Spring Stop; 28, Cap Screw.

Port *b* in the seat leads to the Reducing-Valve pipe. Port *a* leads to that portion of the Distributing-Valve Release Pipe which connects to the distributing valve at IV (Fig. 7). Port *c* leads to the other portion of the release pipe which connects to the automatic-brake valve at III (Fig. 19). Port *d* leads to the application-cylinder pipe which connects to the distributing valve at II (Fig. 7). Port *h*, in the center, is the exhaust port leading directly down to the atmosphere. Port *k* is the warning port, connecting with the atmosphere. Exhaust cavity *g* in the rotary valve is always in communication at one end with exhaust port *h*. Groove *e* in the face of the valve communicates at one end with a port through the valve. This groove is always in communication with a groove in the seat connecting with supply port *b*, and through the opening just mentioned air is admitted to the chamber above the rotary valve, thus keeping it to its seat. Port *m* connects by a small hole with groove *e*; *f* is a groove in the face of the rotary valve; *l* consists of ports in top and face of valve connected by a passage.

Running Position. This is the position that the independent brake valve should be carried in at all times when the independent brake is not in use. Groove *f* in the rotary valve connects ports *a* and *c* in the valve seat, thus establishing communication between the application cylinder of the distributing valve and port *l* of the automatic brake valve (Fig. 19), so that the distributing valve can be released by the latter. It will also be noted that if the automatic brake valve is in running position, and the independent brakes are being operated, they can be released by simply returning the independent valve to running position, as the

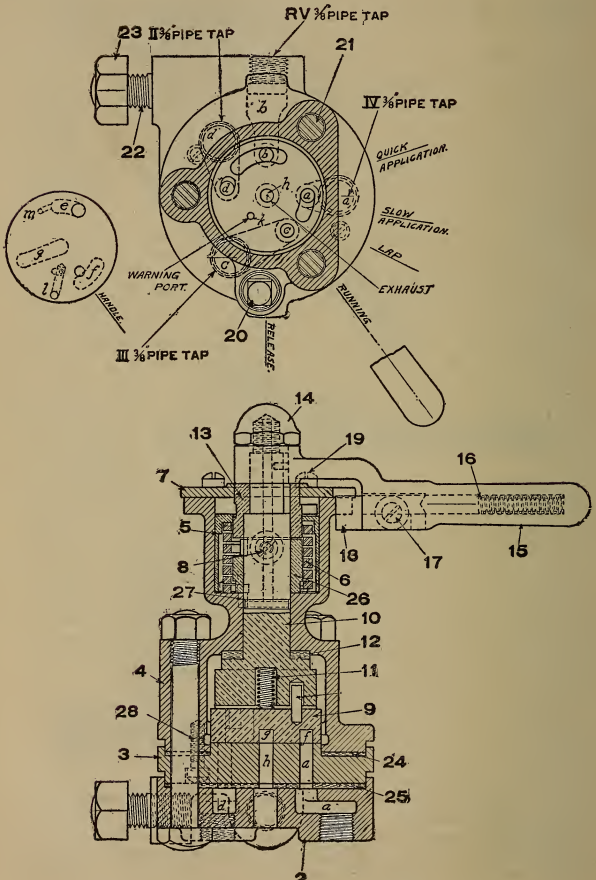


FIG. 25. THE S-6 INDEPENDENT BRAKE VALVE.

application-cylinder pressure can then escape through the release pipe and automatic brake valve.

SLOW-APPLICATION POSITION. To apply the independent brake lightly or gradually, move the brake-valve handle to the slow-application position; port *m* registers with port *d*, allowing air to flow from the reducing-valve pipe through port and groove *b* in the seat, groove *e* in the rotary valve, and the comparatively small port *m* to port *d*; thence through the application-cylinder pipe to the application cylinder of the distributing valve.

Quick-Application Position. To obtain a quick application of the independent brake, move the brake-valve handle to quick-application position; groove *e* then connects ports *b* and *d* directly, making a larger opening between them than in the slow-application position, allowing supply air to flow rapidly from the reducing-valve pipe to the application cylinder of the distributing valve.

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

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

Release Position. This position is used to release the pressure from the application cylinder when the automatic brake valve is not in running position. At such time the offset in cavity *g* registers with port *d*, allowing pressure in the application cylinder to flow through the application-cylinder pipe, ports *d*, *g* and *h* to the atmosphere.

The purpose of return spring 9 is to automatically move the handle 15 from the release to the running position, or from the quick-application to the slow-application position, as soon as the engineer lets go of it. The automatic return from release to running position is to prevent leaving the handle in the former, and thereby make it impossible to operate the locomotive brake with the automatic brake valve. The action of the spring between quick-application and slow-application positions serves to accentuate the latter, so that in rapid operation of the valve, the engineer is less likely to unintentionally pass over it to the quick-application position, thereby obtaining a heavy application of the locomotive brake when only a light one was desired. As a warning to the engineer in case of a broken return spring, port *l* in the face of the rotary registers in release position with port *k* in the seat, allowing air to escape to the atmosphere.

The purpose of the oil plug 20 is the same as that described in the automatic brake valve.

The location of this valve should be governed by the same considerations as those mentioned concerning the automatic brake valve.

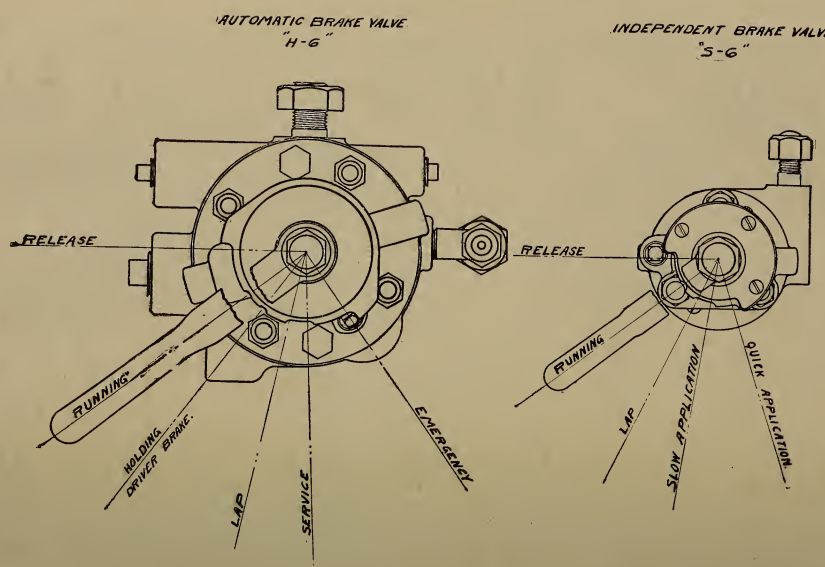


FIG. 26. POSITIONS OF BRAKE-VALVE HANDLES.

Fig. 26 gives a top view of both brake valves, showing the position of their handles.

THE B-6 FEED VALVE.

The B-6 feed valve (Figs. 27 and 28), furnished with the No. 6 equipment, is an improved form of the slide-valve type. It differs from previous ones in charging to the regulated pressure somewhat quicker, and in maintaining the pressure more accurately under the variable conditions of short and long trains, and of good and poor maintenance. Also, it gives high and low brake-pipe pressure control. It is supplied with air directly from the main reservoir. It regulates the pressure in the feed-valve pipe, and also the brake pipe in running and holding positions of the automatic brake valve as the latter then connects these two pipes. It is connected to a pipe bracket located in the piping between the main reservoir and the automatic brake valve, and is interchangeable with previous types.

Figs. 29 and 30 are diagrammatic views of the valve and pipe bracket having the ports and operating parts in one plane to facilitate description. The names of the parts shown in the diagram are as follows: 2, Valve Body; 3, Pipe Bracket; 5, Cap Nut; 6, Piston Spring; 7, Piston Spring Tip; 8, Supply-Valve Piston; 9, Supply Valve; 10, Supply-Valve Spring; 11, Regulating-Valve Cap; 12, Regulating Valve; 13, Regulating-Valve Spring; 14, Diaphragm; 15, Diaphragm Ring; 16, Diaphragm Spindle; 17, Regulating Spring; 18, Spring Box; 19, Upper Stop; 20, Lower Stop; 21, Stop Screw; 22, Adjusting Handle.

This feed valve consists of two sets of parts, the supply and regulating. The supply parts, which control the flow of air through the valve, consist of the supply valve 9 and its spring 10; the supply-valve piston 8 and its spring 6. The regulating parts consist of the regulating valve 12, regulating-valve spring 13, diaphragm 14, diaphragm spindle 16, regulating spring 17, and regulating handle 22.

Main-reservoir air enters through port *a*, *a* to the supply-valve chamber B, forces supply-valve piston 8 to the left, compresses piston spring 6 and causes the port in supply valve 9 to register with port *c* (See Fig. 30). This permits air to pass through ports *c* and *d* to the feed-valve pipe at FVP, and through port *e* to diaphragm chamber L.

Regulating valve 12 is then open and connects chamber G, on the left of piston 8, to the feed-valve pipe through passage *h*, port *k*, chamber L, and passage *e*, *d*, *d*. Air feeding by the piston cannot accumulate above feed-valve pipe pressure. When regulating valve 12 is closed, the pressure on the left of piston 8 quickly rises, to the main-reservoir pressure on the right, and piston spring 6 forces piston 8 and supply valve 9 to the right, closes port *c*, and stops the flow to the feed-valve pipe.

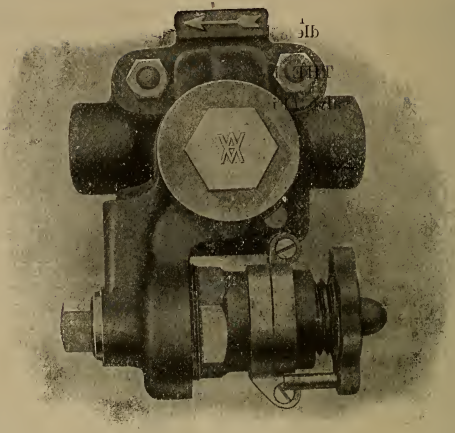


FIG. 27. VALVE AND PIPE BRACKET COMPLETE.

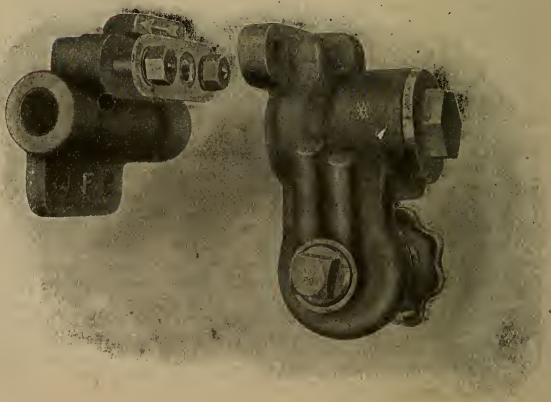


FIG. 28. VALVE REMOVED FROM PIPE BRACKET.

THE B-6 FEED VALVE.

The regulating valve is operated by diaphragm 14. When the pressure of regulating spring 17 on its right is greater than the feed-valve pipe pressure in chamber L on its left, it opens regulating valve 12. This causes the supply valve to admit air to the feed-valve pipe. When the feed-valve pipe pressure in chamber L is greater than that of the regulating spring 17, the diaphragm allows regulating valve 12 to close. This causes the supply valve to stop admitting air to the feed-valve pipe.

As already explained under H-6 Automatic Brake Valve, in release position of the latter, the warning port is supplied from the feed-valve pipe. (See Fig. 20.) This insures that the excess-pressure governor head will regulate the brake-pipe pressure in release position even though the feed valve is leaking slightly, but not enough to be otherwise detrimental.

The distinguishing feature of this type of feed valve is the duplex adjusting arrangement by which it eliminates the necessity of the two feed valves in high and low pressure service. The spring box, 18, has two rings encircling it, which are split through the lugs marked 19 and 20 in the diagram, and which may be secured in any position by the screw 21. The pin forming part of adjusting handle 22, limits the movement of the handle to the distance between stops 19 and 20. When testing the valve, stop 19 is located so that the compression of spring 17 will give the desired high brake-pipe pressure, and stop 17 so that the spring compression is enough less to give the low brake-pipe pressure. Thereafter, by simply turning handle 22 until its pin strikes either one of these stops, the regulation of the feed valve is changed from one brake-pipe pressure to the other.

To adjust this valve, slacken screws 21, which allows stops 19 and 20 to turn around spring box 18. Adjusting handle 22 should be turned until the valve closes at the lower brake-pipe pressure desired, when stop 20 should be brought in contact with the handle pin, at which point it should be securely fastened by tightening screw 21. Adjusting handle 22 should then be turned until the higher adjustment is obtained, when stop 19 is brought in contact with the handle pin and securely fastened. We recommend that the stops be placed to give 110 pounds high, and 70 pounds low, brake-pipe pressure.

When replacing this feed valve on its pipe bracket after removal, the gasket, shown in Fig. 28, must always be in place between the valve and bracket, to insure a tight joint.

THE C-6 REDUCING VALVE.

This valve, illustrated in Fig. 31, is the well known feed valve that has been used for many years in connection with the G-6 brake valve, but in this equipment is attached to a pipe bracket. The only difference between it and the B-6 feed valve just described is in the adjustment, it being designed to reduce

main-reservoir pressure to a single fixed pressure, which in this equipment is, as already stated, 45 pounds. To adjust this valve, remove the cap nut on the end of the spring box; this will expose the adjusting nut, by which the adjustment is made. It is called a "Reducing Valve" when used with the independent brake and air-signal systems, simply to distinguish it from the feed valve supplying the automatic brake valve.

THE SF TYPE OF PUMP GOVERNOR.

The duty of the SF Pump Governor is to sufficiently restrict the speed of the pump, when the desired main-reservoir pressure is obtained, so as to prevent this pressure from rising any higher. During most of the time on a trip, the automatic brake valve is in running position, keeping the brakes charged. But little excess pressure is then needed, and the governor regulates the main-reservoir pressure to about 20 pounds only above the brake-pipe pressure, thus making the work of the pump easier. On the other hand, when the brakes are applied (lap position of the automatic brake valve, following the use of its service position) a high main-reservoir pressure is needed to insure their prompt release and recharge. Therefore, as soon as the use of lap, service or emergency positions is commenced, the governor allows the pump to work freely until the maximum main-reservoir pressure is obtained. Again, when the brake-pipe pressure is changed from one amount to another by the feed valve, as where a locomotive is used alternately in high-speed-brake and ordinary service, the governor automatically changes the main-reservoir pressure to suit, and at the same time maintains the other features just described.

Another important feature is that, before commencing and during the descent of steep grades, this governor enables the engineer to raise and maintain the brake-pipe pressure about 20 pounds above the feed-valve regulation merely by the use of release position of the automatic brake valve, the position which should be used during such braking.

The following will explain the construction and operation of the SF Governor.

Fig. 32 shows a sectional view of this governor with steam valve 5 open. By reference to the piping diagram in Fig. 1-B, connection B leads to the boiler; P to the air-pump; MR to the main reservoir; ABV to the automatic brake valve; FVP to the feed-valve pipe; W is the waste-pipe connection. Steam enters at B and passes by steam valve 5 to the connection P and to the pump. The governor regulating head on the left is called the "excess-pressure head," and the one on the right the "maximum-pressure head." Air from the main reservoirs flows through the automatic brake valve (when the latter is in release, running or holding position) to the connection marked ABV into chamber *d*

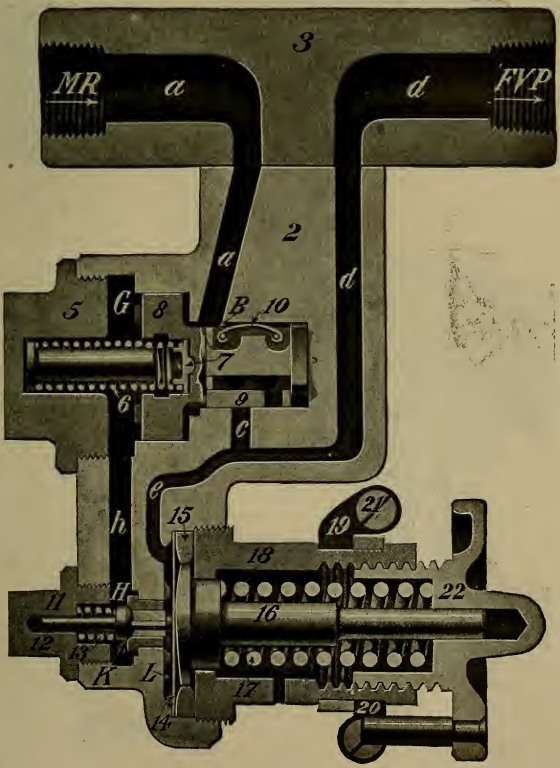


FIG. 29. DIAGRAM OF B-6 FEED VALVE, CLOSED.
Connections: MR—Main-Reservoir Pipe; FVP—Feed-Valve Pipe.

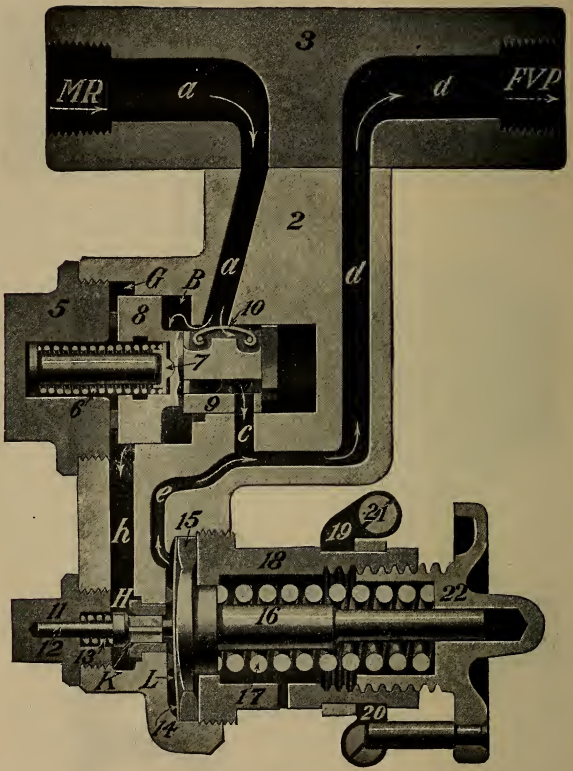


FIG. 30. DIAGRAM OF B-6 FEED VALVE, OPEN.
Connections: See Fig. 29.

below diaphragm 28. Air from the feed-valve pipe enters at the connection FVP to chamber *f* above diaphragm 28, adding to the pressure of regulating spring 27 in holding it down. As this spring is adjusted to about 20 pounds, this diaphragm will be held down until the main-reservoir pressure in chamber *d* slightly exceeds the combined air and spring pressure in chamber *f*. At such time, diaphragm 28 will rise, unseat its pin valve, and allow air to flow to chamber *b* above the governor piston, forcing the latter downward, compressing its spring and restricting the flow of steam past steam valve 5 to the point where the pump will just supply the leakage in the brake system. When main-reservoir pressure in chamber *d* becomes reduced, the combined spring and air pressure above the diaphragm forces it down, seating its pin valve. As chamber *b* is always open to the atmosphere through the small vent port *c*, the pressure in chamber *b* above the governor piston will then escape to the atmosphere and allow the piston spring, and steam pressure below valve 5, to raise it and the governor piston to the position shown. Since the connection from the main reservoir to chamber *d* is open only when the handle of the automatic brake valve is in release, running or holding positions, in the other positions this governor head is cut out. The connection marked MR in the maximum-pressure head should be connected to the main reservoir cut-out cock, or to the pipe connecting the two main reservoirs, so as to be *always* in communication with the main reservoir, so that when the excess-pressure head is cut out by the brake valve, or by the main-reservoir cut-out cock, this head will control the pump. When main-reservoir pressure in chamber *a* exceeds the adjustment of spring 19 in the maximum-pressure head, diaphragm 20 will raise its pin valve and allow air to flow in to chamber *b* above the governor piston, controlling the pump as above described. The adjustment of spring 19 thus forms the maximum limit of main-reservoir pressure, as for example when the train brakes are applied.

As each governor head has a vent port *c*, from which a small amount of air escapes whenever pressure is present in port *b*, to avoid an unnecessary waste of air, one of these should be plugged.

To adjust the excess-pressure head of this governor, remove cap nut 25 and turn adjusting nut 26 until the compression of spring 27 gives the desired difference between main reservoir and brake-pipe pressures, the handle of the automatic brake valve being in running position. To adjust the maximum-pressure head remove cap nut 17 and turn adjusting nut 18 until the compression of spring 19 causes the pump to stop at the maximum main-reservoir pressure required, the handle of the automatic brake valve now being on lap. It is recommended that spring 27 be adjusted for 20 pounds excess pressure, and spring 19 for a pressure ranging from 120 to 140 pounds, depending on the service.

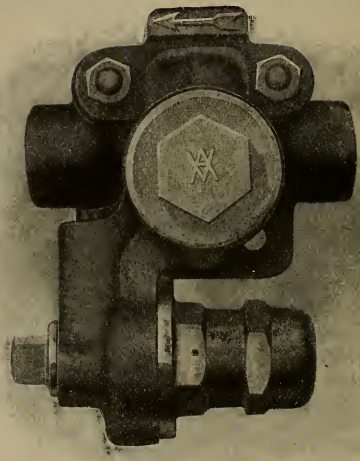


FIG. 31. THE C-6 REDUCING VALVE.

THE "DEAD-ENGINE" FEATURE.

The "Dead Engine" feature shown in Fig. 1-A, and 1-B shown at Z, is for the operation of the locomotive brakes when the pump on a locomotive in a train is inoperative through being broken down, or by reason of no steam. Fig. 33 shows the combined strainer, check valve, and choke fitting. 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, Fig. 33, passes through the curled hair strainer, lifts check valve 4, held to its seat by a strong spring, passes through the choke bushing, and out at MR to the main-reservoir, thus providing pressure for operating the brakes on this locomotive. The double-heading cock should be closed, and the handle of each brake valve should be in running position. Where absence of water in the boiler, or other reason, justifies keeping 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.

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, as would otherwise occur with an uncharged main reservoir cut in to a charged brake pipe. In this, it operates similarly to the feed groove in a triple valve.

MANIPULATION AND TRAIN HANDLING.

The following instructions are general, and must necessarily be supplemented to a limited extent to fully meet the varying local conditions on different railways.

The instructions for manipulating the ET equipment are practically the same as those given for the combined automatic and straight air brake; therefore, no radical departure from present methods of brake manipulation is required to get the desired results.

The necessary instructions are briefly as follows:

When not in use, carry the handles of both brake valves in running position.

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 brakes applied.

To release the train brakes, move the handle to the *release position* and hold it there until all triple valves are in release position; if locomotive brakes are to be released at once, use *running position;* but if they are to be held for a time, move to *holding position,* and then graduate them off by short, successive movements between running and holding positions. With all freight trains and especially long ones, both release and holding positions must, of course, be used very much longer than with short trains, particularly passenger.

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 or the danger is past.

To make a smooth and accurate *two-application passenger stop,* make the first application sufficiently heavy to bring the speed of train down to about 15 miles per hour at a convenient distance from the stopping point, then release train brakes by moving the handle to *release position,* then the locomotive brakes by moving it to *running position* for two or three seconds before re-applying. A little experience with the E. T. equipment will enable the engineer to make smooth and accurate stops with much greater ease than was heretofore possible.

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.* Independent release position is for use only when the automatic-brake-valve handle is not in running position, as an example, when the engineer desires to release the engine brakes independent of the train brakes.

While handling long trains of cars, in road or switching service, the independent brake should be operated with care, to prevent damage to cars and lading, caused by running the slack in or out too hard. In cases of emergency arising while the independent brake is applied, apply the automatic brake instantly. The safety valve will restrict the brake-cylinder pressure to the proper maximum.

The brakes on the locomotive and on the train should be alternated in heavy grade service to prevent overheating of driving-wheel tires and to assist the pressure retaining valves in holding the train while the auxiliary reservoirs are being recharged. This is done by keeping the locomotive brakes released by use of the independent brake valve when train brakes are applied, and applying locomotive brakes just before train brakes are released, and then releasing locomotive brakes after train brakes are reapplied.

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

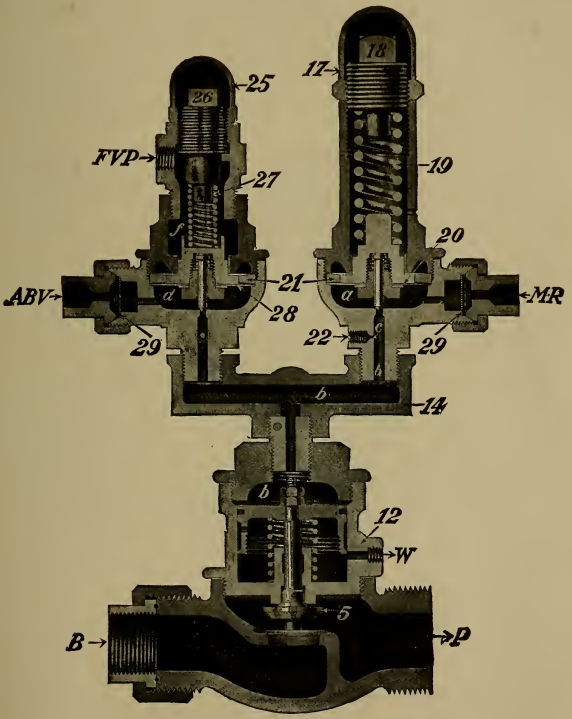


FIG. 32. THE SF-4 PUMP GOVERNOR.

The red hand of gauge No. 2 (Fig. 1) will show at all times the pressure in the locomotive brake cylinders, and this hand should be observed in brake manipulation.

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

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

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

The independent brake is a very important safety feature in this connection, as it will hold a locomotive with a leaky throttle or quite a heavy train on a fairly steep grade if, as the automatic brakes are released, the slack is prevented from running in or out, (depending on the tendency of the grade) and giving the locomotive a start. To illustrate—the best method to make a stop on a descending grade is to apply the independent brake heavily as the stop is being completed, thus bunching the train solidly; then, when stopped, place and *leave* the handle of the independent brake valve in application position; then release the automatic brakes and keep them charged. Should the independent brake be unable to prevent the train from starting, the automatic brakes will become sufficiently recharged to make an immediate stop; in such an event enough hand brakes should at once be applied as are necessary to assist the independent brake to hold the train. *Many runaways and some serious wrecks have resulted through failure to comply with the foregoing instructions.*

When leaving the engine while doing work about it, or when it is standing at a coal chute or water plug, always leave the independent-brake-valve handle in *application position.*

In case the automatic brakes are applied by a bursted hose, a break-in-two or the use of a conductor's valve, place the handle of the automatic brake valve in lap position.

Where there are two or more locomotives in a train, the *double-heading cock must be closed,* and the handle of the automatic brake valve must be carried in *running position* on each except the one from which the brakes are being operated.

Before leaving the round house, the engineer should try the brakes with both brake valves, and see that no serious leaks exist.

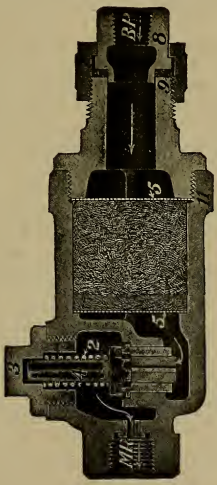


FIG. 33. COMBINED AIR STRAINER AND CHECK VALVE.

The pipes H and I (Fig. 1-B) between the distributing valve and the brake valves should be absolutely tight.

QUESTIONS AND ANSWERS ON NO. 6 ET LOCOMOTIVE BRAKE EQUIPMENT.*

Q. 1. What is the No. 6 ET Equipment?

A. It is a brake equipment for engine and tender adapted to all kinds of engines and classes of service and combines the operative features of the standard automatic, straight-air, high-speed, and double pressure control brake equipments, with many additional features.

Q. 2. Is the operation of the train brakes affected by the ET Equipment?

A. No; the operation of the train brakes is the same with this equipment as with former locomotive brake equipments.

Q. 3. What is meant by the term *train* brakes?

A. All brakes in the train except those upon the locomotive from which the brakes are being handled.

Q. 4. What is meant by the term *locomotive* brake?

A. The brake upon the engine and tender.

Q. 5. What new features of operation are obtainable with the ET Equipment?

A. (a) Locomotive brake may be used with or independently of the train brakes, whether the train brakes are in use or not.

(b) Uniform and proper cylinder pressure is obtained regardless of piston travel or leakage.

(c) Cylinder pressure is automatically maintained regardless of brake cylinder leakage.

(d) Locomotive brake can be graduated on or off with either the automatic or the independent brake valves.

(e) Increased flexibility in service operations, with increased braking power in emergency applications.

(f) Brakes on second locomotive or helper can be released or applied without in any way interfering with any other brakes in the train.

PARTS OF THE EQUIPMENT.

Q. 6. Name the essential parts of the ET Equipment.

A. 1, Air Compressor; 2, Main Reservoir; 3, Duplex Pump Governor; 4, Feed Valve; 5, Reducing Valve; 6, Automatic Brake Valve with Equalizing Reservoir; 7, Independent Brake Valve; 8,

*Formulated by The Air Brake Association.

Distributing Valve and Double Reservoir; 9, Two Duplex Air Gages; 10, Combined Air Strainer and Check Valve; 11, Choke Fitting; 12, Locomotive Brake Cylinders; also various cocks and fittings. (See Figs. 1-A and 1-B.)

Q. 7. What special parts are sometimes used?

A. (a) Quick-action Cylinder Cap for Distributing Valve.
(b) Combined Air Strainer and Check Valve for Train Air Signal System.
(c) Choke Fitting for Truck Brake.

Q. 8. What furnishes the compressed air for the brake system?

A. The Air compressor.

Q. 9. What operates the air compressor?

A. Steam from the locomotive boiler.

Q. 10. After leaving the compressor, where does the air go?

A. Through the radiating pipes to the main reservoir.

Q. 11. What is the purpose of the radiating pipe?

A. To cool the air after leaving the compressor.

Q. 12. What is the purpose of the main reservoirs?

A. The main reservoirs provide a place for the storage of an abundant supply of compressed air for use in promptly releasing the brakes on the locomotive and train and for recharging the brake system. They also assist in cooling the compressed air and collect moisture, oil or other foreign matter, allowing only clean, dry air to pass to the brake system.

Q. 13. What controls the air pressure in the main reservoirs?

A. The Duplex pump governor.

Q. 14. How does the pump governor control the main reservoir pressure?

A. It automatically regulates the supply of steam to the compressor so as to maintain normal pressure in the main reservoirs.

Q. 15. What connects the main reservoirs to the brake system?

A. The main reservoir pipe.

Q. 16. What provision is made for cutting off the main reservoirs from the rest of the brake system?

A. A cock in the main reservoir pipe close to the main reservoir, known as the "main reservoir cut-out cock."

Q. 17. Where do the pipe branches lead to from the main reservoir pipe?

A. (a) To the duplex pump governor.
(b) To the main reservoir hand of the duplex air gage.
(c) To the automatic brake valve.

(d) To the feed valve.
(e) To the reducing valve.
(f) To the distributing valve.
(g) To the dead engine fixtures.
(h) Other branches leading to various air-using devices on the locomotive, such as sanders, water-scoop, etc.

Q. 18. What is the purpose of the feed valve?

A. To automatically maintain a predetermined pressure in the brake system, lower than that carried in the main reservoirs.

Q. 19. To what does the feed valve pipe connect?

A. To the automatic brake valve, and to the spring chamber of the excess pressure head of the duplex pump governor.

Q. 20. What is the purpose of the reducing valve?

A. It automatically reduces the air pressure from the main reservoirs to the proper pressure used with the independent brake and train air signal system.

Q. 21. What is the purpose of the automatic brake valve?

A. (a) To allow air to flow from the brake system for charging it.
(b) To discharge air from the brake pipe to the atmosphere to apply the brakes.
(c) To prevent the flow of air to or from the brake pipe when holding the brakes applied.
(d) To hold applied or release the locomotive brake as desired while releasing train brakes.
(e) To allow air to flow to the brake system for the purpose of releasing the brakes and recharging the system.
(f) To control the flow of air to the diaphragm chamber of the excess pressure head of the duplex pump governor.
(g) To allow main reservoir to flow to the application cylinder of the distributing valve in *emergency* position.

Q. 22. What is the purpose of the independent brake valve?

A. To operate the brakes on the engine and tender independent of the train brakes.

Q. 23. State briefly the purpose of the distributing valve.

A. (a) To automatically control the flow of air from the main reservoirs to the engine and tender brake cylinders when applying the brakes.
(b) To automatically maintain the brake cylinder pressure against leakage, keeping it constant, when holding the brake applied.

(c) To automatically control the flow of air from the engine and tender brake cylinders to the atmosphere when releasing the brake.

Q. 24. What is the purpose of the locomotive brake cylinders?

A. The brake cylinder is that part of the air brake equipment in which the force contained in the compressed air is transformed into a mechanical force which is transmitted through a suitable combination of rods and levers to the brake shoes and applies them to the wheels.

H-6 AUTOMATIC BRAKE VALVE.

Q. 25. How many positions has the H-6 Brake Valve?

A. Six.

Q. 26. Name the positions beginning at the left.

A. *Release, Running, Holding, Lap, Service* and *Emergency* (see Fig. 19).

Q. 27. Name and describe the purpose of the pipe connections to the H-6 Brake Valve.

A. (a) Main Reservoir Pipe. To connect the main reservoirs to the chamber above the rotary valve and permit a free flow of high pressure air into the brake pipe when the brake valve handle is in *release* position.

(b) Feed Valve Pipe. To connect the feed valve to the underside of the rotary valve. When the brake valve handle is in *running* position this pipe is open to the brake pipe, thus permitting the feed valve to maintain a constant brake pipe pressure below that in the main reservoirs.

(c) Equalizing Reservoir Pipe. This connects the chamber above the equalizing piston to the equalizing reservoir and the equalizing reservoir gage.

(d) Brake Pipe. To connect the distributing valve on the locomotive and the triple valve on each car to the space underneath the equalizing discharge piston and the underside of rotary valve.

(e) Governor Pipe. This makes a connection from the rotary valve chamber (main reservoir pressure) to the underside of the diaphragm of the excess pressure governor head when the brake valve handle is in either *release, running* or *holding* positions.

(f) Distributing Valve Release Pipe. This makes a connection from the application chamber of the distributing valve (through the independent brake valve) to the underside of the automatic rotary

valve, forming a connection to the atmosphere when both brake valve handles are in *running* position.

(g) Application cylinder Pipe. This connects the underside of the automatic rotary valve directly to the application cylinder of the distributing valve. In *emergency* position of the brake valve handle this pipe is open to the chamber above the rotary valve (main reservoir pressure) through the blow-down timing port.

Q. 28. When is *release* position used?

A. When it is desired to quickly charge the brake system and to release brakes on long trains.

Q. 29. Explain the flow of air through the automatic brake valve when in *release* position.

A. Air from the main reservoirs flows directly to the brake pipe, equalizing reservoir and pump governor. Air from the feed valve flows through the warning port to the atmosphere.

Q. 30. When is *running* position used?

A. When running along the road to maintain a predetermined brake pipe pressure lower than that carried in the main reservoirs, to release the engine and tender brakes and also to release the brakes on short trains.

Q. 31. Explain the flow of air through the automatic brake valve when in *running* position.

A. (a) Air from the feed valve flows to the brake pipe and to the equalizing reservoir.

(b) Air from the main reservoirs flows directly to the diaphragm chamber of the excess pressure head of the duplex pump governor.

(c) Air from the distributing valve release pipe flows to the atmosphere.

Q. 32. When is *holding* position used?

A. When it is desired to hold the engine and tender brakes applied by means of the automatic brake valve while releasing and recharging the train brakes.

Q. 33. Explain the flow of air through the automatic brake valve when in *holding* position.

A. The flow of air through the automatic brake valve when in holding position is the same as when in *running* position with one exception, namely: air from the distributing valve release pipe is prevented from flowing to the atmosphere.

Q. 34. When is *lap* position used?

A. When holding all the brakes applied after an automatic application. The handle should never be carried in this position except while bringing the train to a stop.

Q. 35. Is there any flow of air to the brake system through the automatic brake valve when in *lap* position?

A. No.

Q. 36. When is *service* position used?

A. When it is desired to make an automatic application of the brakes.

Q. 37. Explain fully the flow of air through the automatic brake valve when in *service* position.

A. In the automatic brake valve is a piston and valve called the equalizing discharge piston and valve, No. 15, Fig. 19. The underside of this piston is directly connected to the brake pipe. The chamber *D*, above piston 15, is directly connected to the equalizing reservoir *ER* and to a small port *e* in the rotary valve seat called the preliminary exhaust port. In *service* position the preliminary exhaust port is open to the atmosphere through port *h* and exhaust cavity *o* (see small view plan of Rotary Valve at right, Fig. 20) in the rotary valve, thus allowing air from the equilizing reservoir and the chamber *D* above the equalizing discharge piston to flow to the atmosphere. This reduces the pressure on the top of the piston below the brake pipe pressure on the underside, which raises the equalizing discharge piston 15 and permits brake pipe air to flow to the atmosphere through the service exhaust fitting *B. P. Ex.* The flow of air from the equalizing reservoir to the atmosphere continues until the brake valve handle is returned to *lap* position. This closes the preliminary exhaust port *e*, and prevents further decrease of pressure in the equalizing reservoir and chamber *D*. Air will continue to discharge from brake pipe until its pressure has been reduced slightly lower than that remaining in chamber *D*. The higher pressure on the top of the piston then forces the valve to its seat and prevents further reduction of brake pipe pressure.

Q. 38. What is the purpose of the service exhaust fitting?

A. To fix the maximum permissible opening from the brake pipe to the atmosphere when making a service application.

Q. 39. Is it important that all H-6 brake valves be provided with this fitting?

A. Yes.

Q. 40. When is *emergency* position used?

A. When it is desired to make the shortest possible stop. In such case the handle should be moved to *emergency* position quickly and left there until the train stops.

Q. 41. Should this position be used at any other time?

A. Yes; this position should be used in case of an emergency application of the brakes from an unknown cause, such as the

opening of a conductor's valve, bursted hose, etc., in order to prevent loss of main reservoir pressure and to insure a full application of the brakes and the handle should be left there until signal to release is given.

Q. 42. Why should *emergency* position be used as explained in the last answer instead of *lap* position?

A. To insure the brakes remaining applied under all circumstances.

Q. 43. Explain the flow of air through the automatic brake valve when in *emergency* position.

A. A large and direct opening is made from the brake pipe to the atmosphere, through the rotary valve, causing a quick and heavy reduction of brake pipe pressure. At the same time the air in the equalizing reservoir escapes to the atmosphere through ports in the rotary valve. Connection is made from air at main reservoir pressure above the rotary valve through a restricted port in the rotary valve to the application cylinder pipe leading to the application cylinder of the distributing valve. This port is known as the blow-down timing port, and assists in building up and regulating application cylinder pressure during emergency application.

S-6 INDEPENDENT BRAKE VALVE.

Q. How many positions has the S-6 Brake Valve?

A. Five.

Q. 45. Name the positions beginning at the left.

A. *Release, Running Lap, Slow-Application* and *Quick-Application* (see Fig. 24).

Q. 46. Name and describe the purpose of the pipe connections to the S-6 Brake Valve.

A. (a) Reducing Valve Pipe. This is the only source of air supply to the valve and connects the reducing valve to the chamber above the rotary valve, and through the rotary valve when the independent brake valve handle is in either *application* position, to the application cylinder and chamber of the distributing valve and also through the warning port to the atmosphere when the handle is in *release* position.

(b) Distributing Valve Release Pipe *to the distributing valve.* Connects the application chamber of the distributing valve to the underside of the independent brake valve. When the brake valve handle is in *running* position, this pipe is connected through ports in the seat and cavities in the rotary valve to the automatic brake valve.

(c) Distributing Valve Release Pipe to *the automatic brake valve.* This pipe connects the underside of

the rotary valve of the independent brake valve to the underside of the rotary valve of the automatic brake valve. With both brake valve handles in *running* position, free passage is made from the application chamber of the distributing valve to the atmosphere through this pipe.

(d) Application Cylinder Pipe. Connects the application cylinder to the underside of the rotary valve of the independent brake valve. When the handle is in either *application* position air from above the rotary valve flows through this pipe to the application cylinder and chamber of the distributing valve. When the handle is in *release* position this pipe is connected to the atmosphere through ports in the rotary valve and seat.

Q. 47. When is *release* position used?

A. Whenever it may be necessary to release the brake when the automatic brake valve handle is not in *running* position.

Q. 48. Explain the flow of air through the independent brake valve when in *release* position.

A. Air from the application cylinder of the distributing valve flows direct through the application cylinder pipe and independent brake valve to the atmosphere. At the same time air from above the rotary valve (reducing valve pressure) flows through the rotary valve and warning port to the atmosphere.

Q. 49. When is *running* position used?

A. When running along the road and to release the locomotive brake after an independent application, the automatic brake valve handle being in running position.

Q. 50. Explain the flow of air through the independent brake valve when in *running* position. (Automatic brake valve handle in *running* position.)

A. Air from the application chamber of the distributing valve flows through the distributing valve release pipe and independent brake valve, then through the automatic brake valve to the atmosphere.

Q. 51. When is *lap* position used?

A. When holding the engine and tender brake applied after an independent application.

Q. 52. Is there any flow of air through the independent brake valve when in *lap* position?

A. No.

Q. 53. When is *slow-application* position used?

A. When it is desired to apply the locomotive brakes lightly or gradually.

Q. 54. Explain the flow of air through the independent brake valve when in *slow-application* position.

A. Air flows from the chamber above the rotary valve through the restricted service port and application cylinder pipe into the application cylinder and chamber of the distributing valve.

Q. 55. When is *quick-application* position used?

A. When it is desired to apply the locomotive brakes promptly.

Q. 56. Explain the flow of air through the independent brake valve when in quick-application position.

A. Air flows from above the rotary valve through a full open service port in the rotary valve and the application cylinder pipe to the application cylinder and chamber of the distributing valve.

Q. 57. What prevents the independent brake valve handle from remaining in *release* position or in *quick-application* position unless held there?

A. A return spring.

Q. 58. To what position does the return spring move the brake valve handle from *release* position?

A. To *running* position.

Q. 59. Why is this necessary?

A. To prevent the possibility of the independent brake valve handle being left in *release* position, which would cause the engine and tender brakes to release whenever an automatic application was made.

Q. 60. To what position does the return spring move the brake valve handle from *quick-application* position?

A. To *slow-application* position.

Q. 61. Why is the spring used for this purpose?

A. To act as a stop, guarding against a quick application when only a slow application is intended, and to return the handle from *quick* to *slow-application* position.

Q. 62. Why is this latter necessary?

A. In order to limit the flow of air to the application cylinder when the independent brake is to be left applied.

NO. 6 DISTRIBUTING VALVE WITH PLAIN CYLINDER CAP.

Q. 63. What controls the brake cylinder pressure on the locomotive with No. 6 ET equipment?

A. The distributing valve.

Q. 64. How does it do this?

A. It permits air to flow from the main reservoirs to the brake cylinders when applying the brake, from the cylinders to

the atmosphere when releasing the brake, and automatically maintains the pressure against leakage, keeping it constant, when holding the brake applied.

Q. 65. Is the amount of air flowing from the main reservoirs to the brake cylinders limited by the distributing valve?

A. Yes; the distributing valve acts as a reducing valve in supplying air from the main reservoirs to the locomotive brake cylinders.

Q. 66. Facing the distributing valve, name the two pipes on the right hand side of the reservoir and state to what each one connects (see Fig. 5).

A. (a) The upper pipe on the right is the brake cylinder pipe. It connects the distributing valve to all the brake cylinders on the engine and tender.

(b) The lower pipe on the right is the brake pipe branch pipe. It connects the distributing valve to the brake pipe.

Q. 67. Name the three pipes on the left hand side of the reservoir and state to what each one connects (see Fig. 5).

A. (a) The upper pipe on the left is the supply pipe. It connects the distributing valve to the main reservoir pipe.

(b) The intermediate pipe is the application cylinder pipe. It connects the distributing valve to both the automatic and independent brake valves.

(c) The lower pipe is the release pipe, which connects the distributing valve to the independent brake valve and through it to the automatic brake valve.

Q. 68. How many chambers has the distributing valve reservoir?

A. Two.

Q. 69. Name them.

A. Pressure chamber and application chamber (see Fig. 4).

Q. 70. How many pistons has the distributing valve?

A. Two.

Q. 71. Name them.

A. Application piston 10 and equalizing piston 26.

Q. 72. How many slide valves has the distributing valve?

A. Four.

Q. 73. Name them.

A. Application valve 5, exhaust valve 16, equalizing valve 31 and graduating valve 28.

Q. 74. What valves are operated by the application piston?

A. The application valve and exhaust valve.

Q. 75. What valves are operated by the equalizing piston?

A. The equalizing valve and graduating valve.

Q. 76. With the brake released what pressures are present in the distributing valve?

A. Main reservoir pressure, brake pipe pressure and atmospheric pressure.

Q. 77. In what portion of the distributing valve is main reservoir pressure?

A. In chamber *a*, Fig. 7, above the application valve.

Q. 78. In what portion of the distributing valve is brake pipe pressure?

A. In the pressure chamber and in the chamber above the equalizing valve and graduating valve.

Q. 79. In what portion of the distributing valve is atmospheric pressure?

A. In chamber *b* above the exhaust valve 16 and on the right hand side of the application piston 10; in chamber *g* on the left hand side of the application piston (called the application cylinder) and in the application chamber and the ports and cavities connecting to them.

Q. 80. How is chamber *a* charged with air at main reservoir pressure?

A. Through the branch pipe leading from the main reservoir pipe to the connection marked *MR* on the distributing valve reservoir.

Q. 81. Describe the operation of the distributing valve parts when an independent application of the brake is made.

A. Air is admitted to the application cylinder *g* and the application chamber from the reducing valve through the independent brake valve and the intermediate pipe on the left (application chamber pipe). This pressure will force the application piston 10 to the right, Fig. 12, lapping exhaust ports *d* and *e* with exhaust valve 16, and compressing graduating spring 20 and open supply port *b* through the application valve 5 to the brake cylinder chamber *b*, which is connected to the right of the application piston, obtaining a brake cylinder pressure slightly exceeding that in the application cylinder, when it and the graduating spring 20 then moves the piston 10 and the application valve 5 back to lap position Fig. 13. The exhaust valve 16 will remain lapped, as there is sufficient clearance between the shoulders of the piston stem and the exhaust valve to permit the application valve to return to lap without moving the exhaust valve. At the same time cavity *s* in the equalizing valve 31 registers with ports *h* and *l* in the seat, thus connecting the application cylinder port *h* to the safety valve. *The equalizing piston and slide valve do not move during an independent application of the brake.*

Q. 82. Describe the operation of the distributing valve parts when an independent release of the brake is made.

A. By a proper movement of the independent brake handle air from the application cylinder *g* and the application chamber is allowed to flow to the atmosphere, which reduces the pressure in chamber *g* below that in chamber *b*, causing the application piston 10 to move to the left, carrying with it application valve 5 and exhaust valve 16 until ports *d* and *c* are open past and through exhaust valve 16, Fig. 7, permitting the air in the brake cylinders to flow through port *c* into chamber *b*, thence through ports *d* and *e* to the exhaust and atmosphere. *The equalizing piston and its valves do not move during an independent release of the brakes.*

Q. 83. How is the pressure chamber charged with air at brake pipe pressure?

A. Through the branch pipe leading from the brake pipe to the connection marked BP on the distributing valve reservoir, Fig. 5, leading into chamber *p*, Fig. 7, then through feed groove *v* around top of piston 26 into the chamber above the equalizing valve 31 and through port *o* to the pressure chamber until the pressure on both sides of the piston are equal.

Q. 84. From where do the application cylinder and chamber receive their air?

A. From the *reducing valve* through the independent brake valve during independent applications and from the *pressure chamber* during automatic service applications.

Q. 85. Describe the operation of the distributing valve parts when an automatic service application of the brake is made.

A. The brake pipe pressure in chamber *p* on the brake pipe side of equalizing piston 26 being reduced below that in the pressure chamber on the opposite side of the piston results in piston 26 being moved toward the right. The first movement of piston 26 closes the feed groove *v*, and at the same time moves the graduating valve 28 until it opens the service port *z* in the equalizing valve, and connects the safety valve ports *r* and *s* in equalizing valve through cavity *t* in the graduating valve. As the piston continues its movement, the "spider" on the end of the piston stem engages the slide valve 31, which is then moved to the right until the supply port *z* in the equalizing valve registers with the application cylinder port *h* and through cavity *n* in the equalizing valve with application chamber port *w* in the seat. This permits the air in the pressure chamber to expand into the application cylinder. At the same time the safety valve is connected to the application cylinder and application chamber by registering ports *r* and *s* in the equalizing valve with ports *h* and *l* in the seat and through the cavity *t* in the graduating valve, Fig. 8. The amount

of pressure obtained in the application cylinder and chamber depends upon the brake pipe reduction made. When the pressure in the pressure chamber is slightly reduced below that in the brake pipe, the piston and the graduating valve are forced to the left until the collar on the piston stem comes in contact with the equalizing valve. This position is known as "service lap," Fig. 9. In this position the graduating valve has lapped port *z* between the pressure chamber and the application cylinder and has also lapped the safety valve port *l*. The air that expanded into the application cylinder and chamber will force the application piston 10 to the right, lapping the exhaust ports *d* and *e* with the exhaust valve 16, compressing graduating spring 20 and opening the supply port *b* through the application valve 5 to brake cylinder, as explained in answer to question 81.

Q. 86. Describe the operation of the distributing valve when the brake is released with the independent brake valve, after an automatic application.

A. With the independent brake valve handle in *release* position, air in application cylinder *g* and the application chamber flows direct to the atmosphere through the application cylinder pipe. This reduces the pressure in chamber *g* below that in chamber *b*, causing supply valve piston 10 to move to the left, carrying with it application valve 5 and exhaust valve 16 to *release* position, Fig. 14, thus releasing the brake.

Q. 87. Do the equalizing parts of the distributing valve operate at this time?

A. No.

Q. 88. Describe the operation of the distributing valve parts when making an automatic release of the brakes.

A. The brake pipe pressure in chamber *p* on the brake pipe side of equalizing piston 26 being increased above that in the pressure chamber on the opposite side of the piston results in the piston being moved toward the left, carrying with it graduating valve 28 and equalizing valve 31 to release position. In this position cavity *k* in equalizing valve 31 registers with ports *w*, *h* and *i* in the seat. This allows air from the application cylinder *g* and the application chamber to flow through the ports mentioned to the distributing valve release pipe IV and to the atmosphere. At the same time the reduction of pressure in chamber *g* below that in chamber *b* causes the supply piston 10 to move to the left, carrying with it exhaust valve 16 to release position, Fig. 7, thus releasing the brake as described in answer to question 82.

Q. 89. Describe the operation of the distributing valve parts when an automatic emergency application of the brake is made.

A. Brake pipe pressure in chamber *p* on the brake pipe side of equalizing piston 26 is suddenly reduced below that in the pressure chamber on the opposite side of the piston. The considerable dif-

ference in pressure thus created on the two sides of equalizing piston 26 is sufficient to move it to its extreme position to the right, compressing graduating spring 46, Fig. 10. In this position port *h* is open directly to the chamber above equalizing valve 31, past the end of the valve, so that air from the pressure chamber flows through port "o," through the chamber above equalizing valve to port "h" and the application cylinder *g*. The application chamber port *w* is blanked by the equalizing valve 31 and the safety valve port *l* is connected through port *r* and restricted port *q* in valve 31 to port *h* of the application cylinder. The air that expanded into the application cylinder from the pressure chamber will force the application piston 10 to the right opening the application valve 5 as in service application and obtaining cylinder pressure equal to that in the application cylinder, when the application valve will lap, Fig. 11.

Q. 90. What brake cylinder pressure is obtained from a full automatic service application of the brake from a 70 pound brake pipe pressure? (Safety valve set at 68 pounds.)

A. Fifty pounds.

Q. 91. What brake cylinder pressure is obtained with an automatic emergency application from a 70 pound brake pipe pressure? (Safety valve set at 68 pounds.)

A. About seventy pounds.

Q. 92. How is the difference between service and emergency brake cylinder pressure obtained?

A. With all automatic service applications the pressure chamber is connected to both the application chamber and application cylinder, the relative volumes of which are such that the air in the pressure chamber at 70 pounds pressure will equalize with the combined volumes of the application chamber and cylinder at 50 pounds pressure, which is, therefore, the maximum which can be obtained with an automatic service application. With all emergency applications the pressure chamber is not connected to the application chamber, but to the application cylinder only. The air in the pressure chamber then expands into the application cylinder, equalizing at about 65 pounds from a 70 pound brake pipe pressure. During emergency application air is admitted through a small port in the automatic brake valve (called the blow-down timing port) and the application cylinder pipe to the application cylinder. The size of the blow-down timing port in the brake valve is proportioned to the restricted port in the equalizing valve leading to the safety valve so as to give the proper time of blow-down of brake cylinder pressure.

Q. 93. Will piston travel or brake cylinder leakage affect the brake cylinder pressure on the engine and tender?

A. No.

Q. 94. How is a predetermined brake cylinder pressure obtained and maintained in the engine and tender brake cylinder regardless of piston travel and leakage?

A. As the brake cylinders receive their air from the main reservoirs they have practically an unlimited supply to draw from. The distributing valve and its reservoir volumes are constant, so that with a given brake pipe reduction a given application cylinder pressure will be obtained (about 2½ pounds appliication cylinder and chamber pressure for every pound brake pipe reduction). The air that is admitted to the application cylinder forces the application piston and its valves to the right, Fig. 8, closing the exhaust ports and allowing air from the main reservoir branch pipe to flow to the brake cylinders until brake cylinder pressure becomes equal to that in the application cylinder, regardless of what the piston travel is, the number of cylinders or the amount of leakage. When this pressure has been obtained, if brake cylinder leakage exists, the drop in cylinder pressure will reduce the pressure in chamber *b* on the right of piston 10 below that in application cylinder *g* on the opposite side of the piston. This will cause application piston 10 to again move to the right opening application valve 5 and allowing air to flow from the main reservoirs to the brake cylinders until the brake cylinder pressure again equalizes with that in the aplication cylinder, when the application piston 10 and supply valve 5 will move to lap position, Fig. 9. This action will continue indefinitely until the brakes are released.

SAFETY VALVE.

Q. 95. What is the purpose of the safety valve? No. 34, Fig. 4.

A. To prevent abnormal brake cylinder pressure and to act as a high speed reducing valve for the locomotive brake cylinders.

Q. 96. To what is the safety valve connected?

A. To the application cylinder.

Q. 97. When is the safety valve connected to the application cylinder?

A. At all times except in automatic service lap position of the distributing valve.

Q. 98. For what pressure is the safety valve adjusted?

A. Sixty-eight pounds, except when the locomotive is transported light over the road, when it is ordinarily adjusted to 35 pounds.

Q. 99. How does the safety valve act as a high speed reducing valve?

A. When an automatic service application is made and the equalizing valve and graduating valve are in service position, the safety valve is connected to the application cylinder and chamber

through large ports, and will therefore prevent the brake cylinder pressure rising above that for which the safety valve is adjusted. During emergency application the connection between the application cylinder and the safety valve is smaller than during service application, so that the flow of air from the application cylinder to the safety valve is restricted, which, in conjunction with the blow-down timing port, regulates the time of blow-down of brake cylinder pressure.

QUICK-ACTION CYLINDER CAP.

Q. 100. Where is the quick-action cylinder cap located?

A. On the brake pipe end of the distributing valve (see Fig. 16), replacing the plain cylinder cap 23, Fig. 11.

Q. 101. What is its purpose?

A. To vent brake pipe air into the locomotive brake cylinders when an emergency position of the brake is made.

Q. 102. Does it operate at any other time?

A. No.

Q. 103. Why is this cap used?

A. To assist in obtaining an emergency application of the brakes in the train when double heading.

Q. 104. Then the quick-action cylinder cap performs the same function in actuating quick-action as a quick-action triple valve on the tender with other types of locomotive brakes?

A. Yes.

Q. 105. Does the air flowing to the brake cylinders through the quick-action cylinder cap increase the brake cylinder pressure as is the case with the quick-action triple valve?

A. No; as the brake cylinder pressure is governed by the pressure in the application cylinder of the distributing valve.

Q. 106. What advantage has this device over quick-action triple valves on the tender?

A. It is less liable to cause undesired quick-action than a triple valve, as it is much less sensitive.

Q. 107. Why is it possible to use a valve less sensitive to quick-action than a triple valve?

A. As the quick-action cylinder cap is always located close to the automatic brake valve being operated; when an emergency application is made the quick-action cylinder cap is subjected to a more rapid brake pipe reduction than is the case with a triple valve located at a considerable distance from the brake valve, and consequently need not be so sensitive in order to accomplish its purpose.

Q. 108. When the distributing valve is provided with a quick-action cap, how should the automatic brake valve handle be operated?

A. Exactly the same as when the distributing valve has plain cylinder cap.

Q. 109. Describe the operation of the quick-action cylinder cap.

A. When the automatic brake valve handle is moved to emergency position, equalizing piston 26, Fig. 15, moves to the right, which movement causes the knob on the piston to strike the graduating stem 50, causing it to compress graduating spring 55, moving emergency valve 48 so as to open port *j*. Brake pipe pressure in chamber *p* then flows to chamber X, unseats check valve 53 and passes to the brake cylinders through port *m* in the cap and distributing valve body.

Q. 110. What duty does the check valve 53 perform?

A. When the brake cylinder and brake pipe pressures become equal, the check valve is forced to its seat by spring 54, thus preventing air in the brake cylinders from flowing back into the brake pipe.

Q. 111. What takes place when a release is made?

A. Piston 26 is moved back to *release* position, spring 55 forces graduating stem 50 and emergency valve 48 back to the position shown in Fig. 15.

Q. 112. Are there any other differences in the operation of the distributing valve having this cap?

A. No; in all other respects the operation of the distributing valve is the same as described under the heading "No. 6 Distributing Valve With Plain Cylinder Cap."

THE B-6 FEED VALVE.

Q. 113. How does the B-6 feed valve differ from that used with former automatic brake equipments?

A. The B-6 feed valve is made adjustable for either high or low brake pipe pressure and can easily be changed from one to the other. Otherwise, except for improvements in the mechanical design of the valve, it is the same as that used with former equipments.

Q. 114. How is the change in adjustment accomplished?

A. The adjusting nut is provided with a hand wheel, having a lug, working between two adjustable stops on the body of the valve. These stops are adjusted for the high and low brake pipe pressure which it is desired to carry and the change of pressure from one to the other is accomplished by simply turning the hand wheel from one stop to the other.

Q. 115. Where is the feed valve located?

A. On a bracket interposed between the main reservoir and feed valve pipes.

Q. 116. Why is this bracket used?

A. To support the valve and permit it to be easily removed and replaced.

Q. 117. What are the essential working parts of the feed valve?

A. The supply valve and actuating piston, the regulating valve, diaphragm, regulating spring and supply valve piston spring.

Q. 118. Explain the general arrangement of the feed valve?

A. The feed valve consists of two sets of parts designated as the supply parts and the regulating parts. The supply parts, which control the flow of air through the valve consist of the supply valve 9, Fig. 29, and its spring 10, supply valve piston 8 and supply valve piston spring 6. The regulating parts consist of the regulating valve 12, regulating valve spring 13, diaphragm 14, diaphragm spindle 16 and regulating spring 17.

Q. 119. What is the normal position of this valve?

A. Closed, as shown in Fig. 29.

Q. 120. Explain the duty of the various operative parts?

A. Supply valve 9 is for the purpose of opening and closing port *c* in its seat. Piston 8 is for the purpose of moving the supply valve 9. Spring 6 is for the purpose of moving the piston and closing the supply valve when the pressures have equalized on both sides of piston 8.

Q. 121. What are the duties of the regulating parts?

A. To control the action of the supply valve piston and supply valve when opening and closing the supply port *c* in the seat.

Q. 122. Explain the operation and flow of air through the feed valve when open.

A. By referring to Fig. 29, which is a diagrammatic view of the valve in its closed position, air entering through port *a* from the main reservoir is free to pass into the supply valve chamber "B" causing the supply valve piston 8 to be moved to the left, compressing piston spring 6, as shown in Fig. 30, by which movement the supply valve 9 uncovers port *c* in the valve seat, thereby permitting air to pass directly through ports *c* and *dd* to the feed valve pipe at the same time air is passing by the supply valve piston 8, which is not an airtight fit, to chamber *G*, thence through port *hH* by the regulating valve 12, and through port *K* to diaphragm chamber *L* and on through ports *edd* to the feed valve pipe.

Q. 123. What will cause a valve to close and stop the flow of air from the main reservoir to feed valve pipe?

A. When the pressure in the feed valve pipe and chamber *L* slightly exceeds the tension of the regulating spring 17, the

diaphragm 14 will yield and allow regulating valve 12 to move to its seat, closing port *K*, and preventing the flow of air from chamber *G*. As the air continues to leak by supply valve piston 8, it will equalize the pressure on both sides of the piston and allow supply valve piston spring 6, which was previously compressed, to react and move the piston and supply valve to the position shown in Fig. 30 closing port *c* in the supply valve seat.

Q. 124. With the feed valve closed, and the pressure equalized on each side of the supply valve piston, what will cause it to open to supply the feed valve pipe when the pressure has been reduced?

A. Diaphragm chamber *L* is always in direct communication with the feed valve pipe; therefore, any reduction in feed valve pipe pressure reduces the pressure in chamber *L*, which allows the tension of the regulating spring to overcome the diminished air pressure in chamber *L*, and force the diaphragm 14 to the left. This unseats the regulating valve 12, permitting the accumulated air pressure in chamber *G* to escape to the feed valve pipe through ports *hH* and through port *K*, diaphragm chamber *L* and ports *edd*. The equilibrium of pressure on the two sides of the supply valve piston now being destroyed, the main reservoir pressure which is present in supply valve chamber *B* forces the supply valve piston 8 to the left, which moves the supply valve 9 with it, opening port *c* and again permitting the air to pass to the feed valve pipe until the pressure has been restored to the proper amount.

Q. 125. The supply valve then maintains practically a wide open port until maximum pressure is obtained?

A. Yes; and when maximum pressure is obtained, the supply valve closes the supply port quickly.

C-6 REDUCING VALVE.

Q. 126. What is the difference in the construction and operation of the C-6 reducing valve, Fig. 31, and the B-6 feed valve?

A. The only difference between it and the B-6 feed valve just described is in the convenience of adjustment, the C-6 reducing valve having the ordinary adjusting nut and cap nut used on former types of feed valves instead of the hand adjusting wheel 22 used with the B-6 feed valve shown in Fig. 30. It is called a "Reducing Valve" simply to distinguish it from the B-6 feed valve.

SF-4 PUMP GOVERNOR.

Q. 127. Where is the SF-4 pump governor located?

A. In the pipe supplying steam to the air compressor.

Q. 128. Explain the general arrangement of the pump governor.

A. It consists of a standard steam portion, with Siamese fitting, and two diaphragm portions, as illustrated in Fig. 32.

Q. 129. How are these diaphragm portions designated?

A. That having two pipe connections the *excess pressure head* and that having a single pipe connection the *maximum pressure head.*

Q. 130. What are the pipe connections of the governor?

A. *B*, to the boiler; *P*, the air compressor; *MR*, main reservoir; *AB*, the automatic brake valve; *FVP*, the feed valve pipe; *W*, waste pipe.

Q. 131. When does the excess pressure head govern the operation of the air compressor?

A. At all times when the automatic brake valve handle is in *release, running* or *holding* positions.

Q. 132. When does the maximum pressure head govern the operation of the air compressor?

A. During the time the automatic brake valve handle is in *lap, service,* or *emergency* positions.

Q. 133. Explain the flow of steam through the governor.

A. Steam enters at *B*, passes by steam valve 5 to the connection *P*, and on to the air compressor.

Q. 134. With the automatic brake valve handle in *release, running* or *holding* position, what pressures act on the diaphragm 28 of the excess pressure head?

A. Air from the main reservoir flows through the automatic brake valve to the connection marked *ABV*, to chamber *d* under diaphragm 28. Air from the feed valve pipe enters at connection *FVP* and flows to chamber *f* above diaphragm 28. In addition to this, regulating spring 27 also acts upon the upper side of the diaphragm.

Q. 135. What is the adjustment of this spring?

A. About 20 pounds.

Q. 136. What total pressure is, therefore acting upon the upper side of diaphragm 28?

A. Whatever pressure the feed valve pipe may have, plus the tension of the regulating spring 27.

Q. 137. What pressure in chamber *d* below diaphragm 28 will be required to overcome that acting on the upper side of the diaphragm?

A. A pressure slightly higher than that in the feed valve pipe plus the spring pressure. For example, with a pressure of 70 pounds in the feed valve pipe, about 90 pounds pressure below diaphragm 28 will be required to overcome that acting upon the upper side of the diaphragm.

Q. 138. How does a variation in feed valve adjustment affect the governor?

A. When the feed valve adjustment is changed from one amount to another as where the locomotive is used alternately in high speed brake and ordinary service, the excess pressure head of the governor automatically changes the main reservoir pressure so as to maintain the same excess pressure (20 pounds).

Q. 139. Why is this of advantage?

A. Because it insures that the main reservoir pressure will always be 20 pounds higher than that of the feed valve pipe.

Q. 140. Explain the operation of the governor when main reservoir pressure in chamber *d* below diaphragm 28 becomes slightly higher than that acting on top of the diaphragm.

A. Diaphragm 28 will rise, unseat its pin valve 33, and allow air to flow to chamber b above the governor piston 6, forcing the latter down, compressing piston spring 9 and restricting the flow of steam past steam valve 5 to a point where the compressor will just supply the leakage in brake system.

Q. 141. How long will the flow of steam through the governor be restricted in this manner?

A. Until main reservoir pressure in diaphragm chamber *d* becomes reduced slightly below the combined spring and air pressure in chamber *f* above the diaphragm, which will then force diaphragm down, seating its pin valve.

Q. 142. How does this effect the flow of steam through the governor?

A. As chamber *b* is always open to the atmosphere through the small vent port *c*, the air pressure in chamber *b* above the governor piston 6 will then escape to the atmosphere and allow piston spring 9 and the steam pressure below valve 5 to raise it and the governor piston 6 to the position shown. Fig. 32.

Q. 143. With the automatic brake valve handle in *release, running* or *holding* position, does the maximum pressure head operate?

A. No; as during this time its diaphragm pin valve remains seated.

Q. 144. To what is chamber *a* in the maximum pressure head always connected?

A. To the main reservoir.

Q. 145. When does the maximum pressure head of the governor control the operation of the compressor?

A. When the automatic brake valve handle is in *lap, service* or *emergency* position, or when the main reservoir cut-out cock is closed.

Q. 146. With the automatic brake valve handle in *lap*, *service* or *emergency* position, or when the main reservoir cut-out cock is closed, what pressures act on the diaphragm 20 of the maximum pressure head?

A. Main reservoir pressure which flows directly to chamber *a* on the underside of diaphragm 20 and the pressure of regulating spring 19 on the upper side.

Q. 147. What is the adjustment of spring 19?

A. Spring 19 is adjusted to the maximum pressure which is desired in the main reservoirs.

Q. 148. Explain the operation of the governor when main reservoir pressure in chamber "a" exceeds the tension of spring 19.

A. When main reservoir pressure in chamber *a* slightly exceeds the adjustment of spring 19, diaphragm 20 will rise, unseat its pin valve 33, and allow air to flow into chamber *b* above the governor piston, forcing it down, compressing its spring 9 and restricting the flow of steam past steam valve 5 to a point where the compressor will just supply the leakage in brake system.

Q. 149. How long will the flow of steam through the governor be restricted in this manner?

A. When main reservoir pressure in chamber *a* becomes slightly reduced, the spring 19 forces diaphragm 20 down, seating its pin valve. As chamber *b* is always open to the atmosphere through the small vent port *c*, the pressure in chamber *b* above the governor piston 6 will then escape to the atmosphere and allow the piston spring 9 and steam pressure below valve 5 to raise the valve and governor piston to the position shown. Fig. 32.

Q. 150. Is the maximum pressure head of the governor in any way controlled by the automatic brake valve?

A. No; as the chamber *a* below the diaphragm is in no way connected to the brake valve.

Q. 151. With the automatic brake valve handle in *lap*, *service* or *emergency* positions or when the main reservoir cut-out cock is closed why does not the excess pressure head operate instead of the maximum pressure head?

A. Because under these conditions, communication from the main reservoir to chamber *d* is cut off by the brake valve and at the same time connection from the feed valve pipe to chamber *f* above diaphragm 28 still remains open, so that the combined air and spring pressure on top of the diaphragm holds the pin valve to its seat, rendering the excess pressure head inoperative.

Q. 152. Under ordinary running conditions, why is only a moderate excess pressure desirable?

A. Because most of the time the automatic brake valve handle is in *running* position, (keeping the brakes charged) but little

excess pressure is needed and the governor regulates the main reservoir pressure to about 20 pounds above the brake pipe pressure, thus relieving the compressor of unnecessary work.

Q. 153. When an application of the brakes is made, why is the higher excess pressure of advantage?

A. To insure a prompt release of the brakes and recharge of the system.

DEAD ENGINE FIXTURES.

Q. 154. What are the parts composing the dead engine fixtures.

A. A ⅜-inch pipe connecting the brake pipe and main reservoir pipe, a combined strainer and check valve with choke fitting, and a ⅜-inch cut-out cock.

Q. 155. What is the purpose of the "Dead Engine" feature of the ET Equipment?

A. To enable the compressor on a "live" engine to charge the main reservoir on a "dead" engine, so that the brake on the dead engine may be operated with the other brakes in the train.

Q. 156. How is this done?

A. Air from the main reservoir of the live engine passes through the brake pipe and dead engine fixtures to the main reservoirs of the dead engine.

Q. 157. When is this apparatus used?

A. Only when the air compressor on the locomotive is inoperative.

Q. 158. Should the cut-out cock always be closed except when the compressor is inoperative?

A. Yes.

Q. 159. Describe the flow of air through the combined strainer and check valve. Fig. 33.

A. With the cut-out 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 pipe.

Q. 160. Why is the "strong" spring 2 used in this valve?

A. This spring over the check valve insures the valve seating and keeps the main reservoir pressure somewhat lower than the brake pipe pressure, yet assures ample pressure to operate the locomotive brakes.

Q. 161. What is the object of the choke fitting?

A. It prevents a sudden drop in brake pipe pressure and the application of the brakes in the train, as might otherwise occur with uncharged main reservoirs cut into a charged brake

pipe or if for any reason the main reservoir pressure was lower than the brake pipe pressure.

Q. 162. How can the maximum brake cylinder pressure be regulated on a dead engine?

A. By the adjustment of the safety valve on the distributing valve.

Q. 163. Can the brake on a dead engine be controlled with the independent brake valve the same as on a live engine?

A. Yes, if it becomes necessary.

Q. 164. When the dead-engine feature is used, in what position should the automatic and independent brake valve handles be carried?

A. *Running* position.

Q. 165. What should be the position of the double heading cock?

A. Closed.

Q. 166. Is it sometimes desirable to keep the braking power of a locomotive below the standard?

A. Yes; when there is no water in the boiler.

Q. 167. How is this done?

A. By adjusting the safety valve on the distributing valve to the maximum brake cylinder pressure which is desired in the locomotive brake cylinders.

AIR GAGES.

Q. 168. How many and what type of gages are used in connection with the ET Equipment?

A. Two duplex gages, designated—No. 1, Large Duplex Air Gage; No. 2, Small Duplex Air Gage. (See Figs. 1-A and 1-B.)

Q. 169. What pressures are indicated by gage No. 1?

A. Red Hand, Main Reservoir Pressure; Black Hand, Equalizing Reservoir Pressure.

Q. 170. What pressures are indicated by gage No. 2?

A. Red Hand, Brake Cylinder Pressure; Black Hand, Brake Pipe Pressure.

Q. 171. Which gage hand shows the amount of reduction being made during a service application of the brakes?

A. Black Hand, Gage No. 1.

Q. 172. Why, then, is the black hand of gage No. 2 necessary?

A. To show brake pipe pressure when engine is second in double-heading or a helper.

Q. 173. What pressure is indicated by the red hand of gage No. 2 when operating the automatic or independent brake valve?

A. Brake cylinder pressure.

CUT-OUT COCKS.

Q. 174. What provision is made for cutting off the main reservoirs from the brake system?

A. The main reservoir cut-out cock in the main reservoir pipe.

Q. 175. What takes place when this cock is closed?

A. The flow of air from the main reservoirs is cut off and the air in the brake system back of it is exhausted to the atmosphere.

Q. 176. When this cock is closed can air flow from the main reservoirs to any part of the system?

A. Yes; to the maximum pressure head of the pump governor.

Q. 177. Why is this necessary?

A. To provide for the automatic control of the compressor when the cut-out cock is temporarily closed.

Q. 178. What provision is made for cutting out the driver brake?

A. A ¾-inch cut-out cock located in the pipe leading from the distributing valve to the driver brake cylinders.

Q. 179. What provision is made for cutting out the tender brake?

A. A ¾-inch cut-out cock located in the pipe between the distributing valve and the hose connection leading to the tender brake cylinder.

Q. 180. What difference is there between this cock and the ¾-inch cocks generally used?

A. It has a choke fitting.

Q. 181. Why is this choke fitting used?

A. To prevent a loss of driver and truck brake cylinder pressure in the event of a hose or tender brake cylinder pipe bursting.

Q. 182. Is there another cock with choke fitting sometimes used in connection with this apparatus?

A. Yes; when a truck brake is used a ½-inch cock is located in the pipe leading from the distributing valve to the truck brake cylinder with choke fitting.

Q. 183. For what purpose is the ¾-inch cut-out cock in the main reservoir supply pipe to the distributing valve?

A. To cut off the supply of air from the main reservoirs to the distributing valve to permit of inspection and repairs.

Q. 184. For what purpose is the one-inch double heading cock underneath the brake valve?

A. To cut off the flow from the automatic brake valve to the brake pipe or vice versa.

Q. 185. What is the purpose of the brake pipe air strainer.

A. To prevent foreign matter entering the distributing valve, which might seriously interfere with its proper operation.

AIR SIGNAL SYSTEM.

Q. 186. From what source is the supply of air to the signal system obtained with the ET Equipment?

A. From the reducing valve pipe between the reducing valve and the independent brake valve, as shown in Figs. 1-A and 1-B.

Q. 187. Why is this supply taken from the reducing valve pipe?

A. That the one reducing valve may govern the pressure for both the independent brake valve and the signal system.

Q. 188. What device is interposed between the reducing valve pipe and the air signal pipe?

A. A combined strainer and check valve.

Q. 189. Why is the strainer necessary?

A. To protect the check valve and signal system from foreign matter.

Q. 190. Why is the check valve employed?

A. To prevent a back flow of air from the signal pipe to the reducing valve pipe.

Q. 191. In what way does this combined strainer and check valve differ from that used with the dead engine fixtures?

A. Only in the tension of the check valve spring.

GENERAL OPERATION OF THE NO. 6 EQUIPMENT.

NOTE.—Details of construction and operation of the various devices will be found under their respective headings.

Q. 192. What is the proper position of the brake valve handles and cut-out cocks before starting the compressor?

A. The automatic and independent brake valve handles in *running* position all cut-out cocks must be open, except the ⅜-inch cut-out cock in the dead engine connection and the angle and stop cocks at the front and rear end of the locomotive.

Q. 193. Explain the charging of the ET Equipment.

A. While the compressor is operating, the main reservoir pressure continues to rise until it reaches the point for which the governor is adjusted. The governor then automatically stops the compressor. From the main reservoirs air flows through the main reservoir pipe to the chamber above the application valve of the distributing valve. It also flows to the feed valve which reduces the pressure of the air to that carried in the brake pipe. The air at this reduced pressure flows through the automatic

brake valve to the brake pipe and thence through the branch pipe and distributing valve to the pressure chamber charging it up to brake pipe pressure. Air also flows from the main reservoirs through the reducing valve to the independent brake valve and air signal system.

Q. 194. What must be done to make an automatic service application of the brake?

A. Move the automatic brake valve handle to *service* position.

Q. 195. How does this apply the brake?

A. It starts a reduction of brake pipe pressure which causes the distributing valve to operate so as to allow air to flow from the main reservoirs into the brake cylinders.

Q. 196. How is the application of the brake limited to any desired cylinder pressure?

A. By returning the automatic brake valve handle to *lap* position.

Q. 197. What must be done to make an emergency application of the brakes?

A. Move the automatic brake valve handle to *emergency* position.

Q. 198. How does an emergency application of the brake differ from a service application?

A. Brake pipe reduction takes place more rapidly, brake cylinder pressure rises more quickly and a higher brake cylinder pressure is obtained than in service applications.

Q. 199. In what position should the automatic brake valve handle be placed to release the locomotive brake?

A. *Running* position.

Q. 200. Is there any position besides *running* position in which the locomotive brake can be released by the use of the automatic brake valve?

A. No.

Q. 201. Can the locomotive brake be applied otherwise than by using the automatic brake valve?

A. Yes. By the independent brake valve.

Q. 202. In what position should the independent brake valve handle be placed to apply the locomotive brakes?

A. *Application* position.

Q. 203. How does this apply the brake?

A. It allows air to flow from the reducing valve through the independent brake valve to the distributing valve, causing it to operate and allow air to flow from the main reservoirs into the brake cylinders at a reduced pressure.

Q. 204. Is the operation of the train brakes affected in any way by the independent application of the locomotive brakes?

A. No.

Q. 205. How is the independent application of the locomotive brake limited to any desired cylinder pressure?

A. By returning the independent brake valve handle to *lap* position.

Q. 206. How can the locomotive brake be released by the independent brake valve?

A. (a) If the automatic brake valve handle is in *running* position, move the independent brake valve handle to *running* position.

(b) If the automatic brake handle is *not* in *running* position, the independent brake valve handle must be moved to *release* position.

Q. 207. Can the locomotive brake be released without in any way interfering with the train brakes under any and all conditions?

A. Yes; by placing the independent brake valve handle in *release* position.

TESTING AND OPERATING THE ET EQUIPMENT.

TESTING LOCOMOTIVE BRAKE.

Q. 208. Preparatory to making a test of the brake what should be done?

A. Blow out the brake pipe and signal pipe by opening and closing quickly a number of times the angle and stop cocks, both at the pilot and rear of the tender.

Q. 209. Why is this done?

A. To remove scale and other foreign matter that may be in the brake and signal pipes.

Q. 210. What observations should the engineer make before taking the engine to the train?

A. He should observe by the gages that the proper pressures are present indifferent parts of the system. This will show that the regulating devices (governors, feed valves, etc.) are properly adjusted. He should also observe that the brake is in proper condition generally.

Q. 211. What test should then be made?

A. The brake should be applied and released with both the automatic and independent brake valves, to determine if the brake is in proper operative condition.

MANIPULATION OF LOCOMOTIVE AND TRAIN BRAKES.

Q. 212. What is the proper position of the automatic and independent brake valve handles when not being operated?

A. *Running* position.

Q. 213. After attaching the engine to the train in what position should the automatic brake valve be carried while charging the train brakes?

A. *Release* position.

Q. 214. How long should the brake valve handle be left in this position?

A. Until the brake pipe system is charged to the pressure to be carried.

Q. 215. How should the automatic brake valve be handled when testing the brakes?

A. A full service application of the brakes should be made and the handle then moved to *lap* position.

Q. 216. How should the brakes be released?

A. Place the brake valve handle in *release* position for the proper length of time, then return it to *running* position, leaving it there.

Q. 217. If the brakes apply in emergency from an unknown cause, while train is running, what should be done?

A. Move automatic brake valve handle quickly to *emergency* position and leave it there until train stops.

Q. 218. Why is this done?

A. To insure the brakes remaining applied and to prevent loss of main reservoir pressure.

Q. 219. What must be done in the event of sudden danger?

A. Move the automatic brake valve handle quickly to *emergency* position and leave it there until the train stops and the danger is past.

Q. 220. With brakes applied in emergency, would anything be gained by moving the independent brake valve handle to *application* position?

A. No. Because in an application of this kind the application cylinder pressure is higher than the maximum pressure obtainable with the independent brake.

Q. 221. If, in making a stop, the driving wheels slide, can they be released?

A. Yes; by placing the independent brake valve handle in *release* position and holding it there until the wheels again revolve, reapplying the brakes, if desired, with this brake valve.

Q. 222. In the event of releasing and reapplying the locomotive brake in this manner, in what position should the independent brake valve handle be left after the application is made?

A. *Running* position.

Q. 223. Why?

A. Because if left in any other position the locomotive brake cannot be released by the automatic brake valve.

Q. 224. Does the releasing and reapplying of the engine and tender brakes with the independent brake valve in this way have any effect on the train brakes?

A. No; as the operation of the independent brake valve does not interfere with the train brakes.

Q. 225. In making a service application, how should the automatic brake valve be handled?

A. The same as with the older types of brake valves.

Q. 226. In making the first release of a two-application stop, how should the brake valve be handled?

A. (a) With short passenger trains release the brakes by moving the brake valve handle to *running* position a sufficient length of time to start the locomotive and train brakes releasing, then to *lap* position.

(b) With the long passenger trains the brake valve handle should be moved to *release* position for about three seconds to start the train brakes releasing, then to *running* position to partly release the locomotive brake, then to *lap*.

Q. 227. In making the final release of a two-application stop, how should the automatic brake valve be handled?

A. (a) With short passenger trains, release the brakes just before coming to a stop by moving the brake valve handle to *running* position and leaving it there.

(b) With long passenger trains, the brakes should be held applied until the train stops.

Q. 228. In making a release after a one-application stop, how should the brake valve be handled.

A. The same as a final release of a two-application stop, as just explained.

Q. 229. Why is it necessary to move the automatic brake valve handle promptly to *running* position after going to *release* in releasing the brakes?

A. Because with the brake valve in *release* position, the locomotive brake is held applied.

Q. 230. What is the only position of the automatic brake valve handle which will permit the release of both the locomotive and train brakes together?

A. *Running* position.

Q. 231. Is there any other position besides *running* position which will release train brakes?

A. Yes; *release* position and *holding* position.

Q. 232. Is there any other than running position in which the locomotive brake can be released by the automatic brake valve?

A. No.

Q. 233. Can the locomotive brake always be released by placing the automatic brake valve handle in *running* position?

A. No.

Q. 234. Why?

A. Because if the independent brake valve handle is not in *running* position, the locomotive brake cannot be released by the automatic brake valve.

Q. 235. If the driving wheels pick up and slide while making a stop, what should be done?

A. Release with the independent brake valve.

Q. 236. In handling a light locomotive, which brake valve should be used?

A. The independent brake valve.

Q. 237. For a gradual application of the locomotive brake, how should the independent brake valve be used?

A. Place the brake valve handle in *slow-application* position until the brake is sufficiently applied; then return it to *lap* position.

Q. 238. How operated if a quick application of the locomotive brake is desired?

A. Place the independent brake handle in quick-application position until the brake is sufficiently applied, then return it to *lap* position.

Q. 239. Should the independent brake valve be used in completing a train stop?

A. No.

Q. 240. Why?

A. Because to apply the locomotive brake with the train brakes released will cause slack to run in and produce shocks.

Q. 241. In case of emergency, should the independent brake valve be used on a light locomotive?

A. No; in *all* cases of emergency, move the *automatic* brake valve handle to *emergency* position.

Q. 242. Why?

A. Because a considerably higher brake cylinder pressure is obtained than would be possible with the use of the independent brake valve.

Q. 243 How can the locomotive brake always be released regardless of the position either brake handle may be in?

A. By placing the independent brake valve handle in *release* position.

Q. 244. How can the locomotive brake be held applied while releasing the train brakes?

A. By moving the automatic brake valve handle to either *release* or *holding* positions.

Q. 245. Can this be done in any other way?

A. Yes; by placing the independent brake valve handle in *lap* position.

Q. 246. Why should not the independent brake valve be used for this purpose?

A. First—Because it is better to use the automatic brake valve alone instead of in conjunction with the independent brake valve. Second—Because if the independent brake valve is used for this purpose, it may be left in *lap* position by mistake and the proper operation of the brakes by the automatic brake valve interfered with.

Q. 247. Why should the automatic brake valve handle never be left in *lap* position except while bringing the train to a stop?

A. Because if the handle is left in *lap* position when the brakes are not applied, brake pipe leakage may materially reduce the brake pipe and auxiliary reservoir pressures, so that full braking power cannot be obtained and because the driver brakes are likely to apply as the outlet from the application chamber is closed.

Q. 248. If, after a brake application, the automatic brake valve handle is moved to *release* position and returned to *lap* position, what will be the result?

A The locomotive brake will remain applied.

Q. 249. What is the advantage of having the locomotive brake remain applied under these conditions?

A. It would serve as a warning in case of neglect to move the handle to the proper position.

Q. 250. Would anything be gained by moving the automatic brake valve handle to *release* position for a short time just before making an application of the brakes?

A. No; this should never be done.

Q. 251. Why?

A. Because by placing the automatic brake valve handle in *release* position the brake pipe will be charged higher than the pressure in the auxiliary reservoirs; consequently, the brakes cannot be applied until after this difference in pressure has been drawn off.

FREIGHT BRAKING.

Q. 252. What feature of the No. 6 ET Equipment is of particular advantage in handling trains on long, descending grades?

A. The ability to handle the locomotive brake with or entirely independent of the train brakes.

Q. 253. What is gained by this?

A. The locomotive and train brakes can be alternated without interfering with each other.

Q. 254. With all the brakes applied, can the locomotive brake be released without releasing the train brakes?

A. Yes.

Q. 255. How can this be done?

A. By placing the handle of the independent brake valve in *release* position, holding it there until the brake is released.

Q. 256. After releasing in this manner, where should the handle of the independent brake valve be placed?

A. *Running* position.

Q. 257. If it is then desired to release the train brakes and recharge the reservoirs, and reapply the locomotive brakes, in order to assist the retaining valves, in holding the train, how can this be accomplished?

A. Place the independent brake valve handle in *application* position until the desired locomotive brake cylinder pressure is obtained, then return it to *running* position, then move the automatic brake valve handle to *release* position and leave it there until the train is charged.

Q. 258. What is the maximum pressure obtainable in the brake pipe under these conditions?

A. As the excess pressure head of the duplex governor will be in control, the maximum pressure obtainable will be twenty pounds above that ordinarily carried in the brake pipe.

Q. 259. When reapplying the train brakes, how can excessive locomotive brake cylinder pressure be prevented?

A. By partially releasing the locomotive brake with the independent brake valve before reapplying the train brakes.

Q. 260. How can the overheating of driving wheel tires be prevented?

A. By either holding the independent brake valve handle in *release* position when making an automatic application or by releasing immediately with the independent brake valve after the automatic application.

Q. 261. When releasing the brakes on a freight train when in motion should the automatic brake valve be handled in the same manner as with passenger trains?

A. No; the brake valve handle should be moved to *release* position and allowed to remain there for a period of time, according to the length of the train, but not to exceed twenty seconds.

Q. 262. Why should this be done?

A. To insure a proper release of the train brakes and hold the locomotive brake applied, thus preventing the slack of the train running out.

Q. 263. In making releases on long trains, after brake valve handle has been returned to *running* position, should it again be moved to *release* position for an instant?

A. Yes; after being in *running* position for about three seconds.

Q. 264. Why?

A. Because in making such a release some of the head brakes may have been overcharged and may reapply.

BROKEN PIPES.

Q. 265. What would be the result if the brake pipe branch to the distributing valve broke off?

A. The locomotive and train brakes would apply.

Q. 266. What should be done if this happens on the road?

A. Plug the end leading from the brake pipe; release the locomotive brake by placing the independent brake valve handle in *release* position and proceed.

Q. 267. Would it be possible to use the locomotive brake in this case?

A. Yes; with the independent brake valve, always using *release* position to release the brake.

Q. 268. What would be the result if any of the pipe connections between the distributing valve and the brake cylinders broke off?

A. It would permit a constant escape of air when the brake is applied and may cause the release of one or more of the locomotive brake cylinders, depending on where the break occurs.

Q. 269. What should be done in a case of this kind?

A. If the pipe cannot be repaired, close the cut-out cock in the pipe leading to the broken pipe. If breakage occurs next to the distributing valve reservoir, close the cut-out cock in the distributing valve supply pipe.

Q. 270. What would be the effect if the supply pipe to the distributing valve broke off?

A. It would permit main reservoir pressure to escape and prevent the use of the locomotive brake.

Q. 271. What should be done?

A. If repairs cannot be made to the pipe, the cut-out cock in the supply pipe should be closed or the pipe plugged.

Q. 272. What would be the effect if the application cylinder pipe to the distributing valve broke off?

A. It would be impossible to apply the locomotive brake.

Q. 273. What should be done?

A. The connection to the distributing valve should be plugged and the brake could then be applied, but with the automatic brake valve only.

Q. 274. With this opening plugged and the brake automatically applied, can it be released with the independent brake valve?

A. No. It can only be released by placing the automatic brake valve handle in *running* position.

Q. 275. If the release pipe to the distributing valve breaks off, what would be the effect?

A. It would cut out the holding feature of the automatic brake valve.

Q. 276. With this pipe broken off would it interfere with the independent operation of the brake?

A. Yes; if an independent application was made and the equalizing parts of the distributing valve were in release position, it would allow the independent brake to release when the independent valve was moved to lap position.

Q. 277. With this pipe broken off and the brakes automatically applied, can they be released with the independent brake valve?

A. Yes.

Q. 278. Should any delay be occasioned by the breaking off of this pipe?

A. No. Proceed and operate the brake with the automatic brake valve but without attempting to use the holding feature.

Q. 279. What would be the effect if the pipe connection to the spring chamber of the excess pressure head of the pump governor broke off?

A. The compressor would not operate when the main reservoir pressure was about forty pounds or over.

Q. 280. What should be done in this case?

A. Plug the broken pipe and place a blind gasket in the pipe leading to the chamber below the diaphragm of the excess pressure head.

Q. 281. What should be done if the pipe connection leading to the chamber below the diaphragm of the excess pressure head breaks off?

A. Plug the broken pipe and proceed.

Q. 282. With the lower pipe to the excess pressure head plugged, or with both pipes plugged, what would control the compressor?

A. The maximum pressure head.

Q. 283. What should be done in the event of the pipe connection to the maximum pressure head breaking off?

A. Plug the pipe.

Q. 284. What would control the compressor?

A. The excess pressure head.

Q. 285. In such a case, would the excess pressure head control the compressor at all times?

A. No; only with the automatic brake valve handle in *release, running,* or *holding* positions.

Q. 286. What would happen if the handle were left in *lap. service* or *emergency* positions or it became necessary to close the main reservoir cut-out cock for any length of time?

A. The governor then being out of commission, the compressor will continue to run until air pressure and steam pressure become approximately equal.

Q. 287. What precaution should be taken with the governor out of commission in this way?

A. Compressor should be throttled so that too high a main reservoir pressure could not be obtained and in case of main reservoir cock being closed compressor should be shut off.

Q. 288. What should be done if the equalizing reservoir pipe breaks off?

A. Plug the equalizing reservoir pipe to the brake valve and the service exhaust opening. The brakes should then be applied in service by a careful use of the *emergency* position.

Q. 289. Why should extreme care be used when operating the brake valve in this manner?

A. To avoid causing quick-action and to prevent the head brakes "kicking" off when returning to *lap* position.

ROUND HOUSE INSPECTORS TEST.

General:

Q. 290. What are the objects of these tests?

A. To determine the condition of the detail parts of the ET Equipment.

Q. 291. What should be done by the round house air-brake inspector when testing the brakes preparatory to turning out the engine on the road?

A. The following cocks must be closed: The drain cocks in the main reservoirs, the brake pipe angle cocks and the signal pipe cut-out cocks at each end of the locomotive, and the ⅜-inch cut-out cock in the dead engine pipe.

The following cocks must be opened: Main reservoir cut-out cock, distributing valve cut-out cock, the double-heading cock and cut-out cocks in the brake cylinder pipes.

Both the automatic and independent brake valve handles should be in *running* position before starting the compressor.

Q. 292. When the locomotive brake system has become fully charged what should first be done?

A. Blow out the brake pipe and signal pipe by opening and closing quickly a number of times the angle and stop cocks, both at the pilot and rear of the tender.

Q. 293. Why is this done?

A. To remove scale and other foreign matter that may be in the brake and signal pipes.

Q. 294. What pressure should there be in the brake pipe and distributing valve before testing the brake?

A. The standard brake pipe pressure for the service in which the locomotive is to be used.

Q. 295. What are the parts that should be tested first?

A. The air gages.

Q. 296. What method should be employed to test the air gages?

A. Use a test gage that is known to be correct. This gage should be coupled to the front or to the rear brake pipe hose; then with system charged and automatic brake valve in *release* position, note if main reservoir, equalizing reservoir and brake pipe pressures as indicated by the air gages correspond with the pressure indicated on the test gage.

Q. 297. How should the brake cylinder gage be tested?

A. Connect the test gage to the brake cylinder, make a brake application, and see that the brake cylinder gage registers with the test gage.

Q. 298. What test should follow the gage test?

A. A test of the pump governor.

Q. 299. How should this test be made?

A. Place the automatic brake valve handle in *running* position. In this position main reservoir pressure should register twenty pounds higher than that in the brake pipe. Then place the handle in *lap* position. In this position the main reservoir pressure should register the maximum pressure standard on the road for the class of service to which the engine is assigned.

Q. 300. What should next be done?

A. The feed valve should be tested.

Q. 301. How should the feed valve be tested?

A. Place the automatic brake valve handle in *running* position to see that the feed valve regulates the brake pipe pressure to the proper standard.

Q. 302. What test should follow the feed valve test?

A. A test of the automatic rotary valve for leakage.

Q. 303. How should this be tested?

A. Make a 20-pound service reduction, place the handle on *lap* position and close the double-heading cut-out cock under the brake valve. Harmful rotary valve leakage will be denoted in a few seconds by a material increase of pressure in the equalizing reservoir (shown on gage) or by the equalizing piston lifting.

Q. 304. Would any other defect cause the equalizing piston to lift?

A. Yes; a leak from the equalizing reservoir, which will be shown on the gage, will cause this. If the piston lifts, due to a rotary valve leak, however, the gage hand does not fall.

Q. 305. What should next be done?

A. The locomotive brake pipe should be tested for leakage.

Q. 306. How should test be made for break pipe leakage?

A. Charge the brake pipe and system to maximum pressure, then make a five-pound service application and observe the fall in brake pipe pressure as indicated by the *brake pipe gage*, not by the equalizing reservoir gage.

Q. 307. What should the limit of this leakage be?

A. It should not exceed five pounds per minute.

Q. 308. What test should be made to determine if the brake is in good order?

A. Apply the brake by making a full service application with the automatic brake valve, and if it applies properly, release by placing the automatic brake valve handle in *running*

position and note if the brake shoes properly clear the wheels and the cylinder pistons return to the end of the cylinder.

Q. 309. What other test should be made?

A. Apply the brake with the independent brake valve, noting that a full application (forty-five pounds) is registered by the red hand of the small air gage and that the hand returns to zero when the brake is fully released.

Q. 310. With the independent brake valve handle in *quick-application* position how long should it take to get forty-five pounds cylinder pressure?

A. From two to four seconds.

Q. 311. How long should it then take from the time the independent brake valve handle is placed in *release* position until the flow of air from the application chamber at the brake valve ceases.

A. From two to three seconds.

Q. 312. What should be observed regarding piston travel?

A. That the piston travel is only sufficient to give proper brake shoe clearance.

Q. 313. What is usually about the proper piston travel?

A. Driver brakes about four inches; engine truck brake about six inches, and tender brake about seven inches standing travel.

Q. 314. Why is too long piston travel objectionable?

A. It may cause a loss of the brake due to the piston striking the head or levers fouling, which will lengthen the time of release of the brake and cause a waste of air.

PUMP GOVERNOR TEST.

Q. 315. Before adjusting the pump governor, what should be observed?

A. That all air pipe connections are tight and that the vent port and drain port are open.

Q. 316. What would be the effect of a stopped-up vent port?

A. There might be a considerable drop in main reservoir pressure before the compressor would start.

Q. 317. If, in addition to a stopped-up vent port, either diaphragm pin valve were leaking, what would be the effect?

A. The compressor would not operate when the main reservoir pressure was about forty pounds or over.

Q. 318. What would be the effect of a stopped-up drain port?

A. The governor would not shut off the compressor.

Q. 319. If, with the handle of the automatic brake valve in *running* position, the main reservoir and brake pipe pressures do not stand 20 pounds apart, where is the trouble?

A. In the adjustment of the excess pressure head of the pump governor.

Q. 320. What should then be done?

A. The excess pressure head of the pump governor should be properly adjusted.

Q. 321. Before commencing to adjust the excess pressure head, what is it important to note?

A. First—That the maximum pressure head is adjusted higher than the standard main reservoir pressure to be carried with the handle of the brake valve in *running* position. Second—That the air brake pressure is known to be correct. Third—That there is no obstruction either in the main reservoir connection to the chamber under the diaphragm of the excess pressure head or in the pipe connection to the spring chamber.

Q. 322. How should the adjustment of the excess pressure head be made?

A. Remove the cap nut from the excess pressure head and screw the regulating nut up or down, as may be required.

Q. 323. With the automatic brake valve handle in *lap* position if the main reservoir pressure varies from the maximum employed on the road, where is the trouble?

A. In the maximum pressure governor head.

Q. 324. If such variation exists, what should be done?

A. The maximum head should be properly adjusted.

Q. 325. In case of a steady blow of air from the vent port when the compressor is operating, where is the trouble?

A. A leak past the seat of one or both of the diaphragm pins valves.

FEED VALVE TEST.

Q. 326. How should the B-6 feed valve be tested?

A. With brake released and system charged to standard pressure, open the angle cock at the rear of the tender sufficiently to represent a brake pipe leakage of from seven to ten pounds per minute and observe the brake pipe gage pointer.

Q. 327. With this amount of brake pipe leakage, what should the brake pipe gage pointer do?

A. It should fluctuate.

Q. 328. What does this fluctuation of the gage pointer indicate?

A. The opening and closing of the supply valve of the feed valve.

Q. 329. If the gage hand does not fluctuate, what does it indicate?

A. That the supply valve piston is too loose a fit, and that the brake pipe leakage is being supplied past this piston and the regulating valve.

Q. 330. How much variation should there be between the opening and closing of the feed valve supply valve?

A. Not more than two pounds.

Q. 331. If the variation is more than two pounds, what does it indicate?

A. Undue friction of the parts or a sticky or dirty condition of the operating parts of the valve, causing insufficient opening past the piston.

Q. 332. If the feed valve charges the brake pipe to a pressure higher than that for which it is adjusted, what does it indicate?

A. That the piston has been made too tight a fit by oil or water.

Q. 333. If the feed valve charges the brake pipe too slowly when nearing its maximum, what does it indicate?

A. Either a loose fitting piston or a gummy condition of the regulating valve.

REDUCING VALVE TEST.

Q. 334. How should the C-6 reducing valve be tested?

A. First, with the system charged to standard pressure, fully apply the independent brake (handle in *slow-application* position) and note the amount of brake cylinder pressure obtained.

Q. 335. What should this pressure be?

A. Forty-five pounds

Q. 336. If, in this test, the brake cylinder pressure is other than forty-five pounds, what does it indicate?

A. A leaky supply valve, a leaky regulating valve, or that the reducing valve is out of adjustment.

Q. 337. After completing the test, what next should be done?

A. Release the brake and make an application in *quick-application* position.

Q. 338. How can the reducing valve be tested for sensitiveness?

A. By applying a test gage to the signal line hose, and produce a leakage of from seven to ten pounds per minute in the signal line pipe and note the fluctuation of the gage pointer.

Q. 339. What is important in making this test?

A. It must be known that the combined strainer and check valve is in a condition to permit a free flow of air through it.

Q. 340. What other diseases might affect the operation of the reducing valve?

A. Those given in questions 329 to 333 for the feed valve.

AUTOMATIC BRAKE VALVE TEST.

Q. 341. What should be observed concerning the automatic brake valve?

A. That all its pipe connections are tight and that the handle moves freely between its various positions and that the handle latch and its spring are in good condition.

Q. 342. If the handle does not operate easily, what are the probable causes?

A. A dry rotary valve seat, a dry rotary valve key gasket or a dry handle latch.

Q. 343. What should be done?

A. Rotary valve and seat, rotary valve key and handle latch should be properly lubricated.

Q. 344. What is the proper method of lubricating the valve and seat?

A. Close the double-heading cock under the brake valve, then the main reservoir cut-out cock and after the air pressure has escaped, remove the oil plug in the valve body and fill the oil hole with valve oil.

Q. 345. After filling the oil hole and before replacing the oil plug, what should be done?

A. The handle should be moved a few times between *release* and *emergency* positions to permit the oil to work in between the rotary valve and its seat. The oil hole should then be refilled and the oil plug replaced.

Q. 346. How should the rotary valve key and gasket be lubricated?

A. Remove the cap nut from the rotary valve key and fill the oil hole.

Q. 347. Before replacing the cap nut, what should be done?

A. Push down on the key and rotate the handle a few times between *release* and *emergency* positions; then refill the oil hole and replace the cap nut.

Q. 348. If the handle latch becomes dry, what should be done?

A. Lubricate the sides of the latch and the notches on the quadrant.

Q. 349. If, with the handle in *release*, *running*, *holding* or *lap* positions, there is a leak at the brake pipe service exhaust, what does it indicate?

A. That the equalizing piston valve is unseated, probably due to foreign matter.

Q. 350. How can this leak usually be stopped?

A. By closing the double-heading cut-out cock under the brake valve, making a heavy service application and returning the brake valve handle to *release* position. This will cause a heavy blow at the service exhaust fitting and usually remove the foreign matter and allow the valve to seat.

Q. 351. With the handle of the automatic brake valve in *service application* position, brake pipe pressure seventy pounds, how long should it take to reduce the equalizing reservoir pressure twenty pounds?

A. From six to seven seconds.

Q. 352. From a brake pipe pressure of 110 pounds, how long should it take?

A. From five to six seconds.

Q. 353. In case the equalizing reservoir pressure reduces considerably faster than the time given, what is the probable cause?

A. Either an enlarged preliminary exhaust port, leakage past the rotary valve, seat, lower gasket, or in the equalizing reservoir and its connections to the brake valve or gage.

Q. 354. If the reduction is materially slower than the figures given, what is probably the cause?

A. A partial stoppage of the preliminary exhaust port or leakage into the equalizing reservoir.

Q. 355. How should test be made for a leaky rotary valve?

A. By placing the brake valve handle in *service* position and allowing it to remain there until the brake pipe gage pointer drops to zero; then close the double-heading cock under the brake valve and place the brake valve handle on *lap*. If a blow starts at the brake pipe exhaust, it indicates a leak by the rotary valve into the brake pipe; if an increase of pressure is noted on the equalizing reservoir gage it indicates a leak past the rotary valve or body gasket into the chamber above the equalizing piston and reservoir.

Q. 356. During this test, if an increase of brake cylinder pressure results or the safety valve blows intermittently, what does it indicate?

A. A leak by the rotary valve into the application cylinder of the distributing valve.

Q. 357. With the brake valve handle on *lap* position after making a service application, if the brake pipe service exhaust continues to blow and the air gage indicates a fall in pressure in both the equalizing reservoir and brake pipe, where should the trouble be looked for?

A. In the equalizing reservoir and its connections, both to the brake valve and to the air gage, and also the inner tube of the gage.

INDEPENDENT BRAKE VALVE TEST.

Q. 358. What are the important things to observe in connection with the independent brake valve?

A. That no external leakage exists in the brake valve or its pipe connections and that the handle and return spring work freely and properly.

Q. 359. What can cause the handle to move hard?

A. Lack of lubrication on the rotary valve and seat, rotary valve key and gasket or handle latch, same as with the automatic brake valve.

Q. 360. What should be done to make the handle move freely?

A. Follow the same recommendations as prescribed for the automatic brake valve.

Q. 361. Should the handle continue to work hard after the parts have been lubricated, where is the trouble?

A. Probably something is wrong with the return spring or its housing.

Q. 362. How should test for leaky rotary valve be made?

A. Make a partial independent application of the brakes, place the handle on *lap*, and note if brake cylinder pressure increases gradually to the limit of adjustment of the reducing valve.

Q. 363. Should the handle fail to automatically return to *running* position or to *slow-application* position, what is the probable cause?

A. Too much friction of the moving parts or a weak or broken return spring.

DISTRIBUTING VALVE TEST.

Q. 364. With the system charged to standard pressure, if a five-pound service reduction in brake pipe pressure fails to apply the locomotive brake, what is the probable cause?

A. Excessive friction in one or more of the operative parts of the distributing valve.

Q. 365. How should the test be made to determine which of the operating parts caused the trouble?

A. By recharging and then making a slow independent application. If the brake applies properly, the indications are that the trouble is in the equalizing portion of the distributing valve; if it does not, the indications are that it is in the application portion.

Q. 366. How frequently should the distributing valve be cleaned and oiled?

A. At least every six months.

Q. 367. What parts of the distributing valve should be lubricated?

A. All operating parts.

Q. 368. If water is found in the distributing valve, what is usually the cause?

A. Improper piping on the locomotive; not sufficient length of radiating pipe between the compressor and reservoirs.

Q. 369. How should the equalizing piston, slide valve and graduating valve be removed from the distributing valve?

A. Remove the equalizing cylinder cap and carefully pull out the piston and valves so as not to injure them.

Q. 370. How should the application piston, application valve and exhaust valve be removed?

A. First take off the application valve cover and remove the valve, then take out the application valve pin, after which the application cylinder cover should be removed and the piston and exhaust valve carefully pulled out.

Q. 371. Must the application valve pin always be removed before attempting to take out the application piston and exhaust valve?

A. Yes; if this is not done, damage will result, as the piston *cannot* be taken out unless the pin is removed.

Q. 372. With the valves removed from the distributing valve, what should be done?

A. Air should be blown through the ports and passages to remove any foreign matter.

Q. 373. Before assembling the parts, what should be done?

A. All seats and bushings should be thoroughly cleaned and carefully examined to see that no lint is on the seats.

Q. 374. What else should be given attention?

A. The feed groove in the equalizing piston bushing should be carefully cleaned out.

Q. 375. What should be the resulting brake cylinder pressure from a ten-pound brake pipe reduction?

A. About twenty-five pounds.

Q. 376. For each pound reduction of brake pipe pressure, what should be the resulting brake cylinder pressure?

A. About two and one-half pounds.

Q. 377. If, after a partial service application has been made and the brake valve lapped, the brake cylinder pressure continues to increase, what are the causes?

A. The most probable cause is brake pipe leakage. Others may be a leak past the automatic rotary valve, the independent rotary valve, the equalizing valve, or the graduating valve in the distributing valve.

Q. 378. What brake pipe pressure should be used when testing the ET Equipment?

A. Seventy pounds.

Q. 379. Why?

A. With seventy pounds brake pipe pressure the point of equalization is below the adjustment of the safety valve. With 110 pounds pressure the point of equalization is above the adjustment of the safety valve and therefore leakage could not be so easily discovered.

Q. 380. How is the source of leaks determined?

A. By making a partial service application and observe to what figure the brake cylinder pressure rises. If it increases to fifty pounds and remains constant, it indicates brake pipe leakage.

Q. 381. If the increase in the brake cylinder pressure is due to a leaky rotary in the automatic brake valve, how may it be detected?

A. The brake cylinder pressure will increase up to the limit of adjustment of the safety valve, causing it to blow.

Q. 382. If brake cylinder pressure increases to forty-five pounds and stops, where may the trouble be looked for?

A. In the independent brake valve, due to a leaky rotary.

Q. 383. With the safety valve removed and the brake applied with a partial service application, if a continuous leak exists at the safety valve connection to the distributing valve, what would probably be the cause?

A. A leaky graduating or equalizing valve.

Q. 384. If the equalizing valve leaks, how can it be detected?

A. By a steady discharge of air through the exhaust port of the automatic brake valve when the handle of both this brake valve and the independent brake valve is in *running* position.

Q. 385. If, with a service application there is an intermittent blow at the brake cylinder exhaust port, what does it indicate?

A. A leaky application valve, provided the application cylinder and the application cylinder pipe is tight.

Q. 386. What indicates exhaust valve leakage?

A. A continuous discharge of air from the exhaust port when the brake is applied.

Q. 387. If after a service application the equalizing piston, slide valve and graduating valve move to release position because of graduating valve leakage, will the locomotive release?

A. On the engine from which the brakes are being operated the locomotive brake will not release, but on the second engine in double headers or helpers with the brake valves cut out (double-heading cock closed) the locomotive brake will release.

Q. 388. Why does not the brake release on the locomotive from which the brakes are being operated?

A. Because under these conditions the automatic brake valve is on *lap;* consequently the air cannot exhaust from the application chamber.

Q. 389. Why will the brake release on the second locomotive or helper?

A. Because the release pipe is open to the atmosphere.

Q. 390. If the brake released after an automatic application, when the handle is placed in *release* or *holding* position, but remains applied after an independent application, where would you look for the trouble?

A. It is caused by a leak from the distributing valve release pipe, between the automatic and the independent brake valves.

Q. 391. If the brake releases after an independent application, but remains applied after an automatic application, what would cause the trouble?

A. A leak in the distributing valve release pipe between the distributing valve and the independent brake valve.

Q. 392. If the brake releases after either an automatic or an independent application, what would cause the trouble?

A. A leak from the application cylinder pipe or past the application cylinder cap gasket.

Q. 393. How could a weak or broken application piston graduating spring be detected?

A. If this spring becomes weak or broken, the application portion of the distributing valve would not be as sensitive to graduation.

Q. 394. How should test for leakage in the application cylinder pipe be made?

A. Make a *service* application of the brake, lap the handle and note if the brake remains applied. If it does not, it indicates that the application cylinder pipe or possibly that the application cylinder cap gasket is leaking.

Q. 395. To determine if the release pipe is leaking, how should test be made?

A. Make a service application of the brake with the automatic brake valve. If the brake remains applied with handle in *lap* position but releases when handle is returned to *holding*, it indicates release pipe leakage.

Q. 396. If the brake cylinder pressure does not remain at that to which it is applied, what is the cause?

A. Leakage from application chamber, application cylinder or their pipe connections.

BRAKE CYLINDER LEAKAGE TEST.

Q. 397. Can brake cylinder leakage be readily determined with ET Equipment?

A. Yes.

Q. 398. How?

A. By noting the number of strokes which the compressor makes in a given period of time. Then apply the brake with the independent brake valve and after the compressor has restored the main reservoir pressure again note the number of strokes. The difference in the number of strokes indicates the amount of leakage in the brake cylinders.

Q. 399. Is there any other method of determining brake cylinder leakage?

A. Yes; apply the brake with the independent brake valve, then close the cut-out cock in the distributing valve supply pipe and observe the brake cylinder gage. The gage will indicate the amount of leakage from the brake cylinders.

Q. 400. Can it be determined which of the brake cylinders is leaking?

A. Yes.

Q. 401. How?

A. Apply the brake with the independent brake valve and close the cut-out cock in the distributing valve supply pipe, then close the cut-out cocks in the pipes leading to the truck brake cylinder, driver brake cylinder and tender cylinder in order, noting the gage after each cock is closed.

SAFETY VALVE TEST.

Q. 402. What attention should be given the E-6 Safety Valve?

A. It should be noted that the safety valve is screwed properly in place, that the cap nut is screwed down on the regulating nut, making an air tight joint with the body, and that all vent holes and ports are open.

Q. 403. If the cap nut is not screwed down properly, what would be the effect?

A. The valve and its stem would have too much lift and the leakage of air around the threads of the regulating nut to the atmosphere would interfere with its proper operation.

Q. 404. How should the safety valve be tested to determine if it is properly adjusted?

A. Make an emergency application of the brake, allowing the handle to remain in *emergency* position, and note if the proper brake cylinder pressure is obtained.

Q. 405. What brake pipe pressure should be used when testing the safety valve?

A. 110 pounds.

Q. 406. Within what limits should the safety valve limit the locomotive brake cylinder pressure?

A. Between 68 and 70 pounds.

Q. 407. If the safety valve is adjusted at 68 pounds, and the pressure increases above 70 pounds, what would be the cause?

A. The holes leading from the spring chamber of the valve are restricted or the piston valve has worn loose.

Q. 408. If the safety valve permits the pressure to reduce considerably below 68 pounds before closing, what would be the trouble?

A. The holes leading from the spring chamber of the valve have been enlarged or gum or dirt has made the piston valve too close a fit.

Q. 409. Within what limits should the safety valve limit the locomotive brake cylinder pressure for ordinary service applications (110 lbs. brake pressure)?

A. Between 65 and 70 pounds.

AIR SIGNAL SUPPLY SYSTEM TEST.

Q. 410. In testing the air signal, what should first be done?

A. The signal pipe should be charged and all stop cocks, joints and unions carefully examined for leakage.

Q. 411. How can it be determined whether the proper pressure is being carried in the signal line?

A. By attaching a test gage to the signal line hose.

Q. 412. What would a too high signal pipe pressure indicate?

A. That the reducing valve was improperly adjusted or was leaking.

Q. 413. What effect might this have?

A. In combination with a leaky signal line it might cause the signal whistle to blow when an independent application of the brake is made.

Q. 414. How can reducing valve leakage be determined?

A. By making a signal pipe reduction and noting if the pressure gradually increases after the standard maximum signal pipe pressure has been attained.

Q. 415. With a reasonably tight signal pipe, if the whistle blows when an independent application of the brake is made, what would be the cause?

A. A leaky check valve in the combined strainer and check valve.

Q. 416. If, in charging up the signal pipe the test gage indicates a too slow increase of pressure, where should the trouble be looked for?

A. Probably an obstruction in the strainer or choke fitting or a loose fitting feed valve piston.

Q. 417. If, with the signal system of the locomotive fully charged, the signal whistle blows, what is the probable cause?

A. Leakage in the signal system and a sluggishly operating reducing valve.

PART II.

THE NEW YORK B-3 LOCOMOTIVE BRAKE EQUIPMENT.

THE NEW YORK B-3 LOCOMOTIVE BRAKE EQUIPMENT.

This locomotive brake equipment is known as the B-3 equipment, and is arranged in four different schedules to cover the general requirements of railroad service.

SCHEDULE B-3 is for engines in passenger or freight service, where but one brake pipe pressure is used. Both pump governor and pressure controller have single regulating heads, which should be adjusted for the standard brake pipe and main reservoir pressure.

SCHEDULE B-3S is for switch engines only. A single pump governor and single pressure controller are used. The controller is set to give a brake pipe pressure of 70 pounds and the pump governor for 90 pounds main reservoir pressure, for ordinary switching service. However, when the engine is used for passenger switching service, and handles trains that are using 110 pounds brake pipe pressure, the pump governor should be adjusted to 110 pounds main reservoir pressure. When handling a train using the high pressure, close cock No. 2 between the regulating and supply portions of the controller. This renders the controller inoperative, allowing the main reservoir pressure of 110 pounds to pass to the brake valve and brake pipe, so that trains using the high speed brake can be handled without delay without the necessity of carrying additional apparatus. A quick release valve is furnished with this schedule, to be placed in the straight air pipe, so that the brakes can be released quickly, permitting quicker movement. The divided reservoir and accelerator valve are not furnished with this schedule. The supplementary reservoir is substituted for the divided reservoir.

SCHEDULE B-3HP is for freight service where heavily loaded trains are handled on heavy grades, or loads handled down grades and empties up. Both regulating portions of the pump governor and pressure controller are duplex, so that pressures of 70 and 90 pounds can be carried in the brake pipe and 90 and 110 pounds in the main reservoir for the ordinary brake pipe pressure and the high pressure control.

For the operation of these duplex regulating portions, three-way cocks are provided, being connected as shown in the piping diagram. To operate these cocks, turn the handle in line with the pipe leading to the regulating head to be used, high or low pressure as desired. This will cut in the head to regulate the supply portion, and cut off the pressure to the one not in use.

SCHEDULE B-3HS is the high speed brake. It includes the duplex pressure controller and the duplex pump governor. The regulating heads of the pressure controller should be adjusted to 70 pounds and 110 pounds for brake pipe pressure, and the pump governor heads adjusted to 90 pounds and 130 pounds for the main reservoir pressure. A union four-way cock is used with the regulating heads of the pressure controller. This is a special cock with a connection to each regulating top, one to the supply pipe, between the controller and brake valve, and one to the pipe between the brake valve and accelerator reservoir. When the handle of the four-way cock is in the position to operate the regulating head adjusted to 110 pounds brake pipe pressure, a small port in the accelerator reservoir connection is brought into communication with a port to the atmosphere. The object of this port is to prevent more than the usual predetermined reduction of brake pipe air, obtained in the graduating notches, taking place with 110 pounds pressure. A union three-way cock connected to the main reservoir and pump governor regulating tops is used to change the main reservoir pressures.

The piping diagrams of the four schedules of the B-3 equipment, shows the several parts comprising each schedule, as well as the proper pipe connections. This equipment is an improvement on former equipments. It not only includes all necessary features for the automatic brake, but also a straight air brake for the locomotive and tender, all operated by the automatic brake valve, without any additional positions.

Some of the notable improvements incorporated in the B-3 brake valve, which will be appreciated by those who come in contact with it, are: the use of tap bolts instead of screws to fasten the valve cover to the body; port O is cored in the valve body instead of being drilled through the cover; the projection for centering the piston packing leather EV 107 is on the piston instead of on the follower. A new packing leather can now be applied without removing the piston from the brake valve. It is only necessary to remove the back cap and the piston follower.

Other parts of the equipment fully described under their different headings are the 1¼" pressure controller by which the brake pipe pressure is regulated; the accelerator valve which assists the brake valve in discharging brake pipe air when making service applications with long trains, the ¾" controller which controls the straight air brake pressure; the high speed controller which acts as a reducing valve for the driver and truck brake cylinders, the lever safety valve and the quick release valve.

MANIPULATION.

To apply the automatic brakes on the locomotive and train, move the handle of the brake valve to the graduating notch necessary to make the required brake pipe reduction.

To release both locomotive and train brakes, move the handle to Running and Straight air release position.

To release the train brakes and hold the locomotive brakes set, move the handle to Automatic release and Straight Air Application position.

To apply the locomotive brakes (Straight Air), move the handle to Full Automatic release and Straight Air Application position.

To release the locomotive brakes move the handle to Running and Straight Air release position.

To apply the brakes in an emergency, move the handle quickly to Emergency position and leave it there until the train stops.

In case the automatic brakes are applied by the bursting of a hose, the train parts, or a conductor's valve is opened, place the handle in Lap position to retain the main reservoir pressure.

To graduate off or entirely release the locomotive brakes while holding the train brakes applied, use the lever safety valve to make the required reduction.

The handle of the brake valve will be found to work freely and easily at all times, as the pressure on the main slide valve does not exceed the maximum brake pipe pressure.

The cylinder gauge will show at all times the pressure in the locomotive brake cylinder and should be observed in brake manipulations.

Where there are two or more locomotives in a train, cut-out cock No. 1 should be turned to close the brake pipe and the brake valve handle carried in Running and Straight Air release position on all locomotives except the one from which the brakes are operated.

In case it becomes necessary to cut out the Straight Air brake, close cut-out cock No. 3, located in the straight air pipe.

To cut out the automatic brake on the engine, close cut-out cock No. 6, located in the pipe connecting the triple valve with the double check valve. By locating the cut-out cock at this point the auxiliary reservoir will remain charged if the brake is cut out, and can be cut in immediately should it be so desired. This cut-out cock and also cut-out cock No. 3 are special; they are of the three-way pattern and when turned off drain the pipes leading to the double check valve, which insures the check valve remaining seated in the direction of the closed cock. If desired, cut-out cock No. 8 can be substituted for cock No. 6; the latter is, however, recommended.

The main reservoir cock No. 4 is to cut off the supply of air when removing any of the apparatus except the governor.

B-3 Brake Valve.

The straight air controller is to limit the pressure in the driver, truck and tender brake cylinders for the straight air brake, and should be adjusted to 40 pounds pressure.

Cut-out cocks Nos. 5, 6 and 7 are recommended when truck brake is used, their purpose being fully understood. Nos. 9 and 10 can be added, if desired, so that the driver brake cylinders and reservoir can be cut out and engine truck brake operated by truck brake reservoir.

B-3 BRAKE VALVE.

Figure 1 is a longitudinal side section of the brake valve (Running position), showing the main slide valve EV 312, and how the graduating valve EV 317 is controlled by the piston EV 311 and lever EV 302, also port O in the back cap, closed by the vent valve, EV 180. This view also shows the different positions of the brake valve handle. Fig. 3 is a cross section through the valve (rear view). Fig. 4 is a cross section through the main slide valve, EV 312. This view shows the main reservoir and brake pipe connection. It also shows the location of passage H, which connects the supplementary reservoir and chamber D, back of piston EV 311, also port O drilled to the slide valve seat and cavity R in the slide valve. Fig. 2 is a top view of the valve with the cover, slide valve and handle removed, showing the seat and connections for the straight air and divided reservoir pipes. A shows the opening through the slide valve seat to the brake valve chamber A, beneath the slide valve. B is a cavity back of the slide valve seat, into which the air flows from the main reservoir pipe, although all the space under the valve cover and above the slide valve is known as chamber B. C is the exhaust passage. V is through to the exhaust passage and is an exhaust port for the straight air brake in running and straight air release positions, and is also an exhaust port for the air from chamber D, through port O in the release, running and lap positions. Port T is to the accelerator reservoir. Port W is to the passage H and the supplementary reservoir. The location of port O in the seat is also shown.

Port O is used for the purpose of venting air from chamber D to the atmosphere, so as to permit piston EV 311 to return to its normal position (Fig. 1), when releasing brakes. It runs from the vent valve seat through the back cap, lengthwise through the body of the brake valve to a point shown in Fig. 4, thence up to the seat of the slide valve. It is connected to the exhaust passage by cavity R in the slide valve, and port V in the seat, in full release, running and lap positions.

Chamber D air is prevented from escaping to the atmosphere in these positions by the vent valve EV 180 on the end of piston EV 311. Just before the slide valve reaches the first graduating notch, it covers port O, so that when the piston moves forward

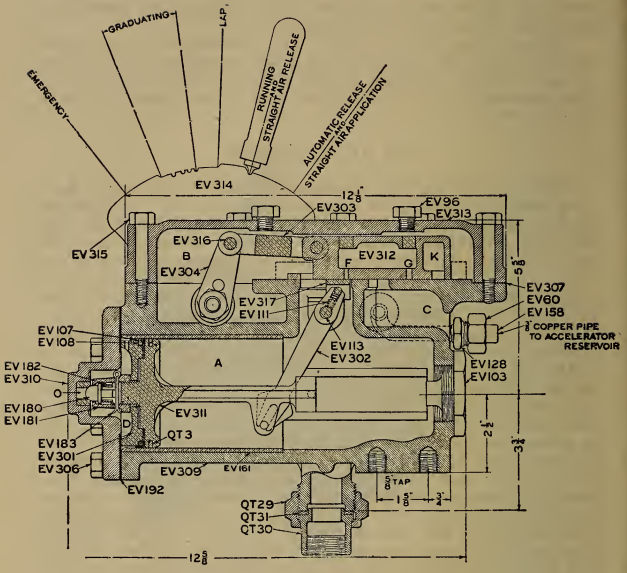

GRADUATING
LAP
RUNNING
STRAIGHT AIR RELEASE
AUTOMATIC RELEASE AND STRAIGHT AIR APPLICATION
EMERGENCY
EV 314
12 1/8"
EV 303
EV 96
EV 313
EV 315
EV 316
B
EV 304
EV 312
F
G
K
5 5/8"
EV 307
EV 60
EV 158
1/4" COPPER PIPE TO ACCELERATOR RESERVOIR
EV 317
EV 111
C
EV 107
EV 108
EV 113
EV 302
A
EV 182
EV 310
O
EV 180
EV 181
EV 311
D
QT 3
EV 128
EV 103
2 1/2"
3 1/8"
EV 183
EV 301
EV 306
EV 309
EV 161
EV 192
3/8" TAP
1 5/8"
3/4"
QT 29
QT 31
QT 30
12 3/8"

Fig. 1.

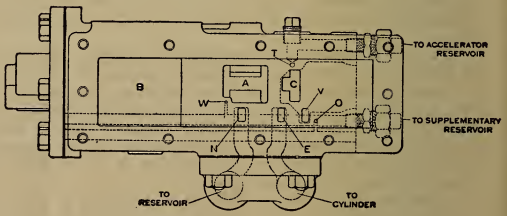

TO ACCELERATOR RESERVOIR
T
A
B
C
V
W
O
TO SUPPLEMENTARY RESERVOIR
N
E
TO RESERVOIR
TO CYLINDER

Fig. 2.

to automatically close the service exhaust port F, and unseats vent valve EV 180, chamber D air only gets to the face of the slide valve. When the brake valve is placed in the full release, running or lap positions, air from chamber D flows through port O, cavity R and port V to the atmosphere until the pressure in chamber D is slightly below that in chamber A (brake pipe), when the brake pipe pressure being the greater it forces piston EV 311 to the position shown in Fig. 1, seating the vent valve, and preventing further escape of chamber D air.

EV 326 is a pipe bracket bolted to the side of the brake valve. It has two pipe connections, one to the main reservoir and the other to the brake cylinders. Dotted lines show the cored passage from the main reservoir connection to port N, and from port E to the cylinder pipe connection.

Figure 5 shows the face of the slide valve. F and G are the service exhaust ports and are connected by a passage through the center of the slide valve. J and K are the emergency exhaust ports connected by passages on each side of the central passage, connecting F and G. S is a small port connected by passage X to the elongated port Ae, which registers with port T in the seat in all the service application positions. P is a groove whose function is to connect port W and the supplementary reservoir with brake pipe pressure in release and running positions. L is a passage through which air passes from the main reservoir pipe to the brake cylinder pipe in straight air application position. R is a cavity connecting ports E and V in the running and straight air release positions to release the straight air brake and O and V in release, running and lap positions. It also permits the partial opening of port N to E in the last graduating notch and full opening in emergency position. Ports M are through the slide valve and are for charging the brake pipe.

Main reservoir air, reduced to brake pipe pressure by the pressure controller, flows into chamber B. The slide valve EV 312 controls the flow of air from the main reservoir to the brake pipe and from the brake pipe to the atmosphere. The brake pipe is connected to chamber A. Discharge of brake pipe air to the atmosphere for service applications occurs through ports F and G and exhaust passage C, but for emergency applications through ports J and K and exhaust passage C. In full automatic release position air is free to pass from the main reservoir to the brake pipe through ports M, and past the end of the slide valve EV 312. In the running position ports M only are open betewen the main reservoir and brake pipe, but they are sufficiently large to permit release of train brakes. Small slide valve EV 317 is a cut-off or graduating valve operated by piston EV 311 and lever EV 312. In service applications it automatically laps port F and stops the discharge of brake pipe air when the brake pipe reduction corresponding to the service graduating notch in which the handle is placed has been made. Piston EV 311, which is exposed on one

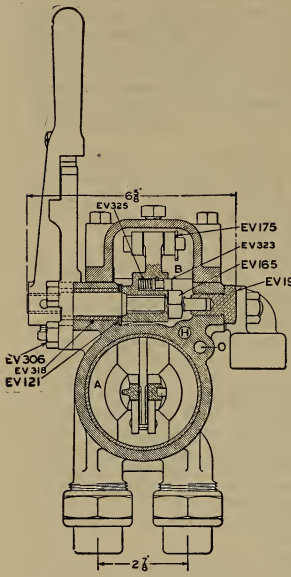


FIG. 3.

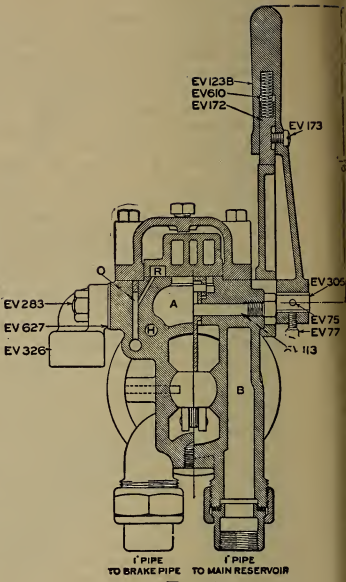


FIG. 4.

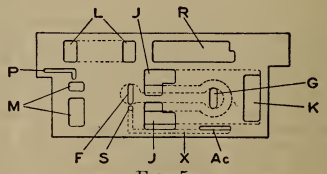


FIG. 5.

side to brake pipe pressure and on the other to chamber D or supplementary reservoir pressure, through the agency of lever EV 302 causes valve EV 317 to move automatically whatever distance is necessary to close port F.

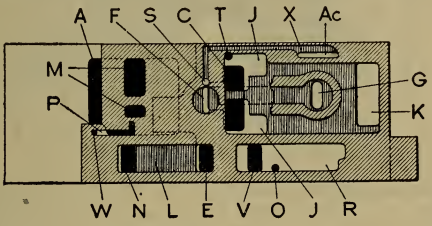


Fig. 6.

RELEASE POSITION.

Automatic Release and Straight Air Application Position (Fig. 6). The purpose of this position is to promptly release and recharge the automatic brakes and to apply the straight air brakes or retain the pressure in the locomotive and tender brake cylinders. In this position air flows directly from chamber B (main reservoir), into chamber A (brake pipe), past the end of the slide valve and through ports M. Port O is open to the atmosphere through port V to permit piston EV 311 to return to its normal position. Port T is open to the atmosphere through J and C. The supplementary reservoir is being charged to brake pipe pressure through groove P and port W from chamber A. Port E is brought into communication with port N by passage L, permitting air to pass to the locomotive and tender brake cylinders through the straight air pipe and double check valve until shut off by the ¾″ pressure controller, the regulating top of which is connected to the straight air pipe and adjusted at 40 pounds. By placing the valve handle about midway between release and running positions the straight air ports can be lapped, making it possible to increase or decrease the brake cylinder pressure as may be necessary.

RUNNING POSITION.

Running and Straight Air Release Position (Fig. 7). This is the proper position in which to place the handle when wishing to release the train and locomotive brakes simultaneously, or to release the straight air brake when it only has been applied.

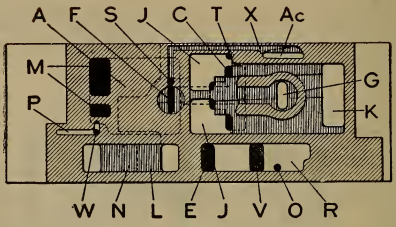


FIG. 7. RUNNING POSITION.

Air passes from the main reservoir to the brake pipe through ports M. Port N is closed. Port E is brought into communication with port V and the atmosphere by cavity R, releasing the straight air brake. Ports O and T are still open to the atmosphere as in full release position. Port T is open to the atmosphere through J and C in release and running positions, so that in case of a release following a partial application, the accelerator reservoir pressure can escape and prevent the operation of the accelerator valve. Groove P still holds port W in communication with the brake pipe pressure in chamber A.

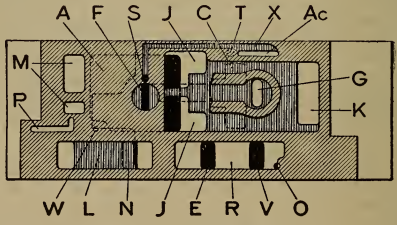


FIG. 8. LAP POSITION.

LAP POSITION (Fig. 8). The brake valve handle should be placed in this position when a hose bursts, the train parts or a conductor's valve is opened to save the main reservoir air. All ports are closed in this position excepting port O, which is open to the atomsphere through port V and the exhaust passage in release, running and lap positions.

SERVICE APPLICATION POSITION (Figs. 9 and 10). This position is for the purpose of gradually applying the brakes and is divided

into five graduating positions designated by notches on the quadrant. The reductions obtained in the different notches are respectively, 5, 8, 11, 15 and 23 pounds. The amount of the initial reduction should always be governed by the length of the train,

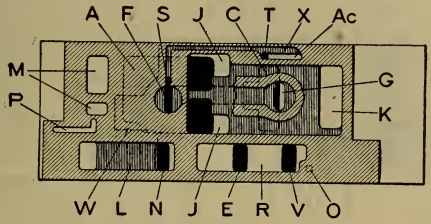


FIG. 9. FIRST GRADUATING NOTCH.

speed, grade, etc. Always place the handle of the brake valve in the notch which will give the required reduction. When the handle of the brake valve is moved to the first graduating notch the slide valve is in the position shown. Port ∪ is closed to prevent the escape of chamber D pressure. Port F is moved back of the graduating valve EV 317 and port G registers with the exhaust port C. Brake pipe air now flows to the atmosphere. It also flows through port S, passage X and port T to the accelerator reservoir, building up a pressure to operate the accelerator valve.

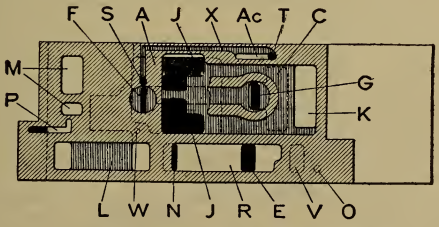


FIG. 10. LAST GRADUATING NOTCH.

As soon as the pressure in the brake pipe reduces, the pressure in chamber D, being now greater than brake pipe pressure, it begins to expand to equalize with the brake pipe pressure. In doing so it moves piston EV 311 forward. The piston carries with it the

lower end of the graduating valve lever EV 302, which is so proportioned that the graduating valve EV 317, on the other end of it, is just moved back far enough to close ports F and S when the pressures in chamber D and the brake pipe have equalized.

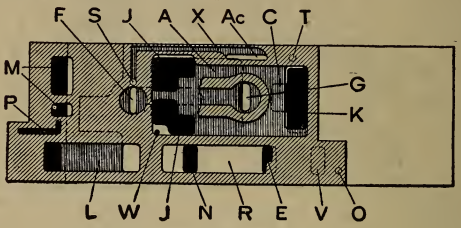


FIG. 11. EMERGENCY POSITION.

This stops the flow of air from the brake pipe to the atmosphere and to the accelerator reservoir (see accelerator valve). This action is called automatic lap and it takes place in all the graduating positions. A further reduction of the brake pipe pressure is made by moving the handle back to any of the service notches, the piston moving farther forward for each successive reduction. The

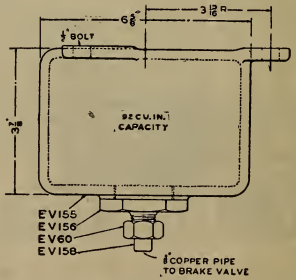


FIG. 12. SUPPLEMENTARY RESERVOIR. USED WITH SWITCH ENGINE EQUIPMENT, SCHEDULE B3-S.

action of the brake valve is the same and the ports are in the same relation to each other in all service positions of the brake valve except the last graduating position. In this position a partial

opening of port N admits air slowly to the locomotive and tender brake cylinders through cavity R and port E up to the adjustment of the controller on the straight air pipe. This is to insure full braking pressure on the engine with a full application, regardless of piston travel and brake cylinder leakage.

EMERGENCY APPLICATION POSITION (Fig. 11). This position is for the purpose of producing a quick, heavy reduction in brake pipe pressure so that all triple valves on the train will operate in quick action and apply the brakes in the shortest possible time.

Ports J register with chamber A and K with the exhaust port C, allowing brake pipe air to escape rapidly to the atmosphere. Cavity R allows air from the main reservoir to pass through ports N and E to the locomotive brake cylinders, and the full pressure of the straight air brake is maintained on the engine.

PRESSURE CONTROLLER.

The pressure controller is in reality, a part of the brake valve, taking place of the excess pressure or feed valves, and is connected in the main reservoir pipe near the brake valve to control brake pipe pressure. The principle of operation is the same as a pump governor. The regulating and supply portions are separate, being connected by piping, and the regulating heads connect directly to the pipe between the supply portion and the brake valve.

With the pressure controller the excess pressure is confined to the main reservoir, and while it has sufficient capacity to promptly release the brakes and recharge the auxiliary reservoirs on a train of any length, there is no danger of overcharging the auxiliary reservoirs on the forward end of the train. Thus the possibility of reapplication, due to the charging of the rear brakes when the auxiliary reservoirs on the forward end are overcharged, which is common without the use of the controller, is eliminated.

The controller is made in two styles, single and duplex, to cover the requirements of the different schedules. Figs. 14 and 15 are photographic views of a duplex pressure controller, regulating and supply portions. Fig. 16 is a sectional view of a duplex regulating portion and Fig. 17 a similar view of a single regulating portion. Figs. 18 and 19 show the four-way, three-way and cut-out cocks, which are used to control the air pressure to the regulating heads. Fig. 21 is a sectional view of the supply portion.

Referring to Fig. 21, connection with the main reservoir is made at MR, and by means of the cored passage air is free to pass to the under side of the valve, PG 95. Connection BV leads to the brake valve, main reservoir connection, and connection D to the regulating portion (single or duplex) connecting at D in Figs. 16 and 17.

In operation with either a single or duplex regulating portion, as soon as the pressure in the brake pipe is great enough to over-

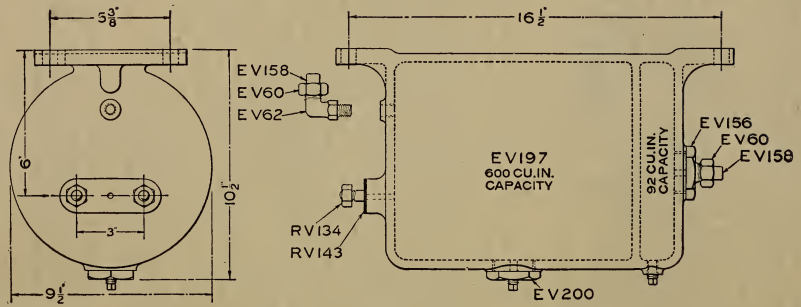


FIG. 13. DIVIDED RESERVOIR.

NAMES OF PARTS.

E V 60—Small union nut.
E V 62—Small union ell.
E V 156—Reservoir plug.
E V 158—Union swivel.
E V 197—Divided reservoir.
E V 200—Bottom plug.
R V 134—½″ stud and nut.
R V 143—Accelerator valve gasket

come the resistance of the spring PG 10, which is holding the diaphragm PG 13, seated over port B, the pressure will pass through passage E to connection D, and by piping to the space E, in the supply portion of the controller above the piston PG 4, forcing the piston and valve PG 95 down until seated, cutting off communication between main reservoir and brake pipe.

As soon as the pressure falls in the brake pipe below the adjustment of spring PG 10, the latter will force diaphragm PG 13 to its seat, closing off port B, whereupon pressure in passage E and piping connecting supply and regulating portions and space E above piston PG 4 will immediately escape to the atmosphere through the small port C, in the regulating head of the controller, after which main reservoir pressure will lift valve PG 95 off its seat and again open communication to the brake valve, thus maintaining a constant pressure in the brake pipe.

Port X in the supply portion of the controller connects the under side of piston PG 4 with atmosphere, so that it will be free to operate and to discharge any leakage by the ring PG 24 or valve PG 95.

The regulating portions are provided with brackets, so that they can be attached to the cab in some convenient place where they will be handy for adjustment. The adjustment of these regulating heads is accomplished by means of nut PG 35, which regulates the tension of spring PG 10.

As each regulating head has a vent, port C, to avoid unnecessary waste of air, one of these heads should be plugged with a screw, PG 33, with all duplex regulating portions.

The hand wheel, PG 45, can be used in case of any defect that would cause a sluggish action of the controller. By screwing the wheel up, it will lift the valve, PG 95, off its seat and allow the free passage of air from the main reservoir to the brake valve. The controller will then be inoperative, main reservoir and brake pipe pressures will be equal until the controller is again restored to its operative condition.

By referring to the piping diagrams, it will readily be seen how the three-way cock is connected with the regulating heads in schedule B3-HP, and how the four-way cock is connected to the regulating heads and accelerator reservoir in schedule B3-HS.

As before stated, the cut-out cock shown in Fig. 20 is used with the B3-S equipment between the regulating and supply portions. When the cut-out cock is closed the supply portion of the controller is cut off, making it inoperative for the reasons stated in the instructions already given.

A ¾″ controller is used to control the straight air brake pressure. It is located in a ¾″ pipe, which is attached to the main reservoir pipe between the cut-out cock, No. 4 and the 1¼″ controller, and leads to the main reservoir connection of the pipe bracket, EV 326. The regulating head is connected to the straight air pipe between the pipe bracket and the double check

FIG. 14. DUPLEM REGULATING PORTION OF PRESSURE CONTROLLER.

FIG. 15. SUPPLY PORTION OF PRESSURE CONTROLLER.

valve. It is adjusted to 40 pounds and maintains that pressure in the locomotive brake cylinders when the straight air brake is applied. Its operation is identical with that of the 1¼" pressure controller.

ACCELERATOR VALVE.

It is well known that with the ordinary brake valves alone, it is almost impossible to set all the brakes on trains of 75 to 100 cars without making a very heavy reduction. This is caused by the back flow of air from the auxiliary reservoirs to the brake pipe through the feed grooves, and from the brake cylinder to the atmosphere through the leakage grooves. It is the result of the comparatively slow brake pipe reduction through the service application ports of the brake valves, which for obvious reasons cannot be enlarged. The accelerator valve was designed to overcome this difficulty. Its duty is to assist the brake valve in discharging brake pipe air when making service applications on long trains, and to bring about a more uniform and prompt application of the brakes than is possible with the ordinary brake valves. It operates only when a service application of brakes is made with the brake valve and then only when the volume of brake pipe air is sufficient to warrant its use. The reductions, however, are no greater with the accelerator valve than with the former types of brake valves, as the automatic cut-off of the brake valve controls the flow of air that actuates the accelerator. This valve does exactly what its name would imply. It accelerates the discharge of brake pipe air. The operation of the accelerator valve is automatic, it opens about four seconds after the brake valve handle has been moved to the graduating notch and closes in about the same length of time after the graduating valve has closed ports F and S in the slide valve. It requires from about 10 to 12 pounds pressure in the large compartment of the divided reservoir to operate it, consequently, it does not open with a shorter train than eight cars, as with that length of a train the automatic lap of the brake valve takes place before sufficient pressure has been accumulated in the divided reservoir to move the piston of the accelerator valve down against the spring.

It is bolted to the divided reservoir, the large chamber of which is the accelerator reservoir and the small one the supplementary reservoir.

The arrangement of piping to it is shown in the piping diagrams. Fig. 22 is an outside view of the valve showing the brake pipe connection and exhaust elbow. Fig. 23 is a sectional view. The working parts are the piston BV 65, slide valve RV 64 and slide valve spring EV 656, valve stem RV 67, with leather seat RV 70 and spring QT 231.

Brake pipe pressure is always present in chamber O, around the slide valve RV 74, and is prevented from escaping to chamber

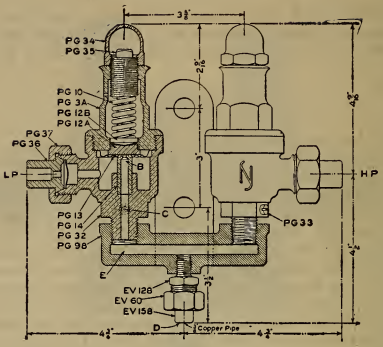

PG 34
PG 35
PG 10
PG 3A
PG 12B
PG 12A
PG 37
PG 36
LP
B
HP
PG 13
PG 14
PG 32
PG 96
C
PG 33
E
EV 128
EV 60
EV 158
D
Copper Pipe

FIG. 16.

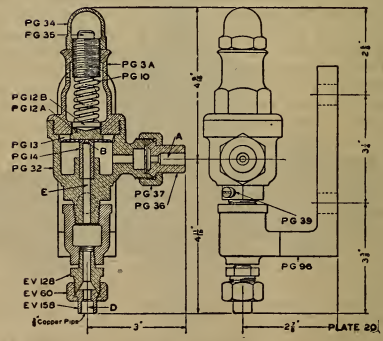

PG 34
PG 35
PG 3A
PG 10
PG 12B
PG 12A
PG 13
PG 14
PG 32
A
B
E
PG 37
PG 36
PG 39
PG 96
EV 128
EV 60
EV 158
D
Copper Pipe
PLATE 29

FIG. 17.

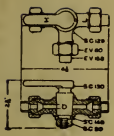


FIG. 18.

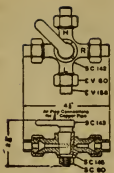


FIG. 19.

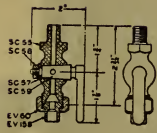
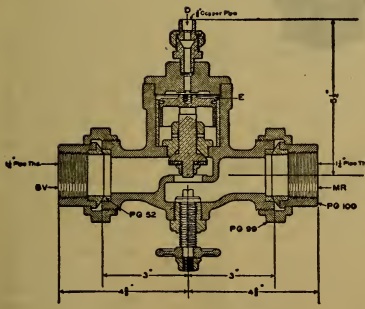


FIG. 20.



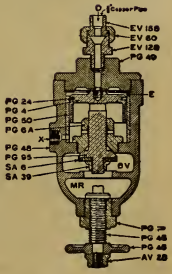


FIG. 21.

FIG. 22. ACCELERATOR VALVE.

B by the leather seat RV 70, which is held to its seat by the spring QT 231. There is an oblong port, *a*, in the slide valve, and a triangular port, *b*, in the slide valve bush, with its point upward. When the brake valve is placed in the service position port S in the slide valve is open to the brake pipe, and the long port Ac, also in the slide valve, registers with port T in the seat-allowing brake pipe air to pass through ports S and T to the accelerator reservoir and to the top of piston RV 65, which is always in direct communication with the accelerator reservoir. When a pressure of from 10 to 12 pounds is accumulated in the reservoir, the piston, valve stem, and slide valve are moved down, compressing spring QT 231. Port *a* then registers with *b*, but as the small part of the port opens first the brake pipe air flows slowly to the atmosphere, the discharge increasing as the port opens wider, until the full travel of the piston and slide valve gives a full opening of the port. When the cut-off valve of the brake valve goes to automatic lap and closes port S, air stops flowing to the accelerator reservoir. The pressure on piston RV 65 reduces through ports R and T in the body of the valve and through port S, in the piston. As soon as the pressure above the piston has been reduced sufficiently, the spring QT 231 pushes the slide valve and piston upwards, first closing port R, then ports *a* and *b*, lastly closing the leather seated valve RV 70, and stopping the flow of brake pipe air to the atmosphere. The piston closes port R before the slide valve closes port *b*, so that the air from the accelerator reservoir, flowing more slowly through the port S in the piston, gives the slide valve the slow closure desired.

This action of the accelerator valve will allow a much larger volume of air to pass from the brake pipe than could flow in the same time through the service ports F and G in the brake valve.

It stays open longer with a long train than with a short one, because the volume of brake pipe air to be reduced is greater and the cut-off valve EV 317 stays open longer.

The high speed controller is used with schedule B3-HS. Fig. 24 is a photographic view and Fig. 25 is a sectional view of it, showing the operative parts. These are piston HS 107 with valve HS 108, which is provided with one large and one smaller annular groove, as shown, the spring RV 105A, valve stem RV 131, pop valve RV 133 and the lever handle RV 129.

It is connected to the brake cylinders at BC and the brake pipe at BP. Its normal position is shown in the illustration, where it is held by brake pipe pressure. During all ordinary service applications the piston remains in this position and brake cylinder pressure can pass freely to the safety valve through the large groove, when higher than that which safety valve is set to retain. However, when an emergency application is made the brake pipe pressure is greatly reduced, the brake cylinder pressure will move the piston and valve their full traverse to the seat C. This movement brings the smaller groove directly under the passage G,

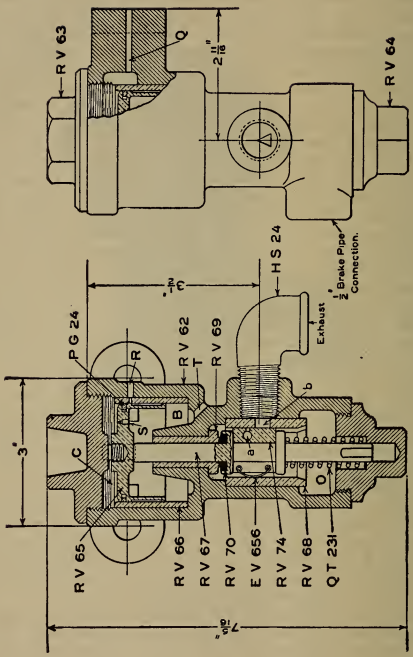

R V 63
Q
2 11/16"
R V 64
H S 24
1" Brake Pipe Connection.
Exhaust
P G 24
R
R V 62
T
R V 69
S
B
C
3"
R V 65
R V 66
R V 67
R V 70
E V 656
R V 74
R V 68
Q T 231
7 3/16"

FIG. 23.

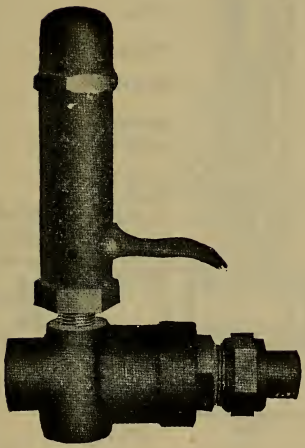
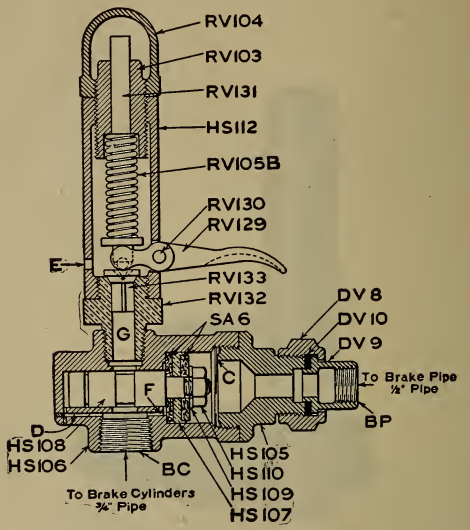


FIG. 24. HIGH SPEED CONTROLLER.

which restricts the passage of brake cylinder air to the safety valve and causes a gradual blow down until stopped by the safety valve. The safety valves should be adjusted to 53 pounds, and



HIGH SPEED CONTROLLER LEVER SAFETY VALVE.

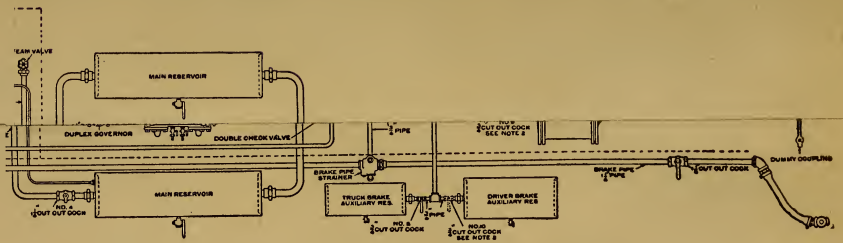
FIG. 25.

whether used alone or with the high speed controller are piped to the engine brake cylinders so that they will relieve the cylinders of all over that amount, whether obtained with the automatic or straight air application.

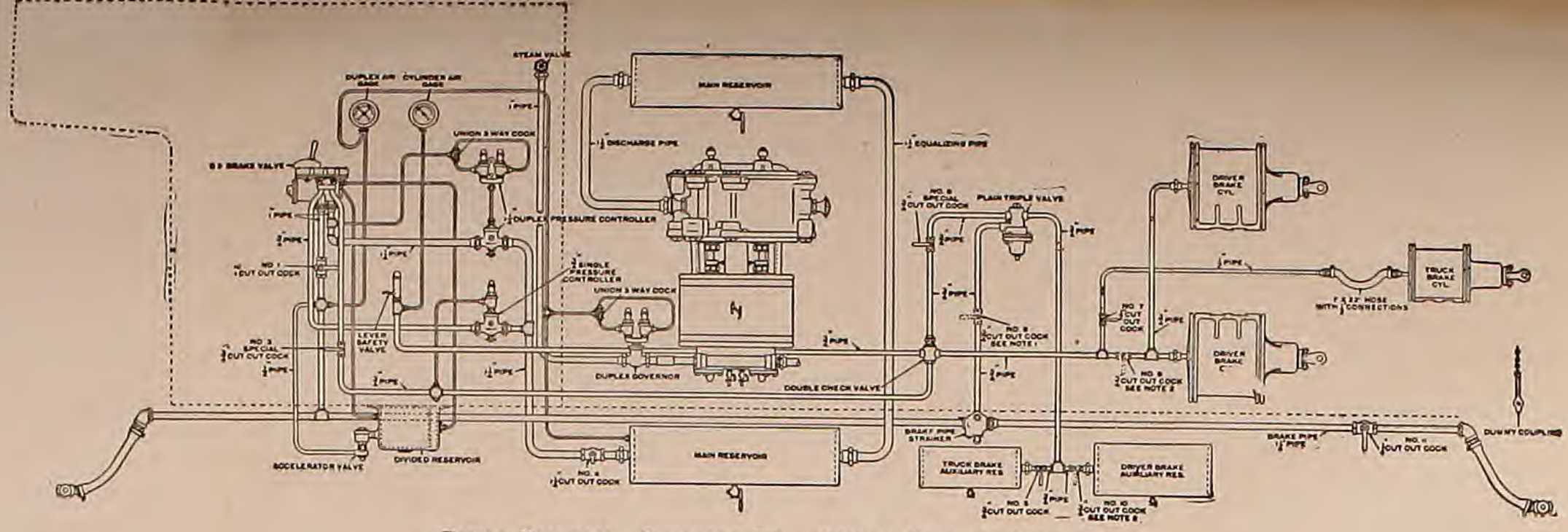
Ports F and D allow the brake cylinder pressure to circulate around the piston HS 107 and back of valve HS 108 so that they will move with a slight difference of pressure.

THE QUICK RELEASE VALVE.

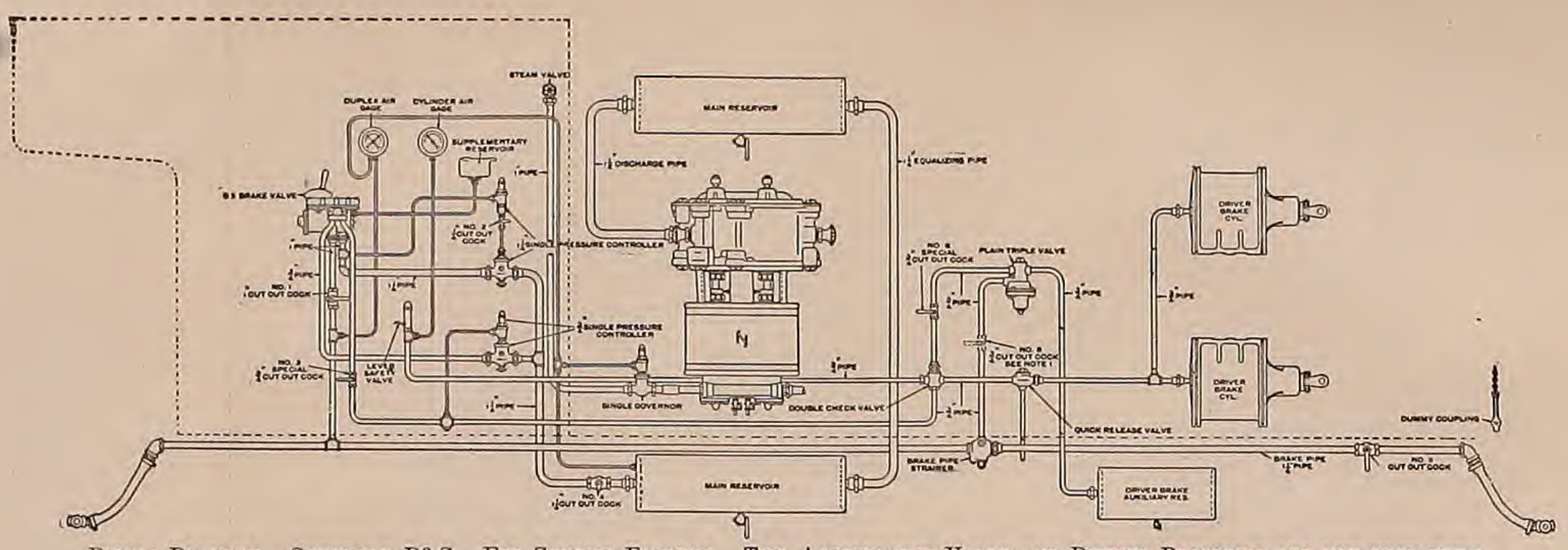
The quick release valve shown in Fig. 27, as before stated, is for use with schedule B3-S switch engine equipment. This valve



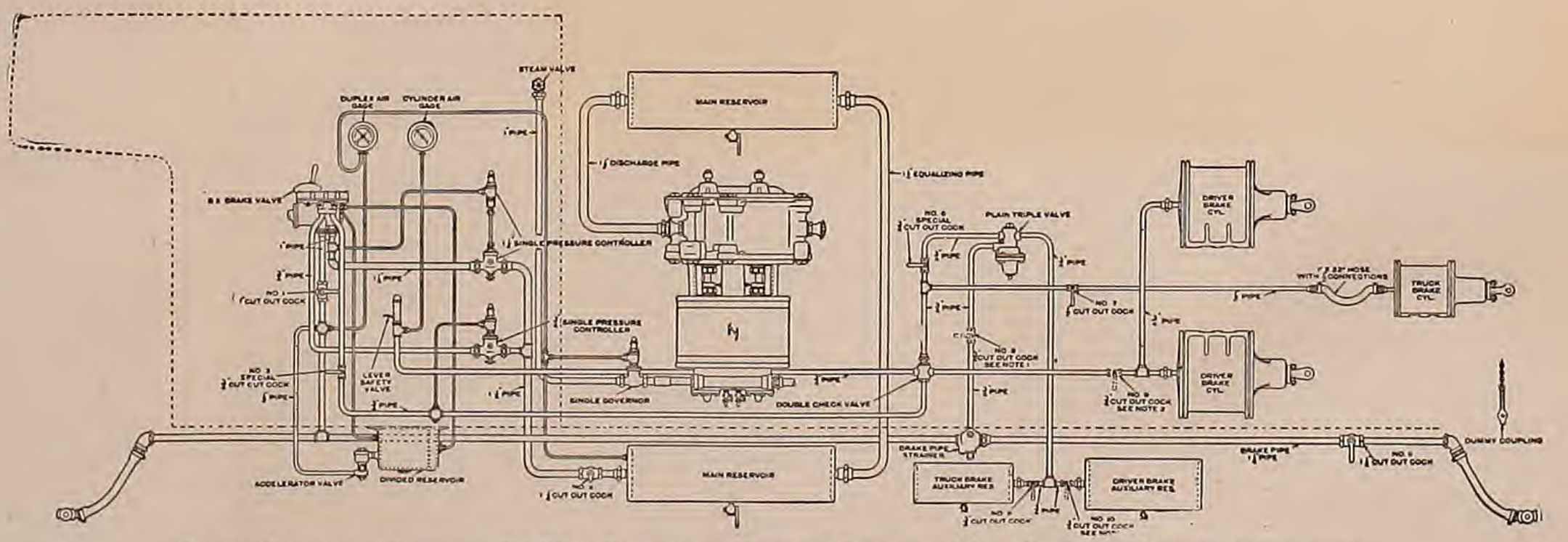
EDULE B3-HS. FOR USE IN PASSENGER SERVICE. (HIGH SPEED BRAKE.)



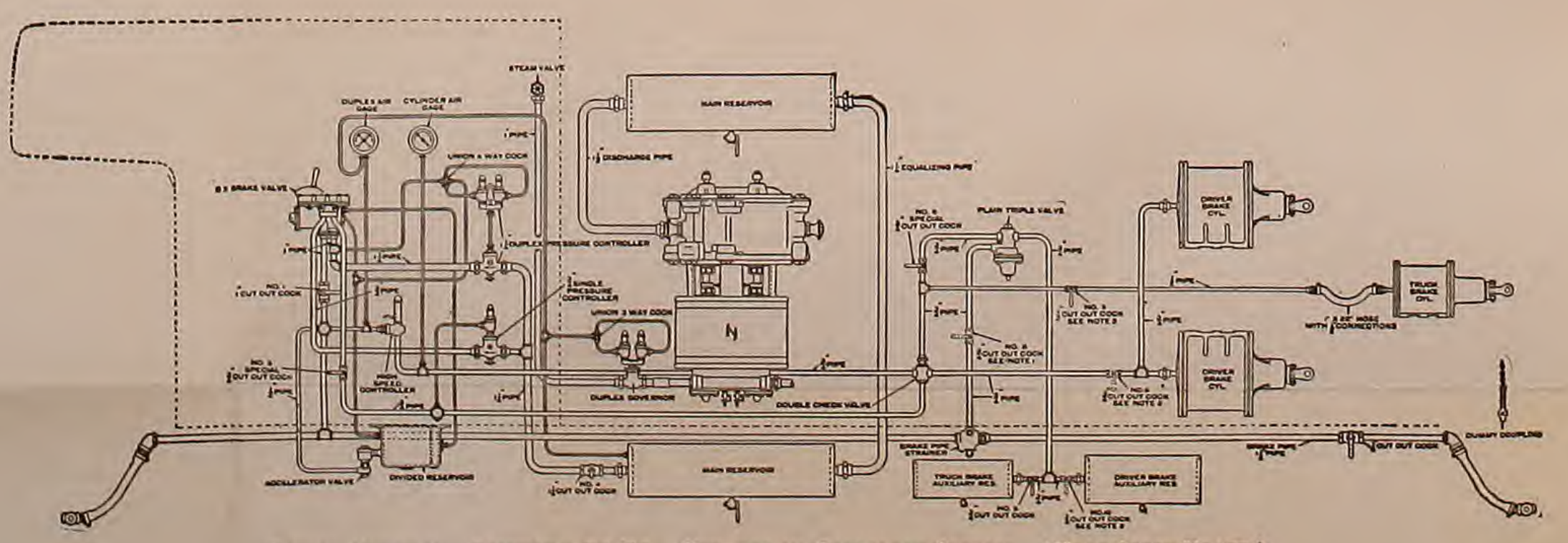
PIPING DIAGRAM. SCHEDULE B3. (SINGLE PRESSURE SYSTEM.)



PIPING DIAGRAM. SCHEDULE B3-S. FOR SWITCH ENGINES. THE ACCELERATOR VALVE AND DIVIDED RESERVOIR ARE NOT USED WITH THIS SCHEDULE; THE SUPPLEMENTARY RESERVOIR OF SCHEDULE B IS SUBSTITUTED FOR THE DIVIDED RESERVOIR.



PIPING DIAGRAM. SCHEDULE B3-HP. FOR USE IN FREIGHT SERVICE. (HIGH PRESSURE CONTROL APPARATUS.)



PIPING DIAGRAM. SCHEDULE B3-HS. FOR USE IN PASSENGER SERVICE. (HIGH SPEED BRAKE.)

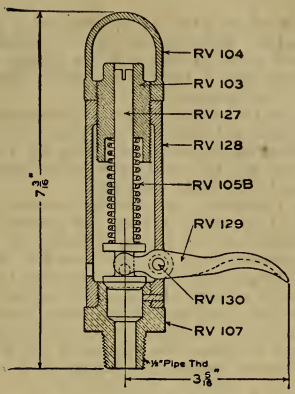

RV 104
RV 103
RV 127
RV 128
RV 105B
RV 129
RV 130
RV 107
¼" Pipe Thd
3 5/8"
7 3/16"

FIG. 26.

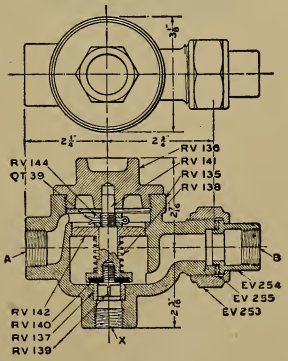

RV 136
RV 141
RV 135
RV 138
RV 144
QT 39
RV 142
RV 140
RV 137
RV 139
EV 254
EV 255
EV 253
A
B
X

FIG. 27.

is to hasten the release after an application of the automatic or straight air brakes. Referring to Fig. 27, connection A leads to the double check valve as shown in the piping diagram of this equipment. Connection B leads to the driver brake cylinders and connection X to the exhaust.

As soon as the brakes are applied by automatic or independent application pressure will pass to top of piston RV 142, forcing the same down against the resistance of spring RV 138 until it strikes the collar on valve RV 141, clearing the valve body enough to give a direct opening to the brake cylinders.

In effecting a release, as soon as the handle of the brake valve has been returned to release position, the pressure will be reduced from the upper side of the piston, allowing the pressure on the under side to operate it and lift the valve RV 141 off its seat to discharge the pressure from the brake cylinders to the atmosphere.

While the quick release valve is shown, in the piping diagram, between the double check and driver brake cylinders, it can, if desired, be placed in the straight air pipe between the brake valve and double check to hasten the release of the straight air brake on engine and tender, leaving the release of the automatic brake normal.

The double check valve is not shown in this pamphlet, as it is of an old and well understood design.

PART III.

DUPLEX AIR PUMPS AND PUMP GOVERNORS.

DUPLEX AIR PUMPS AND PUMP GOVERNORS.

The Duplex Air Pumps manufactured by The New York Air Brake Company for locomotive service are of four different sizes, and are known as the Nos. 1, 2, 5 and 6. The dimensions of these pumps are as follows:

Pump No.	Diameter of Steam Cyl.	Diameter of L. P. Air Cyl.	Diameter of H. P. Air Cyl.	Stroke.	Illustrated in Appendix.
1	5 in.	7 in.	5 in.	9 in.	Plate Q-2
2	7 "	10 "	7 "	9 "	Plate Q-2
5	8 "	12 "	8 "	12 "	Plate No. 5
6	7 "	11 "	7 "	10 "	

The No. 1 and No. 2 differ somewhat from the No. 5 and No. 6 in design as well as in size, although the principle of operation is practically the same.

To meet the demand for a pump that would furnish air for a freight train of 100 cars, and still be sufficiently within its capacity to reduce the liability of failure to a minimum, the No. 5 pump was designed and perfected, and such structural changes made as to materially improve the design and increase the efficiency and economy of the duplex air pump.

The valve gear of the duplex air pump is exceedingly simple, consisting of two ordinary D slide valves, similar to the same type of valve used in locomotives, actuated by valve stems which extend into the hollow piston rods and are moved by contact with the tappet plates bolted on the steam piston heads. The valve on one side controls the admission of steam to, and exhaust from the opposite cylinder, as shown, so that while one of the pistons is moving the other is at rest. This feature also allows the air valves to seat by gravity.

The air cylinders are known as the low pressure and high pressure cylinders, and in each type of the pumps herein described, the difference in the areas of the air cylinders is in the same proportion, the low pressure piston having twice the area of

the high, and the high pressure the same area as the steam cylinders. Thus three measures of air are compressed with two measures of steam.

The operation of all the duplex air pumps is practically the same, the difference being in the arrangement of the air valves. The No. 1 and No. 2 have six air valves, viz., upper and lower receiving, upper and lower intermediate and upper and lower discharge valves, and the same air inlets for both cylinders. The No. 5 and No. 6 have separate air inlets for each cylinder and eight air valves, viz., upper and lower receiving for low pressure cylinder, upper and lower intermediate, upper and lower receiving for high pressure cylinder and upper and lower discharge. All air valves of the No. 5 pump are the same size and are interchangeable. This is also the case with those of the No. 6.

The No. 5 and No. 6 pumps are identical except in size, and as this type of pump is the later one, we will describe the operation of the No. 5.

By referring to the plates Nos. 1, 2, 3 and 4, it will be seen that each part has a reference letter and the pump pistons are shown in different positions. We will use these letters in the description of the operation, so that the movements can be easily followed, by referring to the plates when reading the explanation.

OPERATION.

Before the pump has been started, both pistons will naturally be at the bottom of the cylinders, due to their own weight, or, if not completely down, will at least have dropped enough to permit the slide valves to fall to the bottom of the steam chests.

Assuming for convenience of explanation that the pistons are both down, when the pump throttle is opened live steam flows into both steam chests B, and is always present in them when the pump is taking steam. In this instance only, steam is admitted to both cylinders at once, through port g, to the upper side of piston H, which being at the bottom is merely held in that position, and through port o, to the under side of piston T (Plate 1). Piston T now moves upward and in doing so forces the air that is above the piston in low pressure cylinder D, through intermediate valve K, into the high pressure cylinder F. At the same time, the low pressure piston tends to create under it a vacuum, which is filled with air at atmospheric pressure through the air inlet at the right, and receiving valve W. Just before piston T reaches the end of its upward stroke, the tappet plate Q engages the button on the end of the valve stem P, which moves the slide valve C, to its highest position, allowing the steam above piston H to pass through ports g, cavity r, in slide valve C, and the exhaust X, to the atmosphere, and live steam through port s, to the under side of piston H. As piston H moves upward (Plate 2) the high pressure piston in cylinder F forces the air above it, which may be said to

be under the first stage of compression, through discharge valve M, to the main reservoir, while its upward movement tends to create a vacuum under it in the high pressure cylinder F, which is filled with air at atmospheric pressure through high pressure receiving valve N.

Just before piston H completes its upward stroke (Plate 3), tappet plate L engages with the button on the valve stem, raising it with the slide valve A, exhausting the steam under piston T, through port o, cavity r, in slide valve A and the exhaust X to the atmosphere, and admitting steam through ports v to the upper side of piston T, moving it downward. During the downward movement of piston T the low pressure piston in cylinder D forces the air under it, which was taken in on its upward stroke, through the intermediate valve E to the under side of the piston in high pressure cylinder F, and at the same time cylinder D is filled with air at atmospheric pressure through the air inlet and upper receiving valve U. Just before the piston T completes its downward stroke (Plate 4), the tappet plate Q, coming in contact with the lower tappet or shoulder on the valve stem P, moves the slide valve C to its lowest position, allowing the steam under the piston H to exhaust to the atmosphere through port s, cavity r, in slide valve C and the exhaust X, and admitting live steam to the upper side of piston H, through ports g, moving it downward. As piston H moves downward, the high pressure piston forces the air under it through the lower discharge valve I into the main reservoir, while the cylinder is filled above with air at atmospheric pressure through the air inlet at the left, and receiving valve J.

The completion of this stroke completes one cycle of the pump. The movements described are repeated through each succeeding cycle.

The air valves through which air is being received or discharged during the movements of the pistons are shown in the illustrations as being raised from their seats.

Before starting a pump, open the drain cocks in the steam and exhaust passages. Open the steam valve slightly at first, and run the pump very slowly until all the condensation has been worked out of the steam cylinders. Then the steam valve may be opened a little more, but the pump should be run slowly until a pressure of 50 or 60 pounds has been accumulated in the main reservoir. It should be run just fast enough to promptly restore the pressure in brake system, but never raced.

The steam cylinders should receive a constant supply of oil from the lubricator (about one drop a minute), and it is necessary to keep all joints between the lubricator and pump perfectly tight, so that no oil will be wasted. Oil can leak away at the steam joints, where there is little or no indication of steam leakage.

The piston rods should be kept well packed, and good, clean swabs well oiled should be maintained on them.

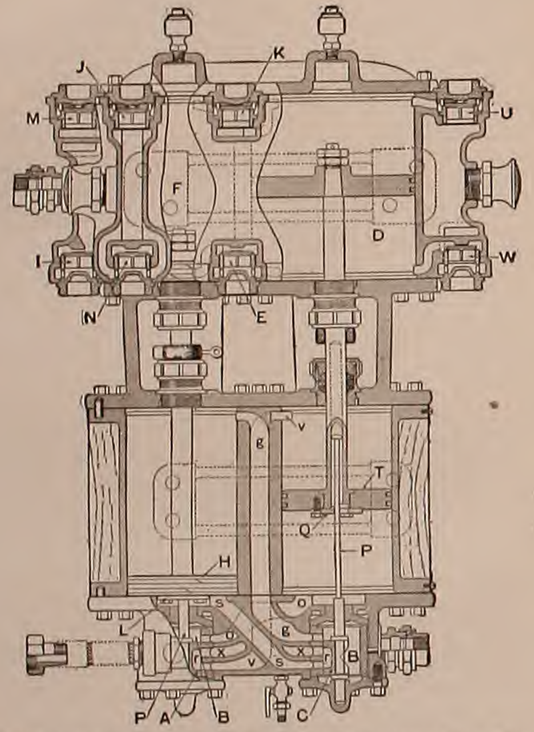


PLATE 1. LOW PRESSURE PISTON MOVING UPWARD. HIGH PRESSURE PISTON AT REST.

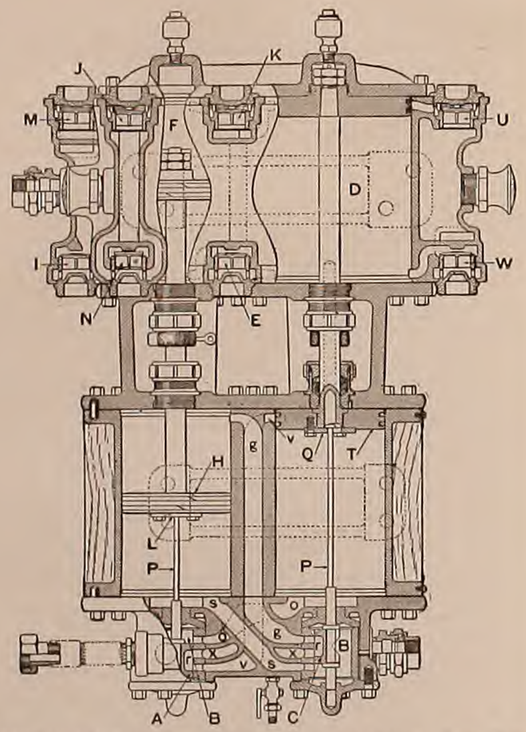


PLATE 2. HIGH PRESSURE PISTON MOVING UPWARD. LOW PRESSURE PISTON AT REST.

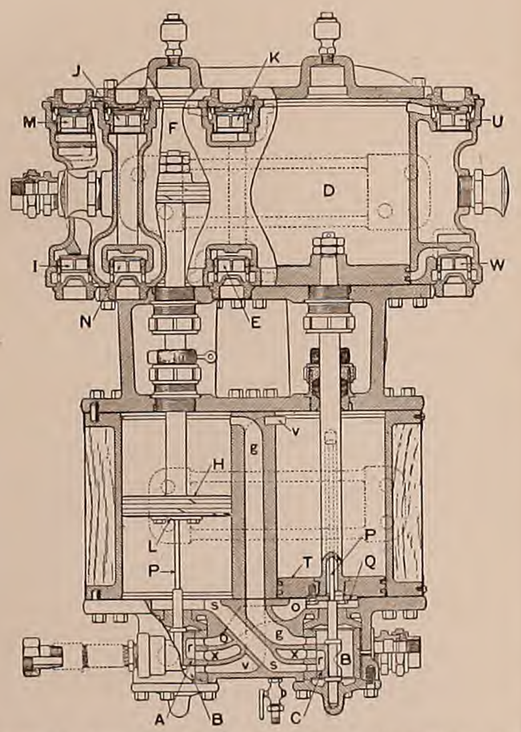


PLATE 3. LOW PRESSURE PISTON MOVING DOWNWARD. HIGH PRESSURE PISTON AT REST.

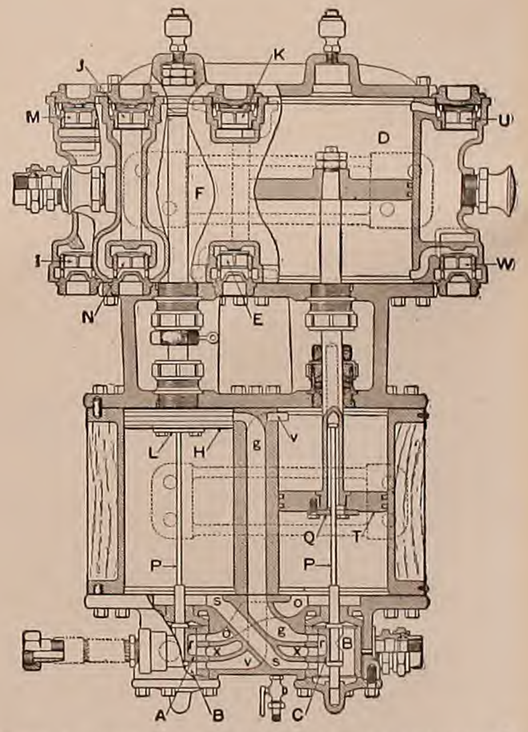


PLATE 4. HIGH PRESSURE PISTON MOVING DOWNWARD. LOW PRESSURE PISTON AT REST.

AIR PUMP DISORDERS.

Broken or stuck air valves or seats will materially reduce the efficiency of the pump. They almost invariably cause the pump to work unevenly, and can usually be located by watching the action of the pistons. Leaky piston packing rings will also reduce the efficiency of the pump, and cause an uneven stroke. To detect them, pump up about 90 pounds in the main reservoir and stop the pump. Remove the oil cup. If there is a continuous blow, it denotes a leaky discharge valve. If not, the discharge valve is tight. Start the pump again, and note if there is a blow from the oil cup hole on the down stroke; if so, it denotes leaky packing rings. However, most roads have their air pumps tested in the round-house, and they are supposed to maintain the standard pressure against a certain size orifice, the failure to perform which results in their removal for repairs.

Should the pump stop and refuse to go to work again, first see that the governor is working properly, and that the pump is getting a full supply of steam, by opening the drain cock in the steam passage (see governor disorders). Sometimes a pump will stop on account of insufficient lubrication, and may be started by shutting off the steam for a few moments, opening the drain cock in the steam passage and again turning on the steam, letting the lubricator feed a few extra drops of oil. If it will not then go to work, it will undoubtedly be due to a breakdown, which would have to be repaired in the shop or round-house, as engines are not usually equipped with the tools and parts necessary to make such repairs on the road.

THE AUTOMATIC OIL CUP.

The principle of operation of the automatic oil cup is as follows:

As the air piston makes its up-stroke, compressed air is driven upward through the passage drilled through the center post in the body of the oil cup, next passes downward inside the extended sleeve of the cap nut, and then through the regulating ports drilled in this sleeve, to the surface of the oil in the reservoir, on which it creates pressure. As the air piston makes its down-stroke, a vacuum is formed in the passage in the center post, and also inside the extended sleeve of the cap nut which envelops the center post, and the air pressure on the surface of the oil, formed when the air piston made its up-stroke, on the down-stroke forces the oil to the inside of the sleeve, and a small portion of it is drawn into the air cylinder through the hole in the feed cap, OC15, which screws into the center post.

With this cup, the quantity of oil fed to the air cylinder is governed by the diameter of the hole drilled in the feed cap, OC15.

This automatic oil cup supplies oil to the air cylinders only when the air pump is working; so that although it performs the

service required of it effectively, it also performs it with a maximum economy in the use of oil. Its use will increase the life of the air cylinders, packing rings and piston rod packing, as well as prevent hot pumps and the annoyance caused by the accumulation of the gum in other parts of the engine equipment, due to the imperfect, wasteful and uneven lubrication of the air cylinders heretofore in vogue.

This cup should be filled before starting on a trip. Use only good cylinder oil to fill it, as other oils do not lubricate air cylinders on account of their low flash point. Never oil through the air inlets, as it clogs the passages and valves. The automatic cup can be filled whether the pump is running or not, and it is a good plan to start the pump first, so as to be sure that the small port in the feed cap, OC15, is open. Be careful not to enlarge it when cleaning it out.

PUMP GOVERNORS—STYLE C.

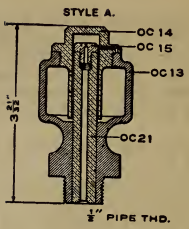
The function of the pump governor is to stop the pump when the maximum pressure has been obtained, and to again allow steam to be admitted to the pump when this pressure has been slightly reduced, thus practically maintaining a constant pressure.

The pump governor is shown with the steam valve open in one illustration and with it closed in the other, the arrows indicating the direction of flow of steam and of air.

OPERATION.

When sufficient air pressure, the amount for which the governor is adjusted, accumulates in the diaphragm air valve chamber to overcome the resistance of regulating spring PG 10, the diaphragm air valve PG 13 is lifted, uncovering the air passage in its seat PG 14, and air flows down on top of piston PG 4, which rests on top of steam valve PG 5. Then the piston and steam valve together are forced downward until the latter seats as shown in the cut showing the valve closed, and closes the steam passage leading to the air pump, thus cutting off the supply of steam. This action takes place when the air pressure for which the governor is adjusted has been obtained.

When the air pressure in the diaphragm air chamber falls below the tension of the regulating spring, diaphragm air valve PG 13 seats, as shown in the cut showing valve open, and cuts off the flow of air to the governor piston PG 4. The remaining air pressure in the governor piston chamber is quickly reduced on account of the air escaping from this chamber through small vent port, indicated by the small dotted circles, in the air passage connecting the diaphragm air valve and the governor piston air chambers; then the steam pressure acting upwardly on the face of the steam valve PG 5 forces this valve open and admits steam to the pump.



ADJUSTING.

The pump governor is adjusted to regulate the amount of air pressure carried, by means of the regulating spring PG 10. By screwing down the adjusting nut PG 35 the tension of this spring is increased; and by screwing up the nut the tension is decreased.

Increasing the tension of the spring increases the air pressure that may be carried, and decreasing the tension decreases the air pressure.

Screw down adjusting nut until the pump stops at the desired pressure, and note the promptness with which it starts when the air pressure reduces slightly, screwing down adjusting nut a trifle if the pump does not start promptly, after which replace cap nut securely.

When adjusting governors, be sure that the air gage is correct.

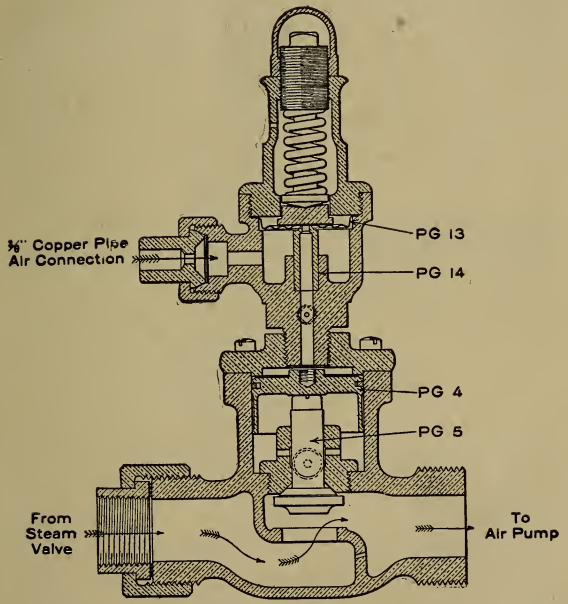
Often difficulty experienced in adjusting governors is due to erratic action of the air gage.

PUMP GOVERNOR DISORDERS.

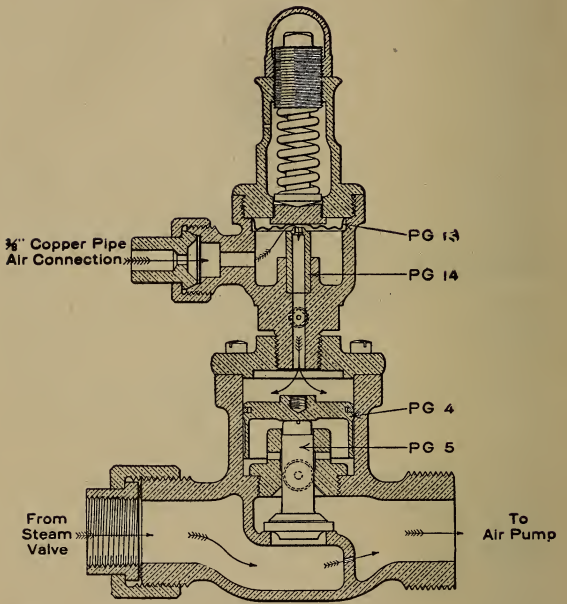
After the pump governor has been properly adjusted and it is found that it permits a gradual increase of pressure to be carried, no change in the adjustment having been made, before it stops the pump, it is likely that gum has accumulated on the face of the diaphragm air valve, between it and its seat PG 14, thus increasing slightly the height of this seat and, consequently, the tension of the regulating spring, and reducing the lift of the diaphragm.

When the governor stops the pump, and does not permit it to go to work promptly upon a slight reduction in air pressure, it is probable that the diaphragm PG 13 is leaking. This leakage tends to hold the steam valve closed, and make the pump work slower than before. The leakage past the diaphragm can be detected by the constant flow of air from the small relief port (small dotted circle) in the diaphragm body PG 32.

When the pump has been working properly but begins to run slower each day, of its own accord, it is an indication that there



PUMP GOVERNOR. STEAM VALVE OPEN.



PUMP GOVERNOR. STEAM VALVE CLOSED AND AIR PASSING TO TOP OF PISTON PG 4.

is an accumulation of lime or other matter on the stem of the steam valve PG 5, which reduces the lift of that valve and makes it throttle the pump.

When the governor fails to stop the pump, and the standard pressure has been accumulated, assuming, of course, that it has been properly adjusted, it is probable that the relief, or drainage, port (indicated by the larger dotted circles) in the governor body PG 30 is stopped up. This port is for the relief of any steam and of any air leakage that might occur into the chamber below the governor piston and form a pressure under it. When the relief port is blocked up—and this is likely to occur only in extreme cold weather when the condensation from the steam can freeze—the leakage into this chamber is trapped and forms a pressure underneath the governor piston that will be greater than the air pressure coming in on top of this piston, hence the governor cannot operate to close the steam valve, and the pump will run uncontrolled.

When a waste pipe is screwed into this port it should be very short. Long ones will surely freeze up in cold weather.

Should the diaphragm air valve PG 13 leak around the edges into the spring case PG 3A and at the same time the small relief port in this case should happen to be stopped up, the governor would allow the pump to run uncontrolled. The same would be true if the air passage through seat PG 14 should become blocked up solid with gum. The last two causes of loss of pump control, however, seldom, if ever, occur.

GENERAL CARE OF GOVERNOR.

The pump governor should be kept clean, and the air and steam valves free from leakage. All pipe connections to the governor should be kept absolutely air and steam tight; this to prevent waste of air and of steam, and to insure the proper working of the governor, and the proper lubrication of the pump. On account of the curious fact that oil supplied by the lubricator can leak away at the steam joint connections even when there is little or no indication of steam leakage, it will be necessary to see that these joints are kept perfectly tight so that all oil furnished to the pump may be carried to it, and lubricate it. Before connecting up the air pipe to the diaphragm body PG 32, see that the small strainer in this connection is perfectly clean. If this strainer should become blocked up air could not freely pass to the governor piston, and the governor would not work satisfactorily.

In all cases where the pump stops and refuses to go to work, before doing anything else examine all relief ports in the governor and see that they are perfectly free. Open the drain cock in the steam passage of the steam head of the pump and note whether or not steam is passing freely to the pump.

PART IV.

THE DUKESMITH ENGINE CONTROL AIR BRAKE EQUIPMENT NO. 6.

THE DUKESMITH ENGINE CONTROL AIR BRAKE EQUIPMENT NO. 6.

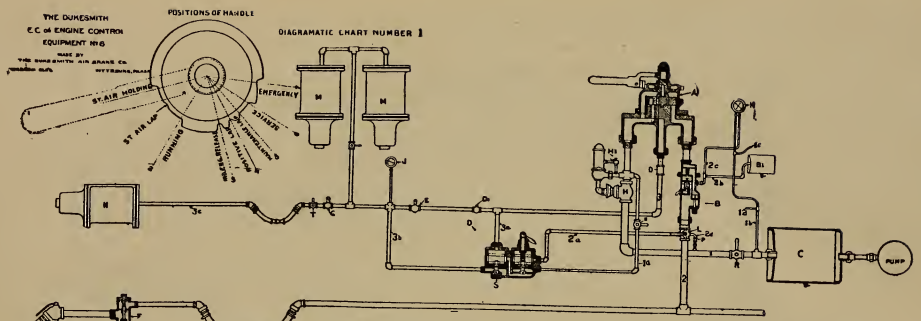
FUNCTIONS. It is claimed by its manufacturers that the functions of this equipment are: 1. Engine and tender brakes may be applied independently of the train brakes and without overcharging the train pipe. 2. Slack of the train may be taken by graduated application of locomotive brakes and immediately thereafter of the train brakes by using one handle. 3. Entire or graduated release of engine brakes without disturbing train brakes. 4. Engine brakes may be reapplied without making a further train pipe reduction or at the same time the train brakes are being harder applied. 5. Engine and train brakes released together as with an ordinary brake valve. 6. Release of train brakes while engine brakes are set. 7. Releasing engine brakes while train brakes are applied and reapplying and holding engine brakes while releasing train brakes with one movement of the handle. 8. Maintaining engine brakes against brake cylinder leakage with the triples at lap or release position. 9. Uniform pressure per square inch, regardless of piston travel, of engine and tender brake cylinders. 10. Automatic application of engine brakes in case hose bursts and continued application thereof, regardless of cylinder leakage. 11. Immediate release of engine brakes without releasing train brakes, after emergency application. 12. Quick train pipe reduction at train triples in double-heading emergency application, regardless of number of coupled engines.

OPERATION. The only features in its operation which differ materially from the operation of the standard Air Brake are:

First—When the handle of the valve is moved toward the left, from Running to Release Position, it applies the engine brakes without applying the train brakes, and by returning the handle to Running Position it releases the engine brakes.

Second—By placing the handle in the notch between Running and Lap Positions (known as Independent Release) it will release the engine brakes without releasing the train brakes.

Third—By placing the handle on Maintenance Lap Position it



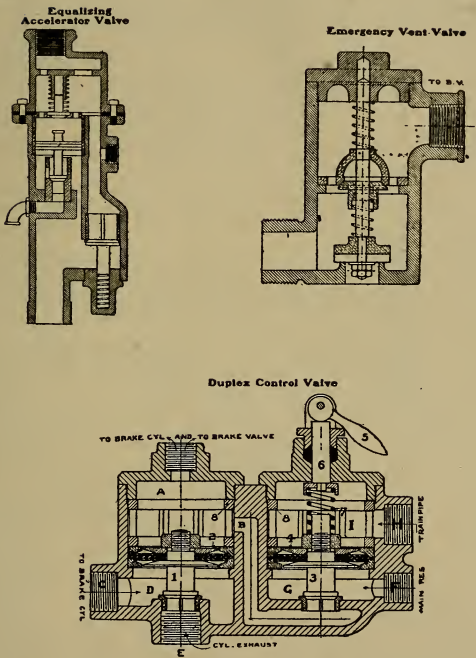
THE DUKESMITH "E. C." OR ENGINE CONTROL EQUIPMENT NO. 6.

FUNCTIONS OF NO. 6 BRAKE VALVE.

1st Position—Applies and Holds Engine Brakes While Releasing Train Brakes.
2nd " Releases Engine and Train Brakes.
3rd " Releases Engine Brakes While Holding Train Brakes.
4th " Closes all Ports.
5th " Gradually Applies Engine Brakes or Keeps Them Applied Against Cyl. Leakage.
6th " Applies Engine and Train Brakes in Service.
7th " Applies Engine and Train Brakes in Emergency.

INDEX TO CHART.

A—Brake Valve.
B—Equalizing Accelerator Valve.
B1—Equalizing Reservoir.
C—Main Reservoir.
D—Duplex Control Valve.
D1—Non-Return Check Valve.
E—Brake Cylinder Reducing Valve.
F—Emergency Vent Valve.
G—Safety Valve.
H—Pressure Controller.
H1—Pressure Controller Valve.
J—Brake Cylinder Gage.
K—Duplex Gage.
L—Train Pipe Cut-Out Cock.
M—Drive Brake Cylinders.
N—Tender Brake Cylinders.
O—Partial Check Valve.
P—Double Heading Check Val.
Q—Cut-Out Cock.
R—Cut-Out Cock.
S—Eng. Brake Cylinder Exhaust.
T—Cut-Out Cock.
1—Main Reservoir Pipe.
1a—Supply Pipe to Duplex Control Va
1b—Pump Governor Pipe.
1c—Pump Governor Connection.
1d—Air Sander.
2—Train Pipe.
2a—Branch Pipe to Duplex Control Valv
2b—Branch Pipe to Equalizing Reservoi
2c—Train Pipe Gage.
2d—Double Heading Pipe.
3—Eng. Brake Cylinder Pipe.
3a—Cyl. Branch Pipe to Dupx. Con. Val
3b—Brake Cylinder Exhaust Pipe.
3c—Tender Brake Cylinder Pipe.



DETAILS OF EQUALIZING ACCELERATOR VALVE, EMERGENCY VENT VALVE, AND DUPLEX CONTROL VALVE OF DUKESMITH, E. C. OR ENGINE CONTROL EQUIPMENT NO. 6 SHOWN IN CHART.

will cause the engine brakes to apply very gradually or keep them applied against cylinder leakage, without applying the train brakes.

POSITIONS. The positions on the brake valve are arranged in the usual order. The valve handle is moved toward the left when releasing train brakes, and toward the right when applying train brakes.

The first position, to the extreme left, is Straight Air and Holding Position. This puts the engine brakes on or keeps them on while the train brakes are being released.

The second is Running Position, which releases both the engine and the train.

The third is Independent Engine Release, which lets the engine brakes off without releasing the train brakes.

The fourth is Positive Lap, when the ports are all closed.

The fifth is Maintenance Lap, which allows main reservoir pressure to flow to the engine brake cylinders while the train pipe exhaust is kept closed.

The sixth is Service; in this position the train pipe pressure is allowed to exhaust through a small opening, while the main reservoir pressure is allowed to flow to the engine brake cylinders, thus making a straight air application on the engine while the train brakes are being applied automatically.

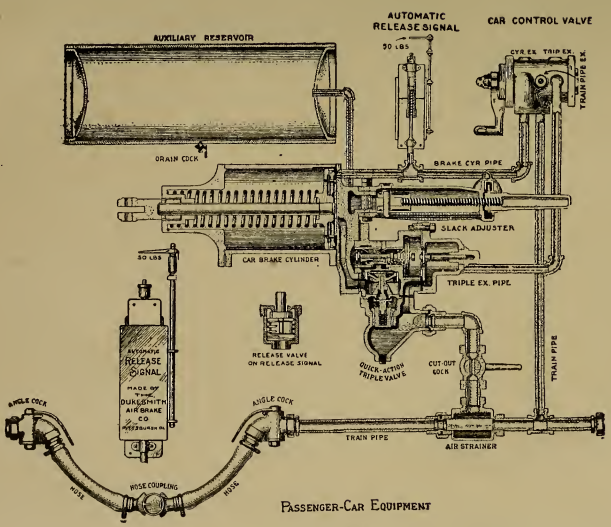
The seventh is Emergency; in this position the train pipe exhaust is wide open and the main reservoir pressure is free to pass into the engine brake cylinders.

Straight Air Lap Position is about midway between Holding and Running Positions.

The Equalizing Discharge Valve is located in the train pipe just below the brake valve; it is also an Accelerator Valve, because it accelerates, or quickens the flow of air from the train pipe when the surge rushes forward from a long train pipe, thereby insuring full braking power regardless of the length of the train.

When a hose bursts the driver brakes may be immediately released by closing the cut-off cock marked Q, as shown on the Chart, and placing the handle of the brake valve on Independent Release Position.

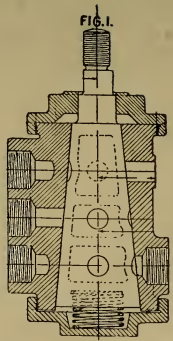
The Dukesmith Car Control Valve is intended for use on both freight and passenger cars. It is connected to the exhaust port of the triple and to the brake cylinder and to the train pipe, and hence enables trainmen to independently close the triple exhaust or open the brake cylinder without regard to the action of the triple valve and also to open the train pipe to the atmosphere either suddenly or gradually, thus making either a service or emergency application of the brakes on the entire train, as may be desired.



PASSENGER-CAR EQUIPMENT

DUKESMITH CAR CONTROL VALVE.

FIG. I.



SECTIONAL VIEW DUKESMITH CAR CONTROL VALVE.

OCT 28 1911

SUPPLEMENT TO THE VOLUME

AIR BRAKE

OF

THE SCIENCE OF RAILWAYS

BY

MARSHALL M. KIRKMAN

EMBODYING DESCRIPTIONS AND INSTRUCTIONS FOR THE MANIPULATION OF

THE WESTINGHOUSE No. 6 "E T" ENGINE AND TENDER BRAKE EQUIPMENT, TOGETHER WITH QUESTIONS AND ANSWERS RELATIVE TO THE PRACTICAL OPERATION THEREOF; THE NEW YORK B-3 LOCOMOTIVE BRAKE EQUIPMENT; NEW YORK DUPLEX AIR PUMPS AND PUMP GOVERNORS; AND THE DUKESMITH E. C. EQUIPMENT No. 6 AND CAR CONTROL VALVE

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