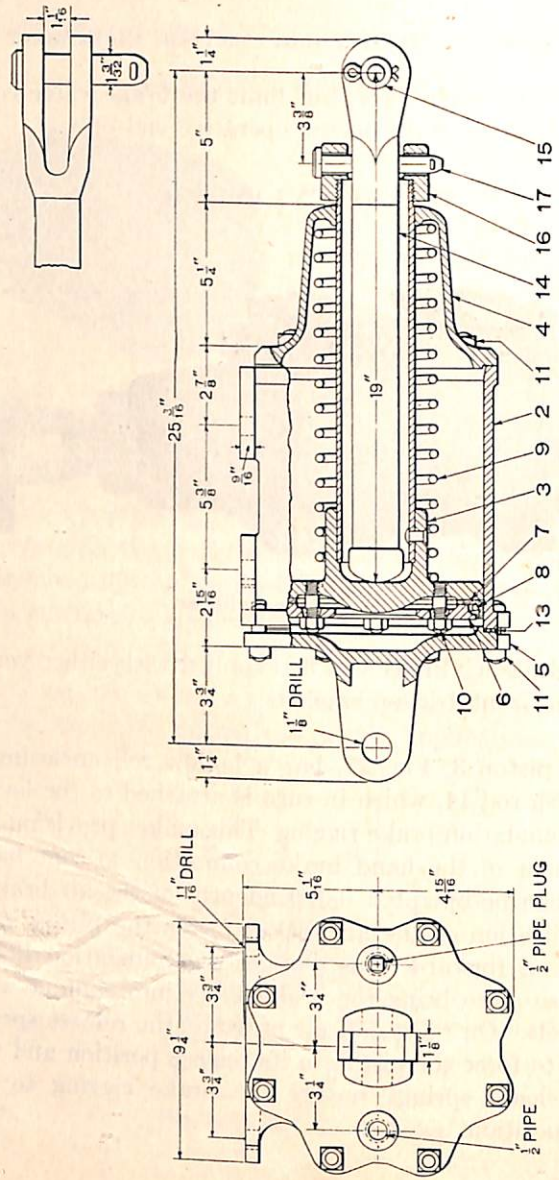


Fig. 27. Brake Cylinder, Sectional View

DOOR AND STEP CONTROLLER

Fig. 28 shows a photographic view of the door and step controller while Fig. 49 shows cross sectional and assembled views. It will be seen that the door and step controller is of the double acting piston type with a rack connecting the two pistons. These pistons operate by admitting air on one end at the same time exhausting air from the other end. Air is permitted to flow freely to the door and step controller while the exhaust of air from the opposite end is restricted for the purpose of providing a satisfactory cushioning effect by means of ball checks, suitable ports, and an adjustable choke plug. The movement of the pistons and rack operates segmental gear C-194 secured to a shaft C-153, which in turn is attached to the rods and levers actuating the doors and steps.

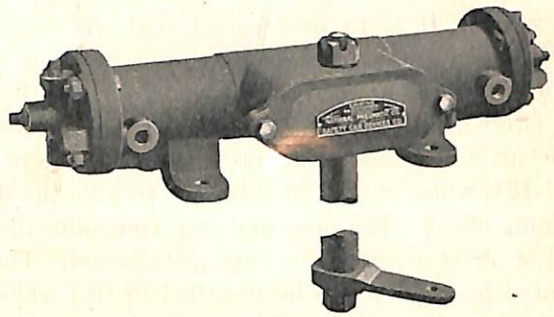


Fig. 28. Door and Step Controller

The door and step controller has two pipes leading to same, one at each end. These pipes are the admission and exhaust pipes for the respective ends of the cylinder.

By reference to the sectional views shown in the lower right hand and upper left hand corners of Fig. 49, air is admitted at the admission port B, flowing through the cylinder casting through port B to the space between the two balls. A slight amount of air passes the end of choke plug C-154, but the main path for the flow of air is by raising the large bronze ball and thence into the cylinder behind the piston. During this time the small ball is held to its seat.

Assuming the door to have been opened by the operation just described and it is now desired to close same, the brake valve handle will be moved to the proper position when the admission pipe now becomes an exhaust pipe. Air is permitted to exhaust from behind the piston through port A, past the small ball, and out through port B and pipe connection at B to the atmosphere at the brake valve. It is to be recalled that air pressure is being supplied behind the piston at the opposite end at this time. When the piston has passed port A the cushioning effect of door movement is established by restricting the further exhaust of air pressure by means of choke plug C-154, which should be adjusted to give the desired cushioning effect. The door and step controller illustrated in Fig. 28 is intended for floor installation. The type illustrated in Fig. 49 can be installed in two ways; one. with the rotating shaft C-153 vertical, in which case the lever attached to this shaft must be underneath; and two, with the rotating shaft horizontal. In either case it is necessary to insure that the heads containing the balls have been properly arranged, i. e., with the port containing the seats for these balls in a vertical position.

Adjustment

The choke plug C-154 is intended for the purpose of controlling the final movement of the door and step and may be adjusted by screwing in or out to provide a greater or lesser cushioning effect. The door and step will be found to travel rapidly until the piston on the side from which air is being exhausted travels past the port *a*, after which unrestricted exhaust to the atmosphere is ended and the remaining air pressure must be exhausted past the choke plug.

When the proper cushioning effect is not secured, if there is reason to believe that the leather cup C-26 is in good condition, the difficulty will more than likely be found in connection with the large ball which may be held off its seat by some particle of foreign matter.

The travel of the door and step controller shaft is 90 degrees. To allow for lost motion in pins, door and step shafts, etc., it is desirable to use a lever on the door engine shaft ⅛″ longer than the levers on the door and step shaft. This door and step controller can also be used to actuate sliding doors with corresponding steps.

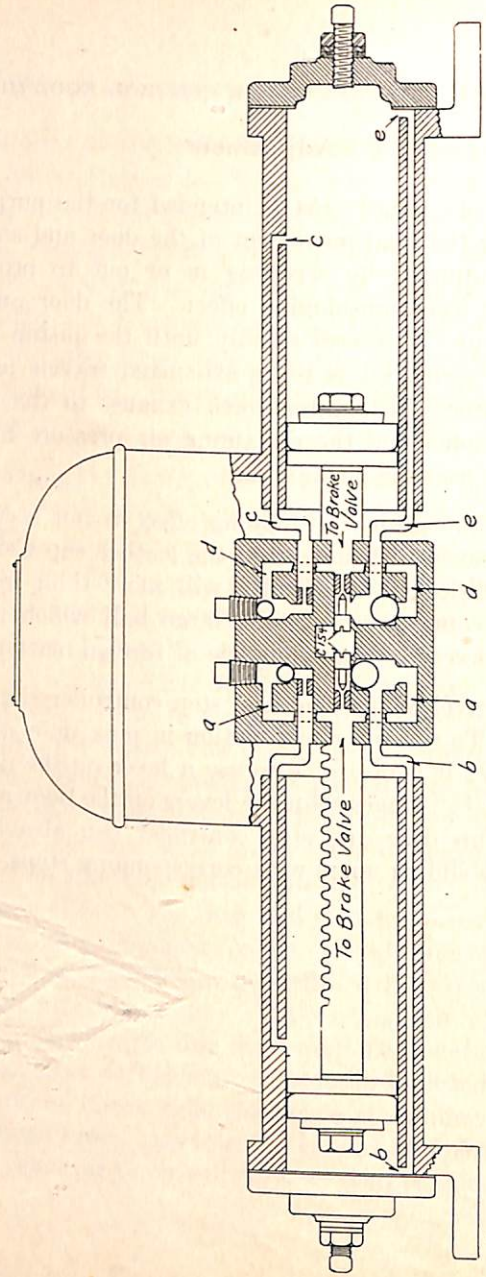


Fig. 29. Diagrammatic View of the Type G. S. 8" B. C. Door and Step Controller

Type G. S. 8" B. C. for Sliding Doors

This door and step controller is practically the same as that already described (folding door type) except that the ball check valves are located in a valve block in the center of the engine instead of in the cylinder ends.

Actual section and plan views are shown in Fig. 50, and a diagrammatic view in Fig. 29. Referring to Fig. 29, suppose air from the brake valve enters the pipe connection communicating with passage *a* between the two ball check valves. A slight amount of air passes the end of the adjustable choke plug C-154 but on account of the pressure under the large ball building up much more rapidly than on top, the ball will lift from its seat and allow air to flow into passage *b* and thence into the end of the cylinder in front of the piston, which will be forced toward the right together with the rack and the piston on the other end.

In the meantime, the other pipe connection is open to the atmosphere through the brake valve, permitting the air in front of the right-hand piston to exhaust through passage *c*, past the small ball which will lift from it seat, and through passage *d* and the brake valve. When the piston passes port *c* in the cylinder wall, the remaining air pressure must exhaust through passage *e*, and past the end of the adjustable choke plug C-154. This choke plug, by restricting the exhaust of the remaining air pressure, establishes a cushioning effect of door movement which may be regulated by the adjustment of the choke plug.

Assuming that the door was opened by the movement just described and it is now desired to close the door; by

placing the brake valve handle in the proper position, the direction of the flow of air through the valve block will be reversed. The return movement will be the same as above described except that the direction of the air flow through the various passages and the positions of the ball check valves will be just the reverse.

3/8" CUT-OUT COCK WITH VENT

Fig. 30 shows a 3/8" cut-out cock with 1/8" side vent to be located so that side vent is open to the door controller when the cut-out cock is closed. This will enable

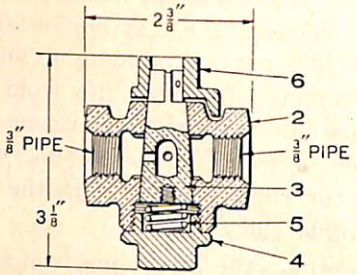


Fig. 30. 3/8" Cut-out Cock with 1/8" Side Vent

the operator to open and close the door by hand when necessary to leave the car as might be required at car barns.

This cock is operated by means of the brake valve handle which fits over the handle extension 6.

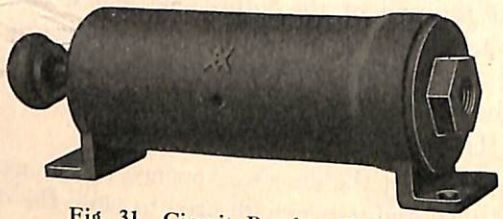


Fig. 31 Circuit Breaker Cylinder

CIRCUIT BREAKER CYLINDER

A circuit breaker cylinder, Figs. 31 and 32, is installed with its piston directly in line with the handle or button of the circuit breaker, or line switch, so that its piston may complete its full stroke before the handle of the

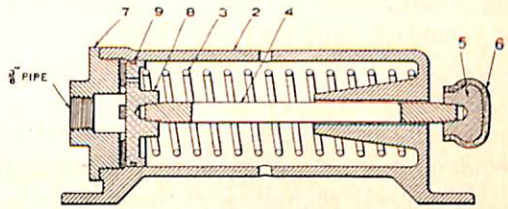


Fig. 32. Circuit Breaker Cylinder

circuit breaker comes up solid against its "off" position. The pipe leading from this circuit breaker cylinder is connected to the relay valve exhaust port of the emergency valve, thus when an emergency application is caused by actuation of the relay valve, air is permitted to flow to the circuit breaker cylinder, and forcing its piston outward into contact with the handle or button of the circuit breaker, causes the circuit to be opened. The circuit breaker cylinder has a return spring which returns the piston to its normal position and permits the resetting of the circuit breaker or switch after restoration of normal conditions. The circuit breaker cylinder is indirectly controlled from the controller safety attachments and does not respond to emergency application made by use of the brake valve handle.

CONTROLLER SAFETY ATTACHMENTS

The controller safety attachments, that is, the apparatus which is attached direct to the top of the controller, as shown in Fig. 33, consist of a controller handle, a handle base portion, and a controller pilot valve. Three pipe connections are made to the controller pilot valve, one supplying main reservoir pressure, the second forming the safety control pipe and the third extending to the atmosphere. The controller pilot valve is attached at the top of the controller by means of set screws or bolts, while the handle base portion is attached at the spindle of the controller drum by means of a countersunk set screw. The controller handle is of the removable type for single end as well as double end cars.

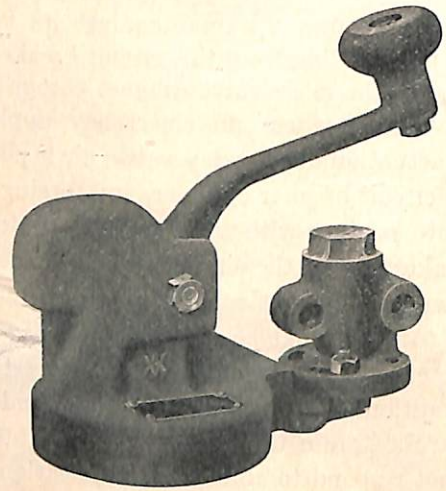


Fig. 33. Controller Handle and Pilot Valve

Referring to Fig. 34, which shows a cross section of the controller handle, the handle base portion, and controller pilot valve, it will be seen that the handle 2 is hinged on fulcrum 11, which permits the handle to be pressed downward, thereby raising pin 9 from lever 17. This lever is fulcrumed at pin 18, and, with the removal of the spring tension stored in spring 8, by pressing downward on the controller handle, the inner valve 21 is forced

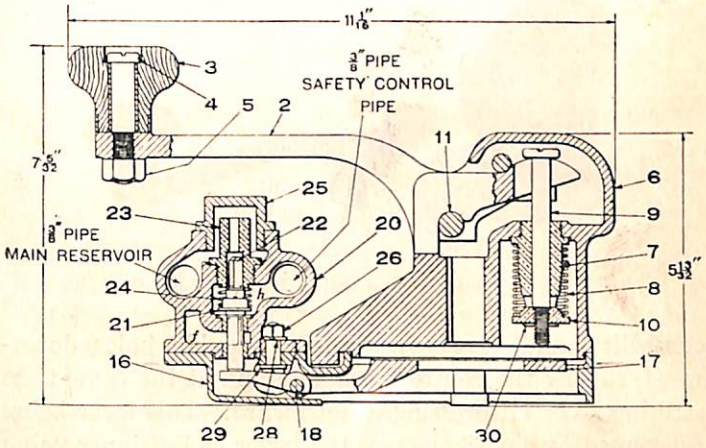


Fig. 34. Controller Handle and Pilot Valve—Sectional View

downward by valve spring 24 against its seat; at the same time outer valve 22 is unseated and air communication is established between main reservoir pipe, past the stem and seat of valve 22 into cavity *h* leading to the safety control pipe. This charges the safety control pipe which extends through the foot valve, the No. 15 double check valve and to the relay valve of Type K-1 emer-

gency valve. With the handle pressed downward, as just related, the controller safety apparatus is in its normal operating position, at which time the controller handle can be rotated to supply current for the motors in accordance with the usual practice. This handle should be held down at all times when the car is in motion with the exceptions as related under the subject of foot valve on the next page. Upon release of the pressure on the

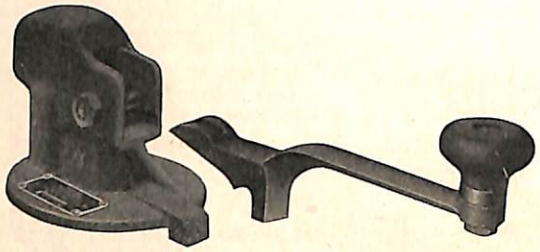


Fig. 35. View of Controller Handle, Detached

controller handle, spring 8 will force shoulder bolt 9 downward, raising the controller handle and at the same time striking lever 17, pressing it downward. This lever being fulcrumed at pin 18 engages the lower end of inner valve 21, raising it from its seat and at the same time compressing valve spring 24, raising outer valve 22 until it engages its seat. Under these conditions the flow of air from main reservoir past outer valve 22 to chamber *h* and the safety control pipe is cut off. Communication is established between cavity *h* and the safety control pipe, and cavity f, which leads to the atmosphere.

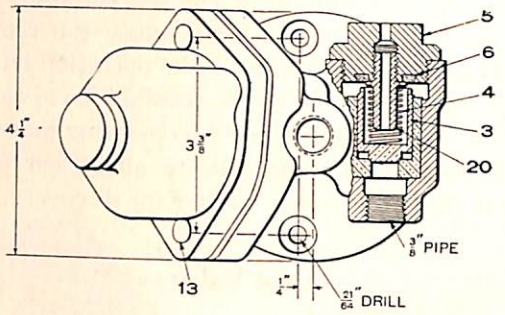
Fig. 35 is a photographic view of the controller handle. The slot in the end opposite the handle is intended to engage a bolt, as shown in Fig. 33. The controller safety attachments are designed for installation in such a way that it is most difficult to defeat the purpose for which this apparatus is intended. Obviously the removal of parts will affect the reliability of its operation but special attention has been given to the possibilities of tampering with these features, and since the operating parts are entirely enclosed, it is impossible to alter their functions without making it a simple matter for discovery.

Foot Valve

The foot valve, Fig. 36, is an auxiliary device located in the floor of the cab so placed as to be most convenient for operation by the car operator. It automatically causes the safety features to become inoperative when a straight air brake application of a predetermined amount has been made.

Straight air pipe pressure on face of valve 3 overcomes the force of spring 4 lifting valve 3, thereby permitting straight air pipe pressure to flow to face of collapsible piston 16. Piston 16 will then be forced down, carrying with it plunger 9 and valve 7, thus holding valve 7 to its seat against safety control pipe and pressure and spring 8.

Should the operator find it necessary to remove his hand from the controller handle without having previously made a straight air application, the safety control features may be made inoperative by the car operator pressing down on button 15, thus carrying collapsible piston 16, plunger 9 and valve 7 down; valve 7 seating and being held against safety control pipe pressure and spring 8 as in pneumatic operation.



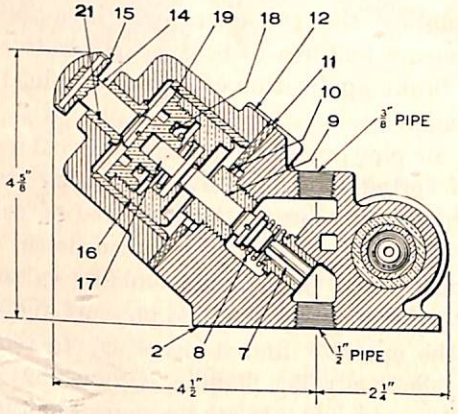


Fig. 36. Foot Valve—Sectional View

Wing Check Valve

The wing check valves in the by-pass line around each combined foot and cut-off valve, provides against emergency applications when changing ends by permitting the safety control pipe on the operative end to charge as soon as the controller handle is in place and

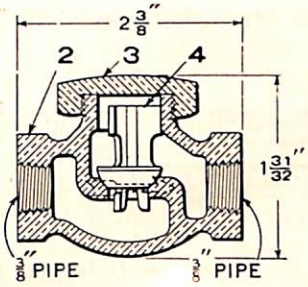


Fig. 37. Wing Check Valve

held down. Without these by-pass lines and check valves, an emergency application would result in case the foot valve on the non-operative end should open before that on the operative end when the brake valve handle is moved to release position.

Rear Door Unlatching Device

The rear door unlatching device, Fig. 38, is used on single end cars to lock the rear or emergency exit door and step and to prevent recharge of the equipment until this rear door is closed. Emergency pipe pressure forces piston 3 outward, carrying with it bolt 5 against the tension of spring 4. At such time as an emergency application of the brake is made, the emergency pipe pressure is exhausted to the atmosphere, in which case the spring 4

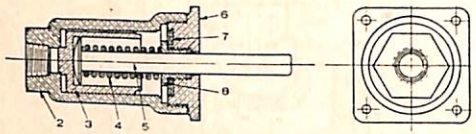


Fig. 38. Rear Door Unlatching Device

forces the piston and bolt inwardly, and when properly installed, unlocks the door. It is seen, therefore, that during the emergency brake application the rear door and step is available for exit. It is assumed, of course, that some suitable handle latch will be attached to the door, if necessary, so that should it be required for use as an exit when an emergency application has been made, the door can be opened in the ordinary way.

GENERAL DESCRIPTION OF SAFETY CONTROL EQUIPMENT

The circuit breaker cylinder, the controller handle, the handle base portion, the controller pilot valve and the foot valve form a group of apparatus known as the Safety Control Group. The object of their use is to insure that the car operator shall perform the necessary details of starting, running and stopping the car in an approved manner.

Considering the car to be at a standstill, either for the purpose of loading or unloading passengers, or for any other purpose, with the straight air brake applied, it is obviously necessary to release the brake application before the car can be put under headway. Before this release of brakes takes place, the operator must press downward on the controller handle, preliminary to feeding current to the motors. When this is done the brakes can be released, and by advancing the controller handle the car will be made to move. Under ordinary conditions, the hand pressure on this controller handle will be retained until the car is brought to a standstill at the next stopping point. In the meantime, however, by use of the foot valve, as previously described, the hand may be removed from the controller handle for temporary use or convenience of the operator. Correspondingly, should the hand be removed from the controller handle, without either making use of the foot valve or having made a straight air brake application of approximately 35 lbs. brake cylinder pressure, which in itself would bring the car to a standstill, air pressure in the control pipe will be

allowed to flow through the controller pilot valve to the atmosphere at such a rate that the relay valve of the emergency valve will be unseated. This action causes the circuit breaker cylinder to open the circuit breaker and cut-off the power to the motors, and also causes the main piston of the emergency valve to move so as to make an emergency brake application together with distribution of sand from the sand traps, and removal of air pressure from the door closing side of the door and step controller, thereby balancing same. Thus, in short, the power is cut off, the brakes are applied to emergency force, sand is distributed and the doors and steps are arranged for hand operation, as may be required.

It is seen then that the car operator must not only remain at his post of duty where he can reach the controller handle or the foot valve, but he must be attentive to his work, else the car will be automatically brought to a standstill. The straight air brake application of sufficient amount to prevent this automatic operation would in itself, of course, bring the car to a standstill.

OPERATION OF THE EQUIPMENT

Charging and Release Position (Doors Closed) Fig. 51

With the main reservoir charged, brake valve handle in release position and hand on the controller handle, air flows from the main reservoirs through the main reservoir pipe to the main reservoir cut off valve, then to the brake valve, then through passage *a* therein to chamber A above the rotary valve. From this chamber the air passes through port *m* in the rotary valve to port *h* in the seat. From port *h* the air flows in two directions; first, through port *r* in the rotary valve and port *g* in the seat and door closing pipe to the door closing side of the door and step controller; second, through emergency pipe and pasage *b* in the emergency valve to chamber B in the face of the emergency valve piston. Air also flows from passage *b* through passage *e* to the relay valve, thence through groove *y* to port *m* leading to the safety control pipe.

Main reservoir air also flows directly to the emergency valve through port *n* to chamber B; also through passage *t* to chamber C in back of the emergency valve piston, thence through port *k* in the slide valve to port *g* in the seat to the sanding reservoir.

Main reservoir air is in communication with the safety control pipe through the main reservoir pipe port *a* in the controller pilot valve past outer valve 22 and chamber *h* to chamber A of the foot valve past valve 7. Main reservoir air in chamber *h* in the controller pilot valve is free to flow through the by-pass pipe and check

valve to the safety control pipe and thence through the No. 15 double check valve to port *m* in the emeregency valve.

The brake cylinder is connected through ports *a* and *d* in the emergency valve and cavity *f* in the slide valve, the straight-air pipe and ports *b*, *n*, *o* and *p* to exhaust port *e* of the brake valve.

The door opening side of the door and step controller is connected to the atmosphere through ports *c*, *b* and *a* of the door and step controller, to door opening pipe and ports *c*, *q*, *o*, *p* and *e* of the brake valve.

Service Application Position (Doors Closed) Fig. 52

To make a service application the brake valve handle is moved to service application or third position. Main reservoir air in chamber A above the rotary valve then flows through ports *s* and *b* in the brake valve to the straight air pipe and thence through ports *d* and *a* in the emergency valve and cavity *f* in the slide valve to the brake cylinder.

Air in the straight air pipe also flows to chamber F in the foot valve. When a predetermined pressure is obtained in the straight air pipe sufficient to overcome the tension of the spring above valve 3 of the foot valve, this valve will be lifted permitting straight air pipe air to flow through port *b* and chamber C to the face of collapsible piston 16, forcing the piston down and seating valve 7, thereby closing communication between the controller pilot valve and relay valve 17 in the emergency valve via the No. 15 double check valve. With this communication

closed the hand may be removed from the controller handle without causing emergency action through the operation of the controller pilot valve.

Lap Position (Doors Closed) Handle Off

To hold brakes applied and prevent further flow of air to the brake cylinder or to the atmosphere, the brake valve handle is placed in Lap or second Position, thereby closing communication between the supply in chamber A of the brake valve and the straight air pipe or between the straight air pipe and exhaust port *e* in the brake valve.

Door Open Position (Brakes Applied) Fig. 53

To open the door applying brakes at the same time, the brake valve handle is moved to Door Open or Fourth Position applying the brakes as previously described. In this position the foot valve and pilot valve also operate the same as in service application position, permitting the removal of the hand from the controller handle without causing emergency action through the operation of the controller pilot valve. The door opening operation is as follows: Air is vented from the door closing end of the door and step controller through ports *g*, *f* and *e* of the door and step controller, then through the door closing pipe and ports *g*, *r* and *d* of the brake valve to the brake valve exhaust port *e*. Main reservoir air from chamber A above the rotary valve is admitted through ports *u* and *c* to the door opening pipe and passages *a*, *b* and *c* pass ball 7 and through port *d* forcing piston forward carrying with it rack 3 to the right, thereby opening the doors.

A feature of the door and step controller is the quick opening and closing of the doors without the objectionable feature of slamming. This is accomplished through control of the air exhausted from the face of piston 5 during the initial movement of the piston through port h, past ball 10 and through passages f and e. After the piston has partially completed its stroke port *h* is cut off by the piston and the remaining air in front of the piston is vented through passages g, f and e only, thereby providing a cushioning effect. The quick building up of the pressure on the face of the opposite piston is obtained by the lifting of ball 7. A choke plug has been provided in port *g* by which the rate of exhaust of air from the face of piston 5 during the latter part of its stroke can be regulated.

Emergency Application

An emergency application may be obtained in two ways; by removing the brake valve handle to Emergency or fifth Position, or by removing the hand from the controller handle.

Emergency from Brake Valve. Fig. 54

When the brake valve handle is moved to Emergency Position, the emergency pipe is vented to the atmosphere through ports *h, n, o, p* and *e,* thereby exhausting air from chamber B on the outer face of the emergency valve piston. Main reservoir air in chamber C of the emergency valve then forces the piston and slide valve to the right to application position, permitting main reservoir air to flow from chamber C through port *a* and piping to the brake cylinder. Cavity *p* connects ports *g* and *h*

in the seat, allowing air from the sanding reservoir to flow to the sanding pipe. If for any reason the emergency valve piston should fail to move to application position, a straight air application will be obtained since port *b* in the brake valve leading to the straight air pipe is connected to port *y* in the rotary valve to main reservoir air in chamber A.

Immediately after the brake valve handle is moved to emergency position the controller handle should be released.

Emergency from Controller Handle. Fig. 55

If from any cause the operator should remove his hand from the controller handle and his foot from the foot valve without having previously made a straight air application, an emergency application will be produced by the venting of air from chamber E above the relay valve in the emergency valve through passage *m* and the safety control pipe, thence past valve 7 and chamber A of foot valve to chamber *h* of the controller pilot valve, past inner valve 21 and port *f* to the atmosphere, thus permitting emergency pipe air under emergency relay valve 17 to lift the valve and flow to the circuit breaker cylinder, moving the piston out past port *a* in the circuit breaker cylinder body. This results in throwing the circuit breaker, cutting off the power and venting emergency pipe air through port *a* in the circuit breaker cylinder, chamber A and port *e* in the emergency valve to the atmosphere, causing the emergency piston and slide valve to move to emergency position. Brake cylinder pressure is then obtained through the emergency

valve in the same manner as when emergency application is initiated at the brake valve.

Balancing Doors in Emergency. Figs. 54 and 55

Since the door opening piston 4 of the door and step controller is connected to the atmosphere when the doors are closed and the door closing piston 5 is connected to emergency pipe pressure, the venting of emergency pipe pressure either through the brake valve or the operation of the controller pilot valve will also result in a drop of the pressure in the door closing side to atmospheric pressure, thereby balancing the pistons of the door and step controller which permit easy opening of the doors by hand.

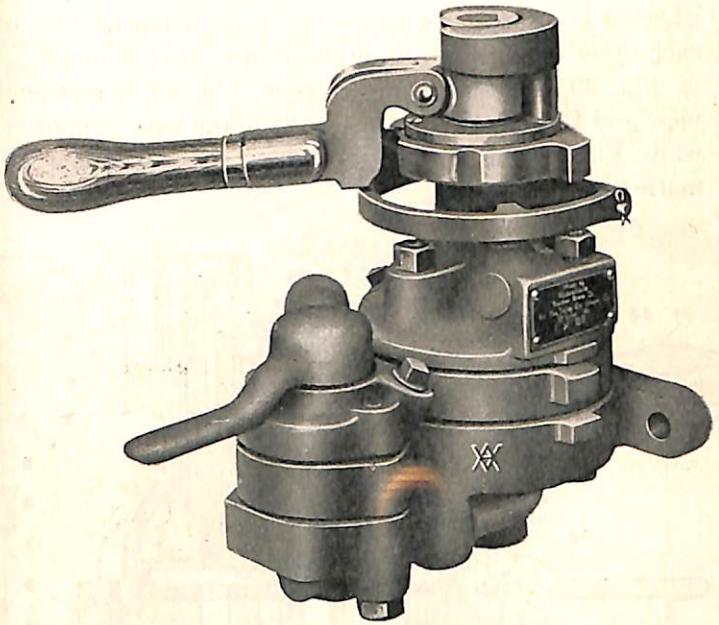


Fig. 39. M-28 Brake Valve with Selector Valve (Exterior View)

M-28 BRAKE VALVE WITH SELECTOR VALVE

The M-28 Brake Valve with Selector Valve has been designed for use with the Safety Car Control Equipment on cars having separate entrance and exit doors and where it is desired to operate the doors independently of each other or together, as circumstances may demand.

Fig. 39 shows an exterior view, Fig. 40, a sectional view and Fig. 41 a plan view of the brake valve complete, while Figs. 42 to 48 inclusive show sectional diagrammatic views.

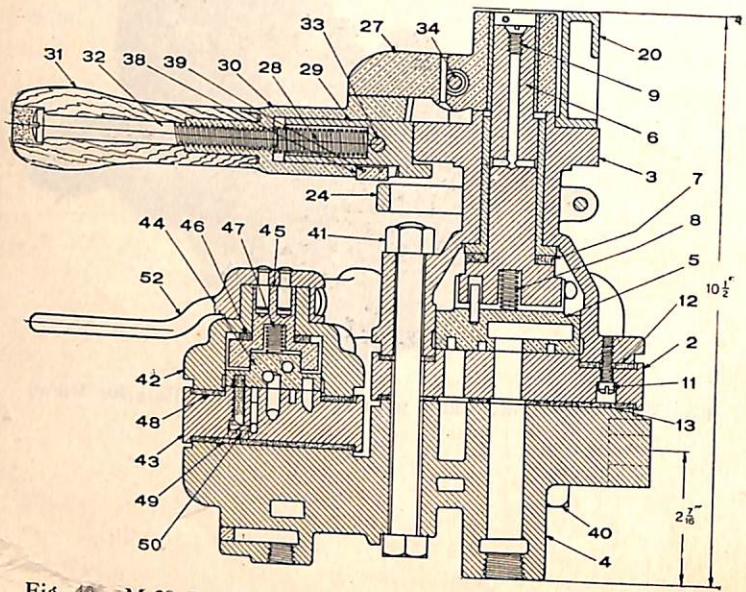


Fig. 40. M-28 Brake Valve with Selector Valve, Sectional View

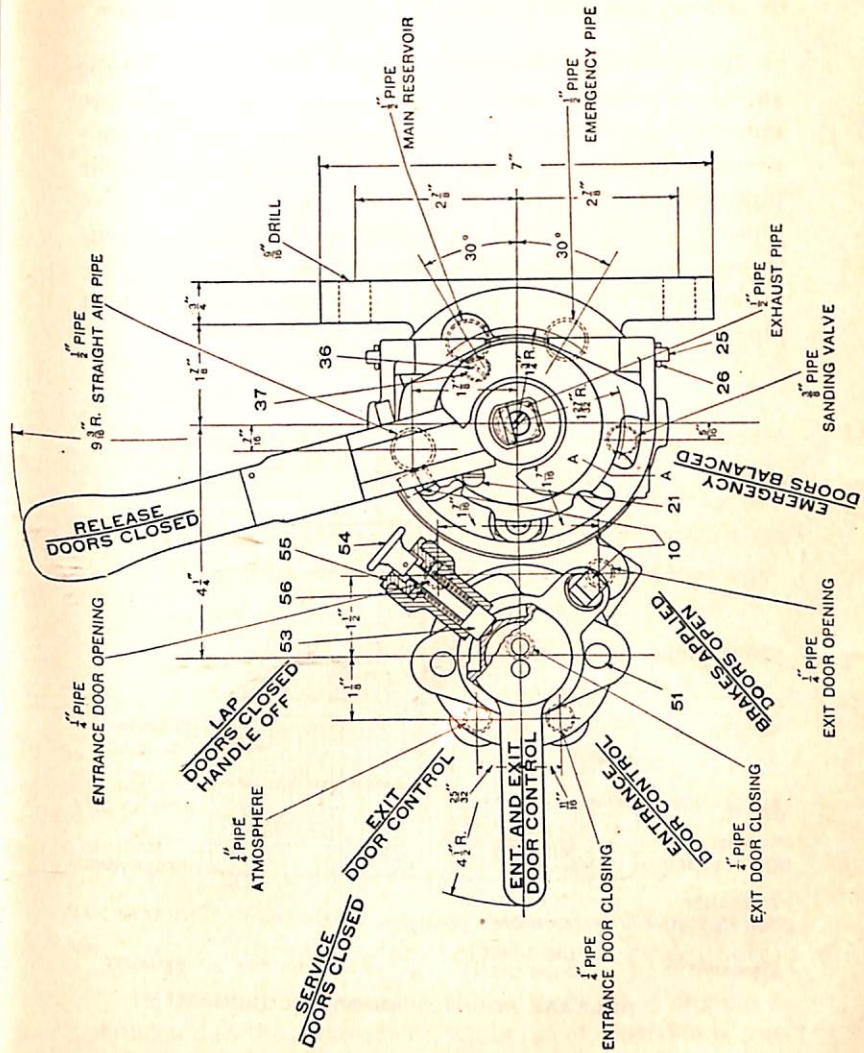


Fig. 41. Plan View of the M-28 Brake Valve with Selector Valve

The door selector portion is of the rotary valve type similar to the brake valve proper. Both portions are mounted on a common bracket to which all pipes are connected. These connections are as follows: main reservoir pipe, emergency pipe, straight air pipe, sanding valve pipe, exit door opening pipe, exit door closing pipe, entrance door opening pipe, entrance door closing pipe, the brake valve exhaust pipe, and the selector valve exhaust pipe.

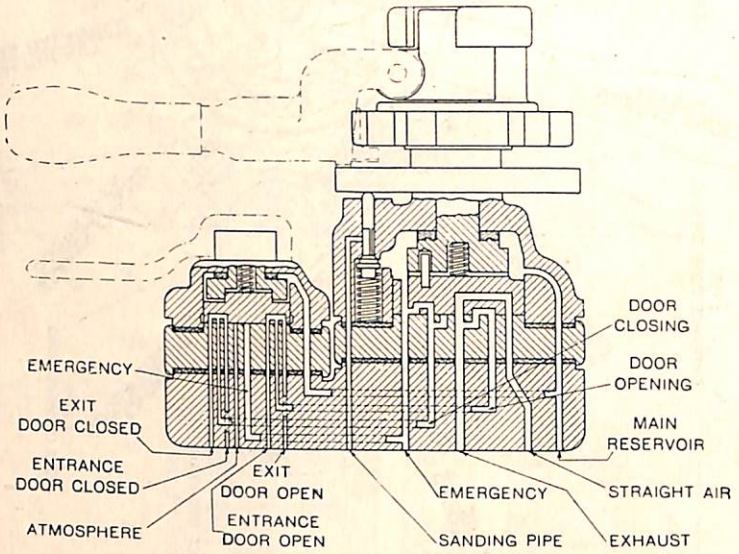


Fig. 42. Door Selector Valve in Entrance and Exit Door Control Position

The brake valve handle has positions as follows, (in order from the extreme left: Release, doors closed, Lap doors closed (handle off), Service, doors closed, rakes Applied, doors open, and Emergency, doors balanced.

The selector valve handle has positions as follows, in order from the extreme left: Exit door control, Entrance and Exit door control, Entrance door control.

The operation of the brake valve as far as brake manipulation is concerned is the same as that of the M-28 Brake Valve previously described.

The desired control of the doors is effected as follows:

Doors Closed

(A) Entrance door control cut in (that is with the selector valve handle in Entrance Door Control position) the port connections are—

(1) Entrance door *closing* pipe to the *emergency* pipe (through both rotary valves).

(2) Entrance door *opening* pipe to the *atmosphere* (through both rotary valves).

(3) Exit door *closing* pipe to the *emergency* pipe (through rotary valve of selector portion only).

(4) Exit door *opening* pipe to the *atmosphere*, (through rotary valve of selector valve only).

In this way the opening side of both door engines is connected to the atmosphere, while the closing side is connected to emergency pipe pressure, and *both doors are therefore held closed.*

(B) Exit door control cut in (that is, with the selector valve handle in Exit Door Control position) the port connections are—

(1) Exit door *closing* pipe to the *emergency* pipe (through both rotary valves).

(2) Exit door *opening* pipe to the *atmosphere* (through both rotary valves).

(3) Entrance door *closing* pipe to the *emergency* pipe (through rotary valve of selector valve only).

(4) Entrance door *opening* pipe to the *atmosphere* (through rotary of selector valve only).

In this way the opening side of both door engines is connected to the atmosphere while the closing side is connected to emergency pipe pressure, and *both doors are therefore held closed.*

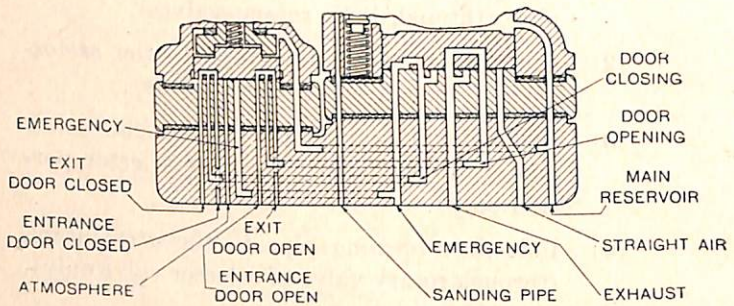


Fig. 43. Door Selector Valve in Entrance and Exit Door Control Position

(C) Entrance and Exit door control cut in (that is with the selector valve handle in its mid position), see Figs. 43, 44 and 45.

(1) Entrance and exit door *closing* pipes both to the *emergency* pipe (through both rotary valves).

(2) Entrance and exit door *opening* pipes both to the *atmosphere* (through both rotary valves).

In this way the opening side of both door engines is connected to the atmosphere while the closing side is connected to the emergency pipe pressure, and *both doors are therefore held closed.*

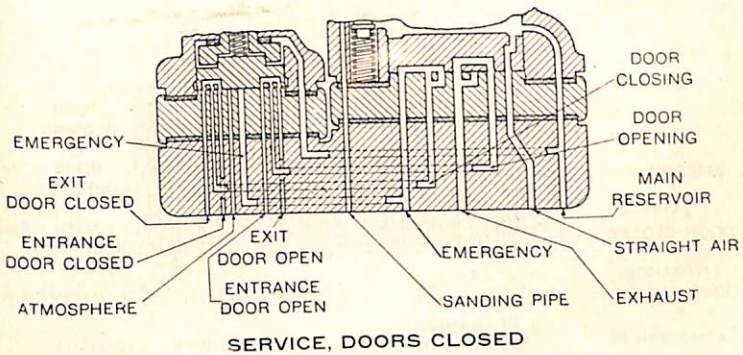


Fig. 44. Door Selector Valve in Entrance and Exit Door Control Position

DOORS OPEN (that is, with brake valve handle in door opening position).

(A) Entrance door control cut in, the port connections are (See Fig. 45).

(1) Entrance door *opening* pipe is connected to the *main reservoir* pipe (through both rotary valves).

(2) Entrance door *closing* pipe is connected to the *atmosphere* (through both rotary valves).

In this way the closing side of the entrance door engine is connected to the atmosphere while the opening side is connected to main reservoir pressure, and the *entrance door is therefore opened.*

The connections to the exit door engine are the same as described under DOORS CLOSED, Entrance door control cut in.

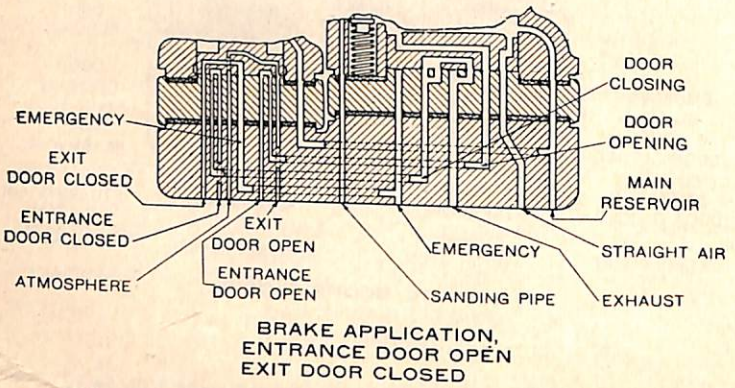


Fig. 45. Door Selector Valve in Entrance Door Control Position

(B) Exit door control cut in, the port connections are (See Fig. 46)—

(1) Exit door *opening* pipe is connected to the *main reservoir* pipe (through both rotary valves).

(2) Exit door *closing* pipe is connected to the *atmosphere* (through both rotary valves).

In this way the closing side of the exit door engine is connected to the atmosphere while the opening side is connected to main reservoir pressure, and the *exit door is therefore opened.*

The connections to the entrance door engine are the same as described under DOORS CLOSED, Exit door control cut in.

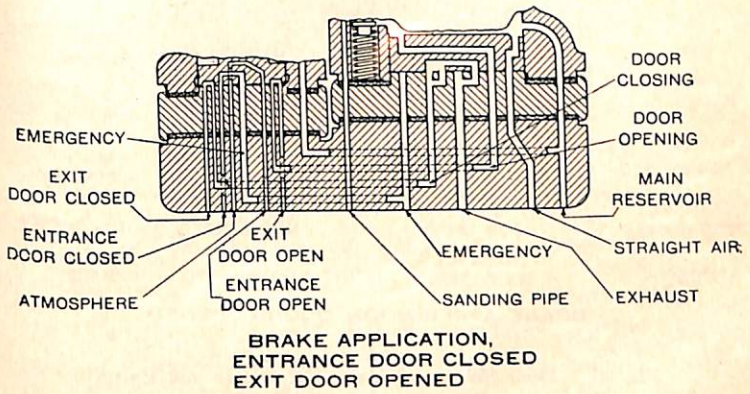


Fig. 46. Door Selector Valve in Exit Door Control Position

(C) Entrance and Exit door control cut in, the port connections are (See Fig. 47)—

(1) Entrance and exit door *opening* pipes are both connected to the main reservoir pipe (through both rotary valves).

(2) Entrance and exit door *closing* pipes are both connected to the atmosphere (through both rotary valves).

In this way the closing side of both door engines is connected to the atmosphere while the opening side is connected to main reservoir pressure, and *both doors are therefore opened.*

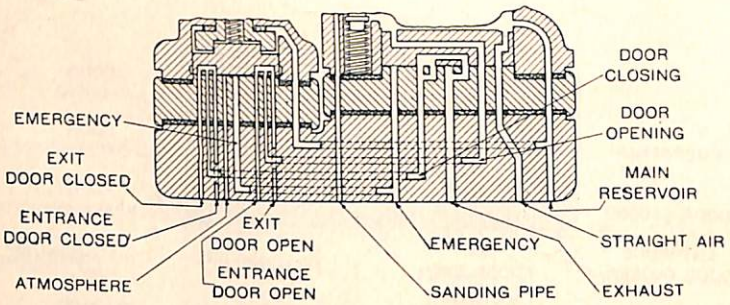


Fig. 47. Door Selector Valve in Entrance and Exit Door Control Position

When the brake valve handle is placed in Brake Application, Door Open Position, the brakes will apply and the door or doors will be opened as determined by the position of the Selector Valve. For example, if the Selector Valve handle is in Exit Door Control position the exit door will be opened. Now, by simply moving the Selector Valve handle to Entrance Door Control position the Exit Door will be closed and the entrance door opened: or if the handle is moved to Entrance and Exit Door Control position, both doors will be opened. Either door can then be closed at will, but both doors will not be closed at the same time unless the brake valve handle is moved to Doors Closed position.

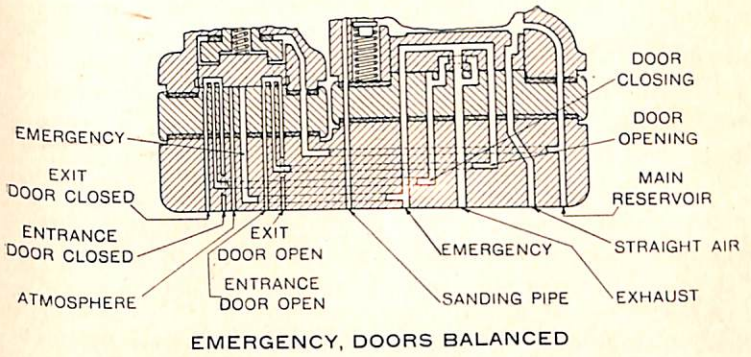


Fig. 48. Door Selector Valve in Entrance and Exit Door Control Position

When the brake valve handle is placed in emergency position (Fig. 48) all doors will be balanced regardless of the position of the door selector portion, that is, both the entrance and exit door will be balanced.

Since the door opening ends of the door engine cylinders are connected to the atmosphere when the doors are closed and the door closing ends of said cylinders are connected to the emergency pipe pressure, the venting of the emergency pipe pressure either through the brake valve (or by the operation of the controller pilot valve), will result in a drop of emergency pipe pressure, hence the venting of pressure to the atmosphere from the door closing ends of the door engine cylinders, thereby balancing the doors, which permits easy opening of the doors by hand.

MAINTENANCE

Air Compressor

Approximately every six months, all oil should be drained from the compressor, and the crank case thoroughly cleaned with gasoline and re-supplied with fresh oil. At the same time, remove the valves and clean them and their cavities. *Keeping the crank case oil clean is the surest way of keeping down maintenance costs.*

The air gap should be checked at intervals in order to preclude any possibility of bearings wearing sufficiently to permit the motor to get down on the field and damage, or perhaps destroy, the winding.

The construction of the compressor is such that all parts are easily accessible for inspection or repairs. The gear, crank shaft, crank shaft bearings and connecting rods are exposed for examination by taking off the crank case top cover 29. The commutator door 146, Fig. 6, covers practically the whole end of the motor, so that when the door is open, the commutator, brushes and interior are entirely exposed to view and easy of access.

To remove the armature, open the commutator door and remove the brush holders. Take off the hand hole cover 26, as shown in Fig. 4. Then withdraw the cotter and place a wrench on the castle nut to keep it from turning. With a wrench on the flats on the outer end of the armature shaft, turn the shaft to the left until it is unscrewed from the castle nut, after which the armature can be easily withdrawn from the motor.

The procedure is simply reversed to replace the armature. Make the electrical connections as before and replace the brushes as they were, in order that the bearing between the brushes and commutator be not destroyed. If the brushes are interchanged, they should be ground to a bearing by using a strip of sandpaper on the commutator under the brushes with the sand toward a brush until a full bearing is obtained. This will prevent the excessive sparking which would result from an improper brush bearing and thus preserve the commutator glaze. With the hand hole still open, turn the armature by hand a few times to make sure that the gears run freely, then replace hand hole cover and start compressor.

Keep the suction strainer clean. If it is permitted to become choked with dirt the efficiency of the compressor is greatly reduced.

If a pounding develops in the compressor, take off the crank case cover, examine the connecting rod caps where lost motion is most likely to occur, and remove the necessary liners to take up the wear in the bearing. Never leave an unfilled gap between the cap and the rod, as in that case the bearing may bind on the crank pin. Be sure and tighten the lock nuts and replace the cotter pins.

To get at the piston packing rings or wrist pin, it is necessary to detach the connecting rod from the crank shaft, and after removing the cylinder head, draw the piston out. Wrist pin bushes should last for years; lost motion at this point requires replacement of bushes.

The best results are obtained with the lifts of the valves, $\frac{5}{32}$" for the inlet valves and $\frac{1}{8}$" for the discharge valves for the DH-16 compressor.

If a compressor blows its fuse frequently, and the motor is found to be in good order it may be assumed that the compressor is not working freely. It should be examined for stuck valves, hot bearings or tight pistons, and the trouble remedied.

Compressor Governor

This governor needs very little attention after being properly adjusted except to be cleaned and oiled at some stated interval, say once a year. When cleaning and oiling the governor, a few drops of good oil should be placed on the surface passed over by the cutting-in and cutting-out valves. See also that the exhaust opening in the switch portion is free from dirt or gum.

The air piston will probably require cleaning less frequently than the valve portions. Piston 24 may be removed, 1st, by removing the pipe bracket; 2nd, remove the top cover; 3rd, remove the cotter pin and nut at extreme end of piston rod, which will allow the latter to slip through the insulating bush and washer; spring 29 will then force piston and rod out from the cylinder. In replacing this piston, see that the groove in the rod embraces the end of the T-shaped guide pin 21. The purpose of this pin is to keep the rod from rotating, which would cause the contacts 28 to miss the fingers 7. Do not turn this pin, 21, as its end is flattened to fit the groove, and the piston rod cannot be inserted unless the flattened sides of the end of the pin are parallel with the sides of the groove.

The chief rule regarding care and maintenance of this governor is to avoid meddling or experimenting with it after it is once in good condition and adjustment and in proper position on the car.

Lubrication of Brake Valves

Brake valves should be lubricated at regular car inspection periods. In order to oil a brake valve it is necessary to exhaust the air from the valve. The oil should then be applied through the oil plugs, the valve stem pushed down a few times and the valve operated to work the oil on to the various surfaces. Lost motion or play between the handle and the stem prevents the proper registration of ports and should be eliminated by making the necessary repairs. The best lubricant for the rotary valve of the brake valve is a good grade of graphite grease which should be applied very sparingly.

Lubrication of the Emergency Valve

Under ordinary service conditions, the emergency valve should be thoroughly cleaned and lubricated once in three months. The proper intervals is best determined for each particular case by a careful inspection and trial. Where conditions are severe, more frequent inspections will, no doubt, be found necessary. Where the valve is not subjected to hard usage the interval may be lengthened.

Never remove the movable parts of the emergency valve while it is on the car. If the valve is not working properly or needs cleaning and oiling, take it down and replace it by a valve in good condition. All cleaning and oiling should be done at a bench, by a competent man,

where the liability of damage to the internal parts of the valve is least. Any attempt to take the emergency valve apart while still on the car is almost sure to result in a large percentage of valves being injured by careless handling or dirt getting inside the pipes or valve. If repairs are necessary, such emergency valves should be returned to our shops for that purpose. Our facilities for doing this work are of the best. We can, therefore, do it more quickly, accurately, and guarantee better satisfaction than where it is handled by other shops not so well equipped. Furthermore, it is of the utmost importance that the manufacturer's standards be not departed from if the parts of the apparatus are to be perfectly interchangeable.

Following is the recommended practice with reference to lubricating emergency valve:

All oil, gum or grease should be thoroughly removed from the slide valve and its seat in the bush, using benzine or gasoline to insure this.

The slide valve and its seat and the upper portion of the bushing where the slide valve spring bears should be lubricated with a high grade of very fine, dry, pure graphite, rubbing it in until the slide valve and seat show a dark copper color.

To apply the graphite, use a stick in the shape of a paddle about 8 inches long and having a small piece of chamois glued to one end. Put a small amount on the chamois skin and rub on the surfaces specified. Leave no free graphite on the face of the slide valve or seat. When the work is completed, the slide valve and its seat must be

entirely free from oil or grease. Care should be taken when handling the parts after lubricating that the hands do not come in contact with the lubricated parts as the thin coating of graphite is easily removed.

The emergency valve piston and ring, and the bushing in which they work should be sparingly lubricated by first pushing the piston to release position and applying a drop or two of oil to the circumference of the large piston bushing, then move pistons to the opposite end and lubricate small piston bushing, spreading the oil over the surface as uniformly as possible, and then moving the piston back and forth several times to insure proper distribution of this oil on the wall of the bushing cylinders. There should be no free oil left on the parts. Care should be taken not to permit any oil to get upon the gaskets.

Cleaning and Lubrication of Brake Cylinders

For the purpose of cleaning the brake cylinders it is necessary to remove the nuts from the non-pressure head bolts; then remove piston from the cylinder.

Scrape the old lubricant from the cylinder wall and wipe the surface clean and dry. Kerosene may be used to assist in cleaning the cylinders but must be completely removed to prevent serious damage to the cylinder gaskets and the packing leather. If the cylinder wall is rusted, the rust should be removed with sand paper.

Remove expander ring from piston. Scrape old lubricant from the metal part and packing leather, and wipe all surfaces clean and dry. Leather should be carefully examined, and should be renewed if brittle, thin at any point, cut, cracked, or otherwise defective. *Do not use kerosene or gasoline on leathers.* Examine piston and follower plate for cracks and tighten up the follower plate nuts.

Examine follower studs for tightness in the piston head. Place the leather centrally on the piston, flesh side against the piston. Place the follower in position. Apply the nuts, bringing them in contact with the follower without tightening. Then draw them down uniformly.

Apply a thin coating of high grade graphite grease to the wall of the cylinder with a brush. Fill the expander ring groove, at the same time coating the inside of the leather, and place the expander ring in position.

The piston should be stood on end with the top edge or flat side of the non-pressure head flange and the opening of the expander ring toward the workman. With the piston in this position, enter it into the cylinder. The sleeve or rod should then be raised and the piston moved into the cylinder until the upper portion of the leather engages the cylinder wall. Form this portion of the leather into the cylinder with a dull edged, round cornered putty knife or similar instrument while the sleeve or rod is being gradually raised, taking special care not to crimp or otherwise damage the leather. Then pull upward and outward on the sleeve or rod until it is in a horizontal position. Push the piston to its release position and then raise the sleeve or rod to the top of the cylinder and determine whether the expander is in its proper position which will be indicated by freedom of movement.

NOTE: These instructions apply particularly to brake cylinders having leather packings. If WABCO Cups are used the same general procedure should be followed except that no expander ring is needed, and a generous amount of lubricant may be used, and kerosene employed for cleaning purposes, without fear of damage to the packing cup.

The above instructions for assembly apply particularly when the brake cylinder is in a horizontal position. However, for other positions, the methods employed must be changed as required to produce similar results.

BRAKE CYLINDER PISTON TRAVEL

The travel of the piston should be adjusted to not more than 4″ (standing) for double truck cars and 3″ (standing) for single truck cars, as nearly as practicable.

The correct operation of the brakes can be secured only by maintaining a uniform piston travel. The increase in the slack of brake rigging due to the wearing away of brake shoes must be closely watched and taken up by means provided in the brake rigging, thereby maintaining the piston travel as nearly uniform as possible. Proper inspection and adjustment must be made at frequent intervals. As this inspection and adjustment has to be made while the car is standing, it must be remembered that running travel in traction service is generally from ½″ to 1″ longer than standing travel, so that if a 5″ running travel is desired with double truck cars, the standing travel should be adjusted to about 4″. On single truck cars the running piston travel should be maintained as closely to 4″ as practicable.

Piston travel should never be altered to obtain sufficient shoe clearance. This should be obtained by using a brake cylinder of proper size for the brake force to be developed and through proper proportioning of the foundation brake gear. When inserting new shoes to replace

those worn out, the brake slack should be let out first, and the piston travel adjusted properly after the new shoes are in place.

The application of new brake shoes should be so arranged that but one new shoe will be applied at any given time.

Lubrication of Door and Step Controller

Non-fluid oil or grease should be used for the lubrication of the rack C-193, gear C-194 and gear shaft C-632. These parts may be very readily lubricated by removing gear case cover C-148 and applying the lubricant in a suitable manner. When this work is undertaken with the door and step controller, care should be taken that particles of dirt and other foreign matter are not permitted to drop into the gear case.

The lubrication of pistons and their respective cylinders should be undertaken as follows:

Move the doors and steps, if connected, to either opened or closed position. This will move one of the pistons to its extreme point of travel toward the cylinder end. Remove the cylinder end cover after which the piston with its follower and nut will be exposed and readily accessible. After removing the nut with follower C-23, the gear shaft may be rotated sufficiently to withdraw the end of the rack through the piston C-192, leather cup C-26, and its expander C-16.

Care should be taken at this time to guide the threaded portion of the end of the rack through the opening in the piston, the leather, and its follower. After the end of

the rack has been drawn partially through the piston, the gear shaft may be rotated in the opposite direction, which will push the piston with its leather and follower out of the cylinder as well as the washer C-272. As was described under the process of cleaning and lubricating of brake cylinder, a graphite grease should be used for lubricating purposes, the piston may be reassembled and installed, subsequent to which the same procedure should be undertaken at the opposite end of the door and step controller.

Care should be taken not to disengage the teeth of the segmental gear C-194 from the rack C-193 during these operations, particularly if the door and step levers have been disconnected from the gear shaft.

On re-applying the cylinder end C-675 which is applicable to either the right or left end, it must be assured that the port containing the balls stands vertically. These cylinder end covers may be applied so far as the bolt holes go, in different ways, but unless the port containing the balls stands vertically, the functions which they are intended to perform will be obviated.

The leather cylinder end gaskets C-152 should be examined to know they are in good condition to prevent the leakage of air pressure.

When it is desired to merely clean and lubricate but not thoroughly inspect the cylinders and pistons, it is unnecessary to remove the pistons from the rack for the reason that the work of cleaning and lubrication can be accomplished by merely removing the cylinder end covers.

PRACTICAL CAR TESTS

Preliminary to making a test of the Air Brake and Safety Car Control equipment for service or otherwise, observe carefully the instructions given under the heading of "Charging," on page 5.

Tests for Leakage

When the system is fully charged and the compressor is stopped by action of the governor, the brake valve handle being in Release (Door Closed) Position, an observation of the air gage will indicate the amount of leakage from the piping as well as the door closing sides of the door and step controller. The rate of leakage under these conditions should be carefully noted, after which place the brake valve handle in Service Application Position. By so doing the leakage from the brake cylinder is added to that previously determined and can therefore, be noted also. With the brake valve handle in Service Application Position as stated, the total leakage should not exceed 4 lbs. per minute, and if it is desired to locate source of leakage, close the cocks underneath brake valves on the respective ends of the car. This cuts off the supply of air to the door closing side of the door and step controller and by observing the gage after each operation of the cocks the source of leakage can be finally located.

Following these operations, place the brake valve handle in Door Open Position, at which time the combined leakage from the door opening side of the door and step controller on the operative end and the brake

cylinder can be noted. In this case also the total leakage should not exceed 4 lbs. per minute.

In all of the cases before referred to, it is to be remembered that any leakage in piping will be added to and indicated with the leakage of the devices specified. It is, of course, plain that any such leakage should be eliminated since it forms a constant drain on the supply of compressed air and an unnecessary load on the compressor. For the purpose of testing pipes for combined leakage, the brake valve handle should be in Service Application Position, and after the door closing pipes have been tested, the handle should be moved to Door Open Position when all remaining pipes should be tested. The most reliable method of testing is to coat the pipe and fittings with soap suds.

Testing Individual Devices

With the brake valve handle in Release (Door Closed) Position, the controller handle properly installed and the compressor in operation, if a release of the brakes and normal operating conditions do not obtain, the difficulty will more likely than otherwise be found to result from a particle of pipe scale or foreign matter lodged between the inner valve and its seat in controller pilot valve. To finally test for this condition, place a finger on the opening of pipe from the controller pilot valve to atmosphere to determine if there is a flow of air, being careful at the same time to make sure that the controller handle is held down during the time this observation is being made. If there is a flow of air under these conditions,

the inner valve requires attention. If there is no flow of air at this point, attention must be directed to the No. 15 double check which is located underneath the car close to the emergency valve where it may be found that the floating piston is not permitted to properly come to its seat. The test for this difficulty is to disconnect the pipe leading from the No. 15 double check valve to the opposite end of the car, and determine whether air is flowing in that direction. If air is found to pass in this manner, the No. 15 double check valve is at fault.

Should a test prove the No. 15 double check valve to be in good condition, attention must be directed to the relay valve. This valve is incorporated in the emergency valve and will be found inside the car with pipe connections leading to the circuit breaker cylinder. To determine whether the relay valve is unseated, the pipe connection leading from the relay valve should be opened and an observation made. If air passes the relay valve, this valve is at fault.

If no air passes the relay valve under normal conditions, the emergency piston must be examined to determine if it can move freely.

The foregoing instructions constitute a definite check on the various devices involved, and it is to be understood that after each examination of a device, the parts must be restored to their normal operating condition before moving to the succeeding device for examination.

Under some conditions it may be possible that sufficient packing leather leakage will develop on the closing side of the door and step controller as to constitute a

sufficiently heavy drain on the emergency pipe and cause the emergency piston to move. If this leakage is not disclosed in the leakage tests before specified, it can be determined by closing the cocks underneath the brake valves which cut off the supply of air pressure to the door closing side of the door and step controller.

HINTS TO CAR OPERATORS

Disabled Car

Should the brakes for any reason become inoperative or should the supply of compressed air be lost, any passenger load should be transferred to a succeeding car and the bad order car taken to the barns as promptly as possible. The hand brakes on such disabled car should be tested and some one assigned to operate them if necessary.

Unusual Door Operation

To leave the car and close the door and step, such as might be required at car barns, storage sheds or yards, and ticket offices or reporting booths along the route, the brake valve handle should be moved to Service Application Position, then to Handle Off Position, removing the handle and in closing the cock underneath brake valve at which time the door can be operated by hand. At this time the brake is applied and the car will remain standing. Before putting the car in motion, it is necessary to restore the cock to its normal position.

It is recommended that the brake valve handle be carried by the car operator in all cases where he is called upon to leave the car with doors closed, as related, to insure that the cock underneath the brake valve will be restored to its normal position before any movement of the car is attempted.