INSTRUCTIONS GEH-616

AIR BRAKE AND SAFETY CAR CONTROL EQUIPMENT

GENERAL ELECTRIC COMPANY
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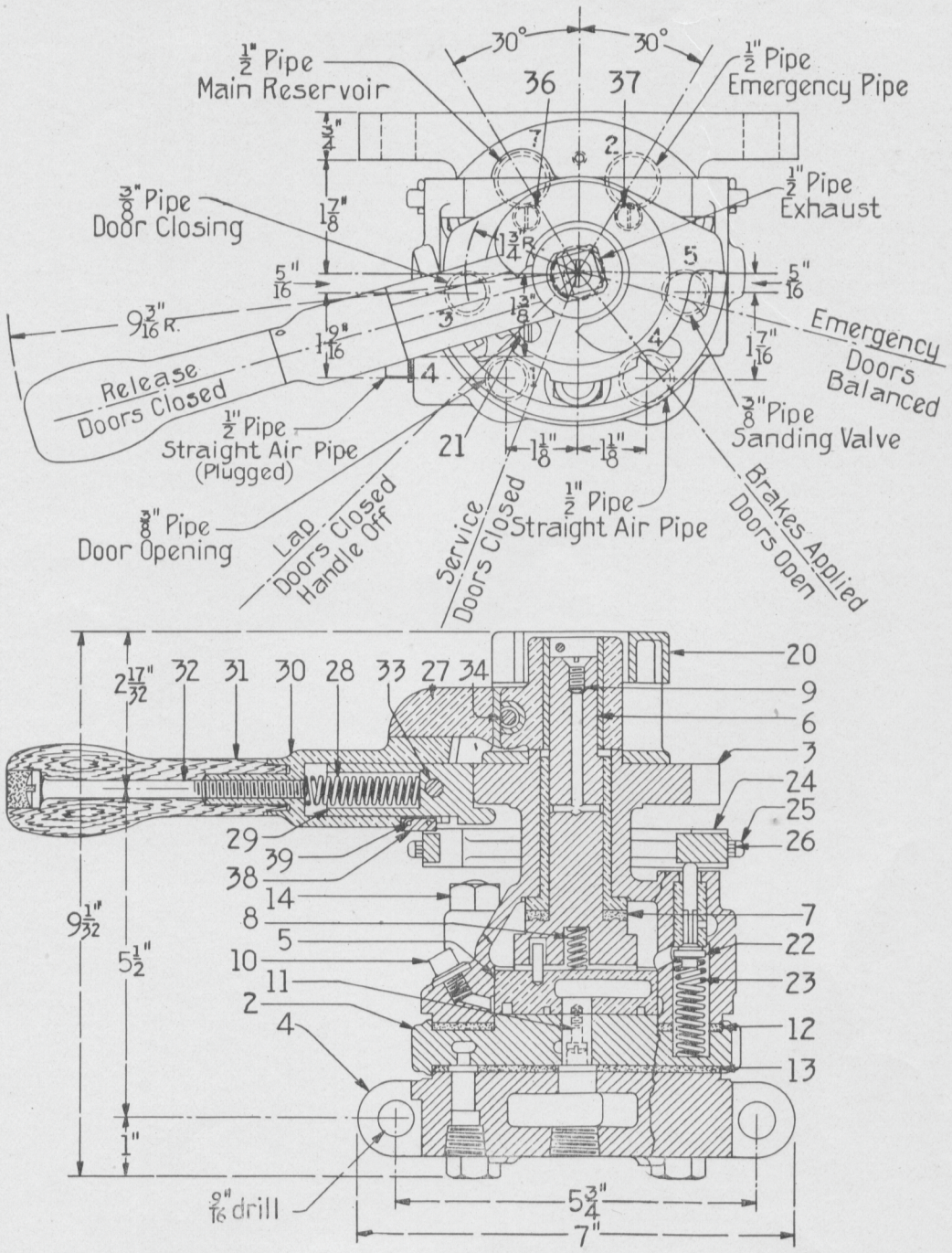


Fig. 1. Type M-28 Brake Valve with Sanding Feature

AIR BRAKE AND SAFETY CAR CONTROL EQUIPMENT

DESCRIPTION

TYPE M-28 BRAKE VALVE AND HANDLE

The M-28 brake valve, located on each operative end of a motor car, is of the rotary-valve type, with a removable handle. The operating parts are contained in a body, mounted on a bracket to which all the pipe connections are made, so that the valve may be removed for examination and repairs without breaking any pipe joints.

The brake-valve handle, included with the standard equipment, is of a hinged type, arranged in such a way that the handle portion is hinged on the socket portion. This is done in order to permit use of the brake-valve handle for sanding operations where, by merely depressing the brake-valve handle in any position in which it may be found, sand will be distributed to the rails, as more fully described on page 5.

Seven pipe connections are made to the brake-valve pipe bracket, as follows: The emergency pipe, main reservoir pipe, straight air-pipe, door-closing pipe, door-opening pipe, sanding pipe and brake-valve exhaust pipe.

Raised figures are cast on the bottom of the pipe bracket, to insure that proper connections are made, as follows: (1) for door-opening pipe, (2) for emergency pipe, (3) for door-closing pipe, (4) for straight air-pipe, (5) for sanding pipe, (6) for brake-valve exhaust pipe, and (7) for main reservoir pipe.

The different positions of the brake-valve handle, in order from the extreme left, are as follows:

1st. **Release running and door-closed position,** in which the air from the main reservoir pipe (which always has access to the top of the rotary valve through a port in the body casting) is permitted to flow directly to the emergency pipe. The emergency pipe is connected, through a port in the rotary valve and seat, to the door-closing side of the door-and-step controller. Also, the door-opening side of the door-and-step controller, as well as the straight air-pipe, is connected through the rotary valve to the atmosphere.

2nd. **Straight air-lap position with doors closed** (this is also handle-off position) in which communication is cut off from the main reservoir pipe to the emergency pipe, and from the straight air-pipe to the atmosphere. In this position also, communication is retained through the rotary valve, between the emergency pipe and the door-closing side of the door-and-step controller, and between the door-opening side of the door-and-step controller and the atmosphere.

3rd. **Service application position** with doors closed, in which communication is cut off between the main reservoir and the emergency pipe, but is established between the main reservoir pipe and the straight air-pipe. Communication is still established between the emergency pipe and the door-closing side of the door-and-step controller, and between the door-opening side of the door-and-step controller and the atmosphere.

4th. **Door-opening and brake-maintaining position,** in which communication is cut off from the main reservoir to the emergency pipe. At the same time air is permitted to flow from the main reservoir pipe to the door-opening pipe, and thence to the door-opening side of the door-and-step controller. The door-closing side of the door-and-step controller is connected through the rotary valve to the atmosphere. Main reservoir pressure is also permitted to flow through the rotary

valve to the straight air-application pipe, thus maintaining brake-cylinder pressure for the period during which the handle remains in this position.

5th. **Emergency position,** in which the emergency pipe, door-closing pipe, and door-opening pipe are connected to the atmosphere, thus actuating the emergency valve and removing air pressure from both sides of the door-and-step controller. Main reservoir pressure is permitted to flow to the straight air-pipe.

SANDING FEATURE

It will be observed that the hinged brake-valve handle is permitted to rotate directly above a bail, which partially surrounds the brake-valve. The bottom of this bail is in contact with the stem of a valve, and by merely depressing the brake-valve handle in any position in which it may be found, this valve will be forced open and air permitted to flow from the main reservoir to the sand traps.

TYPE K-1 EMERGENCY VALVE

The emergency valve contains an equalizing piston, a slide valve, and a relay valve as moving parts. The main piston responds to a decrease or an increase in emergency pipe pressure, to actuate the slide valve. The relay valve responds to a decrease or an increase in control-pipe pressure, to actuate the emergency piston.

The emergency valve is mounted on an angle pipe-bracket, located inside the car. It is of the pipeless type, which facilitates ready removal, and all pipe connections necessary for the correct operation of the emergency valve are made to this pipe bracket. There are eight pipe connections for the emergency valve; i.e., ½-in. pipe to main reservoir marked (1), ½-in. pipe to brake cylinder marked (2), ½-in. straight air-pipe marked (3), ½-in. emergency pipe marked (4), ⅜-in. pipe to sanding reservoir marked (5), ½-in. safety control pipe marked (6), ⅜-in. pipe to sanding line marked (7), and ½-in. pipe connecting the relay valve exhaust port to the circuit breaker cylinder.

SANDING RESERVOIR

The sanding reservoir is connected to the emergency valve, and is used for the purpose of storing main reservoir pressure for distribution to the sand traps when an emergency application of the brakes is made. In this manner the distribution of sand is automatically accomplished, it being presumed that in ordinary service operation of sand, the car operator will make use of the sanding feature incorporated in the brake-valve handle. The sanding reservoir, being of fixed volume, will cause sand to be distributed for the required time to make a stop, resulting from emergency application.

DOOR-AND-STEP CONTROLLER

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 and 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 a segmental gear secured to a shaft which, in turn, is attached to the rods and levers actuating doors and steps.

The door-and-step controller has two pipes attached to same—one at each end. These pipes are the admission and exhaust pipes for their respective ends of the cylinder. Air is admitted at the proper admission port, flowing through the cylinder casting to the space between the two balls. A slight amount of pressure passes the end of choke-plug, 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 recited, 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, past the small ball, and out through a port-and-pipe connection 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. The cushioning effect of door movement is established by restricting the further exhaust of air pressure by means of choke-plug, which should be adjusted to give the desired cushioning effect.

The door-and-step controllers are located either inside the car, or underneath the platform, depending upon climatic conditions to some extent, and also the construction and arrangement of doors and steps. In any event the connection between the door engine-shaft and levers operating the doors and steps should be made with the least possible number of intervening rods and levers. In all cases see that the door-and-step controllers are installed so that the head containing balls used as checks shall have the port, containing the seats for these balls, in a vertical position. The door-and-step controller can be installed in two ways: one, with the rotating shaft 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.

Adjustment

The choke-plug is intended for the purpose of controlling the final movement of the door and step, and may be adjusted by screwing inwardly or outwardly 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, 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 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 deg. and correspondingly, therefore, the same length of lever-arm should be used on swinging door-and-step shafts, as is used on the door-and-step controller shaft. This door-and-step controller can also be used to actuate sliding doors with corresponding steps.

CIRCUIT BREAKER CYLINDER

A circuit breaker cylinder is installed, with its piston directly in line with handle or button of the circuit breaker or line switch. A pipe connects this circuit breaker cylinder to the relay valve exhaust port of the emergency valve; thus, when an emergency application is caused by actuation of the relay valve, air flows to the circuit breaker cylinder, forcing its piston outward into contact with the handle or button of the circuit breaker, causing the circuit to be opened. The pipe connecting the circuit breaker cylinder to the relay valve exhaust port of the emergency valve is vented to atmosphere through ports that are uncovered when the piston moves forward. The circuit breaker cylinder has a return spring which returns the piston to its normal position and permits re-establishing the connection through the circuit breaker or switch after restoration of normal conditions. The circuit breaker cylinder does not respond to emergency applications made by use of the brake-valve handle.

On occasions when the circuit breaker cylinders are called into action, thereby cutting off the current to the motors, it is necessary to turn the controller handle to power-off position before cutting in the power through the circuit breaker.

SAFETY CONTROL ATTACHMENTS

The safety control attachments, that is, the apparatus which is attached direct to the

top of the controller, consists 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 the main reservoir pressure, the second forming the safety control pipe, and the other the pilot-valve exhaust. The valve portion of the controller pilot valve is arranged so that it may be rotated for convenience in making pipe connections, thus providing for a neat installation of pipe back of the controller. 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. (See Fig. 2.)

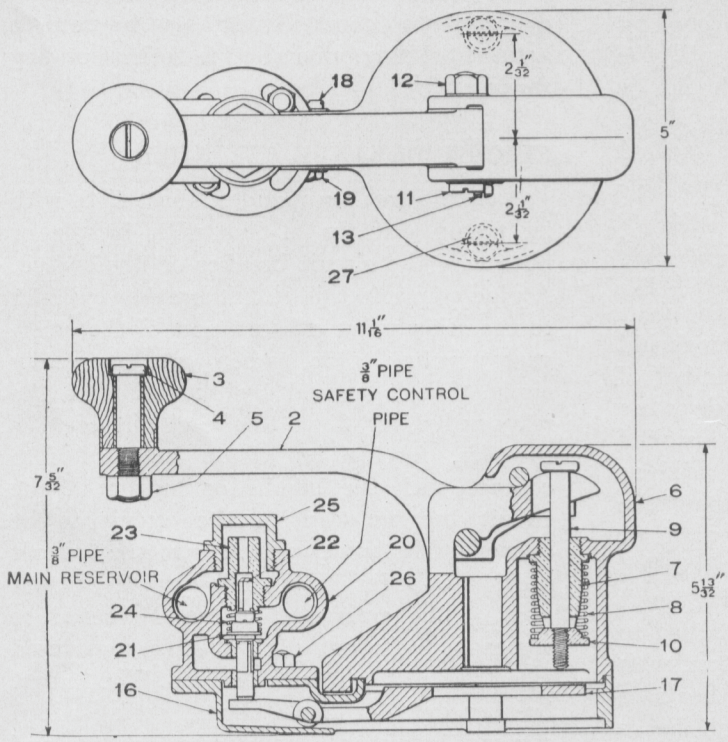


Fig. 2. Controller Handle with Base and Pilot Valve

The controller handle is hinged on a fulcrum, which permits the handle to be pressed downward, thereby raising the shoulder bolt from the lever, and with the removal of the spring tension stored in the spring, by pressing downward on the controller handle, the inner valve is forced downward, by valve spring, against its seat; at the same time, outer valve is unseated and air communication is established between main reservoir pipe, past the stem and seat of valve, into cavity 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 to Type K-1 emergency valve. With the handle pressed downward as just related, the safety control 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 as described in page 7. Upon the release of the pressure on the controller handle, the spring will force the shoulder bolt downward raising the controller handle and at the same time striking the lever, pressing it downward; this lever, being fulcrumed, engages the lower end of the stem of the inner valve, raising it from its seat and at the same time compressing valve spring, raising outer valve until it engages its seat. Under these conditions the flow of air, from the main reservoir past outer valve to cavity leading to safety control pipe, is cut off. Communication is established between the safety control pipe, and the cavity which leads to the pilot-valve exhaust.

The slot in the end opposite the handle is intended to engage a bolt. The safety control attachments are designed for installation in such a way that it is most difficult to defeat the purpose for which this apparatus was 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

By reference to the description of the safety control attachments, Fig. 2, it is stated that the controller handle should be held down at all times when the car is in motion.

As a temporary relief from this obligation, for the convenience of the car operator, a foot valve is installed for operation in connection with each operative end of the car. By gently pressing down on the stem of the foot valve, the connection through the safety control pipe between the relay valve of the emergency valve and the controller pilot valve is cut off. The foot valve is placed in the safety control pipe with one connection leading to the emergency relay valve, one to the controller pilot valve and one to the straight air application pipe.

The foot valve is shown in Fig. 3.

The valve 2, normally held off its seat by spring 3, is adapted to close communication between the pilot-valve connection A and the safety control pipe connection B, through the application of foot pressure on the knob 4. A piston device 5, interposed between the valve 4-A attached to the knob 4 and valve stem 1, is also adapted to close valve 2 through the application of straight air-pipe pressure on its outer face.

Under normal conditions, main reservoir pressure from the pilot valve has unrestricted access to the control pipe through the pilot-valve connection A past the valve 2 to the safety control pipe connection B. The valve 2 abutting against the valve 1 holds the latter against its seat during normal conditions, and prevents leakage of control pipe air to atmosphere via port C.

The piston 5 embraces an annular beading on its inner face adapted to come into contact with the face of the gasket 6 and prevent leakage of air pressure past the piston to atmosphere via the port C. The latter is provided to prevent air from being bottled under the piston 5, when it is forced inwardly. The piston 5 also contains a yielding stop 7, held outwardly by a spring 8, and against which stem 1 abuts. This arrangement is

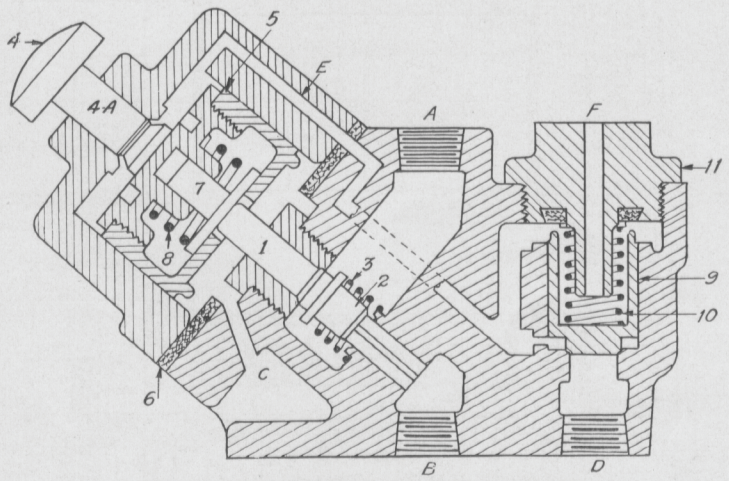


Fig. 3. Sectional View of Foot Valve

provided to permit of an adjustably relative movement between the piston 5 and the valve 2 to allow each to properly seat, regardless of wear of either part.

The valve 4-A is provided to afford a means to prevent leakage of the air pressure past the valve stem, which it does by moving outwardly to its seat whenever the piston 5 is under the influence of straight air-pipe pressure.

Straight air-pipe pressure has access to the foot valve via connection D, whence it reaches the piston 5 via passage E, containing a hold-back 9 weighted by spring 10. This hold-back valve is provided to prevent operation of the piston 5 until the straight air-pipe pressure in normal brake applications has reached approximately 30 lb. and closes again when the pressure has fallen to 12 lb. or 15 lb. A seal provided on the cap 11 prevents loss of

air when valve 9 is off its seat. Port F is provided to prevent pressure from passage when the valve is seated and also to prevent bottling of air when valve 9 is off its seat.

WING CHECK VALVE

On double-end equipments a $\frac{3}{8}$-in. wing check valve is placed in a by-pass around the foot valve, in order that when the operator moves to the other end of the car and depresses the controller handle, thus opening the control pipe supply valve, air will flow by the wing check and charge up the control pipe to the No. 15 double check. When the brake valve is moved into the release position, reducing the pressure on the pistons of both foot valves, they will both open at about the same pressure; the one on what is now the non-operative end will permit the control pipe pressure to drop a small amount, sufficient to cause the No. 15 double check to shift and so stop the flow in that direction.

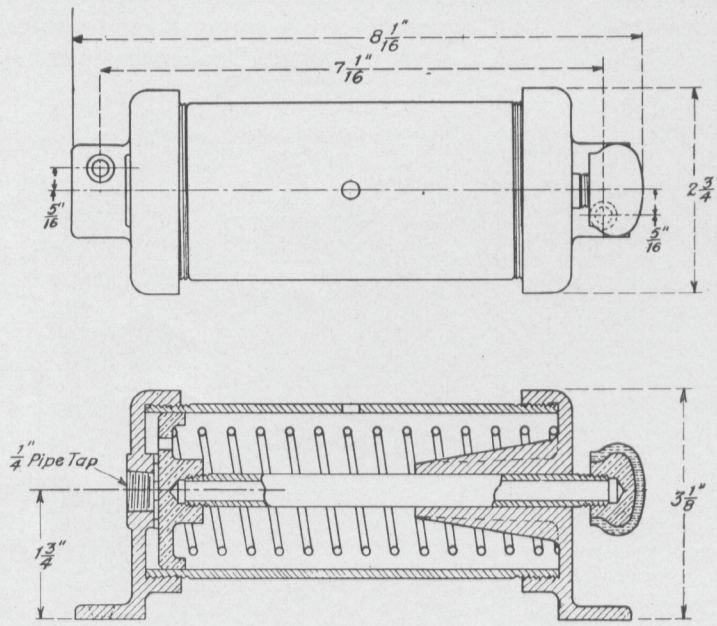


Fig. 4. Outline Circuit Breaker Cylinder

GENERAL DESCRIPTION OF AIR BRAKE AND SAFETY CAR 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 currents 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 the use of the foot valve, 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 making use of the foot valve, or without having made a straight air brake application of approximately 35-lb. 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 exhaust at such a rate that the relay valve of the emergency valve will be unseated. This causes the circuit breaker cylinder to operate the circuit breaker so as to cut off the power to the motors, and it also operates the main piston of the emergency valve, so as to cause an emergency brake application together with distribution of sand to the rails 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 applied to the rails 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 foot valve, but he must be attentive to his work, else the car will be automatically brought to a standstill. A straight air application of sufficient amount to prevent this automatic operation would in itself, of course, bring the car to a standstill.

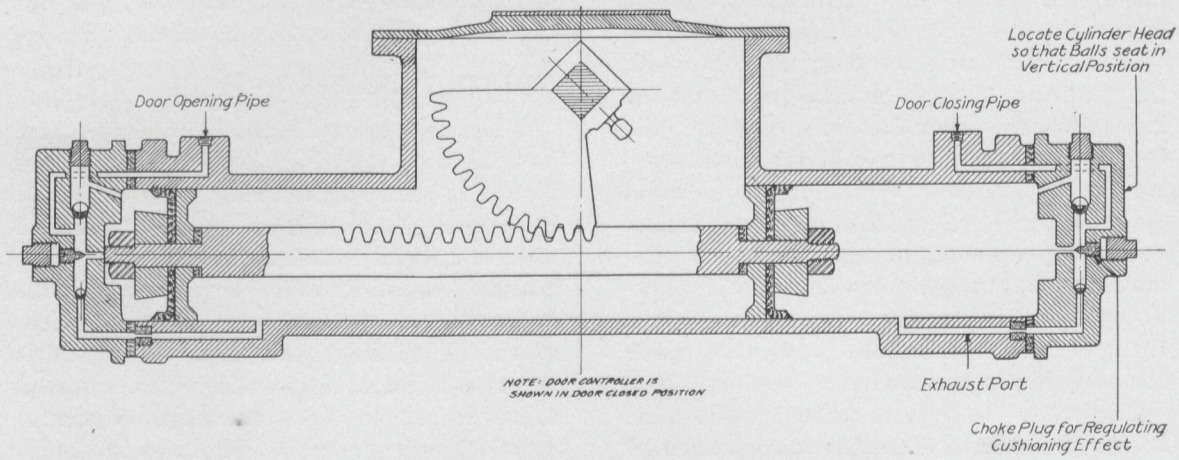


Fig. 5. Diagram of Pneumatic Door-and-step Controller

MAIN RESERVOIR CUT-OFF VALVE

The main reservoir cut-off valve is installed in the main reservoir pipe leading to the brake valves, located on their respective platforms. The object of this safety device is to insure main reservoir supply of air pressure for the brake cylinder, in event of an accident of such a nature as to break the pipes on either platform. The connection supplying main reservoir pressure via the emergency valve to the brake cylinder is taken off before reaching the main reservoir cut-off valve. Thus, such an accident as would break the piping on the platform or underneath the car would cause the cut-off valve to operate and would insure that the proper supply of main reservoir pressure was available for use in the brake cylinder.

OPERATION

CHARGING

Before starting the air compressor, close the drain cocks in the main reservoirs. See that the cocks in door-closing pipes are open. See that all hand brakes are fully released. The compressor circuit must be properly fused. Place a handle on the brake valve to be operated and move it to release, running and door-closing position at the extreme left. Then start the compressor by closing the snap switch in the compressor circuit. Place the controller handle in the handle-base portion and hold same down until the gauge hand indicates at least 50 lb. pressure in the main reservoirs. Under no circumstances should a car be put in motion with less air pressure than that mentioned above.

RUNNING

Keep the brake-valve handle in release, running and door-closing position when not being used. Press downward on the controller handle or foot valve while the car is running. In event of sudden danger, remove the hand or foot from the respective valves, as the case may be, or move the brake-valve handle quickly to emergency position, at the extreme right, and leave it there until the car stops and the danger is past. If the brakes apply while running over the road, due to rupture of

the piping, move the brake-valve handle to emergency position at once, to prevent loss of main reservoir pressure. After the car stops, the cause of the application should be located and remedied before proceeding.

SERVICE APPLICATION

To apply the brakes for an ordinary stop, move the brake-valve handle to service application position. When the desired brake cylinder pressure, depending on the speed, the condition of the rails, the grade and the kind of stop desired, has been obtained, the brake-valve handle should be returned to the lap position, where it should remain until it is desired either to release the brakes, or to make a heavier application. In the latter case, move the handle again to the service application position, further applying the brakes until the desired result is obtained, then return it to the straight air-lap position.

The controller handle or foot valve must be held down until the stop is completed, and the brake-valve handle moved to the service application position or the door opening position.

While the car is standing, the brake-valve handle must remain in the service application position or door-opening position, at which time the pressure on the controller handle or foot valve, as the case may be, can be released; thus permitting the car operator to attend to any duties incident to the stop. The best possible stop will be made when the brakes are applied as hard, at the very start, as the conditions of speed rail and comfort of passengers will permit, and then graduated off as the speed of the car is reduced, so that at the end of the stop, little pressure remains in the brake cylinder, unless on a grade.

Because the retarding effect of any given application is greater at low than at high speed, a heavy application at low speeds will result in an abrupt stop, with perhaps discomfort to the passengers or slide wheels. At high speeds a heavy initial application should be made, in order to obtain the most effective retardation possible when the momentum of the car is greatest. If the brake cylinder pressure is very light at first, and is increased as the speed of the car is dimished, it not only makes a longer stop, but the high cylinder pressure at the end will be liable to produce a rough stop, perhaps slide the wheels and result in loss of time, because of the necessity for waiting until this high cylinder pressure can exhaust before the car can proceed. With practice, these correct methods of stopping can be readily acquired.

HOLDING BRAKES APPLIED

When the desired brake cylinder pressure has been obtained, place the brake-valve handle in the straight air-lap position, where it should remain until it is desired either to make a heavier application, or to release the brakes. Do not allow the brake-valve handle to remain in the straight air-lap position, except while bringing the car to a stop, and in any case it should not be allowed to remain in this position for a sufficient length of time to permit the brake cylinder leakage to dimish the braking power materially.

RELEASE

To fully release the brakes after any application, move the brake-valve handle to release, running and door-closing position. The handle must be left in this position at all times when the brakes are not in use to keep the brake system charged and ready for operation and to insure that the brakes will not be applied by leakage. Immediately before moving the brake-valve handle to release, running and door-closing position, which action usually precedes a movement of the car, the controller handle must be held down.

To graduate, or partially release the brakes, move the brake-valve handle to release, running and door-closing position for a moment, then back to straight air-lap position; repeat this operation as may be necessary, until the car is brought to rest with only enough pressure retained in the brake cylinders to prevent it from rolling. During this manipulation of the brake-valve handle, the controller handle or foot valve must be held down.

OPENING DOORS AND LOWERING STEPS

The car having been brought to a standstill under the methods just described, move the brake-valve handle to the door-opening position for the purpose of opening the doors and lowering the steps on the operating end of the car. After the brake-valve handle has been in this position for approximately one second, the pressure on the controller handle and foot valve can be released. While the doors remain open and steps down, the car cannot be moved for the reason that the brake cylinder is fully charged.

CLOSING DOORS AND RAISING STEPS

All brake-valve handle positions to the left of door-opening position are in addition door-closing positions. Should it be desired to close the doors and raise the steps without releasing the brakes, return the handle to service application position. When it is desired to close the doors and raise the steps and release the brakes at the same time, such as preliminary to a movement of the car, return the brake-valve handle to release, running and door-closing position on the extreme left. Immediately before this last operation of the brake-valve handle, the controller handle must be held down.

UNUSUAL DOOR OPERATION

To leave the car and close the door and raise the 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 for use in closing the cock underneath brake valve, at which time the door can be operated by hand. After making exist, if it is desired to close the door, it can be closed by hand and reopened in the same manner. In the meantime, the brake is applied and the car will remain standing unless unusual leakage prevails.

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.

EMERGENCY

Emergency action may be found to be necessary either because of conditions outside the car, such as the movement of pedestrians and vehicles, or, because of conditions originating within the car, such as inadvertence or inattention on the part of the car operator to his line of duty.

With respect to the class of emergency action first mentioned above, it is assumed that the car operator is at his post of duty, in which case should it become imperative to stop in the shortest possible time and distance, to save life or avoid accident, move the brake-valve handle quickly, from whatever position it may be in, to emergency position, which is at the extreme right, and leave it there until the car has stopped and the danger is past. While the brake-valve handle is in emergency position, it is not necessary to hold down the controller handle or the foot valve. This movement of the brake-valve handle, in addition to providing maximum brake cylinder pressure provides, a supply of air through the emergency valve, for the purpose of sanding the rails. Also by exhausting emergency pipe pressure, air pressure is released from the closing side of the door-and-step controller, so that the doors and steps on both ends of the car can be easily moved by hand. It is intended that the rear door and step be used as an emergency exit.

Concerning the second class of emergency actions mentioned; hold the controller handle down by hand or press the foot valve downward at all times that the car is in motion; that is, without the brake applied to such an extent that the application would in itself stop the car. Should the operator, for any reason, unintentionally or otherwise, release

the controller handle and foot valve while the brakes are not applied, as before mentioned, this may properly be termed an emergency situation which calls for emergency action, and the result will be the same as described under "Emergency" as initiated from the brake valve, with the additional feature of opening the motor circuit by actuating the circuit breaker cylinder.

handle and the controller handle can be removed. This brake application is required to prevent emergency action which would otherwise occur upon removal of the controller handle, and it insures that the car will stand still during the time required to change ends. If the handles are not replaced in their proper positions within a reasonable time to guard against the excessive brake cylinder

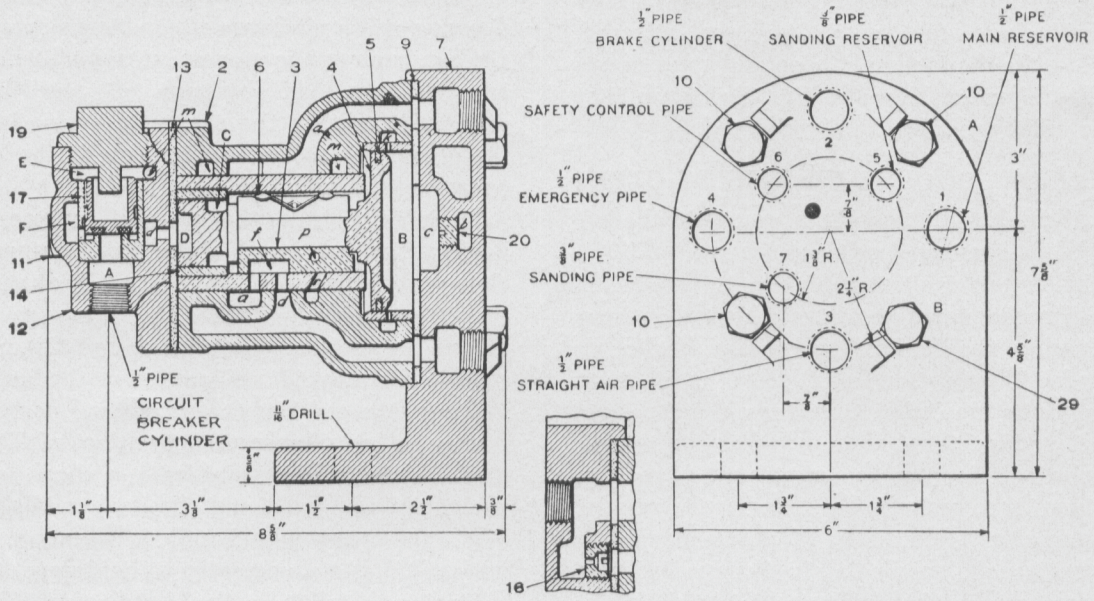


Fig. 6. Type FK-1 Emergency Valve with Angle Bracket

In either case of emergency action just described, the several functions occur practically simultaneously, and it is seen that every proper requirement to bring the car to a stop in the shortest possible time and distance is met.

RELEASE AFTER EMERGENCY

To release the brakes and restore normal conditions after emergency action, see that the brake-valve handle is in release, running and door-closing position, and hold the controller handle down until 50 lb. pressure is reached in the main reservoir, as indicated by the gauge.

CHANGING ENDS

Preliminary to changing ends, the brake must be fully applied, when the brake-valve

leakage, emergency action will automatically occur.

Upon reaching the end of the car from which it is intended to operate, the brake-valve handle should be placed in service application or door-open position, as may be required. Before attempting to move the brake-valve handle to release, running and door-closing position, the controller handle must be in place and held down.

SANDING

When it is desired to sand the rails in making a stop, this should be done, if practicable, before the brakes are applied, for the reason that if the brakes are set and the wheels begin to slide, the application of sand will not —in all probability—cause them to revolve again, and flat spots may result. In such

event, the best practice is to release the brakes slightly at the moment of applying the sand, after which a much higher brake cylinder pressure can be used without causing wheel sliding. If sand is used, the rails should be well and continuously sanded until the stop is made or the brakes released.

INSPECTION, MAINTENANCE AND LUBRICATION

AIR COMPRESSOR

Instructions for the installation, care, maintenance, assembly and disassembly of the air compressor are contained in Instructions GEH-52. Copies of this book may be had on application to the nearest office of the General Electric Company.

AIR COMPRESSOR GOVERNOR

The governor is adjusted for different opening pressures by means of two adjusting screws located in the mechanism base. The pressure can be increased or decreased by screwing the adjusting screws in or out, as the case may be. Turn both screws an equal amount until the proper adjustment is obtained. This will prevent binding the regulating spring.

To renew the rubber diaphragm, remove the cylinder head by unscrewing the four bolts holding it to the frame. When inserting a new diaphragm, place a thin disk of oiled or paraffined paper on each side to prevent the diaphragm sticking to the metal.

To remove the regulating spring, take off the mechanism and mechanism base. Relieve the compression of the regulating spring before unscrewing the bolts that hold the mechanism base to the frame. When replacing the regulating spring, see that it does not touch the inside of the frame.

The range or difference between the opening and closing pressures may be adjusted by changing the location of the pin, which limits the upward movement of the contact carrying lever. This pin is inserted in holes in the fulcrum punchings, and is held in place by means of a cotter pin. By changing the location of this pin, the normal range of 10 lb. may be made 8 lb., 12 lb. or 15 lb.

The part of the arc chute surrounding the contact tips can be removed to give access to the contacts for cleaning and repairing. This is done by loosening the bolt which holds the pole pieces together, and removing the two screws in the upper part of the frame.

Inspect the governor contact tips at regular intervals and clean them with sandpaper when necessary. These tips may be easily removed by unscrewing the screw holding them to the base. The spring carrying the movable contact tip should be inspected to see that the contact has the proper wiping action. The amount of the wipe should be approximately $\frac{1}{8}$ in. The pressure between the contacts should be checked when governors are overhauled. This pressure should be approximately 3 lb. or more, measured on the finger spring $\frac{1}{2}$ in. from the center of the stud which attaches the finger spring to the insulated yoke.

If the blowout coil is removed for any reason, see that it is replaced and connected in the same way as before removal. If this is not done, the arc formed at the contact tips will be blown in against the back of the arc chute and will not be extinguished promptly. Locate the governors inside the car in an upright position, in order to prevent moisture and dirt finding its way into the operating mechanism.

BRAKE CYLINDERS

Cleaning and Lubrication

For the purpose of cleaning the brake cylinders, it is necessary to remove the nuts from the non-pressure head bolts; then remove the piston from the cylinder. Scrape the old lubricant from the cylinder wall and wipe the surface clean and dry. Kerosene may be used for assisting in cylinder cleaning, but must be completely removed to prevent serious damage to the cylinder gaskets and the packing leather. If the cylinder wall is rusted, remove the rust with sandpaper.

Remove the expander ring from the piston. Scrape the old lubricant from the metal part

and the packing leather, and wipe all the surfaces clean and dry. Leather should be carefully examined and renewed if brittle, thin at any point, cut, cracked, or otherwise defective. Do not use kerosene or gasolene on leathers. Examine the piston and the follower plate for cracks and tighten up the follower plate nuts.

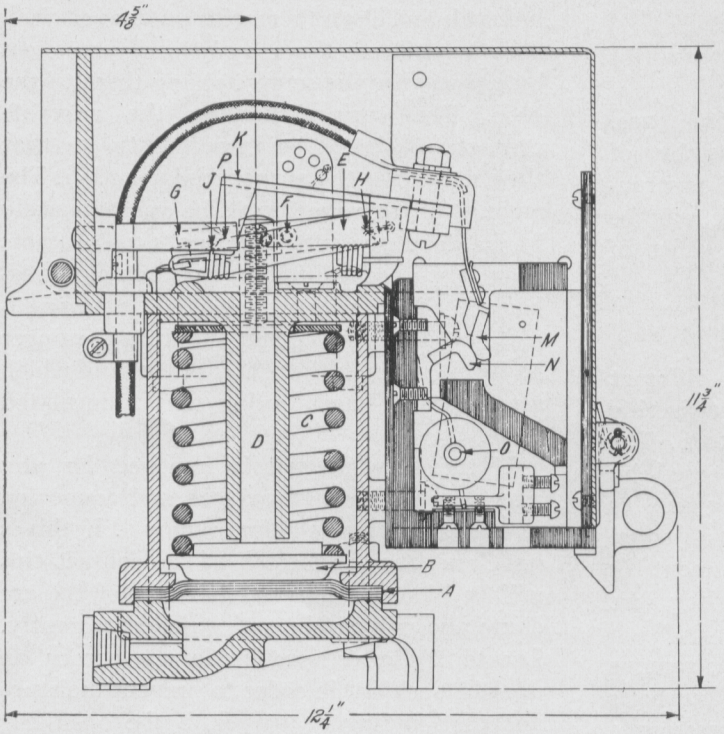


Fig. 7. Sectional View Type ML Form A Air Compressor Governor

Examine the 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, 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.

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 VALVES

Lubrication

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.

EMERGENCY VALVE

Lubrication

Under ordinary service conditions, the emergency valve should be thoroughly

cleaned and lubricated once in three months. The proper interval 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.

Do not 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, remove it from the bracket 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.

Emergency valves which need repairing should be returned to a General Electric service shop.

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

All oil, gum, or grease, should be thoroughly removed from the slide valve and its seat in the bushing, using benzine or gasolene 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 so that as much as possible will adhere and fill in the pores of the brass and leave a very light, thin coat of graphite.

To apply the graphite, use a stick in the shape of a paddle about eight inches long, and having a small piece of chamois glued to the end. Dip the skin-covered end in dry graphite and rub on the surfaces specified. After rubbing, a light blow of the stick on the slide-valve seat will leave the desired light coating of loose graphite. When the work is completed, the slide valve and its seat must be entirely free from oil or grease. When handling the parts after lubricating see that the hands do not come in contact with the lubricated parts, as the thin coating of graphite is easily removed.

The emergency valve pistons 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. Do not permit any oil to get upon the gaskets.

DOOR-AND-STEP CONTROLLER

Lubrication

Since the door-and-step controller may be properly installed in two ways—namely, with the gear shaft vertical or horizontal—it is apparent that the rack and gear, as well as the gear shaft, should be lubricated with some form of non-fluid oil or hard grease, so as to prevent loss of the lubricant under certain conditions of installation. These parts may be readily lubricated by removing cylinder cap and applying the lubricant in a suitable manner. When this work is undertaken with the door-and-step controller in place underneath a car, see 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 open 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 and follower, the gear shaft may be rotated sufficiently to withdraw the end of the rack through the piston, leather cup and its expander.

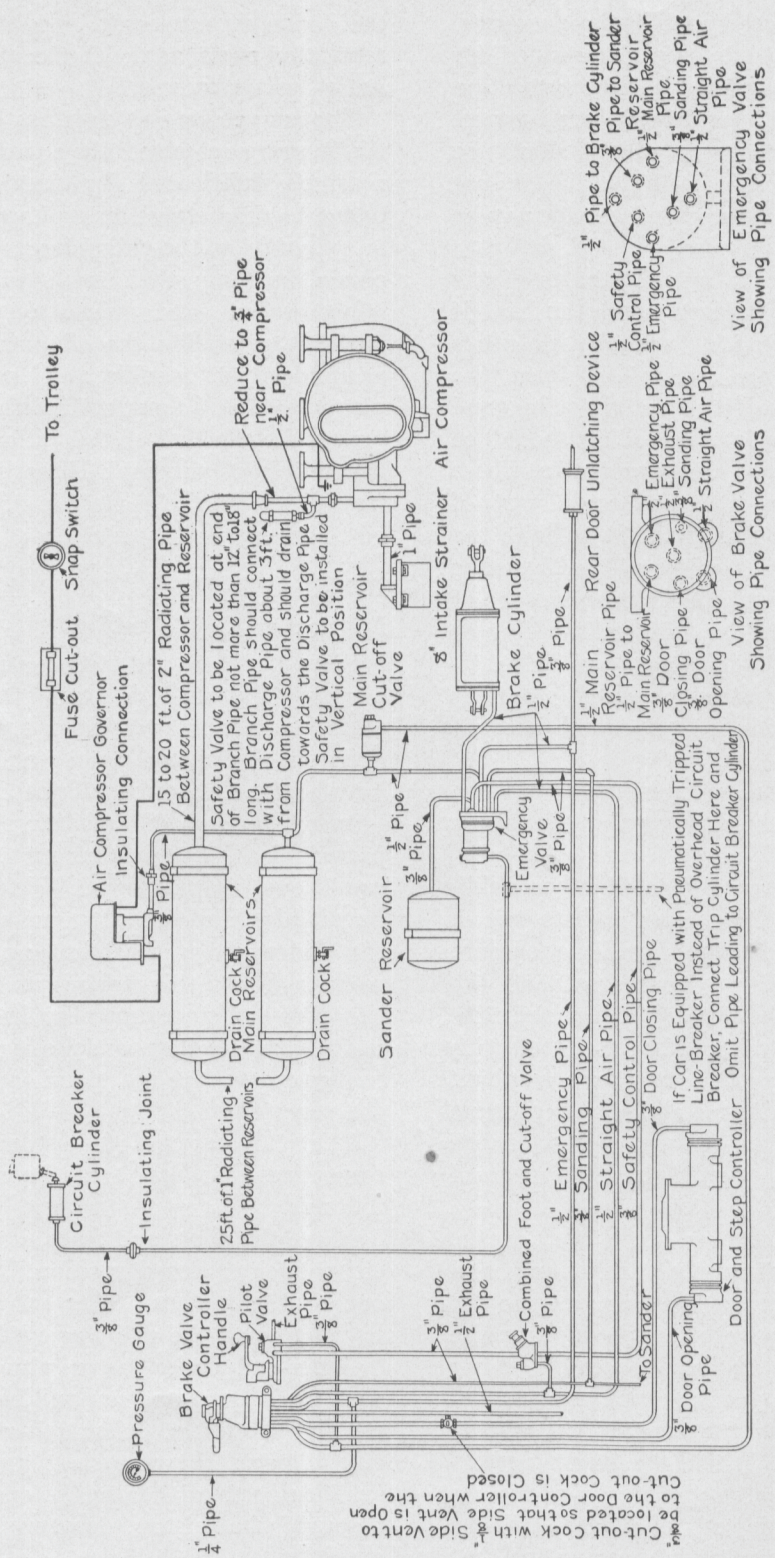


Fig. 8. Piping Diagram of Air Brake and Safety Car Control Equipment for Single-end Car

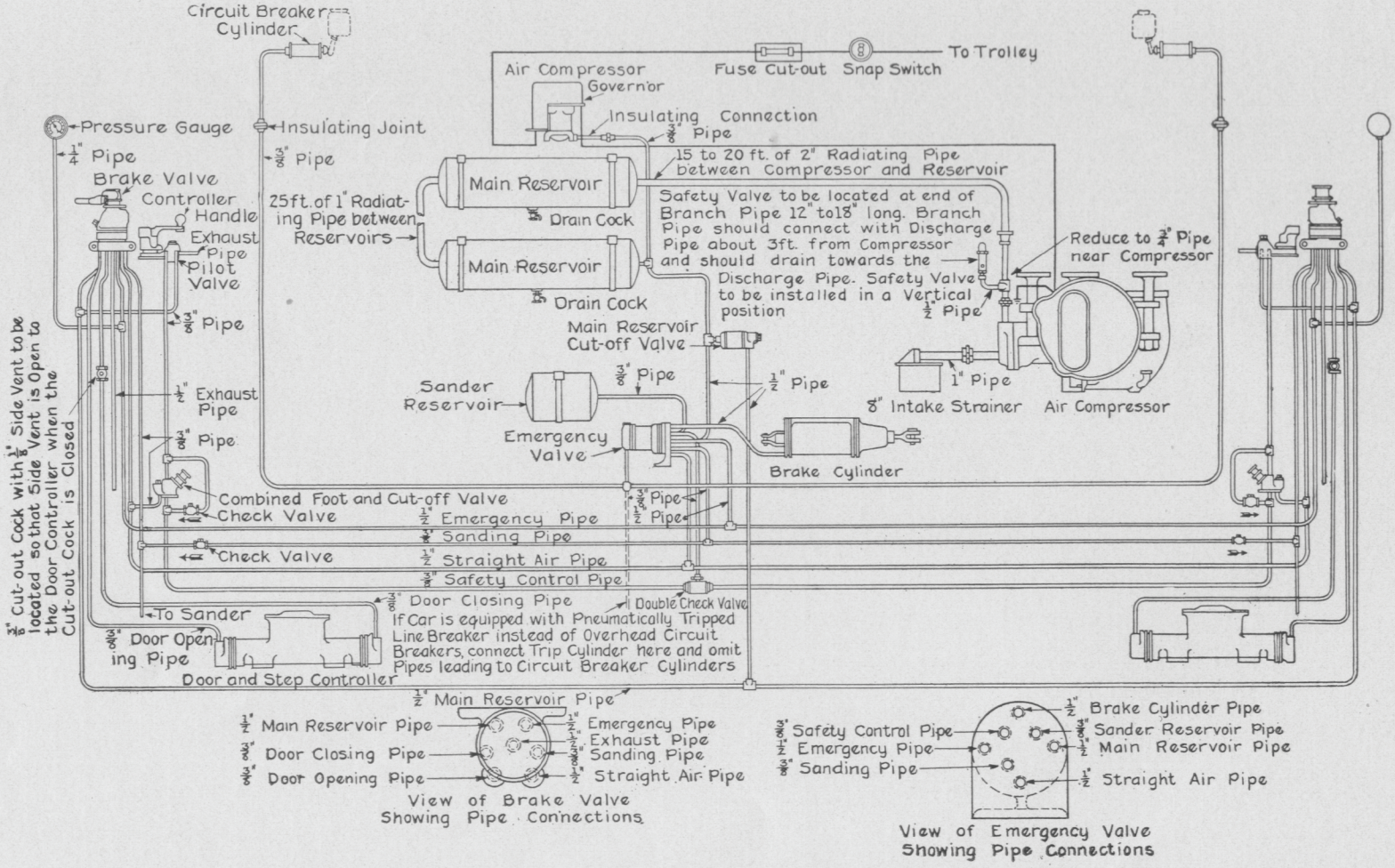


Fig. 9. Piping Diagram of Air Brake and Safety Car Control Equipment for Double-end Car

At this time carefully 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. After a careful treatment of the walls of the cylinders, as well as the washer, the leather cup and expander—as was described under the process of cleaning and lubricating of brake cylinder, using a graphite grease 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.

Do not disengage the teeth of the segmental gear from the rack during these operations, particularly if the door-and-step levers have been disconnected from the gear shaft.

In reapplying the right-hand and left-hand cylinder end covers, 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 perform will be obviated.

The leather cylinder-end gaskets 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 to 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.

BRAKE CYLINDER PISTON TRAVEL

The travel of the piston should be adjusted to not more than 4 in. (standing) for double-truck cars and 3 in. (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 sufficiently frequent intervals to prevent any considerable increase in piston travel. 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 in. to 1 in. longer than standing travel, so that if a 5-in. running travel is desired with double truck cars, the standing travel should be adjusted to about 4 in. On single-truck cars the running piston travel should be maintained as closely to 4 in. as practicable.

Piston travel should not 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.

PIPING INSTALLATION

Before installing the emergency valve, the brake valves and controller pilot valves, hammer and blow out all the piping, in order to loosen and remove all scale or foreign matter, and remove all fins and burrs tending to restrict the opening through the pipe. After the piping is complete, thoroughly test all the joints under pressure with soapsuds and make them air tight. Install all the piping so that there are no pockets in which moisture can collect and freeze in cold weather.

It is recommended that individually tested pipe fittings, known as "Extra Quality Fittings," be used in connection with all air-brake piping. These fittings are thoroughly tested under pressure and guaranteed not to leak; in addition, they are carefully threaded and finished, so that the installation of pipe

and fittings is carried cut with the least amount of testing and substitutions in the way of refitting. Also, it is especially recommended that brass to iron seat unions be used. These insure air-tight joints and greatly facilitate the removal of valves to which pipes are connected. Furthermore, the necessity for providing the ordinary

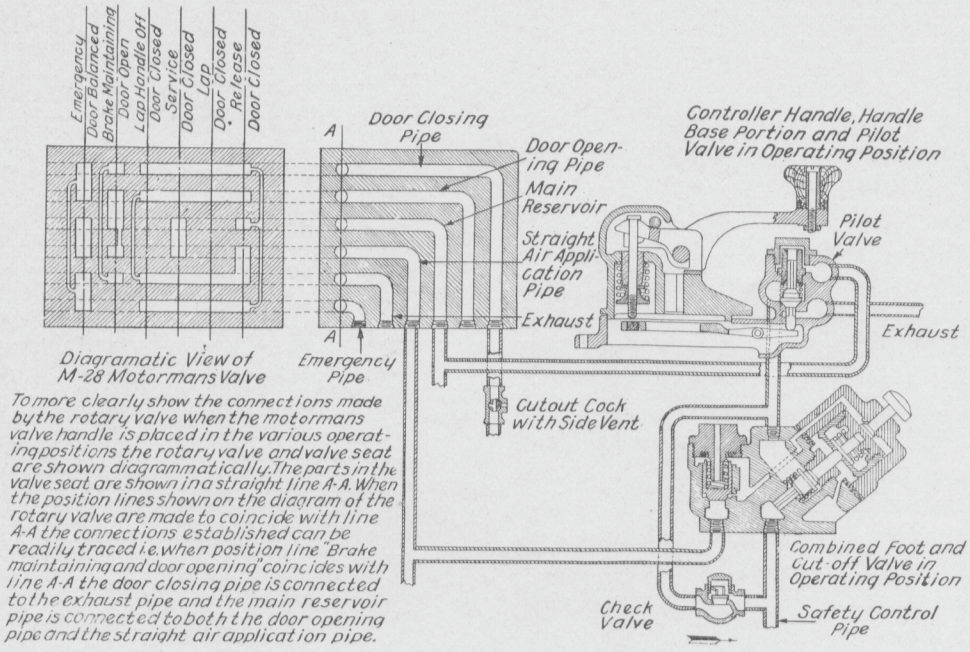


Fig. 10. Diagram of M-28 Motorman's Valve, Air Brake and Safety Car Control Equipment

gaskets and keeping account of same is obviated.

In making installation of piping, the use of lead or some others uitable substance is recommended; but, in all cases, such substance should be applied to the pipe or nipple threads so that it does not enter the piping and be transmitted to the valves. Piping diagram should be referred to for the correct size of pipe to be used in making installations.

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 9.

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, running and door-closing position, an observation of the air gauge will indicate the amount of leakage from the piping as well as the door-closing sides of the door-and-step controllers. 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 2 lb. 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 gauge after each operation of the cocks, the source of leakage can be finally located.

Following these operations, place the brake-valve handle in door-opening 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 2 lb. 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 removed to the door-opening position when all remaining pipes should be tested. The most reliable method of testing is to coat the pipe and fittings with soapsuds.

TESTING INDIVIDUAL DEVICES

With the brake-valve handle in release, running and door-closing 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 is more likely than otherwise to be found to be a particle of pipe scale or foreign matter lodged between the inner valve and its seat in the controller pilot valve. To finally test for this condition, place a finger on the exhaust from the controller pilot valve 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 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 inside 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 attached to 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 sides of the door-and-step controllers 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.