Instruction Pamphlet
S-100

JULY, 1924

Air Brake and Safety Car Control Equipment

Safety Car Devices Co.

ST. LOUIS, MO.

Works and Principal Commercial Offices

WILMERDING, PA.

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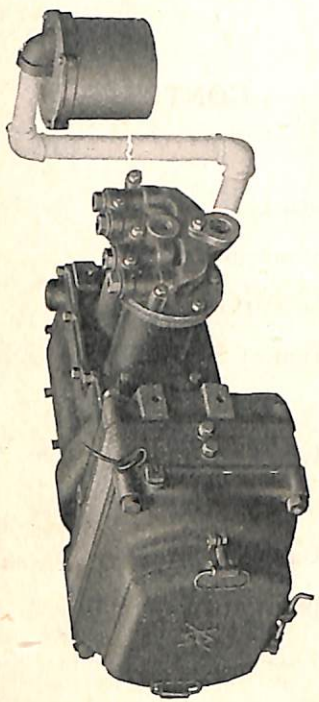


Fig. 1. "Bungalow" Type DH Compressor with 8" Strainer

RULES FOR OPERATING THE AIR BRAKE AND SAFETY CAR CONTROL EQUIPMENT

The following rules are intended to cover in a condensed form the important instructions to be observed in handling this equipment in service. For assistance in a more complete understanding of the operation of the equipment and description of the apparatus, the reader is referred to the section under "Operation of the Equipment."

Charging

Before starting the air compressor, close the main reservoir drain cocks. See that the cocks in the door closing pipes are open. The fuse in the compressor circuit must be in place and "live". Place the handle on the brake valve to be operated and move it to Release (Door Closed) Position at the extreme left. Then start the compressor by closing the snap switch in the compressor circuit. Place controller handle in handle base portion and hold same down until gage hand indicates at least 50 lbs. pressure in main reservoirs. Under no circumstances should a car be put in motion with less air pressure than that mentioned above. When ready to start see that hand brakes are fully released.

Running

Keep the brake valve handle in Release 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 speed, condition of rail, grade and kind of stop desired, has been obtained, the brake valve handle should be returned to 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 Service Application Position, further applying the brakes until the desired result is obtained, then return it to Lap Position.

The controller handle or foot valve must be held down until the stop is completed and the brake valve handle moved to Service Application or Door Open Position. While car is standing, brake valve handle must remain in

Service Application or Door Open 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, so that at the end of the stop little pressure remains in the brake cylinder, unless on grade.

Because the retarding effect of any given application is greater at low than at high speed, a heavy application at low speed will result in an abrupt stop with perhaps discomfort to passengers or slid 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 cars is greatest. If the brake cylinder pressure is very light at first, and is increased as the speed of the car is diminished, 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. With practice, these correct methods of stopping can be readily acquired.

Holding Brakes Applied

When the desired brake cylinder pressure has been obtained, the brake valve handle should be placed in Lap Position where it should remain until it is desired either to make a heavier application or to release the brakes. Never allow the brake valve handle to remain in 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 diminish the braking power materially.

Release

To fully release the brakes after any application, move the brake valve handle to Release (Door Closed) 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 brake will not be applied by leakage. Immediately before moving the brake valve handle to Release (Door Closed) 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 (Door Closed) Position for a moment, then back to Lap Position; repeat this operation as often as may be necessary until the car is brought to rest with only enough pressure retained in the brake cylinder to prevent it from moving. During this manipulation of brake valve handle, either the controller handle or the 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 Door Open Position for the purpose of opening doors and lowering steps on the operating end of 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 Open Position are Door Closed Positions. Should it be desired to close the doors and raise the steps without releasing the brake, return the handle to Service Application Position. Where it is desired to close the door and raise the steps and release the brake at the same time, such as preliminary to a movement of the car, return the brake valve handle to Release (Door Closed) Position on the extreme left. Immediately before this last operation of the brake valve handle, the controller handle must be held down.

Emergency

Emergency action of the Safety Car Control Features 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 situations 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, the brake valve handle should be moved quickly from whatever position it may be in to Emergency position which is at the extreme right, and left there until the car has stopped and the danger is past. While the brake valve handle is in emergency position, the controller handle should be released, and it is not necessary to hold down the foot valve. This movement of the brake valve handle, in ad-

dition 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 controllers 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 situations mentioned above, it is to be remembered that the operator is required to either 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.

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 (Door Closed) Position, and hold the controller handle down until 50 lbs. pressure is reached in the main reservoirs, as indicated by the gage.

Changing Ends

Preliminary to changing ends, the brake must be fully applied when the brake valve 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 excessive brake cylinder 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 (Door Closed) Position, the controller handle must be in place and held down.*

Sanding

A feature of great importance in obtaining the most effective operation of any brake is that of properly sanding the track when making the stop, since the maximum retarding force is developed when the adhesion between the wheels of the vehicle and the rail is the highest possible. Whether this be realized or not, necessarily depends very largely upon the condition of the rail. Various independent sanding devices have heretofore been used which tend to detract the operator's attention from

the devices directly controlling the operation of the car, but by incorporating the sanding device in the brake valve, sand may be applied to the rails with the minimum amount of effort on the part of the car operator, and greater safety and efficiency thereby insured.

The brake valve is provided with a hinged handle, the downward movement of which operates a poppet valve through the medium of a bail, and air may thus be admitted from the main reservoir pipe to the sand box for sanding the rail in service operations, this manipulation being possible in any position of the brake valve handle without requiring the operator to remove his hand from the handle.

To insure that sand will be applied to the rails in all emergency applications of the brake, no matter how initiated, air is admitted from a sanding reservoir, normally kept charged from the main reservoir to the sand pipe through the medium of the emergency valve when in emergency position. Whenever 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.

PARTS OF THE AIR BRAKE AND SAFETY CAR CONTROL EQUIPMENT (DOUBLE END)

1. *A Motor Driven Air Compressor* which furnishes the compressed air for use in the Air Brake and Safety Car Control Equipment.

2. An electric *Compressor Governor* which automatically controls the operation of the compressor between pre-determined minimum and maximum main reservoir pressures.

3. A *Fuse* and *Snap Switch* in the line from the trolley to the governor and air compressor, protecting the latter from any excessive flow of current and enabling the current supply to the compressor to be entirely cut off when desired.

4. Two *Main Reservoirs* to which the compressed air is delivered, and in which it is cooled, and stored for use in charging the system.

5. A *Main Reservoir Cut-off Valve* in the main reservoir piping, to conserve the main reservoir and brake cylinder pressure in the event of rupture of certain supply pipes on either platform.

6. A *Safety Valve,* which protects against excessive main reservoir pressure in case the Governor for any reason fails to stop the compressors.

7. Two *Single Pointer Air Gages,* one at each end of the car, which show, excepting under emergency applications, the main reservoir pressure.

8. Two *Brake Valves*, one at each end of the car, through which (a) air is permitted to enter the straight air pipe for the purpose of applying the brake; (b) the flow of air to or from the brake cylinder may be prevented as when the brakes are being held applied; (c) air is allowed to exhaust from the straight air pipe as when releasing the brakes; (d) air is caused to flow to and from the door and step controller for the purpose of opening and closing the doors and steps; (e) air is permitted to flow to the sand traps for the purpose of distributing sand to the rails; (f) air is exhausted from the emergency line for the purpose of actuating the emergency valve and releasing the air pressure from the closing side of the door and step controller.

9. An *Emergency Valve* which operates automatically in response to: (a) a reduction in emergency pipe pressure, which reduction is in turn produced either by the brake valve or by the controller safety attachments; (b) a restoration of emergency pipe pressure; (c) it causes an emergency application of the air brakes by permitting air to flow from the main reservoir to the brake cylinder; (d) it permits air to flow from the sanding reservoir through the sanding pipe to the sand boxes on the car; (e) it causes emergency pipe pressure to flow to the circuit breaker cylinders for the purpose of opening the control circuit which actuates the car motors; (f) it releases air pressure from the closing sides of the door and step controllers.

10. A *No. 15 Double Check Valve* for the purpose of establishing connection between the safety control apparatus and the emergency valve, depending on the respective ends from which the car is operated.

11. A *Sanding Reservoir* in which is stored the air supply for operating sand traps when an emergency application is made.

12. Two 3/8" *Non-Return Check Valves* in the sanding pipe to effect proper distribution of sand from the brake valve.

13. A *Brake Cylinder* with a piston and rod so connected through the brake levers and rods to the brake shoes that when the piston is forced outward by air pressure this force is transmitted through the rods and levers to the brake shoes, forcing them against the wheels.

14. Two *Door and Step Controllers*, are installed for the purpose of opening and closing the doors and steps. Special requirements may involve the use of more than one door and step controller per end.

15. A 3/8" *Cut-Out Cock with* 1/8" *Side Vent* in door closing pipe for convenience in car barn inspection; or, under other conditions, where it is desirable to balance the air pressure on the respective ends of the door and step controllers.

16. A *Circuit Breaker Cylinder* is installed in such manner that its movable piston may strike the handle or button of the circuit breaker for the purpose of breaking the power circuit through same.

17. A *Controller Handle* is used in conjunction with a suitable handle base for the purpose of operating the car controller in the usual way.

18. A *Controller Handle Base Portion* is attached to the stem of the controller drum, extending above the controller cover plate, and operates in conjunction with a controller pilot valve.

19. The *Controller Pilot Valve* is attached to the controller cover plate and has suitable pipe connections for establishing control of braking, as well as door and step and sanding operations.

20. A *Foot Valve* and *by-pass check valve* for the purpose of providing the same degree of safety as is established through the hinged controller handle on such occasions as it may be found desirable to remove the hand from the controller handle.

Items 16 to 20 inclusive, are termed the "Safety Control Group". A detailed explanation concerning their operation and relation will be found beginning on page 58.

Single End Equipment

The equipment for single end cars is the same as for double end cars except as follows:

A *Rear Door Unlatching Device* is used only with single end cars for controlling a suitable lock securing the rear or emergency exit door and step, and to prevent recharge of the equipment unless this door is closed.

Only one each of the following devices used—

Brake Valve, 3/8" Cut-out Cock with Side Vent, Controller Handle Base, Controller Pilot Valve, Circuit Breaker Cylinder, Combined Foot and Cut-off Valve, and Door and Step Controller.

The following are not used—

Two 3/8" Ball Check Valves
Two 3/8" Wing Check Valves
The No. 15 Double Check Valve.

A more comprehensive idea of the relation of the foregoing parts to one another will be obtained by reference to the isometric diagrammatic piping arrangement shown in Figs. 56 and 57 for double end and single end equipments respectively.

DESCRIPTION OF THE PARTS
DH-16 Air Compressor

This compressor is of the horizontal duplex air cylinder type, single acting (that is, the air is compressed on only one side of the piston), and is driven by a motor through herringbone gearing. However, it is different in general design from preceding types. The motor is at the side of the compressor portion instead of behind it, and the motor pinion is in front of the gear, as shown in Fig. 3,

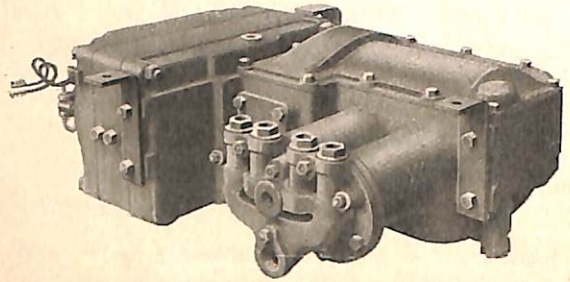


Fig. 2. "Bungalow" Type DH Compressor in Suspension Hangers

thereby giving greater compactness. The low height of the compressor makes it particularly adapted to the "Easy Entrance, Easy Exit" type of car, in which track clearance has been reduced to a minimum. The motor is provided with a large door at the commutator end, shown in Fig. 6, giving easy access to the commutator for inspection, adjustment of brushes and cleaning. The armature shaft has no bearing on the commutator end, thereby facilitating the removal of the armature, as described under "Maintenance," and also eliminating the possibility of oil reaching the commutator from that source.

Compressor Portion

The cylinders, crank case, motor housing, and bearing brackets are cast in one piece, thus eliminating the necessity for a bed plate, or adjustment to obtain proper centers of gear and pinion, and providing a construction which is rigid and of few parts.

The cover 3, Fig. 3, for both cylinders is in one piece, and may be easily removed. It is tapped for the suction and discharge pipe connections and contains the air valves.

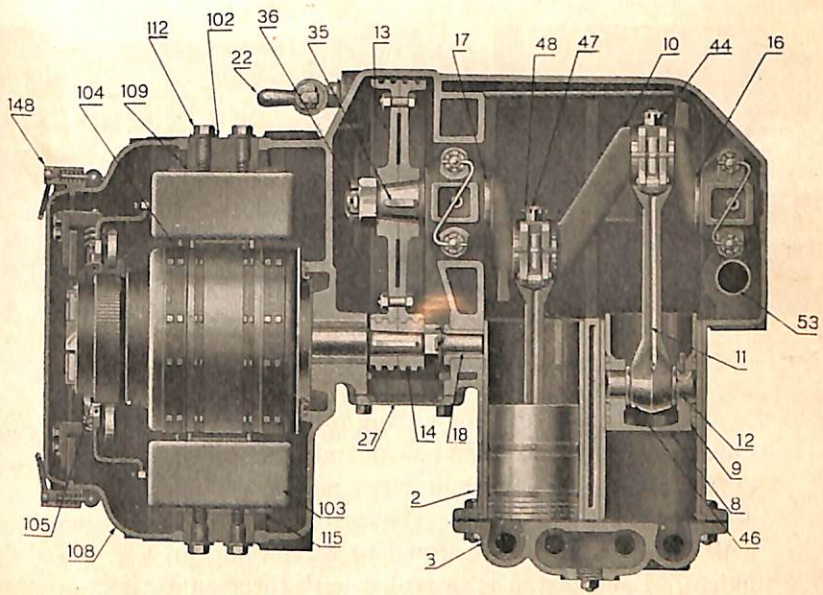


Fig. 3. Sectional View Type DH Compressor

These valves, 4 and 6, (four in number—one suction and one discharge valve for each cylinder) are located close to the cylinder to reduce valve clearance. The valves are accurately machined hydraulic forgings, giving longer life than valves turned from cold rolled commercial stock. These valves require little or no attention. Placed vertically, they close by gravity so that there are no springs to break, corrode or lose their temper. They are easily accessible by simply removing the caps. The valve stops 5 and 7 are of such a design as to reduce clearance and prevent sluggish action of the valve.

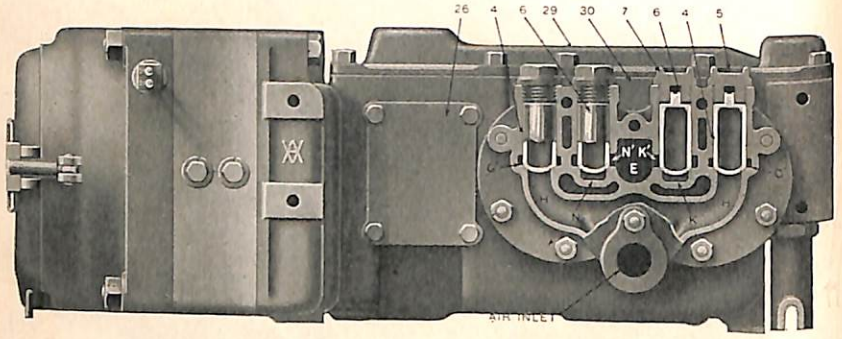


Fig. 4. Type DH Compressor with Cylinder Cover in Section

The pistons 8 and connecting rods 11 have been made unusually long with a view of insuring minimum and even wear on the cylinders, wrist pins, wrist pin bearings and pistons themselves. The pistons are of the trunk type and are carefully turned to fit the bore of the cylinders. Each piston is provided with three snap rings of standard form, a special quality of cast iron being used so as to give minimum and uniform wear.

The wrist pins 12 are of hardened steel, carefully ground. They are pressed into the pistons and held in place by set screws.

The connecting rods and crank shaft 10 are drop forgings of high grade steel, the latter being specially heat treated. The wrist pin ends of the connecting rods are provided with liberal special bearing metal bushings 46 which can be readily replaced when worn. The crank shaft ends of the connecting rods are provided with split bearings of special bearing metal, allowance being made between the connecting rods and bearing caps 44 to take up wear quickly and readily by removing liners and again tightening the nut 48 on eye bolt 47 which is hinged to the connecting rod.

All bearings are of our special bearing metal mixture and may be easily renewed.

The crank shaft is designed to make a center or thrust bearing unnecessary.

The power is transmitted from motor shaft to crank shaft by a herringbone pinion 14 and gear 13. These gears have a large number of fine teeth which make for quiet running for a long time. The gear is forced on to the taper shaft over a square key 35 and secured by a castle nut 36 and cotter. The arrangement, combined with a steep taper on the crank shaft, makes removal of the gear easy.

OPERATION OF COMPRESSOR

Referring to Fig. 3 and the lower view in Fig. 5, the right-hand piston being assumed to be on its backward stroke a suction is created in that cylinder (A). This draws air through the suction strainer and inlet pipe into chamber H where it lifts inlet valve 4 and passes into the cylinder A. On the return stroke, the inlet valve closes and the compressed air lifts the discharge valve 6 and passes through ports K and K¹ into chamber E, Fig. 4,

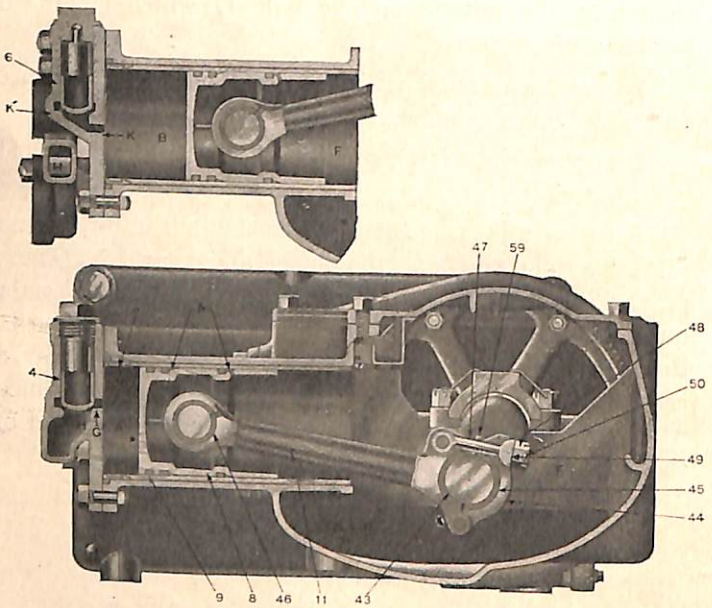


Fig. 5. Sectional Views Type DH Compressor

and thence through the discharge pipe into the reservoir. The same operation takes place in the left-hand cylinder B except that it is compressing (see upper view, Fig. 5), while the right-hand cylinder is drawing air in and vice versa.

Fig. 5 shows the method of preventing oil from passing into the discharge pipe. Two "blow back" passages *a* are provided in the walls of each cylinder at the pressure end. Circumferential beveled grooves *b* are cut in the piston immediately back of the second and third packing rings. When the piston is at the end of its stroke, compressed air tapped in the clearance space by-passes the first two packing rings reaching the groove back of the second ring and then "blows back" into the crank case any excess oil that may have crept along the piston. The wiping action of the second and third rings also assists in preventing the passage of oil.

Inasmuch as there might at times be a slight vacuum or pressure in the crank case, due to ring leakage and the movement of the pistons, a vent or "breathing" opening is made to the atmosphere. This consists simply of a vent fitting 53 connecting the interior of the crank case to the atmosphere. The fitting has been made long enough to insure that no dirt will be drawn into the compressor due to pulsations of air when there is a vacuum and is protected against loss of oil due to direct splash from the crank case.

NOTE: In the DH-10 Compressor the crank case vent is connected to the suction instead of to the atmosphere direct as in the DH-16. The DH-10 Compressor does not have the blow-back holes, but does have the circumferential grooves.

Motor

The motor is of the enclosed, four pole, direct current series wound type with two field coils.

The field yoke 102 is made up of laminated soft steel punchings, insuring uniformity of section and minimum weight. The yoke fits between milled surfaces of the motor housing, being supported firmly in place by means of long bolts and studs which hold the two parts of the motor housing together.

The pole pieces 109 are each held in place by two cap screws 112 and may, therefore, be very easily removed. The field coils are impervious to oil and water to a high degree. The consequent poles are a part of the field yoke.

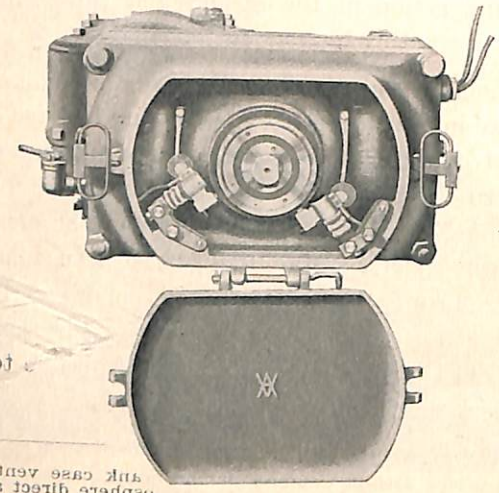


Fig. 6. Type DH Compressor, Commutator Door Open

To prevent injury due to vibration, the coils are held firmly in place by a flat steel spring 115 which presses them against the pole tip guards.

The armature 104 is of generous proportions and is built up of soft sheet steel punchings keyed to a spider. The coils are form-wound and of uniform size. The commutator 105 is of liberal dimensions, using 1/32″ strips of the best grade of mica. The mica insulation between the commutator bars is undercut. In order to prevent possibility of any movement that might damage the leads, special care is taken in supporting them from coil to commutator by a heavily insulated steel coil support fastened securely against the armature core, while the coils are banded in the core and on the ends to prevent any movement. The oiling system is designed with extra precautions to prevent entrance of oil into the motor, as described later.

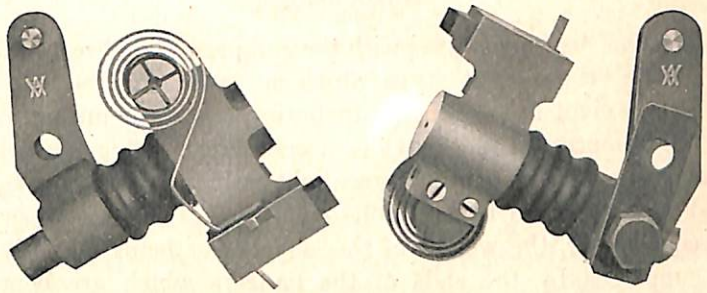


Fig. 7. Carbon Holder

The brush holders, Fig. 7, are permanently located in a position slightly back of the mechanical neutral position which is the most efficient location on account of the fact that the armature always rotates in one direction; they

are, however, arranged for easy radial adjustment by means of a set screw which secures the brush holder stud in the clamp. The holders are fastened to the motor case with one cap screw and one dowel pin, giving accuracy of location but easy removal. The brushes are held in contact with the commutator by a combination of a coiled spring and a flat spring fastened at the uncoiled end of the former, thus providing a spring of double amplitude. The flat uncoiled spring exerts only a light pressure upon the brush and, therefore, takes care of the small vibrations. This tends to eliminate chattering and improves commutation.

The brushes are located on the lower quadrant of the commutator. This position is most accessible from the pit and in itself tends to keep the brushes and commutator clean.

Suspension

The suspension used with the compressor is direct and of the "three-point" type which not only contributes to light weight but facilitates mounting and dismounting of the compressor and provides accessibility. This type of suspension consists of three light-weight steel hangers, Fig. 2, fastened by two bolts each to lugs cast upon the compressor, the weight of the compressor being actually supported by the ends of the hangers which are bent sharply underneath these lugs. The upper ends of two of these hangers are bolted by one bolt each to brackets bolted to the car body. No bolt is needed for the third hanger since the other two hangers act to hold it in place. This method of suspension requires the removal of only two bolts to disengage the compressor from the car body.

8″ SUCTION STRAINER

A sectioned view of the suction strainer used with the DH Compressor is shown in Fig. 8 and as applied to the compressor in Fig. 1.

Fig. 8. 8″ Suction Strainer

The ample cross-sectional area provides for a slow rate of flow into and through the strainer, together with sufficient capacity to retain dirt and dust drawn into it without noticeable restriction to the flow of air. A compact layer of pulled curled hair prevents the passage through it of even the finest dust, the construction being such that all the air must filter through the entire thickness of the bed of hair. When the strainer is installed with the opening downward, as it should be, any dirt or dust which might be drawn into it when the compressor is running tends to be shaken out by the jolting of the moving car after the compressor stops.

S-16 ELECTRIC COMPRESSOR GOVERNOR

The S-16 governor is of the pneumatic double "safety valve" type and is intended for use with either direct current or single phase alternating current motor driven air compressors requiring not over 10 amperes at 750 volts.

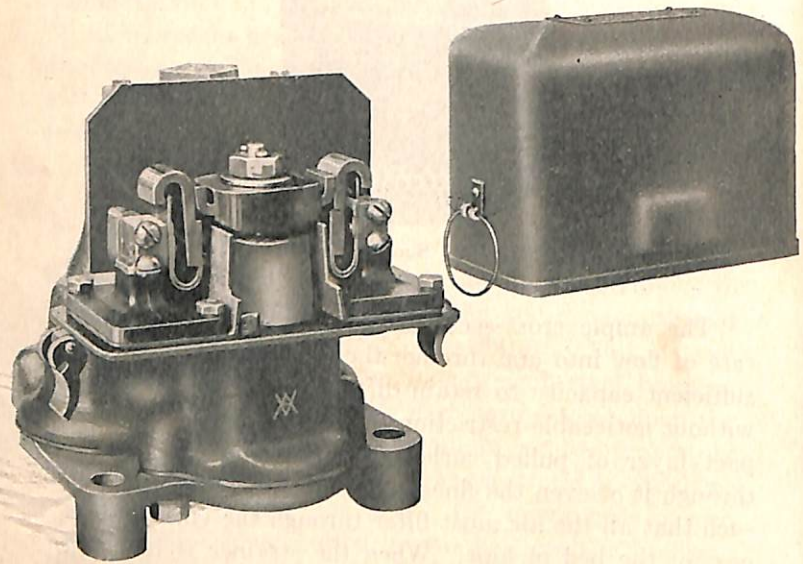


Fig. 9. Photographic View of the Type S-16 Electric Compressor Governor with cover removed

Construction and Operation

Referring to the illustrations, it will be seen that the governor consists of two distinct portions; an operating portion and a pipe bracket. The operating portion includes the electrical details and the regulating mechanism. The electric circuit from the trolley to the air compressor is made or broken by the electric portion, which consists, essentially, of a switch spider with contacts 28 rigidly attached to the switch piston and rod 24 and forming the connection between the finger contacts 7, when the governor is in cut-in position as illustrated.

An ingenious arrangement of the air cylinder and cut-out details affords a pneumatic blow-out of unusual efficiency so that no coils are necessary for affording a magnetic blow-out. For this reason, the governor can be used with either direct or alternating current and may be connected in either the positive or negative side of the circuit. The electric details are thoroughly insulated and are covered with a pressed steel casing, lined with asbestos, which may be quickly and easily removed by means of two spring rings toggle latches.

Referring to Fig. 12, with the compressor in operation and main reservoir pressure building up, main reservoir pressure is delivered to the face of the cut-out valve 38, also to the underside of the tail valve 43 of the cut-in valve 39, via the main reservoir pipe connection, passage *r*, chamber A, through strainer 49 to passages *a* and *q*.

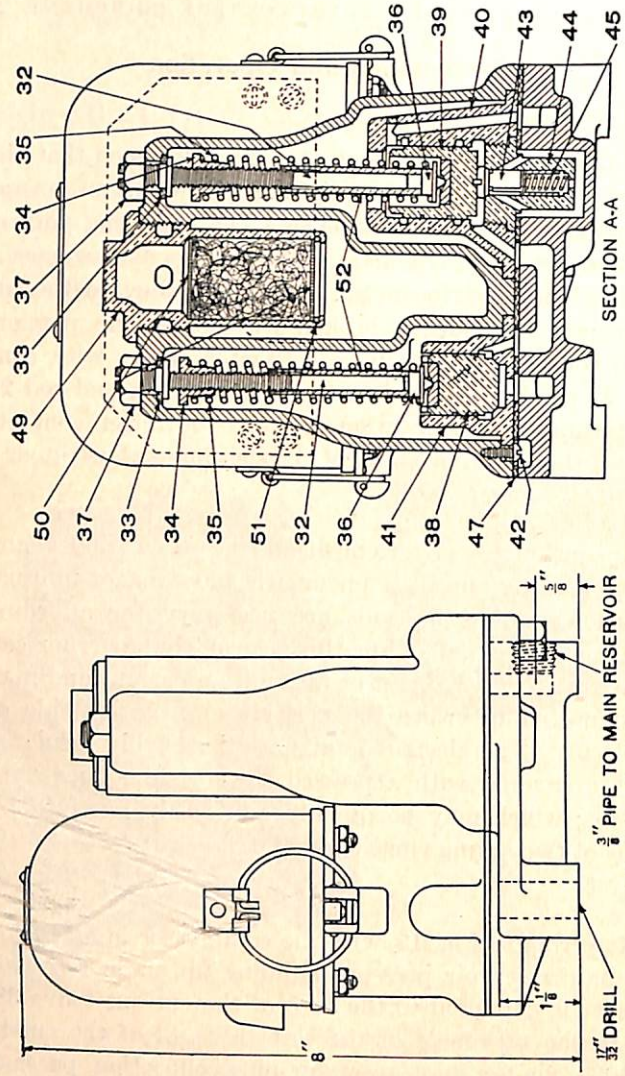


Fig. 10. Outline of the S-16 Governor showing Pipe Connection and Section through the Regulating Portion

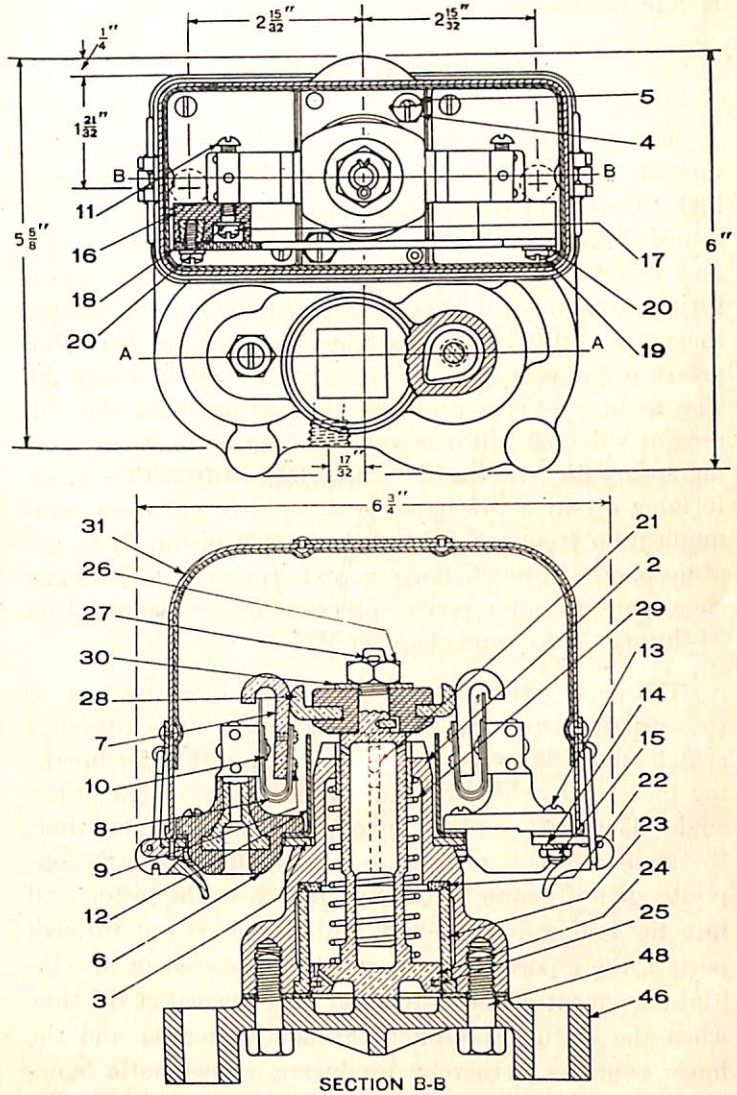


Fig. 11. Type S-16 Governor, Plan View and Section through the Switch Piston

Cutting-out Operation

The main reservoir pressure building up against the face of cut-out valve 38 eventually becomes sufficiently high to overcome the tension of the cut-out valve regulating spring 35, causing valve 38 to lift from its seat and due to the construction of this valve, the slight lifting from its seat exposes an increased area, causing the valve to lift quickly, at the same instant delivering pressure via port *e* to the face of the cut-in valve 39. The main reservoir pressure now acting upon the full area of valve 39 will overcome the tension of its regulating spring 35′, causing the valve 39 to lift with a snap, forming a seal at its upper seat *j* which will close communication from the face of the switch piston 24 to the atmosphere (through ports *g* and *d*) and, at the same time connect main reservoir pressure to the face of piston 24 through port *g* and chamber W.

The main reservoir pressure acting upon the face of the switch piston 24 will cause it with the attached switch spider 53 to move quickly to a position for breaking the circuit which is made through the switch piston spider 53 and the contact fingers 7 and, at the same time, the main reservoir pressure which is supplied to the opposite side of piston 24 through port h in the piston and into the hollow piston stem, will be forced out through ports *i*, these ports being partially uncovered by the initial movement of the piston and fully opened at the time when the circuit is broken through spider 53 and the finger contacts 7, thereby producing a pneumatic blow-out at the time when the circuit is broken.

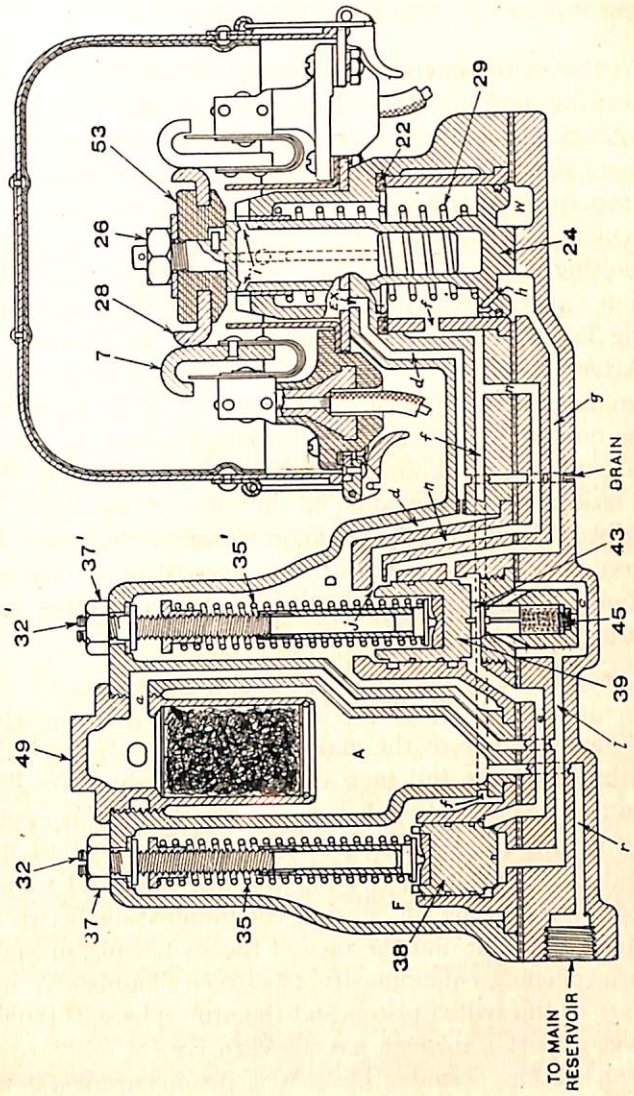


Fig. 12. Diagrammatic View of the S-16 Governor in Cut-in Position

As the switch piston completes its full travel towards the cut-out position, the piston will seat against piston seal 22 thereby preventing further loss of main reservoir pressure through port *h* and, by the same movement of the piston, main reservoir pressure will be connected to the cut-out regulating spring chamber F through port *f*, resulting in equalizing the air pressures on each side of cut-out valve 38, whereupon the tension of the regulating spring 35 will then move the cut-out valve to its seat.

After cut-out valve 38 has been returned to its seat, the main reservoir pressure will continue to be supplied to the face of the switch piston through passages *a*, *q* and *c*, past tail valve 43, and through port *g* to chamber W. The switch piston remains in the cut-out position, as described above, until the main reservoir pressure is reduced to a point where the force exerted by it against the face of the cut-in valve 39 is equal to a fraction below the tension of the regulating spring 35′.

Cutting-in Operation

When the force of the main reservoir pressure, which is acting upon the full face area of the cut-in valve 39, is reduced to a fraction below the tension of the regulating spring 35′, cut-in valve 39 will be moved to its normal cut-in position, causing the tail valve 43 to be seated by its spring 45, closing communication between the main reservoir and the face of the switch piston and, in turn, opening communication between chamber W on the face of the switch piston and the atmosphere, through passage *g*, port *j*, through passage *d* to Ex.

This action permits the switch piston spring 29 to return the switch piston to its normal cut-in position,

at the same time, opening communication between the cut-out regulating spring chamber F and the atmosphere, through passages *f* and *n*, port *j*, cut-in regulating spring chamber D, and passage *d* to Ex, thereby freeing spring chamber F of main reservoir pressure. The cut-out valve 38 which is now held to its seat only by the tension of the regulating spring 35, will immediately rise from its seat upon a slight increase of main reservoir pressure above the setting of the regulating spring.

As the exhaust port Ex opens into the switch portion under the cover, the venting of main reservoir through this port during the cutting-in operation insures the discharge of all copper gases from the cover.

Regulation and Adjustment

Loosen check nuts 37 and 37′ and screw cut-out regulating stem 32 down until the desired cutting-out point is reached. At the same time screw down cut-in regulating stem 32′ to as nearly the same tension as can be judged under ordinary observation. If when the cutting-out point is reached the range is not as desired, screw the cut-in regulating stem down to raise the cutting-in point or to decrease the range and back it off to lower the cutting-in point or to increase the range.

The ordinary range in safety car service is 10 lbs., the cutting-in point usually 50 lbs, and the cutting-out point 60 lbs.

SNAP SWITCH AND FUSE BLOCK

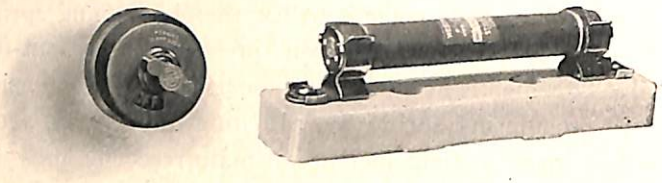


Fig. 13. Snap Switch and Open Fuse Block

In the circuit between the trolley and governor are placed a *snap switch* and an *open fuse block* with *fuse*, Fig. 13. The snap switch affords a means of cutting off the current to the air compressor when so desired; while the fuse serves to protect the motor from a dangerous continued overload by blowing, and thus opening the circuit, when the amount of current flowing to the compressor exceeds the capacity of the fuse.

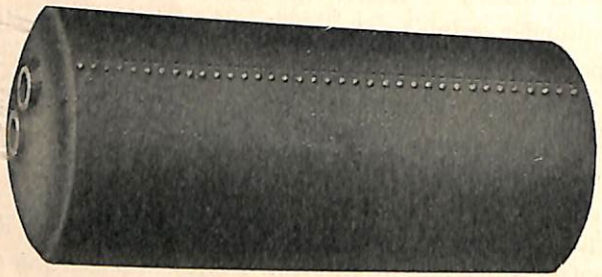


Fig. 14. Brazed Main Reservoir

MAIN RESERVOIRS

Two main reservoirs are used for the purpose of storing an abundant supply of compressed air to permit promptly applying the brake and operating the doors and steps. The division of the storage volume into two reservoirs gives a most efficient arrangement for cooling the air and depositing the moisture, oil, or other foreign matter carried into the reservoirs, before passing on to the brake system. To assist in this, the piping should be so installed as to drain into the reservoirs and the drain cocks should permit easily draining same. An accumulation of water or other foreign matter is not only injurious to the reservoirs but is liable to seriously reduce their capacity. They should be drained at regular and frequent intervals.

The main reservoirs, Fig. 14, recommended and furnished with Air Brake and Safety Car Control Equipments, are enameled by a special process which adds greatly to their durability. Both inside and outside surfaces are protected against corrosion, oxidation, etc., thereby preserving the initial factor of safety. These reservoirs are of the lightest weight possible, consistent with reliable manufacturing processes and mechanical strength. Briefly, the reservoirs, as received from the shop, are cleaned in an acid bath, neutralized by an alkaline bath, and carefully washed and dried. They are then dipped in warm enamel to coat both inside and outside surfaces and baked at a high temperature, the dipping and baking processes being repeated to give a second coat.

A *main reservoir cut-off valve*, when used, is installed in the main reservoir branch to the reservoir pipe. Under normal operating conditions the parts of this valve occupy the positions shown in Fig. 15, there being communication through the valve between the main reservoirs and the reservoir pipe. However, should the

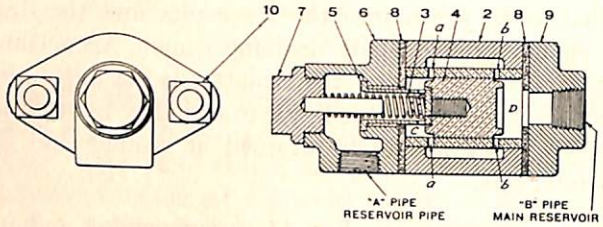


Fig. 15. Main Reservoir Cut-off Valve

reservoir pipe be ruptured, the pressure on the left of valve 4 is exhausted, permitting main reservoir pressure on the right to force valve 4 to the extreme left, against the pressure of spring 3, blanking the ports at that end and thereby cutting off communication between the main reservoirs and the reservoir pipe. The use of this valve therefore prevents loss of main reservoir pressure under such conditions and thereby insures a proper supply of main reservoir air for use in the brake cylinder in emergency.

SAFETY VALVE

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

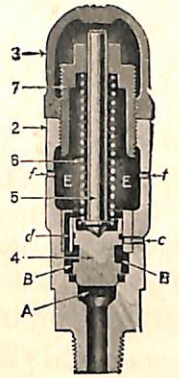


Fig. 16. E-1 Safety Valve

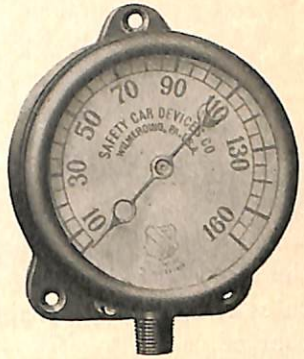


Fig. 17. Air Gage

and the compression of the spring forces the stem and valve downward, the valve restricts the lower ports to

the atmosphere and opens those between the valve and spring chambers.

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

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

AIR GAGE

The *Single Pointer Air Gage,* Fig. 17, indicates emergency line pressure. This pressure is identical with main reservoir pressure at all times excepting when an emergency application of the brakes has been made, in which case the emergency pipe pressure is exhausted to the atmosphere and the gage hand correspondingly indicates zero, while the main reservoirs are practically fully charged.

BRAKE VALVE

The M-28 Brake Valve, Fig. 18, located on each operative end of a motor car, is of the rotary valve type, with 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.

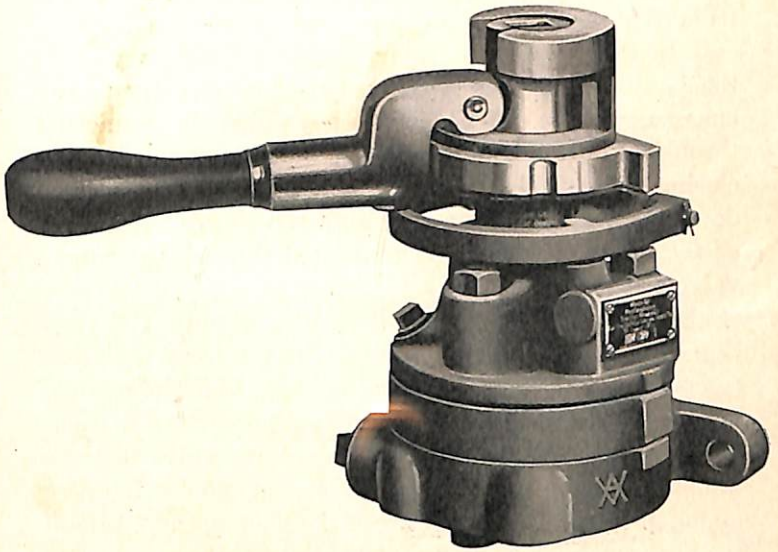


Fig. 18. M-28 Brake Valve

The brake valve handle, included with the standard equipment, is 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, air will be delivered to the sand traps.

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.

The different positions of the brake valve handle, in order from the extreme left, Fig. 19, are as follows:

Release (*Doors 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.

Lap (*Doors Closed*) position 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.

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 con-

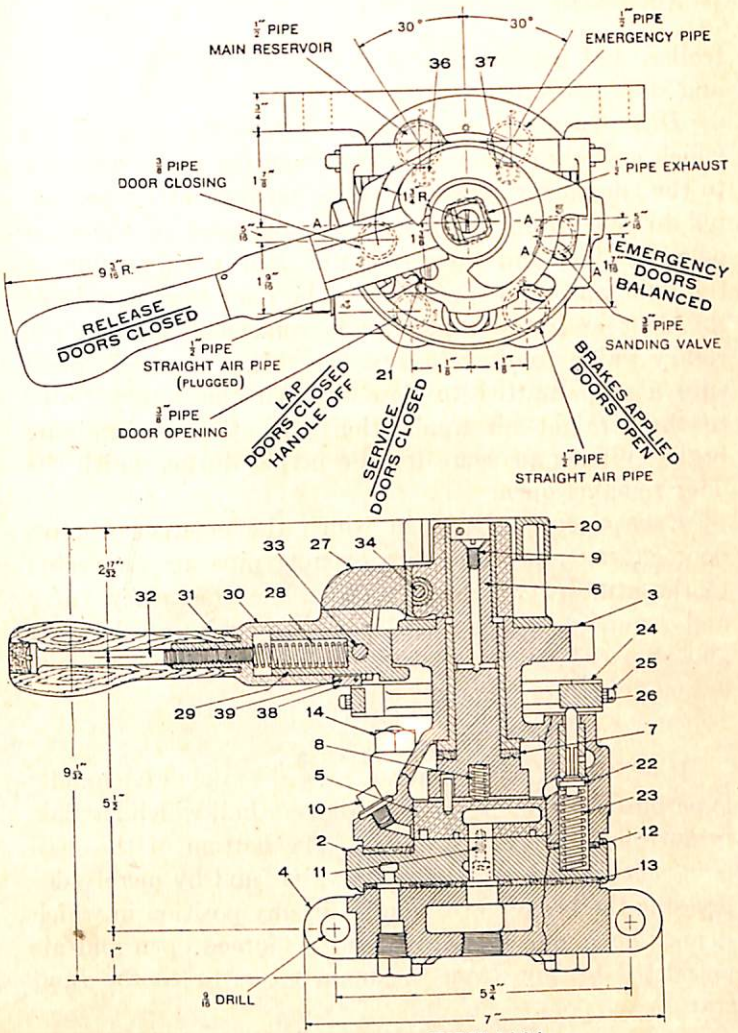


Fig. 19. M-28 Brake Valve, Plan and Sectional Views

troller, and between the door opening side of the door and step controller and the atmosphere.

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 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 door remains open.

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.

NOTE: Some of the older brake valves in service have the "Handle Off Position" between "Service (Doors Closed) Position" and "Brakes Applied (Doors Open) position." In the brake valve above described, the handle is removable in the second position (Lap, Doors Closed).

EMERGENCY VALVE

The emergency valve, Figs. 20 and 21, contains an equalizing piston 4, a slide valve 3, and a relay valve 17, as moving parts. The piston 4 responds to a pre-determined decrease or an increase in emergency pipe pressure to actuate slide valve 3. The relay valve 17 responds to a pre-determined decrease or an increase in control line pressure to actuate the piston 4 in emergency.

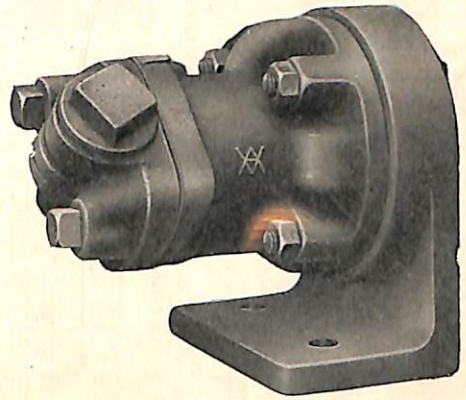


Fig. 20. K-1 Emergency Valve

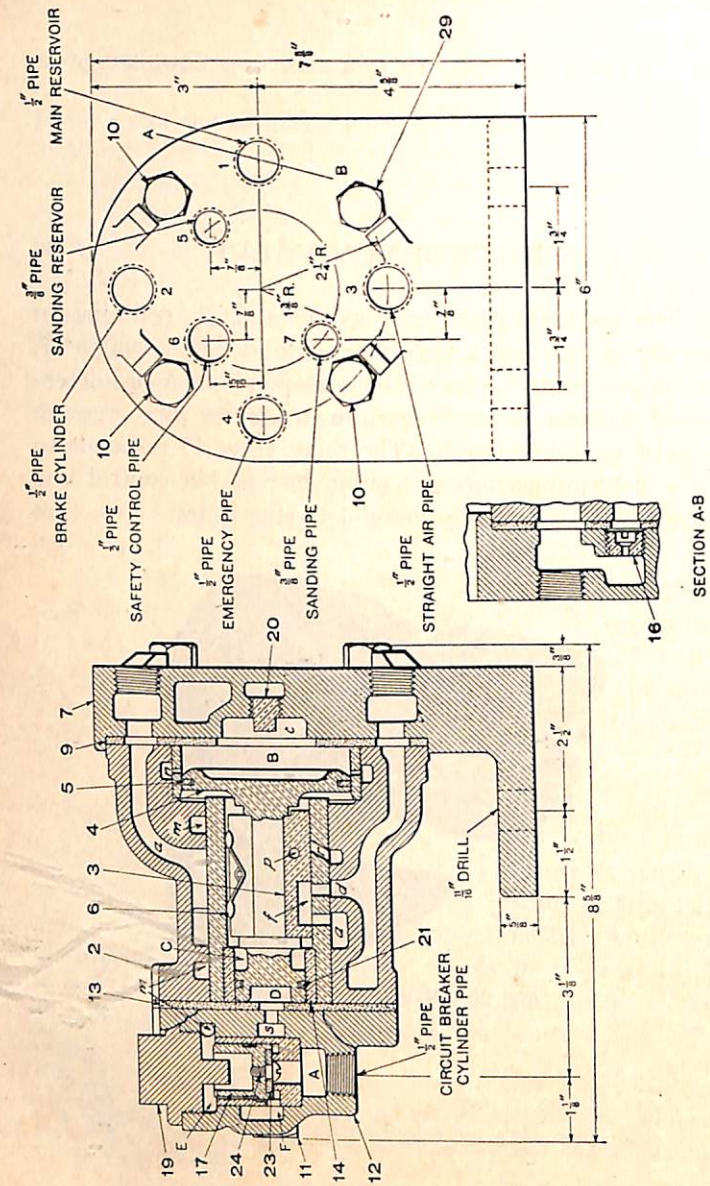


Fig. 21. K-1 Emergency Valve—Vertical Section and View of Pipe Bracket

Fig. 22 illustrates the actual arrangement of the ports and cavities in the slide valve and slide valve seat of the K-1 Emergency Valve. The letters signifying the ports and passage ways, appearing in Figs. 21 and 22, correspond to those shown on Figs. 51 and 55 inclusive. By comparing these diagrammatic views and the explanation given below, with reference to Figs. 21 and 22, the various connections and relations of the different ports will be clear.

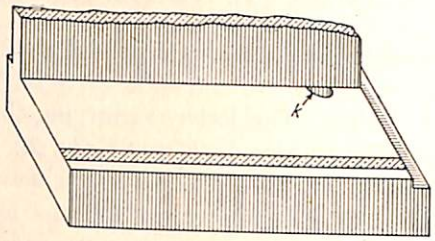
Port a leads to the brake cylinder; port d leads to the Straight Air Pipe and thus, when the emergency valve is in release position, these ports being connected by cavity *f*, a straight air application is made by admitting air to the straight air pipe at the brake valve, and this flows through cavity *f* in the slide valve into port *a* and to the brake cylinder.

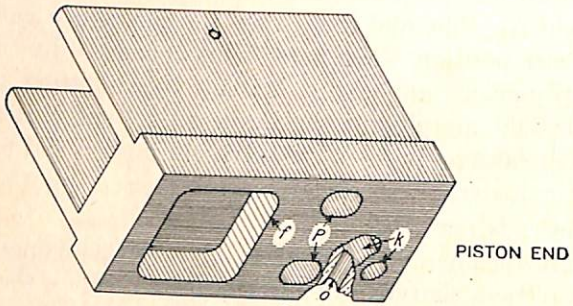
Port *r* is not used.

Port *g* leads to the sanding reservoir which is normally, in release, charged to main reservoir pressure through ports *o* and *k* in the slide valve.

Port *h* leads to the sanding pipe and is lapped except in emergency when port *p* in the slide valve connects ports *g* and *h* and thus connects the supply of air in the sanding line, thence to the sand traps.

The emergency valve is mounted on an angle pipe bracket of the pipeless type and all pipe connections, but one, relay valve exhaust valve, are made to this pipe bracket. There are eight pipe connections, namely:—½" pipe to main reservoir marked 1, ½" pipe to brake cylinder marked 2, ½" straight air pipe marked 3, ½" emergency pipe marked 4, ⅜" pipe to sanding reservoir marked 5, ½" control pipe marked 6, ⅜" pipe to sand-





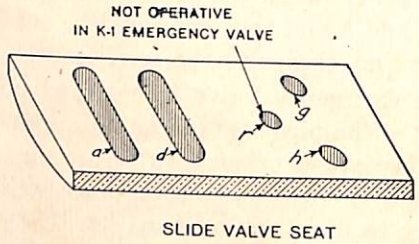


Fig. 22. Slide Valve and Slide Valve Seat K-1 Emergency Valve

ing line marked 7, and ½" pipe connected to the relay valve exhaust.

No. 15 DOUBLE CHECK VALVE

Fig. 23 shows the No. 15 Double Check Valve which has a double acting, floating piston. This valve is installed in the safety control pipe with a pipe connection to the relay valve of the emeregency valve. The other

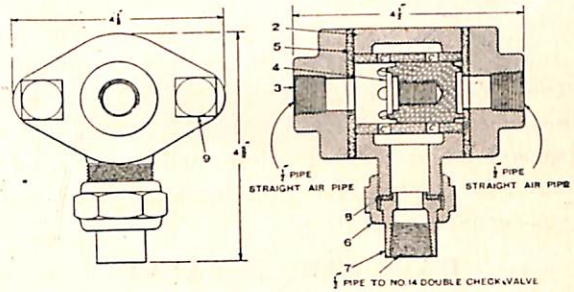


Fig. 23. No. 15 Double Check Valve

two pipe connections are made to the controller pilot valves, the object being to blank the pipe connection leading to the controller pilot valve on the rear, or inoperative, end of the car. The No. 15 Double Check Valve is not required with single end cars.

SANDING RESERVOIR

Fig. 24. 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 understood 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.

BALL CHECK VALVE

The ball check valves in the sanding pipe permit the emergency valve during emergency applications to supply air to all sand traps, but limit the brake valve control to the sand traps on the operative end only.

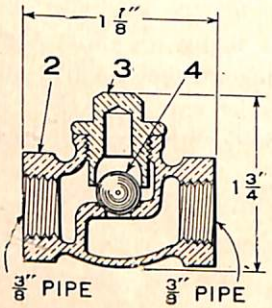


Fig. 25. Ball Check Valve

BRAKE CYLINDER

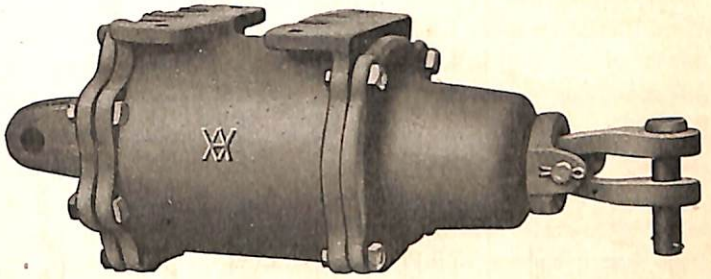


Fig. 26. Brake Cylinder

The Brake Cylinder can be supplied with either vertical or horizontal lever brackets.

The piston 3, Fig. 27, has a hollow rod enclosing a solid push rod 14, which in turn is attached to the levers of the foundation brake rigging. This makes provision for attachment of the hand brake connection so that hand brakes can be operated independently of the air brakes. An application of the air brakes forces the piston with hollow rod forward, thus moving the foundation brake rigging so as to bring the brake shoes into contact with the wheels. On release of air pressure, the release spring 9 tends to force the piston to its release position and the truck release springs restore the brake rigging to its release position.

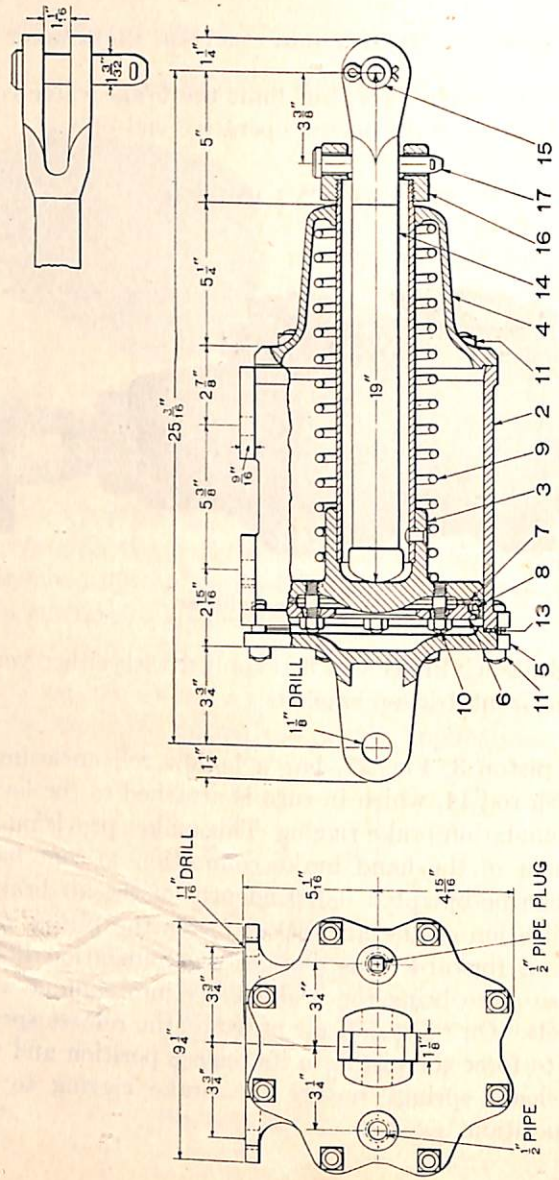


Fig. 27. Brake Cylinder, Sectional View

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.

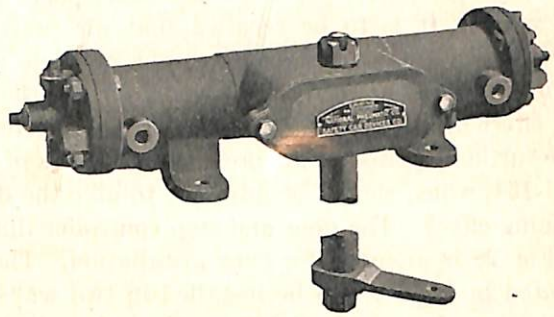


Fig. 28. Door and Step Controller

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.

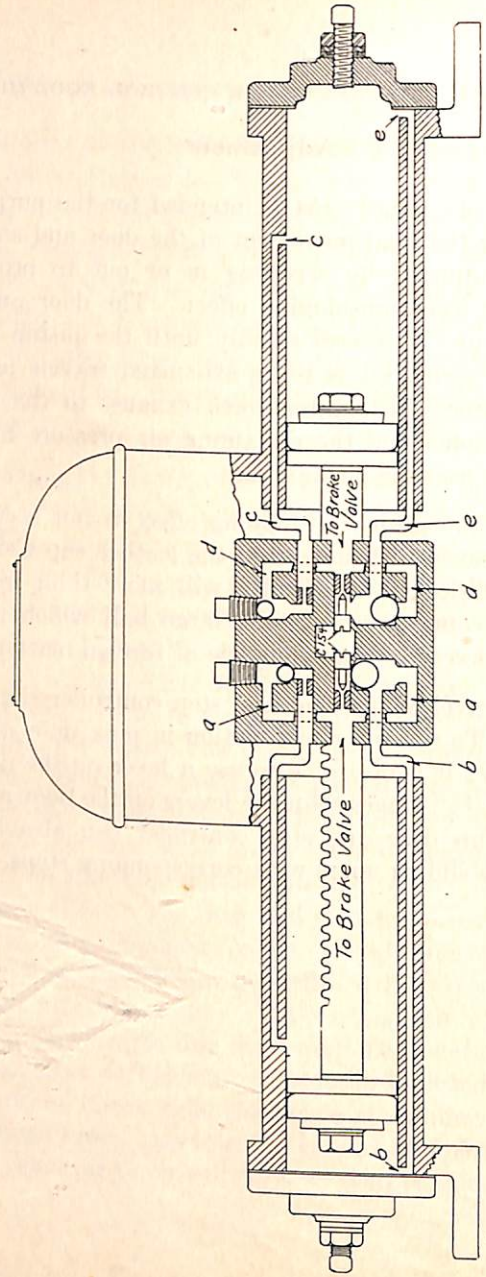


Fig. 29. Diagrammatic View of the Type G. S. 8" B. C. Door and Step Controller

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

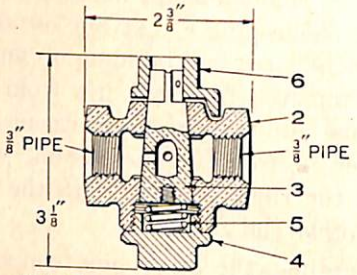


Fig. 30. 3/8" Cut-out Cock with 1/8" Side Vent

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.

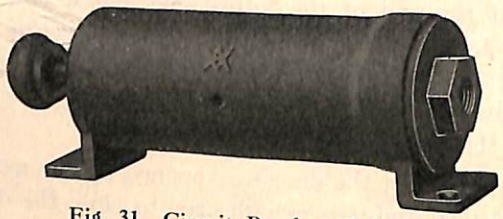


Fig. 31 Circuit Breaker Cylinder

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

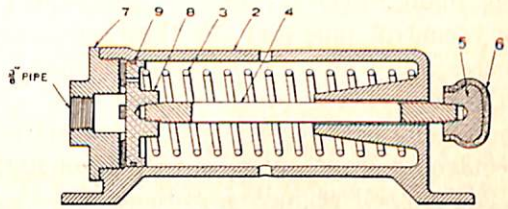


Fig. 32. Circuit Breaker Cylinder

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.

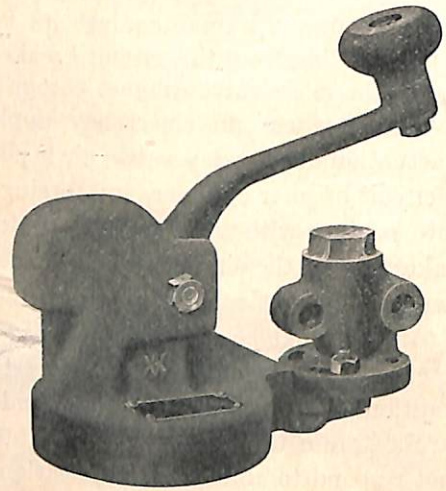


Fig. 33. Controller Handle and Pilot Valve

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

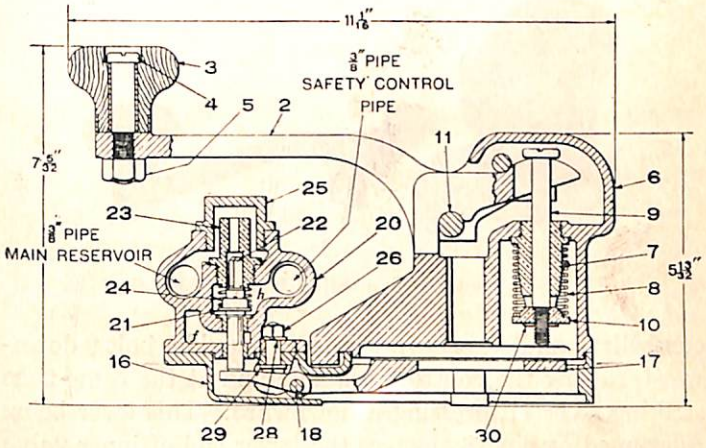


Fig. 34. Controller Handle and Pilot Valve—Sectional View

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

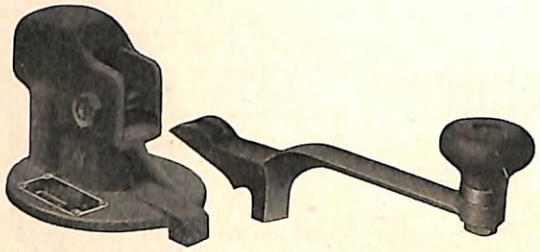


Fig. 35. View of Controller Handle, Detached

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.

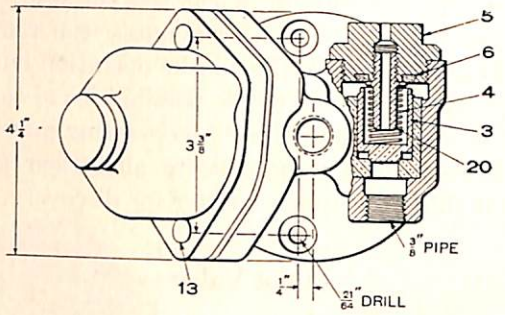
Fig. 35 is a photographic view of the controller handle. The slot in the end opposite the handle is intended to engage a bolt, as shown in Fig. 33. The controller safety attachments are designed for installation in such a way that it is most difficult to defeat the purpose for which this apparatus is 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.



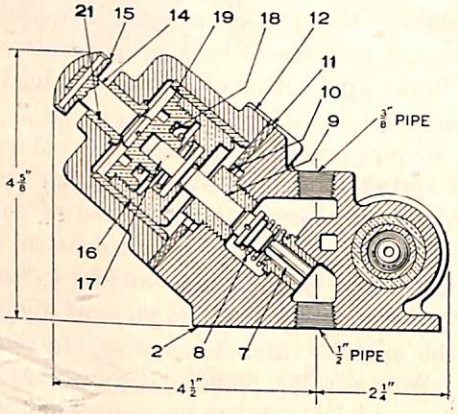


Fig. 36. Foot Valve—Sectional View

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

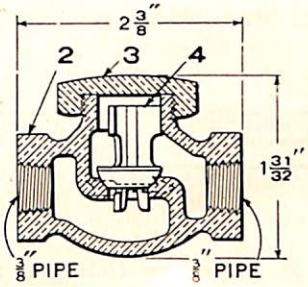


Fig. 37. Wing Check Valve

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

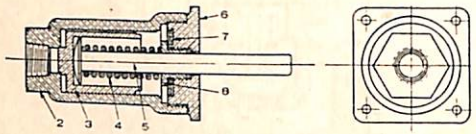


Fig. 38. Rear Door Unlatching Device

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.

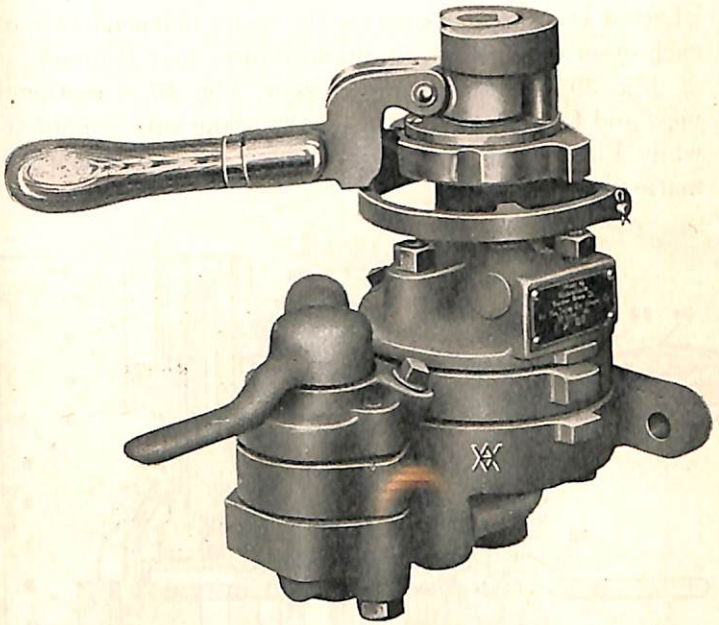


Fig. 39. M-28 Brake Valve with Selector Valve (Exterior View)

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.

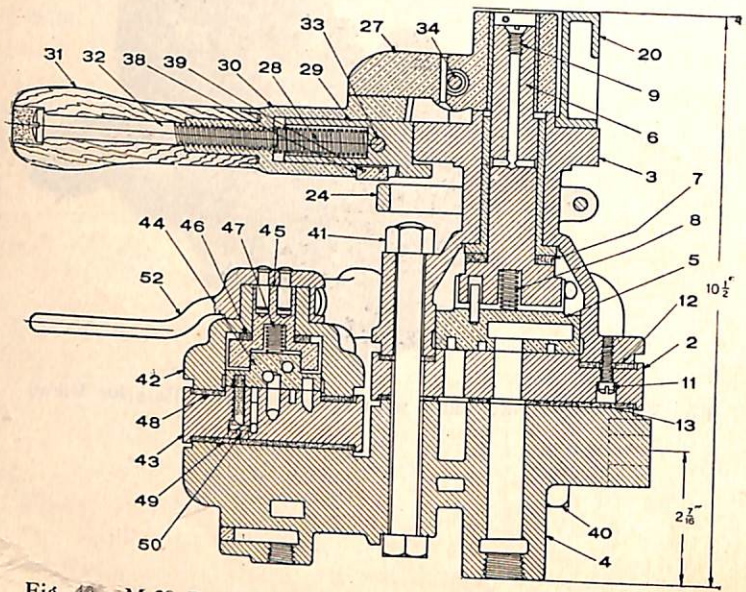


Fig. 40. M-28 Brake Valve with Selector Valve, Sectional View

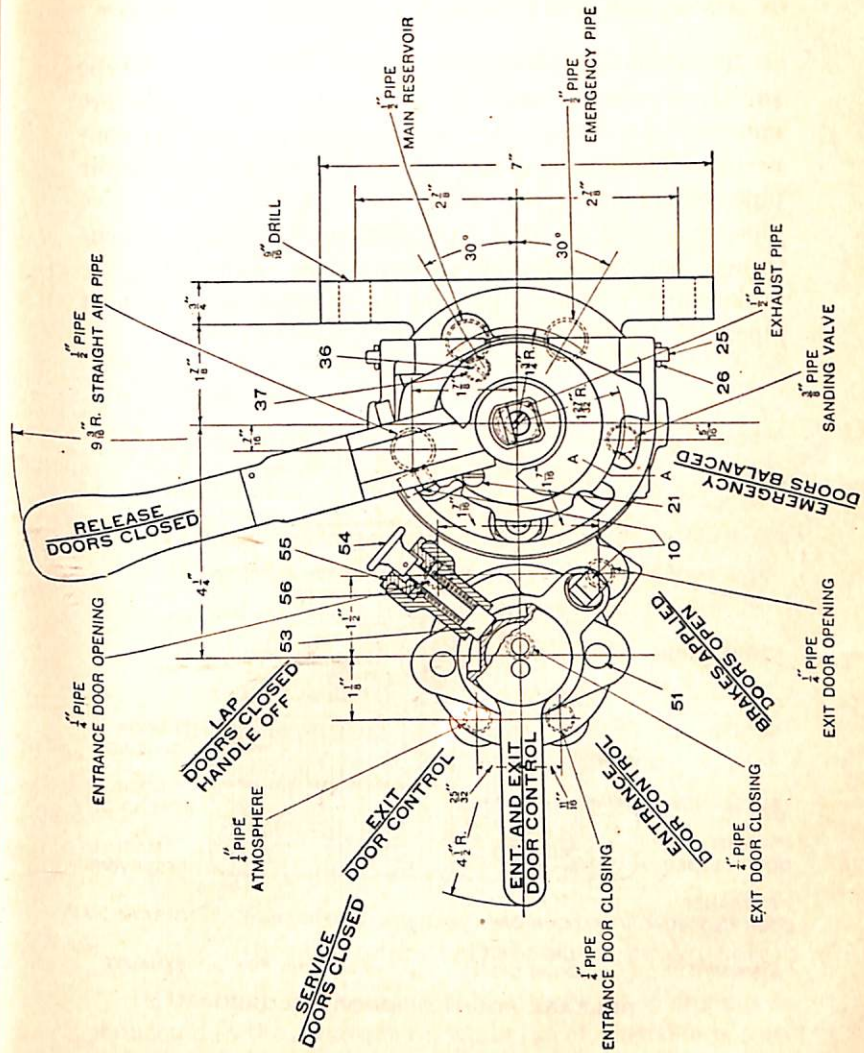


Fig. 41. Plan View of the M-28 Brake Valve with Selector Valve

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.

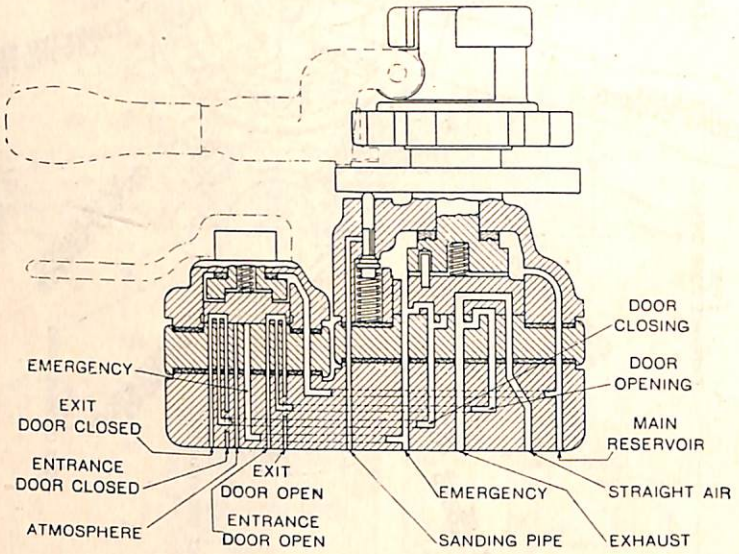


Fig. 42. Door Selector Valve in Entrance and Exit Door Control Position

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.*

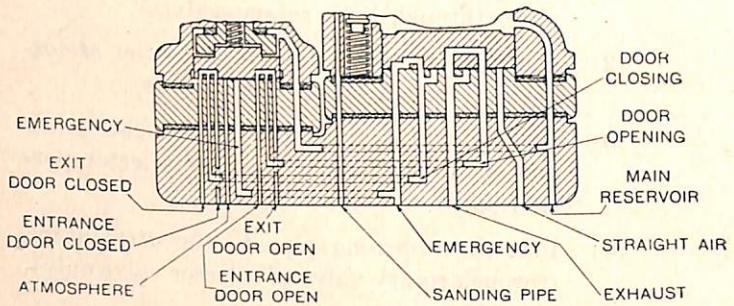


Fig. 43. Door Selector Valve in Entrance and Exit Door Control Position

(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.*

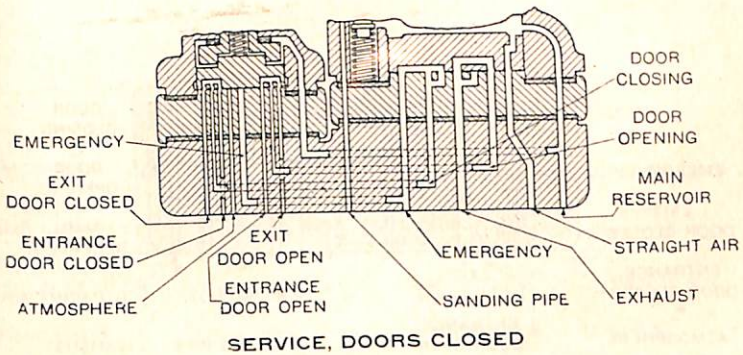


Fig. 44. Door Selector Valve in Entrance and Exit Door Control Position

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.

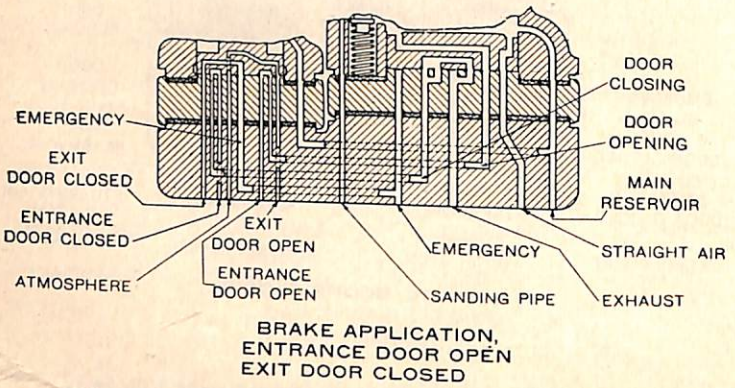


Fig. 45. Door Selector Valve in Entrance Door Control Position

(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.

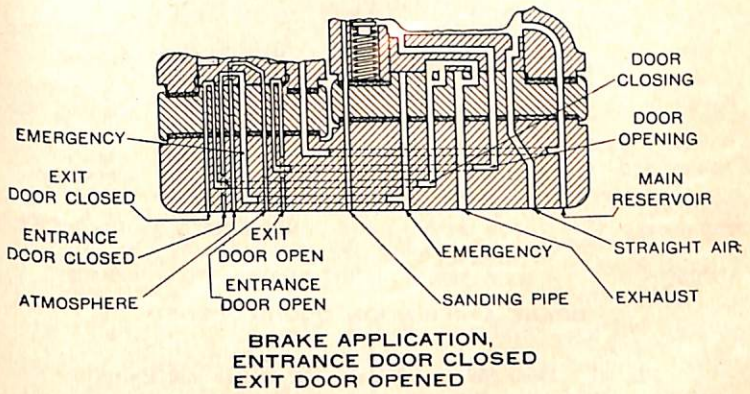


Fig. 46. Door Selector Valve in Exit Door Control Position

(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.*

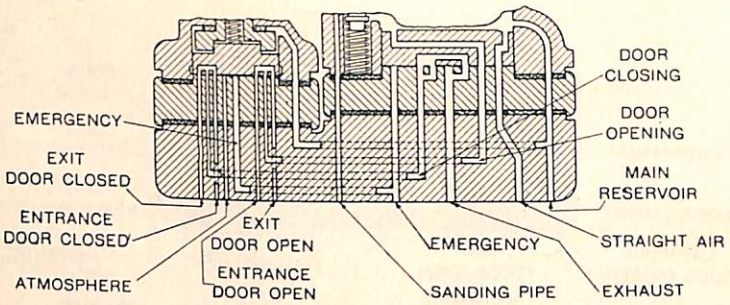


Fig. 47. Door Selector Valve in Entrance and Exit Door Control Position

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.

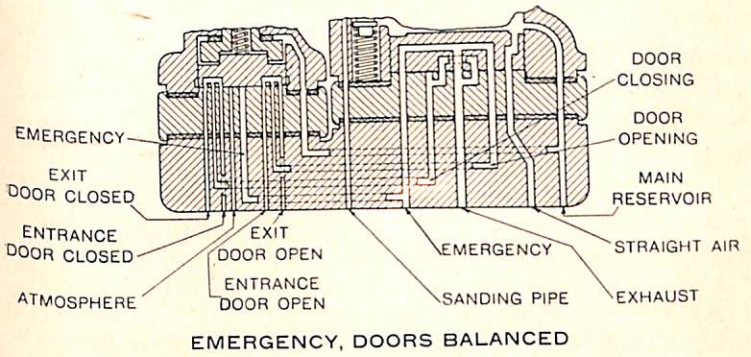


Fig. 48. Door Selector Valve in Entrance and Exit Door Control Position

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.

Uses of the Foot Valve

The foot valve is intended as an auxiliary to the controller handle operation to provide for temporary use of the hand which is normally engaged in holding down the controller handle. In bringing the foot valve into service, care must be taken that it be pressed down before releasing the controller handle, and vice versa, the controller handle must be pressed downward before releasing the foot valve, otherwise an emergency application will occur. The foot valve may be called into action while making a stop preparatory to receiving passengers and can also be used after the car is in motion. The controller handle can be left in any running position and the car kept in motion if pressure is maintained on the foot valve. Also the car can be permitted to coast while pressing on the foot valve.

Circuit Breakers

On such occasions as the circuit breaker cylinder is called into action, thereby cutting off the current to the motors, it is necessary to turn the controller handle to power-off position before closing the circuit breaker.

Correct Brake Operation

To gain time and economy in the use of power for propelling the car, the brake application should be adapted to the speed and load condition. For example—at a high speed or with heavy load, make a full application of the brakes and graduate off the pressure by partial releases as the car is coming to a stop. During the stop, the point at which these graduations should be

begun and the amount of the graduations will be readily acquired through experience. The initial application should be heavy enough and the distance from the stopping point at which it is begun should be such that the car will stop before reaching the stopping point, unless the graduations are made as related. When the actual stop is made, there should be just sufficient brake cylinder pressure to insure that the car will remain standing.

It is to be remembered that in making these graduated releases, if a mistake in judgment has been made and the car is not likely to stop until it is past the stopping point, the cylinder pressure should be increased by making a reapplication. With a small amount of practice, the required degree of skill in making correct stops can be very readily obtained. The condition of the rail is to be considered at all times when making brake applications so as to avoid wheel sliding which greatly lengthens stops.

Emergency Applications

When it is desired to make an emergency application the hand or foot should be removed from their respective valves, as the case may be, or the handle of the brake valve should be moved quickly to Emergency Position and permitted to remain there until the car has come to a full stop and the danger is past. Emergency applications should be made at sufficiently frequent intervals to insure that all the apparatus, including the brake rigging, is in reliable operating condition.

In cases where the brake does not respond at once to attempted service applications, such as where a car

operator has mis-judged the location of the Service Application Position, the brake valve handle should be moved quickly to Emergency Position. In fact, familiarity with this position on the part of car operations will greatly add to the security of the car and passengers under their care.

GENERAL HINTS

Brake failures may be caused by defects in apparatus accessory to the Air Brake and Safety Car Control Equipment. We, therefore wish to point out that in addition to the Air Brakes, there remain three possible forces which can be controlled to produce a retarding effect.

The *Hand Brake* should be applied, if the occasion permits of a comparatively long stop distance, in case the air brakes have proven inoperative.

The Hand Brake, however, is also open to failure if its mechanism or the brake rigging is at fault.

Reverse Motors if an accident is impending, or if the hand and air brake are inoperative, by throwing the reverse lever in the direction opposite the car motion, and feeding up the controller two or three points.

Buck the Motors if the reversing has failed to produce a retarding effect due to the loss of power, either at the trolley or circuit breaker, by feeding the controller into the parallel positions with the reverse lever set in the opposite direction to the car motion.

The last two forces mentioned are particularly severe in their action on the car equipment, and should only be used to prevent an impending accident, when the brakes have proven inoperative.

The controller and reverse drum contacts must be cleaned of dirt and gummy oil, or other foreign substance on the regular car inspection period, to maintain the ability to buck the motors.

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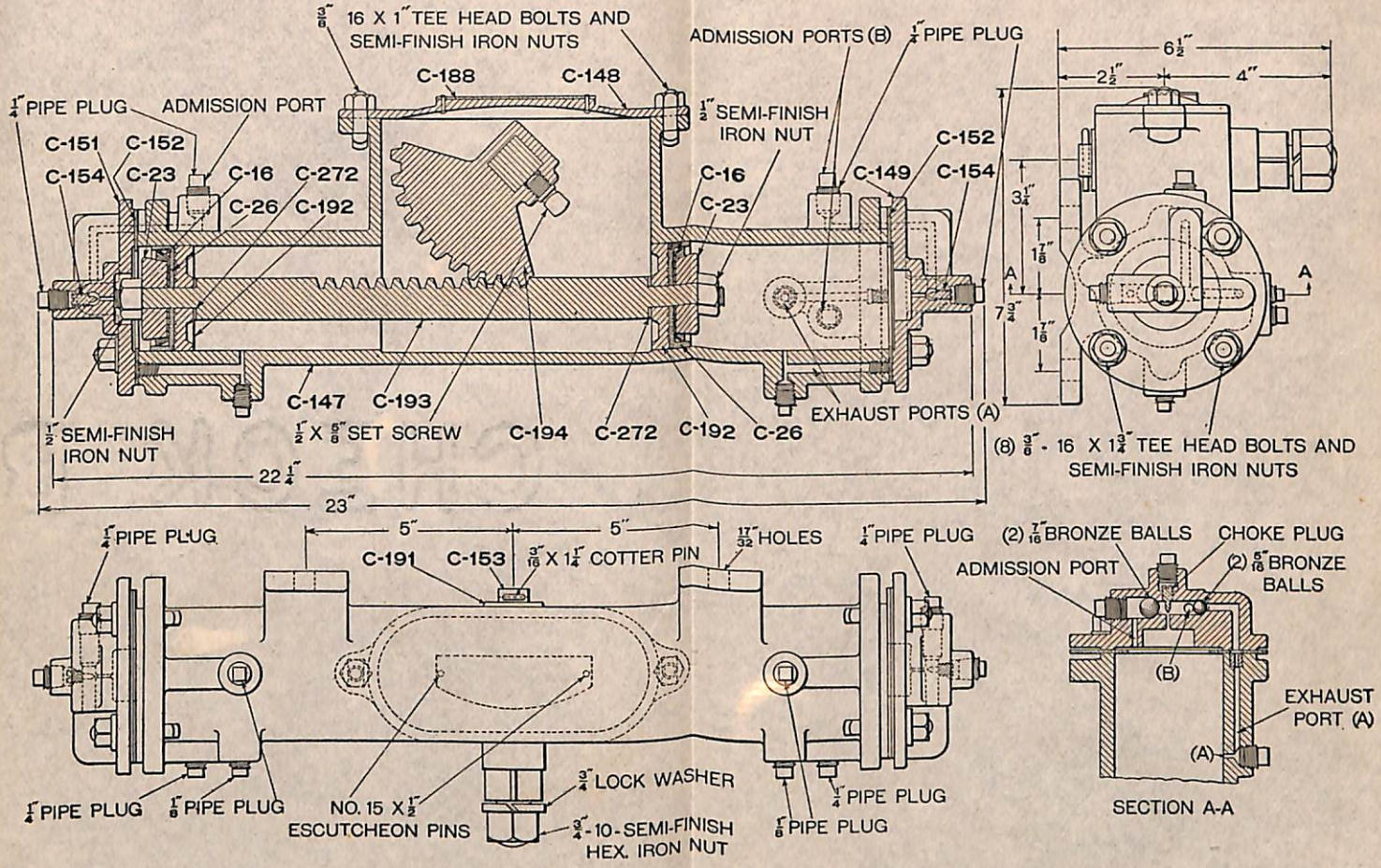


Fig. 49. Sectional and Plan Views of Door and Step Controller

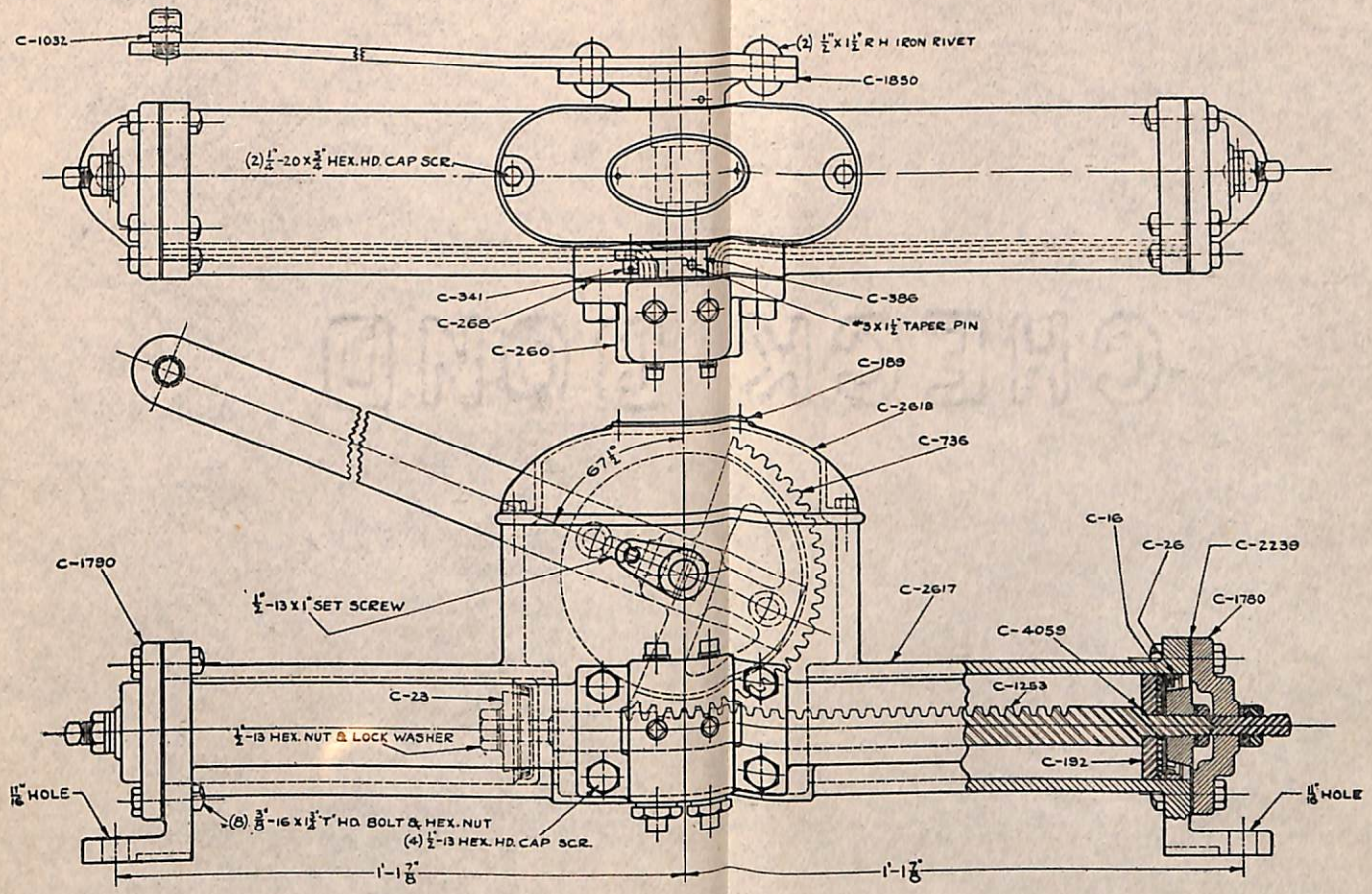


Fig. 50. Sectional and Plan Views of Door and Step Controller for Sliding Doors

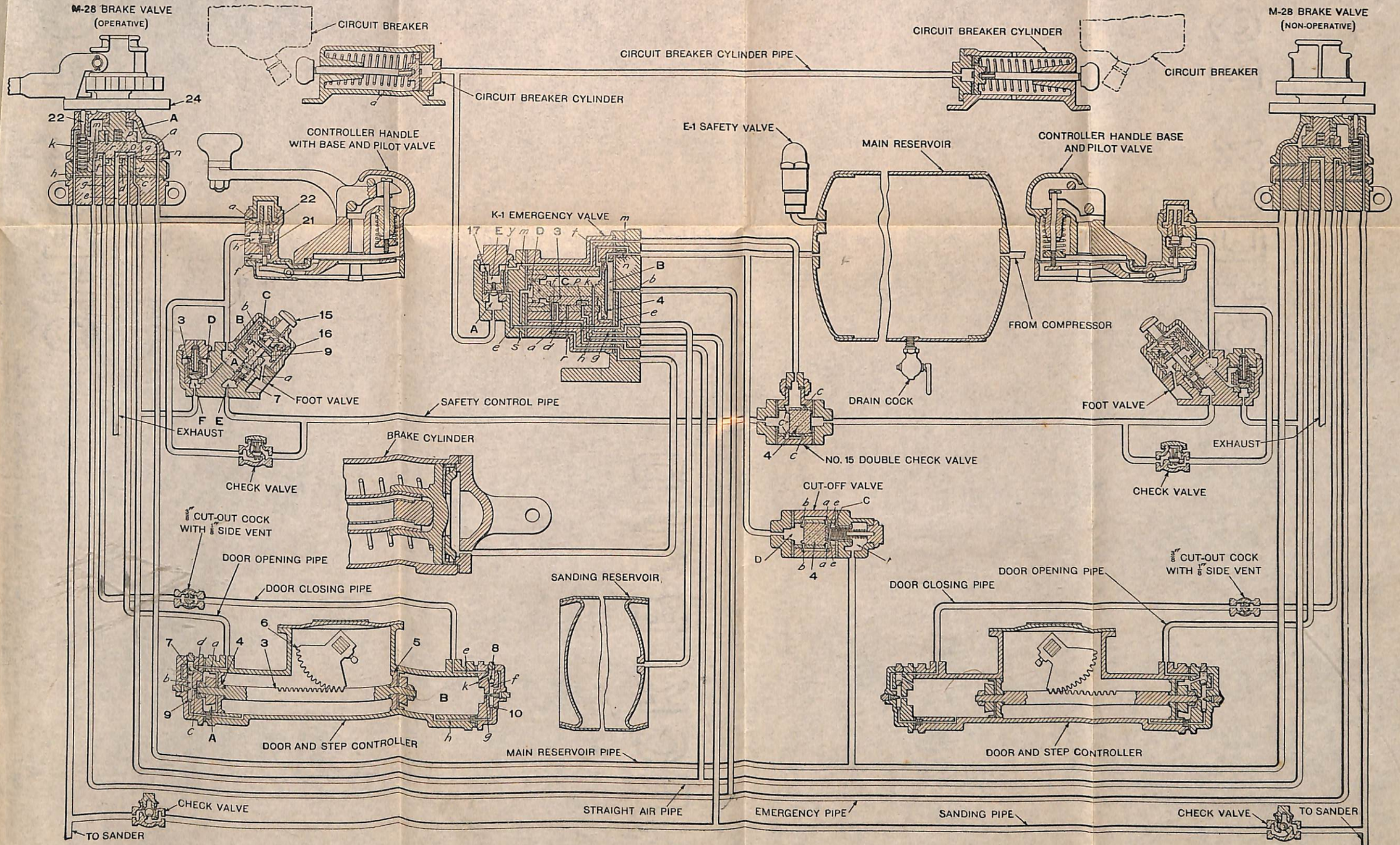


Fig. 51. Diagrammatic View of Air Brake and Safety Car Control Equipment Charging and Release Position. Doors Closed

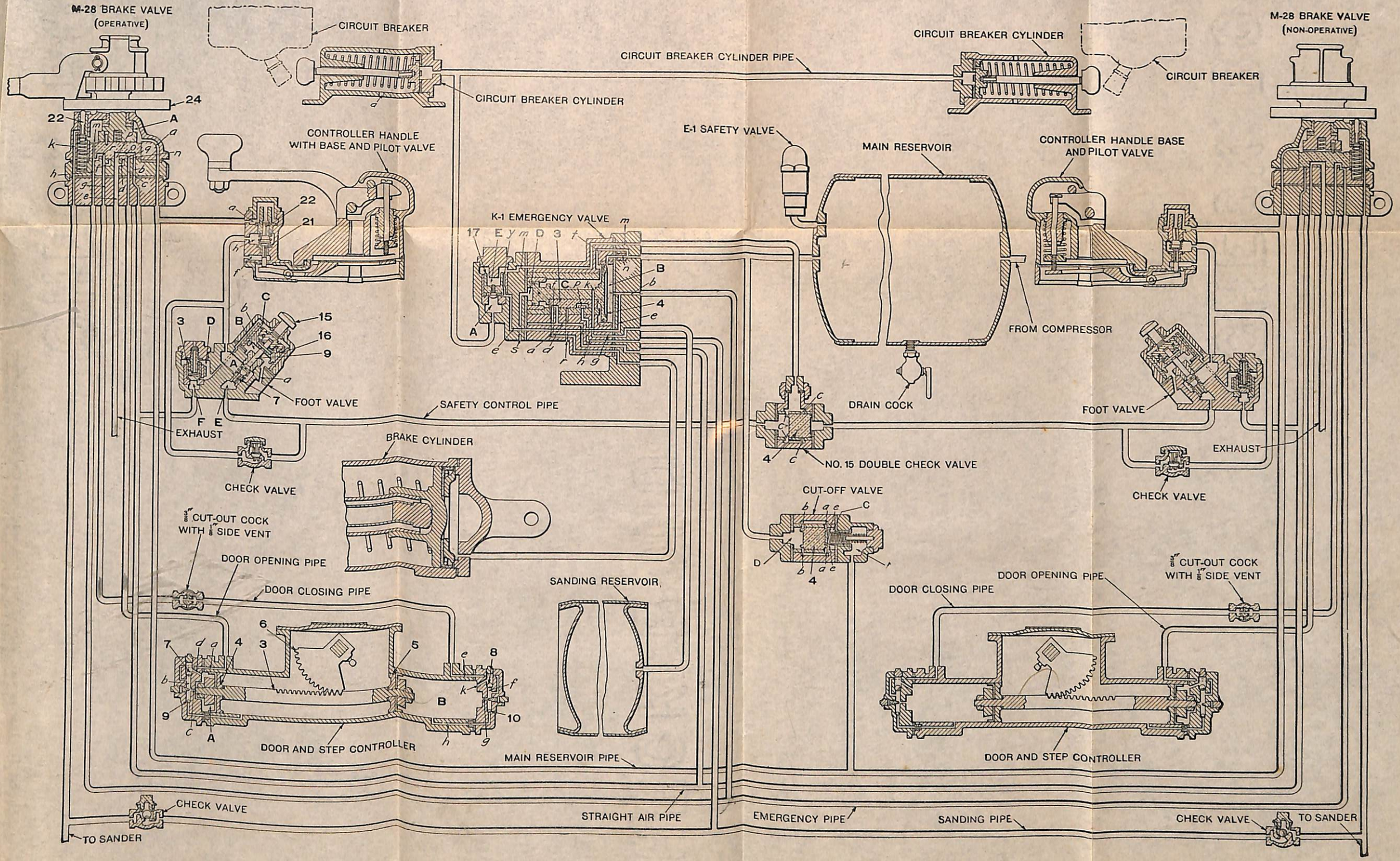


Fig. 51. Diagrammatic View of Air Brake and Safety Car Control Equipment Charging and Release Position. Doors Closed

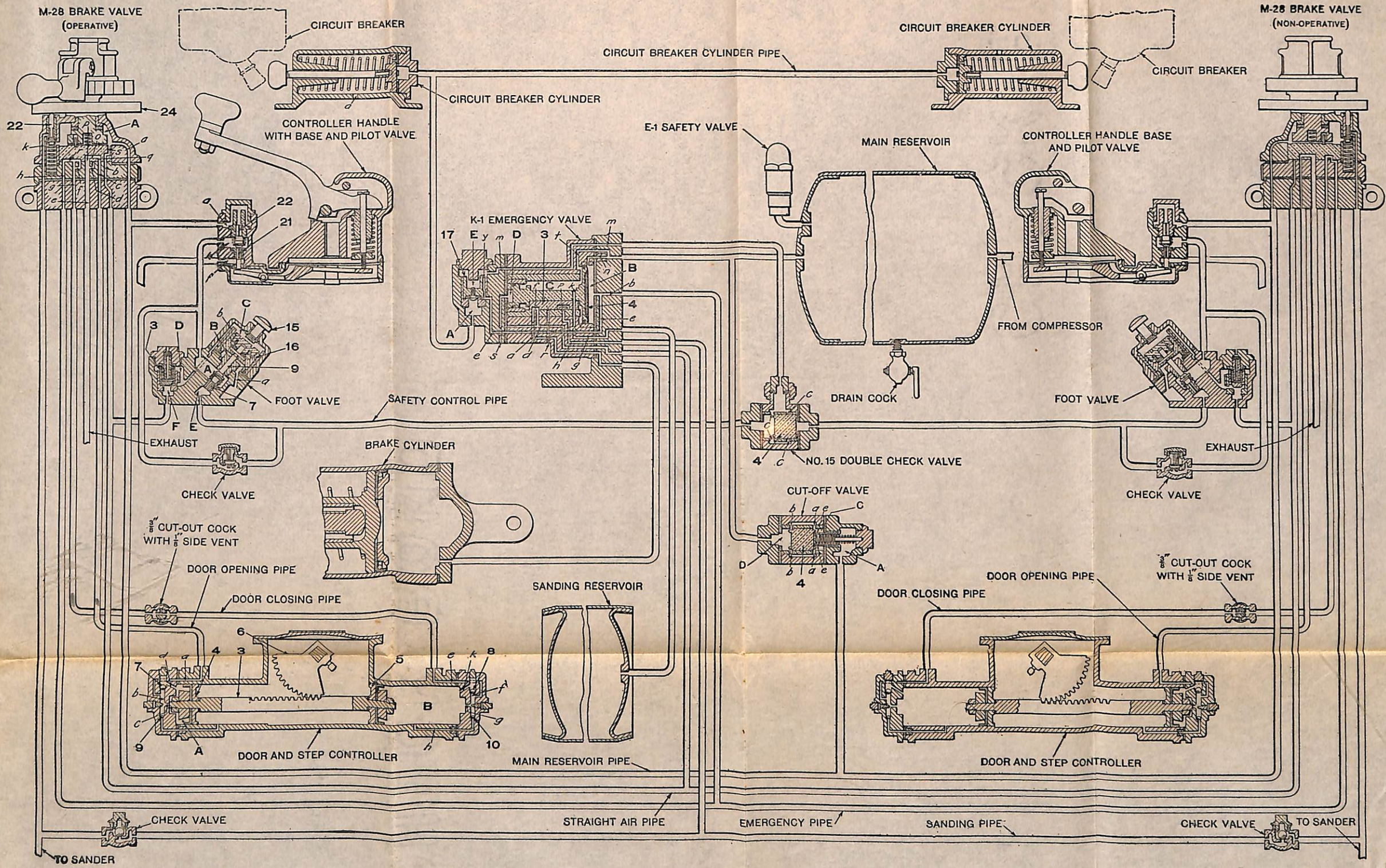


Fig. 52. Diagrammatic View of Air Brake and Safety Car Control Equipment
Service Application Position, Doors Closed

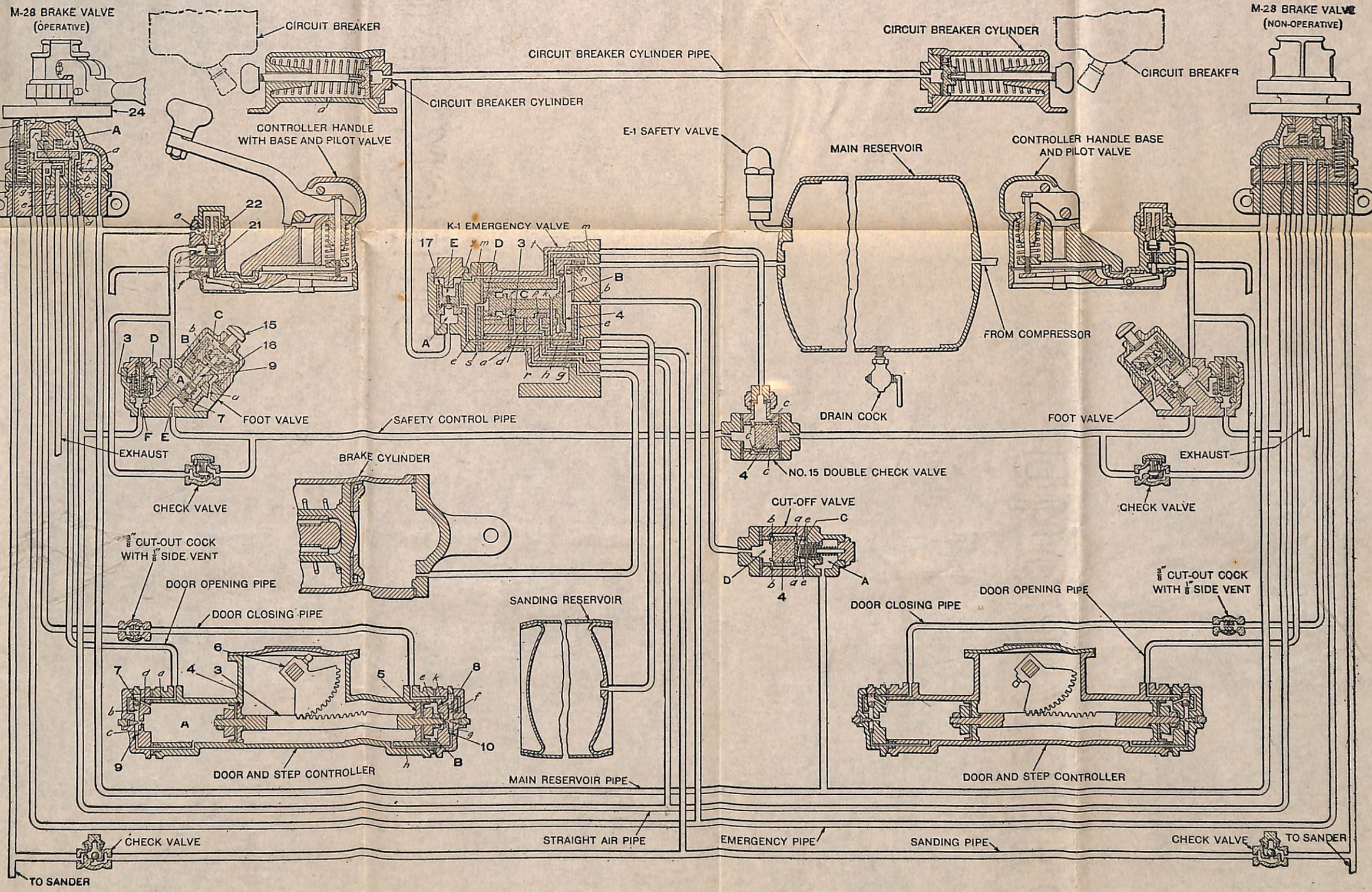


Fig. 53. Diagrammatic View of Air Brake and Safety Car Control Equipment
Door Open Position, Brakes Applied

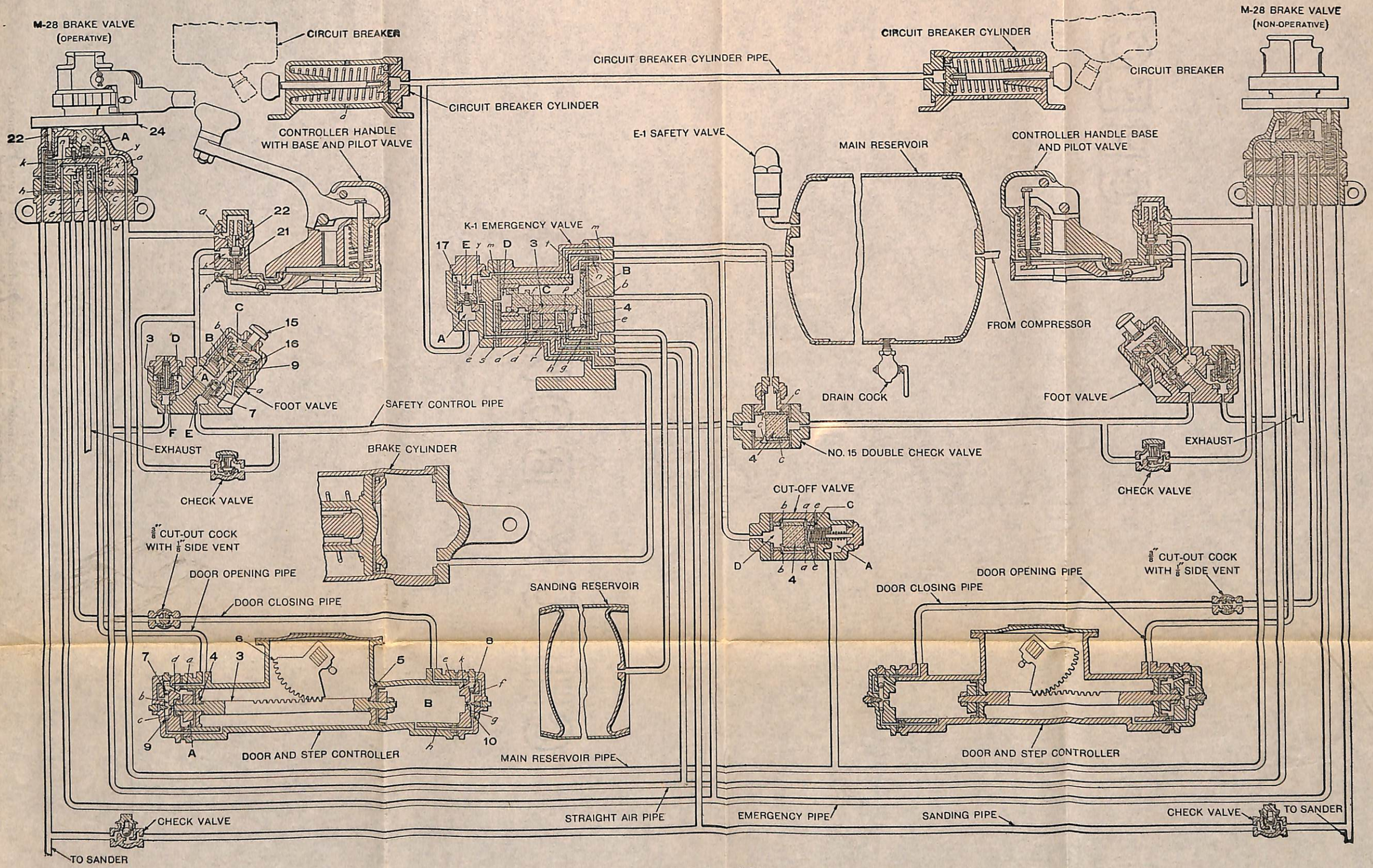


Fig. 54. Diagrammatic View of Air Brake and Safety Car Control Equipment
Emergency Application from Brake Valve. Doors Balanced

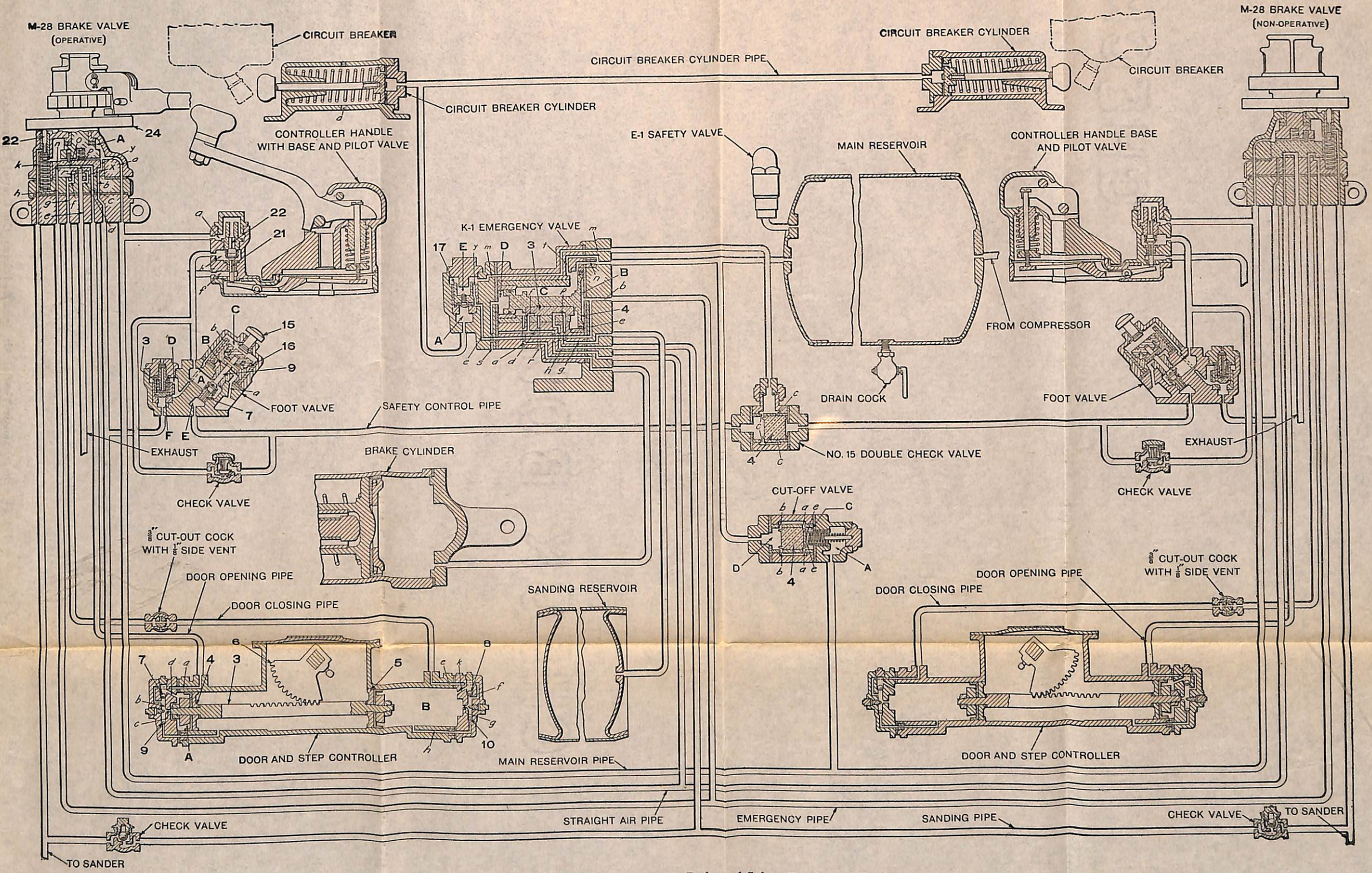


Fig. 54. Diagrammatic View of Air Brake and Safety Car Control Equipment
Emergency Application from Brake Valve. Doors Balanced

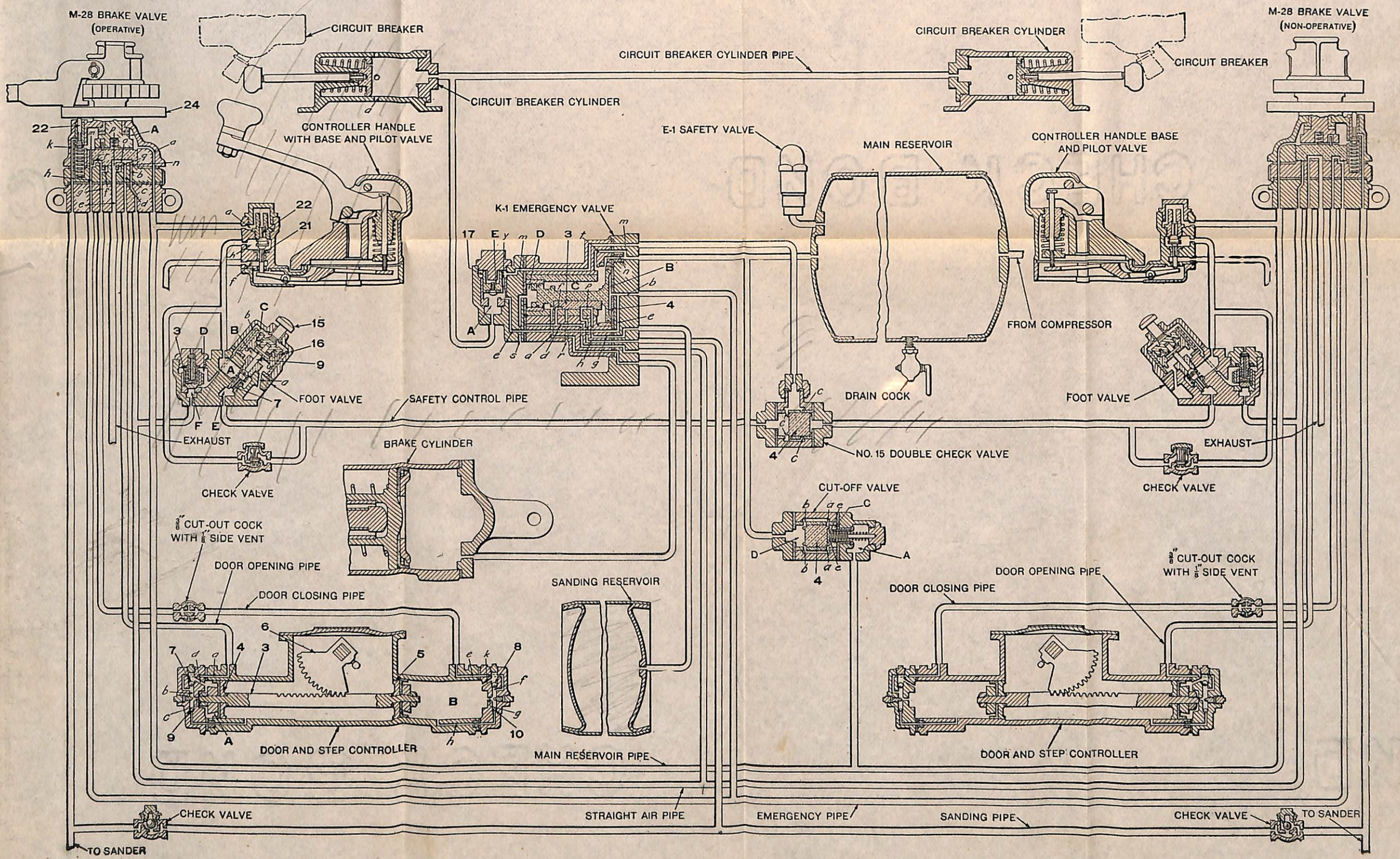


Fig. 55. Diagrammatic View of Air Brake and Safety Car Control Equipment. Emergency Application from Controller Handle, Brake Valve in Release Position. Doors Balanced

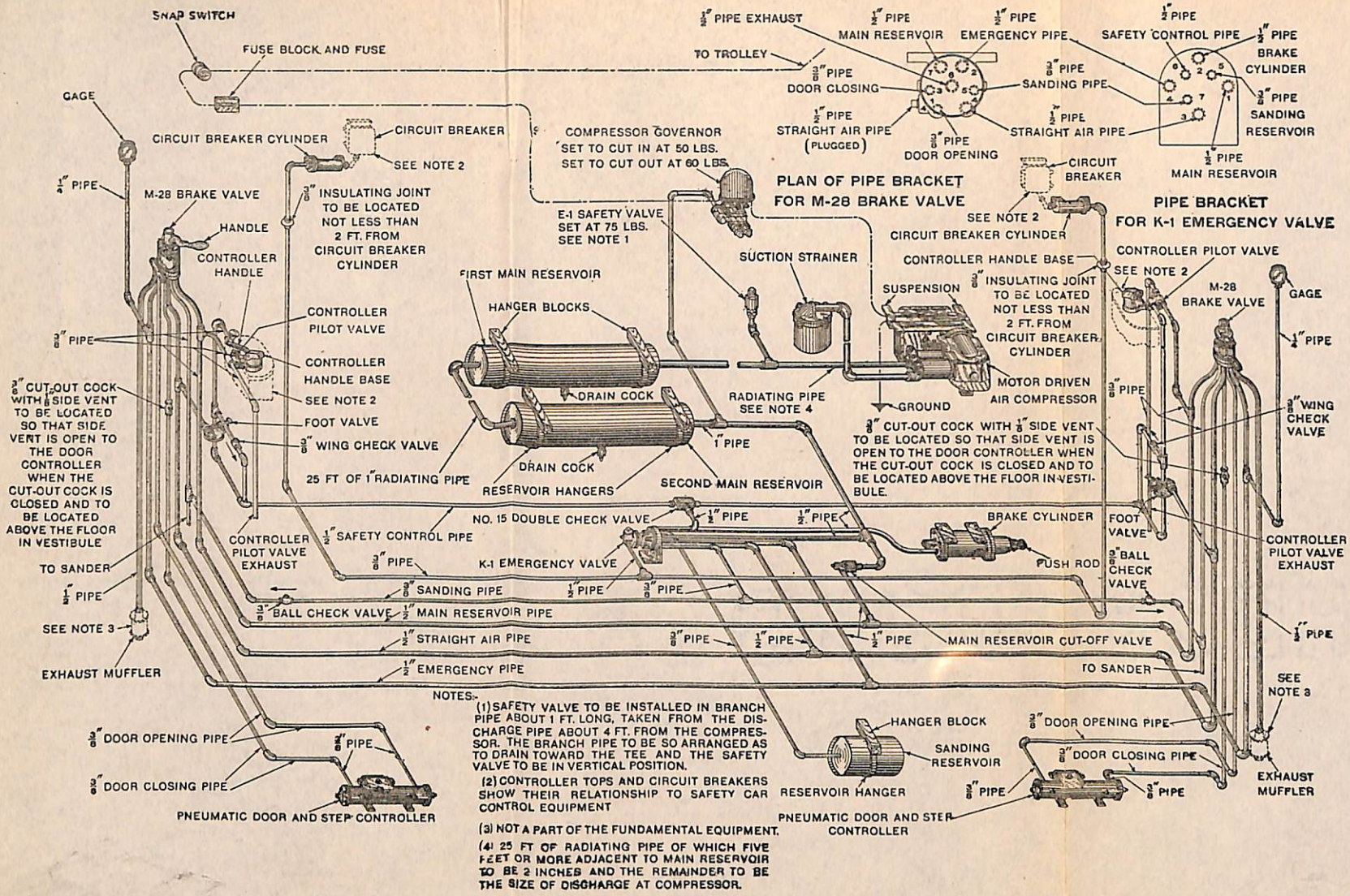
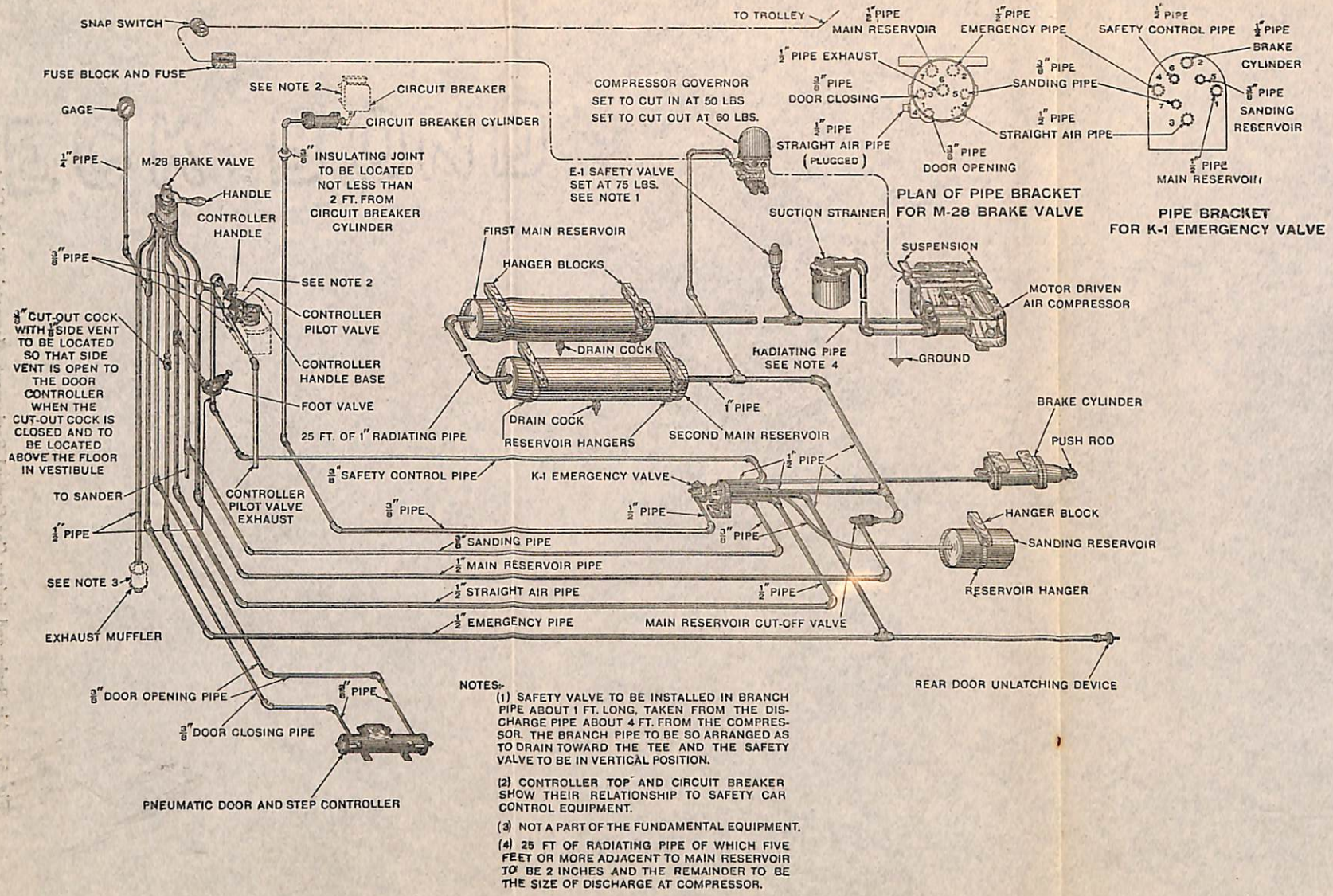


Fig. 56. Air Brake and Safety Car Control Equipment. Isometric Piping Diagram. Double End.



NOTES:-

(1) SAFETY VALVE TO BE INSTALLED IN BRANCH PIPE ABOUT 1 FT. LONG, TAKEN FROM THE DISCHARGE PIPE ABOUT 4 FT. FROM THE COMPRESSOR. THE BRANCH PIPE TO BE SO ARRANGED AS TO DRAIN TOWARD THE TEE AND THE SAFETY VALVE TO BE IN VERTICAL POSITION.

(2) CONTROLLER TOP AND CIRCUIT BREAKER SHOW THEIR RELATIONSHIP TO SAFETY CAR CONTROL EQUIPMENT.

(3) NOT A PART OF THE FUNDAMENTAL EQUIPMENT.

(4) 25 FT OF RADIATING PIPE OF WHICH FIVE FEET OR MORE ADJACENT TO MAIN RESERVOIR TO BE 2 INCHES AND THE REMAINDER TO BE THE SIZE OF DISCHARGE AT COMPRESSOR.

Fig. 57. Air Brake and Safety Car Control Equipment. Isometric Piping Diagram. Single End

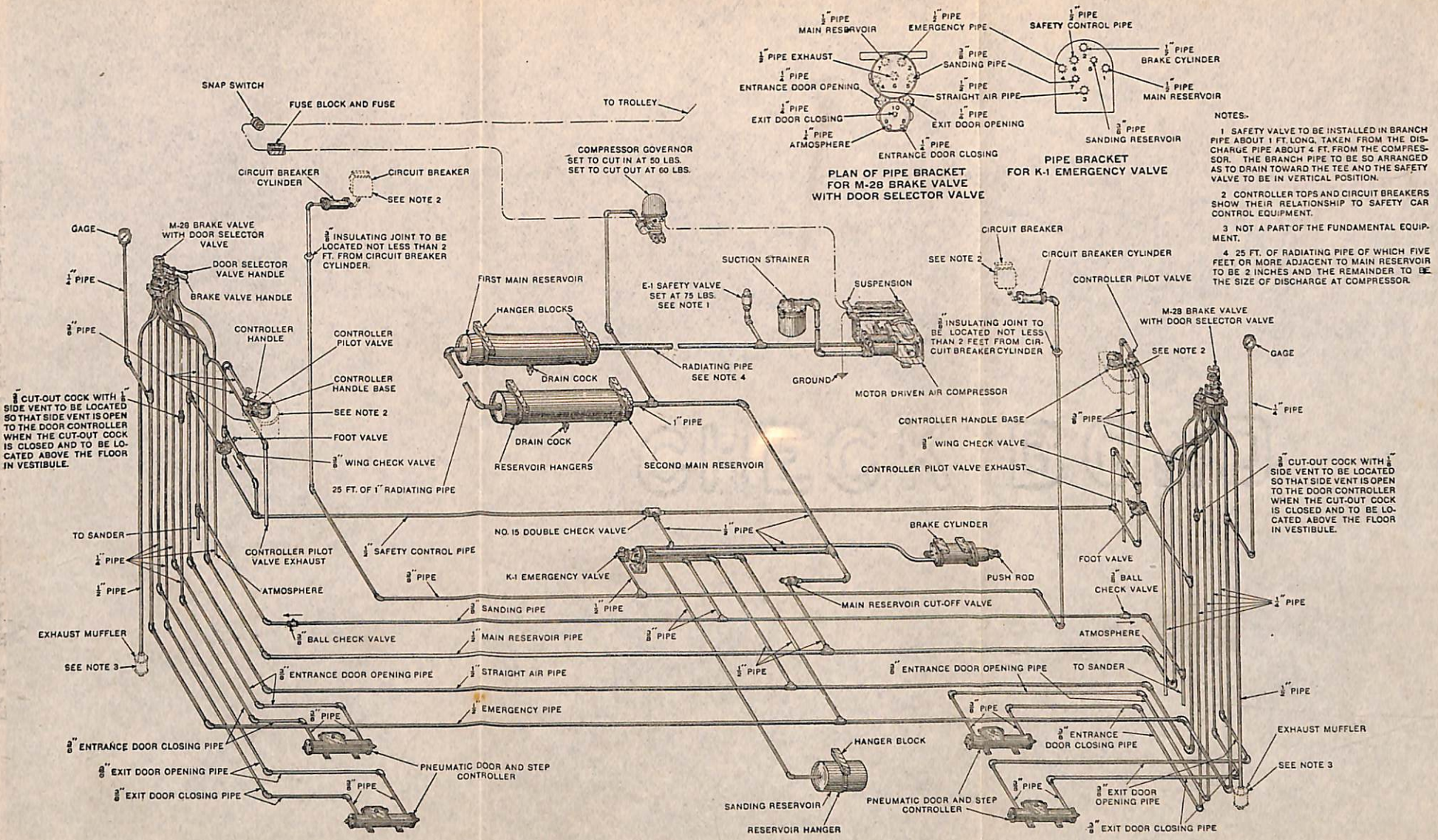


Fig. 58. Piping Diagram of Air Brake and Safety Car Control Equipment with M-28 Brake Valve having Selector Valve