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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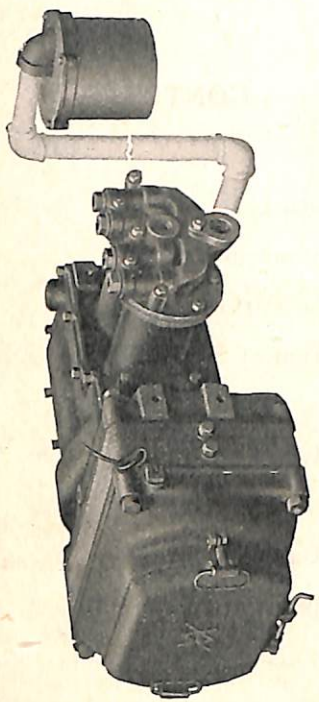


Fig. 1. "Bungalow" Type DH Compressor with 8" Strainer

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,

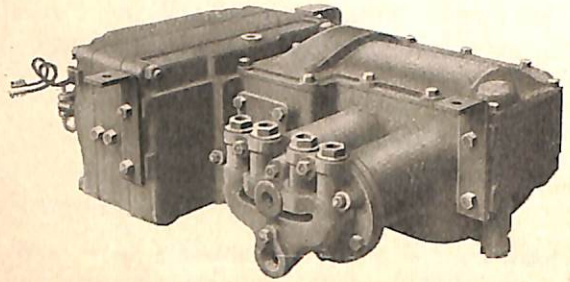


Fig. 2. "Bungalow" Type DH Compressor in Suspension Hangers

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.

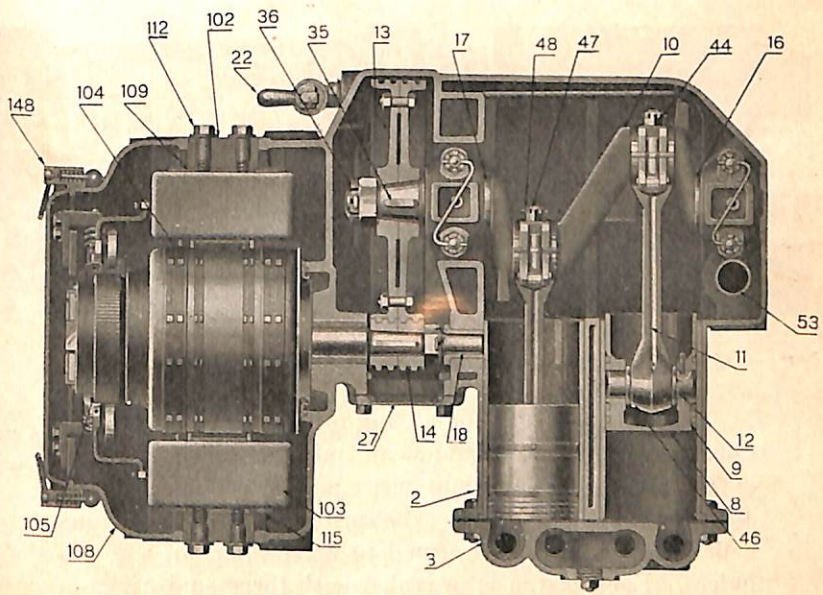


Fig. 3. Sectional View Type DH Compressor

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.

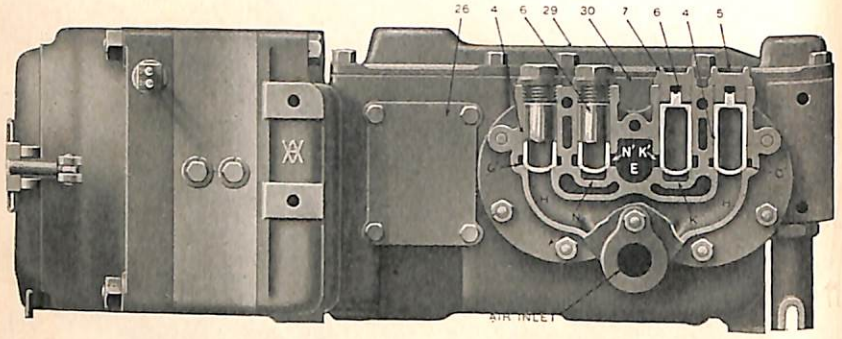


Fig. 4. Type DH Compressor with Cylinder Cover in Section

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,

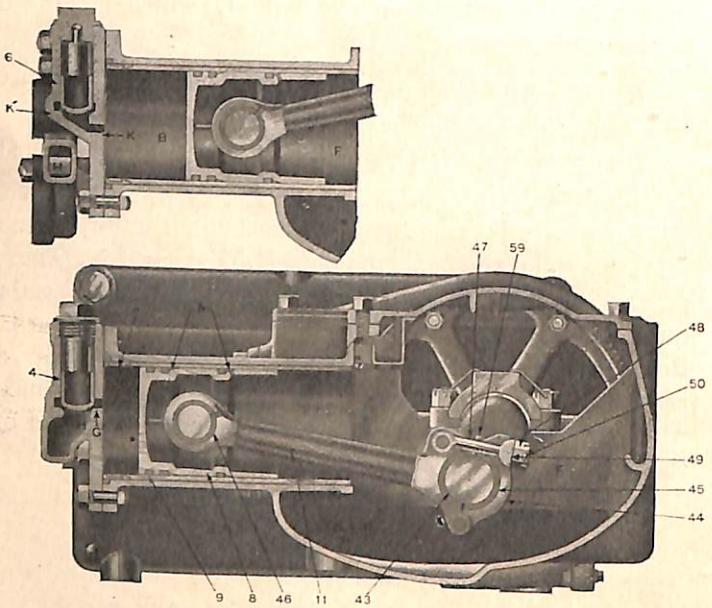


Fig. 5. Sectional Views Type DH Compressor

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.

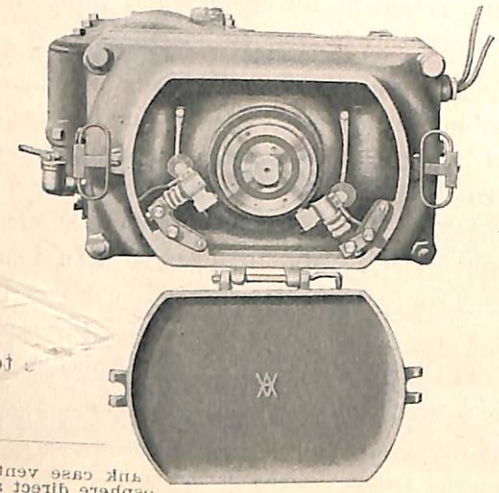


Fig. 6. Type DH Compressor, Commutator Door Open

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.

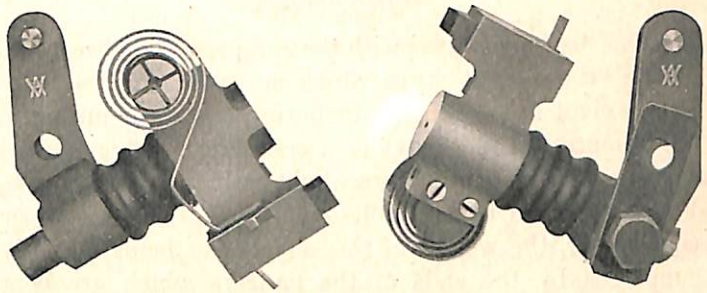


Fig. 7. Carbon Holder

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.

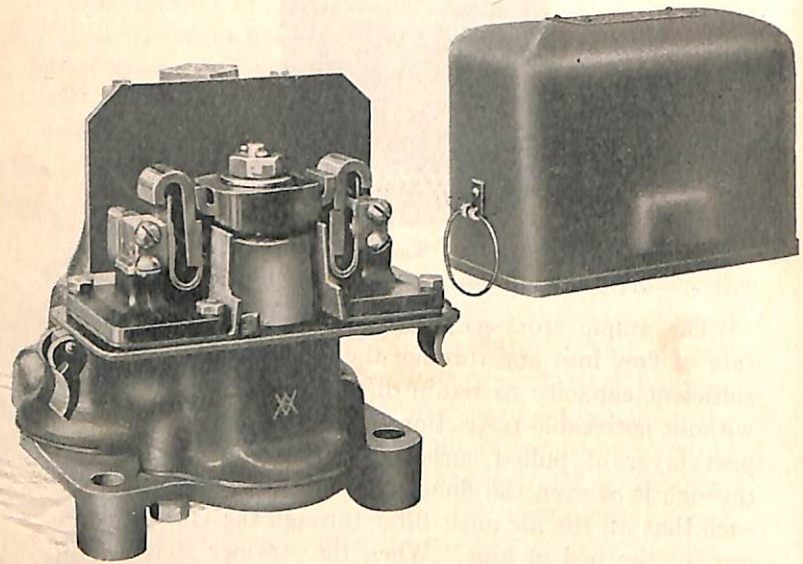


Fig. 9. Photographic View of the Type S-16 Electric Compressor Governor with cover removed

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*.

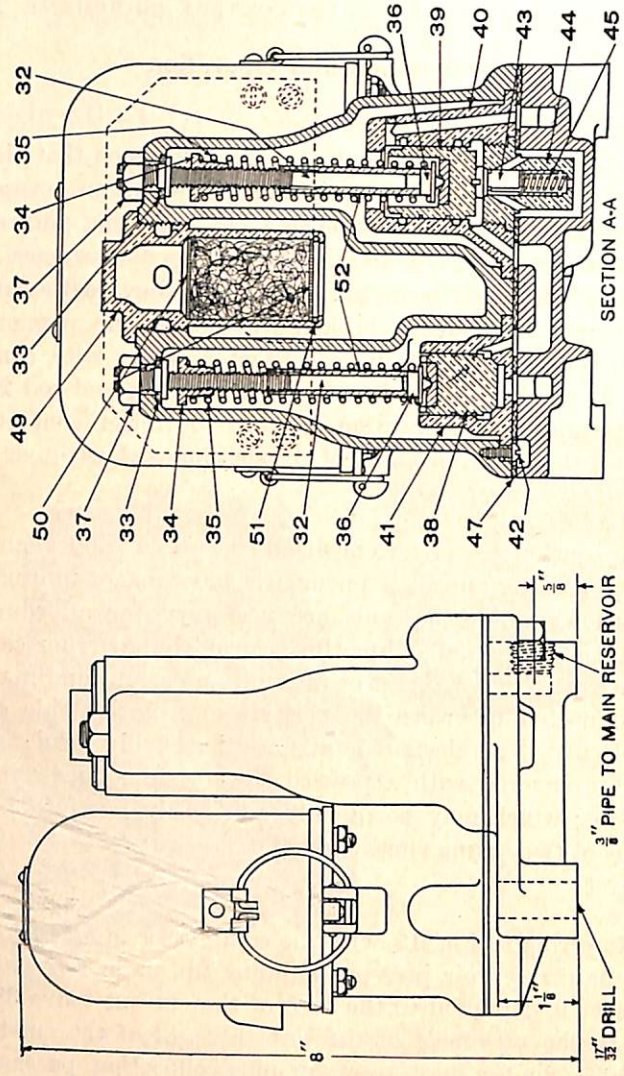


Fig. 10. Outline of the S-16 Governor showing Pipe Connection and Section through the Regulating Portion

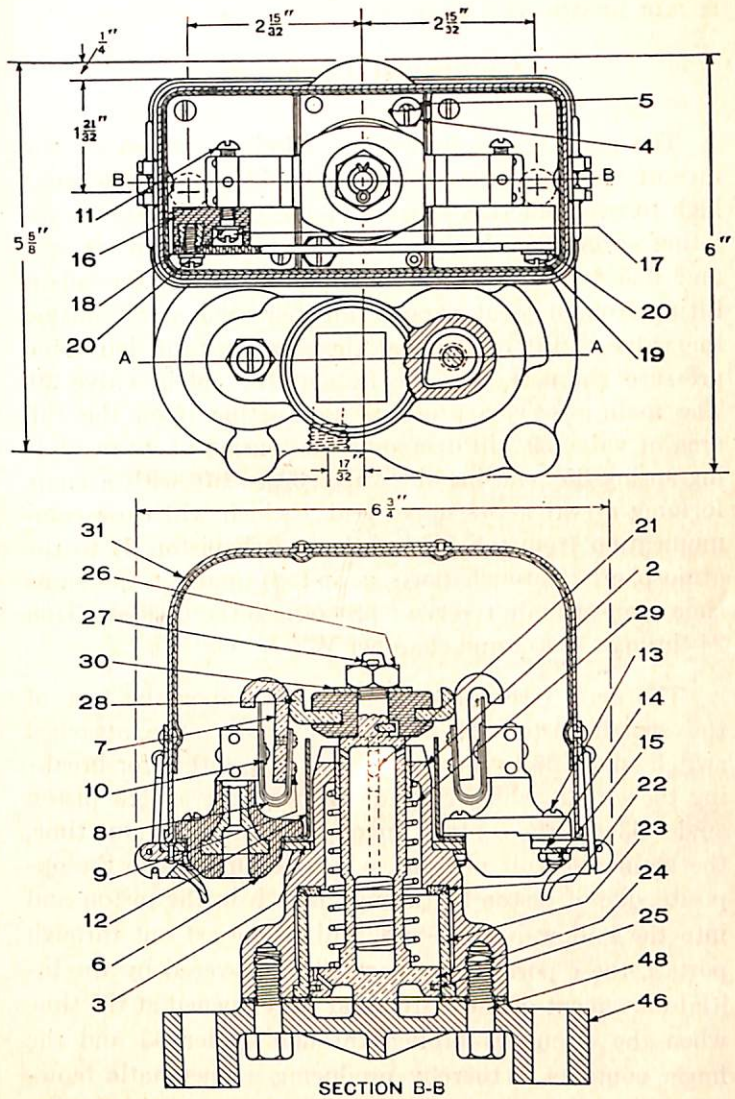


Fig. 11. Type S-16 Governor, Plan View and Section through the Switch Piston

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.

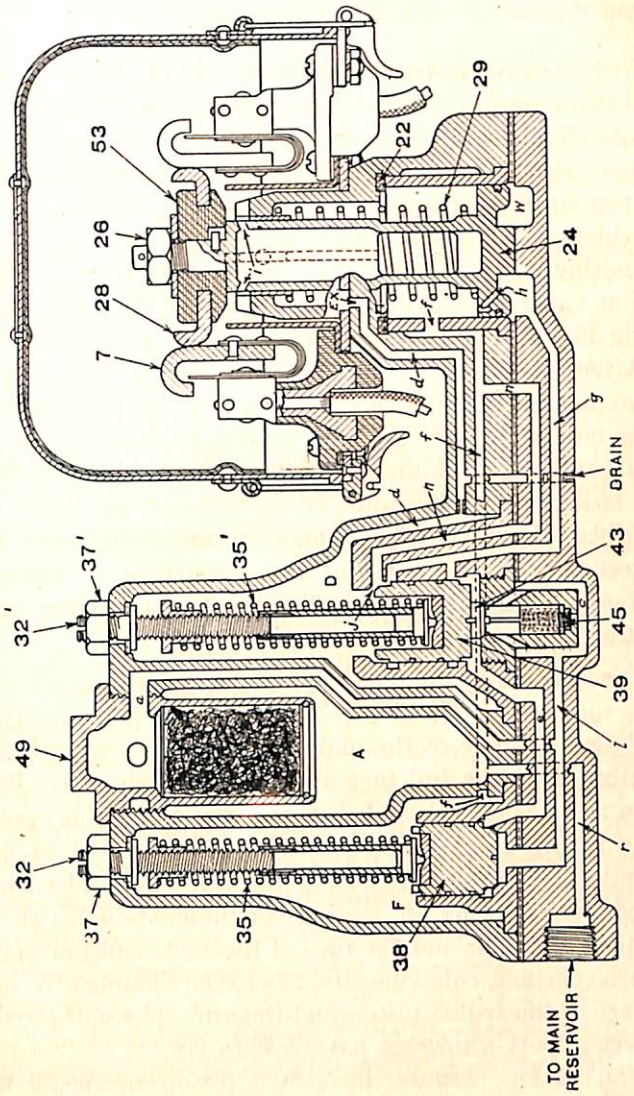


Fig. 12. Diagrammatic View of the S-16 Governor in Cut-in Position

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

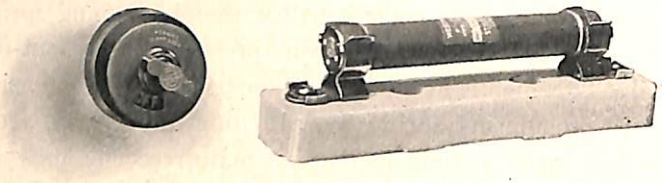


Fig. 13. Snap Switch and Open Fuse Block

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.

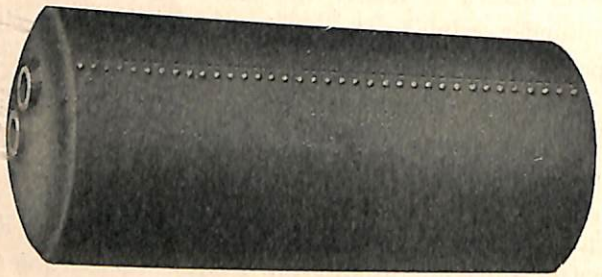


Fig. 14. Brazed Main Reservoir

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

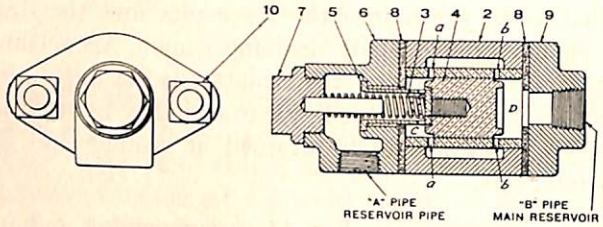


Fig. 15. Main Reservoir Cut-off Valve

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,

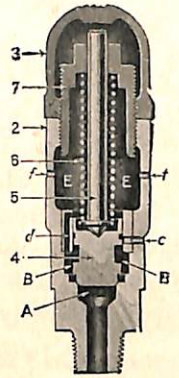


Fig. 16. E-1 Safety Valve

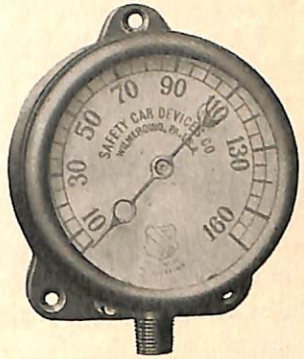


Fig. 17. Air Gage

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.

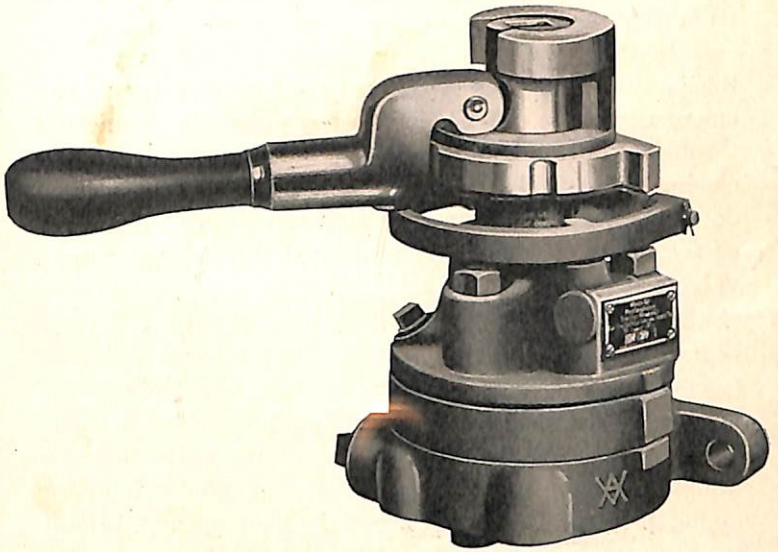


Fig. 18. M-28 Brake Valve

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-

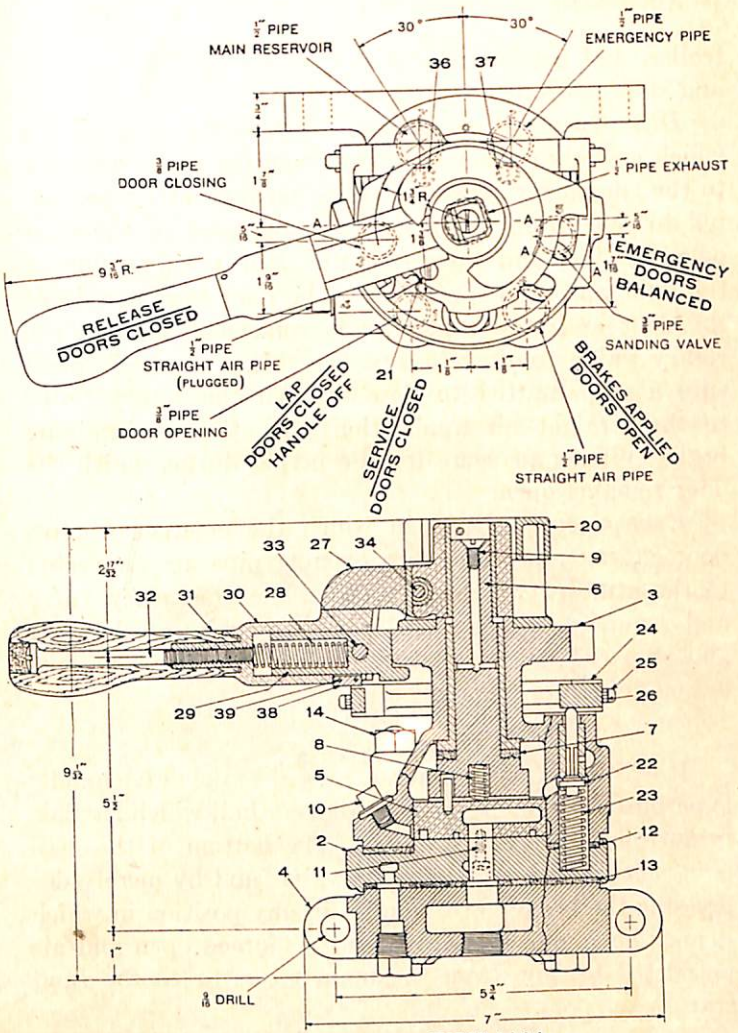


Fig. 19. M-28 Brake Valve, Plan and Sectional Views

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.

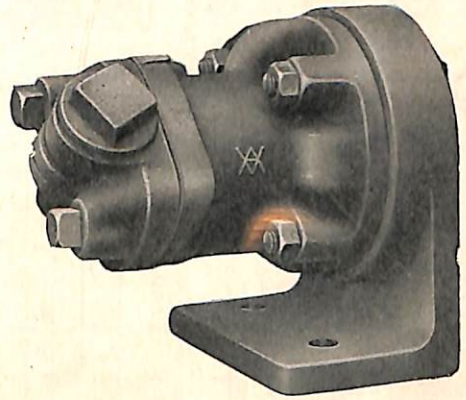


Fig. 20. K-1 Emergency Valve

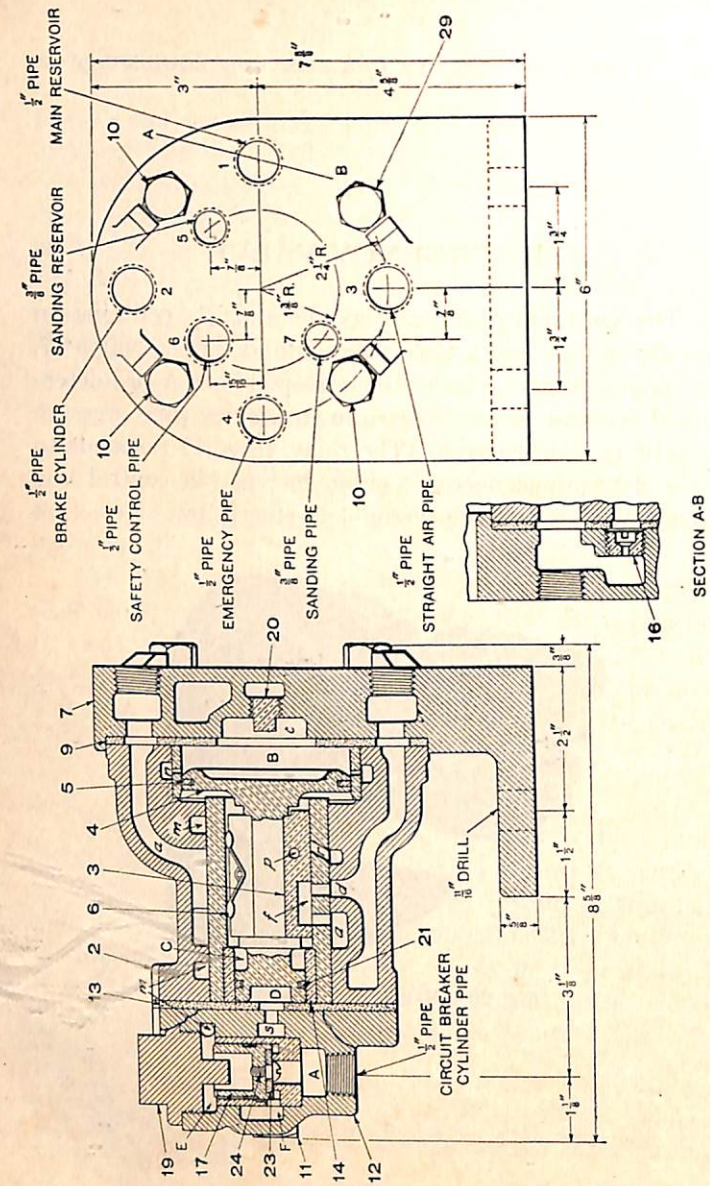


Fig. 21. K-1 Emergency Valve—Vertical Section and View of Pipe Bracket

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.

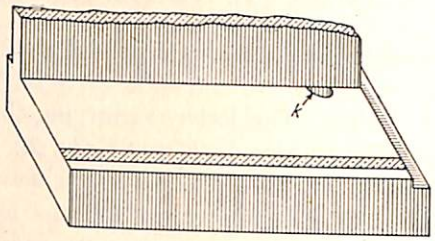
Port a leads to the brake cylinder; port d leads to the Straight Air Pipe and thus, when the emergency valve is in release position, these ports being connected by cavity *f*, a straight air application is made by admitting air to the straight air pipe at the brake valve, and this flows through cavity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

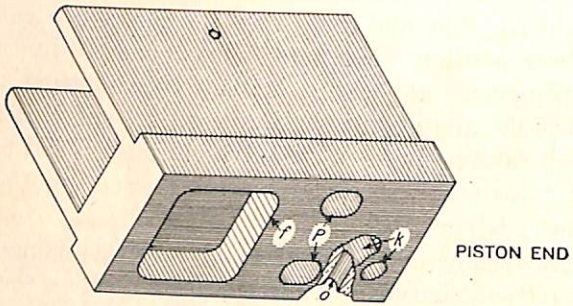
Port *r* is not used.

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-





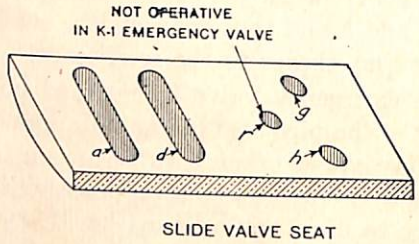


Fig. 22. Slide Valve and Slide Valve Seat K-1 Emergency Valve

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

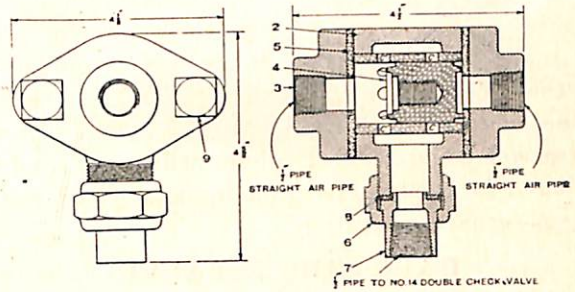


Fig. 23. No. 15 Double Check Valve

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.

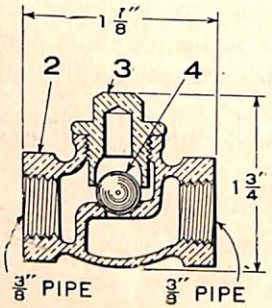


Fig. 25. Ball Check Valve

BRAKE CYLINDER

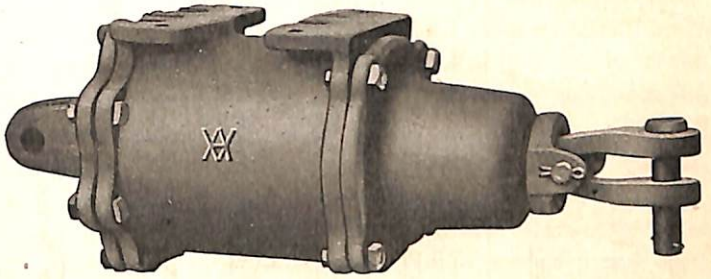


Fig. 26. Brake Cylinder

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.