WESTINGHOUSE

COMPRESSED AIR
BRAKES
FOR
TRAMWAYS

THE WESTINGHOUSE BRAKE & SAXBY SIGNAL Co. LD.

82 YORK ROAD KING'S CROSS, LONDON, N. 1.

Telegrama: "Westinghouse, Kincross, London." Telephone 2415 North (6 lines)

WORKS: LONDON AND CHIPPENHAM.

D.P.12

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May, 1929.

Typical layout of "straight air" Brake Equipment.

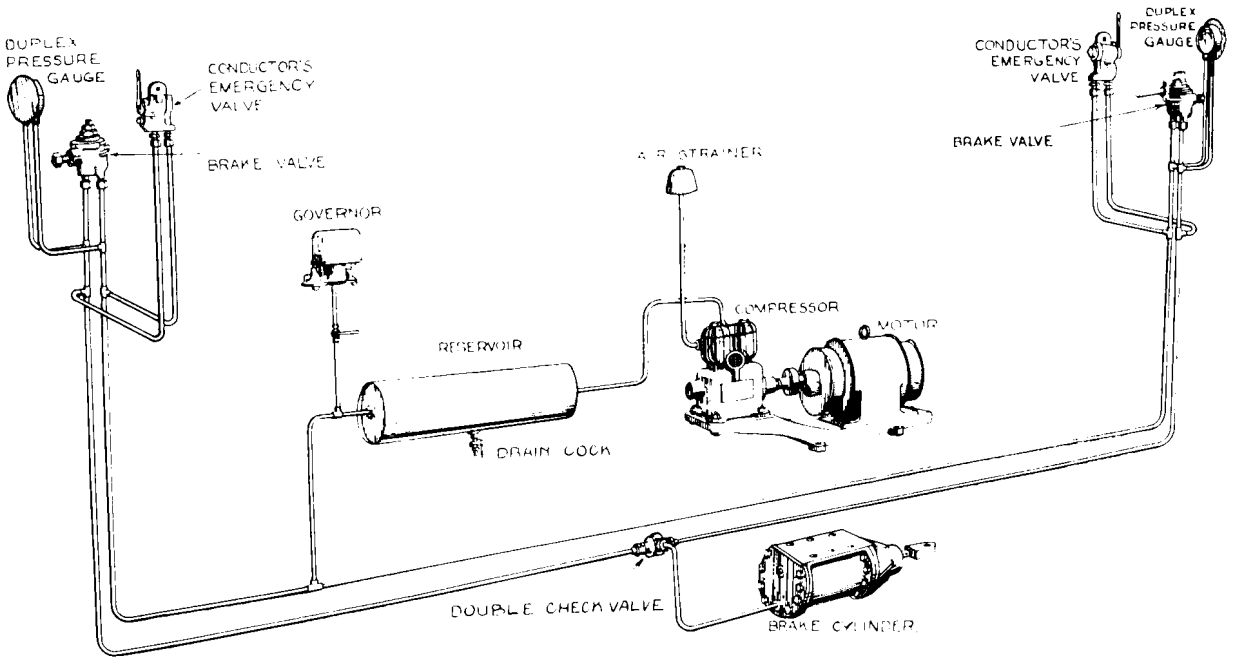


Fig. 1.

We will be pleased to submit suitable schemes of brake installations if drawings of the truck, body and underframe on which the brake is to be installed are supplied, and particulars given as per detachable sheet at the back of this catalogue.

Automatic Brakes suitable for tramways where trailers are hauled, and "One Man Car" brakes, are described in the appendix at the back of this catalogue.

COMPRESSED AIR BRAKES FOR TRAMWAYS

PRESENT-DAY conditions make it necessary for most Tramway Authorities to consider increasing the speed of their vehicles. This entails the installation of brakes, not only more powerful, but more easily and quickly operated, than the usual type of mechanical hand brake.

The brake should be sufficiently powerful to stop the vehicle in the shortest possible time and distance in case of emergency. In ordinary traffic it should be capable of slowing down or stopping the vehicle without discomfort to the passengers and with the minimum of effort on the part of the motorman.

In making stops with the ordinary mechanical brake an appreciable amount of time elapses between the first movement of the brake handle and retardation, whilst graduation of application, or release, is difficult, if not practically impossible. Seeing that a car travelling at a speed of 20 miles per hour covers a distance of approximately 30 feet in one second, this time interval is a very important factor in emergency stops. The Westinghouse compressed air brake will stop a car in a much shorter distance than is possible with the hand brake, because retardation commences directly the motorman operates the brake valve. Further, the release is rapid, enabling the car to get under way again quickly.

The effort required to apply the hand brake is very considerable, and fatiguing to the motorman, The effort required to apply the air brake is almost negligible, and the movement of the brake valve handle is accomplished in a fraction of a second ; whilst the brake is so sensitive that the motorman can " feel " the effect of every application he makes, and can regulate (or graduate) easily the amount of pressure required for service stops, slowing down, or full emergency.

The air brake, therefore, provides a much greater margin of safety than do hand brakes.

For single cars the simplest, and cheapest, form of air brake equipment is shown in Fig. 1, and is usually referred to as the " straight air " brake. This name is derived from the fact that the compressed air in the reservoir is admitted or released " straight " to or from the brake cylinder by means of the brake valve. In other forms of air brakes, such as the " automatic " brake used where one or more trailer vehicles are coupled to the motor vehicle, the air which operates the cylinders does not come straight from the reservoir on the motor-car, but from small auxiliary reservoirs on each vehicle through the functioning of special valves.

The conductor's emergency valve is an essential " safety device " in tramway air-brake equipment. The purpose of this valve is to enable the conductor to make an emergency application of the air brake independently of the motorman, should necessity arise. This is simply and quickly done by turning down a cock handle placed in a convenient position. Once applied, the conductor cannot, however, release the brakes even if he returns the cock handle to its normal position. The release can only be made by the motorman after the conductor has put the emergency valve handle back to normal. This valve is in effect a safety device, whether operated when the car is on the flat or on inclines.

As shown by diagrams on pages 8 to 11, the braking of the vehicle can be effected by the air brake acting on wheel blocks only, or on wheel blocks and track shoes. Owing to space restriction, single-deck cars are illustrated, but the braking arrangement is identical for both single and double-deck cars, and varies only as to size of brake cylinder, according to the empty weight of vehicle to be braked. (See p. 7.)

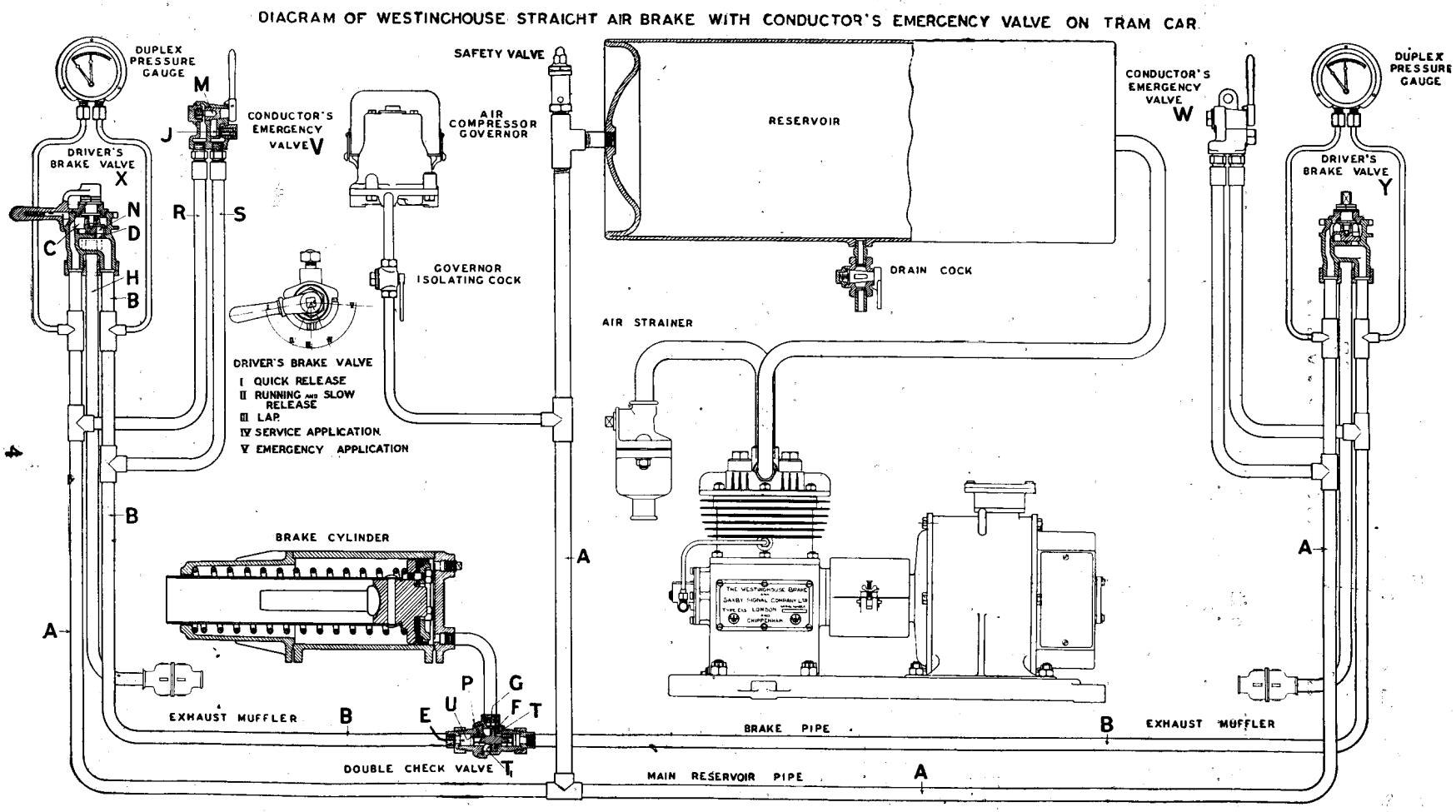


Fig. 2. Diagrammatic Arrangement of Straight Air Brake, showing certain parts in section.

Straight Air Brake

Description of Operation

FIG. 2 shows in diagrammatic form the straight air brake system. The air compressor delivers compressed air to the air reservoir, the pressure being governed by the setting of the air compressor governor, which normally has a range of about 12 to 15 lb. per sq. in. between its " cutting in " and " cutting out " pressures. Maximum and minimum pressures of 70 and 58 lb. per sq. in. respectively are those most usually adopted, but these pressures can be varied by altering the adjustment of the pneumatic controlling mechanism of the governor. A safety valve is set to blow off at a pressure of about 5 lb. per sq. in. above the " cutting out " point of the governor. A drain cock on the air reservoir provides means for draining off water of condensation, etc.

The diagram illustrates the equipment with the brake fully released, and it is assumed that the car is being driven from the left-hand end, the brake valve handle at this end being in the release position. One handle only is provided for the two brake valves, and is removable only in the " lap " position, so that the brake valve at the non-operative end is always " on lap," in which position communication between pipes A and B, and B and H, is cut off.

Air from the reservoir flows by way of pipe A to the chamber C of the brake valve. To apply the brake, the brake valve handle is moved to lap position (III) and then towards application position (IV), which permits air from chamber C to flow to the pipe B by way of port D, thence to the chamber E of the double check valve, and, forcing valve F over to the right, by port G to the brake cylinder, the piston of which is moved out to apply the brakes. When the desired pressure has been attained, the handle is returned to lap position (III). The brake is released by moving the handle to release position (I), which permits the compressed air previously admitted to the brake cylinder to escape to atmosphere by way of pipe B, cavity N in the rotary valve, and pipe H. The pressure in the brake cylinder can be increased, or decreased, to any degree at the will of the motorman. In emergency the handle is moved quickly to the emergency position (V), which brings the large end of port D into communication with pipe B, so that the brake is almost instantaneously applied with its full available force. While running, the handle is left in position II (in which position also a gradual release of the brake is made).

Conductor's Emergency Control

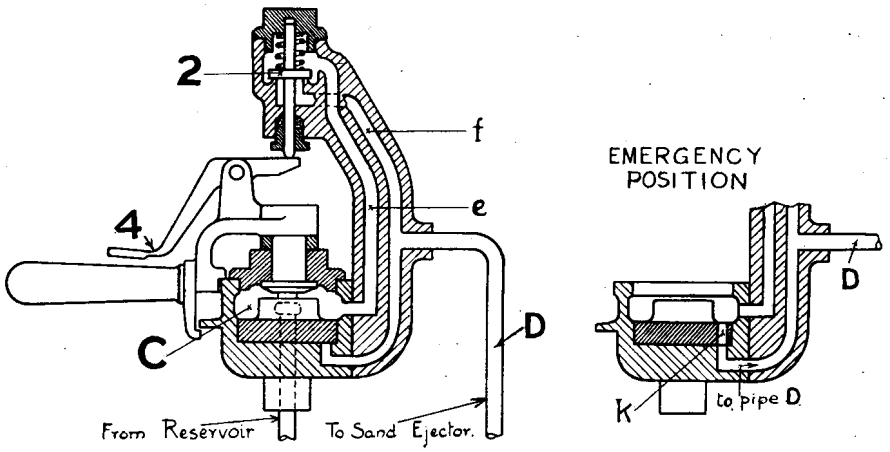
The conductor's valve for emergency application of the brake combines in one piece a plug cock and check valve, the latter being spring loaded, so that the pressure of air admissible to the brake cylinder by the conductor is materially below the normal pressure which can be admitted by the motorman.

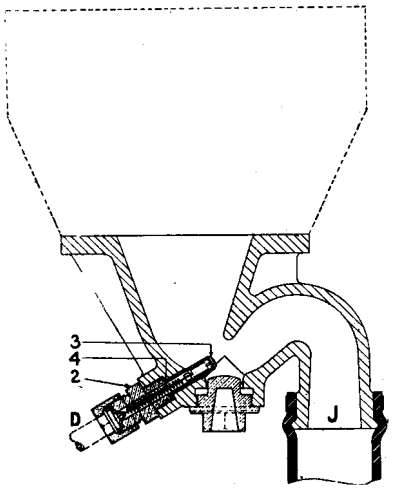
The conductor is in charge of emergency valve W, when the motorman is at the other end of the car, viz., at brake valve X. When the conductor moves the handle of emergency valve W to application position, the port M in the cock plug connects pipes R and S, so that air is free to flow past check valve J into pipe B and thence to the brake cylinder through the double check valve. The valve F, which seats on gasket T, prevents the air, admitted by the conductor, from gaining access to pipe B at the motorman's end. Upon the replacement of the handle of emergency valve W to the closed position, the air admitted to the brake cylinder is locked up in the piping, and the brake will still be held on, but the motorman, having at his command a higher pressure than that admitted by the conductor, can reverse the double check valve by making a brake application through brake valve X. When the check valve has moved to its right-hand seat (T) it seals pipe B on that side and the slide valve U uncovers port P on the side of the check valve remote from brake valve X, so that the air locked up in the pipe can escape to atmosphere. The above movement of the check valve, by unseating valve F, places the brake cylinder into communication with the brake valve X, so that the air previously admitted by the conductor may be released or increased in pressure at the will of the motorman.

Sanding

If desired, provision can be made for sanding by means of compressed air. This involves the addition of a small valve device mounted upon the motorman's brake valve (see page 32 and diagram on page 21).

The illustration shows, diagrammatically, the connections to the pneumatic sanding valve mounted on the motorman's brake valve. The trigger enables the motorman to apply sand to the track at any time independently of the position of the brake valve handle, though, when the latter is in its emergency position, sanding is automatic. The operation is as follows :—





When the trigger 4 is depressed the valve 2 is lifted from its seat, allowing air from chamber C of the brake valve to flow via ports "*e*" and "*f*" to pipe D, and thence to nozzle 2 of sand ejector valve. This valve is of the self-clearing type, and incorporates a non-return valve 3, actuated by a spring 4, which prevents clogging of the air nozzle. The pressure of the air pushes valve 3 off its seat, and the air blows through, lifting the sand lying in the ejector bend and blowing it over to the outlet nozzle and out of the delivery pipe connected at J.

When the brake valve handle is moved to the emergency braking position, a port "*k*" in the rotary valve allows air to flow direct into pipe D, independent of trigger 4, and thence to the sand ejectors as described above.

The standard outlet nozzle of the ejector is constructed to take a rubber hose, but a nozzle to take a screwed metal tube can be supplied.

For piping connections, see page 21.

Braking Ratio

For wheel brakes on cars operating over routes having no severe gradients, a nominal brake force equal to 85 per cent. of the empty weight of the car is recommended, but conditions may require a brake force as high as 100 per cent. to provide the necessary retarding force. Track brakes are usually limited to a brake force on the track slippers equal to 50 per cent. of the car weight, and operate through rigging having a much lower leverage than that given below.

Tables for Determining Size of Brake Cylinders

The following tables give the maximum allowable empty weight of car for various sizes of brake cylinders and brake percentages. Brake cylinders are listed having maximum strokes of 12 in. and 8 in., but the brake rigging must always be adjusted so that the working piston stroke does not exceed two-thirds thereof.

Brake cylinders for the automatic brake are provided with a leakage groove (L. page 34), in which case the rigging must be adjusted so that the minimum working stroke is not less than 2".

Diameter of Brake Cylinder in ins.	*Load on piston at 50 lb. per sq. in.*	*Maximum Leverage of Brake Rigging 10—1.* 12" *Maximum Stroke.* *Maximum Weight of Car in tons allowable with a nominal brake force of*				*Maximum Leverage of Brake Rigging 8–1.* 8" *Maximum Stroke.* *Maximum Weight of Car in tons allowable with a nominal brake force of*			
		75 %	85 %	90 %	100 %	75 %	85 %	90 %	100 %
6	1,410	8·38	7·425	7	6·3	6·7	5·94	5·6	5·04
8	2,510	14·95	13·2	12·45	11·2	11·95	10·55	9·95	9
10	3,925	23·4	20·7	19·5	17·5	18·75	16·5	15·62	14·03
12	5,650	—	—	—	—	26·8	23·65	22·3	20·2

Reservoirs

Although it is desirable to maintain as nearly as possible a minimum reservoir capacity for a given size of brake cylinder, it is practically impossible to establish a definite standard of size, which must depend upon the space available for its installation. This is usually restricted, and moreover varies in almost every instance.

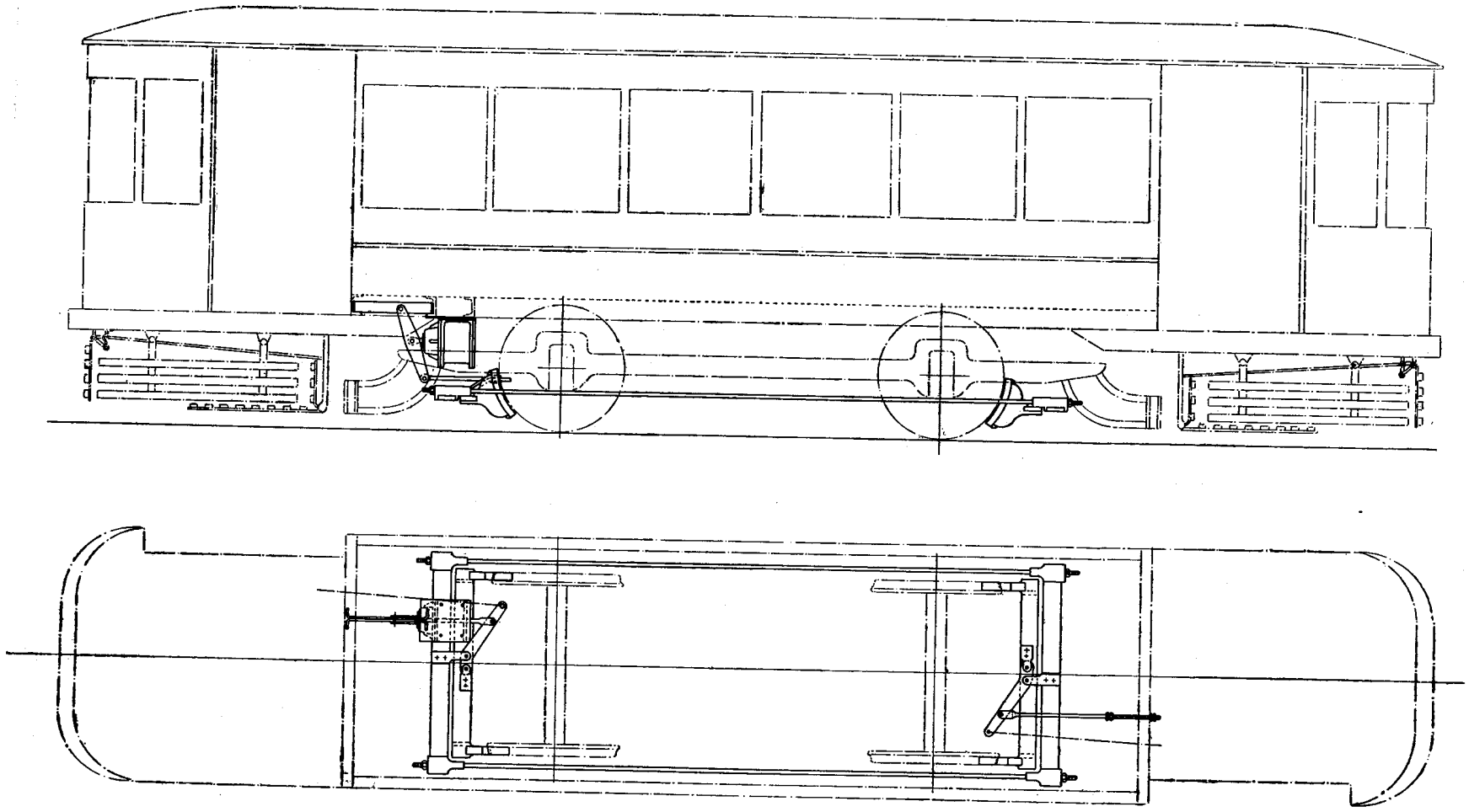


Diagram of Single Truck Car fitted with Wheel Brakes.

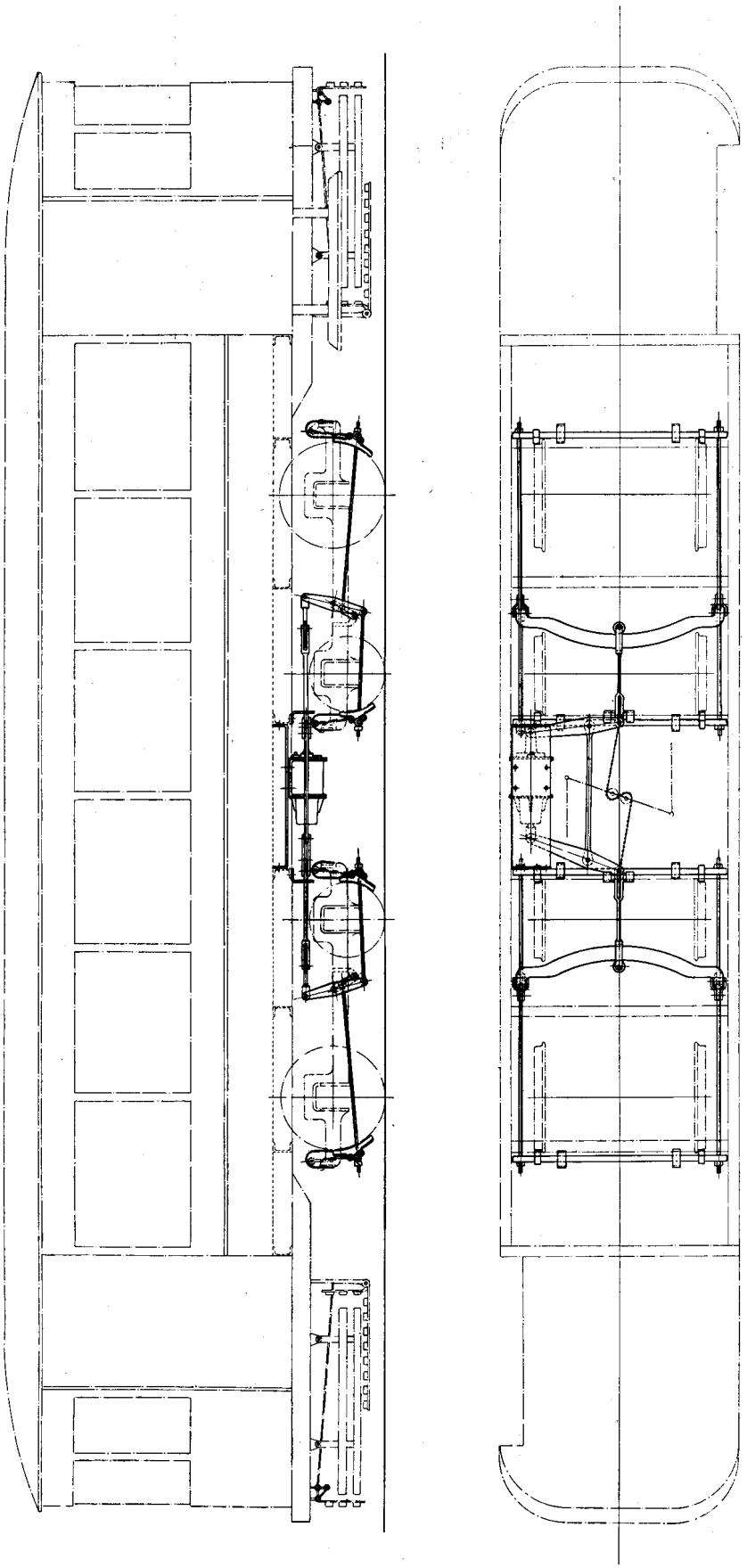


Diagram of Bogie Truck Car fitted with Wheel Brakes.

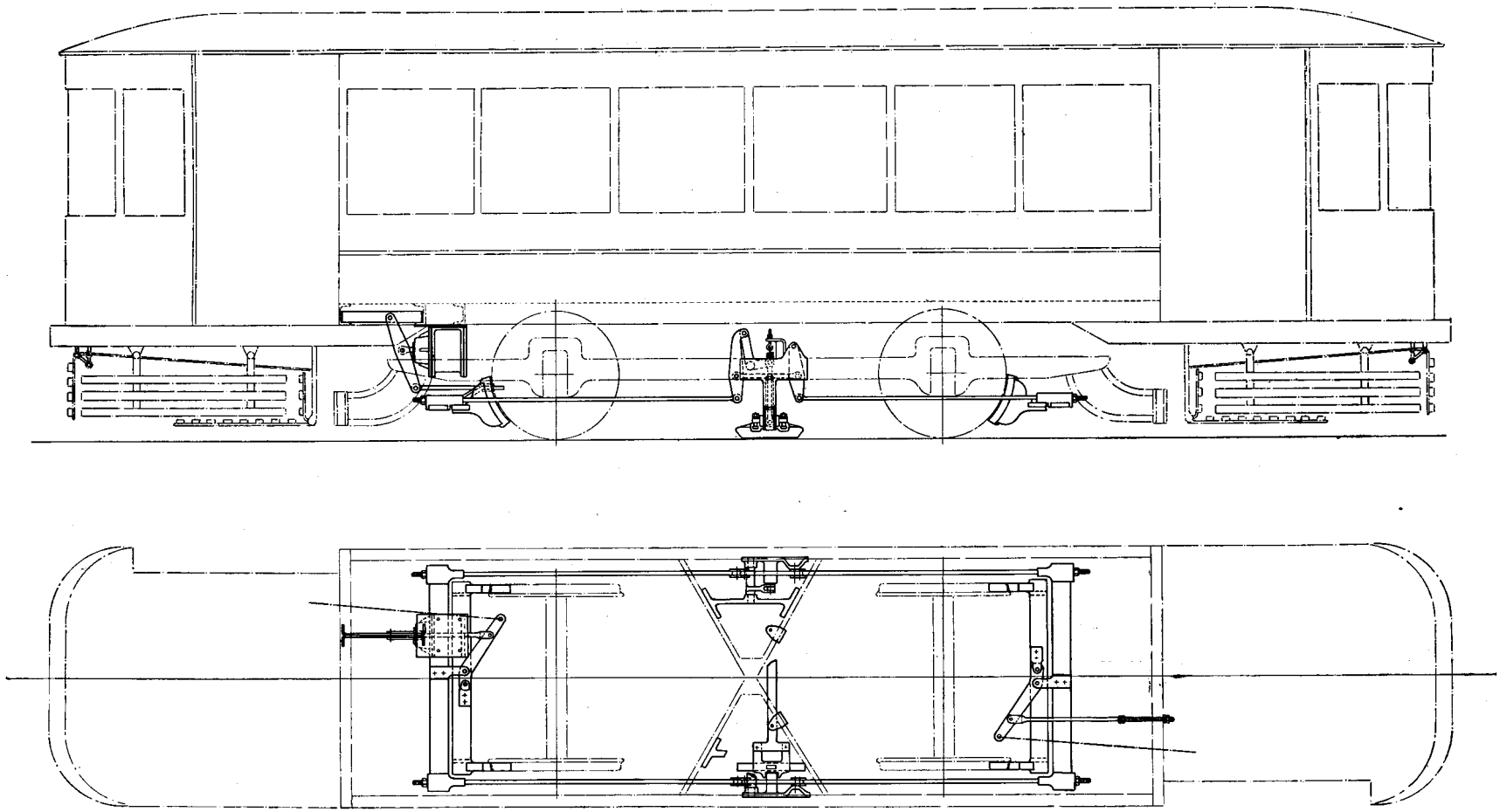


Diagram of Single Truck Car fitted with Wheel and Track Brakes.

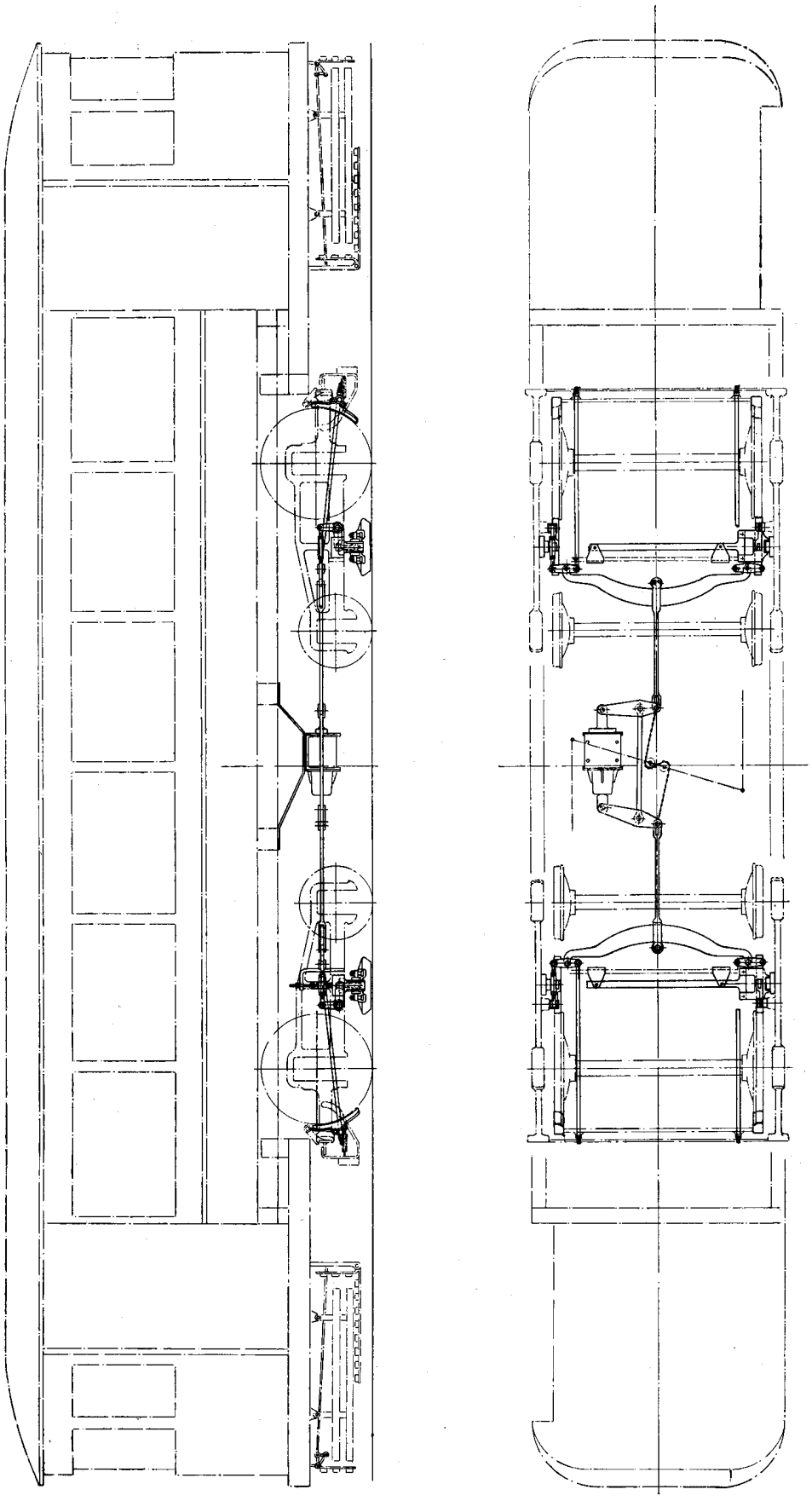


Diagram of Bogie Truck Car fitted with Wheel and Track Brakes.

Air Compressor. Type E.13.

Piston Displacement at 1,075 r.p.m., 13 cu. ft. per min.

THE compressor is of the duplex vertical single-acting type, and is directly coupled to the motor by flexible couplings, the whole being mounted on a cast iron bed plate, having a raised surrounding lip to retain waste oil. Four lugs are provided for bolting down to the floor or cradle.

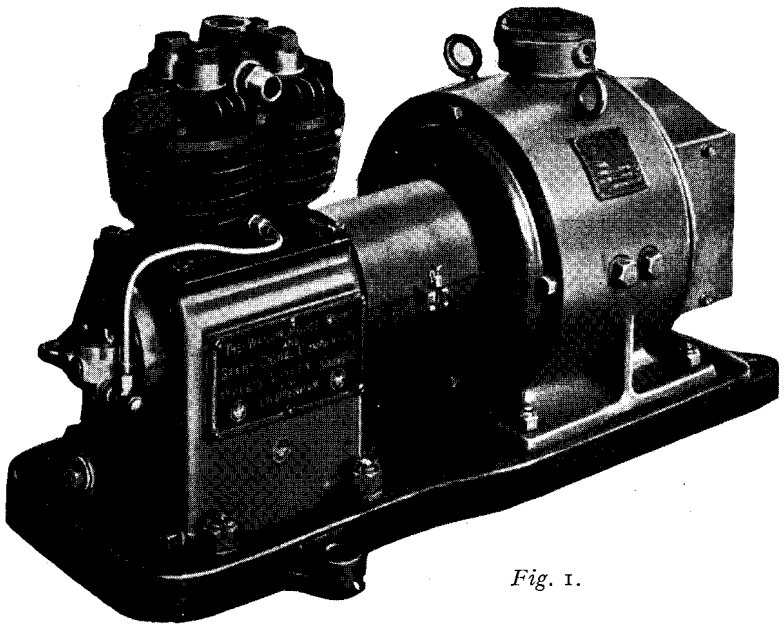


Fig. 1.

The crankshaft 4 is mounted on deep-groove ball-bearings 31, and the connecting-rod big-end bearings 7 are lined with white metal and have ample bearing surface.

The gudgeon pins 9 are of steel, hardened and ground, and the small ends of the connecting rods 6 are bronze bushed. Both the cylinder head 2, which is common to both cylinders, and the upper portion of the cylinder barrels are provided with heat radiating fins. Both suction 16a and delivery valves 14a are of the annular disc type, and are normally held seated by three light springs 20 per valve. The whole valve assembly, consisting of valve seat (14 or 16), valve disc, valve guide (15 or 17), springs 20, and stud (46 or 47), is readily accessible by unscrewing the valve cap 19, and the valve holder (48 or 49), when it can be withdrawn as a unit for inspection or replacement without the necessity of removing the cylinder head 2 or of breaking any pipe joints. The design of the valve assembly is such that, in the unlikely event of a valve disc breaking, it is prevented from falling into the cylinder.

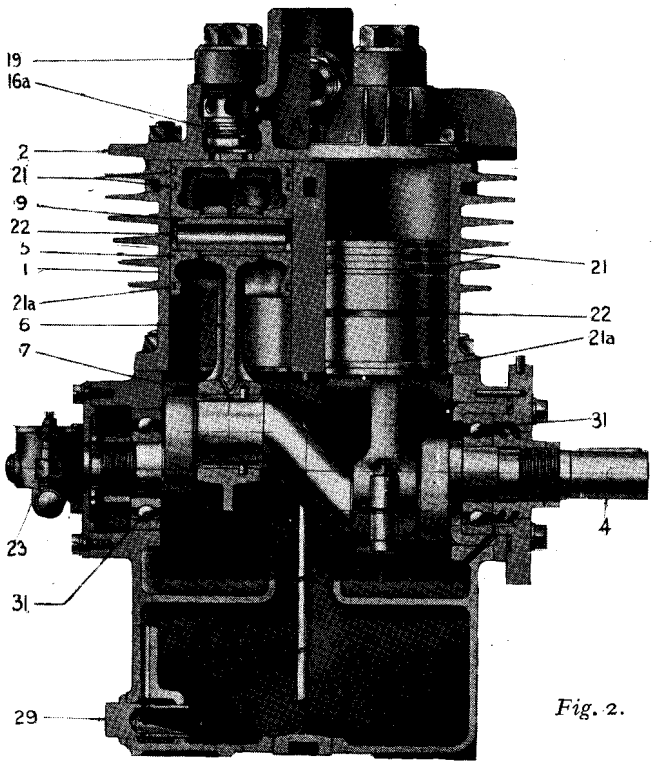


Fig. 2.

The suction valves are in communication with chamber A, to which is piped the suction strainer, while the delivery valves are in communication with delivery nipple 30.

A mechanical oil pump 23 of the positive plunger type is driven from the end of the crankshaft 4 by a steel worm and bronze gearwheel. The pump transfers oil from the sump via a filter 29 to a point in the cylinder block 1 between the cylinders above the crankshaft 4, on to which the oil falls and is splashed on to the big ends and cylinder walls, thence finding its way to the main ball bearings and maintaining the level of oil in the trays into which the big end caps dip. The oil filling plug 28 incorporates a dip-stick by which the oil level can be determined.

The operation of the oil pump (*see* Figs.

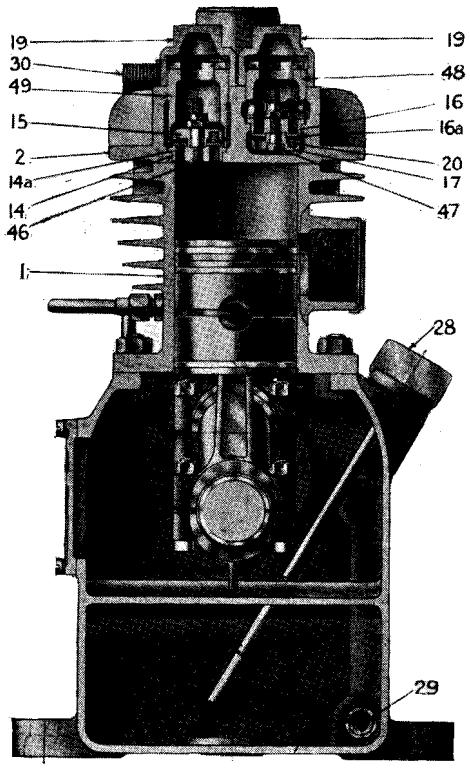


Fig. 3.

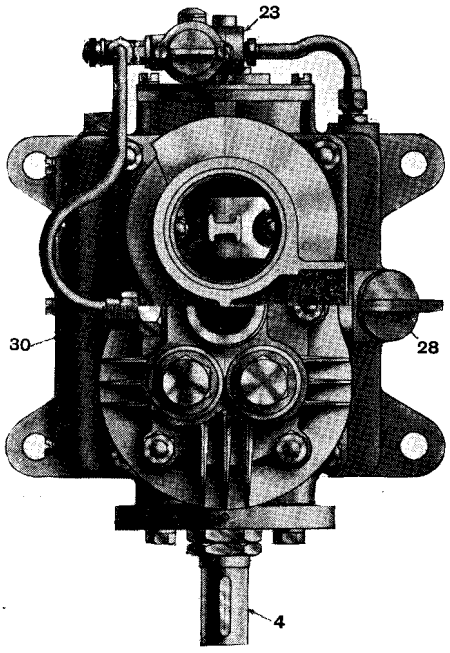


Fig. 4.

Overall dimensions in inches.

A.	B.	C.	D.	E.	F.	G.	H.	J.	K.
31	17¾	15¾	14¾	13	14¾	12⅞	1⅝	1¼	11/16 dia. holes.

5 and 6 below) is as follows : The plunger (5061·4) is caused to rotate and reciprocate in sleeve 5061·3 by means of a lug moving in a fixed groove and sliding up and down a slot in the sleeve. The rotary movement is imparted to the plunger and sleeve by the gear wheel—which forms an integral part of the sleeve—and worm (5061·5) driven from the crankshaft of the compressor. A slot or port in the sleeve registers with the supply port on the up-stroke of the plunger, and with the delivery port on the down-stroke thus acting as a valve. The flow of oil is regulated by turning the block (5061·2), in which the cam groove is cut. This alters the timing of the plunger stroke in relation to the opening and closing of the supply and delivery ports. When the correct adjustment is found, the block is fastened in position by the two screws.

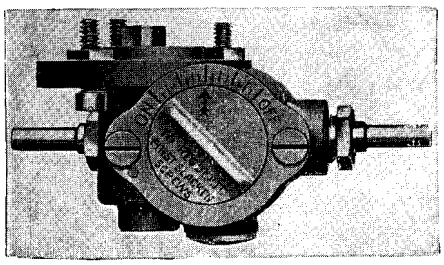


Fig. 5.

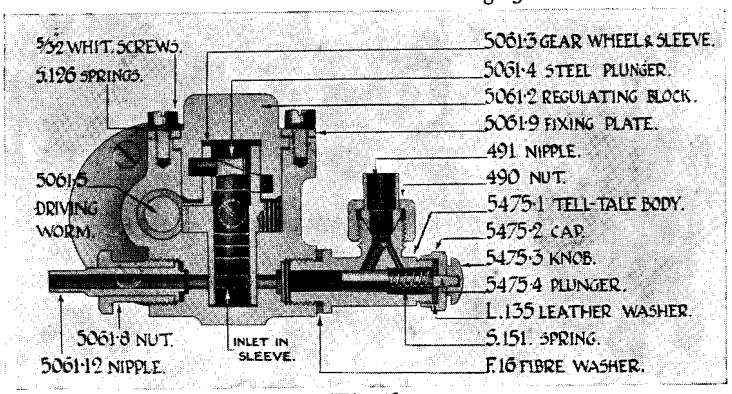
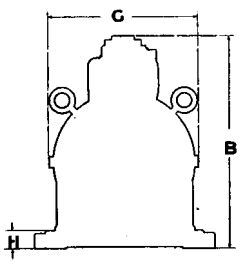
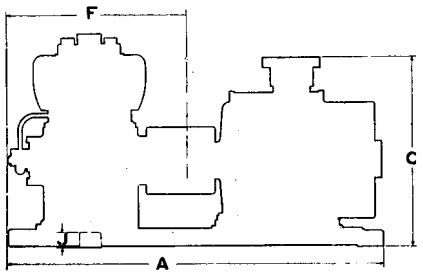


Fig. 6.

The electric motor is of the totally enclosed series-wound type, fitted with ball bearings.





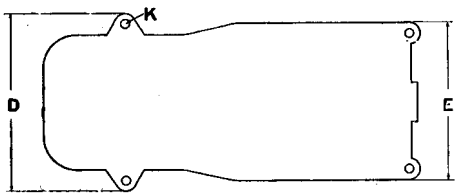


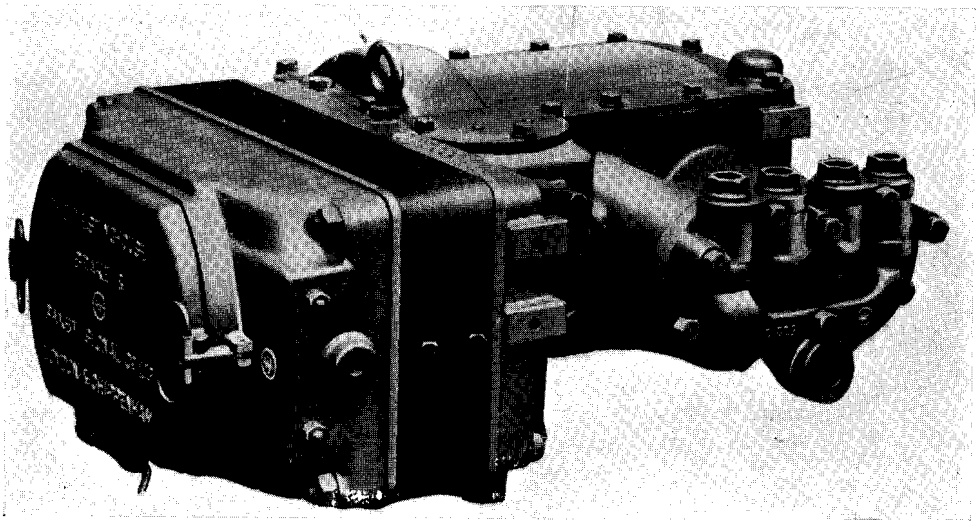
Fig. 7.

Air Compressors. Type D.H.16

Piston Displacement at 1,100 r.p.m. of motor, 16 cu. ft. per min.

Dimensions.

Length.	Width.	Height.
$34\frac{3}{4}''$	$24\frac{1}{16}''$	$12\frac{1}{2}''$ (excluding lifting eye bolt)



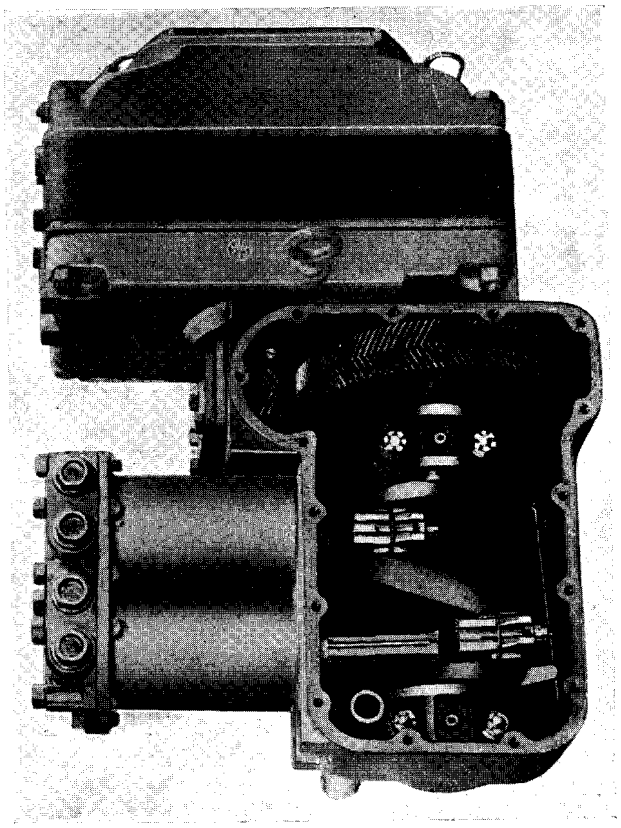
THIS compressor has been designed especially to meet conditions of restricted space and clearance. The overall height has been reduced to the minimum, and the weight kept down to the lowest possible. " Herringbone " gearing ensures smooth and quiet running. Accessibility to all working parts is attained by the provision of large doors and covers.

The compressor, when hung beneath the car, is attached to the under frame by three steel suspension hangers, each fastened by two bolts to lugs on the body casting. To avoid shear on these bolts the weight of the compressor is taken by the bent ends of the hangers. The upper ends of the hangers are secured by bolts to brackets attached to the car frame. (*See* Sketch on page 17.)

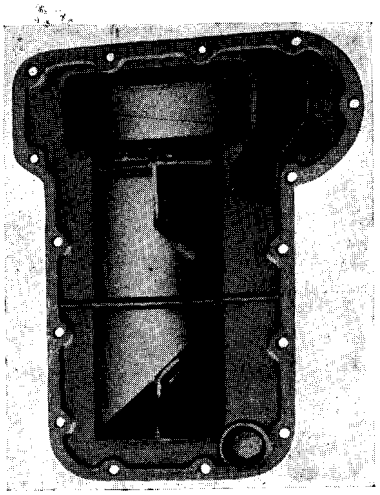
Type D.H. Air Compressor

The compressor is of the single-acting horizontal duplex air-cylinder type. The cover for both air cylinders is in one piece containing the valves, is tapped for the suction and discharge connections, and may be easily removed.

THE COMPRESSOR



The four air valves (one suction and one discharge valve for each cylinder), are located close to the cylinder compression space to reduce clearance. The valves are machined from pressings of a special steel, and are exceedingly light in weight. Placed vertically, they close by gravity, no valve springs being required. The valve stops are designed to reduce clearance and prevent sluggish action of the valve.



The pistons and connecting rods are unusually long, to insure minimum and even wear on the cylinders, gudgeon pins, gudgeon pin bearings and pistons themselves.

The pistons are of the trunk type, each being fitted with three packing rings of the "snap" type.

The gudgeon pins are of steel, hardened and ground, and held in place by slotted grub screws.

The connecting rods and crank shaft are drop forgings of high grade, heat treated steel.

All bearings are of special bearing metal, and are easily renewable.

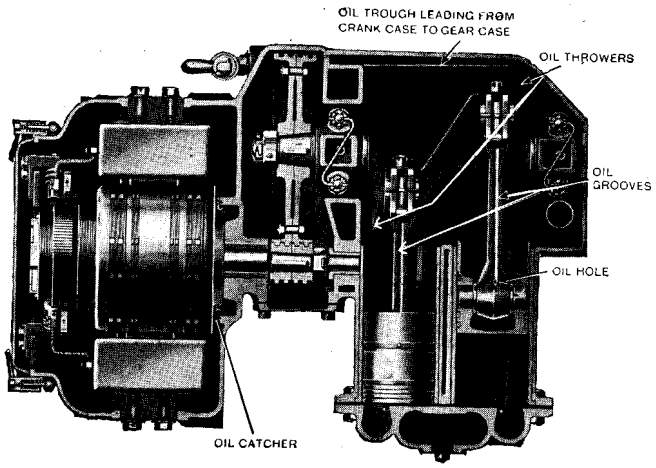
The crank-shaft design renders a centre bearing unnecessary.

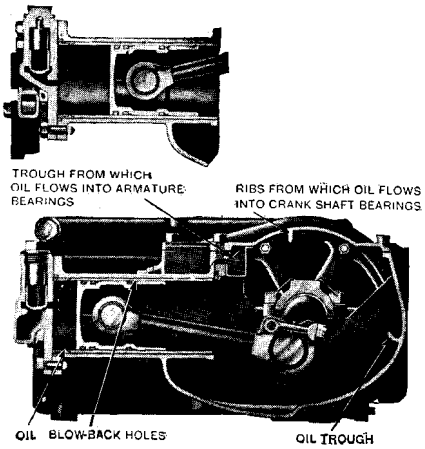
Type D.H. Air Compressor

As already stated, the compressor is single acting, each piston inhaling atmospheric air through its inlet valve on the suction stroke, and delivering it through the discharge valve and pipe into the reservoir on the compression stroke.

Inasmuch as there might be at times a slight vacuum or pressure in the crank case, due to the movement of the pistons or to ring leakage, a vent or " breathing " opening is made to the atmosphere. This consists simply of a vent fitting (which is seen in the view of the compressor on page 15), connecting the interior of the crank case to the atmosphere. The fitting is made long enough to afford protection against loss of oil due to direct splash from the crank case.

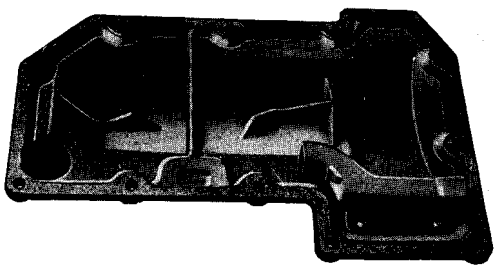
Lubrication





The oiling system is entirely automatic, requiring no attention other than to replenish the oil supply in the crank case at intervals which can safely equal the longest permissible interval between general inspections of other car equipment. This is a simple matter, since there is but one place in which to pour oil—a fitting which also serves as a gauge to indicate the oil level.

The cheeks of the crank shaft are extended to form oil throwers, which splash a copious amount of oil on to the front and back walls of the crank case and on to the cover as the crank shaft rotates. The oil thrown against the front wall drips down on to the pistons and thoroughly lubricates them. The oil thrown up on to the cover drains from ribs provided for this purpose into both crank shaft bearings and the connecting rod bearing, providing these parts with flood lubrication. Some of the oil dropping on the connecting rod flows down a groove in the top of the rod to the gudgeon pin bearing. The oil splashed against the back wall of the crank case flows down into a trough by which it is conducted into the gear case. Some of this oil is carried up by the gear and thrown off into a trough fixed to the crank-case chamber cover, and so arranged above the gear as to drop a definite and ample amount of oil into the armature bearings, the surplus flowing back into the gear case.



Type D.H. Air Compressor

The oil passage leading from the crank case to the gear case is restricted to a size that, combined with the pump action of the gear, will maintain a certain definite oil level in the gear case. Thus the gear is amply lubricated and sufficient oil carried up to the armature bearings ; and at the same time the gear runs in a small quantity of oil, thereby preventing the generation of heat.

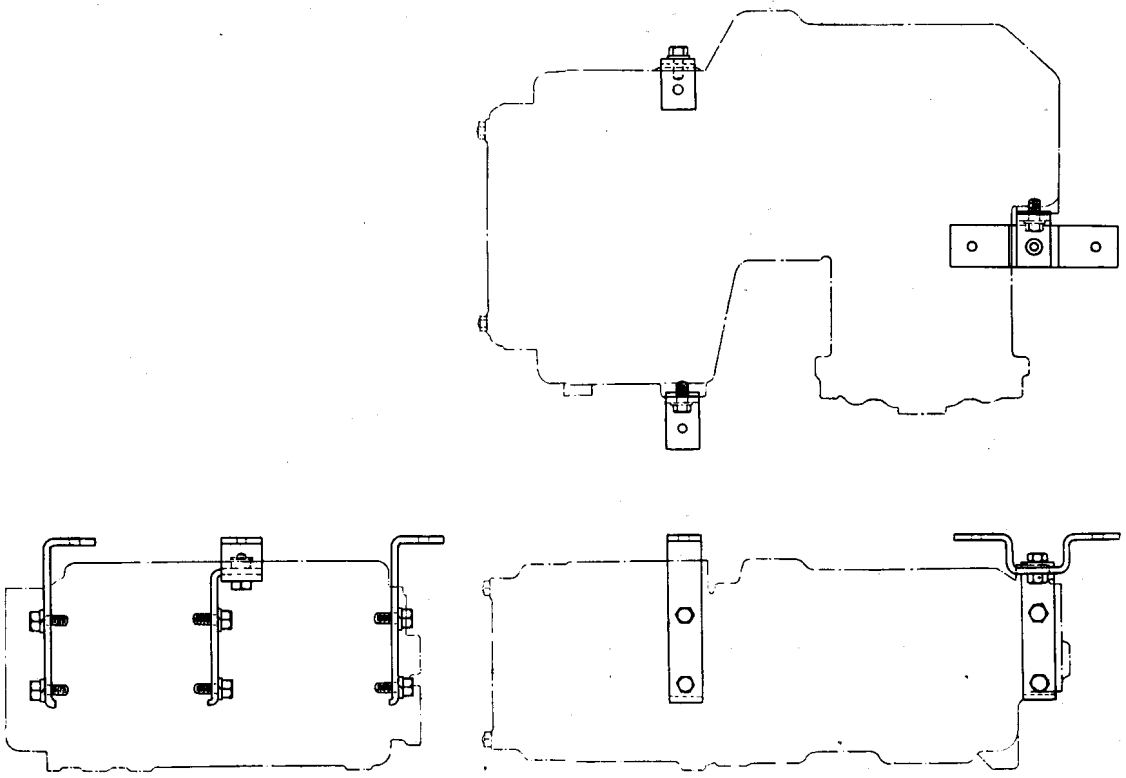
Oil throwers on the armature shaft and a catcher on its housing, with a return passage to the gear case, ensure that any excess oil passing by the large armature bearing will go to the gear case instead of over into the motor. This return passage is connected into the bottom of the gear case, which provides a seal and prevents even oil vapour reaching the motor.

The concave end of the armature is protected by a metal shield, and any oil which may have seeped past the bearing will be deflected into a passage and conducted away, instead of being permitted to reach the motor windings.

The various oil conductors and passages are so arranged that the efficiency of the lubricating system will not be affected by the tilting of the car on a curve, either to restrict the flow of oil to the parts where it is required, or to permit the flooding of oil to parts it should not reach.

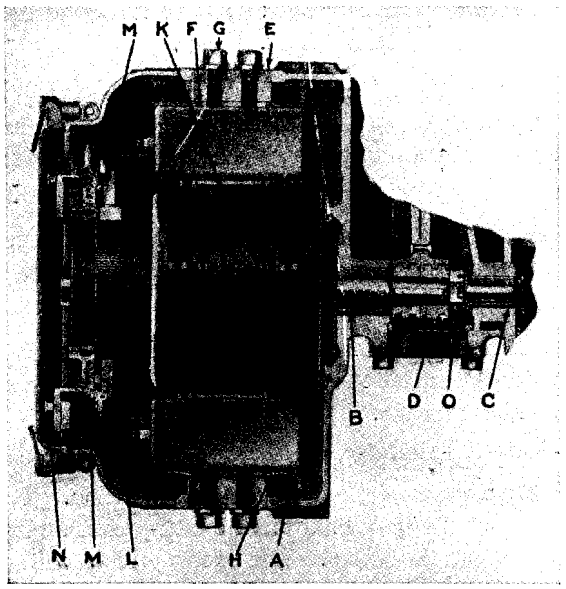
The design of the pistons and cylinders is such as to limit the passage of oil from the crank case side to the pressure side of the pistons to an amount sufficient to ensure just the proper lubrication. The pistons are neatly fitted to the cylinders, and bevelled grooves are provided on the non-pressure edge of the rear packing ring groove, and that immediately ahead of the gudgeon pin. The excess oil is therefore wiped back by the rings, finally reaching the rear groove, from which it drains into the crank case through a hole provided for this purpose.

A TYPICAL METHOD OF SUSPENSION FROM CAR FRAME



Type D.H. Air Compressor

THE MOTOR



The motor is of the enclosed, four-pole, direct-current series-wound type, with two field coils A; is of the salient pole construction; and lies flat at the side of the compressor. It has no out-board bearing, but has a long liberal bearing B extending into the concave rear end of the armature beyond its centre of gravity (*see* illustration on page 26), and a smaller bearing C on the inner end of the shaft on the opposite side of the pinion D, so that the latter is not overhung.

The field yoke E is of laminated soft steel, insuring uniformity of section and minimum weight; the consequent poles are a part of the field yoke.

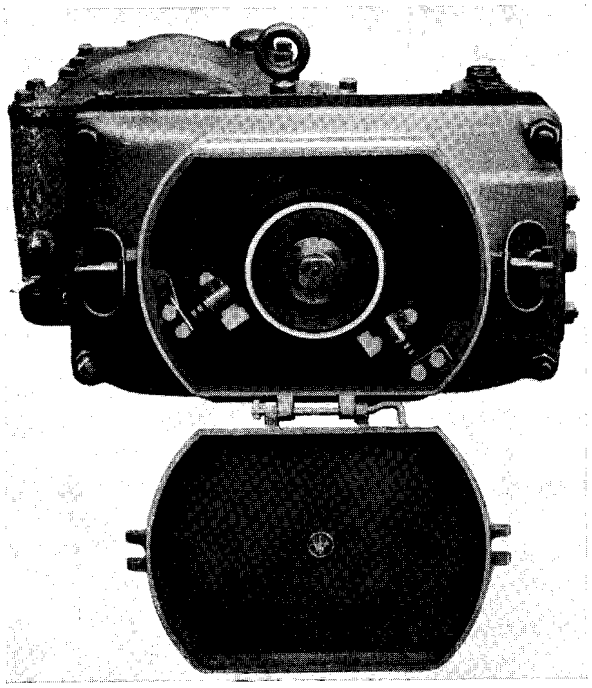
The pole pieces F are each held in place by two cap screws G, and are very easily removed.

The field coils are impervious to oil and water to a high degree, and, to prevent injury due to vibration, are held firmly in place by a flat steel spring H, which presses them against the pole tip guards.

The armature K is of generous proportions, and is built up of soft sheet steel punchings keyed to a spider. The coils are former wound and of uniform size. The commutator L is of liberal dimensions, the mica insulation between the commutator bars being undercut. The oiling system is designed with extra precautions to prevent entrance of oil into the motor, as previously described.

The brush holders, M, are permanently located slightly behind the mechanical neutral position. This is the most efficient location, because 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. The brushes are held in contact with the commutator by the combination of a coiled spring and a flat spring fastened at the uncoiled end of the former. 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.

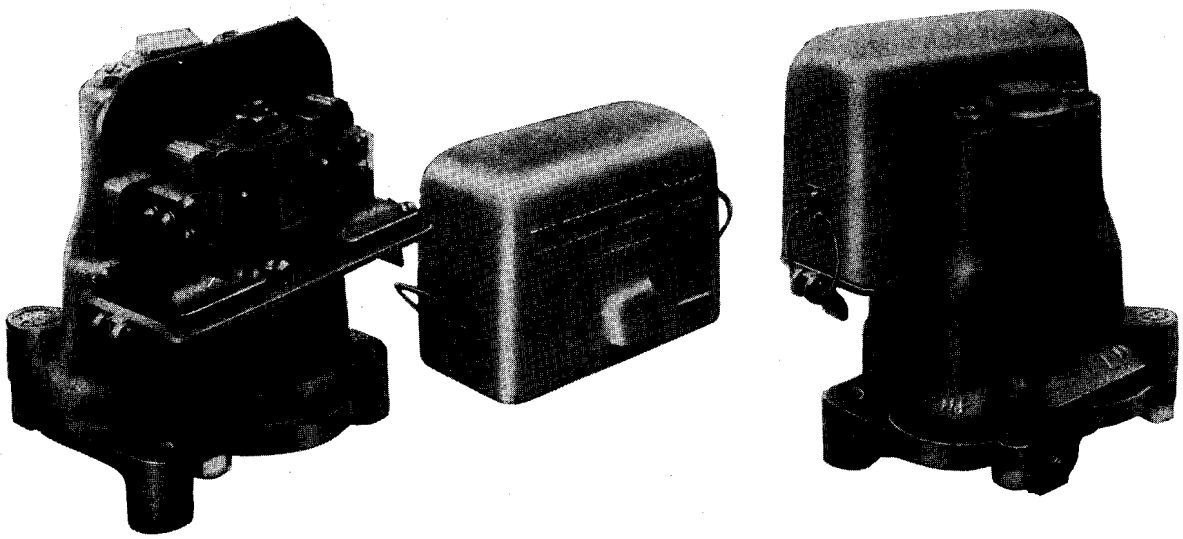
The brushes are located on the lower quadrant of the commutator. This position is most accessible from the pit, and in itself tends to keep the brushes and commutator clean.



Electric Compressor Governor, Type E.S.16

THIS is of the double safety-valve type, and automatically breaks, and makes, the circuit to the electric motor driving the compressor as the pressure in the air reservoir reaches the predetermined maximum and minimum limits to which the governor is set.

It embodies also an effective and efficient pneumatic blow out, which prevents damage to the contacts by arcing when the governor cuts out.



Construction

The apparatus comprises two distinct parts ; an operating portion, which includes the electrical parts and the pneumatic regulating mechanism ; and a pipe bracket or base.

The electrical portion which controls the motor circuit consists essentially of a switch spider, with contacts carried by the switch piston rod. The contacts form the connection between the contact fingers when the governor is cut in, as illustrated.

The contact fingers are complete units, their supports and cable connections being encased in a moulded insulating block, which is fixed into position by two screws. An insulating shield, forming part of the moulded block, provides insulation between the contact fingers and the switch piston cylinder casing. The contact finger adjustment is permanent, the use of screws, which may loosen in service, being avoided.

The design of air cylinders and cut-out mechanism provides for a pneumatic blow-out of such efficiency that no coils are required to effect a magnetic blow-out. This is especially advantageous, as the governor can be used, as previously stated, with either direct or alternating current, and may, in addition, be connected to either the positive or negative side of the circuit.

All electrical parts are thoroughly insulated, and are protected by an asbestos-lined aluminium cover, which is quickly and easily secured in place by spring rings and toggle latches.

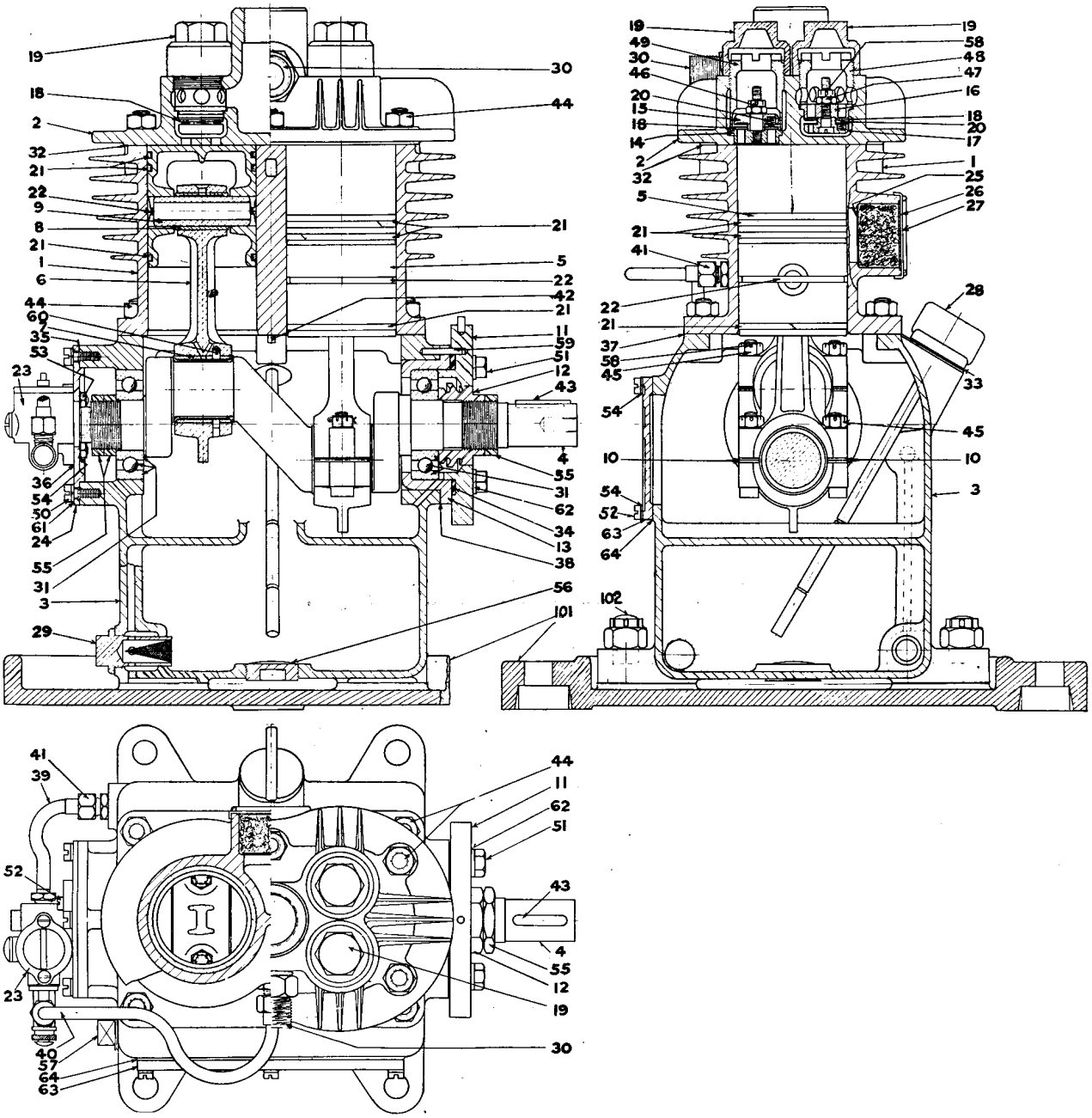
Pressure adjustment is simple and particularly accessible.

The air strainer is a self-contained unit and screws direct into the top of the casting.

The regulating valves and their seats are also self-contained units, and can be quickly removed when the body is detached from the base by loosening small screws, the purpose of which is to ensure that the valve seats are replaced in their proper positions.

No pipe connection need be broken to remove the operating parts, these being all contained in the body, which is detachable from the base or pipe bracket.

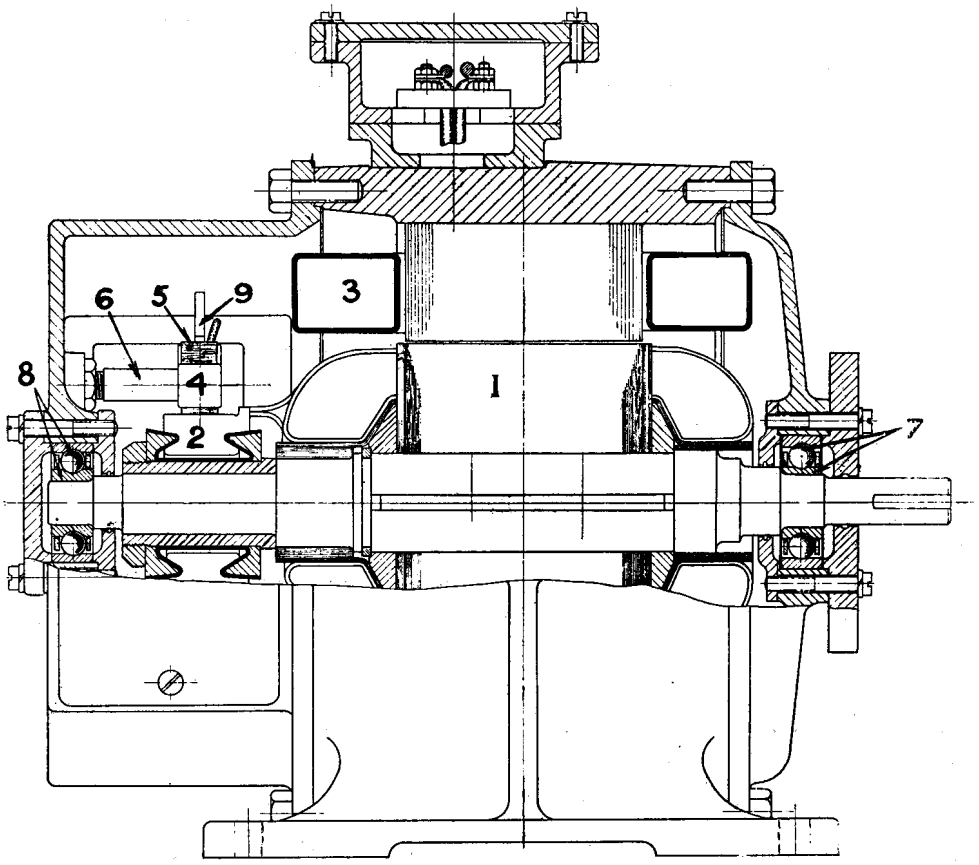
Air Compressor, Type E.13



Air Compressor, Type E.13

Ref. No.	Name of Part.
1	Cylinder.
2	Cylinder Head.
2A	*Cylinder Head Complete—includes two each of* 14, 15, 16, 17, 46, 47, 48, 49, *four each of* 18, 19, *twelve of* 20, *one of* 30 *and* 32.
3	Crankcase (includes 63 and 64, and two of 52).
4	Crankshaft.
4A	*Crankshaft Complete—includes three of* 55, *one of* 12 *and* 43, *and two of* 31.
5	Piston.
5A	*Piston Complete—includes one each of* 9, 22, *and three of* 21.
6	Connecting Rod—includes one each of 8 and 60, two each of 7, 45 and 58.
7	Big End Brasses.
8	Small End Bush.
9	Gudgeon Pin.
10	Laminated Shims.
11	Bearing Cover (driving end).
12	Oil Thrower.
13	Bearing Bush (driving end).
14A	*Delivery Valve Complete—includes one each of* 14, 15, 18, 46, 58, *and three of* 20.
14	Delivery Valve Seat.
15	Delivery Valve Guide.
16A	*Suction Valve Complete—includes one each of* 16, 17, 18, 47, 58, *and three of* 20.
16	Suction Valve Seat.
17	Suction Valve Guide.
18	Disc Valve.
19	Valve Cap.
20	Valve Spring.
21	Piston Packing Ring.
22	Gudgeon Pin Retaining Ring.
23	Pump complete.
—	Gear Wheel and Sleeve for Oil Pump (not shown). Ref. 5061.3 (see page 13).
24	Bearing Cover, Pump end.
25	Inner Vent Plate.
26	Outer Vent Plate.
27	Vent Plate Retaining Wire.
28	Oil Filling Plug and Dipstick.
29	Oil Strainer.
30	Air Delivery Nipples.
31	Ball Bearings.
32	Cylinder Head Gasket.
33	Oil Filling Plug Gasket.
34	Bearing Cover Gasket (driving end).
35	Bearing Cover Gasket (Pump end).
36	Oil Pump Gasket.
37	Cylinder Gasket.
38	Bearing Bush Gasket.
39	Oil Pipe (Suction).
40	Oil Pipe (Delivery).
41	Brass Union.
42	Spigot Tube.
43	Crankshaft Key.
44	Stud and Nut (cylinder head to cylinder, and cylinder to crankcase).
45	Bolt and Nut (Connecting Rod).
46	Delivery Valve Stud and Nut.
47	Suction Valve Bolt and Nut.
48	Suction Valve Holder.
49	Delivery Valve Holder.
50	Cheesehead Screws (bearing cover, pump end).
51	Bolt for cover (driving end).
52	Cheesehead Screw for Pump and Crankcase Side Cover.
53	Nut for ditto.
54	Spring Washer.
55	Crankshaft Nut.
56	1″ Plug.
57	½″ Plug.
58	Split Pin for Connecting Rod or Valves.
59	Dowel Pin (Crankcase).
60	Dowel Pin (Big-end Brasses).
61	Spring Washer.
62	Spring Washer.
63	Crankcase Side Cover.
64	,, ,, ,, Gasket.
101	Bedplate.
102	Stud, Castle Nut and Pin complete.

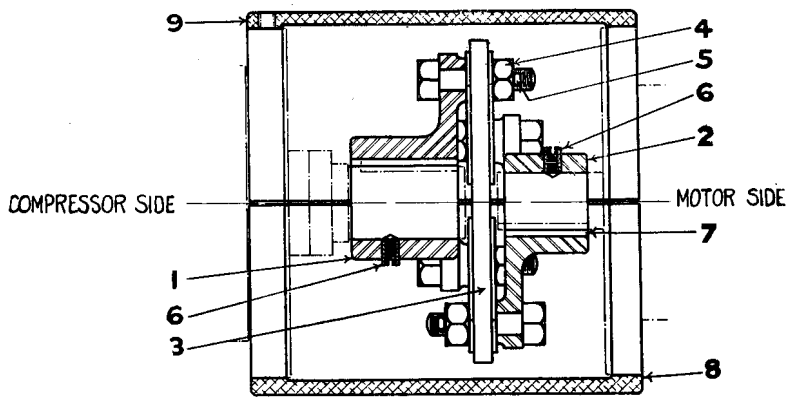
Electric Motor for Type E.13 Air Compressor



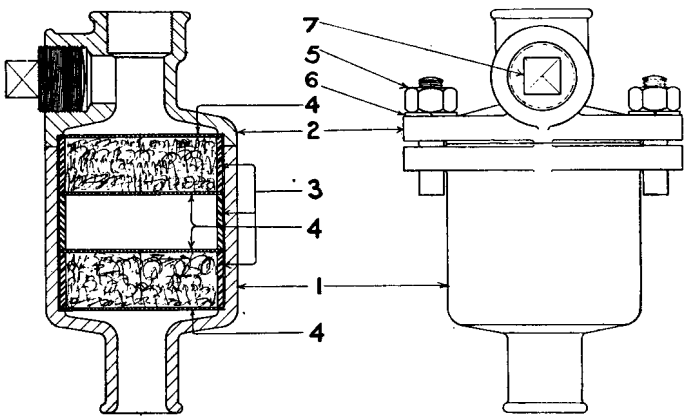
Ref. No.	*Name of Part.*
1	Armature complete.
2	Commutator.
3	Field Coil.
4	Brush Holder, complete.
5	Bru-h.
6	Brush Holder insulated rod and nut.
7	Rear end bearing complete.
8	Front end bearing complete.
9	Brush Spring.

Flexible Coupling

between Type E.13 Compressor and Electric Motor



Ref. No.	*Name of Part.*
1	Coupling, Compressor half.
2	,, Motor half.
3	Coupling disc.
4	Bolt and Nut.
5	Split Pin.
6	Grub Screw.
7	Key for Motor Shaft.
8	Coupling Cover, bottom half.
9	,, top half.
10	Cover Hinge Pin. Not shown.
11	Eyebolt Hinge Pin. ,,
12	Eyebolt complete. ,,
13	Spring Washer for Eyebolt. Not shown.
14	Spint Pin for Eyebolt Hinge Pin and Cover hinge Pin. Not shown.

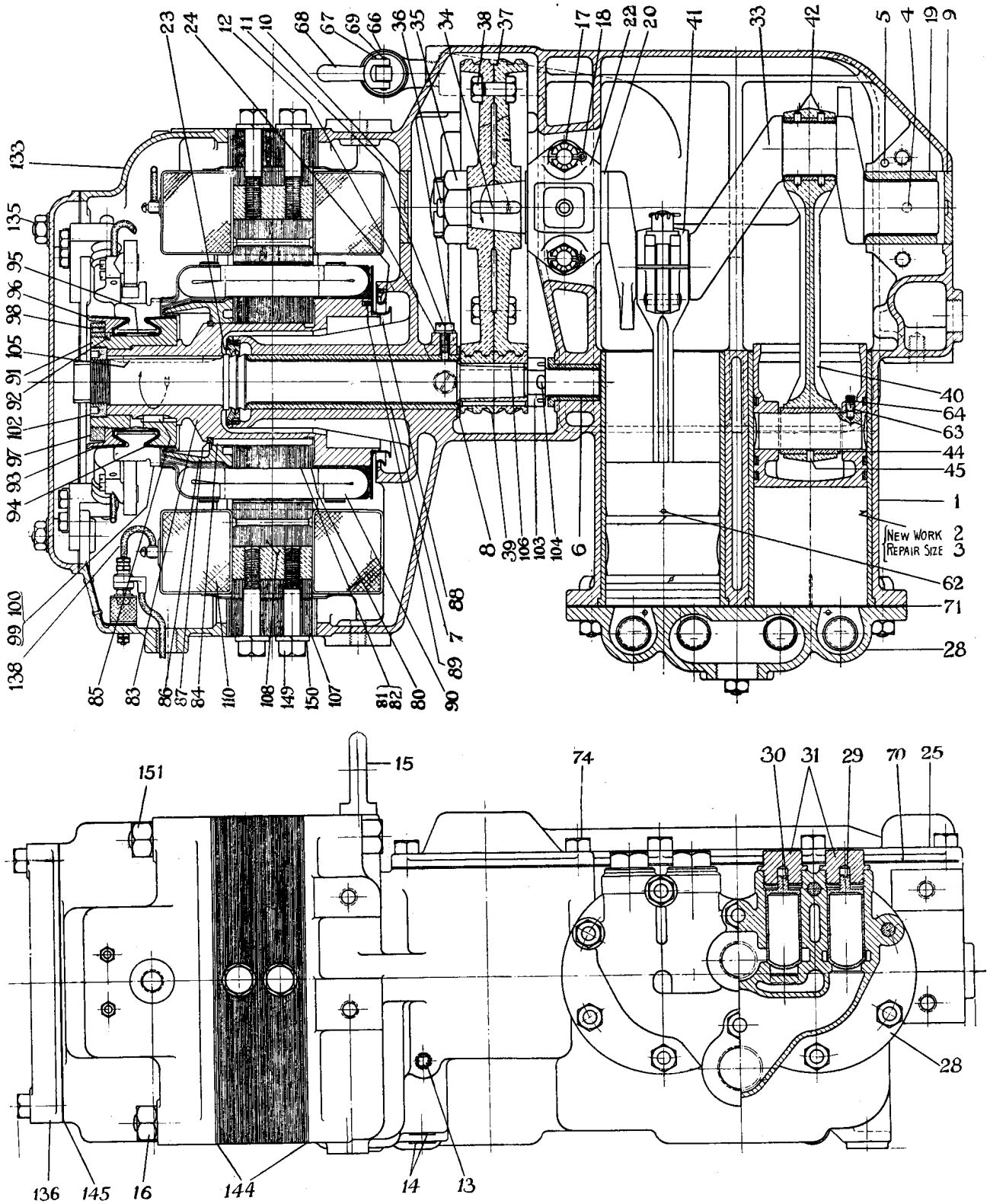


Suction Strainer.

for Type E.13 Air Compressor

Ref. No.	*Name of Part.*
1	Body.
2	Cover.
3	Distance Piece.
4	Perforated Plate.
5	$\frac{1}{2}'' \times 1\frac{7}{8}''$ Tee Head Bolt.
6	$\frac{1}{2}''$ Spring Washer.
7	Plug.
8	Curled Hair.

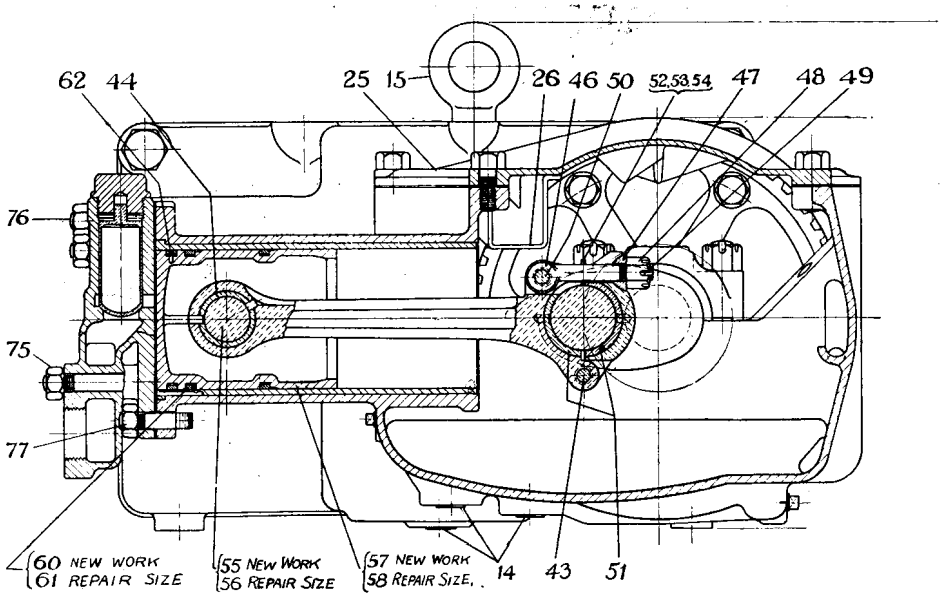
Air Compressor Type D.H.

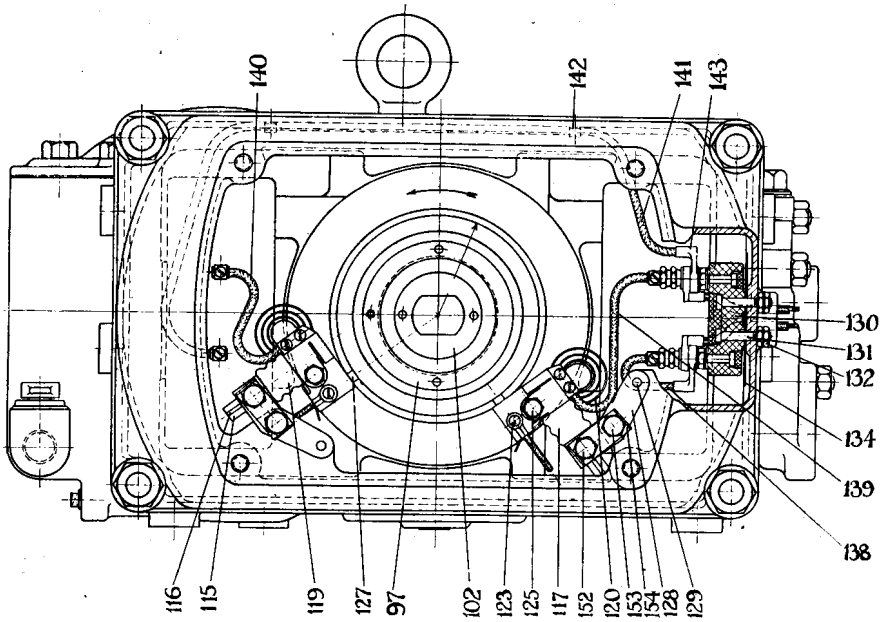


Air Compressor Type D.H.

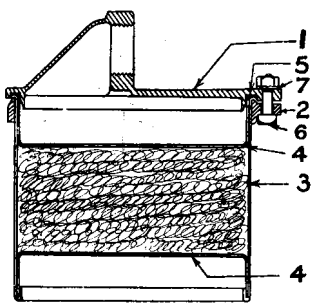
Ref. No.	Name of Part.
1	Cylinder and Crankcase (includes 1 each of 6, 7, 8, 9, 10, 11, 12, 15 ; 2 each of 2, 4, 5, 16 ; 3 each of 13, 14 ; and 4 each of 17, 18.
2	Cylinder Liner (New).
3	,, ,, (Repair Size).
4	Dowel Pin, $\frac{3}{8}'' \times \frac{5}{8}''$.
5	,, $\frac{5}{16}'' \times \frac{7}{8}''$.
6	Small Motor Bearing.
7	Motor Bearing.
8	Non-Magnetic Washer.
9	Plug for Crankcase.
10	,, Motor Crankcase.
11	$\frac{3}{8}''$ Set Screw, for Motor Bearing.
12	Lock Washer for do.
13	$\frac{3}{8}''$ Pipe Plug.
14	$\frac{3}{4}''$ Socket Plug.
15	$\frac{3}{4}''$ Lifting Eye Bolt.
16	Stud and Nut, End Bell to Casing.
17	$\frac{5}{8}''$ Stud and Nut for Bearing Caps.
18	Split Pin for do.
19	Rear Crankshaft Bearing.
20	Front do.
21	Rear do. Cap (not shown).
22	Front do. Cap.
23	Oil Deflector for Motor End of Casing.
24	Oil Deflector.
25	Crank Case Top Cover (includes 1 of 26 and 3 of 27).
26	Oil Trough.
27	Rivets for do. (not shown).
28	Cylinder Cover (includes 2 of each of 29, 30, and 4 of 31).
29	Inlet Valve.
30	Discharge Valve.
31	Valve Chamber Cap.
32	Casing Vent Nozzle (not shown).
33	Crankshaft (includes 1 each of 34, 35, 36).
34	Crankshaft Key.
35	,, Nut.
36	Split Pin for do.
37	Gear Wheel (includes 6 of 38).
38	$\frac{1}{2}''$ Bolt and Nut for do.
39	Pinion Wheel complete.
40	Connecting Rod complete (includes 1 each of 41, 43, 44, 45, 46, 47, 48, 49, 50, 52 ; 2 of 51 ; 3 of 53 ; 4 of 42 ; and 5 of 54).
41	Connecting Rod Cap.
42	Dowel Pin.
43	Pin for Securing Cap.
44	Gudgeon Pin Bush.
45	Dowel Pin.
46	Eye Bolt.
47	Alignment Washer.
48	Castle Nut for Eye Bolt.
49	Split Pin for do.
50	Pin for Securing Eye Bolt.
51	Connecting Rod Bearing ($\frac{1}{2}$).
52	Con. Rod Shims, $\frac{1}{16}''$ thick.
53	,, ,, ·006″ thick.
54	,, ,, ·009″ thick.
55	Gudgeon Pin (New).
56	,, (Repair Size).
57	Piston (New).
58	,, (Repair Size).
59	Piston complete (includes 1 each of 57, 63, 64 ; 2 of 62 ; and 3 of 60).
60	Piston Ring (New).
61	,, ,, (Repair Size).
62	Dowel Pin.
63	$\frac{3}{8}''$ Grub Screws for Gudgeon Pin.
64	Split Pin for do.
65	Oil Filling Elbow complete (includes 1 each of 66, 67, 68, 69).
66	Oil Filling Elbow.
67	,, ,, ,, Plug.
68	,, ,, ,, Handle.
69	Pin for do.
70	Gasket, Top Cover to Crank Case.
71	Gasket, Cylinder Cover to Cylinder.
72	No. 3BA. Screw for Oil Deflector. } (not
73	No. 1BA. ,, ,, } shown)
74	$\frac{1}{2}''$ Set Screw for Top Cover.
75	$\frac{1}{2}''$ Tee Bolt & Nut for Cyl. Cover (4″ long).
76	$\frac{1}{2}''$ do. ($1\frac{5}{8}''$ long).
77	$\frac{1}{2}''$ do. (3″ long).

D.H. Compressor (continued)





8in. Suction Strainer, Type H

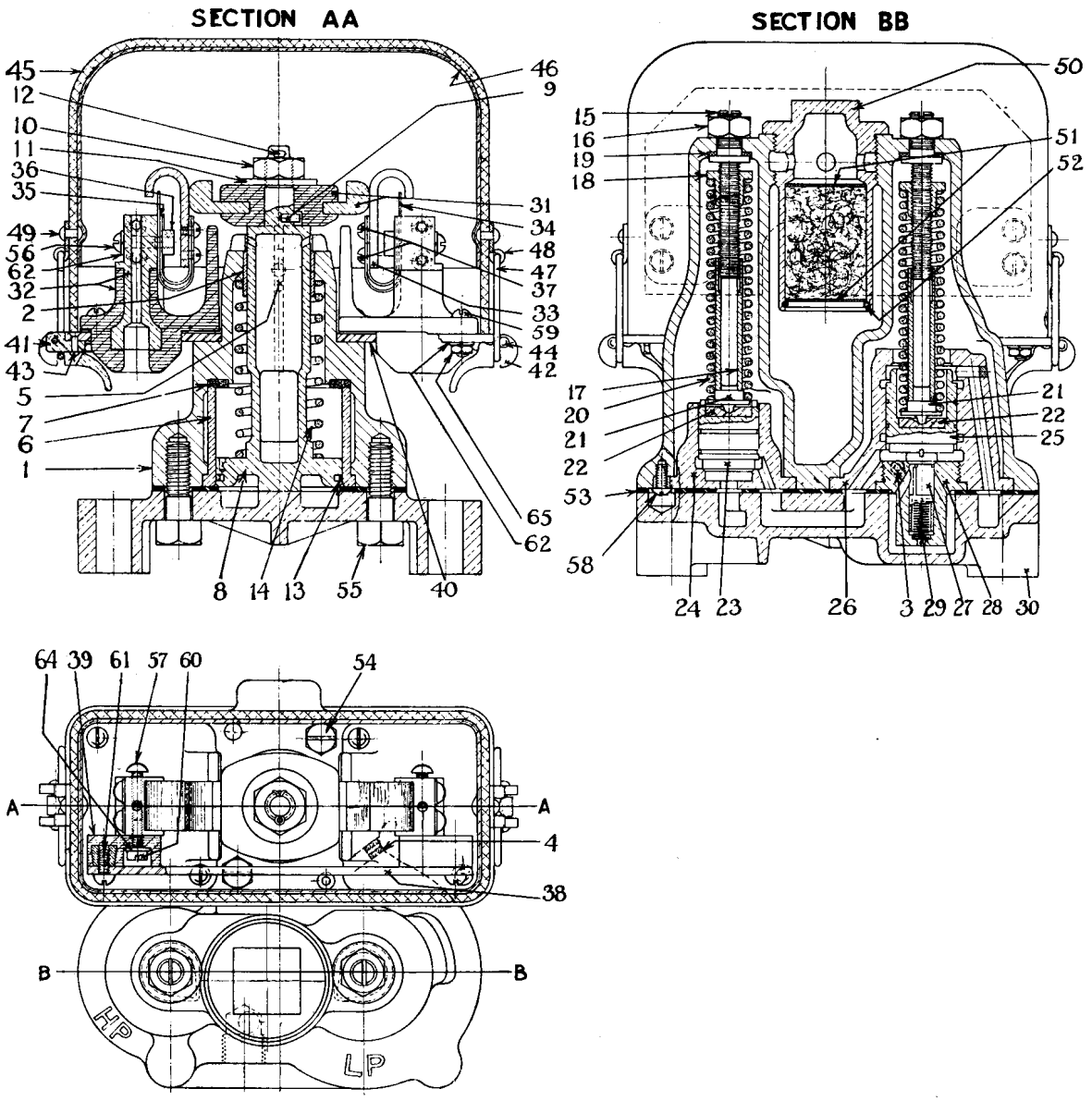


Ref. No.	*Name of Part.*
1	Cover.
2	Ring.
3	Shell.
4	Strainer Plates.
5	Gasket.
6	Bolt and Nut.
7	Lock Washer.
—	Curled Hair.

D.H. Compressor (continued)

Ref. No.	Name of Part.
79	Armature complete.
80	,, Core End Laminations, ·064" thick, 8⅞" dia.
81	Armature Core Laminations, ·018" thick, 8⅞" dia.
82	Ditto ·018" thick, 9" dia.
83	Armature Spider.
84	Key for Armature Core.
85	,, Commutator.
86	Front Coil Support.
87	,, ,, ,, Ring.
88	Oil Deflector.
89	No. 4BA. Screws for ditto.
90	Armature Coil complete (45 per set).
91	Commutator Bushing (includes 1 of 92).
92	Dowel Pin for ditto.
93	Commutator Front Insulating V. Ring.
94	,, Rear Insulating V. Ring.
95	,, Insulating Sleeve.
96	,, Taper Ring.
97	,, Nut.
98	Grub Screw for ditto.
99	Commutator Segments.
100	,, ,, Insulating Strips.
101	Armature Shaft complete (includes 1 each of 102, 103, 104, 105, 106).
102	Armature Shaft Nut.
103	Pinion Wheel Nut.
104	Split Pin for ditto.
105	Armature Shaft Key for Spider.
106	Ditto for Pinion Wheel.
107	Field Yoke complete.
108	Salient Pole complete (includes 1 of 109).
109	Salient Pole Nut (not shown).
110	Field Coil complete.
111	R.H. Carbon Holder complete (includes 1 each of 113, 115, 116, 117, 118, 119, 120, 122, 124, 125, 126 ; and 3 of 123).
112	L.H. Carbon Holder complete (includes 1 each of 114, 115, 116, 117, 118, 119, 120, 122, 124, 125, 126 ; and 3 of 123).
113	R. H. Carbon Holder.
114	L.H. ,, ,,
115	Carbon Holder Stud.
116	,, ,, ,, Key.
117	,, ,, ,, Insulation (not shown).
118	Carbon Holder Insulating Tube (not shown).
119	Carbon Holder Insulating Sleeve.
120	Carbon Holder Spring (includes 1 of 121).
121	Carbon Holder Spring Wearing Plate (not shown).
122	Carbon Holder Lead Sleeve (not shown).
123	Cheese Head Screw.
124	Lock Washer (not shown).
125	5/16" Set Screw for Clamping.
126	Lock Washer for ditto.
127	Carbons.
128	Carbon Holder Clamp complete (includes 1 of 129).
129	Dowel Pin.
130	Terminal Block complete (2-way).
131	Sq. Hd. Bolt, Terminal Block to End Bell.
132	¼" Lock Nuts for ditto.
133	Front End Bell complete (includes 1 of 134 and 4 of 135).
134	Terminal Block Insulation.
135	Stud and Nut, Commutator Cover to End Bell.
136	Commutator Cover.
137	Nameplate.
138	Lead, Terminal to Field Coil.
139	,, Field Coil to Brush.
140	,, Brush to Field Coil.
141	,, Field Coil to Terminal.
142	Cleats (single) for ditto.
143	Connectors.
144	Gasket, Field Yoke to Casing and End Bell.
145	Gasket, Commutator Cover to End Bell.
146	Cheese Hd. Screw for Cleats (not shown).
147	Lock Washer for ditto (not shown).
148	Screw for Nameplate (not shown).
149	Set Screw for Salient Pole.
150	Lock Washer for ditto.
151	Bolt and Nut, End Bell to Casing.
152	Set Screw, Cup Point, Clamp to Stud.
153	Set Screw, Clamp to End Bell.
154	Double Lock Washer for ditto.

Air Compressor Governor
Type E.S.16

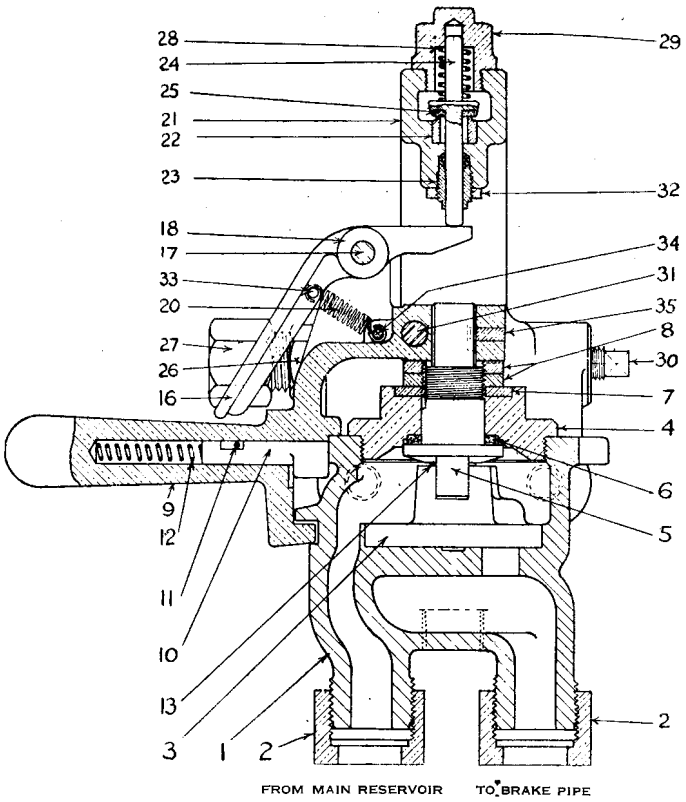


Air Compressor Governor, Type E.S.16

Ref. No.	Name of Part.
—	*Body complete* (*includes* 1, 2, 3, 4 *and* 5).
1	Body only.
2	Piston Stem Bush.
3	Choke Plug $\frac{3}{16}$″ × $\frac{3}{16}$″ with $\frac{1}{16}$″ hole.
4	Choke Plug $\frac{3}{16}$″ × $\frac{1}{4}$″ with $\frac{1}{16}$″ hole.
5	Guide Pin for Switch Piston.
6	Piston Bush.
7	Piston Seat.
—	*Piston complete* (*includes* 8, 9, 10, 11 *and* 12).
8	Piston only.
9	Pin for ditto. $\frac{1}{8}$″ × $\frac{3}{32}$″.
10	Piston Nut.
11	Piston Washer.
12	Split Pin. $\frac{3}{32}$″ × $\frac{5}{8}$″.
13	Piston Ring.
14	Piston Spring.
15	Valve Adjusting Stem.
16	Lock Nut for ditto.
17	Valve Adjusting Stem Sleeve.
18	Valve Adjusting Nut.
19	Valve Adjusting Washer.
20	Adjusting Spring.
21	Adjusting Spring Seat.
—	*Cut-out Valve, complete with Centring Seat* (*includes* 22 *and* 23).
22	Centring Seat.
23	Cut-out Valve only.
24	Cut-out Valve Seat.
—	*Cut-in Valve, complete with Centring Seat* (*includes* 22 *and* 25).
25	Cut-in Valve only.
26	Cut-in Valve Seat.
27	Cut-in Tail Valve.
28	Cut-in Tail Valve Seat.
29	Cut-in Tail Valve Spring.
30	Bracket.
31	Insulated Switch Contact.
32	Insulated Finger Base.
—	*Spring Finger complete* (*includes* 1 *each of* 33, 34, 35, 36; 3 *of* 37; *and* 6 *of* 35).

Ref. No.	Name of Part.
33	Finger only.
34	Finger Spring.
35	Finger Laminations.
36	Finger Washer.
37	No. 4 B.A. Screws for Finger.
38	Arc Shield.
39	Insulated Arc Shield Spacer.
—	*Finger Base Plate complete* (*includes* 1 *of* 40, *and* 2 *each of* 41, 42, 43 *and* 44).
40	Finger Base Plate only.
41	Latch Fulcrum Bracket.
42	Latch.
43	Rivet: Fulcrum Bracket to Plate.
44	Rivet: Fulcrum Bracket to Latch.
—	*Cover complete* (*includes* 1 *each of* 45, 46, *and* 2 *each of* 47, 48, 49).
45	Cover only.
46	Asbestos Lining for ditto.
47	Latch Ring.
48	Latch Ring Hanger.
49	Rivet: Cover to Hanger.
—	*Strainer complete* (*includes* 1 *each of* 50, 52, 2 *of* 51, *and hair*).
50	Strainer Case.
51	Strainer Plate.
52	Strainer Plate Ring.
—	Curled Hair.
53	Gasket: Bracket to Body.
54	$\frac{1}{4}$″ Set Screw: Base Plate to Body.
55	$\frac{3}{8}$″ Set Screw: Bracket to Body.
56	Screw No. 2BA: Switch Finger to Base.
57	Screw No. 2BA: Leads to Base.
58	Screw No. 2BA: Valve Seat to Body.
59	Screw No. 2BA: Finger Base to Base Plate.
60	Screw No. 2BA: Finger Base to Arc Shield Spacer.
61	Screw No. 2BA: Arc Shield to Arc Shield Spacer.
62	Lock Washer for 56. / Lock Washer for 59.
63	Lock Washer for 54 (not shown).
64	Plain Washer for 60.
65	Hexagon Nut for 59.

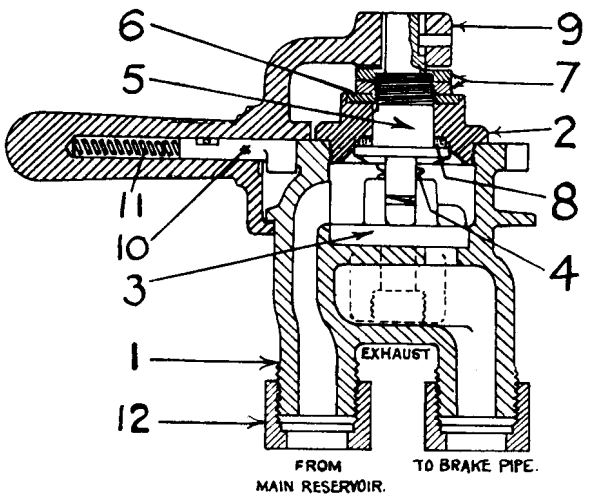
Brake Valve No. 13



Ref. No.	*Name of Part.*	*Ref. No.*	*Name of Part.*
1	Body.	19	Sanding Lever Split Pin (not shown).
2	Union Nut (Main Reservoir & Brake Pipe).	20	,, ,, Spring.
3	Main Valve.	21	,, Valve Body.
4	,, Chamber Cap.	22	,, ,, Body Bush.
5	,, Spindle.	23	,, ,, Gland.
6	,, ,, Gasket.	24	,, Valve.
7	,, ,, Washer.	25	,, ,, Gasket.
8	,, ,, Nuts.	26	,, ,, Union Nipple.
9	Handle with Sanding Attachment.	27	,, ,, Union Nut.
10	Handle Stop.	28	,, ,, Spring.
11	,, Pin.	29	,, ,, Chamber Cap.
12	,, Spring.	30	$\frac{1}{4}$" Gas Plug.
13	Main Valve Spring.	31	Bolt, Wing-nut and Washer.
14	Gasket, Sanding Valve or Blank Flange to body (not shown).	32	Lock-nut for Valve Gland.
15	Stud and Nut ,, ,, (not shown).	33	Pin for Sanding Lever.
16	Sanding Lever.	34	,, ,, Spring.
17	,, ,, Pin.	35	,, ,, Handle Peg.
18	,, ,, ,, Washer.	36	,, ,, Clamping Bolt (not shown).
		37	*Blank Flange (not shown).* (*See note below.*)

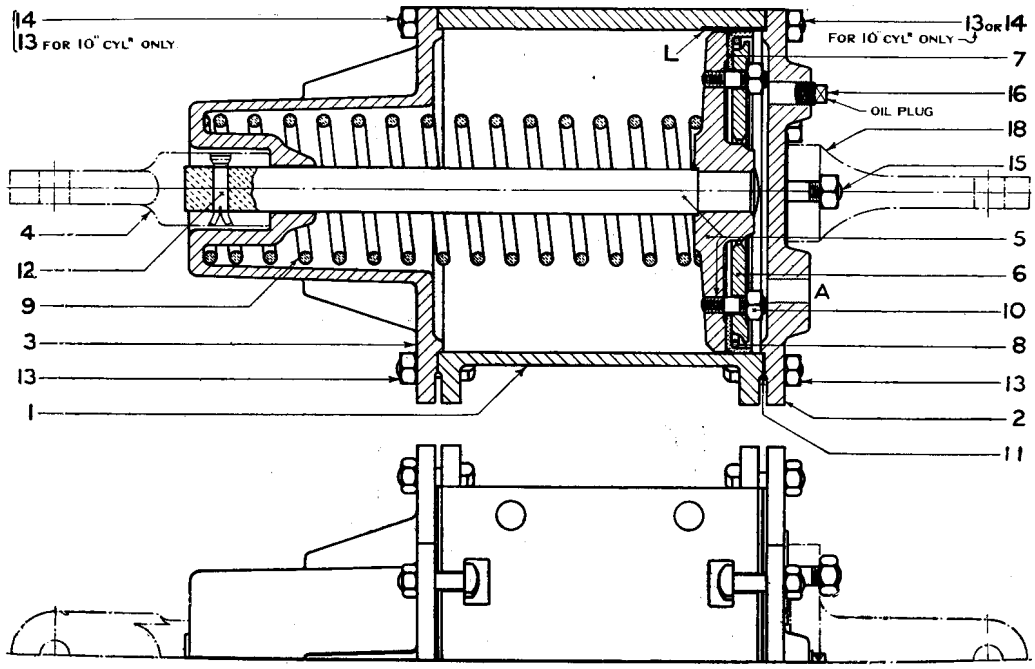
N.B.—This brake valve can be supplied without the sanding valve, in which case parts Nos. 16 to 30 are omitted, and a blank flange substituted therefor.

Brake Valve No. 9



Ref. No.	*Name of Part.*
1	Body.
2	Main Valve Chamber Cap.
3	Main Valve.
4	,, Spring.
5	,, Spindle.
6	,, ,, Washer.
7	,, ,, Nuts.
8	,, ,, Gasket.
9	Handle.
10	,, Stop.
11	,, ,, Spring.
12	Union Nut (Main Reservoir and Brake Pipe).
	Fixing Stud and Nut (not shown).

Brake Cylinder



FOR sizes of brake cylinders, see page 7.

Orders should state size and stroke of cylinder for which repair part is required, and whether piston has a fixed push rod as shown, or loose rod with trunk.

Ref. No.	*Name of Part.*
1	Body (state whether for 12″ or 8″ stroke).
2	Cover.
3	Head.
4	Crosshead (Flat Ordinary or Flat Slotted).
5	Piston and rod with studs and nuts only.
5A	,, ,, complete (includes 1 each of 5, 6, 7, 8).
5B	*Piston Rod for trunk piston cylinder.*
5C	,, *and trunk complete with studs and nuts only.*
6	,, Follower.
7	,, Packing Leather.
8	,, ,, Expander.
9	Release Spring (state whether for 12″ or 8″ stroke).
10	Piston Stud and Nut.
11	Gasket for Cover.
12	Crosshead Pin.
13	Bolt and Nut.
14	Stud and Nut.
15	,, ,, for Fulcrum Bracket.
16	Plug, $\frac{1}{2}$″ Gas.
17	Fulcrum Bracket.

N.B.—Crossheads and Fulcrum Brackets.

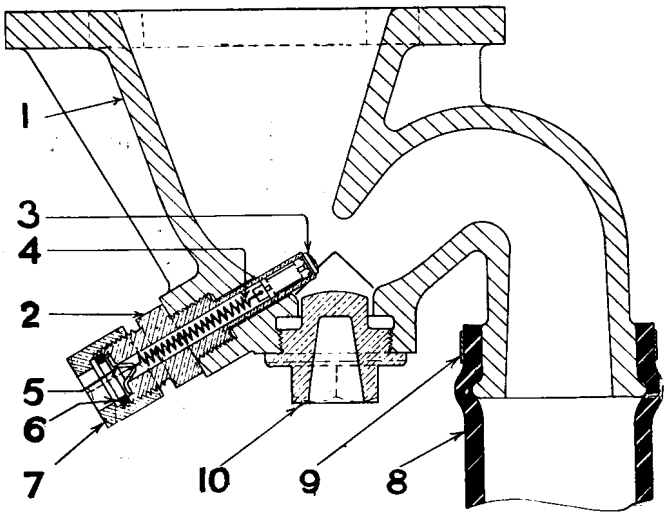
If the hand brake is connected to the air brake cylinder lever, specify " Flat Slotted Crosshead " ; but if the hand brake has no connection to this lever, specify " Flat Ordinary Crosshead."

If brake cylinder is fitted with a loose push rod, crosshead and fulcrum bracket are not required.

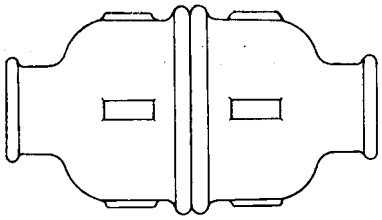
Leakage groove L is used only for " automatic " brakes, and is not provided in cylinders when " straight air " brakes are fitted.

Sand Ejectors

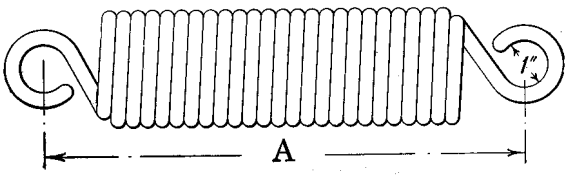
Ref. No.	Name of Part.
1	Body.
1A	*Body, with nozzle screwed for metal pipe (not shown).*
2	Nozzle.
3	Nozzle Valve.
4	Valve Spring.
5	Spring Anchor.
6	Leather Gasket.
7	Union Nut.
8	Hose (state length required).
9	Clamp.
10	Cap.



Exhaust Muffler



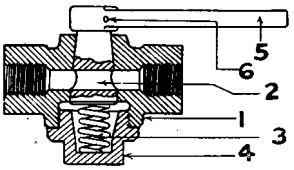
Release Springs



Length A.

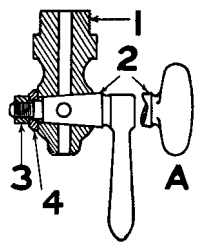
$7\frac{1}{4}''$, $9\frac{1}{2}''$, or $10\frac{3}{16}''$

Governor Isolating Cock



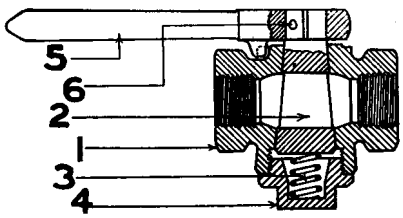
1. Body. 2. Plug.
3. Spring. 4. Cap.
5. Handle. 6. Handle Pin.

Reservoir Drain Cocks

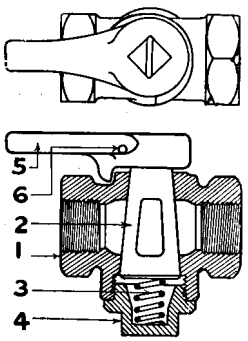


Ref. 1. Body.
2. Plug Handle.
3. Nut.
4. Washer.

Open in line of Pipe.

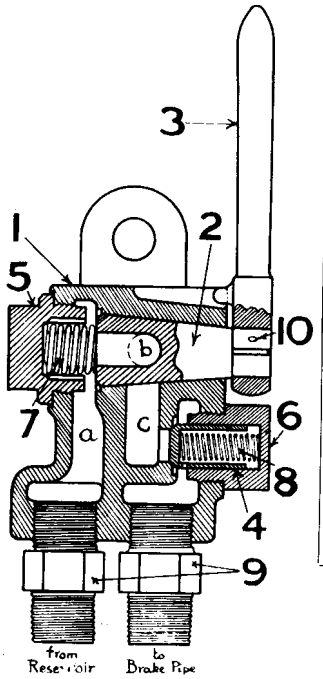


Closed in line of Pipe.



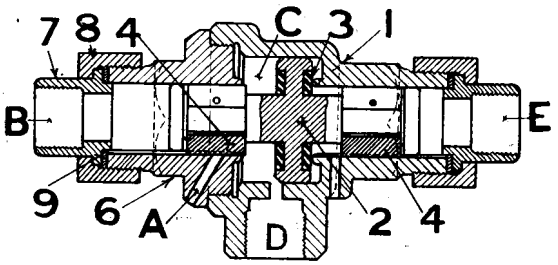
1. Body. 2. Plug. 3. Spring. 4. Cap. 5. Handle. 6. Handle Pin.

Conductor's Emergency Valve



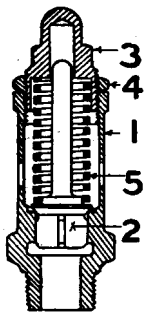
Ref. No.	*Name of Part.*
1	Body.
2	Plug.
3	Handle.
4	Valve.
5	Cap for Plug.
6	,, Valve.
7	Spring for Plug.
8	,, ,, Valve.
9	Nipples.
10	Handle Pin.

Double Check Valve



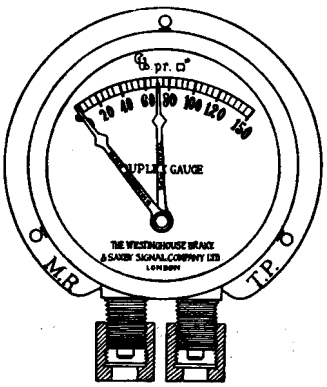
Ref. No.	*Name of Part.*
1	Body.
2	Piston.
3	Gaskets.
4	Slide Valve.
5	,, Spring (not shown).
6	Cap.
7	Union Socket.
8	,, Nut.
9	Gasket.

3/4" Safety Valve Type N.

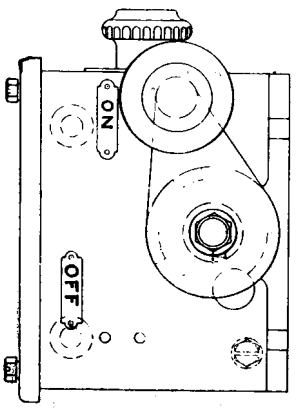


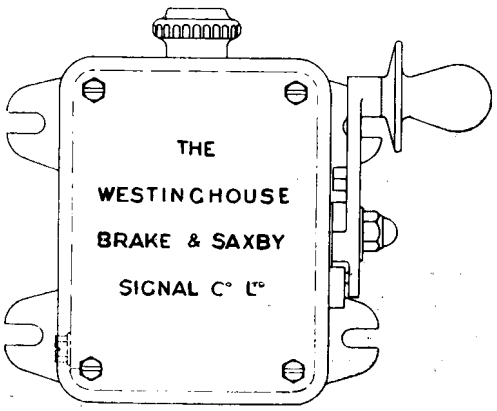
Ref. No.	*Name of Part.*
1	Body.
2	Valve.
3	Adjusting Screw.
4	Lock Nut.
5	Spring.

Duplex Pressure Gauge



Canopy Switch and Fuse





APPENDIX

Notes on Special Equipments

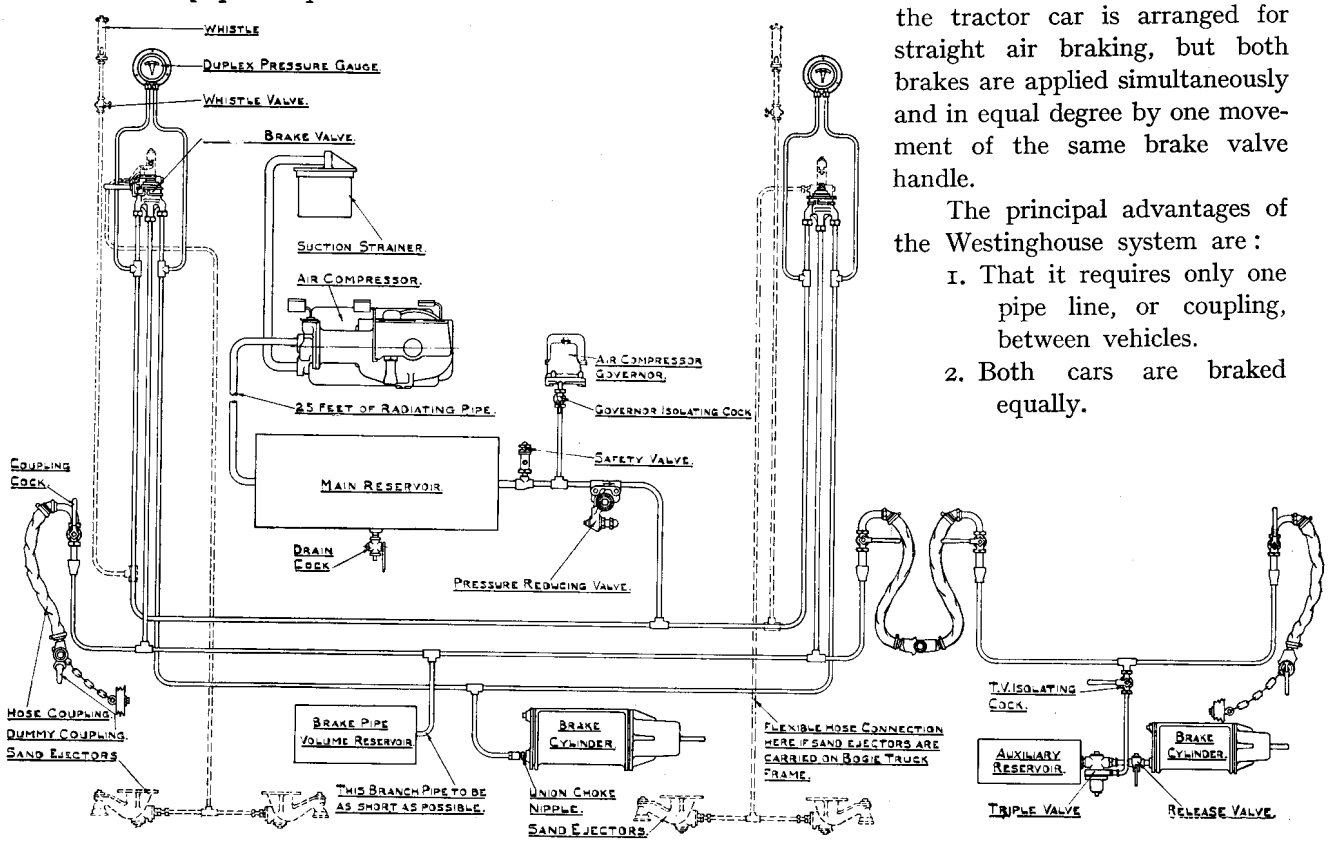
The Automatic Brake, Type N.A.M.

THE illustration below shows the complete equipment for a motor and a trailer, in which is incorporated the feature which causes the brake to be applied automatically to the trailer in event of a break-away.

The equipment provides for the automatic feature on the trailer only, while the apparatus on the tractor car is arranged for straight air braking, but both brakes are applied simultaneously and in equal degree by one movement of the same brake valve handle.

The principal advantages of the Westinghouse system are:

1. That it requires only one pipe line, or coupling, between vehicles.
2. Both cars are braked equally.



3. Trailer brakes can be released and auxiliary reservoir on trailer re-charged without releasing the tractor car brakes.
4. All brakes can be released simultaneously and rapidly.
5. Automatic application of trailer brakes in the event of a break-away or rupture of brake pipe.

The trailer equipment is of the purely automatic type, viz., it consists of a brake cylinder, an auxiliary reservoir, and a triple valve. The latter is shown diagrammatically in Figs. 1 and 2, the connections being A to the brake pipe, B to the brake cylinder, and C to the auxiliary reservoir. Its operation is as follows: When compressed air is fed into the brake pipe the pressure pushes the piston D over to the left (Fig. 1), and in this position feed groove E is uncovered, so that air can pass through to chamber F and thence to the auxiliary reservoir, until the pressure in the latter equalises with that in the brake pipe. Should the pressure in the brake pipe, however, now be reduced, the higher pressure from the auxiliary reservoir immediately pushes the piston to the right (Fig. 2), first covering the feed groove E, and at the same time pulling slide valve G with it until port H coincides with port J connected to the brake cylinder, and opening graduating valve K, so that air from the auxiliary reservoir (C) can flow to the brake cylinder via valve G and ports H and J, thus applying the brakes. An application will also occur if the brake pipe pressure is lost through a coupling parting. Should the reduction in brake pipe pressure be less than that required for a full application of the brake, piston D will move towards the left immediately the pressure in the chamber F equals the reduced pressure in the brake pipe. This will close graduating valve K, cutting off the flow of air to the brake cylinder, the pressure in which will then be proportional to the brake pipe reduction. As soon as full pressure is restored to the brake pipe, the higher pressure therein pushes the piston D back to the left-hand side, first closing graduating valve K, and moving slide valve G until port H is blanked off. Cavity L in the slide valve then bridges port J with port M through which the air in the brake cylinder can then exhaust. The auxiliary reservoir is then fed up to brake pipe pressure again through feed groove E.

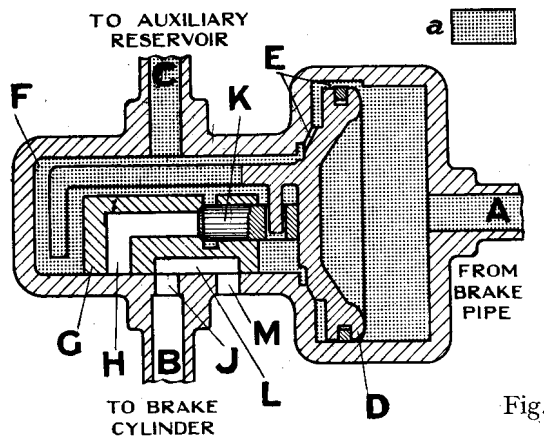


Fig. 1.

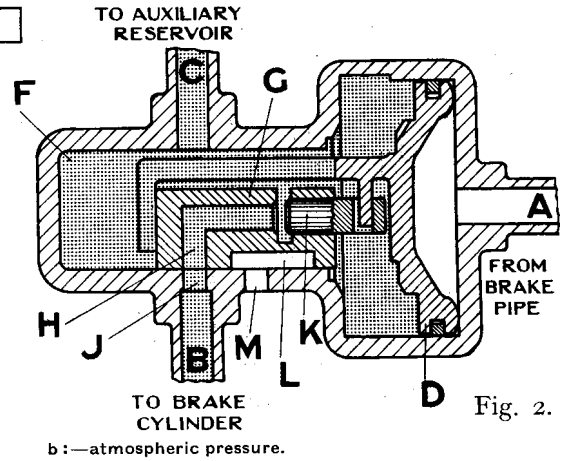


Fig. 2.

a :—brake pipe pressure. b :—atmospheric pressure.

The apparatus on the tractor car is very similar to the ordinary straight air-brake equipment, except that a volume reservoir, the purpose of which is explained later, is added ; the piping connections are differently made, and a brake valve No. 15.N is used. This valve is similar in construction to the No. 13, and can be fitted with sanding valve and trigger if desired, but the ports and rotary valve differ.

The positions of the brake valve handle are—

1. Total Release (running position).
2. Release trailer brakes while holding tractor brakes applied.
3. Lap (handle takes off in this position).
4. Service Application.
5. Emergency Application.

In **Position 1,** air is fed from the main reservoir, the pressure in which is controlled by a reducing valve at a maximum pressure of 70 lb. per sq. in., through ports in the brake valve to the automatic brake pipe, charging the brake pipe and releasing the brakes on the trailer car as described above ; and air previously admitted to the brake cylinder on the tractor is allowed to escape to atmosphere through ports in the brake valve.

In **Position 2,** air is still feeding from the main reservoir to the automatic brake pipe, thus releasing the trailer brakes and re-charging the auxiliary reservoir, but the ports in the brake valve communicating with the tractor brake cylinder are lapped. After a service application, the trailer car brakes can be released and re-charged with the tractor brakes still applied by moving the handle from lap to position 2. The tractor brakes can then be graduated off at will, by moving the handle between positions 1 and 2.

In **Position 3,** all ports in the brake valve are lapped. To release the brakes fully after a service application has been made, the handle should be moved from position 3 to position 1, and left there.

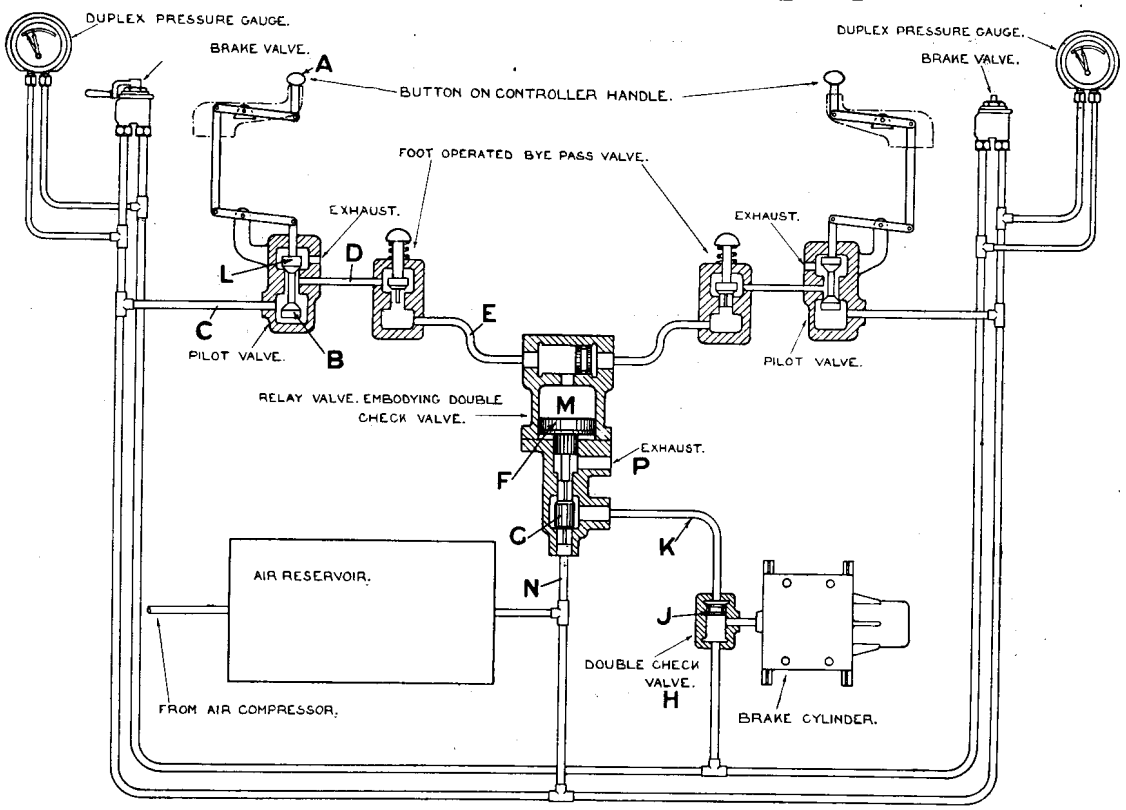
In **Position 4,** air from the automatic brake pipe is allowed to pass through ports in the brake valve to the tractor brake cylinder. To provide a proportional application of the brakes on tractor and trailer, a reservoir is connected to the brake pipe line on the tractor car so that, for example, when a full service application of the brakes has been made, the brake pipe pressure will have been reduced from 70 to 50 lb. per sq. in. This reduction of brake pipe pressure causes the trailer car triple valve to act, and feed up the brake cylinder to 50 lb. per sq. in. The tractor brake cylinder will also have been charged to 50 lb. per sq. in. by the air passed from the brake pipe and its reservoir, in reducing their pressure from 70 to 50 lb. per sq. in.

In **Position 5** the automatic brake pipe is vented direct to atmosphere, and main reservoir air is supplied direct (at 70 lb. per sq. in. pressure) to the tractor brake cylinder.

The handle should be moved sharply to this position, and left there until the tram stops ; and no attempt should be made to graduate the release after an emergency application. Sanding automatically takes place in this position of the handle, irrespective of the operation of the trigger, if pneumatic sanding is embodied in the equipment.

It should be noted that in the event of a break-away the trailer only has its brake applied automatically, the motorman on the tractor car applying his brake at will by moving the brake valve handle to emergency position.

One-man Car Brake Equipment



THE principal feature of this equipment is the provision of the " dead man " device, which causes an emergency brake application to be made should the motorman inadvertently remove his hand from the controller handle. This is important, as there is no conductor to apply the brakes in the event of any emergency.

The equipment consists of the ordinary straight air-brake apparatus, except for the conductor's emergency feature, which is replaced by a relay valve, a pilot valve, a foot-operated by-pass valve, a double-check valve, and a button on the controller handle. This button A must be kept depressed the whole time the car is travelling, so that the valve B in the pilot valve to which the button is connected is kept open to compressed air from the reservoir pipe line C, and the pressure can pass via pipes D and E to chamber M behind the large piston F of the relay valve. On the further end of the relay valve stem is a smaller valve G. This valve, although also exposed to reservoir pressure via pipe N, is kept closed on its outer seat by the pressure behind the piston F, which is of larger area than valve G.

Should the button A be released, valve B rises to its seat and cuts off the air supply from pipe C, at the same time opening valve L, so that the air in chamber M can exhaust via pipes E and D. When the pressure is removed from piston F, valve G is opened by pressure from pipe N and seated on its upper seat, so that the exhaust port P is cut off and air can flow via pipe K to the double check valve H in which the valve J is pushed to the further end, uncovering pipe R to the brake cylinder and applying the brake.

When button A is depressed again, air is re-admitted through pipes D and E to chamber M, forcing down piston F until valve G is seated at the lower end. Air from the brake cylinder can then exhaust through double check valve H, pipe K, past the upper side of valve G, and through port P.

So far, no reference has been made to the foot-operated bye-pass valve. Its purpose is to allow the motorman to remove his hand from the button A to collect fares, etc., without thereby applying the brakes and wasting reservoir pressure. Its operation is quite simple. When the plunger is depressed, communication between pipes D and E is cut off, so that the air in chamber M cannot escape when valve L in the pilot valve opens.

This equipment can be operated electrically by means of push buttons controlling circuits to the valves, which are electro-magnetically operated. In this case only one each of the pilot valve and by-pass valve is required, as they can be operated by parallel circuits from either end of the car.

ENQUIRY

The Westinghouse Brake and Saxby Signal Co. Ltd.,
82, York Road, King's Cross, London, N.1.

Dear Sirs,

We enclose herewith drawings of truck body and underframe of tramcar, and shall be glad to receive your estimate for the supply of ..... sets of Westinghouse Air Brake Equipment to meet the following particulars :—

Voltage ... ... Volts.

Weight of vehicle, empty ... ... Tons.

,, ,, loaded ... ... Tons.

Type of truck ... ...

Maximum speed on level ... ... m.p.h.

Maximum gradient ... ... 1 in.....

Length of maximum gradient ... ...

Maximum speed on gradients ... ... m.p.h.

Reservoirs *can / cannot be placed under seats.

Air compressor *can / cannot be placed on platform at one end of car.

*Wheel Brakes only / Combined wheel and track brakes } are required.

Pneumatic sanding * is / is not required.

* *Delete wording not required.*

Yours truly,

.....19.....