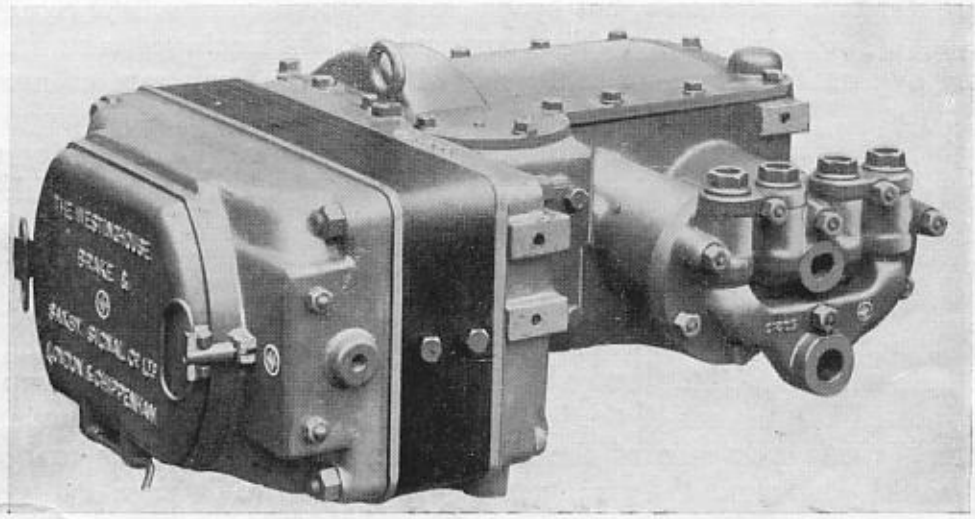
WESTINGHOUSE

MOTOR DRIVEN

AIR COMPRESSOR

Type DH.



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When considering the installation of electrically driven air compressors on railway, motor cars, and tramcars, difficulty is often experienced in finding a suitable location, owing not only to the presence of electrical equipment, etc., but also—and this is particularly the case with tramcars—to the small amount of clearance between the car frame and the track. The difficulty has hitherto been lost sight of somewhat in the design of air compressors driven by high-speed electric motors through reduction gearing, an arrangement which has prevented the restrictions in height and other dimensions necessitated by the above-named conditions.

THE TYPE DH
MOTOR DRIVEN AIR COMPRESSOR

has been designed especially to meet these conditions of restricted space and clearance, without in any way impairing the strength and efficiency which are characteristic of all Westinghouse productions. The overall height has been reduced to the minimum, and the weight kept down to the lowest possible; not by sacrificing any essential details, but by a careful disposition of all the compressor parts within one integral casting. The compactness of the machine has been further facilitated by locating the motor at the side of the compressor portion instead of behind it, with its pinion in front of the gear wheel. The gearing being of the "herringbone" type ensures smooth and quiet running. Accessibility to all working parts is attained by the provision of large doors and covers, which can be opened or removed easily and quickly.

Installation.

The compressor is attached to the car frame by three steel suspension hangers, fastened by two bolts each to lugs on the body casting, the weight of the compressor being supported by the ends of the hangers which are bent sharply underneath these lugs. The upper ends of the hangers, are secured by bolts to brackets attached to the car frame, the arrangement being as shown on page 8.

Special forms of suspension, embodying rubber pads under compression, are sometimes used in order to provide a resilient mounting.

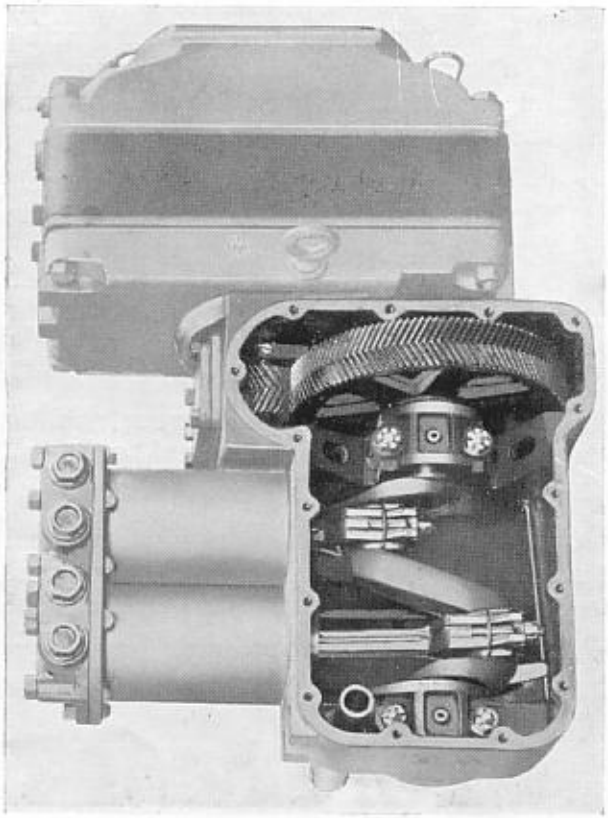
If floor fixing is required instead of suspension, three brackets are supplied, with holes which take the same bolts as used with the suspension brackets, and with holes also for fixing to the floor. The weight of the compressor in this case is taken by three bosses cast on the under side of the crankcase.

Wherever possible, the compressor should be mounted with the long axis at right angles to the centre line of the car, *i.e.* with the commutator door facing to one side of the car.

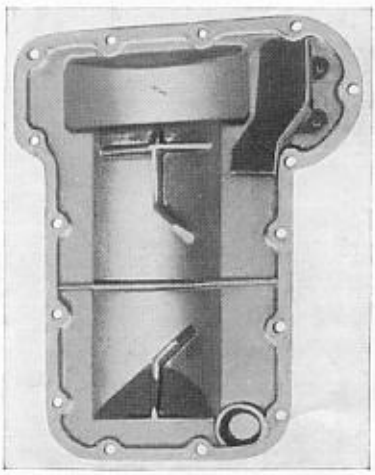
The compressor delivery pipe should include a length of approximately 25 feet of radiating pipe, of the same size as the delivery pipe, in order to cool the air as much as possible before it enters the reservoirs, this pipe being arranged to drain into the first reservoir.

GENERAL DESCRIPTION

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 air valves, four in number (one suction and one discharge valve for each cylinder) are located close to the cylinder compression space to reduce valve clearance. 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 ensure minimum and even wear on the cylinders, gudgeon pins, gudgeon pin bearings, and pistons themselves.

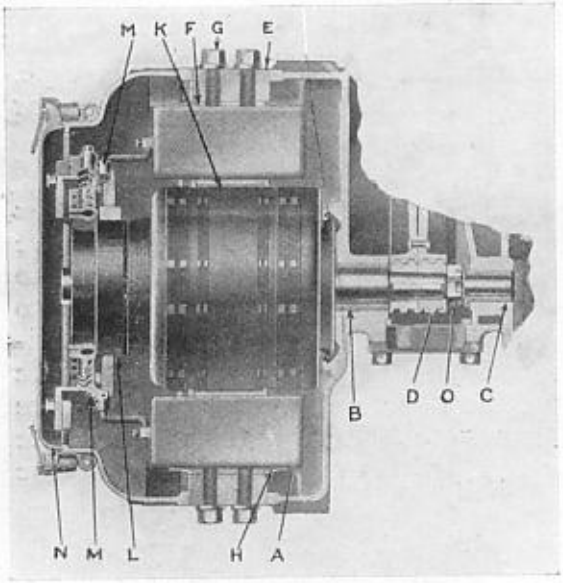
The pistons are fitted with two packing rings of the "snap" type, and one oil scraper ring.

The gudgeon pins are of hardened steel carefully ground, and are pressed into the pistons and held in place by slotted grub screws.

The connecting rods and crank shaft are drop forgings of high grade, oil-tempered steel.

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

The crank shaft design renders a centre bearing unnecessary.



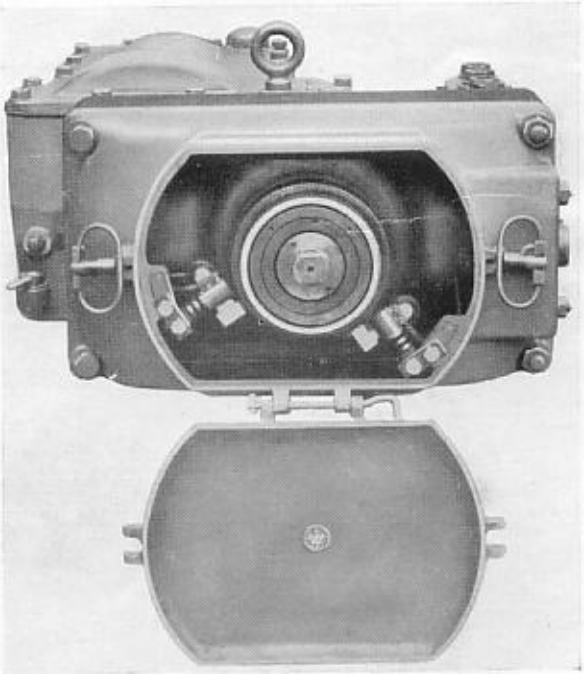
The motor is of the enclosed, four-pole, direct-current series-wound type, with two field coils **A**; is of the salient pole construction; and lies flat at the side of the compressor. It has no outboard bearing, but has a long liberal bearing **B** extending into the concave rear end of the armature beyond its centre of gravity, 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 soft steel; the consequent poles are a part of the field yoke.

The pole pieces **F** are each held in place by two set 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.

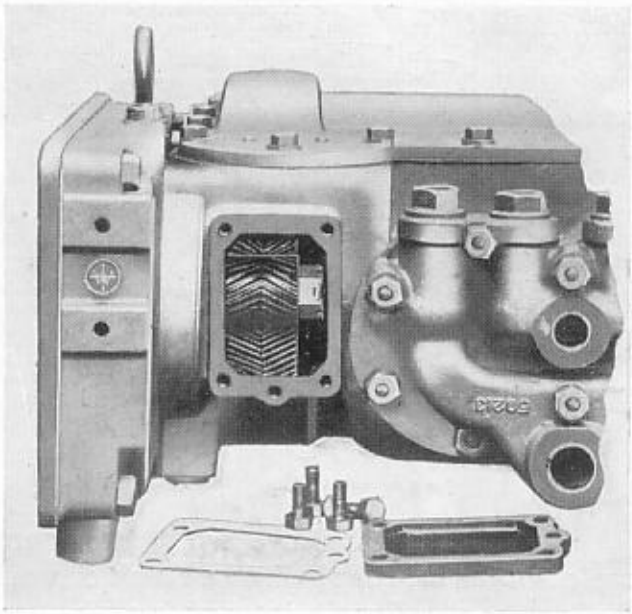
The armature **K** is of generous proportions and is built up of soft sheet steel punchings keyed to a spider. The coils are former wound and of uniform size. The commutator L is of liberal dimensions, the mica insulation between the commutator bars being undercut. The oiling system is designed with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



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 set 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.

ADJUSTMENTS AND REPAIRS



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

To remove the armature, open the commutator door and remove the brush holders. Take off the pinion chamber cover, withdraw the cotter, and place a wrench on the castle nut **O** to keep it from turning. With a wrench on the flats on the outer end of the armature shaft, turn the shaft to the left until it is unscrewed from the castle nut, after which the armature can be easily withdrawn from the motor.

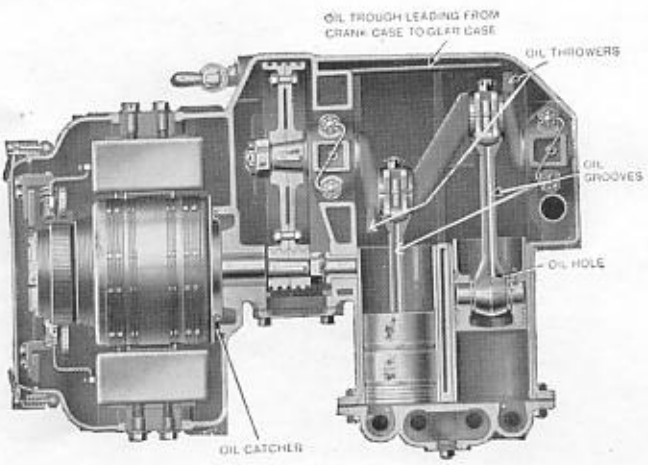
The procedure is simply reversed to replace the armature. Make the electrical connections as before and replace the brushes as they were, in order that the bearing between the brushes and commutator be not destroyed. If the brushes are inter-changed, they should be ground to a bearing by using a strip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

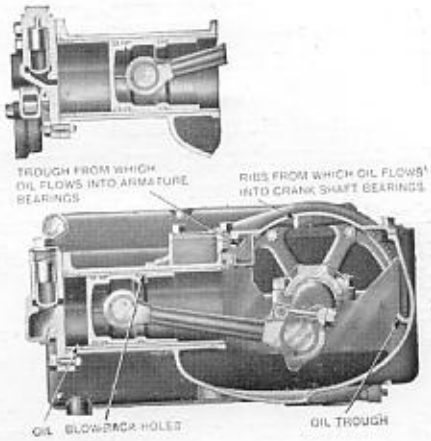
OPERATION

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

Inasmuch as there might at times be a slight vacuum or pressure in the crank case, due to the movement of the pistons and 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 3), connecting the interior of the crank case to the atmosphere. The fitting has been made long enough to ensure 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.

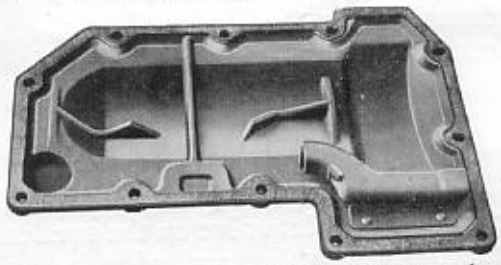
LUBRICATION





The oiling system is entirely automatic, requiring no attention other than to replenish the oil supply, in the crank case only, 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 compressor should be filled with oil to a level within $\frac{1}{2}$ inch of the top of the filler.

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.



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, ensures 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.

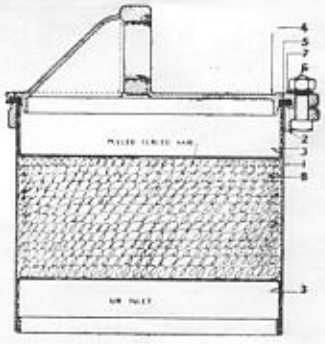
The concave end of the armature is protected by a metal shield and any oil which may have seeped past the bearing will be deflected into a passage and conducted away, instead of being permitted to reach the motor windings.

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 piston 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.

SUCTION STRAINER

A strainer of the type illustrated is supplied with this compressor. This should be mounted in a position where a clean cool air supply is available, and with the pipe connection uppermost as shown in the illustration.

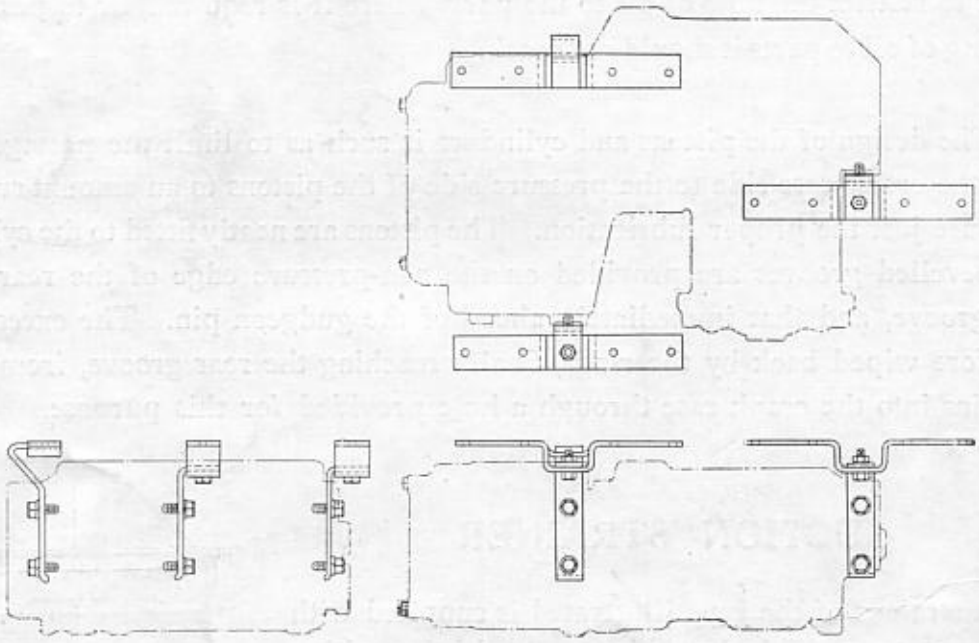


THE DH COMPRESSOR FOR BELT DRIVE

Where no motor is required, and the compressor is to be belt-driven the pinion shaft is extended to carry a pulley.

No outboard bearing is required for the shaft, as a long overhung bearing is provided in the crank case.

ARRANGEMENT OF SUSPENSION HANGERS FOR DH COMPRESSOR



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