

FOR

ELECTRIC RAILWAY SERVICE

7

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WESTINGHOUSE

AIR BRAKE COMPANY

TRACTION BRAKE DIVISION

WILMERDING, PA., U. S. A.



Fig. 1. Type "DII-16" Air Compressor



Fig. 2. Type D-3-F Air Compressor

Motor Driven Air Compressors

Motor driven air compressors are used on electric motor curs and electric locomotives as a part of the air brake equipment to supply compressed air for operation of the brake and a her air operated devices.

Westinghouse compressors have been on the market for many years and represent advanced engineering practice in design and construction as well as painstaking care in manufacture. Every effort has been made to produce compressors that are reliable, durable, efficient, quiet in operation, easy of acress, and as free from operating treubles as possible. These characteristics, together with low maintenance cost and little attention required, make certain types of Vertiaghouse compressors particularly suitable for industrial service as well.

Inasmuch as the compressors discussed in this pamphlet have many points in common, in order to avoid repetition, the DH and D-EG have been selected as representative of the mean widely different types and have been fully described. The sections devoted to the other types include brief descriptions of their salient characteristics and designation of the class of service for which they are adapted, while only those details of design and construction in which they are different from the DH and D-EG types are discussed, the other features being re-

ferred to the DH or D-EG for explanation. Thus, the "blow back" feature is described for the DH type of compressor and thereafter is only mentioned.

It should be noted, moreover, that the operation of all types of compressors is gractically identical, and for that reason, the instructions for ears and maintenance found in the chapters for the DH and D-EC types and at the end of the pamphlet apply to all the types unless the contrary is stated.

Before leaving the factory each compressor is worn in and tested to determine its efficiency and accurate adjustment of its parts. The compressor must show a high cylinder efficiency before it is allowed to pass. The operation is carefully noted with regard to connecting rod adjustment, meshing of gear and pinion, proper circulation of all, smooth and quiet running, etc.

Motors are thoroughly tested to insure their performance meeting certain rigid requirements. The motors are tested for open circuit, short circuit, ground, proper speed at rated lead, satisfactory commutation, and end thrust.

Electric Compressor Geormors, which control the operation of the air compressors, are described in separate instruction paraphlets as follows:—

No. T 5042 Electric Compressor Governors J Types and G-1-D.

No. T 5042-1 Type S Electric Compressor Governors Covernor Synchronizing System.

Choice of Compressor

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In choosing the proper size of motor-driven compressor, several points should be considered, as follows

ist. In street railway work the weight of ear determines the size of brake cylinder, which, with the number of stops made in a certain length of time, will determine the quantity of air used. The compressor should be chosen for the conditions requiring the most frequent stops.

2nd. The use of air whistles or horns requires additional compressor capacity in proportion to the size of whistle (or horn) and the frequency with which it is used.

and. The Westinghouse Electro-Procumatic Multiple-Unit Control System requires a very small additional compressor capacity, depending on the size of equipment and frequency of operation.

4th. *Preumatically operated doors* and other such devices require additional capacity depending on the size of equipment and frequency of operation and maintenance.

5th. A motor car (or locomotive) handing trailers, requires considerable extra compressor capacity in proportion to the number of trailers handled, and the size of brake cylinders used in their equipment as well as the frequency of stops.

There is nothing gained by installing a compressor that is too small for a given screece since the extra effort required to produce the necessary volume of air will cause overheating, loss in efficiency, and probably serious damage resulting in excessive maintenance.

Type DH Compressor

The DH type of motor driven air compressor is a light weight, low height compressor developed especially for use in low-built, light weight cars, but is none the less adaptable to all types of cars.

it embadies the following important features: Provision for preventing oil passing into the brake system; few bolts throughout, facilitating taking apact and assembling; easily removed armature; easily adjusted brush pressure; perfect alignment, which is fixed—not adjustable; accessibility of all working parts; direct "three point" suspension; minamum height over-all; minimum weight; high over-all efficiency and large capacity motor.

This compressor is of the horizontal two cylinder type, single stage, single acting (that is, the air is compressed only on one side of the piston), and is driven by a motor through herringbone graning. As can be seen from Fig. 3, the DH compressor motor is at the side of the compressor pertion and the motor pinion is in front of the gear, as shown in Fig. 6, thereby giving greater compactness.



Fig. 3. DH-16 Air Compressor with 8" Air Strainer

DESCRIPTION OF DH TYPES

The second secon

The motor is provided with a large door at the commutator end, shown in Fig. 4, 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 possibility of oil reaching the commutator from that so caree.

These compressors are built in four sizes, viz.: DH-10, DH-16, DH-20, and DH-25, the numeral portion of each designation indicating the displacement in cubic feet per minute.

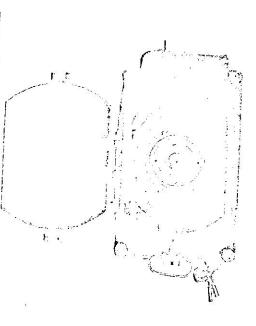


Fig. 4. Type DH Compressor, Commutator Door Open

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The parts with which we are chiefly concerned in this

paniphlet are as follows (Figs. 5, 6 and 8): 44 Connecting Red Cap

16 hear Crank State forming 17 broat Crank Shaft learing 18 Shall Moster hearing 19 Metor Peccing 21 Oil Filling lill. 20 Metor Peccing 10 Metor Peccing 22 Crank Clase Top Cover 22 Crank Shaft New End 38 hearing Cap. Rearing Cap.	10 Crank Shaft 11 Crank Shaft 11 Connecting Rod 12 Wrist In 12 Cour 13 Cour 14 Philoty To the Vegring	2 Cylinder and Crams Cong 3 Cylinder Cover 4 Ithr Vulve 6 IVthorge Valve 7 Valve Chamber Cap 8 Yelon 8 Yelon Bing	17507 056
108 Fract Park 1906 Gap Serew 112 Salient Pole Cap Serew 113 Fald Coil Spring 121 Phalon Castle Nut 122 Control Pin 130 Commutator Door 146 Door Latch		JO West Fit Dust JS Eve Bolt Castle Nut St West Fit Set Serew O West Cover G2 Oil Ring	THE COURT OF THE PARTY OF THE P

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Type DH Compressor with Cylinder Cover in Section

Fig. 5.

Compressor Portion

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

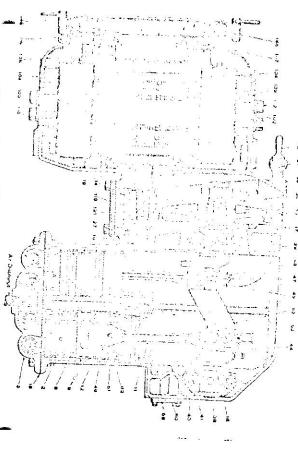
and discharge pipe connections and contains the air and may be easily removed. It is tapped for the intake valves. The cover 3, Fig. 6, for both cylinders is in one piece,

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

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

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

46, which can be readily replaced when worn. The crank are provided with liberal special bearing metal bushings heat treated. The wrist pin ends of the connecting rods drop torgings of high grade steel, the latter being specially The connecting rods 11 and the crank shaft 10, are



lig. 6. Sectional View Type DH Compressor

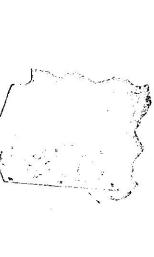
DESCRIPTION OF DH TYPES

the connecting rod tightening the nut 48 on eye bolt 47, which is hinged to up wear quickly and readily by removing shims and again shaft ends of the connecting rods are provided with split between the connecting rods and bearing caps 44, to take bearings of special bearing metal, allowance being made

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

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

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



View of the Crunk Case Vent with Cover Removed

Operation of Compressor

This draws air through the intake strainer and inlet pipe stroke, a partial vacuum is created in that cylinder (A). into chamber II where it lifts inlet valve 4 and passes into left-hand piston being assumed to be on its backward Referring to Fig. 6 and the lower view in Fig. 8, the

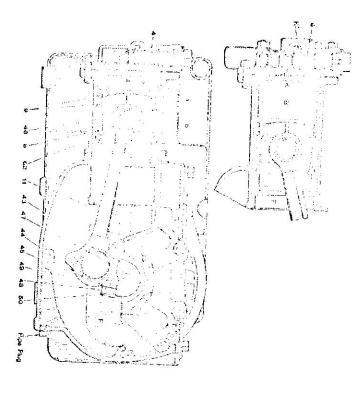


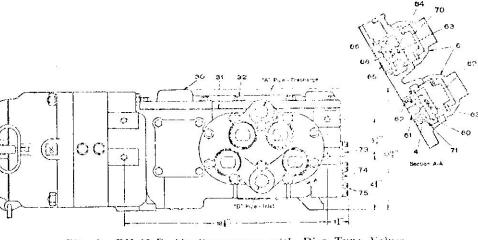
Fig. 8. Sectional Views Type DH Compressor

while the left-hand cylinder is drawing air in, and vice B except that it is compressing (see upper view, Fig. 8), The sume operation takes place in the right-hand cylinder and thence through the discharge pipe into the reservoir. and the compressed air lifts the discharge valve 6 and passes through ports K and K' into chamber F, Fig. 5, the cylinder A. On the return stroke, the inlet valve closes

in preventing the passage of oil. the paton. The wiping action of the oil ring also assists crarit case any excess oil that may have crept along back of the second ring and then "blows back" into the by-tusses the two compression rings, reaching the groove a are provided in the walls of each cylinder at the presits stroke, compressed air trapped in the elearance space ring and the oil ring. When the piston is at the end of the piston immediately back of the second compression ing into the discharge pipe. Two "blow back" passages Fig. 8 shows the method of preventing oil from pass-Circumierential beveled grooves b are out in

from the air. A plate 60 (Fig. 6) held in place by six cap contact with the baffles, which tends to separate the dirt arranged that any air entering the vent must come in with air flowing into the crank case. The baffles are so passage for the purpose of preventing the entrance of dirt the bottom, see Fig. 7. into the erank case at the top and to the atmosphere at opening is made to the atmosphere. This consists of a passage cast in one corner of the crank case, opening the movement of the pistons, a vent or "breathing" or pressure in the crank case, due to ring lenkage and Inasmuch as there might at times be a slight vacuum Baffle plates are cast in the

DESCRIPTION OF DH TYPES



Air Compressor with Disc Type 9. DH-10-D Fig.

screws provides access to the baffles for cleaning pur-

removed for inspection or replacement by the removal bottle type valves (as above described and illustrated by ed, the disc type of valve is capable of long, quiet service. ground on both sides. With a small lift and spring weightof valve cap 6 and the plug (inlet 69 or discharge 70) valve unit is a complete assembly which may be readily Figs. 5 and 8) or with disc type valves, Fig. 9. Each disc holes, but does have the circumferential grooves. The valve 4 is a thin washer of stainless steel, accurately The DII-10 Compressor does not have the blow-back The DII-10 size compressor is supplied either with

supplied with disc value cylinder covers. The DII-16 and Dif-20 air compressors can also be

Motor Portion

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

of the motor housing together. of the motor housing, being supported firmly in place by minimum weight. The yoke lits between milled surfaces soft steel punchings, insuring uniformity of section and means of long belts and study which hold the two parts The field yoke, 102, (Fig. 6) is made up of laminated

firmly in place by a flat sleel spring 115, which presses To prevent injury due to vibration, the coils are held degree. The consequent poles are a part of the field yoke The field coils are impervious to oil and water to a high screws 112, and may, therefore, be very easily removed them against the pole tip guards. The pole pieces 100 are each held in place by two cap

The state of the s

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 \(\frac{1}{2}\)"strips of the best grade of mica. The mica insulation between the commutator bars is undercent. In order to prevent possibility of any movement that night damage the leads, special care is taken in supporting them from coil to commutator by heavily insulated steel clips fastened securely against the armature core, while the coils are handed in the core and on the ends to prevent any movement. The offing system is designed with extra precautions to prevent entrance of oil into the motor, as described later.

The brush holders, Fig. 10, 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 serew which secures the brush holder stud



Fig. 16. Photographic Views of the Brush Holders

37 20

in the champ. 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.

Lubrication

The lubrication of the compressor is entirely automatic and is effected by the splash system, as shown in the first

Oil is poured into the crank case through the oil fitting 21 until the level maintained by the fitting is reached. As the crank rotates, the connecting rods dip into oil, splushing it onto the interior surfaces, lubricating the cylinders and crank shait and connecting rod bearings. The oil 3,3 shed into the trough on the rear wall of the crank case, flows through a passage into the gear case chamber where it is carried up by the gears and into the armature shaft bearings.

This arrange next allows the oil to lubricate the teeth of the gear without having the gear run in oil, incidently reducing the amount of heat generated by churning the oil in the gear case.

The main motor bearing is provided with cored passages leading to the bottom of the generale through which the excess oil returns. The ends of these passages are sealed by oil against vapor getting into the motor.

As there is only one place to oil the compressor, back of lubrication is not likely to occur. The fitting has a large opening through it so that it is not likely to become clogged and give false oil level. The plug covers the end of the fitting so that dirt cannot enter the fitting when removing plug for filling.

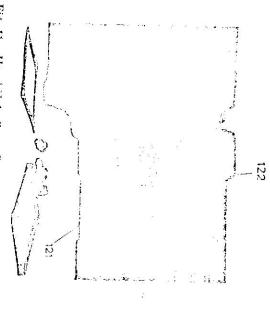


Fig. 11. Hand Hole Cover Removed, Showing Pinion

Inspection For Adjustments and Repairs

DESCRIPTION OF DH TYPES

The construction of the compressor is such that all purts 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 easer top cover 29. The commutator door, Fig. 4, 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 rem) e the arauture, open the commutator door and remove the brush holders. Take off the hand hole cover 26, as shown in Fig. 11. Then withdraw the cotter 122 and place a wrench on the eastle nut 121 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 unserewed from the eastle nut, after which the armature can be easily withdrawn from the motor.

The procedure is simply reversed to replace the armature. Make the electrical connections as before and replace the brushes as they were, in order that the bearing between the brushes and commutator be not destroyed. If the brushes are interchanged, they should be ground to a bearing by using a strip of sandpaper on the commutator under the brushes with the sand toward the brush excessive sparking is obtained. This will prevent the brush bearing and thus preserve the commutator glaze. With the hand hole still open, turn the armature by hand a few times to make sure that the gears run freely, then replace hand hole cover and start compressor.

-	Scor		- - - - -	Compressors Amperes Weigl Oper 5 Section 18			2.5	mate R.P.M.		1.	iproxima imension	Pipe Size		Valve Lift		
	Compressor	Dis.Cu.Fl.perN	Volta	Oper lating	Par -	Net	Ship.	Com-	Motor	Length	Width	Height	Inlet	Dis- charge	Inlet	Dis- charge
-	DH-10	10		$\frac{7.1}{2.6}$		435	525	226 	1200	25]4"	3034"	1034"	1 "	1.	7 ×	£ ⁷ 1 *
2	DH-16	16	`	$\frac{12.3}{4.55}$	44.14	650	760	217	1120	2434"	31"	12,5	114"	1"	32	1.6°
	DH-20	20	64	92 50 5.85	' 75 !	650	760	273	1400	2434*	34"	 12½°	114"	1"	5 F	1,4"
:-	DH-25	25	115 125 150	131 65.5 36.6 5 33.6 0 28.0 0 10.5	60.	990	1050	200	1080	20/5"	303/*	1534"	11/4"	1,	5.7	1/8*
			600	600 7 10 9	990	1050	200 10	1080	981/	3034	1534"					
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Suspension

of the compressor and provides accessibility. light weight but facilitates mounting and dismounting of the "three-point" type which not only contributes to The suspension used with the compressor is direct and

from the car body. removal of only two bolts to disengage the compressor hold it in place. This method of suspension requires the the third hanger since the other two hangers serve to brackets bolied to the ear body. No bolt is needed for of two of these hangers are bolted by one bolt each to are bent sharply underneath these lugs. The upper ends being actually supported by the ends of the hangers which cust upon the compressor, the weight of the compressor steel hangers, Fig. 1, fastened by two bolts each to lugs This type of suspension consists of three light-weight

is then raised and the bent part of the hangers slipped side of the sill. The compressor, with the hangers attached, of the bracket may be straightened up and bolted to the into place. Then the two bolts are set up solidly. bracket. Do not use lag screws. If desirable, the ends a suitable piece for the other. Use 5%" bolts for each ticable, an existing timber for one of them and putting in framing, at the proper distance apart, utilizing, if pracup solidly; then fisten the brackets seemely to the car sides of the compressor and be sure to set the cap serews To install the suspension, fasten the hangers to the

DESCRIPTION OF DH TYPES

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Type D-EG Compressor

In design, this compressor is of the duplex air cylinder type, driven by a totally enclosed series wound motor, both motor and compressor being mounted on a common bed plate and connected by herringbone genting.

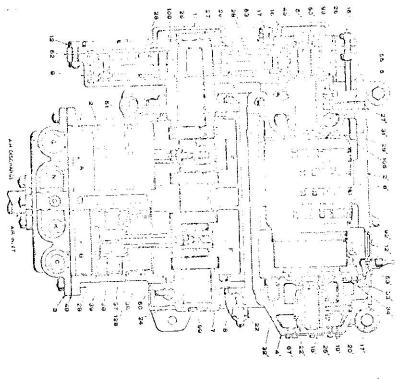


Fig. 12. Sectional View Type D-EG Compressor

Compressor Portion

The functions of the compressor portion, as shown in Figs. 12, 13 and 14, are identical with those of the DH, the air being drawn past the inlet valves into the cylinders, compressed, and discharged through the discharge valves into the reservoir. The mechanical construction is somewhat different, however, for in addition to the bed plate 82, the motor is located directly back of the compressor, instead of at the side, with an air space between for see using ventilation. The gear 28 and pinion 98 are enclesed in a gear case 9 which is attached to the compressor and motor. It protects the gearing from injury and carries the necessary lubrication. This gear case is known as the EG type and is provided with a cover 11

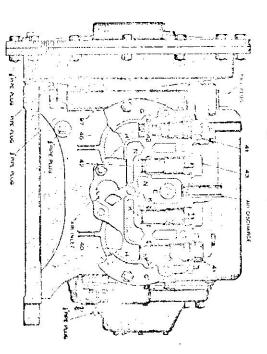
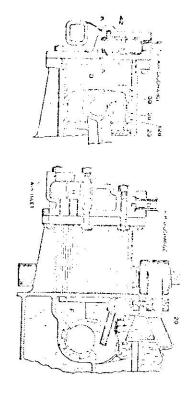


Fig. 13. Type D-EG Compressor with Cylinder Cover in Section

bearings in brass bushings, 99 and 100, and a middle which is bolted to it. bearing of babbitt. The crank shaft 24 has two end



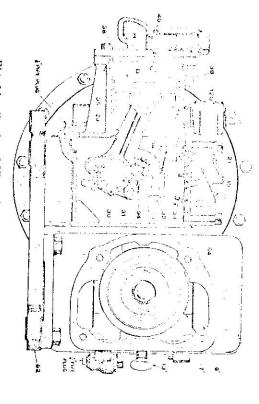


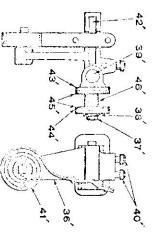
Fig. 14. Sectional Views Type D-EG Compressor

of compressors covered in this Instruction Pamphlet. This instruction also holds good for all the other types rotate in a clockwise direction when viewed from the gear end. stroke. of the thrust and consequent wear during the compression the erank shaft in order to reduce the vertical component the center line of the cylinders is slightly above that of the outside of the compressor. It should be noted that The crank case vent, however, is through the pipe 97 on back" feature and crank case vent to the atmosphere. pins 56 being of the same design. It also has the "blow same as the DII type, the pistons 38, connecting rods 29, packing rings 39, oil ring 128, valves 40 and 42 and wrist In other respects the compressor is practically the For that reason, the crank shaft should always

Motor

of set screws 20' and 27' insets are centered in the housings and secured by means shells 22' and 29', of ample proportions, with babbitt which carry the armature bearing. Cast iron bearing the ends of the frame are centered housings, 4' and 5', frame, which is tight fitting, excluding rain and dust. In commutator. This opening has a door 12, hinged to the doorway to permit of ready access to the brushes and nutator end, which is provided with an opening or frame 5 (Fig. 12) having a prolongation on the comtype, with two field coils. It has an annealed cast steel The motor is of the enclosed, series wound, four pole

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ig. 15. Type D-EG Compressor Brush Holder

other two being made of laminations of soft sheet steel sulated from the voke by fibre, fullerboard and mica 39' in the holder to seeme them in position, and are inon the adjustable east iron rocker arm 32', Fig. 12, are of the field cells. The two brush holders, Fig. 15, mounted and are holted to the frame, thus also seeming in place provents excess oil from the rear motor bearing coming The armature shaft is provided with a deflector 105 which screws to secure the leads firmly to the brush holder. ing the life of the brush. 41' of bronze ribbon, thus giving a uniform pressure darheld in contact with the commutator by a coiled spring The carbon brushes 42' slide in machined holders and are that ample insulation has been provided at this point. washers, 45', 44' and 45', respectively, and tube 46', so east brass, with a tap bolt 37′, threaded into a steel plug Two of the four field poles are a part of the frame, the The screws 40' are binding

The other electrical details are similar to those of the DiI motor, the functions being the same, and the only differences being those due to variation in mechanical construction.

Lubrication

splash system, the oil being poured into the crank case oil well filled through holes 17', Fig. 12, and are supplied enters the gear case where it serves to lubricate the gear rear crank shall bearing seeps through the bearing and erank shaft bearings. Some of the oil splashed into the rotates, oil is splashed into the cylinders and into the through the fitting 22, Fig. 12. As the crank shaft ings, connecting rods and pistons are lubricated by the except the bearing on the commutator end of the motor with constant lubrication by means of the oil rings returns to the latter. The motor bearings each have an the oil well and the crank case, whereby any overflow is a direct connection through a cored passage a between tor. This oil cannot, however, flood the motor, for there teeth. Part of this oil is earried up by the gear to the by hand through hole 17, Fig. 12. The crank shaft bear The oil well must be filled and proper level maintained tion other than to replenish the oil supply when needed pinion and thence into the rear bearing oil well of the mo-The lubrication of the compressor requires no atten

Inspection For Adjustment and Repairs

To remove the armature, first take out the four cap screws which seems the housing at the commutator end of the motor, and, after disconnecting the brush holder leads and removing the brushes, withdraw the housing. Then take out the three screws which seems the cap 16, Fig. 12, on gear case; block the crank shaft with a wooden block, remove the lock nut 50' from the end of armature shaft, using the special box wrench provided for this purpose. Then unscrew the next nut 49', which at same time

DESCRIPTION OF DE-G TYPES

pulls off the pinion. As the pinion cannot move outwardly on account of the gear teeth, it is necessary that the armatare should be free to move in the opposite direction before attempting to unscrew nut. The armature can so move when the housing is removed as above indicated. The armature may now be withdrawn from the motor, care being taken to prevent it from dropping on the pole pieces and thereby damaging the armature coils.

To put in an armature, slide it carefully into the field until the threaded end projects from the bearing, having the key uppermost. Now put in the pinion, with keyway at top, and with a small lever pry the pinion into line with the shaft. In motors of early construction it is necessary to lift the remaining oil ring by means of a scriber or similar implement passed through the pinion, and push the pinion it is necessary to place the special pinion nut in its position against the pinion with its collar within the flange on the latter by which it is drawn off when the pinion, the nut must be turned until the pinion is pressed firmly to its bearing, then it must be locked with the ad-



Fig. 16. Type D-3-EG Compressor in Suspension Cradle

ditional nut provided for that purpose. Put back the housing with the commutator end bearing, having, in the case of the older machines, removed the plate at the end to admit of lifting the oil rings, and bolt in place. Make the electrical connections as before and replace the brushes exactly as they were, in order that the bearing between brushes and commutator may not be destroyed. While the pinion hole in gear case cover is still open, turn the urnature by hand to make sure that the gears run freely, then replace pinion cover and start the compressor.

Suspension Cradle

This device consists of two parts, the cradle, Fig. 16, which is belted to the base of the compressor (and thereby becomes an integral part of it) and the brackets by becomes an integral part of it) and the brackets by becomes an integral part of it) and the brackets have two pockets, each containing a rubber cushion, fitted in an iron easing, with a suitable cover, and these parts are provided with a slot through which the ends of the uprights may pass. These ends also have slets for notched keys which latter, when in place, support the cradle with its compressor and cannot work out. By raising the compressor one-half inch and slipping out four keys, the compressor may readily be lowered from the car.

Sizes and Performance Data

Type D-F Compressors

the same of the sa

These compressors are light weight, compact, rigid machines developed from the D-EG type. The crank case, cylinders, most or end bells, and half the genr case are all east in one piece, thus eliminating the bed plate and securing perfect alignment.

Compressor Portion Type D-2-F

The compressor periton is of the two cylinder type, similar to the D-EG except that a two bearing crank shalt is used, and the pistons and the piston rods are made longer to insure minimum and even wear on the cylinders, wrist pins and pistons.

The gent case cover is in reality half of the gear case, and when removed exposes the entire gear and pinion. There is also a small removable cover over the pinion, so that the armature may be removed without taking off the gear case cover.



Fig. 17. Photographic View of the D-2-F Air Compressor with Suspension

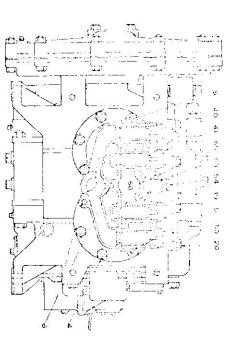
In other respects the compressor is practically identical with the D-EG type, and the description of the latter will apply.

D-2-F Compressor Motor

The motor is of the enclosed, series wound, four pole type, with two field coils and a laminated field yoke. The field yoke fits between the milled surfaces of the meter housing and is held firmly in place by long cap bolts. The motor is provided with a commutator door which, when open, gives access to the brushes. This door is supported by a new type of hinge, which facilitates opening, and which, when closed, makes the notor entirely dust proof. The armature itself is of generous proportions to prevent overheating. The construction is in accordance with the best rallway practice, and is similar to that of the DH. The brush helders are germanently mounted on the motor frame and are well insulated from it. The brushes are given a position of slight backward lead, which is best suited for good commutation.

Lubrication

The lubrication system is like that of the D-EG, the pistons and crank shaft bearings being lubricated by oil splashed from the crank case while the motor bearings are provided with separate oil wells and rings. As with the D-EG, some of the oil seeps over into the gear case and is carried by the gears to the rear motor bearings. A passage between its oil well and the crank case prevents the motor being flooded from that source, however. The oil level in the rear bearing is maintained from the gear case after once being filled, the excess returning direct to crank case.



D-3-F Air Compressor Assembly Views

Brush had die 3 & No

DESCRIPTION OF D-F TYPES

6.7

Type D-3-F Air Compressor

This compressor, which is intended for use on large motor cars and small electric locomotives, has a displacement of 35 cu. ft. against 100 pounds air pressure and is capable of continuous operation without exceeding safe temperature limits.

The compressor partion is similar in design to that of the D-2-F type except the cylinders are provided with bushings which can be renewed when worn, and the pistons are fitted with four rings, three of which are compression rings (39) while the fourth (inner ring) is an oil ring. The method of lubrication is also somewhat different. An oil wheel, mounted on the crank shaft between the connecting rods, picks up oil from the crank case cover and ribs on the crank case cover and ribs on the crank case wall, distributes the oil to the crank shaft and connecting rod bearings.

The motor portion is provided with a ventilating system which enables it to drive the compressor continuously as before stated. A fan on the rear end of the amouture draws air through screened openings in the front end of the motor, through duets in the commutator bashing and armatare core, and is blown out through a fer housing and nozzle. This nozzle is so designed that the air from the fan induces a flow of air across the surface of the armatare and between the field coils.

During the year 1938 some modifications were made which affect certain maintenance operations.

The a mature instead of being assembled direct on the armature shaft is now assembled on a steel sleeve which is pressed on the shaft and secured by a key (77) and a nut (48) at the armature end.

shaft. Generally, there are two locations on the periphery

apart to permit shifting the gear position on the crank-

The gear is provided with two keyways 90 degrees

of the gear teeth (grankshaft positions of maximum

torque and torque reversal) where the greatest wear of

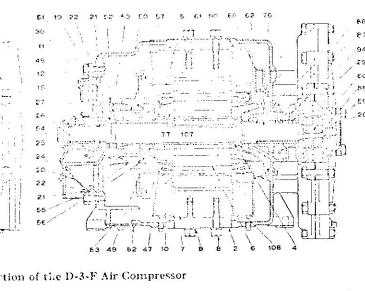


Fig. 19. Motor Portion of the D-3-F Air Compressor

gear is thereby prolonged.

plain pinion and a plain mut, and the pinion cover en-

The special pinion and nut have been replaced by a

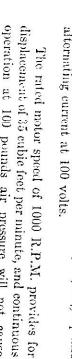
grees, the points of the highest stress are transferred to

By changing the gear position 90 de-

teeth where little wear has occured, and the life of the

shewn in Fig. 17. neath the car it into grooved recesses located near the outside edge of in the piston bosses by spring retaining rings which snap larged to permit the use of a conventional gear paller. Wrist pins are of the "floating" type and are retained Suspension

method of suspension makes it easy to remove the comwhich in turn are attached to the car, and are held in compressor slightly and drive out the keys place by notched keys as with the D-EG type. pressor from the ear, it being necessary only to raise the The compressor has feet for use when it rests upon the the car or locomotive, and when suspended beis supported by three steel hangers as These hangers are fastened to bruckets



described except that it is provided with an A.C. motor which is designed for operation on 25 cycle, single phase

This compressor is quite similar to the D-3-F just

XD-3-F Air Compressor

displacement of 35 cubic feet per minute, and continuous operation at 100 pounds air pressure will not cause dangerous overheating.

The rotor runs on ball bearings which contribute to a cool running rotor shaft while a motor ventilating system comprising a fan, air ducts and screened openings, insures against overheating of the rotor and stator

An alemite litting is used to lubricate the front motor bearing while the rear motor bearing is lubricated by the circulation of oil in the gear case. The crank case is filled with oil (through the oil fitting 13) which, when filled to the proper level, provides for the lubrication of the compressor portion as described for the D-3-F compressor, and also the rear motor bearing as above stated.

The rotor is readily accessible upon removal of the cover, the fan and the bearing housing, and if the pinion is loosened the rotor can then be easily withdrawn from the motor.

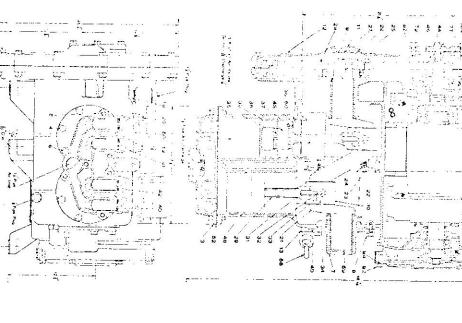


Fig. 20. Outline and Sectional Views of the XD-3-F Air Compressor

Type DF Air Compressors. Sizes and Performance Data Based on 100 P. S. I.

3	1055	a.		; Ampares ; }	Approximate Weight		R. P. M.		Approximate Dancusions			Pipe Size		Valve Lift	
	Сетри	004 Ca		Oper 1	Net	Släp.	Cota-	Motor	Leagth	Width	Height	lulet	Dis- charge		Dis- charge
	D-2-F	25 (:00 	7.0 16	97.5	1975	2(6)	1150	37)4	2984"	21]]]"	114"	1.	52) ś*
ŧ	D-3-F	35 :	64 125 230 306 200	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	Ī	1615	179	1100	42"		2432"				l ś "
	XD-3-1	35]	i (U	90 150	1470	1600	179	1000	45"	33 "	27	1,12"	114"	9	
	D-4-FS	50. 8	 500	15.5. 20		i	225	1575	42"	348 ; "	2412"	112	114"	3 °	1/8"

D-4-P Air Compressor

The D-t-P Compressor supersedes the D-t-K and was developed in order to provide that size of compressor with a motor of such design as will have a greater margin against overheating and will give good commutation

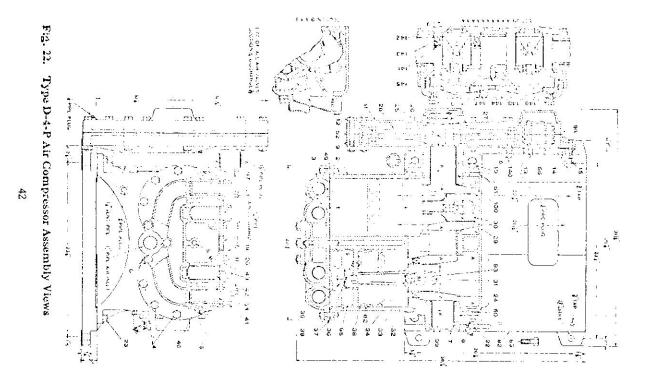


Fig. 21. Photographic View of the D-4-P Air Compressor

under a wider range of operating conditions. The compressor portion and the motor are of separate construction, being mounted on a common bed plate and supported by the cradle form of suspension, as described for the D-EG type.

The compressor portion, Fig. 22, is identical with the D-4-K except that the F type of gear case is used, and a larger bed plate is required on account of the increased size of the motor.

The motor, Fig. 23, is larger than that of the D-4-K and can be supplied for operation at various voltages as specified in the table.



Type D-4-P Air Compressors-Sizes and Performance Data Based on 100 P. S. I.

Dis. Cn. Ft. per Min.	Voltaçe	Ampères		Approximate Weight		R. P. M.		Approximate Dimensions			Pipe Size		Valve Lift	
		Oper- ating	Fuse	Net	Ship.	Com-	Motor	Length	Width	Height	Inlet	Dis- charge	Inlet	Dis- charge
50	64 90 115 235 480 600 1200 1500	120.9 86 67.5 33 16.2 12.9 6.45 5.15	20 + 10		1875	184	1000	41″	34)2"	25 *	11/2"	114"	16	37

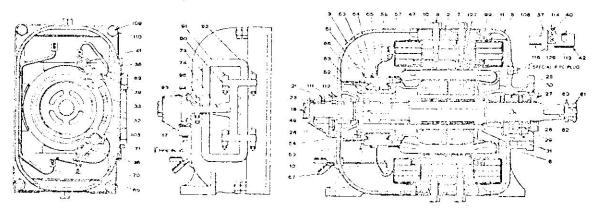


Fig. 23. Type D-4-P Compressor Motor

No. 54 Intake Strainer

Suitable for compressors of displacements up to 150 C.F.M., this is a very large double cylindrical strainer (overall dimensions approximately 10"x14") with an inner strainer of perforated sheet steel, galvanized, and an outer strainer of coarse galvanized wire mesh, the intervening space being well packed with curled hair. A galvanized iron shell encircles the strainer proper, preventing dirt, oil and water from striking directly against the strainer and thereby reducing the possibility of trouble from clogging. The strainer may be quickly and conveniently taken apart, without disturbing any pipe connections, by removing the nuts from the four studs.



Fig. 40. Disassembled View of the No. 54 Air Strainer

Types "G" and "L" Intake Filters

These air filters are of the "cartridge type" which permits removal of the filter unit without the necessity of dismounting or disconnecting from the air compressor.

The Type G Air Filter, as illustrated by Fig. 42, is designed for use with compressors of displacements up to 150 C.F.M. The Type L is a smaller filter of similar design intended for use with compressors of displacements up to 50 C.F.M.

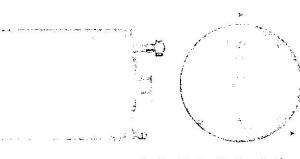


Fig. 41. Sectional View of the No. 54 Air Strainer

The cover is centrally threaded for the pipe connection to the air compressor, and is also provided with two mounting lugs for securing to a supporting bracket. The lugs are tapped for studs, 34" for the Type G filter and ½"

The casing is of pressed steel, and is attached to the cover by means of a tie bolt, washer and nut. The casing houses the filter unit, and acts as a dirt chamber. In the bottom are several small holes to permit drainage of moisof ture from this chamber.

spring retainer assembly and the filter unit. and then a second nut from the tie bolt to release the nut from the end of the tie bolt to release the easing, the filter unit, it is necessary to remove the cotter and To dismantle the air filter for eleaning or replacing

oughly in an alkali-free hydrocarbon solvent and then The filter unit should be eleaned by washing thor-

blown out by air blast from the inside.

enters this opening, it passes upward and inward to the cover as an annular ring around the casing. As the air the discharge opening. Some of the heavier particles of downward before passing through the filter unit into inside of the casing where it strikes a baffle and is directed dirt are carried downward and deposited at the bottom of the casing cavity. The inlet opening is formed in the under side of the

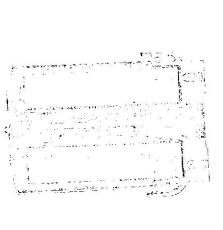


Fig. 42. Sectional Assemt by View of the Type "G" Air Filter

Installation

cylinders. Also, the oil fitting in the compressor crank allow a free circulation of air around the compressor on a car, it is important that the position be such as to case should be easily accessible from the street, In the selection of a position for a motor compressor

should be placed under the car in a manner to insure than that for which the compressor outlet is tapped and the compressed air. It should be one or two sizes larger less than 25 feet of pipe to the main reservoir. The of air all around it and should be placed along the side proper cooling of the air and consequent precipitation of n.cisture. It should be low enough for a good circulation function of this pipe is to afford ample cooling surface for ing air at that point but be in no danger of striking platforms or objects in the track or street. Avoid, if under the car as near the outside of the frame as practhrable, where it will get the benefit of the rapidly changpossible, hanging such pipe under the car inside of the paratively little circulation. outside width of trucks as the air at that point has com-The discharge opening should be connected by not

sarily precipitated in the cooling of compressed air, as through the reservoir and deposit the water that is necesfrom the compressor enters so that all air will pass made at the end opposite to that at which the discharge well as any oil or dirt that may have been entrapped by it. All other connections to the main reservoir must be

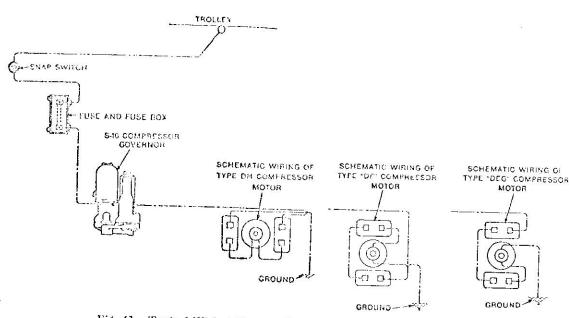


Fig. 43. Typical Wiring Diagram for Motor Driven Air Compressor

circuit should be tapped to the main trolley line is detershown in Fig. 43. The point at which the compressor and where all important parts are easily accessible. where it can be easily dismantled when occasion requires operation. siderable above that which is suitable for satisfactory ceiling as the temperature of that locality is usually conmend suspending the compressor from a point near the sary. It should always be placed in as cool a location as dry air is always available. We possible and the intake piped to a floor, set in a cement foundation, or suspended if necesnary industrial purposes, it can be bolted to a substantial The wiring diagram for all types of compressors When installing a motor driven compressor for ordi-The location of the compressor should be do not usually recompoint where cost, clean,

mined by the conditions of each individual case, but we recommend connecting between the choke coll and circuit breaker in order to obtain lightning protection, and at the same time be independent of the circuit breaker. For all types, run the wire from the trelley connection to the switch, making sure that when it is open, the dial shows the words "Off" and when closed "Ou"; there it is run through the fuse box to the governor where connections may be made to whichever terminal is more convenient.* Carry the wire from the remaining terminal to the motor where connection must be made to the field and at the point where it comes out of the frame. The other lead should be connected to the main motor ground

In making

the connections

to the

motor

brass terminals which accompany it, being sure to tighten the set serews solidly and cover the entire connection with insulating tape. The switch in the compressor circuit should be placed in an accessible location. The fuse box should be connected between this switch and the governor. It ought to be placed so that a serew driver or other implement is not needed to get at it, but it should be easily accessible, in a dry place, with its box well removed from any ground connection. The size of fuse designated for the compressor should always be used and under no circumstances should one with a larger capacity be installed. If the fuse repeatedly blows, examine the motor and compressor for disorders.

The direction of rotation of the crank shaft must be clock-wise when viewed from the gear end. If necessary to change the direction of rotation, reverse the brush holder connection.

Inspection and Maintenance

from the oil filling elbows at the motor end (except the Stiling located at the back of the crank case. Cap nuts at any filling place does not get more than H-inch below all oil should be drained from the compressor, and the fresh oil. At the same time, remove the valves and clean unscrewing the cap nut from the crank case oil fitting and DH type) and filling the receptueles with a good grade of air compressor oil. The DII type has only one oil should always be replaced after oiling to prevent dirt Inspection and oiling should occur at sufficient intervals to see that the oil level the top of the fitting. Approximately every six months, crank case thoroughly cleaned and re-supplied with them and their cavities. Keeping the crank case oil clean The compressor should be regularly lubricated by is the surest way of keeping down maintenance costs. getting inside the compressor.

Special precautions should always be observed to replace the piston rings on the same pistons from which they were removed and in the same eylinders from which should also be replaced in the same eylinders from which they were removed. To facilitate this, a letter is stamped at the top of the outside flange of each eylinder, and on the outside face of each piston.

Piston rings are now supplied without dowel pin holes, consequently, when installing new rings on pistons with the dowel pins, the pins must be removed.

One oil ring is now used on each piston in the ring grown eases. The outside bearing sur-

the of the ring. that is, the nurther bearing against the which is started with the install to the office of the line sharp of second with the sharp of sharp will be sharp of second with the sharp will be sharp of second with the sharp will be sharp of second with the sharp will be second with the sh

The commutator should be took them. The brushes therefore it is a finishing the in their hoteless and the dear their first in the point of the first in the motor. Occasionally blow the carbon dust out of the motor to avoid possibility of short dust in the motor to avoid possibility of short dustries.

The eligan should be therefore intervals in order to predicte in a possibility of bearings remains sufficiently to permit the motor to get town on the field souldsmage or perhaps desired, the wholing.

The removabel the fractions of the DR compressor is discribed under that heading. The removal for the other types is as described for the D.DC.

To remove a find both the compressor should be liften.

We strongly recommend that relivery using our springers provide themselves with one or many to prompily replaced. Remain our he may be prompily replaced. Remain our he may be to prompily relieved. Remain our he may be to b

at night. With such equipment, all but the very mibor repairs san be profinably handled in this way, and with the care in the barn a minimum length of time.

Keep the intuke strainer clean. If it is permitted to become shoked with the the efficiency of the compressor is greatly reduced. If a pounting develops in the connecting sed caps where confirms and selections where the properties of caps where less motivate the process, and remove the recessory share. In take up the year, in the boaring. Never that case the bearing may between the cap and the red, as in that case the bearing may baid on the caps for the red, as in that case the bearing may baid on the caps for the policy.

To get at the composition sings or wrist, pith, it is necessary, to detach the composition and from the orank shuft, and after removing the cylinder head, then the piston out. Whis pin bushes should last for years, lost motion at the point expression replacement of finishes.

This post results are obtained with the little of the valves as given in the faths of dimensions for each type of compressor, and they should always be adhered for

Three sizes of repair pistons, k-firch, Minch and frinch larger than the original size som. He supplied for the bared cylinders. Rebornel and brashed cylinders in original size are scommented in preference to larger mass of cells done and fines.