



A541/3B.

**AIR COMPRESSOR**  
**TYPE D.H. 16B.**  
**WITH INTEGRAL MOTOR**

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## MAINTENANCE FOR COMPRESSOR PORTION.

Maintenance periods quoted in this pamphlet are approximate, being based on general experience of average service conditions. The best routine for examination under particular conditions will be indicated by actual experience.

### Starting and Running.

Check the oil level. Sump Capacity 7.1/2 pints.

Correct oil level - Fill the crankcase to within 1/2" from the top of the oil filler elbow.

### LUBRICATION.

#### Recommended Oils

Cold Climates	-	Osmolin L.T.
Temperate Climates	-	"Osmolin C" or Mobil D.T.E. Heavy Medi
Tropical Climates	-	Mobil D.T.E. Heavy.

#### Recommended Oil Changing Periods.

1. After 3 months service for a new machine.
2. After re-sleeving or renewal of bearings, change the oil after running in and again after 3 months service.
3. Subsequent oil changes -
  - Every 18 months in cold or temperate climates
  - Every 12 months in tropical climates.
 more frequent oil changing may be necessary in unusually arduous conditions.

Note:- The sump should be drained immediately after running, while the oil is warm.

### PERIODICAL INSPECTION.

(The reference numbers occurring in the following text refer to the numbers shown on the illustrations).

#### Daily.

Check the oil level before starting the machine. This may be extended to a weekly attention according to the conditions of service at the discretion of the maintenance engineer.



Every Six Months.

Dismantle and inspect the suction and delivery valves as described below.

VEHICLE OVERHAUL PERIODS.

The compressor should be dismantled and all parts thoroughly cleaned and examined as described below. It is recommended that all gaskets be renewed, jointing compound should NOT be used.

To Remove the Motor Portion from the Compressor.

1. Drain the sump.
2. Remove the commutator cover 92, disconnect the external supply connections and release the carbon brushes.
3. Remove the end bell 86A complete with brush gear.
4. Remove the field yoke 75A complete with field coils 77 etc., leaving the armature and shaft in position.
5. Remove compressor top cover plate 46A and split pin 82.
6. Hold slotted nut 81 with a spanner and with a spanner on the flats at the outer end of the armature shaft, turn the shaft anti-clockwise until it is unscrewed from the slotted nut 81, the armature and shaft may now be removed from the bearing housing.

CYLINDER HEAD AND VALVE GEAR. FIG.3.

1. Remove the cylinder head complete with valve gear.
2. Unscrew the valve caps 43 and remove valves 44 and 45.  
Note:  
It is important to ensure that each valve is mated with its own seat and valve cap on re-assembly.
3. Thoroughly clean and inspect the valves, examine the valve seats, reseat if necessary, but if the seats are badly worn or pitted the valves should be renewed.
4. Check the valve lift, particularly after reseating or replacement.

The Minimum Valve lift should be:-

Inlet Valves	-	5/32"
Delivery Valves	-	3/32"



If the valves have been reseated the correct valve lift should be restored by relieving the bottom face of the valve cap flange.

5. After re-assembly check that the valve caps are air-tight by pouring a little light oil around them when the compressor is running, any leakage will be indicated by bubbles.
6. Ensure that all cylinder head ports and ducts are free from obstruction and foreign matter, When replacing the cylinder head, the holding down nuts should be tightened evenly, centre nuts first.

#### PISTONS AND PISTON RINGS. FIG.2 AND 4.

Having removed cylinder head 15 and top cover 46A remove the split pins and nuts from the hinged connecting rod end caps. (Note the amount of shimming fitted). The pistons complete with connecting rods can now be removed through the cylinders.

1. Check the diametrical clearance of the pistons in their respective liners with the piston rings removed.

Clearance with new:- 0.003" - 0.005"

if this clearance at any point exceeds:- 0.012"

new pistons and/or liners, as may be indicated by examination, should be fitted.

Piston diameters when new:- 4.246" - 4.247"

2. Check the piston rings for gap clearance and side play in their grooves. If the clearance is excessive new rings should be fitted.

	<u>Closed Gap Clearance</u>	<u>Side Play.</u>
Clearance when new	0.015" - 0.025" (when ring is fitted to a 4.250" dia. gauge).	0.002"-0.004"

These limits apply to compression and oil rings.

#### SMALL END BEARINGS. FIG.2.

1. If any play can be felt between the gudgeon pin and the small end bearings, new bearings should be fitted and new pins if required.



2. Check the play of a new gudgeon pin in the piston and if any play is felt, fit a new piston.

New gudgeon pins are a press fit in new pistons at normal room temperature.

3. When fitting replacement smallend bushes:-
  - (a) Press the bush into position so that the oil hole in the bush lines up with the oil hole in the connecting rod.
  - (b) With the bush in position drill a dowel hole in the bush through the dowel hole in the end of the connecting rod.

Dia. of dowel holes. - 0.246" (Letter 'D' drill)

Fit the dowel pin.

4. After assembly of the bush and dowel pin into the connecting rod remove all burrs and swarf.
5. Finally the gudgeon pin hole in the bush should be reamed in position to:-

1.376" - 1.3765"

#### CYLINDERS FIG.2.

The diameters of the cylinder liner bores when new are:-

4.250" - 4.251"

Check for wear in the bores. If the bore diameter exceeds that of a new liner by more than 0.010" at any point, a new liner should be fitted.

#### CRANKSHAFT FIG.2.

Having removed the crankcase top cover 46A (Fig.3.) remove the main bearing caps 3 and 39, the crankshaft complete with gear wheel 35 can now be removed through the top of the crankcase.

1. Check for wear and ovality of the crankshaft journals and if necessary re-grind and fit new bearings to suit.

Note:- Details of undersize bearings available should be obtained from Westinghouse Brake & Signal Co.Ltd., before re-grinding the crankshaft.



Crankshaft diameters when new:-

Main Bearing Journal.	1.9985" - 2.000"
Big End Bearing Journal	1.9985" - 2.000"

Check the end play of the crankshaft in the main bearings. This should be between 0.008" - 0.025".

#### MAIN BEARINGS. FIG.2.

Check the main bearings for wear, the diametrical clearance between the crankshaft and bearing when new is - 0.002" - 0.0045". Replacement bearings should be checked for size, and if necessary the bearing should be scraped to give the clearance stated on the label supplied. If necessary the radii at the end of the bearing should be corrected to fit the crankshaft.

#### BIG END BEARINGS. FIG.4.

Check the diametrical clearance and side play of the big end bearings (half shells) 67 on the crankshaft. The hinged bearing housing is fitted with shims so that any excessive play can be taken up. On removal of a shim it is essential to scrape the bearings to the crankshaft. If a good "all round" bearing cannot be obtained, fit new bearings, adjust the shimming and scrape the bearings to give a true bearing. It may be necessary to correct the radii at the ends of the bearings to fit the radii between the crankshaft pins and web. Side play of big end bearing on crankshaft journal - 0.016" - 0.036".

#### MOTOR BEARINGS FIG.2.

Check the motor bearings 17 and 20 for wear.

	<u>Large Bearing.</u>	<u>Small Bearing</u>
Bore diameter when new	1.5655"-1.5665"	0.9707"-0.971"
Diametrical Clearance when new	0.003"-0.005"	0.002"-0.004"
Armature Shaft diameter	1.5615"-1.5625"	0.9677"-0.9687"

#### Fitting Replacement Motor Bearings.

Small Motor Bearing - Press into position, ensuring that the oil hole coincides with the oil hole in the crankcase. When in position, the bearing should be reamed in line with the large motor bearing to the dimensions given above. Remove all burrs and swarf.

Large Motor Bearing - Press into position ensuring that the oil holes coincide. Drill a 19/64" hole for the locating set screw. When the bearing is in position ream in line with the small motor bearing to the dimensions given above. Remove all burrs and swarf.



If it should be necessary to regrind the armature shaft, details of undersize bearings available should be obtained from Westinghouse Brake & Signal Co.Ltd. Details for removing and fitting the armature shaft are given in the maintenance directions for the motor portion of this machine on pages 10 - 12.

#### GEAR AND PINION FIG.2.

Examine the gear 35 and pinion 18 for wear especially if the machine has become noisy in operation after long service. The gear and pinion should be renewed if the backlash is found to be excessive.

The gear and pinion are selectively fitted during manufacture to obtain the correct meshing of the gears, this is indicated by figures stamped on the sides of the gear wheel, pinion and crankcase. Care must be taken to ensure that the correct gear wheel and pinion are re-assembled.

The algebraic sum of the figures on the pinion and gear wheel should be equal to the figure stamped on the crankcase. It may be found that departure from this rule will give quieter running on some machines, when the best combination is found by trial and error.

When replacements are required for the gear wheel and pinion the numbers stamped on the gear wheel, pinion and crankcase must be quoted.

#### GEAR CASING, SUMP AND OIL THROWERS. FIGS.2 AND 4.

The gear case and sump should be thoroughly cleaned, paying particular attention to the oil grooves and cored passages. Check also that the oil throwers on the crank webs and the oil troughs are clean and undamaged. After re-assembly the sump should be refilled with recommended oil, as mentioned under "Lubrication". The oil level in the sump will fall slightly after the compressor has been run. Top up as necessary.



### RUNNING IN AFTER OVERHAUL

When series resistances are used with these machines similar resistances must be connected in the circuit during the running in period.

#### AFTER OVERHAUL, NOT INCLUDING REPLACEMENT OF BEARINGS AND CYLINDER LINERS.

After re-assembly and attachment of the motor portion to the compressor portion, fill the sump to the correct level with oil of the approved grade. Run the compressor light for at least 15 minutes at about normal speed to ensure adequate lubrication of all working parts.

#### AFTER FITTING NEW BEARINGS AND CYLINDER LINERS ETC.

The length of service between relining can be materially increased by adequate running-in. The following procedure is recommended and will be found to justify the additional work involved.

Fill the sump to the correct level with oil of the approved grade. Remove the cylinder head and run the compressor for 5 hours at half the rated motor speed. During this period ensure that the liner bores are well lubricated by adding oil externally if necessary. Ten minutes before the end of the run stop the machine and using a clean rag, wipe the bores and piston heads to remove the oil. Re-start the machine and complete the 5 hour run. During this last period the amount of oil passing the pistons must not be excessive.

Drain the sump and fill with fresh oil.

Follow the above with a run of 3 hours at  $3/4$  rated motor speed with the cylinder head on and running light.

During each of the above runs, check at frequent intervals for undue heating, oil leakage etc.

During the running in period check all joints and gaskets for leakage. Check the valve caps for tightness by pouring a little light oil around them. Other pressure joints should be checked with soap and water. After stopping the machine, and again after 12 hours in service, check all external nuts and set screws for tightness while the machine is still warm, paying particular attention to the cylinder head nuts.

### MAINTENANCE DIRECTIONS FOR MOTOR PORTION

The Railway Regulations for ensuring that compressor motors cannot become "live" during Inspection and Maintenance must be strictly observed.





## PERIODICAL MAINTENANCE.

Monthly - Examine the commutation with the compressor running at normal operating voltage and pressure. Normally, slight intermittent sparking may be seen under each brush, but any undue sparking should be investigated.

Check the wear on the brushes and renew if necessary. It is essential to renew brushes before the brush spring 127 bears on the bottom of the brush holder recess. When the brush holder is set at the maximum clearance (1/8") from the commutator the brushes should not be allowed to become shorter than 13/16" overall. New brushes should be carefully bedded in using a strip of glasspaper (emery cloth must not be used) drawn backwards and forwards until the brush assumes the commutator curvature. All traces of carbon dust should be removed from all parts of the motor.

3 Monthly - Check all connections for tightness. Clean out all carbon dust with suitably shaped nozzles, using either vacuum or clean dry compressed air. Examine the brushes for wear (see monthly servicing above).

6. Monthly. - Remove all foreign matter from the space between adjacent commutator bars, and if necessary undercut the intersegment insulation to 1/32" below the copper bars.

Check the insulation to earth using a 1,000 volt "megger" while the motor is warm. The resistance should not be less than 1 megohm.

Examine the brushes for wear (see monthly servicing above).

Check all brush gear set screws and clamp bolts for tightness.

## VEHICLE OVERHAUL PERIODS.

The motor should be dismantled and all parts thoroughly cleaned.

NOTE: When dismantling the brush gear set screw 128 MUST be removed before removing mounting bar 124 from clamp 117L and 117R, similarly, on re-assembly the set screw MUST NOT be inserted until the clamp nut has been tightened.

1. Disconnect the electrical connections and remove and clean the end bell 86A and field yoke 75A.
2. Examine the brushes for wear (See monthly servicing above) and for freedom in their holders.
3. A worn commutator should be skimmed free from all surface marks using a diamond cutting tool, and the intersegment insulation undercut 1/32". After the commutator has been skimmed the clearance between the base of the brush holders and the commutator should be checked and adjusted to between 1/16" and 1/8". Finally a "bar to bar" test should be made on the commutator to check for short circuits.



4. Check the brush spring tension by placing a spring balance under the pressure finger where it bears on the brush. The nominal spring force so measured on a new brush protruding  $3/32$ " from the bottom of the brush holder should be 5 lb/sq.in.

Check all connections for tightness and ensure that all leads are cleared away from moving parts. During testing the machine should be run long enough to ensure satisfactory bedding of the brushes. This is indicated by the markings on the rubbing face of the brush. The commutation should be observed with the machine running against full load, normally slight intermittent sparking may be seen under each brush.

5. Do not interchange parts of the motor with other machines when overhauling because the brush gear positions, which are set for each machine, may be affected.

Check that the faces of the field yoke 75A and end bell 86A are clean and bolted up flush on re-assembly. The brush gear is dowelled to the end bell in the position for best commutation. If the field yoke and end bell are not correctly attached the commutation may be adversely affected. If it is found necessary to remove the brush holder clamps 117L and 117R the clamps and end bell should be marked before removal to ensure that each clamp is re-fitted in its original position. It is essential that the brushes are correctly located to obtain the best possible commutation.

6. If it should be necessary to renew brush holder clamps 117L and 117R it may be necessary to find the position for best commutation and reposition the dowels.
7. During the motor overhaul the armature shaft bearing surfaces should be checked for wear. For details of the armature shaft and motor bearings see pages 7 and 8 of the maintenance directions for the compressor portion of this machine.

#### To Remove Armature Shaft from the Armature Spider.

Should it be found necessary to remove the armature shaft from the armature, the following procedure should be adopted.

1. Remove set screw and armature nut 90.
2. Place the armature and shaft in a press so that the armature is supported at face 'B' (See Fig.A.) by a sleeve.
3. Press out the armature shaft from the commutator end, using a suitable adaptor on the ram of the press.

To Fit the Armature Shaft to the Armature Spider (Fig. A).

When refitting an armature shaft 79 to the armature spider the following procedure should be adopted.

1. Ensure that each component is clean and in good condition.
2. Remove any sharp edges from the keyway in the shaft.
3. Remove the sharp edges of the key 91 (Fig.5) and file one end to form a "lead" when entering the armature spider.
4. Check the overall dimensions as given below throughout the length of the shaft and key, to ensure that the latter will seat properly and will enter the armature without "riding up" If the key cannot be lightly tapped into the keyway, relieve it slightly.

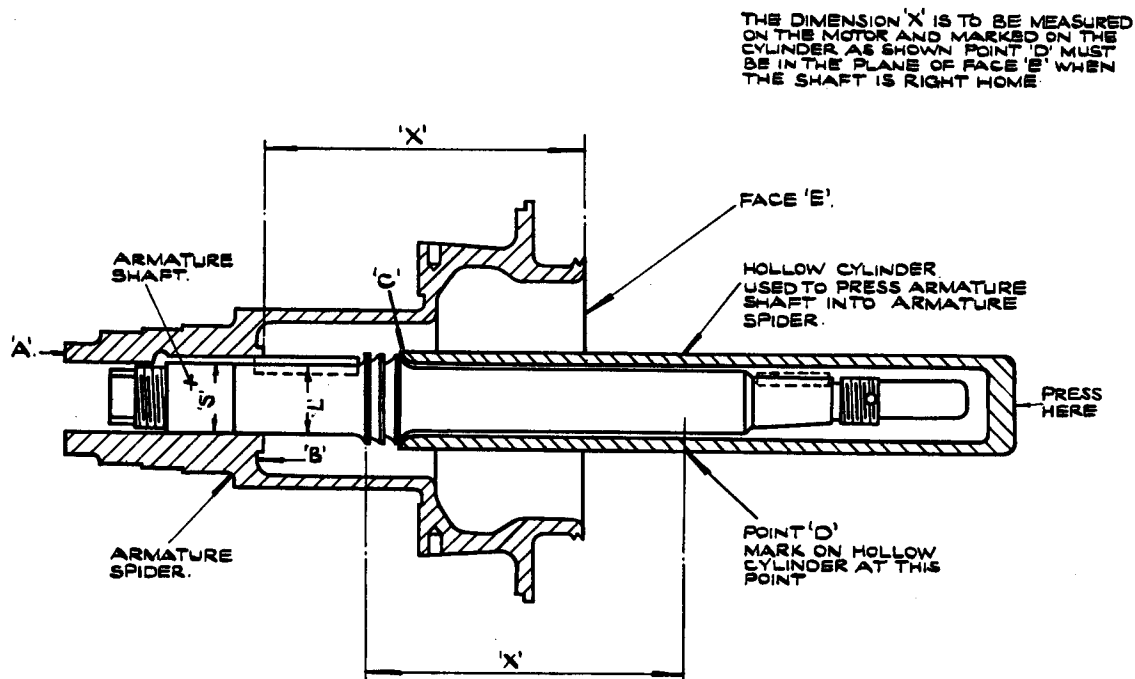


Fig. 'A'. Showing method of fitting armature shaft to armature spider.

5. Place key 91 (Fig.5.) in keyway of shaft with the filed lead uppermost and at the commutator end of the keyway.
6. Smear the shaft with the same grade of oil as that used for the compressor, and enter the shaft in the armature spider; ensure that the key is in alignment with its groove in the armature spider.
7. Place the assembly in a press. Support the commutator end of the spider at face "A" (Fig. 'A').



8. Press the shaft into the spider using a hollow cylinder, one end of which butts against the shoulder marked 'C' (Fig.A) and the other end in contact with the ram of the press. Fig.A illustrates the method of carrying out this operation.

The hollow cylinder should be marked to indicate when the shaft is fully inserted (See Fig.A)

9. Refit armature nut 90 (Fig.5) and tighten fully, it must then be locked with the set screw.

The armature and shaft assembly should be checked at the commutator for concentricity and, if necessary, a light cut should be taken off the commutator with a diamond cutting tool to eliminate any irregularity.

Check that the mica insulation between the commutator segments is undercut  $1/32$ " and free from all foreign matter. The assembly will not require re-balancing unless the armature has been rewound.

10. The dimensions of the armature shaft and the internal dimensions of the armature spider are as follows:-

Armature Shaft.

Dia. of shaft at section 'L' (Fig.'A'. )	1.7500"-1.7504"
Dia. of shaft at section 'S' (Fig. 'A')	1.748" - 1.749"
Depth of keyway	0.117" - 0.126"
Width of keyway	0.249" - 0.250"

Armature Spider

Dia. of bore to take shaft	1.749" - 1.750"
Depth of keyway	0.125" - 0.156"
Width of keyway	0.234"- 0.265"

11. To Replace Armature.

When replacing the armature and shaft, reverse the procedure for dismantling.

After re-assembly of the motor to the compressor:- Pull the armature (at the commutator end) fully forward and check the minimum clearance between the rear of the brush holders and the commutator riser. The minimum clearance should not be less than  $3/32$ ". To obtain this minimum clearance shims may be fitted between the faces of the brush holder clamps and the end bell. An equal amount of shimming must be inserted under each clamp.

NOTE:- Renew split pin 82 each time the slotted nut 81 is replaced on the shaft.



SPARE PARTS.

Component Parts Lists which identify all parts are included in Equipment Catalogues or copies will be supplied on request.

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1st Edition - 500 - 11/59.

MOTOR DRIVEN  
AIR COMPRESSOR TYPE D.H.16B.

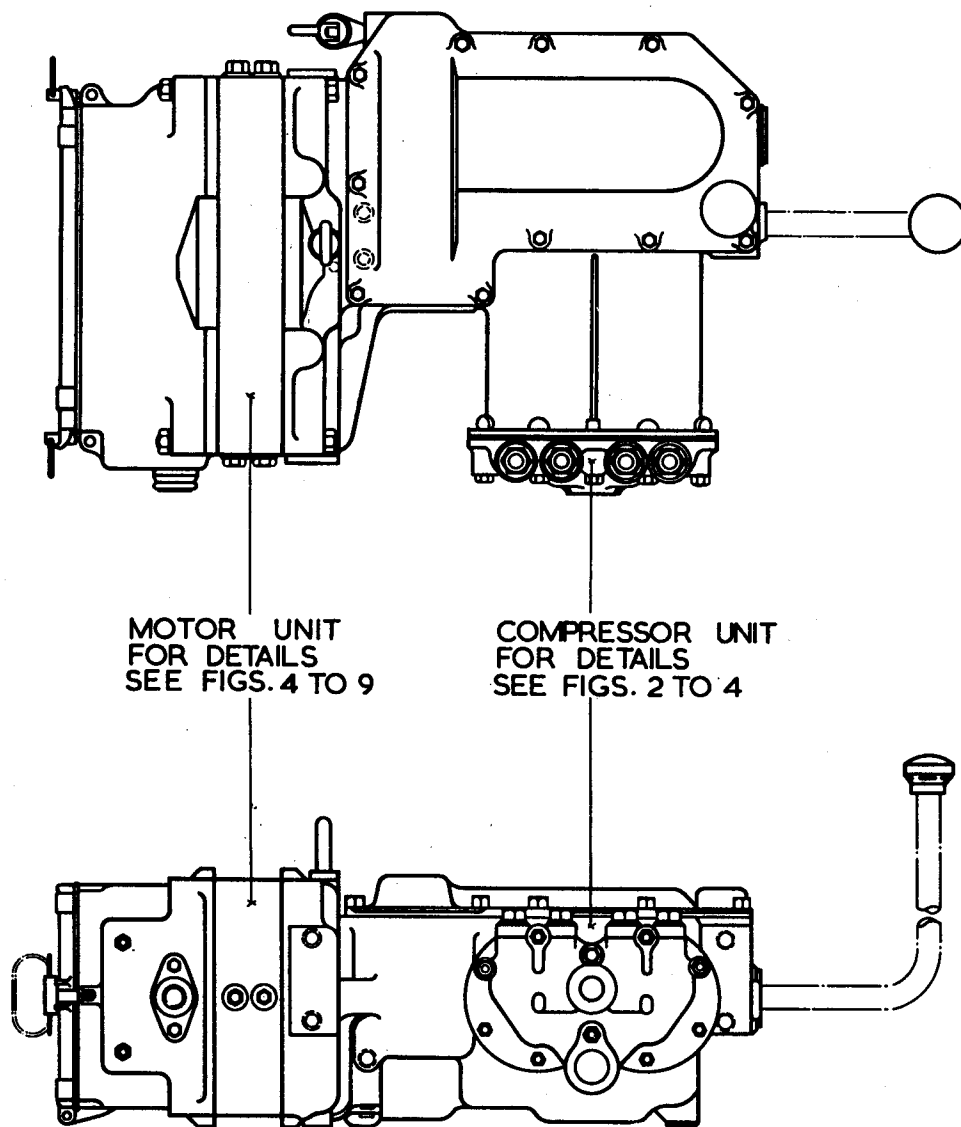


FIG. 1. GENERAL ARRANGEMENT.

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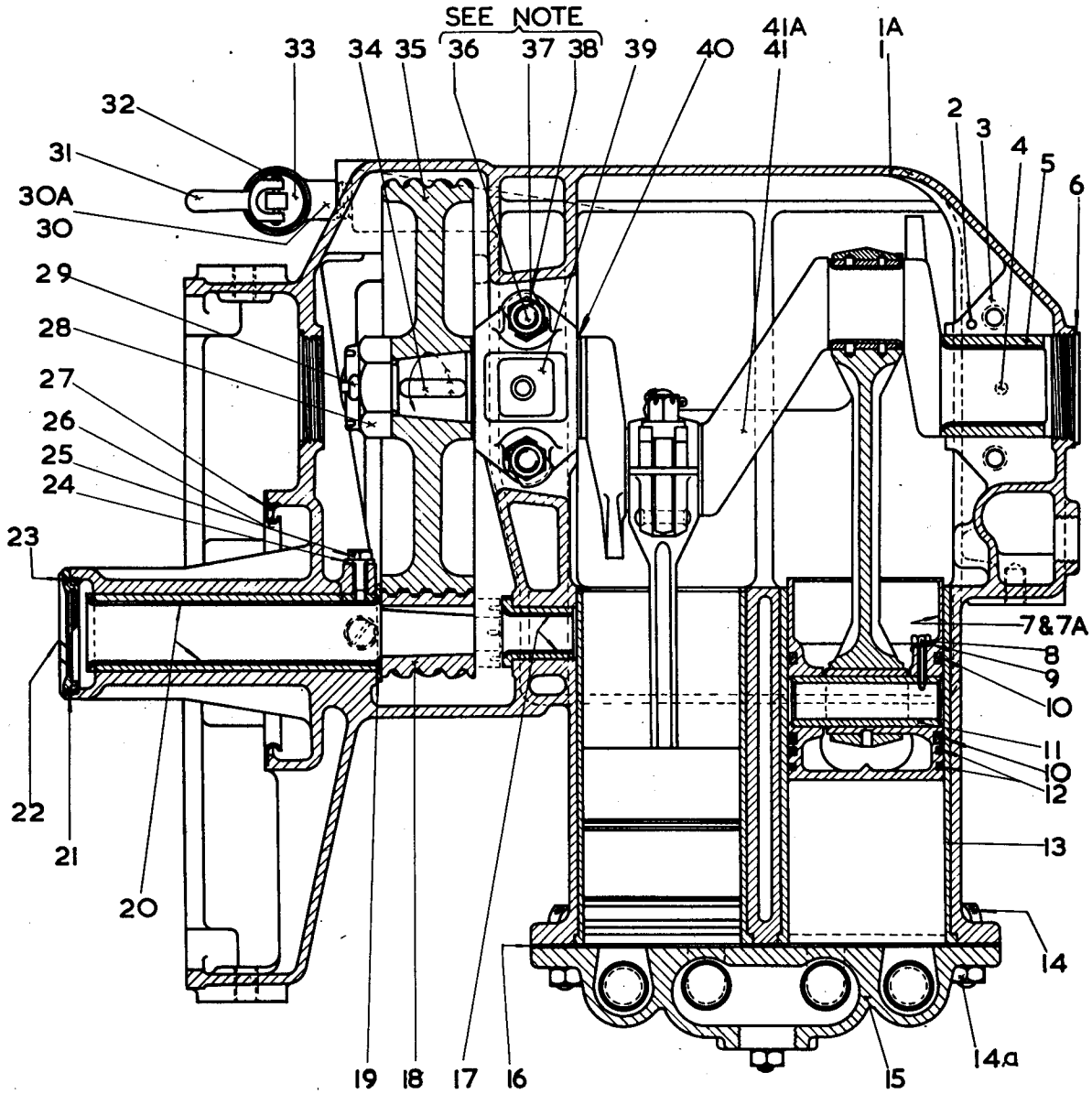


FIG.2. COMPRESSOR - SECTIONAL VIEW.

NOTE: Alternative Arrangement for Securing Crankshaft Bearing Caps - Ref.36 - Bolt: Ref.37 - Castle Nut: Ref.38-Split Pin.

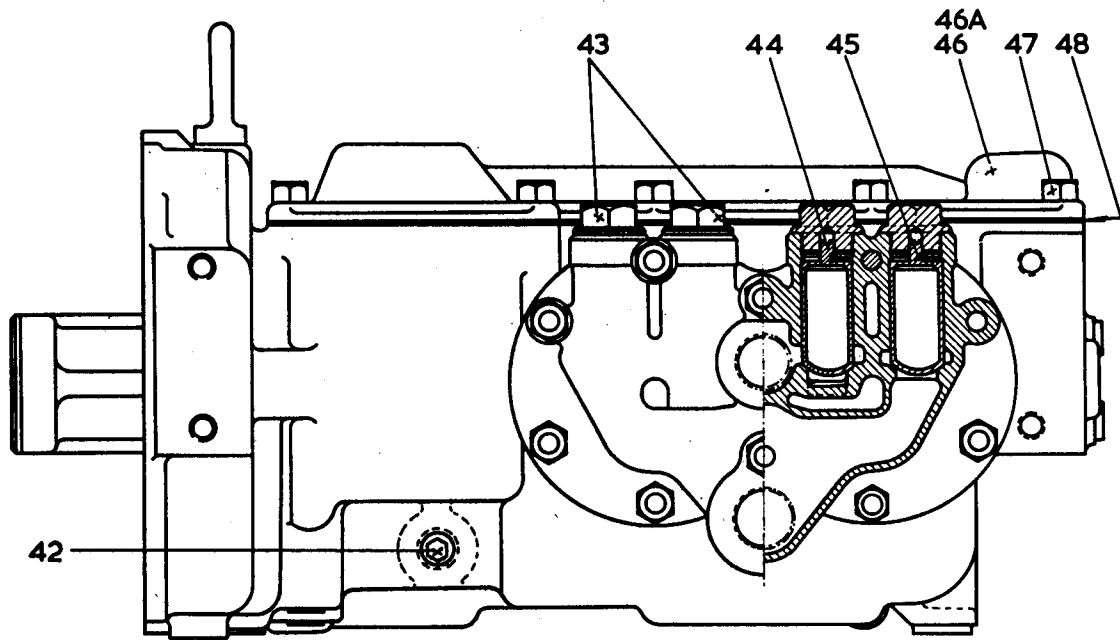


FIG.3 COMPRESSOR - SIDE VIEW  
Showing Valve Arrangement.

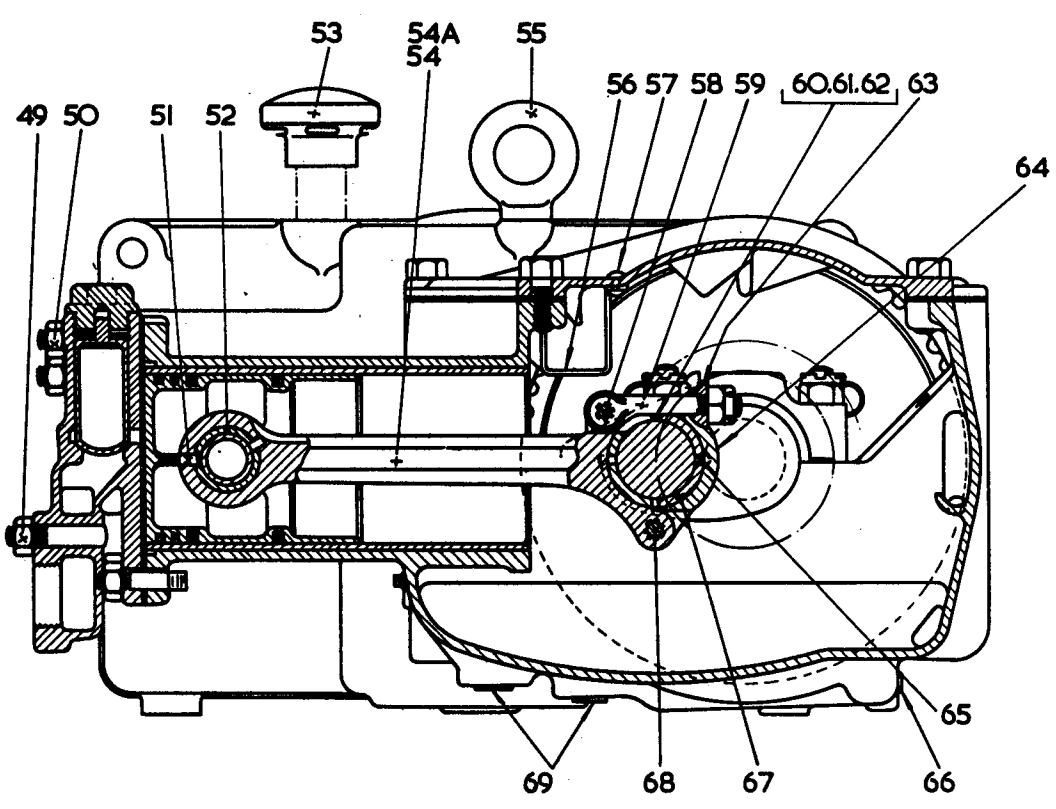


FIG.4. COMPRESSOR - SECTION THROUGH CYLINDER.



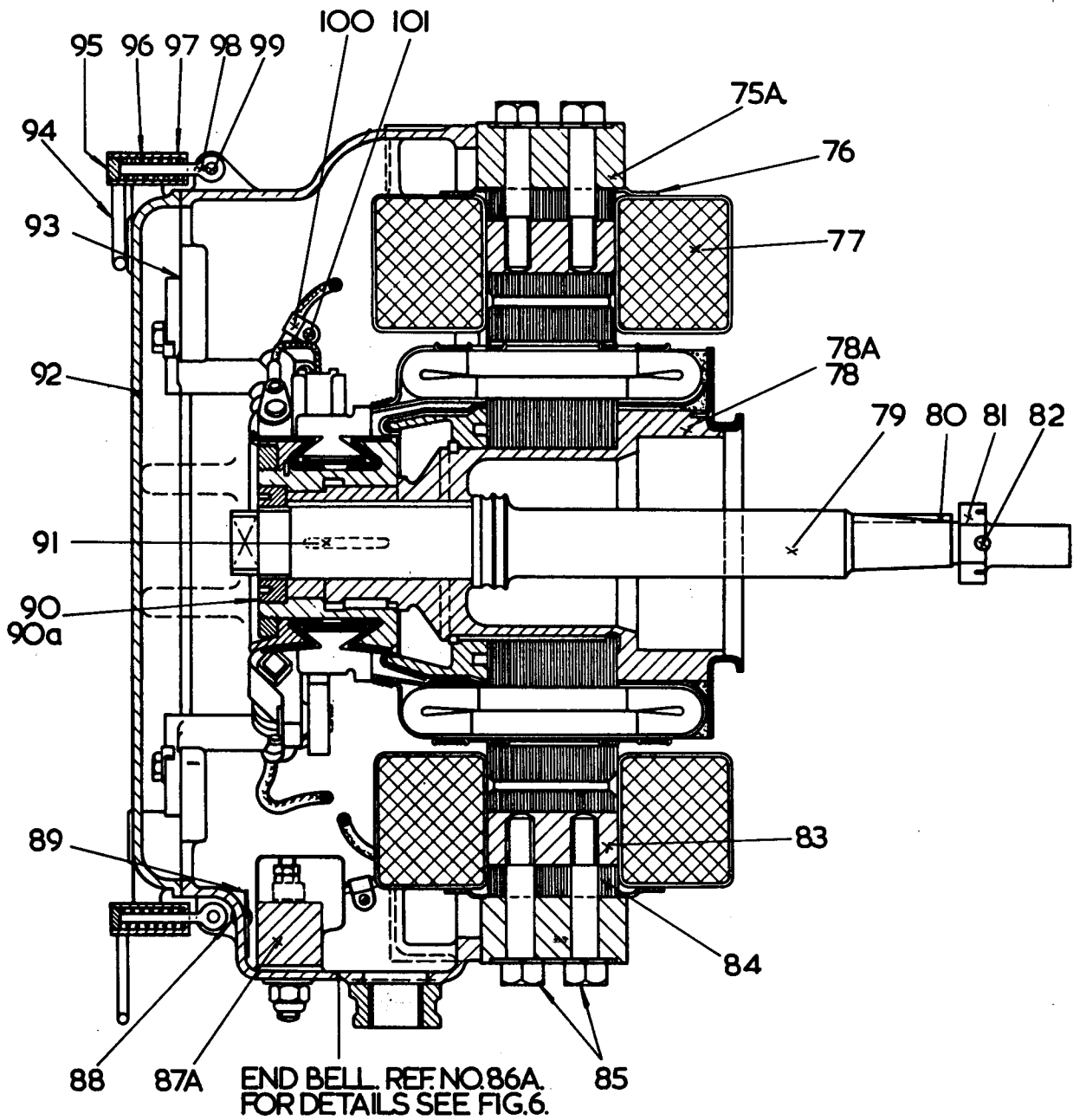


FIG. 5. MOTOR - SECTIONAL VIEW.

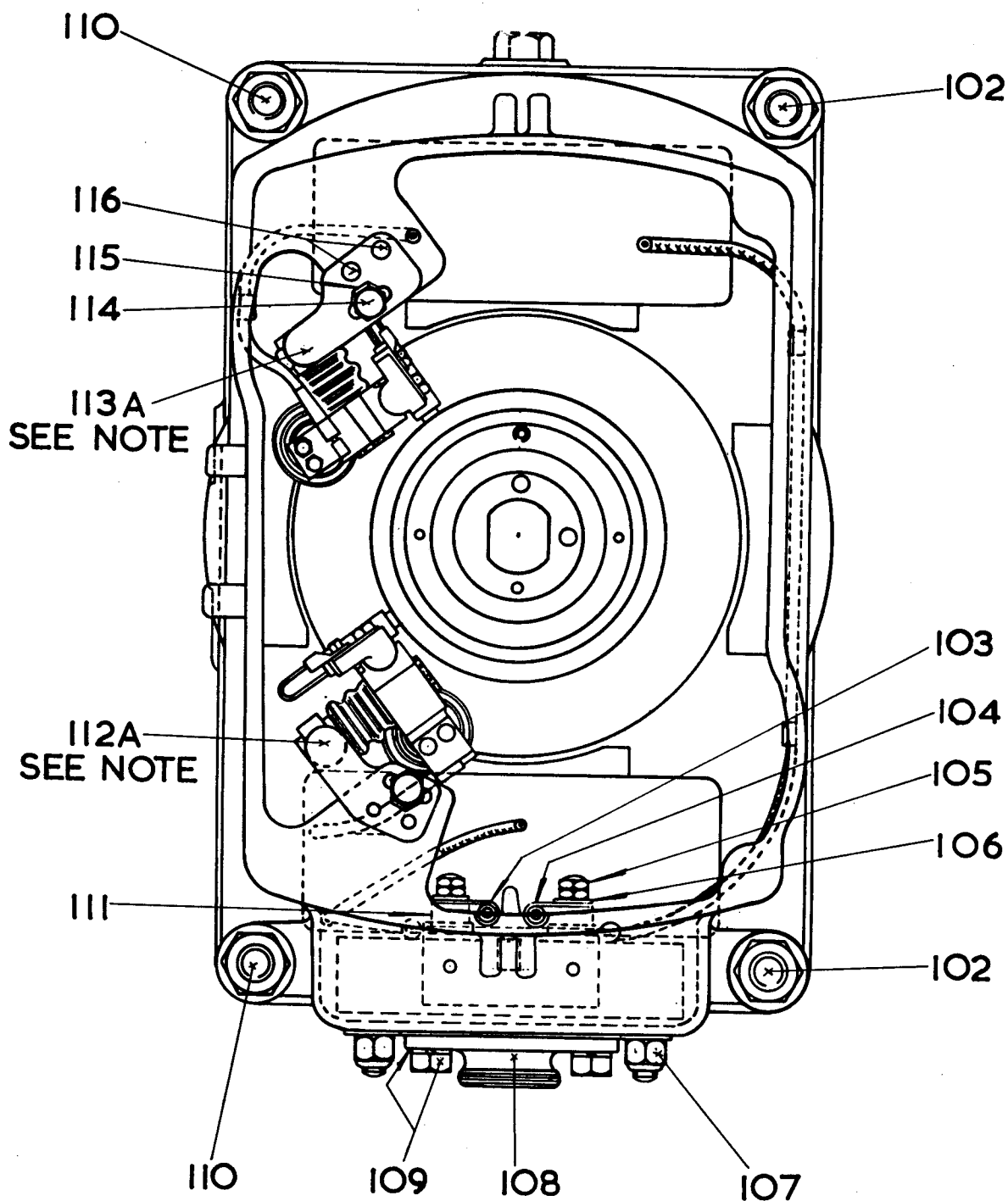


FIG.6. END BELL ARRANGEMENT.

NOTE: Ref.No.112A - Carbon Holder R.H. Complete - For Details see Fig.7.  
 Ref.No.113A - Carbon Holder L.H. Complete - For Details see Fig.8.

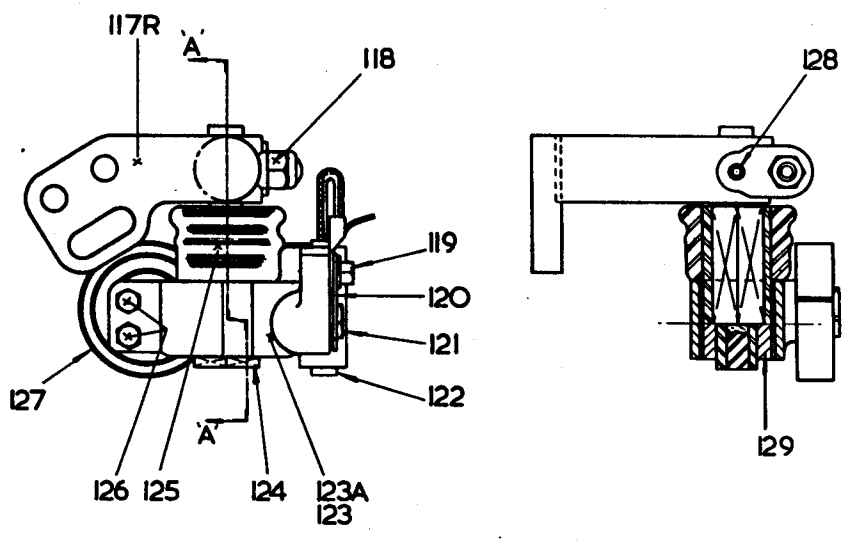


FIG. 7. CARBON HOLDER RIGHT HAND.

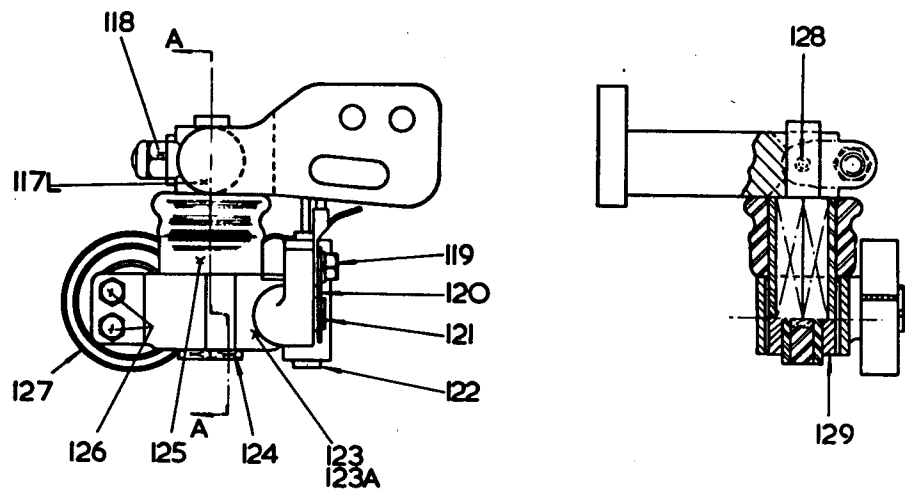


FIG. 8. CARBON HOLDER LEFT HAND

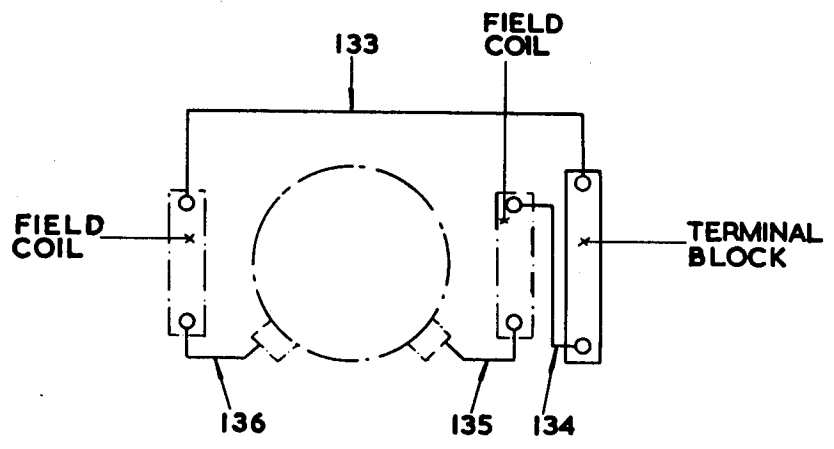


FIG. 9. WIRING DIAGRAM.