SECTION A–5
ISSUE 1, JULY 1962

LUCAS

Quality

EQUIPMENT

WORKSHOP INSTRUCTIONS

ALTERNATOR

MODEL 2AC

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ALTERNATOR

MODEL 2AC

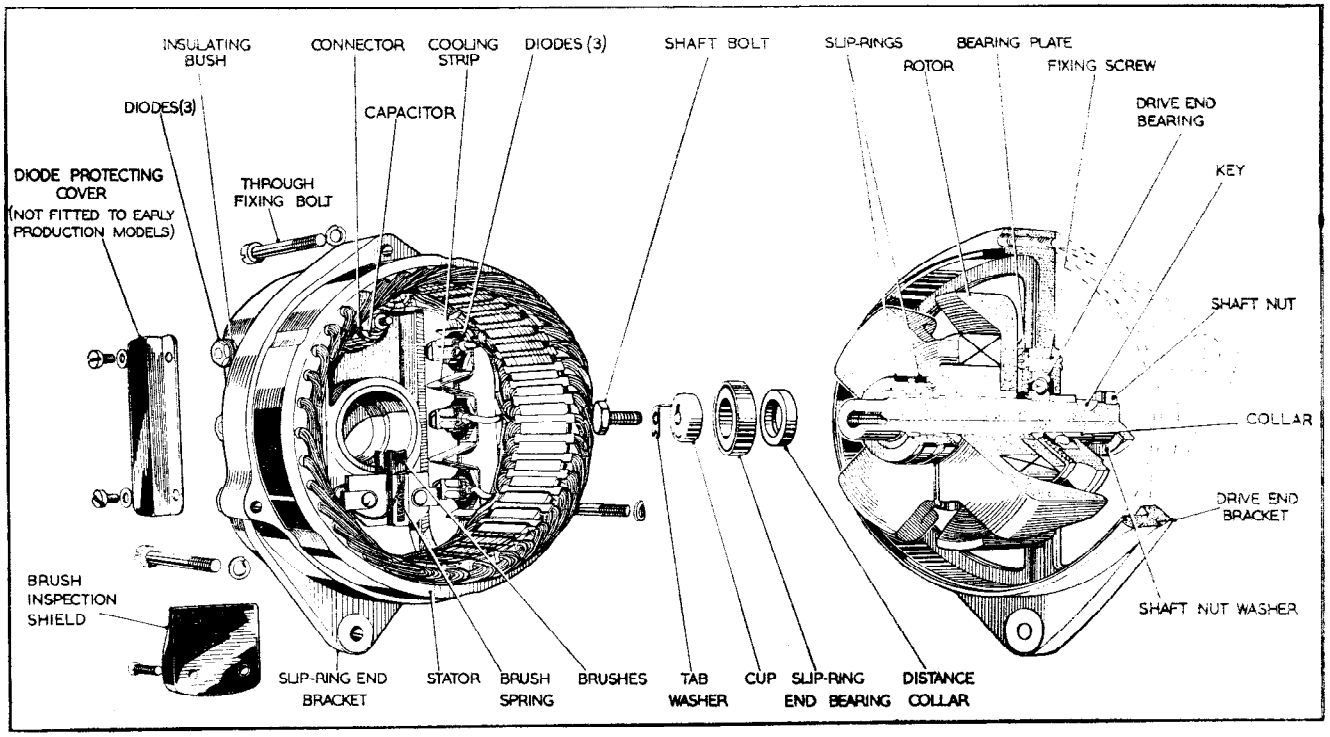

Fig. 1 Alternator, dismantled

1. GENERAL

The stator comprises a 36-slot 3-phase delta-connected winding on a ring-shaped lamination pack housed between two cast aluminium end brackets. The rotor is of 8-pole construction, and is supported at each end by a ball bearing in each end bracket. It carries a field winding connected to two cupro-nickel slip-rings and the associated brush gear is mounted in the slip-ring end bracket.

Rectification of the A.C. output is by six silicon diodes connected to form a 3-phase full-wave bridge circuit. The diodes are built into the slip-ring end bracket and are cooled by the air flow through the machine. The end bracket also acts as a heat sink, while additional cooling surfaces are provided by thin copper strips fitted beneath both sets of three diodes.

The output terminal forms the core of a feed-through, or bushing, capacitor. This capacitor serves to reduce any radio interference and does not in any way affect the performance of the alternator.

Fig. 1 shows the construction of the alternator in detail.

The alternator is polarised to suit a specific earth polarity. Earthing the wrong battery terminal will damage the diodes. Alternators must only be connected to control units of like polarity.

OUTPUT CONTROL

The alternator output voltage is controlled by a regulator (housed in Control Box, Model 2TR) which controls the alternator field current and hence the alternator terminal voltage.

The control box does not include a cut-out relay ; the diodes in the alternator prevent reverse currents from flowing through the stator when the machine is stationary or is generating less than the battery voltage.

No separate current limiting device is incorporated ; the inherent self-regulating properties of the alternator effectively limit the output current to a safe value.

FIELD ISOLATING DEVICE

To de-energise the alternator field and voltage regulator when the engine is at rest, a switching device, mechanically or electrically interlocked with the ignition switch, is inserted between the alternator output and the control box.

Note: Since the alternator output must respond to changes in battery voltage, the regulator must be made sensitive to battery potential and not to conditions occurring elsewhere in the system. In view of this, direct electrical connection to the ignition switch cannot be utilised since the loading at this point, and hence also the voltage, is not constant but varies with the number of sub-circuits in simultaneous use.

Figs. 2 and 3 show the internal connections of the charging circuit, using a relay operated by the ignition switch to isolate the field when necessary.

2. ROUTINE MAINTENANCE

(a) LUBRICATION

The alternator needs no lubrication in normal service. The bearings are packed with grease before assembly and the slip-ring end bearing is sealed.

(b) INSPECTION OF DIODES

Occasionally inspect the alternator diodes. If necessary, carefully wipe away any dirt or oil which may be found on them.

(c) BELT ADJUSTMENT

Occasionally inspect the alternator driving belt. If necessary, adjust to take up any undue slackness. Care should be taken to avoid overtightening the belt, which should have no more tension than is required to transmit the drive without slipping. See that the machine is properly aligned with respect to the drive as otherwise the rotor bearings will be unduly strained.

3. PERFORMANCE DATA

(a) Rotation : Can be driven clockwise or anti-clockwise.

(b) Maximum running speed : 11,000 r.p.m. (rotor).

(c) Cutting-in speed : 800—900 r.p.m. at 13.0 D.C. output volts.

(d) Maximum output : 65 amp. at 6,000—11,000 r.p.m. at 13.5 volts, taken on a 0.21 ohm resistance load without regulator, and at 20°C. (i.e. alternator cold).

(e) Brush spring tension : 4—8½ oz.

(f) Rotor resistance (between slip-rings) : 5.4 ohms ±0.1.

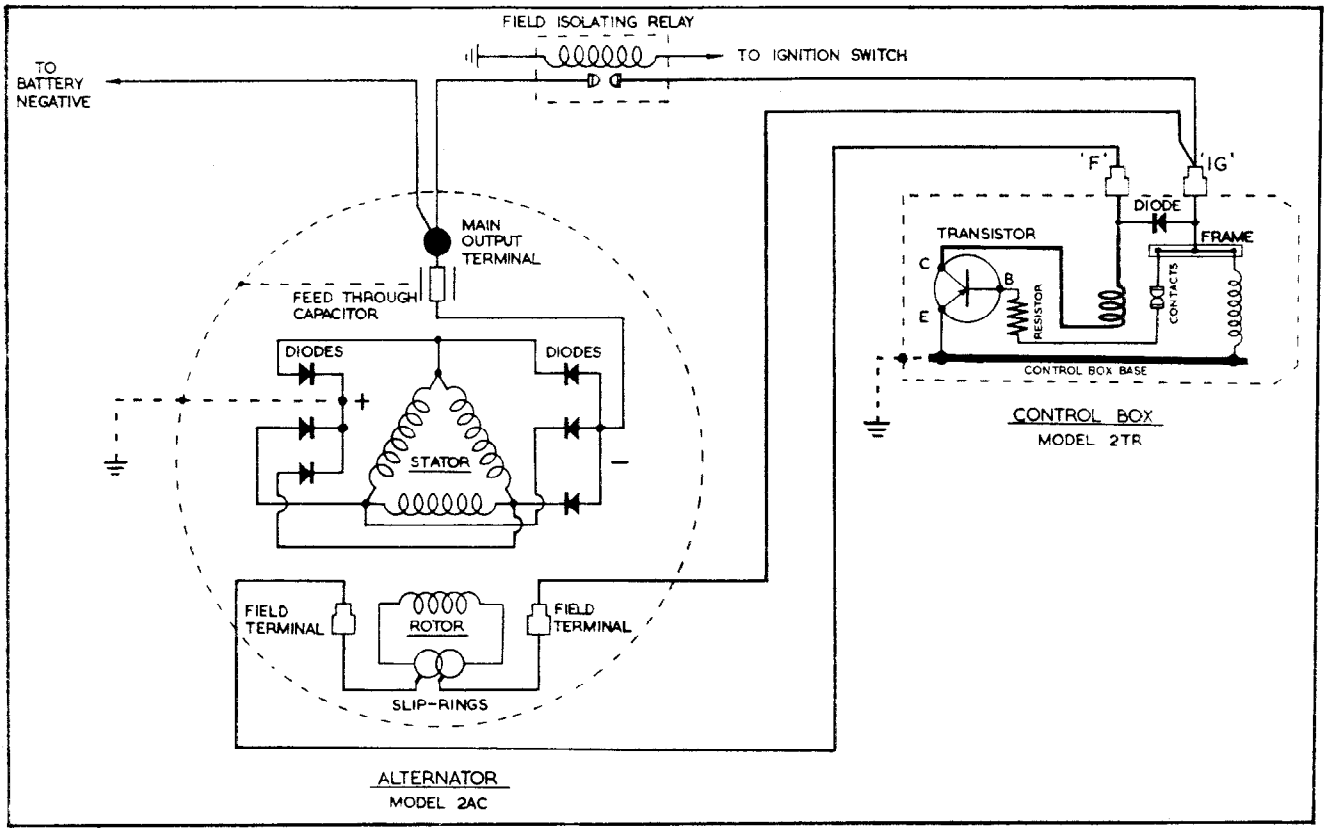

Fig. 2
Internal connections of charging system (positive earth)

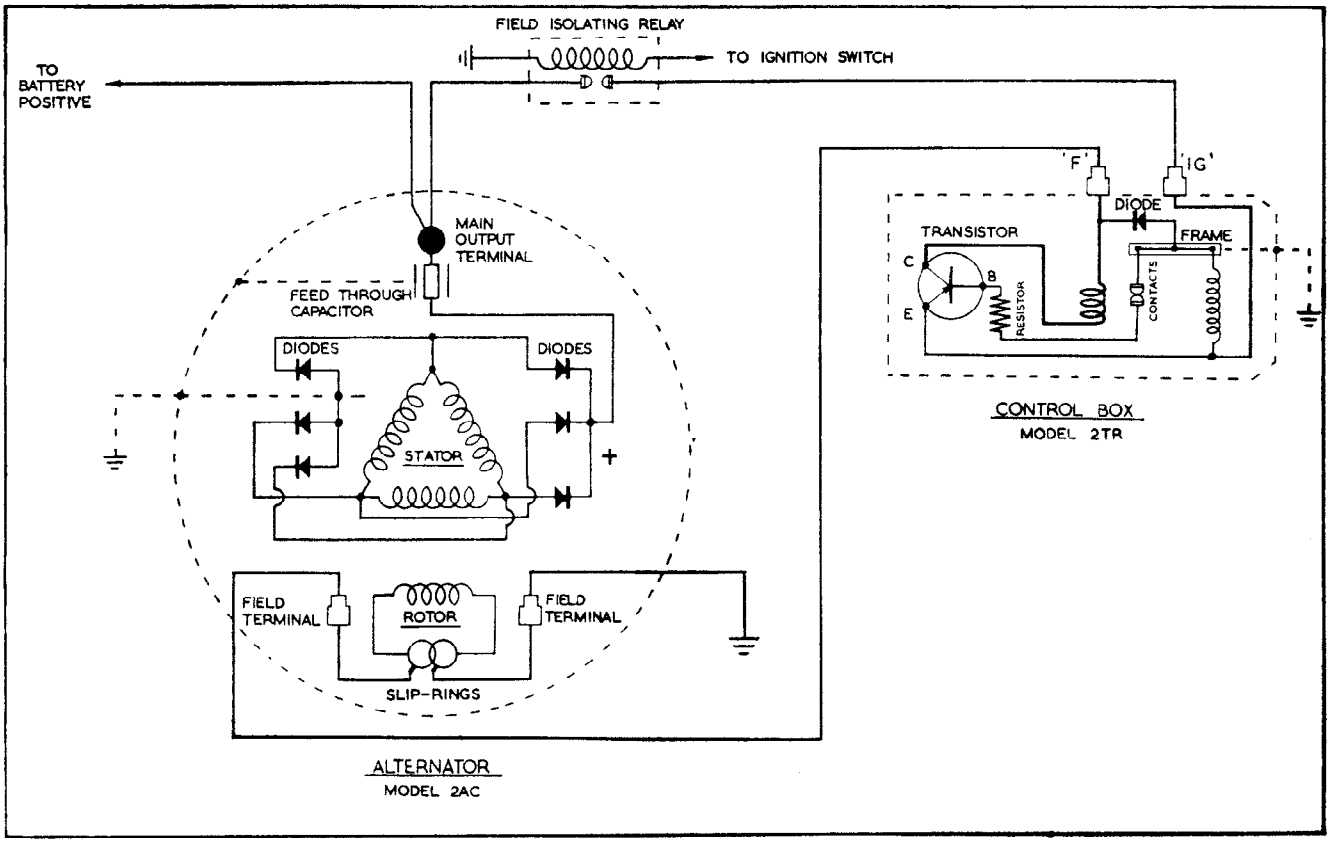

Fig. 3 Internal connections of charging system (negative earth)

4. SERVICING

(a) TESTING IN POSITION TO LOCATE A FAULT IN THE CHARGING CIRCUIT

In the event of a fault in the charging circuit, adopt the following procedure to locate the cause of the trouble:

(i) Inspect the driving belt and adjust if necessary, in accordance with Para. 2 (c).

(ii) Disconnect battery earth lead.

(iii) If an ammeter is not fitted to the vehicle, disconnect both cables from the alternator main output terminal and connect a good quality moving coil D.C. ammeter, reading up to at least 75 amperes, between the alternator main output terminal and the two cables previously disconnected from this terminal.

(iv) Disconnect the cable from the control box terminal marked 'F' and temporarily connect to vehicle chassis (positive earth system) or to lead connected to terminal 'IG' on control box (negative earth system). To facilitate the procedure on negative earth systems, the leads may be joined by using Lucar double contact blade, Part Number 541 900 76.

(v) Reconnect battery earth lead. Switch on the ignition, start the engine and slowly open the throttle until the alternator speed is approximately 2,500 r.p.m. At this point the reading on the ammeter should be in excess of 45 amperes, with the alternator at ambient temperature. A low reading at 2,500 r.p.m. will indicate either a faulty alternator, bad earths or poor circuit wiring connections. If after checking the latter a low reading is still given, proceed to Para. 4 (a) (vi).

A zero reading can be the result of a faulty alternator, faulty field isolating relay, or its associated circuit. If the field isolating relay is suspect, switch off the ignition and connect a jumper lead across the relay contacts, switch on the ignition and again check alternator output. If the alternator now charges, it indicates a faulty relay and the usual checks for continuity of relay winding, faulty wiring and earth connections should be carried out. If the field isolating relay and its associated circuit are functioning correctly, and the alternator is still giving zero output, proceed to Para. 4 (a) (vi).

(vi) With the ignition switched off, remove the leads from the main terminal of the alternator. Using a battery-operated ohmmeter, connect one test lead to the main output terminal of the alternator, and the other test lead to earth. Reverse the leads and observe the effect. The ohmmeter should yield "Infinity" in one direction and some indefinite, but much lower, reading in the other.

If the ohmmeter yields "zero" in both directions, then a defective feed-through capacitor or faulty diodes are indicated. The machine should be dismantled in accordance with Para. 4 (b) and the diodes tested in accordance with Para. 4 (g). The capacitor should be checked by substitution. If the ohmmeter yields incorrect readings, other than those given above, the diodes should be suspected. The machine should be dismantled in accordance with Para. 4 (b) and the diodes tested in accordance with Para. 4 (g).

(vii) Remove the lead from each field terminal and measure the resistance of the rotor coil (field) by means of an ohmmeter connected between the two small Lucar terminal blades on the slip-ring end bracket. The resistance must be 5.4 $\pm$0.1 ohms. If an ohmmeter is not available, connect a 12-volt D.C. supply between the field terminals with an ammeter in series. The ammeter reading should be approximately 2.2 amperes. Zero reading on the ammeter, or an "Infinity" ohmmeter reading, indicates an open circuit in the field system. Proceed to Para. 4 (a) (viii).

If the current reading is much more than 2.2 amperes, or the ohmmeter reading is below 5.4 ohms, it is an indication of a short circuit in the rotor coil. Unless a substitute alternator is available, the rotor/slip-ring assembly must be replaced.

(viii) Remove the two screws in the brushgear inspection plate. The flexible connector from each brush will be visible. Check that the brushes are moving freely in their holders by gently lifting each flexible connector in turn.

Recheck the field resistance. If the ammeter still registers zero, or the ohmmeter still registers "Infinity", the alternator must be dismantled for internal examination, see Para. 4 (b). If the ammeter now registers approximately 2.2 amperes, or the ohmmeter registers approximately 5.4 ohms, the brushgear or slip-rings are suspect and should be examined in accordance with Para. 4 (c)–(d) when the alternator has been dismantled.

(b) TO DISMANTLE

(i) Take off the driving pulley.

(ii) Remove the cover protecting the diode terminals, by unscrewing and removing the two securing screws. (Not fitted to early production machines.)

(iii) Unscrew and withdraw the three through fixing bolts.

(iv) Remove the brush inspection shield. Lift the brushes into their holders and secure them in this position, by introducing a wedge of circular section within each loop formed by the flexible connectors (Fig. 4).

(v) Lift the drive end bracket and rotor assembly from the stator. It may be found necessary to tap the slip-ring end bracket gently.

(vi) The drive end bracket, which on removal from the stator has withdrawn with it the rotor and two end bearings, need not be separated from the shaft unless either bearing is suspected and requires examination, or the rotor is to be replaced; in this event the rotor should be removed from the drive end bracket by means of a hand press, having first removed the shaft key.

The slip-ring end bearing may also be removed by means of a hand press, having first opened back the two ears of the tab washer, unscrewed and removed the shaft bolt together with the tab washer and cup. After removing the slip-ring end ball-bearing, take off the distance collar.

(vii) Separate the stator from the slip-ring end bracket after disconnecting the six Lucar connectors from the diodes in the end bracket. On some early

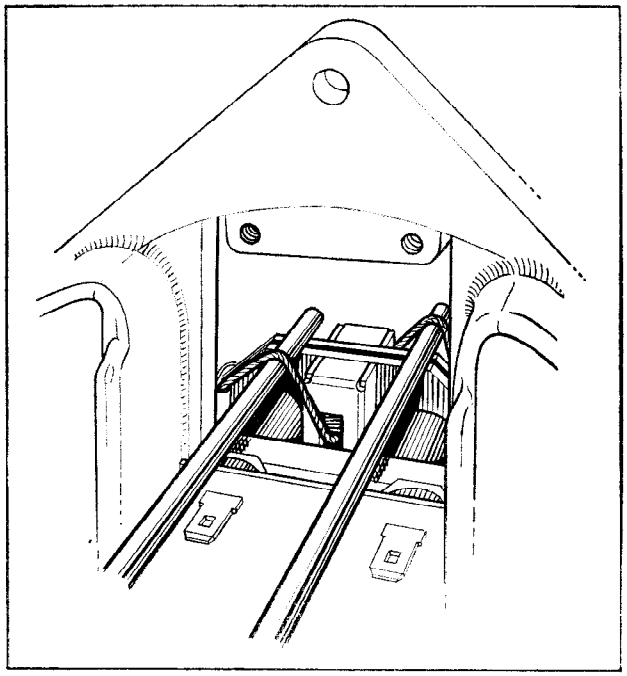

Fig. 4
Method of lifting brushes

production machines, the diodes are connected to the stator coils by means of screws, nuts and washers.

(c) INSPECTION OF BRUSHGEAR

(i) Measure brush length. Brushes are subjected to very little wear as they are running on the smooth unbroken surface of the slip-rings. A new brush is 0.625" long ; a brush which is considered fully worn is 0.185" long. A brush which has worn to about 0.400" has used approximately half of its wearing length, and it is recommended that a new brush should be fitted to avoid the necessity of subsequently having to remove and dismantle the alternator simply to change the brushes.

(ii) Measure the brush spring pressures. To do this, remove the brushes from their holders and withdraw each spring. With the aid of a spring balance (Fig. 5) ensure the load at $\frac{2}{3}\frac{5}{2}$" is 4—5 oz., and the load at $\frac{1}{3}\frac{3}{2}$" is $7\frac{1}{2}$—$8\frac{1}{2}$ oz. If the loading at either of these compression lengths is outside the range given, a replacement brush spring is needed.
When re-fitting the brushes in their holders, take care to ensure that they take up their original positions, with the flexible connector adjacent to the slot in the holder.

(iii) Check that the brushes move freely in their holders ; if they are stiff, remove them and clean their sides with a cloth moistened in petrol. Be careful to replace the brushes in their original positions, in accordance with the procedure given earlier. If the sluggish movement continues, lightly polish the brush sides on a smooth file. Remove all traces of brush dust before re-housing the brushes in their holders.

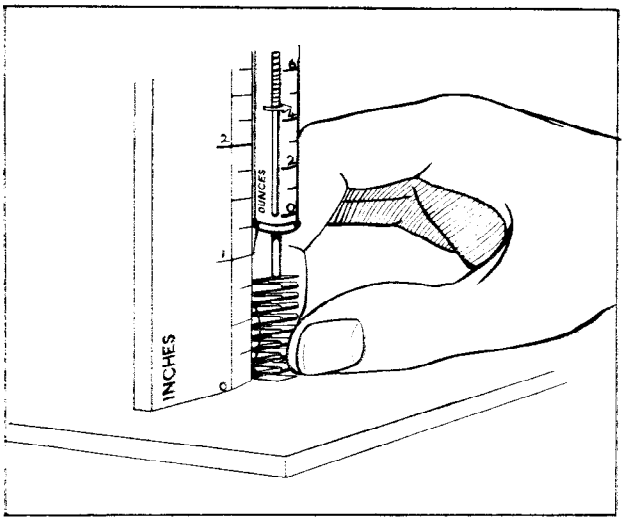

Fig. 5
Measuring brush spring tension

(d) INSPECTION OF SLIP-RINGS

When inspecting the brushgear, examine also the surface of the slip-rings. They should be clean and free from oil or dirt. If necessary, the slip-rings can be cleaned with very fine glass-paper. On no account should emery cloth or other similar abrasives be used. No attempt should be made to machine the slip-rings, as any eccentricity in the machining may have serious effects at maximum rotor speed, in addition to any out-of-balance effect. The small current carried by the rotor winding, and the unbroken surface of the slip-rings, mean that the possibility of pitting or scoring of the slip-rings is almost negligible.

(e) ROTOR

(i) The testing of the rotor winding (field) necessitates the use of an ohmmeter (5.4 ohms $\pm$0.1 between the slip-rings). If no ohmmeter is available, connect a 12-volt D.C. supply with an ammeter in series across the slip-rings when the ammeter should read approximately 2.2 amp. No reading on the ammeter indicates an open circuit.

(ii) Test for insulation between slip-ring and core with a mains test lamp. If the lamp lights, the coil is earthing to the core.

(iii) No attempt should be made to machine the rotor core or to true a distorted shaft.

(iv) When necessary, separate the rotor shaft from the drive end bracket and slip-ring end ball bearing in accordance with the dismantling procedure of Para. 4 (b) (vi). When fitting a new rotor into the drive-end bracket, support the inner journal of the ball bearing, using a mild steel tube of suitable diameter, while pressing the rotor shaft firmly home. See also Para. 4 (j) (i). When fitting a new rotor into the slip-ring end ball bearing, ensure that the distance collar is in its correct position on the shaft prior to inserting the shaft into the ball bearing. See Para. 4 (h) (i).

(f) STATOR

(i) Measure the volt drop between terminals A_1A_2, A_1A_3, A_2A_3, B_1B_2, B_1B_3 and B_2B_3 (Fig. 6) when passing 20 amps. between the terminals. The volt drop should be 3.4 volts $\pm$0.1 in each of the six measurements. If any, or all, of the readings are other than within the range quoted, the stator must be replaced.

(ii) Examine the covering of the six leads from the stator for possible shorting to slip-ring end bracket. Test for insulation between stator coils and core with a mains test lamp. Connect test probes between any one of the six terminals and the core. If the lamp lights the stator coils are earthing to the yoke.

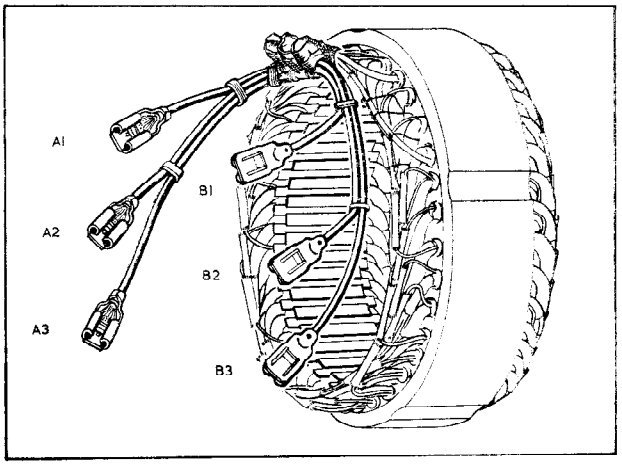

Fig. 6 Nomenclature for testing stator

(g) DIODES

Six silicon diodes are mounted on the slip-ring end bracket. The diodes are arranged in two sets of three, one set having its mounting studs connected directly to the bracket, and the other set being insulated from the bracket.

The diodes are 35 ampere, 50-volt rectifiers for operating in an ambient temperature range —40°C. to +100°C.

Simple Test for Diode Checking

The diodes should be tested in position, the stator leads having first been disconnected. Any dirt or oil should be removed from the diodes.

(i) Connect two test leads to a 12-volt battery. Insert a 12-volt 1.5 watt test lamp (Lucas bulb No. 280) in series with one of the leads, and fit a test probe to each lead.

(ii) Connect one probe to one diode stud and the other probe to its connector. Reverse the probes and observe the effect. Current should flow in one direction only. If the bulb lights in both tests or does not light in either, the diode is defective and must be replaced.

(iii) Repeat the test for each diode in turn. Any diode which appears defective must be replaced.

The above test is adequate for service purposes. Any accurate measurement of diode resistance necessitates the use of factory equipment. Since the forward resistance of a diode varies with the voltage applied, no realistic readings can be obtained from battery ohmmeters. However, if a battery ohmmeter is used, a good diode will yield "Infinity" in one direction and some indefinite, but much lower, reading in the other.

Warning: Ohmmeters of the type incorporating a hand-driven generator must never be used for checking diodes.

Fitting New Diodes

Always ensure that a correct replacement is fitted (see Fig. 7). Substituting a diode having incorrect mounting stud polarity will result in the machine giving a poor output, while at the same time allowing heavy currents to circulate within the stator coils thereby resulting in possible damage to the machine and the diodes. Fig. 8 shows an insulated diode assembly, the mica strip and insulating bush being absent in the earthed diode assembly. Should it be thought necessary to replace a complete set of diodes, or a set having common stud polarity, it is advisable to exchange the diodes singly, in order that the cooling strip and (in the case of the insulated set) the mica strip, are not disturbed unnecessarily.

Early production machines incorporate diodes which do not contain the Lucar terminal blade. When exchanging such units for Lucas diodes, it will be necessary to exchange the eyelet on the corresponding stator lead for a 35 amp. service Lucar connector, Part Number 549 420 79. To effect this exchange, sweat the eyelet from the lead and remove excess solder. Feed the wires through the D-shaped aperture of the connector and bend flat on to the back of the connector. Secure the cable by crimping the cleats over the cable insulation. Keeping the wire strands as flat as possible, solder to the back of the connector. Do not allow the solder to run through the D-shaped aperture.

Before assembling a replacement diode into the end bracket, ensure that the underside of the hexagon and its seating area on the cooling strip are clean, so that good thermal contact is made on subsequent tightening (see Fig. 8).

Mount the diode so that the axis of the Lucar blade is parallel to the axis of the machine and is pointing towards the stator. On no account must the Lucar connector make contact with the cooling strip.

When tightening the hexagon nut on the diode mounting stud, the applied torque must be between 12 lb.-in. minimum and 17 lb.-in. maximum. Exceeding the upper limit will result in internal damage to the diode.

There is no need to disturb either the cooling strip, or the mica strip insulating one set of diodes from the end bracket, providing the procedure recommended earlier is adopted. If, for any reason, the mica strip or either cooling strip is moved from its normal position, ensure that each mating surface is clean before reassembling.

(h) BEARINGS

Bearings which are worn to such an extent that they will allow side movement of the rotor shaft, must be replaced.

(i) To replace the ball bearing at the slip-ring end of the motor shaft, proceed as follows:

Open back the two ears of the tab washer.

Unscrew and remove the shaft bolt, together with the tab-washer and cup.

Remove the bearing from the rotor shaft by means of a hand-press or extractor (shaft tapped $\frac{1}{4}$—28 U.N.F.).

Press the replacement bearing on to the shaft by supporting the inner race, having first ensured that the distance collar is in position on the shaft.

Fit the cup, tab washer and shaft bolt. Finally, bend up the two ears of the tab washer to retain the shaft bolt.

(ii) The ball bearing at the driving end is replaced as follows:

Remove the roll-over on the screws which secure the bearing retaining plate to the end bracket, and unscrew them. Remove the plate.

Press the bearing out of the end bracket.

Before fitting the replacement bearing see that it is clean and pack it with high melting-point grease such as Shell Alvania No. 3 Lithium base grease, or Retinax A, or an equivalent.

Locate the bearing in the housing and press it home.

Refit the bearing retaining plate using replacement screws. Open the screw ends by means of a punch to assist in securing the plate.

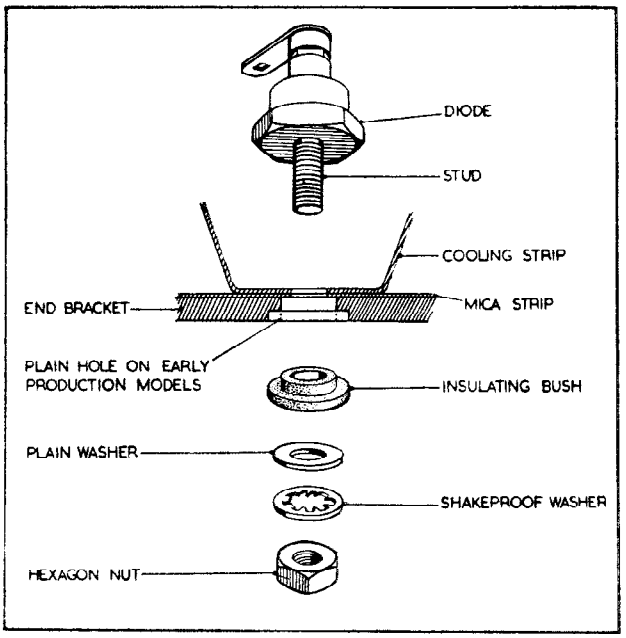

Fig. 7 Insulated diode assembly

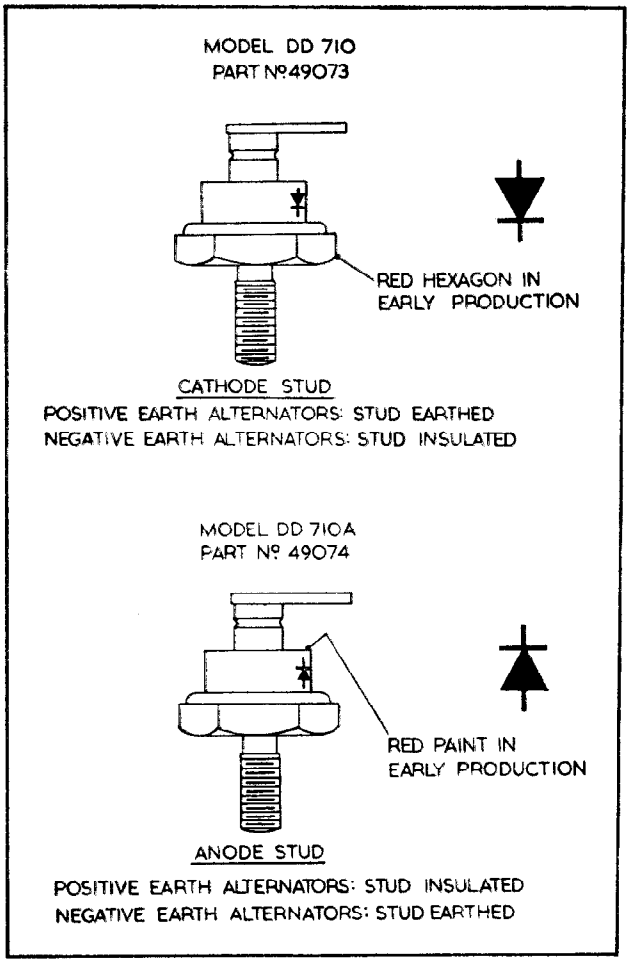

Fig. 8
Details of diodes 49073, 49074

(j) TO REASSEMBLE

(i) Fit the drive end bracket to the armature shaft, having first smeared the surface of the shaft at the driving end with Shell Alvania No. 3 Lithium base grease, or Retinax A, or an equivalent. The inner journal of the bearing must be supported by a tube for the fitting operation.

Do not use the drive end bracket as a support for the bearing while fitting the rotor.

(ii) Fit the stator to the slip-ring end bracket and connect the diodes to the stator lead-outs.

(iii) Push the brushes up into their holders and secure them in that position by introducing a wedge of circular section within each loop formed by the flexible connectors (see Fig. 4).

(iv) See that the slip-ring end bearing on the rotor shaft is clean, and smear the outer surface of the

outer journal with Shell Alvania No. 3 Lithium base grease, or Retinax A, or an equivalent, before assembling the slip ring end bracket and stator to the drive end bracket and rotor.

(v) Refit the three through fixing bolts. Remove the wedges from the flexible connectors on the brushes, and refit the brush inspection shield. Refit the diode protecting cover (when incorporated), fan, pulley, collar and key.

(k) WHEN VEHICLE UNDERGOES GENERAL OVERHAUL

When the vehicle receives a general overhaul, a check should be made of the alternator brushgear and slip-rings. This will involve removing the machine from the vehicle, dismantling in accordance with Para. 4 (b), and inspecting the brushgear and slip-rings as detailed in Para. 4 (c) and (d).

CONVERSION OF MEASUREMENTS OCCURRING IN FOREGOING TEXT

−40° C. = −40° F.
20° C. = 68° F.
100° C. = 212° F.

0.185″ = 4.3 mm.
0.4″ = 10.2 mm.
$\frac{13}{32}$″ = 10.3 mm.
0.625″ = 15.9 mm.
$\frac{25}{32}$″ = 19.8 mm.

4 oz. = 113 g.
5 oz. = 143 g.
$7\frac{1}{2}$ oz. = 213 g.
$8\frac{1}{2}$ oz. = 241 g.

12 lb.-in. = 0.138 kg.-m.
17 lb.-in. = 0.196 kg.-m.