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Section M5

ALTERNATOR AND REGULATOR

C.A.V. Model AC 512 and 440 Regulator

Alternator

The alternator is a three-phase machine of the revolving field and stationary armature type and is self limiting in current output. Rectification of the output into direct current is provided by six silicon diodes contained in the slip ring end-shield and connected in a three phase bridge circuit between the stator and output terminals. A second rectifier bridge is formed by using three auxiliary diodes in conjunction with three of the six main diodes and these supply the energy for the alternator field coil which is fed through slip rings and brushes. This arrangement of auxiliary diodes prevents the battery from discharging through the field coil when the alternator is stationary.

440 Regulator

The regulator is fully transistorised with no moving parts, requires no service attention and is non-repairable. A cut-out relay is not necessary as the diodes in the alternator prevent reverse currents from the battery flowing through the stator when the machine is stationary or when generating less than the battery voltage.

Important The transistors in the regulator and diodes in the alternator are sensitive to voltage changes and high temperature, therefore it is essential that the following precautions are taken to avoid damage to the system when carrying out vehicle maintenance:

THE BATTERY MUST NOT BE CONNECTED OR DISCONNECTED WHEN THE ENGINE IS RUNNING.

2. Whenever a lead is disconnected it should be identified in relation to its terminal to facilitate reconnection. Short circuiting or reverse polarity no matter how brief will cause immediate and permanent damage to transistors and diodes.
3. The battery must not be disconnected whilst the alternator is running nor should the battery be connected into the system without first checking for correct polarity.
4. Do not use insulation testers on the regulator.

Maintenance

The charging system requires very little attention but it should be kept free from dirt build-up and a check made if it fails to keep the battery charged. This may be due to a slipping drive belt.

1. Occasionally inspect the driving belt for wear and correct tension and verify that the alternator is properly aligned with respect to the drive. (See Drive belt - To adjust).
2. Keep the alternator clean with a cloth moistened in paraffin or white spirit and ensure that the ventilation slots and air spaces are clear and unobstructed.
3. Remove any dirt accumulated on the regulator housing and ensure that cooling air can pass freely over the casing.

Alternator—To test in position

1. Connect a 0-50 volt first grade moving coil voltmeter between the regulator negative terminal and the positive terminal marked H1.
2. Connect a 0-100 amp first grade ammeter in series in the alternator positive line.
3. With the battery in a fully charged condition, the system is in correct working order when the following sequence is observed:-

a. Switch the ignition on and observe that the warning lamp marked GEN illuminates.
b. Switch on all the electrical loads with the exception of the windscreen wipers.
c. Start the engine, allow it to run at approximately 1000 r.p.m. and observe that the warning lamp is extinguished.
d. Momentarily increase the engine speed to approximately 3000 r.p.m. and observe that the alternator current is approximately 53 amps.
e. With the engine running at approximately 1500 r.p.m. switch off all the loads. The voltage should rise to between 14.0 and 14.5 volts and then remain constant, the current reading should drop appreciably.

4. Should there be a fault in the system this will be apparent by one or more of the following symptoms:

a. If the warning lamp does not illuminate check the bulb and renew if defective.
b. If the bulb is serviceable but does not illuminate, check the regulator by first switching off the engine and disconnecting the lead from terminal F on the regulator. Clip this lead to earth and switch on the engine. If the lamp now illuminates the regulator is faulty and must be replaced by a new regulator. If the lamp still remains unlit then the alternator is faulty and requires workshop attention (see Alternator - To dismantle).
The tests described in 5 may be used to locate the alternator fault. Having located the fault, switch off the engine and reconnect the F lead to F terminal.

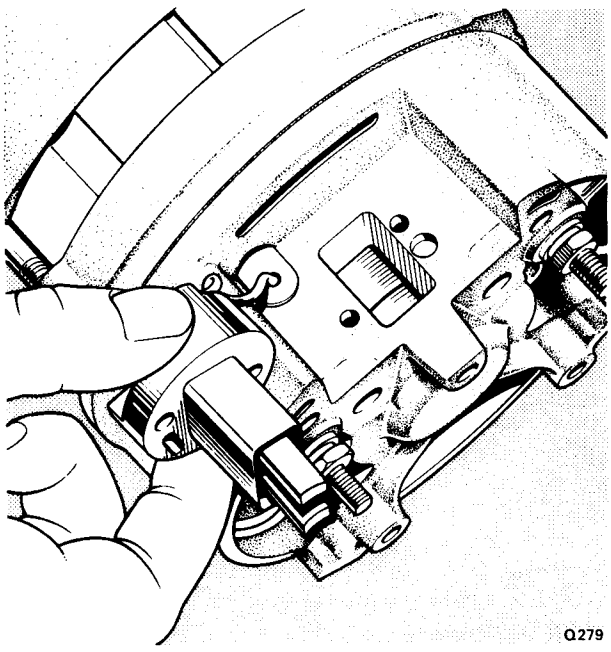

FIG. M18 BRUSHGEAR INSPECTION

5. Tests on the alternator can be carried out on the engine by partial dismantling in the following manner:

a. Field Winding
Disconnect the leads from F and A terminals on the alternator and remove brush gear moulding (*see Fig. M18*). Measure the field resistance across the slip rings which should be 3.2 ohms ± 0.16 ohms. An appreciably lower field resistance could mean a short circuit between the coils: a higher reading indicates that the contact surfaces of the slip rings need cleaning. A reading of infinity indicates an open circuit in the field.

b. Brushes
If the field resistance is correct check that the brush length is greater than the minimum length of 7,94 mm. (0.312 in.) and ensure that proper contact with the slip rings is made.

c. Slip rings
The surface of the slip rings should be smooth and uncontaminated by oil or other foreign matter. The surface may be cleaned with very fine glass paper without fully dismantling the machine. On no account must emery cloth or similar abrasive be used.

d. Stator winding
Low output or no output at all from the alternator may be due to either a faulty stator or a faulty diode in which case it is difficult to distinguish between the two faults without first dismantling the alternator. In these circumstances it is necessary to remove the stator from the alternator and measure the volts drop across each pair of three stator connections as described in Alternator - Bench testing.

Alternator—To dismantle (see Fig. M19)

1. Remove the alternator from the car.
2. Unscrew the three screws and detach the baffle from the slip ring end-shield (SRE).
3. Disconnect the lead from terminal A of brush box, remove the retaining screws, spring and plain washers and withdraw the brush box complete with brushes. Discard the gasket.
4. Remove the field terminal retaining nuts, crinkle washers, Lucar blades and insulator from the terminal posts. Withdraw the brushes and field terminal posts from the brushbox. Discard the sealing washers.
5. Remove the pulley nut from the drive end (DE) and withdraw the pulley, fan, woodruff key and fan spacer.
6. Scribe light correlation marks across both end shields and stator to facilitate alignment on assembly.

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7. Remove the three through bolts and spring washers and withdraw the DE shield complete with rotor. If 'Loctite' grade A has been used to secure the through bolts, local heat should be applied with a heated soldering iron to loosen them, the part should not be overheated. If necessary use a hide faced hammer and gently tap the DE shield away from the stator and SRE shield. Do not damage the slip ring when laying the DE shield and rotor assembly on the bench.

Note The stator is sandwiched between the two end-shields therefore great care must be taken at this stage to prevent the full weight of the stator from falling onto the three stator phase leads.

8. Lay the stator and SRE shield assembly carefully on the bench with the endshield uppermost.
9. Unsolder the three stator phase leads from the heatsink terminal tags (do not remove tags from heatsinks) and separate the SRE shield from the stator using a hide faced mallet if necessary.
10. Remove and discard the 'O' ring from the shield bearing housing using a sharp pointed probe. Do not damage the 'O' ring groove.
11. Place the DE shield with drive shaft upwards over a suitable large diameter cylinder so that the rotor is encased within the cylinder and the cylinder sits squarely against the three end shield webs. Support the rotor from underneath and gently press the rotor from the DE shield with a standard fly-press.

Note It is unnecessary to strip the diode assembly from the SRE shield unless it is established that there is a fault in one or more of the diodes. Accordingly, the diodes should next be subjected to the tests detailed under Alternator - Bench testing. If a faulty diode is detected proceed as instructed in Alternator - Inspection and repair.

Alternator—Inspection and repair

General

After dismantling, all components which require cleaning should be thoroughly cleaned.

1. Examine all parts for cracking, corrosion, serviceability of threads, score marks and excessive wear. The 'nyloc' pulley nut may be used again provided that the nylon insert is in reasonable condition.

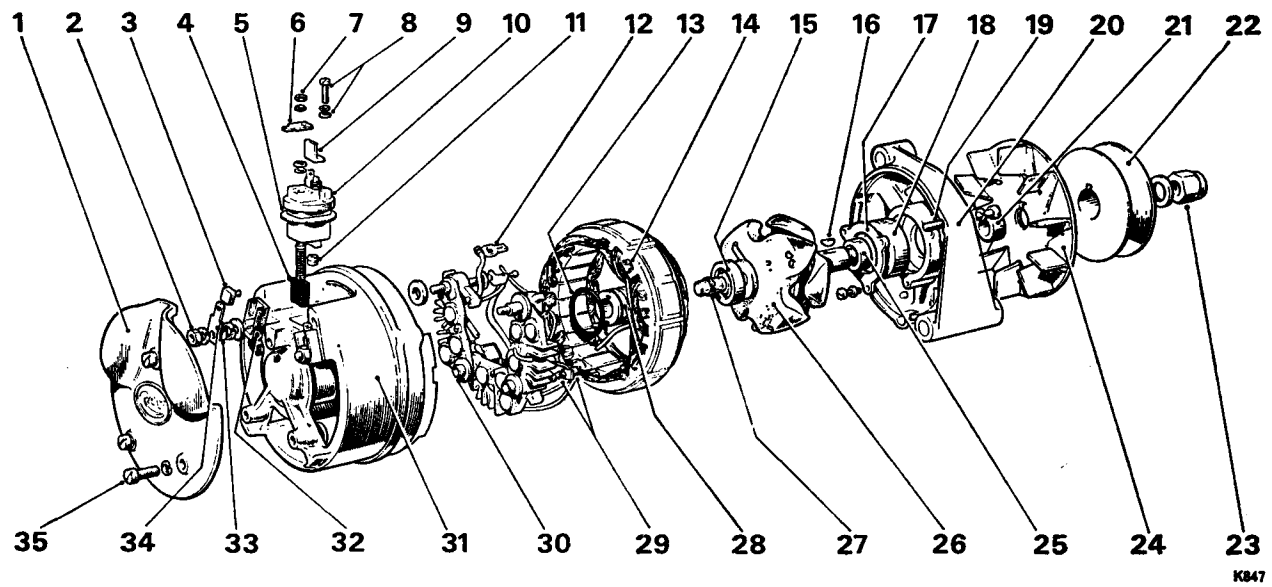

FIG. M19 EXPLODED VIEW OF CAV 512 ALTERNATOR

1 Baffle
2 Main terminal nut
3 Insert
4 Brush
5 Gasket
6 'Lucar' blade
7 Field terminal nuts and washers
8 Retaining screw and washers
9 Insulator
10 Brush holder
11 Grommet
12 'A' lead
13 'O' ring
14 Stator
15 Bearing
16 Woodruff key
17 Clamp plate
18 Bearing
19 'Through' bolt
20 Drive-end shield
21 Fan spacer
22 Pulley
23 Pulley nut
24 Fan
25 Bearing spacer
26 Rotor
27 Circlip
28 Slip rings
29 Heat sink securing screw
30 Diode and heat sink assembly
31 Slip ring end shield assembly
32 Shroud
33 Round slotted nut
34 'Lucar' terminal
35 Baffle screw

2. Remove foreign material from rotor shaft and stator using a clean cloth moistened with white spirit.

Caution Spirit should not be allowed to contact the leads of the stator and must not contaminate the protective coating of the rotor core.

3. Examine the stator windings for security and condition. Check the insulation of the stator leads for deterioration.

4. Check the bearings for excessive play and smoothness of operation. The bearings are sealed and cannot be lubricated therefore any evidence of dryness will necessitate renewal. If the SRE bearing requires replacement it will also be necessary to renew the slip ring.

5. Examine the slip rings for signs of wear and scoring. The slip rings may be skimmed to a minimum diameter of 28,5 mm. (1.136 in.) before replacement is necessary.

6. Check carbon brushes for wear. New brushes are 15,9 mm. long (0.625 in.) and the minimum length of usable brushes is 7,9 mm. (0.312 in.).

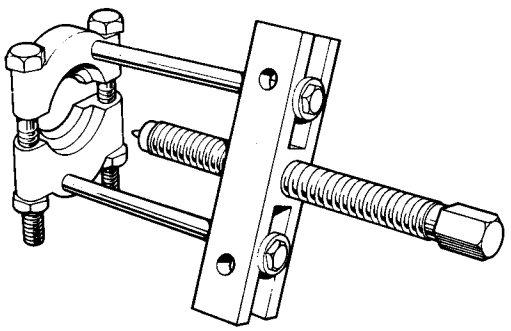

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FIG. M20 BEARING EXTRACTOR

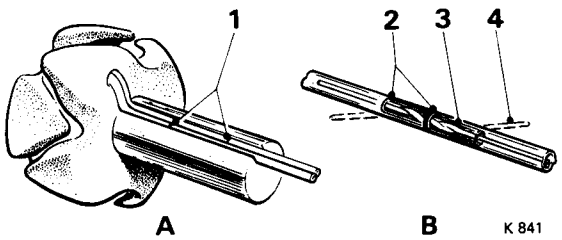

FIG. M21 RENEWING SLIP RING CONNECTING LEADS

1 Staggered wire cuts
2 3 mm sleeving
3 2 mm sleeving
4 Excess wire removed

Bearing renewal—Drive end

1. Remove the three screws and washers securing the clamp plate and push out the bearings with a copper drift.

2. Press a new bearing into the housing, ensuring that it is perfectly square to the housing.

3. Place the clamp plate in position and secure with three screws and washers.

Bearing renewal—Slip ring end

1. Cut the ends of the field leads free from the slip ring terminal posts.

2. Using an extractor (*see Fig. M20*) withdraw the slip ring assembly. Removal of the slip ring renders it unserviceable and a new one must be fitted.

3. Remove bearing circlip. Adjust the jaws of bearing extractor so that the jaws locate between the outer race and the bearing spacer and withdraw bearing.

4. Examine bearing spacer for cracks and distortion. Clean out groove. Renew spacer if damaged.

5. Detaching the rotor leads from the slip ring assembly imposes mechanical stresses that may weaken the leads and produce the possibility of failure under operating conditions at a later date. It is strongly recommended that the leads are renewed in the following manner (*see Fig. M21*). Cut the leads so that the subsequent joints are staggered. Trim back the glass-fibre sleeving and lightly twist a new length of Lumex copper wire (21.5 swg) to the existing wire and solder together. Snip off excess wire. Apply a liberal coating of shellac and slide a short length of 2 mm. glass-fibre sleeving over the joint so that it slides inside the existing sleeve. Apply a further coating of shellac and slide on a new length of 3 mm. glass-fibre sleeving to abutt the original sleeve. Apply a final coat of shellac to the outside.

6. Refit the bearing spacer over the rotor shaft so that the moulded groove is in the correct position to contain the field leads from the rotor. Press into position. Press new bearing onto the rotor shaft with a suitable hand press. Refit the circlip, ensuring it is fully seated and a tight fit in its groove. Plug with 'Silcoset' 151 any gap that appears where the leads enter the spacer between the spacer and the rotor claws. Wipe off any surplus 'Silcoset' 151.

7. Place the rotor (drive end downwards) in a hand press so that the weight is supported on the rotor claws. Pass the two field leads through the bore of a new slip ring and locate the slip ring to the shaft with the terminal posts positioned at 90° relative to the shaft lead slot.

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8. Place press tool (*see Fig. M22*) so that the spigot registers in the slip ring bore with the cut-away portion in line with the field leads. Gently press the slip-ring down until the press tool spigot abutts the rotor shaft. Pass the field leads through cut-away portion of press tool as they appear.

9. Trim off the ends of the glass-fibre sleeve to leave approximately $\frac{1}{4}$ inch projecting beyond the rotor shaft. This will prevent the field leads from shorting onto the shaft during service. Wrap the field leads around the terminal posts of the slip ring, cut to length, and solder in position.

10. Mount the rotor in a suitable lathe, locating the steady on the outer race of the SRE bearing. Lightly skim the slip rings to ensure that they are concentric with the SRE bearing to within 0,05 mm. (0.002 in.). Remove the minimum amount of metal to achieve this degree of concentricity and do not reduce the slip ring diameter to below 28,85 mm. (1.136 in.). To obtain the required surface finish, it is essential that a highly finished diamond or tungsten carbide tipped cutting tool be used for this operation.

Electrical tests

1. Subject the stator to an insulation test between any terminal tag and the frame. The minimum resistance should be 10 megohms.

2. Connect the stator leads, two at a time to a 20 ampere dc supply and check that the voltage drop in each case is 2.2 volts.

Slipring end shield diode tests

Connect a test probe in series with a 48 watt 24 volt lamp on the positive terminal of 24 volt dc supply. Connect another test probe to the negative terminal of the dc supply.

Test No.	Test lead Connection (+)	Test lead Connection (−)	Diode under test	Serviceable
1	Each heat sink in turn	D	Positive	Lamp illuminates
2	D	Each heat sink in turn	Positive	No illumination
3	D-	Each heat sink in turn	Negative	Lamp illuminates
4	Each heat sink in turn	D-	Negative	No illumination
5	Each heat sink in turn	A	Auxiliary	Lamp illuminates
6	A	Each heat sink in turn	Auxiliary	No illumination

The opposite reaction to any of the above tests will establish a faulty diode, and the complete associated heat sink must be renewed.

Note: If any of the diodes have been replaced or if the polyurethane paint (blue) on the diodes is damaged the diodes must be painted with polyurethane paint. (Early cars only).

Diode replacement (SRE shield)

Note: Individual diodes cannot be replaced and a fault in any diode will entail the renewal of the complete associated heat sink.

1. Carefully separate the Ross Courtney tag from the 'A' lead and pull the lead through the rubber grommet in the end shield. Remove and discard grommet.

2. Remove external positive and negative main terminal nuts, spring washers, terminal post retaining nuts, spring and plain washers.

3. Remove heat sink securing screws (two large cheese headed screws), spring and plain washers from underside of SRE shield. Withdraw complete heat sink assembly.

4. Snip the two copper braids of the faulty heat sink close to the angle terminal tags and unsolder the sleeved lead from the third diode. Remove appropriate nylon retaining washers and withdraw heat sink.

5. Assemble new heat sink ensuring that nylon insulating washers are interposed between adjacent heat sinks. Replace outside retaining washers.

6. Solder the diode braids to the appropriate angle tags. (Note: the length of the braids are such that it is impossible to connect them incorrectly).

7. Solder sleeved wire to remaining diode.

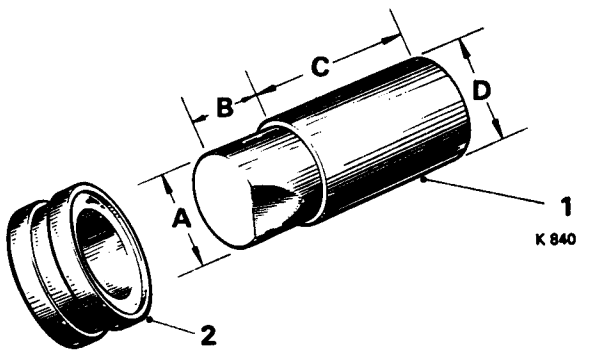

FIG. M22 SLIP RING PRESS TOOL

A 15,875 0.0254 mm. (0.625 0.0010 in.)
B 25,4 mm. (1.00 in.)
C 63,5 mm. (2.5 in.)
D 19,05 mm. (0.75 in.)

1 Tool 2 Slip ring

Warning Excessive heat can cause immediate and permanent damage to diodes. It is recommended that a pair of long nosed pliers be used to grip the diode shank to act as a thermal shunt and that the operation be carried out as quickly as possible.

8. Apply lamp test as detailed under Alternator - Bench testing to ascertain that the diodes are functioning correctly.

9. Thread lead A through a new rubber grommet. If the lead is cotton braided it is advisable to replace this with a Unipren covered lead, size Unipren 4.

10. Replace heat sink assembly in SRE shield. Secure with the two cheese headed screws, plain and spring washers. Replace grommet and A lead, and re-fit Ross Courtney tag.

11. Fit new 'O' ring to groove in internal bore of slip ring housing.

12. Replace plain and spring washers, main terminal post retaining nuts, spring washers and main terminal nuts.

Assembly

Normal workshop practices should be followed taking special care to keep working surfaces and tools clean.

1. Lay the stator on the bench with the three stator phase leads facing upwards.

2. Invert the end shield and locate it over the stator, so that the three wide spaces on the heat sink finning coincide with the three stator phase leads. Carefully lower the slip ring end shield to the stator and align scribe marks. Twist stator phase leads once only around heat sink tags and solder.

3. Fit spacer over the rotor drive shaft and insert drive shaft through the bore of the drive end shield ballrace.

4. Support the rotor, slip rings downwards, between a pair of parallel blocks on a suitable handpress table (great care must be exercised at this stage not to damage the rotor field leads with the blocks). Gently press the drive end shield into place with a suitable piece of tube pressing on the bearing housing.

5. Assemble the rotor and slip ring end shield assembly to the drive end ensuring again that the scribed lines are in alignment. Insert the three through bolts with 'Loctite' grade A applied to the threads and tighten them evenly and progressively whilst gently tapping the slip-ring end shield with a hide faced mallet to draw end shields squarely into position. Finally tighten the through bolts to a maximum torque of 0,52 kg.m. (45 lb.in.).

6. Refit brushes to brush box making sure that the terminals are fully seated. Thread 'O' sealing rings over both the terminal posts and assemble insulator to one of the terminals. Fit Lucar blades and crinkle washers to both terminals and secure with terminal nuts.

7. Fit a new gasket to the brush box moulding and assemble brush gear to the slip ring end shield. Correct positioning is ensured by the locating dowel. Secure with retaining screws, plain and spring washers. Reconnect 'A' lead to terminal post marked 'A', secure with crinkle washer, plain washer and terminal nut.

8. Fit fan spacer machined slot outwards and aligned with keyway. Fit woodruff key, fan pulley and pulley nut. Tighten pulley nut to a torque of 5,3 kg,m. (40 lb.ft.).

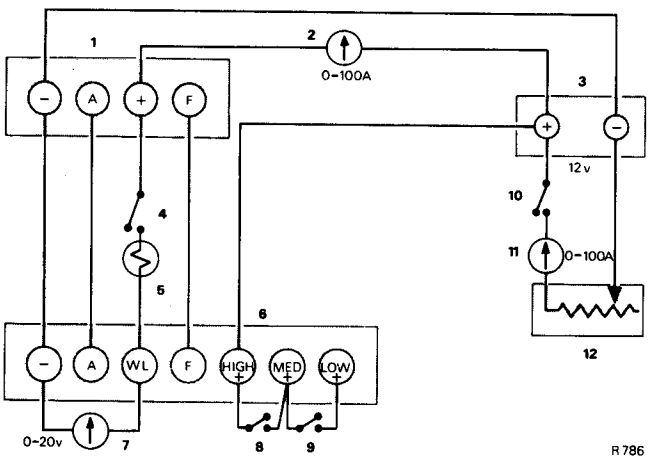

FIG. M23 BENCH TEST CIRCUIT

1 Alternator	7 Voltmeter
2 Ammeter	8 Switch
3 Battery	9 Switch
4 Switch	10 Switch
5 Ignition lamp	11 Ammeter
6 Regulator	12 Carbon pile resistor (60 amps minimum)

Alternator—Bench testing

Procedure

1. Before making any connections, test the alternator for earths by non-destructive flash test (or Megohm Meter) with voltage rating of 110 volt. Connect instrument between D+ and earth, D− and earth and A terminal and earth. Make sure always to keep the one probe on the frame so as not to apply full test voltage between any two terminals on the alternator. If Megohm Meter is used the minimum insulation resistance should be 10 megohms.

2. Mount the alternator to the test machine drive and make all connections to the battery and regulator as wiring diagram.

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3. Close switch 4 and observe that the bulb is lit.
4. Start the drive and increase speed until warning lamp is extinguished which indicates that alternator is charging. This should occur below 2000 r.p.m.
5. Reduce alternator speed to 1125 r.p.m. and measure dc voltage between WL and -ve on the 440 regulator. The voltage should be between 12-14 volt.

Load applied	Ammeter reading	Voltage
40-50 amp	50-55 amp	@13-13.6

6. Increase alternator speed to 10,000 r.p.m. and again observe ammeter reading which should be as follows:-

Ammeter reading	Voltage
60-65 amp	@13-14

Adjust battery load as necessary. Run at top speed of 10,000 r.p.m. for 1 minute.

7. Decrease speed to 3000 r.p.m. and switch off loads connected across the battery, the voltage should rise to between 13-14 volts and then remain constant. At the same time the current reading should drop appreciably. This test indicates that the regulator is working correctly.

With switches 8 and 9 open, the voltmeter reading should be between 14 and 14.5 volts. With 8 closed and 9 open the voltmeter reading should be between 13.5 and 14 volts and with both 8 and 9 closed the voltmeter reading should be between 13 and 13.5 volts.

Alternator

Lucas Model 20 ACR

Important Before commencing work on the alternator, please note the following:

1. If it is necessary to disconnect a lead from the system, the engine must be switched off.
2. Whenever a lead is disconnected it should be identified in relation to its terminal to facilitate reconnection. Short circuiting or reverse polarity no matter how brief will cause immediate and permanent damage to transistors and diodes.
3. The battery must not be disconnected whilst the alternator is running nor should the battery be connected into the system without first checking for correct polarity.
4. Do not use insulation testers on the alternator.

Routine maintenance

a. Cleaning
Wipe away any dirt or oil that has collected around the apertures in the moulded cover.

b. Belt adjustment
Inspect the driving belt for condition and correct tension. If necessary adjust the tension so that an applied force of 3,6 kg. (8 lb.) mid-way between the two pulleys causes the belt to deflect 9,5 mm. (0.375 in.).

Important To avoid damage to the alternator when adjusting belt tension, apply leverage only on the alternator drive end bracket, not on any other part of the alternator. The lever should be of a soft material, preferably wood.

c. Lubrication
The bearings are packed with grease during assembly and will not normally require further lubrication during their service life.

d. Circuit connections
Ensure that parts of the charging circuit, including the battery, are not disconnected or connected while the engine is running. When connecting an alternator, always observe correct polarity i.e. positive to positive and negative to negative.

Alternator—To service in position

Alternator output test

This test should be carried out with the alternator at normal temperature. Run a cold engine at charging speed for 3-4 minutes.

a. With the engine stationary, disconnect the battery earth cable.

b. Connect an ammeter in series with the alternator main output cable.

c. Remove the connections from the alternator, remove the moulded cover and remake the connections. Short together the black lead and the large 'Philips' screw securing the metal plate.

d. Connect the battery earth cable.

e. Switch on all the vehicle loads (except wipers) and switch on the ignition. Observe that the warning lamp is illuminated.

f. Start the engine and slowly increase the speed. At 3000 r.p.m. the ammeter reading should be 66 amps. Any appreciable deviation from this figure will necessitate removal of the alternator for further examination.

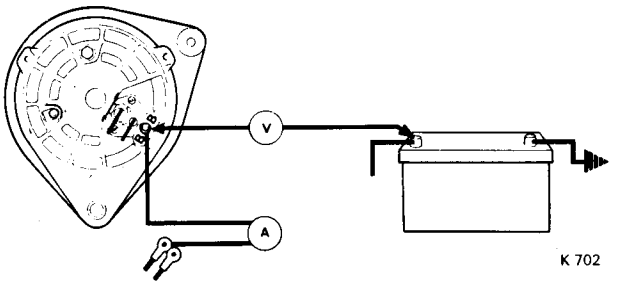

FIG. M24 CHARGING CIRCUIT VOLTAGE DROP TESTING - INSULATION SIDE

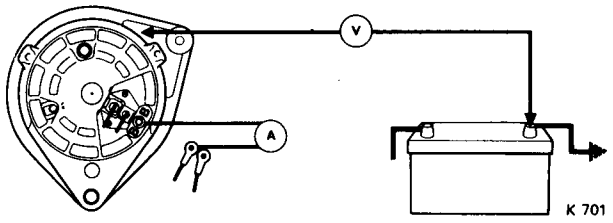

FIG. M25 CHARGING CIRCUIT VOLTAGE DROP TESTING - EARTH SIDE

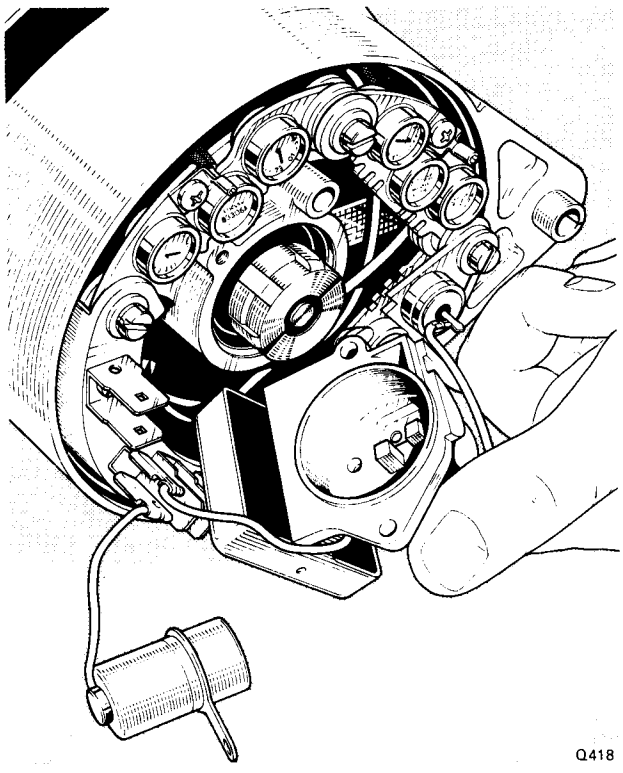

FIG. M26 BRUSHGEAR INSPECTION

Charging circuit—Voltage drop test (see Figs. M24 and M25)

A voltmeter is used to check for high resistance in the charging circuit.

a. Connect a 0-1 volt voltmeter between the battery insulated terminal and alternator main terminal.

b. Switch on the vehicle lights (headlamps on main beam). Start the engine and run at 3000 r.p.m. Note the voltmeter reading. Switch off engine.

c. Transfer the voltmeter connections to the battery earth terminal and alternator earth terminal.

d. Start and run the engine at 3000 r.p.m. and note the voltmeter reading.

The voltmeter readings should not exceed 0.5 volt for the insulated side and 0.25 volt for the earth side. Higher readings indicate high resistance in the circuit which must be located and rectified.

Control unit voltage setting

The charging circuit wiring and connections must be in good order and the battery must be in a well charged condition or temporarily replaced by a charged battery.

a. Connect an ammeter in series with the alternator main output cable, connect a 0-20 volt voltmeter across the battery terminals.

b. Start the engine and run at charging speed (3000 r.p.m.) until the ammeter reading is less than 10 amps. The voltmeter reading should be within 13.6 - 14.4 volts.

An unstable reading or a reading outside the specified limits indicates that the alternator control unit is faulty and should be replaced.

Alternator—To dismantle for electrical tests

The following instructions cover the dismantling required to enable the alternator to be tested electrically. If further dismantling becomes necessary as a result of the tests or because the rotor bearings are to be changed, proceed as described in Alternator - Further dismantling.

a. Disconnect the battery and alternator cables and remove the alternator from the vehicle.

b. Unscrew the two cover securing screws and remove the cover.

c. Remove the brush moulding fixing screw.

d. To remove the brush moulding complete with the control unit - disconnect the black earth lead. Disconnect the red leads from IND and + terminals. The moulding can now be withdrawn.

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Brushgear—To inspect (see Fig. M26)

The brush length when new is 12,7 mm. (0.5 in.). The serviceability of a brush may be determined by measuring the amount by which it protrudes beyond the brush box moulding when in the free position. Replace the brush if there is less than 5 mm. (0.2 in.) protruding. If brushes are changed, take care not to lose the leaf spring fitted at the side of the inner brush.

Check the brush spring pressure using a push type spring gauge. This should indicate 0,255 kg - 0,368 kg (9 - 13 oz) when the brush face is flush with the housing. Sticking brushes may be cleaned with a petrol moistened cloth.

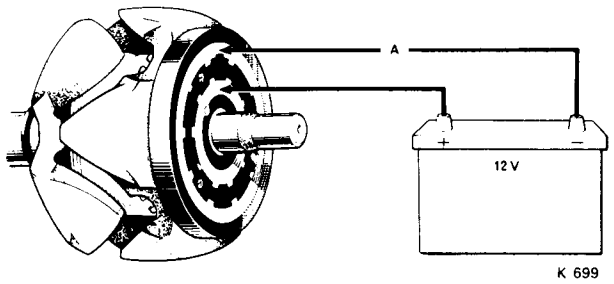

FIG. M27 MEASURING ROTOR WINDING RESISTANCE WITH BATTERY & AMMETER

Sliprings—To inspect

The surfaces of the sliprings should be smooth and uncontaminated by oil or other foreign matter. Clean the surfaces with a petrol moistened cloth, or if there is evidence of burning, very fine glass paper. On no account must emery paper or similar abrasive be used.

Rotor—To test

For clarity, the illustrations of the electrical testing of the rotor and stator shows these components isolated from the remainder of the alternator.

Test the rotor winding by connecting either an ohmmeter or a 12 volt battery and ammeter between the sliprings (*see Fig. M27*). The resistance should be 3.6 ohms at 20 °C or the current approximately 3 amps. Test for defective insulation between one of the sliprings and one of the rotor poles using a 110 volt A.C. mains supply and a 15 watt test lamp. (*see Fig. M28*). If the lamp illuminates the coil is earthed to the rotor core and a replacement rotor/slipring assembly must be fitted.

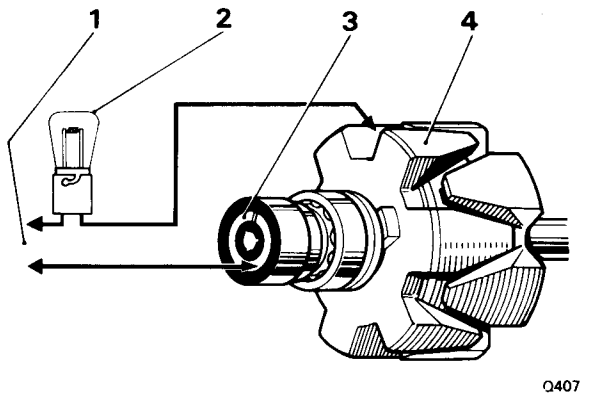

FIG. M28 INSULATION TEST OF ROTOR WINDING

1 110 volts AC
2 15 watt lamp
3 Slipring
4 Rotor poles

Stator—To test

Connect any two of the three stator windings in series with a 12 volt battery and 1.5 watt test lamp (*see Fig. M29*). Replace one winding with the third winding and repeat the test. If the test lamp does not illuminate on either occasion, the stator winding is open circuit and a replacement stator must be fitted.

Test for defective insulation between the stator coils and the lamination pack with the mains test lamp. Connect the test probes between any of the three cable ends and the lamination pack (*see Fig. M30*). If the lamp illuminates, the stator coils are earthing and a replacement stator must be fitted.

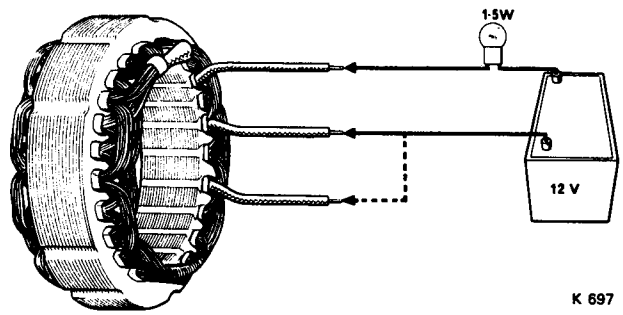

FIG. M29 STATOR WINDING CONTINUITY TEST

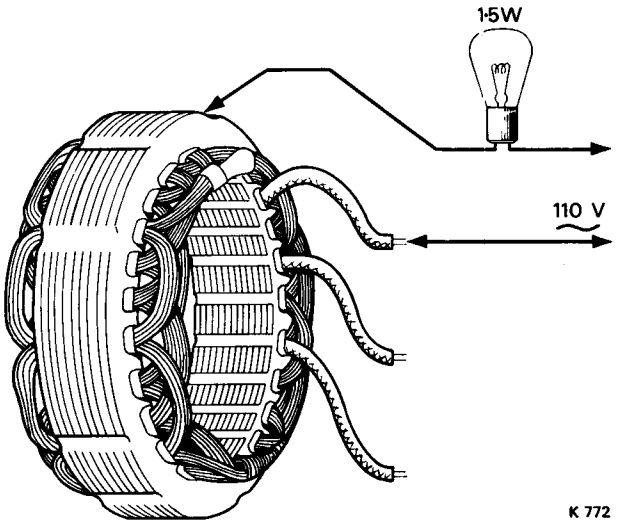

FIG. M30 INSULATION TEST

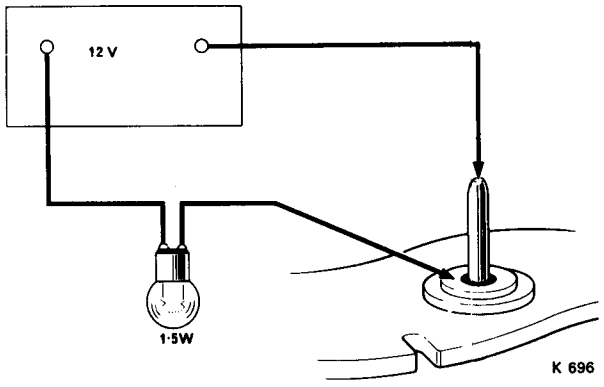

FIG. M31 TESTING DIODES

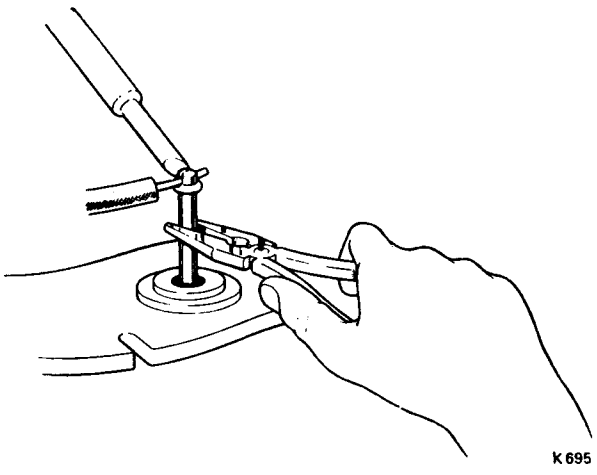

FIG. M32 USE OF THERMAL SHUNT

Diodes—To test

If a fault in a diode is indicated, remove the rectifier/heatsinks complete. Unscrew the three stator winding connections at each diode heatsink. Remove the four screws which pass through the nylon insulating washers and also the small screw which secures the earthing strip to the bracket and remove the complete assembly.

Connect the pin of a diode in series with a 1.5 watt test lamp and one terminal of a 12 volt battery, connect the other battery terminal to the diode heatsink (*see Fig. M31*). Observe the test lamp.

Reverse the connections to the diode and again observe the test lamp. If the lamp illuminates in both tests or remains unlit in both tests then the diode is faulty and a new rectifier/heatsink assembly must be fitted. Repeat the tests for each diode.

Note: When unsoldering any link wires connected to the diodes always use a thermal shunt (*see Fig. M32*).

Alternator—Further dismantling

a Remove the heatsink/terminal block assembly.
b. Withdraw the three through bolts.
c. Separate the slip ring end bracket and stator assembly from the rotor and drive-end bracket by inserting a lever between the stator and drive-end bracket and carefully prise the two apart until the slip ring end bearing is clear of its housing.

If necessary, the rotor shaft can be pressed out from the drive-end bracket having first removed the shaft nut, washers, pulley, fan & shaft key.

d. Drive-end bearing

Dismantle the alternator and separate the rotor from the drive-end bracket. Unscrew the three countersunk screws securing the bearing retaining plate, remove the plate and withdraw the drive-end bearing assembly.

e. Slip ring end bearing

Dismantle the alternator. Unsolder the field winding connections to the slip ring moulding assembly and withdraw the assembly from the rotor shaft. Extract the bearing from the shaft. Fit the new bearing and engage the slip ring moulding with the slot in the motor shaft. Finally, remake the field to slip ring connections using Fry's H.T. 3 solder (or any high melting point solder).

When required, the alternator bearing may be lubricated with Shell 'Alvania' 'RA'.

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Alternator—To assemble

Reverse the dismantling procedure, noting the following points:

a. Ensure that the slip ring bearing is positioned as far as it will go along the rotor shaft towards the field assembly.

b. Ensure that the brushes are in the brush housing before fitting the brush moulding.

c. Tighten the through bolts evenly.

d. If the rotor and drive-end bracket have been separated, support the inner ring of the drive-end bearing with the distance collar. Do not use the drive-end as a support for the bearing when fitting the rotor.

Alternator Lucas Model 11 AC

Field isolating device

With the engine stationary, the control unit and the alternator field windings are isolated from the battery by the normally-open contacts of the Model 6RA relay, the operating coil of which is fed from the ignition switch.

The contacts of the relay are connected in the negative lead of the regulator.

Maintenance

Remove any dirt or oil from around the ventilating apertures of the slip ring end cover.

Lubrication

The alternator bearings are packed with grease during assembly and do not require periodic attention.

Terminal connections

Ensure that all terminal connections are secure.

Alternator—To test in position

A fault in the charging circuit should be located as follows:

1. Examine the alternator driving belts for wear and correct tension.
2. Apply the handbrake and chock the rear wheels. Start the engine and check to ensure that battery voltage is being applied to the rotor winding by connecting a voltmeter between the cable ends normally attached to the field terminals. Stop the engine.
3. Disconnect the battery earth lead.
4. Withdraw the leads from the alternator field terminals, then using a suitable pair of auxiliary cables, connect the terminals directly to the battery (*see Fig. M.23*).
5. Re-connect the battery earth lead. Start the engine and slowly open the throttle until the engine speed is approximately 1 650 r.p.m. At this speed the ammeter should indicate approximately 40 amps. If a Zero reading is registered on the ammeter, stop the engine and disconnect the leads from the field terminals. Remove the two screws securing the brushbox moulding and remove the brushgear for examination (*see Brushgear - To inspect*).

Note When carrying out this operation, on no account should the engine speed exceed 2000 r.p.m., or damage to the diodes will result.

6. If necessary fit new brush and spring assemblies and again test the alternator output. If the Zero reading persists, the alternator must be removed from the engine and dismantled for detailed inspection (*see Alternator - To dismantle*).

A low output current reading will indicate a faulty alternator or poor circuit wiring connections. Check the connections while the alternator is connected and running at 1 650 r.p.m. engine speed. Connect a low range voltmeter between the alternator output terminal and the battery insulated terminal (*see Fig. M24*), and note the voltmeter reading.

Transfer the voltmeter connections to the alternator frame and battery earth terminal (*see Fig. M25*); note the reading.

If either of these readings exceed 0.5 Volt there is a high resistance in the charging circuit, this must be traced and rectified.

If there is no undue resistance in the charging circuit even though the alternator output is low, proceed to dismantle the alternator.

Alternator—To remove

1. Disconnect the alternator electrical connections.
2. Slacken the two upper securing bolts (lower on early cars).
3. Slacken the setscrew on the slotted adjuster link.
4. Move the alternator inwards towards the engine, in order to release the tension on the driving belt; remove the belt.
5. Support the alternator and remove the previously slackened bolts, taking note of the position of the spacers to facilitate assembly.

Alternator—To dismantle (see Figs M33 and M34)

1. Remove the shaft nut, spring washer, pulley and fan from the drive-end of the alternator.
2. Unscrew and remove the three 'through' bolts.
3. Mark the drive-end bracket, lamination pack and slip ring cover so that they can be assembled in correct angular relationship to each other.
4. Withdraw the drive-end bracket and rotor from the stator. The drive-end bracket and rotor need not be separated unless it is necessary to examine the drive-end bearing or to renew the rotor.

   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 and bearing collar.
5. Remove the terminal nuts, washers, insulating pieces, brushbox screws and the 2B.A. hexagon-headed bolt from the slip ring end bracket. Retain the two washers fitted between the brushbox moulding and the end bracket.
6. Withdraw the stator and heat sink assemblies from the slip ring end bracket.
7. Close up the retaining tongue at the base of each field terminal blade and withdraw the brush spring and terminal assemblies from the moulded brushbox.

Brushgear—To inspect

1. Measure the brush length. A new brush is 15,90 mm. (0.625 in.) long, a fully worn brush is 4,00 mm. (0.156 in.) long, and must be renewed at or near this length. The new brush is supplied complete with brush spring and 'Lucar' terminal blade and has merely to be pushed in until the tongue registers. To ensure that the terminal is properly retained, carefully lever up the retaining tongue with a screwdriver blade, so that the tongue makes an angle of 30° with the terminal blade.
2. The nominal brush spring pressures are between 113 g. and 142 g. (4 oz and 5 oz) with the spring compressed to 19,84 mm. (0.781 in.) in length and 212 g. to 242 g. (7.5 oz to 8.5 oz) with the spring compressed to 10,40 mm. (0.406 in.) in length. These pressures should be measured if equipment is available.

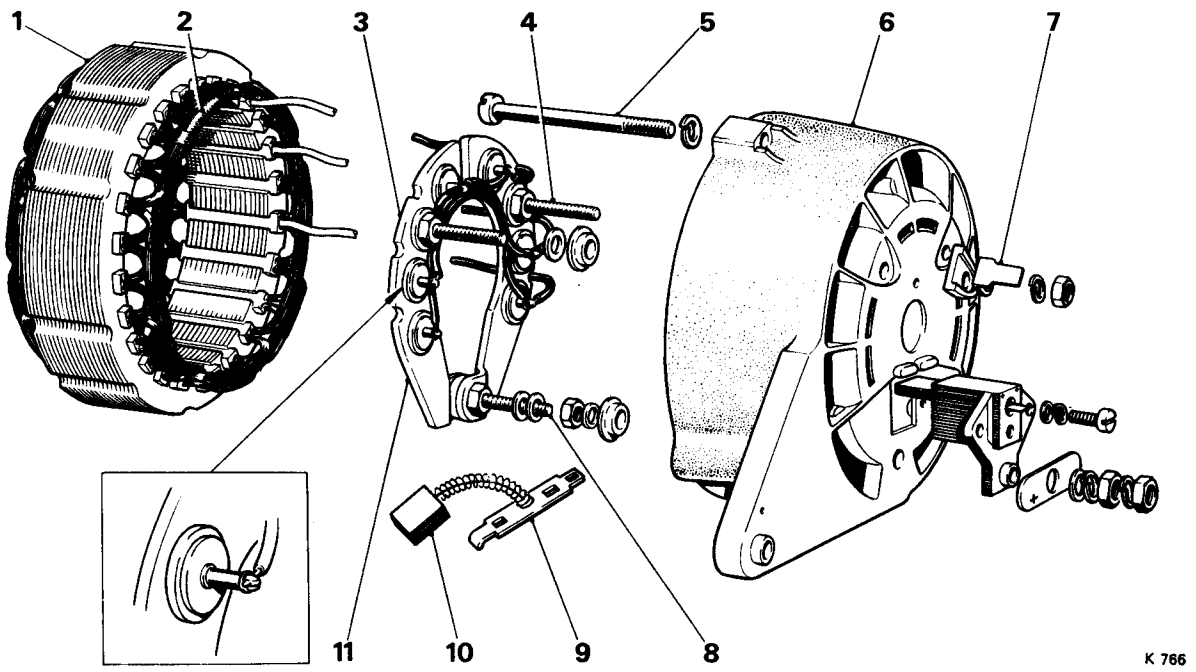

FIG. M33 BRUSHGEAR AND HEATSINKS

1 Stator
2 Star point
3 Negative heat sink and anode base diodes (black)
4 Warning lamp 'AL'
5 Through bolt
6 Slip ring end cover
7 Terminal 'AL'
8 Output terminal
9 Terminal blade retaining tongue
10 Slip ring brush
11 Positive heat sink end cathode base diodes

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3. Check to ensure that the brushes move freely in their holders. If at all sluggish, clean the side of the brush with a cloth moistened in petrol; if this fails to effect a cure, lightly polish the side of the brush on a smooth file. Remove all traces of brush dust before fitting the brushes in the holders.

Note The brush which bears on the inner slip ring is always associated with the Positive pole of the electrical system, since the lower linear speed of the inner ring results in reduced mechanical wear and helps to offset the higher rate of electrical wear peculiar to the Positive connected brush.

Rotor—To test

Test the rotor winding by connecting either an ohmmeter (*see Fig. M35*) or the appropriate battery supply (*see Fig. M36*) between the slip rings.

1. The reading of field coil resistance should be 3.8 ohms at 20 °C (68 °F). If the alternative test has been made, the value of the current should be approximately 3.2 amps.
2. Using a 110 Volt (A.C.) mains supply and a 15 Watt test lamp (*see Fig. M28*), test for defective insulation between one of the slip rings and one of the rotor poles. If the lamp is illuminated the coil is earthing and a replacement rotor/slip ring assembly must be fitted.

No attempt should be made to machine the rotor poles or to true a distorted shaft.

Sliprings—To inspect

The slip ring surfaces should be smooth and uncontaminated by oil or other foreign matter. Clean the surfaces using a cloth moistened in petrol. If there is evidence of burning, clean with very fine glass paper. On no account must emery cloth or similar abrasives be used. The small current carried by the rotor winding, and the unbroken surface of the slip rings mean that the possibility of scored or pitted slip rings is almost negligible.

Stator—To test

1. Unsolder the three stator cables from the heat sink assembly, taking care not to overheat the diodes (*see Alternator diode heat sink assembly - To renew*).
2. Check the continuity of the stator windings, by first connecting any two of the three stator cables in series with a 1.5 Watt test lamp and a 12 Volt battery as shown in figure M29

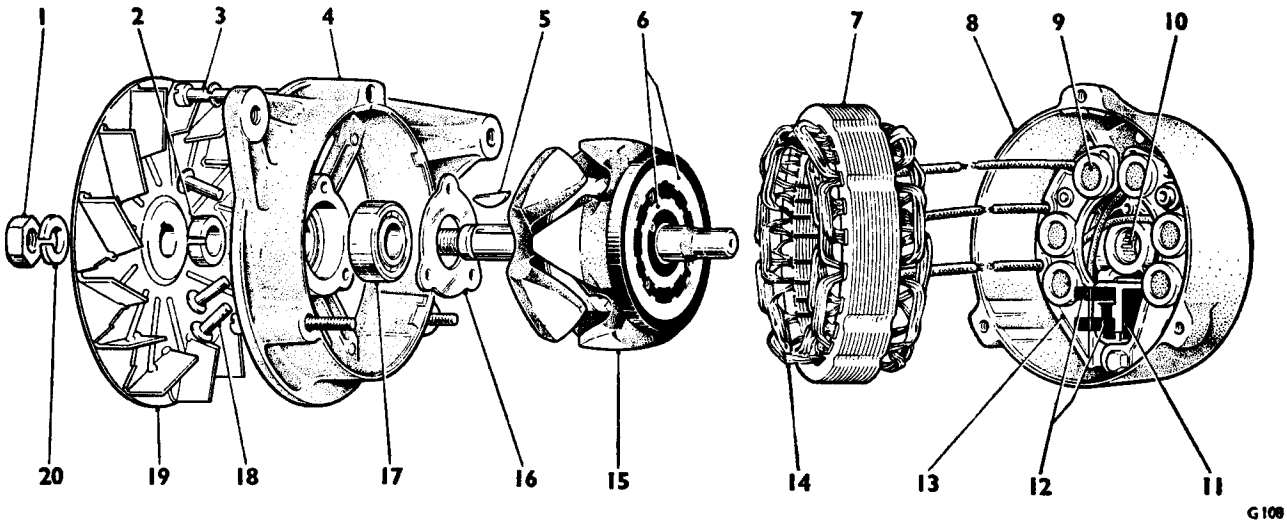

FIG. M34 EXPLODED VIEW OF 11 AC ALTERNATOR

1 Shaft nut
2 Bearing collar
3 'Through' bolts
4 Drive end bracket
5 Key
6 Slip rings
7 Stator laminations
8 Slip ring end bracket
9 Silicon diodes
10 Needle roller bearings
11 Brush box mouldings
12 Brushes
13 Diode heat sink
14 Stator windings
15 Rotor
16 Retaining plate
17 Ball bearing
18 Rivets
19 Cooling fan
20 Shaft spring washer

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3. Repeat the test, replacing one of the two cables by the third cable. Failure of the test lamp to illuminate on either occasion, means that part of the stator winding is open-circuit and the stator must be renewed.

4. Test for defective insulation between the stator coils and lamination pack with the mains test lamp (*see Fig. M30*).

5. Connect the test probes between any one of the three cable ends and the lamination pack. If the lamp is illuminated, the stator coils are earthing and the stator must be renewed.

6. Before soldering the stator cable ends to the diode pins, carry out the following test.

Diodes—To test

1. Each diode can be checked if connected in series with a 1.5 Watt test bulb across a 12 Volt (D.C.) supply. Test again by reversing the connections (*see Fig. M31*).

2. The bulb should be illuminated and current should flow in one direction only. Should the bulb be illuminated in both tests, or not be illuminated in either test, this indicates a defective diode and the appropriate heat sink assembly must be renewed.

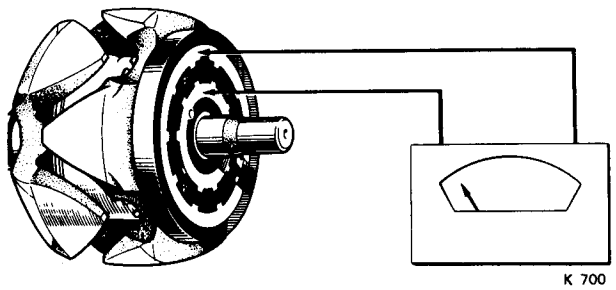

FIG. M35 MEASURING ROTOR WINDING

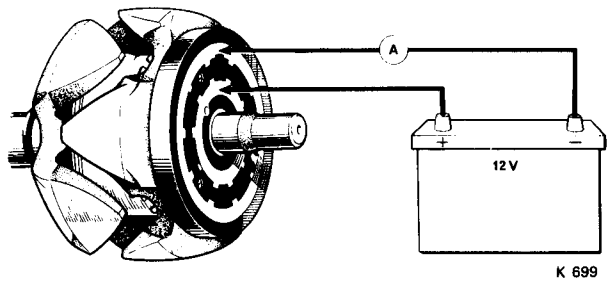

FIG. M36 MEASURING ROTOR WINDING RESISTANCE

3. The above procedure is adequate for service purposes but for any accurate measurement of diode resistance it is necessary for factory equipment to be available. Since the forward resistance of a diode varies with the voltage applied, no realistic readings can be obtained with battery-powered ohmmeters. However, should a battery-powered ohmmeter be used a serviceable diode will yield 'Infinity' in one direction and some indefinite, but much lower reading in the other.

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

Diode heatsink assembly —To renew

The alternator heat sink assembly comprises two parts, one of positive polarity and the other negative (*see Fig. M33*).

The positive portion carries three cathode base diodes coloured Red and the negative portion carries three anode base diodes coloured Black.

The diodes cannot be renewed individually, but for service purposes, they are supplied already pressed into the appropriate heat sink portion.

When soldering the interconnections, 'M' grade 45-55 tin-lead solder should be used.

Great care must be taken to avoid overheating the diodes or bending the diode pins. The diode pins should be lightly gripped with a pair of long-nosed pliers (which act as a thermal shunt). This operation is shown in Figure M32; and the soldering must be carried out as quickly as possible.

After soldering, the connections must be neatly arranged around the heat sinks, to ensure adequate clearance for the rotor and should be tacked down with 'MMM' EC 1022 adhesive where indicated in Figure M43.

The stator connections must pass through the appropriate notches at the edge of the heat sink.

Bearings—To renew

Renew any bearings which are worn to such an extent that they allow excessive side movement of the rotor shaft.

The needle roller bearing in the slip ring end bracket cannot be serviced separately. In the unlikely event of this bearing becoming unserviceable a complete end bracket assembly must be fitted.

1. After withdrawing the rotor shaft from the drive-end bracket, renew the drive-end ball bearing race as follows.

2. File away the head of each of the three rivets securing the bearing retaining plate and punch out the rivets.

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3. Press the old bearing out of the bracket.
4. Before fitting the new bearing, ensure that it is clean and packed with an approved melting-point grease.
5. Locate the bearing in the housing and press squarely into position.
6. When fitting the bearing retaining plate, use new rivets.

Alternator output control unit Model 4 TR

Important The battery must never be disconnected while the alternator is running. Failure to observe this ruling will cause the control unit to be damaged.

Checking and adjusting

1. Before checking and adjusting the control unit it must be established that the alternator and the charging circuit wiring are in good condition.
2. Check the battery to control unit wiring which incorporates the field isolating relay. To ensure correct working of the control unit, the resistance of this complete circuit, including the isolating relay, must not exceed 0.1 ohm. Any unduly high resistance must be traced and rectified.

Control unit—To check

Do not disturb the existing connections to the alternator and control unit.

1. Connect a voltmeter of the suppressed-zero type, reading 12 Volt to 15 Volt between the battery terminals and note the reading with all electrical equipment switched off.
2. Switch on an electrical load of approximately 2 amps., e.g. side and tail lighting. Refer to Figure M37.
3. Start the engine and run the alternator at approximately 1 250 r.p.m. engine speed for eight minutes; this ensures that the system voltage has stabilised.
4. If the charging current is still greater than 10 amps continue to run the engine until this figure is reached. The voltmeter should indicate a reading of between 13.9 Volt and 14.3 Volt.
5. If the reading obtained is stable but outside these limits the unit should be adjusted to control at the correct voltage (*see Control unit - To adjust*).
6. If the voltmeter reading remains unchanged (at open-circuit battery terminal voltage) or increases in an uncontrolled manner, the control unit is faulty and must be renewed.

Control unit—To adjust

1. Remove the screws from the control unit.
2. From the rear of the unit carefully remove the sealing compound which conceals the potentiometer adjuster.
3. Check that the voltmeter is still firmly connected between the battery terminals.
4. Start the engine, and while running the alternator at 1 250 r.p.m. engine speed turn the potentiometer adjuster slot clockwise to increase the setting or anti-clockwise to decrease, until the required setting is obtained.

Important Care must be taken in making this adjustment; a minimal amount of adjuster movement causes an appreciable difference in the voltage reading.

5. Stop the engine and again check the setting: start the engine and run the alternator at 1 250 r.p.m. engine speed.
6. Fit the control unit and disconnect the voltmeter.

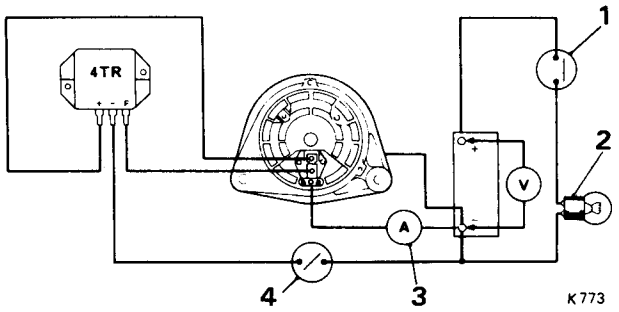

FIG. M37 LUCAS 4 TR CONTROL UNIT TEST CIRCUIT

1 Side and tail lamps circuit switch
2 Side and tail lamps
3 Ammeter
4 Field isolating device