

SECTION P

ELECTRICAL AND INSTRUMENTS

BATTERY

LUCAS CA11/7

Description

The Lucas Model C.A. battery, as listed above, is a new type fitted with an air lock device (Aqualok) which simplifies the topping up procedure. This device consists of a one-piece vent cover and six sliding tubes, perforated to act as air valves and fitted one to each cell aperture.

The tubes are automatically raised when the vent cover is removed and depressed when the cover is refitted.

Air or added water is admitted to the cell venting chamber (via the tube perforations) only while the tubes are in the depressed position.

No provision is provided in the battery top cover for the insertion of the prong of a heavy discharge tester.

DATA

Battery type	CA11/7
Voltage	12
Number of plates per cell	11
Capacity at 10-hour rate	53
Capacity at 20-hour rate	60

Maintenance

Wipe away any foreign matter or moisture from the top of the battery and ensure that the connections and fixings are clean and tight.

Check the electrolyte level weekly. In extreme cold conditions the battery should be topped up immediately prior to driving the car so that the electrolyte mixing can occur to prevent freezing of the added water.

Topping up the battery should be carried out with the car on a reasonably level surface.

Remove the vent cover. If the acid level is below the bottom of the tubes pour distilled water into the

trough until all the tubes are filled.

Replace the vent cover. The electrolyte level is now correct.

DO NOT, under any circumstances, top up the battery by using the normal type of battery filler which incorporates a plunger valve in the filler neck.

The use of this type of filler will depress the sliding tubes and allow the battery to be overfilled.

Important: The vent cover must be kept in position at all times except when topping up.

Distilled water should always be used for topping-up. In an emergency, however, clean soft rain water collected in an earthenware container may be used.

Note: Never use a naked light when examining a battery as the mixture of oxygen and hydrogen given off by the battery when on charge and to a lesser extent when standing idle, can be dangerously explosive.

Clean off any corrosion from the battery cable terminals and coat with vaseline before re-connecting.

Removal

Unscrew the two wing nuts retaining the battery strap; remove the fixing rods and strap. Disconnect terminals and lift out the battery from the tray.

WARNING: Rubber sealing plugs are not incorporated in the manifold filler cover.

When removing the battery it is ESSENTIAL that extreme care is taken to ensure that it is NOT tipped to any degree.

Failure to ensure this will result in acid spillage which may cause severe acid burning to the operator and to the car.

Refitting

Refitting is the reverse of the removal procedure.

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Before refitting the cable connectors, clean the terminals and coat with petroleum jelly.

Persistent low state of charge

First consider the conditions under which the battery is used. If the battery is subjected to long periods of discharge without suitable opportunities for recharging, a low state of charge can be expected. A fault in the alternator or control unit, or neglect of the battery during a period of low or zero mileage may also be responsible for the trouble.

Manifold Vent Cover

See that the ventilating holes in the cover are clear.

Level of Electrolyte

The surface of the electrolyte should be just level with the tops of the separator guards. If necessary, top up with distilled water as detailed on page PY.s.1. Any loss of acid from spilling or spraying (as opposed to the normal loss of **water** by evaporation) should be made good by dilute acid of the same specific gravity as that already in the cell.

Cleanliness

See that the top of the battery is free from dirt or moisture which might provide a discharge path. Ensure that the battery connections are clean and tight.

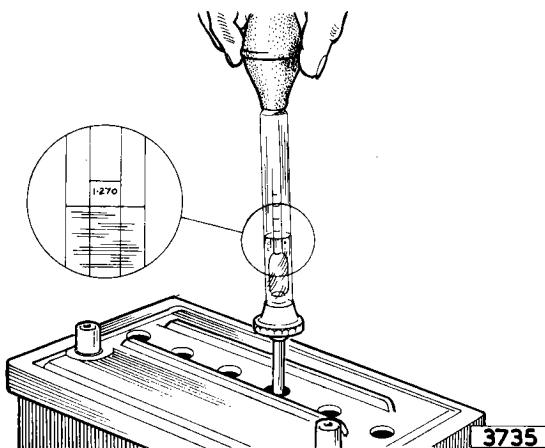


Fig. 1. Method of topping up the Lucas C.A. battery.

Hydrometer Tests

Measure the specific gravity of the acid in each cell in turn with a hydrometer. To avoid misleading readings, do not take hydrometer reading immediately after topping-up.

The reading given by each cell should be approximately the same.

If one cell differs appreciably from the others, an internal fault in the cell is indicated.

The appearance of the electrolyte drawn into the hydrometer when taking a reading gives useful indication of the state of the plates. If the electrolyte is very dirty, or contains small particles in suspension, it is possible that the plates are in a bad condition.

The specific gravity of the electrolyte varies with the temperature, therefore, for convenience in comparing specific gravities, this is always corrected to 60°F (16°C) which is adopted as a reference temperature.

The method of correction is as follows:—

For every 5°F (2.8°C) below 60°F (16°C) deduct 0.002 from the observed reading to obtain the true specific gravity at 60°F (16°C).

For every 5°F (2.8°C) above 60°F (16°C) add 0.002 to the observed reading to obtain the true specific gravity at 60°F (16°C).

The temperature must be that indicated by a thermometer actually immersed in the electrolyte and not in the air temperature.

Compare the specific gravity of the electrolyte with the values given in the table and so ascertain the state of charge of the battery.

If the battery is in a discharged state, it should be recharged, either on the vehicle by a period of daytime running or on the bench from an external supply, as described under "Recharging from an External Supply".

All Service procedure concerning the following items remains as detailed on pages P8–P9 of the 3.8 'E' Type Service Manual.

- (1) Recharging from an external supply
- (2) Preparing new unfilled, uncharged batteries for Service
- (3) Preparing new "Dry-charged" batteries for Service.

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DISTRIBUTOR

(NOT U.S.A. AND CANADA)

A waterproof cover is incorporated in the distributor assembly, located between the distributor cap and body. This cover is detachable after removing the

distributor cap and disconnecting the cable from the contact breaker spring post.

DATA

Ignition Distributor Type	22D6
8 to 1 Compression Ratio	41060A
9 to 1 Compression Ratio	41060A
Cam dwell angle	$34^{\circ} \pm 3^{\circ}$
Contact breaker gap	0.014"–0.016" (0.36–0.41 mm.)
Contact breaker spring tension (Measured at free contact)	18–24 ozs. (512–682 gms.)

IGNITION TIMING

8 to 1 Compression Ratio	9° BTDC
9 to 1 Compression Ratio	10° BTDC

IGNITION DISTRIBUTOR TEST DATA

			VACUUM TIMING ADVANCE TESTS				CENTRIFUGAL TIMING ADVANCE TESTS				
			The distributor must be run immediately below the speed at which the centrifugal advance begins to function to obviate the possibility of an incorrect reading being registered.				Mount distributor in centrifugal advance test rig and set to spark at zero degrees at 100 r.p.m.				
Distributor Type	Lucas Service Number	Lucas Vacuum Unit Number	Vacuum in inches of mercury and advance in degrees		No advance in timing below-ins. of mercury	Lucas Advance Springs Number	Accelerate to-RPM and note advance in degrees		Decelerate to-RPM and note advance in degrees		No advance in timing below-RPM
			Inches	Degrees			RPM	Degrees	RPM	Degrees	
22 D6	41060A	54415894	20	7—9	4½	55415562	2,300	8½—10½	1800	8½—10½	300
			13	6—8½					1250	6½—8½	
			9	2½—5½					800	5—7	
			7½	0—3					650	2—4	
			6	0—½					525	0—1½	
Auto advance weights Lucas number 54413073. One inch of mercury = 0.0345 kg/cm²											

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FUSE UNITS

Fuse No.	CIRCUITS	Amps
1	Headlamps—Main Beam	35
2	Headlamps—Dip Beam	35
3	Horns	50
4	Traffic Hazard Warning System	35
5	Side, Panel, Tail and Number Plate (not Germany) Lamps ..	35
6	Horn Relay, Washer, Radiator Fan Motor and Stop Lamps ..	35
7	Flashers, Heater, Wiper, Choke, Fuel, Water and Oil Gauges ..	35
8	Headlamp Flasher, Interior Lamps and Cigar Lighter	35
In line	Heated Backlight (when fitted)	15
In line	Radio, Optional Extras	5

THE ALTERNATOR

MODEL 11AC (43 AMP)

DESCRIPTION

The Lucas 11 AC alternator is a lightweight machine designed to give increased output at all engine speeds.

Basically the unit consists of a stationary output winding with built in rectification and a rotating field winding, energised from the battery through a pair of slip rings.

The stator consists of a 24 slot, 3 phase star connected winding on a ring shaped lamination pad housed between the slip ring end cover and the drive end bracket.

The rotor is of 8-pole construction and carries a field winding connected to two face type slip rings. It is supported by a ball bearing in the drive end bracket and a needle roller bearing in the slip ring end cover (see Fig. 2).

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The brushgear for the field system is mounted on the slip ring end cover. Two carbon brushes, one positive and one negative, bear against a pair of concentric brass slip rings carried on a moulded disc attached to the end of the rotor. The positive brush is always associated with the inner slip ring. There are also six silicon diodes carried on the slip ring end cover, these being connected in a three phase bridge circuit to provide rectification of the generated alternating current output (see Fig. 2). The diodes are cooled by air flow through the alternator induced by a 6" (15.24 cm.) ventilating fan at the drive end.

The alternator is matched to an output control unit, Model 4TR, which is described on page PY.s.11.

This unit controls the alternator field current and hence the alternator terminal voltage.

A cut-out is not included in the control unit as 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.

A Lucas 3AW warning light control unit is incorporated in the circuit.

The output control unit and the alternator field windings are isolated from the battery when the engine is stationary by a Lucas 6RA relay incorporated in the circuit.

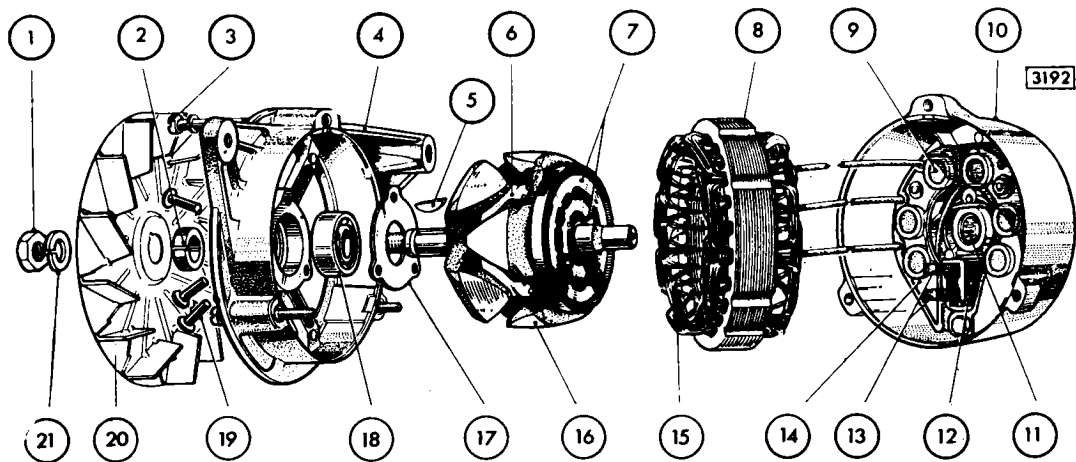


Fig. 2. Exploded view of the Lucas 11 AC alternator.

- | | |
|------------------------------|-------------------------------------|
| 1. Shaft nut. | 12. Brush box moulding. |
| 2. Bearing collar. | 13. Brushes. |
| 3. Through fixing bolts (3). | 14. Diode heat sink. |
| 4. Drive end bracket. | 15. Stator windings. |
| 5. Key. | 16. Rotor. |
| 6. Rotor (field) winding. | 17. Bearing retaining plate. |
| 7. Slip rings. | 18. Ball bearing. |
| 8. Stator laminations. | 19. Bearing retaining plate rivets. |
| 9. Silicon diodes (6). | 20. Fan. |
| 10. Slip ring end bracket. | 21. Spring washer. |
| 11. Needle roller bearing. | |

ELECTRICAL AND INSTRUMENTS

PERFORMANCE DATA

Nominal voltage	12 volts
Nominal d.c. output (hot) in amperes	43 amperes
Stator phases	3
Phase connections	Star
Resistance/phase at 68°F (20°C) ± 5 %	0.107 ohms
Resistance of rotor winding in ohms at 68°F (20°C)	3.8 ± 5 %

REMOVAL

Disconnect the cables from the terminals on the slip ring end cover. Note the colour and location of the cables with Lucar termination for reference when refitting.

Remove the drive belt by pushing the spring loaded jockey pulley inwards and lifting the belt over the alternator pulley.

Remove the two bolts securing the alternator to the mounting bracket and adjuster link. Withdraw the alternator.

REFITTING

Refitting is the reverse of the removal procedure.

When replacing the alternator belt, hold the spring loaded jockey pulley in towards the block and only release when the belt is sitting securely in the "vee" tracks.

SERVICE PRECAUTIONS

Important

4.2 "E" Type cars are equipped with transistors in the control box unit and diode rectifiers in the alternator.

The car electrical system must NOT be checked with an ohmmeter incorporating a hand driven generator until these components have been isolated.

REVERSED battery connections will damage the diode rectifiers.

Battery polarity must be checked before connections are made to ensure that the connections for the car battery are NEGATIVE earth. This is most important when using a slave battery to start the engine.

NEVER earth the brown/green cable if it is disconnected at the alternator. If this cable is earthed, with the ignition switched ON, the control unit and wiring may be damaged.

NEVER earth the alternator main output cable or terminal. Earthing at this point will damage the alternator or circuit.

NEVER run the alternator on open circuit with the field windings energised, that is with the main lead disconnected, otherwise the rectifier diodes are likely to be damaged due to peak inverse voltages.

WARNING: When using electric welding equipment for car accident repair it is advisable to carry out the following precautions.

1. Disconnect the battery.
2. Disconnect the main output and AL cables at the alternator.
3. Disconnect all cables at the 4TR control unit.

SERVICING

Testing the Alternator in position

In the event of a fault developing in the charging circuit check by the following procedure to locate the cause of the trouble.

1. Disconnect the battery.
2. Disconnect the cable (brown) from the alternator output terminal and connect a good quality moving-coil ammeter between the disconnected cable and the output terminal.

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3. Detach the terminal connector block from the base of the control unit and connect the black and brown/green cables together by means of a short length of cable with two Lucar terminals attached. This operation connects the alternator field winding across the battery terminals and by-passes the output control unit (Fig. 3).
4. Reconnect the battery earth lead. Switch on the ignition and start the engine. Slowly increase the engine speed until the alternator is running at approximately 4,000 r.p.m. (2,000 engine r.p.m.). Check the reading on the ammeter which should be approximately 40 amperes with the machine at ambient temperature.

A low current reading will indicate either a faulty alternator or poor circuit wiring connections.

If, after checking the latter, in particular the earth connections, a low reading persists on repeating the test refer to paragraph (5).

In the case of a zero reading, switch on the ignition and check that the battery voltage is being applied to the rotor windings by connecting a voltmeter between the two cable ends normally attached to the alternator field terminals. No reading on this test indicates a fault in the field isolating relay or the wiring associated with this circuit. Check each item in turn and rectify as necessary.

5. If a low output has resulted from the test described in paragraph (4) and the circuit wiring is in order; measure the resistance of the rotor coil field by means of an ohmmeter connected between the field terminal blades with the external wiring disconnected.

The resistance must approximate 3.8 ohms.

When a ohmmeter is not available connect a 12 volt DC supply between the field terminals with an ammeter in series. The ammeter reading should be approximately 3.2 amperes Fig. 4.

A zero reading on the ammeter, or an infinity reading on the ohmmeter indicates an open circuit in the field system, that is, the brush gear slip rings or winding. Conversely, if the current reading is much above, or the ohmmeter is much below, the values given then it is an indication of a short circuit in the rotor winding in which case the rotor slip ring assembly must be changed.

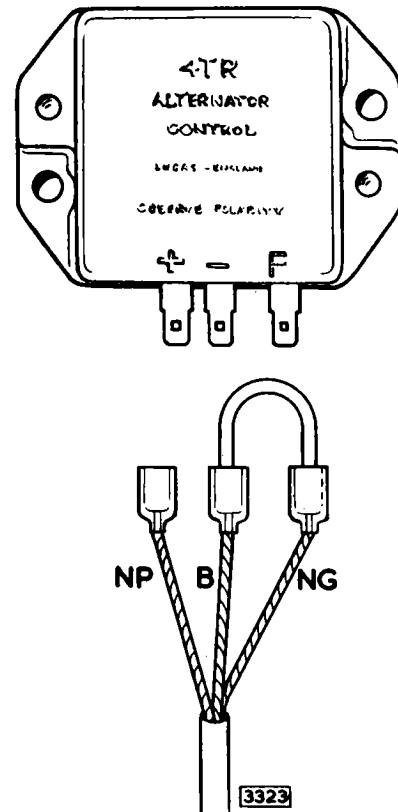


Fig. 3. Detach the terminal connectors from the base of the control unit.

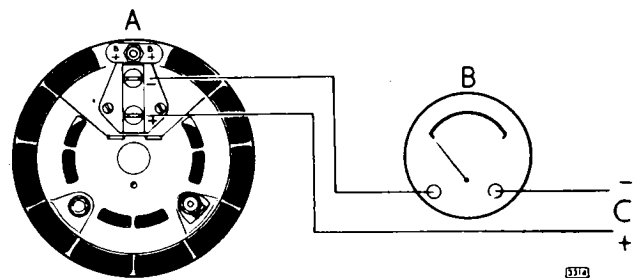


Fig. 4. Testing the alternator with an ammeter.

A—Alternator. B—Ammeter. C—Battery.

DISMANTLING THE ALTERNATOR (Fig. 2).

Disconnect the battery and remove the alternator as detailed on page PY.s.6.

Remove the shaft nut (1) and spring washer (21). Withdraw the pulley and fan (20).

Remove bolts (3) noting that the nuts are staked to the through bolts and that the staking must be removed before the nuts are unscrewed. If the threads of the nuts or bolts are damaged, new bolts must be fitted when reassembling.

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Mark the drive end bracket (4), lamination pack (8) and slip ring end bracket (10) so that they may be reassembled in correct angular relation to each other. Care must be taken not to damage the lamination pack when marking.

Withdraw the drive end bracket (4) and rotor (16) from the stator (8). The drive end bracket and rotor need not be separated unless the bearing requires examination or the rotor is to be replaced.

In the latter case the rotor should be removed from the drive end bracket by means of a hand press having first removed the shaft key (5) and bearing collar (2).

Remove the terminal nuts, washers and insulating pieces brush box screws and the 2 B.A., hexagon headed setscrew. Withdraw the stator and diode heat sink assemblies from the slip ring end cover.

Close up the retaining tongue at the root of each field terminal blade and withdraw the brush spring together with the terminal assemblies from the moulded brushbox.

REASSEMBLY

Reassembly of the alternator is the reverse of the dismantling procedure. Care must be taken to align the drive end bracket, lamination pack, slip ring and bracket correctly.

Tighten the three through bolts evenly to a maximum torque of 45 to 50 lb./ins. (0.518 to 0.576 kgm.). Restake the nuts after tightening.

Tighten the brush box fixing screws to a maximum torque of 10 lb./ins. (0.115 kgm.).

IMPORTANT

It is important to ensure that a .045" (1.28 mm) gap exists between the non-pivotal end of the heat sinks (see Fig. 15) when reassembling the alternator.

INSPECTION OF BRUSHGEAR (EARLY MODELS)

a maxi-

Measure brush length. A new brush is $\frac{5}{8}$ " (15.88 mm.) long; a fully worn brush is $\frac{5}{32}$ " (3.97 mm.) and must be replaced at, or approaching, 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 fine screwdriver blade, so that the tongue makes an angle of 30° with the terminal blade.

The normal brush spring pressures are 4-5 oz. (113 to 142 gms.) with the spring compressed to $\frac{25}{32}$ " (19.84 mm.) in length and 7½ to 8½ oz. (212 to 242 gms.)

with the spring compressed to $\frac{13}{32}$ " (10.31 mm.) in length. These pressures should be measured if the necessary equipment is available.

Check that the brushes move freely in their holders. If at all sluggish, clean the brush sides with a petrol moistened cloth or, if this fails to effect a cure, lightly polish the brush sides on a smooth file. Remove all traces of brush dust before re-housing the brushes in their holders.

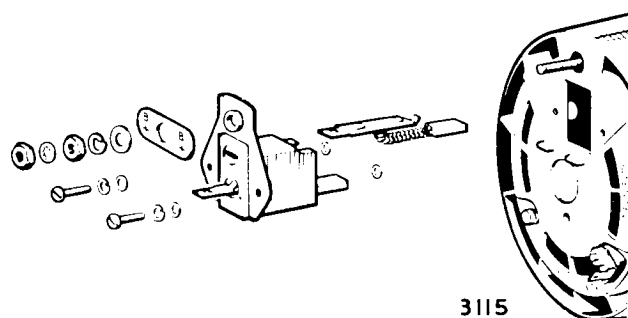


Fig. 5. Showing the brush removal (early cars).

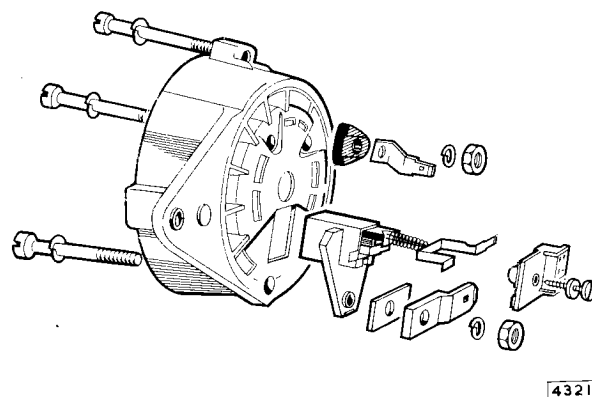


Fig. 6. Showing the brush removal (later cars).

INSPECTION OF BRUSHGEAR (LATER MODELS)

Later model alternators will have side entry cables. The characteristics of the alternator remain the same as the previous model (side entry cables) with the exception of the method of inspection and the fixing of the brush gear as detailed below:—

The brush length when new is $\frac{5}{8}$ " (15.9 mm.). The serviceability of the brushes may be gauged by measuring the amount by which they protrude beyond the brushbox moulding when in the free position. For a brush to remain serviceable this should exceed 0.2" (5 mm.).

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Renew the brush assemblies if the brushes are worn to or below this length.

The new brush is supplied complete with brush spring and 'Lucar' terminal blade and is retained in position by a plate secured with a single fixing screw.

Check the brush spring pressure by using a push type spring gauge. Push each spring back against its spring until the brush face is flush with the housing.

The gauge should then register 8–16 oz. (227–454 grammes). Replace a brush assembly which gives a reading appreciably outside these limits where this is not due to the brush movement being impeded for any reason.

INSPECTION OF SLIP RINGS

The surfaces of all slip rings should be smooth and uncontaminated by oil or other foreign matter. Clean the surfaces using a petrol moistened cloth, or if there is any evidence of burning, very fine glasspaper. On no account must emery cloth or similar abrasives be used. No attempt should be made to machine the slip rings, as any eccentricity in the machining may adversely affect the high-speed performance of the alternator. The small current carried by the rotor winding together with the unbroken surface of the slip rings mean that the likelihood of scored or pitted slip rings is almost negligible.

ROTOR

Test the rotor winding by connecting an ohmmeter (Fig. 7) or 12 volt D.C. (Fig. 8) supply between the slip rings. The readings of resistance or current should be as given on page PY.s.6.

Test for defective insulation between each of the slip rings and one of the rotor poles using a mains low-wattage test lamp for the purpose. If the lamp lights, the coil is earthing therefore 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.

STATOR

Unsolder the three stator cables from the heat sink assembly, taking care not to overheat the diodes—(see 4h page 6). Check the continuity of the stator windings by first connecting any two of the three stator cables in series with a test lamp of not less than 36 watts and a 12-volt battery as shown in Fig. 10. Repeat the test, replacing one of the two cables by the third cable. Failure of the test lamp to light on either occasion means that part of the stator winding is open-circuit and a replacement stator must be fitted.

Test for defective insulation between stator coils and lamination pack with a mains test lamp. Connect the test probes between any one of the three cable ends and the lamination pack. If the lamp lights, the stator coils are earthing and a replacement stator must be fitted.

Before re-soldering the stator cable ends to the diode pins check the diodes.

DIODES

Each diode can be checked by connecting it in series with a 1.5 watt test bulb (Lucas No. 280)

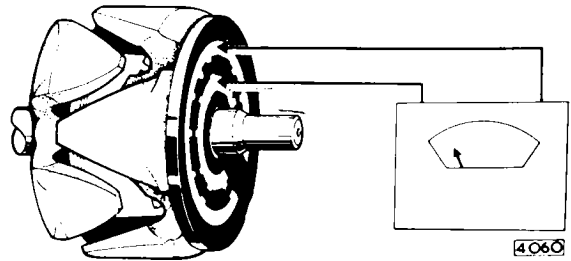


Fig. 7. Measuring the rotor winding resistance with an ohmmeter.

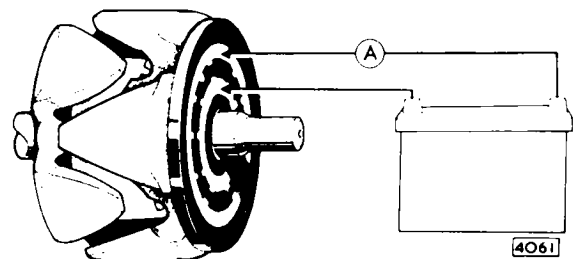


Fig. 8. Measuring the rotor winding resistance with an ammeter and battery.

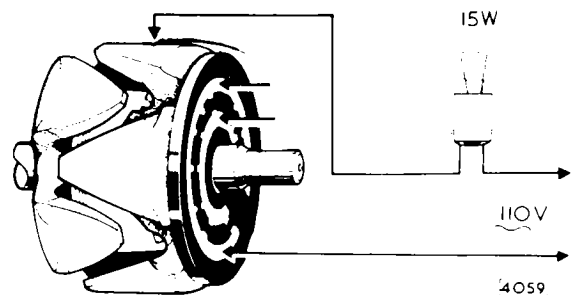


Fig. 9. Insulation test of rotor winding.

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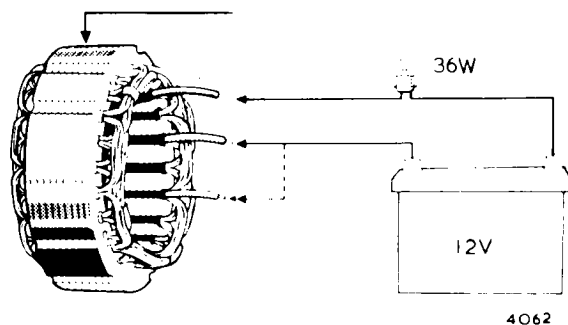


Fig. 10. Stator winding continuity test.

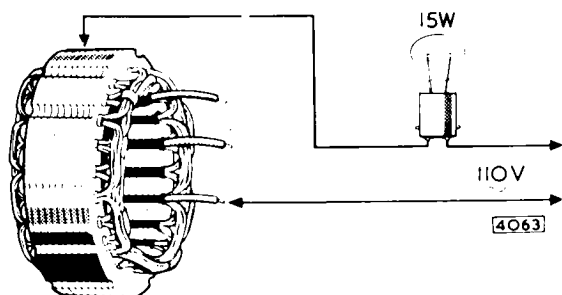


Fig. 11. Stator winding insulation test.

across a 12 volt D.C. supply and then reversing the connections.

Current should flow and the bulb light in one direction only. If the bulb lights up in both tests or does not light up in either then the diode is defective and the appropriate heat sink assembly must be replaced.

The above procedure is adequate for service purposes. Any accurate measurement of diode resistance requires factory equipment. Since the forward resistance of a diode varies with the voltage applied, no realistic readings can be obtained with battery-powered ohmmeters.

If a battery—ohmmeter is used, a good diode will yield "Infinity" on 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.

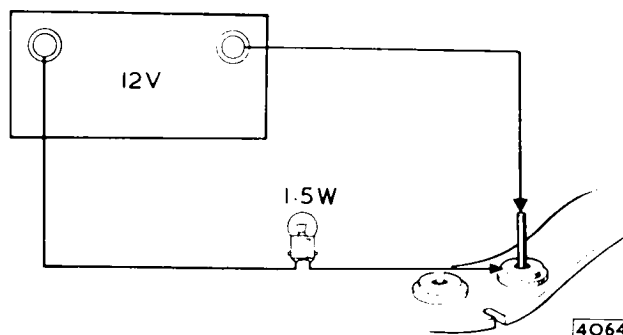


Fig. 12. Method of testing diodes.

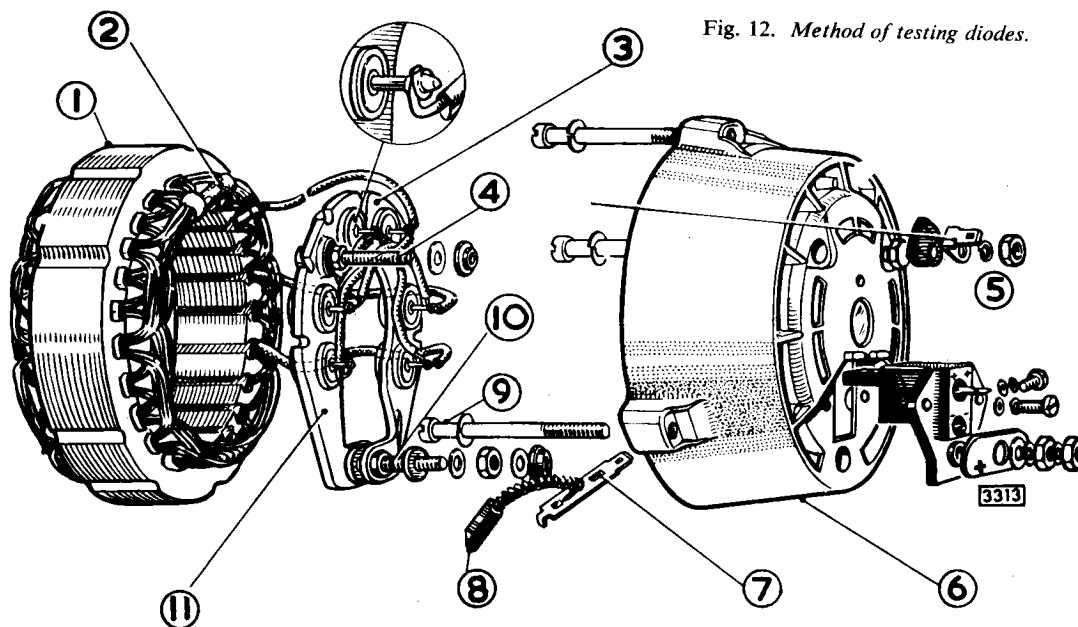


Fig. 13. Exploded view of the slip ring end cover.

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|--|-------------------------------------|--|
| 1. Stator. | 4. Warning light terminal 'AL'. | 8. Rotor slip ring brush (2). |
| 2. Star point. | 5. Field terminal (2) | 9. "Through" bolts (3). |
| 3. Negative heat sink anode base diodes (black). | 6. Slip ring end cover. | 10. Output terminal (+). |
| | 7. Terminal blade retaining tongue. | 11. Positive heat sink and cathode base diode (red). |

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ALTERNATOR DIODE HEAT SINK REPLACEMENT

The alternator heat sink assembly consists of two mutually insulated portions, one of positive and the other of negative polarity. The diodes are not individually replaceable but, for service purposes, are supplied already pressed into the appropriate heat sink portion. The positive carries three cathode base diodes marked black.

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 suitable long-nosed pliers, acting as a thermal shunt and the operation of soldering carried out as quickly as possible.

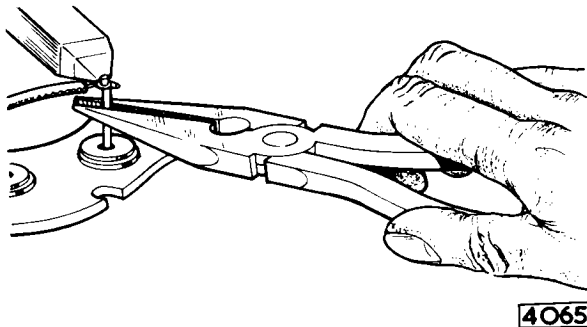


Fig. 14. Use of thermal shunt when soldering diode connections

After soldering to ensure adequate clearance of the rotor, the connections must be neatly arranged around the heat sinks and tacked down with "MMM" EC 1022 adhesive where indicated in Fig. 15. The stator connections must pass through the appropriate notches at the edge of the heat sink.

ALTERNATOR OUTPUT CONTROL UNIT MODEL 4 TR.

GENERAL

Model 4 TR is an electronic control unit. In effect its action is similar to that of the vibrating contact type of voltage control unit but switching is achieved by transistors instead of vibrating contacts. A Zener diode provides the voltage reference in place of the voltage coil and tension spring system. No cut-out is required since the diodes incorporated in the alternator prevent reverse currents flowing. No current regulator is required as the inherent self-regulating properties of the alternator effectively limit the output current to a safe value.

The control unit and the alternator field windings are isolated from the battery, when the engine is stationary, by a special double-pole ignition switch.

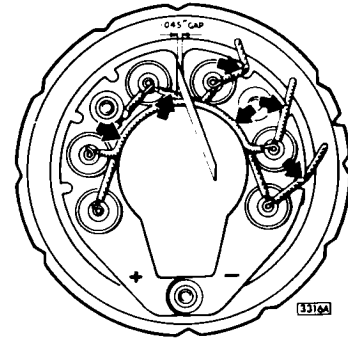


Fig. 15. Showing the silicon diodes and connection in the slip ring end cover.

The feeler gauge inserted between the diode carriers.

BEARINGS

Bearings which are worn to the extent that they allow excessive side movement of the rotor shaft must be renewed. The needle roller bearing in the slip ring end cover is supplied complete with the end cover.

To renew the drive end ball bearing following the withdrawal of the rotor shaft from the drive-end bracket, proceed as follows:—

- File away the roll-over on each of the three bearing retaining plate rivets and punch out the rivets.
- Press the bearing out of the bracket.
- Locate the bearing in the housing and press it home. Refit the bearing retaining plate using new rivets.

Note: Before fitting the replacement bearing see that it is clean and, if necessary, pack it with high-melting point grease such as Shell Alvania No. 3 or an equivalent lubricant.

On cars fitted with a steering column lock, the field windings are isolated by means of a relay replacing the ignition switch control.

Care must be taken at all times to ensure that the battery, alternator and control unit are correctly connected. Reversed connections will damage the semi conductor devices employed in the alternator and control unit.

OPERATION

When the ignition is switched on, the control unit is connected to the battery through the field isolating switch or relay. By virtue of the connection through

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R1 (see Fig. 16), the base circuit of the power transistor T2 is conducted so that, by normal transistor action, current also flows in the collector-emitter portion of T2 which thus acts as a closed switch to complete the field circuit and battery voltage is applied to the field winding.

As the alternator rotor speed increases, the rising voltage generated across the stator winding is applied to the potential divider consisting of R3, R2 and R4. According to the position of the tapping point on R2, a proportion of this potential is applied to the Zener diode (ZD). The latter is a device which opposes the passage of current through itself until a certain voltage is reached above which it conducts comparatively freely.

The Zener diode can thus be considered as a voltage-conscious switch which closes when the voltage across it reaches its "breakdown" voltage (about 10 volts) and, since this is a known proportion of the alternator output voltage as determined by the position of the tapping point on R2, the breakdown point therefore reflects the value of the output voltage.

Thus at "breakdown" voltage the Zener diode conducts and current flows in the base-emitter circuit of the driver transistor T1. Also, by transistor action, current will flow in the collector-emitter portion of T1 so that some of the current which previously passed through R1 and the base circuit of T2 is diverted through T1. Thus the base current of T2 is reduced and, as a result, so also is the alternator field excitation. Consequently, the alternator output voltage will tend to fall and this, in turn, will tend to reduce the base current in T1, allowing

increased field current to flow in T2. By this means, the field current is continuously varied to keep the output voltage substantially constant at the value determined by the setting of R2.

To prevent overheating of T2, due to power dissipation, this transistor is operated only either in the fully-on or fully-off condition. This is achieved by the incorporation of the positive feed-back circuit consisting of R5 and C2. As the field current in transistor T2 starts to fall, the voltage at F rises and current flows through resistor R5 and capacitor C2 thus adding to the Zener diode current in the base circuit of transistor T1. This has the effect of increasing the current through T1 and decreasing, still further, the current through T2 so that the circuit quickly reaches the condition where T1 is fully-on and T2 fully-off. As C2 charges, the feed-back current falls to a degree at which the combination of Zener diode current and feed-back current in the base circuit of T1 is no longer sufficient to keep T1 fully-on. Current then begins to flow again in the base circuit of T2. The voltage at F now commences to fall, reducing the feed-back current eventually to zero. As T2 becomes yet more conductive and the voltage at F falls further, current in the feed-back circuit reverses in direction thus reducing, still further, the base current in T1.

This effect is cumulative and the circuit reverts to the condition where T1 is fully-off and T2 is fully-on.

The above condition is only momentary since C2 quickly charges to the opposite polarity when feed-back current is reduced and current again flows in

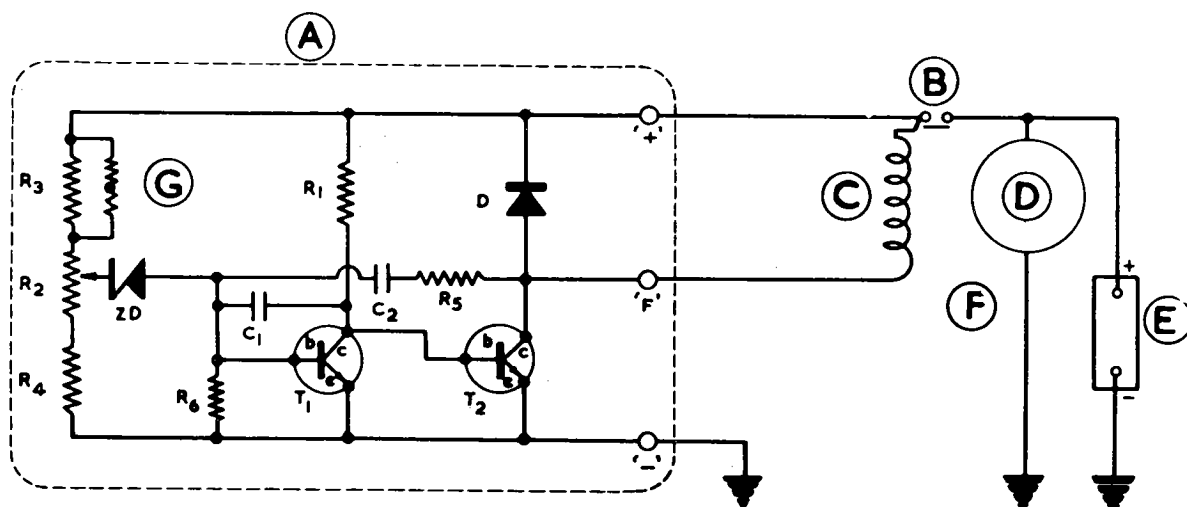


Fig. 16. 4TR Control Unit Circuit Diagram.

A—Control unit.
B—Field isolating device.
C—Rotor field winding.
D—Alternator.

E—12-volt battery.
F—Stator winding (rectified) output.
G—Thermistor.

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the base circuit of T1. The circuit thus oscillates, switching the voltage across the alternator field winding rapidly on and off.

Transistor T2 is protected from the high induced voltage surge, which results from the collapse of the field current, by the surge quench diode D connected across the field windings. This diode also provides a measure of field current smoothing since current continues to flow in the diode after the excitation voltage is removed from the field.

The elimination of radio interference is achieved by connecting condenser C1 between the base and collector terminals of T1 to provide negative feedback. At high temperatures, a small leakage current may flow through the Zener diode even though the latter is in the nominally non-conductive state. Resistor R6 provides a path for this leakage current which otherwise would flow through T1 base circuit and adversely affect the regulator action.

A thermistor is connected in parallel with resistor R3. The thermistor is a device whose resistance increases as the temperature falls and vice versa. Any alteration in its ohmic value will modify the voltage distribution across the potential divider and thus affect the voltage value at which the Zener diode begins to conduct, so matching the changes which take place in battery terminal voltage as the temperature rises.

CHECKING AND ADJUSTING THE CONTROL UNITS

Important:

Voltage checking and setting procedure may be carried out only if the alternator and associated wiring circuits have been tested and found satisfactory in conjunction with a well-charged battery, (i.e., charging current not exceeding 10 amperes).

VOLTAGE CHECKING

Run the alternator at charging speed for eight minutes. This operation applies when bench testing or testing on the car.

Leave the existing connections to the alternator and control unit undisturbed. Connect a high quality voltmeter between control unit terminals positive and negative. If available, use a voltmeter of the suppressed-zero type, reading 12 to 15 volts.

Switch on an electrical load of approximately 2 amperes (e.g., side and tail lighting).

Start the engine and run the alternator at 3,000 r.p.m. (1,500 engine r.p.m.).

The voltmeter should now show a reading of 13.9 to 14.3 volts at 68° to 78° F. (20° to 26° C.) ambient temperature. If not, but providing the reading obtained has risen to some degree above battery terminal voltage before finally reaching a steady value, the unit can be adjusted to control at the correct voltage (see Adjusting).

If, however, the voltmeter reading remains unchanged, at battery terminal voltage, or, conversely, increases in an uncontrolled manner, then the control unit is faulty and, as its component parts are not serviced individually a replacement unit must be fitted.

ADJUSTING

Stop the engine and withdraw the control unit mounting screws.

Invert the unit and chip away the sealing compound which conceals the potentiometer adjuster (see Fig. 7).

Check that the voltmeter is still firmly connected between terminals +ve and -ve. Start the engine and, while running the alternator at 3,000 r.p.m., turn the potentiometer adjuster slot (clockwise to increase the setting or anti-clockwise to decrease it) until the required setting is obtained.

Use care in making this adjustment as a small amount of adjuster movement causes an appreciable difference in the voltage reading.

Recheck the setting by first stopping the engine then again running the alternator at 3,000 r.p.m.

Remount the control unit and disconnect the voltmeter.

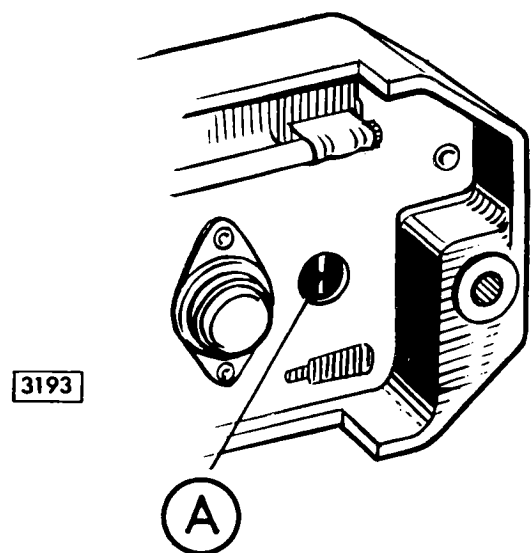


Fig. 17 4 TR Alternator Control.
A Potentiometer adjuster.

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WARNING LIGHT CONTROL UNIT Model 3AW

DESCRIPTION

The Model 3AW warning light unit is a device connected to the centre point of one of the pairs of diodes in the alternator and operates in conjunction with the ignition warning light to give indication that the alternator is charging.

The unit is mounted on the bulkhead adjacent to the control box and is similar in appearance to the flasher unit but has different internal components consisting of an electrolytic (polarised) capacitor; a resistor and a silicone diode mounted on an insulated base with three "Lucar" terminals.

The unit is sealed, therefore servicing and adjustment is not possible. Faulty units must be replaced. Due to external similarity of the 3AW warning light unit and the flasher unit, a distinctive green label is attached to the aluminium case of the 3AW unit.

Checking Check by substitution after ensuring that the remainder of the charging circuit (including the drive belt) is functioning satisfactorily.

Warning. A faulty diode in the alternator or an intermittent or open-circuit in the alternator to battery circuit can cause excessive voltages to be applied to the warning light unit.

To prevent possible damage to a replacement unit, it is important to first check the voltage between the alternator "AL" terminal and earth. Run the engine at 1,500 r.p.m. when the voltage should be 7-7.5 volts

measured on a good quality moving-coil voltmeter. If a higher voltage is registered, check that all charging circuit connections are clean and tight; then, if necessary, check the alternator rectifier diodes before fitting a replacement 3AW unit.

TRAFFIC HAZARD WARNING DEVICE (OPTIONAL EQUIPMENT)

Description

The system operates in conjunction with the four flashing (turn) indicator lamps fitted to the car. The operation of the dash panel switch will cause the four turn indicator lamps to flash simultaneously.

A red warning lamp is incorporated in the circuit to indicate that the hazard warning system is in operation.

A 35 amp. in-line fuse incorporated in the sub-panel circuit.

The flasher unit is located and is similar in appearance to the one used for the flashing turn indicators but has a different internal circuit. A correct replacement unit must be fitted in the event of failure.

The pilot lamp bulb is accessible after removing the bulb holder from the rear of the panel.

Failure of one or more of the bulbs due to an accident or other cause will not prevent the system operating on the remaining lamps.

THE STARTER MOTOR

DESCRIPTION

The purpose of the pre-engaged, or positive engagement, starting motor is to prevent premature pinion ejection.

Except on occasions of tooth to tooth abutment, for which special provision is made, the starter motor is connected to the battery only after the pinion has been meshed with the flywheel ring gear, through the medium of an electro-magnetically operated linkage mechanism.

After the engine has started, the current is automatically switched off before the pinion is retracted.

On reaching the out of mesh position, the spinning armature is brought rapidly to rest by a braking device. This device takes the form of a pair of moulded shoes driven by a cross peg in the armature shaft and spring loaded (and centrifuged) against a steel ring insert in the commutator end bracket. Thus, with the supply switched off and the armature subjected to a braking force, the possibility is minimised of damaged teeth resulting from attempts being made to re-engage a rotating pinion.

A bridge-shaped bracket is secured to the front end of the machine by the through bolts. This bracket carries the main battery input and solenoid winding

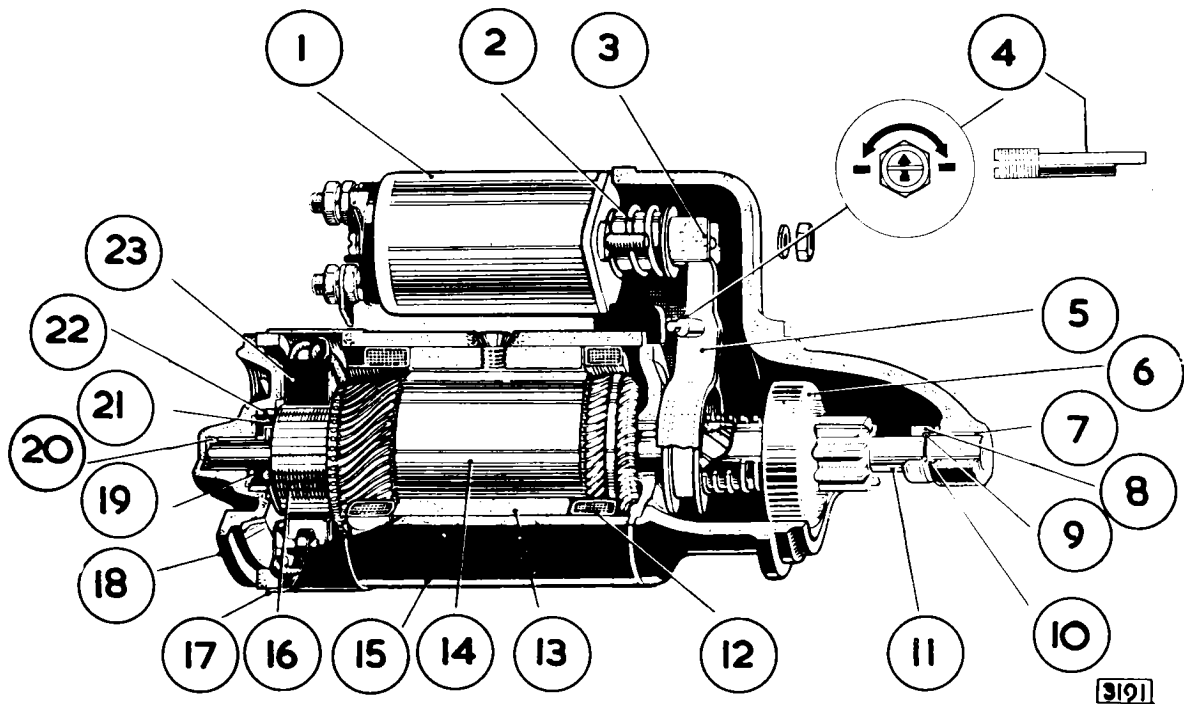


Fig. 18. *The Pre-engaged Starter Motor Model M45G.*

- | | | |
|-------------------------|-------------------------------|--------------------------------|
| 1. Actuating solenoid. | 9. Jump ring. | 17. Band cover. |
| 2. Return spring. | 10. Thrust washer. | 18. C.E. bracket. |
| 3. Clevis pin. | 11. Armature shaft extension. | 19. Thrust washer. |
| 4. Eccentric pivot pin. | 12. Field coils. | 20. Porous bronze bush. |
| 5. Engaging lever. | 13. Pole shoe. | 21. Brake shoes and cross peg. |
| 6. Roller clutch. | 14. Armature. | 22. Brake ring. |
| 7. Porous bronze bush. | 15. Yoke. | 23. Brushes. |
| 8. Thrust collar. | 16. Commutator. | |

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terminals, short extension cables being connected between these and the corresponding solenoid terminals.

TOOTH TO TOOTH ABUTMENT

The electro-magnetically actuated linkage mechanism consists essentially of a pivoted engaging lever having two hardened steel pegs (or trunnion blocks) which locate with and control the drive through the medium of a groove in an operating bush. This bush is carried, together with the clutch and pinion assembly, on an internally splined outboard driving sleeve, the whole mechanism being housed in a cut-away flange mounting snout-shaped end bracket. This operating bush is spring loaded against a jump ring in the driving sleeve by an engagement spring located between the bush and the clutch outer cover. The system return or drive demeshing spring is located round the solenoid plunger.

On the occurrence of tooth to tooth abutment (between the ends of the starter pinion teeth and those of the flywheel ring gear), the pegs or trunnion blocks at the "lower" end of the engaging lever can move forward by causing the operating bush to compress the engagement spring, thus allowing the "upper" end of the lever to move sufficiently rearwards to close the starter switch contacts. The armature then rotates and the pinion slips into mesh with the flywheel ring gear under pressure of the compressed engagement spring.

THE "LOST MOTION" (SWITCH-OFF) DEVICE

As it is desirable that the starter switch contacts shall not close until the pinion has meshed with the flywheel ring gear therefore it is important that these same contacts should always re-open before the pinion has been retracted or can be opened in the event of a starter pinion remaining for some reason enmeshed with the flywheel ring gear. To ensure this, a measure of "lost motion" is designed into some part of the engagement mechanism, its effect being to allow the starter switch or solenoid contacts (which are always spring-loaded to the open position) to open before pinion retraction begins.

Several methods of obtaining "lost motion" have been adopted, but each depends upon the yielding of a weaker spring to the stronger system return (drive demeshing or dis-engagement) spring of the solenoid plunger.

This initial yielding results in the switch contacts being fully-opened within the first $\frac{1}{4}$ " (3.18 mm.) of plunger return travel; this action being followed by normal drive retraction.

Solenoid model 10S has a weaker (lost motion) spring located inside the solenoid plunger. Here, enclosed at the outer end by a retaining cup, it forms a plunger within a plunger and it is spring loaded against the tip of the engaging lever inside the plunger clevis link.

THE ROLLER CLUTCH

Torque developed by the starting motor armature must be transmitted to the pinion and flywheel through an over-running or free-wheeling device which will prevent the armature from being rotated at an excessively high speed in the event of the engaged position being held after the engine has started. The roller clutch performs this function.

The operating principle of the roller clutch is the wedging of several plain cylindrical rollers between converging surfaces. The convergent form is obtained by matching cam tracks, to a perfectly circular bore. The rollers, of which there are three, are spring loaded and, according to the direction of drive, are either free or wedge-locked between the driving and driven members. The clutches are sealed in a rolled over steel outer cover and cannot be dismantled for subsequent reassembly.

THE STARTER SOLENOID

The starter solenoid is an electro-magnetic actuator mounted pick-a-back fashion on the yoke of the pre-engaged starter motor. It contains a soft iron plunger (linked to the engaging lever), the starter switch contacts and a coil consisting of a heavy gauge pull-in or series winding and a lighter-gauge hold-on or shunt winding.

Initially, both windings are energised in parallel when the starter device is operated but the pull-in winding is shorted out by the starter switch contacts at the instant of closure—its purpose having been effected.

Magnetically, the windings are mutually assisting.

Like the roller clutch assembly, the starter solenoid is sealed in a rolled-over steel outer case or body and cannot be dismantled for subsequent reassembly.

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STARTER MOTOR PERFORMANCE DATA

Model	M45G Pre-engaged
Lock Torque	22·6 lb./ft. (3·13 kg./m.) with 465 amperes at 7·6 terminal volts
Torque at 1,000 r.p.m.	9·6 lb./ft. (1·33 kg./m.) with 240 amperes at 9·7 terminal volts
Light running current	70 amperes at 5,800 to 6,500 r.p.m.

SOLENOID SWITCH DATA

Model	10 S
Closing Coil Resistance (measured between terminal STA with copper link removed and Lucar terminal)	0·36 to 0·42 ohms
Hold on Coil Resistance (measured between Lucar terminal and solenoid outer case)	1·49 to 1·71 ohms

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REMOVAL

DISCONNECT THE BATTERY EARTH LEAD.

Disconnect and remove the transmitter unit from the top of the oil filter.

Disconnect the battery cable and solenoid switch cable from the starter motor.

Remove the distributor clamping plate retaining screw and withdraw the distributor.

Remove the two setscrews and lock washers securing the motor to the housing, gently bend away the carburettor drain pipes and remove the starter motor through the chassis frame.

The two setscrews are accessible from beneath the car or through an access panel in the right-hand side of the gearbox tunnel. Remove the front carpet to expose the panel.

Refitting

Refitting is the reverse of the removal procedure.

Care must be taken when refitting the two setscrews, which have a fine thread, that they are not cross-threaded.

Insert the distributor and rotate the rotor until the drive dog engages correctly and secure with the clamping plate setscrew.

Note: If the clamping plate has been removed from the distributor or its position altered, the engine must be re-timed as detailed in Section B.

SERVICING

Checking the Brushgear and Commutator

Remove the starter motor from the engine.

Release the screw and remove the metal band cover.

Check that the brushes move freely in the brush boxes by holding back the spring and pulling gently on the flexible connection. If a brush is inclined to stick, remove it from its holder and clean its sides with a petrol moistened cloth. Replace the brushes in their original position in order to retain "bedding". Brushes which will not "bed" properly or have worn to $\frac{5}{16}$ " (7.94 mm.) in length must be renewed. See page PY.s.20 for renewal procedure.

Check the tension of the brush springs with a spring balance. The correct tension should be 52 ozs. (1.47 kg.) on a new brush.

Replace each existing brush in turn with a new brush to enable the tension of the brush springs to be tested accurately.

Check that the commutator is clean and free from oil or dirt. If necessary clean with a petrol moistened cloth or, if this is ineffective, rotate the armature and polish the commutator with fine glass paper. DO NOT use emery cloth. Blow out all abrasive dust with a dry air blast.

A badly worn commutator can be reskipped by first rough turning, followed by diamond finishing. DO NOT undercut the insulation. Commutators must not be skimmed below a diameter of $1\frac{1}{2}$ " (38.89 mm.). Renew the armature if below this limit.

SERVICING

Testing in position

Check that the battery is fully charged and that the terminals are clean and tight. Recharge if necessary.

Switch on the lamps together with the ignition and operate the starter control. If the lights go dim and the starter does not crank the engine this indicates that the current is flowing through the starter motor windings but the armature is not rotating for some reason. The fault is due possibly to high resistance in the brush gear or an open circuit in the armature or field coils. Remove the starter motor for examination.

If the lights retain their full brilliance when the starter switch is operated check the starter motor and the solenoid unit for continuity.

If the supply voltage is found to be applied to the starter motor when the switch is operated the unit must be removed from the engine for examination.

Sluggish or slow action of the starter motor is usually due to a loose connection causing a high resistance in the motor circuit. Check as described above.

If the motor is heard to operate, but does not crank the engine, indication is given of damage to the drive.

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BENCH TESTING

Remove the starter motor from the engine

Disconnect the battery. Disconnect and remove the starter motor from the engine (see page PY.s.18 for the removal procedure).

Measuring the light running current

With the starter motor securely clamped in a vice and using a 12-volt battery, check the light running current and compare with the value given on page

P.X.s.15. If there appears to be excessive sparking at the commutator, check that the brushes are clean and free to move in their boxes and that the spring pressure is correct.

Measuring lock torque and lock current

Carry out a torque test and compare with the values given on page PY.s.17. If a constant voltage supply is used, it is important to adjust this to be 7.6 volts at the starter terminal when testing.

FAULT DIAGNOSIS

An indication of the nature of the fault, or faults, may be deduced from the results of the no-load and lock torque tests.

Symptom	Probable Fault
1. Speed, torque and current consumption correct.	Assume motor to be in normal operating condition.
2. Speed, torque and current consumption low.	High resistance in brush gear, e.g., faulty connections, dirty or burned commutator causing poor brush contact.
3. Speed and torque low, current consumption high.	Tight or worn bearings, bent shaft, insufficient end play, armature fouling a pole shoe, or cracked spigot on drive end bracket. Short circuited armature, earthed armature or field coils.
4. Speed and current consumption high, torque low.	Short circuited windings in field coils.
5. Armature does not rotate, high current consumption.	Open circuited armature, field coils or solenoid unit. If the commutator is badly burned, there may be poor contact between brushes and commutator.
6. Armature does not rotate, high current consumption.	Earthed field winding or short circuit solenoid unit. Armature physically prevented from rotating.
7. Excessive brush movement causing arcing at commutator.	Low brush spring tension or out-of-round commutator. "Thrown" or high segment on commutator.
8. Excessive arcing at the commutator.	Defective armature windings, sticking brushes or dirty commutator.
9. Excessive noise when engaged.	Pinion does not engage fully before solenoid main contacts are closed. Check pinion movement as detailed under Setting Pinion Movement.
10. Pinion engaged but starter motor not rotating.	Pinion movement excessive. Solenoid main contacts not closing. Check pinion movement as detailed under Setting Pinion Movement.

ELECTRICAL AND INSTRUMENTS

DISMANTLING

Disconnect the copper link between the lower solenoid terminal and the starting motor yoke.

Remove the two solenoid unit securing nuts. Detach the extension cables and withdraw the solenoid from the drive end bracket casting, carefully disengaging the solenoid plunger from the starter drive engagement lever.

Remove the cover band and lift the brushes from their holders.

Unscrew and withdraw the two through bolts from the commutator end bracket. The commutator end bracket and yoke can now be removed from the intermediate and drive end brackets.

Extract the rubber seal from the drive end bracket.

Slacken the nut securing the eccentric pin on which the starter drive engagement lever pivots. Unscrew and withdraw the pin.

Separate the drive end bracket from the armature and intermediate bracket assembly.

Remove the thrust washer from the end of the armature shaft extension using a mild steel tube of suitable bore. Prise the jump ring from its groove and slide the drive assembly and intermediate bracket from the shaft.

To dismantle the drive further prise off the jump ring retaining the operating bush and engagement spring.

BENCH INSPECTION

After dismantling the motor, examine individual items.

Replacement of brushes

The flexible connectors are soldered to terminal tags; two are connected to brush boxes and two are connected to free ends of the field coils. Unsolder these flexible connectors and solder the connectors of the new brush set in their place.

The brushes are pre-formed so that "bedding" to the commutator is unnecessary. Check that the new brushes can move freely in their boxes.

Commutator

A commutator in good condition will be burnished and free from pits or burned spots. Clean the commutator with a petrol moistened cloth. Should this be ineffective, spin the armature and polish the commutator with fine glass paper; remove all abrasive dust with a dry air blast. If the commutator is badly

worn, mount the armature between centres in a lathe, rotate at high speed and take a light cut with a very sharp tool. Do not remove more metal than is necessary. Finally polish with very fine glass paper. The INSULATORS between the commutator segments **MUST NOT BE UNDERCUT**: Commutators must not be skimmed below a diameter of $1\frac{1}{32}$ " (38.89 mm.).

Armature

Lifted conductors

If the armature conductors are found to be lifted from the commutator risers, overspeeding is indicated. In this event, check that the clutch assembly is operating correctly.

Fouling of armature core against the pole faces

This indicates worn bearings or a distorted shaft. A damaged armature must in all cases be replaced and no attempt should be made to machine the armature core or to true a distorted armature shaft.

Insulation test

To check armature insulation, use a 110 volt a.c., test lamp. The test lamp must not light when connected between any commutator segment and the armature shaft.

If a short circuit is suspected, check the armature on a "growler". Overheating can cause blobs of solder to short circuit the commutator segments.

If the cause of an armature fault cannot be located or remedied, fit a replacement armature.

Field Coils

Continuity Test

Connect a 12-volt test lamp and battery between the terminal on the yoke and each individual brush (with the armature removed from the yoke). Ensure that both brushes and their flexible connectors are clear of the yoke. If the lamp does not light, an open circuit in the field coils is indicated.

Replace the defective coils.

Insulation test

Connect a 110-volt a.c., test lamp between the terminal post and a clean part of the yoke. The test lamp lighting indicates that the field coils are earthed to the yoke and must be replaced.

When carrying out this test, check also the insulated pair of brush boxes on the commutator end bracket.

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Clean off all traces of brush deposit before testing. Connect the 110-volt test lamp between each insulated brush box and the bracket.

If the lamp lights this indicates faulty insulation and the end bracket must be replaced.

Replacing the field coils

Unscrew the four pole-shoe retaining screws, using a wheel operated screwdriver. Remove the insulation piece which is fitted to prevent the inter-coil connectors from connecting with the yoke.

Draw the pole-shoes and coils out of the yoke and lift off the coils. Fit the new field coils over the pole-shoes and place them in position inside the yoke. Ensure that the taping of the field coils is not trapped between the mating surfaces of the pole-shoes and the yoke.

Locate the pole-shoes and field coils by lightly tightening the retaining screws. Replace the insulation piece between the field coil connections and the yoke.

Finally, tighten the screws by means of the wheel operated screwdriver while the pole pieces are held in position by a pole shoe expander or a mandrel of suitable size.

Bearings and Bearing Replacement

The commutator and drive end brackets are each fitted with a porous bronze bush and the intermediate bracket is fitted with an indented bronze bearing.

Replace bearings which are worn to such an extent that they will allow excessive side play of the armature shaft.

The bushes in the intermediate and drive end brackets can be pressed out whilst that in the commutator bracket is best removed by inserting a $\frac{9}{16}$ " (14.29 mm.) tap squarely into the bearing and withdrawing the bush with the tap.

Before fitting a new porous bronze bearing bush, immerse it for 24 hours in clean engine oil (SAE 30 to 40). In cases of extreme urgency, this period may be shortened by heating the oil to 100° C. for 2 hours and then **allowing the oil to cool before removing the bush.** Fit new bushes by using a shouldered, highly polished mandrel approximately 0.0005" (0.13 mm.) greater in diameter than the shaft which is to fit in the bearing. **Porous bronze bushes must not be reamed out after fitting, as the porosity of the bush will be impaired.**

After fitting a new intermediate bearing bush, lubricate the bearing surface with Rocol "Molypad" molybdenised non-creep, or similar, oil.

CHECKING THE ROLLER CLUTCH DRIVE

A roller clutch drive assembly in good condition will:—

- (i) Provide instantaneous take-up of the drive in the one direction.
- (ii) Rotate easily and smoothly in the other.
- (iii) Be free to move round or along the shaft splines without roughness or tendency to bind.

Similarly, the operating bush must be free to slide smoothly along the driving sleeve when the engagement spring is compressed. Trunnion blocks must pivot freely on the pegs of the engaging lever. All moving parts should be smeared liberally with Shell Retinax "A" grease or an equivalent alternative.

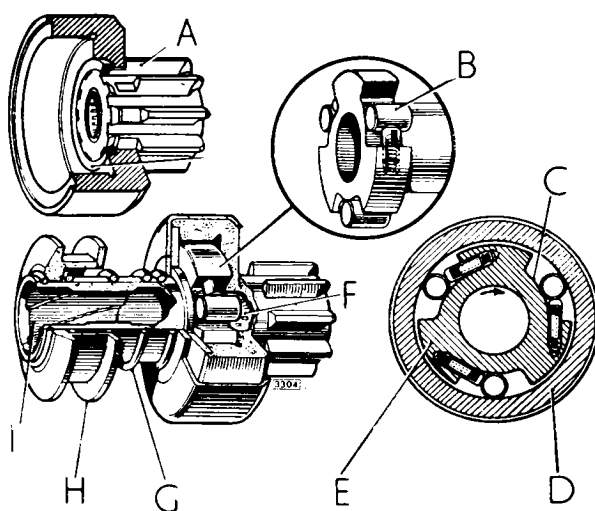


Fig. 19. The roller clutch drive components.

- A—Alternative construction (pinion pressed and clear-ringed into driven member).
B—Spring loaded rollers.
C—Cam tracks.
D—Driven member (with pinion).
E—Driving member.
F—Bush.
G—Engagement spring.
H—Operating bush.
I—Driving sleeve.

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REASSEMBLY

After cleaning all parts, reassembly of the starting motor is a reversal of the dismantling procedure given on page PY.s.20 but the following special points should be noted:—

- (i) The following parts should be tightened to the maximum torques indicated:—

Nuts on solenoid copper terminals	20 lb./in. (0.23 kgm.)
Solenoid fixing bolts	4.5 lb./ft. (0.62 kgm.)
Starting motor through bolts	8.0 lb./ft. (0.83 kgm.)

- (ii) When refitting the C.E. bracket see that the moulded brake shoes seat squarely and then turn them so that the ends of the cross peg in the armature shaft engage correctly with the slots in the shoes.

Setting Pinion Movement (Fig. 10)

Connect the solenoid Lucar terminal to a 6-volt supply. **DO NOT** use a 12-volt battery otherwise the armature will turn.

Connect the other side of the supply to the motor casing (this throws the drive assembly forward into the engage position).

Measure the distance between the pinion and the thrust washer on the armature shaft extension. Make this measurement with the pinion pressed **lightly** towards the armature.

For correct setting the dimension should be 0.005" to 0.015" (0.13 to 0.38 mm.).

Disconnect the battery.

Adjust the setting by slackening the eccentric pivot pin securing nut and turning the pin until the correct setting is obtained.

Note: The head of the arrow stamped on the end of the eccentric pivot pin should be set only between the ends of the arrows cast in the drive end bracket.

Turning the screw to the left (anti-clockwise) will increase the gap between the pinion and the thrust washer, turning to the right (clockwise) will decrease the gap.

Reconnect the battery and recheck the setting.

After setting tighten the securing nut to retain the pin position.

CHECKING OPENING AND CLOSING OF STARTER SWITCH CONTACTS

The following checks assume that pinion travel has been correctly set.

Remove the copper link connecting solenoid terminal STA with the starting motor terminal.

Connect, through a switch, a supply of 10 volts d.c., to the series winding, that is, connecting between the solenoid Lucar terminal and large terminal STA. **DO NOT CLOSE THE SWITCH AT THIS STAGE,**

Connect a separately energised test lamp circuit across the solenoid main terminals.

Insert a stop in the drive end bracket to restrict the pinion travel to that of the out of mesh clearance, normally a nominal $\frac{1}{8}$ " (3.17 mm.). An open-ended spanner or spanners of appropriate size and thickness can often be utilised for this purpose, its jaws embracing the armature shaft extension.

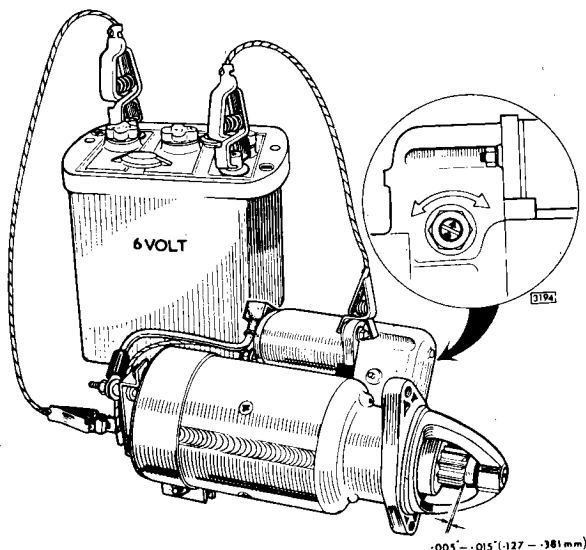


Fig. 20. Setting pinion movement.

ELECTRICAL AND INSTRUMENTS

WINDSCREEN WIPER

(LUCAS MODEL 15W)

DESCRIPTION

The windscreen wiper assembly consists of a two-speed motor coupled by connecting rods to three wiper arm spindle bearings (Open Sports and F.H.C.) or two spindles (2+2).

Windshield wiper motor model 15W is designed to operate a link-type wiper installation. The motor is self-switching to the OFF (or park) position. A two-pole permanent magnet field is provided by two ceramic magnets which form part of the yoke assembly. Inside the motor gearbox a worm gear on the armature shaft drives a shaft-and-gear assembly comprising a moulded gearwheel assembled to a location-plate-and-shaft. Power from the motor is transmitted through the gearwheel, location-plate-and-shaft to, finally, a rotary link which serves as a coupling between the motor and the links which operate the wiper arm spindles.

Associated with the terminal assembly is a two-stage plunger operated limit switch. The plunger is actuated by a cam on the underside of the moulded gearwheel inside the gearbox. When the manually-operated control switch is moved to OFF (or park) the motor continues to operate under the automatic control of the limit switch. As the wiper blades near the parked position the first-stage contacts open and the motor is switched off but continues to rotate under its own momentum. The second-stage contacts, to which are connected the positive and negative brushes, then close and regenerative braking of the armature takes place to maintain consistent parking of the blades.

Two-speed operation is provided by a third (stepped) brush incorporated in the brushgear assembly. When the main control switch is moved to the high speed position, the positive feed to the normal brush is transferred to the third brush, and a higher-than-normal wiping speed is obtained. (The higher speed should not be used in heavy snow or on a partially wet windshield).

The blades and arms fitted to the two models are of different lengths and are individually cranked for Right-hand and Left-hand drive cars.

Note: The wiper blades are manufactured with special anti-smear properties. Renew only with genuine Jaguar replacement parts.

Energise the shunt winding with a 10-volt d.c., supply and then close the switch in the series winding circuit.

The solenoid contacts should close fully and remain closed, as indicated by the test lamp being switched on and emitting a steady light.

Switch off and remove the stop.

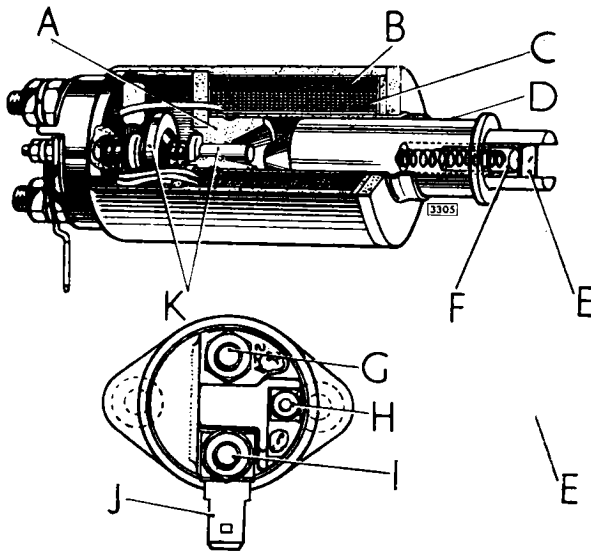


Fig. 11. Checking the opening and closing of the starter switch contacts.

- A—Core.
- B—Shunt winding.
- C—Series winding.
- D—Plunger.
- E—Clevis pin.
- F—"Lost motion" device.
- G—Starter terminal.
- H—Solenoid terminal.
- I—Battery terminal.
- J—Accessories terminal.
- K—Spindle and moving contact assembly.

Switch on again and hold the pinion assembly in the fully engaged position.

Switch off and observe the test lamp.

The solenoid contacts should open, as indicated by the test lamp being switched off.

ELECTRICAL AND INSTRUMENTS

4.2 'E' Type RHD 10½" (R.H. crank) 12"
LHD 10½" (L.H. crank) 12"

SERVICING

Note: Since the motor is of permanent magnet design, the direction of rotation of the armature depends on the polarity of the supply of its terminals. If it is necessary to run the motor while it is removed from the vehicle, the negative supply cable must be connected to motor terminal number 1 and the positive supply cable to terminal number 5 for normal speed or terminal number 3 for high speed (see Fig. 23).

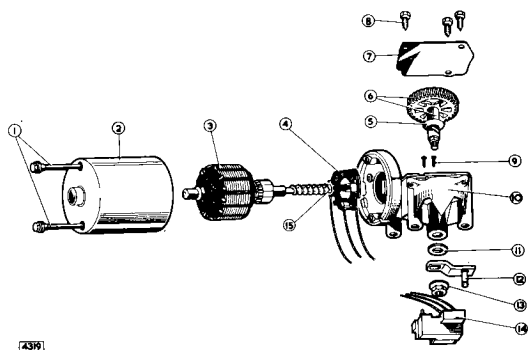


Fig. 22. Exploded view of the 15W windscreen wiper motor.

- 1—Yoke fixing bolts.
- 2—Yoke assembly comprising two permanent-magnet poles and retaining clips and armature bearing bush.
- 3—Armature.
- 4—Brushgear, comprising insulating plate and brushboxes, brushes, springs and fixing bolts.
- 5—'Dished' washer.
- 6—Shaft and gear.
- 7—Gearbox cover.
- 8—Cover fixing screws.
- 9—Limit switch fixing screws.
- 10—Gearbox.
- 11—Flat washer.
- 12—Rotary link.
- 13—Link fixing nut.
- 14—Limit switch assembly.
- 15—Nylon thrust cap.

MAINTENANCE

All bearings are adequately lubricated during manufacture and require no maintenance.

Oil, tar spots or similar deposits should be removed from the windshield with methylated spirits (denatured alcohol). Silicone or wax polishes must not be used for this purpose.

Efficient wiping is dependent upon keeping wiper blades in good condition. Worn or perished blades are easily removed for replacement.

DATA

MOTOR

(i) Typical light running current (i.e. with the rotary link disconnected from the transmission) after 60 seconds from cold:	1.5 amp. (normal speed)
	2.0 amp. (high speed)

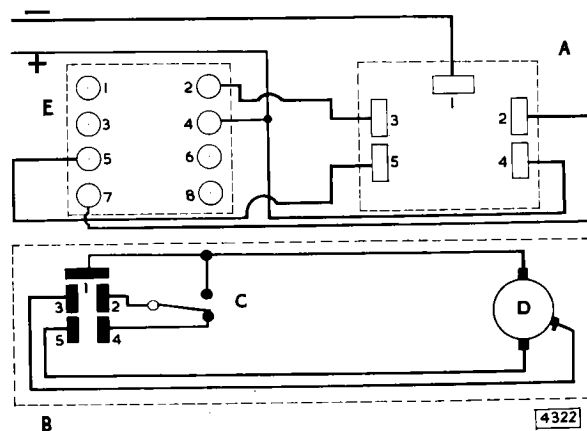


Fig. 23. 15W Wiper wiring diagram.

- A—Moulded terminal connector on cable harness.
B—Terminal connector on wiper motor.
C—Limit switch.
D—Armature.
E—152 SA switch.
Switch internal connections.

OFF
(5-7)

NORMAL SPEED
(4-5)

HIGH SPEED
(2-4)

ELECTRICAL AND INSTRUMENTS

Systematic Check of Faulty Wiping Equipment

Unsatisfactory operation (if the supply voltage to the motor is adequate) may be caused by a fault that is mechanical or electrical in origin. Before resorting to dismantling, consideration should be given to the nature of the fault.

The symptoms and remedial procedure associated with the more common causes of wiper failure (or poor performance) are described in (i) and (ii) below.

(i) Frictional Wiper Blades

Excessive friction between apparently satisfactory wiper blades and the windshield may result in a marked reduction in wiping speed when the blades are operating on a windshield that is only partially wet. A further symptom is that the blades become noisy at each end of the wiping arc. When possible, the blades should be temporarily replaced with a pair known to be in good condition. If this rectifies the fault, fit new blades.

(ii) Low Wiping Speed or Irregular Movement of the Blades

To determine whether a low wiping speed is due to excessive mechanical loading or to poor motor performance, the rotary link must first be disconnected from the transmission linkage and the light running current and speed of the motor can then be checked under no load conditions.

Measuring Light Running Current and Speed

Connect a first-grade moving coil ammeter in series with the motor supply cable and measure the current consumption. Also check the operating speed by timing the speed of rotation of the rotary link or moulded gearwheel. The current consumption and speed are given in Data.

If the motor does not run, or current consumption and speed are not as stated, an internal fault in the motor is indicated and a replacement unit should be fitted or the motor removed for detailed examination.

If current consumption and speed are correct, check for proper functioning of the transmission linkage and wiper arm spindles.

Removal

4.2 litre Open Sports and F.H.C.

Disconnect the battery.

Remove the two thumbscrews and lower the instrument panel.

Remove two drive screws and detach the hazard warning unit carrier plate. Disconnect the drive link from the ball joint on the centre wheelbox.

Remove the P.V.C. cable strap from the body of the windscreen wiper motor and disconnect the cables by withdrawing the cable plug from the socket.

Mark the position of the throttle fulcrum lever bracket relative to the bulkhead, remove two setscrews, and detach the bracket. It is not necessary to disconnect the throttle control pads.

Remove four setscrews securing the motor mounting plate to the bulkhead and withdraw the motor with the attached drive link.

4.2 litre 2 + 2

Disconnect the battery.

Remove the top facia panel as detailed in Body and Exhaust System—Section N, page NY.s.1.

Disconnect the motor drive link from the ball joint on the L/H wheel box.

Remove the cable strap and plug as detailed above.

Remove the setscrews securing the mounting plate to the bulkhead and withdraw the motor.

Dismantling

Remove the gearbox cover.

The rotary link may be fitted to the gearwheel shaft in one of two positions (180° apart) depending on the parking requirement of the windshield installation. To ensure that the original parking position is maintained, the position of the rotary link in relation to the zero mark on the gearwheel location plate must be noted before removing the link.

Important: The moulded gearwheel inside the gearbox must be prevented from moving while the rotary link fixing nut is slackened (or, on reassembly, tightened). This is most easily achieved by securing the rotary link in a vice while the nut is turned.

Remove the fixing nut and withdraw the rotary link and flat washer.

Remove the shaft-and-gear from the gearbox, taking care not to lose the dished washer fitted beneath the gearwheel. It is not normally necessary to dismantle the shaft-and-gear assembly since this is serviced only in an assembled condition. However, should it become necessary to assemble the moulded gearwheel

ELECTRICAL AND INSTRUMENTS

to the location-plate-and-shaft, it is essential to fit the gear wheel in the correct one of the two alternative positions to maintain the original parking position of the wiper blades. The gearwheel is correctly fitted to the location-plate-and-shaft when the 'zero' mark on the location plate is positioned furthest away from the gearwheel cam.

Unscrew and remove the two fixing bolts from the motor yoke and carefully remove the yoke assembly and armature. While removed, the yoke must be kept well clear of swarf, etc., which may otherwise be attracted to the pole pieces.

Undo the two sets of fixing screws and remove from the gearbox the brushgear and the terminal and switch unit assemblies, linked together by the connecting cables.

Bench Inspection

After dismantling, examine individual items.

(i) Brush replacement

The original specified length of the brushes is sufficient to last the life of the motor. If, due to accidental damage to the brushes, or faulty commutator action, it becomes necessary to renew the brushes, the complete brushgear service-assembly must be fitted. The brushgear assembly must be renewed if the main (diametrically-opposed) brushes are worn to $\frac{3}{16}$ in. (4.8 mm.), or if the narrow section of the third brush is worn to the full width of the brush. Check that the brushes move freely in the boxes.

(ii) Check Brush Springs

The design of the brushgear does not allow for easy removal of the brush springs. This is due to the fact that, similar to the brushes, the springs are expected to last the life of the motor and should not normally require renewing. In the unlikely event of the spring pressure failing to meet the specified requirements, the complete brushgear service-assembly must be renewed in a similar manner to that necessary for servicing the brushes.

Note the location of the cables before unsoldering for reference when refitting.

To check the spring pressure on the end face of the brush with a push-type spring gauge push until the bottom of the brush is level with the bottom of the slot in the brush box, when the spring pressure reading should be 5-7 oz.f. (140-200 gf).

(iii) Testing and Servicing the Armature

Use armature testing equipment to check the armature windings for open and short circuits. Test the insulation by using a mains test lamp (Fig. 24). Lighting of the lamp indicates faulty insulation.

If the commutator is worn, it can be lightly skimmed while the armature is mounted in a lathe.

Afterwards, clear the inter-segment spaces of copper swarf.

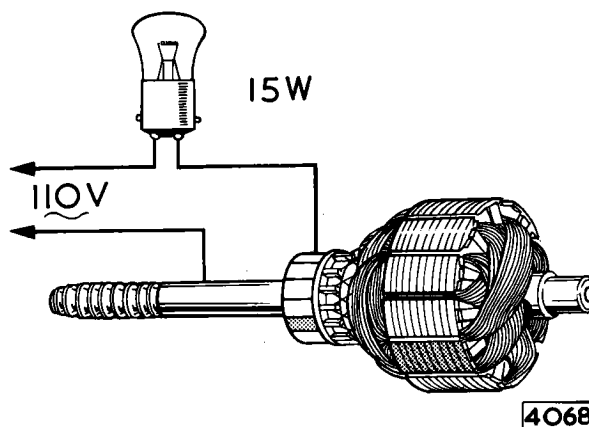


Fig. 24. Armature insulation test.

(iv) Inspection of Moulded Gear

Examine the gearwheel, especially the teeth, for signs of wear or damage. If the gearwheel needs renewing, a shaft-and-gear service replacement assembly will have to be fitted.

Re-assembly

Reassembly is the reverse of the dismantling procedure.

A liberal quantity of Ragosine Listate grease is necessary for lubrication of the gearwheel teeth, the gearwheel cam and the worm gear on the armature shaft. The total quantity of grease must not be less than 15 cc.

Apply Shell Turbo 41 oil to the bearing bushes, armature shaft bearing surfaces (sparingly), gearwheel shaft, and the felt-oiler washer in the yoke bearing (thoroughly soak).

ELECTRICAL AND INSTRUMENTS

Reassembly of Yoke

Before refitting the armature to the yoke, inspect the inside of the yoke and ensure that the thrust disc and the felt-oiler washer are in place in the yoke bearing.

The correct method of assembly is with the thrust disc flat against the end face of the bearing, followed by the felt-oiler washer which must have a hole in the centre to allow the captive ball bearing in the end of the armature shaft to contact the thrust disc.

If the felt-oiler is renewed, check that the replacement is provided with the necessary hole and, if not, make a $\frac{1}{8}$ " (3 mm.) diameter hole in the centre of the felt. (A felt-oiler without a hole could result in the armature end-float becoming excessive in service due to the ball bearing wearing away the felt after the end-float adjustment has been made). Soak the felt-oiler in Shell Turbo 41 oil.

The yoke fixing bolts should be tightened to a torque of 12–16 lb in. (0.138–0.184 kg.m.). If a service replacement armature is being fitted, it is advisable to first slacken the armature end-float thrust screw before tightening the yoke fixing bolts. Afterwards, reset the thrust screw.

Armature End-Float Adjustment

Armature end-float is 0.002–0.008" (0.05–0.2 mm.).

To obtain a satisfactory end-float adjustment with the motor and gearbox completely assembled, position the unit with the thrust screw uppermost, tighten the thrust screw until abutment takes place and then slacken it off one quarter turn and secure it in this position by tightening the locknut.

WINDSCREEN WIPER SPINDLE HOUSINGS

2+2 Models

Removal

Disconnect the battery. Remove both windscreen wiper arms.

Lower the instrument panel and remove the screen rail facia assembly. Disconnect the motor link rod from the ball joint on the left-hand spindle lever.

Unscrew the large nuts securing the housings to the scuttle and remove the distance pieces and rubber seal washers. Withdraw the twin spindle and carrier plate assembly through the scuttle panel and complete the removal through the left-hand aperture in the bulkhead inner panel.

Housings are replaceable only as a complete assembly comprising both housings and carrier plate.

Open Sports and F.H.C. Models

Removal (Right or Left Hand Housing)

Disconnect the battery.

Withdraw the wiper arm from the spindle housing to be removed. Unscrew the large nut securing the housing to the scuttle and remove the distance piece and rubber seal washer.

Lower the instrument panel after removing the two retaining screws in the top corners. Remove the four nuts and washers retaining the screen rail facia assembly. Two are accessible from the centre aperture and one each at the outer edges below the screen rail.

Disconnect the ball joint from the spindle lever.

From inside the car remove two nuts and washers securing the housing bracket to the base plate and withdraw the housing.

Removal (Central Housing)

Disconnect the battery. Remove all wiper arms from the spindles.

Lower the instrument panel, remove the screen rail facia and outer housings as detailed previously.

Remove the large nut, distance piece and rubber seal washer from the central housing. Withdraw the housing and carrier plate assembly through the scuttle panel and complete the removal through the left-hand aperture in the bulkhead inner panel.

WIPER MOTOR LINKAGE SETTING (2+2 cars)

It is essential that the wiper motor primary linkage (motor to wheelbox) is adjusted as detailed below if the link length is altered from the original dimension or, if a new link is fitted. Failure to carry out these instructions will result in a knock when the wiper arms are operating.

R.H.D. Cars

Disconnect the primary link (motor to wheelbox) from the ball joint on the wheelbox spindle.

Manually operate the non-adjustable link, connecting the two wiper spindles, to the extreme left position.

Adjust the ball joint socket on the link until it fits on the ball whilst maintaining the position of the lever to the left.

Disconnect the socket and turn to the **right (clockwise) four complete** turns, i.e. shorten the length of the rod between the socket and the motor.

Refit the socket on the ball and secure with the locknut.

L.H.D. Cars

Proceed as for R.H.D. cars, but for the following exceptions.

Manually operate the non-adjustable link to the extreme right and after adjustment turn the ball socket four complete turns to the left (anti-clockwise) to increase the length of the rod.

ELECTRICAL AND INSTRUMENTS

THE INSTRUMENTS

ELECTRIC CLOCK

Description

The electric clock, fitted in the centre of the instrument panel, is a fully transistorised instrument powered by a mercury cell housed in a plastic holder attached to the back of the clock.

Frontal adjustment is provided by means of a small knurled knob for setting the hands and a slotted screw for time-keeping regulation.

To reset the hands, pull out the knurled knob, rotate and release.

To regulate the time-keeping, turn the slotted screw with a small screwdriver towards the positive (+) sign if gaining, and towards the minus (—) sign if losing.

Moving the indicator scale through one division will alter the time-keeping by five minutes per week.

The action of resetting the hands automatically restarts the movement.

The window of the clock is a plastic moulding, and should only be cleaned with a cloth or chamois leather slightly dampened with water. Oil, petrol or other fluids associated with cleaning, are harmful and must not be used.

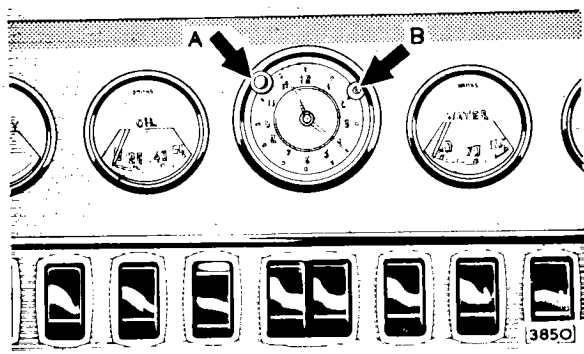


Fig. 25. Clock controls.

A — Handsetting. B — Time regulator.

MAINTENANCE

The mercury cell life is in the region of 18 months, throughout which it ensures a steady and continuous voltage to the clock.

Renew the cell at this period to maintain perfect time-keeping.

Battery Replacement

Remove the instrument panel retaining screws and lower the panel.

Lever the battery out of the holder and discard.

Press the new battery into the holder.

Refit the panel.

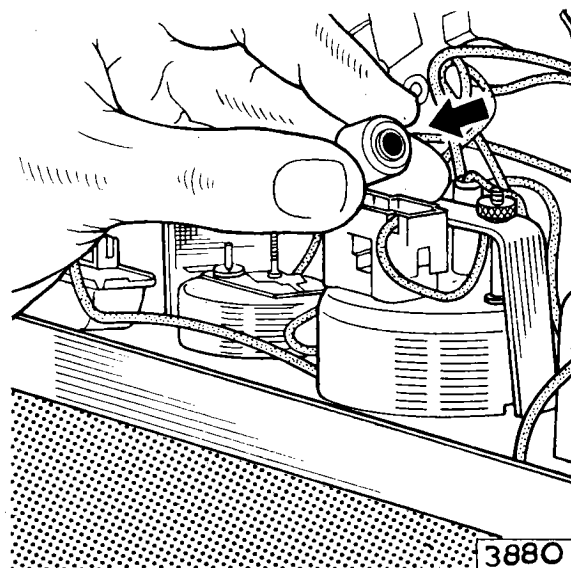


Fig. 26. Renewing the electric clock battery.

Clock—Removal

Lower the instrument panel.

Withdraw the illumination bulb holder from the back of the clock.

Remove the two nuts and the clamp strap from the back of the clock.

Withdraw the clock, complete with the battery holder, from the instrument panel.

Refitting

Refitting is the reverse of the removal procedure.

THE REVOLUTION COUNTER (TACHOMETER)

Description

The revolution counter is an impulse tachometer instrument incorporating transistors and a printed

ELECTRICAL AND INSTRUMENTS

circuit, the pulse lead (coloured WHITE) being wired in circuit with the S/W terminal on the ignition coil and the ignition switch.

Mechanical drive cables or an engine-driven generator are not required with this type of instrument.

The performance of this instrument is not affected by the distributor contact setting, by corrosion of the sparking plug points, or by differences in the gap settings.

Connection to the back of the instrument is by means of a locked plug and socket, the contacts being offset to prevent incorrect coupling.

Removal

Disconnect the battery.

Remove the screen rail facia assembly as detailed on Page NY.s.1 to gain access to the instrument.

Remove the two knurled nuts, earth lead and instrument retaining pieces.

Withdraw the tachometer from the facia panel and remove the illumination bulb holders.

Disconnect the plug and socket as follows:—

Pinch together the prongs of the plastic retaining clip and withdraw from the plug and socket assembly (Fig. 27).

Detach the plug from the socket and complete the removal of the instrument.

IMPORTANT

Do not detach the green and white cables connected to the plug and the instrument.

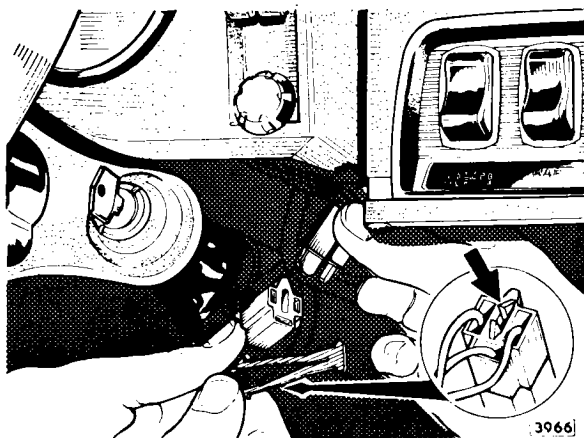


Fig. 27. The tachometer plug and socket assembly.
(Inset shows the clip in its fitted position).

Refitting

Refitting is the reverse of the removal procedure.

Reconnect the plug and socket assembly and lock with the retaining clip.

THE INSTRUMENT PANEL

The instrument panel differs from that fitted to all previous cars in respect of the following items:—

- (1) Rocker Switches—Replacing tumbler switches.
- (2) Battery Indicator—Replacing Ammeter.
- (3) Panel Light Dimming Resistance—Replacing resistance previously attached to the panel light switch.
- (4) The combined Ignition/starter switch which is now mounted on a separate sub-panel. These switches were previously two separate items mounted in the instrument panel.
- (5) The Cigar Lighter—Now located in the console below the instrument panel, was previously part of the instrument panel assembly.

THE SWITCHES

The rocker switches are mounted in a sub-panel which is attached to the instrument panel by four self-tapping screws.

Individual switches may be removed without detaching the sub-panel cluster as follows:—

Removal

Disconnect the battery.

Lower the instrument panel.

Remove the cables from the switch, noting location for reference when refitting.

Press in the two locking tabs located at the bottom and the top faces of the switch body and push the switch through the aperture.

Refitting

Press the switch into the panel aperture until the nylon locking tabs register.

Reconnect the cables as noted on removal.

ELECTRICAL AND INSTRUMENTS

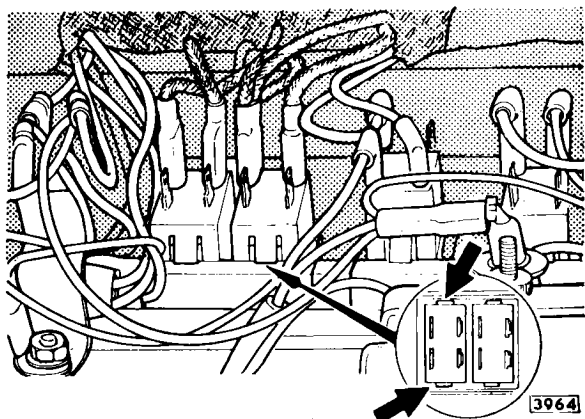


Fig. 28. Instrument panel rocker switch removal
(Inset shows arrowed the nylon locking tabs).

THE IGNITION/STARTER SWITCH

A Lucas 47SA combined ignition/starter switch replaces the separate switches previously used.

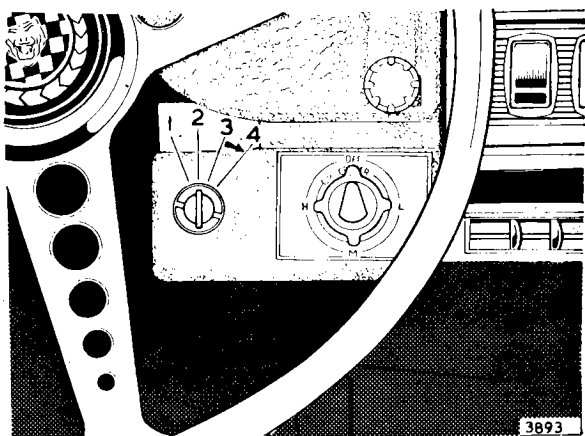


Fig. 29. The ignition/starter switch location when air-conditioning system is fitted.

1 — Auxiliaries. 2 — Ignition "OFF"
3 — Ignition "ON". 4 — Starter.

The switch is mounted on a bracket attached to the steering column (if Air-conditioning equipment is installed the bracket is attached to the evaporator unit).

In conjunction with the 47SA ignition/starter switch a Lucas 6RA relay is included in the alternator circuit. This functions as a field isolating relay, the relay coil being energised by operation of the ignition switch.

Removal

Remove the locking ring and withdraw the switch through the bracket with the brass locknut and wave washer.

Disconnect the cables and remove the switch. Note the location of the cables for reference when refitting.

The lock barrel can be withdrawn by inserting a thin rod through a hole in the body of the switch and depressing the plunger in the lock. Insert the key and turn to the 'OFF' position to gain access to the plunger.

Refitting

Refitting is the reverse of the removal procedure.

When refitting a new lock barrel, check that the number on the face of the barrel and the key is the same as that on the barrel removed. This will be identical to the door locks.

Insert the key in the lock and turn the switch to the 'OFF' position before inserting the barrel.

PANEL LIGHT DIMMING RESISTOR

The resistor unit is comprised of a wire resistance attached to two 'Lucar' cable contact blades mounted on an insulating carrier plate.

The plate is secured to two studs on the back face of the instrument panel by means of distances peices, nuts and lockwashers.

Excessive force should not be used when connecting the cable terminals to the blades.

This may force the blade retaining tongues through the insulating plate and allow the resistor to make contact with the metal face of the panel, resulting in a short circuit in the side light feed line.

BATTERY INDICATOR

This instrument is a voltmeter with a specially calibrated dial which indicates the condition of the battery. It does not register the charging rate of the alternator.

The position of the needle with a charged battery will be within the area marked 'Normal'.

Removal

Disconnect the battery and lower the instrument panel.

Disconnect the cables, noting the location for reference when refitting.

Detach the illumination bulb holder.

Remove two nuts and clamp strap and withdraw the instrument forward through the panel.

Refitting

Refitting is the reverse of the removal procedure.

ELECTRICAL AND INSTRUMENTS

Check the condition of the battery by means of the panel shown below

RED (Off Charge)		NORMAL			RED (On Charge)
BATTERY CHARGE EXTREMELY LOW	BATTERY CHARGE LOW	WELL CHARGED BATTERY	CHARGING VOLTAGE LOW	CHARGING VOLTAGE SATISFACTORY	CHARGING VOLTAGE TOO HIGH
If with the ignition and electrical equipment e.g. headlamps etc., switched on, but with the engine not running the indicator settles in this section—your battery requires attention.		Ideally the indicator should settle in this section when the ignition and electrical equipment e.g. headlamps etc., are switched on and the engine is not running.	This condition may be indicated when the headlights and other equipment are in use.	The indicator should point to this section when the engine is running above idle.	If the indicator continues to point to this section after 10 minutes running either your voltage regulator requires adjustment or some other fault has developed.

IMPORTANT All readings on the indicator should be ignored when the engine is idling, since readings may vary at very slow engine speeds due solely to operation of the voltage regulator.

OFF CHARGE

This means more energy is being used from your battery than is being replaced by the alternator on your car. This condition is satisfactory provided it does not persist for long periods, when the engine is running above idle or at speed. If the indicator remains in the section, it may mean that you have a broken or slipping fan belt, a faulty alternator, a badly adjusted voltage regulator or some other fault:

ON CHARGE

This means your battery is having more energy put into it than is being taken out of it. In the ordinary way this condition predominates and your battery is continuously being recharged by the alternator whenever the engine is running above idle. If however the engine is continually running slowly as may be the case in traffic—or when, in winter, lights and cold starting make extra demands on the battery—you may find the rate of discharge exceeds the rate of charge—that is to say the battery is running down, as will be indicated on your Battery Condition Indicator and you may need an extra charge if "battery charge low or extremely low" is indicated by the instrument.

LAMPS

HEADLAMP

Scaled beam units are fitted to all cars with the exception of certain European Countries which retain the pre-focus bulb (see Bulb Data Chart).

The beam setting and unit replacement instructions differ from those stated on Page P.24 as follows:—

Beam Setting

If beam setting adjustment is required, prise off the headlamp rim (retained by spring clips). Switch on the headlamps and check that they are on Main beam.

The setting of the beams is controlled by two screws A' and 'B' on Fig. 30.

The top screw 'A' is for vertical adjustment, i.e. to raise or lower the beam; turn the screw anti-clockwise to lower the beam or clockwise to raise the beam.

The side screw 'B' is for horizontal adjustment, i.e. to turn the beam to right or left. To move the beam to the right, turn the screw clockwise. To move the beam to the left, turn the screw anticlockwise.

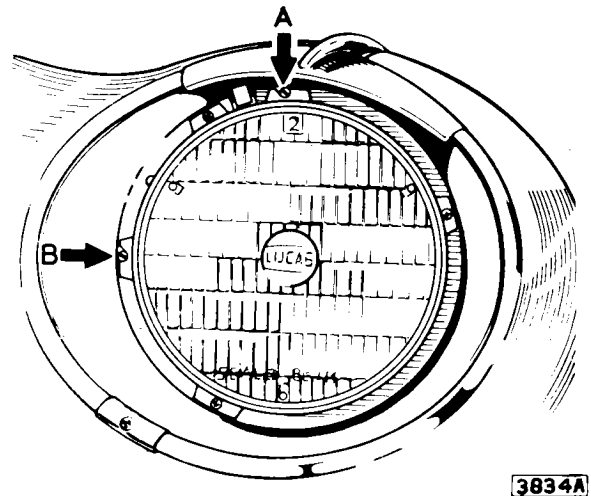


Fig. 30. Adjustment of the screw 'A' will alter the headlamp beams in the vertical plane; adjustment of the screw 'B' will alter the headlamp beams in the horizontal plane.

ELECTRICAL AND INSTRUMENTS

Sealed Beam Unit — Replacement

Prise off the headlamp rim (retained by spring clips).

Remove the three cross-headed screws and detach the retaining ring.

Note: Do not disturb the two beam setting screws.

Withdraw the sealed beam unit and unplug the adaptor.

Replace the sealed beam unit with one of the correct type (see 'Lamp Bulbs').

On cars fitted with bulb light units, proceed as directed above until the unit is removed. Release the bulb retaining clips and withdraw the bulb. Replace with a bulb of the correct type (see 'Lamp Bulbs').

When reassembling, note the groove in the bulb plate which must register with the raised portion on the bulb retainer.

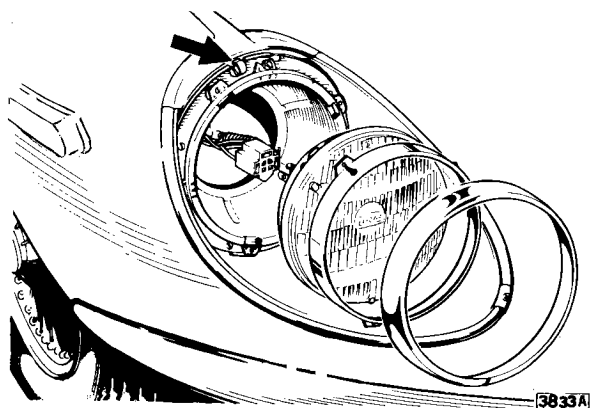


Fig. 31. Headlamp sealed beam unit removal. The arrow indicates one of the spring clips retaining the rim.

SIDE LAMP BULB—REPLACEMENT

Remove three screws and detach the lens. Remove the bulb by pressing inwards and rotating outwards. Check the condition of the lens seal when refitting.

On cars for certain European countries the side lamp bulb is mounted in the headlight unit and is accessible after removing the light unit as detailed under 'Headlamps'.

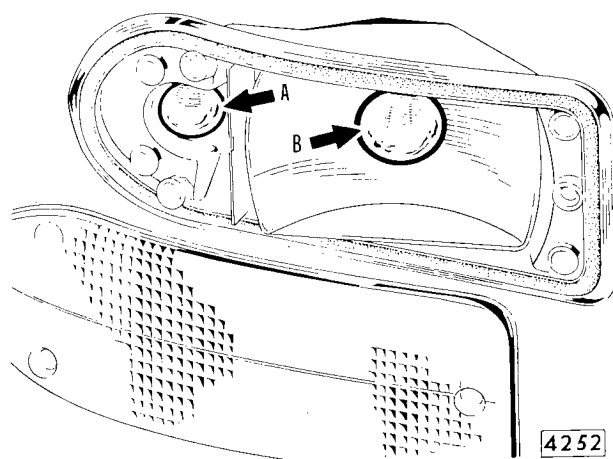


Fig. 32. A—Side lamp bulb.
B—Flasher bulb.

FRONT FLASHER BULB—REPLACEMENT

Proceed as detailed for 'Side Lamp Bulb'.

REAR/BRAKE LIGHT BULB—REPLACEMENT

Remove the four screws and detach the glass. The rear/braking light bulb is the lower one of the two exposed and is removed by pressing inwards and rotating anti-clockwise. When refitting a replacement bulb note that the pins are offset.

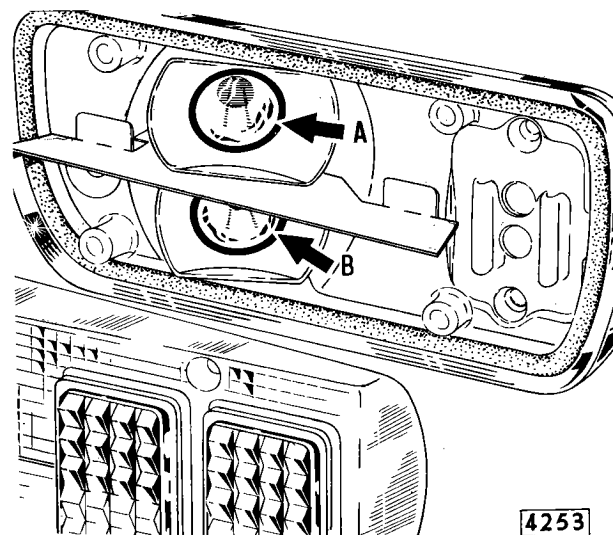


Fig. 33. A—Rear flasher bulb.
B—Rear/Brake bulb.

ELECTRICAL AND INSTRUMENTS

REAR FLASHER BULB—REPLACEMENT

Proceed as detailed for 'Rear/Brake Light Bulb—Replacement.' The flasher bulb is the top one of the two exposed.

INTERIOR LIGHT BULB—REPLACEMENT

(2+2).

Release the spring side clip and withdraw the retaining tongue on the glass cover from the slot in the lamp base. Remove the faulty bulb and replace with one of the correct value.

When refitting ensure that the retaining tongue is inserted in the slot in the base before locking into position.

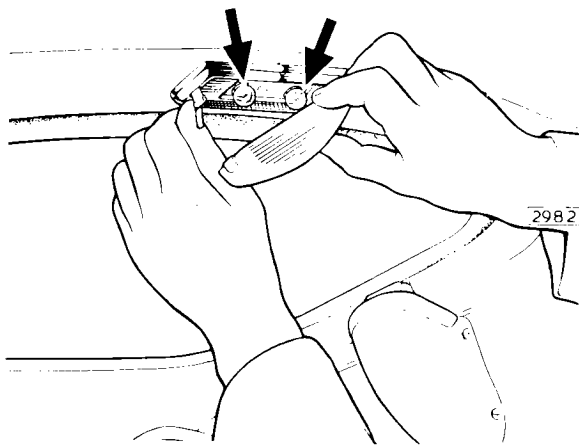


Fig. 34. Interior lamp bulb removal (2+2).

INTERIOR/LUGGAGE LIGHT BULB—REPLACEMENT (Open 2 seater)

Proceed as detailed in the 3.8 'E' type Service Manual—page P.26.

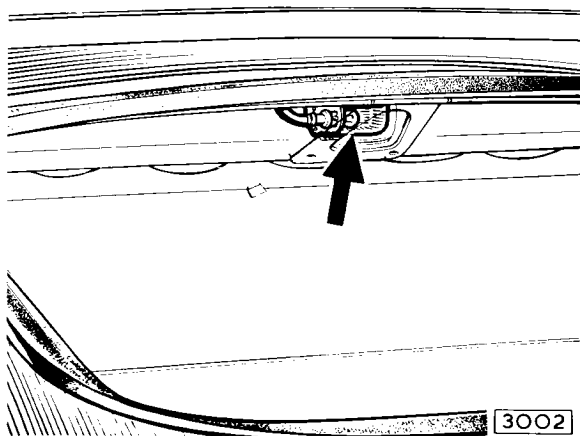


Fig. 35. Interior lamp bulb removal (open 2 seater).

NUMBER PLATE LAMP BULB—REPLACEMENT

Remove two screws and detach the glass and rim. Replace the faulty bulb with one of the correct value. Check the condition of the seal before refitting.

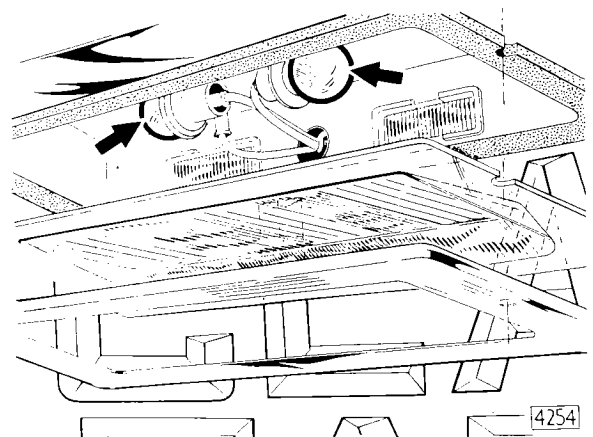


Fig. 36. Number plate lamp bulb removal.

REVERSE LAMP BULB—REPLACEMENT

Remove the two retaining screws and detach the lamp glass. Lift the upper contact and withdraw the bulb. Check the condition of the lens seal before refitting.

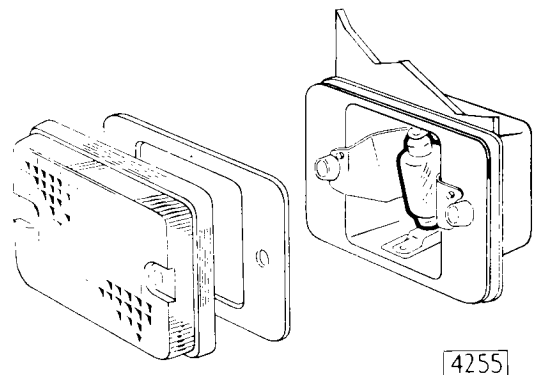


Fig. 37. Reverse lamp bulb removal.

ELECTRICAL AND INSTRUMENTS

TRAFFIC HAZARD INDICATOR BULB—REPLACEMENT

Remove the chrome bezel and unscrew the bulb from the holder.

HEATED BACK LIGHT INDICATOR BULB—REPLACEMENT

Proceed as detailed under 'Traffic Hazard Indicator Bulb'.

AUTOMATIC TRANSMISSION INDICATOR BULB—REPLACEMENT

Remove the drive screws, detach the arm rest and transmission unit cover.

Unscrew the gear control knob. Withdraw two screws and remove the gear indicator cover. Replace the bulb with one of the same value (24 volts).

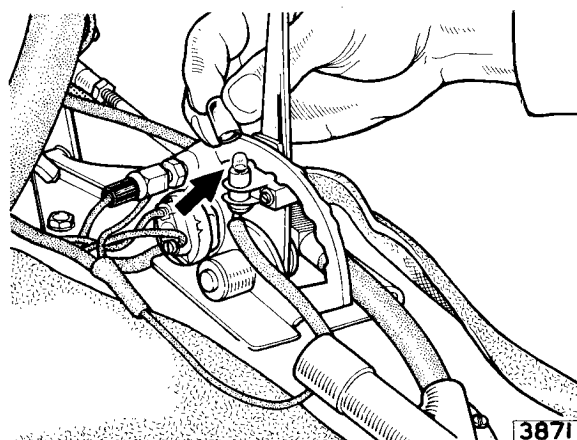


Fig. 38. Automatic transmission indicator bulb removal.

HORNS—MODEL 9H

DESCRIPTION

The horns are mounted on brackets attached to the sub-frame lower cross-member.

The horns are now mounted on brackets attached to the sub-frame lower cross-member.

The horn circuit operates through a Lucas 6RA relay, the contacts C1 and C2 closing when the relay coil is energised by depressing the horn switch button located in the direction (turn) indicator switch lever.

Maintenance

In the event of the horns failing to sound or performance becoming uncertain, check before making adjustments that the fault is not due to external causes.

Check as follows and rectify as necessary:

- (i) Battery condition.
- (ii) Loose or broken connections in the horn circuit.
- (iii) Loose fixing bolts. It is important to keep the horn mountings tight and to maintain rigid the mounting of any unit fitted near the horns.
- (iv) Faulty relay. Check by substitution after verifying that current is available at terminal C2 (cable colour—brown/purple) and terminal W1 (cable colour—Green).
- (v) Check that fuse No. 3 (50 amperes) and fuse No. 6 (35 amperes) have not blown.

Note: Horns will not operate unless the ignition is switched on.

Adjustment

As the horns cannot conveniently be adjusted in position, remove and mount securely on a test fixture.

A small serrated adjusting screw located adjacent to the horn terminal is provided to take up wear of moving parts in the horn. Turning this screw does not alter the pitch of the horn note.

Connect a moving coil ammeter in series with the horn supply feed. The ammeter should be protected from overload by connecting an ON-OFF switch in parallel with its terminals.

Keep this switch ON except when taking readings, that is when the horn is sounding.

Turn the screw clockwise until the horn operates within the specified limits of 6.5-7.0 amperes.

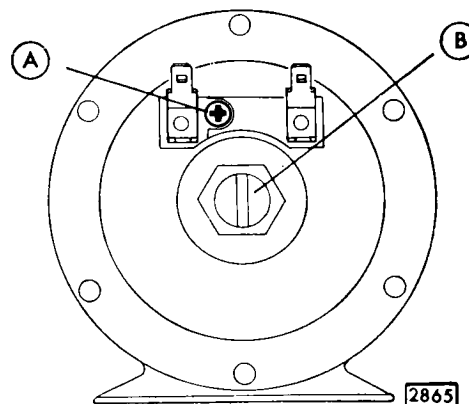


Fig. 39. The Lucas 9H horn.

A — Contact breaker adjustment screw.
B — Slotted centre core (Do not disturb).

ELECTRICAL AND INSTRUMENTS

Service Replacements

When fitting replacement horns it is essential that the following procedure be carried out:—

- (i) Refit the lockwashers in their correct positions, one at each side of the mounting bracket centre fixing.
- (ii) Ensure, after positioning the horn, that the $\frac{5}{16}$ " centre fixing bolt is secure but not over-tightened. Over-tightening of this bolt will damage the horn.
- (iii) Ensure that, when a centre fixing bolt or washers other than the originals are used, the bolt is not screwed into the horn to a depth greater than $\frac{1}{16}$ " (17.5 mm).

Muted Horns (Holland only)

These horns are muted to comply with the Dutch Traffic Regulations and incorporate a rubber plug inserted in the trumpet.

Horn Relay—Checking

If the horn relay is suspected, check for fault by substitution or by the following method:—

- (i) Check that fuses No. 3 and No. 6 have not blown. Replace if necessary.
- (ii) Check with a test lamp that current is present at the relay terminal W1 (Green) and C2 (Brown/Purple). Switch on the ignition before checking terminal W1.

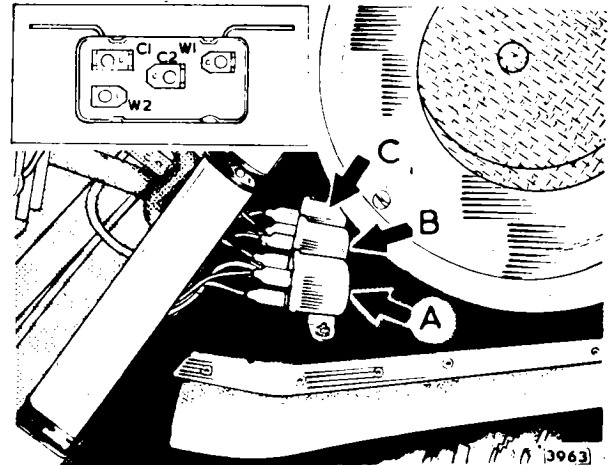


Fig. 40. Location of horn and alternator relays.

A — Horn relay.
B — Alternator/Ignition relay.
C — Air conditioning equipment relay (when fitted).
(Inset shows the connections).

- (iii) Remove the cable from terminal W2 (Purple/Black) and earth the terminal to a clean part of the frame. The relay coils should now operate and close the contacts.

Reconnect cable.

- (iv) Remove cable from terminal C2 (Brown/Purple). Check for continuity by means of an earthed test lamp. Check with the horn button depressed and the ignition 'ON'. Replace the relay if faulty.

RADIATOR COOLING FANS

Twin electrically motor driven cooling fans are fitted, automatic operation being controlled by a thermostat switch mounted in the radiator header tank.

A Lucas 6RA relay is incorporated in the circuit to prevent over-loading the thermostat switch contacts.

When air-conditioning is fitted a second relay is also included to over-ride the thermostat switch when the car is stationary and the air-conditioning system is working.

THERMOSTAT

Checking

Check by substitution or by the following test procedure:—

Drain off sufficient water from the radiator and remove the switch from the header tank.

Wire the switch in series with a 12 volt battery and a 1.5 watt bulb and suspend in water with a thermo-

meter.

Heat the water and note the temperature at which the contacts close and the bulb lights up. Cool the water and note the temperature at which the contacts open. Replace if faulty.

Renew the joint between the tank and the thermostat switch if damaged.

TEST DATA

Closing temperature 75°C ± 2°C
Opening differential 3°–5°

FAN MOTOR

Checking

Disconnect the cables and check the fan motors by connecting to a 12 volt battery.

Remove for inspection if faulty.

ELECTRICAL AND INSTRUMENTS

Inspection

Withdraw the two through bolts, and detach the end cover. Expand the retaining spring and lift off the two brush carriers as an assembly.

Note: The brushes are loose in the carriers and care must be taken that they are not misplaced when removed.

Examine the commutator and clean with a petrol moistened cloth or fine glass paper if dirty or scored.

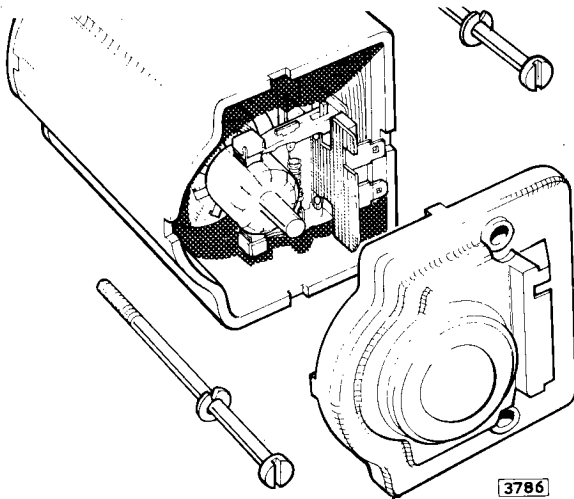


Fig. 41. Exploded view of the fan motor.

FAN RELAY

Checking

Check that fuse No. 6 has not blown. Replace if necessary.

Check that the current is present at terminal C2 (Green) with the ignition 'ON'.

Earth the terminal W1 (Black/red), switch on the ignition and check by means of an earthed test lamp that current is available at terminal C1 (Black/green).

If air-conditioning system is fitted, check the over-riding relay as detailed under 'Horn relay'. Ignore reference to horn button.

Refer to the wiring diagram when checking.

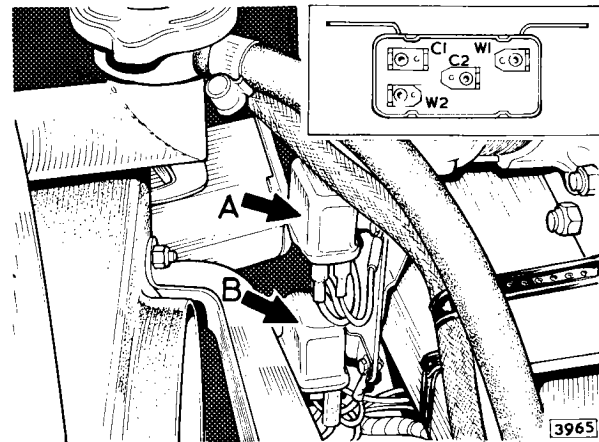


Fig. 42. The radiator fan relays.

A—Fan relay.
B—Over-riding relay.

STEERING COLUMN LOCKS

Description

Steering column locks, if fitted, replace the normal Starter/Ignition Switch.

The lock, mounted on a bracket attached to the steering column, has five operative positions as follows:—

(1) Lock, (2) Park, (3) Accessories, (4) Ignition, (5) Start.

During the assembly of the switch/lock to the column, the hexagon portions of the lock securing bolts which are of the necked type, are sheared when fully tightened and cannot subsequently be removed, thus preventing unauthorised removal of the lock.

IMPORTANT

The steering column lock is brought into action when the key is turned to the 'LOCK' position and then removed.

IMMEDIATELY THIS IS DONE IT BECOMES IMPOSSIBLE TO STEER THE CAR.

It is, therefore, important to remember that if the ignition is switched off whilst the car is in motion the key should not be turned past the 'PARK' position. The ignition key should **NEVER** be removed from the lock whilst the car is moving.

ELECTRICAL AND INSTRUMENTS

OPERATION

(1) Lock

This is a locked stop position. The key can be removed leaving the steering locked by engagement of the lock bolt with the register in the inner steering column.

(2) Park

This is the normal stop position. The key can be removed leaving the car capable of being steered with the ignition "OFF".

(3) Accessories

This position will allow the operation of accessories such as Radio and Electric Window Lift control (when either is fitted) with the ignition 'OFF'.

The key cannot be removed.

(4) ON

This is the normal starting position. On release, the key will automatically return to the ignition 'ON' position.

IMPORTANT

Re-engagement of the starter (cranking) motor will not be possible until the key is returned to the 'Park' position. This is a safety device introduced to prevent damage to the starter drive through accidental engagement when the engine is running.

SERVICING

No servicing is possible with the exception of the switch carrier contact plate which can be replaced if faulty as follows:—

- (1) Disconnect the cables at the connectors.
- (2) Remove two hexagon headed screws and plain washers and withdraw the contact plate with attached harness.
- (3) Refit by reversing the removal procedure.

Note: The contact plate is indexed and cannot be fitted incorrectly.

Two Lucas 6RA relays are incorporated in the circuits controlled by the ignition switch to prevent overloading of the switch contacts.

Both units are located under the screen rail facia.

Operation of the individual relays should be checked when testing for a fault in the ignition/starter switch circuits.

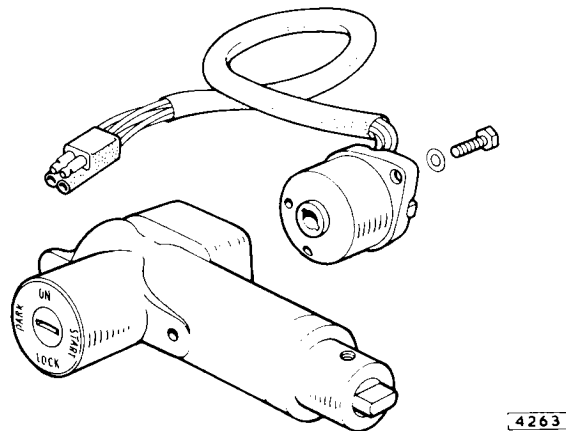


Fig. 43. The steering column lock dismantled.
(The lock is shown removed from the column for clarity).

**CABLE
COLOUR CODE**

B BLACK

U BLUE

N BROWN

G GREEN

K PINK

P PURPLE

R RED

S SLATE

W WHITE

YELLOW

D DARK

LIGHT

M MEDIUM

