SECTION P

ELECTRICAL AND INSTRUMENTS

DISTRIBUTOR

From Engine No. 7E2459 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°±3°
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 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.				CENTRIFUGAL TIMING ADVANCE TESTS 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 — Inches	Degrees	No advance in timing below-ins. of mercury	Lucas Advance Springs Number	Acelerate to-RPM and note advance in degrees — RPM	Degrees	Decelerate to-RPM and note advance in degrees — RPM	Degrees	No advance in timing below-RPM
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

ROUTINE MAINTENANCE

EVERY 3,000 MILES (5,000 KM.)

Lubricate distributor and check contact points' gap.

FUSE UNITS

Fuse No.	CIRCUITS	Amps
1	Headlamps—Main Beam	35
2	Headlamps—Dip Beam	35
3	Horns	50
4	Spare	—
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
In line	Traffic Hazard Warning System	35

THE ALTERNATOR

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. 1).

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 P.X.s.8.

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 flying 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.

On later cars 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 separate pair of contacts in the ignition switch.

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

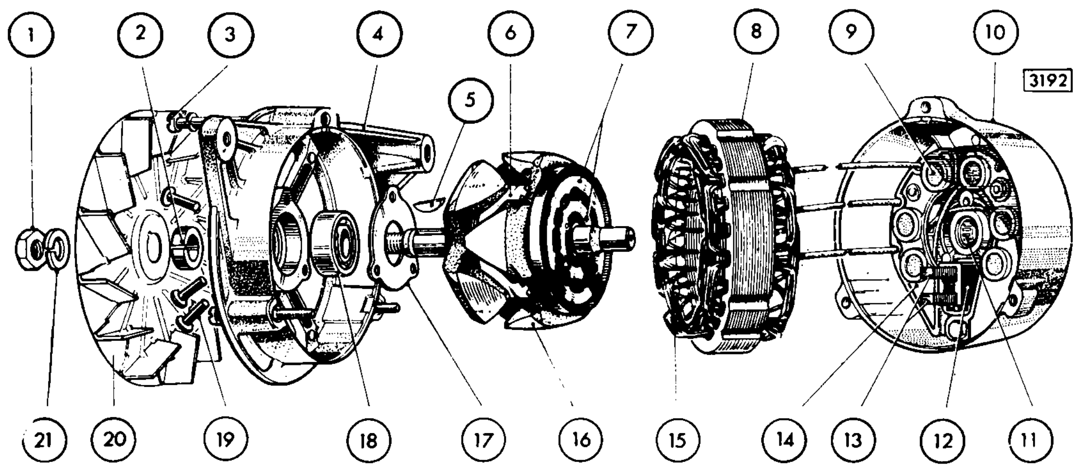


Fig. 1. *Exploded view of the Lucas 11 AC alternator.*

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

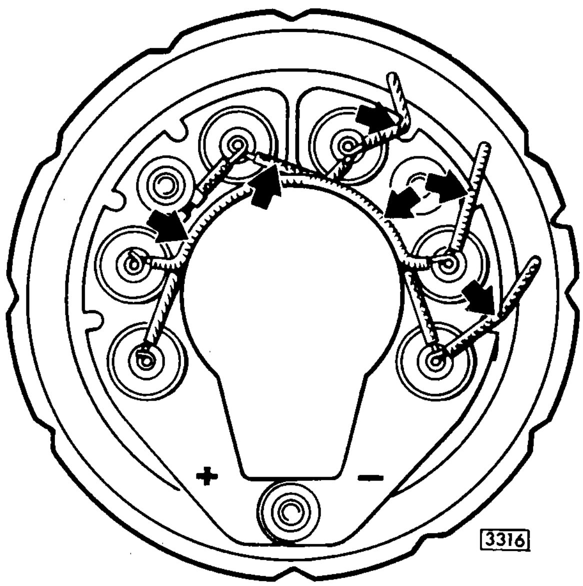


Fig. 2. *Showing the silicon diodes and connections in the slip ring end cover.*

ROUTINE MAINTENANCE

No routine maintenance is necessary with the alternator or control unit.

Occasionally wipe away any dirt or oil which may collect around the slip ring end cover.

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.

Note: Later cars having the 3AW warning light control unit to give an indication that the alternator is charging, also have a positive lock connector on the main alternator output cable making it impossible to connect the harness incorrectly. The cable to the 3AW control unit is connected to the fourth terminal on the slip ring.

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.

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. Lower the instrument panel and disconnect the brown and brown/white cables from the ammeter Connect the two cables to a good quality moving-coil ammeter registering at least 75 amperes.

3. Detach the terminal connectors 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 contacts in the ignition switch or the wiring associated with this circuit. Check each item in turn and rectify as necessary.

   Note: There being no vibrating contact cut-out with the alternator, field isolation is by means of two extra contacts on the ignition switch. When a steering column lock is fitted, field isolation is by means of a relay.

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.

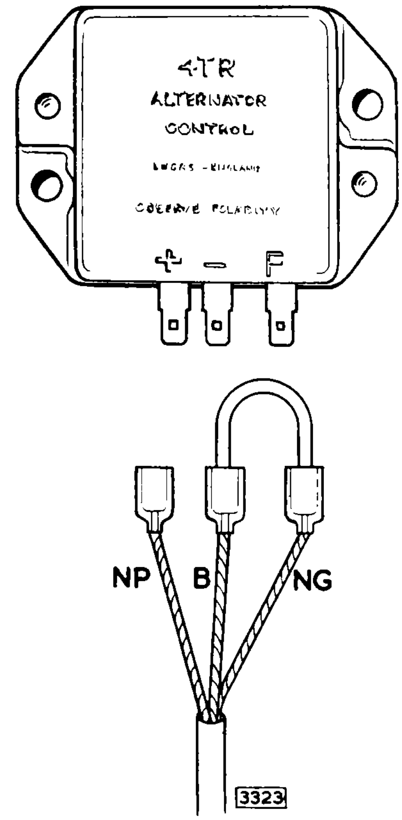


Fig. 3. *Detach the terminal connectors from the base of the control unit.*

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.

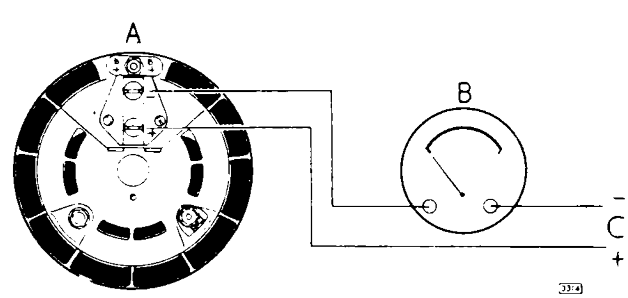


Fig. 4. *Testing the alternator with an ammeter.*
A—*Alternator.* B—*Ammeter.* C—*Battery.*

DISMANTLING THE ALTERNATOR (Fig. 1).

Disconnect the battery and remove the alternator as detailed on Page P.X.s.4.

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.

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 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.).

INSPECTION OF BRUSHGEAR

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 $7\frac{1}{2}$ to $8\frac{1}{2}$ 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.

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 or 12 volt D.C., supply between the slip rings (as described on page P.X.s.5) where this test was made with the brushgear in circuit. The readings of resistance or cuttent should be as given on page P.X.s.5.

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 Fig. 1). By lettering these cables A, B and C, three pairs of cables AB, BC and AC—are available for testing the stator windings. Measure the voltage drop across each of these pairs in turn while passing 20 amps between the cable ends. The voltage drop should be approximately 4·3 volts in each of the three measurements.

If any, or all, of the readings are other than these, 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) 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.

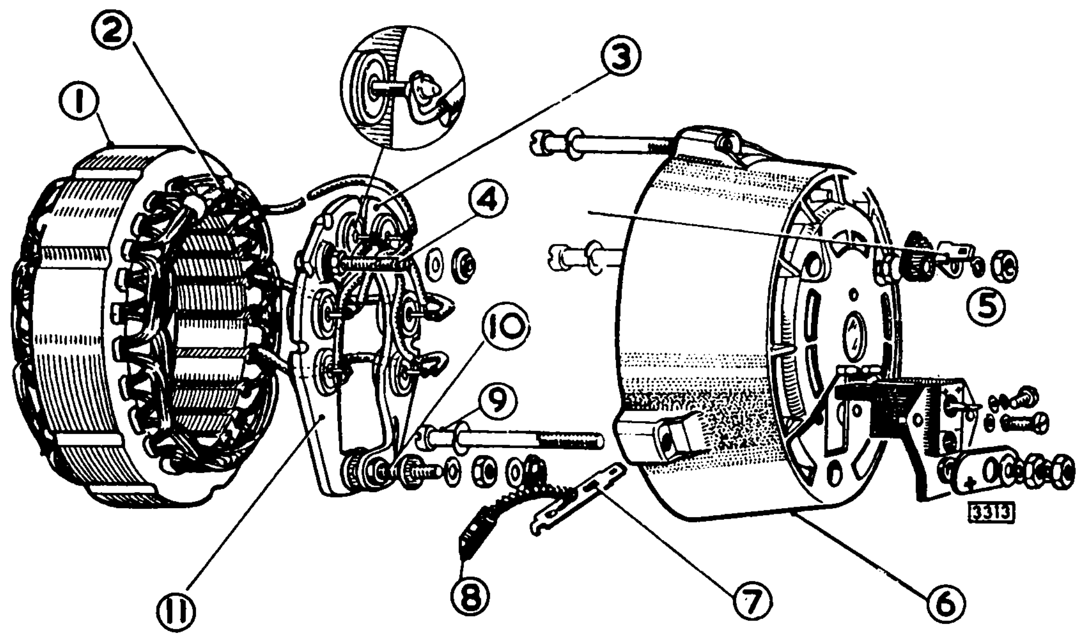


Fig. 5. *Exploded view of the slip ring end cover.*

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

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.

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

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:—

(a) File away the roll-over on each of the three bearing retaining plate rivets and punch out the rivets.

(b) Press the bearing out of the bracket.

(c) 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.

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.

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 R1 (see Fig. 6), 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

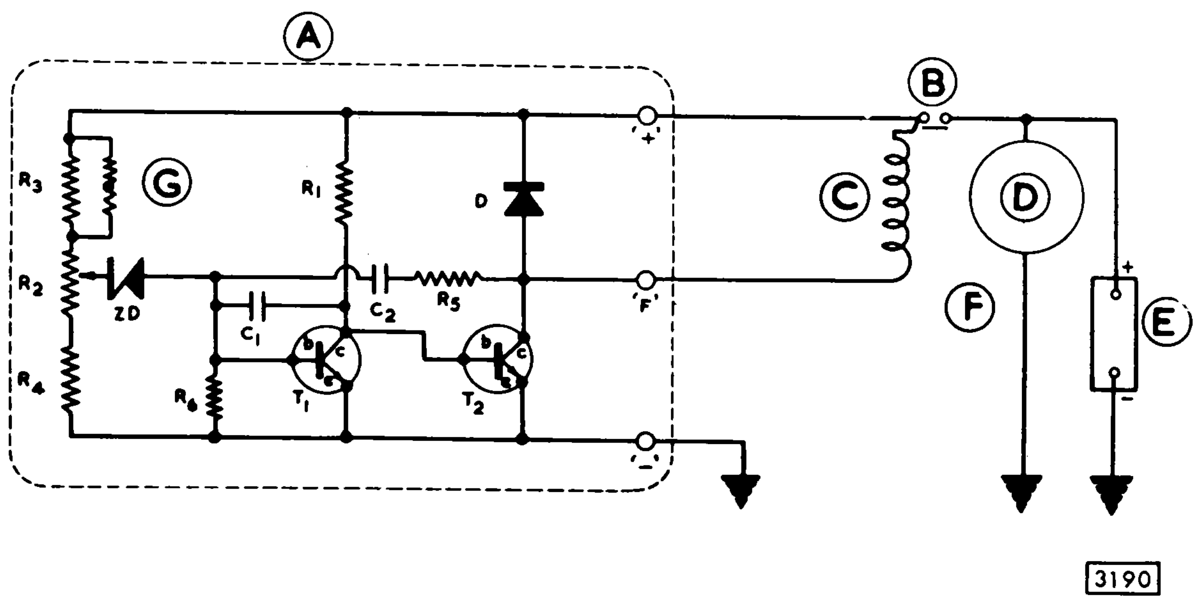


Fig. 6. *4TR Control Unit Circuit Diagram.*

A—Control unit.
B—Field isolating device.
C—Rotor field winding.
D—Alternator.
E—12-volt battery.
F—Stator winding (rectified) output.
G—Thermistor.

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 feed-back. 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 verse. 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.

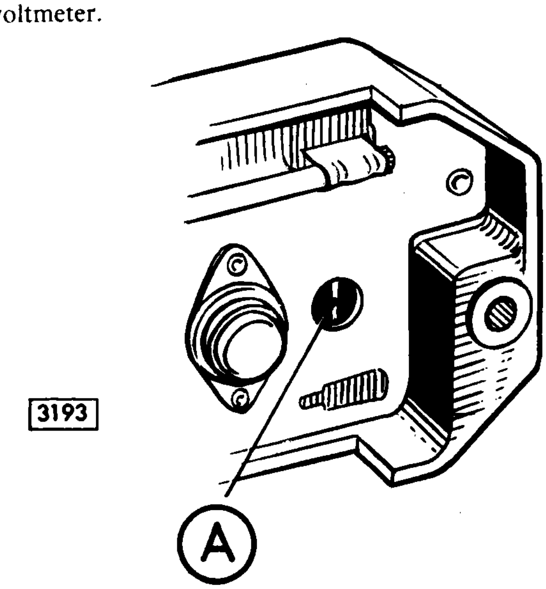


Fig. 7. *4 TR Alternator Control.*
A *Potentiometer adjuster.*

WARNING LIGHT CONTROL UNIT
Model 3AW

DESCRIPTION

The Model 3AW warning light unit fitted to later cars 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 differenti internal circuit. A correct replacement unit must be fitted in the even 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

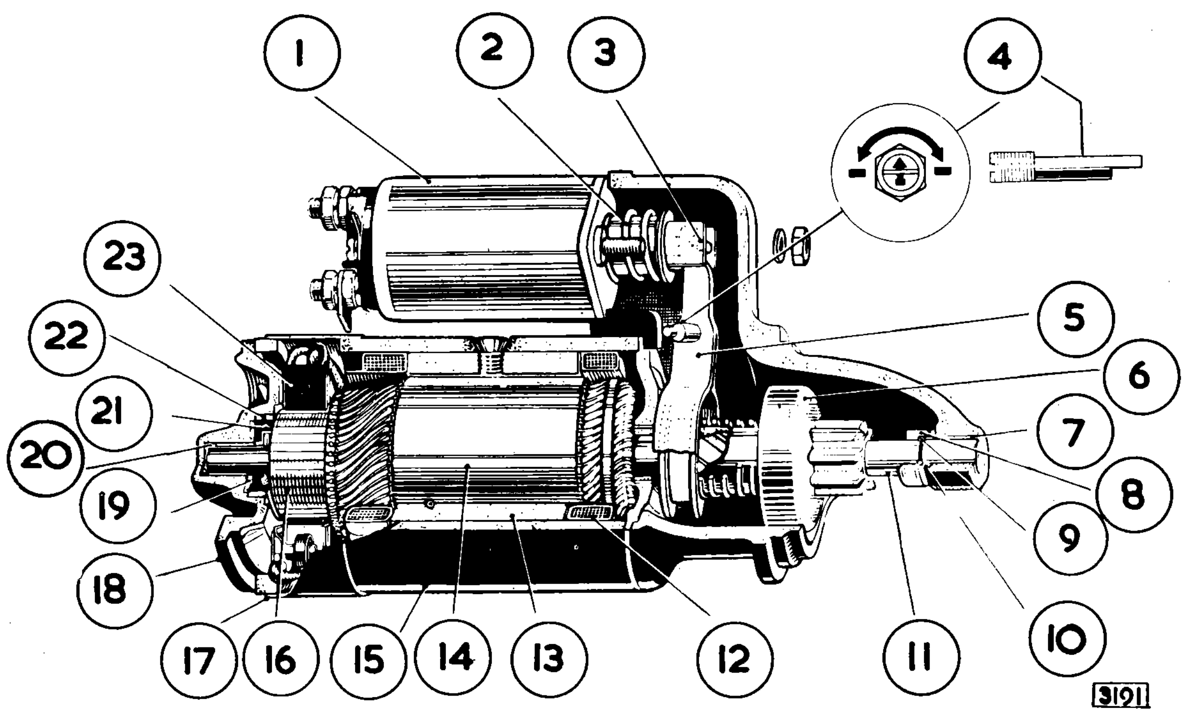


Fig. 8. *The Pre-engaged Starter Motor Model M45G.*

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

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 $\frac{1}{8}''$ (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.

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

ROUTINE MAINTENANCE

EVERY 24,000 MILES (38,400 KM.)

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 P.S.s.17 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 reskimmed by first rough turning, followed by diamond finishing. DO NOT undercut the insulation. Commutators must not be skimmed below a diameter of $1\frac{17}{32}$" (38·89 mm.). Renew the armature if below this limit.

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 carburetter 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

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.

BENCH TESTING

Remove the starter motor from the engine

Disconnect the battery. Disconnect and remove the starter motor from the engine (see page P.X.s.15 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 P.X.s.15. 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.

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 $1\frac{17}{32}$" (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.

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" (·013 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.

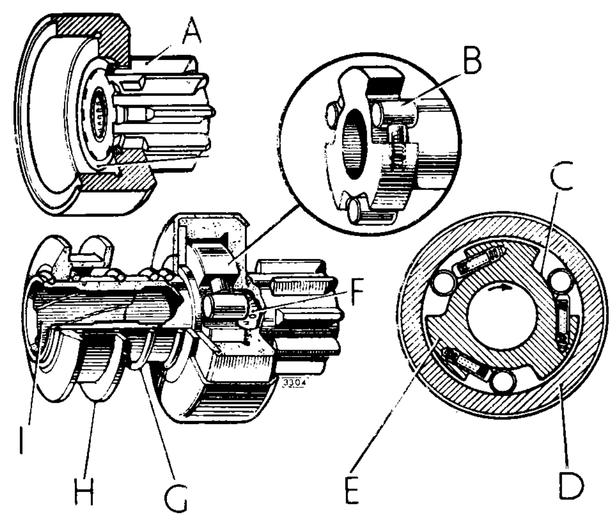


Fig. 9. *The roller clutch drive components.*

A—*Alternative contruction (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.*

REASSEMBLY

After cleaning all parts, reassembly of the starting motor is a reversal of the dismantling procedure given **on page P.X.s.15 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).

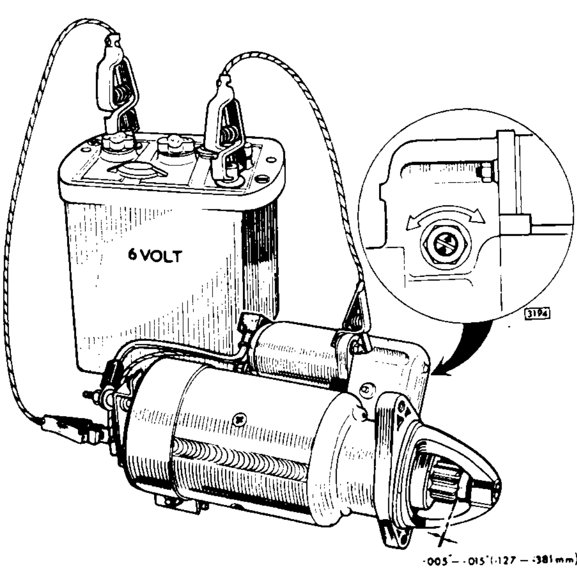


Fig. 10. *Setting pinion movement.*

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.

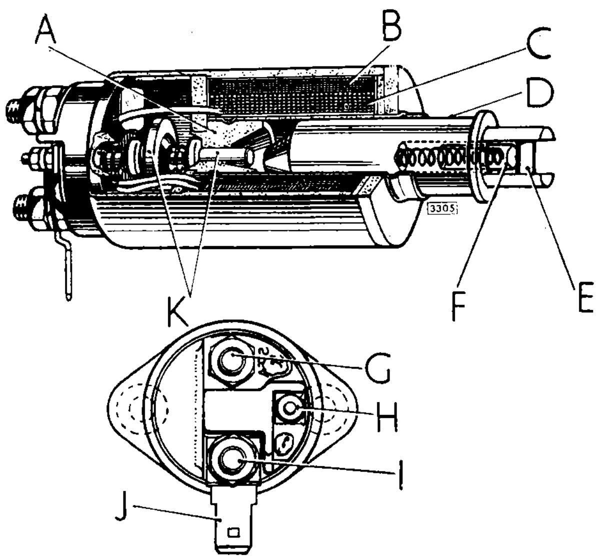
Connect a separately energised test lamp circuit across the solenoid main terminals.

Insert a stop in the drive end bracket to restrict the pinion travel to that of the out of mesh clearance, normally a nominal ⅛″ (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.

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.



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.

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.*

B—*Shunt winding.*

WINDSCREEN WIPER

Model	Chassis Number L.H. Drive
Open 2 Seater ..	1E.15980–U.S.A. Only
	1E.16010–Other than U.S.A.
Fixed Head Coupe ..	1E.34583–U.S.A. Only
	1E.34752–Other than U.S.A.
2+2	1E.77709

At the above chassis numbers, a Lucas DL3A windscreen wiper unit was introduced **on L.H. Drive cars only.**

It consists of a two-speed self-starting motor coupled by connecting rods to three wiper spindles.

Adjustment of the parked position is controlled by the location of the parking switch carrier plate mounted in the gear housing.

To adjust the parking position, if necessary, unscrew the three hexagon-headed drive screws sufficient to release the tension of the clamping plate, and rotate the switch carrier plate in the direction of the arrow on the plate.

Slight movement only should be necessary. Do not allow the blades to park below the glass lower edge.

Tighten the screws and recheck.

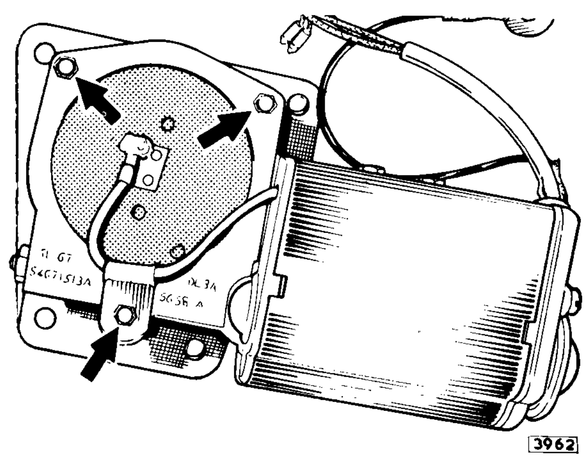


Fig. 1. The windscreen wiper motor parking adjustment. The arrows show the three screws to be released when adjusting the switch carrier plate.

WIPER MOTOR

Removal

Disconnect the battery.

Remove the spring clip retaining the throttle pedal link rod to the bellcrank lever and withdraw the rod.

Mark the location of the carrier bracket on the bulkhead, remove the two setscrews and detach the bracket.

Remove the plastic strap from the wiper motor and disconnect the cables from the snap connector block. Note the location of the cables for reference when refitting.

Lower the instrument panel after removing the two screws in the top corners and disconnect the ball joint from the centre windscreen wiper motor spindle bearing.

Remove the four setscrews retaining the motor to the bulkhead and withdraw the motor with attached link rod.

Note the sealing joint fitted between the motor bracket and the bulkhead.

Refitting

Refitting is the reverse of the removal procedure.

Note : It is essential when refitting to ensure that the length of the link rod is not altered. Any alteration in the length of this rod will place the windscreen wiper arms out of phase with each other.

When refitting the throttle bellcrank carrier bracket, care must be taken to ensure that the lever is central in its bearing. Adjustment is provided by means of the two slotted holes in the bracket.

WINDSCREEN WIPER SPINDLE HOUSINGS

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.

Detach the two leads from the map light terminals.

Disconnect the demister ducts at the 'Y' pieces and withdraw the facia assembly.

Disconnect the ball joint from the spindle lever.

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

Remove the spring retainer and withdraw the pivot pin with attached outer link rods.

Complete the removal of the housing.

Removal (Central Housing)

Disconnect the battery.

Withdraw the wiper arm from the spindle.

Unscrew the large nut securing the housing to the scuttle and remove the distance piece and rubber seal washer.

Lower the instrument panel as detailed previously.

Disconnect the link ball joint from the spindle lever.

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

Remove the spring retainer and withdraw the pivot pin with the attached outer link rods.

Complete the removal of the housing.

Model	Chassis Number	
	R.H. Drive	L.H. Drive
Open 2 Seater	1E.2037	1E.15980–U.S.A. Only 1E.16010–Other than U.S.A.
Fixed Head Coupe	1E.21786	1E.34583–U.S.A. Only 1E.34752–Other than U.S.A.
2+2	1E.51197	1E.77709

In subsequent text, the above mentioned are the commencing chassis numbers at which these items were introduced.

FAULT DIAGNOSIS

Poor performance can be electrical or mechanical in origin and not necessarily due to a faulty motor, for example:—

Low voltage at the motor due to poor connections or a discharged battery.

Excessive loading on the wiper blades.

Spindles binding in the housing.

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.

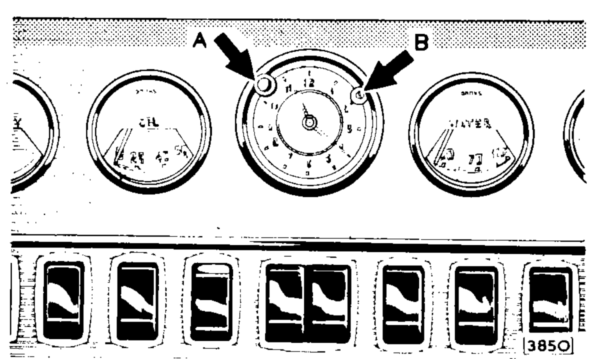


Fig. 13. Clock controls.
A — Handsetting. B — Time regulator.

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.

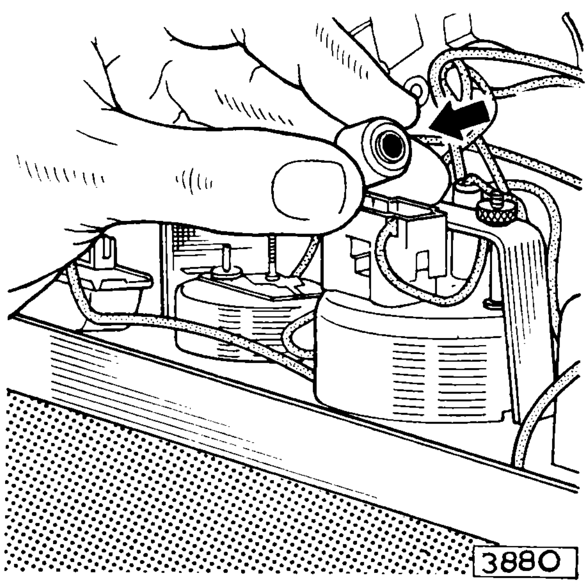


Fig. 14. Renewing the electric clock battery.

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 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 P.X.s.00 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. 15).

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.

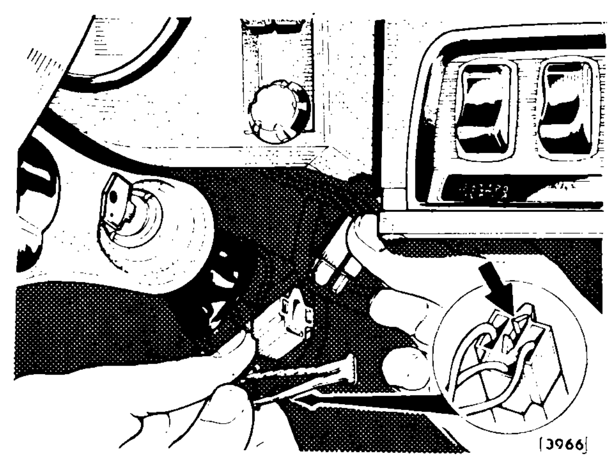


Fig. 15. The tachometer plug and socket assembly. (Inset shows the clip in its fitted position).

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.

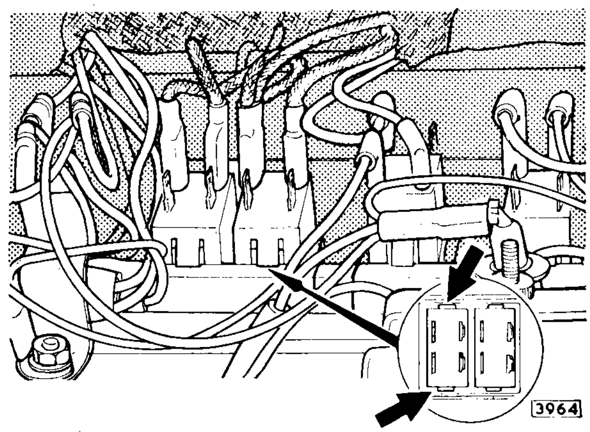


Fig. 16. Instrument panel rocker switch removal (Inset shows arrowed the nylon locking tabs).

THE IGNITION/STARTER SWITCH

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

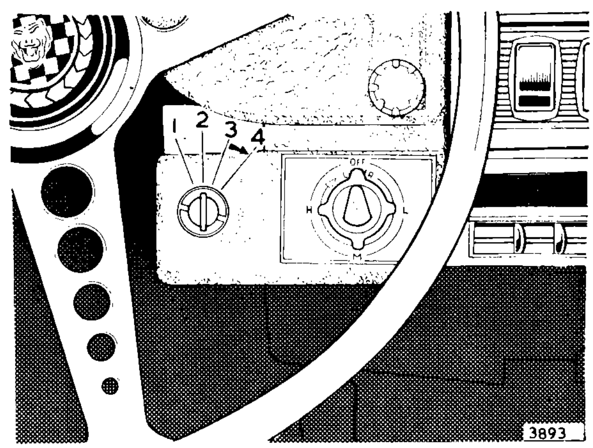


Fig. 17. The ignition/starter switch location when air-conditioning system is fitted.
1 — Auxiliaries. 2 — Ignition "OFF"
3 — Ignition "ON". 4 — Starter.

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.

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.

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

Sealed 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. 18

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.

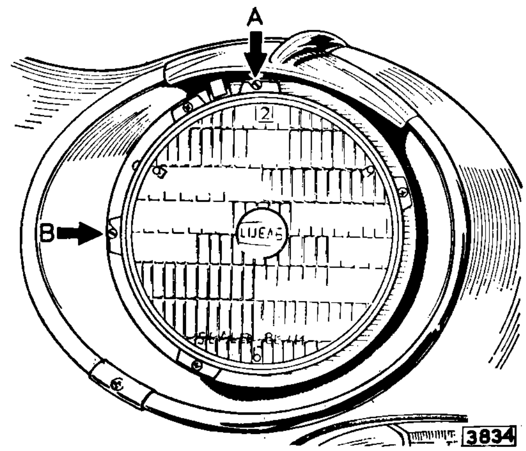


Fig. 18. Adjustment of the screw 'A' will alter the headlamp beams in the vertical plane; adjustment of the screw 'B' will alter the headlamp beams in the horizontal plane.

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.

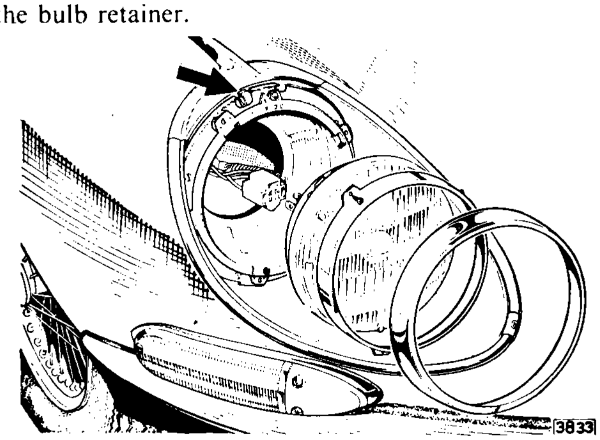


Fig. 19. Headlamp sealed beam unit removal. The arrow indicates one of the spring clips retaining the rim.

HORNS

DESCRIPTION

Lucas 9H horns are fitted replacing the WT618 Units previously fitted to early 4.2 'E' type cars.

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 on 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.

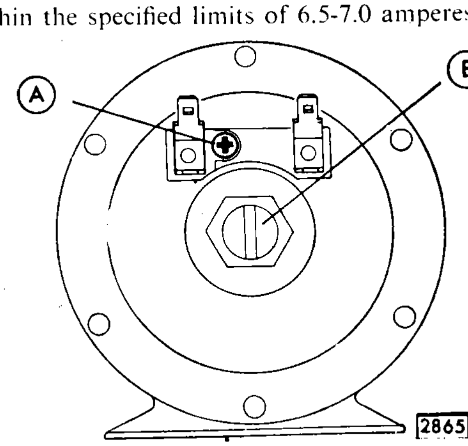


Fig. 20. The Lucas 9H horn.
A — Contact breaker adjustment screw.
B — Slotted centre core (Do not disturb).

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 fxing 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 $\frac{11}{16}$" (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.

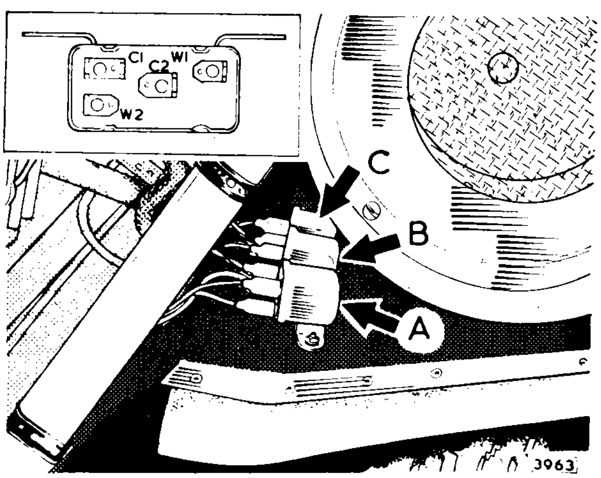


Fig. 21. Location of horn and alternator relays.
A — Horn relay.
B — Alternator/Ignition relay.
C — Air conditioning equipment relay (when fitted).
(Inset shows the connections).

(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.

THE ALTERNATOR

The alternator differs from that detailed on Page P.X.s.00 in respect of the following items only:—

(i) Inclusion of a Lucas 6RA relay in the alternator circuit due to the introduction of the Lucas 47SA Ignition switch.

(ii) Location on cars fitted with Air-conditioning Equipment. On cars so equipped the alternator is mounted centrally at the front of the engine. Belt adjustment and servicing details remain unaltered.

Alternator Relay—Checking

Check with test lamp that current is available at terminals C1 and W1. Switch on ignition before checking W1.

Check earth connection to terminal W2.

Switch on the ignition and check that the relay coil is energised and contacts C1-C2 have closed by means of an earthed test lamp connected to terminal C2.

The relay is mounted on the closing panel, adjacent to the battery, below the horn relay.

Refer to the wiring diagram when checking.

RADIATOR FANS

Radiator Fan Relays

A Lucas 6RA relay is included in the radiator fan/thermostat switch circuit to prevent overloading of the thermostat contacts. The relay is mounted on the front upper cross tube behind the radiator matrix.

When Air-conditioning Equipment is fitted, a second relay is included to over-ride the thermostat circuit when the car is stationary and, the air-conditioning system is operational.

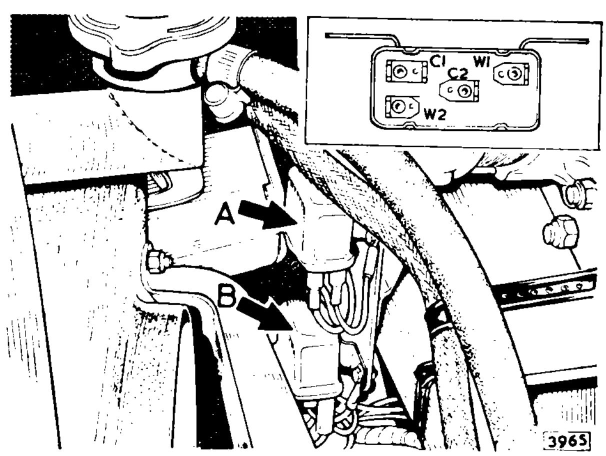


Fig. 22. The radiator fan relays.
"B" when air-conditioning is NOT fitted.
"A" is an over-riding relay when air-conditioning IS fitted.
(Inset shows the connections).

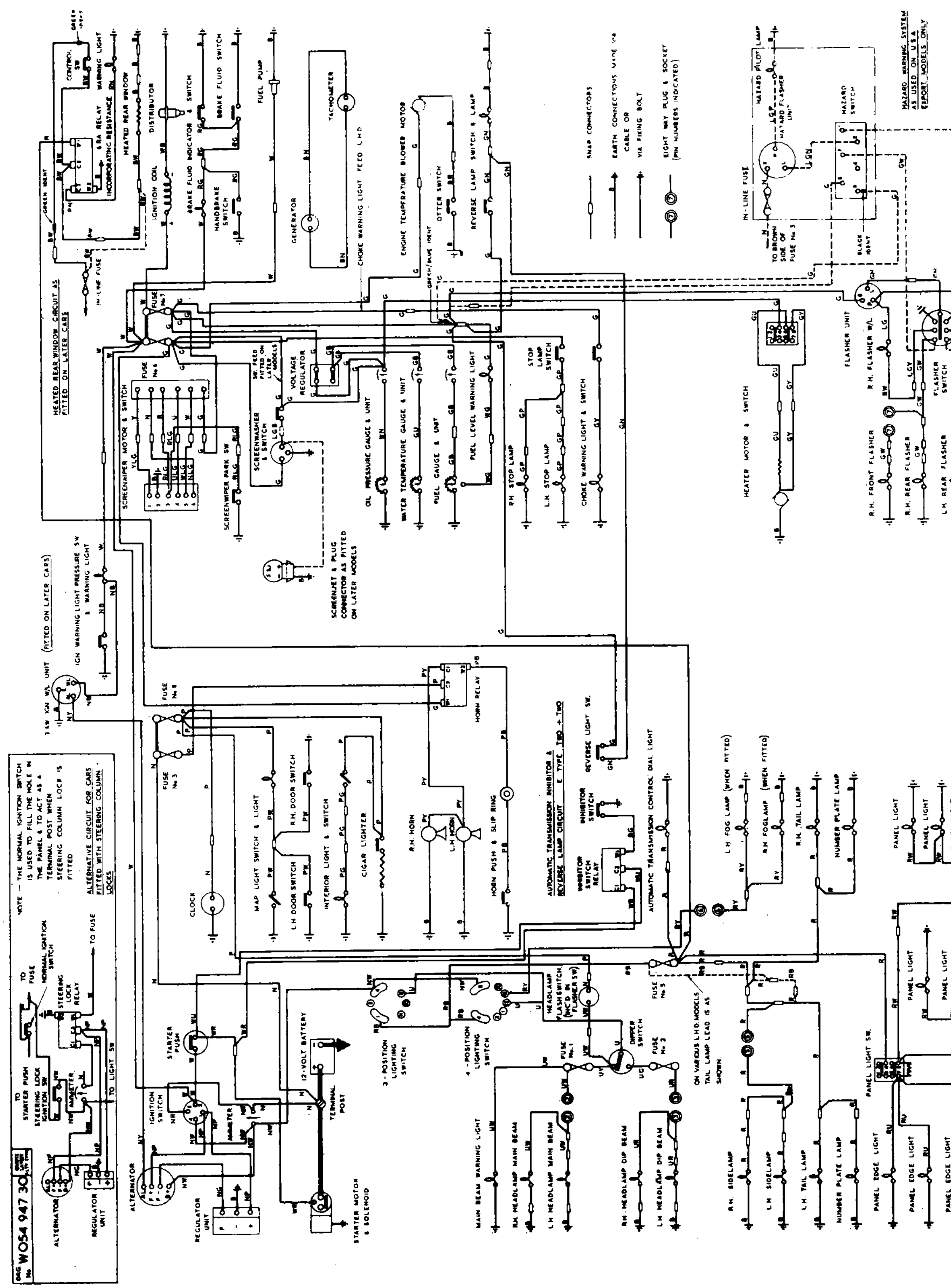


Fig. 23. Wiring diagram for use on cars from chassis number 1E.50001 (R.H. Drive) *and* 1E.75001 (L.H. Drive) *to*

1E.15979—Open 2 Seater
1E.34582—Fixed Head Coupe } L.H. Drive—U.S.A. Only
1E.16009—Open 2 Seater
1E.34751—Fixed Head Coupe } L.H. Drive—Other than U
1E.77709—2+2

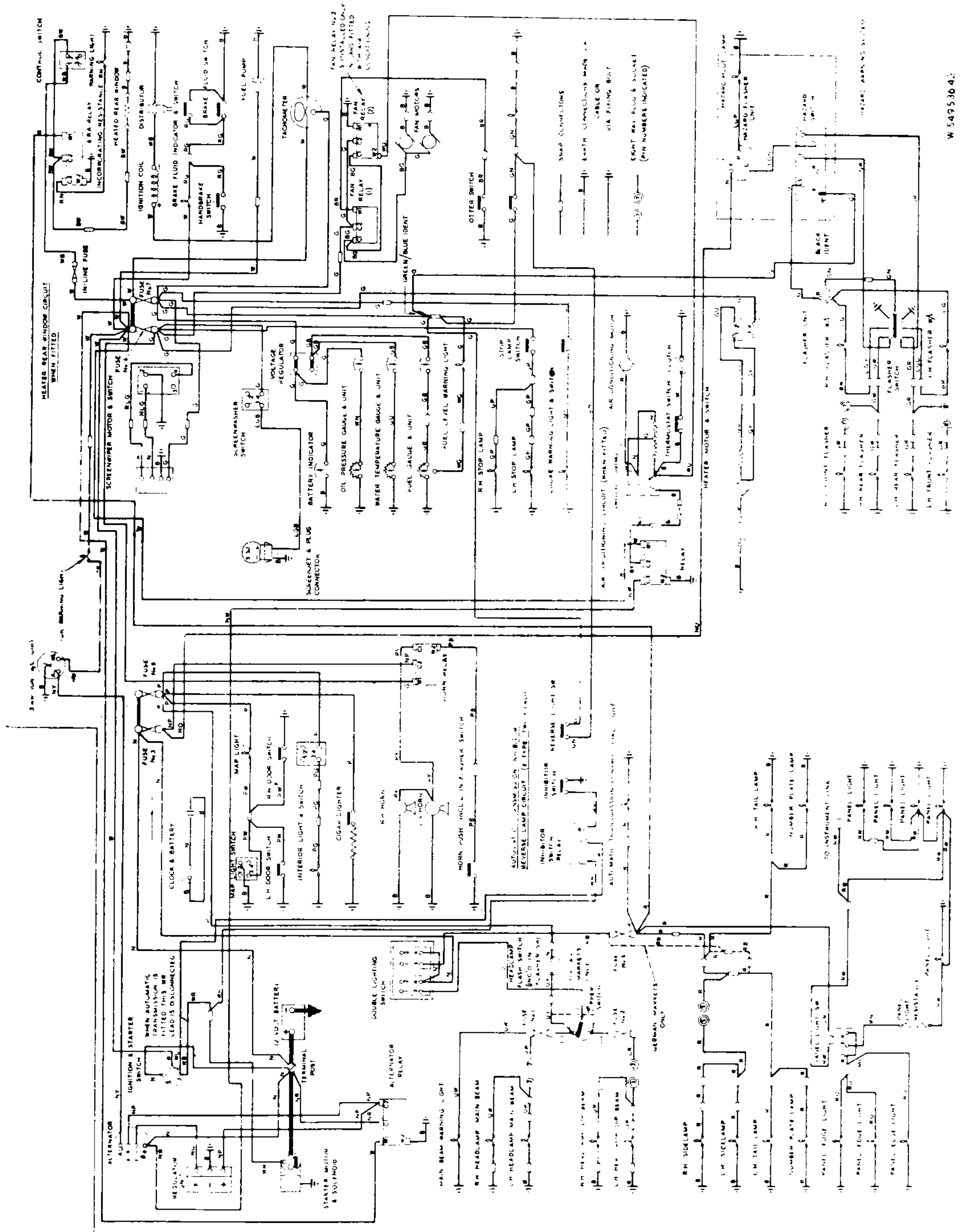


Fig. 24. Wiring diagram for use on cars bearing chassis numbers listed below and subsequent numbers.

	R.H. Drive	L.H. Drive
Open 2 Seater ..	1E.2037	1E.15980-U.S.A. Only 1E.16010-Other than U.S.A.
Fixed Head Coupe	1E.21786	1E.34583-U.S.A. Only 1E.34752-Other than U.S.A.
2+2	1E.51197	1E.77709

CABLE COLOUR CODE

B	BLACK	**S**	SLATE
U	BLUE	**W**	WHITE
N	BROWN	**Y**	YELLOW
R	RED	**D**	DARK
P	PURPLE	**L**	LIGHT
G	GREEN	**M**	MEDIUM

When a cable has two colour code letters, the first denotes the main colour and the second denotes the tracer colour.