SECTION P

ELECTRICAL AND INSTRUMENTS

3·8 "E" TYPE
GRAND TOURING MODELS

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Instruments *(continued)*

ELECTRICAL AND INSTRUMENTS

BATTERY

The Lucas FRV11/7A battery is of the semi-linkless type, the short cell inter-connectors being partially exposed to enable testing of the individual cells to be carried out with a heavy discharge tester.

DATA

Battery type	FRV11/7A
Voltage	12
Number of plates per cell	11
Capacity at 10-hour rate	55 ampere hours
Capacity at 20-hour rate	60 ampere hours

ROUTINE MAINTENANCE

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

About once a month, or more frequently in hot weather, examine the level of the electrolyte in the cells. If necessary add distilled water to bring the electrolyte just level with the separator guards, which can be seen when the vent plugs are removed.

The use of a Lucas battery filler will be found helpful in this topping-up process as it ensures that the correct electrolyte level is obtained automatically and also prevents distilled water from being spilled over the battery top.

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.

REMOVAL

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

REFITTING

Refitting is the reverse of the removal procedure. 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 generator or regulator, or neglect of the battery during a period of low or zero mileage may also be responsible for the trouble.

Vent Plugs

See that the ventilating holes in each vent plug are clear.

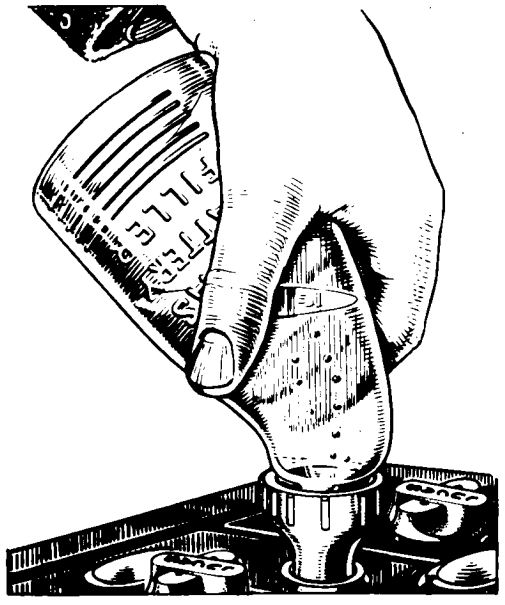


Fig. 1. Lucas battery filler.

Level of Electrolyte

The surface of the electrolyte should be just level with the tops of the separators guards. If necessary, top up with distilled water. 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.

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 readings immediately after topping-up.

The readings 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 a 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., which is adopted as a reference temperature. The method of correction is as follows:—

For every 5°F. below 60°F. deduct ·002 from the observed reading to obtain the true specific gravity at 60°F.

For every 5°F. above 60°F. add ·002 to the observed reading to obtain the true specific gravity at 60°F.

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

Discharge Test

A heavy discharge tester consists of a voltmeter, 2 or 3 volts full scale, across which is connected a shunt resistance capable of carrying a current of several hundred amperes. Pointed prongs are provided for making contact with the inter-cell connectors.

Press the contact prongs against the exposed positive and negative terminals of each cell. A good cell will maintain a reading of 1·2—1·5 volts, depending on the state of charge, for at least 6 seconds. If, however, the reading rapidly falls off, the cell is probably faulty and a new plate assembly may have to be fitted.

State	Home and climates with shade temperature ordinarily below 80°F (26·6°C). Specific gravity of electrolyte (corrected to 60°F)	Climates with shade temperature frequently over 80°F (26·6°C). Specific gravity of electrolyte (corrected to 60°F)
Fully charged	1·270—1·290	1·210—1·230
About half discharged	1·190—1·210	1·130—1·150
Completely discharged	1·110—1·130	1·050—1·070

RECHARGING FROM AN EXTERNAL SUPPLY

If the battery tests indicate that the battery is merely discharged, and is otherwise in a good condition, it should be recharged, either on the vehicle by a period of daytime running or on the bench from an external supply.

If the latter, the battery should be charged at 5·5 amperes until the specific gravity and voltage show no increase over three successive hourly readings. During the charge the electrolyte must be kept level with the tops of the separator guards by the addition of distilled water.

A battery that shows a general falling-off in efficiency common to all cells, will often respond to the process known as "cycling". This process consists of fully charging the battery as described above and then discharging it by connecting to a lamp board, or other load, taking a current of 5 amperes. The battery should be capable of providing this current for at least 7 hours before it is fully discharged, as indicated by the voltage of each cell falling to 1·8. If the battery discharges in a shorter time, repeat the "cycle" of charge and discharge.

PREPARING NEW UNFILLED, UNCHARGED BATTERIES (MODEL FRV11/7A) FOR SERVICE

Preparation of Electrolyte

Batteries should not be filled with acid until required for initial charging.

Electrolyte of the specific gravity required is prepared by mixing distilled water and concentrated sulphuric acid, usually of 1·835 specific gravity. The mixing must be carried out either in a lead-lined tank or in a suitable glass or earthenware vessel. Slowly add the acid to the water, stirring with a glass rod. **Never add the water to the acid,** as the resulting chemical reaction causes violent and dangerous spurting of the concentrated acid. The correct specific gravity for the filling acid and approximate proportions of acid and water are indicated in the following table;

Specific Gravity of Filling Acid (corrected to 60°F.)	
Home and Climates with shade temperature ordinarily below 80°F (26·6°C) 1·270 Add 1 part by volume of acid (1·835 S.G.) to 2·8 parts of distilled water to mix this electrolyte	Climates with shade temperatures frequently above 80°F (26·6°C) 1·210 Add 1 part by volume of acid (1·835 S.G.) to 4 parts of distilled water to mix this electrolyte
Quantity of electrolyte required per cell 1¼ pints approximately (720 cc.)	

Heat is produced by the mixture of acid and water, and the electrolyte should be allowed to cool before taking hydrometer readings—unless a thermometer is used to measure the actual temperature, and a correction applied to the reading before pouring the electrolyte into the battery.

Filling the Battery

The temperature of the acid, battery and filling-in must not be below 32°F.

Carefully break the seals in the filling holes and fill each cell to the level of the separator guard with electrolyte of the appropriate specific gravity. Allow the battery to stand for twelve hours, in order to dissipate the heat generated by the chemical action of the acid on the plates and separators. Restore levels by adding more acid of the same specific gravity and then proceed with the initial charge.

Initial Charge Rate

Charge at a rate of 3·5 amps until the voltage and specific gravity readings show no increase over five successive hourly readings. This may take up to 80 hours, depending on the length of time the battery has been stored before charging.

Keep the current constant by varying the series resistance of the circuit or the generator output.

This charge should not be broken by long rest periods. If, however, the temperature of any cell rises above the permissible maximum (that is, 100°F. for batteries filled with 1·270 S.G. acids, 120°F. for those with 1·210 S.G. acid), the charge must be interrupted until the temperature has fallen at least 10°F., below that figure. Throughout the charge, the electrolyte must be kept level with the top of the separator guards by the addition of acid solution of the same specific gravity as the original filling-in acid, until the specific gravity and voltage readings have remained constant for five successive hourly readings. If the charge is continued beyond that point, top up with distilled water.

At the end of the charge carefully check the specific gravity in each cell to ensure that, when corrected to 60°F., it lies within the specified fully-charged limits. If any cell requires adjustment, some of the electrolyte must be siphoned off and replaced either by distilled water or by acid of the strength originally used for filling-in, depending on whether the specific gravity is too high or too low. Continue the charge for an hour or so to ensure adequate mixing of the electrolyte and again check the specific gravity readings. If necessary, repeat the adjustment process until the desired reading is obtained in each cell. Finally, allow the battery to cool, and siphon off any electrolyte above the tops of the separator guards.

PREPARING NEW "DRY-CHARGED" BATTERIES (MODEL FRVZ11/7A) FOR SERVICE

Filling the Cells

Carefully break the seals in the filling holes and fill each cell with correct specific gravity acid as shown in the table on page P.8 to the top of the separator guards in one operation. The temperatures of the filling room, battery and acid should be maintained at between 60°F. and 100°F. If the battery has been stored in a cool place, it should be allowed to warm up to room temperature before filling.

Freshening Charge

Batteries filled in this way are up to 90% charged and capable of giving a starting discharge one hour after filling. When time permits, however, a short freshening charge will ensure that the battery is fully charged.

Such a freshening charge should be 5 amperes for not more than 4 hours.

During the charge the electrolyte must be kept level with the top of the separators by the addition of distilled water. Check the specific gravity of the electrolyte at the end of the charge; if 1·270 acid was used to fill the battery, the specific gravity should now be between 1·270 and 1·290; if 1·210 acid, between 1·210 and 1·230.

Maintenance in Service

After filling, a dry-charged battery needs only the attention normally given to all lead-acid type batteries.

DISTRIBUTOR

REMOVAL

Spring back the clips and remove the distributor cap.

Disconnect the low tension wire from the distributor.

Disconnect the vacuum pipe by unscrewing the union nut at the vacuum advance unit.

Remove distributor clamping plate retaining set-screw and withdraw distributor.

REFITTING

If the distributor clamping plate pinch bolt has not been slackened during removal of distributor refitting will be the reverse of the removal procedure. Enter the distributor into the cylinder block with the vacuum advance unit connection facing the cylinder block.

Rotate the rotor arm until the driving dog engages with the distributor drive shaft.

If the distributor clamping plate pinch bolt has been slackened during removal of distributor it will be necessary to reset the ignition timing as follows:—

Ignition Timing

Set the micrometer adjustment in the centre of the scale.

Connect the low tension wire to the terminal on the distributor body.

Enter the distributor into the cylinder block with the vacuum advance unit connection facing the cylinder block.

Rotate the rotor arm until the driving dog engages with the distributor drive shaft.

Rotate the engine until the rotor arm approaches the No. 6 (front) cylinder segment in the distributor cap.

Slowly rotate the engine until the ignition timing scale on the crankshaft damper is the appropriate number of degrees before the pointer on the sump. (See Data).

Connect a 12 volt test lamp with one lead to the distributor terminal (or the CB terminal of the ignition coil) and the other to a good earth.

Slowly rotate the distributor body until the points are just breaking, that is, when the lamp lights up.

Tighten the distributor plate pinch bolt.

A maximum of six clicks on the vernier adjustment from this setting, to either advance or retard, is allowed.

ROUTINE MAINTENANCE

Distributor Contact Breaker Points

Every 2,500 miles (500 miles with new contact set) check the gap between the contact points with feeler gauges when the points are fully opened by one of the cams on the distributor shaft. A combined screwdriver and feeler gauge is provided in the tool kit.

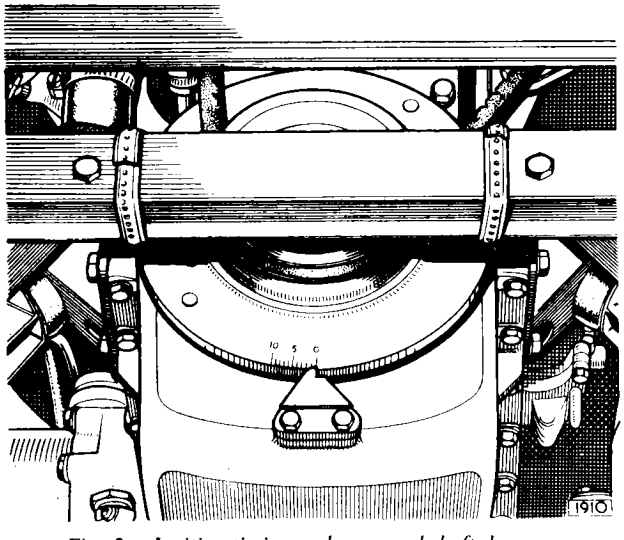


Fig. 2. Ignition timing scale on crankshaft damper.

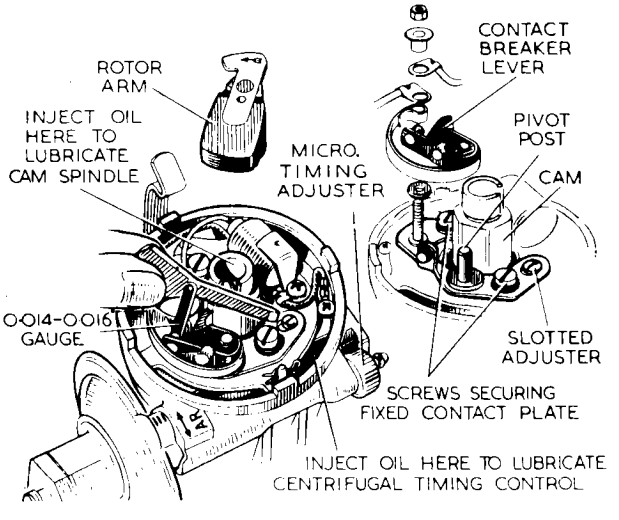


Fig. 3. Checking point gap and lubrication points.

The correct gap is ·014"—·016" (·36—·41 mm.).

If the gap is incorrect, slacken the two screws securing the fixed contact plate and turn the eccentric-headed adjustment screw in its slot until the required gap is obtained. Tighten the securing screws and recheck the gap. (Fig. 3).

Lubrication—Every 2,500 miles

Remove the moulded cover and withdraw the rotor arm. A tight rotor arm can be withdrawn by using a suitable pair of levers carefully applied at opposite points below the rotor moulding—never against the metal electrode.

Important: Do not allow oil or grease on or near the contacts when carrying out the following lubrication.

Cam Bearing

To lubricate the cam bearing, inject a few drops of thin machine oil into the rotor arm spindle (Fig. 3). Do not remove or slacken the screw located inside the spindle—a space is provided beneath the screwhead to allow the lubricant to reach the cam bearing.

Cam

Lightly smear the faces of the cam (Fig. 3) with Mobilgrease No. 2 or with clean engine oil.

DATA

Ignition Distributor Type	DMBZ.6A
8 to 1 Compression Ratio	40617A
9 to 1 Compression Ratio	40617A
Cam dwell angle	35° ± 2°
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.)

Centrifugal Timing Control

Inject a few drops of thin machine oil through a convenient aperture in the contact breaker base plate.

Cleaning

Clean the moulded cover inside and outside with a soft dry cloth. Pay particular attention to spaces between the terminals. Check that the small carbon brush inside the moulding can move freely in its holder.

Whiist the rotor arm is removed, examine the contact breaker. Rough, burned or blackened contacts can be cleaned with fine carborundum stone or emery cloth. After cleaning remove any grease or metallic dust with a petrol moistened cloth.

Contact cleaning is facilitated by removing the lever to which the moving contact is attached. To do this, remove the nut, insulating piece and electrical connections from the post to which the contact breaker spring is anchored. The contact breaker lever can then be lifted off the pivot post and the spring from the anchor post.

After cleaning and trimming the contacts, smear the pivot post (Fig. 3) with Ragosine Molybdenised Non-creep Oil or with Mobilgrease No. 2. Re-assemble the contact breaker and check the setting.

Refit the rotor arm, carefully locating its moulded projection in the spindle keyway and pushing it on as far as it will go.

Refit the moulded cover and spring the two side clips into position.

IGNITION TIMING

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

SERVICING

Dismantling

When dismantling, note carefully the position in which the various components are fitted in order to simplify their re-assembly

Bearing Replacement

The ball bearing at the upper end of the shank can be removed with a shouldered mandrel locating on the inner journal of the bearing.

When fitting a new ball bearing, the shouldered mandrel must locate on both inner and outer journals of the bearing.

The bearing bush at the lower end of the shank can be driven out with a suitable punch.

A bearing bush may be prepared for fitting by allowing it to stand completely immersed in medium viscosity (S.A.E. 30—40) engine oil for at least 24 hours. In cases of extreme urgency, this period of soaking may be shortened by heating the oil to 100°C. for 2 hours and then allowing to cool before removing the bush.

The bush is pressed into the shank with a shouldered mandrel. The mandrel should be hardened and polished and approximately 0·0005″ greater in diameter than the distributor shaft. To prevent subsequent withdrawal of the bush with the mandrel, a stripping washer should be fitted between the shoulder of the mandrel and the bush.

Under no circumstances should the bush be overbored by reamering or by any other means, since this will impair the porosity and therefore the lubricating quality of the bush.

Re-assembly

When re-assembling, Ragosine molybdenised non-creep oil or (failing this) clean engine oil, should be smeared on the shaft and, more lightly, on the contact breaker bearing plate.

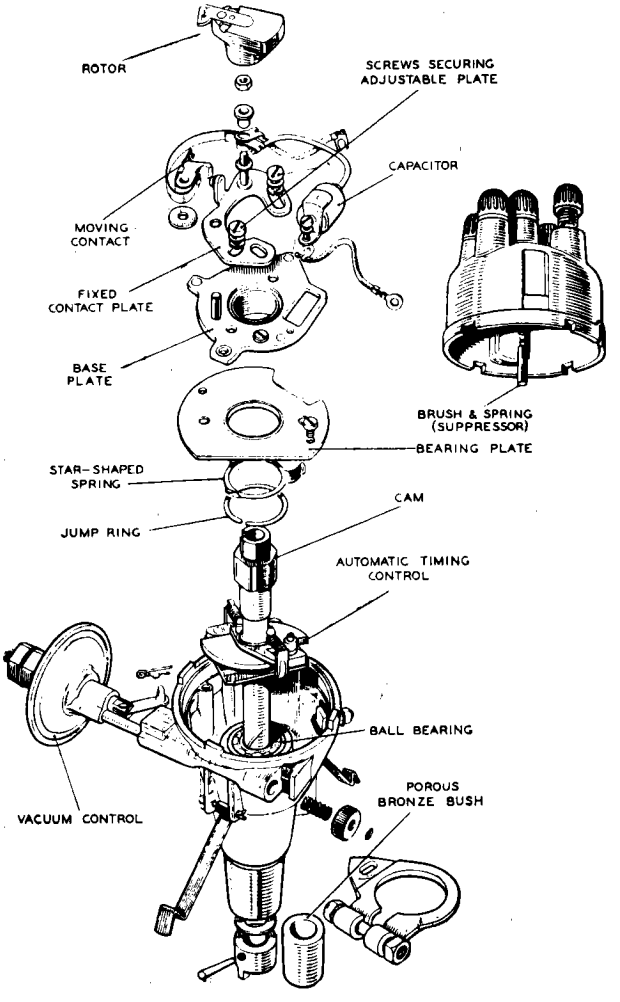


Fig. 4. Exploded view of distributor.

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		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	
DMBZ 6A	40617A	54410415	20 13 9 7½ 6	7—9 6—8½ 2½—5½ 0—3 0—½	4½	54410416	2,000	12	1,500 1,300 850 650 450	10—12 9—11 7—9 3½—6½ 0—2½	325

Auto advance weights Lucas number 410033/S. One inch of mercury = 0·0345 kg/cm²

FLASHER UNITS

The flasher unit is housed in a cylindrical container plugged into a base block which is a part of the main wiring harness, and is attached to the bulkhead behind the facia on the driver's side.

The electrical contact is made by means of three blades, extending from the base of the unit. These blades are offset to prevent any possibility of a wrong connection being made.

The automatic operation of the flasher lamps is controlled by means of a switch, contained in the flasher unit, being operated automatically by the alternative heating and cooling of an actuating wire; also incorporated is a small relay to flash the indicator warning lights when the system is functioning correctly. Failure of either of these lights to flash will indicate a fault.

In the event of trouble occurring the following procedure should be followed:—

(i) Check bulbs for broken filaments.

(ii) Refer to the wiring diagram and check all flasher circuit connections.

(iii) Switch on the ignition and check with a voltmeter that flasher unit terminal 'B' is at 12 volts, with respect to earth.

(iv) Connect together flasher unit terminals 'B' and 'L' and operate the direction indicator switch. If the flasher lamps now light the flasher unit is defective and must be replaced.

(v) If after the above checks the bulb still does not light a fault is indicated in the flasher switch which is best checked by substitution.

Note: It is important that only bulbs of the correct wattage rating (that is, 21 watts) are used in the flasher lamps.

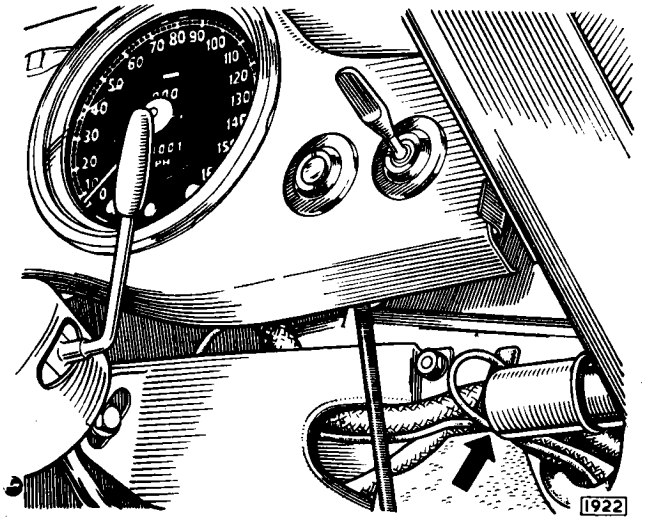


Fig. 5. Showing position of flasher unit behind facia panel.

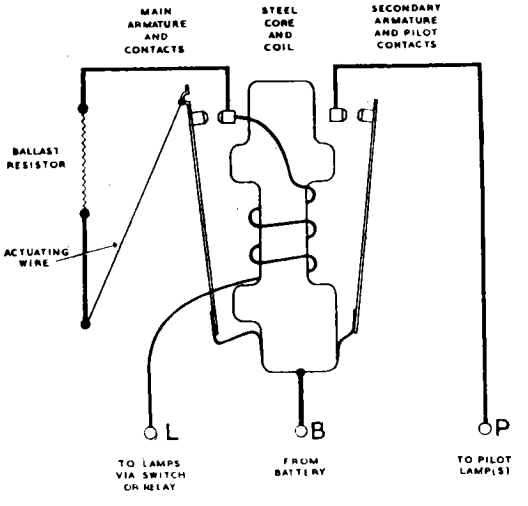


Fig. 6. Flasher unit circuit diagram.

FUSE UNITS

Four Model 4 FJ fuse units, each carrying two live glass cartridge type fuses and two spares, are incorporated in the electrical system and are located behind the instrument panel.

Access to the fuses is obtained by removing the two instrument panel retaining screws (top left-hand and top right-hand corners).

The instrument panel will then hinge downwards exposing the fuses and the fuse indicator panel. The circuits controlled by individual fuses are shown on the indicator panel and it is essential that the blown fuse is replaced by one of the correct value.

Only one end of the spare fuses is visible and they are retained in position by a small spring clip. Always replace the spare fuse as soon as possible.

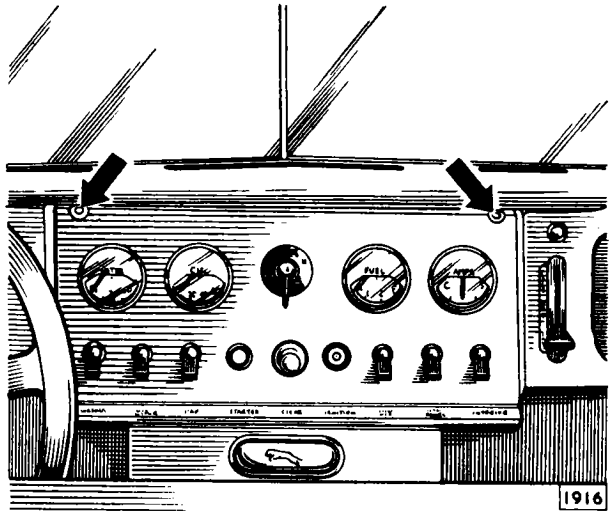


Fig. 7. The instrument panel, the two arrows indicate the securing screws.

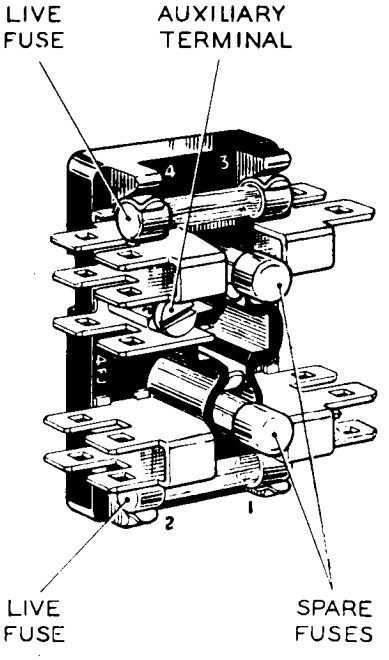


Fig. 8. The Model 4J fuse unit.

GENERATOR—MODEL C42

(Fitted to later "E" Type models)

REMOVAL

Disconnect the cables from the two terminals at the rear of the dynamo noting that they are of different sizes.

Remove the nut and bolt securing the adjusting link to the dynamo.

Remove the two nuts and bolts securing the dynamo to the mounting bracket when the dynamo can be lifted out.

Remove the dynamo belt.

REFITTING

Refitting is the reverse of the removal procedure. When the dynamo belt has been refitted move the dynamo to a position where it is possible to depress the belt about ½" (12 mm.) midway between the water pump and dynamo pulleys.

1. GENERAL

The generator is a shunt-wound, two-pole, two-brush machine, arranged to work in conjunction with Lucas regulator unit model RB340. A fan, integral with the driving pulley, draws cooling air through the generator, inlet and outlet holes being provided in the end brackets of the unit.

The output of the generator is controlled by the regulator unit and is dependent on the state of charge of the battery and the loading of the electrical equipment in use. When the battery is in a low state of charge, the generator gives a high output, whereas if the battery is fully charged, the generator gives only sufficient output to keep the battery in good condition without any possibility of over-charging. An increase in output is given to balance the current taken by lamps and other accessories when in use.

2. ROUTINE MAINTENANCE

(a) **Lubrication**

Every 5,000 miles, inject a few drops of high quality viscosity (S.A.E. 30) engine oil into the hole marked "OIL" at the end of the C.E. bracket bearing housing.

(b) **Inspection of Brushgear**

Every 24,000 miles the generator should be removed from the engine and the brushgear checked as detailed in paragraph 4c.

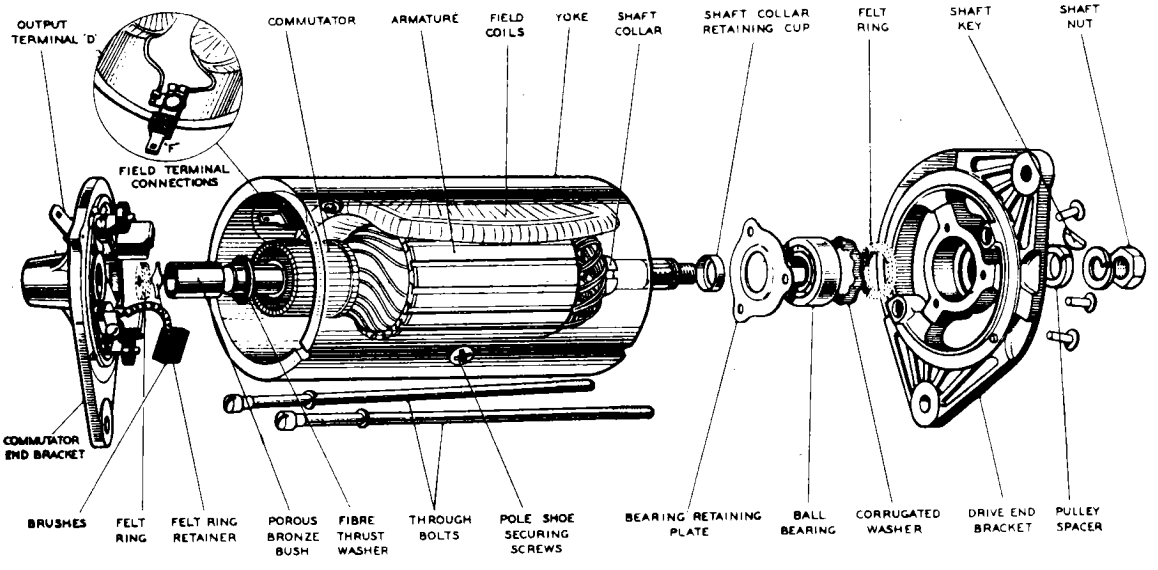


Fig. 9. Exploded view of Model C42 generator.

(c) **Belt Adjustment**

Occasionally inspect the generator driving belt and, if necessary, adjust to take up any undue slackness by turning the generator on its mounting. Care should be taken to avoid overtightening the belt, the tension needed being just enough to drive without slipping. See that the machine is properly aligned, otherwise undue strain will be thrown on the generator bearings.

3. PERFORMANCE DATA

Cutting-in Speed	1,250 r.p.m. (max.) at 13·0 generator volts.
Maximum Output	30 amps at 2,200 r.p.m. (max.) at 13·5 generator volts.
Field Resistance	4·5 ohms.

4. SERVICING

(a) **Testing in position to Locate Fault in Charging Circuit**

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

i. Inspect the driving belt and adjust if necessary (see Paragraph 2c).

ii. Check the connections on the commutator end bracket. The larger connector carries the main generator output, the smaller connector the field current.

iii. Pull off the connectors from the terminal blades of the generator and connect the two terminal blades with a short length of wire.

iv. Start the engine and set to run at normal idling speed.

v. Clip the negative lead of a moving coil type voltmeter, calibrated 0—20 volts, to one generator terminal and the positive lead to a good earthing point on the yoke.

vi. Gradually increase the engine speed, when the voltmeter reading should rise rapidly and without fluctuation. Do not allow the voltmeter reading to reach 20 volts and do not race the engine in an attempt to increase the voltage. It is sufficient to run the generator up to a speed of 1,000 r.p.m.

If the voltage does not rise rapidly and without fluctuation the unit must be dismantled (see Paragraph 4b) for internal examination.

Excessive sparking at the commutator in the above test indicates a defective armature which should be replaced.

NOTE : If a radio suppression capacitor is fitted between the output terminal and earth, disconnect this capacitor and re-test the generator before dismantling. If a reading is now given on the voltmeter, the capacitor is defective and must be replaced.

If the generator is in good order, remove the link from between the terminals and restore the original connections.

(b) **To Dismantle**

i. Take off the driving pulley.

ii Unscrew and withdraw the two through bolts.

iii Withdraw the commutator end bracket from the yoke.

iv. Lift the driving end bracket and armature from the yoke. Take care not to lose the fibre thrust washer or collar from the commutator end of the shaft.

v. The driving end bracket, which on removal from the yoke has withdrawn with it the armature and armature shaft ball bearing, need not be separated from the shaft unless the bearing is suspected and requires examination, or the armature is to be replaced; in this event the armature should be removed from the end bracket by means of a hand press, having first removed the shaft key.

(c) **Brushgear** (Checking with yoke removed)

i. Lift the brushes up into the brush boxes and secure them in that position by positioning the brush spring at the side of the brush.

ii. Fit the commutator end bracket over the commutator and release the brushes.

iii. Hold back each of the brush springs and move the brush by pulling gently on its flexible connector. If the movement is sluggish, remove the brush from its holder and ease the sides by lightly polishing on a smooth file. Always refit

brushes in their original positions. If the brushes are badly worn, new brushes must be fitted and bedded to the commutator. The minimum permissible length of brush is $\frac{1}{4}$".

iv. Test the brush spring tension utilizing a spring balance. The tension needed to just lift the spring from contact with the brush with a new spring and a new brush is 33 ozs. but with a brush worn to $\frac{1}{4}$" it may reduce to 16 ozs. Both pressures should be measured. Renew any brush spring when the tension falls below these values.

(d) **Commutator**

A commutator in good condition will be smooth and free from pits or burned spots.

Clean the commutator with a petrol-moistened cloth. If this is ineffective carefully polish with a strip of fine glass paper while rotating the armature. To remedy a badly worn commutator, first rough turn the commutator and then undercut the insulator between the segments to a depth of $\frac{1}{32}$". Finally, take a light skim with a very sharp (preferably diamond-tipped) tool. If a non-diamond tipped tool is used for machining, the commutator should be lightly polished with a very fine glass paper. Emery cloth must not be used on the commutator. Finally clean away any dust.

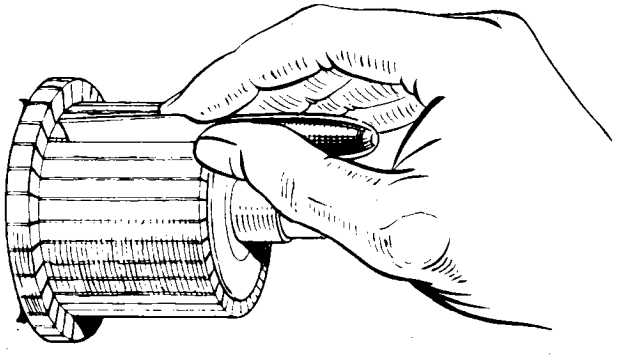


Fig. 10. Undercutting the commutator insulation.

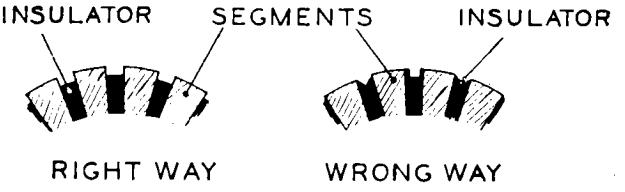


Fig. 11. Showing the correct and incorrect way of undercutting the commutator insulation.

(e) **Armature**

Indication of an open-circuited armature winding will be given by burnt commutator segments. If armature testing facilities are not available, an armature can be checked by substitution. To separate the armature shaft from the drive end bracket, press the shaft out of the drive end bracket bearing.

When fitting the new armature, support the inner journal of the ball bearing, using a mild steel tube of suitable diameter, whilst pressing the armature shaft firmly home (see also paragraph 4h).

(f) **Field Coils**

Measure the resistance of the field coils, without removing them from the generator yoke, by means of an ohm meter connected between the field terminal and the yoke. Field resistance is 4·5 ohms.

If an ohm meter is not available, connect a 12 volt d.c. supply between the field terminal and generator yoke with an ammeter in series. The ammeter reading should be approximately 2·7 amperes. Zero reading on the ammeter or an "Infinity" ohm meter indicates an open circuit in the field winding.

If the current reading is much more than 2·7 amperes, or the ohm meter reading much below 4·5 ohms, it is an indication that the insulation of one of the field coils has broken down.

In either event, unless a substitute generator is available, the field coils must be replaced. To do this, carry out the procedure outlined below:

i. Drill out the rivet securing the field coil terminal assembly to the yoke and remove the insulating sleeve from the terminal block to protect it from the heat of soldering. Unsolder the terminal blade and earthing eyelet.

ii. Remove the insulation piece which is provided to prevent the junction of the field coils from contacting with the yoke.

iii. Mark the yoke and pole shoes so that the latter can be refitted in their original positions.

iv. Unscrew the two pole shoe retaining screws by means of a wheel-operated screwdriver.

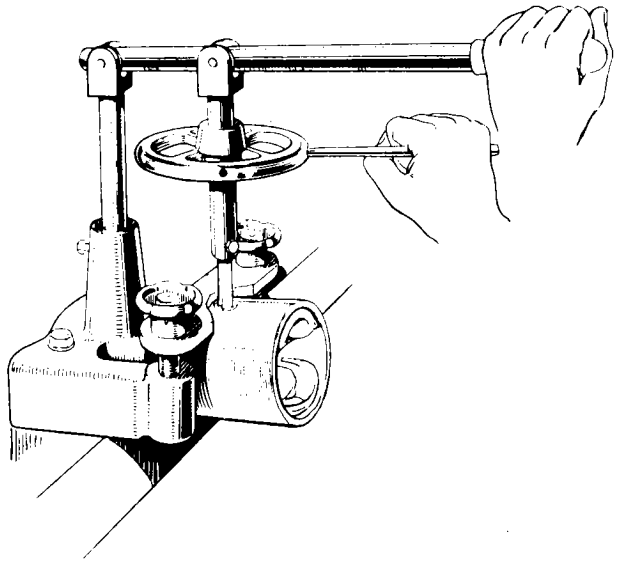


Fig. 12. Tightening the pole shoe retaining screws.

v. Draw the pole shoes and coils out of the yoke and lift off the coils.

vi. Fit the new field coils over the pole shoes and place them in position inside the yoke. Take care to ensure that the taping of the field coils is not trapped between the pole shoes and the yoke.

vii. Locate the pole shoes and field coils by lightly tightening the fixing screws.

viii. Fully tighten the screws by means of the wheel-operated screwdriver.

ix. Solder the original terminal blade and earthing eyelet to the appropriate coil ends.

x. Refit the insulating sleeve and re-rivet the terminal assembly to the yoke.

xi. Refit the insulation piece behind the junction of the two coils.

(g) **Bearings**

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

To replace the bearing bush in a commutator end bracket, proceed as follows:—

i. Remove the old bearing bush from the end bracket. The bearing can be withdrawn with a suitable extractor or by screwing a $\frac{5}{8}$" tap into the bush for a few turns and pulling out the bush with the tap. Screw the tap squarely into the bush to avoid damage to the bracket.

ii. Withdraw and clean the felt retainer and felt ring.

iii. Insert the felt ring and felt ring retainer in the bearing housing, then press the new bearing bush into the end bracket, using a self-extracting tool as illustrated, the fitting pin or mandrel portion being of 0·5924" diameter and highly polished. To withdraw the pin after pressing

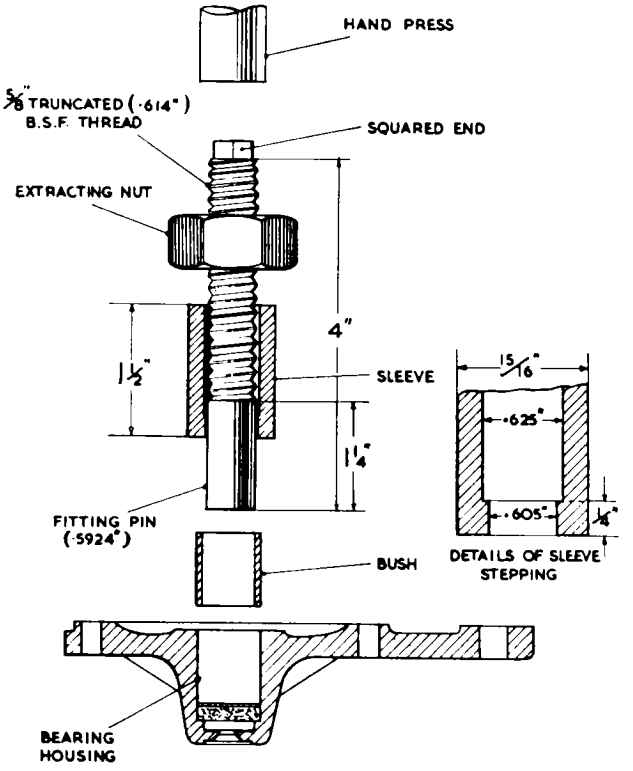


Fig. 13. Method of fitting the porous bronze bush.

the bush fully home, turn the nut against the sleeve while gripping the squared end of the fitting pin.
Porous bronze bushes must not be opened out after fitting, or the porosity of the bush may be impaired.

Note: Before fitting the new bearing bush, it should be allowed to stand for 24 hours completely immersed in a good grade S.A.E. 30 engine oil; this will allow the pores of the bush to be filled with lubricant.
The ball bearing at the driving end is replaced as follows:—

i. Drill out the rivets which secure the bearing retaining plate to the end bracket and remove the plate.

ii. Press the bearing out of the end bracket. Remove and clean the corrugated washer and felt ring.

iii. Before fitting the replacement bearing, see that it is clean and pack it with high melting point grease such as Energrease RBB3.

iv. Place the felt ring and corrugated washer in the bearing housing in the end bracket.

v. Locate the bearing in the housing and press it home.

vi. Fit the bearing retaining plate. Insert the new rivets from the pulley side of the end bracket and open the rivets by means of a punch to secure the plate rigidly in position.

(h) **To Re-assemble**

i. Fit the drive end bracket to the armature shaft. The inner journal of the bearing must be supported by a tube, approximately 4" long $\frac{1}{8}$" thick and internal diameter $\frac{5}{8}$". Do not use the drive end bracket as a support for the bearing whilst fitting an armature.

ii. Fit the yoke to the drive end bracket.

iii. Lift the brushes up into the brush boxes and secure them in that position by positioning each brush spring at the side of its brush.

iv. Fit the fibre thrust washer on the shaft. Fit the commutator end bracket to the yoke, so that the dowel on the bracket locates with the groove on the yoke. Take care not to trap the brush connector pigtails. Insert a thin screwdriver through the ventilator apertures adjacent to the brush boxes and carefully lever up the spring arms until the bushes locate correctly on the commutator.

v. Refit the two through bolts, pulley spacer and shaft key.

vi. After reassembly, lubricate the commutator end bearing (see Paragraph 2a).

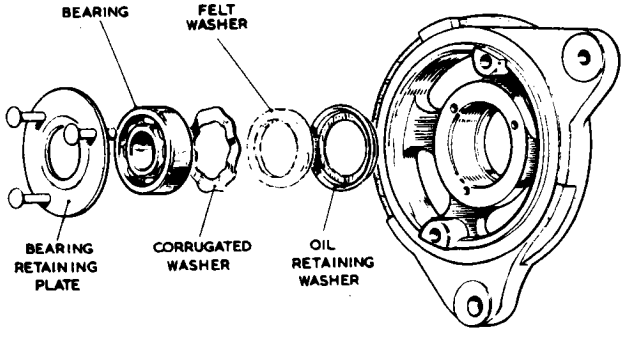


Fig. 14. Exploded view of drive and bearing.

GENERATOR — MODEL C.45 PVS-6

(Fitted to early "E" Type models)

REMOVAL

Disconnect the cables from the two terminals at the rear of the dynamo noting that they are of different sizes.

Remove the nut and bolt securing the adjusting link to the dynamo.

Remove the two nuts and bolts securing the dynamo to the mounting bracket when the dynamo can be lifted out.

Remove the dynamo belt.

REFITTING

Refitting is the reverse of the removal procedure. When the dynamo belt has been refitted, move the dynamo to a position where it is possible to depress the belt about ½" (12 mm.) midway between water pump and dynamo pulleys.

While the generator has different dimensions and performance from Model C42 previously described, its construction is similar, and the same servicing procedure applied in general. The essential differences between the two generators concern:—

(i) Performance.
(ii) Brushgear inspection.
(iii) Commutator end bearing.

PERFORMANCE

Cutting-in Speed	1,300 (max.) r.p.m. at 13·0 generator volts.
Maximum Output	25 amperes at 2,050 (max.) r.p.m. at 13·5 generator volts.
Field Resistance	6·0 ohms.

BRUSHGEAR INSPECTION

The yoke is provided with "windows" and a band cover. The instructions given for model C42 under paragraph 4c (i-iii) need not, therefore, be followed in order to gain access to the brushes for inspection and spring testing—it being only necessary to slacken a single clamping screw and release the band cover. Minimum permissible brush length is $\frac{11}{32}$". Brush spring tesion 28 ozs. with new brush, 20 ozs. with brush worn to $\frac{11}{32}$".

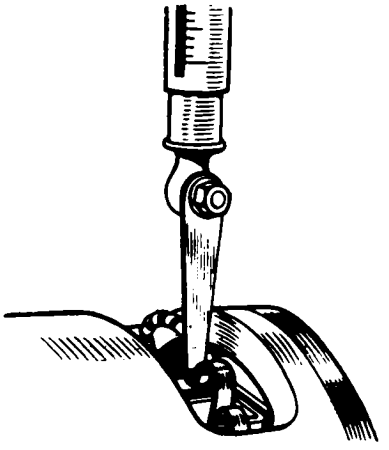


Fig. 15. Testing the brush spring tension.

COMMUTATOR END BEARING

A ball bearing is fitted at the commutator end of the armature shaft. Details are shown in the illustration. The bearing is secured to the shaft by a thrust screw and can be withdrawn with an extractor after the screw has been removed.

When replacing a defective bearing see that the new bearing is clean and packed with high melting point grease. It must be pressed home against the shoulder on the shaft and secured with the thrust screw.

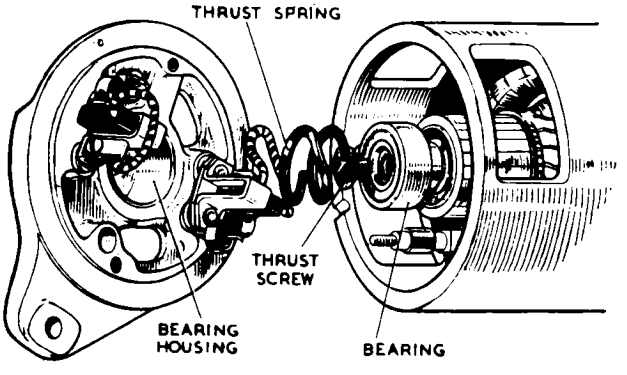


Fig. 16. Showing the end plate removed.

HORNS

It is important to keep the horn mounting bolts tight and to maintain rigid the mountings of any units fitted near the horns. Electrical connections and cables should be checked occasionally and rectified as required.

REMOVAL

Remove the six screws securing the headlight rim, remove the rim, rubber seal and headlight glass. Remove the three screws securing the headlight duct to the diaphragm panel and withdraw the duct forwards through the headlight glass aperture. The horn may now be seen through the aperture. Remove the two securing nuts and bolts, remove the cover from the horn by unscrewing the central screw and detach the wires. The horn may now be withdrawn.

ADJUSTMENT

Adjustment is effected after removal of the domed cover by means of the fixed contact screw.

Connect a 0—20 first grade moving coil ammeter in series with horn. Release contact locknut and adjust contact until horn will pass 13—15 amperes at 12 volts. Retighten locknut and check.

Refit domed cover.

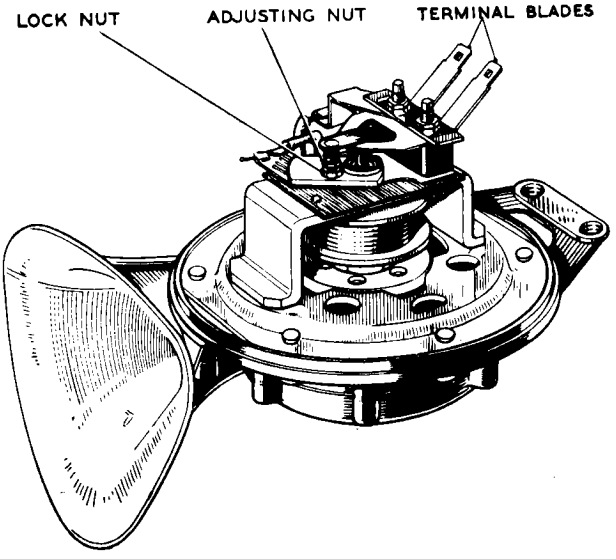


Fig. 17. The horn adjustment screw.

LAMPS

LIGHT BULBS

LAMP	LUCAS BULB NUMBER	VOLTS	WATTS	APPLICATION
Head	416	12	60/40	Home and R.H. Drive Export
	417	12	60/40	L.H. Drive Export
	410	12	45/40	European Continental
(Yellow)	411	12	45/40	France
		Sealed beam unit		U.S.A. and Canada
Side	989	12	6	
Front and Rear Flashing Indicators	382	12	21	
Rear/Brake	380	12	21/6	
Interior Lights	382	12	21	Open 2 Seater
	989	12	6	Fixed Head Coupe
Map Light	989	12	6	
Instrument Illumination Headlamp Warning Light Ignition Warning Light Fuel Level Warning Light Handbrake/Brake Fluid Warning Light Mixture Control Warning Light	987	12	2·2	
Switch Indicator Strip Flashing Indicator Warning Light	281	12	2	

HEADLAMPS

The headlamps comprise two Lucas light units with pre-focus double-filament bulbs (excepting U.S.A., export models, which are provided with an adaptor to accept American Sealed Beam Units) front rims and dust excluding rubber rings.

Since the spread of light and its position on the kerbside in the dipped position is a function of lensing and bulb design, special light units and bulbs are fitted to suit lighting regulations of the country in which a car is used. Special care should therefore be taken when replacing a bulb to see that the correct replacement is fitted.

Bulb Replacement

Remove the six screws holding glass headlamp cover retaining ring to wing. Remove ring and rubber ring now exposed. Remove glass cover.

Release the three cross-headed screws retaining headlamp glass and reflector unit rim and remove rim by turning in an anti-clockwise direction.

Note: It is not necessary to remove screws completely.

Light unit can now be withdrawn.

Remove plug with attached cables from unit. Release bulb retaining spring clips and withdraw bulb.

Replace with bulb of correct type. When re-assembling note that a groove in the bulb plate must register with a raised portion on the bulb retainer.

Replace spring clips and refit light unit assembly.

Refit retaining ring by turning in a clockwise direction and tighten the three cross-headed screws.

Note: Do not turn the two slotted screws or the setting of the headlamp will be upset.

Refit glass cover and retaining ring with rubber seal.

Headlamp Setting

The headlamps should be set so that when the car is carrying its normal load the driving beams are projected parallel with each other and parallel with the ground (see Fig.19).

When setting remove glass cover retaining ring rubber seal and glass cover. Cover one lamp whilst adjusting the other.

The setting of the beams are adjusted by the two slotted screws, one being located at the bottom centre and the other one at centre right-hand side. The bottom screw is for vertical adjustment, the side screw being for horizontal. After adjustment replace glass cover and retaining ring with rubber seal.

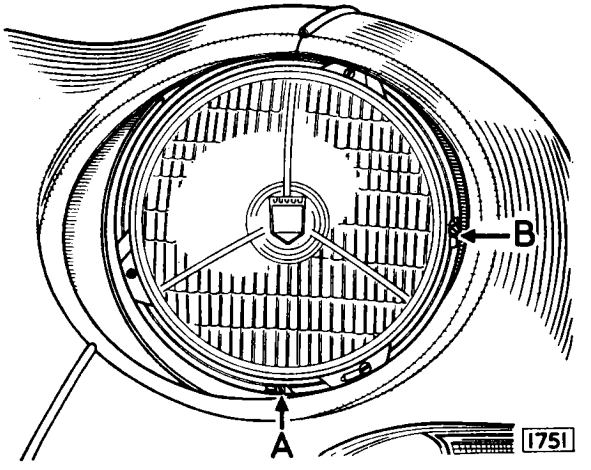


Fig. 19. Adjustment of the screw 'A' will alter the headlamp beam in the vertical plane; adjustment of the screw 'B' will alter the beam in the horizontal plane.

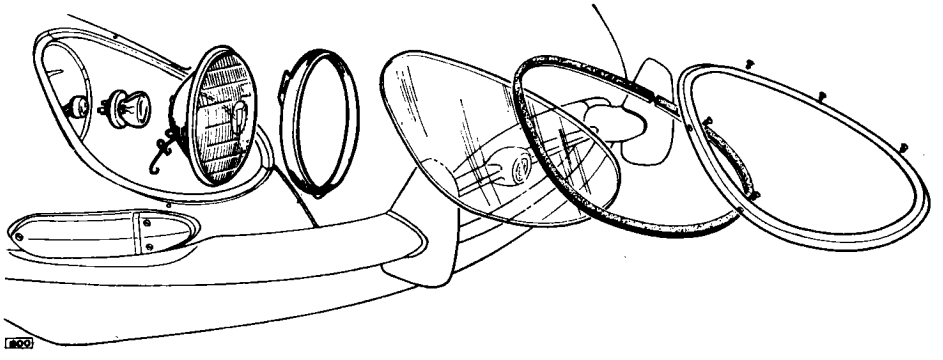


Fig. 18. Headlamp bulb removal.

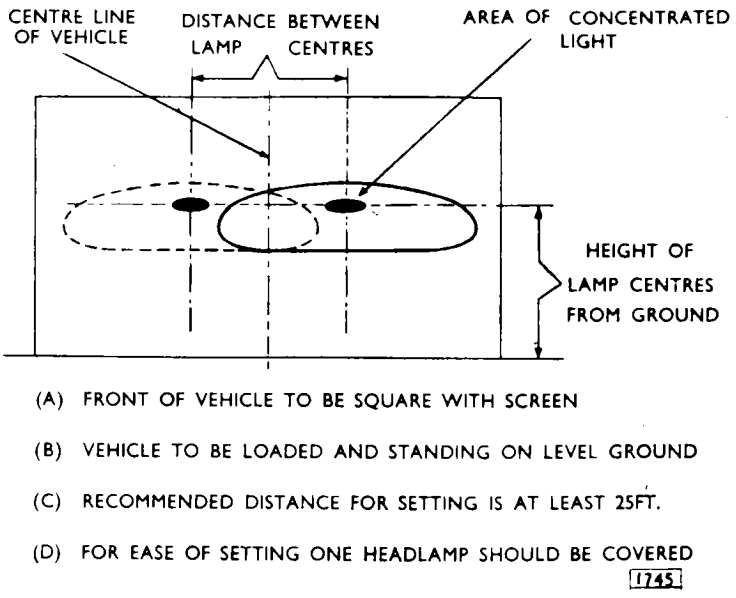


Fig. 20. Headlamp beam setting.

Sidelamp Bulb—Replacement

Remove the three screws retaining the lamp glass and remove glass. The sidelamp bulb is the inner one of the two exposed and is removed by pressing inwards and turning anti-clockwise.

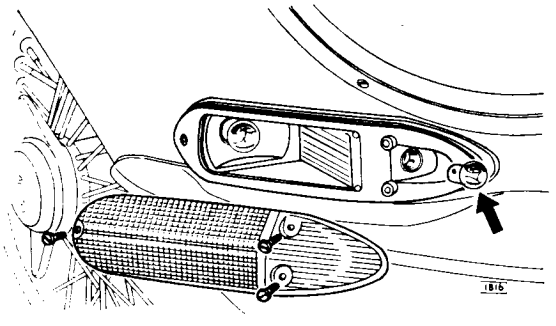


Fig. 21. Sidelamp bulb removal.

Front Flasher Bulb—Replacement

Proceed as for the sidelamp bulb. The flasher bulb is the outer one of the two exposed.

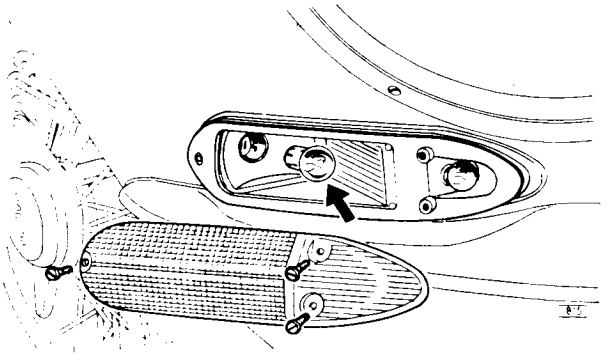


Fig. 22. Front flasher bulb removal.

Rear/Brake Bulb—Replacement

Remove the two screws retaining the lamp glass and remove glass. The rear/brake bulb is the inner one of the two bulbs exposed and is removed by pressing inwards and turning anti-clockwise. When fitting a replacement bulb note that the pins are offset.

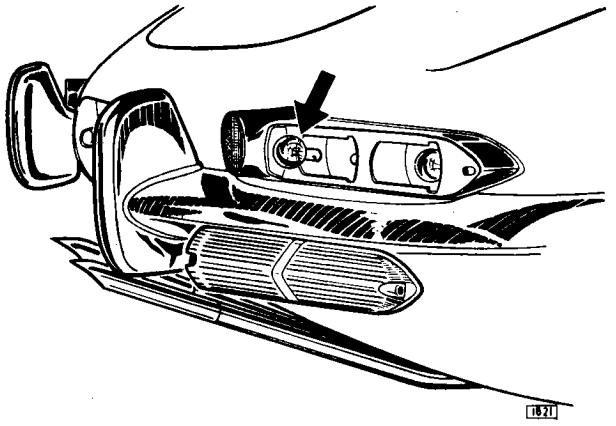


Fig. 23. Rear/brake bulb removal.

Rear Flasher Bulb—Replacement

Proceed as for rear/brake bulb. The flasher bulb is the outer one of the two exposed.

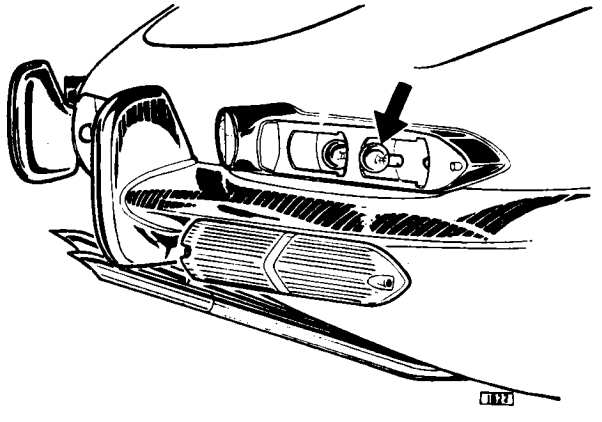


Fig. 24. Rear flasher bulb removal.

Number Plate Lamp Bulb—Replacement

Remove the fixing screw retaining rim and lamp glass and detach glass rim and gasket. Remove bulb by pressing inwards and turning anti-clockwise.

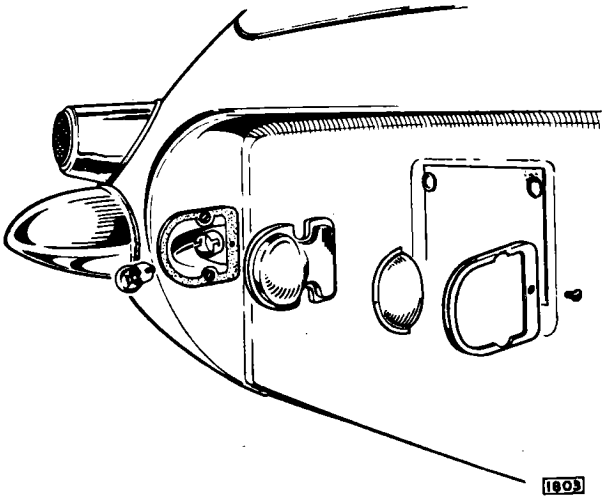


Fig. 25. Number plate lamp bulb removal.

Interior—Luggage Lamp Bulb—Replacement

The interior—luggage lamp bulb is retained in a holder accessible when the boot lid is raised. To remove bulb from its holder press inwards and turn anti-clockwise.

Reverse Lamp Bulb—Replacement

Remove the two screws retaining the lamp glass and detach the glass and gasket. Remove the bulb by pressing and rotating in an anti-clockwise direction.

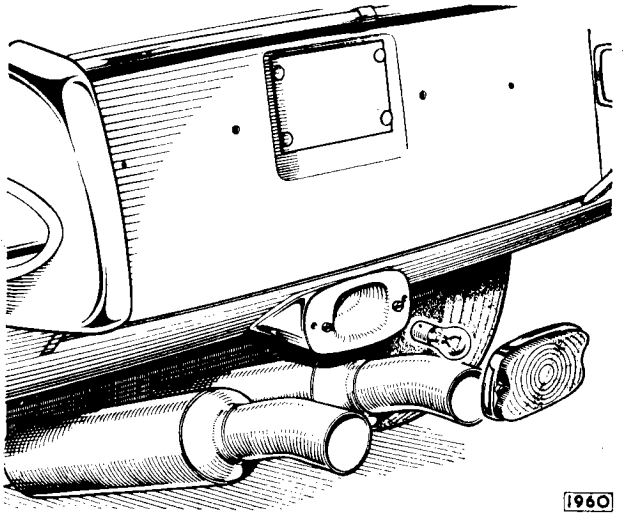


Fig. 26. Reverse lamp bulb removal.

RB 310 CURRENT–VOLTAGE REGULATOR

(Fitted to early "E" type models to control generator C45 PV-6)

(a) CHECKING CONTINUITY BETWEEN BATTERY AND CONTROL BOX

If the generator and battery are in order, disconnect the cables from control box terminal blades 'B' and connect them to the negative terminal of a good quality 0—20 moving coil voltmeter.

Connect the positive terminal of the voltmeter to an earthing point on the chassis. If the meter registers battery voltage, i.e. 12 volts, the wiring is in order and the control box settings should be checked.

If there is no reading, re-connect the cables to terminal blades 'B' and examine the wiring between battery, ammeter, and control box for defective cables or loose connections.

(b) VOLTAGE REGULATOR ADJUSTMENT

The regulator is carefully set during manufacture and, in general, it should not be necessary to make further adjustment. However, if the battery fails to keep in a charged condition or if the generator output does not fall when the battery is fully charged, the setting should be checked and, if necessary, corrected.

It is important to check before altering the regulator setting that the low state of charge of the battery is not due to a defective battery or to slipping of the generator belt. Only a good quality MOVING COIL VOLTMETER (0—20 volts) must be used when checking the regulator. The open circuit setting can be checked without removing the cover from the control box.

Disconnect the cables from the control box terminal blades 'B' and join the ignition and battery feeds together using a suitable "jumper lead".

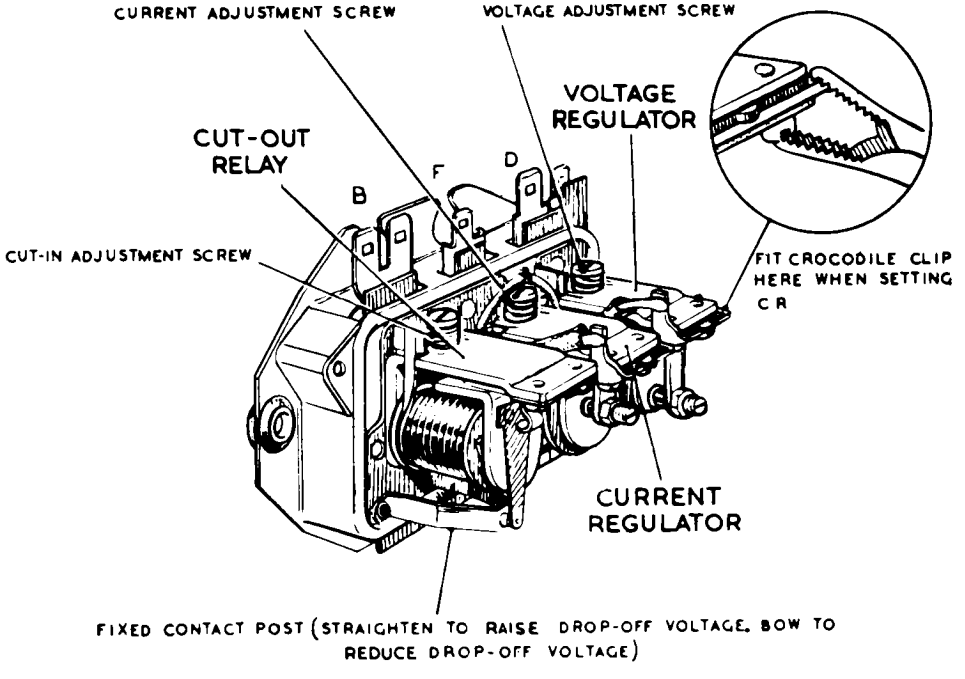


Fig. 27. The RB.310 control box showing the position of the three spring loaded adjusting screws.

Connect the voltmeter to control box terminal 'D' and a good earthing point.

The regulator should be at ambient temperature, i.e. as measured in its immediate vicinity, and adjustment should be completed within thirty seconds, otherwise heating of the shunt coil by the energising current may cause false settings to be made.

Run the engine up until the generator speed reaches 3,000 r.p.m. (2,000 engine r.p.m.) when the open circuit voltage reading should lie within the following limits:—

Ambient Temperature	Open Circuit Voltage Setting
10°C. (50°F.)	15·1—15·7
20°C. (68°F.)	14·9—15·5
30°C. (86°F.)	14·7—15·3
40°C. (104°F.)	14·5—15·1

If the voltmeter reading is outside the specified limits rotate the voltage regulator adjusting screw, which is adjacent to the 'D' terminal, clockwise, to raise the setting or anti-clockwise to reduce the setting. Check the setting by switching off the engine, restarting and then raising the generator speed to 3,000 r.p.m. (2,000 engine r.p.m.) and make any final adjustment.

(c) CURRENT REGULATOR ADJUSTMENT

When setting the current regulator on the vehicle, the generator must be made to develop its full rated output, regardless of the state of charge of the battery at the time of setting. The voltage regulator must therefore be rendered inoperative. To do this, the voltage regulator contact should be short-circuited with a crocodile or bulldog clip placed between the insulated fixed contact bracket and the voltage regulator frame.

Disconnect the cables from terminal blades 'B' and, using a suitable "jumper lead" connect a 0—40 first grade moving coil ammeter between these cables and terminal blades 'B'.

Start the engine and run the generator at about 4,000 r.p.m. (2,700 engine r.p.m.) when the ammeter should read 24—26 amperes. If the ammeter is outside the specified limit rotate the current adjusting screw, which is the centre of the three, clockwise to raise the setting or anti-clockwise to reduce the setting. Check the setting by switching off the engine, restarting and then raising the generator speed to 4,000 r.p.m. (2,700 r.p.m.) and make any final adjustment.

Restore the original connections.

(d) CLEANING REGULATOR CONTACTS

After long periods of service it may be found necessary to clean the contacts of the voltage and current regulators. These may be cleaned with silicon carbide paper, fine carborundum stone or fine emery cloth. All traces of metal dust or other foreign matter must be removed with methylated spirits (denatured alcohol).

(e) CUT-OUT ADJUSTMENT

If the regulator is correctly set but the battery is still not being charged, the cut-out may be out of adjustment.

i. **Method of Setting Cut-in Voltage**

Partially withdraw the Lucar cable connector from control box terminal blade 'D'.

Connect a first-grade 0—20 volt moving coil voltmeter between the exposed portion of terminal blade 'D' and a good earthing point, taking care not to short-circuit terminal 'D' to the base.

Start the engine and slowly increase the speed, while observing the voltmeter pointer. The voltage should rise steadily and then drop slightly at the instant of contact closure. The cut-in voltage is that which is indicated immediately before the pointer drops back. It should lie between the limits 12·7—13·3 volts.

Note: Should the instant of contact closure be indeterminate and difficult to ascertain, due to the cut-in and battery voltages being approximately equal, switch on the headlamps in order to depress the battery voltage. Repeat the rising voltage check, when a definite drop should be observed as contacts close.

If the cut-in voltage occurs outside the above limits, an adjustment must be made by rotating the cut-out adjusting screw, which is adjacent to the 'B' terminal blades, a fraction at a time clockwise to raise the setting or anti-clockwise to reduce the setting. Test after each adjustment by increasing the engine speed and note the voltmeter reading at the instant of contact closure. Electrical settings of the cut-out, like the voltage regulator, must be effected as quickly as possible because of temperature rise effects.

ii. **Method of Setting Drop-off Voltage**

Withdraw the cables from control box terminal blades 'B' and (to provide a battery feed to the

ignition coil) connect them together with a suitable "jumper lead".

Connect a first-grade 0—20 volt moving coil voltmeter between one of the terminal blades 'B' and a good earthing point.

Start the engine and run it up to above cut-in speed.

Slowly decelerate and observe the voltmeter pointer.

Opening of the contacts, indicated by the voltmeter pointer dropping to zero, should occur between the limits 9·5—11·0 volts. If it does not, the spring force exerted by the moving contact blade must be adjusted by altering the height of the fixed contact.

To do this, carefully straighten the legs of the fixed contact post to raise the drop-off voltage or bow them to reduce it. Repeat the test and, if necessary, re-adjust until the armature releases at the specified voltage.

(f) CLEANING CUT-OUT CONTACTS

After long periods of service it may be found necessary to clean the cut-out contacts. These may be cleaned with fine glass paper. All traces of metal dust or other foreign matter must be removed with methylated spirits (de natured alcohol).

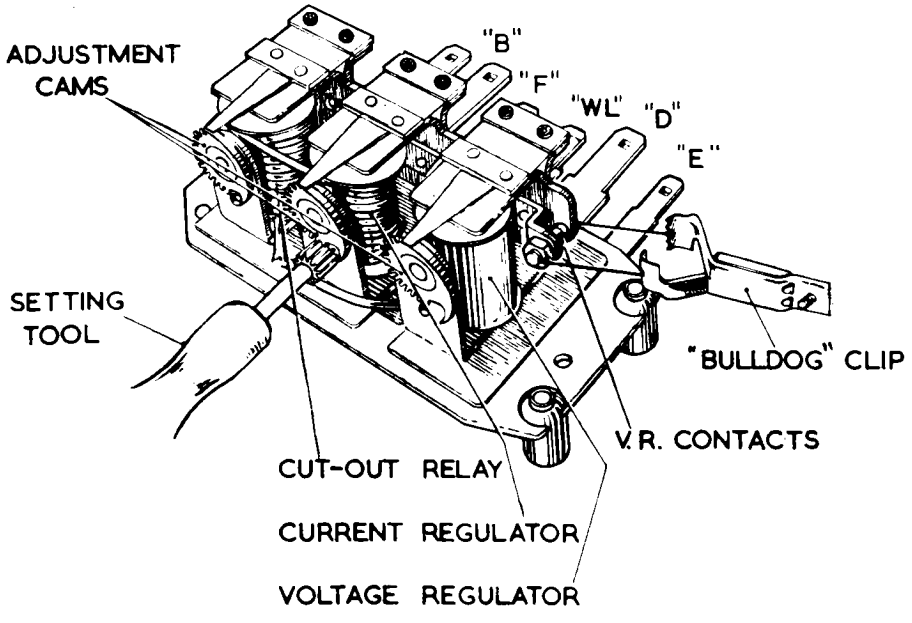


Fig. 28. The RB.340 control box showing the position of the three cam adjusters.

RB. 340 CURRENT—VOLTAGE REGULATOR

(Fitted to later "E" type models to control generator model C42)

(a) CHECKING CONTINUITY BETWEEN BATTERY AND CONTROL BOX

Instructions as given for model RB.310.

(b) VOLTAGE REGULATOR ADJUSTMENT

Instructions as given for model RB.310 except for actual setting procedure and voltage limits which are as follows:—

Using a suitable tool, turn the voltage adjustment cam until the correct setting is obtained—turning the tool clockwise to raise the setting or anti-clockwise to lower it.

Ambient Temperature	Open Circuit Voltage Setting
10°C. (50°F.)	15·0—15·6
20°C. (68°F.)	14·8—15·4
30°C. (86°F.)	14·6—15·2
40°C. (104°F.)	14·4—15·0

(c) CURRENT REGULATOR ADJUSTMENT

Instructions as given for model RB.310 except for actual setting procedure and current limits, which are as follows:—

Using a suitable tool, turn the current adjustment cam until the correct setting is obtained—turning the tool clockwise to raise the setting or anti-clockwise to lower.

Current Regulator Setting $30 \pm 1\frac{1}{2}$ amperes.

(d) CLEANING REGULATOR CONTACTS

Instructions as given for model RB.310.

(e) CUT-OUT ADJUSTMENT

Instructions as given for model RB.310 except as follows:—

i. **Method of Setting Cut-in Voltage**

Using a suitable tool, turn the cut-out relay adjustment cam until the correct setting is obtained —turning the tool clockwise to raise the setting or anti-clockwise to lower it.

Cut-in Voltage Setting 12·6—13·4 volts.

ii. **Method of Setting Drop-off Voltage**

between the limits 9·25—11·25 volts.

To do this, carefully bend the fixed contact bracket. Closing the gap will raise the drop-off voltage. Opening the gap will reduce the drop-off voltage.

(f) CLEANING CUT-OUT CONTACTS

After long periods of service it may be found necessary to clean the cut-out contacts. These may be cleaned with fine glass paper. All traces of metal dust or other foreign matter must be removed with methylated spirits (denatured alcohol).

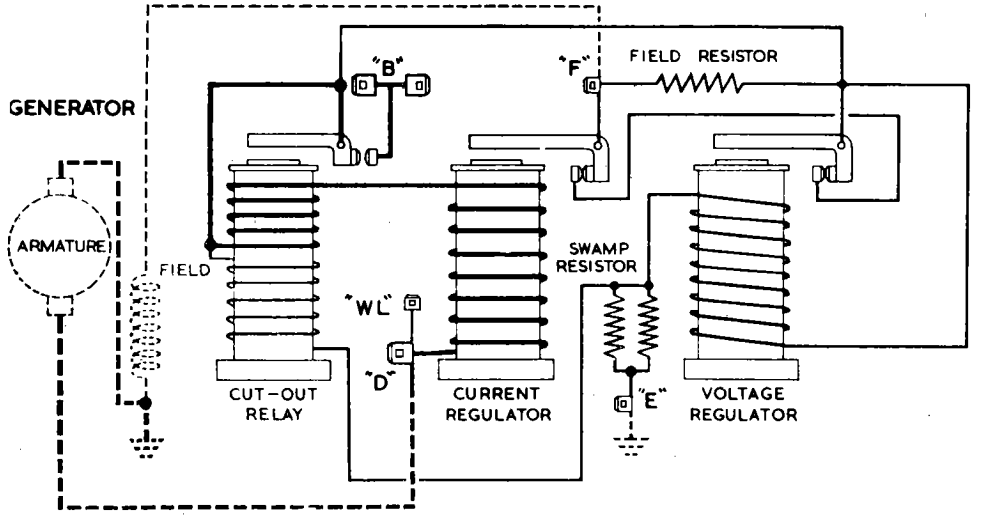


Fig. 29. The circuit diagram of the RB.340 control box.

STARTER MOTOR

REMOVAL

Detach the earth lead from the battery. Disconnect the cable from the terminal at the end of the starter motor.

Release the clips and detach the two rubber hose pipes from the brake servo vacuum situated on the bulkhead above the starter motor (Note hose pipe connections for later fitting).

Remove the four nuts and washers retaining vacuum tank to bulkhead and remove tank.

Remove the two nuts from the rear ends of the starter motor securing bolts. Support starter motor from below by hand and withdraw both bolts.

Withdraw starter motor through chassis frame.

REFITTING

Refitting is the reverse of the removal procedure. Care must be taken when reconnecting to ensure that the vacuum tank hoses are fitted to the correct unions. Refer to Section L "Brakes" before making connections.

1. GENERAL

The electric starting motor is a four-pole, four-brush machine having an extended shaft which carries the engine engagement gear, or starter drive as it is more usually named. The diameter of the yoke is $4\frac{1}{2}$".

The starting motor is of similar construction to the generator except that heavier copper wire is used in the construction of the armature and field coils. The field coils are series parallel connected between the field terminal and the insulated pair of brushes.

2. ROUTINE MAINTENANCE

The only maintenance normally required by the starting motor is the occasional checking of brush-gear and commutator. About every 10,000 miles, remove the metal band cover. Check that the brushes move freely in their holders by holding back the brush springs and pulling gently on the flexible connectors. If a brush is inclined to stick, remove it from its holder and clean its sides with a petrol moistened cloth. Be careful to replace brushes in their original positions in order to retain "bedding". Brushes which have worn so that they will not "bed" properly on the commutator or have worn less than $\frac{5}{16}$" in length must be renewed.

The commutator should be clean, free from oil or dirt and should have a polished appearance. If it is dirty, clean it by pressing a fine dry cloth against it while the starter is turned by hand by means of a spanner applied to the squared extension of the shaft. Access to the squared shaft is gained by removing the thimble-shaped metal cover. If the commutator is very dirty moisten the cloth with petrol.

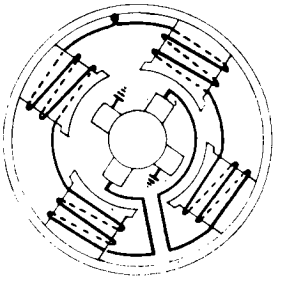


Fig. 30. Showing the internal connections of the starter motor.

3. PERFORMANCE DATA

Model	M 45 G
Lock Torque	22 lbs/ft. with 430–450 amperes at 7·8–7·4 volts.
Torque at 1,000 r.p.m.	8·3 lbs/ft. with 200–220 amperes at 10·2–9·8 volts.
Light running current	45 amperes at 5,800–6,800 r.p.m.

4. SERVICING

(a) TESTING IN POSITION

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

(i) Switch on the lamps and operate the starter control. If the lights go dim, but the starter motor is not heard to operate, an indication is given that the current is flowing through the starting motor windings but that the armature is not rotating for some reason; possibly the pinion is meshing permanently with the geared ring on the flywheel. In this case the starting motor must be removed from the engine for examination.

(ii) Should the lamps retain their full brilliance when the starter switch is operated, check the circuit for continuity from battery to starting motor via the starter switch, and examine the connections at these units. If the supply voltage is found to be applied to the starting motor when the switch is operated, an internal fault in the motor is indicated and the unit must be removed from the engine for examination.

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

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

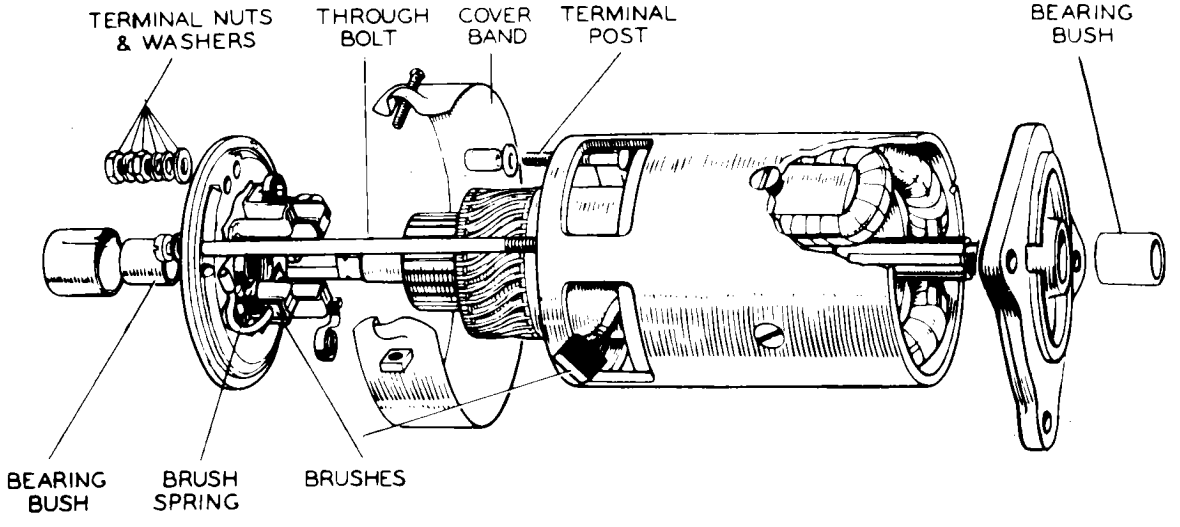


Fig. 31. Exploded view of the starter motor.

(b) **BENCH TESTING AND EXAMINATION OF BRUSHGEAR AND COMMUTATOR**

(i) Remove the starting motor from the engine, as described on page P.31.

(ii) After removing the starting motor from the engine secure the body in a vice and test by connecting it with heavy gauge cables to a battery of the appropriate voltage. One cable must be connected to the starter terminal and the other held against the body or end bracket. Under these light load conditions, the starter should run at a very high speed (see Paragraph 3) without excessive noise and without excessive sparking at the commutator.

(iii) If the operation of the starting motor is unsatisfactory, remove the cover band and examine the brushes and commutator. Hold back each of the brush springs and move the brush by pulling gently on its flexible connector. If the movement is sluggish, remove the brush from its holder and ease the sides by lightly polishing on a smooth file. Always replace brushes in their original positions. If the brushes are worn so that they will not bear on the commutator, or if the brush flexible is exposed on the running face, they must be replaced (see paragraph 4d).
Check the tension of the brush springs with a spring scale. The correct tension is 30—40 ozs. New springs should be fitted if the tension is low.

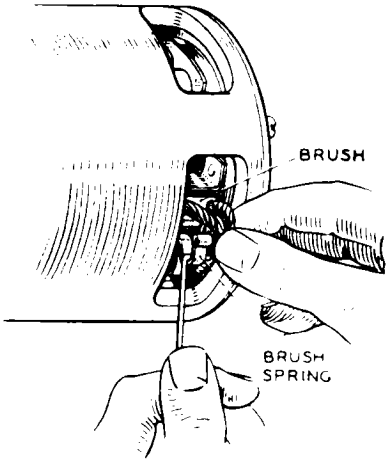


Fig. 32. Checking the brush gear.

If the commutator is blackened or dirty, clean it by holding a petrol-moistened cloth against it while the armature is rotated.

(iv) Re-test the starter as described under (ii). If the operation is still unsatisfactory, the unit can be dismantled for detailed inspection and testing as follows:—

(c) **TO DISMANTLE**

(i) Remove the cover band, hold back the brush springs and lift the brushes from their holders.

(ii) Remove the nuts from the terminal post which protrudes from the commutator end bracket.

(iii) Unscrew the two through bolts from the commutator end bracket. Remove the commutator end bracket from the yoke.

(iv) Remove the driving end bracket complete with armature and drive from the starting motor yoke. If it is necessary to remove the armature from the driving end bracket, it can be done by means of a hand press after the drive has been dismantled.

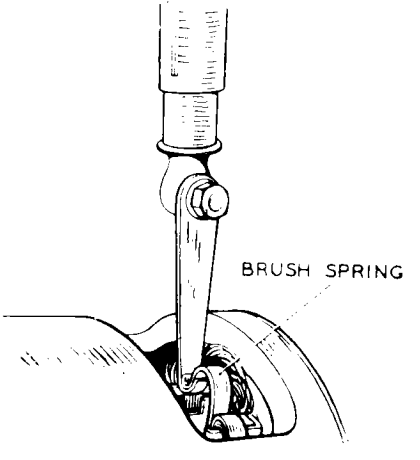


Fig. 33. Testing the brush spring tension.

(d) REPLACEMENT OF BRUSHES

If the brushes are worn to less than $\frac{5}{16}$" in length, they must be replaced.

Two of the brushes are connected to terminal eyelets attached to the brush boxes on the commutator end bracket and two are connected to the field coils.

The flexible connectors must be removed by unsoldering and the connectors of the new brushes

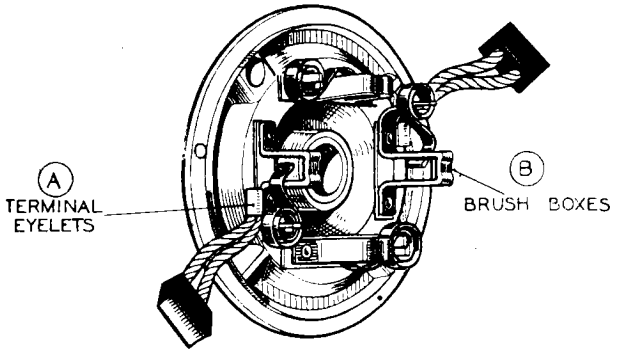


Fig. 34. The commutator end bracket brush connections.

secured in their place by soldering. The new brushes are preformed so that the bedding to the commutator is unnecessary.

(e) COMMUTATOR

A commutator in good condition will be smooth and free from pits and burned spots. Clean the commutator with a petrol-moistened cloth. If this is ineffective, carefully polish with a strip of fine glass paper, while rotating the armature. To remedy a badly worn commutator, dismantle the starter drive and remove the armature from the end bracket. Now mount the armature in a lathe, rotate at a high speed and take a light cut with a very sharp tool. Do not remove any more metal than is necessary. Finally polish with very fine glass paper.

The insulators between the commutator segments MUST NOT BE UNDERCUT.

(f) ARMATURE

Examination of the armature may reveal the cause of failure, e.g., conductors lifted from the commutator due to the starter motor being engaged while the engine is running and causing the armature to be rotated at an excessive speed. A damaged armature must always be replaced—no attempts should be made to machine the armature core or to true a distorted armature shaft.

(g) FIELD COILS

(i) Test the field coils for continuity by connecting a 12-volt test lamp between the starting motor terminal and to each field brush in turn.

(ii) Lighting of the lamp does not necessarily mean that the field coils are in order, as it is possible that one of them may be earthed to a pole-shoe or to the yoke. This may be checked with a 110-volt test lamp, the test leads being connected between the starting motor terminal and a clean part of the yoke. If the lamp lights, defective insulation of the field coils or of the terminal post is indicated. In this event, see that the insulating band is in position and examine the field coils and terminal connections for any obvious point of contact with the yoke. If from the above tests the coils are shown to be open-circuited or earthed and the point of contact cannot be readily located and rectified, either the complete starting motor or the field coils must be replaced. If the field coils are to be replaced, follow the procedure outlined below, using a wheel-operated screwdriver.

Remove the insulation piece wich is provided to prevent the intercoil connectors from contacting with the yoke.

Mark the yoke and pole shoes so that the latter can be refitted in their original positions.

Unscrew the four pole shoe retaining screws with the wheel-operated screwdriver.

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.

Take care to ensure that the taping of the field coils is not trapped between the pole shoes and the yoke.

Locate the pole shoes and field coils by lightly tightening the fixing screw. Fully tighten the screws with the wheel-operated screwdriver.

Replace the insulation piece between the field coil connections and the yoke.

(h) BEARINGS

Bearings which are worn to such an extent that they will allow excessive side-play of the armature shaft must be replaced. To replace the bearing bushes proceed as follows:—

(i) Press the bearing bush out of the end bracket.

(ii) Press the new bearing bush into the end bracket using a shouldered, highly polished mandrel of the same diameter as the shaft which is to fit in the bearing. Porous bronze bushes must not be opened out after fitting, or the porosity of the bush may be impaired.

Note: Before fitting a new porous bronze bearing bush it must be completely immersed for 24 hours in clean thin engine oil.

(j) REASSEMBLY

The re-assembly of the starting motor is a reversal of the dismantling procedure.

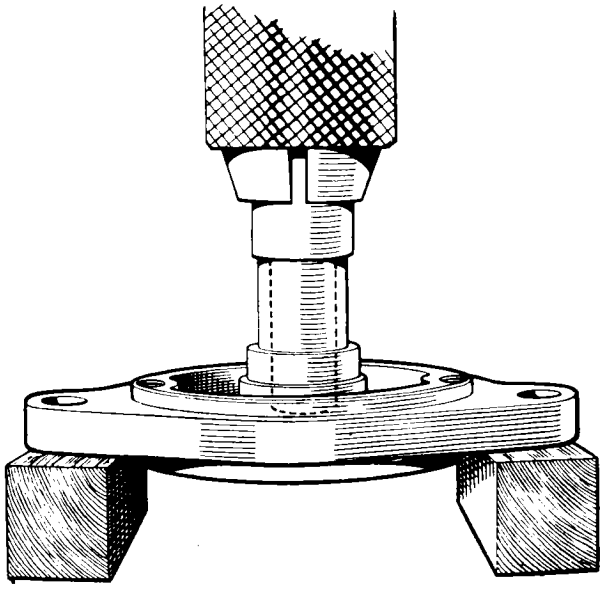


Fig. 35. Method of fitting bush.

STARTER DRIVE

1. GENERAL

The pinion is mounted on a threaded sleeve which is carried on splines on the armature shaft, the sleeve being arranged so that it can move along the shaft against a compression spring so as to reduce the shock loading at the moment engagement takes place.

When the starter switch is operated, the shaft and screwed sleeve rotate, and owing to the inertia of the pinion the screwed sleeve turns inside the pinion causing the latter to move along the sleeve into engagement with the flywheel ring. The starter will then turn the engine.

As soon as the engine fires and commences to run under its own power, the flywheel will be driven faster by the engine than by the starter. This will cause the pinion to be screwed back along the sleeve and so thrown out of mesh with the flywheel teeth. In this manner the drive safeguards the starter against damage due to being driven at high speeds by the engine.

A pinion restraining spring is fitted over the starter shaft to prevent the pinion being vibrated into contact with the flywheel when the engine is running.

2. ROUTINE MAINTENANCE

If any difficulty is experienced with the starting motor not meshing correctly with the flywheel, it may be that the drive requires cleaning. The pinion should move freely on the screwed sleeve; if there is any dirt

or other foreign matter on the sleeve it must be washed off with paraffin.

In the event of the pinion becoming jammed in mesh with the flywheel, it can usually be freed by turning the starter motor armature by means of a spanner applied to the shaft extension at the commutator end.

This is accessible by removing the cap which is a push fit.

3. DISMANTLING AND REASSEMBLY

Having removed the armature as described in the section dealing with starting motors the drive can be dismantled as follows:—

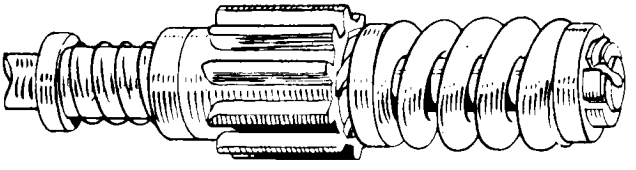


Fig. 36. Showing the starter drive assembled.

Remove the split pin (A) from the shaft nut (B) at the end of the starter drive. Hold the squared starter shaft extension at the commutator end by means of a spanner and unscrew shaft nut (B). Lift off the main spring (C), washer (D), screwed sleeve with pinion (E), collar (F), pinion restraining spring (G) and restraining spring sleeve (H).

Note: If either the screwed sleeve or pinion are worn or damaged they must be replaced as a pair, not separately.

The reassembly of the drive is a reversal of the dismantling procedure.

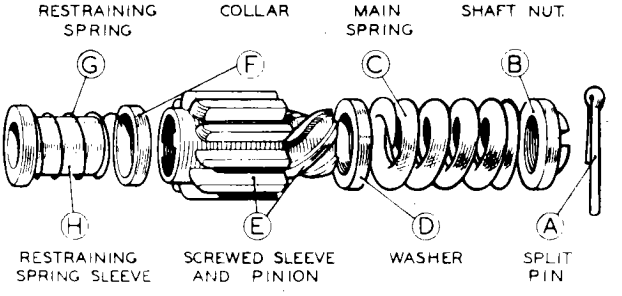


Fig. 37. Exploded view of the starter drive assembly.

WINDSCREEN WIPER

The windscreen wiper assembly consists of a two-speed motor coupled by connecting rods to three wiper spindle bearings. A control cable is attached to the centre spindle bearing mechanism for adjustment of the parking switch. The knurled adjusting knob attached to the cable is accessible in the engine compartment on the bulkhead.

Turning this control will raise or lower the parking limits of wiper arms.

REMOVAL OF WIPER MOTOR

Disconnect the battery earth cable.

Disconnect the ball joint from the throttle control shaft at the pivot bracket and remove bracket by unscrewing the two setscrews.

Release snap connector clip from bulkhead and disconnect cables. Lower the instrument panel after removing the two retaining screws in the top right hand and left hand corners and disconnect the ball

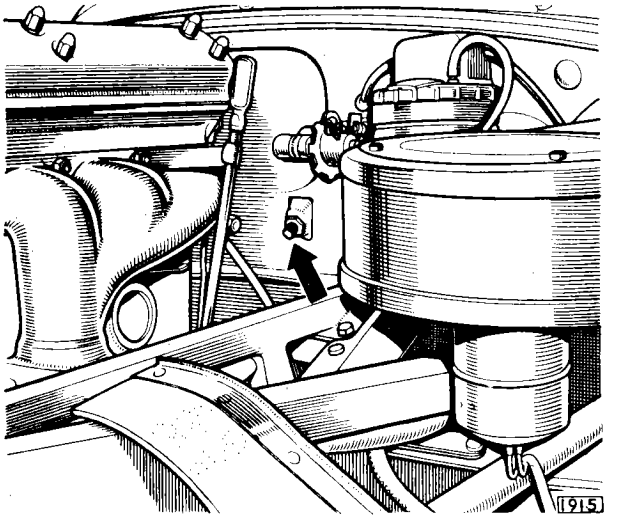


Fig. 38. The windscreen wiper parking adjuster screw.

joint from the central windscreen wiper spindle housing. Remove the four setscrews retaining the windscreen wiper motor to bulkhead and withdraw the motor complete with the attached link rod.

REFITTING

Refitting is the reverse of the removal procedure.

Note: It is essential when refitting 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 control pivot bearing bracket, care must be taken that the control rod is central in its bearing. Adjustment is provided by means of the two slotted holes in the bracket.

REMOVAL OF WINDSCREEN WIPER SPINDLE HOUSINGS

The following instructions apply to right-hand drive cars; instructions for left-hand drive models are identical with the exception of the side facia panels which are in this case reversed (i.e.) the instrument facia panel being in each case on the driver's side.

REMOVAL (Right-hand or Left-hand Housings)

Disconnect battery.

Withdraw wiper arms from spindles.

Lower the centre instrument panel after removing the two retaining screws in the top right hand and top left hand corners.

Remove side facia panel (see page P.45) for the removal of right hand spindle housing or remove glove box (see page P.44) for removal of left hand spindle housing.

Disconnect the ball joint from the wiper spindle crank. From outside the car unscrew the large nut securing the spindle housing to the scuttle.

Remove the chrome distance piece and rubber seal.

From inside the car withdraw the spindle housing.

REFITTING

Refitting is the reverse of the removal procedure.

Note: It is essential when refitting 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. If both spindle housings are removed care must be taken to ensure when refitting that the spindle with the longer crank is fitted to the driver's side.

CENTRE HOUSING

Disconnect battery.

Withdraw wiper arm from spindle.

Lower the centre instrument panel after removing the two retaining screws in the top right-hand and top left-hand corners. Remove side facia panel (see page P.45) and glove box (see page P.44).

Disconnect the ball joints from the two outer spindle cranks.

Disconnect the two cables attached to parking switch.

Remove the nut attaching the wiper parking switch control to the engine side of the bulkhead and withdraw the control from inside the car.

From outside the car unscrew the large nut securing the centre housing to the scuttle. Remove the chrome distance piece and rubber seal.

From inside the car withdraw the housing from the scuttle.

Withdraw housing and attached rods through centre aperture in dash panel.

REFITTING

Refitting is the reverse of the removal procedure.

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

DATA

	Normal	High
Wiping Speeds	44—48 Cycles/minute	58—68 Cycles/minute
Operating Currents		
Arms and Blades removed ..	3·0—3·7 amp.	2·2—2·9 amp.
Motor only	2·5—3·2 amp.	1·7—2·4 amp.
Resistance of Field Coil	8·0—9·5 ohms	
Value of Field Resistor	9·5—11·0 ohms	
Pressure of Blades against Windscreen	11—13 ozs.	

DESCRIPTION

The windscreen wiper is a two-speed, thermostatically protected, self parking, link operated unit.

The link and spindle housing assembly comprises a back plate with the three attached spindle housings, the spindle housings being detachable separately from the assembly.

One control rod operates from the motor to the centre spindle and the remaining two from the centre to the two outer spindles.

The motor is controlled by a switch giving Park, Normal and High speed operation. The higher speed is intended to be used when driving fast through heavy rain or light snow. It should not be used with heavy snow or with a dry or drying windscreen.

If overloaded the motor windings will overheat and cause the thermostat to trip and isolate the motor from the supply. Possible causes include: Packed snow or ice on screen, over-frictional or oil contaminated blades, damaged drive mechanism or spindle units. Provided the obstruction or other cause of excessive heating is removed, normal working resumes automatically when the temperature falls to a safe level.

MAINTENANCE

Efficient wiping is dependent upon having a clean windscreen and wiper blades in good condition.

Use methylated spirits (denatured alcohol) to remove oil, tar spots and other stains from the windscreen. Silicone and wax polishes should not be used for this purpose.

Worn or perished wiper blades are readily removed for replacement.

When necessary, adjustments to the self-parking mechanism can be made by turning the knurled nut located on the bulkhead. Turn the nut only one or two serrations at a time and test the effect of each setting before proceeding.

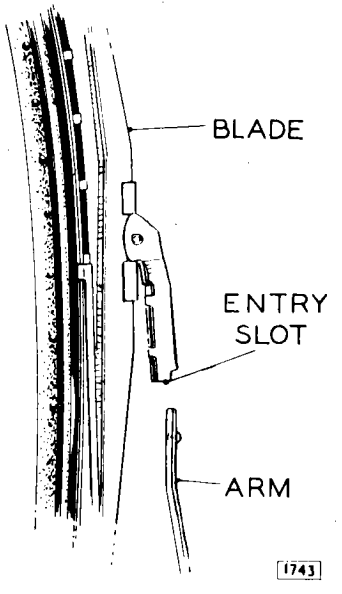


Fig. 39. Wiper blade to arm attachment.

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 housings.

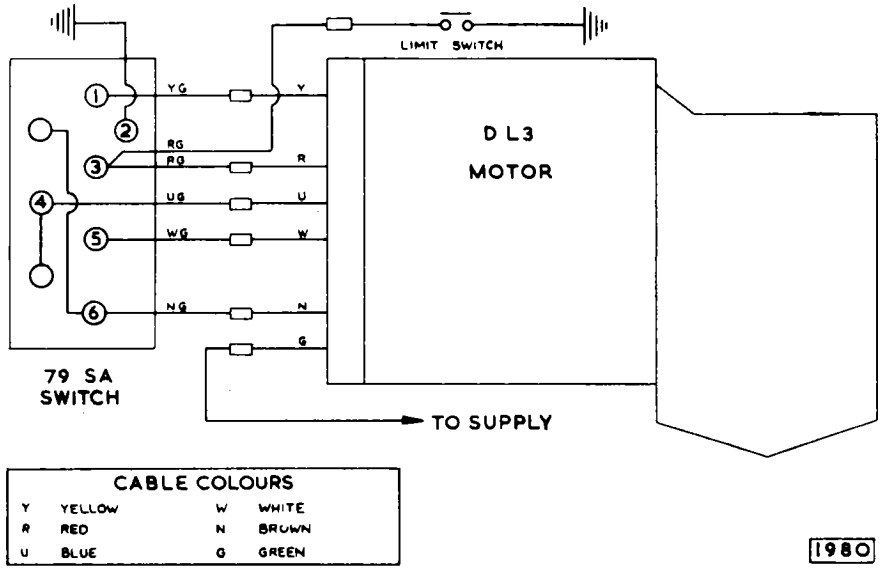


Fig. 40. Wiring connections switch to wiper.

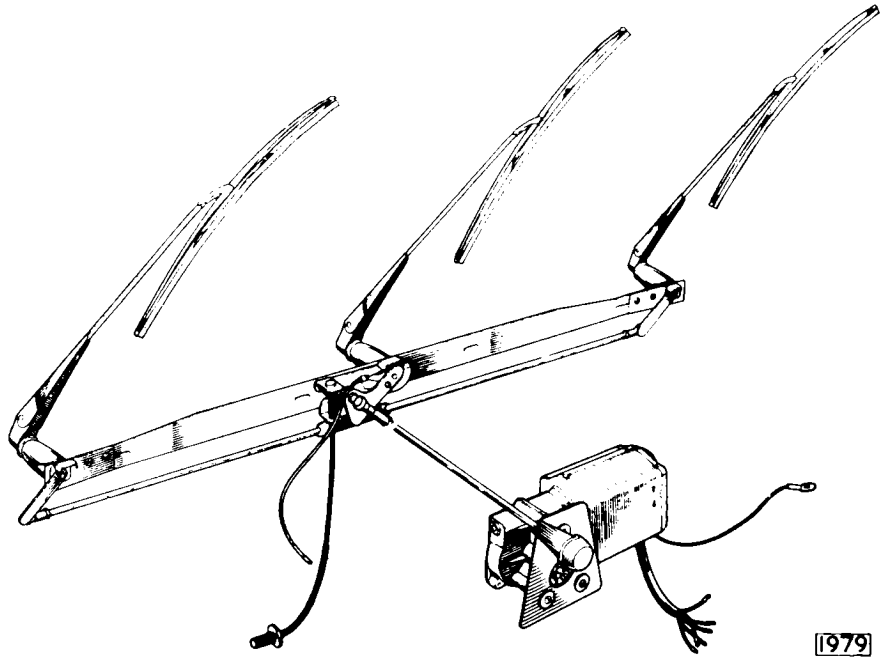


Fig. 41. The DL3 wiper motor and linkage.

TESTING

Unless the origin of the fault is apparent, proceed as follows to determine the cause of failure.

Measuring Supply Voltage

Using a first grade moving coil voltmeter, measure the voltage between the motor supply terminal (to which the green cable is connected) and a good earthing point. This should be 11·5 volts with wiper working normally. If the reading is low, check the battery, switch (by substitution), cabling and connections.

Measuring Light Running Current

If the normal terminal voltage is correct, measure the light running current by means of a first grade moving coil ammeter, connected in series withthe supply cable.

Remove the windscreen wiper arms and blades.

To Check the "Fast" Speed Current

Using a fully charged 12v battery and two test leads, connect the "GREEN" cable on the wiper motor to the "Negative" battery terminal. Join the "YELLOW" and "RED" cables together and connect to the "Positive" battery terminal. Connect the "BLUE" and "WHITE" cables together. Check the cycles per minute of the wiper spindle.

To Check the "Slow" Speed Current

Connect the "GREEN" cable to the "Negative" battery terminal.

Join the "BROWN" and "RED" cables together and connect to the "Positive" battery terminal. Connect the "BLUE AND WHITE" cables together. Check the cycles per minute of the wiper spindle.

The light running current must not exceed:

3·0—3·7 amperes at slow speed—44—48 c.p.m./or r.p.m. of output motor shaft or 2·2—2·9 amperes at fast speed—58—68 c.p.m./or r.p.m. of output motor shaft.

If the current is in excess of these figures change the motor. See DATA chart for other information.

Checking Spindle Housings

Renew seized housings.

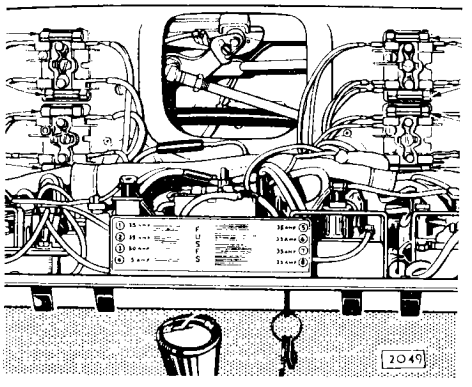


Fig. 43. The central wiper wheel box.

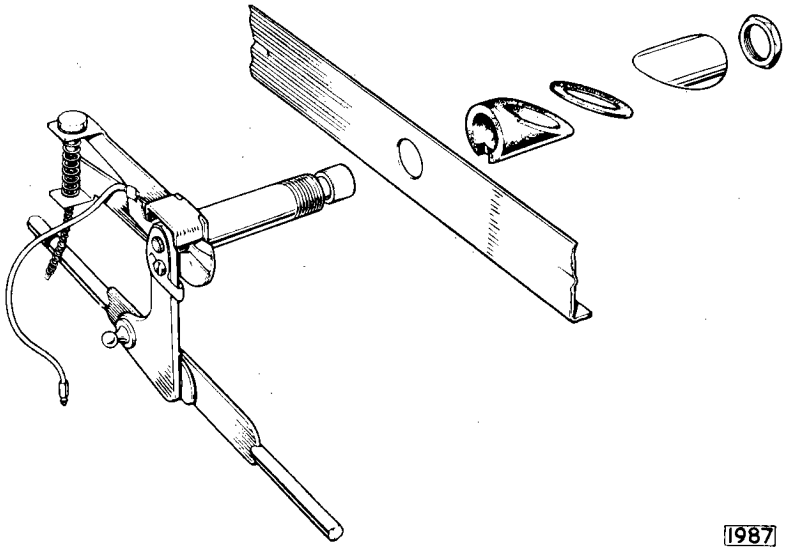


Fig. 42. Exploded view of wheel box and parking switch assembly.

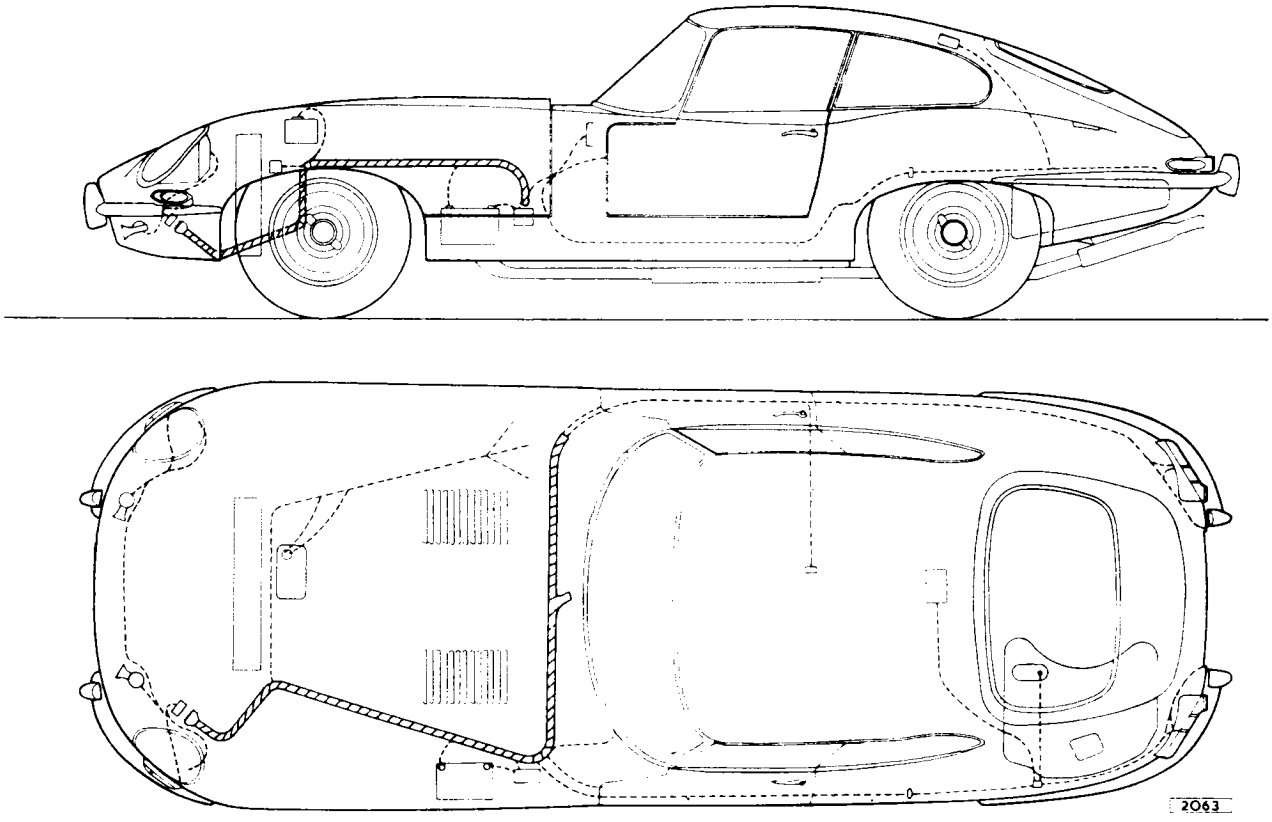


Fig. 44. The layout of wiring harnesses.

MISCELLANEOUS

ELECTRIC CLOCK

Removal

Detach the earth lead from the battery. Remove the revolution counter from the instrument panel as detailed under "Revolution Counter and Clock Removal". Detach the clock from the hidden face of the revolution counter by removing the two nuts. The flexible setting drive can be removed by slackening the knurled nut. Disconnect the cable at the snap connector.

Adjustment

Adjustment is effected by means of a small screw surrounded by a semi-circular seal, located at the back of the instrument.

If the clock is gaining turn the screw towards the minus (—) sign; if the clock is losing turn the screw towards the positive (+) sign.

Note: The action of resetting the hands automatically restarts the clock.

Refitting

Refitting is the reverse of the removal procedure.

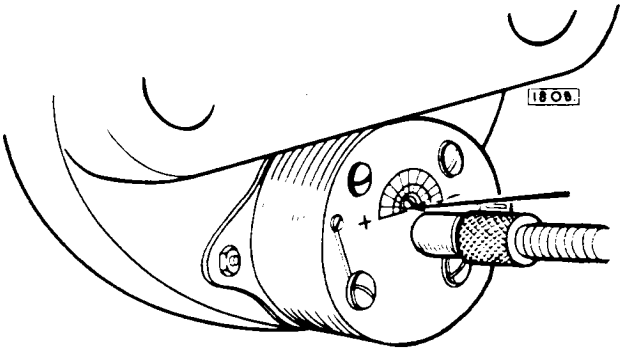


Fig. 45. Adjustment screw for clock.

BRAKE FLUID AND HANDBRAKE WARNING LIGHT

Unscrew the bezel of the lamp, exercising care to control the run of the spring loaded bulb beneath. Feed the bulb into the spring-loaded bulb holder, ensure that the red transparent window is retained in the bezel by a small circlip, position the designation plate on the bulb holder and screw on the bezel.

CARBURETTER MIXTURE CONTROL WARNING LIGHT

Renewing the Bulb

Withdraw the bulb holder from the rear of the light unit above the lever quadrant and withdraw the bulb by rotating in an anti-clockwise direction.

Replace the bulb holder and bulb by reversing the removal sequence.

The lamp unit can be removed from the side facia panel after the bulb holder has been removed by unscrewing the body of the unit and withdrawing the red plastic window from the front face of the facia board. The replacement of the lamp unit is the reverse of the removal sequence but the angle terminal bracket must not be omitted.

SETTING THE CARBURETTER MIXTURE CONTROL WARNING LIGHT SWITCH

Set the lever of the carburetter mixture control $\frac{1}{4}$" (6·350 mm.) from the bottom limit of its travel, when a click will be heard and utilizing the two nuts on the threaded shank of the switch, position the switch so that the warning light ceases to glow when the ignition is switched "on". Actuate the lever up and down once or twice and make any final adjustments necessary.

FLASHING INDICATOR CONTROL

Removal

Detach the earth lead from the battery.

Disconnect the seven cable harness from the snap connectors situated behind the facia panel.

Remove inner half of switch cover by withdrawing towards the centre of the car; cover is retained in position by means of spring clips. Switch and outer half of cover can now be withdrawn after removing the two screws and the clamp retaining the switch to steering column. Detach the outer half of switch cover from switch by removing the two fixing screws.

Refitting

Refitting is the reverse of the removal procedure. Particular attention must be paid to ensure that the switch is positioned correctly on the steering column, that the spigot on the switch is located in the hole drilled in the steering column.

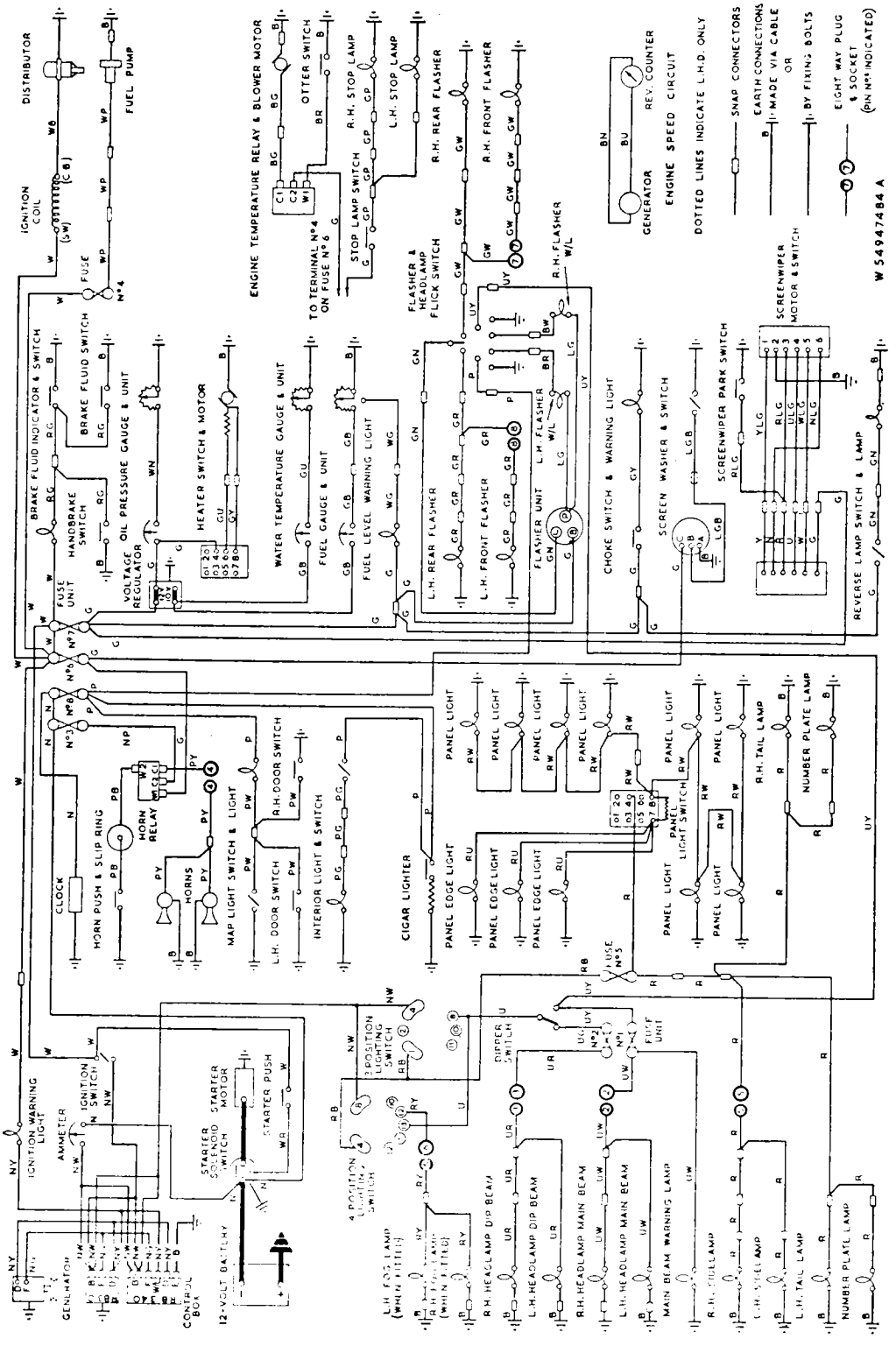
Reconnect cable harness into the multi-snap connector so that similar coloured cables are connected together.

FLASHING DIRECTION INDICATOR WARNING LIGHT BULB

Replacement

Detach the earth lead from the battery. Withdraw one or both of the bulb holders from the rear of the light unit situated between the speedometer and the revolution counter. Remove the bulb from the holder by applying an inward pressure and turning in an anti-clockwise direction.

Refitting is the reverse of the removal sequence. Care must be taken to ensure that the bulb holders are replaced in the correct position, i.e., replace right hand indicator bulb behind right hand arrow.



CABLE COLOUR CODE

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

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

Fig. 46. The wiring diagram.

THE INSTRUMENTS

DASH CASINGS

Removal

Detach one or both dash casings situated beneath the glove box or side facia panel by withdrawing the drive screws, and in the instance of the dash casing on the steering column side, the screwed bezels of the odometer and clock setting drives.

Refitting

Refitting is the reverse of the removal procedure but in the instance of the dash casing on the steering column side, it will be necessary to attach the odometer and clock setting drives to the casing before attaching the latter to the underside of the instrument panel.

THE INSTRUMENT PANEL

Opening

Detach the earth lead from the battery.

Remove the ignition key and cigar lighter for safe keeping. Hinge the centre instrument panel downwards on its bottom edge, after withdrawing the thumb screws situated in each top corner.

Removal

The ingtrument panel can be removed completely by detaching the earth lead from the battery, identifying and removing the leads from the instruments, cigar lighter and switches, removing the electrical harness and clips from the instrument panel and withdrawing the two hinge pivot bolts from the instrument panel support brackets.

Refitting

Refitting is the reverse of the removal procedure, but particular attention must be given to the following point.

That the leads are refitted in accordance with their colour coding, utilizing the wiring diagram as a reference.

Closing

Closing is the reverse of the opening proceedure but particular attention must be given to the following points:

(i) That the leads are replaced in accordance with their colour coding, utilizing the wiring diagram as a reference.

(ii) That the clips securing the main harness to the instrument panel will in no way foul any of the switch or instrument terminals, otherwise a direct short will occur when the battery is connected.

GLOVEBOX—Removal

Disconnect battery.

Lower the centre instrument panel after removing the two retaining setscrews in the top right hand and top left hand corners.

Remove the three setscrews retaining glove box now exposed. Remove the two nuts retaining glove box to the bracket located on side panel below screen pillar.

Detach glove box and disconnect the heater control cables from heater control quadrant. Remove glove box.

Refitting

Refitting is the reverse of the removal procedure. Care must be taken to ensure that the heater control is connected correctly and full travel of the control maintained.

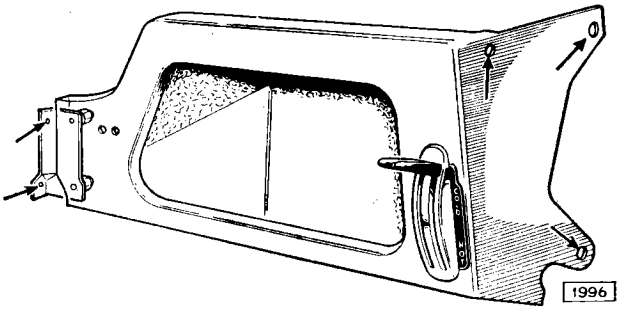


Fig. 47. The glove box showing attachment details.

SIDE FACIA PANEL—Removal

Disconnect battery.

Lower the centre instrument panel after removing the two retaining setscrews in the top right hand and top left hand corners. Remove the three setscrews retaining side facia panel now exposed. Remove the two nuts retaining facia panel to the bracket located on side panel below screen pillar.

Disconnect speedo cable from speedometer and the flexible setting cable from the electric clock.

Remove the circular nut retaining dipper switch to panel and remove switch.

Detach facia panel.

Disconnect the brake fluid level warning light cables from the unit and the electric clock cables from the snap connector.

Disconnect the mixture control cable from the mixture control quadrant and detach the warning light unit by withdrawing the bulb holder from the socket. Disconnect the cable from mixture control warning light switch. Disconnect the two cables attached to the revolution counter and remove the ignition main beam and petrol tank warning lights. Detach the two flasher warning light bulbs by withdrawing the bulb holders from the two sockets; withdraw panel illumination bulbs.

Remove facia panel.

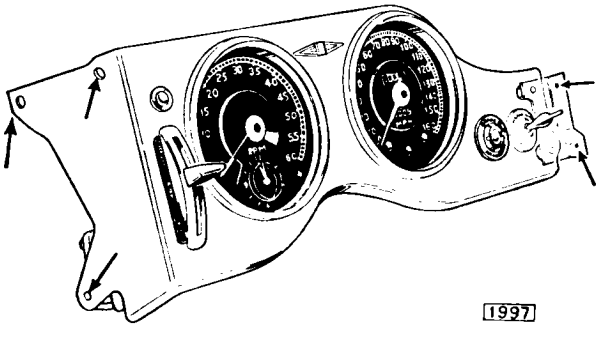


Fig. 48. The side facia panel showing attachment details.

Refitting

Refitting is the reverse of the removal procedure. Care must be taken when refitting to ensure that the mixture control cable is connected correctly and the full travel of the control maintained. Replace flasher warning light units in their correct holders. When refitting dipper switch ensure that the two terminals on the switch with the cables coloured blue/yellow and blue/green are uppermost.

THE SPEEDOMETER

Removal

Detach the earth lead from the battery and raise the steering to the highest position. Detach the speedometer from the facia board by removing the two knurled nuts, earth lead and the two retaining pieces.

Withdraw the flexible drive from the centre of the instrument by slackening the knurled sleeve nut.

Remove the speedometer from the facia board; identify and remove the three warning lamps and the two instrument illumination lamps from the hidden face of the instrument. Remove the flexible odometer trip setting drive by slackening the knurled sleeve nut.

Refitting

Refitting is the reverse of the removal procedure but particular attention must be paid to the following points.

(i) That the two instrument illumination lamps are inserted in the apertures at the side of the instrument.

(ii) That the headlamp warning light is inserted in the right hand bottom aperture.

(iii) That the fuel warning light is inserted in the centre bottom aperture.

(iv) That the ignition warning light is inserted in the left hand bottom aperture.

THE REVOLUTION COUNTER AND CLOCK

The revolution counter and clock are of the electrical type and the electrical leads to both are included in the car harness.

The clock is mounted at the bottom of the revolution counter indicator head and to effect its removal it is necessary to remove the revolution counter from the side facia panel.

The revolution counter consists of an A.C. generator fitted to the rear end of the camshaft with, an indicator head mounted in the side facia panel.

Removal

Detach the earth lead from the battery.

Detach the revolution counter from the facia board by removing the two knurled nuts, earth lead and retaining pieces. Withdraw the revolution counter, remove the two centre leads and the two instrument illumination lamps from the hidden face of the instrument and from the clock at the snap connector.

Detach the flexible clock setting drive by slackening the knurled sleeve nut, and the clock from the revolution counter, by removing the two nuts.

TESTING OPERATION OF REVOLUTION COUNTER

Utilizing an A.C. voltmeter check the current across the terminals of the generator at the rear of the right hand camshaft while the engine is running; as a rough guide it can be assumed that there is one volt output per 100 r.p.m. When electrical current is evident, check the continuity of the two leads by attaching the terminals to the generator and connecting the voltmeter to the opposite ends of the cables after removal from revolution counter. If when running engine continuity is evident, it can be assumed that the instrument is unserviceable and must be exchanged.

THE REVOLUTION COUNTER DRIVE

The revolution counter drive takes the form of a small A.C. electrical generator fitted at the rear R.H. end of the cylinder head where its tongued driving spindle engages a slotted adaptor screwed in the rear end of the inlet camshaft. Leads included in the electrical harness of the car connect with the Lucar tabs pointing upward in the body of the generator and with similar tabs at the rear of the instrument lead in the side facia panel. The Lucar tabs are of the same size and the leads can be fitted either way round.

Removal

Open the engine compartment and detach the earth lead from the battery. Remove the electrical harness from the two Lucar tabs on the A.C. generator on the rear R.H. end of the cylinder head. Detach the A.C. generator from the rear R.H. end of the cylinder head by withdrawing three allen screws and a plate washer, remove the generator in a rearward direction and note the position of the tongued driving spindle.

Refitting

Refitting is the reverse of the removal procedure but particular attention must be given to the following point:

That the tongued driving spindle is positioned in the same attitude as it was when it was removed; whenever difficulty is experienced in engaging the tongued spindle do not apply any force but remove the generator, ascertain the position of the slot in the camshaft with a mirror and set the tongued drive in a similar position.

THE REMOVAL OF THE INSTRUMENT PANEL COMPONENTS

The Ignition Switch

Detach the earth lead from the battery and hinge the instrument panel downward. Identify and remove the leads from the ignition switch. Withdraw the ignition switch from the hidden face of the instrument panel by removing the chrome ring. The lock barrel can be withdrawn by inserting a thin rod through a hole in the body of the switch.

Refitting is the reverse of the removal procedure but particular attention should be given to the following points:

(i) That the number of the ignition key is stamped on the lock barrel.

(ii) That the flat on the thread is positioned toward the right-hand side of the panel.

(iii) That the leads are refitted in accordance to their colour coding, utilizing the wiring diagram as a reference.

Renewing the Cigar Lighter Element

Withdraw the cigar lighter unit from the instrument panel and ensure that it is cold. Place the unit into the palm of the hand, knob first, and hold the sleeve downward against the pressure of the spring with the fingers and unscrew the lighter element and fit a replacement. It must be noted that the spring must not be omitted or tampered with for it ejects the lighter unit when it attains its correct temperature.

Cigar Lighter Unit—Removal

Withdraw the cigar lighter unit, detach the earth lead from the battery and hinge the instrument panel downward. Identify and remove the leads from the cigar lighter housing. Withdraw the cigar lighter housing through the face of the instrument panel after removing the nut and 'U' piece from the centre terminal post. It is not wise to dismantle the cigar lighter housing any further, otherwise direct shorting may occur on assembly.

Refitting is the reverse of the removal procedure but particular attention must be given to the following points:

(i) That the centre terminal post is firm and tight.

(ii) That the insulated washer in the 'U' piece is tight and in good condition, a sub-standard fit and poor condition of this washer could cause a direct short.

(iii) That the black lead is attached by its Lucar connection to the tag at the top of the instrument panel and the purple lead from the main harness is attached to the centre terminal post.

The Starter Push Switch

Detach the earth lead from the battery and hinge the instrument panel downward. Identify and remove the leads from the starter push switch. Withdraw the starter push switch through the face of the instrument panel by removing the nut on the hidden face.

The Head and Side Light Switch—Removal

Remove the light switch control lever from the face of the instrument panel by depressing the plunger in the right hand side.

Detach the earth lead from the battery and hinge the instrument panel downward. Identify and remove the leads from the light switch and detach the light switch from the three posts on the hidden face of the instrument panel by removing the three nuts.

The designation plate can be removed from the face of the instrument panel by detaching the nut on the hidden face.

Refitting

Refitting is the reverse of the removal procedure but particular attention must be given to the following points:

(i) That the designation plate is mounted on the face of the instrument panel by allowing the flat on the threaded barrel to locate a flat in the panel.

(ii) That the control lever is pressed on to the rod of the switch protruding through the face of the instrument panel so that the control rod plunger locates a drilling in the hub of the lever, a smear of vaseline on the plunger greatly facilitates this operation.

(iii) That the leads are refitted in accordance to their colour coding utilizing the wiring diagram as a reference.

The Tumbler Type Switches

Detach the earth lead from the battery and hinge the instrument panel downward. Identify and remove the leads from the Lucar tags on the body of the desired switches and withdraw the tumbler switch from the hidden face of the instrument panel by holding the switch lever in a horizontal position and removing the screwed chromium ring from the face of the instrument panel.

Refitting is the reverse of the removal procedure but particular attention must be given to the following points:

(i) That the switch is fitted to the instrument panel so that the flat face of the switch lever is downward.

(ii) That the leads are refitted in accordance to their colour coding and utilizing the wiring diagram as a reference.

The Ammeter and Oil Pressure Gauge—Removal

Detach the earth lead from the battery and hinge the instrument panel downward. Withdraw the illumination bulb holder from the instrument and detach the leads. Remove the two knurled nuts and 'U' clamp.

Withdraw through front face of panel.

Refitting is the reverse of the removal procedure but particular attention must be given to the following points:

(i) That the 'U' piece is fitted so that it will not foul any terminal or bulb holder, one side is cut away for this purpose.

(ii) That the leads are refitted in accordance with the colour coding utilizing the wiring diagram as a reference.

The Fuel and Water Temperature Gauges

These instruments are removed and refitted in a similar manner to the ammeter and oil pressure gauges but in this instance only one knurled nut secures the 'U' piece.

The removal and replacement of the fuel gauge tank unit and the water temperature transmitter unit are detailed in the "Fuel System" and "Cooling System" sections respectively.

The Voltage Regulator (Fuel and Water Temperature Gauges)

Removal

Detach the earth lead from the battery and hinge the instrument panel downwards. Identify and remove the leads from the voltage regulator situated at the top right hand side of the instrument panel.

Detach the voltage regulator from the panel by removing one nut.

Refitting

Refitting is the reverse of the removal procedure but particular attention must be given to the following points:

(i) That a good earth is made between the voltage regulator and the panel.

(ii) That the leads are refitted in accordance with the colour coding utilizing the wiring diagram as a reference.

Renewing the Switch Indicator Strip Bulbs

Detach the earth lead from the battery and hinge the instrument panel downwards. Three bulbs are provided, one being in each bottom corner and one at the bottom centre. Withdraw the bulb holder from the socket. Remove the bulb from the holder by applying an inward pressure and rotating 90°. The bulb is replaced by inserting the cap in the holder and rotating 90° until the notches in the bulb holder are located.

Remove the indicator strip, chrome finisher and light filter from the bottom edge of the instrument panel by withdrawing the four screws.

THE BI-METAL RESISTANCE INSTRUMENTATION

Engine Temperature, Fuel Tank and Oil Pressure Gauges

DESCRIPTION

The Bi-metal Resistance Instrumentation for engine temperature, petrol tank contents and engine oil pressure consists of a gauge unit fitted in the instrument panel, a transmitter unit fitted in the engine unit or petrol tank and connected together to the battery, the oil pressure gauge being an exception, through a common voltage regulator. The purpose of the latter is to ensure a constant power supply at a predetermined voltage thus avoiding errors due to a low battery voltage. In the instance of the oil pressure gauge this is not quite so critical to supply voltage.

In all systems the gauge unit operates on the thermal principal utilizing a heater winding wound on a bi-metal strip, while the transmitter units of the engine temperature and petrol tank contents gauge are of the resistance type but in both instances the system is voltage sensitive. The transmitter unit of the oil pressure gauge is of the thermal pressure principal utilizing a heater winding wound on a bimetal strip having contact at one end with the second contact mounted on a diaphragm which is sensitive to engine oil pressure.

OPERATION OF THE ENGINE TEMPERATURE GAUGE

The transmitter unit of the engine temperature gauge is fitted in the water outlet pipe of the engine unit and is a variable resistance and consists of a temperature sensitive resistance element contained in a brass bulb. The resistance element is a semi-conductor which has a high negative temperature co-efficient of resistance and its electrical resistance decreases rapidly with an increase in its temperature. As the temperature of the engine unit rises the resistance of the semi-conductor decreases and increases the flow of current through the transmitter similarly a decrease in engine temperature reduces the flow of current.

The gauge unit fitted in the instrument panel consists of a heater winding, connected at one end to the transmitter unit and at the second end to the 'I' terminal of the voltage regulator, wound on a bimetal strip which is linked to the indicator needle. The heater winding and bimetal strip assembly is sensitive to the changes in voltage received from the transmitter unit causing the heater winding to heat or cool in the bimetal strip, resulting in the deflection of the indicator needle over the scale provided. The calibration of the scale is such that the movement of the indicator needle over it is relative to the temperature of the transmitter unit bulb and therefore the temperature of the engine unit.

OPERATION OF THE FUEL TANK GAUGE

The transmitter unit of the petrol gauge is fitted in the petrol tank and is a variable resistance actuated by a float, the arm of which carriers a contact travelling across a resistance housed in the transmitter body. The float arm takes up a position relative to the level of petrol in the tank and thus varies the amount of current passing through the indicator unit.

The gauge unit in the instrument panel consists of a heater winding, connected at one end to the transmitter unit and at the other to the 'I' terminal of the voltage regulator, wound on a bimetal strip which is linked to the indicator needle. The heater winding and bimetal strip assembly is sensitive to the changes in voltage received from the position of the transmitter float, causing the heater winding to heat or cool the bimetal strip, resulting in the deflection of the indicator needle over the scale provided. The calibration of the scale is such that the movement of the indicator needle over it is relative to the position of the transmitter float actuated by the level of the contents in the petrol tank.

Exaggerated indicator needle movement due to petrol swirl in the tank is considerably reduced as there is a delay before current changes from the transmitter unit can heat or cool the bimetal and heater winding assembly in the indicator unit, which in fact causes the deflection of the needle. Similarly the indicator needle will take a few moments to register the contents of the petrol tank when the ignition is first switched on.

ANALYSIS OF THE ENGINE TEMPERATURE AND PETROL TANK GAUGE FAULTS

NOTE: THE INSTRUMENT PANEL GAUGES MUST NEVER BE CHECKED BY SHORT-CIRCUITING THE TRANSMITTER UNITS TO EARTH

Symptom	Unit Possibly at Fault	Action
Instrument panel gauge showing a "zero" reading	Voltage regulator	Check that output voltage at terminal 'I' is 10 volts
	Instrument panel gauge	Check for continuity between the gauge terminals with the leads disconnected.
	Transmitter unit in petrol tank or engine unit.	Check for continuity between the terminal and the case with lead disconnected.
	Wiring	Check for continuity between the gauge, the transmitter and the voltage regulator, also that the transmitter unit is earthed.
Instrument panel gauge showing a high/low reading when ignition switched on	Voltage regulator	Check output voltage at terminal 'I' is 10 volts.
	Instrument panel gauge Transmitter unit in petrol tank or engine	Check by substituting another instrument panel gauge. Check by substituting another transmitter unit in petrol tank or engine unit.
	Wiring	Check for leak to earth.
Instrument panel gauge showing a high reading and overheating	Voltage regulator	Check output voltage at terminal 'I' is 10 volts.
	Wiring	Check for short circuits on wiring to each transmitter unit.
Instrument panel gauge showing an intermittent reading	Voltage regulator	Check by substituting another voltage regulator.
	Instrument panel gauge	Check by substituting another instrument panel gauge.
	Transmitter unit in petrol tank or engine unit	Check by substituting another transmitter unit in petrol tank or engine unit.
	Wiring	Check terminals for security, earthing and wiring continuity.

OPERATION OF THE OIL PRESSURE GAUGE

The transmitter unit of the oil pressure gauge, fitted in the head of the engine oil filter, is a voltage compensated pressure unit and consists of a diaphragm, a bimetal strip with a heater winding wound thereon, a resistance and a pair of contacts. One contact is attached to the diaphragm while the second is mounted on one end of the bimetal strip, the second end of which is connected through the resistance and the gauge unit to the battery supply; the heater winding is also connected to the battery supply but not through the resistance. Engine oil pressure will close the contacts causing current to flow through the gauge unit, bimetal strip and contacts to earth resulting in the heating of the heater winding which will, after a time, open the contacts.

The gauge unit fitted in the instrument panel consists of a winding, connected at one end to the battery supply and at the second to the transmitter unit wound on to a bimetal strip which is linked to an indicating needle. The heater winding and bimetal strip assembly is sensitive to the continuity changes received from the thermal pressure unit, fitted in the engine oil filter, causing the heater winding to heat or cool the bimetal strip resulting in the deflection of the indicating needle over the scale provided.

The changes in continuity of current from the transmitter unit will vary according to the amount of oil pressure for, as the latter rises, the outward moving diaphragm contact limits the return travel of the bimetal strip contact thus allowing a longer continuity period. This results in a greater heating of the heater winding in the gauge unit and increased deflection of the indicating needle over the scale showing a greater oil pressure.

The opening and closing of the transmitter unit contacts is continuous thus the temperature of the heater winding in the gauge unit is kept within close limits and the calibration of the scale is such that the movement of the indicating needle over it is relative to the opening of the transmitter unit contacts and therefore the oil pressure of the engine is recorded.

ANALYSIS OF THE OIL PRESSURE GAUGE FAULTS

Symptom	Unit Possibly at Fault	Action
Instrument panel gauge showing a "zero" reading	Wiring	Check for continuity between the gauge and the transmitter unit and that the latter is earthed.
	Instrument panel gauge	Check for continuity between the gauge terminals with leads disconnected. If satisfactory replace the transmitter unit.
Instrument panel gauge showing a reading with ignition switched on but engine not running	Transmitter unit on oil filter head	Check by substituting another transmitter unit.
Instrument panel gauge showing a high reading and overheating	Transmitter unit on oil filter head	Check by substituting another transmitter unit.
Instrument panel gauge showing a below "zero" reading with ignition switched off	Instrument panel gauge	Check by substituting another instrument panel gauge.

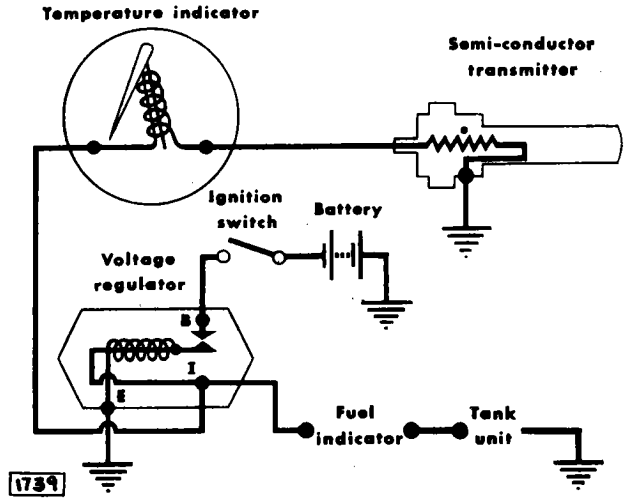


Fig. 49. The combined wiring diagram of the fuel tank contents and water temperature gauges with the voltage regulator.

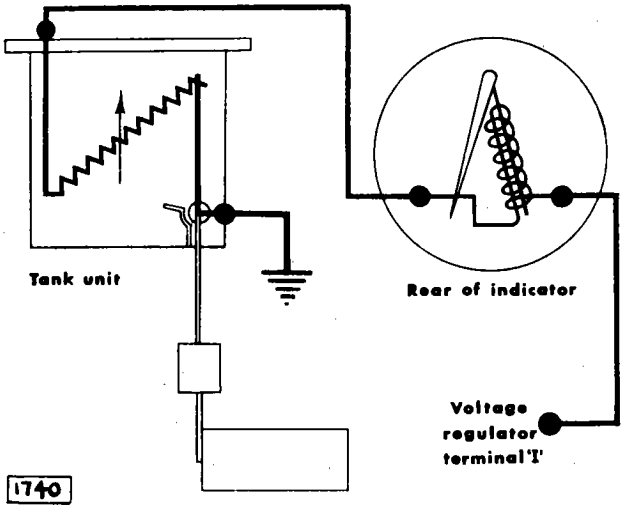


Fig. 50. The fuel tank contents gauge circuit.

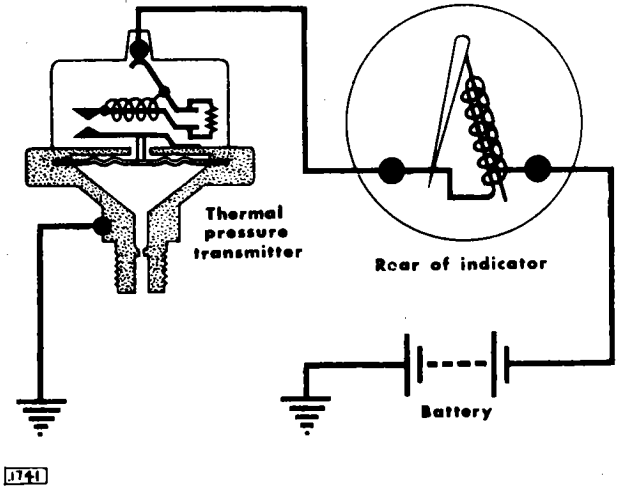


Fig. 51. The engine oil pressure gauge circuit.

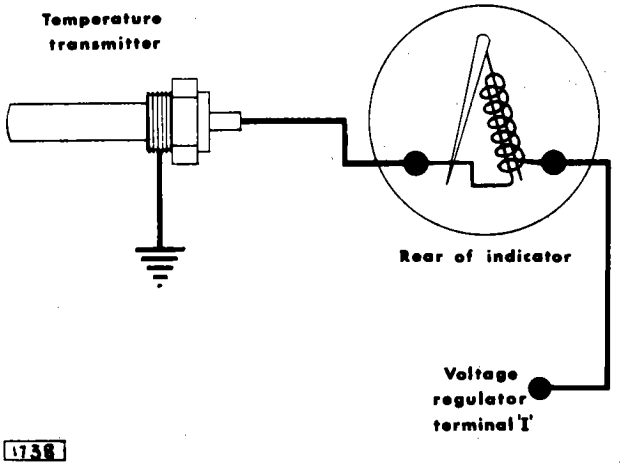


Fig. 52. The water temperature gauge circuit.

THE SPEEDOMETER DRIVE CABLE

Removal

Disconnect the flexible drive cable and remove the speedometer from the side instrument facia as previously detailed. Detach the flexible drive cable from the right-angle drive attachment on the gearbox and release it from the retaining clips.

Refitting

Refitting is the reverse of the removal procedure but particular attention must be given to the following points:

(i) That the run of the flexible drive cable is without any sharp bends.

(ii) That the securing clips are so shaped that they only hold the cable in position without crushing it.

SPEEDOMETER CABLE—GENERAL INSTRUCTIONS

Flexible cable condition to a great extent affects performance of speedometers. Poor installation or damage to the flexible drive will show up as apparent faults. It is most important that the flexible drive should be correctly fitted and maintained as illustrated in the following diagrams.

1. **Smooth Run**

   Run of flexible drive must be smooth. Minimum bend radius 6". No bend within 2" of connections.

2. **Securing**

   Avoid sharp bends at clips. If necessary change their positions. Do not allow flexible drive to flap freely. Clip at suitable points.

3. **Securing**

   Avoid crushing flexible drive by over-tightening clip.

4. **Connection**

   Ensure tightness of outer flex connections. They should be finger tight only. It may be necessary to clean thoroughly the point of drive before the connection can be screwed completely home.

5. **Connection of Inner Flexible Shaft**

   Where possible slightly withdraw inner flex and connect outer first. Then slide inner into engagement.

6. **Removal of Inner Shaft**

   Most inner flexes can be removed by disconnecting instrument end and pulling out flex. Broken inner flex will have to be withdrawn from both ends.

7. **Examination of Inner Flexible Shaft**

   Check for kinked inner flexible shaft by rolling on clean flat surface. Kinks will be seen and felt.

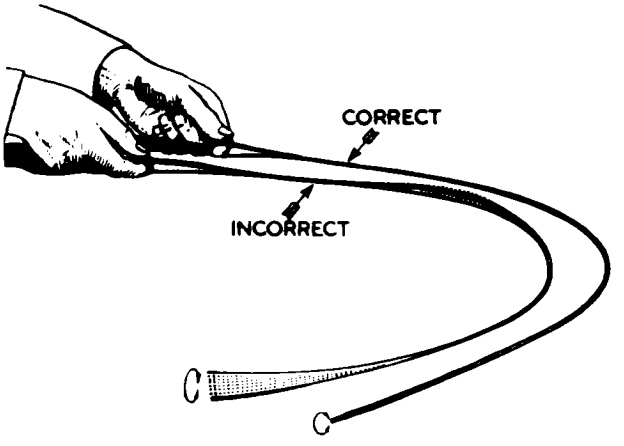


Fig. 53. Checking the inner flex for kinks.

8. **Lubrication Every 10,000 Miles**

   Withdraw inner flexible drive (see paragraph 6). Place blob of grease on end of outer cable and insert flex through it, carrying grease inside. Use Esse T.S.D. 119 or equivalent. Do NOT use oil.

9. **Excessive Lubrication**

   Avoid excessive lubrication. If oil appears in flexible drive, suspect faulty oil-seal at point of drive.

10. **Inner Shaft Projection**

Check $\frac{3}{8}$" projection of inner flex beyond outer casing at instrument end. This ensures correct engagement in instrument and point of drive.

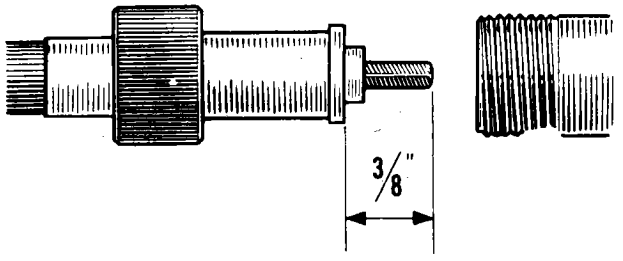


Fig. 54. Showing the amount the inner flex must protrude from outer cable.

11. **Concentric Rotation**

Check that inner flex rotates in centre of outer cable.

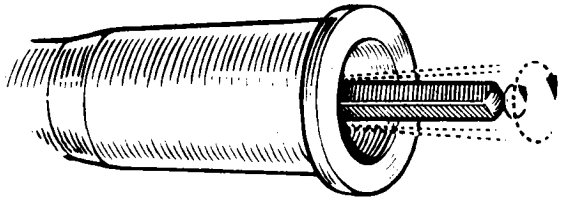


Fig. 55. Checking the inner flex for "run-out."

12. **Damaged Inner Shaft**

Examine inner flex ends for wear or other damage. Before fitting new flex ensure instrument main spindle is free.

13. **Damage Drive End Connections**

Examine point of drive for damage or slip on gears in gearbox.

14. **Ensuring Correct Drive Fitted**

When ordering, state Make, Year and Model of vehicle. State also length of drive required when alternatives are shown.

SPEEDOMETERS—GENERAL INSTRUCTIONS

Speedometer performance is dependent on the flexible drive, and apparent faults in the instrument may be due to some failure of the drive. Before returning a speedometer for service, the flexible drive should be checked, as described in the previous paragraphs. The following diagrams show you how to check the instrument performance.

15. **Instrument Not Operating**

Flexible drive not properly connected (see paragraph 5). Broken or damaged inner flexible shaft or fault at point of drive (see paragraphs 12 and 13), in which case remove and replace flex (see paragraphs 6 and 8) or rectify point of drive fault. Insufficient engagement of inner shaft (see paragraph 10). Defective instrument—return for service.

16. **Instrument Inaccurate**

Incorrect speedometer fitted. Check code number.

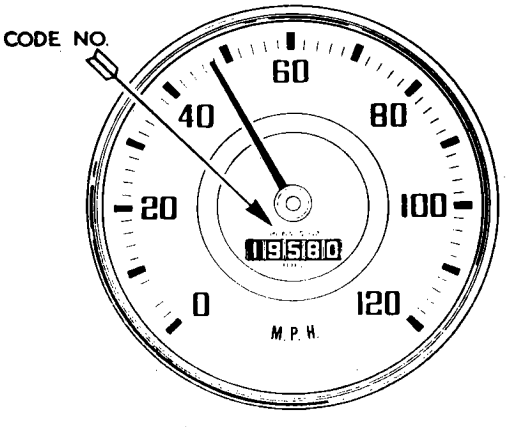


Fig. 56. Showing the code number on the face of the instrument.

17. **Speedometer Inaccurate**
Check tyre pressures. Inaccuracy can be caused by badly worn tyres. Non-standard tyres fitted, apply to Smiths for specially calibrated instrument.

18. **Speedometer Inaccurate**
Rear axle non-standard. Drive ratio in vehicle gearbox non-standard. A rapid and simple check is obtained by entering in the formula the figures found in the test (see paragraph 19).

$$\frac{1680\ N}{R} = \text{T.P.M. No.}$$

Where N = Number of turns made by the inner shaft for 6 turns of rear wheel and R = Radius of rear wheel in inches measured from centre of hub to ground.

Example

Cardboard pointer on inner shaft (see 19) rotates $9\frac{1}{8}$ times as vehicle is pushed forward 6 turns of rear wheel. Rear wheel radius $12\frac{1}{4}$".

Flex turns per mile:

$$\frac{1680 \times 9\frac{1}{8}}{12\frac{1}{4}} = \frac{15330}{12\frac{1}{4}} = 1251 = \text{T.P.M. No.}$$

19. **Gearing Test**
Disconnect flexible drive from speedometer. With the gears in neutral, count the number of turns of the inner shaft for six turns of the rear wheels when the vehicle is pushed forward in a straight line. Measure rolling radius of rear wheels—centre of hub to ground. Apply figures in formula (see paragraph 18).

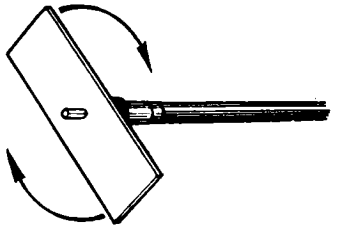


Fig. 57 Cardboard counter on the inner flex for checking the number of turns.

20. **Correct Speedometer**
Number illustrated should correspond within 25 either way with the number obtained from paragraphs 18 and 19. If it does not, apply to Smiths for specially calibrated instrument, giving details of test and vehicle.

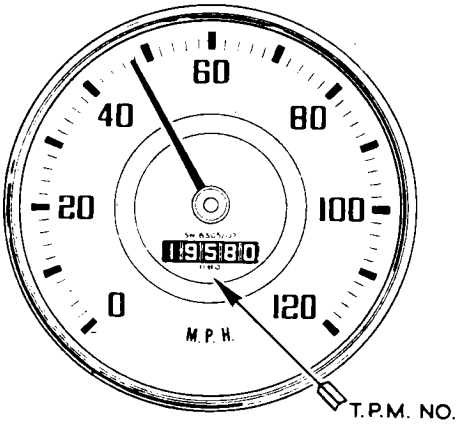


Fig. 58 Showing the turns per mile on the face of the instrument.

21. **Pointer Waver**
Oiled up instrument. Replace oil seal if necessary, clean and lubricate flexible drive (see paragraph 8). Return instrument for replacement.

22. **Pointer Waver**
Inner flexible shaft not engaging fully. Check 10, then try 4. Also check 12.

23. **Pointer Waver**
Kinked or crushed flexible drive. Check 7 and 3. For withdrawal of inner shaft see paragraph 6. Bends of too small radius in flexible drive, check 1.

24. **Pointer Waver**
If 21, 22 and 23 show no sign of trouble, instrument is probably defective. Return for replacement.

25. **Noisy Installation**
Tapping noises. Check 5 and 2. Flexible drive damaged. Check 7 and 12 (also see paragraph 6), check lubrication is sufficient. Check 10 and 11.

26. **Noisy Installation**

General high noise level. Withdraw inner shaft (see paragraph 6) and reconnect outer flex. If noise continues at lower level then source of noise is in vehicle point of drive. Fitting new P.V.C. covered flexible drive with nylon bush on inner shaft and instrument with rubber mounted movement should overcome this trouble.

27. **Noisy Installation**

Regular ticking in time with speedometer decimal distance counter. Return speedometer for replacement.

28. **Noisy Installation**

Loud screeching noise more prevalent in cold weather return instrument for replacement.

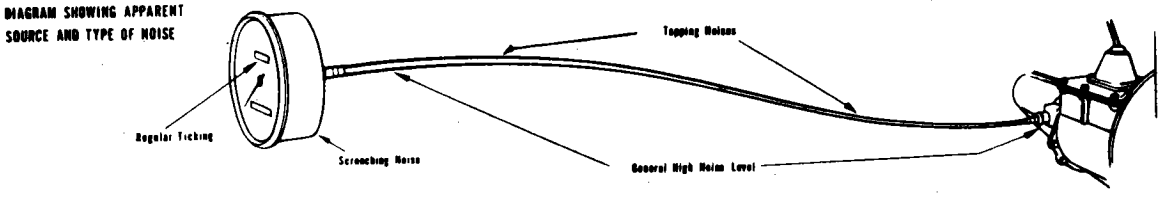


Fig. 59 Diagram showing apparent source and type of noise

RIGHT ANGLE DRIVE ATTACHMENT

No provision is made for lubrication or dismantling this unit. If faulty remove and replace with new unit.

Removal

Detach the speedometer cable from unit.

Remove unit from gearbox by releasing the large thumb nut.

Refitting

Refitting is the reverse of the removal procedure but particular attention must be given that the square drive shaft protruding from the unit has entered into the gearbox drive correctly before tightening nut.

SUPPLEMENTARY INFORMATION TO SECTION P "ELECTRICAL AND INSTRUMENTS"

Introduction of Modified Distributor

Later 3·8 Litre "E" type cars were fitted with a new distributor—the Lucas 22D6. This type of distributor differs from its predecessor—DMBZ6 type—in construction but the advance curves remain the same.

The method of adjusting the contact points differs also.

If the gap is incorrect, slacken, very slightly, the contact plate securing screw and adjust the gap by turning a screwdriver in the slot in the contact plate (clockwise to decrease the gap and anti-clockwise to increase the gap). Tighten the securing screw and re-check the gap.

The correct gap remains the same—·014"–·016" (·36 mm.–·41 mm.).

Electric Time Clock

	Commencing Chassis Numbers	
	R.H. Drive	L.H. Drive
"E" Type Open 2 Seater	850702	879324
Fixed Head Coupe	861169	888543

Commencing at the above chassis numbers the electric clock fitted to the revolution counter dial incorporates a rectifier. This is to reduce fouling of the contact points in the clock.

If at any time the clock is removed for servicing and subsequent bench testing, IT IS MOST IMPORTANT that the feed terminal on the back of the clock is connected to the negative side of the battery and that the outer casing of the clock is positively earthed. Incorrect connection of a rectified clock to the battery will instantly destroy the rectifier.