SECTION P

# ELECTRICAL AND INSTRUMENTS

## 2·4 litre and 3·4 litre models

*ISSUED BY*

**JAGUAR CARS LIMITED, COVENTRY, ENGLAND**

Telephone ALLESLEY 2121 (P.B.X.) | CODE BENTLEY'S SECOND | Telegraphic Address "JAGUAR," COVENTRY. Telex. 31/622

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# BATTERY

The battery is of the semi-linkless type, the short intercell connectors being partially exposed, to enable testing of individual cells to be carried out. Batteries models GTW9A and GT9A are supplied dry and uncharged, and battery model GTZ9A supplied dry but with its plates in a charged condition. Routine maintenance is the same for all three models.

## DATA

| | |
|---|---|
| Type | GTW9A, GT9A or GTZ9A |
| Voltage | 12 |
| Number of plates per cell | 9 |
| Capacity—at 10 hour rate | 51 ampere hour |
| —at 20 hour rate | 58 ampere hour |

## 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 level up to the top of the separators.

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, drinking water, clean rain water or melted snow may be used. Salt water, chlorinated water, chemically softened water and stagnant water must not 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

Mark the positions of the bonnet hinges relative to the bonnet. Remove the four set-bolts securing the bonnet to the hinges.

Release the two spring clips and remove the battery cover.

Remove the two securing screws and detach the terminals from the lugs.

Unscrew the two battery securing bolts and detach the retaining band and rubber.

Lift out the battery from the tray.

## REFITTING

Refitting is the reverse of the removal procedure. Before refitting the cables clean the terminals and coat with petroleum jelly.

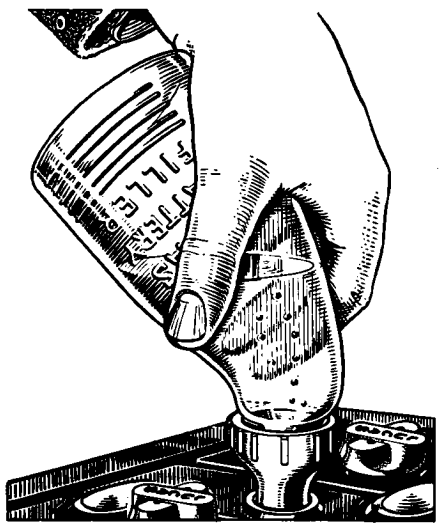


*Fig. 1. Lucas battery filler.*

## BATTERY PERSISTS IN 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.

### Level of Electrolyte

The surface of the electrolyte should be level with the tops of the separators. 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 in the air temperature.

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

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

### 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 of Charge | Home and Climates Ordinarily Below 90°F. (32°C.) Specific Gravity of Electrolyte (Corrected to 60°F.) | Climates Frequently Over 90°F. (32°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 | 1.120—1.150 |
| Completely discharged | 1.110—1.130 | 1.050—1.070 |

## RECHARGING FROM AN EXTERNAL SUPPLY

If the foregoing 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 the rate of 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 separators 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 (MODELS GTW9A AND GT9A) 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-lines tank or in 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 approximate proportions of acid and water are indicated in the following table :

| | Specific Gravity of Acid Required When Filling | |
|---|---|---|
| Battery | Home and Climates Ordinarily Below 90°F (32°C.) Specific Gravity of Acid (Corrected to 60°F.) | Climates Frequently Over 90°F. (32°C.) Specific Gravity of Acid (Corrected to 60°F.) |
| GTW9A | 1.340 | 1.290 |
| GT9A | 1.270 | 1.210 |

| To obtain Specific Gravity (corrected to 60°F.) of : | Add 1 vol. of acid of 1.835 S.G. (corrected to 60°F.) to : |
|---|---|
| 1.340 | 2.0 volumes of water |
| 1.290 | 2.7 volumes of water |
| 1.270 | 2.9 volumes of water |
| 1.210 | 4.0 volumes of water |

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 and before pouring the electrolyte into the battery.

**Filling the Battery**

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

Carefully break the seals in the filling holes and **half-fill** each cell with electrolyte of the appropriate specific gravity. Allow the battery to stand for at least six hours, in order to dissipate the heat generated by the chemical action of the acid on the plates and separators. Allow to stand for a further two hours and then proceed with the initial charge.

**Initial Charge**

The initial charging rate is 3.5 amperes.

Charge at this rate until the voltage and specific gravity readings show no increase over five successive hourly readings. This will take from 40 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 quoted in table, 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 separators by the addition of acid solution of the same specific gravity as the original filling-in acid, until 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 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 separators.

## PREPARING NEW "DRY-CHARGED" BATTERIES, MODEL (GTZ9A) FOR SERVICE.

**Filling the Cells**

Carefully break the seals in the filling holes and fill each cell with correct specific gravity acid to the top of the separators 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

| Maximum Permissible Electrolyte Temperature During Charge | |
|---|---|
| Home and Climates normally below 90°F. (32°C.) | Climates frequently over 90°F. (32°C.) |
| 100°F. (37.7°C.) | 102°F. (48.8°C.) |

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.

| Specific Gravity of Acid Required When Filling Battery | |
|---|---|
| Home and Climates Ordinarily Below 90°F. (32°C.) Specific Gravity of Acid (Corrected to 60°F.) | Climates Frequently Over 90°F. (32°C.) Specific Gravity of Acid (Corrected to 60°F.) |
| 1.270 | 1.210 |

## DISTRIBUTOR

### REMOVAL

Spring back the clips and remove the distributor.

Disconnect the low tension wire from the distributor terminal.

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

Slacken the distributor plate pinch bolt and withdraw the distributor.

### REFITTING

Refitting is the reverse of the removal procedure, but 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).

**Note :** The crankshaft damper fitted to earlier cars did not have a timing scale and on these engines it will be necessary to set the timing by the number of flywheel teeth before top dead centre. On all 3.4 litre engines and 2.4 litre engines on and after BB.2846 the top dead centre marks are visible through a hole in the bottom of the clutch housing (see Fig.3) 2.4 litre engines prior to the above number have a hole in the left-hand side of the clutch housing.

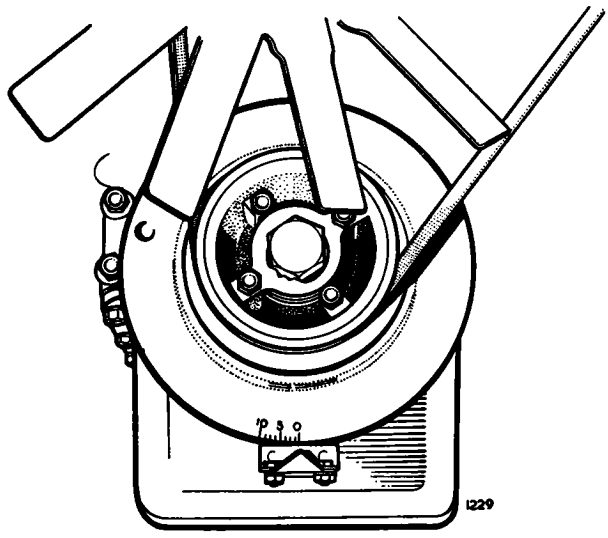



*Fig. 2. Ignition timing scale on crankshaft damper.*

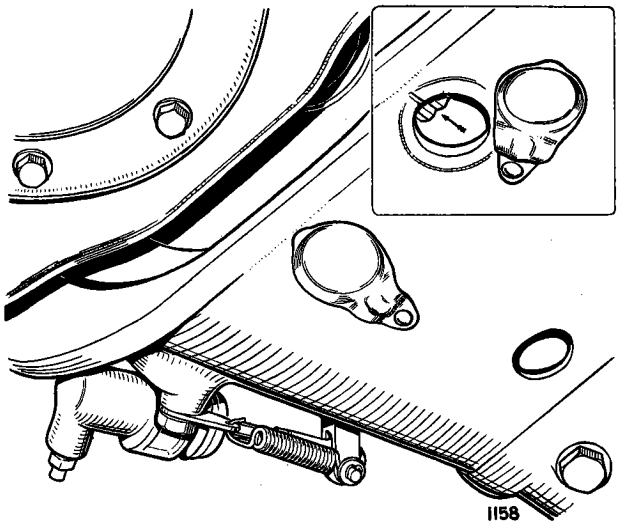



*Fig. 3. Top dead centre marks at the bottom of the clutch housing.*

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.

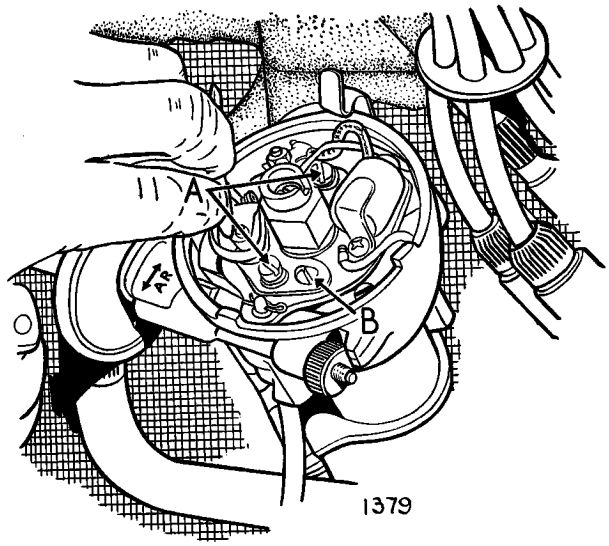
Slowly rotate the distributor body until the points are just breaking, that is, when the lamp lights up.

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

After first 500 miles (of new distributor or contact set) and every 2,500 miles check the contact breaker gap. This should measure 0.014″—0.016″ when fully open.




A. Screws securing fixed contact plate.
B. Eccentric headed adjusting screw.

*Fig. 4. Checking distributor point gap.*

### Lubrication—Every 2,500 miles

Remove the moulded cover and withdraw the rotor arm. A tight rotor arm can be withdrawn using a pair of suitable 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 (A. Fig. 5.) 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.

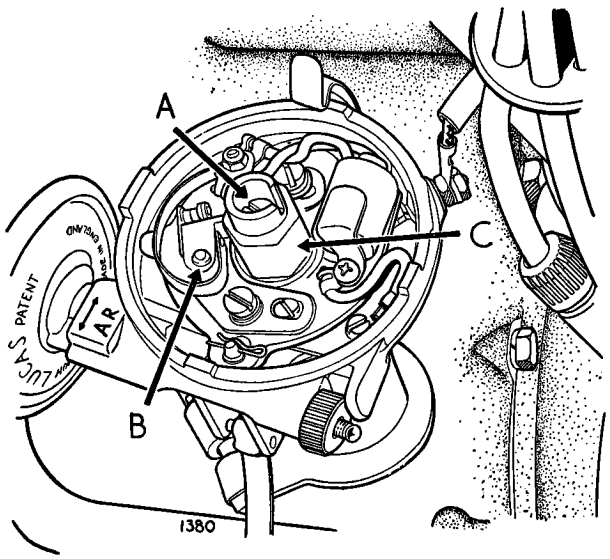



*Fig. 5. Distributor lubrication points.*

### Cam

Lightly smear the faces of the cam (C. Fig. 5) with Mobilgrease No. 2 or high melting point grease.

### 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.

Whilst 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 (B. Fig. 5) with Ragosine Molybdenised Non-creep Oil or with Mobilgrease No. 2. Reassemble 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.

**DATA**

| | 2.4 litre | 3.4 litre |
|---|---|---|
| Type | DMBZA | DMBZA |
| Lucas Service Number (Stamped on distributor body) | | |
| 7 to 1 compression ratio | 40557 | 40578 |
| 8 to 1 compression ratio | 40528 | 40576 |
| 9 to 1 compression ratio | — | 40617 |
| Contact breaker gap | .014" to .016" (.36—.41 mm.) | |
| Cam dwell angle | 35° ± 2° | |
| Contact breaker spring tension (measured at contacts) | 18—24 ozs. (512—682 gms.) | |

**Note:** Early 7 to 1 compression ratio 2.4 litre cars were fitted with a 40528 type distributor and the ignition timing set at 1° B.T.D.C.

**Ignition Timing**

| Model | Compression Ratio | Setting | No. of Fly-wheel teeth |
|---|---|---|---|
| 2.4 litre | 7 to 1 | 4°B.T.D.C | 1⅓ |
| 2.4 litre | 8 to 1 | 6°B.T.D.C. | 1¾ |
| 3.4 litre | 7 to 1 | T.D.C. | - |
| 3.4 litre | 8 to 1 | 2°B.T.D.C. | ⅔ |
| 3.4 litre | 9 to 1 | T.D.C. | - |

## CENTRIFUGAL TIMING ADVANCE TESTS.

### DMBZ6A 40528

(i) Mount distributor in auto advance test rig and set to spark at zero degrees when driven at 100 r.p.m.

(ii) Decelerate and check at the following points :—

| R.P.M. | Advance |
|---|---|
| 2500 | 18°—20° |
| 1700 | 14°—16° |
| 1100 | 11°—13° |
| 800 | 8°—11° |
| 450 | ½°—3½° |

No advance below 300 r.p.m.

### DMBZ6A 40557

(i) Mount distributor in auto advance test rig and set to spark at zero degrees when driven at 100 r.p.m.

(ii) Accelerate to 3,500 r.p.m.
Advance to be 24°—26°

(iii) Decelerate and check at the following points :—

| R.P.M. | Advance |
|---|---|
| 2500 | 22°—24° |
| 1650 | 17°—19° |
| 1400 | 15°—17° |
| 950 | 8°—10° |
| 500 | 1°— 3° |

No advance below 300 r.p.m.

### DMBZ6A 40576

(i) Mount distributor in auto advance test rig and set to spark at zero degrees when driven at 100 r.p.m.

(ii) Accelerate to 3,200 r.p.m.
Advance to be 17°—19°

(iii) Decelerate and check at the following points :—

| R.P.M. | Advance |
|---|---|
| 2250 | 15°—17° |
| 1000 | 10°—12° |
| 800 | 7½°—10½° |
| 450 | ½°—3½° |

No advance below 275 r.p.m.

### DMBZ6A 40578

(i) Mount distributor in auto advance test rig and set to spark at zero degrees when driven at 100 r.p.m.

(ii Accelerate to 3,500 r.p.m.
Advance to be 16°—18°

(iii) Decelerate and check at the following points :—

| R.P.M. | Advance |
|---|---|
| 2400 | 14°—16° |
| 1300 | 10°—12° |
| 1100 | 7°—10° |
| 650 | ½°—3½° |

No advance below 400 r.p.m.

### DMBZ6A 40617

(i) Mount distributor in auto advance test rig and set to spark at zero degrees at 100 r.p.m.

(ii) Accelerate to 2,000 r.p.m.
Advance to be 12°

(iii) Decelerate and check at the following points :—

| R.P.M. | Advance |
|---|---|
| 850 | 7°— 9° |
| 450 | 0°—2½° |

No advance below 325 r.p.m.

## VACUUM TIMING ADVANCE TESTS

| Distributor | Vacuum in inches of Mercury | Advance in degrees | No advance below |
|---|---|---|---|
| DMBZ6A 40528 | 18<br>11½<br>7½<br>4 | 11—13<br>10—12½<br>5½—9<br>0—4 | 2½" of Mercury |
| DMBZ6A 40557 & 40578 | 20<br>13<br>9½<br>6½ | 10—12<br>9½—11½<br>6—8½<br>1½—5 | 4" of Mercury |
| DMBZ6A 40576 | 20<br>12<br>8½<br>6½ | 8—10<br>6—8<br>3—5<br>½—3 | 5" of Mercury |
| DMBZ6A 40617 | 20<br>13<br>9<br>7½ | 7—9<br>6—8½<br>2½—5½<br>0—3 | 6" of Mercury |

## 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 must 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.

### Reassembly

When reassembling, 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.

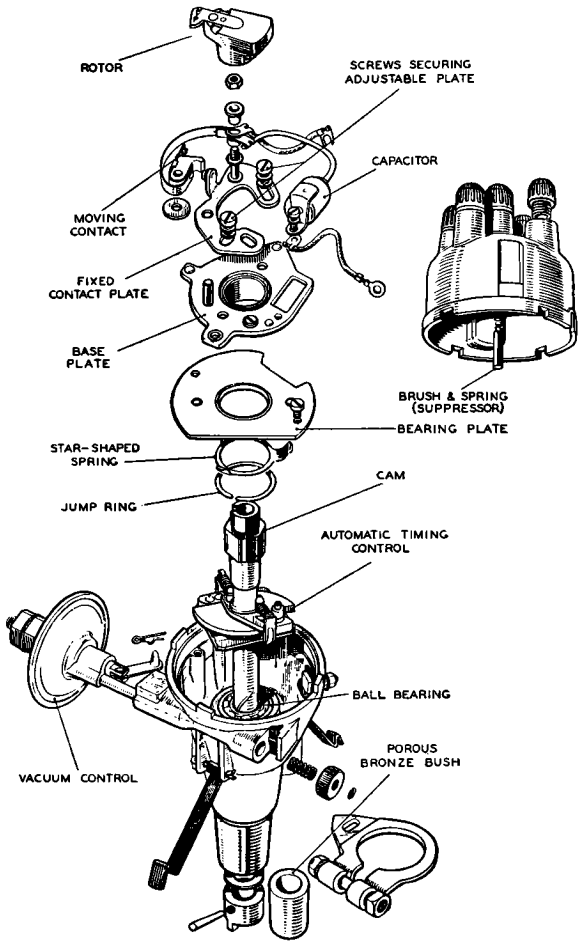



*Fig. 6. Exploded view of distributor.*

## FLASHER UNITS

Flasher Unit model FL3 was fitted to early 2.4 litre cars but was later superseded by model FL5 which is also fitted to the 3.4 litre saloon.

The flasher unit is housed in a small cylindrical container. Inside a switch is operated automatically by the alternate heating and cooling of an actuating wire. Also incorporated is a small relay to flash the switch warning light when the system is functioning correctly. Failure of this light to flash will indicate a fault. In the event of trouble occurring, the following procedure should be followed :—

(i) Check the bulbs for broken filaments.

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

(iii) Switch on the ignition.

(iv) Check with a voltmeter that flasher unit terminal 'B' is at 12 volts with respect to earth.

(v) 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.

The direction-indicator switch is best checked by substitution. It is important that only bulbs of the correct wattage rating (i.e. 21 watts) are used in the flasher lamps.

The side/flasher and rear/stop/flasher lamps are fitted with a double filament bulb. This is the Lucas No. 380 12-volt 21/7-watt non-reversible small bayonet cap bulb.

Special contacts in the direction-indicator switch ensure that responses to the flasher unit take precedence over any simultaneous application of the brake switch.

The switch warning light is Lucas No. 280 12-volt 1.5-watt lilliput Edis on screw cap.

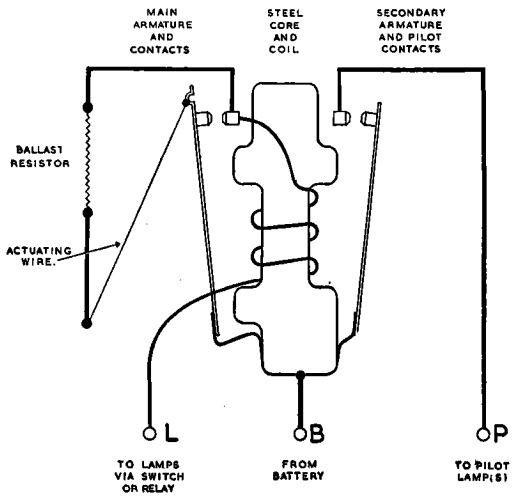



*Fig. 7. Flasher unit wiring diagram.*

## FUSE UNIT

Model SF6 Fuse Unit carries two live glass cartridge type fuses and two spare fuses. Originally, 35-amp fuses were fitted but were later superseded by 50-amp fuses.

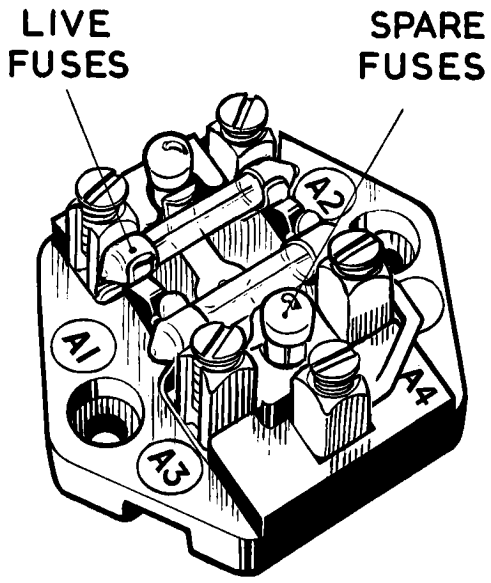



*Fig. 8. Fuse unit.*

# GENERATOR — TYPE C.45. PV-5.

**(Fitted to 2.4 litre 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 fan belt.

## REFITTING

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

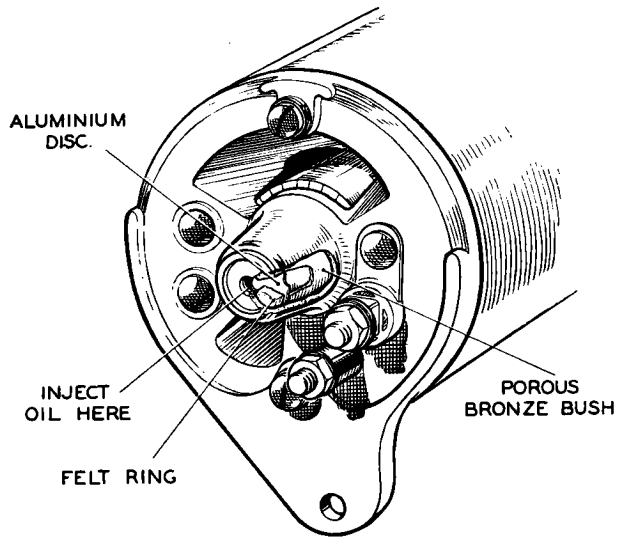



*Fig. 9. Generator bush lubrication hole.*

## 1. GENERAL

The generator is a shunt-wound two-pole two-brush machine, arranged to work in conjunction with a Lucas regulator unit. 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 10,000 miles, inject a few drops of high quality medium viscosity (S.A.E. 30) engine oil into the hole marked " OIL " at the end of the bearing housing.

(b) **Inspection of Brushgear**

Every 10,000 miles the brushgear should be checked as detailed in paragraph 4.C.

(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 : | 1100—1250 r.p.m. at 13.0 generator volts. |
| Max. Output : | 22 amp. at 1700—1900 r.p.m. at 13.5 generator volts and a resistance load of 0.61 ohms. |
| Field Resistance : | 6.0 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 Para. 2c).

ii. Check that the generator and control box are connected correctly. The larger generator terminal must be connected to control box terminal " D " and the smaller generator terminal to control box terminal "F ".

iii. Switch off all lights and accessories, disconnect the cables from the terminals of the generator and connect the two terminals 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 Para. 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 te minal 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, taking care to connect the larger generator terminal to control box terminal " D " and the smaller generator terminal to control box terminal " F ".

(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.

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.

(c) **Brushgear**

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 and bracket over the commutator and release the brushes.

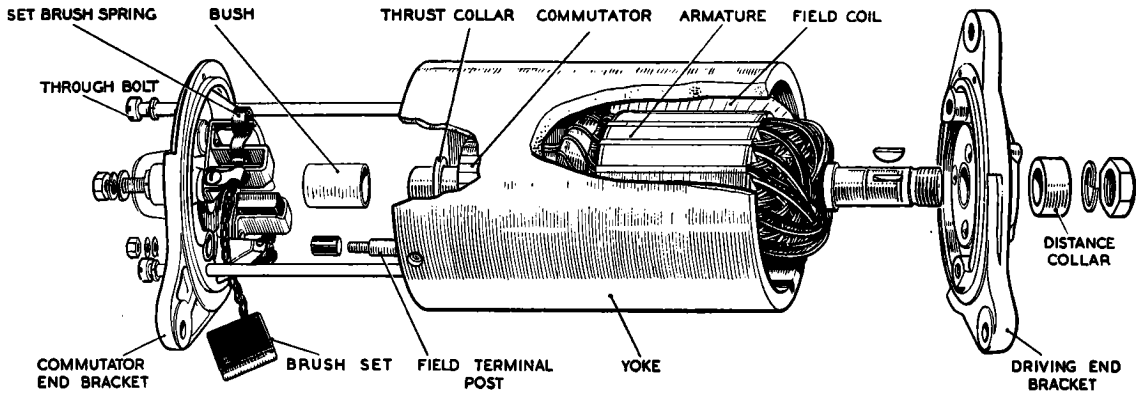



*Fig. 10. Exploded view of generator.*

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 $\frac{7}{16}$".

iv. Test the brush spring tension using a spring scale. The tension of the springs when new is 36—44 oz. In service, it is permissible for this value to fall to 30 oz. before performance may be affected. Fit new springs if the tension is low.

(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, mount the armature, with or without drive end bracket, in a lathe, rotate at high speed and take a light cut with a very sharp tool. Do not remove more metal than is necessary. Polish the commutator with a very fine glass paper. Emery cloth must not be used on the commutator. Undercut the insulators between the segments to a depth of $\frac{1}{32}$" with a hack saw blade ground to the thickness of the insulator.

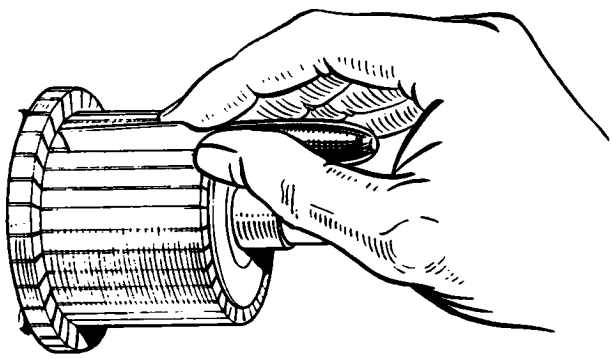


*Fig. 11. Undercutting the commutator insulation.*

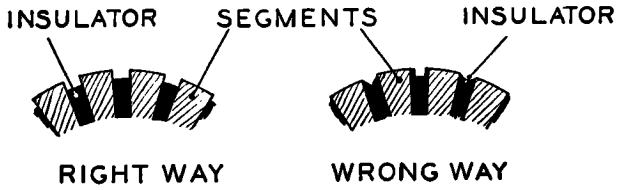



*Fig. 12. Showing the correct and incorrect way of undercutting the commutator insulation.*

(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 remove the armature shaft from the drive end bracket and bearing, support the bearing retaining plate firmly and press the shaft out of the drive end bracket.

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 Para. 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 6.0 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 in each case should be approximately 2 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 amperes, or the ohm meter reading much below 6 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 unsolder the field coil connections.

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.

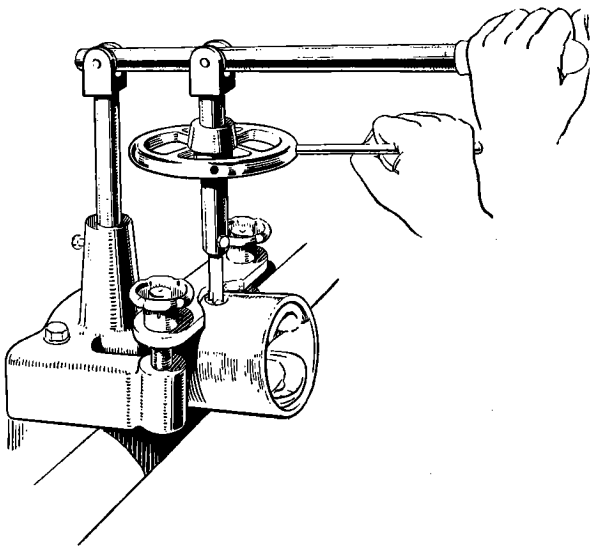


*Fig. 13. Tightening the pole shoe retaining screws.*

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 and lock them by caulking.

ix. Replace the insulation piece between the field coil terminal and re-rivet the terminal assembly to the yoke.

(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 :—

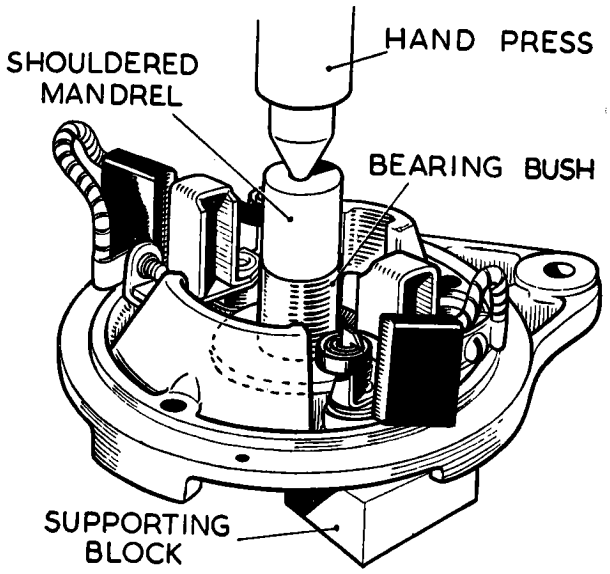



*Fig. 14. Method of fitting the porous bronze bush.*

i. Remove the old bearing bush from the end bracket. The bearing can be withdrawn with a suitable extractor or by screwing an $\frac{11}{16}$" 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. Insert the felt ring and aluminium disc in the bearing housing, then 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, until the visible end of the bearing is flush with the inner face of the bracket.
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 thin 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.

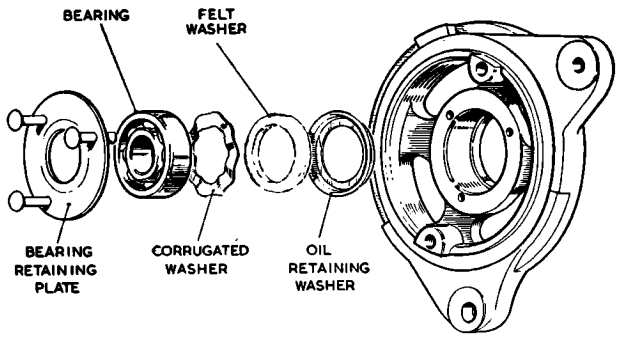



*Fig. 15. Exploded view of drive end bearing.*

ii. Press the bearing out of the end bracket and remove the corrugated washer, felt washer and retaining washer.

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

iv. Place the oil retaining washer, felt washer 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 inside of the end bracket and open the rivets by means of a punch to secure the plate rigidly in position.

(h) **To Reassemble**

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 $\frac{11}{16}$″. 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 the brush spring at the side of the brush.

iv. Fit the commutator end bracket on the armature shaft until the brush boxes are partly over the commutator. Place a thin screwdriver on top of each brush in turn and press the brush down on the commutator.

The brush springs should then position themselves on top of the brushes.

v. Fit the commutator end bracket to the yoke so that the projection on the bracket locates in the yoke.

vi. Refit the two through bolts.

After reassembly lubricate the commutator end bearing (see Para. 2a).

# GENERATOR — TYPE C.45. PVS-5.

**(Fitted to 3.4 litre Models.)**

## REMOVAL

Remove the windscreen washer bottle and cage, noting the respective positions of the rubber pipes.

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 fan belt.

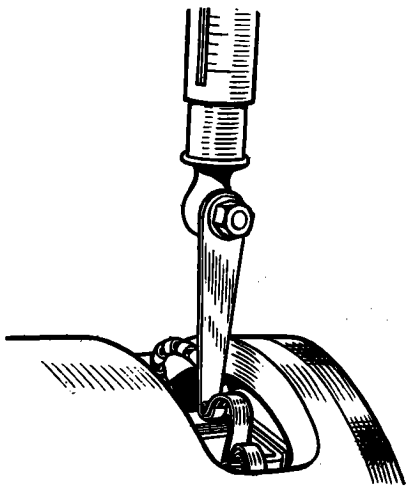


*Fig. 16. Testing the brush spring tension.*

## REFITTING

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

Except for the differences described below, the instructions given for C.45.PV-5 generator fitted to the 2.4 litre model apply equally to C.45.PVS-5. The essential differences between the two generators concern :

(i) Brushgear inspection.

(ii) Commutator end bearings.

## BRUSHGEAR INSPECTION

The yoke is provided with " windows " and a band cover. The instructions given for model C.45.PV-5 under Para. 4(c) (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.

## 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.

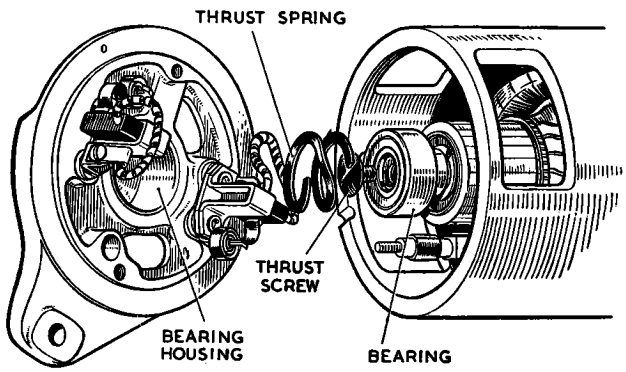



*Fig. 17. Showing the commutator end plate removed.*

# 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 cabling should be checked occasionally and rectified as required.

**Adjustment**

A horn in correct adjustment will pass 3.5—4.0 amperes at 12 volts. Adjustment does not alter the note but serves to take up wear of the moving parts which if not corrected will result in loss of power and roughness of tone.

When adjusting, use a first grade 0—10 moving coil ammeter and turn the horn adjustment screw clockwise to increase the current, or anti-clockwise to decrease the current.

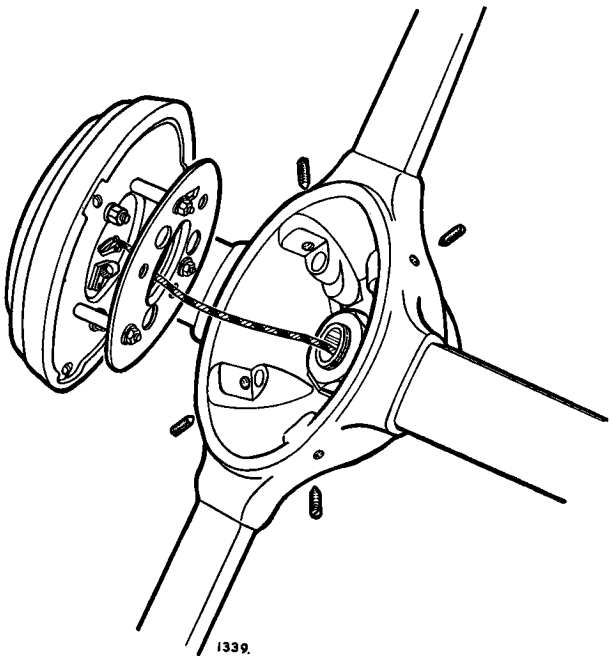



*Fig. 18. Horn push removal.*

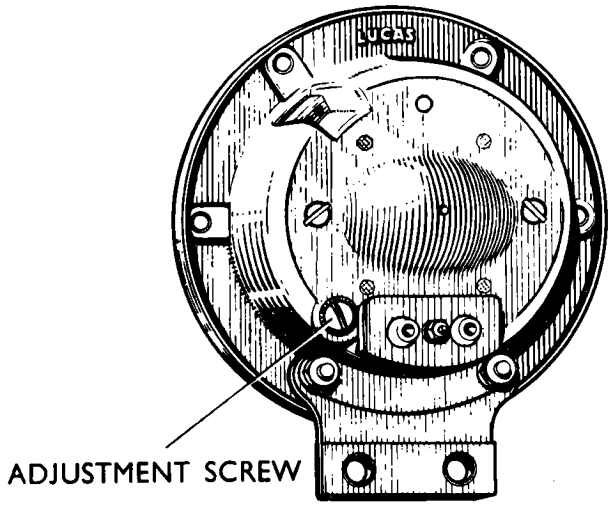



*Fig. 19. Horn adjustment screw.*

# LAMPS

## LAMP BULBS

| LAMP | LUCAS BULB No. | VOLTS | WATTS | APPLICATION |
|---|---|---|---|---|
| Headlamp | | | | |
| Early cars | 354 | 12 | 42/36 | Home and R.H.D. Export |
| Early cars | 355 | 12 | 42/36 | L.H.D. Export |
| Later cars | 404 | 12 | 60/36 | Home and R.H.D. Export |
| Later cars | 405 | 12 | 60/36 | L.H.D. Export |
| | 370 | 12 | 45/40 | Continental |
| Yellow | 372 | 12 | 45/36 | France |
| | 350 | 12 | 35/35 | Germany, Norway and Sweden, |
| | Sealed beam units | | | U.S.A. and Canada. |
| Side/Flasher | 380 | 12 | 6/21 | — |
| Rear/Stop/Flasher | 380 | 12 | 6/21 | — |
| Number plate & Boot | 222 | 12 | 4 | — |
| Reverse | 382 | 12 | 21 | — |
| Fog | 323 | 12 | 48 | — |
| Interior light | 254 | 12 | 16 | — |
| Panel | | | | |
| Warning Lights— Ignition, Headlamp Petrol Level Carburetter Mixture | 987 | 12 | 2.2 | — |
| Flasher Warning Light | 280 | 12 | 1.5 | — |

## 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.

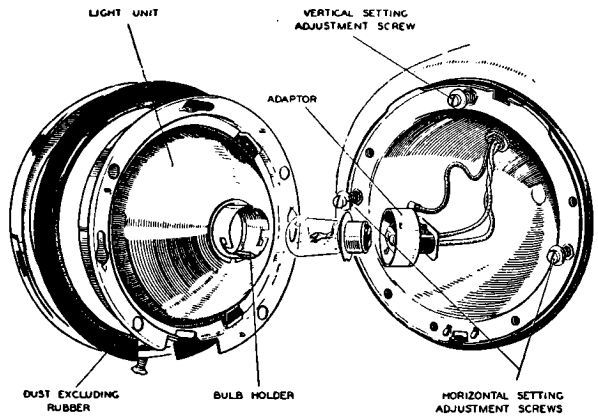



*Fig. 20. Showing the headlamp adjustment screws and bulb location.*

### Bulb Replacement

Slacken the single rim securing screw and withdraw the rim and dust excluding rubber ring.

Press the light unit inwards against the three spring-loaded adjustment screws and turn it anti-clockwise to disengage it through the keyhole slots.

Release the bayonet adaptor with a press-in anti-clockwise motion and withdraw the defective bulb.

Note that a notch in the flange of the bulb is arranged to locate with a ridge in the bulb-holder.

Fit the new bulb and refit the adaptor, light unit, dust excluder and front rim.

After fitting, the headlamp setting should be checked.

### 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 road. (see Fig. 21.).

When setting, remove the lamp rims and dust excluding rubber rings. Cover one lamp whilst adjusting the other.

Vertical trimming is effected by screwing in (or out) the top spring-loaded screw. Horizontal trimming is effected with the two side screws.

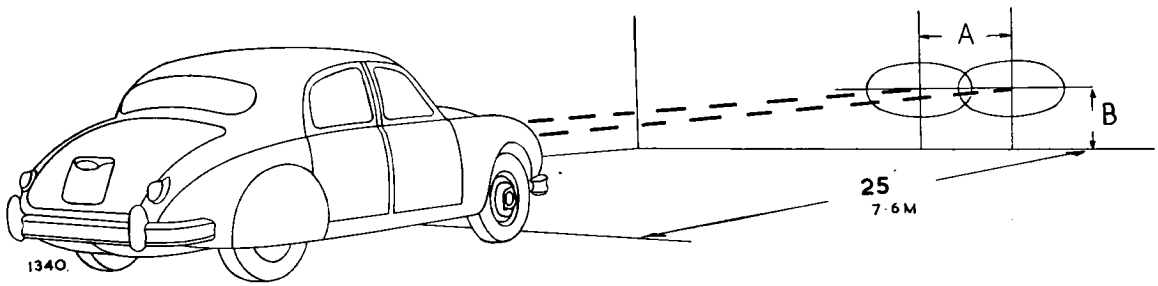



*Fig. 21. Headlamp beam setting. 'A' is the distance between the centres of the headlamps. 'B' is the height of the centres of headlamps from the ground.*

### SIDE/FLASHER BULB—REPLACEMENT

Remove the two screws at the front of the lamp and detach the glass.

To remove the bulb from the holder, press inwards and rotate anti-clockwise. When replacing the bulb note that the pins are offset.

### REAR/STOP/FLASHER BULB—REPLACEMENT

Remove the two screws securing the glass. To remove the bulb, press upwards and rotate anti-clockwise. To ensure that the bulb filaments are correctly positioned in relation to the holder, the pins of the bulb are offset.

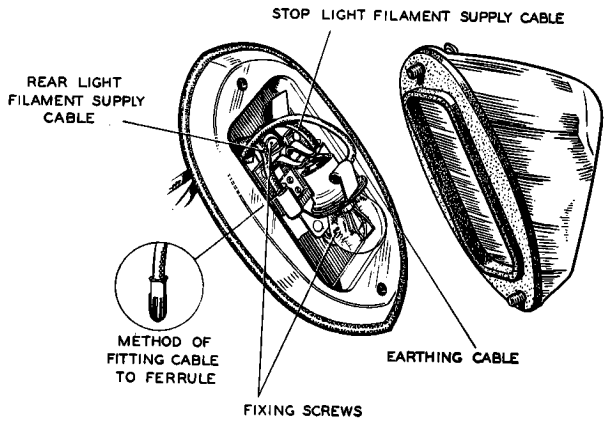



*Fig. 22. Rear/Stop/Flasher lamp.*

### REVERSE, NUMBER PLATE, AND LUGGAGE BOOT BULBS—REPLACEMENT

The reverse light bulb, the two number plate bulbs and the boot light bulb are retained in a holder accessible from the under-side of the luggage boot lid. To remove the holder unscrew the two cheese-headed screws when the holder can be withdrawn ; all the bulbs are retained in the holder by bayonet fixings. The luggage boot light is accessible without having to remove the holder.

### FOG LAMP BULB—REPLACEMENT

Remove the screw and clamp from the bottom of lamp, and withdraw the light unit. Remove the adaptor by rotating anti-clockwise and withdraw the bulb from the back of the reflector. When replacing the bulb note that the groove in the bulb plate must be aligned with its register in the rear of the reflector. (Fog lamps are not fitted on cars for U.S.A.).

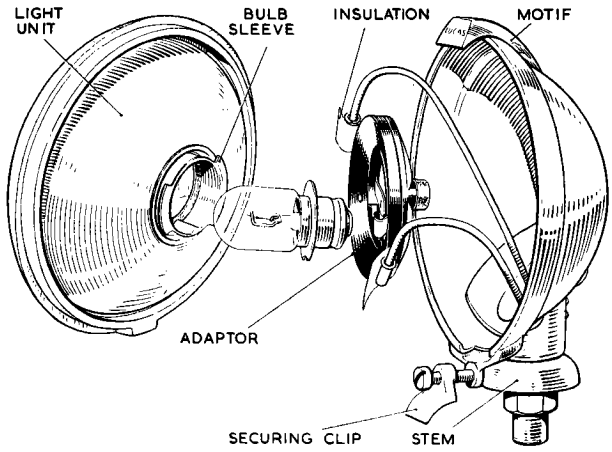



*Fig. 23. Fog lamp showing method of bulb replacement.*

# RB 106 VOLTAGE REGULATOR

## (EARLY 2·4 LITRE CARS.)

### (a) CHECKING CONTINUITY BETWEEN BATTERY AND CONTROL BOX

If the generator and battery are known to be in order, disconnect the cable from control box terminal ' A ' and connect it to the negative terminal of a good quality 0—20 moving coil voltmeter.

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

If there is no reading, examine the wiring between battery and control box for defective cables or loose connections.

Re-connect the cable to control box terminal ' A '

### (b) 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.

Withdraw the cables from control box terminals ' A ' and ' A1 ' and connect these cables together.

Connect the voltmeter to control box terminals ' D ' and ' E '.

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., (2,100 engine r.p.m.) when the open circuit voltage reading should lie within the following limits :—

| Regulator Temperature | Voltage Setting |
|---|---|
| 50°F. (10°C.) | 16.1—16.7 |
| 68°F. (20°C.) | 16.0—16.6 |
| 86°F. (30°C.) | 15.9—16.5 |
| 104°F. (40°C.) | 15.8—16.4 |

If the voltmeter reading is outside the appropriate limits slacken the locknut of the voltage adjusting

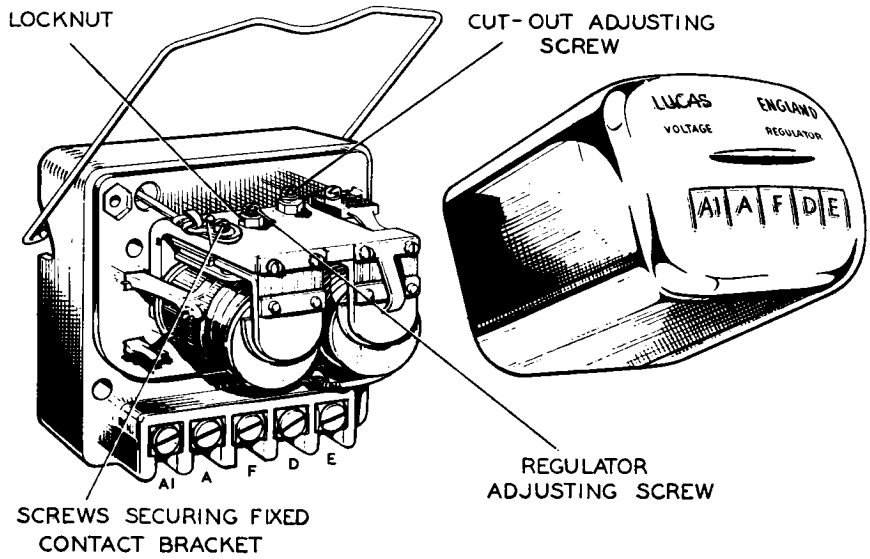



*Fig. 24. The RB106/1 control box.*

screw and turn screw (clockwise to raise the setting or anti-clockwise to lower it) until the correct setting is obtained. Retighten the locknut.

Check the setting by switching off and then again raising the generator speed to 3,000 r.p.m.

### (c) CLEANING REGULATOR CONTACTS

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

### (d) 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. To check the voltage at which the cut-out operates, remove the control box cover and connect the voltmeter between terminals 'D' and 'E'. Start the engine and slowly increase its speed, until the cut-out contacts are seen to close, noting the voltage at which this occurs. This should be 12.7—13.3 volts.

If operation of the cut-out takes place outside these limits, it will be necessary to adjust. To do this slacken the locknut securing the Cut-out Adjusting Screw and turn this screw in a clockwise direction to raise the voltage setting or in an anti-clockwise direction to reduce the setting. Turn the screw only a fraction of a turn at a time and then tighten the locknut. Test after each adjustment by increasing the engine speed and noting the voltmeter readings at the instant of contact closure. Electrical settings of the cut-out like the regulator, must be made as quickly as possible because of temperature-rise effects. Tighten the locknut after making the adjustment.

### (e) 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).

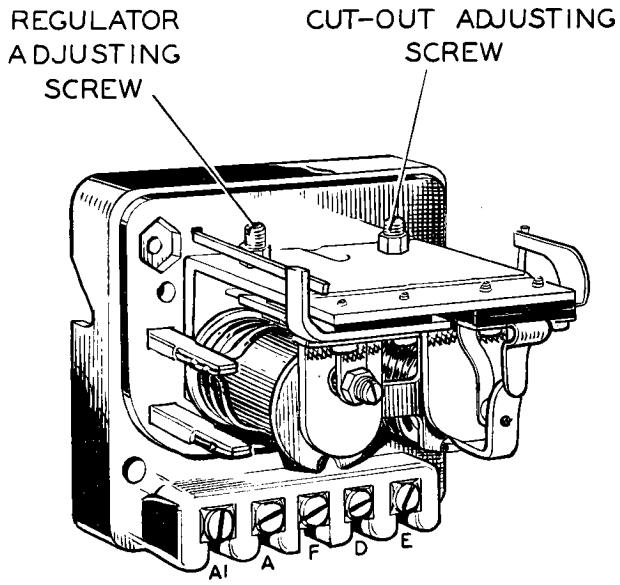



*Fig. 25 The RB106/2 control box.*

# RB 310 VOLTAGE AND CURRENT REGULATOR

## (LATER 2·4 LITRE CARS AND ALL 3·4 LITRE CARS.)

### (a) CHECKING CONTINUITY BETWEEN BATTERY AND CONTROL BOX

If the generator and battery are in order, disconnect the cable from control box terminal ' B ' and connect it 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 cable to terminal ' B ' and examine the wiring between battery and control box for defective cables or loose connections.

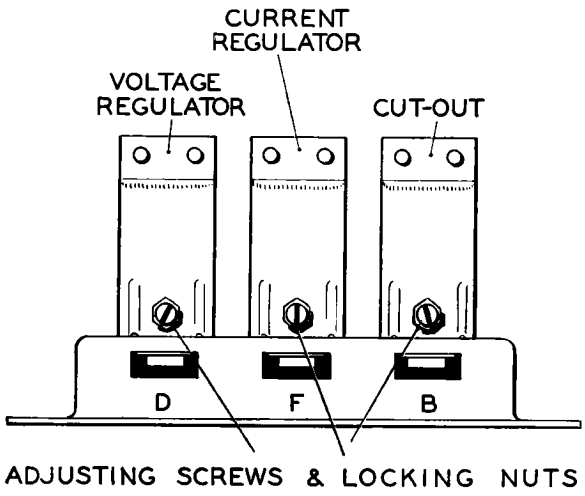



*Fig. 26. The RB310 control box.*

### (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 cable from the control box terminal ' B '.

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 :—

| Regulator Temperature | Voltage Setting |
|---|---|
| 50°F. (10°C.) | 15.1—15.7 |
| 68°F. (20°C.) | 14.9—15.5 |
| 86°F.(30°C.) | 14.7—15.3 |
| 104°F. (40°C.) | 14.5—15.1 |

If the voltmeter reading is outside the appropriate limits, slacken the locknut of the voltage regulator adjusting screw and turn (clockwise to raise the setting or anti-clockwise to lower it) until the correct setting is obtained. Re-tighten the locknut. Check the setting by switching off and then raising the generator speed to 3,000 r.p.m.

### (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 contacts should be short-circuited with a crocodile clip placed between the insulated fixed contact bracket and the voltage regulator frame.

Disconnect the cable from terminal ' B ' and connect a 0—40 first grade moving coil ammeter between this cable and terminal ' B '.

Start the engine and run the generator at about 4,000 r.p.m. (2,700 engine r.p.m.). The ammeter should register 21—23 amperes. If necessary slacken the locknut of the current adjusting screw which is the centre screw of the three. Turn the screw in a clockwise direction to raise the setting or in an anti-clockwise direction to lower the setting.

When the correct setting is obtained, tighten the locknut and re-check.

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 fine carborundum stone or fine emery cloth. All traces of metal dust or other foreign matter must be removed with methylated spirits (de-natured 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. To check the voltage at which the cut-out operates, remove the control box cover and connect the voltmeter between terminals ' D ' and ' E '. Start the engine and slowly increase its speed until the cut-out contacts are seen to close, noting the voltage at which this occurs. This should be 12.7—13.3 volts.

If operation of the cut-out takes place outside these limits, it will be necessary to adjust. To do this, slacken the locknut securing the cut-out adjusting screw and turn this screw in a clockwise direction to raise the voltage setting or in an anti-clockwise direction to reduce the setting. Turn the screw only a fraction of a turn at a time and then tighten the locknut. Test after each adjustment by increasing the engine speed and noting the voltmeter readings at the instant of contact closure. Electrical settings of the cut-out, like the regulator, must be made as quickly as possible because of temperature-rise effects. Tighten the locknut after making the adjustment.

### (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).

# STARTER MOTOR

## REMOVAL

Disconnect one of the battery cables.

Disconnect the cable from the terminal at the end of the starter motor.

Remove the two nuts securing the starter motor to the crankcase and clutch housing. Access to the top bolt is gained through an aperture (covered by a circular plate) in the right-hand side of the gearbox cowl.

**Note :** Early cars did not have this aperture and a suitable hole should be made in the gearbox cowl in the position shown in Fig. 27. This hole can be covered by a metal plate and secured with three self-tapping screws.

Remove the two starter securing bolts, which are connected by a metal strap, when the starter can be withdrawn.

## REFITTING

Refitting is the reverse of the removal procedure.

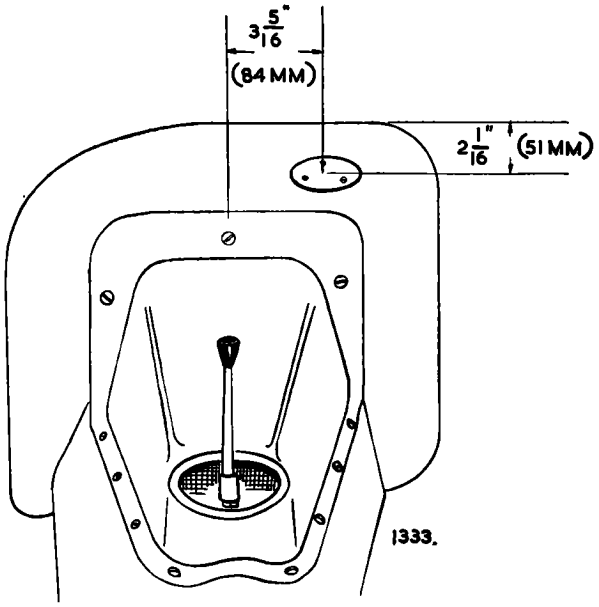



*Fig. 27. Starter motor access hole*

## 1. GENERAL

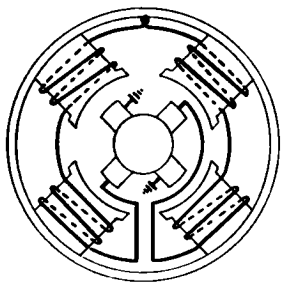
The electric starting motor is a series-wound four-pole four-brush machine having an extended shaft which carries the engine engagement gear, or starter drive as it is more usually named. The diameter of the yoke is 4½".

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 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.



MODELS M45G & M418G

*Fig. 28. Showing the internal connections of the starter motor.*

## 3. PERFORMANCE DATA

**2.4 Litre**
**(Type M.418.G)**

Lock torque. 17 lb. ft. with 440—460 amps at 7.4—7.0 volts. Torque at 1,000 r.p.m. 8.0 lb. ft. with 250—270 amps at 9.4—9.0 volts. Light running current. 45 amperes at 7,400—8,500 r.p.m.

**3.4 Litre**
**(Type M.45.G)**

Lock torque. 22 lb. ft. with 430—450 amps at 7.8—7.4 volts. Torque at 1,000 r.p.m. 8.3 lb. ft. with 200—220 amps 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

(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 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.

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

(i) If it is necessary to remove the starting motor from the engine, proceed as follows :—
Disconnect one of the battery cables at the battery, to avoid any danger of causing short circuits.
Disconnect the cable from the starter motor,

(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

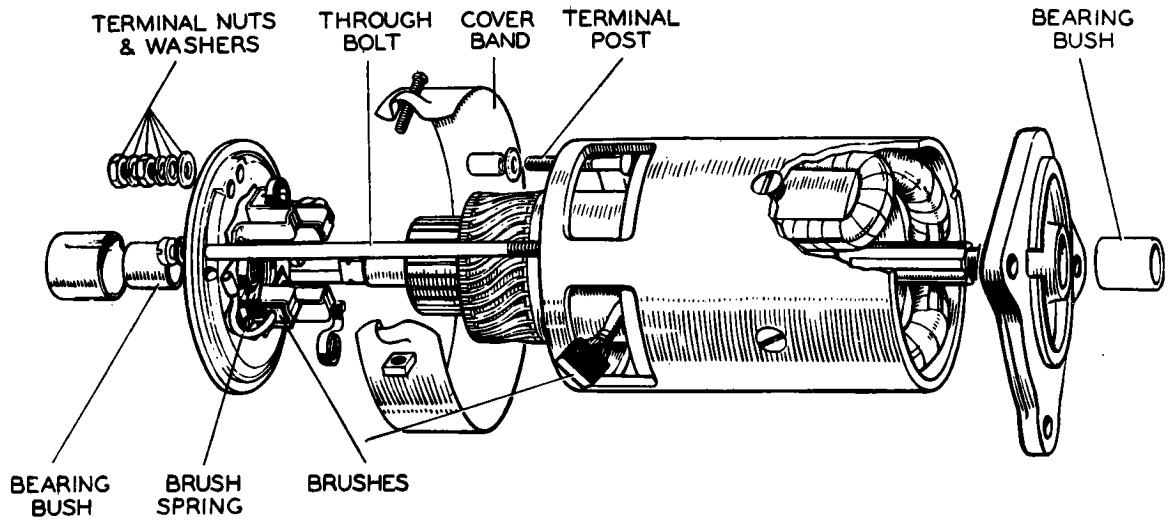



*Fig. 29. Exploded view of starter motor.*

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 Para. 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 Para. 4D).

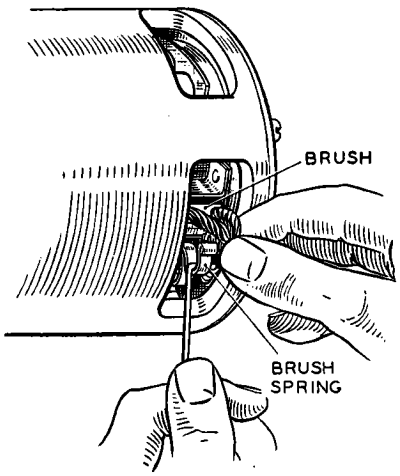



*Fig. 30. Checking the brush gear.*

Check the tension of the bush springs with a spring scale. The correct tension is 30—40 ozs. New springs should be fitted if the tension is low.

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

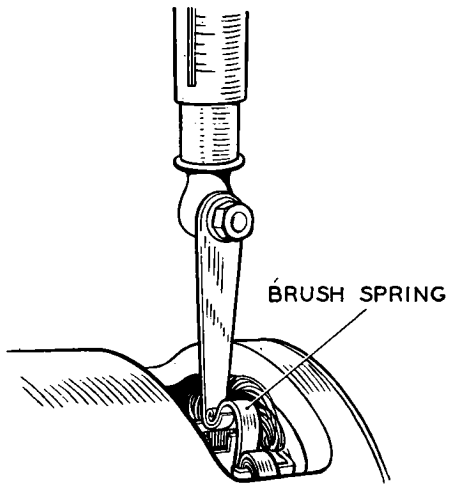



*Fig. 31. Testing the brush gear tension.*

(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.

### (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 secured in their place by soldering. The brushes are pre-formed so that bedding to the commutator is unnecessary.

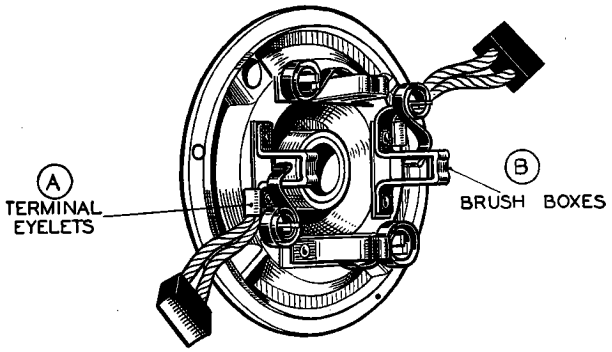



*Fig. 32. Commutator end bracket brush connections.*

### (e) COMMUTATOR

A commutator in good condition will be smooth and free from bits 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 attempt 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 which is provided to prevent the intercoil connectors from contacting with the yoke.

Mark the yoke and pole shoes so that the latter can be re-fitted 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 reassembly of the starting motor is a reversal of the dismantling procedure.

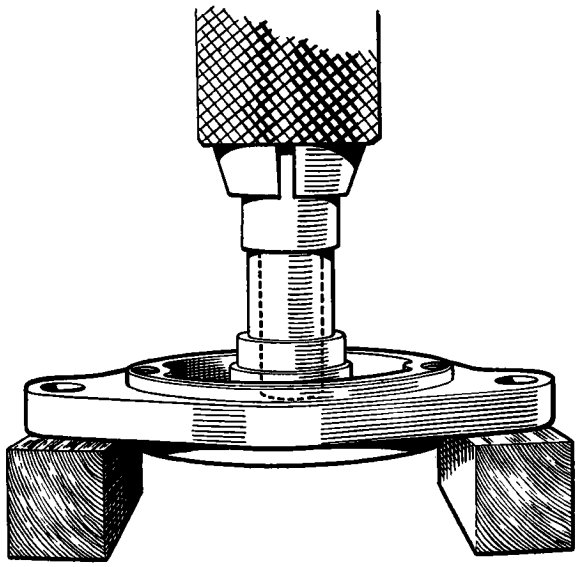


*Fig. 33. Method of fitting bush.*

## 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 :—

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).

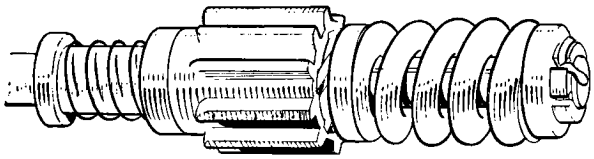


*Fig. 34. Showing the starter drive assembled.*

**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.

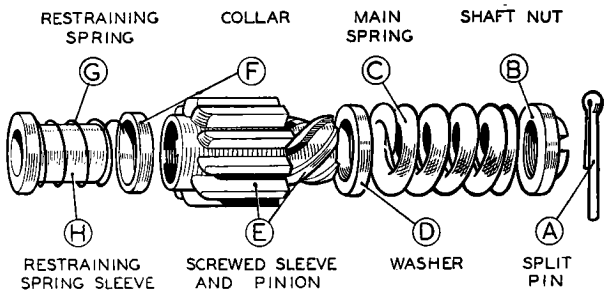



*Fig. 35. Exploded view of the starter drive assembly.*

## WINDSCREEN WIPER

### REMOVAL OF WIPER MOTOR AND CABLE

Withdraw the wiper arms from the spindles. Unscrew the large nut connecting cable guide to the wiper motor.

Remove the single screw securing the plate covering the electrical connections on the wiper motor. Withdraw the electrical cables from the wiper motor complete with the rubber retainer.

From the underneath of the right hand front wing remove the three screws securing the wiper motor to the wing valance.

The wiper motor cable can now be removed as an assembly by drawing the cable through the guide tube.

**Disconnecting the Cable**

Remove the four small set bolts from the gear cover.

Lift off the cover, remove the circlip from the post in the gear wheel.

Remove the washer, spring, shaped washer and connecting link from the post. Lift out the connecting link from the crosshead.

Lift out the cable ferrule from the gear casing.

### REFITTING

Refitting is the reverse of the removal procedure.

### REMOVAL OF WHEELBOXES

Remove the centre facia as described on page 40.

Remove the screen rail as decribed on page 40.

Withdraw both wiper arms from the spindles.

From outside the car unscrew the large nuts securing the wheelboxes to the scuttle.

Remove the chrome distance pieces and rubber seals.

Remove the backplates from the wheelboxes by removing the two screws.

Pull the cable away from the worm wheels and slide off the spacer tubing.

From inside the car withdraw the wheelboxes and spacers.

### REFITTING

Refitting is the reverse of the removal procedure.

## DATA

| | |
|---|---|
| Wiping Speed | |
| Normal : | 45—50 cycles per minute |
| High : | 60—70 cycles per minute |
| Light Running Current | |
| Normal Speed : | 2.7—3.4 amperes |
| High Speed : | 2.6 (or less) amperes |
| Stall Current | 10—11 amperes (DR3) 8—9 (DR1) |
| Control Switch | PRS7 |
| Pressure of Blades against Windscreen | |
| Arms with leaf type springs : | 4.5—7.5 ounces |
| Arms with coil type springs : | 5.5—7.5 ounces |
| Maximum permissible force to move cable rack in protective tubing with motor, arms and blades disconnected | 6.0 lbs. |

## DESCRIPTION

The windscreen wiper is a two-speed, thermostatically protected, self-parking, cable rack unit.

The cable rack comprises a flexible inner core of steel wire wound with a wire helix. The rack passes through protective tubing from an underbonnet mounted motor to a pair of scuttle mounted wheelboxes. A reciprocating motion is imparted to the rack by a crank in the wiper gearbox and transmitted to the wiper arm spindles by engagement of the rack with a gear in each wheelbox.

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 in 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. Provided the obstruction or other cause of excessive heating is removed, normal working resumes automatically when the temperature falls to a safe value.

## MAINTENANCE

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

Use methylated spirits (de-natured 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 near the cable rack outlet. Turn the nut only one or two serrations at a time and test the effect of each setting before proceeding.

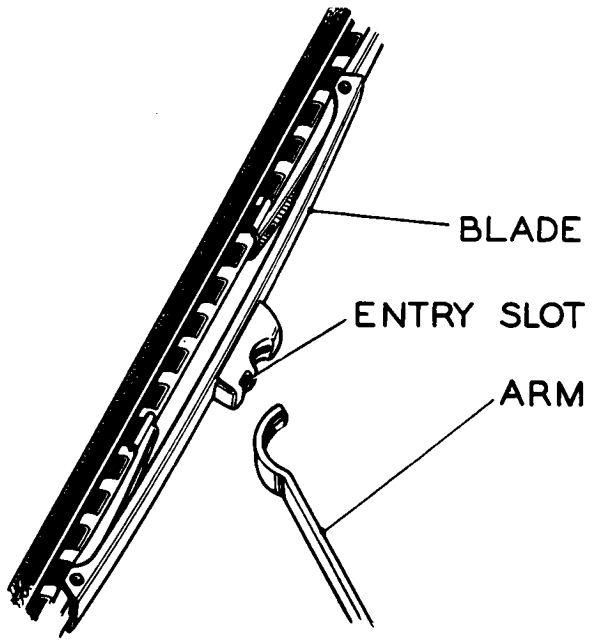



*Fig. 36. Wiper blade to arm attachment.*

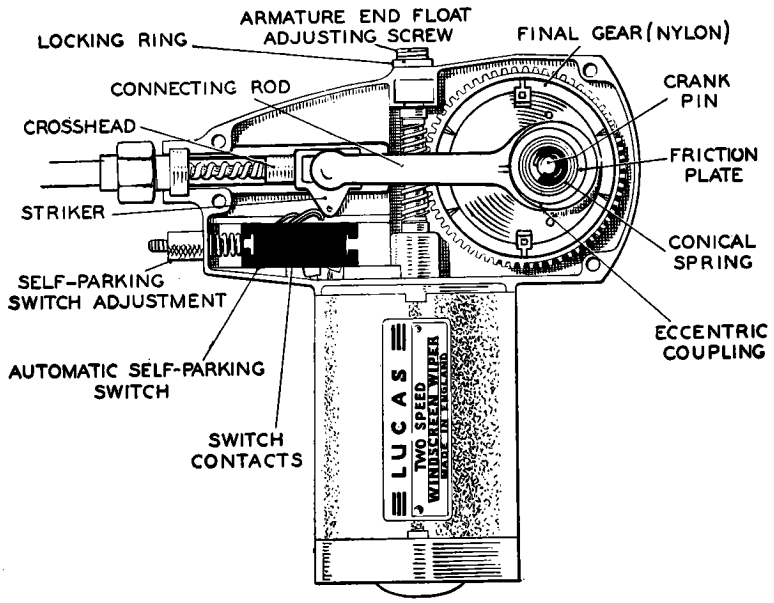



*Fig. 37. Showing the DR1 wiper motor with cover plate removed.*

## 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 to a discharged battery ;

Cable rack binding in protective tubing ;

Eccessive loading on the wiper blades ;

Wheelboxes loose, out of alignment or spindles binding in the bearing housing.

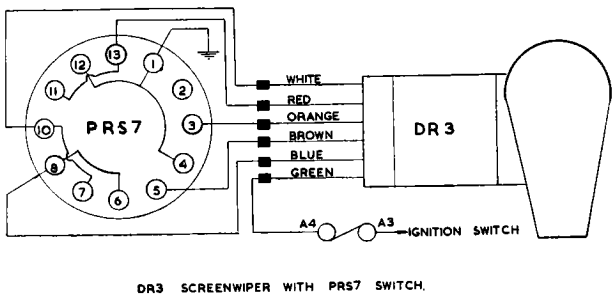



*Fig. 38. Wiring connections switch to wiper.*

## 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 running terminal voltage is correct, disconnect the cable rack at the wiper gearbox and measure the light running current with a first grade moving coil ammeter connected in the supply cable.

As this involves removing the gearbox cover, the opportunity can be taken to observe the speed of operation by counting the revolutions per minute of the final gear.

The light running current must not exceed 3.4 amperes at Normal speed (45—50 c.p.m.). If it does, fit a new windscreen wiper motor.

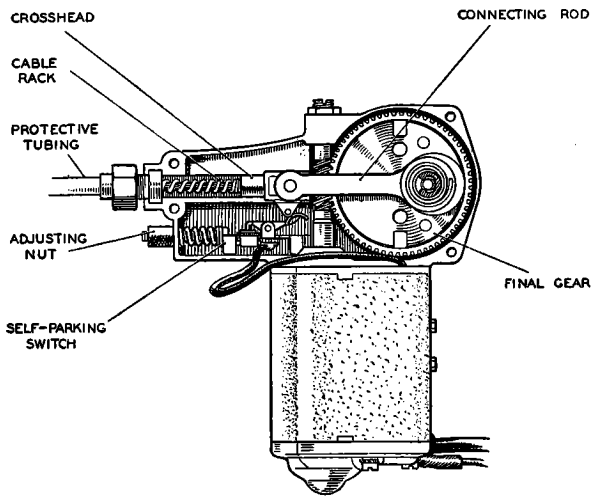



*Fig. 39. Showing the DR3 wiper motor with cover plate removed.*

### Checking Cable Rack and Tubing

The maximum permissible force to move the cable rack in its protective tubing is 6 pounds with the wiper arms, blades and motor disconnected. The measurement can be made by hooking a spring balance in the hole in the cross-head (into which a pin on the connecting rod is normally located) and withdrawing the rack with the balance.

Binding of the rack can be due to kinked or flattened tubing or to faulty installation. Minor faults can be cleared with a suitable tested mandrel sold specifically for checking wiper installations. Badly kinked or flattened tubing must be renewed. Any bends of less than 9″ radius must be reformed.

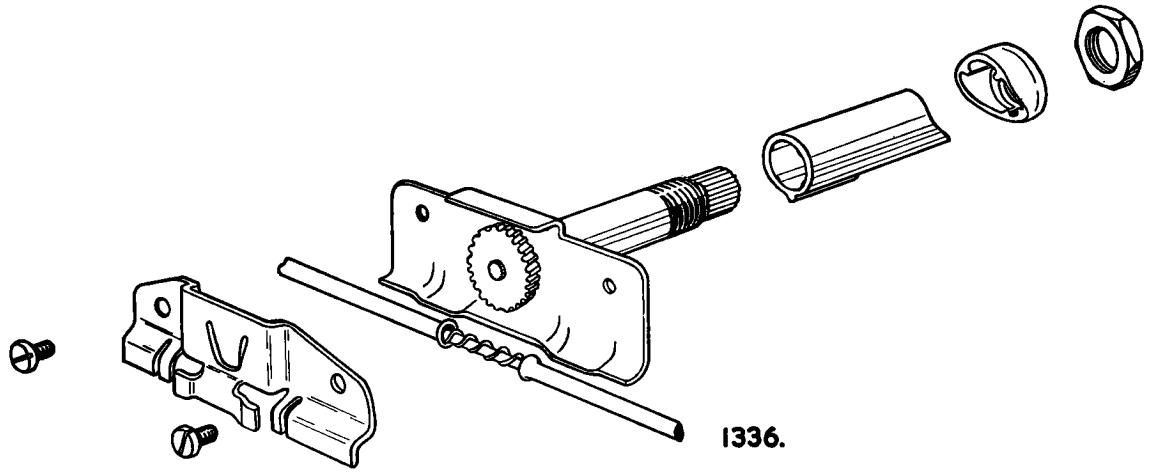



*Fig. 40. Exploded view of wheelbox.*

At the wheelboxes the flared ends of the intermediate tubing should be located in the inner wide slots of the wheelbox clamp plates but the end of the main tubing should be located in the outer narrow slot.

The cable rack should be well lubricated with Duckhams HBB grease.

**Checking Wheelboxes :**

Check the wheelboxes for misalignment or looseness and rectify as required.

Renew seized wheelboxes.

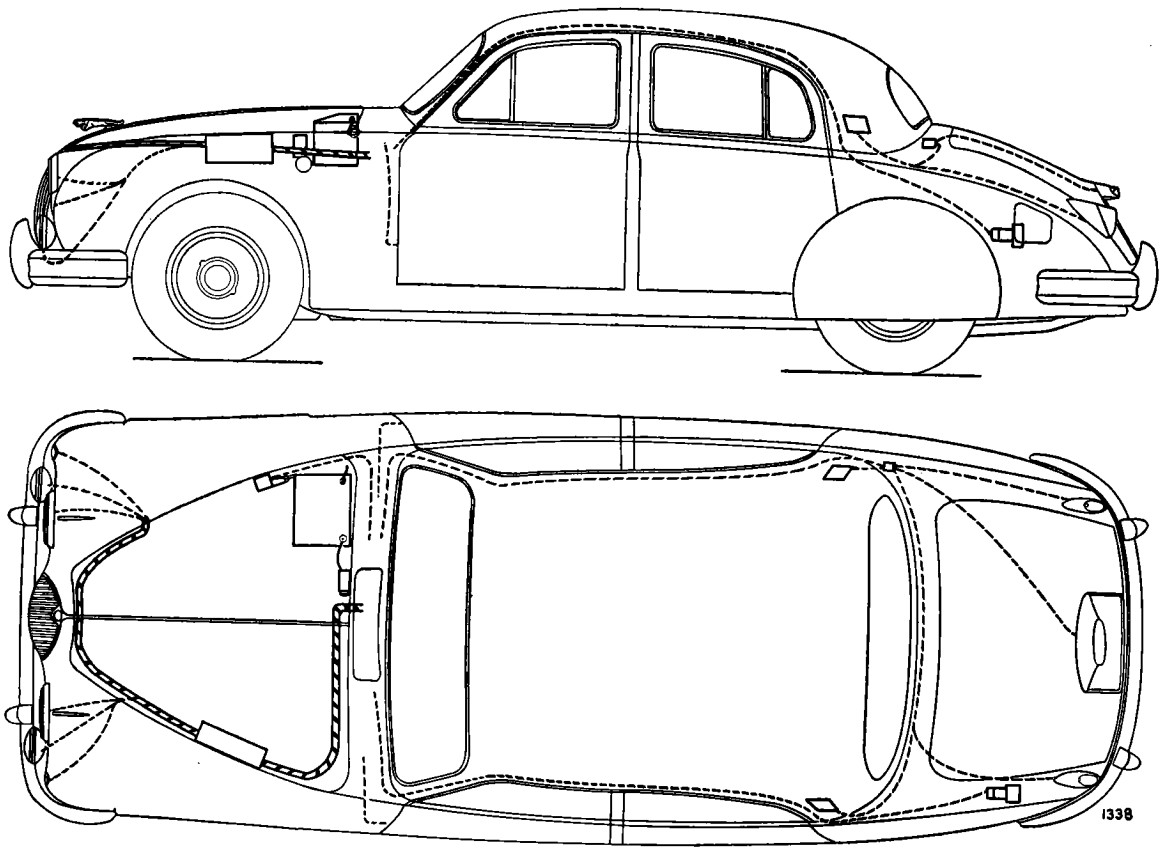



*Fig. 41. Layout of wiring harnesses.*

# MISCELLANEOUS

## ELECTRIC CLOCK

### Removal

Remove the revolution counter from the instrument panel as described under " Removal of Instrument Panel Components ". Disconnect the feed wire to the electric clock by removing the screw.

Remove the two screws securing the flange of the clock to the rear of the instrument and lift out the clock.

### Adjustment

At the back of the time clock is a small screw surrounded by a semi-circular scale. 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 setting the hands automatically restarts the clock.

### Refitting

Refitting is the reverse of the removal procedure.

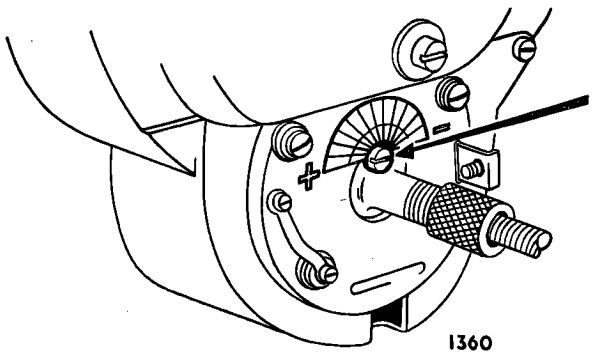



*Fig. 42. Adjustment screw for clock.*

## MIXTURE CONTROL WARNING LIGHT (2.4 Litre Model)

### Replacement

Remove the dash casing by unscrewing the scuttle vent knob and removing all the securing screws. This will allow the warning light holder and bulb to be withdrawn from the rear of the socket.

## OVERDRIVE AND INTERMEDIATE SPEED HOLD SWITCHES

### Removal

Remove the screen rail as described on page 40.

At the front of the screen rail unscrew the locking ring which secures the switch and escutcheon, when the switch can be withdrawn from the back of the rail.

**Note :** On early cars the overdrive switch was situated at the side of the glovebox. In this case remove the dash casing, unscrew the knurled nut and push the switch through the hole in the glovebox ; the connecting wires are long enough to allow the overdrive switch to be drawn below the bottom of the glovebox.

### Refitting

Refitting is the reverse of the removal procedure.

## FLASHING INDICATOR CONTROL

### Removal

Remove the dash casing by unscrewing the scuttle vent knob and removing all the securing screws.

Pull out the wires from the multi-snap connector leading to the indicator control.

Remove the four screws from the underside of the switch and remove the top cover.

Remove the two screws securing the cover which conceal the two indicator control mounting screws, directly below the steering column telescopic control.

Remove the two large screws securing the switch to the steering column and detach the flashing indicator control.

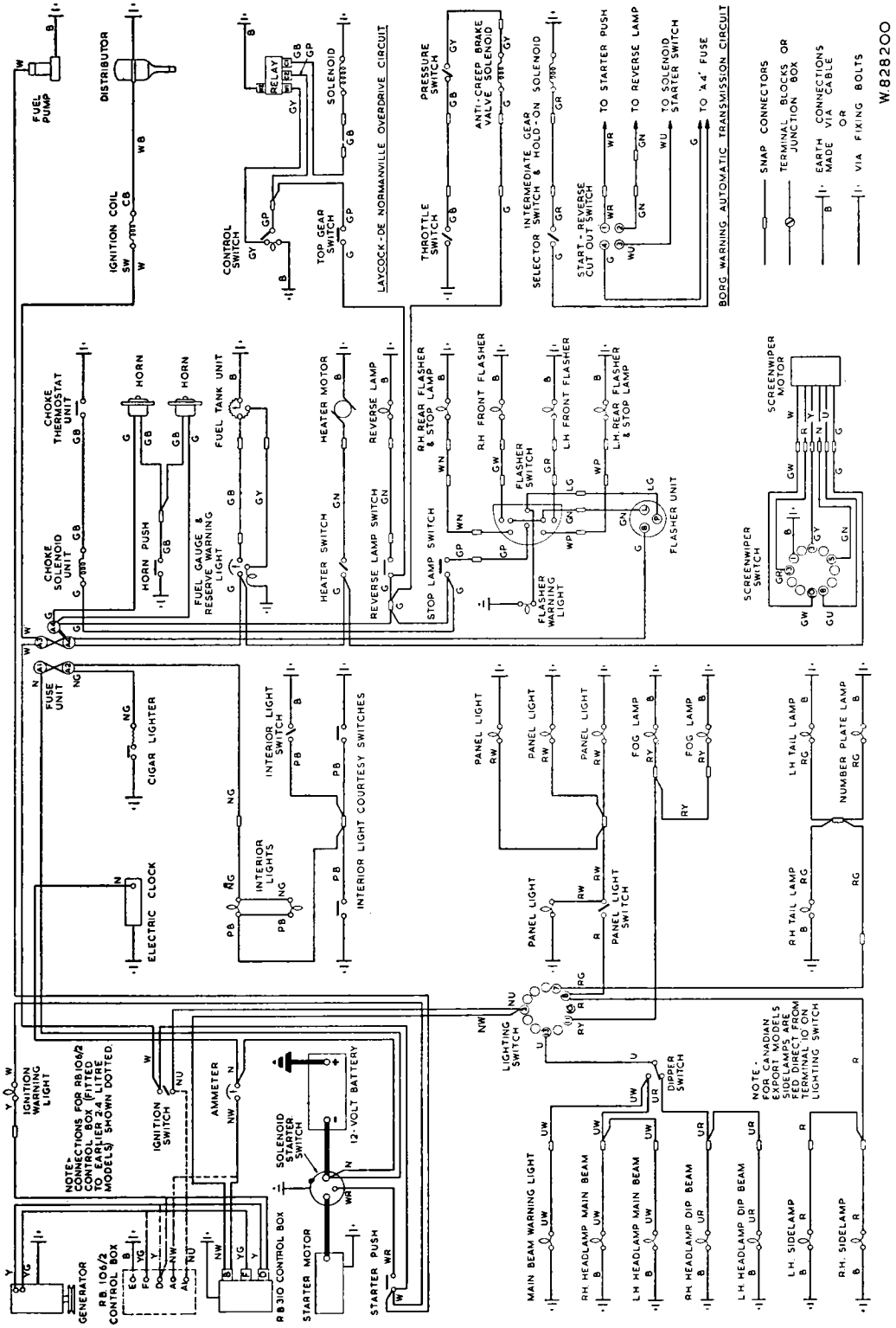
### Refitting

Refitting is the reverse of the removal procedure. Insert the wires into the multi-snap connector so that similar coloured wires are opposite each other.

## FLASHING INDICATOR WARNING LIGHT BULB

### Replacement

Remove the four screws from the underside of the switch and remove the top cover. Remove the small piece of rubber from around the bulb and unscrew the bulb.




**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. 43. Wiring diagram for 2.4 litre and 3.4 litre models.*

# INSTRUMENTS

## REMOVAL OF THE CENTRE FACIA PANEL

### Removal of the Dash Casing

Remove the scuttle vent lever knob and remove all the screws from the casing. The casing can now be drawn downwards.

### Removal of the Facia Panel

Remove both thumb screws (A) Fig. 44. from the top of the facia panel. Take out the ignition keys and cigar lighter (B). Insert a piece of stiff wire into the hole in the side of the light switch (C) to depress the plunger when the switch can be withdrawn. Repeat for the wiper switch (D).

Remove the ash tray (E) and remove both screws (F) attaching the ash tray mounting bracket (G) to the facia. Remove the two screws (H) from the underside of the facia panel.

The facia panel can now be removed by sliding it over the remaining switches.

## REMOVAL OF THE SCREEN RAIL

Remove the centre facia panel as described above. Remove the four nuts and washers from underneath the screen rail (see Fig. 45).

If the car is fitted with either an overdrive or intermediate speed hold switch on the screen rail unscrew the knurled bezel in the middle of the escutcheon.

The screen rail can now be lifted off.

## REMOVAL OF THE RIGHT-HAND GLOVEBOX

Remove the centre facia panel and screen rail as described in the previous paragraphs.

On the 2.4 litre model remove the mixture control by slackening the pinch bolts on the carburetter mixture levers and the outer cable. This will allow the cable to be drawn through when the glovebox is removed.

Remove the screws (A Fig. 46) securing the glovebox to the dash and the nut (B) and washer from the bracket at the rear of the glovebox.

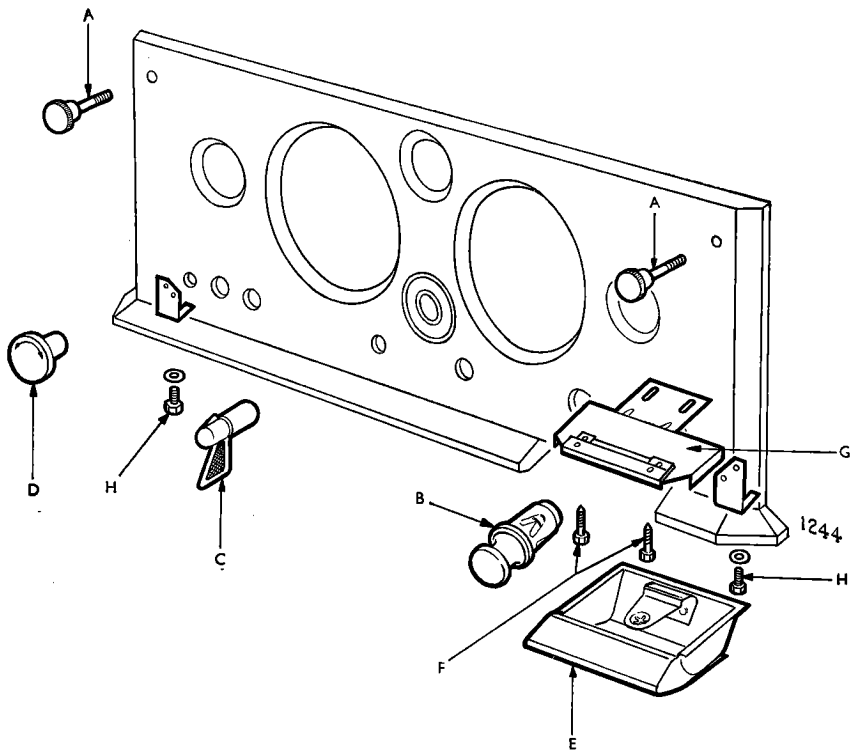



*Fig. 44. Centre facia panel, removal.*

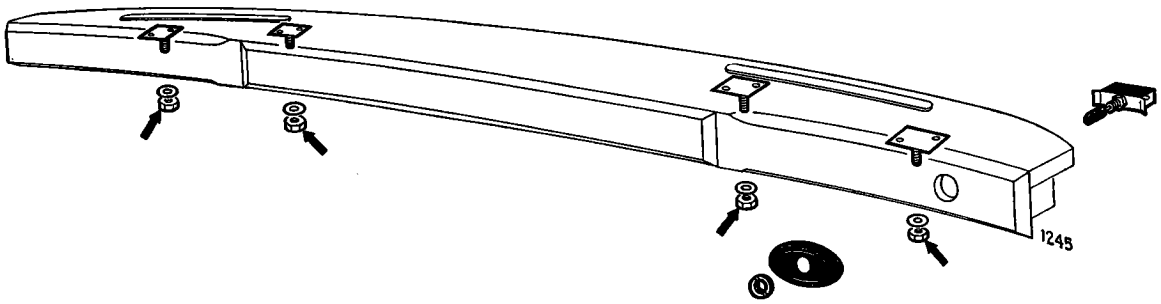



*Fig. 45. Screen rail removal.*

If the steering column is on the right-hand side, fully extend the steering wheel and remove the two bolts attaching the steering column bracket to the dash.

The glovebox can now be removed.

## REMOVAL OF THE LEFT-HAND GLOVEBOX

Remove the centre facia panel and screen rail as described in the previous paragraphs.

Slacken the pinch bolts securing the heater control wire to the control valve situated at the rear of the engine compartment; also slacken the pinch bolt securing the outer cable. This will allow the cable to be drawn through when the glovebox is removed.

Remove the screws (A Fig. 47.) securing the glovebox to the dash and the nut (B) and washer from the bracket at the rear of the glovebox.

If the steering column is on the left-hand side, fully extend the steering wheel and remove the two bolts attaching the steering column bracket to the dash.

The glovebox can now be removed.

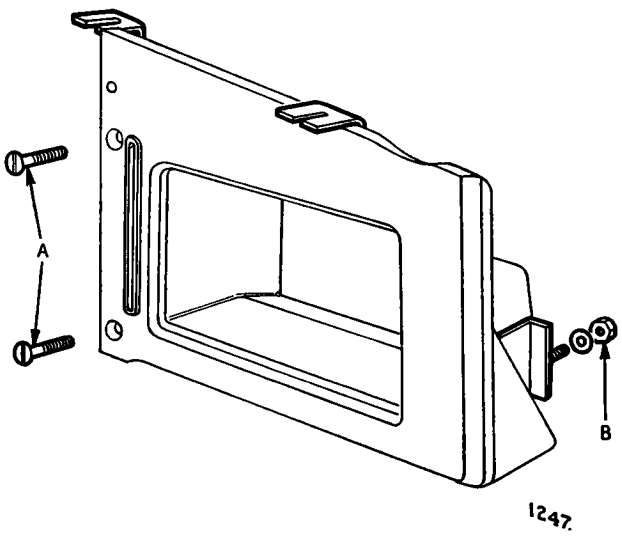



*Fig. 46. Right-hand glovebox removal.*

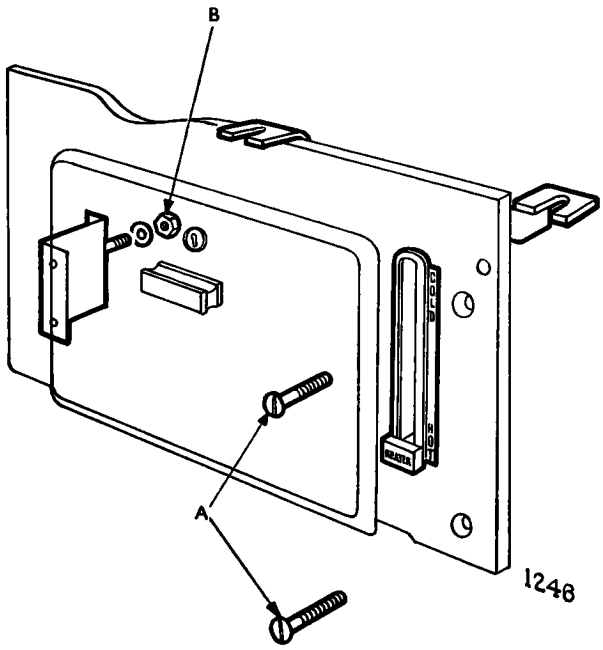



*Fig. 47. Left-hand glovebox removal.*

## REMOVAL OF THE INSTRUMENT PANEL COMPONENTS

Remove the centre facia panel as described on page 40.

Remove one of the battery terminals.

**Note:** On early 2.4 litre cars the instruments were mounted from the rear of the instrument panel. On these cars it will be necessary to pull the instrument panel forward and disconnect the speedometer and revolution counter cables, the remote control cables and the oil pressure gauge pipe. This will enable the panel to be pulled forward sufficiently to allow access to the instrument retaining screws.

### Revolution Counter

Remove the two screws securing the clock adjuster cable at the front of the gearbox cowl adjacent to the left-hand heater door.

Mark with a pencil the relative positions of the three instrument panel securing bolts ; remove the bolts.

Ease the instrument panel forward into the car and unscrew the flexible cable from the rear of the rev. counter instrument.

From above unscrew the pipe connection from the rear of the oil gauge.

Disconnect the cable from the electric clock.

Unscrew the three screws securing the rev. counter to the instrument panel and remove the instrument from the front of the panel.

### Speedometer

Remove the two screws securing the mileometer trip cable at the front of the gearbox cowl adjacent to the right-hand heater door.

Mark with a pencil the relative positions of the three instrument panel securing bolts ; remove the bolts.

From the above unscrew the pipe connection from the rear of the oil gauge.

Ease the instrument panel forward into the car and unscrew the flexible cable from the rear of the speedometer.

Withdraw the two warning light bulb holders from the rear of the instrument.

Unscrew the three screws securing the speedometer to the instrument panel and remove the instrument from the front of the panel.

### Petrol Gauge

Unscrew the two screws securing the petrol gauge to the instrument panel.

Pull the gauge forward out of the panel and disconnect the wires at the rear of the instrument noting their respective positions.

### Ammeter

Unscrew the two screws securing the ammeter to the instrument panel.

Pull the ammeter forward out of the panel and disconnect the wires at the rear of the instrument noting their respective positions.

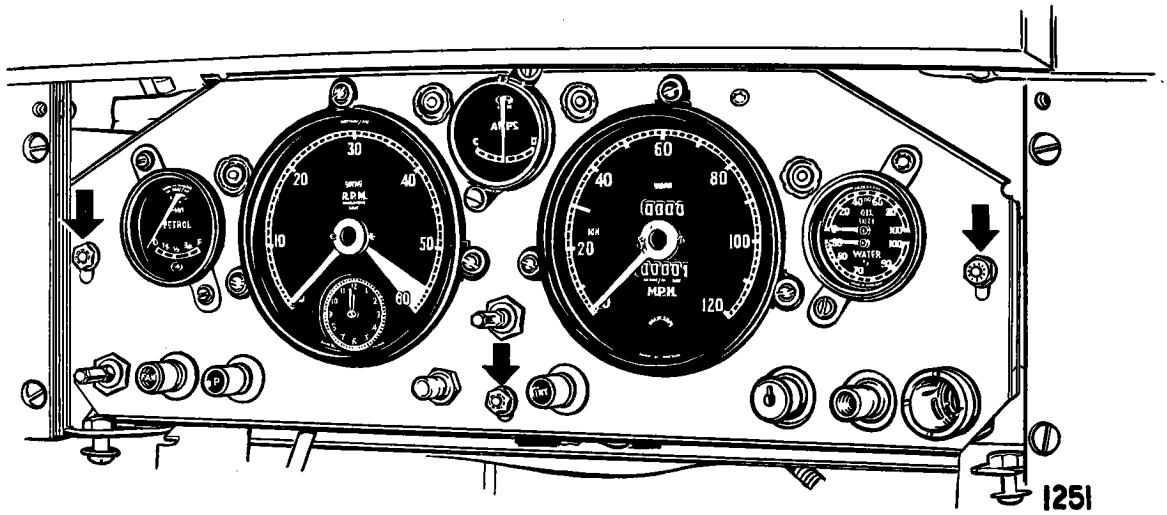



*Fig. 48. Instrument panel securing screws.*

**Oil Pressure and Water Temperature Gauge**

Partially drain the radiator.

Unscrew the water temperature gauge bulb from the inlet manifold water jacket by holding the flats on the bulb and unscrewing the union nut.

Remove the grommet at the rear of the engine compartment through which oil gauge pipe and water temperature capillary tube pass.

Release the water temperature capillary tube from its retaining clips taking care not to bend the tube.

Mark with a pencil the relative positions of the three instrument panel securing bolts; remove the bolts.

Ease the instrument panel forward into the car and unscrew the oil gauge union nut from the rear of the instrument.

Remove the two screws securing the gauge to the instrument panel and withdraw the gauge into the car complete with the water temperature capillary tube.

**Cigar Lighter**

Remove the nut and washers from the centre screw and disconnect the feed wire.

Remove the nut and washers securing the bridge piece and withdraw the bridge.

Withdraw the lighter-holder from the front of the instrument panel.

Unscrew the nut and washer and remove the insulating washer and earth wire plate.

**Important :** Refitting is the reverse of the removal procedure but it is essential that the earth wire plate and insulating washer are fitted correctly otherwise a short-circuit may take place.

Firstly, fit the earth wire plate next to the holder so that the holes in the plate engage with the projections in the holder.

Secondly, fit the insulating washer so that the two holes also engage with the projections in the holder ; secure with the flat washer, shakeproof washer and nut.

Fit the bridge piece and secure with the flat washer, shakeproof washer and nut.

Connect the feed wire and fit the remaining flat washer, shakeproof washer and nuts.

**Switches**

From the front of the instrument panel unscrew the nut or locking ring securing the switch to the panel.

Withdraw the switch from the rear of the panel and disconnect the wires, noting their respective positions.

## SPEEDOMETER CABLE

**Removal**

Remove the centre facia panel as described on page 40. Mark with a pencil the relative positions of the three instrument panel securing screws.

Remove the three bolts attaching the instrument panel to the mounting brackets. This will allow the instrument panel to be drawn forward a sufficient amount to allow the speedometer cable connection to be unscrewed from the instrument.

Unscrew the speedometer cable connection from the back of the gearbox or overdrive. Detach the cable from the retaining clips.

Remove the grommet at the rear of the engine compartment through which the speedometer cable passes, when the cable can be withdrawn.

**Refitting**

Refitting is the reverse of the removal procedure, but it is important to follow the correct run as illustrated in Figs. 49 and 50.

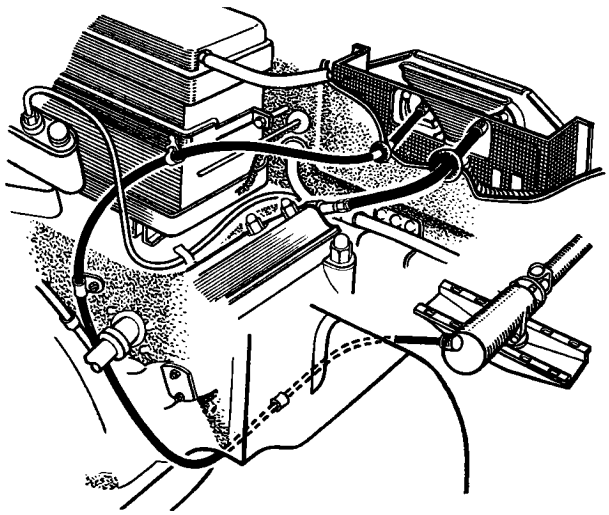


*Fig. 49. Showing run of speedometer and revolution counter cables on standard transmission cars.*

## REVOLUTION COUNTER CABLE

**Removal**

Remove the dash casing and facia panel as described on page 40.

Remove the three bolts attaching the instrument panel to the mounting brackets. This will allow the instrument panel to be drawn forward a sufficient amount to allow the rev. counter cable connection to be unscrewed from the instrument.

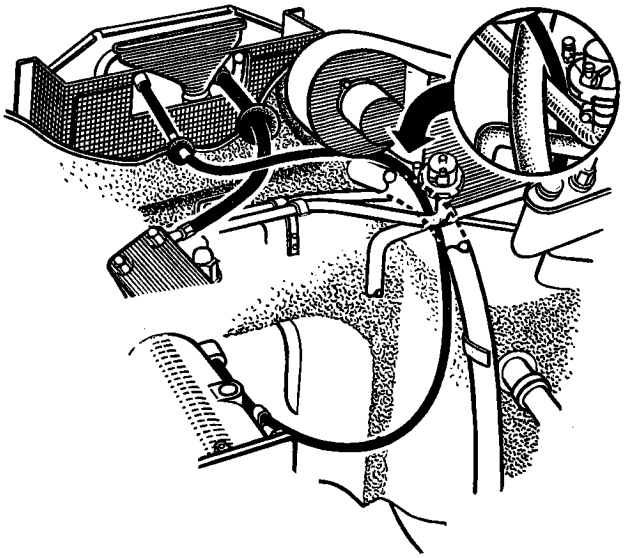


*Fig. 50. Showing run of speedometer and revolution counter cables on automatic transmission cars.*

Remove the rev. counter cable from the rear of the cylinder head by unscrewing the cable connection from the right angled drive.

Remove the large grommet from the rear of the engine compartment through which the speedometer cable passes and withdraw the cable.

**Refitting**

Refitting is the reverse of the removal procedure, but it is important to follow the correct run as illustrated in Figs. 49 and 50.

## SPEEDOMETER AND REVOLUTION COUNTER CABLES—GENERAL INSTRUCTIONS

Flexible cable condition to a great extent affects performance of speedometers and revolution counters. 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 position. 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.

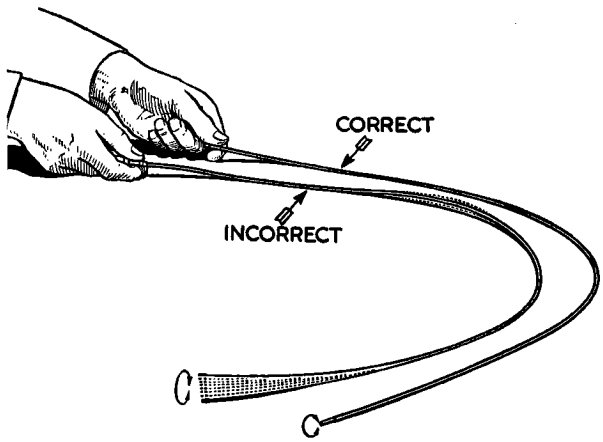



*Fig. 51. Checking inner flex for kinks.*

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 Esso 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.

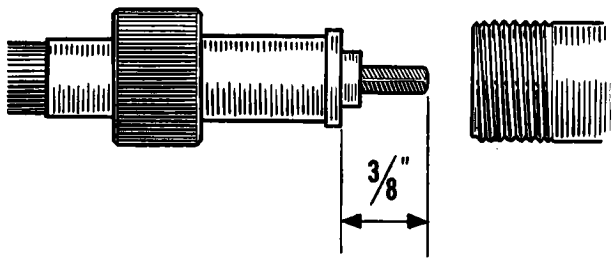



*Fig. 52. Showing the amount the inner flex must protrude from outer cable.*

11. **Concentric Rotation**

Check that inner flex rotates in centre of outer cable.

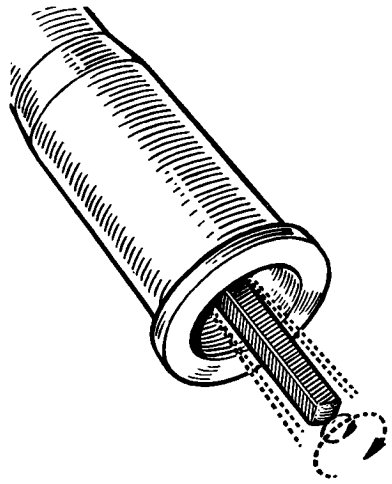


*Fig. 53. Checking inner flex for "run out."*

12. **Damaged Inner Shaft**

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

13. **Damaged 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 AND REVOLUTION COUNTERS—GENERAL INSTRUCTIONS

Speedometer or revolution counter 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 or revolution counter 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 or revolution counter fitted. Check code number.

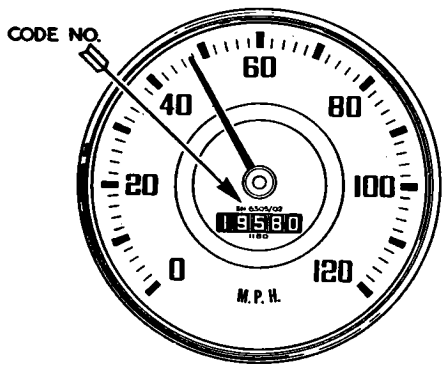



*Fig. 54. Showing the code number on face of instrument.*

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 ratio 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).

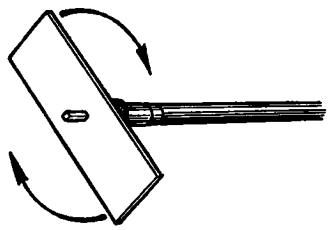


*Fig. 55. Cardboard pointer on inner flex for checking the number of turns.*

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.

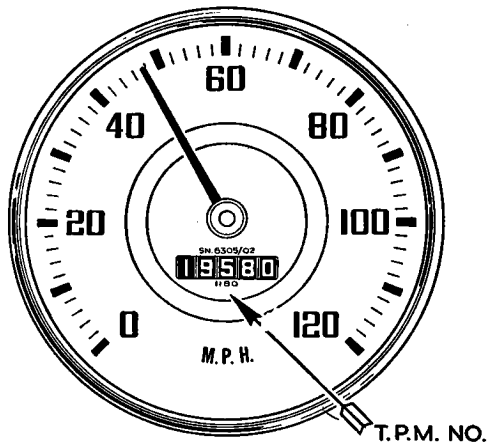



*Fig. 56. Showing the turns per mile on face of instrument.*

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.

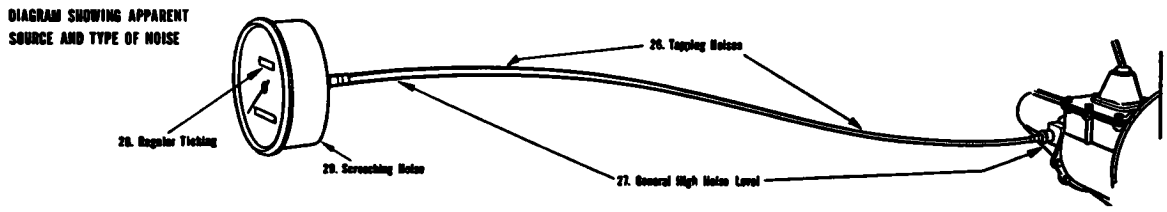



*Fig. 57.*