






Chapter 5

Engine electrical systems

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Degrees of difficulty

Easy , suitable for novice with little experience		Fairly easy , suitable for beginner with some experience		Fairly difficult , suitable for competent DIY mechanic		Difficult , suitable for experienced DIY mechanic		Very difficult , suitable for expert DIY or professional	
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Specifications

Battery

Type	Lead-acid, maintenance-free
Rating - Cold cranking/Reserve capacity	480 A/90 RC, 570 A/110 RC, 520 A/120 RC

Ignition coil

4-cylinder engines:	
Primary resistance at 20°C (68°F)	0.71 to 0.81 ohms
Current consumption - engine idling	0.25 to 0.75 amps
V6 engines:	
Primary/secondary resistance at 20°C (68°F) - see text:	
Between terminals C and D	0.35 to 0.42 ohms
Between terminals B and D	2.1 to 2.3 kohms
Between terminals A and HT terminal (manual transmission)	9.0 to 13.5 kohms
Between terminals A and HT terminal (automatic transmission)	14.0 to 21.6 kohms

Ignition timing

2.5 litre engines (at idle speed, vacuum connected)*:	
Manual transmission:	
Unleaded fuel	9° ± 2°
Leaded fuel	13° ± 2°
Automatic transmission:	
Unleaded fuel	7° ± 2°
Leaded fuel	11° ± 2°
2.7 litre engines (at idle speed)*:	
Unleaded fuel	11° ± 2°
Leaded fuel	15° ± 2°

* **Note:** The ignition timing is only adjustable on the non-catalyst equipped V6 engines shown. On all other engines, ignition timing is controlled by the fuel or ignition ECU and is not adjustable.

Firing order

4-cylinder engines	1-3-4-2 (No 1 cylinder at crankshaft pulley end)
V6 engines	1-4-2-5-3-6 (No 1 cylinder at crankshaft pulley end of rear cylinder head)

Alternator

Type:	
4-cylinder engines	Lucas/Magneti-Marelli A127, A133 or A1271
V6 engines	Nippondenso CGK 46
Brush length (nominal):	
New	20.0 mm
Minimum	10.0 mm

Starter motor

Type:	
4-cylinder engines	Lucas/Magneti-Marelli M78R or M79
V6 engines	Nippondenso DR 5U1
Minimum brush length (nominal):	8.0 mm

Torque wrench settings	Nm	lbf ft
4-cylinder engines:		
Ignition coil bracket bolts	24	18
Knock sensor	12	9
Crankshaft sensor bolts	6	4
Alternator pivot and mounting bolts	25	18
Alternator adjustment bracket bolts	12	9
Starter motor bolts:		
Manual transmission	85	63
Automatic transmission	45	33
V6 engines:		
Alternator side pivot bolt	45	33
Alternator lower mounting nut	24	18
Starter motor bolts	45	33

1 General information, precautions and battery disconnection

General information

The engine electrical systems include all ignition, charging and starting components. Because of their engine-related functions, these components are discussed separately from body electrical devices such as the lights, the instruments, etc (which are included in Chapter 12).

Precautions

Always observe the following precautions when working on the electrical system:

- (a) Be extremely careful when servicing engine electrical components. They are easily damaged if checked, connected or handled improperly.
- (b) Never leave the ignition switched on for long periods of time when the engine is not running.
- (c) Don't disconnect the battery leads while the engine is running.
- (d) Maintain correct polarity when connecting a battery lead from another vehicle during jump starting - see the "Jump starting" section at the front of this manual.
- (e) Always disconnect the negative lead first, and reconnect it last, or the battery may be shorted by the tool being used to loosen the lead clamps.

It's also a good idea to review the safety-related information regarding the engine electrical systems located in the "Safety first!" section at the front of this manual, before

beginning any operation included in this Chapter.

Battery disconnection

Several systems fitted to many of the cars covered by this manual require battery power to be available at all times, either to ensure their continued operation or to maintain control unit memories (such as those used to control the seat and mirror positions, the operation of the electric windows and sun roof, and the retention of the radio/cassette and CD player security codes). Additionally, on engines with single-point fuel injection, the idle mixture settings stored in the fuel system ECU will also be lost when the battery is disconnected. Whenever the battery is to be disconnected therefore, first note the following, to ensure that there are no unforeseen consequences of this action:

- (a) First, on any vehicle with central locking, it is a wise precaution to remove the key from the ignition, and to keep it with you, so that it does not get locked in if the central locking should engage accidentally when the battery is reconnected!
- (b) If the battery is disconnected while the alarm system is armed or activated, the alarm will remain in the same state when the battery is reconnected.
- (c) As mentioned above, on cars equipped with single-point fuel injection, the idle mixture settings stored in the memory of the fuel system electronic control unit will be lost whenever the battery is disconnected. When the battery is reconnected, the control unit will adopt a set of nominal parameters which will allow

the engine to run, but the mixture setting will be outside the manufacturer's specification. Should the engine performance be unsatisfactory, the control unit can be calibrated as a temporary measure using the procedure described in Chapter 4, Part A, Section 11, until such time as, the setting can be accurately adjusted by a dealer.

- (d) Recalibration procedures for the seat and mirror position memory, the electric sun roof and window memories, and the "lazy locking" memories on models so equipped are provided in Chapter 11, Section 1.
- (e) If a Rover original equipment radio/cassette player or CD player is fitted, and the unit and/or the battery is disconnected, the unit will not function again on reconnection until the correct security code is entered. Details of this procedure, which varies according to the unit and model year, are given in the Rover "In-car entertainment" booklet supplied with the vehicle when new. Ensure you have the correct code before you disconnect the battery. For obvious security reasons, the procedure is not given in this manual. If you do not have the code or details of the correct procedure, but can supply proof of ownership and a legitimate reason for wanting this information, the vehicle's selling dealer may be able to help.

Devices known as "memory-savers" (or "code-savers") can be used to avoid some of the above problems. Precise details vary according to the device used. Typically, it is plugged into the cigarette lighter, and is

connected by its own wires to a spare battery; the vehicle's own battery is then disconnected from the electrical system, leaving the "memory-saver" to pass sufficient current to maintain audio unit security codes and ECU memory values, and also to run permanently-live circuits such as the clock, all the while isolating the battery in the event of a short-circuit occurring while work is carried out. Before using any of these devices, seek the advice of a Rover dealer as to their suitability for use on your car.



Warning: Some of these devices allow a considerable amount of current to pass, which can mean that many of the vehicle's

systems are still operational when the main battery is disconnected. If a "memory-saver" is used, ensure that the circuit concerned is actually "dead" before carrying out any work on it!

2 Battery - removal and refitting



Note: Refer to the previous Section before proceeding and also the relevant Sections of Chapter 1.

Removal

- 1 The "sealed for life" battery is located on the left-hand side of the engine compartment.
- 2 Slacken the negative (-) terminal clamp bolt and lift the terminal off the battery post.
- 3 Lift the plastic cover from the positive (+) terminal, slacken the clamp bolt and lift the terminal off the battery post (see illustration).
- 4 Undo the retaining bolt and remove the battery clamp plate (see illustration).
- 5 Lift the battery from the tray keeping it upright and taking care not to touch any clothing. Be careful - it's heavy.
- 6 If required, the battery tray can be removed after undoing the three retaining bolts.
- 7 Clean the battery terminal posts, clamps and the battery casing. If the battery tray is rusted as a result of battery acid spilling onto it, clean it thoroughly and re-paint with reference to Chapter 1.
- 8 If you are renewing the battery, make sure that you get one that's identical, with the same dimensions, amperage rating, cold cranking rating, etc. Dispose of the old battery in a responsible fashion. Most local authorities have facilities for the collection and disposal of such items - batteries contain sulphuric acid and lead, and should not be simply thrown out with the household rubbish!

Refitting

- 9 Refitting is a reversal of removal. Smear the battery terminals with a petroleum-based jelly prior to reconnecting. Always connect the positive terminal clamp first and the negative terminal clamp last.



2.3 Lift off the plastic cover for access to the battery positive terminal

3 Ignition system - general information and precautions

General information

4-cylinder engines

All 4-cylinder engine models covered by this manual are equipped with a programmed electronic ignition system, which utilizes computer technology and electro-magnetic circuitry to simulate the main functions of a conventional ignition distributor.

A reluctor ring on the periphery of the engine flywheel, and a crankshaft sensor whose inductive head runs between the reluctor ring teeth, replace the operation of the contact breaker points in a conventional system. The reluctor ring utilizes 34 teeth spaced at 10° intervals, with two spaces, 180° apart, corresponding to TDC for Nos 1 and 4 pistons, and Nos 2 and 3 pistons respectively. As the crankshaft rotates, the reluctor ring teeth pass over the crankshaft sensor, which transmits a pulse to the ignition or ignition/fuel electronic control unit (ECU) every time a tooth passes over it. The ECU recognises the absence of a pulse every 180°, and consequently establishes the TDC position. Each subsequent pulse then represents 10° of crankshaft rotation. This, and the time interval between pulses, allows the ECU to accurately determine crankshaft position and speed.

A small bore pipe connecting the inlet manifold to a pressure transducer within the ECU supplies the unit with information on engine load. From this constantly-changing data, the ECU selects a particular advance from a range of ignition characteristics stored in its memory. The basic setting can be further advanced or retarded, according to information sent to the ECU from the coolant temperature sensor, knock sensor and on certain models, from the throttle pedal switch.

With the firing point established, the ECU triggers the ignition coil, which delivers HT voltage to the spark plugs in the conventional manner. The cycle is then repeated many times a second for each cylinder in turn.



2.4 Removing the battery clamp retaining bolt

In addition to the above operations, many of the ignition system components have a second function in the control and operation of the fuel injection system. Further details will be found in the appropriate Part of Chapter 4.

V6 engines

On all V6 engines a breakerless electronic ignition system is used which comprises the distributor, an igniter unit and the ignition coil. The distributor is mounted on the left-hand end of the front cylinder head and is driven directly by the front camshaft. The ignition system forms part of the engine management package controlled by the fuel system electronic control unit (ECU).

The distributor contains a reluctor mounted on the distributor shaft, and a stator and pick-up coil mounted on the baseplate. On 2.5 litre engines the igniter unit is attached to the side of the distributor body, whereas on 2.7 litre engines it is mounted separately at the rear left-hand side of the engine compartment.

When the ignition is switched on, but the engine is stationary, the transistors in the igniter unit prevent current flowing through the ignition system primary (LT) circuit. As the crankshaft rotates, the reluctor moves through the magnetic field created by the stator. When the reluctor teeth are in alignment with the stator projections, a small AC voltage is created and sensed by the pick-up coil. The igniter uses this voltage to switch the transistors in the unit and completes the ignition system primary (LT) circuit.

As the reluctor teeth move out of alignment with the stator projections, the AC voltage changes and the transistors in the igniter are switched again to interrupt the primary (LT) circuit. This causes a high voltage to be induced in the coil secondary (HT) windings which then travels down the HT lead to the distributor and onto the relevant spark plug.

On 2.5 litre engines ignition advance is controlled by both centrifugal and vacuum operated systems. Centrifugal advance is controlled by engine speed whereas vacuum advance is controlled by the ignition control system. This system uses solenoid valves and sensors to apply vacuum to one of the two distributor vacuum diaphragms dependant on engine operating parameters. Sensors

monitor manifold pressure, coolant temperature, intake air temperature, atmospheric pressure and engine speed and pass signals to the fuel system ECU. According to the signals received, the ECU controls the operation of the solenoid valves to provide the appropriate vacuum necessary to create the required ignition advance.

On 2.7 litre engines ignition advance is controlled entirely by the fuel system ECU. As with the 2.5 litre engines, sensors monitor engine parameters and send signals to the ECU accordingly. From the information received, the required ignition advance is determined by the ECU for all engine operating conditions. In addition to the sensors described for 2.5 litre engines, 2.7 litre models also utilise a crank/cylinder sensor, mounted just behind the front camshaft sprocket, to detect the TDC position for No 1 cylinder and to determine engine speed and piston position. An additional TDC sensor, mounted in the distributor, is used to provide a fixed ignition timing setting during engine cranking and as a back-up unit should the crank/cylinder sensor fail, or produce erroneous signals.

In addition to the above operations, many of the ignition system components have a second function in the control and operation of the fuel injection system. Further details will be found in the appropriate Part of Chapter 4.

Precautions

When working on the ignition system, take the following precautions:

- (a) *Do not keep the ignition switched on for more than 10 seconds if the engine will not start.*
- (b) *If a separate tachometer is ever required for servicing work, consult a dealer service department before buying a tachometer for use with this vehicle - some tachometers may be incompatible with these types of ignition systems - and always connect it in accordance with the equipment manufacturer's instructions.*
- (c) *Never connect the ignition coil terminals to earth. This could result in damage to the coil and/or the ECU or igniter unit.*
- (d) *Do not disconnect the battery when the engine is running.*
- (e) *Refer to the warning at the beginning of the next Section concerning HT voltage.*

4 Ignition system - testing



Warning: Voltages produced by an electronic ignition system are considerably higher than those produced by conventional ignition systems. Extreme care must be taken when working on the system if the ignition is switched on. Persons with surgically implanted cardiac pacemaker devices should keep well clear of the ignition circuits, components and test equipment.

General

1 The components of the electronic ignition system are normally very reliable; most faults are far more likely to be due to loose or dirty connections, or to "tracking" of HT voltage due to dirt, dampness or damaged insulation, than to the failure of any of the system's components. **Always** check all wiring thoroughly before condemning an electrical component, and work methodically to eliminate all other possibilities before deciding that a particular component is faulty.

2 The old practice of checking for a spark by holding the live end of an HT lead a short distance away from the engine is **not** recommended; not only is there a high risk of a powerful electric shock, but the HT coil, ECU or igniter unit may be damaged. Similarly, **never** try to "diagnose" misfires by pulling off one HT lead at a time.

Engine will not start

3 If the engine either will not turn over at all, or only turns very slowly, check the battery and starter motor. Connect a voltmeter across the battery terminals (meter positive probe to battery positive terminal) then note the voltage reading obtained while turning the engine over on the starter for (no more than) ten seconds. If the reading obtained is less than approximately 9.5 volts, first check the battery, starter motor and charging system as described in the relevant Sections of this Chapter.

4 If the engine turns over at normal speed but will not start, check the HT circuit by connecting a timing light (following its manufacturer's instructions) and turning the engine over on the starter motor; if the light flashes, voltage is reaching the spark plugs, so these should be checked first. If the light does not flash, check the HT leads themselves, followed by the distributor cap, carbon brush and rotor arm, using the information given in Chapter 1.

5 If there is a spark, check the fuel system for faults, referring to the relevant part of Chapter 4 for further information.

6 If there is still no spark, check the condition of fuse 15 (early models) or fuse 19 (later models) in the passenger compartment fusebox. If the fuse is sound, check the voltage at the ignition coil "+" terminal (light green wire on V6 engines and early 4-cylinder engines, brown/pink wire on later 4-cylinder engines); it should be the same as the battery voltage (ie, at least 11.7 volts). If the voltage at the coil is more than 1 volt less than that at the battery, check the condition of all the circuit wiring, referring to the wiring diagrams at the end of this manual.

7 If the feed to the coil is sound, check the coil's primary and secondary winding resistance as described later in Section 7. If faulty, a new coil should be fitted. However, check carefully the condition of the LT connections themselves before doing so, to

ensure that the fault is not due to dirty or poorly-fastened connectors.

8 If the coil is in good condition, the fault is probably within the crankshaft sensor or the fuel or ignition ECU on 4-cylinder engines, or within the pick-up coil, igniter, or fuel ECU on V6 engines. Testing of these components should be entrusted to a Rover dealer.

Engine misfires

9 An irregular misfire suggests either a loose connection or intermittent fault on the primary circuit, or an HT fault on the coil side of the rotor arm.

10 With the ignition switched off, check carefully through the system, ensuring that all connections are clean and securely fastened. If the equipment is available, check the LT circuit as described above.

11 Check that the ignition coil, the distributor cap and the HT leads are clean and dry. Check the leads themselves and the spark plugs (by substitution if necessary), then check the distributor cap, carbon brush and rotor arm as described in Chapter 1.

12 Regular misfiring is almost certainly due to a fault in the distributor cap, HT leads or spark plugs. Use a timing light (paragraph 4 above) to check whether HT voltage is present at all leads.

13 If HT voltage is not present on any particular lead, the fault will be in that lead, or in the distributor cap. If HT is present on all leads, the fault will be in the spark plugs; check and renew them if there is any doubt about their condition.

14 If no HT is present, check the ignition coil; its secondary windings may be breaking down under load.

5 Distributor cap and rotor arm - removal and refitting



Removal

1 Using an open-ended spanner, undo the two retaining screws and lift off the distributor cap from the cylinder head or distributor as applicable (**see illustration**). On V6 engines, recover the large O-ring seal from the base of



5.1 Undo the two retaining screws and lift off the distributor cap

the cap. Clean and check the cap as described in Chapter 1.

2 If the cap is to be renewed, record the position of the HT leads in relation to the cap, then pull them off. Transfer the leads to a new cap, refitting them in the same position.

3 To remove the rotor arm, withdraw the plastic shield (where fitted), then undo the retaining grub screw using an Allen key (see illustrations). Withdraw the rotor arm from the end of the camshaft or distributor shaft.

Refitting

4 Refitting the rotor arm, shield and distributor cap is a reversal of removal. Ensure that all traces of thread locking compound are removed from the rotor arm retaining grub screw and its threaded hole, then apply fresh thread locking compound, such as Loctite 222 or equivalent prior to refitting. Failure to remove all traces of old compound first, may cause seizure of the grub screw, making subsequent removal impossible.

6 Distributor (V6 engines) - removal and refitting



2.5 litre engines

Removal

1 Disconnect the battery negative (earth) lead (refer to Section 1 before doing this).

2 Using an open-ended spanner, undo the two retaining screws and lift off the distributor cap. Recover the large O-ring seal from the base of the cap.

3 Release the wiring multiplug and, where applicable, the EGR valve vacuum hose from the distributor support clips.

4 Mark the position of the vacuum hose connections at the distributor vacuum unit and disconnect the hoses.

5 Disconnect the distributor multiplug from the ignition coil and the lead from the radio condenser then release the wiring from the cable clips.



6.14 Undo the bolt (arrowed) and release the wiring harness from the side of the distributor body



5.3a Where fitted, withdraw the plastic shield . . .

6 Prise off the plastic cap from the bolt securing the distributor to the cylinder head.

7 Using a small punch or fine file, mark the position of the distributor base relative to the cylinder head.

8 Undo the distributor retaining bolt and withdraw the unit from the cylinder head. Recover the O-ring at the base of the distributor body.

Refitting

9 With the distributor located on the cylinder head, turn the rotor arm until the offset drive dog positively engages with the slot in the end of the camshaft, then push the distributor body fully home. Once in place, align the distributor body with the mark made on removal. The remainder of refitting is a reversal of removal. After installation, adjust the ignition timing as described in Section 10.

2.7 litre engines

Removal

10 Disconnect the battery negative (earth) lead (refer to Section 1 before doing this).

11 Using an open-ended spanner, undo the two retaining screws and lift off the distributor cap. Recover the large O-ring seal from the base of the cap.

12 Release the wiring multiplug and the EGR valve vacuum hoses from the distributor support clips.

13 Disconnect the distributor multiplug from the connector on the side of the distributor.



6.15a Undo the distributor retaining bolt . . .



5.3b . . . then undo the rotor arm grub screw

14 Undo the support clip bolt and release the harness from the side of the distributor body (see illustration).

15 Undo the distributor retaining bolt and withdraw the unit from the cylinder head (see illustrations). Recover the O-ring at the base of the distributor body.

Refitting

16 With the distributor located on the cylinder head, turn the rotor arm until the offset drive dog positively engages with the slot in the end of the camshaft, then push the distributor body fully home. The remainder of refitting is a reversal of removal.

7 Ignition coil - testing, removal and refitting



Testing

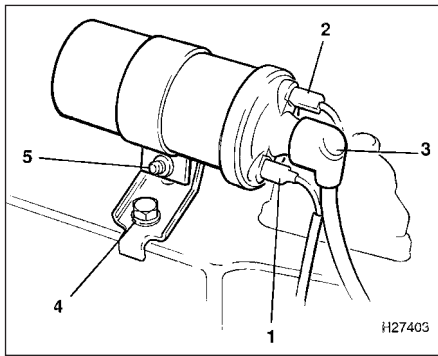
1 The ignition coil is mounted on the left-hand side of the engine compartment, on the suspension strut tower.

2 Testing of the coil is carried out using an ohmmeter, or multi-meter set to its resistance function, to check the primary and secondary coil windings for continuity. Ensure that the ignition is switched off before carrying out the following checks.

3 On 4-cylinder engines disconnect the LT and HT wiring at the coil, and connect an ohmmeter across the positive and negative LT



6.15b . . . and withdraw the unit from the cylinder head



7.3 Ignition coil connections and attachments on 4-cylinder engines

- 1 LT negative lead
- 2 LT positive lead
- 3 HT lead
- 4 Mounting bracket retaining bolt
- 5 Coil-to-bracket retaining screw

terminals (see illustration). The primary winding resistance should be as given in the Specifications at the beginning of this Chapter. If the resistance is not as specified, the coil should be renewed.

4 On V6 engines, disconnect the wiring multiplug(s) and the distributor HT lead at the coil and connect an ohmmeter across the multiplug terminals as follows (see illustration).

Between terminals C and D.

Between terminals B and D.

Between terminal A and the HT terminal.

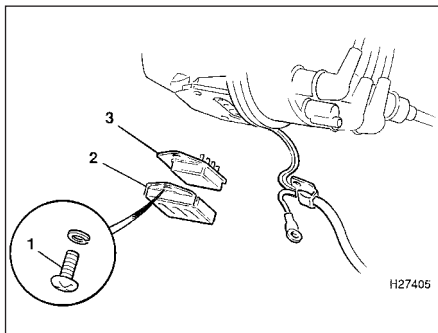
The resistances should be as given in the Specifications at the beginning of this Chapter. If the resistance is not as specified, the coil should be renewed.

5 If the coil is thought to be faulty, have your findings confirmed by a Rover dealer before renewing the coil.

Removal

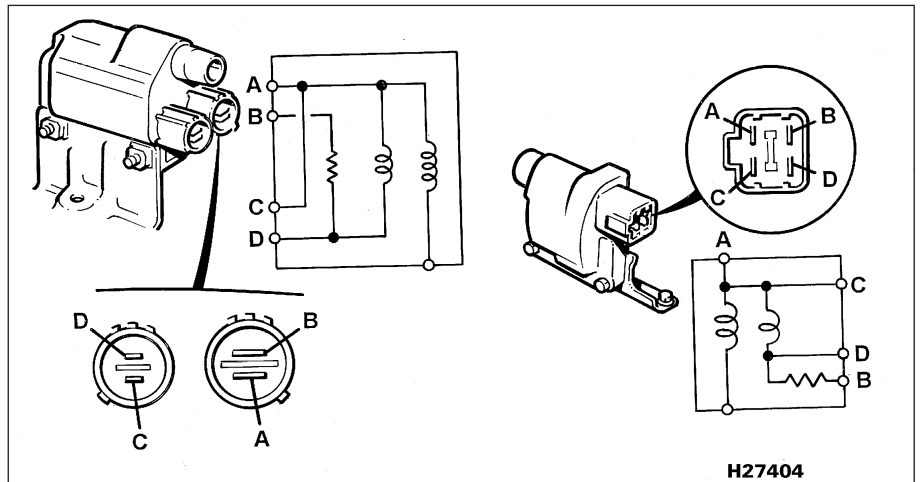
6 To remove the coil, disconnect the LT leads or multipugs at the coil terminals, and the HT lead at the centre terminal.

7 Undo the mounting bracket retaining bolt(s) and remove the coil.



8.2 Igniter component details on 2.5 litre engines

- 1 Retaining screws
- 2 Igniter cover
- 3 Igniter



7.4 Ignition coil connections and terminal identification on V6 engines

Left-hand illustration - manual transmission

Right-hand illustration - automatic transmission

8 On 4-cylinder engines, note the position of the positive and negative terminals in relation to the mounting bracket, then slacken the mounting bracket screw and slide out the coil.

Refitting

9 Refitting is a reversal of removal.

8 Igniter (V6 engines) - removal and refitting

2.5 litre engines

Removal

1 Remove the distributor as described in Section 6.

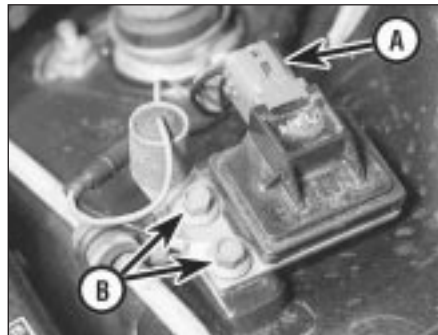
2 Undo the two igniter cover securing screws on the side of the distributor body (see illustration).

3 Move the wiring aside and lift off the cover.

4 Carefully withdraw the igniter from its connection on the side of the distributor.

Refitting

5 Thoroughly clean the mating faces of the igniter and distributor and apply a silicone grease to the distributor mating face.



8.8 Igniter multiplug (A) and retaining screws (B) on 2.7 litre engines

6 Locate the igniter in position then refit the cover and the wiring clip.

7 Refit the distributor as described in Section 6, then adjust the ignition timing as described in Section 10.

2.7 litre engines

Removal

8 The igniter is located on the left-hand side of the engine compartment, behind the fusebox (see illustration).

9 Ensure that the ignition is switched off then disconnect the igniter wiring multiplug.

10 Undo the two retaining screws and withdraw the igniter from its mounting bracket.

Refitting

11 Refitting is a reversal of removal.

9 Ignition timing sensor/adjuster (V6 engines) - removal and refitting

General

1 The ignition timing sensor/adjuster is only fitted to 2.7 litre engines and is located in the control box mounted on the engine compartment bulkhead. On non-catalyst equipped engines, the ignition timing adjuster is used to alter the ignition timing to allow the engine to run on leaded or unleaded fuel. On catalyst equipped engines the ignition timing is not adjustable and the ignition timing sensor is used in a monitoring capacity by the fuel system ECU.

Removal

2 Disconnect the battery negative (earth) lead (refer to Section 1 before doing this).

3 Slacken the two bolts securing the control box to the bulkhead.



9.5 Wiring multiplug connections on the front of the control box

4 Undo the three screws and lift off the control box upper cover.

5 Release the wiring multiplugs from the mounting brackets on the front of the control box and disconnect them (see illustration). Note their connections for refitting.

6 Remove the control box lower cover from the valve plate assembly.

7 Undo the two screws securing the ignition timing adjuster to the valve plate and withdraw the adjuster from its location.

Refitting

8 Refitting is a reversal of removal. On non-catalyst equipped engines, adjust the ignition timing as described in Section 10 on completion.

10 Ignition timing - adjustment



General

1 The ignition timing is only adjustable on non-catalyst equipped V6 engines; on all other engines, ignition timing is controlled entirely by the fuel or ignition system ECU.

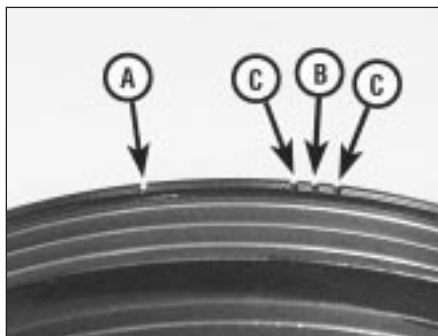
2 All the following adjustments require the use of a stroboscopic timing light. Additionally, if the adjustment is being carried out on 2.5 litre engines to allow the use of unleaded fuel, the timing light will need to be of the adjustable type which allows the unit to be pre-set to the actual ignition timing value. This is necessary because the timing marks provided on the crankshaft pulley are only applicable to leaded fuel adjustment. However, by using an adjustable timing light, the TDC mark on the pulley can be used instead.

2.5 litre engines

Adjustment for use with leaded fuel

3 Remove the access cover under the right-hand wheelarch.

4 Using a socket and bar on the crankshaft pulley bolt, rotate the crankshaft pulley, in the normal direction of rotation, until the timing marks are visible. Note that the timing marks



10.4 Timing mark identification on the crankshaft pulley

A TDC notch

B Ignition timing setting notch

C $\pm 2^\circ$ tolerance notches

are four very small notches on the pulley inner rim and are easily missed. The first notch (usually coloured white) represents Top Dead Centre (TDC) for No 1 piston on compression. The next three notches are the actual timing marks. The centre notch of the three represents 13° BTDC (manual transmission) or 11° BTDC (automatic transmission). The remaining two notches represent a timing tolerance of $\pm 2^\circ$ (see illustration).

5 Once the marks have been located, it is a good idea to highlight them, and the pointer on the timing belt cover, with a dab of quick-drying white paint to make them easily recognisable when using the timing light (see illustration).

6 Start the engine and allow it to warm up to normal operating temperature. Check that the idling speed is correct and, if necessary, adjust it as described in Chapter 1.

7 Switch the engine off and connect the timing light to No 1 cylinder plug lead as described in the timing light manufacturer's instructions. No 1 cylinder is on the rearmost cylinder at the crankshaft pulley end (beneath the brake master cylinder).

8 Start the engine again and allow it to idle. Point the timing light at the timing marks. The pointer on the timing belt cover should be aligned with the appropriate notch on the crankshaft pulley.

9 If adjustment is required, prise off the plastic cap from the bolt securing the distributor to the cylinder head, and slacken the bolt slightly. Rotate the distributor body clockwise to advance the timing, or anti-clockwise to retard it, until the pointer and pulley notch are aligned. Tighten the distributor securing bolt, recheck that the marks are still aligned, then refit the plastic cap.

10 Switch off the engine and disconnect the timing light. Refit the access cover under the wheelarch.

Adjustment for use with unleaded fuel

11 As mentioned at the beginning of this Section, an adjustable timing light will be required for this operation.



10.5 Highlight the pointer on the timing cover (arrowed) and the relevant pulley notch with white paint

12 Refer to paragraphs 3, 4 and 5 above and highlight the TDC notch on the pulley and the pointer on the timing belt cover. Note that the other three timing marks are not used in the following procedure and can be ignored.

13 Start the engine and allow it to warm up to normal operating temperature. Check that the idling speed is correct and, if necessary, adjust it as described in Chapter 1.

14 Switch the engine off and connect the timing light to No 1 cylinder plug lead as described in the timing light manufacturer's instructions. No 1 cylinder is on the rearmost cylinder at the crankshaft pulley end (beneath the brake master cylinder).

15 Refer to the Specifications at the beginning of this Chapter for the correct ignition timing setting. Set the timing light to this figure in accordance with the timing light manufacturer's instructions.

16 Start the engine again and allow it to idle. Point the timing light at the timing marks. The pointer on the timing belt cover should be aligned with the TDC notch on the crankshaft pulley.

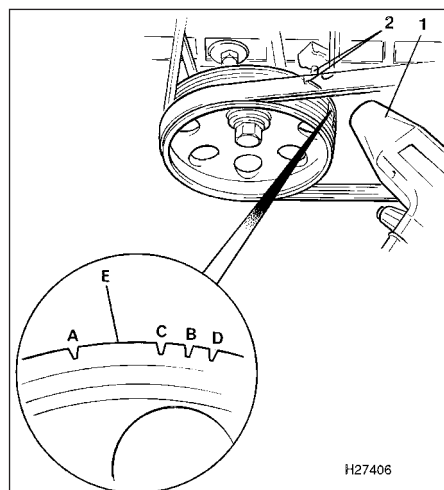
17 If adjustment is required, prise off the plastic cap from the bolt securing the distributor to the cylinder head and slacken the bolt slightly. Rotate the distributor body clockwise to advance the timing, or anti-clockwise to retard it, until the pointer and pulley notch are aligned. Tighten the distributor securing bolt, recheck that the marks are still aligned, then refit the plastic cap.

18 Switch off the engine and disconnect the timing light. Refit the access cover under the wheelarch.

2.7 litre engines

19 Remove the access cover under the right-hand wheelarch.

20 Using a socket and bar on the crankshaft pulley bolt, rotate the crankshaft pulley, in the normal direction of rotation, until the timing marks are visible. Note that the timing marks are four very small notches on the pulley inner rim and are easily missed. The first notch (usually coloured white) represents Top Dead Centre (TDC) for No 1 piston on compression. The next three notches are the actual timing



10.21 Ignition timing adjustment on 2.7 litre engines

- 1 Timing light
- 2 Timing cover pointer and TDC notch
- A Pulley TDC notch
- B 15° BTDC notch
- C 13° BTDC notch
- D 17° BTDC notch
- E New notch position (11° BTDC) for unleaded fuel setting

marks. The centre notch of the three (usually coloured red) represents 15° BTDC. The remaining two notches represent a timing tolerance of $\pm 2^\circ$ (see illustration 10.4).

21 If the engine is being adjusted to run on unleaded fuel, it will be necessary to make an additional notch on the pulley (the existing notches are only applicable when adjusting for use with leaded fuel). To do this, measure the distance from notch C to notch B and make an additional notch E, that distance from C (see illustration). Use a small file to make the new notch.

22 Once the marks have been located, it is a good idea to highlight them, and the pointer on the timing belt cover, with a dab of quick-drying white paint to make them easily recognisable when using the timing light.

23 Start the engine and allow it to warm up to normal operating temperature. Check that the idling speed is correct and, if necessary, adjust it as described in Chapter 1.



10.26 Undo the three screws and lift off the control box upper cover

24 Switch the engine off and connect the timing light to No 1 cylinder plug lead as described in the timing light manufacturer's instructions. No 1 cylinder is on the rearmost cylinder at the crankshaft pulley end (beneath the brake master cylinder).

25 Start the engine again and allow it to idle. Point the timing light at the timing marks. The pointer on the timing belt cover should be aligned with the appropriate notch on the crankshaft pulley.

26 If adjustment is required, slacken the two screws securing the control box to the engine compartment bulkhead. Undo the three screws and lift off the control box upper cover (see illustration).

27 Engage a small screwdriver with the adjustment slot in the ignition timing adjuster and turn the adjuster clockwise to advance the timing or anti-clockwise to retard it (see illustration).

28 Make a final check of the setting, then switch off the engine and disconnect the timing light. Refit the control box cover and the access cover under the wheelarch.



10.27 Turn the ignition timing adjuster to advance or retard the timing

procedures contained in the relevant Parts of Chapter 4.

Removal

- 1 Disconnect the battery negative (earth) lead (refer to Section 1 before doing this).
- 2 Disconnect the wiring multiplug from the ECU (located on the left-hand side of the engine compartment), either behind the battery or on the bulkhead (see illustration). To do this, press the retaining tab upwards, release the bottom of the multiplug, then disengage the top lug.
- 3 Disconnect the vacuum supply hose.
- 4 Undo the retaining screw, slide the unit out of its mounting bracket to disengage the retaining lug, and remove the ECU.

Refitting

- 5 Refitting is a reversal of removal.

12 Knock sensor - removal and refitting

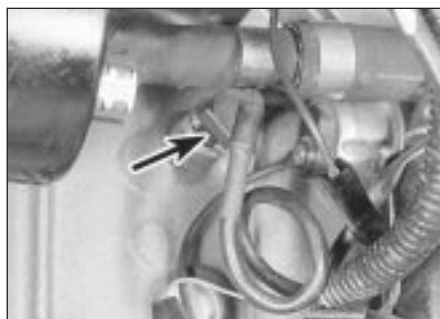


Removal

- 1 The knock sensor (4-cylinder engines only) is located in the centre of the rear-facing side of the cylinder block, beneath the inlet manifold.
- 2 Jack up the front of the car and support it on stands.
- 3 Disconnect the wiring multiplug, then unscrew the sensor from its location (see illustrations).



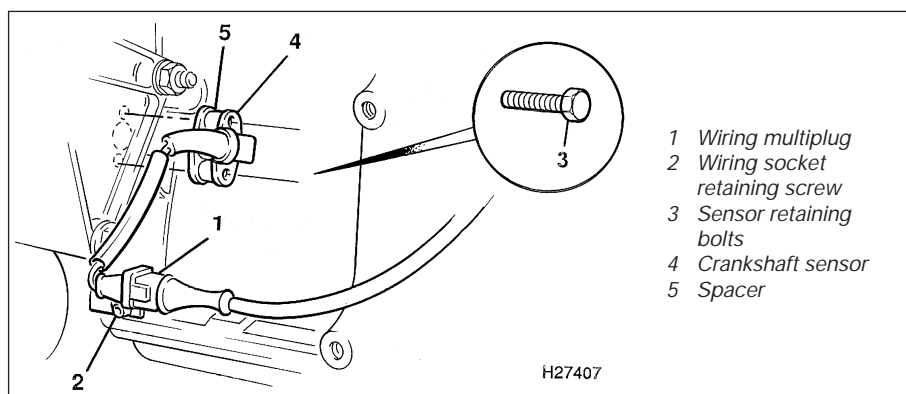
11.2 Ignition ECU location on the engine compartment bulkhead



12.3a Disconnect the knock sensor multiplug (arrowed) . . .



12.3b . . . then unscrew the sensor



13.3 Crankshaft sensor attachments

Refitting

4 Refitting is a reversal of removal, but ensure that the sensor and cylinder block mating faces are clean.

13 Crankshaft sensor - removal and refitting



Removal

1 The crankshaft sensor, fitted to 4-cylinder engines is attached to the transmission adaptor plate on the rear facing side of the engine.

2 Jack up the front of the car and support it on stands.

3 Disconnect the multiplug from the crankshaft sensor wiring socket (see illustration).

4 Undo the retaining screw and remove the wiring socket from its mounting bracket.

5 Undo the two bolts securing the crankshaft sensor to the adaptor plate, and withdraw the sensor, complete with spacer and wiring socket.

Refitting

6 Refitting is a reversal of removal, but ensure that the sensor and cylinder block mating faces are clean.

14 Crank/cylinder sensor - removal and refitting



Removal

1 The crank/cylinder sensor is located behind the timing belt sprocket on the front facing cylinder head of V6 engines.

2 Remove the timing belt and the front camshaft sprocket as described in Chapter 2, Part B.

3 Undo the four bolts and remove the timing belt backplate from the front cylinder head (see illustration).

4 Disconnect the crank/cylinder sensor wiring

multiplug and undo the cable clip retaining bolt. Slip the sensor wiring harness grommet out of the slot in the cylinder head (see illustration).

5 Undo the two bolts and withdraw the sensor from its location.

Refitting

6 Refitting is a reversal of removal. Refer to Chapter 2, Part B for timing belt refitting and adjustment procedures.

15 Charging system - general information and precautions

General information

The charging system includes the alternator, an internal voltage regulator, a no-charge (or "ignition") warning light, the battery, and the wiring between all the components. The charging system supplies electrical power for the ignition system, the lights, and all the cars accessories. The alternator is driven by the alternator (auxiliary) drivebelt from the crankshaft pulley.

The purpose of the voltage regulator is to limit the alternator's voltage to a preset value. This prevents power surges, circuit overloads, etc., during peak voltage output.

The charging system doesn't ordinarily require periodic maintenance. However, the

drivebelt, battery and the wires and connections should be inspected at the intervals outlined in Chapter 1.

The instrument panel warning light should come on when the ignition key is turned to positions "II" or "III", then should go off immediately the engine starts. If it remains on, or if it comes on while the engine is running, there is a malfunction in the charging system (see Section 16). If the light does not come on when the ignition key is turned, and the bulb is sound (see Chapter 12), there is a fault in the alternator.

Precautions

Be very careful when making electrical circuit connections to a vehicle equipped with an alternator, and note the following:

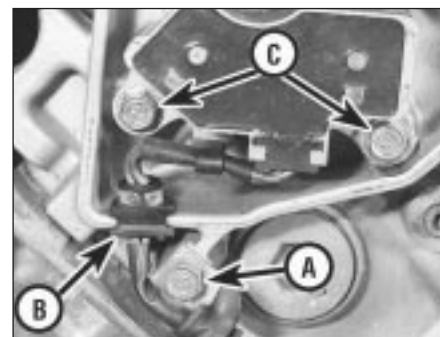
- When reconnecting wires to the alternator from the battery, be sure to note the polarity.
- Before using arc-welding equipment to repair any part of the vehicle, disconnect the wires from the alternator and the battery terminals.
- Never start the engine with a battery charger connected.
- Always disconnect both battery leads before using a battery charger.
- The alternator is driven by an drivebelt which could cause serious injury if your hand, hair or clothes become entangled in it with the engine running.
- Because the alternator is connected directly to the battery, it could arc or cause a fire if overloaded or shorted-out.
- Wrap a plastic bag over the alternator, and secure it with rubber bands, before steam-cleaning or pressure-washing the engine.
- Never disconnect the alternator terminals while the engine is running.

16 Charging system - testing



5

1 If a malfunction occurs in the charging circuit, don't automatically assume that the alternator is causing the problem. First check the following items:



14.4 Crank/cylinder sensor attachments



14.3 Remove the timing belt backplate from the front cylinder head



17.4 Typical alternator wiring connections (arrowed) on 4-cylinder engines

- (a) Check the tension and condition of the alternator (auxiliary) drivebelt - renew it if it is worn or deteriorated (see Chapter 1).
- (b) Ensure the alternator mounting bolts and nuts are tight.
- (c) Inspect the alternator wiring harness and the electrical connections at the alternator; they must be in good condition, and tight.
- (d) Check the relevant fuses in the fusebox (see Chapter 12). If any are blown, determine the cause, repair the circuit and renew the fuse (the vehicle won't start and/or the accessories won't work if the fuse is blown).
- (e) Start the engine and check the alternator for abnormal noises - for example, a shrieking or squealing sound may indicate a badly worn bearing or brush.
- (f) Make sure that the battery is fully-charged - one bad cell in a battery can cause overcharging by the alternator.

2 Using a voltmeter, check the battery voltage with the engine off. It should be in excess of 12 volts.

3 Start the engine and check the battery voltage again. Increase engine speed until the voltmeter reading remains steady; it should now be approximately 13.5 to 14.5 volts.

4 Switch on as many electrical accessories (eg the headlights, heated rear window and heater blower) as possible, and check that the alternator maintains the regulated voltage at around 13 to 14 volts. The voltage may drop and then come back up; it may also be



17.12 Pull back the rubber cap and unscrew the main terminal nut



17.10a V6 engine alternator side pivot bolt (arrowed) . . .



17.10b . . . and adjusting bolt (arrowed)

necessary to increase engine speed slightly, even if the charging system is working properly.

5 If the voltage reading is greater than the stated charging voltage, renew the voltage regulator (see Section 18).

6 If the voltmeter reading is less than that stated, the fault may be due to worn brushes, weak brush springs, a faulty voltage regulator, a faulty diode, a severed phase winding, or worn or damaged slip rings. The brushes and slip rings may be checked (see Section 18), but if the fault persists, the alternator should be renewed or taken to an auto-electrician for testing and repair.

17 Alternator - removal and refitting



4-cylinder engines

Removal

1 Disconnect the battery negative (earth) lead (refer to Section 1 before doing this).

2 Remove the auxiliary drivebelt as described in Chapter 1.

3 Undo the two nuts and remove the alternator rear cover.

4 Disconnect the electrical leads at the rear of the alternator noting their locations for reconnection (see illustration).

5 On cars with a rear-mounted power steering pump, remove the previously-slackened pivot bolt and adjustment arm bolt,

then withdraw the alternator from the engine.

6 On cars with a front-mounted power steering pump, undo the alternator upper and lower mounting bolts, and remove the unit.

Refitting

7 Refitting is a reversal of removal. Refit and adjust the drivebelt (Chapter 1), before tightening the adjustment and mounting bolts.

V6 engines

Removal

8 Disconnect the battery negative (earth) lead (refer to Section 1 before doing this).

9 Undo the three bolts and one nut securing the power steering pump and alternator pulley covers to the top of the engine. Move the pipes and cables clear and lift off the covers.

10 Slacken the alternator side pivot bolt and lower mounting nut, then turn the adjusting bolt anti-clockwise to release the tension on the drivebelt (see illustrations).

11 Slip the drivebelt off the alternator pulley.

12 Pull back the rubber cap and unscrew the main terminal nut, then remove the washers and lead from the terminal stud (see illustration).

13 Disconnect the wiring multiplug from the rear of the alternator and release the wiring harness from the support bracket.

14 Remove the alternator mounting bolts/nuts and the adjusting bolt then remove the unit.

Refitting

15 Refitting is a reversal of removal. Adjust the drivebelt as described in Chapter 1, before tightening the mounting bolts/nuts.

18 Alternator brushes and voltage regulator - inspection and renewal



1 Remove the alternator as described in Section 17 then proceed as described below the relevant sub-heading.

A127 alternator - 4-cylinder engines

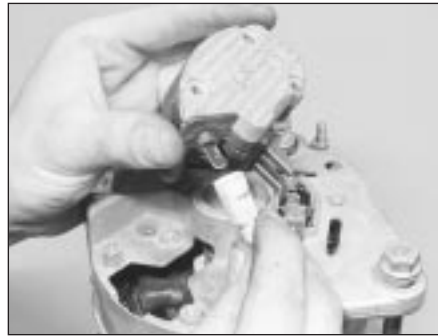
2 Undo the three small screws securing the regulator and brushbox assembly to the rear of the alternator (see illustration).



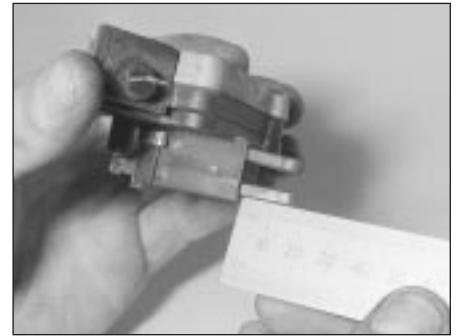
18.2 Undo the regulator and brushbox retaining screws



18.3a Withdraw the regulator and brushbox . . .



18.3b . . . and disconnect the wiring



18.4 Checking alternator brush length

3 Tip the assembly upwards at the edge, and withdraw it from its location. Disconnect the wiring terminal and remove the regulator and brushbox from the alternator (see illustrations).

4 Measure the brush length and renew the brushbox and regulator assembly if the brushes are worn below the figure given in the Specifications (see illustration).

5 Clean the slip rings with a solvent-moistened cloth, then check for signs of scoring, burning or severe pitting. If evident, the slip rings should be attended to by an automobile electrician.

6 Refitting is a reversal of removal.

A133 alternator - 4-cylinder engines

7 Disconnect the lead then undo the bolt and remove the suppression capacitor from the alternator rear cover.

8 Undo the two retaining screws and remove the rear cover from the alternator.

9 Disconnect the regulator leads, undo the retaining screws and remove the regulator from the brush box.

10 Undo the retaining screws and extract the brushes from the brush box.

11 Undo the retaining screws and withdraw the brush box from the slip ring end bracket.

12 Measure the brush length and renew the brushes if worn below the figure given in the Specifications.

13 Clean the slip rings with a solvent-moistened cloth, then check for signs of scoring, burning or severe pitting. If evident, the slip rings should be attended to by an automobile electrician.

14 Refitting is a reversal of removal.

A1271 alternator - 4-cylinder engines

15 The A1271 alternator fitted to later models is only serviced as a complete assembly. No parts are available separately and repairs to the unit are not possible.

CGK 46 alternator - V6 engines

16 Undo the nut, remove the washer and slip off the insulator from the alternator main feed terminal. Note the position of the insulator slot for refitting.

17 Undo the three end cover retaining nuts and remove the cover.

18 Undo the two brush holder retaining screws and withdraw the brush holder complete with brushes.

19 Undo the four regulator retaining screws and withdraw the regulator from the rectifier assembly. Note the screw lengths and their locations for refitting.

20 Withdraw the brushes from the brush holder and measure their lengths. Renew the brushes if worn below the figure given in the Specifications.

21 Clean the slip rings with a solvent-moistened cloth, then check for signs of scoring, burning or severe pitting. If evident, the slip rings should be attended to by an automobile electrician.

22 Refitting is a reversal of removal.

19 Starting system - general information and precautions

General information

The starting system consists of the battery, the starter motor, the starter solenoid, and the wires connecting them. The solenoid is mounted directly on the starter motor.

When the ignition key is turned to position "III", the starter solenoid is actuated through the starter control circuit. The solenoid then connects the battery to the starter. The battery supplies the electrical energy to the starter motor, which does the actual work of cranking the engine.

The starter motor on a vehicle equipped with automatic transmission can be operated only when the selector lever is in Park or Neutral ("P" or "N").

Precautions

Always observe the following precautions when working on the starting system:

- (a) *Excessive cranking of the starter motor can overheat it, and cause serious damage. Never operate the starter motor for more than 15 seconds at a time without pausing to allow it to cool for at*

least two minutes. Excessive starter operation will also risk unburned fuel collecting in the catalytic converter's element, causing it to overheat when the engine does start (see Chapter 4, Part E).

- (b) *Always detach the lead from the negative terminal of the battery before working on the starting system (see Section 1).*

20 Starting system - testing



1 If the starter motor does not turn at all when the switch is operated, make sure that, on automatic transmission models, the selector lever is in Park or Neutral ("P" or "N").

2 Make sure that the battery is fully-charged, and that all leads, both at the battery and starter solenoid terminals, are clean and secure.

3 Check the condition of the relevant fuse and fusible link, referring to Chapter 12 and the wiring diagrams at the end of this manual for further information.

4 If the starter motor spins but the engine is not cranking, the overrunning clutch or (when applicable) the reduction gears in the starter motor may be slipping, in which case the starter motor must be overhauled or renewed. (Other possibilities are that the starter motor mounting bolts are very loose, or that teeth are missing from the flywheel ring gear.)

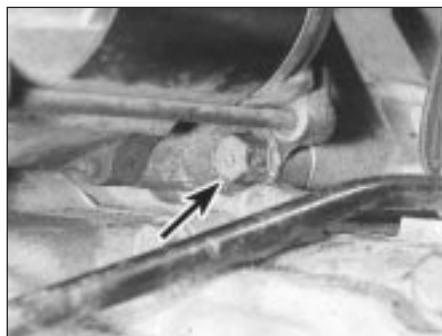
5 If, when the switch is actuated, the starter motor does not operate at all but the solenoid clicks, then the problem lies with either the battery, the main solenoid contacts, or the starter motor itself (or the engine is seized).

6 If the solenoid plunger cannot be heard to click when the switch is actuated, the battery is faulty, there is a fault in the circuit, or the solenoid itself is defective.

7 The solenoid contacts can be checked by connecting a voltmeter or test light between the battery positive feed connection on the starter side of the solenoid, and earth. When the ignition switch is turned to the "start" position, there should be a reading or lighted bulb, as applicable. If there is no reading or lighted bulb, the solenoid is faulty and should be renewed.



21.4 Removing the starter motor on 4-cylinder engines



21.11a V6 engine starter motor lower retaining bolt (arrowed)



21.11b Removing the starter motor on V6 engines

8 If the starter motor still does not operate, remove it (see Section 21). The brushes and commutator may be checked (Section 22), but if the fault persists, the motor should be renewed, or taken to an auto-electrician for testing and repair.

9 If the starter motor cranks the engine at an abnormally-slow speed, first make sure that the battery is charged, and that all terminal connections are tight. If the engine is partially seized, or has the wrong viscosity oil in it, it will crank slowly.

10 If the engine is known to be OK, and with the correct viscosity oil, but the cranking speed is still slow, the solenoid contacts are burned, the motor is faulty, or there is a poor internal connection.

21 Starter motor - removal and refitting



4-cylinder engines

Note: On some models, the starter motor is positioned under the inlet manifold, and access is severely limited. No further information was available at the time of writing.

Removal

1 Disconnect the battery negative terminal. (Refer to Section 1 before doing this).

2 Refer to the relevant Part of Chapter 4 and remove the air cleaner air intake trunking as necessary to gain access to the starter motor.

3 Disconnect the main feed cable and the Lucar spade connector at the solenoid.

4 Support the weight of the engine/transmission with a jack, then unscrew and remove the starter motor retaining bolts. Withdraw the starter motor from the transmission (see illustration).

Refitting

5 Refitting is a reversal of removal, but tighten the retaining bolts to the specified torque.

V6 engines

Removal

6 Disconnect the battery negative (earth) lead (refer to Section 1 before doing this).

7 Undo the nut and remove the washer and main feed cable from the solenoid terminal stud.

8 Disconnect the smaller Lucar connector from the other solenoid terminal.

9 Apply the handbrake, prise off the left-hand front wheel trim and slacken the wheel nuts. Jack up the front of the car and support it on axle stands. Remove the front roadwheel.

10 Undo the three retaining bolts and remove the access panel from under the front wing.

11 Unscrew and remove the two starter motor retaining bolts and withdraw the starter motor from the transmission (see illustrations).

Refitting

12 Refitting is a reversal of removal.

22 Starter motor - brush renewal



M78R starter motor - 4-cylinder engines

1 Remove the starter motor from the car as described in Section 21.

2 Undo the nut and detach the feed wire from the solenoid terminal stud.

3 Undo the two nuts and two screws then withdraw the commutator end bracket from the yoke (see illustration).

4 Release the rubber grommet from the side of the yoke and withdraw the brush holder assembly complete with brushes (see illustration).

5 Remove the brush springs from the brush holder.

6 Unclip the earth brushes from the brush holder.

7 Remove the insulator plate and withdraw the remaining brushes complete with their connector lead.

8 Clean and inspect the brush assemblies. If the brushes have worn beyond (or down to) the specified minimum length they must be renewed as a set.



22.3 Withdraw the commutator end bracket



22.4 Release the rubber grommet (arrowed) and remove the brush holder



22.10 Using pointed-nose pliers to compress the brushes

9 Prior to refitting the brushes, check the condition of the commutator face on which they run. Wipe the commutator with a solvent-moistened cloth. If the commutator is dirty, it may be cleaned with fine glass paper, then wiped with the cloth.

10 Fit the new brushes using a reversal of the removal procedure. When refitting the brush holder assembly, carefully compress the brushes one at a time using pointed-nose pliers, tip the holder slightly and ease the brushes over the commutator (see illustration).

M79 starter motor - 4-cylinder engines

11 Undo the two retaining screws and remove the end cap and seal.

12 Wipe free the grease from the end of the armature shaft then prise free and remove the C-clip from the shaft groove. Remove the spacer(s).

13 Unscrew the retaining nut and detach the connecting link from the solenoid.

14 Undo the two retaining screws and withdraw the solenoid yoke from the drive end housing. Lift it upwards and disengage the solenoid armature from the actuation lever in the end housing.

15 Unscrew and remove the two through-bolts then remove the commutator end housing from the yoke and armature unit.

16 Detach the brush housing insulator and withdraw the brushes from the housing.

17 If the brushes have worn down to or beyond the minimum length specified, they must be renewed as a set. To renew them, cut their leads mid-point and make a secure soldered joint when connecting the new brushes.

18 Prior to refitting the brushes, check the condition of the commutator face on which they run. Wipe the commutator with a solvent-moistened cloth. If the commutator is dirty, it may be cleaned with fine glass paper, then wiped with the cloth.

19 Fit the new brushes and reassemble the starter motor unit using a reversal of the removal procedure. Make sure that the brushes move freely in their holders. When fitting the armature unit to the yoke, engage the actuating arm in the drive end housing together with the plastic bracket (locates in the notch in the yoke face) and rubber block. Ensure that the drive end housing is correctly aligned before fully tightening the retaining screws.

DR 5U1 starter motor - V6 engines

20 Brushes are not separately available for this starter motor and, should renewal be necessary, a complete brush holder and yoke assembly must be obtained. As this is likely to be prohibitively expensive, a better alternative may be to obtain a complete reconditioned starter motor, or seek the advice of an automobile electrician.