






Chapter 5 Part A:

Starting and charging 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

5A

General

System type	12-volt, negative-earth
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Starter motor

Type	Magneti-Marelli pre-engaged
Rating	12 volts, 0.9 to 1.4 kW, depending on model

Battery

Capacity	40 to 50 amp-hours
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Alternator

Type	Bosch or Magneti-Marelli
Output	65 to 80 amps, depending on model
Regulated voltage	14.3 to 14.6 volts

Torque wrench settings

	Nm	lbf ft
Alternator:		
M8 nuts/bolts	25	18
M10 nuts/bolts	50	37
M12 nuts/bolts	70	52
Battery support tray	29	21

1 General information and precautions

General information

The engine electrical system consists mainly of the charging and starting systems. Because of their engine-related functions, these components are covered separately from the body electrical devices such as the lights, instruments, etc (which are covered in Chapter 12). Refer to Part B for information on the ignition system.

The electrical system is of 12-volt negative-earth type.

The battery fitted as original equipment is of 'limited-maintenance' type and is charged by the alternator, which is belt-driven from the crankshaft pulley. The original-equipment battery does not require regular topping-up, and some of the types fitted cannot be topped-up (see Chapter 1).

The starter motor is of the pre-engaged type, incorporating an integral solenoid. On starting, the solenoid moves the drive pinion into engagement with the flywheel ring gear before the starter motor is energised. Once the engine has started, a one-way clutch prevents the motor armature being driven by the engine until the pinion disengages from the flywheel.

Further details of the various systems are given in the relevant Sections of this Chapter. While some repair procedures are given, the usual course of action is to renew the component concerned. The owner whose interest extends beyond mere component renewal should obtain a copy of the *Automobile Electrical & Electronic Systems Manual*, available from the publishers of this manual.

Precautions



Warning: It is necessary to take extra care when working on the electrical system to avoid damage to semi-conductor devices (diodes and transistors), and to avoid the risk of personal injury. In addition to the precautions given in *Safety first!*, observe the following when working on the system:

Always remove rings, watches, etc before working on the electrical system. Even with the battery disconnected, capacitive discharge could occur if a component's live terminal is earthed through a metal object. This could cause a shock or nasty burn.

Do not reverse the battery connections. Components such as the alternator, electronic control units, or any other components having semi-conductor circuitry could be irreparably damaged.

Never disconnect the battery terminals, the alternator, any electrical wiring or any

test instruments when the engine is running.

Do not allow the engine to turn the alternator when the alternator is not connected.

Never 'test' for alternator output by 'flashing' the output lead to earth.

Always ensure that the battery negative lead is disconnected when working on the electrical system.

If the engine is being started using jump leads and a slave battery, connect the batteries **positive-to-positive** and **negative-to-negative** (see *Jump starting*). This also applies when connecting a battery charger.

Never use an ohmmeter of the type incorporating a hand-cranked generator for circuit or continuity testing.

Before using electric-arc welding equipment on the car, **disconnect the battery, alternator and components such as the electronic control units** (where applicable) to protect them from the risk of damage.

The radio/cassette unit fitted as standard equipment by FIAT is equipped with a built-in security code, to deter thieves. If the power source to the unit is cut, the anti-theft system will activate - see *Disconnecting the battery* in the Reference section for more information.

2 Battery - testing and charging

Standard or limited-maintenance battery - testing

Note: Some models are fitted with a limited-maintenance battery which is sealed, meaning that the electrolyte specific gravity cannot be checked. The condition of the battery can therefore only be tested using a voltmeter - refer to paragraphs 6 to 8.

1 If the vehicle covers a small annual mileage, it is worthwhile checking the specific gravity of the electrolyte every three months to determine the state of charge of the battery. Use a hydrometer to make the check, and compare the results with the following table. Note that the specific gravity readings assume an electrolyte temperature of 15°C (60°F); for every 10°C (18°F) below 15°C (60°F) subtract 0.007. For every 10°C (18°F) above 15°C (60°F) add 0.007.

	Above 25°C	Below 25°C
Fully charged	1.210 to 1.230	1.270 to 1.290
70% charged	1.170 to 1.190	1.230 to 1.250
Discharged	1.050 to 1.070	1.110 to 1.130

2 If the battery condition is suspect, first check the specific gravity of electrolyte in each cell. A variation of 0.040 or more between any cells indicates loss of electrolyte or deterioration of the internal plates.

3 If the specific gravity variation is 0.040 or more, the battery should be renewed. If the

cell variation is satisfactory but the battery is discharged, it should be charged as described later in this Section.

Maintenance-free battery - testing

4 In cases where a 'sealed for life' maintenance-free battery is fitted, topping-up and testing of the electrolyte in each cell is not possible. The condition of the battery can therefore only be assessed using the battery condition indicator or a voltmeter.

5 Certain models may have been fitted with a maintenance-free battery with a built-in charge condition indicator. The indicator is located in the top of the battery casing, and indicates the condition of the battery from its colour. If the indicator shows green, then the battery is in a good state of charge. If the indicator turns darker, eventually to black, then the battery requires charging, as described later in this Section. If the indicator shows clear/yellow, then the electrolyte level in the battery is too low to allow further use, and the battery should be renewed. Do not attempt to charge, load or jump start a battery when the indicator shows clear or yellow.

6 If testing the battery using a voltmeter, connect the voltmeter across the battery terminals. The test is only accurate if the battery has not been subjected to any kind of charge for the previous six hours. If this is not the case, switch on the headlights for 30 seconds, then wait four to five minutes before testing the battery after switching off the headlights. All other electrical circuits must be switched off, so check that the doors and tailgate are fully shut when making the test.

7 If the voltage reading is less than 12 volts, then the battery is discharged, whilst a reading of 12.0 to 12.4 volts indicates a partially-discharged condition.

8 If the battery is to be charged, remove it from the vehicle (Section 3) and charge it as described later in this Section.

Standard or limited-maintenance battery - charging

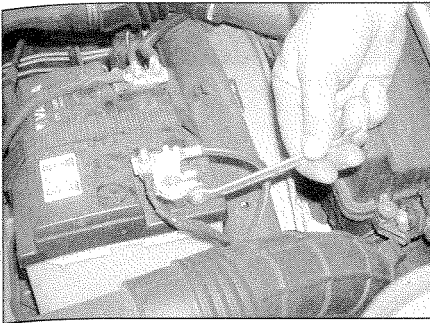
Note: The following is intended as a guide only. Always refer to the manufacturer's recommendations (often printed on a label attached to the battery) before charging a battery.

9 Charge the battery at a rate of 3.5 to 4 amps and continue to charge the battery at this rate until no further rise in specific gravity is noted over a 4-hour period.

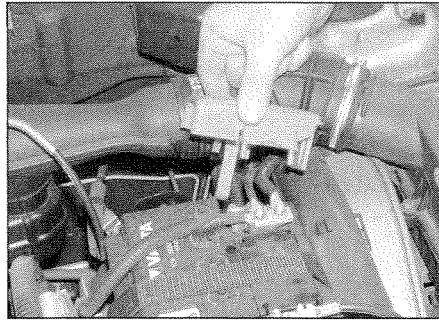
10 Alternatively, a trickle charger charging at the rate of 1.5 amps can safely be used overnight.

11 Specially rapid 'boost' charges which are claimed to restore the power of the battery in 1 to 2 hours are not recommended, as they can cause serious damage to the battery plates through overheating.

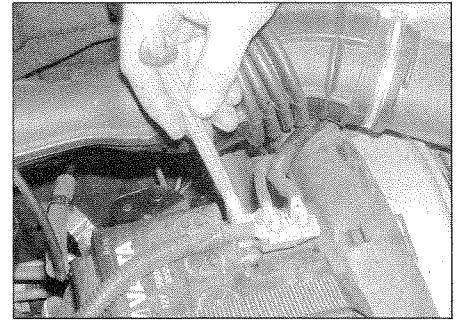
12 While charging the battery, note that the temperature of the electrolyte should never exceed 37.8°C (100°F).



3.1 Disconnecting the battery negative terminal



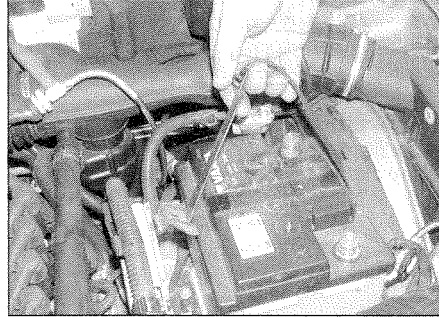
3.2a Lift off the cover for access to the positive terminal . . .



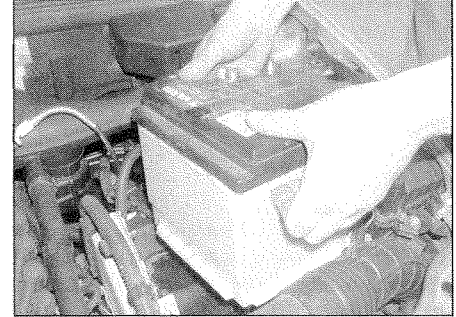
3.2b . . . then unscrew the clamp and disconnect it



3.3a Unscrew the clamp plate bolt . . .



3.3b . . . then lift away the holding strap



3.4 Removing the battery

Maintenance-free battery - charging

Note: The following is intended as a guide only. Always refer to the manufacturer's recommendations (often printed on a label attached to the battery) before charging a battery.

13 This battery type takes considerably longer to fully recharge than the standard type, the time taken being dependent on the extent of discharge, but it can take anything up to three days.

14 A constant voltage type charger is required, to be set, when connected, to 13.9 to 14.9 volts with a charger current below 25 amps. Using this method, the battery should be usable within three hours, giving a voltage reading of 12.5 volts, but this is for a partially discharged battery and, as mentioned, full charging can take considerably longer.

15 If the battery is to be charged from a fully discharged state (condition reading less than 12 volts), have it recharged by your FIAT dealer or local automotive electrician, as the charge rate is higher and constant supervision during charging is necessary.

3 Battery - removal and refitting

Note: If the vehicle has a security-coded radio, check that you have a copy of the code number before disconnecting the battery cable; refer to *Disconnecting the battery in the Reference section* for details.

Removal

1 Loosen the clamp bolt and disconnect the

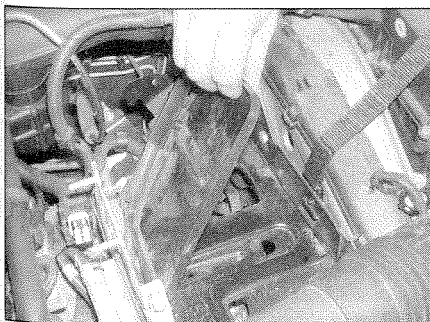
battery negative cable from the terminal (see illustration).

2 Lift up the plastic cover, and disconnect the positive cable in the same manner (see illustrations).

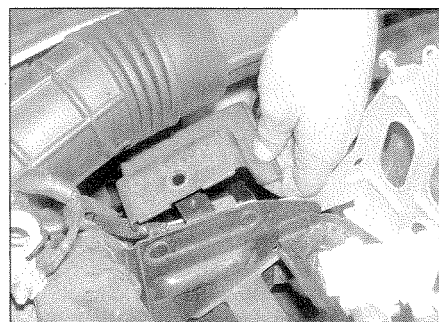
3 At the base of the battery, unscrew the bolt from the battery holding clamp plate, and lift away the clamp plate and battery holding strap (see illustrations).

4 Remove the battery from the engine compartment (see illustration).

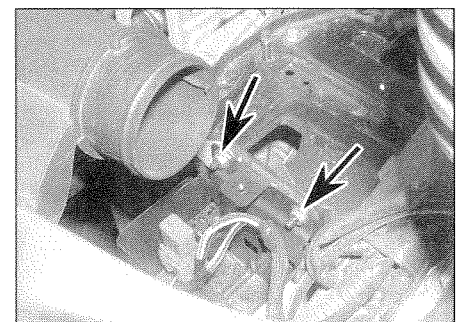
5 If necessary, the plastic tray beneath the battery can be lifted out. The main battery tray may be removed by unscrewing the bolts - note, however, that on 1.6 litre models, this also entails removing the ECU - see Chapter 4B, Section 4. Before removing the tray completely, unbolt the relay holder(s) (where applicable) and place to one side (see illustrations).



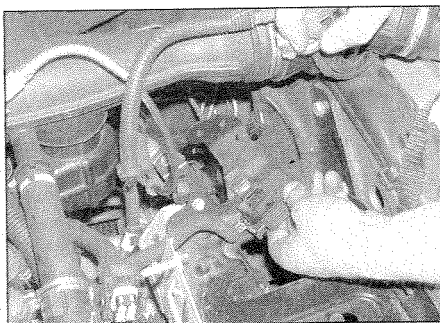
3.5a Removing the battery drip tray



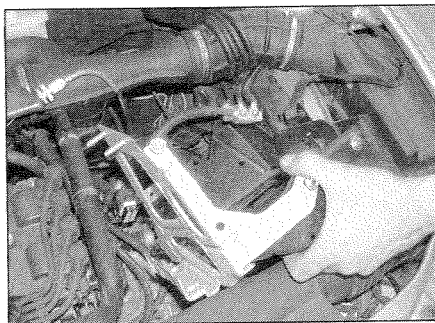
3.5b Lift off the fuse/relay carrier lid . . .



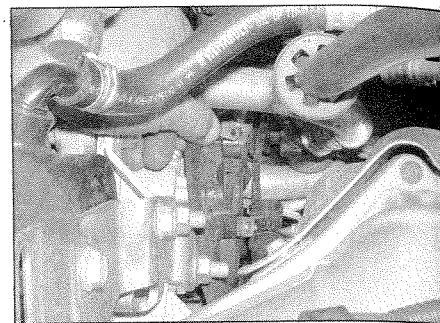
3.5c . . . for access to the mounting nuts



3.5d Removing the rear fuse/relay carrier



3.5e Removing the battery tray



5.9 Remove the plastic cover from the alternator connections

Refitting

6 Refitting is a reversal of removal, but make sure that the positive terminal is connected first, followed by the negative terminal.

4 Alternator/charging system - testing in vehicle

Note: Refer to the warnings given in Safety first! and in Section 1 of this Chapter before starting work.

1 If the ignition warning light fails to illuminate when the ignition is switched on, first check the alternator wiring connections for security. If satisfactory, check that the warning light bulb has not blown, and that the bulbholder is secure in its location in the instrument panel. If the light still fails to illuminate, check the continuity of the warning light feed wire from the alternator to the bulbholder. If all is satisfactory, the alternator is at fault and should be renewed or taken to an auto-electrician for testing and repair.

2 If the ignition warning light illuminates when the engine is running, stop the engine and check that the drivebelt is correctly tensioned (see Chapter 1) and that the alternator connections are secure. If all is so far satisfactory, have the alternator checked by an auto-electrician.

3 If the alternator output is suspect even though the warning light functions correctly, the regulated voltage may be checked as follows.

4 Connect a voltmeter across the battery terminals and start the engine.

5 Increase the engine speed until the voltmeter reading remains steady; the reading should be approximately 12 to 13 volts, and no more than 14 volts.

6 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.

7 If the regulated voltage is not as 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 alternator should be renewed or taken to an automotive electrician for testing and repair.

5 Alternator - removal and refitting

1.2 and 1.4 litre models

Removal

1 Disconnect the battery negative cable and position it away from the terminal.

2 Refer to Chapter 1 and remove the auxiliary drivebelt which drives the alternator.

3 Unplug the wiring from the rear of the alternator at the connectors.

4 Unscrew and remove the bolts securing the upper mounting bracket to the alternator and the engine, then remove the bracket from the engine compartment.

5 Slacken and withdraw the lower mounting

bolt then remove the alternator from the engine compartment.

Refitting

6 Refitting is a reversal of removal. Refer to Chapter 1 for details of refitting and tensioning the auxiliary drivebelt. On completion, tighten all mounting bolts securely.

1.6 and 1.8 litre models without air conditioning

Removal

7 Disconnect the battery negative cable and position it away from the terminal.

8 Refer to Chapter 1 and remove the auxiliary drivebelt which drives the alternator.

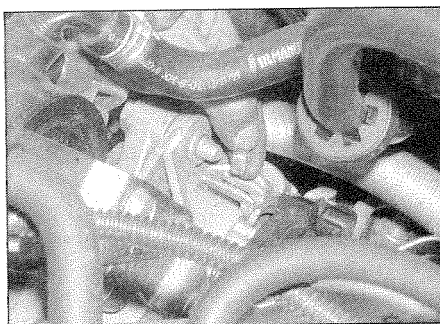
9 Remove the plastic cover which fits over the alternator wiring connections (see illustration). Noting the locations of the wiring, and of any washers used, unscrew the terminal nuts and disconnect the wiring from the rear of the alternator.

10 Slacken and remove the alternator upper mounting nut and bolt (see illustrations).

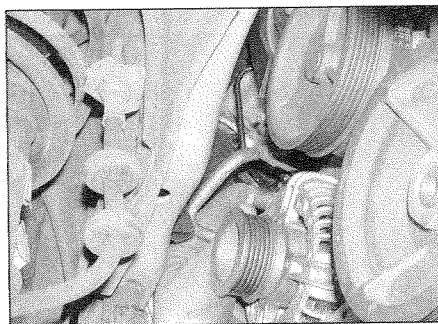
11 Slacken the nut on the alternator's captive lower mounting bolt, noting that this was found to be extremely tight on the project car, and with the limited access, loosening it was not easy. Success was finally achieved using a socket and very long extension bar, working to the left of the exhaust downpipe.

1.6 litre models

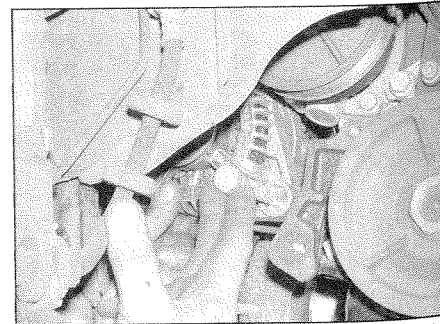
12 Remove the lower mounting bolt nut and two washers. Supporting the alternator (which is quite heavy), withdraw the lower mounting bolt, and move the alternator to the rear, resting it on the subframe (see illustration).



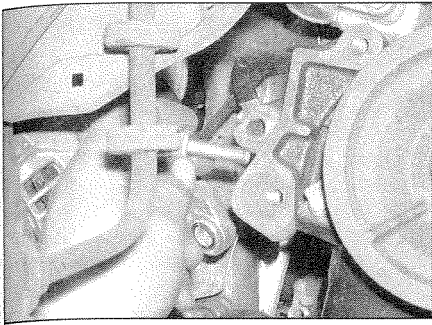
5.10a Remove the upper mounting nut ...



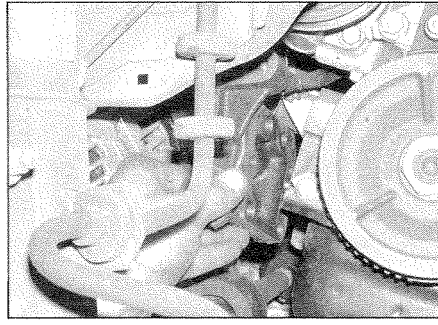
5.10b ... and withdraw the bolt



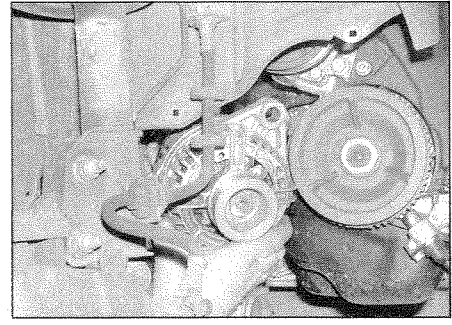
5.12 Withdraw the lower mounting bolt, and move the alternator to the rear



5.13a Unscrew the bolts securing the alternator lower mounting bracket ...



5.13b ... and remove the bracket



5.14 Withdraw the alternator through the inner wheelarch

13 Remove the four bolts securing the alternator mounting bracket to the engine block, and remove the mounting (see illustrations). Access to the bolts is hampered by the driveshaft, but they are less tight than the alternator lower mounting bolt.

14 With the mounting bracket removed, the alternator can be removed through the inner wheelarch, and out from under the car (see illustration).

1.8 litre models

15 In order for the alternator to be withdrawn, the right-hand driveshaft and its support bracket/shield must be removed, with reference to Chapter 8 (see illustration).

16 With the driveshaft removed, support the alternator, then remove the lower mounting bolt and lower the alternator out of position.

Refitting

17 Refitting is a reversal of removal. Refer to Chapter 1 for details of refitting and tensioning the auxiliary drivebelt. On completion, tighten all mounting bolts securely.

1.8 litre models with air conditioning

Removal

18 Disconnect the battery negative cable and position it away from the terminal.

19 Refer to Chapter 1 and remove the auxiliary drivebelt.

20 Unbolt and remove the exhaust system downpipe from the exhaust manifold and catalytic converter, as described in Chapter 4C.

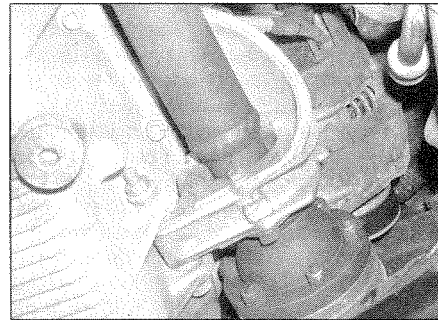
21 Prise open the protective plastic cover and unplug the wiring from the rear of the alternator at the connectors.

22 Support the engine and transmission on a trolley jack, then unbolt the rear engine mounting from the engine, with reference to Chapter 2D. Lower the rear of the engine slightly using the trolley jack, to allow the alternator to be withdrawn without obstruction.

23 Undo the upper and lower alternator mounting bolts and remove the alternator from the engine compartment.

Refitting

24 Refitting is a reversal of removal. Refer to Chapter 1 for details of refitting and tensioning the auxiliary drivebelt. On completion, tighten the mounting bolts securely.



5.15 Right-hand driveshaft support/shield, with alternator visible above (seen from below)

6 Alternator - brush holder/regulator module renewal

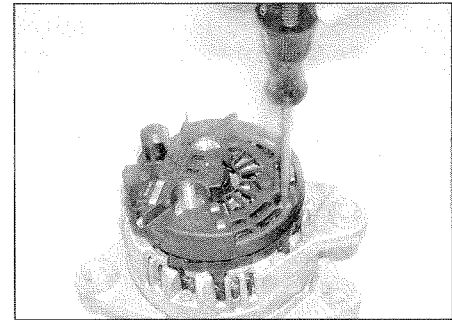
1 Remove the alternator as described in Section 5.

2 Where applicable, remove the screw and nut securing the alternator rear cover, and take off the cover (see illustrations).

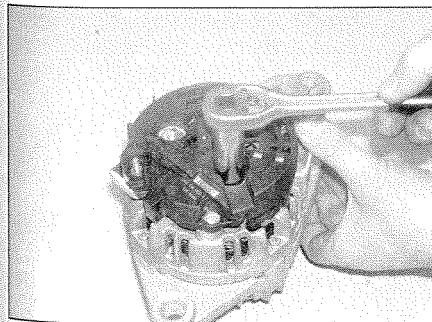
3 Extract the two small screws (marked with green paint, on our project vehicles) and withdraw the brush holder (see illustrations).

4 Using a steel rule check the length of the brushes. If less than 5.0 mm, the complete brush holder assembly should be renewed.

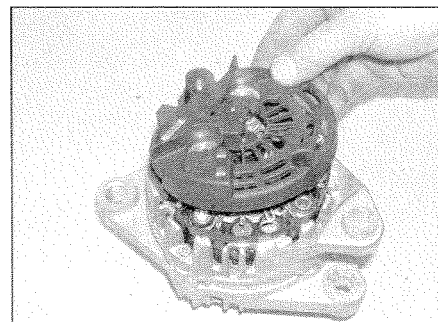
Note: On Bosch alternators, it may be possible to obtain the brushes separately, in which case the brush leads should be



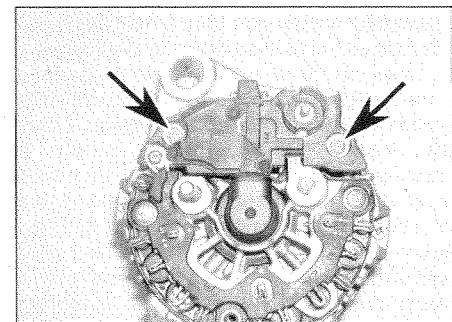
6.2a Remove the cover screw ...



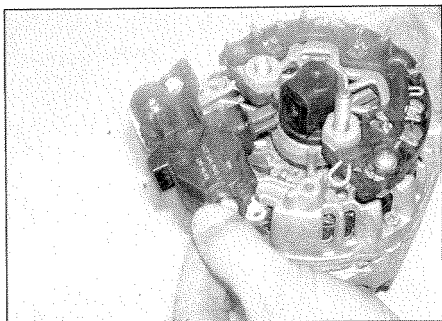
6.2b ... and the nut ...



6.2c ... and remove the alternator rear cover



6.3a Unscrew the brush holder screws (arrowed) ...



6.3b ... and withdraw the brush holder from the alternator

unsoldered from the terminals and the new brush leads soldered onto the terminals. Refer to an automotive electrical specialist for advice.

5 Check the slip rings for excessive wear and clean them with a cloth; do not use coarse abrasives that may damage the contact surface.

6 Fit the new holder using a reversal of the removal procedure, but make sure that each brush moves freely.

7 Starting system - testing

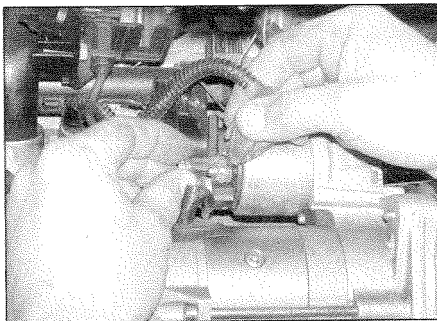
Note: Refer to the precautions given in Safety first! and in Section 1 of this Chapter before starting work.

1 If the starter motor fails to operate when the ignition key is turned to the appropriate position, the following possible causes may be to blame.

- a) The battery is faulty.
- b) The electrical connections between the switch, solenoid, battery and starter motor are somewhere failing to pass the necessary current from the battery through the starter to earth.
- c) The solenoid is faulty.
- d) The starter motor is mechanically or electrically defective.
- e) On models fitted with an ignition immobiliser or anti-theft alarm, either the immobiliser has not been deactivated, or is faulty.

2 To check the battery, switch on the headlights. If they dim after a few seconds, this indicates that the battery is discharged - recharge (see Section 2) or renew the battery. If the headlights glow brightly, operate the ignition switch and observe the lights. If they dim, then this indicates that current is reaching the starter motor, therefore the fault must lie in the starter motor. If the lights continue to glow brightly (and no clicking sound can be heard from the starter motor solenoid), this indicates that there is a fault in the circuit or solenoid - see following paragraphs.

3 If the starter motor turns slowly when



8.4a Unscrew the nut ...

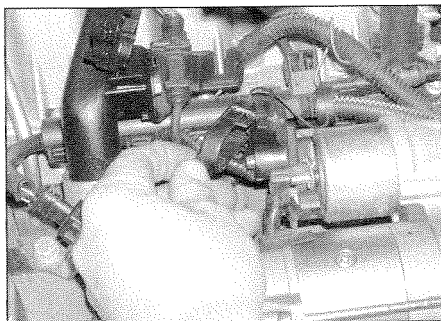
operated, but the battery is in good condition, then this indicates that either the starter motor is faulty, or there is considerable resistance somewhere in the circuit.

4 If a fault in the circuit is suspected, disconnect the battery leads (including the earth connection to the body), the starter/solenoid wiring and the engine/transmission earth strap. Thoroughly clean the connections, and reconnect the leads and wiring, then use a voltmeter or test light to check that full battery voltage is available at the battery positive lead connection to the solenoid, and that the earth is sound. Smear petroleum jelly around the battery terminals to prevent corrosion - corroded connections are amongst the most frequent causes of electrical system faults.

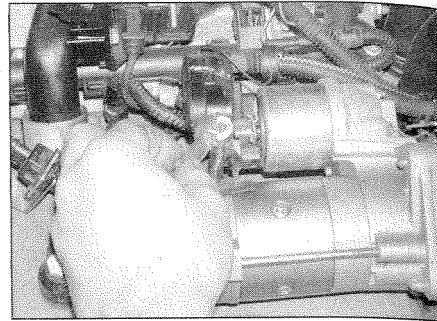
5 If the battery and all connections are in good condition, check the circuit by disconnecting the wire from the solenoid blade terminal. Connect a voltmeter or test light between the wire end and a good earth (such as the battery negative terminal), and check that the wire is live when the ignition switch is turned to the 'start' position. If it is, then the circuit is sound - if not, the circuit wiring can be checked as described in Chapter 12.

6 The solenoid contacts can be checked by connecting a voltmeter or test light across the solenoid. 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.

7 If the circuit and solenoid are proved sound, the fault must lie in the starter motor.



8.5a Lift up the outer cover ...



8.4b ... and disconnect the smaller wire from the solenoid

In this event, it may be possible to have the starter motor overhauled by a specialist, but check on the cost of spares before proceeding, as it may prove more economical to obtain a new or exchange motor.

8 Starter motor - removal and refitting

Removal

1 Disconnect the battery negative cable and position it away from the terminal.

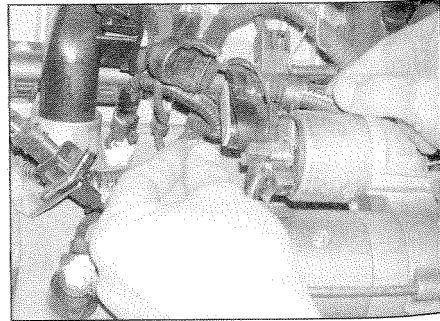
2 On 1.8 litre models, carry out the following:

- a) Remove the battery and its support tray as described in Section 3.
- b) Remove the airflow meter and its associated air ducting as described in Chapter 4B, Section 4.
- c) Unbolt the throttle body housing from the inlet manifold, as described in Chapter 4B, Section 4, and move it to one side leaving all coolant hoses and wiring attached.

3 Apply the handbrake, then jack up the front of the vehicle and support on axle stands (see Jacking and vehicle support).

4 Working beneath the vehicle, unscrew the nut and disconnect the smaller wire from the solenoid lower terminal (see illustrations).

5 Raise the plastic cover, then disconnect the wiring from the larger solenoid terminal. Note the fitted order of all components, for use when refitting. Separate the wiring connector incorporated into the main battery lead (see illustrations).



8.5b ... unscrew the nut ...

6 Unscrew and remove the starter motor upper mounting bolts, located at the top of the transmission bellhousing (see illustration). Note that on 1.8 litre models, access is extremely limited - a cranked ring spanner will be required to reach the bolt heads.

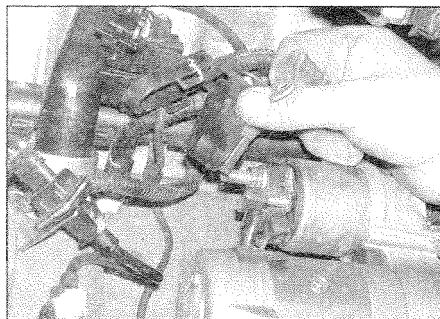
7 Unscrew the starter motor lower mounting bolt(s), then withdraw the starter motor from the engine (see illustration). Note that on 1.6 litre models, the three starter mounting bolts are all accessible from the transmission side of the bellhousing.

Refitting

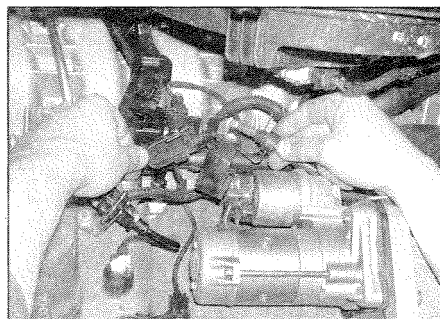
8 Refit the starter motor by following the removal procedure in reverse. Tighten the mounting bolts securely.

9 Starter motor - testing and overhaul

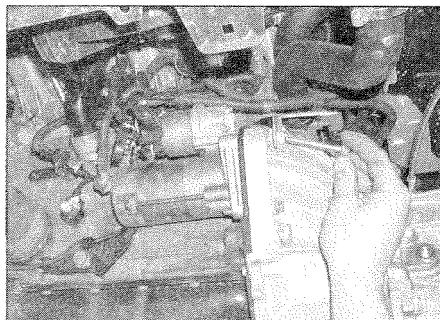
If the starter motor is thought to be suspect, it should be removed from the vehicle and taken to an auto-electrician for testing. Most automotive electricians will be able to supply and fit brushes at a reasonable cost. However, check on the cost of repairs before proceeding, as it may prove more economical to obtain a new or exchange motor.



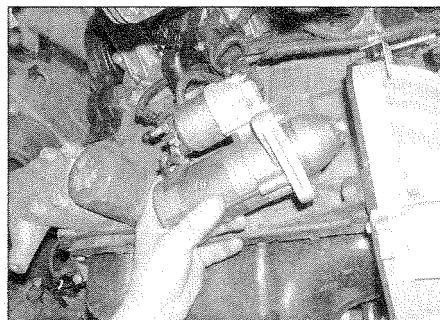
8.5c ... and disconnect the wiring from the larger solenoid terminal



8.5d Separate the wiring plug in the battery supply lead



8.6 Removing the starter motor upper mounting bolt



8.7 Withdrawing the starter motor from the engine