

Chapter 5 Part A:

Starting and charging systems

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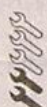
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Degrees of difficulty

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



Specifications

System type	12-volt, negative earth
Battery	
Type	Low-maintenance or maintenance-free, depending on model
Charge condition:	
Poor	12.5 volts
Normal	12.6 volts
Good	12.7 volts
Alternator	
Type	Bosch, Magneti Marelli, Mitsubishi or Hitachi (depending on model)
Minimum brush length:	
Bosch	10.0 mm
Magneti Marelli	5.0 mm
Mitsubishi	8.0 mm
Hitachi	6.0 mm
Starter motor	
Type	Magneti Marelli, Mitsubishi or Hitachi (depending on model)
Minimum brush length:	
Magneti Marelli	5.0 mm
Mitsubishi	12.0 mm
Hitachi	11.0 mm

so check that the doors and tailgate are fully shut when making the test.

12 If the voltage reading is less than 12.2 volts, then the battery is discharged, whilst a reading of 12.2 to 12.4 volts indicates a partially-discharged condition.

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

Standard and low-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.

14 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 four-hour period.

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

16 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.

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

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.

18 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.

19 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.

20 If the battery is to be charged from a fully-discharged state (condition reading less than 12.2 volts), have it recharged by your Nissan dealer or local automotive electrician, as the charge rate is higher, and constant supervision during charging is necessary.

3 Battery - removal and refitting

Note: Refer to Disconnecting the battery in the Reference Section of this manual before proceeding.

Removal

1 The battery is located on the left-hand side of the engine compartment.

2 Slacken the clamp nut/bolt, and disconnect the clamp from the battery negative terminal.

3 Remove the insulation cover (where fitted) and disconnect the positive clamp in the same way.

4 Unscrew the nuts, and remove the battery retaining clamp.

5 Lift the battery out of the engine compartment and, where necessary, remove the plastic battery tray. If necessary, the battery mounting bracket can also be unbolted and removed from the engine compartment.

Refitting

6 Refitting is a reversal of removal, but smear petroleum jelly on the terminals when reconnecting the leads, and always reconnect the positive lead first, and the negative lead last.

4 Charging system - testing

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

1 If the ignition/no-charge warning light fails to come on 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 come on, 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 taken to an auto-electrician for testing and repair.

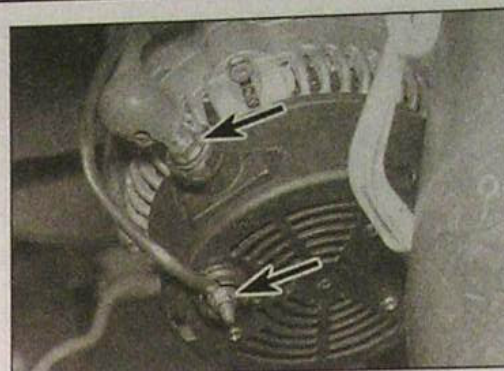
2 If the ignition warning light comes on when the engine is running, stop the engine as soon as possible. Check that the drivebelt is correctly tensioned (see Chapter 1), that the drivebelt is not contaminated (with oil or water, for example), and that the alternator connections are secure. If all is so far satisfactory, check the alternator brushes and slip-rings as described in Section 6. If the fault persists, the alternator should be taken to an auto-electrician for testing and repair.

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



5.3 Alternator wiring connections (arrowed) - 2.0 litre models

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 brushes and slip-rings may be checked (see Section 6), but if the fault persists, the alternator should be taken to an auto-electrician for testing and repair.

5 Alternator - removal and refitting

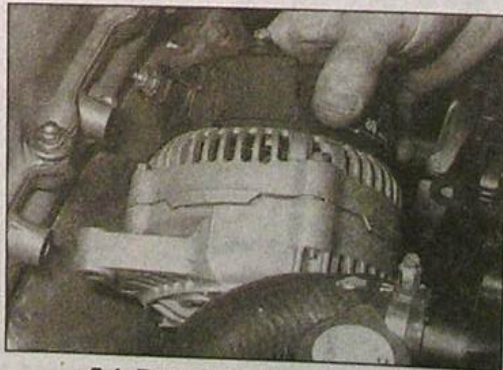
Removal

1 Disconnect the battery negative terminal (refer to Disconnecting the battery in the Reference Section of this manual).

2 Slacken the auxiliary drivebelt as described in Chapter 1, and disengage it from the alternator pulley.

3 Remove the rubber covers (where fitted) from the alternator terminals, then unscrew the retaining nut(s) and disconnect the wiring from the rear of the alternator. Where necessary, also undo the retaining screw and disconnect the earth lead (see illustration).

4 Unscrew the alternator upper and lower mounting bolts and washers, then manoeuvre the alternator away from its mounting brackets and out of position (see illustration). On 1.6 litre models, recover the spacer (where fitted) from between the alternator and the



5.4 Removing the alternator (2.0 litre model shown)

transferred to the other components, as this could damage them. Slacken and remove the retaining screws and plate, and remove the regulator/brush holder assembly.

17 To renew the brushes individually, remove the small insulator (where fitted) from the base of regulator/brush holder assembly, to expose the brush leads. Then, using a pair of pointed-nose pliers as a heat sink, unsolder the leads.

Note: Work quickly to ensure excess heat is not transferred to the other components, as this could damage them. With the leads unsoldered, slide the brushes out of position, and recover the springs. Insert the new brushes and springs into the holder, and solder the leads onto their terminals. Each brush should be positioned so that its wear mark is 2.0 mm above the regulator/brush holder surface (see illustration). Work quickly again, to avoid excess heat affecting the other components - use a pair of pliers as a heat sink. Check that the wires are securely retained, then (where necessary) clip the insulator into position.

18 Fit the regulator/brush holder assembly, and solder on the wires to the correct terminals. Work quickly, to avoid excess heat affecting the other components - use a pair of pliers as a heat sink.

19 Push the brushes fully into their holders, and retain them there by inserting a length of wire through the hole in the rear cover to hold them in position.

20 Fit the retaining clip to the rear bearing groove. Noting that the groove is eccentric, position the clip so that it protrudes above the outer race surface by the minimum possible amount (see illustration).

21 Align the marks made on removal, and refit the stator and rear cover assembly to the rotor and front cover. If necessary, heat the rear cover bearing box (see paragraph 12) to ease installation.

22 Refit the screws to the front cover, and tighten them securely.

23 Withdraw the wire from the rear cover, so that the brushes contact the slip-rings, and refit the alternator as described in Section 5.

Hitachi alternator

24 Refer to the information given above in paragraphs 10 to 23, noting that the regulator and brush holder are separate components. If the brushes are to be renewed individually, solder their leads into position so that the brushes protrude from the holder by 10.5 to 11.5 mm.

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 may be to blame:

- The battery is faulty.
- 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.
- The solenoid is faulty.
- The starter motor is mechanically or electrically defective.

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. If the starter motor turns slowly when 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.

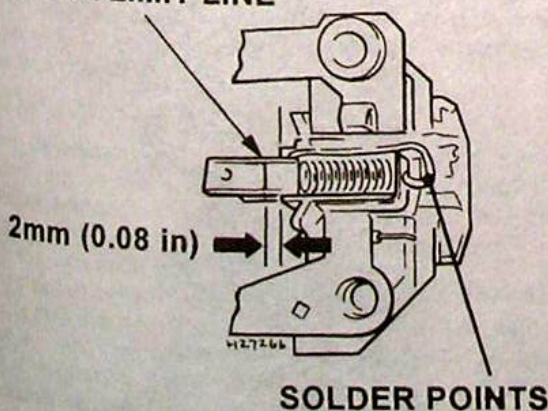
3 If a fault in the circuit is suspected, disconnect the battery leads (including the earth connection to the body), the starter/solenoid wiring and the engine/transmission earth strap (refer to *Disconnecting the battery* in the Reference Section of this manual). Thoroughly clean the connections, reconnect 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.

4 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.

5 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.

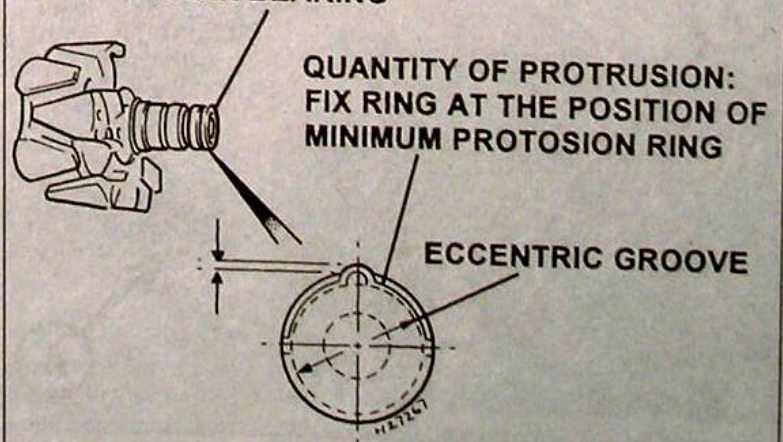
6 If the circuit and solenoid are proved sound, the fault must lie in the starter motor. Begin checking the starter motor by removing it (see Section 8), and checking the brushes (see Section 9). If the fault does not lie in the brushes, the motor windings must be faulty. In this event, it may be possible to have the starter motor overhauled by a specialist, but check on the availability and cost of spares before proceeding, as it may prove more economical to obtain a new or exchange motor.

WEAR LIMIT LINE

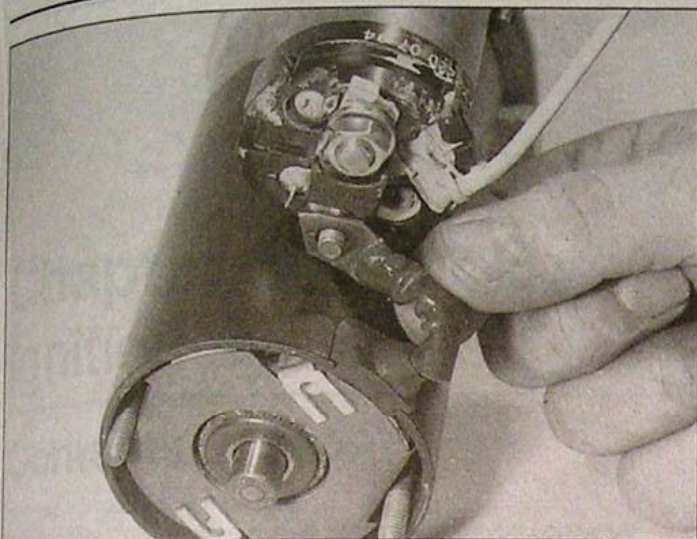


6.17 On Mitsubishi alternator, position the brushes as shown on refitting

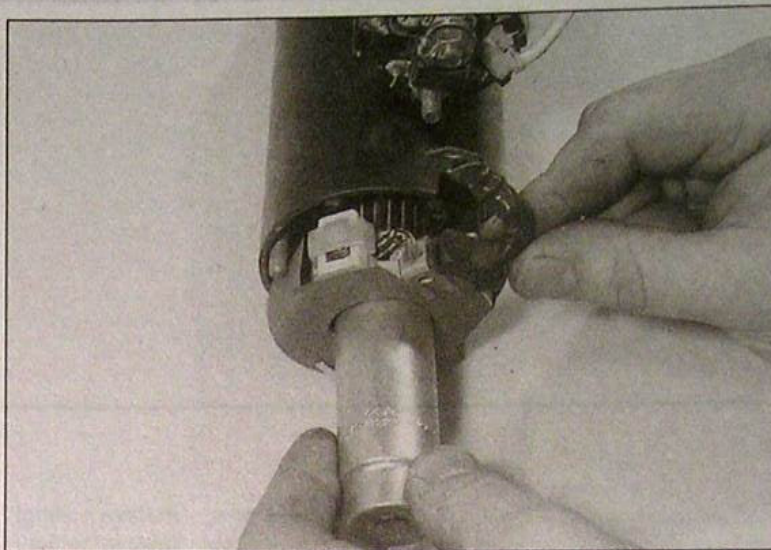
REAR BEARING



6.20 Alternator rear bearing retaining clip fitting position - Mitsubishi alternator



9.4 Undo the retaining nut, then disconnect the lead from the solenoid and remove the brush holder assembly



9.9 Refitting the brush holder assembly. Note the use of the socket to help keep the brushes in their holders as the assembly is engaged with the commutator

8 On refitting, slot the brushes into position in the holder, ensuring that the small threaded brackets are correctly positioned on the brush holder, then refit the springs and brush retaining caps. Check that each brush is free to move smoothly in its holder.

9 Clip the insulating plate onto the rear of the brush holder, and fit the brush holder assembly to the commutator (see illustration). Check that the brushes are pressed firmly against the commutator by spring pressure.

10 On motors with a one-piece end cover, ensure that the rubber grommet is correctly seated, then install the cover and refit the retaining nuts and brush holder screws, tightening them securely.

11 On motors where a small end cover is fitted to the rear cover, fit the end cover, engaging it with the grommet, and align the marks noted on removal. Tighten the cover through-bolts securely. Refit any necessary thrustwashers to the end of the armature, and secure them in position with the C-clip. Refit the gasket and small cover to the end cover, and tighten its retaining screws securely.

12 On all motors, fit the brush holder lead to the solenoid terminal, then fit the washer and retaining nut, tightening it securely. Refit the starter motor as described in Section 8.

Hitachi and Mitsubishi starters

13 Where necessary, undo the retaining screws and remove the centre cap from the starter motor end cover. Recover any shims which are fitted to the end of the armature.

14 Undo the two small screws securing the brushplate assembly to the rear cover, and remove the two starter motor through-bolts. Withdraw the rear cover, and release it from the rubber grommet. Remove any shim(s) from the armature shaft.

15 Disconnect the brushes from their holders by lifting the springs with a screwdriver, then remove the brush plate assembly.

16 Check the brushes and commutator as described above in paragraphs 6 and 7.

17 On refitting, fit the brushes into their holders, and check that they are able to slide freely.

18 Fit the brush plate assembly over the commutator, and make sure that all springs are correctly located in the brush slots.

19 Refit any relevant shims to the armature shaft.

20 Engage the rear cover with the grommet, and fit it to the motor. Align the cover holes with those of the brushplate, and install the brushplate retaining screws, tightening them securely.

21 Refit the starter motor through-bolts and tighten them securely.

22 Install the starter motor as described in Section 8.

10 Ignition switch - removal and refitting



The ignition switch is integral with the steering column lock, and can be removed as described in Chapter 10.

11 Oil pressure warning light switch - removal and refitting



Removal

1 The switch is located at the rear of the cylinder block, towards its right-hand end (see illustration). Access to the switch is improved if the vehicle is jacked up and supported on axle stands (see *Jacking and Vehicle Support*), so that the switch can be reached from underneath.

2 Disconnect the battery negative terminal (refer to *Disconnecting the battery* in the Reference Section of this manual).

3 Remove the protective sleeve from the wiring plug (where applicable), then disconnect the wiring from the switch.

4 Unscrew the switch and recover the sealing washer (where fitted). Be prepared for oil spillage. If the switch is to be left removed from the engine for any length of time, plug the hole to prevent excessive oil loss.

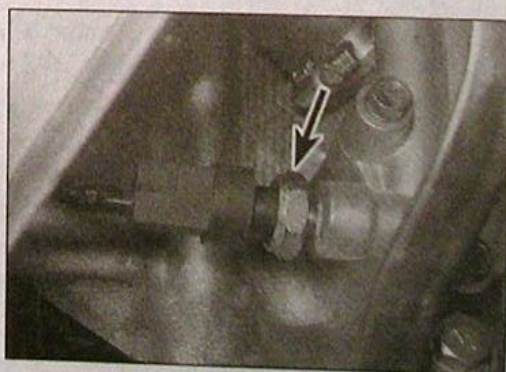
Refitting

5 Where the switch was fitted with a sealing washer, examine the sealing washer for signs of damage or deterioration, and if necessary renew it. Where no sealing washer was fitted, clean the switch and apply a smear of sealant to its threads.

6 Refit the switch, tightening it securely, and reconnect the wiring connector.

7 Lower the vehicle to the ground, then check and if necessary, top-up the engine oil as described in Chapter 1.

5A



11.1 On 2.0 litre models, the oil pressure switch (arrowed) is screwed into the oil filter housing assembly, which is mounted on the rear of the cylinder block



8.5a Peel back the rubber cover, then unscrew the nut (arrowed) and disconnect the main battery cable from the starter solenoid

8 Starter motor - removal and refitting

Removal

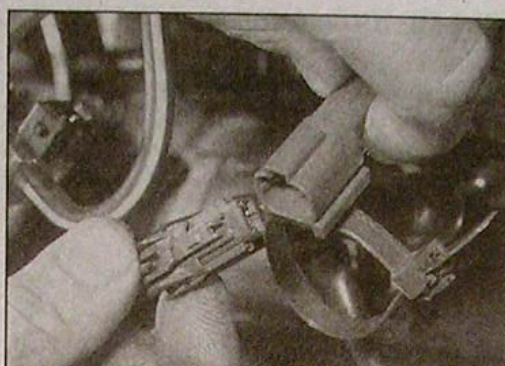
1 Disconnect the battery negative terminal (refer to *Disconnecting the battery* in the Reference Section of this manual).

2 So that access to the motor can be gained both from above and below, apply the handbrake, then jack up the front of the car and support it on axle stands (see *Jacking and Vehicle Support*).

3 Remove the exhaust front pipe as described in the relevant Part of Chapter 4.

4 To improve access to the starter motor, undo the bolts securing the inlet manifold support bracket(s), and move the bracket(s) clear of the starter motor. Note that it is not necessary to remove the brackets completely.

5 Slacken and remove the retaining nut, and disconnect the main battery cable from the starter motor solenoid. Also disconnect the wiring connector from the solenoid (see illustrations).



8.5b Disconnecting the solenoid wiring connector

6 Unscrew the starter motor mounting bolts, supporting the motor as the bolts are withdrawn, and manoeuvre the starter motor out from underneath the engine (see illustration).

Refitting

7 Refitting is a reversal of removal.

9 Starter motor - brush renewal

1 Remove the starter motor as described in Section 8. Proceed as described below the relevant sub-heading.



Consult your dealer on the cost and availability of spare parts before stripping the starter motor, as some parts for certain starter motors may not be available.

Magneti Marelli starter

2 On motors where a small centre cover is fitted to the rear cover, undo the two screws, and remove the centre cover and gasket from



8.6 Removing the starter motor assembly

the end cover. Prise out the C-clip, and withdraw any shims fitted to the armature end. Make alignment marks between the end cover and yoke, then unscrew the two through-bolts and withdraw the end cover.

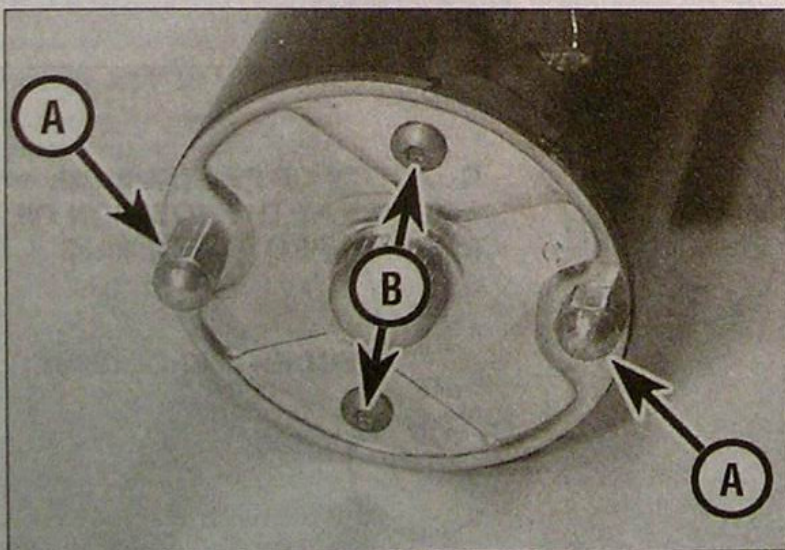
3 On motors with a one piece end cover, undo the end cover retaining nuts and the brush holder assembly screws, and remove the end cover from the motor (see illustrations).

4 Remove the nut and spring washer securing the positive brush lead to the solenoid terminal, and slide the brush holder assembly off the end of the commutator (see illustration).

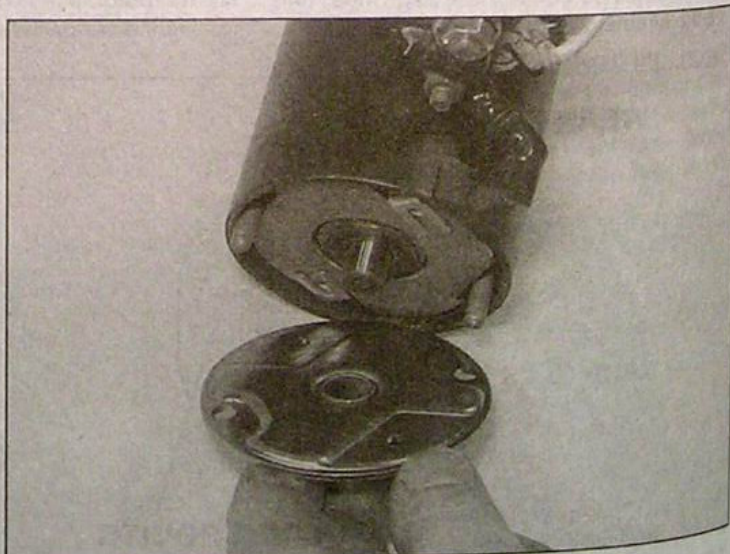
5 Withdraw the plastic insulating plate from the brush holder, then carefully prise off the brush retaining caps, and remove the springs and brushes.

6 Measure the length of each brush. If any brush is worn to less than, or close to, the minimum specified length, then all the brushes should be renewed as a complete set.

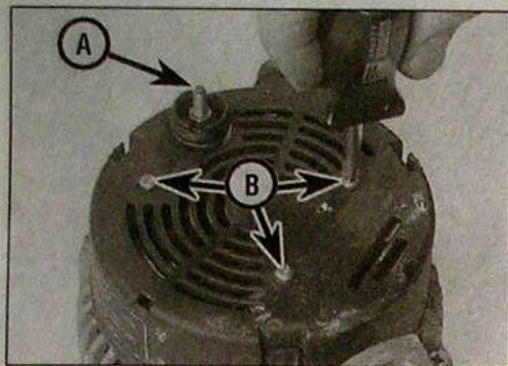
7 Clean the commutator with a solvent-moistened cloth, then check for signs of scoring, burning, excessive wear or severe pitting. If worn or damaged, the commutator should be attended to by an auto-electrician.



9.3a On Magneti Marelli starter motors with a one-piece end cover, undo the cover retaining nuts (A) and brush holder screws ...



9.3b ... then remove the end cover



6.2a Unscrew the terminal nut (A), then undo the three retaining screws (B) . . .

adjuster strap. On 2.0 litre models with ABS, in order to gain the clearance required to remove the alternator, it may be necessary to drain the cooling system (see Chapter 1) and remove the radiator top hose. Additional clearance can also be gained by unbolting the ABS wiring connector and air conditioning pipe support brackets.

Refitting

5 Refitting is a reversal of removal, tensioning the auxiliary drivebelt as described in Chapter 1, and ensuring that the alternator mountings are securely tightened.

6 Alternator brushes and regulator - inspection and renewal

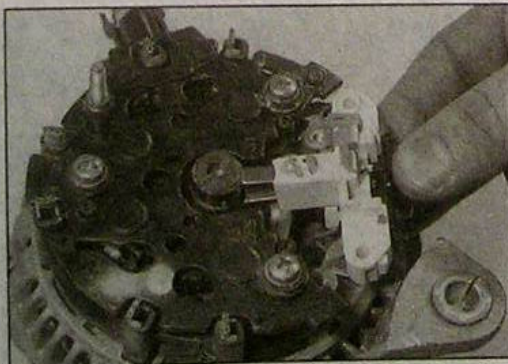
1 Remove the alternator as described in Section 5. Proceed as described below the relevant sub-heading.



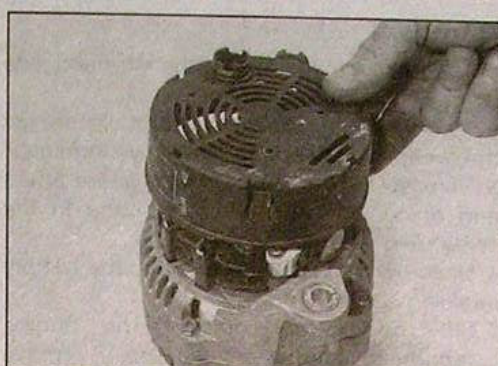
Consult your dealer or an auto electrician on the cost and availability of spare parts before stripping the alternator, as some parts for certain alternators may either be unavailable or more expensive than an exchange unit.

Bosch alternator

2 Unscrew the retaining screws and terminal nut (where necessary), and unclip the cover from the rear of the alternator (see illustrations).



6.3b . . . and remove the regulator/brush holder assembly



6.2b . . . and remove the rear cover from the alternator

3 If necessary, scrape the sealing compound from the rear of the alternator, to expose the regulator/brush holder assembly retaining screws. Slacken and remove the retaining screws, and remove the regulator/brush holder from the rear of the alternator (see illustrations).

4 Note the length of each brush. If either brush is worn down to, or close to, its wear marking (in the form of a line on the brush), the complete regulator/brush holder assembly must be renewed (see illustration). It is not possible to renew the brushes separately.

5 If the brushes are still serviceable, clean them with a petrol-moistened cloth. Check that the brush spring tension is equal for both brushes, and that it provides a reasonable pressure. The brushes must move freely in their holders.

6 Clean the alternator slip-rings with a petrol-moistened cloth. Check for signs of scoring, burning or severe pitting on the surface of the slip-rings (see illustration). It may be possible to have the slip-rings renovated by an electrical specialist.

7 Refit the regulator/brush holder assembly, and securely tighten its retaining screws.

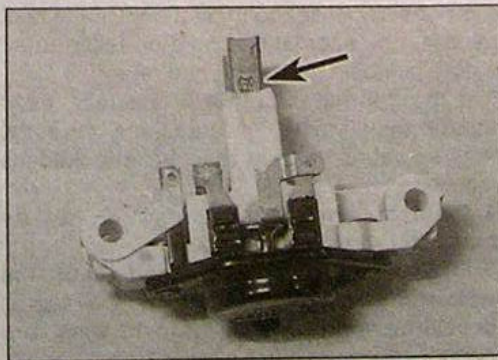
8 Clip the rear cover onto the alternator, and refit the alternator as described in Section 5.

Magneti Marelli alternator

9 Refer to the information given above in paragraphs 3 to 7.

Mitsubishi alternator

10 Make alignment marks between the stator coil and the front and rear covers.



6.4 Brush wear markings are in the form of a line (arrowed) on each brush



6.3a Undo the two screws . . .

11 Undo the four screws securing the front cover to the rear cover.

12 Carefully prise the stator coil away from the front cover, and remove the rear cover and stator assembly from the alternator. If difficulty is encountered, heat the rear cover bearing box for a few minutes with a large soldering iron - this will expand the cover, and help to release it from the rotor.



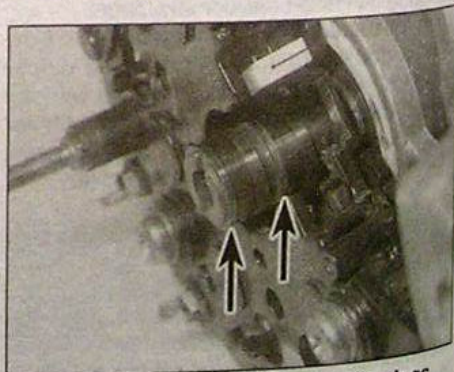
Warning: Do attempt to heat the cover with any other source of heat, such as a welding torch or heat gun, as the diode assembly will almost certainly be damaged.

13 Note the length of each brush. If either brush is worn down to, or close to, its wear marking (in the form of a line on the brush), both brushes and their springs should be renewed.

14 If the brushes are still serviceable, clean them with a petrol-moistened cloth. Check that the brush spring tension is equal for both brushes, and that it provides a reasonable pressure. The brushes must move freely in their holders.

15 Clean the alternator slip-rings with a petrol-moistened cloth. Check for signs of scoring, burning or severe pitting on the surface of the slip-rings. It may be possible to have the slip-rings renovated by an electrical specialist.

16 To remove the regulator/brush holder assembly, unsolder the wires, noting their correct fitted positions, whilst using a pair of pointed-nose pliers as a heat sink. **Note:** Work quickly to ensure excess heat is not



6.6 Examine the alternator slip-rings (arrowed) for sign of wear or damage

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). Information on the ignition system is covered in Part B of this Chapter.

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

The battery is of the low-maintenance or 'maintenance-free' (sealed for life) type, and is charged by the alternator, which is belt-driven from the crankshaft pulley.

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.

Precautions

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.

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!* at the beginning of this manual, 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, ECCS control unit (where applicable), or any other components having semi-conductor circuitry, could be irreparably damaged.

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 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.

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

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

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

Several systems fitted to the vehicle require battery power to be available at all times, either to ensure their continued operation (such as the clock) or to maintain security codes which would be wiped if the battery were to be disconnected. To ensure that there are no unforeseen consequences of this action, Refer to *Disconnecting the battery* in the Reference Section of this manual for further information.

2 Battery - checking, testing and charging

Standard and low-maintenance battery - checking

1 In addition to the checks described in *Weekly checks* at the start of this manual, the battery electrolyte level should also be periodically checked as follows.

Batteries with a translucent casing

2 On this type of battery, the electrolyte level is visible through the casing. Make sure that the level in each cell is between the UPPER and LOWER level marks on the side of the battery casing.

3 If topping-up is necessary, remove the cell cap(s) and top-up the relevant cell to the UPPER level marking using only distilled water. **Note:** Do not use ordinary tap water, as this will damage the battery. Refit the cell cap(s), ensuring each one is securely fitted, and mop up any spilt water.

Batteries with a solid (non-translucent) casing

4 On batteries where it is not possible to see the electrolyte level through the casing, the level is checked via the cell filler cap apertures. Remove the cap from each battery cell and, looking down through cap apertures, check that the electrolyte level is up to the base of the aperture neck.

5 If topping-up is necessary, top-up the relevant cell to the base of the neck using only distilled water. **Note:** Do not use ordinary tap water, as this will damage the battery. Refit the cell cap(s), ensuring each one is securely fitted, and mop up any spilt water.

Standard and low-maintenance battery - testing

6 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. However, for convenience, the temperatures quoted in the following table are **ambient** (outdoor air) temperatures, above or below 25°C (77°F):

	Above 25°C (77°F)	Below 25°C (77°F)
Fully-charged	1.210 to 1.230	1.270 to 1.290
70% charged	1.170 to 1.190	1.230 to 1.250
Fully-discharged	1.050 to 1.070	1.110 to 1.130

7 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.

8 If the specific gravity variation is 0.040 or more, a new battery should be fitted. 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

9 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 tested using a battery condition indicator or a voltmeter.

10 One type of maintenance-free battery which may be fitted is the 'Delco' type 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/yellow.

11 If testing the battery using a voltmeter, and connect the voltmeter across the battery, and compare the result with those given in the Specifications under 'charge condition'. 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.