






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

Battery

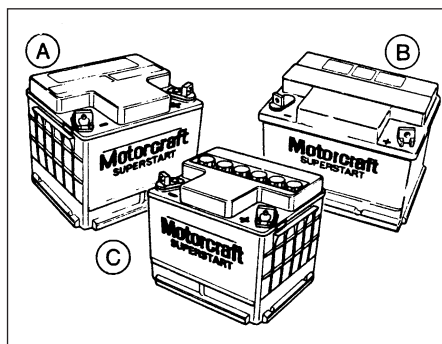
Type	12 volt lead-acid, 35 to 52 Ah depending on model
Charge condition:	
Poor	12.4 volts or less
Normal	12.6 volts
Good	12.7 volts or over

Alternator

Minimum brush length:	
Bosch, Lucas and Mitsubishi	5.0 mm
Motorola	4.0 mm
Regulator voltage at 4000 rpm with 3 to 7A load (all models)	13.7 to 14.6 volts

Starter motor

Type	Pre-engaged
Make:	
Bosch	0.8 kW, 0.85 kW, 0.9 kW, 0.95 kW
Lucas	8M 90, 9M 90, M 79
Nippondenso	0.6 kW, 0.9 kW
Minimum brush length:	
Bosch	10.0 mm
Lucas	8.0 mm
Nippondenso 0.6 kW	10.0 mm
Nippondenso 0.9 kW	9.0 mm



1.3 Battery types

- A Maintenance-free sealed cell type
 B Maintenance-free removable cell top type
 C Low maintenance type

1 General information and precautions

General information

The engine electrical system includes all charging, starting and ignition system components and the engine oil pressure sensor. 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 of this Chapter for information on the ignition system.

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

The battery is of the low maintenance or maintenance-free type and is charged by the alternator, which is belt-driven from a crankshaft-mounted pulley (see illustration).

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

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 items 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 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, or any other having semi-conductor, 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*. This also applies when connecting a battery charger.

Never disconnect the battery terminals, or alternator multi-plug connector, when the engine is running.

The battery leads and alternator multi-plug must be disconnected before carrying out any electric welding on the car.

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

2 Electrical fault finding - general information

Refer to Chapter 12.

3 Battery - testing and charging

Note: Refer to the precautions at the end of Section 1 before proceeding.

Standard and low maintenance battery - testing

1 If the car 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.

Ambient temperature:

	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

Note that the specific gravity readings assume an electrolyte temperature of 15°C (60°F); for every 10°C (50°F) below 15°C (60°F) subtract 0.007. For every 10°C (50°F) above 15°C (60°F) add 0.007.

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 type can therefore only be tested using a battery condition indicator or a voltmeter.

5 If testing the battery using a voltmeter, connect it 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 subject 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 components must be switched off, so check that the doors and tailgate are fully shut when making the test.

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

7 If the battery is to be charged, remove it from the vehicle (Section 4) and charge it as described later in this Section.

Standard and low maintenance battery - charging

8 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.

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

10 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.

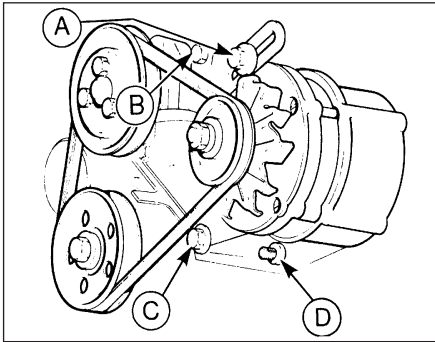
11 While charging the battery note that the temperature of the electrolyte should never exceed 37.8°C (100°F).

Maintenance-free battery - charging

12 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.

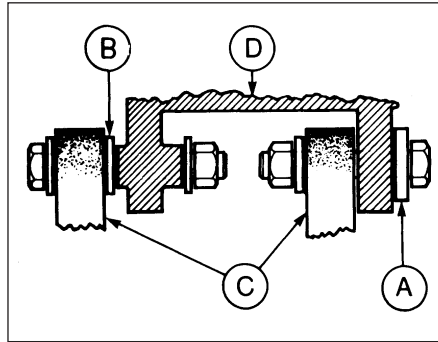
13 A constant voltage type charger is required, set to 13.9 to 14.9 volts with a charger current below 25 amps. Using this method the battery should be usable within three hours, giving a voltage reading of 12.5 volts, but this is for a partially discharged battery and, as mentioned, full charging can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

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



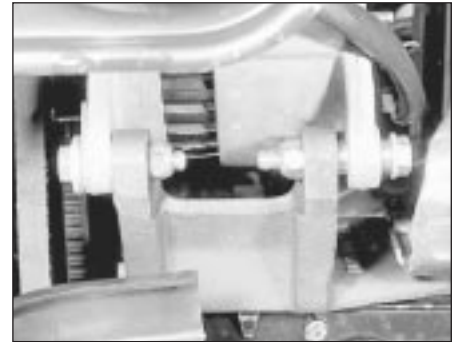
5.4 Alternator mounting and adjuster link bolts

- A Adjuster link-to-alternator bolt
B Adjuster link-to-engine bolt
C and D Alternator mounting bolts



5.6a Correct fitting of alternator mounting components - early models

- A Large washer
B Small washer (pre-1985 CVH engines only)
C Mounting bracket
D Alternator



5.6b Alternator mounting bolt arrangement - later models

4 Battery - removal and refitting

Note: Refer to the precautions at the end of Section 1 before proceeding.

Removal

- 1 The battery is located on the left-hand side of the engine compartment on a bulkhead platform.
- 2 Disconnect the leads at the negative (earth) terminal by undoing the retaining nut and removing the bolt. Disconnect the positive terminal leads in the same way.
- 3 Undo the bolts securing the two battery clamps and remove the clamps.
- 4 Lift the battery from its location, keeping it in an upright position to avoid spilling electrolyte on the paintwork.

Refitting

- 5 Refitting is the reverse sequence to removal. Smear petroleum jelly on the terminals when refitting and always connect the positive lead first and the negative lead last.

5 Alternator - removal and refitting

Note: Refer to the precautions at the end of Section 1 before proceeding.

Removal

- 1 The operations are similar for all makes of alternator.
- 2 Disconnect the battery negative terminal, then disconnect the multiplug or leads from the rear of the alternator.
- 3 On certain CVH engine models it may be necessary to remove the air cleaner hose, and disconnect the radiator bottom hose to give sufficient clearance to enable removal of the alternator, in which case the cooling system must be drained with reference to Chapter 1.
- 4 Release the mounting and adjuster link bolts, push the alternator in towards the engine and remove the drivebelt (see

illustration). It may be necessary to remove the adjuster link-to-alternator bolt to facilitate removal of the drivebelt.

- 5 Undo and remove the mounting nuts and bolts and adjuster link bolt, if not already removed, and withdraw the alternator from the engine.

Refitting

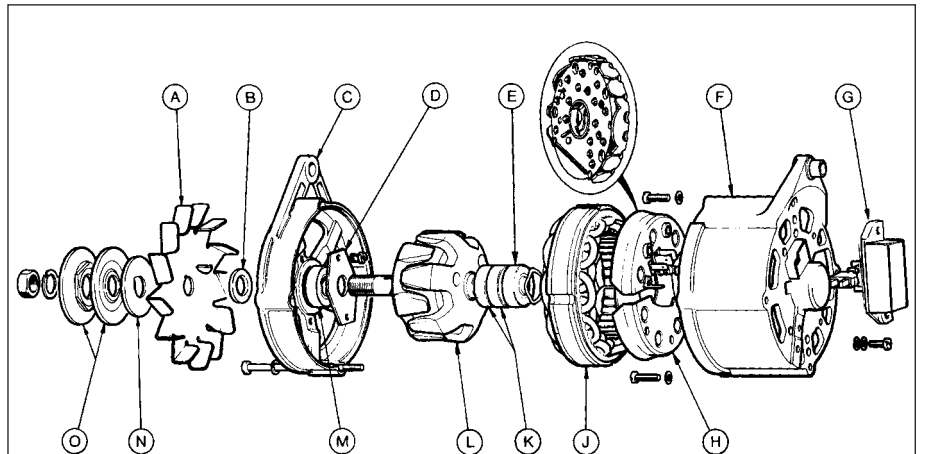
- 6 Refitting is the reverse sequence to removal, bearing in mind the following points.

- a) Ensure that the mounting bolts and washers are assembled as shown (see illustrations).
- b) Adjust the drivebelt tension as described in Chapter 1.
- c) On completion, where applicable, refill the cooling system as described in Chapter 1.

6 Alternator brushes and regulator - renewal

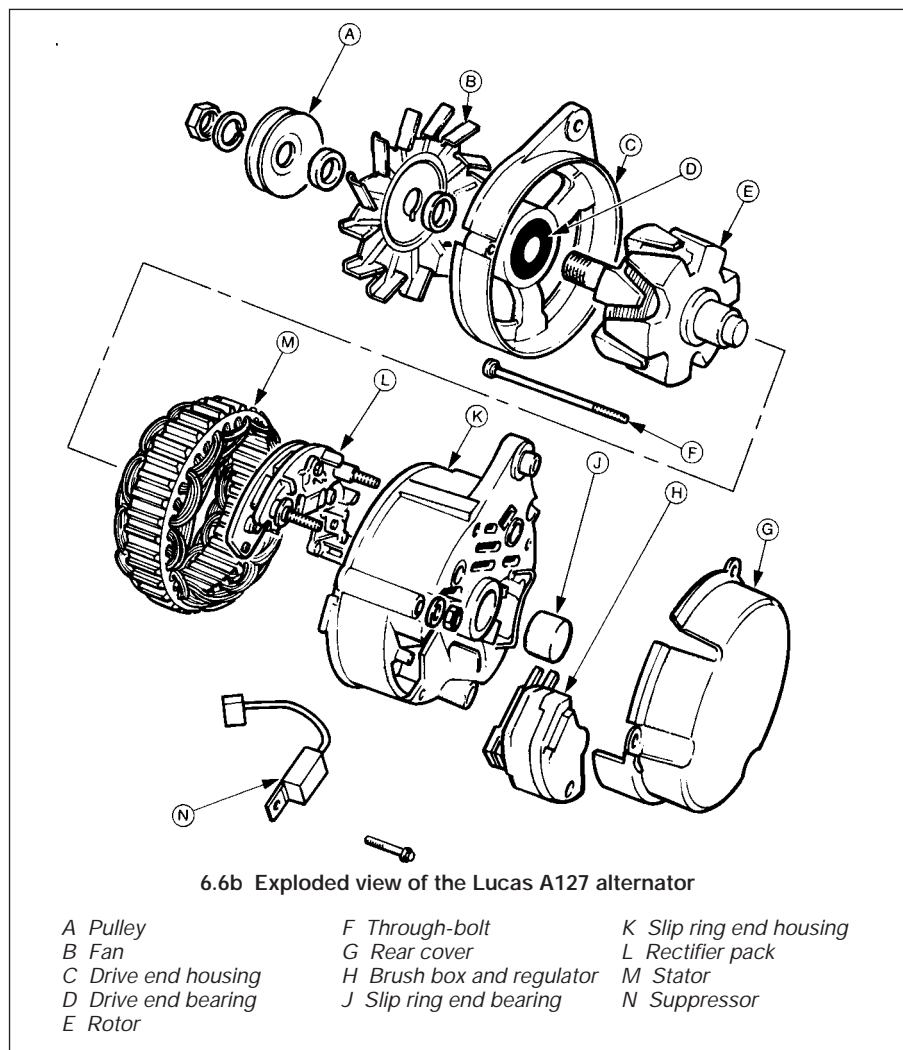
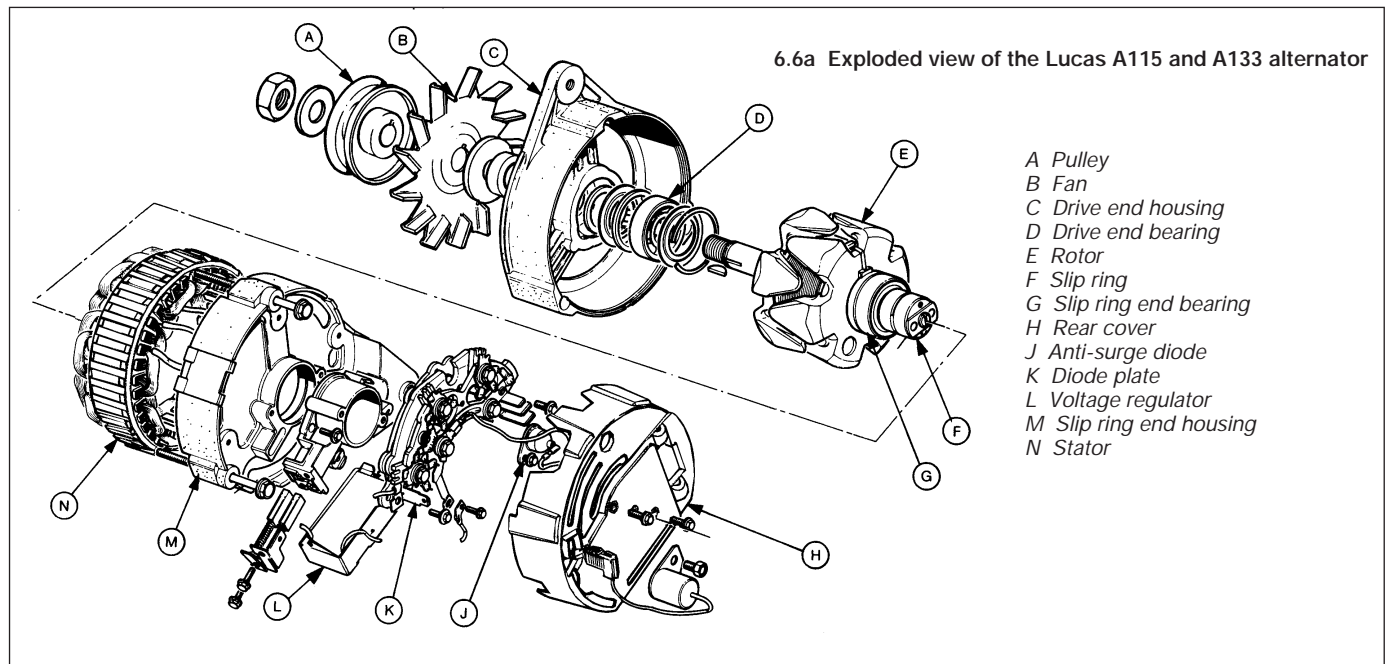
Bosch alternator

- 1 With the alternator removed from the engine, clean the external surfaces free from dirt.
- 2 Extract the brush box/regulator screws from the rear cover and withdraw the brush box/regulator (see illustration). Check the brush length and, if less than the specified minimum, renew them.
- 3 Unsolder the brush wiring connectors and remove the brushes and the springs.
- 4 Refit by reversing the removal operations.



6.2 Exploded view of the Bosch G1 and K1 series alternators

- | | |
|-------------------------------------|------------------------|
| A Fan | H Rectifier diode pack |
| B Spacer | J Stator |
| C Drive end housing | K Slip rings |
| D Drive end bearing retaining plate | L Rotor |
| E Slip ring end bearing | M Drive end bearing |
| F Slip ring end housing | N Spacer |
| G Brush box/regulator | O Pulley |



Lucas alternator

- 5 Proceed as described in paragraph 1.
- 6 Remove the alternator rear cover (see illustrations).
- 7 Extract the brush box retaining screws and withdraw the brush assemblies from the brush box.
- 8 If the length of the brushes is less than the specified minimum, renew them. Refit by reversing the removal operations.
- 9 To remove the regulator, disconnect the wires from the unit and unscrew the retaining screw (A115 and A133 units only - three screws on A127 type).
- 10 Refit by reversing the removal operations, but check that the small plastic spacer and the connecting link are correctly located.

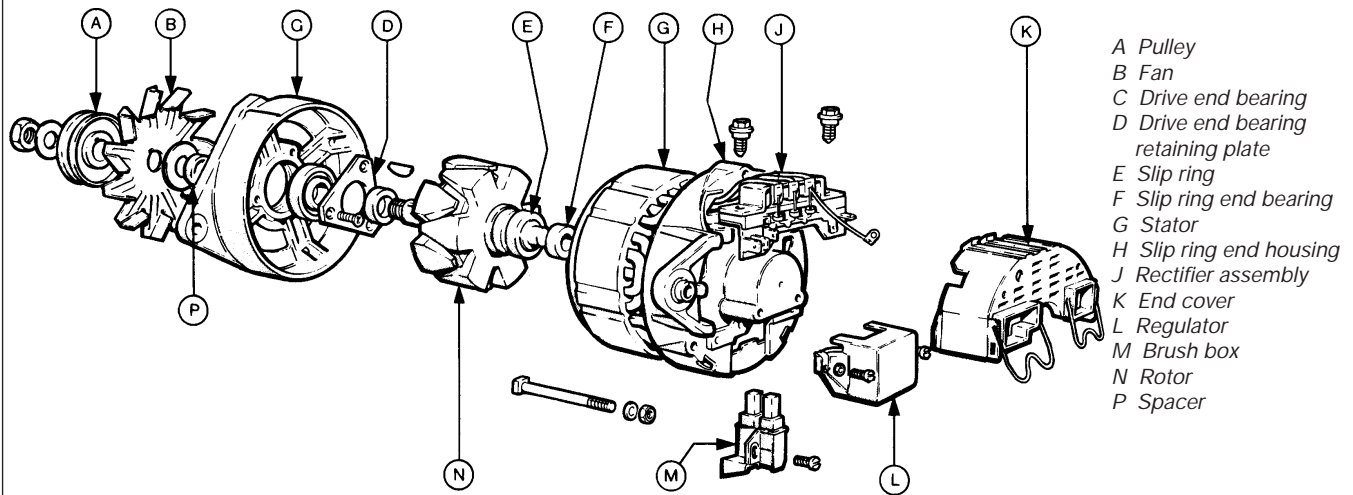
Motorola alternator

- 11 Proceed as described in paragraph 1.
- 12 Extract the two regulator securing screws, disconnect the two regulator leads and withdraw the unit (see illustration).
- 13 Extract the brush box retaining screw and pull and tilt the brush box from its location, taking care not to damage the brushes during the process.
- 14 If necessary, unsolder the brush connections.
- 15 Fit the new brushes by reversing the removal operations.

Mitsubishi alternator

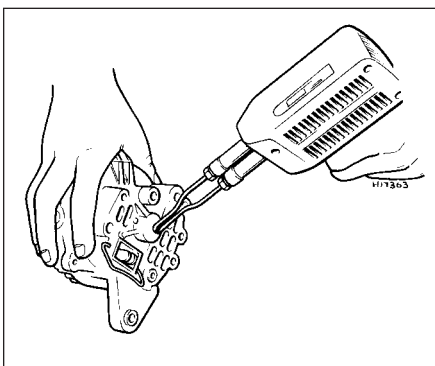
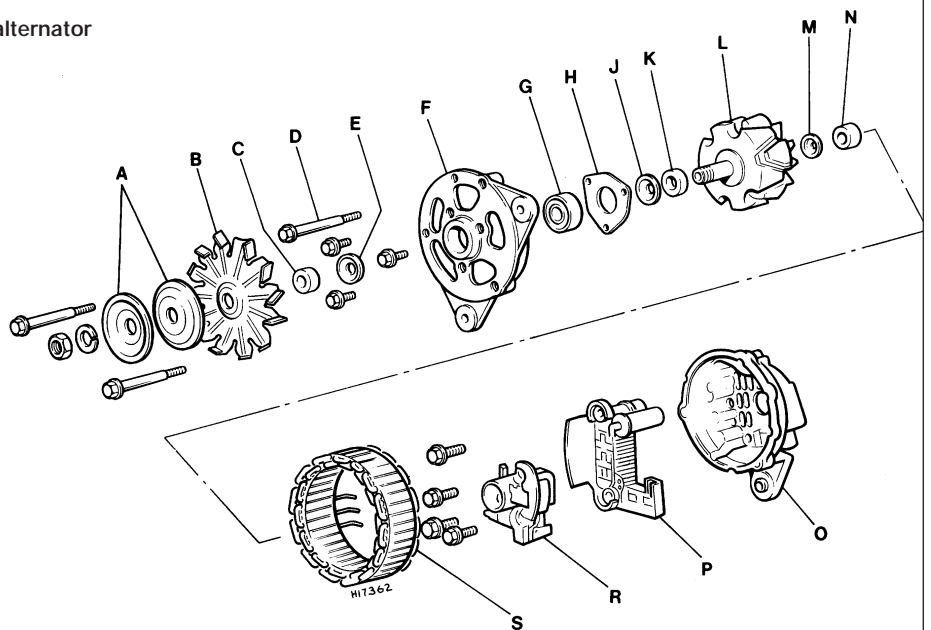
- 16 Proceed as described in paragraph 1.
- 17 Undo the three housing through-bolts and remove the slip ring end housing. It may be necessary to apply heat from a high-power (200 watt) soldering iron to the centre of the end housing for a few minutes if the housing refuses to free from the rotor (see illustrations).

6.12 Exploded view of the Motorola alternator

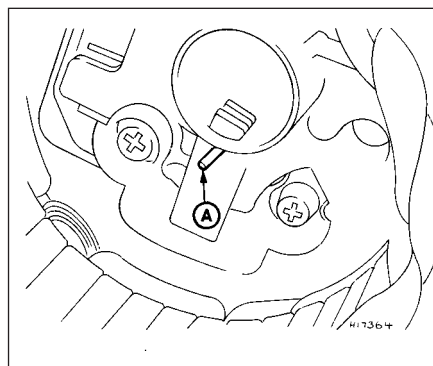


6.17a Exploded view of the Mitsubishi alternator

- A Pulley
B Fan
C Large spacer
D Through-bolt
E Dust cap
F Drive end housing
G Drive end bearing
H Bearing retainer
J Dust seal
K Small spacer
L Rotor
M Seal
N Bearing
O Slip ring end housing
P Rectifier assembly
R Brush box
S Stator



6.17b Using a soldering iron to heat the slip ring end housing - Mitsubishi alternator



6.21 Using a length of wire (A) to hold brushes in the retracted position - Mitsubishi alternator

18 Undo the four bolts and remove the stator and rectifier assembly from the slip ring end housing.

19 Unsolder the brush box-to-rectifier assembly terminal and remove the brush box.

20 Renew the brush box and brushes if they are worn below the specified minimum.

21 Fit the new brushes by reversing the removal operations.

HAYNES
HINT Insert a suitable piece of wire through the access hole in the housing to keep the brushes retracted as the housing is fitted (see illustration). After fitting the housing release the brushes by removing the wire.

7 Starter motor - testing in the car



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

1 If the starter motor fails to operate when the ignition key is turned to the appropriate position, the possible causes are as follows.

- 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 headlamps. If they dim after a few seconds, this indicates that the battery is discharged - recharge (see Section 3) or renew the battery. If the headlamps glow brightly, operate the starter switch and observe the lamps. If they dim, then this indicates that current is reaching the starter motor, therefore the fault must lie in the starter motor. If the lamps 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 the following paragraphs. If the starter motor turns slowly when operated, but the battery is in good condition, then this indicates either that 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, the starter/solenoid wiring and the engine/transmission earth strap(s). Thoroughly clean the connections, and reconnect the leads and wiring. Use a voltmeter or test lamp to check that full battery voltage is available at the battery positive lead connection to the solenoid. Smear petroleum jelly around the battery terminals to prevent corrosion - corroded connections are among 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 lamp 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, there is a fault in the ignition/starter switch or wiring.

5 The solenoid contacts can be checked by connecting a voltmeter or test lamp 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. The starter motor can be checked by a Ford dealer or an automotive electrical specialist. A specialist may be able to overhaul the unit at a cost significantly less than that of a new or exchange starter motor.

8 Starter motor - removal and refitting



Removal

- Disconnect the battery.
- Working from under the vehicle, disconnect the main starter motor cable and the two wires from the starter solenoid (see illustration).
- Unbolt the starter motor and withdraw it from its location.

Refitting

- Refit by reversing the removal operations.

9 Starter motor brushes - renewal



1 Starter motor brush renewal is a relatively difficult procedure, requiring skill in the use of a soldering iron. It should also be borne in mind that if the starter motor has been in service long enough to wear the brushes out, the rest of the unit is likely to be well worn also. In such a case the best course is to obtain a new or reconditioned starter motor.

2 For further advice on brush renewal and on starter motor overhaul in general, consult an auto electrical specialist.

10 Ignition switch - removal and refitting



Pre-1986 models

Removal

- Disconnect the battery, undo the screws and remove the steering column lower shroud.
- Insert the ignition key into the lock and turn it to position I.
- Using a flat-bladed screwdriver, depress the switch retaining clip, at the same time pulling out the switch using the ignition key (see illustration).

Refitting

- Refitting is a reversal of removal, ensuring that the ignition key is in position I.

1986 models onwards

Removal

- Disconnect the battery, undo the screws and remove the steering column lower shroud.



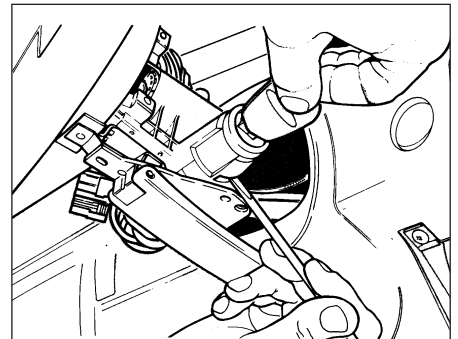
8.2 Disconnecting the wiring from the starter motor solenoid

6 Insert the ignition key into the switch and turn it to position I.

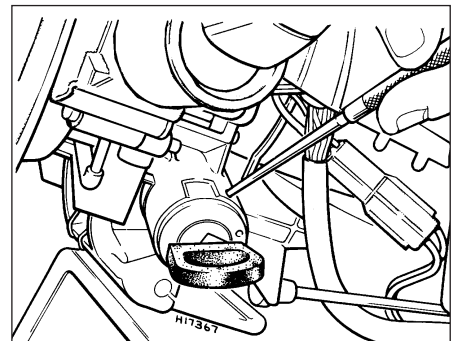
7 Using a thin pointed tool, depress the lock spring through the access hole in the lock housing (see illustration). Pull on the key while holding the lock spring depressed, and remove the switch. It may be necessary to move the key slightly to the left and right to align the key barrel and lock housing cam, so permitting removal.

Refitting

8 Refitting is a reversal of removal, ensuring that the ignition key is in position I.



10.3 Ignition switch removal using a screwdriver to depress the switch retaining clip - pre-1986 models



10.7 Ignition switch removal using a pointed tool to depress the lock spring - 1986 models onwards