

# Chapter 5

## Engine electrical systems

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### Degrees of difficulty

|   |  |   |   |   |   |   |  |   |   |
|---|--|---|---|---|---|---|--|---|---|
|  | <b>Easy</b> , suitable for novice with little experience |  | <b>Fairly easy</b> , suitable for beginner with some experience |  | <b>Fairly difficult</b> , suitable for competent DIY mechanic |  | <b>Difficult</b> , suitable for experienced DIY mechanic |  | <b>Very difficult</b> , suitable for expert DIY or professional |
|---|--|---|---|---|---|---|--|---|---|

### Specifications

#### Ignition system

|  |                   |
|--|-------------------|
| Ignition timing (all models) . . . . . | Not adjustable    |
| Ignition coil resistance (at 68°F):    |                   |
| Primary resistance . . . . .           | 0.4 to 0.5 ohms   |
| Secondary resistance . . . . .         | 6.0 to 6.5 k-ohms |

#### Charging system

|                            |                    |
|----------------------------|--------------------|
| Charging voltage . . . . . | 13.9 to 15.1 volts |
| Standard amperage:         |                    |
| No load . . . . .          | Less than 10 amps  |
| Full load . . . . .        | 30 amps or more    |

#### 1 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 chassis electrical devices such as the fuses, relays, lights, etc. (which are included in Chapter 12).

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

- Be extremely careful when servicing engine electrical components. They are easily damaged if checked, connected or handled improperly.
- Never leave the ignition switch on for long periods of time (10 minutes maximum) with the engine off.

- Don't disconnect the battery cables while the engine is running.
- Maintain correct polarity when connecting a battery cable from another vehicle during jump starting.
- Always disconnect the negative cable first and hook it up last or the battery may be shorted by the tool being used to loosen the cable clamps.

It's also a good idea to review the safety-related information regarding the engine electrical systems in the *Safety first* section near the front of this manual before beginning any operation included in this Chapter.

#### 2 Battery - emergency jump starting

See "Jump starting" in "Roadside repairs" at the front of this Manual.

#### 3 Battery - removal and refitting

1 Disconnect the negative terminal, then the positive terminal from the battery. On 1989 to 1992 models, the battery is located in the engine compartment on the passenger side bulkhead and on 1993 and 1994 models, it is located in the boot.

**Caution:** If the stereo in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery.

- Remove the battery hold-down clamp.
- Lift out the battery. Be careful, it's heavy.
- While the battery is out, inspect the carrier (tray) for corrosion.
- If you are replacing the battery, make sure that you get one that's identical, with the

## 5•2 Engine electrical systems

same dimensions, amperage rating, cold cranking rating, etc. as the original.

6 Refitting is the reverse of removal.

### 4 Battery cables - check and renewal



**Caution:** If the stereo in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery.

1 Periodically inspect the entire length of each battery cable for damage, cracked or burned insulation and corrosion. Poor battery cable connections can cause starting problems and decreased engine performance.

2 Check the cable-to-terminal connections at the ends of the cables for cracks, loose wire strands and corrosion. The presence of white, fluffy deposits under the insulation at the cable terminal connection is a sign that the cable is corroded and should be renewed. Check the terminals for distortion, missing mounting bolts and corrosion.

3 When removing the cables, always disconnect the negative cable first and hook it up last or the battery may be shorted by the tool used to loosen the cable clamps. Even if only the positive cable is being renewed, be sure to disconnect the negative cable from the battery first (see Chapter 1 for further information regarding battery cable removal).

4 Disconnect the cables from the battery, then trace each of them to their opposite ends and detach them from the starter solenoid and earth terminals. Note the routing of each cable to ensure correct refitting.

5 If you are replacing either or both of the old cables, take them with you when buying new items. It is vitally important that you replace the cables with identical parts. Cables have characteristics that make them easy to identify: positive cables are usually red, larger in cross-section and have a larger diameter battery post clamp; earth cables are usually black, smaller in cross-section and have a slightly smaller diameter clamp for the negative post.

6 Clean the threads of the solenoid or earth connection with a wire brush to remove rust and corrosion. Apply a light coat of battery terminal corrosion inhibitor, or petroleum jelly, to the threads to prevent future corrosion.

7 Attach the cable to the solenoid or earth connection and tighten the mounting nut/bolt securely.

8 Before connecting a new cable to the battery, make sure that it reaches the battery post without having to be stretched.

9 Connect the positive cable first, followed by the negative cable.

### 5 Ignition system - general information and precautions

1 All models are equipped with a computerised ignition system. The ignition system consists of the ignition coil, the crankshaft position sensor, the amplifier and the electronic control unit (ECU). The ignition ECU controls the ignition timing and advance characteristics for the engine. The ignition timing is not adjustable, therefore, changing the position of the distributor will not change the timing in any way. **Note:** In the event the distributor must be removed from the engine, be sure to follow the precautions described in Section 9 and mark the engine and distributor with paint to ensure correct refitting. If the distributor is not marked and the crankshaft is turned while the distributor is out of the engine, have the distributor installed by a dealer service department. The distributor must be installed using a special alignment tool.

2 The distributor is driven by the intermediate shaft which also drives the power steering pump. The crankshaft position sensor is located on the front timing cover. It detects crank position by pulsing an electronic signal to the ECU. This signal is sent to the ECU to provide ignition timing specifications.

3 The computerised ignition system provides complete control of the ignition timing by determining the optimum timing in response to engine speed, coolant temperature, throttle position and vacuum pressure in the intake manifold. These parameters are relayed to the ECU by the crankshaft position sensor, throttle potentiometer, coolant temperature sensor and MAF sensor. Ignition timing is altered during warm-up, idling and warm running conditions by the ECU. This electronic ignition system also consists of the ignition switch, battery, coil, distributor, spark plug leads and spark plugs.

4 Refer to a dealer parts department or car accessory outlet for any questions concerning the availability of the distributor parts and assemblies. Testing the crankshaft position sensor is covered in Chapter 6.

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

- a) Do not keep the ignition switch on for more than 10 seconds if the engine will not start.
- b) Always connect a tachometer in accordance with the manufacturer's instructions. Some tachometers may be incompatible with this ignition system. Consult a dealer service department before buying a tachometer for use with this vehicle.
- c) Never allow the ignition coil terminals to touch earth. Earthing the coil could result in damage to the igniter and/or the ignition coil.
- d) Do not disconnect the battery when the engine is running.

### 6 Ignition system - check



**Warning:** Because of the high voltage generated by the ignition system, extreme care should be taken when working on the ignition components. This not only includes the amplifier, coil, distributor and spark plug leads, but related components such as connectors, tachometer and other test equipment also.

1 With the ignition switch turned to the "ON" position, a "Battery" light or an "Oil Pressure" light is a basic check for ignition and battery supply to the ECU.

2 Check all ignition wiring connections for tightness, cuts, corrosion or any other signs of a bad connection.

3 Use a calibrated ignition tester to verify adequate secondary voltage (25,000 volts) at each spark plug (see illustration). A faulty or poor connection at that plug could also result in a misfire. Also, check for carbon deposits inside the spark plug boot.

4 Check for carbon tracking on the coil. If carbon tracking is evident, renew the coil and be sure the secondary wires related to that coil are clean and tight. Excessive wire resistance or faulty connections could damage the coil.

5 Check for battery voltage to the ignition coil (see illustration). If battery voltage is available, check the ignition coil primary and secondary resistance (see Section 8).

6 Check the distributor cap for any obvious signs of carbon tracking, corroded terminals or cracks (see Chapter 1).

7 Using an ohmmeter, check the resistance of the spark plug leads. Each wire should measure less than 25,000 ohms.

8 Check for battery voltage to the ignition amplifier (see Section 7). If battery voltage does not exist, check the circuit from the ignition switch (refer to the wiring diagrams at the end of Chapter 12).



6.3 To use a calibrated ignition tester (available at most car accessory outlets), remove a plug lead from a cylinder, connect the spark plug boot to the tester and clip the tester to a good earth - if there is enough voltage to fire the plug, sparks will be clearly visible between the electrode tip and the tester body



6.5 Check for battery voltage to the coil (+) terminal



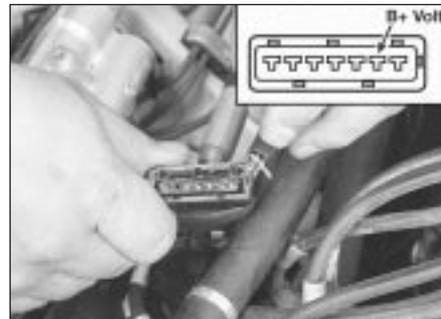
6.9 Check for battery voltage to the IGN ON relay



6.11 Refit the LED test light to the coil negative (-) terminal, crank the engine over and observe the light flash in response to the trigger signal from the computer



7.1 Remove the clip that retains the harness connector to the amplifier



7.2 Check for battery voltage to the ignition amplifier

9 Check for battery voltage to the Ignition ON relay (see illustration). If battery voltage does not exist, check the circuit from the ignition ON relay to the battery (refer to the wiring diagrams at the end of Chapter 12). **Note:** See Chapter 12 for the location of the Ignition ON relay.

10 Check the operation of the crankshaft position sensor (see Chapter 6).

11 If all the checks are correct, check the voltage signal from the computer. Using an LED type test light, backprobe the coil power lead (negative terminal) on the ignition coil (see illustration). Remove the coil secondary wire and earth the terminal to the engine. Now have an assistant crank the engine over and observe that the test light pulses on and off. If there is no flashing from the test light, most likely the computer is damaged. Have the ECU diagnosed by a dealer service department.

12 Additional checks should be performed by a dealer service department or an automotive repair workshop.

**components. This not only includes the amplifier, coil, distributor and spark plug leads, but related components such as connectors, tachometer and other test equipment also.**

**Note:** Because of the complexity and the special tools required to test the amplifier, the following procedure only describes a test to verify battery voltage is reaching the amplifier. If the wiring harness and the relays are working properly and battery voltage is available to the amplifier, have the ignition system and the ECU diagnosed by a dealer service department.

### Check

1 Disconnect the amplifier electrical connector (see illustration).

2 Turn the ignition key ON (engine not running), check for battery voltage (see illustration) to the amplifier.

3 If no battery voltage is present, check the harness from the ignition switch to the amplifier. Refer to the wiring diagrams at the end of Chapter 12.

### Renewal

4 Disconnect the negative battery terminal.

**Caution:** If the stereo in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery.

5 Remove the amplifier mounting bolts (see illustration).

6 Refitting is the reverse of removal.

## 8 Ignition coil - check and renewal



### Check

1 Detach the cable from the negative terminal of the battery.

**Caution:** If the stereo in your vehicle is equipped with an anti-theft system, make



7.5 Remove the amplifier mountings screws (arrowed) and lift the unit from the engine compartment

## 7 Amplifier - check and renewal



**Warning:** Because of the high voltage generated by the ignition system, extreme care should be taken whenever an operation is performed involving ignition



8.3a To check the primary resistance of the coil, measure the resistance between the positive and the negative terminals



8.3b To check the secondary resistance of the coil, measure the resistance between the positive terminal and the HT terminal



8.7 Remove the nuts from the coil mounting bracket (arrowed)

**sure you have the correct activation code before disconnecting the battery.**

2 Disconnect the electrical connectors and the coil wire from the coil.

3 Using an ohmmeter, check the coil resistance:

a) Measure the resistance between the positive and negative terminals (see illustration). Compare your reading with the specified coil primary resistance listed in this Chapter's Specifications.

b) Measure the resistance between the positive terminal and the high tension (HT) terminal (see illustration). Compare your reading with the specified coil secondary resistance listed in this Chapter's Specifications.

4 If either of the above tests yield resistance values outside the specified amount, renew the coil.

### Renewal

5 Detach the battery negative cable.

**Caution: If the stereo in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery.**

6 Label and disconnect the electrical wires from the coil terminals.

7 Remove the coil mounting fasteners (see illustration).

8 Refitting is the reverse of removal.

## 9 Distributor - removal and refitting



**Note: The timing on this ignition system cannot be adjusted by turning the distributor. Ignition timing is maintained by the ECU at all times. In the event the distributor must be removed from the engine, be sure to follow the precautions described in this section and mark the engine and distributor with paint to ensure correct refitting. If the distributor is not marked, and the crankshaft is turned while the distributor is out of the engine, have the distributor installed by a dealer service department. The distributor must be installed using a special alignment tool.**

### Removal

1 Detach the battery negative cable.

**Caution: If the stereo in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery.**

2 Disconnect the electrical connectors from the distributor.

3 Look for a raised "1" on the distributor cap. This marks the location for the number one cylinder spark plug lead terminal. If the cap does not have a mark for the number one terminal, locate the number one spark plug and trace the wire back to the terminal on the cap.

4 Remove the distributor cap (see Chapter 1) and rotate the engine until the rotor is pointing toward the number one spark plug terminal.

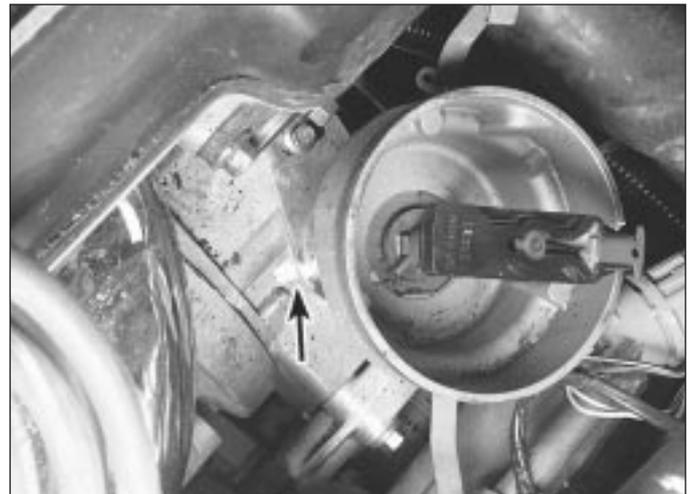
5 Make a mark on the edge of the distributor base directly below the rotor tip and in line with it. Also, mark the distributor base and the engine block to ensure that the distributor is installed correctly (see illustrations).

6 Remove the distributor hold-down bolt, then pull the distributor out to remove it.

**Caution: DO NOT turn the crankshaft while the distributor is out of the engine, or the alignment marks will be useless.**



9.5a Paint or scribe a mark (arrowed) on the edge of the distributor housing below the rotor tip to ensure that the rotor is pointing in the same direction when the distributor is reinstalled



9.5b Paint or scribe another mark across the cylinder head and the distributor body (arrowed) to ensure that the distributor is aligned correctly when it is reinstalled

### Refitting

7 Insert the distributor into the engine in exactly the same relationship to the block that it was in when removed.

8 If the distributor does not seat completely, recheck the alignment marks between the distributor base and the block to verify that the distributor is in the same position it was in before removal. Also check the rotor to see if it's aligned with the mark you made on the edge of the distributor base.

9 Refit the distributor hold-down bolt(s).

10 The remainder of refitting is the reverse of removal.

### 10 Charging system - general information and precautions

The charging system includes the alternator, an internal voltage regulator, a charge indicator light, load dump module, the battery, an ignition ON relay, an in-line fuse and the wiring between all the components (see illustration). The charging system supplies electrical power for the ignition system, the lights, the radio, etc. The alternator is driven by a drivebelt at the front of the engine.

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.

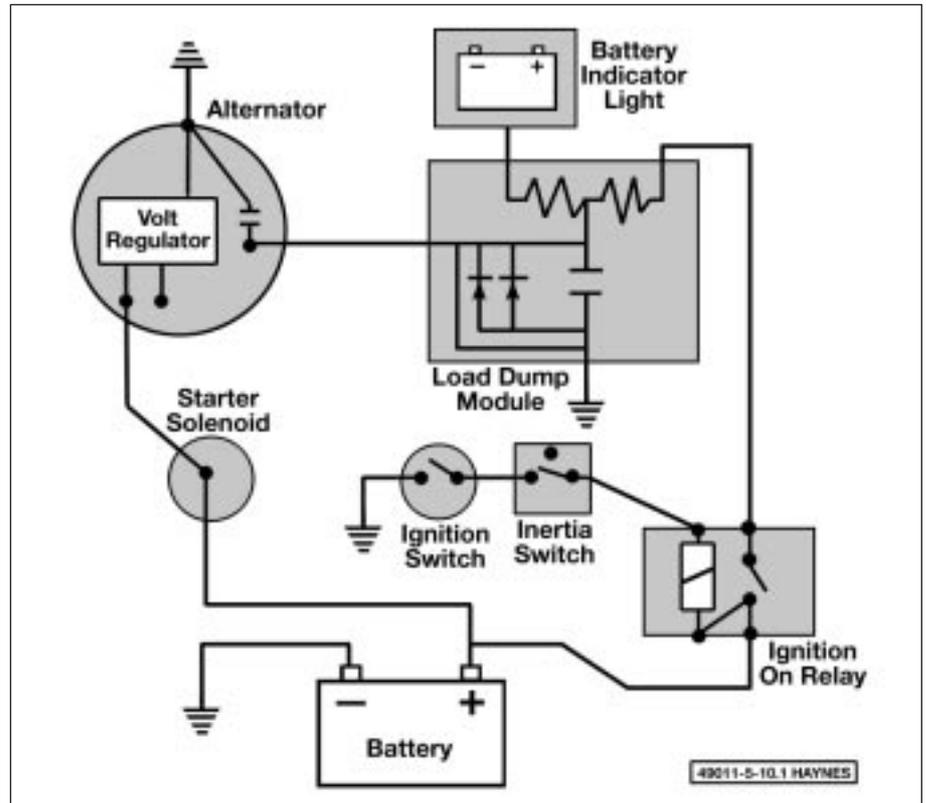
The alternator load dump module protects the electrical circuits from excessive voltage surges. When the battery cables are removed large amounts of transient voltage is released through the electrical circuits. This device diverts up to 30 load volts of excess voltage to earth by way of a voltage dependent resistor.

The in-line fuse is a special fuse installed into the circuit with the engine compartment wiring harness (see Chapter 12). The in-line fuse protects the electrical system in the event of excess voltage surges or a power to earth short circuit. Refer to Chapter 12 for additional information concerning the in-line fuses and their locations.

1993 and 1994 models have a Starter Logic Relay. This microprocessor (computer) gathers information from the ignition switch, linear gear position switch, park/neutral switch, the security switch and the electronic door lock system. If all the conditions are in order, the computer allows battery voltage to be transferred from the ignition switch to the starter/solenoid assembly.

The charging system doesn't ordinarily require periodic maintenance. However, the drivebelt, battery and wires and connections should be inspected at the intervals outlined in Chapter 1.

The dashboard warning light should come on when the ignition key is turned to Start, then should go off immediately. If it remains on, there is a malfunction in the charging system. Some vehicles are also equipped with a voltage gauge. If the voltage gauge



10.1 Schematic of a typical charging system

indicates abnormally high or low voltage, check the charging system (see Section 11).

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

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

### 11 Charging system - check



**Note:** 1993 and 1994 models are equipped with a Starter Logic Relay. This microprocessor (computer) gathers information from the

ignition switch, linear gear position switch, park/neutral switch, the security switch and the electronic door lock system. If all the conditions are in order, the computer allows battery voltage to be transferred from the ignition switch to the starter/solenoid assembly. If all the components of the charging system are working properly and the system still does not charge properly, have the Starter Logic Relay diagnosed by a dealer service department.

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:

- a) Check the drivebelt tension and its condition. Renew it if worn or damaged.
- b) Make sure the alternator mounting and adjustment bolts are tight.
- c) Inspect the alternator wiring harness and the electrical connectors at the alternator and voltage regulator. They must be in good condition and tight.
- d) Check the fusible link (if equipped) located between the starter solenoid and the alternator or the large main fuses in the engine compartment. If it's burned, determine the cause, repair the circuit and renew the link or fuse (the vehicle won't start and/or the accessories won't work if the fusible link or fuse blows).
- e) Check all the in-line fuses that are in series with the charging system circuit (see Chapter 12). The location of these fuses and fusible links may vary from year and



**11.2** Connect the probes of a voltmeter to the battery terminals and observe battery voltage with the engine OFF and then with the engine running



**11.9** The load dump module is located on the bulkhead next to the MAF sensor

model but the designations are the same. Refer to the wiring diagrams at the end of Chapter 12.

- f) Start the engine and check the alternator for abnormal noises (a shrieking or squealing sound indicates a bad bushing).
- g) Check the specific gravity of the battery electrolyte. If it's low, charge the battery (doesn't apply to maintenance free batteries).
- h) Make sure that the battery is fully charged (one bad cell in a battery can cause overcharging by the alternator).
- i) Disconnect the battery cables (negative first, then positive). **Caution:** If the stereo in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery. Inspect the battery posts and the cable clamps for corrosion. Clean them thoroughly if necessary (see Chapter 1). Reconnect the positive cable, then the negative cable.

**2** Using a voltmeter, check the battery voltage with the engine off. It should be approximately 12 volts (see illustration).

**3** Start the engine and check the battery voltage again. It should now be approximately 13.5 to 15.1 volts.

**4** Turn on the headlights. The voltage should drop and then come back up, if the charging system is working properly.

**5** If the voltage reading is greater than the specified charging voltage, renew the alternator.

**6** If you have an ammeter, connect it up to the charging system according to its maker's instructions. If you don't have a professional-type ammeter, you can also use an inductive-type current indicator. This device is inexpensive, readily available at car accessory outlets and accurate enough to perform simple amperage checks like the following test.

**7** With the engine running at 2000 rpm, check the reading on the ammeter with all accessories and lights off (no load), then again with the high-beam headlights on and the heater blower switch turned to the HI position (full load). Compare your readings to the standard amperage listed in this Chapter's Specifications.

**8** If the ammeter reading is less than standard amperage, repair or renew the alternator.

**9** If the alternator is working but the charging system still does function properly, check the operation of the load dump module (see illustration). Have this component checked at a dealer service department.

## 12 Alternator - removal and refitting



**1** Detach the cable from the negative terminal of the battery.

**Caution:** If the stereo in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery.



**12.3** Loosen the lock bolt and back-off the adjustment bolt (arrowed) to remove the drivebelt

**2** Detach the electrical connectors from the alternator.

**3** Loosen the alternator adjustment and pivot bolts (see illustration) and detach the drivebelt.

**4** Remove the adjustment and pivot bolts (see illustration) from the alternator adjustment bracket.

**5** If you are replacing the alternator, take the old alternator with you when purchasing a replacement unit. Make sure that the new/rebuilt unit is identical to the old alternator. Look at the terminals - they should be the same in number, size and locations as the terminals on the old alternator. Finally, look at the identification markings - they will be stamped in the housing or printed on a tag or plaque affixed to the housing. Make sure that these numbers are the same on both alternators.

**6** Many new/rebuilt alternators do not have a pulley installed, so you may have to switch the pulley from the old unit to the new/rebuilt one. When buying an alternator, find out the policy regarding refitting of pulleys - some shops will perform this service free of charge.

**7** Refitting is the reverse of removal.



**12.4** Remove the pivot bolt and nut

- 8 After the alternator is installed, adjust the drivebelt tension (see Chapter 1).
- 9 Check the charging voltage to verify proper operation of the alternator (see Section 11).

### 13 Starting system - general information and precautions

The sole function of the starting system is to crank the engine over quickly enough to allow it to start.

The starting system consists of the battery, the starter motor, the starter solenoid, the starter relay and the electrical circuit connecting the components. The solenoid is mounted directly on the starter motor.

The solenoid/starter motor assembly is installed on the upper part of the engine, next to the transmission bellhousing.

When the ignition key is turned to the START position, the starter solenoid is actuated through the starter control circuit. The starter 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 on a vehicle equipped with an automatic transmission can be operated only when the transmission selector lever is in Park or Neutral.

These vehicles are equipped with either a Bosch or Lucas starter assembly. The Lucas unit is distinguished by the separate earth strap from the solenoid to the starter body. Bosch starter assemblies are equipped with a solid metal earthing bar.

The starting system circuit is equipped with a relay. The relay allows the ignition switch to power the starter solenoid.

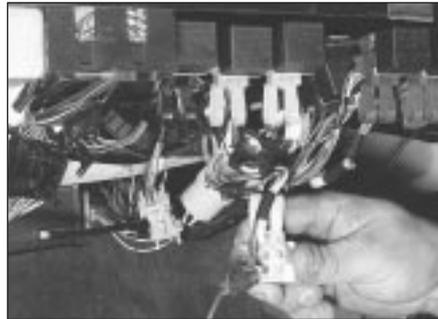
Always observe the following precautions when working on the starting system:

- 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.
- b) The starter is connected directly to the battery and could arc or cause a fire if mishandled, overloaded or short circuited.
- c) Always detach the cable from the negative terminal of the battery before working on the starting system.

**Caution:** If the stereo in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery.

### 14 Starter motor - testing in vehicle

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



14.5 With the ignition key ON (engine not running), check for battery voltage to the starter relay

2 If the starter motor does not turn at all when the switch is operated, make sure that the shift lever is in Neutral or Park (automatic transmission) or that the clutch pedal is depressed (manual transmission).

3 If the starter motor spins but the engine is not cranking, the overrunning clutch in the starter motor is slipping and the starter motor must be renewed.

4 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).

5 If the solenoid plunger cannot be heard when the switch is actuated, the battery is bad, the in-line fuse is burned (the circuit is open), the starter relay (see illustration) is defective or the starter solenoid itself is defective.

6 To check the solenoid, connect a jumper lead between the battery (+) and the ignition switch terminal (the small terminal) on the solenoid. If the starter motor now operates, the solenoid is OK and the problem is in the ignition switch, linear switch (1988 to 1992), rotary switch (1993 and 1994) or in the wiring.

7 If the starter motor still does not operate, remove the starter/solenoid assembly for dismantling, testing and repair.

8 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.

9 Run the engine until normal operating temperature is reached, then disconnect the coil wire from the distributor cap and earth it on the engine.

10 Connect a voltmeter positive lead to the battery positive post and connect the negative lead to the negative post.

11 Crank the engine and take the voltmeter readings as soon as a steady figure is indicated. Do not allow the starter motor to turn for more than 15 seconds at a time. A reading of nine volts or more, with the starter motor turning at normal cranking speed, is normal. If the reading is nine volts or more but the cranking speed is slow, the motor is faulty. If the reading is less than nine volts and the cranking speed is slow, the solenoid contacts are probably burned, the starter motor is bad, the battery is discharged or there is a bad connection.

### 15 Starter motor - removal and refitting



- 1 Detach the cable from the negative terminal of the battery.

**Caution:** If the stereo in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery.

- 2 Raise the vehicle and support it securely using axle stands.

3 Drain the transmission fluid (see Chapter 7) and remove the transmission fluid filler tube from the transmission.

4 Detach the electrical connectors from the starter/solenoid assembly (see illustrations).

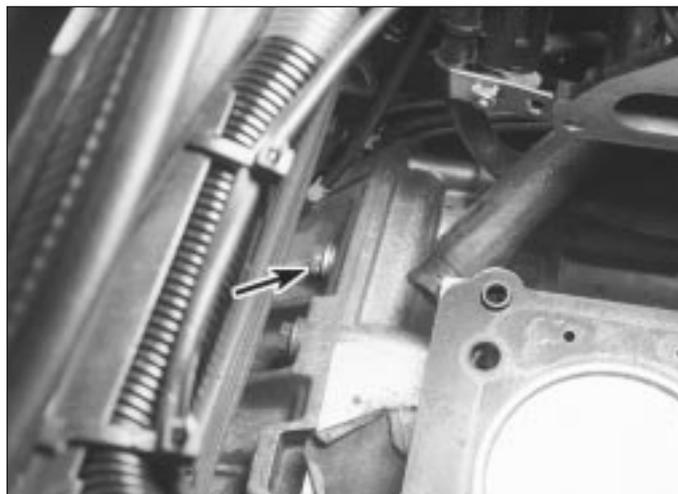
5 Place a trolley jack under the tail section of the transmission, remove the rear transmission mount (see Chapter 7) and lower the transmission slightly to gain access to the upper transmission bellhousing bolts. Using an extension with a swivel socket, remove the upper starter mounting bolt (see illustration).



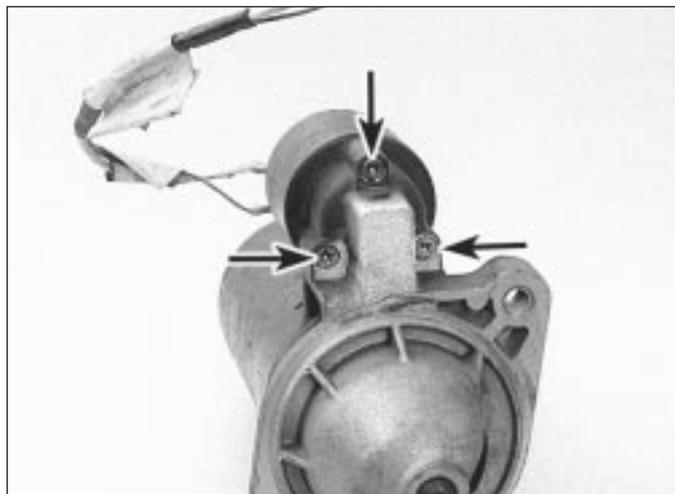
15.4a Disconnect the solenoid electrical connector at the harness connector located near the bulkhead behind the cylinder head (arrowed)



15.4b From underneath the vehicle, remove the cylinder terminal from the solenoid (cylinder head removed for clarity)



15.5 The upper starter bolt can be reached from underneath the vehicle using a long extension and swivel socket (cylinder head removed for clarity)



16.4 Remove the three solenoid mounting screws (arrowed) and separate the solenoid from the starter assembly

6 Working forward of the transmission, reach up into the engine bellhousing area, under the intake manifold and remove the lower starter mounting bolt.

7 Tilt the starter down and carefully lower the starter assembly through the front, ahead of the transmission.

8 Refitting is the reverse of removal.

### 16 Starter solenoid - removal and refitting



- 1 Remove the starter motor (see Section 15).
- 2 Scribe or paint a mark across the starter motor and solenoid assembly.

3 Disconnect the strap from the solenoid to the starter motor terminal (if equipped).

4 Remove the screws which secure the solenoid to the starter drive end housing (see illustration).

5 Separate the solenoid from the starter.

6 Refitting is the reverse of removal. Be sure to align the paint or scribe mark.