CHARGING SYSTEM

CONTENTS

DESCRIPTION AND OPERATION

CHARGING SYSTEM

DESCRIPTION

The charging system consists of:

- Generator
- Electronic Voltage Regulator (EVR) circuitry within the Powertrain Control Module (PCM)
- Ignition switch (refer to the Ignition System for information)
- Battery (refer to the Battery for information)
- Battery temperature sensor
- Voltmeter (refer to the Instrument Panel and Gauges for information)
- Wiring harness and connections (refer to the Wiring for information)

OPERATION

The charging system is turned on and off with the ignition switch. When the ignition switch is turned to the ON position, battery voltage is applied to the generator rotor through one of the two field terminals to produce a magnetic field. The generator is driven by the engine through a serpentine belt and pulley arrangement.

The amount of DC current produced by the generator is controlled by the EVR (field control) circuitry, contained within the PCM. This circuitry is connected in series with the second rotor field terminal and ground.

Temperature data, along with data from monitored line voltage, is used by the PCM to vary the battery charging rate. This is done by cycling the ground path to control the strength of the rotor magnetic field. The PCM then compensates and regulates generator current output accordingly and to maintain the proper voltage depending on battery temperature.

All vehicles are equipped with On-Board Diagnostics (OBD). All OBD-sensed systems, including the EVR (field control) circuitry, are monitored by the PCM. Each monitored circuit is assigned a Diagnostic Trouble Code (DTC). The PCM will store a DTC in electronic memory for any failure it detects.

GENERATOR

DESCRIPTION

The generator is belt-driven by the engine. It is serviced only as a complete assembly. If the generator fails for any reason, the entire assembly must be replaced.

OPERATION

As the energized rotor begins to rotate within the generator, the spinning magnetic field induces a current into the windings of the stator coil. Once the generator begins producing sufficient current, it also provides the current needed to energize the rotor.

The Y type stator winding connections deliver the induced AC current to 3 positive and 3 negative diodes for rectification. From the diodes, rectified DC current is delivered to the vehicles electrical system through the generator, battery, and ground terminals.

Noise emitting from the generator may be caused by:

- Worn, loose or defective bearings
- Loose or defective drive pulley
- Incorrect, worn, damaged or misadjusted drive belt
- Loose mounting bolts

DESCRIPTION AND OPERATION (Continued)

- Misaligned drive pulley
- Defective stator or diode
- Damaged internal fins

BATTERY TEMPERATURE SENSOR

DESCRIPTION

The sensor is located on the rear side of the front bumper beam. (Fig. 1).

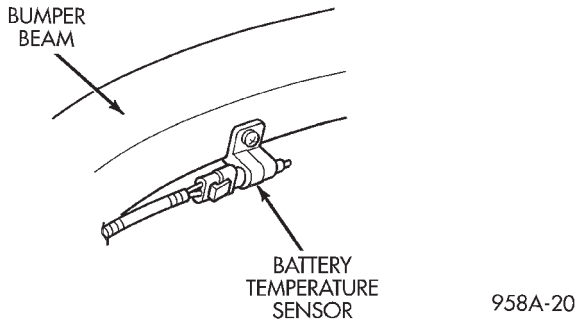

Fig. 1 Battery Temperature Sensor

OPERATION

The battery temperature sensor is used to determine the battery temperature. This temperature data, along with data from monitored line voltage, is used by the PCM to vary the battery charging rate. System voltage will be higher at colder temperatures and is gradually reduced at warmer temperatures.

The battery temperature sensor is also used for OBD II diagnostics. Certain faults and OBD II monitors are either enabled or disabled depending upon the battery temperature sensor input (example: disable purge and EGR, enable LDP). Most OBD II monitors are disabled below 20°F.

ELECTRONIC VOLTAGE REGULATOR

DESCRIPTION

The Electronic Voltage Regulator (EVR) is not a separate component. It is actually a voltage regulating circuit located within the Powertrain Control Module (PCM). The EVR is not serviced separately. If replacement is necessary, the PCM must be replaced.

OPERATION

The amount of DC current produced by the generator is controlled by EVR circuitry contained within the PCM. This circuitry is connected in series with the generators second rotor field terminal and its ground.

Voltage is regulated by cycling the ground path to control the strength of the rotor magnetic field. The EVR circuitry monitors system line voltage and battery temperature (refer to Battery Temperature Sensor for more information). It then compensates and regulates generator current output accordingly. Also refer to Charging System Operation for additional information.

DIAGNOSIS AND TESTING

CHARGING SYSTEM

When the ignition switch is turned to the ON position, battery potential will register on the voltmeter. During engine cranking a lower voltage will appear on the meter. With the engine running, a voltage reading higher than the first reading (ignition in ON) should register.

The following are possible symptoms of a charging system fault:

- The voltmeter does not operate properly
- An undercharged or overcharged battery condition occurs.

Remember that an undercharged battery is often caused by:

- Accessories being left on with the engine not running
- A faulty or improperly adjusted switch that allows a lamp to stay on. See Ignition-Off Draw Test in the Battery section for more information.

The following procedures may be used to correct a problem diagnosed as a charging system fault.

INSPECTION

(1) Inspect condition of battery cable terminals, battery posts, connections at engine block, starter solenoid and relay. They should be clean and tight. Repair as required.

(2) Inspect all fuses in the fuseblock module and Power Distribution Center (PDC) for tightness in receptacles. They should be properly installed and tight. Repair or replace as required.

(3) Inspect generator mounting bolts for tightness. Replace or tighten bolts if required. Refer to the Generator Removal/Installation section of this group for torque specifications.

(4) Inspect generator drive belt condition and tension. Tighten or replace belt as required. Refer to Belt Tension Specifications in the Cooling System.

(5) Inspect automatic belt tensioner (if equipped). Refer to the Cooling System for information.

(6) Inspect connections at generator field, battery output, and ground terminals. Also check ground connection at engine. They should all be clean and tight. Repair as required.

CHARGING SYSTEM RESISTANCE TESTS

These tests will show the amount of voltage drop across the generator output wire from the generator output (B+) terminal to the battery positive post.

DIAGNOSIS AND TESTING (Continued)

They will also show the amount of voltage drop from the ground (-) terminal on the generator (Fig. 2) or (Fig. 3) to the battery negative post.

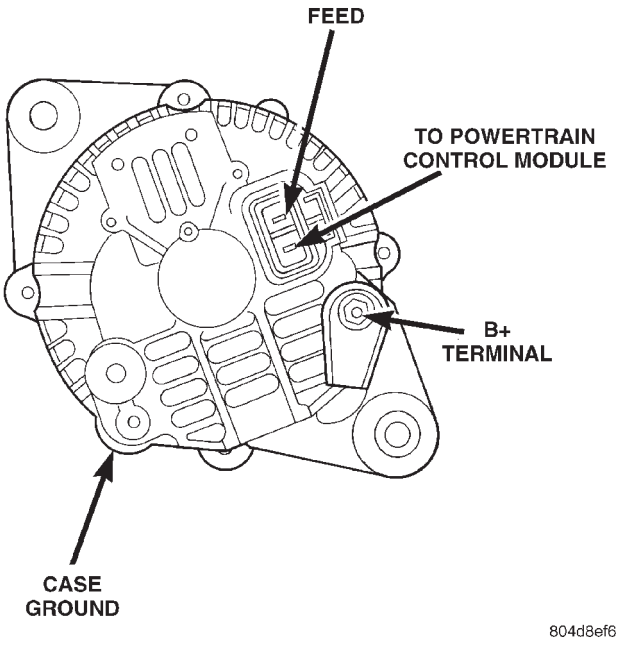

Fig. 2 Generator Terminals—2.5L

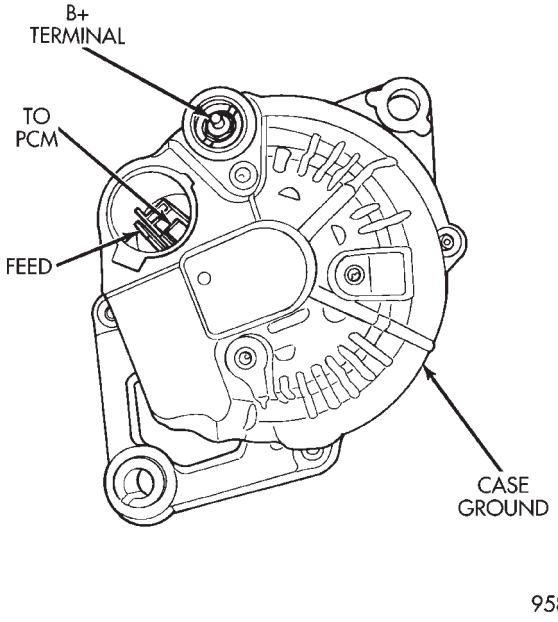

Fig. 3 Generator Terminals—2.0/2.4L

A voltmeter with a 0–18 volt DC scale should be used for these tests. By repositioning the voltmeter test leads, the point of high resistance (voltage drop) can easily be found.

Test points on the generator may be reached by either removing the air cleaner housing or below by raising the vehicle on a hoist.

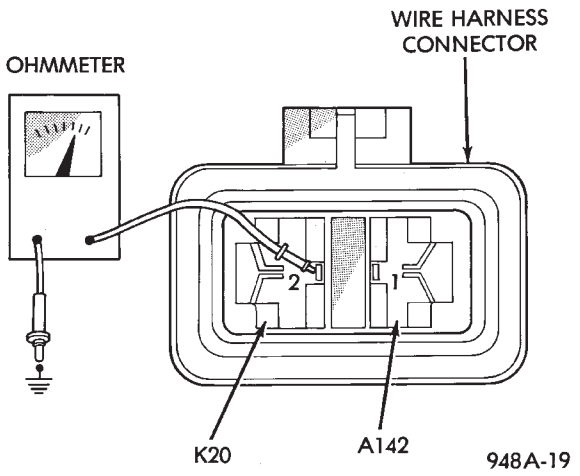

Fig. 4 Electrical Resistance Test

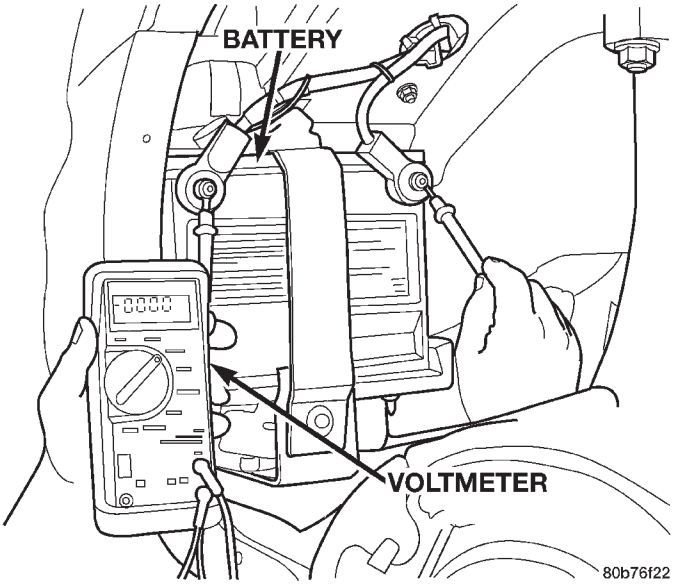

Fig. 5 Battery Voltage Test

PREPARATION

(1) Before starting test, make sure battery is in good condition and is fully-charged. See the Battery section for more information.
(2) Raise vehicle and support.
(3) Remove left front tire.
(4) Remove wheel well splash shield.
(5) Check condition of battery cables at battery. Clean if necessary.
(6) Start the engine and allow it to reach normal operating temperature.
(7) Shut engine off.
(8) Connect an engine tachometer.
(9) Fully engage the parking brake.

TEST

(1) Start engine.
(2) Place heater blower in high position.

DIAGNOSIS AND TESTING (Continued)

(3) Turn on headlamps and place in high-beam position.

(4) Turn vehicle interior lamps on.

(5) Bring engine speed up to 2400 rpm and hold.

(6) Testing (+ positive) circuitry:

(a) Touch the positive lead of voltmeter directly to battery positive **POST** (Fig. 5).

(b) Touch the negative lead of voltmeter to the B+ output terminal stud on the generator (not the terminal mounting nut). Voltage should be no higher than 0.6 volts. If voltage is higher than 0.6 volts, touch test lead to terminal mounting stud nut and then to the wiring connector. If voltage is now below 0.6 volts, look for dirty, loose or poor connection at this point. Also check condition of the generator output wire-to-battery bullet connector. Refer to Group 8, Wiring for connector location. A voltage drop test may be performed at each (- ground) connection in this circuit to locate the excessive resistance.

(7) Testing (- ground) circuitry:

(a) Touch the negative lead of voltmeter directly to battery negative **POST**.

(b) Touch the positive lead of voltmeter to the generator case. Voltage should be no higher than 0.3 volts. If voltage is higher than 0.3 volts, touch test lead to generator case and then to the engine block. If voltage is now below 0.3 volts, look for dirty, loose or poor connection at this point. A voltage drop test may be performed at each connection in this circuit to locate the excessive resistance. This test can also be performed between the generator case and the engine. If test voltage is higher than 0.3 volts, check for corrosion at generator mounting points or loose generator mounting.

(8) When finished with test, install splash shield and tire, then lower vehicle.

CURRENT OUTPUT TEST

The current output test will determine if the charging system can deliver its minimum test current (amperage) output. Refer to the Specifications section at the end of this group for minimum test current (amperage) requirements.

The first part of this test will determine the combined amperage output of both the generator and the Electronic Voltage Regulator (EVR) circuitry.

PREPARATION

(1) Determine if any Diagnostic Trouble Codes (DTC) exist. For repair, refer to the appropriate Powertrain Diagnostic Procedures manual.

(2) Before starting test, make sure battery is in good condition and is fully-charged. See the Battery section for more information.

(3) Check condition of battery cables at battery. Clean if necessary.

(4) Be sure the generator drive belt is properly tensioned. Refer to the Cooling System for information.

(5) A volt/amp tester equipped with both a battery load control (carbon pile rheostat) and an inductive-type pickup clamp (ammeter probe) will be used for this test. Refer to operating instructions supplied with tester. When using a tester equipped with an inductive-type clamp, removal of wiring at the generator will not be necessary.

(6) Start the engine and allow it to reach operating temperature.

(7) Shut engine off.

(8) Turn off all electrical accessories and all vehicle lighting.

(9) Connect the volt/amp tester leads to the battery post or jump start posts. Be sure the carbon pile rheostat control is in the OPEN or OFF position before connecting leads. See Load Test in the Battery section for more information. Also refer to the operating instructions supplied with test equipment.

(10) Connect the inductive clamp (ammeter probe). Refer to the operating instructions supplied with test equipment.

(11) If volt/amp tester is not equipped with an engine tachometer, connect a separate tachometer to the engine.

TEST

(1) Perform the previous test Preparation.

(2) Fully engage the parking brake.

(3) Start engine.

(4) Bring engine speed to 2500 rpm.

(5) With engine speed held at 2500 rpm, slowly adjust the rheostat control (load) on the tester to obtain the highest amperage reading. Do not allow voltage to drop below 12 volts. Record the reading. **This load test must be performed within 15 seconds to prevent damage to test equipment.** On certain brands of test equipment, this load will be applied automatically. Refer to the operating manual supplied with test equipment.

(6) The ammeter reading must meet the Minimum Test Amps specifications as displayed in the Generator Ratings chart. This can be found in the Specifications section. A label stating a part reference number is attached to the generator case. On some engines this label may be located on the bottom of the case. Compare this reference number to the Generator Ratings chart.

(7) Rotate the load control to the OFF position.

(8) Continue holding engine speed at 2500. If EVR circuitry is OK, amperage should drop below 15–20 amps. With all electrical accessories and vehicle

DIAGNOSIS AND TESTING (Continued)

lighting off, this could take several minutes of engine operation. If amperage did not drop, refer to the appropriate Powertrain Diagnostic Procedures manual for testing.

(9) Remove volt/amp tester.

If minimum amperage could not be met, refer to the appropriate Powertrain Diagnostic Procedures manual for testing.

BATTERY TEMPERATURE SENSOR

To perform a complete test of this sensor and its circuitry, refer to the appropriate Powertrain Diagnostic Procedures manual. To test the sensor only, refer to the following:

(1) Disconnect the sensor from the engine harness.

(2) Attach ohmmeter leads to the wire terminals of the sensor.

(3) At room temperature of 25° C (75–80° F), an ohmmeter reading of 9K to 11K ohms should be observed.

(4) If reading is above or below the specification, replace the sensor.

(5) Refer to the Removal and Installation section for procedures.

ON-BOARD DIAGNOSTIC SYSTEM TEST

GENERAL INFORMATION

The Powertrain Control Module (PCM) monitors critical input and output circuits of the charging system, making sure they are operational. A Diagnostic Trouble Code (DTC) is assigned to each input and output circuit monitored by the OBD system. Some circuits are checked continuously and some are checked only under certain conditions.

If the OBD system senses that a monitored circuit is bad, it will put a DTC into electronic memory. The DTC will stay in electronic memory as long as the circuit continues to be bad. The PCM is programmed to clear the memory after 50 engine starts if the problem does not occur again.

DIAGNOSTIC TROUBLE CODES

A DTC description can be read using the DRB scan tool. Refer to the appropriate Powertrain Diagnostic Procedures manual for information.

A DTC does not identify which component in a circuit is bad. Thus, a DTC should be treated as a symptom, not as the cause for the problem. In some cases, because of the design of the diagnostic test procedure, a DTC can be the reason for another DTC to be set. Therefore, it is important that the test procedures be followed in sequence, to understand what caused a DTC to be set.

ERASING DIAGNOSTIC TROUBLE CODES

The DRB Scan Tool must be used to erase a DTC.

REMOVAL AND INSTALLATION

GENERATOR—2.0L (NIPPONDENSO)

REMOVAL

(1) Disconnect battery negative cable from remote negative terminal on shock tower (Fig. 6).

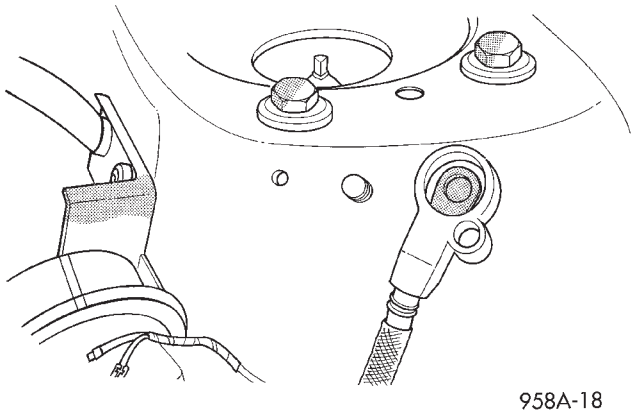

Fig. 6 Remove Battery Cable at Shock Tower

(2) Unplug field circuit from generator.

(3) Remove B+ terminal cover by spreading the cover with a small flat blade tool.

(4) Remove the B+ terminal nut and wire (Fig. 7).

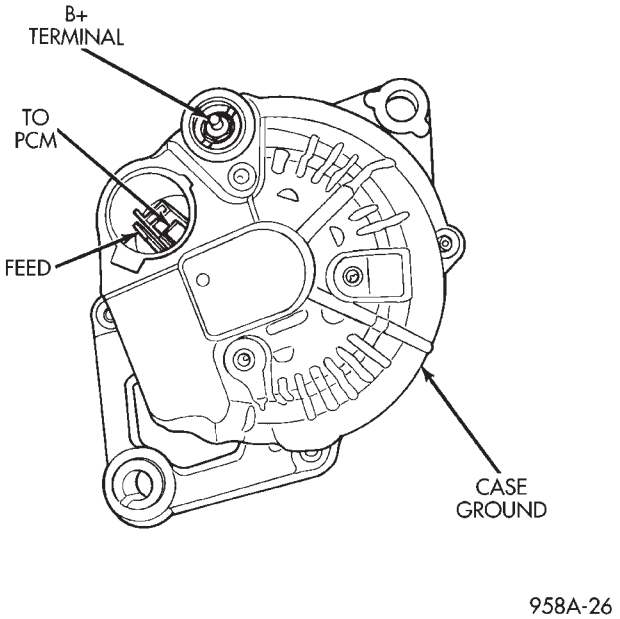

Fig. 7 Wiring Connections—2.0/2.4L

REMOVAL AND INSTALLATION (Continued)

(5) Loosen adjusting T-bolt, but do not remove (Fig. 8).

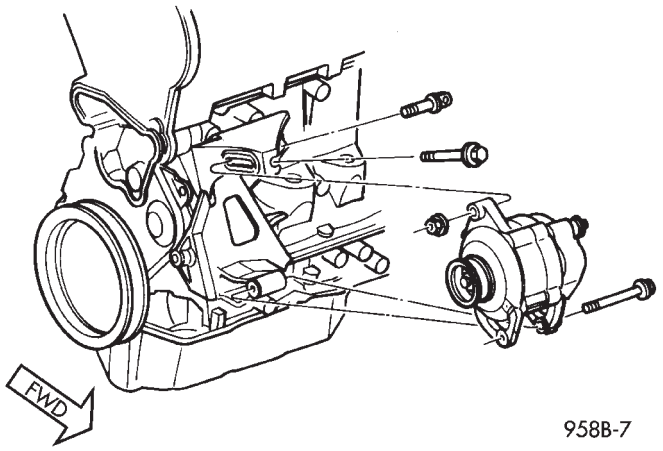

Fig. 8 Generator—2.0L Engine

(6) Loosen pivot bolt, but do not remove.
(7) Loosen adjusting bolt to allow removal of the generator drive belt. Refer to the Cooling System.
(8) Remove adjusting T-bolt.
(9) Remove pivot bolt, do not drop spacer.
(10) Release generator from mounting bracket and move it toward passenger head lamp bucket.
(11) Remove generator from head lamp bucket area.

INSTALLATION

(1) For installation, reverse above procedures. Tighten all fasteners to the proper torque. Refer to the Torque Specifications chart.

GENERATOR—2.4L (NIPPONDENSO)

REMOVAL

(1) Disconnect battery negative cable from remote negative terminal on shock tower (Fig. 9).
(2) Unplug field circuit from generator.
(3) Remove B+ terminal cover by spreading the cover with a small flat blade tool.
(4) Remove the B+ terminal nut and wire (Fig. 10).
(5) Loosen adjusting T-bolt, but do not remove (Fig. 10).
(6) Loosen pivot bolt, but do not remove.
(7) Loosen adjusting bolt to allow removal of the generator drive belt. Refer to the Cooling System.
(8) Remove adjusting T-bolt.
(9) Remove pivot bolt.
(10) Remove ABS braking unit by removing the two lower plate mounting bolts. Refer to the Brake section.

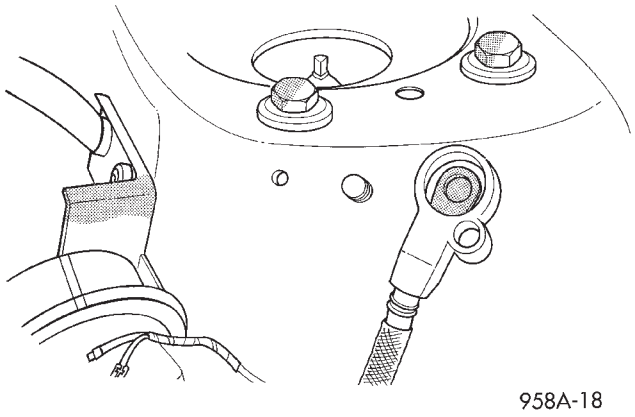

Fig. 9 Battery Cable at Shock Tower

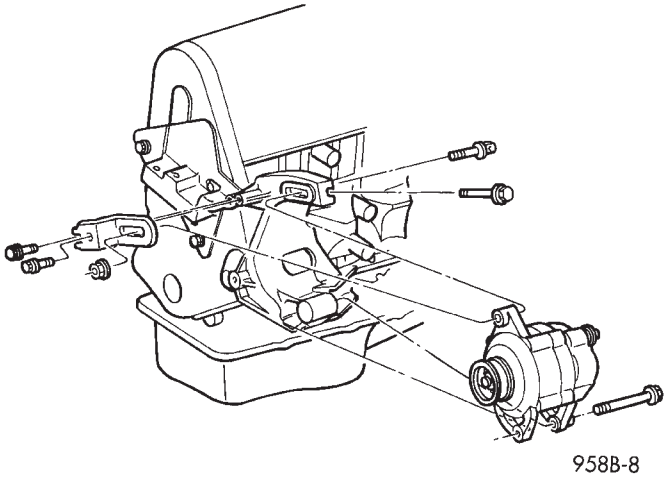

Fig. 10 Generator—2.4L Engine

(11) Remove Coolant Overflow bottle. Refer to the Cooling System.
(12) Remove by sliding alternator under the air conditioning lines towards passenger side of vehicle.
(13) Remove generator from vehicle.

INSTALLATION

(1) For installation, reverse above procedures. Tighten all fasteners to the proper torque. Refer to the Torque Specifications chart.

GENERATOR—2.5L

REMOVAL

(1) Disconnect battery negative cable from remote negative terminal on shock tower.
(2) Unplug field circuit from generator.
(3) Remove the B+ terminal nut and wire (Fig. 11).

REMOVAL AND INSTALLATION (Continued)

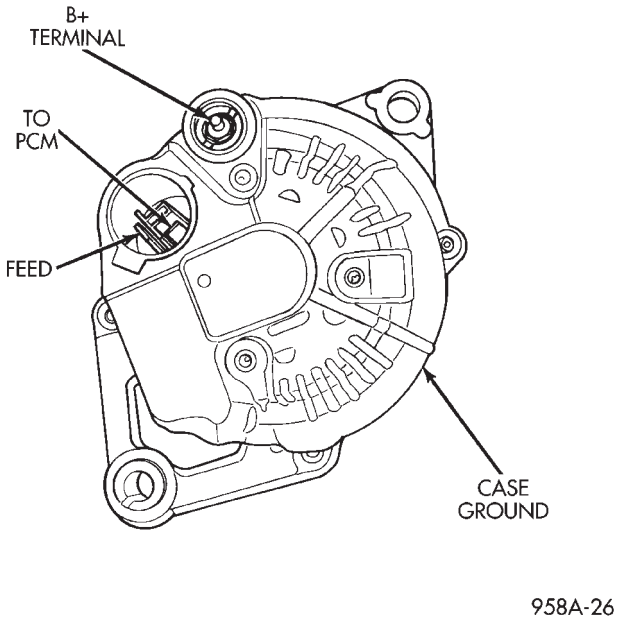

Fig. 11 Wiring Connections—2.5L

(4) Loosen top mounting ear bolt.

(5) Loosen pivot bolt, but do not remove. Be careful not to lose nut (Fig. 12).

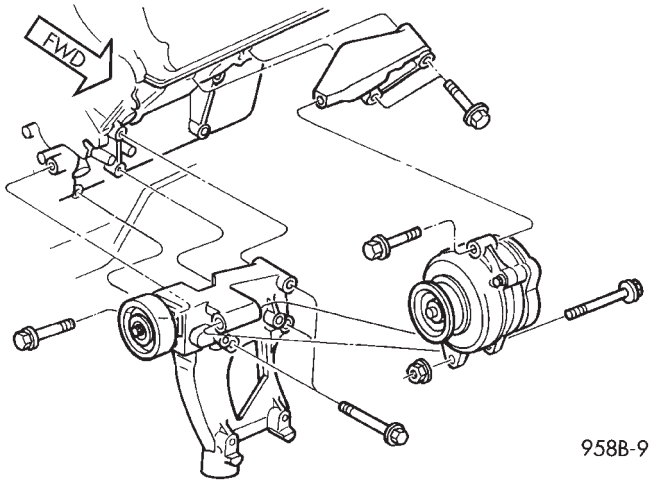

Fig. 12 Generator—2.5L Engine

(6) Loosen adjusting bolt on idler to allow removal of the generator drive belt. Refer to the Cooling System.

(7) Remove pivot bolt, do not drop spacer.

(8) Remove top mounting ear bolt.

(9) Remove upper generator bracket.

(10) Remove generator.

INSTALLATION

(1) For installation, reverse above procedures. Tighten all fasteners to the proper torque. Refer to the Torque Specifications chart.

BATTERY TEMPERATURE SENSOR

REMOVAL

(1) Raise vehicle on host.

(2) Remove screw from sensor.

(3) Disconnect electrical connector from sensor.

INSTALLATION

(1) Connect electrical connector to sensor.

(2) Install screw and tighten.

(3) Lower vehicle.

SPECIFICATIONS

GENERATOR RATINGS

TYPE	ENGINES	MINIMUM TEST AMPS
DENSO	2.0L	74 amps
DENSO	2.4L	74 amps
MELCO	2.5L	74 amps
The Test Specifications are: 1. 2500 ±20 RPMS 2. Voltage Output 15V ±.3V 3. Field Current 5amps ±.1amp		

TORQUE

DESCRIPTION	TORQUE
Battery Terminal Nut	10 N·m (90 in. lbs.)
Battery Hold Down Clamp Bolt	10 N·m (90 in. lbs.)
Battery Negative Cable Nut at Shock Tower	10 N·m (90 in. lbs.)
Generator B+ Terminal	9 N·m (75 in. lbs.)
Generator Mounting Bolt	54 N·m (40 ft. lbs.)
Generator Pivot Bolt	54 N·m (40 ft. lbs.)