IGNITION SYSTEMS

CONTENTS

2.5L AND 3.0L IGNITION SYSTEMS—SYSTEM OPERATION

INDEX

GENERAL INFORMATION

This section describes the ignition systems of the 2.5L and 3.0L engines.

On Board Diagnostics is described in the Fuel Injection Sections of Group 14.

Group 0, Lubrication and Maintenance, contains general maintenance information for ignition related items. The Owner's Manual also contains maintenance information.

DISTRIBUTOR CAP

Remove the distributor cap and inspect the inside for flashover, cracking of carbon button, lack of spring tension on carbon button, cracking of cap, and burned, worn terminals (Fig. 1). Also check for broken distributor cap towers. If any of these conditions are present the distributor cap and/or cables should be replaced.

When replacing the distributor cap, transfer spark plug wires from the original cap to the new cap one at a time. Ensure that each wire is installed into the tower of the new cap that corresponds to its tower position in the original cap. Fully seat the wires into the towers. If necessary, refer to the appropriate engine firing order diagram (Fig. 2 or Fig. 3).

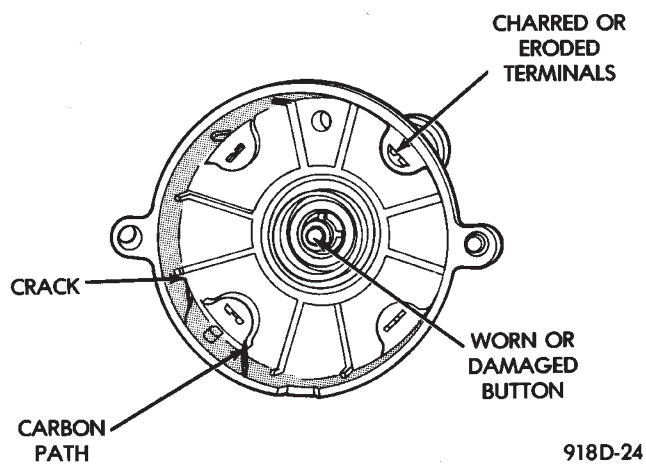

Fig. 1 Distributor Cap Inspection

Light scaling of the terminals can be cleaned with a sharp knife. If the terminals are heavly scaled, replace the distributor cap.

A cap that is greasy, dirty or has a powder-like substance on the inside should be cleaned with a solution of warm water and a mild detergent. Scrub the cap with a soft brush. Thoroughly rinse the cap and dry it with a clean soft cloth.

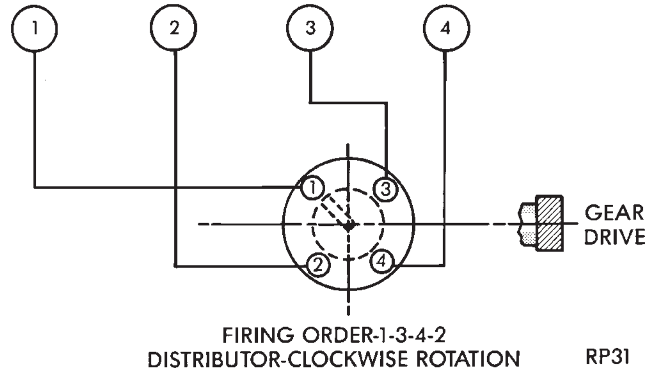

Fig. 2 Engine Firing Order—2.5L Engine

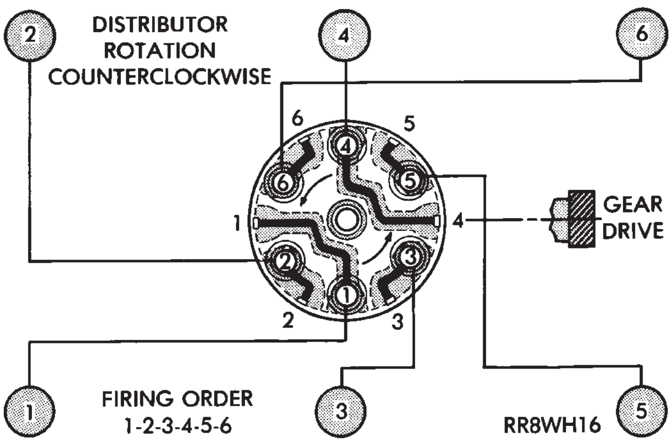

Fig. 3 engine firing order—3.0l engine

ROTOR—2.5L AND 3.0L ENGINES

Replace the rotor if it is cracked, the tip is excessively burned or heavily scaled (Fig. 4). If the spring terminal does not have adequate tension, replace the rotor.

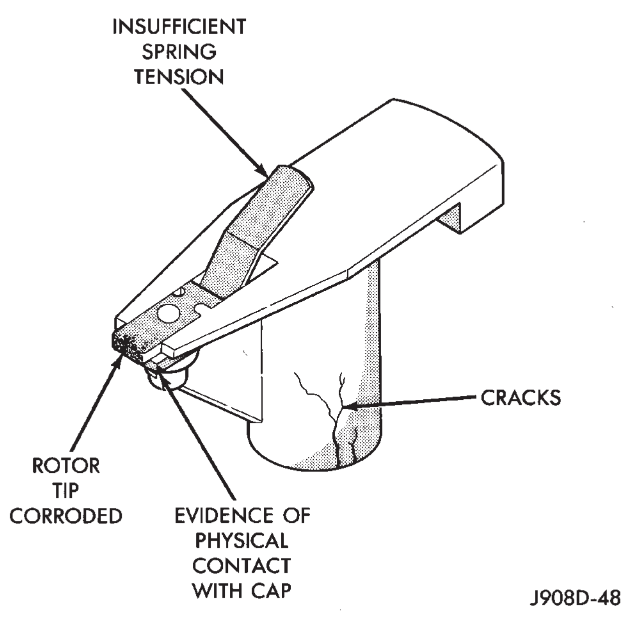

Fig. 4 Rotor Inspection—Typical

SPARK PLUG CABLES

Spark Plug cables are sometimes referred to as secondary ignition wires. They transfer electrical current from the distributor to individual spark plugs at each cylinder. 2.5L and 3.0L engines use resistance type cables. The cables suppress radio frequency emissions from the ignition system.

Check the spark plug cable connections for good contact at the coil and distributor cap towers and at the spark plugs. Terminals should be fully seated. The nipples and spark plug covers should be in good condition. Nipples should fit tightly on the coil and distributor cap towers and spark plug cover should fit tight around spark plug insulators. Cable connections that are loose will corrode and increase the resistance and permit water to enter the towers causing ignition malfunction. **To maintain proper sealing at the terminal connections, the connections should not be broken unless testing indicates high resistance, an open circuit or other damage.**

CAUTION: Do not pull spark plug cables from distributor cap of four cylinder engines. The cables must be released from inside the distributor cap (Fig. 5).

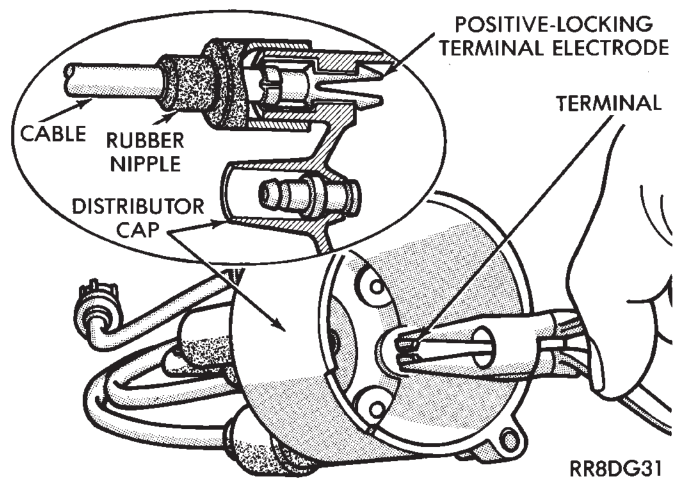

Fig. 5 Spark Plug Cable Removal/Installation—2.5L Engines

Clean high tension cables with a cloth moistened with a non-flammable solvent and wipe dry. Check for brittle or cracked insulation.

When testing secondary cables for punctures and cracks with an oscilloscope, follow the equipment manufacturers instructions.

If an oscilloscope is not available, secondary cables can be tested as follows:

CAUTION: Do not leave any one spark plug cable disconnected any longer than necessary during testing. Excessive heat could damage the catalytic converter. Total test time must not exceed ten minutes.

(a) With the engine not running, connect one end of a test probe (i.e. a piece of wire with insulated alligator clips on each end) to a good ground, other end free for probing.

(b) With engine running, move test probe along entire length of all cables (approximately 0 to 1/8 inch gap). If punctures or cracks are present there will be a noticeable spark jump from the faulty area to the probe. Check the coil cable the same way. Replace cracked, leaking or faulty cables.

When replacing the cables, install the new high tension cable and nipple assembly over cap or coil tower. When entering the terminal into the tower, push lightly, then pinch the large diameter of nipple to release air trapped between the nipple and tower. Continue pushing on the cable and nipple until cables are properly seated in the cap towers. Snap should be heard as terminal goes into place.

Use the same procedure to install cable in coil tower. Wipe the spark plug insulator clean before reinstalling cable and cover.

Use the following procedure when removing the high tension cable from the spark plug. First, remove the cable from the retaining bracket. Then grasp the terminal as close as possible to the spark plug. Rotate the cover and pull the cable straight back. **Pulling on the cable itself will damage the conductor and terminal connection. Do not use pliers and do not pull the cable at an angle. Doing so will damage the insulation, cable terminal or the spark plug insulator. Wipe spark plug insulator clean before reinstalling cable and cover.**

Resistance type cable is identified by the words **Electronic Suppression** printed on the cable jacket.

Use an ohmmeter to check resistance type cable for open circuits, loose terminals or high resistance as follows:

(a) Remove cable from spark plug.

(b) Lift distributor cap from distributor with cables intact. **Do not remove cables from cap.** The cables must be removed from the spark plugs.

(c) Connect the ohmmeter between spark plug end terminal and the corresponding electrode inside the cap, make sure ohmmeter probes are in good contact. Resistance should be within tolerance shown in the cable resistance chart. If resistance is not within tolerance, remove cable at cap tower and check the cable. If resistance is still not within tolerance, replace cable assembly. Test all spark plug cables in same manner.

To test coil to distributor cap high tension cable, remove distributor cap with the cable intact. **Do not remove cable from the cap.** Connect the ohmmeter between center contact in the cap and remove the cable at coil tower and check cable resistance. If resistance is not within tolerance, replace the cable. Also, check for a loose connection at the tower or for a faulty coil.

Inspect coil tower for cracks or carbon tracking.

CABLE RESISTANCE CHART

MINIMUM	MAXIMUM
250 Ohms Per Inch	1000 Ohms Per Inch
3000 Ohms Per Foot	12,000 Ohms Per Foot

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SPARK PLUGS

Resistor spark plugs are used in all engines and have resistance values of 6,000 to 20,000 ohms when checked with at least a 1000 volt tester.

Remove the spark plugs and examine them for burned electrodes and fouled, cracked or broken porcelain insulators. Keep plugs arranged in the order in which they were removed from the engine. An isolated plug displaying an abnormal condition indicates that a problem exists in the corresponding cylinder. Replace spark plugs at the intervals recommended in Group O.

Undamaged low mileage spark plugs can be cleaned and reused. Refer to the Spark Plug Condition section of this group. After cleaning, file the center electrode flat with a small point file or jewelers file. Adjust the gap between the electrodes (Fig. 6) to the dimensions specified in the chart at the end of this section.

Always tighten spark plugs to the specified torque. Over tightening can cause distortion resulting in a change in the spark plug gap. Tighten 2.5L and 3.0L engine spark plugs to 28 N•m (20 ft. lbs.) torque.

SPARK PLUG CONDITION

NORMAL OPERATING CONDITIONS

The few deposits present will be probably light tan or slightly gray in color with most grades of commercial gasoline (Fig. 7). There will not be evidence of electrode burning. Gap growth will not average more than approximately 0.025 mm (.001 in) per 1600 km (1000 miles) of operation. Spark plugs that have normal wear can usually be cleaned, have the electrodes filed and regapped, and then reinstalled.

Some fuel refiners in several areas of the United States have introduced a manganese additive (MMT) for unleaded fuel. During combustion, fuel with MMT coats the entire tip of the spark plug with a

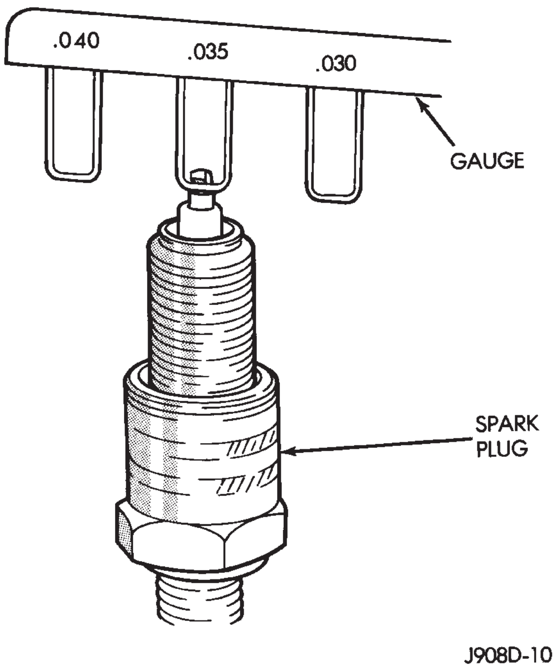

Fig. 6 Setting Spark Plug Electrode Gap—Typical

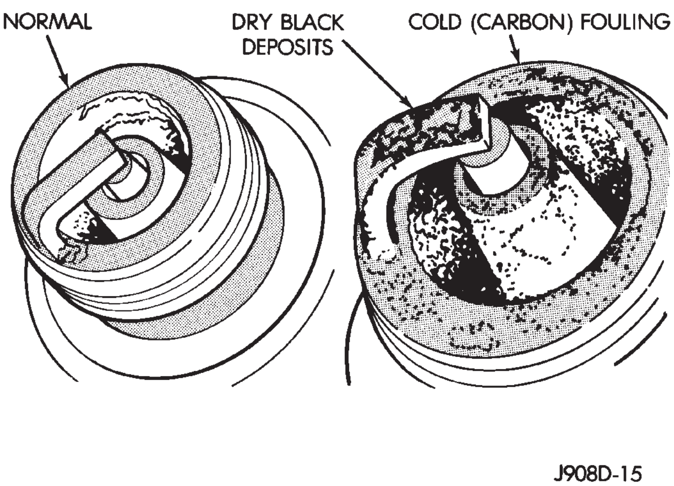

Fig. 7 Normal Operation and Cold (Carbon) Fouling

rust color deposit. The rust color deposits could be misdiagnosed as being caused by coolant in the combustion chamber. MMT deposits do not affect spark plug performance.

COLD FOULING (CARBON FOULING)

Cold fouling is sometimes referred to as carbon fouling. The deposits that cause cold fouling are basically carbon (Fig. 7). A dry, black deposit on one or two plugs in a set may be caused by sticking valves or defective spark plug cables. Cold (carbon) fouling of the entire set may be caused by a clogged air cleaner.

Cold fouling is normal after short operating periods. The spark plugs do not reach a high enough operating temperature during short operating periods.

WET FOULING

A spark plug that is coated with excessive wet fuel or oil is wet fouled. In older engines, wet fouling can be caused by worn rings or excessive cylinder wear. **Break-in fouling of new engines may occur before normal oil control is achieved. In new or recently overhauled engines, wet fouled spark plugs can be usually be cleaned and reinstalled.**

OIL OR ASH ENCRUSTED

If one or more plugs are oil or oil ash encrusted, the engine should be evaluated for the cause of oil entry into the combustion chamber (Fig. 8).

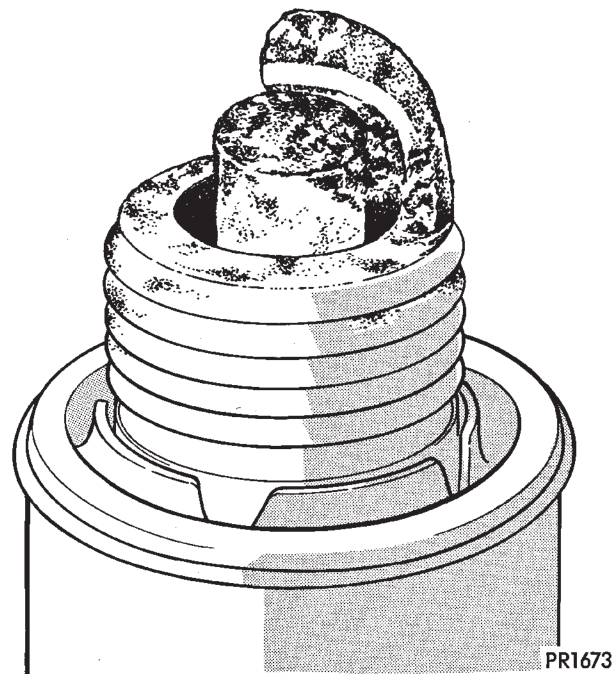

Fig. 8 Oil or Ash Encrusted

HIGH SPEED MISS

When replacing spark plugs because of a high speed miss condition; **wide open throttle operation should be avoided for approximately 80 km (50 miles) after installation of new plugs.** This will allow deposit shifting in the combustion chamber to take place gradually and avoid plug destroying splash fouling shortly after the plug change.

ELECTRODE GAP BRIDGING

Loose deposits in the combustion chamber can cause electrode gap bridging. The deposits accumulate on the spark plugs during continuous stop-and-go driving. When the engine is suddenly subjected to a high torque load, the deposits partially liquefy and bridge the gap between the electrodes (Fig. 9). This short circuits the electrodes. Spark plugs with electrode gap bridging can be cleaned using standard procedures.

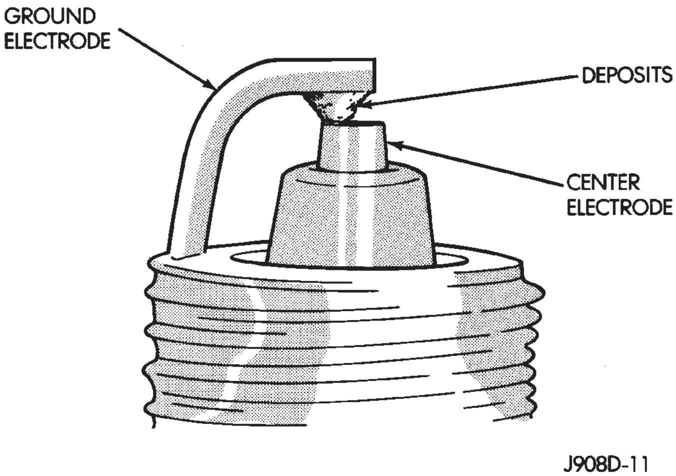

Fig. 9 Electrode Gap Bridging

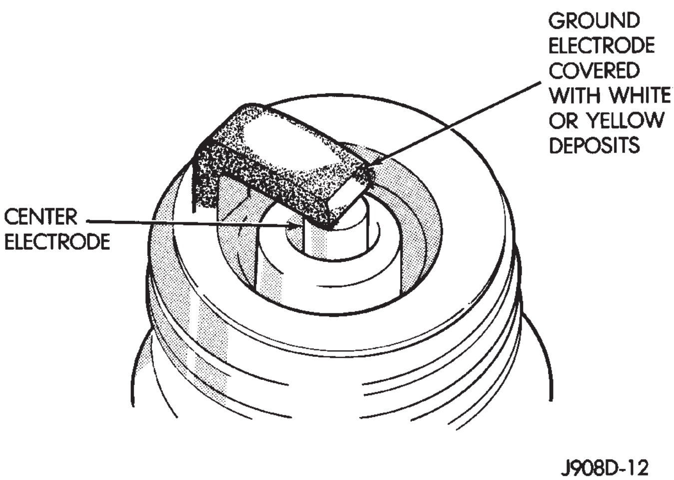

Fig. 10 Scavenger Deposits

SCAVENGER DEPOSITS

Fuel scavenger deposits may be either white or yellow (Fig. 10). They may appear to be harmful, but are a normal condition caused by chemical additives in certain fuels. These additives are designed to change the chemical nature of deposits and decrease spark plug misfire tendencies. Notice that accumulation on the ground electrode and shell area may be heavy but the deposits are easily removed. Spark plugs with scavenger deposits can be considered normal in condition and cleaned using standard procedures.

CHIPPED ELECTRODE INSULATOR

A chipped electrode insulator usually results from bending the center electrode while adjusting the spark plug electrode gap. Under certain conditions, severe detonation also can separate the insulator from the center electrode (Fig. 11). Replace spark plugs with chipped electrode insulators.

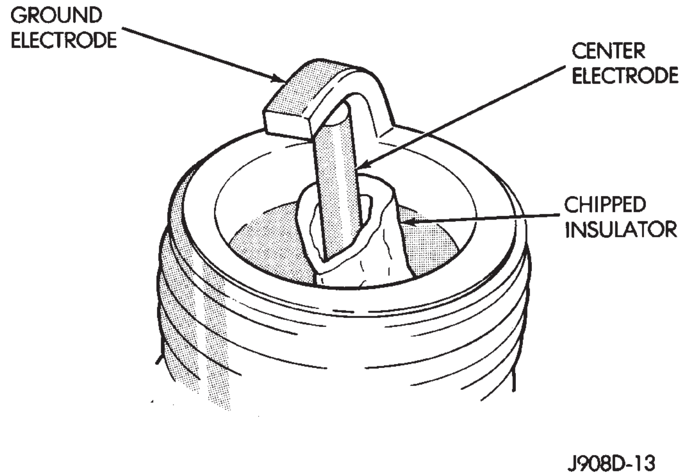

Fig. 11 Chipped Electrode Insulator

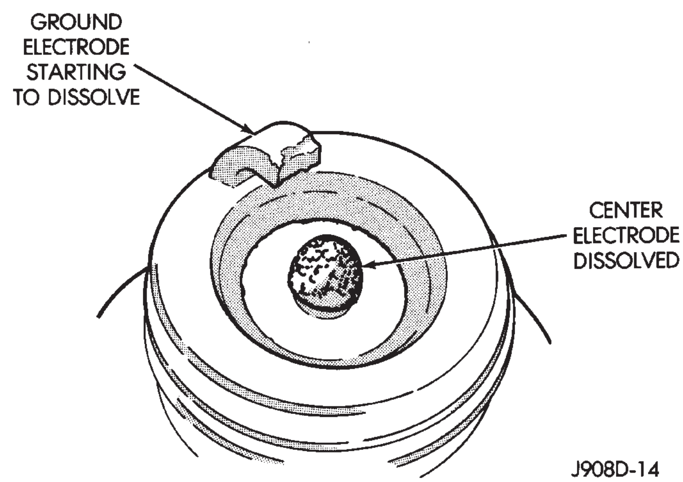

Fig. 12 Preignition Damage

PREIGNITION DAMAGE

Excessive combustion chamber temperature can cause preignition damage. The center electrode dissolves first and the ground electrode dissolves somewhat later (Fig. 12). Insulators appear relatively deposit free. Determine if the spark plug has the correct heat range rating for the engine, if ignition timing is over advanced or if other operating conditions are causing engine overheating. (The heat range rating refers to the operating temperature of a particular type spark plug. Spark plugs are designed to operate within specific temperature ranges depending upon the thickness and length of the center electrode and porcelain insulator.)

SPARK PLUG OVERHEATING

Overheating is indicated by a white or gray center electrode insulator that also appears blistered (Fig. 13). The increase in electrode gap will be considerably in excess of 0.001 in per 1000 miles of operation. This suggests that a plug with a cooler heat range rating should be used. Over advanced ignition timing, detonation and cooling system malfunctions also can cause spark plug overheating.

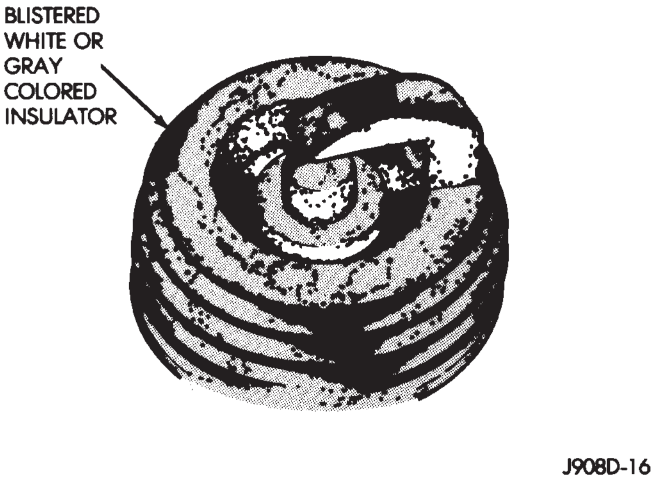

Fig. 13 Spark Plug Overheating

SPARK PLUG SERVICE

When replacing the spark plug and coil cables, route the cables correctly and secure them in the appropriate retainers. Failure to route the cables properly can cause the radio to reproduce ignition noise, cross ignition of the spark plugs or short circuit the cables to ground.

SPARK PLUG REMOVAL

Always remove the spark plug cable by grasping at the spark plug boot, turning the boot 1/2 turn and pulling straight back in a steady motion.

(1) Prior to removing the spark plug spray compressed air around the spark plug hole and the area around the spark plug.

(2) Remove the spark plug using a quality socket with a rubber or foam insert.

(3) Inspect the spark plug condition. Refer to Spark Plug Condition in this section.

SPARK PLUG GAP ADJUSTMENT

(1) Check the spark plug gap with a gap gauge. If the gap is not correct, adjust it by bending the ground electrode (Fig. 6).

SPARK PLUG INSTALLATION

(1) To avoid cross threading, start the spark plug into the cylinder head by hand.

(2) Tighten spark plugs to 28 N•m (20 ft. lbs.) torque.

(3) Install spark plug cables over spark plugs.

ENGINE CONTROLLER

The ignition system is regulated by the Single board Engine Controller II (SBEC II), **referred to in this manual as the Engine Controller (Fig. 14).** The controller supplies battery voltage to the ignition coil through the Auto Shutdown (ASD) Relay. The controller also controls the ground circuit for the ignition coil. By switching the ground path for the coil on and off, the engine controller adjusts ignition timing to meet changing engine operating conditions.

During the crank-start period the controller advances ignition timing a set amount. During engine operation, the amount of spark advance provided by the engine controller is determined by three input factors:

- coolant temperature
- engine RPM
- available manifold vacuum

The engine controller also regulates the fuel injection system. Refer to the Fuel Injection sections of Group 14.

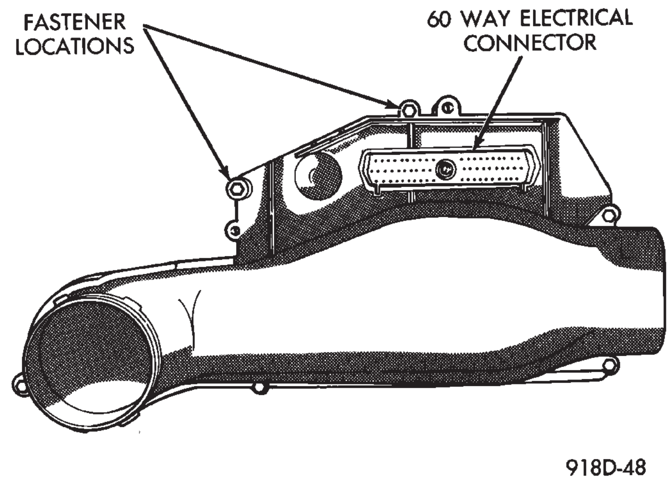

Fig. 14 Engine Controller

HALL EFFECT PICK-UP—2.5L ENGINES

The hall effect pick-up (Fig. 15) is located in the distributor assembly. It supplies engine rpm and ignition timing data to the engine controller. This allows the engine controller to advance or retard the ignition spark as required by different operating conditions.

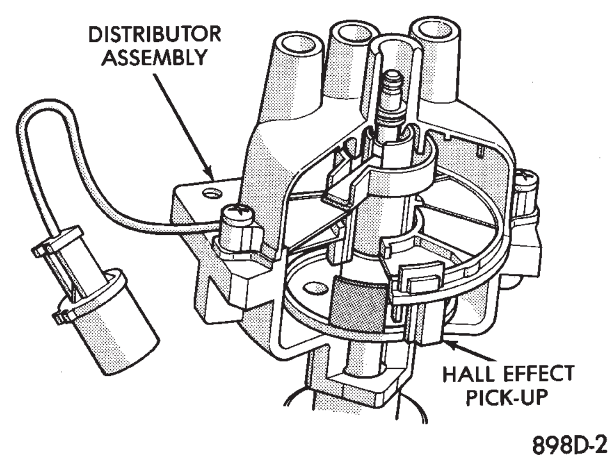

Fig. 15 Hall Effect Distributor—2.5L Engines

DISTRIBUTOR PICK-UP—3.0L ENGINE

The distributor pick-up provides two inputs to the engine controller. From one input the engine controller determines RPM (engine speed). From the other input it derives crankshaft position. The engine controller regulates injector synchronization and adjusts ignition timing and engine speed based on these inputs.

The distributor pick-up contains two signal generators. The pick-up unit consists of 2 light emitting diodes (LED), 2 photo diodes, and a separate timing disk. The timing disk contains two sets of slots. Each set of slots rotates between a light emitting diode and a photo diode (Fig. 16). The inner set contains 6 large slots, one for each cylinder. The outer set contains several smaller slots.

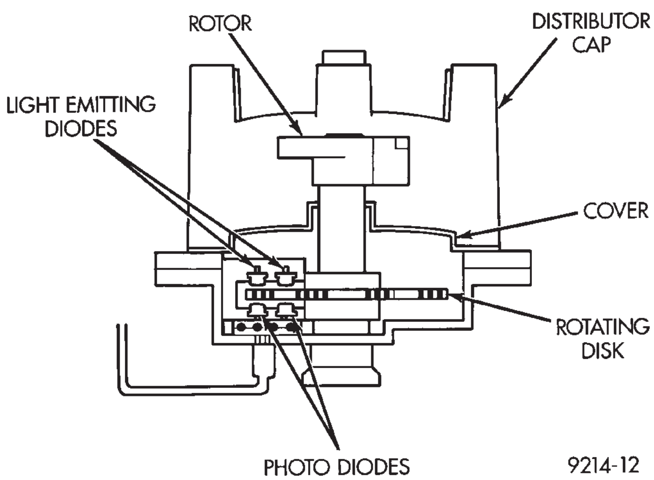

Fig. 16 Distributor Pick-up—3.0L Engine

The outer set of slots on the rotating disk represents 2 degrees of crankshaft rotation. Up to 1200 engine RPM, the controller uses the input from the outer set of slots to increase ignition timing accuracy.

The outer set of slots contains a 10 degree flat spot. This area is not slotted (Fig. 17). The flat spot tells the engine controller that the next piston at TDC will be number 6. Each piston's position is referenced by one of the six inner slots (Fig. 17).

As each slot on the timing disk passes between the diodes, they interrupt the beam from the light emitting diode. This creates an alternating voltage in each photo diode which is converted into on-off pulses. The pulses are the input to the engine controller.

During cranking, the engine controller cannot determine which cylinder will be at TDC until the 10 degree flat spot on the outer set of slots rotates through the optical unit. Once the flat spot is detected, the controller knows piston in cylinder number 6 will be the next piston at TDC.

Since the disk rotates at half crankshaft speed, it may take up to 2 engine revolutions during cranking before the engine controller determines the position of piston number 6. For this reason the engine controller energizes all six injectors at the same time until it senses the position of piston number 6.

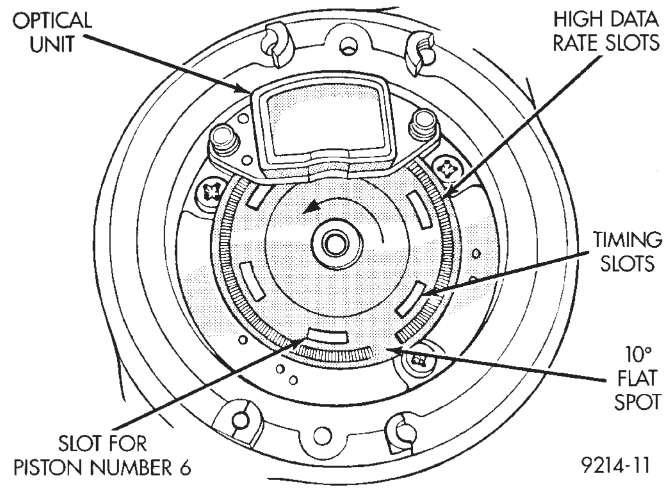

Fig. 17 Inner and Outer Slots of Rotating Disk—3.0L Engine

COOLANT TEMPERATURE SENSOR

On 2.5L engines, the coolant temperature sensor is installed behind the thermostat housing and ignition coil in the hot box (Fig. 18). On 3.0L engines the sensor is located next to the thermostat housing (Fig. 19). The sensor provides an input voltage to the engine controller. The sensor is a variable resistance (thermistor) with a range of -40°F to 265°F. As coolant temperature varies, the sensors resistance changes, resulting in a different input voltage to the engine controller.

The engine controller contains different spark advance schedules for cold and warm engine operation. The schedules reduce engine emissions and improve driveability. Because spark advance changes at different engine operating temperatures during warm-up, all spark advance testing should be done with the engine fully warmed.

When the engine is cold, the engine controller demands slightly richer air-fuel mixtures and higher idle speeds until normal operating temperatures are reached.

The coolant sensor input is also used for cooling fan control.

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR

The MAP sensor reacts to absolute pressure in the intake manifold and provides an input voltage to the engine controller. As engine load changes, manifold pressure varies. The changes in engine load causes the MAP sensors resistance to change. The change in MAP sensor resistance results in a different input voltage to the engine controller.

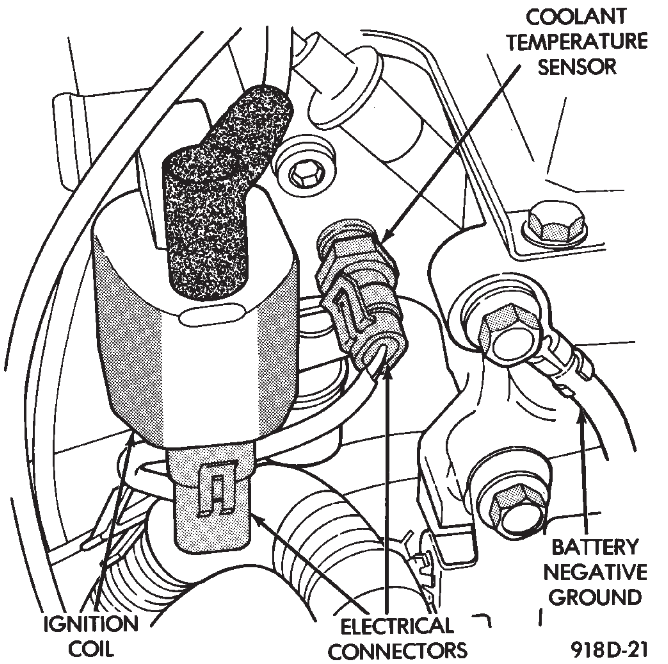

Fig. 18 Coolant Temperature Sensor—2.5L Engines

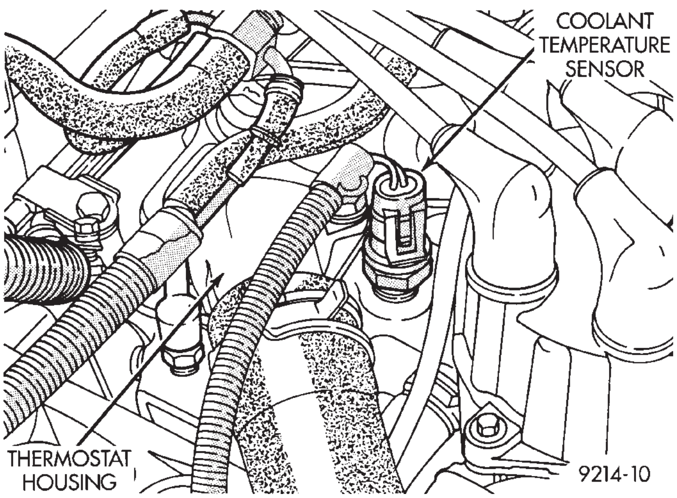

Fig. 19 Coolant Temperature Sensor—3.0L Engines

The input voltage level supplies the engine controller with information relating to ambient barometric pressure during engine start-up (cranking) and engine load while its operating. The engine controller uses this input along with inputs from other sensors to adjust air-fuel mixture.

On 2.5L engines, the MAP sensor is mounted to the dash panel (Fig. 20). On 3.0L engines, the sensor is mounted to a bracket across from the distributor (Fig. 21). The sensor is connected to the throttle body with a vacuum hose and to the engine controller electrically.

AUTO SHUTDOWN (ASD) RELAY AND FUEL PUMP RELAY

The engine controller operates the auto shutdown (ASD) relay and fuel pump relay through one ground path. The controller operates the relays by switching the ground path on and off. Both relays turn on and off at the same time.

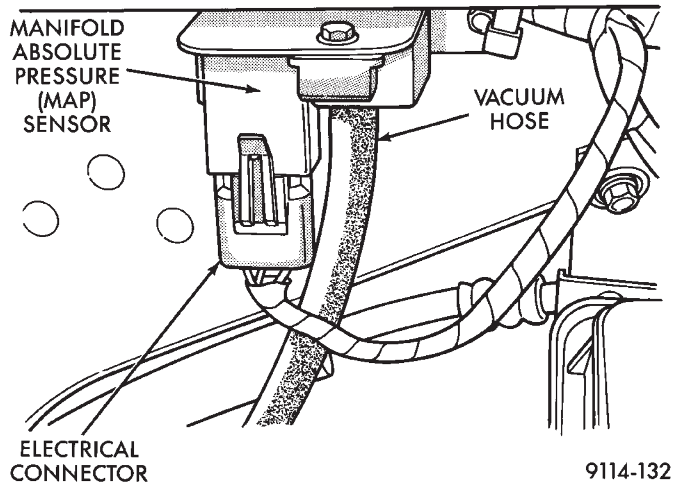

Fig. 20 MAP Sensor—2.5L TBI Engines

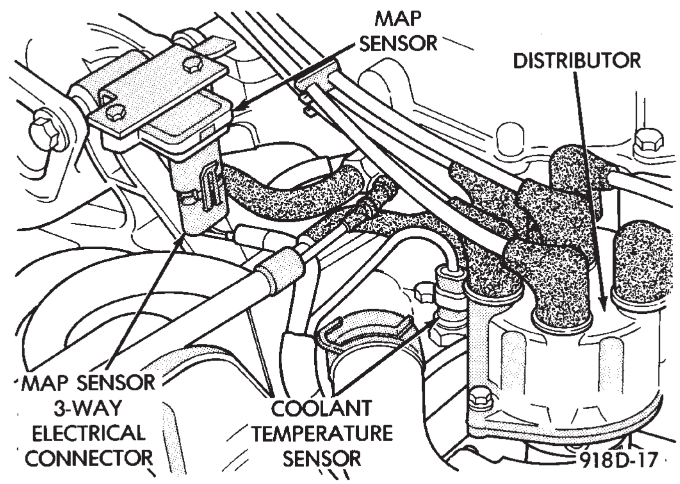

Fig. 21 MAP Sensor—3.0L Engine

The ASD relay connects battery voltage to the fuel injector and ignition coil. The fuel pump relay connects battery voltage to the fuel pump and oxygen sensor heating element.

The engine controller turns the ground path off when the ignition switch is in the Off position. Both relays are off. When the ignition switch is in the On or Crank position, the engine controller monitors the distributor pick-up signal to determine engine speed and ignition timing (coil dwell). If the engine controller does not recieve a distributor signal when the ignition switch is in the Run postion, it will de-energize both relays. When the relays are de-energized, battery voltage is not supplied to the fuel injector, ignition coil, fuel pump and oxygen sensor heating element.

The ASD relay and fuel pump relay are mounted on the drivers side fender well, near to the engine controller (Fig. 22).

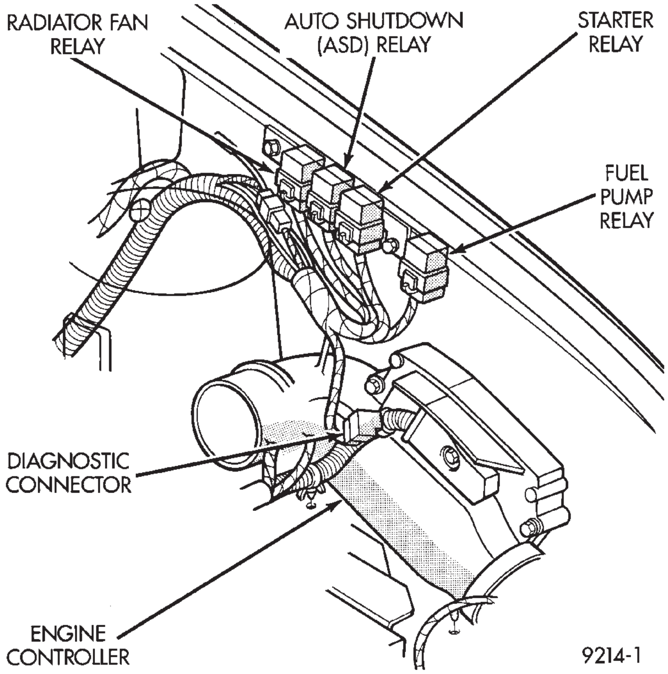

Fig. 22 Auto Shutdown Relay and Fuel Pump Relay

IGNITION COIL

The 2.5L and 3.0L engines use an epoxy type coil. The coils are not oil filled. The windings are embedded in a heat and vibration resistant epoxy compound.

The engine controller operates the ignition coil through the auto shutdown (ASD) relay. When the relay is energized by the engine controller, battery voltage is connected to the ignition coil positive terminal. The engine controller will de-energize the ASD relay if it does not receive an input from the distributor pick-up. Refer to Auto Shutdown (ASD) Relay and Fuel Pump Relay in this section.

On 2.5L engines the ignition coil is mounted to the thermostat housing (Fig. 23). On 3.0L engines the coil is mounted on the rear of the intake manifold next to the air cleaner (Fig. 24).

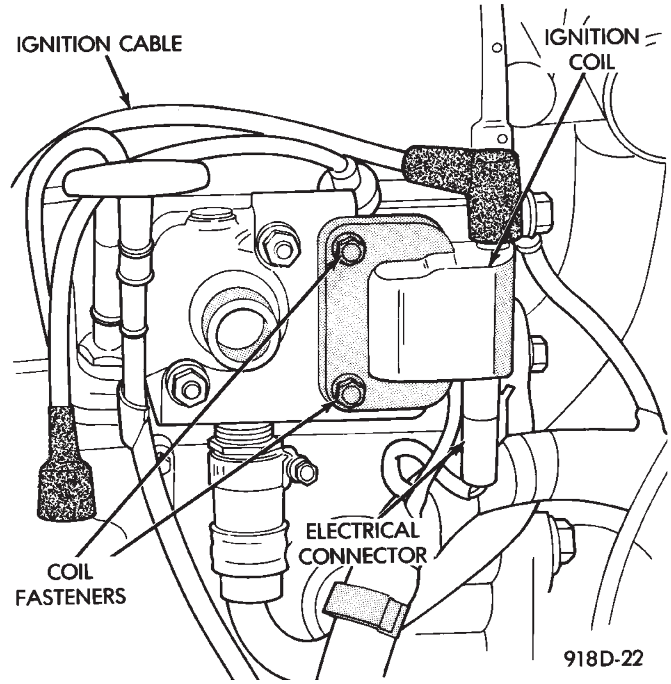

Fig. 23 Ignition Coil—2.5L Engine

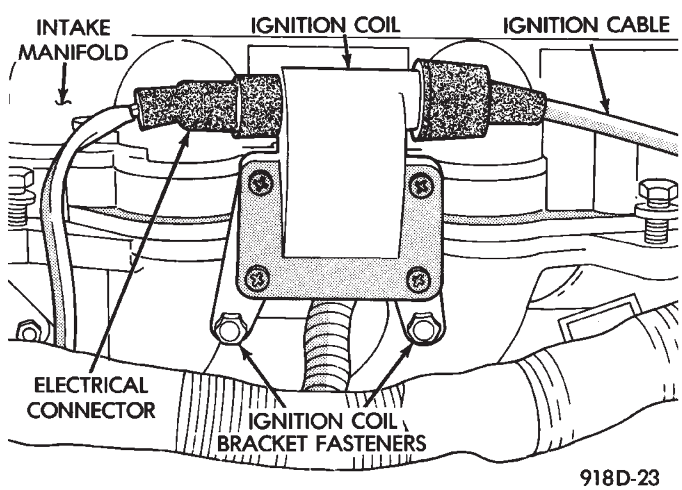

Fig. 24 Ignition Coil—3.0L Engine

2.5L AND 3.0L IGNITION SYSTEMS—DIAGNOSTIC PROCEDURES

INDEX

GENERAL INFORMATION

For additional information, refer to On Board Diagnostics in the Fuel Injection General Diagnosis sections of Group 14.

SPARK PLUGS

Faulty or fouled spark plugs may perform well at idle speed, but frequently fail at higher engine speeds. Faulty plugs can be identified in a number of ways: poor fuel economy, power loss, decrease in engine speed, hard starting and, in general, poor engine performance.

Spark plugs also malfunction because of carbon fouling, excessive electrode air gap, or a broken insulator. Refer to the General Information Section of this group for spark plug diagnosis.

IGNITION COIL

The ignition coil is designed to operate without an external ballast resistor.

Inspect the coil for arcing. Test the coil according to coil tester manufacturer's instructions. Test coil primary and secondary resistance. Replace any coil that does not meet specifications. Refer to the Coil Resistance chart.

If the ignition coil is replaced due to a burned tower, carbon tracking, arcing at the tower, or damage to the terminal or boot on the coil end of the secondary cable, the cable must be replaced. Arcing at the tower will carbonize the nipple which, if it is connected to a new coil, will cause the coil to fail.

If a secondary cable shows any signs of damage, the cable should be replaced with a new cable and new terminal. Carbon tracking on the old cable can cause arcing and the failure of a new coil.

TESTING FOR SPARK AT COIL

WARNING: APPLY PARKING BRAKE AND/OR BLOCK THE WHEELS BEFORE PERFORMING ANY TEST WITH THE ENGINE RUNNING.

CAUTION: Spark plug cables may be damaged if this test is performed with more than 1/4 inch clearance between the cable and engine ground.

Remove the coil secondary cable from the distributor cap. Hold the end of cable about 6 mm (1/4-inch) away from a good engine ground (Fig. 1). Crank the engine and inspect for spark at the coil secondary cable.

There must be a constant spark at the coil secondary cable. If the spark is constant, have a helper continue to crank engine and, while slowly moving coil secondary cable away from ground, look for arcing at the coil tower. If arcing occurs at the tower, replace the coil. If spark is not constant or there is no spark, proceed to the failure to start test.

If a constant spark is present and no arcing occurs at the coil tower, the ignition system is producing the necessary high secondary voltage. However, make sure that the spark plugs are firing. Inspect the distributor rotor, cap, spark plug cables, and spark plugs. If they are in proper working order, the

COIL RESISTANCE

COIL (MANUFACTURER)	PRIMARY RESISTANCE 21–27°C (70–80°F)	SECONDARY RESISTANCE 21–27°C (70–80°F)
Diamond	0.97 - 1.18 Ohms	11,300 - 15,300 Ohms
Toyodenso	0.95 - 1.20 Ohms	11,300 - 13,300 Ohms

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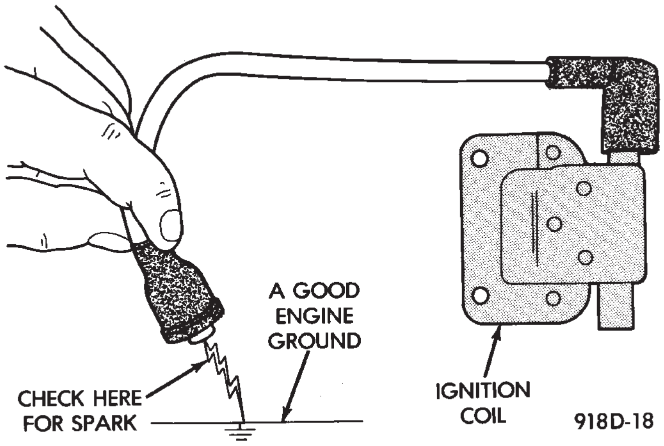

Fig. 1 Checking for Spark

ignition system is not the reason why the engine will not start. Inspect the fuel system and engine for proper operation.

FAILURE TO START TEST—2.5L TBI AND 3.0L ENGINES

Before proceeding with this test make sure Testing For Spark At Coil has been performed. Failure to do this may lead to unnecessary diagnostic time and wrong test results.

WARNING: BE SURE TO APPLY PARKING BRAKE AND/OR BLOCK WHEELS BEFORE PERFORMING ANY TEST WITH THE ENGINE RUNNING.

(1) Battery voltage must be at least 12.4 volts to perform test.

(2) Crank the engine for 5 seconds while monitoring the voltage at the coil positive (+) terminal (Fig. 2 or Fig. 3). If the voltage remains near zero during the entire period of cranking, refer to Group 14 for On-Board Diagnostic checks. These checks will help diagnose problems with the engine controller and auto shutdown relay.

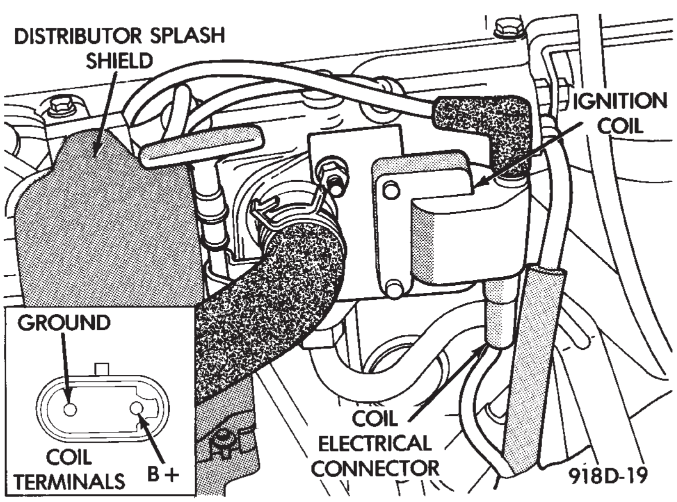

Fig. 2 Coil Terminals—2.5L Engines

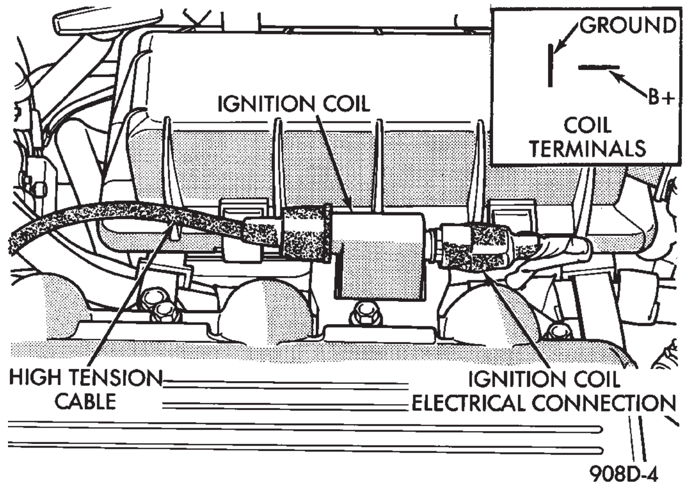

Fig. 3 Coil Terminals—3.0L Engine

(3) If voltage is at near-battery voltage and drops to zero after 1-2 seconds of cranking, see Group 14 for On-Board Diagnostic check for the distributor reference pickup circuit to the engine controller.

(4) If voltage remains at near battery voltage during the entire 5 seconds, **with the key off,** remove the engine controller 60-way connector. Check the 60-way connector for any terminals that are pushed out or loose.

(5) Remove the connector to coil (+) and connect a jumper wire between battery (+) and coil (+).

(6) Using the special jumper (Fig. 4), momentarily ground terminal #19 of the 60-way connector (Fig. 5). A spark should be generated when the ground is removed.

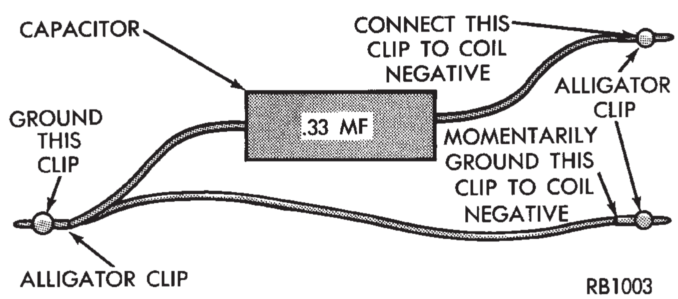

Fig. 4 Special Jumper to Ground Coil Negative

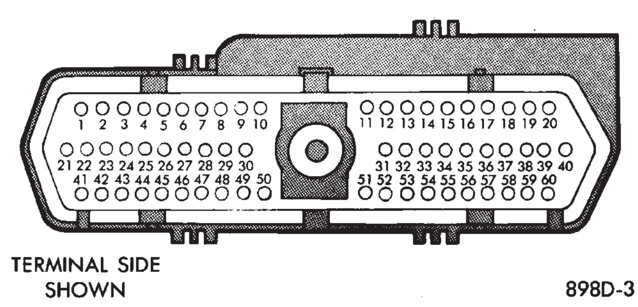

Fig. 5 60-Way Electrical Connector, Engine Controller

(7) If spark is generated, replace the engine controller.

(8) If no spark is seen, use the special jumper to ground the coil (-) terminal directly.

(9) If spark is produced, inspect wiring harness for an open condition.

(10) If no spark is produced, replace the ignition coil.

POOR PERFORMANCE TEST

To prevent unnecessary diagnostic time and possible incorrect results, the Testing For Spark At Coil procedure should be performed before this test.

WARNING: APPLY PARKING BRAKE AND/OR BLOCK THE WHEELS BEFORE PERFORMING ANY ENGINE RUNNING TESTS.

Check and adjust basic timing (refer to the specification section of this group and see service procedures).

Refer to Group 14, General Diagnosis On Board Diagnostics.

COOLANT TEMPERATURE SENSOR TEST

(1) With key off, disconnect wire connector from coolant temperature sensor (Fig. 6).

(2) Connect one lead of ohmmeter to one terminal of coolant temperature sensor.

(3) Connect the other lead of ohmmeter to remaining connector of coolant temperature sensor. The ohmmeter should read as follows;

- Engine/Sensor at normal operating temperature around 200°F should read approximately 700 to 1,000 ohms.
- Engine/Sensor at room temperature around 70°F, ohmmeter should read approximately 7,000 to 13,000 ohms.
- **See On Board Diagnostics in the General Diagnosis section of Group 14, or refer to the appropriate diagnostic manual for further test procedures.**

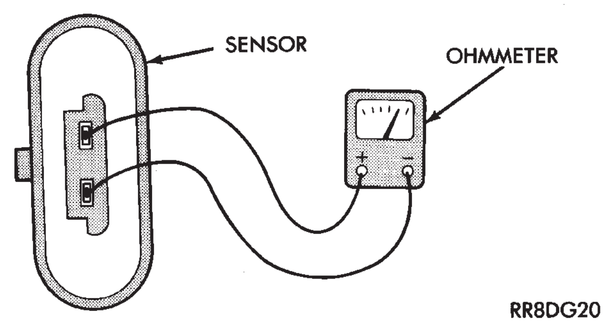

Fig. 6 Coolant Temperature Sensor Test

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR TEST

Refer to Board Diagnostics in the Fuel Injection General Diagnosis sections of Group 14, or the appropriate Powertrain Diagnostic Procedures manual for further test procedures.

2.5L AND 3.0L IGNITION SYSTEMS—SERVICE PROCEDURES

INDEX

ENGINE CONTROLLER

The engine controller is located next to the battery (Fig. 1).

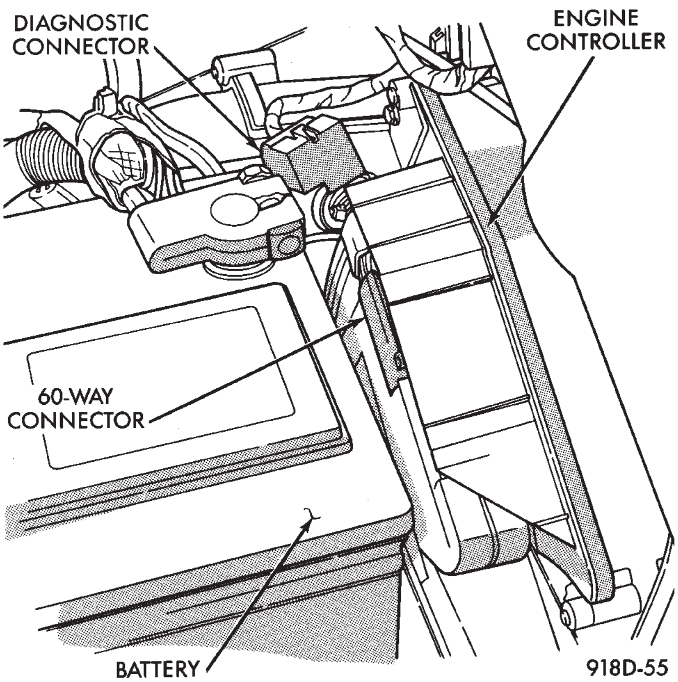

Fig. 1 Engine Controller

REMOVAL

(1) Remove air cleaner duct or air cleaner assembly.

(2) Remove battery.

(3) Remove engine controller mounting screws.

(4) Remove 60-way wiring connector from the engine controller.

(5) Remove controller.

INSTALLATION

(1) Connect 60-Way electrical connector to Engine Controller (Fig. 1).

(2) Install engine controller. Tighten mounting screws.

(3) Install battery.

(4) Install air cleaner duct or air cleaner assembly.

COOLANT TEMPERATURE SENSOR

On 2.5L engines the coolant temperature sensor is located behind the ignition coil (Fig. 2). On 3.0L engines the sensor is located next to the thermostat housing (Fig. 3).

REMOVAL

(1) Drain cooling system until coolant level is below coolant sensor. Refer to Group 7, Cooling System.

(2) Disconnect electrical connector from sensor.

(3) Remove sensor from engine.

INSTALLATION

(1) Install coolant sensor. Tighten 2.5L engine coolant sensor to 28 N•m (20 ft. lbs.) torque. Tighten the 3.0L engine coolant sensor to 7 N•m (60 in. lbs.) torque.

(2) Connect electrical connector to sensor.

(3) Fill cooling system. Refer to Group 7, Cooling System.

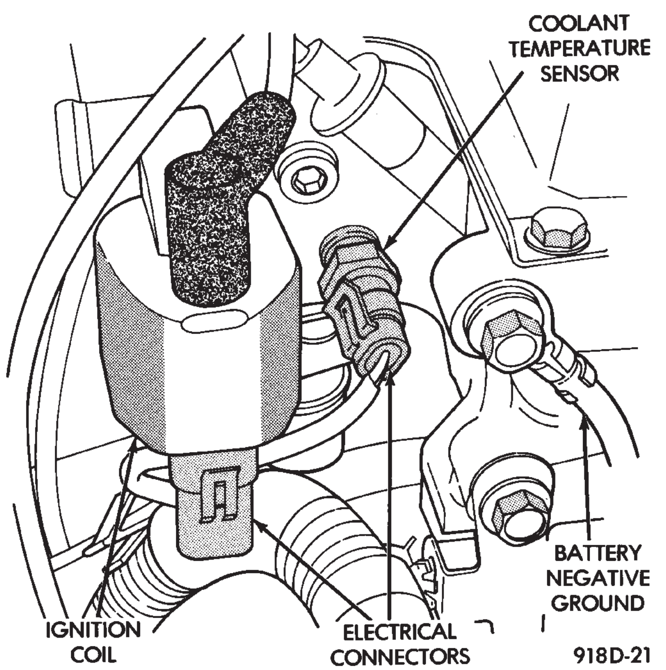

Fig. 2 Coolant Temperature Sensor—2.5L TBI Engines

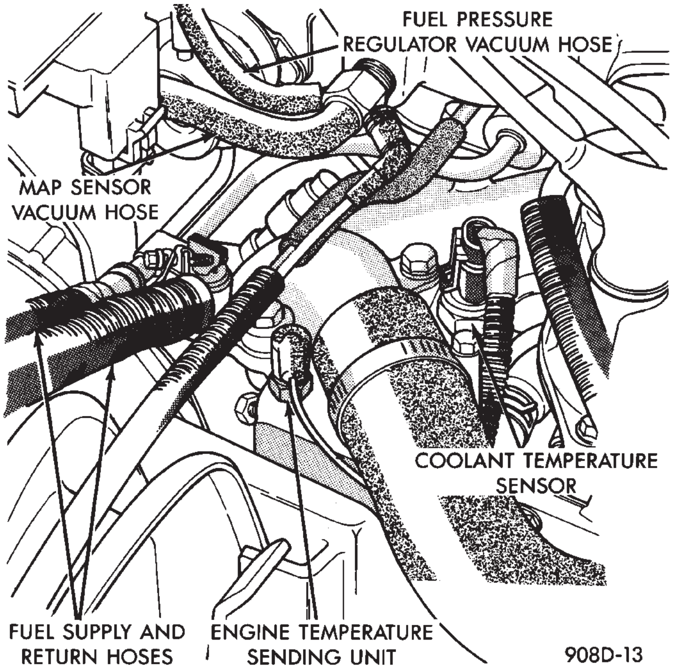

Fig. 3 Coolant Temperature Sensor—3.0L Engine

IGNITION COIL—2.5L TBI ENGINES

The ignition coil mounts to the thermostat housing (Fig. 4).

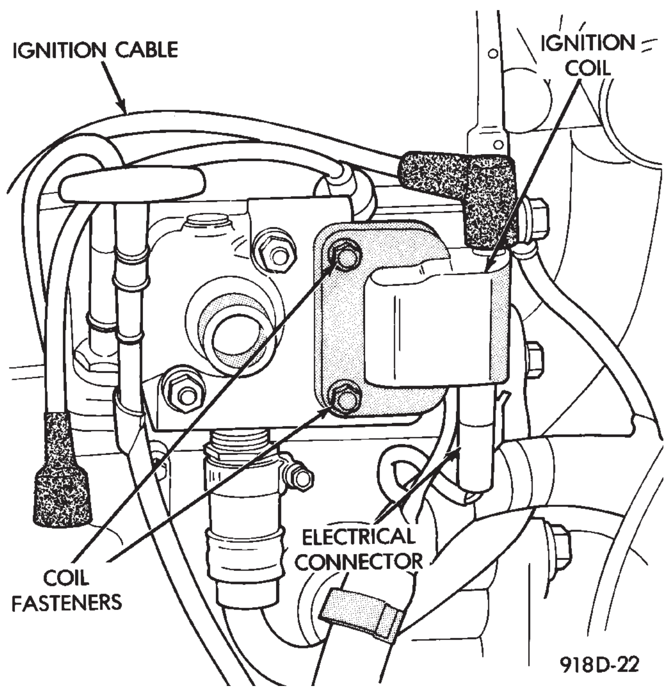

Fig. 4 Ignition Coil—2.5L Engines

REMOVAL

(1) Disconnect the coil to distributor ignition cable (Fig. 4).

(2) Disconnect the wiring harness connector from the coil.

(3) Remove ignition coil mounting screws.

INSTALLATION

(1) Install ignition coil onto the bracket. Tighten the screws to 9.5 N●m (85 in. lbs.) torque.

(2) Connect the wiring harness connector.

(3) Connect the coil to distributor ignition cable.

IGNITION COIL—3.0L ENGINES

The ignition coil is located at the back of the intake manifold (Fig. 5).

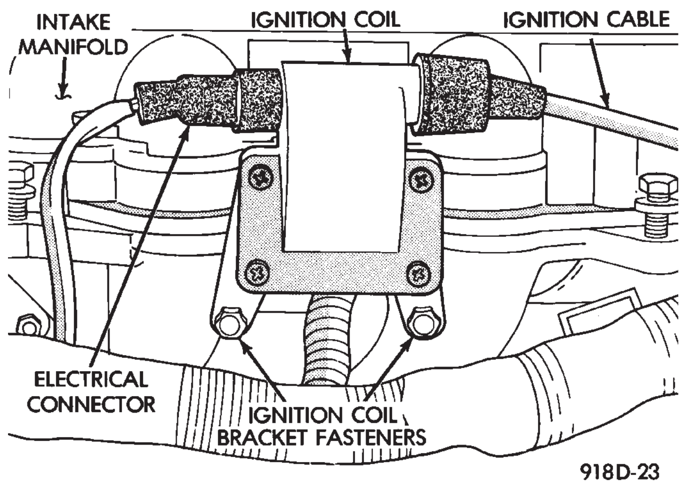

Fig. 5 Ignition Coil—3.0L Engine

REMOVAL

(1) Remove air cleaner assembly.

(2) Disconnect ignition cable from coil.

(3) Disconnect wiring harness connector from coil.

(4) Remove coil mounting screws.

INSTALLATION

(1) Loosely install ignition coil on intake manifold. Tighten the intake manifold fastener to 13 N●m (115 in.lbs.) torque. Tighten ignition coil bracket fasteners to 10 N●m (96 in. lbs.) torque.

(2) Connect the wiring harness connector.

(3) Connect the coil to distributor ignition cable.

(4) Install the air cleaner assembly. Tighten the air cleaner fasteners to 25 N●m (225 in. lbs.) torque.

SPARK PLUG SERVICE

When replacing the spark plug and coil cables, route the cables correctly and secure them in the appropriate retainers. Failure to route the cables properly can cause the radio to reproduce ignition noise, cause cross ignition of the spark plugs or short circuit the cables to ground.

SPARK PLUG REMOVAL

Always remove the spark plug cable by grasping at the spark plug boot, turning the boot 1/2 turn and pulling straight back in a steady motion.

(1) Prior to removing the spark plug spray compressed air around the spark plug hole and the area around the spark plug.

(2) Remove the spark plug using a quality socket with a rubber or foam insert.

(3) Inspect the spark plug condition. Refer to Spark Plug Condition in this section.

SPARK PLUG GAP ADJUSTMENT

(1) Check the spark plug gap with a gap gauge. If the gap is not correct, adjust it by bending the ground electrode (Fig. 6).

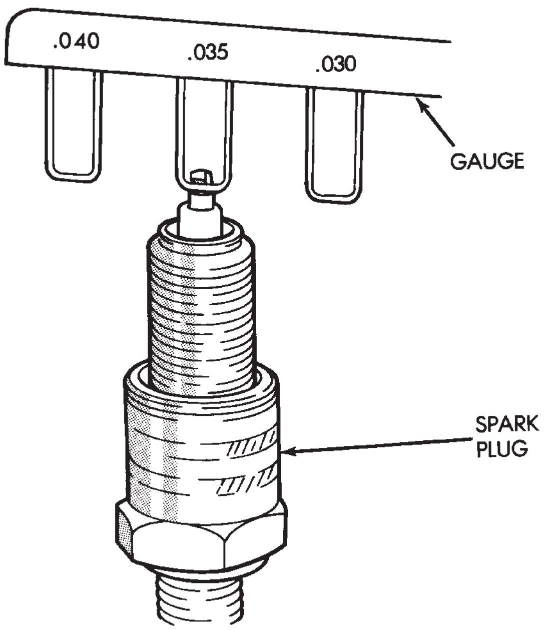

Fig. 6 Setting Spark Plug Gap—Typical

SPARK PLUG INSTALLATION

(1) Start the spark plug into the cylinder head by hand to avoid cross threading.

(2) Tighten spark plugs to 28 N•m (20 ft. lbs.) torque.

(3) Install spark plug cables over spark plugs.

IDLE RPM TEST—2.5L AND 3.0L ENGINES

WARNING: APPLY PARKING BRAKE AND/OR BLOCK WHEELS BEFORE PERFORMING IDLE CHECK OR ADJUSTMENT, OR ANY TESTS WITH A RUNNING ENGINE.

Engine idle set **rpm** should be **tested and recorded when the vehicle is first brought into shop for testing.** This will assist in diagnosing complaints of engine stalling, creeping and hard shifting on vehicles equipped with automatic transmissions.

Proceed to the Throttle Body Minimum Airflow procedures.

THROTTLE BODY MINIMUM AIR FLOW CHECK PROCEDURE—2.5L ENGINE

(1) Connect Diagnostic Readout Box II (DRBII).

(2) Remove air cleaner assembly. Plug the heated air door vacuum hose.

(3) Warm engine in Park or Neutral until the cooling fan has cycled on and off at least once.

(4) Hook-up timing check device and tachometer.

(5) Disconnect the coolant temperature sensor and set basic timing to 12°BTDC ± 2°BTDC.

(6) Shut off engine. Reconnect coolant temperature sensor.

(7) Disconnect the PCV valve hose from the intake manifold nipple.

(8) Attach Air Metering Fitting #6457 (Fig. 7) to the intake manifold PCV nipple.

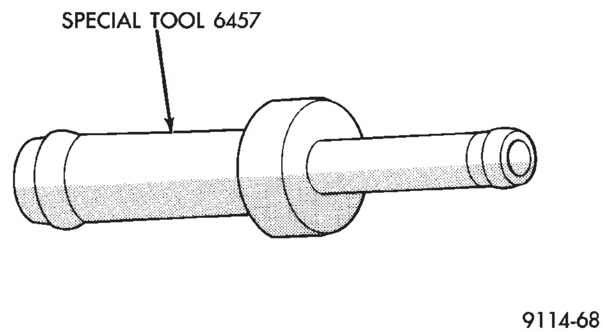

Fig. 7 Air Metering Fitting

(9) Restart the engine, allow engine to idle for at least one minute.

(10) Using the DRBII, Access Min Airflow Idle Spd in the sensor read test mode.

(11) The following will then occur:

- AIS motor will fully close.
- Idle spark advance will become fixed.
- Idle fuel will be provided at a set value.
- Engine RPM will be displayed on Diagnostic Readout Box II (DRBII).

(12) Check idle RPM with tachometer. If idle RPM is within the specifications listed below, then the throttle body minimum air flow is set correctly.

IDLE SPECIFICATIONS

Odometer Reading	Engine	Idle RPM
Below 1000 Miles	2.5L	650–1250 RPM
Above 1000 Miles	2.5L	1050–1250 RPM

9114-163

If idle RPM is not within specification replace throttle body.

(13) Shut off engine.

(14) Remove Special Tool number 6457 from intake manifold PCV nipple. Reinstall the PCV valve hose.

(15) Remove DRBII.

(16) Reinstall air cleaner assembly. Reinstall heated air door vacuum hose.

(17) Disconnect timing check device and tachometer.

THROTTLE BODY MINIMUM AIR FLOW CHECK PROCEDURE—3.0L ENGINE

(1) Warm engine in Park or Neutral until the cooling fan has cycled on and off at least once.

(2) Ensure that all accessories are off.

(3) Hook-up the timing check device and tachometer.

(4) Disconnect the coolant temperature sensor and set basic timing to 12° BTDC ± 2° BTDC.

(5) Shut off engine. Reconnect coolant temperature sensor wire.

(6) Disconnect the PCV valve hose from the PCV valve (Fig. 8).

(7) Plug the PCV valve nipple.

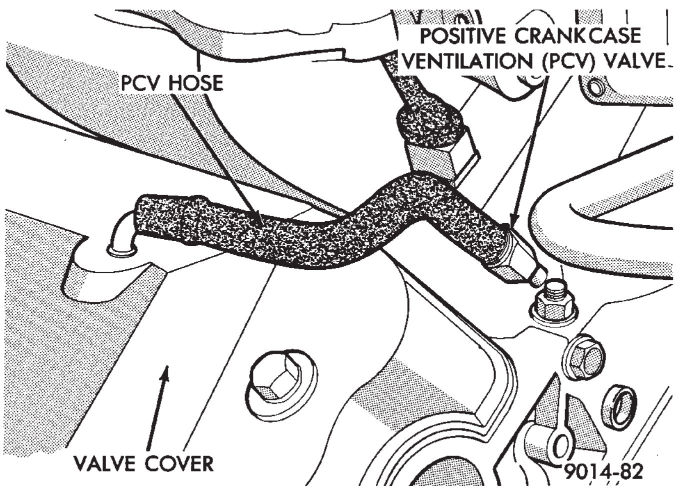

Fig. 8 3.0L PCV Valve

(8) Disconnect the idle purge hose from the engine vacuum harness tee (Fig. 9).

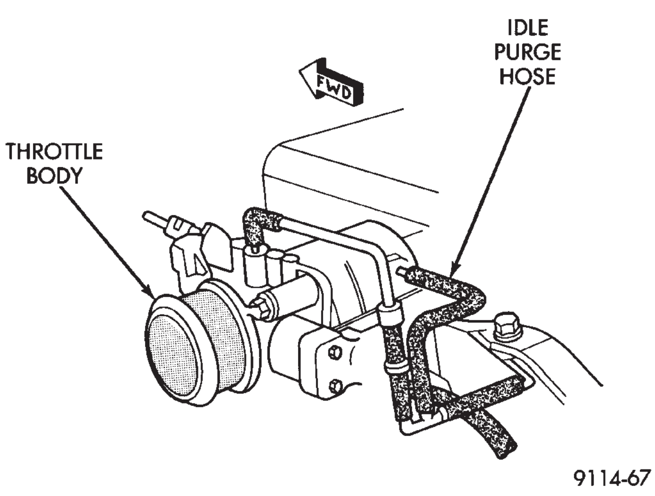

Fig. 9 3.0L Idle Purge Hose

(9) Install air metering fitting, special tool number 6457 (0.125 inch orifice) in the intake manifold mounted idle purge hose (Fig. 7).

(10) Connect Diagnostic Readout Box II (DRB II).

(11) Restart the engine, allow engine to idle for at least one minute.

(12) Using the DRBII, access Min. Airflow Idle Speed.

(13) The following will then occur:

- AIS motor will fully close.
- Idle spark advance will become fixed.
- Engine RPM will be displayed on Diagnostic Readout Box II (DRB II)

(14) Check idle RPM with tachometer, if idle RPM is within the below specification then the throttle body minimum air flow is set correctly.

IDLE SPECIFICATIONS—3.0L ENGINE

Odometer Reading	Idle RPM
Below 1000 Miles	625-950 RPM
Above 1000 Miles	750-950 RPM

9114-69

(15) If idle RPM is not within specifications, shut off the engine and clean the throttle body as follows:

(a) Remove the throttle body from engine.

WARNING: CLEAN THROTTLE BODY IN A WELL VENTILATED AREA. WEAR RUBBER OF BUTYL GLOVES. DO NOT LET MOPAR PARTS CLEANER COME IN CONTACT WITH EYES OR SKIN. AVOID INGESTING THE CLEANER. WASH THOROUGHLY AFTER USING CLEANER.

(b) While holding the throttle open, spray the entire throttle body bore and the manifold side of the throttle plate with Mopar Parts Cleaner. **Only use Mopar Parts Cleaner to clean the throttle body.**

(c) Using a soft scuff pad, clean the top and bottom of throttle body bore and the edges and manifold side of the throttle blade. **The edges of the throttle blade and portions of the throttle bore that are closest to the throttle blade when is closed, must be free of deposits.**

(d) Use compressed air to dry the throttle body.

(e) Inspect throttle body for foreign material.

(f) Install throttle body on manifold.

(g) Repeat steps 1 through 14. If the minimum air flow is still not within specifications, the problem is not caused by the throttle body.

(16) Shut off engine.

(17) Remove Air Metering Fitting #6457 from the intake manifold idle purge hose. Reconnect the hose to the engine vacuum harness tee.

(18) Remove the plug from the PCV valve. Reconnect the PCV valve hose to the PCV valve.

(19) Disconnect the DRB II.

IGNITION TIMING PROCEDURE—2.5L TBI AND 3.0L ENGINES

WARNING: BE SURE TO APPLY PARKING BRAKE AND/OR BLOCK WHEELS BEFORE PERFORMING SETTING IGNITION TIMING OR PERFORMING ANY TEST ON AN OPERATING ENGINE.

Proper ignition timing is required to obtain optimum engine performance. The distributor must be correctly indexed to provide correct initial ignition timing.

(1) Set the gearshift selector in park or neutral and apply the parking brake. All lights and accessories must be off.

(2) If using a magnetic timing light, insert the pickup probe into the open receptacle next to the timing scale window. If a magnetic timing unit is not available, use a conventional timing light connected to the number one cylinder spark plug cable.

Do not puncture cables, boots or nipples with test probes. Always use proper adapters. Puncturing the spark plug cables with a probe will damage the cables. The probe can separate the conductor and cause high resistance. In addition breaking the rubber insulation may permit secondary current to arc to ground.

(3) Turn selector switch to the appropriate cylinder position.

(4) Start engine and run until operating temperature is obtained.

(5) With the engine at normal operating temperature, connect the DRB II to the diagnostic connector. Access the State Display screen. Refer to the appropriate Powertrain Diagnostics Procedures Manual. **If not using the DRB II tester, disconnect the coolant temperature sensor electrical connector.** The electric radiator fan will operate and the Check Engine light will turn on after disconnecting the coolant sensor or starting the DRB II procedure.

(6) Aim Timing Light at timing scale (Fig. 10 or Fig. 11) or read magnetic timing unit. If flash occurs when timing mark is before specified degree mark, timing is advanced. To adjust, turn distributor housing in direction of rotor rotation.

If flash occurs when timing mark is after specified degree mark, timing is retarded. To adjust, turn distributor housing against direction of rotor rotation. Refer to Vehicle Emission Control Information label for correct timing specification. If timing is within ± 2° of value specified on the label, proceed to step (8). If outside specified tolerance, proceed to next step.

(7) Loosen distributor hold-down arm screw enough to rotate the distributor housing (Fig. 12 or Fig. 13). Turn distributor housing to adjust timing. Tighten the hold-down arm screw and recheck timing.

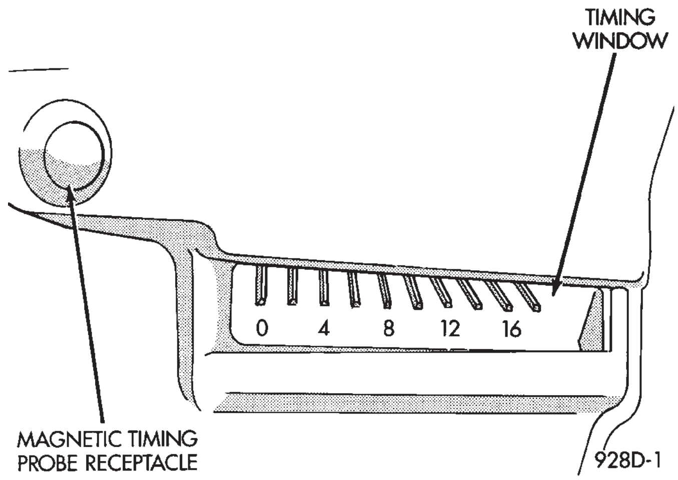

Fig. 10 Timing Scale—2.5L Engine

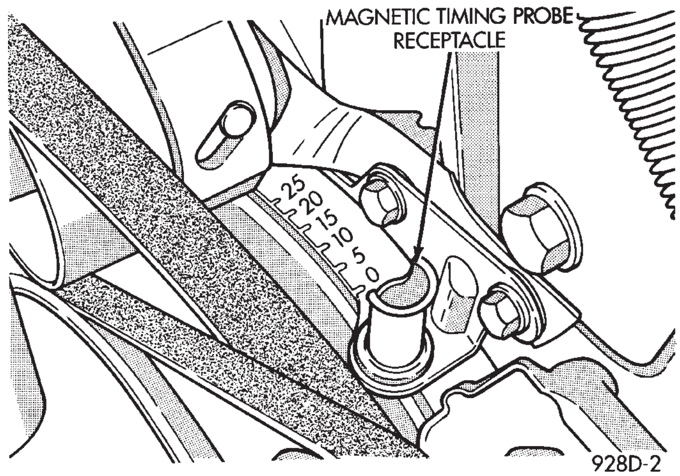

Fig. 11 Timing Scale—3.0L Engine

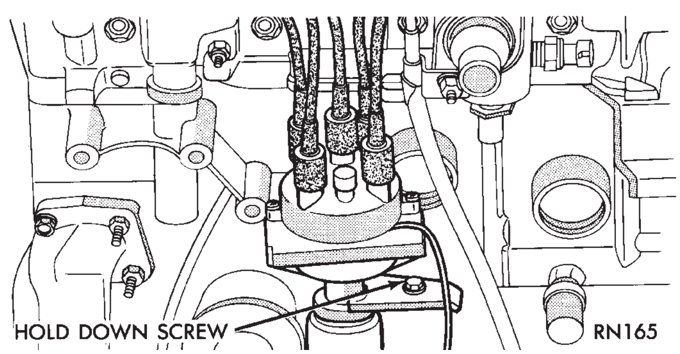

Fig. 12 Distributor Holddown—2.5L Engine

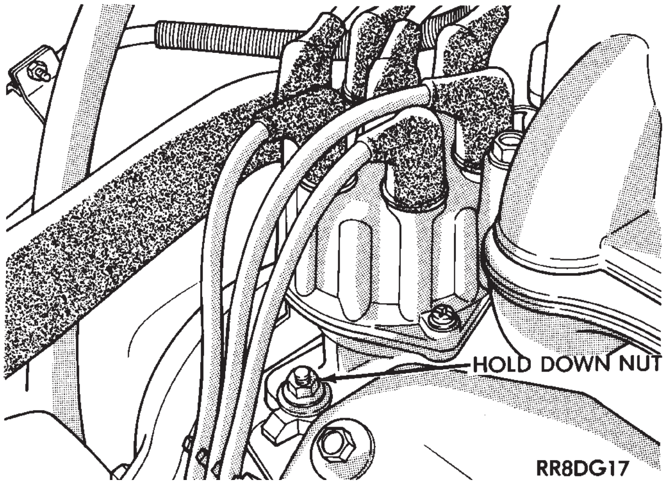

Fig. 13 Distributor Holddown—3.0L Engine

(8) Turn the engine off. Remove timing light or magnetic timing unit and tachometer. If the coolant temperature sensor was disconnected, connect the sensor and **erase fault codes using the Erase Fault Code Mode on the DRBII.** Refer to Group 14 General Diagnosis, On Board Diagnostics.

DISTRIBUTOR—2.5L ENGINE

REMOVAL

(1) Disconnect distributor pick-up connector from wiring harness connector (Fig. 14).

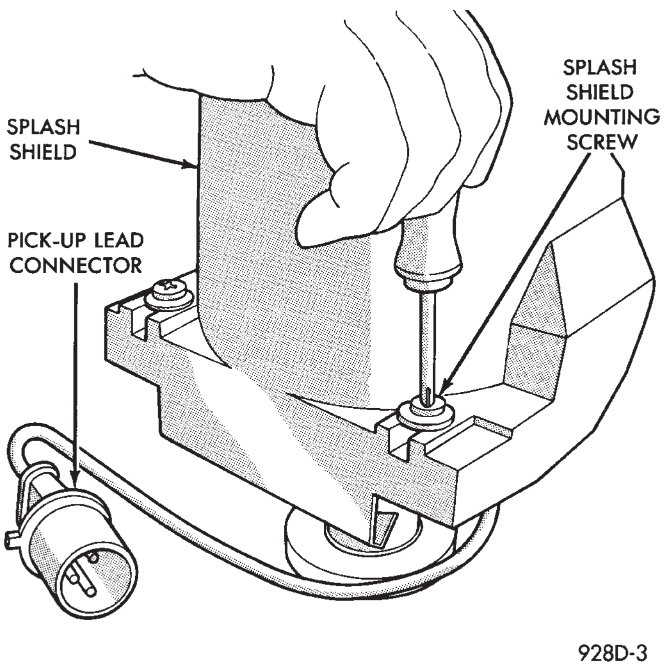

Fig. 14 Distributor Pickup Connector—2.5L Engine

(2) Remove splash shield retaining screws (Fig. 15).
(3) Remove splash shield (Fig. 15).
(4) Loosen distributor cap retaining screws (Fig. 16).
(5) Lift cap off of distributor (Fig. 17).

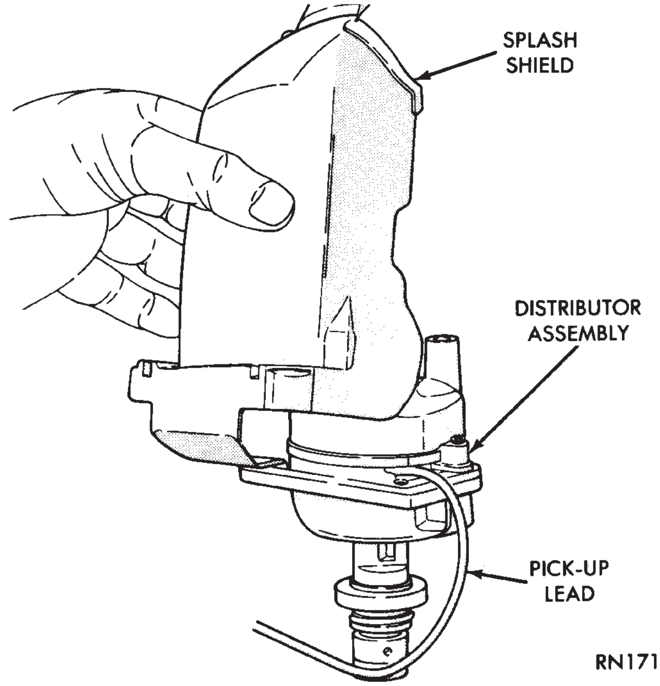

Fig. 15 Splash Shield—2.5L Engine

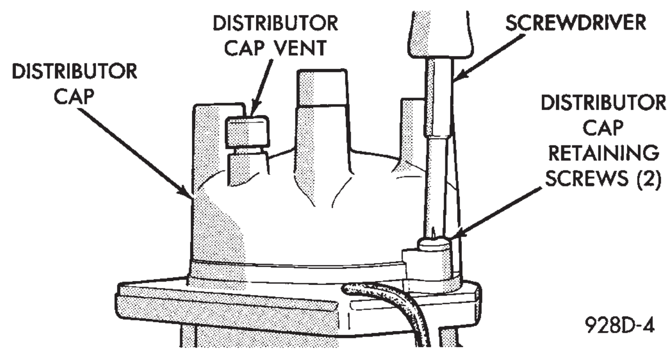

Fig. 16 Distributor Cap Retaining Screws—2.5L Engine

(6) Rotate engine crankshaft until the distributor rotor is pointing toward the cylinder block. Use this as reference when reinstalling distributor.
(7) Remove distributor hold-down screw (Fig. 12).
(8) Carefully lift the distributor from the engine.

INSTALLATION

(1) Position distributor in engine. Make certain that the O-ring is properly seated on distributor. If O-ring is cracked or nicked, replace it with new one.

(2) Carefully engage distributor drive with auxiliary shaft drive. When distributor is installed properly, rotor will be pointing toward cylinder block. **If engine has been cranked while distributor is removed, it will be necessary to establish proper relationship between the distributor shaft and Number 1 piston position as follows:**

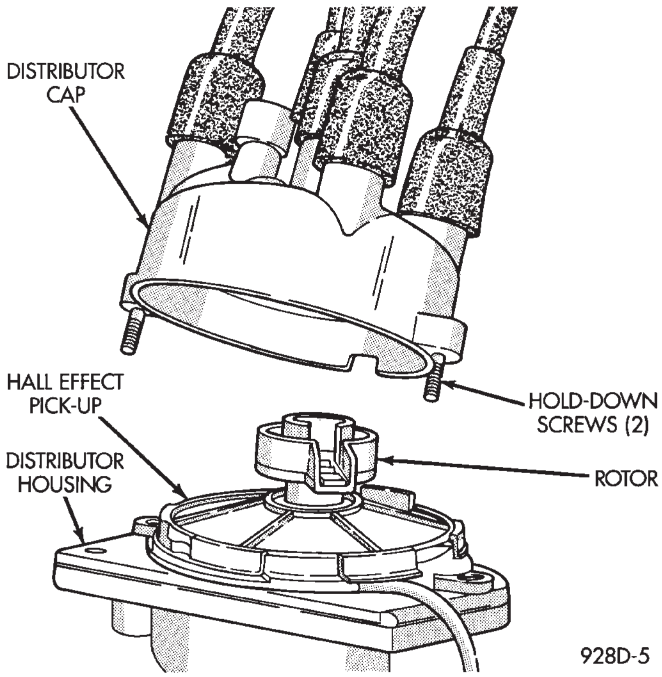

Fig. 17 Distributor Cap—2.5L Engine

(a) Rotate the crankshaft until number one piston is at top of compression stroke. Pointer on clutch housing should be in line with the **O (TDC)** mark on flywheel.

(b) Rotate rotor to a position just ahead of the number one distributor cap terminal.

(c) Lower the distributor into the opening, engaging distributor drive with drive on auxiliary shaft. With distributor fully seated on engine, rotor should be under the cap number 1 tower.

(3) Install the distributor cap. Ensure all high tension wires snap firmly in the cap towers.

(4) Install hold-down arm screw and finger tighten.

(5) Install splash shield.

(6) Connect distributor pick-up connector lead wire at wiring harness connector.

(7) Set ignition timing to specification. Refer to Ignition Timing.

DISTRIBUTOR PICK-UP—2.5L ENGINE

REMOVAL

(1) Remove splash shield and cap. Refer to Distributor Removal.

(2) Remove rotor from shaft (Fig. 18).

(3) Remove **Hall effect pick-up assembly** (Fig. 19).

INSTALLATION

(1) Place pick-up assembly into distributor housing (Fig. 19).

The distributor pick-up wires may be damaged if not properly reinstalled.

(2) Install rotor (Fig. 18).

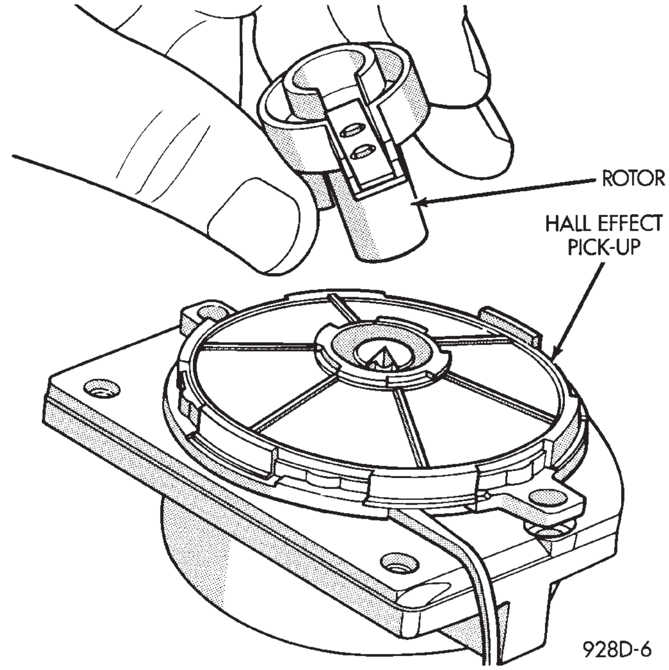

Fig. 18 Ignition Rotor—2.5L Engine

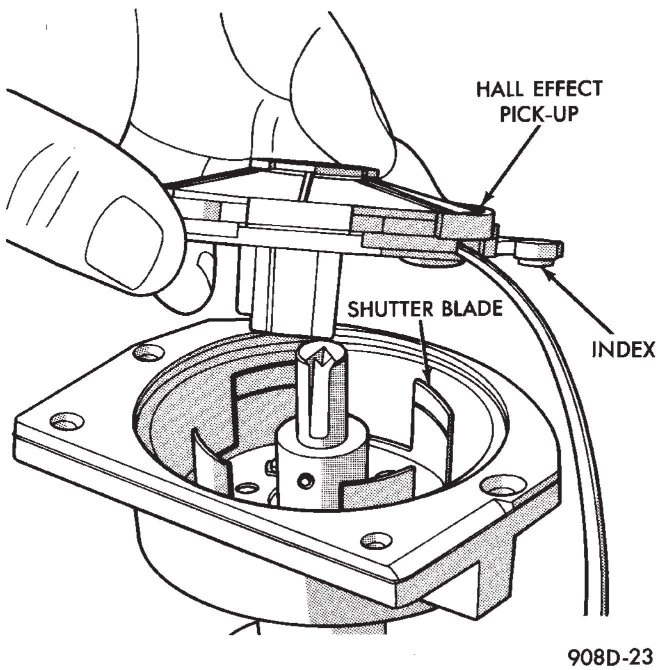

Fig. 19 Hall Effect Pickup Assembly—2.5L Engine

(3) Install cap and splash shield. Refer to Distributor Installation.

DISTRIBUTOR SERVICE—3.0L ENGINE

REMOVAL

(1) Disconnect distributor connector from wiring harness connector (Fig. 20).

(2) Loosen distributor cap retaining screws.

(3) Lift cap of off distributor (Fig. 21).

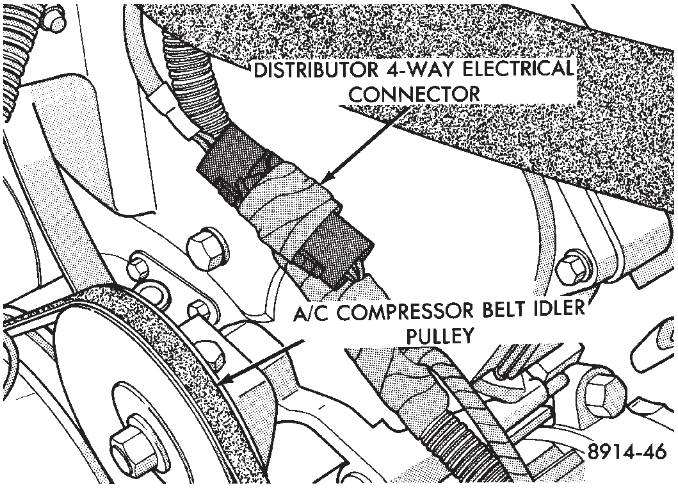

Fig. 20 Distributor Electrical Connector—3.0L Engine

(4) Rotate engine crankshaft until the distributor rotor points the intake manifold plenum. Scribe a mark on the plenum in line with the rotor. The scribe line indicates where to position the rotor when reinstalling the distributor.

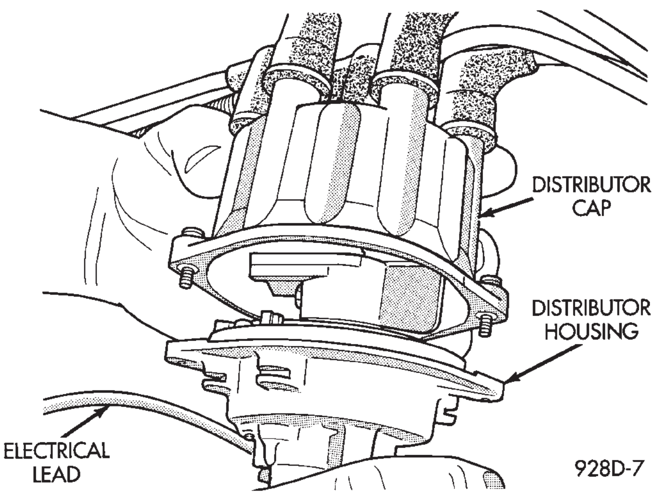

Fig. 21 Distributor Cap—3.0L Engine

(5) Remove distributor hold down nut (Fig. 22).

(6) Carefully lift the distributor from the engine.

INSTALLATION

(1) Position distributor in engine. Make certain that the O-ring is properly seated on distributor. If O-ring is cracked or nicked replace with new one.

(2) Carefully engage distributor drive with gear on camshaft. When the distributor is installed properly, the rotor will be in line with previously scribe line on air intake plenum. **If engine was cranked while distributor was removed, it will be necessary to establish proper relationship between the distributor shaft and Number 1 piston position as follows:**

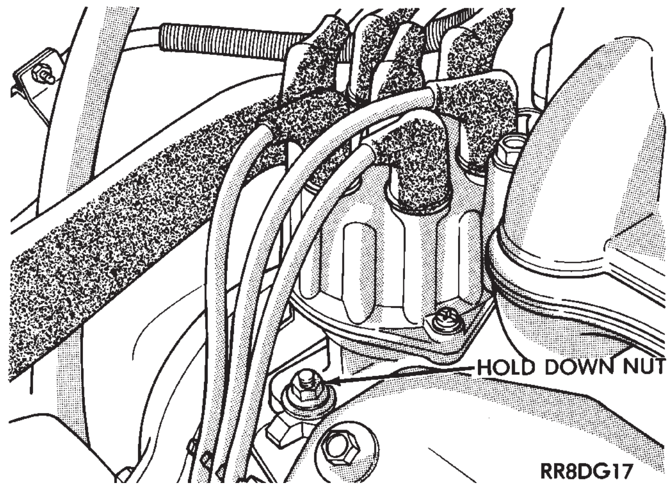

Fig. 22 Distributor Hold-Down—3.0L Engine

(a) Rotate the crankshaft until number one piston is at top of compression stroke.

(b) Rotate rotor to number one rotor terminal (Fig. 23).

(c) Lower the distributor into the opening, engaging distributor drive with drive on camshaft. With distributor fully seated on engine, rotor should be under the number 1 terminal (Fig. 23).

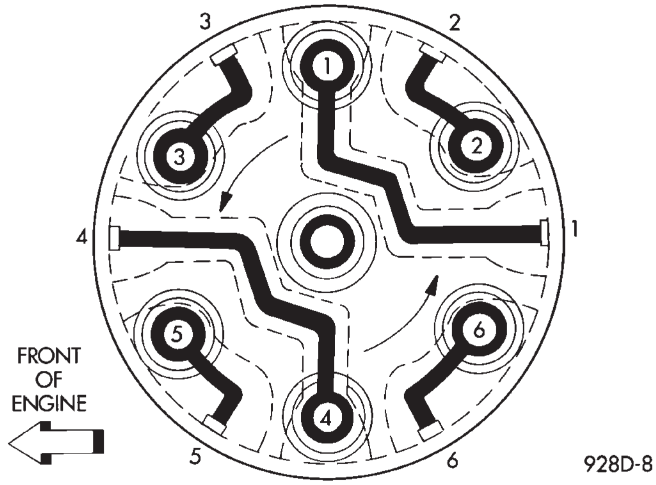

Fig. 23 3.0L Engine Distributor Cap Terminal Routing—View from Top of Cap

(3) Install the distributor cap (Fig. 21). Ensure sure all high tension wires are firmly in the cap towers.

(4) Install hold-down nut and finger tighten (Fig. 22).

(5) Connect distributor electrical connector to wiring harness connector (Fig. 20).

(6) Set ignition timing to specification. Refer to Ignition Timing in this section.

DISASSEMBLY

(1) Remove distributor cap mounting screws (Fig. 21).

(2) Remove distributor cap and inspect for flashover, cracked carbon button, cracked cap, or burned terminals. If any of these conditions exist, replace cap.

(3) Remove rotor screw (Fig. 24). Inspect rotor for cracks or burned electrode. If any of these conditions exist, replace rotor.

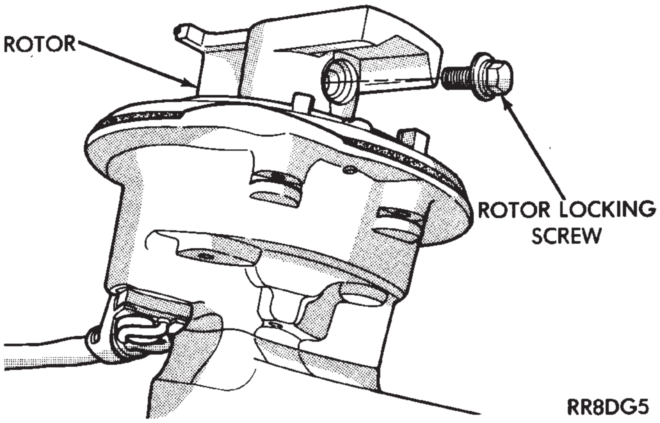

Fig. 24 Rotor Screw

(4) Remove protective cover from distributor housing (Fig. 25).

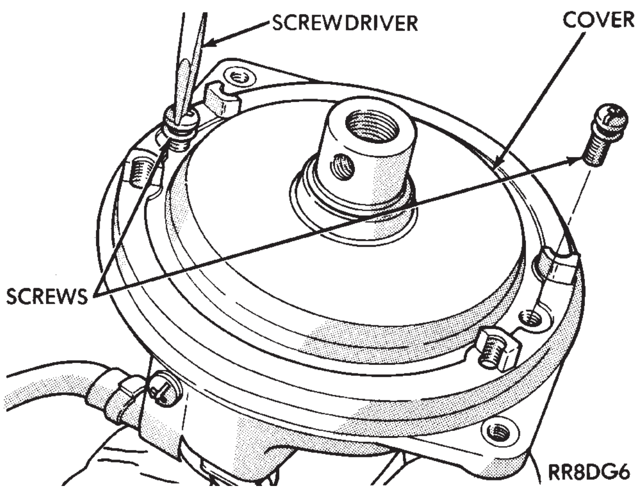

Fig. 25 Protective Cover

(5) Remove lead wire clamp screw and remove lead wire (Fig. 26).

(6) Remove disk assembly screw (Fig. 27).

(7) Remove disk spacers and disk (Fig. 28). Disk and spacers are keyed. Check disk for warpage, cracks or damaged slots (Fig. 29).

(8) Remove bushing and photo optic sensing unit fasteners. Remove unit from distributor housing (Fig. 30).

(9) Remove bearing retainer screws (Fig. 31).

(10) Make reassembly alignment marks on gear and shaft (Figs. 32 and 33).

(11) With a pin punch drive out distributor drive gear roll pin (Fig. 34).

(12) Remove distributor drive gear (Fig. 35).

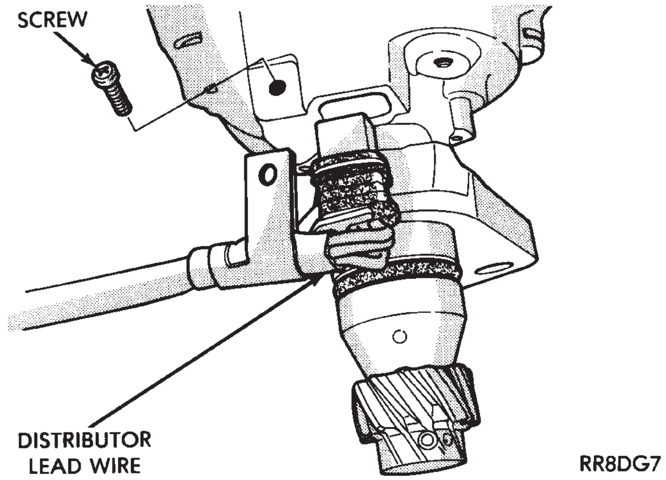

Fig. 26 Lead Wire Clamp

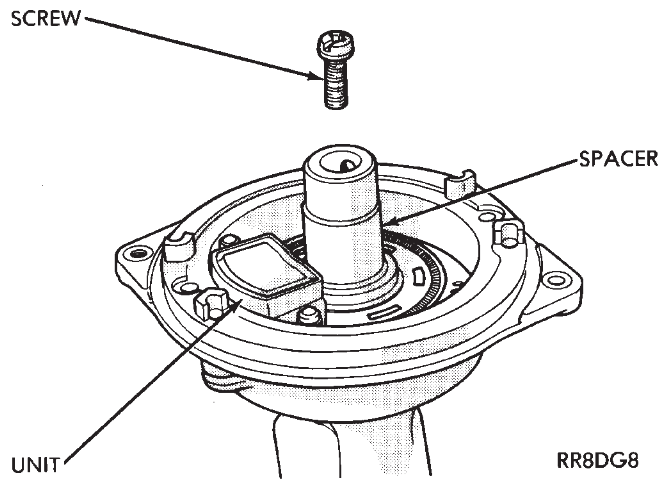

Fig. 27 Disk Assembly Screw

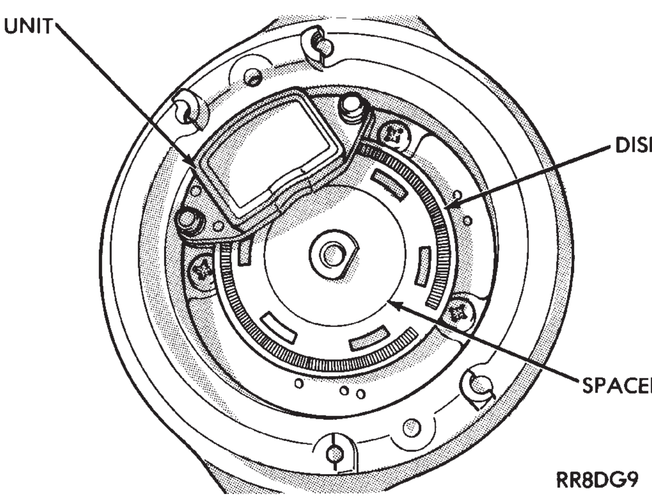

Fig. 28 Disk and Spacers Installed

(13) Remove distributor shaft and bearing assembly (Fig. 36).

(14) To reassemble, reverse preceding procedure. Refer to Fig. 37.

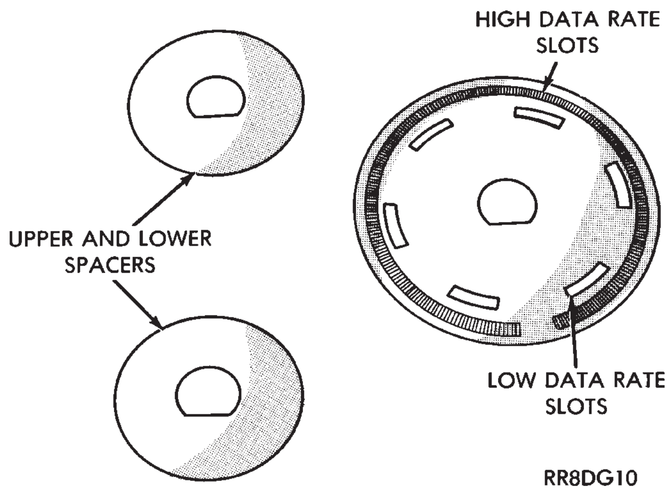

Fig. 29 Disk and Spacers

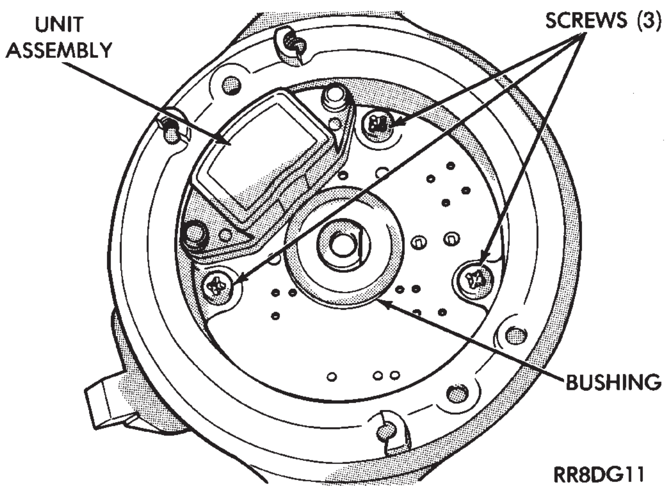

Fig. 30 Photo Optic Sensing Unit Assembly and Bushing

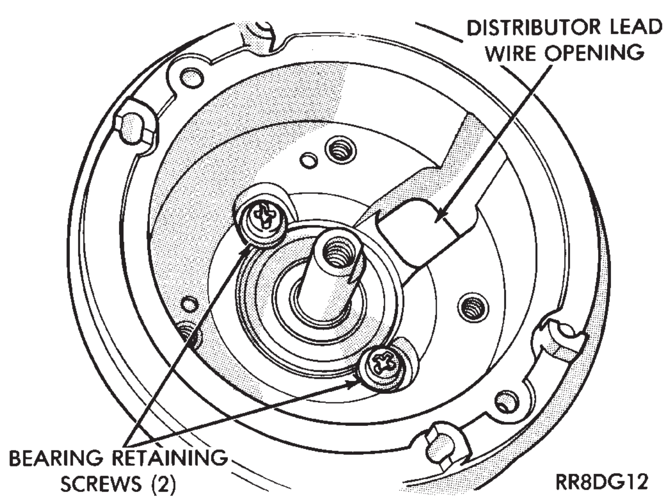

Fig. 31 Bearing Retainer Screws

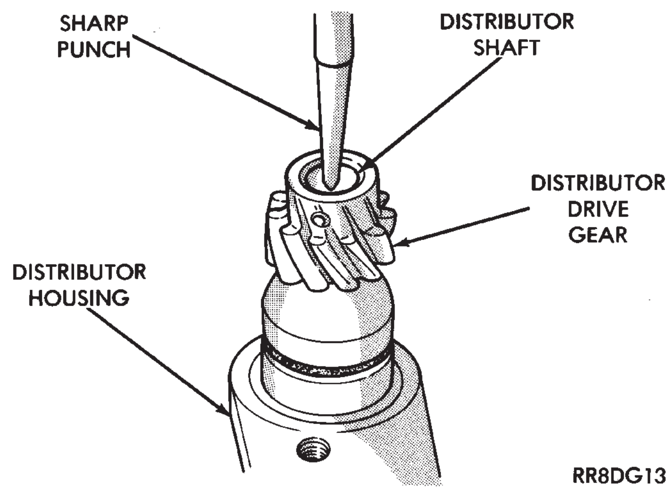

Fig. 32 Marking Drive Gear and Shaft

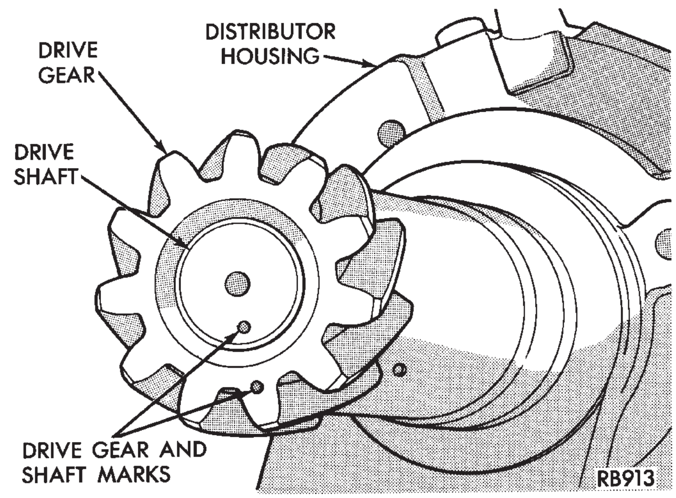

Fig. 33 Marks on Drive Gear and Shaft

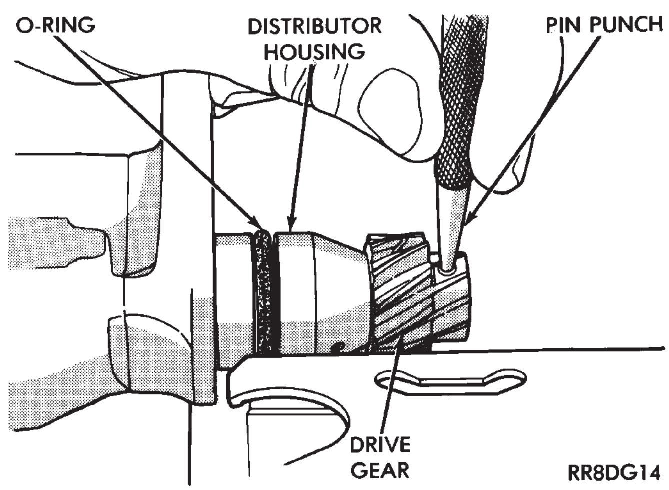

Fig. 34 Drive Gear Roll Pin

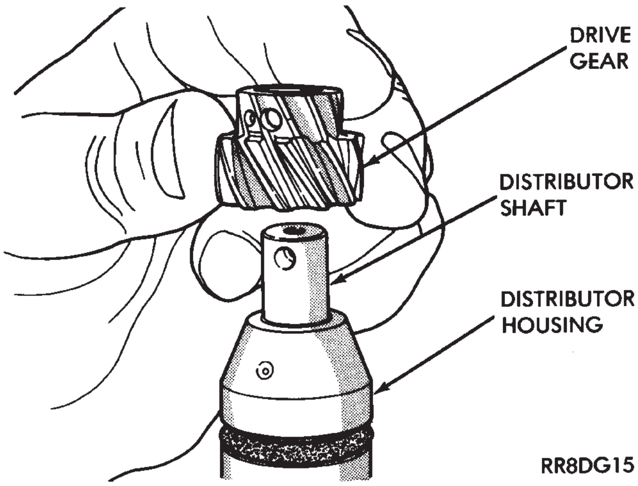

Fig. 35 Drive Gear

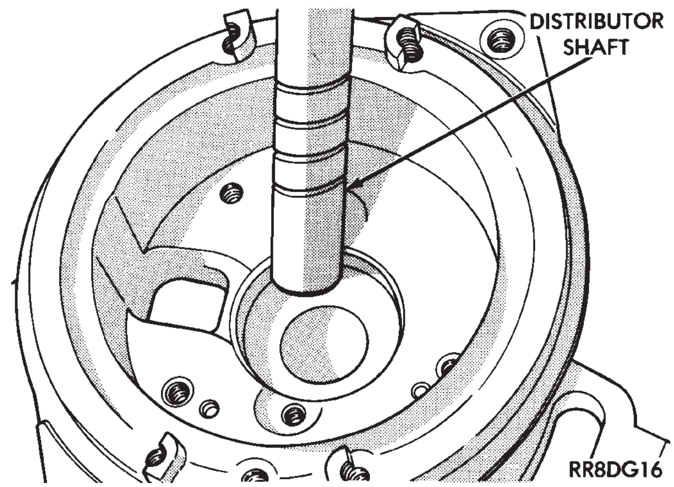

Fig. 36 Distributor Shaft

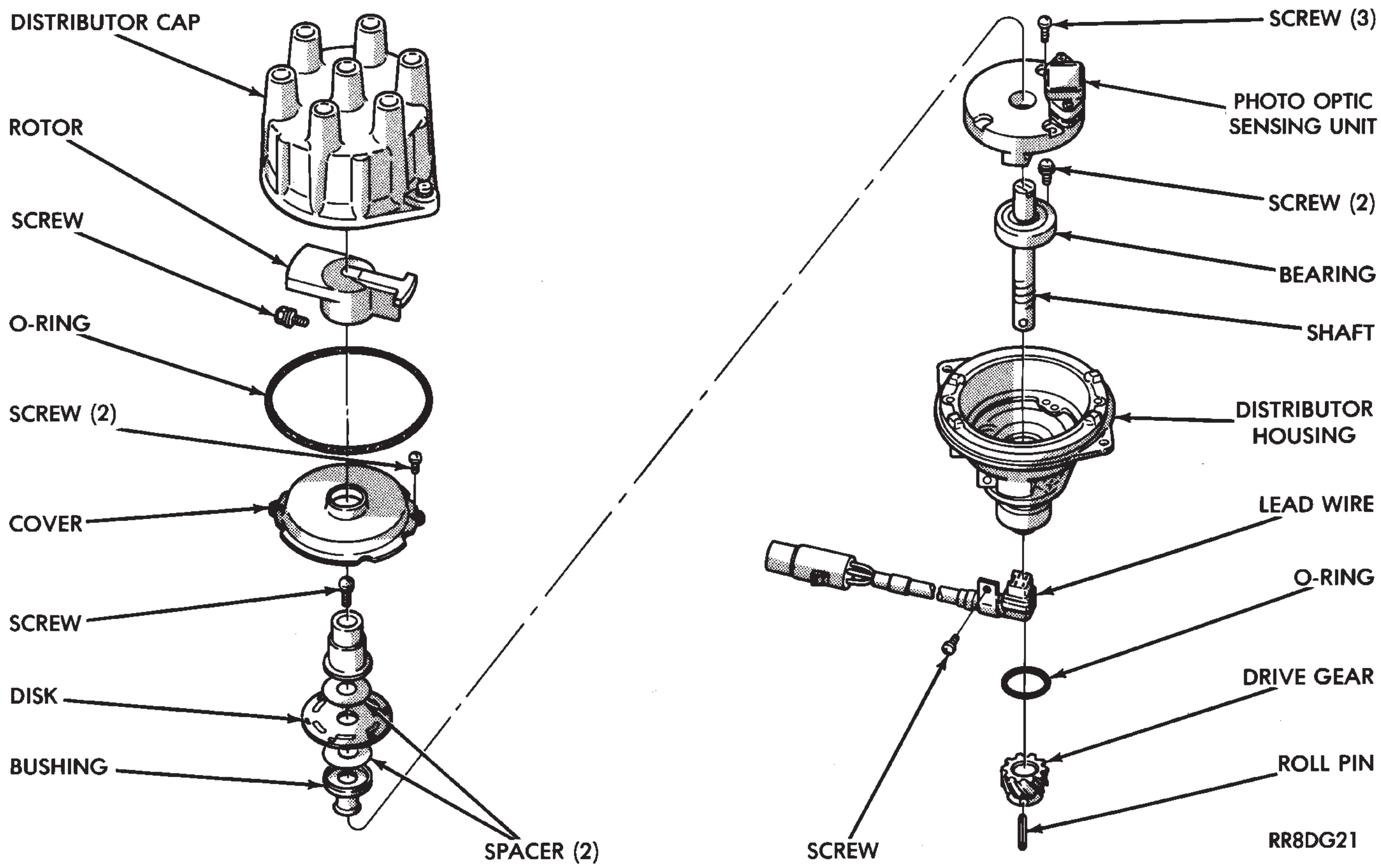

Fig. 37 Distributor—3.0L Engine

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR SERVICE—2.5L TBI AND 3.0L ENGINES

(1) Remove vacuum hose and remove mounting screws from sensor (Fig. 38 and Fig. 39).

(2) Remove wiring harness and remove sensor.

(3) Reverse the above procedure for installation. Check that vacuum hose is attached to vacuum source.

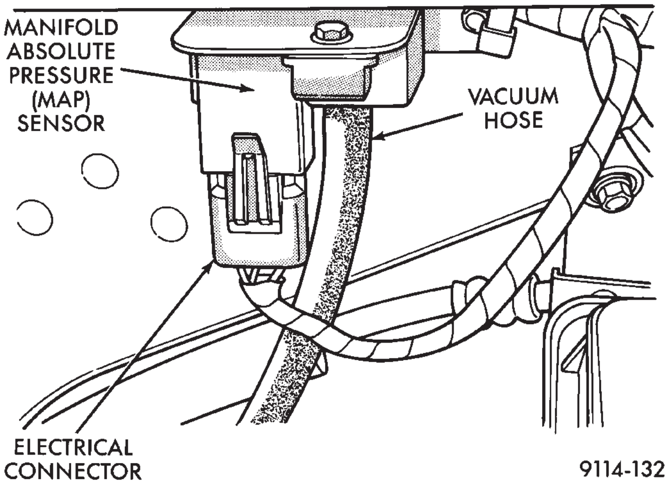

Fig. 38 Manifold Absolute Pressure (MAP) Sensor—2.5L TBI Engines

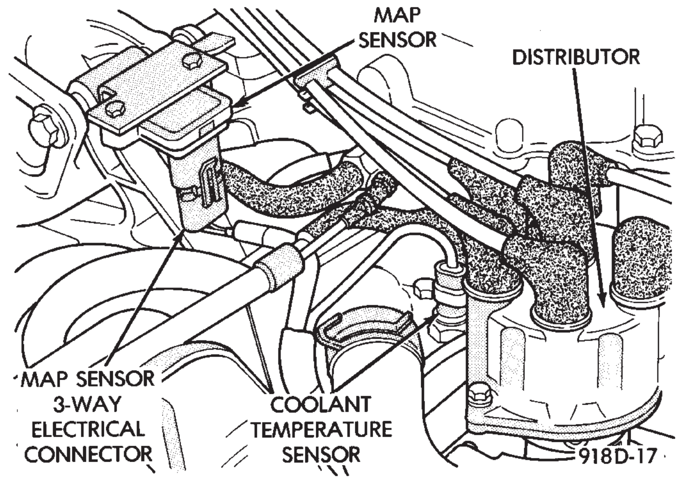

Fig. 39 Manifold Absolute Pressure (MAP) Sensor—3.0L Engine

3.3L IGNITION SYSTEM—SYSTEM OPERATION

INDEX

GENERAL INFORMATION

This section describes the ignition systems for the 3.3L engine.

On Board Diagnostics is described in the Fuel Injection Sections of Group 14.

Group 0, Lubrication and Maintenance, contains general maintenance information for ignition related items. The Owner's Manual also contains maintenance information.

The 3.3L engine uses a fixed ignition timing system. Basic ignition timing is not adjustable. All spark advance is determined by the engine controller.

The 3.3L engine uses a distributorless ignition system, refereed to as the Direct Ignition System. The system's three main components are the coil pack, crankshaft timing sensor, and camshaft reference sensor. The crankshaft and camshaft sensors are hall effect devices.

The camshaft and crankshaft sensors generate pulses that are the inputs sent to the engine controller. The engine controller interprets crankshaft position from these sensors. The engine controller uses crankshaft position reference to determine injector sequence and ignition timing.

The camshaft sensor senses when a slot in the camshaft gear passes beneath it (Fig. 1). The crankshaft sensor senses when a window in the drive plate passes under it (Fig. 2). When a slot or window is sensed, the input voltage from the sensor to the engine controller switches from low (less than .3 volts) to high (5 volts). As the slot or window passes, the input voltage is switched back to low (less than .3 volts).

FIRING ORDER

The firing order of the 3.3L engine direct ignition system is 1-2-3-4-5-6 (Fig. 3).

ENGINE CONTROLLER

The ignition system is regulated by the Single board Engine Controller II (SBEC II), **referred to in this manual as the Engine Controller (Fig. 4).** The controller supplies battery voltage to the ignition coil through the Auto Shutdown (ASD) Relay. The controller also controls ground circuit for the ignition coil. By switching the ground path for the coil on and off, the engine controller adjusts ignition timing to meet changing engine operating conditions.

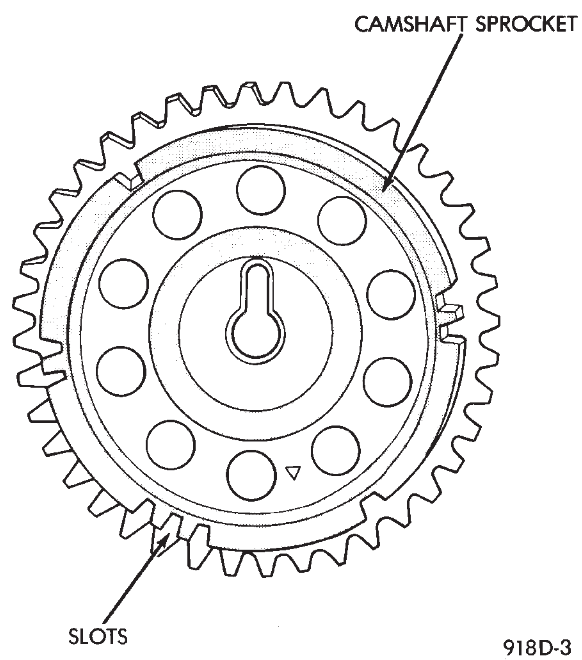

Fig. 1 Camshaft Sprocket

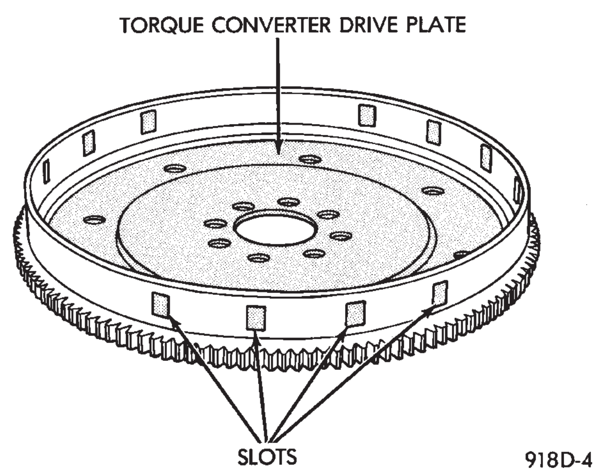

Fig. 2 Driveplate

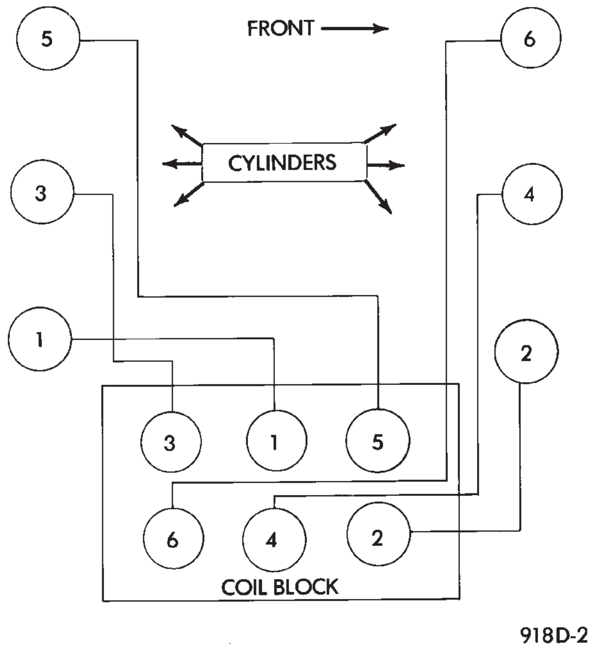

Fig. 3 Spark Plug Wire Routing—3.3L Engine

During the crank-start period the controller advances ignition timing a set amount. During engine operation, the amount of spark advance provided by the engine controller is determined by three input factors:

- coolant temperature
- engine RPM
- available manifold vacuum

The engine controller also regulates the fuel injection system. Refer to the Fuel Injection sections of Group 14.

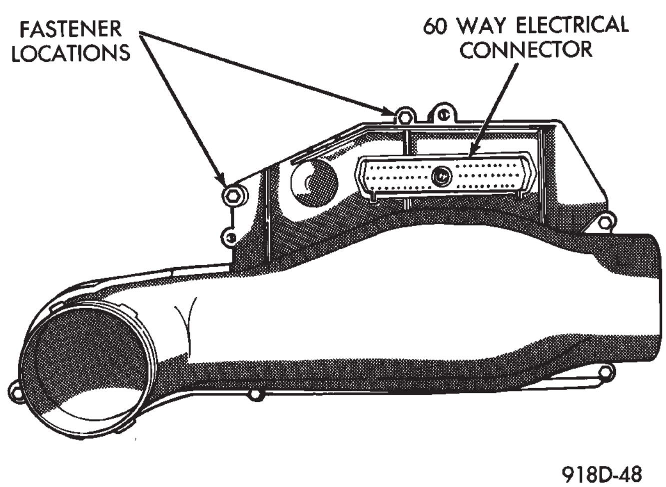

Fig. 4 Single Board Engine Controller

SPARK PLUG CABLES

Spark Plug cables are sometimes referred to as secondary ignition wires. The wires transfer electrical current from the distributor to individual spark plugs at each cylinder. The spark plug cables are of nonmetallic construction and have a built in resistance. The cables provide suppression of radio frequency emissions from the ignition system.

Check the spark plug cable connections for good contact at the coil and distributor cap towers and at the spark plugs. Terminals should be fully seated. The nipples and spark plug covers should be in good condition. Nipples should fit tightly on the coil and distributor cap towers and spark plug cover should fit tight around spark plug insulators. Cable connections that are loose will corrode and increase the resistance and permit water to enter the towers causing ignition malfunction.

SPARK PLUGS

The 3.3L engine uses resistor spark plugs. They have resistance values of 6,000 to 20,000 ohms when checked with at least a 1000 volt tester.

Remove the spark plugs and examine them for burned electrodes and fouled, cracked or broken porcelain insulators. Keep plugs arranged in the order in which they were removed from the engine. An isolated plug displaying an abnormal condition indicates that a problem exists in the corresponding cylinder. Replace spark plugs at the intervals recommended in Group O.

Spark plugs that have low milage may be cleaned and reused if not otherwise defective. Refer to the Spark Plug Condition section of this group. After cleaning, file the center electrode flat with a small point file or jewelers file. Adjust the gap between the electrodes (Fig. 5) to the dimensions specified in the chart at the end of this section.

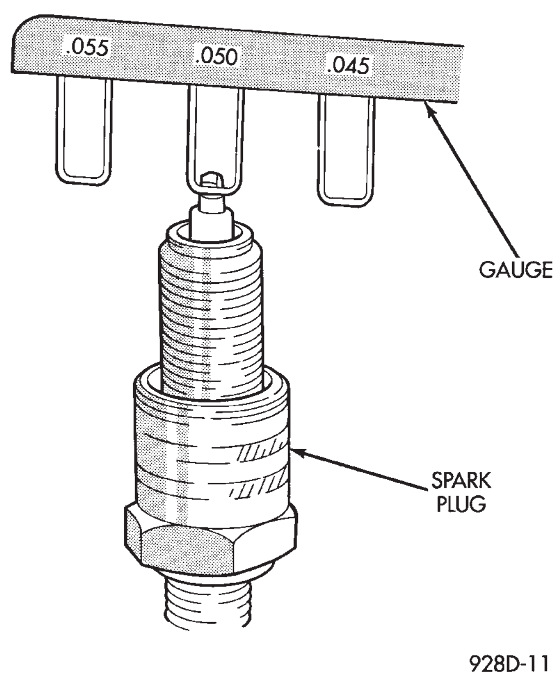

Fig. 5 Setting Spark Plug Electrode Gap—Typical

Always tighten spark plugs to the specified torque. Over tightening can cause distortion resulting in a change in the spark plug gap. Tighten 3.3L engine spark plugs to 28 N●m (20 ft. lbs.) torque.

SPARK PLUG CONDITION

NORMAL OPERATING CONDITIONS

The few deposits present will be probably light tan or slightly gray in color with most grades of commercial gasoline (Fig. 6). There will not be evidence of electrode burning. Gap growth will not average more than approximately 0.025 mm (.001 in) per 1600 km (1000 miles) of operation. Spark plugs that have normal wear can usually be cleaned, have the electrodes filed and regapped, and then reinstalled.

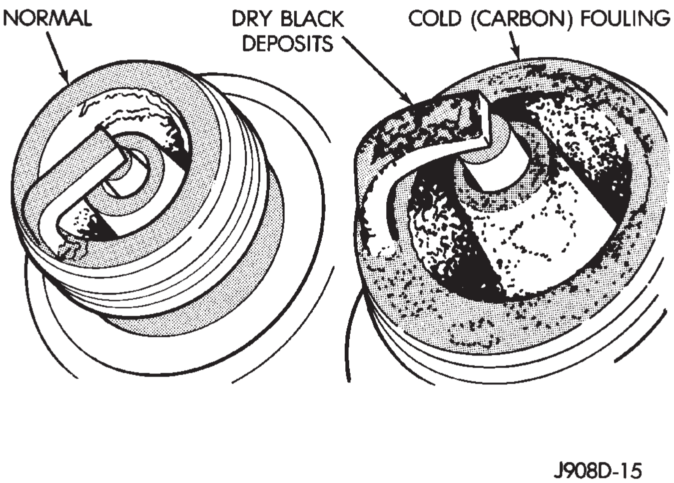

Fig. 6 Normal Operation and Cold (Carbon) Fouling

Some fuel refiners in several areas of the United States have introduced a manganese additive (MMT) for unleaded fuel. During combustion, fuel with MMT may coat the entire tip of the spark plug with a rust colored deposit. The rust color deposits can be misdiagnosed as being caused by coolant in the combustion chamber. Spark plug performance is not affected by MMT deposits.

COLD FOULING (CARBON FOULING)

Cold fouling is sometimes referred to as carbon fouling because the deposits that cause cold fouling are basically carbon (Fig. 6). A dry, black deposit on one or two plugs in a set may be caused by sticking valves or defective spark plug cables. Cold (carbon) fouling of the entire set may be caused by a clogged air cleaner.

Cold fouling is normal after short operating periods. The spark plugs do not reach a high enough operating temperature during short operating periods.

WET FOULING

A spark plug that is coated with excessive wet fuel or oil is wet fouled. In older engines, wet fouling can be caused by worn rings or excessive cylinder wear. **Break-in fouling of new engines may occur before normal oil control is achieved. In new or recently overhauled engines, wet fouled spark plugs can be usually be cleaned and reinstalled.**

OIL OR ASH ENCRUSTED

If one or more plugs are oil or oil ash encrusted, the engine should be evaluated for the cause of oil entry into the combustion chamber (Fig. 7).

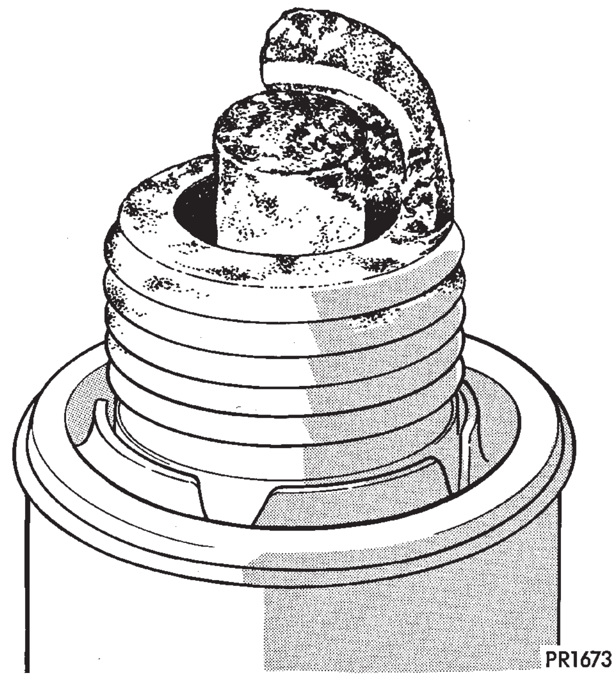

Fig. 7 Oil or Ash Encrusted

HIGH SPEED MISS

When replacing spark plugs because of a high speed miss condition; **wide open throttle operation should be avoided for approximately 80 km (50 miles) after installation of new plugs.** This will allow deposit shifting in the combustion chamber to take place gradually and avoid plug destroying splash fouling shortly after the plug change.

ELECTRODE GAP BRIDGING

Loose deposits in the combustion chamber can cause electrode gap bridging. The deposits accumulate on the spark plugs during continuous stop-and-go driving. When the engine is suddenly subjected to a high torque load, the deposits partially liquefy and bridge the gap between the electrodes (Fig. 8). This short circuits the electrodes. Spark plugs with electrode gap bridging can be cleaned using standard procedures.

SCAVENGER DEPOSITS

Fuel scavenger deposits may be either white or yellow (Fig. 9). They may appear to be harmful, but are a normal condition caused by chemical additives in

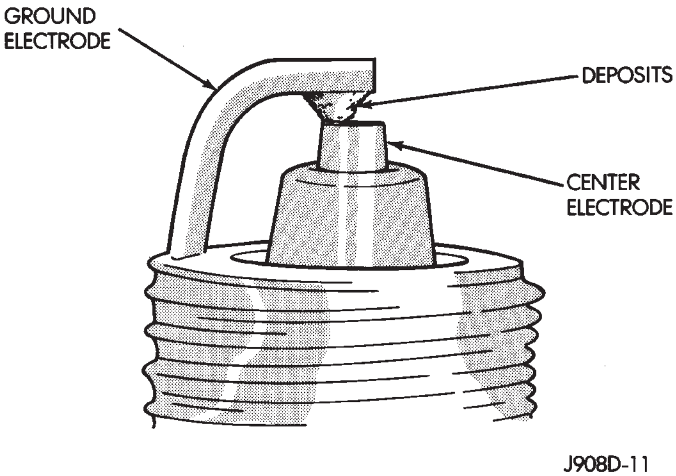

Fig. 8 Electrode Gap Bridging

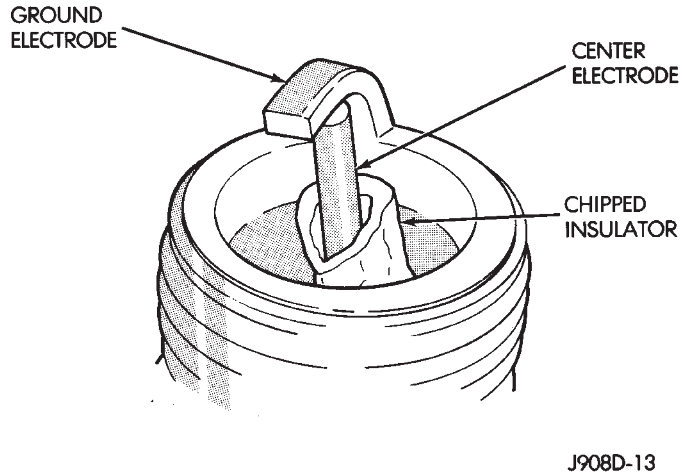

Fig. 10 Chipped Electrode Insulator

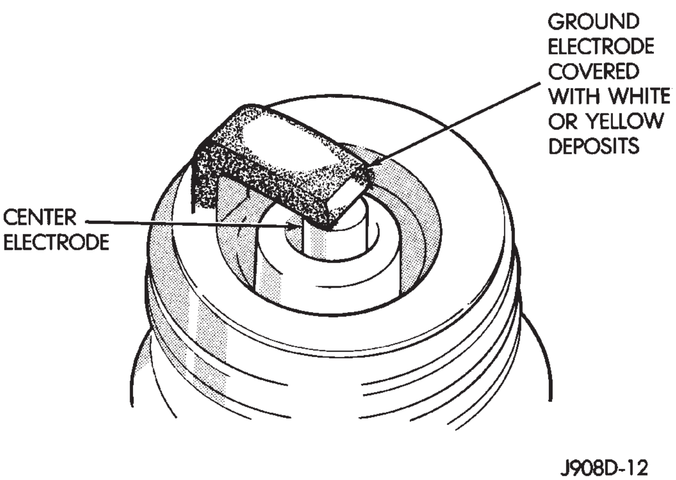

Fig. 9 Scavenger Deposits

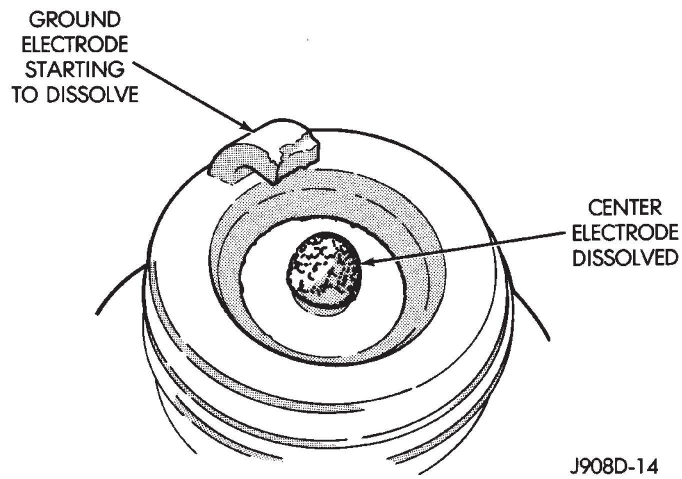

Fig. 11 Preignition Damage

certain fuels. These additives are designed to change the chemical nature of deposits and decrease spark plug misfire tendencies. Notice that accumulation on the ground electrode and shell area may be heavy but the deposits are easily removed. Spark plugs with scavenger deposits can be considered normal in condition and be cleaned using standard procedures.

CHIPPED ELECTRODE INSULATOR

A chipped electrode insulator usually results from bending the center electrode while adjusting the spark plug electrode gap. Under certain conditions, severe detonation also can separate the insulator from the center electrode (Fig. 10). Spark plugs with chipped electrode insulators must be replaced.

PREIGNITION DAMAGE

Excessive combustion chamber temperature can cause preignition damage. First, the center electrode dissolves and the ground electrode dissolves somewhat later (Fig. 11). Insulators appear relatively deposit free. Determine if the spark plug has the correct heat range rating for the engine, if ignition timing is over advanced or if other operating conditions are causing engine overheating. (The heat range rating refers to the operating temperature of a particular type spark plug. Spark plugs are designed to operate within specific temperature ranges depending upon the thickness and length of the center electrode and porcelain insulator.)

SPARK PLUG OVERHEATING

Overheating is indicated by a white or gray center electrode insulator that also appears blistered (Fig. 12). The increase in electrode gap will be considerably in excess of 0.001 in per 1000 miles of operation. This suggests that a plug with a cooler heat range rating should be used. Over advanced ignition timing, detonation and cooling system malfunctions alos can cause spark plug overheating.

CAMSHAFT SENSOR

The camshaft sensor provides fuel injection synchronization and cylinder identification information (Fig. 13). The sensor generates pulses that are the

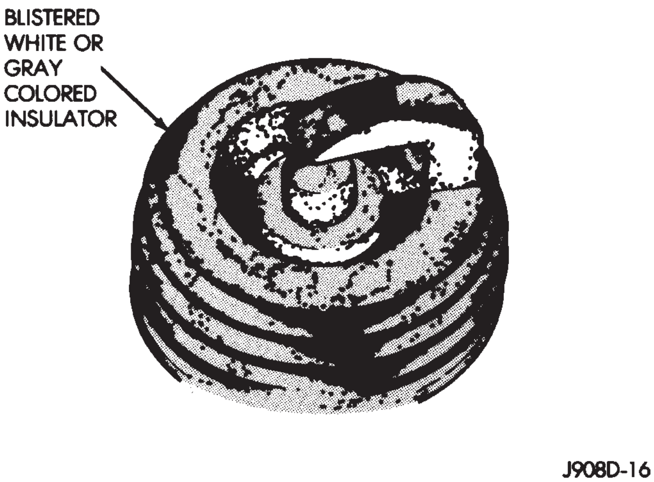

Fig. 12 Spark Plug Overheating

input sent to the engine controller. The engine controller interprets the camshaft sensor input (along with the crankshaft sensor input) to determine crankshaft position. The engine controller uses crankshaft position reference to determine injector sequence and ignition timing.

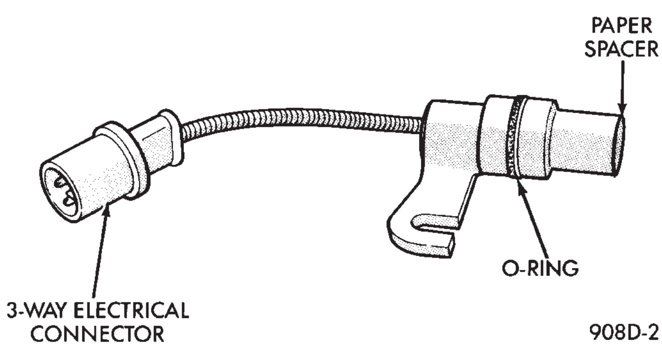

Fig. 13 Camshaft Sensor

The camshaft sensor determines when a slot in the camshaft gear passes beneath it (Fig. 14). When a slot is sensed, the input voltage from the sensor to the engine controller switches from low (less than 0.3 volts) to high (5 volts). As the slot or window passes, the input voltage is switched back to low (less than 0.3 volts).

The camshaft sensor is mounted to the top of the timing case cover (Fig. 15). The bottom of the sensor is positioned above the camshaft sprocket. **The distance between the bottom of sensor and the camshaft sprocket is critical to the operation of the system. When servicing the camshaft sensor, refer to the 3.3L Ignition System—Service Procedures section in this Group.**

CRANKSHAFT TIMING SENSOR

The crankshaft sensor (Fig. 16) senses slots cut into the transmission driveplate extension. There are a 3 sets of slots. Each set contains 4 slots, for a total of 12 slots (Fig. 17). Basic timing is set by the position of the last slot in each group. Once the engine controller

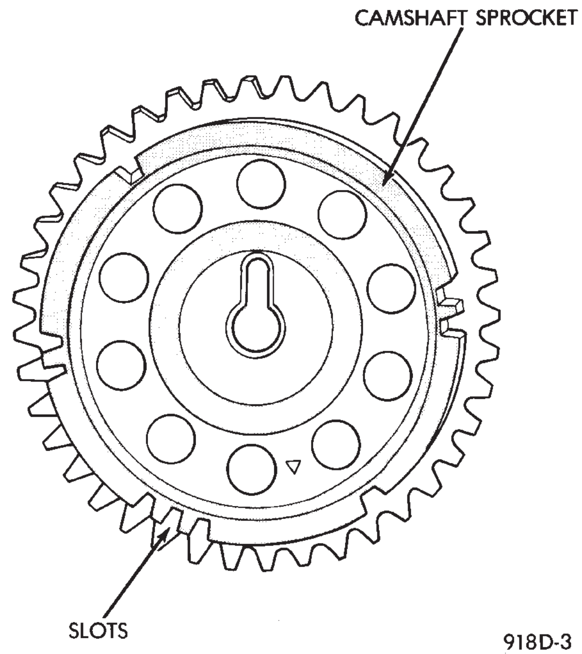

Fig. 14 Camshaft Gear

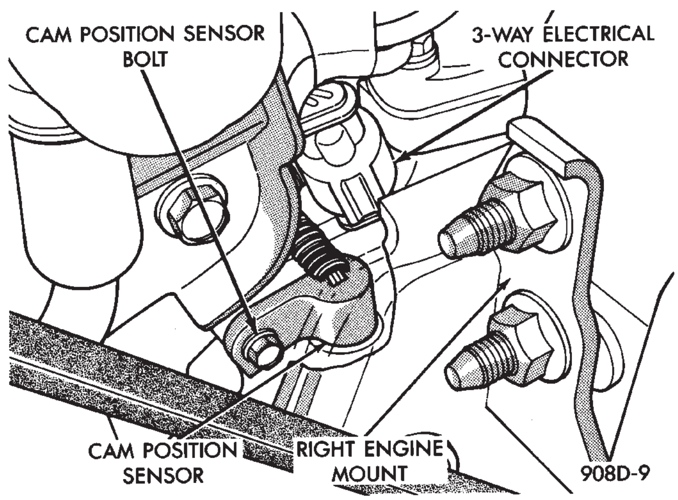

Fig. 15 Camshaft Sensor Location

senses the last slot, it determines crankshaft position (which piston will next be at TDC) from the camshaft sensor input. It may take the controller up to two thirds of an engine revolution to determine crankshaft position.

The engine controller uses crankshaft position reference to determine injector sequence and ignition timing. Once crankshaft position has been determined, the engine controller begins energizing the injectors in sequence.

The crankshaft sensor is located in the transmission housing, above the vehicle distance sensor (Fig. 18). The bottom of the sensor is positioned next to the drive plate. **The distance between the bottom of sensor and the drive plate is critical to the op-**

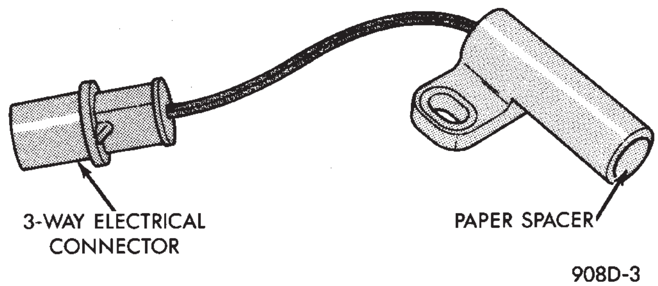

Fig. 16 Crankshaft Sensor

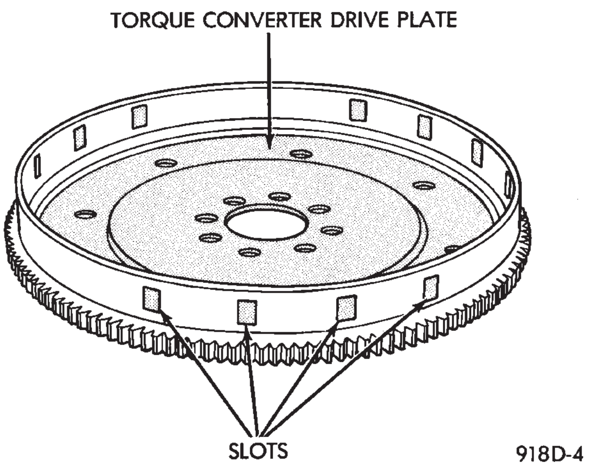

Fig. 17 Timing Slots in Transmission Driveplate

eration of the system. When servicing the crankshaft sensor, refer to the 3.3L Ignition System—Service Procedures section in this Group.

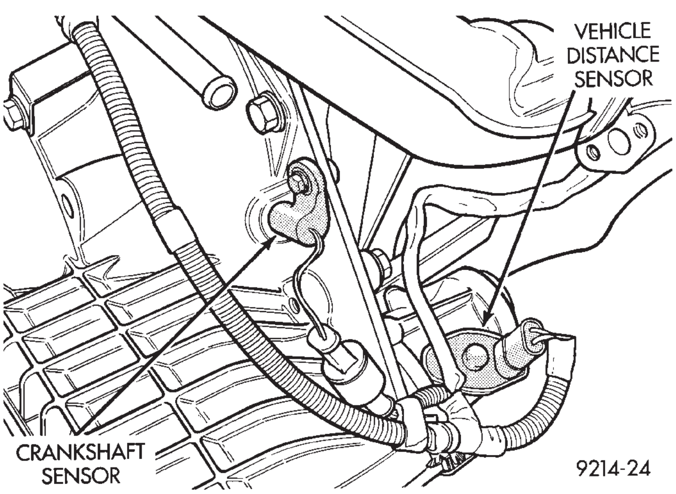

Fig. 18 Crankshaft Sensor Location

IGNITION COIL

WARNING: THE 3.3L ENGINE'S DIRECT IGNITION SYSTEM GENERATES APPROXIMATELY 40,000 VOLTS. PERSONAL INJURY COULD RESULT FROM CONTACT WITH THIS SYSTEM.

The coil assembly consists of 3 coils molded together (Fig. 19). The coil assembly is mounted on the intake manifold. High tension leads route to each cylinder from the coil. The coil fires two spark plugs every power stroke. One plug is the cylinder under compression, the other cylinder fires on the exhaust stroke. The engine controller determines which of the coils to charge and fire at the correct time.

Coils one fires cylinders 1 and 4, coil two fires cylinders 2 and 5, coil three fires cylinders three and six.

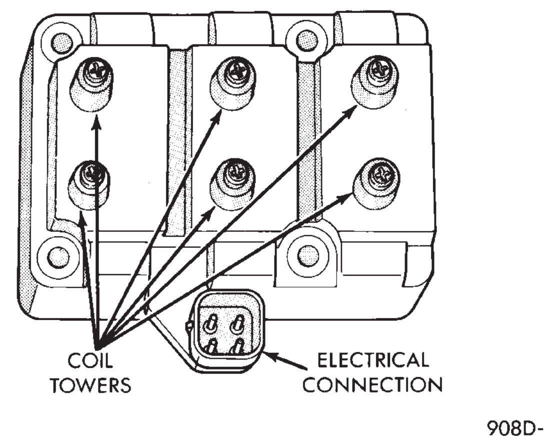

Fig. 19 Coil Pack—3.3L Engine

The coil's low primary resistance (0.5-0.7 ohm) allows the engine controller to fully charge the coil for each firing.

COOLANT TEMPERATURE SENSOR—ENGINE CONTROLLER INPUT

The coolant temperature sensor is located next to the thermostat housing (Fig. 20). The sensor provides an input voltage to the engine controller. The sensor is a variable resistance (thermistor) with a range of -40°F to 265°F. As coolant temperature varies, the sensors resistance changes, resulting in a different input voltage to the engine controller.

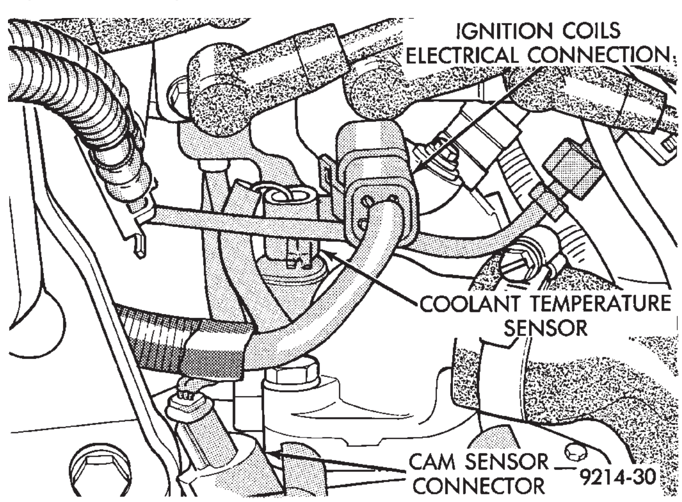

Fig. 20 Coolant Temperature Sensor

The engine controller contains different spark advance schedules for cold and warm engine operation. The schedules reduce engine emission and improve driveability.

When the engine is cold, the engine controller will demand slightly richer air-fuel mixtures and higher idle speeds until normal operating temperatures are reached.

The coolant sensor input is also used for cooling fan control.

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR

The MAP sensor reacts to absolute pressure in the intake manifold and provides an input voltage to the engine controller. As engine load changes, manifold pressure varies. The changes in engine load cause the MAP sensors resistance to change. The change in MAP sensor resistance results in a different input voltage to the engine controller.

The input voltage level supplies the engine controller with information relating to ambient barometric pressure during engine start-up (cranking) and engine load while its operating. The engine controller uses this input along with inputs from other sensors to adjust air-fuel mixture.

The MAP sensor (Fig. 21) is mounted to the side of the intake manifold, below the positive crankcase ventilation (PCV) valve. The sensor is connected to the engine controller electrically.

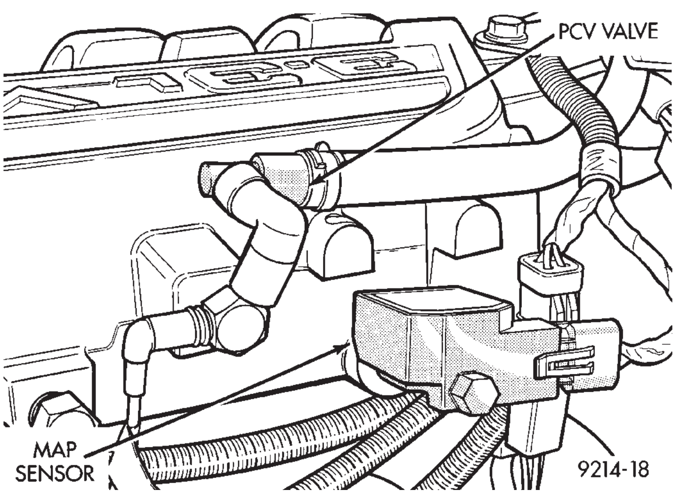

Fig. 21 Map Sensor

AUTO SHUTDOWN (ASD) RELAY—ENGINE CONTROLLER OUTPUT

The Auto Shutdown Relay (ASD) connects battery voltage to the fuel injectors and ignition coil. The ground circuit for the ASD relay is controlled by the engine controller. The engine controller operates the relay by switching the ground circuit on and off.

If the engine controller does not receive an ignition signal input when the ignition key in the RUN position, it de-energizes the ASD relay. When the relay is de-energized the battery voltage is removed from fuel injectors and ignition coil.

The ASD relay is located on the drivers side fender well, near to the engine controller (Fig. 22).

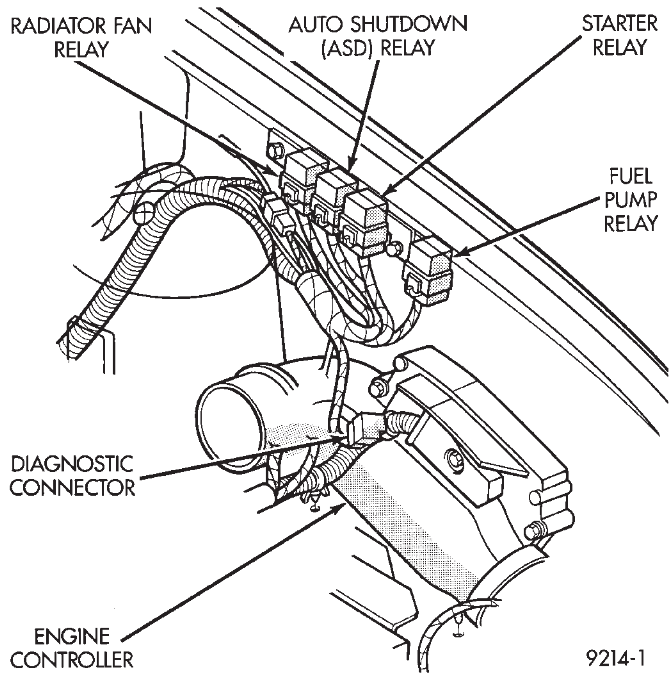

Fig. 22 Auto Shutdown Relay

3.3L IGNITION SYSTEM—DIAGNOSTIC PROCEDURES

INDEX

TESTING FOR SPARK AT COIL

WARNING: THE 3.3L ENGINE DIRECT IGNITION SYSTEM GENERATES APPROXIMATELY 40,000 VOLTS. PERSONAL INJURY COULD RESULT FROM CONTACT WITH THIS SYSTEM.

The coil pack contains 3 independent coils. Each coil must be checked individually.

CAUTION: Spark plug wire damage may occur if the spark plug is moved more than 1/4 inch away from the engine ground.

Remove the cable from number 2 spark plug. Insert a clean spark plug into the spark plug boot, and ground plug to the engine (Fig. 1).

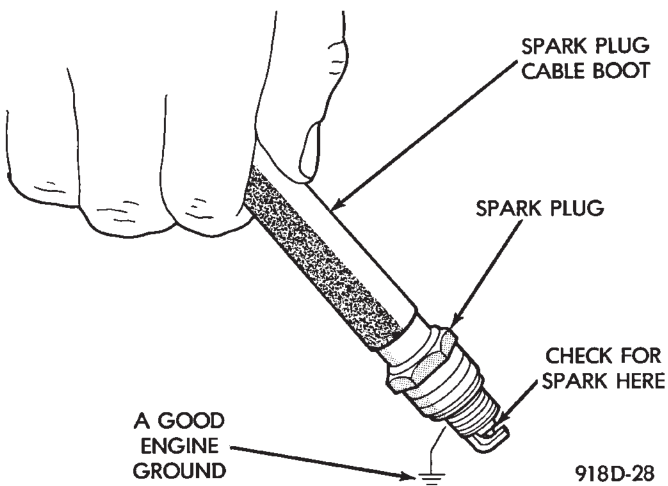

Fig. 1 Testing For Spark

Crank the engine and look for spark across the electrodes of the spark plug. Repeat the above test for the five remaining cylinders. If there is no spark during all cylinder tests, proceed to the failure to start test.

If one or more tests indicate irregular, weak, or no spark, proceed to Check Coil Test.

CHECK COIL TEST—3.3L ENGINE

Coils one fires cylinders 1 and 4, coil two fires cylinders 2 and 5, coil three fires cylinders three and six.

Each coil tower is labeled with the number of the corresponding cylinder.

(1) Remove the ignition cables and measure the resistance of the cables. Resistance must be between 3,000 to 12,000 ohms per foot of cable. Replace any cable not within tolerance.

(2) Disconnect the electrical connector from the coil pack (Fig. 2).

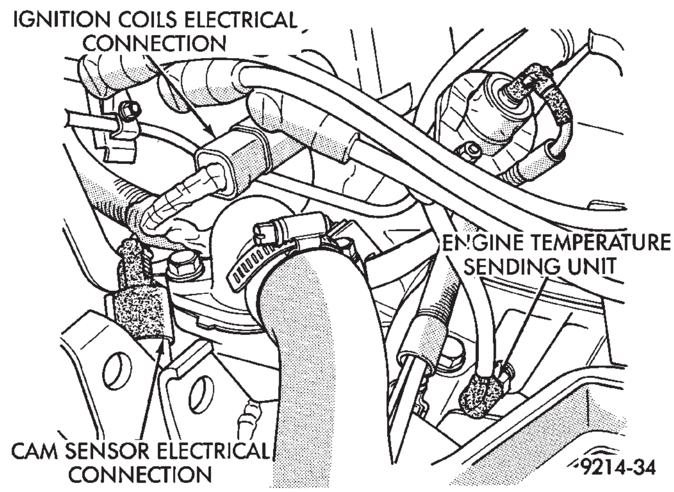

Fig. 2 Ignition Coil Electrical Connection

(3) Measure the primary resistance of each coil. At the coil, connect an ohmmeter between the B+ pin and the pin corresponding to the cylinders in question (Fig. 3). Resistance on the primary side of each coil should be 0.5-0.7 ohm. Replace the coil if resistance is not within tolerance.

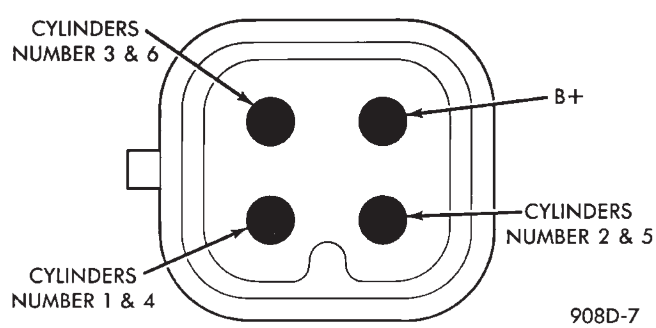

Fig. 3 Ignition Coil Terminal Identification

(4) Remove ignition cables from the secondary towers of the coil. Measure the secondary resistance of

the coil between the towers of each individual coil (Fig. 4). Secondary resistance should be 7,000 to 15,800 ohms. Replace the coil if resistance is not within tolerance.

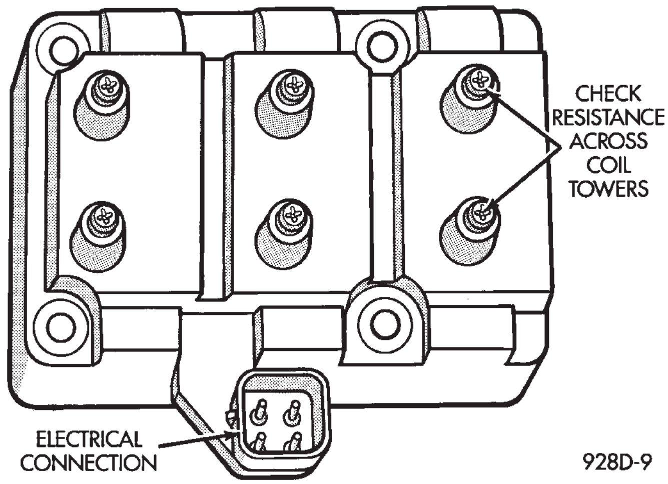

Fig. 4 Checking Ignition Coil Secondary Resistance

FAILURE TO START TEST

This no-start test checks the camshaft sensor and crankshaft sensor.

The engine controller supplies 9 volts to the camshaft sensor and crankshaft sensor through one circuit. If the 9-volt supply circuit is shorted to ground, neither sensor will produce a signal (output voltage to the engine controller).

When the ignition key is turned and left in the On position, the engine controller automatically energizes the auto shutdown (ASD) relay. However, the controller de-energizes the relay within one second because it has not received a crankshaft signal indicating engine rotation.

During cranking, the ASD relay will not energize until the engine controller receives a crankshaft signal. Secondly, the ASD relay remains energized only if the controller senses a camshaft sensor signal immediately after detecting the crankshaft sensor signal.

(1) Check battery voltage. Voltage should approximately 12.66 volts or higher to perform failure to start test.

(2) Disconnect the harness connector from the coil pack (Fig. 2).

(3) Connect a test light to the B+ (battery voltage) terminal of the coil electrical connector and ground. The wire for the B+ terminal is dark green with a black tracer.

(4) Turn the ignition key to the **ON position.** The test light should flash On and then Off. **Do not turn the Key to off position, leave it in the On position**.

(a) If the test light flashes momentarily, the engine controller grounded the auto shutdown (ASD) relay. Proceed to step 5.

(b) If the test light did not flash, the ASD relay did not energize. The cause is either the relay or one of the relay circuits. Use the DRB II to test the ASD relay and circuits. Refer to the appropriate Powertrain Diagnostics Procedure Manual. Refer to the wiring diagrams section for circuit information.

(5) Crank the engine. (If the key was placed in the off position after step 4, place the key in the On position before cranking. Wait for the test light to flash once, then crank the engine.)

(a) If the test light momentarily flashes during cranking, the engine controller is not receiving a camshaft sensor signal. Use the DRB II to test the camshaft sensor and sensor circuits. Refer to the appropriate Powertrain Diagnostics Procedure Manual. Refer to the wiring diagrams section for circuit information.

(b) If the test light did not flash during cranking, unplug the camshaft sensor connector. Turn the ignition key to the off position. Turn the key to the On position, wait for the test light to momentarily flash once, then crank the engine. If the test light momentarily flashes, the camshaft sensor is shorted and must be replaced. If the light did not flash, the cause of the no-start is in either the crankshaft sensor/camshaft sensor 9-volt supply circuit, or the crankshaft sensor 5-volt output or ground circuits. Use the DRB II to test the crankshaft sensor and the sensor circuits. Refer to the appropriate Powertrain Diagnostics Procedure Manual. Refer to the wiring diagrams section for circuit information.

COOLANT TEMPERATURE SENSOR TEST

(1) With key off, disconnect wire connector from coolant temperature sensor (Fig. 5).

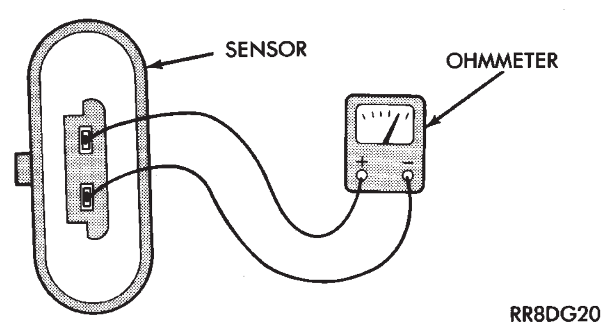

Fig. 5 Coolant Temperature Sensor Test

(2) Connect one lead of ohmmeter to one terminal of coolant temperature sensor.

(3) Connect the other lead of ohmmeter to remaining connector of coolant temperature sensor. The ohmmeter should read as follows;

• Engine/Sensor hot at normal operating temperature around 200°F should read approximately 700 to 1,000 ohms.
• Engine/Sensor at room temperature around 70°F, ohmmeter should read approximately 7,000 to 13,000 ohms.

See On Board Diagnostics in the General Diagnosis section of Group 14, or refer to the appropriate diagnostic manual for further test procedures.

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR TEST

Refer to the appropriate Powertrain Diagnostic Procedure manual.

CRANKSHAFT SENSOR AND CAMSHAFT SENSOR TESTS

Refer to the appropriate Powertrain Diagnositc Procedure manual.

3.3L IGNITION SYSTEMS—SERVICE PROCEDURES

INDEX

ENGINE CONTROLLER

REMOVAL

(1) Remove air cleaner duct or air cleaner assembly.

(2) Remove battery.

(3) Remove engine controller mounting screws (Fig. 1).

(4) Remove 60-way connector from engine controller. Remove controller.

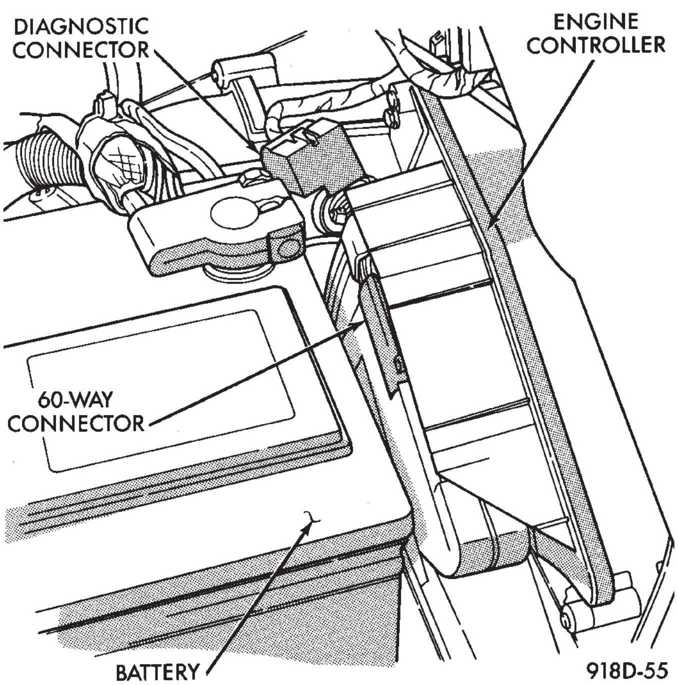

Fig. 1 Removing the Engine Controller

INSTALLATION

(1) Connect 60-Way connector to engine controller (Fig. 1).

(2) Install Engine Controller on inside left front fender (Fig. 1). Install and tighten mounting screws.

(3) Install the battery.

(4) Install air cleaner duct or air cleaner assembly.

COOLANT TEMPERATURE SENSOR

The coolant temperature sensor is located below the ignition coil (Fig. 2).

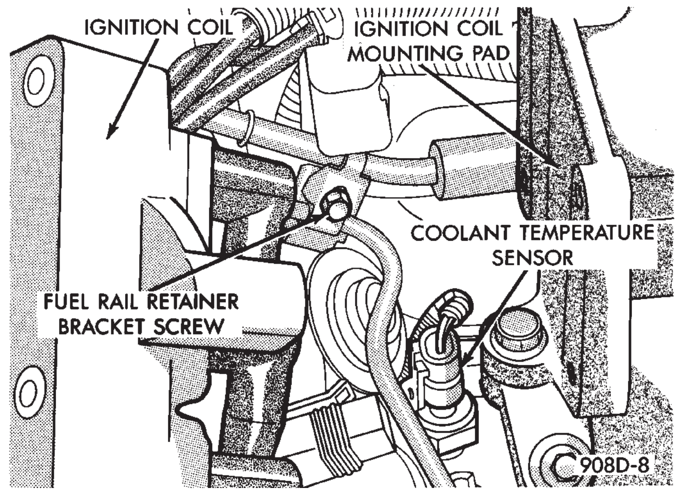

Fig. 2 Coolant Temperature Sensor

REMOVAL

(1) Drain cooling system until coolant level is below coolant sensor. Refer to Group 7, Cooling System.

(2) Remove electrical connector from coil (Fig. 3).

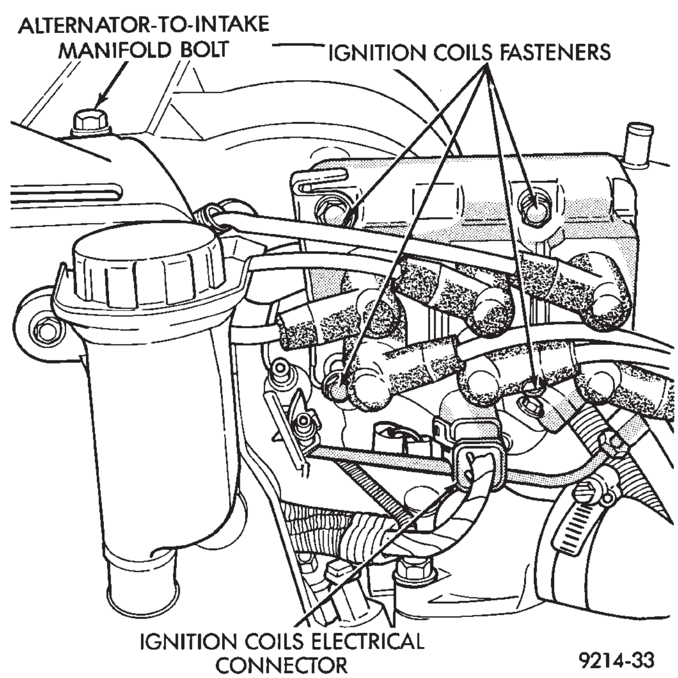

Fig. 3 Ignition Coil Removal

(3) Remove coil mounting screws.

(4) Rotate coil away from coolant temperature sensor.

(5) Disconnect electrical connector from coolant temperature sensor.

(6) Remove sensor from engine.

INSTALLATION

(1) Tighten the coolant sensor to 7 N●m (60 in. lbs.) torque.

(2) Connect electrical connector to sensor.

(3) Fill cooling system. Refer to Group 7, Cooling System.

(4) Install coil. Tighten coil mounting screws to 12 N●m (105 in. lbs.) torque.

(5) Connect electrical connector to coil.

SPARK PLUG CABLE SERVICE

Clean high tension cables with a cloth moistened with a non-flammable solvent. Wipe the cables dry. Check for brittle or cracked insulation.

When testing cables for punctures and cracks with an oscilloscope, follow the instructions of the equipment manufacturers.

CAUTION: Do not leave any one spark plug cable disconnected any longer than necessary during test or possible heat damage to catalytic converter will occur. Total test time must not exceed ten minutes.

If an oscilloscope is not available, cables can be tested as follows:

(1) With the engine not running, connect one end of a test probe (i.e. a piece of wire with insulated alligator clips on each end) to a good ground, other end free for probing.

WARNING: THE 3.3L ENGINE DIRECT IGNITION SYSTEM GENERATES APPROXIMATELY 40,000 VOLTS. PERSONAL INJURY COULD RESULT FROM CONTACT WITH THIS SYSTEM.

(2) With engine running, move test probe along entire length of all cables (approximately 0 to 1/8 inch gap). If punctures or cracks are present there will be a noticeable spark jump from the faulty area to the probe. Cracked, leaking or faulty cables should be replaced.

Use the following procedure when removing the high tension cable from the spark plug. First, remove the cable from the retaining bracket. Then grasp the terminal as close as possible to the spark plug. Rotate the cover (boot) slightly and pull straight back. **Do not use pliers and do not pull the cable at an angle.** Doing so will damage the insulation, cable terminal or the spark plug insulator. **Wipe spark plug insulator clean before reinstalling cable and cover.**

Resistance cables are identified by the words **Electronic Suppression**.

Use an ohmmeter to check cables for opens, loose terminals or high resistance.

(a) Remove cable from spark plug.

(b) Remove cable from the coil tower.

(c) Connect the ohmmeter between spark plug end terminal and the coil end terminal. Resistance should be within tolerance shown in the cable resistance chart. If resistance is not within tolerance, replace cable assembly. Test all spark plug cables in same manner.

CABLE RESISTANCE CHART

MINIMUM	MAXIMUM
250 Ohms Per Inch	1000 Ohms Per Inch
3000 Ohms Per Foot	12,000 Ohms Per Foot

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SPARK PLUG SERVICE

When replacing the spark plug cables, route the cables correctly and secure them in the appropriate retainers. Failure to route the cables properly can cause the radio to reproduce ignition noise, cross ignition of the spark plugs or short circuit the cables to ground.

SPARK PLUG REMOVAL

Always remove the spark plug cable by grasping at the spark plug boot, turning the boot 1/2 turn and pulling straight back in a steady motion.

(1) Prior to removing the spark plug spray compressed air around the spark plug hole and the area around the spark plug.

(2) Remove the spark plug using a quality socket with a rubber or foam insert.

(3) Inspect the spark plug condition. Refer to Spark Plug Condition in this section.

SPARK PLUG GAP ADJUSTMENT

(1) Check the spark plug gap with a gap gauge. If the gap is not correct, adjust it by bending the ground electrode (Fig. 4).

SPARK PLUG INSTALLATION

(1) To avoid cross threading, start the spark plug into the cylinder head by hand.

(2) Tighten spark plugs to 28 N●m (20 ft. lbs.) torque.

(3) Install spark plug cables over spark plugs.

IDLE RPM TEST

WARNING: BE SURE TO APPLY PARKING BRAKE AND/OR BLOCK WHEELS BEFORE PERFORMING ANY ENGINE RUNNING TESTS.

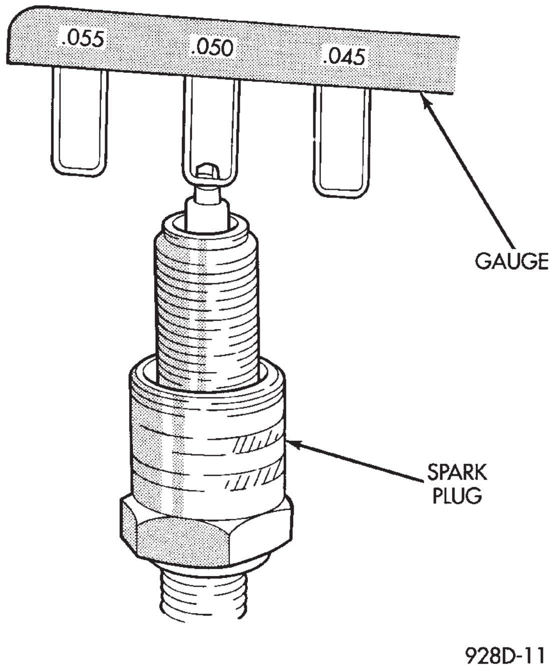

Fig. 4 Setting Spark Plug Gap—Typical

Engine idle set **rpm** should be **tested and recorded as it is when the vehicle is first brought into shop for testing.** This will assist in diagnosing complaints of engine stalling, creeping and hard shifting on vehicles equipped with automatic transmissions.

Proceed to the Throttle Body Minimum Airflow procedures.

THROTTLE BODY MINIMUM AIR FLOW CHECK PROCEDURE

(1) Warm engine in Park or Neutral until the cooling fan has cycled on and off at least once.

(2) Ensure that all accessories are off.

(3) Shut off engine.

(4) Disconnect the PCV valve hose from the intake manifold nipple.

(5) Attach Air Metering Fitting #6457 (0.125 in. orifice) to the intake manifold PCV nipple (Fig. 5).

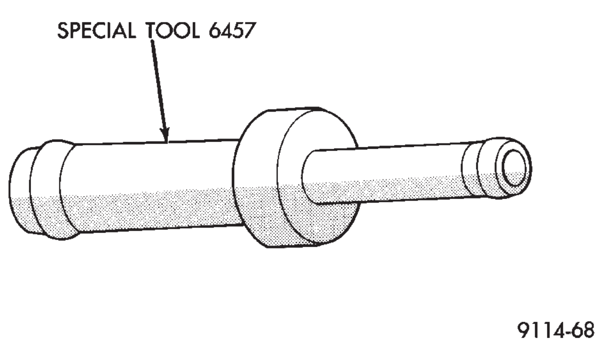

Fig. 5 Air Metering Fitting #6457

(6) Disconnect the 3/16 inch idle purge line from the throttle body nipple (Fig. 6). Cap the 3/16 inch nipple.

(7) Connect Diagnostic Readout Box II (DRB II).

(8) Restart the engine. Allow engine to idle for at least one minute.

(9) Using the DRBII, access Min. Airflow Idle Spd.

(10) The following will then occur:

- AIS motor will fully close.
- Idle spark advance will become fixed.
- Engine RPM will be displayed on DRB II.

(11) If idle RPM is within the range shown in the Idle Specification chart, throttle body minimum airflow is set correctly.

IDLE SPECIFICATIONS

Odometer Reading	Idle RPM
Below 1000 Miles	650-950 RPM
Above 1000 Miles	700-950 RPM

9114-73

(12) If idle RPM is not within specifications, shut off the engine and clean the throttle body as follows:

(a) Remove the throttle body from engine.

WARNING: CLEAN THROTTLE BODY IN A WELL VENTILATED AREA. WEAR RUBBER OF BUTYL GLOVES, DO NOT LET MOPAR PARTS CLEANER COME IN CONTACT WITH EYES OR SKIN. AVOID INGESTING THE CLEANER. WASH THOROUGHLY AFTER USING CLEANER.

(b) While holding the throttle open, spray the entire throttle body bore and the manifold side of the throttle plate with Mopar Parts Cleaner. **Only use Mopar Parts Cleaner to clean the throttle body.**

(c) Using a soft scuff pad, clean the top and bottom of throttle body bore and the edges and manifold side of the throttle blade. **The edges of the throttle blade and portions of the throttle bore that are closest to the throttle blade when is closed, must be free of deposits.**

(d) Use compressed air to dry the throttle body.

(e) Inspect throttle body for foreign material.

(f) Install throttle body on manifold.

(g) Repeat steps 1 through 14. If the minimum air flow is still not within specifications, the problem is not caused by the throttle body.

(13) Shut off engine.

(14) Remove Air Metering Fitting #6457 from the intake manifold PCV nipple. Reinstall the PCV valve hose.

(15) Uncap the throttle body idle purge nipple and connect the idle purge line.

(16) Remove DRB II.

IGNITION TIMING PROCEDURE

The 3.3L engine uses a fixed ignition system. Basic ignition timing is not adjustable. The engine controller regulates ignition timing.

CRANKSHAFT TIMING SENSOR

REMOVAL

(1) Disconnect crankshaft timing sensor electrical connector from the wiring harness connector (Fig. 6).

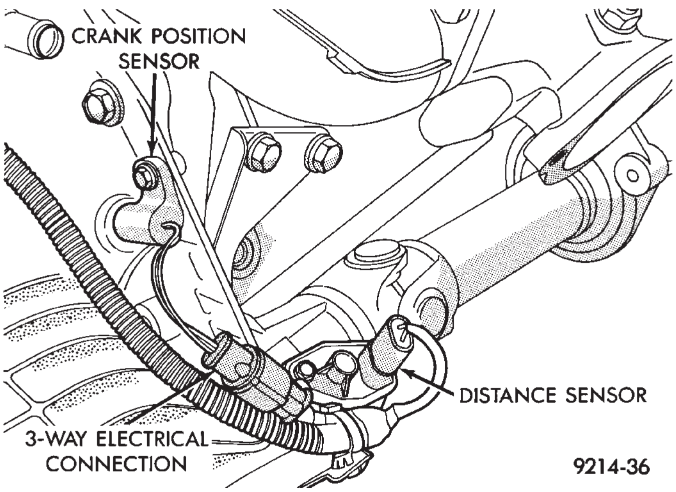

Fig. 6 Crankshaft Timing Sensor

(2) Remove crankshaft timing sensor retaining bolt.

(3) Pull crankshaft timing sensor straight up out of the transaxle housing.

INSTALLATION

If the removed sensor is to be reinstalled, clean off the old spacer on the sensor face. A NEW SPACER must be attached to the sensor face before installation. If the sensor is being replaced, confirm that the paper spacer is attached to the face of the new sensor (Fig. 7).

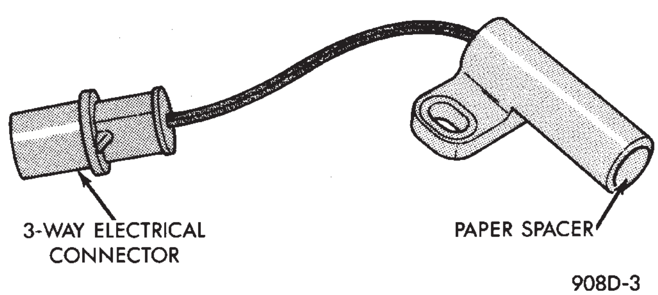

Fig. 7 Crankshaft Sensor and Spacer

(1) Install sensor in transaxle and push sensor down until contact is made with the drive plate. While holding the sensor in this position, install and tighten the retaining bolt to 11.9 N●m (105 in. lbs.) torque.

(2) Connect crankshaft timing sensor electrical connector to the wiring harness connector.

CAMSHAFT SENSOR

REMOVAL

(1) Disconnect camshaft reference sensor electrical connector from the wiring harness connector (Fig. 8).

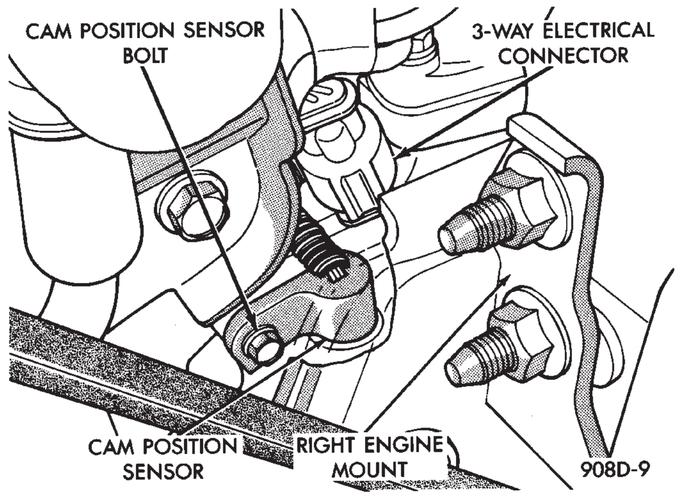

Fig. 8 Camshaft Sensor

(2) Loosen camshaft timing sensor retaining bolt enough to allow slot in sensor to slide past the bolt.

(3) Pull sensor up out of the chain case cover. **Do not pull on the sensor lead.** There is an O-ring on the sensor case. The O-ring may make removal difficult. A light tap to top of sensor prior to removal may reduce force needed for removal.

INSTALLATION

If the removed sensor is reinstalled, clean off the old spacer on the sensor face. A NEW SPACER must be attached to the face before installation. Inspect O-ring for damage, replace if necessary. If the sensor is being replaced, confirm that the paper spacer is attached to the face and O-ring is positioned in groove of the new sensor (Fig. 9).

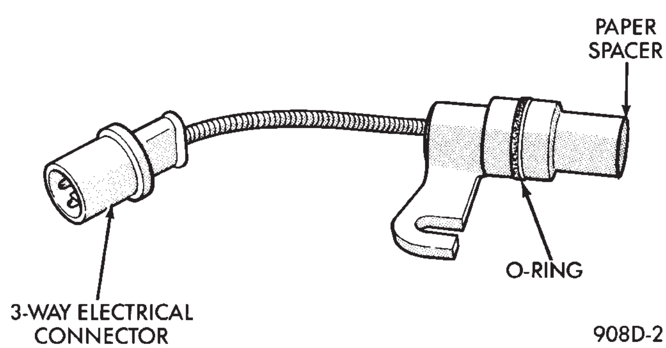

Fig. 9 Camshaft Sensor

(1) Apply a couple drops of clean engine oil to the O-ring prior to installation. Install sensor in the chain case cover and push sensor down until contact is made with the cam timing gear. While holding the sensor in this position, install and tighten the retaining bolt 11.9 N●m (105 in. lbs.) torque.

(2) Connect camshaft reference sensor electrical connector to harness connector. Position connector away from the accessory belt.

IGNITION COIL

(1) Remove spark plug cables from coil (Fig. 10).

(2) Remove ignition coil electrical connector.

(3) Remove ignition coil mounting screws.

(4) Remove ignition coil.

Reverse the above procedure for installation. Tighten mounting screws to 12 N●m (105 in. lbs.) torque.

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR

(1) Disconnect electrical connector from MAP sensor.

(2) Remove sensor by unscrewing from the intake manifold (Fig. 11).

(3) Reverse the above procedure for installation.

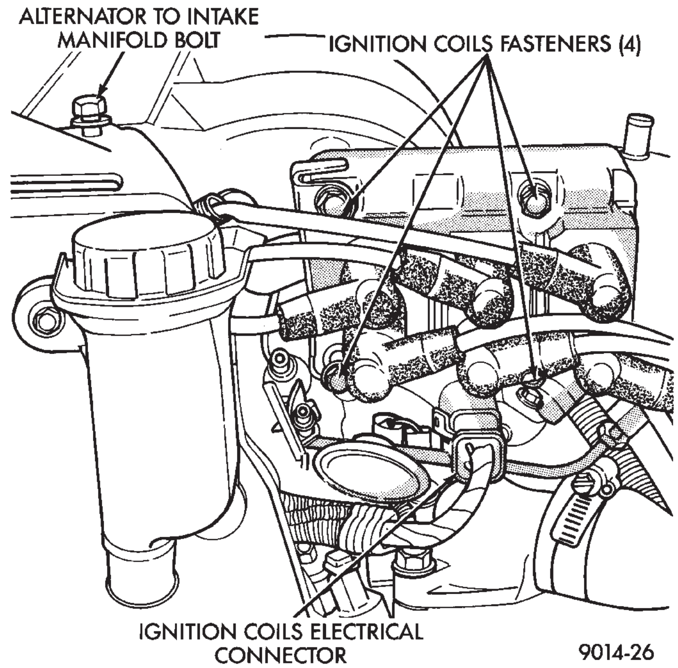

Fig. 10 Ignition Coil Removal and Installation

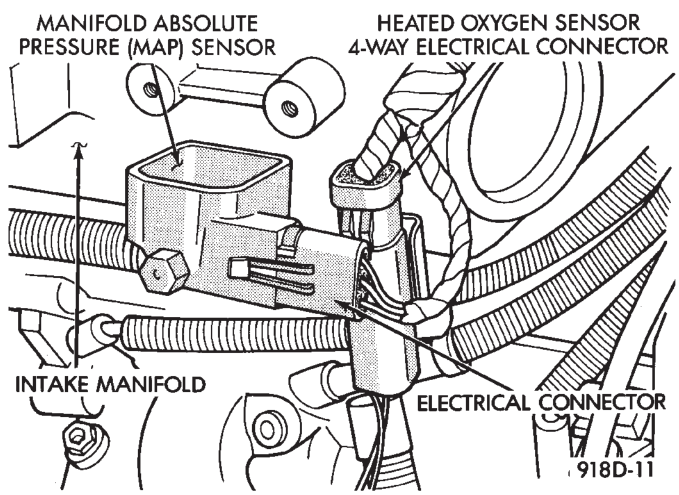

Fig. 11 Manifold Absolute Pressure Sensor

IGNITION SWITCH

IGNITION SWITCH AND KEY CYLINDER SERVICE

The ignition switch is located on the steering column. The Key In Switch is located in the ignition switch module. For diagnosis of the Key In Switch, refer to Section 8M.

IGNITION SWITCH DESIGNATIONS

IGNITION SWITCH CONNECTOR LOOKING INTO SWITCH

WIRE CAVITY	WIRE COLOR	APPLICATION
1	YELLOW	STARTER RELAY
2	DARK BLUE	IGNITION RUN/START
3	GRAY/BLACK	BRAKE WARNING LAMP
4	PINK/BLACK	IGNITION SWITCH BATTERY FEED
5	BLACK/ORANGE	RUN ACCESSORY
6	BLACK/WHITE	ACCESSORY
7	RED	IGNITION SWITCH BATTERY FEED

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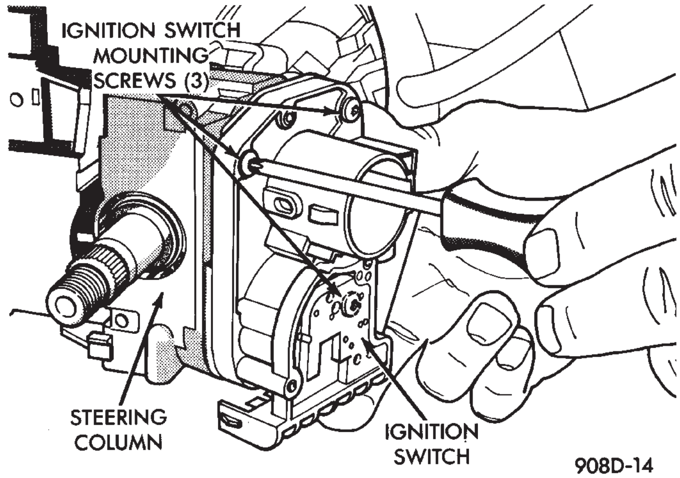


Fig. 1 Ignition Switch Screw Removal

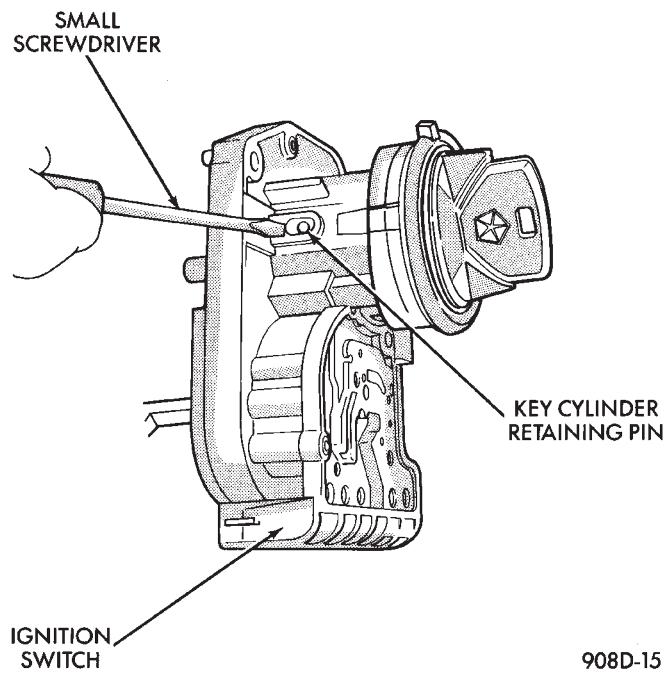


Fig. 2 Key Cylinder Retaining Pin

REMOVAL

(1) Disconnect negative cable from battery.

(2) If the vehicle has a tilt column, remove the tilt lever by turning it counterclockwise.

(3) Remove upper and lower covers from steering column.

(4) Remove ignition switch mounting screws. Use tamper proof torx bit Snap-on TTXR15A2, TTXR20A2 or equivalent to remove the screws (Fig. 1).

(5) Gently pull switch away from the column. Release connector locks on the 7 terminal wiring connector, then remove the connector from the ignition switch.

(6) Release connector lock on the 4 terminal connector, then remove the connector from the ignition switch.

(7) To remove the key cylinder from the ignition switch:

(a) Insert key in the ignition switch. Turn the key to the LOCK position. Using a small screwdriver, depress the key cylinder retaining pin until it is flush with the key cylinder surface (Fig. 2).

(b) Rotate the key clockwise to the OFF position. The key cylinder will unseat from the ignition switch (Fig. 3). When the key cylinder is unseated, it will be approximately 1/8 inch away from the ignition switch halo light ring. **Do not attempt to remove the key cylinder at this time.**

(c) With the key cylinder in the unseated position, rotate the key counterclockwise to the lock position and remove the key.

(d) Remove key cylinder from ignition switch (Fig. 4).

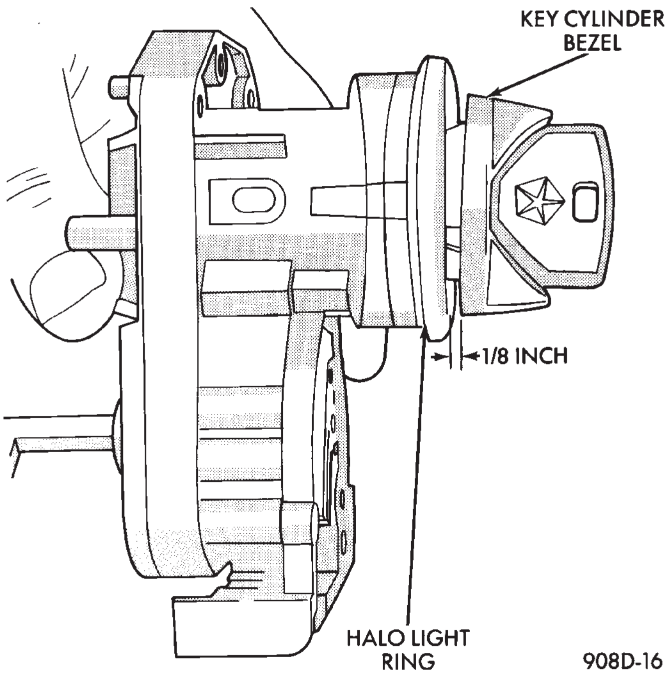


Fig. 3 Unseated Key Cylinder

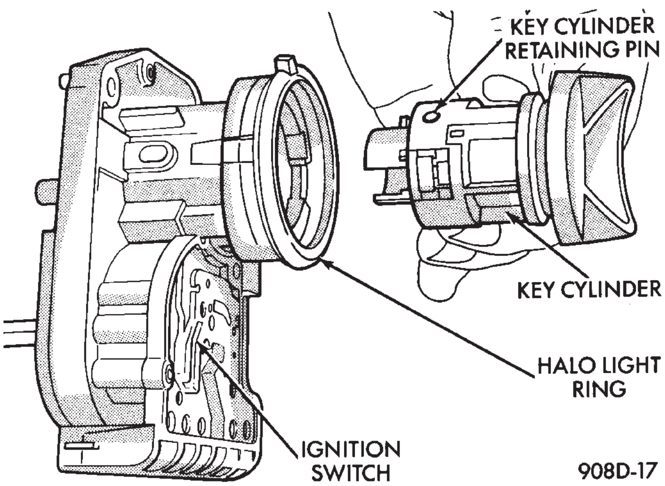


Fig. 4 Key Cylinder Removal

INSTALLATION

(1) Connect electrical connectors to the ignition switch. Make sure that the switch locking tabs are fully seated in the wiring connectors.

(2) Before attaching the ignition switch to a tilt steering column, the transmission shifter must be in Park position. Also the park lock dowel pin and the column lock flag must be properly indexed before installing the switch (Fig. 5).

(a) Place the transmission shifter in the PARK position.

(b) Place the ignition switch in the lock position. The switch is in the lock position when the column lock flag is parallel to the ignition switch terminals (Fig. 5).

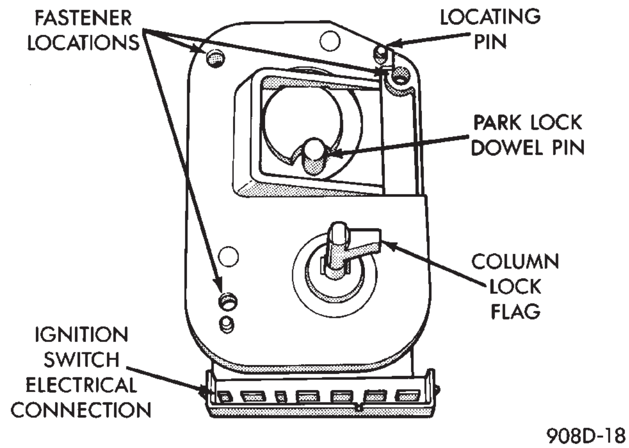


Fig. 5 Ignition Switch View From Column

(c) Position ignition switch park lock dowel pin so it will engage the steering column park lock slider linkage (Fig. 6).

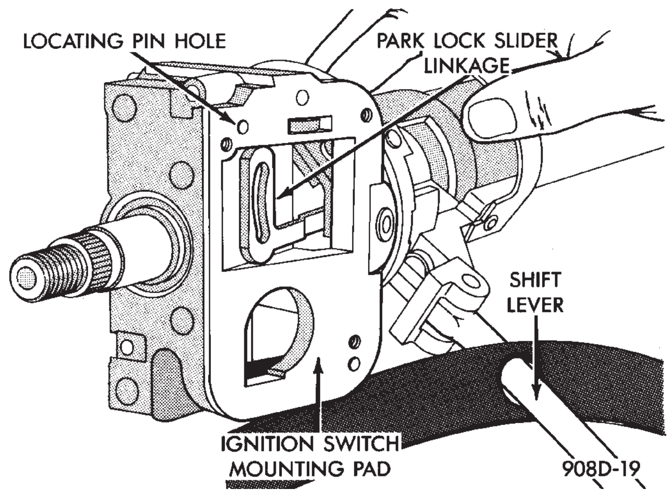


Fig. 6 Ignition Switch Mounting Pad

(d) Apply a light coating of grease to the column lock flag and the park lock dowel pin.

(3) Place the ignition switch against the lock housing opening on the steering column. Ensure that ignition switch park lock dowel pin enters the slot in the park lock slider linkage in the steering column.

(4) Install ignition switch mounting screws. Tighten screws to 2 N●m (17 in. lbs.) torque.

(5) Install steering column covers. Tighten screws to 2 N●m (17 in. lbs.) torque.

(6) If the vehicle is equipped with a tilt steering column, install the tilt lever.

(7) To install the ignition key in the lock cylinder:

(a) With the key cylinder and the ignition switch in the Lock position, insert the key cylinder into the ignition switch until it bottoms.

(b) Insert ignition key into lock cylinder. While gently pushing the key cylinder in toward the ignition switch, rotate the ignition key until to the end of travel.

(c) Connect negative cable to battery.

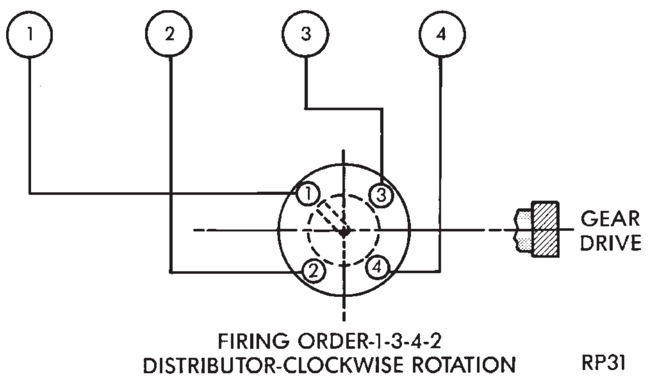
(8) Check for proper operation of the halo light, shift lock (if applicable), and column lock. Also check for proper operation of the ignition switch accessory, lock, off, run, and start positions.

SPECIFICATIONS

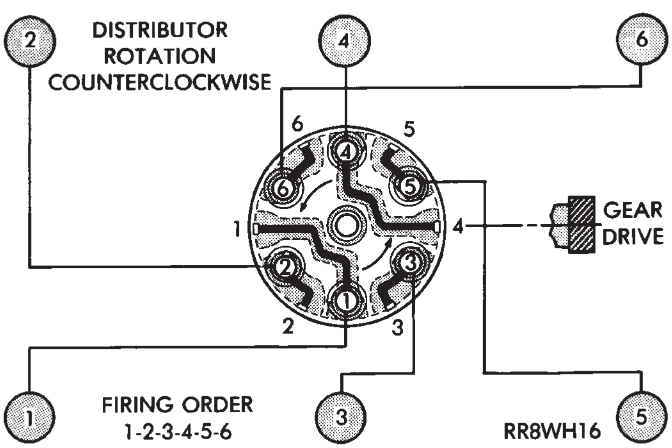
GENERAL INFORMATION

The following specifications are published from the latest information available at the time of publication. If anything differs from the specifications on the Vehicle Emission Control Information Label, use the specifications on the label.

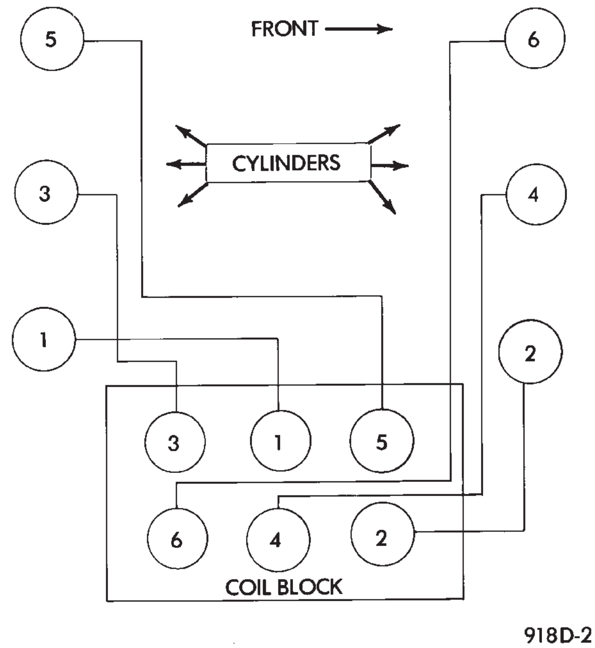
SPARK PLUG WIRE ROUTING—2.5L ENGINES



SPARK PLUG WIRE ROUTING—3.0L ENGINE



SPARK PLUG WIRE ROUTING—3.3L ENGINES



3.3L ENGINE DIRECT IGNITION SYSTEM

Ignition Timing is not adjustable for the Direct Ignition System (DIS)	
Engine	3.3L
Engine Code	EGA
Transmission	Automatic
Firing Order	1-2-3-4-5-6

918D-50

DISTRIBUTORS

Engine	Transmission	Rotation	Basic Timing	Spark Advance at 2000 RPM	Shaft Side Play	Shaft End Play
2.5L	Manual and Automatic	Clockwise	12° BTDC ± 2° Manual and Automatic Trans.	21° ± 4° Manual and Automatic Trans.	Not to Exceed 0.1 mm (0.004 in.)	0.03 to 0.75 mm (0.001 to 0.030 in.)
3.0L	Automatic	Clockwise	12° BTDC ± 2°	38° ± 4° Automatic Trans.		

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IGNITION COILS

Engine	Coil Manufacturer	Primary Resistance at 21°C - 27°C (70°F - 80°F)	Secondary Resistance at 21°C - 27°C (70°F - 80°F)
2.5L	Diamond (Epoxy)	0.97 to 1.18 Ohms	11,300 to 15,300 Ohms
2.5L	Toyodenso (Epoxy)	0.95 to 1.20 Ohms	11,300 to 13,300 Ohms
3.0L	Diamond (Epoxy)	0.97 to 1.18 Ohms	11,000 to 15,300 Ohms
3.3L	Diamond	0.52 to 0.63 Ohms	11,600 to 15,800 Ohms
3.3L	Toyodenso	0.51 to 0.61 Ohms	11,500 to 13,500 Ohms

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SPARK PLUGS

Engine	Spark Plug	Gap	Thread Size
2.5L	RN12YC	0.033 to 0.038 in.	14 mm (3/4 in.) reach
3.0L	RN11YC4	0.039 to 0.044 in.	14 mm (3/4 in.) reach
3.0L	BPR5ES-11	0.039 to 0.044 in.	14 mm (3/4 in.) reach
3.3L	RN16YC5	0.048 to 0.053 in.	14 mm (3/4 in.) reach

928D-13

TORQUE

DESCRIPTION	TORQUE
2.5L Coolant Sensor	28 N•m (20 ft. lbs.)
2.5L Ignition Coil Screws	9.5 N•m (85 in. lbs.)
3.0L Coolant Sensor	7 N•m (60 in. lbs.)
3.0L Ignition Coil Bracket	10 N•m (96 in. lbs.)
3.3L Camshaft Sensor Retaining Bolt	11.9 N•m (105 in. lbs.)
3.3L Coolant Sensor	7 N•m (60 in. lbs.)
3.3L Crankshaft Sensor Retaining Bolt	11.9 N•m (105 in. lbs.)
3.3L Ignition Coil	12 N•m (105 in. lbs.)
Ignition Switch	2 N•m (17 in. lbs.)
Spark Plugs	28 N•m (20 ft. lbs.)

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