IGNITION SYSTEM

CONTENTS

3.0L SIX CYLINDER

INDEX

GENERAL INFORMATION

The ignition system used on the 3.0L engine consists of:

- A solid-state ignition control module to generate the voltage for spark plug firing.
- An electronic control unit (ECU) to process input information to fire the ignition control module.

Ignition timing (advance/retard is controlled by the ECU and is not adjustable.)

- A speed sensor with flywheel trigger to input crankshaft position for the ECU.

IGNITION CONTROL MODULE (ICM)

The ignition control module is mounted to the ignition coil (Fig. 1). Based on control system inputs, the ECU triggers the ignition coil via the ignition control module. The ECU is able to advance or retard ignition timing by controlling the ignition coil through the ignition control module.

The ICM consists of a solid-state ignition circuit and an integrated ignition circuit and an integrated ignition coil that can be removed and serviced separately if necessary.

The ECU provides an input signal to the ICM. The ICM has only two outputs:

- Tach signal to the tachometer and diagnostic connector
- High voltage from the coil to the distributor cap.

ICM CONNECTIONS

Electrical feed to the ICM is through terminal A of Connector No. 1 on the module (Fig. 2).

Electrical supply only occurs with the ignition switch in the START and RUN positions.

Terminal B of Connector No. 1 is grounded at the engine oil dipstick bracket along with the ECU ground wire and oxygen (O_2) sensor ground.

The tachometer output signal wire of the ICM is connected to Pin No. 1 of the D1 diagnostic connector. The wire is routed to the diagnostic connector through a short section of the ECU harness, the engine and instrument panel harness. This type of routing eliminates any potential electrical interference in the various ECU circuitry.

Ignition firing signal from ECU terminal 27 are transmitted through terminal B of Connector No. 2 on the ICM. The ignition signal from the ECU is received by the ICM in the form of a 5

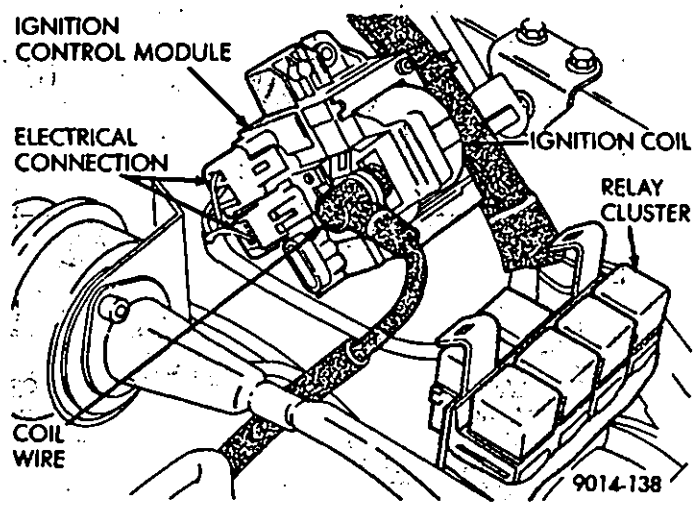

Fig. 1—Ignition Control Module

volt square wave. As the leading edge of the wave contacts the ignition circuitry in the ICM, the ICM charges the coil primary windings.

When coil saturation occurs, the module circuitry opens the primary windings to collapse the magnetic field in the windings. This induces the high voltage in the coil secondary windings which is then transmitted to the spark plugs via the coil wire, distributor cap, and rotor.

ECU INPUTS

Manifold Absolute Pressure (MAP) Sensor

The MAP sensor reacts to absolute pressure in the intake manifold and provides an input voltage to the ECU. As engine load changes manifold pressure varies, causing the MAP sensors resistance to change. The change in MAP sensor resistance results in a different input voltage to the ECU. The input voltage level supplies the ECU with information relating to ambient barometric pressure during engine start-up (cranking) and to engine load while the engine is running. The ECU uses this information to adjust the air-fuel mixture accordingly.

The MAP sensor is mounted in the engine compartment on the dash panel and is connected to the throttle body with a vacuum hose (Fig. 3).

Coolant Temperature Sensor

The coolant temperature sensor is installed in the thermostat housing (Fig. 4). It provides an input voltage to the ECU. As coolant temperature varies the Coolant Temperature Sensor resistance changes resulting in a different input voltage to the ECU. Based on this input the ECU will:

- Adjust fuel injector pulse width. Colder coolant temperatures will result in longer injector pulse width and richer air-fuel mixtures.
- Compensate for fuel condensation in the intake manifold.
- Control engine warm-up idle speed.
- Increase ignition advance when the coolant is cold.
- Energize the EGR valve solenoid thus preventing the flow of vacuum to the EGR valve.

Manifold Air Temperature (MAT) Sensor

The Manifold Air Temperature (MAT) sensor is installed in the throttle body adapter at the rear of the intake manifold with sensor element extending into the air stream (Fig. 5). The MAT sensor provides an input voltage to the ECU. As the temperature of the air stream in the manifold varies, the MAT sensor resistance changes resulting in a different input voltage to the ECU.

Speed Sensor (Crankshaft Position Sensor—CPS)

The speed sensor, attached to the torque converter drive plate housing, provides an input signal to the ECU relating to crankshaft angle (position) (Fig. 6). The ECU converts the rate of change of crankshaft angle into engine RPM and the crankshaft angle to piston position. The speed sensor senses TDC, BDC and engine speed by detecting the flywheel teeth as they pass during

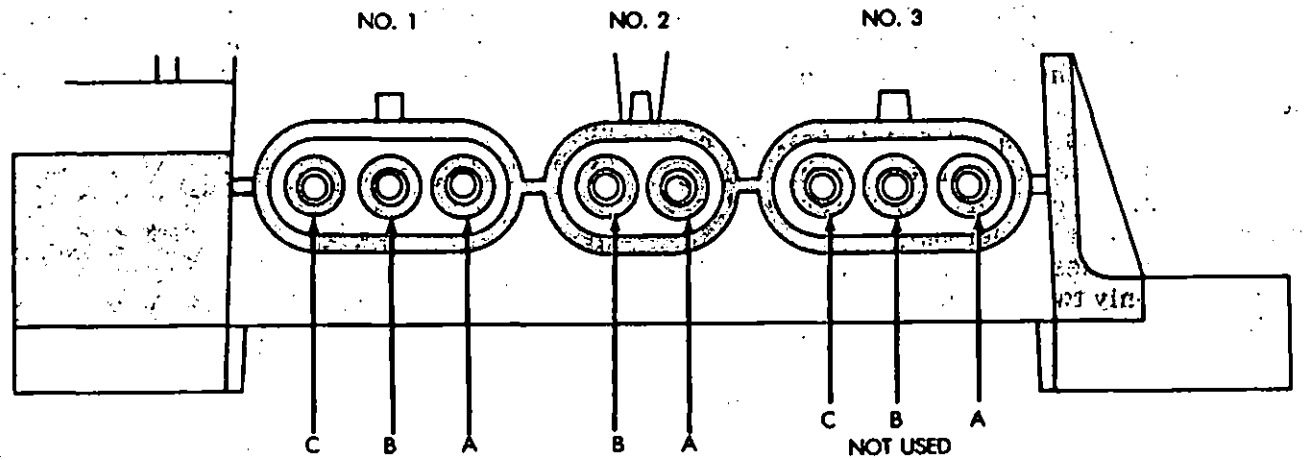

Fig. 2—ICM Connections

engine operation. The speed sensor is non-adjustable.

The drive plate pulse ring has three trigger notches, 120° apart. There are 20 small teeth (windows) between each trigger notch. Each large trigger notch is located 12 small teeth before each Top Dead Center (TDC) position of the corresponding pistons (Fig. 7).

When a tooth and notch pass the magnet core of the speed sensor, a voltage spike is induced in the sensor pick-up coil winding (Fig. 8). The voltage spikes allow the ECU to count the teeth as they pass the sensor. When a trigger notch passes the speed sensor there is a longer than usual delay between voltage spikes. This longer delay tells the ECU that a piston will be at the TDC position 12 voltage spikes later. The ECU uses information from the speed sensor to control spark timing and fuel injection timing for each cylinder.

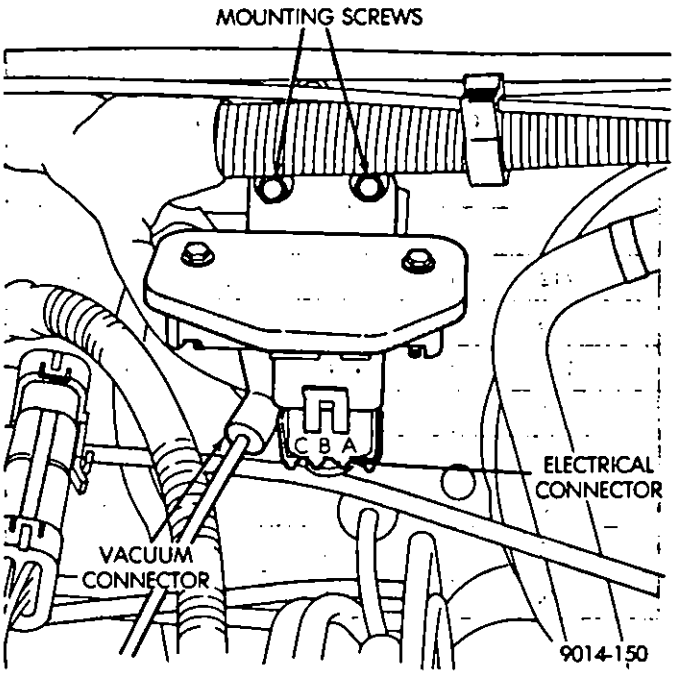

Fig. 3—MAP Sensor

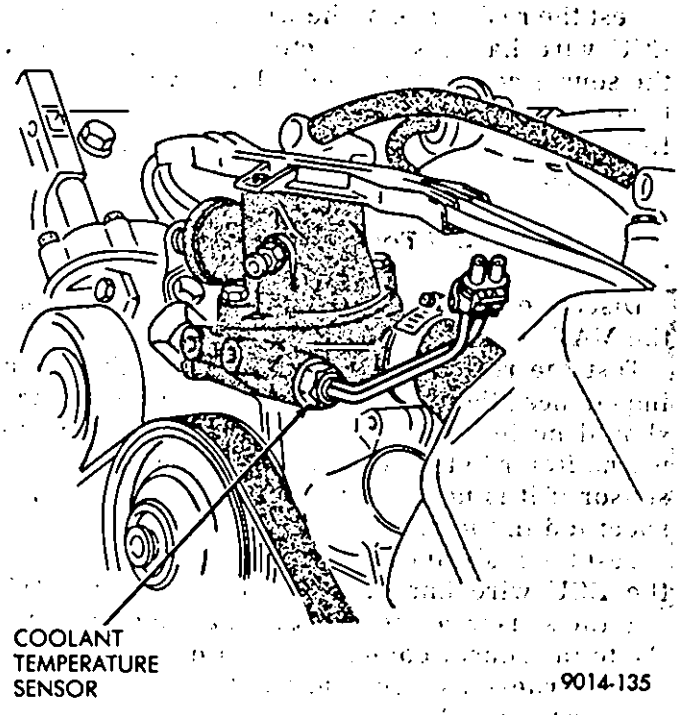

Fig. 4—Coolant Temperature Sensor

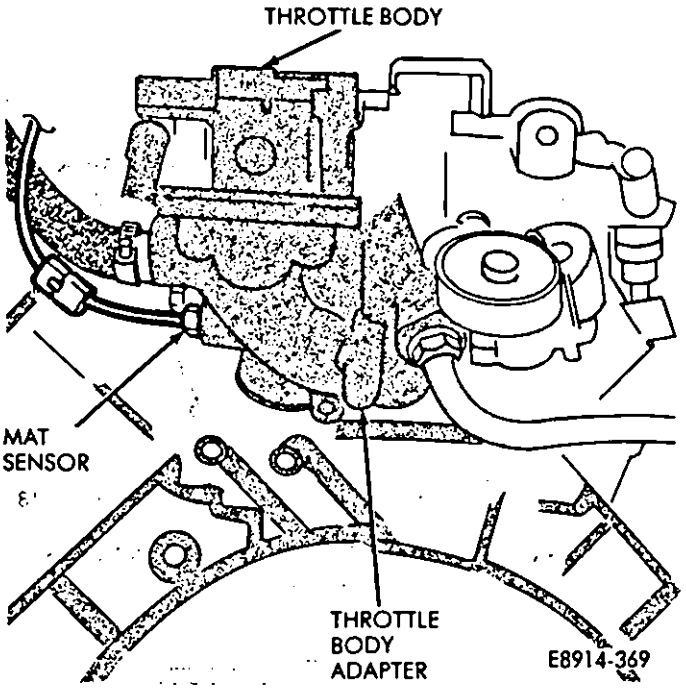

Fig. 5—Manifold Air Temperature Sensor

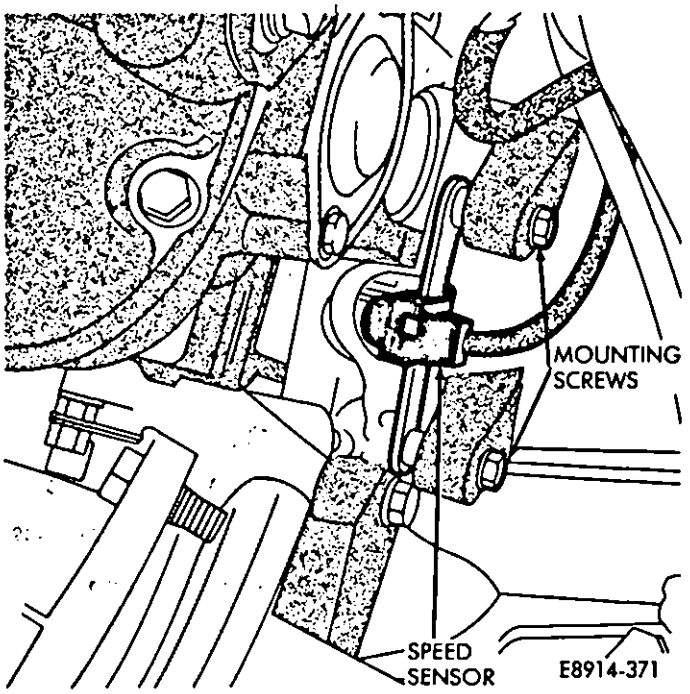

Fig. 6—Engine Speed Sensor

The longer voltage spike indicates to the ECU that a piston will soon be at the TDC position, 12 teeth later. The ignition timing for the particular cylinder is either advanced or retarded as necessary by the ECU according to sensor inputs.

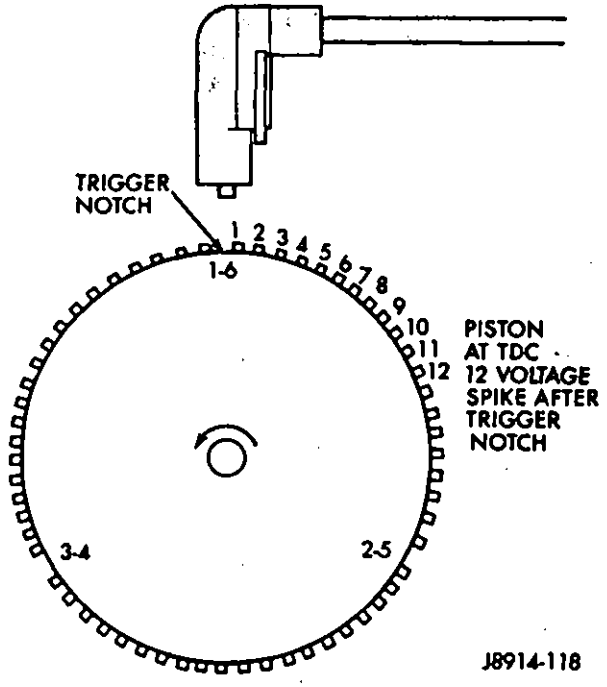

Fig. 7—Engine Speed Sensor, Trigger Notches and TDC Position

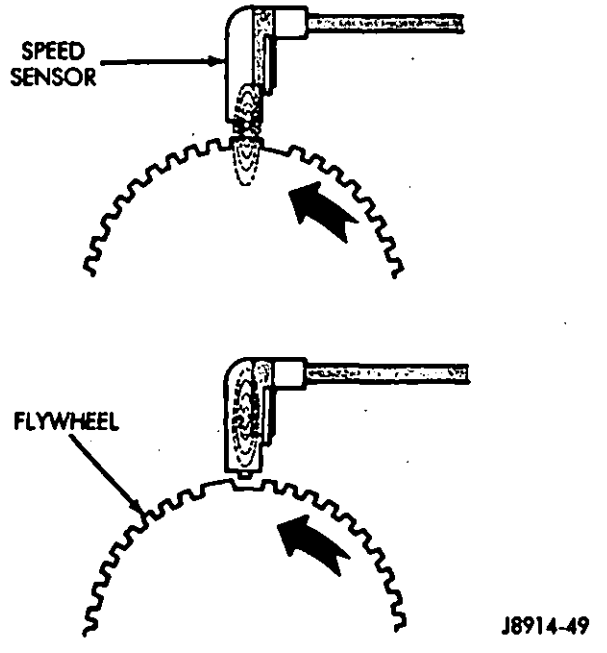

Fig. 8—Engine Speed Sensor Operation

COMPONENT DIAGNOSTIC PROCEDURES

Coolant Temperature Sensor Test

Disconnect wire harness connector from coolant temperature sensor (Fig. 4).

Test the resistance of the sensor with a high input impedance (digital) volt-ohmmeter. The resistance should be less than 1000 ohms with the engine warm. Refer to the resistance chart. Replace the sensor if it is not within the range of resistance specified in the chart.

Coolant Temperature Sensor Temperature-to-Resistance Values (Approximate)

°F	°C	Ohms
212	100	185
160	70	450
100	38	1,600
70	20	3,400
40	4	7,500
20	−7	13,500
0	−18	25,000
−40	−40	100,700

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Test the resistance of the wire harness between ECU wire harness connector terminal D-3 and the sensor connector terminal, and wire harness terminal C-10 to the sensor connector terminal. Repair the wire harness if an open circuit is indicated.

Manifold Air/Fuel Temperature (MAT) Sensor Test

Disconnect the wire harness connector from the MAT sensor (Fig. 9).

Test the resistance of the sensor with a high impedance (digital) volt-ohmmeter. The resistance should be less than 1000 ohms with the engine warm. Refer to the resistance chart. Replace the sensor if it is not within the range of resistance specified in the chart.

Test the resistance of the wire harness between the ECU wire harness connector terminal D-3 and the sensor connector terminal, and terminal C-8 to the sensor connector terminal. Repair the wire harness as necessary if the resistance is greater than 1 ohm.

Manifold Absolute Pressure (MAP) Sensor Test

Inspect the MAP sensor vacuum hose connections at the throttle body and sensor. Repair as necessary.

Manifold Air/Fuel Temperature Sensor Temperature-to-Resistance Values (Approximate)		
°F	°C	Ohms
212	100	185
160	70	450
100	38	1,600
70	20	3,400
40	4	7,500
20	−7	13,500
0	−18	25,000
−40	−40	100,700

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CAUTION: When testing the MAP sensor, insert the tester leads through the back of the connector, ensure that the harness wires are not damaged by the test meter leads.

Test the MAP sensor output voltage at the MAP sensor connector terminal B (as marked on the sensor body) with the ignition switch ON and the engine OFF (Fig. 10). Output voltage should be 4-5 volts. Start the engine and allow idle to stabilize. Recheck output voltage at terminal B. The voltage should drop to 1.5-2.1 volts with a hot, neutral idle speed condition.

Test ECU terminal C-6 for the same voltage described above to verify the wire harness condition. Repair as necessary.

Test MAP sensor supply voltage at sensor connector terminal C with the ignition ON. The voltage should be 5 volts (±0.5V). Five volts (±0.5V) should also be at terminal C-14 of the ECU wire harness connector. Repair or replace the wire harness as necessary.

Test the MAP sensor ground circuit at sensor connector terminal A and ECU connector terminal D-3. Repair the wire harness if necessary.

Speed Sensor (Crankshaft Position Sensor—CPS) Test

Disconnect the speed sensor connector from the harness (Fig. 11).

Place an ohmmeter across terminals A and B (marked on connector). The meter reading should be 200 ± 75 ohms (hot engine). Replace sensor if readings are not to specifications.

Spark Plugs

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

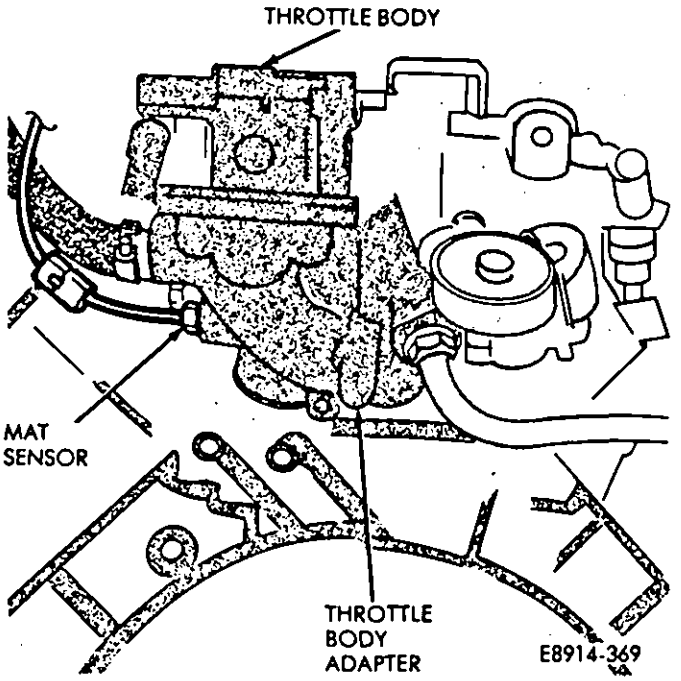
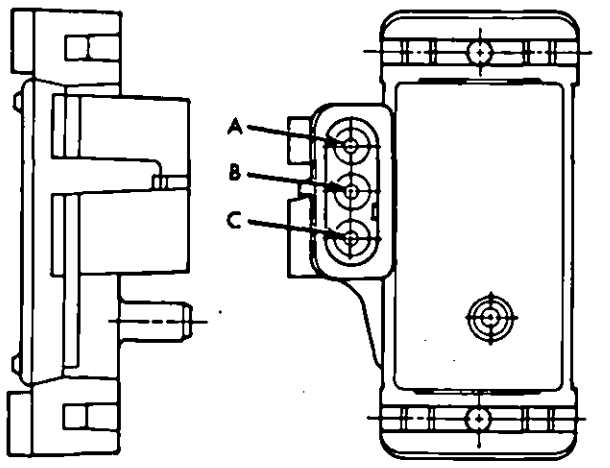


Fig. 9—Manifold Air Temperature Sensor



A. Ground
B. Output Voltage
C. 5 Volts

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Fig. 10—MAP Sensor Connector Terminals

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.

SERVICE PROCEDURES

Ignition Control Module (ICM)

Removal

(1) Disconnect ICM electrical connectors (Fig. 14).
(2) Remove high tension wire.
(3) Remove nuts.
(4) Remove ICM.

Installation

(1) Position ICM and install nuts.
(2) Snap electrical connectors into place on the ICM.
(3) Snap high tension wire onto ICM.

Coolant Temperature Sensor

Removal

The coolant temperature sensor is located in the thermostat housing, above the water pump (Fig. 13).

CAUTION: It is essential that coolant does not contact the accessory drive belt or pulleys because it may cause the belt to slip and/or squeak. Cover the belt and pulleys with shop towels to protect them from coolant spillage. If coolant contacts the belt or pulleys, flush them with clean water.

(1) Disconnect electrical connector.
(2) Remove coolant temperature sensor and immediately plug the opening in the water pump (Fig. 13).

Installation

(1) Screw coolant temperature sensor into the thermostat housing.
(2) Tighten the sensor to 28 N·m (21 ft-lbs) torque.

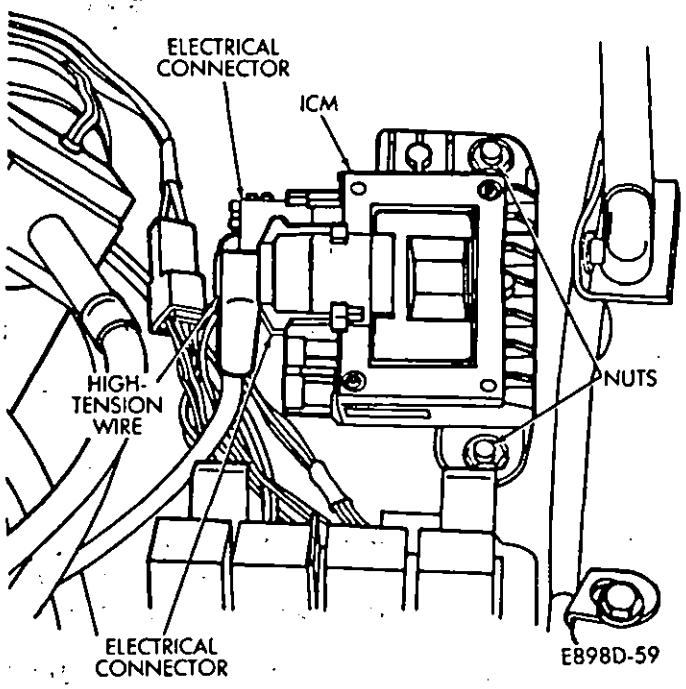


Fig. 12—ICM Removal/Installation

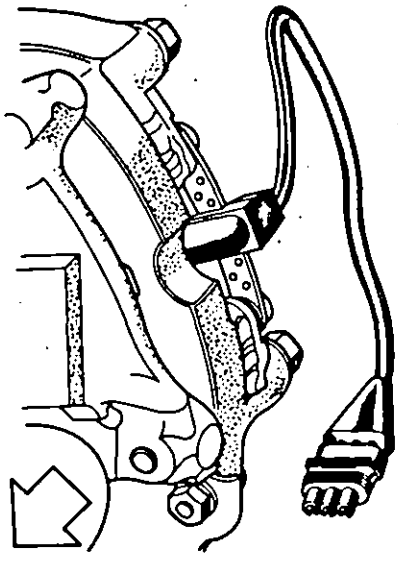


Fig. 11—Engine Speed Sensor

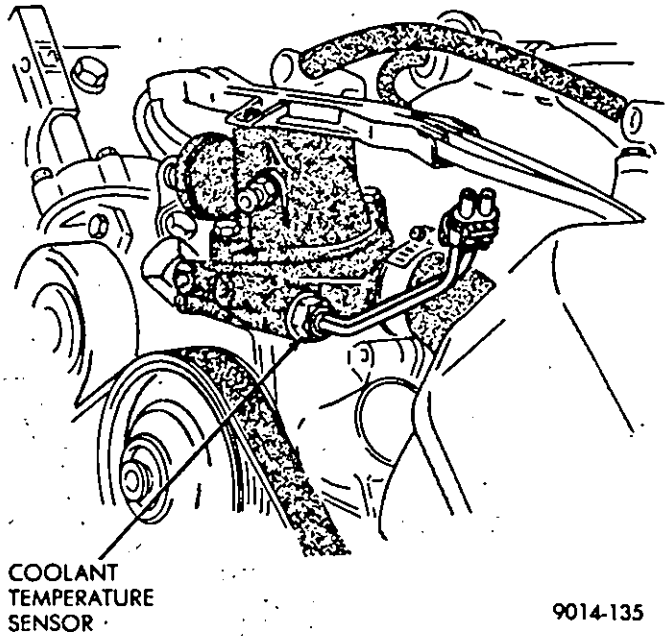


Fig. 13—Coolant Temperature Sensor Removal/Installation

(3) Connect electrical connector to sensor.
(4) Remove the shop towels from the accessory drive belt and pulleys.

Manifold Air Temperature Sensor

Manifold Air Temperature (MAT) sensor is located in the throttle body adaptor below the throttle body and behind the fitting for the Brake Vacuum Booster (Fig. 14).

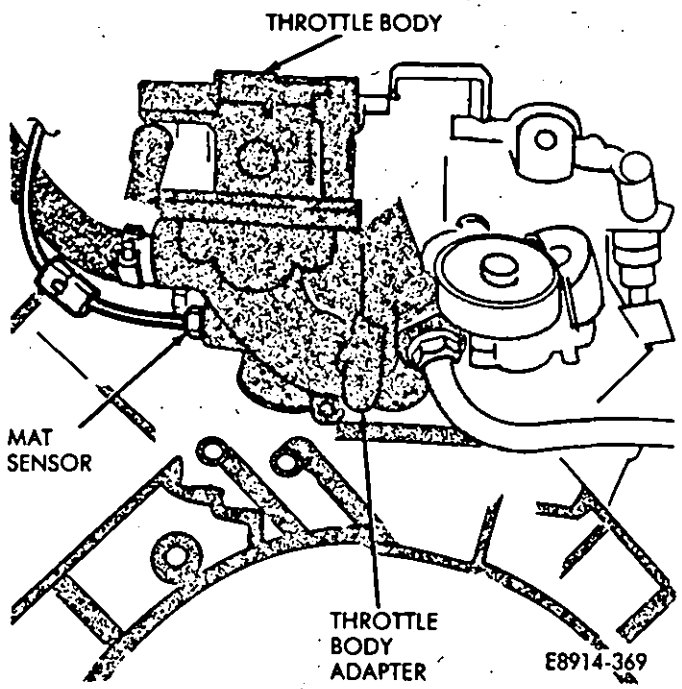


Fig. 14—MAT Sensor Removal/Installation

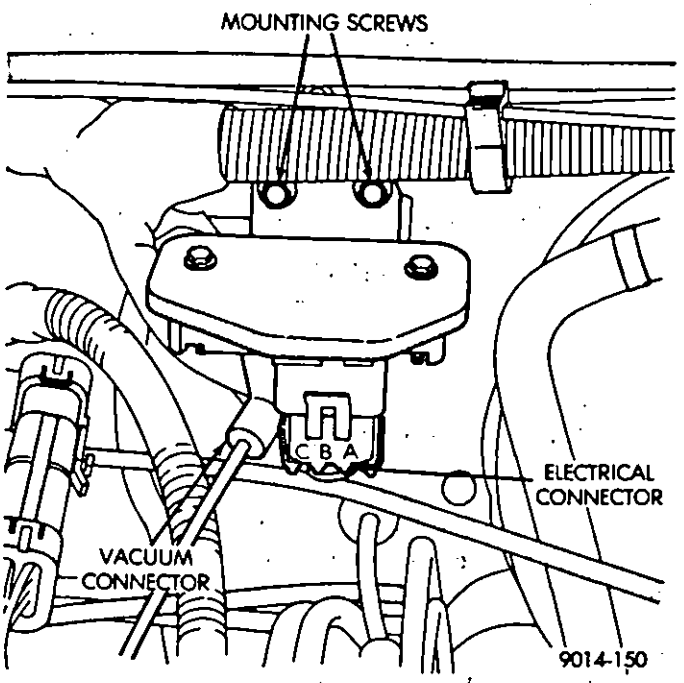


Fig. 15—MAP Sensor Removal/Installation

Removal

(1) Disconnect electrical connector (Fig. 14).
(2) Unscrew MAT sensor from the adaptor.

Installation

(1) Install MAT sensor in throttle body adapter (Fig. 14).
(2) Tighten the MAT sensor to 28 N·m (21 ft-lbs) torque.
(3) Connect electrical connector.

Manifold Absolute Pressure (MAP) Sensor

The Manifold Absolute Pressure (MAP) Sensor is located on the dash panel, next to the Brake Power Booster (Fig. 15).

Removal

(1) Disconnect electrical connector from MAP sensor (Fig. 15).
(2) Disconnect vacuum hose from MAP sensor.
(3) Remove MAP sensor mounting screws.
(4) Remove MAP sensor.

Installation

(1) Install MAP sensor on the dash panel with mounting screws. Tighten the mounting screws.
(2) Connect vacuum hose to MAP sensor.
(3) Connect electrical connector to MAP sensor.

Engine Speed Sensor (Crankshaft Position Sensor—CPS)

The Speed Sensor is located on the left side of the transmission converter housing behind the rear face of the engine (Fig. 16).

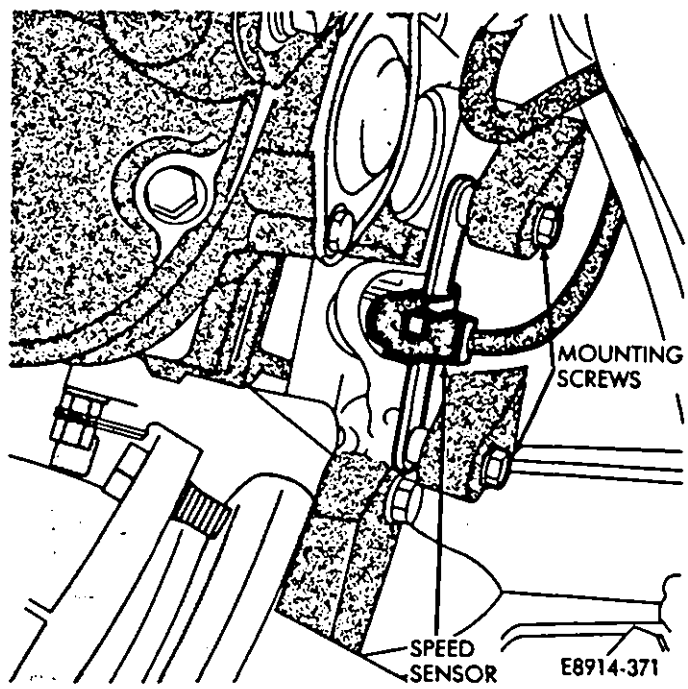


Fig. 16—Engine Speed Sensor Removal/Installation

Removal

(1) Remove the speed sensor mounting screws (Fig. 16).
(2) Disconnect speed sensor wire connector.
(3) Remove speed sensor.

Installation

(1) Install speed sensor (Fig. 16).
(2) Tighten mounting screws to 8 N·m (71 in-lbs) torque.
(3) Connect wire connector to speed sensor.

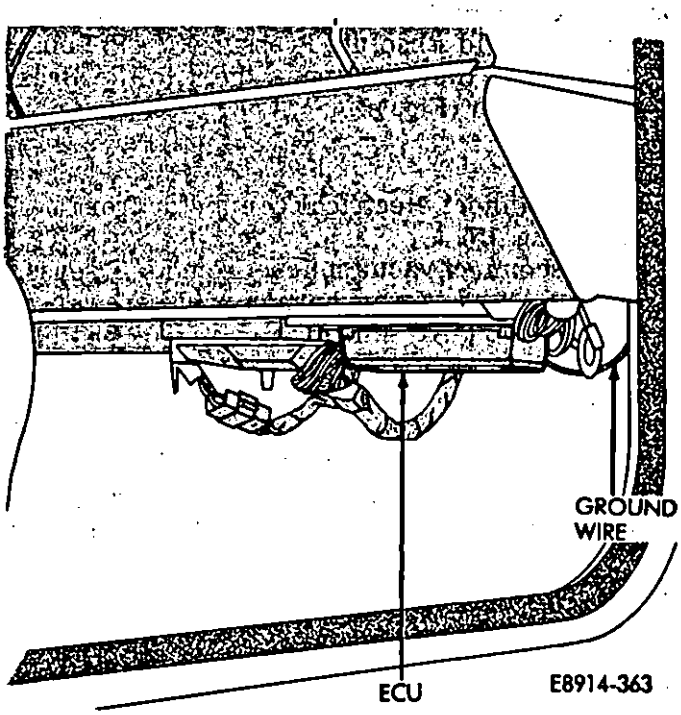


Fig. 17—ECU Removal/Installation

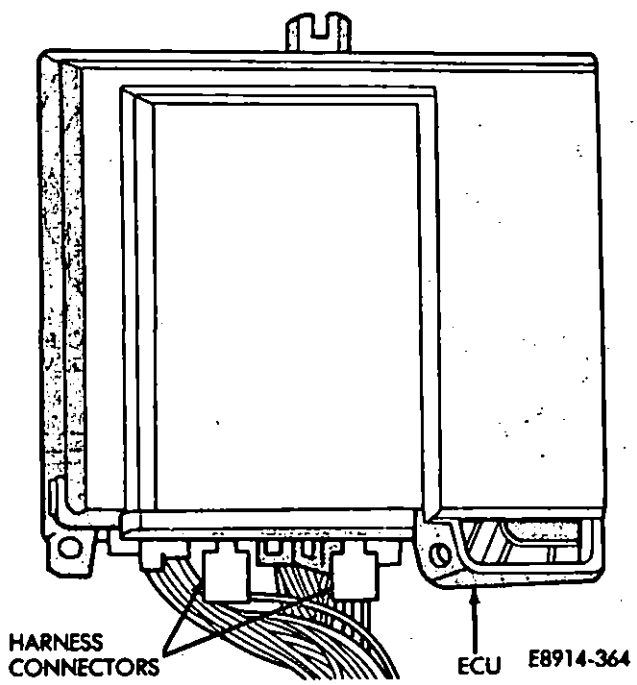


Fig. 18—ECU Connectors

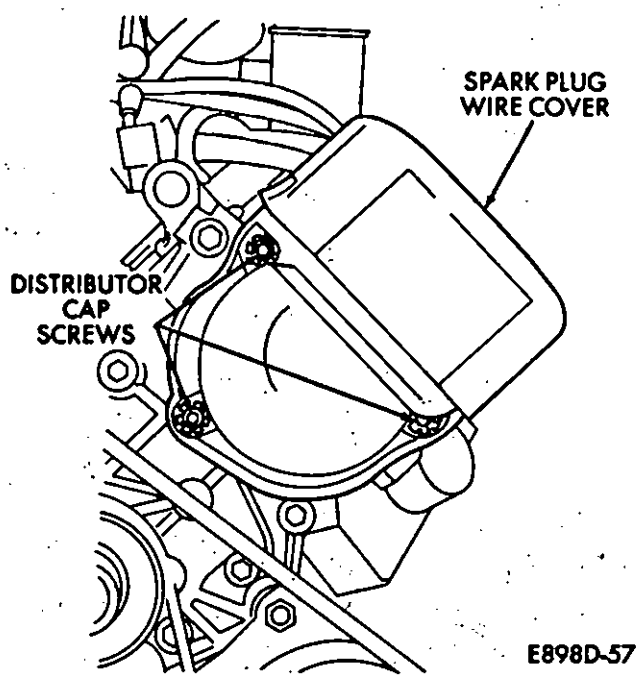


Fig. 19—Distributor Cap Removal/Installation

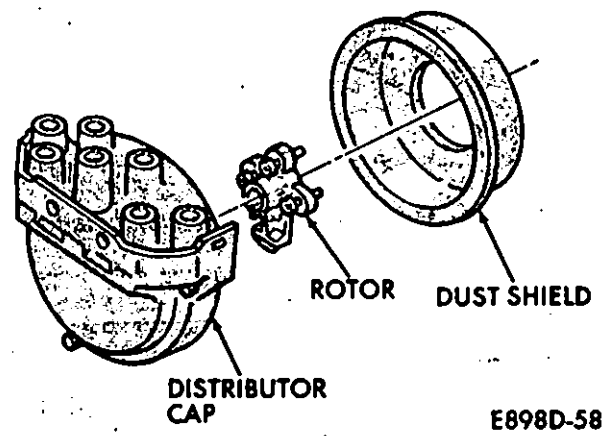


Fig. 20—Distributor Cap/Rotor/Dust Shield

Electronic Control Unit (ECU)

The ECU is located under the instrument panel on the passenger side of the vehicle (Fig. 17).

Removal

(1) Raise the hood and disconnect the battery negative cable.
(2) Remove the ECU mounting nuts and ground strap, remove the ECU from the vehicle (Fig. 17).
(3) Disconnect the harness connectors from the ECU (Fig. 18).

Installation

(1) Connect harness connectors to the ECU.
(2) Push the ECU over the positioning studs.

(3) Install the ground strap and tighten the mounting nuts.
(4) Connect the battery negative cable.
(5) Close the hood.

DISTRIBUTOR CAP/ROTOR/DUST SHIELD REPLACEMENT

The Distributor Cap/Rotor/Dust Shield assembly is located at the front of the left hand cylinder head.
(1) Remove cover over the spark plug wires (Fig. 19).
(2) Remove distributor cap mounting screws.
(3) Remove three screws and the rotor (Fig. 20).
(4) Remove the dust shield.
(5) Transfer the spark plug wires to the new distributor cap. Refer to Specifications for the firing order.
(6) Reverse the removal procedures to install the Distributor Cap/Rotor/Dust Shield.

KEY/LOCK CYLINDER

REMOVAL

(1) Unsnap the horn button (Fig. 1).
(2) Disconnect wires (Fig. 1) and remove the horn button.
(3) Note position of the reference mark (Fig. 1) on the end of the steering shaft.
It is not necessary to use a puller to remove the steering wheel from the shaft.
(4) Remove the steering wheel nut (Fig. 1) and slide the steering wheel off the shaft.
(5) Disconnect electrical connector (Fig. 2) and remove the steering wheel.
(6) Remove turn signal cancel cam (Fig. 3) by unhooking tabs and sliding cancel cam off steering column.
Three small bent paper clips may be used to hold the tabs away from the shaft while sliding the cam off.
(7) If vehicle is equipped with tilt wheel remove tilt wheel control lever (Fig. 4).
(8) Remove the bottom two retaining screws from the left hand switch pod assembly (Fig. 5).

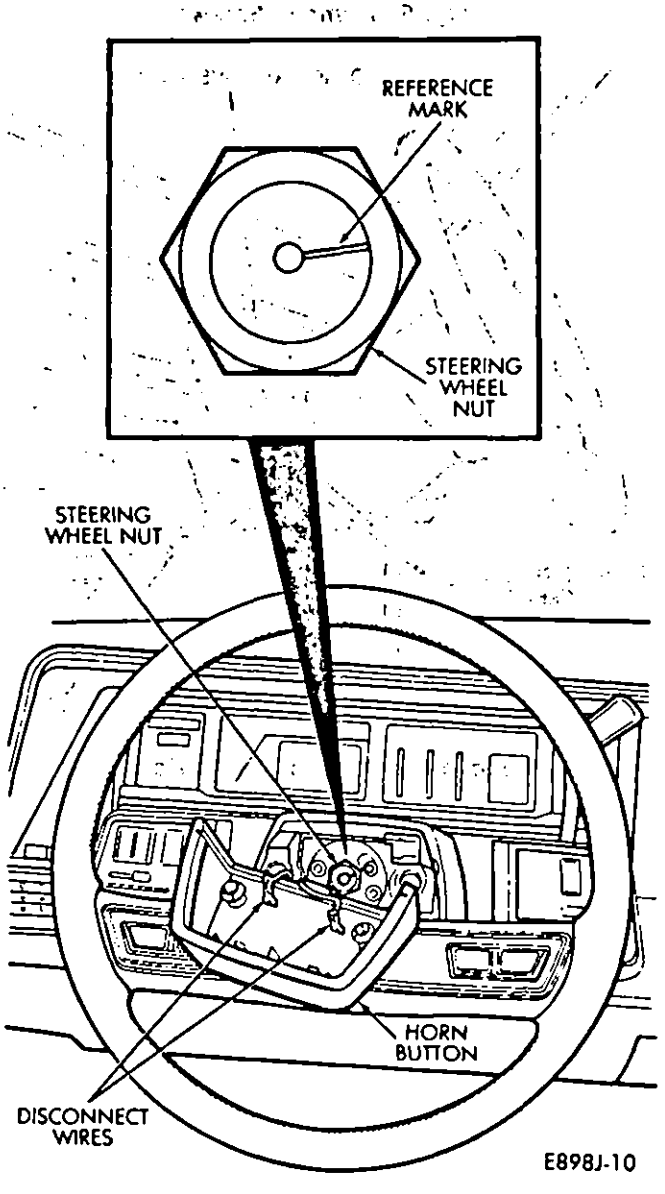


Fig. 1—Remove Horn Button

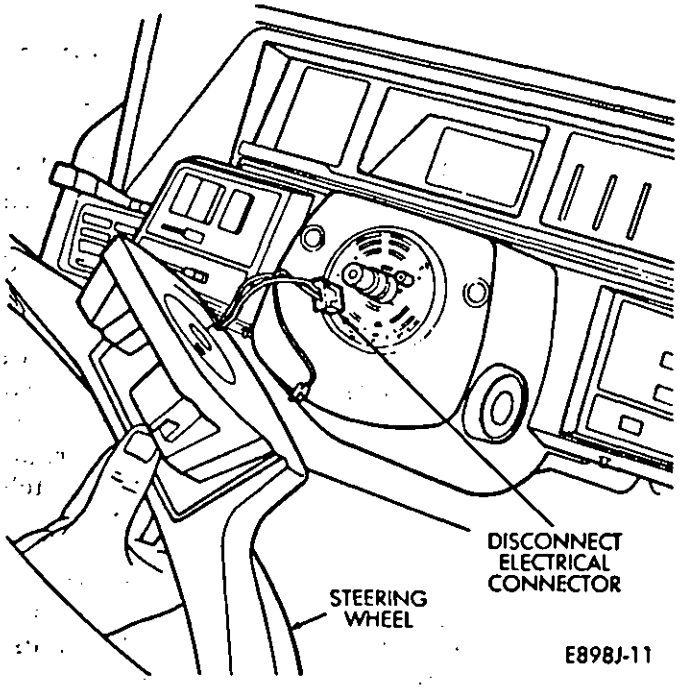


Fig. 2—Remove Steering Wheel

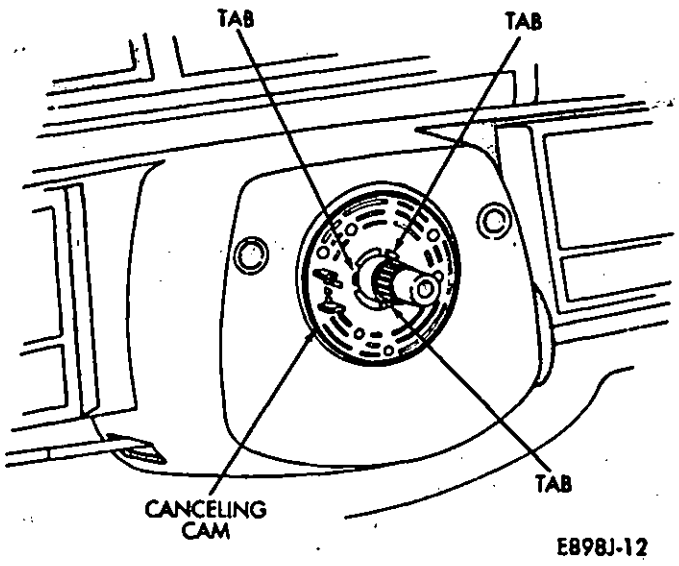


Fig. 3—Remove Turn Signal Cancel Cam

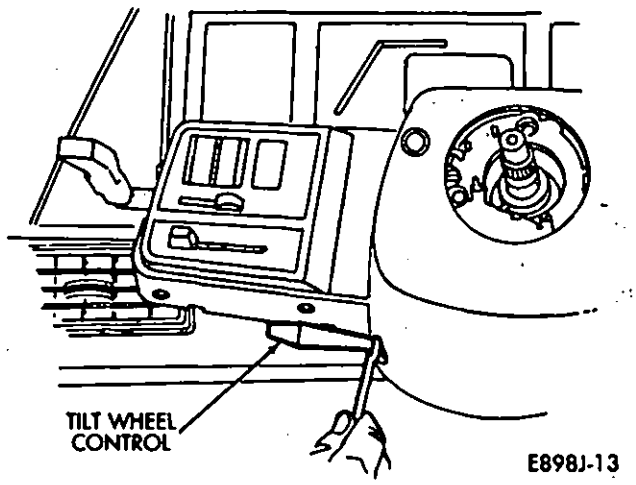


Fig. 4—Remove Tilt Wheel Control Lever

(9) Remove screws from the back of the left hand switch pod assembly, and remove the switch pod housing back cover.

There are small retaining clips on the left hand switch pod that may fall off when the switch is removed.

(10) Remove the bottom two retaining screws from the right hand (Heat/AC) switch pod assembly (Fig. 6).

(11) Remove screws from the back of the right hand switch pod assembly, and remove the switch pod housing back cover.

(12) Remove ignition switch trim ring (Fig. 7) by prying it away from the switch pod housing.

(13) Carefully pull the switch pod assemblies far enough from the housing to expose the housing mounting screws (Figs. 8, 9).

(14) Remove two left hand switch pod housing mounting screws (Fig. 8).

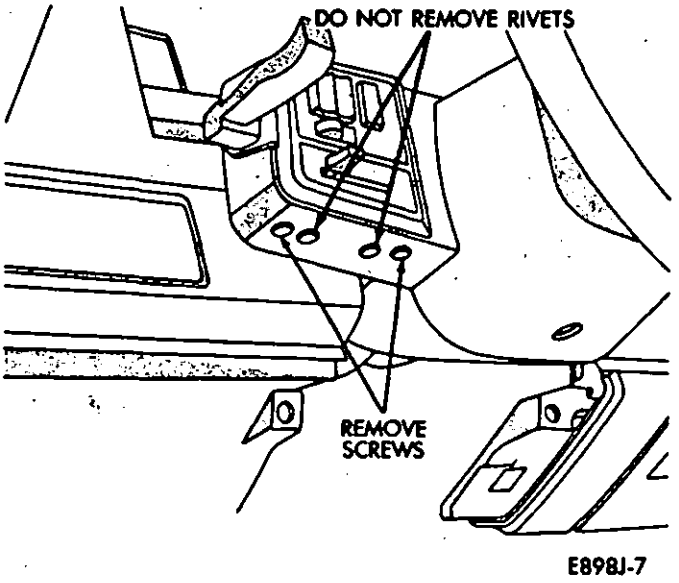


Fig. 5—Remove Screws

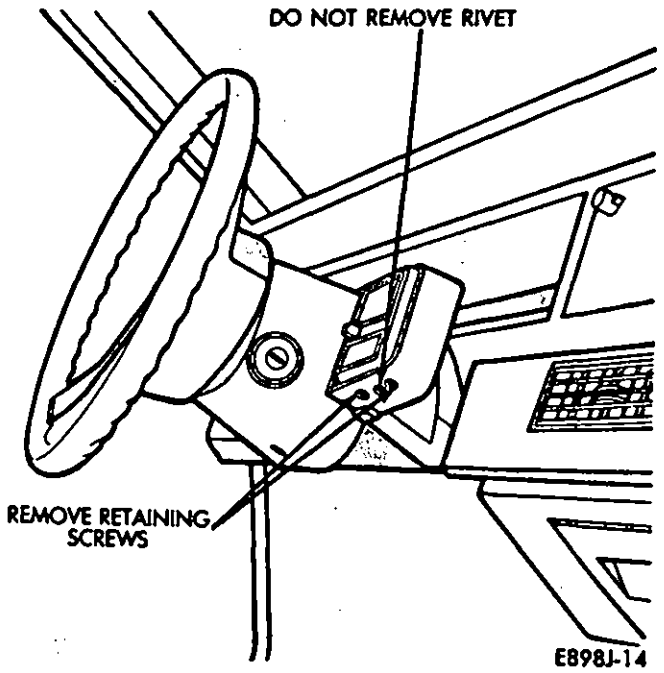


Fig. 6—Remove Right Hand Switch Pod (Heat/AC) Retaining Screws

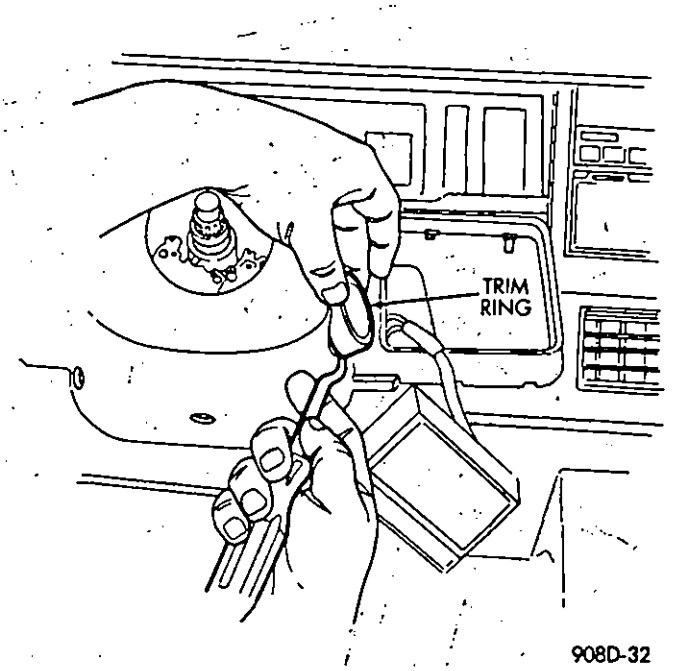


Fig. 7—Remove Ignition Switch Trim Ring

(15) Remove two right hand switch pod housing mounting screws (Fig. 9).
(16) Pass both switch pod assemblies through the back openings in the switch pod housing.
(17) Place key in unmarked position lining up key with groove (Fig. 10) in lock cylinder housing.
(18) Press locking tab (Fig. 10) from underneath as shown.
(19) With tab depressed remove lock cylinder.

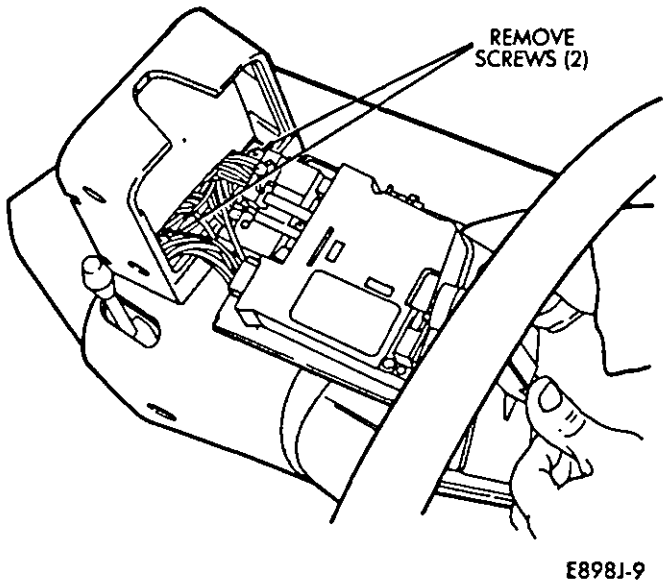


Fig. 8—Remove Two Screws

INSTALLATION

(1) Place key in unmarked position lining up key with groove (Fig. 11).
(2) Depress tab.
(3) Slide lock cylinder into cylinder housing.
(4) Reverse the remaining removal procedures to complete the key/lock cylinder replacement.

There are small retaining clips on the left hand and right hand switch pods that must be in place when the switches are installed.

(5) Align the pin (Fig. 12) on the turn signal cam with the pin bore in the steering wheel and start the wheel onto the steering shaft.
(6) Align the steering wheel with the reference mark on the steering shaft and seat the wheel on the shaft.
(7) Install and tighten the steering wheel nut to 70 N·m (52 ft-lbs) torque.

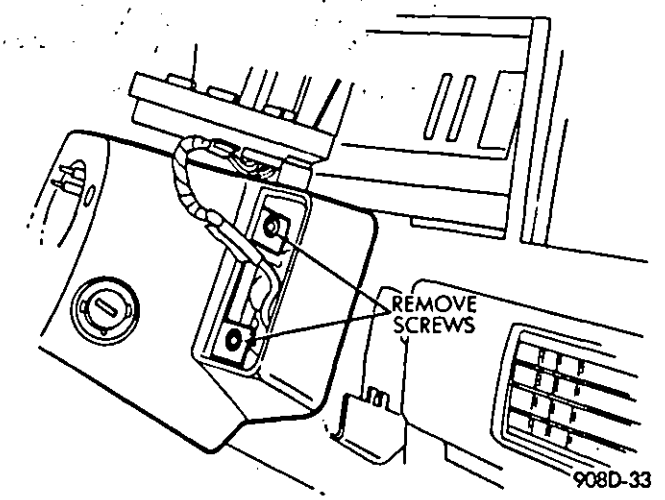


Fig. 9—Remove Two Screws

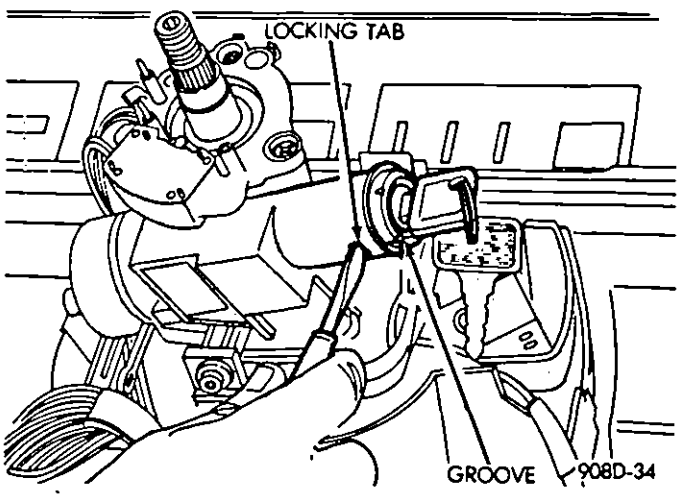


Fig. 10—Line Up Key With Groove

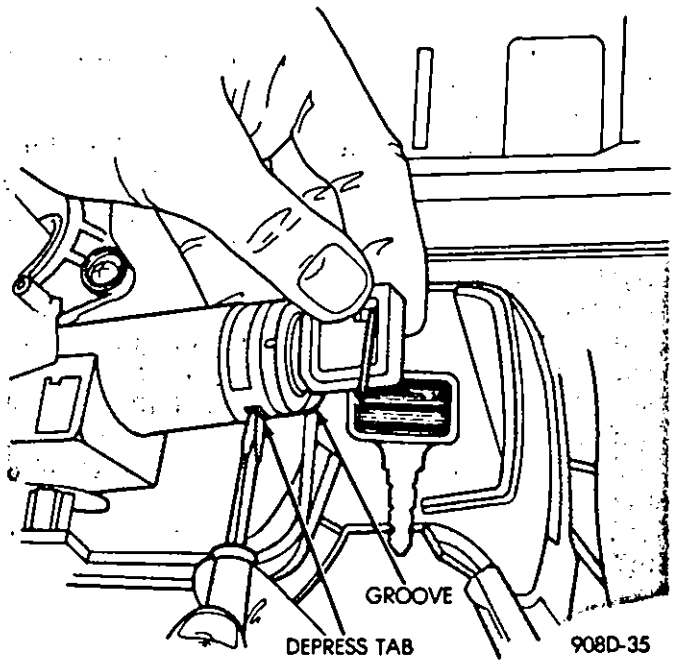


Fig. 11—Lock Cylinder Installation

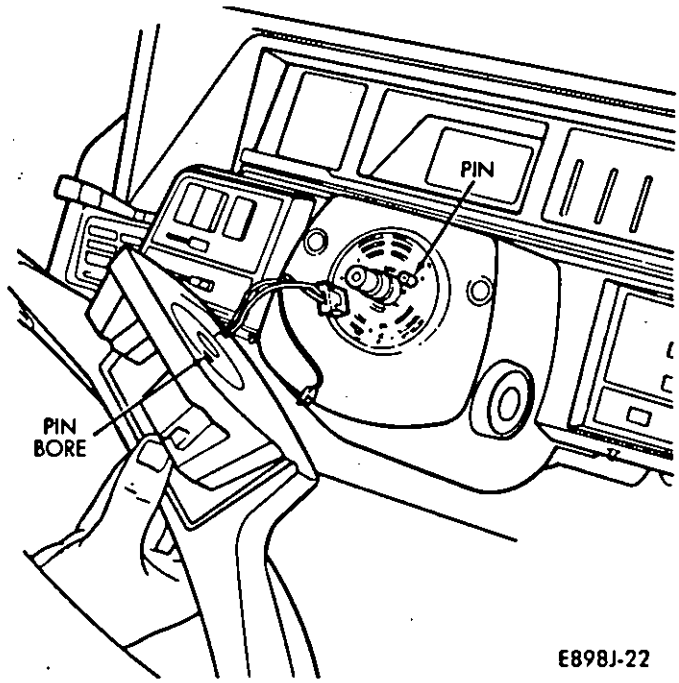


Fig. 12—Steering Wheel Alignment

IGNITION SWITCH

REMOVAL

(1) Remove screws and instrument panel lower cover if equipped (Fig. 1).
(2) Unsnap the horn button (Fig. 2).
(3) Disconnect wires (Fig. 2) and remove the horn button.
(4) Note position of the reference mark (Fig. 2) on the end of the steering shaft.

It is not necessary to use a puller to remove the steering wheel from the shaft.

(5) Remove the steering wheel nut (Fig. 2) and slide the steering wheel off the shaft.
(6) Disconnect electrical connector (Fig. 3) and remove the steering wheel.
(7) Remove turn signal cancel cam (Fig. 4) by unhooking tabs and sliding cancel cam off steering column.

Three small bent paper clips may be used to hold the tabs away from the shaft while sliding the cam off.

(8) If vehicle is equipped with tilt wheel remove tilt wheel control lever (Fig. 5).

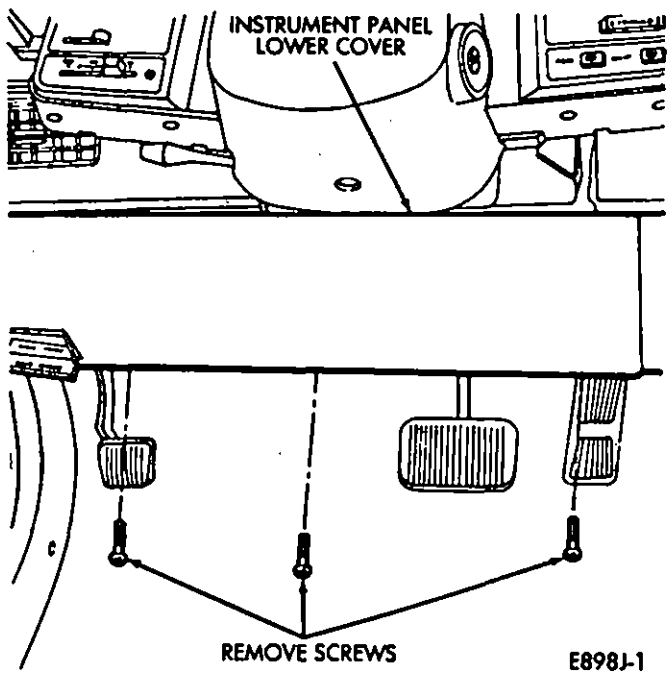


Fig. 1—Remove Instrument Panel Lower Cover

(9) Remove the bottom two retaining screws from the left hand switch pod assembly (Fig. 6).
(10) Remove screws from the back of the left hand switch pod assembly, and remove the switch pod housing back cover.

There are small retaining clips on the left hand switch pod that may fall off when the switch is removed.

(11) Remove the bottom two retaining screws from the right hand (Heat/AC) switch pod assembly (Fig. 7).
(12) Remove screws from the back of the right hand switch pod assembly, and remove the switch pod housing back cover.
(13) Remove ignition switch trim ring (Fig. 8) by prying it away from the switch pod housing.

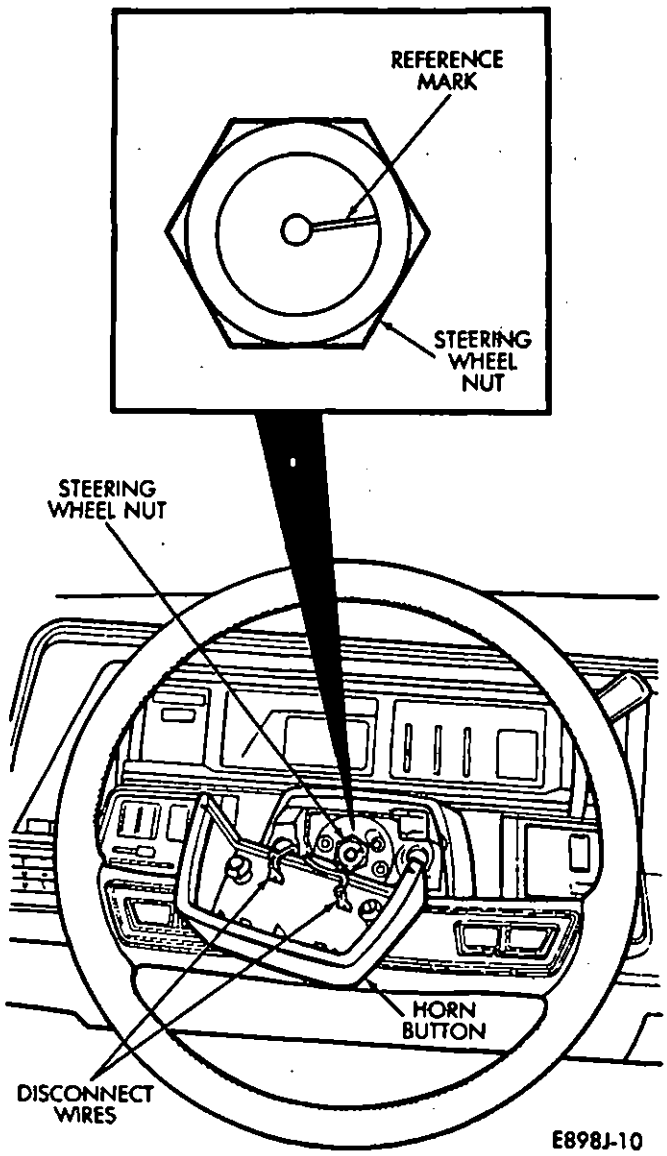


Fig. 2—Remove Horn Button

(14) Carefully pull the switch pod assemblies far enough from the housing to expose the housing mounting screws (Figs. 9, 10).

(15) Remove two left hand switch pod housing mounting screws (Fig. 9).

(16) Remove two right hand switch pod housing mounting screws (Fig. 10).

(17) Pass both switch pod assemblies through the back openings in the switch pod housing.

(18) Remove screw holding lower column shroud (Fig. 11).

(19) Separate and remove the lower column shroud.

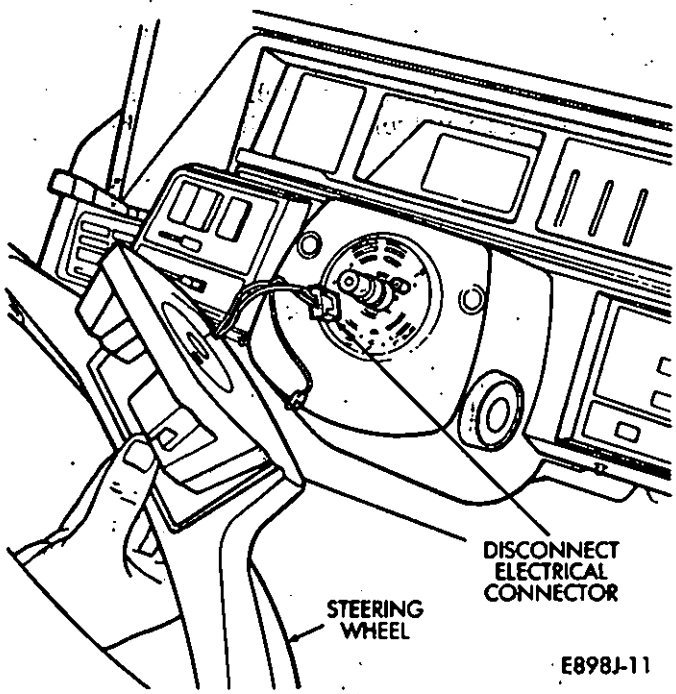


Fig. 3—Remove Steering Wheel

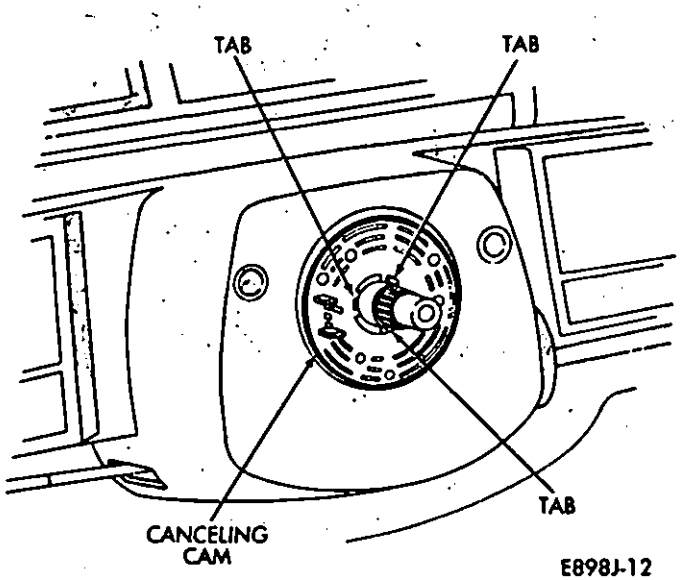


Fig. 4—Remove Turn Signal Cancel Cam

(20) Remove two screws (Fig. 12) and remove upper column shroud.

(21) Remove ignition switch retaining screws (Fig. 13).

(22) Separate ignition switch from lock cylinder housing.

(23) Cut tie straps (Fig. 14).

(24) Remove screw and remove harness anchor (Fig. 15).

(25) Loosen holddown nut (Fig. 16) in center of steering column connector.

(26) Separate the module connectors (Fig. 17) from the steering column connector by placing a flat blade screwdriver between the connectors to disengage locking tab. Push on the wire side of the left hand switch (headlight) pad connector and slide the connector out of the channels of the steering column connector.

Remove ignition switch and harness.

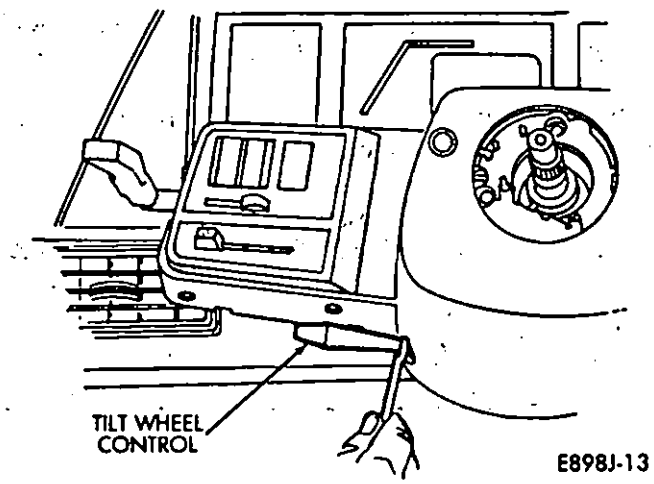


Fig. 5—Remove Tilt Wheel Control Lever

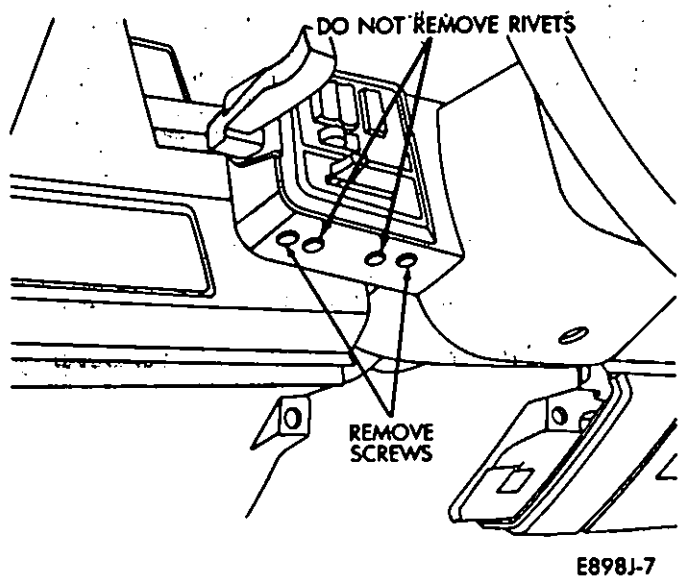


Fig. 6—Remove Screws

INSTALLATION

(1) Slide switch pod connectors into ignition switch connector from wire side and install nut.
(2) Position ignition switch and secure with screws.
(3) Route harnesses along underside of steering column and secure harnesses to column with tie straps.

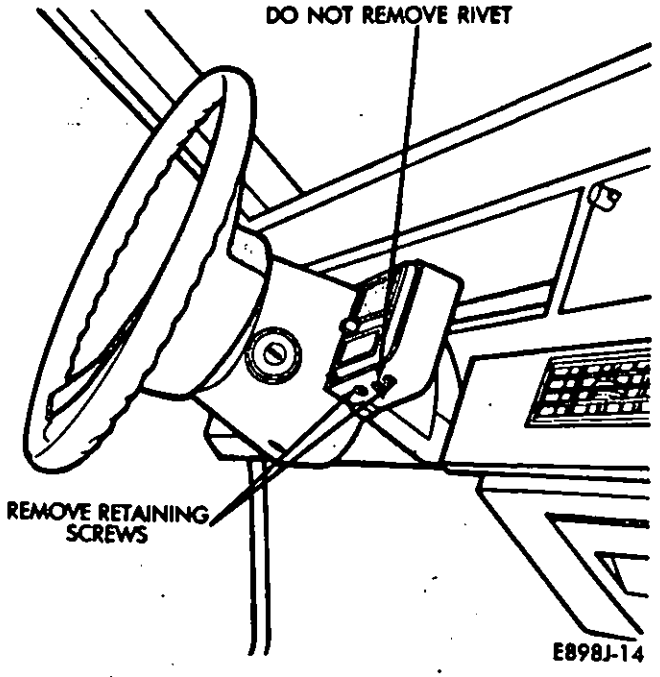


Fig. 7—Remove Right Hand Switch Pod (Heat/AC) Retaining Screws

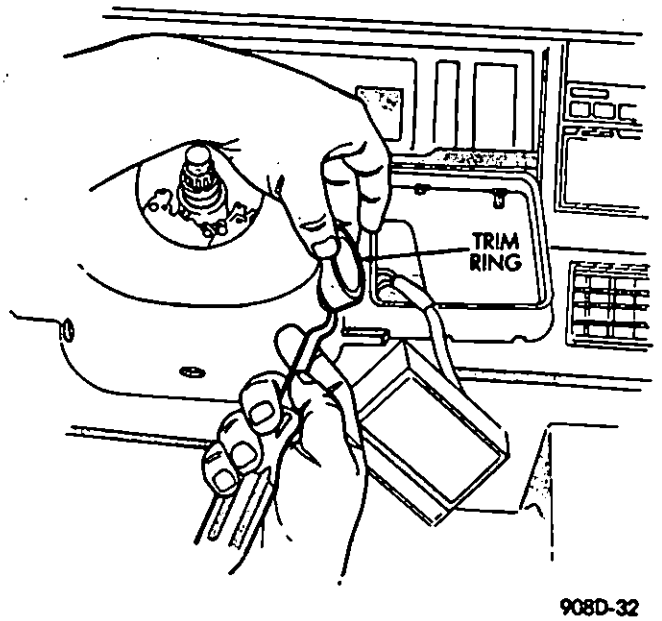


Fig. 8—Remove Ignition Switch Trim Ring

(4) Install harness anchor and secure to column with screw.
(5) Reverse the remaining removal procedures to complete the ignition switch replacement.
There are small retaining clips on the left hand switch pod that must be in place when the switches are installed.
(6) Align the pin (Fig. 18) on the turn signal cam with the pin bore in the steering wheel and start the wheel onto the steering shaft.
(7) Align the steering wheel with the reference mark on the steering shaft and seat the wheel on the shaft.
(8) Install and tighten the steering wheel nut to 70 N·m (52 ft-lbs) torque.

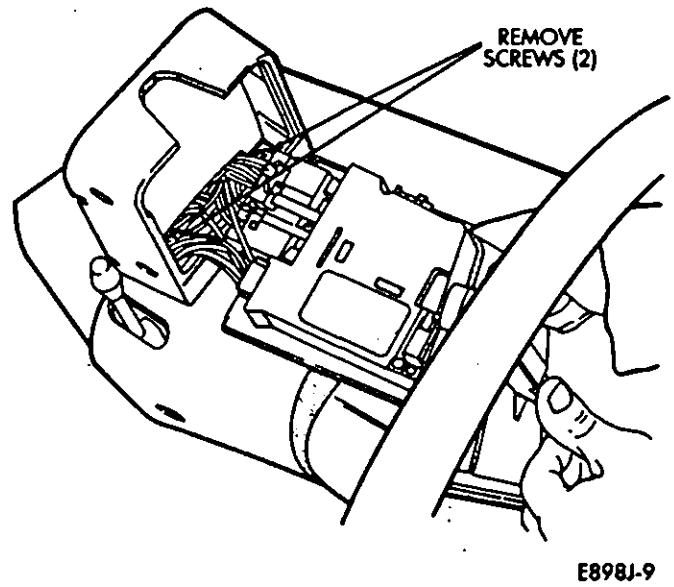


Fig. 9—Remove Two Screws

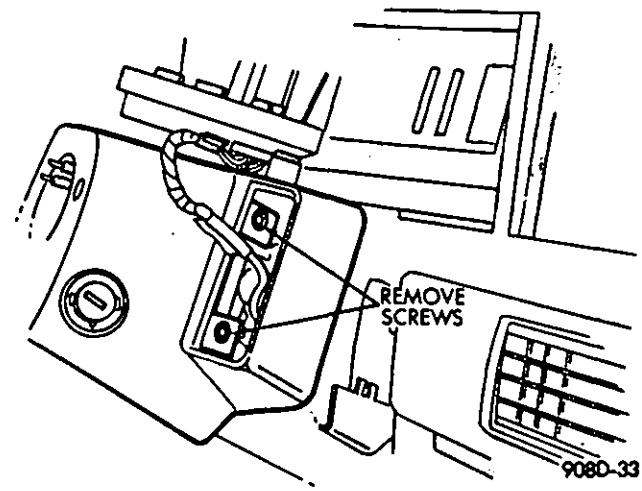


Fig. 10—Remove Two Screws

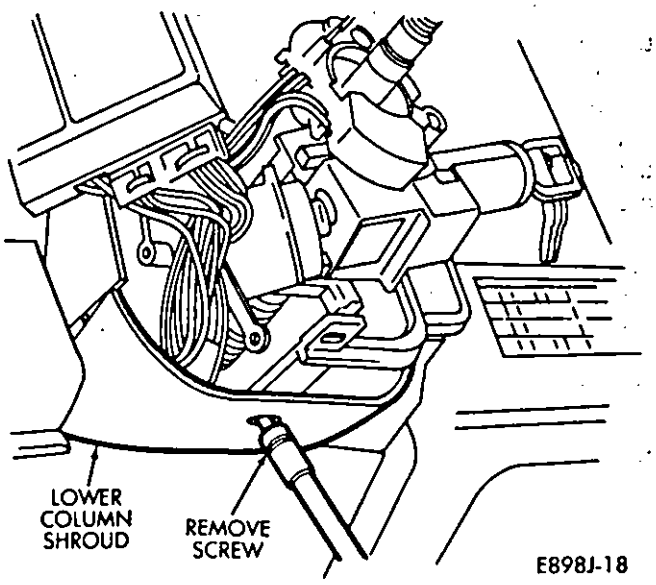


Fig. 11—Remove Lower Shroud Screw

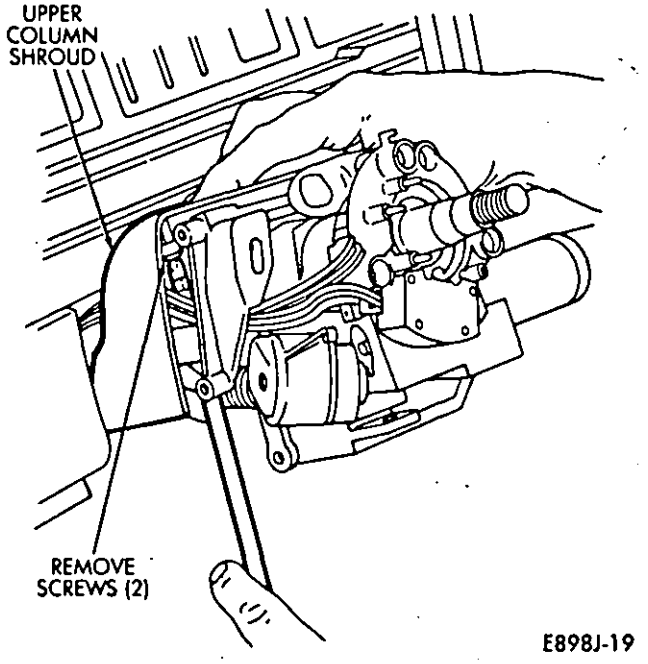


Fig. 12—Remove Two Upper Shroud Screws

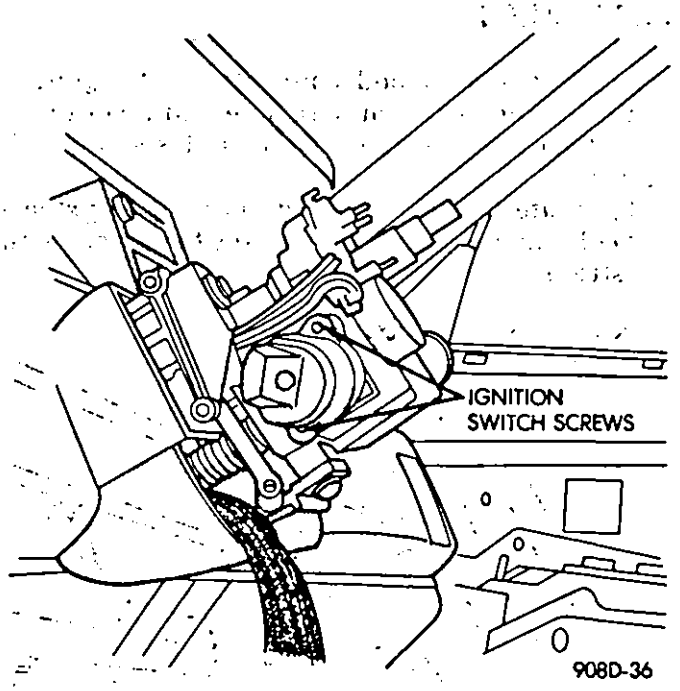


Fig. 13—Remove Ignition Switch Screws

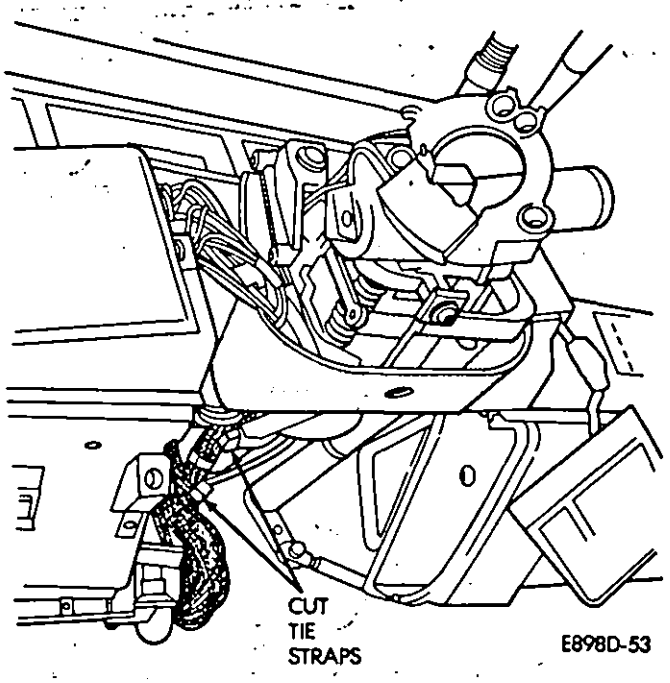


Fig. 14—Cut Tie Straps

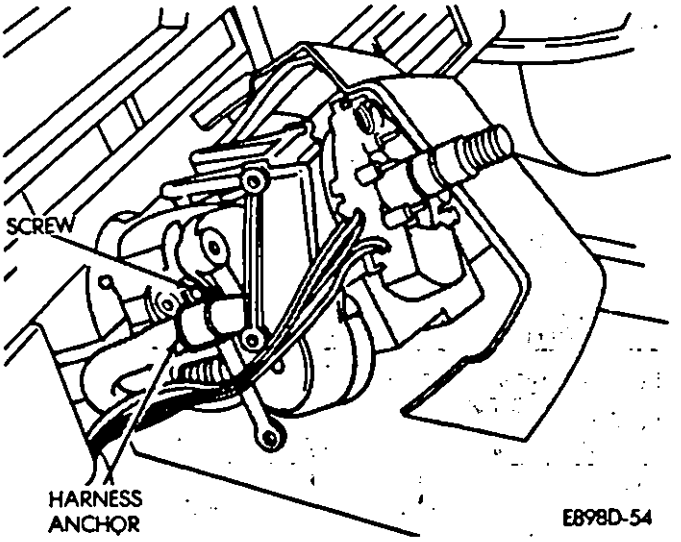


Fig. 15—Remove Harness Anchor

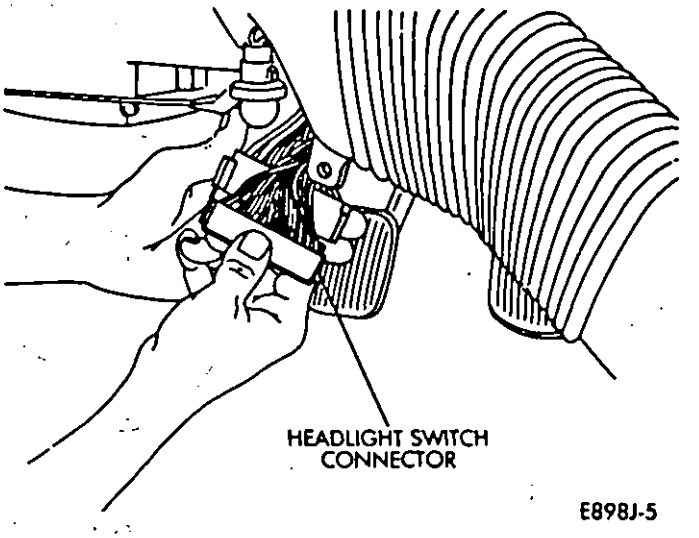


Fig. 17—Separate Switch Pod Connectors

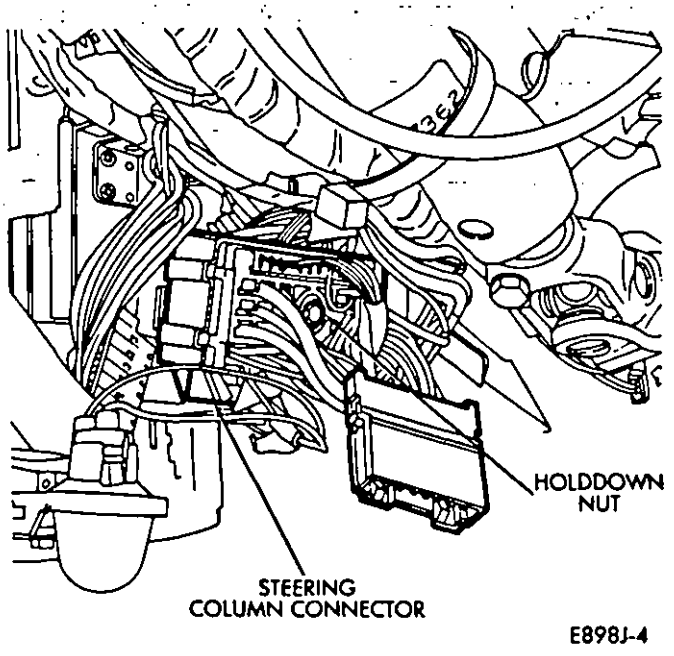


Fig. 16—Loosen Holddown Nut

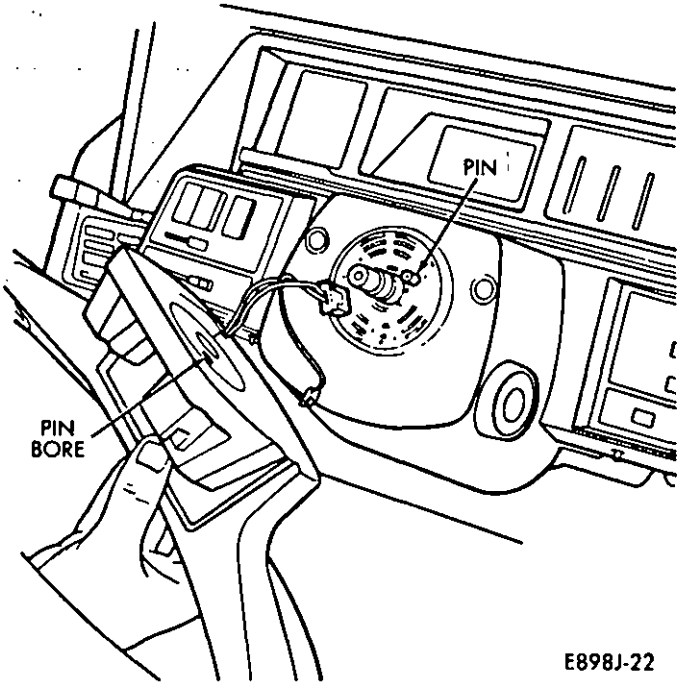
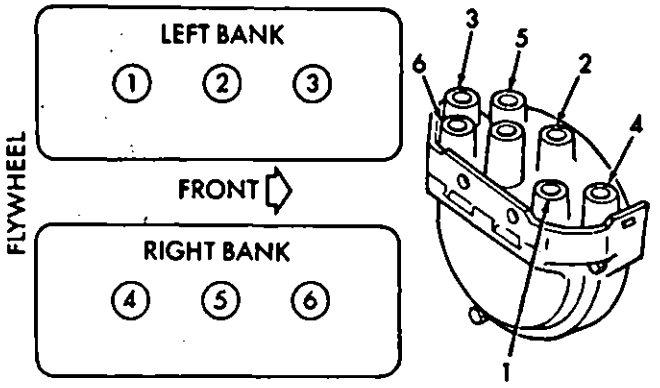


Fig. 18—Steering Wheel Alignment

SPECIFICATIONS



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ENGINE	SPARK PLUG	SPARK PLUG GAP	TORQUE
6-CYL. 3.0L	RS 9YCX	0.9 mm (0.035")	15 N·m (11 FT. LBS.)

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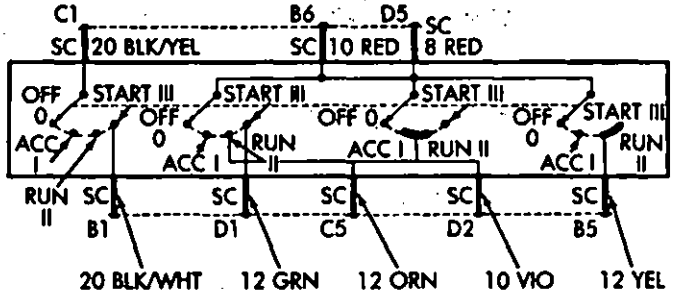

Switch Position	Terminals	Zero Ohms
OFF	All Terminals	No
ACC	D5, B6 and D2	Yes
	All Others	No
RUN	B5, B6, C5, D5 and D2	Yes
	All Others	No
START	B1 and C1	Yes
	B6, D1, D5 and B5	Yes
	All Others	No

908D-38