SECTION 6D1

BATTERY

CONTENTS

GENERAL DESCRIPTION

The engine electrical system includes the battery, ignition (primary and secondary), starter (and related wiring) and the generator (and related wiring). Diagnostic charts (see Section 6D) will aid in trouble-shooting system faults. When a fault is traced to a particular component, refer to that components' section of the service manual.

BATTERY

The sealed battery (see Fig. 1) is standard on all cars. (See Specifications for specific applications.) There are no vent plugs in the cover. The battery is completely sealed, except for two small vent holes in the sides. These vent holes allow the small amount of gas produced in the battery to escape. The battery has the following advantages over conventional batteries:

1. No water addition for the life of the battery.
2. Overcharge protection. If too much voltage is applied to the battery, it will not accept as much current as a conventional battery. In a conventional battery, the excess voltage will still try to charge the battery, leading to gassing which causes liquid loss.
3. Not as liable to self-discharge as compared to a conventional battery. This is particularly important when a battery is left standing for long periods of time.
4. More power available in a lighter and smaller case.

The battery has three major functions in the electrical system: First, it provides a source of energy for cranking the engine; Second, it acts as a voltage stabilizer for the electrical system; And third, it can, for a limited time, provide energy when the electrical load used exceeds the output of the generator.

Ratings

A battery has two ratings: (1) a reserve capacity rating at 27°C (80°F) which is the time a fully charged battery will provide 25 amperes current flow at or above 10.5 volts; and (2) a cold rating at -18°C (0°F) which indicates the cranking load capacity (see Diagnosis Section for specific battery ratings).

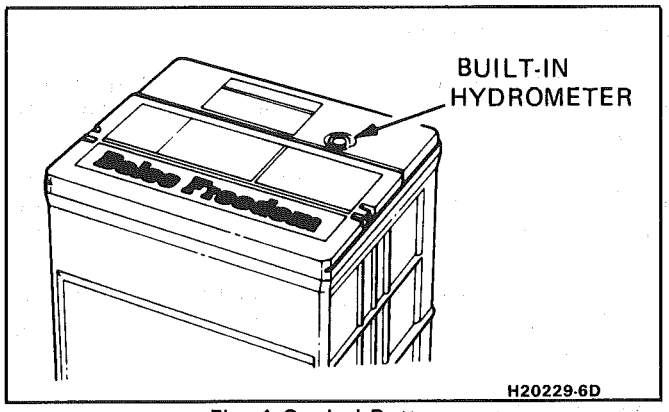


Fig. 1 Sealed Battery

Reserve Capacity

The "Reserve Capacity" is the maximum length of time it is possible to travel at night with minimum electrical load and no generator output.

Expressed in minutes it is the time required for a fully charged battery, at a temperature of 80°F being discharged at a constant current of 25-amperes, to reach a terminal voltage of 10.5 volts.

Cold Cranking Amperage

The "Cold Cranking Amperage" test is expressed at a battery temperature of 0°F. The current rating is the minimum amperage, which must be maintained by the battery for 30 seconds at the specified temperature, while meeting a minimum voltage requirement of 7.2 volts. This rating is a measure of cold cranking capacity.

The battery is not designed to last indefinitely; however, with proper care, it will provide many years of service.

If the battery tests good, but fails to perform satisfactorily in service for no apparent reason, the following are some of the more important factors that may point to the cause of trouble:

1. Vehicle accessories left on overnight.
2. Slow average driving speeds for short periods.

SECTION 6D2

CRANKING SYSTEM

CONTENTS

GENERAL DESCRIPTION

The engine electrical system includes the battery, ignition (primary and secondary), starter (and related wiring) and the generator (and related wiring). Diagnostic charts (see Section 6D) will aid in trouble-shooting system faults. When a fault is traced to a particular component, refer to that components' section of the service manual.

CRANKING SYSTEM

The cranking circuit consists of the battery, starting motor, ignition switch, and related electrical wiring. These components are connected electrically as shown in Fig. 1.

Starter Motor

Wound field starter motors have pole pieces, arranged around the armature, that are energized by wound field coils.

Solenoid

Enclosed shift lever cranking motors have the shift lever mechanism and the solenoid plunger enclosed in the drive housing, protecting them from exposure to dirt, icing conditions and splash.

In the basic circuit shown in Fig. 1, solenoid windings are energized when the switch is closed. The resulting plunger and shift lever movement causes the pinion to engage the engine flywheel ring gear and the solenoid main contacts to close, and cranking takes place. When the engine starts, pinion overrun protects the armature from excessive speed until the switch is opened, at which time the return spring causes the pinion to disengage. To prevent excessive overrun, the switch should open immediately when the engine starts.

DIAGNOSIS

CRANKING SYSTEM

Before removing any unit in a cranking circuit for repair, the following checks should be made:

Electrical System General Diagnosis: Follow the procedures shown in Section 6D to isolate problem.

Battery: To determine the condition of the battery, follow the testing procedure outlined in the Battery section (6D1).

Wiring: Inspect the wiring for damage. Inspect all connections to the cranking motor, solenoid, ignition switch and battery, including all ground connections. Clean and tighten all connections, as required.

Solenoid and Ignition Switch: Inspect all switches to determine their condition.

Starter Motor Noise: To correct starter motor noise during starting, use the following procedure:

1. Refer to Fig. 2 to determine the problem.
2. If the complaint is noise, correction can be achieved by proper "shimming" as follows:
   a. Check flywheel for damage - bent flywheel, unusual wear, etc.
   b. Start engine and carefully touch outside diameter of rotating flywheel ring gear with chalk or crayon to show high point of tooth runout. Turn engine off and rotate flywheel so that the marked teeth are in the area of the starter pinion gear.
   c. Disconnect negative battery cable to prevent cranking of engine.
   d. Check pinion to flywheel clearance, as shown in Fig. 3, by using a wire gage of .5mm (.020") minimum thickness (or diameter). Center a pinion tooth between two flywheel teeth and gage, as shown in Fig. 3. Do not gage in the corners, where a misleading larger dimension may be observed. If the clearance is under this minimum, shimming the starter away from the flywheel is required.
   e. If the clearance is grossly over .5mm (.020") in the vicinity of 1.5mm (.060") or more, shimming the starter toward the flywheel is required. (This is generally the problem causing broken flywheel teeth or starter housings.) Shimming the starter toward the flywheel can be accomplished by shimming only the outboard starter mounting pad. A shim of .4mm (.015") thickness, at this

SECTION 6D3

CHARGING SYSTEM

CONTENTS

GENERAL DESCRIPTION

The engine electrical system includes the battery, ignition (primary and secondary), starter (and related wiring) and the generator (and related wiring). Diagnostic charts (see Section 6D) will aid in trouble-shooting system faults. When a fault is traced to a particular component, refer to that components' section of the service manual.

CHARGING SYSTEM-CS

The CS Charging System has several sizes available, including the CS-130 and CS-144. The number (130 or 144) denotes the OD in mm of the stator laminations.

CS generators use a new type regulator and a diode trio is not used. A delta stator, rectifier bridge, and rotor with slip rings and brushes are electrically similar to earlier generators. A conventional pulley and fan is used and, on the CS-130, an internal fan cools the slip ring end frame, rectifier bridge and regulator.

Unlike three-wire generators, the CS-130 and CS-144 may be used with only two connections - battery positive and an "L" terminal to the charge indicator bulb. Use of "P", "F", and "S" terminals is optional. The "P" terminal is connected to the stator, and may be connected externally to a tachometer or other device. The "F" terminal is connected internally to field positive, and may be used as a fault indicator. The "S" terminal may be connected externally to a voltage, such as battery voltage, to sense voltage to be controlled.

As on other charging systems, the charge indicator lights when the switch is closed, and goes out when the engine is running. If the charge indicator is on with the engine running, a charging system defect is indicated. For all kinds of defects, the indicator will glow at full brilliance, not "half lit". Also, the charge indicator will be on with the engine running if system voltage is too high or too low. The regulator voltage setting varies with temperature, and limits system voltage by controlling rotor field current.

This regulator switches rotor field current on and off at a fixed frequency of about 400 cycles per second. By varying the on-off time, correct average field current for proper system voltage control is obtained. At high speeds, the on-time may be 10% and the off-time 90%. At low speeds, with high electrical loads, on-off time may be 90% and 10%, respectively.

No periodic maintenance on the generator is required.

DIAGNOSIS

SERVICE PROCEDURES

CHARGING SYSTEM

The generator does not require periodic lubrication. The rotor shaft is mounted on ball bearings at the drive end and roller bearings at the slip ring end. Each contains a permanent grease supply. At periodic intervals, check mounting bolts for tightness and adjust belt tension (see Section 6B), if applicable.

- When adjusting belt tension, apply pressure at center of generator, never against either end frame.

GENERATOR BENCH CHECK-CS

To check generator in a test stand, remove as specified in On-Car Service and proceed as follows:

1. Make connections as shown in Figure 1H, except leave the carbon pile disconnected. The ground polarity of generator and battery must be the same. The battery must be fully charged. Use a 30-500 OHM resistor between battery and "L" terminal.

2. Slowly increase generator speed and observe voltage.

3. If the voltage is uncontrolled and increases above 16.0 volts, the rotor field is shorted, the regulator is defective, or both. A shorted rotor field coil can cause the regulator to become defective. NOTE: The battery must be fully charged when making this test.

SECTION 6D4

IGNITION SYSTEM

CONTENTS

GENERAL DESCRIPTION

The engine electrical system includes the battery, ignition (primary and secondary), starter (and related wiring) and the generator (and related wiring). Diagnostic charts (see Section 6D) will aid in trouble-shooting system faults. When a fault is traced to a particular component, refer to that components' section of the service manual.

IGNITION SYSTEM

Distributor Ignition

The ignition circuit consists of the battery, distributor, ignition switch, spark plugs and primary and secondary wiring. Refer to the Battery portion of this section for battery information.

HEI Distributor

The High Energy Ignition (HEI) distributor with Electronic Spark Timing (EST), used on most engines, combines all ignition components in one unit. The ignition coil is in the distributor cap and connects through a resistance brush to the rotor.

The distributor has an internal magnetic pick-up assembly which contains a permanent magnet, a pole piece with internal teeth and a pick-up coil. When the teeth of the timer core, rotating inside the pole piece, line up with the teeth of the pole piece, an induced voltage in the pick-up coil signals the electronic module to trigger the coil primary circuit. The primary current decreases and a high voltage is induced in the ignition coil secondary winding. This voltage is directed through the rotor and secondary leads to fire the spark plugs. The capacitor in the distributor is for radio noise suppression.

All spark timing changes in the HEI (EST) distributor are done electronically by an Electronic Control Module (ECM), which monitors information from various engine sensors, computes the desired spark timing and signals the distributor to change the timing accordingly. A back-up spark advance system is incorporated to signal the ignition module in case of (ECM) failure. No vacuum or mechanical advance is used. Further (EST) information is found in sections 6E Emissions Control, and 8A Electrical Troubleshooting.

Ignition Timing

Timing specifications for each engine are listed in Section 6E. When using a timing light, connect an adapter between the No. 1 spark plug and the No. 1 spark plug wire, or use an inductive type pick-up. **Do not pierce the plug lead.** Once the insulation of the spark plug cable has been broken, voltage will jump to the nearest ground, and the spark plug will not fire properly. **Always follow the tune-up label procedures when adjusting timing.**

Some engines will incorporate a magnetic timing probe hole for use with special electronic timing equipment. Fig. 1A shows a typical magnetic probe hole. Consult manufacturer's instructions for use of this equipment.

Secondary Wiring

The spark plug wiring used with ignition systems is a carbon impregnated cord conductor, encased in an 8MM (5/16") diameter silicone rubber jacket. The silicone jacket withstands very high temperatures and also provides an excellent insulator for the higher voltage of the HEI system. Silicone spark plug boots form a tight seal on the plug. **The boot should be twisted 1/2 turn before removing.** Care should also be exercised when connecting a timing light or other pick-up equipment. Do not force anything between the boot and wiring, or through the silicone jacket. Connections should be made in parallel using an adapter. DO NOT pull on the wire to remove. Pull on the boot, or use a tool designed for this purpose.

Spark Plugs

Resistor type, tapered seat spark plugs are used on all engines (except aluminum heads). No gasket is used on these tapered seat plugs. See Figs. 1B and 1C for an explanation of coding on spark plugs.

Normal service is assumed to be a mixture of idling, slow speed, and high speed driving. Occasional or intermittent high-speed driving is needed for good

SECTION 6D5

ENGINE WIRING

CONTENTS

GENERAL DESCRIPTION

The engine electrical system includes the battery, ignition (primary and secondary), starter (and related wiring) and the generator (and related wiring). Diagnostic charts (see Section 6D) will aid in trouble-shooting system faults. When a fault is traced to a particular component, refer to that components' section of the service manual.

ON-CAR SERVICE

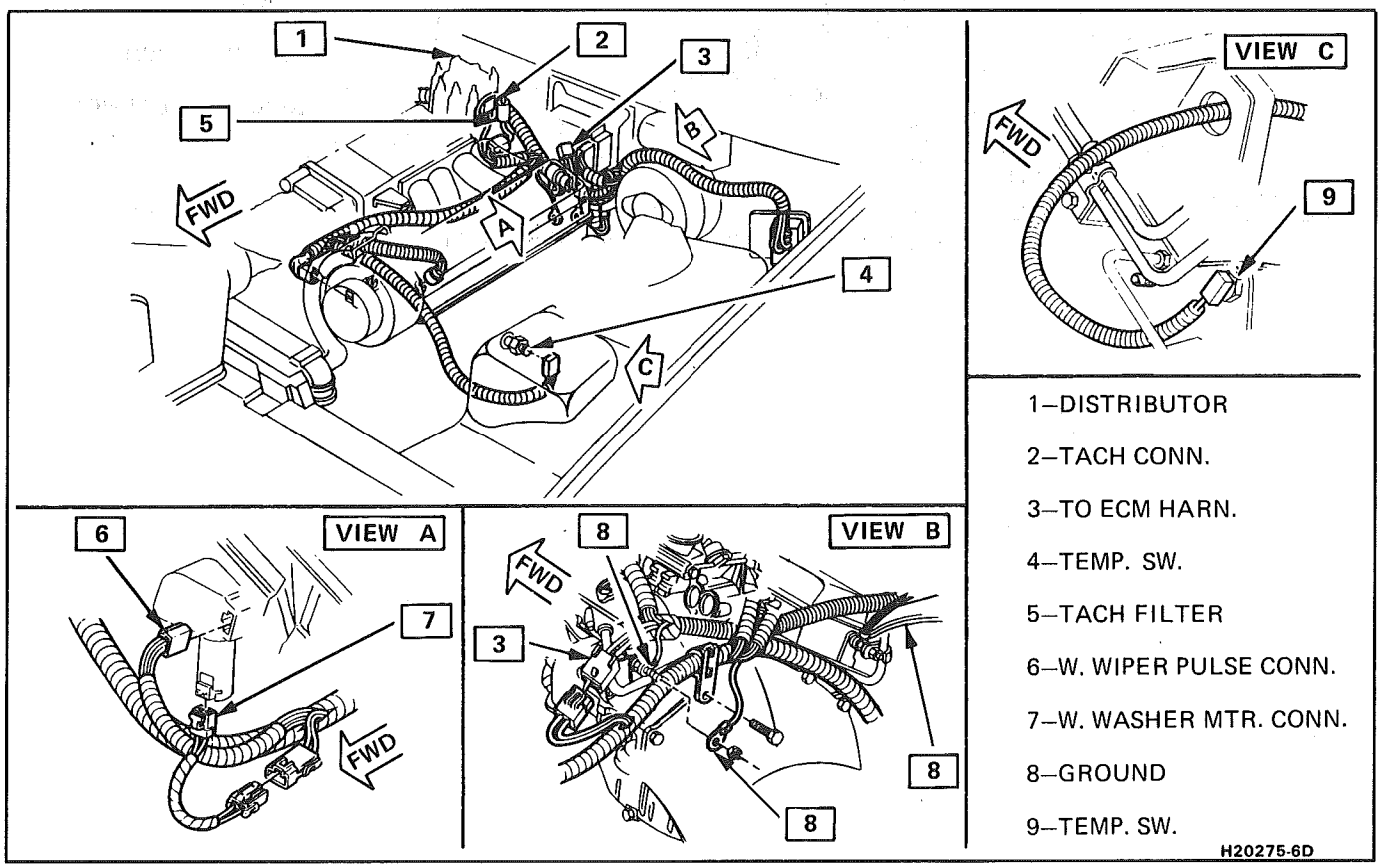


Fig. 601 Engine Harness - Left (LB9/B2L)

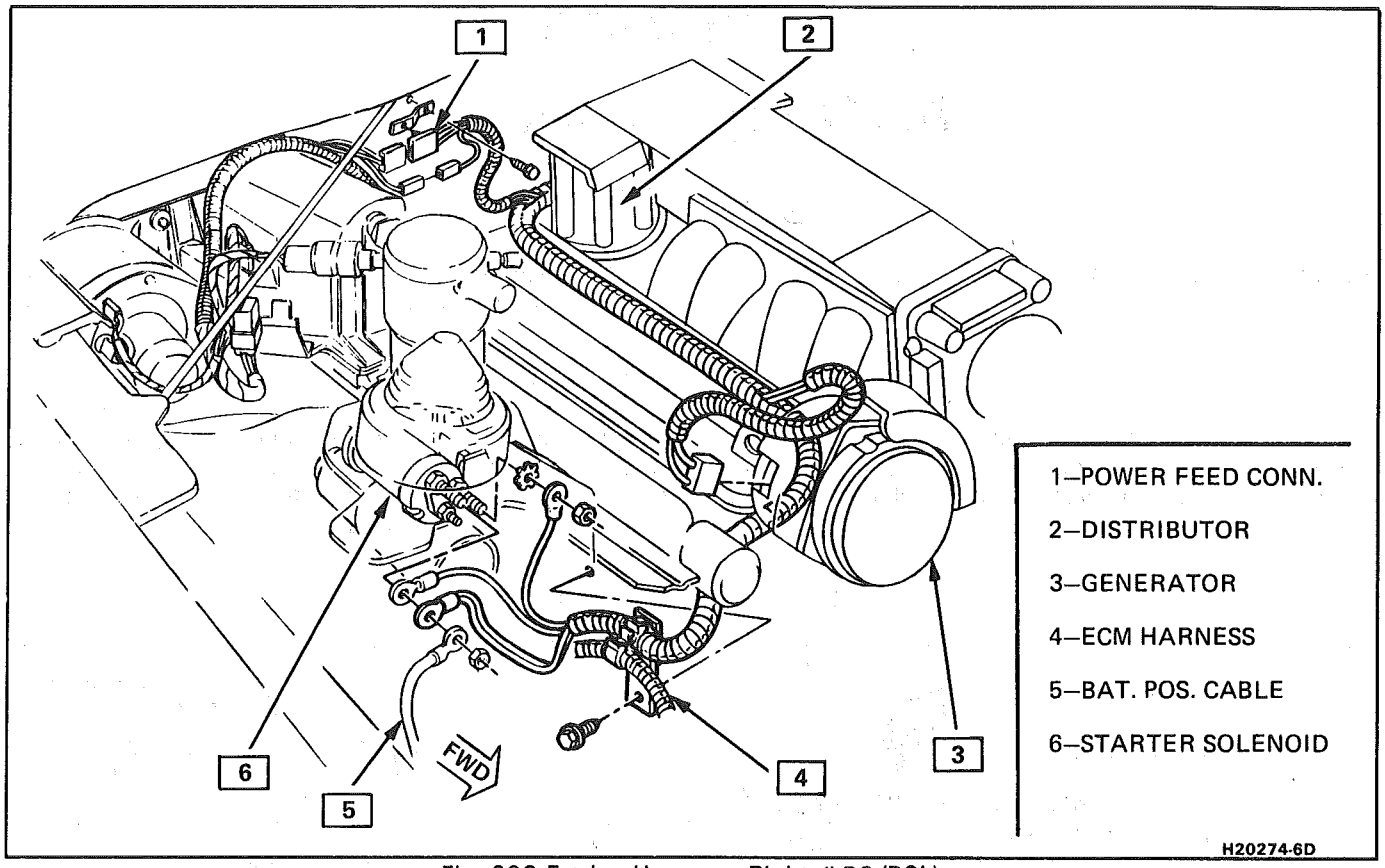
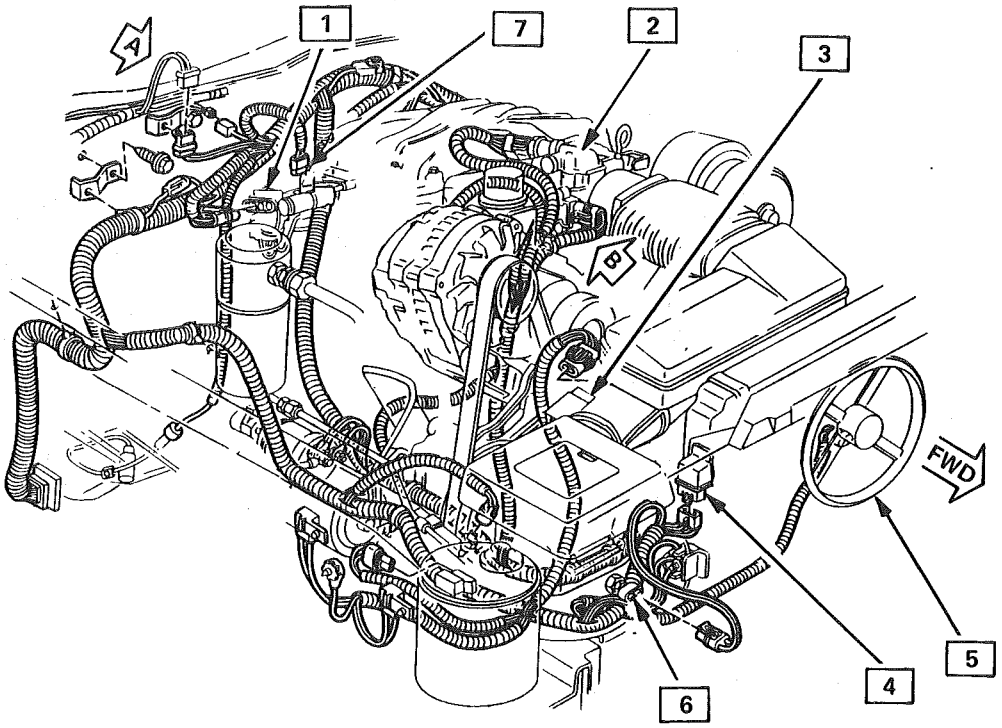
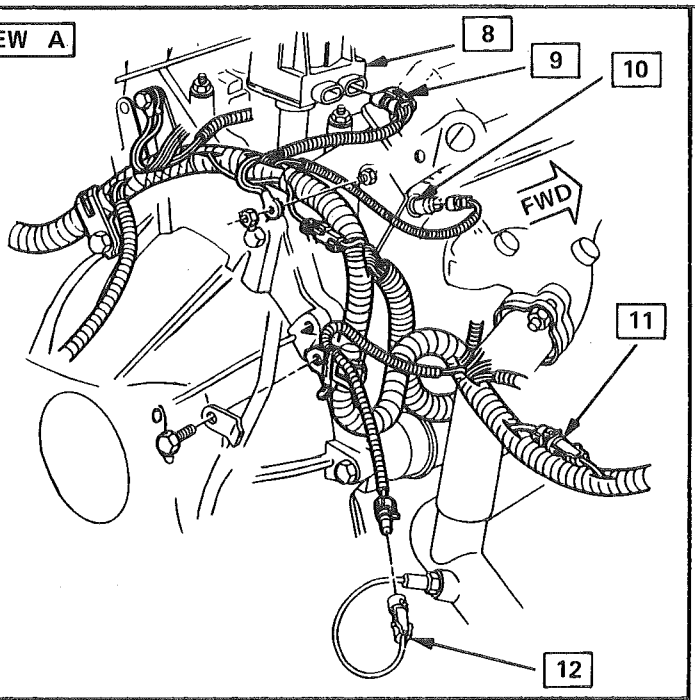
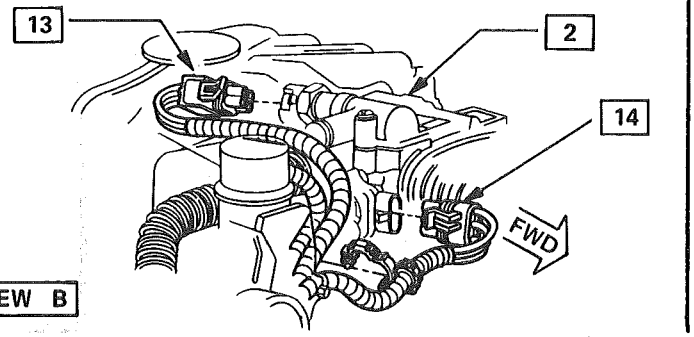


Fig. 602 Engine Harness - Right (LB9/B2L)







1–EVRV SOLENOID & RELAY

2–THROTTLE BODY

3–MAF SENSOR

4–MAF RELAY

5–FAN

6–MAT SENSOR

7–COIL CONNECTOR

8–DISTRIBUTOR

9–EST CONN.

10–FAN SW.

11–SET TIMING

12–O^2SENSOR CONN.

13–IAC CONN.

14–TPS CONN.

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Fig. 603 Engine Harness - Right (LB8)

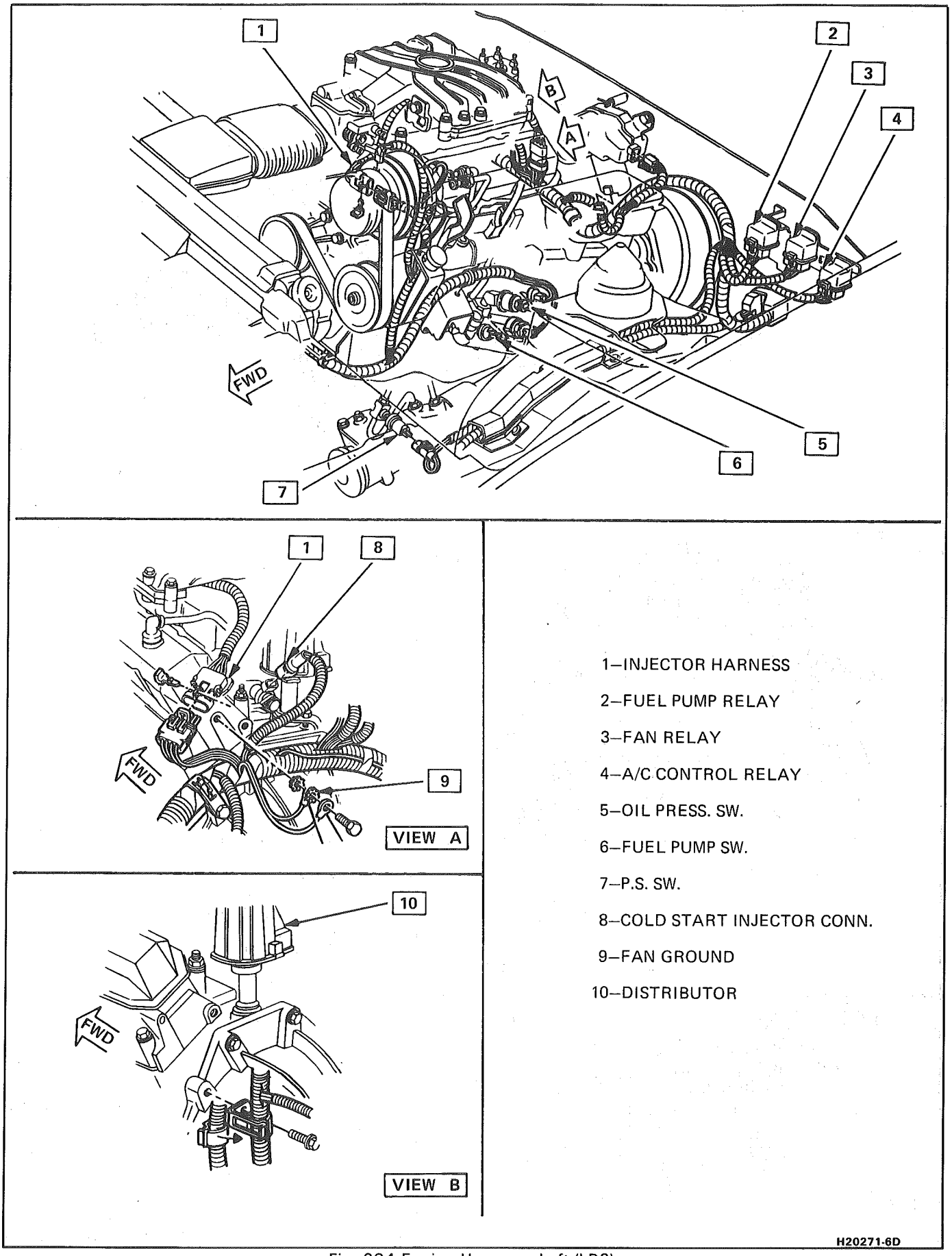


Fig. 604 Engine Harness - Left (LB8)

SECTION 6D

ENGINE ELECTRICAL

CONTENTS

GENERAL DESCRIPTION

The engine electrical system includes the battery, ignition (primary and secondary), starter (and related wiring) and the generator (and related wiring). The accompanying diagnosis charts will aid in trouble-shooting system faults. When a fault is traced to a particular component, refer to that components' section of the service manual.

BATTERY

The sealed battery is standard on all cars.

The battery has three major functions in the electrical system: First, it provides a source of energy for cranking the engine; Second, it acts as a voltage stabilizer for the electrical system; And third, it can, for a limited time, provide energy when the electrical load used exceeds the output of the generator.

CHARGING SYSTEM-CS

The CS Charging System has several sizes available, including the CS-130 and CS-144. The number (130 or 144) denotes the OD in mm of the stator laminations.

CS generators use a new type regulator and a diode trio is not used. A delta stator, rectifier bridge, and rotor with slip rings and brushes are electrically similar to earlier generators. A conventional pulley and fan is used and, on the CS-130, an internal fan cools the slip ring end frame, rectifier bridge and regulator.

IGNITION SYSTEM

Distributor Ignition

The ignition circuit consists of the battery, distributor, ignition switch, spark plugs and primary and secondary wiring. Refer to the Battery Section (6D1) for battery information.

Distributor

The High Energy Ignition (HEI) distributor with Electronic Spark Timing (EST), used on most engines, combines all ignition components in one unit. The ignition coil is in the distributor cap and connects through a resistance brush to the rotor. Another type of HEI/EST ignition system, used on some engines, has a separately mounted coil.

Ignition Timing

Timing specifications for each engine are listed in Section 6E. When using a timing light, connect an adapter between the No. 1 spark plug and the No. 1 spark plug wire, or use an inductive type

Secondary Wiring

The spark plug wiring used with ignition systems is a carbon impregnated cord conductor, encased in an 8MM (5/16") diameter silicone rubber jacket. The silicone jacket withstands very high temperatures and also provides an excellent insulator for the higher voltage of the system.

Spark Plugs

Resistor type, tapered seat spark plugs are used on all engines, except those with aluminum heads.

Ignition Switch

The mechanical switch is located in the steering column on the right hand side just below the steering wheel.

CRANKING SYSTEM

The cranking circuit consists of the battery, starting motor, ignition switch, and related electrical wiring.

Starter Motor

Wound field starter motors have pole pieces, arranged around the armature, that are energized by wound field coils.

Solenoid

Enclosed shift lever cranking motors have the shift lever mechanism and the solenoid plunger enclosed in the drive housing, protecting them from exposure to dirt, icing conditions and splash.

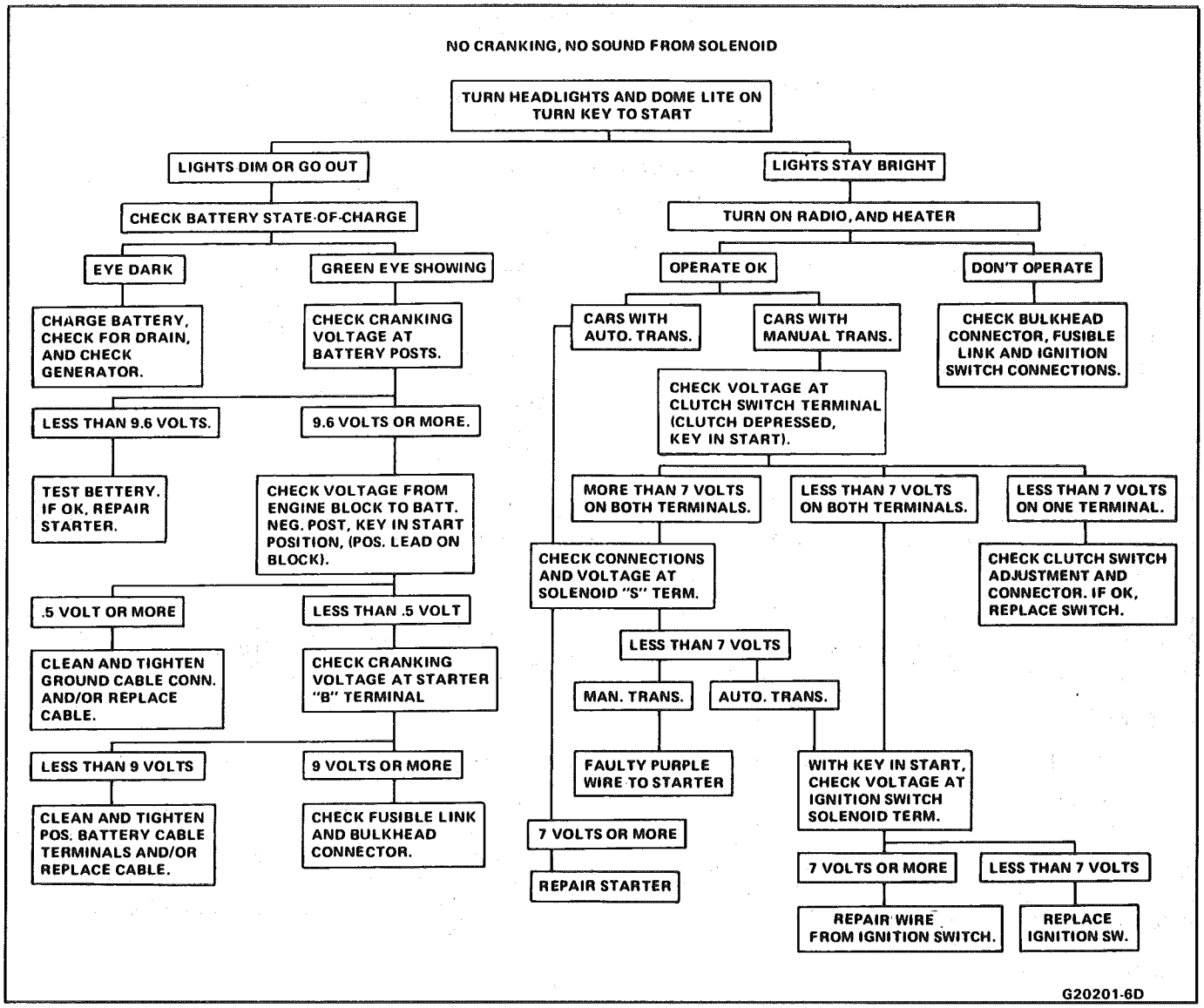


Fig. 1 Electrical System General Diagnosis - 1 of 2

GENERAL ELECTRICAL SYSTEM DIAGNOSIS

Diagnosis and repair procedures for engine electrical subsystems are located in the following subsections:

6D1 - Battery

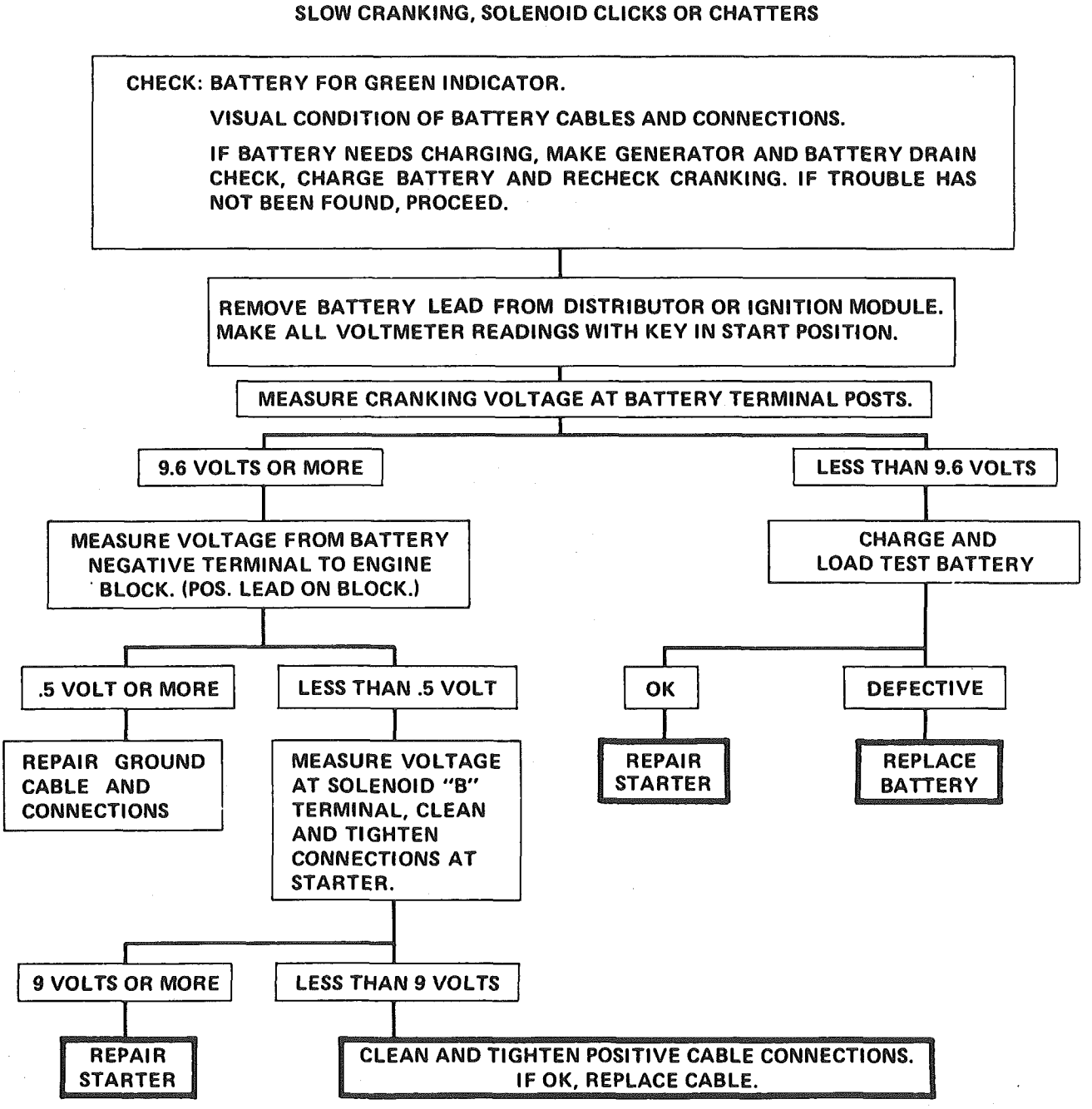
6D2 - Cranking System

6D3 - Charging System

6D4 - Ignition System

6D5 - Engine Wiring

Where a "driveability" complaint exists, or an ECM code is set, go to Section 6E. Wiring diagrams, component locations and system checks are located in Section 8A.



THIS PROCEDURE IS DESIGNED FOR USE ON ENGINES AND BATTERIES AT ROOM OR NORMAL OPERATING TEMPERATURES. IT ALSO ASSUMES THERE ARE NO ENGINE DEFECTS WHICH WOULD CAUSE CRANKING PROBLEMS. TO USE IT UNDER OTHER CONDITIONS MIGHT RESULT IN MISDIAGNOSIS.

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Fig. 2 Electrical System General Diagnosis - 2 of 2