IGNITION SYSTEM - 4.0L W/HEI/EST/ESC (DELCO-REMY)

1988 Jeep Cherokee

Distributors & Ignition Systems
HEI, HEI/EST & HEI/EST/ESC IGNITION SYSTEM

Jeep 4.0L

DESCRIPTION

HIGH ENERGY IGNITION (HEI)

The Delco-Remy High Energy Ignition system is a self-contained unit. It consists of ignition coil, spark plugs, distributor assembly and primary and secondary wiring. The distributor housing contains an electronic control module, pick-up coil, pole piece, timer core, rotor, capacitor for radio noise suppression and timing advance mechanisms. Most applications house the ignition coil assembly within the distributor cap. See Fig. 1.

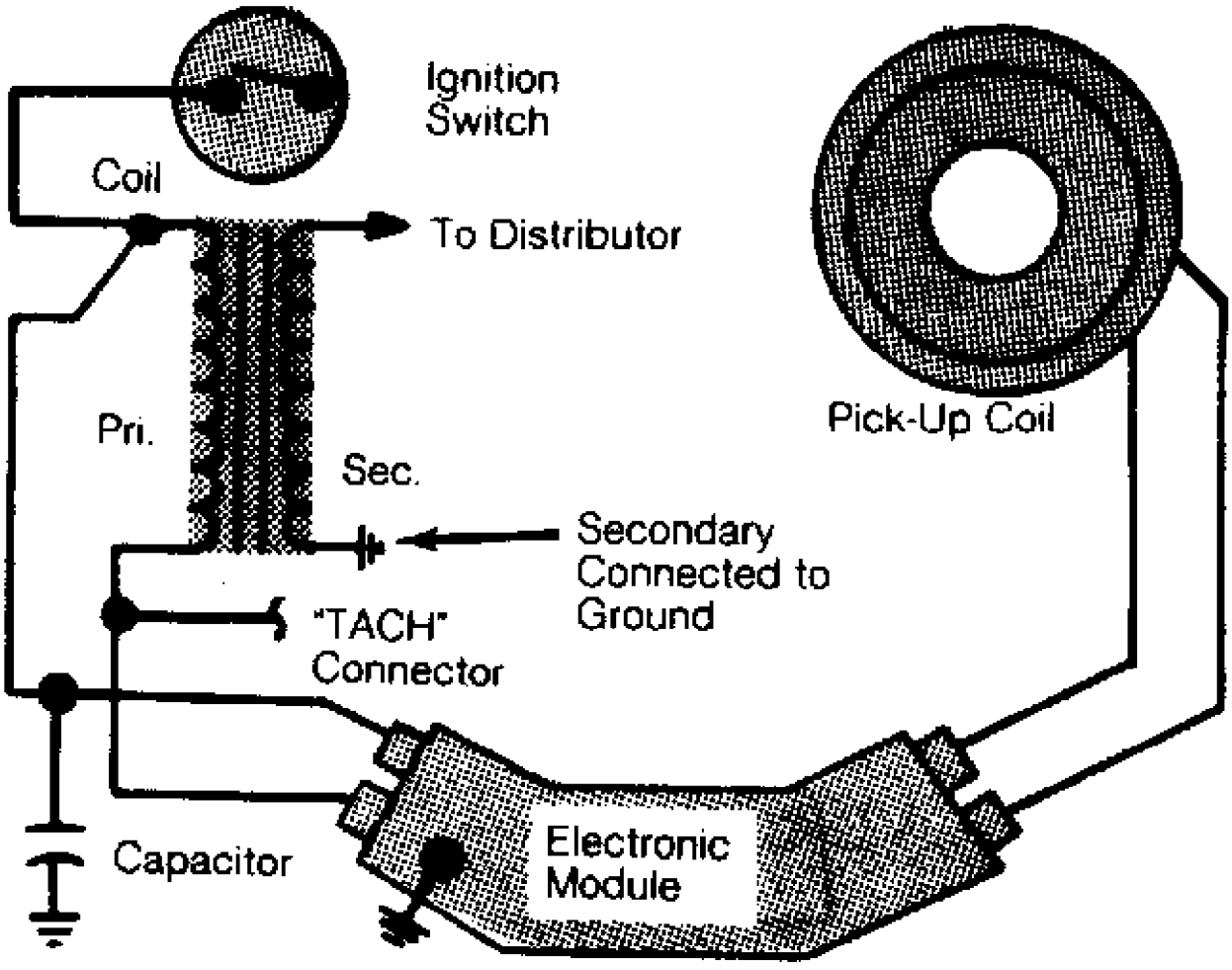

Fig. 1: Delco-Remy HEI System Circuit Diagram
Courtesy of General Motors Corp.

HEI WITH ELECTRONIC SPARK TIMING (EST)

Electronic Spark Timing (EST) is used on most computer controlled systems. The Electronic Control Module (ECM) monitors information from various engine sensors, computes desired spark timing, and signals distributor for correct timing change. The HEI distributor with EST does not have centrifugal advance weights, springs, or a vacuum advance unit. See Figs. 2 and 3.

HEI & EST WITH ELECTRONIC SPARK CONTROL (ESC)

All fuel injected vehicles are equipped with Electronic Spark Control (ESC). ESC systems contain a knock sensor mounted in the engine block. A Blue wire connects the sensor to the ESC module. If the sensor detects knock, it sends a signal to the module which, in turn, signals the ECM. The ECM sends a signal to the distributor to retard spark timing.

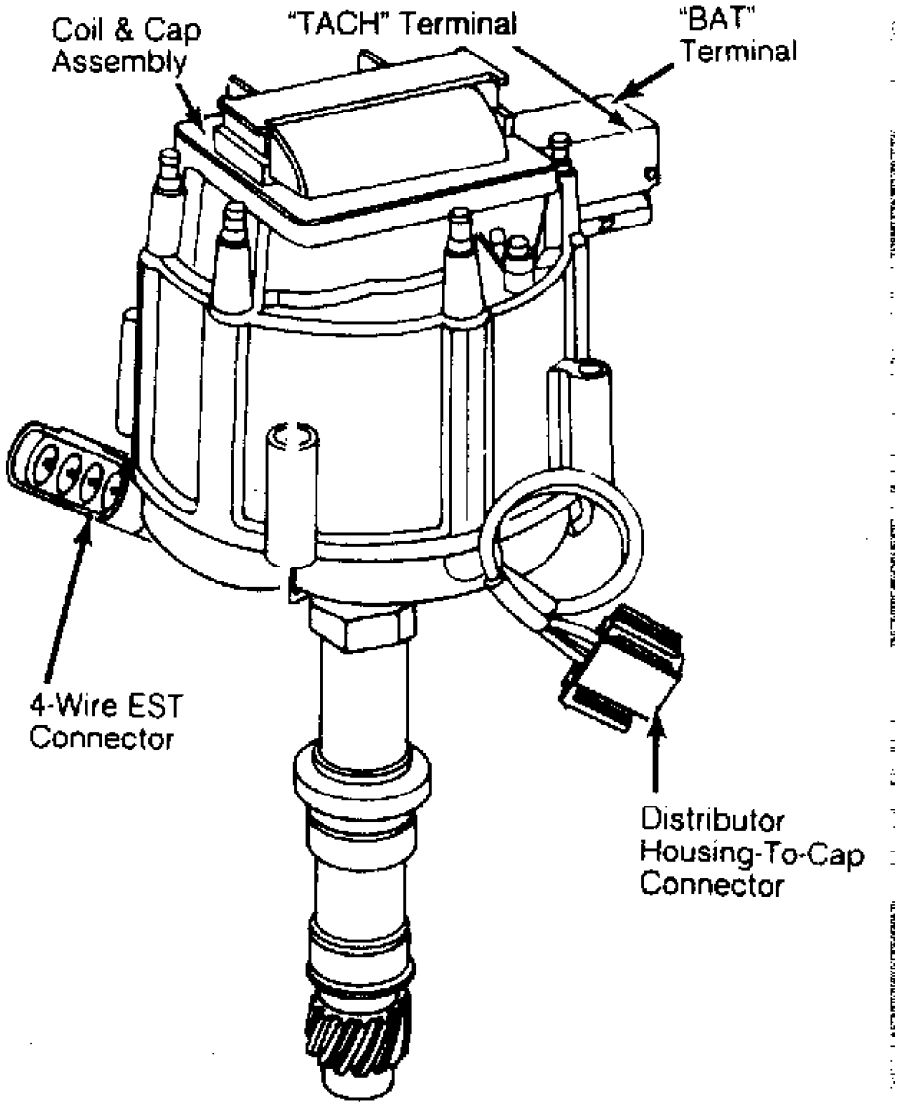

Fig. 2: Typical HEI/EST Distributor, Integral coil system shown. Courtesy of General Motors Corp.

OPERATION

When the external teeth on the timing core approach, align with and pass the internal teeth on pole piece, an alternating current is induced in the pick-up coil windings. This alternating current signals switching transistors in the HEI module to make or break the ignition coil primary ground circuit. When the primary ground circuit is removed, the magnetic field created by the flow of current in the primary windings collapses across the primary and secondary windings of the coil. This induces a high-voltage surge in the secondary windings of the coil. Secondary voltage is then discharged to the rotor which distributes it to the appropriate spark plug terminal. The distributor module has different terminal arrangements depending on application.

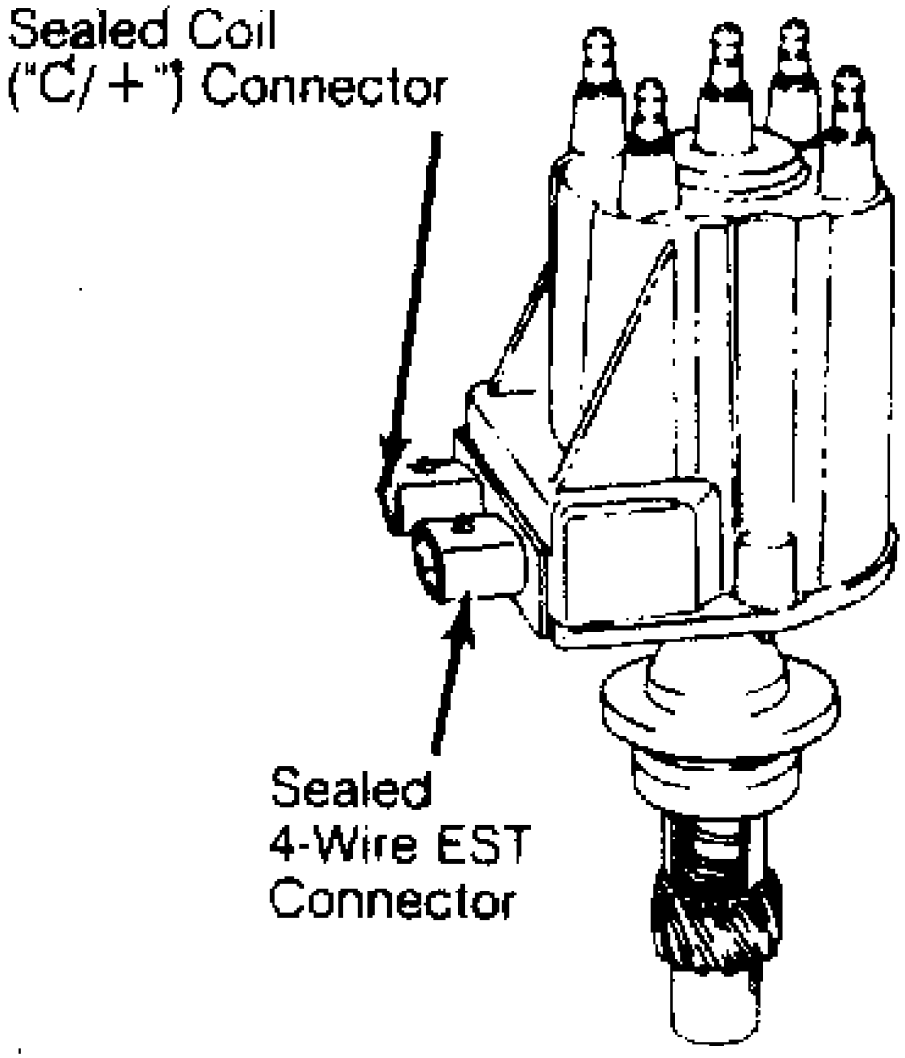

Fig. 3: HEI/EST Distributor w/Sealed Module Connectors, External coil system shown.
Courtesy of General Motors Corp.

The ECM monitors information concerning crankshaft position, engine RPM, engine load, atmospheric conditions, engine temperature, and transmission gear position. This information is used by the ECM to compute desired spark timing which is relayed to the distributor, enabling appropriate changes to be made to ignition timing. A back-up spark advance system is incorporated to signal ignition module in the event of ECM failure.

CAUTION: Although similar in appearance, components of HEI/EST and HEI distributors are NOT interchangeable.

All Models With EST

The distributor module is connected to ECM by a 4-wire EST connector which performs the following functions:

* Terminal "A" of the 4-wire connector is the reference ground low. It is grounded in the distributor and ensures ground circuit does not have a voltage drop. If circuit is open, engine may experience poor performance.
* Terminal "B" of the 4-wire connector is the by-pass circuit. At about 400 RPM, ECM applies 5 volts to this circuit to switch spark timing control from module to ECM. An open or grounded by-pass circuit will set a code 42 and the engine will operate at base timing, plus a slight amount of advance built into the module.
* Terminal "C" is the distributor reference High circuit. This circuit provides the ECM with RPM and crankshaft position information.
* Terminal "D" is the EST circuit, which triggers the module. The ECM does not know what actual timing is, but does know when it receives the reference signal. It will advance or retard spark from that point. If base timing is set incorrectly, engine spark curve will be incorrect.

SENSORS

On EST systems, the coolant temperature sensor signals ECM to advance timing on a cold engine and return timing to programmed advance curve as engine reaches normal operating temperature. If engine overheats, spark is retarded to prevent detonation. During light throttle operation, throttle position sensor input to ECM allows for additional advance.

Spark advance is also governed by input from engine RPM and Manifold Absolute Pressure (MAP) sensor. When MAP output voltage is low (high vacuum), ECM gives less spark advance. More spark advance is given when MAP output voltage is high (low vacuum).

ELECTRONIC SPARK CONTROL (ESC) SYSTEM

All Fuel Injected Engines

The basic components of Electronic Spark Control (ESC) system are detonation (knock) sensor, HEI/EST distributor, ESC module and ECM. When detonation (knock) occurs, sensor sends an electrical signal to ESC module. The ESC module then sends the signal voltage to the ECM. When the ECM senses a voltage drop (to less than one volt) on the knock sensor signal line, spark timing will be retarded. The ECM will retard spark timing until all signals from detonation sensor cease. See Fig. 4.

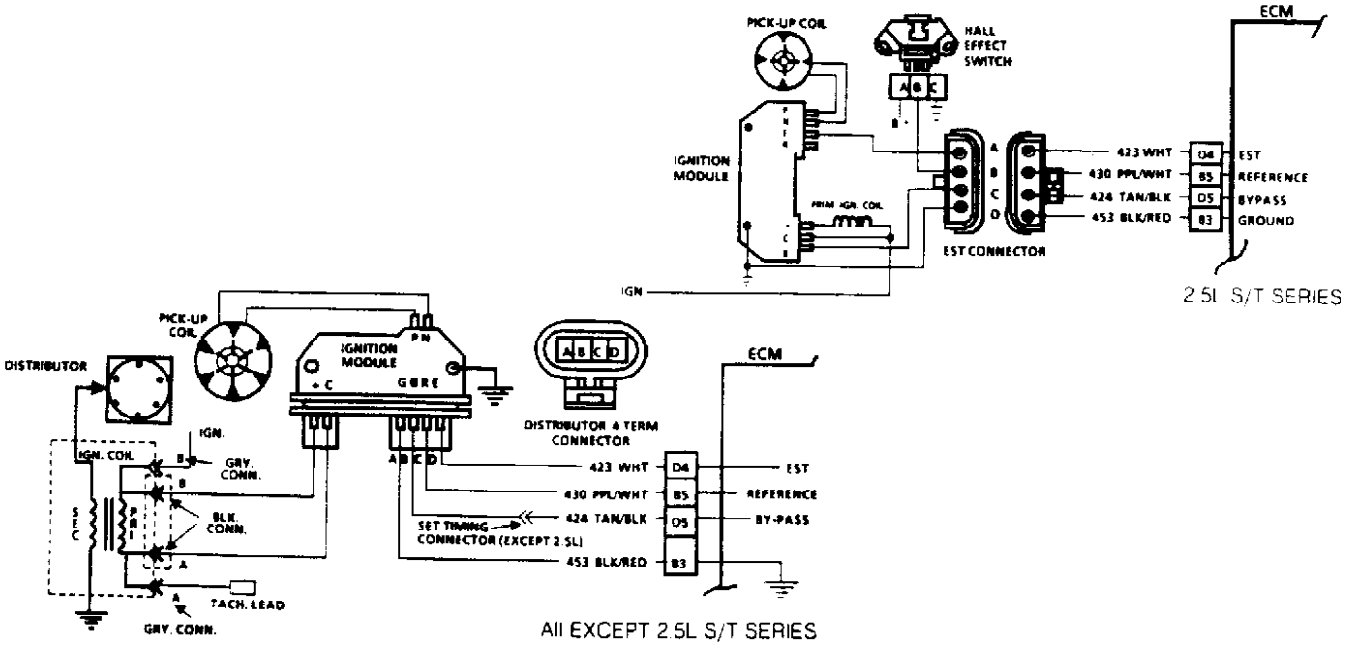

Fig. 4: Circuit Diagram of HEI/EST Ignition System
Courtesy of General Motors Corp.

ADJUSTMENTS

The only adjustments that can be made to HEI/EST igntion system are basic ignition timing and spark plug gap.

DIAGNOSIS

If reference or EST signals are interrupted due to an open circuit or a faulty ECM, HEI/EST module will provide a timing signal based on engine RPM. Engine may continue to run, although less efficiently. If by-pass signal is lost, by-pass switch will direct RPM information directly to coil rather than to ECM.

Normally, 5-15 seconds after starting a warm engine, by-pass signal from ECM will operate a by-pass switch in HEI/EST module. The HEI/EST module's RPM-controlled timing signal will switch over and RPM signal will flow directly to the ECM for processing.

Loss of EST signal from ECM when 5-volt by-pass signal is present will cause engine to stop because HEI/EST module is no longer sending signals directly to ignition coil. Any loss of EST signal will stop all flow to coil. If vehicle is restarted, engine will run for a few seconds and stop when by-pass signal comes back on.

COMPONENT TESTING (HEI)

ELECTRONIC MODULE

NOTE: Testing applies to HEI systems with mechanical weights and vacuum advance only.

1) An approved electronic module tester must be used to test the module. Use Module Tester (J-24642-E). Follow manufacturer's instructions.

2) When installing a new HEI control module, use silicone

lubricant on module-to-distributor housing contact surface to assist heat dispersement.

IGNITION COIL

1) Connect an ohmmeter between the negative terminal and the high voltage terminal. See Fig. 5. Use high resistance scale. If ohmmeter does not indicate below infinite resistance, coil must be replaced.

2) Connect ohmmeter between the positive terminal and coil frame (ground). Use the high resistance scale. If ohmmeter does not indicate infinite resistance, replace coil.

3) Connect ohmmeter between positive and negative terminals. Use low resistance scale. Ohmmeter should indicate 0-1 ohm. If not, replace coil.

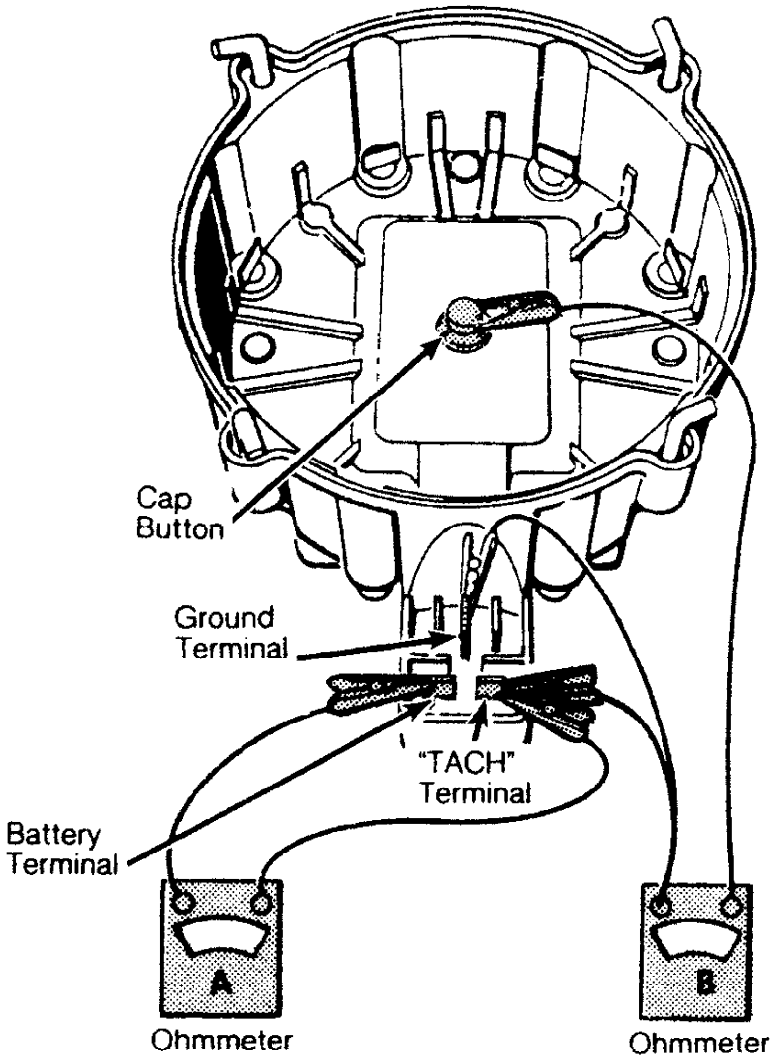

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Fig. 5: Coil Test Connections
Courtesy of General Motors Corp.

PICK-UP COIL

NOTE: Activation of the vacuum advance may align trigger wheel tooth and pick-up coil pole piece causing ohmmeter pointer to deflect. This deflection should not be diagnosed as a faulty pick-up coil.

1) Isolate 2 pick-up coil lead wires. Remove pick-up coil connector from module. Connect ohmmeter to either terminal and ground. See Fig. 6. Connect pump and apply vacuum to test vacuum advance unit. Replace vacuum advance unit if inoperative. Connect ohmmeter to pick-up coil terminals. Operate vacuum pump and observe ohmmeter throughout the vacuum range.

2) Attach ohmmeter to one pick-up coil terminal and distributor housing. Set ohmmeter to middle scale. Operate vacuum advance throughout vacuum range. Reading should be infinite at all times. If not, replace pick-up coil. See Meter "A" in Fig. 6.

3) Connect ohmmeter leads to pick-up coil connector termials. Operate vacuum pump to ensure proper operation throughout vacuum range. Flex terminal wires by hand to check for possible intermittent defects in wiring or connectors. Pick-up resistance should be 500-1500 ohms. If resistance is incorrect, replace the pick-up coil. See Meter "B" in Fig. 6.

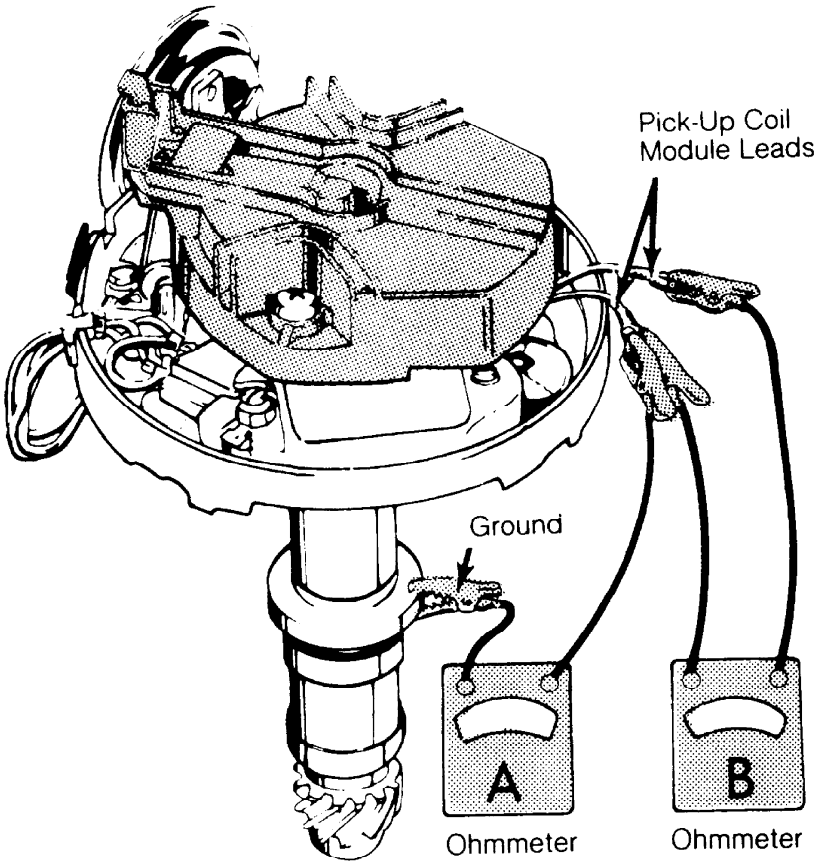

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Fig. 6: Pick-Up Coil Test Connections
Courtesy of General Motors Corp.

CAPACITOR

The capacitor is used for radio noise supression. Set ohmmeter at x1000 scale. Disconnect capacitor. Touch ohmmeter leads to capacitor terminal and ground. Slight needle movement will occur rapidly and return to infinity. A continuous reading other than infinity indicates defective capacitor.

COMPONENT TESTING (HEI WITH EST)

COIL RESISTANCE CHECK

Externally Mounted Ignition Coil (Sealed Module Connector Distributor)

Remove coil connectors and secondary coil wire. In test "A", use high ohmmeter scale. See Fig. 7. If continuity is present, replace coil. In test "B", use low ohmmeter scale. Reading should be very low or near zero. If not, replace coil. In test "C", use high ohmmeter scale. If there is no continuity, replace coil.

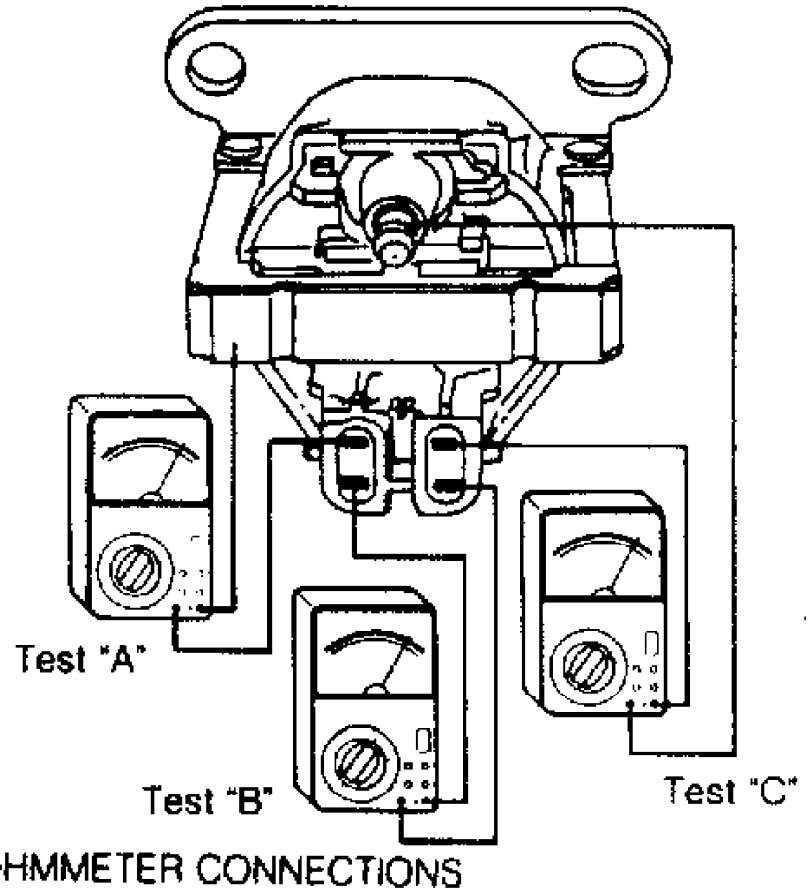

Fig. 7: Testing Ignition Coil Resistance, External coil system shown. Courtesy of General Motors Corp.

Integrally Mounted Ignition Coil

1) Turn ignition off. Remove the distributor cap and coil

assembly. Turn upside down. See Fig. 8. Set ohmmeter to low scale. Connect leads to coil "BAT" and "TACH" terminals. If resistance exceeds one ohm, replace ignition coil.

2) Set ohmmeter on high scale. Connect one lead to coil secondary terminal and the other lead first to "TACH" terminal and then to ground terminal. If resistance reading in BOTH instances is infinity, replace ignition coil.

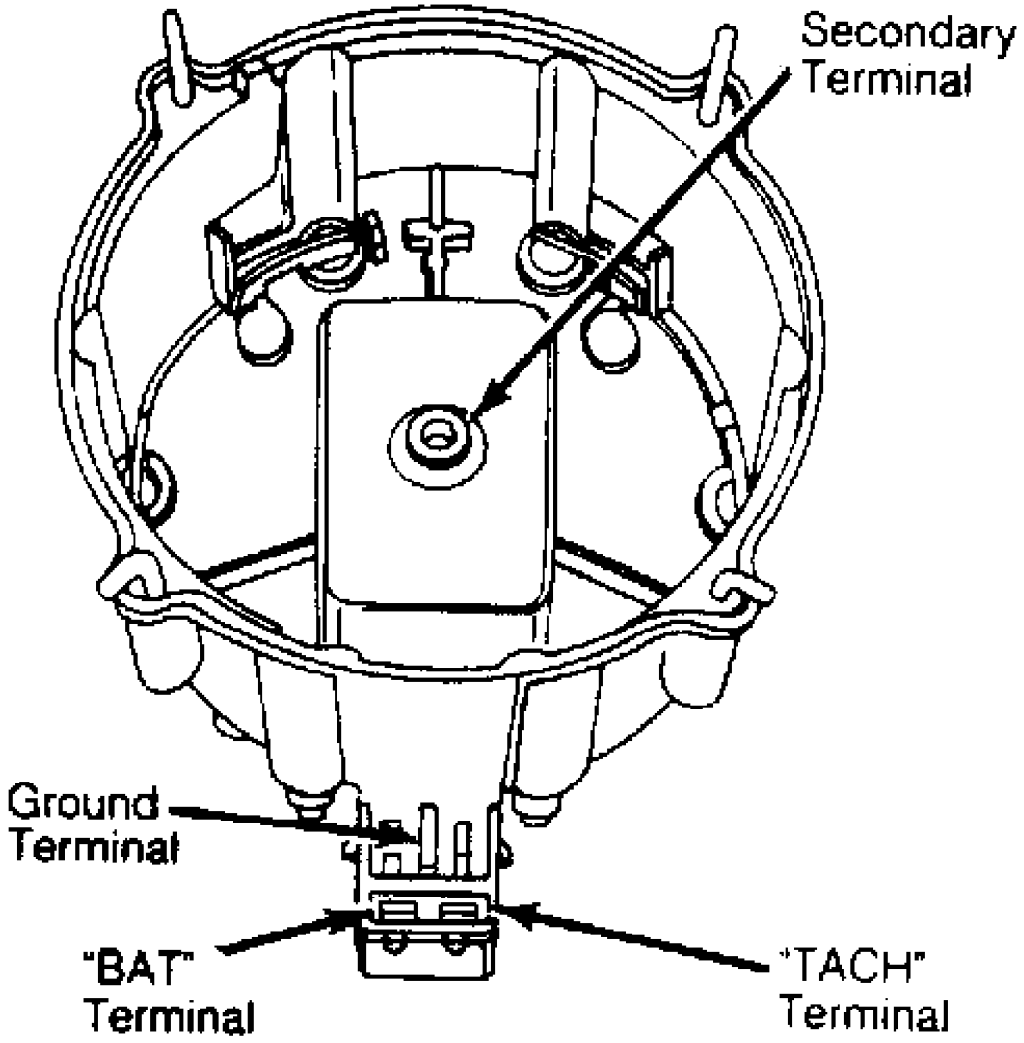

Fig. 8: Testing Ignition Coil Resistance, Integral coil system shown. Courtesy of General Motors Corp.

PICK-UP COIL SHORT & RESISTANCE CHECKS

1) Disconnect pick-up coil leads from HEI/EST module terminals "N" and "P". Set ohmmeter to middle scale and connect one lead to either pick-up coil lead and the other lead to distributor housing. See Fig. 9. Flex pick-up coil leads by hand to check for intermittent shorts to ground. Reading should be infinity at all times. If not, replace pick-up coil.

2) Connect ohmmeter between both pick-up coil leads. Check for intermittent opens by flexing wires and connectors. Resistance should be 500-1500 ohms. If not, replace pick-up coil.

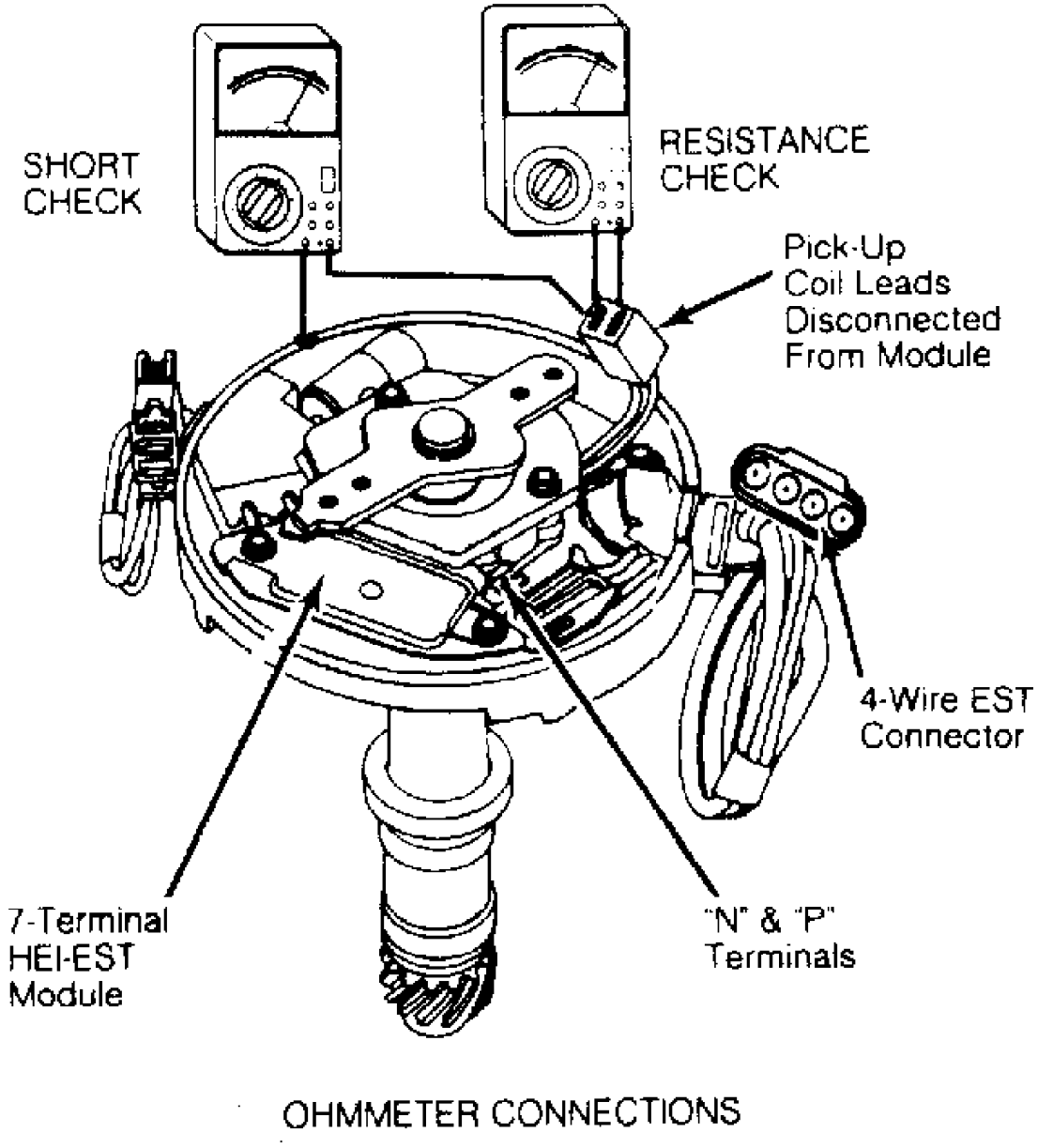

Fig. 9: Checking Distributor Pick-Up Coil, Integral coil system shown. External coil testing is similar
Courtesy of General Motors Corp.

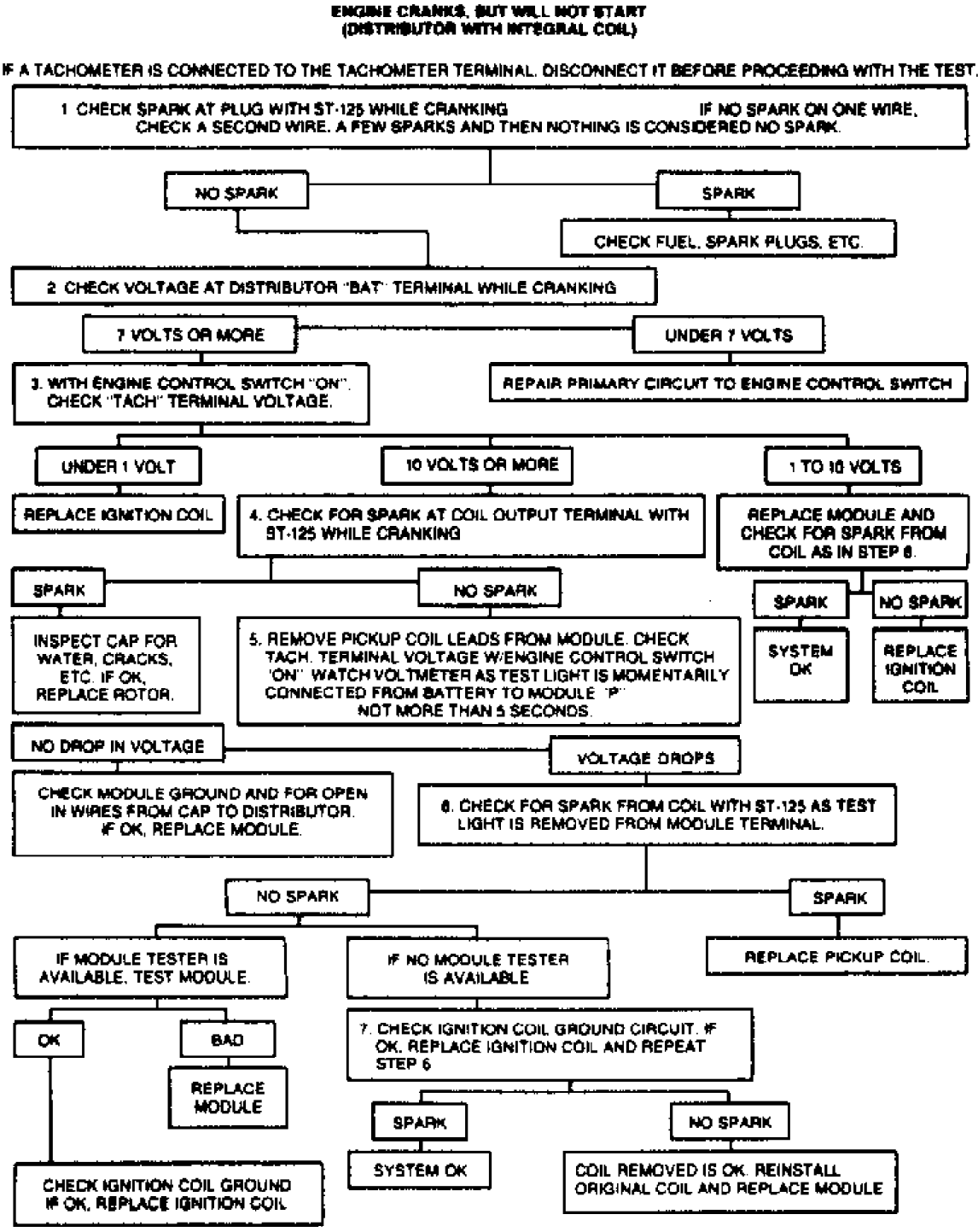

Fig. 10: Integral Coil Spark Tester (ST-125) Hook-Up
Courtesy of General Motors Corp.

NOTE: Diagnosis of HEI systems with EST and EST/ESC require thorough understanding of Computer Command Control (CCC)

system. For testing, see appropriate IGNITION SYSTEM CHECK flow chart in COMPUTERIZED ENGINE CONTROLS section. For diagnosis of HEI system, refer to following diagnostic chart. See Fig. 11.

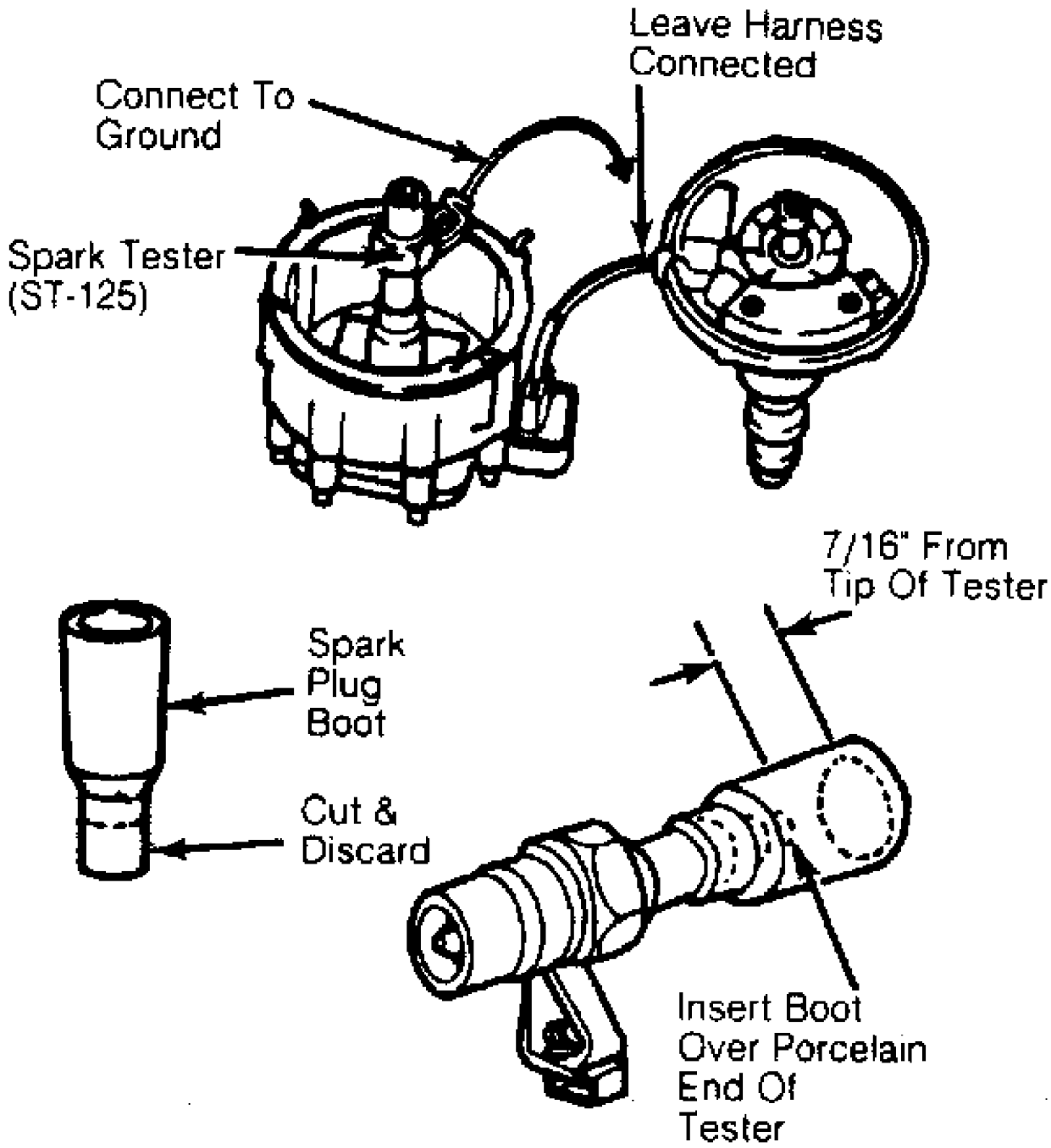

Fig. 11: Ignition Sys Check (HEI Only), Testing applies to HEI sys with mechanical weights and vacuum advance. Courtesy of General Motors Corp.

OVERHAUL

REASSEMBLY

Ensure pick-up assembly arm is correctly installed on pin. If not, arm can float and cause ignition timing to vary. To prevent corrosion, ensure module terminals are lubricated with petroleum jelly before installation. To prevent heat damage, coat bottom of module and module rest pad in housing with silicone grease. Before installation of roll pin in driven gear, ensure timing mark on roll pin and rotor tip align. See Figs. 12 through 14.

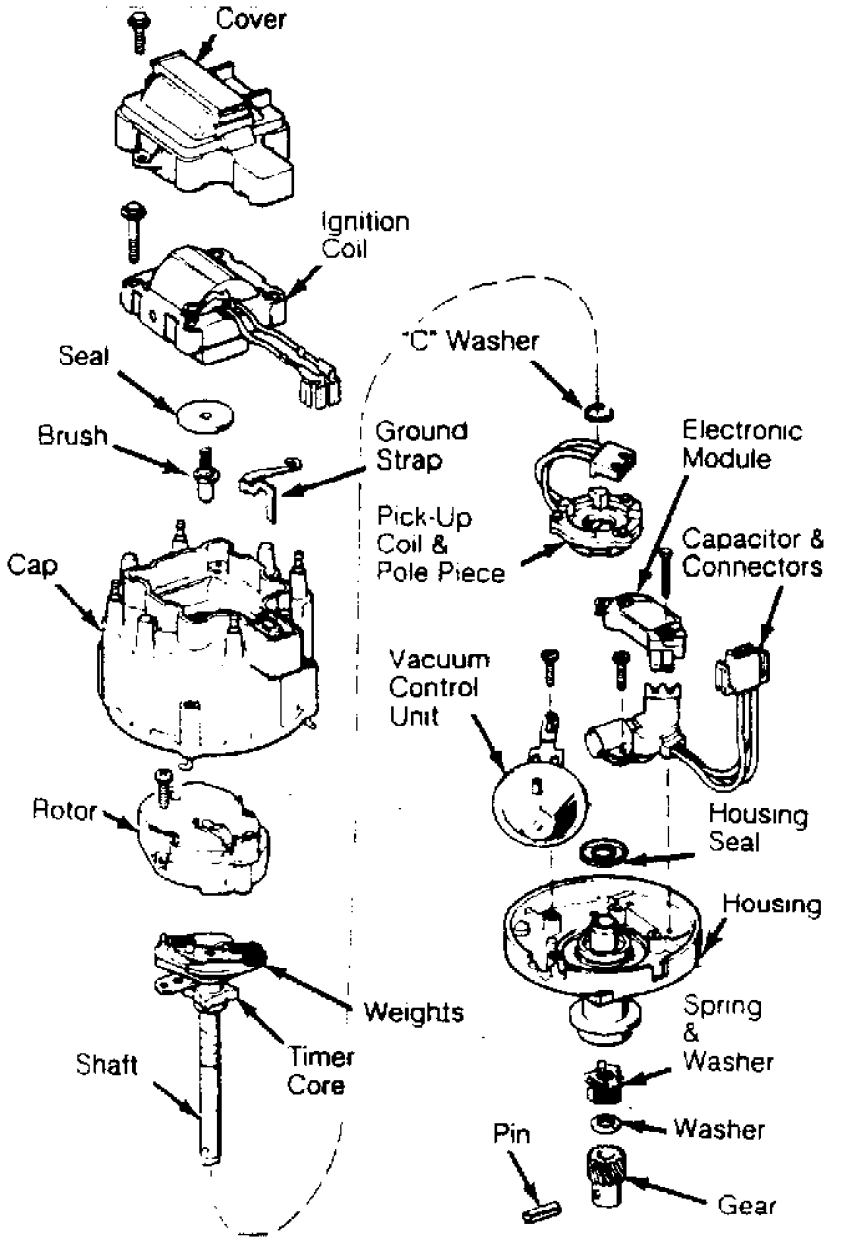

Fig. 12: Exploded View of HEI Distributor
Courtesy of General Motors Corp.

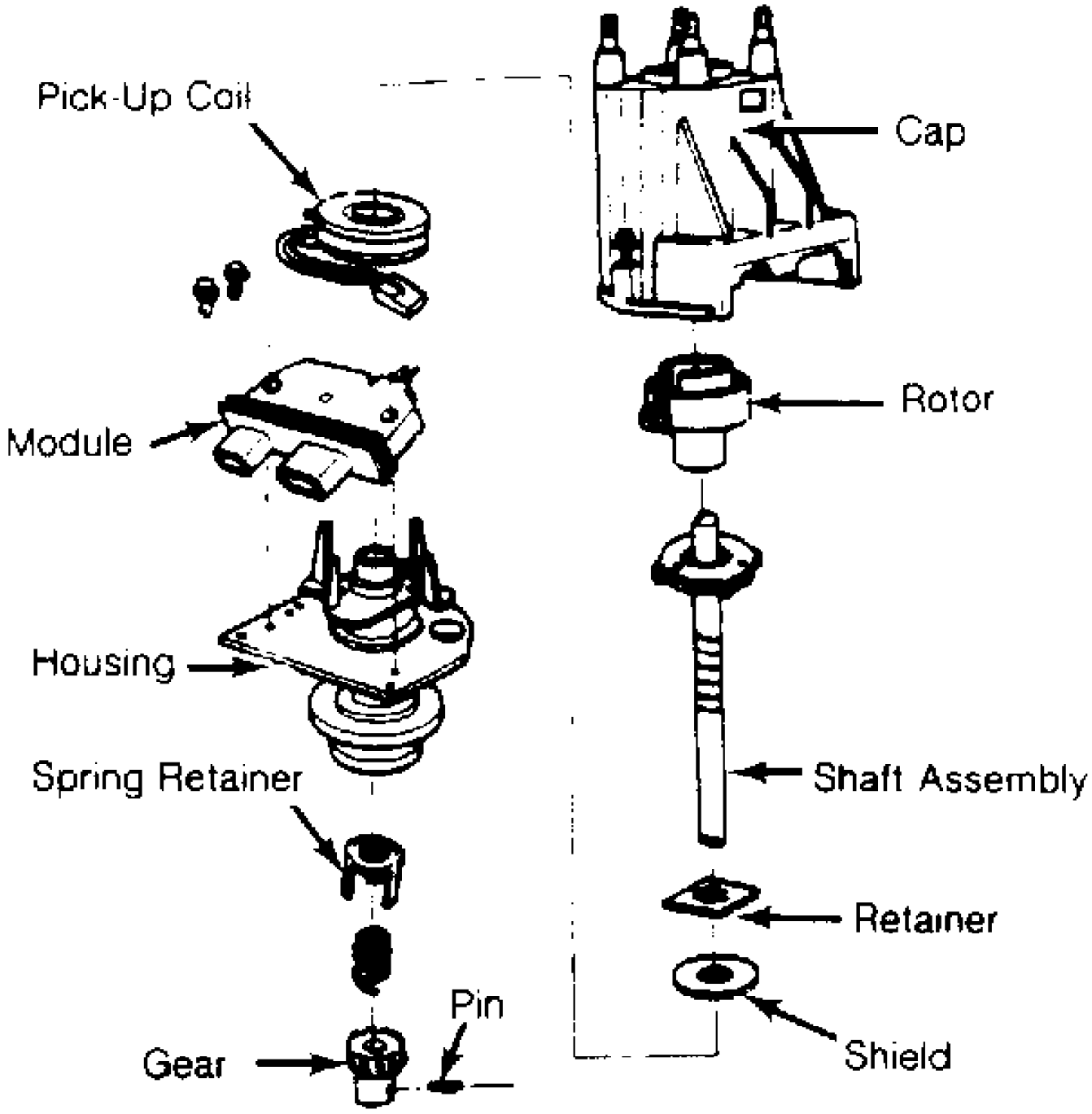

Fig. 13: Exploded View of HEI-EST Distributor With Sealed Connector
Courtesy of General Motors Corp.

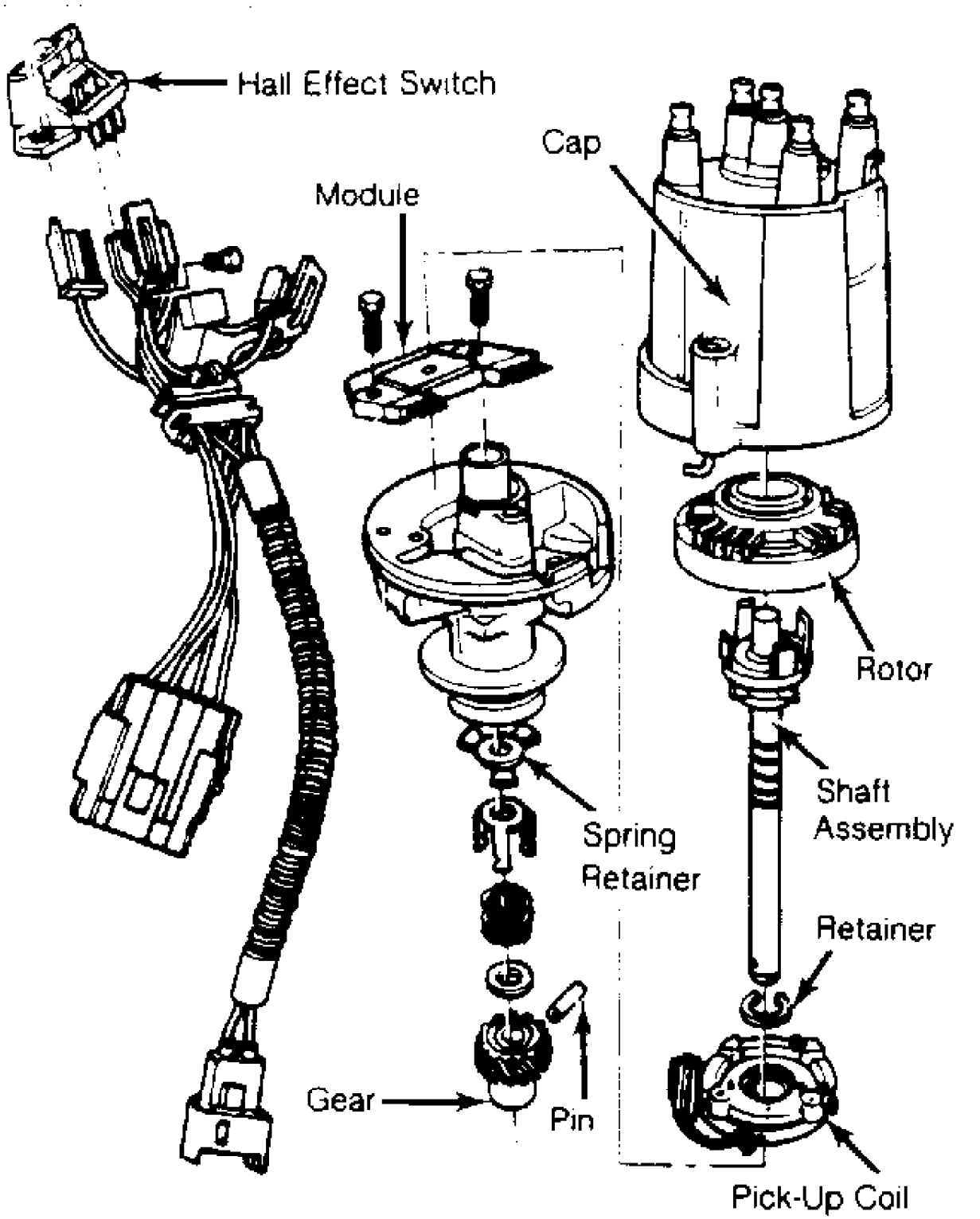

Fig. 14: Exploded View of HEI Distributor Without Sealed Connector
Courtesy of General Motors Corp.