MOTORCRAFT SOLID STATE IGNITION SYSTEM

American Motors
6-Cylinder Engines

DESCRIPTION

The Solid State Ignition system, often called SSI, features a solid state distributor, electronic control unit, an ignition coil, and conventional distributor cap, rotor, spark plug wires and spark plugs. Other components include the battery, ignition switch, starter solenoid and primary resistance wires and by-pass wire.

Electronic Control Unit – There are 6 wires leading from the control unit, 2 to one connector and 4 to the other. The white wire and red wire leading to the 2-wire connector are the ignition feed circuits – the white wire for cranking, the red wire after the engine is running. The control unit uses the green wire to turn power to the ignition coil off and on. The orange and violet wires are used to transmit signals from the distributor's sensor to the control unit. The black wire supplies the distributor ground circuit.

NOTE – *The electronic control unit is permanently sealed to resist moisture, vibration, dirt and atmospheric conditions. It is not repairable and must be serviced as a complete unit.*

Distributor – Components are divided into 3 groups, the sensor and trigger wheel, the spark advance and the cap and rotor. The trigger wheel, which has 6 teeth (one for each cylinder), rotates with the distributor shaft. The sensor is a coil of fine wire mounted around a permanent magnet. There are no contacting surfaces between the trigger wheel and sensor. Dwell is not adjustable and is controlled electronically. Centrifugal advance is controlled by engine speed, vacuum spark advance by carburetor ported vacuum, supplied to the distributor's vacuum unit. Distributor cap and rotor are of conventional design.

Ignition Coil – Coils are oil-filled and, sealed and contain a primary and secondary circuit. As in any system, the coil's basic function is to convert battery voltage applied to the primary circuit into high secondary voltage for firing the spark plugs. The coil has positive and negative primary terminals and a single secondary terminal. A special coil connector slides over the primary terminals.

Resistance Wire – A wire with 1.3-1.4 ohms resistance is provided in the red wire (engine running) circuit to supply less than battery voltage to the coil. This resistance wire is by-passed during starting so that full battery voltage may be applied to the coil. The by-pass is accomplished through the "I" terminal of the starter solenoid.

System Protection – The electronic control unit has built-in reverse polarity and transient voltage protection. However, damage to the system can occur if proper testing procedures are not followed.

OPERATION

The control unit and ignition coil are turned on whenever the ignition switch is in the "START" or "ON" position. When the engine begins turning the distributor shaft, the trigger wheel rotates with it. As each tooth passes the sensor, it interrupts the magnetic field around the sensor. This continual build-up and collapse of the magnetic field provides a signal to the control unit. The control unit receives this signal and turns the power to the ignition coil's primary circuit off and on as each tooth passes the sensor. The collapse of the magnetic field in the ignition coil primary circuit induces a high voltage surge in the secondary, causing current to flow from the coil to the distributor, rotor, cap and spark plug wires.

SOLID STATE IGNITION SYSTEM NOTES

When disconnecting wire from spark plug or distributor cap, twist rubber boot slightly to loosen. Grasp boot (not wire) and pull off with steady, even force.

When disconnecting control unit connectors, pull apart with firm, straight pull. Do not attempt to pry apart with screwdriver. When connecting, press together firmly to overcome hydraulic pressure of grease. If connector locking tabs weaken or break off, it is unnecessary to replace connector. Just press together firmly and bind with electrical tape or a harness tie strap to assure good connection.

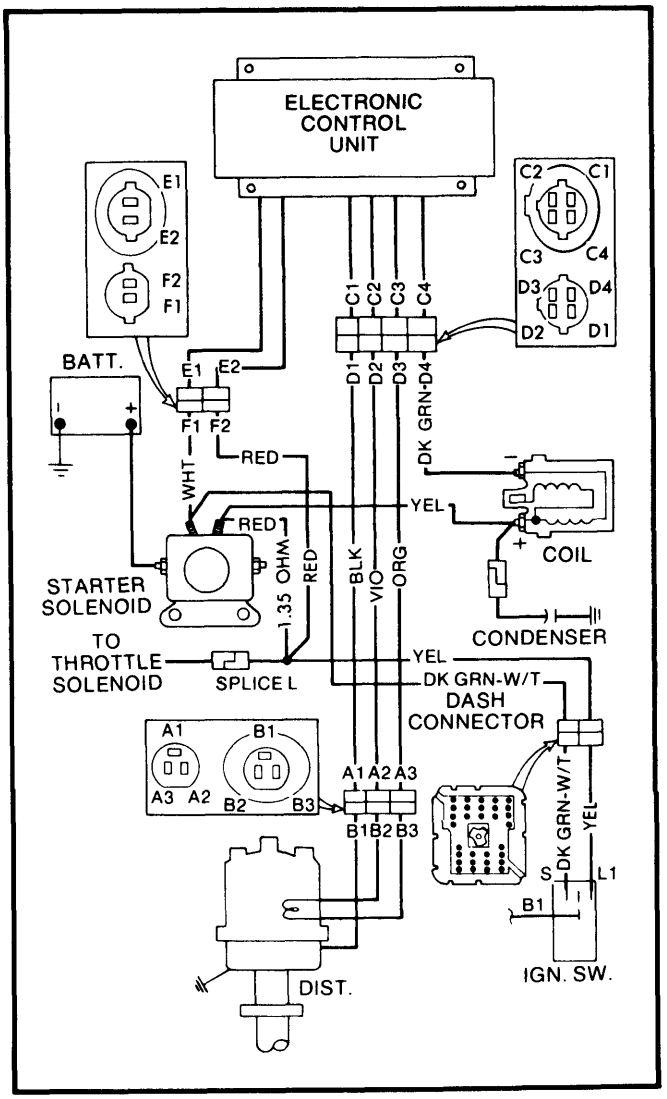

Fig. 1 American Motors Solid State Ignition System Wiring Diagram

MOTORCRAFT SOLID STATE IGNITION SYSTEM (Cont.)

TESTING

SECONDARY IGNITION VOLTAGE CHECK

CAUTION – *When checking the secondary voltage, do not remove spark plug wires from spark plugs No. 3 or 5 on 6-cylinder engines.*

Perform the following tests using an oscilloscope which has inductive type clamps and following the scope manufacturer's instructions. Also use suitable grounding probes and insulated pliers.

NOTE – *On vehicles with a catalytic converter, do not run engine for more than 30 seconds with a spark plug wire removed.*

Secondary Voltage Reserve – 1) Clamp secondary voltage pick-up over distributor-to-coil high voltage wire. Run engine at 2000 RPM and check overall operating condition, then check secondary voltage reserve. Reserve should be 20,000 volts minimum. Regardless of reading, continue testing procedures.

2) Using an ohmmeter, check resistance of coil-to-distributor high voltage wire. Resistance should be 10,000 ohms maximum resistance per wire.

Rotor-to-Cap Voltage Drop – Connect high voltage pick-up to coil-to-distributor secondary wire. Remove one spark plug wire and ground wire to engine. Run engine at idle. Do not let a spark gap appear between wire and ground. High voltage reading should be 8,000 volts maximum. If voltage fails to meet specifiations, check rotor or distributor cap.

Required Spark Plug Voltage – Make this test with engine running at approximately 2000 RPM, secondary voltage pick-up connected over coil-to-distributor high voltage wire. Firing voltage should be relatively even and be 5,000-16,000 volts. If firing voltage is bad, check individual cylinder firing voltage. Each cylinder should receive a minimum of 4,000 volts and all cylinders should be within 50% of each other.

Spark Plug Wire Resistance – Check spark plug wire resistance using an ohmmeter. Resistance should not exceed 5,000 ohms per inch with spark plug wire connected to the distributor cap and resistance test made through the internal distributor cap terminal.

IGNITION COIL RESISTANCE CHECK

Primary Resistance – Remove connector from positive and negative coil terminals. Be sure ignition switch is "OFF." Set an ohmmeter on low scale and connect ohmmeter leads to positive and negative terminals. Ohmmeter reading should be 1.13-1.23 ohms at 75°F. With coil temperature at 200°F, a 1.5 ohm reading is acceptable.

Secondary Resistance – Turn ignition switch "OFF". Set ohmmeter to high scale (x 1000 scale) and connect one lead to coil negative terminal and other lead to coil tower (remove coil secondary wire). Ohmmeter reading should be 7,700-9,300 ohms with coil temperature at 75° F. With coil temperature at 200° F or above, a maximum reading of 12,000 ohms is acceptable.

CURRENT FLOW CHECK

1) Remove connector from ignition coil. Remove positive wire from connector, then negative wire. Connect ammeter between positive terminal of coil and disconnected positive wire. Connect jumper wire from negative terminal to good ground.

2) Turn ignition switch "ON". Current flow should be approximately 7 amps., but should not exceed 7.6 amps. If more than 7.6 amps., replace ignition coil.

3) With ammeter still connected to coil positive terminal, remove jumper wire from negative terminal. Connect coil green wire to negative terminal. Current flow should be approximately 4 amps. If less than 3.5 amps., check for poor connections in 4-wire and 3-wire connectors or for poor ground at distributor ground screw.

4) If current flow is greater than 5 amps., the control unit is defective and must be replaced. Start engine. Normal current flow with engine running is 2.0-2.4 amps. If outside of specifications, replace control unit.

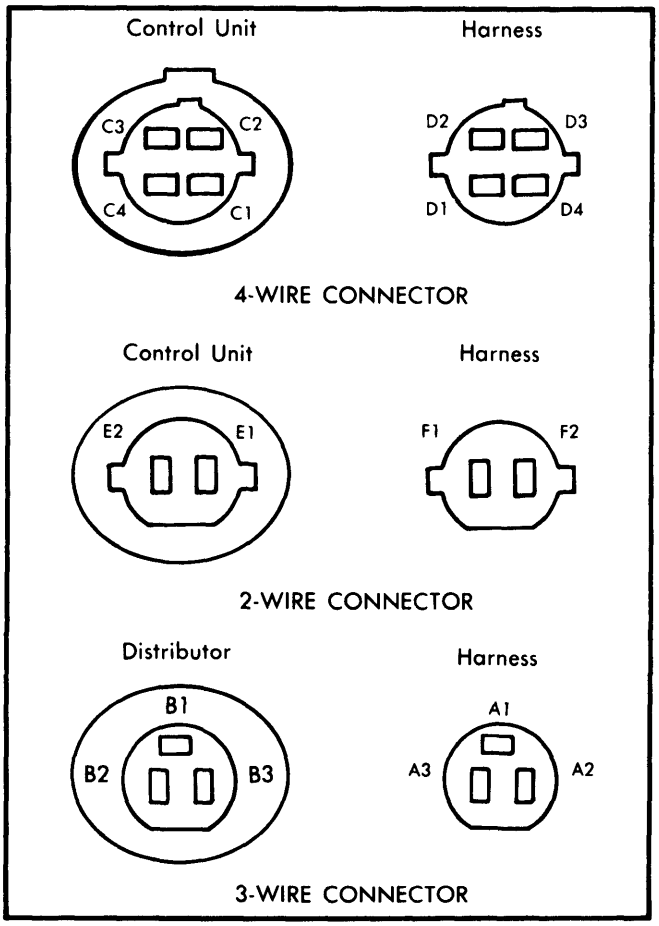

Fig. 2 Solid State Ignition Connectors

MOTORCRAFT SOLID STATE IGNITION SYSTEM (Cont.)

COIL PRIMARY CIRCUIT CHECK

1) Connect a voltmeter to coil positive terminal and ground. Turn ignition switch to "ON" position. Reading should be 5.5-6.5 volts. If voltage is too high (battery voltage), proceed to step **4)**. If voltage is too low (below 5.5 volts), disconnect condenser lead. If voltage is now correct, replace condenser. If voltage is still low, proceed to step **7)**.

2) If voltage was 5.5-6.5 volts in step **1)**, turn ignition switch to "START" position. Voltage should be the same as battery cranking voltage. If correct, check other systems (fuel, mechanical, etc.) for problems. If voltage is not correct, proceed to next step.

3) Check wire connected to starter solenoid "I" terminal for shorts or opens. If wire is OK, check for defective starter solenoid. Replace solenoid if necessary.

4) With ignition switch in "ON" position, voltmeter still connected to coil positive terminal, disconnect wire connected to starter solenoid "I" terminal. If voltage drops to 5.5-6.5 volts, replace starter solenoid.

5) If voltage remains high, connect a jumper wire from coil negative terminal to ground. If voltage drops to 5.5-6.5 volt range, proceed to step **6)**. If voltage does not drop, resistance wire is defective. Replace resistance wire and retest, beginning with step **2)**.

6) With ignition switch "OFF", connect an ohmmeter lead to the coil negative terminal and the other lead to the green wire terminal "D4" of the 4-wire harness connector. Also check from black wire terminal "D1" to ground. If continuity is OK, replace the control unit. If no continuity is present, repair wire in harness and retest beginning at step **2)**.

7) With ignition switch "OFF", connect ohmmeter leads between coil positive terminal and dash connector terminal "AV" (yellow wire). If resistance is not 1.3-1.4 ohms, replace resistance wire. If ohmmeter reading is to specifications, proceed with next step.

8) With ignition switch still "OFF", connect ohmmeter leads between dash connector terminal "AV" (yellow wire) and ignition switch terminal "L1". Resistance should be less than 0.1 ohm. If reading is to specifications, repair feed wire or replace ignition switch.

9) If resistance is more than 0.1 ohm, check for opens in wire or for poor connections at connectors. Repair or replace as necessary.

CONTROL UNIT & SENSOR CHECK

1) Disconnect high tension coil wire from distributor cap. Attach a modified spark plug to coil wire (side electrode of plug cut off and ground wire attached to side of plug casing). If plug is not available, hold coil wire ½" from engine block, using insulated pliers.

2) Turn the ignition switch "ON", then disconnect 4-wire connector from control unit. Watch for spark as connector is disconnected. If sparking occurs, proceed with next step. If no sparking occurs, proceed to step **6)**.

3) Turn ignition switch "OFF" and disconnect 4-wire connector at control unit. Connect an ohmmeter between the orange and violet wire terminals "D2" and "D3" of harness connector. Ohmmeter reading should be 400-800 ohms. If reading is correct, proceed to step **8)**. If reading is not correct, proceed to next step.

TYPICAL MOTORCRAFT IGNITION OSCILLOSCOPE PATTERNS

To analyze the Solid State and Dura-Spark Ignition Systems using an oscilloscope, follow the procedures recommended by the manufacturer of the scope. The electrical display patterns will appear similar to patterns of conventional breaker type ignition systems except as shown below.

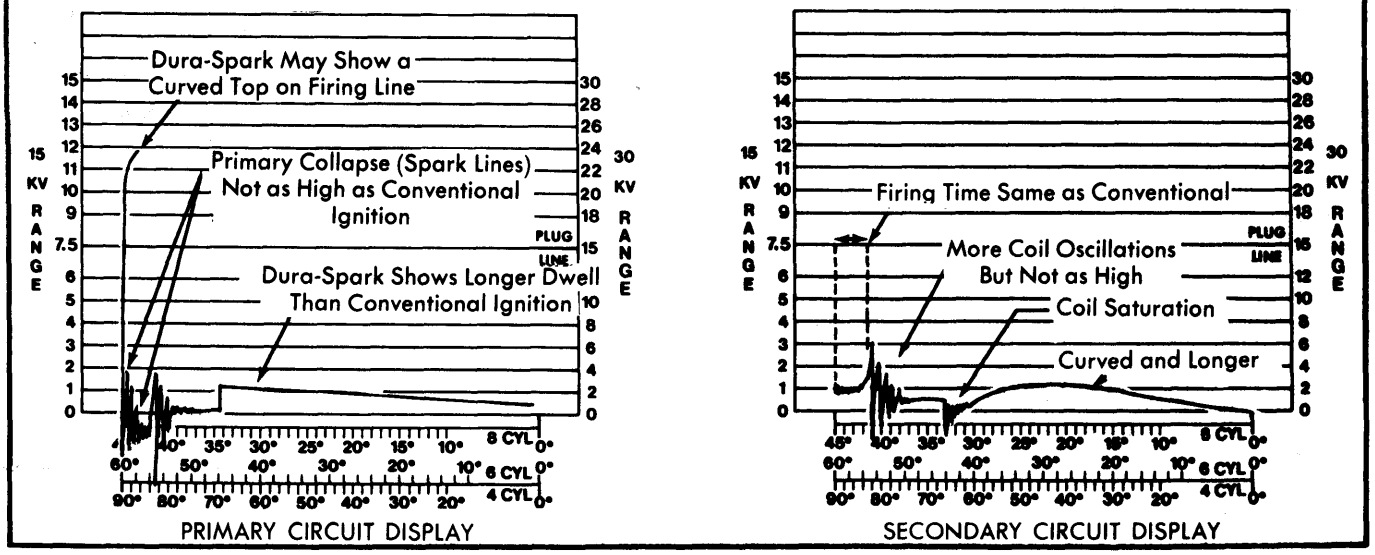

Fig. 3 Normal Oscilloscope Patterns Shown for Solid State Ignition Systems

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4) Disconnect and reconnect the 3-wire connector at the distributor. If ohmmeter reading is now correct, proceed to step **8)**. If reading is still not correct, proceed to next step.

5) Disconnect 3-wire connector at the distributor and connect ohmmeter leads between the orange and violet wire terminals "B2" and "B3" of distributor connector. If reading is now 400-800 ohms, repair harness between 3-wire and 4-wire connectors. If reading is still out of specifications, replace sensor in distributor.

6) With ignition switch "OFF" and 4-wire connector disconnected, connect ohmmeter leads to battery negative terminal (ground) and black wire terminal "D1" in harness connector. Ohmmeter reading should be nearly zero (less than .002 ohms).

7) If ohmmeter reading is OK, recheck system starting at step **3)**. If reading is above specifications, check for the source of the bad ground (ground cable resistance, distributor-to-engine block resistance, or ground screw in distributor to black wire terminal "D1").

8) With ignition switch "ON" and voltmeter connected to harness side of 4-wire connector orange and violet wire terminals "D2" and "D3", crank engine. Voltmeter reading should fluctuate. If no voltage fluctuation occurs, check for defective trigger wheel, distributor shaft not turning, or missing trigger wheel retaining pin (shaft turning but not trigger wheel).

CONTROL UNIT POWER FEED CHECK

NOTE – *Before making this check, always check ignition coil primary circuit first.*

1) Disconnect 2-wire connector at control unit. Connect voltmeter negative lead to ground and positive lead to red wire harness connector terminal "F2". Turn ignition switch "ON". Voltage reading should be battery voltage (within 0.2 volts). If reading is correct, replace control unit. If not, proceed to next step.

2) Locate and repair cause of voltage reduction (corroded connectors, defective ignition switch, etc.) If connectors are repaired and there is spark at coil wires, start engine. If connectors are repaired and there is no spark at coil wire, replace control unit.

3) Connect voltmeter negative lead to ground and positive lead to white wire harness connector terminal "F1" in 2-wire connector. Crank engine. Voltmeter reading should be within 1 volt of battery cranking voltage. If not, check for bad connections, ignition switch or starter solenoid.

4) Turn ignition switch "OFF", connect 2-wire connector and disconnect 4-wire connector. Connect an ammeter to black wire terminal "C1" of control unit connector and to ground. Turn ignition switch "ON". Reading should by 0.9-1.1 amps. If reading is higher or lower than specified, replace control unit.

OVERHAUL

DISTRIBUTOR

Disassembly – **1)** Remove distributor cap and rotor. Using suitable gear puller (J-28509), remove trigger wheel (two screwdrivers can be used to pry trigger wheel upward). Remove pin.

2) Remove sensor retainer and washers from pivot pin on base plate. Remove ground screw from harness tab. Lift sensor assembly from distributor. If replacement is necessary, remove vacuum unit.

Reassembly – Reverse disassembly procedure, being sure to coat brass surface of rotor with silicone grease. If sensor or vacuum unit was replaced, check ignition timing.

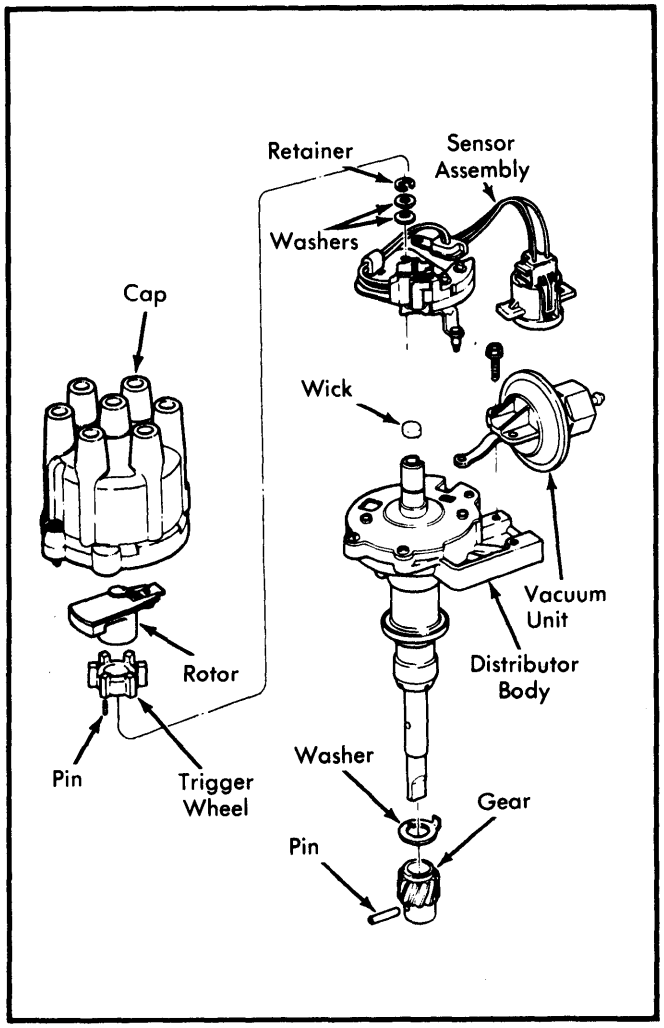

Fig. 4 Overhauling Solid State Distributor