MOTORCRAFT DURA-SPARK II ELECTRONIC IGNITION SYSTEM

Fiesta

DESCRIPTION

The Dura-Spark II ignition system is basically a solid state system, using a larger rotor, distributor cap and adapter, secondary wires and wide gap spark plugs to take advantage of the higher energy produced.

OPERATION

The Dura-Spark II system contains a distributor, electronic control module and ignition coil. See *Fig. 1*. An armature (reluctor) with 4 teeth (one for each cylinder) rotates with the distributor shaft past a stator (pick-up coil). As the teeth pass the pick-up coil, a signal is sent to the electronic control module.

The module then determines when to turn current off and on in the primary windings of the ignition coil. This current collapse in the primary causes a high voltage surge in the secondary, firing the spark plugs. System components include the following:

Electronic Control Module – Each Dura-Spark II module has 6 wires (a 2-wire connector and a 4-wire connector). See *Fig. 2*. The red and white wires are the ignition feed wires – the white for cranking, the red after the engine begins to run. The red wire circuit contains a 1.1 ohm wire resistor. The current in the primary circuit of the ignition coil is turned off and on by the green wire. The orange and purple wires transmit signals to the module from the armature and pick-up coil in the distributor. The black wire is used to ground the distributor. The module is "ON" whenever the ignition switch is in the "RUN" or "START" position.

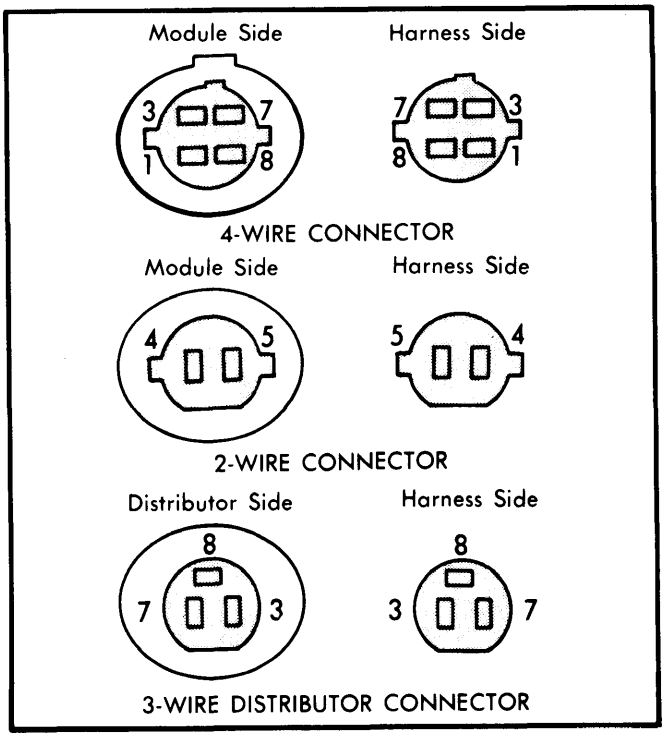

Fig. 2 Control Module and Distributor Connectors for Dura-Spark II

Distributor – A 4-tooth armature (reluctor) and a stator (pick-up coil) combine to signal the control module when to turn the ignition coil off and on. See *Fig. 3*. The distributor has both centrifugal and vacuum advance mechanisms for altering spark timing.

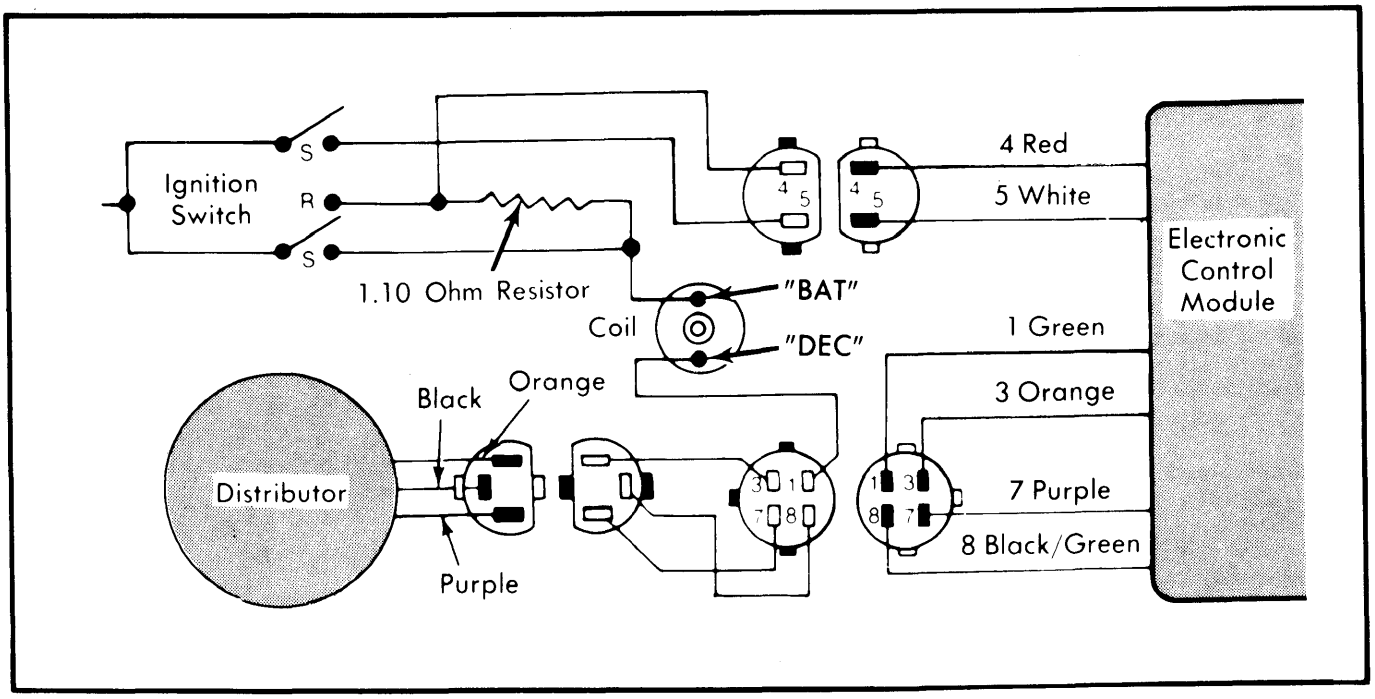

Fig. 1 Dura-Spark II Ignition System Wiring Diagram

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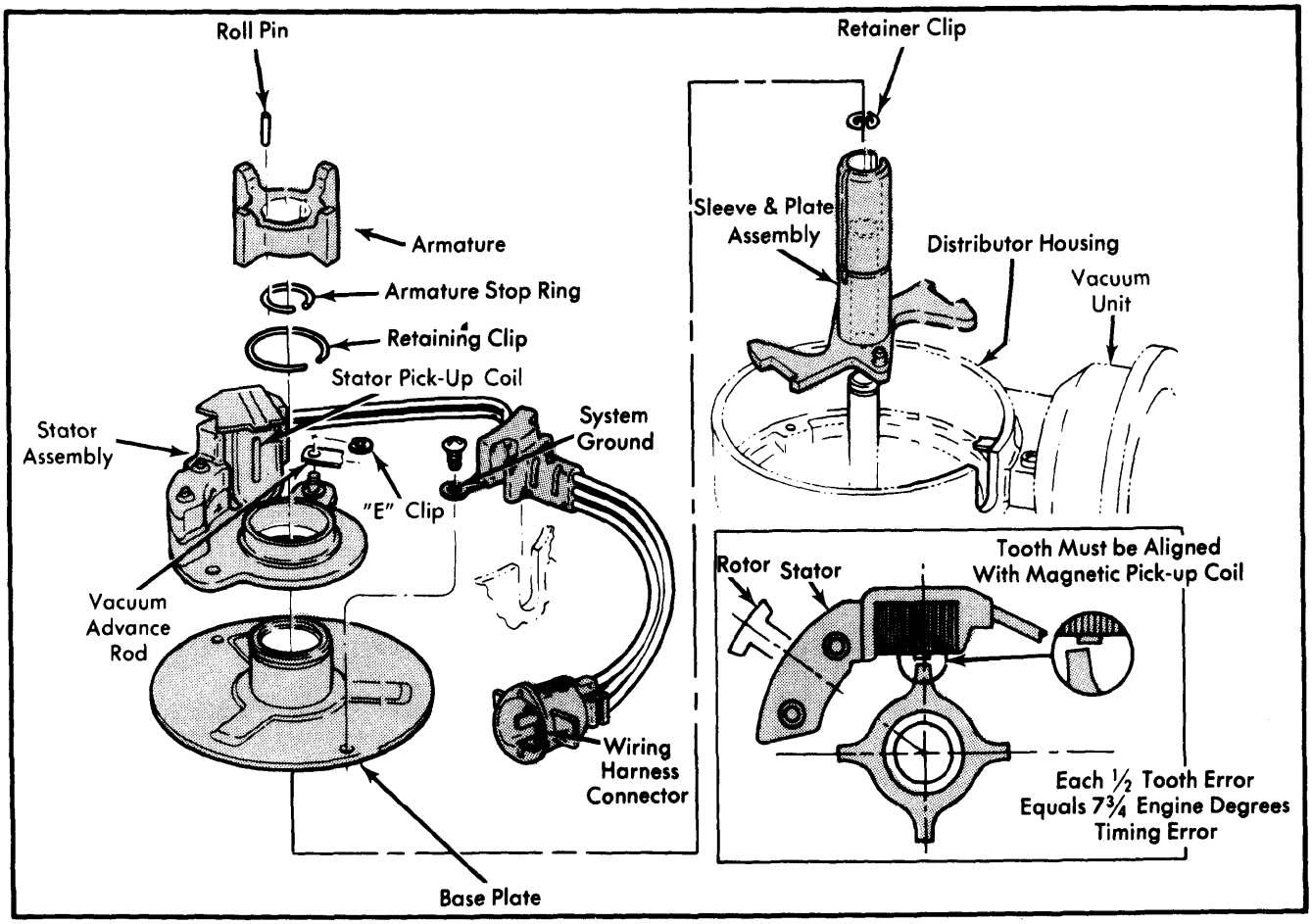

Fig. 3 Components of Dura-Spark II Distributor

Ignition Coil – The coil is "ON" whenever the ignition switch is in the "RUN" or "START" position. It contains a positive ("BAT") and a negative ("DEC") primary terminal and a single secondary terminal. A special connector attaches the green wire from the control module to the coil negative terminal and the wire from the ignition switch to the positive terminal.

NOTE – *"DEC" refers to Distributor Electronic Control. This terminal is also referred to as the "Tach Test" terminal.*

Resistance Wire – The special ignition resistance wire between the ignition switch and "BAT" terminal of the coil must be of specified length and diameter to reduce operating voltage. Under no circumstances should it be replaced by any other wire than the correct service resistor wire. When a new wire is installed, the old wire should be isolated from the system. Resistance value is 1.05-1.15 ohms.

System Protection – The Dura-Spark II system is protected against electrical currents produced or used by any other vehicle component during normal operation. However, damage to the system can occur if proper testing procedures are not followed.

DURA-SPARK II SYSTEM PRECAUTIONS

Since the electronic control module and ignition coil are "ON" whenever the ignition switch is in the "RUN" or "START" position, the system will generate a spark whenever the ignition switch is turned "OFF." This feature may be used as a diagnostic tool to check for continuity of circuit, coil and ignition switch. As spark may occur if distributor cap is removed with the switch "ON", keep switch "OFF" during under-the-hood operations, unless you plan to start the engine or perform a test requiring the switch to be "ON". This will prevent accidental engine rotation during service or test procedures.

Silicone dielectric grease must be applied to all insulating areas at distributor, coil and spark plug boots. To help prevent radio frequency interference, coat the entire brass rotor tip with silicone dielectric grease to a thickness of 1/32" (.75 mm). Do not remove this grease, even if discolored, as grease will maintain its insulating properties.

A ¾" (18 mm) clearance must be maintained at distributor cap mounting edge, spark plug wire terminals and coil tower to prevent high voltage arc to ground.

When replacing spark plug wires, be sure to use the specified Fiesta spark plug wires.

ADJUSTMENTS

No adjustments are to be made to the ignition system, except initial engine timing and spark plug gap.

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TESTING

CAUTION — *When checking the secondary voltage, do not remove the No. 1 or 3 spark plug wires while the engine is running.*

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

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

Coil Reserve Voltage — 1) Clamp secondary voltage pick-up over coil-to-distributor high voltage wire. Run engine at 1000 RPM and check engine operation and read scope pattern. With engine running at 1000 PRM, remove one spark plug wire without letting it arc to ground.

2) Read the highest open circuit voltage indicated on scope. Reserve voltage should be 28,000 volts minimum. Regardless of reading, continue with other tests. Using an ohmmeter, check resistance of coil-to-distributor high voltage wire. Resistance should be 3,500 ohms per foot. Replace if required.

Rotor-to-Cap Voltage Drop — Connect high voltage pick-up to coil-to-distributor secondary wire. Remove one spark plug wire momentarily and ground the wire to the engine. Run engine at idle speed, without letting a spark gap appear between engine and spark plug wire. High voltage reading should be 8,000 volts maximum. If voltage fails to meet specifications, check rotor, adapter and distributor cap.

Spark Plug Required Voltage — 1) Make this test with engine running at 2000 RPM and with secondary voltage probe connected over coil-to-distributor high voltage wire. Read the highest spark plug high voltage requirement for each cylinder. Readings should be 6,000-20,000 volts. If measured voltage is too low, remove probe from coil wire and connect it in turn to each spark plug wire to determine which spark plug is low.

2) When measuring required voltage on individual plug wires, the minimum voltage is reduced to 6,000 volts. If less than 6,000 volts for any cylinder, remove spark plug and check for closed or bridged gap, fouled insulator nose or cracked ceramic.

3) If measured voltage is higher than 20,000 volts (or 50% or more higher than other cylinders), check individual spark plug wires with probe. When problem cylinder is located, check spark plug and its wire. Inspect especially for burned or excessively worn electrodes and high resistance between terminal and center electrode.

Spark Plug Wire Resistance — Check spark plug wire resistance using an ohmmeter. Remove spark plug wire and boot from spark plug, but leave wire attached to distributor cap. Resistance should not exceed 4,100 ohms from boot terminal to internal distributor cap terminal.

IGNITION COIL RESISTANCE CHECK

Primary Resistance — Remove connector from coil's positive and negative primary terminals. Be sure ignition switch is "OFF". Set an ohmmeter on the low scale and connect ohmmeter leads to primary terminals of ignition coil. Ohmmeter reading should be 1.13-1.23 ohms at 75° F (24° C). With temperature of coil at 200° F (93° C), a 1.5 ohm reading is acceptable.

Secondary Resistance — Be sure ignition switch is still "OFF". Set ohmmeter to high scale (x1000) and connect one lead to coil negative terminal and other lead to coil tower (remove coil secondary wire first). Ohmmeter reading should be 7,700-9,300 ohms with coil temperature at 75° F (24° C). With coil temperature at 200° F (93° C), a maximum reading of 12,000 ohms is acceptable.

BASIC SYSTEM CHECK

1) Connect a scope with clamp-on pick-ups to coil high voltage wire, according to manufacturer's specifications. If a scope is not available, remove coil wire from distributor and insert a modified spark plug into coil wire. See *Fig. 4*.

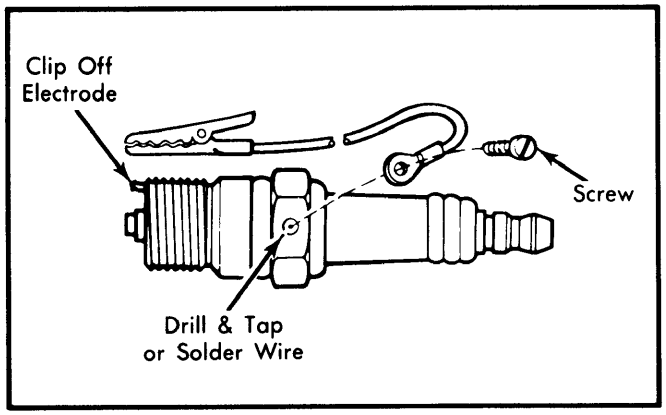

Fig. 4 Modified Spark Plug Tester

NOTE — *To modify spark plug, cut off side electrode and solder or tap and screw a ground lead to spark plug case. Ground wire and insert plug terminal into coil wire.*

2) Turn ignition switch to "RUN" position and tap distributor base with a screwdriver handle. Check for sparks while tapping (visible by checking scope trace or at modified spark plug gap). If spark occurs, see Control Module Feed Check, White Wire Circuit.

3) If no spark, turn ignition switch "OFF". Crank engine to approximately align engine timing pointer with initial timing degree line on damper. Turn key to "RUN" position and repeat tapping of distributor, checking again for sparks. Then proceed to next check.

CONTROL MODULE FEED CHECK

Red Wire Circuit — 1) If no spark occurred in step 3) of Basic System Check, measure battery voltage. Then using a straight pin, puncture red wire of control module's 2-wire harness (between module and connector). See *Fig. 5*.

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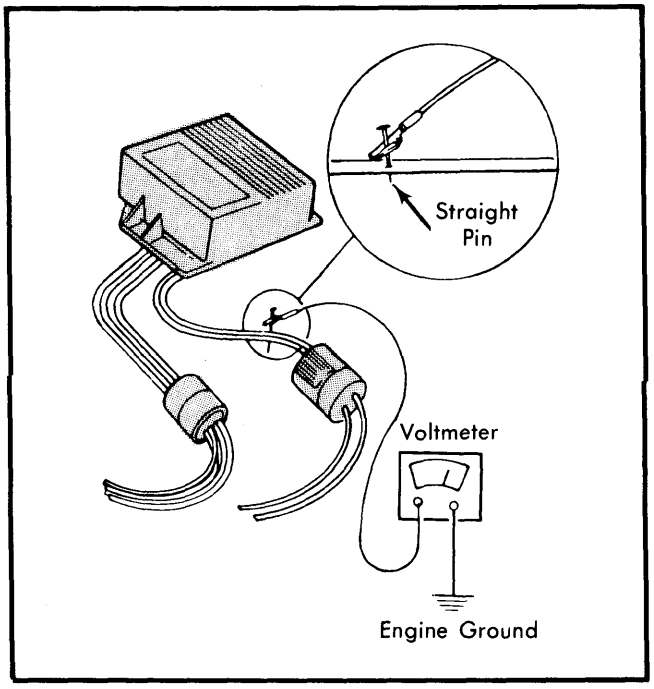

Fig. 5 Checking Control Module Feed (Red or White Wire Circuits)

2) Connect voltmeter positive lead to straight pin and negative lead to ground. Voltage on red wire should be within 1.0 volt of battery voltage. If so, proceed to step **1)** of Coil Primary Circuit Check.

3) If not, repair the wire feeding the red wire and repeat previous tests. If spark occurs at modified plug, ignition system is OK.

White Wire Circuit – 1) Crank engine and check for sparks. If sparks occur, ignition system is OK. Check fuel system instead. If no sparks occur, measure battery voltage while cranking engine. Then, without disconnecting the control module's 2-wire connector, measure voltage on white wire while cranking engine.

2) Using a straight pin, puncture white wire between control module and connector. See *Fig. 5*. Voltage should equal battery cranking voltage. If so, proceed to step **3)**. If not equal, repair wire feeding the control module white wire, and repeat test.

3) If voltage in step **2)** was equal to battery cranking voltage, or if no spark occurred after repairing wire feeding white wire, connect positive lead of voltmeter to ignition coil positive ("BAT") terminal and negative lead to ground. Measure voltage while cranking engine. Battery voltage should exist. If so, proceed to step **4)**. If not, repair wire feeding coil positive ("BAT") terminal and repeat test. If still no sparks occur, see Intermittent Operation Check.

4) If voltage at coil positive ("BAT") terminal was equal to battery voltage, but problems still exist, substitute but do not install a known good control module and repeat the test. If sparks occur, reconnect original module to check if it is faulty. Repeat test. If no sparks, replace module.

COIL PRIMARY CIRCUIT CHECK

1) Refer to step **1)** of Control Module Feed Check for red wire circuit. If voltage was within 1.0 volt of battery voltage, turn ignition switch from "RUN" to "OFF". A spark should be seen each time ignition switch is turned "OFF". Then return ignition switch to "RUN" position. If modified plug sparks, proceed to Control Module & Stator Check. If no spark occurs, proceed to next step.

2) Connect positive lead of voltmeter to ignition coil positive ("BAT") terminal and negative lead to ground. Reading should be 6-8 volts. If so, proceed to step **11)**. If less than 6 volts, proceed to step **10)**.

3) If voltage in step **2)** is battery voltage, disconnect 4-wire connector at control module. Insert a jumper wire (paper clip) into the 4-wire harness connector's terminals that mate with the control module's green and black wires (terminals 1 and 8).

4) Connect voltmeter positive lead to ignition coil positive ("BAT") terminal and negative lead to ground. Measure voltage. If battery voltage, proceed to step **6)**.

5) If voltage now reads 6-8 volts, substitute (but do not install) a known good control module. Repeat previous tests. If no spark, see Intermittent Operation Check. If sparks occur, reconnect original module and retest. If no spark now occurs, replace control module.

6) If voltage in step **4)** was battery voltage, make sure coil connector is fully engaged on primary terminals of ignition coil. Ground the "Tach Test" terminal of coil. See *Fig. 6*. Connect voltmeter positive lead to coil's positive ("BAT") terminal and negative lead to ground.

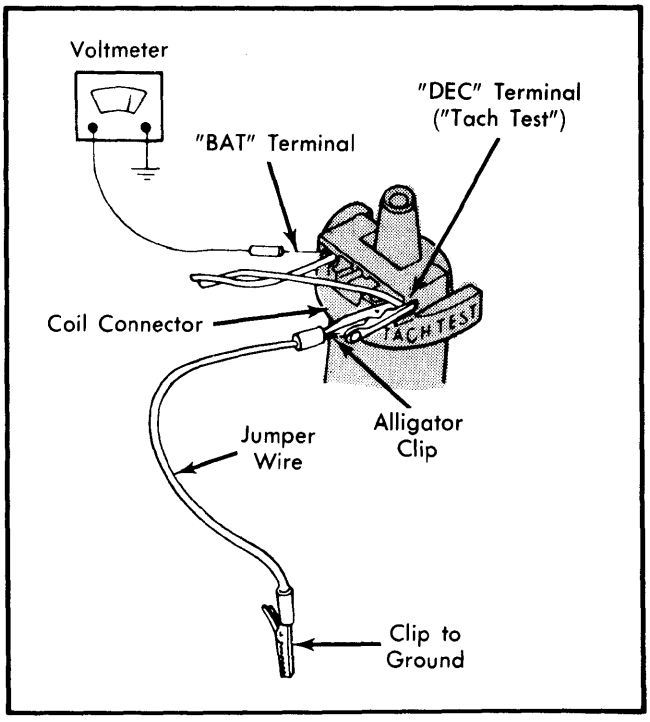

Fig. 6 Grounding "Tach Test" Terminal In Coil Primary Circuit Check

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7) If reading is now 6-8 volts, remove ground wire from "Tach Test" terminal of coil connector. Ground jumper wire (paper clip) in 4-wire connector. Again measure voltage at coil positive ("BAT") terminal. Reading should be approximately 6-8 volts. If so, proceed to step **9)**.

8) If not, repair wire from control module to coil (mates with green wire, terminal 1). Remove jumper wire (paper clip) from 4-wire connector. Reconnect control module and retest system. If sparks occur at modified plug, system is OK. If not, see Intermittent Operation Check.

9) If voltage in step **7)** was 6-8 volts, repair the ground circuit (black wire, terminal 8) from control module to distributor. Remove jumper wire (paper clip) from 4-wire connector and retest system. If sparks occur at modified plug, system is OK. If not, see Intermittent Operation Check.

10) If voltage in step **2)** was less than 6 volts, repair wire feeding the ignition coil positive ("BAT") terminal. Retest system and if spark occurs at modified plug, system is OK. If not, see Intermittent Operation Check.

11) If voltage in step **2)** was 6-8 volts but engine would not run, or if voltage in step **6)** was battery voltage, remove paper clip and reconnect control module. Substitute (but do not install) a known good ignition coil and repeat system test. If spark occurs, reconnect original coil and retest. If sparks now occur, see Intermittent Operation Check. If no spark results, replace ignition coil.

12) If no sparks occurred with substitute coil, connect original ignition coil and be sure connector is fully engaged over terminals. Substitute (but do not install) a known good control module and repeat tests. If sparks occur, reconnect original module and retest. If no spark now occurs, replace control module.

CONTROL MODULE & STATOR CHECK

1) Refer to step **1)** of Coil Primary Circuit Check. If modified plug sparked, but engine would not run, substitute any known good distributor (not limited to 4-cylinder). Attach distributor connector to control module harness connector. Run 15" ground wire from vacuum unit screw to engine ground. Spin drive gear and check for sparks.

2) If sparks occur, reconnect original distributor to check if it is damaged. Repeat tests to check for sparks. If sparks now occur, see Intermittent Operation Check. If no sparks occur, replace distributor stator assembly.

3) If no sparks occurred when gear of good distributor was spun, disconnect 3-wire distributor connector and 4-wire control module connector. Check harness wires as shown in steps **4)** through **8)**.

4) Turn ignition switch "OFF". Connect ohmmeter leads to ends of each wire, one at a time. Wire mating with control module black wire (terminal 8) grounds the distributor. Wires mating with control module orange wire (terminal 3) and purple wire (terminal 7) signal control module as to when coil primary circuit should be shut off and on. Continuity should exist at each wire.

5) Then connect ohmmeter leads to harness wires mating with orange and purple wires of control module. There should be no continuity between these 2 wires.

6) Then connect one ohmmeter lead to ground and touch other lead in turn to wires mating orange and purple control module wires. An open condition should exist.

7) If harness checks OK, reconnect distributor connector and substitute a known good control module and repeat system tests. If no spark occurs, see Intermittent Operation Check. If sparks occur, reconnect original control module and retest. If no sparks occur now, replace control module.

8) If harness proved defective in step **4)** through step **6)**, repair wires or connectors as necessary and retest for spark at modified plug.

INTERMITTENT OPERATION CHECK

1) If the ignition system becomes operative during testing without a repair having been made, attempt to recreate the original problem. With the engine running, wiggle the wires at the coil, module, distributor and other harness connectors. Check connections first that you have previously disconnected.

2) Check the ground connection in the distributor. Then turn engine off, heat the stator pick-up coil by placing a 250 watt heat lamp approximately 1-2 inches (25-50 mm) from its top surface. Apply heat for 5-10 minutes, while checking pick-up coil resistance at the distributor connector terminals 3 and 7 (orange and purple wires). Resistance should be 400-1000 ohms. Tapping with screwdriver may also be helpful.

3) With the engine running, heat control module in the same manner. Do not let module temperature exceed 212°F (100°C). If ignition system malfunctions, substitute (but do not install) a new control module. If malfunction is corrected, recheck old control module before replacing it.

OVERHAUL

Disassembly – **1)** Remove distributor cap and rotor. Disconnect distributor wiring harness connector. Using a small gear puller or 2 screwdrivers, carefully pry armature (reluctor) from sleeve and plate assembly. Remove spring pin.

NOTE – *When removing armature with screwdrivers, lever against lower plate only (not upper plate). Lower plate is supported by base casting.*

2) Remove snap ring, washer and wave washer. Remove ground screw and stator (pick-up coil) assembly. Remove vacuum diaphragm attaching screws and remove unit by tilting downward to disengage link from the advance plate.

Reassembly – Reverse disassembly procedure, but use new spring pin and install pin in groove 180° from original location.

CAUTION – *Do not pinch stator (pick-up coil) wires when removing armature.*