MOTORCRAFT DURA-SPARK II IGNITION SYSTEMS

Ford
All Except Calif. Models with 5.0L (302") and 5.8L (351") W Engines

DESCRIPTION

Dura-Spark II – Dura-Spark II is basically a solid-state ignition system, consisting of a breakerless distributor, electronic control module, ignition coil, battery, ignition switch, secondary wires and various wiring harnesses. *See Figs. 2 and 4.*

All models use a larger rotor, a distributor cap and adapter, secondary wires, and wide gap spark plugs to take advantage of higher energy produced.

Dura-Spark II system can be identified by blue grommet on electronic control module and by module's 2-wire and 4-wire connectors. *See Fig. 3.*

Dura-Spark II with Dual Mode Timing – Some models have a special electronic control module with a third connector having 3 wires. *See Fig. 1.* This connector attaches to a special ignition barometric pressure switch, used on altitude calibration vehicles.

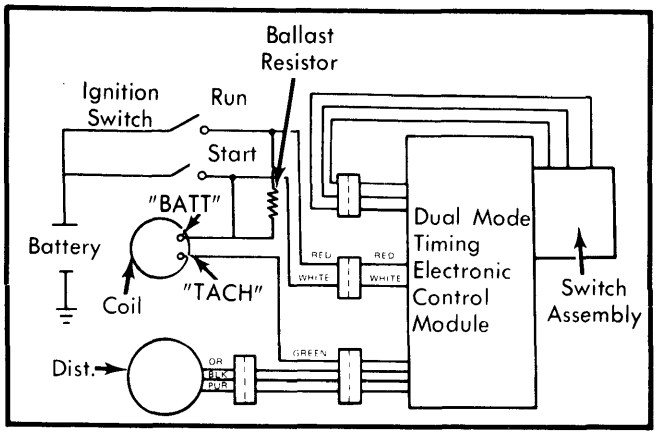

Fig. 1 Dura-Spark II System with Dual Mode Timing Electronic Control Module (Altitude Models)

This switch allows base engine timing to be modified to suit altitude conditions. All other operating charactistics of the module are the same as for Dura-Spark II systems without the special switch.

OPERATION

The Dura-Spark II systems contain a distributor, electronic control module and ignition coil and function much the same as other solid state systems. *See Figs. 1 and 2.* An armature on the distributor shaft rotates past a stator (pick-up coil). *See Fig. 8.*

The armature has the same number of teeth as the engine has cylinders. As the teeth rotate past 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, which is routed to the spark plugs through the rotor, distributor cap and spark plug wires. System components include the following:

Electronic Control Module – Each Dura-Spark II module has 6 wires. (A 2-wire and 4-wire connector). *See Fig. 3.* Modules with dual mode timing have 9 wires; *See Fig. 1.* The Red and White wires are the ignition feed wires – the White circuit is for cranking; the Red circuit, for operation after the engine begins to run. The Red wire circuit contains a 1.1 ohm wire resistor. The current to the primary circuit of the ignition coil is turned off and on through the Green wire. The Orange and Purple wires transmit signals to the module from the armature and stator in the distributor. The Black wire is used to ground the distributor. The module is "ON" whenever the ignition switch is in the "ON" or "START" position.

Distributor – An armature, containing the same number of teeth as the engine has cylinders, turns with the distributor shaft. A stator (pick-up coil) contains a permanent magnet, causing a magnetic field around the stator's pick-up coil. As the teeth of the armature pass the stator, the magnetic field builds and collapses, causing a signal to be sent to the electronic control module. In turn, the control module turns the ignition coil off and on.

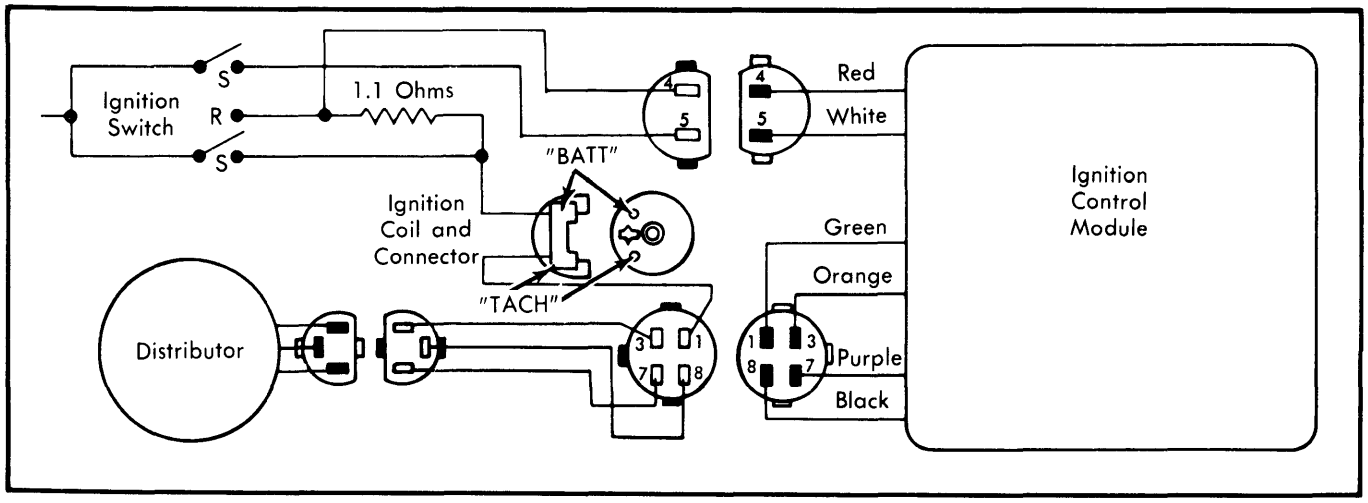

Fig. 2 Dura-Spark II Ignition System Wiring Diagram

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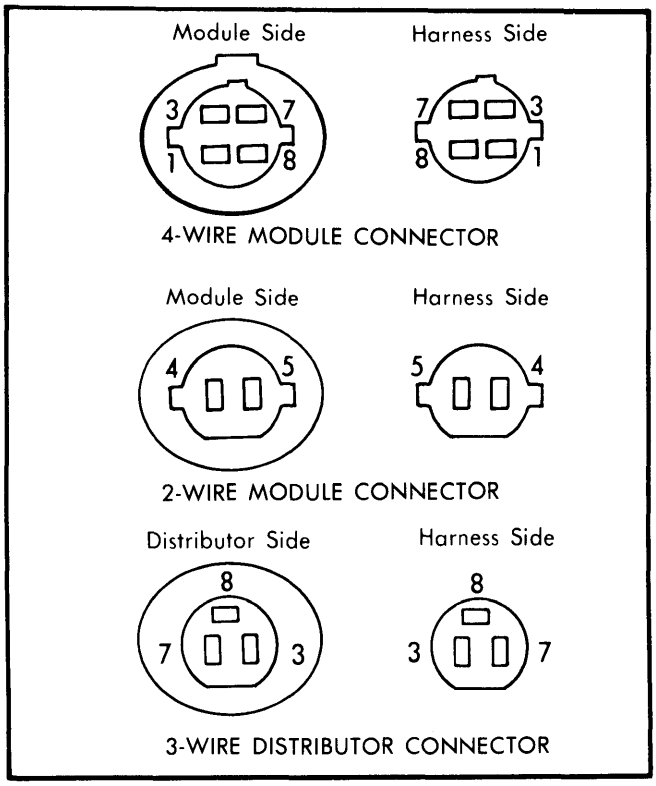

Fig. 3 Control Module and Distributor Connectors for Dura-Spark II

Dura-Spark II systems have an adapter between the distributor housing and cap. See *Fig. 4*. Caps are larger than for conventional distributors and have male terminals. Distributors have both centrifugal and vacuum advance units.

On single diaphragm vacuum units, increased vacuum causes the movable stator to pivot on lower plate assembly, advancing spark timing. On dual diaphragm vacuum units, the outer (primary) diaphragm operates from carburetor vacuum to provide timing advance during normal off idle driving conditions. It is connected to the stator assembly.

The inner (secondary) diaphragm operates from intake manifold vacuum and acts to retard ignition timing. The inner diaphragm is connected to the outer diaphragm by means of sliding linkage. Stronger intake manifold vacuum can override carburetor vacuum during closed throttle operation, retarding spark timing.

Distributors on 6-cylinder models rotate clockwise, those on V8 models, counterclockwise.

Ignition Coil – Coils are oil filled and are energized whenever the ignition switch is in the "ON" or "START" position. They contain a positive "BATT" terminal and a negative "TACH" (sometimes called "DEC") terminal and a single secondary terminal. A special connector attaches the Green wire from the control module to the negative terminal ("TACH") and the wire from the ignition switch to the positive terminal ("BATT"). The wire from the ignition switch contains a 1.1 ohm resistance wire.

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 in the Red wire circuit must be of specified length and diameter to reduce operating voltage. Under no circumstances should it be replaced by any other wire other than correct service resistor wire. When a new wire is installed, old wire should be isolated from system. Resistance value is 1.0-1.1 ohms.

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

ADJUSTMENTS

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

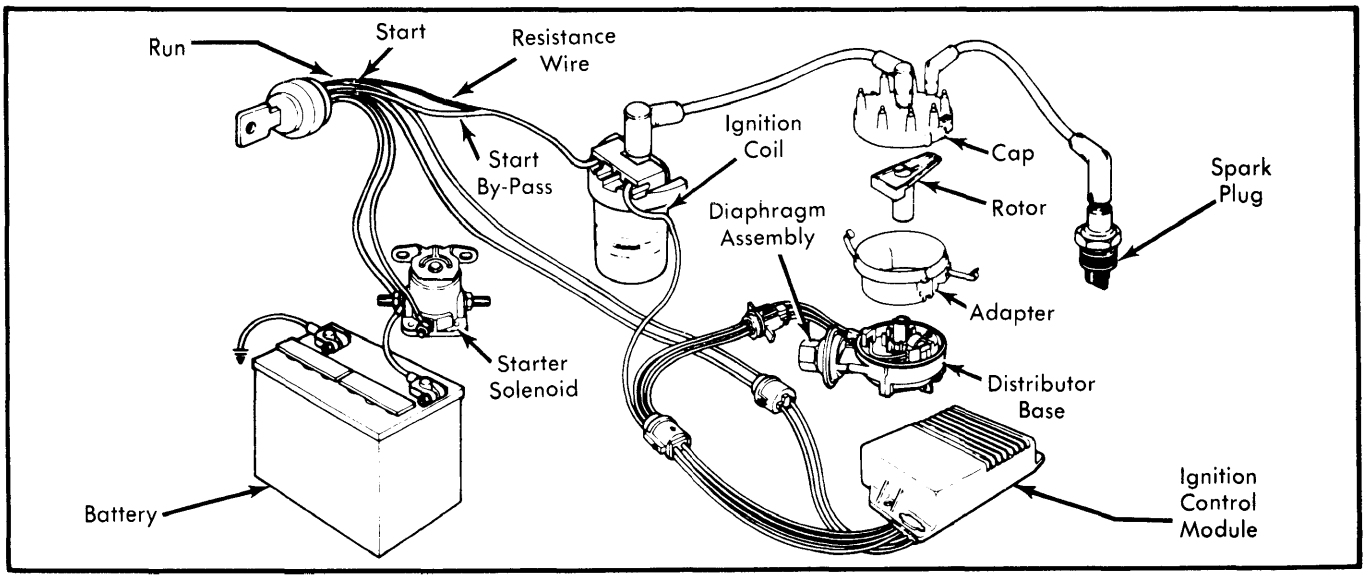

Fig. 4 Schematic of Dura-Spark II Ignition System

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DURA-SPARK II SYSTEM PRECAUTIONS

Since the electronic control module and ignition coil are "ON" whenever the ignition switch is in the "ON" 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 switch "ON", keep switch "OFF" during underhood 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.

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

To help prevent radio frequency interference, coat the entire brass rotor tip with silicone dielectric grease to a thickness of 1/32". Do not remove this grease, even if discolored, as the grease will maintain its insulating properties.

When replacing spark plug wires, insure wire made of the same material is used for a replacement. Silicone/Silicone wire can be identified by the letters "SS" appearing on the wire in WHITE lettering. Silicone/EPDM wire can be identified by the letters "SE" appearing on the wire in BLACK lettering. The "SS" wire is used on cylinders subject to very high engine temperatures.

When removing distributor cap and adapter, always remove the distributor cap first, then the adapter.

TESTING

NOTE – *All wire colors shown refer to colors of ignition control module wires. When making tests, wires must be traced back to control module for proper color identification. Also, when a test is completed and a problem is disclosed, make the repair necessary and repeat failed test to be sure problem has been corrected. All tests are based on the fact that engine cranks but will not start.*

CAUTION – *When checking the secondary voltage, do not remove the following spark plug wires while the engine is running or cranking:*

Plug No. 1 or 8 on V8 Engines.
Plug No. 3 or 5 on 6-Cylinder engines.

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

TEST SPARK PLUG

Either use a spark tester tool or modify a spark plug (cut off side terminal and install spring clip for grounding plug housing) for use in testing ignition system. See *Fig. 5*.

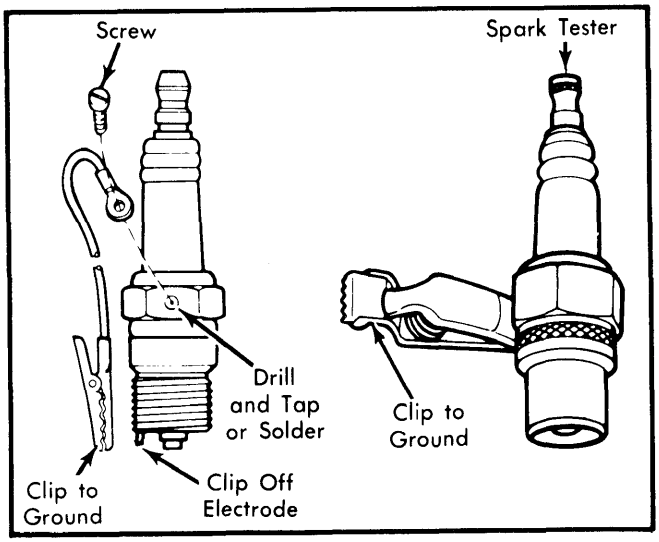

Fig. 5 Modified Spark Plug and Spark Tester

IGNITION COIL OUTPUT VOLTAGE CHECK

1) Connect spark tester between ignition coil high tension wire and engine ground. Crank engine. Disconnect tester and reconnect coil wire to distributor cap.

2) If spark occurs, ignition coil output voltage is OK. Check distributor cap and rotor for damage or lack of silicone grease. Then proceed to "Fouled Spark Plugs."

NOTE – *Do not apply silicone grease to center spring portion of rotor. Apply 1/32" of silicone grease on complete surface (top, bottom, and edges) of rotor blade tip.*

3) If there was no spark in step **1)**, measure resistance of ignition coil wire. Attach ohmmeter leads to each end of wire. Replace if greater than 5,000 ohms per inch resistance is encountered. Remove distributor cap, crank engine, and check for distributor rotation. If none, check distributor. Proceed to "Ignition Coil Primary Voltage Check".

IGNITION COIL PRIMARY VOLTAGE CHECK

1) Turn ignition switch to "RUN" position. Connect positive lead of voltmeter to ignition coil positive ("BATT") terminal. At-

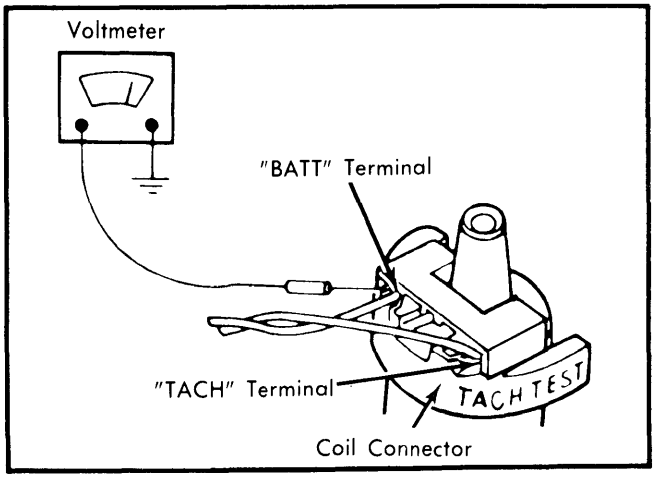

Fig. 6 Checking for Battery Voltage at Ignition Coil Positive ("BATT") Terminal

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tach negative lead to a good ground. See *Fig. 6*. Turn ignition "OFF" after reading voltage.

2) If voltage is 6-8 volts, proceed to "Module Run Circuit Check." If more than 8 volts, proceed to "Ground Circuit Check." If less than 6 volts, perform "Wiring Harness Shorts Check" and "Ignition Coil Circuit Check" and then check for damaged or worn ignition switch.

MODULE RUN CIRCUIT CHECK

1) Insert a straight pin through Red wire of ignition module 2-wire harness, between module and connector. See *Fig. 7*. Attach positive lead of voltmeter to straight pin and negative lead to a good engine ground. Do not allow straight pin to contact ground.

2) Turn ignition switch to "RUN" position, take reading and turn switch "OFF".

3) If reading is at least 90 percent of battery voltage, proceed to "Module Start Circuit Check." If reading is below 90 percent, proceed to "Wiring Harness Shorts Check." Service and replace wires, as necessary.

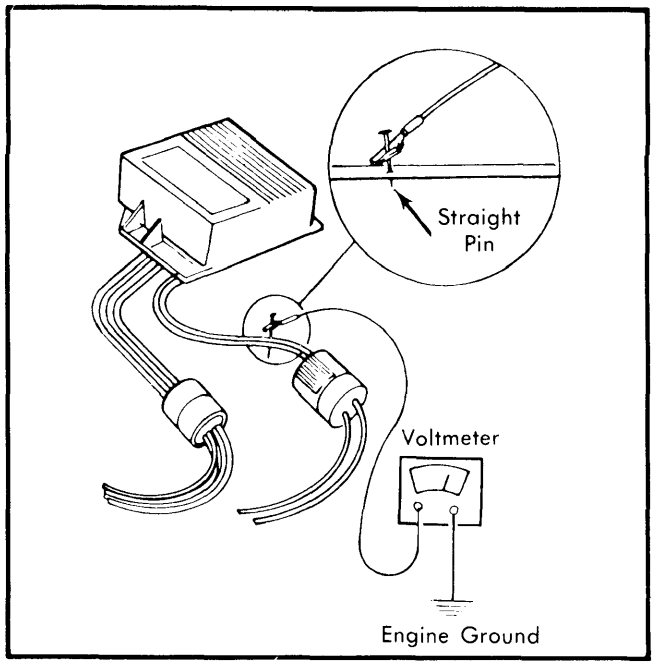

Fig. 7 Checking Control Module Run and Start Circuits with Voltmeter

MODULE START CIRCUIT CHECK

1) If starter relay has an "I" terminal, disconnect cable from relay to motor. If there is no "I" terminal, disconnect wire at "S" terminal of relay.

2) Hold ignition switch in "START" position. Connect voltmeter positive lead to ignition coil positive ("BATT") terminal and negative lead to ground. See *Fig. 6*. Take reading. Then insert a straight pin in White wire of ignition module 2-wire harness, between module and connector. See *Fig. 7*. Attach positive lead of voltmeter to pin, with negative lead still grounded. Again, do not let pin touch ground. Turn ignition switch "OFF" and reattach starter relay wires.

3) Readings in both instances should be 90 percent of battery voltage while cranking. If so, proceed to "Distributor Stator Assembly Check." If less than 90 percent, proceed to "Wiring Harness Shorts Check." Also check ballast resistor by-pass circuit, replace damaged wiring harnesses, and check for worn or damaged ignition switch.

WIRING HARNESS SHORTS CHECK

1) Inspect wiring harness for overheated, burned or bare wires, connecting to control module Red, White, and Green wires or to primary ("BATT" and "TACH") terminals of ignition coil connector.

2) Check control module and ignition coil connectors for dirt, corrosion or damage. Connect one lead of ohmmeter to engine ground and other lead to terminals in 4-wire connector that mate with Orange and Purple module wires.

3) Check resistance, in turn, between the sets of wires in the harness connectors that mate with Red and White wires, Red and Green wires, Red and Orange wires, Red and Purple wires, White and Green wires, and White and Purple wires. Remove ohmmeter and reconnect all connectors.

4) If more than 70,000 ohms, proceed to "Distributor Stator Assembly Check." If less than 70,000 ohms, service or replace defective wires.

GROUND CIRCUIT CHECK

1) Disconnect 3-wire distributor connector and 4-wire module connector. Check for dirt, corrosion or damage. Connect one ohmmeter lead to Black wire in distributor connector and other lead to ground. Wiggle distributor grommet during measurement.

2) Then connect ohmmeter leads to each end of Black wire, between 4-wire and 3-wire connectors. Remove ohmmeter and reconnect connectors.

3) If there is less than 1 ohm resistance, proceed to "Ignition Coil Circuit Check." If more than 1 ohm resistance, check for loose, broken or missing distributor ground screw. Replace defective wires.

IGNITION COIL CIRCUIT CHECK

1) Disconnect ignition coil connector and module connectors. Inspect for dirt, corrosion or damage. Connect ohmmeter leads to "TACH" terminal of ignition coil connector and to terminal in wiring harness connector that mates with module Green wire.

2) If less than 1 ohm resistance, proceed to step **3)**. If greater than 1 ohm, repair or replace wire.

3) Connect ohmmeter leads to "BATT" terminal of ignition coil connector and to terminal in 2-wire connector that mates with

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module Red wire. If resistance is 0.6-1.6 ohms, proceed to "Distributor Stator Assembly Check." If either is more or less than specified range, replace ballast resistor wire.

DISTRIBUTOR STATOR ASSEMBLY CHECK

1) Disconnect 4-wire module connector and check for dirt, corrosion or damage. Clean as required. Connect ohmmeter leads to terminals in 4-wire harness connector that mate with module's Orange and Purple wires.

2) Resistance should be 400-1,000 ohms. If so, proceed to "Distributor Stator Assembly Output Voltage Check." If not within specified range, disconnect distributor connector and check for dirt, corrosion or damage.

3) Connect ohmmeter leads to Orange and Purple wires in distributor connector, take reading and reconnect connector. If reading is now 400-1000 ohms, stator assembly is OK and wiring harness between 3-wire and 4-wire connectors is defective.

4) If resistance reading at distributor connector is still not within specified range, replace stator assembly.

DISTRIBUTOR STATOR ASSEMBLY OUTPUT VOLTAGE CHECK

1) Connect a voltmeter, set in a 2V DC range, so that leads connect to terminals of 4-wire harness connector that mate with Orange and Purple module wires. Crank engine and read voltage. Reconnect harness connector.

2) If voltmeter needle oscillates, proceed to "Module Output Check." If needle does not oscillate, replace stator assembly.

MODULE OUTPUT CHECK

1) Connect positive lead of voltmeter to "TACH" terminal of ignition coil and negative lead to engine ground. Ground distributor cap end of coil high tension wire. Set voltmeter to 50V DC range.

2) Crank engine and while cranking, switch voltmeter to 2V DC range. Observe reading and reconnect coil wire to distributor.

3) If voltmeter needle oscillates, proceed to "Ignition Coil Primary Resistance Check." If needle does not oscillate, proceed to "Module Input Check."

NOTE – *If voltmeter testing does not obtain a usable conclusion, substitute a 12V DC test light. If light flashes, module output is OK.*

MODULE INPUT CHECK

1) Disconnect 4-wire module connector. Connect positive lead of voltmeter to terminal in harness connector that mates with module Green wire. Connect negative lead to engine ground. Turn ignition switch to "ON" position, take reading and turn switch "OFF".

2) If voltage is less than 90 percent of battery voltage, proceed to "Coil Harness Continuity Check." If more than 90 percent of battery voltage but engine will not start, suspect control module.

COIL HARNESS CONTINUITY CHECK

1) Connect ohmmeter leads to coil "TACH" terminal and to 4-wire harness connector terminal that mates with control module Green wire.

2) If resistance is less than 1 ohm, proceed to "Ignition Coil Primary Resistance Check." If more than 1 ohm, repair or replace Green wire from coil to 4-wire harness connector.

IGNITION COIL PRIMARY RESISTANCE CHECK

Disconnect ignition coil connector. Connect ohmmeter leads to coil "BATT" and "TACH" primary terminals. If resistance is 1-2 ohms, proceed to "Ignition Coil Secondary Resistance Check." If not 1-2 ohms, replace ignition coil.

IGNITION COIL SECONDARY RESISTANCE CHECK

1) With coil connector removed from coil, connect ohmmeter leads to coil "BATT" terminal and to coil tower (high tension wire removed).

2) If reading is 7,700-9,600 ohms, resistance is OK. If resistance is outside specified range, replace ignition coil.

FOULED SPARK PLUG CHECK

1) Remove distributor cap, leaving spark plug wires attached. Connect megohmmeter leads to engine ground and, in turn, to each spark plug wire terminal inside distributor cap.

NOTE – *If no megohmmeter is available, proceed to "Power Balance Check."*

2) If resistance reading is greater than 50 megohms, proceed to "Spark Plug Wire Resistance Check." If below 50 megohms, spark plugs are fouled and must be cleaned or replaced.

POWER BALANCE CHECK

Perform power balance according to equipment manufacturer's instructions. If RPM drops, check fuel system instead of ignition. If RPM does not drop, proceed to "Spark Plug Wire Resistance Check."

SPARK PLUG WIRE RESISTANCE CHECK

1) Remove distributor cap and disconnect spark plug end of suspected wire or wires. Connect ohmmeter leads to spark plug terminal and terminal inside distributor cap (each end of wire).

CAUTION – *Never puncture a spark plug wire when measuring resistance.*

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2) If resistance is less than 5,000 ohms, visually inspect wires for damage and remove spark plug for inspection or replacement. If resistance is greater than 5,000 ohms, disconnect suspected wire from distributor cap and again connect ohmmeter leads to each end of wire.

3) If resistance is now less than 5,000 ohms per inch, inspect distributor cap and spark plug wire terminals for damage. Repair as necessary. If resistance is still greater than 5,000 ohms per inch, replace wire(s).

OSCILLOSCOPE PATTERNS

For typical Dura-Spark II ignition oscilloscope patterns, *see article on MOTORCRAFT SOLID STATE IGNITION SYSTEM (JEEP) in this section.*

OVERHAUL

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

CAUTION – *Do not pinch stator wires when removing armature.*

2) On V8 engines, remove large wire retaining clip from base plate annular groove. Remove ground screw base and pull up to remove rubber grommet from base. Remove "E" clip securing diaphragm rod advance link to stator assembly. Lift diaphragm rod off post on stator assembly, and move it out against housing. Remove stator assembly.

3) On 6-cylinder models, remove "E" clip washer and wave washer securing stator assembly to lower plate. Remove stator assembly ground screw and lift assembly from distributor.

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

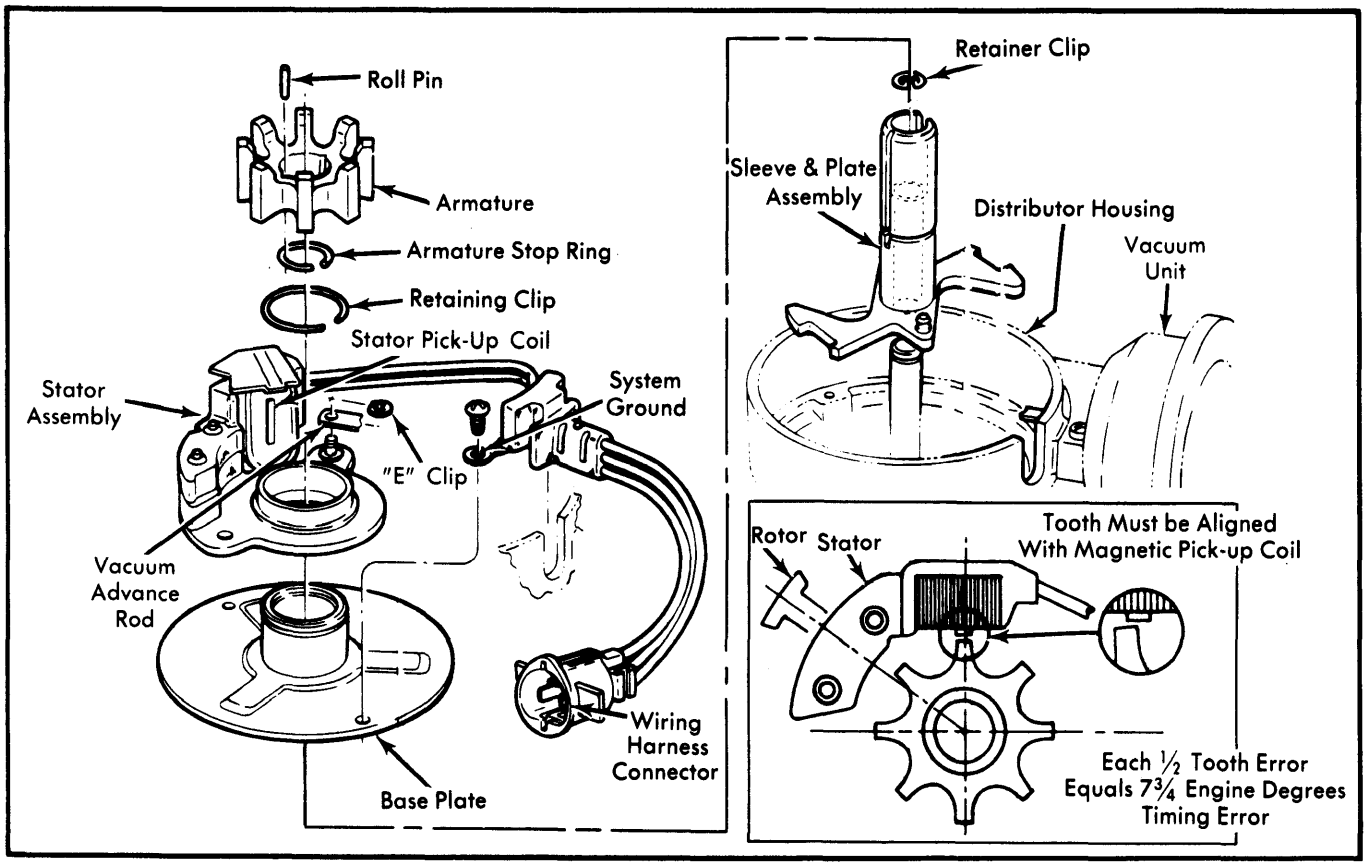

Fig. 8 Components of Dura-Spark II Distributor (V8 Shown)