MOTORCRAFT DURA-SPARK II IGNITION SYSTEMS

Ford Motor Co.
All Except Models with EEC

DESCRIPTION

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

Dura-Spark II with Dual Mode Timing – Some models have a special electronic control module with a third connector. This connector attaches to a special switch. The switch is either a distributor modulator valve, used on engines with the fuel economy package, or ignition barometric pressure switch, used on high altitude calibration vehicles. This switch allows base engine timing to be modified to suit either altitude or engine load conditions. All other operating characteristics 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).

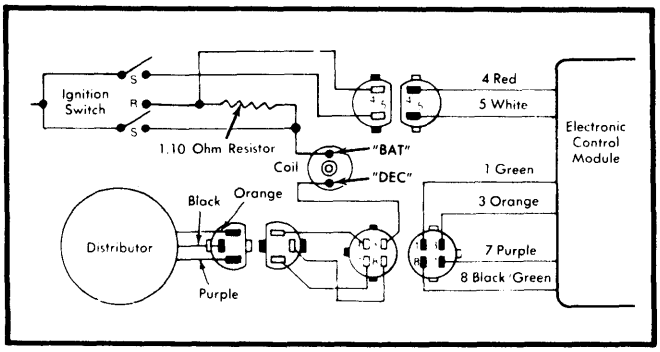

Fig. 1 Dura-Spark II Ignition System Wiring Diagram

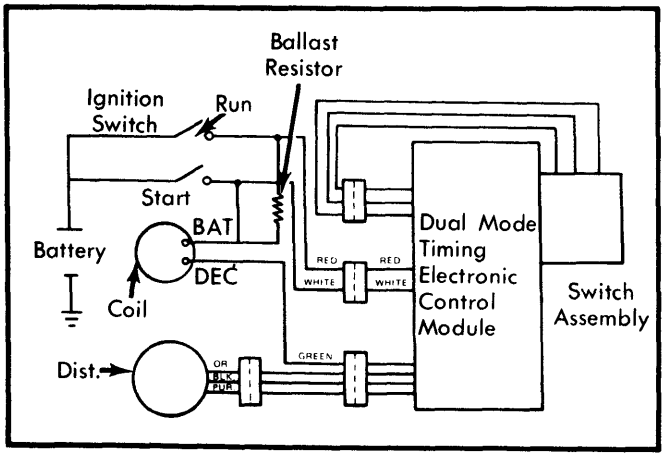

Fig. 2 Dura Spark II System with Dual Mode Timing Electronic Control Module (Used on Some Fuel Economy and Altitude Package Models)

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. 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.

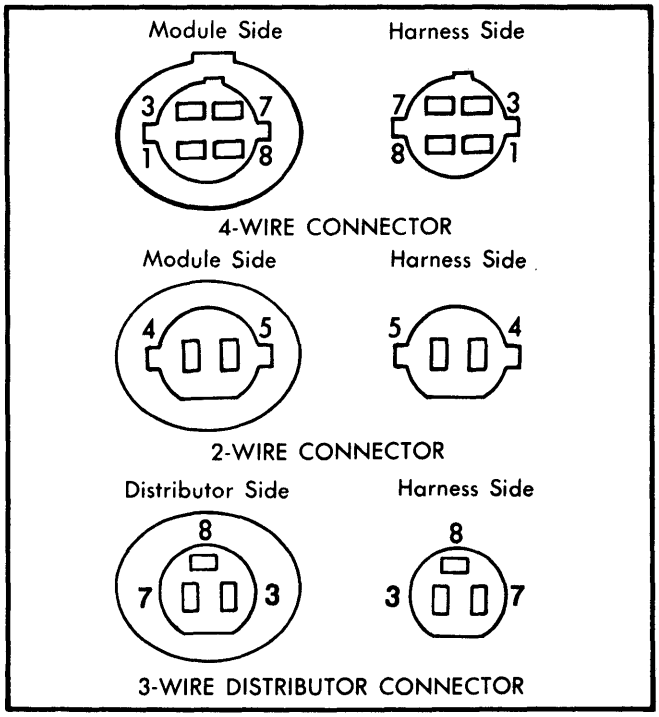

Fig. 3 Control Module and Distributor Connectors for Dura-Spark II

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. The cap is larger than on conventional distributors and the secondary wires have a heavier insulation for the very high secondary voltage. Distributors also have centrifugal and vacuum advance mechanisms.

MOTORCRAFT DURA-SPARK II IGNITION SYSTEMS (Cont.)

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

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.

ADJUSTMENTS

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

TESTING

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.
Plug No. 1 or 3 on 4 Cylinder engines.

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 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 28,000 volts minimum. Regardless of reading, continue testing procedures.

2) Using an ohmmeter, check resistance of coil-to-distributor high voltage wire. Resistance should be 5,000 ohms per inch maximum.

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 or distributor cap.

Required Spark Plug Voltage – Make this test with engine running at approximately 2000 RPM and with secondary voltage pick-up connected over coil-to-distributor high voltage wire. Firing voltage should be relatively even and between 6,000-20,000 volts. If firing voltage is not to specifications, 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 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 negative and positive terminals of ignition coil. Ohmmeter reading should be 1.13-1.23 ohms at 75° F. With temperature of coil at 200° F, a 1.5 ohm reading is acceptable.

MOTORCRAFT DURA-SPARK II IGNITION SYSTEMS (Cont.)

Secondary Resistance – Be sure ignition is still "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 first). Ohmmeter reading should be 7,700-9,300 ohms with coil temperature at 77° F. With coil temperature at 200° F or above, 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.*

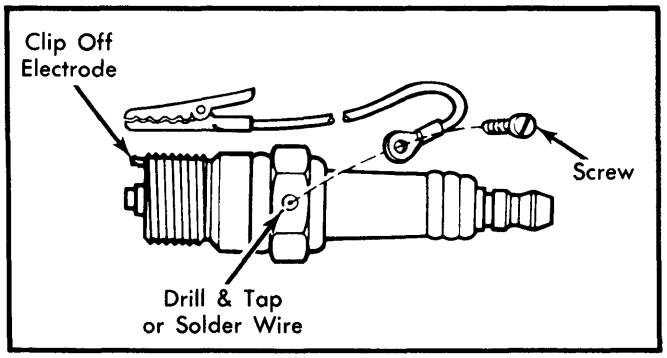

Fig. 4 Modified Spark Plug Tester

NOTE – *To modify spark plug, cut off side electrode and solder 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).

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.

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.* 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.

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

White Wire Circuit – 1) If sparks occurred in step **3)** of Basic System Check, connect voltmeter positive lead to ignition coil's positive ("BAT") terminal and negative lead to ground. Check voltage while cranking engine. Voltage should be within 1.0 volt of battery voltage. If not, repair wire feeding positive terminal of coil.

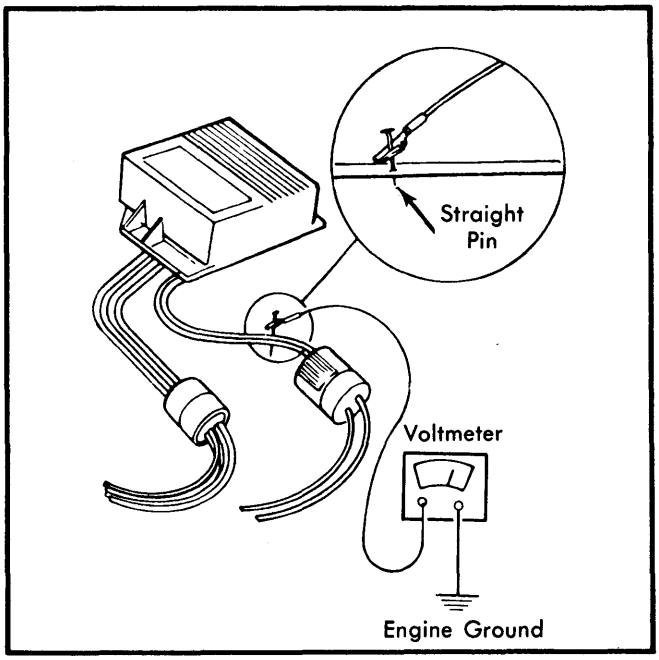

Fig. 5 Checking Control Module Feed (Red or White Wire Circuits)

2) If voltage is OK, crank engine and check for sparks at modified plug. If sparks occur, ignition system is OK. If none occurs, puncture white wire with a straight pin between control module and 2-wire connector. *See Fig. 5.* Connect positive lead of voltmeter to straight pin and negative lead to ground. Crank engine. Voltage should be within 1.0 volt of battery voltage.

3) If not within 1.0 volt, repair wire feeding module white wire and repeat white wire circuit check at step **1)**.

4) If voltage is OK, substitute a known good control module (but do not install). Repeat testing from step **1)**. If sparks now occur, reconnect original module. Retest and if no spark occurs, replace original module with a new one.

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 5-8 volts. If so, proceed to step **11)**. If less than 5 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 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)**.

MOTORCRAFT DURA-SPARK II IGNITION SYSTEMS (Cont.)

5) If voltage now reads 4-7 volts, substitute (but do not install) a known good control module. And repeat previous tests. If spark occurs, reconnect original control module. 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 the coil. See *Fig. 6*. Connect voltmeter positive lead to coil's positive ("BAT") terminal and negative lead to ground.

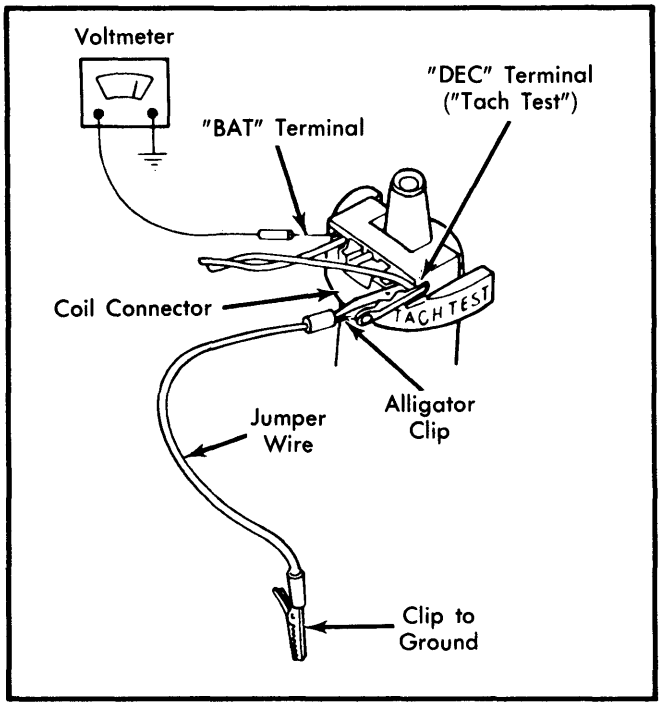

Fig. 6 Grounding "Tach Test" Terminal In Coil Primary Circuit Check

7) If reading is now 4-7 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 4-7 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 connetor. Reconnect control module and retest system. If sparks occur at modified plug, system is OK.

9) If voltage in step **7)** was 4-7 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.

10) If voltage in step **2)** was less than 5 volts, repair wire feeding the ignition coil positive ("BAT") terminal. Retest system and if spark occurs at modified plug, system is OK.

11) If voltage in step **2)** was 5-8 volts, but engine would not run, or if voltage in step **6)** was battery voltage, substitute (but do not install) a known good ignition coil and repeat system test. If sparks occur, reconnect original coil and retest. If no spark, replace ignition coil.

12) If no sparks occurred with substitute coil, connect original ignition coil and be sure connector is fully engaged over terminals. Disconnect control module 4-wire connector and turn ignition switch to "RUN" position. Connect voltmeter positive lead to ignition coil connector's "Tach Test" terminal and negative lead to ground. See *Fig. 6*.

13) If battery voltage exists, measure cranking voltage at positive coil terminal and recheck Control Module Feed Check on White Wire Circuit.

14) If voltage in step **12)** was zero volts, use an ohmmeter with ignition switch turned "OFF" and check for shorts in green wire circuit from control module to ignition coil. If additional wires are attached to negative ("Tach Test") terminal of ignition coil, check those circuits for shorts also. Repair wires as necessary.

CONTROL MODULE & STATOR CHECK

1) Refer to step **1)** of Coil Primary Circuit Check. If modified plug sparked, but engine would not run, substitute a known good distributor (ground but do not install). Spin gear and check for sparks. See *Fig. 7*.

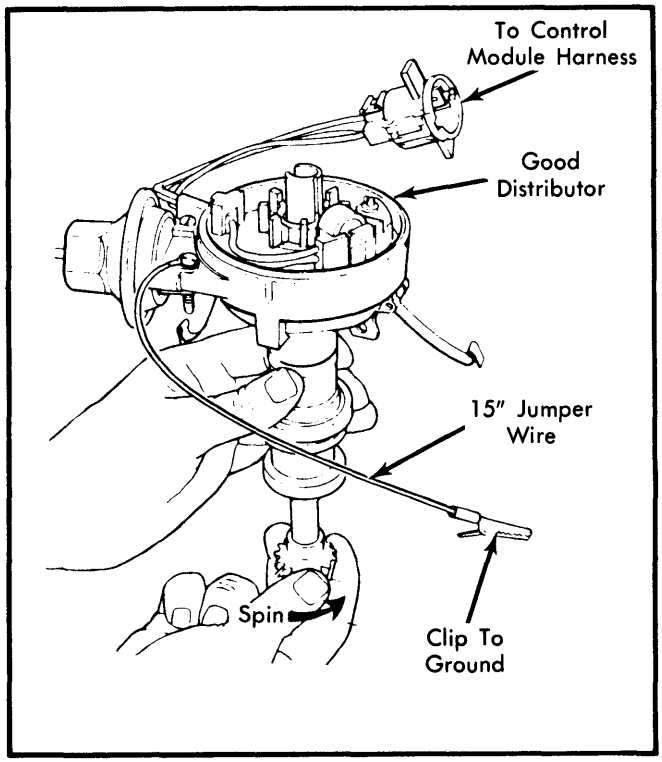

Fig. 7 Checking Control Module & Stator Using Known Good Distributor

2) If sparks occur, reconnect original distributor to check if it is damaged. Repeat tests to check for sparks. If none, 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 in the following manner.

MOTORCRAFT DURA-SPARK II IGNITION SYSTEMS (Cont.)

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 in each case.

5) Then connect ohmmeter leads to harness wires mating with orange and purple wires of control module. There should be no continuity between these two 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 are OK, reconnect distributor connector and substitute a known good control module and repeat system tests. If sparks occur, reconnect original control module and recheck. If no sparks 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.

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 4 cylinder and 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.

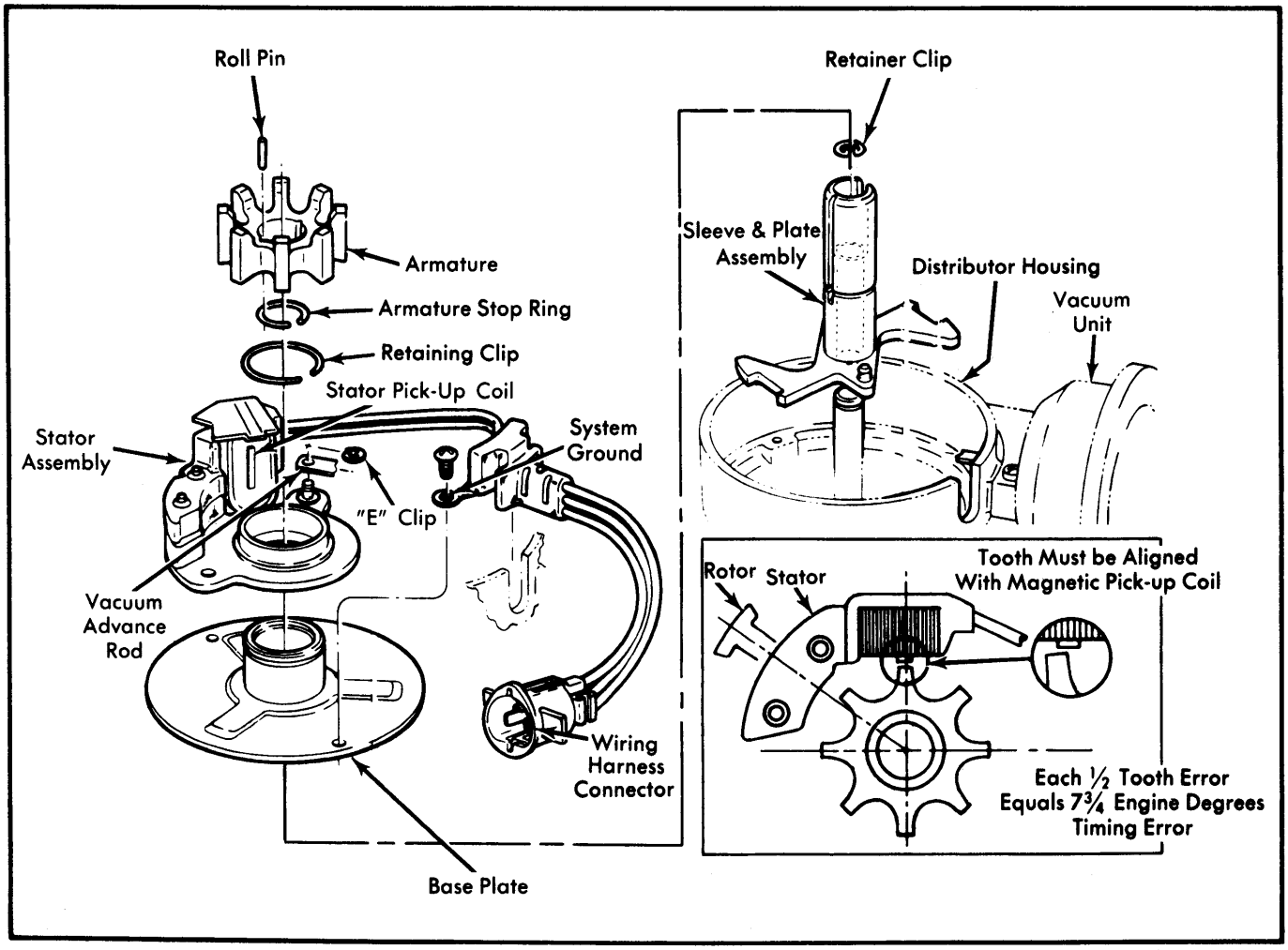

Fig. 8 Components of Dura-Spark II Distributor