## LUCAS "OPUS" ELECTRONIC IGNITION SYSTEM

**Jaguar**
**XJ6**
**MG**
**MGB**
**Triumph**
**Spitfire**
**TR7**
**TR8**

### DESCRIPTION

Although the principle of operation of all Lucas "OPUS" electronic ignition systems is similar, variations do occur between models. See *Fig. 1*.

For example, the XJ6 features a remote electronic control module (amplifier), while the TR8 has the control module mounted inside its distributor. Other models have the module mounted externally on the distributor housing. See *Figs. 4, 5 and 6*.

The XJ6 distributor is equipped with a gear-type reluctor (timing rotor) with one tooth for each cylinder. Other models use a timing rotor with ferrite iron rods (one for each cylinder) imbedded in its outside circumference. In all cases, the reluctor or timing rotor, mounted on the distributor shaft, rotates adjacent to a magnetic pick-up coil (module). The reluctor or timing rotor combines with the pick-up coil to generate signals to the electronic control module (amplifier).

All distributors feature centrifugal advance mechanisms and either vacuum advance or retard units. Some models, such as the TR8, feature ballast-drive resistor assemblies, while others such as the TR7, Spitfire and MGB use ballast wires during normal engine operation.

Other system components include the battery, ignition switch, and ignition coil.

### OPERATION

With the ignition switch turned "OFF" and the engine stopped, the distributor reluctor or timing rotor is normally positioned so the teeth or iron rods do not align with the iron core of the pick-up coil. When the ignition switch is turned "ON", a power transistor in the electronic control module (amplifier) completes the ignition coil primary winding circuit.

At the same time a pulsating alternating current voltage is applied by the module to the distributor pick-up coil windings. A small alternating current voltage is produced, and pick-up coil windings are magnetically balanced.

NOTE – *The pick-up coil is magnetically balanced at the factory and the setting must not be changed. The sealed adjusting screw must not be disturbed.*

The voltage at the pick-up coil is applied to the amplifier unit, but is insufficient to affect the transistor controlling the ignition coil primary circuit.

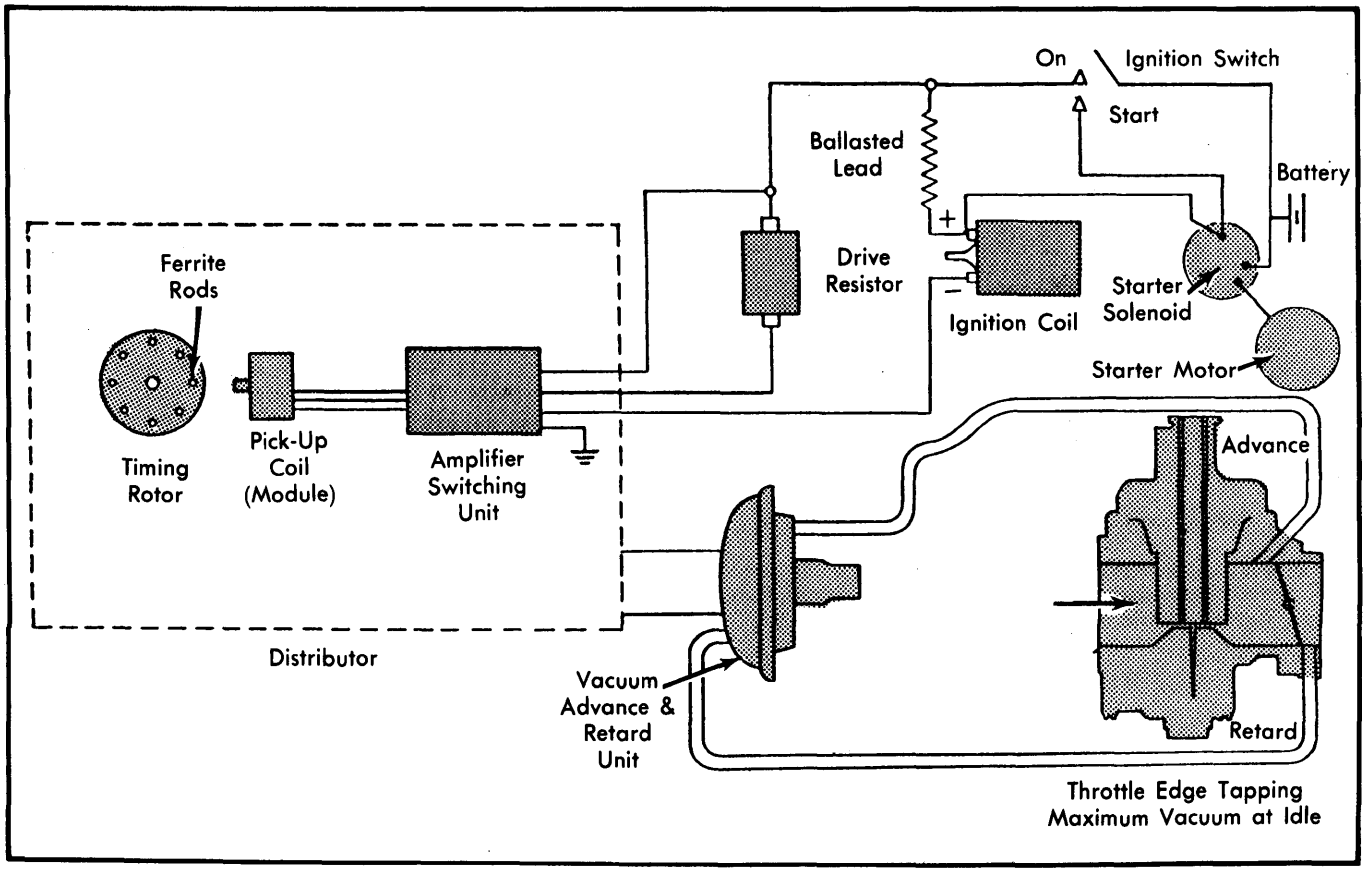


***Fig. 1 Typical Lucas "OPUS" Electronic Ignition System (TR8 Shown)***

## LUCAS "OPUS" ELECTRONIC IGNITION SYSTEM (Cont.)

As the engine is cranked, the teeth or the iron rods come in alignment with the iron core of the pick-up coil. This causes a magnetic unbalancing and voltage increases to maximum as each tooth or rod passes the pick-up coil. The higher voltage signal is then transmitted to the control module. The transistor is switched off and the coil primary windings' magnetic field collapses.

This results in a high voltage surge in the secondary, which is transmitted to each spark plug by the distributor rotor.

### SPECIFICATIONS

**Centrifugal and Vacuum Advance (or Retard)** – *See Specifications Tables in this section.*

### ADJUSTMENT

**Reluctor (Timing Rotor)-to-Pick-Up Coil Air Gap – 1)** Disconnect battery ground cable. Remove distributor cap and rotor and anti-flash cover, if equipped. Using a non-magnetic feeler gauge, check for .014-.016" (.35-.40 mm) air gap (.006-.008" or .15-.20 mm air gap for XJ6 models). *See Fig. 2.* Measurement should be made between timing rotor at iron rod (or reluctor teeth) and center core of pick-up coil.

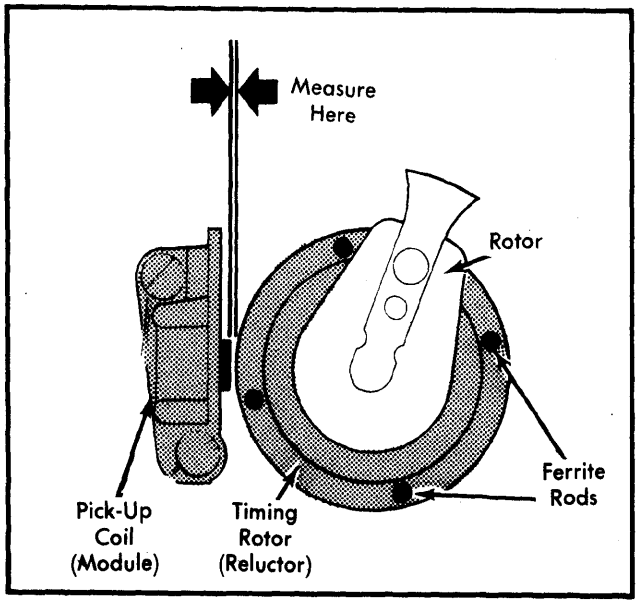


***Fig. 2 Adjusting Air Gap (TR7 Shown)***

**2)** To adjust, loosen pick-up coil mounting screws and position coil against feeler gauge being held against reluctor or timing rotor. Tighten screws and recheck air gap.

### TESTING (XJ6 MODELS)

#### IGNITION SYSTEM CHECK

**1)** Check battery voltage for at least 11.5 volts. If less than 11.5 volts, charge battery. If more than 11.5 volts, attach voltmeter positive lead to coil positive terminal and negative lead to ground. Voltage should be within 1 volt of battery voltage.

**2)** If incorrect reading is obtained, check wiring between coil positive terminal and ignition switch. If voltage was within 1 volt of battery voltage, attach positive voltmeter lead to coil negative terminal and negative lead to ground. Voltage reading should be more than 2 volts.

**3)** If voltage is incorrect, disconnect wire leading to control module (amplifier) at coil negative terminal. Again check voltage at coil negative terminal. If less that 2 volts, replace ignition coil. If more than 2 volts, replace control module.

**4)** If voltage in step **2)** was correct (more than 2 volts), disconnect control module from distributor. Turn ignition switch "OFF" and attach leads of an ohmmeter (set to high scale) to distributor pick-up coil leads. Resistance reading should be 2200-4800 ohms. If not, replace pick-up coil.

**5)** If pick-up coil resistance is correct, connect control module to distributor. Attach voltmeter positive lead to coil negative terminal and negative lead to ground. Measure voltage. Then crank engine and voltage should fall. If not, replace control module.

**6)** If voltage fell in step **5)**, but system still is not operating properly, check high tension wires, ignition coil secondary, rotor arms, distributor cap and spark plugs.

#### CENTRIFUGAL ADVANCE

Check distributor in test stand according to test equipment manufacturer's instructions. Operate distributor up and down the RPM range and check advance at all RPM settings specified.

#### VACUUM ADVANCE OR RETARD

With distributor in test stand, check advance or retard at all vacuum settings specified. If tests indicate vacuum diaphragm unit is inoperative, out of calibration or leaking, replace vacuum unit.

### TESTING (ALL MODELS EXCEPT XJ6)

#### IGNITION SYSTEM CHECK

**1)** Remove coil-to-distributor high tension cable from distributor and hold ¼" (6 mm) from engine ground. Turn ignition switch "ON". If equipped, disconnect white/blue lead at drive resistor and check for spark at gap each time connection is broken. On models without drive resistor, crank engine and check for sparks at gap. Reconnect all wires after test.

**2)** If sparking results, turn off ignition switch. Using a feeler gauge, check air gap between distributor pick-up coil and timing rotor (reluctor). Adjust as necessary. If gap is correct, crank engine to see that distributor shaft rotates.

**3)** If not, check distributor and drive. If shaft does rotate, replace control module (amplifier). If there was no sparking at gap in step **1)**, check supply voltage at white wire (or at "SW" connector of Ballast Resistor 9BR, if equipped). If less than 11 volts, check battery, wiring and ignition switch.

**4)** If voltage supply was more than 11 volts, attach voltmeter positive lead to ignition coil positive terminal and negative lead to ground. Voltage should be 11 volts or more (4-8 volts on ballasted models). If voltage is zero (0) or extremely low, check ballast resistor, coil and wires.

## LUCAS "OPUS" ELECTRONIC IGNITION SYSTEM (Cont.)

**5)** If voltage is normal or high, attach voltmeter positive lead to coil negative terminal and negative lead to ground. If voltage reads more than 2 volts, check drive resistor. Turn ignition switch "OFF" and attach ohmmeter leads to drive resistor and check for 9-11 ohms resistance. If not to specifications, replace drive resistor. If OK, check control module and distributor grounds. If OK, but engine does not perform properly, replace control module.

**6)** If voltage at coil negative terminal was less than 2 volts, disconnect white/blue wire at drive resistor (if equipped). Check voltage again at coil negative terminal. If voltage is now more than 9 volts, check high tension leads, substitute a new ignition coil and replace amplifier, in turn, until problem is corrected.

**7)** If voltage in step **6)**, was less than 9 volts, disconnect coil negative lead and recheck voltage at coil negative terminal. If now less than 9 volts, replace coil. If more than 9 volts, replace control module (amplifier).

### BALLAST RESISTOR CHECK (MODEL 9BR)

**1)** Some models such as the TR8 may be equipped with the Model 9BR Ballast Resistor, a unit consisting of 4 resistors and a printed wiring board mounted in an aluminum heat sink. One side of resistor is connected to (1) starter solenoid ignition terminal, (2) ignition switch and (3) to tachometer. The other side has 2 connections to distributor pick-up coil and 2 connections to primary terminals of ignition coil.

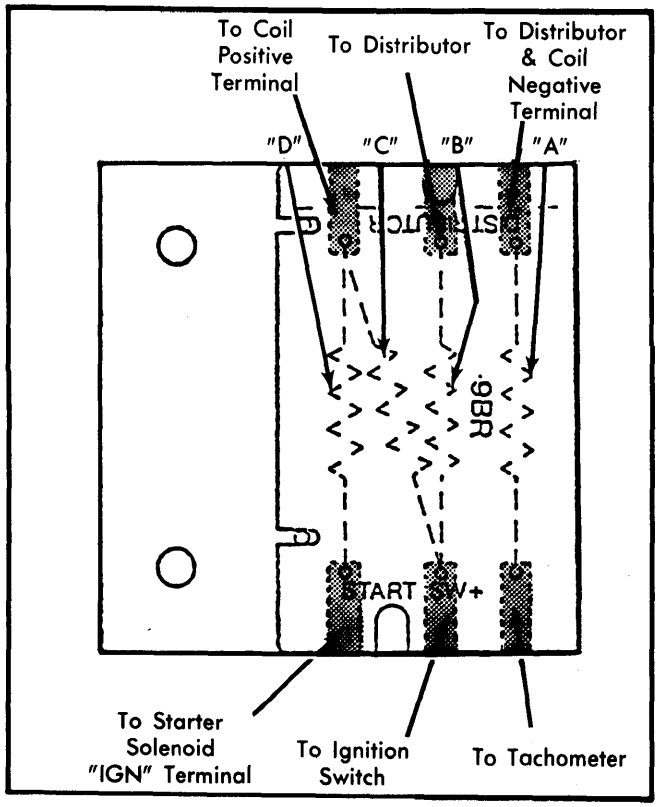


***Fig. 3 Model 9BR Ballast Resistor Connections***

**2)** Turn ignition switch "OFF". Connect ohmmeter leads to each set of terminals shown in *Fig. 3*. Resistor reading "A" (tachometer connection) should be 9,000-11,000 ohms. Reading "B" (drive resistor) should be 0.5 ohm; reading "C" (ballast ignition resistor) should be 1.62-1.80 ohms, and reading "D" (ballast resistor) should read 0.25-0.28 ohm. If not, replace ballast resistor assembly.

### BALLAST WIRE CHECK

**1)** On most models, such as the TR7, a pink/white ballast resistance wire is built into the wiring harness leading to the ignition coil. The wire causes a voltage drop so the 12-volt supply may be used to power the 6-volt ignition coil. During engine start, the resistor is bypassed to apply 12 volts reduced by starter load directly to the coil.

**2)** To check resistor wire, turn ignition switch "OFF" and attach ohmmeter leads to each end of pink/white wire. Resistance should be 1.3-1.5 ohms. If not, replace ballast resistor wire.

### DRIVE RESISTOR CHECK

**1)** A drive resistor is used on some models, such as the TR7, and is mounted externally near the distributor control module (amplifier). This is due to its size and heat dissipating requirements.

**2)** To check, disconnect connectors from resistor. With ignition switch "OFF", attach ohmmeter leads to each resistor terminal. Resistance should be 9.5-11.5 ohms. If not, replace drive resistor.

### IGNITION COIL RESISTANCE

**1)** Connect ohmmeter leads to positive and negative primary terminals of ignition coil. Be sure ignition is "OFF" and coil wires are removed.

**2)** Primary resistance should read 1.30-1.45 ohms. If not, replace ignition coil.

## OVERHAUL

### MGB, SPITFIRE AND TR7 MODELS

**Disassembly – 1)** Disconnect battery and remove distributor from vehicle. Remove cap, rotor, anti-flash cover and felt pad. Remove screws and washers from magnetic pick-up coil (pick-up module). Do not remove pick-up coil at this time.

**2)** Remove screws securing amplifier to distributor. Hold amplifier while removing screw from bottom of housing. Carefully disengage vacuum unit from movable plate.

**3)** Remove wire grommet, amplifier housing, and pick-up coil with lead. Remove spring clips. Tap out roll pin securing vacuum unit and remove unit. Remove external snap ring from distributor shaft and carefully remove timing rotor, washer and "O" ring.

**4)** Remove 2 Phillips head screws and lift out base plate with movable plate attached. Remove springs carefully, noting positions of 2 different springs.

## LUCAS "OPUS" ELECTRONIC IGNITION SYSTEM (Cont.)

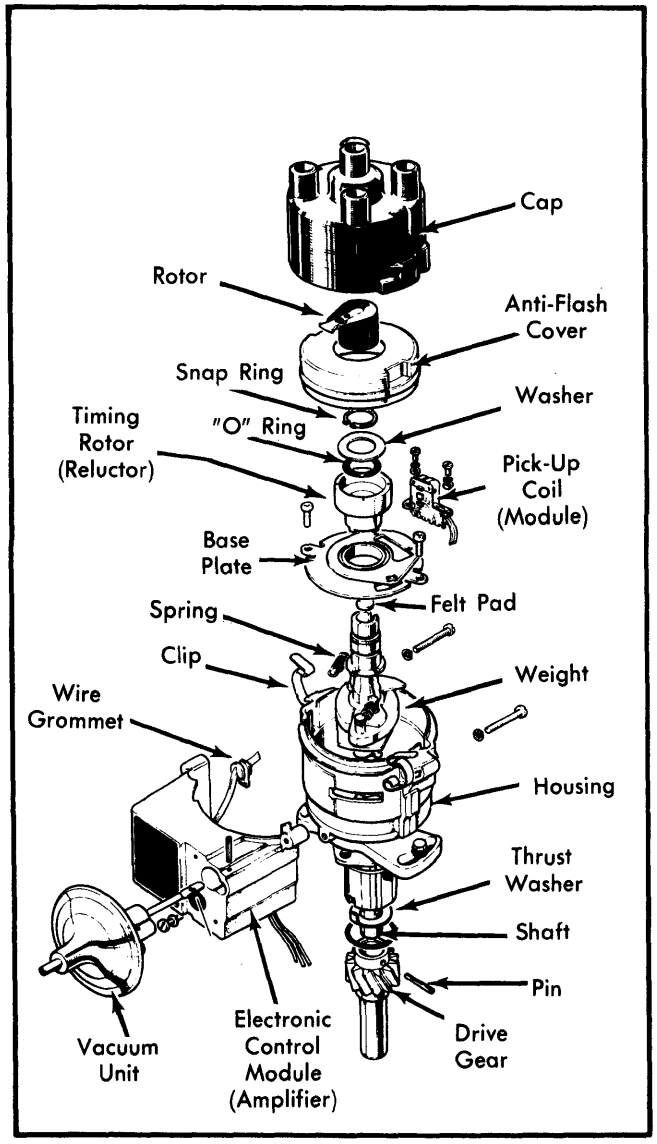


***Fig. 4 Disassembled View of TR7 Distributor (MGB and Spitfire Similar)***

**5)** Drive out pin securing drive collar to distributor shaft. Remove drive collar and thrust washer. Remove shaft from housing, along with shim. Detach return springs.

**Inspection** – Check control springs for proper length. Check pivot holes in weights for wear or deformation. Check distributor shaft for excessive play.

NOTE – *If any part of the distributor body assembly is found to be defective, the complete assembly must be replaced.*

**Reassembly** – To reassemble distributor, reverse disassembly procedure noting the following. Lubricate weight assembly, shaft and moving plate with Rocol "Moly Pad" or equivalent. Make sure vacuum link is properly attached to moving plate pin. Timing rotor tang must fit into slot on shaft. With distributor assembled and replaced in vehicle, set air gap and ignition timing to specifications.

### TR8 MODELS

**Disassembly** – **1)** Remove negative battery cable and then remove distributor from vehicle. Remove cap, rotor, anti-flash cover and felt pad.

**2)** Remove snap ring, plain washer and rubber "O" ring. Remove timing rotor carefully. Remove 3 screws, spring washers and washer. Remove wire grommet and electronic control module assembly as a unit.

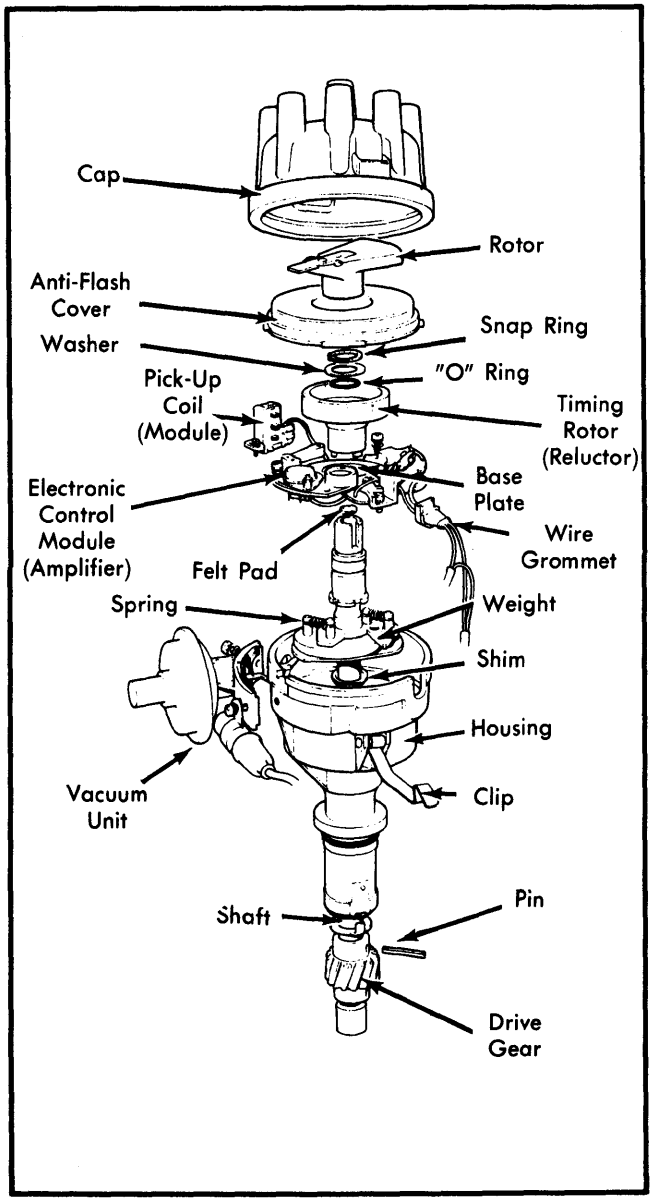


***Fig. 5 Disassembled View of TR8 Distributor***

**3)** Remove 2 screws, 2 spring washers and washer to release vacuum unit, rubber gasket and capacitor. Tap out drive gear pin. Remove drive gear and thrust washer. Be sure shaft is free of burrs, and remove shaft from housing.

## LUCAS "OPUS" ELECTRONIC IGNITION SYSTEM (Cont.)

**4)** Remove plastic collar and control springs, but do not attempt to disassemble further.

**Reassembly** – To reassemble distributor, reverse disassembly procedure, noting the following. Lubricate weight assembly, shaft and moving plate with Rocol "Moly Pad" or equivalent. Make sure vacuum link is properly attached to moving plate pin. Timing rotor tang must fit into slot on shaft. With distributor assembled and installed in vehicle, set air gap and ignition timing to specification.

### JAGUAR XJ6 MODELS

**Disassembly** – **1)** Disconnect negative battery cable and remove distributor from vehicle. Remove distributor cap, anti-flash cover and rotor. Remove snap ring, plain washer and "O" ring. Remove felt pad from end of shaft.

**2)** Remove reluctor gear from distributor shaft. Remove pick-up coil assembly, and base plate assembly. Remove vacuum unit from housing. Drive pin from drive collar and after checking shaft for burrs, remove distributor shaft from housing. Disassemble auto-advance mechanism as necessary.

**Reassembly** – **1)** To reassemble distributor, reverse disassembly procedure. Check parts for wear and lubricate weight assembly, shaft and moving plate with Rocol "Moly Pad" or equivalent. Be sure all parts are properly assembled and move freely.

**2)** Install distributor in vehicle and adjust air gap and ignition timing to specifications.

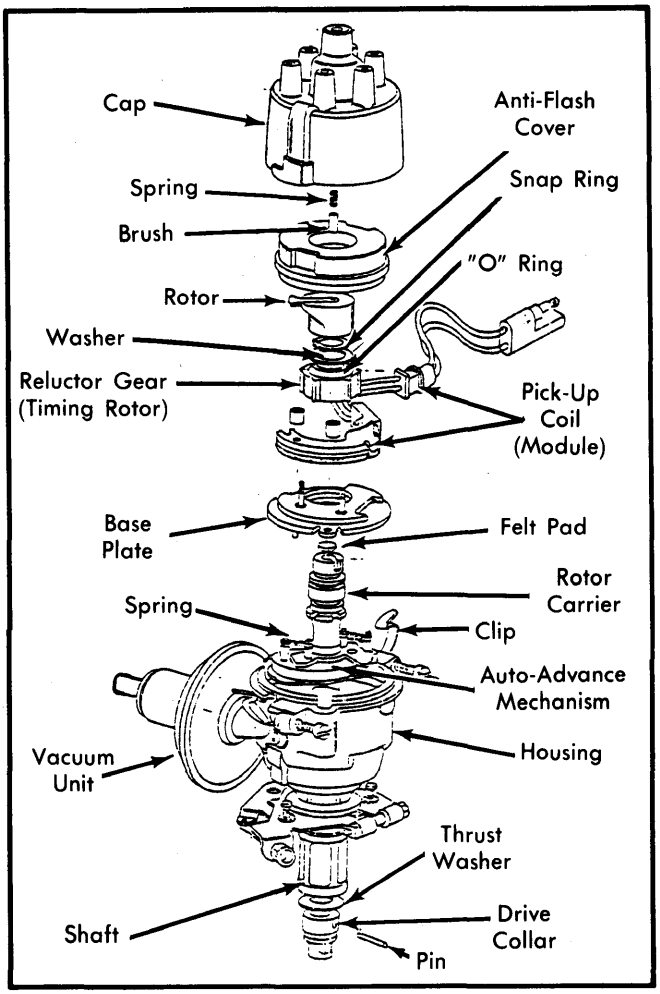


***Fig. 6 Disassembled View of XJ6 Distributor***