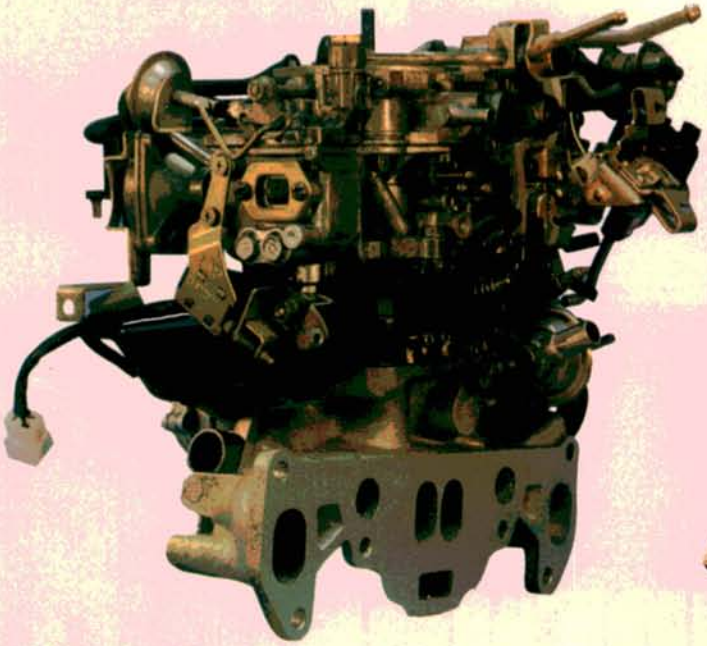
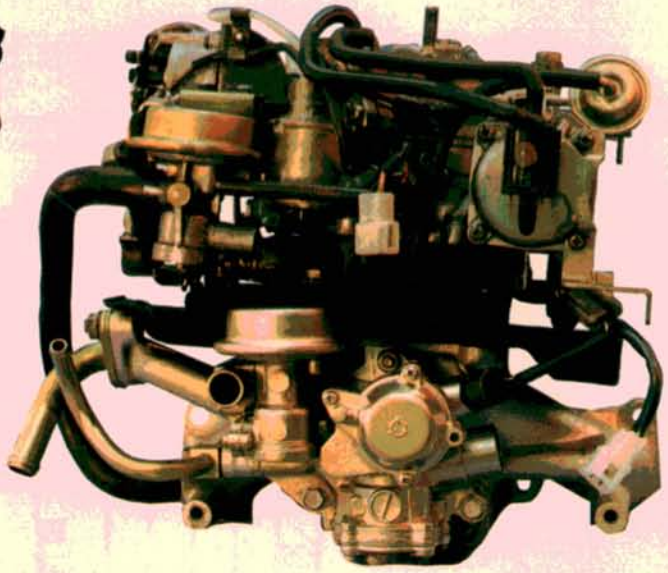
IMPORT SERVICE

RX-7 Carb and Emissions

PART ONE





It's been years since I first heard the over-rev warning buzzer on an old Mazda RX-3. It served its purpose. I was startled enough by its screaming to relax my right foot a bit—which was the buzzer's intention all along. What a shame. The little round and round engine had just been getting warmed up.

When rotary engines were first introduced, a fuel shortage and some reliability problems threatened to pull the rug out from beneath Mazda and her free-revving rotary fleet. For a time, Mazda chose to regroup and offered a more traditional line of economical, piston engine cars. But the rotary was hardly forgotten.

During this time, changes were made in rotary engine design and materials. Finally, the rotary found itself back in business in the RX-7. Since that time, continued refinements have made the engine more and more reliable. Customer abuse and neglect, the inevitable death of hang on components, and the improper repair and adjustment of emission and fuel components are now the most likely causes of premature engine failure. Our test car has been treated to regular maintenance, and its original engine shows no signs of tiring even at 110,000 miles.

Changes

Since the RX-7 was introduced, it has gone through a number of emission and fuel system changes. Originally it was carbureted with a breaker point ignition system. It also had a bake oven bolted to its side called a thermal reactor. Early fuel systems actually used a slightly richer than normal fuel mixture to create an extremely hot fire in the reactor. This intense heat was supposed to scrub the exhaust.

Since that time, breakerless ignition, and even fuel injection, starting with the 1984 GSL-SE, plus the addition of computerized controls and catalytic converters have been introduced.

Nikki

The Nikki four barrel used on the RX-7 is a reliable and surprisingly simple unit. But there are a ton of hang on emission components, miles of vacuum hose, and a fairly complicated air management system used with the carb. Any one of them can make Nikki look guilty when performance problems show up. These add on components include rare and wonderful items like a hot-assist start motor, a sub-zero starting assist device, and a manual choke with automatic choke release. Hardly standard fare.

The carbureted engines used in the RX-7 were designated as the 12A. The larger 13B engine was resurrected from earlier applications, refined, fuel injected, and reintroduced in 1984. For the time being, however, we'll concentrate on the 12A carbureted models, since there are plenty of them still rolling.

Working Together

Since carburetion and the air control system are so dependent on each other to keep the RX-7 running properly, we'll cover both in this two part carb clinic. Part One of our article will take you on a tour beneath the hood of a 1984 GSL model. We'll identify key components and give a quick overview of component operation.

Next month, we'll look at repair and adjustment procedures, list the tools needed for most diagnosis and repair, and visit the local Radio Shack store for the seven bucks worth of parts needed to make a throttle position checker.

One final note. As always, we cannot cover all the bases in an article like this. The fuel and emission system on the RX-7 went through several minor changes, and this manual shift '84 doesn't represent all those changes. Our purpose, as always, is to make you familiar with common components, problems, and procedures. The shop manual for this car was pretty good as manuals go, and becomes a wise investment for anyone doing repeat work on these models.

—By Ralph Birnbaum

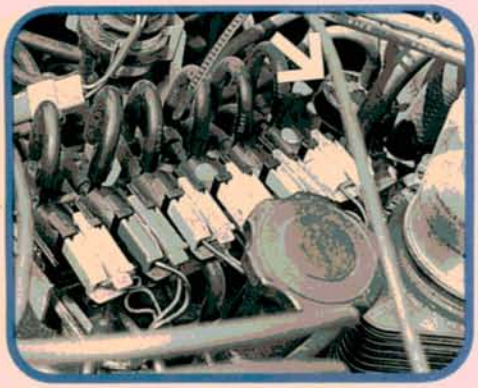
Keep The Pedal Off The Metal

As we mentioned, carbureted cars were equipped with a manual choke knob. When the choke knob is pulled out, a thermal sensor on the engine completes the circuit to a magnetic holding coil. This coil holds the choke knob/cable in the "on" position until the engine is warm. Then the switch opens and releases the choke cable holding coil. A bimetallic spring mounted on the carburetor opens the choke blade gradually, even before the cable is released.

The RX is also equipped with a sub-zero starting assist device that squirts a measured amount of anti-freeze and water into the engine to help prevent rotor icing on extremely cold days. A temperature sensor in the oil pan, and cranking current energize the system. It should only work at ambient temperatures of −18 degrees C (0 degrees F), or below.

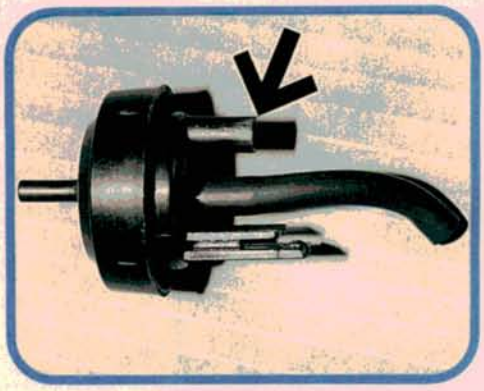
One more assist should be mentioned. The RX is equipped with a hot-assist start motor that opens the throttle valves to a predetermined point when the engine is warm. Don't confuse it with a cruise control device, because that's what it looks like. It's located on the strut tower near the master cylinder.

When everything is working properly, the customer should never have to touch the gas pedal to start the engine, hot or cold. Some customers complained that the cars flooded too easily. Very often, the real cause of flooding was that many of them insisted on pumping the gas.



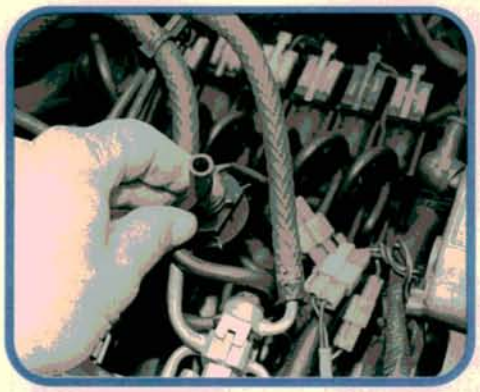
1

Vacuum solenoids are color coded. From front to rear we have: leading ignition vacuum control (orange), trailing vacuum control (green), switching solenoid (gray), shutter valve solenoid (yellow), relief valve solenoid (blue), and the A/C solenoid (white). Note the canister purge valve (arrow).



2

The canister purge valve is a standard vacuum operated purge control for the charcoal canister. We removed it for a better view. To test the valve in the car, rev the engine with the large vacuum hose removed while placing your finger over the large port (arrow), and feel for suction.

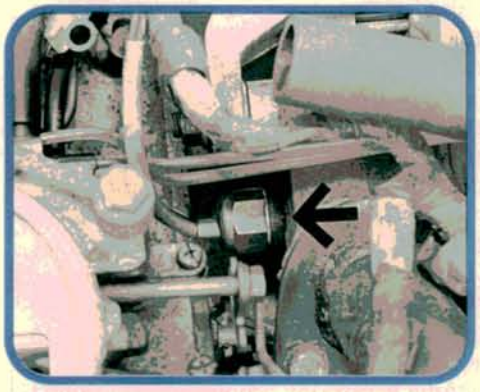


3

There are a total of six vacuum hoses connected to the underside of the air cleaner housing. If you choose to run the engine with the air cleaner removed, you'll be tempted to plug all the hoses, but the only one that will (or should) leak vacuum at idle is this hose leading to the idle compensator.

4

Speaking of the idle compensator, here it is in the air cleaner housing. When intake air is below 65 degrees C (150 degrees F), the bimetal spring on the compensator keeps the valve closed. Above this temperature, the spring opens the valve. This calibrated air leak raises idle speed on a warm engine.

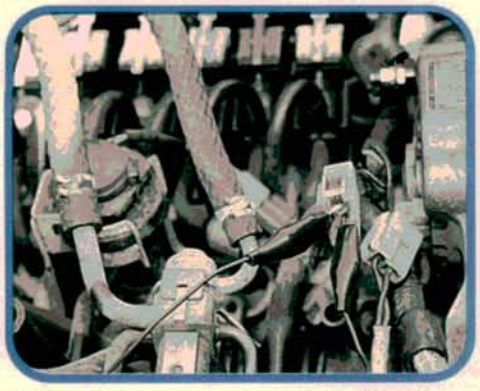


5

Coolant temperature switch number 1 is found in the water pump. This is a very important switch. When the temperature of the coolant in the pump is below 70 degrees C (158 degrees F), the switch closes and completes the circuit through a relay to an electromagnetic coil that holds the choke cable.

6

We removed the choke cable box from the dash. The box around the cable contains an electro-magnetic holding coil. With the engine cold, turn the ignition key to the "on" position. Pull out the choke knob. It should stay out as long as the key is on and engine is cold.

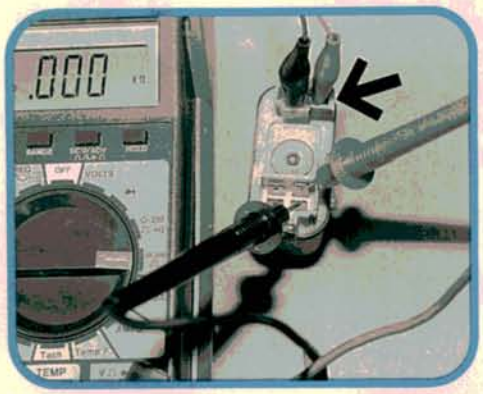


7

If the knob won't stay out when the engine's cold, disconnect the number 1 thermo switch. Jump the two carside harness connectors. If the choke knob stays out now, thermoswitch 1 is open. If it still won't stay out, check for a blown fuse, and for continuity between terminals 6 and 8 at the choke magnet itself.

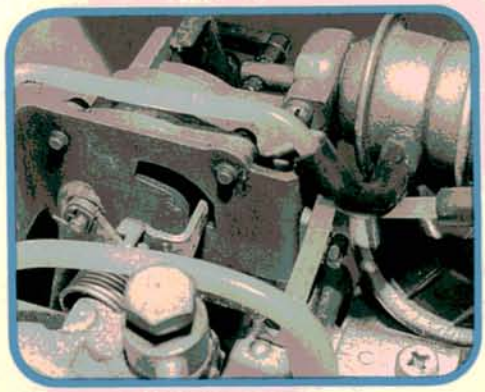
8

Removing the choke magnet assembly is no small task. Removing the magnet means dropping the fuse block and both lower left dash panels. So before condemning the magnet, check circuit operation. That includes the choke and check relay at the rear of the left inner fender behind the left strut tower.



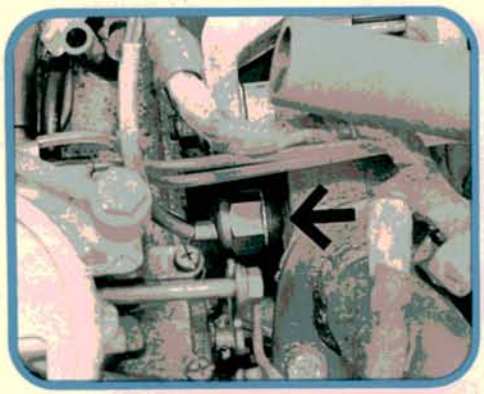
9

The holding coil of the relay is energized at terminals 5 (ground) and 6 (12v). This is the connector shown by an arrow. With the coil energized, look for continuity between 3 and 4, and an open between 1 and 2. Remove the jumpers from 5 and 6. Values should reverse, with 1 and 2 closed, and 3 and 4 open.



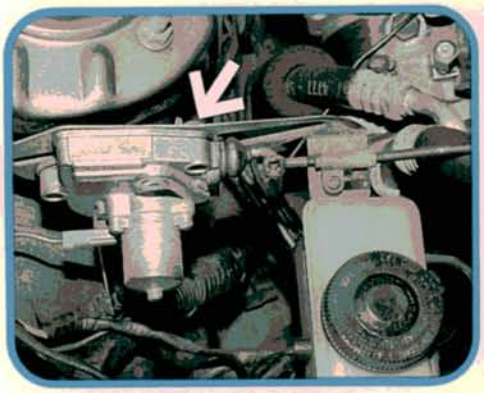
10

You don't have to push the choke knob in to lean the mixture as the engine warms. In addition to three vacuum operated choke unloaders, there's a choke bimetal heater that gradually opens the choke blade as the engine warms. I guess you could think of this system as a manually operated automatic choke!



11

Coolant temperature switch number 1 also does another job. When coolant temperature in the water pump is above 70 degrees C, the switch opens. This open circuit, plus a crank signal from the starter tells the hot assist start motor to crack the throttle just enough to start a warm engine.

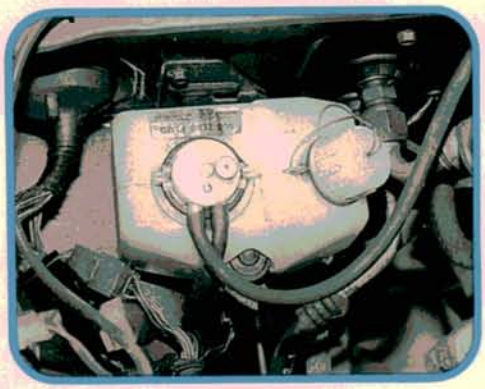


12

The hot assist start motor is near the master cylinder. It has been mistaken for a cruise control motor. You can see it from the driver's seat by peeking around the A pillar with the hood and driver side door open. The hot assist motor should pull on the cable when you crank a warm engine.

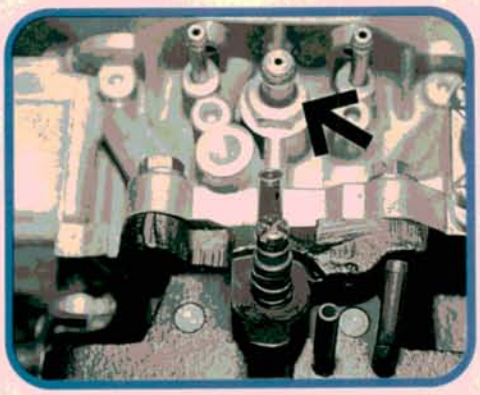
13

To check the hot assist motor cable adjustment, shut the engine off. Grab the cable at the motor end, and pull to check cable free play. Look for 1-2 mm. Adjust cable tension by loosening the screw on the cable mounting bracket, and sliding the cable housing.



14

The sub-zero starting assist device is mounted on the right side of the firewall. The bottle is filled with a solution of 90 percent ethylene glycol and 10 percent water (or washer fluid). In very cold weather, this solution is injected into the engine to keep ice from forming on the rotors.

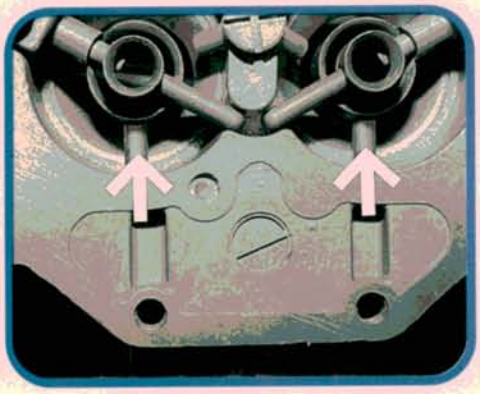


15

A thermo switch in the oil pan grounds the sub-zero unit at temperatures below –18 degrees C (0 degrees F). To check operation, ground the wire from the sensor, pull the hose from the carb at this port (arrow). Crank the engine. The hose should squirt fluid.

16

The sub-zero starting fluid should not be injected when the engine is warm. If it is, disconnect the sensor. Leave the wire hang. If injection stops, the sensor is bad. If it continues squirting, look for a leaking injection control valve or a short to ground in the wire harness from the sensor.



17

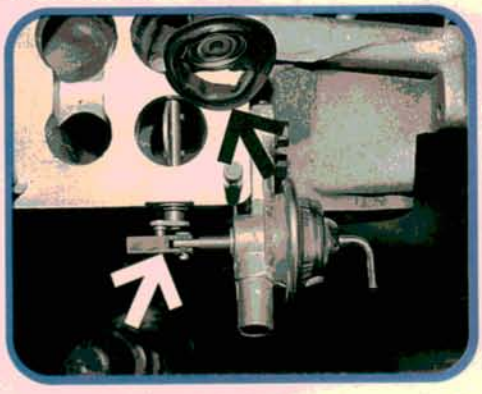
A small metering pump on the front of the engine supplies oil to the carburetor through two small tubes. The oil is injected through these two "nozzles" and squirted against the venturies. This provides additional lube for the rotors. Always check the rubber ends on the supply tubes for dry-cracking.

18

Anti-afterburn valve number 1 provides additional air to the intake ports during deceleration. To check it, remove the short hose between the air pump and air control valve. Run a snap throttle test to 3000 RPM. You should feel suction on decel, and there should be no signs of exhaust leak back.

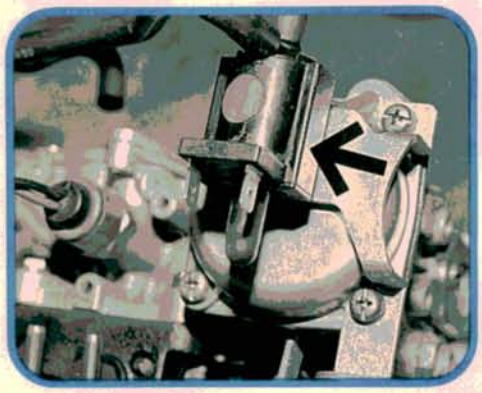
19

This is anti-afterburn valve number 2. Remove this hose from the air cleaner. Run your snap throttle test again to 3000 RPM. Once again, you should feel air being sucked into the hose as the engine decelerates. These two valves provide additional air to the engine during deceleration.



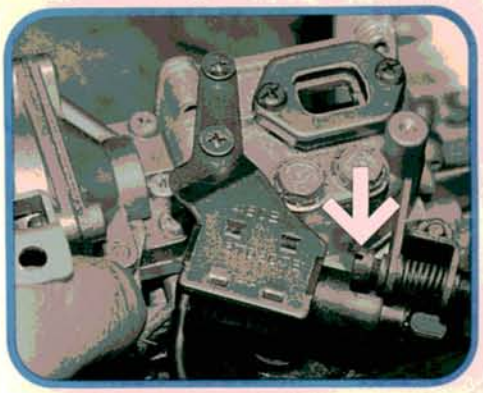
20

The coasting valve bolts to the intake below the carb. This valve has two jobs: On closed throttle decel, it (1) closes the shutter valve (white arrow) and (2) allows fresh air to enter the intake below the shutter valve. We disassembled the old valve to show how the diaphragms rupture over time (arrow).



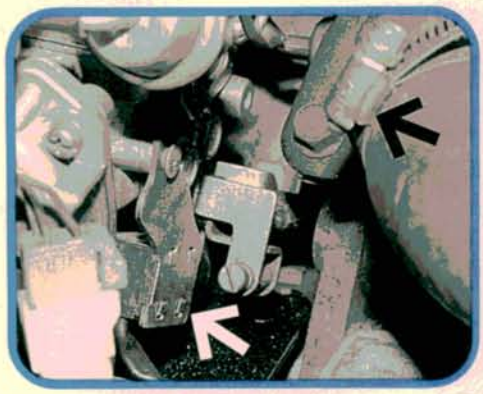
21

More mixture leaning. The main air bleed solenoid is attached to a bracket mounted on the vacuum pod for the secondaries. It's teed into the stationary main air bleed jet, and uses tach and vehicle speed information to lean the fuel mixture at engine speeds between 3000-4000 RPM or at vehicle speeds above 50 MPH.



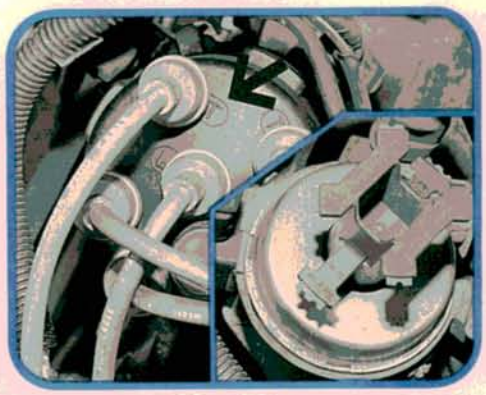
22

The throttle switch screws to the front of the carb. The adjustment screw by the arrow is NOT the curb idle adjustment. It is used only to adjust the switch. Far too many of these cars have been fouled up when someone started cranking on this screw. Proper adjustment of the sensor is critical.



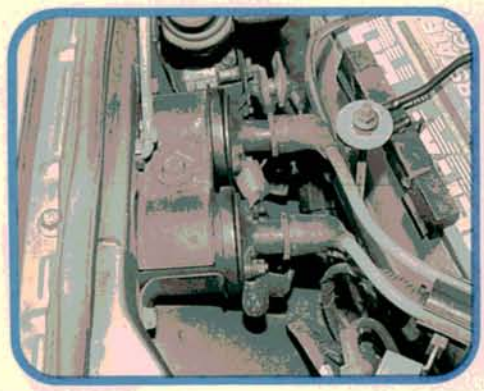
23

A common cause of throttle switch failure has to do with a small coolant leak at the lower part of the upper radiator hose. Coolant blown back by road air or the fan washes into the switch, killing it. If you've ever tried to disassemble and repair one of these sealed switches, you know it's darned near impossible.



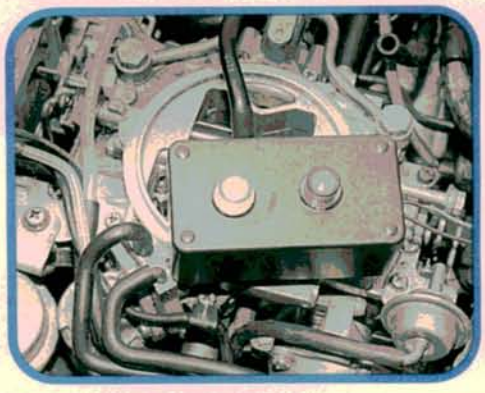
24

There are four spark plugs, two per rotor. The cap and rotor are a little weird as a result, but plug wire replacement is easy. Remember "T" stands for "Top or Trailing plugs. "L" stands for "Lower" or Leading ignition plugs. Distributor cap terminals are marked T1, T2, L1, and L2. Rotor 1 is the front rotor.



25

There are also two ignition coils, two vacuum advances, and two distributor pickups as well. Leading secondary spark is supplied to the lower plugs by one system. "Top" or Trailing ignition is supplied to the upper plugs for emissions reasons. Base ignition timing for the two systems is not the same.



26

That's about all we have room for right now. You'll be happy to know that most tests on this system can be performed with basic test equipment. The one oddball tester needed to test the throttle position switch is this two bulb checker. Come back next month and we'll make it for about seven bucks.