

'Conventional' Honda Ignition

Why a stack of sensors like fabulous totem pole creatures on the distributor shaft? What does an igniter ignite? And why does a simple spark get more complicated over time and yet stay simple?

Honda has systematically changed the ignition systems on their cars over the last twenty years, so an understanding of how Hondaspark works and what changes have occurred can help solve some puzzling no-start and cylinder-miss problems that come your way. For the first of these Honda ignition systems, we'll look at the 'conventional' ignition systems, using a distributor and one or more pickups to signal either the igniter or the computer when to fire the spark and let it calculate how long to set the dwell. This ignition system, in its various versions, bridges the gap between contact points and later ignition systems that do without a distributor altogether. Later articles will cover Honda's solitary waste-spark system and the current coil-on-plug ignition.

System Understanding

Ever notice that flow-charts and trouble-trees almost never lead you to the solution to an automotive electrical problem? It isn't so much that the people who make up the charts don't know what they're doing: Each of the possibilities they list is a real one. The problem is that modern cars are more complicated and can generate more possible problems than the service engineers, at Honda or at any other manufacturer, can anticipate. This is just a



An early ignition distributor from an Integra, this unit contains only the cylinder position sensor, with the centrifugal and vacuum advance/retard diaphragms below and on one side.

fact of the world, not an indictment of the carmakers. We can see this occasionally with DTC's: The computer usually can't tell which failure was the cause and which was the effect — it just lists them all. And the basic problem with a flow-chart/trouble-tree diagnosis is that it conveys no information about how the system works. Everything is supposedly 'go/no-go,' and at the end of each branch you SWAG the circuit. Anything not on the tree might as well be on the dark side of the Moon.

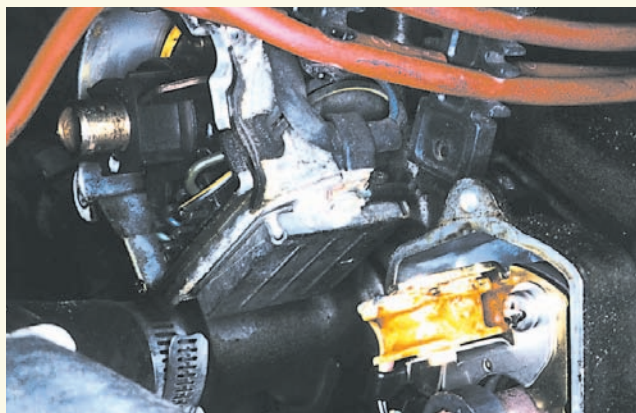
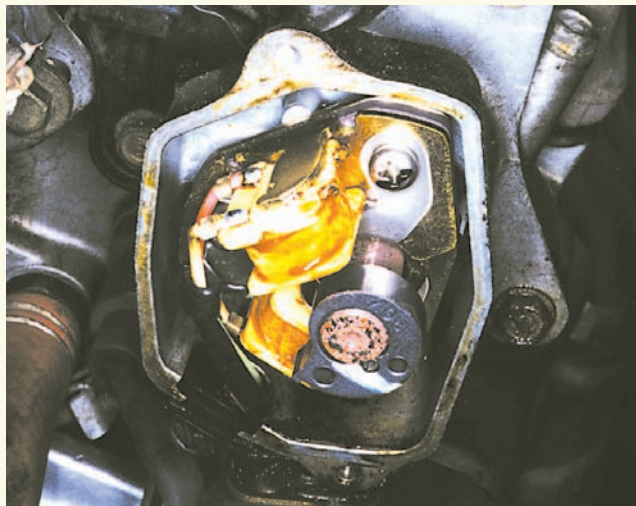
Right: On the other camshaft, the TDC and crankshaft position sensors feed their signals to the computer, for fuel injection sequencing and for more precise control of the engine speed (at idle, for instance).

But if you know the basic structure of the system, even if you run into one of the problems the engineers never thought of, even if you don't know what voltages or scope patterns to expect, you can usually figure out what should have happened at a particular part of the circuit, test for it and identify the faulty part or bad connection. That system-understanding is what we're after here, not a paint-by-numbers, SWAG-it approach to problem solving.

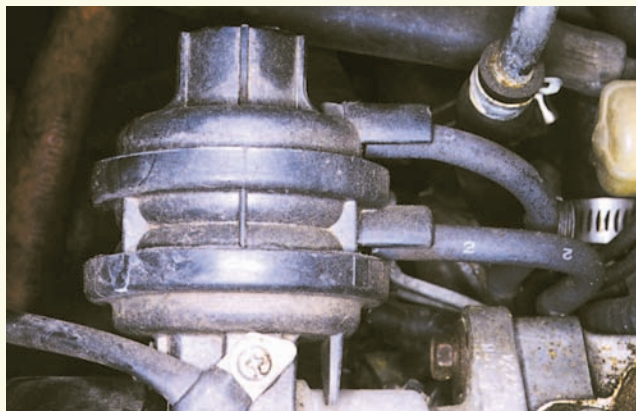
On Hondas, like most modern cars, if there's no spark, there's no fuel injection, either. So you have to know the tests for each of the systems to determine where the fatal shutoff occurred. Earlier carbureted models, of course, may stop the fuel pump, but the engine didn't shudder to an instant stop just because fuel pressure dropped. Instead, perhaps the crankshaft sensor has burned a module circuit open or the rotor has melted on the distributor shaft. In some cases, a glance through the carburetor float-level window can eliminate fuel from your diagnosis, but it's always time-efficient to check for spark first, as soon as you know you have cranking power.

In the earliest electronic ignition systems there is a single inductive pickup in the distributor, feeding its signal directly to the 'igniter.' (Japanese carmakers prefer to call the ignition module an "igniter," but they are the same thing, the power transistor and related electronics that makes and breaks the ignition primary circuit connection, thus building and collapsing the coil's electromagnetic field and triggering the spark). This module takes the ignition reference pulse and calculates the appropriate ignition dwell for the engine speed. The timing set-bolt on the distributor base, the centrifugal advance flyweights and the vacuum advance/retard diaphragms determine the spark advance entirely mechanically.

At that time, Hondas were carbureted, so there is no direct connection with the fuel system. If you suspect no spark, connect a plug cable between the coil tower and a test plug (don't just use a plain spare plug), crank the engine and watch for a spark that can jump a half-inch gap. If you find that, either there is no ignition problem, or it's in the cap, rotor, wires or plugs — in the secondary system electrically downstream of the coil.



The igniter bolts to the side of the distributor and sheds the heat it generates through the distributor shell. On early Honda ignitions, the module responds directly to the ignition pickup; on later versions, the engine computer signals the igniter when to make and break the ignition primary circuit.



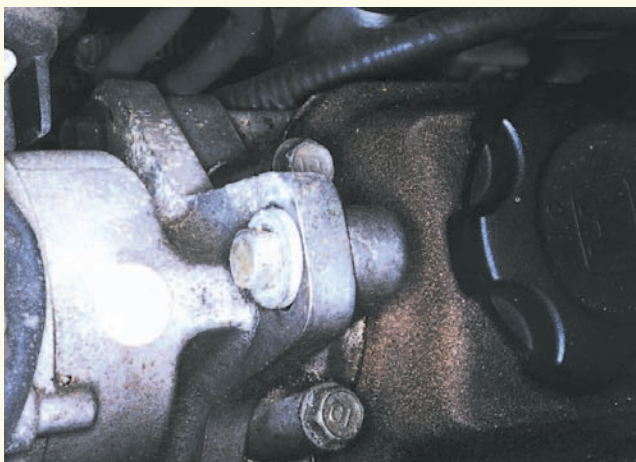
At one period, it looked like Honda was doing everything with vacuum. Perhaps an exaggeration, but complex vacuum advance/retard units festooned each distributor.

'Conventional' Honda Ignition

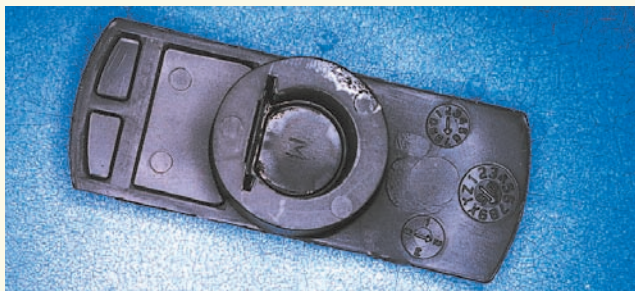
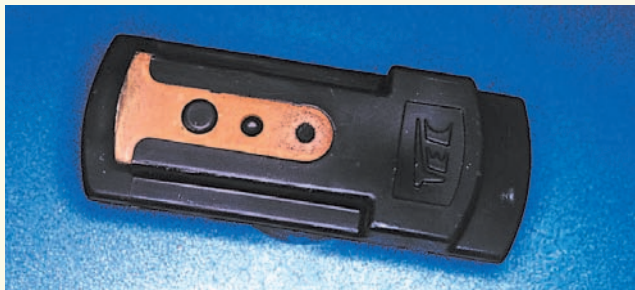
If there's no spark at the test plug, work backwards toward the coil. Plug cables should have 25K ohms resistance or less. Coil resistance varies somewhat by model, but generally the primary windings should show about 1.0 to 1.3 ohms and the secondary between 7,400 and 11,000 ohms at ambient temperature. Unfortunately, coil resistance is a test for failure only: A coil can display proper resistance under the modest load of an ohmmeter test but not under the heat and current of a running engine. If it shows resistance over or under the specifications, however, it is surely defective.

On the primary side of the ignition, resistance specifications through the pickup also vary by model, but obviously should never be open or shorted. The real test for the pickup is whether it produces an alternating-polarity signal as the engine cranks, a signal of sufficient voltage amplitude to trigger the igniter. As you can see from the nonsymmetrical shape of the reluctor teeth, what the ignition looks for is the polarity transition, a correspondence you can recognize on a scope simultaneously tracing pickup and secondary outputs. On the early Honda systems, this is not merely a reference pulse; it signals the exact moment of spark.

A Honda igniter itself should show continuity with the positive meter lead at the black/yellow wire terminal and the negative lead to the blue wire. At the same time, it should show no continuity with the polarity reversed. Again, this is a test for failure, not for pass: The module can still be defective even if its internal diode is good; there are other parts at work you don't test this way or any other direct way I know of.



5. Distributor adjustment changed the spark timing directly on the earlier Honda systems and the calculated spark advance indirectly on the later ones, since it changed the position of the reference pulse.



Distributor rotors are a frequent problem on Honda ignition systems. Watch for damage resulting from a bad upper bearing in the distributor as well as for indications of spark-through. Excessive corrosion on the rotor tip can strike the cap electrodes or build excessive resistance itself.

A Honda ignition module, or igniter, like every other manufacturer's ignition module, is a finite-life component. We say there are no moving parts inside, that the unit is solid-state; and so it is. But there is movement in every ignition module, even if the parts don't work together like gears meshing. The central microcomponent is the power transistor, usually a Darlington stack, a series of transistors each in turn controlling a higher-current transistor. These elements do electrophysical work, and so they generate heat (which is why you have to be so careful to apply the heat-dissipating dielectric grease between the module base plate and its heat sink). As they heat-and-cool over thousands of trips and millions of sparks generated, the transistors of the Darlington stack eventually break the delicate solder connections between themselves and the grounding plate. Once that happens, that module has triggered its very last spark.

The Next Phase

Once Honda switched over to fuel injection, the ignition system became somewhat more complicated. There are thereafter three different sensors generating signals: the TDC sensor, the cylinder position sensor and the crankshaft position sensor. On some early systems such as that shown in our photos, the cylinder position sensor is in the distributor and the other two are on the other camshaft. While they are all in sync, each produces a different frequency and serves a different purpose. One provides information about which cylinder is where in its Otto cycle, one reports the piston position for spark timing, and the last reflects engine speed.

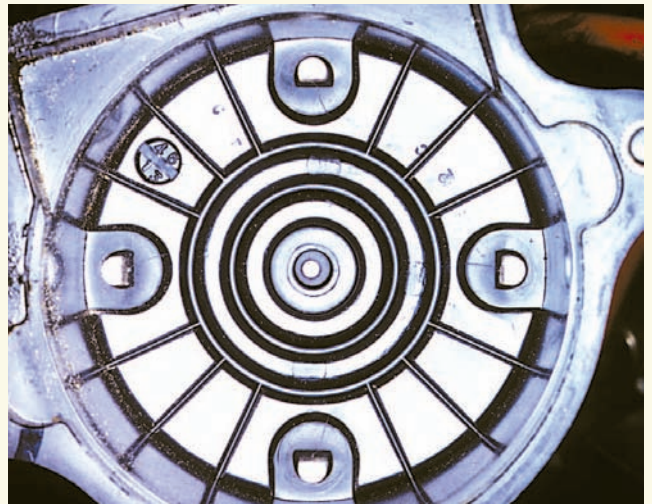
The TDC sensor triggers once per engine cycle, that is, every second crankshaft revolution. Its entire purpose is to sequence the fuel injection, so no one would call it part of the ignition system were it anywhere but in the distributor. The cylinder position sensor produces the ignition reference signal, a pulse which with this development of the Hondaspark system is exclusively a reference signal sent to the engine computer — you can still change the timing by rotating the distributor over its adjustment slot, but what you're changing is the position of the reference pulse, not the actual spark trigger. All matters of ignition timing, previously the work of the centrifugal and vacuum advances, now fall to the computer, calculating the spark instant from signals encoding information about engine speed, load, temperature and other inputs. The crankshaft position sensor, generating the finest-detail signal of all, provides the computer with a reflection of what the engine is doing not just at each spark pulse but in the intervals between, information used for, among other things, controlling idle speed.

As Marlowe Peterson pointed out in his article in the December, 1998, *Import Service*, a very frequent Honda ignition problem on early distributor systems is not electrical at all but mechanical: The top bearing in the distributor is prone to early wear, and once that happens either the reluctor can strike the pickup teeth or the shaft can get hot enough to soften the plastic on the rotor and allow it to melt and shift positions. Sometimes metal chaff from the failed bearing can form ferrous 'hair' on the magnetic reluctor and confuse or fog the signal. A related distributor rotor problem occurs with rotors held onto the shaft with a screw: The factory uses threadlocker to keep the screw from rattling loose and out; sometimes when people replace or inspect those rotors, they forget to apply a new dose of threadlocker to the screw. If it falls out, not only can the rotor wobble on the shaft, but the screw will likely wander to the reluctor wheel, where magnetism will pick it up and, when the screw tries to squeeze into the space between the reluctor and the pickup vanes, there will be component collision and electrical grief.

The System-Understanding Approach

So once we understand the overall system of the Honda ignitions, we can use that understanding as our prime tool for diagnosis. If the engine can crank at all, we first check for spark with a test plug. If there's spark, ignition is probably not our problem. If there's no spark, we trace back to the cable and coil for resistance. If they pass those tests, we check for the regular pulse of the primary circuit on the ground side of the coil. If there is a pulse, the coil is bad, regardless of our resistance measurements. If there is not, we trace back either to the computer or to the module to see whether it's producing the primary control signal. If not, there's our culprit. If so, we go back to the pickup. Throughout all this, of course, we check power and ground to each component to see that it has the electrical supplies to do its job. ■

—By Joe Woods



Inspect Honda distributor caps as carefully as any others, for cracks, for carbon tracks and for worn or missing carbon buttons at the coil terminal.



The whole purpose of the entire ignition system focuses on these gaps between the center and ground electrodes of the spark plugs. While newer, cleaner-burning cars can run a very long time on a set, plugs are not permanent parts of the car. The motorist has gotten his money's worth from this set.