Oven, Stove, Range and Cooktop Repair

Chapter 6

GAS OVEN REPAIR

6-1 NORMAL OPERATION

NOTE:The diagnosis sections of this chapter assume that all other electrical controls, i.e. timer and thermostatic controls, as described in chapter 2, are operating properly, and the malfunction has been isolated to the ignition or heating system!!!

Gas ovens are quite different from gas cooktops; since the burner is inside the oven, you cannot immediately see whether the burner has ignited. If it does not ignite, you certainly do not want the gas valve to stay open. This would dump raw unburned gas into the oven and create an explosion hazard. To avoid this, designers use a gas ***safety valve*** that does not open until ignition is assured.

Different manufacturers have designed different methods of keeping the gas safety valve closed until ignition is guaranteed. Some safety valves use low voltage, some high voltage, and some use hydraulic pressure. It is important to know which you are dealing with, because many of the valves look the same. If you try to test a low voltage valve by putting high voltage across it, you will burn it out.

Do not confuse the oven gas ***thermostat valve*** with the ***safety valve***. The oven gas ***thermostat valve*** is a valve you set by hand (the oven temperature knob) to control the oven temperature. In some types of systems, the thermostat is not a valve at all; it is an electrical switch that opens or closes based on the oven temperature it senses. The gas ***safety valve***, on the other hand, simply prevents gas from flowing to the burner until ignition is guaranteed. In systems with an electrical thermostat, the ***safety valve*** opens and closes to cycle the burner on and off, but it still will not open if there is no ignition.

The nice thing about gas oven repair is that there aren't a whole lot of moving parts, so wear and tear is a relatively minor consideration. In diagnosing them, you basically just have to learn how the system is *supposed* to work, then watch it for a while to see which part of the system has *stopped* working.

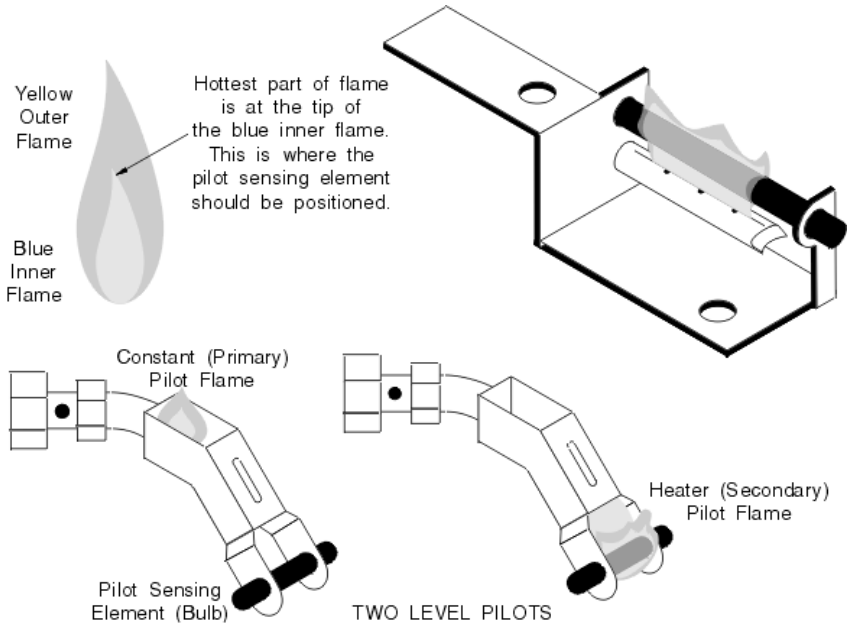
The different systems are detailed in the following sections.

6-2 PILOT IGNITION

Just exactly *where* the sensor sits in the pilot flame is important. (See figure 6-A) If the sensing bulb is not in the right part of the flame, or if the pilot is adjusted too low or too high, it will not get hot enough and the safety valve will not open.

In different systems, the sensor uses one of two methods to open the safety valve: capillary systems or millivolt systems.

Figure 6-A: Gas Oven Pilot Flames



6-2 (a) MILLIVOLT PILOT SYSTEMS

When two dissimilar metals (for example, copper and steel) are bonded together electrically, and then heated, they generate a tiny electrical current between them. The voltage is very small, measured in millivolts. This is the basis for a millivolt oven ignitor system. All that's needed is a safety valve that will sense this tiny voltage and open the valve if it is present. If the pilot is out, there is no millivoltage and the safety valve will not open. See figure 6-B.

The bimetal that generates the millivoltage is called a pilot generator. It generates about 750 millivolts, or about 3/4 volt.

TROUBLESHOOTING AND REPAIR OF MILLIVOLT SYSTEMS

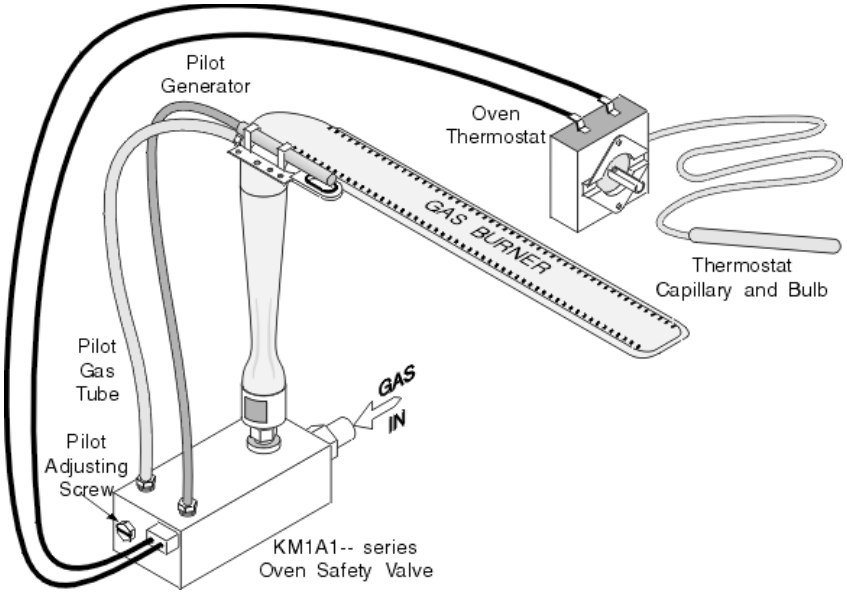
First, of course, if the oven has an automatic baking cycle as described in section 2-6(d), check the automatic cycle (timer) controls.

If the burner in a millivolt system will not start, typically the problem is the gas valve. Occasionally the problem might be the pilot generator or thermostat. The thermostat in these is just a temperature-sensitive on/off switch. To test, turn it on and test for continuity.

Try cleaning the pilot orifice and pilot generator as described in section 6-5 and adjusting it a little higher. The pilot generator needs to be sitting right in the hottest part of the flame as described in section 6-2.

If that doesn't work, we have a minor dilemma in determining whether the problem is the pilot generator or the safety valve. The dilemma here is that the voltages are too small to be measured with standard equipment. VOM millivolt adaptors cost nearly as much as the pilot generator itself. And the safety valve, which is usually the problem, costs twice as much as the pilot generator. So usually you just replace either or both of them. But don't forget they are electrical parts, which are non-returnable. What I recommend is just to replace the gas valve first; that usually will solve the problem. If not, replace the pilot generator. You just ate a gas valve, but trust me, you'd have bought one sooner or later anyway.

Figure 6-B: Millivolt System



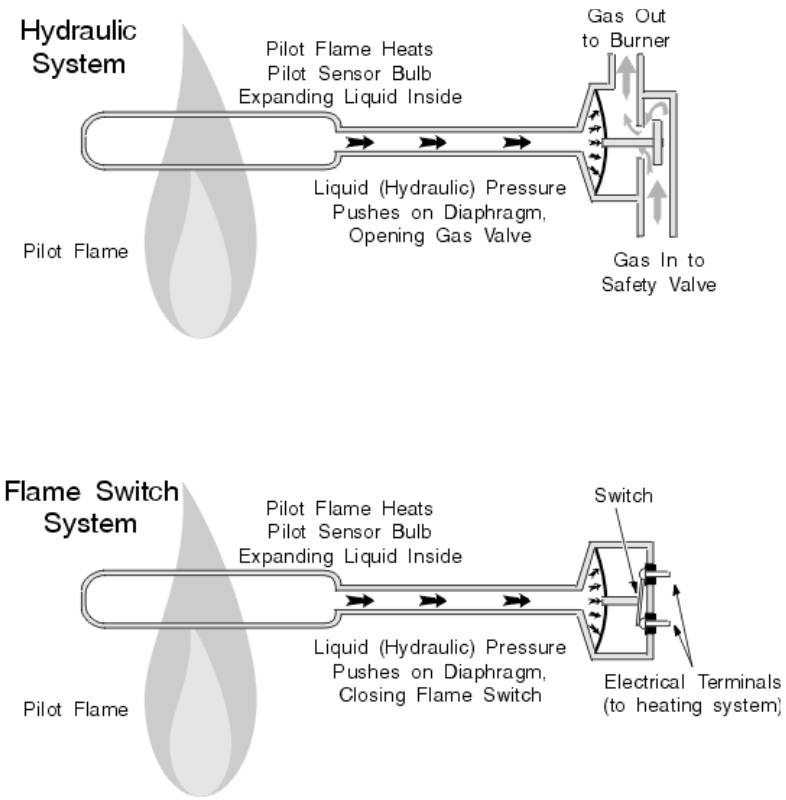
When installing the pilot generator, screw it into the safety valve finger tight, plus 1/4 turn. Any tighter than that and you can damage the electrical contacts on the valve.

6-2 (b) CAPILLARY PILOT SYSTEMS

In some systems the sensor is a liquid-filled bulb, with a capillary to the safety valve or flame switch. When the liquid inside heats up, it expands and exerts pressure on a diaphragm, which opens the valve or closes the switch.

It is important to know that these sensor bulbs ***do not*** cycle the burner on and off to maintain oven temperature. That is the thermostat's function. It has a sensor bulb too, but it senses oven temperature, not pilot flame. The only function of these pilot sensing elements is to prevent gas flow to the burner if the bulb does not get hot enough to assure burner ignition.

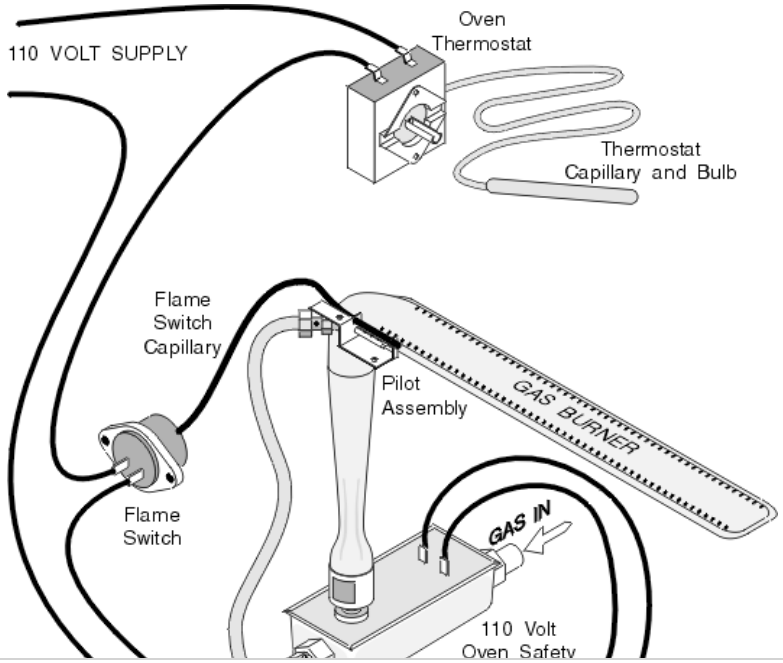
Figure 6-C: Capillary Pilot System Fundamentals



In ***flame switch systems***, hydraulic pressure from the capillary physically closes the switch, which completes an electrical circuit to the safety valve. The safety valve is electrical and operates on 110 volts. See Figure 6-D. If the pilot is out, the flame switch does not close and the 110 volt heating circuit is not complete, so the safety valve will not open.

In ***hydraulic capillary systems***, hydraulic pressure from the capillary physically opens the gas safety valve. Figure 6-E shows one type of these.

Figure 6-D: Flame Switch Systems



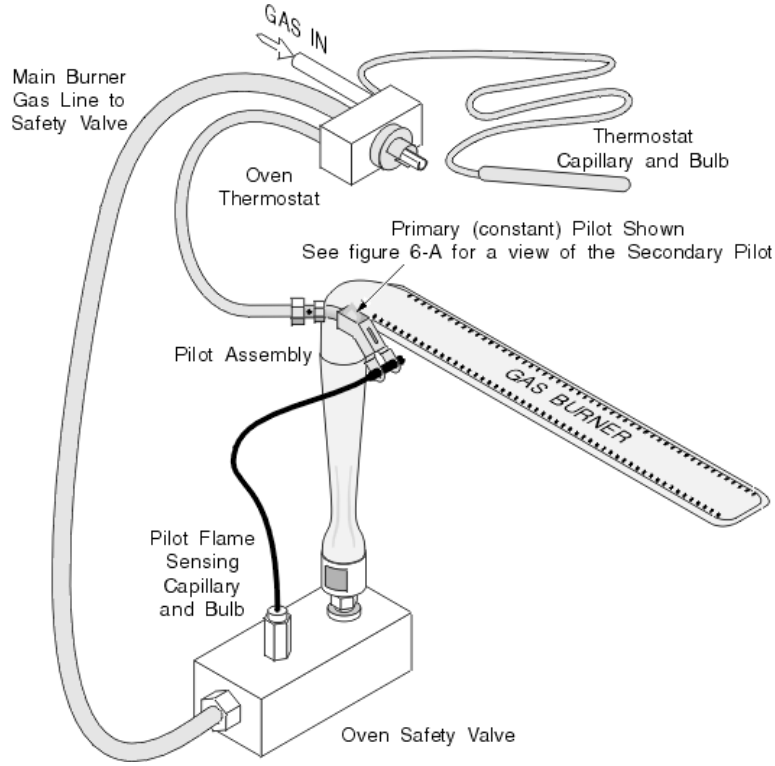
TWO-LEVEL PILOTS

Some of these direct-pressure (hydraulic) systems use a two-level pilot. The pilot stays at a very low level; not even high enough to activate the safety valve. This is called the *constant* pilot, or *primary* pilot. Gas for the primary pilot may come from either the thermostat or directly from the gas manifold.

When the thermostat valve is turned on, the pilot flame gets bigger, heating the sensor bulb, which activates the safety valve (hydraulically) and the burner ignites. This is called the *heater* pilot, or *secondary* pilot. Gas for the secondary pilot comes from the oven thermostat itself.

When the gas oven reaches the correct temperature setting, the thermostat drops the pilot flame back to the lower level, the safety valve closes and the burner shuts off. See figure 6-E.

Figure 6-E: Two-Level Pilots



TROUBLESHOOTING & REPAIR OF CAPILLARY PILOT SYSTEMS

The sensing bulb needs to be sitting right in the hottest part of the flame as described in section 6-2. If you don't have a good strong pilot (secondary pilot, in two-level systems) that engulfs the pilot sensing bulb with flame, try cleaning the pilot assembly and sensor bulb as described in section 6-5. If that doesn't work, replace the pilot assembly.

If you *do* have a good strong pilot that engulfs the pilot sensing bulb with flame, then odds are that the sensing element and/or whatever it is attached to are defective. If it is a flame switch, replace the flame switch. If it is a safety valve replace that.

In a two-level pilot system, remember that the main oven thermostat supplies the secondary pilot with gas. So if you cannot get a good secondary pilot the problem may be the pilot assembly, *or it may be the thermostat*. If you do get a good secondary pilot, you're back to the sensing bulb and safety valve.

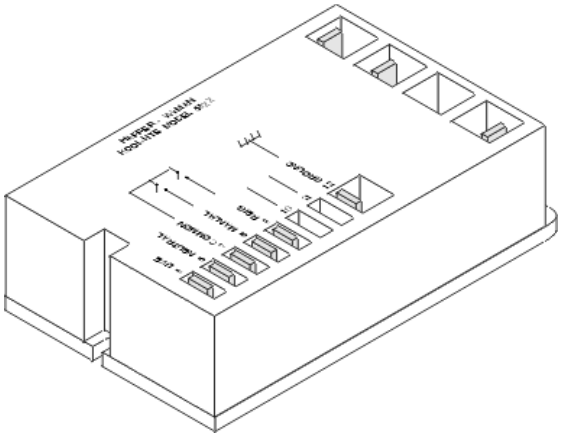
Replace the defective component.

SPARK SYSTEMS

Spark ignition systems use a spark module to generate a pulsing, high-voltage spark to ignite the gas. The spark module is an electronic device that produces 2-4 high-voltage electrical pulses per second. These pulses are at very low amperage, measured in milliamps, so the risk of shock is virtually nil. But the voltage is high enough to jump an air gap and ignite gas. The spark ignition module is usually located either under the cooktop or inside the back of the stove. The same module is used for both the surface burner ignition and the oven burner ignition.

However, the spark is not certain enough to light the oven burner, and the gas flow is too high, to rely on the spark alone. Remember, in an oven, before the safety valve opens, you need to be *assured* of ignition. So the spark ignites a low-gasflow pilot, and then the safety valve opens only when the *pilot* is lit.

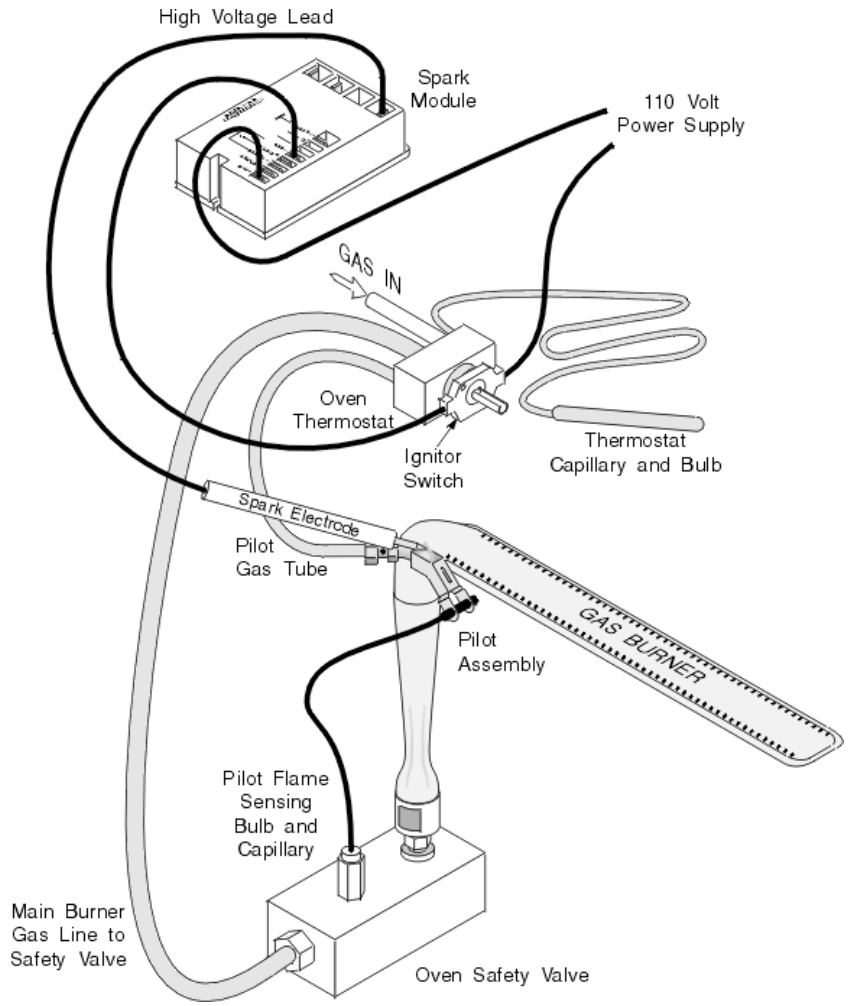
Figure 6-F: Typical Spark Module



TWO-LEVEL PILOT SPARK SYSTEM (figure 6-G)

This is the same two-level pilot system described in section 6-2(b), with a few important exceptions. The *constant* or *primary* pilot does not stay lit when the oven thermostat is turned off. It does, however, stay lit the whole time the oven thermostat is turned on.

Figure 6-G: Two-Level Pilot Spark Oven Ignition System



When the gas oven is turned on, a switch mounted to the oven thermostat stem signals the spark module. These are the same switches as shown in section 5-3

The flame is positioned between the spark electrode and its target. The pilot flame actually conducts electricity. So when the pilot flame is burning, electricity from the spark electrode is drained off to ground, and sparking stops. If the pilot quits, sparking resumes.

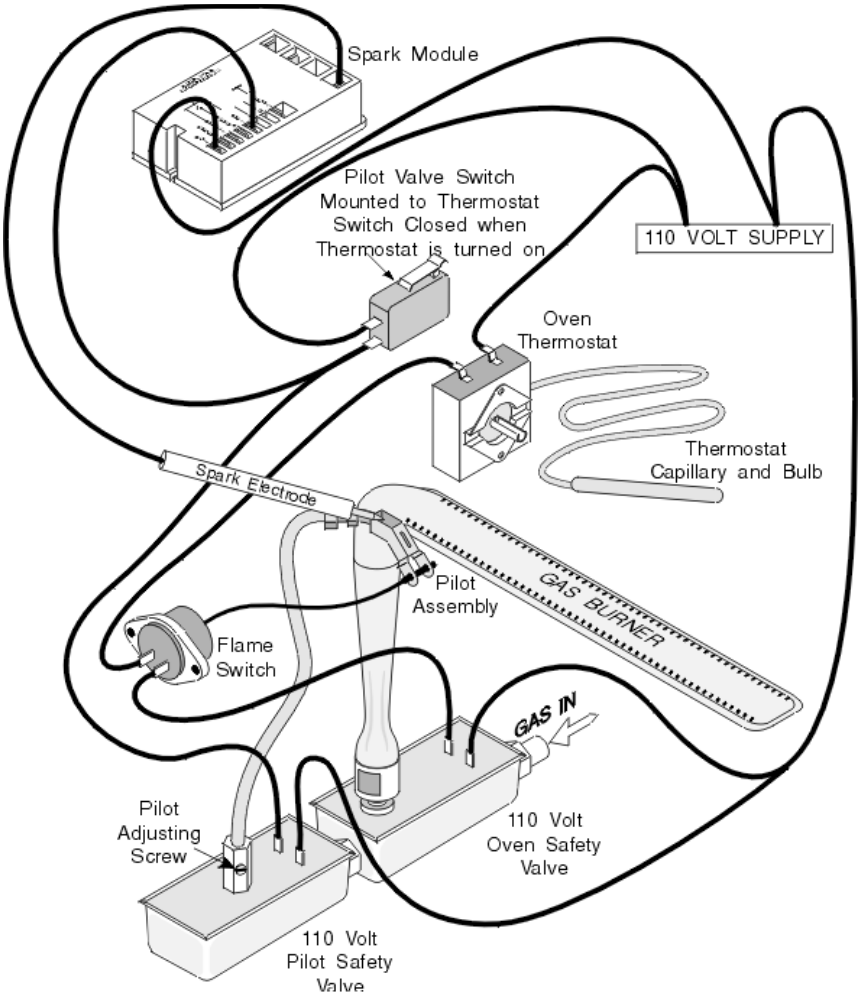
When the thermostat calls for more heat in the oven, the *heater* or *secondary* pilot increases the size of the pilot flame, which heats the sensing bulb, which opens the safety valve and kicks on the burner.

When oven temperature is reached, the thermostat drops the pilot back to the lower level, the pilot sensing bulb cools and the burner shuts down.

PILOT VALVE SPARK SYSTEM

Yup, this ol' boy's got it all. Spark ignition, a pilot, a flame switch and TWO - count 'em - TWO safety valves; one for the pilot and one for the burner. (Figure 6-H)

Figure 6-H: Pilot Valve Spark Gas Oven Ignition System



The operation is actually simpler than the diagram looks. When you turn on the oven thermostat, a cam on the thermostat hub closes the pilot valve switch. This opens the 110 volt pilot safety valve and energizes the spark module, igniting the pilot. As in the other spark system, the pilot flame provides a path that drains off the spark current, so the ignitor stops sparking while the pilot is lit. As long as the oven thermostat is turned on, the pilot valve switch stays closed, so the pilot valve stays open and the pilot stays lit.

When the pilot heats the pilot sensing element of the flame switch, the flame switch closes. This completes the 110 volt circuit to the oven safety valve, so the valve opens and the burner ignites.

When the oven temperature reaches the set point of the thermostat, the thermostat switch opens,

If the oven won't ignite, as always, first check the automatic bake cycle (timer) controls, if any, as mentioned in section 2-6(d).

Now that you know how the system works, first look to see what is not working. When the oven thermostat is on, and there isn't a pilot flame, is the electrode sparking? Is there spark, but no primary pilot? Is the primary pilot igniting, but not the secondary? Is there sparking after the thermostat is shut off?

IF SPARKING OCCURS

(The pilot may or may not light, but the main burner is not lighting) Remember that the thermostat supplies the pilot with gas in these ovens, and only when the thermostat is on. So if you don't have a primary *and* secondary pilot flame, odds are the problem is the pilot orifice or oven thermostat. Try cleaning the pilot assembly and sensor bulb as described in section 6-5. If that doesn't work, adjust the secondary flame a little higher. If that doesn't work, replace the pilot assembly.

If you *do* have a good strong secondary pilot that engulfs the pilot sensing bulb with flame, then odds are that the oven safety valve (or flame switch, whichever is attached to the pilot sensing bulb in your system) is defective. Replace the defective component.

IF SPARKING DOES NOT OCCUR

Something is wrong with the high-voltage sparking system. If you are in a hurry to use your oven, you can turn on the oven thermostat, carefully ignite the primary pilot with a match and use the oven for now; but remember that the minute you turn off the thermostat, the pilot goes out.

Are the cooktop ignitors sparking? If so, the spark module is probably OK. What typically goes wrong with the sparking system is that the rotary switch on the valve stops working. Test continuity as described in section 5-3(a). If that isn't the problem, check the electrode for damage and proper adjustment. The spark target (the nearest metal to the electrode) should be about 1/8” to 3/16” away from it, (about the thickness of 2-3 dimes) and directly across the primary pilot orifice. Replace or adjust the electrode as appropriate. When replacing, make sure you get the right kind of electrode (there are several) and do not cut the electrode lead; follow it all the way back to the spark module and

Usually the ignition switch has gotten some moisture in it and it is shorting. To test, pull the lead off the switch and see if the sparking stops. If so, the switch is bad. Replace it.

In certain ovens, a failure in the spark module will cause this symptom. If the switch does not test defective, replace the spark module.

Remember that these switches are on 110 volt circuits. If you get too fast and loose with pulling these leads off to test them, you might zap yourself.

6-4 GLOW-BAR IGNITION

A glow-bar ignitor is simply a 110 volt heating element that glows yellow-hot, well more than hot enough to ignite the gas when the gas touches it. It is wired ***in series*** with the oven safety valve.

When two electrical components are wired in series, they share the voltage (see figure 6-I) according to how much resistance they have. If the ignitor has, say, two-thirds of the resistance of the entire circuit, it will get two-thirds of the voltage. In reality, the ignitor has *most* of the resistance, so it gets *most* of the voltage. Out of 110 volts, the safety valve only gets about 3 to 4 volts. So unlike the flame safety switch system (which has a safety valve that looks almost exactly like this one,) this safety valve is a ***low voltage*** valve.

Let's talk about honey for a minute. Yes, honey. Stick with me here. (Pardon the pun)

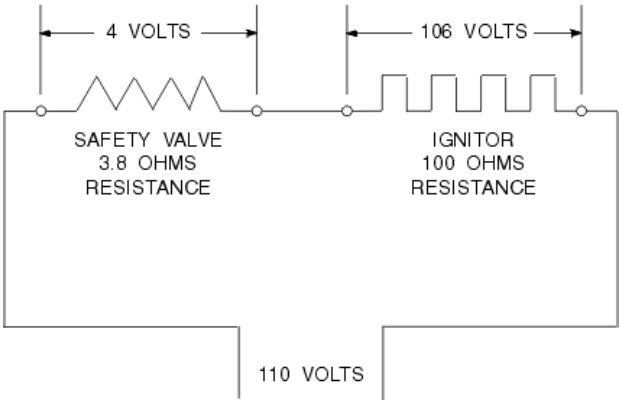
If you take a squeeze bottle full of honey out of a refrigerator and try to squeeze some honey out of it, it is difficult. There is a lot of resistance, because the honey is cold and thick. If you heat up that honey in the microwave for a few seconds, it becomes thinner and flows easier; you can get more honey out of the bottle more quickly.

The same thing happens, electrically speaking, with the ignitor. When you first apply voltage, the ignitor is cold and the resistance is high. When the ignitor heats up, the resistance drops, and electricity is able to flow through it more easily, and the voltage across it drops.

Now apply that fact to what we just said about the ignitor and gas valve splitting the voltage. When the ignitor is cold, its resistance is high, and it gets most of the voltage. *So much, in fact, that there isn't*

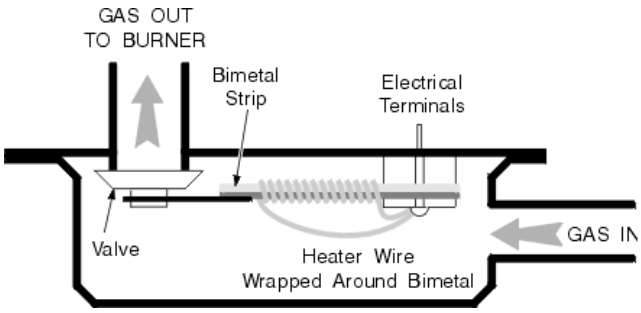
valve gets more voltage, and bingo! The safety valve opens, and the ignitor is hot enough to ignite the gas. ***Note*** *that the ignitor stays on the whole time the burner is burning.*

Figure 6-I: Splitting the Voltage



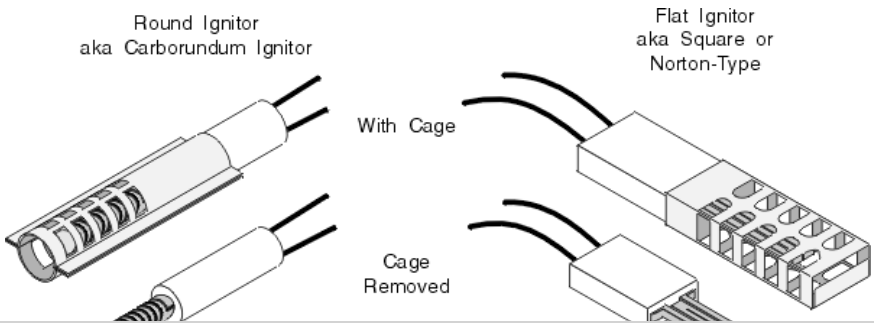
The safety valve contains a small heater and a bimetal connected directly to the gas valve. (see figure 6-J) When enough voltage is applied, the heater heats the bimetal, which opens the valve. When the oven thermostat senses the right oven temperature, it cuts off the power to the ignitor and gas valve, and the bimetal cools and shuts off the gas flow.

Figure 6-J: Typical Safety Valve



There are two different types of ignitors in common use, round (aka carborundum) and flat (aka square, or Norton-type.) (see figure 6-K) Their resistances are different, so the gas safety valve that each uses is different, but the principle is the same.

Figure 6-K: Typical Ignitors



GLOW-BAR IGNITION SYSTEM TROUBLESHOOTING & REPAIR

The symptom, of course, is that the oven burner won't ignite. As always, first check the automatic bake cycle (timer) controls, if any, as mentioned in section 2-6(d).

Aside from the thermostat and other safety controls, there really are only two parts to the glow-bar ignition system; the ignitor and the safety valve. (Figure 6-L)

There may be a fuse as well. Usually the fuse is located down near the safety valve, but in some installations it's under the cooktop or inside the console. If you have a system with a fuse, check that first for continuity.

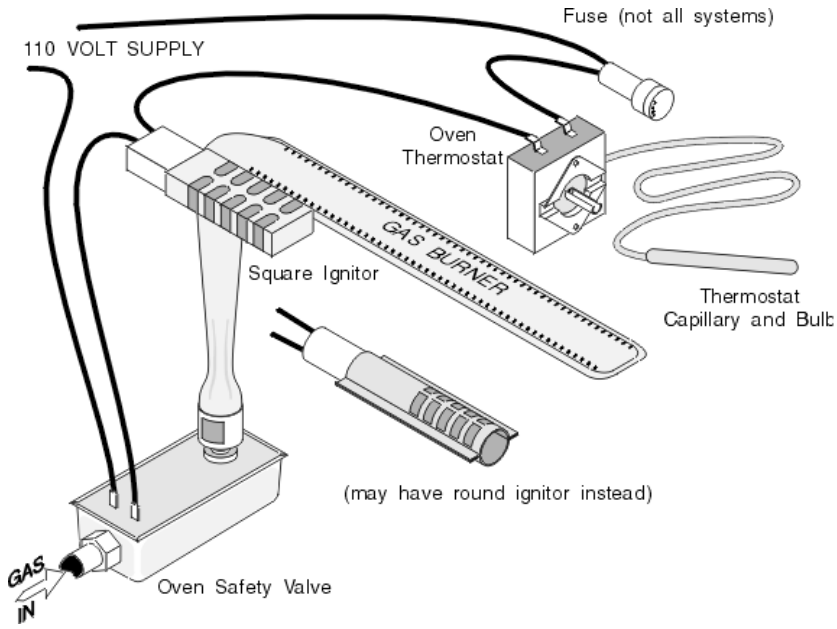
Typically it's the ignitor that fails, and when it does, you can usually see the damage to the element inside the cage.

However, this is not always true. If the ignitor gets old and weak, it will still glow, but usually only red- or orange-hot, not yellow-hot. When this happens, the resistance is still too high for the safety valve to open. It can throw you; since you see the ignitor working, you think the problem is the safety valve. It's usually not. And electrical parts are non-returnable.

When diagnosing these systems, I recommend replacing the ignitor first. If the problem turns out to be the gas valve, you just ate an ignitor, but trust me, you'd have needed one sooner or later anyway.

It is very important to make sure you get the right ignitor and/or gas valve for your oven. The safety valves are matched to the ignitor, and the ignitor is matched to the burner.

Figure 6-L: Typical Gas Oven Ignitor System



Natural gas, they tell us, is clean burning. Well, it makes good ad copy, but it's not 100 percent true. There are trace impurities in gas, and when they burn they become ash. And over a long long period of time this ash can build up and clog tiny gas orifices, like pilot orifices. The symptoms may be that the pilot will not stay lit, or blows out too easily. In an oven, it usually also means that the pilot will not get hot enough to open the safety valve, and the burner will not light. Or the ash might build up on the pilot sensing bulb, and insulate it enough that the safety valve operates intermittently or not at all.

You can usually clean them out with an old toothbrush and some compressed air, but pilot orifices are generally so inexpensive that it's cheaper and safer to just replace them. If you choose to clean them out, use a soft-bristle brush like a toothbrush, and not a wire brush; a wire brush might damage the orifice. Be careful not to push the ash into the orifice and impact it.

Gas oven burners are not like surface burners; rarely are they accidentally contacted by food. If they have any trouble at all, it's usually a little ash around the holes. Clean as described above. If you do have any crusty stuff from accidental contact with food, clean as described in section 5-4.

I hope you have a better understanding what is involved in a **Gas Oven Repair.**

Top