Oven, Stove, Range and Cooktop Repair

Foreword

Table of Contents

CHAPTER 1
System Basics

CHAPTER 2
Troubleshooting Tools & Safety Tips & Tricks

CHAPTER 3
Parts Access

CHAPTER 4
Electric Cooktops and Ovens

CHAPTER 5
Gas Cooktops

CHAPTER 6
Gas Oven Repairs

CHAPTER 7
Digital Controls Fault Codes

Oven, Stove, Range and Cooktop Repair

Chapter 1

COOKING APPLIANCE SYSTEM BASICS

1-1. BASIC FUNCTIONS

In their most basic forms, ovens and cooktops are pretty simple devices. Technically, all they do is develop high, controlled temperatures in specific places, in order to transfer heat to food and cook it.

The important words here are "high" and "controlled." These two requirements present specific challenges to the folks who design and service ovens. And consumers demand gadgets that might make life easier for them, but they sure make the life of a serviceman tougher.

For example, when you talk about controlled temperatures, you are not only talking about keeping the temperature within a certain range with a thermostat, but also controlling the *times* when the heat starts and stops being applied to the food. So there might be a timer wired into the oven circuit to start and stop it. In some models there is a self-cleaning function too, which means that the oven temperature will rise to an extraordinarily high level (around 1000 degrees), stay there for a set amount of time, and then shut off. You need special controls and safety mechanisms to deal with those temperatures.

The other important word here is "high." You need to use powerful energy sources to develop high temperatures. If these energy sources are not tightly controlled, the result can literally be a disaster. For example, before you open a gas valve to a burner, you need to make sure the ignition source is working.

If it isn't, you certainly don't want that gas valve to open and dump a bunch of unburned gas into your oven or kitchen. Talk about an explosion hazard! So you design a safety mechanism to prevent it.

One of the most amazing collections I've ever seen resides at Appliance Parts Equipment Company in Santa Rosa, California. It is a bunch of electric cooktop surface units and gas burner grates that have been brought in over the years, with various things *melted* onto them, from kids' toys to glass plates to aluminum tea kettles, and even an aluminum pressure cooker. If seeing this collection doesn't give you some respect for the heat and power you're dealing with in cooking equipment, nothing will. I suppose there's some profound philosophical lesson in this collection about man harnessing the forces of nature or something, but metaphysics are a little beyond the scope of this manual, so let's move on....

1-2 ELECTRIC COOKTOPS AND OVENS

Most electric cooking equipment uses two different electrical circuits. The heating elements usually run on 220 volts, and accessories such as lights, timers and rotisserie motors run on 110 volts. There are a few notable exceptions. Some smaller "apartment" cooktops run on 110 volts. Also, in some fixed-temperature switch applications, 110 volts is applied to a 220 volt surface unit (burner) to achieve a "low" heat setting.

In most cooktops, the heating element is simply a big resistor wire, with enough resistance to generate a high heat. Usually these are nichrome wire, surrounded in ceramic insulation, with a steel sheath around the ceramic. On higher settings, the element glows red when operating. Heating occurs mainly by conduction; that is, the direct contact of the heating element to the cookware. Since the surface unit coil is flat, flat-bottomed cookware provides the best contact with these units and thus the most efficient operation.

A fairly recent development is the radiant heat cooktop. These have a radiant element (something like a very intense sunlamp) underneath a glass surface. These units do not heat the pot or pan by direct contact (conduction) like coil surface units. They heat by radiation, much like a sunlamp heats your skin.

To maintain a set temperature, the element is cycled on and off, usually by a switch called an ***infinite switch***, so named because it theoretically provides an infinite number of heat settings. There are also ***fixed-temperature switches*** that vary the voltage going to the heating elements to maintain fixed, pre-set temperatures. These are push-button or rotary switches with fixed settings such as warm, low, medium and high. These switches and systems are discussed in detail in chapter 4.

1-3 GAS COOKTOPS AND OVENS

explosion hazards.

The different fuels require valves and burners with different orifice sizes, so when buying parts, make sure you get the right ones for the fuel you are using.

A pressure regulator keeps the gas entering the stove at a constant pressure of about 1/6 PSI, regardless of fluctuations in the supply pressure. In a cooktop or stove, this pressure regulator feeds a main gas header, or *manifold*, located under the cooktop. The surface burner gas valves are mounted directly to the gas header. Gas is piped from the header to the various burners, pilots and safety valves, and in some systems, the oven thermostat.

Temperature control in cooktops is very different from that in ovens. In cooktops, a gas valve varies the flow of gas to the burner. In ovens, the gas is either on or off; the burner cycles on and off to maintain temperature.

Another major difference is that when you turn on a gas cooktop, you can immediately see if it ignites. If it doesn't, you turn off the burner and figure out why. In ovens, 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.

This creates different ignition and safety needs for cooktops versus ovens. Cooktops use a standing pilot or spark ignition system. Ovens use a standing pilot, spark or glow bar ignition system, and gas safety valves that will not open unless ignition is assured. These systems are discussed in detail in chapters 5 & 6.

1-4 SELF CLEANING OVENS

In a self-cleaning oven, the oven temperature will rise to an extraordinarily high level (around 1000 degrees), stay there for a set amount of time (usually 2-3 hours) while the heat incinerates everything, and then shut off. These ovens require a timer to control the length of the cleaning cycle. Of course, you do not want the temperature to go much above 1000 degrees, so you need extra thermostatic controls and fail-safe mechanisms to prevent that.

Neither do you want the user to open the oven door in the middle of the cleaning cycle and get a face full of 1000 degree air. At that temperature there is also a risk of flashback, where the oven temperature is so high that it flashes (burns) the oxygen right out of the air in your kitchen. An oven door locking mechanism prevents the door from being opened at high temperatures. The self-cleaning function is electrically interlocked with the door locking mechanism, so the self-cleaning function cannot be used unless the door locking system is engaged.

A door locking system has two steps. First there is a manual latch that must be engaged to signal your "intent to clean." Then when the oven temperature climbs above about 550 degrees, an automatic doorlock system engages and prevents manual opening until the oven temperature drops back down below 550. The automatic doorlock might be a bimetal or a solenoid, or in some machines there is a very low RPM electric motor (like 1 RPM) that rotates. As a solenoid or motor locking system engages, it throws switches that prevent it from being energized again until a cool-down thermostat tells it that oven conditions are safe to do so.

The temperature of the self-cleaning cycle is controlled by one of two different means.

Either the main oven thermostat has a second sensor built into it, or there is a separate (cleaning) thermostat altogether, with its own temperature probe. The probe usually sticks into the oven through the back or side wall, near the top.

A cleaning cycle will always be wired through a timer. In some machines there is a fixed-time cleaning cycle, but usually you can set the cleaning cycle for however long you want it to last. Usually 2-3 hours is what's recommended.

Self-cleaners tend to be very complex machines. They have many extra safety mechanisms to prevent overheating and burns to the user. When diagnosing these things, you *must* use a wiring diagram. That's the only way to know for sure what switches and interlocks are used by a particular system. See chapter 2 for details.

1-5 CONVECTION OVENS

In order to understand convection ovens, there are a few principles you need to understand first:

2) Heat will always flow ***from*** something of a ***higher*** temperature ***to*** something of a ***lower*** temperature. The farther apart the temperatures are, the faster the heat flow.

3) Heat will continue to flow from one object to another until the temperatures of the two objects are equal.

4) Air is really a poor conductor of heat. It is actually a pretty good insulator.

Lets talk about chill factor for a minute. Chill factor? Isn't that *weather* stuff? In an oven manual? Yeah, because the concepts are the same. Stick with me here.

If the weather outside is freezing, this may sound funny, but it does not make you cold. What it does is to ***remove heat*** from your body, and heat flowing from your body into the air around you is what makes you feel cold.

If the wind is not blowing, your body transfers heat to the cold air around it. The temperature of the air closest to your skin starts to rise. Soon you have a little "blanket" of relatively warm air around you. As the air temperature of this "blanket" rises, the heat flow from your body slows down. When the heat flow slows down, you don't feel as cold.

If the wind is blowing, the air touching your skin does not have a chance to warm. The wind is constantly blowing away the warm layer of air and replacing it with cold air. The heat flow does not slow down, and you feel colder, ***even though the outside air temperature is the same as before***. We humans refer to this as the chill factor.

The same thing happens inside an oven. If the air is still, the heat does not flow from the air to the food as fast, and cooking is slower. If the air is moving, heat gets transferred faster and cooking occurs faster.

All ovens have *some* air moving around inside, due to natural convection (warm air rises, cooler air falls.) In a ***convection*** oven, a fan is used to force the air to move around inside the oven, speeding up the cooking process.

The fan also has two other functions in the oven. Oven temperatures are pretty extreme conditions in which to operate an electric motor. If the oven is also self-cleaning the temperatures are even higher. So the fan motor actually draws air at room-temperature over itself to keep itself cool.

In a gas oven, air is also needed for combustion. The fan pushes air through the burner. In this system there will also be something called a "sail" switch. This is a switch with a little metal "sail" that activates it. Air from the fan closes the switch contacts when the fan is operating. The sail switch is wired in series with the heating system of a convection oven. If the blower fan is not operating, it is not cooling itself, so you do not want the heating system on. In addition, in a gas convection oven, proper combustion will not occur without proper airflow.

1-6 MEAT PROBES

Some oven models were built with meat probes. A meat probe is simply a combination thermometer and variable resistor, called a thermistor, that sticks into meat that you're cooking. The resistance of the thermistor varies with the temperature inside the meat. Then when the meat reaches a certain internal temperature, the thermistor reaches a certain resistance, and a buzzer sounds, or the oven cycles on and off to maintain temperature.

To lessen the hazard of shock, usually meat probes are on a separate low voltage (12 volt) control circuit. To get 12 volts from the 110 volt power supply, a transformer is needed, as well as additional circuitry for the shutdown function, etc.

A rotisserie is just a slow-turning 110 volt motor that turns meat over as you cook it. Getting a small, low-horsepower motor to turn over ten unbalanced pounds of roast beast requires some mechanical help, so the motor drives the spit through a gear train.

Top