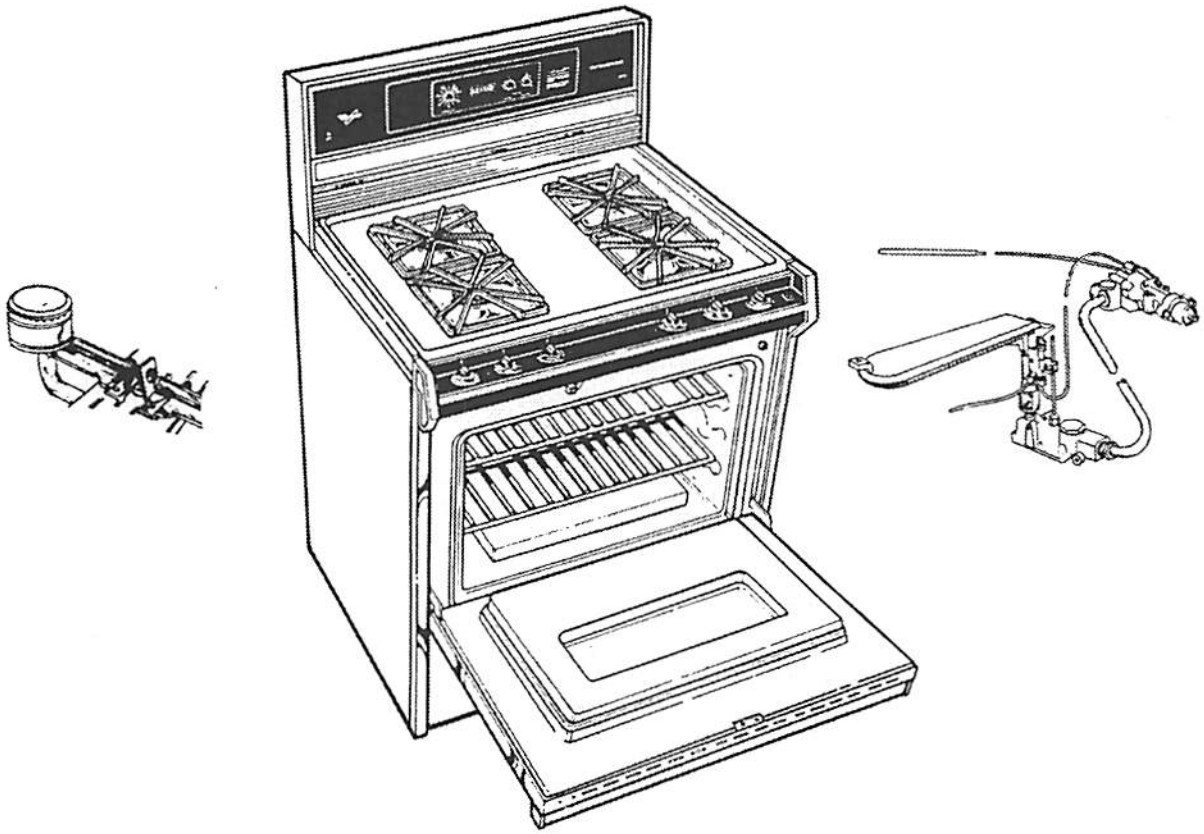
RANGE

STUDY COURSE

UNDERSTANDING RANGE:

- GAS COMPONENTS and FLAME ADJUSTMENTS



MODULE 2

LIT4314425 Rev. B

INTRODUCTION

The material presented in this module is intended to provide you with an understanding of the fundamentals of range servicing.

Major appliances have become more sophisticated, taking them out of the screwdriver and pliers category. Their electrical circuits include several different types of automatic controls, switches, heaters, valves, etc.. Semiconductors, solid-state controls, and other components usually associated with radio and television electronic circuits, are being engineered into automatic washers, dryers, dishwashers and refrigerators.

The appliance technician is emerging into a professional status of his own. He must prepare himself now to be able to perform his duties today as well as to retain his professionalism in the future.

No longer is on-the-job training sufficient to prepare technicians for the complicated procedures required for todays sophisticated appliances. This training can best be obtained through organized classroom study and application. However, much of the knowledge necessary to service todays appliances can be obtained through study courses. Completion of this and other courses will provide you with sufficient understanding of appliances and their operation to enable you to do minor service. It will also serve as a valuable stepping stone to more advanced study and on-the-job training to improve your servicing skills.

Information contained in this module is used on WHIRLPOOL® appliances.

TABLE of CONTENTS

PAGE

CHAPTER 1 - GAS DESCRIPTION 3
Principles Of Burner Operation 3
Gas Valves 4
Top Burner Valves 4
Orifice Selection 4
Pressure Regulators 4
Gas Distribution 5
Gas Pressure Testing 5
Thermostat 6
Natural To LP Gas Conversion 7
Pressure Regulator Setting Change 7
Burner Orifice Hood Adjustment 8
Top Burner 8
Oven Burner 8
Select-A-Gas Screw 8
Broil Burner Orifice Spud 8
Pilot Flame Adjustments 9
Top Burners 9
Oven 9
Burner Flame Adjustments 9
Top Burner 9
Oven 10
Solid State Ignition 10
Oven System 10
Top Burner System 10
Top Ignitor 11

*TEST ..... See Test Book LIT4314428

**NOTE: We recommend taking the TEST for MODULE 2, right after studying it.*

CHAPTER 1

GAS DESCRIPTION

GAS DESCRIPTION

A simplified description of a gas range would be: an insulated metal cabinet containing four gas burners on its top and gas-heated oven cavity inside. Gas is piped to each of the burners where it is mixed with air and allowed to escape from a series of small holes. It is ignited as it flows out the burner holes. The rate of its flow is regulated so that it burns completely and cleanly with flames that can vary from match-head size up to 3/4 inches in length, depending on the application. Adjustments necessary for proper operation are: gas input, gas pressures, air mixtures, pilot regulation and temperature control adjustments.

PRINCIPLES OF BURNER OPERATION

Gas ranges make use of the fact that gas fuel, if burned in the proper mixture with air, provides a hot flame that is odorless and entirely free of dangerous gases. Air mixed with the gas (fig. 1) as it enters the burner assembly, is called "primary air." This air may be adjusted by the air shutter (fig. 2) to give the flame the proper characteristics. Gas is injected into the burner through an orifice, which raises the velocity of the gas. The high velocity for the stream of gas causes a drop in pressure around the stream. Air from outside the burner flows into this region of low pressure through the air shutters or mixing shield.

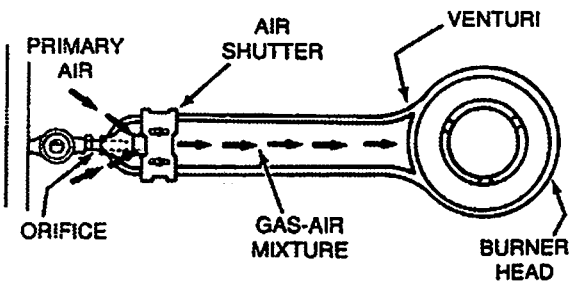


FIGURE 1

Too little primary air will produce a soft yellow flame.

The air surrounding the burner head is called "secondary air." The design of the burner head and the aeration pans provides for an adequate supply of secondary air, making it unnecessary for the technician to be further concerned with it.

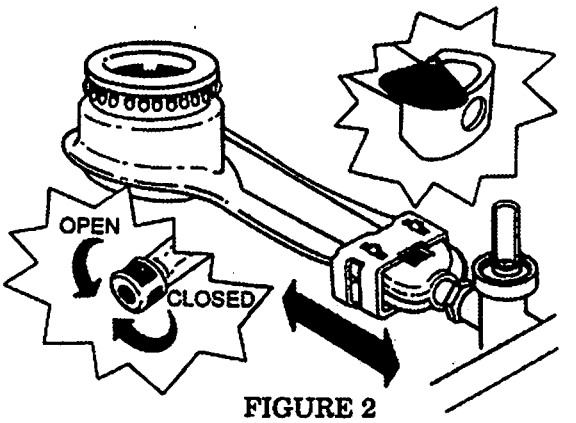


FIGURE 2

The air and gas together pass through a narrow passageway, known as a throat, into the venturi, or mixing chamber. The sides of the venturi slope outward increasing the volume of the gas and air. As the gas and air expand into the increased volume, their velocity is reduced and they become thoroughly mixed.

From the venturi, the mixture passes into the base of the burner, which is a hollow chamber from which the gas-air mixture flows to the burner ports. These ports are designed with sufficient depth and cross-section to further reduce the velocity of the mixture and provide a stream of gas of the proper size to combine with the secondary air and provide complete combustion. The head of the burner is shaped to provide unrestricted flow of secondary air to the flames.

The burner throat and venturi must be in line with the gas stream leaving the orifice. If they are not in line, the velocity of the gas flow to the burner will be reduced. The gas stream will hit the sides of the venturi, bounce from side to side, slowing the flow. Without the proper gas velocity (fig. 3), the aspiration or suction effect needed to pull in air through the air shutter will not be sufficient. The burner will have a yellow flame that shutter adjustments may not affect or eliminate.

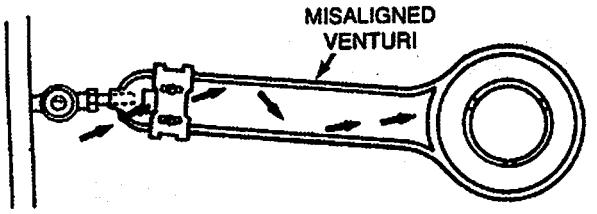


FIGURE 3

Incorrectly aligned venturi and orifice can be due to valve installation, poorly drilled orifice or burner installation. Dirt or cobwebs in the venturi can cause the same effect.

GAS VALVES

The purpose of a gas valve is to control the amount of gas that is admitted to the burner, thereby controlling the heat output of the burner.

The basic gas valve consists of a housing and a plug. The housing is usually threaded on one end (fig. 4) to receive an orifice or hood.

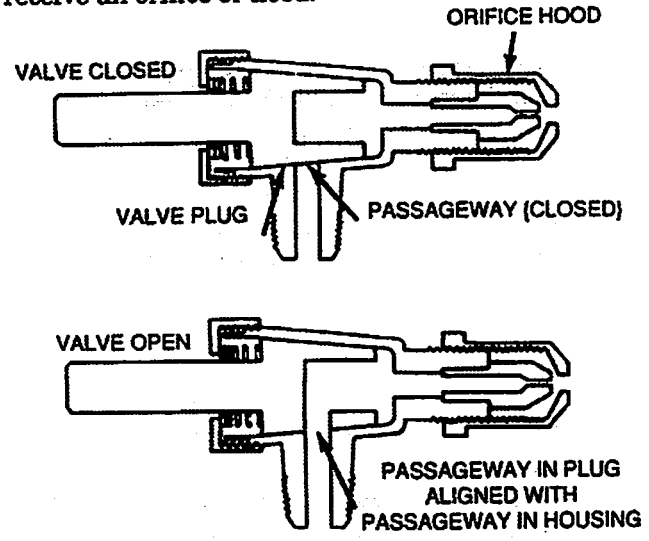


FIGURE 4

Valves having fixed orifices will not contain a spud (needle) and cannot be adjusted. The valve shown is universal and can be adjusted by screwing the orifice hood in or out to attain the correct flame.

Threads on the other end of the valve hold a cap to retain the spring and plug in place. A stem on the plug extends through the cap and is provided with a flat surface for positive location of the valve knob or handle. A bottom-threaded extension screws into the manifold.

TOP BURNER VALVES

Top burner valves control the gas flow to the burners. These valves have a predetermined gas flow and detent settings.

ORIFICE SELECTION

The correct orifice size for any gas burner is determined by the rating of the burner, the specific gravity of the gas, the BTU heating value per cubic foot of the gas, and the water-column pressure of the gas source.

In the event the specific gravity or heat content of the gas in a particular area is unknown, contact the utility for this information. Be aware of local codes, ordinances and regulations.

PRESSURE REGULATORS

A gas pressure regulator should be used on all ranges burning Natural, Mixed, or Manufactured gas. It would be set for 4 inches, wcp (Water Column Pressure). This will insure a constant heat output and stable pilot flames, even if the gas pressure entering the house should fluctuate. If the gas supply pressure drops below the 4-inch regulator setting, the range burners will be affected.

In this case, the utility should be notified that proper pressure is not being maintained.

The purpose of a gas pressure regulator is to maintain the gas pressure to the appliance at a given point below the house inlet pressure.

Regulators should be installed on all gas burning appliances except when LP (liquefied petroleum) gas is used. Regulators are already located at the tank assembly on any LP or bottle gas systems. Its pressure should be set at a minimum of 11 inches, wcp. and a maximum of 14 inches, wcp.

Pressure regulators will vary somewhat with different design and manufacturing, but all have a basic function. Most small regulators of this type will not operate efficiently if the inlet line pressure exceeds 18 inches, wcp.

Gas flow should be in the direction of the arrow. If there is a surge in line pressure, the diaphragm will flex upward, reducing the valve opening to a point where the gas pressure counteracts the spring weight (fig. 5) above the valve and diaphragm.

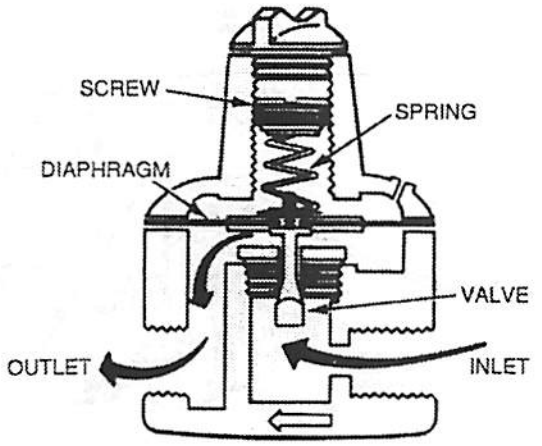


FIGURE 5

House line pressure for natural gas is generally considered properly regulated at a minimum of 6 inches, wcp. and a maximum of 14 inches, wcp. This is reduced to approximately 4 inches, wcp. by the regulator on the appliance, depending on the pressure desired or recommended by the appliance manufacturer.

GAS DISTRIBUTION

Gas in the street mains may be under one of three pressure systems: low, medium, or high.

Low-pressure systems were used in the early days of the gas industry, when gas was used mainly for lighting. These mains carried pressures up to 10 inches, wcp.

As loads on low-pressure mains reached the capacity of the mains, and were still increasing, the only way of increasing the capacity was to increase the pressure.

Medium-pressure distribution systems carry from 10 inches, wcp. to 50 psi (Pounds Per Square Inch) in the street mains. Many utilities maintain an average of 15 lbs. pressure in their medium-pressure lines.

High-pressure mains carry 50 psi to 100 psi. It is obvious that high pressure must be reduced; therefore there is a need for pressure regulators. On high or medium-pressure mains the gas utility has a regulator, usually near the meter, which reduces the main pressure from psi to 6 inches wcp as it enters the house.

We have mentioned gas pressures in inches water column pressure and also in pounds per square inch. For the purposes of conversion, 27.74 inches wcp equals 1 psi. You can see that when we say the gas pressure at the range should be 4 inches wcp, this is less than .144 or a fraction over 1/8 psi in pressure. You can hardly hear it. When you are checking pipe joints with soap suds for possible leaks, you must work carefully and thoroughly.

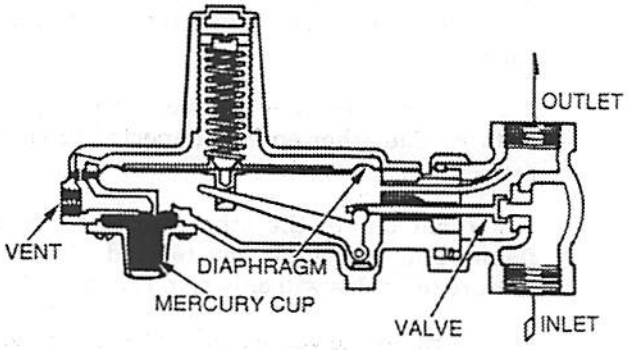


FIGURE 6

This is a cut-away view (fig. 6) of a regulator which will reduce pressures from psi to inches wcp. It is larger than the regulator we use on an appliance and has a somewhat different action, although the principle is the same.

GAS PRESSURE TESTING

How do we test gas flow pressure in an appliance?

To test gas pressures, we use a water-tube manometer which reads in inches wcp. It is sometimes called a "U" gauge. This essential tool is a simple, clear plastic tube with a scale marked off in inches and tenths. If used correctly, the operation is simple and the reading accurate (fig. 7). However, misuse can vary the reading enough to render it useless.

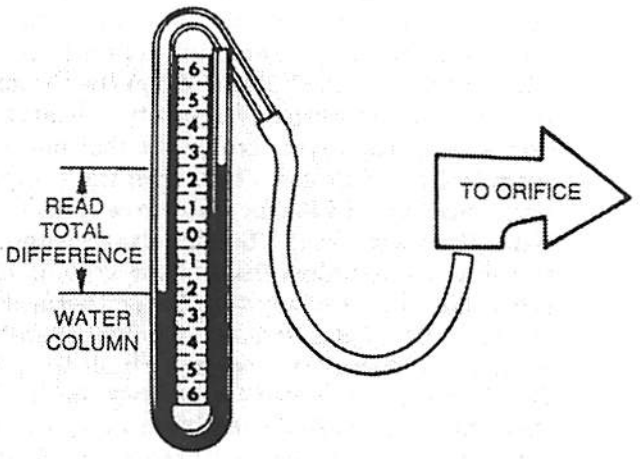


FIGURE 7

To use this manometer correctly, the following procedures are recommended:

1. Fill the tube with clear water to about the ZERO marking on the scale. Volume of water is not critical since the reading is the difference between the two sides.

2. Connect the hose to one of the top gas valve orifices. The other end is connected to the manometer.

3. Light one of the other burners - turn to full flame. This will allow you to read "flow" pressure. Failure to do this will only give you "static" pressure.

4. Turn on the valve leading to the manometer.

5. Hold the "U" gauge vertically and take reading. Read each side to the tenth.

6. The top of the water column in each side of the tube is not flat, but curved upward at the edges. This is called a meniscus. Always read the lower edge of the meniscus, keeping the eyes level with the bottom of the curve for accurate readings. Add the readings of the two sides for the gas pressure.

What reading (fig. 7) do you get on this manometer?

You should read it as 4.5 inches wcp. Add the 2.4 inches above the "0" to the 2.1 inches below the "0" to find a total of 4.5 inches wcp.

THERMOSTAT (Gas Ovens)

The purpose of gas thermostats is to maintain as nearly even temperatures as possible in the oven so that the cooking can be accurately controlled.

Gas thermostats are basically the same for all models. When a thermostat (fig. 8) is turned on, it allows gas (from the manifold) to flow to the safety pilot and then to the burner. When the thermostat's sensing element in the oven cavity is heated by the oven's temperature, it signals the thermostat to restrict or shut off the gas. The thermostat's response to this signal is controlled by the degree of heat selected on the thermostat dial. This signal is accomplished by temperature-sensitive fluid in the sensing element connected by a capillary tube to the thermostat (fig. 8). When the signal becomes stronger than the dial setting, the thermostat reacts to limit the gas flow. The fluid expands against a "bellows" in the thermostat which mechanically restricts the gas supply. If the thermostat capillary is broken or has lost its fluid, the thermostat will act as if it was cold and will not shut the gas off.

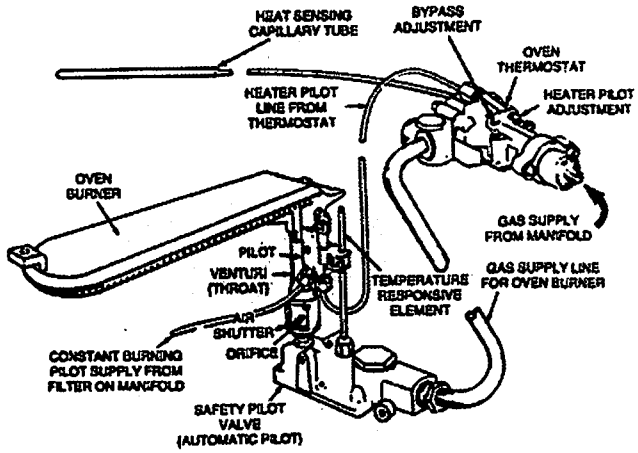


FIGURE 8

The safety pilot is considered part of the oven control and must be studied to understand how the thermostat works. The constant-burning pilot, at the burner, is supplied gas from the manifold, *not* from the thermostat. *This pilot does not ignite the main burner.* When the thermostat is turned on, it immediately supplies gas to another, larger heater pilot. This large heater pilot is ignited by the constant pilot. The thermostat may cycle the burner flame but this large pilot is on whenever the thermostat is on. When the thermostat is turned off, the lack of the large pilot flame causes the safety pilot to shut off the gas supply. Thus, the gas is turned off at two points: (1) at the thermostat and (2) at the safety pilot

Some ranges are equipped with a Lo-Temperature thermostat. This new system gives precise control of gas oven temperatures down to 140°F, instead of the minimum of 200°F, which is the lower limit of standard controls.

At temperatures above 325°F, the oven thermostat operates in the same way as the standard oven control. Below 325°F, operation is somewhat different. At these lower temperatures, the bypass flame tends to override the temperature setting so the *oven burner shuts off completely.* If the temperature drops to a point where more heat is called for, The oven burner automatically relights. It then stays on until the oven reaches the desired temperature, then shuts off again. To accomplish this on-off cycling, which is necessary for low-temperature control, The thermostat shuts off the gas to the large heater pilot. This, in turn, shuts off the gas flow to the oven burner. When oven temperature drops below the set point, gas again flows to the burner pilot, which is promptly relighted by the stand-by pilot. The flame of the burner pilot actuates the temperature-responsive element, opening the automatic pilot valve and allowing gas to flow again to the burner.

In this way, low oven temperatures are controlled as accurately as high temperatures - there are no wide temperature swings.

NATURAL TO LP GAS CONVERSION

Input ratings shown on the rating plate (serial tag) are for elevations up to 2,000 feet. For elevations above 2,000 feet, ratings should be reduced at a rate of 4% for each 1,000 feet above sea level.

Most all ranges are pre-adjusted from the factory for operation on *"NATURAL"* gas. To use the appliance on *"LIQUEFIED PETROLEUM" (LP)* gas, the following (4) four things must be done.

1. Change pressure regulator setting from *"NATURAL"* to *"LP"*.

2. Readjust burner orifice hoods

3. Change the select-a-gas screw on the oven (thermostat) control.

4. Change broil burner orifice spud (SELF CLEANING MODELS ONLY).

PRESSURE REGULATOR CHANGE

There are five (5) different types of pressure regulators that are used on ranges. Use the following as a guide to convert your pressure regulator over to *"LP"* gas. IN ANY CONVERSIONS, DO NOT REMOVE THE PRESSURE REGULATOR.

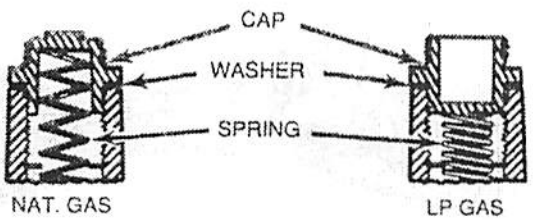


FIGURE 9

1. Remove the cap marked *"NAT."* (fig. 9) and reverse it to read *"LP."* Be sure not to disturb or remove the spring beneath the cap. Also make sure the fiber washer is between the cap and the body of the regulator. Insert the cap in the body of the regulator and tighten.

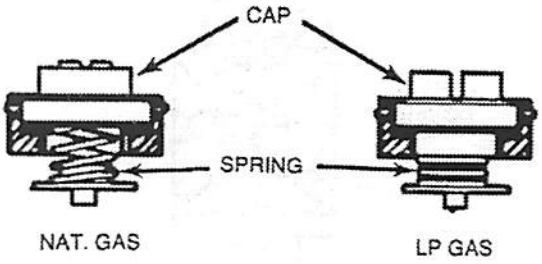


FIGURE 10

2. Remove the cap with the screwdriver slot (fig. 10) and turn it upside down. This cap will have the marking "LPG10" shown. Be sure not to disturb or remove the spring beneath this cap. Insert the cap in the body of the regulator and tighten.

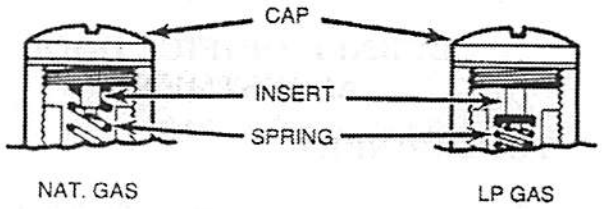


FIGURE 11

3. Remove the cap with the screwdriver slot (fig. 11). Remove the black insert marked *"NAT."* from the cap. Reverse this insert and carefully push it firmly into the hole in the cap. The marking *"LP"* will now be showing on the insert. Also, be sure not to disturb the spring in the body of the regulator. Insert the cap in the body of the regulator and tighten.

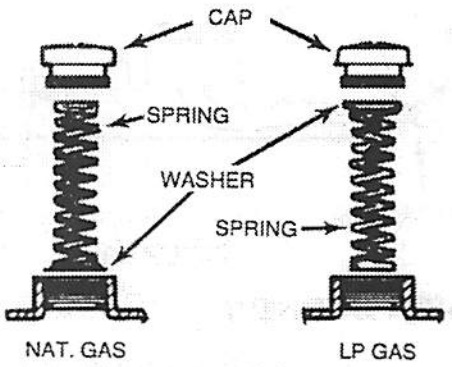


FIGURE 12

4. Remove the cap with the screwdriver slot (fig. 12). Remove the spring and washer (washer will be at bottom of spring). Reverse these so that the washer is now at the top of the spring, then reinstall. Insert the cap (over the washer and spring) in the body of the regulator and tighten.

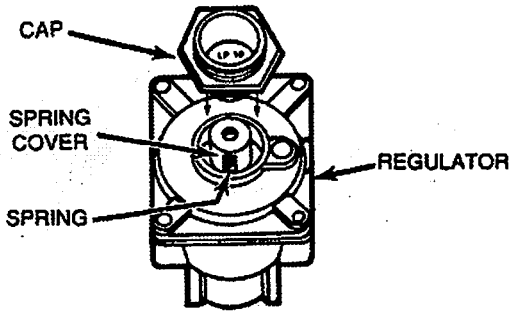


FIGURE 13

5. Use a wrench to unscrew the aluminum cap (fig. 13) by turning counterclockwise. Turn the cap over so the hole end is up. Place the gasket between the cap and regulator. Then place the cap and *gasket* on the regulator and tighten. DO NOT OVERTIGHTEN.

BURNER ORIFICE HOOD ADJUSTMENT

TOP BURNERS

Remove the four top burners by removing the mounting screws, then lift the burners off the brackets. Screw the (4) four burner orifice hoods down snug, approximately 2 to 2 1/2 turns (fig. 14). DO NOT OVERTIGHTEN. Burner flames cannot be properly adjusted if this conversion is not made.

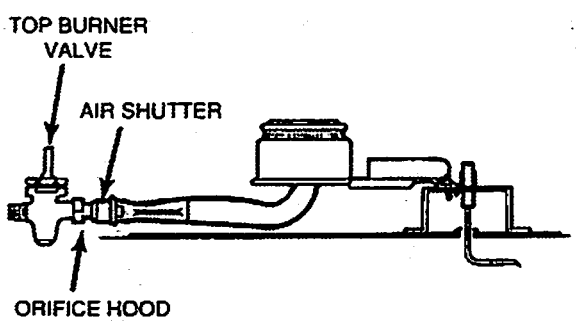


FIGURE 14

OVEN BURNER

Screw the oven orifice hood down snug, approximately 2 to 2 1/2 turns (fig. 15). DO NOT OVERTIGHTEN. Burner flames cannot be properly adjusted if this conversion is not made.

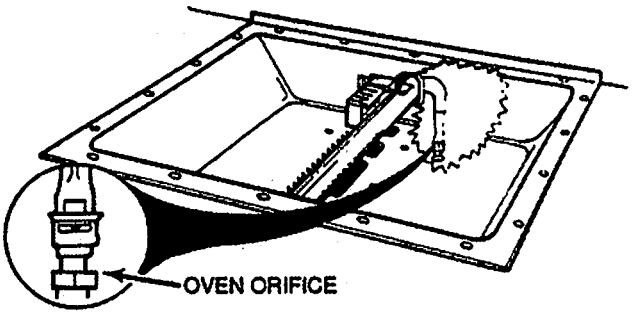


FIGURE 15

SELECT-A-GAS SCREW

Remove the oven thermostat knob to be sure *select-a-gas* adjusting screw is in the proper position (fig. 16) for the type of gas being used. The select-a-gas screw is located on the left side of the Robertshaw thermostat and on the right side of the Harper thermostat.

Turn the screw clockwise to stop, for *LP*, and counterclockwise to stop, for *NAT.*

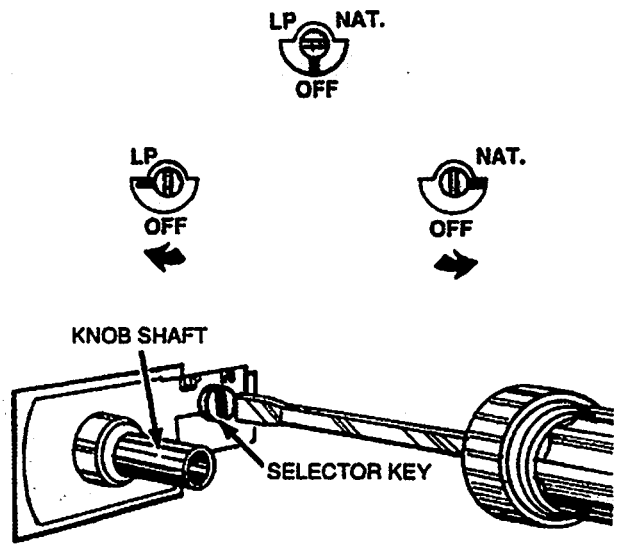


FIGURE 16

BROIL BURNER ORIFICE SPUD (SELF-CLEANING MODELS ONLY)

1. Be sure the proper burner spud is selected for the type of gas being used.

2. Remove the two screws (fig. 17) fastening the broil burner assembly to the oven. Carefully pull the burner towards you, then downward to access the burner orifice spud in the rear wall. Extra care is needed to avoid breaking the ignitor coil. Place burner, screen-side up, in a safe area.

3. Use a nutdriver or wrench to remove the *"NAT"* gas burner orifice spud. Install the selected *"LP"* burner orifice spud.

4. Replace the burner assembly cover, with the louvers facing toward the rear of the range.

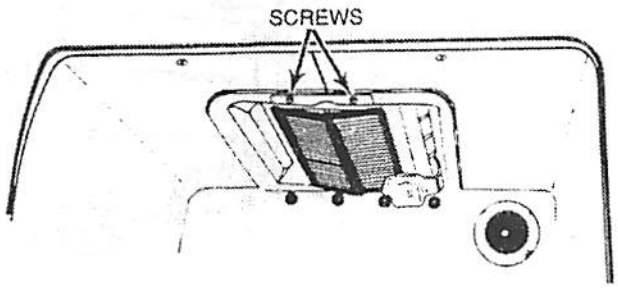


FIGURE 17

PILOT FLAME ADJUSTMENTS (Standard Ignition)

NOTE: On *LP* gas, a slight yellow tip will be visible on top burner flames. This will not affect burner performance.

TOP BURNERS

1. After the pilots have been ignited, the top burner pilots are adjustable from behind the oven control knob (which has to be removed), or on the manifold (which is under the cook top).

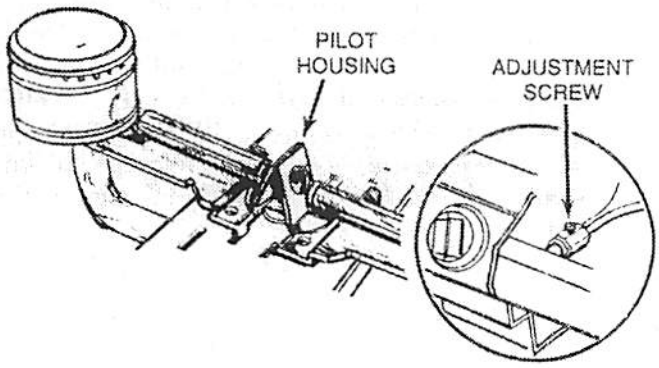


FIGURE 18

2. To adjust the pilot flame, turn the adjustment screw until the pilot flame tip is 1/4 to 3/8 inches high and centered in the hole in the pilot housing. If the flame is too high, carbon (soot) will accumulate under the cooktop.

OVEN

Make sure the oven control knob is in the "Off" position. Remove the lower oven rack and oven bottom. Hold a lighted match (fig. 19) to the opening in the top of the pilot at the rear of the oven burner. No pilot adjustments are required.

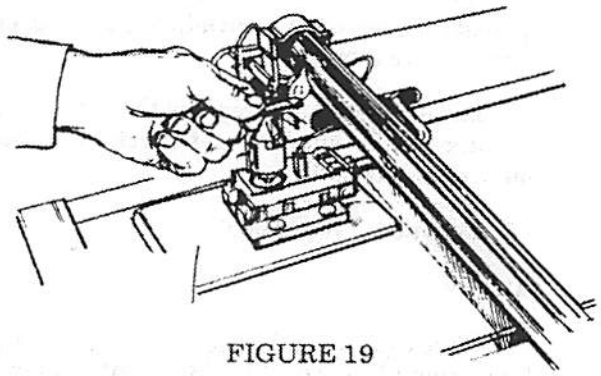


FIGURE 19

NOTE: Main burner should ignite within approximately 45-60 seconds after the thermostat dial is turned to desired temperature setting. This delay is normal. The oven safety valve requires a certain time before it will open and allow gas to flow.

BURNER FLAME ADJUSTMENTS (Standard Ignition)

TOP BURNER

1. Make sure all control knobs are in the "OFF" position. Push-in and turn one of the knobs fully ON (counterclockwise).

2. Adjust the air shutter until the inner blue cones of the flame are approximately 1/4 to 1/2 inch long (fig. 20) from port to end of cone. The outer cone is not as distinct as the inner cone.

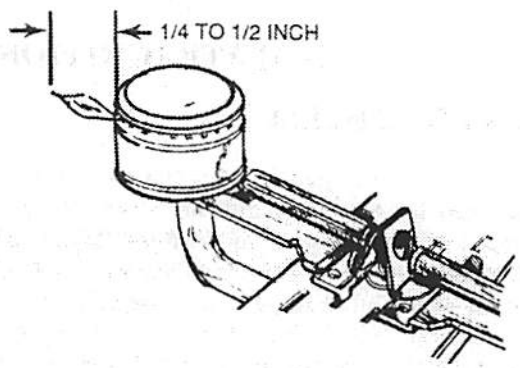


FIGURE 20

The proper way to do this is to open the air shutter until the flames start to lift from the burner, then slowly close the air shutter until the flames are stable.

3. If the proper flame cannot be obtained using this method, adjust the orifice hood.

NOTE: On "LP" gas, the orifice hood must be snug against the orifice pin, then adjust gas supply through burner valve stem.

4. Lower the top and replace the grates. Set a pan of water on the burners and check for lighting and flame characteristics.

5. Readjust if necessary.

OVEN

1. Check the oven burner for proper flame. This flame should be 1/2 inch long, with inner cone of bluish-green, and outer mantle of dark blue and should be clean and soft in character. No yellow tips, blowing or lifting of flame should occur.

2. If oven flame needs to be adjusted, loosen screw and adjust the air shutter (fig. 21) until the proper flame appears. Tighten screw.

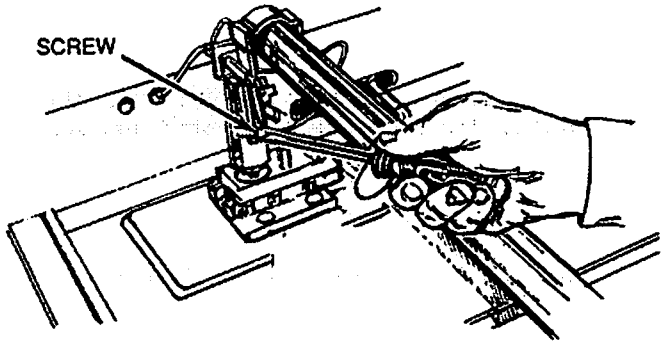


FIGURE 21

SOLID STATE IGNITION

OVEN SYSTEM

On this system (fig. 22), the oven burner pilot is ignited by sparks which are created by having an input of 120 volts, which is passed through a transformer (module). This transformer at this time increases the voltage, which causes the spark to jump to ground. *NOTE:* There is no gas flowing to the pilot with the thermostat in the OFF position. As soon as the pilot ignites, the electrical circuit through the pilot is complete and the ignitor will stop sparking immediately. The oven then cycles just as a conventional range until the thermostat is turned to the OFF position. In case of pilot outage while the oven is in use, the ignitor will begin to spark immediately and will continue to do so until the pilot reignites or until the thermostat is turned off. In either case, the oven burner will go off.

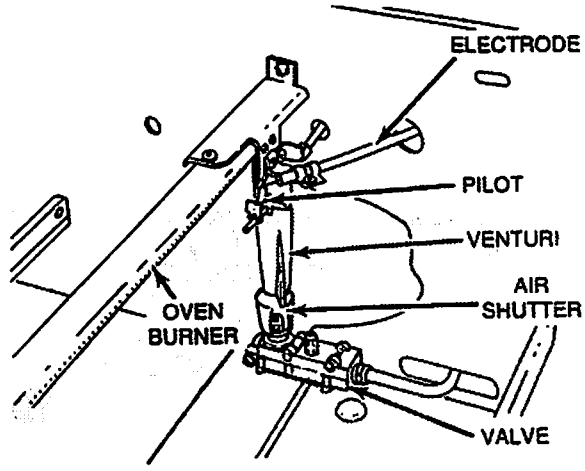


FIGURE 22

In the event of a power failure or a failure with one of the electrical components, the oven can be used by lighting the pilot with a match.

TOP BURNER SYSTEM

The top burners do not use a pilot but are ignited directly from the sparks. Since all the ignitors are wired parallel, both top ignitors and the oven ignitor will spark when either one is turned on.

Before the top burners will ignite, (fig. 23), it is necessary to turn the burner handle to the LITE position (full on). When in the full on position, the small switch located on the burner valve is activated and the sparking begins. Unlike the oven ignitor which stops sparking automatically, the top ignitors spark until the handle is turned off the LITE position.

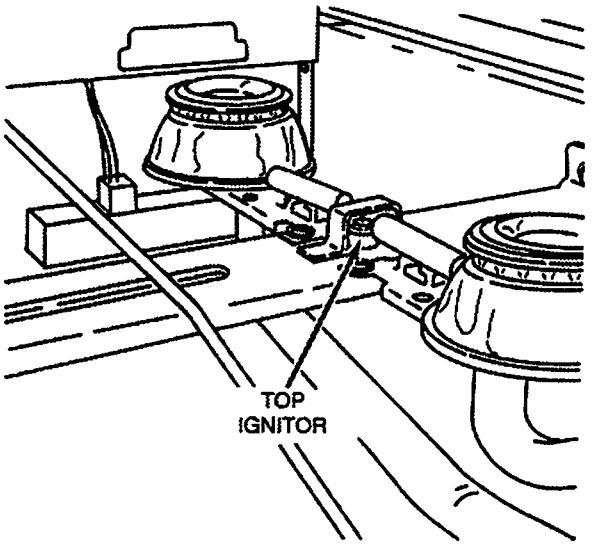


FIGURE 23

In case of a power failure, the top burners can be ignited with a match.

TOP IGNITOR

An electrode may be faulty or a flaw may be present in the high voltage wire. If possible, observe range in dark to help locate breakdown. Replace faulty wiring or electrode. Presence of grease near electrode tips can also sometimes cause accidental grounding to range.

All electrode gap distances (fig. 24), should be approximately 1/10 (7/64) inch or the width of two dimes.

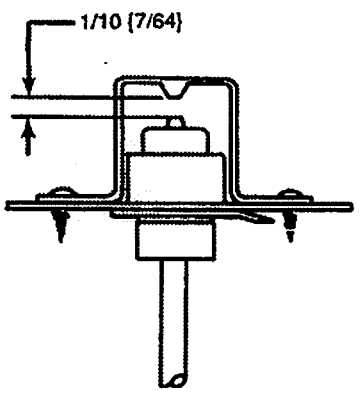


FIGURE 24

Line voltage should be at least 94 VAC. If not, replace ignitor module (fig. 25).

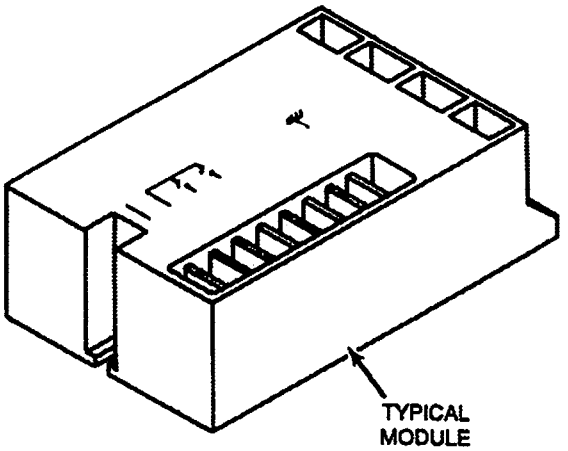


FIGURE 25