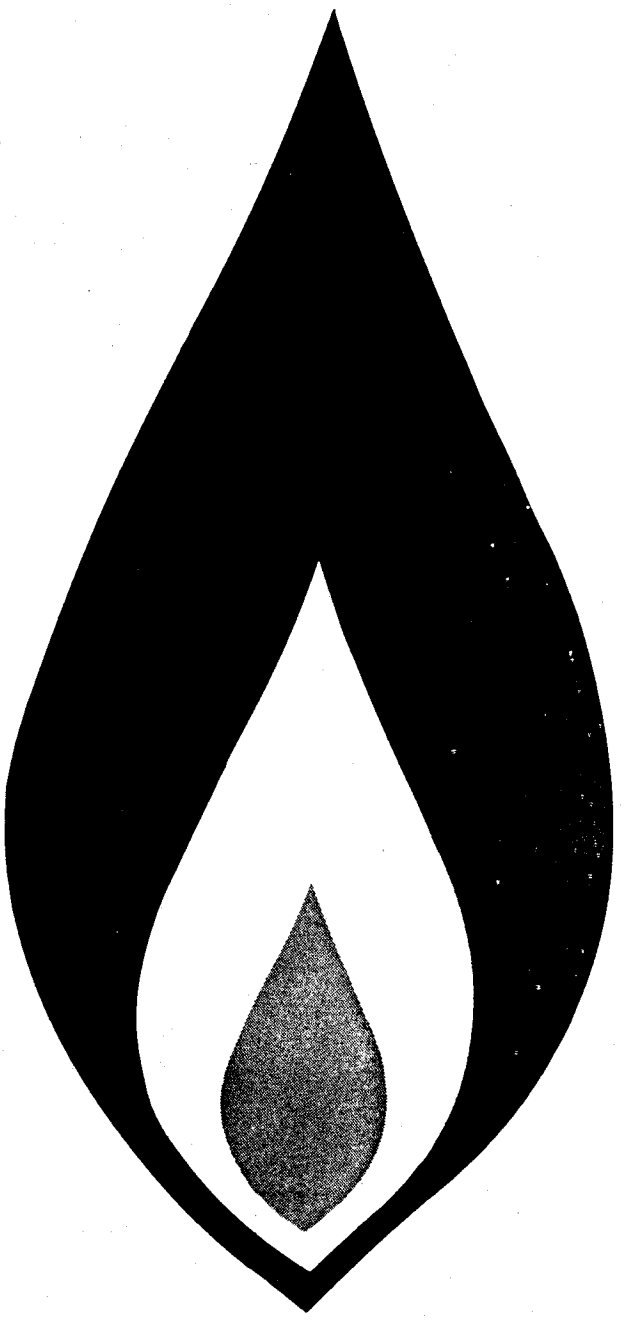
TRADELINE



GAS CONTROLS
SERVICE AND RECONTROL
HANDBOOK

FEATURING...

THE V800 FAMILY OF CONTROLS
WITH THE V500 MODUSNAP

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INTRODUCTION

This handbook is designed to be a quick reference and guide for service technicians who need accurate technical information about Honeywell gas controls on a day-to-day basis. In it, you'll find information on virtually every aspect of gas control installation and service—mounting, installing, wiring, replacing operators and regulators, and troubleshooting—as well as complete specifications and operating descriptions.

If you're familiar with earlier editions of the Gas Controls Service and Recontrol Handbook, you'll find several notable additions and changes in this edition; such as, complete information on the VR (dual valve) type combination gas controls and negative pressure regulated valves, a new chapter on safety, and an expanded OPERATION section describing the operation of all types of Honeywell gas controls and regulators.

Most of the controls in this handbook are part of the V800 family of combination gas controls that Honeywell introduced some years ago.

Back then, a lot of attention was given to developing a family of controls that would not only combine all of the different functions required of a gas control—"A" cock, "B" cock, pressure regulator valve, safety shutoff valve and main automatic valve—but would also have replaceable components for quick, easy field service.

Since its introduction, the V800 concept has proven itself as the "right approach" to valve replacement. Now, with the a new line of VR800 dual valve combination gas controls, Honeywell has embarked on a new era of safety and versatility built on the solid foundation of V800 performance.

The VR type combination gas controls are really an extension of the V800 family. The VR800 dual valve combination gas controls use the same operators and regulators as the V800's. And like the V800's, they include the "A" cock, "B" cock, pressure regulator, automatic main valve, and—on those models for continuous pilot—a safety shutoff valve. The VR type controls, however, have two main valves that double the protection against main valve failure and comply with new, tougher industry safety standards.

SAFETY FIRST

Safety is an important part of your job, both for your own protection and the protection of your customer.

Throughout this handbook, you'll see "Safety First" printed whenever there's a need to alert you to follow special precautions. Be alert for this phrase and follow the precautions given.

Make certain you know and follow the 10 basic rules of safety when working with heating gases and gas controls.

1. Always shut off the gas supply to the device when installing, modifying or repairing it. Allow at least 5 minutes for any unburned gas to leave the area before beginning work. Remember that LP gas is heavier than air and does not vent upward naturally.

2. Always conduct a GAS LEAK TEST after completing the installation or repair as follows.

WARNING

NEVER USE A FLAME TO CHECK FOR A GAS LEAK. WITH MAIN BURNER IN OPERATION, PAINT PIPE JOINTS, PILOT GAS TUBING CONNECTIONS, AND VALVE GASKET LINES WITH RICH SOAP AND WATER SOLUTION. BUBBLES INDICATE A GAS LEAK. TO STOP LEAK, TIGHTEN THE JOINTS AND SCREWS OR REPLACE THE GASKET.

3. Before connecting or disconnecting any wiring, except on millivoltage controls, always disconnect the power supply to prevent electrical shock or equipment damage.

4. When a gas system is being converted from one type of gas to another, the main burner and pilot orifice(s) must be changed to meet the appliance manufacturer's instructions.

5. Always read the instructions supplied with the product carefully. Failure to follow them could damage the product or cause a hazardous condition.

6. Make certain the product is designed for your application. Check the ratings given in the instructions and on the product.

7. After the installation is complete, check out the product operation using the instructions provided.

8. Do not bend the pilot tubing at the control after the compression nut has been tightened. This could cause a gas leak at the connection.

9. Never jumper (or short) the valve coil terminals on 24 V controls. This could short out the valve coil or burn out the heat

anticipator in the thermostat. Never connect millivoltage controls to line voltage or to a transformer as this will burn out the valve operator or the thermotsat anticipator.

10. Do not remove seals over the control inlet or outlet until ready to connect piping. The seals are there to prevent dirt and other materials from getting into the gas control and interferring with its operation.

INSTALLING COMBINATION GAS CONTROLS

Safety First—

— Read instructions carefully. Failure to follow them could damage the control or cause a hazardous condition.

— Check the ratings given in the instructions and on the control to make certain the control is suitable for your application.

— After installation is complete, check out the control operation as provided in the instructions.

— Turn off the main gas supply and wait 5 minutes for unburned gas to vent. Remember that LP gas is heavier than air and does not vent upward naturally.

— Disconnect the power supply before connecting wiring to prevent electrical shock or equipment damage.

— Be sure to conduct a GAS LEAK TEST after completing the installation (page 5).

— Do not bend the pilot tubing at the control after the compression nut has been tightened, as this may result in a gas leak at the connection.

— Never apply a jumper (or short) the valve coil terminals on 24 V controls, as this may damage the system. Never connect mV controls to line voltage or to a transformer.

— Do not remove seals over the control inlet or outlet until ready to connect piping.

INSTALLING PIPING

All piping must comply with local codes and ordinances or with the National Fuel Gas Code (ANSI Z223.1 NFPA No. 54). If semi-rigid tubing is used, use a tube-to-pipe coupling. A sediment trap (drip leg) must be installed in the supply line to the control in all gas appliance piping. See Fig. 1.

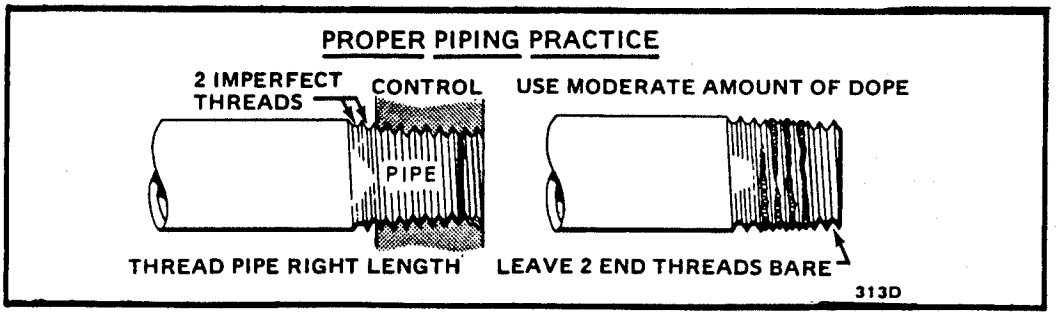
Prepare and install pipe as follows:

1. Use new, properly reamed black iron pipe that is free from chips.

2. Do not thread the pipe too far. Valve distortion or failure may result from too much pipe within the control.

3. Apply a moderate amount of good quality dope to the pipe only, leaving the 2 end-threads bare. If you are performing an LP

gas installation, use a compound that is resistant to liquefied petroleum gases.



4. Install a drip leg (sediment trap) in the supply line to the gas control (Fig. 1).

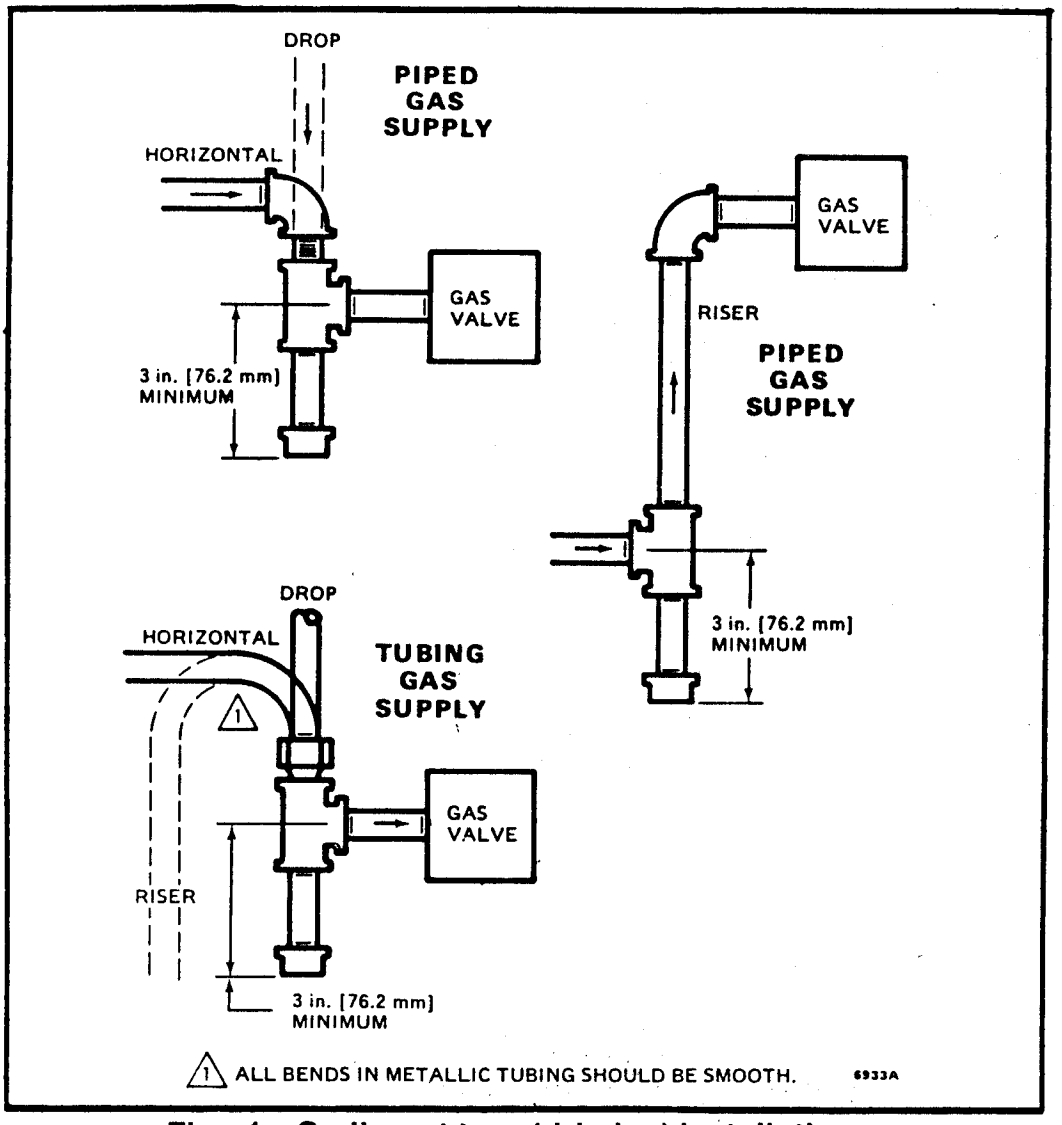


Fig. 1—Sediment trap (drip leg) installation.

LENGTH OF STANDARD PIPE THREADS (in.)

PIPE SIZE	EFFECTIVE LENGTH OF THREAD	OVERALL LENGTH OF THREAD
3/8	3/8	9/16
1/2	1/2	3/4
3/4	1/2 to 9/16	13/16
1	9/16	1

NOTE: SUPER TRADELINE controls have optional side outlets, Fig. 2. If you make a connection to one of the side outlets, be sure to install the plug in the straight-through outlet tapping.

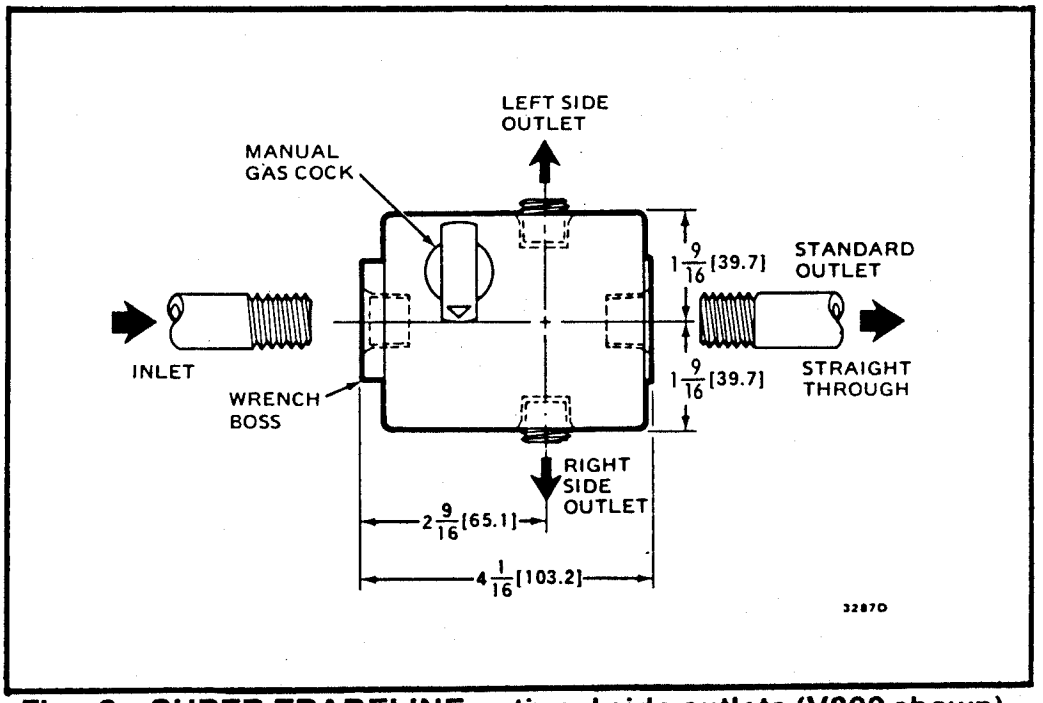


Fig. 2—SUPER TRADELINE optional side outlets (V800 shown).

INSTALLING THE CONTROL

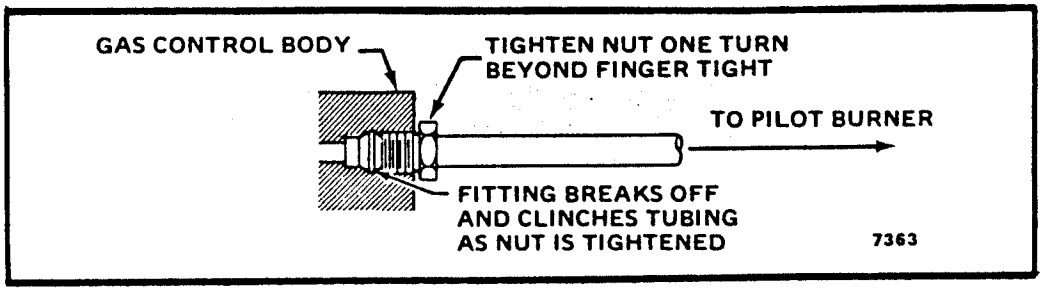
All controls, with the exception of negative pressure valves, can be mounted 0 to 90 degrees, in any direction, from the upright position of the gas cock knob. Negative pressure valves—V859, V860, VR459, VR859 and VR860—must be mounted with the gas cock knob straight up.

Install the control so that the gas supply is connected to the end of the control with the wrench boss. See Fig. 2.

CONNECTING THE PILOT TUBING

1. Square off and remove all burrs from the end of the tubing.

2. Bend the tubing to the desired form for routing to the pilot burner. Do not bend the pilot gas tubing at the control after the compression nut has been tightened as this could cause a gas leak at the connection.



3. Unscrew the brass compression fitting from the pilot outlet. Slip the fitting over the pilot tubing and slide it out of the way.

NOTE: When replacing a valve, always cut off the pilot tubing at the compression fitting. Do not use the old compression fitting on the new valve as it may not provide a tight seal.

4. Push the tubing into the pilot gas tapping until it bottoms. While holding the tubing all the way in, slide the fitting into place and engage the threads. Turn the fitting until finger tight, then use a wrench and tighten one turn beyond finger tight.

5. Connect the other end of the tubing to the pilot burner according to the pilot burner manufacturer's instructions.

CONNECTING THERMOCOUPLE OR THERMOPILE

Low voltage, line voltage and bulb-operated gas controls with Pilotstat pilot safety shutoff mechanisms require a 30 mV thermocouple to energize the power unit. "VS" controls require a 250 or 750 mV thermopile (Powerpile) to operate the control system and supply energy to the power unit.

Position the thermocouple or thermopile in the pilot flame according to the directions provided by the manufacturer.

1. To connect a thermocouple, run the cable to the power unit connector and engage threads. Tighten fitting 1/4 turn beyond finger tight. Remember, this is an electrical connection and must be clean and dry. Never use pipe compound on the thermocouple connection.

2. To connect a thermopile, follow the wiring diagram supplied by the appliance manufacturer or see page 28 on wiring Powerpile controls.

WIRING

Refer to the Operator section in GAS CONTROLS FOR CENTRAL HEATING or GAS CONTROLS FOR HEATING APPLIANCES chapters and follow the wiring instructions given.

STARTUP PROCEDURE

PILOT LIGHTING

The Lite-Rite gas cock knob has 3 settings (ON-PILOT-OFF) on continuous pilot gas controls and 2 settings (ON-OFF) on Intermittent Pilot and Direct Spark Ignition controls.

OFF—prevents the flow of gas to both the main burner and the pilot burner.

PILOT—permits gas to flow to the pilot burner only when the gas cock knob is held down or the thermocouple or thermopile is heated sufficiently to hold in the Pilotstat power unit.

ON—permits gas to flow to both the main burner and the pilot burner (on continuous pilot and IP controls) when the system is functioning properly.

1. Turn the gas cock knob to OFF. (If the knob is in the PILOT position, you must depress it slightly before it will turn to the OFF position.) Wait 5 minutes for all gas to vent. Remember, LP gas does not vent upward naturally.

2. Turn the gas cock knob to PILOT, push it all the way down and hold it there while lighting the pilot burner. Continue holding the knob down for one minute, to give the thermocouple or thermopile time to heat and generate enough current to hold the power unit in.

3. Release the gas cock knob and check that the pilot flame remains burning. If it does not, repeat steps 1 through 3. Check the size of the pilot flame, see below.

PILOT FLAME ADJUSTMENT

For continuous pilot controls. . .

The pilot flame should envelop 3/8 to 1/2 in. [9.5 to 12.7 mm] of the tip of the thermocouple or thermopile (Fig. 3). If the pilot flame needs adjustment, remove the pilot adjustment cover screw (Fig. 4, page 17) and turn the inner adjustment screw clockwise ↷ to decrease the pilot flame, counterclockwise ↶ to increase the pilot flame. Be sure to replace the cover screw after adjustment is complete to prevent gas from leaking.

For intermittent pilot controls. . .

Follow the instructions given by the appliance manufacturer as to how to adjust the pilot flame for proper ignition.

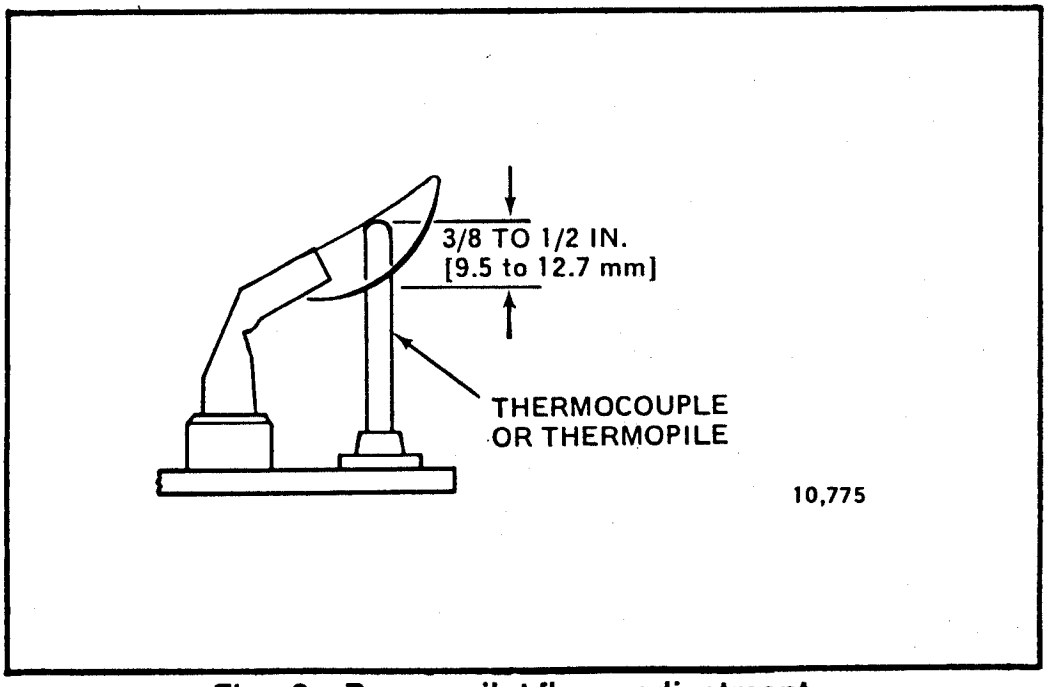


Fig. 3—Proper pilot flame adjustment.

CHECKOUT

Proper checkout consists of testing the control for gas leaks and making certain the input pressure to the appliance is correct.

GAS LEAK TEST

Perform a Gas Leak Test as follows. WITH THE GAS COCK KNOB ON, SET THE THERMOSTAT TO CALL FOR HEAT. WITH THE MAIN BURNER IN OPERATION, PAINT THE PIPE JOINTS, THE PILOT GAS TUBING CONNECTIONS AND THE VALVE GASKET LINES WITH A RICH SOAP AND WATER SOLUTION. BUBBLES INDICATE A GAS LEAK. TO STOP A LEAK, TIGHTEN THE PIPE JOINTS AND THE CONTROL BODY SCREWS OR REPLACE THE GASKET. NEVER USE A FLAME TO CHECK FOR GAS LEAKS.

CHECKING GAS INPUT TO THE APPLIANCE

Safety First—

— Do not exceed the input rating stamped on the appliance nameplate or the manufacturer's recommended burner orifice pressure for the size of orifice(s) used.

— Make certain that the primary air supply to the main burner is properly adjusted for complete combustion. Follow the appliance manufacturer's instructions if available.

MANIFOLD PRESSURE METHOD

1. Turn the gas cock knob to PILOT—for continuous pilot controls—or to OFF—for intermittent pilot controls—to prevent the flow of gas to the pressure tap.

2. Using a 3/16 in. Allen wrench, remove the pressure tapping plug (Fig. 4, page 17) and connect the pressure gauge (manometer).

3. Turn the gas cock knob to ON and turn the thermostat to call for heat. Cycle the burner off and on several times to make certain the system is functioning properly.

4. With the main burner on, read the pressure gauge. If the reading does not conform to the appliance manufacturer's recommended manifold pressure (in in. wc or kPa), adjust the pressure regulator as described in the regulator sections of GAS CONTROLS FOR CENTRAL HEATING and GAS CONTROLS FOR HEATING APPLIANCES chapters.

5. Turn the gas cock knob back to PILOT, or OFF, and remove the pressure gauge. Replace the pressure tap plug and repeat the gas leak test at the plug with the main burner in operation.

METER CLOCKING METHOD

1. Make certain there is no gas flow through the meter other than to the appliance being checked. Other appliances must remain off and their pilots extinguished (or their consumption deducted from the meter reading).

2. Cycle the burner on and off several times to make certain the control system is functioning normally.

3. With the main burner in operation, time the gas meter — using the sweep hand of a clock or wristwatch — to determine the exact rate of gas flow to the main burner in cubic feet per hour. See CONVERSION TABLE on the back cover.

4. Compare the actual input with the appliance manufacturer's recommended hourly input that is stamped on the appliance nameplate.

Convert Btuh to cfh, using the following formula:

$$\frac{\text{input rating in Btu's per hour (Btuh)}}{\text{Btu content of the gas per cubic foot}} = \text{Cubic feet of gas per hour (cfh)}$$

5. If the actual gas flow (cfh) does not conform to the manufacturer's recommended input rating (Btu converted to cfh), adjust the pressure regulator as described in GAS CONTROLS FOR CENTRAL HEATING or GAS CONTROLS FOR HEATING APPLIANCES chapters.

6. Turn the gas supply to other appliances back on, and relight all pilots.

CHECKING SAFETY SHUTOFF

With the gas cock knob in the PILOT position, extinguish the pilot flame and make certain the Pilotstat power unit shuts off the gas flow within 2-1/2 minutes. The safety shutoff of pilot gas proves complete shutdown of the control valve since the Pilotstat control valve blocks the flow of gas to both the main burner and the pilot burner.

FINAL CHECK

Put the system into operation and observe it through at least one complete cycle to make certain all controls are functioning properly.

GAS CONTROLS FOR CENTRAL HEATING

CENTRAL HEATING MODELS

Gas controls designated as central heating models are those controls with a capacity greater than 110 cfh [3.1 m^3/hr]. They are found on gas furnaces, boilers, unit heaters, rooftop units, duct furnaces, and swimming pool heaters.

The following table lists the various models, their capacities, type of operation and application. The models listed are available for all types of heating gases, and most are also available in two ambient temperature ranges, 32 F to 175 F [0 C to 79 C] or minus 40 F to plus 175 F [minus 40 C to plus 79 C].

Some of the controls listed for central heating are also available for heating appliances in 110 cfh [3.1 m^3/hr] capacities. They are covered in the GAS CONTROLS FOR HEATING APPLIANCES chapter. This chapter includes the specifications for and describes the operators and regulators of the V800 and VR800 family of combination gas controls. All information on the V500 family of combination gas controls will be found in the GAS CONTROLS FOR HEATING APPLIANCES chapter.

SPECIFICATIONS

MODELS: Refer to Table 1.

CAPACITIES: See Table 1. The actual valve capacity rating is determined by both the body size of the control (high capacity or standard capacity) and by the diameter of the inlet and outlet tappings. (If reducer bushings are used, the capacity will be determined by the actual diameter of the inlet and outlet.) Table 2 shows the relationship between the two.

TYPE OF GAS: Models are available for all heating gases.

PRESSURE TAPPING:1/8 NPT with plug, recessed for 3/16 in. [4.8 mm] Allen wrench.

PRESSURE RATING: A.G.A. rating 1/2 psig (14.0 in. wc [3.5 kPa]) inlet pressure. Designed for safe operation up to 28 in. wc [7.0 kPa].

PILOT GAS OUTLET: Compression fitting for 1/4 in. [6.4 mm] OD tubing.

TABLE 1 – COMBINATION GAS CONTROLS FOR CENTRAL HEATING

MODEL NUMBER	MAXIMUM STANDARD CAPACITY[a]		MAXIMUM HIGH CAPACITY[a]		OPERATION	APPLICATION
	cfh	m^3/hr	cfh	m^3/hr		
C580	335	9.5	600	16.7	None (30 mV manually operated Pilotstat manifold)	Continuous pilot
CS580	335	9.5	600	16.7	None (750 mV manually operated Pilotstat manifold)	Continuous pilot
V400	335	9.5	600	16.7	120 V, magnetic	Continuous pilot
V444	335	9.5	600	16.7	120 V, magnetic	Intermittent pilot
V445	335	9.5	600	16.7	120 V, magnetic	DSI
V459[c]	335	9.5	–	–	120 V, magnetic	DSI
V500[b]	335	9.5	600	16.7	Bulb, modulating, direct dial	Continuous pilot
V510[b]	335	9.5	600	16.7	Bulb, modulating, remote dial	Continuous pilot
V520[b]	335	9.5	600	16.7	Bulb, on-off, direct dial	Continuous pilot
V530[b]	335	9.5	600	16.7	Bulb, on-off, remote dial	Continuous pilot
V800	335	9.5	600	16.7	24 V, magnetic	Continuous pilot
V810	335	9.5	600	16.7	24 V, bimetal	Continuous pilot
V844	335	9.5	600	16.7	24 V, magnetic	Intermittent pilot
V845	335	9.5	600	16.7	24 V, magnetic	DSI
V850	335	9.5	600	16.7	24 V, 2-stage	Continuous pilot
V852	335	9.5	600	16.7	24 V, 2-stage	Intermittent pilot
V854	335	9.5	600	16.7	24 V, 2-stage	DSI
V859[c]	335	9.5	600	16.7	24 V, magnetic	DSI
V860[c]	335	9.5	600	16.7	24 V, magnetic	DSI
VR400	250	7.1	–	–	120 V, magnetic	Continuous pilot
VR444	250	7.1	600	16.7	120 V, magnetic	Intermittent pilot
VR445	250	7.1	600	16.7	120 V, magnetic	DSI
VR800	250	7.1	–	–	24 V, magnetic	Continuous pilot
VR810	250	7.1	–	–	24 V, bimetal	Continuous pilot
VR844	250	7.1	600	16.7	24 V, magnetic	Intermittent pilot
VR845	250	7.1	600	16.7	24 V, magnetic	DSI
VR850	250	7.1	600	16.7	24 V, 2-stage	Continuous pilot
VR852	250	7.1	600	16.7	24 V, 2-stage	Intermittent pilot
VR854	250	7.1	600	16.7	24 V, 2-stage	DSI
VR859[c]	250	7.1	600	16.7	24 V, magnetic	DSI
VR860[c]	250	7.1	600	16.7	24 V, magnetic	DSI
VS820	335	9.5	600	16.7	750 mV	Continuous pilot

[a] Capacities differ according to inlet and outlet size, see Table 2. Capacity in cfh is based on 1,000 Btu/cu ft, 0.64 sp. gr. nat. gas at 1.0 inch wc pressure drop. Capacity in MJ/m^3 is based on 37.3 MJ/m^3, 0.64 sp. gr. nat. gas at 0.25 kPa pressure drop.

For other gases, use the conversion factors in the table below.

SP. GR.	MULTIPLY LISTED CAPACITY BY
0.60	0.516
0.70	0.765
1.53	1.62

[b]See GAS CONTROLS FOR HEATING APPLIANCES chapter for information.

[c]The gas controls are negative pressure regulated.

TABLE 2–CAPACITY RATINGS AND PIPE SIZE (inlet-outlet)

BODY TYPE	INLET TAPPING in.	OUTLET TAPPING in.	CAPACITY cfh	CAPACITY m^3/hr
Standard capacity "V" and "C" type controls	1/2	1/2	225	6.4
	1/2	3/4	250	7.1
	3/4	3/4	335	9.5
Standard capacity "VR" type controls	1/2	1/2	200	6.2
	1/2	3/4	225	6.4
	3/4	3/4	250	7.1
High capacity "V," "C" and "VR" type controls	3/4	3/4	450	12.7
	3/4	1	503	14.2
	1	1	600	16.7

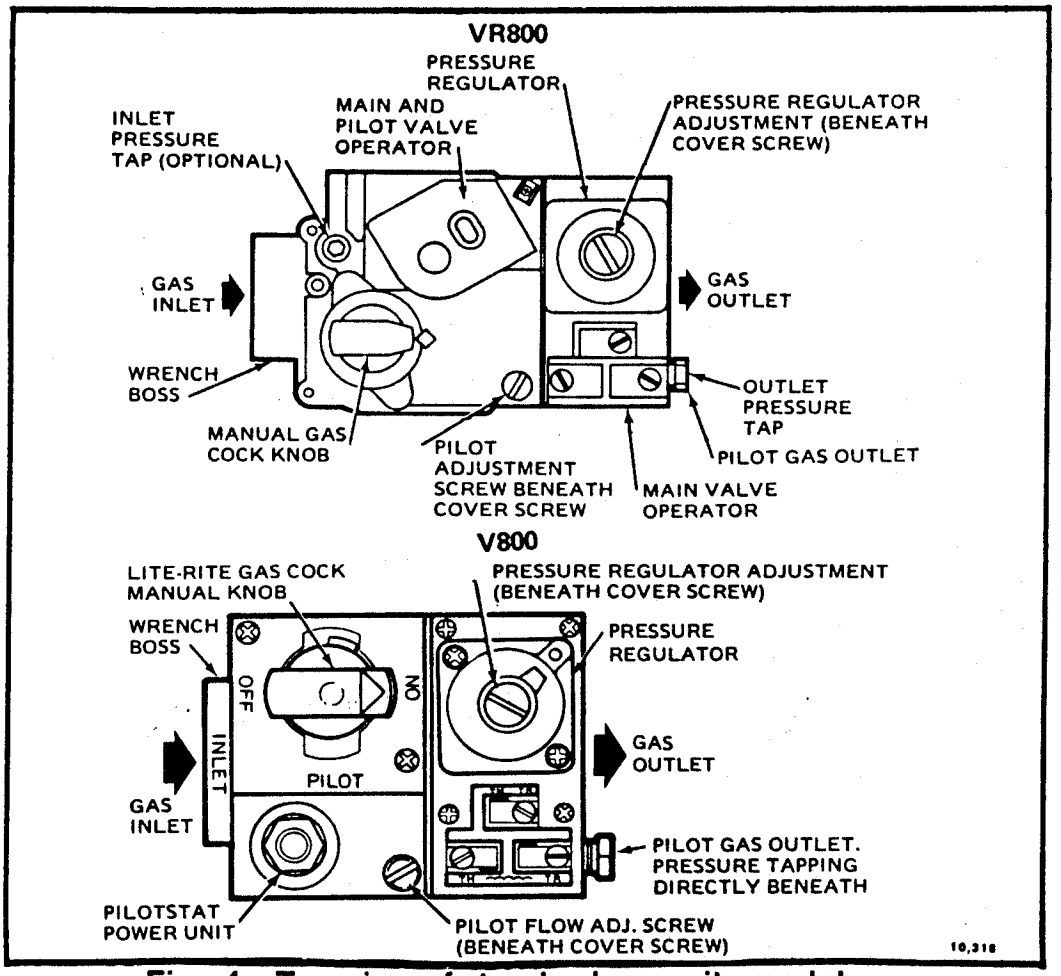


Fig. 4—Top view of standard capacity models.

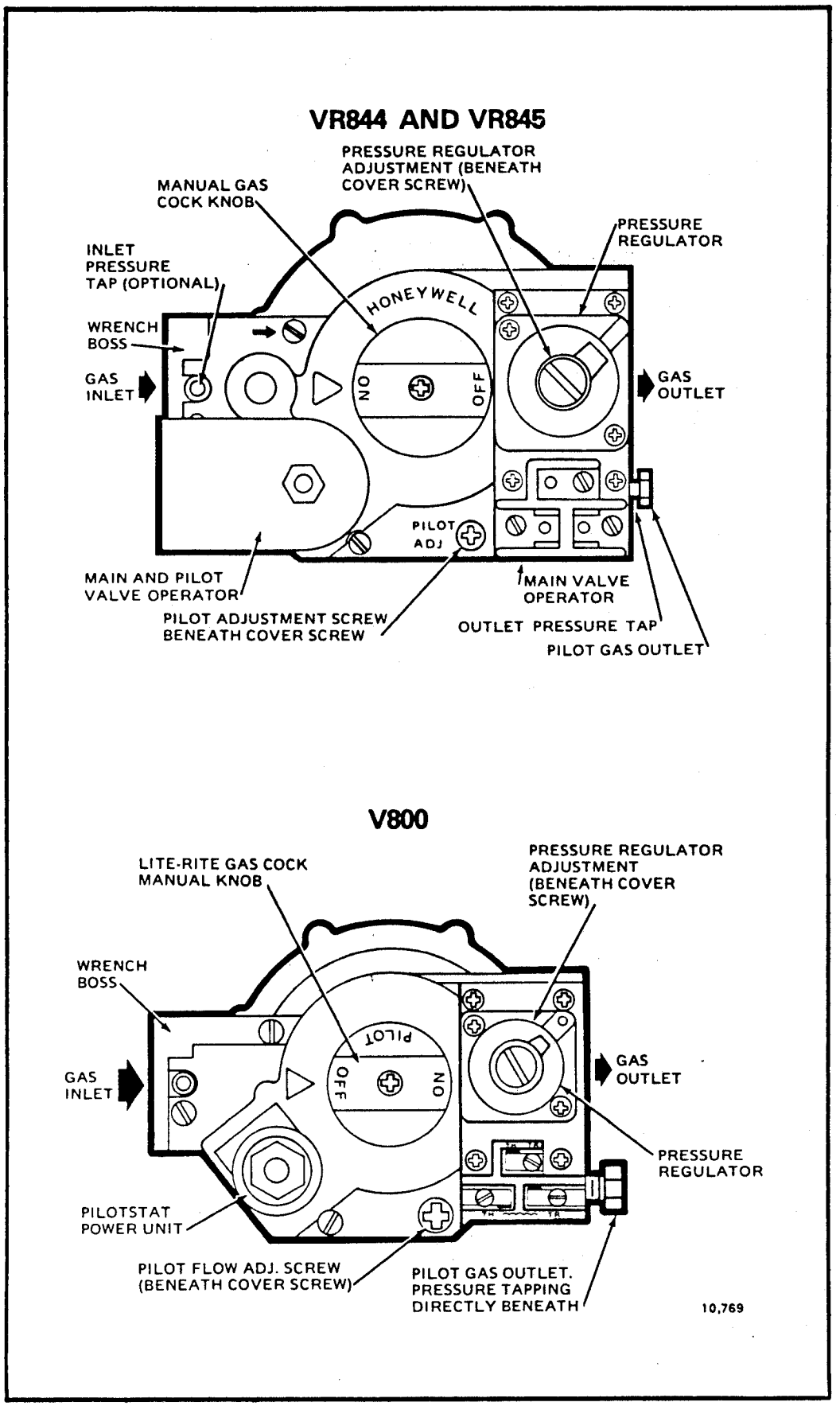


Fig. 5—Top view of high capacity models.

ELECTRICAL CONNECTIONS: 120 V operators have 36 in. [0.9 m] leadwires; 24 V and Powerpile valve operators have combination screws and 1/4 in. male quick-connects.

GENERAL ELECTRICAL DATA:

CONTROL VOLTAGE	VALVE OPERATOR TIMING[b]	PILOTSTAT			
		TYPE	HOLD-IN	DROP-OUT	TURNDOWN mV-OPEN CIRCUIT
MANUAL C580,C581 and Bulb Controlled V500 Models	Does not apply . . .	30 mV (0.018 ohm)	300 mA max.	250 to 70 mA max.	2 mV
24 V[a]	V804 — less than 3 sec. V814 — 30 sec. delay time				
120 V	V404 — less than 3 sec.				
Powerpile[c]	VS824 — 3 sec. nominal	750 mV (11 ohm)	15 mA max.	10.5 to 5.5 mA min.	141 mV

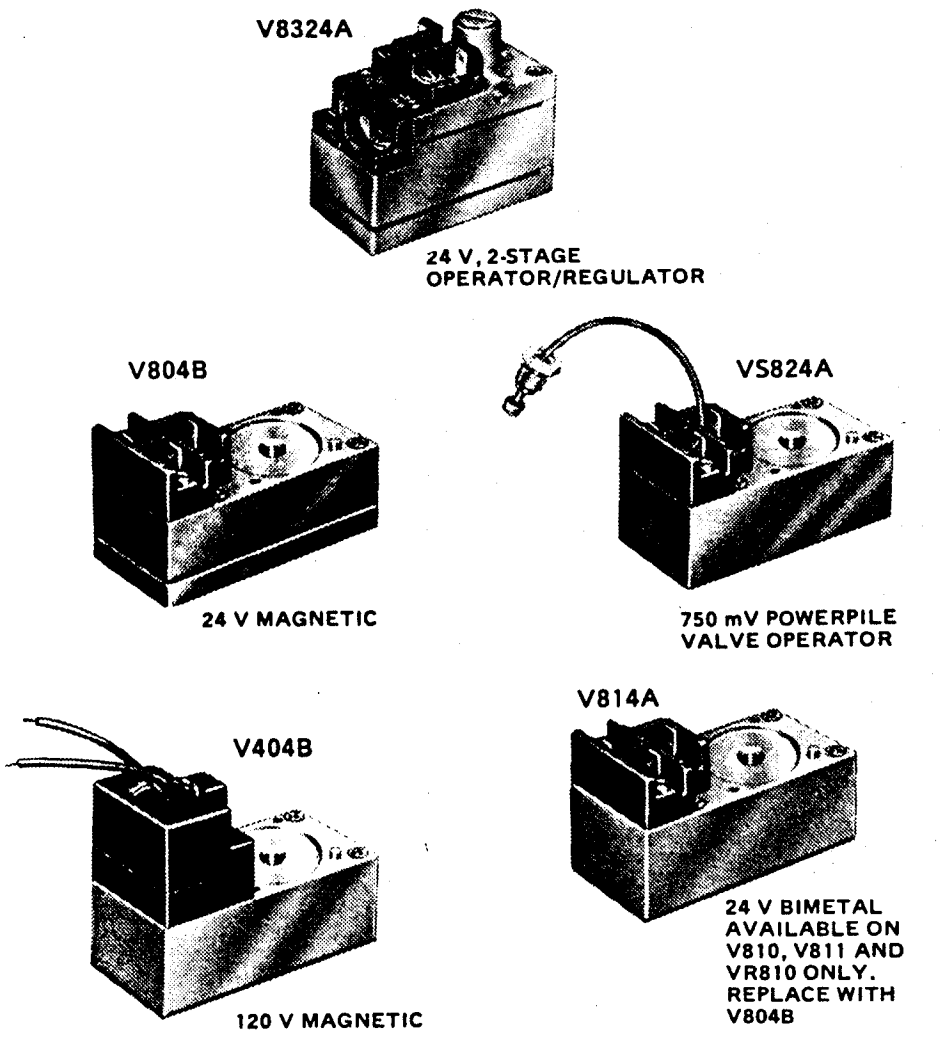
[a] Recommended transformers: AT12, AT20, AT40, or AT72.

[b] Applies to both opening and closing cycles.

[c] Powerpile valve operator pull-in current 65 mA max.

VALVE OPERATORS FOR V800 AND VR800 GAS CONTROLS

INTERCHANGABLE VALVE OPERATORS
FOR SERVICE REPLACEMENT OR FIELD ADD-ON



AUTOMATIC VALVE OPERATORS

The operating voltage of the gas control is determined by the voltage of its main valve operator(s). Although 5 operators are available as original equipment—V404A, 120 V magnetic; V804A, 24 V magnetic; V814A, 24 V bimetal (supplied on the V810, VR810 and V811 only); V8324, 24 V 2-Stage Operator/Regulator; and VS824A, 750 mV magnetic—only the V404A, V804A, V8324A and VS824A may be used for field replacement. The same operators are used on both standard and high capacity models of the V800 and VR800 controls.

Note, however, that on dual valve, "VR" type, gas controls the 1st main valve operator that is built into the control body is not replaceable.

See GAS CONTROLS FOR HEATING APPLIANCES chapter for information on bulb type operators for V500 gas controls.

OPERATOR INSTALLATION

Safety First—

- — Installer must be an experienced, trained service technician.
- — Disconnect power supply to prevent electrical shock or equipment damage.
- — If the gas control is in operation (Lite-Rite gas cock knob in ON position), turn the gas cock to PILOT or OFF before starting work.
- — Be sure to conduct a Gas Leak Test after turning the gas back on.

ADDING AN OPERATOR TO A MANUAL GAS CONTROL

1. Remove the adapter casting and its gasket from the manifold body, Fig. 6. Check to make certain that the gas ports are clear and the gasket seating surfaces are clean.

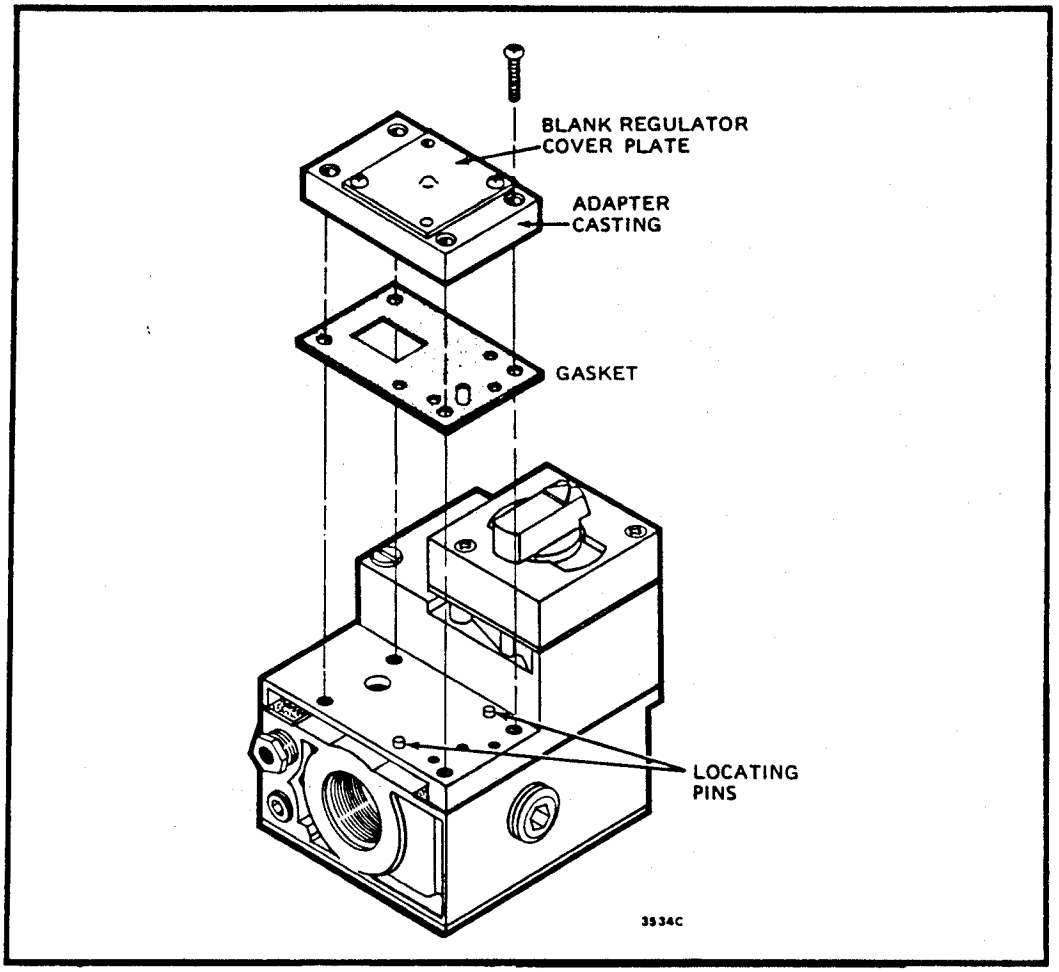


Fig. 6—Remove the adapter casting and gasket from the gas control manifold before installing the operator.

2. Place the new gasket in position on the manifold body. The locator pins are used for properly seating the gasket.

3. Carefully position the new operator over the gasket, again using the locator pins as a guide, and screw it down using the screws provided. The shorter screws are for standard capacity gas controls; the longer screws are for high capacity controls. Make certain all screws are tightened down evenly and securely.

NOTE: If a V5307A step-opening regulator is to be added to the operator, omit the screw on the outside corner. The V5307A uses this hole for a long mounting screw which extends into the control body.

REPLACING V404A, V804A AND VS824A OPERATORS

If you are replacing an original operator, disconnect the existing wiring as follows.

1. 24 V and Powerpile systems. Disconnect the leadwires at the terminal block (and on "VR" type controls, the 1st main valve operator wires), carefully noting the terminal markings for each connection. On Powerpile systems, also disconnect the jumper lead to the Pilotstat power unit.

120 V systems. To gain access to the screws holding the operator onto the body: first, disconnect the operator leadwires at the junction box and then disconnect the conduit at the fitting in the operator cover. Remove the terminal cover.

2. Remove the pressure regulator from the operator. Save the regulator and its gasket for reassembly on the new operator.

3. Remove the old operator and its gasket.

4. Check that all gas ports are clear and that the gasket seating surface is clean. Place the new gasket in position on the control, using the locating pins to position it (Fig. 7).

5. Carefully position the new operator over the gasket, again using the locating pins for proper positioning, and mount the control using the screws provided. Use the short screws for standard capacity controls; use the long screws for high capacity controls. Tighten the screws down evenly and securely.

NOTE: On controls equipped with a V5307A step-opening regulator, omit the screw on the outside corner. The V5307A needs this hole for a long mounting screw which extends into the control body.

REPLACING V8324,2-STAGE OPERATOR/REGULATORS

The V8324A is a special purpose operator/regulator for replacement on 2-stage gas controls. The operator and regulator are not separately replaceable. Replace the V8324A as follows:

1. Tag each leadwire as it is removed (including the 1st main operator leadwires on "VR" type controls).

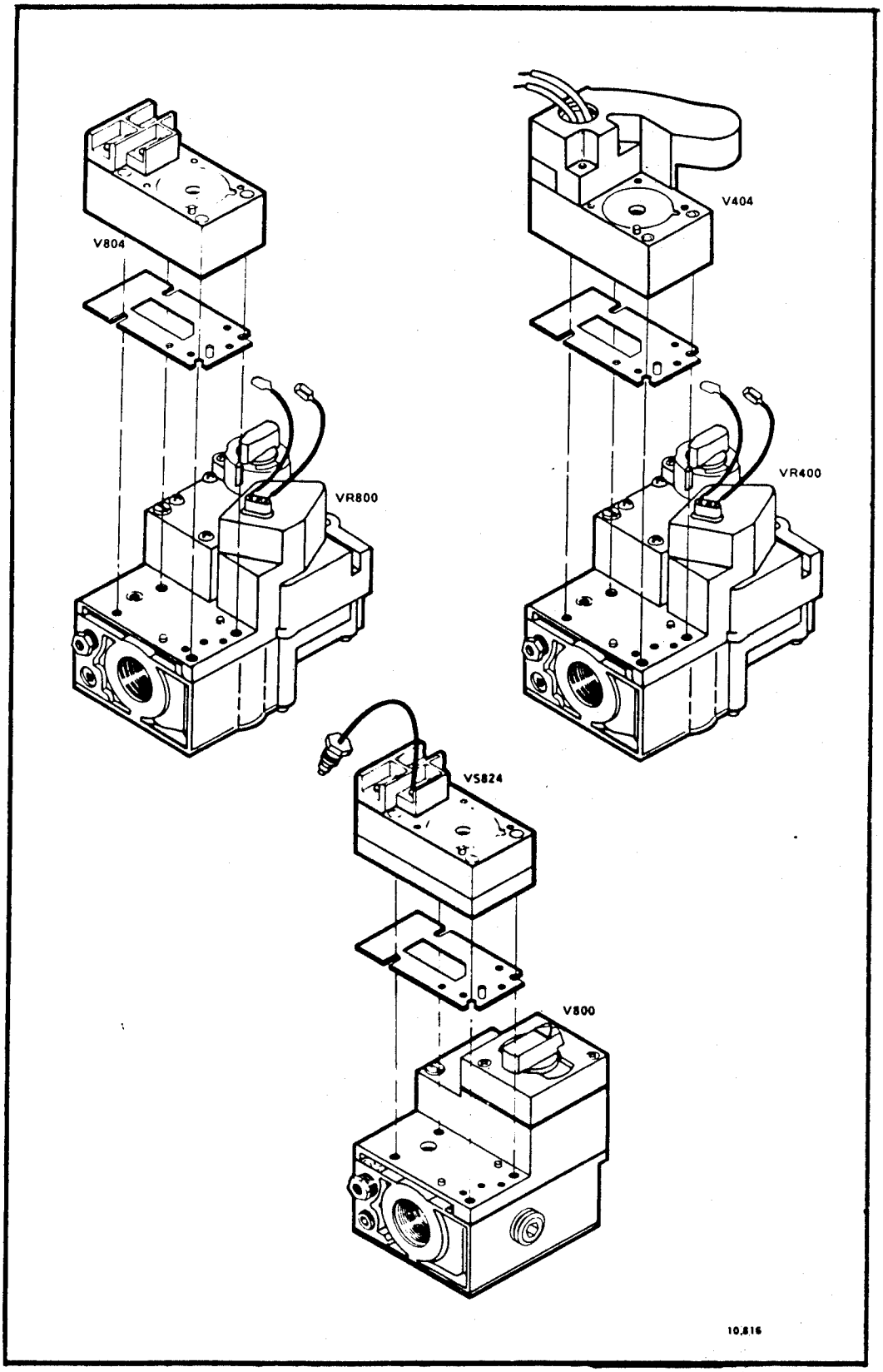


Fig. 7—Removing and installing valve operators on V800 and VR800 gas controls.

2. If the "C" terminals are jumpered, remove the jumper and install it on the new control.

3. Loosen the 4 mounting screws and remove the old operator.

4. Remove and discard the old gasket.

NOTE: When installing the V8324A, do not remove the tape to separate the operator/regulator assembly. This may result in loss of calibration and damage to the control. See Servo Pressure Regulators, page 36 for information on adjusting the pressure regulator of the V8324.

5. Place the new gasket over the locating pins shown in Fig. 8 and position the new V8324B over the gasket and pins.

6. Tighten down the mounting screws evenly and securely.

7. Reconnect the wires as originally installed.

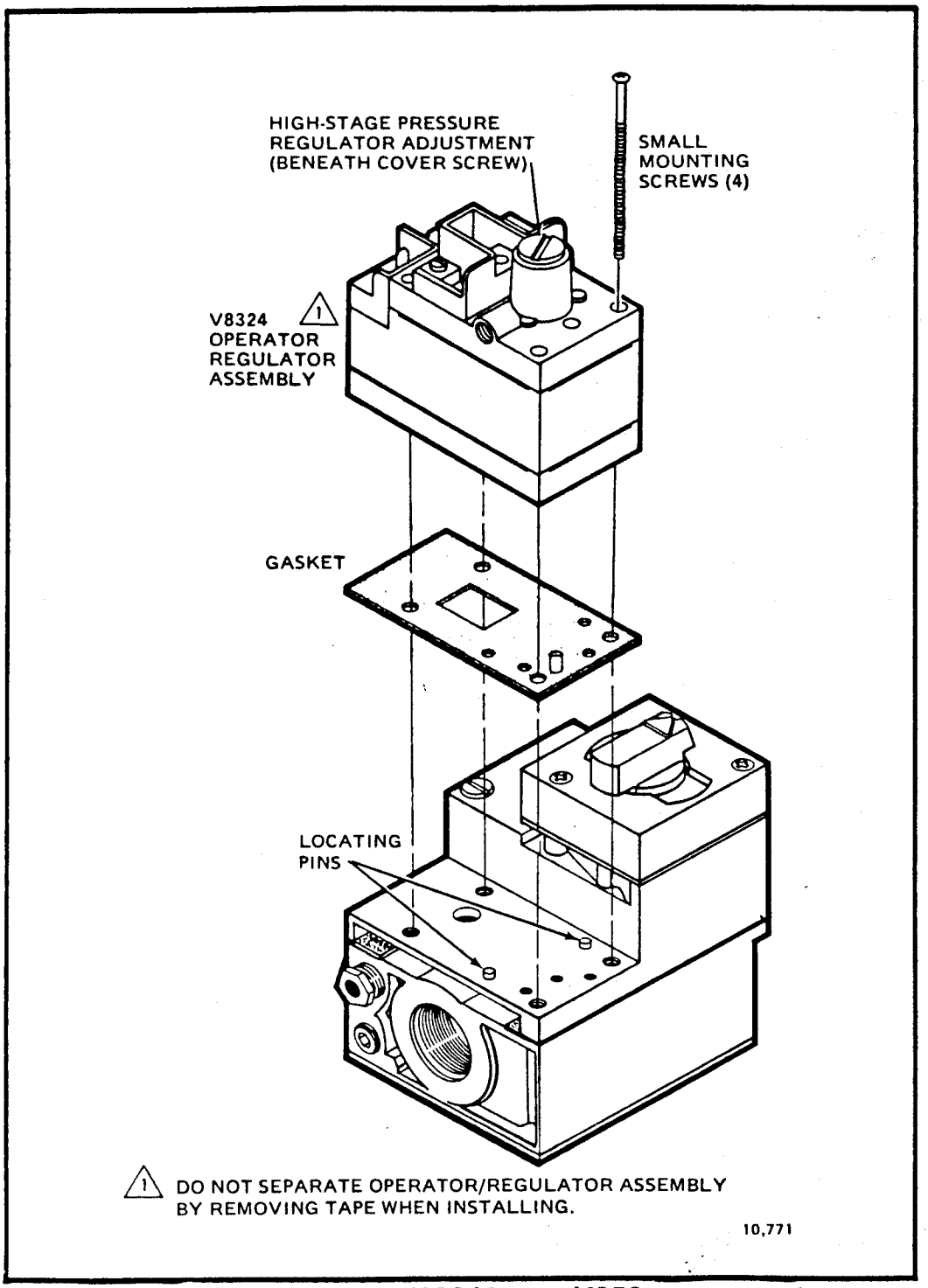


Fig. 8—Replacing the V8324A on a V850 gas control.

WIRING OPERATORS

Safety First—

— Disconnect the power supply before connecting the wires to prevent electric shock or equipment damage.

1. If you are replacing an operator, reconnect the wiring as originally installed.

Valve operators are color coded:

Blue—24 V, V804B.
Black—24 V (bimetal), V814A and V8324.
Red—Powerpile, VS824A.
Black conduit cover—120 V, V404B.

2. If you are installing an operator on a manual, "C" or "CS" Pilotstat power unit manifold, follow the appropriate procedure below.

V804 (24 V, magnetic)

Never jumper, or short, the valve coil terminals even temporarily, as this may burn out the heat anticipator in the thermostat.

1. Install the transformer, low voltage thermostat, and other controls as required.

2. Connect the control circuit to the operator terminals as shown in Fig. 9.

3. Adjust the thermostat heat anticipator to 0.2 A for "V" type valves, 0.6 A for standard capacity "VR" type valves, and 0.9 A for high capacity "VR" type valves. If another control is placed in the control circuit, add its current rating to that of the gas controls and set the anticipator accordingly.

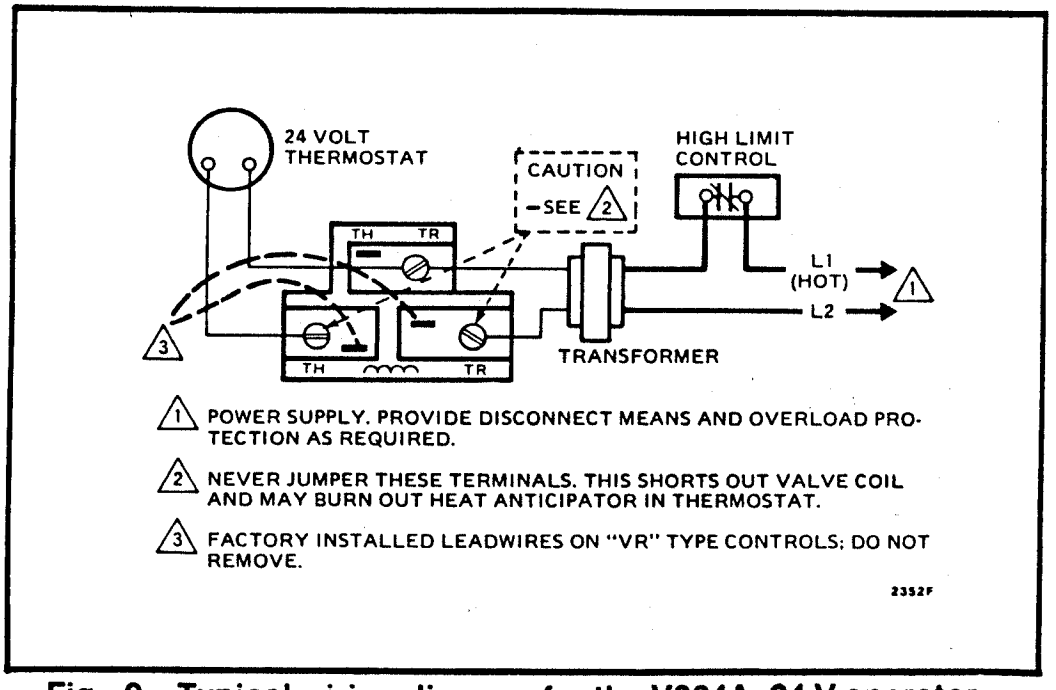


Fig. 9—Typical wiring diagram for the V804A, 24 V operator.

V404A (120 V, magnetic)

1. Install the line voltage thermostat (or controller) and other controls as required (Fig. 10).

2. Be sure to use a junction box when connecting the control circuit to the valve operator.

Make conduit connections to operator(s) as follows—

— Slip the conduit fitting over the leadwires and screw it securely into the hole in the operator cover.
— Cut the conduit to the appropriate length, slip the conduit over the leadwires and attach it to the fitting.
— Connect the conduit to the junction box and connect the wires to the control circuit. Do not splice the wire except within a junction box.

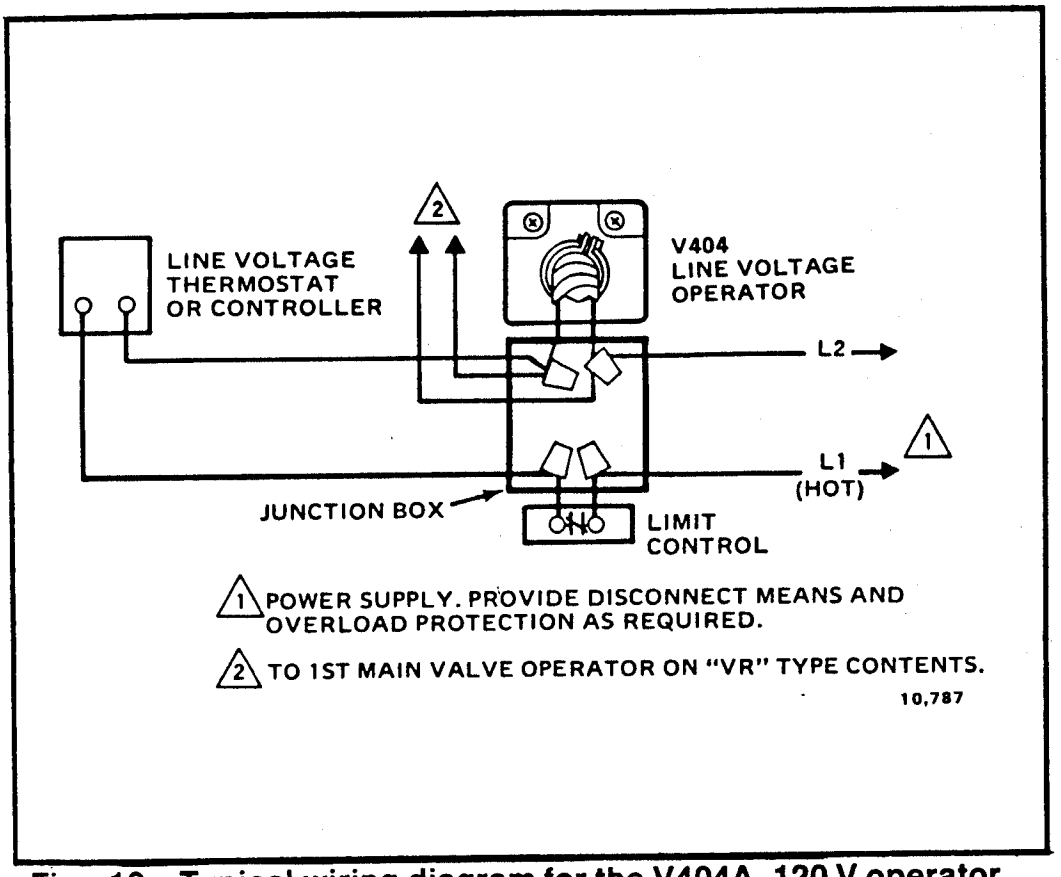


Fig. 10—Typical wiring diagram for the V404A, 120 V operator.

V8324B (24 V, 2-stage)

1. Connect the terminals as shown in the complete circuit diagram provided by the appliance manufacturer. If not furnished, refer to Fig. 11.

NOTE: Do not jumper, or short, terminals C and W1 or C and W2 as this will burn out the heat anticipator in the thermostat.

2. Set the heat anticipators of the 2-stage thermostat at: Stage 1, 0.20 A; Stage 2, 0.24 A.

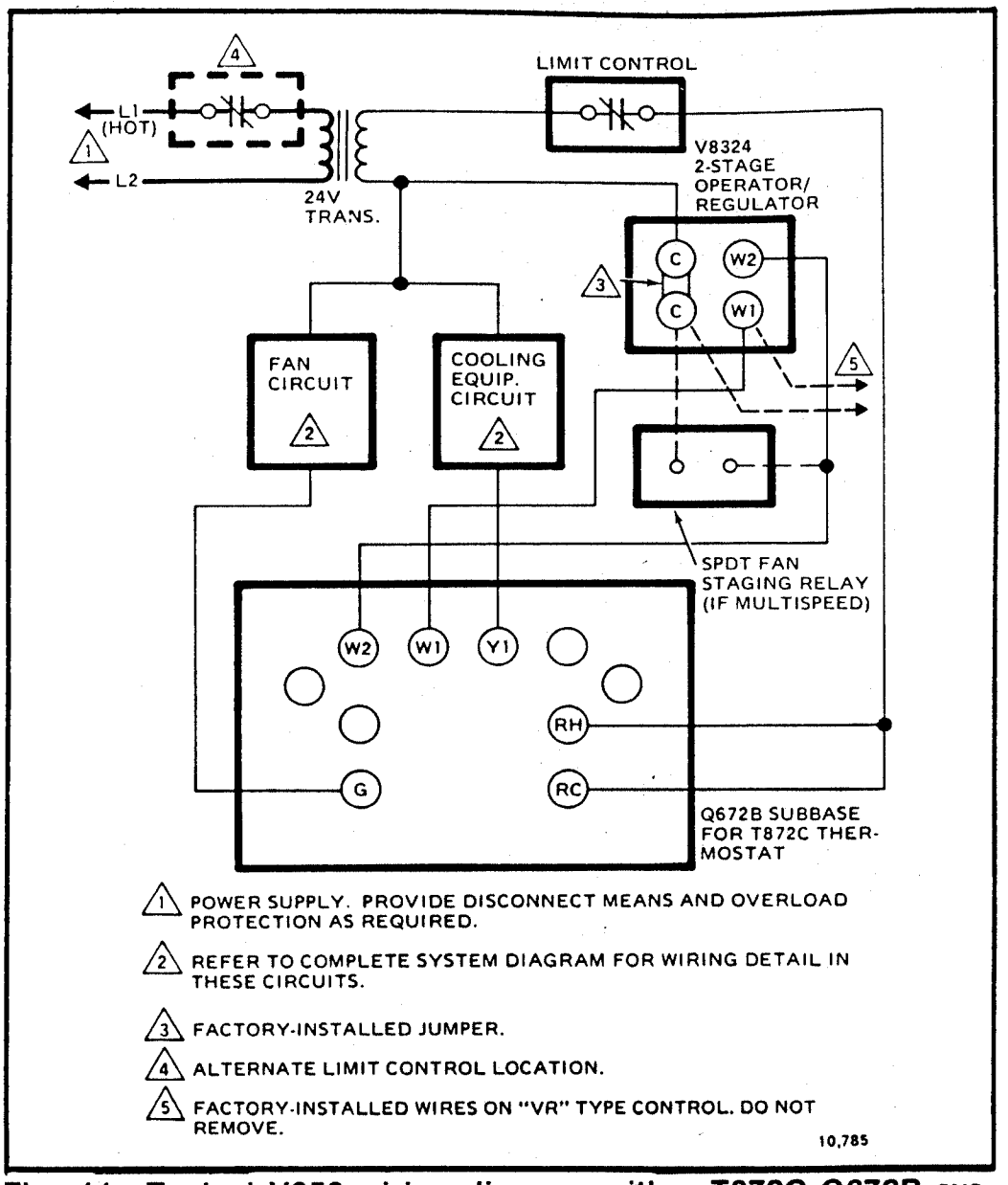


Fig. 11—Typical V850 wiring diagram with a T872C-Q672B system with 24 V relays controlling fan and cooling equipment.

VS824A (Powerpile, magnetic)

Never connect millivoltage operators to line voltage or to a transformer as this may burn out the valve coil. Also, since the entire system is powered by the millivoltage generated by the Powerpile generator, it is important to clean and scrape all wires before connecting. Solder and tape all necessary splices using rosin flux to prevent corrosion. Tighten terminal screws.

Total control circuit wiring must not exceed 30 ft [9 m] of 2-wire, 18 gauge cable or 50 ft [15 m] of 2-wire, 16 gauge cable.

1. Install the Powerpile thermostat, limit control, and Powerpile generator as required.

2. After the Powerpile generator is installed, connect the leads to the operator at terminals labeled PP (Fig. 12). Make certain the

jumper lead from the operator to the safety shutoff Pilotstat power unit is connected and tightened 1/4 turn beyond finger tight.

3. Connect the wires from the control circuit to the operator terminals labeled TH.

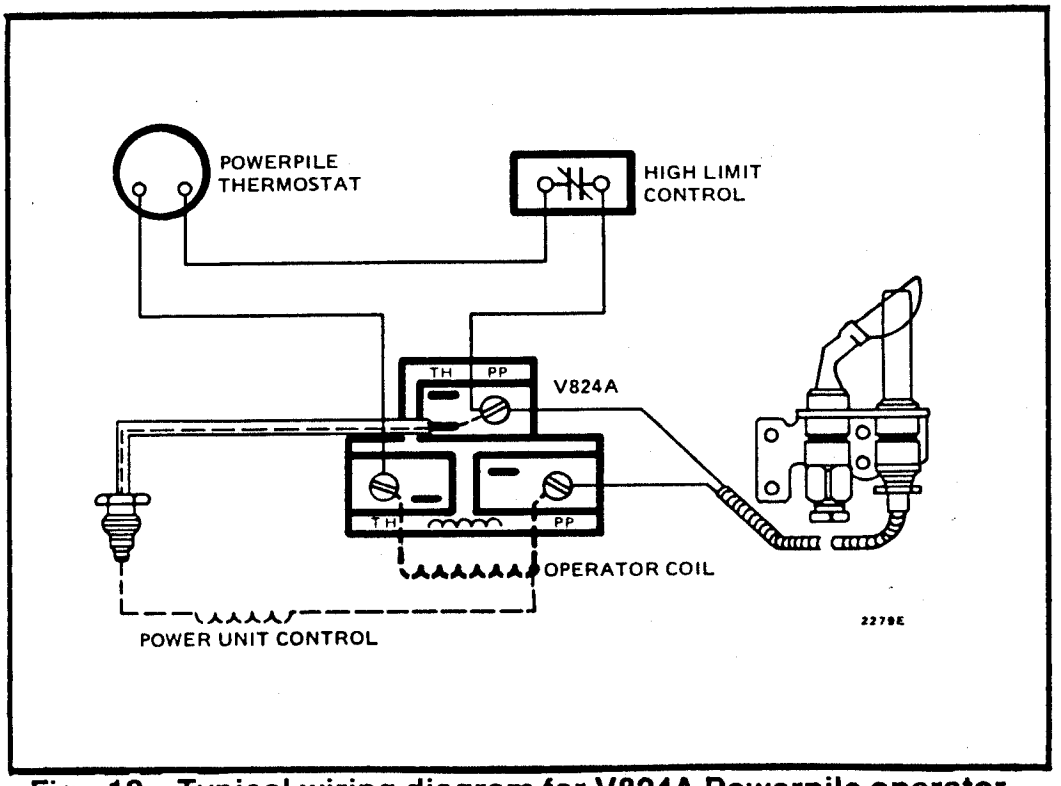


Fig. 12—Typical wiring diagram for V824A Powerpile operator.

OPERATOR CHECKOUT

1. Turn on power supply and relight pilot burner if it was extinguished.

2. Turn the gas cock knob to ON and adjust the thermostat to call for heat. Check for proper burner ignition and flame condition.

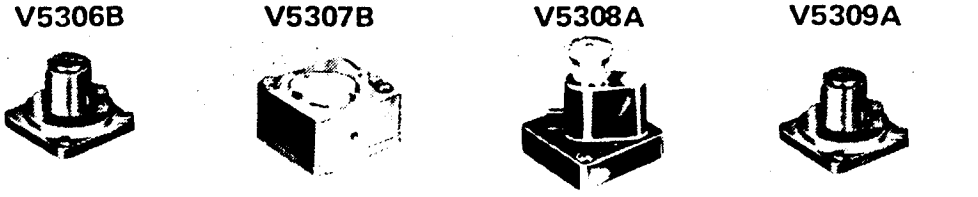
NOTE: Bimetal operator, V814A, used on V810, VR810 and V811 opens the valve 30 seconds after a call for heat; it closes the valve 20 seconds after the thermostat is satisfied.

3. Observe the system through at least one complete cycle to make certain all controls are working properly.

4. Conduct a Gas Leak Test as follows. WITH THE MAIN BURNER IN OPERATION, PAINT THE VALVE OPERATOR AND PRESSURE REGULATOR OR COVER PLATE GASKET LINES WITH A RICH SOAP AND WATER SOLUTION. BUBBLES INDICATE A GAS LEAK. TO STOP LEAK, TIGHTEN ASSEMBLY SCREWS OR, IF NECESSARY, REPLACE THE GASKET. NEVER USE A FLAME TO CHECK FOR A GAS LEAK.

SERVO PRESSURE REGULATORS FOR THE V800 AND VR800 FAMILY

INTERCHANGABLE—FOR ADD-ON OR REPLACEMENT, LP OR NATURAL GAS



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SERVO PRESSURE REGULATORS

V5306A,B,C; V5307A,B; V5308A and V5309A

These pressure regulators can be used on all V800 and VR800 gas controls (except 2-stage gas controls) for replacement, add-on or change-over. See GAS CONTROLS FOR HEATING APPLIANCES chapter for information on V500 regulators.

Regulators are mounted on the operator, if used, or on the adapter casting, if no operator is used. Models are available for both Natural and LP gas installations.

The V5306A,B,C is the standard pressure regulator. Complete gas controls equipped with the V5306 have an "A" following the basic model number: for example, V810A or VR844A. See notes 1 and 2 under Tables 3 and 4 for differences between A, B and C models of the V5306. Conversion kits, Part Nos. 391936 and 391937, allow field converting the V5306 from a Natural gas regulator to an LP gas regulator or vice versa.

The V5307A,B is a step-opening pressure regulator. Complete gas controls equipped with the V5307 have a "C" after the basic model number for example, V800C or VR445C.

The V5308A is a hi-lo flame pressure regulator. Complete gas controls equipped with the V5308A have a "D" after the basic model number; for example, V445D.

The V5309A is a convertible regulator for use on either Natural gas or LP gas. It has a fixed setting and is not field adjustable. Complete gas controls equipped with the V5309A have an "E" following the basic model number; for example, V400E. See Table 3 and 4 for complete specifications.

V8324

The regulator of the V8324 2-Stage Operator/Regulator is not independently replaceable as are other regulators, nor can it be converted in the field with any conversion kit (Part Nos. 391936 and 391937). The operator/regulator assembly must be replaced as a single unit and the gas type must be specified when ordering. Regulation of the first-stage is factory-set and not field adjustable. See Tables 3 and 4 for complete specifications.

TABLE 3 – SERVO PRESSURE REGULATOR SPECIFICATIONS (NATURAL GAS)

PRESSURE REGULATOR MODEL NUMBER AND TYPE		OUTLET PRESSURE TO BURNER					
		STANDARD FACTORY SETTING		RANGE OF OPTIONAL FACTORY SETTINGS		RANGE OF FIELD ADJUSTMENT	
		in. wc	kPa	in. wc	kPa	in. wc	kPa
V5306[a,b] Standard		3.5	0.9	3.0 to 5.0	0.7 to 1.2	3.0 to 5.0	0.7 to 1.2
V5307 Step-opening	Step	0.9 (50% of full)	0.2 (50% of full)	0.6 to 0.9	0.1 to 0.2	not adjustable	
	Full-rate	3.5	0.9	3.0 to 5.0	0.7 to 1.2	3.0 to 5.0	0.7 1.2
V5308 Hi-Lo Flame	Lo	0.9 (50% of Hi)	0.2 (50% of Hi)	0.6 to 0.9	0.1 to 0.2	not adjustable	
	Hi	3.5	0.9	3.0 to 5.0	0.7 to 1.2		
V5309 LP-Nat. Changeover		3.5	0.9	3.0 to 5.0	0.7 to 1.2		
V8324 2-stage operator/ regulator	1st stage	1.3	0.3	0.9 to 2.5	0.2 to 1.2		
	2nd stage	3.5	0.9	3.0 to 5.0	0.7 to 1.2	3.0 to 5.0	0.7 to 1.2

[a]V5306B Pressure Regulator ("A" models) is low temperature rated for minus 40 to plus 175 F [minus 40 to plus 80 C]. The V5306B may be used to replace a V5306A with 32 to 175 F [0 to 80 C] ambient temperature rating.

[b]V5306C ("A" models) has a 1.0 inch wc [.25 kPa] adjustment range.

TABLE 4 – SERVO PRESSURE REGULATOR SPECIFICATIONS (LP GAS)

PRESSURE REGULATOR MODEL NUMBER AND TYPE		OUTLET PRESSURE TO BURNER					
		STANDARD FACTORY SETTING		RANGE OF OPTIONAL FACTORY SETTINGS		RANGE OF FIELD ADJUSTMENT	
		in. wc	kPa	in. wc	kPa	in. wc	kPa
V5306[a,b] Standard		11.0	2.7	8.0 to 12.0	2.0 to 3.0	8.0 to 12.0	2.0 to 3.0
V5307 Step-opening	Step	2.2 (45% of full)	0.5 (45% of full)	1.0 to 2.5	0.3 to 0.6	not adjustable	
	Full-rate	11.0	2.7	8.0 to 12.0	2.0 to 3.0	8.0 to 12.0	2.0 to 3.0
V5308 Hi-Lo Flame	Lo	2.8 (50% of Hi)	0.7 (50% of Hi)	1.0 to 2.8	0.3 to 0.7	not adjustable	
	Hi	11.0	2.7	8.0 to 12.0	2.0 to 3.0		
V5309 LP-Nat. Changeover		11.0	2.7	8.0 to 12.0	2.0 to 3.0		
V8324 2-stage operator/ regulator	1st stage	2.2	0.5	1.0 to 6.0	0.3 to 1.5		
	2nd stage	11.0	2.7	8.0 to 12.0	2.0 to 3.0	8.0 to 12.0	2.0 to 3.0

[a] V5306B Pressure Regulator ("A" models) is low temperature rated for minus 40 to plus 175 F [minus 40 to plus 80 C]. The V5306B may be used to replace a V5306A with 32 to 175 F [0 to 80 C] ambient temperature rating.

[b] V5306C ("A" models) has a 1.0 inch wc [.25 kPa] adjustment range. .

NOTE: The step-opening rate on the V5307B and the pressure settings on the V5308A and V5309A are not field adjustable. Some appliance manufacturers use regulators with settings differing from the standard values in the table. If you are making a service replacement, check the factory setting stamped on the body of the original regulator and be sure to replace it with an identical model.

INSTALLING PRESSURE REGULATORS

Safety First—

— Installer must be an experienced, trained service technician.
— If the system is in operation (Lite-Rite gas cock knob ON), turn the gas cock knob back to PILOT or OFF.
— Be sure to conduct a Gas Leak Test (page 5) after the regulator is installed and the gas is turned back on.

1. See Figs. 13 and 14 for regulator location. Remove the old regulator, or the cover plate on manual Pilotstat power unit manifolds with adapter castings, and discard the old gasket. Check to be sure all gas ports are clear and the gasket seating surface is clean.

2. Press the new gasket into the circular recess shown, seat the regulator, and fasten it down with the 2 screws provided. Tighten screws evenly and securely.

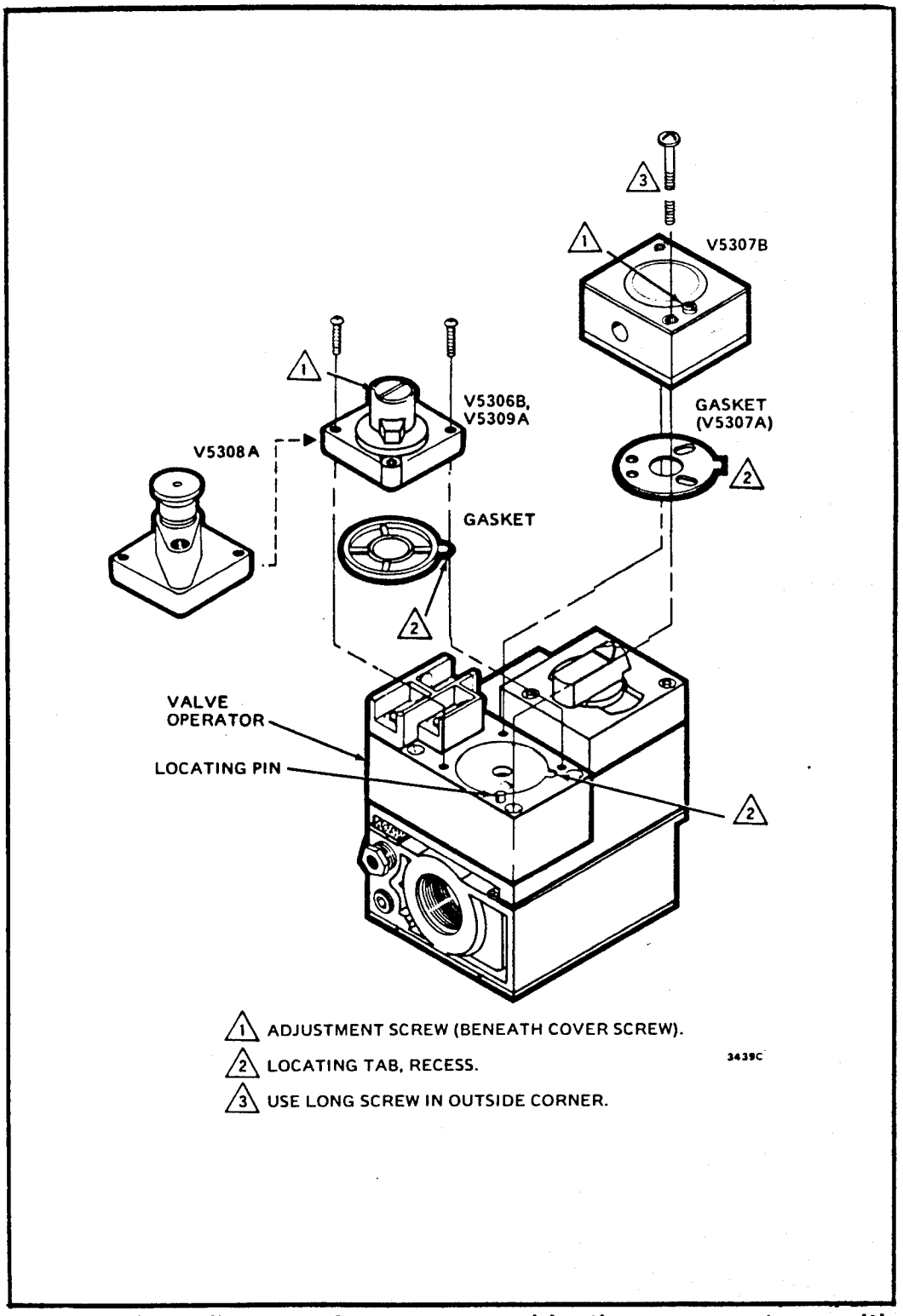


Fig. 13—Installing regulators on combination gas controls with valve operators. (V800 shown.)

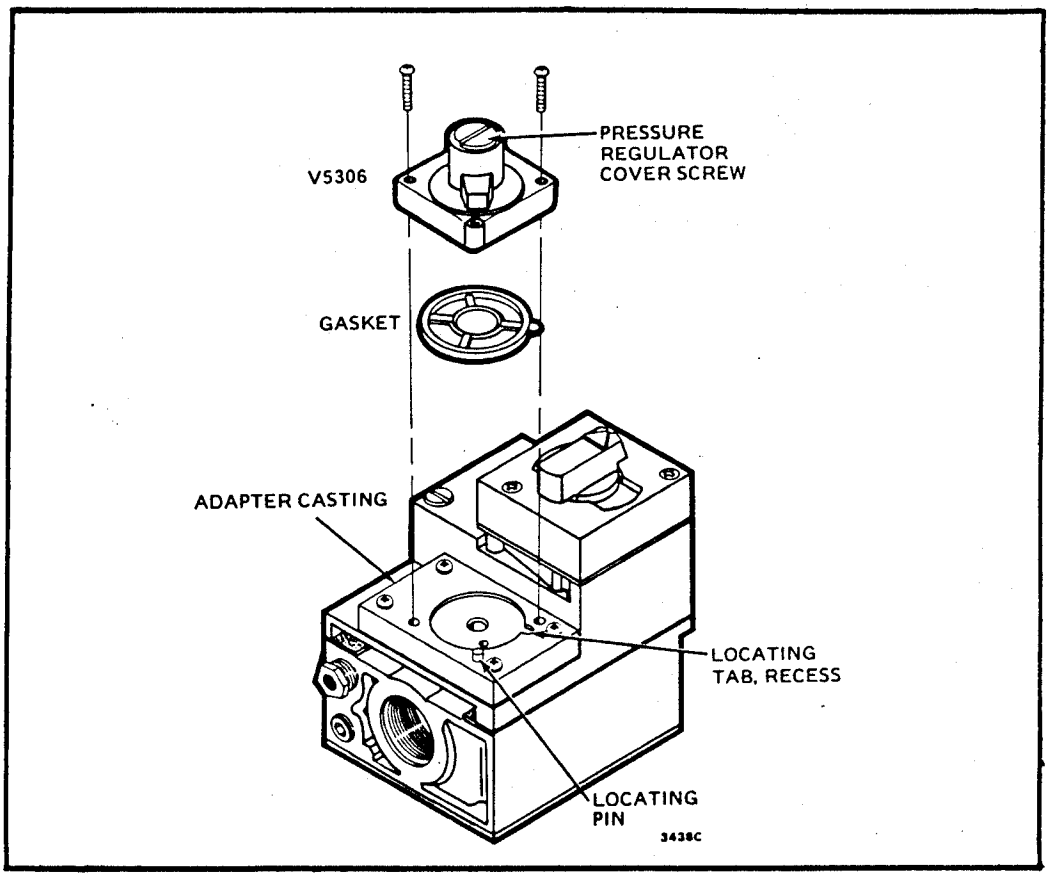


Fig. 14—Installing regulators on manual Pilotstat power unit manifold controls with operator adapter casting.

PRESSURE REGULATOR CHECKOUT AND ADJUSTMENT

Conduct a Gas Leak Test as follows. WITH THE MAIN BURNER IN OPERATION, PAINT THE REGULATOR GASKET LINE WITH A RICH SOAP AND WATER SOLUTION. BUBBLES INDICATE A GAS LEAK. TO STOP THE LEAK, TIGHTEN THE SCREWS OR REPLACE THE GASKET AND CHECK AGAIN FOR LEAKS.

CHECKING GAS INPUT TO THE APPLIANCE

Safety First—

- — Do not exceed the input rating stamped on the nameplate of the appliance, or the manufacturer's recommended burner orifice pressure for the sizes of orifice(s) used.
- — Make certain that the primary air supply to the main burner is properly adjusted for complete combustion. Follow the instructions of the appliance manufacturer if available.

V5306A,B,C STANDARD REGULATOR

1. Turn the gas cock knob to PILOT or OFF.

2. Connect a manometer (pressure gauge) to the pressure tapping located just below the pilot gas outlet.

3. Turn the gas cock knob to ON and set the thermostat to call for heat.

The V5306 is factory-set at 3.5 in. wc [0.9 kPa] outlet pressure for natural gas or 11.0 in. wc [2.7 kPa] for LP gas. If adjustment is required, proceed with step 4.

4. Remove the pressure regulator cover screw, Fig. 14. Using a screwdriver, turn the adjustment screw clockwise ↷ to increase the gas pressure to the burner, counterclockwise ↶ to decrease the gas pressure to the burner.

The pressure may be adjusted from 3.0 to 5.0 in. wc [0.7 to 1.2 kPa] for natural gas or 8.0 to 12.0 in. wc [2.0 to 3.0 kPa] for LP gas.

NOTE: The adjustment screw is plastic and may require a slightly greater turning force than a metal screw.

5. Replace the cover screw to prevent gas from leaking. Turn the gas cock knob to PILOT or OFF, disconnect the manometer, and replace pressure tap plug.

6. Turn the gas cock knob to ON and with main burner in operation, conduct a Gas Leak Test (page 5) at the pressure tap.

7. Observe the system through at least one cycle to make certain it is operating properly.

V5307A,B STEP-OPENING REGULATOR

1. Turn the gas cock knob to PILOT or OFF.

2. Connect a pressure gauge (manometer) to the pressure tapping located just below the pilot gas outlet.

3. Turn the gas cock knob to ON, set the thermostat to call for heat, and wait for burner operation at full rate.

The step pressure is not field adjustable. Standard full rate pressure is 3.5 in. wc [0.9 kPa] for natural gas or 11.0 in. wc [2.7 kPa] for LP gas. If adjustment is required, proceed with step 4.

4. Remove the pressure regulator cover screw, Fig. 13. Using a small screwdriver, turn the adjusting screw clockwise ↷ to increase pressure to the main burner, counterclockwise ↶ to decrease pressure to the main burner.

The full rate pressure may be adjusted from 3.0 to 5.0 in. wc [0.7 to 1.2 kPa] for natural gas or 8.0 to 12.0 in. wc [2.0 to 3.0 kPa] for LP gas.

NOTE: The adjustment screw is plastic and may require slightly greater turning force than a metal screw.

5. Replace the cover screw to prevent gas from leaking. Turn the gas cock knob to PILOT or OFF, disconnect the manometer, and replace the pressure tap plug.

6. Turn the gas cock knob to ON and with main burner operating, conduct a Gas Leak Test (page 5) at the pressure tapping.

7. Check the burner performance at the step-opening pressure by observing the burner ignition and flame characteristics. The burner should ignite promptly—without flashback to orifice—and all ports should remain lit when full rate is established. Cycle the burner several times, waiting 30 seconds between cycles to allow the servo regulator time to resume step action. Repeat after allowing the appliance to cool.

V5308A HI-LO FLAME REGULATOR

The Hi and Lo settings are selected using the knob shown in Fig. 15. The burner will operate at high flame when the knob is pushed down, low flame when the knob is pulled up.

1. Check low flame operation by observing the ignition and flame characteristics. The burner should ignite promptly and without flashback to the orifice. All ports should remain lit. Cycle the burner several times, then repeat the check after allowing the appliance to cool.

2. Turn the gas cock knob to PILOT or OFF.

3. Connect a pressure gauge (manometer) to the pressure tapping located just below the pilot gas outlet.

4. Turn the gas cock knob to ON, set the burner for high flame, and set the thermostat to call for heat.

This pressure regulator is not field adjustable. If the gas input at high flame exceeds the appliance nameplate rating, check the main burner orifice diameter against the appliance manufacturer's specifications for the gas being used.

5. Turn the gas cock knob to PILOT or OFF, disconnect the manometer and replace the pressure tap plug.

6. Turn the gas cock knob to ON and with main burner operating at high flame conduct a Gas Leak Test (page 5) at the pressure tap.

7. Observe the system through at least one cycle to make certain it is operating properly.

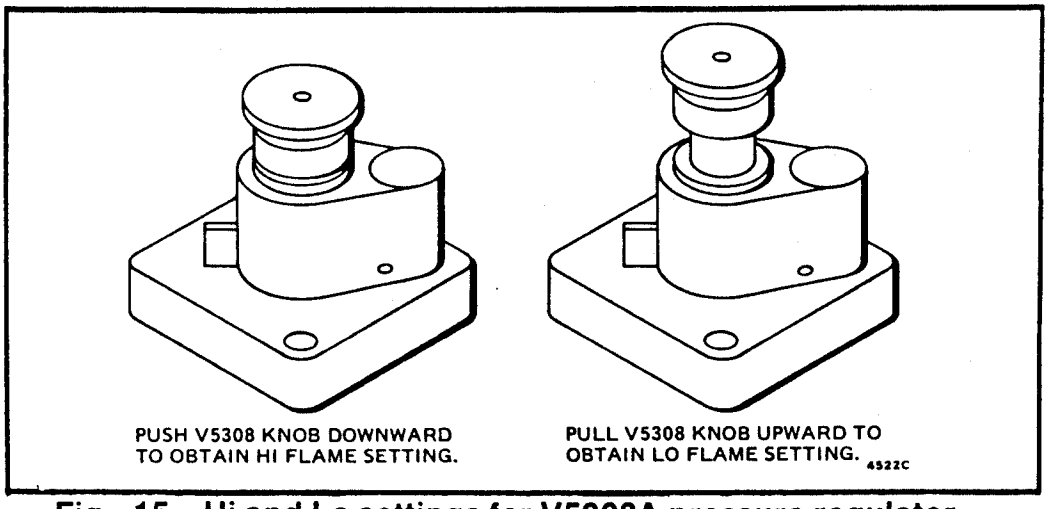


Fig. 15—Hi and Lo settings for V5308A pressure regulator.

V5309A LP-NATURAL GAS CHANGEOVER

Safety First—

— When a gas system is being converted for operation on another gas, the main burner and pilot orifices must be changed to meet the appliance manufacturer's specifications for the particular gas. Refer to the appliance manufacturer's instructions for orifice specifications and changeover procedures.

The natural and LP gas settings are selected by positioning the slotted shaft as shown in Fig. 16.

Adjust to LP gas or natural gas setting as follows:

1. Remove the pressure regulator cover screw, Fig. 13.

2. For LP gas, using a small screwdriver, depress and rotate the shaft so the slot is in line with LP, stamped on the bushing. The shaft will remain depressed for LP gas operation.

For natural gas, rotate the shaft so the slot is in line with N, stamped on the bushing.

3. Replace cover screw.

Check gas input to the main burner as follows:

1. Turn the gas cock knob to PILOT or OFF.

2. Connect a pressure gauge (manometer) to the pressure tapping located below the pilot gas outlet.

3. Turn the gas cock knob to ON and set the thermostat to call for heat.

The V5309 is not field adjustable. If the gas input exceeds the appliance nameplate rating, check the burner orifice diameter against the appliance manufacturer's specifications for the gas being used.

4. Turn the gas cock knob to PILOT or OFF, disconnect the manometer, and replace the pressure tap plug.

5. Turn the gas cock knob to ON and with main burner operating, conduct a Gas Leak Test (page 5) at the pressure tap.

6. Observe the system through at least one complete cycle to make certain it is operating properly.

V8324 2-STAGE OPERATOR/REGULATOR

1. Turn the gas cock knob to PILOT or OFF.

2. Connect a pressure gauge (manometer) to the pressure tapping located just below the pilot gas outlet.

3. Turn the gas cock knob to ON and set the thermostat several degrees above room temperature to call for second-stage heating.

First stage will open within 3 seconds, second stage will open approximately 60 seconds later.

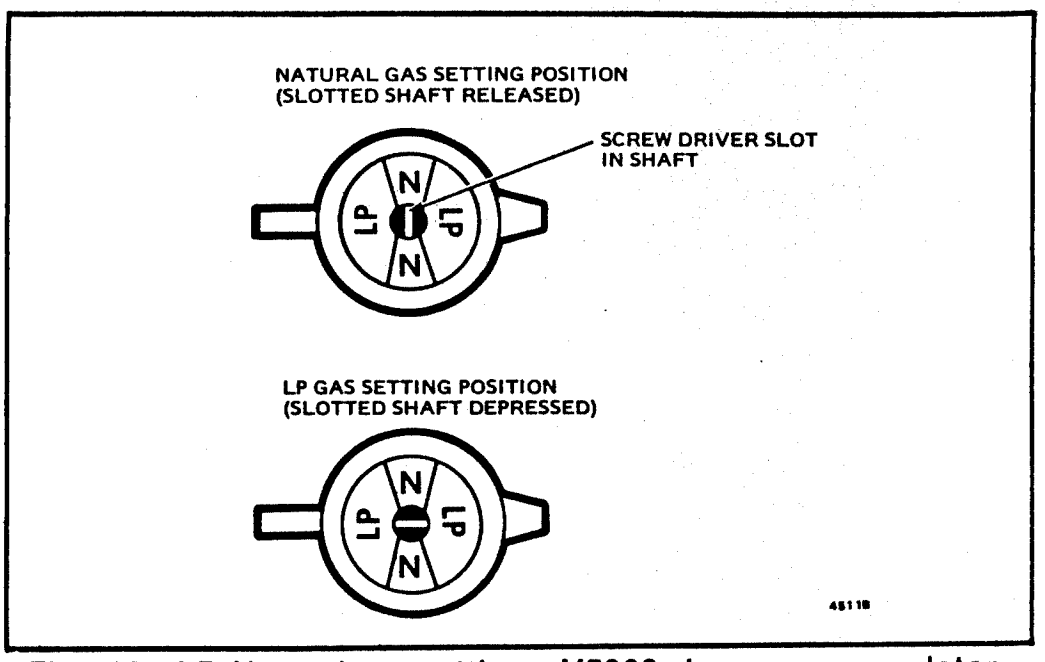


Fig. 16—LP-Natural gas settings, V5309 changeover regulator.

4. Check pressure. The standard second stage pressure is 3.5 in. wc [0.9 kPa] for natural gas, 11.0 in. wc [2.7 kPa] for LP gas. If adjustment is required, proceed with step 5.

5. Remove the pressure regulator cover screw, see Fig. 8. Using a small screwdriver, turn the adjustment screw clockwise ↷ to increase pressure to the main burner, counterclockwise ↶ to decrease the pressure to the main burner.

The full-rate (second stage) pressure may be adjusted from 3.0 to 5.0 in. wc [7.0 to 1.2 kPa] for natural gas or 8.0 to 12.0 in. wc [2.0 to 3.0 kPa] for LP gas.

NOTE: The adjustment screw is plastic and may require slightly greater turning force than a metal screw.

6. Replace the cover screw to prevent gas from leaking. Turn the gas cock knob to PILOT or OFF, disconnect the manometer, and replace the pressure tap plug.

7. Turn the gas cock knob on to ON and with the main burner operating at second-stage, conduct a Gas Leak Test (page 5) at the pressure tapping.

8. Check the burner performance at first-stage pressure by adjusting the thermostat to call for heat.

Observe ignition and flame characteristics. The burner should ignite promptly, without flashback to orifice, and all ports should remain lit.

9. Cycle the burner several times, waiting at least 2 minutes between cycles to allow the bimetal in the regulator to cool so that lightoff will be at first-stage pressure. (If the thermostat is fast cycled, the burner may ignite at high fire.) Repeat test after allowing the appliance to cool.

REPLACING THE PILOTSTAT POWER UNIT

V800 AND V500

All V800 and V500 gas controls use the same power unit for both high and low capacity models.

24V, 120V, bulb-operated and C580, C581 manually operated controls use a 30 mV, 0.018 ohm power unit—Part No. 392393.

The CS580, CS581 and all "VS" (Powerpile) operated controls use a 750 mV, 23 ohm power unit—Part No. 392394.

NOTE: Original equipment on Powerpile controls is a 750 mV, 11 ohm power unit—Part No. 392395.

To replace the power unit:

1. Turn off the gas supply to the appliance at the service cock or the gas meter.

2. Using a wrench, unscrew the thermocouple or Powerpile system connector.

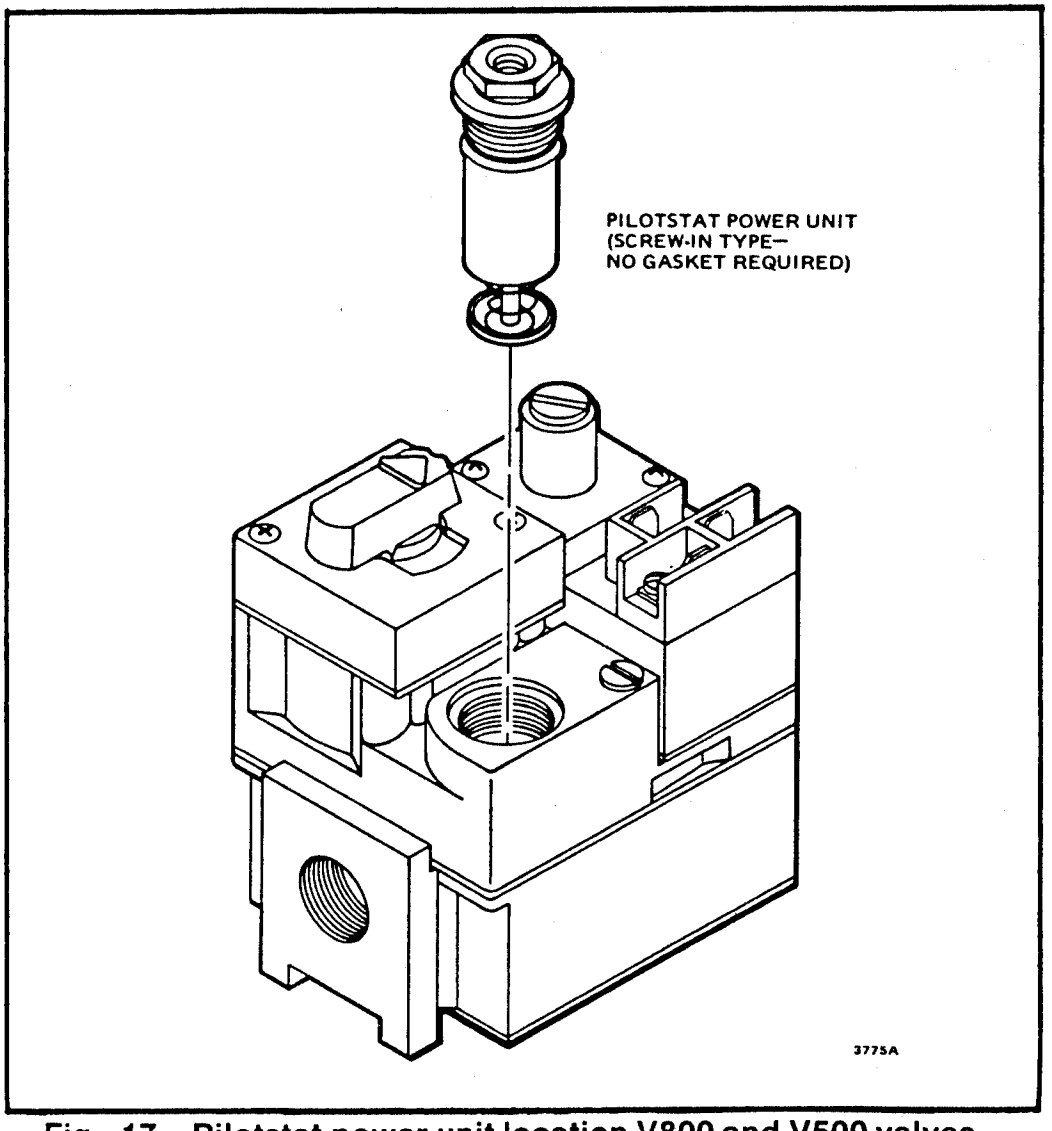


Fig. 17—Pilotstat power unit location V800 and V500 valves.

3. Remove the power unit using a wrench. See Fig. 17 for location.

4. Install the new power unit and tighten it securely; no gasket is required.

5. Make certain the tip of the thermocouple or Powerpile system connector is clean. Remember, this is an electrical connection, never use pipe dope on the thermocouple or Powerpile system connector. Reconnect the thermocouple or Powerpile system connector to the power unit and tighten it 1/4 turn beyond finger tight.

VR800

The 392147 Pilotstat Power Unit is designed for field replacement of original VR800 Dual Valve Combination Gas Control power units.

Similar in function to other Honeywell Pilotstat power units, the 392147 differs only in that it has the safety shutoff disc attached directly to it. (No rocker arm is included in the Pilotstat power unit mechanism of the VR800.)

The thermocouple-powered 392147 provides 100 percent shutoff of both main and pilot gas if thermocouple fails or pilot goes out. A replacement gasket is included.

To replace the power unit:

1. Turn off the main gas supply to the appliance. The power unit plate assembly is located on the bottom of the gas control, (Fig. 18). If there is not enough working space below the gas control to remove it easily (minimum 2-1/2 in. [63.5 mm], the gas control will have to be rotated or removed to gain access to the assembly.

2. Disconnect the thermocouple leadwire from the power unit.

3. Remove the power unit plate assembly and remove the hex nut that holds the power unit onto the plate.

4. Remove and discard the old gasket.

5. Install the new power unit and tighten the hex nut tightly against the assembly plate.

6. Clean the surfaces where the gasket will seal the gas control and then place the new gasket on the assembly plate and reinstall the power unit plate assembly. Tighten down all screws evenly and firmly.

7. Connect the thermocouple lead to the power unit, making certain that the lead connection is clean and dry and makes good contact with the power unit.

The thermocouple connection to the Pilotstat safety control power unit is an electrical connection. Never use pipe compound. Tighten only 1/4 turn beyond finger tight to give electrical continuity.

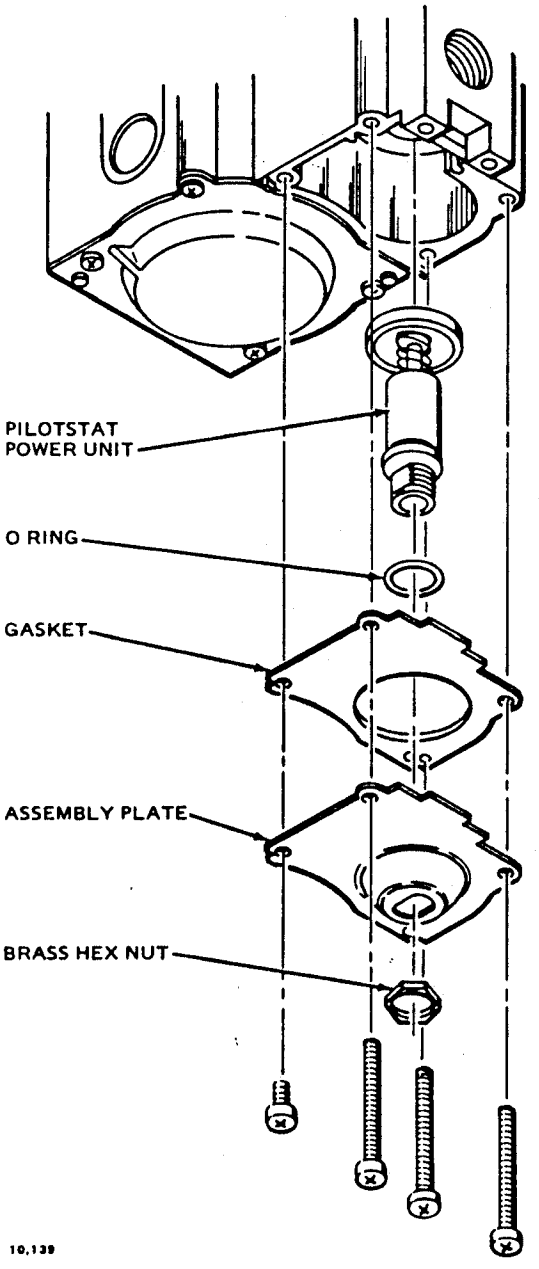


Fig. 18—Pilotstat power unit location on VR type valves.

CHECKOUT

1. Turn on the gas supply and test for gas leaks. See Gas Leak Test, page 5.

2. With the gas cock knob in the pilot position, extinguish the pilot flame and make certain that the Pilotstat power unit shuts off the flow of pilot gas within 2-1/2 minutes.

GAS CONTROLS FOR HEATING APPLIANCES

HEATING APPLIANCE MODELS

Gas controls designed for heating appliance application are those controls with capacities of from 40.5 to 110 cfh [1.1 to 3.1 m^3/hr]. They are used on vented and unvented room heaters, wall and floor furnaces, and gas fireplace heaters.

Table 5 lists the gas controls from the V800 and V500 families that are designed for heating appliance application and the models of the 40.5 and 80 cfh [1.1 and 2.3 m^3/hr] series.

SPECIFICATIONS

MODELS: See Table 5.

CAPACITIES:
- V800 and V500 Families—See Table 5.
- 40.5 and 80 cfh [1.1 and 2.3 m^3/hr] series—See Table 5; suffix "E" and "F" models have a maximum capacity of 80 cfh [2.3 m^3/hr]; suffix "R" models have a maximum capacity of 40.5 cfh [1.1 m^3/hr].

TYPE OF GAS: Models available for all heating gases.

PRESSURE RATING:
- V800 and V500 Families—A.G.A. rating 1/2 psig (14.0 in. wc [3.5 kPa]) inlet pressure. Designed for safe operation up to 28.0 in. wc [7.0 kPa].
- 40.5 and 80 cfh [1.1 and 2.3 m^3/hr] series—1/2 psig (14.0 in. wc [3.5 kPa]) inlet pressure maximum.

PRESSURE TAPPING: 1/8 NPT with plug, recessed for 3/16 in. [4.8 mm] Allen wrench.

TEMPERATURE SETTING RANGE:
- V500 Families—50 F to 90 F [10 C to 32 C].
- 40.5 and 80 cfh [1.1 and 2.3 m^3/hr] series—60 F to 100 F [16 C to 38 C].

PILOT GAS OUTLET: Compression fitting for 1/4 in. [6.4 mm] OD gas tubing.

MOUNTING: All V500 and V800 controls for heating appliances can be mounted 0 to 90 degrees, in any direction, from the upright position of the gas cock knob. All 405 and 80 cfh [1.1 and 2.3 m^3/hr] series controls, except the VS8194, can be mounted in any position.

TABLE 5 – COMBINATION GAS CONTROLS FOR HEATING APPLIANCES

MODEL NUMBER	MAXIMUM CAPACITY		OPERATION	APPLICATION
	cfh	m^3/hr		
C581	110	3.1	30 mV manually controlled Pilotstat power unit manifold.	Continuous pilot
C5290	80/40.5	2.3/1.1	30 mV manually controlled Pilotstat power unit manifold.	Continuous pilot
CS581	110	3.1	750 mV manually controlled Pilotstat power unit manifold.	Continuous pilot
CS5290	80	2.3	750 mV manually controlled Pilotstat power unit manifold.	Continuous pilot
V401	110	3.1	120 V – magnetic.	Continuous pilot
V501	110	3.1	Bulb – modulating, direct dial.	Continuous pilot
V511	110	3.1	Bulb – modulating, remote dial.	Continuous pilot
V521	110	3.1	Bulb – on-off, direct dial.	Continuous pilot
V531	110	3.1	Bulb – on-off, remote dial.	Continuous pilot
V5267	80/40.5	2.3/1.1	Bulb – modulating, direct dial.	Continuous pilot
V5269	80	2.3	Bulb – modulating, remote dial.	Continuous pilot
V5272	80/40.5	2.3/1.1	Bulb – on-off, direct dial.	Continuous pilot
V801	110	3.1	24 V – magnetic.	Continuous pilot
V811	110	3.1	24 V – bimetal.	Continuous pilot
VR401	110	3.1	120 V – magnetic.	Continuous pilot
VR801	110	3.1	24 V – magnetic.	Continuous pilot
VR811	110	3.1	24 V – bimetal.	Continuous pilot
V8277	80	2.3	24 V – oil filled.	Continuous pilot
VS821	110	3.1	750 mV – magnetic.	Continuous pilot
VS8194	80/40.5	2.3/1.1	750 mV – magnetic.	Continuous pilot

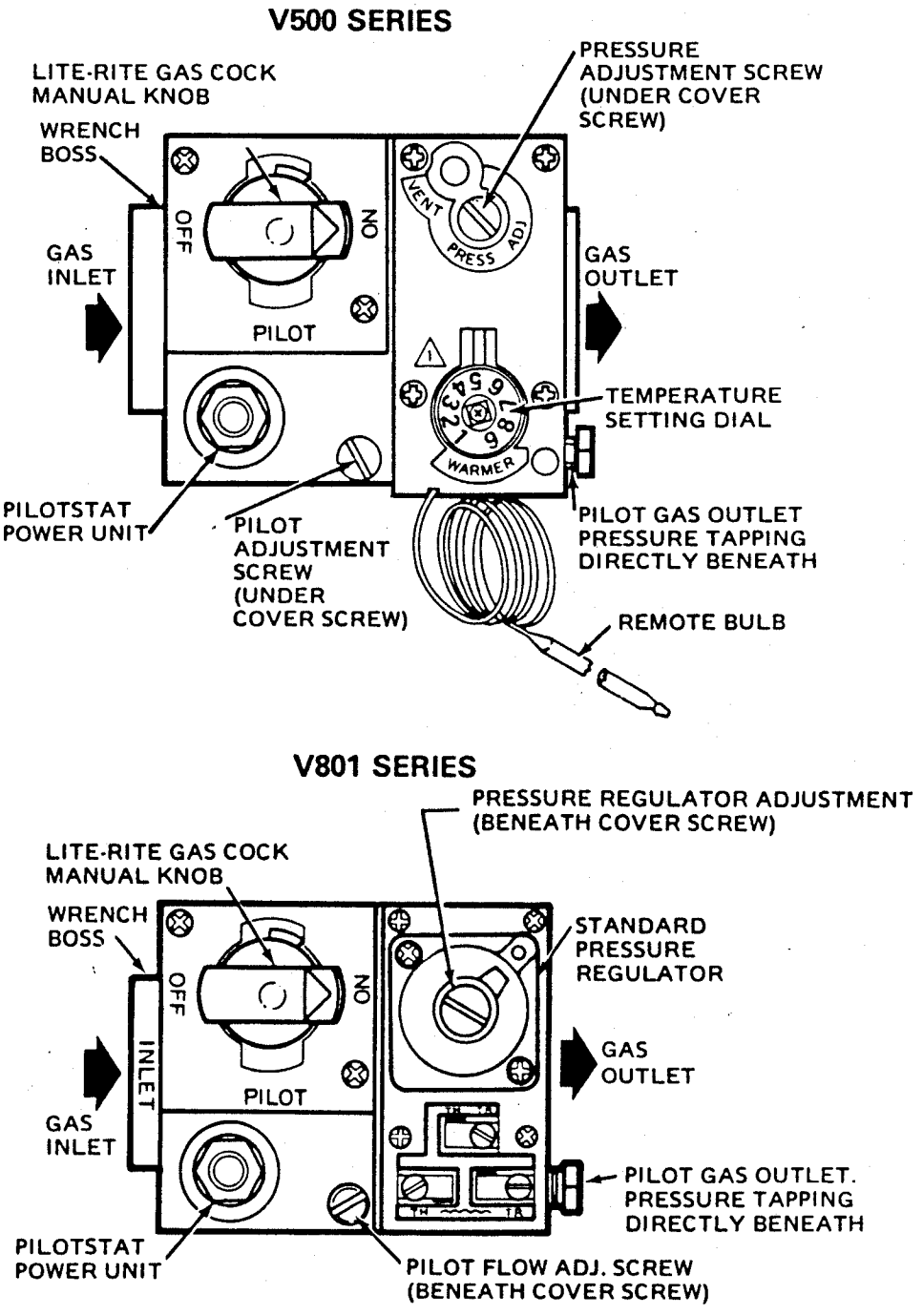


Fig. 19—Top view of typical V801 and V500 Controls.

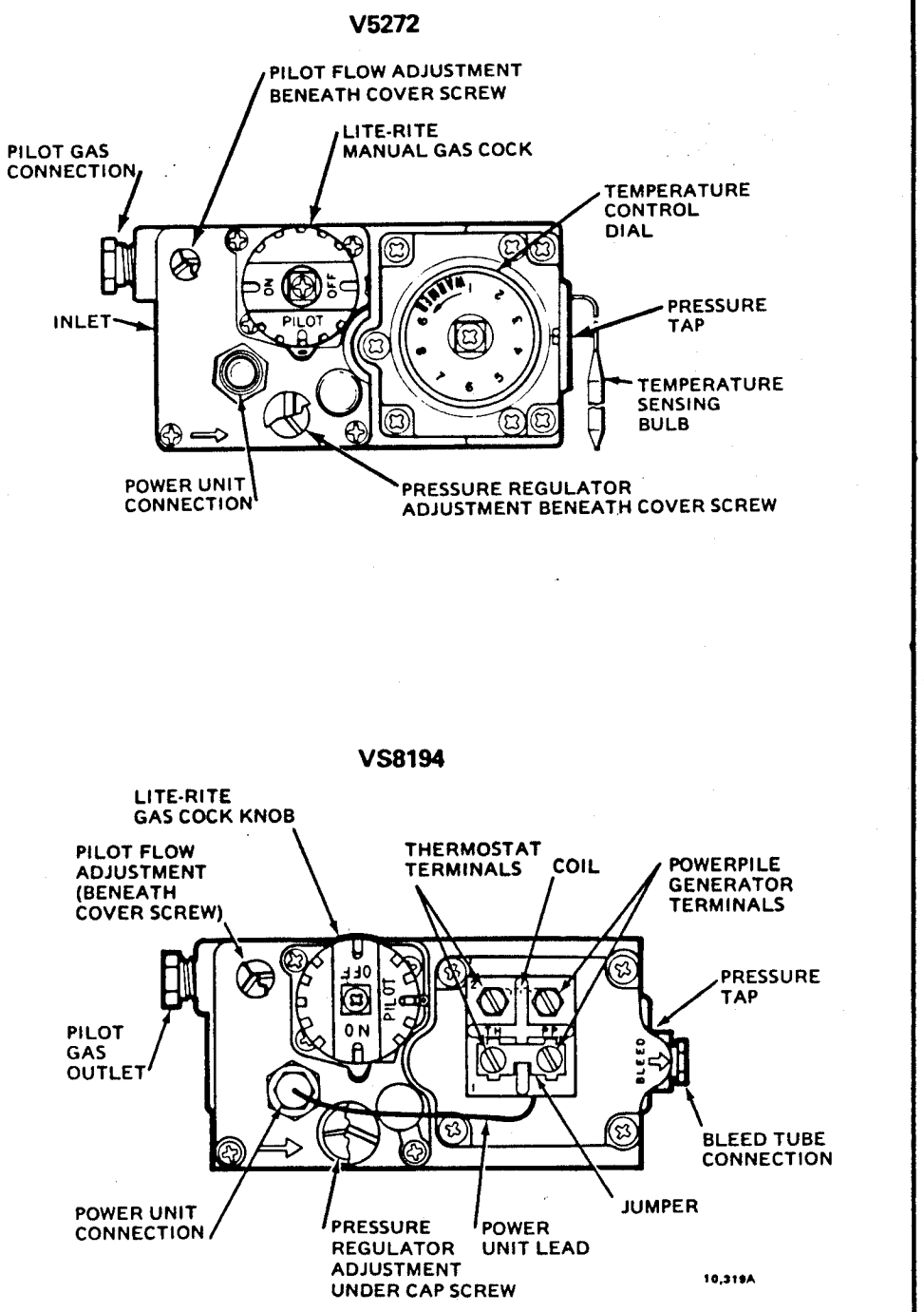
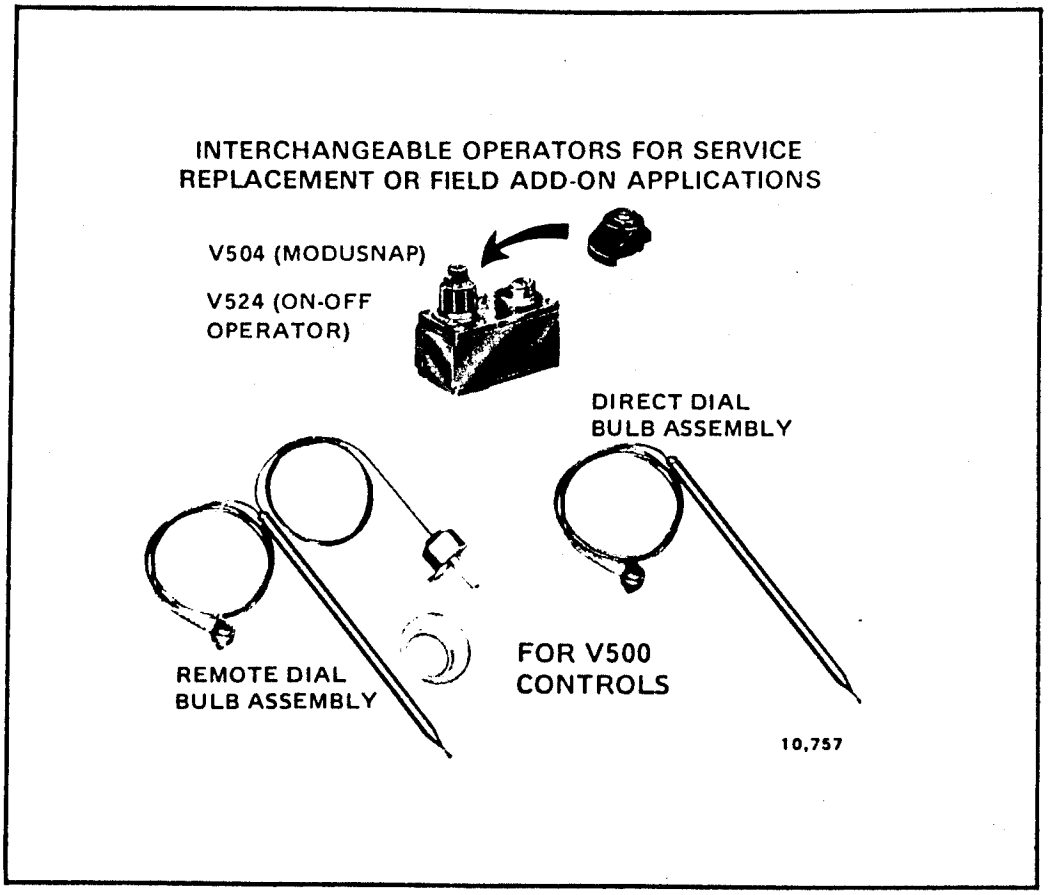


Fig. 20—Top view of typical 40.5 and 80 cfh [1.1 and 2.3 m³/hr] series controls.



The mechanical, bulb-controlled V504 and V524 valve operators are used on V500 combination gas controls.

The V504 and V524 include pressure regulation. Suffix "A" models have a 1.0 in. wc [0.2 kPa] limited full-rate pressure adjustment, suffix "B" models are not adjustable. The minimum-rate pressure cannot be adjusted on either model.

Replacement operators include two setting dials: a red temperature setting dial to mount directly on the operator and a black knob to mount on the operator if a remote dial is used. See Table 6 for bulb and bellows replacement description.

V500 OPERATORS

OPERATOR MODEL NO.	PRESSURE SETTING				DESCRIPTION
	MIN. RATE		MAX. RATE		
	in. wc	kPa	in. wc	kPa	
V504A	1.2	0.3	3.5	0.9	Modulating control, limited adjustment
V504B	4.0	1.0	11.0	2.7	Modulating control, LP only
V524A	–	–	3.5	0.9	ON-OFF control, limited adjustment
V524B	–	–	11.0	2.7	ON-OFF control, LP only

TABLE 6 – REPLACEMENT BULB AND BELLOWS ASSEMBLY FOR V500 FAMILY

ORDER NO.	DESCRIPTION	TEMPERATURE RANGE	
		F	C
394268–1	Remote Bulb and Bellows	50 to 90	10 to 32
394268–2	Remote Bulb and Bellows	35 to 75	2 to 24
394268–3	Remote Bulb, Bellows and Remote Dial (self-index)	50 to 90	10 to 32
394268–4	Remote Bulb, Bellows and Remote Dial (concealed)	50 to 90	10 to 32
394268–6	Remote Bulb, Bellows and Remote Dial (self-index or concealed)	50 to 90	10 to 32

INSTALLING OPERATORS, BULB AND BELLOWS ASSEMBLY

1. a. To replace operator:
   Loosen the 4 mounting screws and remove the old operator, bellows and gasket from the control body. DO NOT loosen the screw at the edge of the operator, see Fig. 21.
   b. To add operator:
   Remove the adapter casting and gasket from the manual C580 or C581 gas control (Fig. 6).

2. Check the condition of the bulb and bellows assembly. If it appears damaged, cracked or there is any indication that it is not functioning properly, replace it with a new one. Also check that all gas ports are clear and that the gasket seating surface is clean.

3. Mount a new gasket on the control body using the two locating pins.

4. Place the bellows tip into the hole in the control body, Fig. 21.

5. Place the new operator over the bellows, making certain that the operator fits on the metal locating pins and that the bulb capillary runs through the rubber notch in the bottom of the operator and runs up the groove. Tape the capillary in place.

6. Install and tighten the 4 operator screws provided: long screws on high capacity models, short screws on standard capacity models.

NOTE: Recalibration may be necessary if a new bulb and bellows is installed. Recalibration is required if the operator is added or replaced. See Calibrating the Temperature Dial, below.

MOUNTING TEMPERATURE SENSING BULB

The bulb should be mounted in the return air path to the appliance in a location where it will be exposed to freely circulating air. Avoid contact with hot surfaces and do not run the tubing through the heated air discharge or other hot areas.

If the bulb is exposed to direct radiant heat, install a shield of fireproof material. The shield must not obstruct the circulation of air over the bulb.

Securely mount the bulb in place using supports of the point-contact type to reduce heat conduction to the bulb to a minimum.

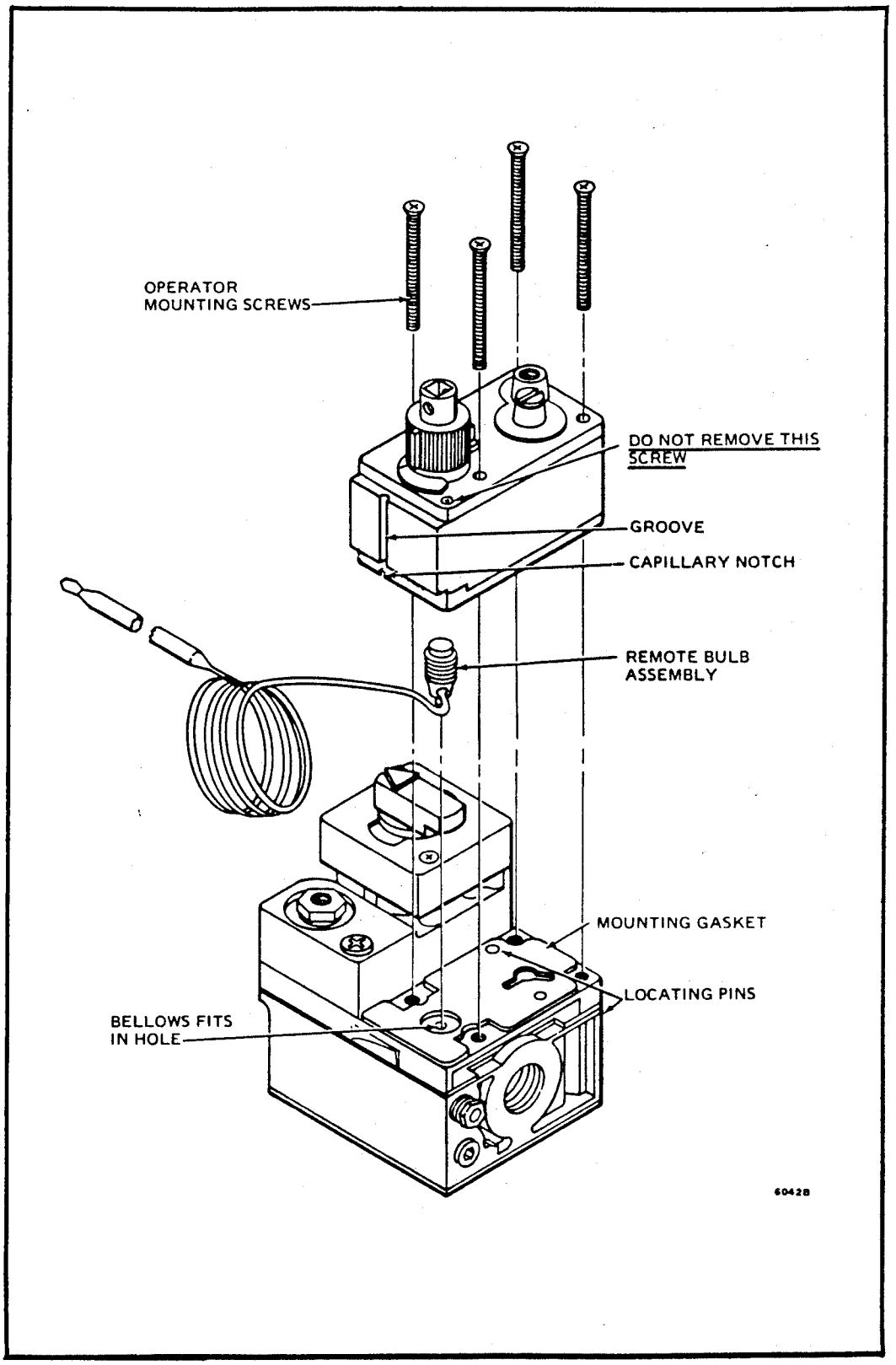


Fig. 21—Installing operator, bulb and bellows assembly on V500 control.

MOUNTING REMOTE DIAL ASSEMBLY

The remote dial—on bulb and bellows assemblies so fitted—is installed from within the appliance through the hole provided in the cabinet panel.

Route the capillary tubing to the location of the remote dial, avoiding excessively high temperatures and hot surfaces. Insulate the tubing if necessary.

Bulb and bellows assembly, Part No. 394268-6, will replace either concealed, self-indexing or hex nut mounted remote dials. Use the dial knob supplied with the appliance cabinet.

REPLACING DIAL WITH HEX MOUNTING NUT

1. Remove the old dial from the appliance cabinet.

2. Place the index piece over the existing 7/16 in. [11.1 mm] hole left by the old dial.

3. Insert the dial shaft so that the flat portion of the index and shaft base align (Fig. 22).

4. Insert the lock nut and hex nut on the shaft and tighten the hex nut.

5. Place the dial knob over the shaft.

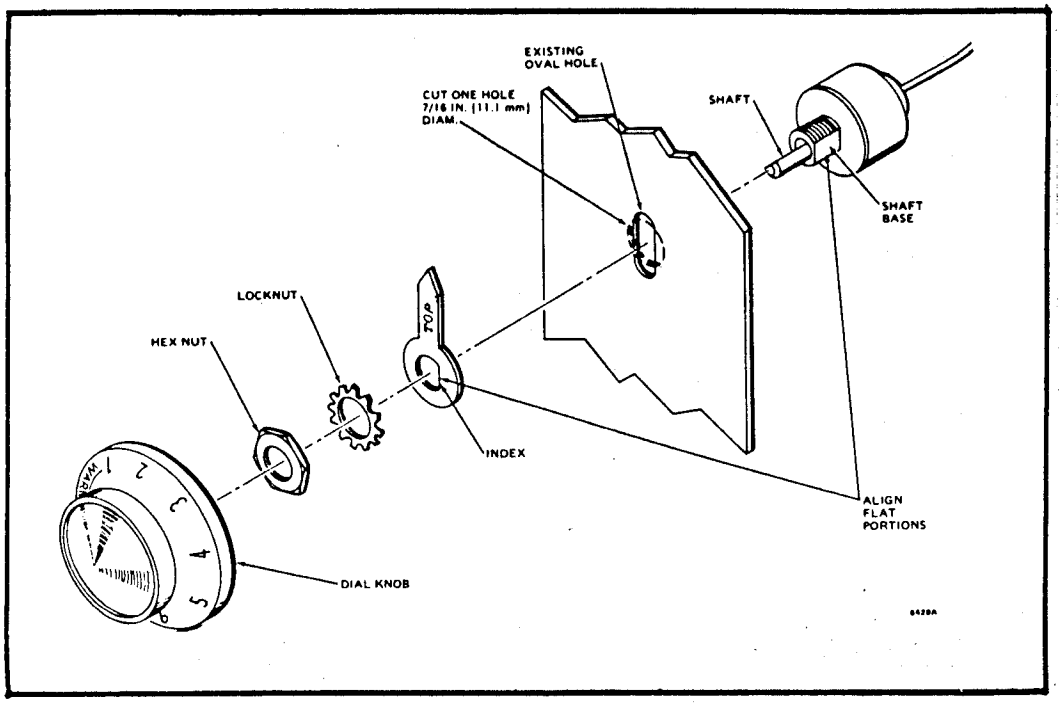


Fig. 22—Replacing a concealed remote dial or a dial with hex mounting nut.

REPLACING CONCEALED DIAL

1. Remove the old dial from the appliance cabinet.

2. Cut a hole with a 7/16 in. [11.1 mm] diameter drill in the center of the oval hole left by the old dial.

3. Place the index piece over the hole. Insert the dial shaft so that the flat portion of the index and shaft base align (Fig. 22).

4. Insert the lock nut and hex nut on the shaft and tighten the hex nut.

5. Place the dial knob over the shaft.

REPLACING SELF-INDEXING DIAL

1. Remove the old dial from the appliance cabinet.

2. Place the ring in the large hole left by the old dial (Fig. 23).

3. Place the index piece over the ring. Insert the dial shaft so that the flat portions of the index piece and the shaft base align.

4. Insert the lock nut and hex nut on the shaft and tighten the hex nut.

5. Place the dial knob over the shaft.

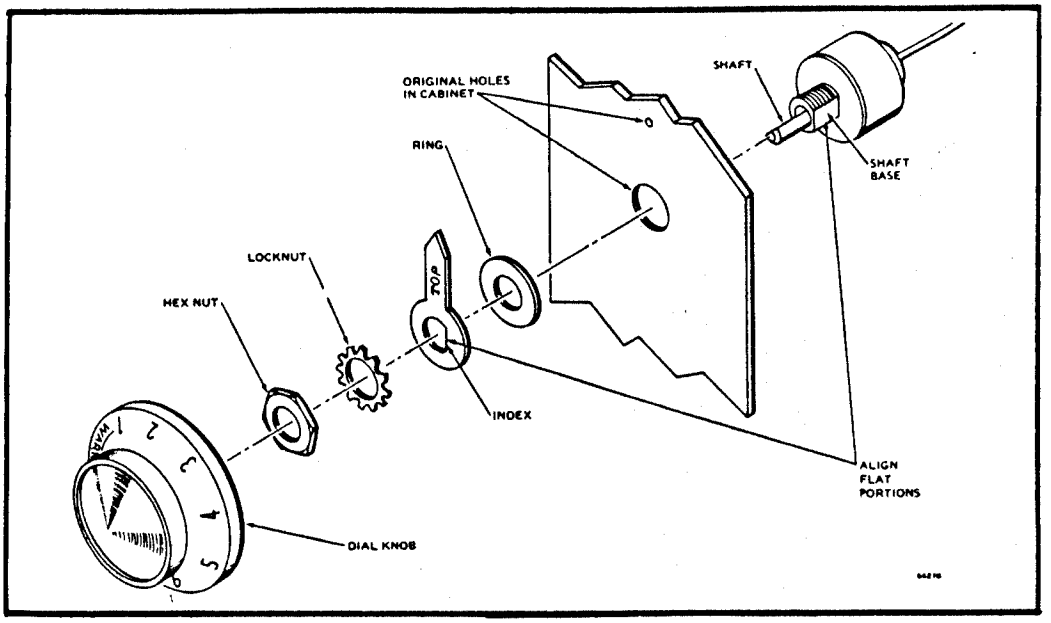


Fig. 23—Replacing self-indexing dial.

PRESSURE REGULATION ADJUSTMENT AND CHECKOUT

Conduct a Gas Leak Test as follows. WITH THE BURNER IN OPERATION, PAINT THE OPERATOR GASKET LINE WITH A RICH SOAP AND WATER SOLUTION. BUBBLES INDICATE A GAS LEAK. TO STOP THE LEAK, TIGHTEN THE SCREWS OR REPLACE THE GASKET AND CHECK AGAIN FOR LEAKS.

CHECKING GAS INPUT TO THE APPLIANCE

Safety First—

— Do not exceed the input rating stamped on the appliance nameplate or the manufacturer's recommended burner orifice pressure for the size of orifice(s) used.

— Make certain that the primary air supply to the main burner is properly adjusted for complete combustion. Follow the instructions of the appliance manufacturer if available.

1. Turn the gas cock knob to PILOT and connect a pressure gauge (manometer) to the pressure tapping located just below the pilot gas outlet.

2. Turn the gas cock knob to ON and turn the temperature dial to 9.

On V500A models, the standard natural gas model is factory-set at 3.5 in. wc [0.9 kPa] full rate outlet pressure, and the standard LP gas model is set at 11.0 in. wc [2.7 kPa]. If adjustment is required, proceed with step 3.

On V500B models the pressure is not adjustable. If the pressure is not as specified by the appliance manufacturer:

a. On LP models, readjust the regulator on the LP tank.
b. On natural gas models, replace the operator.

3. Remove the pressure regulator cover screw (Fig 19) and check that the temperature dial is turned to 9 for full rate pressure. Using a screwdriver, turn the adjustment screw clockwise ↷ to increase or counterclockwise ↶ to decrease the gas pressure to the burner. Do not force the adjustment screw beyond stops, there is a limited 1.0 in. wc [0.2 kPa] adjustment.

4. Replace the cover screw to prevent gas from leaking. Turn the gas cock knob to PILOT and remove the manometer.

5. Turn the gas cock knob to ON, and conduct a Gas Leak Test (page 5) at the pressure tap.

6. Observe the system through at least one complete cycle to make certain it is functioning properly.

CALIBRATING THE TEMPERATURE DIAL

The temperature dial on the control comes factory-set at 5, which represents approximately 70 F [21 C]. Each division represents a change of approximately 5 F [3 C], see table below.

To check calibration, turn the temperature dial slowly until the main burner just starts. Check the dial number against the table below and compare the room temperature (using an accurate thermometer) with the temperature given in the table.

TEMPERATURE SETTING TABLE

Dial No.		1	2	3	4	5	6	7	8	9
Temperature	F	50	55	60	65	70	75	80	85	90
	C	10	13	16	18	21	24	27	29	32

Deviations from the temperatures listed above may be caused by an improperly located or improperly mounted temperature

sensing bulb. Before calibrating the control, review the precautions under Mounting the Temperature Sensing Bulb, above, and make any necessary corrections. If calibration is necessary, follow the appropriate procedure below.

MODELS WITH DIAL ON OPERATOR

1. Place a reliable thermometer near the temperature sensing bulb to measure room temperature.

2. Start the burner and remove the temperature dial and screw (Fig. 24).

3. Turn the calibration knob clockwise ↷ just until the burner snaps off.

4. Replace the temperature dial and screw so that the dial number corresponding to the room temperature, as shown in the table, is aligned with the indicator on the control body. Hold the dial down firmly and tighten the screw so the knife edges in the knob lock into the ring inside the plastic dial.

5. Recheck the system to see that it is maintaining the desired temperature. The burner should come on when room temperature drops below the dial setting.

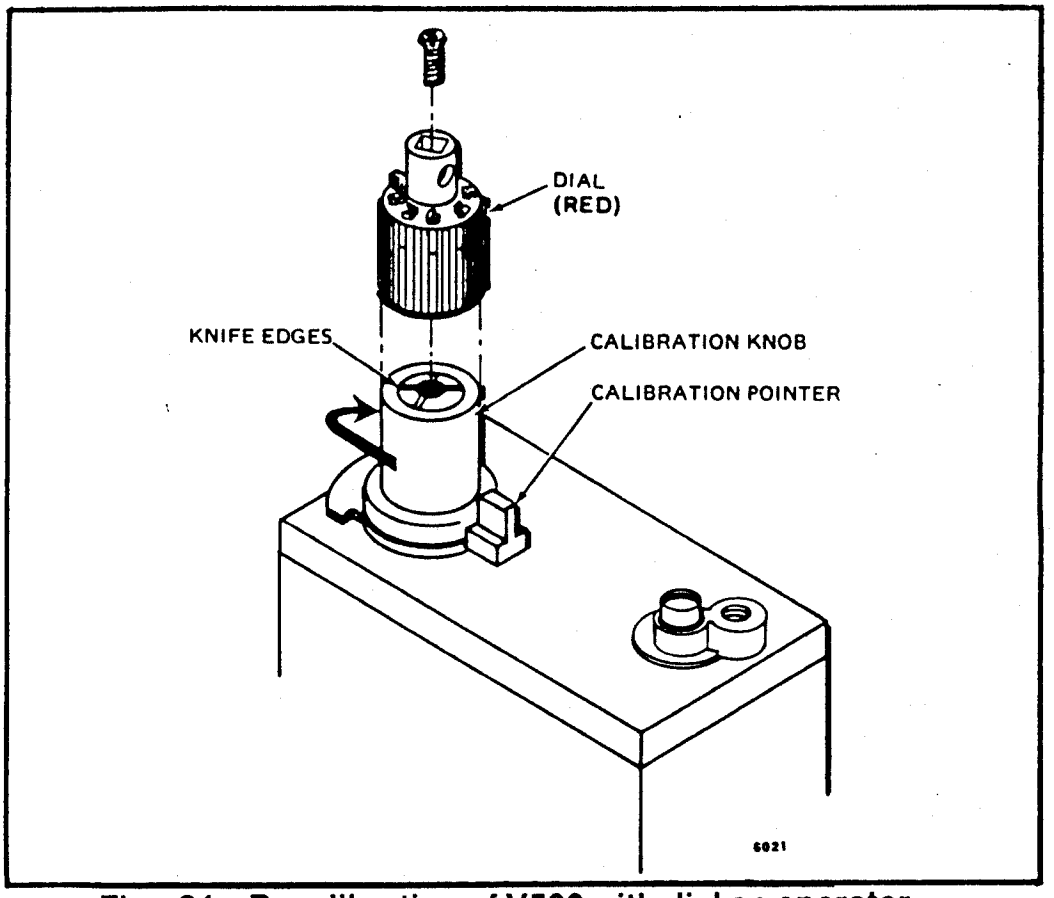


Fig. 24—Recalibration of V500 with dial on operator.

MODELS WITH REMOTE, CABINET-MOUNTED DIAL

1. Place a reliable thermometer near the temperature sensing bulb to measure room temperature.

2. Start the burner and remove the plastic locking knob and screw from the calibration knob on the control.

3. Refer to the table above and set the remote dial to the number corresponding to the thermometer reading.

4. a. If the burner remains on, turn the metal calibration knob (Fig. 25) slowly clockwise ↷ until the burner snaps off.
   b. If the burner turns off, turn the metal calibration knob (Fig. 25) slowly counterclockwise ↶ until the burner snaps on.

5. Replace the locking knob over the calibration knob. Hold the knob down firmly and tighten the screw so that the knife edges in the knob lock into the ring inside the plastic knob.

6. With the system operating, check that the control is maintaining the desired temperature. The burner should turn off when the room temperature is above the desired setting.

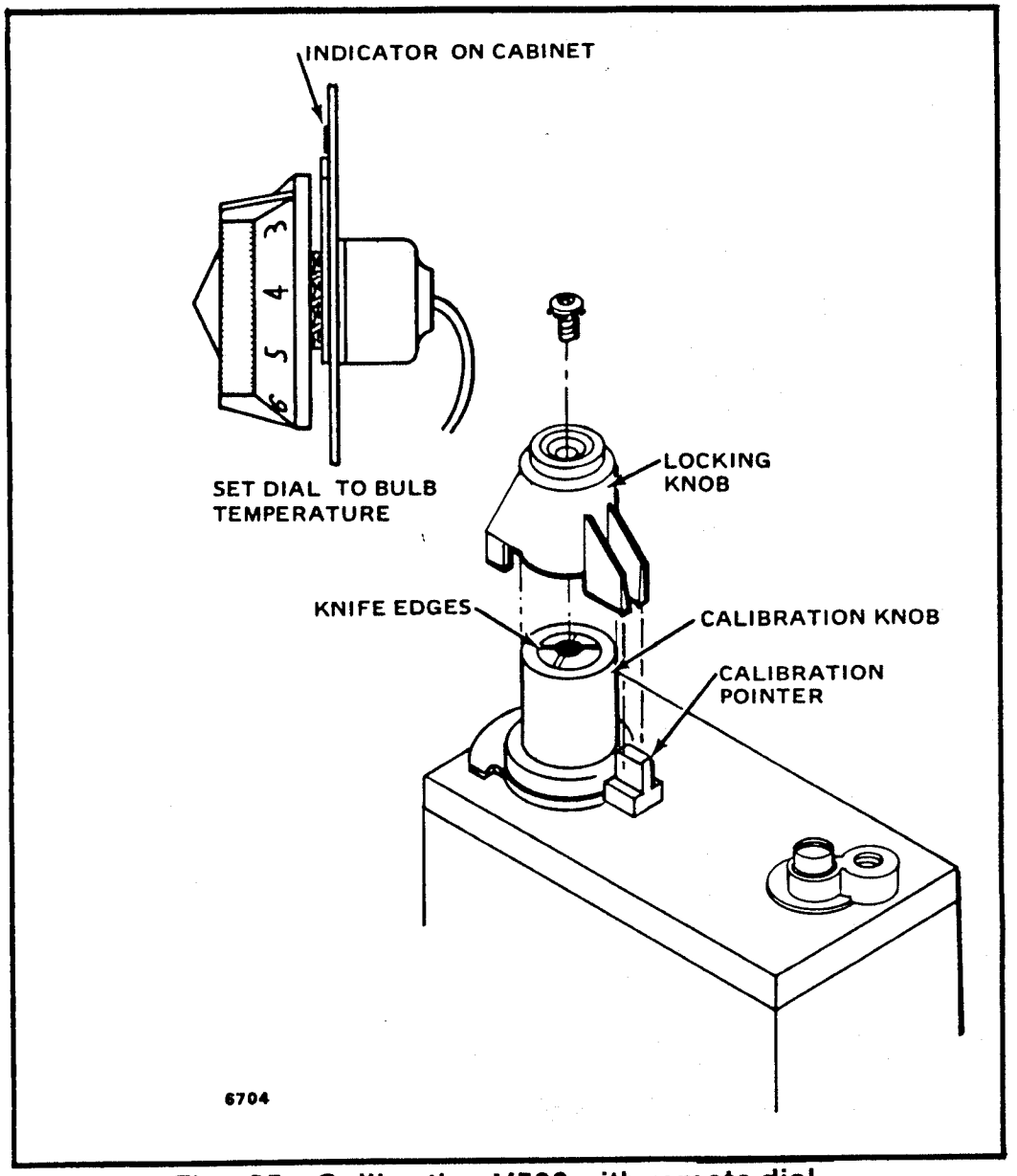


Fig. 25—Calibrating V500 with remote dial.

40.5 and 80 cfh [1.1 and 2.3 m³/hr] SERIES COMPONENTS

40.5 and 80 cfh [1.1 and 2.3 m³/hr] capacity combination gas controls for heating appliances use the Adatrol concept. All models are built using the manual C5290 and various operators, Lite-Rite gas cock Pilotstat safety control and the V5106 pressure regulator (Fig. 26). Model numbers with suffix letters "E" and "F" have a maximum capacity of 80 cfh [2.3 m³/hr]. Those with suffix letter "E" are factory equipped with the V5106 Pressure Regulator. Model numbers with suffix letter "F" do not have a pressure regulator and are generally used on LP gas, although a pressure regulator may be added. Model numbers with suffix "R" have a maximum capacity of 40.5 cfh [1.1 m³/hr].

The V5106 Pressure Regulator is factory-set at 3.5 in. wc and has a 1.0 in. wc [0.2 kPa] limited field adjustment.

OPERATORS

The operators listed in the following table maintain constant room temperature either under the control of a room thermostat (24 V and Powerpile systems) or a temperature sensitive bulb mounted in the return air path of the appliance (bulb type control system).

OPERATOR	FACTORY-INSTALLED ON MODEL NO.	TYPE OF OPERATION
T5266	V5267	Bulb type, Modusnap
T5286	V5272	Bulb type, ON-OFF
T5298	V5269	Bulb type, Modusnap with Remote Dial
V8285	V8277	24 V, Oil-filled
VS8299	VS8194	Powerpile (750 mV)

GAS-COCK AND PILOTSTAT

LITE-RITE GAS COCK AND PILOTSTAT POWER UNIT	FACTORY-INSTALLED ON MODEL NO.	OPERATING VOLTAGE
C5281B	C5290, V5267, V5272, V5269, and V8277	30 mV (thermocouple)
CS5281B	VS8194	750 mV (Powerpile)

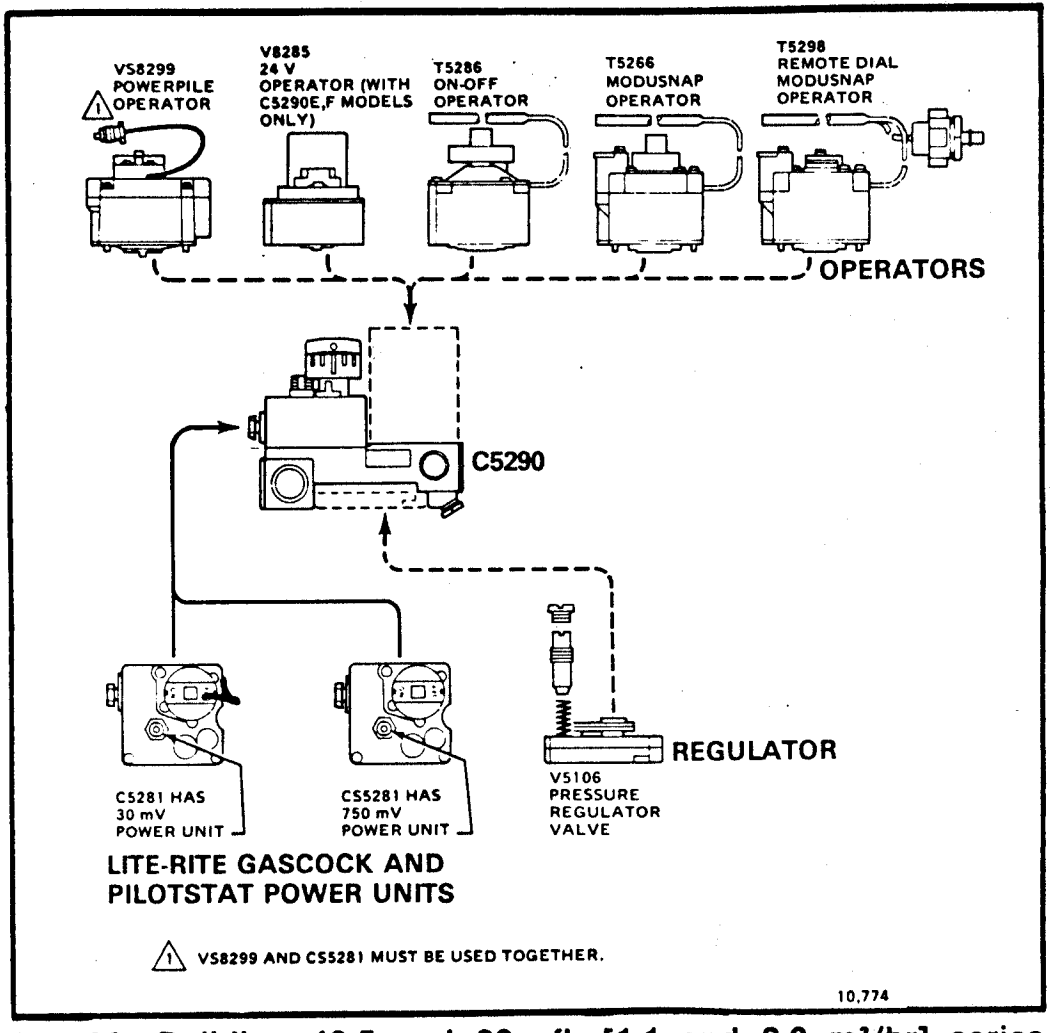


Fig. 26—Building 40.5 and 80 cfh [1.1 and 2.3 m³/hr] series controls.

INSTALLING OPERATORS

BULB TYPE OPERATORS

1. Turn off the main gas supply to the appliance.

2. Remove the screws and lift off the old operator or cover plate and the gasket. See Figs. 27, 28, and 29.

3. Check that the gas ports are clear and the gasket seating surface is clean and smooth. Remove any foreign material from the cavity of the control.

4. Place the new gasket in position—properly aligned and undamaged to be sure of a gas tight seal.

5. Seat the operator on the control body and tighten screws evenly and securely.

6. Mount the temperature sensitive bulb in the return air path to the appliance in a location where it will be exposed to freely circulating air using supports of the point-contact type to reduce heat conduction to the bulb to a minimum. Avoid contact of the bulb or capillary tubing with hot surfaces. Do not run tubing through the heated air discharge or through hot areas.

If the bulb is exposed to direct radiant heat, install a shield of fireproof material. The shield must not obstruct the circulation of air over the bulb.

See Mounting Remote Dial Assembly (page 48) for mounting the remote dial of the T5298.

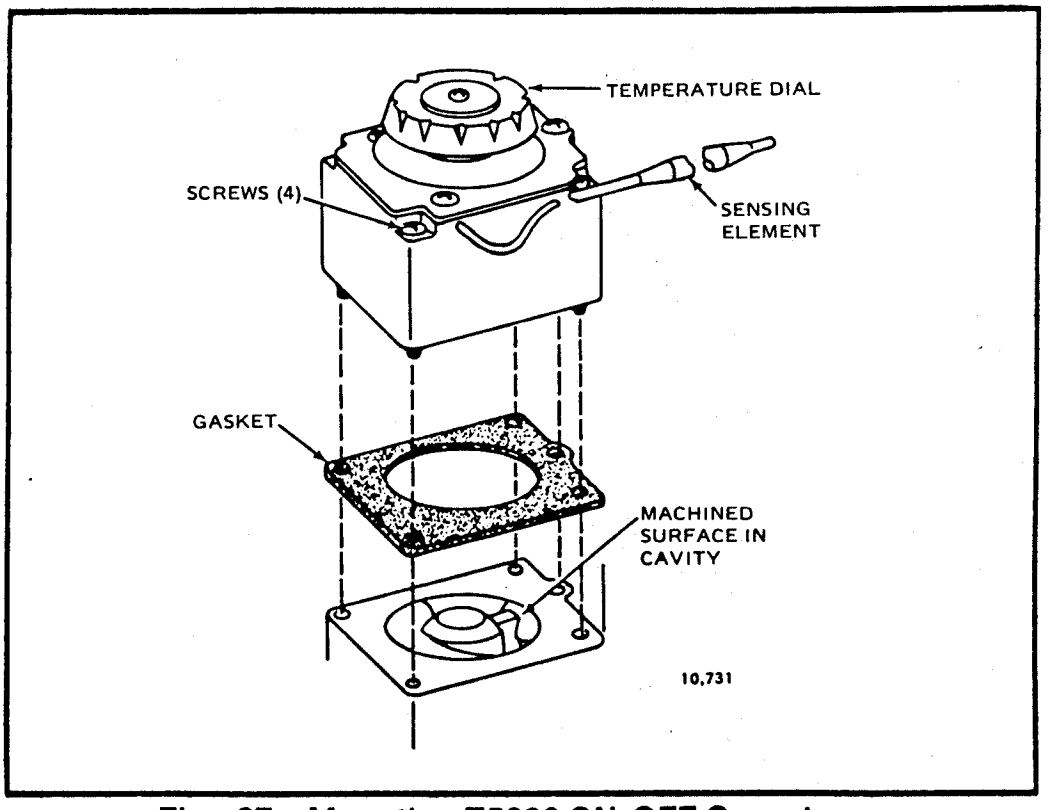


Fig. 27—Mounting T5286 ON-OFF Operator.

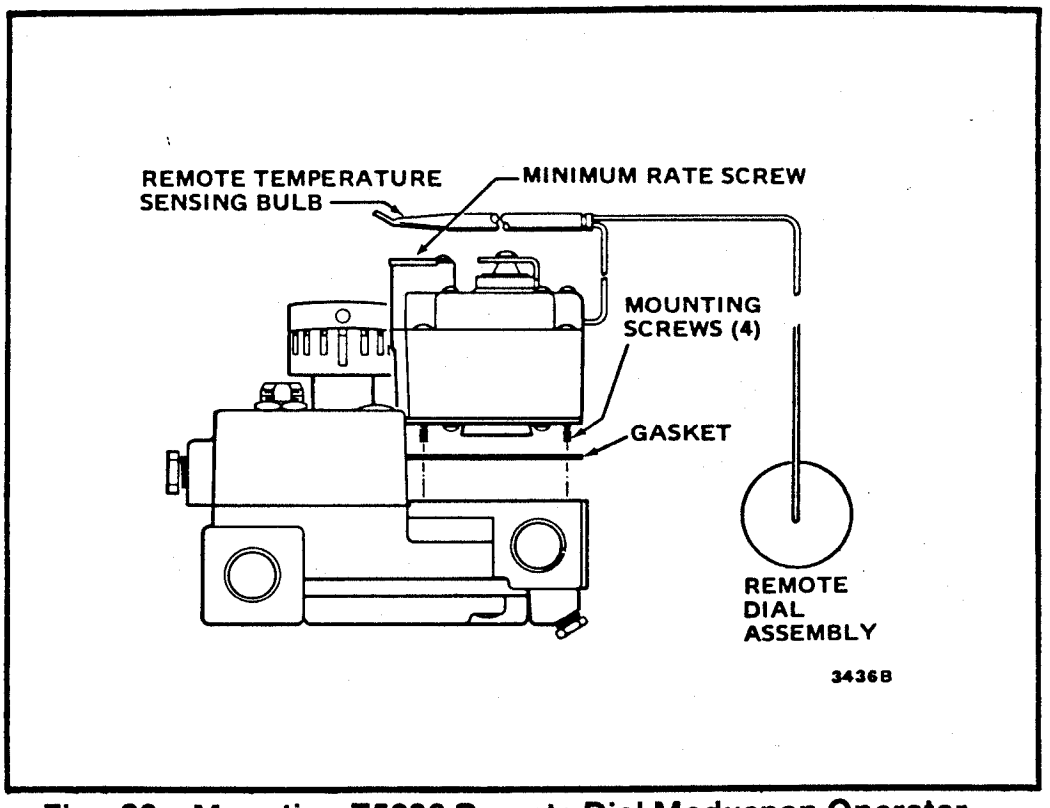


Fig. 28—Mounting T5298 Remote Dial Modusnap Operator.

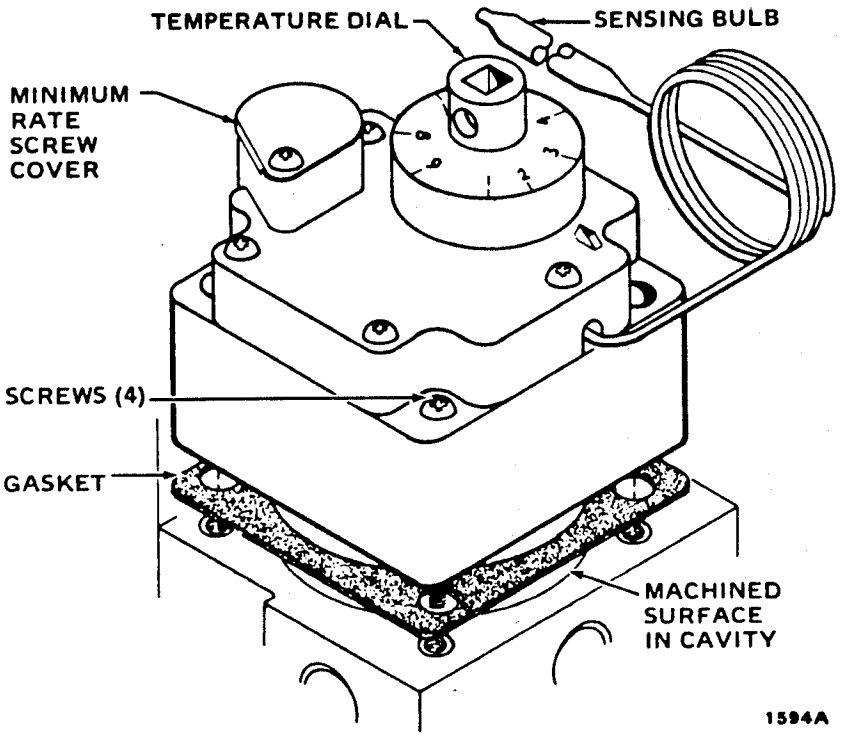


Fig. 29—Mounting T5266 Modusnap Operator.

ELECTRIC OPERATORS

V8285, 24 V

1. Turn off the main gas supply to the appliance and disconnect the power supply.

2. Remove the screws and lift off the old operator, or cover plate, and gasket (Fig. 30).

3. Check that the gas ports are clear and the gasket seating surface is clean and smooth. Remove any foreign material from the cavity of the control.

4. Place the new gasket in position—properly aligned and undamaged to be sure of a gas tight seal.

5. Seat the operator on the control body and tighten screws evenly and securely.

Wiring

1. Install low voltage thermostat and other controls as required, following the appliance manufacturer's instructions. All wiring must comply with applicable electrical codes (Fig. 31).

2. Adjust the thermostat heat anticipator to match the 0.4 A rating stamped on the valve operator.

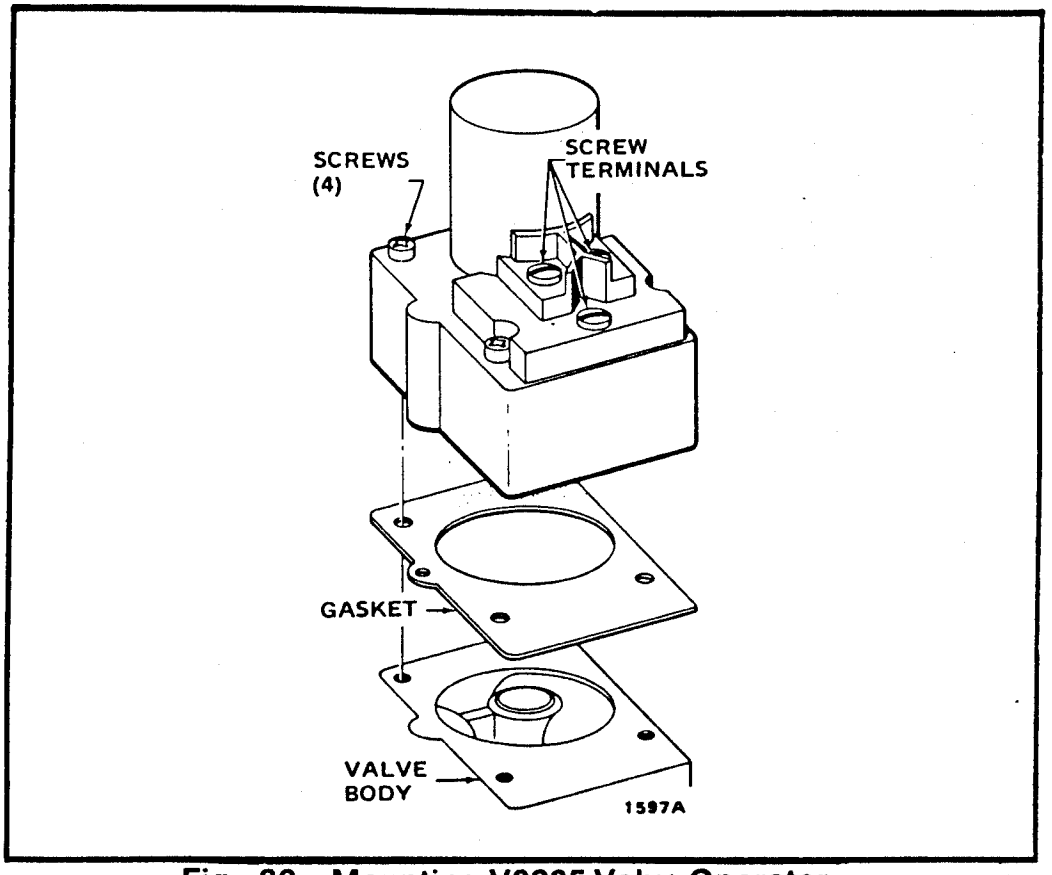


Fig. 30—Mounting V8285 Valve Operator.

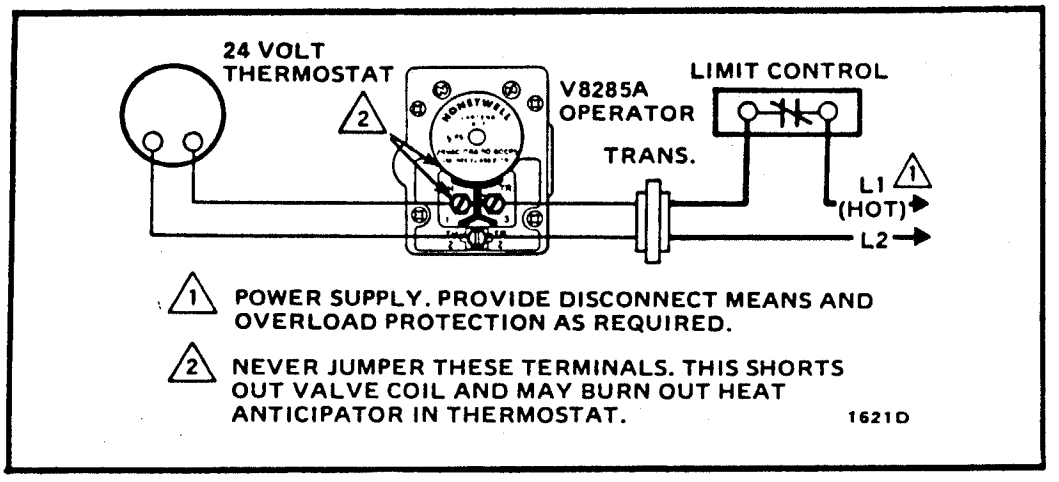


Fig. 31—Typical wiring diagram for V8285.

VS8299, POWERPILE

1. Turn off the main gas supply to the appliance.

2. Disconnect the thermocouple leadwires and power unit connection.

3. Remove the screws and lift off the old operator (or cover plate) and the gasket.

4. Check that the gas ports are clear and the gasket seating surface is clean and smooth. Remove any foreign material from the cavity of the control.

5. Carefully position the diaphragm, gasket, valve disc and spring assembly over the valve cavity. Make certain the spring is pointing outward from the valve cavity (Fig. 32). The holes in the diaphragm and gasket must be positioned to match the raised gas port hole and the 4 raised screw holes in the valve casting.

6. Carefully press the gasket and diaphragm downward around each of the raised screw holes for a snug fit.

7. Seat the Powerpile operator as shown, and tighten the screws evenly and securely.

8. Connect the jumper from the terminal block to the Pilotstat power unit. (This is an electrical connection. It must be clean, dry, and securely made. Do not use pipe dope on this connection.) Engage threads and tighten until finger tight. With a wrench, tighten the connector approximately 1/4 turn beyond finger tight.

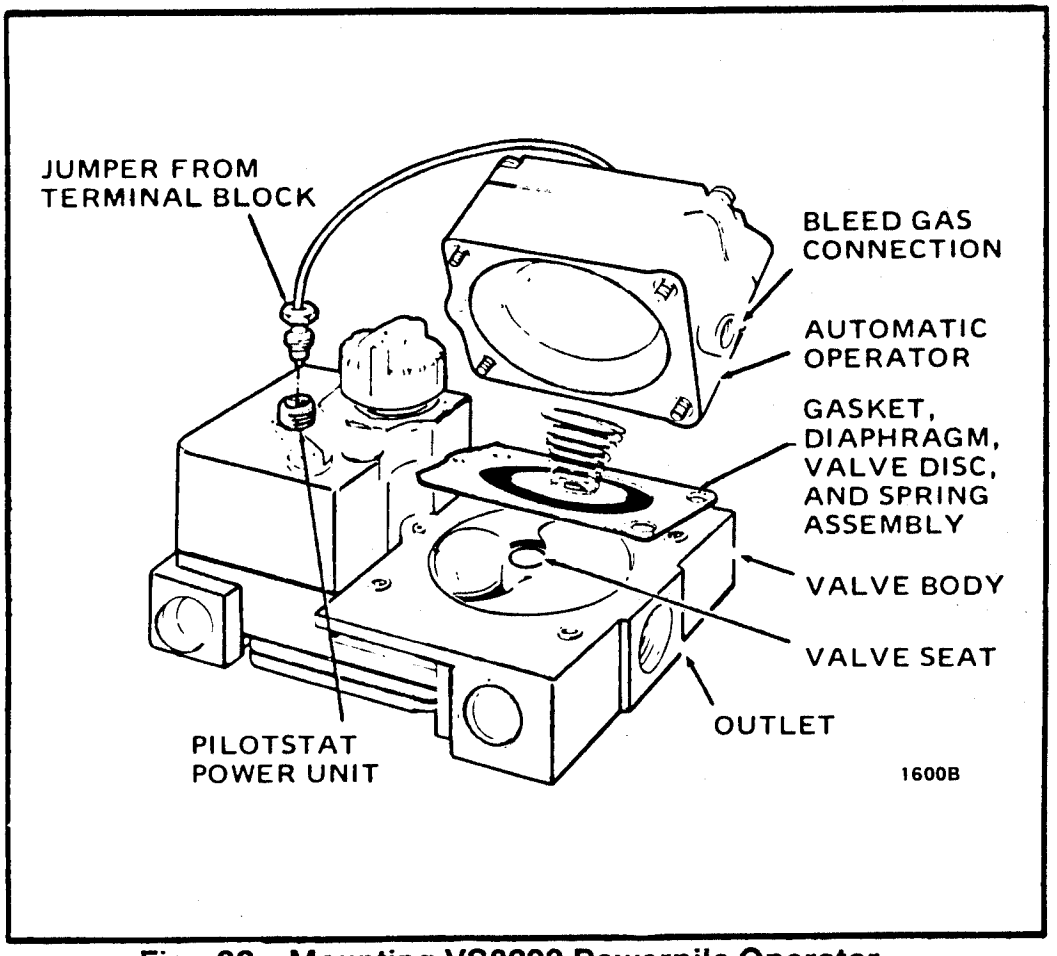


Fig. 32—Mounting VS8299 Powerpile Operator.

9. Connect 1/8 in. [3.2 mm] OD steel tubing to the bleed gas tapping on the outlet end of the operator—use the same procedure as for Pilot Gas Supply Tubing, page 9.

10. Route the bleed tubing to the pilot burner location and secure it to the burner according to the manufacturer's instructions. See Fig. 33 for typical installation.

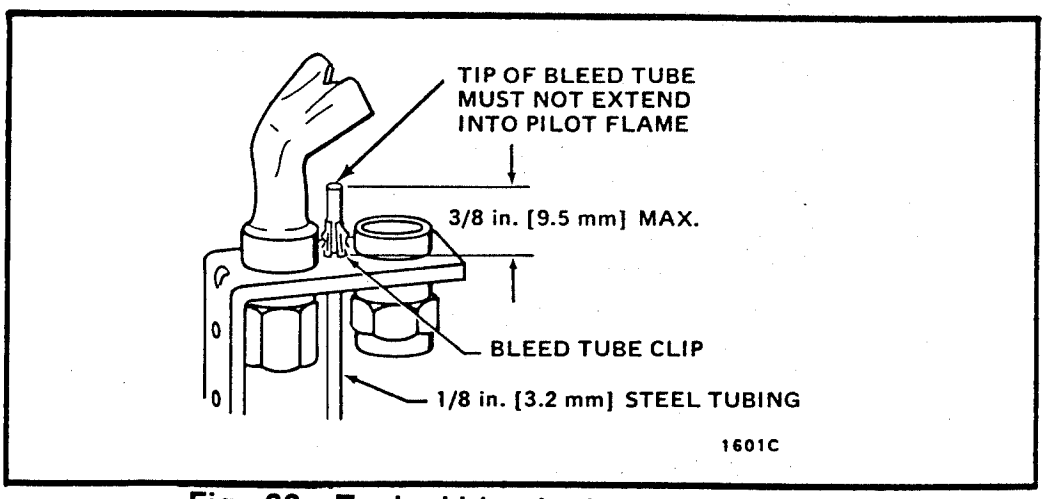


Fig. 33—Typical bleed tube installation.

Wiring

Safety First—

- — All wiring must comply with applicable electrical codes.
- — Never connect these millivoltage controls to line voltage or to a transformer, as it will burn out the operator coil.
- — Since the entire system is powered by the millivoltage generated by the Powerpile generator, it is important to clean and scrape all wires before connecting. Solder and tape all necessary splices using rosin flux to prevent corrosion. Tighten terminals securely.
- — The total circuit wiring must not exceed 20 ft [6.0 m] of 2-wire, 18 gauge cable or 50 ft [15 m] of 2-wire, 16 gauge cable.

1. Install Powerpile thermostat, limit control (if required) and Powerpile generator according to the manufacturer's installation instructions (Fig. 34).

2. After the Powerpile generator is installed, route the generator lead to the VS8299 and connect to the terminals labeled PP. Make certain the jumper from the operator to the Pilotstat power unit is connected and tightened 1/4 turn beyond finger tight.

3. Route the wires from the control circuit and connect them to the operator terminals labeled TH.

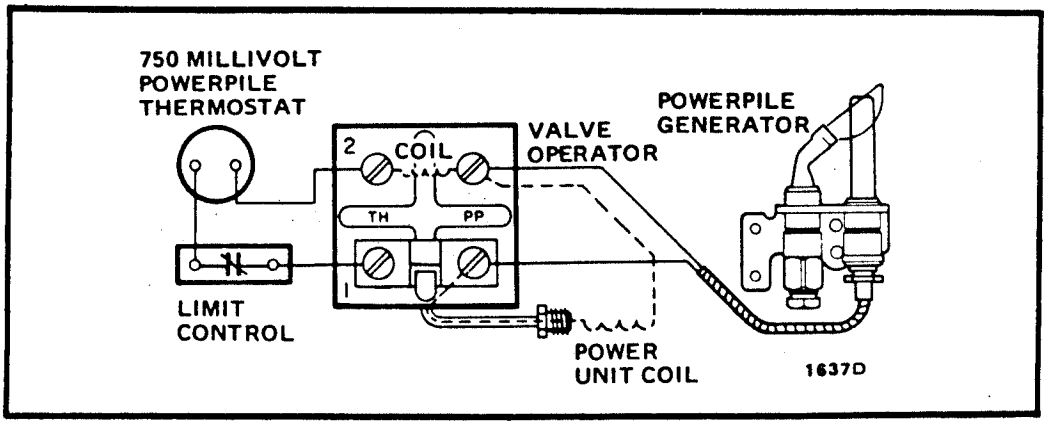


Fig. 34—Wiring Powerpile operators.

ADJUSTMENT AND CHECKOUT

Conduct a Gas Leak Test as follows. WITH THE MAIN BURNER IN OPERATION, PAINT THE OPERATOR GASKET LINE WITH A RICH SOAP AND WATER SOLUTION. BUBBLES INDICATE A GAS LEAK. TO STOP THE LEAK, TIGHTEN THE SCREWS OR REPLACE THE GASKET AND CHECK AGAIN FOR LEAKS.

CHECKING GAS INPUT TO THE APPLIANCE

Safety First—

- — Do not exceed the input rating stamped on the appliance nameplate, or the manufacturer's recommended burner orifice pressure for the size of orifice(s) used.
- — Make certain that the primary air supply to the main burner is properly adjusted for complete combustion. Follow the instructions of the appliance manufacturer if available.

1. Turn the gas cock knob to PILOT and connect a pressure gauge (manometer) to the pressure tap, Fig. 20.

2. Turn the gas cock knob to ON, and turn the temperature dial to 9 or set the thermostat up. The V5106 is factory-set at 3.5 in. wc [0.9 kPa] full rate outlet pressure, and the standard LP model is set at 11.0 in. wc [2.7 kPa]. If adjustment is required, proceed with step 3.

3. Remove the pressure regulator cover screw (Fig. 20) and check that the temperature dial is turned to 9 for full rate pressure or that the thermostat is set above room temperature. Using a screwdriver, turn the adjustment screw clockwise ↷ to increase or counterclockwise ↶ to decrease the gas pressure to the burner. Do not force the adjustment screw beyond its stops. This is a limited 1.0 in. wc [0.2 kPa] adjustment. If the screw cannot be adjusted, replace the V5106.

4. Replace the cover screw to prevent gas from leaking. Turn the gas cock knob to PILOT and remove the manometer.

5. Turn the gas cock knob to ON, and, with the burner in operation, conduct a Gas Leak Test (page 5) at the pressure tap.

6. Observe the system through at least one complete cycle to make certain it is working properly.

MINIMUM-FLAME PRESSURE ADJUSTMENT OF BULB TYPE OPERATORS

The correct minimum-flame gas supply is essential for the proper operation of the gas control. Follow the appliance manufacturer's instructions if available, otherwise proceed as follows.

1. Make the adjustment when the temperature at the bulb is within the range of the controller (60 F to 100 F [16 C to 38 C]).

If the ambient temperature is too low, turn the temperature control dial counterclockwise ↶ to 9 and allow the burner to operate until the temperature at the bulb is within the control range. Then, turn the dial clockwise ↷ to 1 and proceed.

2. Determine the desired minimum firing rate pressure as a percent of full rate pressure.

For example, if an appliance is rated for full rate output of 60 cfh [1.7 m^3/hr] at 3.5 in. wc [0.9 kPa], and the desired minimum firing rate is 20 cfh [.57 m^3/hr], calculate what the minimum firing rate pressure should be using the following equation and graph.

$$\frac{\text{Minimum Firing Rate}}{\text{Full Rate Flow}} \times 100 = \text{The Percent of Full Rate}$$

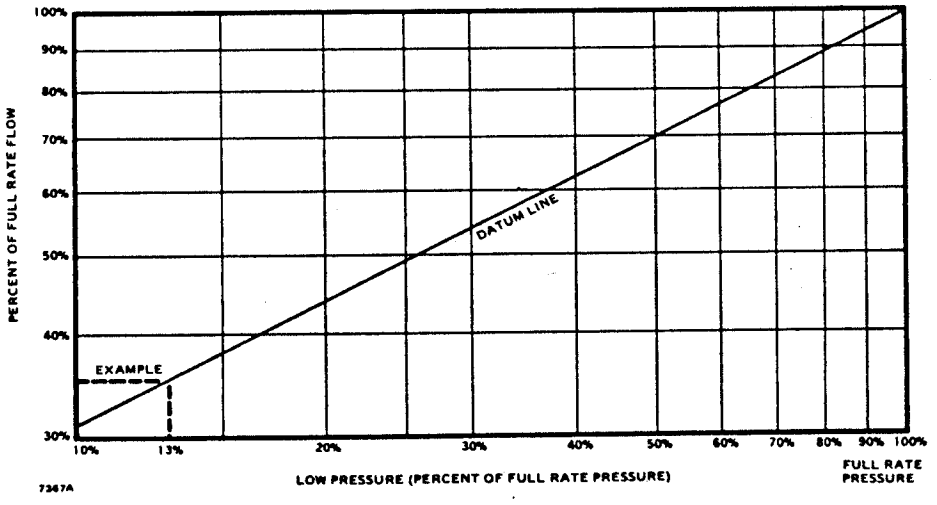
In above example:

$$\frac{\text{20 cfh [0.57 } m^3\text{/hr]}}{\text{60 cfh [1.7 } m^3\text{/hr]}} \times 100 = 34\%$$

On the following graph find 34 percent on the vertical axis (Percent of Full Rate). Draw a horizontal line from that point to the Datum Line and then draw a vertical line down from there to the horizontal axis (Low Pressure. . .). For our example, the percent of full rate pressure is 13 percent.

Now multiply the full rate pressure in in. wc by the *percent* of full rate pressure as determined using the formula and graph to find what the outlet pressure at minimum firing rate should be. For our example:

$$0.13 \times 3.5 = 0.5 \text{ in. wc}$$
$$[0.13 \times 0.9 = 0.1 \text{ kPa}]$$



3. With the temperature dial set at 1, no call for heat, connect a pressure gauge (manometer) to the pressure tapping plug.

4. Now, turn the dial slowly counterclockwise ↶ until the valve snaps open to minimum flame. (You should be able to hear the valve snap open.) Leave the dial at this setting and proceed quickly with step 5.

5. Remove the minimum rate cover screw and adjust the minimum flame until the pressure gauge reads the desired minimum pressure (0.5 in. wc [0.1 kPa] in example).

6. Replace the cover screw, turn off the main burner by setting the dial back to 1 and allow the appliance to cool (but not cool enough to cause the burner to light at setting of 1).

7. Turn the burner on and off to minimum flame several times to check for proper ignition and operation at minimum flame.

8. If necessary, increase the size of the minimum flame until completely satisfactory operation results.

9. Turn the gas cock knob to PILOT, disconnect the manometer and replace pressure tap plug.

10. Turn gas cock knob to ON, set temperature dial to 9 to call for heat, and conduct a Gas Leak Test (page 5) on the pressure tap.

11. Observe the system through at least one cycle to be certain it is operating properly.

CALIBRATING THE TEMPERATURE DIAL

The operator dial comes factory set at 5, which represents approximately 80 F [27 C]. Each division represents approxiately 5 F [3 C]; see table below.

To check calibration, turn the temperature dial slowly until the main burner just starts. Check the dial number against the table below and compare the room temperature (using an accurate thermometer) with the temperature given in the table.

Dial No.		1	2	3	4	5	6	7	8	9
Temperature	F	60	65	70	75	80	85	90	95	100
	C	16	18	21	24	27	29	32	35	38

Deviations from the normal setting may be caused by improper location or mounting of the temperature setting bulb. Therefore, before calibrating or recalibrating the control, see Mounting The Temperature Sensing Bulb, page 70.

If recalibration is necessary, follow the appropriate procedure below.

MODELS WITH DIAL ON OPERATOR

1. Place a reliable thermometer near the temperature sensing bulb to measure room temperature.

2. Start burner and remove the temperature dial and screw.

3. Turn the calibration screw clockwise just until the burner snaps off, Fig. 35.

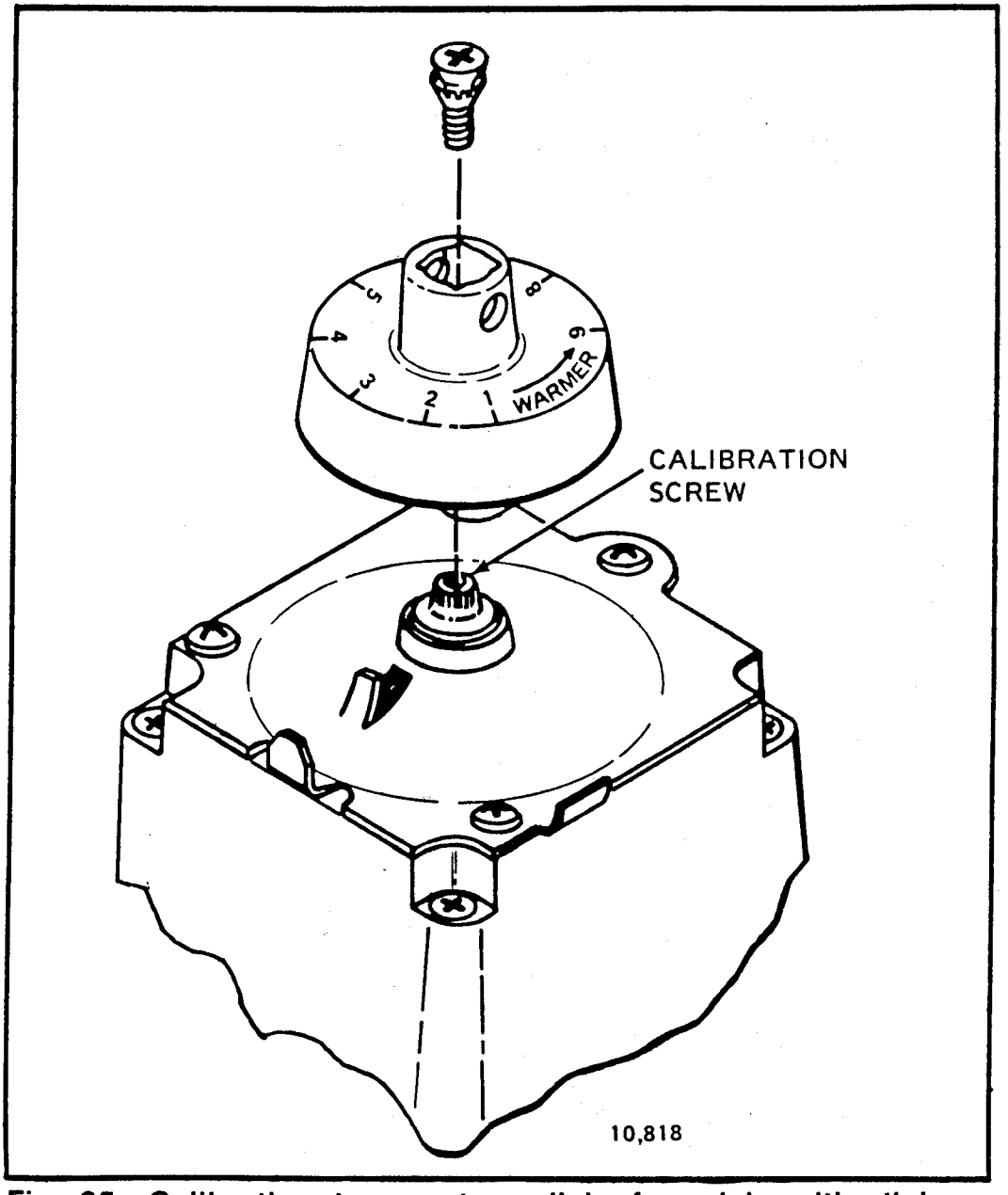


Fig. 35—Calibrating temperature dial of models with dial on operator.

4. Replace the temperature dial and screw so that the dial number corresponding to the room temperature, as shown in the table, is aligned with the indicator on the control body.

5. Recheck after the system is back in operation to see that it is maintaining the desired temperature. The burner should come on when room temperature drops below the dial setting.

MODELS WITH REMOTE, CABINET-MOUNTED DIAL

1. Place a reliable thermometer near the temperature sensing bulb to measure room temperature.

2. Start the burner and remove the plastic locking knob and screw from the calibration knob on the control, or remove the bellows locking bracket on the control body, Fig. 36. Turn the calibration screw clockwise ↷ until the burner just snaps off.

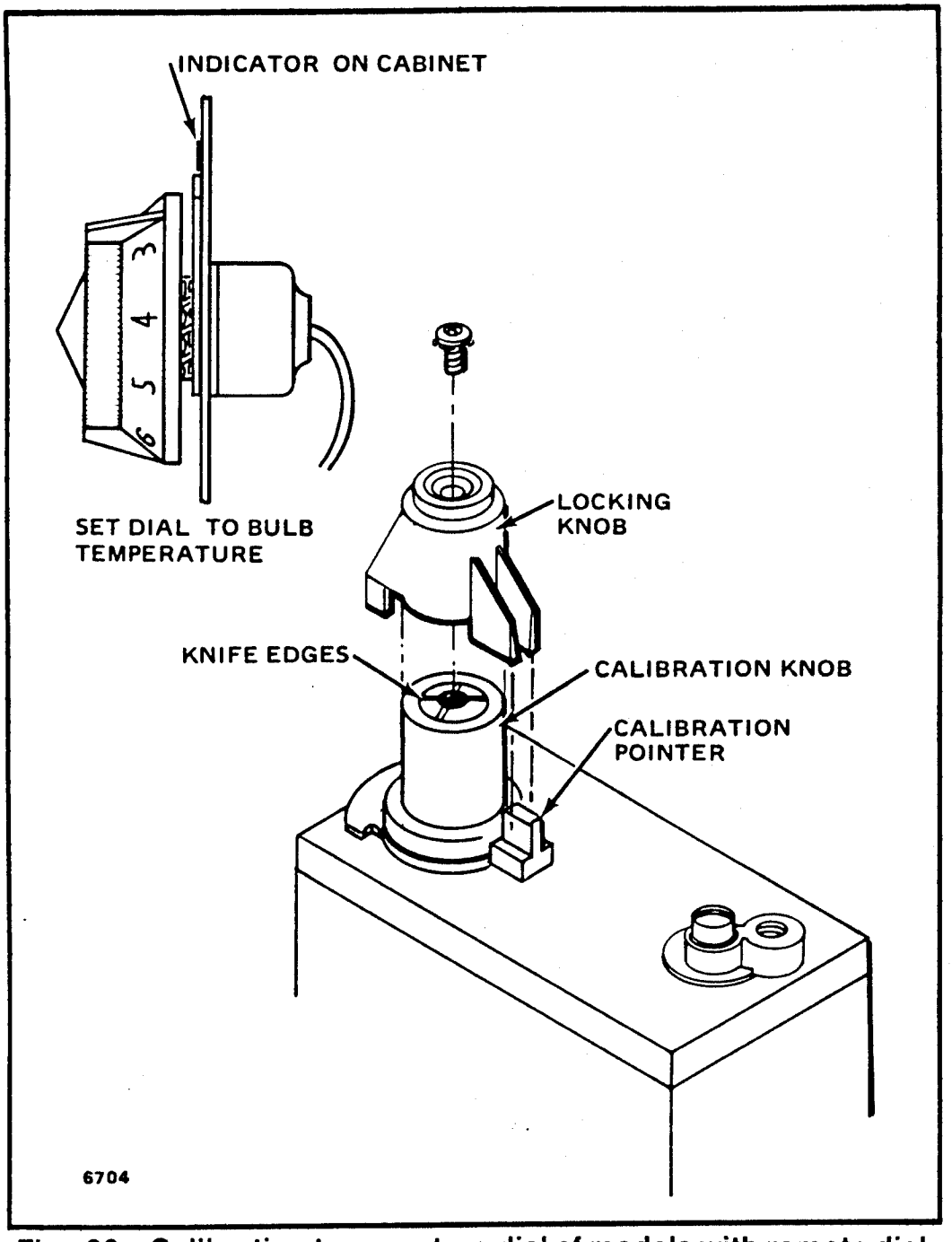


Fig. 36—Calibrating temperature dial of models with remote dial.

3. Replace the locking bracket on the control body.

4. When the system is operating, check that the control is maintaining the desired temperature. The burner should turn off when the room temperature is above the desired setting.

REPLACING PILOTSTAT POWER UNIT
REMOVING OLD POWER UNIT

Safety First—

— Turn off main gas supply and wait 5 minutes for unburned gas to vent. Remember, LP gas is heavier than air and does not vent upward naturally.

1. Disconnect the thermocouple or generator lead from the power unit connection and disconnect the pilot gas tubing from the pilot gas outlet connection.

2. Remove the screws holding the Pilotstat gas-cock assembly in place and lift it off (Fig. 37).

3. Use a stout rubber band around the Pilotstat unit to hold the safety shutoff valve disc in place during installation of the new power unit (the spring will force the disc out if not secured).

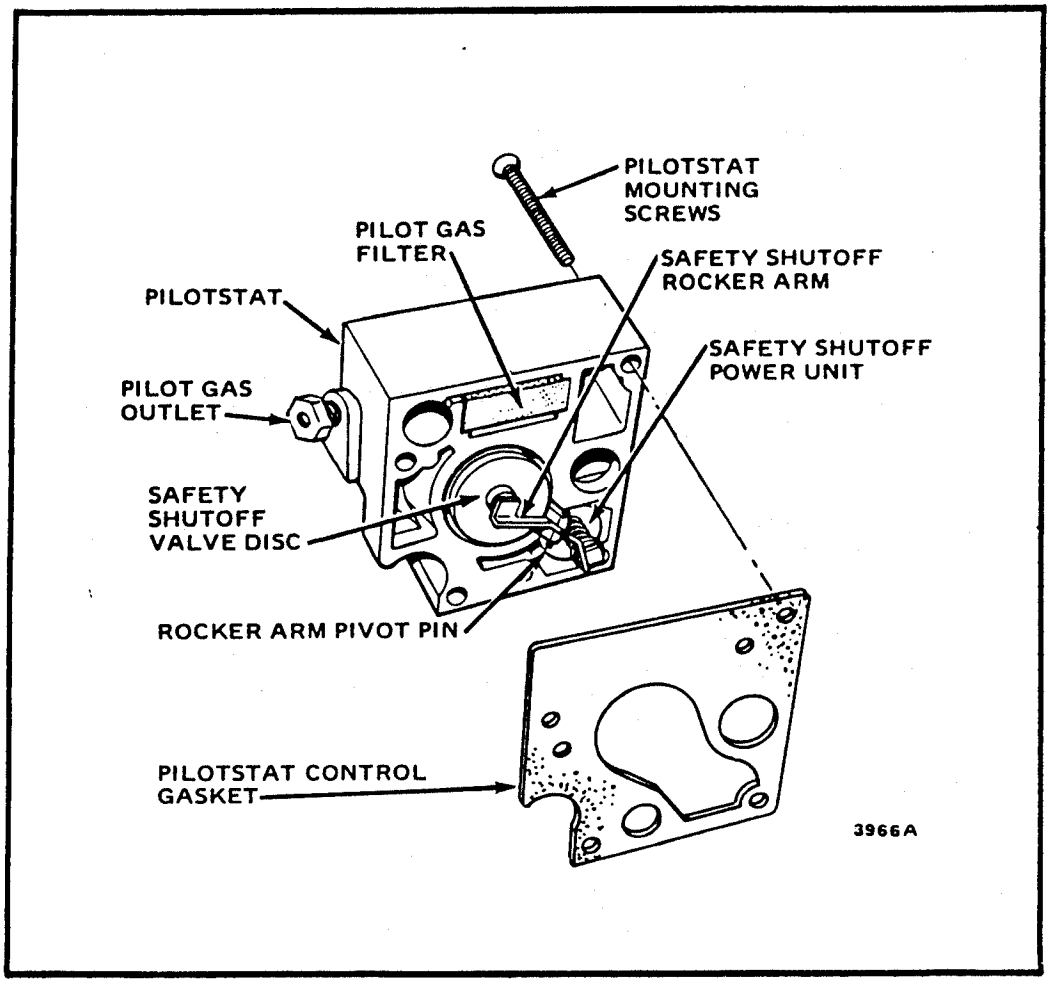


Fig. 37—Typical Pilotstat gas-cock assembly.

4. Pull out the rocker arm pivot pin and lift off the safety shutoff rocker arm.

5. Remove the hex nut holding the power unit in place (Fig. 38). Push out the old power unit and remove the nonmetallic washer.

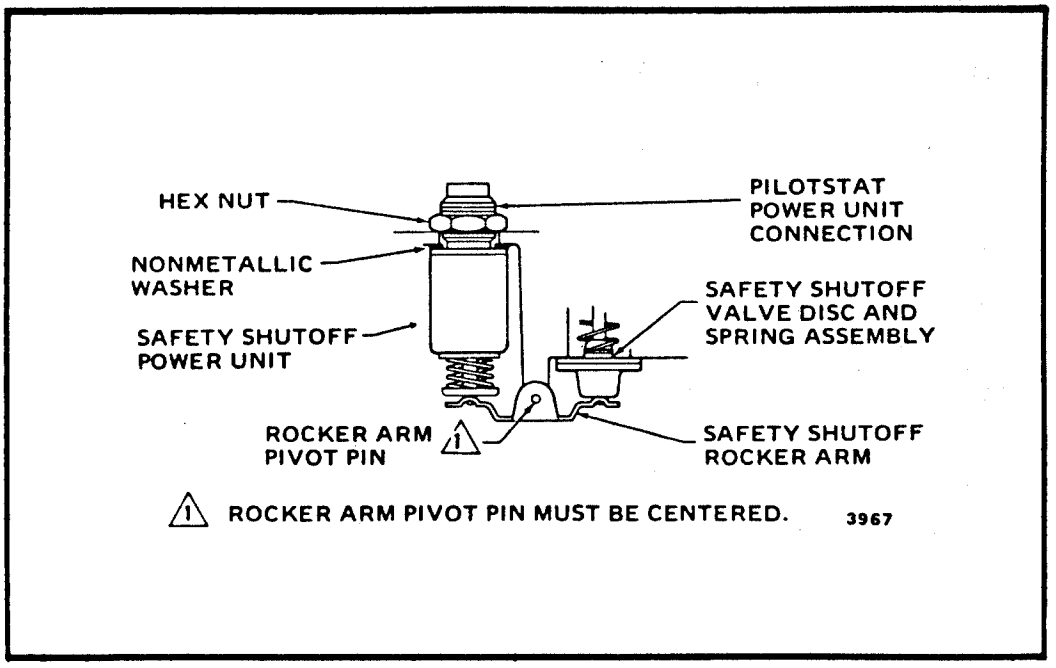


Fig. 38—Typical power unit assembly.

INSTALLING NEW POWER UNIT

NOTE: Before installing the new power unit, determine whether the nonmetallic washer removed from the old power unit is of the flat or the O-ring design illustrated in Fig. 39. Both types are provided in the replacement kit. For a proper gas seal, it is essential that the same type be used as a replacement.

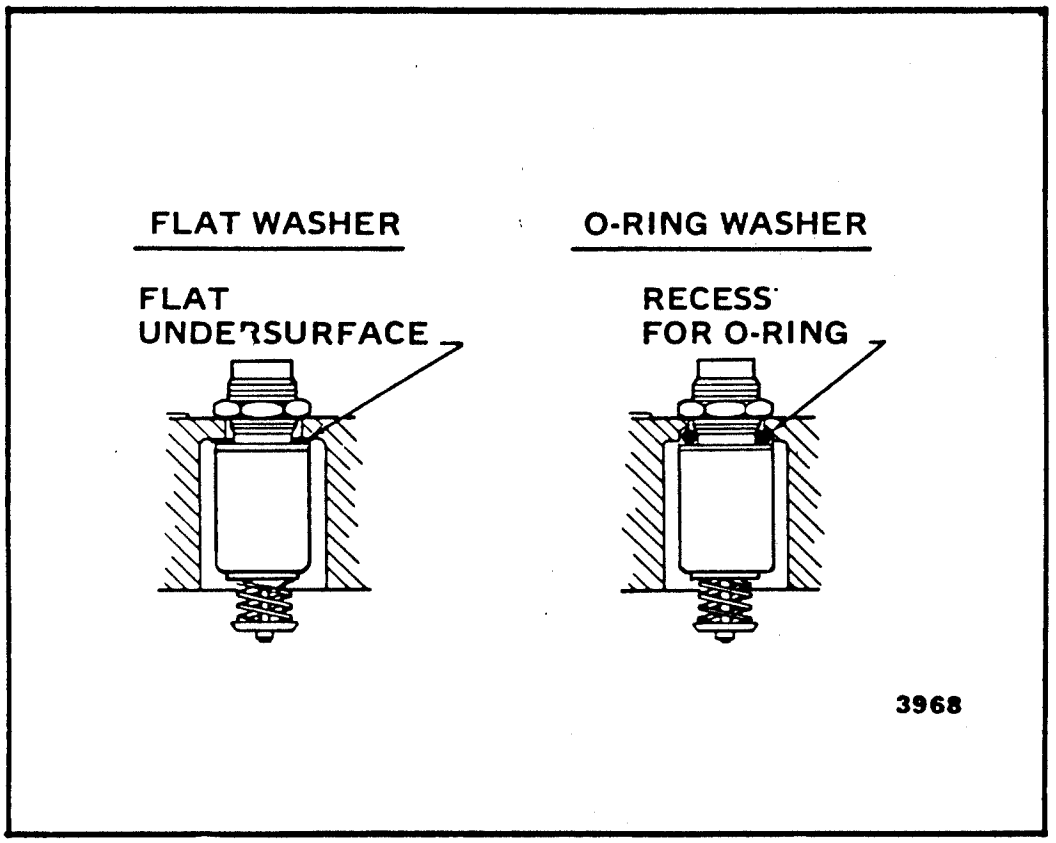


Fig. 39—Comparison of power unit washers. Use same type as originally installed.

1. Select the proper washer and place it on the new power unit.

2. Insert the power unit into the control and secure it with the hex nut. Tighten the hex nut 1/4 turn beyond finger tight.

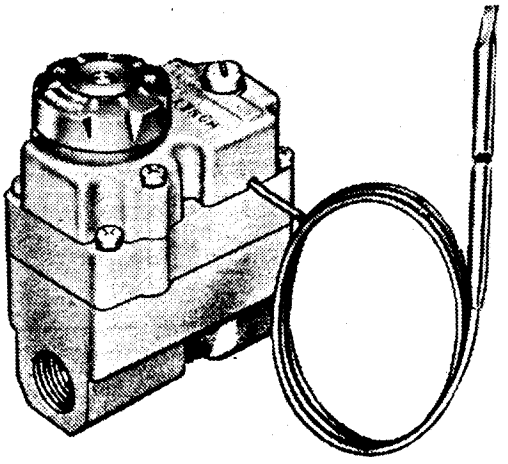
NOTE: Reposition the rocker arm so that the end with the hole extends beneath the power unit. With the end of the power unit shaft centered in the hole, reinstall the pivot pin.

3. Check the gasket on the Pilotstat gas-cock assembly. If the old gasket is damaged, replace it with a new one. Inspect the body cavity for cleanliness.

4. Replace gasket, seat the Pilotstat gas-cock assembly on the control and tighten all screws evenly and securely. Reconnect pilot tubing.

5. Reconnect the thermocouple or generator lead and with main burner in operation, conduct a Gas Leak Test, page 5.

V5155A THERMOSTATIC GAS VALVE



The V5155A single function gas valve is used on duct heaters and hot water boilers. The V5155A uses a T5001 modulating thermostatic operator that snaps open to minimum flame and then modulates betwen minimum and maximum flame in proportion to the demand for heat. If the minimum flame exceeds the heat load, the minimum rate valve snaps closed.

If on-off operation is desired, the minimum flame adjustment screw can be turned all the way counterclockwise ↶ .

Models are available for all types of heating gases in two capacities: 252 cfh [7.1 m^3/hr] and 485 cfh [13.7 m^3/hr].

V5155 MODELS

CAPACITY		INLET-OUTLET SIZE	CAPIL-LARY LENGTH		TEMP. RANGE	
cfh	m^3/hr		in.	m	F	C
252	7.1	1/2 x 1/2 NPT	36	0.9	60-100	16-38
485	13.7	1 x 1 NPT	138	3.5	75-200 120-240	24-93 49-116

Capacity is based on 1000 Btu/ft^3 for natural gas, 0.64 sp gr, at 1.0 in. wc pressure drop [37.3 MJ/m^3, 0.64 sp gr at 0.25 kPa pressure drop]. For other gases, see the conversion chart on page 17.

REPLACING THE OPERATOR

Safety First—

— Turn off main gas supply and wait 5 minutes for all unburned gas to ventilate. Remember, LP gas is heavier than air and does not vent upward naturally.

1. Remove the old operator and gasket (Fig. 40).
2. Clean the gasket seating surface.
3. Place the new gasket in position, and mount the new T5001 on the control. Tighten all screws evenly and securely.
4. Conduct a Gas Leak Test (page 5).

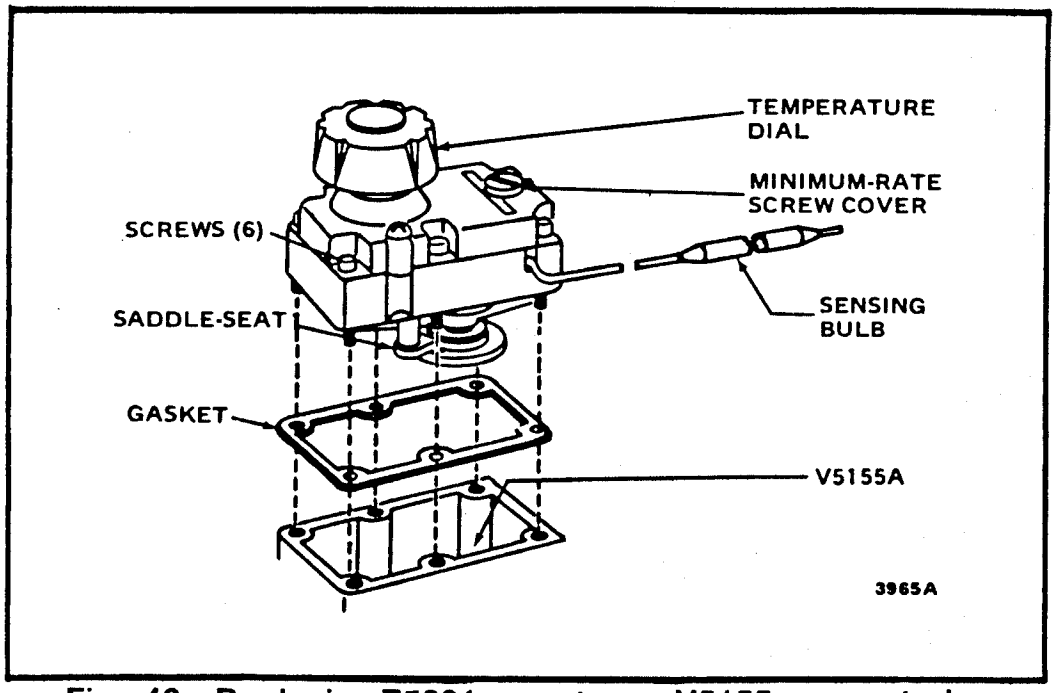


Fig. 40—Replacing T5001 operator on V5155 gas control.

MOUNTING THE TEMPERATURE SENSING BULB

The bulb should be installed in the return air path to the heater where it will be exposed to freely circulating air. Two or three spring clips fastened to the heater wall should give good results.

Shield the bulb from radiant heat sources with a fireproof material if necessary. Do not run the tubing through the hot air discharge or other extremely hot areas.

MINIMUM FLAME ADJUSTMENT

A correct minimum-flame gas supply is essential to V5155 applications. In many cases, the heater manufacturer furnishes either a predrilled minimum-rate orifice that requires no adjustment, or the instructions for setting an adjustable orifice for the specific heater. Follow the heater manufacturer's directions if available.

The following procedure should be used only if the heater manufacturer's instructions are not available. The pilot must be burning and the gas supply to the V5155A must be on.

1. Make the adjustment when the temperature at the bulb is within the range of the controller. If the ambient temperature is too low, set the dial at 9, and allow the burner to operate at this rate until the temperature bulb is within the control range. Turn the setting back to 1 and proceed.

2. Turn the dial slowly until the valve snaps open to minimum flame. Leave the dial at this setting and go on to step 3 quickly.

3. Remove the minimum-rate screw cover and turn the minimum-rate orifice screw to adjust the flame to its smallest safe size—all ports lit, no flashback at the main burner. Turn the screw clockwise  to decrease the flame.

For on-off control, turn the screw counterclockwise  as far as it will go.

4. Replace the cover screw, turn off the main burner by setting the dial back to 1, and allow the heater to cool (but not cool enough to cause the burner to light at a setting of 1).

5. Check for proper ignition and operation at minimum flame by turning the burner on and off several times to minimum flame.

If necessary, increase the size of the minimum flame or adjust the pilot burner until you are completely satisfied with the system operation.

OPERATION

V800 FAMILY

Honeywell V800 combination gas controls use the servo pressure regulation method for maintaining constant gas outlet pressure to the main burner. This type of regulation uses "working gas" to sense the need for regulation at the control outlet. The need for regulation is then transmitted to the main valve diaphragm and the main valve disc is repositioned to maintain constant outlet pressure.

The basic principle of servo pressure regulation can best be illustrated by considering a V800 combination gas control using a standard V5306 pressure regulator (Figs. 42 and 43). The operation of other regulators can best be explained as variations of the standard means of pressure regulation.

BURNER OFF

Fig. 42 illustrates a typical Honeywell control in the OFF position—no call for heat.

NOTE: The Pilotstat power unit and gas cock knob are not illustrated since, under normal conditions, with the pilot burning and the gas cock knob turned to ON, the Pilotstat power unit and gas cock knob would not interfere with the flow of gas into the control body.

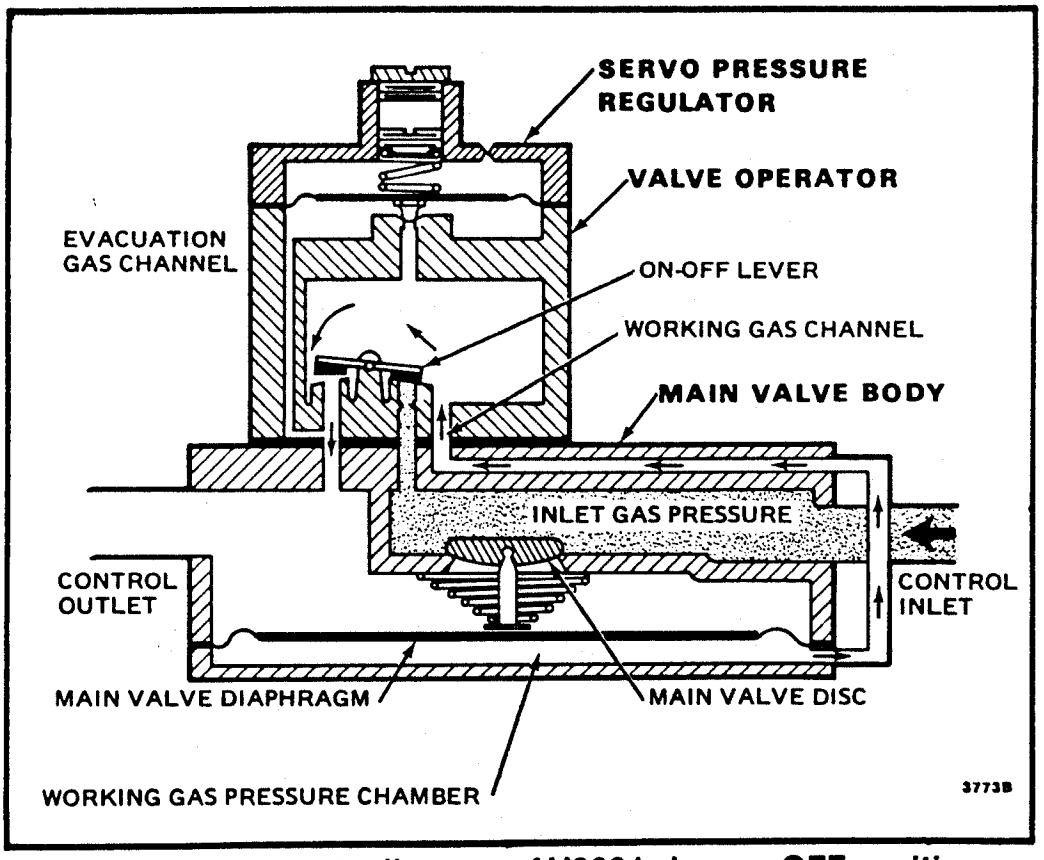


Fig. 42—Schematic diagram of V800 in burner OFF position.

Notice that the ON-OFF lever of the valve operator is in the OFF position, preventing working gas from flowing into the operator chamber, and that the main valve disc is seated firmly so that no gas can flow through the control to the main burner.

BURNER ON

When the thermostat calls for heat, the ON-OFF lever inside the operator switches to the ON position and allows gas to flow into the operator (Fig. 43).

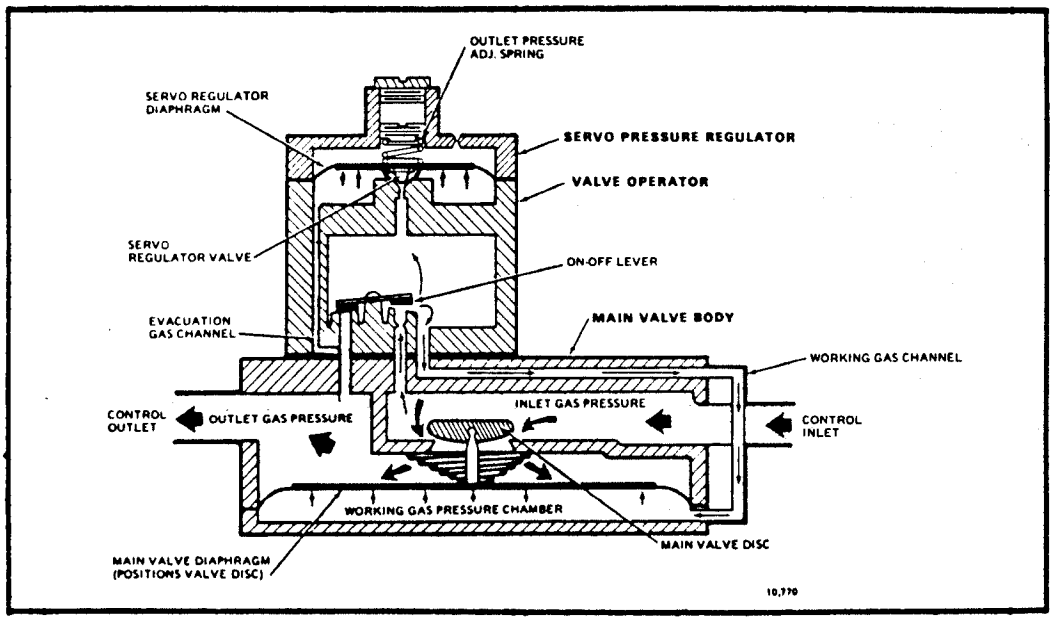


Fig. 43—Schematic diagram of V800 in burner ON position.

Working gas quickly fills the operator and flows through the Working Gas Channel to the chamber beneath the Main Valve Diaphragm. The working gas exerts pressure beneath the diaphragm and pushes it up, which lifts the Main Valve Disc and allows gas to flow through the outlet to the main burner.

STANDARD V5306 PRESSURE REGULATION

As outlet gas pressure builds, it exerts pressure under the Servo Regulator Diaphragm—by way of the Evacuation Gas Channel—opens the servo regulator valve, and allows working gas to flow out of the operator through the evacuation channel. Remember, since outlet gas pressure is always lower than inlet gas pressure, working gas will always be flowing out of the operator through the evacuation channel once the servo regulator valve is opened. Remember, it is the RATE at which the working gas is allowed to escape that keeps the outlet pressure regulated.

The outlet pressure is maintained at the pressure regulator setting as follows.

If the outlet pressure begins to rise above the pressure setting, it pushes up on the servo regulator diaphragm and allows more working gas to escape into the evacuation channel. This decreases

the pressure of the working gas in the chamber beneath the main valve diaphragm and lowers the main valve disc closer to the main valve, allowing less gas to flow through the main valve.

If the outlet pressure begins to fall below the pressure setting, the pressure beneath the servo regulator diaphragm also drops and the servo regulator valve closes slightly, reducing the amount of working gas that can bleed out into the evacuation channel. This increases the working gas pressure in the chamber beneath the main valve diaphragm and raises the main valve disc, allowing more gas to flow through the main valve.

V5307 STEP-OPENING REGULATOR

The V5307 regulates outlet pressure in the same manner as the standard pressure regulator described above. However, this step-opening regulator includes a second diaphragm assembly with an independent pressure chamber (Fig. 44).

On a call for heat, working gas enters the operator and flows through the Working Gas Channel to fill the chamber beneath the Main Valve Diaphragm and push it up. This opens the main valve and allows gas to flow to the burner. The outlet pressure is controlled at the step-pressure setting by the Servo Regulator Diaphragm (Fig. 44) just as it is by a standard pressure regulator.

Meanwhile, working gas is flowing past the Step-Timing Orifice and exerting pressure on the Step-Timing Diaphragm. As pressure builds above the diaphragm, it pushes down. The force of this added pressure is transferred through the Transfer Spring to the Diaphragm Loading Spring and to the Servo Regulator Diaphragm. This added force makes it more difficult for the outlet pressure to keep the Regulator Valve open. Working gas pressure builds and the main valve opens farther. Regulation continues at the full rate pressure until the call for heat is ended.

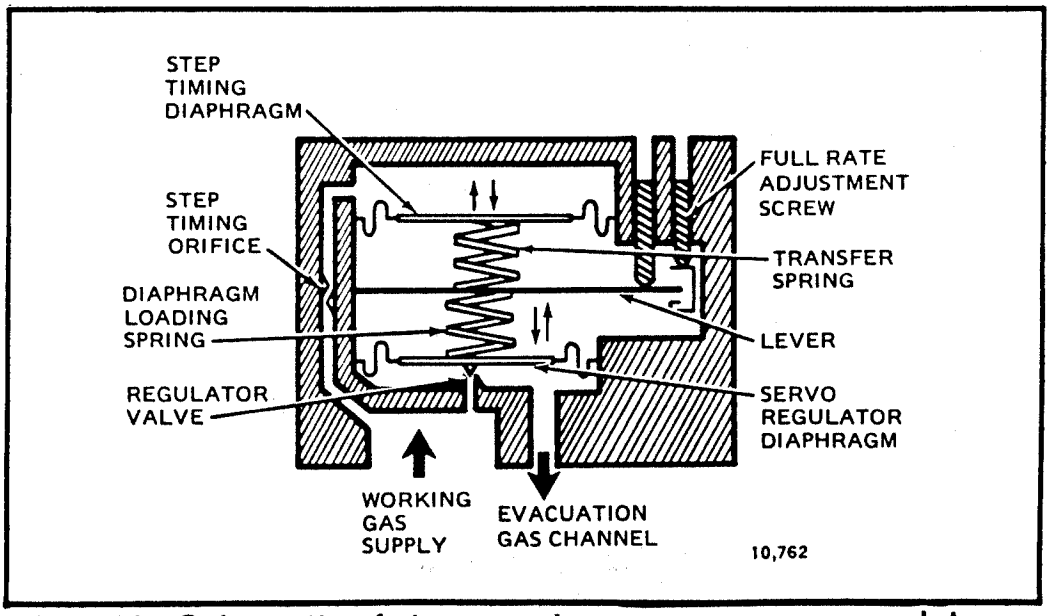


Fig. 44—Schematic of step-opening servo pressure regulator.

V5308 HI-LO AND V5309 LP-NATURAL GAS CHANGEOVER REGULATORS

These regulators control outlet gas in the same manner as the standard pressure regulator. Both, however, allow manual changing from one pressure to another. What takes place when you switch these regulators from Lo to Hi or Natural gas to LP gas is that more tension is added to the spring above the servo regulator diaphragm, which means that more working gas is directed to the chamber beneath the main valve diaphragm and the main valve disc is pushed up. A higher outlet pressure, then, is required to keep the pressure regulator valve open.

V8324 TWO-STAGE OPERATOR/REGULATOR

This is a special purpose operator/regulator for two-stage combination gas controls that uses the same servo method of regulating outlet pressure as the standard pressure regulator. Its operation is similar to the step-opening V5307, with one notable exception. The two-stage operator/regulator is controlled by a two-stage thermostat and does not go to high flame unless the call for heat is several degrees above room temperature.

Fig. 45 shows the two-stage operator/regulator in the first stage ON position. It regulates outlet pressure exactly like the standard pressure regulator.

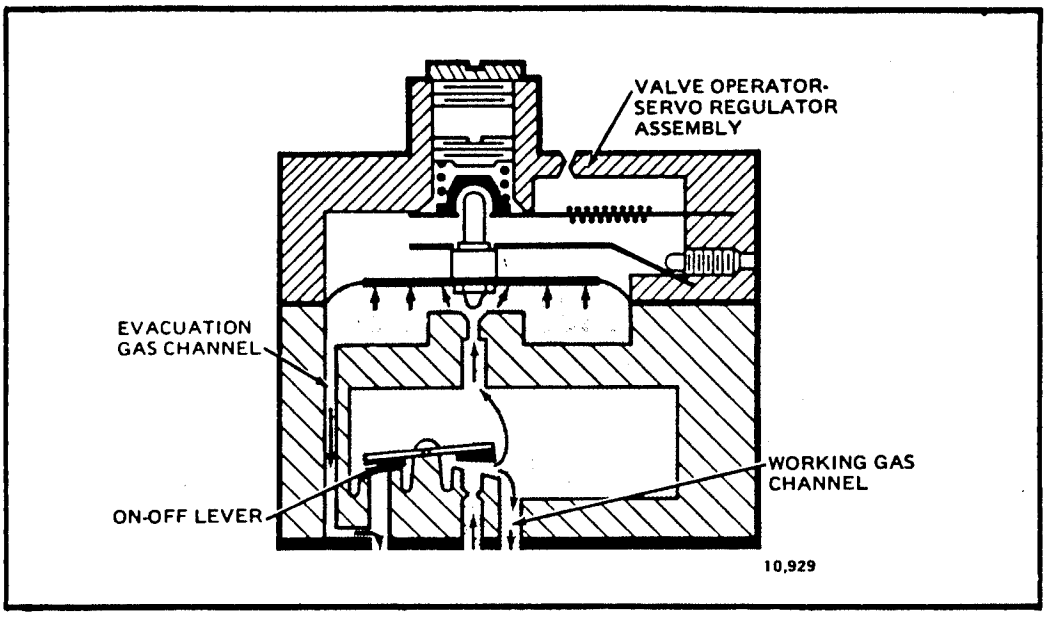


Fig. 45—First-stage ON position.

Fig. 46 shows the operator/regulator in the second stage ON position. Before the second stage is activated, two things must happen: (1) the second stage of the thermostat must close and provide current to the second stage bimetal heater, and (2) the heater must cause the bimetal to warp down. (This usually takes approximately 60 seconds.) Once the heater has warped the bimetal down, the second stage regulator spring puts more tension on the regulator diaphragm and pushes it down. Less working gas

escapes into the evacuation gas channel and more working gas flows to the chamber beneath the main valve diaphragm. This opens the main valve to its full second-stage position and outlet pressure is regulated at the second-stage pressure until the second stage of the thermostat is satisfied, interrupting current to the wire-wound bimetal heater and allowing the bimetal to return to its original position. First stage operation then continues until the call for heat has ended.

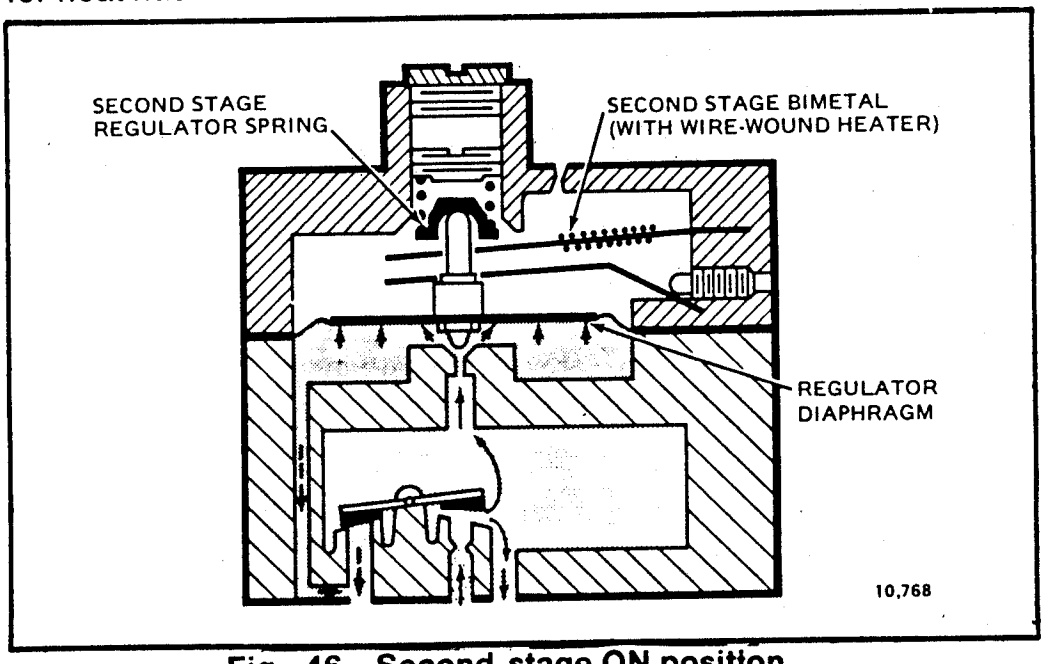


Fig. 46—Second-stage ON position.

VR800 FAMILY

Dual valve, VR type, combination gas controls operate in the same manner as single valve, V type, gas controls, and the same operators and regulators are used for both.

Fig. 47 illustrates the VR type gas controls.

1. The VR type control has two main valves. The First Main Valve is magnetically operated and is open whenever there is a call for heat. It is not controlled by the operator or regulator. The Second Main Valve is servo-operated and regulates the amount of gas that flows to the burner under the control of the operator and regulator.

2. The Pilotstat power unit mounts from the bottom of the control and has the safety shutoff disc attached directly to it.

NEGATIVE PRESSURE REGULATED VALVES

The V859, V860, VR859 and VR860 are designed to control gas flow at less than atmospheric pressure and are used only on power burners with Direct Spark Ignition systems.

The operators and regulators used on negative pressure controls are not field repairable or replaceable; they are factory-adjusted and mounted.

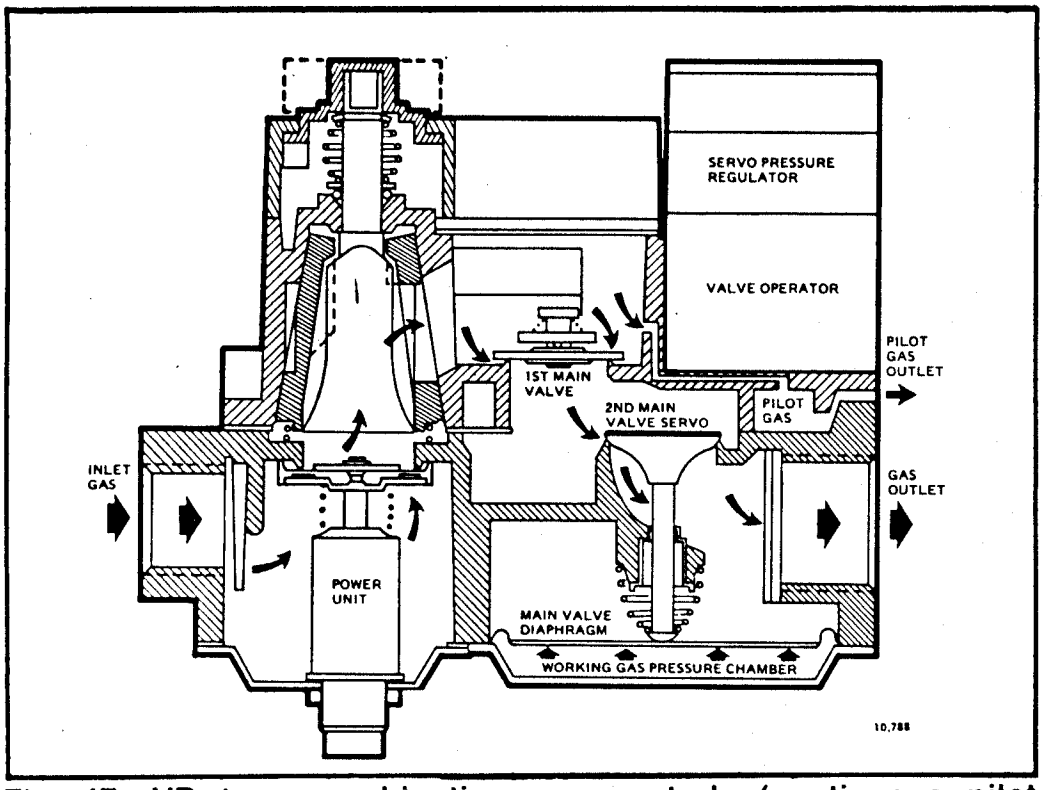


Fig. 47—VR type combination gas controls (continuous pilot shown).

Operation is as follows:

When the operator valve is closed, the regulator diaphragm is held up by a spring and the main valve is seated tightly.

When the control is energized, the operator valve opens and working gas begins entering the operator chamber and escapes through the evacuation gas channel. Keep in mind that a negative pressure (vacuum) is building at the outlet of the gas control as the blower comes up to full speed.

As the blower speed increases and this vacuum builds, it creates a lower than atmospheric (negative) pressure below the regulator diaphragm. This causes the diaphragm to move down, reducing the amount of working gas that can escape. The working gas fills the operator chamber and flows into the chamber beneath the main valve diaphragm. The working gas pressure builds and pushes the main valve diaphragm up, allowing gas to flow to the main burner.

NOTE: The main valve will not open until the negative pressure is established by the blower, even though the operator valve is energized and the system is calling for heat.

Regulation is maintained as follows:

If the negative pressure decreases toward zero in. wc, the regulator diaphragm will move up and more working gas will escape, reducing the pressure beneath the main valve diaphragm and closing the main valve slightly.

If the negative pressure increases, the regulator diaphragm will move down and less working gas will escape, increasing the

pressure beneath the main valve diaphragm and opening the main valve slightly.

V500 FAMILY OPERATION

The V500 family combination gas controls are mechanically controlled and operated by means of a gas-filled bulb and bellows assembly. The bulb is mounted in the appliance's return air path and performs the same function as a thermostat to sense room temperature. The bellows is installed inside the operator body and functions as the operator valve controller.

BURNER ON

BULB TYPE VALVE OPERATORS

These valve operators control room temperature automatically by means of the liquid-filled, temperature sensitive bulb. Change in temperature of the air surrounding the bulb causes the liquid fill to expand or contract. This change in volume of the liquid is transmitted through the capillary tubing to the bellows in the operator to actuate the gas valve.

ON-OFF operators—the gas valve snaps fully open when the temperature bulb senses the need for heat and snaps closed when the demand for heat is satisfied.

Modusnap operators—the valve snaps open to minimum flame and then modulates between minimum and maximum flame, in proportion to the heating load, until the demand for heat is satisfied.

As the room temperature decreases past the dial set point, the gas in the bulb and bellows assembly contracts (Fig. 48). This positions the ON-OFF lever so that working gas can flow into the operator and into the chamber beneath the main valve diaphragm. The working gas pressure beneath the main valve diaphragm pushes the diaphragm up and with it the main valve disc, allowing gas to flow to the main burner.

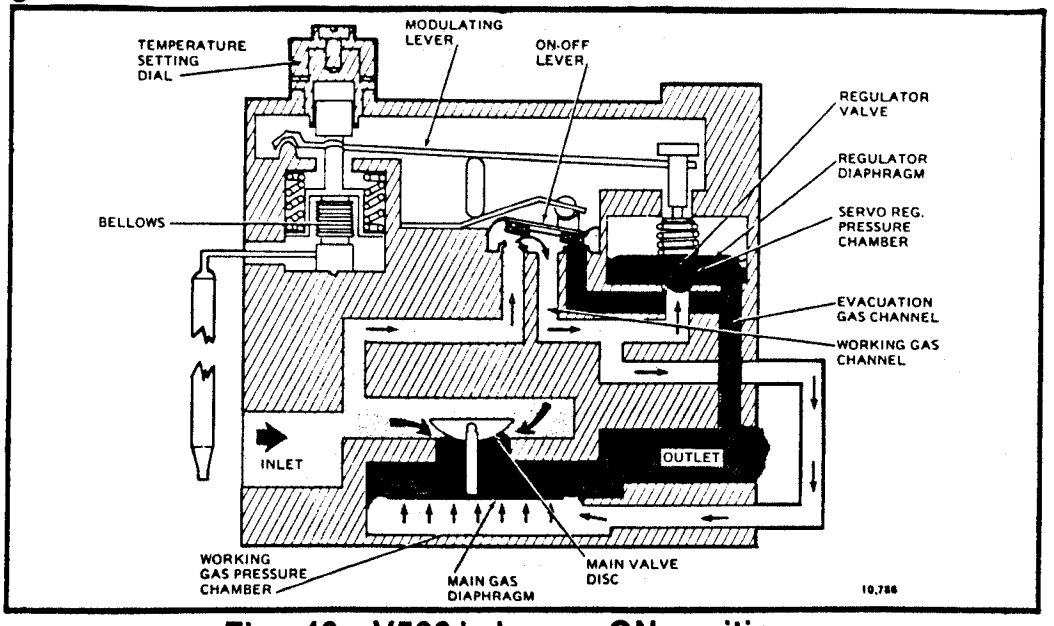


Fig. 48—V500 in burner ON position.

BURNER OFF

As the room temperature increases above the dial set point, the gas in the bulb and bellows assembly expands (Fig. 49). This positions the ON-OFF lever to block the flow of working gas into the operator and into the chamber beneath the main valve diaphragm. The working gas beneath the main valve diaphragm bleeds off through the evacuation gas channel and the main valve closes.

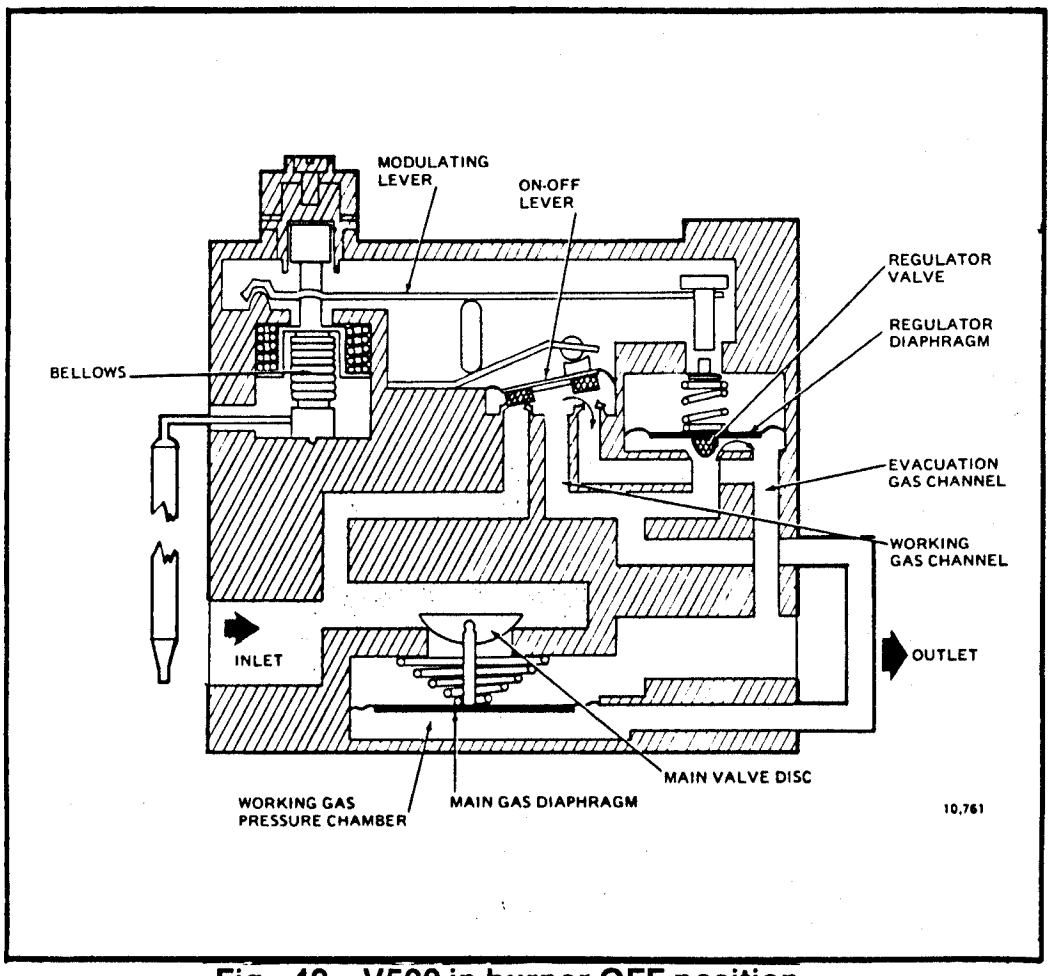


Fig. 49—V500 in burner OFF position.

V504 AND V524 REGULATION

The outlet gas pressure is REGULATED in the same way as on the standard pressure regulator of the V800 Family controls (page 74).

V504 MODULATING LEVER

The modulating lever of the V504, shown in Figs. 48 and 49, VARIES THE OUTLET GAS PRESSURE according to the demand for heat. As the room temperature decreases, the contracting bellows forces the modulating lever to gradually press the servo regulator valve closer to its seat. This forces more working gas into the chamber beneath the main valve diaphragm and opens the main valve, allowing more gas to flow to the main burner.

As the room temperature approaches the dial set point, the expanding bellows drives the modulating lever upward and the servo regulator valve opens farther. This allows more working gas to escape through the evacuation channel and also allows working gas to escape from the chamber beneath the main valve diaphragm. This causes the main valve to close slightly, reducing the flow of gas to the main burner.

PILOTSTAT POWER UNIT SAFETY SHUTOFF MECHANISM

Fig. 50 illustrates the Pilotstat power unit safety shutoff mechanism found on all C & V type Honeywell gas controls for continuous pilot applications.

NOTE: On VR type combination gas controls for continuous pilot application, the Power Unit mounts from the bottom of the control (Fig. 47). The principle of operation, however, is basically the same.

The Pilotstat power unit blocks the flow of gas to both the main burner and the pilot burner if the pilot burner flame is extinguished or becomes too small for satisfactory ignition.

Fig. 50 shows the Pilotstat Power Unit mechanism in the operating position. The pilot is burning and supplying heat to the thermocouple or thermopile which, in turn is providing the electrical energy required to hold-in the Pilotstat power unit against the force of the Loading Dropout Spring. Note that the Safety Shutoff Valve Disc at the end of the Rocker Arm is in the open postion and allows gas to flow into the gas control through the Tapered Plug Gas Cock.

In the event of pilot outage (or decrease in thermocouple or thermopile output due to a low flame), the power unit will no longer hold in the Loading Spring and the Safety Shutoff Valve Disc will seat against the entrance port of the gas cock and prevent the flow of gas into the control.

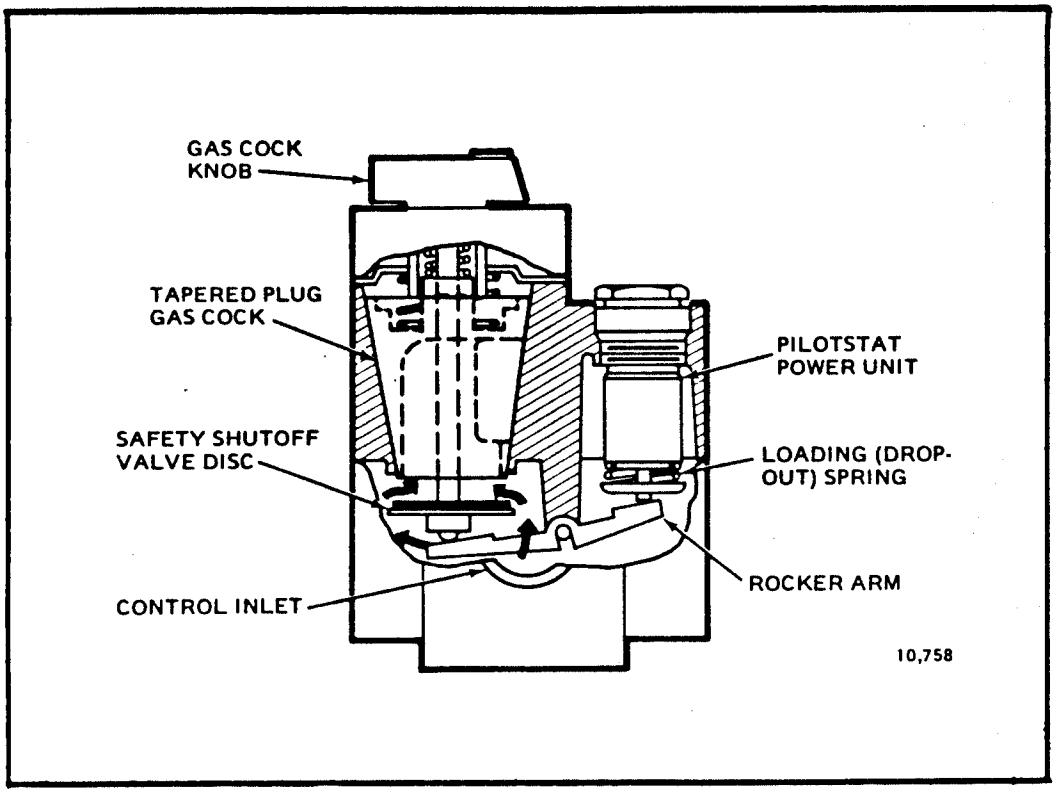
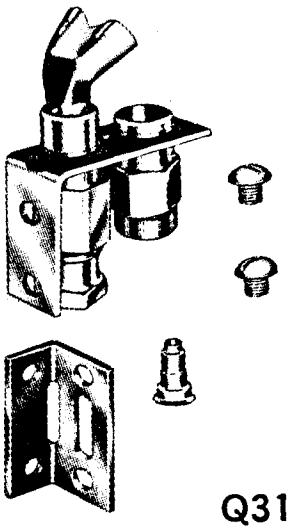
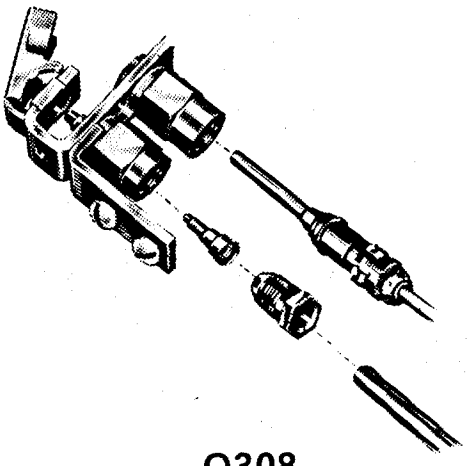


Fig. 50—Cutaway view of the Pilotstat power unit mechanism in its normal operating position.

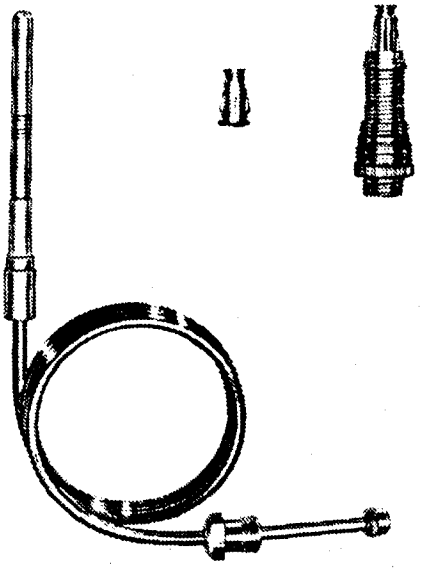
IGNITION



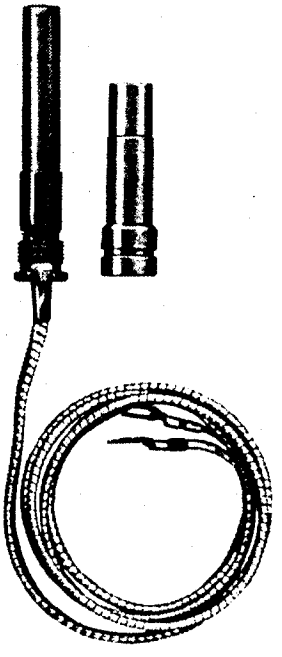
Q314



Q308



Q340



Q313

This section includes installation and replacement information on all components needed to maintain a continuous pilot in a gas-fired heating system. Information on Direct Spark Ignition and Intermittent Pilot systems is covered in a separate handbook.

A continuous pilot system includes a pilot burner with orifice and a thermocouple or thermopile. A thermocouple supplies 30 mV of power to the safety shutoff Pilotstat power unit in gas controls using low volt, line volt, or remote bulb operators. A thermopile generator supplies power to a 250 or 750 mV safety shutoff Pilotstat power unit and also provides power for the gas control operator, the control circuit, and any necessary limits.

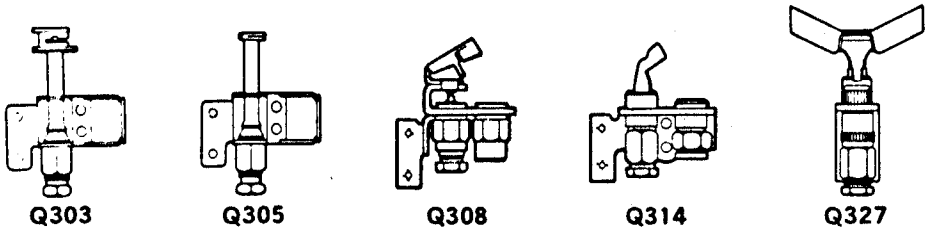
PILOT BURNERS

Pilot burners have three primary functions: to direct the pilot flame for proper main burner ignition, to provide a mount for the thermocouple or thermopile generator, and to heat the thermocouple or thermopile generator to provide the voltage required to hold in the Pilotstat power unit.

No single type of pilot burner can provide an adequate ignition flame for all types of main burners. As a result, there are many different pilot burners and a wide selection of mounting styles.

The two basic types of pilot burners are primary-aerated and nonprimary-aerated. The primary-aerated burners mix air with the gas before it leaves the burner ports, the nonprimary-aerated burners do not.

PILOT BURNERS WITHOUT THERMOCOUPLE OR THERMOPILE



Q303
Q324

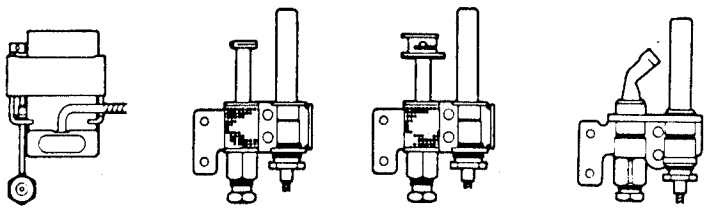
Q305

Q308

Q314
Q350

Q327

PILOTS WITH POWERPILE GENERATORS



CS82

CS893

CS894

CS897

10,773

MODELS

PILOT BURNER OR POWERPILE GENERATOR	TYPE OF ORIFICE	DESCRIPTION
Q303	Spud	Primary-aerated, multiport tip
Q305	Spud	Primary-aerated, single-port tip
Q308	Insert	Nonprimary-aerated, divided flame tip
Q314	Insert	Nonprimary-aerated, target type tip
Q324	Spud	Primary-aerated, multiport tip
Q327	Spud	Nonprimary-aerated, target type tip
Q350	Insert	Nonprimary-aerated, target type tip
CS82A	Internal spud	Nonprimary-aerated, universal tip
CS893	Spud	Primary-aerated, single-port tip
CS894	Spud	Primary-aerated, multiport tip
CS897	Insert	Nonprimary-aerated, target tip

INSTALLATION

Follow the instructions provided by the appliance manufacturer when installing the pilot burner. If unavailable, it is important to follow these basic locating and mounting requirements.

LOCATION

The pilot burner. . .

- must be positioned for easy access, observation and lighting.
- must be rigidly mounted so that the ignition flame remains properly positioned with respect to the main burner.
- must not receive the full force of igniting or extinguishing puffs from the main burner.
- must not be exposed to draft conditions that will extinguish the pilot flame or pull it away from the thermocouple or thermopile.

The pilot flame...

- must not be exposed to falling scale, which could prevent ignition of the main burner.
- must not impinge on adjacent parts; main burner must not impinge on pilot burner (Fig. 51).
- must have an ample air supply that is free from products of combustion.

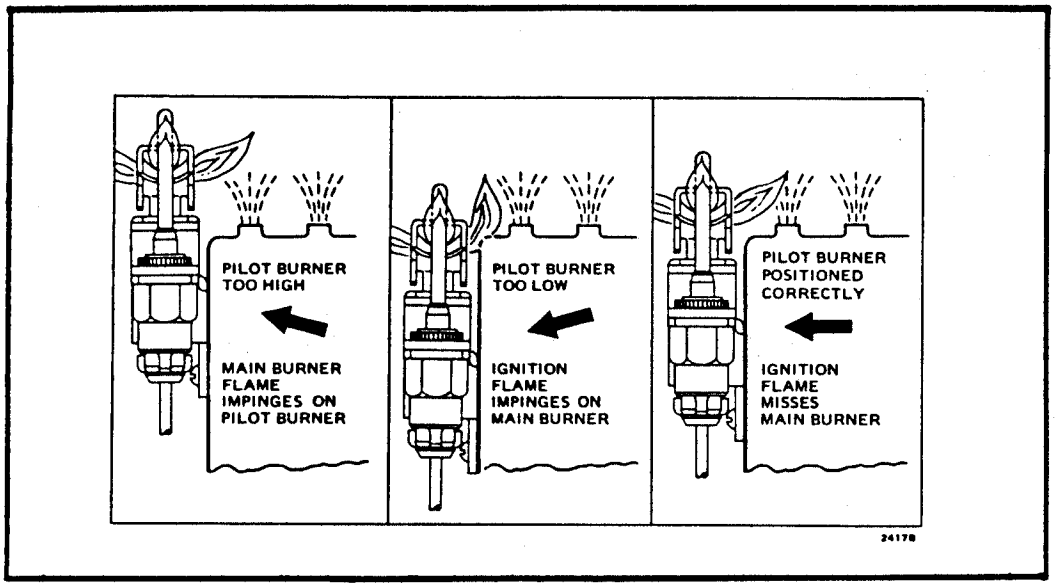


Fig. 51—Proper location of the pilot burner.

MOUNTING

The pilot burner should be rigidly mounted to the main burner (Fig. 52). Mounting surfaces other than on the main burner must be used with CAUTION. These surfaces may shift, or warp, as a result of metal contraction or expansion due to furnace temperature extremes.

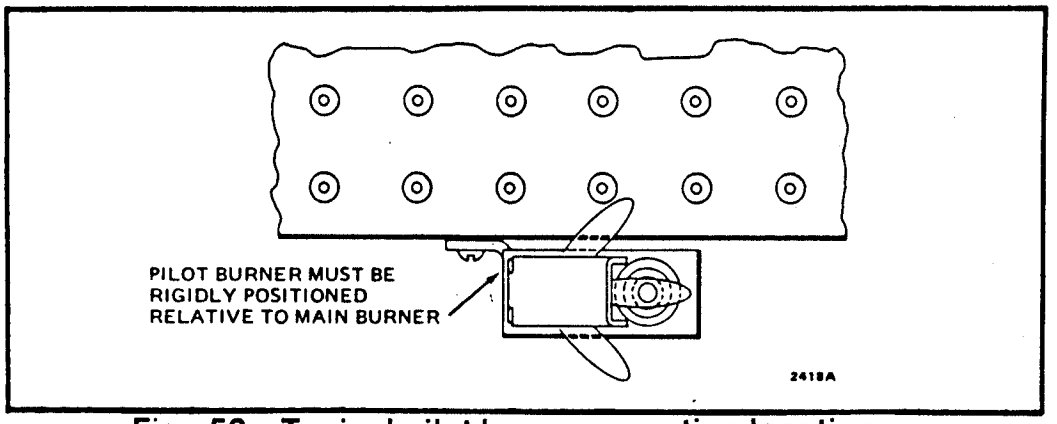


Fig. 52—Typical pilot burner mounting location.

PILOT FLAME ADJUSTMENT

1. Before lighting the pilot burner, turn the thermostat or controller down to its lowest setting and set the gas cock knob to PILOT.

2. Light the pilot burner according to the appliance manufacturer's lighting instructions.

3. Remove the pilot adjustment cover screw and adjust the pilot flow adjustment screw to give a soft, steady flame that envelops 3/8 to 1/2 in. [9.5 to 12.7 mm] of the tip of the thermocouple or thermopile generator.

If the pilot flame is properly adjusted but goes out during normal operation, check Mounting and Location, above.

If necessary to protect the pilot flame from main burner concussion on ignition or extinction, or from drafts or recirculation of products of combustion, construct a hot and cold junction shield similar to that shown on page 102.

CHECKOUT

MAIN BURNER IGNITION

NOTE: This test should be performed only after gas input pressure and primary air adjustments have been made to the main burner. Observe operation of the pilot burner with the appliance doors in the operating position; i.e., closed; a mirror may be helpful.

The pilot burner should ignite the main burner quickly and reliably under all operating conditions, including low gas supply pressure.

The pilot flame must not smother or snuff out when tested as follows—

- — Cold start main burner ignition.
- — During continuous operation of main burner.
- — Main burner ignition with appliance at maximum operating temperature.

PILOT TURNDOWN TEST (30 mV SYSTEMS)

It is an ANSI requirement that the pilot flame must ignite the main burner within 4 seconds after the gas reaches the main burner ports when the pilot gas supply is reduced to an amount just sufficient to hold in the Pilotstat power unit, or just above the point of pilot flame extinction (if this occurs at a higher pilot gas flow rate).

The Turndown Test Procedure is as follows:

1. With both the pilot and main burner operating, shut off the main burner by lowering the thermostat temperature setting or by turning the gas cock knob to the PILOT position.

NOTE: If using a Honeywell W720 Systems Tester, steps 2 and 3 below may be omitted. Instead, by means of the pilot flow adjustment screw, reduce the pilot flame until the thermocouple output drops to 2 mV open circuit as outlined in the W720 manual. Then proceed with step 4.

2. Turn the pilot gas adjustment screw clockwise  until the pilot flame begins to decrease in size. Thereafter, turn the screw clockwise  1/4 turn at a time (waiting 1 minute between each 1/4 turn to allow the thermocouple to cool) until the safety shutoff power unit just drops out, causing safety shutdown.

3. Turn the pilot gas adjustment screw back, counterclockwise  , very slightly, and relight the pilot burner. (The power unit should barely hold in.)

4. Turn the gas cock knob ON and adjust the thermostat temperature setting above room temperature. The main burner must light within 4 seconds without flame roll-out. If it does not, recheck the pilot location and repeat steps 1 through 4.

5. Readjust the pilot gas adjustment screw to obtain a normal flame enveloping 3/8 to 1/2 in. [9.5 to 12.7 mm] of the thermocouple tip.

EFFECTIVE IGNITION TEST (250 and 750 mV SYSTEMS)

On millivoltage controls, a low pilot flame will cause the valve operator to fail before the generator ouput has decreased enough for the power unit to drop out. Therefore, main burner ignition is checked with the pilot flame adjusted to the minimum pull-in millivoltage required to open the main valve.

Proceed as follows:

1. Light the pilot burner according to the appliance manufacturer's instructions. Allow the pilot to burn at least 5 minutes to heat the generator to its normal operating temperature.

2. Remove one thermostat lead (TH) at the valve terminal.

3. Decrease the pilot flame, using the pilot gas adjustment screw, until the flame begins to pull away from the generator. Allow the generator to cool at least one minute at this reduced flame level.

4. Temporarily jumper the thermostat terminals on the Powerpile valve. If the main burner ignites, reduce the flame further by turning the pilot adjustment screw 1/4 turn at a time until the valve fails to pull in. Allow the generator to cool at least one minute between each reduction in the pilot flame level.

5. Increase the pilot flame just enough to pull in the valve.

6. Jumper the thermostat terminals again. The main burner should light within 4 seconds and without flame roll-out. If it does not, check the pilot location and repeat steps 1 to 6.

NOTE: A pilot that goes out after igniting the main burner complies with this requirement.

7. Remove the jumper to shut off the main burner, and readjust the pilot to envelop 3/8 to 1/2 in. [9.5 to 12.7 mm] of the generator tip.

8. Reconnect the thermostat lead, and be sure all connections are correct and the system is functioning normally.

DETERMINING PILOT GAS CONSUMPTION

Table 7 lists pilot gas consumption rate by orifice size, type of gas and orifice pressure.

TABLE 7 – GAS CONSUMPTION CHART

ORIFICE DIAM.		PILOT GAS CONSUMPTION IN cfh [m^3/hr] FOR TYPE OF GAS AND ORIFICE PRESSURE INDICATED							
		NATURAL GAS				PROPANE		BUTANE	
in.	mm	cfh at 3.5 in. wc	m^3/hr at 1 kPa	cfh at 7 in. wc	m^3/hr at 1.7 kPa	cfh at 11 in. wc	m^3/hr at 2.7 kPa	cfh at 11 in. wc	m^3/hr at 2.7 kPa
0.009	0.23	0.20	0.006	0.28	0.008	0.22	0.006	0.20	0.006
0.010	0.25	0.25	0.007	0.35	0.001	0.28	0.008	0.25	0.007
0.011	0.28	0.30	0.009	0.43	0.012	0.34	0.010	0.30	0.009
0.012	0.30	0.35	0.010	0.50	0.014	0.40	0.011	0.36	0.010
0.013	0.33	0.43	0.013	0.60	0.017	0.48	0.014	0.43	0.013
0.014	0.36	0.48	0.014	0.69	0.020	0.56	0.016	0.49	0.014
0.015	0.38	0.57	0.016	0.80	0.023	0.65	0.018	0.57	0.016
0.016	0.41	0.64	0.018	0.90	0.025	0.74	0 021	0.64	0.018
0.018	0.46	0.79	0.022	1.12	0.032	0.91	0.26	0.79	0.022
0.020	0.51	0.98	0.028	1.39	0.040	1.12	0.032	0.99	0.028
0.021	0.53	1.07	0.030	1.50	0.042	1.22	0.035	1.06	0.030
0.022	0.56	1.23	0.035	1.73	0.049	–	–	–	–
0.024	0.61	1.39	0.040	1.96	0.056	–	–	–	–
0.025	0.63	1.53	0.043	2.16	0.061	–	–	–	–
0.026	0.66	1.66	0.047	2.35	0.067	–	–	–	–
0.028	0.71	1.92	0.054	2.72	0.078	–	–	–	–
0.030	0.76	2.21	0.063	3.12	0.088	–	–	–	–

PILOT BURNER ORIFICES

There are two basic orifice design types for pilot burners, spud type orifices and insert type orifices (Fig. 53). A spud type orifice is a machined plug or cap with the orifice (hole) drilled into it that is screwed into the pilot burner. An insert type orifice is a stamped metal piece that drops into the pilot burner and is held in place by a separate threaded fitting.

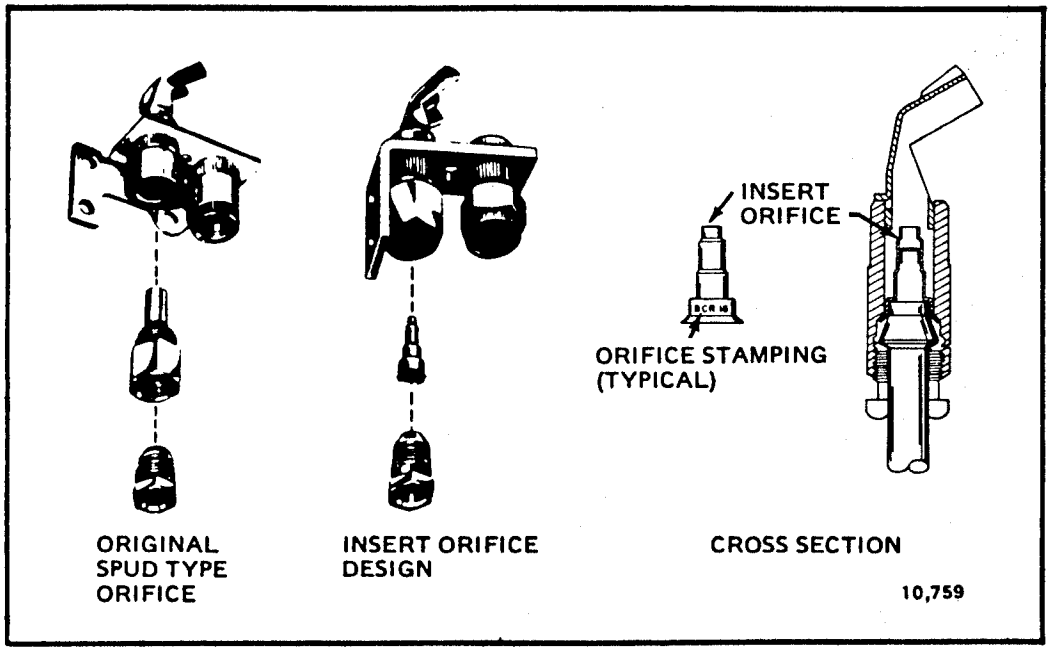


Fig. 53—Insert and spud type orifice designs.

SPUD TYPE ORIFICES

Fig. 54 shows the various types of orifice inlet fittings for use on Honeywell pilot burners using spud type orifices. All of the fittings are available for different types of heating gases as shown in Table 8.

To use Table 8, find the appropiate fitting for your application, find the pilot burner model number and the type of gas being used in columns 1 and 2; then follow across the table to find the types of orifice inlet fittings that may be used.

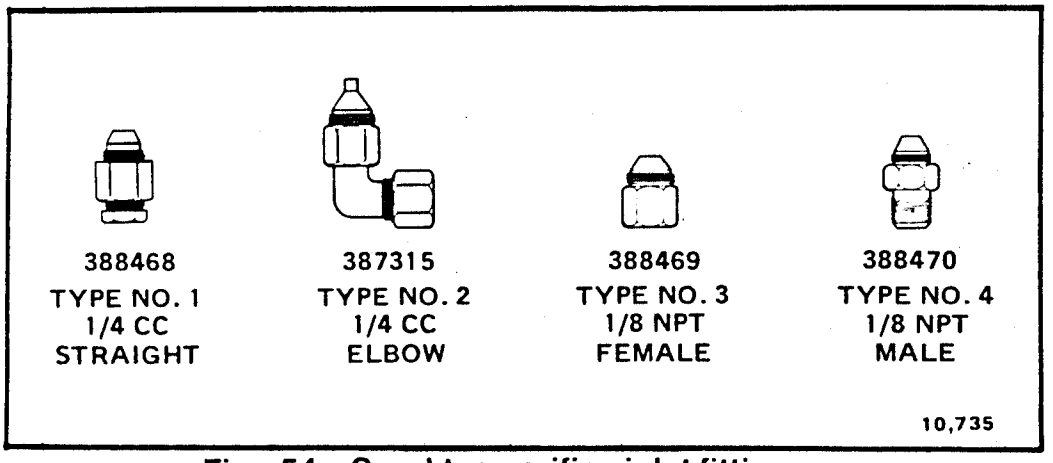


Fig. 54—Spud type orifice inlet fittings.

TABLE 8 – SPUD TYPE ORIFICE SELECTION TABLE.

PILOT BURNER	TYPE OF GAS USED	ORIFICE STAMPING	ORIFICE DIAM. SIZE		TYPES OF ORIFICE INLET FITTINGS (SEE ABOVE)			
			in.	mm	No. 1	No. 2	No. 3	No. 4
Q303 Q305	Natural	N-18	0.018	0.46	388468H	387315A	388469F	388470F
	Mixed	N-18	0.018	0.46	388468H	387315D	388469F	388470F
	Mfd.	M-225	0.023	0.58	388468T	387315C	388469D	388470D
	LP	L-10	0.010	0.25	388468D	387315B	388469C	388470C
	LP-Air (500-650 Btu [.15-1.9 kW])	BA-26	0.026	0.66	388468M		388469H	388470H
	LP-Air (1100-1450 Btu [.32-.42 kW])	N-16	0.016	0.41	388468A		388469A	388470A
	Mixed Special	N-20	0.020	0.51	388468V		388469M	388470M
Q324 CS893 CS894	Natural	N-18	0.018	0.46	388468H	387315D	388469F	388470F
	Mixed	N-20	0.020	0.51	388468V	387315E	388469M	388470M
	Mfd.	M-225	0.023	0.58	388468T	387315C	388469D	388470D
	LP	L-10	0.010	0.25	388468D	387315B	388469C	388470C
	LP-Air (500-650 Btu [1.5-1.9 kW])	BA-26	0.026	0.66	388468M	387315G	388469H	388470H
	LP-Air (1100-1450 Btu (.32-.42 kW])	N-18	0.018	0.46	388468H	387315D	388469F	388470F

(Continued next page)

(Table 8 continued)

PILOT BURNER	TYPE OF GAS USED	ORIFICE STAMPING	ORIFICE DIAM. SIZE		TYPES OF ORIFICE INLET FITTINGS (SEE ABOVE)			
			in.	mm	No. 1	No. 2	No. 3	No. 4
	LP-Air (1100-1450 Btu [.32-.42 kW])	15	0.015	0.38				
Q327	Natural	A-26	0.026	0.66	388146AG	388149AG	388148AG	
	Mixed	A-28	0.028	0.71	388146AK	388149AK	388148AK	
	LP	K-14	0.014	0.36	388146KR	388149KR	388148KR	
CS897	Natural	A-18	0.018	0.46	388146AC	388149AC	388148AC	
	LP	A-11	0.011	0.28	388146AA	388149AA	388148AA	
	Mfd.	J-22	0.022	0.56	388146JE	388149JF	388148JE	
	Mixed	A-20	0.020	0.51	388146AD	388149AD	388148AD	
	LP-Air (500-600 Btu)	C-30	0.030	0.76	388146CH	388149CH	388148CH	
	LP-Air (600-800 Btu)	B-26	0.026	0.66	388146BG	388149BG	388148BG	
	LP-Air (800-1100 Btu)	B-23	0.023	0.58	388146BF	388149BF	388148BF	
	LP-Air (1100-1400 Btu)	A-18	0.018	0.46	388146AC	388149AC	388148AC	

INSTALLING SPUD TYPE ORIFICES

Safety First—

— Shut off main gas supply and allow 5 minutes for unburned gas to vent. Remember, LP gas is heavier than air and does not vent upward naturally.
— Do not bend tubing near the orifice fitting after the nut has been tightened, as this may cause a gas leak at the connection.

1. Disconnect the pilot tubing from the orifice.

2. Unscrew the spud orifice and discard. Cut off the old compression fitting.

3. Square off the end of the tubing and remove all burrs.

4. Remove the nut and ferrule from the new orifice assembly.

5. Slip the nut and ferrule over the tubing and slide it out of the way.

6. Screw the new orifice into the pilot burner and tighten it securely.

7. Push the pilot tubing into the orifice until it bottoms. Slide the nut and ferrule up to the orifice and engage the threads.

8. With a wrench, tighten one turn beyond finger tight.

CHECKOUT

1. Turn on the main gas supply, light the pilot, and check the pilot tubing connections for gas leaks as follows.

WARNING

WITH MAIN BURNER IN OPERATION, PAINT THE TUBING CONNECTIONS WITH A RICH SOAP AND WATER SOLUTION. BUBBLES INDICATE A GAS LEAK. TO STOP LEAK, TIGHTEN FITTING.

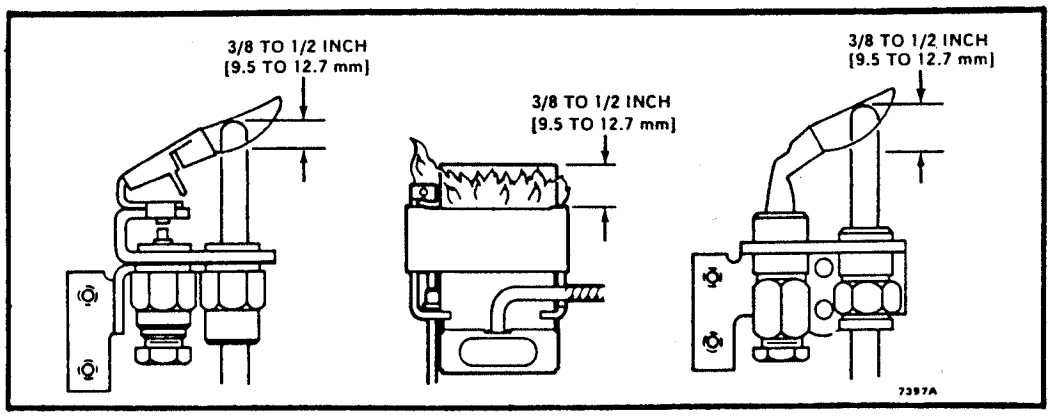


Fig. 55—Proper pilot flame adjustment.

2. Adjust the pilot to obtain a normal flame enveloping 3/8 to 1/2 in. [9.5 to 12.7 mm] of the thermocouple or thermopile (Fig. 55).

3. Place the system in operation and. . .

. .Check for satisfactory ignition of the main burner.

. . .Make certain the Pilotstat power unit holds in and that safety shutdown occurs within 2-1/2 minutes after the pilot flame is extinguished.

. . .Check system operation for at least one cycle to be sure it is functioning properly.

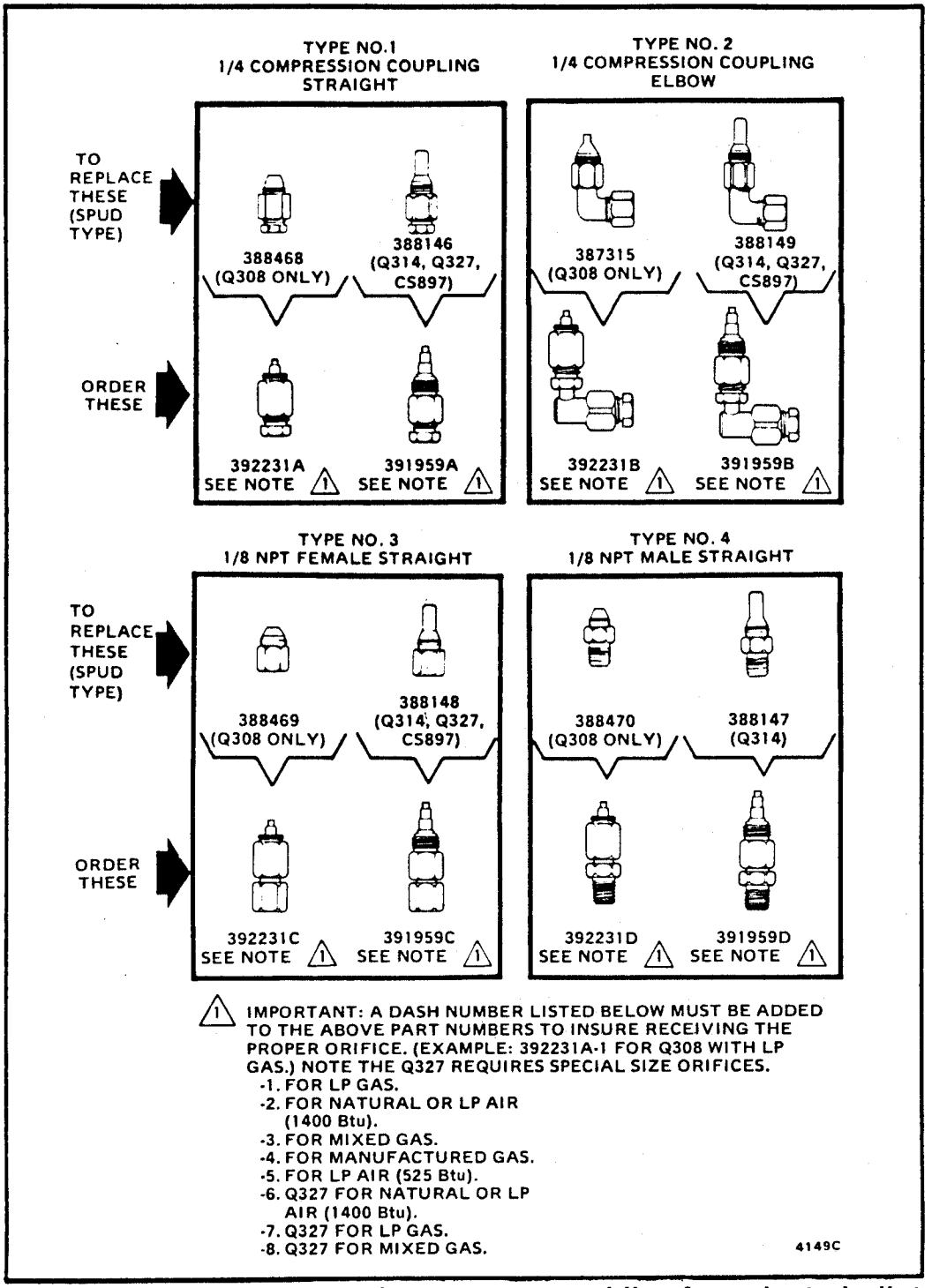


Table 9—Insert orifice replacement assemblies for selected pilot burners.

REPLACEMENT ASSEMBLIES

Old style Q308 and Q314 pilot burners and new style Q327 pilot burners and CS897 Powerpile generators, which require spud type orifice assemblies, can be converted to use insert type orifices. Table 9 shows the appropriate part numbers for the conversion assemblies.

INSERT TYPE ORIFICES

Fig. 56 illustrates the insert type orifices used on new style Q308, Q314 and Q350 pilot burners and the CS82 Powerpile Generator.

Table 10 shows the part number and orifice size necessary for different gases.

When replacing inset orifices, do not reuse the old compression fitting. Order replacement fittings from Fig. 57.

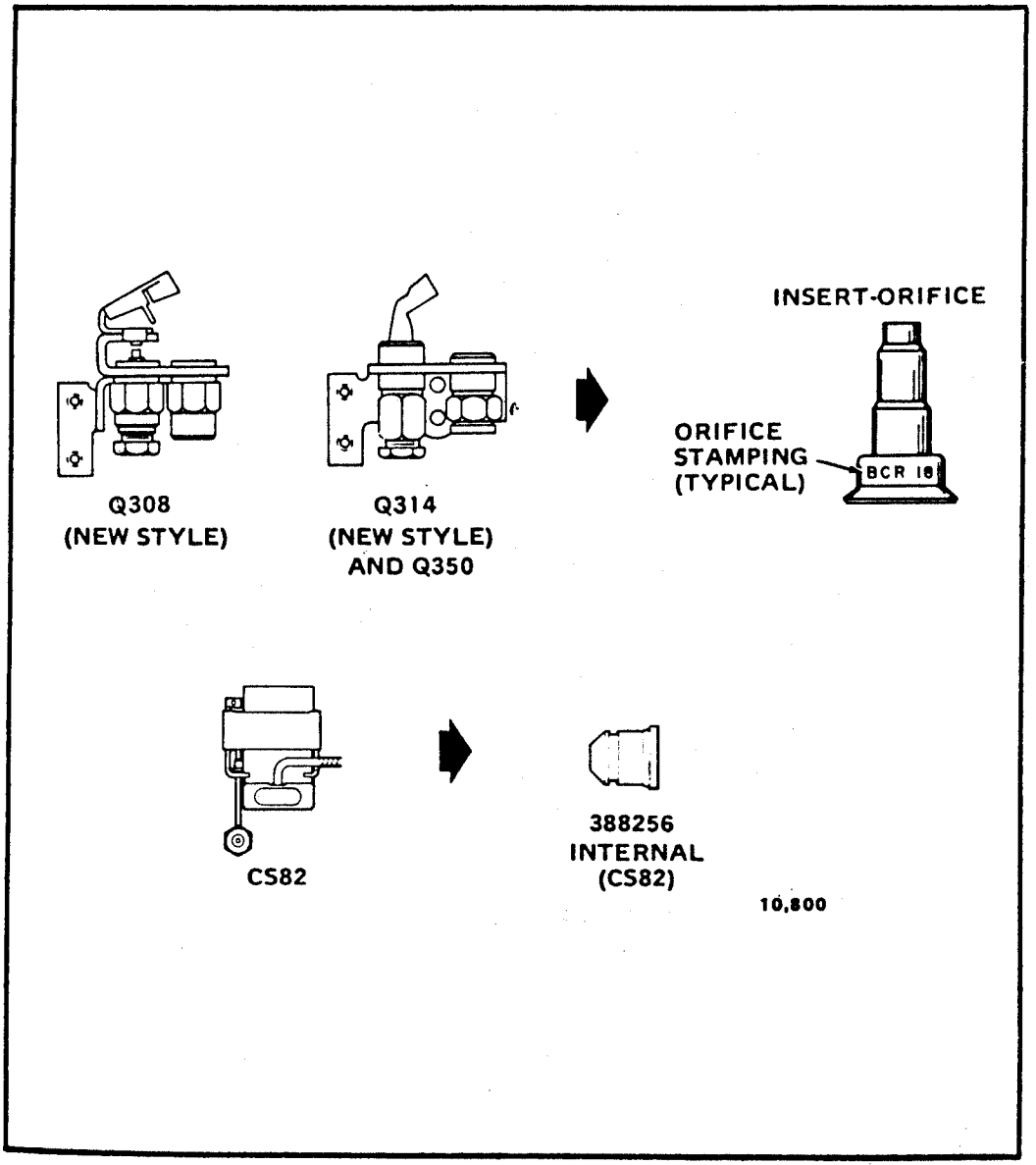


Fig. 56—Pilot burners with insert type orifices.

TABLE 10 – REPLACEMENT ORIFICES FOR Q308, Q314 AND Q350 PILOT BURNERS

PILOT BURNER	TYPE OF GAS USED	ORIFICE STAMPING	ORIFICE DIAMETER		INSERT ORIFICE PART NO.
			in.	mm	
Q308	Natural	BCR-18	0.018	0.46	390686–4
	LP	BBR-10	0.010	0.25	390686–1
	Mfd.	BCR-22	0.022	0.56	390686–6
	Mixed	BCR-20	0.020	0.51	390686–5
	But.-Air (1400 Btu)	BCR-18	0.018	0.46	390686–4
	But.-Air (525 Btu)	EAR-26	0.026	0.66	389575–10
Q314	Natural	BCR-18	0.018	0.48	390686–4
	LP	BBR-10	0.010	0.25	390686–1
	Mfd.	CAR-24	0.024	0.61	390686–8
	Mixed	BCR-20	0.020	0.51	390686–5
	But-air (1400 Btu)	BCR-18	0.018	0.46	390686–4
	But-air (525 Btu)	EAR-26	0.026	0.66	390686–10
Q350	Natural	CAR-12	.012	0.30	390686–23
	LP	GAF-8	.008	0.20	390686–23
CS82	Natural	15	0.015	0.38	388256G
	LP	9	0.009	0.23	388256B
	Mfd.	15	0.015	0.38	388256G
	Mixed	15	0.015	0.38	388256G
	But-air (1400 Btu)	15	0.015	0.38	388256G
	But-air (525 Btu)	22	0.022	0.56	388256K

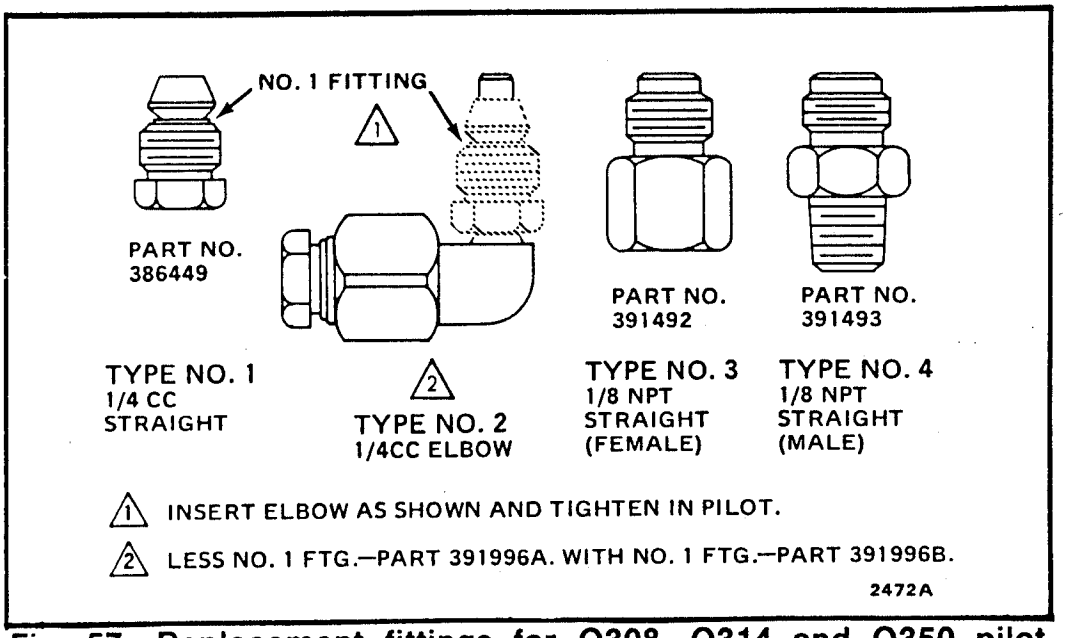


Fig. 57—Replacement fittings for Q308, Q314 and Q350 pilot burners.

INSTALLING INSERT ORIFICES

Safety First—

— Shut off main gas supply and allow 5 minutes for unburned gas to vent. Remember, LP gas is heavier than air and does not vent upward naturally.
— Do not bend tubing near the orifice fitting after the nut has been tightened, as this may cause a gas leak at the connection.

1. Disconnect the pilot tubing from the pilot burner, then remove the insert orifice. (It may be necessary to tap the burner to loosen the old orifice.)

2. Cut off the old compression fitting.

3. Square off the end of the tubing and remove all burrs.

4. Slip the new compression nut over the tubing and slide it out of the way.

5. Insert the new orifice into the pilot burner and push the tubing into the pilot burner until it bottoms (Fig. 58).

6. Slide the compression nut up to the pilot burner and engage threads.

7. With a wrench, tighten one turn beyond finger tight.

8. Checkout the installation as described above, page 87.

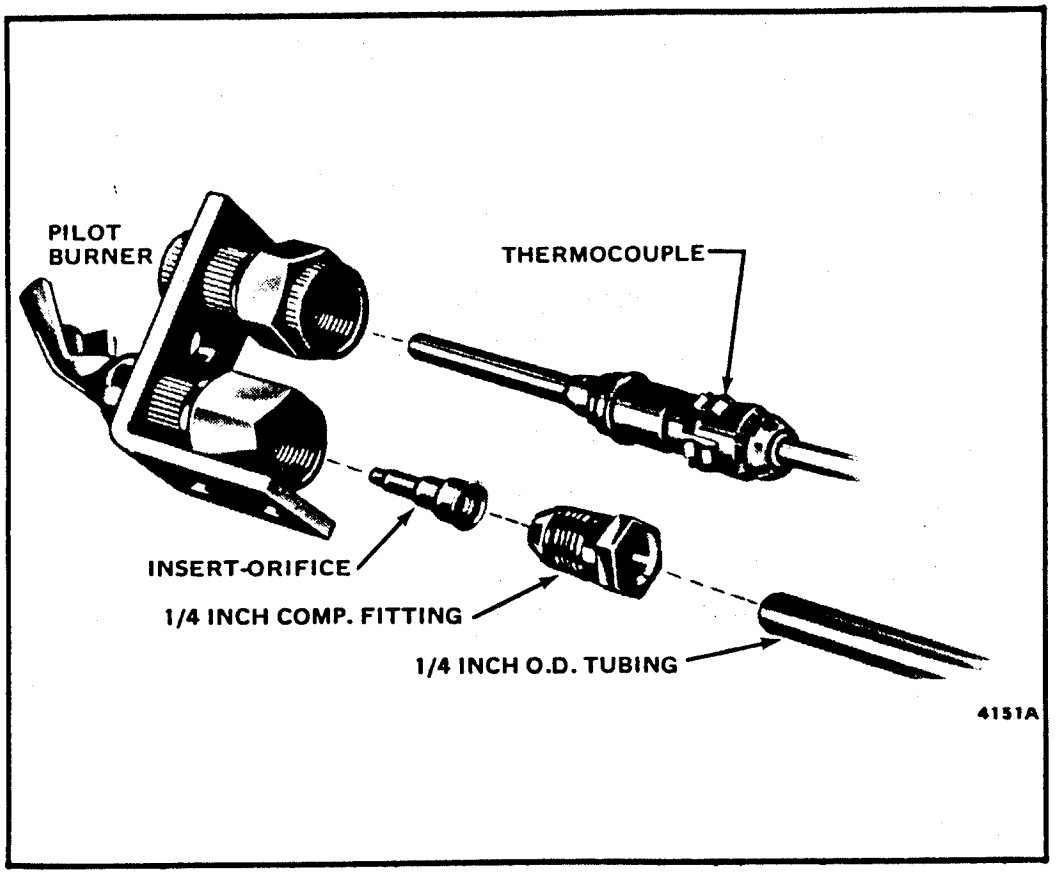
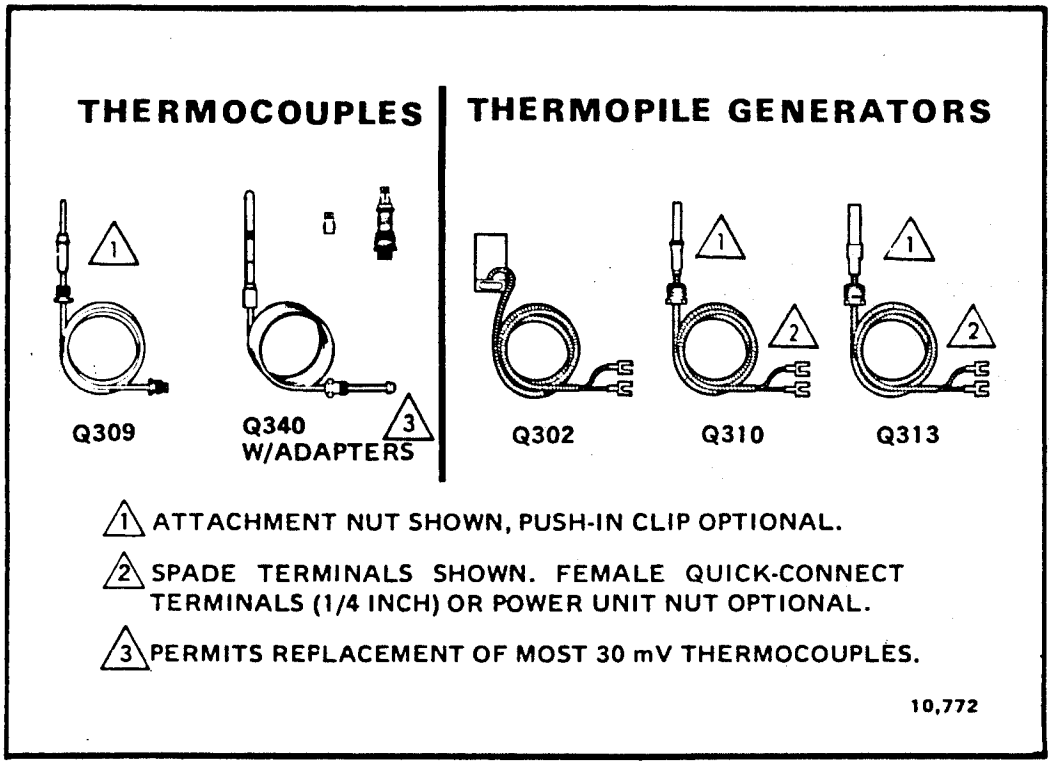


Fig. 58—Replacing insert orifice in Q314 pilot burner.

THERMOCOUPLES AND THERMOPILES



A thermocouple supplies the 30 mV current required to hold in the Pilotstat safety shutoff power unit on low voltage, line voltage and bulb-operated combination gas controls. A thermopile supplies either a 250 mV or a 750 mV current to power the complete control circuit of the heating system as well as the current required to hold in the Pilotstat power unit.

Table 11 shows the replacement thermocouples and thermopiles that will fit the pilot burners listed.

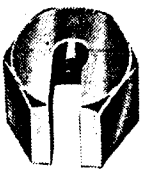
TABLE 11 – REPLACEMENT THERMOCOUPLES AND THERMOPILES

PILOT BURNER OR POWERPILE GENERATOR	30 mV THERMOCOUPLES	THERMOPILES	
		250 mV	750 mV
Q303	Q309 or Q340 w/adapters	Q310	–
Q305	Q309 or Q340 w/adapters	Q310	Q313
Q308	Q309 or Q340 w/adapters	Q310	–
Q314	Q309 or Q340 w/adapters	Q310	Q313
Q324	Q309 or Q340 w/adapters	Q310	Q313
Q327	Q309 or Q340 w/adapters	Q310	Q313
Q350	Q309 or Q340 w/adapters	Q310	Q313
CS82			Q302
CS893			Q313
CS894			Q313
CS897			Q313

Several adapters are available for special requirements.

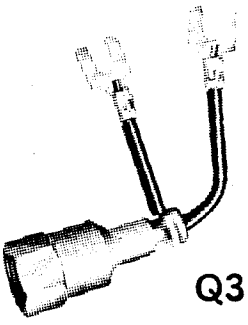
THERMOCOUPLE ADAPTERS

390012C Power Unit Female Adapter—adapter nut to assemble a thermocouple to a power unit with a male thread connector.



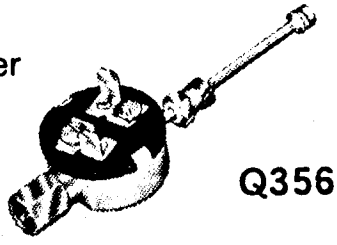
390012C

Q357 Thermocouple Adapter—a screw type thermocouple adapter for use with Q309, Q340, or similarly threaded thermocouples. Replaces the terminal connection type thermocouples.



Q357

Q356 Junction Block Adapter—adapter to convert any 30 mV thermocouple lead to a junction block connection.



Q356

INSTALLATION

PUSH-IN CLIP DESIGN

From beneath, insert the tip of the thermocouple or thermopile into the hole or barrel in the pilot burner. Push in firmly to lock in place (Fig. 59).

NOTE: Q310 only. To assemble push-in clip model Q310 to old style spud type Q308 pilot burner, remove the clip and use split nut, Part No. 391653.

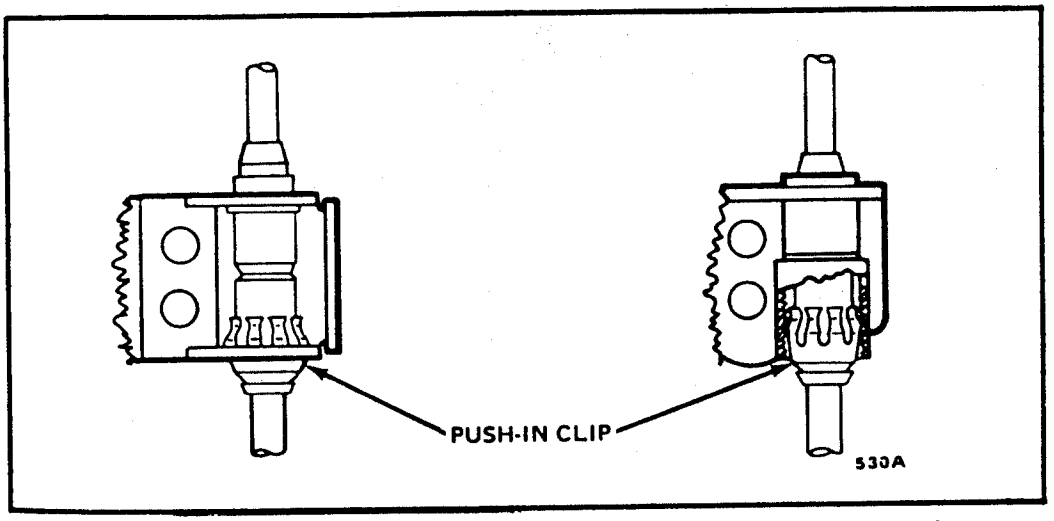


Fig. 59—Push-in clip model Q309 installed in typical pilot burner. Q310 and Q313 are installed in a similar manner.

ATTACHMENT NUT DESIGN

From beneath, insert the tip of the thermocouple or thermopile into the hole or barrel provided in the pilot burner. Engage the threads of the attachment nut and tighten (Fig. 60).

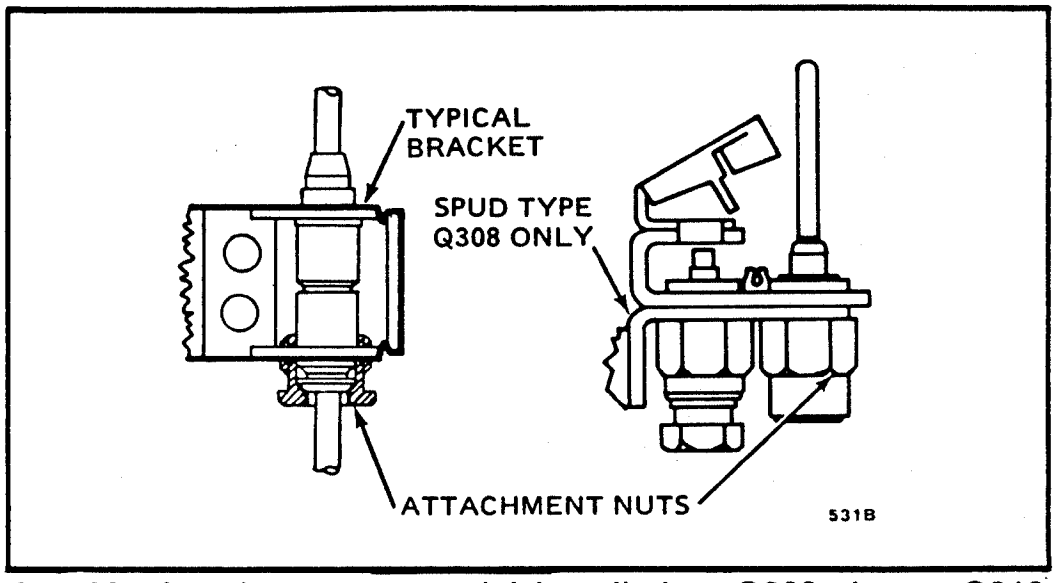


Fig. 60—Attachment nut model installation. Q309 shown, Q310 and Q313 similar.

PILOTSTAT POWER UNIT CONNECTION (male connector-nut models)

Insert the end of the lead into the female connector on the power unit. Engage the male nut and turn until finger tight. With a wrench, tighten 1/4 turn beyond finger tight (Fig. 61). Remember, this is an electrical connection and contact surfaces must be clean and dry. Never use pipe dope on this connection.

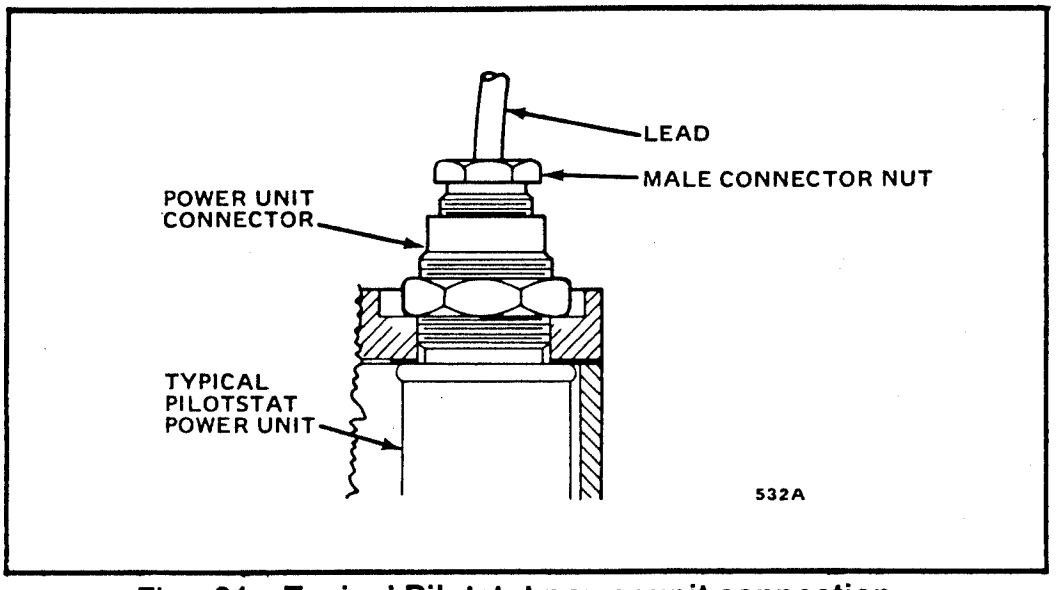


Fig. 61—Typical Pilotstat power unit connection.

POWERPILE VALVE OPERATOR CONNECTION (spade or quick-connect terminal model thermopiles)

Route the lead wire cable to the Powerpile valve operator, avoiding hot surfaces and high temperatures. Connect the leads to the two terminals marked "PP" on the valve operator. Since the complete control system is powered by the output of the Powerpile generator, all connnections must be clean and dry. Follow the appliance manufacturer's directions for installing the high limit or energy cut-out (ECO) control on Q310B and Q313B.

PILOT FLAME ADJUSTMENT

Adjust the pilot flow adjustment screw to give a soft, steady flame enveloping 3/8 to 1/2 in. [9.5 to 12.7 mm] of the thermocouple or thermopile (Fig. 62). An excessively large flame will shorten generator life.

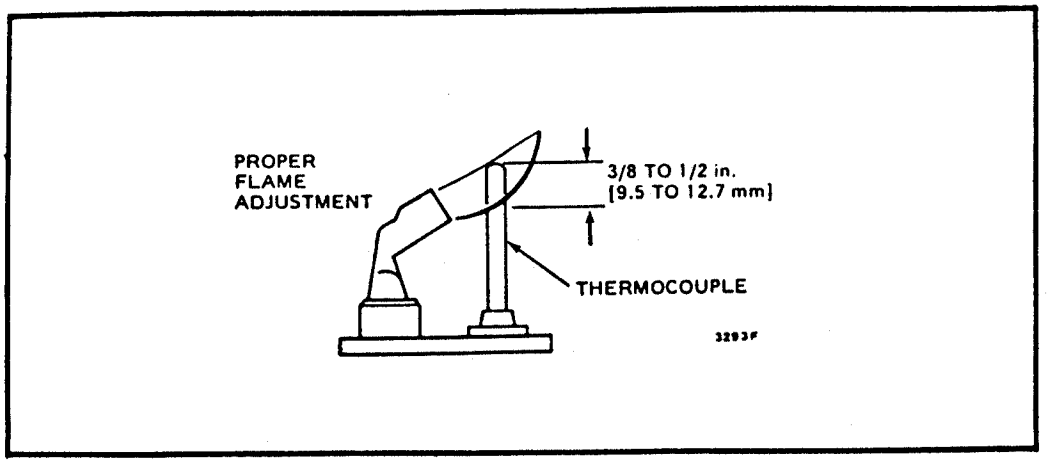


Fig. 62—Proper pilot flame adjustment.

CHECKOUT

Follow the appliance manufacturer's instructions for lighting the pilot burner. Make certain the Pilotstat power unit holds in, and the Powerpile valve operator (if used) opens properly when the pilot is burning normally.

Check that safety shutoff occurs within 2-1/2 minutes after the pilot flame is extinguished.

Observe system operation through at least one cycle to be certain it is functioning normally.

HOT AND COLD JUNCTION SHIELDING

A proper temperature differential between the hot and cold junctions of the thermocouple or thermopile is essential to satisfactory operation. Excessively high cold-junction temperatures caused by heat radiation from adjacent hot surfaces may be reduced by using a properly located radiant shield (Fig. 63).

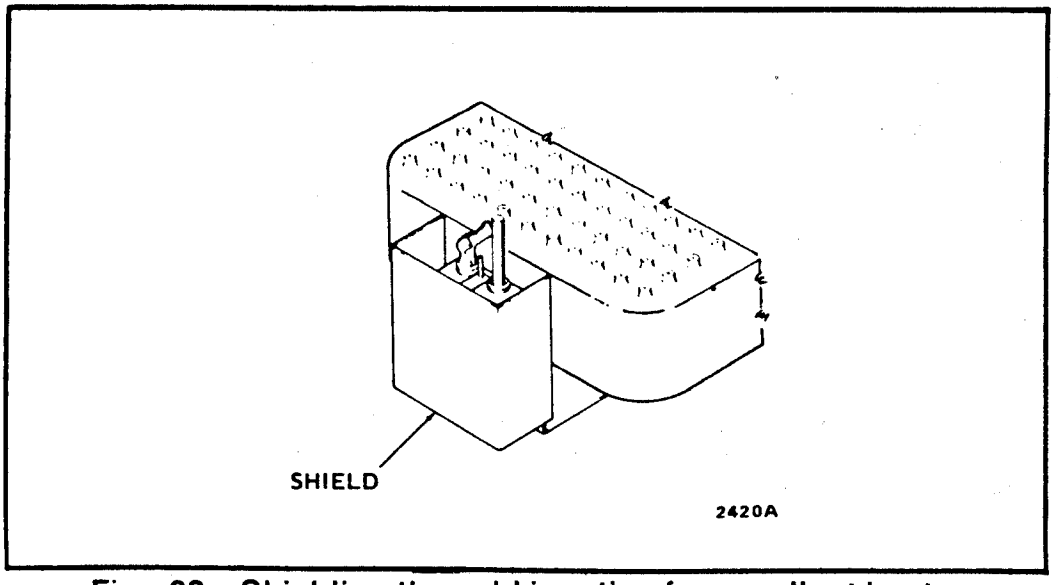


Fig. 63—Shielding the cold junction from radiant heat.

High ambient air temperatures may also cause excessively high cold-junction temperatures. A baffle to direct secondary air over the base of the pilot burner may improve this condition.

NOTE: The shield or baffle must not disturb the stability or combustion of the pilot flame.

To prevent excessive hot-junction temperatures, it is necessary to adjust the pilot flame as described above. Normal gas pressure, 3.5 in. wc [0.9 kPa] for natural gas, will produce satisfactory thermocouple and thermopile output and maximum life.

TROUBLESHOOTING

EQUIPMENT

To properly troubleshoot heating control circuits requires a voltmeter, ammeter, millivoltmeter, milliammeter, ohmmeter and a temperature meter. All of these functions are provided by the Honeywell W720 Systems Tester shown on the inside back cover of this handbook, when equipped with the suggested accessories. The W720 also includes an instruction book that gives the procedures for open circuit and closed circuit testing of the various parts of the circuit.

TROUBLESHOOTING DATA

These specifications cover the normal operation of components in a gas-fired system. Refer to these specifications when troubleshooting.

THERMOCOUPLE AND THERMOPILE
MAXIMUM RESISTANCES (80 F [26 C] AMBIENT)

DEVICE, COMPONENT OR PART	RESISTANCE
Q302, 32 in. [813 mm] (CS82)	3.38 ohms
Q309, 24 in. [609.5 mm]	0.02 ohms
Q310, 32 in. [813 mm]	1.43 ohms
Q313, 32 in. [813 mm]	3.38 ohms
Q340, 24 in. [609.5 mm]	0.02 ohms
30 mV Power Unit (C Type)	0.018 ohms
250-750 mV Power Unit used in "CS" controls and "VS" controls	23.1 ohms
Powerpile Valve Coil	2 ohms + 5 percent
Thermostat with heater and 30 ft. [9.2 m], 18 gauge wire cable	1.68 ohms

THERMOCOUPLE AND GENERATOR MILLIVOLTAGE
OUTPUTS (DC) – OPEN CIRCUIT

THERMOCOUPLE OR GENERATOR	NORMAL OPEN CIRCUIT OUTPUT RANGE	LOWEST ACCEPTABLE OPEN CIRCUIT OUTPUT	TURNDOWN OPEN CIRCUIT
Q302 (CS82)	600-750 mV	540 mV	141 mV
Q309[a]	26- 32 mV	18 mV	2 mV
Q310[a]	270-350 mV	250 mV	85 mV
Q313[a]	600-750 mV	540 mV	141 mV
Q340[a]	26- 32 mV	18 mV	2 mV

[a]Q309B, Q310B, Q313B, and Q340B have terminal block in leadwire for connecting high limit control in series in Pilotstat power unit circuit.

HOT AND COLD JUNCTION
TEMPERATURE RATINGS

THERMOCOUPLE OR THERMOPILE GENERATOR	MAXIMUM HOT JUNCTION	MAXIMUM COLD JUNCTION	RECOMMENDED HOT JUNCTION
Q309, Q310, Q313, Q340	1400 F [760 C]	780 F [416 C]	1200 F [649 C]
Q302 (CS82)	1250 F [677 C]	765 F [407 C]	

DC MILLIAMPERAGES –
PILOTSTAT POWER UNITS

CONTROLS	PILOTSTAT DROP-OUT	PILOTSTAT HOLD-IN
"C" and "V" (30 mV)	250 to 50 mA	300 mA max.
"CS" and "VS"	7 to 3 mA	15 mA max.

POWERPILE VALVE OPERATORS

CONTROLS	OPERATOR PULL-IN
"VS" controls	85 mA max.

PROCEDURE

Before you begin troubleshooting the system, ask the customer to explain the problem. Pay close attention; the customer may have a very good idea as to what the problem is, or they may say something that will remind you of a past problem and make the job a lot easier and quicker to handle.

Most service calls are the "no heat" type, so we will deal with handling that problem first. For troubleshooting other types of problems, see page 116.

If, after talking to the customer, you have no clear idea as to the exact nature of the problem, take a good look at the system and the components that make it up. Get in the habit of identifying what the system is supposed to do and what it is doing now. Work on the difference.

To troubleshoot a "no heat" complaint, use the following as a guide:

1. Make certain the thermostat switch is set at HEAT. Some people forget to change the switch at the end of the cooling season.

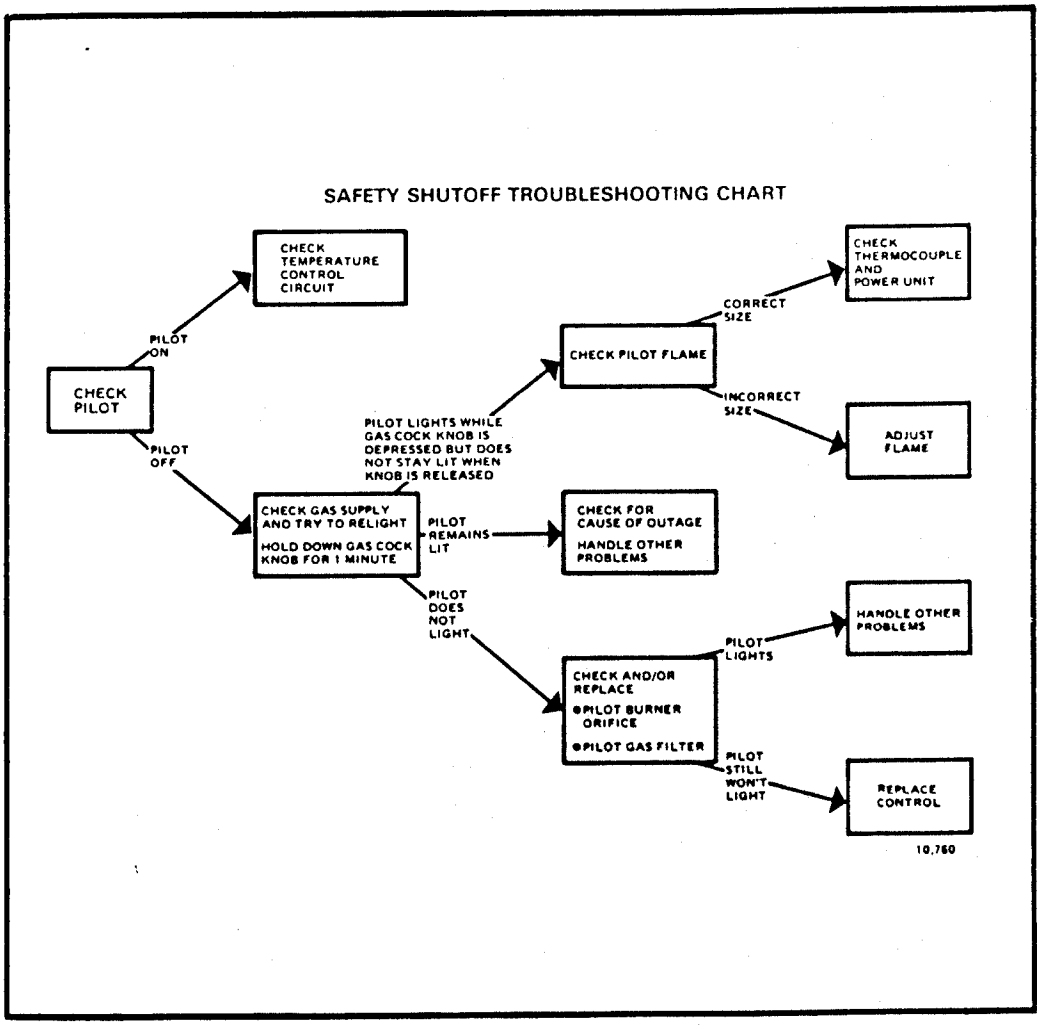
2. Check the furnace switch to make sure the system has electrical power.

3. Set the thermostat to call for heat—
   — If the main burner starts, observe the system through one cycle and handle miscellaneous complaints as required.
   — If the main burner does not start, make sure there is voltage to the gas control, then check the safety shutoff system and pilot flame, the temperature control circuit and the fan or water circulator circuit as described below.

SAFETY SHUTOFF

When checking the safety shutoff system, always start by looking at the pilot burner. It should envelop 3/8 to 1/2 in. [9.5 to 12.7 mm] of the thermopile or thermocouple and be blue and steady.

Use the safety shutoff troubleshooting chart, below, to troubleshoot the safety shutoff systems. If the chart indicates that the thermocouple or thermopile and power unit should be checked, follow the instructions below under Check Safety Shutoff Circuit.



CHECK SAFETY SHUTOFF CIRCUIT

OPEN CIRCUIT TEST

Using the W720 or a millivoltmeter such as the W129, read the open circuit output of the heated thermocouple or thermopile when it is disconnected from the power unit (Fig. 64). Push down on the gas cock knob to keep the pilot burning during this time.

If the output conforms to the manufacturer's specifications, the thermocouple or thermopile is okay. Replace the power unit. If the open circuit output differs from the manufacturer's specifications, replace the thermocouple or thermopile.

If a meter is not available for the open circuit test, simply replace the thermocouple. Then, if the power unit will still not hold in, replace the power unit.

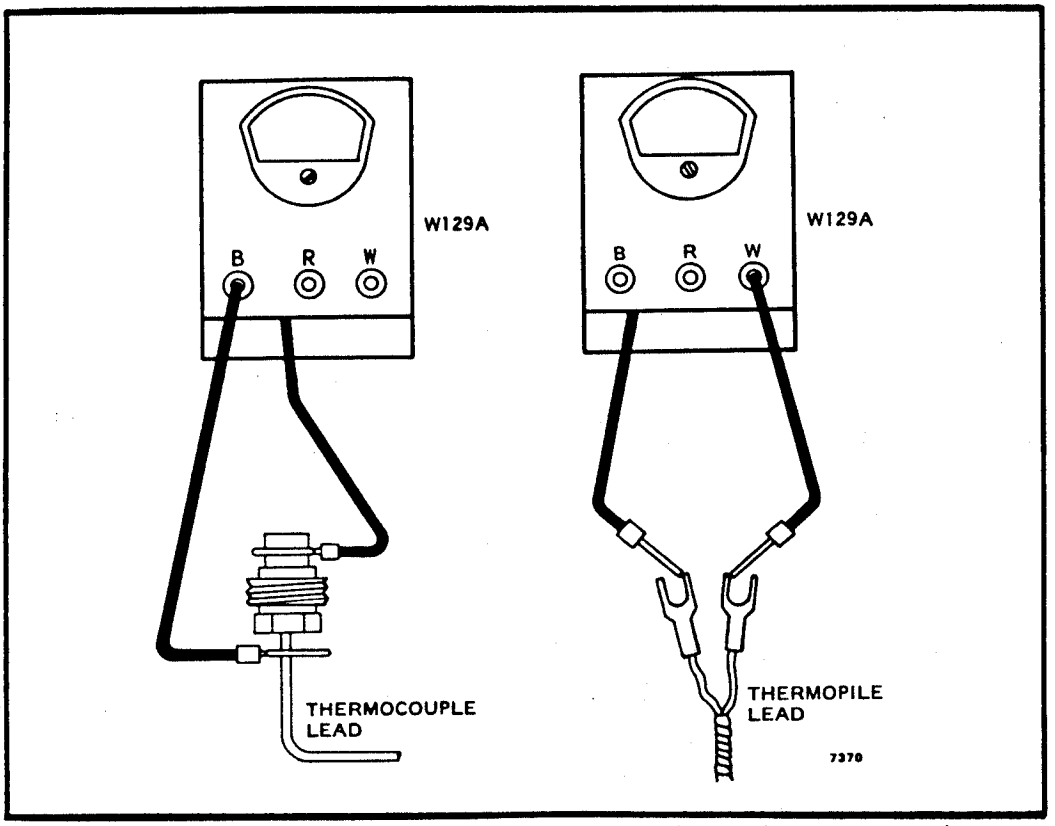


Fig. 64—Checking disconnected thermopile or thermocouple output with W129 millivoltmeter.

CHECKING PILOT FLAME

The pilot flame should be checked if the thermocouple output is still low after the thermocouple has been replaced, or if an open-closed circuit check indicates a pilot flame problem on the graph in the W720 Systems Handbook.

The first step is to observe the pilot flame. Does it cover 3/8 to 1/2 in. [9.5 to 12.7 mm] of the thermocouple tip? See Fig. 65.

So that the condition of the pilot flame is normal, have the furnace air-door in place when checking the pilot flame. (A small mirror is useful to check the pilot flame.)

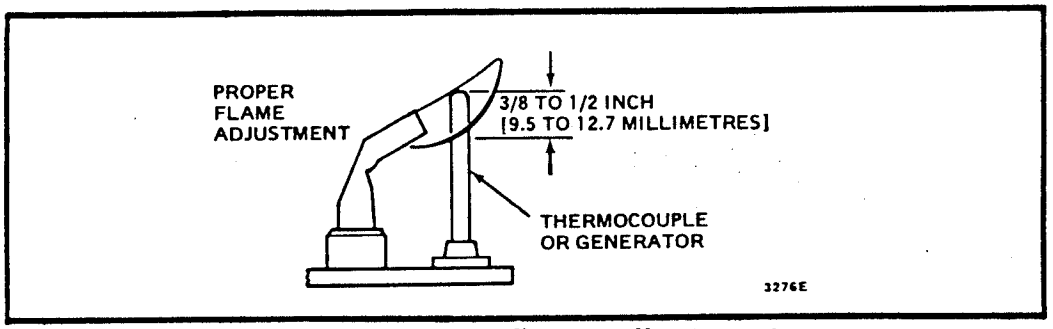
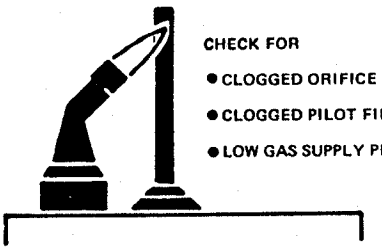


Fig. 65—Proper flame adjustment.

If the pilot flame is too small, turn the pilot adjustment screw (located under the cover screw on the combination gas control) counterclockwise ↷ to increase the pilot flame.

If the flame is still too small, check for a clogged pilot orifice. If the orifice is OK, check for a clogged gas filter. Then check for low gas supply pressure and adjust pressure, if necessary.

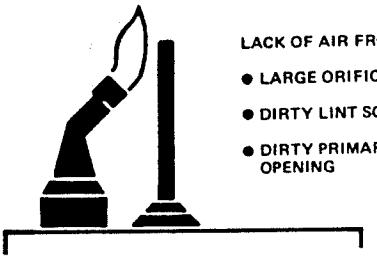
SMALL BLUE FLAME



CHECK FOR
- CLOGGED ORIFICE FILTER
- CLOGGED PILOT FILTER
- LOW GAS SUPPLY PRESSURE

A lazy, yellow flame means lack of air. This problem may come from an overly large orifice, a dirty lint screen, or a dirty primary air opening.

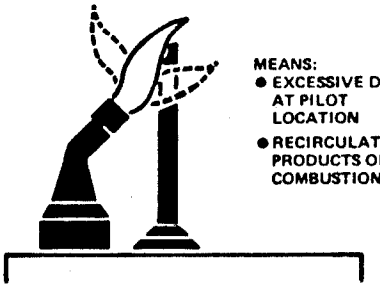
LAZY YELLOW FLAME



LACK OF AIR FROM
- LARGE ORIFICE
- DIRTY LINT SCREEN
- DIRTY PRIMARY AIR OPENING

A waving, blue flame means an excessive draft at the pilot location. Install a shield to protect the pilot.

WAVING BLUE FLAME

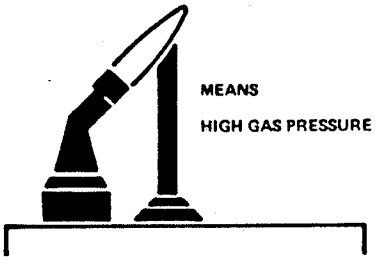


MEANS:
- EXCESSIVE DRAFT AT PILOT LOCATION
- RECIRCULATING PRODUCTS OF COMBUSTION

A noisy, lifting flame means high gas pressure.

Relieve this situation by adding a V5274 pilot pressure reducer to the pilot gas line. It will help increase thermocouple life and also reduce gas consumption.

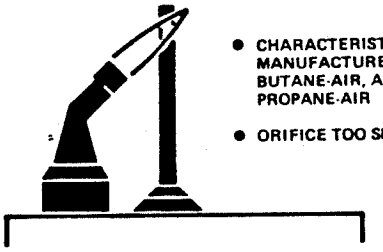
NOISY LIFTING BLOWING FLAME



MEANS
HIGH GAS PRESSURE

A hard, sharp flame may mean the orifice is too small. However, this flame is normal for manufactured, butane-air or propane-air fuels.

HARD SHARP FLAME



- CHARACTERISTIC OF MANUFACTURED. BUTANE-AIR, AND PROPANE-AIR
- ORIFICE TOO SMALL

If checking the power unit, thermocouple or thermopile and pilot flame adjustment does not indicate the problem, go on to trouble-shoot the temperature control circuit.

Use the Pilot Burner Service Analysis Chart, below, to cross-check the present pilot condition with possible causes.

Pilot Burner Service Analysis Chart

CONDITION									
Pilot cannot be lighted	Pilot out when reset knob released	Pilot outage during system use	Pilot burning but on safety shutdown	Pilot flame lazy, yellow	Pilot flame waving, blue	Pilot flame small, blue	Pilot flame noisy, lifting, blowing	Pilot flame hard, sharp	POSSIBLE CAUSES
x									Pilot gas supply is turned off
x									Pilot gas line not purged of air
x		x				x			Pilot burner orifice is clogged (replace)
x									Lighting knob not being held depressed
x									Reset button not being held depressed
x									Lighting knob not set at pilot position
x						x			Pilot gas flow adjustment is closed off
		x	x		x				Gas supply pressure is too low
		x	x						Pilot unshielded from excessive draft
	x								Lighting knob released too soon
	x								Reset button released too soon
	x	x	x						Thermocouple or thermopile is bad
	x	x	x						Pilotstat power unit is bad
	x	x	x						Power unit connection dirty, loose or wet
	x	x	x						Pilot flame is improper size
	x	x	x						Powerpile terminals shorted or loose
		x							Thermocouple cold junction too hot
		x		x					Pilot burner lint screen clogged
		x							Pilot unshielded from burner concussion
				x					Pilot burner primary air opening clogged
				x					Pilot burner orifice is too large
					x				Pilot unshielded from combustion products
						x		x	Pilot burner orifice too small
							x		Pilot gas pressure too high
								x	Typical of mfd., butane-air and propane-air
	x	x				x			Pilot filter clogged
				x					Excessive ambient temperature
			x	x					Incorrect or marginal appliance venting
			x						Gas line too small or restricted

TEMPERATURE CONTROL CIRCUIT

If no problem is found in the safety shutoff system, the next step is to check the temperature control circuit. IF YOU HAVE NOT ALREADY CHECKED THE SAFETY SHUTOFF SYSTEM, GO BACK TO PAGE 105.

PROCEDURE

Determine the type of temperature control system you are working with and refer to the appropiate page listed below.

Check each temperature control component until the problem is located, and then decide whether the component at fault should be repaired or replaced—refer to the TRADELINE Catalog for the availability of a direct replacement or a suitable equivalent.

Use the Thermostat Service Analysis Chart, page 110, to cross-check the present thermostat condition with possible causes.

LOW VOLTAGE SYSTEMS

1. Set the thermostat to call for heat—main burner should light.

2. If the main burner does not light, connect a voltmeter, or the W720 Systems Tester, between the transformer secondary terminals (Fig. 66).
   - — If approximately 24 V is present at the transformer secondary terminals, proceed to step 3.
   - — If approximately 24 V is not present at the transformer secondary terminals, check for 120 V at the transformer primary terminals. Replace the transformer if it is burned out.

3. Temporarily jumper the thermostat (and the high limit control if it is in the low voltage temperature control circuit)—
   - — If the main burner lights, the thermostat (or high limit) is at fault.
   - — If the main burner does not light, the wiring or the control valve operator is at fault.

4. If wiring is okay but the valve will not open, check the gas control operator as follows.

   V804 and V814 operators. . .
   - — Adjust thermostat several degrees above room temperature.

Thermostat Service Analysis Chart

T/S INDICATES ROOM THERMOSTAT

CONDITION								
T/S jumpered; system won't work	T/S jumpered; system works	Room temp overshoots T/S setting	Room temp doesn't reach T/S setting	T/S seems out of calibration	T/S cycles too often	T/S doesn't cycle often enough	Room temp swings excessively	POSSIBLE CAUSES
x								T/S not at fault; check elsewhere
		x						T/S mounted on cold wall
		x						T/S wiring hole not plugged
		x						T/S exposed to cold drafts
		x				x	x	T/S not exposed to circulating air
		x	x	x				T/S not mounted level (mercury switch type)
		x	x	x				T/S not properly calibrated
			x			x		Heating plant too small or underfired
x			x					Limit control set abnormally low
			x					T/S exposed to direct rays of sun
			x					T/S affected by heat from fireplace
			x					T/S affected by lamp, TV or appliances
			x					T/S affected by stove or oven
			x					T/S is mounted on warm wall
			x					T/S mounted near register or radiator
		x				x	x	T/S heater set too high
					x			T/S heater set too low
		x					x	Heating plant too large or input excessive
		x				x	x	T/S does not have heater
	x		x			x		T/S contacts are dirty
x								Low voltage control circuit open
x								Low voltage transformer burned out
x								Main valve operator is bad
x			x	x				Bad terminals, staking, splicing or soldering
	x							T/S damaged
			x	x				Clogged filter in forced warm air system

— On VR type controls, listen for audible click as first valve operator opens. If no click is heard and voltage is present between TH and TR, replace the control valve.
— Using an ac voltmeter, measure the voltage across terminals TH and TR.

— Then if:
  a. No voltage is present, recheck the temperature control circuit.
  b. 24 Vac is present, but valve still does not open, replace the operator.

V8324 two stage operator/regulator. . .

— Adjust thermostat several degrees above room temperature.
— On VR type controls, listen for audible 'click' as first valve operator opens. If no click is heard and voltage is present between C (common) and W1, replace the control valve.
— Using an ac voltmeter, measure the voltage across terminals C (common) and W1, and terminals C and W2.
— Then if:
  a. No voltage is present, recheck the temperature control circuit.
  b. 24 Vac is present, but valve still does not open, replace the operator/regulator.

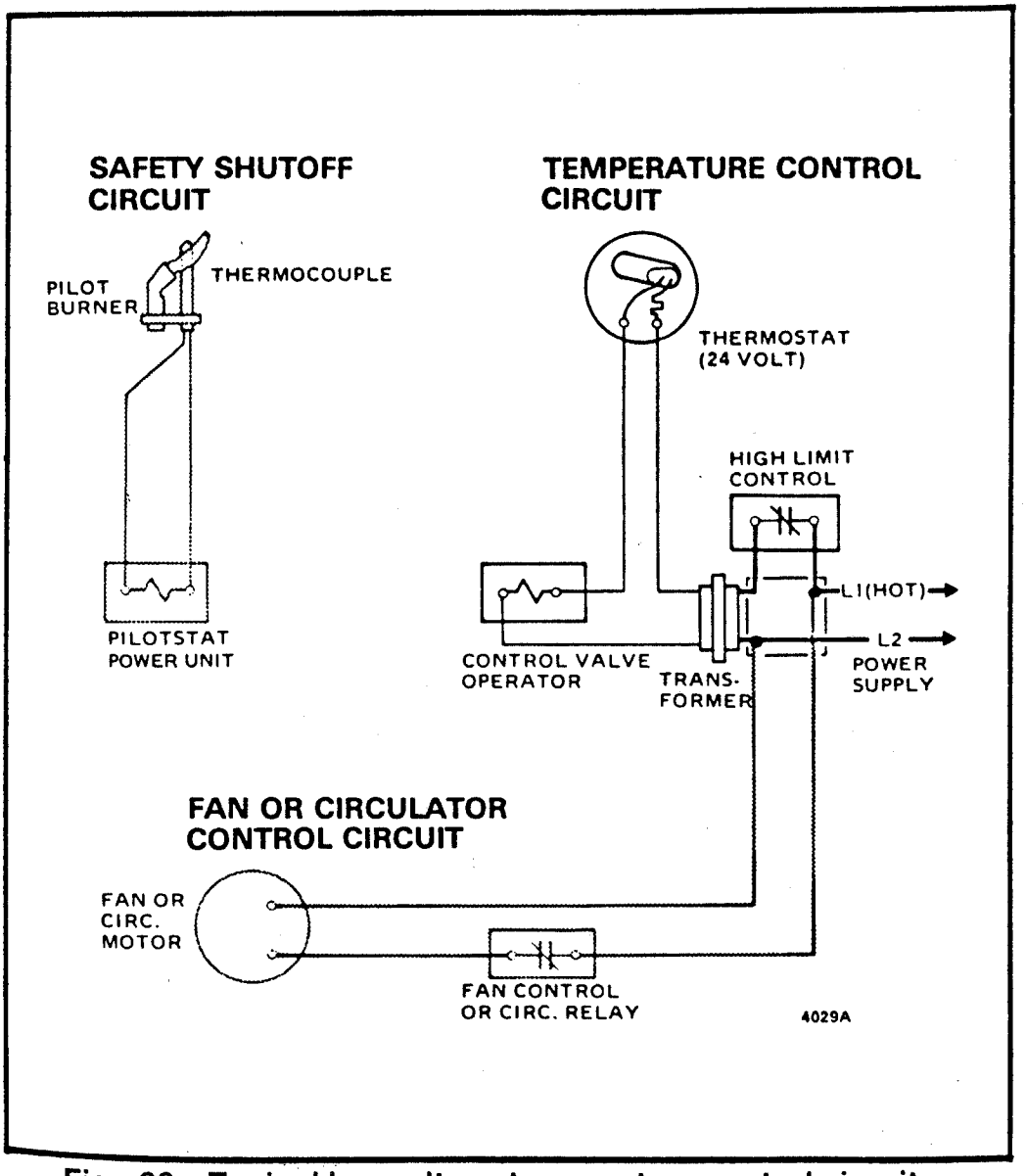


Fig. 66—Typical low voltage temperature control circuit.

LINE VOLTAGE SYSTEMS

1. Set the thermostat to call for heat. Main burner should light.

2. If the main burner does not light, connect a voltmeter, or the W720 Systems Tester, between the line voltage supply leads in the junction box (Fig. 67)—
   - — If approximately 120 V is present between the line voltage supply leads in the junction box, proceed with step 3.
   - — If approximately 120 V is not present between the supply leads in the junction box, check the line voltage supply circuit.

3. Temporarily jumper the thermostat (and the high limit control if it is in the line voltage circuit)—
   - — If the main burner lights, the thermostat (or high limit) is at fault.
   - — If the main burner does not light, the wiring or the valve operator is at fault.

4. If wiring is okay but the valve will not open, check the gas control operator as follows.

   V404 operator. . .
   - — Adjust thermostat several degrees above room temperature.
   - — On VR type controls, listen for audible 'click' as first valve operator opens. If no 'click' is heard and voltage is present between TH and TR, replace the control valve.
   - — Using an ac voltmeter, measure the voltage across terminals TH and TR.
   - — Then if:
     a. No voltage is present, recheck the temperature control circuit.
     b. 120 Vac is present, but valve still does not open, replace the operator.

POWERPILE SYSTEMS

1. Set the thermostat to call for heat. The main burner should light.

2. If the main burner does not light, temporarily jumper the thermostat and high limit control (Fig. 68).
   - — If the main burner lights, the thermostat or the high limit control is at fault.
   - — If the burner does not light, the wiring, the valve operator, or the Powerpile generator is at fault.

3. If wiring is okay but the valve will not open, check the gas control as follows.
   - — Check Powerpile generator connections to valve terminals PP and PP. Connections must be clean and secure.

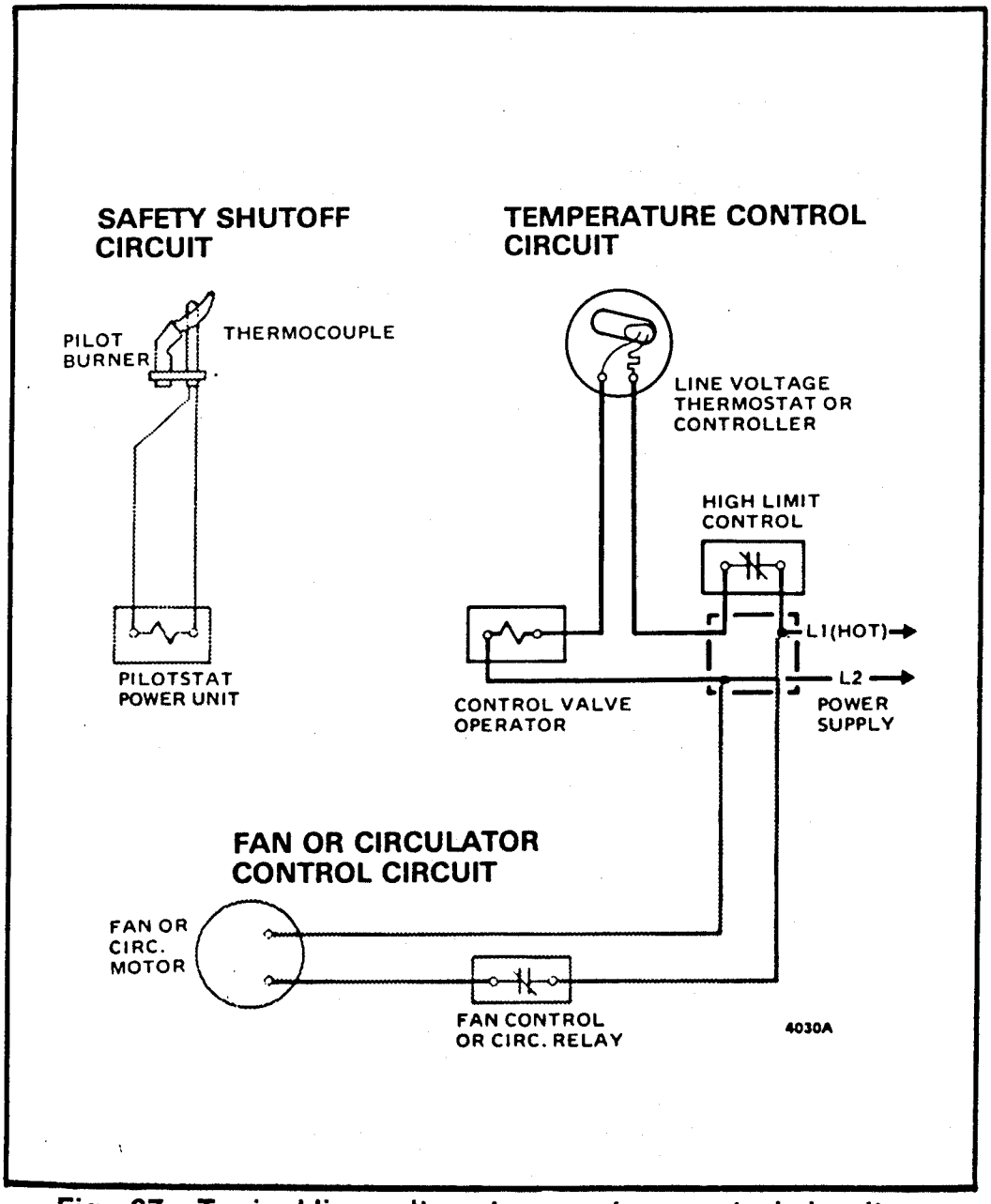


Fig. 67—Typical line voltage temperature control circuit.

— Temporarily jumper between upper terminal PP and lower terminal TH. If valve opens, trouble is in thermostat-high limit circuit.

— If valve does not open—

a. Disconnect leadwires to lower left terminal TH and lower right terminal PP to isolate valve coil from balance of circuit. Measure resistance of valve coil (normal resistance is 2 ohms ± 10 percent). If not in range or open circuit, the valve must be replaced.

b. If coil resistance is normal, trouble is with Powerpile generator. Use W720 System Tester to determine open circuit-closed circuit output performance. Replace generator if outside acceptable range. (If Systems Tester is not available, replace generator with a new one as a check against old.)

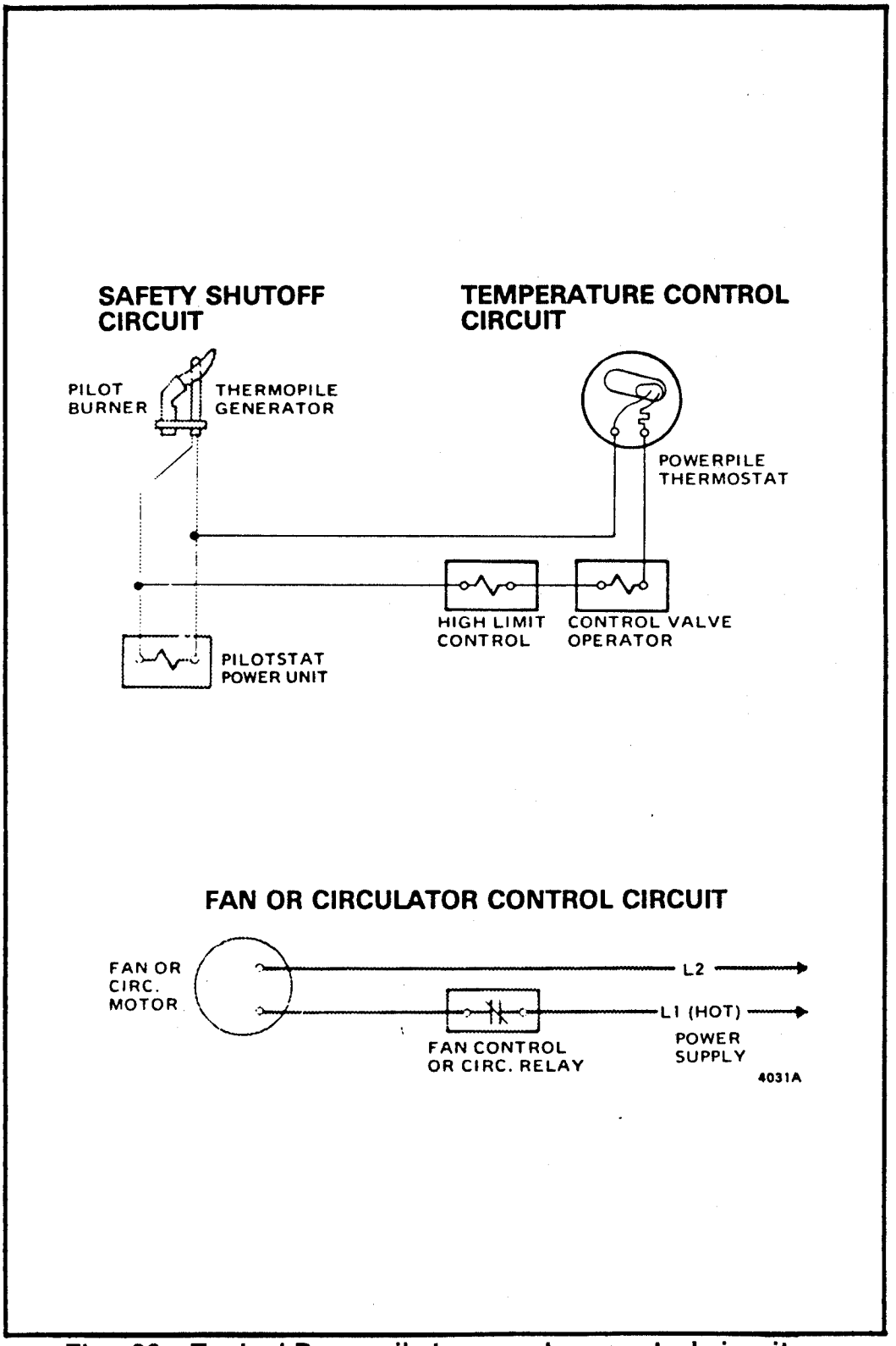


Fig. 68—Typical Powerpile temperature control circuit.

BULB TYPE SYSTEMS

Set the temperature dial to call for heat. Main burner should light. If the main burner does not light, the valve operator is probably at fault or the sensing bulb location is improper. See Fig. 69 and page 46.

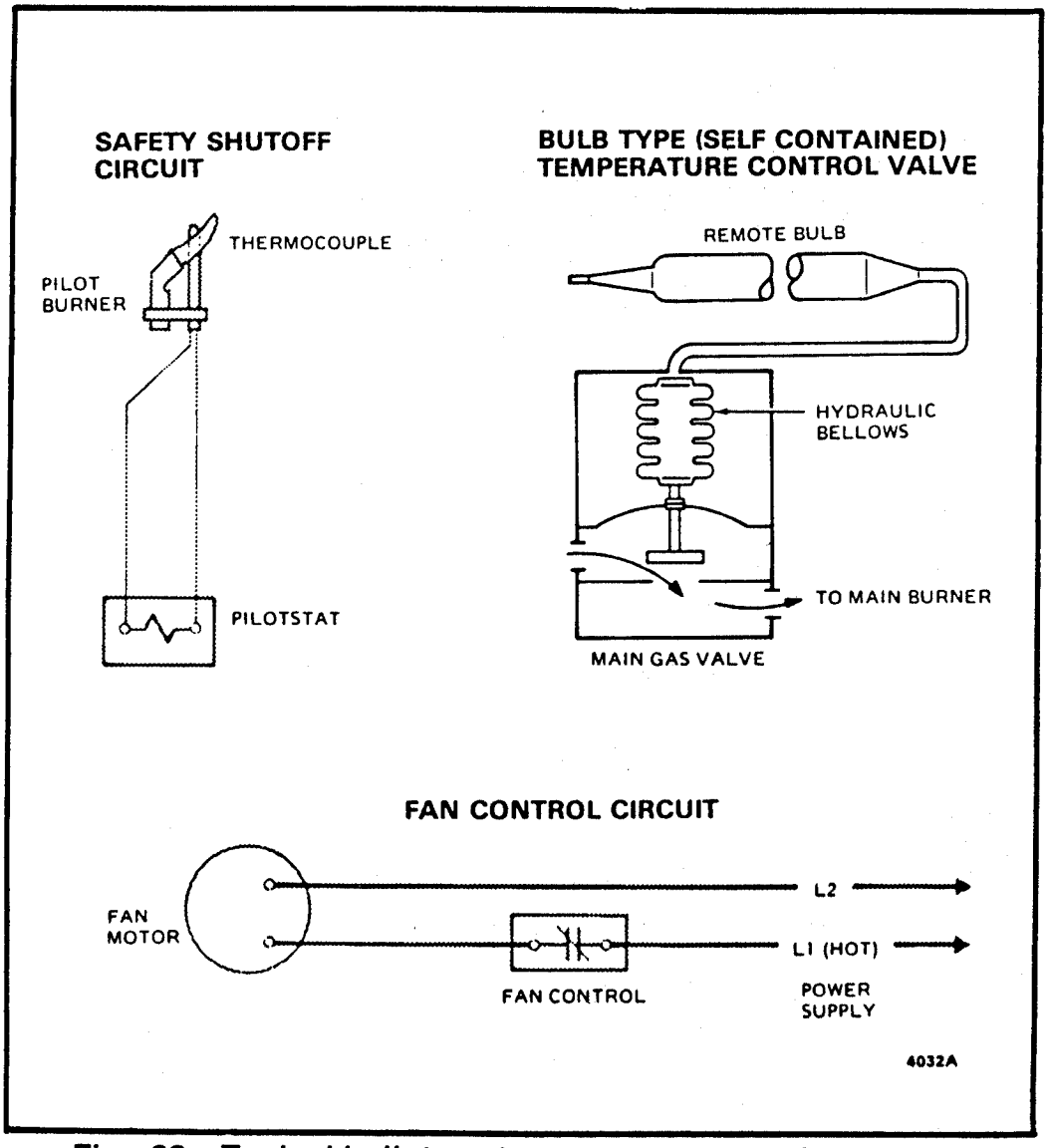


Fig. 69—Typical bulb type temperature control system.

FAN OR WATER CIRCULATOR CONTROL CIRCUIT

The fan or water circulator control circuit does not operate unless the safety shutoff circuit and temperature control circuit are operating properly. Therefore, CHECK THE SAFETY SHUTOFF SYSTEM AND TEMPERATURE CONTROL CIRCUIT BEFORE TROUBLESHOOTING THE FAN OR WATER CIRCULATOR CONTROL CIRCUIT.

If the safety shutoff system and the temperature control circuit has been checked and the fan or water circulator control circuit is still not working, proceed as follows.

1. Set the thermostat to call for heat. Main burner should light—
   — If the main burner lights, proceed with step 3.
   — If the main burner does not light and the system is not overheated—on high limit shutdown, check the heating appliance according to the manufacturer's instruction.

2. Jumper the fan or water circulator control terminals—
   — If the fan or water circulator comes on, remove the jumper and check the control. Repair, change to correct setting, or replace the control as necessary.
   — If the fan or water circulator does not come on, leave the jumper in place and use a meter to check the electrical supply voltage, wiring, and fan or water circulator motor to find the cause of the problem.

OTHER SERVICE PROBLEMS

CONVERSION FROM LP TO NATURAL GAS

1. Change the pilot orifice and the main gas orifice to orifices rated for natural gas.

2. Add a pressure regulator to the gas control valve or change regulator.

3. Change piping if necessary. (Usually piping is sized to allow for natural gas conversion.)

CONVERTING UNSUPERVISED PILOT TO CONTROLLED PILOT

Unsupervised pilot applications do not have a 100 percent safety shutoff control. To convert to controlled pilot, the best solution is to replace the unsupervised pilot control with a V800 or VR800 combination gas control with built-in 100 percent safety shutoff mechanism.

MISCELLANEOUS COMPLAINTS

These complaints include overheating, underheating, noise, odors and frequent cycling. Such complaints are often more difficult to locate than "no heat" complaints. There is no simple approach that will work in all cases.

Check the Pilot Burner Service Analysis Chart (page 108) and the Thermostat Service Analysis Chart, (page 110) to find possible causes for these complaints. Also see Service Aids (page 125).

NEW—VR8440/VR8450 GAS CONTROL FAMILY

Honeywell's new VR8440/VR8450 Family of dual automatic valve combination gas controls are designed for intermittent pilot (IP) and direct spark ignition (DSI) application on central heating and heating appliances that require regulation capacities from 11 cfh to 380 cfh [0.31 m3/hr to 10.8 m3/hr].

The controls feature a new compact body design, a pop-pet-valve type manual gas valve, and use the same operators and regulators as the V800 and VR800 families of gas controls.

Standard models are available for all heating gases, and for low or line voltage application. Special models are available for 50 Hz application and low ambient temperatures, see list of models and specifications below. Optional side outlets are available on all models.

Like the VR800 Family, this second generation of dual automatic valve combination gas controls provide two main valve operators that provide added protection against valve failure and meet tougher industry standards.

SPECIFICATIONS

MODELS:

MODEL NO.	OPERATION	APPLICATION
VR4440	120 V, magnetic	Intermittent pilot
VR4450	220/240 V, magnetic	DSI
VR8440	24 V, magnetic	Intermittent pilot
VR8450	24 V, magnetic	DSI
VR8520	24 V, magnetic	Pilot (two stage)
VR8540	24 V, magnetic, 2-stage	DSI (two stage)
VR8590	24 V, magnetic	DSI (negative pressure regulated)
VR8600	24 V, magnetic	DSI (negative pressure regulated)

CAPACITIES: See table, below. The capacity rating is determined by the inlet and outlet tappings. (If reducer bushings are used, the capacity will be determined by the actual diameter of the inlet and outlet.)

CAPACITIES – VR8440/VR8450 GAS CONTROL FAMILY

INLET TAPPING in.	OUTLET TAPPING in.			REGULATION CAPACITY[a]			
		cfh	m^3/hr	cfh		m^3/hr	
				MIN.	MAX.	MIN.	MAX.
1/2	3/8	110	3.1	11.0	110	0.31	3.1
1/2	1/2	225	6.4	22.5	225	0.64	6.4
1/2	3/4	250	7.1	25.0	290	0.71	8.2
3/4	3/4	275	7.8	27.5	380	0.78	10.8

[a]Capacity in cfh is based on 1,000 Btu/ft 3, 0.64 sp. gr. Nat. gas at 1.0 in. wc pressure drop [37.3 MJ/m^3, 0.64 sp. gr. Nat. gas at 0.25 kPa pressure drop]. For other gases, use the conversion factors in the table below.

sp gr	MULTIPLY LISTED CAPACITY BY
0.60	0.516
0.70	0.765
1.53	1.62

TYPE OF GAS: Models available for all heating gases.

PRESSURE TAPPING: 1/8 NPT with plug on outlet end of control, recessed for 3/16 in. Allen wrench. Optional 1/8 in. NPT pressure tap on inlet end of control.

PRESSURE RATING: A.G.A. rating 1/2 psig (14 in. wc [3.5 kPa] inlet pressure. Designed for safe operation up to 28 in. wc [7.0 kPa].

PILOT GAS OUTLET (IP valves only): Compression fitting for 1/4 in. [6.4 mm] OD tubing.

ELECTRICAL CONNECTIONS: 120 V models have 36 in. [0.9 mm] leadwires; 24 V models have combination screws and 1/4 in. [6.4 mm] quick connect terminals.

ELECTRICAL RATINGS:

MODEL	VOLTAGE AND FREQUENCY	TOTAL CURRENT (amps) BOTH OPERATORS
VR4440	120 Vac, 60 Hz	.12 at 60 Hz
VR4450	220/240 Vac 50 Hz	.06 at 60 Hz
VR8440	24 Vac, 50/60 Hz	.65 50/60 Hz
VR8450		
VR8520	24 Vac, 50/60 Hz	.90 50/60 Hz
VR8540		
VR8590	24 Vac, 50/60 Hz	.65 50/60 Hz
VR8600		

AMBIENT TEMPERATURE RATING: 32 F to 175 F [0 C to 79 C] in 60 Hz application. 32 F to 156 F [0 C to 70 C] in 50 Hz application. Special models available with minus 40 to plus 175 F [minus 40 C to plus 79 C] rating in 60 Hz application; minus 40 F to plus 156 F [minus 40 C to plus 70 C] in 50 Hz application.

MOUNTING: All controls, except negative pressure regulated VR8590 and VR8600, can be mounted 0 to 90 in any direction from the upright position of the manual gas cock knob. Negative pressure regulated VR8590 and VR8600 must be mounted in the upright position—manual gas cock knob straight up.

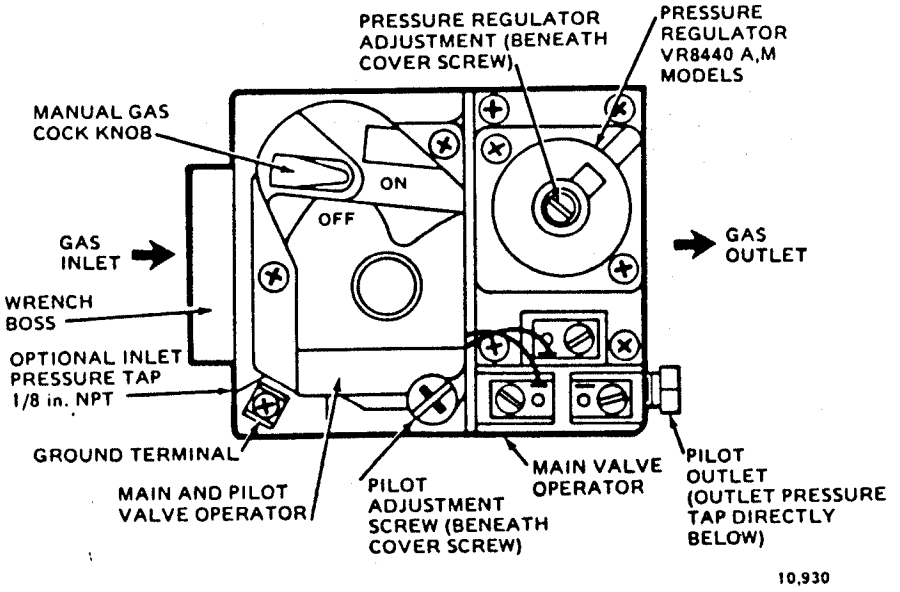


Fig. 70—Top view of standard capacity VR8440/VR8450 gas control valve.

OPERATORS AND REGULATORS

The VR8440/VR8450 Family of combination gas controls uses the same operators and regulators as the V800 and VR800 families. For information and specifications on operators and regulators, see pages 20 through 37.

WIRING

The VR8440/VR8450 Family is designed for use on DSI and IP systems only. For information concerning wiring these valves to system controllers, see the Honeywell Intermittent Ignition Handbook or the specifications sheet provided by the appliance manufacturer.

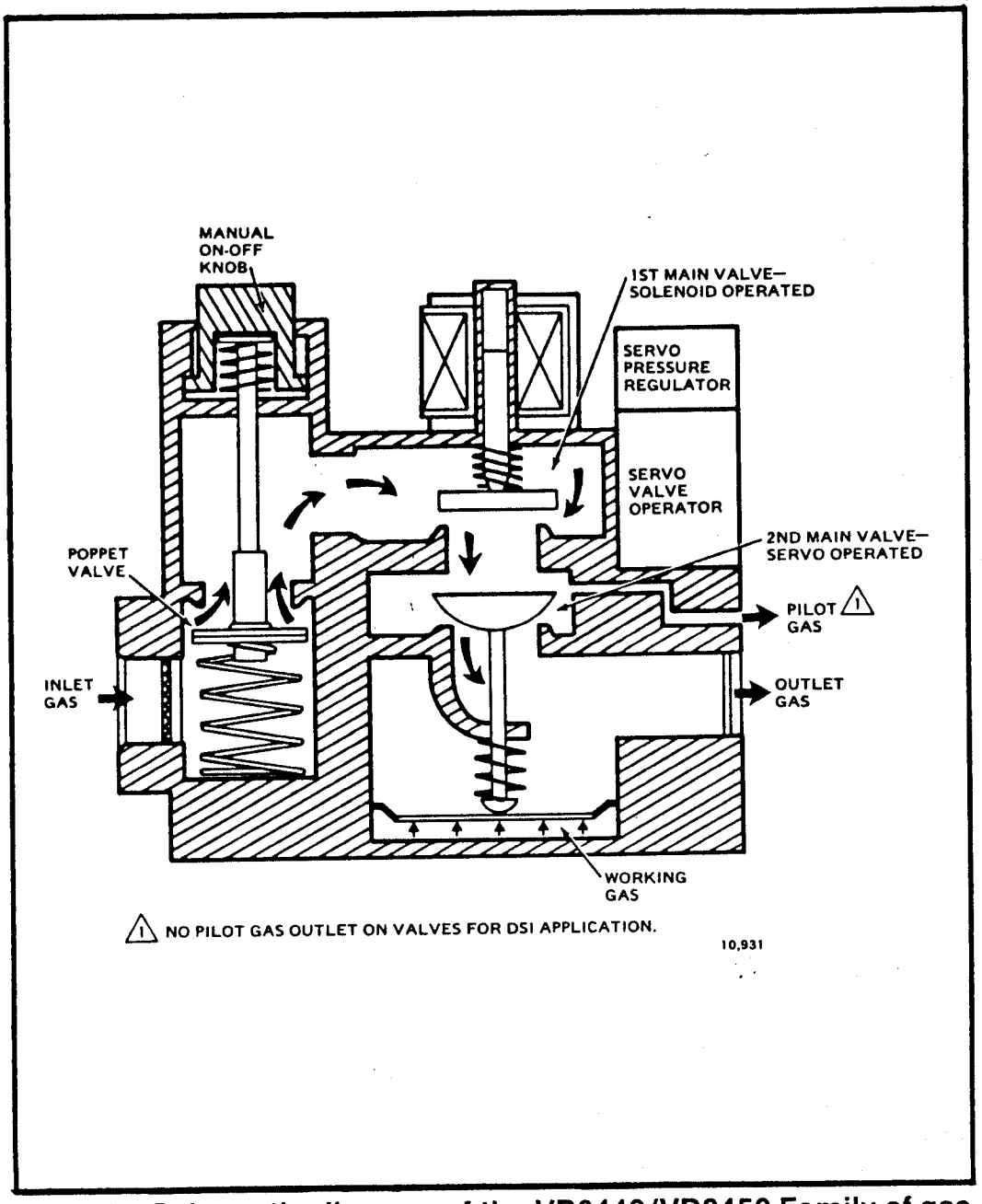


Fig. 71—Schematic diagram of the VR8440/VR8450 Family of gas controls.

OPERATION

The operation of the VR8440/VR8450 Family of combination gas controls is very similar to that of the VR800 Family. On a call for heat, gas enters the control through the ON/OFF valve, past the solenoid operated "first" main-valve and flows through the servo-pressure operated "second" main-valve Fig. 2.

On IP systems, the first main-valve is energized when the system controller calls for heat, and gas is allowed to flow to the pilot burner. The second main-valve is not energized until the pilot flame is proved.

On DSI systems, both the first and second main-valves are energized when the system controller calls for heat.

Regulation of the gas flow to the outlet is maintained by the pressure regulator just as it is for the VR800 and V800 families, see pages 74-77.

Aside from the compact body design of the VR8440/VR8450 Family the only notable difference between these controls and the VR800 controls is in the operation of the manual valve. The VR800 Family uses a tapered-plug type gas cock. The VR8440/VR8450 Family uses a simple poppet valve. To open the manual valve, turn the ON/OFF knob counterclockwise ↶ 60 degrees, push down and continue turning counterclockwise ↶ until the knob locks in the open position.

TROUBLESHOOTING

Before troubleshooting the gas control, make certain that the system controller is operating properly. Follow the troubleshooting procedures provided by the appliance manufacturer, if available, or those provided with the IP or DSI system control module.

After troubleshooting the control module and verifying that it is operating properly, proceed as follows.

IP SYSTEM GAS CONTROLS

Determine the type of operator on the gas control and follow the appropriate troubleshooting procedure below.

Controls with V804 operators . . .

1. Check that the manual ON-OFF valve is set to ON. Set the temperature controller to call for heat.

2. Use a voltmeter and check for 24 Vac between terminals TH-TR and TH.
   — If voltage is present, but no gas flows to the pilot burner, check the connectors from the first main-valve operator and check the pilot burner, the pilot burner orifice and the pilot gas tubing. If these checks are okay, replace the gas control.

— If no voltage is present, check the wiring and troubleshoot the system control module again.
— If voltage is present and gas flows to the pilot burner, proceed with step 3.

3. After the pilot flame lights, the system control module should sense the presence of the flame and energize the second main-valve operator (V804). Use a voltmeter and check for 24 Vac between terminals TH and TR.
— If voltage is present but no gas flows to the main burner, replace the V804 operator.
— If no voltage is present, check wiring and troubleshoot the system control module again.

Controls with V404 operators . . .

1. Check that the manual ON-OFF valve is set to ON. Set the temperature controller to call for heat.

2. Use a voltmeter and check for 120 Vac between leadwires connected to MV-PV and PV.
— If voltage is present, but no gas flows to the pilot burner, check the connectors from the first main-valve operator and check the pilot burner, the pilot burner orifice and the pilot gas tubing. If these checks are okay, replace the gas control.
— If no voltage is present, check the wiring and troubleshoot the system control module again.
— If voltage is present and gas flows to the pilot burner, proceed with step 3.

3. After the pilot flame lights, the system control module should sense the presence of the flame and energize the second main-valve operator (V404). Use a voltmeter and check for 120 Vac between leadwires connect to MV-PV and MV.
— If voltage is present but no gas flows to the main burner, replace the V804 operator.
— If no voltage is present, check wiring and troubleshoot system control module again.

Controls with V8324 Two Stage operator/regulators . . .

1. Check that the manual ON-OFF valve is set to ON. Set the temperature controller *several degrees* above room temperature.

2. Use a voltmeter and check for 24 Vac between the top center (unmarked) terminal and C (bottom), Fig. 3.

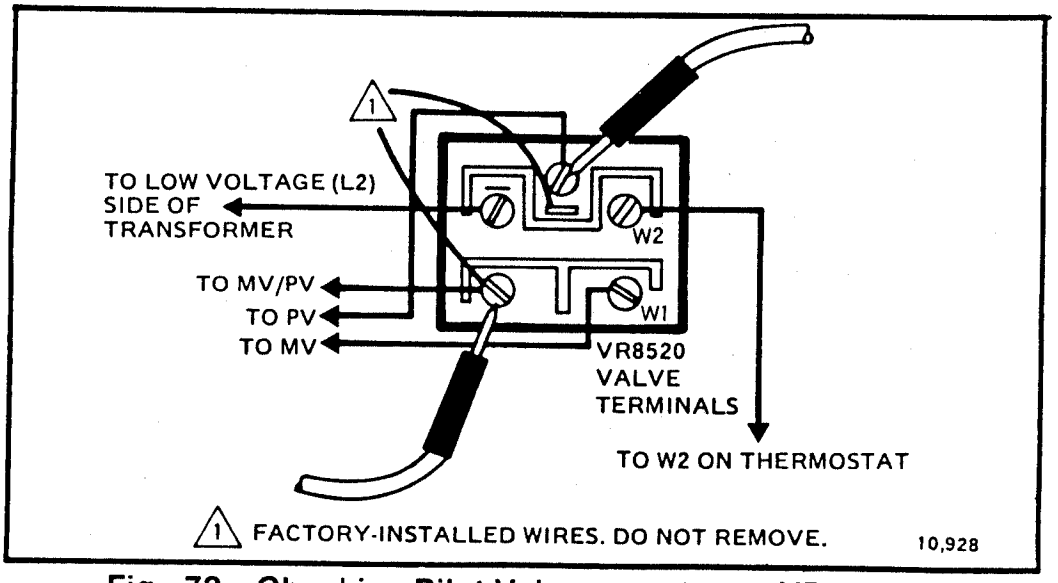


Fig. 72—Checking Pilot Valve operator on VR8520.

— If voltage is present but no gas flows to the pilot burner, check the connectors from the first main-valve operator and check the pilot burner, the pilot burner orifice and the pilot gas tubing. If these checks are okay, replace the gas control.
— If no voltage is present, check the wiring and troubleshoot the system control module again.
— If voltage is present and gas flows to the pilot burner, proceed with step 3.

3. After the pilot flame lights, the system control module should sense the presence of the pilot flame and energize the second main-valve operator (V8324). Use a voltmeter and check for 24 Vac between terminals W1 and C (top).
— If voltage is present but no gas flows to the main burner, replace the V8324 operator/regulator assembly.
— If no voltage is present, check the wiring and troubleshoot the system control module again.
— If main burner lights, but does not transfer to high-fire in approximately 60 seconds, proceed with step 4.

4. With main burner operation at low-fire, use a voltmeter and check for 24 Vac between terminals W2 and C (bottom).
— If voltage is present but burner does not transfer to high-fire, replace the V8324 operator/regulator assembly.
— If no voltage is present, check temperature controller and wiring.

DSI SYSTEM CONTROLS

Find the type of operator the gas control has and troubleshoot as described.

Controls with V804 operators . . .

1. Check that the manual ON-OFF valve is set to ON. Set the temperature controller to call for heat.

2. Listen for an audible 'click' as the first main-valve opens. Then use a voltmeter and check for 24 Vac between terminals TH and TR.

— If voltage is present, but no 'click' was heard and gas does not flow to the main burner, check the connectors from the first main-valve operator. if these connections are okay, replace the gas control.
— If voltage is present and 'click' was heard but no gas flows to the main burner, replace the V804 operator.
— If no voltage is present, check the wiring and troubleshoot the system control module again.

Controls with V404 operators . . .

1. Check that the manual ON-OFF valve is set to ON. Set the temperature controller to call for heat.

2. Listen for an audible 'click' as the first main-valve opens. Then use a voltmeter and check for 120 Vac between the gas control leadwires.

— If voltage is present, but no 'click' was heard and gas does not flow to the main burner, check the connectors from the first main-valve operator. If these connections are okay, replace the gas control.
— If voltage is present and 'click' was heard but no gas flows to the main burner, replace the V404 operator.
— If no voltage is present, check the wiring and troubleshoot the system control module again.

Controls with V8324 operator/regulators . . .

1. Check that the manual ON-OFF valve is set to ON. Set the temperature controller *several degrees* above room temperature.

2. Listen for an audible 'click' as the first main-valve opens. Then use a voltmeter and check for 24 Vac between terminals C (bottom) and W1.

— If voltage is present but no 'click' was heard and no gas flows to the main burner, check the connectors from the first main-valve operator. If these connections are okay, replace the gas control.
— If voltage is present and 'click' was heard but no gas flows to the main burner, replace the V8324 operator/regulator assembly.
— If no voltage is present, check the wiring and troubleshoot the system control module again.
— If main burner lights but does not transfer to high-fire in approximately 60 seconds, proceed with step 3.

3. With main burner operation at low-fire, use a voltmeter and check for 24 Vac between terminals W2 and C (top).

— If voltage is present but burner does not transfer to high-fire, replace the V8324 operator/regulator assembly.
— If no voltage is present, check the temperature controller and the wiring.

SERVICE AIDS

SIZING TRANSFORMERS

A transformer is used on all 24 V control systems. A general rule of thumb is to size the transformer to the largest total load occurring at one time.

On a heating-only system, the total heating load determines the transformer size. On a heating-cooling system, the total cooling load determines the transformer size, since it is almost always greater than the total heating load.

SIZING TO HEATING LOAD ONLY

1. For the total heating load, add the amperage draw of each parallel load in the system. FOR EXAMPLE:

Gas Valve	0.2 to 0.6 A
Heat Relay (if used)	0.4 A
Fan Timer (if used)	0.4 A
TOTAL	1.0 to 1.4 A

2. Now, multiply the total amperage draw by the transformer secondary voltage to equal the system VA rating.

IN OUR EXAMPLE: 1.0 A x 24 V = 24 VA

The tranformer must have a higher VA rating to allow for inrush VA. So, for our example, a tranformer with a minimum rating of 40 VA should be used.

SIZING HEATING-COOLING LOAD

To determine the total cooling load, add the sealed VA rating of each of the parallel loads. Typical loads are:

Blower Relay	10 VA
Cooling Contactor	15 VA
TOTAL	25 VA

Since the 25 VA cooling load is greater than the heating load in our example above, the transformer is sized for the cooling load. Allowing for inrush VA, we need a transformer with a VA of at least 40.

ADJUSTING THERMOSTAT HEAT ANTICIPATORS

Adjust the heat anticipator to match the current rating of the primary control; this rating is usually stamped on the control nameplate. Move the indicator on the scale to correspond with this rating and the anticipator will be properly adjusted for optimum comfort with most types of heating systems.

A slightly higher setting, to obtain longer burner-on times (and thus fewer cycles per hour) may be desirable on some systems. If, for example, the nominal heater setting is 0.4, adjust to 0.45 and check the system operation; adjust to 0.5 and recheck, etc., until the desired burner-on time is obtained.

If the room temperature overshoots the thermostat setting excessively, decreasing the burner-on time may result in a more constant temperature. To accomplish this, adjust the heat anticipator setting downward in the same manner as above.

CONVERSION FACTORS

Cfh capacity ratings in this book are based on Nat. gas at 1000 Btu per ft^3, 0.64 sp gr, at a pressure drop of 1.0 in. wc [37.3 MJ/m^3, 0.64 sp gr at 0.25 kPa pressure drop].

To convert cfh to Btuh for Nat. gas, multiply the listed capacity by 1000. To convert m^3/hr to MJ/m^3 for Nat. gas, multiply by 37.3.

To convert cfh or m^3/hr to Btuh or MJ/m^3 for other gases, use the following formulas.

$$\frac{\text{Btu/ft}^3 \text{ of gas "x"}}{1000 \text{ Btu/ft}^3} \times \text{cfh given in the table} = \text{capacity}$$

OR

$$\frac{\text{MJ/m}^3 \text{ of gas "x"}}{37.3 \text{ MJ/m}^3} \times \text{m}^3\text{/hr given in the table} = \text{capacity}$$

To correct the capacity for different specific gravities:

$$\sqrt{\frac{0.64 \text{ sp gr}}{\text{sp gr of gas "x"}}} \times \text{cfh or m}^3\text{/hr given in the table} = \text{capacity}$$

To correct pilot gas consumption for a different orifice pressure:

$$\sqrt{\frac{\text{pressure measured at the pilot}}{\text{pressure used in the table}}} \times \text{cfh or m}^{(3)}\text{/hr given in the table} = \text{actual gas consumption}$$

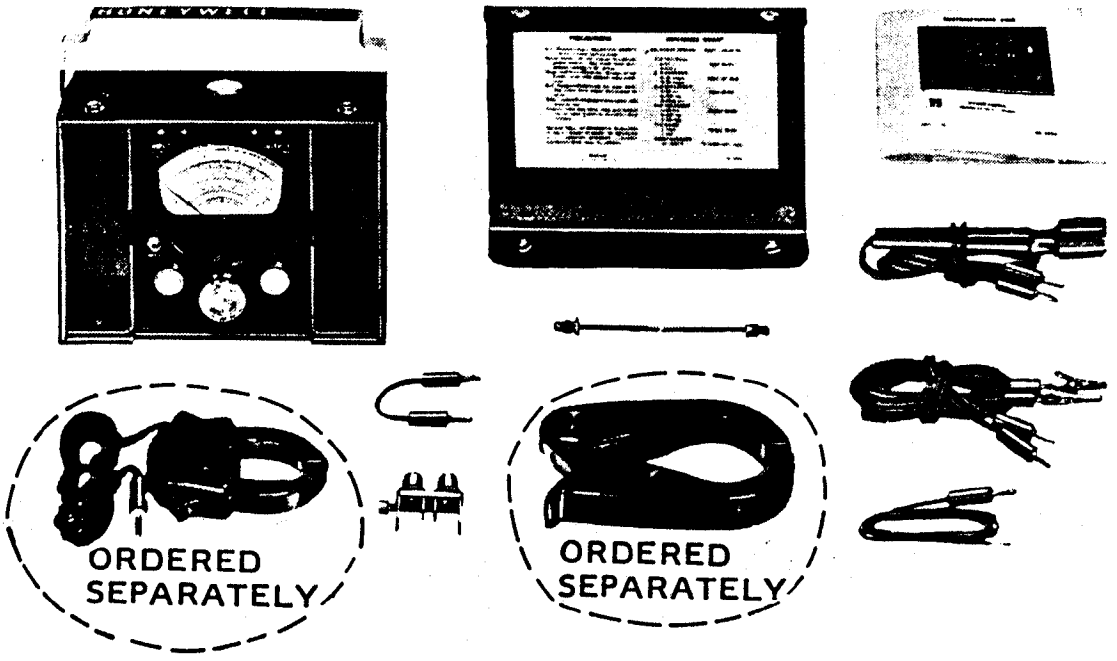
The conversion table adjusts capacity for different Btu per cu ft and sp gr of common gases.

GAS CAPACITY CONVERSION FACTORS

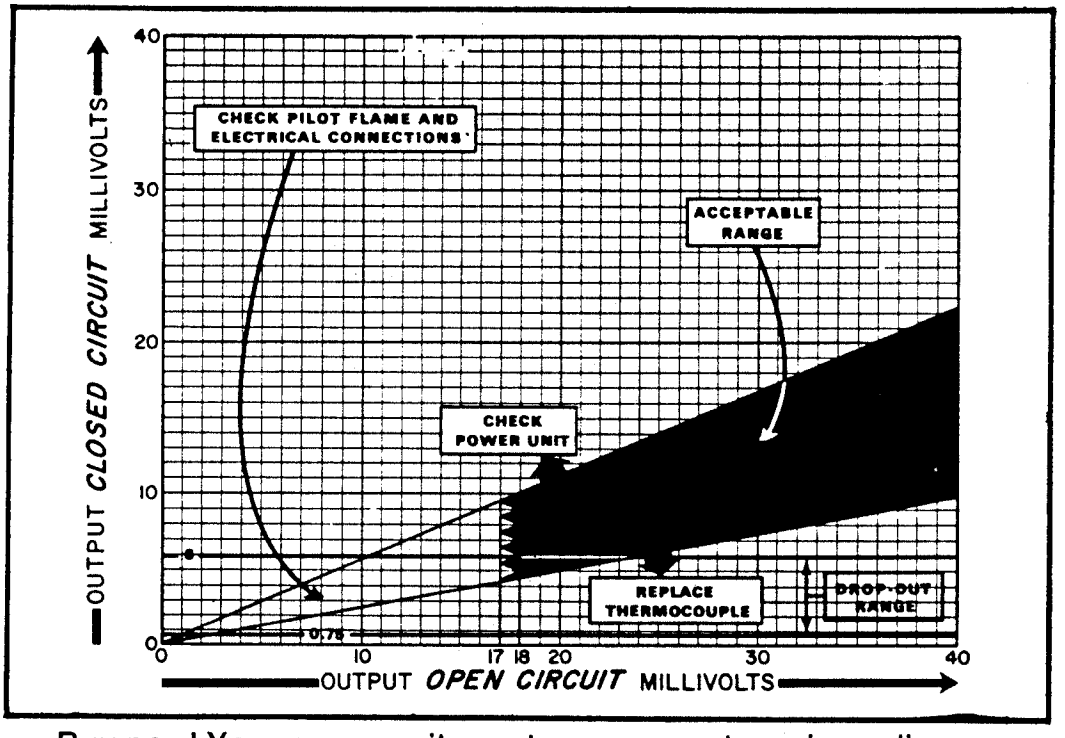
BTU PER CU FT	SP GR	MULTIPLY LISTED CAPACITY BY
500	0.60	0.516
800	0.70	0.765
2,500	1.53	1.62

W720 - FOUR TESTERS IN ONE

- volt-ohm-milliamp tester
- temperature tester (0 F to 1500 F [minus 18 C to plus 801 C])
- ammeter (0 to 75 or 0 to 75°)
- millivolt tester



The W720 Tester instruction book includes procedures for open circuit tests, and closed circuit tests. The two readings are plotted on a graph in the booklet, and you can see exactly where the problem lies. Each type of gas system has an individual graph.



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CHECKING GAS INPUT TO APPLIANCE
METER CLOCKING METHOD

See Page 13 for Manometer (pressure gauge) Method.

CAUTION: Make certain there is no gas flow through the meter other than to the appliance being checked.

Use Table to determine exact rate of gas flow to appliance.

METER FLOW RATE - CUBIC FEET PER HOUR (cfh)

(To convert cfh to cubic metres per hour (M^3/hr) multiply by .0283)

Sec for One Rev.	Meter Dial used-Cu Ft per Rev.		Sec for One Rev.	Meter Dial used-Cu Ft per Rev.			Sec for One Rev.	Meter Dial used-Cu Ft per Rev.		
	(1/2)	(1)		(1/2)	(1)	(2)		(1)	(2)	(5)
10	180	360	35	52	103	206	60	60	120	300
11	164	327	36	50	100	200	62	58	116	290
12	150	300	37	49	97	195	64	56	112	281
13	139	277	38	48	95	189	66	55	109	273
14	129	257	39	46	92	185	68	53	106	265
15	120	240	40	45	90	180	70	52	103	257
16	113	225	41	44	88	176	72	50	100	250
17	106	212	42	43	86	172	74	49	97	243
18	100	200	43	42	84	167	76	48	95	237
19	95	189	44	41	82	164	78	46	92	231
20	90	180	45	40	80	160	80	45	90	225
21	86	171	46	39	78	157	84	43	86	214
22	82	164	47	38	77	153	88	41	82	205
23	78	157	48	38	75	150	92	39	78	196
24	75	150	49	37	74	147	96	38	75	188
25	72	144	50	36	72	144	100	36	72	180
26	69	138	51	35	71	141	105	34	69	172
27	67	133	52	35	69	138	110	33	66	164
28	64	129	53	34	68	136	120	30	60	150
29	62	124	54	33	67	133	130	28	55	138
30	60	120	55	33	66	131	140	26	52	129
31	58	116	56	32	64	129	150	24	48	120
32	56	113	57	32	63	126	160	23	45	113
33	55	109	58	31	62	124	170	21	43	106
34	53	106	59	31	61	122	180	20	40	100

TO CONVERT METER FLOW RATE (cfh) TO BTU PER HOUR—

Multiply cfh (from Table above) by the Btu heat content of the gas being used.

TO CONVERT INPUT RATING
(Btu per hour as stamped on appliance nameplate)
TO METER FLOW RATE (cfh)

$$\text{(Divide)}\ \frac{\text{Input Rating in Btu per Hour}}{\text{Btu Content of Gas per Cu ft}} = \text{cfh}$$

0-2602

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