

# CO-RAY-VAC®

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## INSTALLATION — OPERATION & SERVICE INSTRUCTIONS

### CRV-A, CRV-B, & CRV5-40 SYSTEMS

*This manual contains instructions for several different models of CO-RAY-VAC Systems. Refer to your packing slip and the outside of delivered cartons to verify models received. Follow appropriate instructions.*

*INSTALLER — Please take time to read and understand these instructions prior to any installation.*

*OWNER — Keep this manual in a safe place to provide your serviceman with helpful information if the need arises.*

**Roberts**  **Gordon**



**A LEADER IN HEATING EQUIPMENT FOR OVER 50 YEARS**

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**INSTALLATION — OPERATION**  
**&**  
**SERVICE INSTRUCTIONS**  
  
**CRV-A, CRV-B, & CRV5-40 SYSTEMS**

**WARNING**

FIRE OR EXPLOSION HAZARD.

CAN CAUSE PROPERTY DAMAGE, SEVERE INJURY OR DEATH.

- 1) Read this manual carefully before installing or servicing this equipment. Improper installation, adjustment, alteration, service or maintenance can cause property damage, injury or death.
- 2) Check clearances given on the inside cover of each burner to make sure the product is suitable for your application.
- 3) Installer must be a trained, experienced service technician.
- 4) All service must be performed only by a trained service technician or representative.
- 5) After installation is complete check out product operation as provided in these instructions.

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# CO-RAY-VAC INSTALLATION, OPERATION AND SERVICE INSTRUCTIONS

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# PART I

## CO-RAY-VAC® INSTALLATION INSTRUCTIONS

### CRV-A & CRV-B SERIES

#### INTRODUCTION

##### CHECKING SHIPMENT

As material is being delivered, check shipment against Bill of Lading for shortages. Also check for external damage to cartons or tubes. Shortages and/or external damage to cartons or tubes must be noted on the Bill of Lading in the presence of delivery trucker. The delivery trucker should acknowledge any shortages or damages by initialling this "noted" Bill of Lading.

Claims for damaged material, or shortages that were not evident upon receipt of shipment must be reported to carrier and Roberts-Gordon Sales Representative as soon as they become known.

#### IMPORTANT

This heater is designed for heating non-residential indoor spaces. These instructions, the layout drawing, local codes and ordinances, and applicable standards such as apply to gas piping, electrical wiring, venting, etc., must be thoroughly understood before proceeding with the installation.

##### NATIONAL STANDARDS AND APPLICABLE CODES

Installation must comply with local codes and recommendations of the local gas company, and the National Fuel Gas Code, ANSI Z223.1-1988 (same as Bulletin No. 54).

Installation in (1) aircraft hangars must be in accordance with the Standard for Aircraft Hangars, ANSI/NFPA 409-1985 and (2) garages in accordance with the Standard for Parking Structures, NFPA 88A-1985 or the Standard for Repair Garages, NFPA 88B-1985.

##### ELECTRICAL GROUNDING

Burner units must be electrically grounded in accordance with the National Electrical Code, ANSI/NFPA 70-1990.

##### HAZARDOUS LOCATIONS

Where there is the possibility of exposure to combustible airborne materials or vapor, consult the local Fire Marshal, the fire insurance carrier or other authorities for approval of the proposed installation.

##### INSTALLER QUALIFICATIONS

Only firms or individuals qualified to perform work in accordance with the applicable specifications should be engaged to install a CO-RAY-VAC® system. Consult local Building inspectors, Fire Marshals or the local Roberts-Gordon representative for guidance.

##### INSTALLER RESPONSIBILITY

CO-RAY-VAC® systems are installed on the basis of information given in a layout drawing, which together with these instructions and the cited codes and regulations comprise the basic information needed to complete the installation. The installer must furnish all needed material that is not furnished as standard CO-RAY-VAC® equipment, and it is his responsibility to see that such materials, as well as the installation methods he uses result in a job that is workmanlike and in compliance with all applicable codes.

Roberts-Gordon Factory Representatives have had training and experience in the application of this equipment and can be called on for suggestions about installation which can save material and labor.

## INSTALLATION

### PLANNING

Take maximum advantage of the building upper structure, beams, joists, purlins, etc., from which to suspend the system.

There is no correct sequence for installation of radiant and tailpipe lines. On-site observation will usually reveal a logical sequence. When radiant lines deviate appreciably from length given on layout drawing, use Table 1 on Page 5 as a guide. Any deviations must be approved by the designer.

Begin the installation at the most critical dimension. This could save time. Watch for swinging doors, overhead cranes, car lifts, etc.

Start at the end burner of one of the runs.

Hang all of the burner runs, then cut and hang the four-inch tubing to connect the burner runs. Reflectors, burners and gas line could be installed as you move along. Carefully adjust system pitch at each position.

### CRITICAL CONSIDERATIONS

CO-RAY-VAC is a suspended system which requires that consideration be given to the factors that determine its stability, flexibility, safety, and satisfactory operation. Before starting installation, be sure the following requirements can be met:

- Maintain specified clearances to combustibles, and to heat-sensitive material, equipment and work stations.
- Provide approved heat-radiation shielding or barriers where needed. Refer to the National Fuel Gas Code for guidance.
- Provide proper installation of gas connectors.
- Provide a suspension with vertical length of chain or swinging rod which has at least two inches horizontal travel for each burner in a straight run. Be sure suspension system is sufficiently flexible to accommodate thermal expansion which occurs as the system heats up.
- Provide access to burners for servicing, preferably on both sides and above for burner removal.
- Provide for a minimum of 18 inches of clearance between end burners and building walls.
- Install combustion chambers with arrow pointing towards pump.
- Be sure the system can accommodate a downward pitch of one-half inch per 20 feet in radiant lines and one inch per 20 feet in manifold and tailpipe.
- Use damper couplings where specified on the layout drawing. These are essential to balance the vacuum in various portions of a system.
- Put the correct end vent plate on the end burners. These are installed on end burners only.
- Determine whether rotation of vacuum pump will be counterclockwise as shipped or must be reversed. See Page 15.
- Provide signs in storage areas to specify maximum stacking height to maintain required clearance to combustibles.

Plan location of supports so as to put one at each burner, one between burners that are on 22-foot centers, two between burners on 32-foot centers and three between burners on 42-foot centers. Locate a support near all elbows, also one for every 10 feet of tailpipe. See Diagram No. 2, Page 11 and Diagram No. 3, Page 12.



**IMPORTANT**

DO NOT USE IN AN ATMOSPHERE CONTAINING HALOGENATED HYDROCARBONS OR OTHER CORROSIVE CHEMICALS.

Some compounds in the air can be ingested into the equipment and cause an accelerated rate of corrosion of some of the parts of heating components. The use of such chemical compounds in or near the enclosure should be avoided where a longer life of the burner, tubing and other parts is desirable.

**WARNING**

**FIRE OR EXPLOSION HAZARD:**

There is expansion of the radiant pipe with each firing cycle, and this will cause the burner to move with respect to the gas line.

This can cause a gas leak resulting in an unsafe condition if the gas connection is not made strictly in accordance with Diagram No. 34 or Diagram No. 35 as applicable.

**WARNING**

**FIRE OR EXPLOSION HAZARD.**

**CAN CAUSE PROPERTY DAMAGE, SEVERE INJURY OR DEATH.**

**FAILURE TO MAINTAIN THE SPECIFIED MINIMUM CLEARANCES TO COMBUSTIBLES COULD RESULT IN A SERIOUS FIRE HAZARD.**

**DO NOT LOCATE FLAMMABLE OR COMBUSTIBLE MATERIALS WITHIN THIS DISTANCE.**

## GLOSSARY OF TERMS

**BARRIER SHIELD:** Standard section of reflector inverted and attached at the edges of standard reflector.

**BURNER CONTROL ASSEMBLY:** An assembly of various valves, burner head, ignition system, filter, etc., necessary to operate and control the burner.

**COMBUSTION CHAMBER:** A 20-inch-long section of four-inch tubing with a side fitting to accept a burner. A window is provided to observe the flame. P/N 02722300. See Diagrams No. 42 and 44, Pages 38 and 39; and Pages 45 and 47.

**COMBUSTION CHAMBER: (Cast Iron)** A combustion chamber P/N 01305500 made of cast iron and tapped for two-and-one-half inch pipe; furnished with the CRV5-40 burner. Also, a combustion chamber P/N 02713900 made of cast iron and tapped for four-inch pipe which can be used with the CRV-B burners.

**COMBUSTION CHAMBER: (End)** A combustion chamber that receives the first burner in a series of burners. (Farthest from the vacuum pump.)

**CONNECTOR-STOP COCK ASSEMBLY:** A flexible connection between the gas line and the burner control assembly. The assembly consists of a flexible tube with a three-eighths inch N.P.T. female adapter and a mating stop cock with a one-half inch N.P.T. female connection. For the assembly, see Page 33; and Diagrams No. 34 and 35, Page 34.

**COUPLING:** A device used to connect sections of tubing. A standard unlined coupling is used to connect radiant tubes, P/N 01312700. See Diagram No. 4, Page 13.

**COUPLING, DAMPER:** A coupling with a damper. This is installed where needed to adjust the vacuum in a system. P/N 01331900.

**COUPLING, LINED:** A coupling lined with inconel. It is used to connect tailpipe tubes. P/N 01312701.

**DECORATIVE GRILLE (Optional):** A one-half inch square honeycomb aluminum grille installed below the radiant tube. This is for decorative purposes only. A one-foot-wide model installs directly on the reflector. A two-foot-wide model installs in a suspended ceiling. See Diagram No. 17, Page 21; and Diagram No. 21, Page 23.

**DUAL FUEL BURNER: (Optional — CRV-A and CRV5-40)** A burner design with two separate orifices and gas trains for both pilot gas flow and main gas flow. This permits a fuel conversion to be made by selective energization of the gas trains (i.e., and without physical change of orifices).

**END BURNER:** The burner control assembly installed at the end of a series of burners farthest from the vacuum pump.

**END VENT PLATE:** A plate (approximate four-inch diameter) that is attached to the end combustion chamber. This plate is predrilled and the correct size must be installed to match the burner. See Diagrams No. 38 and 39; Page 36. This is used with or without air system.

**INTERLOCK SWITCH:** A normally open switch used to prove vacuum system is operating before burners can fire. One interlock switch is an end switch in the blower motor (required in the CRV-A and CRV5-40 Systems). One interlock switch is the air proving switch, P/N 90430600, (required in the CRV-B Systems).

**LANCED STOP:** A tab in the lined coupling used to prevent racking of the coupling when driving lock member. See Diagram No. 4, Page 13.

**RADIANT TUBE:** That section of tubing run between burners and up to 40 feet (depending on burner size) downstream from the last burner in a series. This tubing is of bare steel.

**SINGLE FUEL BURNER:** This is the standard burner in which the pilot and main orifices can be changed to fire with either natural gas or propane. No change is required in the regular settings.

**TAILPIPE:** That section of tubing connecting the last section of radiant tubing in a series of burners to the vacuum pump. This tubing is porcelain lined.

**DESIGN REQUIREMENTS**

The dimensions in the table below are used in the design of CO-RAY-VAC® systems. Every effort should be made to hold the dimensions given on the layout drawing, but necessary deviations should keep the system dimensions within the limits shown.

**TABLE 1**

DESCRIPTION	MODEL					
	CRV-A2 CRV-B2	CRV-A4 CRV-B4	CRV-A6 CRV-B6	CRV-A8 CRV-B8	CRV-B10	CRV-B12
Rate	20,000	40,000	60,000	80,000	100,000	120,000
Radiant Pipe Between Burners						
Maximum	20'	25'	35'	45'	60'	70'
Recommended	15'	20'	25'	30'	40'	50'
Minimum	10'	12.5'	20'	25'	30'	35'
Run From Combustion Chamber						
Downstream to elbow (min.)	5'	5'	10'	10'	15'	15'
Upstream to elbow (min.)	2'	2'	2'	2'	2'	2'
Maximum No. of Burners per radiant branch	6	4*	4	3	3	2

\*Maximum number of burners per radiant branch for CRV-A4 is six.

**RADIANT BRANCH FLOW**

The flow in a radiant branch consists of the end vent flow units plus the flow units of combustion air from all burners. This is illustrated in Diagram 2, Page 11, where the branch flow is 36 flow units.

The limiting factor for maximum flow in the radiant section has been determined experimentally in terms of the maximum burner inlet flow units that can be tolerated without degradation of combustion characteristics at the last downstream burner. Also, if more than maximum number of burners are installed per radiant branch, the vacuum loss across the additional burners will increase appreciably.

This maximum flow in the radiant branch can be expressed for each burner firing rate by either a maximum number of burners per branch or the corresponding maximum number of flow units.

**TABLE 2****MAXIMUM NUMBER OF BURNERS AND FLOW UNITS PER RADIANT BRANCH**

MODEL	BURNER RATE (BTU/HR.)	NUMBER BURNERS	NUMBER FLOW UNITS
CRV-A2	20,000	6 maximum	18 maximum
CRV-A4	40,000	6 maximum	32 maximum
CRV-A6	60,000	4 maximum	36 maximum
CRV-A8	80,000	3 maximum	40 maximum
CRV-A	Combinations	6 maximum	36 maximum
CRV-B2	20,000	4 maximum	14 maximum
CRV-B4	40,000	4 maximum	26 maximum
CRV-B6	60,000	4 maximum	39 maximum
CRV-B8	80,000	3 maximum	44 maximum
CRV-B10	100,000	3 maximum	50 maximum
CRV-B12	120,000	2 maximum	44 maximum
CRV-B	Combinations	4 maximum	54 maximum

**TAILPIPE FLOW**

Excessive flow loading in a single section of tailpipe can cause low vacuum and lower effective pump capacity if care is not taken to observe the necessary design requirements. These necessary design requirements can be expressed in terms of combinations of flow units and the length of tailpipe that will not result in excessive vacuum loss. There is no firm cutoff point for excessive vacuum loss. In practice this vacuum loss may vary in the tailpipe from 2.0 to 4.0 in w.c. (water column).

The vacuum pump has a capacity of 120 flow units under normal operating conditions. This assumes certain restrictions on the flow characteristics of the entire vacuum pump system.

Of these referenced restrictions, one of the most important is the proper combination for length of tailpipe section and flow units. This is referred to as the vacuum line loss requirement.

This is important because if the pump is to develop the proper vacuum at the end vent, the length of tailpipe must not be excessive for the number of flow units carried. There is a complication, however. The definition of excessive length changes according to the number of flow units carried.

**CLEARANCES TO COMBUSTIBLES**

<b>CAUTION</b>	
FIRE OR EXPLOSION HAZARD.	
CAN CAUSE PROPERTY DAMAGE, SEVERE INJURY OR DEATH.	
CAUTION must be used when operating this heating system near combustible materials such as wood, paper, rubber, etc.	
1) Consideration must be given to partitions, storage racks, hoists, building construction, etc.	
2) Diagram No. 1 and the chart below give the MINIMUM acceptable clearances.	
3) In areas of storage or stacking, an appropriate warning of the maximum stacking height below must be posted. This maximum stacking height must be below the clearance to combustibles.	

**TABLE OF MINIMUM CLEARANCES TO COMBUSTIBLES  
AND OPTIONAL EQUIPMENT INFORMATION**

REFLECTOR TYPE	PART No.	CRV-A2, -A4, -A6 and -A8 CRV-B2, -B4, -B6 and -B8				CRV-B10 and -B12			
		SIDE w/ SHIELD	SIDE w/o SHIELD	TOP	BE- LOW	SIDE w/ SHIELD	SIDE w/o SHIELD	TOP	BE- LOW
Standard System (any location in System)									
Standard Reflector	02750300	—	20	4	48	—	36	4	60
With One Side Extension	01368000	12	20	4	56	12	42	4	60
With Two Side Extensions	01368000	12	—	4	56	12	—	4	60
One-Foot-Wide w/ Grille	91406700	—	12	4	48	—	18	4	56
Two-Foot-Wide w/ Grille	02750300	—	12	4	48	—	18	4	56
Barrier Shield	02750300	12	—	4	12	18	—	8	24
Universal Shield (Pos. 1)	02751801	12	—	4	12	18	—	8	24
Universal Shield (Pos. 2)	02751301	—	24	4	48	—	36	4	48
Universal Shield (Pos. 3)	02751801	12	30	4	56	12	42	8	60
*Standard System									
Standard Reflector	02750300	—	10	4	18	—	18	4	24

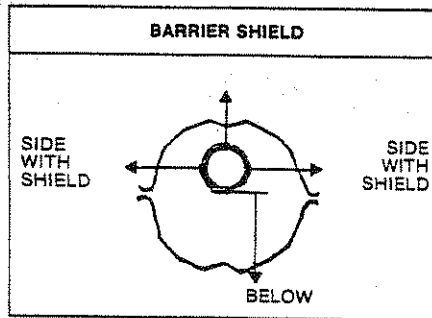
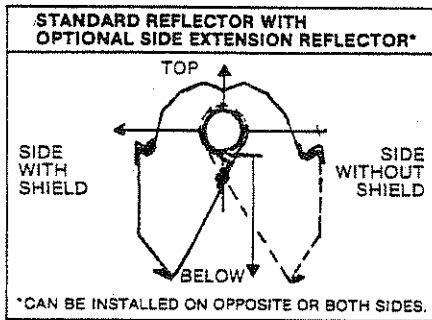
\*Clearances from tube as shown apply only downstream from the last burner in the system as follows:

- CRV-A2, -A4, -A6 and -A8 — Over 20 feet downstream
- CRV-B2, -B4, -B6 and -B8 — Over 20 feet downstream
- CRV-B10 and -B12 — Over 30 feet downstream

**WARNING**

FIRE OR EXPLOSION HAZARD.  
 CAN CAUSE PROPERTY DAMAGE, SEVERE INJURY OR DEATH.  
 FAILURE TO MAINTAIN THE SPECIFIED MINIMUM CLEARANCES TO COMBUSTIBLES  
 COULD RESULT IN A SERIOUS FIRE HAZARD.  
 DO NOT LOCATE FLAMMABLE OR COMBUSTIBLE MATERIALS WITHIN THIS DISTANCE.

**SIDE EXTENSION AND BARRIER SHIELD**



**UNIVERSAL SHIELD (Solid or Perforated)**

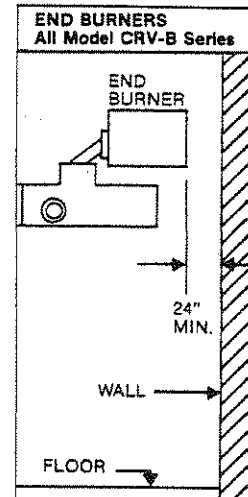
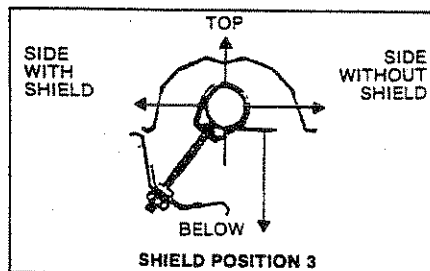
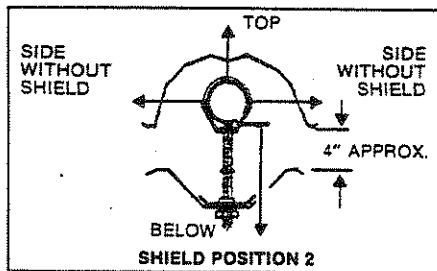
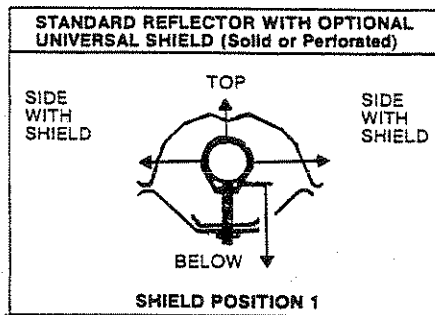


Diagram No. 1

**HEAT EXCHANGER SURFACE (RADIANT AND TAILPIPE)**

**RADIANT PIPE**

The main purpose of the tailpipe and the radiant pipe is to provide sufficient heat exchanger surface to transfer the heat from the flue gases to the tube wall where it can be released from the outside surface of the tube as useful heat. Radiant pipe is defined as the tubing between burners firing in a radiant branch, plus the radiant tubing for the last downstream burner. Tailpipe is defined as all the four-inch steel tubing between the radiant pipe and the vacuum pump.

Most of the radiant heat supplied by each burner is released from the outside surface of the radiant pipe; the balance is released by the tailpipe. The replacement of radiant pipe to correspond to areas of major heat loss is the key to providing uniform comfort levels. The use of adequate tailpipe is the key to high combustion efficiency and proper operation of the vacuum pump.

The following considerations in selecting the length of radiant pipe per Table 1, Page 5, include the following:

- Minimum —** This provides for the highest level of average intensity per foot of radiant pipe and good uniformity between burners. This requires more tailpipe to maintain operating efficiency and pump capacity.
- Recommended —** This provides a medium value of average intensity per foot of radiant pipe and a good compromise between length of radiant pipe without undue reduction or intensity near the inlet to the next burner.
- Maximum —** This provides the lowest average value of intensity per foot of radiant pipe and consequently the largest span between burners. The intensity will be reduced slightly for the last five to ten feet of radiant pipe before the next burner.

The length of radiant pipe required for burners varies according to the firing rates. Also, consideration has been given to usage of standard 10-foot length or lengths that can be cut from same without waste.

For radiant pipe use uncoated 4.0 in O.D. steel tubing and unlined couplings as supplied by Roberts-Gordon, Inc.

**TAILPIPE**

The considerations in selecting the amount of tailpipe include the following:

- Minimum —** This is the minimum length of tailpipe to cool the flue gases sufficiently for proper operation of the vacuum pump. Excessive temperatures at the inlet to the pump will reduce the effective flow capacity and the vacuum obtainable in the system.
- Recommended —** This represents an optimum length of tailpipe that together with the recommended length of radiant pipe can be expected to provide high combustion efficiency and optimum performance of the vacuum pump.
- Maximum —** This permits the use of an extended connecting length of tailpipe if a branch of burners is remotely located which would otherwise require a separate vacuum pump. It should be noted that if there are traces of corrosive contaminants in the combustion air, much of this longer section of tailpipe will be exposed to the corrosive conditions in the low temperature end of the tailpipe. As a practical maximum, the value as heat exchanger surface is minimal at lengths much above three foot per Flow Unit. Also, there may be excessive vacuum losses with longer lengths of tailpipe.

In regard to the length of tailpipe required per flow unit, there is a trade-off between length of radiant pipe and length of tailpipe. Consequently, the requirements for tailpipe are stated in Table 3, Page 9.

TABLE 3

Tailpipe Length (with **recommended** or **maximum** length of radiant pipe)

**Minimum** — 2.0 feet/Flow Unit

**Recommended** — 2.5 feet/Flow Unit

Tailpipe Length (with **minimum** length of radiant pipe)

**Minimum** — 2.5 feet/Flow Unit

**Recommended** — 3.0 feet/Flow Unit

### THE SUSPENSION SYSTEM (See Diagram No. 2, Page 11)

Install appropriate suspension hardware, beam clamps, chain, (rod or perforated strap) and a turnbuckle at predetermined locations (for one branch at a time), making provision at this time for required pitching of the system (one-half inch per 20 feet Radiant and one inch per 20 feet Tailpipe). Adjustment of chain length and turnbuckle will provide uniform pitch. Normally the wire-form tube and reflector hangers, P/N 02790300, would not be installed at this time, but if job conditions do not permit preassembly of several lengths of tubing, it may be advantageous to put these hangers on the turnbuckles at this stage. Weight to be supported may be figured as follows:

Tubing — 2.8 lbs. per foot

Burner and Combustion Chamber — 21 lbs. per unit

### TUBING AND FITTINGS

#### IMPORTANT

Use only porcelain-lined tubing and fittings and lined couplings in the tailpipe. Normally only plain tubing and fittings are used in radiant lines. See Diagram No. 4, Page 13.

### COUPLINGS (See Diagram No. 4, Page 13 for coupling details)

Tubing, combustion chambers and tube fittings are connected by wrap-a-round couplings which clamp by means of a tapered hammer-driven lock member. The starting ends of the coupling and lock member are identified by 1/4-inch holes which are put together when starting assembly.

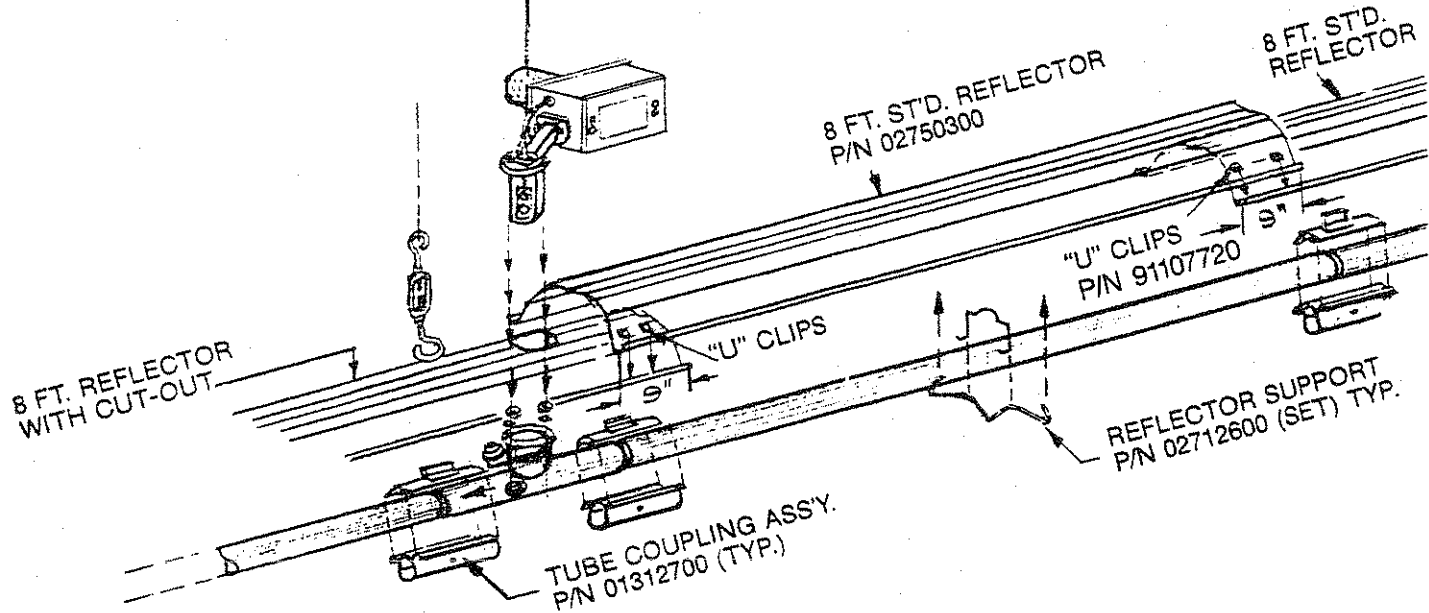
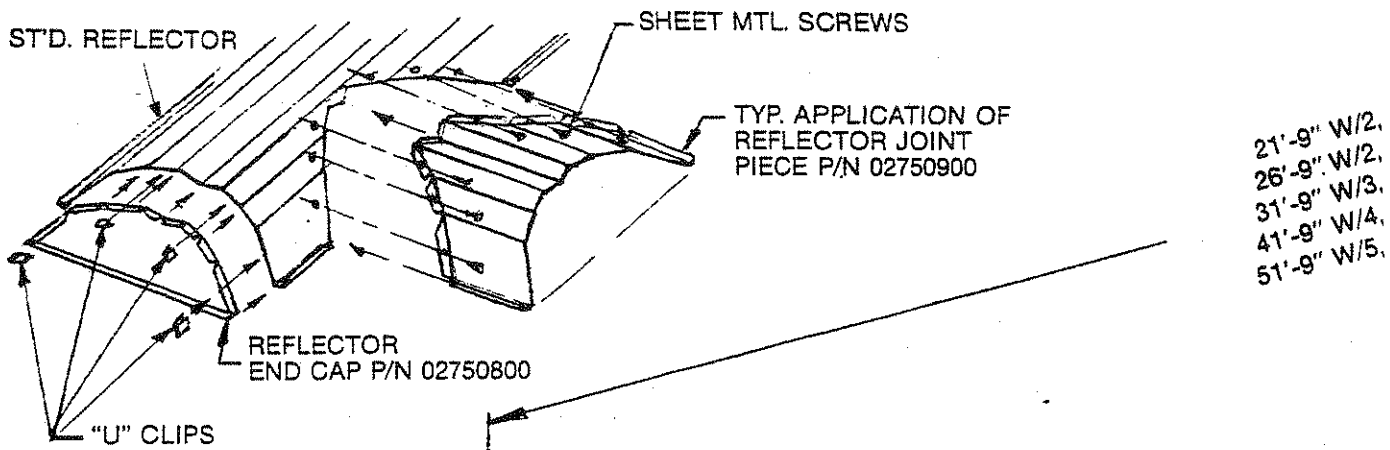
Be sure tubes are in line and tube ends butt against stop pin(s) inside coupling. When assembling lined couplings be sure the end of the coupling is engaged in the lanced stop. This stop prevents racking of the coupling as the lock member is driven tight. Use care to avoid distortion of the liner.

The hammer-driven lock member (slide bar) maintains a  $\pm 2$  inch tolerance in reference to lining up with the end of the wrap-a-round. It may be necessary to drive the slide bar short or past alignment in order to have a tight fit (see Page 13). **OVER TIGHTENING WILL DAMAGE THE COUPLING.**

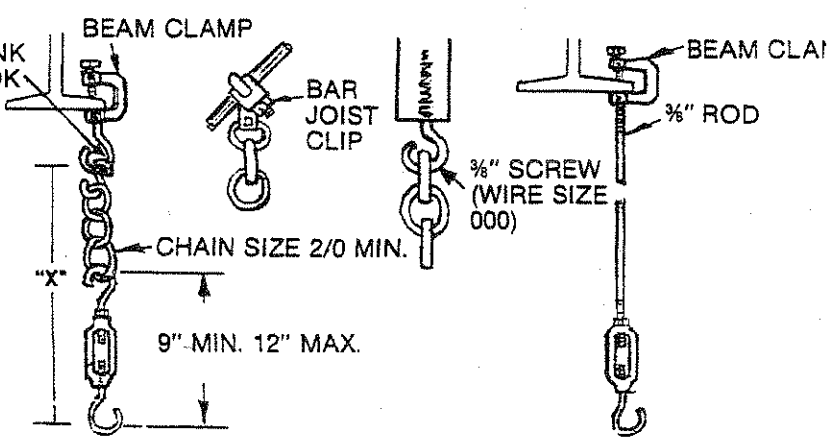
### RADIANT AND TAILPIPE LINES (See Diagram No. 2, Page 11)

If the wire-form hangers or the turnbuckles are not already hanging, put one on the combustion chamber, connect the chamber and the designated lengths of plain tubing. Locate all of the lock members down about 45° from the top. This will eliminate the need to remove the reflectors for access to the lock members should later disassembly be required. **BE SURE THE COMBUSTION CHAMBER IS INSTALLED WITH THE ARROW POINTING TOWARD THE PUMP.** The 10-24 weld screws on the combustion chamber should be to the rear, away from the pump. (These weld screws are used only at the end burner position to attach the end vent plate.) Raise and hang this assembly, using a hanger at each combustion chamber. Repeat this procedure as required, connecting successive assemblies together. Each end combustion chamber must be fitted with the proper end vent plate. Plates are marked 2, 4, 6, 8-12 to identify them with their corresponding burner. These plates are also coded — see Diagrams No. 43 and 45, Pages 38 and 39. Tailpipe is assembled in the same manner except there are no combustion chambers, and the use of coated tube and fittings and lined couplings is required. When damper couplings are specified on the layout drawing, be sure to install where shown.

Pitch of the entire system should be checked and adjusted as the sections are installed.



STRAIGHT RUN LENGTH (ft.)	MIN. LENGTH "X" (in.)	TYPICAL EXPANSION (in.)
50	12	±1
100	24	±2
150	36	±3
200	46	±4
250	57	±5



**TYPICAL SUSPENSION DETAILS**

NOTE: Use only the turnbuckles furnished by Roberts-Gordon, Inc.



INSTALLATION

T. LG. RADIANT TUBES  
 T. LG. & 1.5 FT. RADIANT TUBES  
 T. LG. RADIANT TUBES  
 T. LG. RADIANT TUBES  
 T. LG. RADIANT TUBES

TURNBUCKLE ASS'Y.  
 P/N 91903200 (TYP.)

TUBE AND REFLECTOR  
 HANGER P/N 02790300

8 FT. REFLECTOR  
 WITH CUT-OUT  
 P/N 02750301

REFLECTOR END CAP  
 P/N 02750800

"U" CLIPS  
 (USED TO SECURE  
 BURNER IN  
 COMB. CHAMBER)

HEX NUTS (BRASS) (2)  
 LOCK WASHERS (2)

GASKET  
 P/N 01367800

END VENT PLATE  
 P/N 013676...

COMBUSTION CHAMBER  
 P/N 02722300 (TYP.)

SLIDE JOINTS  
 NO "U" CLIPS

4" O.D. x 10 FT. TUBING TYP.  
 P/N 91409300

BURNER AND  
 CONTROLS  
 HOUSING ASS'Y.

FILTER

16 1/2" CLEARANCE FOR  
 BURNER REMOVAL

STD. REFLECTOR

HORIZONTAL LINE

SIDE EXT. REFLECTOR  
 SUPPORT BRKT. ASS'Y.  
 WITH 4" O.D. TUBE  
 P/N 01329910

10 1/4" SIDE EXTENSION  
 REFLECTOR ( IF USED)  
 P/N 01368000

FLOOR

END VIEW

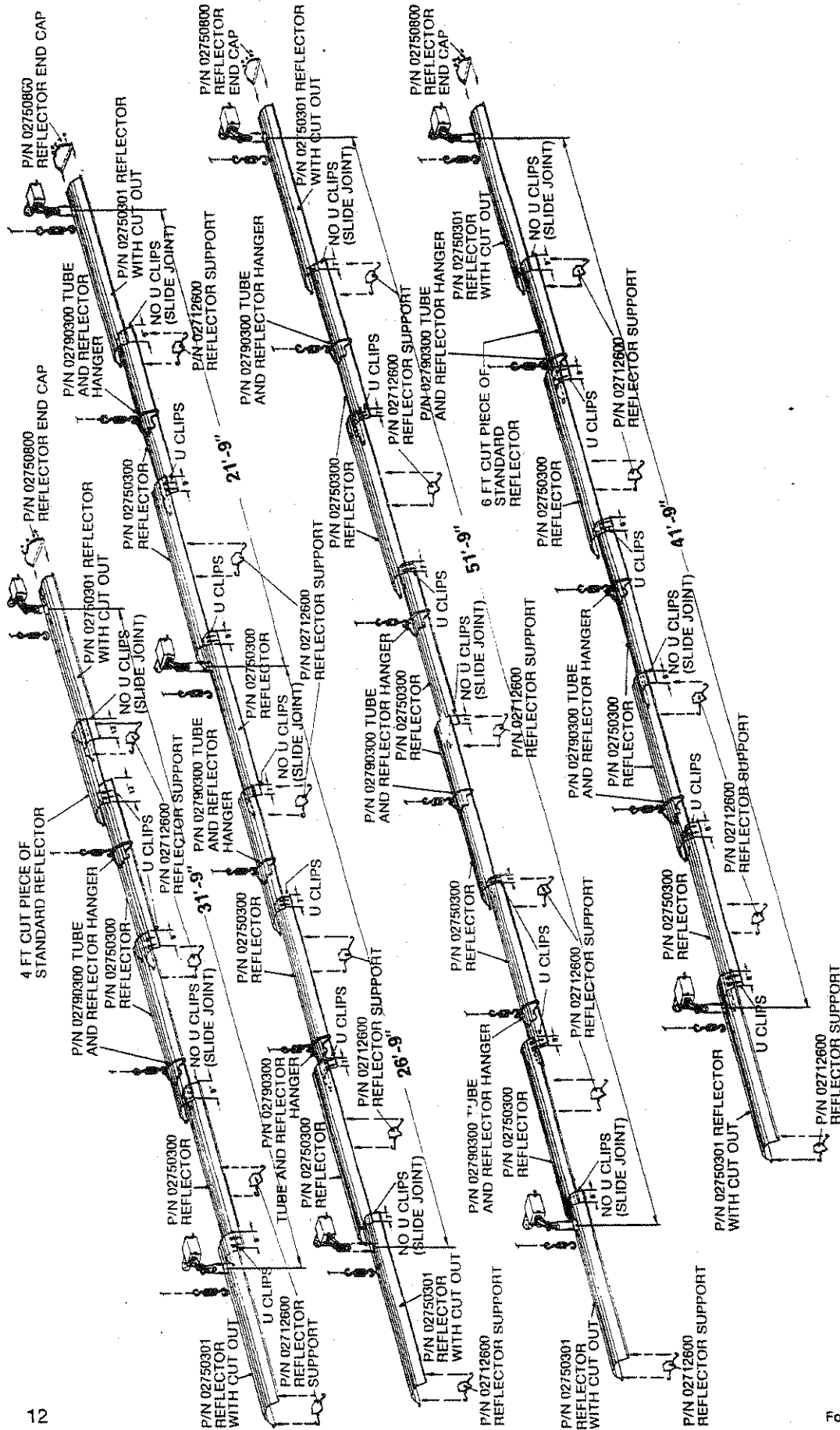
**CAUTION**

Use appropriate suspension hardware, beam clamps (rod or perforated strap) and turnbuckle at predetermined locations.

The weight and normal movement of the heating system may cause support failure if the below minimum requirements are not met. Failure of the supports can cause property damage, severe injury or death.

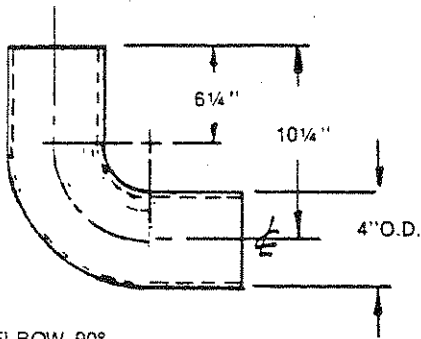
- 1) Distance between supports 10 feet or less.
- 2) Chain size 2/0 minimum or equivalent.

**SUSPENSION AND ASSEMBLY DETAILS  
 CRV-A AND CRV-B SERIES  
 Diagram No. 2**



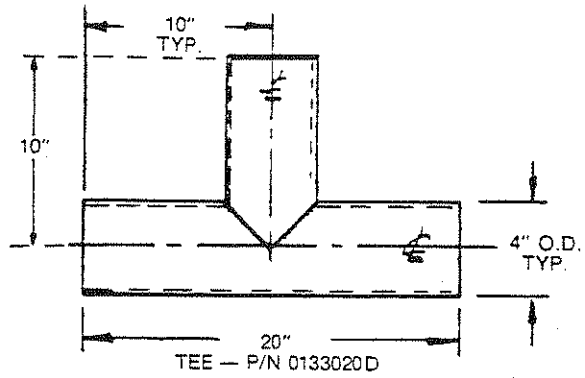
**TYPICAL REFLECTOR AND HANGER SPACINGS  
FOR VARIOUS BURNER SPACINGS**  
Diagram No. 3

INSTALLATION

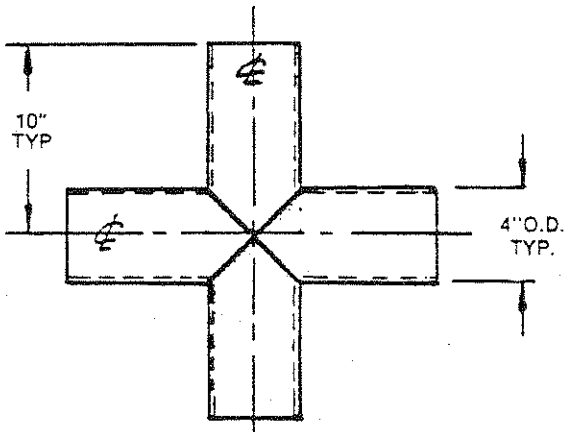


ELBOW, 90°  
P/N 0133010D

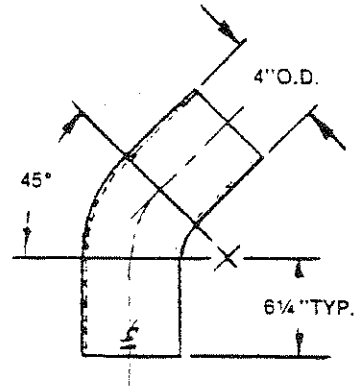
NOTE:  
AFTER SEPTEMBER, 1990, P/N BECOMES 0133580D;  
6 1/4" DIMENSION BECOMES 15 1/4".



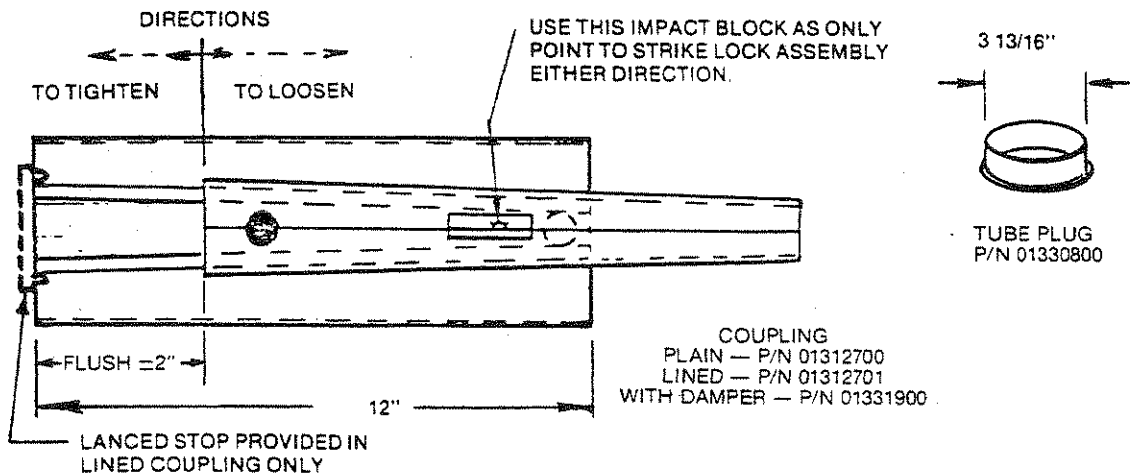
TEE — P/N 0133020D



CROSS — P/N 0133090D

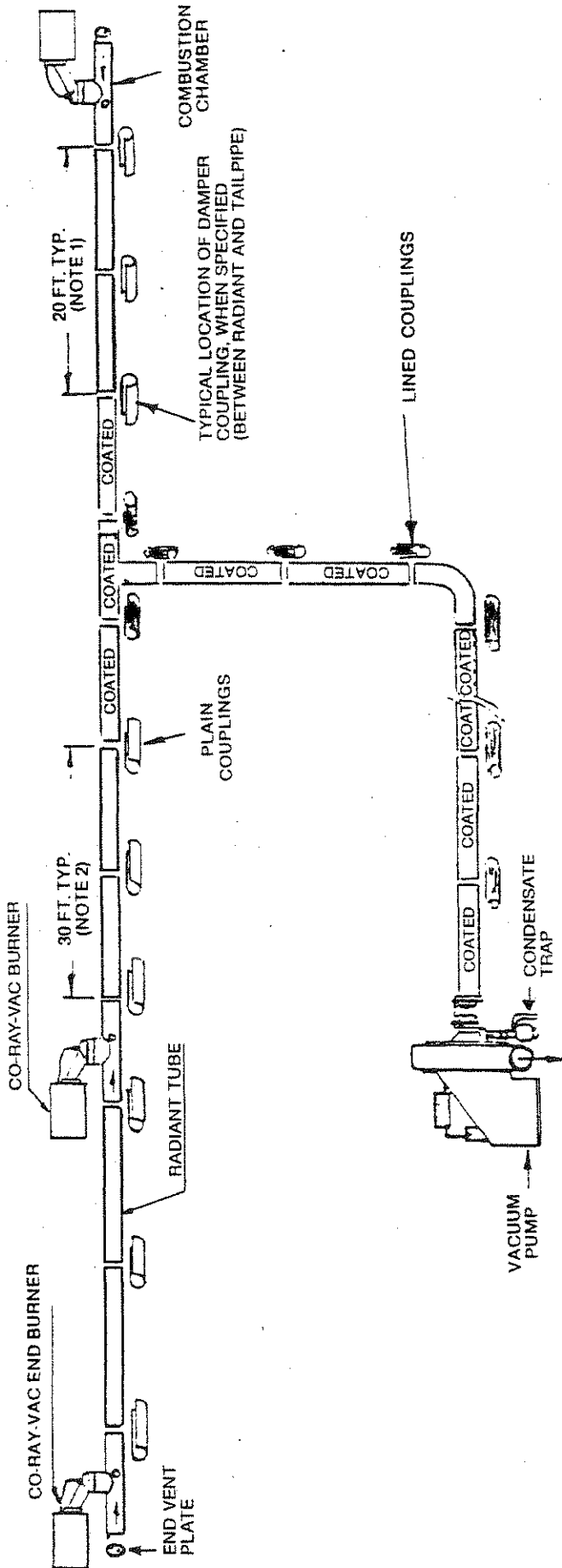


ELBOW, 45°  
P/N 0133070D



**TUBE FITTING DIMENSIONS**  
Diagram No. 4

INSTALLATION



**INSTALLATION GUIDE**  
**COATED TUBING AND LINED COUPLINGS**  
 Diagram No. 5

- NOTE:**
1. Tubing between burners, and 20 to 50 feet downstream of the last downstream burner is normally uncoated. ALL OTHER TUBING MUST BE COATED.
  2. Plain couplings are used to connect combustion chambers to plain tubing, plain tubing to plain tubing and plain tubing to coated tubing. ALL OTHER COUPLINGS MUST BE LINED.

**INSTALLATION OF THE VACUUM PUMP (See Diagrams No. 6 thru 12, Pages 15 thru 17)**

The layout drawing shows the general location of the vacuum pump. Specific pump location and discharge details must meet the following criteria:

- Applicable venting codes and regulations must be observed.
  - Adequate tailpipe length must be provided.
  - Discharge into a public area must be at least seven feet above ground level.
  - Discharge must be not less than 12 inches from any building opening, nor less than two feet from an adjacent building.
  - Discharge through a combustible wall or structural member must employ a suitable ventilated thimble.
  - To avoid staining building wall, extend discharge three feet from building.
  - Horizontal discharge is preferred. Vertical discharge must be arranged as shown in Diagram No. 12.
  - Only corrosion resistant materials should be used for the discharge line from the pump to the point of discharge.
- If tailpipe for any one burner is less than recommended length, use only corrosion resistant metal such as porcelain coated steel, cast iron pipe, etc.
- If tailpipe length for all burners branches is **at least recommended length**, either corrosion resistant steel or ABS or PVC plastic may be used.
  - Discharge pipe length is defined as excessive if not within one of the following conditions:  
 10 feet maximum of four inch O.D. tube (14 ga. max.)  
 25 feet maximum of five inch O.D. tube (1/4 inch wall max.)  
 40 feet maximum of six inch O.D. tube (1/4 inch wall max.)

A common practice is to mount the pump on the building wall, using the mounting hardware furnished. If this is not practical, it may be mounted on an elevated floor pad, on a platform suspended from the ceiling, or for maximum quietness, outdoors in an enclosure.

Pumps are shipped partially assembled. The scroll must be attached to the back plate with either right or left hand discharge as the job requires. **THE DISCHARGE MUST BE BOTTOM HORIZONTAL.** Any other arrangement will permit condensate to collect in the scroll. For pump assembly, follow the instructions packed in pump carton.

**DANGER**

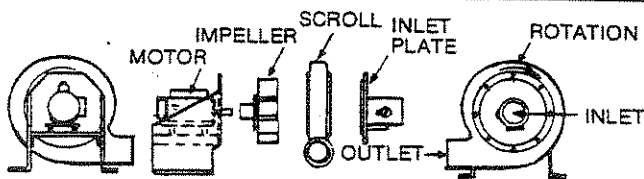
**HIGH SPEED ROTATING IMPELLER CAN CAUSE SEVERE INJURY.**

Do not operate when not installed.	Keep hands and fingers away from inlet and outlet.
Loose clothing can be drawn into unguarded inlet and entangle with impeller.	Install "bird screen" guard on outlet.

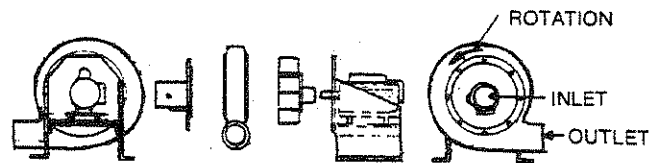
**IMPORTANT**

**DO NOT OPERATE PARTIALLY ASSEMBLED PUMP OR WITH AN UNRESTRICTED INLET.**

- 1) Operating pump when not installed in system requires that damper is one-half closed. An unrestricted air flow will overload the motor causing burnout and failure.
- 2) Pump impellers are precision balanced by Roberts-Gordon, Inc., then bench tested with their motor for vibration and noise. It is important that extreme care be used when handling the pump to be sure that it is not put out of balance by dropping, tipping or bumping.
- 3) After installation the condensate trap should be connected to the bottom of the pump inlet, and a suitable drain installed. The trap should be filled with water **BEFORE THE BURNERS ARE TURNED ON**. Be sure the vacuum control damper in the pump inlet is locked open. Failure to fill the trap may reduce system vacuum resulting in the burners underfiring.

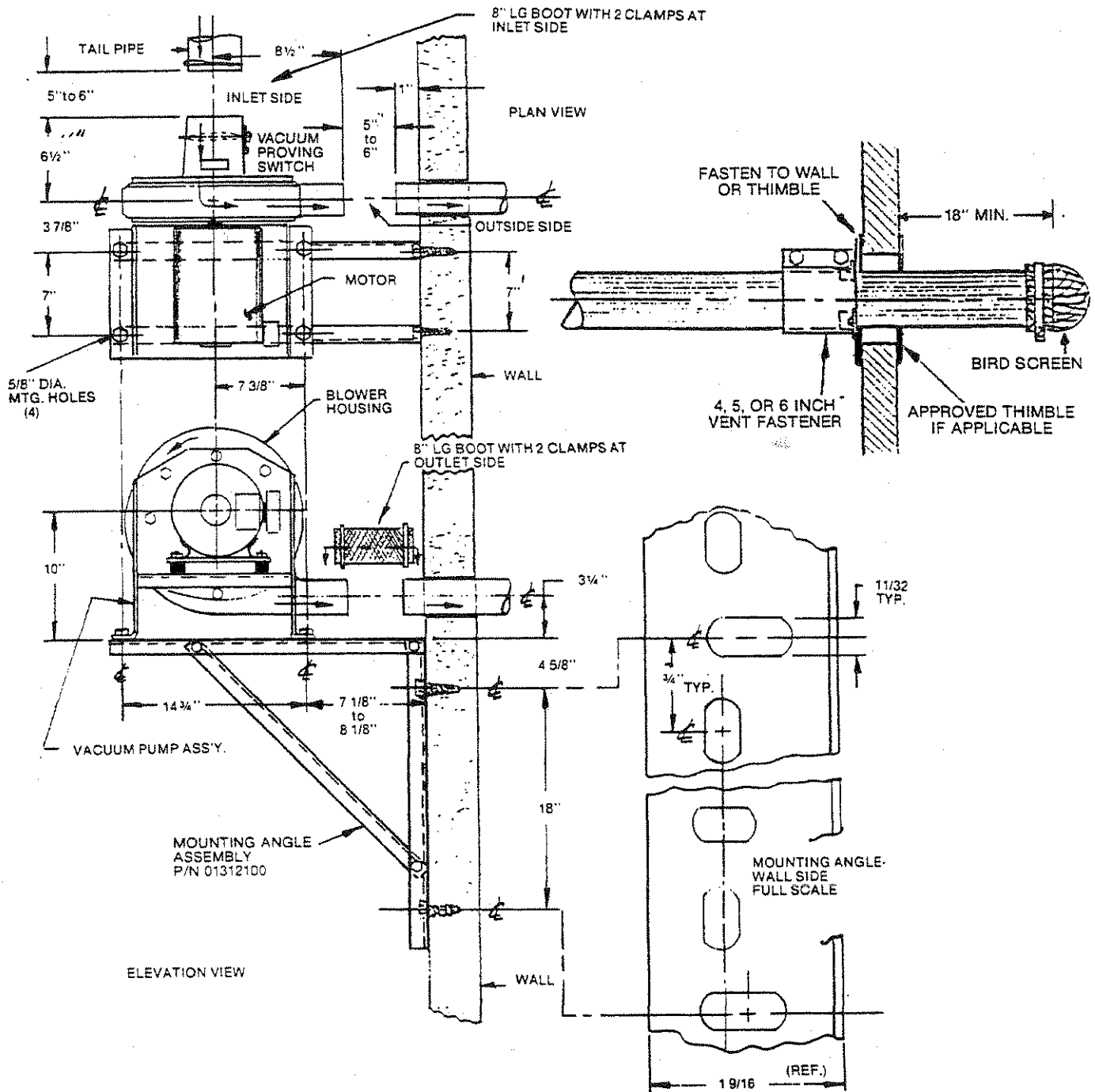


**COUNTERCLOCKWISE  
MOTOR ROTATION (AS SHIPPED)  
FOR BOTTOM RIGHT DISCHARGE  
AS VIEWED FROM MOTOR END  
Diagram No. 6**



**CLOCKWISE MOTOR ROTATION  
(AFTER ROTATION REVERSED)  
FOR BOTTOM LEFT DISCHARGE  
AS VIEWED FROM MOTOR END  
Diagram No. 7**

INSTALLATION



**STANDARD VACUUM PUMP INSTALLATION**  
**Diagram No. 8**

Unless otherwise noted the motor rotation is counterclockwise as shipped for bottom right discharge as viewed from the motor side (for clockwise rotation, see Diagram No. 7, Page 15 and Diagram No. 11, Page 17).

The condensate trap in the discharge line can be eliminated if the discharge line is horizontal through the wall and pitched down at least one inch per foot. A condensate trap on the discharge side is a must if there is a vertical rise in the discharge line. See Diagram No. 12, Page 17.

It is possible to eliminate the condensate trap on the vacuum pump if the one-inch pipe tapping is plugged. This arrangement will permit drainage of condensate through the pump and outside via the horizontal (pitched) discharge line or through the condensate trap/drain.

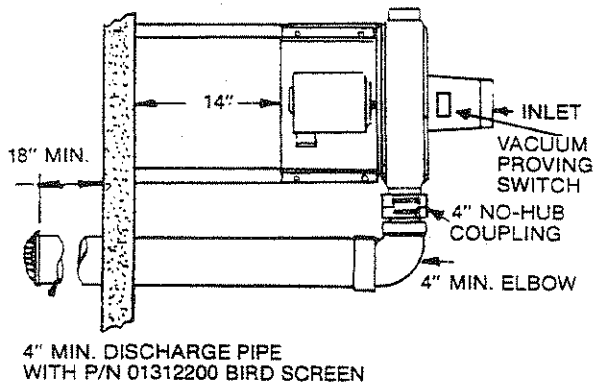


Diagram No. 9

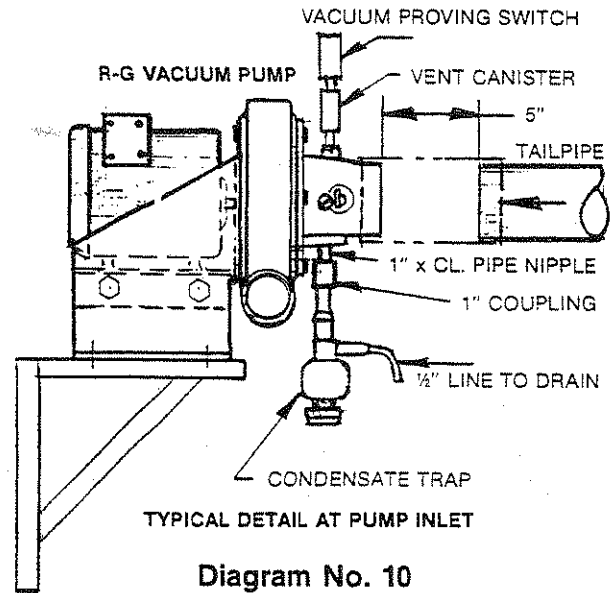


Diagram No. 10

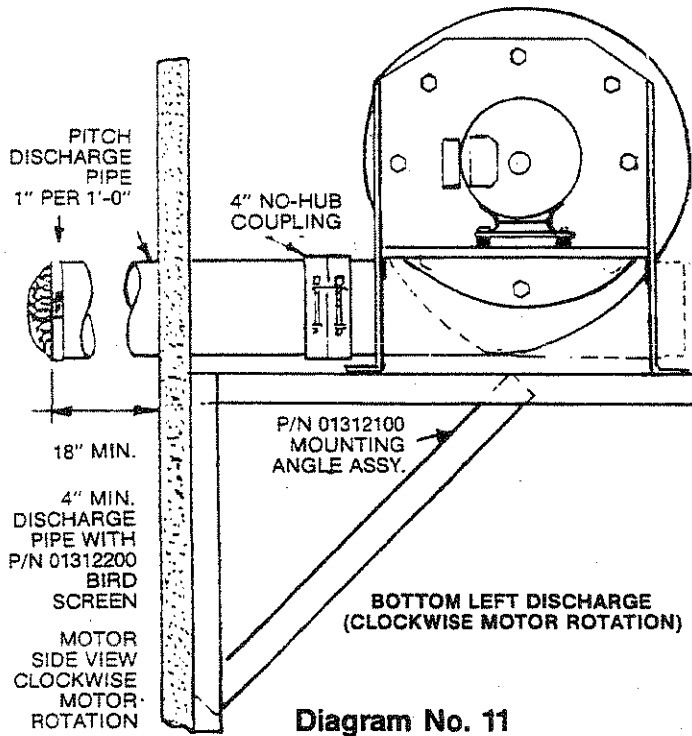


Diagram No. 11

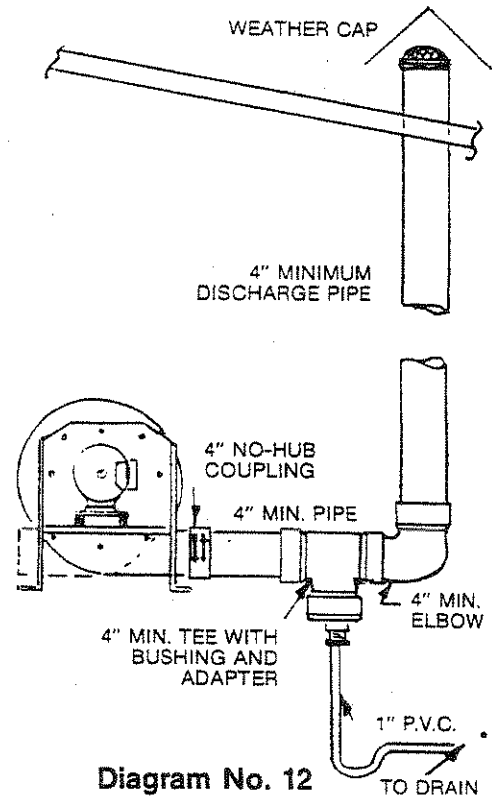


Diagram No. 12

ALTERNATE VACUUM PUMP INSTALLATIONS

**STANDARD REFLECTORS** (See Diagram No. 2, Page 11 and Diagram No. 3, Page 12)

This is the part of the system that is most apparent and where a neat job marks the installer as a craftsman.

Basic features of reflector installation are:

- A slip joint at each third reflector joint to accommodate thermal expansion. Reflectors at all other joints are locked with "U" clips.
- Reflector supports should be used at each slip joint and wherever needed to adequately support the reflector.
- Reflectors not supported by a hanger or reflector support should rest on a reflector that is supported. Provide at least a nine inch overlap to provide for thermal expansion.
- Reflectors should be level side to side.
- Reflector end caps must be used at all end burners and at elbows or tees where a reflector end would otherwise be left open.
- End caps cut out for tubing should be used where reflectors end on tailpipe.
- Reflectors must be carefully handled to avoid finger marks and dents.
- Finger marks are best removed with window spray cleaner.

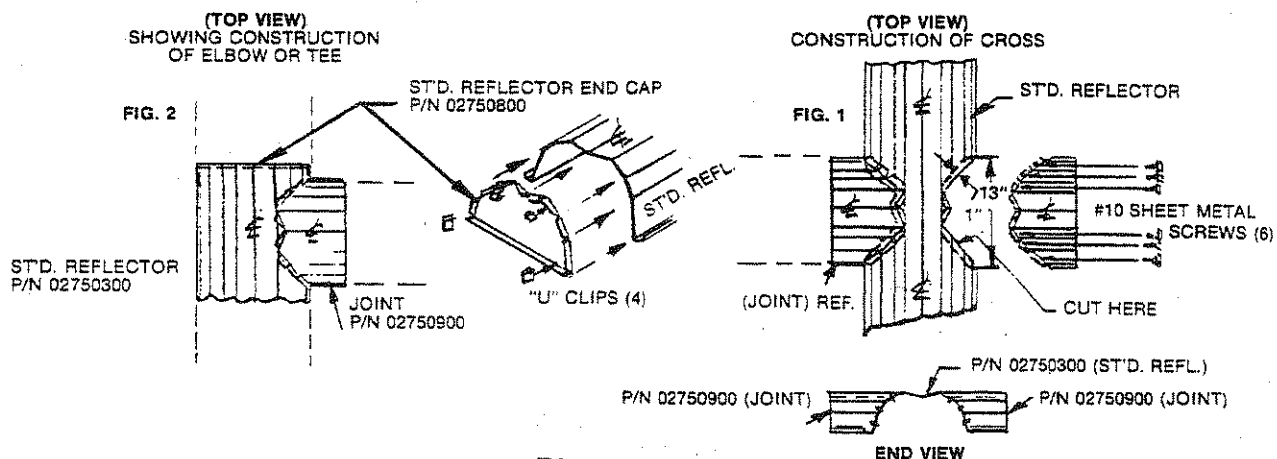
**Installation Details**

The following procedure is typical of reflector installation on a standard radiant section with burners on 22-foot or 32-foot centers. A similar procedure should be followed for manifold and tailpipe reflectors.

Unless another procedure is specifically indicated or found more practicable, proceed as follows:

Start at an end burner with a reflector having a burner cutout. Disconnect the turnbuckle, slide the hanger down the tube far enough to get the long end of the reflector through it, then push the reflector down over the riser of the combustion chamber. This is purposely a tight fit to avoid leakage. Put the hanger back in position and reconnect the turnbuckle. Install an end cap, using four clips. Next install a P/N 02750501 reflector support about four inches from the other end. A plain reflector is next slipped through the downstream hanger, then under the first reflector into the reflector support, with nine inches overlap. This will be a slip joint so reflectors are not clipped together. The next reflector is then installed with nine inches overlap. Use another reflector support at or near the overlap, and use clips to tie reflectors together. Since the next reflector is at a combustion chamber, it should be put under the reflector just installed before fitting it to the combustion chamber. When burners are on 32-foot centers (three tubing lengths), four full-length and one half-length reflectors are needed for coverage. Again, leave the first joint downstream of the burner free for a slip joint. See Diagram No. 3, Page 12 for arrangements with various lengths of radiant tube.

Where reflectors are over tube elbows, tees or crosses, reflectors should fit each other in a neat workmanlike manner. Reflector joint pieces preformed (P/N 02750900) to connect reflectors, together with reflector end caps (P/N 02750800) are illustrated in Diagram No. 13. Follow instructions for assembly.





## INSTALLATION

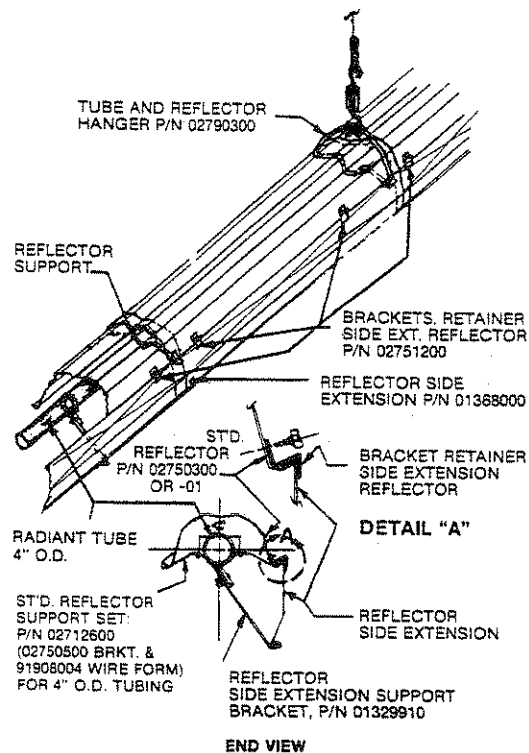
This accessory joint piece simplifies the field construction of CO-RAY-VAC Reflector Elbows, Tees and Crosses:

1. Flatten reflector edge where joint piece matches.
2. Put a mark on the reflector, directly over the tube center. Center the accessory joint piece on the mark and scribe its outside contour on the reflector.
3. Scribe location of mounting holes.
4. Cut away the reflector to clear the tube, leaving about one inch of material inside the scribed contour to attach the accessory joint.
5. With an awl or other pointed tool, or a nail, punch holes about 3/32" diameter in reflector.
6. Use four No. 10 sheet metal screws to attach joint piece.
7. Use clips to secure the next reflector to the joint piece.

### SIDE EXTENSION REFLECTORS (Optional)

May be installed either side of the standard reflector, as required.

1. Attach a reflector side extension support bracket (P/N 01329910) to radiant tube as needed. These brackets should be located adjacent to the overlapped joints of the reflector side extension.
2. Insert lower edge of reflector side extension in extension support bracket.
3. Cut suitable relief notch for each reflector support bracket (P/N 02756501 and/or P/N 02790300).
4. Hook top edge of perimeter reflector (P/N 01368000) over edge of reflector (P/N 02750300) (see Detail "A").
5. A slip joint must be provided in the perimeter reflector side extension at the location of each slip joint in the reflector. The overlap should be the same as the reflector.
6. Where severe air movement may be encountered, as at large door, one (1) or two (2) sheet metal screws in each reflector should be used, except where slip joint is required.
7. Install at least two brackets (P/N 02751200) for each side extension.



**NOTE:** TO INSTALL P/N 02751200 BRACKETS: LAY BRACKET OVER THE SIDE EXTENSION REFLECTOR AND STANDARD REFLECTOR AT SELECTED LOCATION. BY USING HOLE IN THE BRACKET AS THE TEMPLATE, DRILL OR PUNCH APPROXIMATELY 3/32" DIAMETER PILOT HOLE IN THE STANDARD REFLECTOR. INSTALL #8 x 3/8 SHEET METAL SCREWS AS SHOWN (DETAIL "A").

**Diagram No. 14**

INSTALLATION

SHIELD OPTIONS

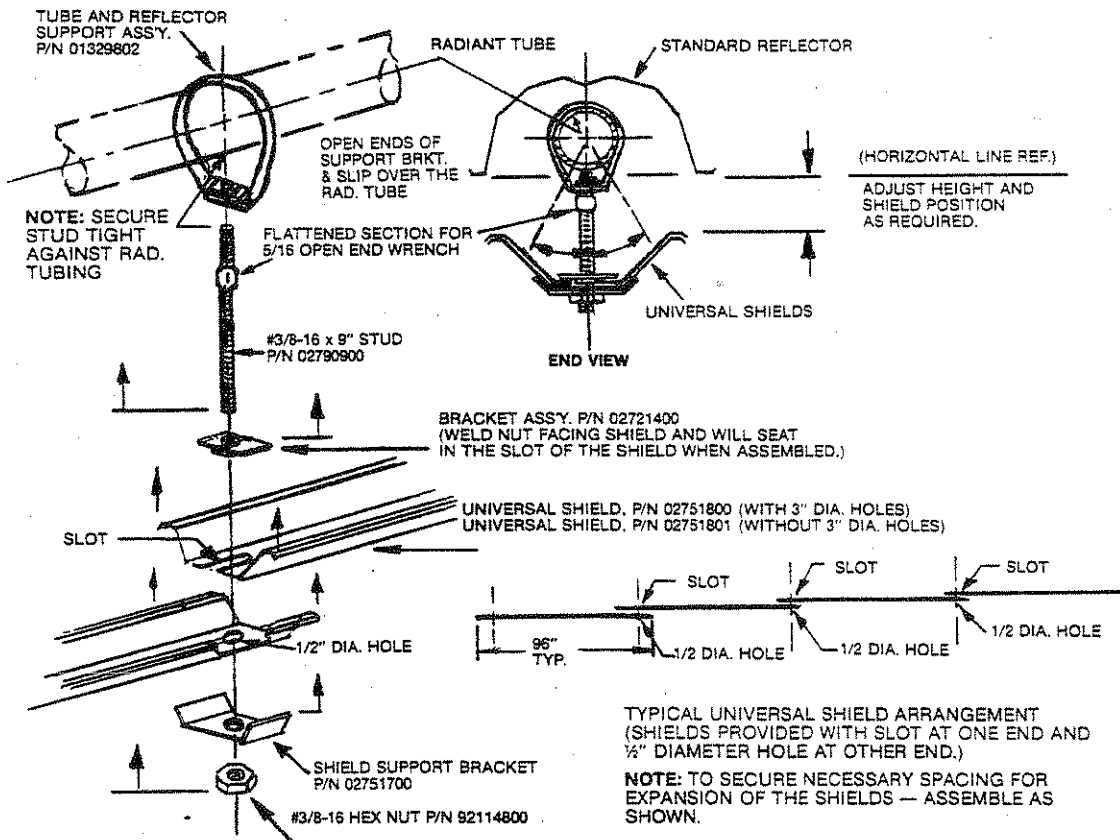
**UNIVERSAL SHIELD P/N 02751800 (with holes P/N 02751801)**

This is an adjustable shield which can be installed horizontally as shown in Diagram No. 15, Page 20 or angled (as shown on Diagram No. 1, Page 7). It is required that the slot in the end of the reflector (P/N 02751800) straddles the weld nut on bracket (P/N 02721400) to allow for expansion. The shield angle may be adjusted by changing the angle of the support bracket assembly (P/N 02721400).

**NOTE:** When installing the Universal Shield options, two P/N 02721400 brackets are required for single shield installations and one bracket for each adjoining shield.

**IMPORTANT**

Prior to installation of universal shields see A.G.A. certified table of minimum clearances to combustible materials.



**UNIVERSAL SHIELD INSTALLATION WITH CRV-B SERIES CO-RAY-VAC**  
**Diagram No. 15**

**BARRIER SHIELD P/N 02750300**

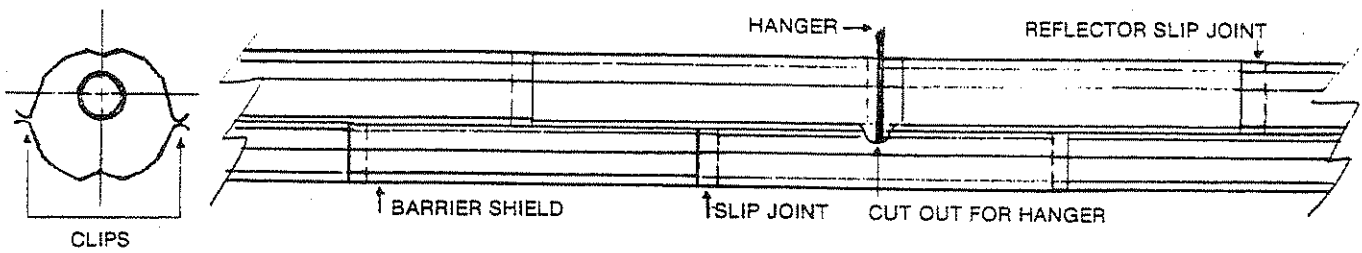
The Barrier Shield is a non-adjustable shield installed as shown in Diagram No. 16; Page 21 and used to minimize the exposure of infrared to the objects below. In order to avoid tube (heat exchanger) overheating, installation is to be a minimum of 20 feet downstream of any burner.

A slip joint in the reflector must be provided immediately upstream or downstream of the Barrier Shield. When adjoining shields are used, a slip joint must be provided in each shield.

**THIMBLE ASSEMBLY P/N 91609600**

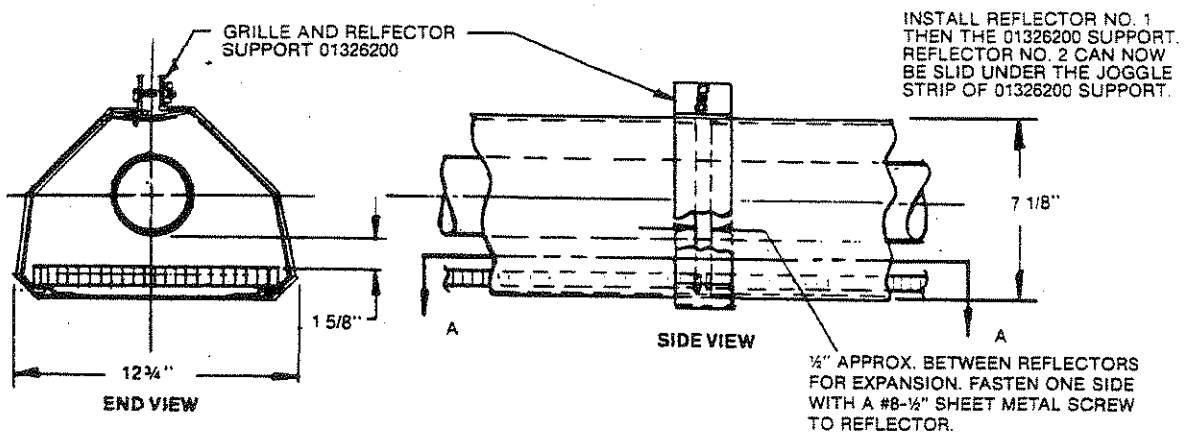
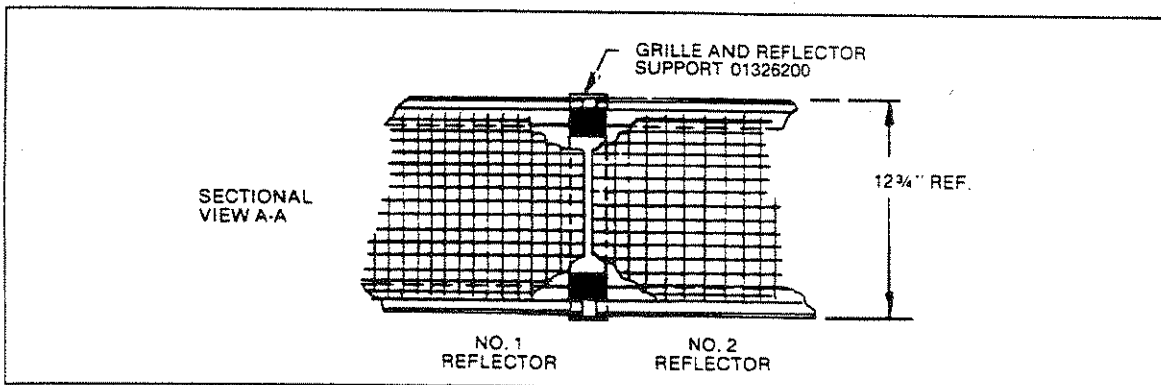
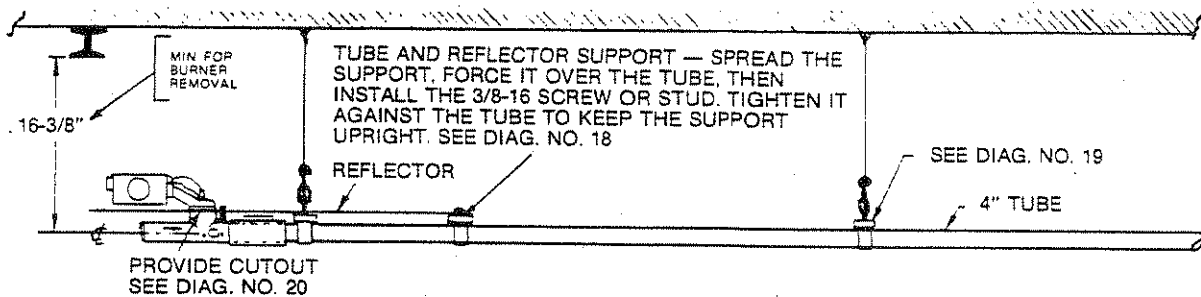
This assembly is installed where minimum clearances are required; such as through a wall or over a combustible beam. Connections are to be made with standard couplings and reflector is to be terminated at the larger diameter of the thimble assembly.

**NOTE:** The thimble assembly is to be installed a minimum of 20 feet downstream of any burner.



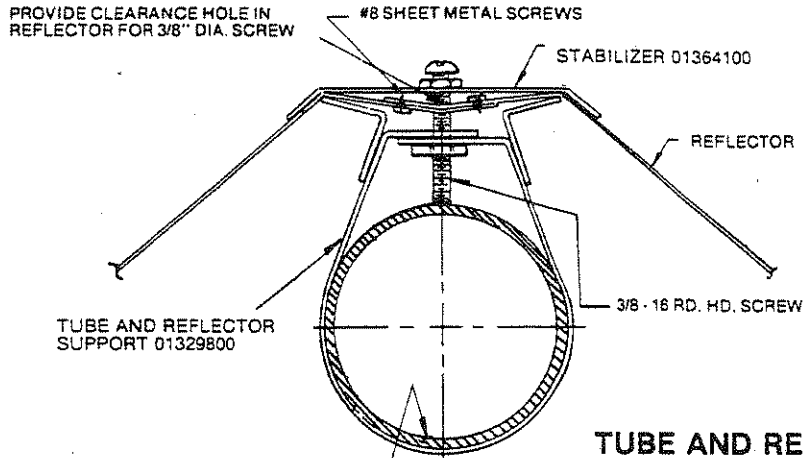
**BARRIER SHIELD OPTION**  
Diagram No. 16

**ONE FOOT WIDE DECORATIVE GRILLE**

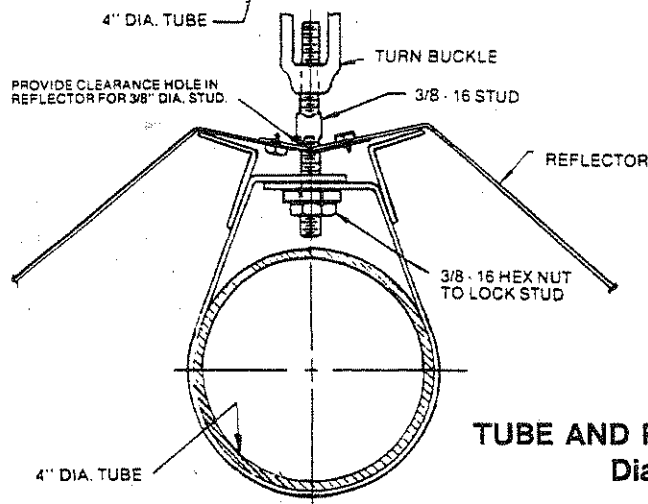


**INSTALLATION DETAILS OF ONE-FOOT-WIDE FREE-HANGING DECORATIVE GRILLE SYSTEM (OPTIONAL)**  
Diagram No. 17

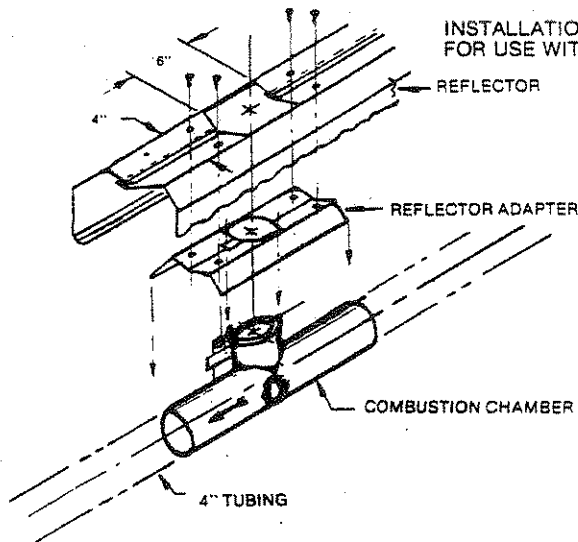
INSTALLATION



**TUBE AND REFLECTOR SUPPORT**  
Diagram No. 18



**TUBE AND REFLECTOR HANGER**  
Diagram No. 19

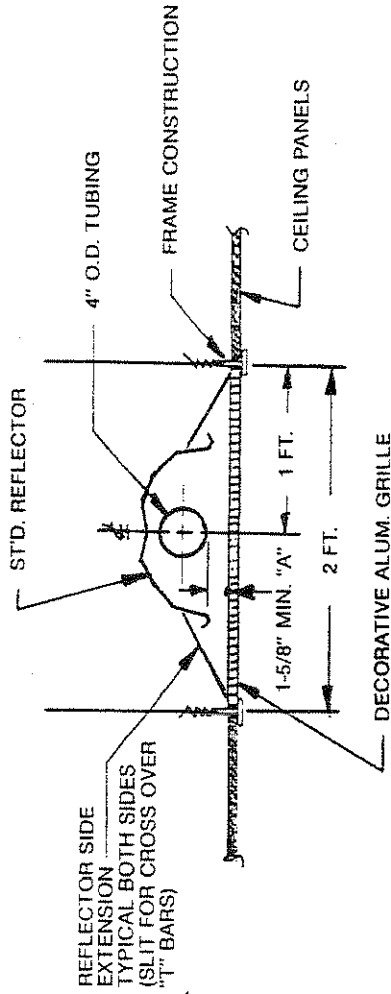
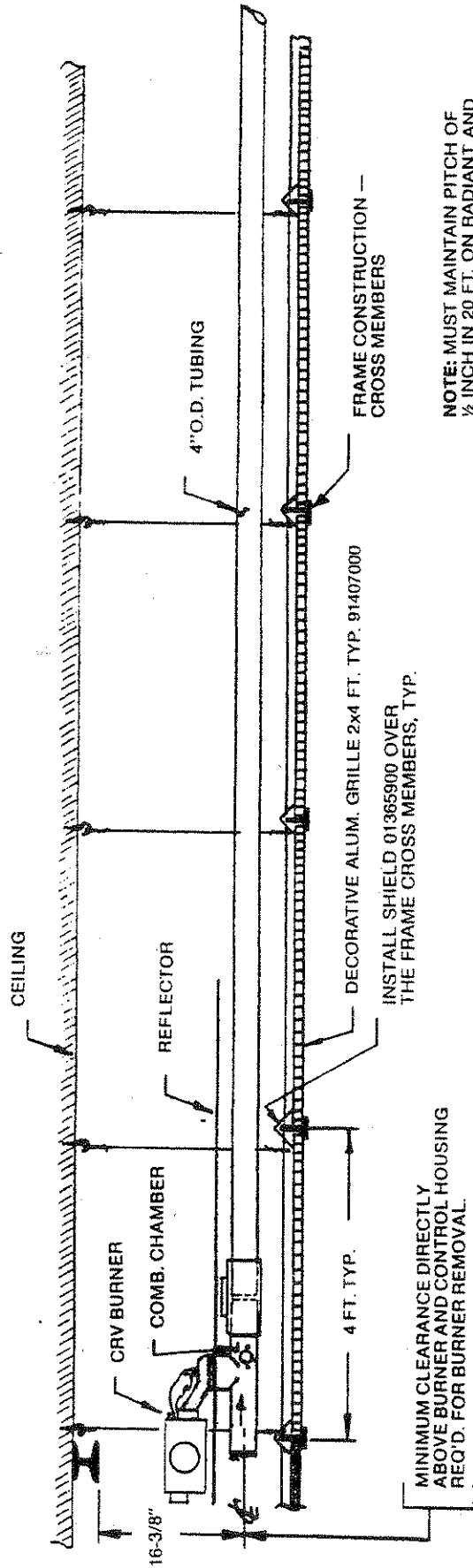


INSTALLATION INSTRUCTIONS FOR REFLECTOR ADAPTER  
FOR USE WITH ONE-FOOT-WIDE DECORATIVE ALUMINUM GRILLE

1. PROVIDE A 4" x 6" CUT-OUT IN THE REFLECTOR RISER OF THE COMBUSTION CHAMBER
2. PUT ADAPTER OVER COMBUSTION CHAMBER
3. INSTALL REFLECTOR OVER THE ADAPTER
4. SECURE WITH 4 SHEET METAL SCREWS

**Diagram No. 20**

**ASSEMBLY DETAILS FOR TYPICAL  
ONE-FOOT-WIDE DECORATIVE GRILLE**



PART NO.	SIDE EXTENSION WIDTH	"A"	
		MIN.	MAX.
01370408	8"	1.62	5.75
01370412	12"	5.75	10.12
01370416	16"	10.12	14.375

**INSTALLATION OF CRV-A AND CRV-B SERIES BURNERS  
WITH TWO-FOOT-WIDE DECORATIVE ALUMINUM GRILLE (OPTIONAL)**  
Diagram No. 21

**WIRING**

The overall plan for the CO-RAY-VAC system is shown in Diagram No. 22, Page 25. This includes both standard parts as required in the system plus the optional parts (in dotted lines).

**IMPORTANT**

The control panel, burner, vacuum pump and outside air blower if used, must be electrically grounded in accordance with the National Electrical Code ANSI/NFPA 70-1990.

Wiring must conform to the most current National Electrical Code, local ordinances and any special diagrams furnished.

All burners are supplied with a junction box and a three-prong plug. An outlet box with a three-wire grounded receptacle must be located at each burner, accessible to the 24-inch cord on the burner (see Diagrams No. 23 and 24, Pages 26 and 27). In order to accommodate the expansion movement of the system of several inches, slack must be incorporated in the burner cord.

Vacuum Pump	6.3 Amps Run (full load) 30-40 Amps Start, 115V
	3.2 Amps Run (full load) 15-20 Amps Start, 230V
Air Supply Blower	2.4 Amps Max. @ 115V
Pump Zone Relay	12.0 Amps @ 115V (inductive)
Single Fuel Burner	0.30 Amps @ 115V
Dual Fuel Burner	0.60 Amps @ 115V

**CONTROL PANEL**

Standard equipment with each vacuum pump is a pre-wired 12" x 12" x 4" control panel box which contains all the controls normally used with CO-RAY-VAC system except thermostats. It features two terminal blocks which accommodate connections to the power supply, vacuum pump motor, vacuum switch, burners and thermostats. Wiring from the power supply to the panel must be 12 AWG or larger to maintain proper voltage to the panel under full load conditions. Inside the cover of each control panel box are wiring diagrams which show the internal wiring of panel components and the connections to external components. As an option, the cover can contain six (6) indicator lights making it possible to determine the system mode of operation at a visible distance from the panel. See Diagrams No. 23 thru 26, Pages 26 thru 29. Install the panel in a safe place that is convenient to reach for service.

**INTERLOCK SWITCHES**

It is necessary that the burners be interlocked with the operation of the vacuum pump. This is accomplished as follows:

**A Series** — All vacuum pump motors are provided with a centrifugal end switch rated for 20 amp at 115 volts. It is required that this switch be utilized as the interlock.

**B Series** — A vacuum switch preset at two inches water column is included for installation on the inlet casting of the vacuum pump. This switch is rated for 20 amp at 115 volts and is required to be utilized as the interlock.

It is recommended as an option that both switches be used and wired in series as per Diagrams No. 27, 28, and 29, Page 30.

**THERMOSTATS**

24 volt thermostats must be connected to the panel thermostat terminals. See Diagram No. 33, Page 32 for wiring of night set-back controls.

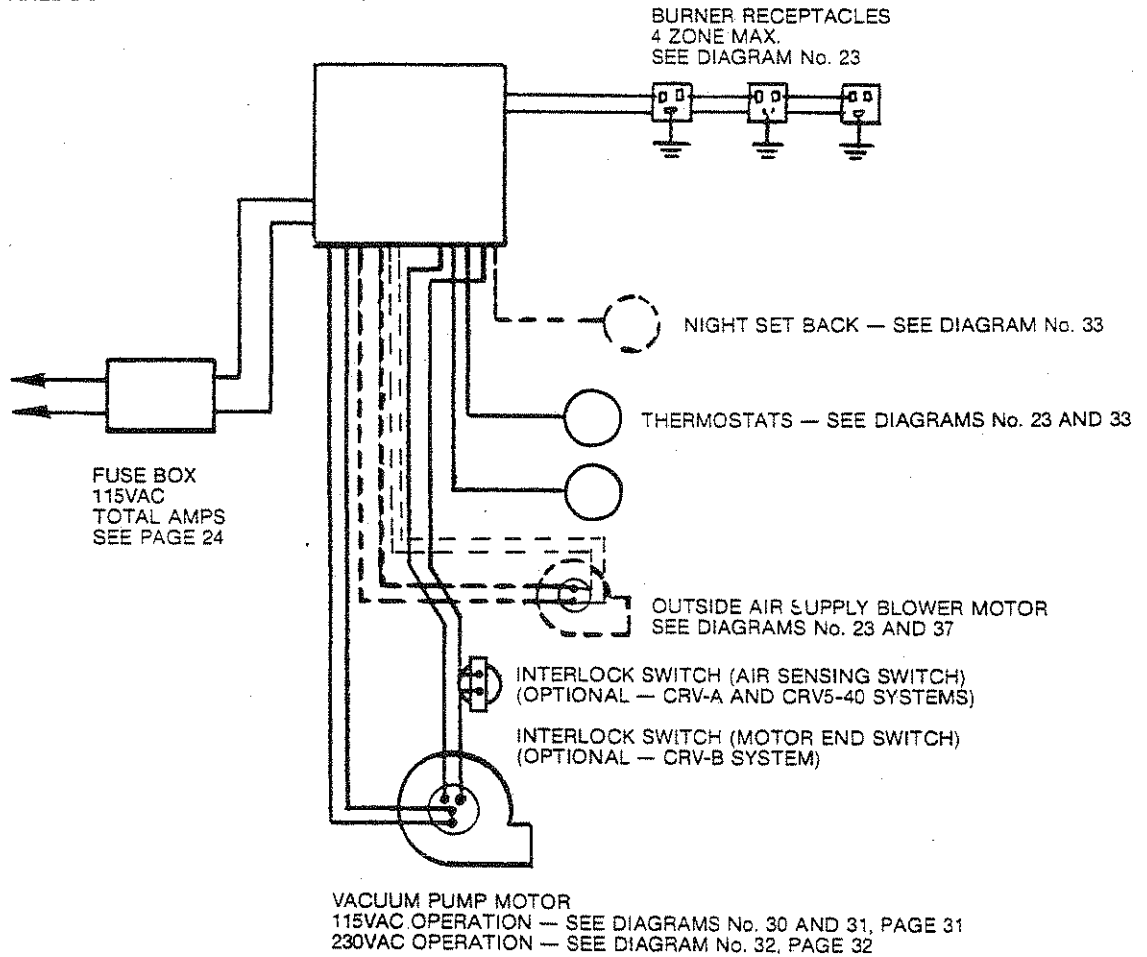
**BURNERS**

Burners are factory wired for 115 volts and supplied with a three-prong plug and two-foot cord. See burner cover plate and/or wiring Diagram No. 23, Page 26 for internal wiring.

**OUTSIDE AIR SUPPLY BLOWER**

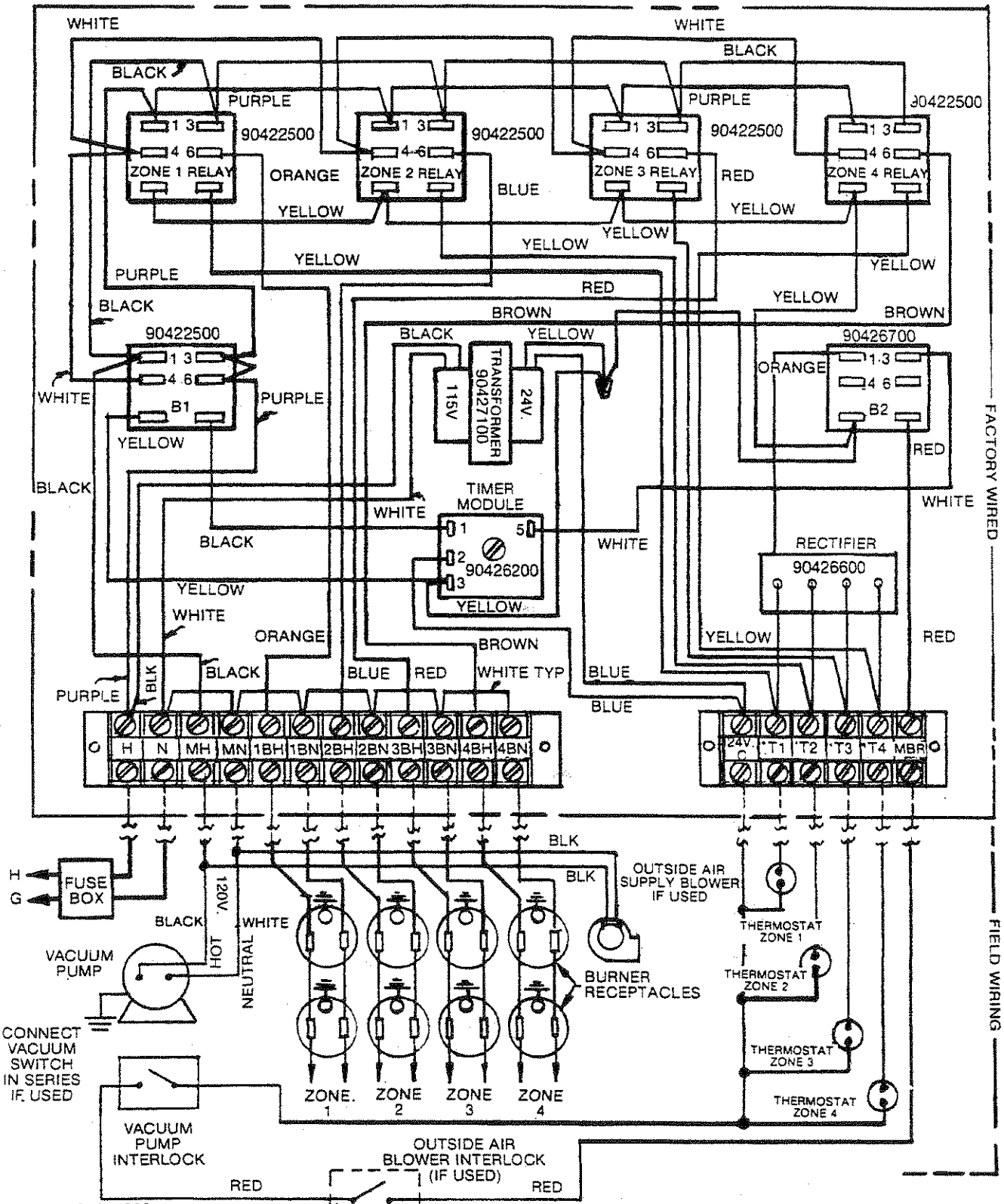
If used, it is to be wired in parallel with the vacuum pump; the blower motor incorporates an internal centrifugal interlock switch which must be wired in series with the vacuum switch. This insures proper inlet air pressure. See Diagram No. 23, Page 26, for wiring details.

PANEL BOX — SEE DIAGRAM No. 23, PAGE 26



**GENERAL WIRING DIAGRAM**  
**Diagram No. 22**

INSTALLATION



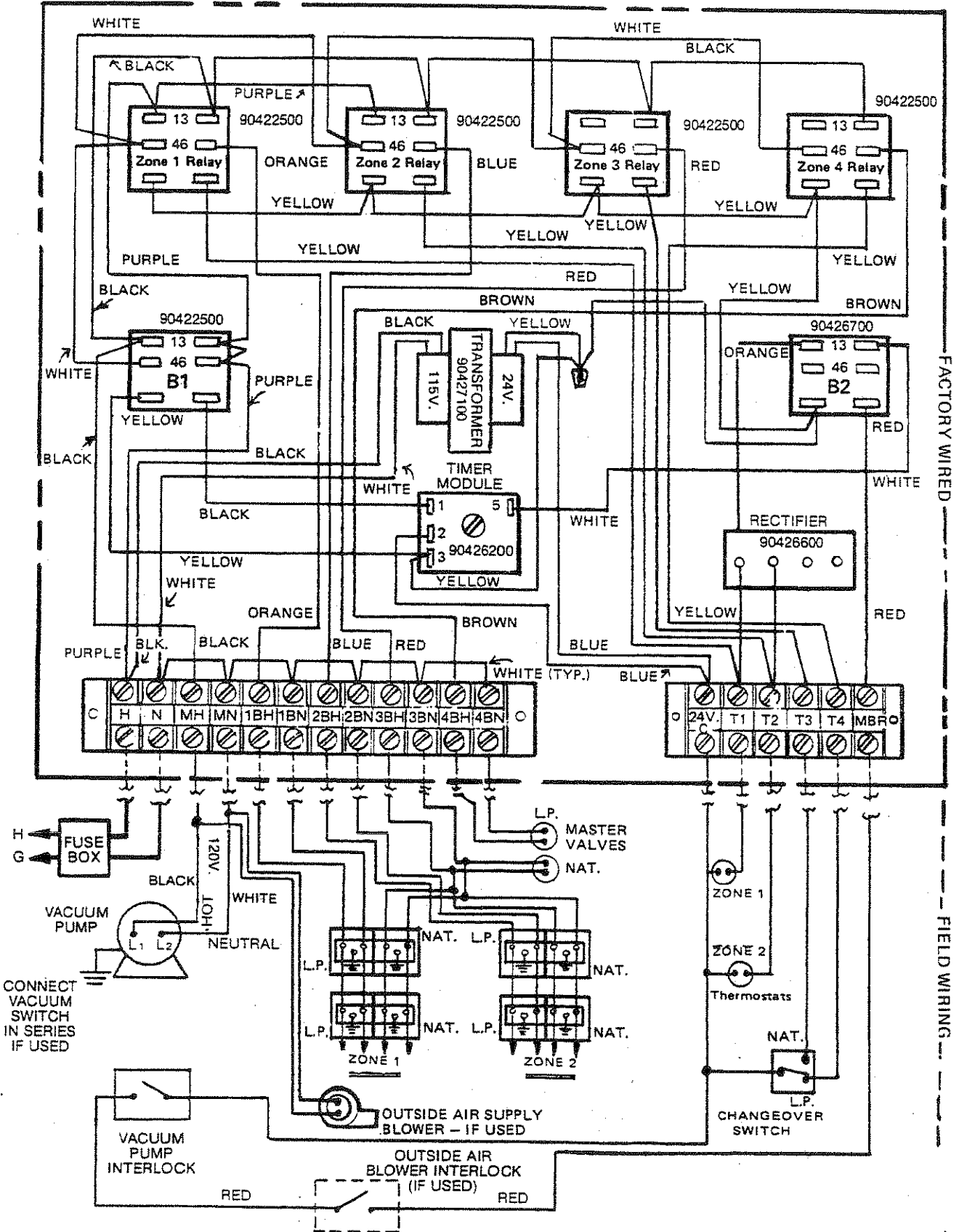
01311600  
 VACUUM PUMP MOTOR  
 BURNER INTERLOCK (NOT VISIBLE)

P/N 01312301 Without Lights (Shown)  
 P/N 01312302 With Lights

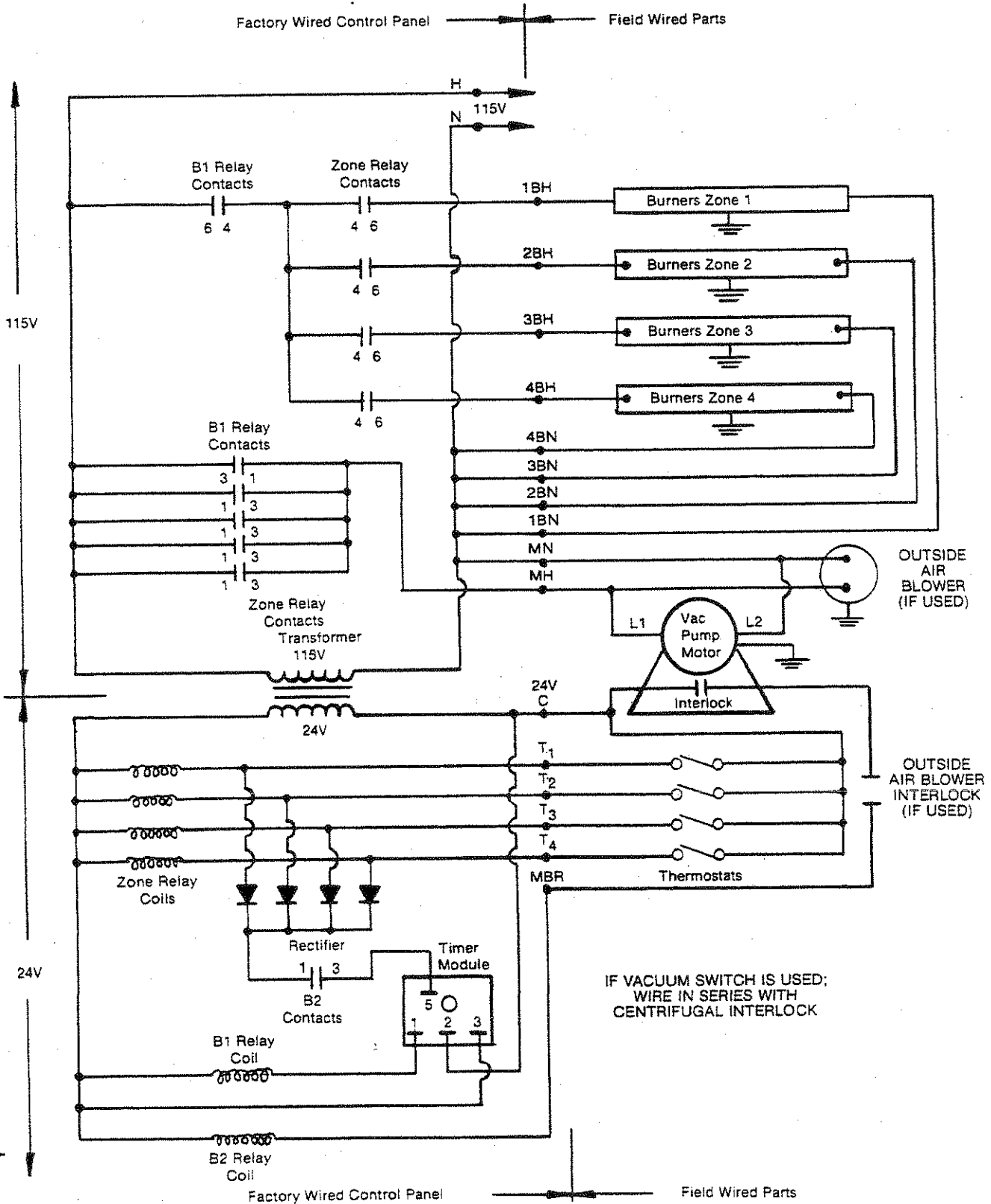
**CONTROL PANEL (SINGLE FUEL)**  
 Diagram No. 23



INSTALLATION

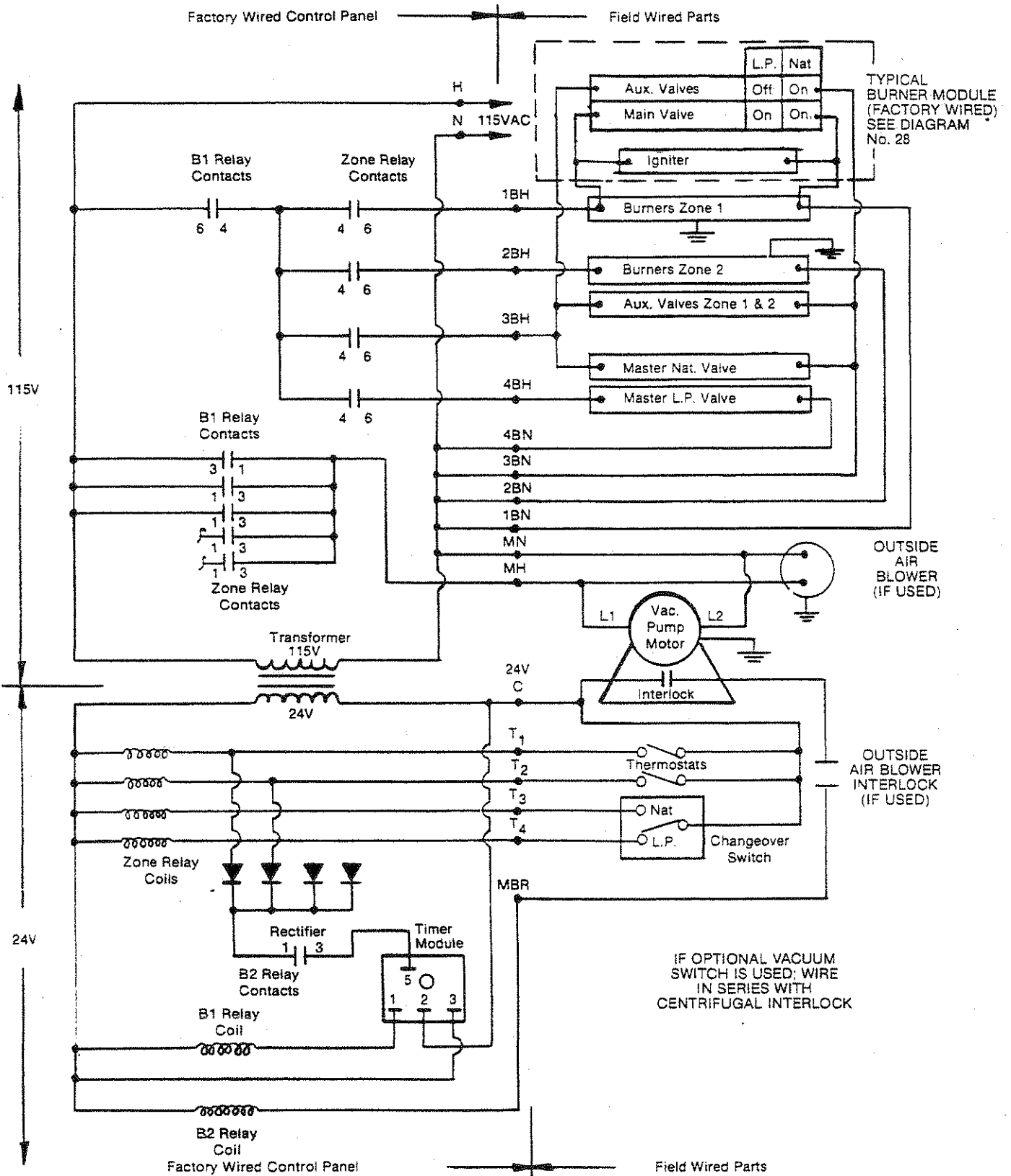


**CONTROL PANEL (DUAL FUEL)**  
**CRV-A AND CRV5-40 SERIES ONLY (P/N 01312303)**  
**Diagram No. 25**



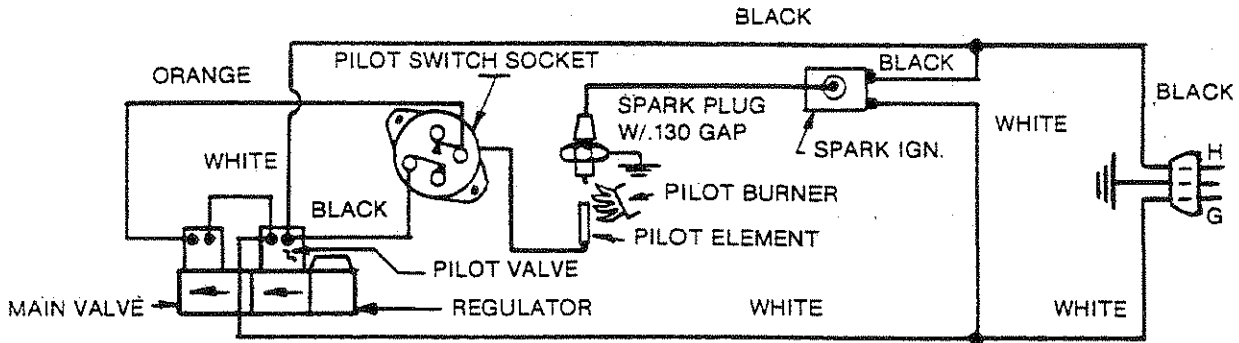
WIRING DIAGRAM (SINGLE FUEL)

Diagram No. 24

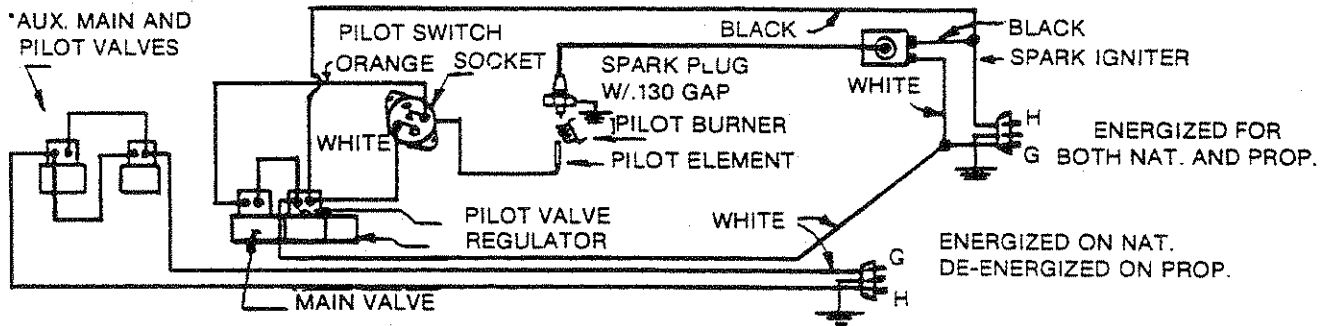


**WIRING DIAGRAM (DUAL FUEL)  
CRV-A AND CRV5-40 SERIES ONLY  
Diagram No. 26**

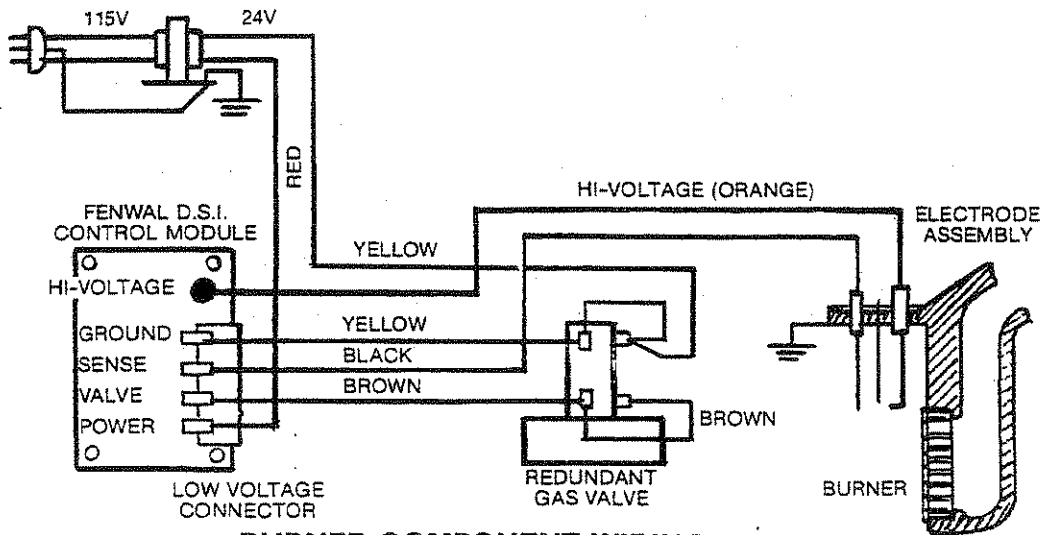
INSTALLATION



**BURNER COMPONENT WIRING (SINGLE FUEL)  
CRV-A AND CRV5-40 SERIES ONLY  
Diagram No. 27**

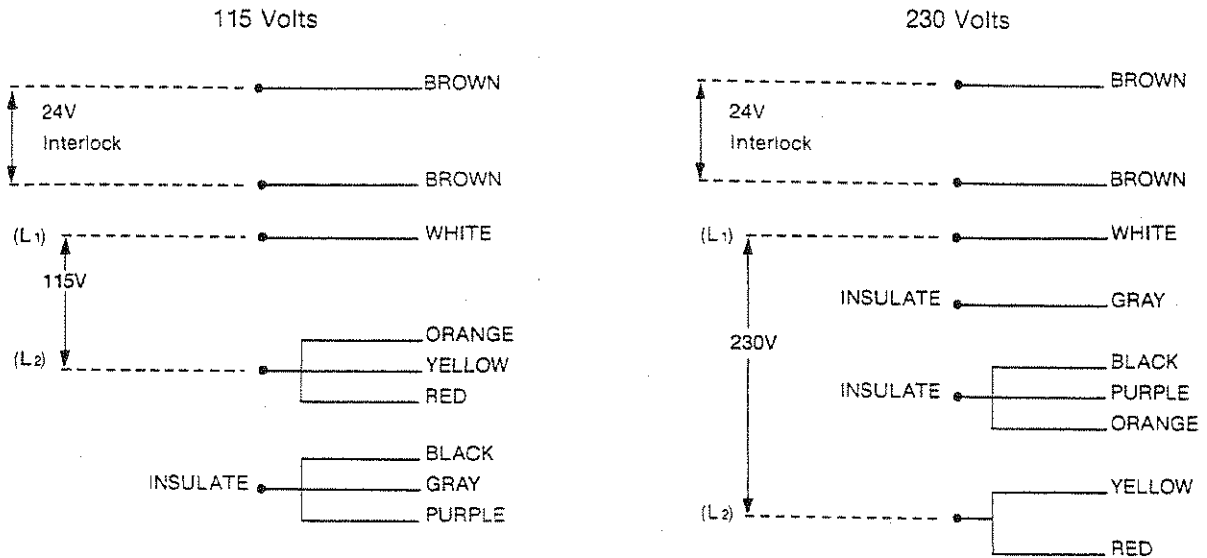


**BURNER COMPONENT WIRING (DUAL FUEL)  
CRV-A AND CRV5-40 SERIES ONLY  
Diagram No. 28**



**BURNER COMPONENT WIRING (FENWAL)  
CRV-B SERIES ONLY  
Diagram No. 29**

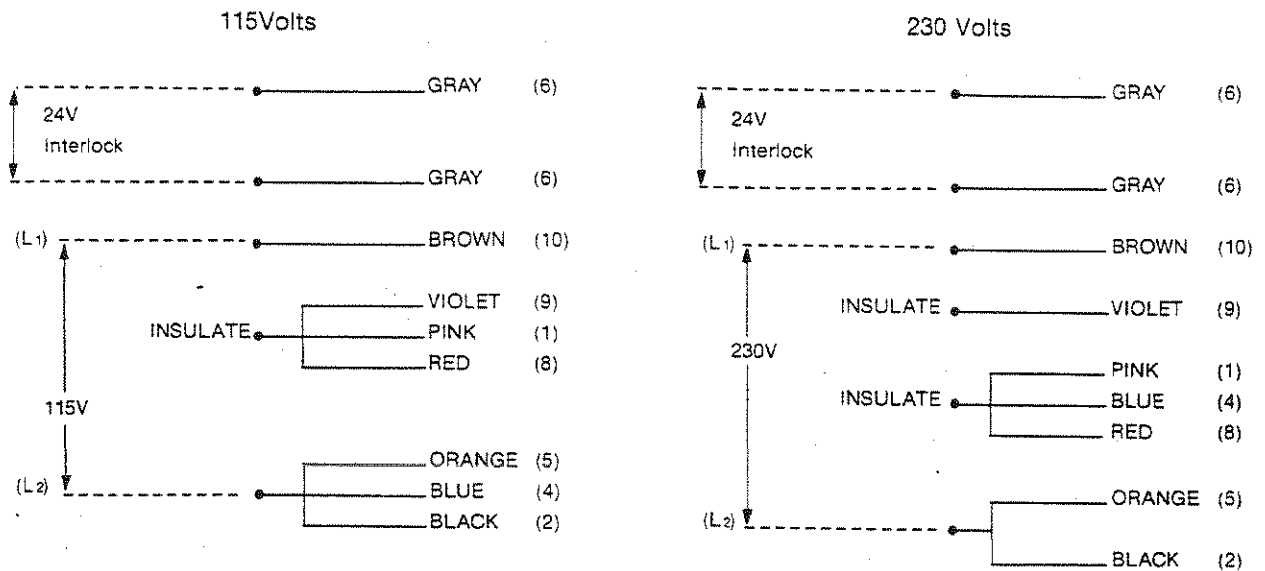
**VACUUM PUMP WIRING  
EMERSON ¼ HP T.E.N.V. MOTOR**



Wiring as shown is for counterclockwise rotation facing end opposite shaft. To reverse rotation, interchange red and black leads.

**Diagram No. 30**

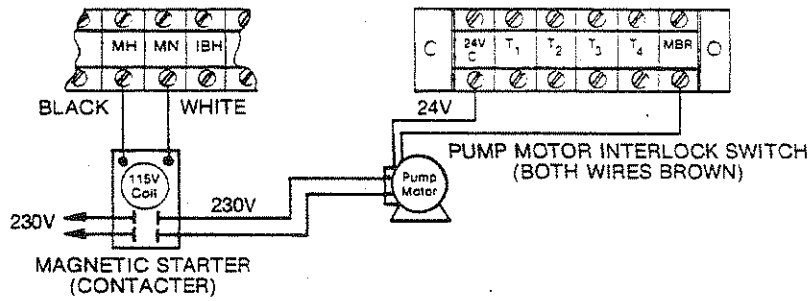
**FRANKLIN ¼ HP T.E.N.V. MOTOR**



Wiring as shown is for counterclockwise rotation facing end opposite shaft. To reverse rotation, interchange orange (5) and red (8) leads.

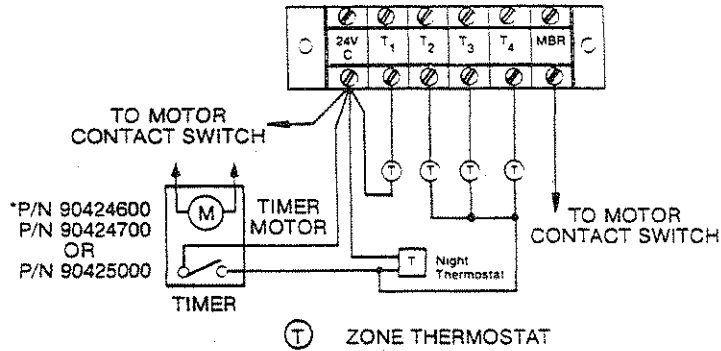
**Diagram No. 31**

**NOTE:** Refer to Wiring Diagrams 23 thru 26 for connecting the vacuum pump to the control panel.



**NOTE:** If outside air blower is used, (black wires) must be connected in parallel with 115 volt coil and blower interlock (red wires). If used, must be in series with pump motor interlock.

**WIRING — 230 VOLT MOTOR  
Diagram No. 32**



- \*P/N 90424600 — Seven day time clock.
- P/N 90424700 — 24-hour time clock.
- P/N 90425000 — Seven day time clock with ten-hour power failure reserve.

Three zones are shown on night set back. Zone one is not on set back.

**NOTE:** Use 1.2 for heat anticipator setting. Use no more than three zones on set back.

**WIRING — NIGHT TEMPERATURE SET BACK  
Diagram No. 33**

**GAS PIPING**

Meter and service must be large enough to handle all the burners being installed plus any other connected load. When gas piping is not included in the layout drawing, the local gas supplier will usually help in planning the gas piping. A one-half inch tapping at each burner location must be located and oriented as shown on Diagram No. 34 or 35. To check system pressure, a plugged one-eighth inch pipe tapping should be incorporated in the gas line at the connection to the burner most remote from the meter or supply. Joint compound resistant to the action of L.P. gas should be used on all pipe threads. **Do not use compound on the flare fittings** on either end of the flexible connector tubing.

**CAUTION****FIRE OR EXPLOSION HAZARD.**

Failure to follow these instructions could result in a dangerous gas leak and/or damage to the gas controls.

- 1) Do not use thread compound on flare fittings; doing so may result in a gas leak.
- 2) For high pressure testing on gas piping, **DISCONNECT COMPLETELY ALL BURNER UNITS AND SHUT-OFF COCKS SUPPLIED WITH SAME**; then install a pipe cap on system and conduct test.

Failure to follow this procedure will exceed pressure tolerances of both burner gas controls and the stop cock. This will result in component failure and may create a hazardous gas leak. In ALL cases it will require replacement of these parts.

**GAS CONNECTORS**

The purpose of the gas connector from the burner to the gas piping is twofold as follows:

1. To facilitate installation and replacement of the burner.
2. To accommodate movement between the burner and the gas piping. See Warning Below.

Two methods are available for making this gas connection, and the selection must be made by the designer to meet applicable local codes. Subject to this constraint of meeting local codes, these two methods are recommended as follows:

**STANDARD** — Semirigid steel tubing assembly standard on burners except B10 and B12 Natural. See Diagram No. 35.

**OPTIONAL** — Flexible metallic connector assembly mandatory on B10 and B12 Natural. Optional on all others. See Diagram No. 34.

The optional construction per Diagram No. 34 is sometimes not acceptable for use with L.P., and may not be acceptable for natural gas in some localities.

**INSTALLATION OF BURNERS**

1. Verify that all high pressure testing of gas piping has been completed.
2. It is important that the combustion chamber hook be utilized in order to prevent rotation or tipping of the burner and combustion chamber assembly. This tipping may occur initially or after several months of service.
3. Install burner per Diagram No. 2, Page 11.
4. Install gas connector per Diagram No. 34 or 35 as appropriate. Check for gas leaks at each end of connector before firing the system.
5. Plug the burner electric cord into the receptacle. See Diag. No. 23, Pg. 26. On end burners, verify that burner and end plate match. See Diag. No. 43 and 45, Pgs. 38 and 39.

**IMPORTANT**

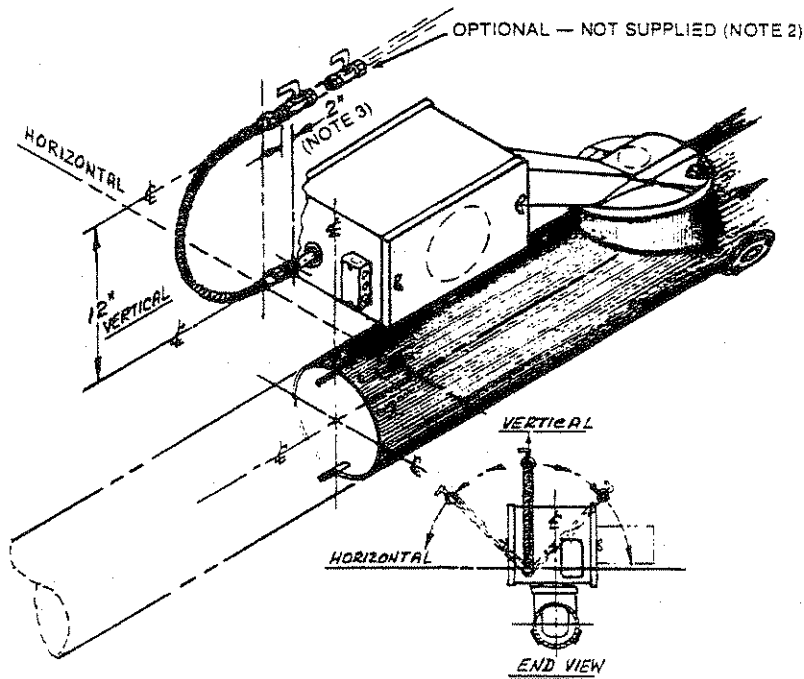
CO-RAY-VAC burners are made in six (6) firing rates as designated on the nameplate on each burner. In some systems the burner sizes are intermixed. It is extremely important that, in such systems, the proper size burners be installed where shown on the layout drawing. Failure to do so may result in damage to the system.

**WARNING****FIRE OR EXPLOSION HAZARD.**

There is expansion of the radiant pipe with each firing cycle, and this will cause the burner to move with respect to the gas line.

This can cause a gas leak resulting in an unsafe condition if the gas connection is not made strictly in accordance with Diagram No. 34 or Diagram No. 35 as applicable.

INSTALLATION

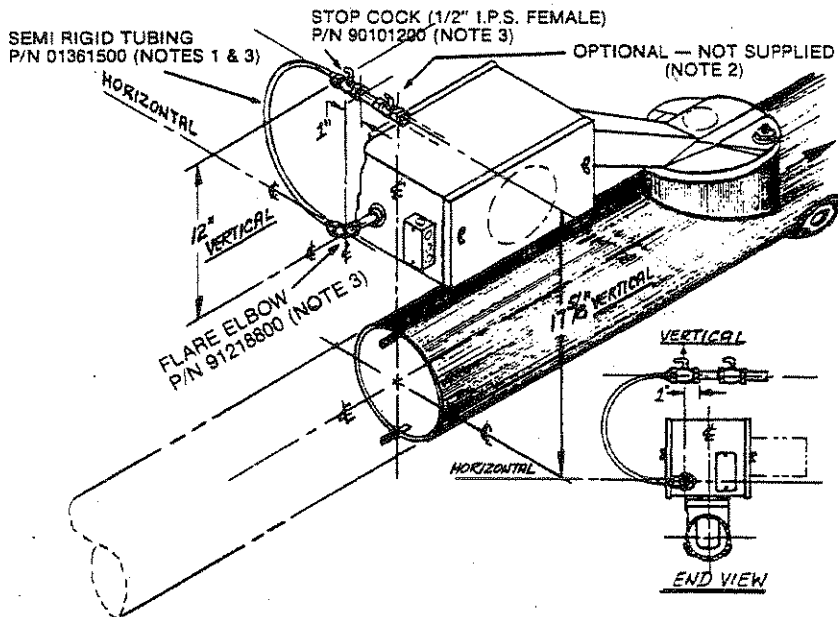


P/N 91412201

NOTES:

1. STOP COCK MUST BE PARALLEL TO ONE-HALF INCH BURNER INLET PIPE.
2. HIGH PRESSURE STOP COCK AS SUPPLIED BY THE INSTALLER IF REQUIRED.
3. THE TWO-INCH DISPLACEMENT AS SHOWN IS FOR THE COLD CONDITION. THIS DISPLACEMENT WILL BE REDUCED AS THE SYSTEM IS FIRED.

**GAS LINE CONNECTION TO BURNER  
WITH FLEXIBLE METALLIC CONNECTOR ASSEMBLY**  
Diagram No. 34



P/N 02712800

NOTES:

1. THE SEMIRIGID TUBING MUST BE INSTALLED WITH THE 12-INCH "U" BEND IN A VERTICAL PLANE PERPENDICULAR TO THE RADIANT PIPE. THE CONFIGURATION OF THE "U" BEND MUST BE MAINTAINED AS SUPPLIED. WHEN THE SYSTEM IS COLD, THE VERTICAL PLANE MUST BE VERTICAL WITHIN ONE INCH IN 12 INCHES AS MEASURED WITH A CARPENTER'S LEVEL OR PLUMB LINE.
2. HIGH PRESSURE STOP COCK AS SUPPLIED BY THE INSTALLER IF REQUIRED.
3. THESE PARTS ARE INCLUDED IN ASSEMBLY P/N 90410600.

**GAS LINE CONNECTION TO BURNER  
WITH SEMIRIGID CONNECTOR ASSEMBLY**  
Diagram No. 35

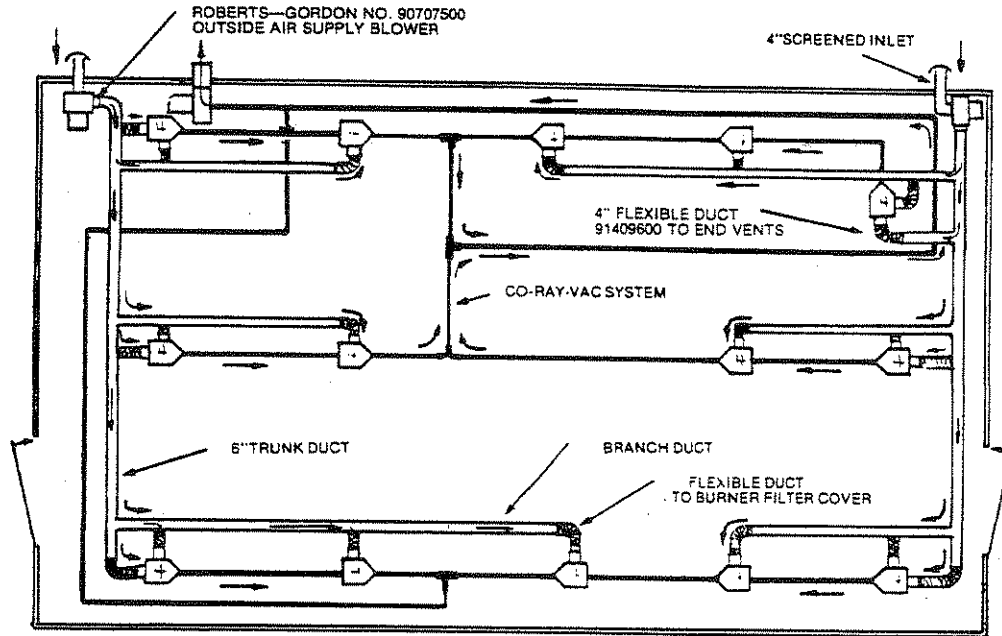


**OUTSIDE AIR SUPPLY (PRESSURIZED)**

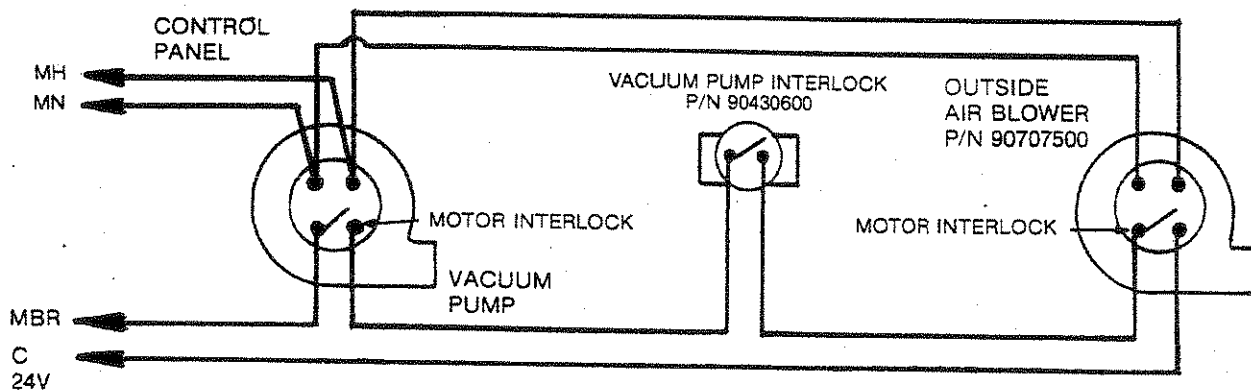
The air supply system should be installed as indicated on the heating plans. The diagram below shows a typical layout with some pertinent information. If there are any questions, consult the sales representative.

Outside air supply blower should be wired in parallel with the vacuum pump, and in accordance with the National Electrical Code and local ordinances. Centrifugal end switch must be wired in series with the interlock switch. See Diagram No. 23, Page 26.

All joints and seams in the air supply system must be made airtight, preferably by use of duct tape. The filters and filter housings should be attached to the burner covers using the wire from supports and wing nuts provided. Covers should then be attached to the burners on the side that will put the filter housing nearest to the flexible duct which will be connected. Secure the duct to the filter housing by means of a band clamp to facilitate filter changing.



**TYPICAL LAYOUT  
PRESSURIZED AIR SUPPLY SYSTEM  
Diagram No. 36**



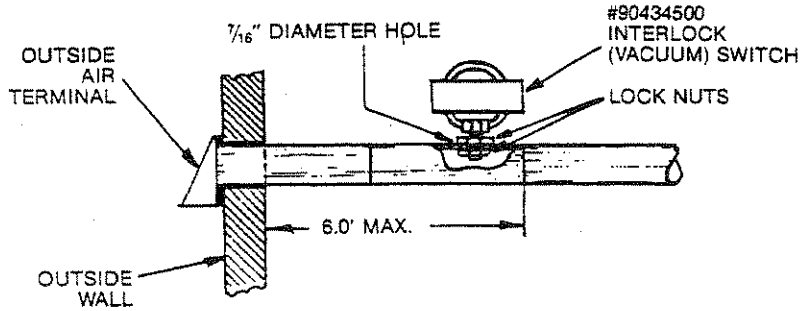
**VACUUM PUMP WITH OUTSIDE AIR BLOWER  
Diagram No. 37**

INSTALLATION

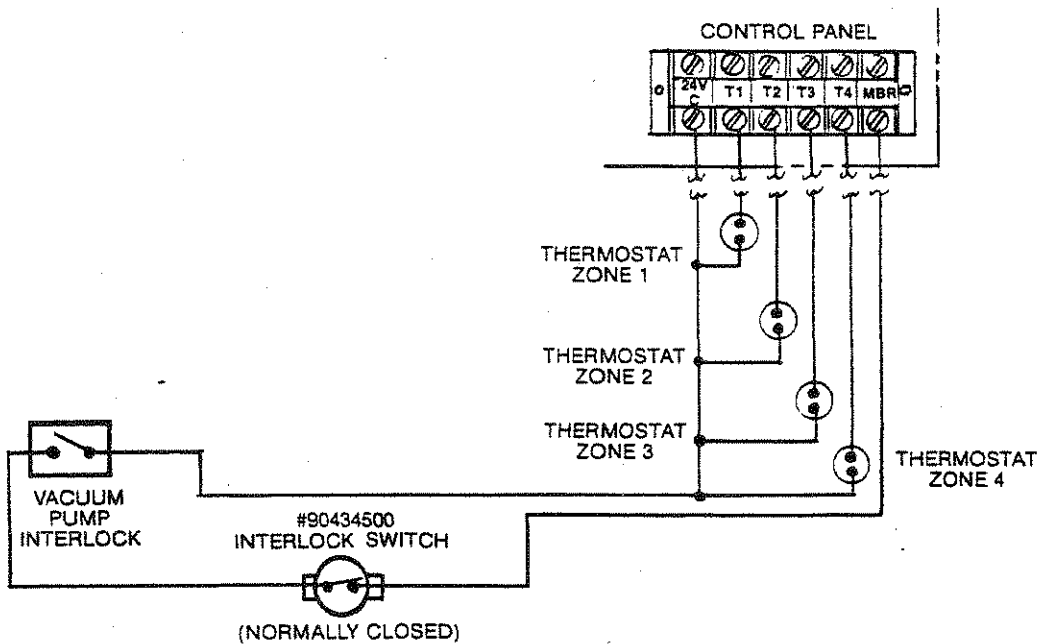
**OUTSIDE AIR SUPPLY (NON-PRESSURIZED)**

If a non-pressurized outside combustion air supply is desired, it is required that a flow proving interlock (vacuum) switch be installed at the air supply inlet and wired as per Diagram No. 39.

Drill a 7/16-inch diameter hole in the top of the supply pipe within six feet of the inlet opening. Secure switch (P/N 90434500) with two 7/16-27 lock nuts (P/N 91104001). Drill and tap for one-eighth inch NPT if PVC pipe is used. See Diagram No. 38 below.



**Diagram No. 38**

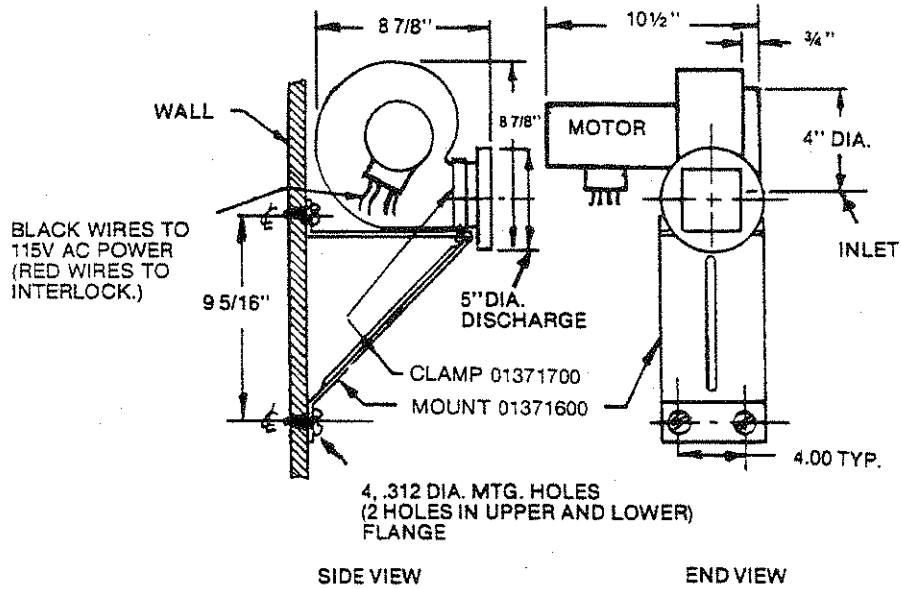


**WIRING  
Diagram No. 39**

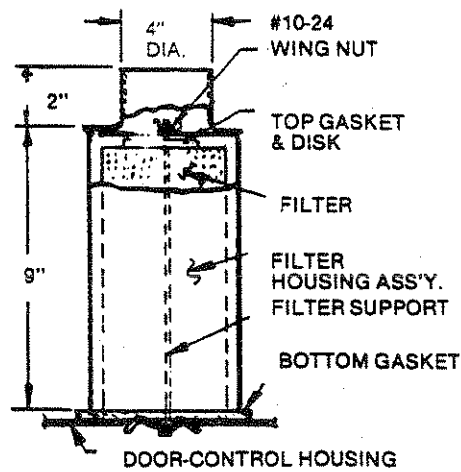
To aid in the installation of the outside air supply system Roberts-Gordon, Inc. can furnish:

- The outside air supply blower P/N 90707500
- The four-inch flexible ducts P/N 91409600
- The filter housings P/N 01326801
- The take-off four-inch, outside air P/N 01324401
- The mounting assembly P/N 01316000

All other materials must be supplied by the installer.

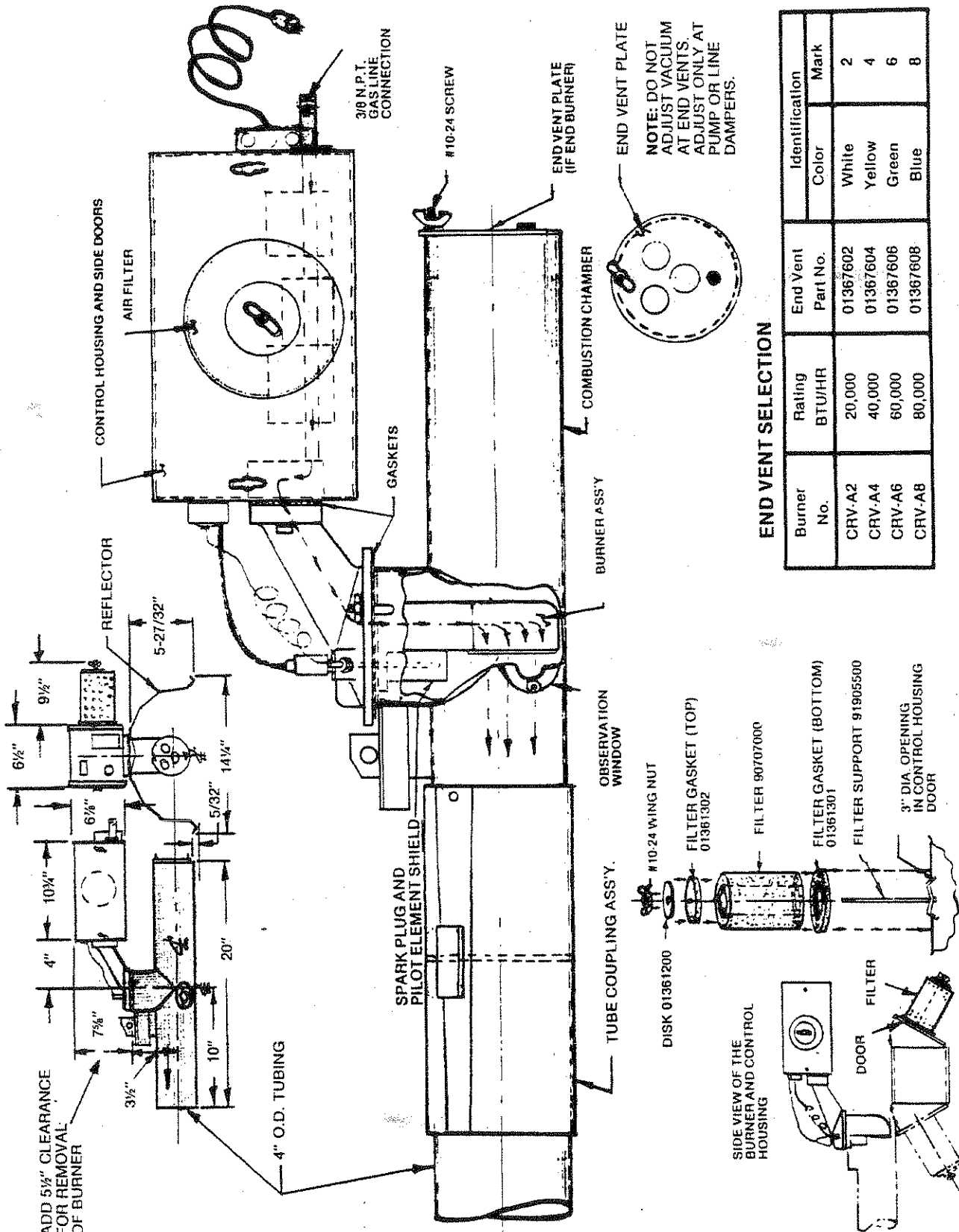


**AIR SUPPLY BLOWER DIMENSIONS**  
Diagram No. 40



**FILTER HOUSING**  
Diagram No. 41

INSTALLATION



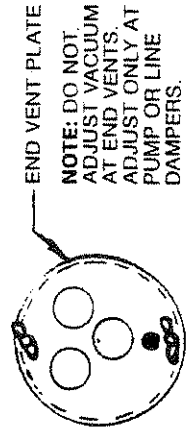
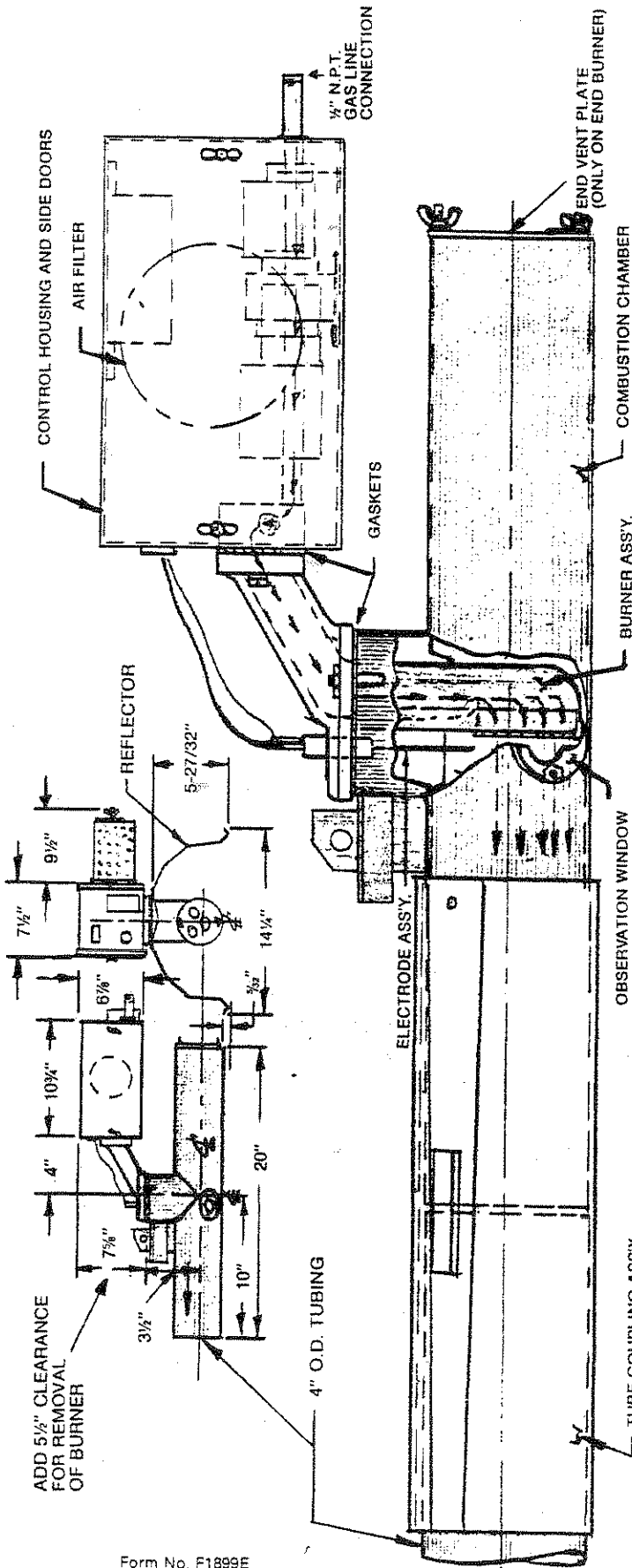
END VENT SELECTION

Burner No.	Rating BTU/HR	End Vent Part No.	Identification	
			Color	Mark
CRV-A2	20,000	01367602	White	2
CRV-A4	40,000	01367604	Yellow	4
CRV-A6	60,000	01367606	Green	6
CRV-A8	80,000	01367608	Blue	8

CRV-A END VENT SELECTION  
Diagram No. 43

AIR FILTER ASSEMBLY  
Diagram No. 42

END VIEW OF THE BURNER CONTROL HOUSING

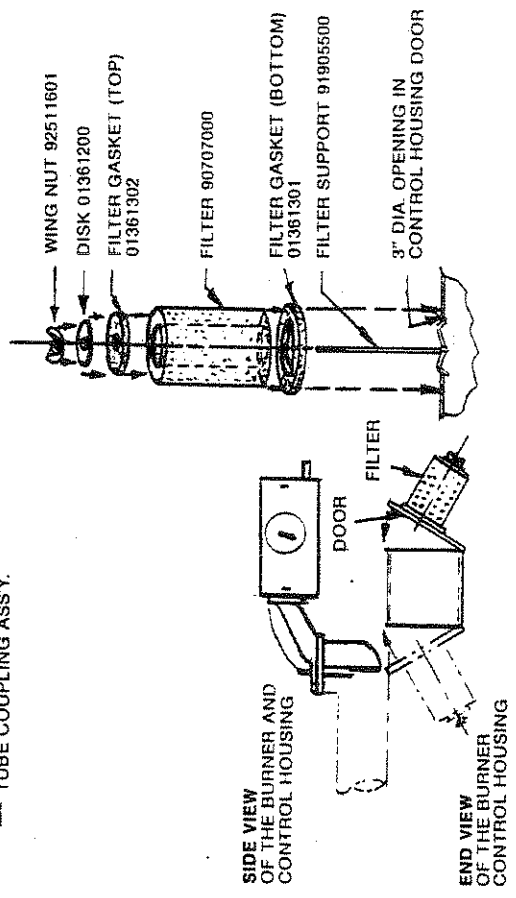


**END VENT SELECTION**

BURNER NO.	RATING BTU/HR	END VENT PART NO.	IDENTIFICATION MARK
CRV-B2	20,000	01367604	4
CRV-B4	40,000	01367604	4
CRV-B6	60,000	01367606	6
CRV-B8	80,000	01367608	8-12
CRV-B10	100,000	01367608	8-12
CRV-B12	120,000	01367608	8-12

REFER TO PAGE 51 FOR HOLE DIAMETER

**CRV-B END VENT SELECTION**  
Diagram No. 45



**AIR FILTER ASSEMBLY**  
Diagram No. 44

## INSTALLATION

### SPECIAL CONSIDERATIONS FOR CAST IRON COMBUSTION CHAMBER FOR CRV-B SERIES

Most of information and requirements given in Part I apply to the cast iron combustion chamber options. The only exceptions are the specific references to hardware or other requirements which are unique to the cast iron combustion chamber. These exceptions are detailed in this section.

As can be seen from Diagrams No. 46 and 47, the hardware that differs in design includes:

Cast iron combustion chamber option with 16 Ga. standard H.R. tube.

1. Combustion chambers are cast iron.
2. Chamber is tapped four inch N.P.T.
3. Two pipe to tube adaptors (P/N 02722100) are required per each chamber.
4. All other parts are identical. This includes reflectors, hangers, supports, etc.

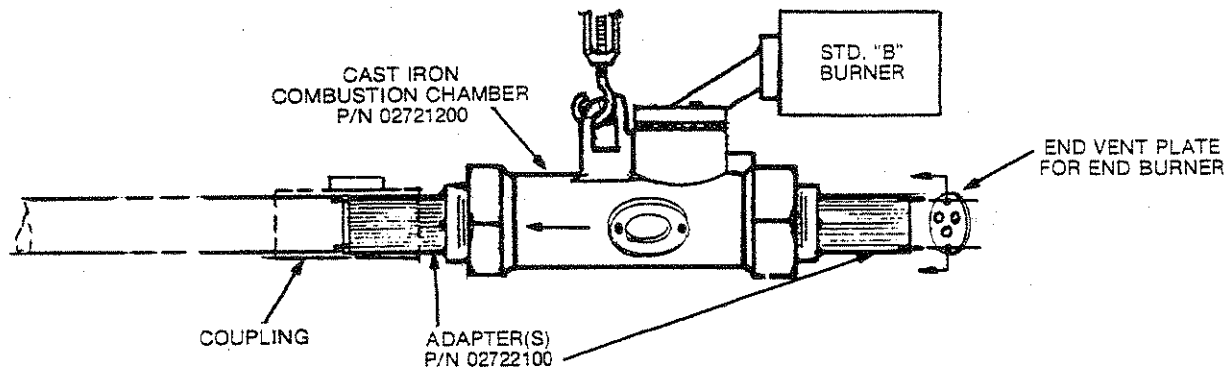


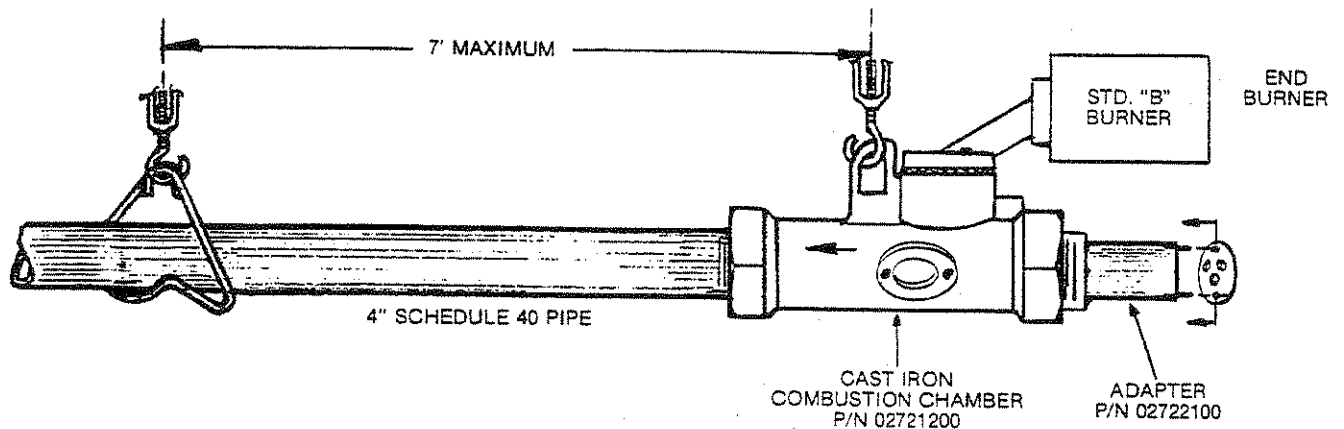
Diagram No. 46

Cast iron combustion chamber option utilizing four-inch schedule 40 black pipe.

1. Combustion chambers are cast iron.
2. Chamber is tapped four-inch N.P.T.
3. One pipe to tube adapter (P/N 02722100) is required for every end burner to attach the end vent plate.
4. Reflector supports P/N 02716400 sized for schedule 40 pipe.

**HANGING THE PIPE**

It is recommended that the threads be wiped with a high temperature release agent, such as "Never Seez" manufactured by Never-Seez Compound Corp., 1538 N. Mannheim Rd., Stone Park, IL. It is also advisable that all pipe be taken up just beyond hand-tight. It is not necessary to tighten the pipe to the same extent as in connecting pipe conveying gas, steam or water. It might be desirable at a later date to disconnect the pipe, either to add to the system or inspect it internally, and for this reason it is recommended that the pipe should not be tightened any further than suggested.

**Diagram No. 47**

Four-inch O.D. 16 Ga. Tubing = 2.8 pounds per foot.

Four-inch schedule 40 pipe = 10.9 pounds per foot.

Total weight of each burner and combustion chamber is 40.25 pounds.

**CAUTION**

Use appropriate suspension hardware, beam clamps (rod or perforated strap) and turnbuckle at predetermined locations.

The weight and normal movement of the heating system may cause support failure if the below minimum requirements are not met. Failure of the supports can cause property damage, severe injury or death.

- 1) Distance between supports seven feet or less.
- 2) Chain size 2/0 minimum or equivalent.
- 3) Suspend all combustion chambers at cast loop.

**COLOR CODING TO DESIGNATE FIRING RATE**

Each burner control assembly is marked with the input firing rate on the nameplate. Also, each cover with the nameplate has affixed a colored disk (1 1/4") in the upper right hand corner; the color designates firing rate as follows:

SUFFIX	RATE BTU/HR	COLOR KEY
-A2, -B2	20,000	White
-A4, -B4	40,000	Yellow
-A6, -B6	60,000	Green
-A8, -B8	80,000	Blue
-B10	100,000	White
-B12	120,000	Brown

For parts that differ according to burner rate the color key as shown above will designate firing rate as follows:

PART	RATE DESIGNATION
Air Shutter	Imprint Number
End Vent Plate	Imprint Number
Burner Carton	1 1/4 inch diameter color disk and suffix -B( )

The color coding of orifices for natural gas follow the same color key as shown above. The color key for orifices for L.P. gas is as follows:

CRV-A		CRV-B	
RATE BTU/HR	COLOR KEY	RATE BTU/HR	COLOR KEY
20,000	Brown	40,000	Red
40,000	Red	60,000	Yellow
60,000	Black	80,000	Pink
80,000	Orange	100,000	Green
		120,000	Black

**CHECKING OUT AND STARTING THE SYSTEM**

Start with main gas valve closed and electric power off.

**CHECKING THE GAS LINE**

1. Open main valve and verify that no gas is flowing through the gas meter.
2. Purge the line if this was not done following pressure testing with air.
3. Verify that the gas pressure is not above 14 inches water column (one-half P.S.I.G.).
4. Close main gas valve.

**CHECKING THE ELECTRICAL SYSTEM**

1. See that all thermostats are set below room temperature, or disconnect the wire(s) to terminals T<sub>1</sub> - T<sub>4</sub> to deactivate all thermostats.
2. Turn on power to the panel.
3. Check to see that no other part of the system, i.e., burners, vacuum pump or air supply blowers are powered.
4. Individually check each zone, either by reconnecting thermostats or by jumping thermostat terminals in the panel. Each zone thermostat should start the vacuum pump. Then after the prepurge cycle of 30 to 90 seconds, the burners will be energized; this can be checked by measuring 115 volts at the burner terminals. Also, it is possible to see through the viewer window and hear the spark ignition. The "B" Series burner valves are silent and slow opening. It takes approximately nine seconds for the valve to reach the full open position. "A" Series pilot valves open immediately with a distinctive "clicking" sound. After heating the pilot sensor (60 to 120 seconds), the main valve will open with the same "clicking" sound.
5. If more than one panel is used, be sure that no part of one system is affected by the controls of a different system.



6. Make a preliminary vacuum check at end burners in lines which have adjustable damper, (P/N 01331900). See Diagram No. 48, Page 43. This check is to assure that all system dampers are open before the system is fired. Vacuum, as measured at the end vent, should be three inches w.c. or more.

### STARTING THE SYSTEM

**NOTE:** During the initial firing, the protective oil on the tubing may smoke for 30 to 60 minutes and adequate ventilation should be provided.

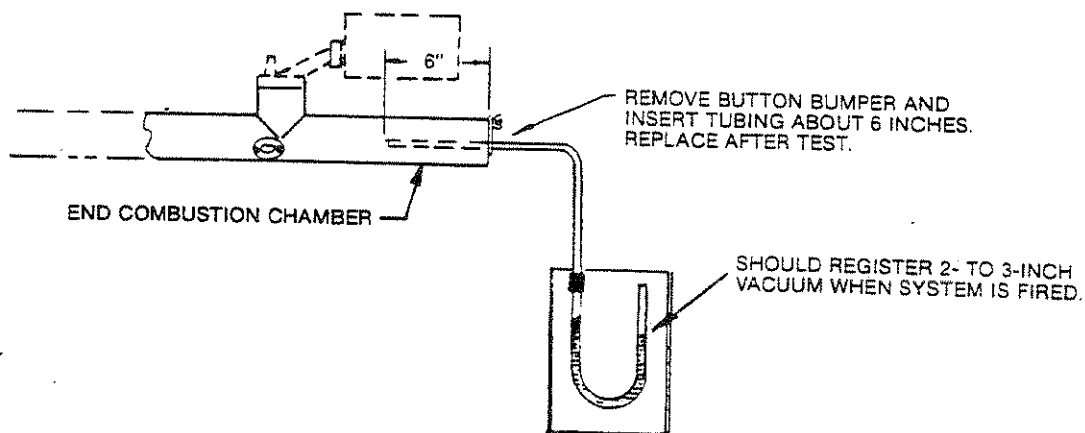
The CO-RAY-VAC control system provides a pre-purge, which delays energizing the burners for about one minute after the vacuum pump starts, and post-purge, which keeps the vacuum pump running for about one minute after the last thermostat is satisfied.

Before starting the system fill the condensate traps with water.

1. Start with all thermostats below room temperature.
2. Open main gas valve.
3. Turn up thermostats one at a time, waiting to see that all burners in a zone start. When the burner ignites, a large blue flame will be observed through the viewer window.
4. If any abnormal operation occurs, see the Service Manual which follows these instructions.

### SETTING THE VACUUM

1. Set thermostats above room temperature. See that all burners are operating properly.
2. Allow at least one-half hour operation for temperature to normalize then check system vacuum. See Diagram No. 48. Remove the rubber plug from the end vent plate and insert the probe of the vacuum gauge or manometer about six inches. Normal operating vacuum is two to three inches water column at all end vents. Vacuum adjustments are made by means of the damper in the pump inlet and the adjustable restrictors in the system. Check the vacuum at all end vents, then adjust the restrictors to obtain approximately equal vacuum readings at slightly above three inches w.c., then adjust the pump damper until vacuum is about two to three inches w.c. With systems designed to capacity it may not be possible to obtain vacuum readings above three inches w.c. If so, adjust restrictors to maximum but approximate equal vacuum readings. Be sure to lock all dampers securely after adjustment.
3. Reset thermostats to desired room temperature.
4. If heat is not required, turn off main switch and close main gas valve.



**VACUUM READING**  
Diagram No. 48

## CRV-A SERIES CO-RAY-VAC EQUIPMENT SPECIFICATIONS

### PHYSICAL

#### BURNERS

Model	CRV-A2	CRV-A4	CRV-A6	CRV-A8
Capacity (BTU/HR)	20,000	40,000	60,000	80,000
Color Identification	White	Yellow	Green	Blue
Sizes (all models)	See details on Diagram No. 42, Page 38.			
Weight (all models)	20 lbs.			
Gases (all models)	Natural, L.P., Dual Fuel (Nat./L.P.)			
Inlet pressure (Natural)	14" w.c. max.	4.5" w.c. min.		
Inlet pressure (L.P.)	14" w.c. max.	10.5" w.c. min.		

#### VACUUM PUMP

Size	See details on Diagram No. 8, Page 16.
Capacity	200 CFM std. air @ 6.0" w.c. (120 CRV flow units)
Weight	85 lbs.
Inlet and Outlet	4.5" diam.
Rotation	Reversible, furnished counterclockwise facing motor side of pump
Speed	3450 RPM

#### AIR SUPPLY BLOWER

Capacity	210 CFM @ 0.75" w.c.
Weight	7 lbs.
Inlet	4" diam.
Outlet	5" diam.
Size	See Diagram No. 40, Page 37.

### ELECTRICAL

#### BURNERS

115V/60 Hz.	0.30 amps
Dual Units	0.60 amps

#### VACUUM PUMP (See Motor Nameplate)

3/4 H.P.	115/230V	60 Hz.	1 PH	3450 RPM
Totally enclosed fan cooled				
6.3 amps F.L., 58 amps L.R., 115VAC				
3.2 amps F.L., 29 amps L.R., 230VAC				
Ball bearing, thermally protected				

#### PANEL

115V	60 Hz
Low voltage terminals for four zone thermostats and interlock.	
All other terminals line voltage.	
Contact capacity, each of four zone relays, 12 amps @ 115VAC.	

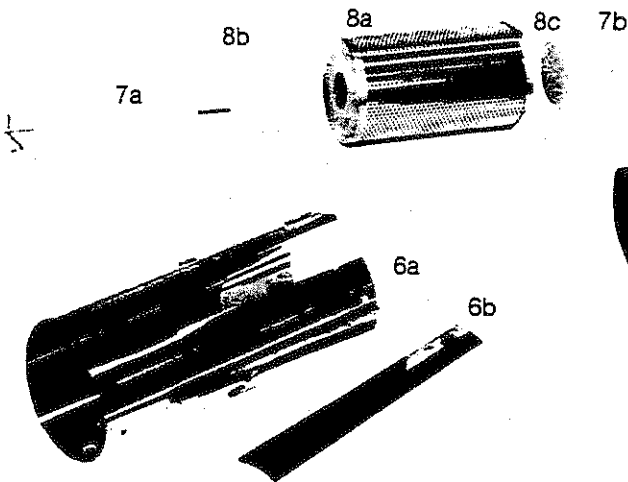
#### AIR SUPPLY BLOWER

115V	60 Hz.	2.3 amps max.
Ball bearing, thermally protected.		

DESCRIPTION OF EQUIPMENT SUPPLIED

CRV-A SERIES CO-RAY-VAC BASIC UNIT CONSISTS OF:

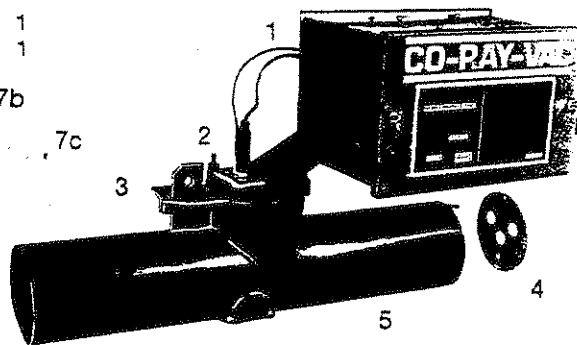
ITEM No.	PART No.	DESCRIPTION	QTY.
1.		Burner and Controls Assembly	1
2.	92123900	Burner Mounting Nut	2
3.	01367900	Burner Gasket	1
4.	01367600	End Vent Plate	1
5.	02722300	Combustion Chamber Assembly	1
6.	01312700	4" O.D. Coupling Assembly Unlined	1
		a. Coupling Unlined (P/N 01367400)	1
		b. Slide Bar (P/N 01329700)	1
7.	01315000	a. Filter Support (P/N 91905500)	1
		b. Filter Support Disk (P/N 01361200)	1
		c. Wing Nut (P/N 92511601)	1
8.	01312400	a. Filter Cartridge (P/N 90707700)	1
		b. Gasket Filter Bottom (P/N 01361301)	1
		c. Gasket Filter Top (P/N 01361302)	1



GAS CONNECTORS (Not Pictured)

(Order either P/N 91412201 or P/N 01316500 per applicable codes.)

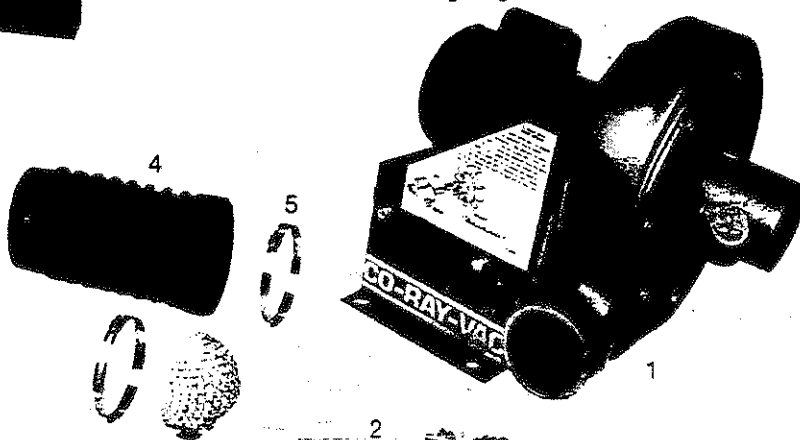
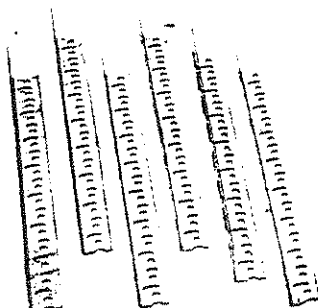
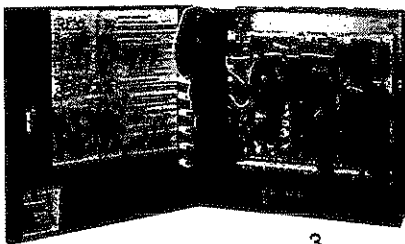
- a. Flex Assembly P/N 91412201 (See Diagram No. 34, Page 34). Flex Connector with Adapter, 3/8" Female Elbow P/N 91410700 Shut-off Cock (Furnished with Natural Gas Burners if none other specified).
- b. Semirigid Assembly P/N 02712800 (See Diagram No. 35, Page 34). Semirigid Tubing (Bundy) P/N 01361500 Flared Elbow 3/8" Female P/N 91213800 Shut-off Cock (Furnished with L.P. or Dual Fuel Burners if none other specified).



CONTROL PANEL	"A"	"B"
SINGLE FUEL	02716300	01312301
DUAL FUEL	02716301	01312303
SINGLE FUEL/LIGHTS	02716302	01312302

ROBERTS-GORDON VACUUM PUMP PACKAGE No. "A" CONSISTS OF:

ITEM No.	PART No.	DESCRIPTION	QTY.
1.		Pump Assembly w/Vacuum Adjuster	1
2.	01311700	Accessory Bag for Pump Assembly	1
3.	"B"	Pre-wired Control Panel	1
4.	91411901	Boot	2
5.	91901300	Clamps for Boots (4) and Bird Screen (1)	5
6.	01365400	Bird Screen	1
7.	01365000	Mounting Angles	6



DESCRIPTION OF EQUIPMENT SUPPLIED

**CRV-B SERIES  
CO-RAY-VAC EQUIPMENT SPECIFICATIONS**

**PHYSICAL**

**BURNERS**

Model	CRV-B2	CRV-B4	CRV-B6	CRV-B8	CRV-B10	CRV-B12
Capacity (BTU/HR)	20,000	40,000	60,000	80,000	100,000	120,000
Color Identification	White	Yellow	Green	Blue	White	Brown
Sizes (all models)	See details on Diagram No. 44, Page 39.					
Weight (all models)	20 lbs.					
Gases (all models)	Natural, L.P.					
Inlet pressure (Natural)	14" w.c. max.	4.5" w.c. min.				
Inlet pressure (L.P.)	14" w.c. max.	10.5" w.c. min.				

**VACUUM PUMP**

Type	Totally enclosed
Size	See details on Diagram No. 8, Page 16.
Capacity	200 CFM std. air @ 6.0" w.c. (120 CRV flow units)
Weight	85 lbs.
Inlet and Outlet	4.5" diam.
Rotation	Reversible, furnished counterclockwise facing motor side of pump
Speed	3450 RPM

**AIR SUPPLY BLOWER**

Capacity	210 CFM @ 0.75" w.c.
Weight	7 lbs.
Inlet	4" diam.
Outlet	5" diam.
Size	See Diagram No. 40, Page 37.

**ELECTRICAL**

<b>BURNERS</b>	115V/60 Hz. 0.30 amps
<b>VACUUM PUMP</b> (See Motor Nameplate)	3/4 H.P. 115/230V 60 Hz. 1 PH 3450 RPM Totally enclosed fan cooled 6.3 amps F.L., 58 amps L.R., 115VAC 3.2 amps F.L., 29 amps L.R., 230VAC Ball bearing, thermally protected
<b>PANEL</b>	115V 60 Hz Low voltage terminals for four zone thermostats and interlock. Contact capacity, each of four zone relays, 12 amps @ 115VAC.
<b>AIR SUPPLY BLOWER</b>	115V 60 Hz. 2.3 amps max. Ball bearing, thermally protected.

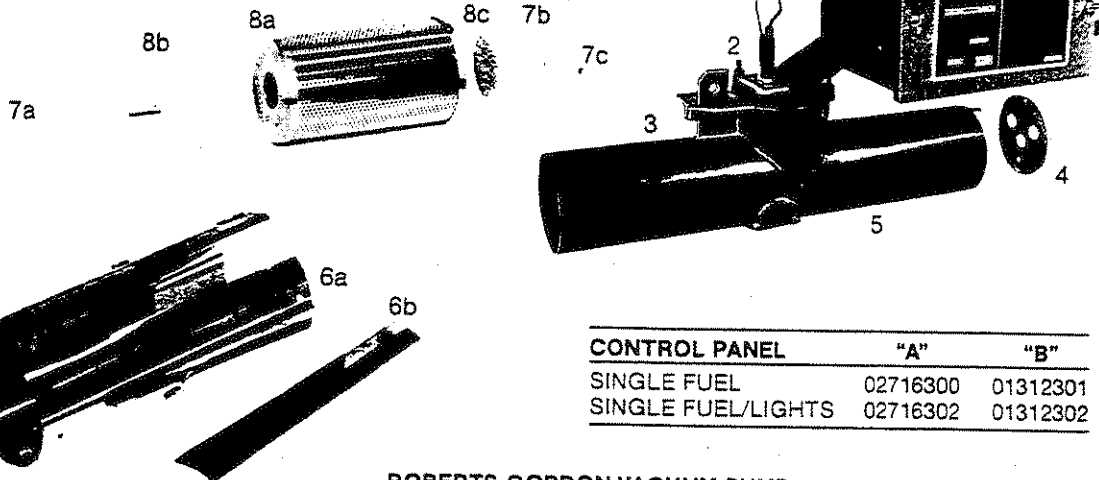
**CRV-B SERIES CO-RAY-VAC BASIC UNIT CONSISTS OF:**

ITEM No.	PART No.	DESCRIPTION	QTY.
1.		Burner and Controls Assembly	1
2.	92123900	Burner Mounting Nut	2
3.	01367900	Burner Gasket	1
4.	01367600	End Vent Plate	1
5.	02722300	Combustion Chamber Assembly	1
6.	01312700	4" O.D. Coupling Assembly Unlined	1
		a. Coupling Unlined (P/N 01367400)	1
		b. Slide Bar (P/N 01329700)	1
7.	01315000	a. Filter Support (P/N 91905500)	1
		b. Filter Support Disk (P/N 01361200)	1
		c. Wing Nut (P/N 92511601)	1
8.	01312400	a. Filter Cartridge (P/N 90707700)	1
		b. Gasket Filter Bottom (P/N 01361301)	1
		c. Gasket Filter Top (P/N 01361302)	1

**GAS CONNECTORS (Not Pictured)**

(Order either P/N 91412200 or P/N 02712800 per applicable codes.)

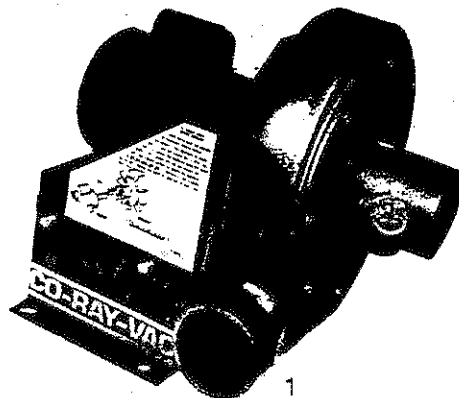
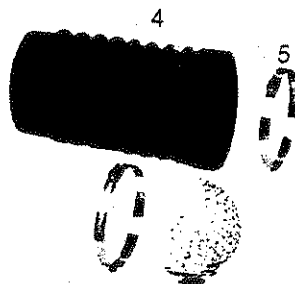
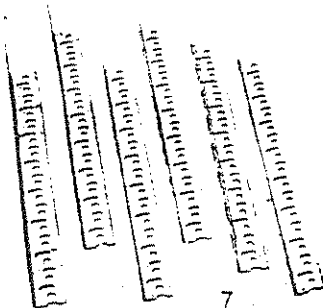
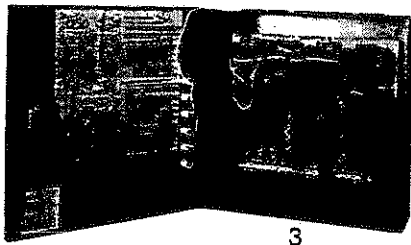
- a. Flex Assembly P/N 91412201  
(See Diagram No. 34, Page 34).  
Flex Connector with Adapter, 1/2" Female  
Elbow P/N 91410500  
Shut-off Cock
- b. Semirigid Assembly P/N 02712800  
(See Diagram No. 35, Page 34).  
Semirigid Tubing (Bundy) P/N 01361500  
Flared Elbow 3/8" Female P/N 91213800  
Shut-off Cock



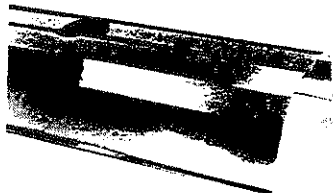
CONTROL PANEL	"A"	"B"
SINGLE FUEL	02716300	01312301
SINGLE FUEL/LIGHTS	02716302	01312302

**ROBERTS-GORDON VACUUM PUMP PACKAGE No. "A" CONSISTS OF:**

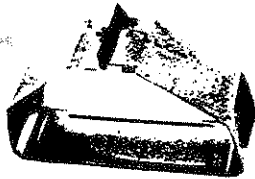
ITEM No.	PART No.	DESCRIPTION	QTY.
1.		Pump Assembly w/Vacuum Adjuster	1
2.	01311700	Accessory Bag for Pump Assembly	1
3.	"B"	Pre-wired Control Panel	1
4.	91411901	Boot	2
5.	91901300	Clamps for Boots (4) and Bird Screen (1)	5
6.	01365400	Bird Screen	1
7.	01365000	Mounting Angles	6



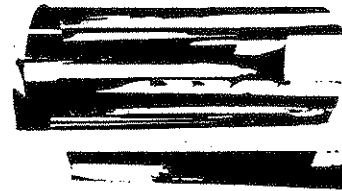
CO-RAY-VAC ACCESSORIES



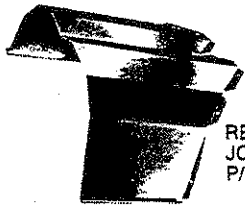
REFLECTOR (STD. 8 FT.)  
P/N 02750300  
REFLECTOR (STD. WITH  
CUTOUT) — P/N 02750301



GRILLE AND REFLECTOR  
SUPPORT (1 FT.)  
P/N 01326200



TUBE COUPLING  
PLAIN — P/N 01312700  
LINED — P/N 01312701  
w/DAMPER — P/N 01331900



REFLECTOR  
JOINT PIECE  
P/N 02750900



AIR SUPPLY BLOWER  
P/N 90707500



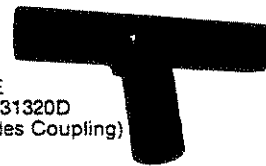
4" CROSS  
P/N 0131330D  
(Includes Coupling)



REFLECTOR  
SIDE  
EXTENSION  
8" x 48" — P/N 01370408  
12" x 48" — P/N 01370412  
16" x 48" — P/N 01370416



AIR SUPPLY BLOWER  
MOUNTING BRACKET  
P/N 01371600



4" TEE  
P/N 0131320D  
(Includes Coupling)



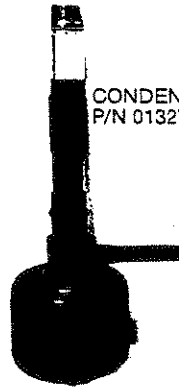
REFLECTOR FOR  
1 FT. DECORATIVE GRILLE  
P/N 01363000



4" x 45° ELBOW  
P/N 0131310D  
(Includes Coupling)



REFLECTOR ADAPTER  
FOR 1 FT.  
DECORATIVE GRILLE  
P/N 01369900



CONDENSATE TRAP  
P/N 01327000

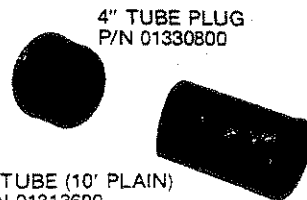


4" x 90° ELBOW  
P/N 0133010D  
(P/N 0133580D after 9/1/90)

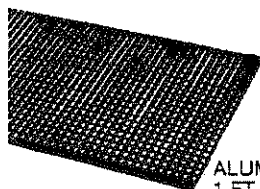


REFLECTOR  
SIDE  
EXTENSION  
P/N 02712700

REFLECTOR  
END CAP (STD.)  
P/N 02750800  
REFLECTOR END CAP (1 FT.)  
P/N 01363600



4" TUBE PLUG  
P/N 01330800



ALUMINUM GRILLE  
1 FT. x 8 FT. — P/N 91406700  
2 FT. x 4 FT. — P/N 91407000

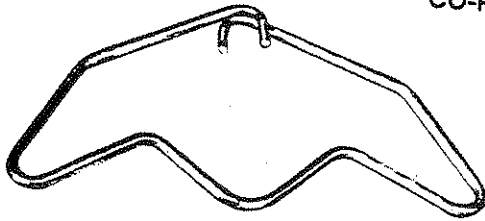
END VENT PLATE



B4 P/N 01367604  
B6 P/N 01367606  
B8 P/N 01367608  
B10 P/N 01367608  
B12 P/N 01367608  
SC P/N 01367612

4" TUBE (10' PLAIN)  
P/N 01313600  
4" TUBE (10' COATED INSIDE ONLY)  
P/N 0131360C  
4" TUBE (10' COATED INSIDE & OUTSIDE)  
P/N 0131360D

CO-RAY-VAC ACCESSORIES



TUBE AND REFLECTOR HANGER  
P/N 02790300

LOCK NUT

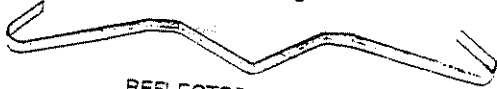


TURNBUCKLE — P/N 91903201

STRAP  
P/N 02750500



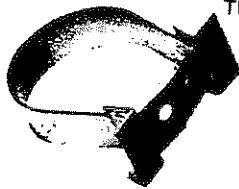
CLAMP WIRE  
P/N 91908004



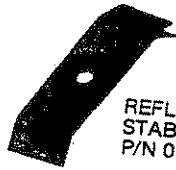
REFLECTOR SUPPORT  
P/N 02712600



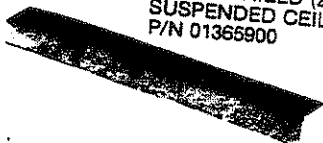
REFLECTOR SIDE EXTENSION SUPPORT  
P/N 01329910



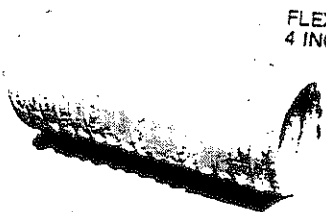
TUBE AND REFLECTOR SUPPORT  
(1 FT. WIDE)  
P/N 01329800



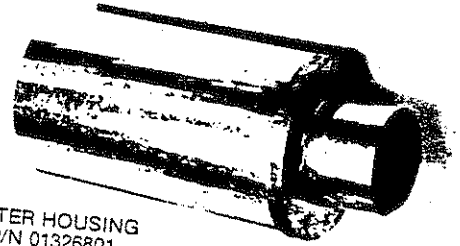
REFLECTOR STABILIZER  
P/N 01364100



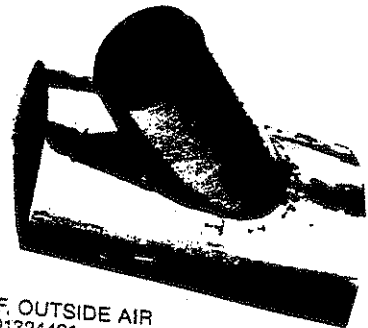
FRAME SHIELD (2 FT. WIDE)  
SUSPENDED CEILING  
P/N 01365900



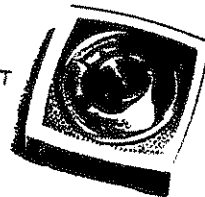
FLEXIBLE DUCT  
4 INCH — P/N 91409600



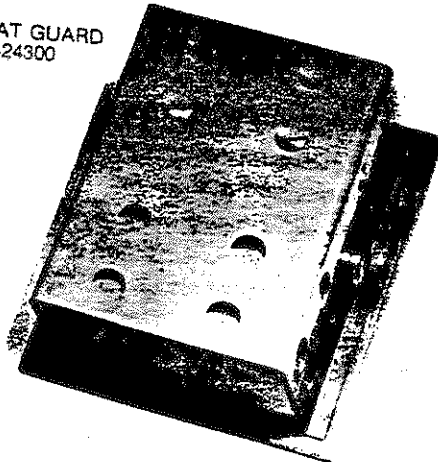
FILTER HOUSING  
P/N 01326801



4" TAKE-OFF, OUTSIDE AIR  
P/N 01324401



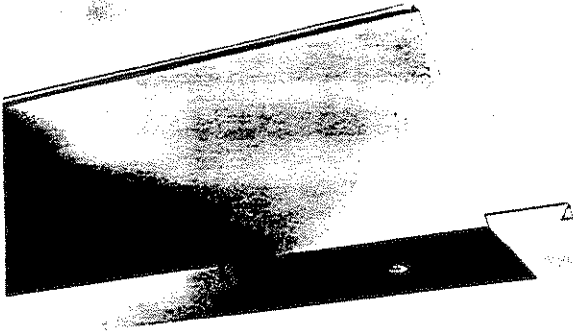
"CO-RAY-VAC"  
24V THERMOSTAT  
P/N 90423000



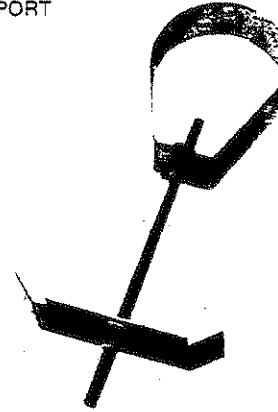
THERMOSTAT GUARD  
P/N 90424300

DESCRIPTION OF EQUIPMENT SUPPLIED

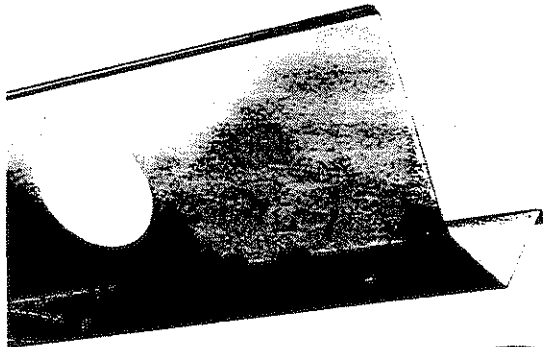
UNIVERSAL SHIELD  
P/N 02751801



UNIVERSAL SHIELD SUPPORT  
P/N 02712100

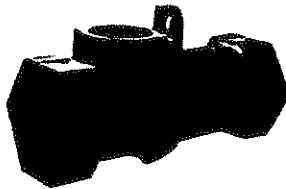


UNIVERSAL SHIELD — PERFORATED  
P/N 02751800



VACUUM PROVING SWITCH  
P/N 90430600

CAST IRON COMBUSTION  
CHAMBER — P/N 02721200



ADAPTER ASSEMBLY  
P/N 02722100



(USE ON "B" SERIES ONLY)  
CAST IRON COMBUSTION CHAMBER  
WITH ADAPTER — P/N 02713900

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**SHIPPING CARTONS**

Each CO-RAY-VAC shipment consists of:

Marked cartons, each containing a burner, filter components, combustion chamber, end vent plate, and a coupling for four inch tube. See Page 45 or 47.

Marked carton(s) containing a vacuum pump, mounting platform components, flexible inlet boot with two clamps, bird screen with band clamp, air sensing switch and a control panel. See Page 45 or 47.

Accessories — See Pages 48, 49 and 50.

Four inch diameter x 10 feet long plain steel tubing for use immediately downstream of combustion chambers. Porcelain coated tubing for use in balance of the system.

Cartons of reflectors — Several types are available, all eight feet long. Quantity variable.

When ordered, cartons of decorative "egg-crate" grille. Quantity variable.

Miscellaneous cartons — Fittings, hardware, hangers, couplings, etc.



## PART II

### SPECIAL CONSIDERATIONS FOR MODEL CRV5-40

Most of information and requirements given in Part I for CRV-A Series burners apply for CRV5-40 burners. The only exceptions are the specific references to hardware or other requirements which are unique to CRV-A Series. These exceptions are detailed in this section.

As can be seen from Diagram No. 52, Page 55, most of the components for the Model CRV5-40 system are identical to the CRV-A Series. The hardware that differs in design includes:

1. Combustion chambers are cast iron.
2. Radiant pipe sections are schedule 40 black iron pipe. (The sizes are 2½" between burners except three inches between third and fourth burner.)
3. Tailpipe can be either four-inch pipe or four-inch porcelain coated steel tubing.
4. End vent assembly is P/N 01325700.
5. Nameplate on the burner module.
6. Miscellaneous hardware per Diagram No. 52, Page 55.

Also as shown, the identical hardware components include:

1. All parts of the burner module are interchangeable but only the 40,000 rate burner is available.
2. Control Panels.
3. Tailpipe (with four-inch tubing option).

#### CAUTION

CRV5-40 burners are tested and certified only for use in the 2½-inch 5-40 cast iron combustion chamber. Use of other burners in this chamber may cause it to overheat and burn out.

#### HANGING THE PIPE

It is recommended that the threads be wiped with a high temperature release agent, such as "Never Seez" manufactured by Never-Seez Compound Corp., 1538 N. Mannheim Rd., Stone Park, IL. It is also advisable that all pipe be taken up just beyond hand-tight. It is not necessary to tighten the pipe to the same extent as in connecting pipe conveying gas, steam or water. It might be desirable at a later date to disconnect the pipe, either to add to the system or inspect it internally, and for this reason it is recommended that this pipe should not be tightened any further than suggested.

CO-RAY-VAC equipment includes hangers for pipe and reflectors (P/N 01396600), turnbuckle assemblies (P/N 91903200). The hanger (P/N 01396600) may also be used to support manifold pipe and tailpipe. System piping may be supported from beam clamps or other suitable supports, see Diagram No. 2, Page 11. Your pipe supplier can recommend methods and equipment to meet your needs.

Weight to be supported may be figured by using the following Table:

WEIGHT OF PIPE PER LINEAR FOOT		
PIPE SIZE	APPROX. WEIGHT PER LINEAR FOOT	
2½"	5.8 lbs.	Total weight of each burner and combustion chamber is 40 lbs.
3"	7.6 lbs.	
4"	10.9 lbs.	
4" O.D. x .065" Tubing	2.8 lbs.	

#### IMPORTANT

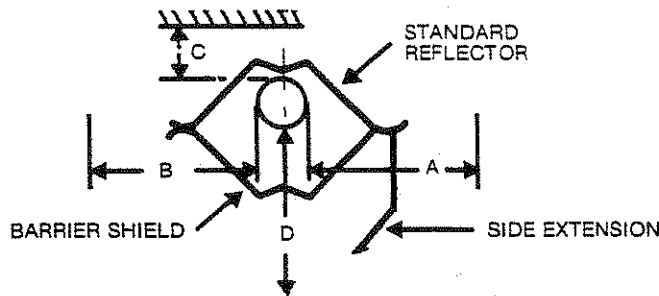
End burners must always be supported at the cast loop in the combustion chamber. See Diagram No. 52, Page 55.

It is recommended that coated four-inch O.D. x 16 ga. steel tubing with approved fittings and clamps as furnished by Roberts-Gordon, Inc. be used for tailpipe. As a substitute, black steel pipe A.S.A. Schedule 40 (ASTM A 120) may be used.

**End Burner**

Each end burner must be equipped with an end vent assembly (P/N 01325700) which should be ordered from Roberts-Gordon, Inc. as an accessory. Install as shown in Diagram No. 52, Page 55. Screw the end vent assembly into rear of the combustion chamber as far as it will go — with wing nut at top position.

DESCRIPTION	CRV5-40 40,000
Radiant pipe between burners	
Maximum	25'
Recommended	21'
Minimum	15'
Run from combustion chamber	
Downstream to elbow (min.)	5'
Upstream to elbow (min.)	2'
Maximum No. of burners Per radiant branch	4



REFLECTOR TYPE	DESIGN OPTION	"A" SIDE WITH SIDE EXTENSION	"B" SIDE WITHOUT SIDE EXTENSION	C TOP	D BELOW
Standard	—	—	16	4	36
Standard	1 side ext.	12	16	4	36
Standard	2 side ext.	12	—	4	40
1-foot wide	—	—	12	4	36
2-foot wide	—	—	12	4	36
Standard	barrier shield*	4	4	4	4

\*Standard section of reflector inverted and attached at the edges of standard reflector.

**CLEARANCES TO COMBUSTIBLES**  
**Diagram No. 49**

Where reflectors are over tube elbows, tees or crosses, reflectors should fit each other in a neat workmanlike manner. Reflector joint pieces preformed (P/N 01369000) to connect reflectors, together with reflector end caps (P/N 01368900) are illustrated in Diagram No. 50 below. Follow instructions for assembly.

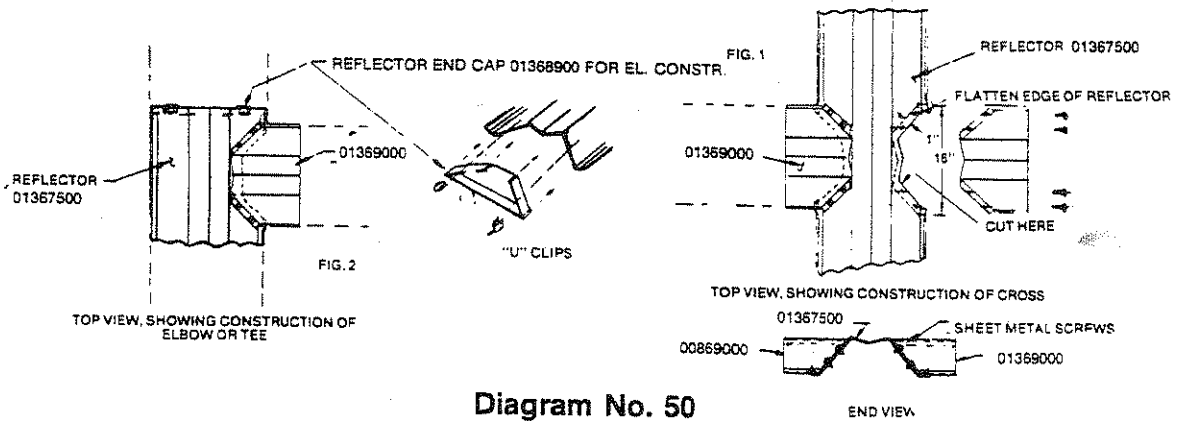


Diagram No. 50

**PERIMETER SIDE EXTENSIONS (optional)**

1. Attach a reflector side extension support bracket (P/N 01329900) to radiant tube as needed. These brackets should be located adjacent to the overlapped joints of the reflector side extension.
2. Insert lower edge of reflector side extension in extension support bracket.
3. Cut suitable relief notch for each reflector support bracket (P/N 01312800 and P/N 01395200).
4. Hook top edge of perimeter reflector (P/N 01368000) over edge of reflector (P/N 01367500). See Detail "A".
5. A slip joint must be provided in the perimeter side extension at the location of each slip joint in the upper reflector.
6. Where severe air movement may be encountered, as at a large door, one (1) or two (2) sheet metal screws in each reflector should be used.
7. Install at least two brackets (P/N 01370300) for each side extension.

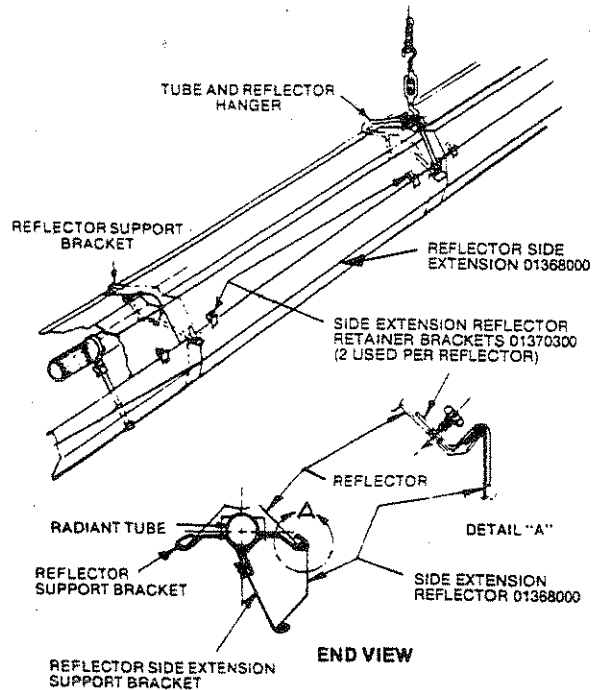
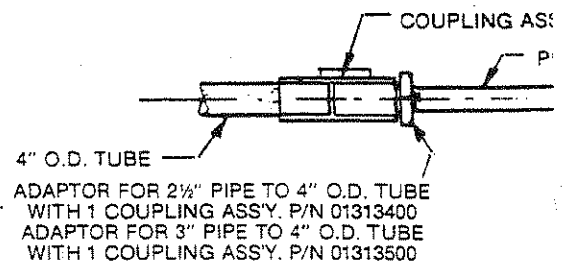
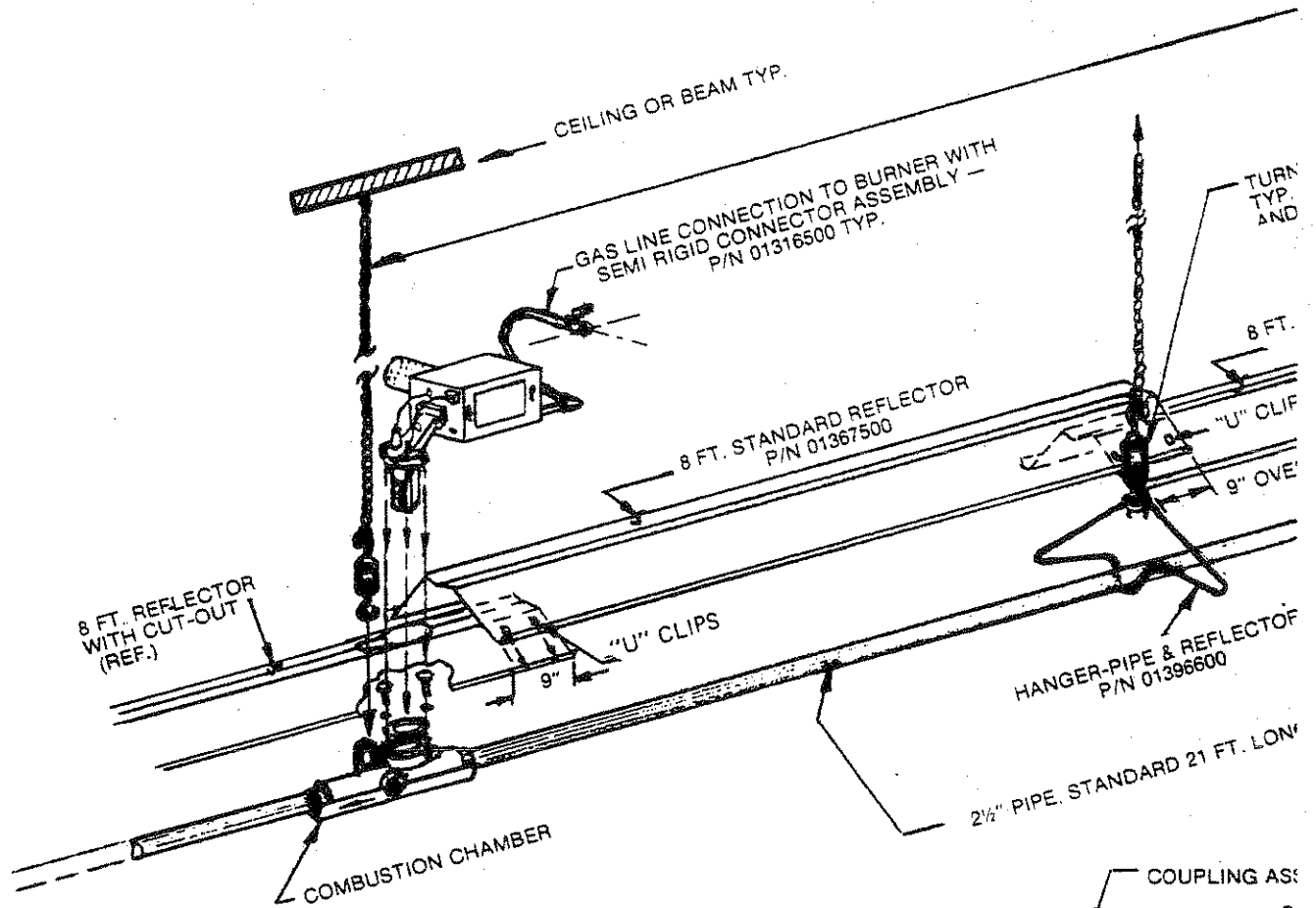
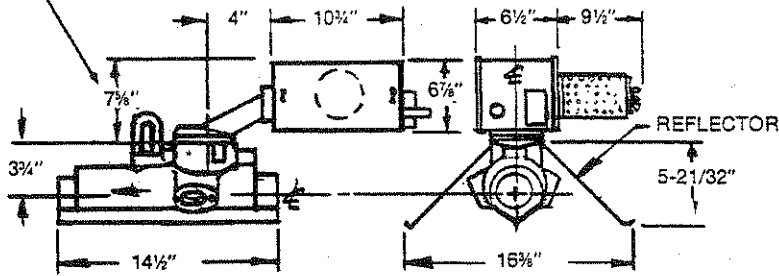


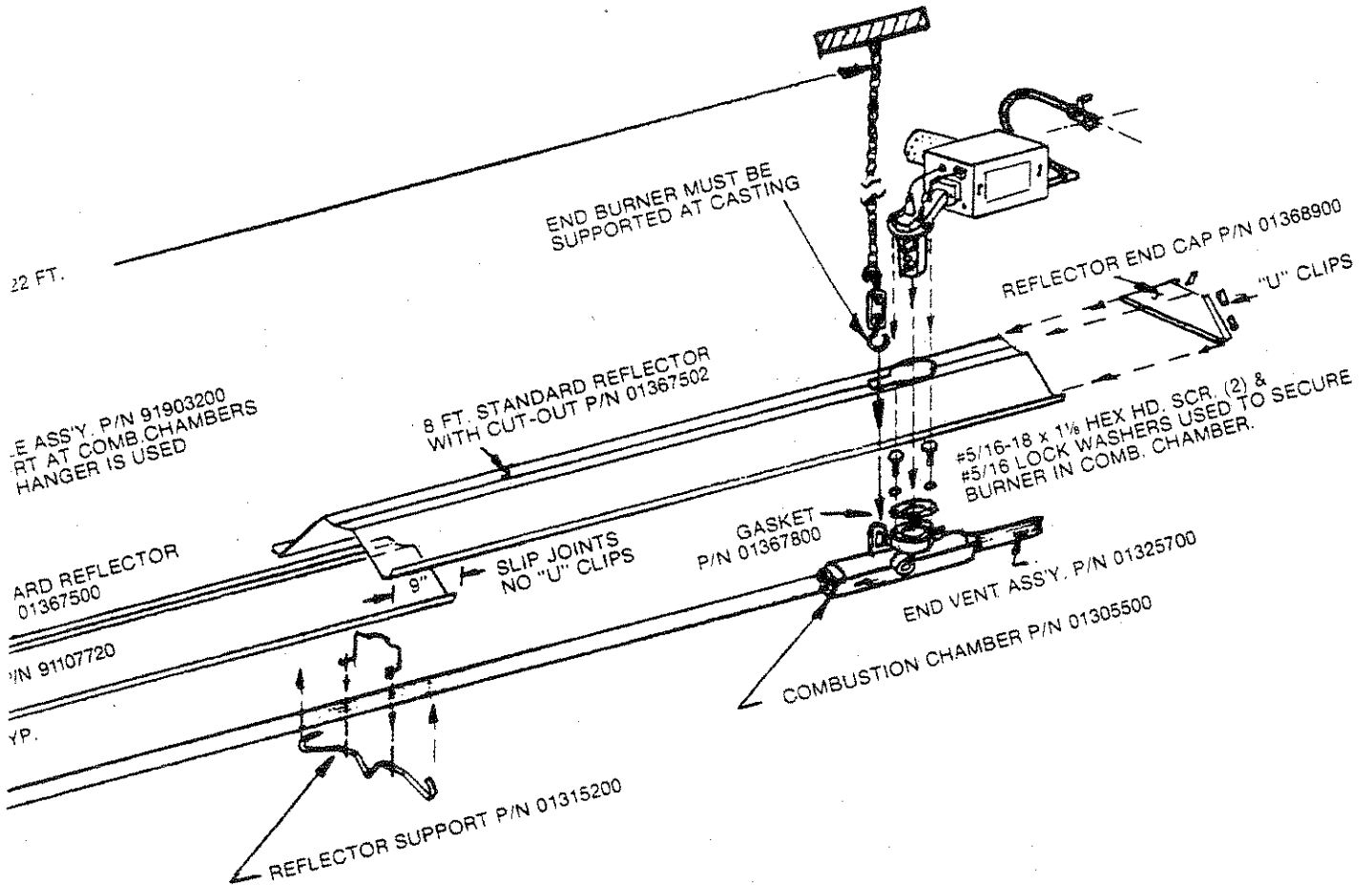
Diagram No. 51

**NOTE:** TO INSTALL P/N 1370300 BRACKETS: LAY BRACKET OVER THE SIDE EXTENSION REFLECTOR AND STANDARD REFLECTOR AT SELECTED LOCATION. BY USING HOLE IN THE BRACKET AS THE TEMPLATE, DRILL OR PUNCH APPROXIMATELY 3/32" DIAMETER PILOT HOLE IN THE STANDARD REFLECTOR. INSTALL #8 x 3/8 SHEET METAL SCREWS AS SHOWN.

SPECIAL CONSIDERATIONS FOR CRV5-40 SERIES

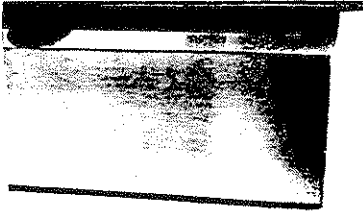
ADD 5 1/2" CLEARANCE FOR REMOVAL OF BURNER



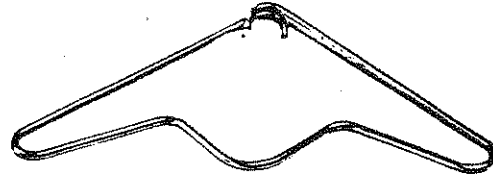


**ASSEMBLY DETAILS**  
Diagram No. 52

CO-RAY-VAC ACCESSORIES



REFLECTOR (STD. 8 FT.) — P/N 01367500  
REFLECTOR (STD. WITH CUTOUT) — P/N 01367502



TUBE AND REFL.  
HANGER  
P/N 01395200



REFLECTOR JOINT PIECE (STD.) — P/N 01369000  
REFLECTOR JOINT PIECE (1 FT. WIDE) — P/N 01363200



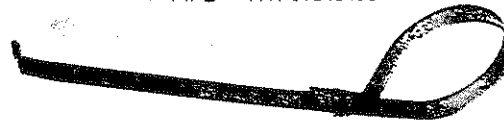
STRAP  
P/N 01367700

CLAMP WIRE  
P/N 91908000

REFLECTOR SUPPORT FOR  
4" TUBE — P/N 01312800  
2.5" PIPE — P/N 01315200  
3" PIPE — P/N 01315300  
4" PIPE — P/N 01315400



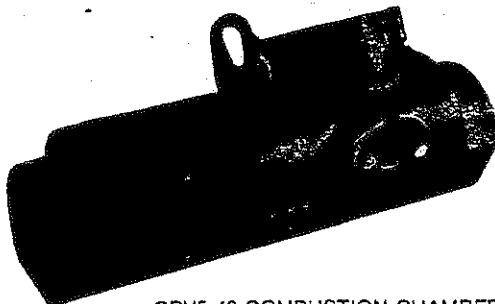
REFLECTOR SIDE EXT. (STD. 8 FT.) — P/N 01314200



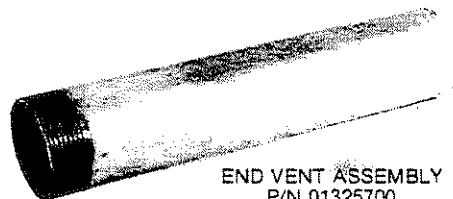
REFLECTOR SIDE EXTENSION SUPPORT  
(4" TUBING) — P/N 01329900  
(2.5" PIPE) — P/N 01324001  
(4.0" PIPE) — P/N 01324301



REFLECTOR END CAP (STD.)  
P/N 01368900  
REFLECTOR END CAP (1 FT.)  
P/N 01363600



CRV5-40 COMBUSTION CHAMBER  
P/N 01305500



END VENT ASSEMBLY  
P/N 01325700

## PART III

### SERVICE INSTRUCTIONS FOR ALL MODELS

#### INTRODUCTION

CO-RAY-VAC burners are carburetor-like devices in which the vacuum developed by the flue exhauster (vacuum pump) induces a flow of fuel gas and air in the correct ratio for maximum combustion efficiency. The normal vacuum of two to three inches water column is, therefore, necessary for proper operation.

#### CHECKING AND SETTING THE VACUUM (SEE DIAGRAM No. 48, PAGE 43)

Allow system to operate at least one-half hour.

Check the vacuum at all end burners. Use a manometer or a vacuum gauge calibrated in inches w.c. All readings should be between two and three inches w.c.

Vacuum is controlled by means of a damper in the vacuum pump inlet and in many systems, a damper in one or more of the branches of the system. Adjust as follows:

1. If overall vacuum is too high, adjust the pump damper to get two to three inches w.c.
2. If any branch is abnormally low or high, adjust the branch damper for proper vacuum.
3. If a branch is too high and has no damper, it may be necessary to install one.
4. If a branch that has no damper has low vacuum and no apparent cause, it may be possible to open the pump damper to raise the system vacuum; then if necessary, reduce vacuum in other branches by closing branch dampers.

If system vacuum is low, below two inches w.c., check the following:

1. Branch dampers closed.
2. Pump damper closed.
3. Pump rotation wrong.
4. Pump speed not 3450 RPM (incorrect wiring, wrong replacement motor).
5. Pump impeller loose or defective.
6. Blockage in pump discharge. (Bird's nest, etc.)
7. Motor improperly wired for applied voltage.
8. Air leaks in system at couplings, pump inlet boot, or end vent plate.
9. Blockage in tubing system.
10. Improper pitch, allowing water blockage.
11. Condensate trap dry.

If cause cannot be found above, consult the Roberts-Gordon, Inc. representative. It may be necessary to check the system design for excess loading or insufficient tubing ahead of the vacuum pump to provide necessary cooling of flue gases.

#### CONTROL PANEL OPERATION P/N 01312301, P/N 01312302 AND P/N 01312303

##### START-UP (SEE DIAGRAM No. 24, PAGE 27 OR DIAGRAM No. 26, PAGE 29)

1. Thermostats make to complete circuit from transformer to zone relay coil.
2. Zone relay contacts 1-3 and 4-6 close, energizing vacuum pump motor (and combustion air blower if used).
3. When up to speed, motor interlock switch and/or air sensing interlock switch closes, energizing coil B2 which closes contacts 4-6 on relay B2 to start timing cycle. System is now in "pre-purge".
4. After 30-60 seconds in pre-purge mode, timer (P/N 90426200) energizes coil B1 which closes contacts 1-3 and 4-6 of relay B1.
5. Contacts 1-3 of relay B1 close to provide an additional circuit to energize vacuum pump motor. Contacts 4-5 of relay B1 supply power to all burners in the zones.
6. Pilot valve energized on CRV-A and CRV5-40 series; module energizes on CRV-B series.

## OPERATION

### SHUT-DOWN

1. When the last thermostat calling for heat is satisfied and opens, this de-energizes the zone relay and timer.
2. Zone relay contacts 1-3 and 4-6 open shutting down burner immediately. The vacuum pump motor is still energized through contact 1-3 in relay B1.
3. Timer begins "post-purge" countdown of 30-60 seconds before de-energizing coil B1.
4. B1 relay contacts 4-6 open de-energizing motor. System now ready for next duty cycle.

With single fuel burners as shown in Diagram No. 25, Page 28, the CO-RAY-VAC control panel has four zone relays, each controlled by a thermostat with all zone relay contacts 3-1 in parallel, and all 6-4 contacts in parallel, thus any thermostat calling for heat will start the vacuum pump, which will stay on until the last thermostat is satisfied. With dual fuel burners there are two or three zones available. See Diagram No. 25, Page 28.

### OPERATION UNIQUE TO SINGLE FUEL WITH LIGHTS P/N 01312302

The operation of this control panel is identical to the single fuel model P/N 01312301 except lights are provided to show the operational mode.

1. The "line power" light will be on whenever power is supplied to the panel.
2. The "pump power" light will be on when power is supplied to the pump motor. This includes operation during "pre-purge" burner firing and "post-purge."
3. The "zone" lights (zone one through four) will be on when power is supplied to the respective burner(s). This occurs when the thermostat is calling for heat except during "pre-purge".

### OPERATION UNIQUE TO DUAL FUEL P/N 01312303 (CRV-A AND CRV5-40 SERIES ONLY)

Zone three and four controls are unavailable for burner zones; instead they are used to energize relays three and four as shown in Diagram No. 25, Page 28.

1. When the selector switch\* is set to the natural position (Diagram No. 25) this initiates the conditions as follows:
  - The valves in the auxiliary portion of the gas train are energized and opened.
  - The L.P. master valve is de-energized and closed.
  - The natural gas master valve is energized and opened.
2. When the selector switch is set to the L.P. position (Diagram No. 25) this initiates the conditions as follows:
  - The valves in the auxiliary portion of the gas train are de-energized and closed.
  - The L.P. master valve is energized and opened.
  - The natural gas master valve is de-energized and closed.

\*A SPDT selector switch with a minimum two amp per 125V rating must be used in order to insure safe operation of the fuel master valves.



**PILOT IGNITION — CRV-A AND CRV5-40 SERIES****WARNING**

**EXPOSED LINE VOLTAGE PARTS.**

**HAZARD OF ELECTRICAL SHOCK OR BURN.**

Turn power off before servicing components.

Electrical service must be performed by a trained electrician or service technician or other individuals qualified to safely perform electrical tests.

**PILOT FAILS TO IGNITE**

Check to make sure there is electric current at the control box. This can be done quickly by pulling the plug from the outlet receptacle and plugging it in again. If you hear a click of the solenoid valve, you know you have current.

Now look up through window in combustion chamber to see if there is spark at the spark plug. If there is no spark, then proceed to check out controls in the following order:

**TRANSFORMER (Also called "Spark Generator")**

1. Disconnect electric current by pulling plug.
2. Disconnect high tension lead from spark plug.
3. Replace plug in electrical outlet and holding high tension lead by insulated portion, bring metal connector close to burner casting and observe if you get a good spark. If there is no spark or a very weak spark, this would indicate the transformer is defective. Before changing transformer, check the ground connection on the transformer (green wire) to make sure it is making a good contact at the grounding post and that the transformer is well grounded. A factory-installed tooth lock washer is used under one leg of the transformer in order to provide a well grounded connection to the control housing.

**CAUTION**

DO NOT ALLOW TRANSFORMER TO OPERATE MORE THAN A FEW MOMENTS WITH MORE THAN A .130 GAP TO GROUND AT THE SPARK PLUG TERMINAL, BECAUSE AN EXTERNAL SPARK GAP WHICH IS TOO LARGE MAY CAUSE THE TRANSFORMER TO ARC INSIDE AND ULTIMATELY SHORT OUT.

If there is a good spark, then:

**CHECK SPARK PLUG**

1. Pull electric plug to disconnect current.
2. Remove spark plug.
3. Connect high tension lead to the plug and allow plug to make contact with burner casting.
4. Replace electric plug in outlet and observe spark at the spark plug. If the spark is very weak or erratic, it would indicate either carbon or dirt at the points or clearance of points is improper. Clean plug and check clearance (approximately .130"). If there is no spark after cleaning, it must be assumed the plug is defective and requires replacement.

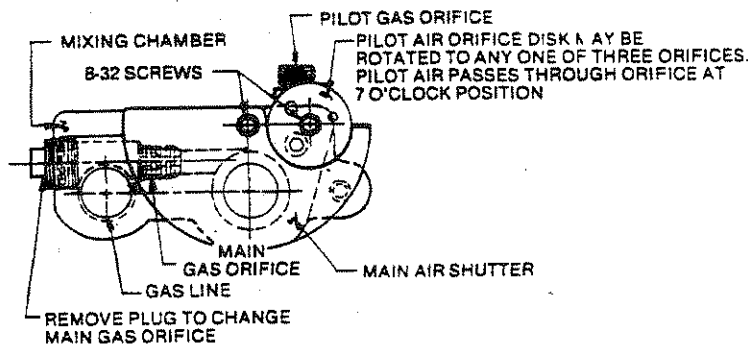
Having established the transformer and spark plug are O.K., proceed as follows:

## OPERATION

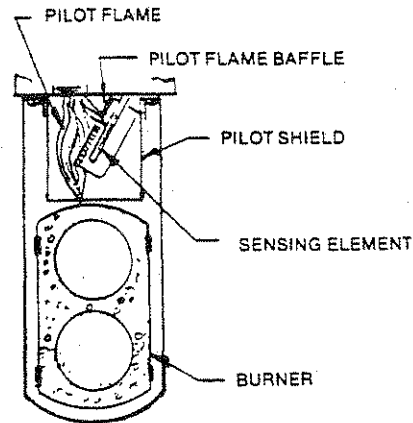
### PILOT COMBUSTION

#### AIR ADJUSTMENT

Pilot air may be adjusted by loosening 8-32 screw holding pilot orifice disc in place and rotating the disc to one of the fixed openings provided. Use a 9/64" Allen wrench. See Diagram No. 53.



**Diagram No. 53**



**Diagram No. 54**

To aid in observing pilot flame, turn off main burner flame by unplugging pilot element switch at front end of burner box.

If you are unable to adjust pilot flame by using one of the fixed pilot air holes, then proceed as follows:

1. Check for air leaks at the burner flange, at the spark plug, at inspection windows and where pilot element enters burner casting. Check for leaks at pilot tubing.
2. Remove pilot gas orifice (See Diagram No. 53) and make sure there are no stoppages due to chips or dirt, and that it is properly sized (No. 61 drill-natural gas, No. 68 drill-propane gas.)

### MAIN BURNER IGNITION AND COMBUSTION

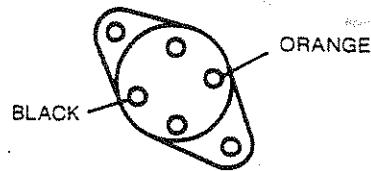
#### MAIN BURNER FAILS TO IGNITE AND/OR BURN PROPERLY

Main burner fails to ignite and/or burn properly. Observe pilot flame which should be blue and contained in the pilot shield. If the pilot flame is ragged and extends outside the shield, check to see that pilot air orifice is properly aligned. Also try the other air orifices by rotating the orifice disc as described above under "PILOT COMBUSTION".

The pilot sensing element is heated by a portion of the pilot flame which is diverted through a small hole in the pilot flame baffle. When the flame is correctly adjusted, this baffle usually glows red, masking the glow of the sensing element. In most cases if the baffle glows, the sensing element will heat sufficiently to operate.

Check the pilot switch by installing a test "jumper" wire between the black and orange terminals at the pilot switch socket (see Diagram No. 55, Page 61). If the main burner ignites, indications are that the pilot switch is defective and must be cleaned or replaced. Remove the test "jumper" wire.

If with the pilot switch "jumpered" the main burner valve does not energize, check for a broken wire, faulty connection or defective main valve coil.



**PILOT SWITCH SOCKET**  
**Diagram No. 55**

If it has been established that the main burner solenoid valve is open and there is no visible flame, it may be assumed gas is flowing from the main burner but the gas-air mixture is improper and may be adjusted as follows: (Refer to Diagram No. 53, Page 60).

1. Shut off burner by unplugging pilot element switch and unplug power cord(s) to burner.
2. Loosen 8-32 screw holding main flame air shutter in place. Use a 9/64" Allen wrench.
3. Turn auxiliary air shutter counterclockwise to close fixed air opening in shutter.
4. Rotate main flame shutter clockwise to allow full air opening in the shutter.
5. Turn on main burner by plugging in pilot element switch and observe flame through observation window in combustion chamber.
6. Slowly close the main flame shutter and then open shutter to the point where the flame changes from green to blue. The flame should be well defined and the flame cones should be about three-eighths inch long. Too much air will result in a "stringy" flame with a tendency to float away from the burner head.
7. Tighten 8-32 screw, locking shutter in place.

If main burner flame cannot be adjusted as outlined above, check as follows:

1. Turn burner off at shut-off cock.
2. Remove three-eighths inch plug in mixing block and remove gas orifice with 3/16-inch Allen wrench.
3. Check size of orifice. See Tables, Pages 69 and 73.
4. Replace orifice and attach "U" gauge at three-eighths inch tapping.
5. Turn off burner and take reading on "U" gauge. This will indicate vacuum in system at this point. If vacuum is less than two inches, check out vacuum as described above. If vacuum in system is satisfactory and you cannot get reading of  $0 \pm 0.3$  water column with burner on and gas supply is normal, replace burner.

**BURNER FAILS TO OPERATE PROPERLY WHEN CONTROL HOUSING DOOR IS IN PLACE —  
FLAME SMALL — DIRTY FILTER**

When control housing doors are in place and securely fastened to burner and the main flame is smaller than normal, it is usually an indication that the air filter is very dirty and blocking the air supply for the burner. To check for this condition, carefully observe the main flame while in operation. Then loosen the screws holding door in position and crack the door open slightly. If the flame is larger with the door cracked open, it is an indication that the filter is dirty and needs cleaning or replacing.

The filter might be cleaned by removing it from the burner and blowing it out with compressed air, however, this type of cleaning is effective probably only once, since much of the dirt particles become securely embedded in the filter media and cannot be easily removed. A new filter may be required.

Where severe dust problems exist, a special filter door capable of accepting two filters should be considered. Under these conditions it would be wise to install a ducted air supply system. Consult your Roberts-Gordon, Inc. representative.

## SERVICE INSTRUCTIONS FOR CRV-B SERIES BURNER

### BURNER FAILS TO LIGHT

#### INSUFFICIENT VACUUM AT BURNER

1. **Check** — Vacuum at burner end vent test port of branch containing burner being checked. Vacuum should be between two and three inches water column.
2. **Check** — For air leaks around burner head gasket, combustion chamber gasket, ignitor electrode gasket, observation window gasket.

#### NO POWER AT BURNER

See "Checking Electrical Circuits in Control Panel," Page 65.

#### POWER AT BURNER — NO SPARK

With gas to burner turned OFF set thermostat above room temperature. Following prepurge period spark module should be energized. The spark electrode may be observed through the observation window in burner combustion chamber. Spark should appear as a bright blue arc across the electrodes. Spark duration is approximately 15 seconds since main flame is not established so recycling of thermostat may be necessary for observation purposes if no spark appears.

1. **Check** — For loose or broken leads to D.S.I. module.
2. **Check** — For loose or broken high tension lead to electrode.
3. **Check** — For carbon bridge or broken porcelain insulator on spark electrode.
4. **Check** — Spark electrode, gap should be .125 inches.
5. **Check** — For loose ground wire connection on D.S.I. module.
6. **Check** — For blown fuse on D.S.I. module (if applicable).
7. **Replace** — D.S.I. module if defective, module is not field repairable.

#### NO GAS PRESENT

Set thermostat above room temperature. Following prepurge period gas valve should be energized. If no gas flow or flame is established:

1. **Check** — To see that manual gas supply valve to burner is ON.
2. **Check** — To see that dial knob on redundant valve burner control housing is ON.
3. **Check** — For gas pressure at one-eighth inch NPT tapping upstream of burner control housing on manual shut-off valve.
4. **Check** — For loose or broken wire leads from gas valve to D.S.I. module.
5. **Check** — For power 24 volts at valve terminals.
6. **Check** — For gas flow at main orifice tap. Install pressure tap at three-eighths plug (Item 4c, Diagram No. 62, Page 70 and measure vacuum. Burner off vacuum equals approximately three inches w.c. As valve opens vacuum normally decreases to less than 0.8 inch w.c.
7. **Replace** — Defective gas valve.
8. **Replace** — D.S.I. module, module is not field repairable.

#### BURNER LIGHTS AND THEN GOES OUT

Flame current is the current which passes through the flame from the sensor to ground to complete the primary circuit which allows the flame to remain lighted. A minimum flame current in micro amps is necessary to keep the ignitor from locking out. To measure flame current see Diagram No. 56 and 57.

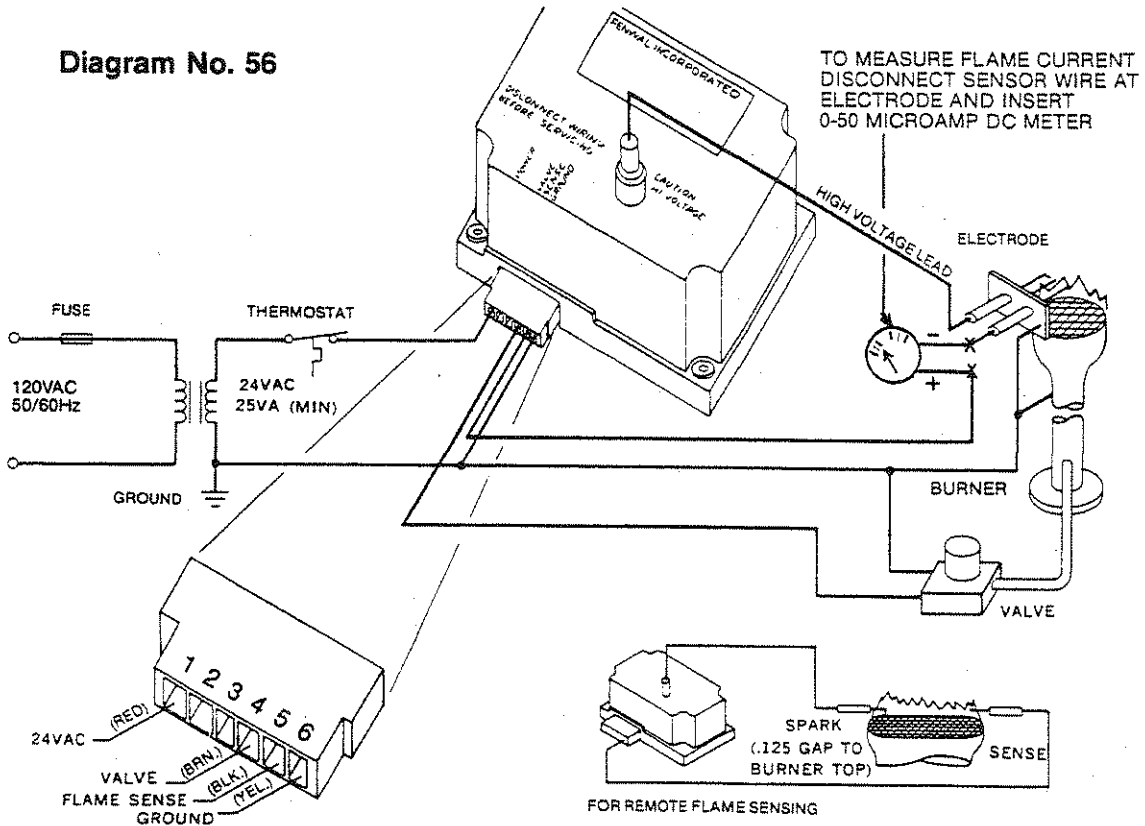
**CRV-B WITH FENWAL CONTROL**

Flame current is the current which passes through the flame from the sensor to ground to complete the primary safety circuit. The minimum flame current necessary to keep the ignitor from lockout is five microamps. To measure flame current, DISCONNECT INPUT VOLTAGE then remove low voltage sensing lead wire from electrode terminal and insert a 0-50 DC microamp meter in a series with the sensor probe and sensor wire (see Figure 3a). Meter reading should be five microamps or higher.

If meter reads below "0" on scale, the leads are reversed. Disconnect power and reconnect leads for proper polarity.

If the flame current reading is less than five microamps, reposition the electrode in the flame to get a higher reading.

**Diagram No. 56**



**CRV-B WITH HONEYWELL CONTROL**

**FLAME SENSOR CIRCUIT**

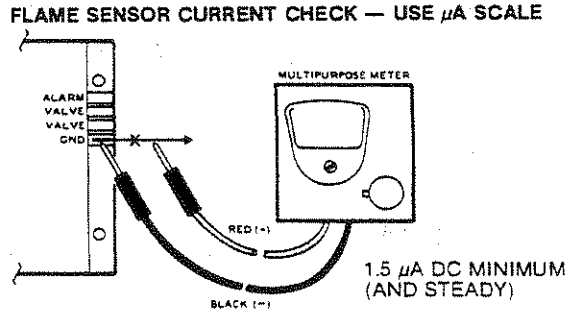
The S87 provides AC power to the ignitor/sensor (on S87 A and B) or flame sensor (on S87 C and D) which the burner flame rectifies to direct current. If the flame signal back to the S87 is not at least 1.5  $\mu$ A DC, the system will lock out.

The output of the flame sensing circuit cannot be checked directly on the S87. Check the flame sensing circuit indirectly by checking the flame sensing current from the flame sensor to the S87 as follows:

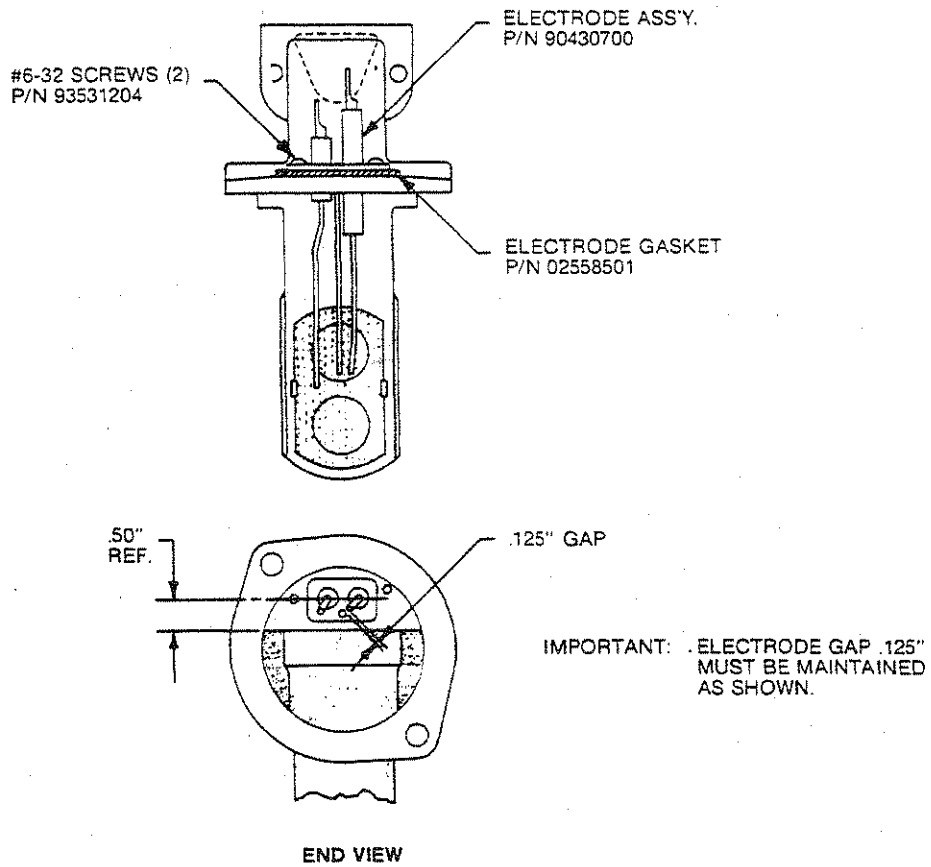
1. Connect a meter (DC microammeter scale) in series with the flame signal ground wire as shown in Diagram No. 57, Page 64. (Use the Honeywell W136A Test Meter, or equivalent.) Disconnect the ground wire at the S87. Connect the red (positive) lead of the meter to the free end of the ground wire. Connect the black (negative) meter lead to the quick-connect ground terminal on the S87.
2. Restart the system and read the meter. The flame sensor current must be at least 1.5  $\mu$ A and steady. If the reading is below 1.5  $\mu$ A or unsteady, see Low or Unsteady Flame Current Diagram No. 57, Page 64.

### LOW OR UNSTEADY FLAME CURRENT

If the current to the flame circuit is less than  $1.5 \mu\text{A}$  or is unsteady, check the burner flame, flame sensor (ignitor/sensor) location and electrical connections as follows:



### FLAME CURRENT MEASUREMENT Diagram No. 57



**Diagram No. 58**

**CHECKING ELECTRICAL CIRCUITS IN CONTROL PANEL**  
**P/N 01312301, P/N 01312302 AND P/N 01312303**

**WARNING**

**EXPOSED LINE VOLTAGE PARTS:**

**HAZARD OF ELECTRICAL SHOCK OR BURN.**

Turn power off before servicing components.

Electrical service must be performed by a trained electrician or service technician or other individuals qualified to safely perform electrical tests.

**MOTOR RUNS (NO CURRENT TO ANY BURNERS)**

Wait three minutes after thermostat makes before proceeding.

1. Make sure the thermostat circuit is calling for heat by connecting a jumper wire from terminal "C 24V" to the terminal for the thermostat of the zone under test (i.e., "T<sub>1</sub>," "T<sub>2</sub>," "T<sub>3</sub>," or "T<sub>4</sub>"). If zone relay(s) actuate, thermostat(s) were not calling for heat, are defective or wiring to the thermostats is open (see Diagram No. 24, Page 27).
2. If zone relay(s) operate, but burners are still not powered, put a jumper from terminal "C 24V" to "MBR" to bypass the interlock switch. Wait one minute, if burners become powered, vacuum switch is defective or wiring is open (see Diagram No. 23, Page 26).
3. If burners are not powered, with zone relay in, check for current terminal four, then terminal six of the zone relay. If powered at four but not at six, zone relay is defective (see Diagram No. 23, Page 26).
4. If no current at four, check for current at terminals four and six of relay B1. With coil actuated if not at six and not at four, relay B1 is defective.
5. If relay B1 is not energized, check terminals four and six of relay B2. If "hot" (24V) at six and not at four, relay B2 is defective.
6. If "hot" at both terminal four and six on relay B2, timer is defective.

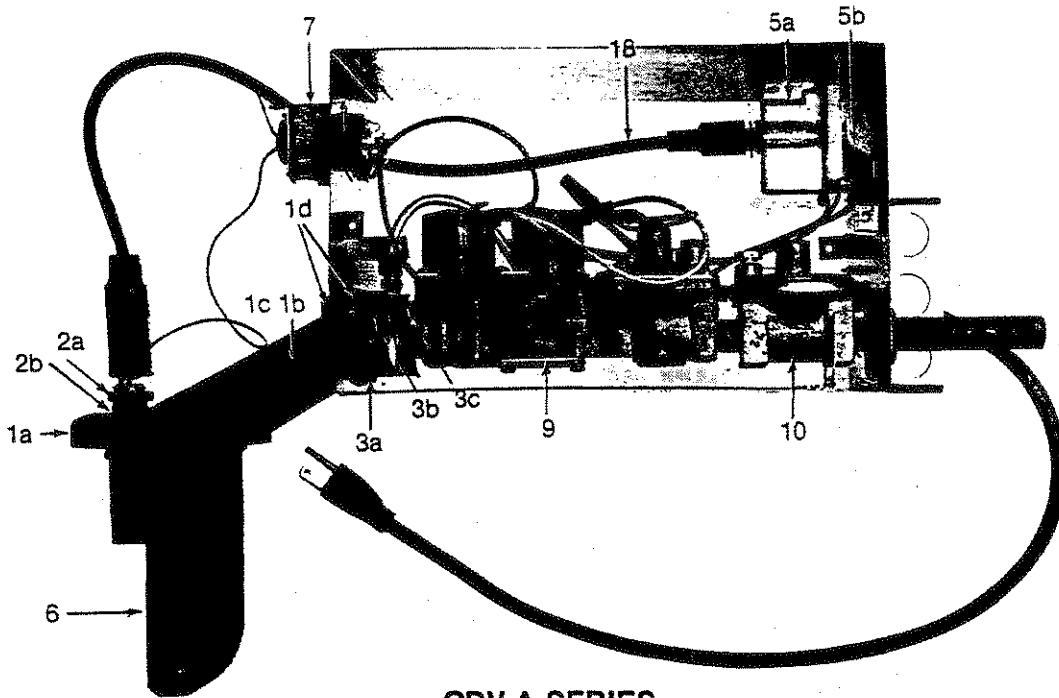
**PUMP MOTOR DOES NOT RUN**

1. Make sure thermostats are calling for heat.
2. Check fuses in main line.
3. Check for power to system with voltmeter or test lamp at thermal "H".
4. Check for power (24V) at "C 24V" to "T<sub>1</sub>" to "T<sub>2</sub>", etc. If power present, jump terminals "C 24V" to "T<sub>1</sub>". If relay operates, the thermostat is either satisfied, defective or wiring to thermostat is open. If relay does not actuate, either the relay or the wiring to the relay is defective.
5. If no power at "C 24V" transformer is defective, check for power at the pump motor terminal ("L<sub>1</sub>" and "L<sub>2</sub>") for operation with 115V.
6. If power is present, motor is defective or improperly wired.
7. If no power at MH (Motor Hot), check terminals one and two of actuated zone relay. If "Hot" at one and not three, zone relay is defective.

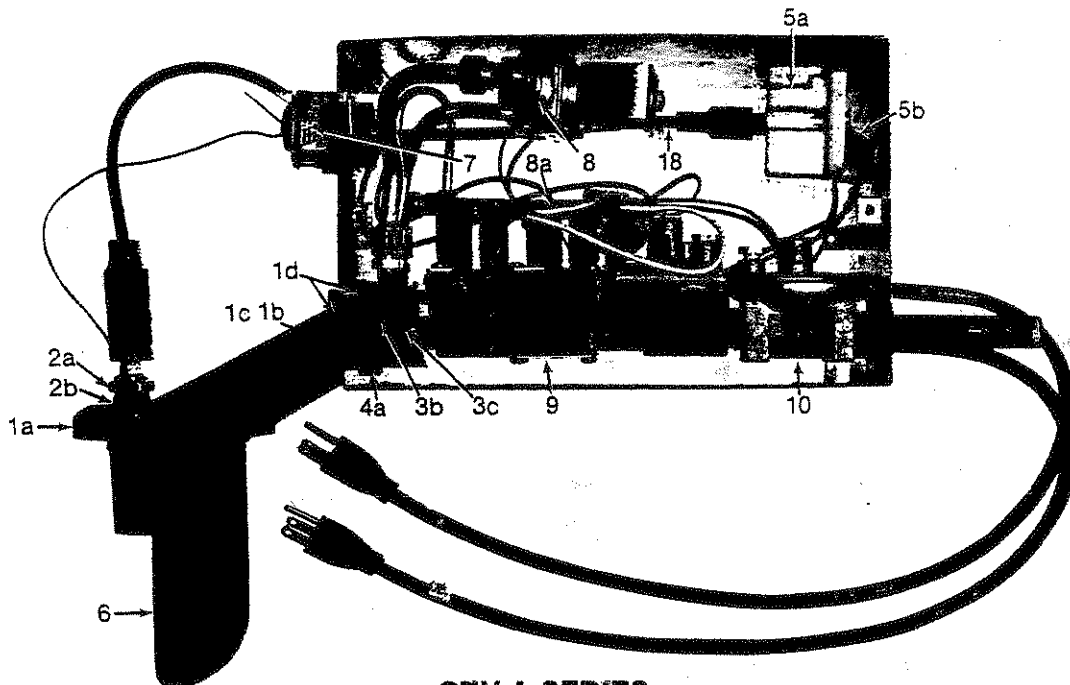
**SPECIAL CONDITIONS**

1. If one thermostat is actuated and all zone relays close or partially close (clatter), P/N 90426600 package with four rectifiers is defective or incorrectly wired.
2. If system operates without "post-purge" or "pre-purge," relay B1 is defective or improperly wired.

REPLACEMENT PARTS



**CRV-A SERIES  
BURNER CONTROL ASSEMBLY  
SINGLE FUEL  
Diagram No. 59**



**CRV-A SERIES  
BURNER CONTROL ASSEMBLY  
DUAL FUEL  
Diagram No. 60**



## REPLACEMENT PARTS PACKAGES FOR CRV-A AND CRV5-40

ITEM No.	DESCRIPTION	QTY.	ITEM No.	DESCRIPTION	QTY.
<b>Package No. 01320100</b>			<b>Package No. 01316600</b>		
<b>Burner Head Assembly CRV-A</b>			<b>Spark Igniter Assembly</b>		
1a	Burner Head Subassembly	1	5a	Spark Igniter	1
1b	1/4-20 x 1-3/8" Socket Hd. Screw	2	5b	Mounting Bracket	1
1c	1/4" Lockwasher	2		6 x 1/2" Sheet Metal Screw	2
1d	Gasket	2		12 x 1/2" Sheet Metal Screw	2
	Combustion Chamber Gasket	1		External Tooth Washer	3
	5/16-18 Hex Nut	2			
	5/16" Lockwasher	2			
<b>Package No. 01320101</b>			<b>Package No. 01313800</b>		
<b>Burner Head Assembly CRV5-40</b>			<b>Vacuum Pump Damper Assembly</b>		
1a	Burner Head Subassembly	1		Damper	1
1b	1/4-20 x 1-3/8" Socket Hd. Screw	2		Damper Support	1
1c	1/4" Lockwasher	2		5/16" Washer	1
1d	Gasket	2		5/16" Ext. Tooth Washer	1
	Combustion Chamber Gasket	1		1/4-20 x 1/2" Hex Hd. Screw	1
	5/16-18 x 1-1/8" Hex. Hd. Screw	2		Insulating Sleeving	2
	5/16" Lockwasher	2			
<b>Package No. 01320200</b>			<b>Package No. 02713100</b>		
<b>Spark Plug</b>			<b>Ceramic Block</b>		
2a	Spark Plug	1	6	Ceramic	1
2b	Washer	1		Clip	4
				Grid Retainer	1
				Cement	
<b>Package No. 013203__</b>			<b>Package No. 02713700</b>		
<i>(Specify Burner Model 02, 04, 06, 08)</i>			<b>Mica Window CRV-A</b>		
<b>Mixing Chamber Assembly - Single Fuel</b>				Gasket	2
3a	Mixing Chamber	1		Mica Window	1
3b	3/8" Pipe Plug	1		1/4-20 Hex Nuts	2
3c	Air Shutter	1			
1d	Gasket	2	<b>Package No. 02713701</b>		
	Orifice Disk	1	<b>Mica Window CRV5-40</b>		
				Gasket	2
<b>Package No. 013204__</b>				Mica Window	1
<i>(Specify Burner Model 02, 04, 06, 08)</i>				1/4-20 x 1/2" Hex. Hd. Screw	2
<b>Mixing Chamber Assembly - Dual Fuel</b>			7	01313701 Pilot Switch Assembly	
4a	Mixing Chamber	1	8	90025800 FJ 42 Gas Valve	
3b	3/8" Pipe Plug	1	8a	90025900 FJ 3000 Gas Valve	
3c	Air Shutter	1	9	70100600 Gas Valve	
1d	Gasket	2	10	90201400 Regulator	
	Orifice Disk	1	11	013676__ End Vent*	
			12	013942__ Main Orifice — Single Fuel*	
<b>Package No. 013205__</b>			13	008788__ Pilot Orifice — Single Fuel*	
<i>(Specify Burner Model 02, 04, 06, 08)</i>			14	013942__ Main Orifice — Dual Fuel*	
<b>Air Shutter</b>			15	008788__ Main Aux. Orifice — Dual Fuel*	
3c	Air Shutter	1	16	008788__ Pilot Orifice — Dual Fuel*	
	8-32 x 1/2" Screw	1	17	008788__ Pilot Aux. Orifice — Dual Fuel*	
	Washer	1	18	01320700 Ignition Cable	

\*See Parts Schedule



**REPLACEMENT PARTS PACKAGES FOR  
CRV-A & CRV5-40 (Cont'd)**

**PARTS SCHEDULE**

**ITEM No. 11  
END VENT PLATE**

PART NUMBER	INPUT	HOLE DIAMETER
01367602	20,000	.359 (23/64)
01367604	40,000	.421 (27/64)
01367606	60,000	.593 (19/32)
01367608	80,000	.687 (11/16)

**ITEM No. 3c  
AIR SHUTTER**

PART NUMBER	INPUT	HOLE DIAMETER
01360502	20,000	.328 (21/64)
01360504	40,000	.469 (15/32)
01360506	60,000	.593 (19/32)
01360508	80,000	.687 (11/16)

**ITEM No. 12  
SINGLE FUEL MAIN ORIFICE**

NATURAL				L.P.			
PART NUMBER	INPUT	DIAMETER	DRILL SIZE	PART NUMBER	INPUT	DIAMETER	DRILL SIZE
01394243	20,000	.0890	43	01394250	20,000	.0700	50
01394230	40,000	.1285	30	01394239	40,000	.0995	39
01394221	60,000	.1590	21	01394230	60,000	.1285	30
01394216	80,000	.1770	16	01394227	80,000	.1470	26

**ITEM No. 13  
SINGLE FUEL PILOT ORIFICE**

NATURAL			L.P.		
PART NUMBER	DIAMETER	DRILL SIZE	PART NUMBER	DIAMETER	DRILL SIZE
00878861	.0390	61	00878868	.0310	68

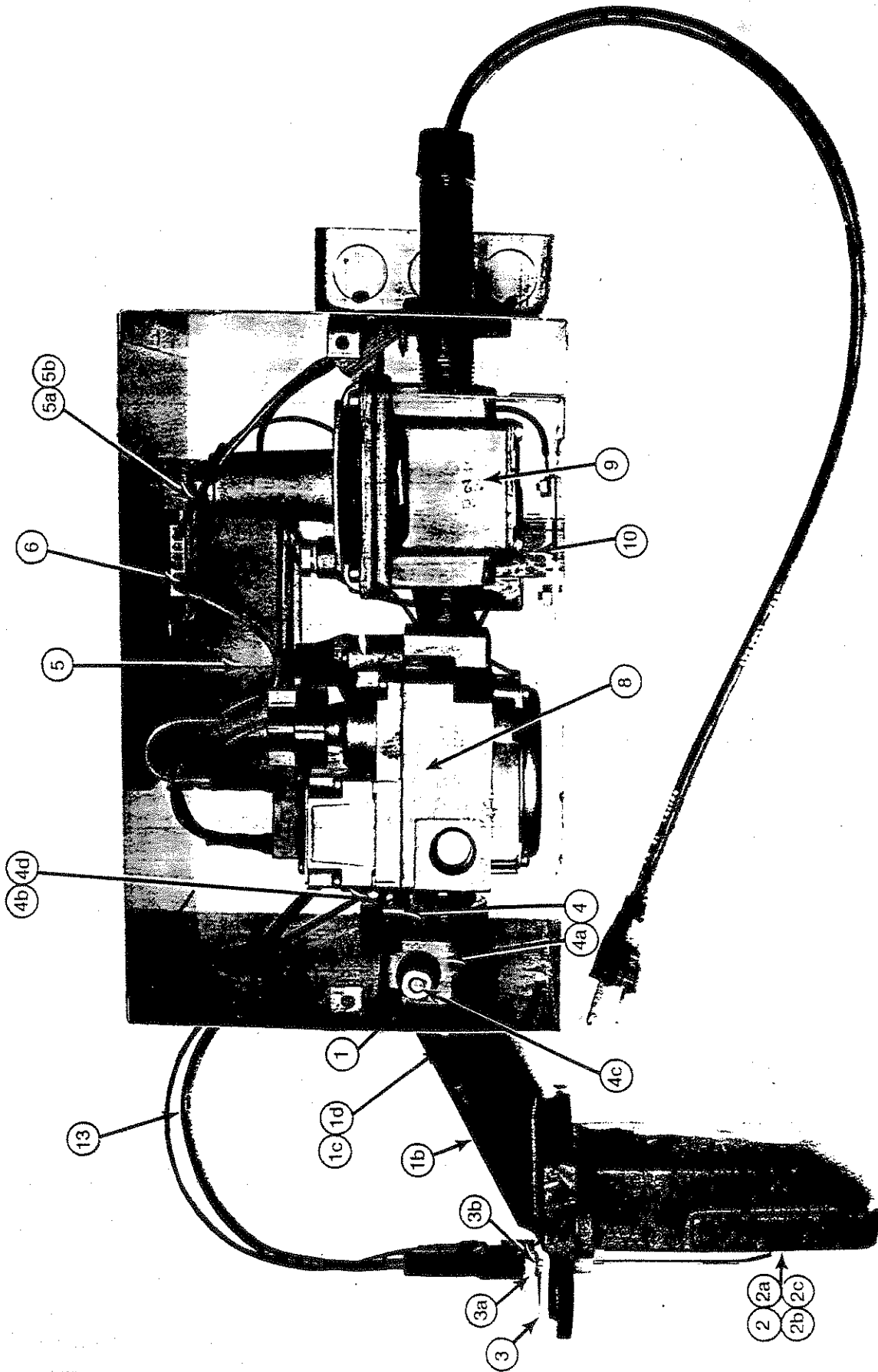
**ITEMS No. 14 AND 15  
DUAL FUEL MAIN AND AUXILIARY ORIFICE**

MAIN ORIFICE				MAIN AUXILIARY ORIFICE			
PART NUMBER	INPUT	DIAMETER	DRILL SIZE	PART NUMBER	INPUT	DIAMETER	DRILL SIZE
01394250	20,000	.0700	50	01397255	20,000	.0520	55
01394239	40,000	.0995	39	01397247	40,000	.0785	47
01394230	60,000	.1285	30	01397236	60,000	.1065	36
01394226	80,000	.1470	26	01397228	80,000	.1405	28

**ITEMS No. 16 AND 17  
DUAL FUEL PILOT AND AUXILIARY ORIFICE**

PILOT ORIFICE			PILOT AUXILIARY ORIFICE		
PART NUMBER	DIAMETER	DRILL SIZE	PART NUMBER	DIAMETER	DRILL SIZE
00878868	.0310	68	00878873	.0240	73

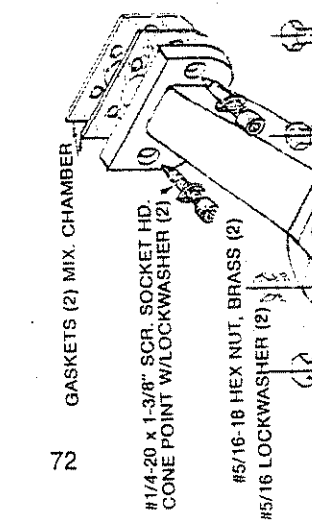
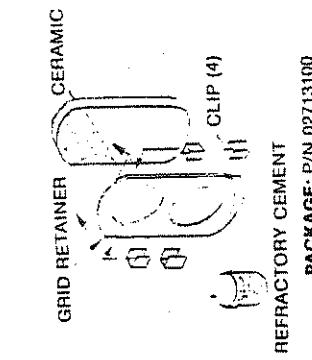
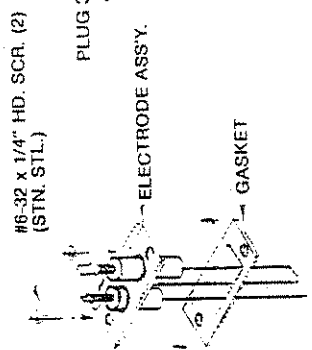
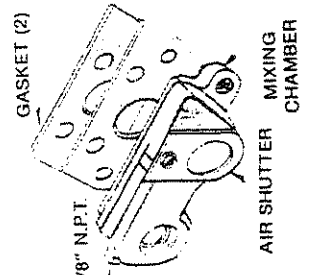
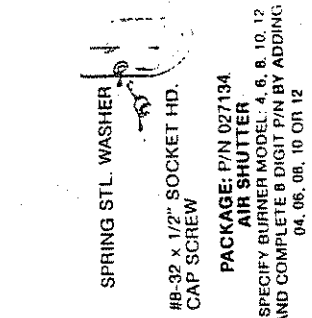
REPLACEMENT PARTS



CRV-B SERIES  
BURNER CONTROL ASSEMBLY  
Diagram No. 62

## REPLACEMENT PARTS PACKAGES FOR CRV-B

ITEM No.	DESCRIPTION	QTY.	ITEM No.	DESCRIPTION	QTY.
<b>Package No. 02713000</b>			<b>Package No. 027134__</b>		
<b>Burner Head Assembly CRV-B</b>			(Specify Burner Model 04, 06, 08, 10, 12)		
1	Burner Gasket	1	4	Air Shutter	1
1a	Combustion Chamber Gasket	1	4b	Spring Washer	1
1b	Burner Head Assembly	1	4d	8-32 Socket Hd. Screw	1
1c	1/4-20 Socket Head Screw	2	<b>Package No. 02713500</b>		
1d	1/4 Lockwasher	2	<b>Fenwal Ignition Control Module</b>		
1e	5/16 Lockwasher	2	5	Ignition Control	1
1f	5/16-18 Brass Nut	2	5a	6-32 Hex Nut	4
<b>Package No. 02713001</b>			5b	6-32 Screw	4
<b>Burner Head Assembly CRV-B</b>			<b>Package No. 02720401</b>		
(For Cast Iron Combustion Chamber)			<b>Fenwal Low Voltage Wire Assembly</b>		
1	Burner Gasket	2	6	Wire Assembly	1
1a	Combustion Chamber Gasket	1	<b>Package No. 02713700</b>		
1b	Burner Head Assembly	1	<b>MICA Window — Tubing Combustion Chamber</b>		
1c	1/4-20 Socket Head Screw	2	7	Window Gasket	2
1d	1/4 Lockwasher	2	7a	MICA Window	1
1e	5/16 Lockwasher	2	7b	1/4-20 Nut	2
1g	5/16-18 Screw	2	<b>Package No. 02713701</b>		
<b>Package No. 02713100</b>			<b>MICA Window — C.I. Combustion Chamber</b>		
<b>"B" Ceramic Block</b>			7	Window Gasket	2
2	Burner Grid Clips	4	7a	MICA Window	1
2a	Ceramic Block	1	7c	1/4-20 Screw	2
2b	Grid Retainer	1	8	90032000 Gas Valve	
2c	Refractory Cement		9	90207100 Maxitrol Regulator	
<b>Package No. 02713200</b>			10	90424200 Transformer	
<b>Fenwal Electrode</b>			11	013676__ End Vent Plate*	
3	Gasket	1	12	027910__ Orifice*	
3a	Electrode	1	13	90427700 Ignition Cable	
3b	6-32 Screw	2	*See Parts Schedule		
<b>Package No. 027133__</b>					
(Specify Burner Model 04, 06, 08, 10, 12)					
<b>Mixing Chamber Assembly</b>					
1	Burner Gasket	2			
4	Air Shutter	1			
4a	Mixing Chamber	1			
4b	Spring Washer	1			
4c	3/8 Pipe Plug	1			
4d	8-32 Socket Head Screw	1			



PACKAGE: P/N 0271394  
AIR SHUTTER  
SPECIFY BURNER MODEL: 4, 6, 8, 10, 12  
AND COMPLETE 8 DIGIT P/N BY ADDING:  
04, 06, 08, 10 OR 12

PACKAGE: P/N 0271333  
MIXING CHAMBER ASSEMBLY  
SPECIFY BURNER MODEL: 4, 6, 8, 10, 12  
AND COMPLETE 8 DIGIT P/N BY ADDING:  
04, 06, 08, 10 OR 12

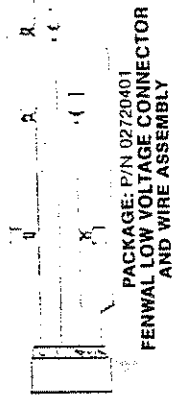
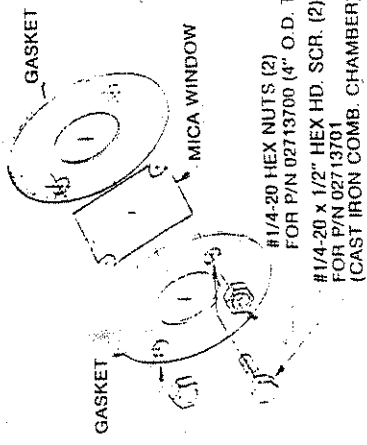
PACKAGE: P/N 02713200  
FENWAL ELECTRODE

PACKAGE: P/N 02713100  
CERAMIC BLOCK

#5/16-18 x 1-1/8" (2)  
HEX HD. SCR. WITH LOCKWASHER  
USED WITH CAST IRON COMB. CHAMBER AND  
SUPPLIED WITH PACKAGE P/N 02713001 ONLY

GASKET -  
COMB. CHAMBER

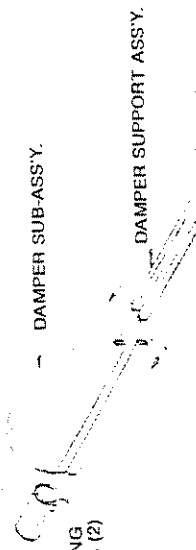
PACKAGE: P/N 02713000 (WITH 4" O.D. TUB. COMB. CHAMBER)  
PACKAGE: P/N 02713001 (WITH CAST IRON COMB. CHAMBER)  
BURNER HEAD ASSEMBLY



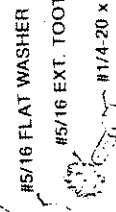
#1/4-20 HEX NUTS (2)  
FOR P/N 02713700 (4" O.D. TUB. COMB. CHAMBER)  
#1/4-20 x 1/2" HEX HD. SCR. (2)  
FOR P/N 02713701  
(CAST IRON COMB. CHAMBER)

PACKAGE: P/N 02713700  
PACKAGE: P/N 02713701  
MICA WINDOW

#6-32 HEX NUTS (4)  
#6-32 x 7/8" RD. HD. SCREW (4)



INSULATING  
SLEEVING (2)



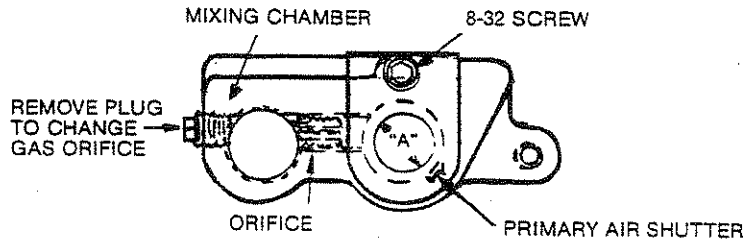
PACKAGE: P/N 01313800  
VACUUM PUMP DAMPER ASSEMBLY

PACKAGE: P/N 02713500  
FENWAL IGNITION CONTROL MODULE

**REPLACEMENT PART PACKAGES**  
**CRV-B SERIES**  
Diagram No. 63

## REPLACEMENT PARTS PACKAGES FOR CRV-B (Cont'd)

### PARTS SCHEDULE



#### ITEM No. 4 AIR SHUTTER

PART NUMBER	"A" HOLE DIAM.	USED ON
02753200	Blank or w/Pilot Hole	—
02753202	.375 (3/8)	CRV-B2
02753204	.469 (15/32)	CRV-B4
02753206	.593 (19/32)	CRV-B6
02753208	.687 (11/16)	CRV-B8
02753210	.812 (13/16)	CRV-B10
02753212	.937 (15/16)	CRV-B12

#### ITEM No. 11 END VENT PLATE

PART NUMBER	INPUT	HOLE DIAM. (3 Holes)
01367604	20,000	.421 (27/64)
01367604	40,000	.421 (27/64)
01367606	60,000	.593 (19/32)
01367608	80,000	.687 (11/16)
01367608	100,000	.687 (11/16)
01367608	120,000	.687 (11/16)

#### ITEM No. 12 MAIN ORIFICE

NATURAL				L.P.			
PART NUMBER	INPUT	DIAMETER	DRILL SIZE	PART NUMBER	INPUT	DIAMETER	DRILL SIZE
02791042	20,000	.0935	42	02791039	40,000	.0995	39
02791030	40,000	.1285	30	02791030	60,000	.1285	30
02791021	60,000	.1590	21	02791026	80,000	.1470	26
02791016	80,000	.1770	16	02791021	100,000	.1590	21
02791007	100,000	.2010	7	02791012	120,000	.1890	12
02791001	120,000	.2280	1				

**MAINTENANCE**

For best performance, the following maintenance procedures are recommended prior to each heating season.

Only firms or individuals qualified to perform work in accordance with the applicable specifications should be engaged to service a CO-RAY-VAC System.

1. Be sure gas and electric supply to heater are turned OFF before performing any service or maintenance on heater.
2. Remove burner(s) and check its condition.
3. **"A" Series** — Make a visual check of the pilot sensor, shield and spark plug. Clean or replace if there is excessive carbon residue. Replace if there is erosion or other defects.  
**"B" Series** — Make a visual check of electrode. Replace if there is excessive carbon residue, erosion of electrodes or other defects. Gap must be .125 inches.
4. Make a visual check of ceramic and retainer grid. Replace if there is carbon residue or evidence of cracks or holes.
5. Check the burner observation window and gasket. Window should be clean and free of cracks or holes. Clean or replace as necessary.
6. Check firing tube inside and out for holes or cracks. Replace if any defects are found.
7. Check combustion air filter. Replace if contaminated with dirt.
8. Inspect vacuum pump and flue pipe for soot or dirt or any obstruction to the outdoors. After cleaning as necessary, reattach flue pipe.
9. Inspect acoustical boot for cracks or leaks. Replace as necessary.
10. Check for leaks with soap solution on any pipe joints that were disconnected during maintenance procedure before putting heater back in service.
11. Check performance of heater, and visually observe flame for proper flame characteristics.
12. Outside surfaces of heater may be cleaned with damp cloth.
13. Reflectors can be cleaned with window cleaner.
14. Inspect outside air blower and blower intake for leaks or obstructions. Remove or repair as necessary.



# WARRANTY CARD

## CO-RAY-VAC Installation Information

Name \_\_\_\_\_  
Address Where Installed \_\_\_\_\_  
Phone No. \_\_\_\_\_ Person To Contact \_\_\_\_\_  
Installation Date \_\_\_\_\_ Installer \_\_\_\_\_  
Purchased From \_\_\_\_\_  
DID THESE UNITS REPLACE AN EXISTING HEATING SYSTEM?     YES     NO  
Type \_\_\_\_\_ BTU's Replaced \_\_\_\_\_  
CO-RAY-VAC Units No. \_\_\_\_\_ Type \_\_\_\_\_  
Serial No's. \_\_\_\_\_

### Type of Application — Please Indicate

<input type="checkbox"/> AIRPORT FACILITY <input type="checkbox"/> Hangar <input type="checkbox"/> Warehouse <input type="checkbox"/> Other _____	<input type="checkbox"/> FARM IMPLEMENT DEALER <input type="checkbox"/> FIRE STATION <input type="checkbox"/> GARAGE TYPE _____	<input type="checkbox"/> SCHOOL TYPE _____
<input type="checkbox"/> AUTO BODY SHOP <input type="checkbox"/> AUTO DEALER <input type="checkbox"/> AUTO SERVICE SHOP <input type="checkbox"/> ASSEMBLY PLANT <input type="checkbox"/> BOTTLING PLANT OR WAREHOUSE	<input type="checkbox"/> GREENHOUSE <input type="checkbox"/> HOCKEY RINKS <input type="checkbox"/> HIGHWAY DEPT. BUILDING TYPE _____	<input type="checkbox"/> STORE TYPE _____
<input type="checkbox"/> CAR WASH <input type="checkbox"/> CONSTRUCTION EQUIP. DEALER <input type="checkbox"/> FABRICATION PLANT TYPE _____	<input type="checkbox"/> LUMBER COMPANY <input type="checkbox"/> MANUFACTURING PLANT TYPE _____	<input type="checkbox"/> SWIMMING POOL <input type="checkbox"/> TENNIS COURT <input type="checkbox"/> TRUCKING COMPANY <input type="checkbox"/> UTILITY COMPANY BUILDING TYPE _____
<input type="checkbox"/> FARM <input type="checkbox"/> Cattle <input type="checkbox"/> Dairy <input type="checkbox"/> Horse <input type="checkbox"/> Pig <input type="checkbox"/> Poultry	<input type="checkbox"/> MACHINE SHOP <input type="checkbox"/> PUBLIC BUILDING TYPE _____	<input type="checkbox"/> UTILITY TYPE _____
<input type="checkbox"/> FARM BUILDING TYPE _____	<input type="checkbox"/> POST OFFICE <input type="checkbox"/> RESTAURANT TYPE _____	<input type="checkbox"/> WAREHOUSE <input type="checkbox"/> WELD SHOP TYPE _____
		<input type="checkbox"/> ZOO <input type="checkbox"/> OTHER _____

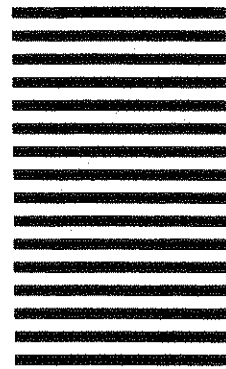


NO POSTAGE  
NECESSARY  
IF MAILED  
IN THE  
UNITED STATES

**BUSINESS REPLY MAIL**

FIRST CLASS PERMIT NO. 7406 BUFFALO, NY

POSTAGE WILL BE PAID BY ADDRESSEE



**Roberts-Gordon, Inc.**  
Subsidiary of A.J. Industries, Inc.  
P.O. Box 44  
Buffalo, NY 14240-0044

**ROBERTS-GORDON, INC.**  
**LIMITED WARRANTY**

**WARRANTY COVERAGE:** ROBERTS-GORDON, INC. ("Seller") warrants that entire heating systems sold by it (individually a "System") and any replacement parts which it sells relating to any System ("Parts") shall be free from defects in workmanship and material for the time periods described as follows. With respect to a System this warranty shall apply for a period of three years from delivery to the original purchaser ("Buyer"). With respect to Parts, this warranty shall apply for the longer of the original System warranty period or for a period of one year. ("Systems" and "Parts" are hereinafter collectively referred to as "Products".) This warranty extends only to the original purchaser of Products.

Seller manufactures products which are designed only to provide predetermined ranges of heat rises in various enclosures when properly used in systems designed by purchaser or others and installed by others. Seller makes no representation or warranty with respect to the effect upon enclosure, or upon any of the contents of the enclosure, including, without limitation, all plant or animal life, kept or processed in the enclosure subject to the limitations outlined below.

**WARNING:** THIS WARRANTY IS VOID IF THE PRODUCTS HAVE BEEN DAMAGED DUE TO ACCIDENT, ABUSE, MISHANDLING OR ANY OTHER CAUSE WHATSOEVER OTHER THAN DEFECTS IN MATERIAL OR WORKMANSHIP. Specifically, Seller's warranty shall not apply: (a) to damage to Products when used in an atmosphere containing halogenated hydrocarbons or other corrosive chemicals. Some compounds in the air can be ingested into the equipment and can cause an accelerated rate of corrosion of some of the Products. The use of such chemical compounds in or near the enclosure should be avoided where a longer life of the burner, tubing and other parts is desirable; (b) to Products which have been repaired or replaced with other than factory parts, modified in any way, misused or damaged; or which have been installed and used contrary to Seller's written instructions or manuals; or (c) to any damage resulting from improper service or a lack of proper maintenance.

**LIMITATIONS OF WARRANTY:** OTHER THAN AS STATED HEREIN OR IN ANY OTHER WRITTEN WARRANTY OF SELLER, THERE ARE NO OTHER WARRANTIES OF ANY KIND WHATSOEVER, EXPRESS OR IMPLIED, AND ALL OTHER EXPRESS AND ALL IMPLIED WARRANTIES OF MERCHANTABILITY AND/OR FITNESS FOR ANY PARTICULAR PURPOSE ARE HEREBY SPECIFICALLY DISCLAIMED.

**EXCLUSIVE REMEDY:** THE SOLE AND EXCLUSIVE REMEDY FOR ANY LOSS, DAMAGE OR LIABILITY, OR OTHERWISE, IS LIMITED TO THE OBLIGATION OF SELLER TO REPAIR OR REPLACE PARTS, AT ITS FACTORY, OF ANY PRODUCT OWNED BY ORIGINAL BUYER AND RETURNED TO SELLER'S FACTORY WITHIN THREE (3) YEARS AFTER SHIPMENT TO JOB SITE IN THE CASE OF SYSTEMS AND WITHIN ONE (1) YEAR AFTER SHIPMENT TO JOB SITE IN THE CASE OF PARTS, TRANSPORTATION CHARGES PREPAID, WHICH EXAMINATION REVEALS TO HAVE BEEN DEFECTIVE. UNDER NO CIRCUMSTANCES SHALL SELLER BE LIABLE FOR ANY LOSS, DAMAGE, COSTS, EXPENSES, OR INCIDENTAL OR CONSEQUENTIAL DAMAGES OF ANY KIND, IN CONNECTION WITH THE SALE, INSTALLATION, USE, MAINTENANCE, OR REPAIR, OF ANY PRODUCT.

**BUYER RESPONSIBLE FOR DATA:** Seller and its representative may furnish Buyer, upon Buyer's request, data relating to the function and use of Products. Seller shall not be liable for loss, damage, cost, expenses or incidental or consequential damages of any kind, sustained directly or indirectly, by any person, or to any property, if Buyer adopts and uses such data in whole or in part.

**LIMITATIONS ON AUTHORITY OF REPRESENTATIVES:** No representative of Seller, other than an Executive Officer, has authority to change or extend these provisions. Changes or extensions shall be binding only if confirmed in writing by Seller's duly authorized Executive Officers.

Direct any questions or warranty claims to the original installer.

Company: \_\_\_\_\_

Address: \_\_\_\_\_

Phone: \_\_\_\_\_

Or to: Warranty Claims, ROBERTS-GORDON, INC., 1250 William Street, Buffalo, New York 14206.

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