

INSTALLATION and OPERATING INSTRUCTIONS

For Use By Qualified Service Technicians Only

CARLIN OIL BURNER MODEL 702CRD

DESCRIPTION

The model 702CRD burner is designed to fire No. 2 fuel oil and is a low-high-low-off (step modulating) high-speed flame retention burner. Oil flow-rate is step-modulated by the use of two oil valves with a dual pressure fuel unit. Combustion air is controlled by a damper motor. Its end-switch energizes the second stage valve as the air shutter approaches the open position.

Model 702CRD is currently for use on H.B. Smith "18" series, Weil-McLain "88" series, and Burnham "V9" series boilers. Other applications should be reviewed with Carlin factory support personnel if questionable.

ASSEMBLING THE BURNER (TWO-PAK)

1. Remove the air tube and nozzle line assembly from the smaller carton. If nozzles are not installed, see instructions under (4).
2. Remove the main housing assembly from the larger carton.
3. Install air tube assembly in housing using set screws provided. Be sure air tube is fully seated against step in housing.
4. Install and tighten the proper nozzles (Table 3, Page 3) in the adapter. Be careful not to damage the electrode insulators or to bend the wires.

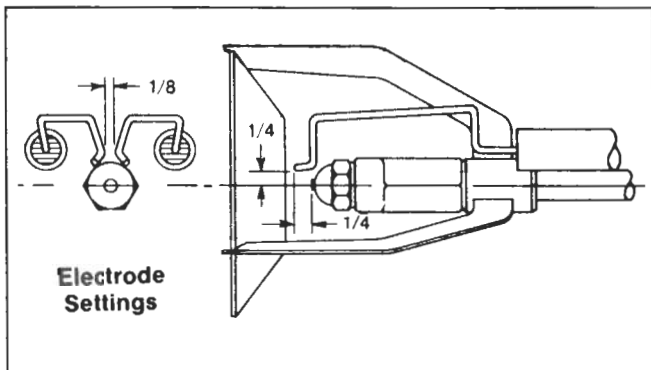
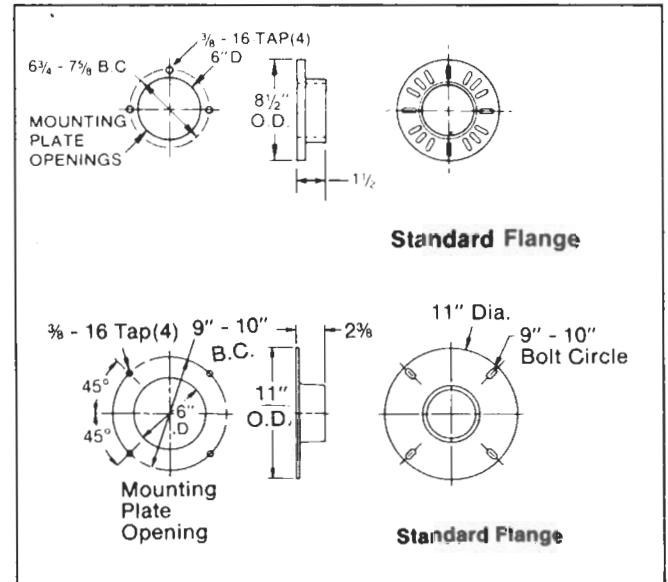


Figure 1. Electrode Settings

5. Check the electrode settings (Figure 1).
6. Swing open the transformer, and slide the nozzle line assembly into the air tube. The flame retention ring must be lifted and guided through the throttle ring (a reduced diameter) in the end of the air tube. DO NOT FORCE IT.
7. Fasten the high tension leads to the transformer terminals.
8. Place the nozzle line yoke in the groove in the adjusting screw.
9. Swing the transformer to the closed position.
10. Connect the flared fitting on the copper oil line to the nozzle line and tighten.
11. See sections on Page 4 for adjustments of combustion head and combustion air.

DIMENSIONS



VENTILATION

Boiler room areas of commercial buildings of normal construction generally do not allow for sufficient air infiltration. Provision must be made for an outside air supply to the boiler room area. This is required because combustion of oil consumes about 30 cfm of air per 1 gph input. To ensure an adequate air supply, provision must be made for 30 cfm per 1 gph plus 50% additional for draft regulator.

Example:

Burner is firing at 6.00 gph. $6 \times 30 = 180$ cfm. Add 50% = 270 cfm. Install an opening of approximately 30 sq. in. free area per 1 gallon per hour input. When louvers are used, consider the free area half of the total.

Example:

Firing 6.00 gph free area = $6 \times 30 = 180$ sq. in. A louvered opening would be $180 \times 2 = 360$ sq. in. gross. Fresh air louvers must be above ground level to prevent obstruction by leaves and snow.

INSTALLING THE BURNER: FLANGE MOUNTED

1. Measure, in the burner opening, the distance from the inside of the combustion chamber to the outside of the mounting plate to find the insertion length of air tube needed. Position flange (Figure 2) with sleeve inside on air tube at a point from end of burner corresponding to this measurement. Tighten set screws to anchor flange. The flange is now located so that the end of the burner will be flush, or almost flush, with the inside of the combustion chamber.
2. Slide the end of the air tube into the opening and secure the flange to the front plate.

INSTALLING THE BURNER: PEDESTAL MOUNTED

1. Adjust the pedestal (Figure 3) so that the height of the air tube matches the location of the burner opening.
2. Slide the end of the air tube into the opening so that it is flush or nearly flush with the inside of the combustion chamber.
3. From the outside of the unit, seal the space around the air tube with asbestos cement or equivalent.

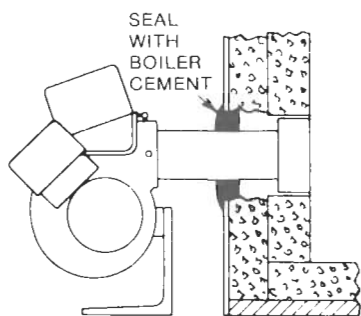
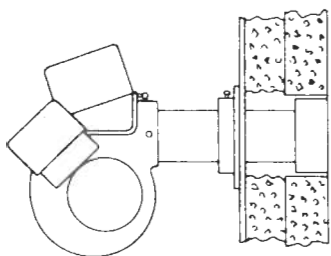


Figure 2. Flange mounted. Figure 3. Pedestal mounted.

FIRING BOILERS WITH COMBUSTION CHAMBERS

The 702CRD burner operates with superior efficiency and cleanliness in properly designed refractory-type combustion chambers (Figure 4). Very wide tolerance to burner adjustments and other variables is found when these chambers are used.

Table 1 shows the recommended minimum inside dimensions for refractory brick, refractory pre-cast and pre-formed refractory fiber chambers. Due to their quick warm-up properties, the light, insulating-type materials are slightly preferable although these burners show less dependence upon refractory temperature than previous models. Refractory materials in boilers and furnaces should be capable of withstanding 2600° F (1427° C) or higher.

The note accompanying Table 1 provides further details relative to variations in dimensions and geometry.

TABLE 1.
MINIMUM DIMENSIONS RECOMMENDED IN
REFRACTORY COMBUSTION CHAMBERS (Inches)

High-Fire Oil Delivery Rate GPH @ 300 PSI	Length "L"	Width "W"	Dim. "C"	Suggested Height "H"	Min. Dia. Vertical Cylinder
5.95	19	13.5	7.0	13	17
6.80	23	14.5	7.0	14	21
7.65	27	15.0	7.5	15	25
8.50	32	15.5	8.0	15	30
9.35	34	16.0	8.0	16	32
10.20	35	16.0	8.0	16	33
11.05	37	16.5	8.5	16	35
11.90	48	16.5	8.5	16	46
12.75	55	16.5	8.5	16	53

Note: These are minimum dimensions and each may be exceeded without much effect.

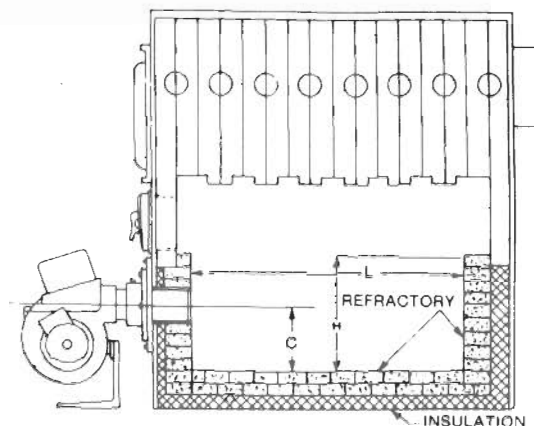


Figure 4. Brick combustion chamber (side view).

FIRING BOILERS WITHOUT REFRACTORY CHAMBERS

Depending upon the geometry of the combustion space, some units perform better than others without refractory (Figures 5 and 6). When the back wall of the unit coincides approximately with the end of the flame, a target of refractory material is usually required.

Table 2 shows minimum dimensions required for good combustion *without* refractory. They may be exceeded without much effect.

TABLE 2.
MINIMUM DIMENSIONS RECOMMENDED IN BOILERS
FIRED WITHOUT COMBUSTION CHAMBERS (Inches)

High-Fire Oil Delivery Rate GPH @ 300 PSI	"L" With Target	"L" Without Target	Width "W"	Dim. "C"	Dim. "D"
5.95	19	23	15.5	8.0	10.0
6.80	23	27	16.5	8.0	10.0
7.65	27	32	17.0	8.5	10.5
8.50	32	37	17.5	9.0	11.0
9.35	34	40	18.0	9.0	11.0
10.20	35	41	18.0	9.0	11.0
11.05	37	43	18.5	9.5	11.5
11.90	48	54	18.5	9.5	11.5
12.75	55	61	18.5	9.5	11.5

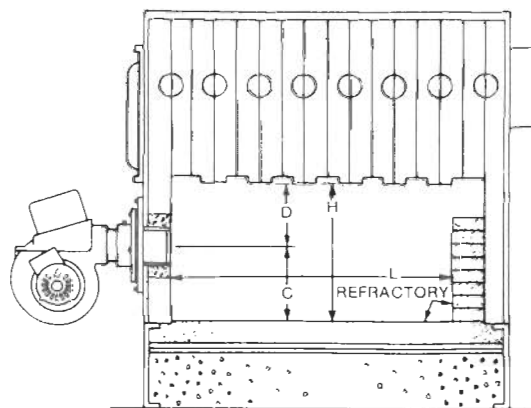


Figure 5. Wet leg boiler. No combustion chamber (side view).

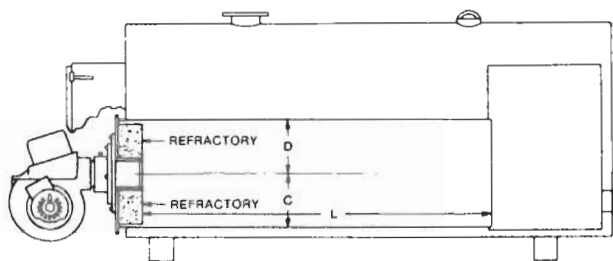


Figure 6. Scotch Marine boiler. No combustion chamber.

OPERATION

1. Call for heat. Burner motor and ignition are energized. Air is in the *low-fire* position. The *low-fire* oil valve admits oil at 100 psi to the nozzle and its spray ignites, burning clean with proper air/fuel ratio.
2. If demand exceeds *low-fire*, the damper motor is energized through a *high-fire* operating control (aquastat, airstat, pressuretrol, or outdoor thermostat). As the damper motor approaches a half open position, the auxiliary end switch energizes the *high-fire* valve on the fuel unit, closing the by-pass port, and increasing the nozzle pressure to 300 psi. Thus the full fire with open air burns clean with high CO₂ and high efficiency.
3. As the *high-fire* input begins to exceed the demand of the *high-fire* operator, the operating control de-energizes the damper motor. As the damper motor returns the air shutter to *low-fire*, the auxiliary end switch in the damper motor de-energizes the *high-fire* valve which drops the nozzle pressure to 100 psi.
4. If the demand exceeds *low-fire*, the *high-fire* operating control would again call for more heat as in Step 2 and then Step 3.
5. If, after returning to *low-fire*, the load should drop to below the *low-fire* output, the operating limit would shut off the burner completely.

It is important that the installation of the oil burner, piping and fittings, safety devices, controls, electrical wiring and equipment be done in accordance with national and/or local regulations of the authorities having jurisdiction over such installation.

Table 3.
NOZZLE DATA AND COMBUSTION HEAD SETTINGS

Nozzle Size	Low Fire Pres.**	Low Fire Rate GPH	Head Setting 'A' (Inch)	Low Fire 'X' Air Open (Inch)	High Fire Pres.**	High Fire Rate
3.50	100	3.50	0	3/8	300	5.95
3.75	100	3.75	1/16	3/8	300	6.38
4.00	100	4.00	1/8	3/8	300	6.80
4.50	100	4.50	3/16	3/8	300	7.65
5.00	100	5.00	1/4	3/8	300	8.50
5.50	100	5.50	5/16	3/8	300	9.35
6.00	100	6.00	7/16	7/16	300	10.20
6.50	100	6.50	5/8	7/16	300	11.05
7.00	100	7.00	7/8	1/2	300	11.90
7.50	100	7.50	1 1/4	1/2	300	12.75

* The "low-fire" pump pressures shown are recommended. If higher low-fire inputs are desired for a given situation, the low-fire pressure can be increased only up to 200 psi. Higher low-fire pressures will require higher low-fire air openings.

** The "high-fire" pressure is set at the factory to 300 psi. This is the maximum UL rating for the fuel unit, so higher pressures are not recommended.

NOZZLE SPECIFICATIONS

The 60° P Hago nozzle is the standard nozzle and usually provides the best fire. Substitutions are sometimes recommended in specific packaged boilers.

Following is a list of nozzle specifications for packaged boilers presently using the 702CRD burner:

- Burnham Series V907 - V910: 70° B, Delavan
- Burnham Series V911: 60° PLP Monarch
- H. B. Smith Series 18: 9-11 Section, 45° P Hago
- H. B. Smith Series 19: 7-11 Section, 60° P Hago
- Weil-McLain 488, 488R: 60° PLP Monarch
- Weil-McLain 588: 70° P Hago.

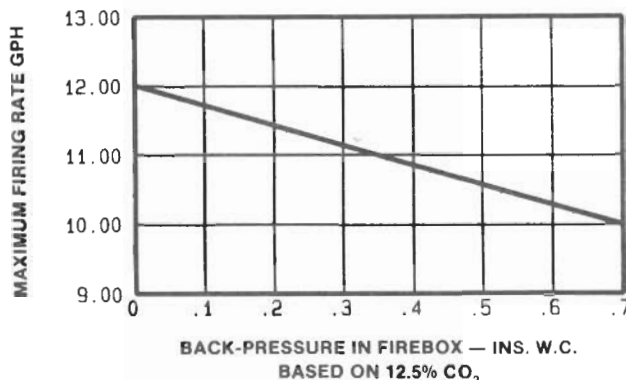
Other makes of nozzles may or may not prove satisfactory. For special applications, other specifications might provide a more desirable pattern.

FORCED DRAFT FIRING

Due to the back pressure in forced draft units, the maximum firing rate of a burner is reduced. The greater the pressure, the lower the maximum GPH capability becomes. Table 4 shows this. Note that the Table stops at 0.70 inches W.C., the maximum recommended back pressure for the 702CRD burner.

The combustion head settings for forced draft firing would be somewhat greater than those shown in Table 3 which is for zero pressure or natural draft.

TABLE 4.
MAXIMUM FIRING RATES (GPH) — FORCED DRAFT



HOW TO ADJUST THE COMBUSTION HEAD

The retention ring position ahead of the throttle ring is adjustable from zero (flush) to 1/4 inches (Dimension "A," Figures 7 and 8). Turning the adjusting screw (clockwise) increases the distance "A" ahead. This distance is indicated by lifting the housing cover and reading the scale on the nozzle line across the corners on sides of the channel guiding the nozzle line. Each division is 1/16 inch.

Refer to "A" dimension (Table 3) for corresponding nozzle selection. **Example:** 702CRD burner firing at 6.80 GPH *high-fire* setting, Column "A" reads 1/8-inch.

1. Turn adjusting screw counter clockwise until zero on scale is aligned with rear of housing. ("A" equals zero, see Figure 8.)
2. Now turn adjusting screw clockwise until the 1/8-inch graduation on the scale coincides with rear of housing. Each mark (or line) is 1/16 inch. (See Figure 8.)
3. The retention ring will now be 1/8-inch ahead of the throttle ring. (See "A" dimension, Figure 7.)

CAUTION: Housing cover should be raised slightly when attempting to change retention ring setting ("A" dimension) otherwise scale will be torn or distorted. This can be done by backing out the two hold-down screws 2 to 3 turns, and then lifting cover slightly while adjusting. Be sure to tighten screws after adjusting.

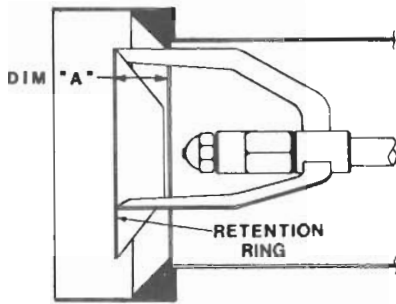


Figure 7. Dimension "A".

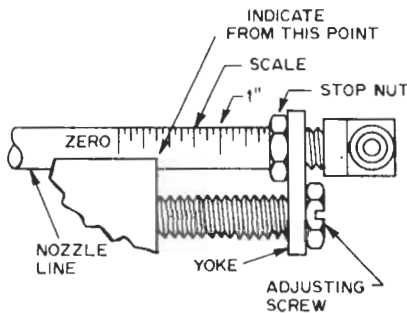


Figure 8. Combustion Head Adjustment.

COMBUSTION HEAD ADJUSTMENT FOR COMBUSTION AIR

When adjusting the combustion head forward or back, the space around the rim of the retention ring is increased or decreased which increases or decreases the amount of combustion air to correspond with the nozzle sizes used.

Also, by using the specified nozzle, the air fuel ratio for both *low* and *high-fire* are optimized by the automatic damper motor and its associated linkage. **This linkage has been pre-set at the factory and should not be adjusted.** It is set to be in the fully open position when the burner is in *high-fire*.

By adjusting the combustion head for the firing rate delivered by the particular nozzle, the burner should deliver very close to the proper amount of combustion air and CO₂. Slight increases or decreases will usually be required depending upon the draft. Normally a draft of 0.02 to 0.04 inches W.C. (negative pressure) is recommended over the fire for natural draft applications.

Adjust the combustion head only while in high-fire. The burner is provided with a *low-fire* air shutter adjusting screw. This adjustment limits the amount of shutter closure which thereby increases or decreases the amount of combustion air required for proper burning.

WIRING FOR LOW-HIGH-LOW STEP MODULATION

In order to take full advantage of the energy savings potential of the 702CRD burner, it should be wired to operate with *low-high-low* cycles. Hence the firing cycle would be much longer by going from *low* to *high* to *low* once or several times before shutting off.

The following examples illustrate wiring for a "Water Boiler" (Figure 9), and a "Steam Boiler" (Figure 10). In each case we have a limit circuit which starts and stops the burner and a *high-fire* control which brings the *high-fire* on and off.

Also, prewired and built into the burner is a manual *high-fire* switch which enables the installer or operator to hold the burner on *low-fire* if so desired.

Refer to the appropriate example for your installation.

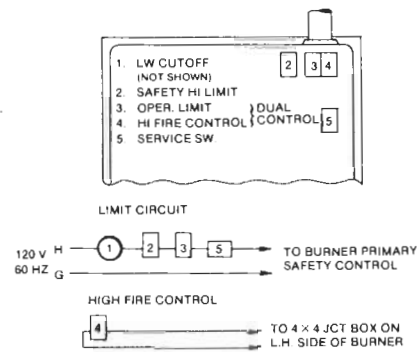


Figure 9. Wiring for Low-High Step Modulation in "Water Boiler".

Example: Water Boiler

Operating Range: 170° — 190° F

2. Set Safety Hi Limit: Cut in 200 — Cut out 210
3. Set Operating Limit: Cut in 180 — Cut out 190
4. Set Hi-Fire Control: Cut in 170 — Cut out 180

Operation:

1. Call for heat; cold start. Burner starts on low and goes to *high-fire*.
2. When the temperature rises to 180° F the burner goes to *low-fire*.
3. If temperature drops to 170° F burner returns to *high-fire*.
4. If temperature rises to 190° F burner shuts off.

NOTE: Since the calibrations on the limit controls are seldom exact, it will be necessary to readjust the settings during operation.

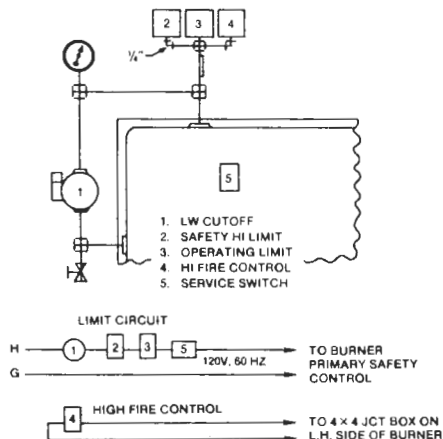


Figure 10. Wiring for Low-High-Low Step Modulation in "Steam Boiler".

Example: Steam Boiler

Operating Range: 3 to 6 PSI

2. Set Safety Hi Limit: Cut in 8 PSI — Cut out 10 PSI
3. Set Operating Limit: Cut in 5 PSI — Cut out 6 PSI
4. Set Hi-Fire Control: Cut in 3 PSI — Cut out 4 PSI

Operation:

1. Call for heat; cold start. Burner starts on low and goes to *high-fire*.
2. When pressure rises to 4 PSI the burner goes to *low-fire*.
3. If pressure drops to 3 PSI burner returns to *high-fire*.
4. If pressure rises to 6 PSI burner shuts off.

NOTE: Since the calibrations on the limit controls are seldom exact, it will be necessary to readjust the settings during operation.

FUEL UNIT AND OIL LINES

The 702CRD burner is provided with a two-stage dual pressure fuel unit. *Low-fire* operating pressure is 100 psi, adjusted by turning the slotted screw located on top of the solenoid coil on the pump (See Figure 11.) The *high-fire* operating pressure is 300 psi. The high pressure is adjusted by the screw opposite the nozzle port on the pump while the burner is in the *high-fire* mode.

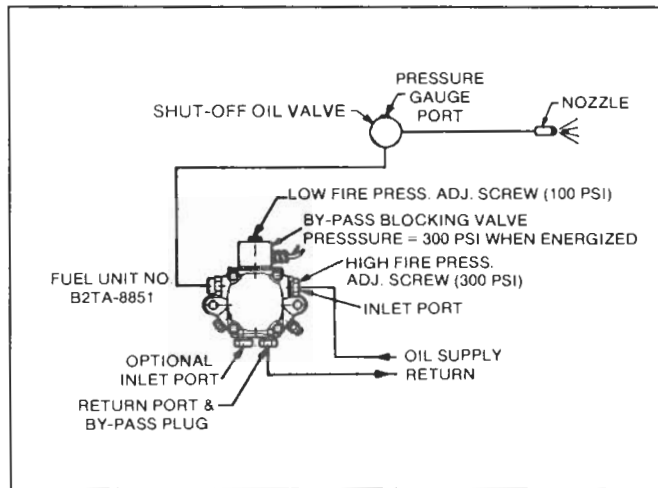


Figure 11. Two-stage Dual Pressure Fuel Unit.

A single-pipe system is recommended whenever the bottom of the fuel tank is above the burner or is at the same level as the burner. This includes outdoor fuel tanks that are at such levels. The length of run should not exceed 100 ft. and the vacuum should not exceed 12" mercury. Be sure the by-pass plug has been removed for single-pipe systems.

A two-pipe system is recommended when the fuel tank is below the level of the burner, and the fuel unit must pull (lift) the fuel up to the burner. The vacuum reading should not exceed 12" mercury. For two-pipe installations the by-pass plug must be installed.

Table 5 shows, for the standard two-stage fuel unit, the allowable lift and lengths of $\frac{3}{8}$ " and $\frac{1}{2}$ " OD tubing for both suction and return lines in two-pipe systems.

**TABLE 5.
TWO-PIPE SYSTEMS**

Lift (Feet)	Length of Tubing (Feet)	
	$\frac{3}{8}$ " OD	$\frac{1}{2}$ " OD
0	41	100
2	37	100
4	32	100
6	28	100
8	24	96
10	20	80
12	16	64
14	—	48
16	—	32

Be sure that all oil line connections are absolutely airtight. Check all connections and joints. Flared fittings are recommended. Do not use compression fittings.

Open the air-bleed valve and start the burner. For clean bleed, slip a $\frac{3}{16}$ " ID hose over the end of the bleed valve and bleed into a container. Continue to bleed for 15 seconds after oil is free of air bubbles. Stop the burner and close the bleed valve.

LIGHT-OFF AND ADJUSTMENT

Before starting the burner, pre-set the retention ring position for the particular firing rate according to Table 3.

If the fire is a little too rich, move the combustion head forward by increasing dimension "A," Figures 7 and 8. At the lower inputs, a very slight change is usually enough. **DO NOT ALTER THE LINKAGE. IT IS PRE-SET AT THE FACTORY.**

Adjust draft to 0.02 to 0.04 inches W.C. over the fire for natural draft units.

Run a smoke test. Strive for zero or a trace. Each time further adjustment of retention ring is made, reset the draft to 0.02 to 0.04 inches W.C. over the fire.

Check CO₂. This should be 12 to 12½%.

Check for good ignition and clean cut-off. If cut-off continues to be poor, look for air leaks in the suction line, filters or valves and correct them.

For different boiler applications, it is sometimes necessary to have the *high-fire* pull in earlier or later than normal during the swing to achieve a smooth, cleaner transition.

If the swing from *low-fire* to *high-fire* is rough, i.e., bangs or rumbles, or is extremely smoky, the internal end switch of the damper motor is possibly not set correctly. The *high-fire* should pull in when the air shutter (**not the damper arm**) is about half way through its swing.

If the fire is lean all the way to *high-fire*, the *high-fire* valve should be energized earlier. If during the swing, the fire gets very smoky, then cleans up again, the *high-fire* valve should be energized later.

To adjust the damper end switch, remove the damper motor cover. This will expose a white plastic gear with notches. With the burner off, use the end of a small blade screwdriver inserted into one of the notches of the white gear. Turn the gear one notch clockwise if a later pull-in is required, or counter clockwise for an earlier pull-in.

The linkage between the damper motor arm and the air shutter crank is set at the factory and should only need adjustment if the damper motor or damper rod is replaced. With the burner in *high-fire*, there should be minimal play in the connecting rod.

1-YEAR LIMITED WARRANTY

For Commercial Oil Burners Over 3 GPH

The Carlin Company warrants its commercial oil burners to be free from defects in material and workmanship under normal use and service for 12 months from the date of manufacture.

This warranty does not extend to equipment subjected to misuse, neglect, or accident; nor does this warranty apply unless the product covered by it is properly installed by a qualified, competent technician, who is licensed where state or local codes require, and who is experienced in making such installations, in accordance with NFPA No. 31 of the National Fire Protection Association and in accordance with all applicable local, state and national codes. Equipment that is defective in material or workmanship and within the warranty period will be repaired or replaced as follows:

1. Motors, fuel units, transformers and other components should be sent for repair or replacement to an authorized service point or distributor of the manufacturer of such components when reasonably available in Customer's locality.
2. Where such local service is not available with respect to the above listed components, or where other components are involved, such defective equipment should be returned, freight prepaid to The Carlin Company. The repaired equipment or replacement will be provided to the Customer freight prepaid by The Carlin Company unless the returned equipment is determined by The Carlin Company to be out of warranty or not to be defective, in which case, it will be returned to the Customer F.O.B., The Carlin Company, Windsor, Connecticut.
3. The Carlin Company is not responsible for any labor cost for removal and replacement of equipment.
4. Equipment that is repaired or replaced will carry the unexpired portion of the original equipment warranty.
5. If inspection by The Carlin Company does not disclose any defect covered by this warranty, the equipment will be repaired or replaced at the expense of Customer, and The Carlin Company's regular charges will apply.

This warranty is limited to the precise terms set forth above, and provides exclusive remedies expressly in lieu of all other remedies and in particular there shall be excluded the implied warranties of merchantability and fitness for a particular purpose. In no event will The Carlin Company be liable for any incidental or consequential damage of any nature. The Carlin Company neither assumes nor authorizes any person to assume for The Carlin Company any other liability or obligation in connection with the sale of this equipment. The Carlin Company's liability and Customer's exclusive remedy being limited to repairs or replacement as set forth above.



NOTES



70 Maple Street
East Longmeadow, MA 01028
413-525-7700 Fax 413-525-8306