| Installation Guide 130 |
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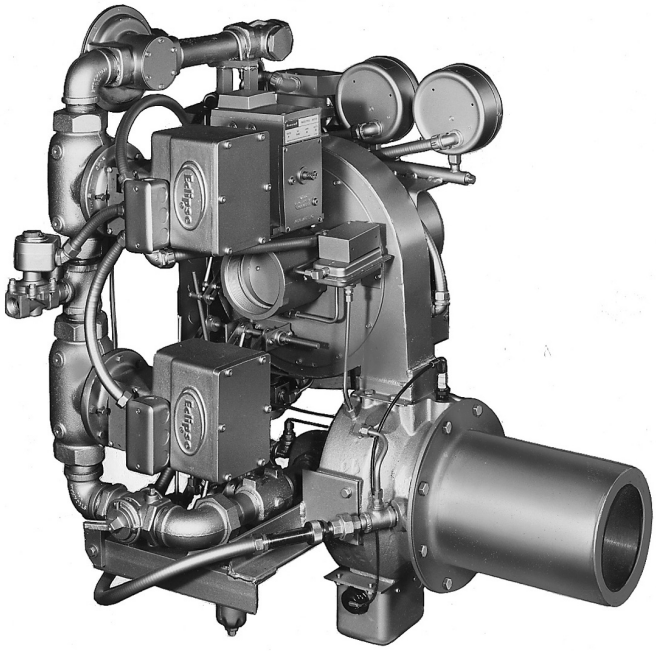
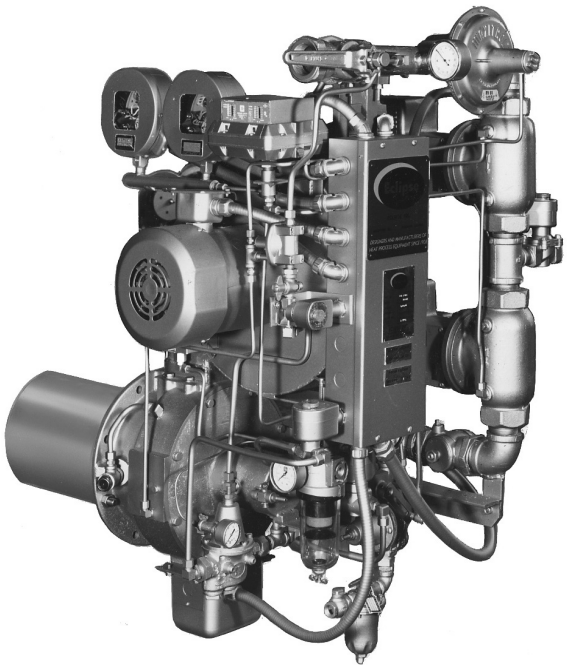
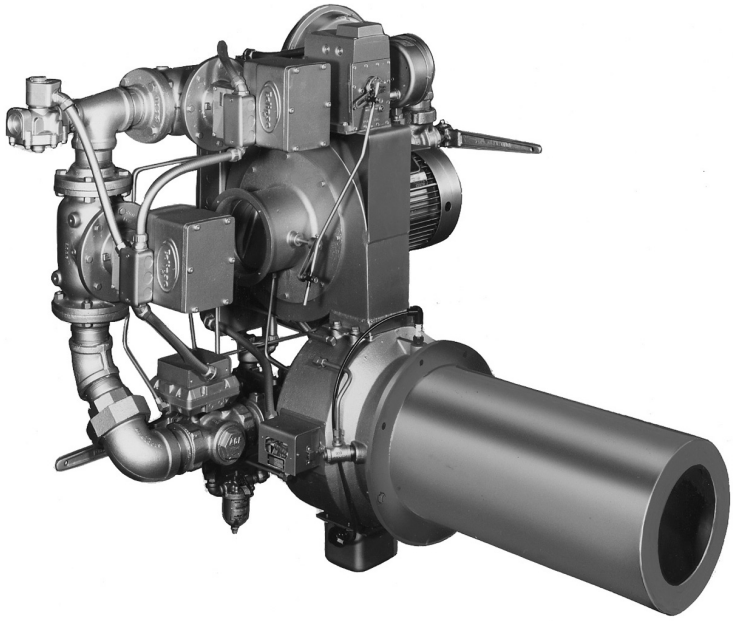
| 3/1986 |

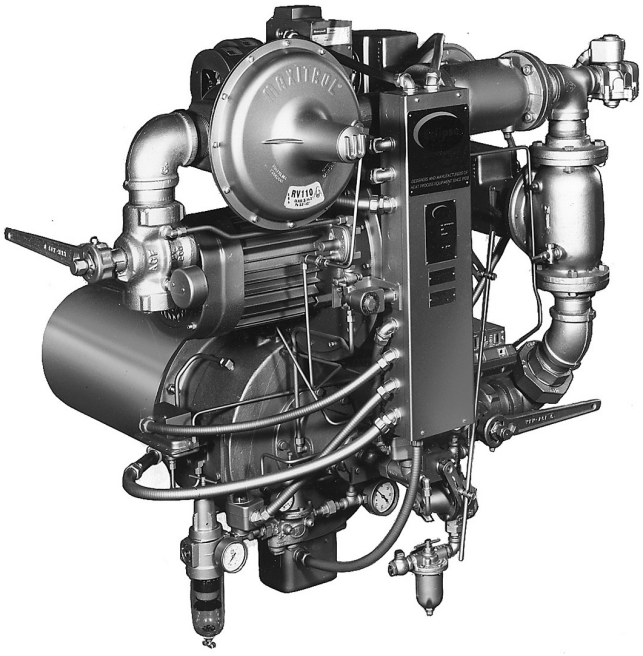
# Eclipse Mark IV Combination Gas/Oil Burners

*Series "MF"*









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There are several special symbols in this document. You must know their meaning and importance.

The explanation of these symbols follows below. Please read it thoroughly.

## How To Get Help

If you need help, contact your local Eclipse representative. You can also contact Eclipse at:

1665 Elmwood Rd.
Rockford, Illinois 61103 U.S.A.
Phone: 815-877-3031
Fax: 815-877-3336
http://www.eclipsenet.com

Please have the information on the product label available when contacting the factory so we may better serve you.

ECLIPSE Innovative Thermal Solutions www.eclipsenet.com
Product Name
Item #
S/N
DD MMM YYYY

| | |
|---|---|
|  | This is the safety alert symbol. It is used to alert you to potential personal injurt hazards. Obey all safety messages that follow this symbol to avoid possible injury or death. |
|  | Indicates a hazardous situation which, if not avoided, will result in death or serious injury. |
|  | Indicates a hazardous situation which, if not avoided, could result in death or serious injury. |
|  | Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury. |
| ***NOTICE*** | Is used to address practices not related to personal injury. |
| **NOTE** | Indicates an important part of text. Read thoroughly. |

# Table of Contents

# Introduction 1

## Product Description

Eclipse Mark IV Burners are packaged, nozzle-mixing, combination gas/oil burners for use in process heating applications including ovens and dryers. Mark IV burners can be used with any commercially available fuel gas and with fuel oils up to #2 oil.

Mark IV burners have been used to dry paint, paper and paper products, fabric, food products, ink, laminates, packaging film, carpets and a wide variety of other products. In addition, the Mark IV is capable of firing boilers, furnaces, incinerators, metal smelters and other equipment requiring a combustion block.

**Figure 1.1 Mark IV Burner**

## Audience

This manual has been written for people who are already familiar with all aspects of a nozzle-mix burner and its add-on components, also referred to as “the burner system”.

These aspects are:

- Design / Selection
- Use
- Maintenance

The audience is expected to have previous experience with this type of equipment.

## Mark IV Documents

**Installation Guide 130**

- This document

**Datasheet 130**

- Required to complete design and selection

**Related Documents**

- EFE 825 (Combustion Engineering Guide)
- Eclipse Bulletins and Info Guides: 684, 710, 732, 756, 760, 902, 930

# Safety

# 2

Important notices which help provide safe burner operation will be found in this section. To avoid personal injury and damage to the property or facility, the following warnings must be observed. All involved personnel should read this entire manual carefully before attempting to start or operate this system. If any part of the information in this manual is not understood, contact Eclipse before continuing.

## Safety Warnings

**⚠ DANGER**

- **The burners, described herein, are designed to mix fuel with air and burn the resulting mixture. All fuel burning devices are capable of producing fires and explosions if improperly applied, installed, adjusted, controlled or maintained.**
- **Do not bypass any safety feature; fire or explosion could result.**
- **Never try to light a burner if it shows signs of damage or malfunction.**

**⚠ WARNING**

- **The burner and duct sections are likely to have HOT surfaces. Always wear the appropriate protective equipment when approaching the burner.**
- **Eclipse products are designed to minimize the use of materials that contain crystalline silica. Examples of these chemicals are: respirable crystalline silica from bricks, cement or other masonry products and respirable refractory ceramic fibers from insulating blankets, boards, or gaskets. Despite these efforts, dust created by sanding, sawing, grinding, cutting and other construction activities could release crystalline silica. Crystalline silica is known to cause cancer, and health risks from the exposure to these chemicals vary depending on the frequency and length of exposure to these chemicals. To reduce the risk, limit exposure to these chemicals, work in a well-ventilated area and wear approved personal protective safety equipment for these chemicals.**

***NOTICE***

- **This manual provides information regarding the use of these burners for their specific design purpose. Do not deviate from any instructions or application limits described herein without written approval from Eclipse.**

## Capabilities

Only qualified personnel, with sufficient mechanical aptitude and experience with combustion equipment, should adjust, maintain or troubleshoot any mechanical or electrical part of this system. Contact Eclipse for any needed commissioning assistance.

## Operator Training

The best safety precaution is an alert and trained operator. Train new operators thoroughly and have them demonstrate an adequate understanding of the equipment and its operation. A regular retraining schedule should be administered to ensure operators maintain a high degree of proficiency. Contact Eclipse for any needed site-specific training.

## Replacement Parts

Order replacement parts from Eclipse only. All Eclipse approved valves or switches should carry UL, FM, CSA, CGA and/or CE approval where applicable.

# Installation 3

## Introduction

In this chapter you will find information and instructions needed to install the burner and system components.

## Handling & Storage

### Handling

- Make sure that the area is clean.
- Protect the components from the weather, damage, dirt and moisture.
- Protect the components from excessive temperatures and humidity.
- Take care not to drop or damage components.

### Storage

- Make sure that the components are clean and free of damage.
- Store the components in a cool, clean, dry room.
- After you have made sure that everything is present and in good condition, keep the components in the original package as long as possible.

## Approval of Components

### Limit Controls & Safety Equipment

All limit controls and safety equipment must comply with all applicable local codes and/or standards and must be listed for combustion safety by an independent testing agency. Typical application examples include:

- American: NFPA 86 with listing marks from UL, FM, CSA
- European: EN 746-2 with CE mark from TuV, Gastec, Advantica

### Electrical Wiring

All the electrical wiring must comply with all applicable local codes and/or standards such as:

- NFPA Standard 70
- IEC60364
- CSA C22
- BS7671

### Gas Piping

All the gas piping must comply with all applicable local codes and/or standards such as:

- NFPA Standard 54
- ANSI Z223
- EN 746-2

### Where to Get the Standards:

**The NFPA Standards are available from:**
National Fire Protection Agency
Batterymarch Park
Quincy, MA 02269
www.nfpa.org

**The ANSI Standards are available from:**
American National Standard Institute
1430 Broadway
New York, NY 10018
www.ansi.org

**The UL Standards are available from:**
333 Pfingsten Road
Northbrook, IL 60062
www.ul.com

**The FM Standards are available from:**
1151 Boston-Providence Turnpike
PO Box 9102
Norwood, MA 02062
www.fmglobal.com/approvals

**Information on the EN standards and where to get them is available from:**
Comité Européen de Normalisation
Stassartstraat 36
B-1050 Brussels
Phone: +32-25196811
Fax: +32-25196819
www.cen.eu

Comité Européen de Normalisation Electronique
Stassartstraat 36
B-1050 Brussels
Phone: +32-25196871
Fax: +32-25196919
www.cenelec.org

## Checklist Before Installation

### Intake

To admit fresh combustion air from outdoors, provide an opening in the room of at least one square inch per 4,000 Btu/h (1.17 kW). If there are corrosive fumes or materials in the air, then supply the burner with clean air from an uncontaminated area, or provide a sufficient air filtering system.

### Exhaust

Do not allow exhaust fumes to accumulate in the work area. Provide some positive means for exhausting from the furnace and the building.

### Access

Make sure that you install the burner in such a way that you can gain easy access for inspection and maintenance.

### Environment

Make sure the local environment matches the original operating specifications. Check the following items:

- Voltage, frequency and stability of the electrical power
- Type and supply pressure of the fuel
- Availability of enough fresh, clean combustion air
- Humidity, altitude and temperature of air
- Presence of damaging corrosive gases in the air
- Prevent direct exposure to water

## Mounting the Burner (see Figures 3.1 and 3.2)

1. Figure 3.1 illustrates burner mounting when there is access to the inside of the appliance wall. This method is preferred since the tube can be removed for replacement or to allow servicing of the nozzle without disturbing the burner or its linkage and piping. Figure 3.2 illustrates burner mounting when there is no access to the inside of th appliance wall. The studs are pressed in or welded to the wall. The burner and the tube mount from the outside. The nozzle can be removed through the rear of the burner in these installations.
2. If the burner weight is to be supported entirely by the appliance wall, the wall must be at least 1/4" thick plate. If it is not, support must be provided for the burner.
3. Bolts or studs can be utilized to mount the burner and firing tube to the appliance wall. Care should be taken to match the mounting bolt pattern to the burner mounting flange bolt circle. All Mark IV burners and firing tubes have (8) 9/16" diameter holes for mounting. Bolt circle diameters are as follows: 100 and 200 MF, 10-1/2"; 300 and 500 MF, 14-5/8". Bolts or studs used for mounting should be 1/2" NC
4. An adequately sized opening must be provided in the appliance wall to grant clearance for the burner firing tube. If the appliance wall is insulated, 4" additional cleareance should be provided all around the firing tube so air can circulate around the tube and protect the firing tube from overheating in the area of the insulation.
5. If the burner has been supplied with a combustion block, refer to P-5 Installaiton Instructions covering combustion blocks and block holders.

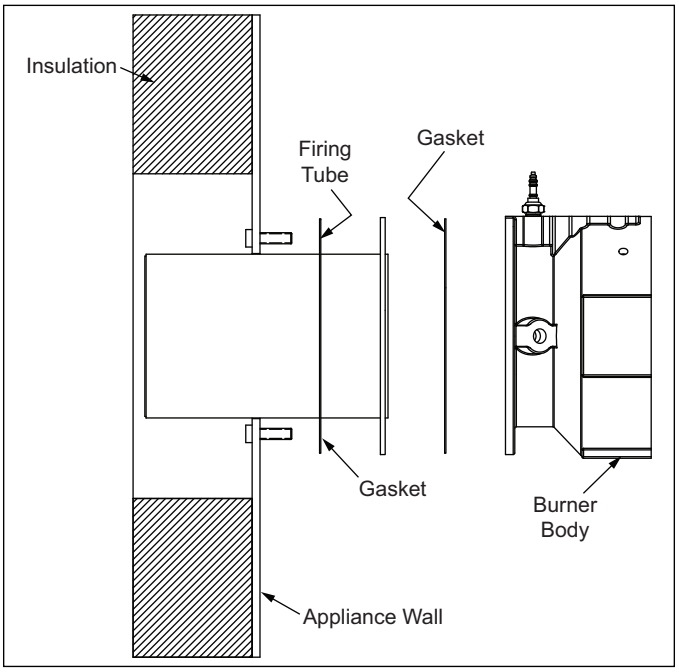


**Figure 3.1. Mounting with Access to Inside of Appliance**

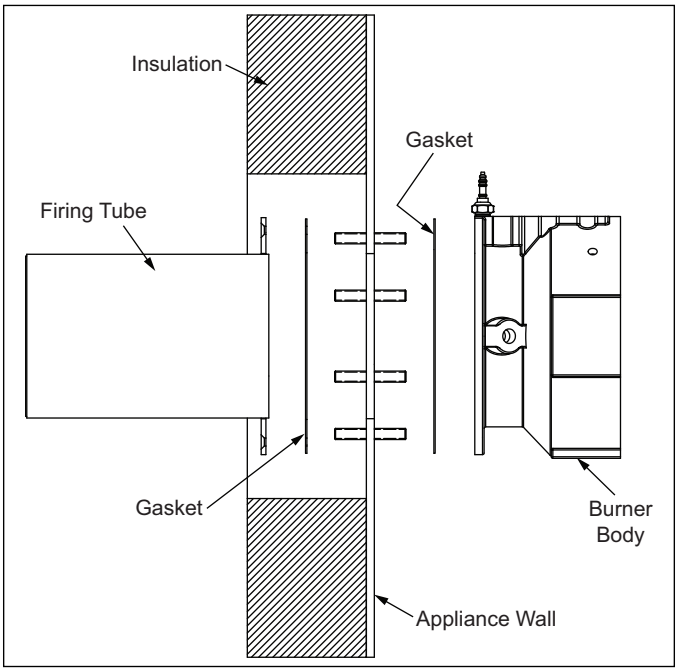


**Figure 3.2. Mounting with No Access to Inside of Appliance**

## Electrical Connections

1. All electrical equipment furnished with the "complete" Mark IV burner is prewired to a terminal strip. See Figure 3.3.
2. A combustion control panel is required for all Mark IV burners. Figure 3.4 illustrates the suggested control panel wiring diagram and operating sequence.

   Interface wiring between the control panel and the burner terminal strip must be done correctly and electrical sources supplying power to the burner must be of proper voltage and frequency. The three phase motor supplied with the Mark IV burner to drive the combustion air fan has been wired for the voltage requested on the customer's order. If motor voltage is questioned, check motor nameplate and physical wiring in the motor terminal box.

   The Eclipse Mark IV burner is not supplied standard with flame monitoring equipment. Eclipse offers three different scanner mounting parts groups: a PCI scanner; a Honeywell scanner; or a Fireye scanner. If ordered, each is installed on the burner with necessary fittings and conduit and wired to the terminal strip. It is the customer's responsibility to provide a compatible relay in the control panel. If the Mark IV burner has been ordered without one of the three scanner mounting parts groups, it is also the customer's responsibility to provide a scanner for mounting on the burner and all wiring from the scanner to the relay.

***NOTICE***

- **Do not attempt to operate this burner without adequate flame monitoring equipment. The owner/user and/or his insurance underwriter must assume responsibility for the acceptance, use, and proper maintenance of the limit controls and other safety devices included with this burner. They must also assume responsibility of the flame supervision provided in the control panel, the interfacing of all electrical equipment, and the sequencing of burner operation between the control panel and the burner.**

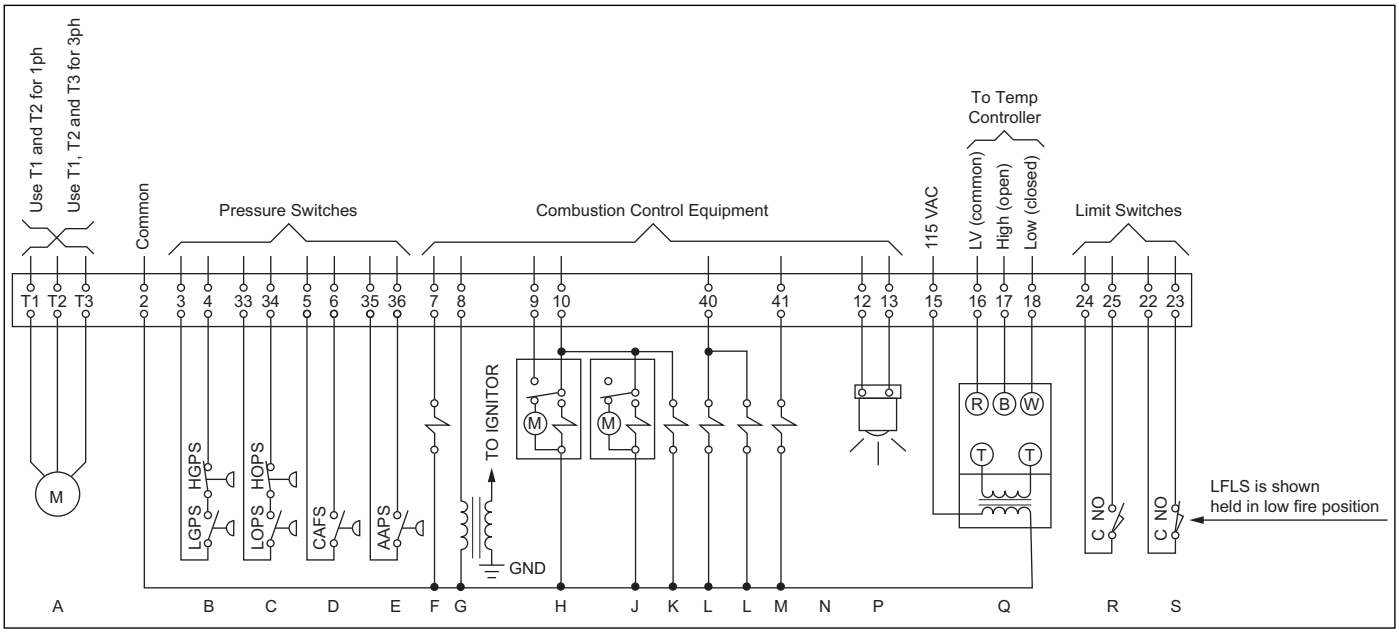


**Figure 3.3. Terminal Strip Wiring Diagram for MF-CGO-IRI (FIA) Burner**

| | |
|---|---|
| A | Combustion Blower Motor |
| B | Low and High Gas Pressure Switches |
| C | Low and High Oil Pressure Switches |
| D | Combustion Air Flow Switch |
| E | Atomizing Air Pressure Switch |
| F | Pilot Valve |
| G | Ignition Transformer (115/6000 V) |
| H | Automatic Main Gas Valve |
| J | Automatic Gas Shutoff Valve |

| | |
|---|---|
| K | Vent Valve |
| L | Main Oil Shutoff Valves, #1 and #2 |
| M | Atomizing Air Valve |
| N | |
| P | Ultraviolet Flame Detector |
| Q | Control Motor M941-A with Cover Mounted Transformer |
| R | High Fire Proving Limit Switch (optional) |
| S | Low Fire Proving Limit Switch (optional) |

## Sequence of Operation for Suggested Control Panel

### Gas Operation Sequence

Power on, fuel selector in "GAS" position.

1. The "start" push button is depressed, powering the motor starter (MS) coil through the "MS-OLS" NC contacts.
2. The MS NO auxiliary contacts close; to hold in the start circuit and initiate the FS limit circuit.
3. The combustion blower motor starts to run and the combustion air flow switch (CAFS) closes, causing the "blower on" yellow light to illuminate.
4. If the customer's external limiting circuit (ELC) is closed and all necessary fuel pressure switches are closed, power will pass through both the "gas-oil" selector switch and the TR2 and CR2 NC contacts to energize the CR1 relay.
5. The CR1 NC and NO contacts reverse to drive TCA control motor to the high fire (open register) position.
6. The high fire proving limit switch (HFLS) closes to power the pre-purge timer (PPT) and illuminate the "purging" amber light through PPT NC contact.
7. When the 0 - 5 minute adjustable, pre-purge timer times out, it switches to energize the CR2 relay and turn off the "purging" amber light.
8. The CR2 NC contact opens to de-energize the CR1 relay, and the CR2 NO contact closes for the PPT timer holding circuit.
9. The CR1 NC and NO contacts return to normal position and the TCA control motor drives back to low.
10. The low fire proving limit switch (LFLS) closes to power terminal 1 on the protectofier and starts the ignition cycle.
11. Protectofier terminal 3 powers the ignition transformer through TR1 NC contact, the pilot valve through TR2 NC contact, and the TR1 timed relay (10 seconds).
12. Protectofier terminal 5 powers the "flame on" blue light.
13. After a 10 second delay, the TR1 NC contact opens to de-energize the ignition transformer, the TR1 NO contact closes to hold in the circuit around the PPT timer and the LFLS, and the TR1 NO contact closes to energize the main gas valve, the gas shutoff valve and the vent valve.
14. When the main gas valve is fully opened, it switches to illuminate the "gas burner on" green light and to energize the TR2 timed relay (10 seconds).
15. After a 10 second delay, the TR2 NC contact opens to reset the purge timer, the TR2 NC contact opens to de-energize the pilot gas valve, and the TR2 NC and NO contacts reverse to release the TCA control motor from low fire start.
16. The burner is now on (flame proven) and operating from the temperature controller.

### Oil Operation Sequence

Power on, fuel selector in "OIL" position.

1. The "start" push button is depressed, powering the motor starter (MS) coil through the "MS-OLS" NC contacts.
2. The MS NO auxiliary contacts close; to hold in the start circuit and initiate the FS limit circuit.
3. The combustion blower motor starts to run and the combustion air flow switch (CAFS) closes, causing the "blower on" yellow light to illuminate.
4. If the customer's external limiting circuit (ELC) is closed and all necessary fuel pressure switches are closed, power will pass through both the "gas-oil" selector switch and the TR2 and CR2 NC contacts to energize the CR1 relay.
5. The CR1 NC and NO contacts reverse to drive TCA control motor to the high fire (open register) position.
6. The high fire proving limit switch (HFLS) closes to power the pre-purge timer (PPT) and illuminate the "purging" amber light through PPT NC contact.
7. When the 0 - 5 minute adjustable, pre-purge timer times out, it switches to energize the CR2 relay and turn off the "purging" amber light.
8. The CR2 NC contact opens to de-energize the CR1 relay, and the CR2 NO contact closes for the PPT timer holding circuit.
9. The CR1 NC and NO contacts return to normal position and the TCA control motor drives back to low.
10. The low fire proving limit switch (LFLS) closes to power terminal 1 on the protectofier and starts the ignition cycle.
11. Protectofier terminal 3 powers the ignition transformer through TR1 NC contact, the pilot valve through TR2 NC contact, and the TR1 timed relay (10 seconds).
12. Protectofier terminal 5 powers the "flame on" blue light.
13. After a 10 second delay, the TR1 NC contact opens to de-energize the ignition transformer, the TR1 NO contact closes to hold in the circuit around the PPT timer and the LFLS, and the TR1 NO contact closes to energize the atomizing air valve.
14. The atomizing air pressure switch (AAPS) should close shortly after the atomizing air valve is powered. This will power the main oil valves, which will illuminate the "oil burner on" green light and energize the TR2 timed relay (10 seconds).
15. After a 10 second delay, the TR2 NC contact opens to reset the purge timer, the TR2 NC contact opens to de-energize the pilot gas valve, and the TR2 NC and NO contacts reverse to release the TCA control motor from low fire start.
16. The burner is now on (flame proven) and operating from the temperature controller.

## Bill of Material

### MF Burner Equipment

| | |
|---|---|
| LGPS | Low Fire Gas Pressure Switch |
| HGPS | High Gas Pressure Switch |
| LOPS | Low Oil Pressure Switch |
| HOPS | High Oil Pressure Switch |
| CAFS | Combustion Air Flow Switch |
| AAPS | Atomizing Air Pressure Switch |
| LFLS | Low Fire Proving Limit Switch (optional) |
| HFLS | High Fire Proving Limit Switch (optional) |
| PGV | Pilot Gas Valve |
| PIT | Ignition Transformer (115 / 6000V) |
| VGV | Vent Valve (NO) |
| SGV | Automatic Gas Shutoff Valve |
| MGV | Automatic Main Gas Valve |
| MOV1 | Mail Oil Shutoff Valve #1 |
| MOV2 | Mail Oil Shutoff Valve #2 |
| AAV | Atomizing Air Valve |
| UVS | Ultravoilet Flame Detector |
| TCA | Control Motor (Electric - Honeywell shown) |

### Panel Equipment

| | |
|---|---|
| CB | Circuit Break or Disconnect Switch (See Note 1) |
| MS | Motor Starter (See Note 1) |
| CCT | Control Circuit Transformer (See Notes 1 and 3) |
| FI | Fuse |
| PPT | Pre-Purge Timer (0 - 5 minute adjustment) |
| 7256BH | PCI Protectofier Combustion Safeguard |
| AH | Alarm Horn (Flame Failure Lockout) |
| CR1 | Relay, Drive Control Motor to High Fire Position |
| CR2 | Relay, interrupts power to CR1 and provides holding circuit for purge timer |
| TR1 | Timed Relay (10 seconds) interrupted ignition, FS holding circuit and delay on energizing main fuel valves |
| TR2 | Timed Relay (10 seconds) interrupted pilot, low fire start and purge timer reset |

### External Equipment

| | |
|---|---|
| ELC | External Limiting Circuit (example: high temperature limit switch) |
| TC | Temperature Controller (Partlow shown) |

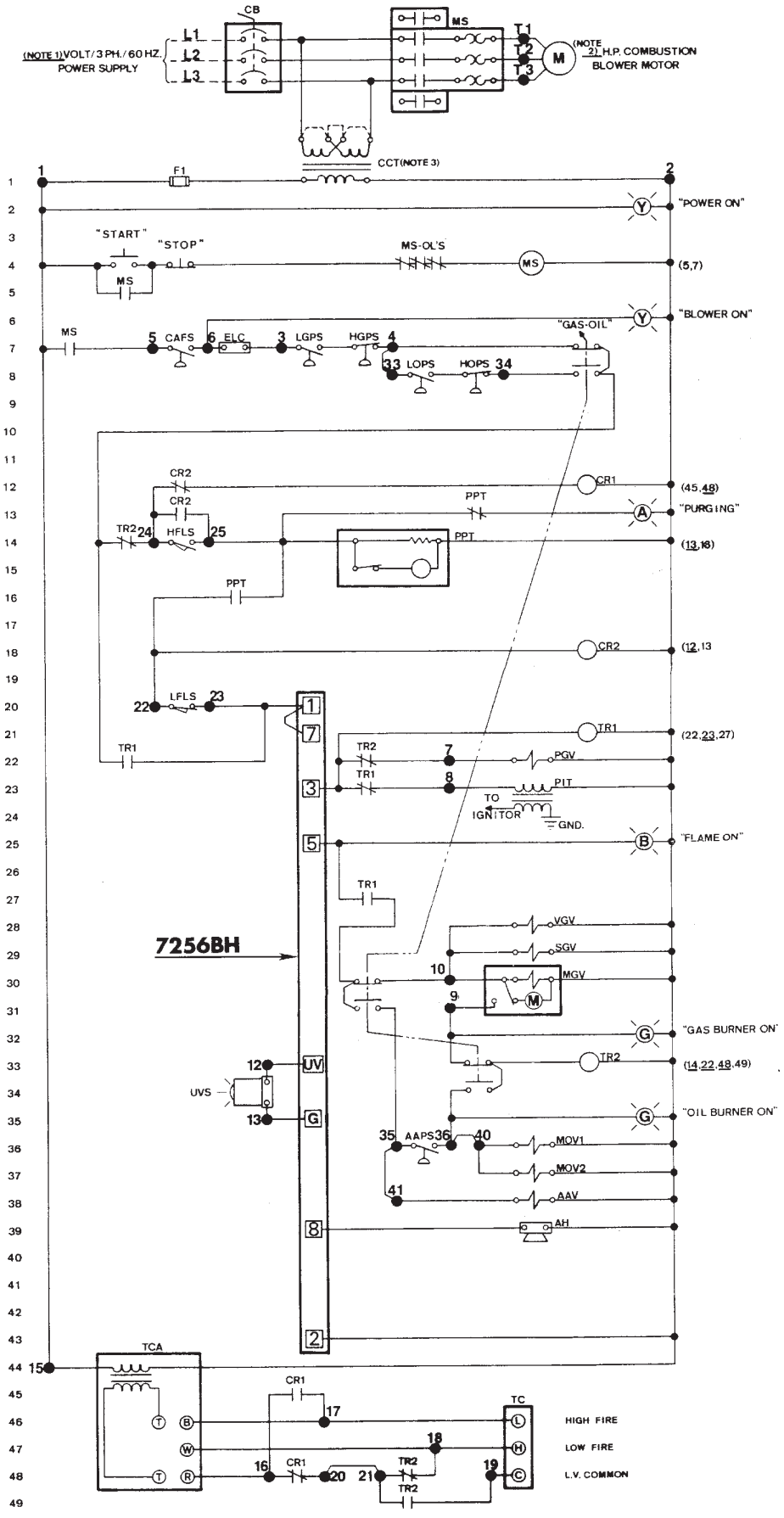


**Figure 3.4. Wiring Diagram for Suggested Control Panel**

## Gas, Oil and Atomizing Air Piping (see Figure 3.5)

1. All field piping, particularly the fuel oil and atomizing air supply pipes, should be inspected during field assembly to insure they are free from foreign material and pipe scale. Use of clean pipe will help ensure trouble-free startup and operation.
2. Never use Teflon tape for field piping connections. Since commercial piping usually does require some type of sealant on the threads to ensure leak-free connections, Eclipse suggests the use of Loctite Teflon Pipe Sealant #92-31. Any pipe sealant used should be applied with care and excess sealant should be removed before joints are made up. Fittings should be torqued to 60 in. lb. +/- 20 in. lb.
3. Eclipse recommends that suitable pipe union disconnects be used in the pipe trains as near to the burner as is convenient. Burner pipe sizes supplied on the burner are adequate for short piping runs. If longer piping runs are to be utilized, piping loss must be taken into consideration and pipe sized accordingly.
4. Refer to the "Inlet Pressure Requirements" table on page 12 for pressures required at the burner valve train inlets.
5. It is the customer's responsibility to supply #2 or lighter fuel oil to the burner at the steady pressure indicated in the table on page 12. The fuel supply must be clean and it is the customer's responsibility to supply filters and strainers capable of removing particles larger than 40 microns in the oil pipe line. The oil filter on the burner should be considered only as a final filter.
6. It is the customer's responsibility to supply #2 or lighter fuel oil to the burner at the steady pressure indicated in the table on page 12. The fuel supply must be clean and it is the customer's responsibility to supply filters and strainers capable of removing particles larger than 40 microns in the oil pipe line. The oil filter on the burner should be considered only as a final filter.
7. It is the customer's responsibility to supply compressed air to the atomizing air valve train at the pressure indicated in the chart. The atomizing air must be clean (40 micron maximum particle size) and dry (dew point 30°F below ambient). The customer is to supply adequate dryers and filters in the atomizing air supply piping. The filter and moisture separator supplied on the burner assembly should be considered only as a final filter and separator.
8. All piping should be checked for leakage before attempting initial lightoff.
9. See "Pressure Settings" table on page 12 for pressures at locations A, B, C and D on Figure 3.5.

Figure 3.5 shows the order in which the components appear in the valve trains and the approximate location where the valve trains connect to the burner. The pressure checking cocks are also shown in their approximate locations. This schematic is NOT an exact representation of the burner's appearance and is intended only to aid in identification of the various components.

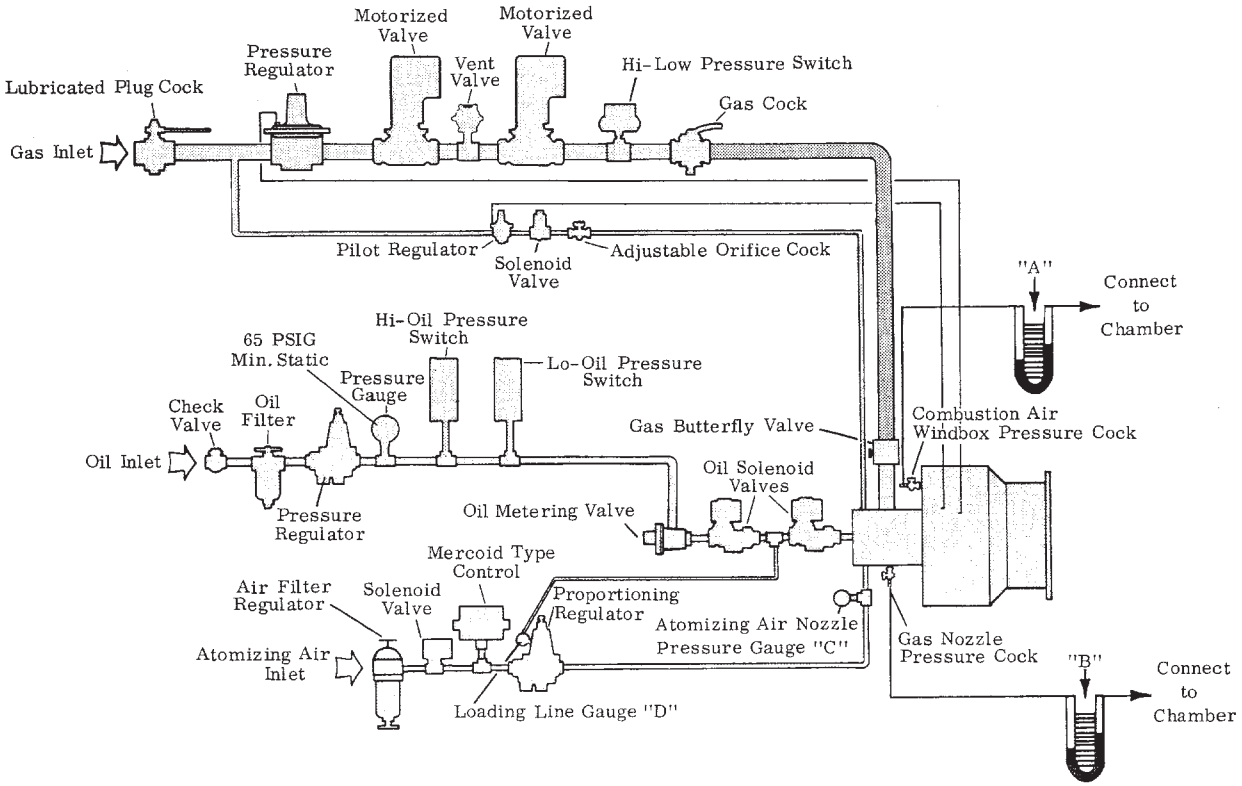


**Figure 3.5. Component Identification**

**Inlet Pressure Requirements***

| Burner Catalog Number | Natural Gas, 0.65 sp. gr. | Propane, 1.52 sp. gr. | #2 Fuel Oil | Atomizing Air Required Flow and Pressure |
|---|---|---|---|---|
| 100 MF | 14" - 28" w.c. | 6" - 12" w.c. | 75 - 100 psig | 3.25 scfm @ 65 - 100 psig |
| 200 MF | 14" - 28" w.c. | 6" - 12" w.c. | 75 - 100 psig | 3.25 scfm @ 65 - 100 psig |
| 300 MF | 14" - 28" w.c. | 6" - 12" w.c. | 75 - 100 psig | 13.0 scfm @ 65 - 100 psig |
| 500 MF | 14" - 28" w.c. | 6" - 12" w.c. | 75 - 100 psig | 14.5 scfm @ 65 - 100 psig |

*Figures are for complete burners only and are taken at the valve train inlets.

**Pressure Settings**

| Burner Catalog Number | A | | B | | C | | D |
|---|---|---|---|---|---|---|---|
| | Combustion Air Pressure | | Natural Gas Pressure, 0.65 sp. gr. | Propane Pressure, 1.52 sp. gr. | Atomizing Air Pressure | | Oil Landing Pressure |
| | Low Fire | High Fire | High Fire | High Fire | Low Fire | High Fire | High Fire |
| 100 MF | 0.2" w.c. | 7.3" w.c. | 6.4" w.c. | 2.6" w.c. | 20 psig | 45 psig | 50 psig |
| 200 MF | 0.15" w.c | 5.5" w.c. | 12.0" w.c. | 4.8" w.c. | 20 psig | 45 psig | 50 psig |
| 300 MF | 0.2" w.c. | 6.0" w.c. | 5.8" w.c. | 2.3" w.c. | 10 psig | 45 psig | 50 psig |
| 500 MF | 0.2" w.c. | 6.0" w.c. | 4.6" w.c. | 1.8" w.c. | 20 psig | 45 psig | 50 psig |

NOTE: All above pressure settings are approximate. For actual settings, refer to the tags supplied with the burner.

## Initial Lightoff

1. The burner has been test fired and adjusted at the factory. If duct suction/pressure varies no more than 0.5" w.c. from neutral, no further adjustments should be required to put the burner in operation.
2. On a new installation, the gas pipe line usually requires some purging to remove trapped air from the gas line. On a new installation it is recommended that the oil pipe line be bled before attempting a startup. This is to remove the foreign materials normally found in new systems.
3. Before attempting initial lightoff, refer to any instructions included with the control panel and familiarize yourself with the sequence of operation that is under control of the panel.
4. When observing the burner fuel and air controls, it shoud be noted that the control motor (air or electric) and the connected flow control valves (air, gas and oil) move through na arc of approximately 90°. The flow control valves are preset at the factory, however, the linkage can be readjusted to obtain the exact low and high fire capacities desired (see "Linkage Adjustment 100 and 200 MF" section or "Linkage Adjustment 300 and 500 MF" section).

### Pilot Ignition

1. Read the control panel instructions and set the panel for the desired fuel.
2. Open the inlet lubricated plug cock and the adjustable orifice pilot cock.
3. Begin the ignition sequence on the control panel. Check for spark and opening of the pilot solenoid valve.
4. Several trials for ignition may be required if the piping was inadequately purged.
5. If, after several tries, ignition cannot be established with the pilot solenoid valve open and the spark present, it will be necessary to adjust the adjustable orifice pilot cock.
6. To adjust the pilot cock, remove the top screw and top screw washer. This gives access to the adjusting screw. Turn the adjusting screw "in" for less gas or "out" for more. Replace the washer and the top screw.

### Main Flame Ignition

1. Once the pilot is established, open the gas cock (gas operation ONLY). The motorized gas valves or oil solenoid valves should open.
2. Check the gas or oil pressure and atomizing air pressure (oil ONLY) at low fire. If they are not the same as those on the test tags, adjustments will be necessary (see "Linkage Adjustment 100 and 200 MF" section or "Linkage Adjustment 300 and 500 MF" section).
3. Check the gas or oil pressure and atomizing air pressure (oil ONLY) at high fire. If they are not the same as those on the test tags, adjustments will be necessary (see "Linkage Adjustment - 100 and 200 MF" section or "Linkage Adjustment - 300 and 500 MF" section).
4. After all adjustments have been made, run the burner through its complete operating range, from full off to high fire, several times.

# Adjustment, Start & Stop

4

## Linkage Adjustment - 100 and 200 MF

1. The components involved in the linkage are as follows (see Figure 3.5): rod A and driven arm A transfer the motion of the control motor to the jackshaft; driving arm B, rod B and driven arm B1 transfer motion from the jackshaft to the combustion air butterfly valve; driving arm C, rod C and driven arm C1 transfer motion from the jackshaft to the gas butterfly valve; driving arm D, rod D and driven arm D1 transfer motion from the jackshaft to the oil metering valve.
2. All linkage arms move in an upward direction when going from low to high fire.
3. When adjusting linkage, start with the driving and driven arms approximately parallel to each other. (Does not apply to the gas butterfly valve. See Figure 3.6 for approximate position).
4. Lengthening the distance between the rotating center of the driving arm and the link connecting point on the driving arm will cause the driven arm to move through a larger angle. Shortening this distance will cause the driven arm to move through a smaller angle. Making these adjustments on the driven arm will reverse the results.
5. All linkage adjustments, including those which will alter the high fire rate, must be made with the burner at low fire. Care should be taken not to alter the low fire setting, as it serves as a constant reference point. Making an adjustment at the link connecting point ONLY will alter both the high and low firing rates. To maintain one firing rate while changing the other, the link and rod connnecting points must both be loosened.
6. Adjust rod and arm A so that the jackshaft will rotate 90° as the control motor drives from low to high fire.

## Combustion Air Flow Adjustment - 100 and 200 MF

1. Close the lubricated plug cock and the oil solenoid valves, set the control motor at low fire and start the combustion air blower.
2. Loosen the link and rod connecting points at arm B1, set the butterfly valve to give a differential pressure between the burner windbox and the firing chamber of approximately 0.25" w.c. (low fire).
3. Tighten the loose connecting points.
4. Drive the control motor to high fire. The differential pressure should be 6" w.c. If it is not, return to low fire, loosen the link and rod connecting points at either arm B or B1 and move the link connecting point in the appropriate direction (see step 4 under "Linkage Adjustment - 100 and 200 MF" above) without moving arms B and B1 or changing the low fire air flow rate.
5. Tighten the loose connecting points and recheck the high fire differential pressure. Once the burner is firing, it may be necessary to readjust the air flow slightly.

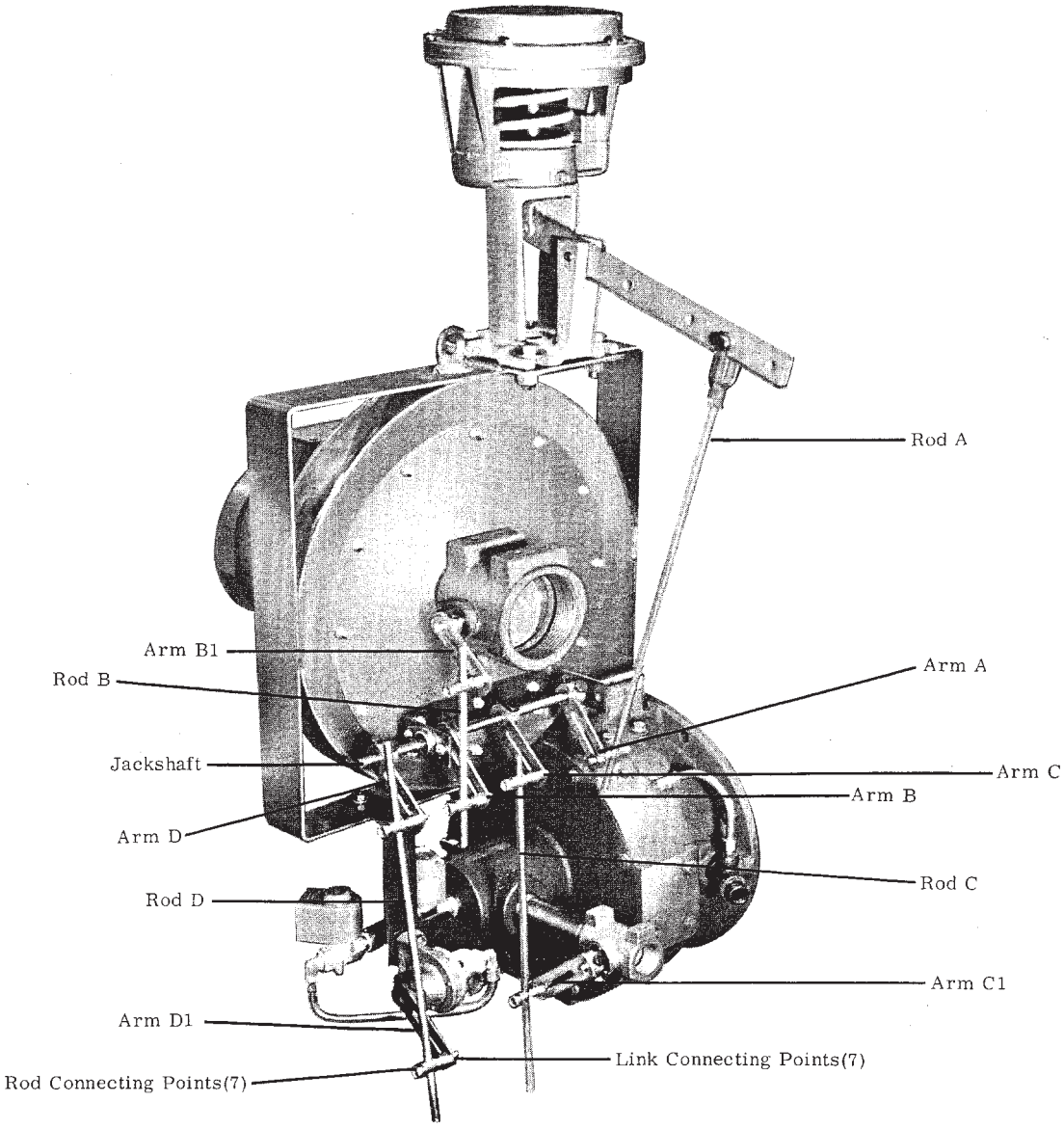


**Figure 3.1. 100 and 200 MF**

## Linkage Adjustment - 300 and 500 MF

1. The components involved in the linkage are as follows (see Figure 3.5): rod A and driven arm A transfer the motion of the control motor to butterfly shaft B; driving arm C, rod C and driven arm C1 transfer motion from butterfly shaft B to the gas butterfly valve; driving arm D, rod D and driven arm D1 transfer motion from butterfly shaft B to the oil metering valve.
2. All linkage arms move in an upward direction when going from low to high fire.
3. When adjusting linkage, start with the driving and driven arms approximately parallel to each other.
4. Lengthening the distance between the rotating center of the driving arm and the link connecting point on the driving arm will cause the driven arm to move through a larger angle. Shortening this distance will cause the driven arm to move through a smaller angle. Making these adjustments on the driven arm will reverse the results.
5. All linkage adjustments, including those which will alter the high fire rate, must be made with the burner at low fire. Care should be taken not to alter the low fire setting, as it serves as a constant reference point. Making an adjustment at the link connecting point ONLY will alter both the high and low firing rates. To maintain one firing rate while changing the other, the link and rod connnecting points must both be loosened.

## Combustion Air Flow Adjustment - 300 and 500 MF

1. Close the lubricated plug cock and the oil solenoid valves, set the control motor at low fire and start the combustion air blower.
2. Loosen the link and rod connecting points at arm A and the shaft connecting points for arms C and D, and set the butterfly valve to give a differential pressure between the burner windbox and the firing chamber of approximately 0.25" w.c. (low fire).
3. Tighten the loose connecting points.
4. Drive the control motor to high fire. The differential pressure should be 6" w.c. If it is not, return to low fire, loosen the link and rod connecting points at arm A and move the link connecting point in the appropriate direction (see step 4 under "Linkage Adjustment - 100 and 200 MF" above) without moving arm A or changing the low fire flow rate.
5. Tighten the loose connecting points and recheck the high fire differential pressure. Once the burner is firing, it may be necessary to readjust the air flow slightly.

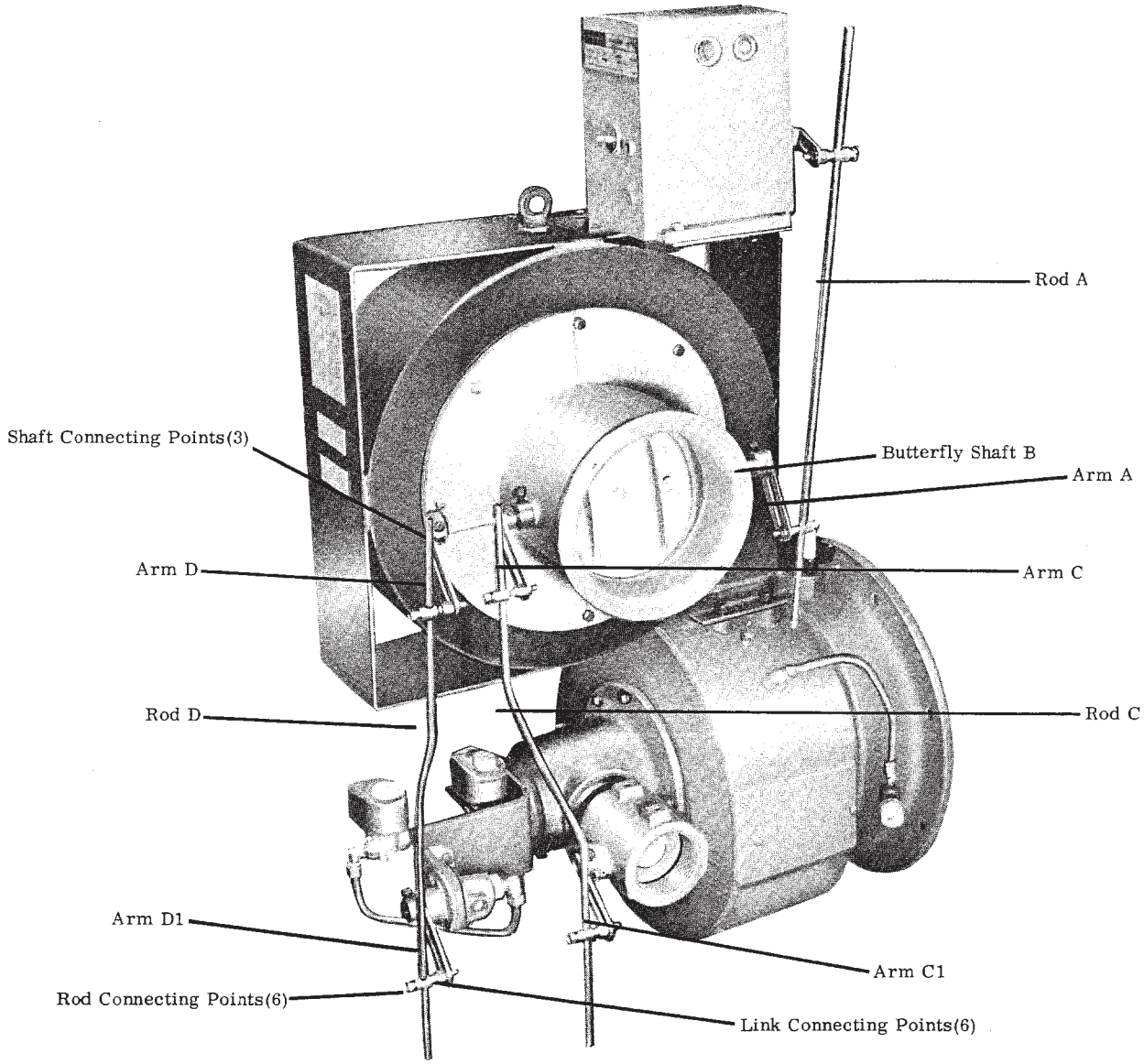


**Figure 3.2. 300 and 500 MF**

## Gas Flow Adjustment - all models

1. Make sure the burner is in the gas operation mode. Refer back to the Initial Lightoff section above, light the burner and set the control motor for low fire.
2. If the butterfly valve does not go to the full "off" position or it it is at full "off" and there is not sufficient leakage past the butterfly to maintain a stable low fire, loosen the link and rod connecting points at arm C1 and move arm C1 in the appropriate direction (see step 4 under "Linkage Adjustment - 100 and 200 MF" above).
3. Tighten the loose connecting points.
4. Drive the control motor to high fire. If the gas pressure is not within 1/2" w.c. of that indicated on the test tag, adjust the gas pressure regulator togive the required pressure.
5. If the required high fire pressure cannot be achieved by adjusting the regulator, return to low fire, loosen the link and rod connecting points at either arm C or C1, and move the connecting point in the appropriate direction (see step 4 under "Linkage Adjustment - 100 and 200 MF" above) without moving arms C and C1 or changing the low fire flow rate.
6. Tighten the loose connecting points and recheck the gas pressure at high fire.

## Oil Flow Adjustment - all models

1. Set the oil pressure regulator for a static output of 60 - 65 psig. Set the atomizing air filter regulator for a static output pressure of 55 psig.
2. Make sure the burner is in the oil operation mode. Refer back to the Initial Lightoff section above, light the burner and set the control motor for low fire.
3. Read the low fire atomizing air pressure at the nozzle gauge. If it is not the same as on the test tag, adjust it using the screw on top of the atomzing air proportioning regulator. Be sure to tighten the locking nut after the adjustment is made.
4. Low fire oil pressure is adjusted by loosening the rod and link connecting points at arm D1 and moving arm D1 until the oil pressure is as indicated on the test tag. This pressrue can be read at the loading line gauge on the atomizing air proportioning regulator.
5. Tighten the loose connecting points, drive the control motor to high fire and check the atomizing air pressure at the nozzle gauge. If it is as indicated on the test tag, proceed to the next step below, if it is not, adjust the atomizing air filter regulator.
6. If the oil pressure is not as indicated on the test tag, return to low fire, loosen the link and rod connecting points at either D or D1 and move the connecting point in the appropriate direction without moving arms D and D1 or changing the low fire oil pressure.
7. Tighten the loose connecting points and recheck the oil pressure at high fire.

# Maintenance & Troubleshooting

5

1. Air, oil and compressed air filters must be cleaned rountinely, depending on ambient conditions.
2. Fuel oil must be purchased from a dependable source and be free of impurities, and especially, free of sulfur.
3. Kerosene or hydro-treated oil may be required for the product being processed.
4. Linkage and valves must be lubricated and inspected to assure proper operation.
5. Flame monitoring equipment must be cycled, tested and understood.
6. Ignition system - spark plugs, transformer and lead wires - must be maintained in topnotch conditions.
7. Oil spills, leaks, etc. must be cleaned up - just good housekeeping.
8. Fuel oil piping must be tight, air must be purged from the system, and the oil must be filtered.
9. Compressed air must be of sufficient quantity, DRY, and free of oil and dirt. Air pressure should be steady so it doesn't affect any of the burner controls.

   - If there is a large amount of water present at a burner, this can be reduced considerably by putting an air/oil separator at each burner with an automatic water drain. The burners already have a filter with a visible bowl to remove the moisture but the amount of water in an air supply may exceed the ability of this filter regulation unit to remove the large quantity of water present. There are several makes of filters available that can be supplied with automatic water drains. This is strictly a stopgap or final filter ahead of the burner, and the least desirable solution.

   - The preferred method is to remove the moisture from the air to a saturation point below the lowest expected temperature to which the air piping is likely to drop. For most piping in factories or mills, a temperature of 50°F should be low enough for this purpose. This degree of saturation can only be achieved with refridgeration-type air drying equipment.

     Reducing the saturation point of air down to 50°F reduces the moisture down to 4.076 grains per cubic foot. This compares to 7.980 at 70°F. This is a very significant reduction in water content. Reducing the saturation point below 70°F is a very good improvement in removing water content from air lines.

# Appendix

## Conversion Factors

### Metric to English

| From | To | Multiply By |
|---|---|---|
| actual cubic meter/h ($am^3/h$) | actual cubic foot/h (acfh) | 35.31 |
| normal cubic meter/h ($Nm^3/h$) | standard cubic foot /h (scfh) | 38.04 |
| degrees Celsius (°C) | degrees Fahrenheit (°F) | (°C x 9/5) + 32 |
| kilogram (kg) | pound (lb) | 2.205 |
| kilowatt (kW) | Btu/h | 3415 |
| meter (m) | foot (ft) | 3.281 |
| millibar (mbar) | inches water column (“w.c.) | 0.402 |
| millibar (mbar) | pounds/sq in (psi) | $14.5 \times 10^{-3}$ |
| millimeter (mm) | inch (in) | $3.94 \times 10^{-2}$ |
| $MJ/Nm^3$ | $Btu/ft^3$ (standard) | 26.86 |

### Metric to Metric

| From | To | Multiply By |
|---|---|---|
| kiloPascals (kPa) | millibar (mbar) | 10 |
| meter (m) | millimeter (mm) | 1000 |
| millibar (mbar) | kiloPascals (kPa) | 0.1 |
| millimeter (mm) | meter (m) | 0.001 |

### English to Metric

| From | To | Multiply By |
|---|---|---|
| actual cubic foot/h (acfh) | actual cubic meter/h ($am^3/h$) | $2.832 \times 10^{-2}$ |
| standard cubic foot /h (scfh) | normal cubic meter/h ($Nm^3/h$) | $2.629 \times 10^{-2}$ |
| degrees Fahrenheit (°F) | degrees Celsius (°C) | (°F - 32) x 5/9 |
| pound (lb) | kilogram (kg) | 0.454 |
| Btu/h | kilowatt (kW) | $0.293 \times 10^{-3}$ |
| foot (ft) | meter (m) | 0.3048 |
| inches water column (“w.c.) | millibar (mbar) | 2.489 |
| pounds/sq in (psi) | millibar (mbar) | 68.95 |
| inch (in) | millimeter (mm) | 25.4 |
| $Btu/ft^3$ (standard) | $MJ/Nm^3$ | $37.2 \times 10^{-3}$ |

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