CleaverBrooks®

D/LND Series

Burners

Gas/Oil/Dual Fuel

Installation, Operation, Service, and Parts

750-204
04/08

WARNING

ONLY FACTORY AUTHORIZED BURNER SERVICE PERSONNEL SHOULD START UP, ADJUST, OR SERVICE THIS EQUIPMENT

D/SERIES TABLE OF CONTENTS

OPERATING PRECAUTIONS

This operating manual presents information that will help to properly operate and care for the equipment. Study its contents carefully and save for reference. The unit will provide good service and continued operation if proper operating and maintenance instructions are followed. No attempt should be made to operate the unit until the principles of operation and all of the components are thoroughly understood. Only trained and authorized personnel should be allowed to operate, adjust or repair this equipment.

If you are operating a burner(s), it is your responsibility to ensure that such operation is in full accordance with all applicable safety requirements and codes.

Placed on all CB Profire burners are warning or caution labels designed to inform the operator of potential hazards and stress important information.
These symbols and their meanings are as follows:

⚠ WARNING

HAZARD OF ELECTRIC SHOCK !!! MORE THAN ONE DISCONNECT MAY BE REQUIRED TO DISCONNECT ALL POWER TO THIS PANEL. SERIOUS PERSONAL INJURY OR DEATH MAY RESULT.

⚠ WARNING

READ PRODUCT MANUAL AND FULLY UNDERSTAND ITS CONTENTS BEFORE
ATTEMPTING TO OPERATE THIS EQUIPMENT. SERIOUS PERSONAL INJURY OR

⚠ WARNING

TO AVOID PERSONAL INJURY FROM MOVING PARTS, SHUT OFF ALL ELECTRICAL POWER BEFORE SERVICING THIS EQUIPMENT.

CAUTION

PROVIDE SUPPORT FOR THIS PANEL TO PREVENT DAMAGE TO THE ELECTRICAL COMPONENTS.

CAUTION

ONLY FACTORY AUTHORIZED BURNER SERVICE PERSONNEL SHOULD START- UP, ADJUST, OR SERVICE THIS EQUIPMENT.

CAUTION

AFTER FINAL FUEL INPUT ADJUSTMENTS ARE MADE, VERIFY FUEL INPUT BY METER IF POSSIBLE.

Further warning and caution references have been made in this manual and should be adhered to for smooth operation of the burner.

WARNING	This symbol precedes information which, if disregarded, may result in injury to the user of the burner or to others.
CAUTION	This symbol precedes information which, if disregarded, may result in damage to the burner.
NOTE	This symbol precedes information which is vital to the operation or maintenance of the burner.

Model Designations, Sizes and Inputs

Model designations are based on the type of fuel(s) to be fired and the amount of furnace pressure to be overcome. Burner size is based on firing rate (maximum input in BTU/HR).

MODELS STANDARD	FUEL - AIR ATOMIZATION
DG	GAS
DL	#2 Oil
DLG	#2 Oil and Gas
DM	#2-5 Oil
DMG	#2-5 Oil and Gas
DE	#2-6 Oil
DEG	#2-6 Oil and Gas

S-Models for up to 1.5" W.C. furnace pressure.
P-Models for up to 4.0" W.C. furnace pressure.

EXAMPLE: Model number on nameplate is DLG-252P, No. 2 oil and gas burner with input rated at 25,200 MBTU per hour, against furnace pressures up to 4" W.C. at 60hz

THE INSTALLATION OF A BURNER SHALL BE IN ACCORDANCE WITH THE REGULATIONS OF AUTHORITIES HAVING JURISDICTION. THE EQUIPMENT MUST BE INSTALLED IN ACCORDANCE WITH APPLICABLE LOCAL, STATE OR PROVINCIAL INSTALLATION REQUIREMENTS INCLUDING THE NATIONAL ELECTRICAL CODE (NEC) AND ASSOCIATED INSURANCE UNDERWRITERS. WHERE APPLICABLE, THE CANADIAN GAS ASSOCIATION (CGA) B149 AND CANADIAN STANDARD ASSOCIATION (CSA) B140 AND B139 (FOR OIL BURNERS) CODES SHALL PREVAIL.

OIL AND GAS BURNING EQUIPMENTS SHALL BE CONNECTED TO FLUES HAVING SUFFICIENT DRAFT AT ALL TIMES, TO ASSURE SAFE AND PROPER OPERATION OF THE BURNER.

THE D SERIES BURNERS ARE DESIGNED TO BURN EITHER GAS OR LIGHT OIL No.1 OR 2 AS DEFINED BY ASTM D396-1978 SPECIFICATIONS, AND HEAVY OILS.
DO NOT USE GASOLINE, CRANKASE OIL, OR ANY OIL CONTAINING GASOLINE.

BURNER SIZE	MAX.BURNER GAS INPUT MBTU/HR.	
	60hz	50hz
42 (S or P)	4,200	3,360
54 (S or P)	5,400	4,200
63 (S or P)	6,300	5,250
84 (S or P)	8,400	6,300
105 (S or P)	10,500	8,400
145 (S or P)	14,500	10,500
175 (S or P)	17,500	14,700
210 (S or P)	21,000	16,800
252 (S or P)	25,200	21,000
300 (S or P)	30,000	25,200
315 (P)	31,500	30,000
336 (P)	33,600	31,500
378 (P)	37,800	33,600
420 (P)	42,000	37,800

Gas input based on natural gas at 1,000 Btu/cu.ft and 0.60 spe-

BURNER SIZE	MAX.BURNER OIL INPUT U.S.G.P.H.	
	60hz	50hz
42 (S or P)	30	24
54 (S or P)	39	30
63 (S or P)	47	38
84 (S or P)	60	53
105 (S or P)	75	60
145 (S or P)	107	90
175 (S or P)	125	105
210 (S or P)	150	120
252 (S or P)	180	150
300 (S or P)	215	180
315 (P)	225	215
336 (P)	240	225
378 (P)	270	240
420 (P)	300	270

Oil input based on No.2 oil at 140,000Btu/

SECTION 1
INTRODUCTION

A. GENERAL INFORMATION

CB Profire D/Series burners are assembled, wired and tested at the factory. They are listed by the Underwriters Laboratory, CSD-1, NFPA-85, I.R.I., F.M., including the National Electrical Code (NEC) and associated insurance underwriters. Where applicable, the Canadian Gas Association (CGA) B149 and Canadian Standards Association (CSA) B140 codes shall prevail. Other regulatory agency control options are available.

CAUTION

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The operator must be familiar with the individual functioning of all controls to understand the operations and procedures described in the manual. Identify and locate each item in the illustrations as they are described in the following sections.

B. DESCRIPTION

The CB Profire D/Series oil burners are of the low pressure, air atomizing (nozzle) type. Gas burners are of the periopheral mix type. All burners feature ignition by spark-ignited gas pilot flame. With either fuel, the burner operates with full modulation. A switch permits changeover from automatic fully modulated firing to manually set firing at any desired rate between minimum and maximum. Additional safeguards assure that the burner always returns to minimum firing position for ignition.

D/Series burners are designed for automatic, unattended operation except for periodic inspection and maintenance. After selecting the proper overload settings for the starter, the rest of the control panel components require little attention except for occasional cleaning.

C. OPERATING CONTROLS
CONTROL PANEL

The control panel contains a flame safeguard programming control, motor starters, relays, time delays and terminal strips mounted internally on a panel subbase. Lights, switches, potentiometers, a control circuit breaker and flame safeguard displays are mounted externally on the panel as indicated below.

1. **ON-OFF BURNER SWITCH** - (for gas or oil only)

2. **FUEL SELECTOR SWITCH** - Gas-Off-Oil
   (for combination gas-oil burners only)
   Gas position: Selects gas as the firing fuel .
   Off position: Burner off.
   Oil position: Selects oil as the firing fuel.

NOTE

WHEN CHANGING FROM OIL TO GAS FUEL, ALLOW PROGRAMMER TO COMPLETE POST PURGE AND SHUTDOWN BEFORE MOVING SELECTOR SWITCH TO GAS POSITION. THIS WILL ALLOW THE INTERLOCK CIRCUIT TO OIL-AIR PUMP OR COMPRESSOR TO DE-ENERGIZE

3. **CONTROL CIRCUIT BREAKER** - supplementary low overcurrent protection only. No larger than 15 amps.

4. **AUTO-MANUAL MODULATION SELECTOR SWITCH.**
   Auto Position: Selects boiler modulation control.
   Manual Position: Selects 135 ohm potentiometer for manual modulating control.

5. **MANUAL MODULATING CONTROL 135 ohm** increases or decreases the burner firing rate manually.

6. **SIGNAL LAMPS.**
   a. POWER ON (white) illuminates when the control circuit is energized (powered).

   b. IGNITION (amber) illuminates when the ignition transformer is powered, and gas pilot valve is energized (opened).

   c. MAIN FUEL (green) illuminates when the main fuel valve or valves (gas or oil) are energized (open).

   d. FLAME FAILURE (red) illuminates when the flame safeguard system fails to detect pilot or main flame.

D. FLAME SAFEGUARD CONTROLS

The flame safeguard programmer incorporates a flame sensing cell (scanner) to shut down the burner in the event of pilot flame or main flame failure. Other safety controls shut down the burner based on sequence of operation as shown in the manufacturers flame safeguard manual.

WARNING

READ THE FLAME SAFEGUARD MANUAL AND FULLY UNDERSTAND ITS CONTENTS BEFORE ATTEMPTING TO OPERATE THIS EQUIPMENT. SERIOUS PERSONAL INJURY OR DEATH MAY RESULT.

E. COMBUSTION AIR HANDLING SYSTEM

The combustion air handling system consists of three major components: (See Figure 1-1)

1. DAMPER ASSEMBLY.

A rotary damper regulates the combustion air volume and is positioned by a modulating motor. The damper is normally ALMOST CLOSED in the low fire position and opens as the burner drives toward a high fire position.

2. MOTOR DRIVEN IMPELLER.

The diameter of the impeller determines available air pressure and the width determines air capacity in cubic feet per minute. Alternate motor-impeller combinations are available for 50 cycle or 60 cycle power and for firing against either moderate or high furnace pressure. At altitudes up to 2000 ft. above sea level, model "S" impellers are recommended for up to 1.5". W.C. furnace pressure. Model "P" impellers are recommended for furnace pressures from 1.5" to 4.0" W.C. For higher altitudes and higher furnace pressures, motor and impeller combinations are determined at the factory.

3. STATOR CONE.

The stator cone in the air housing transforms the rotating air velocity pressure to static pressure prior to air entry into the blast tube.

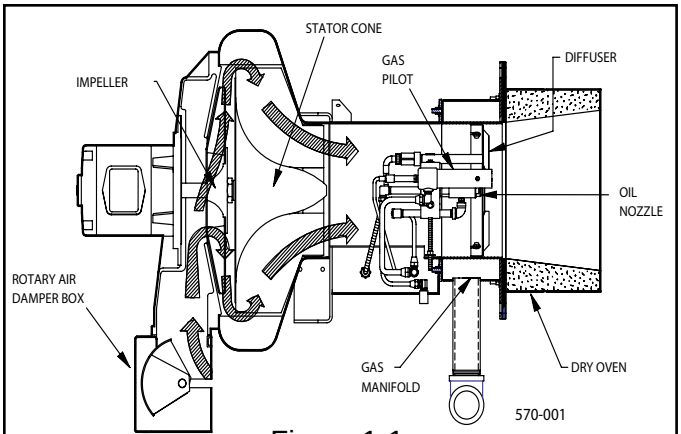


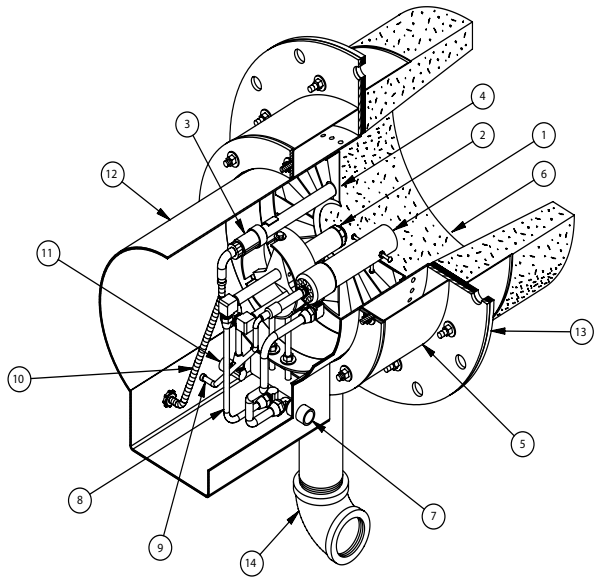
Figure 1-1

F. FIRING RATE CONTROLS

Regardless of the fuel used, burner input is fully modulated between low fire and high fire on boiler demand. Firing rate is controlled by the potentiometer-regulated modulating motor. Combustion air control damper, oil metering pump and/or gas volume butterfly valve are through variable rate rod and lever linkages. The modulating motor rotates 90 degrees from low to high position. Flow rate through each component is adjusted by positioning the control rods on the levers and the angular position of levers on shafts. Lever on the modulating motor shafts actuate the high fire position proving switch.

G. FIRING HEAD

Access to the firing head is provided by swinging open the impeller housing. First, disconnect the damper linkage, release the housing latch and swing the housing to open position. An internal gas pilot is standard on all burners. Pilot gas pressure is adjusted at the pilot pressure regulator.



1- GAS PILOT ASSEMBLY WITH ELECTRIC SPARK IGNITOR
2- AIR ATOMIZING OIL NOZZLE (SINGLE OR DUAL)
3- FLAME SCANNER
4- AIR DIFFUSER
5- GAS PORTS IN SURROUNDING MANIFOLD
6- REFRACTORY OVEN
7- GAS PILOT INLET CONNECTION
8- ATOMIZING AIR LINE
9- ELECTRODE LEAD
10- SCANNER LEAD
11- FUEL OIL INLET
12- BLAST TUBE
13- DRY OVEN GASKET
14- GAS INLET

FIRING HEAD ASSEMBLY 570-005

Figure 1-2

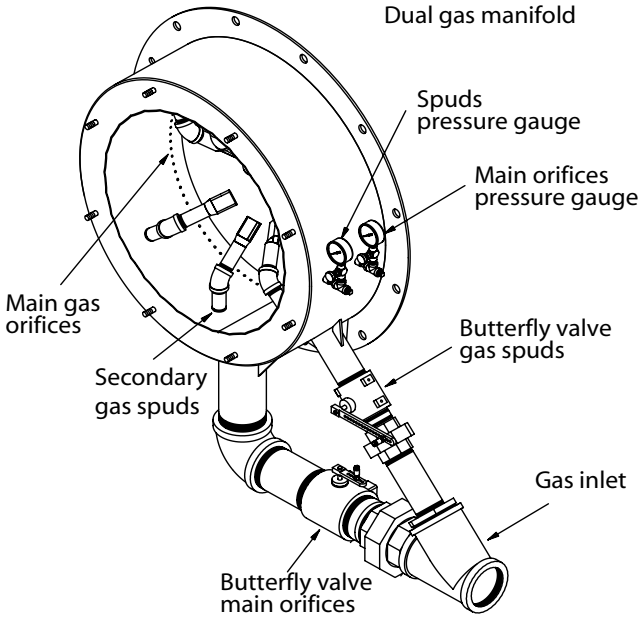


Figure 1-3

H. OIL SYSTEM AIR ATOMIZING

D Model burners use compressed air for atomization. Atomizing air is independent of combustion air. Either of two air/oil systems are used, depending on burner size and fuel. One system uses an integral air compressor/oil metering unit mounted on the burner and is driven by a separate motor. The other system is supplied with a separate compressor module for mounting near the burner.

3-WAY SOLENOID VALVE.

Metered oil enters the common port of the 3-way solenoid valve. During shutdown, pre and post purge the valve is de-energized (N.C. port closed) and all metered fuel oil returns to the storage tank. When the valve is energized, metered oil is directed to the nozzle through the N.C. port.

NOZZLE ASSEMBLY.

The nozzle assembly consists of four main parts: body, compression spring, swirler, and tip. The swirler is held against the nozzle tip by the compression spring.
The nozzle body has inlet ports for air and oil lines. Metered fuel oil enters the nozzle body and flows through a tube to the swirler. Oil is forced from the core of the swirler to the side ports where it meets with the atomizing air.
Atomizing air enters and passes through the nozzle body to grooves in the swirler, where it mixes with fuel oil. Air/oil passes through grooves and out of the nozzle orifice in a cone of atomized oil. Proper velocity and angle of the fine spray ensures good mixing with the combustion air, providing quiet starts and excellent combustion efficiency.
During pre and post purge, the nozzle tip is purged with air. This prevents afterdrip or baked-on residue.

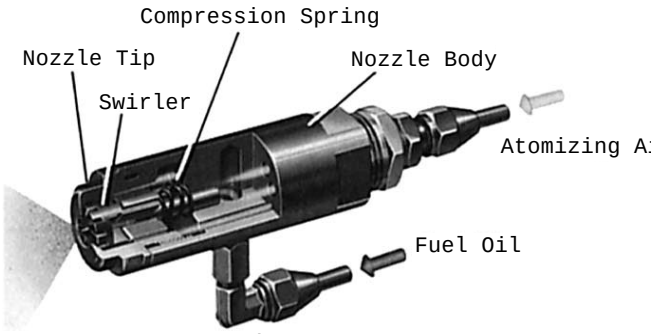


Figure 1-4

NOZZLE LINE ELECTRIC HEATER.

Provides heat for No. 4, 5, and 6 fuel oil for cold starts and is located between the metering pump and 3-way valve. This heater should not be used as a continuous run line heater. The heater has an adjustable thermostat and a cold oil lockout switch which prevents burner from starting until proper atomizing temperature is attained.

OIL STRAINER.

Prevents foreign matter from entering the burner oil system.

ATOMIZING AIR PROVING SWITCH.

Pressure actuated switch contacts close when sufficient atomizing air pressure is present.The oil valve will not open unless switch contacts are closed.

AIR/LUBE OIL TANK.

Burner mounted tank stores compressed air for oil atomization and oil for compressor lubrication. Contains wire mesh filter to separate lube oil from compressed air.

INTEGRAL AIR/OIL UNIT.

Model designation DL, DLG, DM, DMG No. 2 through 5 oil with air atomization (model D42 to 145). These models utilize an integral air compressor/oil metering unit which is separately driven at 1725 rpm and mounted on the burner.
See Figure 1-5

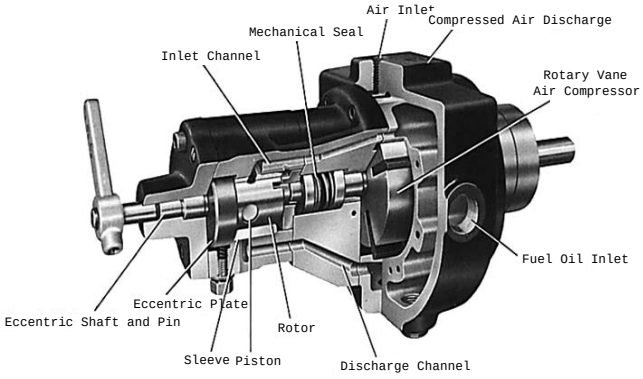


Figure 1-5

AIR COMPRESSOR.

Air is drawn into the vane-type, rotary compressor section of the air/oil unit through an air cleaner. The compressed air flows to an air-lube oil tank which serves the multiple purpose of lube oil mist recovery, lube oil sump and air storage. The compressor is cooled and lubricated continuously by oil under pressure from the bottom of the tank. Oil vapor is extracted from the compressor air, by a mist eliminator in the upper section of the tank. Atomizing air flows to the nozzle at a constant volume, but air pressure increases as the firing rate increases. Atomizing air is regulated by an adjusting valve in the return air line on integral metering units or in the air inlet on air compressor module burners.

OIL METERING.

Fuel oil under nominal pressure in the circulating loop, flows to the adjustable positive displacement,(volumetric metering unit. Oil metering is accomplished by changing the piston stroke by means of an eccentric shaft and pin assembly. The pistons reciprocate in a rotor assembly, turning in a hardened steel sleeve having oil inlet and discharge slots. During each revolution the pistons go through the following cycle:

1. Inlet Cycle. The piston is at the bottom dead center position. At this position the cavity between the top of the piston and the outside diameter of the rotor fills with oil.

2. Discharge Cycle. (180° from inlet cycle.) The piston is at the top dead center position. At this position the oil is forced out of the discharge port to the nozzle. The piston stroke length is determined by the position of the eccentric shaft and plate. The piston adjustment plate is positioned by an adjustable eccentric shaft. The eccentric shaft is positioned by the modulator through adjustable linkage. Counterclockwise rotation of the eccentric shaft increases the piston stroke (more oil delivered to nozzle); clockwise rotation decreases the amount of oil delivered. When the eccentric shaft is stationary, at any position, the stroke of the pistons remains constant delivering a constant volume of oil regardless of viscosity.

SEPARATE COMPRESSOR MODULE.
All models DE, DEG, (also DL, DMG, DM, DMG 175-420) burners have, a burner mounted oil metering unit and a separate compressor module. The system functions as follows

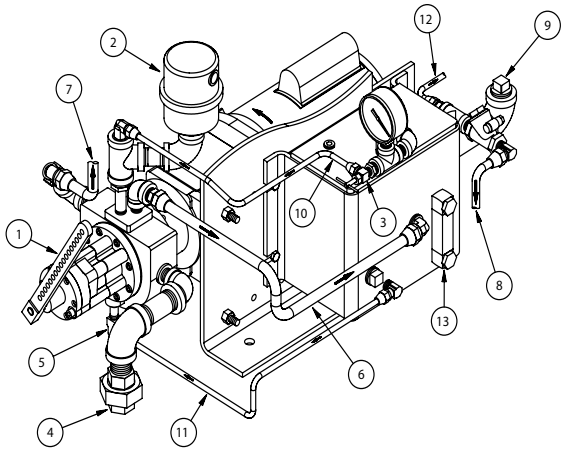
AIR COMPRESSOR MODULE.
Air is supplied by a positive displacement rotary vane compressor. This provides a constant volume of atomizing air regardless of pressure.The compressor module includes motor, air-oil reservoir tank, air filter and lube oil cooling coil. Air enters the compressor through the filter. The air flows from the compressor into the air-oil separating and reservoir tank. Filtering material and baffles separate the lube oil from the compressed air. The tank air pressure forces lubricating oil from the tank to the compressor to lubricate bearings and vanes. A sight glass indicates the level of lubricating oil in the air/oil reservoir. Lubricating oil must be visible in the gauge glass at all times. Air compression heat is absorbed in part by the flow of lube oil, creating a hot oil mist. The air/oil mist is cooled by a coil assembly. Lube oil is also cooled before entering the compressor.

OIL METERING.
The oil metering unit is cored with channels through the housing. Fuel oil circulates through these channels keeping the metering unit warm to prevent heavy oils from congealing when the burner is idle.

The operation of the oil metering unit is the same as the integral air/oil unit.

OPERATION
Fuel is delivered to the positive displacement metering pump at 10 to 15 psi. Metered oil is delivered to the common port of a 3-way solenoid valve for transfer to the burner nozzle through the normally closed port or back to the storage tank through the normally open port. During pre - and post purge, metered oil is returned to the tank. During normal firing, all metered oil is delivered to the nozzle. Heavy oil burners have a supplementary nozzle line heater between the metering pump and the 3-way valve. For the description of typical fuel oil piping installations, see Section 2. Air enters a rotary vane compressor through an air cleaner where it is compressed to atomizing pressure. Air flows from the compressor to an air oil tank which serves the multiple purpose of dampening air pulsation, lube oil mist recovery, lube oil and atomizing air storage. The compressor rotor is cooled and lubricated continuously by oil under pressure from the air oil tank. Oil vapor is extracted by a mist eliminator in the upper section of the tank. Atomizing air from the upper tank section is delivered to the nozzle at a constant volume. Air pressure increases as the burner firing rate increases. Atomizing pressure may be adjusted by the needle valve located on the air-oil pump. The valve allows air to be bled from the tank to the compressor inlet. Delivery rate of the fuel oil metering pump is controlled by the modulating motor through adjustable linkage.

REFERENCE TO THE INTEGRAL SYSTEM
See Figure 1-6 and 1-8
REFERENCE TO THE SEPARATE SYSTEM
See Figures 1-7 and 1-9

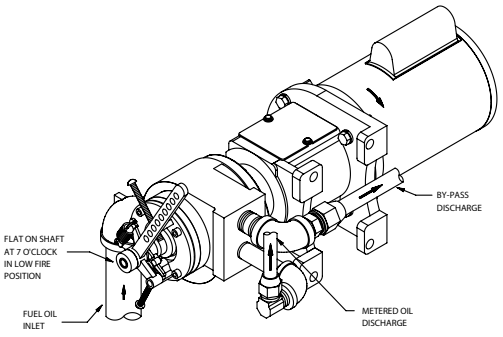


1. OIL-AIR PUMP ACTUATING ARM
2. AIR INLET FILTER
3. ATOMIZING AIR PRESSURE ADJUSTING VALVE
4. FUEL OIL INLET
5. LUBE OIL INLET
6. OIL-AIR DISCHARGE
7. FUEL OIL DISCHARGE TO SOLENOID VALVE

TANK CONNECTIONS:
8. ATOMIZING AIR TO BURNER NOZZLE
9. OIL TANK FILL PLUG
10. ATOMIZING AIR BYPASS LINE
11. LUBE OIL OUTLET TO PUMP
12. ATOMIZING AIR TO PRIMARY AIR PRESSURE SWITCH
13. SIGHT GLASS

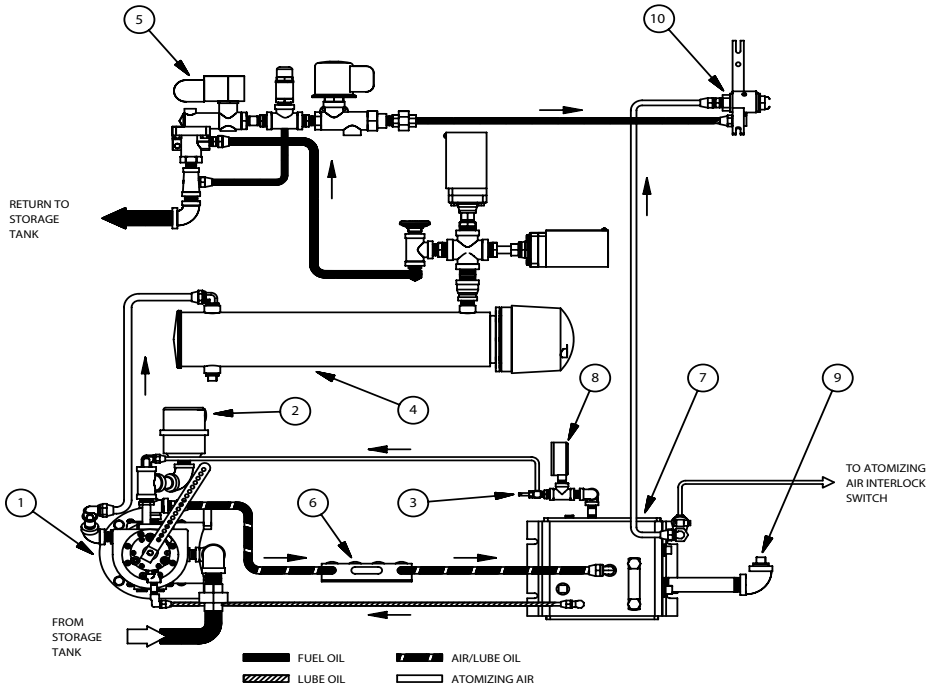
INTEGRAL OIL-AIR METERING SYSTEM AND TANK 570-007

Figure 1-6



FUEL OIL METERING SYSTEM (USED WITH SEPARATE COMPRESSOR) 570-008

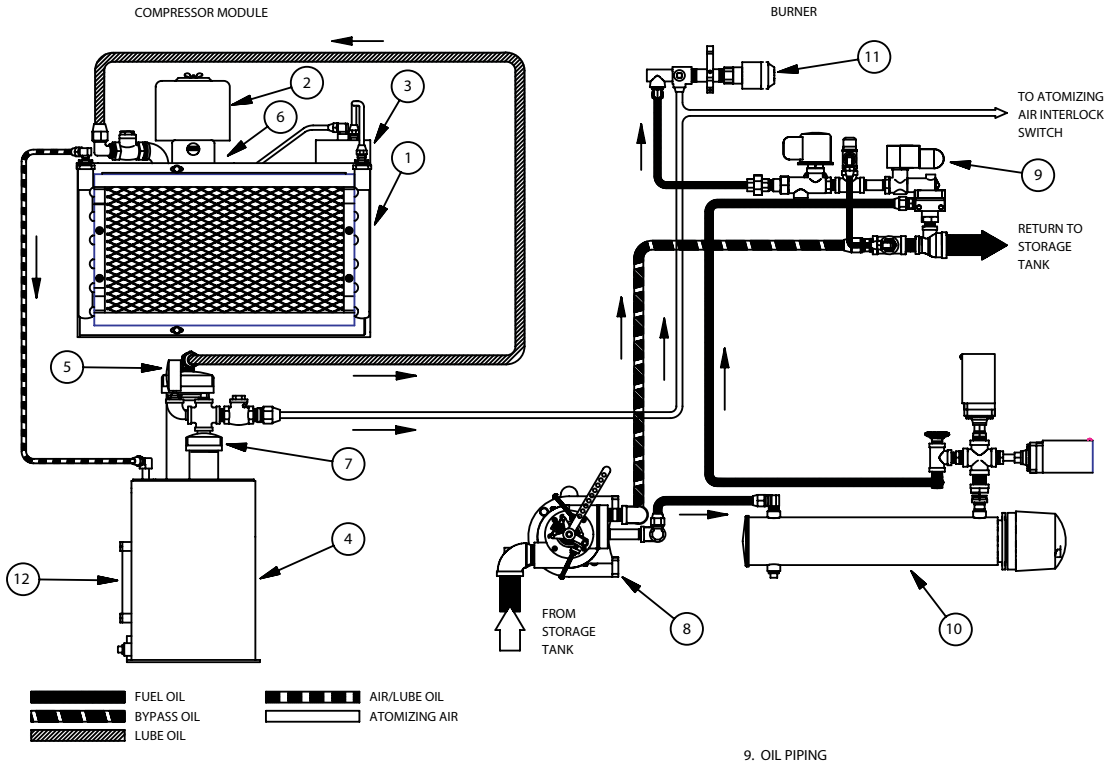
Figure 1-7



1. OIL-AIR METERING PUMP
2. AIR CLEANER
3. ATOMIZING AIR ADJ. VALVE
4. NOZZLE LINE HEATER
   No. 4 TO 6 OIL ONLY
5. OIL PIPING
6. AIR COOLER
7. OIL-AIR TANK
8. ATOMIZING AIR PRESSURE GAUGE
9. TANK FILLER PLUG
10. BURNER OIL NOZZLE

INTEGRAL COMPRESSOR OIL-AIR METERING SYSTEM 570-006

Figure 1-8



1. COMPRESSOR
2. AIR CLEANER
3. STRAINER
4. OIL-AIR TANK
5. ATOMIZING AIR PRESSURE GAUGE
6. ATOMIZING AIR PRESSURE ADJ. VALVE
7. TANK FILLER PLUG
8. OIL METERING PUMP
9. OIL PIPING
10. NOZZLE LINE HEATER
    No. 4 TO 6 OIL ONLY
11. BURNER NOZZLE
12. SIGHT GLASS

SEPARATE COMPRESSOR OIL-AIR METERING SYSTEM 570-009

Figure 1-9

I. GAS SYSTEM

Gas is introduced into the combustion zone from a circular manifold through multiple ports in the blast tube. Firing rate is determined by the size and number of ports, by manifold pressure and by combustion zone pressure. The firing rate is regulated by a rotary, butterfly type throttling valve at the manifold inlet. The valve is actuated by an adjustable linkage from the modulating motor. Depending upon specific requirements, one or two safety shutoff, motorized main gas valves are provided for installation in the gas train upstream of the butterfly valve. Safety shutoff gas valves are wired into the programming control to automatically open and close at the proper time in the operating sequence.

MAIN GAS TRAIN COMPONENTS

Depending upon the requirements of the regulating authority, the gas control system and gas train may consist of some, or all, of the following items. A typical gas train is shown in Figure 1-4.

GAS VOLUME VALVE.

The butterfly type valve is positioned by linkage from the modulating motor and controls the rate of flow of gas.

MAIN GAS VALVES.

Electrically operated safety shutoff valve(s) that open to admit gas to the burner. Standard U.L. burners include:

-Models: D42; One motorized gas valve and one solenoid valve
-Models: D54-105; One motorized gas valve w/closure interlock and one solenoid valve.
-Models: D145-420; One motorized gas valve w/closure interlock and one standard motorized valve.

MAIN GAS REGULATOR

Regulates gas train pressure to specified pressure required at inlet to gas train. Input is set by main gas pressure regulator adjustment.

MAIN GAS COCKS

For manual shutoff of the gas supply upstream of the pressure regulator. A second shutoff cock downstream of the main gas valve(s) provides a means of testing for leakage through the gas valve(s).

HIGH GAS PRESSURE SWITCH.

A pressure actuated switch that remains closed when gas pressure is below a preselected setting. Should the pressure rise above the setting, the switch contacts will open causing main gas valve(s) to close. This switch requires manual reset after being tripped.

LOW GAS PRESSURE SWITCH.

A pressure actuated switch that remains closed when gas pressure is above a preselected setting. Should the pressure drop below this setting, the switch contacts will open, causing main gas valve(s) to close. This switch requires manual reset after being tripped.

PILOT GAS TRAIN

GAS PILOT VALVE.

A solenoid valve that opens during the ignition period to admit fuel to the pilot. It closes after main flame is established.

GAS PRESSURE REGULATOR.

Reduces gas pressure to that required by the pilot.

GAS PILOT SHUT-OFF COCK.

For manually closing the pilot gas supply.

OPERATION

Metered gas flows through the main gas shutoff cock, through the pressure regulator to the automatic gas valves and butterfly valve to the gas manifold.

The butterfly gas valve modulates flow to burner input demand. The butterfly valve is positioned through mechanical linkage by the modulating motor. The air control damper is positioned simultaneously by the modulating motor.

The automatic gas valve(s) cannot be energized unless the combustion air proving switch is closed. The low and high gas pressure switches must be closed to prove proper gas pressure.

A normally open vent valve, if required, is located between the two automatic gas valves. This valve is shut when the automatic gas valves are open. When the automatic valves are closed, the vent valve is open for venting gas to the outside, should any be present.

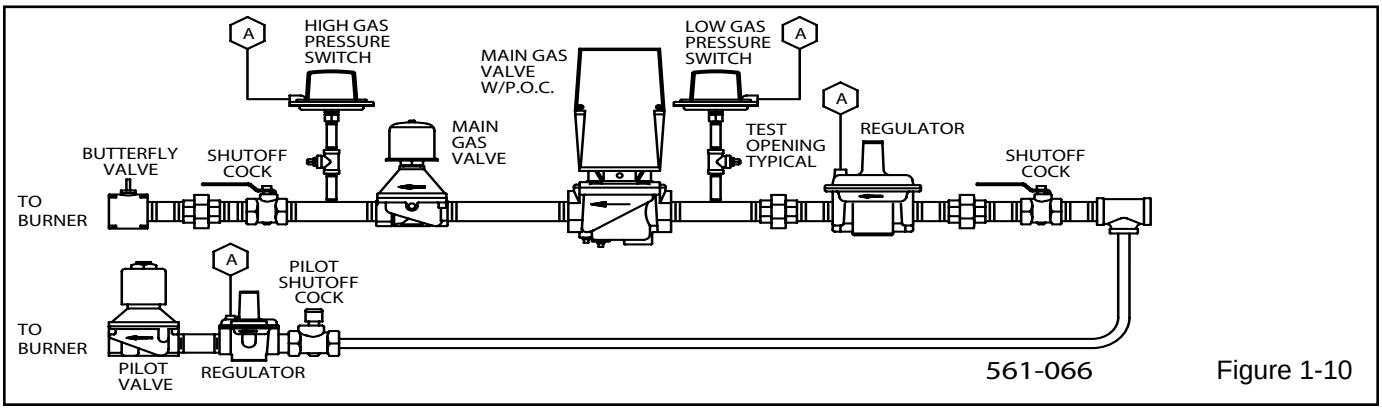


Figure 1-10

SECTION 2
INSTALLATION

A. APPLICATION

Electrical power available is usually 208 volt, 3 phase, 60 cycle, 230/460 volt, 3 phase, 60 cycle or 380 volt, 3 phase, 50 cycle. Control circuit is 115 volt, single phase, 60 cycle or 115 volt, single phase, 50 cycle. Refer to the electrical schematic diagram shipped with the burner. Power connections are made at the control panel. Wiring from the panel to burner mounted components is installed at the factory. Wiring from the burner panel to boiler controls, low water controls, remote compressor motor and remotely located fuel valves is furnished by the installer.

Automatic over-fire draft control or barometric draft regulators are not usually required except where the system has a tall chimney. The exact height of a chimney requiring draft control is indeterminate, but draft regulation is seldom needed for chimneys less than fifty feet high, especially with Scotch Marine or sealed firebox boilers. Fuel requirements for burners of all sizes are listed in specifications, on Page 4. Fuel oil piping and gas piping instructions are described in this Section.

B. COMBUSTION CHAMBER CONSTRUCTION

The combustion chamber dimensions should be proportioned to the heating load of the boiler as shown in Figure 2-5 and 2-6.

C. INSTALLATION

Locate the burner properly. The burner is designed for operation with the blast tube level. Do not tilt burner up or excessively downward. Installation of the refractory oven, or combustion cone, shipped with the burner is shown in Figures 2-3 and 2-4. Securely support the burner pedestal on the floor or foundation. Allow enough clearance at the rear of the burner to allow the housing to swing open for service and maintenance. Figure 2-6 shows an installation with typical burner support. Many boilers, including some Scotch Marine types, do not have sufficiently rigid front plates and require additional support under the burner base. Bases under the support leg must be long enough to support the burner when being inserted or withdrawn from the boiler. Boilers operating with the combustion pressure above atmospheric pressure must be sealed to prevent escape of combustion products into the boiler room. The burner mounting flange is designed to provide for a seal. The face of the boiler and burner flange must be sealed with the gasket provided with the burner. Carefully place the gasket over the dry oven bolts before it is mounted onto the burner flange. The I.D. of the dry oven is slightly larger than the blast tube I.D. Make sure the dry oven and burner blast tube are concentric. Due to bolt hole tolerances, the dry oven may have to be shifted to accomplish this. After the dry oven nuts are properly tightened, the burner and dry oven assembly can then be mounted into the boiler. For maximum safety it is recommended that boilers not operating under pressure should also be sealed.

CAUTION

IT IS IMPORTANT THAT YOU PROVIDE SUPPORT FOR THE HOUSING WHEN IN THE OPEN POSITION TO PREVENT DAMAGE TO THE HINGES AND SUBSEQUENT COMPONENTS.

D. PACKING PLASTIC REFRACTORY AROUND OVEN

The area between the outside circumference of the dry oven and existing refractory should be packed with Kaiser Refractory Mono T-9 Airset or equal within two hours after coating the dry oven with Trowleze. From inside the furnace, ram plastic refractory from the front to the rear parallel to outside surface of the dry oven.

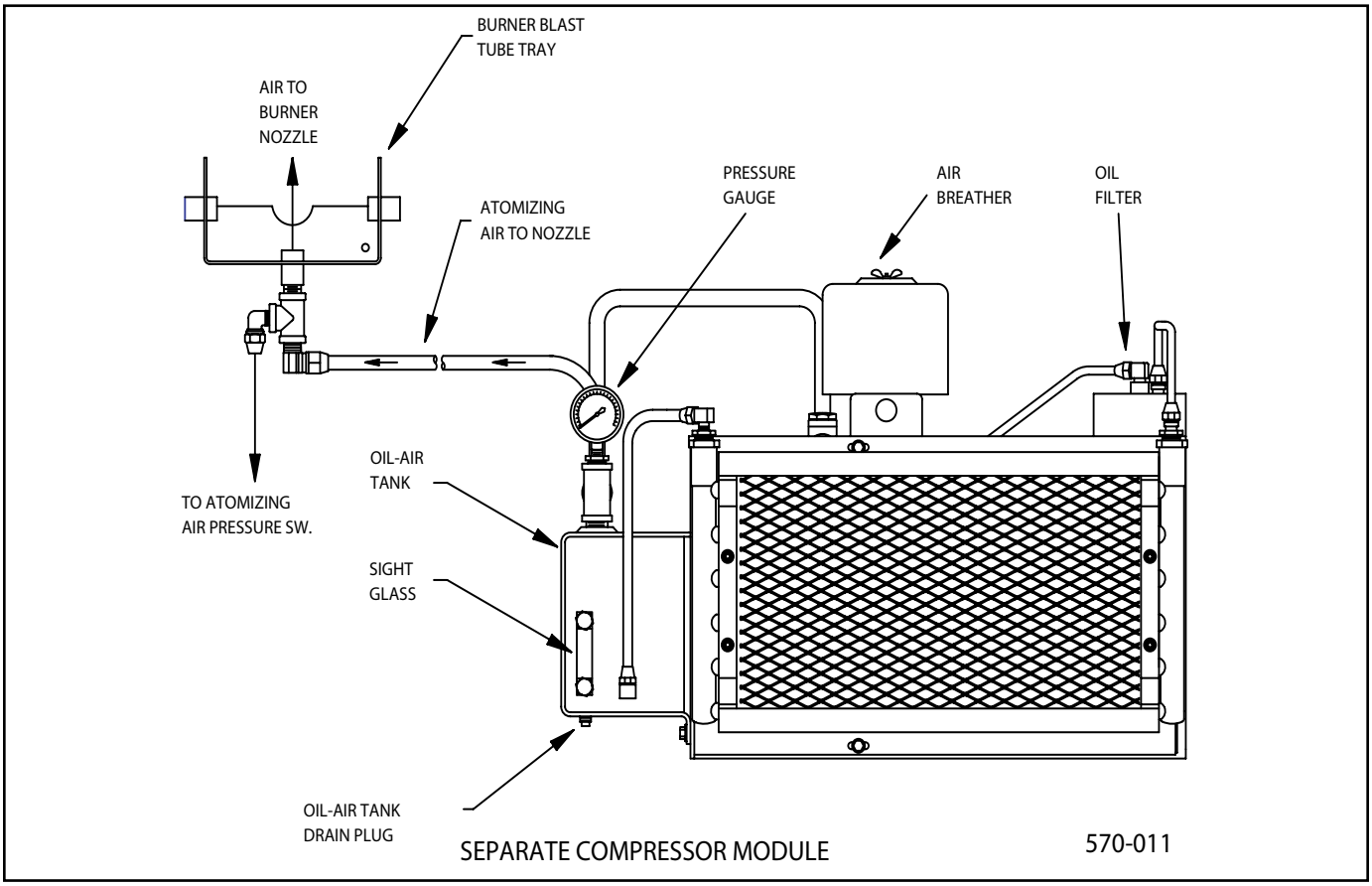
E. SEPARATE COMPRESSOR MODULE

For oil burners supplied with the separate compressor module, piping to the burner is installed as shown in Figure 2-1. Earlier models have the oil cooler finned coil located below the damper. The earliest units used a coil in the blast tube, but piping to the compressor and tank is essentially similar. Copper tubing for the installation is not supplied with the burner.

F. TYPICAL OIL SUPPLY LOOP

Refer to Figure 2-2

Continuous oil circulation must be supplied to the burner at a rate of 50 percent greater than the high fire burning rate. The oil circulating pump should be located as close as possible to the storage tank to keep suction lines short and minimize to prevent suction loss. Pipe line sizes indicated on the following oil piping schematics are of ample size to reduce pressure losses. If heating of the fuel oil is required, the lines must be large enough to prevent restriction of flow through any cold spots in the system. Note that the supply line is approximately 20 inches or higher above the burner metering pump inlet to help eliminate air problems. Above that is an adjustable, spring-loaded back pressure valve that sets approximately 10 to 15 PSI on the circulating loop. The return line to the tank is connected at the discharge port of the back pressure valve. Since air rises to the highest point, it will rise from the supply entrance and pass through the back pressure valve to the return line and on to the tank. Metered oil is pumped (by the metering pump) to the common port of a 3-way valve. With the 3-way valve de-energized, the metered oil returns to the tank through the back pressure valve and return line. When the 3-way valve is energized, metered oil is passed on to the burner oil nozzle and atomized by air from the compressor. The proper strainers, check valves, vacuum and pressure gauges, etc. should be installed as indicated. All lines should be pressure tested after installation.



G. OIL CIRCULATING LOOP OPERATION,

NO. 2 OIL Refer to Figure 2-7 to 2-9.

NO. 4 & 5 OIL Refer to Figures 2-10 to 2-12
See paragraph "I" for heater operation

NO. 6 OIL
Refer to Figures 2-13 & 2-14
See paragraph "I" for heater operation

MULTIPLE BURNERS PIPING LOOP
See Figure 2-15 for an example of multiple burners piping installation.

An oil circulating pump provides continuous oil circulation to the circulation loop. A back pressure valve holds 10 to 15 psi on the loop system. With the oil supply line connected only to the oil metering pump inlet, all oil must pass through the pump. During pre purge unmetered oil flows through a bypass section of the oil metering pump. Metered oil passes through the metering section to a de-energized 3-way oil valve (common port). Both unmetered and metered oil must pass through the back pressure valve and return to an oil storage tank. The oil metering pump will only meter oil. It will not serve as a circulating pump. At trial for main flame (main fuel) the 3-way oil valve is energized admitting metered oil to the nozzle for atomization and fast smooth ignition. Unmetered oil continues to flow through the bypass section of the oil metering pump and returns to an oil storage tank.

H. CIRCULATING OIL PUMP

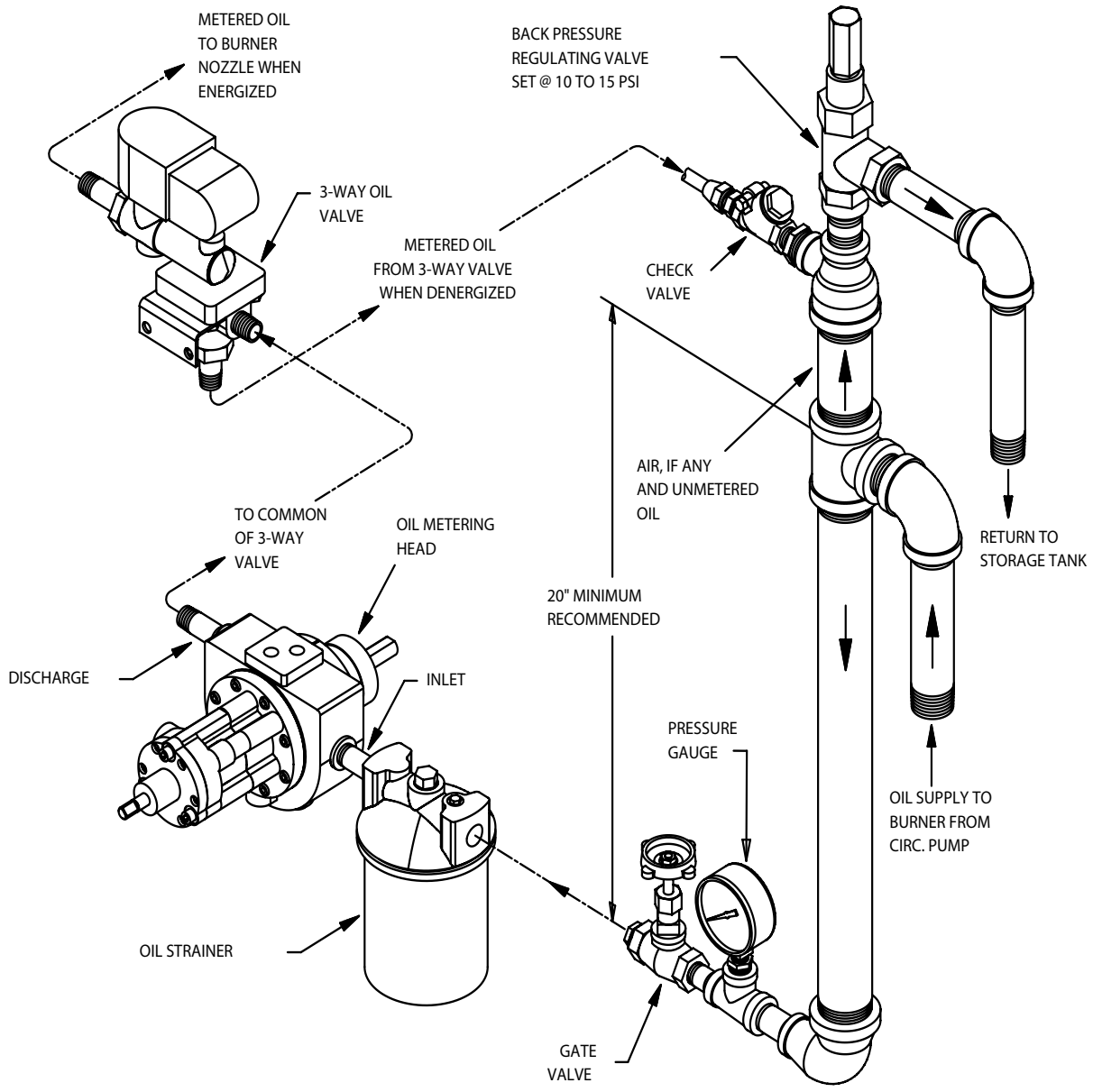
A circulating oil pump is required to deliver fuel oil from the storage tank to the burner at a minimum of 150% of the maximum burner firing rate. The excess oil allows a margin for piping error, viscosity changes in the fuel oil, and circulating pump wear. Correct pipe sizing is determined by circulating rate , not burner capacity. Install the pump as close to the supply tanks as possible. Suction lift should be as low as possible. Maximum suction of 15" Hg vacuum is good practice for either light or heated heavy oil. The strainer should be installed in the suction line just ahead of the circulating pump to prevent foreign material from entering the pump. Locate the strainer so it may be easily cleaned.

I. OIL LOOP HEATER

This heater should heat the fuel oil for proper burning at full firing rate. The proper oil temperature is that which gives the best results with the particular oil being fired. This may vary widely with different fuels in different firing systems.

Residual oil viscosity can vary widely within grade limits
and is not always within the specified limits of the grade.

Fuel viscosity requirements for air atomizing burners are not critical. Under typical circumstances a viscosity of 100 SSU might be optimum, but good results may be obtained up to 150 SSU. There is no advantage to less than 100 SSU.



TYPICAL OIL SUPPLY LOOP
Figure 2-2

Where the burning characteristics of the fuel are unknown, the following may be considered as typical:

No. 4	80° - 125°F
No. 5L	115° - 160°F
No. 5H	145° - 180°F
No. 6	180° - 220°F

J. BURNER MOUNTED TRIM HEATER

An auxiliary trim heater is in line between the metering pump and 3-way oil valve. The auxiliary trim heater is used for topping off oil temperature prior delivery to the nozzle.

K. BACK PRESSURE VALVE

A back pressure valve, similar to Watson McDaniel type "R", need to be installed on the return line as shown on Figure 2-2. This valve must be installed in an upright vertical position. Before installing the valve, be sure to blow out the pipe line, removing all dirt, pipe scale and sediment.This type of valve is actuated by the system pressure which enters the body beneath the main valve. Valve loading is provided by a spring that can be adjusted to the desired set pressure.

To adjust the set pressure, remove the top cap, loosen the brass locknut and adjust the pressure with the steel set screw. By increasing the compression on the spring, screwing down the screw, you increase the set pressure within the limits of the spring range. Reversing the set screw lowers the set pressure.

Adjust to 10-15 PSI for No.2 oil systems and 15 to 20 for heavy oils. When the desired pressure is reached, tighten the lock nut and replace the top cap and gasket.

L. GAS PIPING

Refer to Figures, 2-16 to 2-19 for typical gas piping schematics.

Gas service and house piping must supply the quantity of gas demanded by the unit at the pressure required at the burner gas train inlet. All piping must be in strict accordance with applicable codes, ordinances and regulations of the supplying utility. In the absence of other codes, piping should be in accordance with the following standards:
"National Fuel Gas Code" NFPA No. 54, ANSI No. Z 223.1.
(for Canada: the Canadian Gas Association (CGA) B149 and Canadian Standards Association (CSA) B140 codes shall prevail.)

Gas train components upstream of the butterfly valve are shipped loose. These components should be mounted by the installer as close to the butterfly valve as practical. Normally, the control train is ordered to suit a particular code or insurance regulation - such as Underwriters Laboratories , Inc., CGA, Factory Mutual, or Industrial Risk Insurance.

Arrange gas piping at the burner so that the burner is accessible for servicing without disassembly.

The gas pilot supply line must be connected upstream of the main gas regulator. If a reducing bushing is required between the house piping and the burner piping, it should be close to the burner shut-off-valve.

The gas piping must be internally clean and free of foreign material. Before using in service, a leak test must be performed.

M. INSTALLATION CHECKLIST

All burners are carefully assembled and tested at the factory, but before being placed in service all connectors should again be checked for looseness caused during shipment.
Check:

1. Electrical terminals in the control panel and on all electrical components.

2. Pipe fittings and unions.

3. Tubing connections.

4. Nuts, bolts, screws.

Before operating pumps, metering heads and compressors, make certain that reservoirs are properly filled with the specific lubricant. Open all necessary oil shut-off valves. **Do not** run compressors, pumps, or metering units without oil.

Before connecting electrical current to any component, be sure the supply voltage is the same as that specified on component nameplates

Before burner operation, be sure all motors are rotating in the correct direction. See Motor Rotation Reference on page 39.

Before firing, make sure that the refractory flame cone is properly sealed to the burner mounting flange and the boiler front plate.

Make certain that the operator in charge is properly instructed in the operation and maintenance procedures.

CAUTION

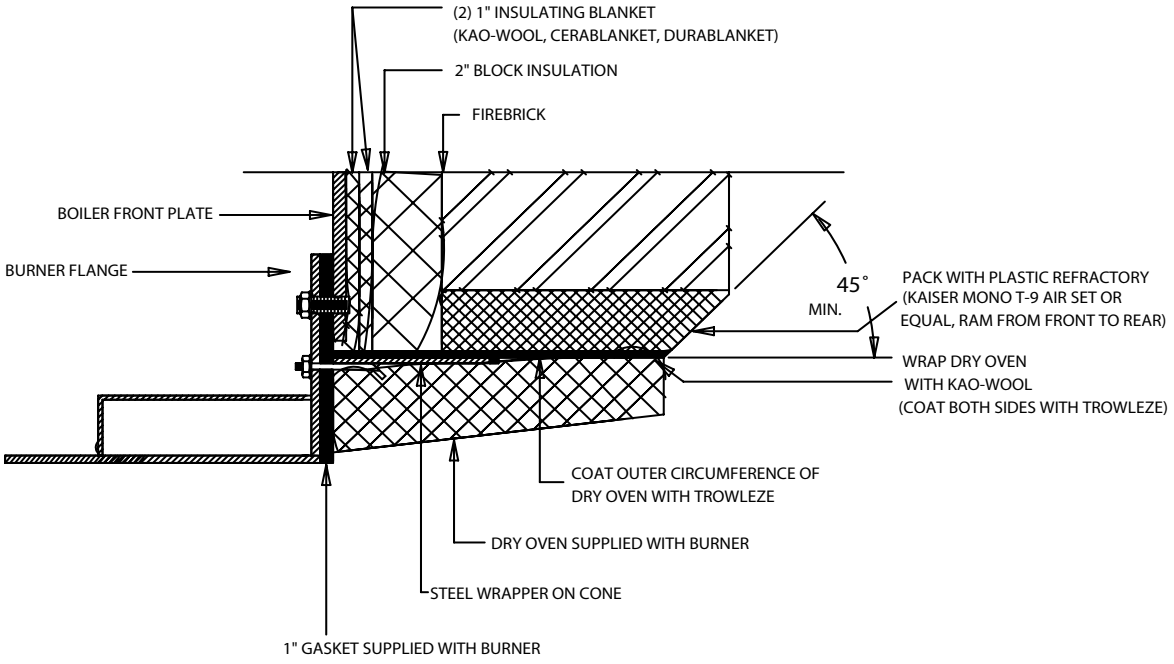
BEFORE OPENING THE GAS SHUT-OFF VALVES, READ THE REGULATOR INSTRUCTIONS CAREFULLY. OPEN SHUT-OFF VALVE SLOWLY TO ALLOW INLET PRESSURE TO BUILD-UP SLOWLY IN THE REGULATOR UNTIL IT IS FULLY PRESSURIZED. OPENING THE SHUT-OFF VALVE QUICKLY WILL DAMAGE THE REGULATOR. DO NOT EXCEED THE REGULATOR PRESSURE RATINGS.

CAUTION

LUBRICATING OIL IS DRAINED FROM THE AIR OIL TANK BEFORE SHIPMENT. BEFORE ATTEMPTING TO START THE BURNER, ADD OIL TO THE RECOMMENDED LEVEL .

CAUTION

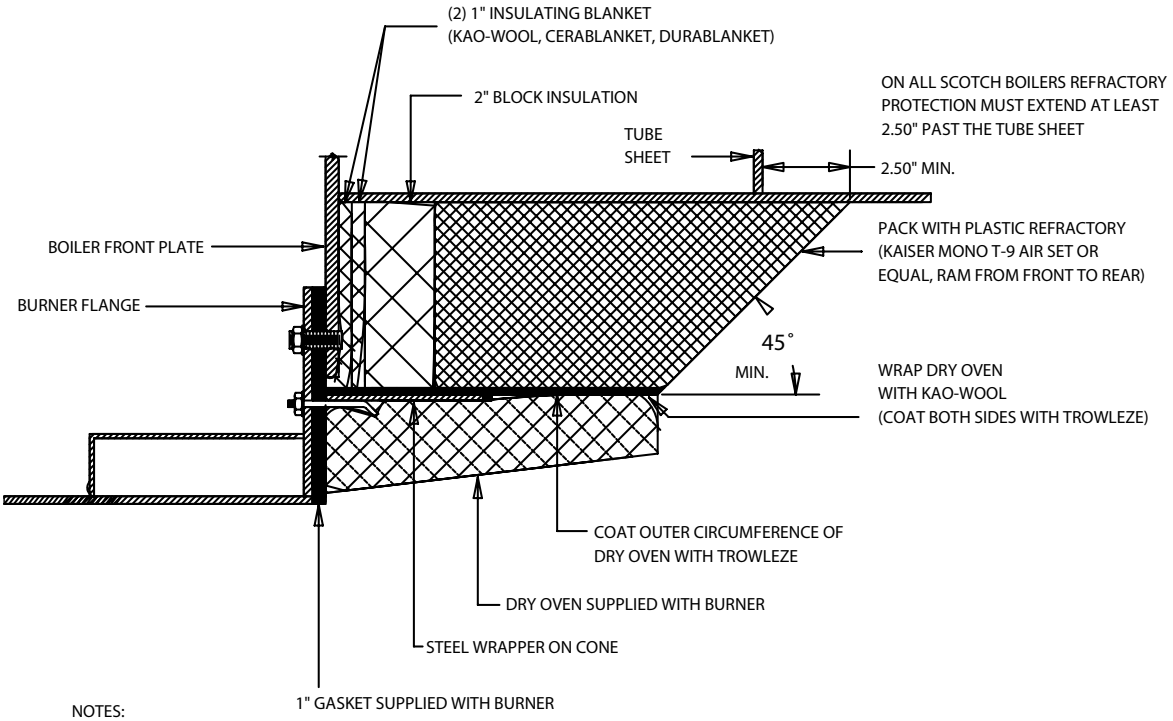
THE BURNER REFRACTORY CONE IS AIR-CURED ONLY. HEAT-CURING MUST BE INITIATED AT INITIAL START-UP. RUN THE BURNER AT LOW FIRE FOR A PERIOD OF 6 TO 8 HOURS BEFORE STARTING TO GRADUALY INCREASE THE FIRING RATE. FAILURE TO DO SO WILL RESULT IN DAMAGE AND CRACKS IN THE REFRACTORY.



NOTES:

1. LAY THE DRY OVEN ON THE FLOOR WITH THE STUDS UP. CAREFULLY PRESS THE GASKET OVER THE STUDS.
2. LIFT THE DRY OVEN ONTO THE BURNER FLANGE AND GENTLY TIGHTEN THE BOLTS.
3. MAKE SURE THE DRY OVEN IS CENTERED ON THE BURNER FLANGE SO THE SPACE IS EQUAL ALL AROUND THE BURNER BLAST TUBE.
4. MAKE SURE THAT NONE OF THE GASKET IS PROTRUDING INTO THE AIR STREAM. TIGHTEN THE DRY OVEN NUTS.
5. WRAP THE DRY OVEN WITH TROWLEZE COATED KAO-WOOL AND LIFT THE BURNER ONTO THE BURNER STUDS AND BOLT SECURELY IN PLACE.
6. FINISH REFRACTORY WORK INSIDE FURNACE.

BURNER MOUNTING DETAILS FOR FIREBOX AND WATERTUBE BOILERS 565-002 Figure 2-3



NOTES:

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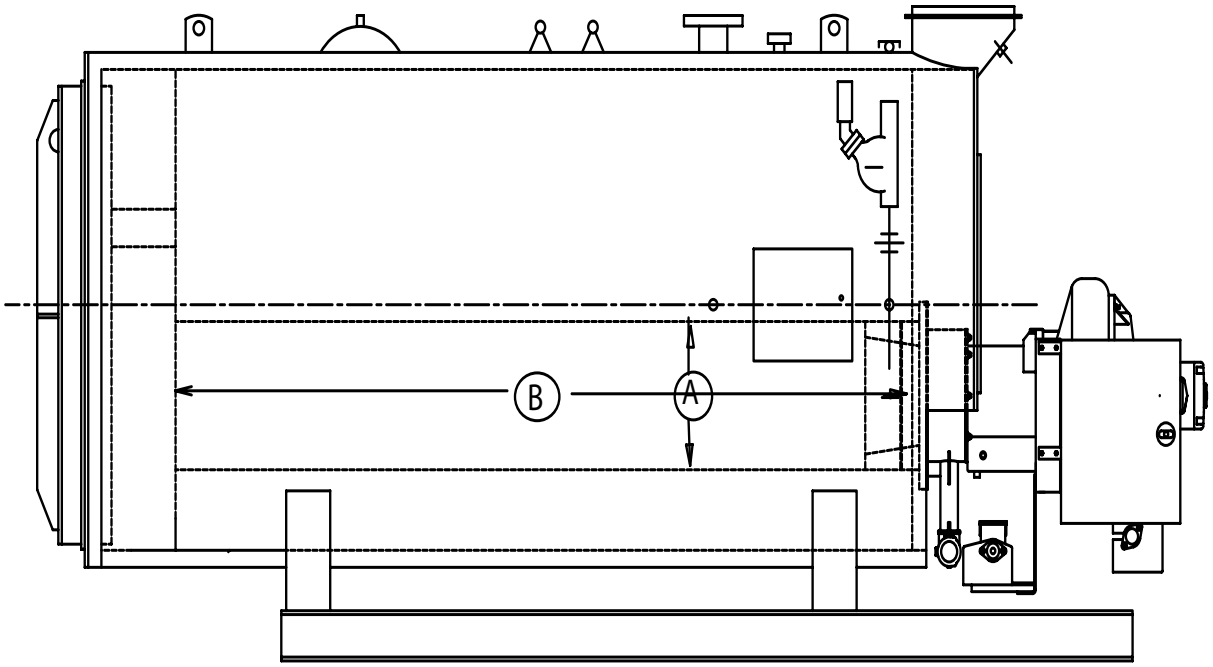
5. WRAP THE DRY OVEN WITH TROWLEZE COATED KAO-WOOL AND LIFT THE BURNER ONTO THE BURNER STUDS AND BOLT SECURELY IN PLACE.
6. FINISH REFRACTORY WORK INSIDE FURNACE.

BURNER MOUNTING DETAILS FOR SCOTCH MARINE BOILERS 565-003 Figure 2-4

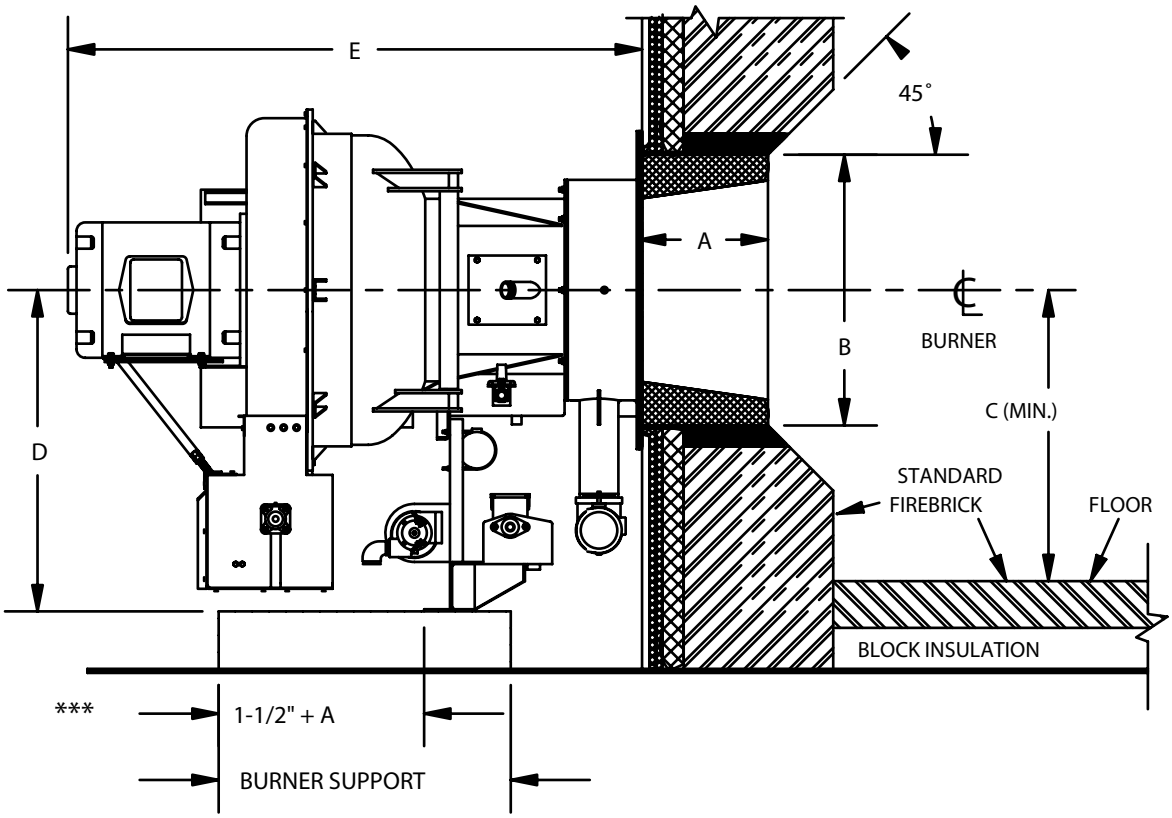


RECOMMENDED COMBUSTION CHAMBER DIMENSIONS - SCOTCH MARINE BOILERS

BURNER MODEL	BOILER H.P.	"A" DIAMETER O.D.	"B" LENGTH
D42	100	24	120
D54	125	30	110
D63	150	30	133
D84	200	34	115
D105	250	34	144
D145S	300	38	158
D145P	350	38	185
D175	400	42	155
D210	500	42	195
D252	600	46	194
D300	700	48	204
D315	750	50	201
D336	800	50	230
D378	900	52	250
D420	1000	52	280

570-006

Figure 2-5



(ALL DIMENSIONS IN INCHES)

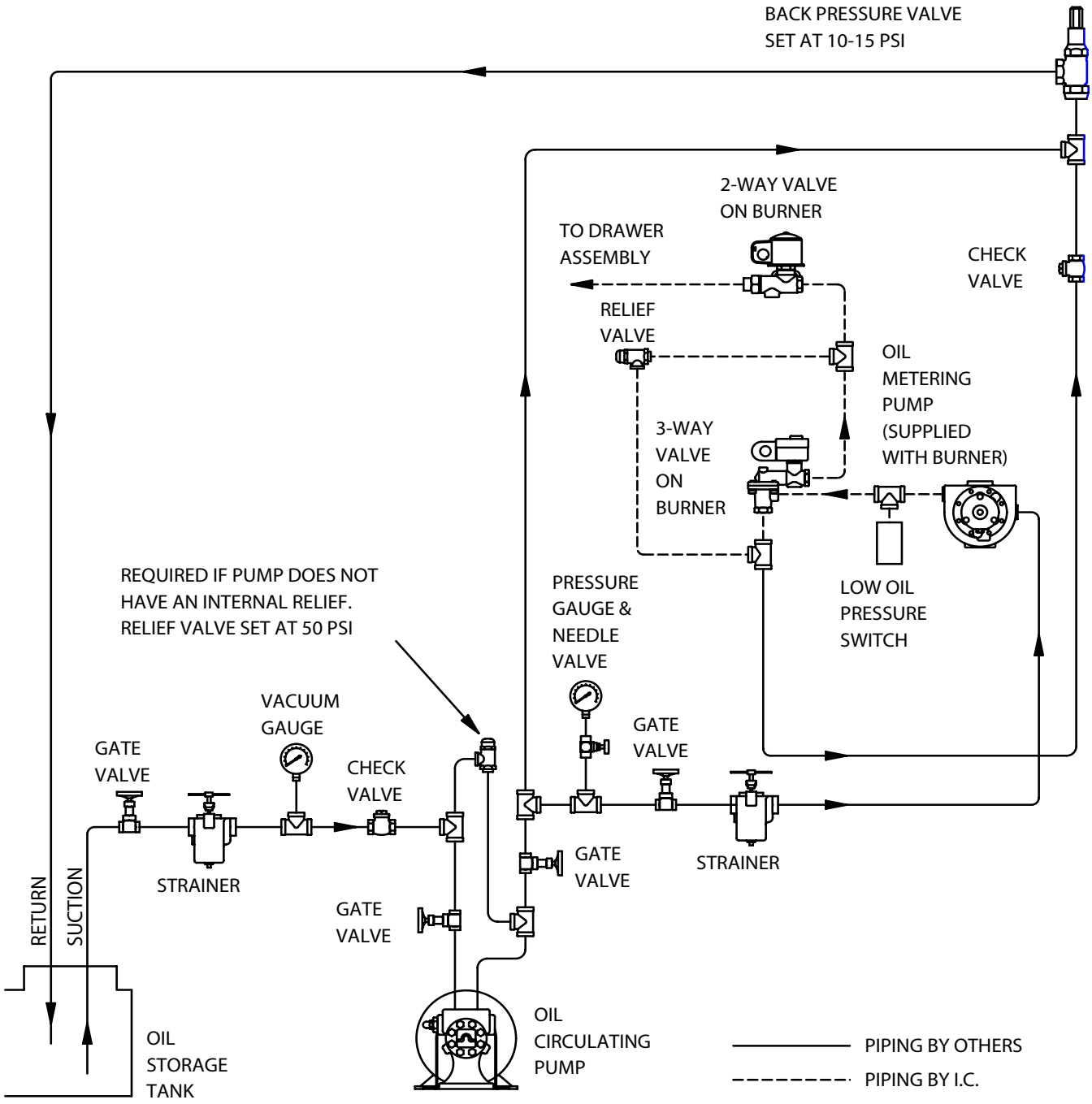
BURNER SIZE		DIM. A LGTH. OVEN REFRACTORY	DIM. B O.D. OVEN REFRACTORY	DIM. C ℄ BURNER TO FLOOR	DIM. D ℄ BURNER TO SUPPORT	DIM. E BURNER LENGTH	COMBUSTION CHAMBER	
D	LND						MIN. WIDTH	MIN. LENGTH
	42 P	9	15-7/8	14	23-3/4	43-3/4	28	55
42 S/P	54 P	9	15-7/8	14	23-3/4	43-3/4	28	56
54 S/P	63 P	9	15-7/8	15	23-3/4	43-3/4	32	60
63 S/P	84 S	9	15-7/8	16	23-3/4	43-3/4	34	65
84 S/P	105 S	10	19	19	25-3/8	45-5/8	38	74
105 S/P	145 S	10	19	23	25-3/8	45-5/8	46	84
125 S/P	145 P	10	19	24	25-3/8	47	50	90
145 S/P	175 P	12	22	25	30-1/8	56-7/8	55	100
175 S/P	210 P	12	27-1/2	27	31-7/8	60	60	108
210 S/P	252 P	12	27-1/2	30	35-7/8	64-1/8	70	120
252 S/P	300 P	15	31-1/2	30	37-3/8	67	84	132
300 S/P	315 P	15	31-1/2	32	37-3/8	67	84	144
315 P	336 P	15	31-1/2	34	37-3/8	69-3/8	84	147
336 P	378 P	18	34-5/8	34	38-7/8	68-1/2	86	152
378 P	420 P	18	34-5/8	36	39-7/8	73-7/8	92	160
420 P		18	34-5/8	38	39-7/8	73-7/8	96	170

* For Installation of Furnished Refractory, See Fig. 2 & 3.
** Floor can be Lowered or Pitted to Obtain Dimension C.
*** For Support of Burner During Installation or Removal.

570-010

RECOMMENDED COMBUSTION CHAMBER DIMENSIONS FOR FIREBOX AND WATERTUBE BOILERS

Figure 2-6



NO. 2 OIL

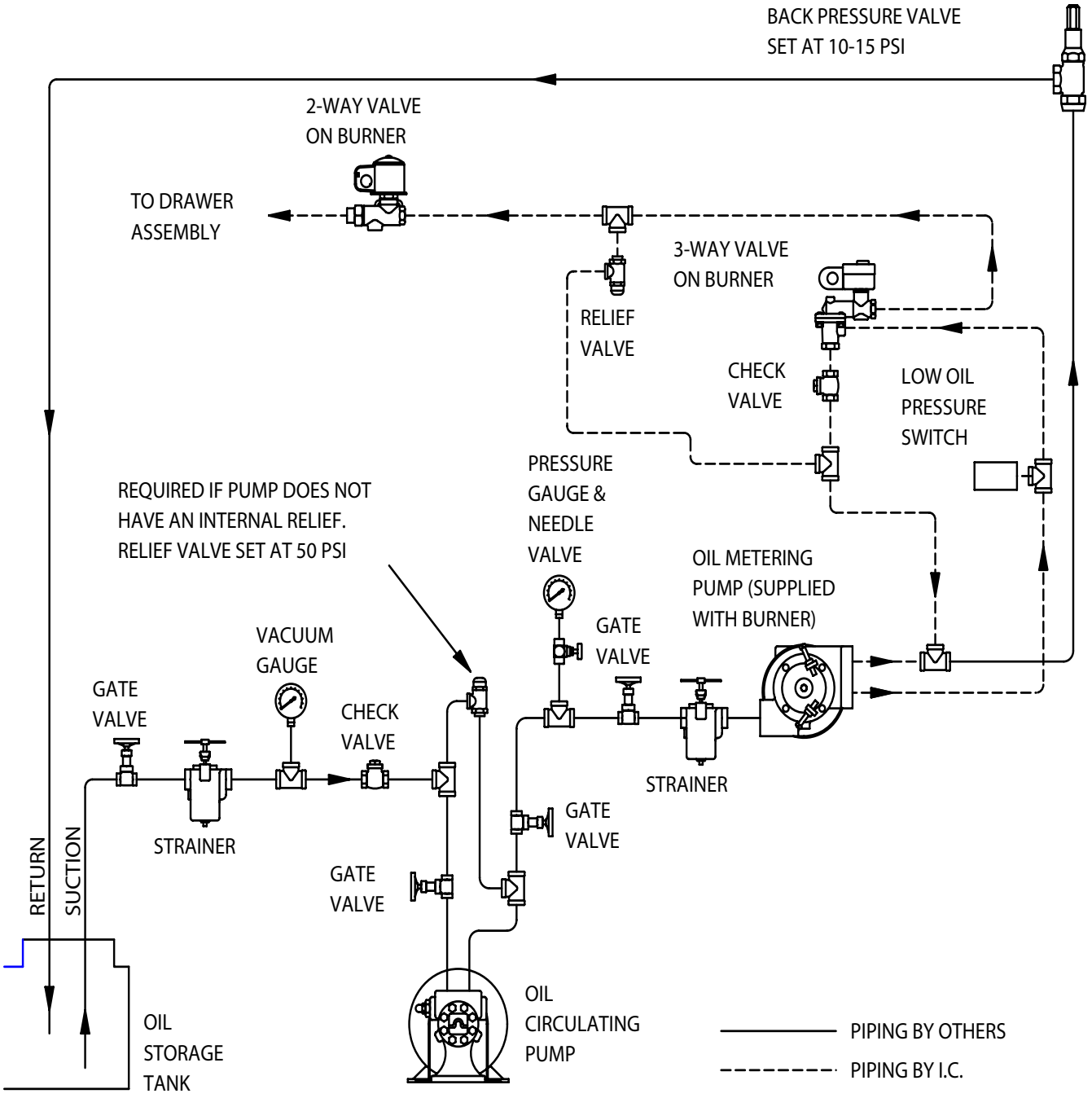
RECOMMENDED PIPE SIZE

563-033

TANK TO CIRCULATING PUMP		CIRC. OIL PUMP TO BURNER & RETURN	
1 ½"	DL,LNDL-42,54,63,84	1 ½"	DL,LNDL-42,54,63,84

THIS PIPING LAYOUT IS FOR REFERENCE ONLY AND IS SUBJECT TO CHANGE WITHOUT NOTICE. OPTIONAL EQUIPMENT MAY CHANGE THIS LAYOUT

Figure 2-7



NO. 2 OIL

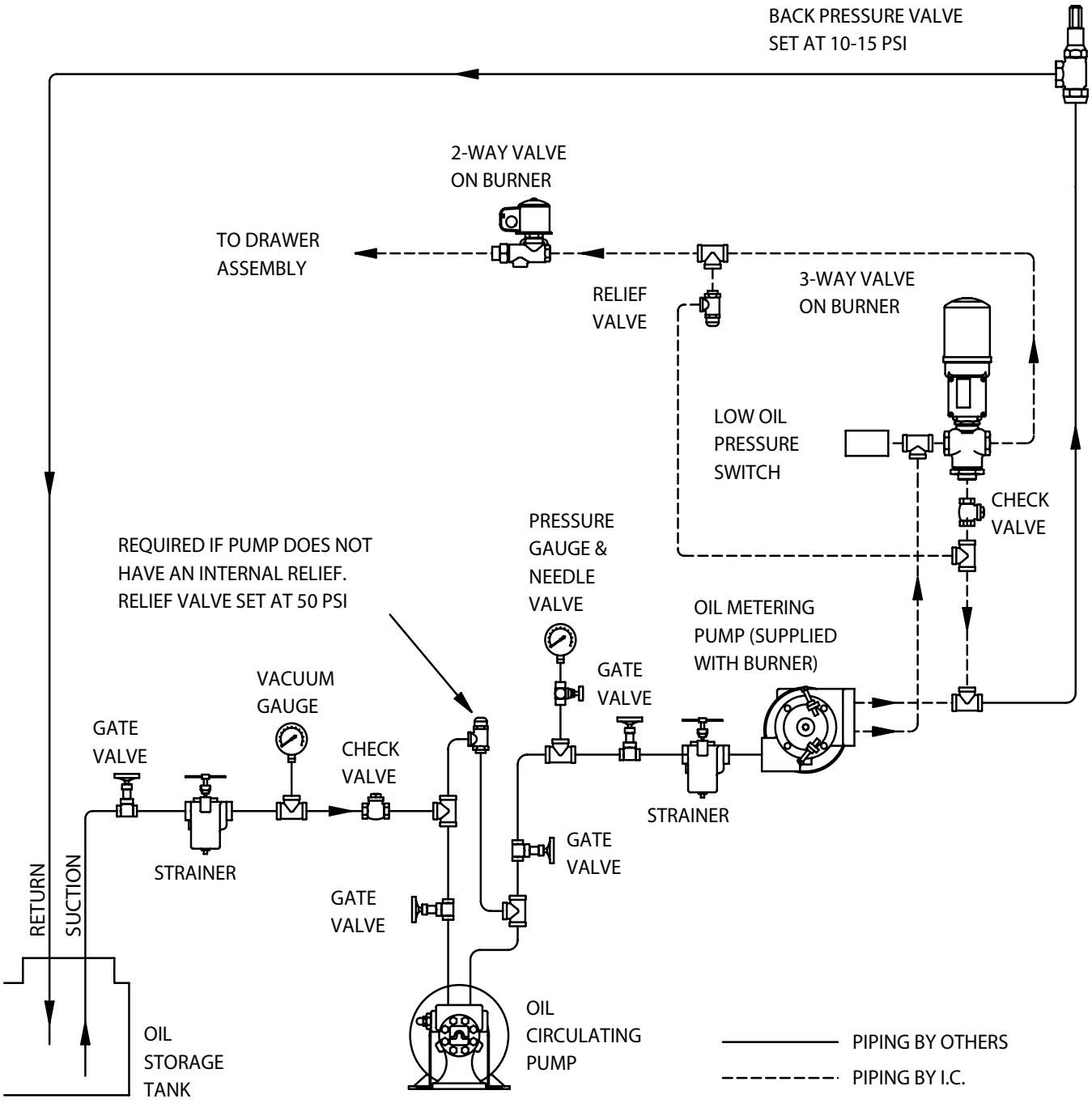
RECOMMENDED PIPE SIZE

563-034

TANK TO CIRCULATING PUMP		CIRC. OIL PUMP TO BURNER & RETURN	
2"	DL,LNDL 105,145,175,210	1 1/2"	DL,LNDL 105,145,175,210

THIS PIPING LAYOUT IS FOR REFERENCE ONLY AND IS SUBJECT TO CHANGE WITHOUT NOTICE. OPTIONAL EQUIPMENT MAY CHANGE THIS LAYOUT

Figure 2-8



NO. 2 OIL

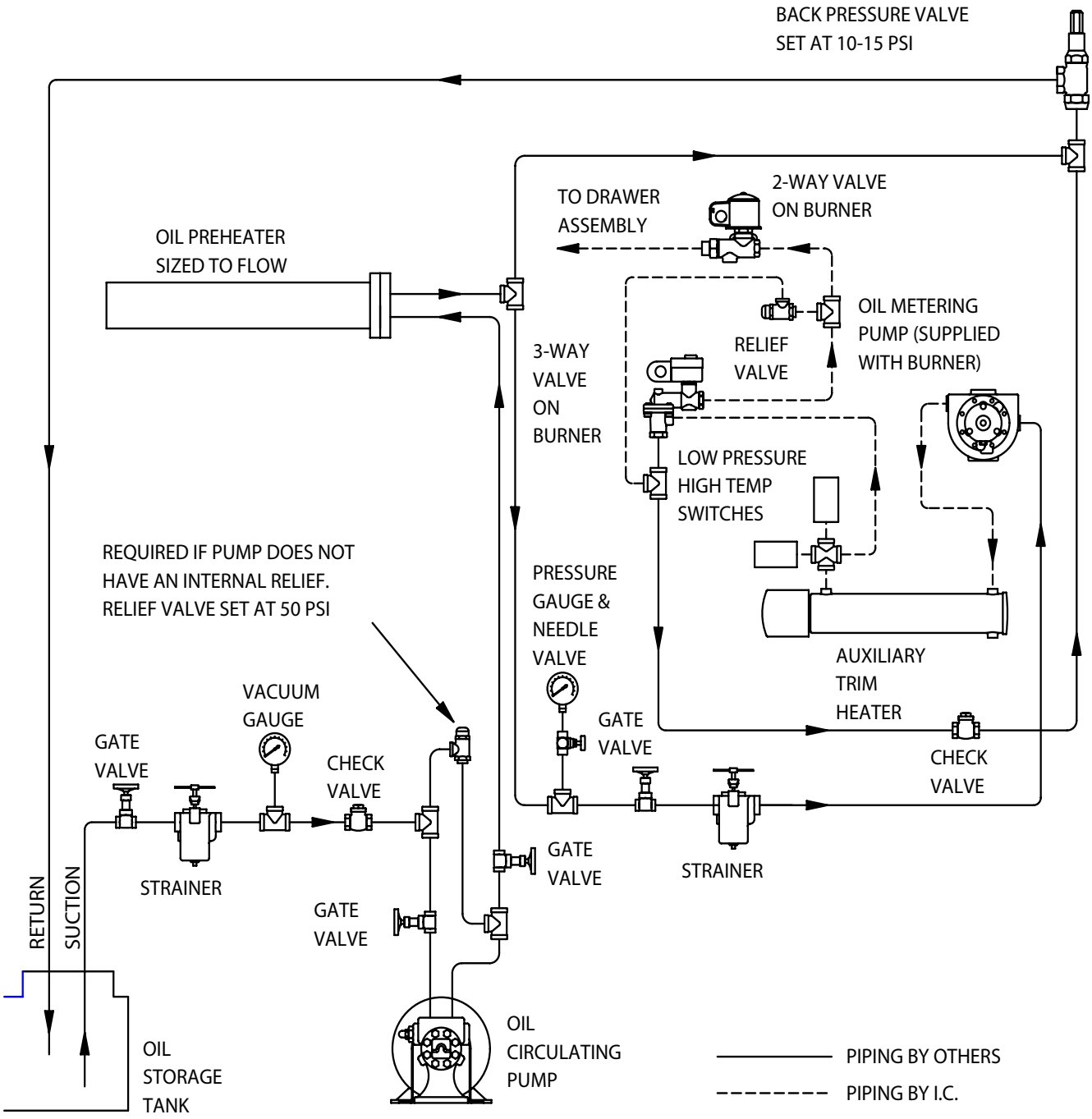
RECOMMENDED PIPE SIZE

563-035

TANK TO CIRCULATING PUMP		CIRC. OIL PUMP TO BURNER & RETURN	
2"	DL,LNDL-252,300,315,336 378,420	1 1/2"	DL,LNDL-252,300,315,336,378,420

THIS PIPING LAYOUT IS FOR REFERENCE ONLY AND IS SUBJECT TO CHANGE WITHOUT NOTICE. OPTIONAL EQUIPMENT MAY CHANGE THIS LAYOUT

Figure 2-9



NO. 4 & 5 OIL

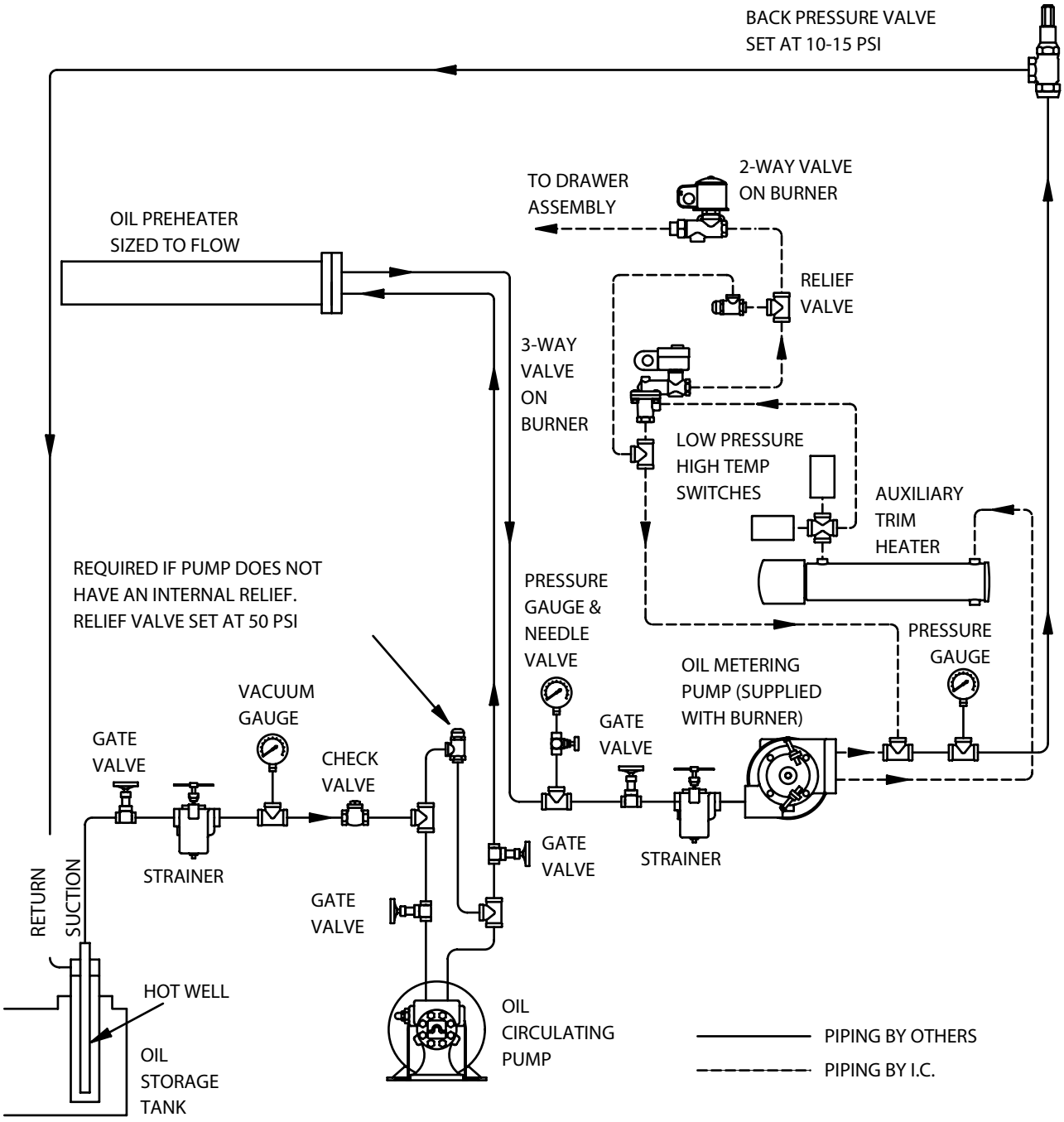
RECOMMENDED PIPE SIZE

563-036

TANK TO CIRCULATING PUMP		CIRC. OIL PUMP TO BURNER & RETURN	
1 ½"	DM-42,54	1 ½"	DM-42,54

THIS PIPING LAYOUT IS FOR REFERENCE ONLY AND IS SUBJECT TO CHANGE WITHOUT NOTICE. OPTIONAL EQUIPMENT MAY CHANGE THIS LAYOUT

Figure 2-10



NO. 4 & 5 OIL

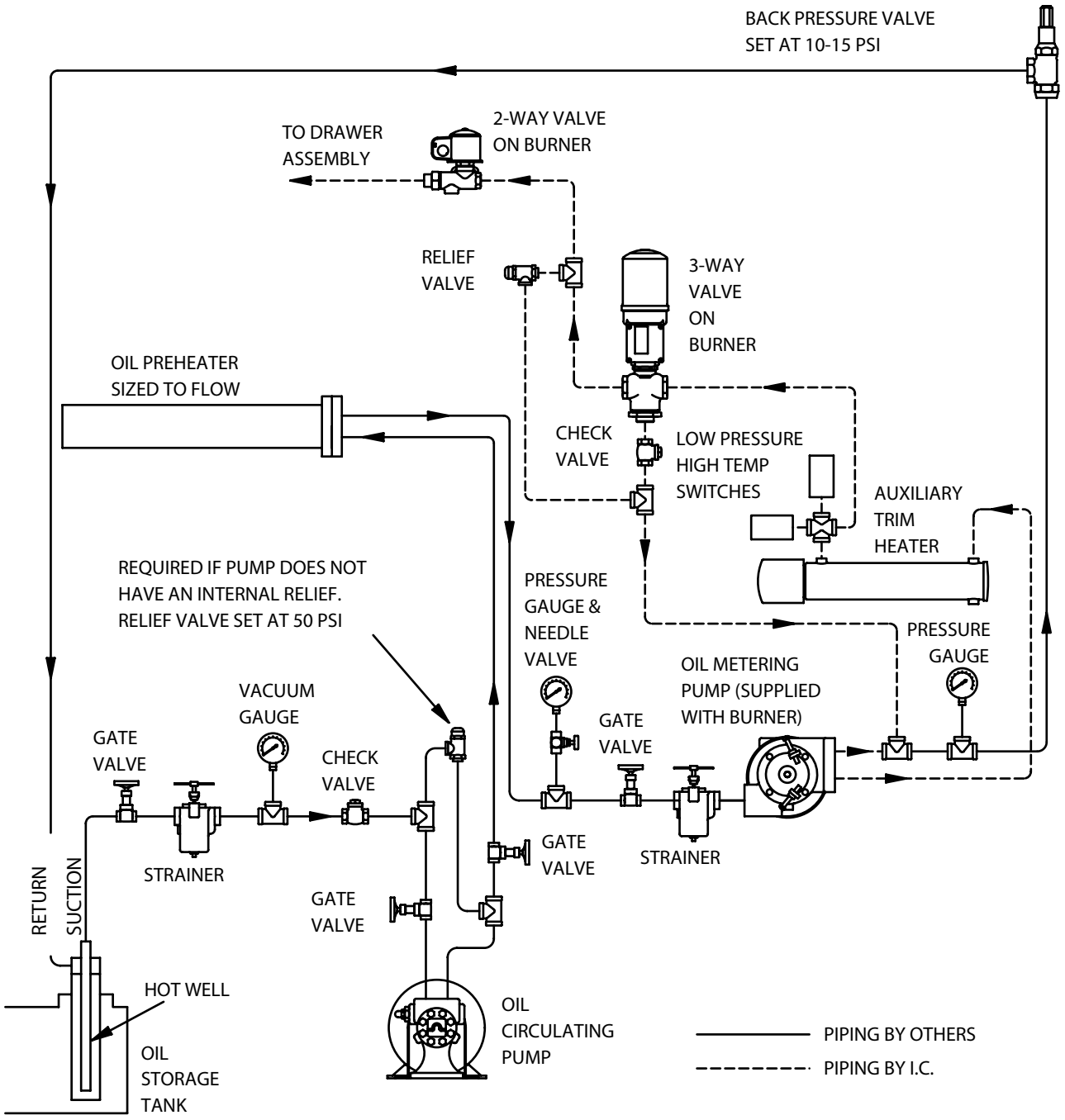
RECOMMENDED PIPE SIZE

563-037

TANK TO CIRCULATING PUMP		CIRC. OIL PUMP TO BURNER & RETURN	
2"	DM-63,84,105,175,210	1 1/2"	DM-63,84,105
		2"	DM-145,175,210

THIS PIPING LAYOUT IS FOR REFERENCE ONLY AND IS SUBJECT TO CHANGE WITHOUT NOTICE. OPTIONAL EQUIPMENT MAY CHANGE THIS LAYOUT

Figure 2-11



NO. 4 & 5 OIL

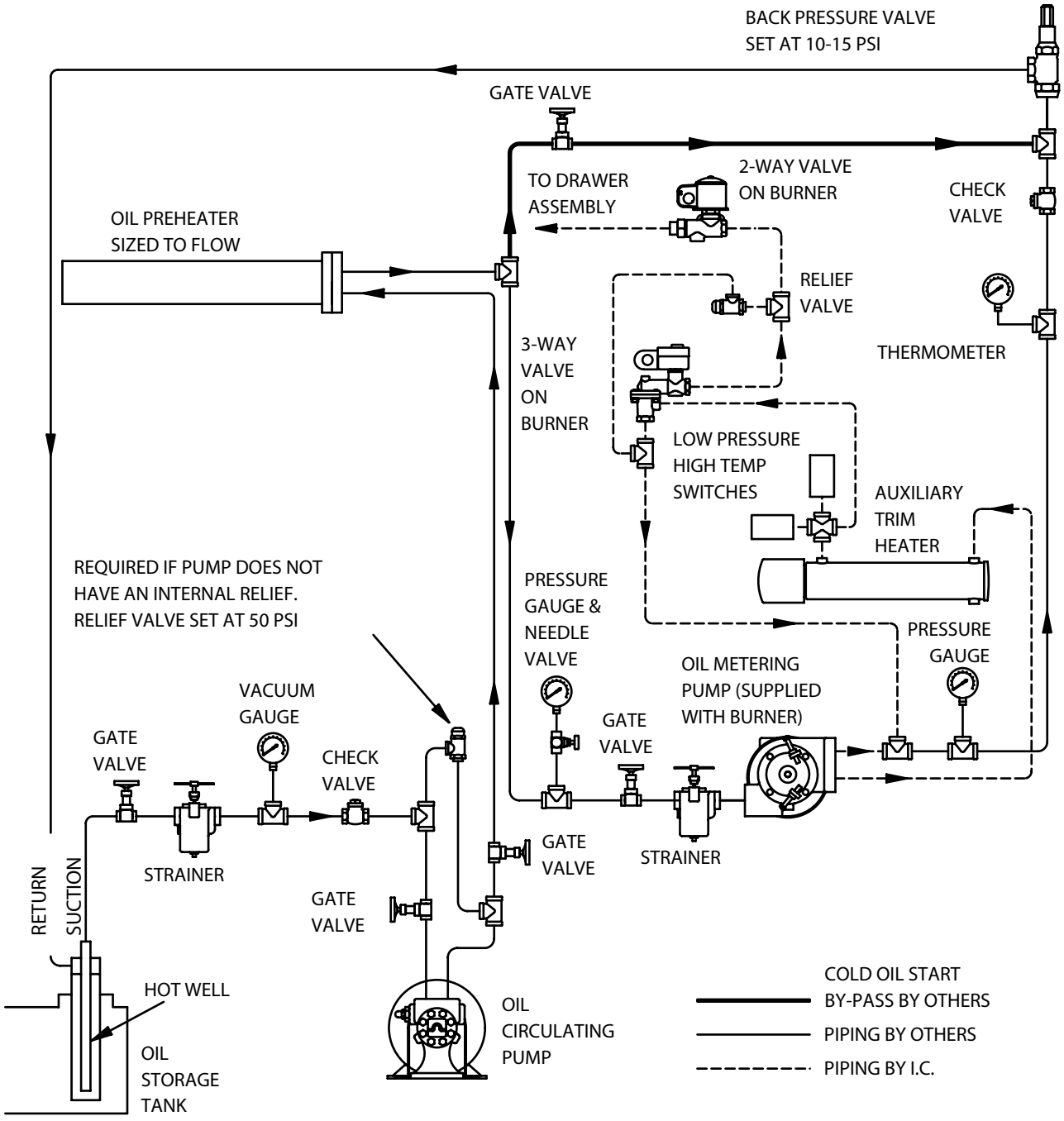
RECOMMENDED PIPE SIZE

563-038

TANK TO CIRCULATING PUMP		CIRC. OIL PUMP TO BURNER & RETURN	
2"	DM-252,300,315,336,378,420	2"	DM-252,300,315,336,378,420

THIS PIPING LAYOUT IS FOR REFERENCE ONLY AND IS SUBJECT TO CHANGE WITHOUT NOTICE. OPTIONAL EQUIPMENT MAY CHANGE THIS LAYOUT

Figure 2-12



NO. 6 OIL

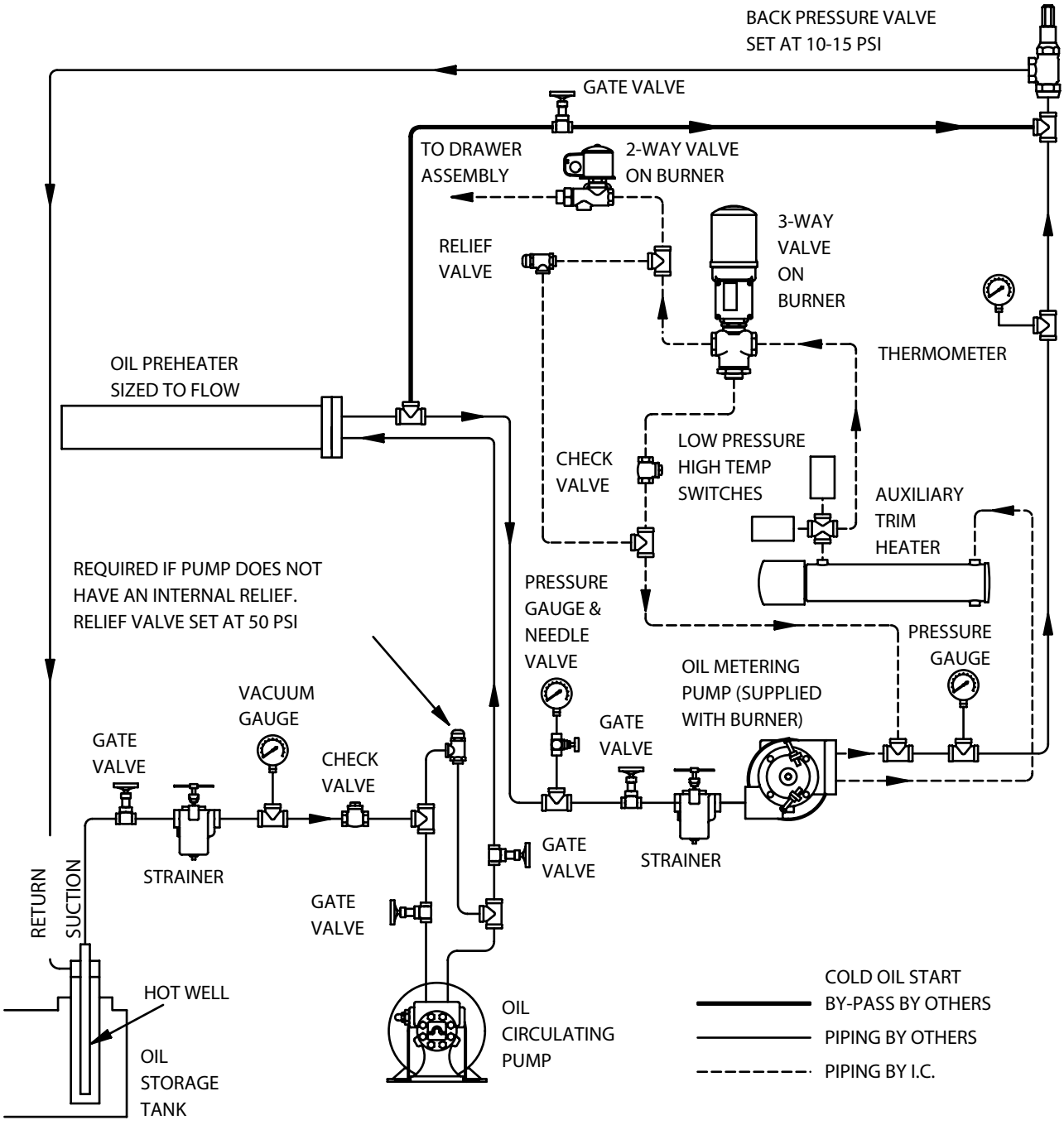
RECOMMENDED PIPE SIZE

563-039

TANK TO CIRCULATING PUMP		CIRC. OIL PUMP TO BURNER & RETURN	
2"	DE-42,54,63,84,105,145,175,210	1 ½"	DE-42,54,63
		2"	DE-84,105,145,175,210

THIS PIPING LAYOUT IS FOR REFERENCE ONLY AND IS SUBJECT TO CHANGE WITHOUT NOTICE. OPTIONAL EQUIPMENT MAY CHANGE THIS LAYOUT

Figure 2-13



NO. 6 OIL

RECOMMENDED PIPE SIZE

563-040

TANK TO CIRCULATING PUMP		CIRC. OIL PUMP TO BURNER & RETURN	
2"	DE-252,300,315,336,378,420	2"	DE-252,300,315,336,378,420

THIS PIPING LAYOUT IS FOR REFERENCE ONLY AND IS SUBJECT TO CHANGE WITHOUT NOTICE. OPTIONAL EQUIPMENT MAY CHANGE THIS LAYOUT

Figure 2-14

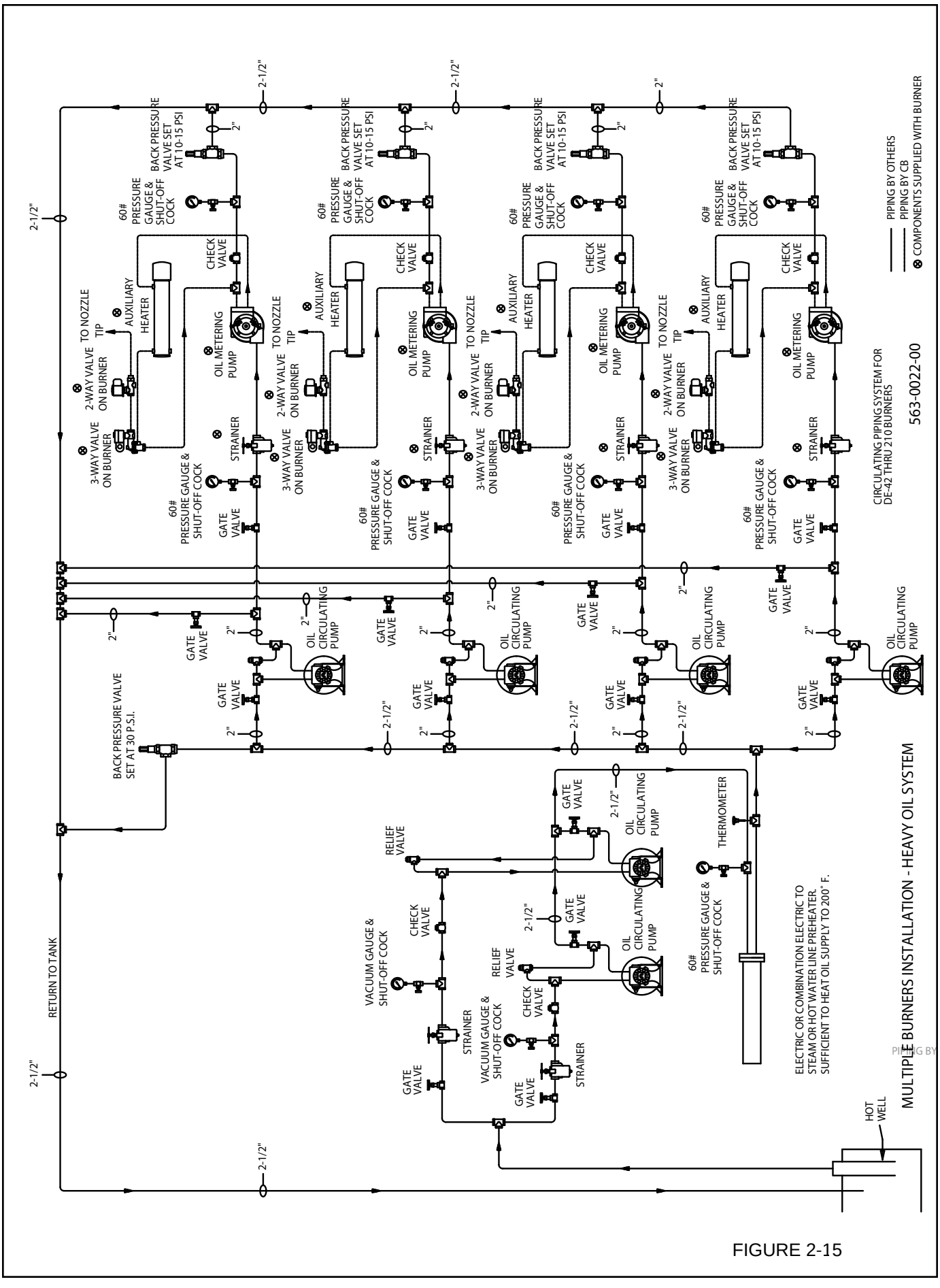
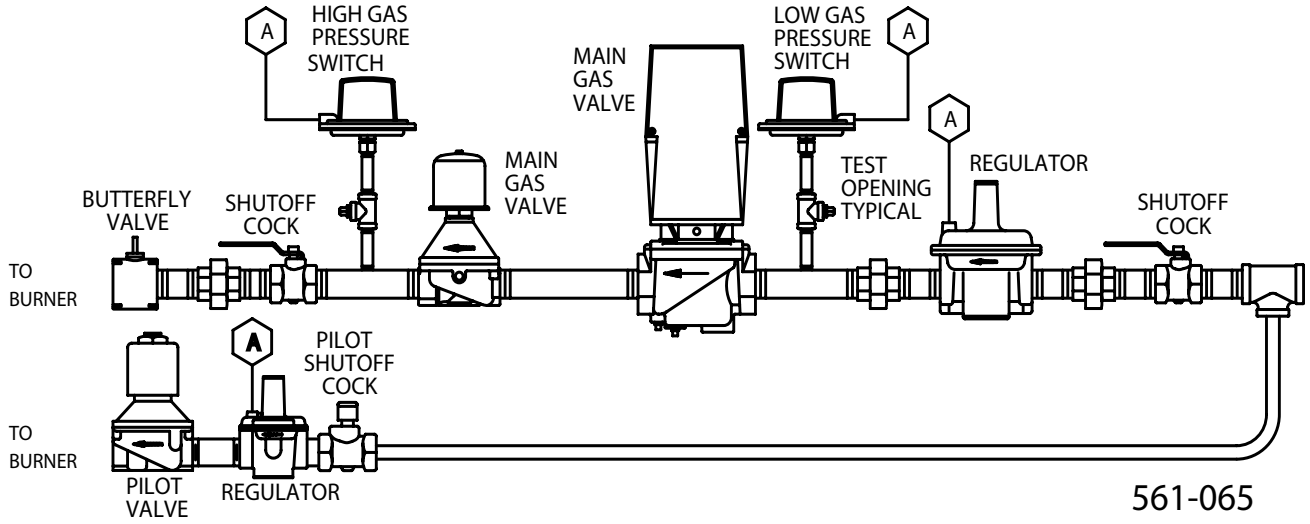

MULTIPLE BURNERS INSTALLATION - HEAVY OIL SYSTEM
563-0022-00
CIRCULATING PIPING SYSTEM FOR DE-42 THRU 210 BURNERS
PIPING BY OTHERS
PIPING BY CB
COMPONENTS SUPPLIED WITH BURNER
RETURN TO TANK
HOT WELL
BACK PRESSURE VALVE SET AT 30 P.S.I.
ELECTRIC OR COMBINATION ELECTRIC TO STEAM OR HOT WATER LINE PREHEATER. SUFFICIENT TO HEAT OIL SUPPLY TO 200° F.
THERMOMETER
60# PRESSURE GAUGE & SHUT-OFF COCK
BACK PRESSURE VALVE SET AT 10-15 PSI
OIL CIRCULATING PUMP
OIL METERING PUMP
AUXILIARY HEATER
2-WAY VALVE ON BURNER
3-WAY VALVE ON BURNER
TO NOZZLE TIP
STRAINER
CHECK VALVE
GATE VALVE
RELIEF VALVE
VACUUM GAUGE & SHUT-OFF COCK

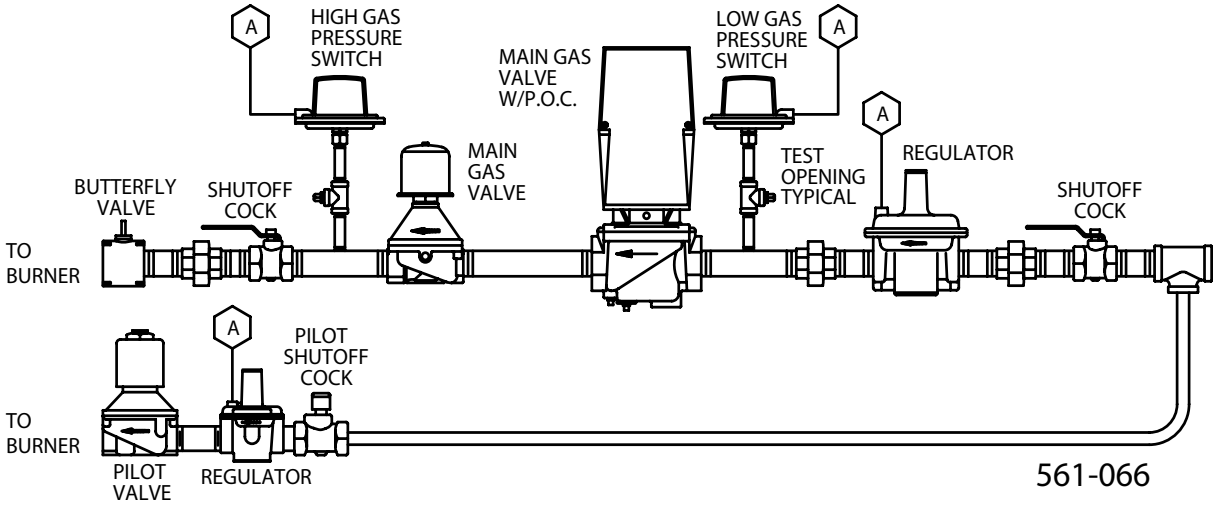
FIGURE 2-15



TYPICAL UL GAS PIPING OVER 2,500,000 UP TO 5,000,000 BTU - FULL MODULATION - MODELS D, LND 42

A 1) FULL SIZE (1/4" OR LARGER) PIPE TO BE RUN FROM THE VENT OPENING TO OUTSIDE OF BUILDING.
2) NO TRAPS ALLOWED IN VENT LINE.
3) VENT LINE SHALL TERMINATE AWAY FROM ALL DOORS AND WINDOWS.
4) PROVISIONS SHALL BE MADE TO PREVENT FOREIGN OBJECTS FROM ENTERING VENT PIPING.

FIGURE 2-16

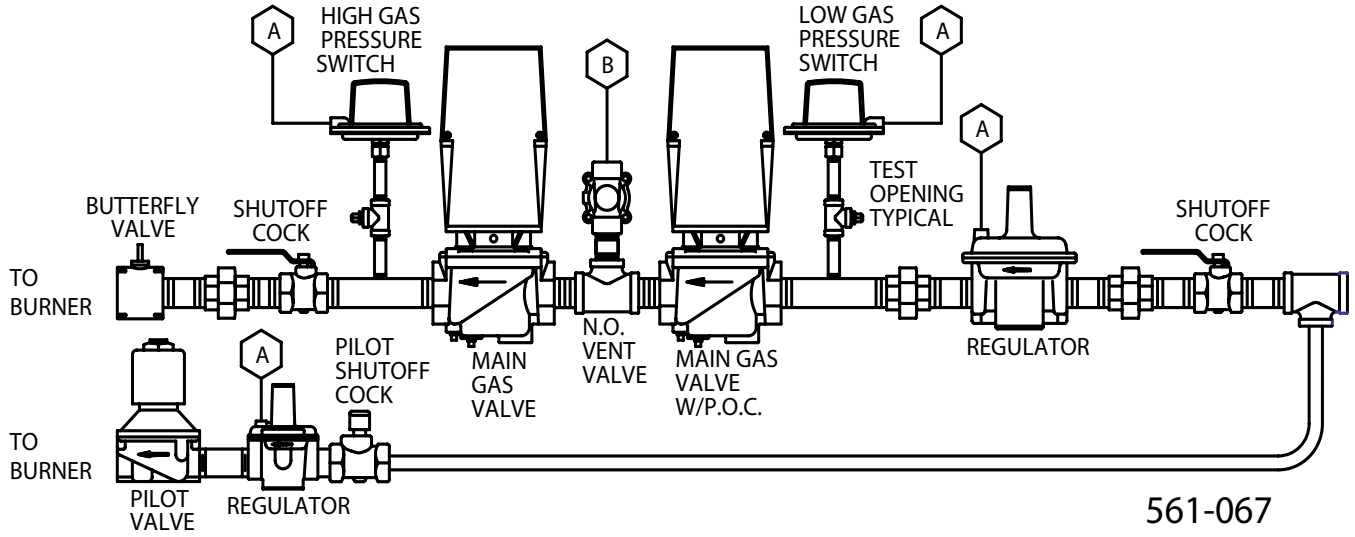


TYPICAL UL GAS PIPING OVER 5,000,000 UP TO 12,500,000 BTU - FULL MODULATION - MODELS D, LN 54 TO 105

A 1) FULL SIZE (1/4" OR LARGER) PIPE TO BE RUN FROM THE VENT OPENING TO OUTSIDE OF BUILDING.
2) NO TRAPS ALLOWED IN VENT LINE.
3) VENT LINE SHALL TERMINATE AWAY FROM ALL DOORS AND WINDOWS.
4) PROVISIONS SHALL BE MADE TO PREVENT FOREIGN OBJECTS FROM ENTERING VENT PIPING.

THESE PIPING LAYOUTS ARE FOR REFERENCE ONLY AND ARE SUBJECT TO CHANGE WITHOUT NOTICE. OPTIONAL EQUIPMENT MAY CHANGE THIS LAYOUT.

FIGURE 2-17

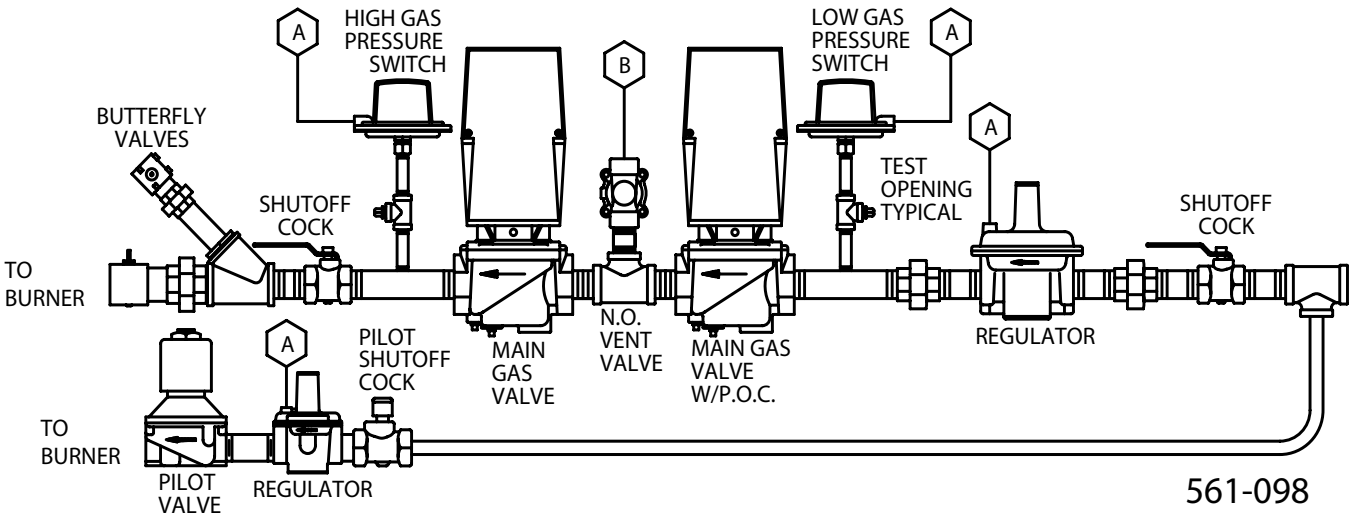


TYPICAL UL GAS PIPING OVER 12,500,000 BTU - FULL MODULATION - MODELS D, LN 378 & 420

A 1) FULL SIZE (1/4" OR LARGER) PIPE TO BE RUN FROM THE VENT OPENING TO OUTSIDE OF BUILDING.
2) NO TRAPS ALLOWED IN VENT LINE.
3) VENT LINE SHALL TERMINATE AWAY FROM ALL DOORS AND WINDOWS.
4) PROVISIONS SHALL BE MADE TO PREVENT FOREIGN OBJECTS FROM ENTERING VENT PIPING.

B 1) NORMALLY OPEN VENT VALVE LINE SHALL BE HALF OF THE MAIN GAS TRAIN PIPING SIZE (3/4" MIN.).

FIGURE 2-18



TYPICAL UL GAS PIPING OVER 12,500,000 BTU - FULL MODULATION - MODELS D, LN 378 & 420

A 1) FULL SIZE (1/4" OR LARGER) PIPE TO BE RUN FROM THE VENT OPENING TO OUTSIDE OF BUILDING.
2) NO TRAPS ALLOWED IN VENT LINE.
3) VENT LINE SHALL TERMINATE AWAY FROM ALL DOORS AND WINDOWS.
4) PROVISIONS SHALL BE MADE TO PREVENT FOREIGN OBJECTS FROM ENTERING VENT PIPING.

B 1) NORMALLY OPEN VENT VALVE LINE SHALL BE HALF OF THE MAIN GAS TRAIN PIPING SIZE (3/4" MIN.).

FIGURE 2-19

THESE PIPING LAYOUTS ARE FOR REFERENCE ONLY AND ARE SUBJECT TO CHANGE WITHOUT NOTICE. OPTIONAL EQUIPMENT MAY CHANGE THIS LAYOUT.

SECTION 3
OPERATION

A. PREPARATIONS FOR STARTING

When the installation is complete and all electrical, fuel, water and vent stack connections are made, make certain said connections are tight. The operator should become familiar with the burner, boiler controls and components. To identify controls and components refer to contents of Chapter 1. Adjustment procedures given in Chapter 4 should be revised prior to firing. The wiring diagram should also be studied along with the operating sequence of burner programmer.

Read and understand starting instructions before attempting to operate the burner. Before attempting to start the burner, the following checks must be made:

1. BOILER.

Check the boiler water level. Be sure all boiler valves are installed correctly and positioned properly. Set the high limit control sightly above the desired temperature. Set modulating controls at the desired temperature or pressure.

2. BURNER.

Check the electrical power supply to the burner in accordance with the nameplate voltage on all motors and the control circuit. Check the direction or rotation of the motors. Refer to Page 46. Open the housing to check the electrode setting. Refer to Section 5, Figure 2, Page 42. Check the gas pilot pressure at the pilot gas regulator. Normal setting is 3" to 6" W.C.

For protection in shipment, the flame safeguard control chassis is shipped unmounted. Check all screw connections before attaching flame safeguard chassis to base. Screw must be secure to assure low resistance connections. The relay chassis is mounted on the subbase with a screw which, when tightened, completes the connection between the subbase and chassis contacts. Press manual reset button to be sure safety switch contacts are closed.

Check control linkage for proper movement of the air volume damper and fuel metering components. This can be done by loosening the linkage at the actuator level and manipulating by hand.

Check the air shutter and adjust low fire setting.

3. FIRING PREPARATIONS FOR OIL BURNERS

Prior to initial firing, oil flow pressure and temperature should be verified.

Inspect the compressor lube oil sump level. Add oil to bring the oil level to the midpoint or slightly higher in the reservoir sight glass. Refer to item 4.

Make certain that the drive belts or couplings are aligned and properly adjusted

To verify air flow and pressure, momentarily flip the switch “ON” and immediately turn “OFF”. The programmer will continue through its cycle, however, without ignition or energizing the fuel valves. Observe the air pressure gauge. With compressor running and no oil flow, the pressure should be approximately 10 psi. The schematic flow diagram(s), Figure 7 & 9 in Section 1, indicates the flow of fuel and atomizing air.

If the burner is a dual fuel model, make certain that the main gas shut off cock is closed and the fuel selector switch set to “OIL”.

OIL FLOW

LIGHT OIL. Refer to piping diagrams. Open all valves in the oil suction and return line. The burner oil metering units are not capable of creating suction. Fuel oil must be supplied to the metering unit at a nominal 10 to 15 psi pressure by a circulating supply pump.

HEAVY OIL. Refer to Piping diagrams, for burners using heavy oil. Note the by-pass valve between the supply and return lines. At initial system start-up or after prolonged shutdown, start the system as follows:

1. A vacuum (or compound pressure-vacuum) gauge should be installed in the oil suction line, and its reading noted. This gauge indicates the tightness of the suction system.

2. Open valve No.1 in the bypass line and close valve No. 2 in the supply line to the metering pump.

3. Turn on the pre-heater and the circulating pump. Oil will circulate from the tank through the circulating pump and pre-heater, returning to the tank through the bypass and return lines. Observe the oil supply pressure gauge for indication that oil flow is established. If no pressure shows after a few moments, and the vacuum gauge shows little or no suction, stop the circulating pump and re-prime. Heavy oil in the storage tank (i.e. hot well) must be warm enough to permit flow.

4. As the system becomes warm, the pressure required for circulation will gradually drop. When the return is warm, open No. 2 valve and throttle the flow in the bypass line with valve No. 1. This will cause the oil to flow through the back pressure valve to the tank via the return line. **The pressure in this loop around the burner should not exceed 25 psi** When the loop around the burner becomes warm, gradually close valve No. 1 in the bypass line. All supply oil will then flow through the burner loop.

OIL PRESSURE.

The system pressure is regulated by the back pressure valve. This should be set between 10-15 psi (DL & DM models) or 12-20 psi (DE models) at the burner inlet after the temperature stabilizes.

OIL TEMPERATURE.

Heavy oil flow and burning characteristics are dependent on oil viscosity, which in turn requires temperature regula-

tion. A loop heater in the supply line between the circulating pump and the burner heats the oil. The loop heater should be adjusted to give the designed operating temperature. Where the burning characteristics of the fuel are unknown, the following may be considered as typical:

No. 4	80° - 125°F
No. 5L	115° - 160°F
No. 5H	145° - 180°F
No. 6	180° - 220°F

4. OIL- AIR TANK (LUBE OIL).

Check the lube oil level in the air-oil tank. Inspect oil level regularly. Loss of oil will damage the compressor. Fill the tank with **non detergent** SAE30 oil to a level midway up the sight glass. Do not overfill the tank.

For normal environment use SAE30 oil. For a 32 degree F. and below environment use SAE10 oil. Change oil every 2000 hours of operation.

5. FIRING PREPARATIONS FOR GAS BURNERS

A representative of the gas utility should turn on the gas. Determine by a test gauge upstream of the burner regulator that sufficient pressure exists at the entrance to the gas train. The gas pressure regulator must be adjusted to the pressure required and the pressure setting recorded.

On combination fuel models, set the selector switch to gas. On initial start-up it is recommended that the main gas shutoff cock remain closed until the programmer has cycled through pre-purge and pilot sequences to deter

Check for leaks and determine there is adequate gas pressure available at the burner for operating at full capacity. Check with the local utility if necessary. Check gas pressure at the pilot and the main burner. Close the manual gas valve.

B. ELECTRICAL INTERFERENCE TEST

Prior to putting the burner into service, conduct the following test to ascertain that the ignition spark will not cause the flame relay to pull in.

1. GAS FIRED

Close the pilot and the main line manual gas valves.

Start the burner and at time of pilot trial with just the electrical ignition system energized, the flame relay should not pull in (i.e. be energized).

Upon completion of successful test, proceed with start-up procedures.

2. OIL FIRED

Disconnect the electrical power to the burner.

Disconnect the electric oil safety shutoff valve.

Reconnect electric power to the burner. Close the pilot line manual gas valve, if used.

Start burner and at the time of pilot trial, with just the electrical ignition system energized, the flame relay should not pull in.

Upon completion of successful test, disconnect power supply. Reconnect oil safety shutoff valve and turn on manual pilot gas valve. Reconnect power supply and proceed with start-up procedures.

C. GAS PILOT FLAME ADJUSTMENT

The gas pilot flame is regulated by adjusting the pressure setting of the pilot regulator. Normal setting is 3" to 6" WC when the pilot is burning. The flame must be sufficient to be proven by the flame detector and ignite the main flame.

Although it is possible to visibly adjust the size of the pilot flame, obtain a proper DC volt or microamp reading of the flame signal.

The flame safeguard amplifier has a meter jack for this purpose. At initial start-up and during planned maintenance, test the pilot flame signal, pilot turndown, and safety switch lockout.

WARNING

READ THE FLAME SAFEGUARD MANUAL AND FULLY UNDERSTAND ITS CONTENTS BEFORE ATTEMPTING TO OPERATE THIS EQUIPMENT. SERIOUS PERSONAL INJURY OR DEATH MAY RESULT.

WARNING

Should a starting failure occur for any reason, combustible fumes may fill the combustion chamber. Never attempt to re-light the burner under these conditions without first purging the combustion chamber.

WARNING

KEEP FINGERS AWAY FROM THE COMBUSTION AIR INTAKE BELOW THE DAMPER. The damper is actuated with sufficient force to cause severe injury. Repeat the procedure until the high fire rate is reached. Always make high and intermediate rate adjustments when the burner has reached low fire position. DO NOT disturb the low fire setting.

D. START-UP SEQUENCE

The programming control sequences the operation of all controls and components through the starting, ignition, firing, and shutdown cycle. The burner and control system are in starting condition when:

a. The operating and high limit control (temperature or pressure) are below their cutoff setting;
b. All power supply switches are closed;
c. Power is present at the control panel.

Refer to the manufacturers literature on programming controls and burner wiring diagrams for detailed information.

1. Begin starting sequence, with burner switch off, and with all manual valves closed. Switch main power on. (Power On) light.
2. When firing oil, open the manual oil valves.
3. When firing on gas, open the main manual gas valve.
4. When firing on gas, manually reset the high and low gas pressure switches.
5. Place the gas /oil selector switch in position for desired fuel. With all limit and operating controls calling for heat, the burner will follow the Flame Safeguard Sequence below.
6. When the burner motor starts, open the gas cock.
7. If firing on gas, when the main fuel lamp lights indicating pilot flame proven open the manual leak test valve.

Time in seconds	External Operation
0	Provided the fuel valve is proven closed the burner motor and flame safeguard timer will start
7	Air flow must be proven before ignition, or the flame safeguard will lockout. If the inter lock circuit opens during a firing period, the burner will shutoff and the flame safeguard will lockout.
60	Firing on gas and providing the air flow and low fire have been proven, the pilot ignition transformer and ignition lamp are energized and the gas pilot valve opens to ignite the pilot.
70	Firing on oil, providing air flow and pilot have been proven, the main fuel lamp lights. When on gas or oil, the main valve opens to ignite the burner at low fire.
80	The pilot ignition transformer is de-ener gized, and the main safety shut off pilot valve closes, scanner proves main flame only.If the low/auto. switch is in the auto position, the following will occur: On gas, the butterfly valve and the burner air louvre move to "low fire" position. On oil, the metering pump and the burner air louvre move to "low fire" position.
100	"Normal run" position. Burner continues.

E. AUTOMATIC SHUTDOWN

	Limit or operating controls open:
100	Fuel valves close. Main fuel lamp goes off. Flame safeguard timer starts.
115	Flame safeguard timer and burner motor stop. Burner is ready for start up on the next call for heat

F. MANUAL SHUTDOWN

1. Turn gas/oil selector switch off. Burner shuts down in Automatic Shutdown as above.
2. When burner motor stops, close all manual valves

G. SAFETY SHUTDOWN

1. If at any time during the operating cycle a flame failure occurs, the burner shuts down as in Automatic Shutdown, with an additional post-purge, and the flame failure lamp is energized.

   A. The lockout switch on the flame safeguard control must be manually reset after a waiting period of two minutes, before the burner will fire again.

2. If a low water condition occurs, the burner shuts down as in Automatic Shutdown.

3. If a high or low gas pressure condition occurs while firing on gas, the burner shuts down as in Automatic Shutdown.

   A. Condition must be corrected and the respective gas pressure switch manually reset before the burner will fire again on gas.

H. START-UP AND OPERATING

GAS BURNERS

Close the main and pilot gas cocks. Make sure the “ON-OFF” switch is in the “OFF” position and the fuel selector switch on “GAS”. Actuate the manual reset button of the flame safeguard control to close the safety switch contacts.
Set the “MANUAL-AUTO” switch in the “MANUAL” position.
Set The manual potentiometer in low fire position.
Open the gas pilot cock.

Set the “ON-OFF” switch to “ON”. The burner will start and pre-purge. After pre-purge, the ignition transformer and the gas pilot solenoid are energized. Before proceeding conduct electrical interference and pilot turndown tests if not previously done. Refer to Paragraph B.

On initial start-up it is recommended that the main gas shutoff cock remain closed until the programmer has cycled through prepurge and pilot sequence. Then determine that main gas valve opens. When this is confirmed, turn the burner switch “OFF” and let programmer finish its cycle. Check to see that gas valve has closed tightly. If ignition does not occur, turn the burner switch “OFF” and allow programmer to recycle for a new ignition trial.

Turn burner “ON” and after pilot ignition when the flame relay pulls in, the slow opening, motorized, main gas valve is energized. Slowly open the downstream manual shutoff gas cock. Main flame should ignite at this time. The gas valve and air damper continue advancing until high fire is reached.

Do not repeat unsuccessful light off attempts without rechecking burner and pilot adjustment. Vent fuel vapors from the combustion chamber after each unsuccessful light off attempt. Set the gas low fire rate by adjusting

butterfly valve and air linkage. When low fire is adjusted, shut down burner. Restart several times to be sure the low fire setting is suitable. Readjust if necessary. Never start the burner with fuel vapor in the furnace. In case of emergency, open main power switches and close all fuel valves. After combustion adjustments are satisfactorily set, allow the heating vessel to slowly reach normal operating pressure or temperature.

Turn the potentiometer switch to the high fire position. Check high fire at this point using combustion instruments.

Do not disturb established low fire adjustment. Allow the burner to return to low fire position before adjusting high or intermediate settings.

High fire combustion analysis typically is 9 to 10.5 percent CO2. When conditions covered above are assured, refer to Sections I and J.

OIL BURNERS

The fuel selector switch should be set to “OIL”. On initial start-up of a combination burner, it is recommended that oil firing be adjusted before gas firing. Gas low firing rate is set to match oil low fire rate.

Be sure the “ON-OFF” switch is in the “OFF” position and the fuel selector switch is on “OIL”. Actuate the manual reset button of the flame safeguard control to close the safety switch contacts. Be sure the “MANUAL-AUTO” switch in “MANUAL” position. Set manual modulating control potentiometer in “LO” fire position.Open the pilot gas valve (if used).

Set the “ON-OFF” switch to “ON”. The burner will start and pre-purge. After pre-purge, the ignition transformer and the gas pilot (if used) are energized. Before proceeding conduct electrical interference and pilot turndown tests if not previously done. Refer to Chapter 4, Section C and D.

Observe the primary atomizing air pressure gauge on the air/oil tank. The gauge reading should be approximately 10 psi during pre-purge.

When the pilot flame is proven, the programmer will proceed to the main flame position. Allow the burner to operate in low fire, to warm the boiler before moving to high fire.

Typically, for No. 2 through 4 oil, CO2 is 8 to 11 percent and No. 5 and 6 oil is 8 to 13 percent at low fire.

Turn the manual potentiometer switch to the high fire position. Check high fire combustion at this point. Do not disturb previously established low fire adjustment. Allow the burner to return to low fire position before adjusting high or intermediate settings. The primary atomizing air pressure will increase automatically with the oil flow rate.

Typically, for No. 2 through 4 oil, CO2 is 10 to 13 percent and No. 5 and 6 oil is 11 to 15 percent at high fire.

When conditions covered above are assured, refer to section I and J

I. NORMAL OPERATION

Normal operation must be with the “MANUAL-AUTO” switch selector at “AUTO”.

In automatic operation, the operating cycle always proceeds sequentially through pre-purge, pilot ignition, main flame ignition, run and post-purge. The length of purge and ignition trial vary according to the type of programmer used.

During the run cycle, burner input is regulated to the load demand by the modulating pressure or temperature control on the boiler. The burner will continue to modulate until the operating pressure or temperature is reached.

Programmer control operation should be tested when the burner is initially placed into service, when a control is replaced, and at scheduled intervals in the maintenance program.

Refer to adjustments procedures and maintenance instructions given in Chapters 4 and 5.

J. SHUTDOWN

When the operating limit control setting is reached or the burner switch is turned “OFF”, the following sequence occurs:

The fuel valve(s) de-energize and flame extinguishes. The blower motor continues running during post-purge.

At the end of the post-purge the blower motor is de-energized. The programmer returns to its starting position and stops. Unit is ready to restart.

Abnormal shutdown might result from motor overload, flame outage, low water, current or fuel supply interruption, combustion or atomizing air pressure below minimum level, tripped circuit breakers, blown fuses, or other interlock devices. Check for cause and correct before restarting burner.

Safety shutdown caused by ignition or flame failure will actuate a red indicator light and energize an audible alarm (if so equipped). If the programmer has a non-recycling interlock circuit, any interruption in this circuit during the pre-purge or firing cycle will cause a safety shutdown. This type of shutdown requires manual reset of the programming control and must be corrected before operation can be resumed

WARNING

AN ULTRAVIOLET FLAME SENSOR ELECTRICAL SPARK INTERFERENCE TEST MUST BE PERFORMED AFTER FINAL ADJUSTMENT. SEE THIS SECTION PARAGRAPH "B" FOR ADDITIONAL INFORMATION

SECTION 4
ADJUSTMENTS

A. GENERAL

While each burner is tested at the factory for correct operation before shipment, variable conditions such as burning characteristics of the fuel used and operating load conditions may require further adjustment after installation to assure maximum operating efficiency.

Prior to placing the boiler into initial service, a complete inspection should be made of all controls, connecting piping, wiring and all fastenings such as nuts and bolts and setscrews to be sure that no damage or misadjustments occurred during shipping and installation.

A combustion efficiency analysis made during the initial start-up will help to determine what additional adjustments are required in a particular installation

B. COMBUSTION ADJUSTMENT ON GAS AND OIL

Efficient combustion cannot be properly judged by flame appearance, although it may help in making preliminary settings.

The proper settings of air-fuel ratios **must** be determined by flue gas analysis. Combustion gas analysis indicates the air to fuel ratio and the degree of complete combustion. Instruments are available to measure carbon dioxide (CO_2), oxygen (O_2) and carbon monoxide (CO).

STACK TEMPERATURE

Net stack temperature is obtained by subtracting the ambient temperature from the flue gas temperature. A high

net stack temperature indicates wasted heat. Stack temperature should be as low as possible without causing flue gas condensation.

Stack heat loss can be reduced by decreasing either the temperature or the volume of the flue gas, or both. Flue gas temperature is reduced by improving heat transfer or by reducing excess combustion air. A certain amount of excess air is necessary to complete combustion. More efficient burners require minimum excess air.

SMOKE MEASUREMENT

Smoke measurements can be made using a variety of different methods. The standards will vary somewhat according to the equipment used, and instructions accompanying the instrument should be followed.

Smoky combustion can result from: Improper air delivery, insufficient draft, improper fuel viscosity, improper fuel-air ratio, excessive air leaks in the combustion chamber, or improper fuel oil temperature.

GAS ADJUSTMENTS

Low fire combustion analysis typically is 7 to 9 percent CO_2 and less than .04 percent CO (400 ppm). High fire reading typically is 9 to 10.5 percent CO_2 and less than .04 percent CO.

FUEL OIL ADJUSTMENTS

Adjust for a “clean fire”. Typically for No. 2 through 4 oil, CO_2 is 8 to 11 percent at low fire and 10 to 13 percent at high fire. No. 5 and 6 oil, CO_2 is 8 to 13 percent at low fire and 11 to 15 percent at high fire.

C. ELECTRICAL INTERFERENCE TEST

Prior to putting the burner into service, conduct the following test to ascertain that ignition spark will not cause the flame relay to pull in.

GAS FIRED

Close the pilot and main line manual gas valves.

Start the burner and at time of pilot trial with just the electrical ignition system energized, the flame relay should **not** pull in (i.e. be energized).

Upon completion of successful test, proceed with start-up procedures.

OIL FIRED

Disconnect the electrical power to the burner.

Disconnect the electric oil safety shutoff valve.

Reconnect electric power. Close the pilot line manual gas valve, if used.

Start burner and at the time of pilot trial, with just the electrical ignition system energized, the flame relay should **not** pull in.

Upon completion of successful test, disconnect power supply. Reconnect oil safety shutoff valve and turn on manual pilot gas valve. Reconnect power supply and proceed with start-up procedures.

D. GAS SYSTEM

GAS PRESSURE

Gas must be supplied at a pressure high enough to overcome the pressure loss in the burner gas train and furnace pressure while running at full input. Refer to Namplate inside control panel, for gas pressure requirements at train inlet and manifold. The pressures listed are based on nominal 1000 Btu/cu ft natural gas at elevations up to 2000 feet above sea level.

GAS FLOW

The volume of gas is measured in cubic feet as determined by a meter reading. The gas flow rate required depends on the heating value (Btu/cu ft). The supplying utility can provide this information as well as pressure correction factors. To determine the required number of cubic feet per hour of gas, divide burner input (Btu/hr) by the heating value (Btu/cu ft).

NOTE

When checking the input rate, make sure no other equipment is operating on the same meter.

GAS PILOT FLAME ADJUSTMENT

The gas pilot flame is regulated by adjusting the pressure setting of the pilot regulator. Normal setting is 3" to 6" WC when the pilot is burning. The flame must be sufficient to be proven by the flame detector and ignite the main flame.

Although it is possible to visibly adjust the size of the pilot flame, obtain a proper DC volt or microamp reading of the flame signal.

The flame safeguard amplifier has a meter jack for this purpose. At initial start-up and during planned maintenance, test the pilot flame signal, pilot turndown, and safety switch lockout.

WARNING

An ultra- violet flame sensor electrical spark interference test must be performed after final adjustment. See Section C of this chapter for additional information.

MAIN GAS PRESSURE REGULATOR

The gas pressure required at the burner manifold is the pressure that is required to fire the burner at its rated capacity. The gas pressure regulator must be adjusted to achieve this pressure to assure full input. Refer to manufacturer's literature for regulator adjustment.

LOW GAS PRESSURE SWITCH

Turn adjusting screw until indicator moves to a pressure setting slightly below the operating gas pressure. The control will break a circuit if pressure is below this set point. The control should be finally adjusted to prevent operation with low gas pressure, but not at a pressure so close to normal operating pressure that unnecessary shutdowns occur. The switch must be manually reset after tripping. To reset, allow gas pressure to rise and press the manual reset button.

HIGH GAS PRESSURE SWITCH

Turn adjusting screw until indicator moves to a pressure setting slightly above the maximum operating gas pressure. The control will break a circuit if pressure exceeds this value. The control should be adjusted to prevent operation with excessive gas pressure, but not at a pressure so close to normal operating pressure that unnecessary shutdowns occur.This switch must be manually reset after tripping. To reset, allow gas pressure to drop and press the manual reset button.

GAS COMBUSTION ADJUSTMENT

After operating for a sufficient period of time to assure a warm boiler, make adjustments for most efficient combustion.

The butterfly gas valve directly controls the rate of flow. The low fire light-off setting should be regarded as preliminary until proper gas pressure for high fire operation is established.

Determine the actual gas flow from a meter reading at high fire. With the butterfly valve open and with regulated gas pressure set, the actual flow rate should be quite close to the required input. If corrections are necessary, increase or decrease the gas pressure by adjusting the gas pressure regulator, following manufacturer's directions for regulator adjustment.

When proper gas flow is obtained take a flue gas analysis reading.

With the high fire air-fuel ratio established the gas pressure regulator needs no further adjusting.

Recheck low fire and adjust if necessary.

Proper setting of the air/fuel ratios at all rates must be determined by combustion analysis. See Section B of this chapter for additional information.

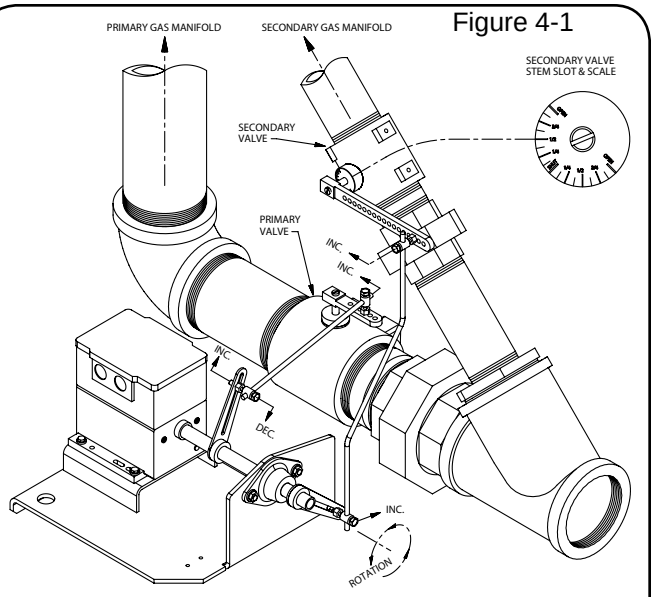
NOTE

Check for CO through the entire firing

SECONDARY VALVE ADJUSTMENT
GAS MODELS D 378 AND 420

The secondary valve feeds gas to the inner spuds. A slot in the valve stem in relationship to the shut/open scale on the valve indicates the blade position. In the LOW FIRE starting position the stem slot should be positioned at the left hand 1/4 mark and travel in a counterclockwise direction to the MID FIRE shut position. Continuing in a counterclockwise direction the stem slot should stop at the right hand 1/4 mark. This is the HIGH FIRE position. Both low and high fire positions are approximate. Adjustments to the valve should be made on the secondary valve linkage arm. To increase the travel move the linkage arm closer to the pivot point. To decrease the travel move the linkage arm away from the pivot point. The primary valve which feeds the outer spuds should be adjusted as normal.

Figure 4-1



GAS PRIMARY AND SECONDARY VALVE ARRANGEMENT D 378-420 568-045

E. OIL SYSTEM

OIL METERING SYSTEM

Fuel oil supply to the integral metering unit must be 10-15 psi and up to 20 psi on separate metering units. The oil spray should ignite as soon as the oil solenoid valve opens. If the oil spray fails to ignite, move the metering unit adjustment lever a few degrees counterclockwise. This increases the amount of oil at low fire and makes ignition easier; it will also increase the oil on high fire, so this must be checked later. Once adjusted, the pump should operate with a minimum amount of adjustment. If a burner failure is caused by the oil metering pump, check the following:

1. See that the oil tanks are not empty.
2. That all oil valves between the burner and the tank are open.
3. That the suction line is not airbound.
4. That the low-fire setting has not been disturbed.
5. That there is pressure at the integral metering unit but not to exceed 15 psi (20 psi on separate metering unit).
6. That the pump turns freely.
7. Check for a clogged strainer at the suction side of the circulating pump.
8. Check for a dirty burner strainer.
9. Check for a plugged or carboned nozzle. This will show up as excessive primary air pressure.
10. That the oil by-pass valve is not by-passing the metered fuel oil.

Internal wear of the pump may take place due to the presence of dirt in the oil and in time this will result in excessive clearances which reduces the pump capacity.
If oil metering pump fails to deliver capacity or meters erratically, replace the oil and air pump as a unit and return the old pump for repair or exchange (where allowed).

ATOMIZING AIR PRESSURE.

Atomizing air in the air/oil tank is regulated by adjusting valve in the return air line on integral metering units or in the air inlet on air compressor module burners. The air pressure is indicated by the pressure gauge at the air/oil tank.
A minimum of 10 psi air pressure in low fire is suggested. As the firing rate increases, the air pressure also increases. Air pressure will be less with light oils. If any change in atomizing air pressure is made, check ignition several times for reliable light off. Adjustments should be set to obtain reliable ignition with best low and high fire combustion results.
If the required atomizing air pressure cannot be maintained, a lack of lubricating oil may be the cause or the intake filter may be dirty.

ATOMIZING AIR PROVING SWITCH.

The knurled nut between the switch and bellows is turned in to raise pressure setting. The minimum amount of atomizing air is during pre- and post-purge. During pre-purge, adjust switch until it breaks the circuit. Readjust switch above this circuit break point to actuate under a condition of minimum pressure, but not so close as to cause nuisance shutdowns. Air pressure against the Bourdon tube actuates two single pole, single throw mercury switches, which when made completes a circuit, proving the presence of atomizing air. Since the pressure of the atomizing air is at minimum when no fuel is present at the nozzle, adjustment of the switch should be made while the unit is purging, but not firing.

LOW OIL PRESSURE SWITCH

The low oil pressure switch is adjusted at the minimum setting of 4 psi. Turning the knob clockwise will increase pressure, counter clockwise will decrease pressure.

HIGH OIL TEMPERATURE SWITCH

The temperature switch is set slightly below the maximum of 260°F. To adjust, remove cover and turn the screw located on top. Clockwise will increase temperature, counter clockwise will decrease temperature.

NOZZLE LINE HEATER

NOTE

Be sure manifold is filled with oil prior to start-up.

1. Remove the cover which encloses the thermostat and interlock switch. The pointer controls the thermostat setting. The knurled knob controls the cold oil interlock switch.
2. The thermostat pointer should be set at position 6 and then raised or lowered as required. Higher numbers indicate higher temperatures.Let unit run before making further adjustments. The thermostat governing the nozzle line heater element is set lower than the thermostat governing the oil heater in the circulating loop.
3. The cold oil interlock switch is controlled by the small brass knurled knob under the pointer. This is set to prevent the burner from starting until proper oil temperature is attained. Set below the oil thermostat setting. If the cold oil interlock is set higher than the oil temperature, the burner will not run.
4. Replace cover.

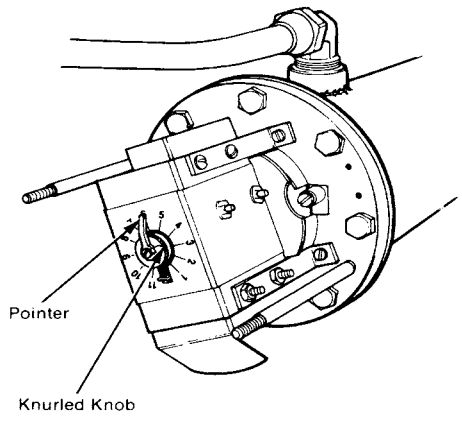
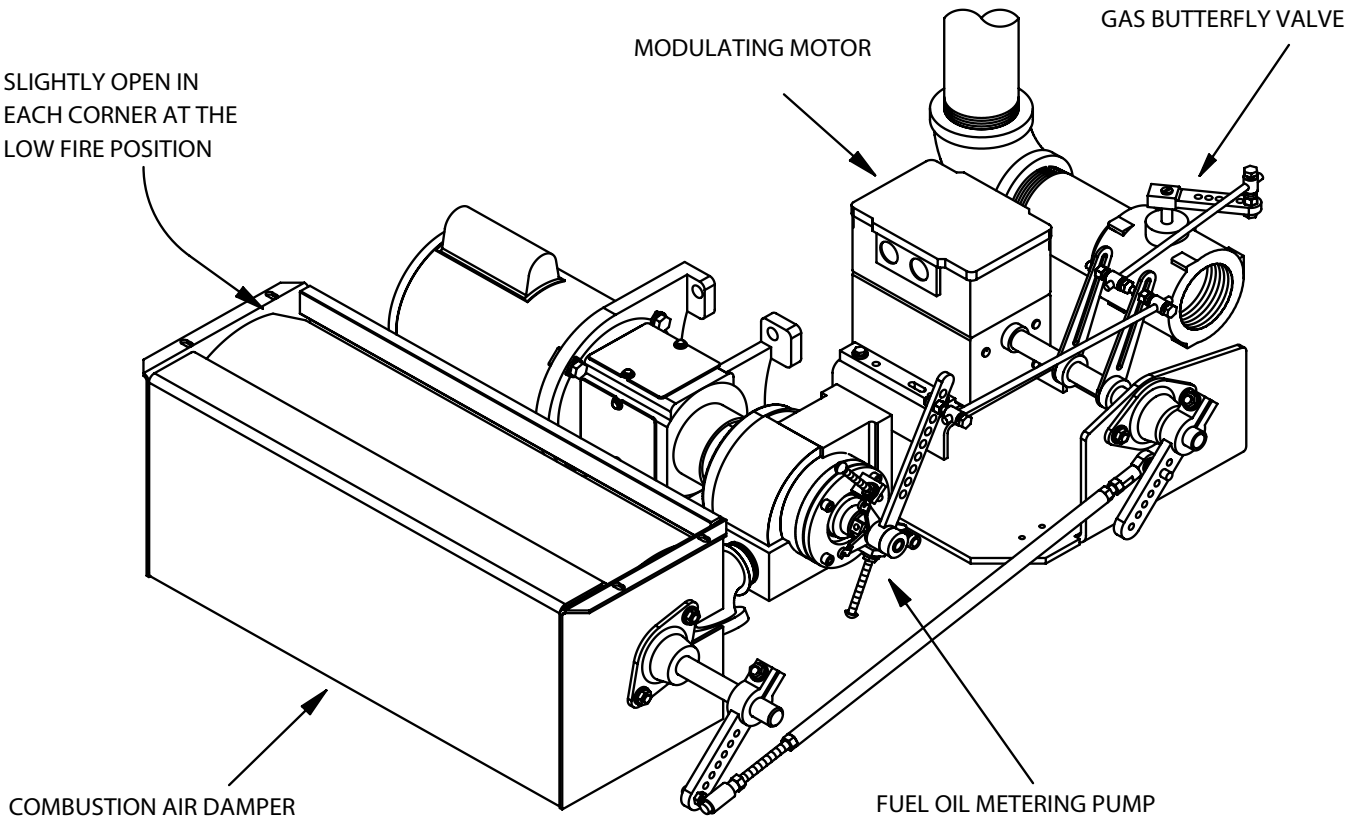
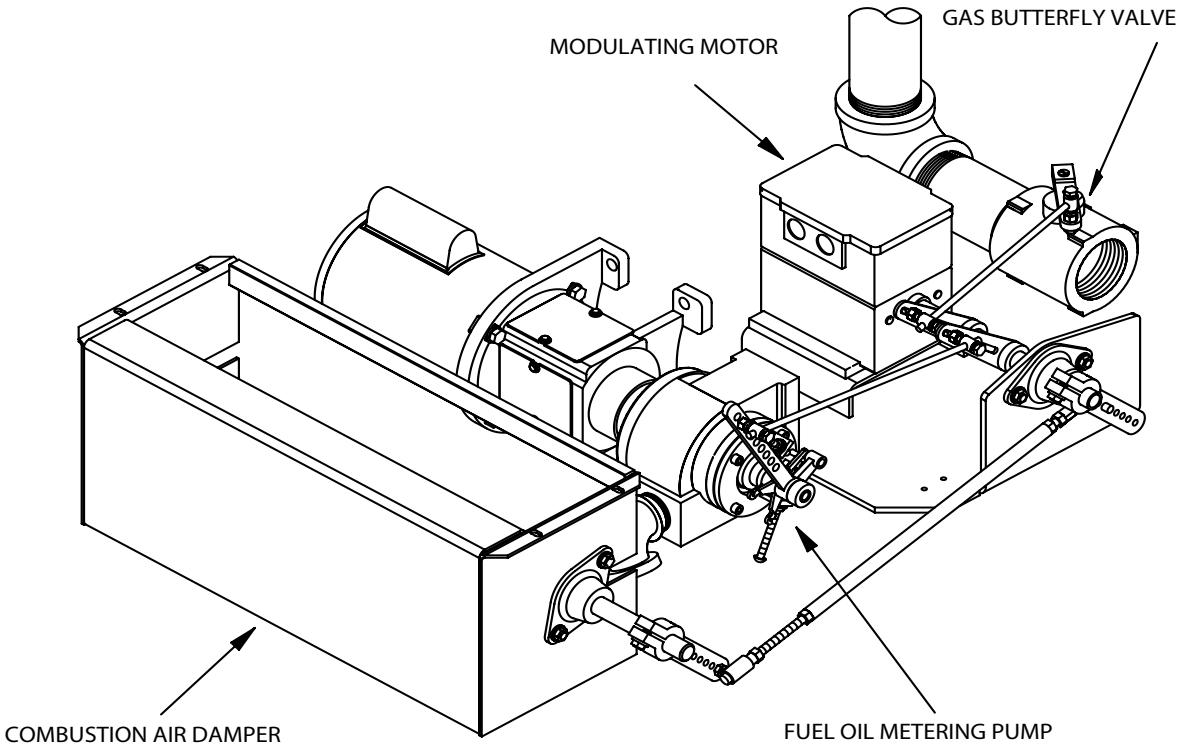


Figure 4-2



LOW FIRE POSITION
Figure 4-3



HIGH FIRE POSITION
Figure 4-4

F. LINKAGE-MODULATING MOTOR

The linkage consists of adjustable cams, levers, rods and ball joints that transmit motion from the modulating motor to the air damper, gas butterfly valve, and oil metering unit. When properly adjusted, coordinated movement of the air and fuel control devices provide proper fuel/air ratios through the firing range. In linkage adjustments, several important factors serve as guides:

1. The modulating motor must be able to complete its full travel range. Restrictions will damage the motor and/or the linkage.
2. Lever and rod adjustments should be made with the motor in the low fire position.

The modulating motor will be stopped at the end of its stroke by an internal limit switch. Combustion gas analysis indicates the air to fuel ratio and the degree of complete combustion. The closer the rod comes to parallel with the lever, the slower the rod moves.The angles of the driven levers on the jackshaft can be adjusted to vary the rate of change. The closer the rod to the hub of the lever, the less distance it will travel.Increasing the lever length on the damper, metering unit and valve(s) decreases flow rate.

G. CAM TRIM ADJUSTMENT

Fine tuning the modulating cam. Figure 4-5

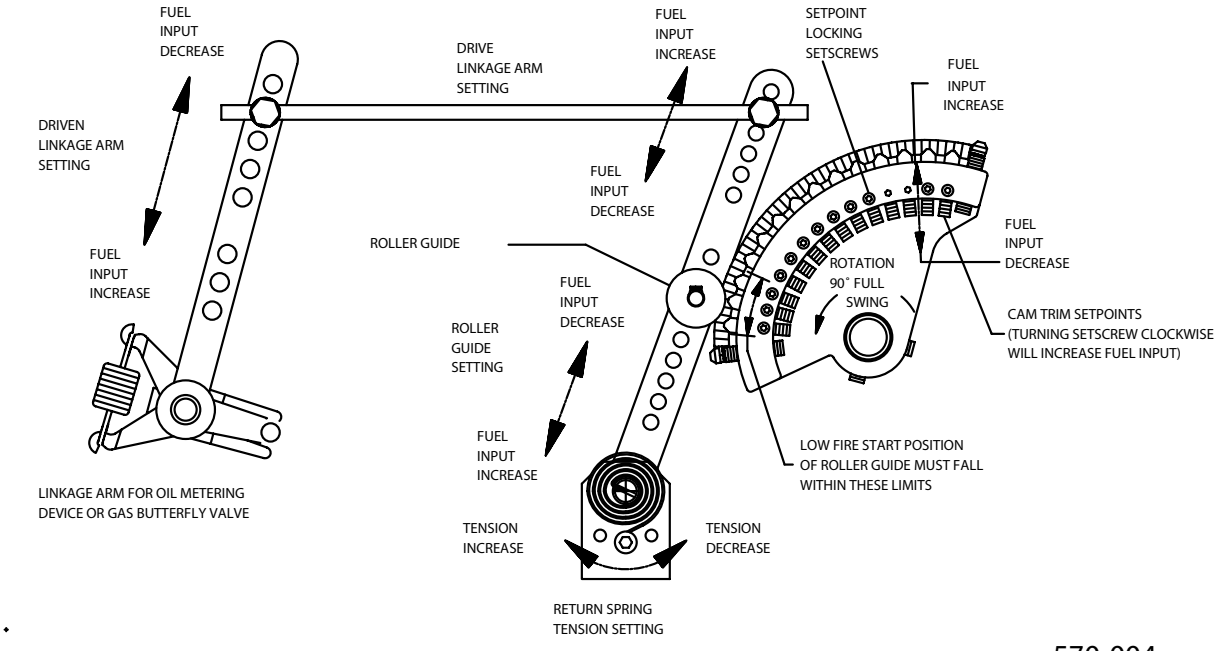
After low and high fire adjustments are complete, final adjustment is made with the cam assembly to obtain a good air/fuel ratio throughout the entire firing range.The input of combustion air is fixed at any given point in the modulating cycle. The fuel input may be varied to obtain correct flue gas readings. The adjustment is made to the metering cam by means of the 14 adjusting screws which are turned in (clockwise from the hex-socket end) to increase the flow of fuel, and out (counterclockwise from the hex-socket end) to decrease it. A 3/32" hex key is required. It will be necessary to cut off the short end of a hex key to approximately 3/8" to adjust the first two socket head setscrews at the low fire position. Take a combustion analysis at various points of the cam profile. Adjustment can be made without cycling the burner then operate the automatic modulating cycle to assure satisfactory results. Tighten the locking set screws.

> **NOTE**
>
> It is essential that the cam spring, cam follower bearing wheel and cam follower arm at the pivot point (see figure 1) be grease sparingly every month to ensure smooth operation of the cam assembly. Regular automotive bearing grease should be used.

H. FIRING RATE CONTROLS

Refer to Figure 4-6

Firing rate adjustments are made at the modulating motor linkages to the combustion air inlet damper, air-oil metering pump and main gas butterfly valve. Settings are determined by the operating length of the levers and the angular position on the shafts. Increasing the lever lengths on damper, pump or valve decreases the flow rate. Driving and driven levers are approximately Parallel, but the angles can be adjusted to vary the rate of change. The most rapid rod travel occurs when the lever is perpendicular to the rod. The closer the rod comes to being parallel with



CAM TRIM ADJUSTMENT
Figure 4-5

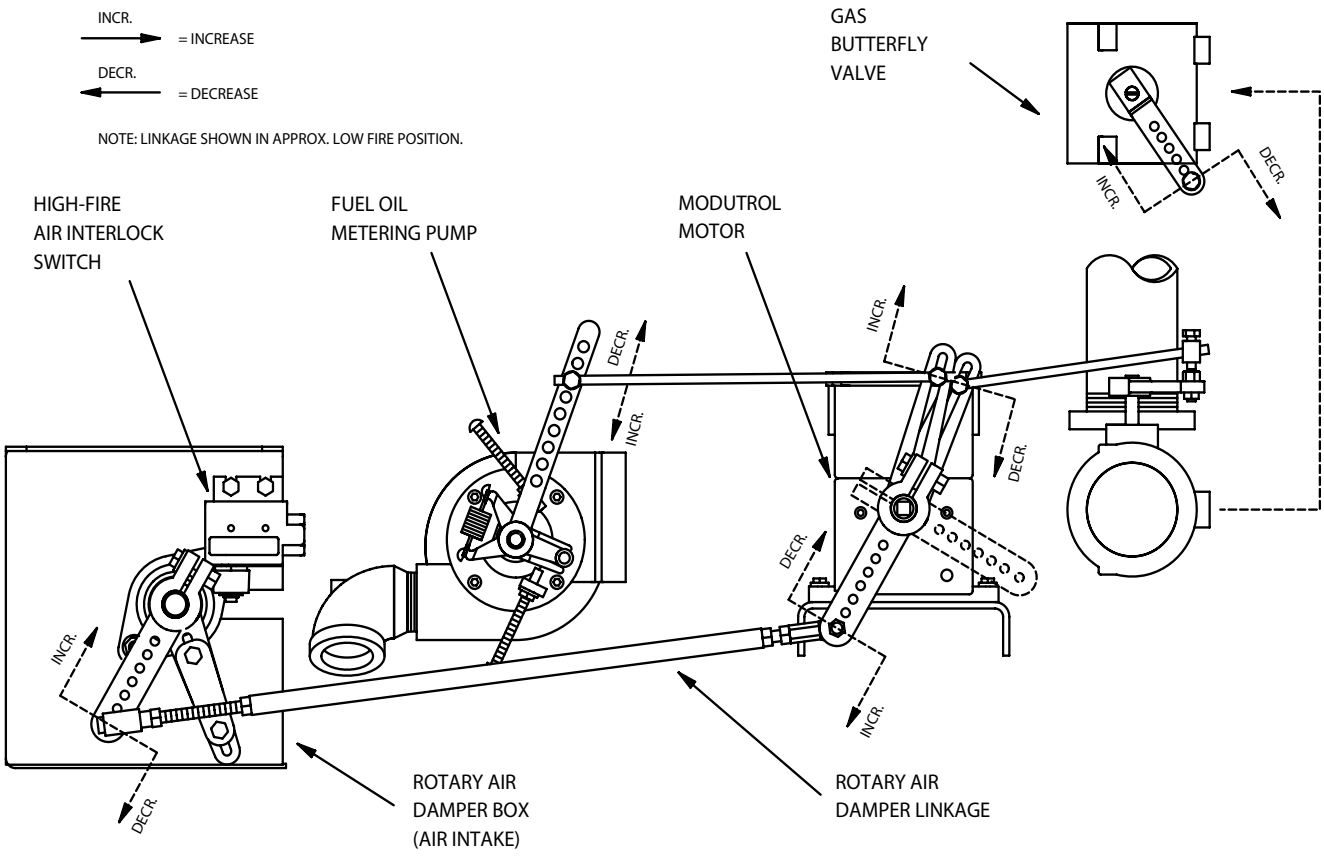


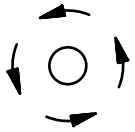
Figure 4-6

the lever, the slower the rod moves. **ALWAYS** allow the burner to return to low fire position before adjusting high or intermediate settings. **DO NOT** alter low fire settings. Normally, the air control damper will be almost closed in low fire position. For best pilot operation, the damper should be set as low as possible. Excessive opening in low fire can cause pilot ignition problems. Air to the pilot is supplied under pressure to compensate for variations in furnace pressure, but the damper must be in low fire position for reliable ignition.

WARNING

KEEP FINGERS AWAY FROM THE AIR INTAKE BELOW THE DAMPER. THE DAMPER IS ACTUATED WITH SUFFICIENT FORCE TO CAUSE SEVERE INJURY

MOTOR ROTATIONS



CCW ROTATION

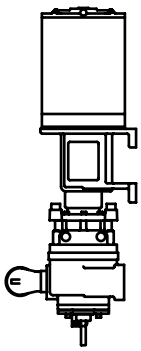
FACING REAR OF MOTOR

"E" OIL-AIR PUMPS

OIL-AIR

5 - 5
6 - 5
7 - 5
7 - 6
8 - 6
9 - 6

REAR



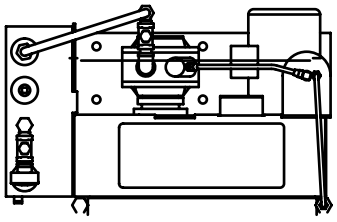
USED ON MODELS
DL, DLG 105-145
DM, DMG 63 TO 145

OIL METERING PUMPS

30- 125
40- 150
60- 180
75- 200
100- 250

USED ON MODELS
DL, DLG 175 TO 420
DM, DMG 175 TO 420
DE, DEG 42 TO 420

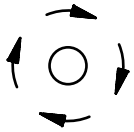
REAR



AIR COMPRESSOR

7
2"
2-3/4"
5"
10"

SEPARATE AIR COMPRESSOR MODULE
USED ON MODELS
DL, DLG ,DM, DMG 175 TO 420
DE, DEG 42 TO 420



CW ROTATION

FACING REAR OF MOTOR

"AM" OIL-AIR PUMPS

OIL-AIR

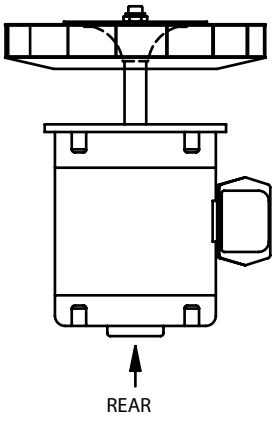
4 - 4
5 - 4
6 - 4
7 - 4
8 - 4
2 - 3
3 - 3
3 - 4
5 - 7S
6 - 7S
7 - 7S
8 - 7S

REAR

INTEGRAL OIL-AIR SYSTEM
USED ON MODELS
DL, DLG 42 TO 84
DM, DMG 42-54

BURNER AIR IMPELLERS:

D-SERIES



REAR

ALL D SERIES MODELS

AHO-7096-01

Figure 4-6

START-UP / SERVICE REPORT

The following information should be fillled in by the service technician at start-up or after any adjustment to the burner

A copy of the start-up report MUST be returned to CB in order to validate the warranty of the burner.

Burner Model_____ Serial number_____ Start-up Date_____

Test Conducted	GAS			OIL		
	Low	50%	High	Low	50%	High
Firing Rate						
Stack Temp (Gross) F						
O2%						
CO2%						
CO (PPM)						
NOx (PPM)						
Smoke (Bacharach)						
Combustion Eff.%						
Stack Draft						
Furnace Pressure						
Blast tube Pressure						
Steam Pressure						
Water Temperature						
Supply oil pressure						
Return oil pressure						
Oil Temperature						
Atom. air pressure						
Gas Pressure @ Regulator inlet						
Gas Pressure @ Burner Manifold						
Pilot Gas pressure @ Regulator Outlet						
Flame Signal Pilot						
Flame Signal Main						
Ambient Temperature F						

Control Checks	Test	Set Point
Low Water C.O.		
Aux. LWCO		
Low Water Alarm		
High Water Alarm		
Operating Limit		
High Limit		
Operating control		
Stack Temp interlock		
Flame Failure		
Combustion air switch		
High Purge switch		
Low Fire interlock		
Oil pressure switch		
Oil Temperature switch		
Oil valve P.O.C. interlock		
Atomizing air switch		
High Gas Press. switch		
Low Gas Press. switch Gas valve P.O.C.interlock		

(For Low Nox Burners)

Blast tube temp. interlock		
FGR Line Purge switch		
FGR valve P.O.C. switch		

Electric Motors	Voltage			Amperage		
	L1	L2	L3	L1	L2	L3
Control Voltage						
Blower Motor						
Air Compressor						
Air-Oil or Metering						

SECTION 5
MAINTENANCE

WARNING

Any cover plates, enclosures, or guards anchored to the burner, or any burner related equipment, must remain in position at all times. Only during maintenance and service shutdown can these cover plates, enclosures, or guards be allowed to be removed. They must be replaced, and securely anchored before testing, adjusting, or running the burner or burner related equipment.

CAUTION

IT IS IMPORTANT THAT YOU PROVIDE SUPPORT FOR THE HOUSING WHEN IN THE OPEN POSITION TO PREVENT DAMAGE TO THE HINGES AND SUBSEQUENT COMPONENTS.

A. GENERAL

A maintenance program avoids unnecessary down time, costly repairs, and promotes safety. It is recommended that a record be maintained of daily, weekly, monthly, and yearly maintenance activities. See Section H.

Electrical and mechanical devices require systematic and periodic inspection and maintenance. Any “automatic” features do not relieve the operator from responsibility, but rather free him from certain repetitive chores, providing time for upkeep and maintenance.

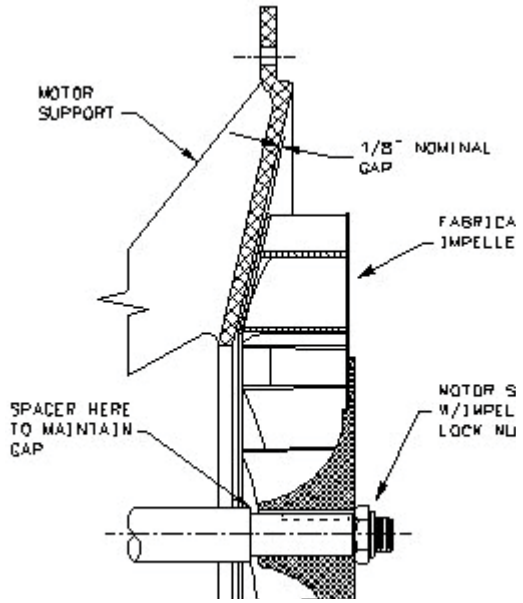
Unusual noise, improper gauge reading, leak, sign of overheating, etc., can indicate a developing malfunction, requiring corrective action.

B. CONTROL SYSTEM

Most operating controls require very little maintenance beyond regular inspection. Examine electrical connections. Keep the controls clean. Remove any dust from the interior of the control. Covers should be left on controls at all times. Keep the control cabinet doors closed. Dust and dirt can damage motor starters and relay contacts. Starter contacts are plated with silver and are not harmed by discoloration. Never use files or abrasive materials such as sandpaper on contact points.

PROGRAMMING CONTROL

This control requires no adjustment, nor should any attempt be made to alter contact settings or timing logic. Those programmers with contacts may require occasional cleaning. If so, follow instructions given in the manufacturer’s bulletin. Never use abrasive materials. The manufacturer’s bulletin also contains troubleshooting information. The flame detector lens should be cleaned as often as conditions demand. A periodic safety check procedure should be established to test the complete safeguard system. Tests should verify safety shutdown with a safety lock out upon failure to ignite the pilot or the main flame, and upon loss of flame. Each of these conditions should be checked on a scheduled basis. The safety check procedures are contained in the manufacturer’s bulletin.



IMPELLER AND STATOR CONE Figure 5-1

FOR MOTOR ROTATION REFER TO PAGE 39

C. IMPELLLER AND STATOR CONE

Refer to Figure 5-1.

Proper clearance between the impeller and the inlet housing and between the impeller and stator cone is not critical and is set at 1/8" nominal When installing or removing the impeller it is mandatory to use a impact wrench. **UNDER NO CIRCUMSTANCES SHOULD YOU USE ANYTHING OTHER THAN AN IMPACT WRENCH.** Inserting a bar through the impeller blade and using it as a lever will only damage the blade and also void the 5 year impeller warranty. If the impeller is changed to a different width, the stator cone position may require adjustment. This is provided for by means of slotted mounting holes in the blast tube. Loosen the three screws to reposition the cone. If a wide impeller is used to replace a narrower one, it may be necessary to trim the vanes for additional clearance.

D. FIRING HEAD INSPECTION

Refer to Figure 5-2

Disconnect the damper linkage, release the impeller housing latch and swing the housing open for access to

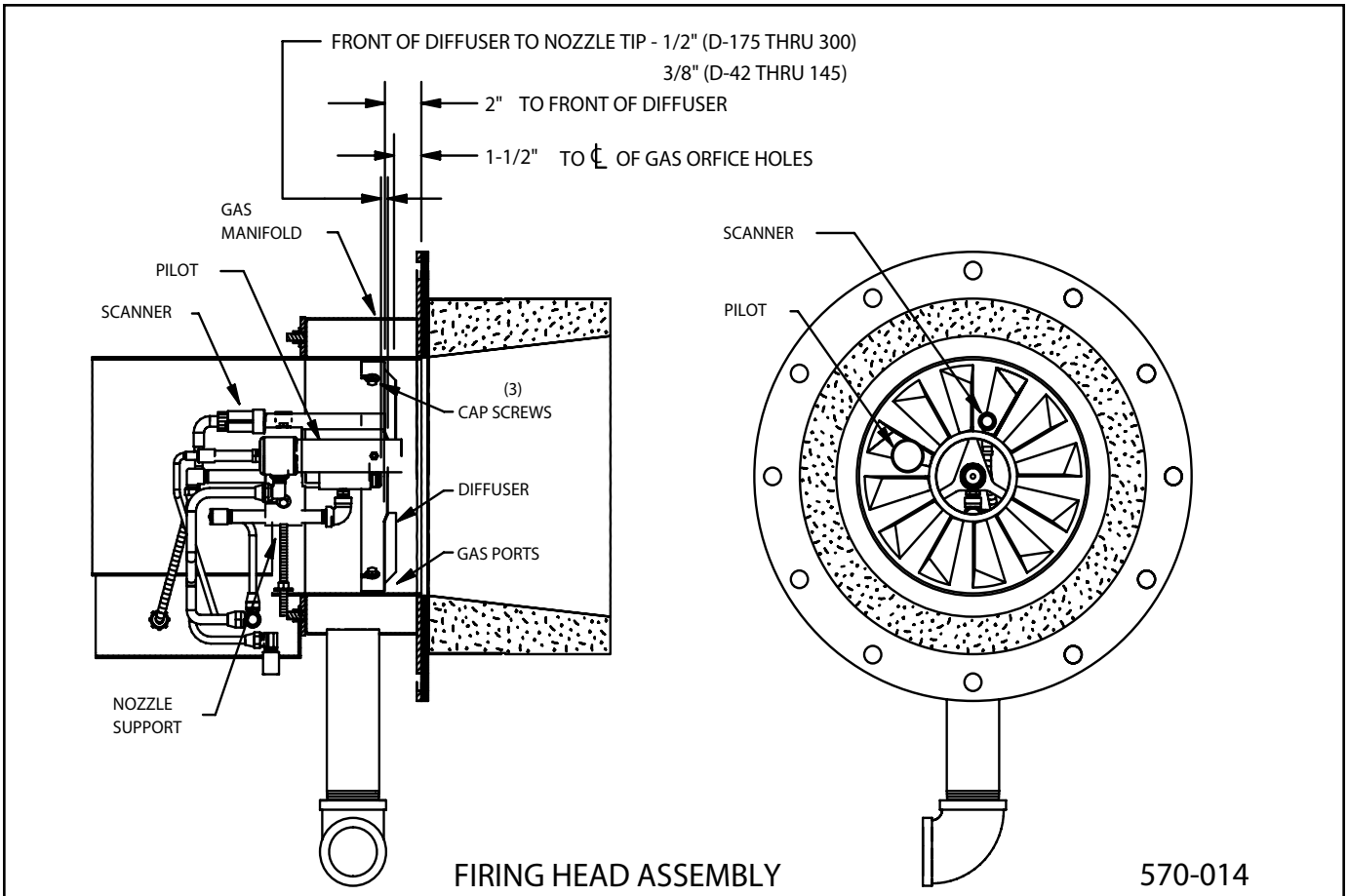
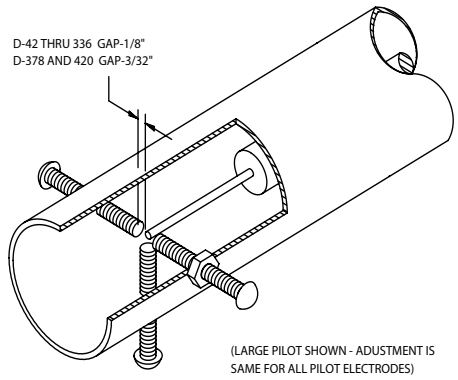


Figure 5-2

the firing head. Inspect the flame scanner lens to be sure it is clean and the support tube is in proper position to sight the flame through the hole in the diffuser. Inspect the lead wire to the ignition electrode. It must be firmly attached and the insulation should be clean and free of cracks. The oil nozzle should be inspected periodically depending on the grade of oil burned and the cleanliness of the environment.

E. PILOT AND IGNITION ELECTRODE

The ignition transformer requires little attention other than making sure the ignition wire is firmly attached to the transformer and the electrode. Be sure the wire insulation is in good condition and not grounded. Failure to keep the ignition electrode clean and properly set can cause faulty operation. Refer to Figure 5-3, for electrode gap setting and position (1/8" for D42 to 336 and 3/32" for D378-420). The pilot assembly is supported by a socket in the diffuser and gas inlet tube. No adjustment is required except proper positioning of the electrode wire.



IGNITION PILOT ELECTRODE SETTING 570-013

Figure 5-3

F. FLAME SCANNER

The scanner must be clean. Even a small amount of contamination will reduce the flame signal. Wipe the scanner lens with a clean soft cloth.

G. OIL NOZZLE.

Successful burner operation requires use of the proper style nozzle tip and keeping the orifice clean. Standard nozzle tips furnished on the burners are of a special emulsifying type which delivers a spray of extreme fineness and at an angle which insures proper mixing with the air stream. Unsatisfactory performance and loss of efficiency can result from the use of nonstandard nozzle tips. If the burner flame becomes stringy or lazy, it is possible that the nozzle spring is not properly in place or the nozzle is clogged. Refer to Figure 4. This problem is usually indicated by an abnormally high reading on the atomizing air pressure gauge on the air-oil tank. To remove the nozzle, disconnect the oil and air tubes to the nozzle assembly. Loosen the three 1/4" screws holding the nozzle spider bracket to the support ring. Withdraw the nozzle and bracket assembly. Refer to

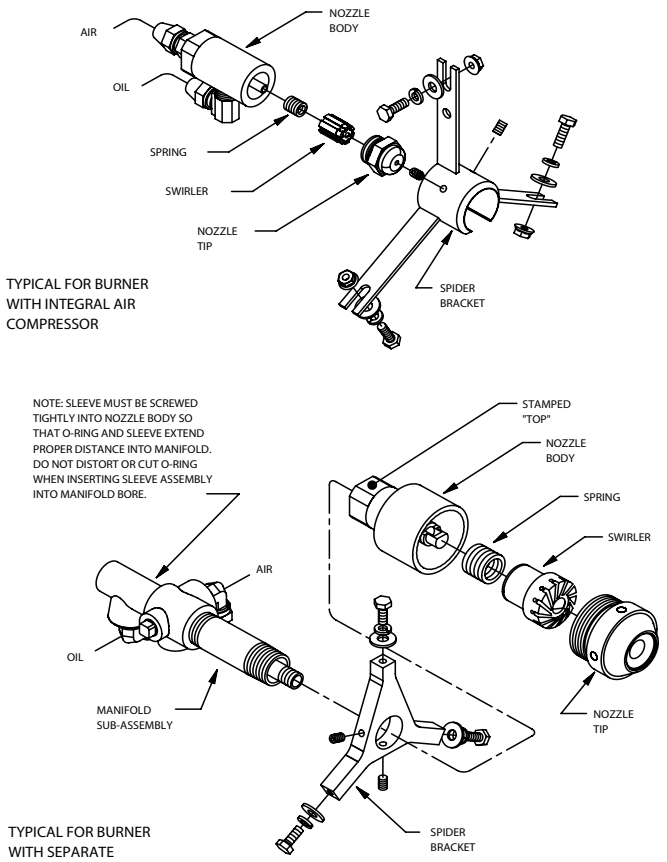


Figure 5-4

Figure 5-4. To clean the nozzle tip and swirler, unscrew the tip from the nozzle body. Use care not to distort the tube. Hold the nozzle body in a vise or use two wrenches, one on the body and one on the tip. Disassemble the nozzle tip. Carefully clean all parts in solvent and reassemble the nozzle. To insure proper atomizing, the tip must be screwed in tightly with the swirler seating spring pressing the swirler tight against the nozzle tip. Turn the swirler a few times to be sure it fits snugly in the nozzle and the spring is pressing the two parts firmly together. When reinstalling, be sure the nozzle is centered with the proper distance from the diffuser as shown in Figure 5-2

CAUTION DO NOT attempt to use wire or a sharp metal tool to clean the nozzle orifice as this will distort the fine orifice and ruin the nozzle. Use a sharp pointed piece of soft wood.

H. DIFFUSER

The diffuser is factory set and does not require attention under normal operating conditions. If fouled with carbon, the diffuser should be removed for cleaning. First remove the electrode and scanner leads, the gas pilot assembly, air and oil tubes and the nozzle support assembly, before you attempt to remove the diffuser. Mark the diffuser relative position to the blast tube, with a scribed or pencil line where the three mounting screws are located, to insure that the diffuser is placed back in the same position. Remove the three screws holding the diffuser to the blast tube and slowly pull the diffuser along the blast tube towards the firing head. Keep the diffuser as parallel as possible. If it should became stuck or tight do not apply any tool which would distort the shape or blade configuration. A small wooden block tapped gently against the diffusers outer edge will help expedite its removal. Clean all carbon from the diffuser vanes and reinstall in reverse order of disassembly aligning the diffuser with the scribed marks. Do not attempt to drive the diffuser back along the blast tube with anything other than a small block of wood tapped against the diffuser's outer edge. When reinstalling, be sure the diffuser is centered with the proper distance as shown in Figure 5-2.

I. FIRING RATE CONTROLS

Check all rods and linkages. Make sure all connections are tight. Adjust if necessary. Perform a combustion test as per section 4 Adjustments, and readjust burner if necessary.

NOTE

It is essential that the cam spring, cam follower bearing wheel and cam follower arm at the pivot point be grease sparingly every month to ensure smooth operation of the cam assembly. Regular automotive bearing grease should be used.

J. BURNER MOUNTING INSPECTION

The seal between the burner flange and furnace front plate must not permit combustion gases to escape. Periodic inspection is important. Replace gasket if necessary. Inspect burner head for signs of discoloration. A change in the head colour paint, might indicate gas leakage between the dry oven and the boiler refractory. If leakage occurs, refer to Chapter 2, Section D for proper sealing procedure and drawings 2-3 and 2-4.

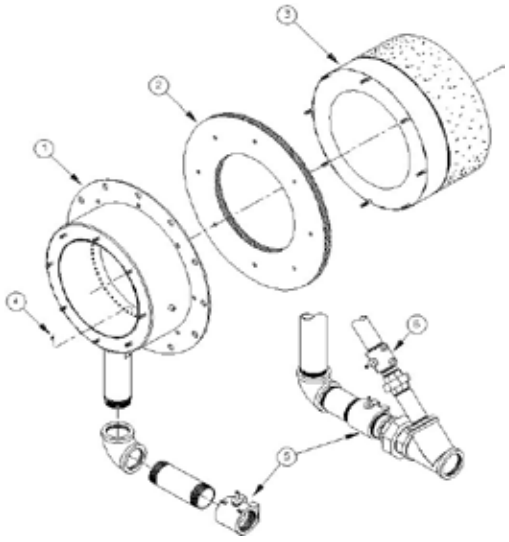


Figure 5-5

K. FUEL OIL SYSTEM

FUEL OIL CIRCULATING PUMP

Failure of the circulating pump to deliver sufficient oil may be due to one of the following reasons:

1. Insufficient fuel oil in the storage tank.
2. Suction line or check valve clogged.
3. Air leaks or air traps in the suction line. If the line has a high point at which an air trap can occur, the line must be changed.
4. Oil strainer clogged (line strainer or burner strainer).
5. Suction line piping too small (See Section 2, Figures 2-7 through 2-15).
6. Pump rotating in wrong direction (See page 39).
7. Three phase pump motor operating on single phase because of fuse failure.
8. Low voltage applied to pump motor.

CAUTION DO NOT attempt field repair of the compressor. Installation of a new compressor is mandatory. Send the old compressor in for repair or exchange (where allowed).

CAUTION DO NOT attempt to disassemble the oil metering pump should be made in the field. Any attempt will void the warranty or the exchange policy

CAUTION The metering pump is lubricated by fuel oil and **MUST NOT** be operated longer than **ONE MINUTE** if it's not pumping oil. Failure to comply will result in premature pump failure and void any warranty implied or otherwise.

NOTE

Heavy fuel oil sometimes will not leak out through a suction line joint when the burner is idle, but the same joint may allow air leakage inward when a vacuum is created in the line by pump action. The cause of a pulsating burner fire can often be traced directly to air leakage in the oil suction line. Always be sure suction line joints are absolutly air tight.

AIR-OIL METERING PUMP

Both the integral air-oil metering pump for light oil and the heavy oil metering pump, are precisely fitted units employing a seal on the shaft to prevent oil leakage. Internal wear can take place due to dirt in the oil and may in time result in excessive clearances, reducing pump capacity. Once adjusted, the pump will continue to operate with a minimum of readjustment. If burner failure appears to be caused by the metering pump, check the following:

1. See that the oil is at sufficient level in both fuel oil tank and air-oil tank on burner.
2. Make sure all valves between the fuel oil tank and the burner are open.
3. Be sure the oil suction line is not air bound and check the suction line strainer.
4. Check the low fire setting of the metering pump to be sure it has not been disturbed.
5. Make sure the pump turns freely.
6. Inspect the burner oil nozzle for clogging.

Whenever an oil metering pump fails to deliver full capacity or pressure, order a replacement pump at once and return the old pump for repair or exchange (where allowed)

PRIMARY AIR PUMP OR COMPRESSOR

The air compressor itself requires little maintenance, however its life is dependent upon sufficient clean, cool lubricating oil. The oil level in the air-oil tank must be checked regularly. Lack of oil will damage the compressor. Disassembly or field repairs to the air compressor are not recommended. Check the air-oil tank sight glass for proper oil level. The level should be kept at midpoint up the glass. The compressor rotor must turn freely. All tube connections must be air tight.

Alignment of the compressor and motor sheaves and proper belt tension are important.

Belt tension is adjusted according to the displacement on the belt with thumb pressure. The displacement should be 3/8 to 1/2 inch.

To adjust, loosen the two bolts on the compressor mounting flange and the three set screws which hold the compressor in place.

The mounting flange is slotted at the top, which permits belt tightening. If the slot in the mounting flange is insufficient for obtaining proper belt tension, the modular base has two extra holes for this purpose.

Move the top bolt to the next hole and adjust. Tighten bolts and setscrews. Replace belt guards. If belt becomes frayed or cracked, replace it.

AIR CLEANER.

Never operate the compressor without the air cleaner in place. The cleaner should be cleaned at regular intervals. The correct oil level must be maintained in the air cleaner. Use the same oil used for air compressor lubrication.

OIL-AIR TANK

Check the lube oil level in the oil -air tank. Inspect oil level regularly as loss of oil will damage the compressor. Change oil every 2000 hours of operation. The oil-air tank should be drained once a year and thoroughly flushed. Remove the mist eliminator pads from the upper section of the tank, wash thoroughly in kerosene and dry. Refill with **non detergent** SAE30 oil to a level midway up the sight glass. For normal environment use SAE30 oil. For a 32 degree F. and below environment use SAE10 oil.

OIL LEVEL SIGHT GAUGE.

The oil level sight gauge can be cleaned by removing it from the air-oil tank and soaking it in a detergent solution. If cleaning the gauge proves unsatisfactory, replace it.

COMPRESSOR INLET OIL STRAINER (Lube Oil Strainer). The lube oil strainer prevents foreign materials from entering the compressor. The strainer screen must be cleaned at regular intervals.

The screen is easily removed for cleaning by unscrewing the bottom plug. Immerse in solvent and thoroughly clean.

NOZZLE LINE HEATER

Nozzle line heaters damaged by water accumulation, do not qualify for warranty or exchange service. Failure to prevent water accumulation inside the heater manifold constitutes improper care.

Completely drain the heater manifold periodically. This should be part of the preventive maintenance program. Maintenance consists primarily of removing the heating element from the manifold and scraping any accumulation of carbonized oil or sludge deposits from the heat exchange surfaces.

Before breaking electrical connections to the heating elements, mark all wires and terminals to assure correct replacement of wires.

Periodic cleaning is necessary to prevent over heating or burn out of the elements. If operation of the heater becomes sluggish, examine the elements and clean as required.

Inspect the manifold each time the heater is removed. Flush all accumulated sludge and sediment before reinstalling the heater. Heater must be full of oil before power is turned on.

OIL STRAINERS

Oil strainers should be cleaned frequently to maintain a free and full flow of fuel. The strainer screen must be remouved and cleaned at regular intervals. The screen should be removed and clean thoroughly by immersing it in solvent and blowing it dry with compressed air. Light oil strainers should be cleaned each month. Heavy oil strainers should be checked and cleaned as often as the experience indicates the necessity.

L. GAS SYSTEM

MOTORIZED MAIN GAS VALVES

Should the valve fail to operate, check for voltage at the valve. Make certain that the main shutoff cock is closed prior to testing. The actuator is not field repairable nor should it be disassembled. Replace the actuator if valve fails to operate. After replacement, cycle the valve with the fuel shutoff to determine that it opens and closes. If the valve has a visual indicator, observe its position for correct operation.

CAUTION

ALL POWER MUST BE DISCONNECTED BEFORE SERVICING THE VALVES

SOLENOID VALVES

A slight hum from the solenoid is normal when the coil is energized. Should the valve fail to operate, check that there is voltage at the valve coil. If there is no voltage at coil, check for loose wiring connections. If there is proper voltage at the valve coil and the valve still fails to open, replace the coil. Refer to manufacturer's bulletin for correct procedure in coil replacement.

Should it become necessary to replace the complete valve, be sure that the flow is in the drection of the arrow on the body.

Test for gas leaks and check valve action several times to ensure proper operation before attempting to relight burner.

M. ELECTRICAL SYSTEM

Because of the many types of flame safeguard systems applicable to this equipment, complete descriptions of all D/Series burner electrical systems are beyond the scope of this manual. An individual electrical schematic drawing is shipped with each burner and complete operation and troubleshooting instructions are available from the various flame safeguard system manufacturers

ELECTRIC MOTORS

Motor supply voltage must not vary more than 10 percent from nameplate ratings. At initial start-up and at least once a year thereafter, check the motor current with a meter while the burner is in high fire position. If the reading exceeds the nameplate rating plus service factor, determine the cause and correct it immediately. In dusty locations, clean the motor regularly to assure adequate cooling. Lubricate in accordance with the manufacturer's instructions.

N. EXTENDED SHUTDOWN

When shutting down the burner for an extended period of time, the operator should use the following general guidelines to protect the burner from its surrounding elements. This will add to the operating life of the burner.

1. Turn the main electrical disconnect switch to the burner to OFF.

2. Close all main fuel valves.

3. If the burner operates in a damp environment, cover it with plastic to protect all electrical components from moisture. Remove the flame safeguard control and store in a dry atmosphere.

O. MAINTENANCE FLOW CHART

PERIODIC TESTING RECOMMENDED CHECK LIST

ITEM	FREQUENCY	SERVICE BY	REMARKS
Gauges, monitors, and indicators	Daily	Operator	Make visual inspection and record readings in log
Instrument and equipment settings	Daily	Operator	Make visual check against recommended specifications
Firing rate control	Weekly Semi-annually Annually	Operator Service technician Service technician	Verify factory settings Verify factory settings Check with combustion test
Flue, vent, stack, or outlet dampers	Monthly	Operator	Make visual inspection
Igniter	Weekly	Operator	Make visual inspection, Check flame signalstrength
Fuel valves			
Main	Weekly	Operator	Open limit switch, make sure valve close
Pilot and main gas or main oil	Annually	Service technician	Perform leakage tests - Refer to instructions
Combustion safety controls			
Flame failure	Weekly	Operator	Close fuel supply, check safety shutdown
Flame signal strength	Weekly	Operator	Check flame signal reading on control display or test with meter - Low and High fire
Pilot turndown tests	As required/annually	Service technician	Required after any adjustment to flame, scanner mount or pilot adjustment
Refractory hold in	As required/annually	Service technician	See "Pilot turndown tests" instructions
Low-water fuel cutoff and alarm	Daily/weekly Semi-annually	Operator Operator	Refer to boiler instructions - Slow drain test as per ASME pressure vessel code
High limit safety control	Annually	Service technician	Refer to boiler instructions
Operating control	Annually	Service technician	Refer to boiler instructions
Low draft, and damper position interlocks	Monthly	Operator	Refer to instructions
Atomizing air/steam interlock	Annually	Service technician	Refer to instructions
High and low gas pressure interlocks	Monthly	Operator	Refer to instructions
High and low oil pressure interlocks	Monthly	Operator	Refer to instructions
High and low oil temperature interlocks	Monthly	Operator	Refer to instructions
Fuel valve interlock switch	Annually	Service technician	Refer to instructions
Combustion air purge switch	Annually	Service technician	Refer to instructions
Burner position interlock	Annually	Service technician	Refer to instructions
Low fire start interlock	Annually	Service technician	Refer to instructions
Automatic changeover control (dual fuel)	At least annually	Service technician	Refer to instructions
Safety valves	As required	Operator	In accordance to ASME pressure vessel code
Inspect burner components	Semi-annually	Service technician	Refer to instructions

SECTION 6
TROUBLE SHOOTING

WARNING

TROUBLE SHOOTING SHOULD BE PERFORMED ONLY BY PERSONNEL WHO ARE FAMILIAR WITH THE EQUIPMENT AND WHO HAVE READ AND UNDERSTOOD THE CONTENTS OF THIS MANUAL. FAILURE TO FOLLOW THESE INSTRUCTIONS COULD RESULT IN SERIOUS PERSONAL INJURY OR DEATH.

WARNING

DISCONNECT AND LOCK OUT THE MAIN POWER SUPPLY IN ORDER TO AVOID THE HAZARD OF ELECTRICAL SHOCK. FAILURE TO FOLLOW THESE INSTRUCTIONS COULD RESULT IN SERIOUS PERSONAL INJURY OR DEATH.

A. AWARENESS

Section 6 assumes that:

1. The unit in question has been properly installed and that it has been running for some time.

2. The operator has become thoroughly familiar with both the burner and the manual by this time.

The points set forth under each heading are briefly, possible causes, suggestions or clues to simplify locating the source of the trouble. Methods of correcting the trouble, once it has been identified, may be found elsewhere in this manual.

If the burner will not start or operate properly, the trouble shooting Section should be referred to for assistance in pinpointing problems that may be not readily apparent.

The program relay has the capability to self-diagnose and to display a code or message that indicates the failure condition. Refer to the control bulletin for specifics and suggested remedies.

Familiarity with the programmer and other controls in the system may be obtained by studying the contents of this manual. Knowledge of the system and its controls will make trouble shooting that much easier. Costly downtime or delays can be prevented by systematic checks of actual operation against the normal sequence to determine the stage at which performance deviates from normal. By following a set routine may possibly eliminate overlooking an obvious condition, often one that is relatively simple to correct.

If an obvious condition is not apparent, check each continuity of each circuit with a voltmeter or test lamp. Each circuit can be checked and the fault isolated and corrected. In most cases circuit checking can be accomplished between appropriate terminals on the terminal boards in the control cabinet or entrance box. Refer to the wiring schematic supplied for terminal identification.

NEVER ATTEMPT TO CIRCUMVENT ANY OF THE SAFETY FEATURES.

WARNING

THE CAUSE FOR LOSS OF FLAME OR ANY OTHER UNUSUAL CONDITION SHOULD BE INVESTIGATED AND CORRECTED BEFORE ATTEMPTING TO RESTART. FAILURE TO DO SO MAY RESULT IN SERIOUS PERSONAL INJURY OR DEATH.

WARNING

DO NOT REPEAT UNSUCCESSFUL LIGHTING ATTEMPS WITHOUT RECHECKING THE BURNER AND PILOT ADJUSTMENTS. DAMAGE TO THE BOILER OR SERIOUS PERSONAL INJURY OR DEATH MAY RESULT.

WARNING

DO NOT RE-LIGHT THE PILOT OR ATTEMPT TO START THE MAIN BURNER, EITHER OIL OR GAS, IF THE COMBUSTION CHAMBER IS HOT AND/OR IF GAS OR OIL VAPOR COMBUSTION GASES ARE PRESENT IN THE FURNACE OR FLUE PASSAGES OR WHEN EXCESS OIL HAS ACCUMULATED. PROMPTLY CORRECT ANY CONDITIONS CAUSING LEAKAGE. FAILURE TO FOLLOW THESE INSTRUCTIONS COULD RESULT IN SERIOUS PERSONAL INJURY OR DEATH.

B. EMERGENCY SHUT DOWN

In case of emergency, shut down the burner by turning the On-Off switch to the "OFF" position. Turn the fuel selector switch to the OFF position. Shut off the main manual fuel shut off valves on the fuel supply line. The unit can also be shut down with the main electrical power disconnect. Inspect the burner carefully and trouble shoot before re-starting the unit. Follow instruction in Section 3 for starting and operating.

TROUBLE SHOOTING

PROBLEM	SOLUTION
BURNER DOES NOT START	1. No voltage at program relay power input terminals. a. Main disconnect switch open. b. Blown control circuit fuse. c. Loose or broken electrical connection.
	2. Program relay safety switch requires resetting.
	3. Limit circuit not completed - no voltage at end of limit circuit program relay terminal. a. Pressure or temperature is above setting of operation control. b. Water below required level. Low-water light (and alarm horn) should indicate this condition. Check manual reset button, if provided, on low -water control. c. Fuel pressure must be within settings of low pressure and high pressure switches. d. Check burner air proving switch and high fire limit switch. e. Heavy oil fired unit-oil temperature below minimum settings.
	4. Fuel valve interlock circuit not completed. a. Fuel valve auxiliary switch not closed.

NO IGNITION	1. Lack of spark. a. Electrode grounded or porcelain cracked. b. Improper electrode setting. c. Loose terminal on ignition cable; cable shorted. d. Inoperative ignition transformer. e. Insufficient or no voltage at pilot ignition circuit terminal
	2. Spark but no flame. a. Lack of fuel - no gas pressure, closed valve, empty tank, broken line, etc.
	3. Low fire switch open in low fire proving circuit. a. Damper motor not closed, slipped cam, defective switch. b. Damper jammed or linkage binding.
	4. Running interlock circuit not completed. a. Combustion or atomizing air proving switches defective or not properly set. b. Motor starter interlock contact not closed
	5. Flame detector defective, sight tube obstructed, or lens dirty.

TROUBLE SHOOTING

PROBLEM	SOLUTION
PILOT FLAME, BUT NO MAIN	1. Insufficient pilot flame.
	2. Gas fired unit. a. Manual gas cock closed. b. Main gas valve inoperative. c. Gas pressure regulator inoperative.
	3. Oil fired unit. a. Oil supply cut off by obstruction, closed valve, or loss of suction. b. Supply pump inoperative. c. No fuel. d. Main oil valve inoperative. e. Check oil nozzle, gun and lines.
	4. Flame detector defective, sight tube obstructed or lens dirty.
	5. Insufficient or no voltage at main fuel valve circuit terminal.
BURNER STAYS IN LOW FIRE	1. Pressure or temperature above modulating control setting.
	2. Manual-automatic switch in wrong position.
	3. Inoperative modulating motor.
	4. Defective modulating control.
	5. Binding or loose linkages, cams, setscrews etc.
SHUTDOWN OCCURS DURING FIRING	1. Loss or stoppage of fuel supply.
	2. Defective fuel valve; loose electrical connection.
	3. Flame detector weak or defective.
	4. Scanner lens dirty or sight tube obstructed.
	5. If the programmer lockout switch has not tripped, check the limit circuit for an opened safety control.

TROUBLE SHOOTING

PROBLEM	SOLUTION
SHUTDOWN OCCURS DURING FIRING (cont).	6. If the programmer lockout switch has tripped. a. Check fuel lines and valves. b. Check flame detector. c. Check for open circuit in running interlock circuit. d. The flame failure light is energized by ignition failure, main flame failure, inadequate flame signal, or open control in the running interlock circuit.
	7. Improper air/fuel ratio (lean fire). a. Slipping linkage. b. Damper stuck open. c. Fluctuating fuel supply. Temporary obstruction in the fuel line. Temporary drop in gas pressure. Orifice gate valve accidentally opened (heavy oil).
	8. Interlock device inoperative or defective.
	9. Air in the oil lines. Bleed lines.

MODULATING MOTOR DOES NOT OPERATE	1. Manual-automatic switch in wrong position.
	2. Linkage loose or jammed.
	3. Motor does not drive to open or close during pre-purge or close on burner shutdown. a. Motor defective. b. Loose electrical connection. c. Damper motor transformer defective
	4. Motor does not operate on demand. a. Manual/automatic switch in wrong position. b. Modulating control improperly set or inoperative. c. Motor defective. d. Loose electrical connection. e. Damper motor transformer defective.

SECTION 7
ACCESSORIES

The D burners are available with a wide selection of accessories. This section will cover some of the most popular accessories

A. STEAM ATOMIZING SYSTEM

The steam atomizing line is shipped loose and must be piped and wired to the burner as shown in the diagram below. Refer to the wiring diagram for the electrical connection. The air compressor is used for cold oil start-up. Start the boiler with the air atomizing system first. Once the boiler reaches operating pressure, shut down the unit, close the shut-off valve on the air line and open the one on the steam line. set the Air / Steam switch to the Steam position. Restart the unit with the steam atomizing system. You must have a minimum of 70 PSI at the inlet of the steam regulator. Open the needle valve to its maximum. Adjust your steam pressure with the regulator to have 30 PSI on the discharge side of the regulator. While the unit is purging, screw in and adjust the needle valve to have 10-15 PSI in low fire.Install a pressure gauge to monitor the pressure. One or two regulator is supplied depending on the boiler operating steam pressure. Follow the instructions in the Section 4, Adjustments, to set up the burner. Fine tune the steam atomizing with the needle valve.

B. AIR PURGE SYSTEM

The nozzle line air purge option is used to purge the oil out of the nozzle line using the air compressor on a burner shutdown. The air purge line is mounted and piped on the burner. The air line from the compressor to the air purge line is by others.

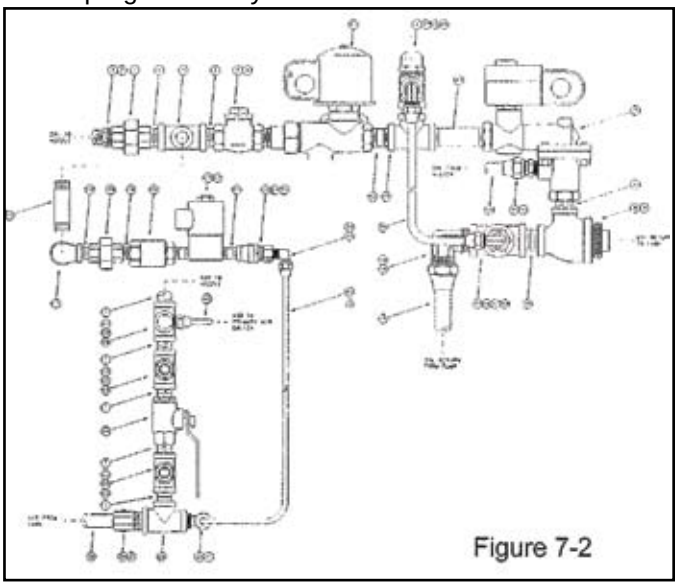


Figure 7-2

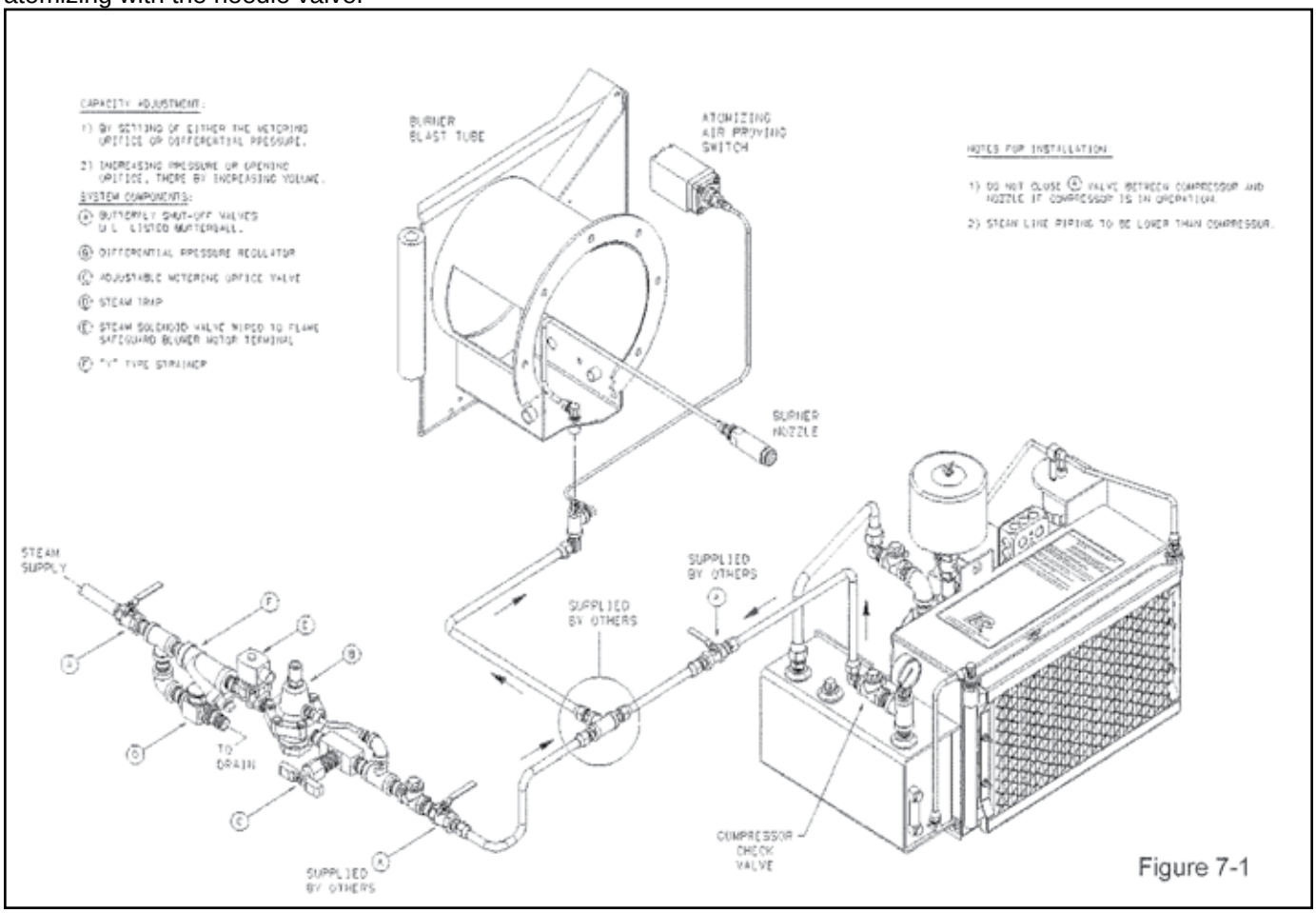


Figure 7-1

C. LIGHT OIL PILOT. (Optional)

The light oil pilot sequences in the same manner as a gas pilot. Flame adjustment is regulated by changing the pressure setting of a light oil pump. The pump is preset for 300 psi and may be adjusted from 80 psi to 300 psi to provide a clean and stable flame. Pressure adjustment requires a 1/8" allen wrench. The flame must be sufficient to be proven by the flame detector and ignite the main flame. Note although it is possible to visibly adjust the flame size, it is preferable to obtain a proper flame signal. Failure to keep the electrodes clean and set in the proper position accounts for the majority of faulty burner operation. Electrode points must be carefully positioned with respect to the nozzle. Figure 3 shows the proper electrode settings. Defective or cracked porcelain on the electrode requires immediate attention, and replacement to prevent short circuiting. A gradual wearing of the electrode tips will require readjustment of the points or replacement of the electrodes.

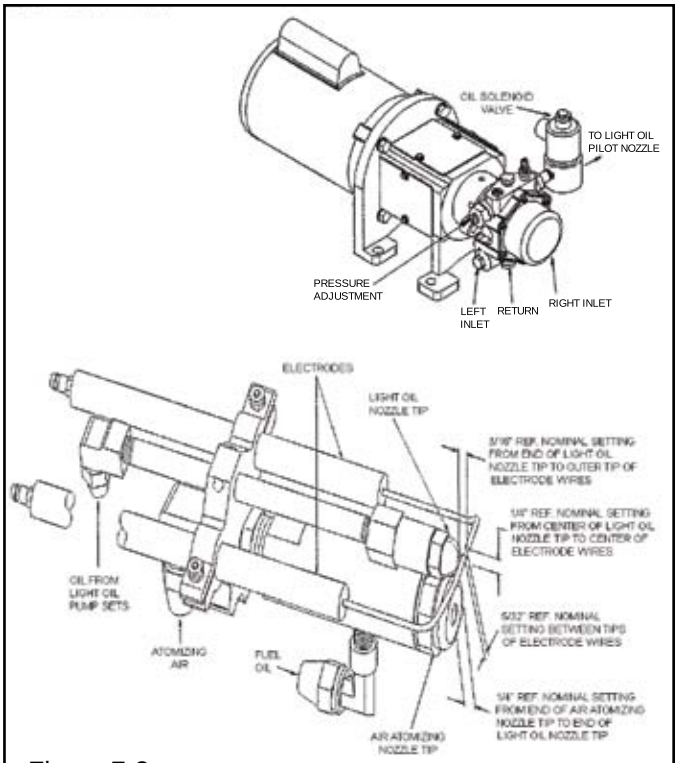


Figure 7-3

D. PLANT AIR SYSTEM

The D series burners are capable to operate with a plant air system instead of the standard IC compressor. In such case the burner is supplied with a atomizing air regulating line.

Adjust the air pressure with the regulator and fine tune

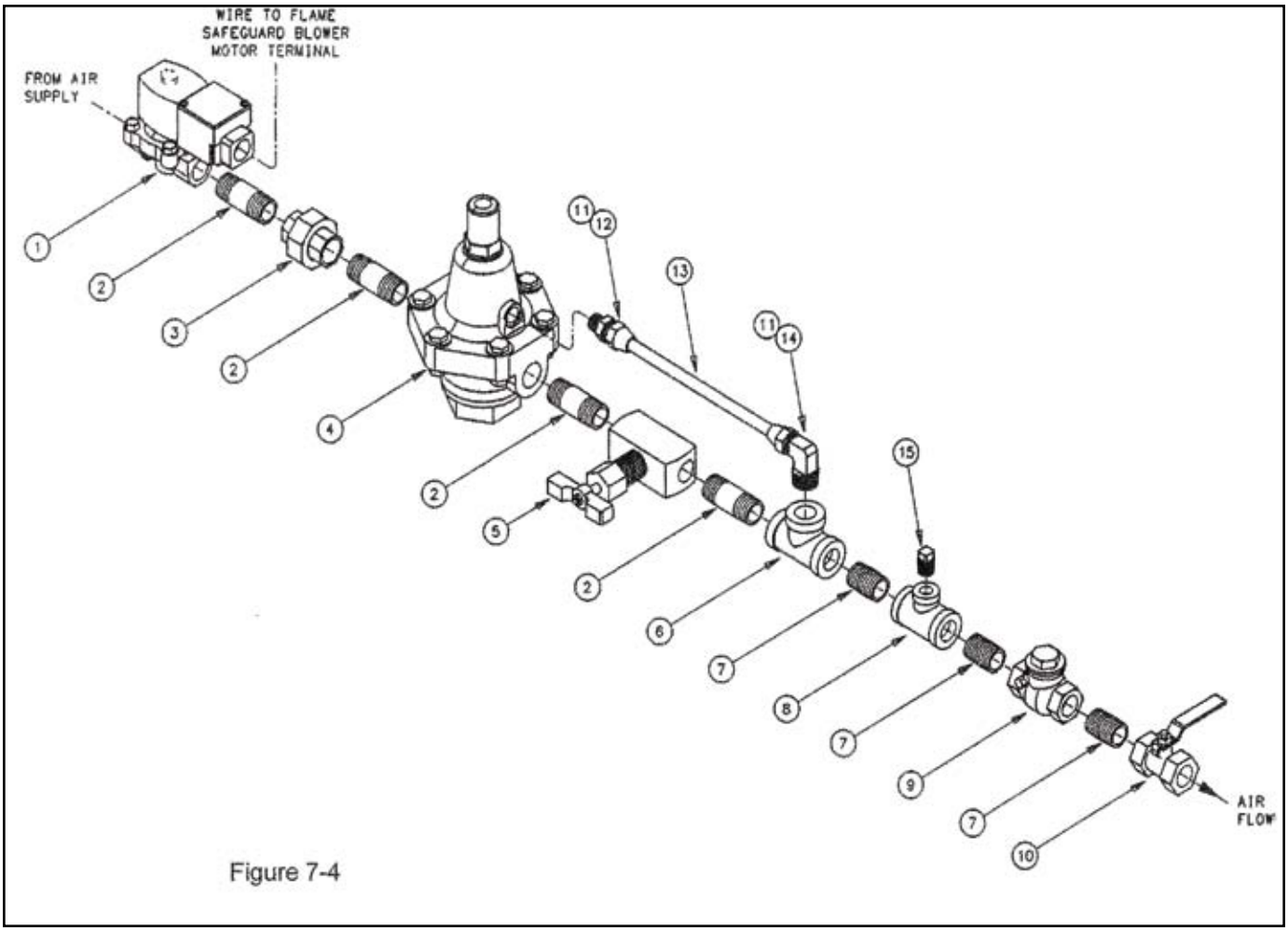


Figure 7-4

CleaverBrooks® warranty policy

A. LIMITED WARRANTY

The Company warrants that at the time of shipment, the equipment manufactured by it shall be merchantable, free from defects in material and workmanship and shall possess the characteristics represented in writing by the Company. The Company's warranty is conditioned upon the equipment being properly installed and maintained and operated within the equipment's capacity under normal load conditions with competent supervised operators. Equipment, accessories and other parts and components not manufactured by the Company are warranted only to the extent of and by the original manufacture's warranty to the Company; In no event shall such other manufacturer's warranty create any more extensive warranty obligations of the Company to the Buyer than the Company's warranty covering equipment manufactured by the Company.

B. EXCLUSIONS FROM WARRANTY

(I) THE FOREGOING IS IN LIEU OF ALL OTHER WARRANTIES, ORAL OR EXPRESS OR IMPLIED, INCLUDING ANY WARRANTIES THAT EXTEND BEYOND THE DESCRIPTION OF THE EQUIPMENT. THERE ARE NO EXPRESS WARRANTIES OTHER THAN THOSE CONTAINED HEREIN TO THE EXTENT PERMITTED BY THE LAW. THERE ARE NO IMPLIED WARRANTIES OF FITNESS FOR A PARTICULAR PURPOSE. THE PROVISIONS AS TO DURATION, WARRANTY ADJUSTMENT AND LIMITATION OF LIABILITY SHALL BE THE SAME FOR BOTH IMPLIED WARRANTIES (IF ANY) AND EXPRESSED WARRANTIES.

(II) The Company's warranty is solely as stated in (a) above and does not apply or extend, for example, to: expendable item; ordinary wear and tear; altered units; units repaired by persons not expressly approved by the Company; materials not of the Company's manufacture; or damage caused by accident, the elements, abuse, misuse, temporary heat, overloading, or by erosive or corrosive substances or by the alien presence of oil, grease, scale, deposits or other contaminants in the equipment.

C. WARRANTY ADJUSTMENT

Buyer must make claim of any breach of any warranty by written notice to the Company's home office within thirty (30) days of the discovery of any defect. The Company agrees at its option to repair or replace, BUT NOT INSTALL, F.O.B. Company's plant, any part or parts of the equipment which within twelve (12) months from the date of initial operation but no more than eighteen (18) months from date of shipment shall prove the Company's satisfaction (including return to the Company's plant, transportation prepaid, for inspection, if required by the Company) to be defective within the above warranty. Any warranty adjustments made by the Company shall not extend the initial warranty period set forth above. Expenses incurred by Buyer in replacing or repairing or returning the equipment or any part or parts will not be reimbursed by the Company.

D. SPARE AND REPLACEMENT PARTS WARRANTY ADJUSTMENT

The Company sells spare and replacement parts. This subparagraph (d) is the warranty adjustment for such parts. Buyer must make claim of any breach of any spare or replacement parts by written notice to the Company's home office within thirty (30) days of the discovery of any alleged defect for all such parts manufactured by the company. The Company agrees at its option to repair or replace, BUT NOT INSTALL, F.O.B. Company's plant, any part or parts or material it manufacture which, within one (1) year from the date of shipment shall prove to Company's satisfaction (including return to the Company's plant, transportation prepaid, for inspection, if required by the Company) to be defective within this part warranty. The warranty and warranty period for spare and replacement parts not manufactured by the company (purchased by the Company, from third party suppliers) shall be limited to the warranty and warranty adjustment extended to the Company by the original manufacturer of such parts; In no event shall such other manufacturer's warranty create any more extensive warranty obligations of the Company to the Buyer for such parts than the Company's warranty adjustment covering part manufactured by the Company as set forth in this subparagraph (d). Expenses incurred by Buyer in replacing or repairing or returning the spare or replacement parts will not be reimbursed by the Company.

E. LIMITATION OF LIABILITY

The above warranty adjustment set forth Buyer's exclusive remedy and the extent of the Company's liability for breach of implied (if any) and express warranties, representations, instructions or defects from any cause in connection with the sale or use of the equipment. THE COMPANY SHALL NOT BE LIABLE FOR ANY SPECIAL, INDIRECT OR CONSEQUENTIAL DAMAGES OR FOR LOSS, DAMAGE OR EXPENSE, DIRECTLY OR INDIRECTLY ARISING FROM THE USE OF THE EQUIPMENT OR FROM ANY OTHER CAUSE WHETHER BASED ON WARRANTY (EXPRESS OR IMPLIED) OR TORT OR CONTRACT, and regardless of any advices or recommendations that may have been rendered concerning the purchase, installation, or use of the equipment.

CB Profire Burner Impeller

5 Year Guarantee

This is to certify that CB Profire Milwaukee, Wisconsin — hereinafter referred to as the Manufacturer — guarantees to the original user the burner blower fan — hereinafter referred to as the impeller — of the CB Profire burner identified on this certificate, to be free of defect in material and factory workmanship under normal use.

The manufacturer agrees to replace F.O.B. factory, to the original user, at any time during the NEXT 5 YEARS from the date of original burner installation, the impeller which our examination shall disclose to be inoperative due to defects in material or factory workmanship or which shall deteriorate under normal use and service so as to become inoperative.

This contract shall not apply to any impeller which has been subjected to alteration, accident or negligence, abuse or misuse, nor does it provide for adjustment or any attention required by the impeller.

This contract shall apply only to CB Profire impellers used on Models D, LND, M, LNM, and MP/Series burners and is supplemental to but not in addition to the standard one year burner warranty and shall not affect such warranty.

Replacement of the impeller will be made only when the complete impeller claimed to be defective is returned to the manufacturer transportation charges prepaid and properly tagged, giving the burner serial number, name and address of purchaser, date of original installation and other necessary information such as nature of defect or cause of damage.

This contract is non-negotiable and non-transferable.

Model No. _____ Serial No. _____

Owner Name _____

Installation Address _____

_____ Date Installed _____

Authorized CB Distributor _____

CleaverBrooks®

LND SERIES BURNERS

WARNING

ONLY FACTORY AUTHORIZED BURNER SERVICE PERSONNEL SHOULD START-UP, ADJUST, OR SERVICE THIS EQUIP-

LN Model Designations, Sizes and Inputs

Model designations are based on the type of fuel(s) to be fired and the amount of furnace pressure to be overcome. Burner size is based on firing rate (maximum input in BTU/HR).

MODELS STANDARD	FUEL - AIR ATOMIZATION
LNDG LNDLG	GAS #2 Oil and Gas

Two designs of low NOx burners are available. One is for less than 30 ppm NOx @ 3% O2 and the other for less than 20 ppm @ 3% O2, when firing natural gas.

EXAMPLE: Model number on nameplate is LNDLG-252P-30, indicate a No. 2 oil and gas burner with input rated at 21,000 MBtu per hour, and NOx performance of less than 30 ppm.
LNDLG-252P-20, indicate a gas and oil burner with input rated at 16,800 MBtu per hour, and NOx per-

THE INSTALLATION OF A BURNER SHALL BE IN ACCORDANCE WITH THE REGULATIONS OF AUTHORITIES HAVING JURISDICTION. THE EQUIPMENT MUST BE INSTALLED IN ACCORDANCE WITH APPLICABLE LOCAL, STATE OR PROVINCIAL INSTALLATION REQUIREMENTS INCLUDING THE NATIONAL ELECTRICAL CODE (NEC) AND ASSOCIATED INSURANCE UNDERWRITERS. WHERE APPLICABLE, THE CANADIAN GAS ASSOCIATION (CGA) B149 AND CANADIAN STANDARD ASSOCIATION (CSA) B140 AND B139 (FOR OIL BURNERS) CODES SHALL PREVAIL.

OIL AND GAS BURNING EQUIPMENTS SHALL BE CONNECTED TO FLUES HAVING SUFFICIENT DRAFT AT ALL TIMES, TO ASSURE SAFE AND PROPER OPERATION OF THE BURNER.

BURNER SIZE	MAX.BURNER GAS INPUT MBTU/HR.	
	<30ppm	<20ppm
42 P	3,360	- -
54 P	4,200	3,360
63 P	5,250	4,200
84 S	6,300	5,250
84 P	7,350	6,300
105 P	8,400	7,350
145 S	10,500	8,400
145 P	12,600	10,500
175 P	14,700	12,600
210 P	16,800	14,700
252 P	21,000	16,800
300 P	25,200	21,000
315 P	29,400	N/A
336 P	31,500	N/A
378 P	33,600	N/A
420 P	37,800	N/A

Gas input based on natural gas at 1,000 Btucu.ft and 0.60 specific gravity and 60 Hz.

BURNER SIZE	MAX.BURNER OIL INPUT U.S.G.P.H.	
	<30ppm	<20ppm
42 P	24	- -
54 P	30	24
63 P	38	30
84 S	45	38
84 P	53	45
105 P	60	53
145 S	75	60
145 P	90	75
175 P	105	90
210 P	120	105
252 P	150	120
300 P	180	150
315 P	215	N/A
336 P	225	N/A
378 P	240	N/A
420 P	270	N/A

Oil input based on No.2 Oil at 140,000 Btu/gal and 60 Hz.

NOTE

CHECK ALL BURNER AND FGR WIRING BEFORE OPERATING THE UNIT. TURN ALL POWER OFF WHEN WORKING WITH ANY WIRING. POWER MUST BE TURNED OFF AT THE DISCONNECT TO THE BOILER. BOILER OPERATION AND FGR ADJUSTMENT MUST BE DONE BY A QUALIFIED CLEAVER-BROOKS SERVICE REPRESENTATIVE.

A. DESCRIPTION

The CB Profire Flue Gas Recirculation (FGR) system is designed to reduce NOx emissions from boilers retrofitted with CB Profire burners by adding a percentage of flue gas to the combustion process. A burner combustion air fan is used to pull flue gas from the stack through the FGR duct and inject it into the combustion zone.

Typical sizing for the FGR ducts are shown in Figure 8-4. All FGR duct piping should be covered with a minimum of 2" of insulation, and supported as required. The following controls are used in the FGR duct for safe operation of the system.

Figure 8-1 illustrate the general layout of the burner.

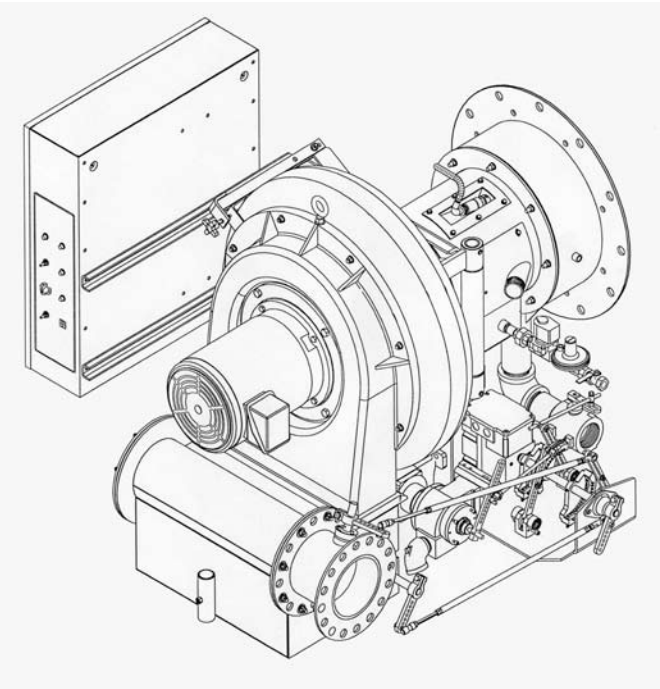
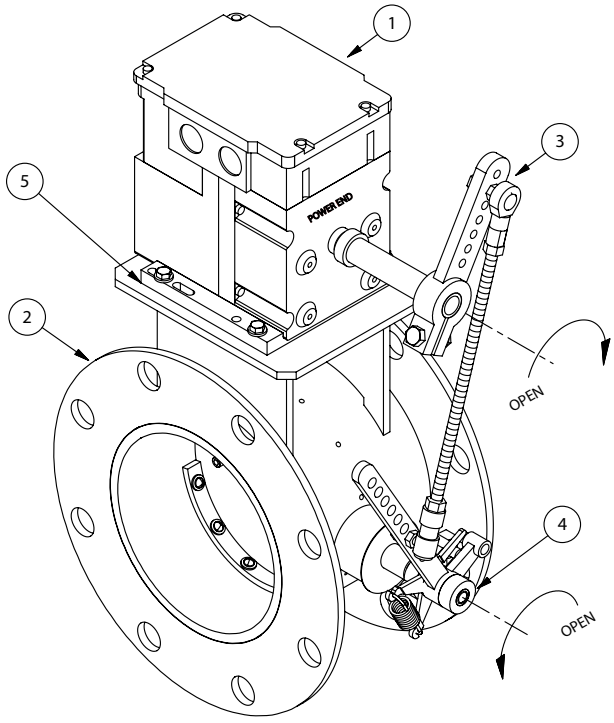


Figure 8-1

B. F.G.R. SHUTOFF VALVE. Figure 8-2.

The FGR shutoff valve is located as close to the stack as possible. A modutrol motor with a 90 degree stroke opens and closes the FGR shut off valve in 15 seconds. Proof of closure for the shutoff valve is provided by an auxiliary switch in the modutrol motor. The modutrol motor has a maximum temperature rating of 150 degrees F. This valve should never be mounted with the motor shaft in a vertical position. Damage to the modutrol motor will result. During pre purge and post purge the FGR shutoff valve is closed to prevent any unused gas fumes from returning to the combustion zone.



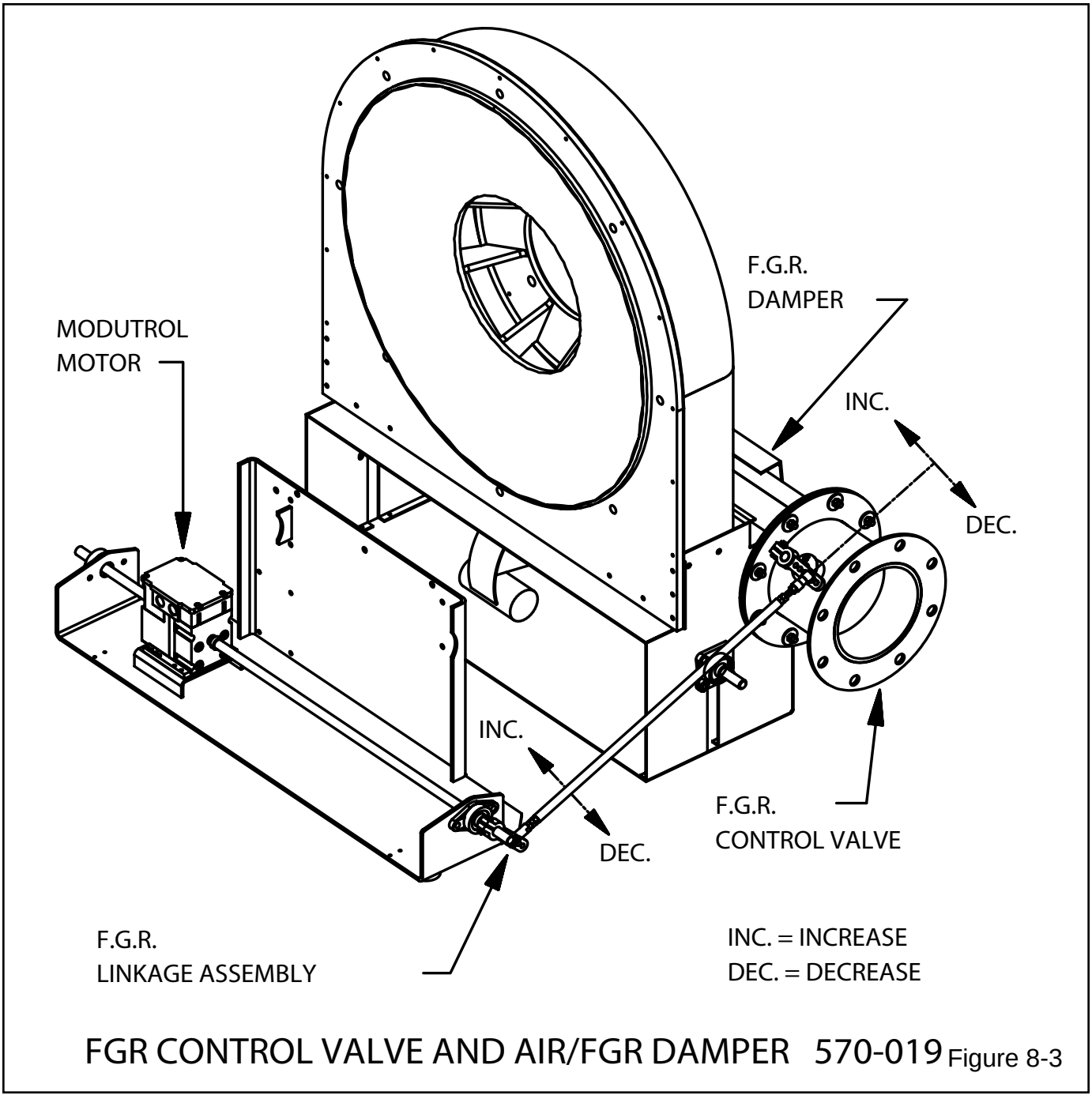
1. MODUTROL MOTOR
2. F.G.R. SHUTOFF VALVE
3. LINKAGE ARM
4. LINKAGE ARM ASSEMBLY
5. GASKET

570--018

Figure 8-2

C. F.G.R. CONTROL VALVE. Figure 8-3.

The FGR control valve is mounted to a FGR damper on the burner. A burner mounted modutrol motor with linkage connections, coordinates the air, fuel and NOx control devices to provide proper fuel/air/NOx ratios through the firing range. The modutrol motor must be able to complete it's full travel range. Restrictions will damage the motor and/or the linkage. Linkage consists of adjustable levers, rods and ball joints that transmits motion from the modutrol motor to the FGR control valve. Lever and rod adjustments should be made with the motor in the low fire position. The angles of the driven levers on the modutrol motor jackshaft can



FGR CONTROL VALVE AND AIR/FGR DAMPER 570-019 Figure 8-3

be adjusted to vary the rate of change. The closer the rod is to the lever hub, the less distance the rod and control valve blade will travel.

WARNING

BEFORE STARTING THE BOILER, MAKE SURE THE CONTROL VALVE IS CLOSED. THE BOILER MUST NEVER BE OPERATED IF THE CONTROL VALVE IS OPEN. THIS WILL RESULT IN HOT COMBUSTION GASES FLOWING BACKWARDS IN THE SYSTEM. THIS WILL DAMAGE THE SYSTEM AND CAN CAUSE BODILY HARM

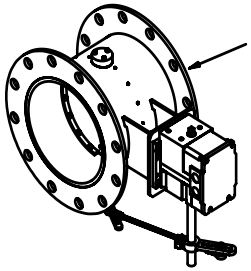
D. AIR/F.G.R. DAMPER ASSEMBLY. Figure 8-3.

The AIR/FGR damper regulates the volume of combustion air. Position of the rotary damper blade is control by a modutrol motor.

The damper blade in the low fire position is normally almost closed. The AIR/FGR damper and FGR control valve blades open as the modutrol motor drives toward the high fire position where flue gas is pulled into the regulated combustion air flow above the damper blade as controlled by the FGR control valve. Combustion air mixed with flue gas is passed on through the blast tube to the combustion zone.

LN 5

BURNER MODEL	F.G.R. PIPING SIZE	F.G.R. VALVE SIZE
LND-42P-30/20	6"	4"
LND-54P-30/20	6"	4"
LND-63P-30/20	6"	6"
LND-84S/P-30/20	6"	6"
LND-105P-30/20	6"	6"
LND-145S-30/20	6"	6"
LND-145P-30/20	8"	8"
LND-175P-30/20	8"	8"
LND-210P-30/20	8"	8"
LND-252P-30/20	8"	8"
LND-300P-30	10"	10"
LND-315P-30/20	10"	10"
LND-336P-30	10"	10"
LND-378P-30	10"	10"
LND-420P-30	10"	10"



WARNING:

THE F.G.R. SHUTOFF VALVE SHOULD NEVER BE MOUNTED IN THIS POSITION! THE MODUTROL MOTOR CAN NOT BE MOUNTED VERTICALLY, (VERTICAL IS DEFINED BY THE AXIS OF THE MOD. MOTOR SHAFT) DAMAGE TO THE MODUTROL MOTOR WILL RESULT.

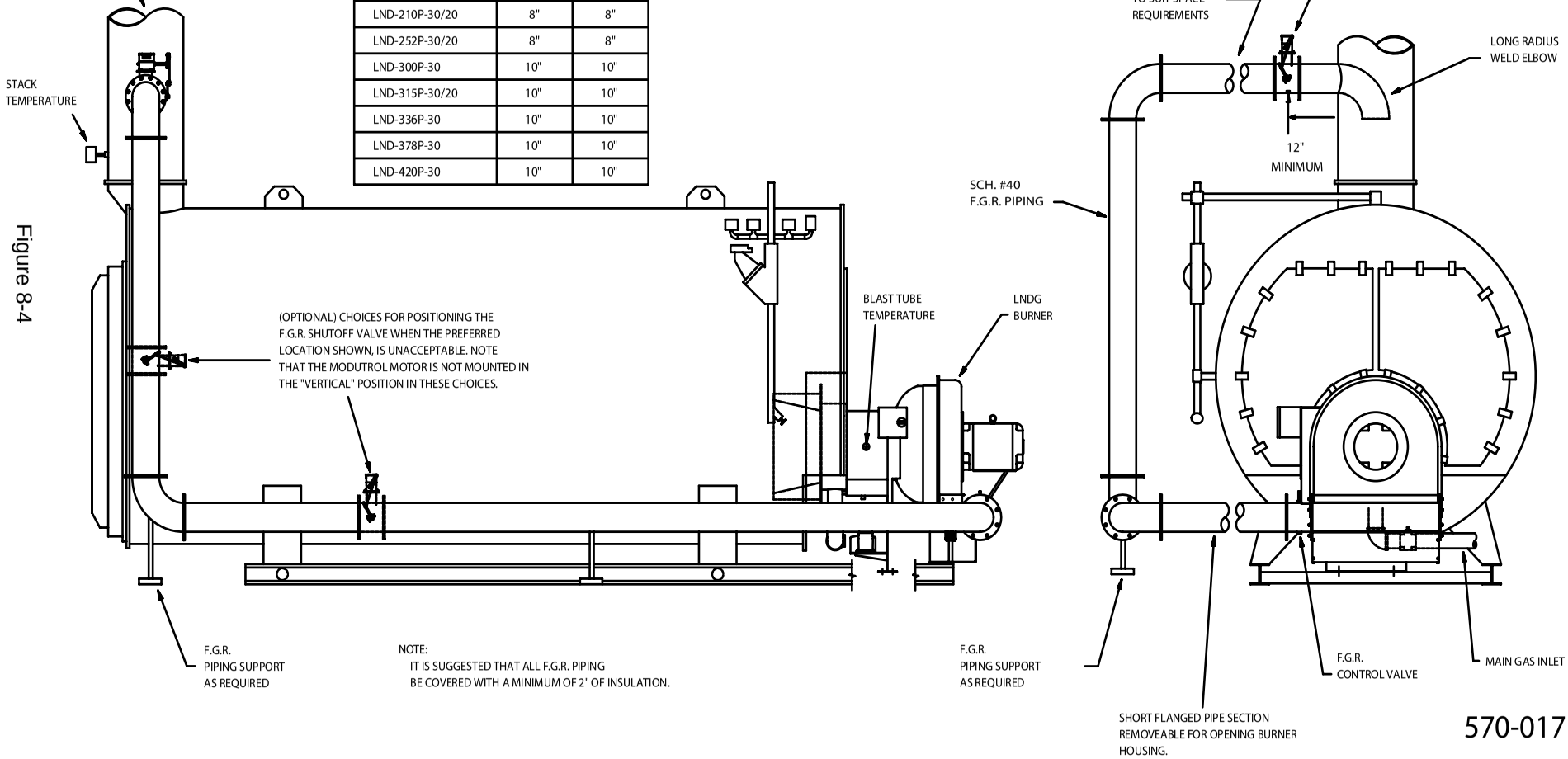


Figure 8-4

TYPICAL F.G.R. SYSTEM FIGURE 8-4

E.BLAST TUBE TEMPERATURE INTERLOCK.

(Optional) Figure 8-4

A blast tube temperature interlock device monitors air temperature in the blast tube area of the burner. If the blast tube temperature rises above 200 degrees F maximum. An external scanner is used on the low emission burners.

F. STACK TEMPERATURE INTERLOCK

(optional) Figure 8-4

A stack temperature interlock device monitors flue gas temperature in the stack. The stack temperature interlock is used as a low fire hold device. The stack temperature interlock is set at 25 degrees F below the minimum stack temperature at low fire (nominal 200 degrees F). After the stack temperature rises above the set point, the interlock closes and allows the burner to modulate.

G. 20 PPM DESIGN

The 20 ppm design feature a dual gas manifold. Each zone is controlled by a butterfly valve linked to a 14 point adjustment cam. The primary large butterfly valve control the main gas orifices and the secondary small butterfly valve control the pre-mix gas spuds.

See Figure 8-5 and 8-6.

Refer to the adjustment section to set-up the burner. In the low fire position the secondary valve controlling the pre-mix spuds is almost closed. After all adjustments are made throughout the modulating range, go back and re-light the burner. Upon start-up, check that the fire is not burning behind the diffuser. If this happens, close the secondary valve until this situation is corrected. Repeat several times.

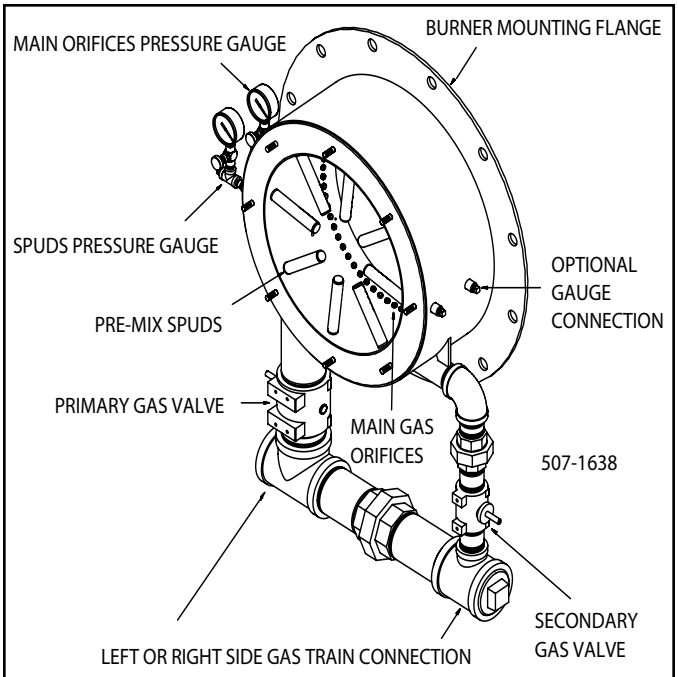


Figure 8-6

20 PPM HEAD ASSEMBLY

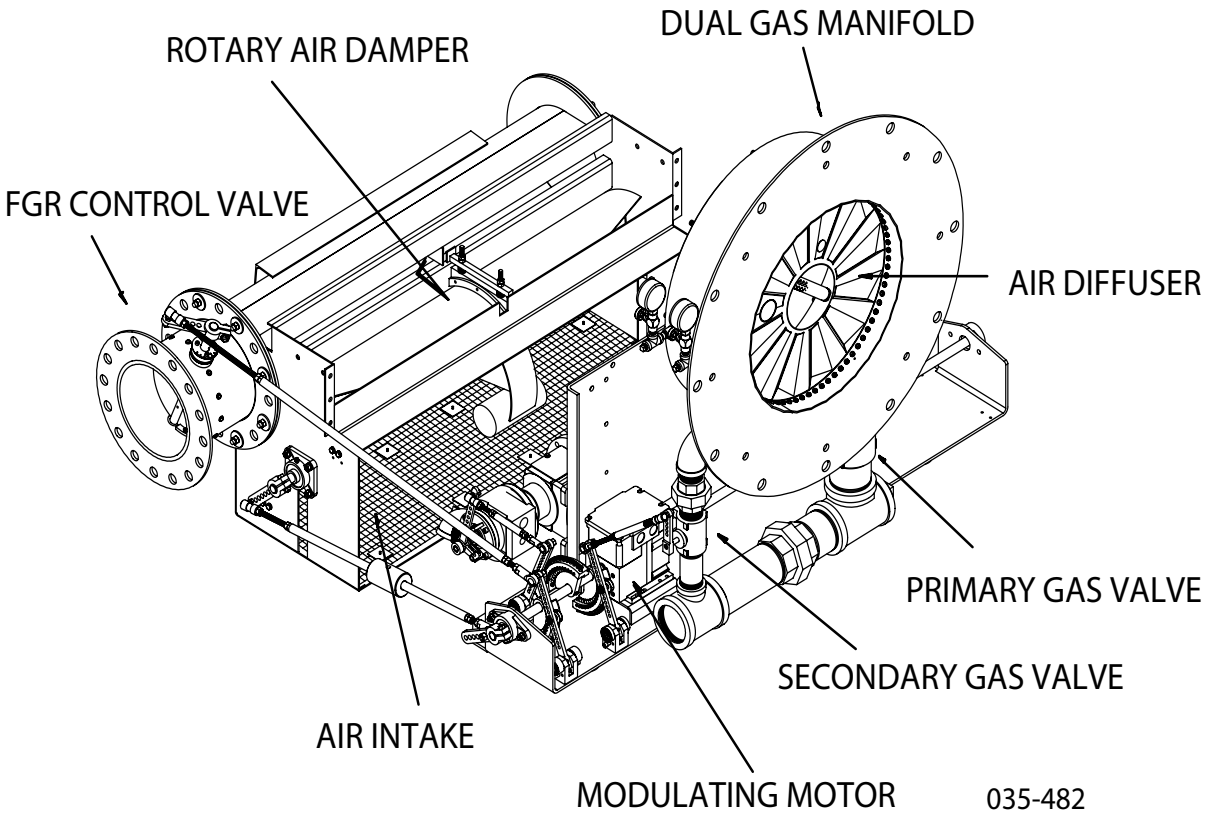


Figure 8-5

D / LND SERIES

parts manual

D & LND SERIES PARTS SECTION

INSTRUCTIONS FOR THE USE OF THIS PART BOOK
WHEN ORDERING REPAIR PARTS, PLEASE INCLUDE PART NUMBER, THE BURNER SERIAL NUMBER, MODEL, SIZE, AND VOLTAGE. THE INFORMATION CAN BE OBTAINED FROM THE BURNER NAMEPLATE AND THE VOLTAGE FROM THE DATA LABEL ON THE PANEL DOOR.

WHEN ORDERING FAN WHEELS, GIVE THE OVERALL DIAMETER, WIDTH, BORE, MANUFACTURER, AND MOTOR HP.

THIS PARTS BOOK DOES NOT INCLUDE SUCH COMMON HARDWARE ITEMS AS NUTS, WASHERS, ELECTRICAL PARTS, COPPER TUBING, FLARE FITTINGS, AND PIPE. ITEMS SUCH AS THESE CAN BE READILY PURCHASED LOCALLY.

THE FOLLOWING PARTS ARE SOLD ON EXCHANGE BASIS:

OIL-AIR METERING PUMPS, OIL AND AIR PUMPS, BEARING ASSEMBLY,, AIR MODULATORS, AND RELIEF VALVES

PARTS SHIPPING POLICY
ALL ORDERS FOR STOCKED ITEMS WILL BE PROCESSED AND READY FOR SHIPMENT WITHIN (24) HOURS OF ITS RECEIPT.

AIR SHIPMENTS (U.P.S. OR OTHERWISE) WILL BE SHIPPED THE SAME DAY IF ORDER IS RECEIVED BEFORE 2:30 P.M. (WEATHER PERMITTING).

GROUND SHIPMENTS TO WISCONSIN AND BORDERING STATES WILL BE SHIPPED THE SAME DAY UPON REQUEST.

ALL PARTS ORDERS AND EXCHANGE PARTS MUST BE SENT TO:

CB PROFIRE
351 - 21st STREET
MONROE, WISCONSIN 53566

PLANT PHONE: 608 325-3141 **PARTS DIRECT: 608 325-5003**
FAX: 608 325-4379 **FAX: 608 329-3190**

RETURN GOODS PROCEDURES (CREDIT OR REPLACEMENT PARTS)

Defective WARRANTY PARTS OR PARTS to be repaired are not to be returned to the PARTS DEPARTMENT without calling for a RETURN GOODS AUTHORIZATION NUMBER.

1) Before any item is RETURNED, PLEASE CALL THE PARTS DEPARTMENT TO OBTAIN AN **RGA** (RETURN GOODS AUTHORIZATION) NUMBER. PLEASE HAVE THE FOLLOWING INFORMATION AVAILABLE WHEN CALLING:

A) PART NUMBER OF ITEM
B) DESCRIPTION OF ITEM
C) REASON FOR THE RETURN WITH A FULL DESCRIPTION OF THE DEFECT(S)
D) PARTS ORDER OR SALES ORDER ITEM WAS PURCHASED ON
E) NAME, ADDRESS, AND DATE OF INSTALLATION
F) DO YOU WANT CREDIT OR REPLACEMENT BEING ISSUED

2) Once an **RGA** number HAS BEEN ISSUED, THE ITEM MAY BE RETURNED. YOU WILL HAVE THIRTY (30) DAYS TO RETURN THE ITEM FROM THE DATE OF THE **RGA** BEING ISSUED OR THERE WILL BE A 10% HANDLING CHARGE.

3) RETURNED GOODS MUST HAVE THE **RGA** NUMBER APPEARING ON THE ADDRESS LABEL ATTACHED TO THE OUTSIDE OF THE BOX BEING RETURNED. IF THE **RGA** NUMBER IS NOT ON THE LABEL, YOUR CREDIT MAY BE DELAYED AND THERE WILL BE A $50.00 SERVICE CHARGE FOR PAPERWORK. ALL NEW PARTS RETURNED TO THE FACTORY WILL BE CHARGED WITH A 25% RESTOCKING FEE.

PLEASE NOTE.
FAILURE TO PROVIDE COMPLETE AND CORRECT INFORMATION MAY RESULT IN DELAYED OR CREDIT REFUSAL.

RETURN OF WARRANTY PARTS: WARRANTY PARTS MUST BE RETURNED TO THE FACTORY FREIGHT PREPAID, WITHIN THIRTY (30) DAYS AFTER A NEW PART HAS BEEN RECEIVED OR THERE WILL BE A 10% HANDLING CHARGE.

SHIPPING CHARGES: ON A WARRANTY PART, WE WILL ASSUME STANDARD SHIPPING CHARGES. THIS DOES NOT INCLUDE SPECIAL HANDLING SUCH AS AIR FREIGHT, U.P.S. NEXT DAY AIR SERVICE, OR U.P.S. SECOND DAY AIR SERVICE, ETC.

MOTOR WARRANTY POLICY.
THE FOLLOWING PROCEDURE MUST BE USED FOR PROPER REPLACEMENT AND/OR REPAIR OF ELECTRIC MOTORS THAT HAVE FAILED UNDER WARRANTY.

1) Remove motor from unit and take to motor a **MANUFACTURER AUTHORIZED SERVICE STATION.**

2) The service station will determine the warranty status by **INSTALLATION DATE OF THE UNIT, AND DATE OF FAILURE,** along with the age of the motor, determined by the **CODE DATE**.

3) If the unit is within warranty, the unit will be inspected for cause of failure and repair r equirements .

4) If the unit is within warranty limitations, the service station will repair on a **"NO CHARGE"** basis.

5) If the repairs are extensive, the service station will contact the motor manufacturer waranty mamager to decide if the motor is to be repaired or replaced.

EXCEPTION TO THE ABOVE PROCEDURE:
EMERGENCY SITUATIONS MAY DICTATE THAT BECAUSE OF THE DISTANCE BETWEEN USER AND AUTHORIZED SERVICE STATIONS, SEVERE DAMAGE OR INTERRUPTIONS MAY RESULT.

THE FOLLOWING PROCEDURE SHOULD BE USED:

1) SELECT A KNOWLEDGEABLE MOTOR REPAIR SHOP.

2) REPAIR SHOP TO CONTACT MOTOR MANUFACTURER WARRANTY REPAIR MANAGER, DETAILING REPAIRS NECESSARY ALONG WITH THE COMPLETE NAMEPLATE DATA BEFORE ANY REPAIRS ARE MADE.

3) IF ANY PROBLEMS OCCUR, THE CB PROFIRE PARTS DEPARTMENT WILL PROVIDE ASSISTANCE.

FAILURE TO FOLLOW THE NEXT PROCEDURE WILL RESULT IN REPAIRS BEING MADE AT THE CUSTOMERS EXPENSE.

*** MARATHON ELECTRIC - ELECTRIC MOTORS WARRANTY REPAIR PROCEDURE**

THE FOLLOWING PROCEDURE MUST BE USED FOR PROPER REPLACEMENT AND/OR REPAIR OF MARATHON ELECTRIC MOTORS THAT HAVE FAILED UNDER WARRANTY.

1) END USER WILL REMOVE MOTOR FROM UNIT AND TAKE FAILED MOTOR TO MARATHON ELECTRIC AUTHORIZED SERVICE STATION.

2) SERVICE STATION WILL DETERMINE WARRANTY STATUS BY INSTALLATION DATE OF UNIT AND DATE OF FAILURE ALONG WITH AGE OF MOTOR DETERMINED BY DATE CODE.

3) IF WITHIN WARRANTY LIMITATIONS, UNIT WILL BE INSPECTED FOR CAUSE OF FAILURE AND REPAIR REQUIREMENTS. DETERMINATION WILL BE MADE THAT FAILURE WAS CAUSED BY DEFECT IN MATERIALS OR WORKMANSHIP AND NOT BY MISUSE, ABUSE, ACCIDENT, OR OTHER EXCLUSIONS LISTED IN OUR WARRANTY.

4) IF MINOR REPAIR IS REQUIRED, SERVICE STATION WILL REPAIR MOTOR AND RETURN TO USER ON A "NO CHARGE" BASIS.

5) IF MAJOR REPAIR (REWIND) IS REQUIRED, SERVICE STATION MAY:

A) REWIND MOTOR AND RETURN TO USER ON A "NO CHARGE" BASIS IF USER REQUIREMENT IS NOT AN EMERGENCY AND REPAIR CAN BE MADE WITHIN MARATHON ELECTRIC PRICE GUIDELINES, OR

B) NAMEPLATE WILL BE REMOVED AND ALONG WITH A REPORT OF CAUSE OF FAILURE WILL BE GIVEN TO THE USER.

1) USER WILL PRESENT NAMEPLATE AND REPORT TO DISTRIBUTOR.

2) DISTRIBUTOR WILL FURNISH USER WITH A NEW MOTOR, NO CHARGE, EITHER FROM HIS INVENTORY OR SECURE REPLACEMENT UNIT DIRECT FROM PARENT ORGANIZATION.

* MARATHON ELECTRIC
WARRANTY REPAIR PROCEDURE, DPN-79-113
ELECTRIC MOTORS, 48-215 FRAME

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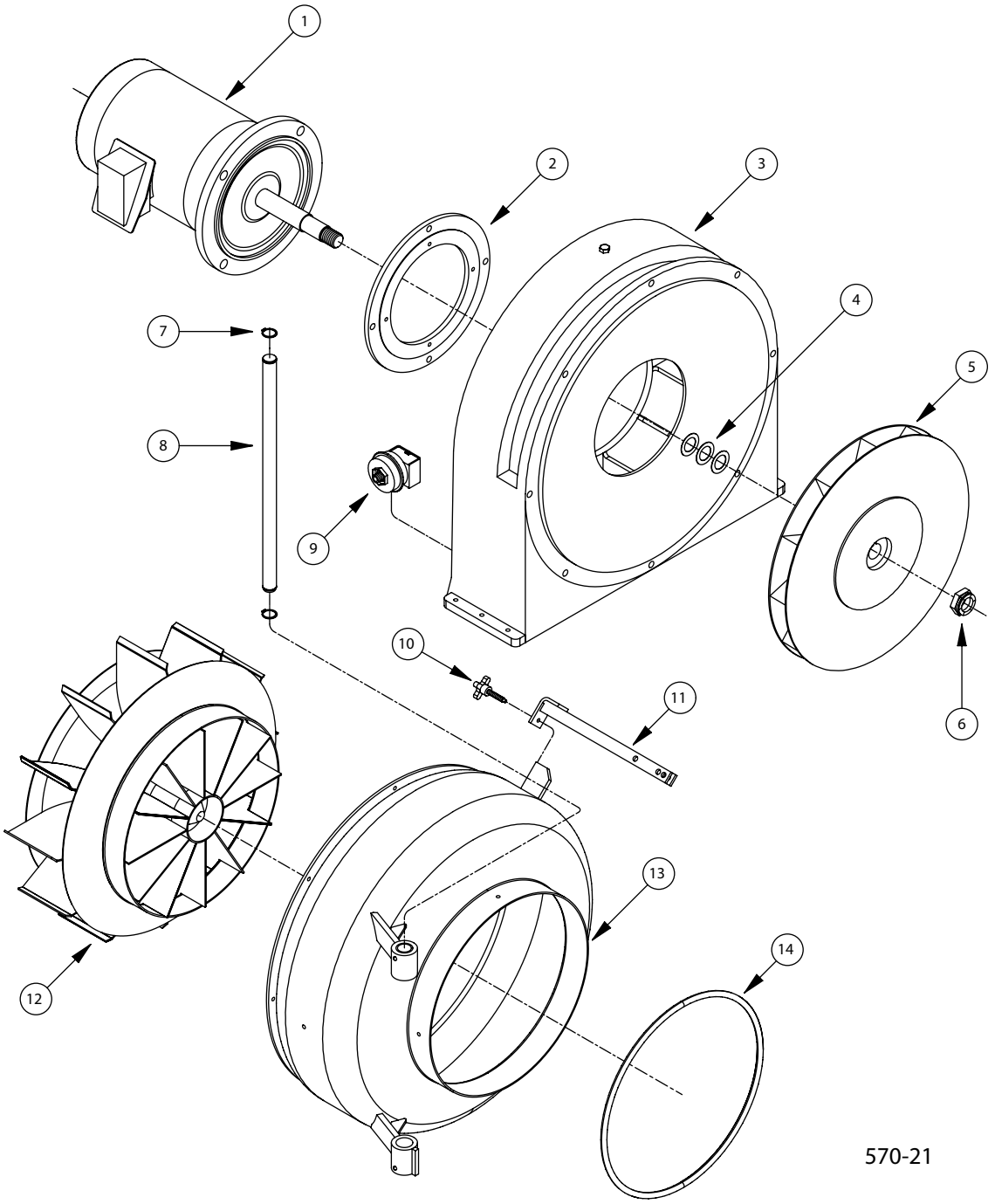


FIGURE 1. BLOWER HOUSING ASSEMBLY. D42 - 175

570-021

BLOWER HOUSING ASSEMBLIES			QUANTITY						
ITEM NO.	PART NUMBER	DESCRIPTION	42	54	63	84	105	145	175
1	894 - 1200	MOTOR, 3 HP.	S&P	S					
	894 - 1237	MOTOR, 5 HP.		*P	S&P	S			
	894 - 1240	MOTOR, 7.5 HP.				P	S		
	894 - 1209	MOTOR, 10 HP.							P
	894 - 1245	MOTOR, 15 HP.						S&P	
	894 - 1247	MOTOR, 20 HP.							S&P
2	29 - 834	FLANGE, MOTOR MOUNTING.	1	1	1				
	29 - 815	FLANGE, MOTOR MOUNTING.				1	1		
3	85 - 807	SUPPORT, MOTOR & AIR DAMPER.	1	1	1	1	1		
	85 - 815	SUPPORT, MOTOR & AIR DAMPER.						1	1
4	91 -	SPACER (VARIES)							
5	192 - 302	IMPELLER ASSEMBLY, 13-1/2" O.D. X 1-7/32" WIDE X 1-1/4" SHAFT.	**S	**S					
	192 - 301	IMPELLER ASSEMBLY, 15" O.D. X 1-1/32" WIDE X 1-1/4" SHAFT.	S.**P	**P					
	192 - 300	IMPELLER ASSEMBLY, 16" O.D. X 1-21/32" WIDE X 1-1/4" SHAFT.		S					
	192 - 305	IMPELLER ASSEMBLY, 16" O.D. X 1-1/32" WIDE X 1-1/4" SHAFT.			S&P	S			
	192 - 314	IMPELLER ASSEMBLY, 18" O.D. X 11/16" WIDE X 1-1/4" SHAFT.	P						
	192 - 313	IMPELLER ASSEMBLY, 19-1/8" O.D. X 1-1/32" WIDE X 1-1/4" SHAFT.			P	**P			
	192 - 304	IMPELLER ASSEMBLY, 19-1/4" O.D. X 1-7/32" WIDE X 1-3/4" SHAFT.					P	S	
	192 - 310	IMPELLER ASSEMBLY, 20" O.D. X 1-19/32" WIDE X 1-3/8" SHAFT.						S	
	192 - 303	IMPELLER ASSEMBLY, 21" O.D. X 1-3/32" WIDE X 1-3/8" SHAFT.					P		
	192 - 309	IMPELLER ASSEMBLY, 21" O.D. X 1-1/2" WIDE X 1-3/8" SHAFT.						P	
	192 - 312	IMPELLER ASSEMBLY, 21" O.D. X 2-1/32" WIDE X 1-3/8" SHAFT.							S
	192 - 311	IMPELLER ASSEMBLY, 23" O.D .X 1-13/16" WIDE X 1-3/8" SHAFT.							P
6	869 - 119	NUT, HEX LOCK 1" 14 UNF.	1	1	1	1	1		
	869 - 145	NUT, HEX LOCK 1-1/4" 12 UNF.						1	1
7	914 - 205	RING, RETAINING EXT. SNAP.	2	2	2	2	2	2	2
8	56 - 272	PIN, HINGE.	1	1	1	1	1		
	56 - 275	PIN, HINGE.						1	1
9	836 - 366	SWITCH, AIR PRESSURE.	1	1	1	1	1	1	1
10	865 - 28	KNOB, BLOWER HOUSING LATCH.	1	1	1	1	1	1	1
11	43 - 10	LATCH, ASSEMBLY.	1	1	1	1	1	1	1
12	265 - 21	CONE ASSEMBLY, STATOR.	1	1	1				
	265 - 24	CONE ASSEMBLY, STATOR.				1	1		
	265 - 22	CONE ASSEMBLY, STATOR.						1	
	265 - 27	CONE ASSEMBLY, STATOR.							1
13	40 - 246	HOUSING ASSEMBLY, FAN.	1	1	1				
	40 - 250	HOUSING ASSEMBLY, FAN.				1	1		
	40 - 247	HOUSING ASSEMBLY, FAN.						1	
	40 - 268	HOUSING ASSEMBLY, FAN.							1
14	32 - 1060	GASKET, FAN HOUSING SEAL.	1	1	1	1	1	1	1
		* DE DEG 3 HP							
		** DE DEG 42, 54 & 63							

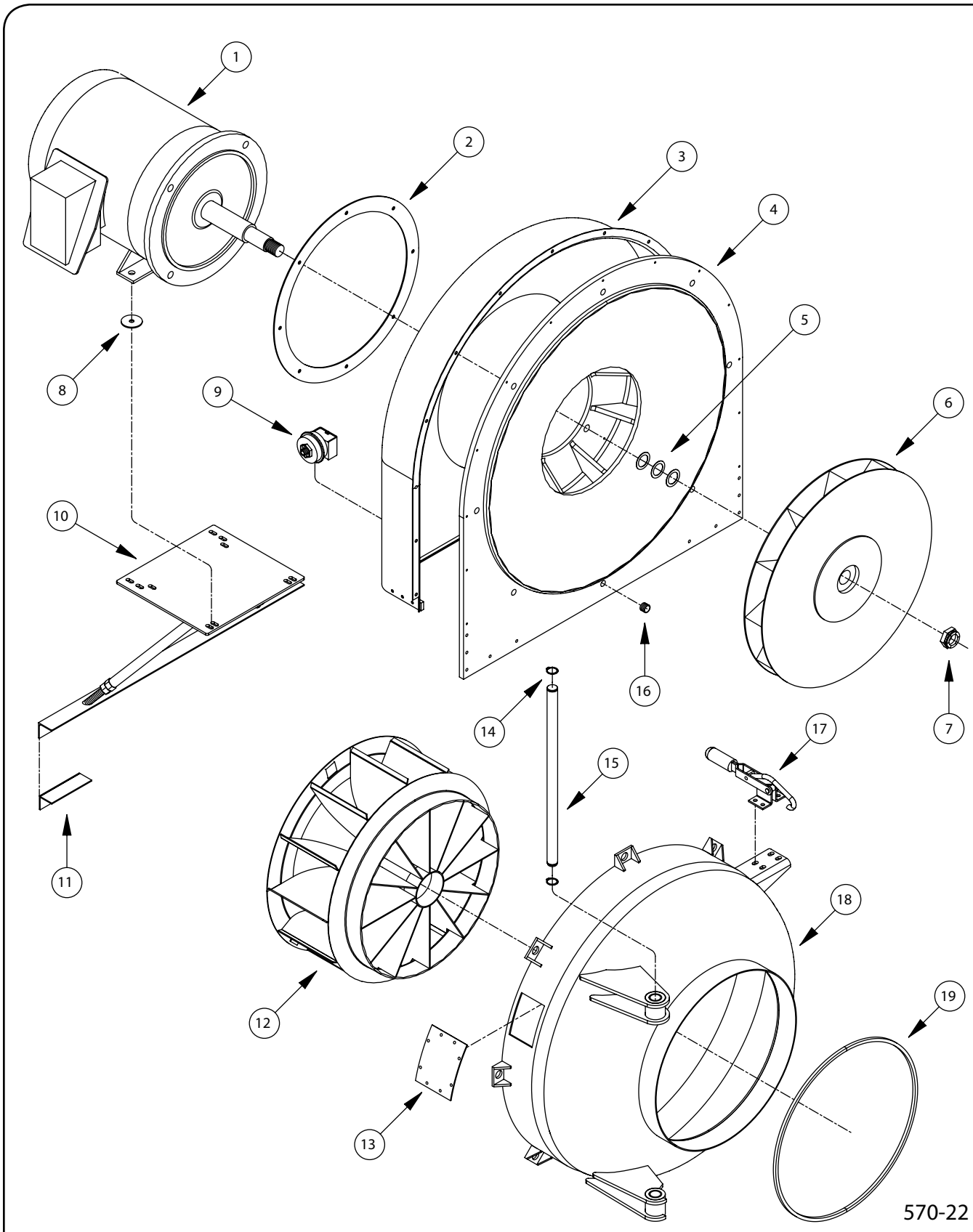


FIGURE 2. BLOWER HOUSING ASSEMBLY. D210 - 336

570-022

BLOWER HOUSING ASSEMBLIES			QUANTITY				
ITEM NO.	PART NUMBER	DESCRIPTION	210	252	300	315	336
1	894 - 1249	MOTOR, 20 HP.	S				
	894 - 1251	MOTOR, 25 HP.	P	S			
	894 - 1255	MOTOR, 40 HP.		P	S&P		
	894 - 1351	MOTOR, 60 HP.				1	1
2	515 - 16	SEAL.	1	1	1		
3	39 - 452	SHROUD ASSEMBLY, AIR HOOD.	1	1	1	1	1
4	85 - 812	SUPPORT, MOTOR AND AIR DAMPER.	S	S			
	85 - 813	SUPPORT, MOTOR AND AIR DAMPER.		P	1	1	1
5	91 -	SPACER (VARIES)					
6	192 - 308	IMPELLER ASSEMBLY. 21-1/2" O.D. X 2-1/2" WIDE X 1-5/8" SHAFT.	S				
	192 - 299	IMPELLER ASSEMBLY. 23" O.D. X 2-11/32" WIDE X 1-5/8" SHAFT.	P	S			
	192 - 307	IMPELLER ASSEMBLY. 23-1/2" O.D. X 2-9/32" WIDE X 1-5/8" SHAFT.		P			
	192 - 321	IMPELLER ASSEMBLY. 25-1/2"' O.D. X 2-5/8" WIDE X 1-5/8" SHAFT.			S&P		
	192 - 306	IMPELLER ASSEMBLY. 25-1/2"' O.D. X 3-9/32" WIDE X 1-5/8" SHAFT.				1	1
7	869 - 185	NUT, HEX LOCK 1-3/8" 12 UNF.	1	1	1	1	1
8	152 - 17	PAD, BLOWER MOTOR MTG. 2-1/4" O.D X 1/2" I.D. X 1/8" THK.			4	4	4
9	836 - 366	SWITCH, AIR PRESSURE.	1	1	1	1	1
10	85 - 878	SUPPORT ASSEMBLY, DAMPER TO MOTOR.		P	S&P	1	1
11	152 - 18	PAD, MOTOR SUPPORT 1-3/4" WIDE X 6" LG. X 1/8" THK.		*4	4	4	4
12	265 - 26	CONE ASSEMBLY, STATOR.	1				
	265 - 25	CONE ASSEMBLY, STATOR.		1	1	1	
	265 - 135	CONE ASSEMBLY, STATOR.					1
13	19 - 520	COVER, ACCESS, FAN HOUSING.				1	1
14	914 - 205	RING, RETAINING EXT. SNAP.	2	2	2	2	2
15	56 - 276	PIN, HINGE.	1				
	56 - 278	PIN, HINGE.		1	1	1	1
16	835-001	INSERT, COIL.	8	8	8	8	8
17	43 - 13	LATCH, TOGGLE CLAMP.	2	2	2	2	2
18	40 - 257	HOUSING ASSEMBLY, FAN.	1				
	40 - 264	HOUSING ASSEMBLY, FAN.		1	1		
	40 - 383	HOUSING ASSEMBLY, FAN.				1	
	40 - 411	HOUSING ASSEMBLY, FAN.					1
19	32 - 1060	GASKET, FAN HOUSING SEAL.	1	1	1	1	1
		* 252P					

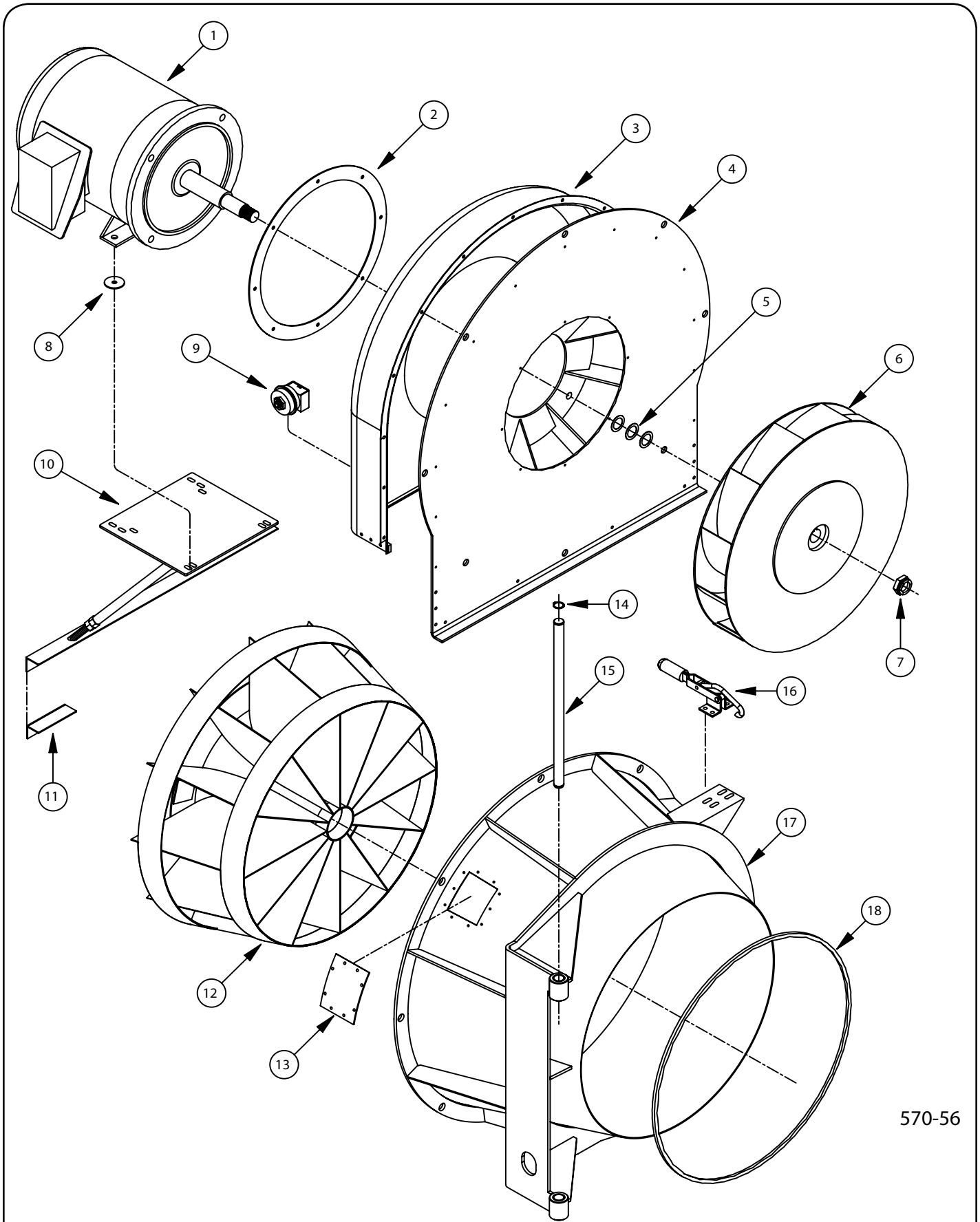


FIGURE 3. BLOWER HOUSING ASSEMBLY. D378 - 420

570-056

BLOWER HOUSING ASSEMBLIES			QUANTITY	
ITEM NO.	PART NUMBER	DESCRIPTION	378	420
1	894-1368	BLOWER MOTOR	1	1
2	515-16	SEAL PLATE	1	
1	3	85-813 SHROUD ASSEMBLY, AIR		
HOOD	1		1	4
	85-891	SUPPORT, MOTOR AND AIR DAMPER	1	1
5	91-	SPACER (VARIES)	1	1
6	192-327	IMPELLER ASSEMBLY	1	1
7	869-185	NUT, HEX LOCK 1-3/8" 12 UNF.	1	1
8	152-17	PAD, BLOWER MOTOR MOUNTING	1	1
9	836-336	SWITCH, AIR PRESSURE	1	1
10	85-892	SUPPORT ASSEMBLY, DAMPER TO MOTOR	1	1
11	152-18	PAD, MOTOR SUPPORT	1	1
12	265-142	STATOR CONE ASSEMBLY	1	1
13	19-530	ACCESS COVER	1	1
14	914-205	EXTERNAL RETAINING SNAP RING	1	1
15	56-290	HINGE PIN	1	1
16	43-13	LATCH TOGGLE CLAMP	2	2
17	40-403	FAN HOUSING ASSEMBLY	1	1

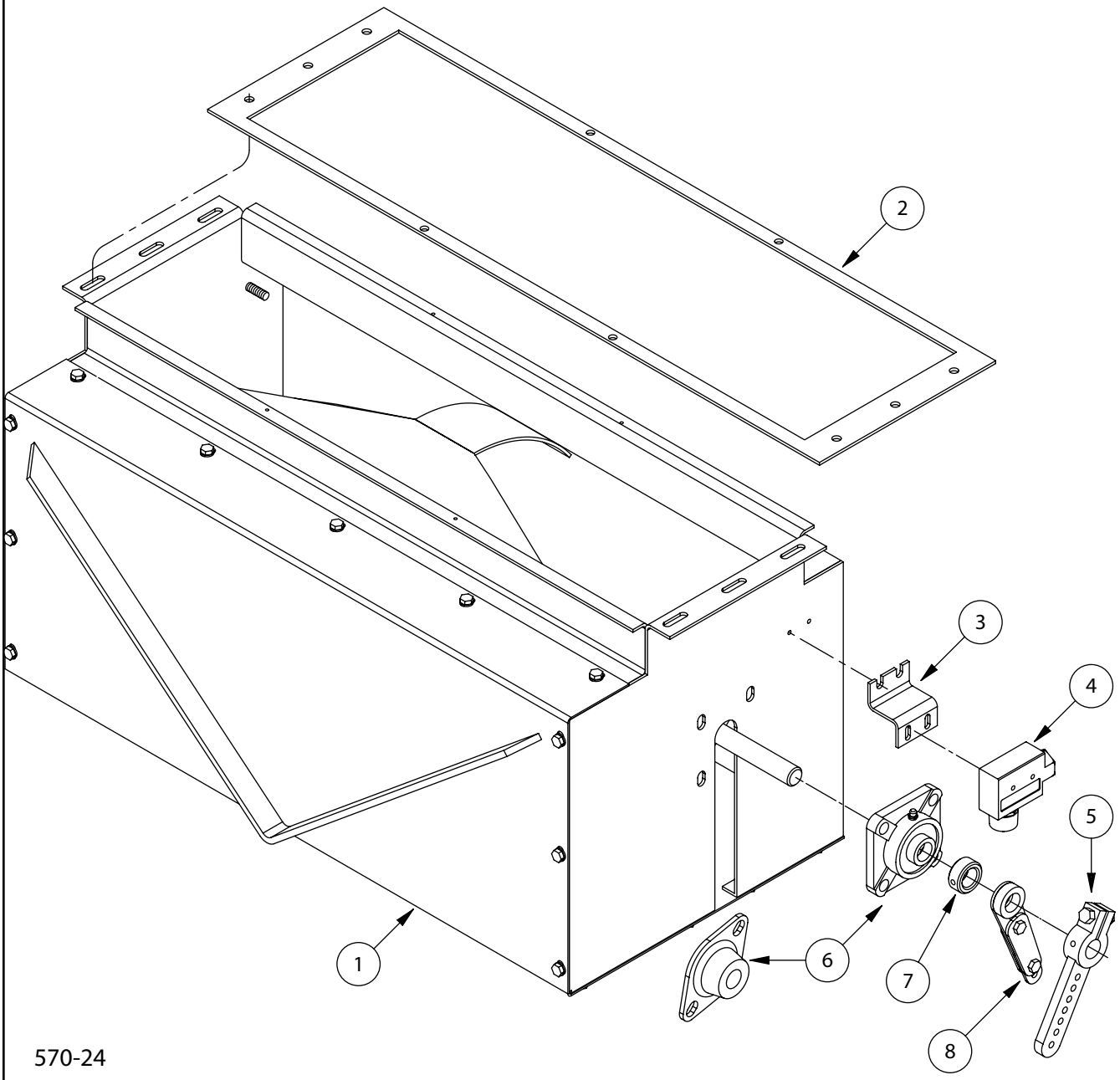


FIGURE 4. DAMPER ASSEMBLY. D42 - 420

570-024

DAMPER ASSEMBLIES			QUANTITY									
ITEM NO.	PART NUMBER	DESCRIPTION	42	54	63	84	105	145	175	210	252	300
1	427 - 42	DAMPER ASSEMBLY, AIR.	1	1	1	1	1					
	427 - 40	DAMPER ASSEMBLY, AIR.						1	1			
	427 - 41	DAMPER ASSEMBLY, AIR.								1	1	1
2	32 - 1124	GASKET.	1	1	1	1	1					
	32 - 1125	GASKET.						1	1			
	32 - 1127	GASKET (VARIES).								1	1	1
3	8 - 1272	BRACKET, DAMPER HIGH FIRE SWITCH.	1	1	1	1	1	1	1	1	1	1
4	836 - 301	SWITCH, HIGH FIRE AIR INTERLOCK.	1	1	1	1	1	1	1	1	1	1
5	2 - 141	ARM, LINKAGE ASSEMBLY.	1	1	1	1	1	1	1			
	2 - 259	ARM, LINKAGE ASSEMBLY								1	1	1
6	807 - 335	BEARING, FLANGED 2 PT, DAMPER SHAFT 3/4"	2	2	2	2	2					
	807 - 333	BEARING, SQUARE 4 PT, DAMPER SHAFT 3/4"						2	2	2	2	2
7	18 - 149	COLLAR.	2	2	2	2	2					
8	2 - 189	ARM, LINKAGE ASSEMBLY, HIGH FIRE SWITCH.	1	1	1	1	1	1	1	1	1	1

ITEM NO.	PART NUMBER	DESCRIPTION	QUANTITY			
			315	336	378	420
1	427 - 41	DAMPER ASSEMBLY, AIR.	1	1		
	427 - 156	DAMPER ASSEMBLY, AIR.			1	1
2	32 - 1127	GASKET (VARIES).	1	1		
	32 - 1126	GASKET .			1	1
3	8 - 1272	BRACKET, DAMPER HIGH FIRE SWITCH.	1	1	1	1
4	836 - 301	SWITCH, HIGH FIRE AIR INTERLOCK.	1	1	1	1
5	2 - 259	ARM, LINKAGE ASSEMBLY.	1	1	1	1
6	807 - 333	BEARING, SQUARE 4 PT, DAMPER SHAFT 3/4"	2	2	2	2

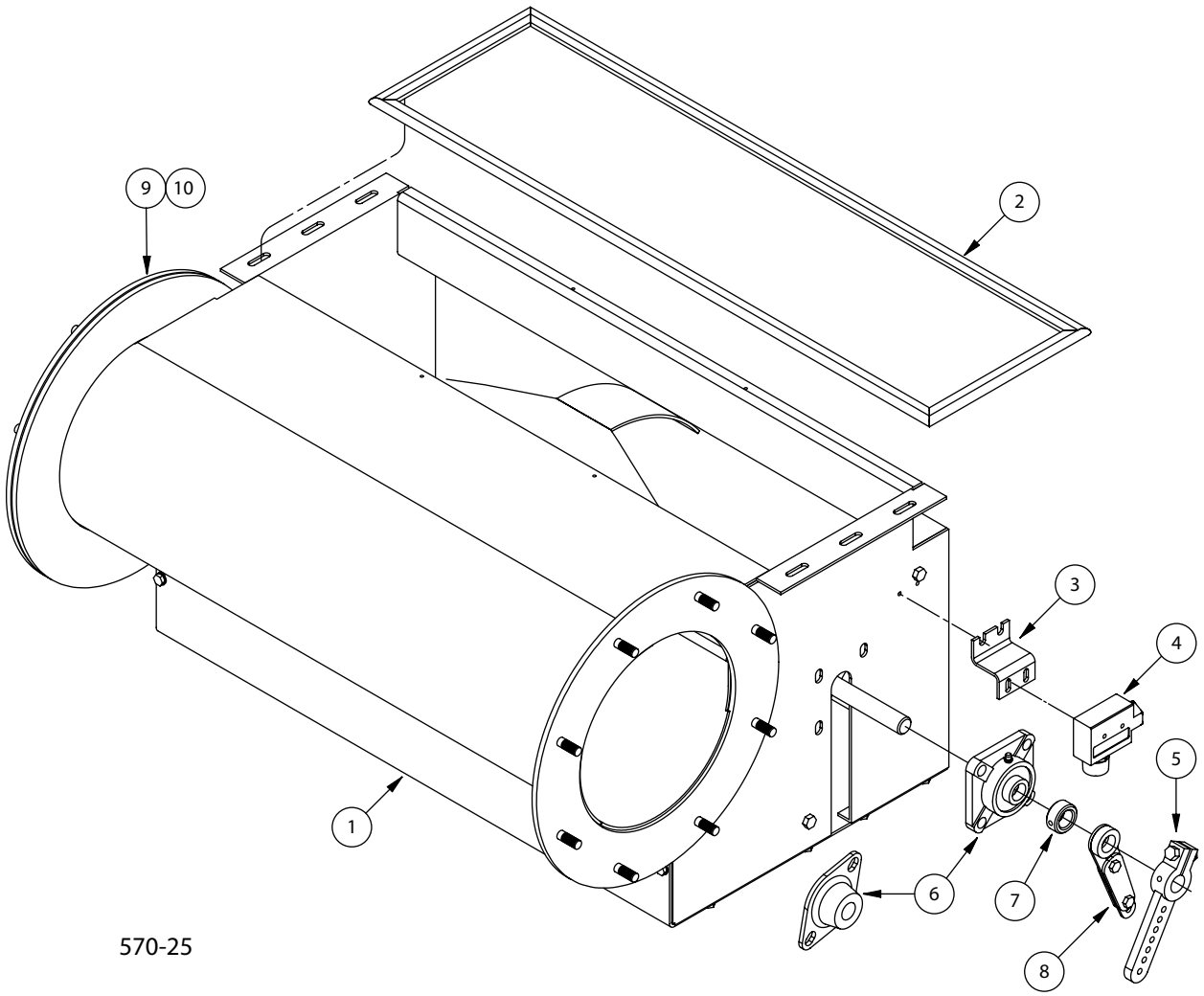


FIGURE 5. DAMPER ASSEMBLY. LND42 - 420

570-025

DAMPER ASSEMBLIES

ITEM NO.	PART NUMBER	DESCRIPTION	QUANTITY									
			42	54	63	84	105	145	175	210	252	300
1	427 - 117	DAMPER ASSEMBLY, AIR 4" FGR INLET.	1	1								
	427 - 127	DAMPER ASSEMBLY, AIR 6" FGR INLET.	1	1	1	1	1					
	427 - 113	DAMPER ASSEMBLY, AIR 6" FGR INLET.						1	1			
	427 - 129	DAMPER ASSEMBLY, AIR 8" FGR INLET.						1	1			
	427 - 114	DAMPER ASSEMBLY, AIR 8" FGR INLET.								1	1	
	427 - 138	DAMPER ASSEMBLY, AIR 10" FGR INLET.										1
2	32 - 1144	GASKET, TADPOLE TAPE, 3/8" BULB X 1" WIDE.	1	1	1	1	1	1	1	1	1	1
3	8 - 1272	BRACKET, DAMPER HIGH FIRE SWITCH.	1	1	1	1	1	1	1	1	1	1
4	836 - 301	SWITCH, HIGH FIRE INTERLOCK.	1	1	1	1	1	1	1	1	1	1
5	2 - 184	ARM, LINKAGE ASSEMBLY.	1	1	1	1	1	1	1	1	1	1
6	807 - 335	BEARING, FLANGED 2 PT, DAMPER SHAFT 3/4"	2	2	2	2	2					
	807 - 333	BEARING, SQUARE 4 PT, DAMPER SHAFT 3/4"						2	2	2	2	2
7	18 - 149	COLLAR.	2	2	2	2	2					
8	2 - 189	ARM, LINKAGE ASSEMBLY, HIGH FIRE SWITCH.	1	1	1	1	1	1	1	1	1	1

ITEM NO.	PART NUMBER	DESCRIPTION	QUANTITY			
			315	336	378	420
1	427 - 117	DAMPER ASSEMBLY, AIR 10" FGR INLET.	1	1	1	1
2	32 - 1126	GASKET.	1	1	1	1
3	8 - 1272	BRACKET, DAMPER HIGH FIRE SWITCH.	1	1	1	1
4	836 - 301	SWITCH, HIGH FIRE AIR INTERLOCK.	1	1	1	1
5	2 - 184	ARM, LINKAGE ASSEMBLY.	1	1	1	1
6	807 - 333	BEARING, SQUARE 4 PT, DAMPER SHAFT 3/4"	2	2	2	2
8	2 - 189	ARM, LINKAGE ASSEMBLY, HIGH FIRE SWITCH.	1	1	1	1

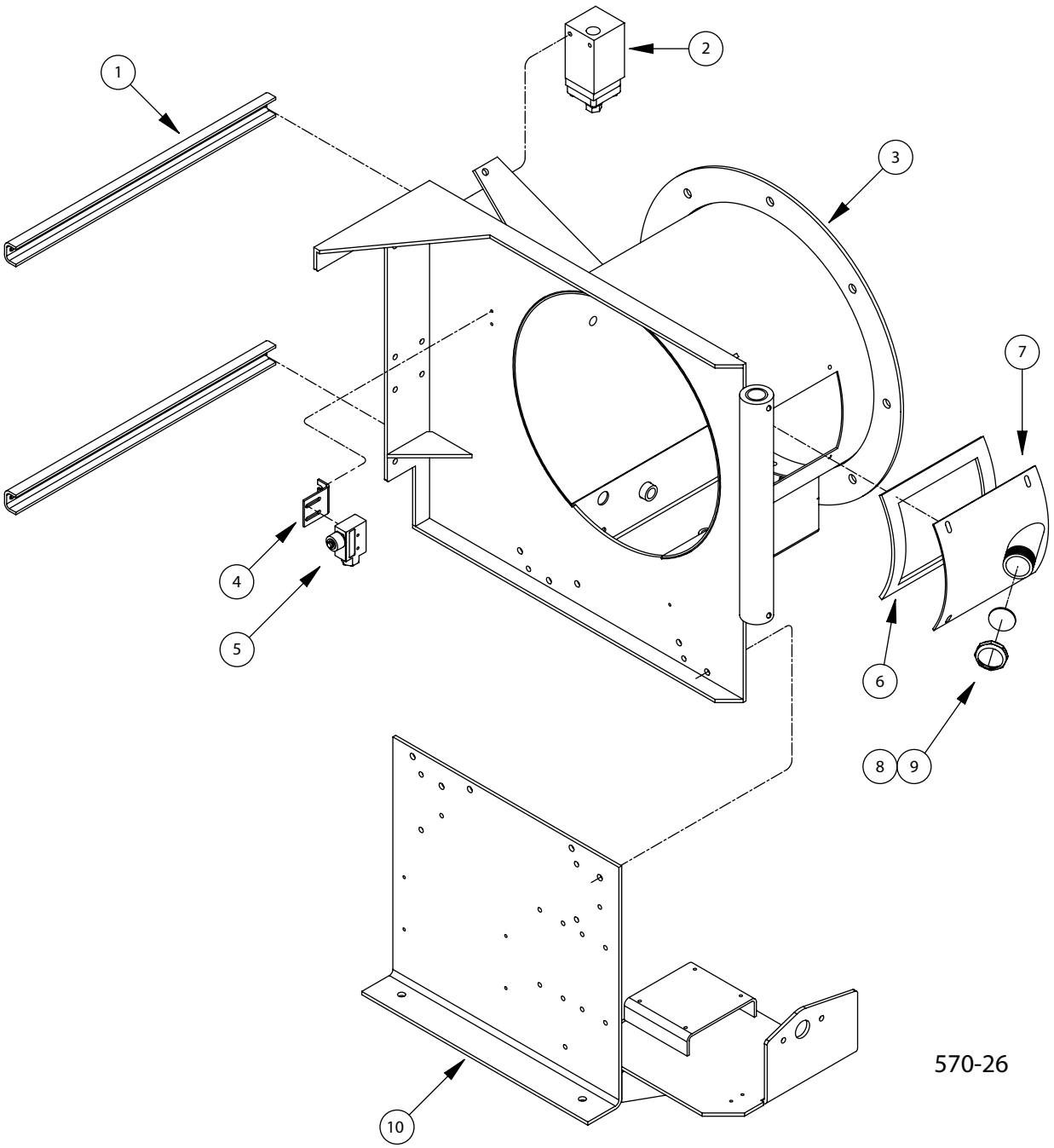


FIGURE 6. BLAST TUBE ASSEMBLY. D42 - 336

570-026

BLAST TUBE ASSEMBLIES			QUANTITY											
ITEM NO.	PART NUMBER	DESCRIPTION	42	54	63	84	105	145	175	210	252	300	315	336
1	8 - 1029	BRACKET, 23" SUPPORT, STANDARD PANEL.	2	2	2	2	2	2						
	8 - 1275	BRACKET, 28" SUPPORT, STANDARD PANEL.							2	2	2	2	2	2
2	817 - 829	SWITCH, PRESSURE, AIR OIL, 4-12 PSI.							*1	*1	*1	*1	*1	*1
3	40 - 377	HOUSING ASSEMBLY, FIRING HEAD.	1	1	1									
	40 - 378	HOUSING ASSEMBLY, FIRING HEAD.				1	1							
	40 - 400	HOUSING ASSEMBLY, FIRING HEAD.						1						
	40 - 381	HOUSING ASSEMBLY, FIRING HEAD.							1					
	40 - 382	HOUSING ASSEMBLY, FIRING HEAD.								1				
	40 - 380	HOUSING ASSEMBLY, FIRING HEAD.									1	1	1	
	40 - 410	HOUSING ASSEMBLY, FIRING HEAD.												1
4	8 - 1025	BRACKET, SAFETY INTERLOCK SWITCH.	1	1	1	1	1	1	1	1	1	1	1	1
5	836 - 301	SWITCH, SAFETY INTERLOCK.	1	1	1	1	1	1	1	1	1	1	1	1
6	32 - 1127	SEAL, (VARIES).												
7	19 - 485	COVER, FIRING HEAD ACCESS.	1	1	1									
	19 - 486	COVER, FIRING HEAD ACCESS.				1	1							
	19 - 487	COVER, FIRING HEAD ACCESS.						1						
	19 - 489	COVER, FIRING HEAD ACCESS.							1	1				
	19 - 488	COVER, FIRING HEAD ACCESS.									1	1	1	1
8	31 - 36	GLASS, FLAME SIGHT.	1	1	1	1	1	1	1	1	1	1	1	1
9	869 - 184	NUT, SIGHT GLASS.	1	1	1	1	1	1	1	1	1	1	1	1
10	85 - 885	SUPPORT ASSEMBLY, BURNER.	1	1	1	1	1							
	85 - 886	SUPPORT ASSEMBLY, BURNER.						1	1					
	85 - 887	SUPPORT ASSEMBLY, BURNER.								1	1	1	1	1
		*DLG												

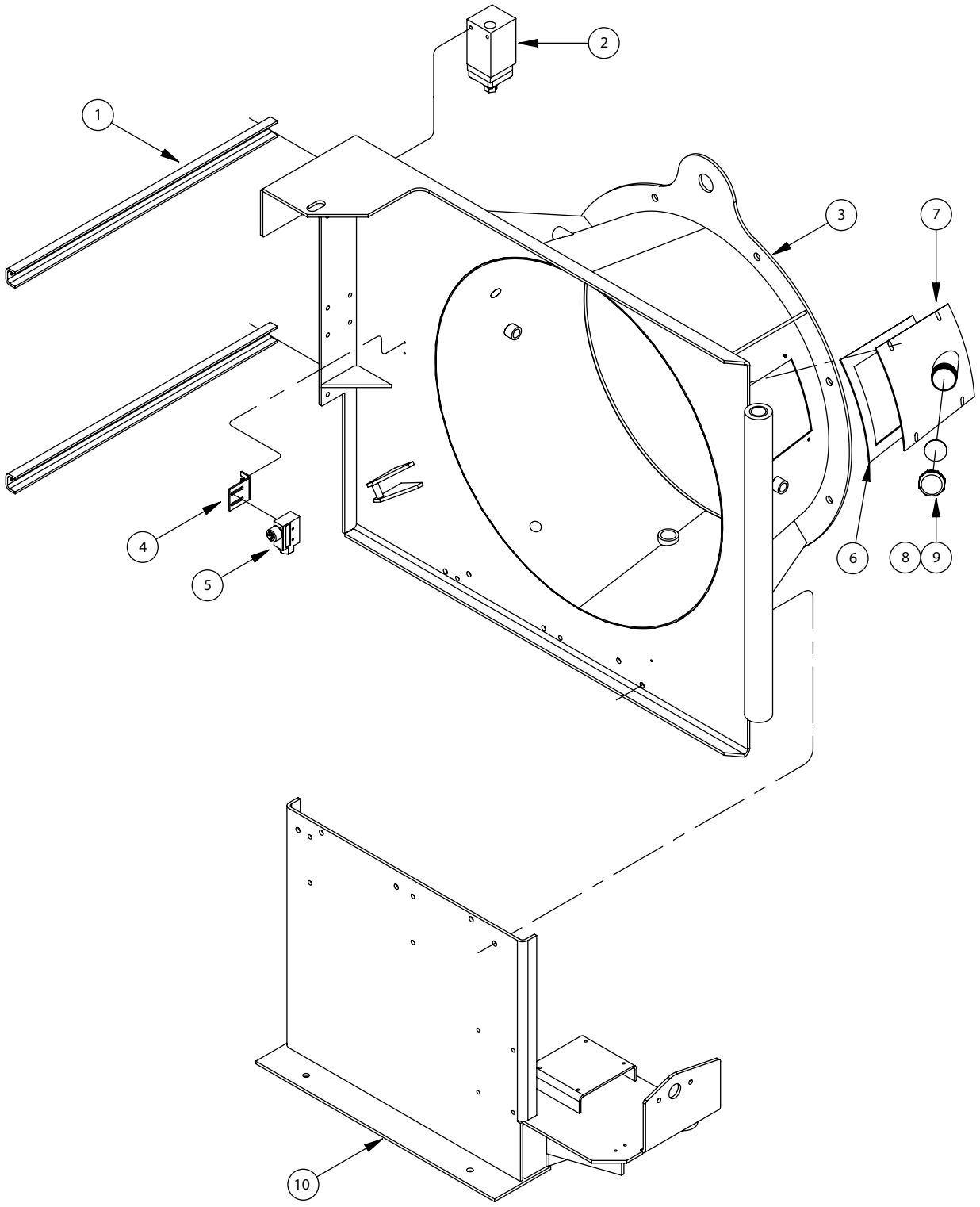


FIGURE 7. BLAST TUBE ASSEMBLY. D378 - 420

570-027

BLAST TUBE ASSEMBLY			QUANTITY			
ITEM NO.	PART NUMBER	DESCRIPTION	315	336	378	420
1	8 - 1275	BRACKET, 28" SUPPORT, STANDARD PANEL.	2	2	2	2
2	817 - 829	SWITCH, PRESSURE AIR-OIL,4-12 PSI.	*1	*1	*1	*1
3	40 - 380	HOUSING ASSEMBLY, FIRING HEAD.	1			
	40 - 410	HOUSING ASSEMBLY, FIRING HEAD.		1		
	40 - 402	HOUSING ASSEMBLY, FIRING HEAD.			1	1
4	8 - 1018	BRACKET.	1	1	1	1
5	836 - 301	SWITCH, SAFETY INTERLOCK.	1	1	1	1
6	32 - 1127	SEAL, (VARIES).	1	1	1	1
7	19 - 488	COVER, FIRING HEAD ACCESS.	1	1		
	19 - 529	COVER, FIRING HEAD ACCESS.			1	1
8	31 - 36	GLASS, FLAME SIGHT.	1	1	1	1
9	869 - 184	NUT, SIGHT GLASS.	1	1	1	1
10	85 - 887	SUPPORT ASSEMBLY, BURNER.	1	1	1	1

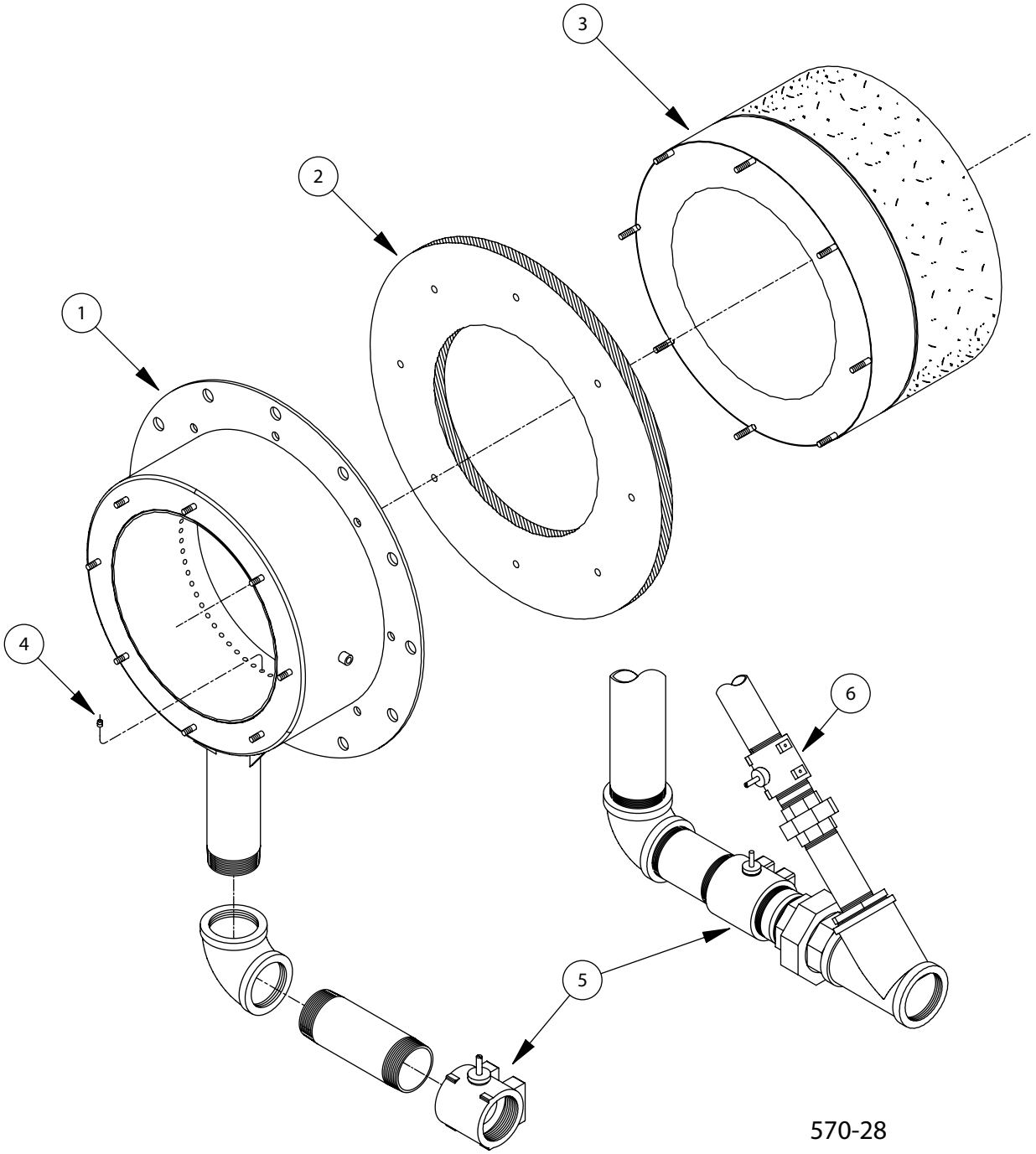


FIGURE 8. FIRING HEAD ASSEMBLY. D42 - 420

570-028

FIRING HEAD ASSEMBLIES			QUANTITY									
ITEM NO.	PART NUMBER	DESCRIPTION	42	54	63	84	105	145	175	210	252	300
1	257 - 156	MANIFOLD ASSEMBLY, GAS FIRING HEAD.	1									
	257 - 157	MANIFOLD ASSEMBLY, GAS FIRING HEAD.		1	1							
	257 - 147	MANIFOLD ASSEMBLY, GAS FIRING HEAD.				1						
	257 - 148	MANIFOLD ASSEMBLY, GAS FIRING HEAD.					1					
	257 - 149	MANIFOLD ASSEMBLY, GAS FIRING HEAD.						1				
	257 - 153	MANIFOLD ASSEMBLY, GAS FIRING HEAD.							1	1		
	257 - 154	MANIFOLD ASSEMBLY, GAS FIRING HEAD.									1	1
2	32 - 1095	GASKET, MOUNTING, DRY OVEN.	1	1	1							
	32 - 1096	GASKET, MOUNTING, DRY OVEN.				1	1					
	32 - 1097	GASKET, MOUNTING, DRY OVEN.						1				
	32 - 1098	GASKET, MOUNTING, DRY OVEN.							1	1		
	32 - 1099	GASKET, MOUNTING, DRY OVEN.									1	1
3	279 - 58	DRY OVEN ASSEMBLY.	1	1	1							
	279 - 60	DRY OVEN ASSEMBLY.				1	1					
	279 - 59	DRY OVEN ASSEMBLY.						1				
	279 - 76	DRY OVEN ASSEMBLY.							1	1		
	279 - 77	DRY OVEN ASSEMBLY.									1	1
4	42 - 52	SPUD, GAS ORIFICE PROTECTION .312" O.D.	3	3	3	3	3	4	4	5	5	5
5	940 - 1192	VALVE, GAS BUTTERFLY 2" F.P.	1									
	940 - 1257	VALVE, GAS BUTTERFLY 2" R.P.		1	1							
	940 - 1193	VALVE, GAS BUTTERFLY 2-1/2" R.P.				1						
	940 - 1230	VALVE, GAS BUTTERFLY 2-1/2" F.P.					1					
	940 - 1194	VALVE, GAS BUTTERFLY 3" R.P.						1	1	1		
	940 - 1195	VALVE, GAS BUTTERFLY 4" R.P.									1	1

ITEM NO.	PART NUMBER	DESCRIPTION	QUANTITY			
			315	336	378	420
1	257 - 154	MANIFOLD ASSEMBLY, GAS FIRING HEAD.	1			
	257 - 165	MANIFOLD ASSEMBLY, GAS FIRING HEAD.		1		
	257 - 164	MANIFOLD ASSEMBLY,, GAS FIRING HEAD.			1	1
2	32 - 1099	GASKET, MOUNTING, RY OVEN.	1			
	32 - 1132	GASKET, MOUNTING, DRY OVEN.		1	1	1
3	279 - 77	DRY OVEN ASSEMBLY.	1			
	279 - 138	DRY OVEN ASSEMBLY.		1	1	1
4	42 - 52	SPUD, GAS ORIFICE PROTECTION .312" O.D.	5	5	5	5
5	940 - 1195	VALVE, GAS BUTTERFLY 4" R.P.	1	1	1	1
6	940 - 1230	VALVE, GAS BUTTERFLY 2-1/2" F.P.			1	1

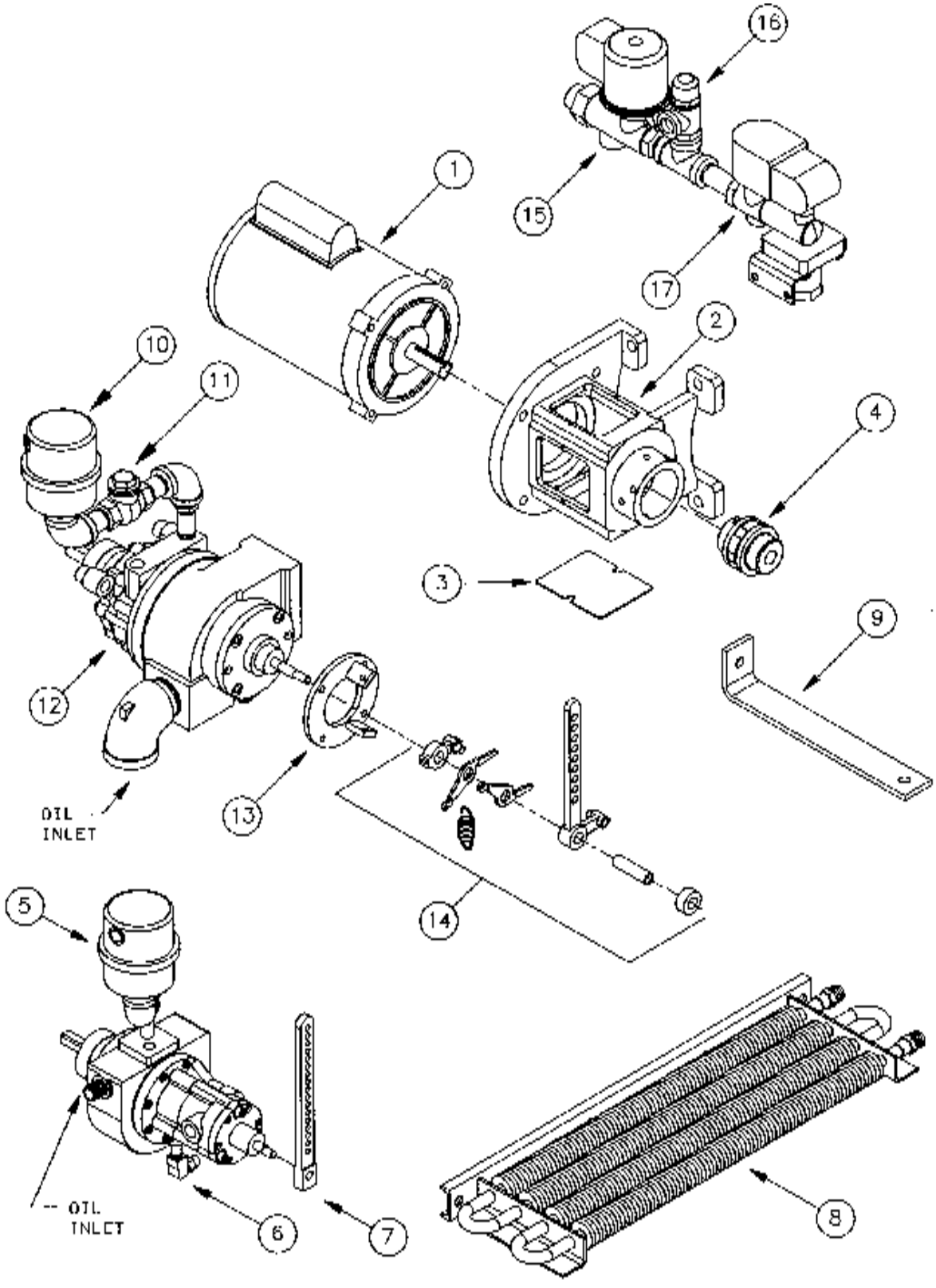


FIGURE 10. OIL METERING ASSEMBLY.
DL, DLG, DM, DMG42 -145

570-031

OIL METERING ASSEMBLIES			QUANTITY					
ITEM NO.	PART NUMBER	DESCRIPTION	42	54	63	84	105	145
1	894 - 1289	MOTOR, 1HP. MODELS: DL, DLG	1	1	1	1		
	894 - 1295	MOTOR, 2HP. MODELS: DL, DLG					1	1
	894 - 1289	MOTOR, 1HP. MODELS: DM, DMG	1	1				
	894 - 1295	MOTOR, 2HP. MODELS: DM, DMG			1	1	1	1
2	40 - 296	HOUSING, MOUNTING OIL PUMP TO MOTOR.	1	1	1	1	1	1
3	19 - 342	COVER, DRIVE COUPLING ACCESS.	2	2	2	2	2	2
4	819 - 114	COUPLING, DRIVE. MODELS: DL, DLG	1	1	1	1		
	819 - 105	COUPLING, DRIVE. MODELS: DL, DLG					1	1
	819 - 114	COUPLING, DRIVE. MODELS: DM, DMG	1	1				
	819 - 105	COUPLING, DRIVE. MODELS: DM, DMG			1	1	1	1
5	923 - 115	FILTER, AIR.	1	1	1	1	1	1
6	695 - 90	METER & COMPRESSOR ASSEMBLY, OIL-AIR #5-4. MODELS: DL, DLG	1					
	695 - 92	METER & COMPRESSOR ASSEMBLY, OIL-AIR #6-4. MODELS: DL, DLG		1				
	695 - 94	METER & COMPRESSOR ASSEMBLY, OIL-AIR #7-4. MODELS: DL, DLG			1			
	695 - 100	METER & COMPRESSOR ASSEMBLY, OIL-AIR #8-4. MODELS: DL, DLG				1		
	695 - 90	METER & COMPRESSOR ASSEMBLY, OIL-AIR #5-4. MODELS: DM, DMG	1					
	695 - 92	METER & COMPRESSOR ASSEMBLY, OIL-AIR #6-4. MODELS: DM, DMG		1				
12	695 - 64	METER & COMPRESSOR ASSEMBLY, OIL-AIR #5-5. MODELS: DM, DMG			1			
12	695 - 66	METER & COMPRESSOR ASSEMBLY, OIL-AIR #7-5. MODELS: DM, DMG				1		
7	287 - 1	ARM, ASSEMBLY.	1	1	1	1		
8	17 - 143	COIL ASSEMBLY, COOLING.			1	1	1	1
9	8 - 1572	BRACKET, COOLING COIL, MOUNTING.			2			2
	8 - 1260	BRACKET, COOLING COIL, MOUNTING.				2	2	
10	923 - 115	FILTER, AIR.	1	1	1	1	1	1
11	940 - 1169	VALVE, CHECK 1/2' HORIZONTAL.					1	1
12	695 - 101	METER & COMPRESSOR ASSY, OIL-AIR #7-6 E STYLE. MODELS: DL, DLG					1	
	695 - 78	METER & COMPRESSOR ASSY, OIL-AIR #8-6 E STYLE. MODELS: DL, DLG						1
6	695 - 90	METER & COMPRESSOR ASSY, OIL-AIR #7-7 E STYLE. MODELS: DM, DMG					1	
6	695 - 92	METER & COMPRESSOR ASSY, OIL-AIR #6-4 E STYLE. MODELS: DM, DMG						1
13	282 - 13	STOP ASSEMBLY, OVERRIDE, METERING HEAD.	1	1	1	1	1	1
14	476 - 53	LINKAGE ASSEMBLY, LIMITING ARM, 9 HOLES 5/16"	1	1	1	1	1	1
15	940 - 1142	VALVE, OIL SOLENOID 3/8" 2 WAY N.C.	1	1	1	1		
	940 - 1372	VALVE, OIL SOLENOID 1/2" 2 WAY N.C.					1	1
16	940 - 1224	VALVE, RELIEF 1/2" 60 PSI.	1	1	1	1	1	1
17	940 - 1347	VALVE, OIL SOLENOID 3/8" 3 WAY N.C.	1	1	1	1		
	940 - 1348	VALVE, OIL SOLENOID 1/2" 3 WAY N.C.						

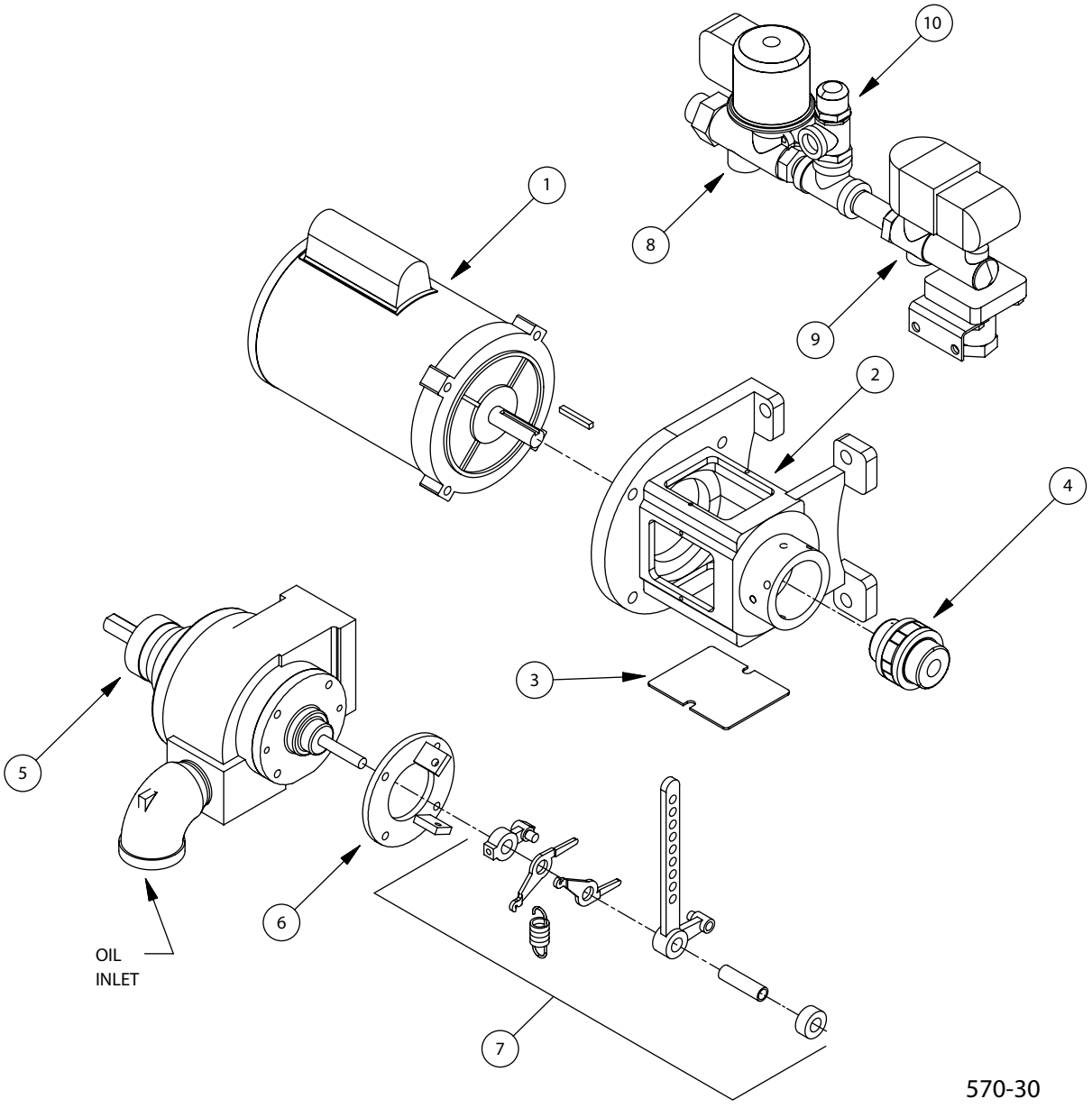


FIGURE 9. OIL METERING ASSEMBLY.
DL, DLG, DM, DMG175 - 420 & DE, DEG42 - 420

570-030

OIL METERING ASSEMBLIES			QUANTITY													
ITEM NO.	PART NUMBER	DESCRIPTION	42	54	63	84	105	145	175	210	252	300	315	336	378	420
1	894 - 934	MOTOR, 1/2 HP.	1	1	1	1	1	1	1							
	894 - 936	MOTOR, 3/4 HP.								1	1	1	1	1	1	1
2	40 - 296	HOUSING, MOUNTING OIL PUMP TO MOTOR	1	1	1	1	1	1	1	1	1	1	1	1	1	1
3	19 - 342	COVER, DRIVE COUPLING ACCESS.	2	2	2	2	2	2	2	2	2	2	2	2	2	2
4	819 - 114	COUPLING, DRIVE 9/16" X 5/8" BORE.	1	1	1	1										
	819 - 105	COUPLING, DRIVE 5/8" X 5/8" BORE.					1	1	1	1	1	1	1	1	1	1
5	695 - 80	METERING HEAD ASSEMBLY, OIL # 30L	1													
	695 - 70	METERING HEAD ASSEMBLY, OIL # 40L		1	1											
	695 - 71	METERING HEAD ASSEMBLY, OIL # 60L				1										
	695 - 81	METERING HEAD ASSEMBLY, OIL # 75L					1									
	695 - 72	METERING HEAD ASSEMBLY, OIL # 100L						1								
	695 - 82	METERING HEAD ASSEMBLY, OIL # 125L							1							
	695 - 73	METERING HEAD ASSEMBLY, OIL # 150L								1						
	695 - 83	METERING HEAD ASSEMBLY, OIL # 180L									1					
	695 - 74	METERING HEAD ASSEMBLY, OIL # 200L										1				
	695 - 75	METERING HEAD ASSEMBLY, OIL # 250L											1	1		
	695 - 112	METERING HEAD ASSEMBLY, OIL # 300L													1	1
6	282 - 13	STOP ASS'Y, OVERIDE, METERING HEAD.	1	1	1	1	1	1	1	1	1	1	1	1	1	1
7	476 - 53	LINKAGE ASS'Y, LIMITING ARM, 9 HOLES 5/16"	1	1	1	1	1	1	1	1	1	1	1	1	1	1
8	940 - 1372	VALVE, OIL SOLENOID 1/2" 2 WAY N.C. DL							1	1	1	1	1	1	1	1
		VALVE, OIL SOLENOID 1/2" 2 WAY N.C. DM							1	1	1	1	1	1	1	1
		VALVE, OIL SOLENOID 1/2" 2 WAY N.C. DE	1	1	1	1	1	1	1	1	1	1	1	1	1	1
9	940 - 1348	VALVE, OIL SOLENOID 1/2" 3 WAY N.C. DL							1	1						
		VALVE, OIL SOLENOID 1/2" 3 WAY N.C. DM							1	1						
		VALVE, OIL SOLENOID 1/2" 3 WAY N.C. DE	1	1	1	1	1	1	1	1						
	940 - 1233	VALVE, OIL MOTORIZED W/POC. DL									1	1	1	1	1	1
		VALVE, OIL MOTORIZED W/POC. DM									1	1	1	1	1	1
		VALVE, OIL MOTORIZED W/POC. DE									1	1	1	1	1	1
10	940 - 1224	VALVE, RELIEF 1/2" 60 PSI.	1	1	1	1	1	1	1	1	1	1	1	1	1	1

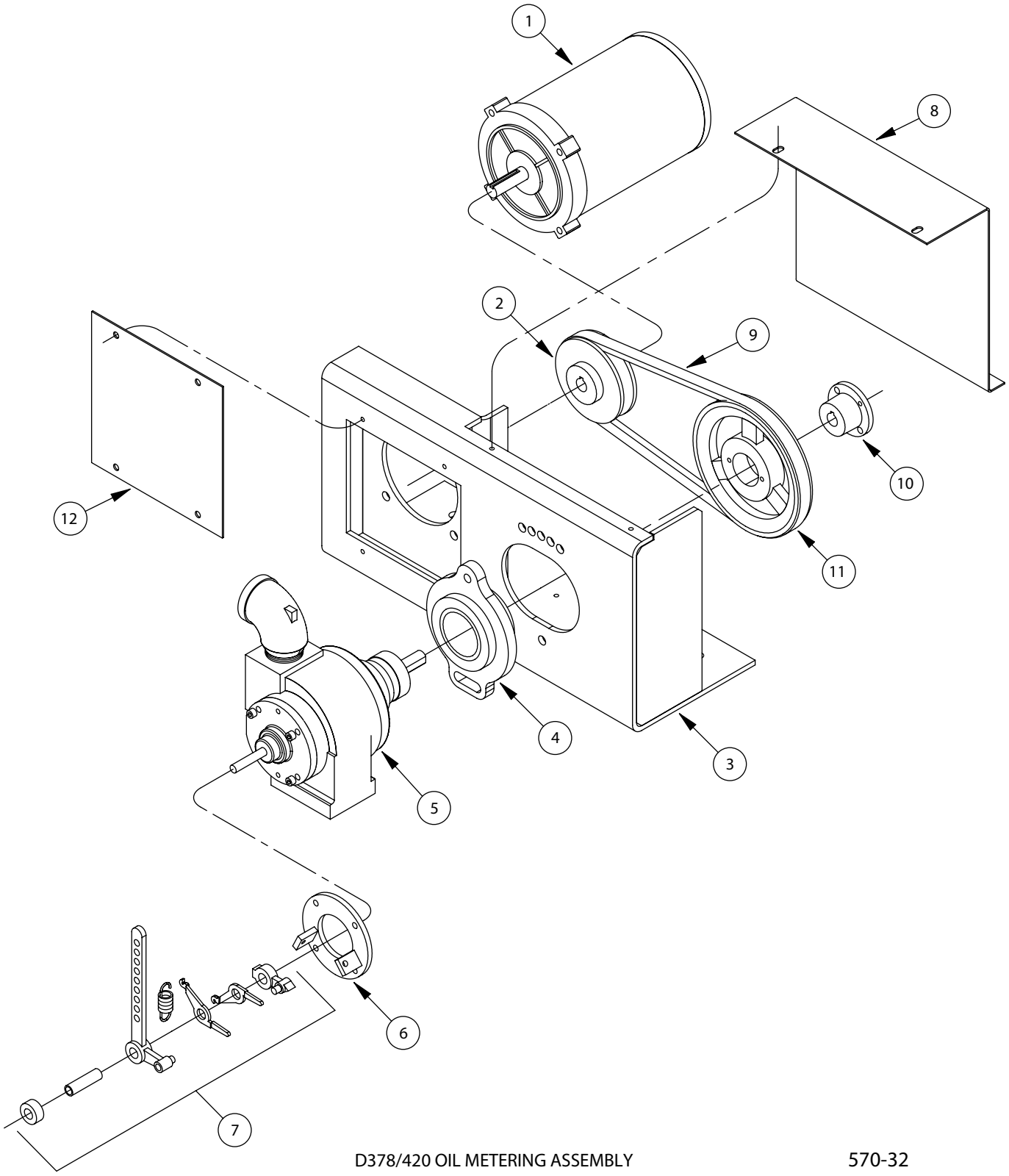


FIGURE 11. OIL METERING ASSEMBLY. D378 - 420

570-032

OIL METERING ASSEMBLY,			QUANTITY	
ITEM NO.	PART NUMBER	DESCRIPTION	378	420
1	894 - 928	MOTOR, 1HP.	1	1
2	921 - 526	SHEAVE, BC38, 5/8" BORE.	1	1
3	8 - 1633	BRACKET, ASSEMBLY, METERING HEAD.	1	1
4	29 - 1149	FLANGE, OIL METERING ADAPTOR.	1	1
5	695 - 112	METERING HEAD ASSEMBLY, OIL #300L	1	1
6	282 - 13	STOP ASSEMBLY, OVERIDE, 'E' STYLE METERING HEAD.	1	1
7	476 - 53	LINKAGE, ASSEMBLY, LIMITING ARM, 9 HOLES 5/16"	1	1
8	35 - 437	GUARD, METERING HEAD AND MOTOR BELT.	1	1
9	809 - 222	BELT, "V".	1	1
10	810 - 71	BUSHING.	1	1
11	921 - 536	SHEAVE, 6-1/2" OD X 6" PD X 1-9/16" I.D.	1	1
12	19 - 531	COVER, MOTOR SHEAVE.	1	1

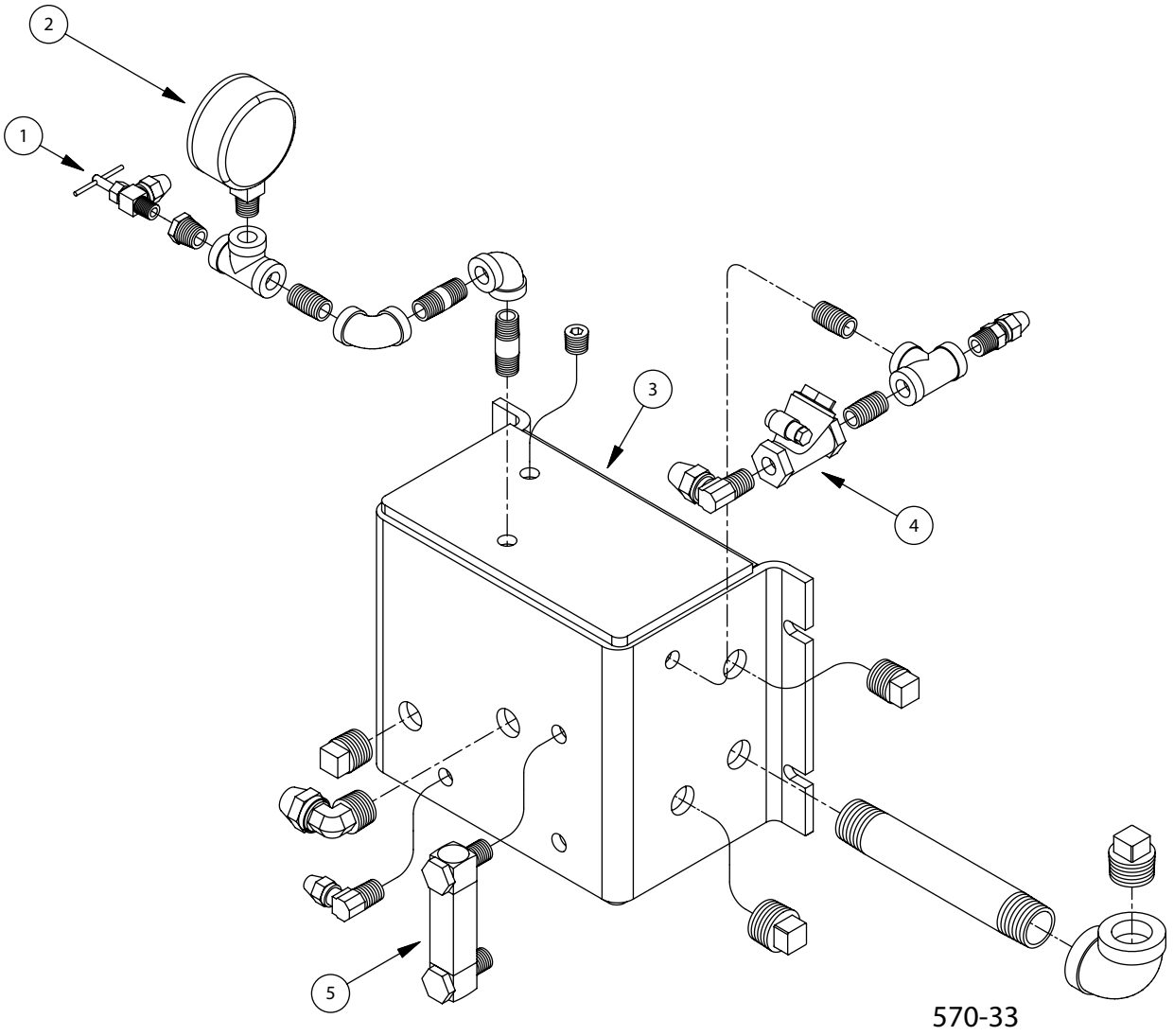


FIGURE 12. OIL AIR TANK. DL, DM42 - 145

570-033

OIL AIR TANK ASSEMBLIES			QUANTITY					
ITEM NO.	PART NUMBER	DESCRIPTION	42	54	63	84	105	145
1	941 - 187	VALVE, NEEDLE, SHUT-OFF.	1	1	1	1	1	1
2	850 - 3	GAUGE, PRESSURE 0 TO 60 PSI.	1	1	1	1	1	1
3	195 - 256	TANK ASSEMBLY, AIR OIL 350 CU. IN.	1	1	1	1	1	1
4	940 - 1200	VALVE, CHECK 1/4" HORIZONTAL.	1	1	1	1	1	1
5	851 - 176	GLASS, SIGHT OIL LEVEL 3" CENTRE.	1	1	1	1	1	1

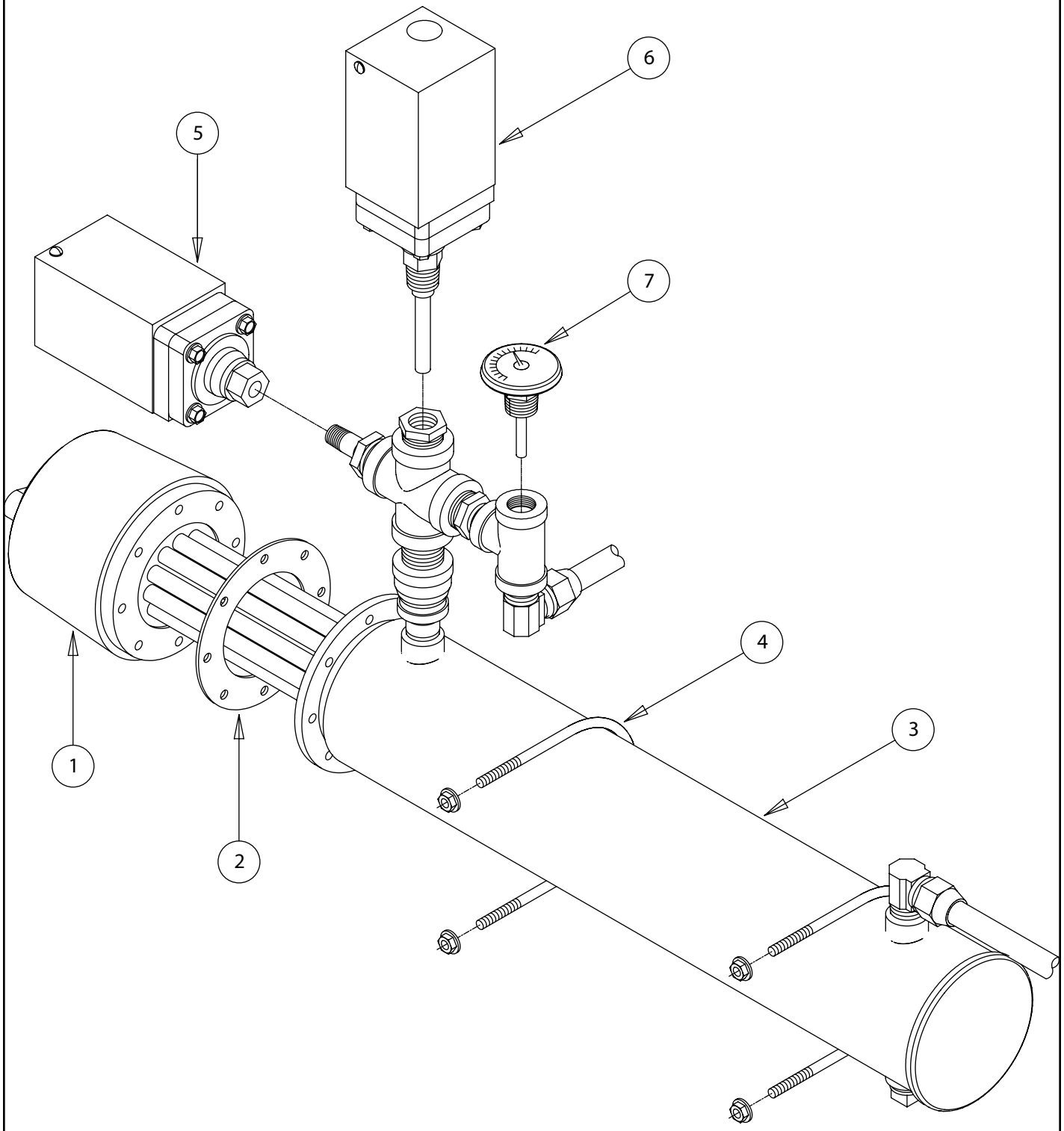


FIGURE 13. OIL HEATER. D42 - 420

HEATER			QUANTITY									
ITEM NO.	PART NUMBER	DESCRIPTION	42	54	63	84	105	145	175	210	252	300
1	832 - 690	HEATER, ELECTRIC, OIL 3KW 230/3/60	1	1	1							
	832 - 689	HEATER, ELECTRIC, OIL 5KW 230/3/60				1	1	1	1			
	832 - 724	HEATER, ELECTRIC, OIL 7KW 230/3/60								1		
	832 - 717	HEATER, ELECTRIC, OIL 10KW 230/3/60									1	
	832 - 718	HEATER, ELECTRIC, OIL 10KW 440/3/60										1
2	77 - 200	SPACER, AUXILIARY HEATER SHIM.	1	1	1	1	1	1	1			
3	257 - 70	MANIFOLD ASSEMBLY, 3 KW & 5 KW HEATERS.	1	1	1	1	1	1	1			
	257 - 72	MANIFOLD ASSEMBLY, 7 KW & 10 KW HEATERS.								1	1	1
4	7 - 144	U-BOLT, 3-1/2" I.D. X 5" LEGS, THREADED 1/4-20	2	2	2	2	2	2	2			
	7 - 144	U-BOLT, 4" I.D. X 6" LEGS, THREADED 1/4-20								2	2	2
5	817 - 829	SWITCH, AIR-OIL PRESSURE 4-12 PSI.	1	1	1	1	1	1	1	1	1	1
6	817 - 620	SWITCH, HIGH OIL TEMPERATURE 160-260 DEG.	1	1	1	1	1	1	1	1	1	1
7	937 - 163	GAUGE, TEMPERATURE 50-300 DEG. 1/2" NPT.	1	1	1	1	1	1	1	1	1	1

ITEM NO.	PART NUMBER	DESCRIPTION	QUANTITY			
			315	336	378	420
1	832 - 718	HEATER, ELECTRIC, OIL 10KW 440/3/60	1	1	1	1
3	257 - 72	MANIFOLD ASSEMBLY, 7 KW & 10 KW HEATERS.	1	1	1	1
4	7 - 144	U-BOLT, 4" I.D. X 6" LEGS, THREADED 1/4-20	2	2	2	2
5	817 - 829	SWITCH, AIR-OIL PRESSURE 4-12 PSI.	1	1	1	1
6	817- 620	SWITCH, HIGH OIL TEMPERATURE 160-260 DEG.	1	1	1	1
7	937- 163	GAUGE, TEMPERATURE 50-300 DEG. 1/2" NPT.	1	1	1	1

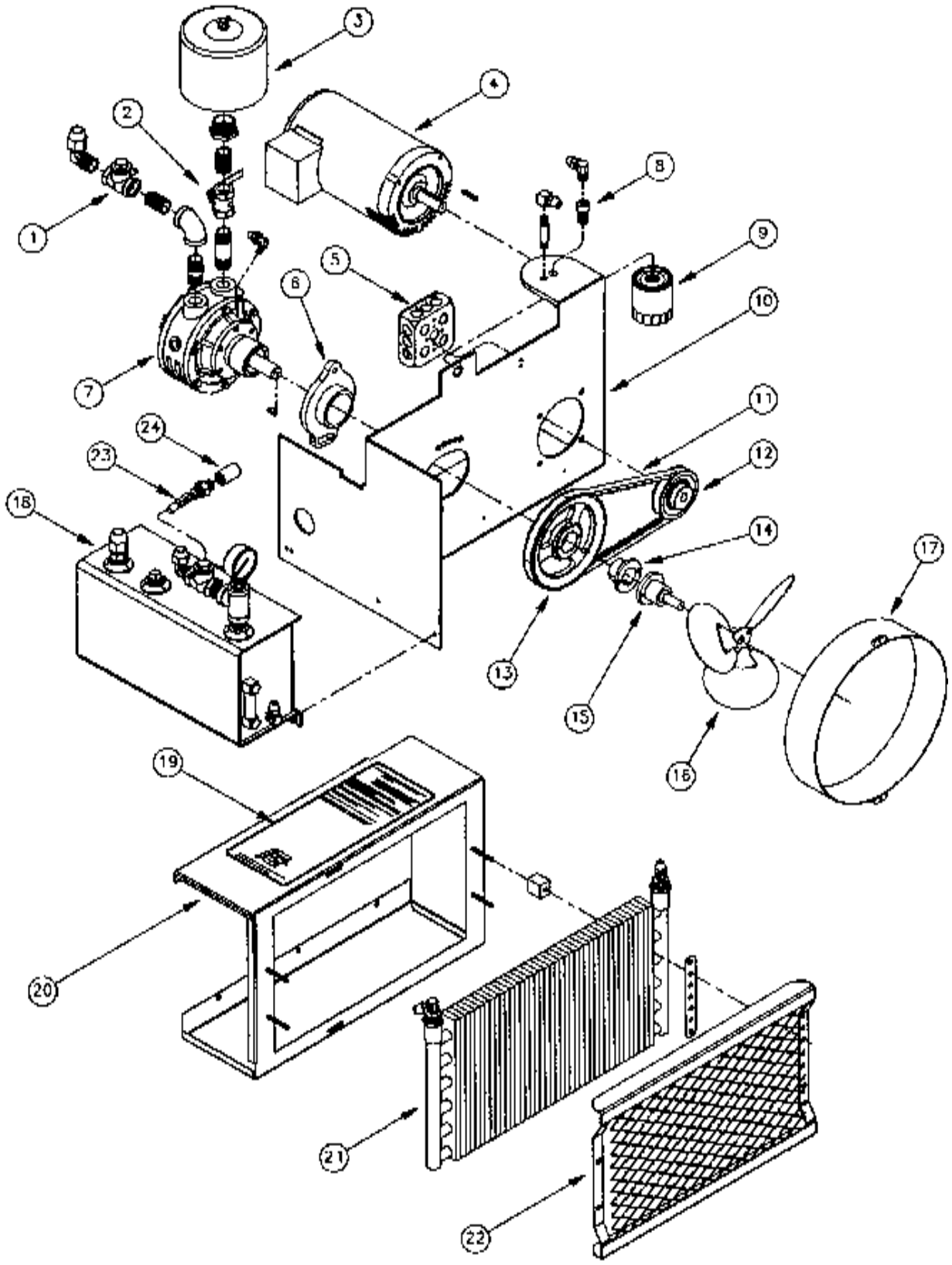


FIGURE 14. COMPRESSOR SET. D42 -145

570-034

SEPARATE COMPRESSOR MODULES			QUANTITY					
ITEM NO.	PART NUMBER	DESCRIPTION	42	54	63	84	105	145
1	940 - 1205	VALVE, CHECK 3/4" HORIZONTAL.	1	1	1	1	1	1
2	941 - 562	VALVE, SHUT-OFF 3/4" NPT (BUTTERBALL).	1	1	1	1		
	941 - 584	VALVE, SHUT-OFF 1-1/4" NPT (BUTTERBALL).					1	1
3	923 - 112	FILTER, AIR.	1	1	1	1	1	1
4	894 - 1291	MOTOR, 3 HP.	1	1	1	1	1	
	894 - 1302	MOTOR, 5 HP.						1
5	848 - 499	BOX, ELECTRICAL W/COVER.	1	1	1	1	1	1
6	29 - 841	FLANGE, COMPRESSOR MOUNTING.	1	1	1	1	1	1
7	505 - 169	COMPRESSOR ASSEMBLY, AIR 2" SINGLE SHAFT.	1	1	1	1		
	505 - 152	COMPRESSOR ASSEMBLY, AIR 2-3/4" SINGLE SHAFT.					1	1
8	10 - 315	BUSHING, OIL FILTER.	1	1	1	1	1	1
9	843 - 106	FILTER, OIL.	1	1	1	1	1	1
10	3 - 361	BASE ASSEMBLY, COMPRESSOR SET.	1	1	1	1	1	1
11	809 - 220	BELT, "V".	1	1	1	1	1	1
12	921 - 526	SHEAVE, 3.45" P.D. X 5/8" BORE 1B GROOVE.	1	1	1	1		
	921 - 525	SHEAVE, 2.9" P.D. X 5/8" BORE 1B GROOVE.					1	
	921 - 527	SHEAVE, 3.15" P.D. X 7/8" BORE 1B GROOVE.						1
13	921 - 524	SHEAVE, 7.1" P.D. X 1-9/16" I.D.	1	1	1	1	1	1
14	810 - 70	BUSHING, SPLIT TAPER 1" BORE X 1-9/16" DIA.	1	1	1	1	1	1
15	74 - 516	SHAFT, COOLING FAN, MOUNTING.	1	1	1	1	1	1
16	951 - 174	FAN, 3 BLADE 12" DIA 5/8" BORE.	1	1	1	1	1	1
17	39 - 446	SHROUD, ASSEMBLY, COOLING FAN.	1	1	1	1	1	1
18	195 - 256	TANK ASSEMBLY, OIL/ AIR 350 CU. IN.	1	1	1	1	1	1
19	118 - 747	NAMEPLATE.	1	1	1	1	1	1
20	39 - 443	SHROUD ASSEMBLY, FAN ENCLOSURE.	1	1	1	1	1	1
21	17 - 193	COIL, LUBE OIL COOLING.	1	1	1	1	1	1
22	35 - 413	GUARD ASSEMBLY, RADIATOR.	1	1	1	1	1	1
23	832 - 925	SENSOR, OIL, LOW LUBE (OPTIONAL).	1	1	1	1	1	1

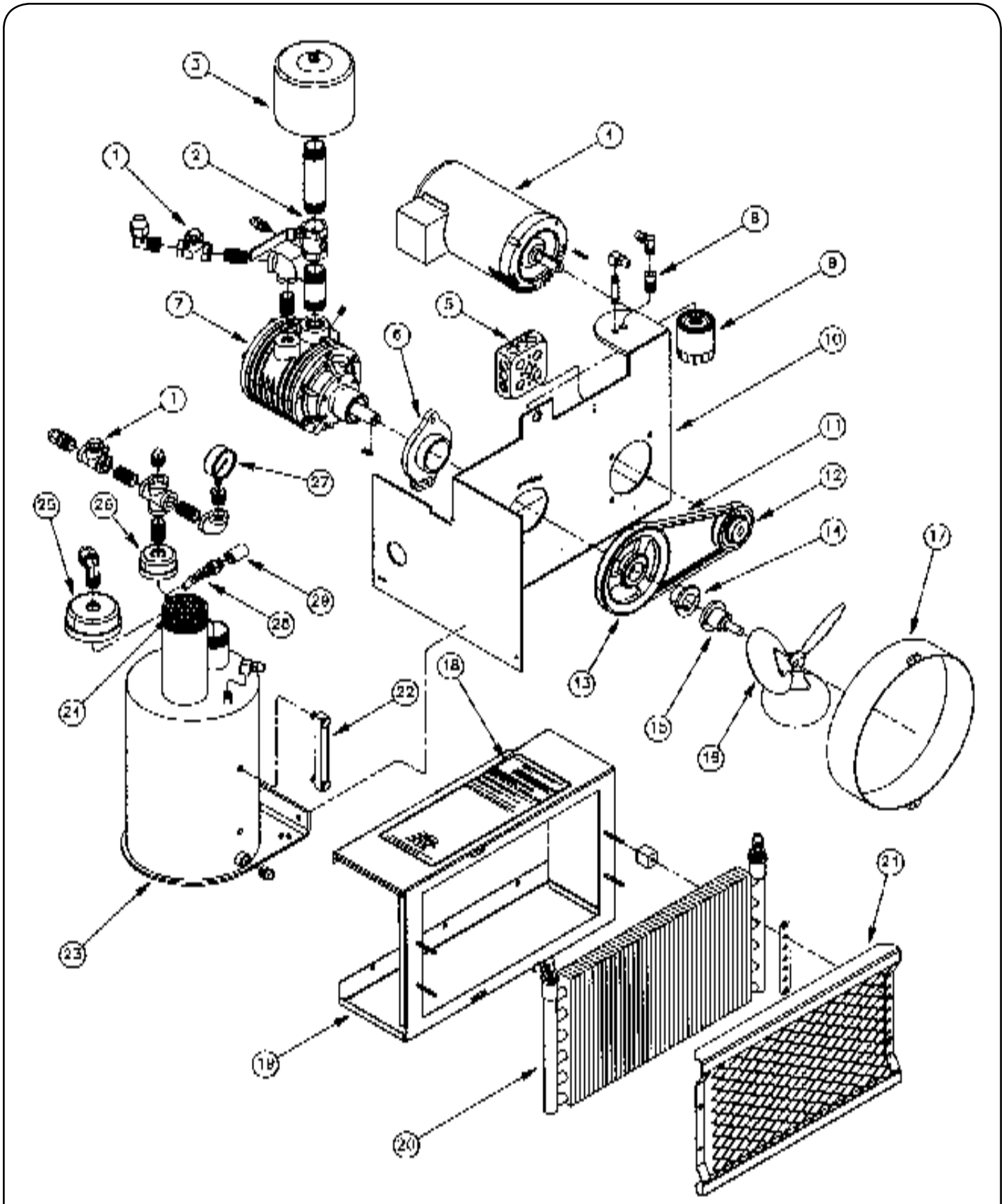


FIGURE 15. COMPRESSOR SET. D175 - 336

570-035

SEPARATE COMPRESSOR MODULES					QUANTITY					
ITEM NO.	PART NUMBER	DESCRIPTION			175	210	252	300	315	336
1	940 - 1205	VALVE, CHECK 3/4" HORIZONTAL.			2	2	2	2		
2	941 - 584	VALVE, SHUT-OFF 1-1/4" NPT (BUTTERBALL).	1	1	1	1	1	1		
3	923 - 112	FILTER, AIR.	1	1	1	1	1	1		
4	894 - 1302	MOTOR, 5 HP.	1	1						
	894 - 1309	MOTOR, 7.5 HP.			1	1	1	1		
5	848 - 499	BOX, ELECTRICAL W/COVER 4"X4"	1	1	1	1	1	1		
6	29 - 841	FLANGE, COMPRESSOR MOUNTING.	1	1	1	1	1	1		
7	505 - 153	COMPRESSOR ASSEMBLY, AIR 5" SINGLE SHAFT.	1	1	1	1	1	1		
8	10 - 315	BUSHING, OIL FILTER.	1	1	1	1	1	1		
9	843 - 106	FILTER, OIL.			1	1	1	1	1	1
10	3 - 361	BASE, ASSEMBLY, COMPRESSOR SET.			1	1	1	1	1	1
11	809 - 220	BELT, "V" BX38			1	1	1	1	1	1
12	921 - 527	SHEAVE, 3.5" P.D. X 7/8" BORE 1B GROOVE.			1	1				
	921 - 528	SHEAVE, 3.85" P.D. X 7/8" BORE 1B GROOVE.			1	1	1	1		
13	921 - 524	SHEAVE, 7.1" P.D. X 1-9/16" DIA.			1	1	1	1		
14	810 - 70	BUSHING, SPLIT TAPER 1" BORE X 1-9/16" DIA.			1	1	1	1		
15	74 - 516	SHAFT, COOLING FAN, MOUNTING.			1	1	1	1	1	1
16	951 - 174	FAN, 3 WING 12" DIA.			1	1	1	1	1	1
17	39 - 446	SHROUD, ASSEMBLY, COOLING FAN.			1	1	1	1	1	1
18	118 - 749	NAMEPLATE.			1	1	1	1	1	1
19	39 - 446	SHROUD ASSEMBLY, FAN ENCLOSURE.			1	1	1	1		
20	17 - 193	COIL, LUBE OIL COOLING.			1	1	1	1		
21	35 - 413	GUARD ASSEMBLY, RADIATOR.			1	1	1	1		
22	851 - 180	GLASS, SIGHT, OIL LEVEL 6" CENTRES			1	1	1	1		
23	195 - 261	TANK ASSEMBLY, OIL/AIR 1175 CU. IN.			1	1	1	1	1	1
24	843 - 97	FILTER, WIRE MESH 2" DIA.			1	1	1	1	1	1
25	13 - 186	CAP, STRAINER.			1	1	1	1		
26	13 - 167	CAP, AIR OUTLET.			1	1	1	1	1	1
27	850 - 3	GAUGE, PRESSURE 0-60 PSI. 2.5" DIAL 1/4 NPT.			1	1	1	1	1	1
28	832 - 925	SENSOR, OIL, LOW LUBE (OPTIONAL).			1	1	1	1	1	1

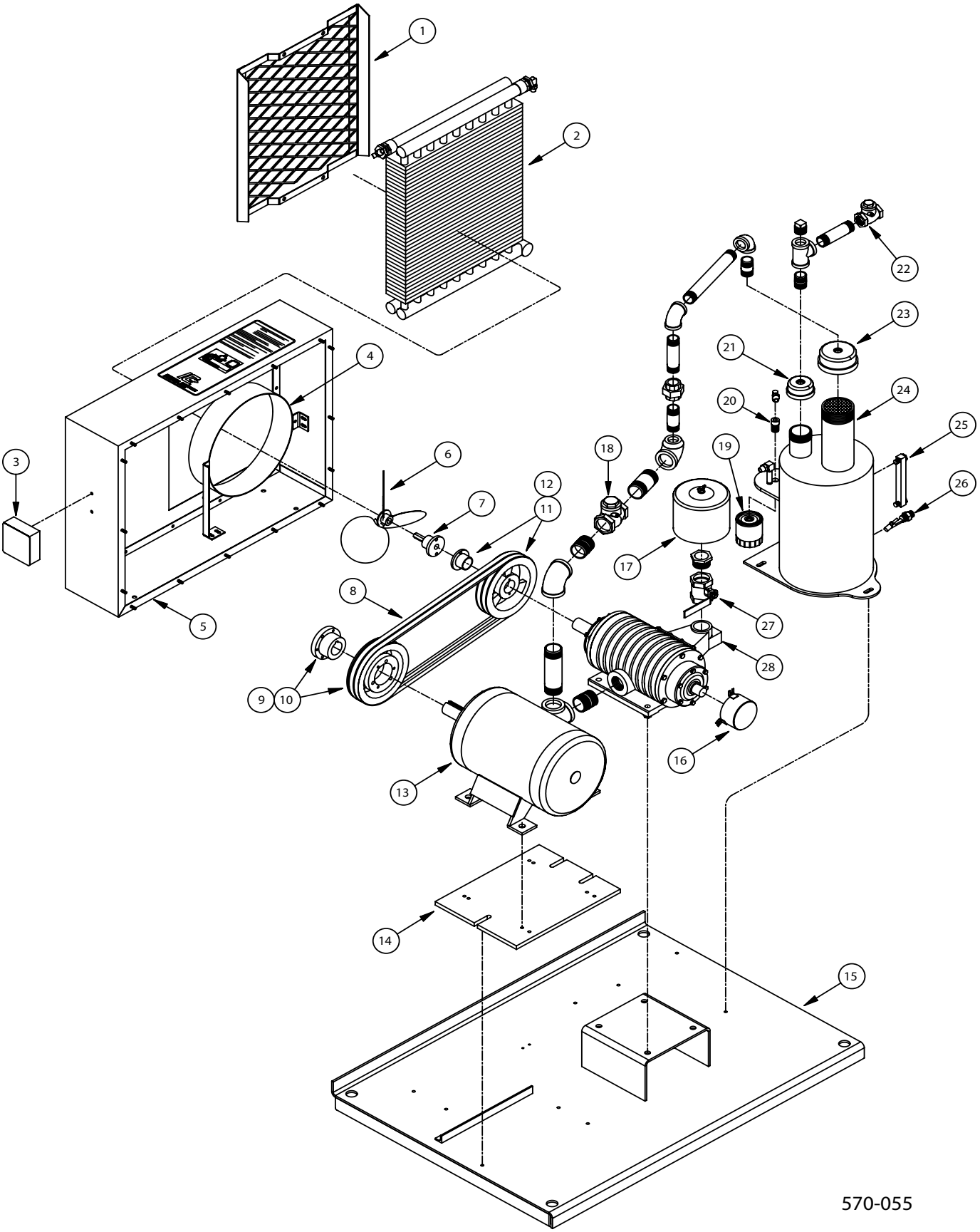


FIGURE 16. COMPRESSOR SET. D378 - 420

COMPRESSOR SET ASSEMBLIES			QUANTITY	
ITEM NO.	PART NUMBER	DESCRIPTION	378	420
1	35-440	RADIATOR GUARD ASSEMBLY	1	1
2	17-234	RADIATOR ASSEMBLY	1	1
3		848-514 ELECTRICAL		
JUNCTION BOX		1	1	
4	39-446	AIR FLOW DUCT ASSEMBLY	1	1
5	35-439	BELT GUARD WELDMENT	1	1
6		951-174 FAN BLADE1		
1	7	74-516 FAN MOUNTING		
SHAFT	11	8 809-223 V-BELT 1		
1	9	810-73 BUSHING 1		
1	10	921-538 SHEAVE 1		
1	11	810-72 BUSHING 1		
1	12	921-537 SHEAVE 1		
1	13	894-1380 MOTOR, 15 HP, 3		
PH 208 VOLT1		1		
	894-1381	MOTOR, 15 HP, 3 PH 230/460 VOLT	1	1
14	59-1284	MOTOR MOUNTING BASE	1	1
15	3-377	COMPRESSOR BASE	1	1
16	35-438	COMPRESSOR SHAFT END GUARD	1	1
17			923-112	
AIR FILTER1 1			18	
940-12	811-1/2" NPT	HORIZONTAL CHECK VALVE	1	1
19	843-106	OIL FILTER	1	1
20	10-315	OIL FILTER MOUNTING BUSHING	1	1
21	13-167	CAP, AIR OUTLET	1	1
22	940-1279	1" NPT HORIZONTAL CHECK VALVE	1	1
23	13-186	CAP, STRAINER	1	1
24	195-261	OIL/AIR TANK ASSEMBLY	1	1
25	851-180	SIGHT GAUGE	1	1

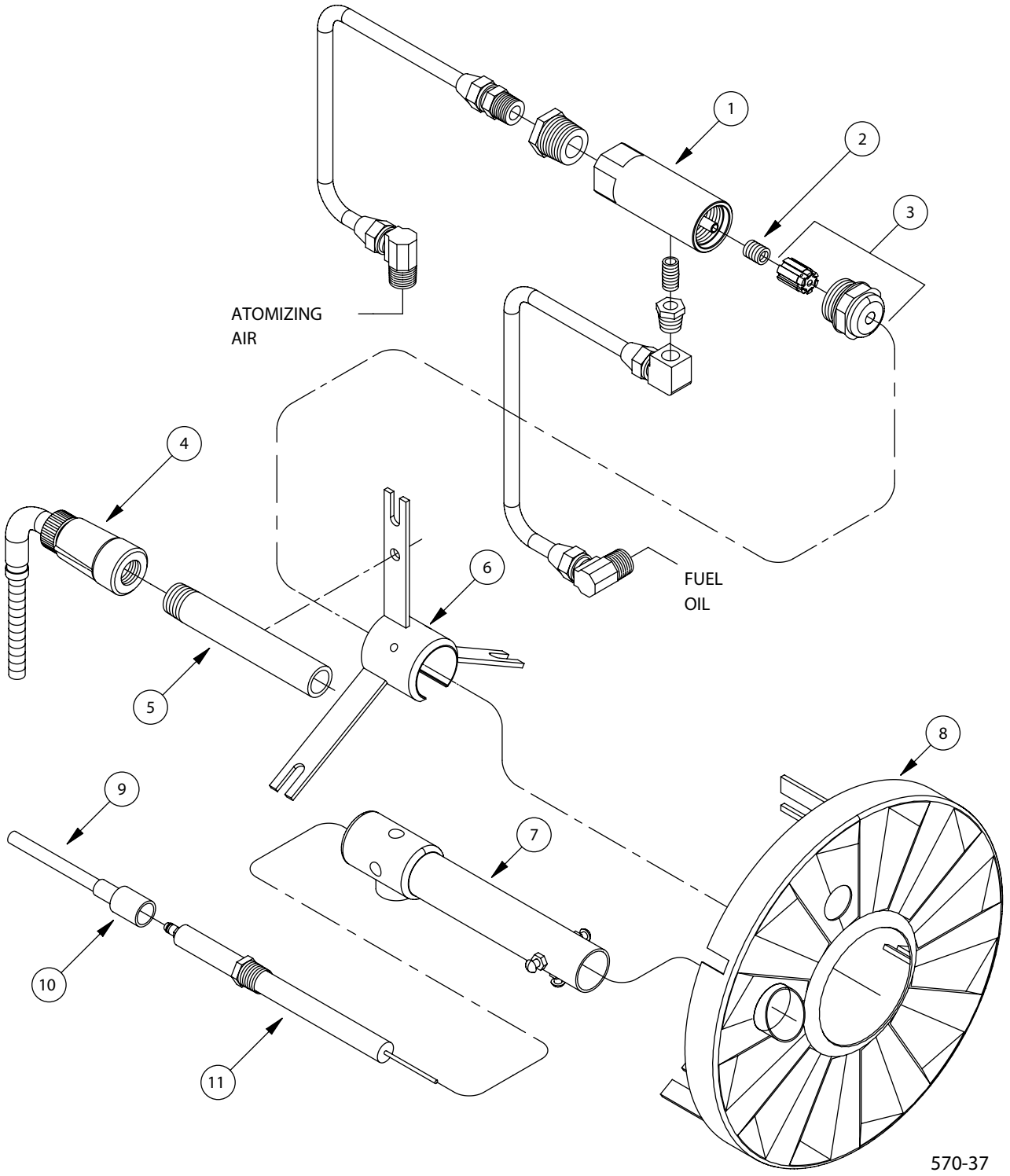


FIGURE 17. DRAWER ASSEMBLY. D42 - 63

570-037

DRAWER ASSEMBLIES			QUANTITY		
ITEM NO.	PART NUMBER	DESCRIPTION	42	54	63
1	277 - 139	NOZZLE BODY ASS'Y, 22 MM X 1.5 MM. NOZZLE THDS. ALL MODELS EXCEPT DE, DEG	1	1	1
	277 - 105	NOZZLE BODY ASS'Y, 1-1/8"-16 NOZZLE THDS. MODELS: DE, DEG	1	1	1
2	82 - 33	SPRING, NOZZLE COMPRESSION .5" FL X 5/16" I.D. X .072". ALL MODELS EXCEPT DE, DEG	1	1	1
	82 - 129	SPRING, NOZZLE COMPRESSION .6" FL X 5/16" I.D. X .082". MODELS DE, DEG	1	1	1
3	528 - 9	NOZZLE ASSEMBLY. MODELS: DL, DLG	1	1	
	528 - 13	NOZZLE ASSEMBLY. MODELS: DL, DLG			1
	528 - 9	NOZZLE ASSEMBLY. MODELS: DG, DM, DMG	1		
	528 - 13	NOZZLE ASSEMBLY. MODELS: DG, DM, DMG		1	
	528 - 29	NOZZLE ASSEMBLY. MODELS: DG, DM, DMG			1
	528 - 47	NOZZLE ASSEMBLY: MODELS: DE, DEG	1	1	1
4	817 -	VARIES.	1	1	1
5	90 - 228	TUBE, SCANNER, SIGHT 8"	1	1	1
6	8 - 1152	BRACKET ASSEMBLY, NOZZLE SUPPORT.	1	1	1
7	48 - 140	GAS PILOT ASSEMBLY.	1	1	1
8	275 - 243	DIFFUSER ASSEMBLY, AIR, STANDARD. MODELS: DL, DLG	1		
	275 - 244	DIFFUSER ASSEMBLY, AIR, STANDARD. MODELS: DL, DLG		1	1
	275 - 243	DIFFUSER ASSEMBLY, AIR, STANDARD. MODELS: DG, DM, DMG	1		
	275 - 244	DIFFUSER ASSEMBLY, AIR, STANDARD. MODELS: DG, DM, DMG		1	1
	275 - 244	DIFFUSER ASSEMBLY, AIR, STANDARD. MODELS: DE, DEG	1	1	1
9	826 - 40	AS REQUIRED.	1	1	1
10	848 - 166	CONNECTOR, IGNITION CABLE, STRAIGHT.	1	1	1
11	873 - 93	ELECTRODE ASSEMBLY, IGNITION WITH BUSHING.	1	1	1

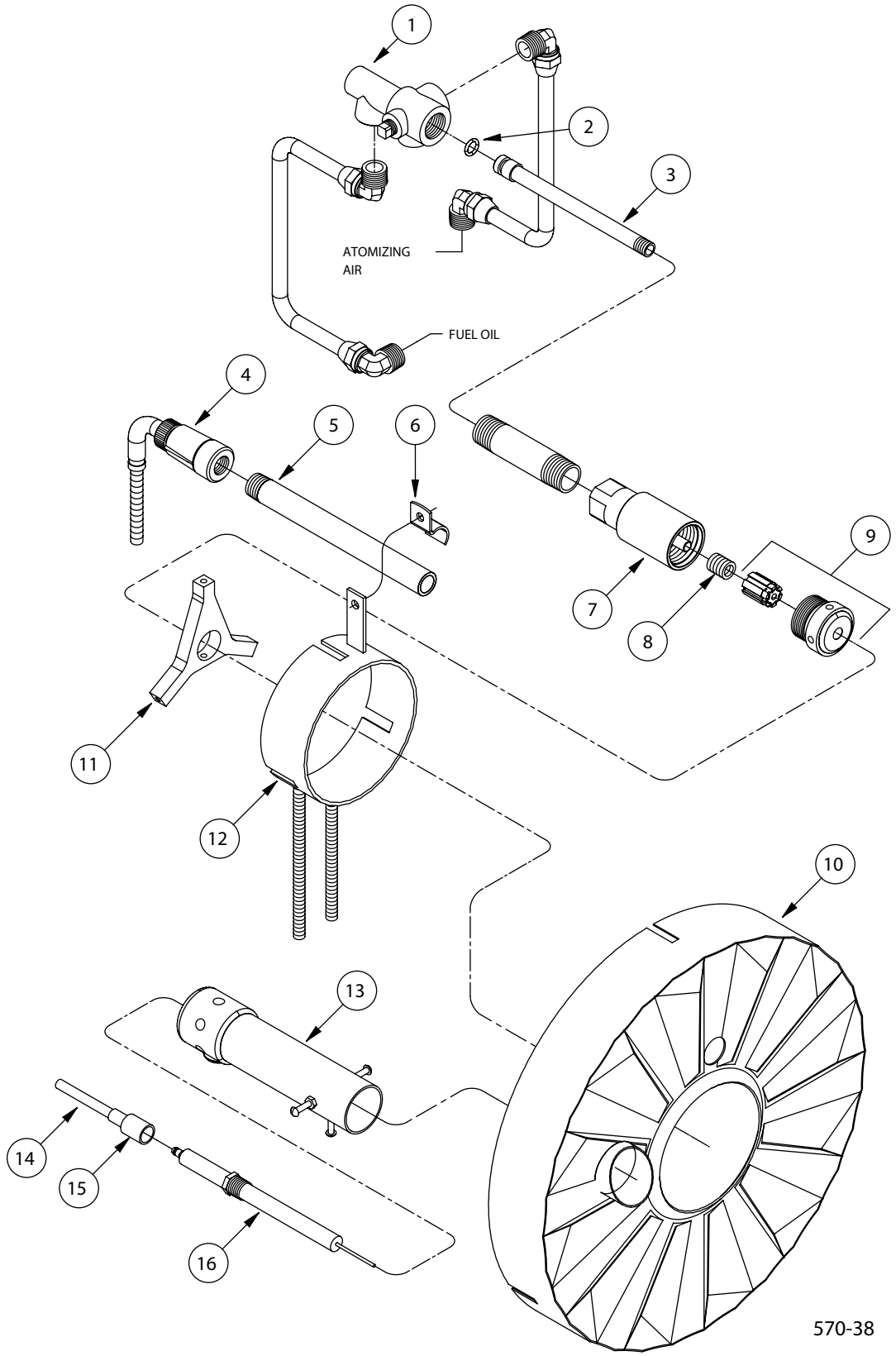


FIGURE 18. DRAWER ASSEMBLY. D84 -145

570-038

DRAWER ASSEMBLIES			QUANTITY		
ITEM NO.	PART NUMBER	DESCRIPTION	84	105	145
1	106 - 101	BLOCK, OIL AIR INLET MANIFOLD.			1
2	853 - 613	O-RING, 5/8' OD X 7/16" ID X 3/32 THK.			1
3	90 - 241	TUBE ASSEMBLY, OIL NOZZLE DELIVER.		1	1
4	817 -	VARIES.	1	1	1
5	90 - 338	TUBE, SCANNER, SIGHT 9"	1	1	1
6	928 - 44	CLAMP, CONDUIT 1/2"	1	1	1
7	277 - 139	NOZZLE BODY ASS'Y, 22 MM X 1.5 MM NOZZLE THDS. MODELS: DL, DLG	1		
	277 - 105	NOZZLE BODY ASS'Y, 1-1/8" X 16 NOZZLE THDS. MODELS: DL, DLG		1	1
	277 - 139	NOZZLE BODY ASS'Y, 22 MM X 1.5 MM NOZZLE THDS. MODELS: DG, DM, DMG	1		
	277 - 105	NOZZLE BODY ASS'Y, 1-1/8" X 16 NOZZLE THDS. MODELS: DG, DM, DMG		1	1
	277 - 105	NOZZLE BODY ASS'Y, 1-1/8" X 16 NOZZLE THDS. MODELS: DG, DM, DMG	1	1	
	277 - 106	NOZZLE BODY ASS'Y, 1 1/2" X 12 NOZZLE THDS. MODELS: DE, DEG			1
8	82 - 33	SPRING, NOZZLE COMPRESSION .5" FL X .312" I.D. X .072". ALL MODELS EXCEPT DE, DEG	1		
	82 - 129	SPRING, NOZZLE COMPRESSION .6" FL X .312" I.D. X .082". MODELS DE, DEG	1		
	82 - 129	SPRING, NOZZLE COMPRESSION .6" FL X .312" I.D. X .082". ALL MODELS		1	
	82 - 129	SPRING, NOZZLE COMPRESSION .6" FL X .312" I.D. X .082". ALL MODELS EXCEPT DE, DEG			1
	82 - 128	SPRING, NOZZLE COMPRESSION .732" FL X .405" I.D. X .092". MODELS DE, DEG			1
9	528 - 13	NOZZLE ASSEMBLY. MODELS: DL, DLG	1		
	528 - 36	NOZZLE ASSEMBLY. MODELS: DL, DLG		1	
	528 - 34	NOZZLE ASSEMBLY. MODELS: DL, DLG			1
	528 - 32	NOZZLE ASSEMBLY. MODELS: DG, DM, DMG	1		
	528 - 36	NOZZLE ASSEMBLY. MODELS: DG, DM, DMG		1	
	528 - 34	NOZZLE ASSEMBLY. MODELS: DG, DM, DMG			1
	528 - 31	NOZZLE ASSEMBLY. MODELS: DE, DEG	1		
	528 - 24	NOZZLE ASSEMBLY. MODELS; DE, DEG		1	
	528 - 25	NOZZLE ASSEMBLY. MODELS: DE, DEG			1
10	275 - 234	DIFFUSER, ASSEMBLY, AIR. MODELS: DL, DLG	1		
	275 - 225	DIFFUSER, ASSEMBLY, AIR. MODELS: DL, DLG		1	
	275 - 167	DIFFUSER, ASSEMBLY, AIR, STANDARD. MODELS: DL, DLG			1
	275 - 234	DIFFUSER, ASSEMBLY, AIR, STANDARD. MODELS: DG, DM, DMG	1		
	275 - 225	DIFFUSER, ASSEMBLY, AIR, STANDARD. MODELS: DG, DM, DMG		1	
	275 - 167	DIFFUSER, ASSEMBLY, AIR, STANDARD. MODELS: DG, DM, DMG			1
	275 - 237	DIFFUSER, ASSEMBLY, AIR, STANDARD. MODELS: DE, DEG	1	1	
	275 - 167	DIFFUSER, ASSEMBLY, AIR, STANDARD. MODELS: DE, DEG			1
11	8 - 1042	BRACKET, NOZZLE SUPPORT.	1	1	1
	8 - 1095	BRACKET, NOZZLE SUPPORT.			1
12	8 - 1026	BRACKET ASSEMBLY, DRAWER SUPPORT.	1	1	
	8 - 1041	BRACKET ASSEMBLY, DRAWER SUPPORT.			1
13	48 - 141	GAS PILOT ASSEMBLY.	1	1	1
14	826 - 40	AS REQUIRED.	1	1	1
15	848 - 166	CONNECTOR, IGNITION CABLE, STRAIGHT.	1	1	1
16	873 - 93	ELECTRODE ASSEMBLY, IGNITION W/BUSHING.	1	1	1

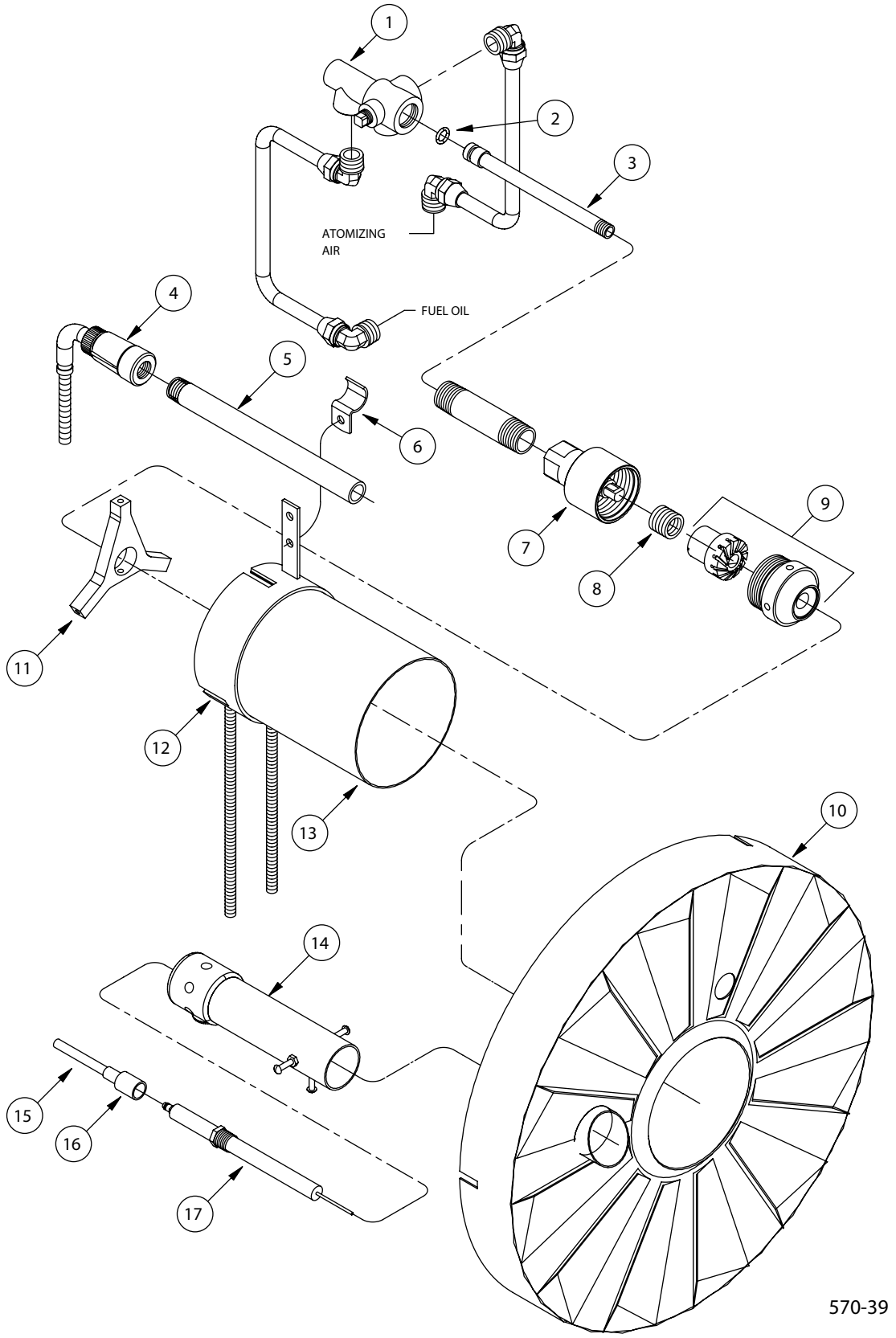


FIGURE 19. DRAWER ASSEMBLY. D175 - 336

570-039

DRAWER ASSEMBLIES			QUANTITY					
ITEM NO.	PART NUMBER	DESCRIPTION	175	210	252	300	315	336
1	106-101	BLOCK, OIL AIR INLET MANIFOLD.	1	1	1	1	1	1
2	853-613	O-RING, 5/8" O.D. X 7/16" I.D. X 3/32 THK.	1	1	1	1	1	1
3	90-241	TUBE ASSEMBLY, OIL NOZZLE DELIVER	1	1	1	1	1	1
4	817-	VARIES.	1	1	1	1	1	1
5	90-339	TUBE, SCANNER SIGHT 9"	1	1	1	1	1	1
6	928-44	CLAMP, CONDUIT 1/2"	1	1	1	1	1	1
7	277-107	NOZZLE BODY ASSEMBLY, 2"-12 NOZZLE BODY THDS. ALL MODELS.	1	1	1	1	1	1
8	82-121	SPRING, NOZZLE COMPRESSION 49/64" F.L. X .7" I.D. X .1". ALL MODELS.	1	1	1	1	1	1
9	528-26	NOZZLE ASSEMBLY. ALL MODELS.	1	1	1			
	528-30	NOZZLE ASSEMBLY. ALL MODELS.				1	1	1
10	275-190	DIFFUSER ASSEMBLY, AIR, STANDARD. ALL MODELS.	1					
	275-189	DIFFUSER ASSEMBLY, AIR, STANDARD. ALL MODELS.		1				
	275-169	DIFFUSER ASSEMBLY, AIR, STANDARD. ALL MODELS.			1			
	275-188	DIFFUSER ASSEMBLY, AIR, STANDARD. ALL MODELS.				1	1	
	275-446	DIFFUSER ASSEMBLY, AIR, STANDARD. ALL MODELS.						
		1 11 8-1095 BRACKET, NOZZLE SUPPORT.						
	1 1	1 1 1 1 12 8-1622 BRACKET ASSEMBLY, DRAWER SUPPORT.						
		1 1 1 1 1 1 13 76-109 SLEEVE, INNER FOR DRAWER ASSEMBLY.						
		1 1 1 1 1 1						
14	48-141	GAS PILOT ASSEMBLY.	1	1	1	1	1	1
15	826-40	AS REQUIRED.	1	1	1	1	1	1
16	848-166	CONNECTOR,IGNITION CABLE, STRAIGHT.	1	1	1	1	1	1
17	873-93	ELECTRODE ASSEMBLY, IGNITION W/BUSHING.	1	1	1	1	1	1

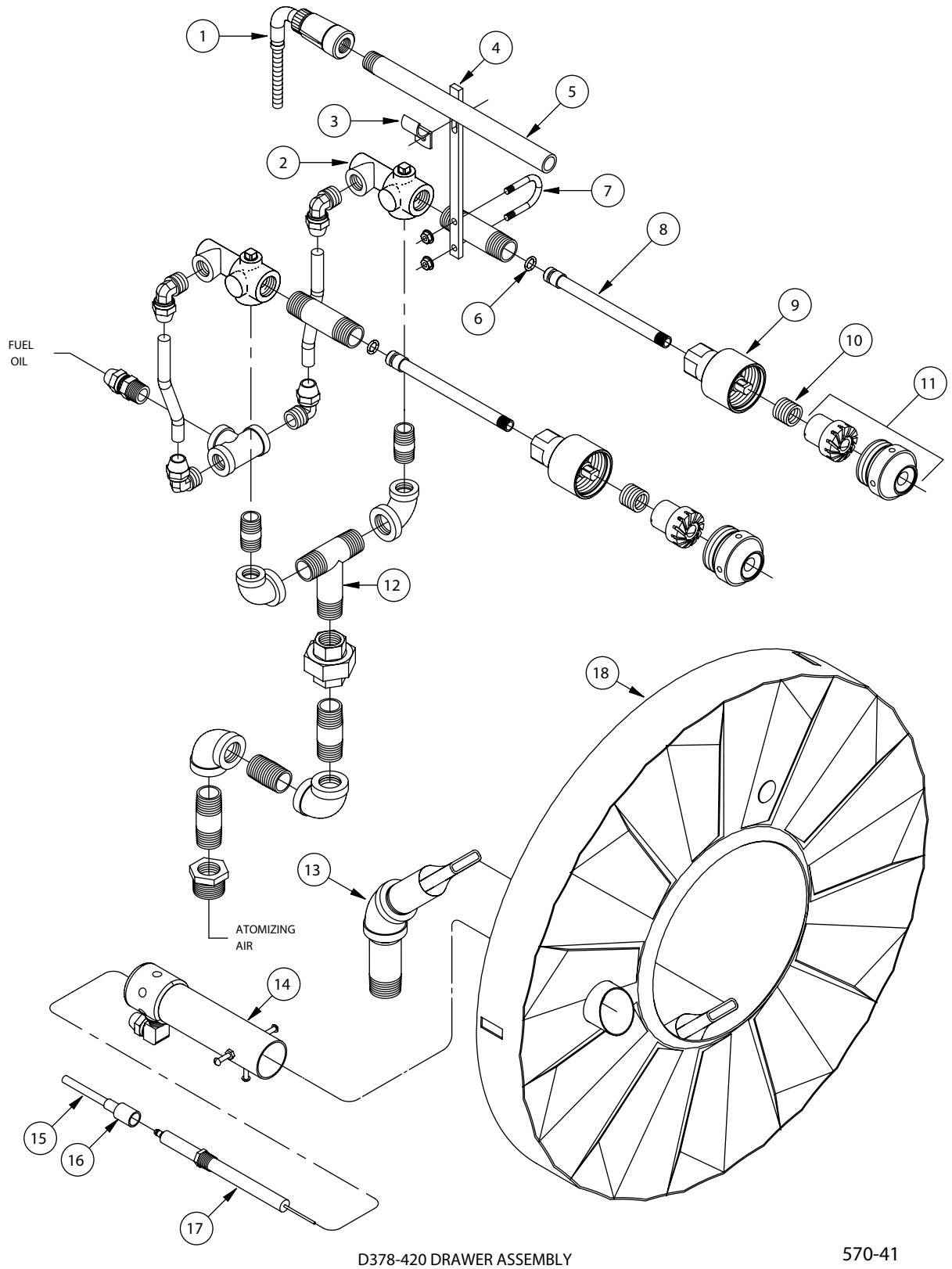


FIGURE 21. DRAWER ASSEMBLY. D378 - 420

570-041

DRAWER ASSEMBLY,			QUANTITY	
ITEM NO.	PART NUMBER	DESCRIPTION	378	420
1	817 -	VARIES.	1	1
2	106 - 101	BLOCK, OIL AIR INLET MANIFOLD.	2	2
3	928 - 80	CLAMP, CONDUIT 3/4"	1	1
4	8 - 1627	BRACKET, SCANNER MOUNT.	1	1
5	90 - 338	TUBE, SCANNER, SIGHT 9"	1	1
6	853 - 613	O-RING, 5/8" OD X 7/16" I.D. X 3/32" THK.	2	2
7	7 - 196	U- BOLT, 3/4" PIPE THD. 1/4-20	1	1
8	90 - 559	TUBE ASSEMBLY, OIL NOZZLE DELIVER.	2	2
9	277 - 107	NOZZLE BODY ASSEMBLY, 2"-12 NOZZLE THDS. ALL MODELS.	1	1
10	82 - 121	SPRING, NOZZLE COMPRESSION 49/64" F.L. X .7" I.D. X .1"	2	2
11	528 - 49	NOZZLE ASSEMBLY. ALL MODELS.	1	1
12	85 - 894	NOZZLE, SUPPORT ASSEMBLY.	1	1
13	42 - 79	SPUD, SECONDARY.	1	1
14	48 - 141	GAS PILOT ASSEMBLY.	1	1
15	826 - 40	AS REQUIRED.	1	1
16	848 - 166	CONNECTOR, IGNITION CABLE, STRAIGHT.	1	1
17	873 - 93	ELECTRODE ASSEMBLY, IGNITION W/BUSHING.	1	1
18	275 - 439	DIFFUSER ASSEMBLY, AIR, STANDARD. ALL MODELS.	1	1

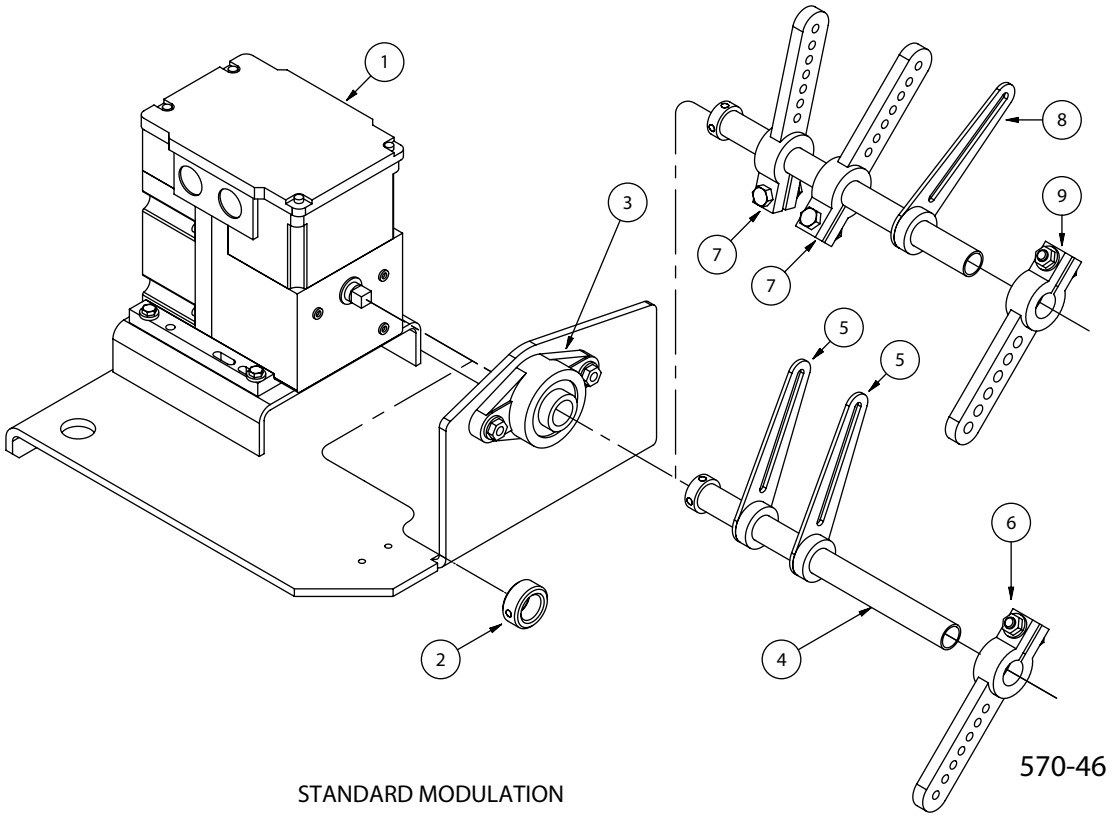
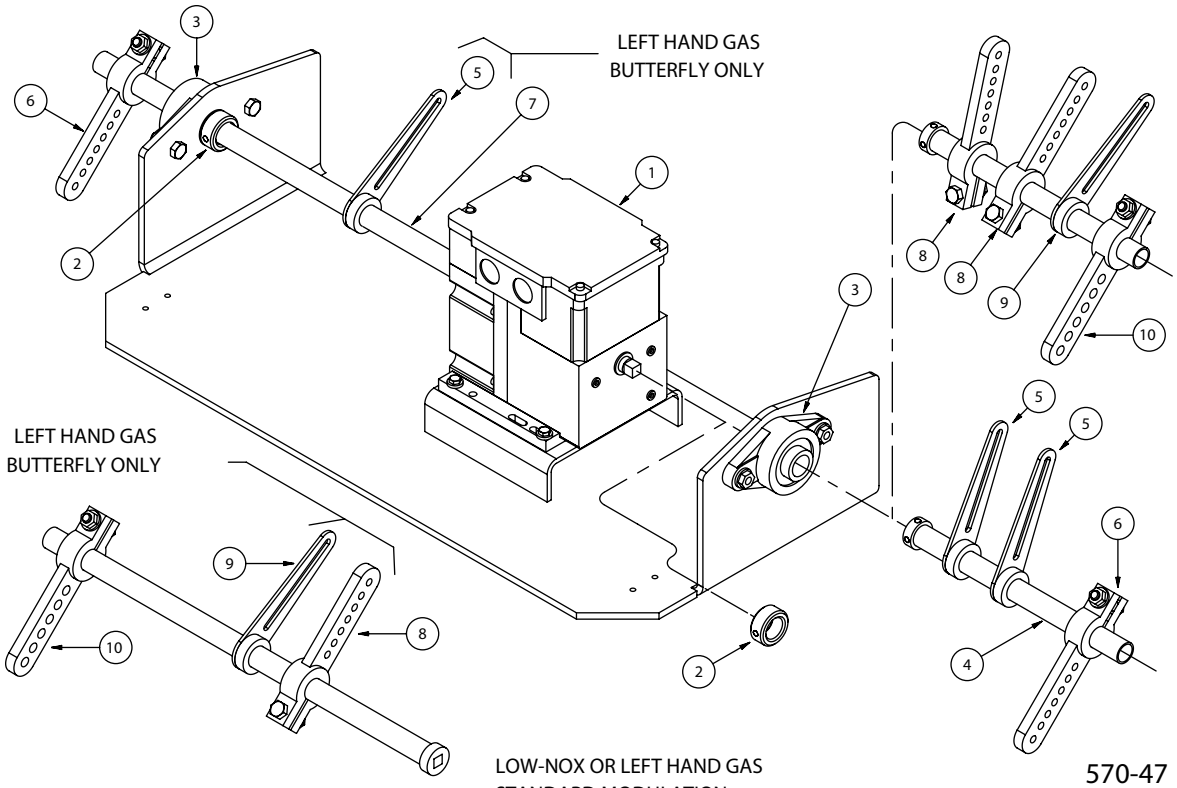


FIGURE 22. MODULATION, STANDARD. 570-046

STANDARD MODULATION			QUANTITY						
ITEM NO.	PART NUMBER	DESCRIPTION	42	54	63	84	105	145	175
1	894 - 1345	MOTOR, MODULATION, 120V., 35 SEC.	1	1	1	1	1		
	894 - 1346	MOTOR, MODULATION, 24V., 30 SEC.						1	1
2	18 - 149	COLLAR, STEEL.	1	1	1	1	1		
3	807 - 335	BEARING, FLANGED 2 PT, 3/4" SHAFT.	1	1	1	1	1		
	807 - 341	BEARING, FLANGED 2 PT, 3/4" SHAFT.						1	1
4	10 - 309	BUSHING, MOD. MOTOR CONTROL ARM, 9-1/2" LG.	1	1	1	1	1	1	1
5	2 - 184	ARM, LINKAGE, 3/4" SHAFT X 3" SLOT.	2	2	2	2	2	2	2
6	2 - 141	ARM, LINKAGE, 3/4" SHAFT, 7 HOLES.	1	1	1	1	1	1	1

ITEM NO.	PART NUMBER	DESCRIPTION	QUANTITY						
			210	252	300	315	336	378	420
1	894 - 1346	MOTOR, MODULATION, 24V., 30 SEC.	1	1	1	1	1	1	1
2	807 - 341	BEARING, FLANGED 2 PT, 3/4" SHAFT.	1	1	1	1	1	1	1
4	10 - 309	BUSHING, MOD. MOTOR CONTROL ARM, 9-1/2" LG.	1	1	1	1	1	1	1
7	2 - 141	ARM, LINKAGE, 3/4" SHAFT, 7 HOLES.	2	2	2	2	2	2	2
8	2 - 184	ARM, LINKAGE, 3/4" SHAFT X 3" SLOT.	1	1	1	1	1	1	1
9	2 - 259	ARM, LINKAGE, 3/4" SHAFT, 6 HOLES.	1	1	1	1	1	1	1

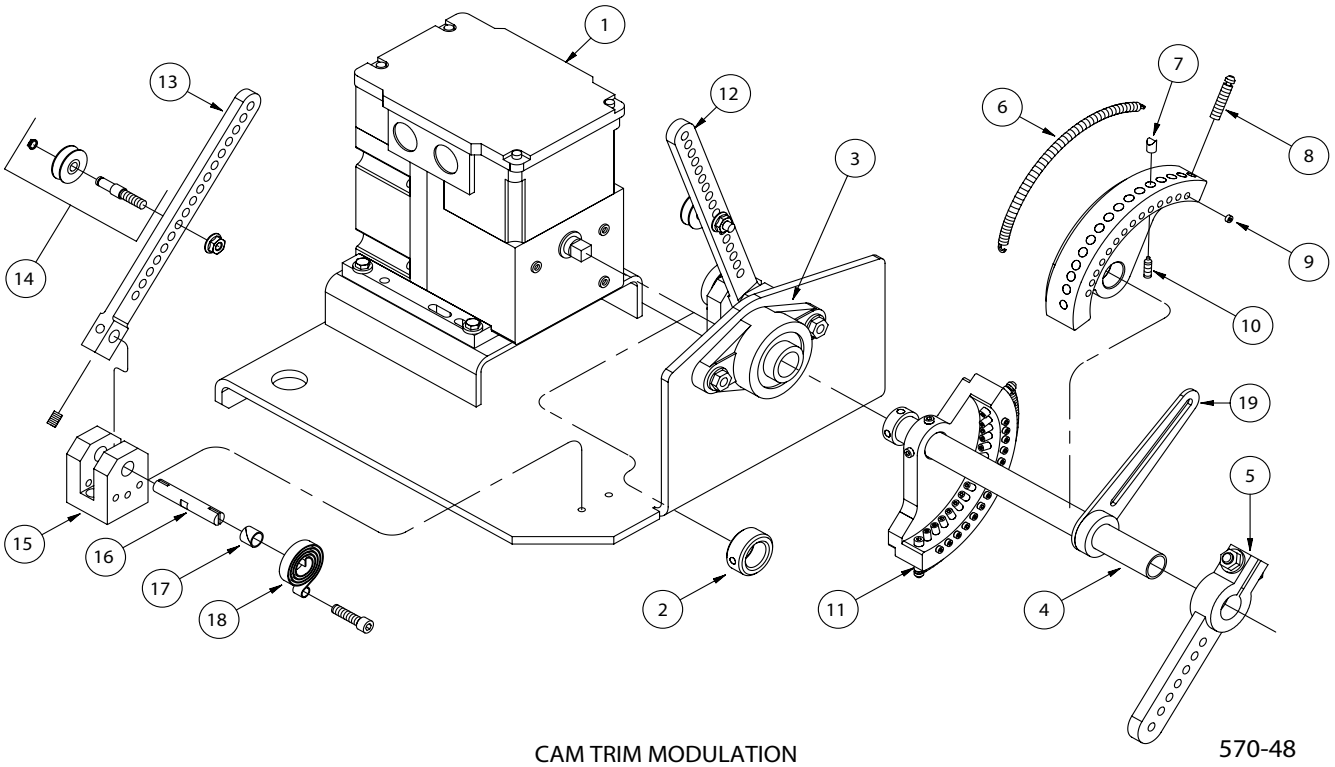


570-047

FIGURE 23. MODULATION STANDARD, LOW NOX OR LEFT HAND GAS.

STANDARD MODULATION			QUANTITY						
ITEM NO.	PART NUMBER	DESCRIPTION	42	54	63	84	105	145	175
1	894 - 1345	MOTOR, MODULATION, 120V., 35 SEC.	1	1	1	1	1		
	894 - 1346	MOTOR, MODULATION, 24V., 30 SEC.						1	1
2	18 - 149	COLLAR, STEEL.	1	1	1	1	1		
3	807 - 335	BEARING, FLANGED 2 PT, 3/4" SHAFT.	2	2	2	2	2		
	807 - 341	BEARING, FLANGED 2 PT, 3/4" SHAFT.						2	2
4	10 - 322	BUSHING, MOD. MOTOR CONTROL ARM, 12" LG.	1	1	1	1	1	1	1
5	2 - 184	ARM, LINKAGE, 3/4" SHAFT X 3" SLOT.	2	2	2	2	2	2	2
6	2 - 141	ARM, LINKAGE, 3/4" SHAFT, 7 HOLES.	2	2	2	2	2	2	2
7	10 - 307	BUSHING, MOD. MOTOR CONTROL ARM, 22" LG.	1	1	1	1	1	1	1

ITEM NO.	PART NUMBER	DESCRIPTION	QUANTITY						
			210	252	300	315	336	378	420
1	894 - 1346	MOTOR, MODULATION, 24V., 30 SEC.	1	1	1	1	1	1	1
3	807 - 341	BEARING, FLANGED 2 PT, 3/4" SHAFT.	2	2	2	2	2	2	2
4	10 - 322	BUSHING, MOD. MOTOR CONTROL ARM, 12" LG.	1	1	1	1	1	1	1
7	10 - 343	BUSHING, MOD. MOTOR CONTROL ARM, 34-11/16" LG.	1	1	1	1	1	1	1
8	2 - 141	ARM, LINKAGE, 3/4" SHAFT, 7 HOLES.	2	2	2	2	2	2	2
9	2 - 184	ARM, LINKAGE, 3/4" SHAFT X 3" SLOT.	1	1	1	1	1	1	1
10	2 - 259	ARM, LINKAGE, 3/4" SHAFT, 6 HOLES.	2	2	2	2	2	2	2



CAM TRIM MODULATION 570-48

FIGURE 24. MODULATION, CAM TRIM. 570-48

CAM TRIM MODULATION			QUANTITY									
ITEM NO.	PART NUMBER	DESCRIPTION	42	54	63	84	105	145	175	210	252	300
1	894 - 1345	MOTOR, MODUTROL, 120V., 35 SEC.	1	1	1	1	1					
	894 - 1346	MOTOR, MODUTROL, 24V., 30 SEC.						1	1	1	1	1
2	18 - 149	COLLAR, STEEL.	1	1	1	1	1					
3	807 - 335	BEARING, FLANGED 2 PT, 3/4" SHAFT.	1	1	1	1	1					
	807 - 341	BEARING, FLANGED 2 PT, 3/4" SHAFT.						1	1	1	1	1
4	10 - 322	BUSHING, MOD. MOTOR CONTROL ARM, 12" LG.	1	1	1	1	1	1	1	1	1	1
5	2 - 141	ARM, LINKAGE, 3/4" SHAFT, 7 HOLES.	1	1	1	1	1	1	1			
	2 - 259	ARM, LINKAGE, 3/4" SHAFT, 6 HOLES.								1	1	1
6	82 - 153	SPRING, ROLLER GUIDE, CAM.	1	1	1	1	1	1	1	1	1	1
7	36 - 111	GUIDE, CAM SPRING.	16	16	16	16	16	16	16	16	16	16
8	71 - 24	SCREW, SPRING FASTENER.	2	2	2	2	2	2	2	2	2	2
9	860 - 301	SCREW, LOCKING SET, KIT. (16 PER KIT).	1	1	1	1	1	1	1	1	1	1
10	860 - 299	SCREW, SET #10-32 X 1" LG, HALF DOG POINT.	16	16	16	16	16	16	16	16	16	16
11	313 - 15	CAM ASSEMBLY, (RIGHT HAND).	2	2	2	2	2	2	2	2	2	2
12	476 - 84	LINKAGE, CAM FOLLOWER ASSEMBLY, (GAS).	1	1	1	1	1	1	1	1	1	1
	476 - 82	LINKAGE, CAM FOLLOWER ASSEMBLY, (OIL).	1	1	1	1	1	1	1	1	1	1
13	2 - 13	ARM, LINKAGE, 5/16" SHAFT, 17 HOLES.	1	1	1	1	1	1	1	1	1	1
14	69 - 303	ROLLER GUIDE ASSEMBLY.	2	2	2	2	2	2	2	2	2	2
15	8 - 1356	BRACKET, LINKAGE ARM, MOUNTING.	2	2	2	2	2	2	2	2	2	2
16	74 - 504	SHAFT, LINKAGE ARM, MTNG, SINGLE SPRING. (GAS).	1	1	1	1	1	1	1	1	1	1
	74 - 506	SHAFT, LINKAGE ARM, MTNG, DOUBLE SPRING. (OIL).	1	1	1	1	1	1	1	1	1	1
17	807 - 339	BEARING, NYLON, 3/8" I.D.	2	2	2	2	2	2	2	2	2	2
18	82 - 140	SPRING, CAM ASSEMBLY RETURN, (GAS).	1	1	1	1	1	1	1	1	1	1
	82 - 155	SPRING, CAM ASSEMBLY RETURN, (OIL).	1	1	1	1	1	1	1	1	1	1

MODULATION			QUANTITY			
ITEM NO.	PART NUMBER	DESCRIPTION	315	336	378	420
1	894 - 1346	MOTOR, MODUTROL, 24V., 30 SEC.	1	1	1	1
3	807 - 341	BEARING, FLANGED 2 PT, 3/4" SHAFT.	1	1	1	1
4	10 - 309	BUSHING, MOD. MOTOR CONTROL ARM, 12" LG.	1	1	1	1
5	2 - 259	ARM, LINKAGE, 3/4" SHAFT, 6 HOLES.	1	1	1	1
6	82 - 153	SPRING, ROLLER GUIDE, CAM.	1	1	1	1
7	36 - 111	GUIDE, CAM SPRING.	16	16	16	16
8	71 - 24	SCREW, SPRING FASTENER.	2	2	2	2
9	860 - 301	SCREW, LOCKING SET, KIT. (16 PER KIT).	1	1	1	1
10	860 - 299	SCREW, SET #10-32 X 1" LG, HALF DOG POINT.	16	16	16	16
11	313 - 15	CAM ASSEMBLY, (RIGHT HAND).	2	2	2	1
12	476 - 84	LINKAGE, CAM FOLLOWER ASSEMBLY, (GAS).	1	1	1	1
	476 - 82	LINKAGE, CAM FOLLOWER ASSEMBLY, (OIL).	1	1	1	1
13	2 - 13	ARM, LINKAGE, 5/16" SHAFT, 17 HOLES.	1	1	1	1
14	69 - 303	ROLLER GUIDE ASSEMBLY.	2	2	2	2
15	8 - 1356	BRACKET, LINKAGE ARM, MOUNTING.	2	2	2	2
16	74 - 504	SHAFT, LINKAGE ARM, MOUNTING, SINGLE SPRING. (GAS).	1	1	1	1
	74 - 506	SHAFT, LINKAGE ARM, MOUNTING, DOUBLE SPRING. (OIL).	1	1	1	1
17	807 - 339	BEARING, NYLON, 3/8" I.D.	2	2	2	2
18	82 - 140	SPRING, CAM ASSEMBLY RETURN, (GAS).	1	1	1	1
	82 - 155	SPRING, CAM ASSEMBLY RETURN, (OIL).	1	1	1	1
19	2 - 184	ARM, LINKAGE, 3/4" SHAFT X 3" SLOT.			1	1

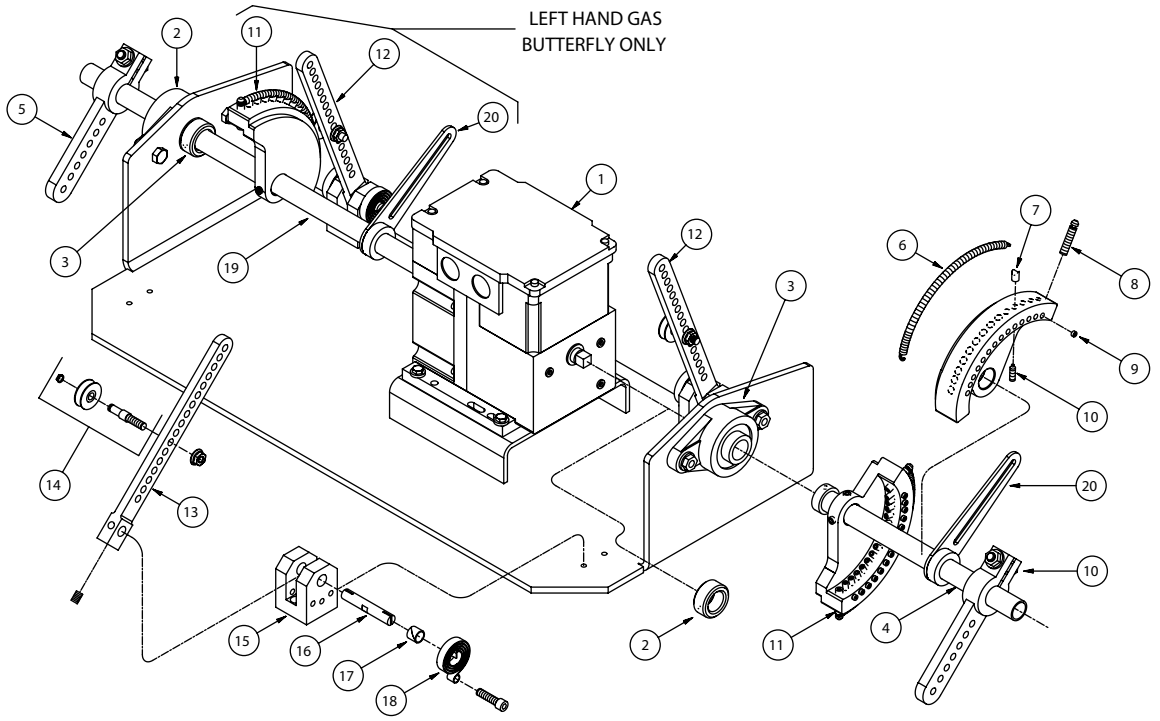


FIGURE 25. MODULATION, CAM TRIM LOW-NOX OR LEFT HAND GAS.

MODULATION			QUANTITY									
ITEM NO.	PART NUMBER	DESCRIPTION	42	54	63	84	105	145	175	210	252	300
1	894 - 1345	MOTOR, MODULATION, 120V., 35 SEC.	1	1	1	1	1					
	894 - 1346	MOTOR, MODULATION, 24V., 30 SEC.						1	1	1	1	1
2	18 - 149	COLLAR, STEEL.	1	1	1	1	1					
3	807 - 335	BEARING, FLANGED 2 PT, 3/4" SHAFT.	1	1	1	1	1					
	807 - 341	BEARING, FLANGED 2 PT, 3/4" SHAFT.						1	1	1	1	1
4	10 - 322	BUSHING, MOD. MOTOR CONTROL ARM, 12" LG.	1	1	1	1	1	1	1	1	1	1
5	2 - 141	ARM, LINKAGE, 3/4" SHAFT, 7 HOLES.	1	1	1	1	1	1	1			
	2 - 259	ARM, LINKAGE, 3/4" SHAFT, 6 HOLES.								1	1	1
6	82 - 153	SPRING, ROLLER GUIDE, CAM.	1	1	1	1	1	1	1	1	1	1
7	36 - 111	GUIDE, CAM SPRING.	16	16	16	16	16	16	16	16	16	16
8	71 - 24	SCREW, SPRING FASTENER.	2	2	2	2	2	2	2	2	2	2
9	860 - 301	SCREW, LOCKING SET, KIT. (16 PER KIT).	1	1	1	1	1	1	1	1	1	1
10	860 - 299	SCREW, SET #10-32 X 1" LG., HALF DOG POINT.	16	16	16	16	16	16	16	16	16	16
11	313 - 14	CAM ASSEMBLY, (LEFT HAND).	1	1	1	1	1	1	1	1	1	1
	313 - 15	CAM ASSEMBLY, (RIGHT HAND).	2	2	2	2	2	2	2	2	2	2
12	476 - 84	LINKAGE, CAM FOLLOWER ASSEMBLY, (GAS).	1	1	1	1	1	1	1	1	1	1
	476 - 82	LINKAGE, CAM FOLLOWER ASSEMBLY, (OIL).	1	1	1	1	1	1	1	1	1	1
13	2 - 13	ARM, LINKAGE, 5/16" SHAFT, 17 HOLES.	1	1	1	1	1	1	1	1	1	1
14	69 - 303	ROLLER GUIDE ASSEMBLY.	2	2	2	2	2	2	2	2	2	2
15	8 - 1356	BRACKET, LINKAGE ARM, MOUNTING.	2	2	2	2	2	2	2	2	2	2
16	74 - 504	SHAFT, LINKAGE ARM, MTNG, SINGLE SPRING. (GAS).	1	1	1	1	1	1	1	1	1	1
	74 - 506	SHAFT, LINKAGE ARM, MTNG, DOUBLE SPRING. (OIL).	1	1	1	1	1	1	1	1	1	1
17	807 - 339	BEARING, NYLON, 3/8" I.D.	2	2	2	2	2	2	2	2	2	2
18	82 - 140	SPRING, CAM ASSEMBLY RETURN, (GAS).	1	1	1	1	1	1	1	1	1	1
	82 - 155	SPRING, CAM ASSEMBLY RETURN, (OIL).	1	1	1	1	1	1	1	1	1	1
19	10 - 307	BUSHING, MOD. MOTOR CONTROL ARM, 22" LG.	1	1	1	1	1	1	1			
	10 - 343	BUSHING, MOD. MOTOR CONTROL ARM, 34-11/16" LG.								1	1	1

MODULATION			QUANTITY			
ITEM NO.	PART NUMBER	DESCRIPTION	315	336	378	420
1	894 - 1346	MOTOR, MODULATION, 24V., 30 SEC.	1	1	1	1
3	807 - 341	BEARING, FLANGED 2 PT, 3/4" SHAFT.	1	1	1	1
4	10 - 322	BUSHING, MOD. MOTOR CONTROL ARM, 12" LG.	1	1	1	1
5	2 - 259	ARM, LINKAGE, 3/4" SHAFT, 6 HOLES.	2	2	2	2
6	82 - 153	SPRING, ROLLER GUIDE, CAM.	1	1	1	1
7	36 - 111	GUIDE, CAM SPRING.	16	16	16	16
8	71 - 24	SCREW, SPRING FASTENER.	2	2	2	2
9	860 - 301	SCREW, LOCKING SET, KIT. (16 PER KIT).	1	1	1	1
10	860 - 299	SCREW, SET #10-32 X 1" LG, HALF DOG POINT.	16	16	16	16
11	313 - 14	CAM ASSEMBLY, (LEFT HAND).	1	1	1	1
	313 - 15	CAM ASSEMBLY, (RIGHT HAND).	2	2	2	2
12	476 - 84	LINKAGE, CAM FOLLOWER ASSEMBLY, (GAS).	1	1	1	1
	476 - 82	LINKAGE, CAM FOLLOWER ASSEMBLY, (OIL).	1	1	1	1
13	2 - 13	ARM, LINKAGE, 5/16" SHAFT, 17 HOLES.	1	1	1	1
14	69 - 303	ROLLER GUIDE ASSEMBLY.	2	2	2	2
15	8 - 1356	BRACKET, LINKAGE ARM, MOUNTING.	2	2	2	2
16	74 - 504	SHAFT, LINKAGE ARM, MOUNTING, SINGLE SPRING. (GAS).	1	1	1	1
	74 - 506	SHAFT, LINKAGE ARM, MOUNTING, DOUBLE SPRING. (OIL).	1	1	1	1
17	807 - 339	BEARING, NYLON, 3/8" I.D.	2	2	2	2
18	82 - 140	SPRING, CAM ASSEMBLY RETURN, (GAS).	1	1	1	1
	82 - 155	SPRING, CAM ASSEMBLY RETURN, (OIL).	1	1	1	1
19	10 - 343	BUSHING, MOD. MOTOR CONTROL ARM, 34-11/16" LG.	1	1	1	1
20	2 - 184	ARM, LINKAGE, 3/4" SHAFT X 3" SLOT.			1	1

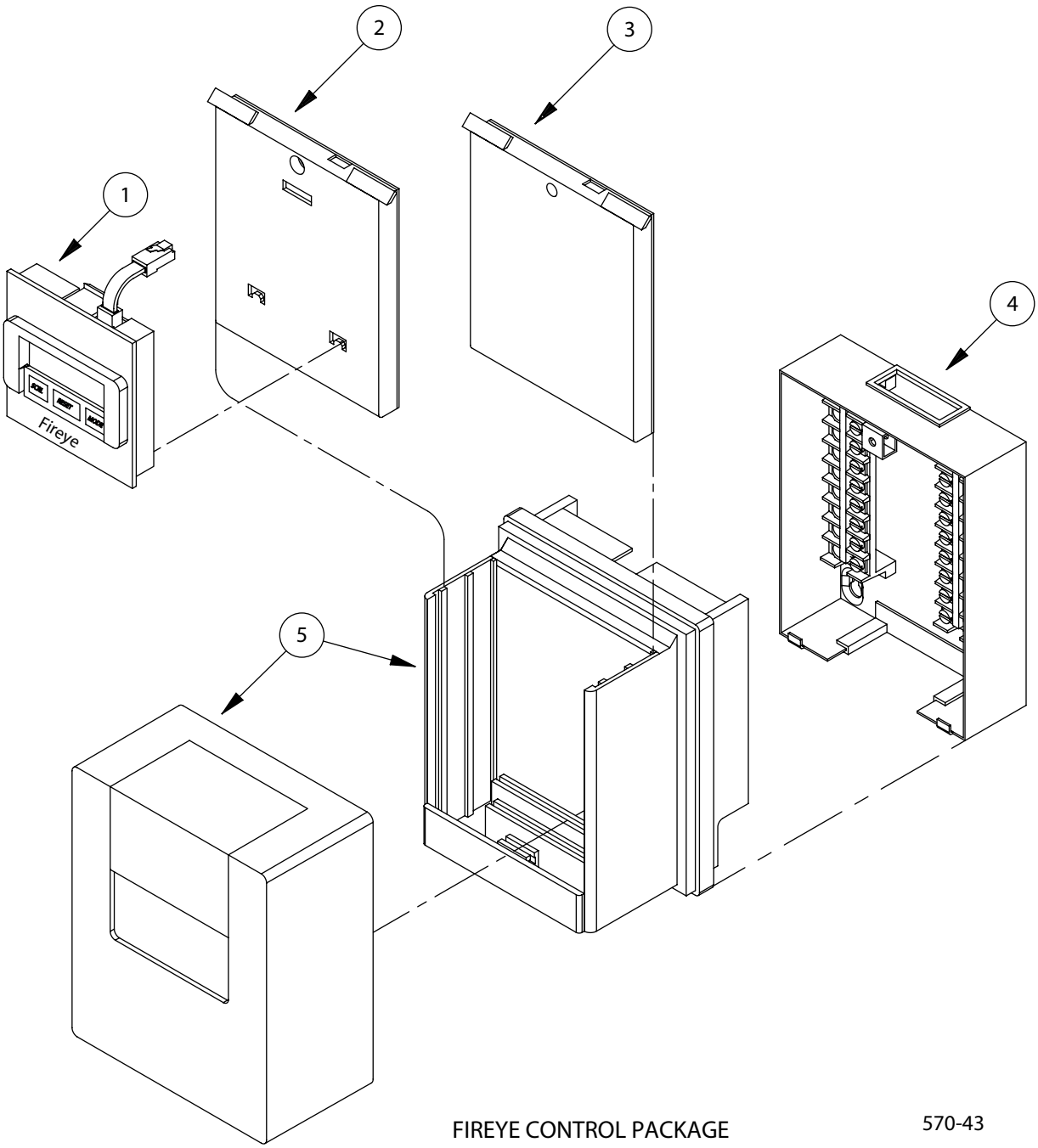


FIGURE 26. CONTROL PACKAGE, FIREYE.

570-043

FIRE CONTROL PACKAGE			QUANTITY									
ITEM NO.	PART NUMBER	DESCRIPTION	42	54	63	84	105	145	175	210	252	300
1	833 - 1340	MODULE, DISPLAY W/CONTROLLER MOUNTING. CABLE.	1	1	1	1	1	1	1	1	1	1
1	2832	-	915PROGRAM MODULE, EP160, 60 SEC. PRE-									
PURGE.	111	1	1	1	1	1	1	1				
	832 - 916	PROGRAM MODULE, EP260, 60 SEC. PREPURGE.	1	1	1	1	1	1	1	1	1	1
	832 - 917	PROGRAM MODULE, EP390, 90 SEC. PREPURGE.	1	1	1	1	1	1	1	1	1	1
3	832 - 914	AMPLIFIER, SIGNAL AUTOCHECKING (INFRA RED).	1	1	1	1	1	1	1	1	1	1
	832 - 918	AMPLIFIER, ULTRA VIOLET.	1	1	1	1	1	1	1	1	1	1
4	833 - 1018	BASE, CONTROLLER.	1	1	1	1	1	1	1	1	1	1

ITEM NO.	PART NUMBER	DESCRIPTION	QUANTITY			
			315	336	378	420
1	833 - 1340	MODULE, DISPLAY W/CONTROLLER MOUNTING. CABLE.	1	1	1	1
	2832	- 915PROGRAM MODULE, EP160, 60 SEC. PRE-				
PURGE.		1 1 1 1				
	832 - 916	PROGRAM MODULE, EP260, 60 SEC. PREPURGE.	1	1	1	1
	832 - 917	PROGRAM MODULE, EP390, 90 SEC. PREPURGE.	1	1	1	1
3	832 - 914	AMPLIFIER, SIGNAL AUTOCHECKING (INFRA RED).	1	1	1	1
	832 - 918	AMPLIFIER, ULTRA VIOLET.	1	1	1	1
4	833 - 1018	BASE, CONTROLLER.	1	1	1	1
5	833 - 1337	CHASSIS, E110.	1	1	1	1

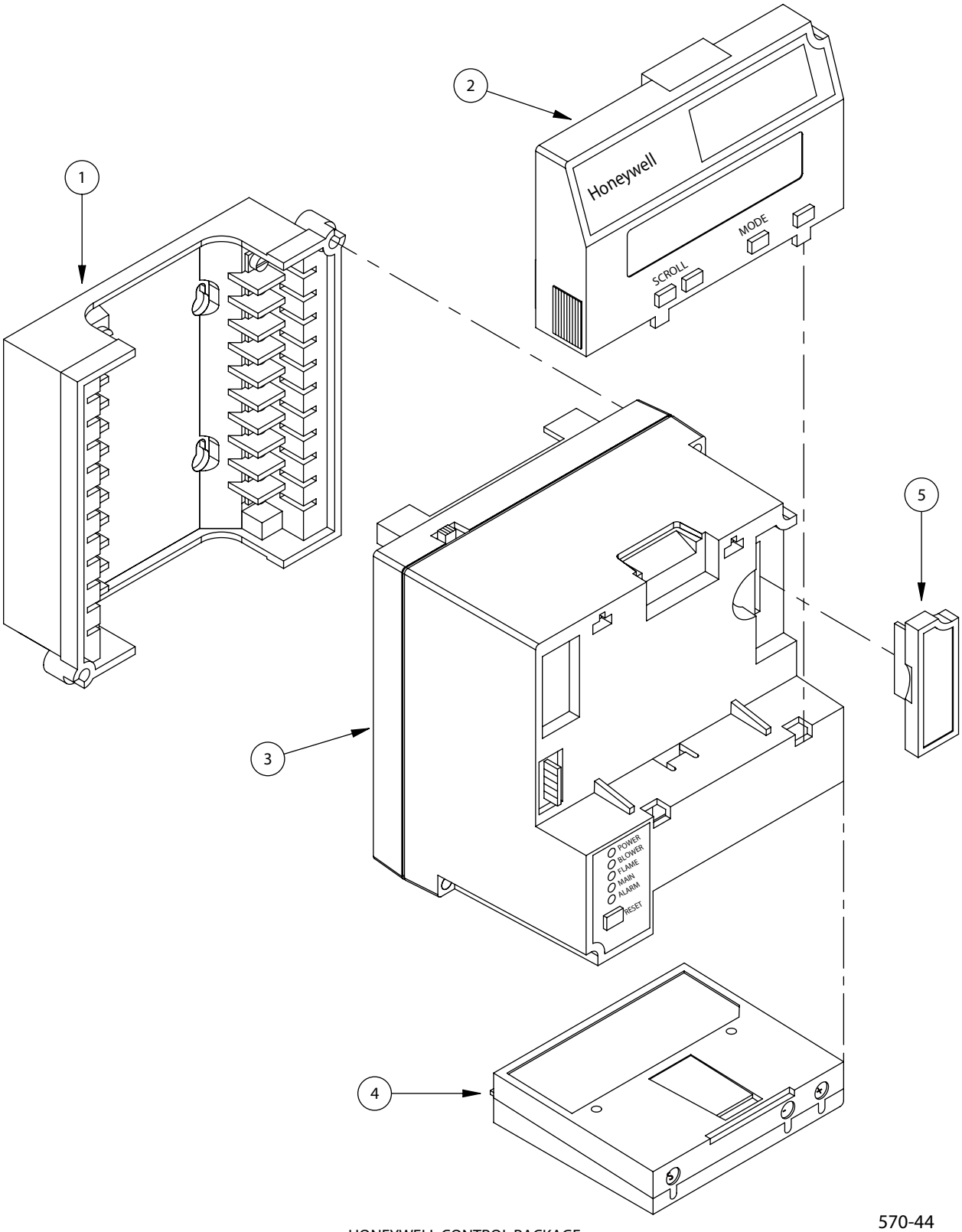


FIGURE 27. CONTROL PACKAGE, HONEYWELL.

570-044

HONEYWELL CONTROL PACKAGE			QUANTITY									
ITEM NO.	PART NUMBER	DESCRIPTION	42	54	63	84	105	145	175	210	252	300
1	833 - 1278	BASE CONTROLLER.	1	1	1	1	1	1	1	1	1	1
2	833 - 1335	CONTROL, KEYBOARD DISPLAY MODULE.	1	1	1	1	1	1	1	1	1	1
3	833 - 1276	CONTROLLER, PROGRAM.	1	1	1	1	1	1	1	1	1	1
4	832 - 1067	AMPLIFIER, INFRARED, 3 SECOND, NON SELF CHECK.	1	1	1	1	1	1	1	1	1	1
	832 - 1069	AMPLIFIER, ULTRA VIOLET, 3 SECOND.	1	1	1	1	1	1	1	1	1	1
5	832 - 1070	TIMER, 30 SECOND.	1	1	1	1	1	1	1	1	1	1
	832 - 1065	TIMER, 60 SECOND.	1	1	1	1	1	1	1	1	1	1
	832 - 1066	TIMER, 90 SECOND.	1	1	1	1	1	1	1	1	1	1

ITEM NO.	PART NUMBER	DESCRIPTION	QUANTITY			
			315	336	378	420
1	833 - 1278	BASE CONTROLLER.	1	1	1	1
2	833 - 1335	CONTROL, KEYBOARD DISPLAY MODULE.	1	1	1	1
3	833 - 1276	CONTROLLER, PROGRAM.	1	1	1	1
4	832 - 1067	AMPLIFIER, INFRARED, 3 SECOND, NON SELF CHECK.	1	1	1	1
	832 - 1069	AMPLIFIER, ULTRA VIOLET, 3 SECOND.	1	1	1	1
5	832 - 1070	TIMER, 30 SECOND.	1	1	1	1
	832 - 1065	TIMER, 60 SECOND.	1	1	1	1
	832 - 1066	TIMER, 90 SECOND.	1	1	1	1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