

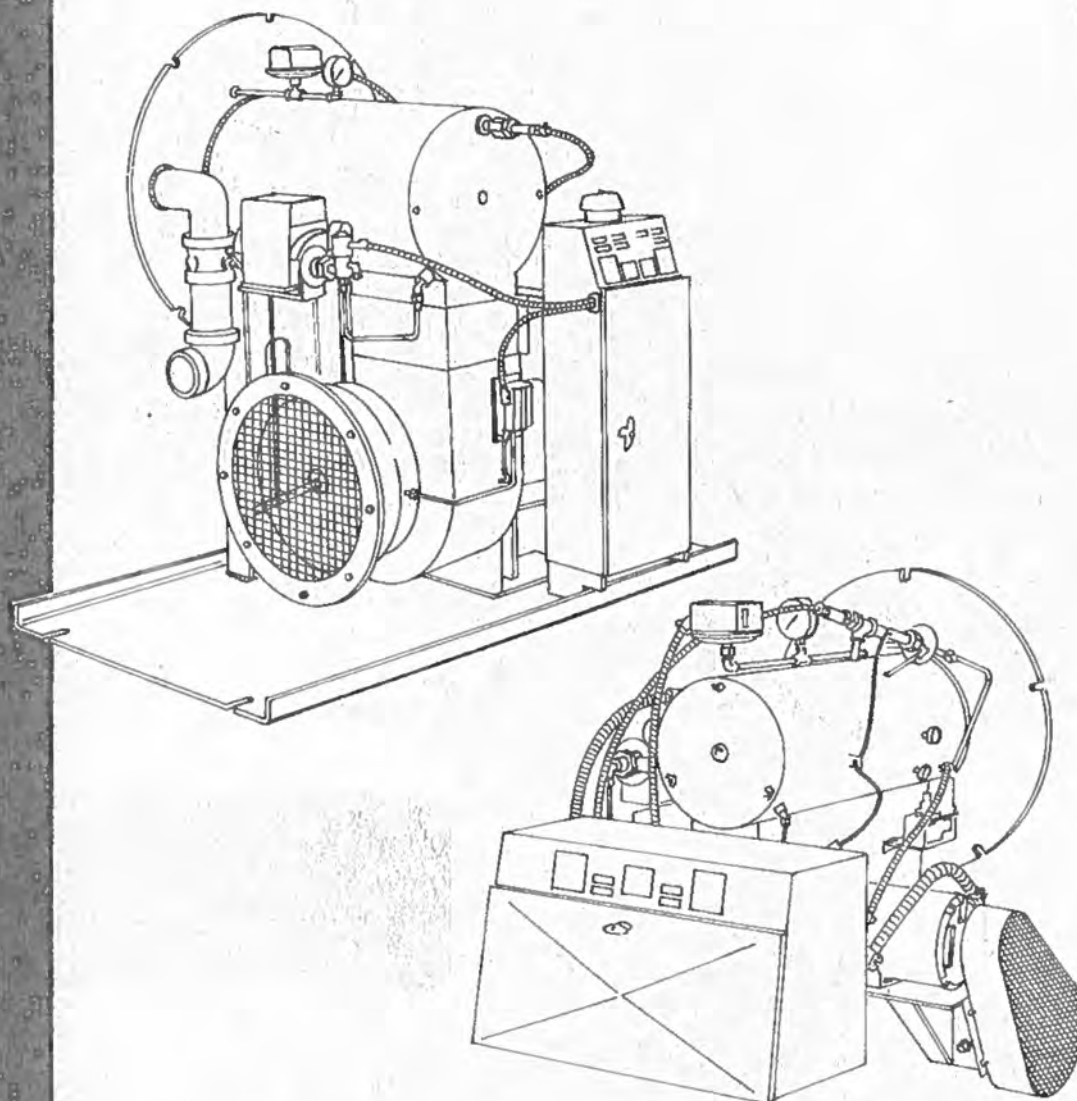


KEWANEE®

BURNER SERVICE MANUAL



NEED PARTS?
OEM Boiler Parts
Phone: (717) 367-9900
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**SERIES F BURNERS 60-750 HP
GAS BURNERS
PRESSURE & AIR ATOMIZING OIL BURNERS
GAS/OIL BURNERS**

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GENERAL INFORMATION

A. INTRODUCTION

This manual on Kewanee Burners has been prepared for the purpose of assisting the installation, operating, maintenance, and service personnel.

The manual information is, of necessity, general in nature since it may be modified by consulting engineer specifications, state or local codes, utility and insurance underwriter's requirements.

For additional information on these modifications, get in touch with your local Kewanee sales representative or write direct to Kewanee Boiler Corporation, Kewanee, Illinois 61443.

B. APPROVALS, AND WARRANTY REQUIREMENTS

Kewanee Burners are listed by Underwriters' Laboratories Inc. to burn Commercial Standard No. 6 or lighter oil and natural, or propane gas.

Kewanee units meeting the requirement of Associated Factory Mutual Fire Insurance Companies. Industrial Risk Insurers and special State, local and utility codes are available on special order.

WARRANTY

Kewanee Boiler Corporation (herein referred to as "Seller") warrants that at the time of shipment the products manufactured by it shall be merchantable, free from defects in material and workmanship, and shall possess the characteristics represented in writing by Seller. Seller's warranty is conditioned upon the product being properly installed, maintained, and operated in a manner that does not vary materially from that under which such product is usually tested under industry standards existing at time of sale. This warranty is made to the Original Buyer and . . .

1. For firetube boilers, packaged firetube boilers, condensate units, and deaerators is for a period of 12 (twelve) months from the date the product is first placed in use or 18 (eighteen) months from the date of shipment, whichever shall be less.

AND/OR

2. For all other products is for a period of 12 (twelve) months from the date of shipment.

WARRANTY ADJUSTMENT

1. Seller agrees to replace or repair (at its sole option), but not install, any product of its manufacture or part or portion thereof which, upon test and examination by Seller, proves defective within the terms of the above warranty.
2. Buyer must notify Seller in writing of any claimed breach of this warranty within 30 (thirty) days of the discovery of any defect, or Buyer's warranty rights hereunder will lapse.

3. No product will be accepted for return or replacement without the written authorization of Seller. Upon such authorization, and in accordance with instructions from Seller, the product will be returned to Seller's place of manufacture, shipping charges prepaid by Buyer. Seller shall not be liable for any costs or expenses connected with warranty adjustments, except that Seller shall furnish a replacement or repair of a product or part which is proved to the satisfaction of Seller to be defective in material or workmanship as provided in the above warranty; further, Seller shall furnish to Buyer the replacement or repaired part with freight allowed (but no local cartage) inside the continental United States (excluding Alaska and Hawaii) to the first destination.

EXCLUSIONS FROM WARRANTY

1. The foregoing warranty is limited solely as set forth herein, and applies only for the period designated above. This warranty takes the place of and supercedes all other warranties, whether express or implied in law. There are no express warranties except those contained herein, and to the extent permitted by law, implied warranties or warranties of fitness for a particular purpose are excluded.
2. Except for the remedies provided by this warranty, Seller shall not be liable for any loss, damage, indirect or consequential damages of any kind, whether based upon warranty, contract or negligence, arising in connection with the sale, use, or repair of the product. In any event, the maximum liability of Seller in connection with this limited warranty shall not exceed the contract price for the product claimed to be defective.
3. This warranty does not extend to any product manufactured by Seller which has been subjected to misuse, misapplication, neglect, accident, improper installation, or use in violation of instructions furnished by Seller.
4. This warranty does not extend to or apply to any product which has been repaired or altered at any place other than Seller's factory, or by persons not expressly approved by Seller; nor to any product, the serial number, model number, or any identification of which has been removed, defaced, or changed.
5. Components manufactured by any supplier other than Seller shall bear only those warranties made by the manufacturer of that product.

NOTICE

The KEWANEE BOILER CORPORATION will NOT honor any backcharges for Servicing, Repairing or replacing any parts of this unit unless prior authorization to do so has been given in writing by the KEWANEE BOILER CORPORATION.

C. BASIC DESCRIPTION

The Kewanee oil burner is available for pressure atomized firing of No. 2 fuel oil for units 60 thru 400. Air atomized firing of No. 2, 4, 5 and 6 oil is available for units 100 thru 750.

On all units using No. 2 oil, the oil pump runs only during the normal firing cycle. On all units using No. 4, 5 or 6 oil, the oil pump runs continuously to provide a constant supply of hot oil at the automatic oil valve for smooth burner ignition.

The Kewanee gas burner is a radial port type with a specially designed burner head to insure flame retention, stability, and quietness of operation.

The following firing modes are available:

	OIL	GAS
High-low-off with low fire start	60-80 HP	60-80 HP
Modulating with low fire start	100-750 HP	100-750 HP

Combustion air is supplied by a forced draft fan. The design of the burner head gives an intimate mixture of the fuel and air for complete combustion. An electric ignited

gas pilot is standard for all fuels except units 60 thru 80 for light oils which use direct spark electric ignition. The fuel metering valves on modulating units are cam-controlled to assure proper proportioning of the fuel and air throughout the entire firing range. A modutrol motor, signaled by a boiler-mounted pressure or temperature control, operates the air inlet damper and the fuel metering valves. An electronic flame safeguard programming control to provide prepurge, postpurge and pilot and main flame supervision, is standard.

Although the Kewanee burner is considered "automatic" in its operation, the operator must become familiar with the functions and maintenance of the various controls, valves, instruments, etc. which affect the safety and efficiency of the unit operation. Carelessness and laxity in testing and maintaining the various controls can lead to high operating costs, boiler damage, and even danger to life and property.

Figures 1-1 through 1-8 show the major items of control equipment for the operator's information and guidance in following the instructions in this manual. Figure 1-9 provides typical data for the complete line of burner sizes.

NOTICE

Dimensions and Data described herein subject to change without notice. Check with your local Kewanee sales representative or the factory for verification of any questionable item.

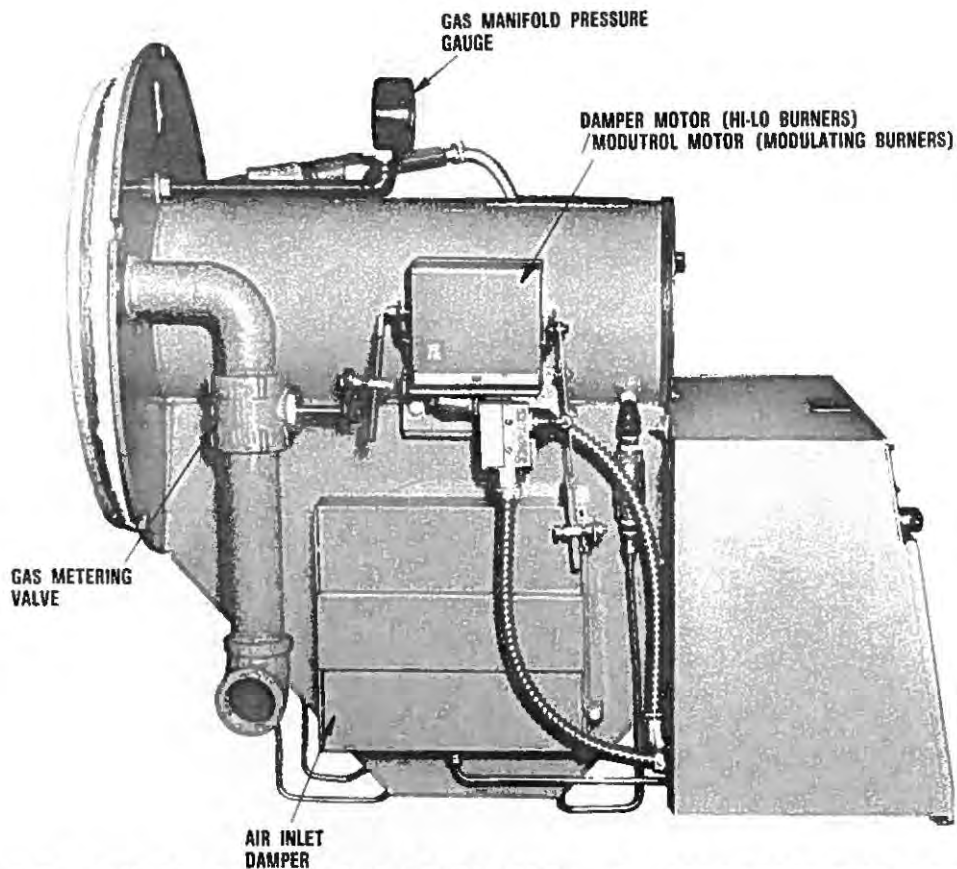


FIG. 1-1 LOCATION OF MAJOR COMPONENTS — FLANGE MOUNTED BURNERS

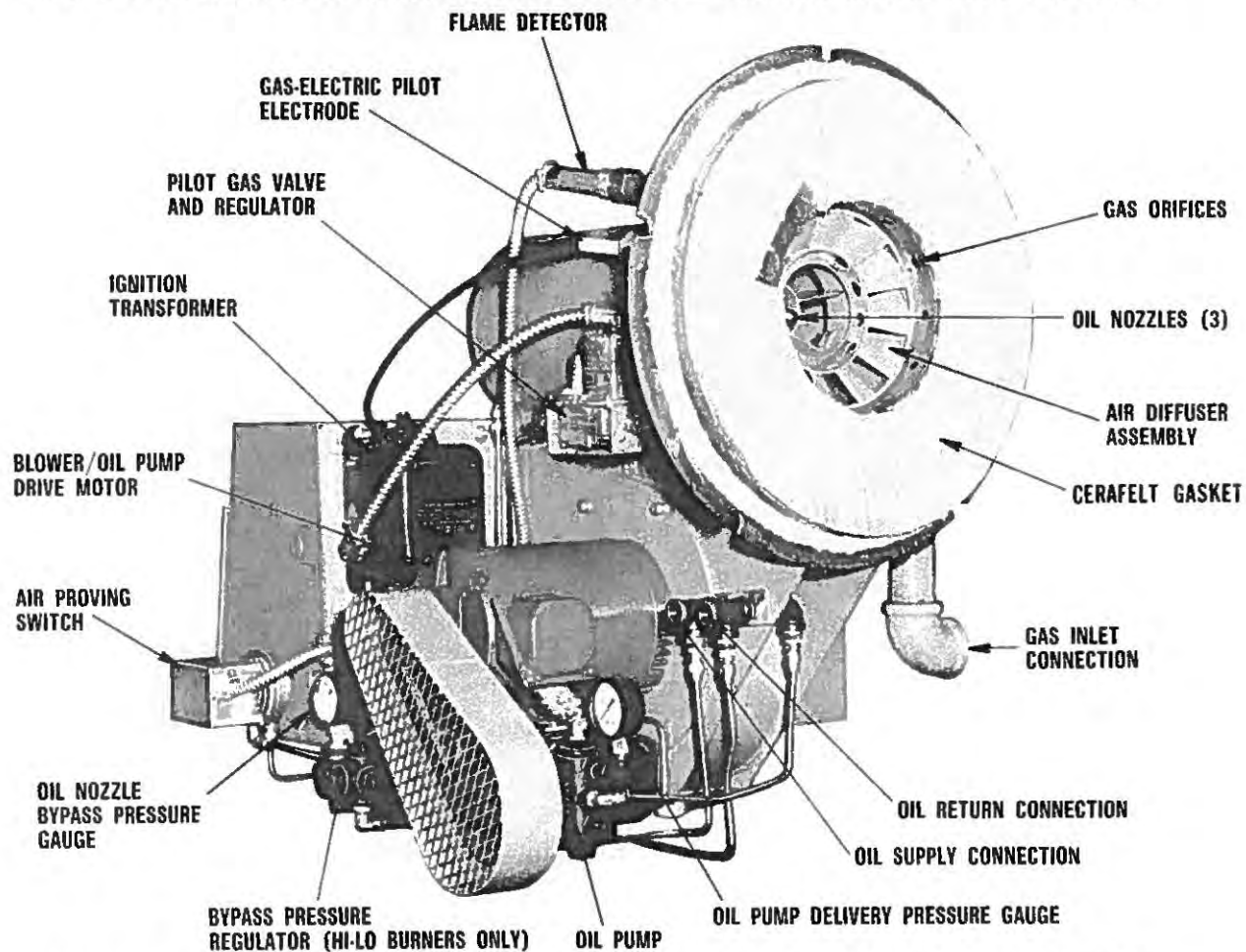


FIG. 1-2 LOCATION OF MAJOR COMPONENTS — FLANGE MOUNTED BURNERS

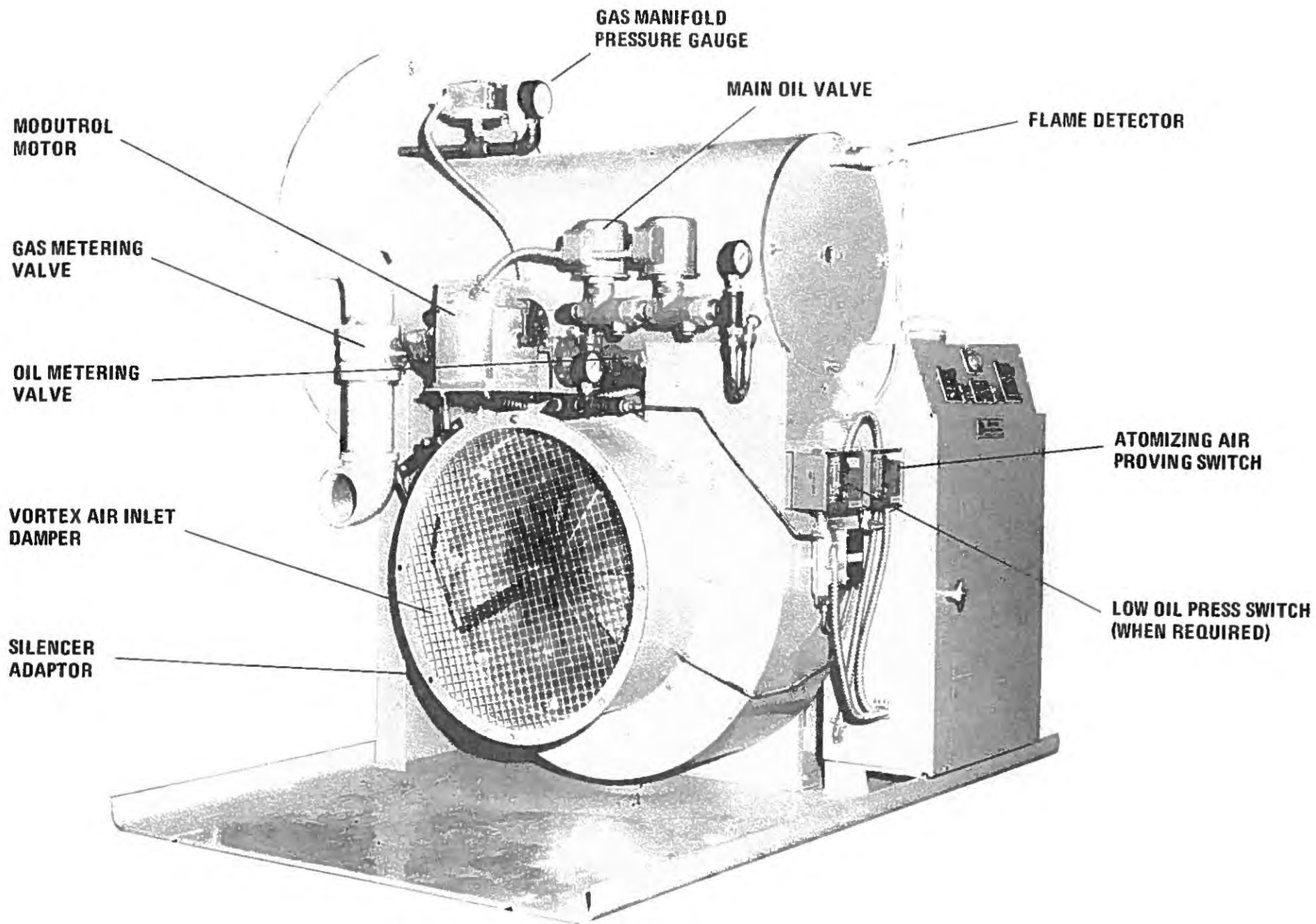


FIG. 1-3 LOCATION OF MAJOR COMPONENTS — BASE MOUNTED BURNERS

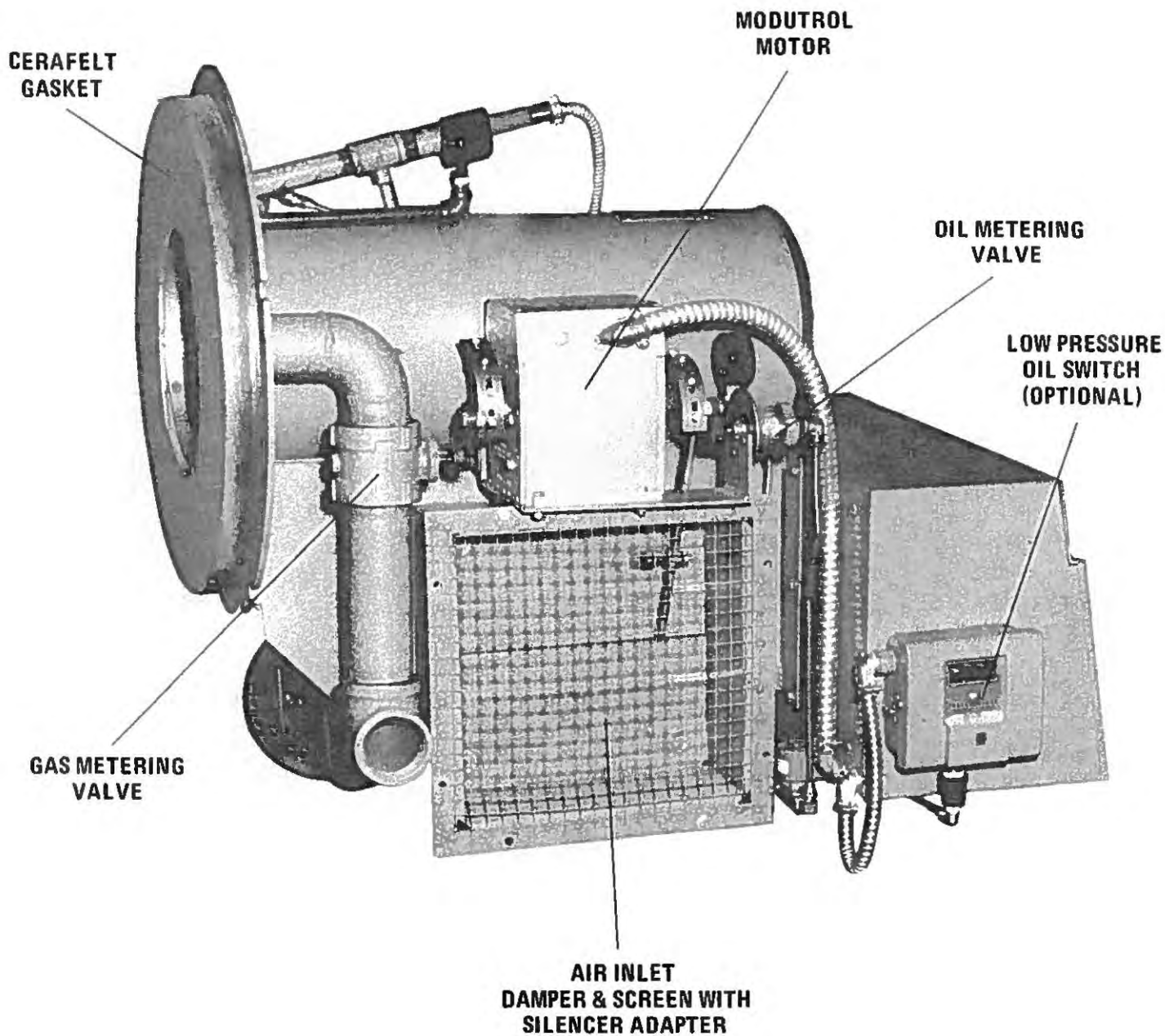


FIG. 1-4 100 HP

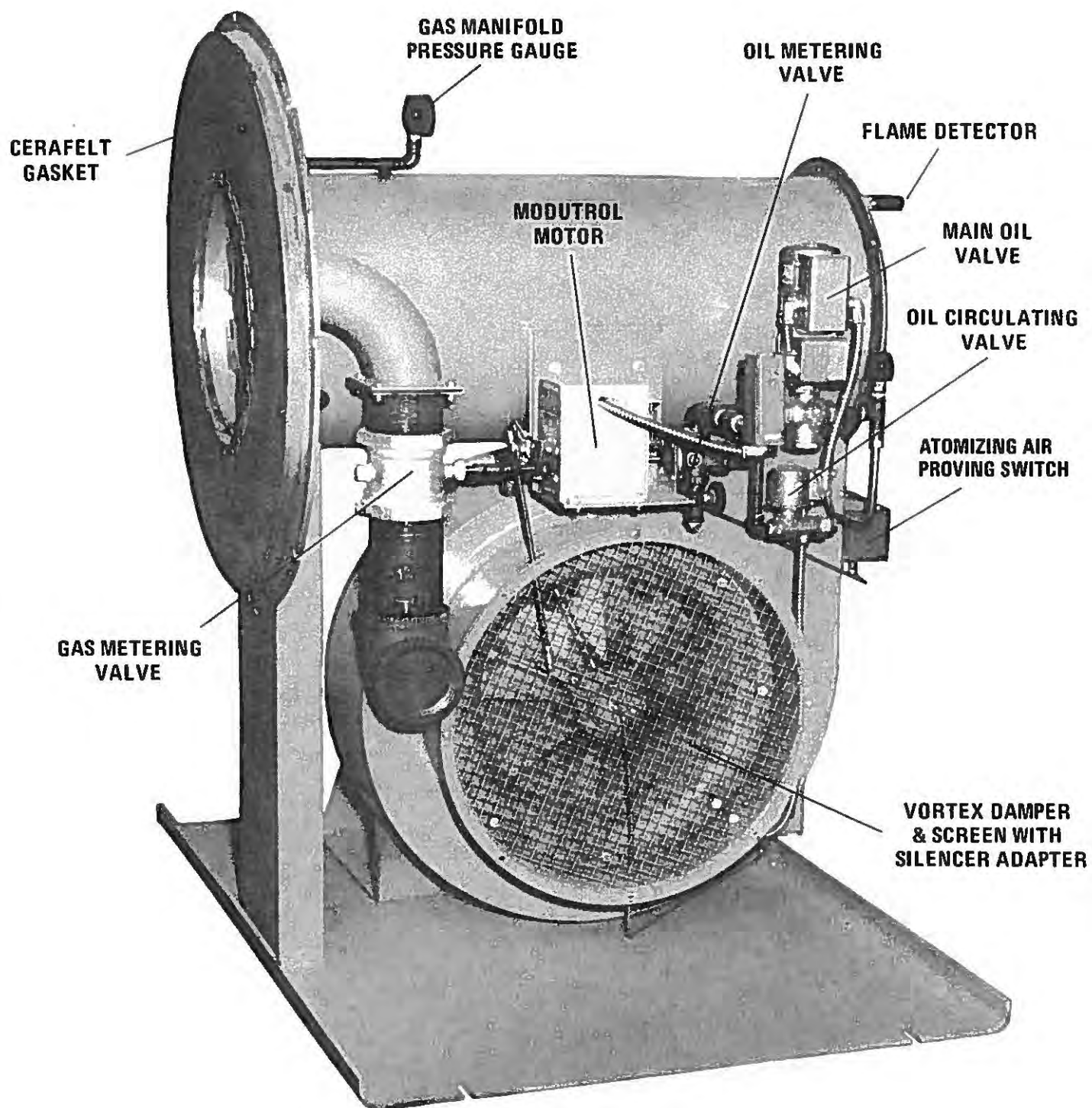


FIG. 1-5 500 HP

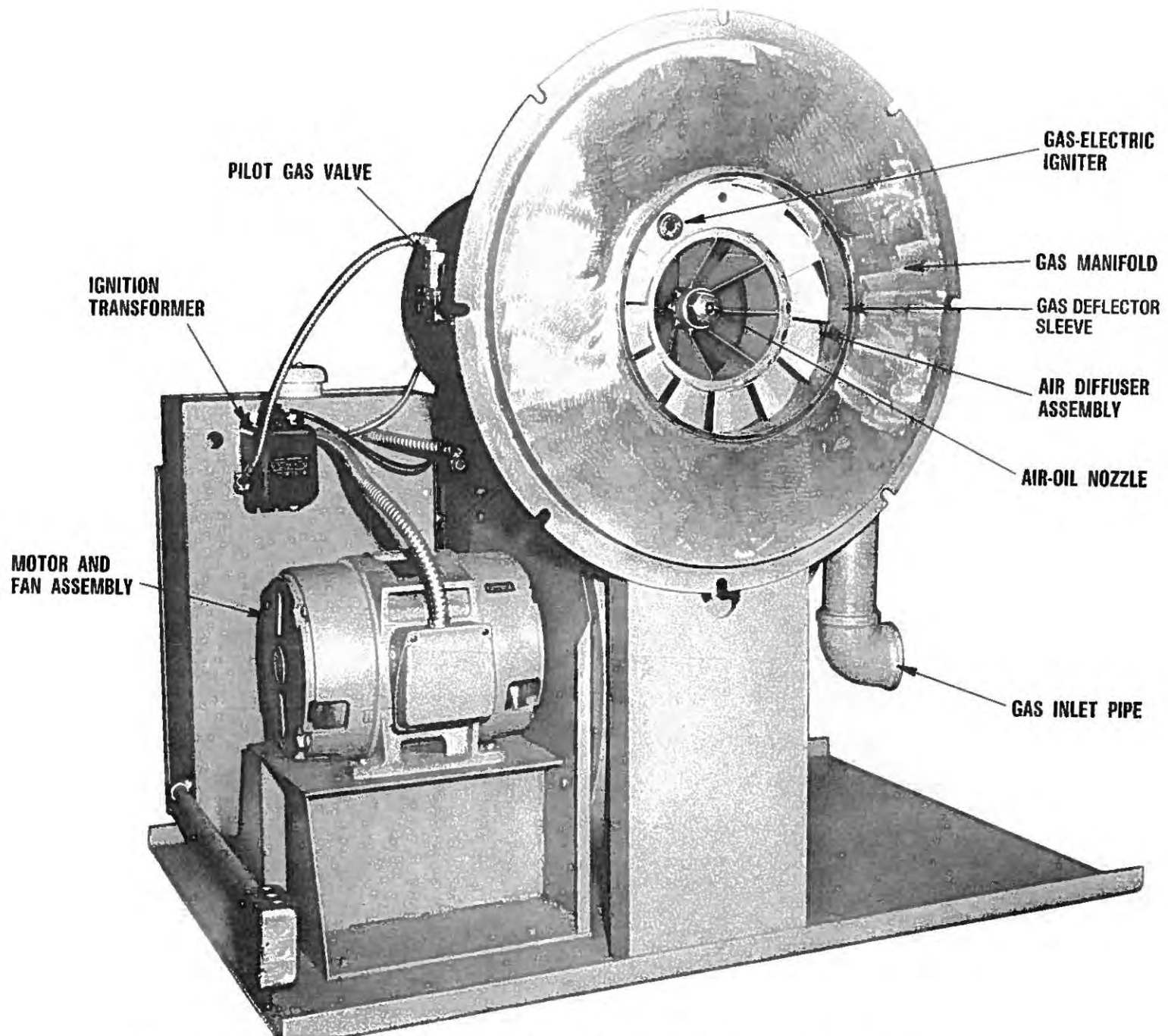


FIG. 1-6 LOCATION OF MAJOR COMPONENTS — BASE MOUNTED BURNERS

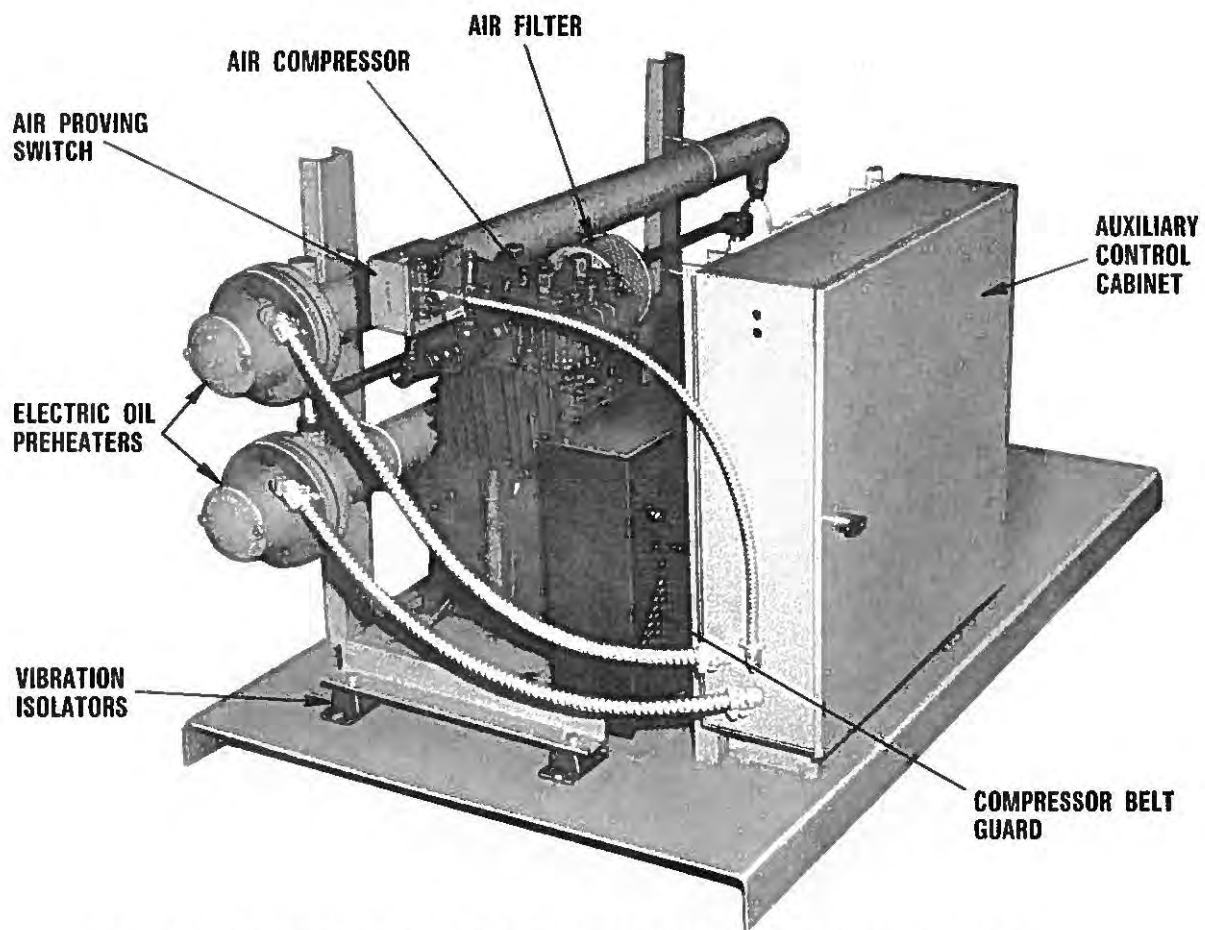


FIG. 1-7 LOCATION OF MAJOR COMPONENTS — AIR-OIL MODULES

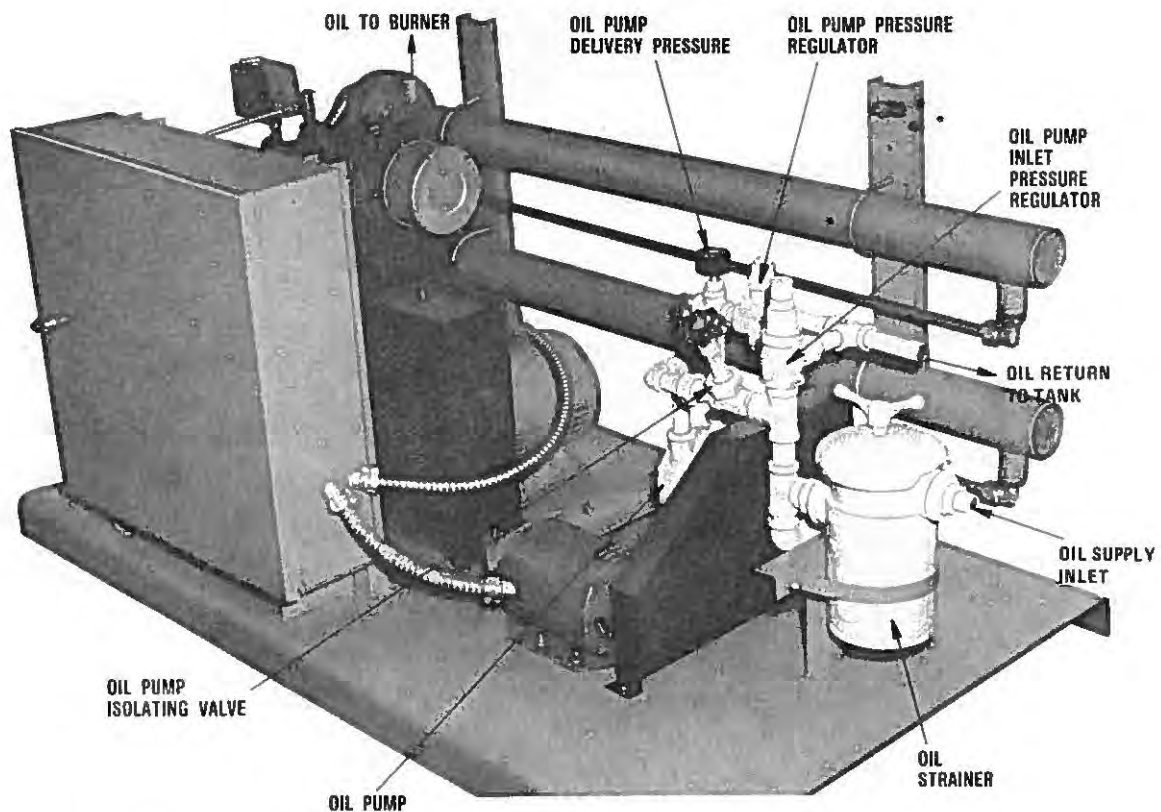


FIG. 1-8 LOCATION OF MAJOR COMPONENTS — AIR-OIL MODULES

FIG. 1-9 RATINGS & DATA — KEWANEE BURNERS

	KF1.0-762.*	KF1.0-762.*	KF1.5-762.*	KF2.0-962.*	KF3.0-962.*	KF5.0-962.*	KF5.0-1162.*	KF5.0-1162.*	KF7.5-1162.*	KF10-1562.*	KF10-1562.*	KF15-1562.*	KF20-1562.*	KF25-1800.*	KF30-1800.*	
Burner Number																
Rating - HP	60	70	80	100	125	150	150	200	250	300	350	400	500	600	750	
Firing Rate:																
Min. Gas - 1000 Btu/Cu. Ft.	1250	1500	1700	1300	1700	2000	2000	2000	2625	2525	2930	3900	4450	5030	6300	
Max. Gas - 1000 Btu/Cu. Ft.	2520	3000	3400	4200	5550	6325	6325	8400	11100	12600	14650	19500	22250	25150	31500	
Min. Propane - 2500 Btu/Cu. Ft.	500	600	680	520	680	800	800	800	1050	NA						
Max. Propane - 2500 Btu/Cu. Ft.	1008	1200	1360	1680	2220	2530	2530	3360	4440	NA						
Min. Oil - No. 2 - GPH - 140,000 Btu/Gal.	9	10.7	12	10	12.5	15	15	15	18.7	18	21	27.9	31.8	36	45	
Max. Oil - No. 2 - GPH - 140,000 Btu/Gal.	18	21	24	30	39.6	45	45	60	79.3	90	105	140	159	180	225	
Min. Oil - No. 6 - GHP - 150,000 Btu/Gal.	NA			9	12	14	14	14	18	17	20	26	29.6	33.5	42	
Max. Oil - No. 6 - GPH - 150,000 Btu/Gal.	NA			28	37	42	42	56	74	84	98	130	149	168	210	
Fuel Control - Gas	High-Low w/ Low Fire Start			Modulating w/Low Fire Start												
#2 Oil																
#4-5-6 Oil	—	—	—													
Gas Supply	1½	1½	1½	2	2	2½	2½	2½	2½	3	3	3	3	4	4	
Size On Burner	1½	1½	1½	2	2	2½	2½	2½	2½	3	3	3	3	4	4	
Min. Req'd. Inler Press. In. W.C.	3.6	3.7	5.5	4.0	6.4	7	4.7	7.7	11.9	7.6	9.5	12.1	15.3	11.9	19.9	
Flame Safeguard Control: Gas	R4140															
PA & Comb.	R4140															
AA Oil & Comb.	—	—	—	R4140												
Control Circuit Voltage	115-60-1															
Forced Draft Fan HP	1½	1½	1½	3	3	5	5	5	7½	10	15	15	20	25	30	
Standard Voltage	230-60-3															
Oil Pump - PA Oil	Belt Drive from Blower Motor						Direct Drive Pump Assembly						NA			
Oil Pump - AA Oil	—	—	—	Direct Drive Pump Assembly						Belt Dr. Pump Ass'y						
Oil Pump - AA - HP	—	—	—	1½						1½						
Standard Voltage	—	—	—	230-60-3												
Air Unit - HP	—	—	—	1½	1½	2	2	2	2	3	3	5	5	5	5	
Standard Voltage	—	—	—	230-60-3												
Standard Ignition - Gas	Direct Spark			Gas-Electric									NA			
#2 PA Oil													Gas-Electric			
AA Oil	—	—	—													
Electric Oil Heater, Watts #4 & 5	—	—	—	4000	5000	6000	6000	8000	12000	12000	15000	15000	20000	24000	30000	
Electric Oil Heater, Watts #6	—	—	—	2000	3000	3000	3000	4000	5000	6000	8000	8000	10000	12000	15000	
Standard Voltage	—	—	—	230-60-3												
Burner Approx. Weight - Lb.																
Gas	700	700	700	730	830	980	980	1080	1180	1280	1720	1890	2000	2040	2160	
Pressure Oil	0	580	580	580	590	680	750	750	900	1000	NA					
Air Atomizing #2	02	—	—	—	730	830	980	980	1080	1180	1280	1720	1890	2000	2160	
Air Atomizing #4-5	04	—	—	—	745	865	1045	1045	1130	1255	1355	1755	1965	2040	2260	
Air Atomizing #6 Steam	06	—	—	—	845	965	1145	1145	1230	1355	1455	1855	2065	2140	2360	
Air Atomizing #6 Water	06	—	—	—	845	965	1145	1145	1230	1355	1455	1855	2065	2140	2360	

*When ordering, refer to this basic number as the primary unit identification then use the horsepower rating desired as a prefix number (see Rating — HP column) and the type of fuel as a suffix number. For example: 60-KF1. 0-762-GO would be a 60 HP-capacity unit model KF1.0 — 762 set up for Gas and No. 2 Oil.

NA — Not Available.

CHAPTER 2

INSTALLATION PROCEDURES

To avoid backtracking and rework, read this section in full to understand the total task before starting work of installation.

A. UNPACKING UNITS

The Kewanee Burner is a self-contained unit, but its gas train, refractory cone, oil pump package and air atomizing oil package, where used, are crated separately for ease of handling. When the unit is received, shipping cartons should be examined for external damage. Care should be taken while uncrating the packages to avoid damaging gages and control valves.

B. INSPECTING UNIT

When the unit is uncrated, check the burner control cabinet, controls, gages and any instruments that may be damaged in transit. Check the shipment against packing list and acknowledgement of original order. *Any claims for damages or shortages should be filed immediately with the carrier by the installer.*

C. BURNER MOUNTING DETAILS

Refractory Cone—Cement the asbestos gasket around the refractory cone, and place the refractory cone into the opening of the boiler mounting plate and firmly tighten nuts of the mounting studs to achieve a rigid installation.

Burner—Cement the Cerafelt gasket to the face of the burner if it is not already there. Cement the asbestos gasket at the burner mounting flange and attach the burner to the mounting studs on the refractory cone. Take care to level the burner before tightening the nuts.

Gas Train—Attach the gas train to the burner connection union, supporting it as necessary from the floor or boiler skid. Connect it to the gas supply. See Figure 2-1 for detailed information on UL, FM, IRI trains. Figure 2-2 provides pressure drop for various flows through several pipe sizes to allow correct piping selection. Equivalent feet of various fittings is provided in Figure 2-3 for aiding pressure drop determination.

Gas piping should be installed in accordance with the National Board of Fire Underwriters' Pamphlet 54 and any other local codes which may apply. All gas piping should be tested after installation with air pressure or inert gas of at least three times the gas pressure that will be used. The piping ahead of the manual shut-off valve should include a full size dirt pocket or trap. **CAUTION:** When testing gas piping, make sure the gas cock upstream of the gas pressure regulator is closed to prevent damage to the regulator.

Oil Train—The oil train components for pressure atomized oil firing are mounted on the burner and termi-

nate in supply and return connection ports. Connect these to their respective lines. See Figure 2-4 for typical piping schematics.

Air Atomizing Module—Place the air compressor-oil module in a convenient location near the burner. On heavy-oil units, keep the interconnecting lines as short as possible. Attach air & oil feed lines to the burner and the oil supply and return lines to the tank. See Figure 2-5 for typical piping schematics.

Typical Piping Arrangement—Typical piping arrangements are shown in Figures 2-6 and 2-7. No gate valve shall be installed in the return line without a relief bypass. Note the use of a remote pump for heavy oil or light oil installation with long runs that may cause the burner oil pump suction to exceed 10" Hg. See Figure 2-8 for selecting sizes of remote pumps. See Figures 2-9, 2-10, and 2-11 for pressure drops through several size pipes to aid in selecting lines for various viscosity oils.

Oil Heating—The pressure atomizing burner is equipped to fire No. 2 or lighter oil only. The air atomizing burner will fire No. 2, 4, 5 or 6 oil.

No oil heating is required to fire No. 2 oil. An electric oil heater is supplied for all No. 4, 5 or 6 oil burners to obtain the necessary oil temperature for proper firing. No additional oil heating is required for No. 4 and light No. 5 oil (viscosity less than 300 SSU at 100°F). Heavy No. 5 oil normally requires auxiliary heating of the oil in the tank for proper pumping.

Heavy No. 5 and No. 6 oil (Bunker C) normally requires an oil tank heater and an auxiliary oil pump so that the oil can be properly pumped. A boiler-mounted water or steam oil heater supplements the electric heater for proper burning temperatures.

Oil Tank Location—The rules of the National Board of Fire Underwriters (Pamphlet 31) and of State and City regulations, if any, should be followed in locating and installing oil storage tanks.

Tank Oil Heaters—All installations using high pour point oils (No. 6 or heavy No. 5) should include equipment for heating the oil in the tank to a pumpable temperature (3000 SSU maximum pumping viscosity). A tank coil or suction bell heater may be used with either steam or forced hot water as a heating medium. The steam or hot water lines supplying heat to the tank coil should be insulated and water-proofed in the same covering with the oil suction and return lines. See Figure 2-12.

Fill pipe and vent line shall be installed on the tank in accordance with local and national code requirements. An antisiphon device may be required by local code if any part of the tank is above the level of the burner. Steel pipe connections to underground tanks should be made

with swinging joints to prevent damage to pipes in case the tank settles.

A typical oil storage tank installation is shown in Figure 2-12.

Installing Oil Tank—Consult local authorities for specifications on installing inside tanks.

Outside underground tanks should be buried with an earth cover or by a combination of earth and concrete. Before starting to excavate, it is advisable to check the location of sewer, water, and gas mains entering the building. Tanks buried in soft earth or in a high moisture area may require anchoring with steel straps to a reinforced concrete mat under the tank.

The burner will operate satisfactorily with the tank above or below the burner level. When the tank is above the burner, the return line pressure should not exceed 5 psi. When the tank is below the burner level, the bottom of the tank should be not more than 10 feet below the level of the oil pump or of the high point of the suction line. Tanks higher or lower than those above can be used with auxiliary oil pumping equipment. Long suction lines normally require an auxiliary oil pump. Consult the local Kewanee sales office in such cases.

D. ELECTRICAL SUPPLY

All Kewanee Burners are prewired at the factory as far as practical. Refer to the specific wiring diagram shipped with the burner to complete the wiring to the gas train, oil train, and boiler controls.

The wiring diagram for your particular unit is located inside the control cabinet. Study this wiring diagram thoroughly before making any connections to assure application of correct voltages.

Make sure all terminal post screws in the control cabinet are tight, since vibration during shipment may have loosened some.

Wiring done on the job shall conform to the rules of the National Electric Code or other local codes having jurisdiction. These are typically No. 14 wire having insulation suitable for 102°C.

Electrical power should be provided from a separate fused disconnect switch located in the boiler room. Fuse protection should be of the "slow-blow" type. Refer to burner data plate for burner current load. Check wiring diagram and follow Code requirements in selecting wire and fuse sizes.

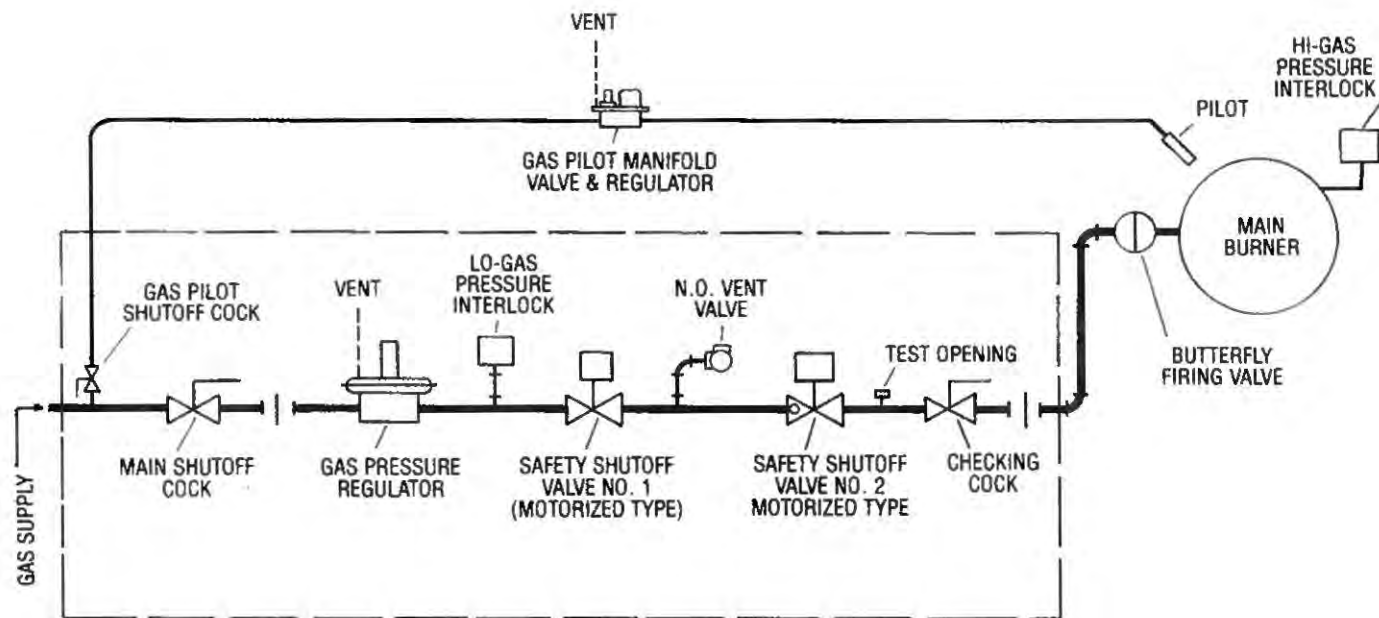
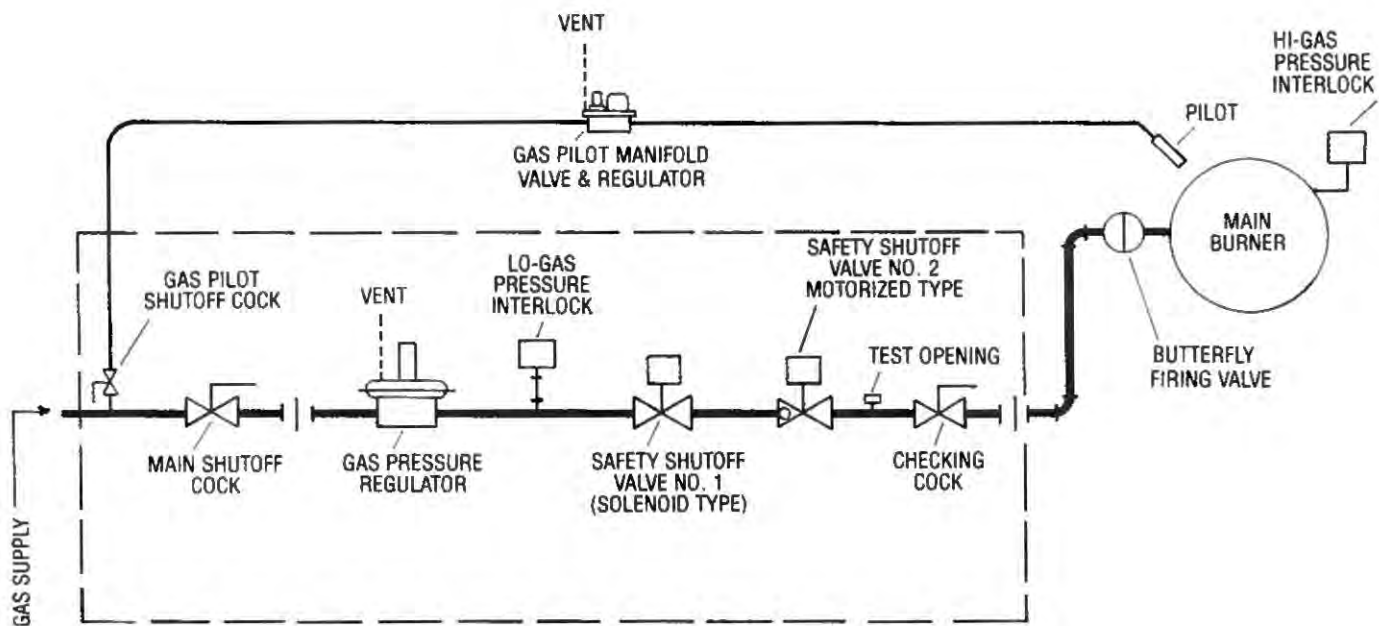
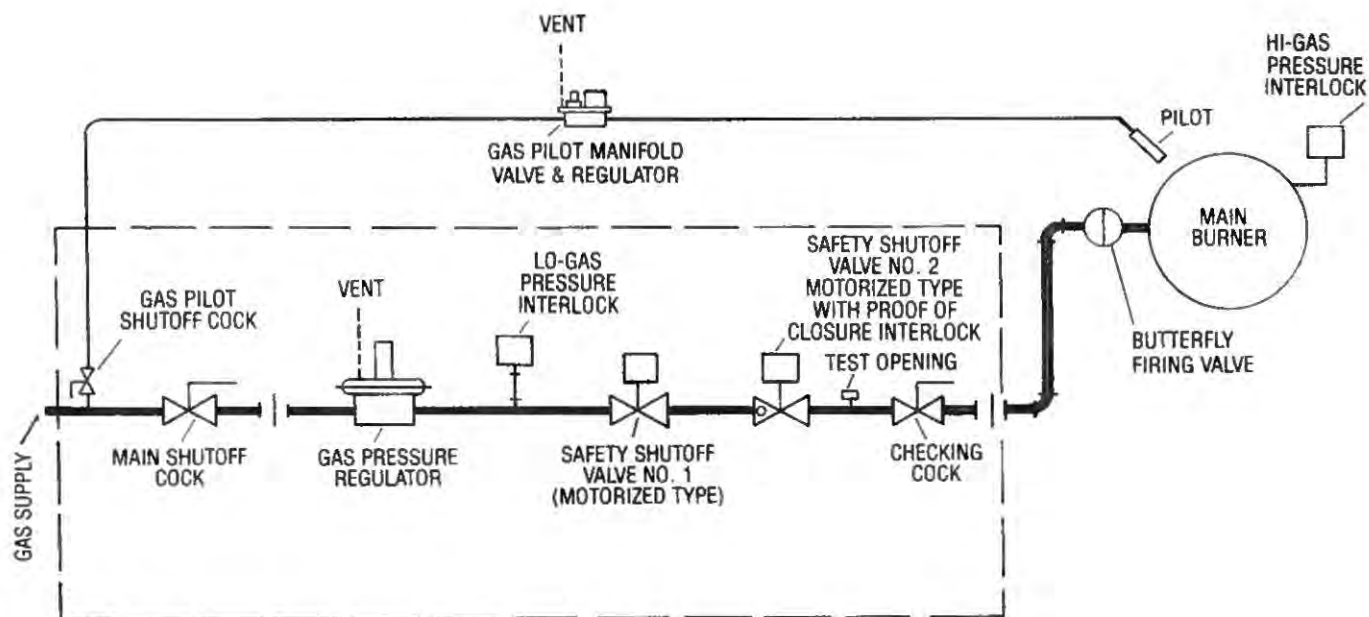
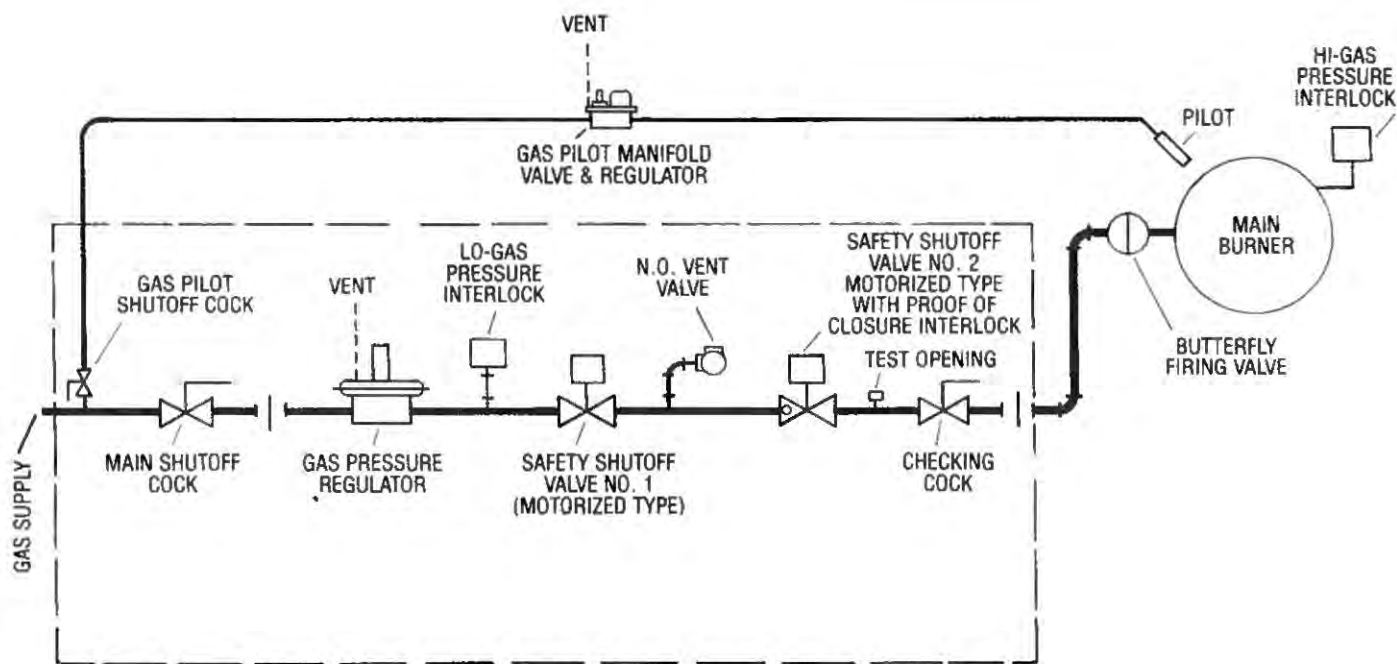


FIG. 2-1 TYPICAL GAS CONTROL GROUPS



UL & FM BTU/hr. INPUT RANGE 5,000,000 To 12,500,000



UL & FM BTU/hr. INPUT RANGE OVER 12,500,000

IRI BTU/hr. INPUT RANGE 5,000,000 AND OVER

FIG. 2-1 TYPICAL GAS CONTROL GROUPS

BOILER HORSEPOWER	60	70	80	100	125	150	200	250	300	350	400	500	600	750
GAS FLOW CFH	2511	2929	3348	4185	5231	6278	8370	10463	12554	14646	16740	20925	25110	31383
PIPE DIA.	PRESSURE DROP - IN. W.C. FOR 10 FEET													
3/4	24.34	33.11	43.26	67.60	105.62	—	—	—	—	—	—	—	—	—
1	6.96	9.47	12.37	19.32	30.19	43.49	77.30	20.79	—	—	—	—	—	—
1-1/4	1.71	2.32	3.04	4.75	7.42	10.68	18.98	29.67	42.71	58.13	75.94	118.65	—	—
1-1/2	0.74	1.00	1.31	2.04	3.19	4.60	8.17	12.77	18.38	25.02	32.69	51.07	73.54	114.88
2	0.20	0.28	0.36	0.56	0.88	1.27	2.25	3.51	5.06	6.89	9.00	14.06	20.24	31.62
2-1/2	0.08	0.11	0.15	0.23	0.35	0.51	0.91	1.42	2.04	2.78	3.63	5.67	8.17	12.76
3	0.03	0.04	0.05	0.07	0.11	0.16	0.29	0.45	0.65	0.89	1.16	1.81	2.61	4.07
4	0.01	0.01	0.01	0.02	0.02	0.04	0.07	0.11	0.15	0.21	0.27	0.43	0.61	0.96

Note:

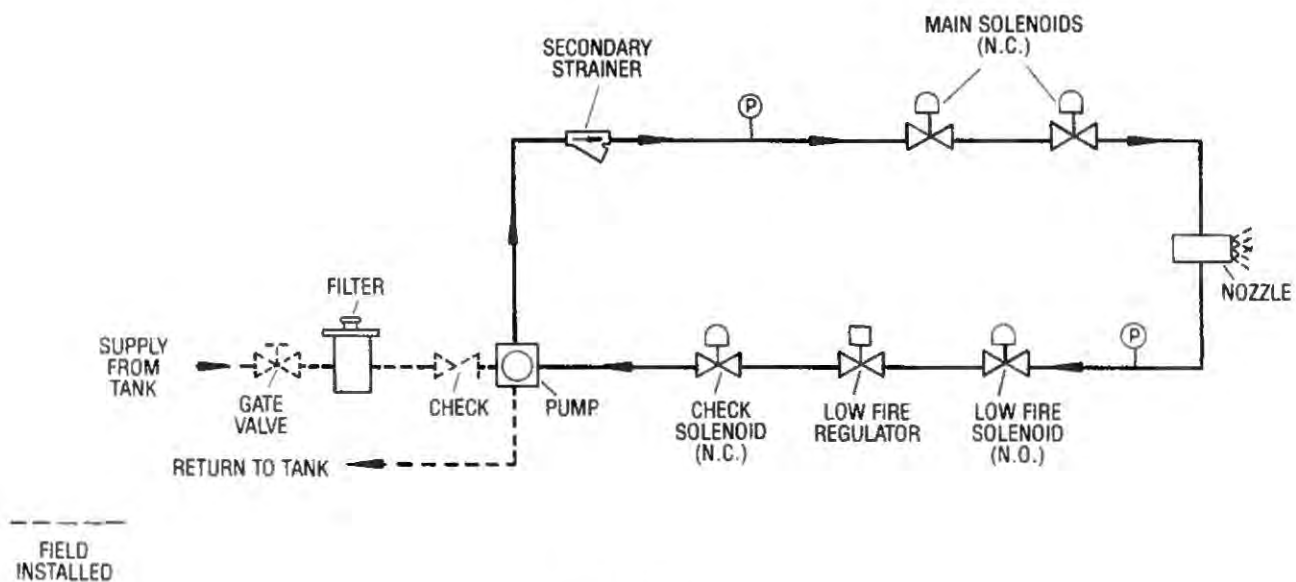
For longer lengths, pressure drop is proportionately greater.
Example: a 2" drop for 10' will be 4" for 20', etc.

FIG. 2-2

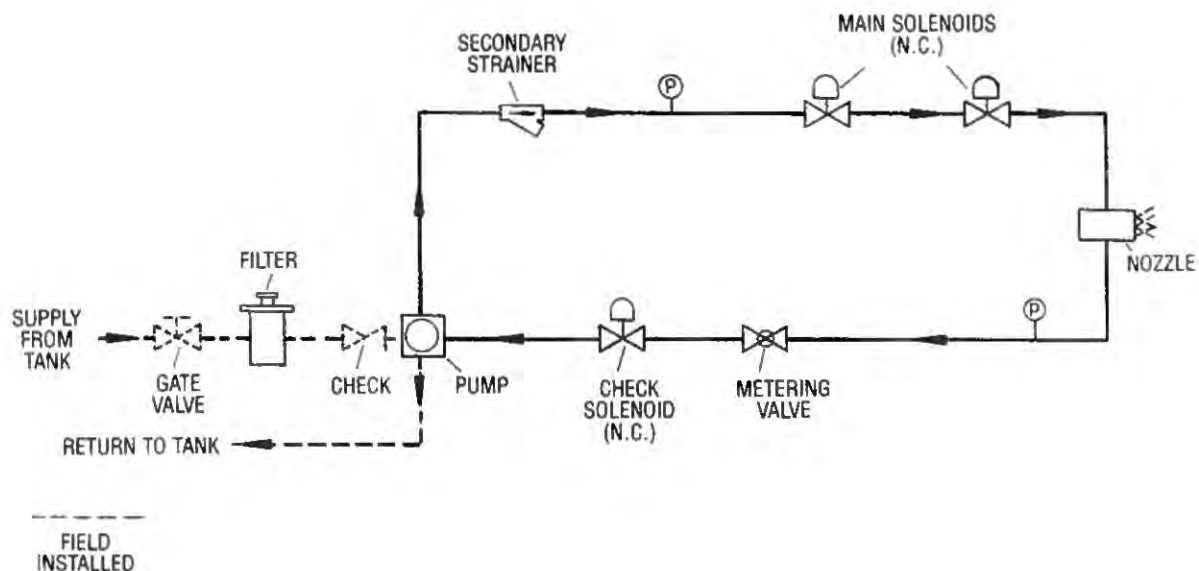
**EQUIVALENT LENGTH IN FEET OF PIPE
FOR
VARIOUS VALVES AND FITTINGS**

DESCRIPTION OF ITEM		SIZES							
		1/2	3/4	1	1 1/2	2	2 1/2	3	4
Conventional Swing Check	Fully Open	5.6	8.4	11.25	16.8	22.5	28.1	33.75	45.0
Clearway Swing Check	Fully Open	2.1	3.1	4.2	6.25	8.4	10.4	12.6	16.8
Globe Lift or Stop Check	Fully Open	14.2	21.25	28.3	42.5	56.6	70.8	84.9	113.3
Angle Lift or Stop Check	Fully Open	6.0	9.1	12.1	18.1	24.2	30.2	36.3	48.3
In-Line Ball Check	Fully Open	6.25	9.4	12.5	18.75	25.0	31.25	37.5	50.0
90 Degree Standard Elbow		1.5	2.2	2.7	4.5	5.2	6.5	8.0	11.0
45 Degree Standard Elbow		0.7	1.0	1.3	2.0	2.6	3.5	3.9	5.3
90 Degree Street Elbow		2.1	3.1	4.2	6.25	8.4	10.4	12.6	16.7
45 Degree Street Elbow		1.1	1.6	2.2	3.2	4.4	5.5	6.6	8.7
Standard Tee - With Flow Thru Run		1.0	1.3	1.7	2.8	3.5	4.3	5.2	7.0
Standard Tee - With Flow Thru Branch		3.2	4.5	5.7	9.0	12.0	14.0	16.0	22.0

FIG. 2-3

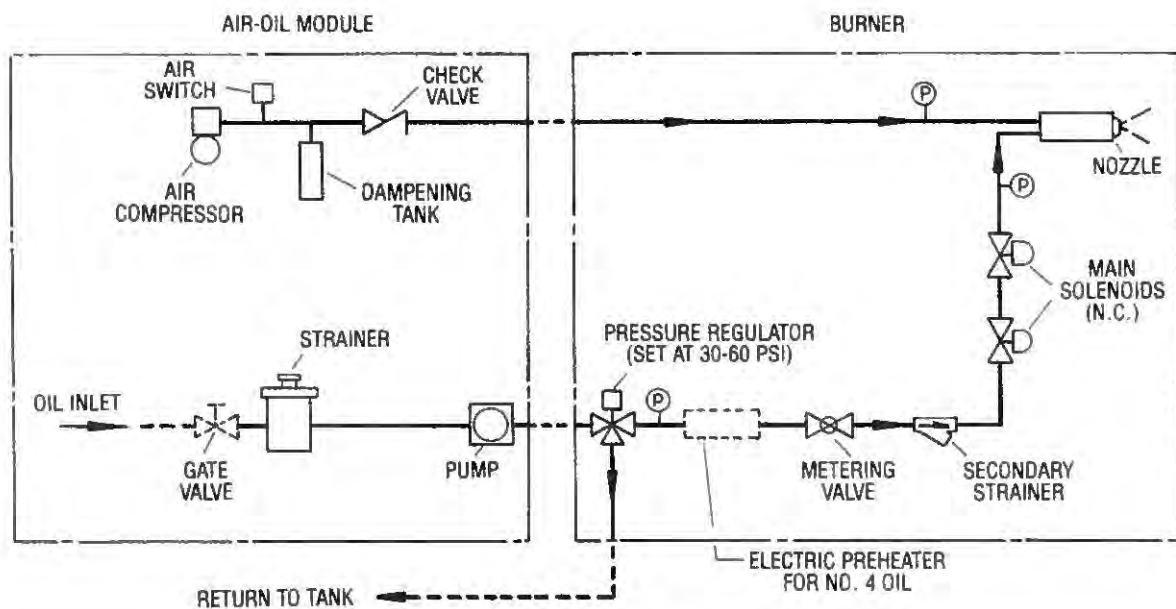


**HIGH/LOW
PRESSURE ATOMIZING NO. 2 OIL**

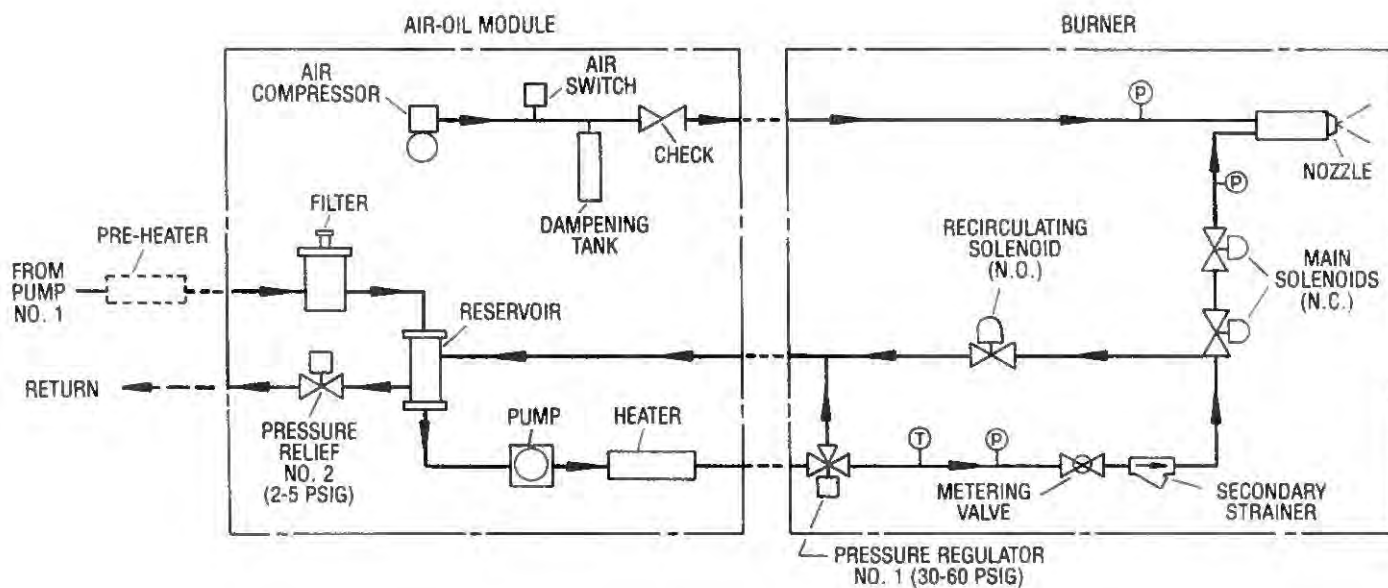


**MODULATING
PRESSURE ATOMIZING NO. 2 OIL**

FIG. 2-4 TYPICAL PRESSURE ATOMIZING NO. 2 OIL SYSTEMS

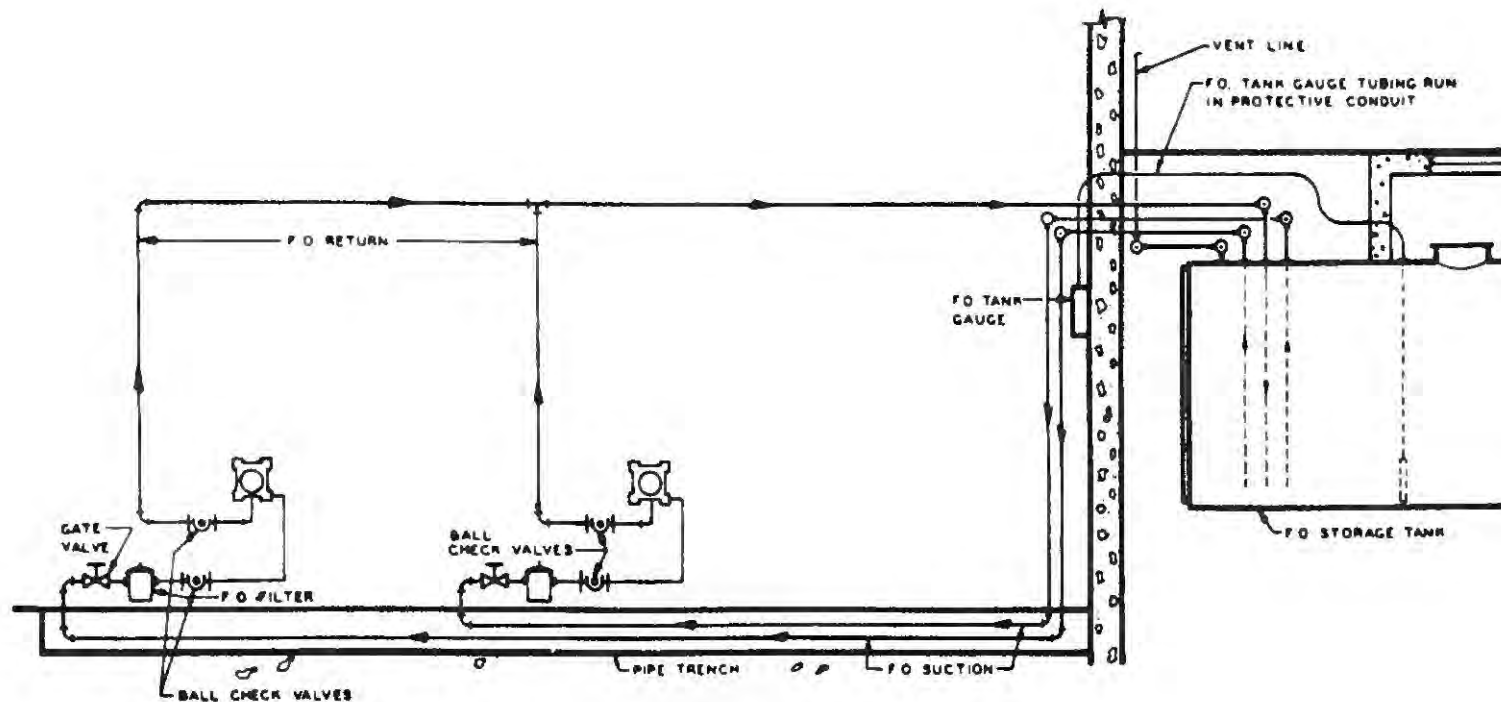


AIR ATOMIZING NO. 2 OIL



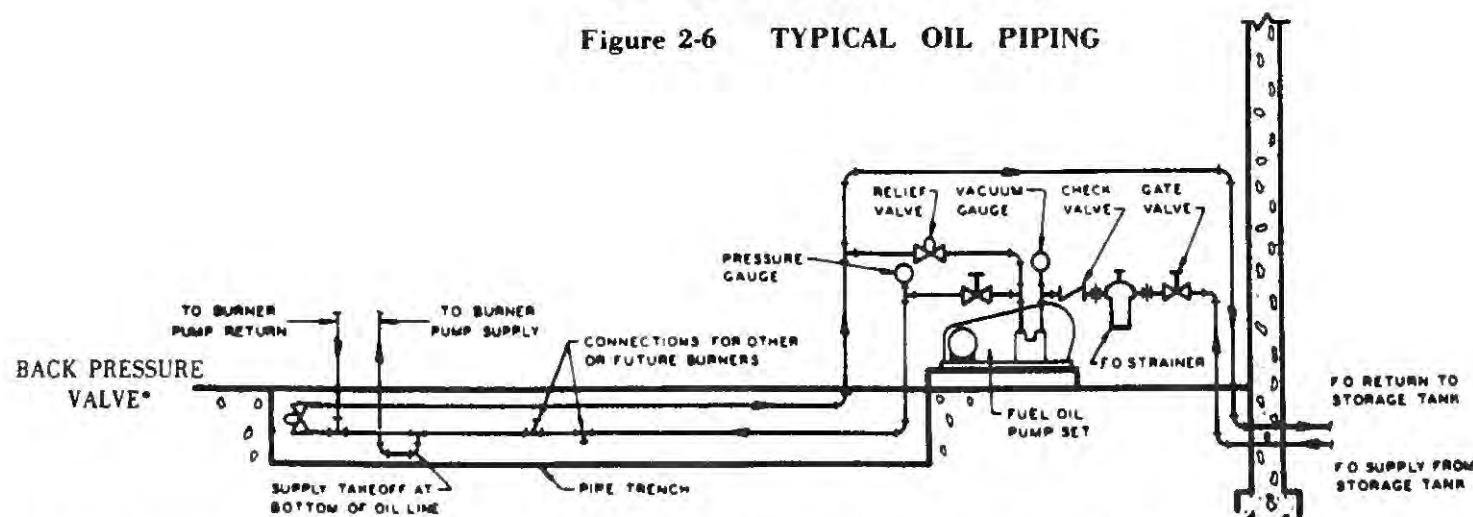
AIR ATOMIZING NO. 5 & 6 OIL

FIG. 2-5 TYPICAL AIR ATOMIZING OIL SYSTEMS



WHEN USED FOR SINGLE BURNER INSTALLATION
SIMPLY OMIT PIPING TO LEFT HAND BURNER

Figure 2-6 TYPICAL OIL PIPING



*May not be required if piping & pump are correctly sized, or if a vertical riser is used, to assure pipeline is full of oil.

FIG. 2-7 TYPICAL OIL CIRCULATING LOOP

REMOTE OIL PUMP SELECTION NO. 6 OIL												
Boiler Size	No. 6 Oil Firing Rate	Standard Burner Oil Pump Capacity @ 50 PSI	Remote Pump		Circulating Loop Oil System				Two Pipe Oil System			
			1 Boiler		2 Boilers		3 Boilers		2 Boilers		3 Boilers	
HP	GPH	GPH	GPH	No.	GPH	No.	GPH	No.	GPH	No.	GPH	No.
100	27.9	58	90	PS-3	90	PS-3	120	PS-4	120	PS-4	180	PS-6
125	34.9	58	90	PS-3	120	PS-4	150	PS-5	180	PS-6	300	PS-7
150	41.9	105	150	PS-5	150	PS-5	180	PS-6	300	PS-7	420	PS-8
200	55.8	105	180	PS-6	300	PS-7	300	PS-7	300	PS-7	420	PS-8
250	69.8	105	180	PS-6	300	PS-7	300	PS-7	300	PS-7	420	PS-8
300	83.7	105	180	PS-6	300	PS-7	420	PS-8	300	PS-7	420	PS-8
350	97.6	185	300	PS-7	300	PS-7	420	PS-8	420	PS-8	560	PS-9
400	111.6	185	300	PS-7	300	PS-7	420	PS-8	420	PS-8	560	PS-9
500	139.5	300	420	PS-8	560	PS-9	750	PS-10	750	PS-10	1250	PS-11
600	167.5	300	420	PS-8	560	PS-9	750	PS-10	750	PS-10	1250	PS-11
750	209.2	300	420	PS-8	560	PS-9	750	PS-10	750	PS-10	1250	PS-11

FIG. 2-8

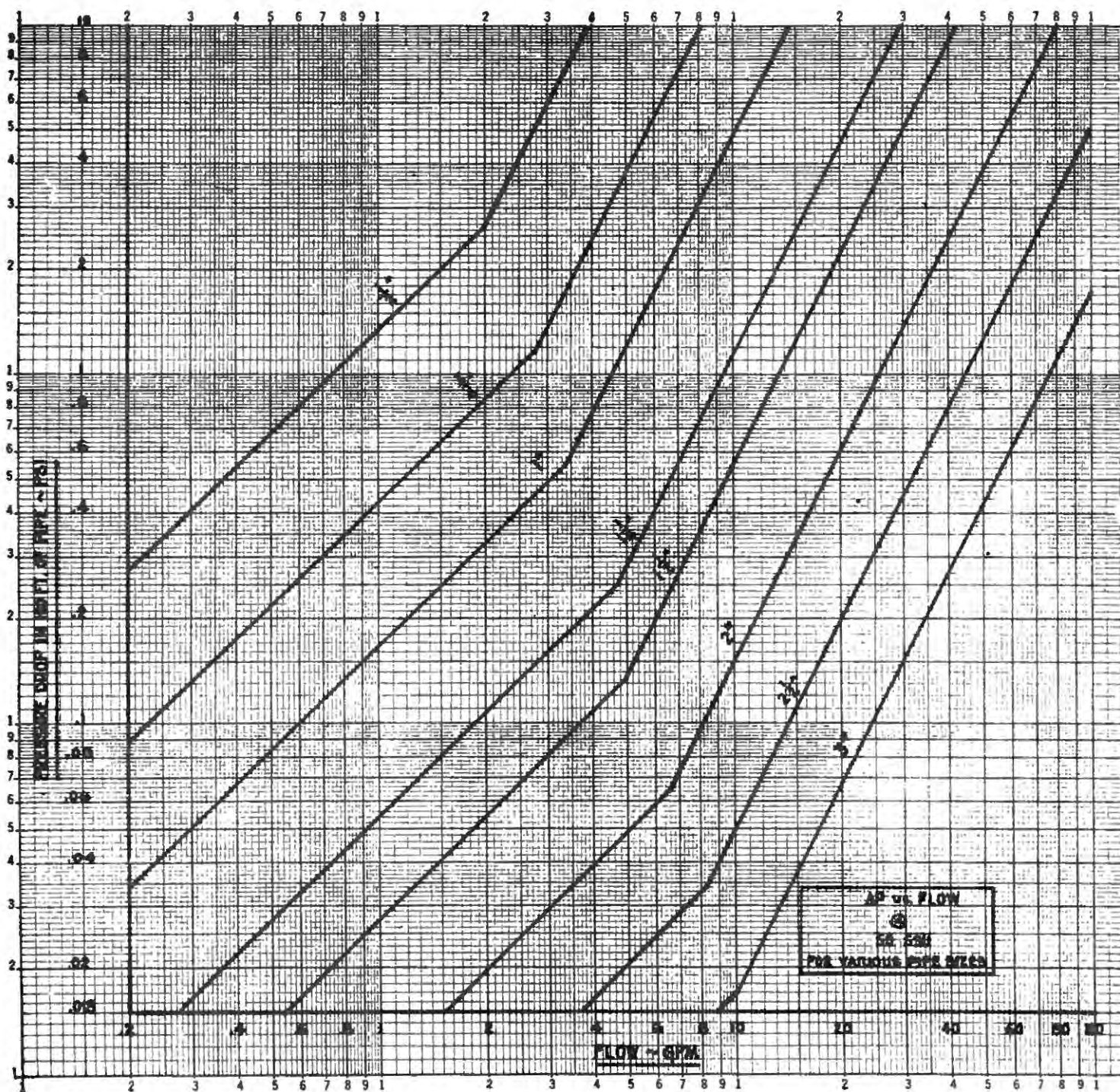


FIG. 2-9

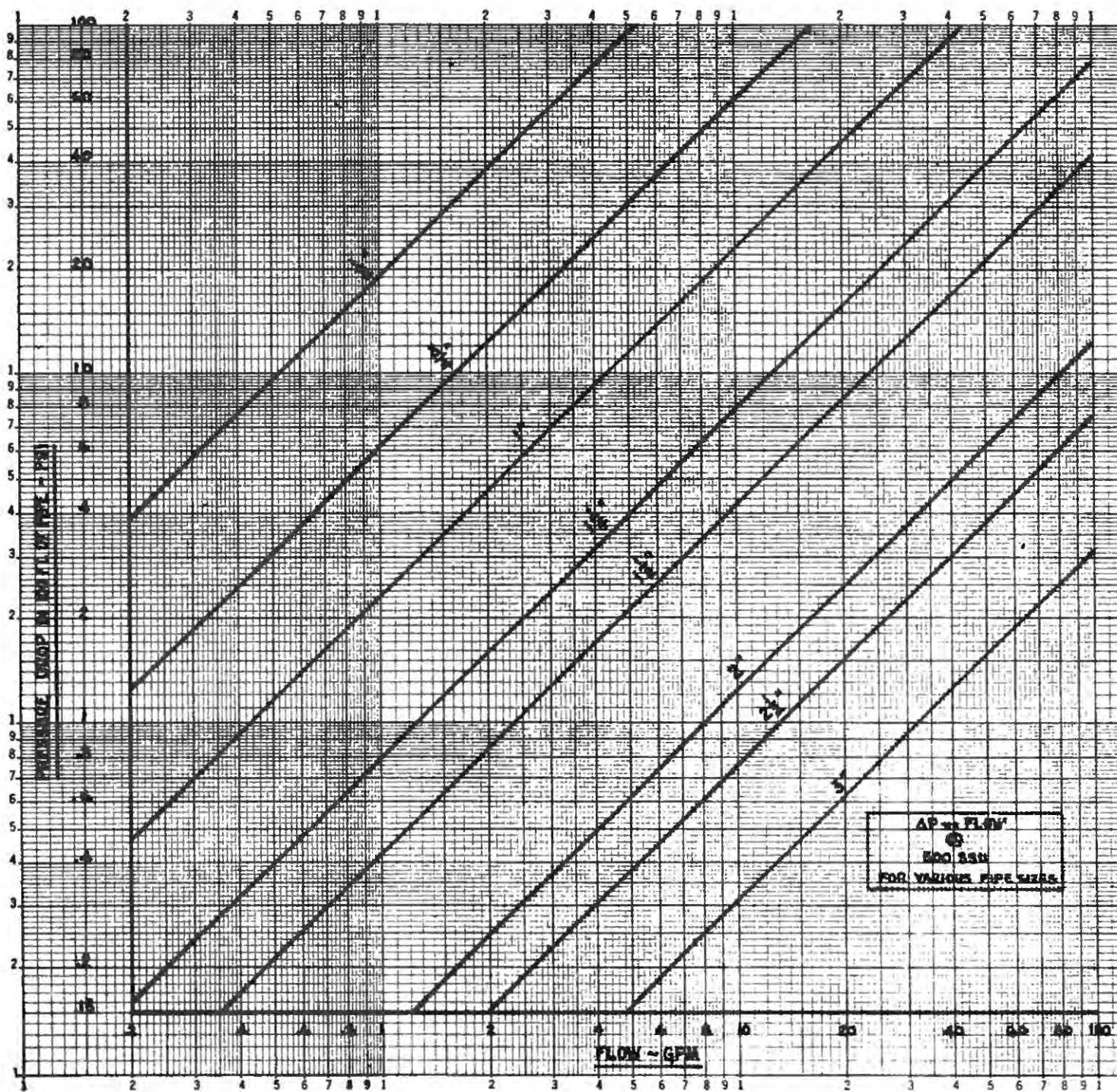


FIG. 2-10

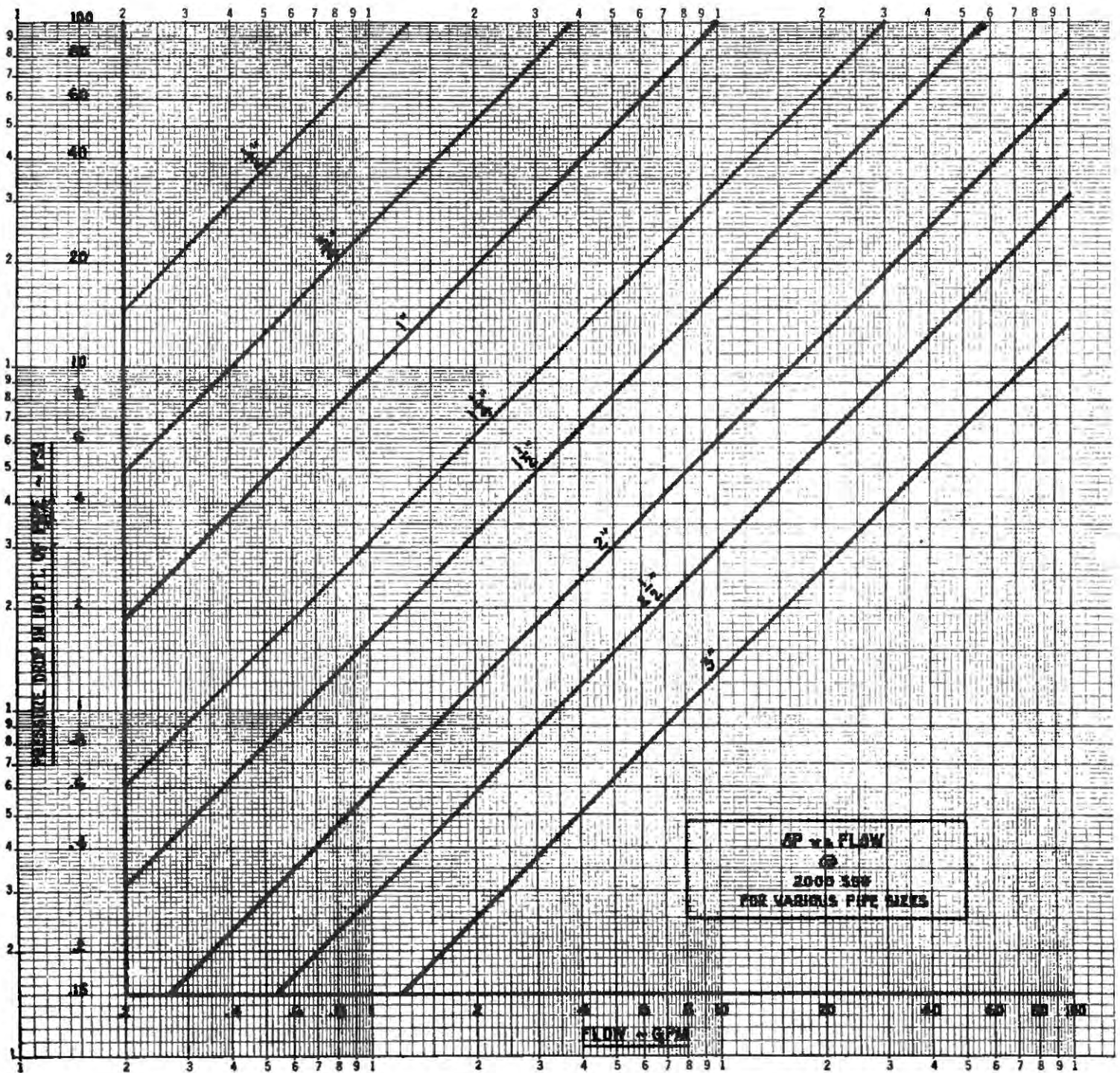
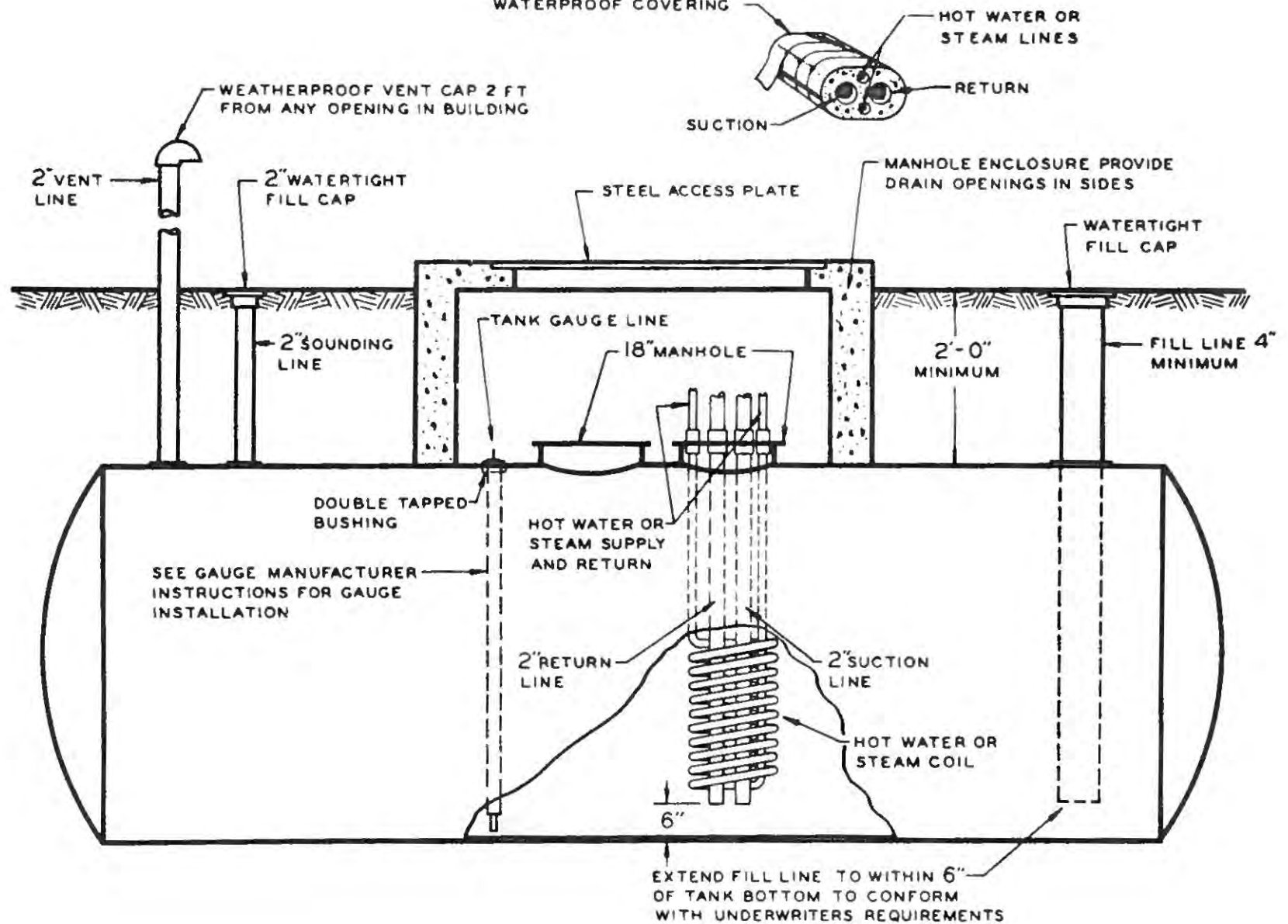


FIG. 2-11

RUN SUCTION AND RETURN UNDERGROUND PIPING
TOGETHER. PROTECT WITH INSULATION AND
WATERPROOF COVERING



NOTE: CHECK LOCAL CODE REQUIREMENTS

FIG. 2-12 TYPICAL OIL STORAGE TANK

CHAPTER 3

STARTING PROCEDURES

A. GENERAL INSTRUCTIONS— PRE-START-UP

1. Kewanee Units are functionally tested at the factory. Even though all electrical and mechanical control settings have been made in accordance with the type of operation specified, some additional adjustments may be necessary in order to provide for local fuel conditions, draft conditions, shipping damages, or changes in operating procedures.
2. A representative of the owner or the operator of the unit should be present during the original start-up in order that he may be instructed in the proper care and adjustment of the unit.
3. Some gas companies require that one of their service representatives be present at the original start-up of a gas-fired unit. Consult your local utility.
4. If heavy oil is to be used, fill tank with hot oil not more than two days before starting unit.
5. Check fuses in main panel and see that wiring to the control cabinet is completed in accordance with the wiring diagram and local code requirements.
6. Make certain that all piping is tight.
7. Check for proper rotation of blower motor, air compressor motor and oil pump motor by momentarily making contact in the motor starters. (CCW fan rotation when viewed through the air inlet; CCW air compressor rotation when viewed from the shaft end.)
8. Be sure all operating and limit controls are calling for burner operation. These controls include the low water cut-off, steam pressure or hot water temperature controls, auxiliary switch on electric oil heater, low fire switch on modutrol motor, combustion control reset, and remote switches or controls.
9. Make sure adequate gas pressure is available at the utility meter.
10. Check boiler room fresh air supply opening to avoid negative room pressure. Each 4000 Btu/hr requires 1 square inch of open area.
11. Check stack draft to assure that the boiler outlet draft is contained between + and $-1/2$ " water column.

B. GENERAL INSTRUCTIONS—CONTROLS

1. Standard primary safety controls used on Kewanee burners are as follows:
 - a. All gas fired units and/or pressure atomizing units 60 thru 400 HP use the Honeywell 4140 control with ultra-violet flame sensing.

- b. All air atomizing or combination gas/air atomizing units use the Honeywell 4140 with lead sulphide flame sensing.

On all units, including FM, IRI, etc., the wiring diagram and instruction manual for the particular control being supplied, will be found in the control cabinet.

For test purposes the 4140 control can be operated manually.

To advance the timer, turn timer knob manually. Do not turn backwards. **WARNING: CAM CONTACTS ARE LINE VOLTAGE.**

All instructions in this manual should be studied carefully, and followed closely, to obtain best results from the Kewanee Burner.

2. A microammeter control is required to measure the strength of the flame response signal. Meter leads plug directly into the flame safeguard control. Do not connect leads when power is on.
3. A manual potentiometer with "manual-automatic" operation is mounted on the control cabinet of units equipped for fully modulated firing. By setting the dial of the manual potentiometer at any position less than full fire, the travel of the modulating motor, and therefore the burner firing rate, will be limited by the dial position. When the switch is in the "automatic," position the firing rate of the burner will modulate in response to the modulating pressure or temperature control between the low-fire rate, and the maximum permitted by the dial position. When in the "manual" position, the burner firing rate will advance to the maximum rate permitted by the dial position, and remain there until the normal firing cycle is completed. The modutrol motor always returns to the low-fire position at the completion of a normal firing cycle.
4. A low-fire hold switch is provided on "High-low-off" burners which may be used to keep the burner on low-fire. Normally the burner will operate at either high-fire or low-fire depending on demand by the operating control.
5. The operator should become familiar with the location and purpose of all controls governing the burners operation. Schematic wiring diagrams and identification photographs in this manual show the most important valves, instruments and electrical controls which regulate the operation of the unit.
6. Unsafe operating conditions result in the following variations from standard operating sequence:

IGNITION FAILURE: On units with direct spark ignition, if the flame is not ignited or not properly scanned within the standard 10 sec. pilot proving time, the main fuel valve will close, and the unit will go to flame failure position as shown by the indicating light.

On units with gas-electric ignition, if the pilot is not ignited or scanner does not properly monitor the pilot, the main fuel valve will not open and the unit will go into flame failure position as shown by the indicating light.

MAIN FLAME FAILURE: Following a normal cycle—pilot on, burner on, pilot off—if the main flame is extinguished or not properly monitored by the scanner, the main fuel valve will close and the unit will go to flame failure position as shown by the indicating light.

COMBUSTION AIR FAILURE: If a failure of the air blower, or the sensing air switch occurs on units equipped to comply with UL requirements, the programming safety control will cycle through the full timing sequence, but will not energize either the pilot valve, or the main fuel valve. Recycling of the control will continue. On units with IRI or FM requirements, a safety lockout will result if the blower or air switch failure lockout during the pilot or main flame period of operation.

COMPRESSOR FAILURE: On air atomizing oil units, proper air supply for atomization is assured by the compressor air switch. If the compressor or air switch fails, the programming safety control will complete the full timing sequence, but the pilot valve and the main oil valve will not be energized. Recycling of the control will continue.

RESTARTING OF THE UNIT: To restart the unit after the burner is in lockout position:

- (1) Turn off the burner switch;
 - (2) Correct the faulty condition, if known;
 - (3) Wait about 3 minutes to allow warp switch to cool;
 - (4) Reset lockout switch of flame safeguard and other manual reset controls;
 - (5) Turn on the burner switch.
 - (6) Check operation carefully during restart cycle.
7. When No. 4, 5, or 6 oil is used, all the oil pumps must run continuously. When No. 2, or Light No. 4 is used, the oil pumps operate intermittently with the burner sequence of operations.

C. GENERAL INSTRUCTIONS— GAS-ELECTRIC IGNITION

1. All units have gas electric ignition as standard equipment for all fuels, except units of 60-80 hp, which have direct spark ignition of main flame for firing No. 2 pressure atomized oil, (Optional on units 100-125 hp).
2. Gas piping, controls and valves should be checked for compliance with local code and customer's insurance underwriter's requirement.
3. Purge the air from the pilot gas line. (Some local gas companies require that this be done by their personnel.) Close the main gas cock and the pilot gas cock.

4. Check the pilot burner for the proper settings for spark gap (Refer to Figure 5-1 or 5-2 as applicable). Open gas cock to the gas-electric igniter.
5. Change the programming control to manual operation as described in Section B, General Instructions—Controls, Paragraph 1.
6. Turn the burner switch to "On" or "gas" on combination units. Slowly advance the timer to pilot ignition ("Pilot Trial" on 4140 control). The pilot should now be ignited. Observe through inspection port in the burner or from the rear of the boiler. If the pilot fails to ignite, make checks as shown in the Honeywell data sheets included with the burner.
7. The pilot flame must be carefully adjusted for stability and proper sighting. With the 4140 control the flame response signal should be checked with the relevant data sheet in Chapter 8. The signal strength should be a steady reading of 4 micro-amperes (minimum). If the signal is not steady, or is less than the minimum, check the size of the pilot and the scanner sighting. Normal pressure to the pilot burner regulator is 6 in. W.C. for natural gas.

D. START-UP INSTRUCTIONS— PRESSURE ATOMIZING OIL WITH DIRECT SPARK IGNITION

NOTE: Before proceeding with this section, the operator should refer to Chapter 5 and familiarize himself with the following figures—

Figure 5-3 - Direct Spark Igniter Electrode Settings
Figure 5-4 - Modulating Oil Nozzle—Pressure Atomizing

Figure 5-6 - Typical Firing Head Adjustments

Figure 5-8 - Adjustment of Webster Pressure Regulator

Figure 5-10 - Oil Pump Adjustments—Pressure Atomizing Units

Figure 5-12 - Adjustment of Lo-Hi Oil Changeover Switch

Figure 5-13 - Air Damper Adjustment

On fully modulating units of 60-80 hp and 100-125 hp the operator should also refer to Figure 5-21. Figures 5-8 and 5-12 would not apply.

1. Burner units of 60-80 hp sizes, equipped for firing pressure atomized No. 2 oil only, have direct spark ignition of the main oil flame as standard equipment. (optional on units 100-125 hp).
2. Oil piping, controls and valves should be checked for compliance with local code and customer's insurance underwriter's requirements.
3. Check all linkages. The linkage and damper should be checked for opening and free operation to make sure that they were not damaged in shipment or installation.
4. Remove the pipe plug from the gage port of the oil pump to purge air from the oil piping. Connect a length of copper tubing to the port to drain the oil discharge into a can or bucket.

5. Change the programming control to manual operation as described in Section B. General Instructions—Controls, Paragraph 1.
6. Turn on the control circuit switch to "on." Turn the control panel switch to "oil." Advance the timer to the prepurge position, at which point the blower motor will start, assuming power is available and all limit switches are closed. The integrally mounted oil pump is driven by the blower motor through a vee-belt (60-80 hp).
7. If pump does not pick up oil within a few minutes, prime the oil pump as follows: Turn burner switch to "off," close gate valve in suction line to prevent vacuum loss, open the oil strainer and fill strainer with fuel oil or lubricating oil. Do not allow pump to run more than a few minutes without additional lubrication. When replacing the oil strainer cap, be very careful to assure a vacuum-tight seal.
8. Operate the oil pump until oil is obtained from the tank and the oil runs clear into the can or bucket. A milky appearance of the oil indicates air in suction line. The flame safeguard may trip out on safety while pumping oil. If necessary, push reset button to repeat operation after safety switch cools.
9. Turn burner switch to "off." Remove copper purging line and install oil pressure gage with a high range of not less than 400 psi.
10. Turn the burner switch to "on." Slowly advance the timer to pilot ignition "pilot trial" on Honeywell 4140. At this point, the spark ignition should come on, and the oil valves open. The main flame should be ignited almost immediately. For smooth light-off, ignition should occur in 1-2 seconds. If light-off does not take place immediately, check the ignition transformer, ignition electrodes, spark gap, and location of gap in relation to oil spray. Also check whether there is immediate delivery of oil to the nozzle.

Note that with the flame safeguard control in automatic operation, the trial for ignition is 10 seconds. If flame is not established in this period, the control will lock out in the flame failure position.

11. After the main flame has been established, advance the timer to the main burner position. The burner will now be under the control of the firing rate controller. On units for which the operation is high-low, the burner system consists of a main oil valve, a low-fire oil valve, an electric check valve, and pressure regulating valve. At low-fire, all valves are open, and the pressure regulator is set to limit the return flow line pressure to the value shown in Figure 3.1. At high-fire, the low-fire valve and check valve are closed, and the full pump pressure is imposed on the nozzle. An end switch in the two-position damper motor controls the low-fire oil valve.
12. Operate the burner at low fire until water in the boiler is warm.
13. High firing rate should be set at whatever input is required to meet maximum load demands. If such

demand loads are not known, set high fire at published input rating.

On water boilers, condensed flue gases may damage boiler, breeching, and stack if the low firing rate or boiler water temperature are too low. Setting the low fire at 1/3 of the high fire rate with boiler water temperature at 170°F or higher will normally prevent such condensation.

14. Adjust the fuel-air ratio to obtain 10.5 to 12.5 percent CO₂ at high fire by flue gas analysis, with a smoke rating not in excess of No. 2 on the Shell-Bacharach smoke scale. Check settings for both high and low firing rates.
15. After completion of the above adjustments and checks, return the flame safeguard control automatic operation by returning the check run switch to the run position.

CAUTION: Turn power off before making change. Recycle the burner several times under full automatic program control, checking burner operation and signal response.

E. START-UP INSTRUCTIONS— PRESSURE ATOMIZING OIL WITH GAS-ELECTRIC IGNITION

NOTE: Before proceeding with this section, the operator should refer to Chapter 5 and familiarize himself with the following figures—

Figure 5-1 or 5-2 - Gas-Electric Ignition

Figure 5-4 - Modulating Oil Nozzle—Pressure Atomizing

Figure 5-6 - Typical Firing Head Adjustments

Figure 5-10 - Oil Pump Adjustments—Pressure Atomizing Units

Figure 5-13 or 5-14 - Air Damper Adjustments

Figure 5-21 - Oil Metering Valve Drive Adjustments

1. Kewanee Burners 100-400 hp have a fully modulated oil firing system with gas-electric ignition as standard equipment.
2. Check oil piping, gas piping, valves, and linkages, and prime the oil pump, as outlined in Section D, Chapter 3.
3. Check the pilot operation as outlined in Section C, Chapter 3, "General Instructions, Gas-Electric Ignition."
4. With the pilot ignited, proceed to light-off the main burner. Advance the 4140 timer to a dial reading of "Ignition Trial." At this time the oil solenoid valve will open, as indicated by the "Main Fuel" light. After a slight delay, oil will be delivered to the nozzle and the main flame will be established. If the oil flame is not established within a few seconds, check to be certain that the pilot is ignited; then check for a closed manual valve in the oil circuit. Finally check the electrical circuit of the oil solenoid valve, including all interlocks. (Refer to the unit wiring diagram.)
5. Set the oil pressure for proper firing at low fire. Oil pressure may vary according to quality of the oil,

capacity desired, or need for matching oil flow to air supply required for gas firing of combination units. Figure 3-1 shows typical operating pressures that may be used.

6. Restart the burner several times to check for smooth light-off.
7. Operate the burner at low-fire until the water in the boiler is warm.
8. Bring the burner to high-fire by advancing the 4140 timer to "Main Burner." The burner is now released to the modulating control system. Turn the manual potentiometer switch to "Manual" and bring the motor to the high-fire position.
9. High firing rate should be set at whatever input is required to meet maximum load demands. If such demand loads are not known, set high fire at published input rating. The operator may reduce the high fire rate by the manual potentiometer setting on "Auto" position during low load demand periods.

On water boilers, condensed flue gases may damage boiler, breeching, and stack if the low firing rate or

boiler water temperature is too low. Setting the low fire at $\frac{1}{3}$ of the high fire rate with boiler water temperature at 170° F or higher will normally prevent such condensation.

10. Adjust the fuel-air ratio to achieve a combination rating of 10.5 to 12.5 percent CO₂ at high fire by flue gas analysis with a smoke rating not in excess of No. 2 on the Shell-Bacharach smoke scale. Check oil pressures and combustion efficiencies for both high and low firing rates.
11. After completion of the above adjustments and checks, return the flame safeguard to automatic operation by returning the check run switch to the run position.

CAUTION: Turn power off before making change. Recycle the burner several times under full automatic operation. Check the flame response signal during the pilot proving and main flame periods to be certain there is a steady signal present. Make any corrections necessary to obtain the steady signal.

**FIG. 3-1
PRESSURE ATOMIZING OIL BURNER
NOZZLE SIZES AND TYPICAL OPERATING PRESSURES**

Note: Nozzles may be Delavan #33769 or Monarch F-80-BPS with 60° spray angle. 3 nozzles required per burner.

Hi-Lo Burners						
Burner Size BHP	Nozzle Size		Pump Pressure		Lo-Fire Regulator	
	Delavan (GPH @ 100 PSIG)	Monarch	Delavan PSIG	Monarch PSIG	Delavan Pressure Setting	Monarch PSIG
60	4.0	4.0	230	235	55	75
70	4.5	4.5	245	250	70	95
80	5.0	5.0	260	265	65	105

Modulating Burners								
Burner Size BHP	Nozzle Size		Pump Pressure		By-Pass Pressure			
	Delavan (GHP @ 100 PSIG)	Monarch	Delavan PSIG	Monarch PSIG	Lo-Fire		Hi-Fire	
					Del.	Mon.	Del.	Mon.
60	4.0	4.5	300	300	50	75	130	170
70	4.5	5.0	300	300	60	95	155	190
80	5.0	5.5	300	300	55	120	135	195
100	6.5	6.5	300	300	75	60	155	205
125	8.0	8.0	300	300	65	95	150	195
150	9.5	9.5	300	300	70	95	155	235
200	12.0	12.0	300	300	50	75	140	235
250	16.0	15.3	300	300	50	60	130	250
300	20.0	19.5	300	300	50	60	140	230
350	22.0	21.5	300	300	30	70	155	235
400	24.0	24.0	300	300	30	78	150	235

NOTE: The above pressures are based on No. 2 oil having a viscosity of 35 SSU and will vary slightly depending upon the viscosity of the oil used. All pressures noted above are ± 5 psig.

F. START-UP INSTRUCTIONS— AIR ATOMIZING OIL FIRING

NOTE: Before proceeding with this section, the operator should refer to Chapter 5 and familiarize himself with the following figures—

Figure 5-1 or 5-2 - Gas-Electric Ignition

Figure 5-5 - Air/Oil Nozzle

Figure 5-6 or 5-7 - Typical Firing Head Adjustments

Figure 5-8 - Adjustment of Webster Pressure Regulator

Figure 5-9 - Adjustment of Cash-Acme Pressure Regulator

Figure 5-11 - Adjustment of Oil Metering Valve Orifice (for burners 500 hp and above)

Figure 5-14 thru 5-17, as applicable - Air Damper Adjustments

Figure 5-22 or 5-23 - Oil Metering Valve Drive Adjustments

1. Oil piping, gas piping, controls and valves should be checked for compliance with local utility and customer's insurance underwriter's requirements.
2. Check all linkages. The linkage and damper should be checked for opening and free operation to make sure that they were not damaged in shipment or installation.
3. Change the programming control to manual operation as described in Section B, General Instructions—Controls, Paragraph 1.
4. Check the oil level in the compressor. Maintain the oil level between the marks on the bayonet dipstick. Do not fill above the full mark.
5. On units using 5 or 6 oil, the oil pumping system is designed for continuous operation. The burner pump is controlled by the heater switch in the auxiliary control cabinet. When the heater switch is in the "On" position, the oil pump motor will run constantly (assuming that power is available at the control cabinet). Also, the electric oil heater will be energized, and will maintain the oil temperature at the setting of the heater thermostat.

On combination gas and No. 5 or 6 oil units, it is recommended that the oil pump be operated periodically when firing on gas to prevent oil from "setting up" in the oil lines.

On the air atomizing No. 4 oil units the oil heater is energized by the burner switch on straight oil units or by the fuel selector switch air combination burners, the oil pump only operating when the fan motor is running.

Air atomized burners with No. 2 oil do not have an electric heater. The oil pump motor is interlocked with the control system, and will run only when the burner runs.

6. To assure that the oil heater is filled, and to purge the oil piping of all air, proceed as follows:
 - (a) On units with an electric heater (No. 4, 5, or 6 oil), remove the wire from terminal 10 in the auxiliary control cabinet to de-energize the oil heater contactor. This prevents heater operation

before the heater well is completely filled. After disconnecting the power to the electric heater, remove the pipe plug from the tee on the heater outlet. On units with no electric heater (No. 2 oil), remove the pipe plug from the tee on the pump discharge.

- (b) Connect a length of copper tubing to the opening to drain the oil discharge into a can or bucket.
 - (c) On units using No. 5 or 6 oil, start the oil pump by means of the heater switch. On No. 2 or No. 4 oil units, turn on the control circuit switch to "on". Turn the control panel switch to "Oil". Advance the timer to the pre-purge position, at which point the blower and oil pump motors will start, assuming power is available and all limit switches are closed.
7. If pump does not pick up oil within a few minutes, prime the oil pump. Turn off oil pump motor, close gate valve in suction line to prevent vacuum loss, open the oil strainer and fill strainer with fuel oil or lubricating oil. Do not allow pump to run more than a few minutes without additional lubrication. When replacing the oil strainer cap, be very careful to assure a vacuum-tight seal.
 8. Operate the oil pump until air-free oil is obtained from the tank. In the case of No. 2 oil, the oil should run clear when run into a can or bucket. A foamy appearance of oil indicates an air leak in the suction line. A suction line air leak on Nos. 4, 5, or 6 oil will be readily apparent as an accumulation of air bubbles.
 9. Turn off the oil pump motor. Remove the copper purging line and replug the openings. On units using No. 4, 5 or 6 oil, replace the oil heater contactor wire on Terminal 10, turn on the oil pump motor at the heater switch, and permit the heater to operate until the oil is hot enough for proper burning. Refer Fig. 3-3.
 10. Check the operation of the gas pilot as outlined in Section C—"General Instructions. Gas-Electric Ignition."
 11. With the pilot ignited, proceed to light-off the main burner. Advance the 4140 timer to 'Ignition Trial'. At this time the main oil solenoid valve will open, provided the compressor air proving switch indicates adequate atomizing air pressure. The "Main Fuel" light will go on (on No. 5 or 6 oil units, the circulating oil valve will close). After a slight delay to fill the nozzle line with oil, oil will be delivered to the nozzle, and the main flame will be established.

If the oil flame is not established within a few seconds on the initial light-off, it may be due to cold oil in the nozzle line. To correct, shut the burner off, and remove the oil nozzle assembly from the burner, and also the oil line from the solenoid valve to the nozzle assembly. Blow out with air, and replace. Proceed to establish the main oil flame as outlined above, after the electric heater has heated the oil to proper burning temperature. Refer Fig. 3-3.

12. Operate the burner at low fire until the water in the boiler is warm.
13. Oil pressure and atomizing air pressure may vary depending on the quality of the oil, the oil temperature, or the capacity desired. Figure 3-2 shows the normal range of pressures that may be expected at various firing rates of 150 SSU No. 5 oil.

Oil pressure adjustments should be made as follows: (refer to Figure 2-5 for identification)

**FIG. 3-2
TYPICAL AIR AND OIL PRESSURES-
MONARCH NOZZLE-
AIR ATOMIZING OIL UNITS**

Unit	Air Pressure - PSI		Oil Pressure To Nozzle - PSI	
	Lo-Fire	Hi-Fire	Lo-Fire	Hi-Fire
100	28-32	44-48	24-28	46-50
125	30-34	48-52	28-32	50-54
150	17-21	24-28	14-16	26-30
200	14-18	22-26	11-13	25-29
250	14-18	24-28	13-15	25-29
300	17-21	26-30	14-18	28-32
350	13-17	21-25	8-12	26-30
400	15-19	21-25	10-14	24-28
500	18-22	25-29	11-15	31-35
600	17-21	28-32	15-19	44-48
750	14-18	32-36	14-18	46-50

Note: All pressures above are ± 5 psig.

- 1) Pressure relief valve No. 2 (upstream of the burner oil pump) should be set at a maximum of 5 psig to protect the pump seals from excessive pressure supplied by the remote oil pump.
 - 2) Pressure regulating valve No. 1 (upstream of the metering valve) should be set at the necessary pressure to supply the desired input of oil with the metering valve in high fire position. Normally, this will range from 30 to 60 psig. The metering valve will regulate the flow to the nozzle at intermediate firing rates.
- Atomizing air pressure normally will require no adjustment since the air pressure varies automatically with the oil pressure. Adjustable sheaves on air compressors permit a reduction in the volume of atomizing air if desired.
14. Proper oil temperatures must be maintained to insure good combustion of all grades of fuel oil. The

following table shows the normal oil temperatures that may be required.

FIG. 3-3 TYPICAL OIL TEMPERATURES

Grade of Oil	Temperature (° F)
No. 2 Oil	No heat
No. 4 Oil	80-120
No. 5 Oil	
Light (under 300 SSU)	120-150
Heavy (over 300 SSU)	150-175
No. 6 Oil	
Light (under 3000 SSU)	180-225
Heavy (over 3000 SSU)	225-260

* All SSU ratings at 100°F

The thermostat on the electric oil heater should be set to maintain the oil temperature high enough to equal 135 to 150 SSU viscosity oil. The auxiliary (cold oil lockout) switch should be set approximately 20°F below the thermostat setting. When an oil pre-heater is used, the temperature regulator should be set approximately 10°F below the electric heater thermostat setting.

15. Bring the burner to high fire by advancing the 4140 timer to "Main Burner" on the dial. The burner is now released to the control of the modulating control system. Turn the manual potentiometer switch to "Manual" and bring the motor to the high fire position.
 16. High firing rate should be set at whatever input is required to meet maximum load demands. If such demand loads are not known, set high fire at published input rating. The operator may reduce the high fire rate by the manual potentiometer setting on "Auto" position during low load demand periods.
- On water boilers, condensed flue gases may damage boiler, breeching, and stack if the low firing rate or boiler water temperature is too low. Setting the low fire at 1/3 of the high fire rate with boiler water temperature at 170°F or higher will normally prevent such condensation.
17. Adjust fuel-air ratio to achieve 10.5 to 12.5 percent CO₂ at high fire by flue gas analysis with a smoke rating not in excess of No. 2 on the Shell-Bacharach smoke scale. Check air and oil pressures and combustion efficiencies for both high and low firing rates.
 18. After completion of the above adjustments and checks, return the flame safeguard control to automatic operation by returning the check run switch to the run position. **CAUTION: Turn off power before making change. Recycle the burner several times under full programmer operation. Check with a micro-ammeter during the pilot proving and main flame periods to be certain there is a steady signal present. Make any corrections necessary to obtain the steady signal.**

G. START-UP INSTRUCTIONS— GAS FIRING

NOTE: Before proceeding with this section, the operator should refer to Chapter 5 and familiarize himself with the following figures—

Figure 5-1 or 5-2 - Gas-Electric Igniter

Figure 5-6 or 5-7 - Typical Firing Head Adjustments

Figure 5-13 thru 5-17, as applicable - Air Damper Adjustments

Figure 5-18, 5-19 or 5-20 - Gas Metering Valve Drive Adjustments

1. The gas piping, controls and valves should be checked for compliance with local utility and customer's insurance underwriter's requirements.
2. Check all linkages. The linkage and damper should be checked for opening and free operation to make sure that they were not damaged in shipment or installation.
3. Check the operation of the gas pilot as outlined in Section C—"General Instructions, Gas-Electric Ignition."
4. With the pilot ignited, proceed to light-off the main burner. Advance the 4140 timer to a dial reading of "Ignition Trial." At this time the operating gas valve and the safety gas valve will open. Slowly open the manual gas shut-off valve. If the gas line has been properly purged of air, the main flame will be established almost immediately. If it is not established in a few seconds, shut off the manual gas valve. Check the operating and safety gas valves to be sure that they are open. Check the firing (butterfly) valve to be sure it is open for a proper low fire. Check the inlet gas pressure and the pressure downstream from the gas train pressure regulator. If all valves open properly, and if the proper gas pressure has been established, the main flame should light.
5. Restart the burner several times to check for smooth light-off.
6. Operate the burner at low fire until the water in the boiler is warm.
7. Bring the burner to high fire by advancing the 4140 timer to "Main Burner." The burner is now released to the control of firing sequence system. On a system with high-low fire sequence (60 thru 80), if there is not sufficient demand for heat to close the switch of the firing rate controller, jumper terminal 9 to 10. This will by-pass the controller, and the damper motor will drive to the high fire position. On a system with modulating firing sequence (100 thru 750), turn the manual potentiometer switch to "Manual" and bring the motor to the high fire position.
8. With the burner in high fire position, check the input at the gas meter, making due allowance for any pressure or temperature correction factors. Minor changes in the firing rate may be affected by increasing or reducing the outlet gas pressure at the pressure regulator on the gas train.

9. High firing rate should be set at whatever input is required to meet maximum load demands. If such demand loads are not known, set high fire at published input rating. On units with modulating fire control, the operator may reduce the high fire rate by the manual potentiometer setting on "Auto" position during low load demand periods.

On water boilers, condensed gases may damage boiler, breeching, and stack if the low firing rate or boiler water temperature is too low. Setting the low fire at 1/3 of the high fire rate with boiler water temperature at 170°F or higher will normally prevent such condensation.

10. Adjust the fuel-air ratio to achieve a combination rating of 8½ to 10 percent CO₂ at high fire by flue gas analysis, with zero CO. Check gas pressures and combustion efficiencies for both high and low firing rates.
11. After completion of the above adjustments and checks, return the flame safeguard to automatic operation by returning the check run switch to the run position.

CAUTION: Turn power off before making change. Recycle the burner several times under full automatic operation. Check the flame response signal during the pilot proving and main flame periods to be certain there is a steady signal present. Make any corrections necessary to obtain the steady signal.

H. START-UP INSTRUCTIONS— GAS-OIL FIRING

1. Set fuel burning equipment in accordance with the specific instructions listed in this chapter for the primary fuel to be used. In most cases the gas firing will be set first.
2. Adjust burner in accordance with the specific instructions listed in this chapter for the secondary fuel to be used. Oil pressure may require resetting to match gas input and to secure a smooth start.
3. Linkage for gas butterfly valve may be adjusted as required without changing the setting of the oil control valve.
4. The change from gas to oil requires:
 - (a) Change fuel selector switch from "gas" to "off."
 - (b) Close main gas shut-off valve.
 - (c) Change fuel selector switch from "off" to "oil."
5. Change from oil to gas requires:
 - (a) Change fuel selector from "oil" to "off."
 - (b) Open main gas shut-off valve.
 - (c) Change fuel selector switch from "off" to "gas."

MAINTENANCE PROCEDURES

A. GENERAL MAINTENANCE

1. After the burner has been started and adjusted, linkage settings, fuel pressures and control settings should not be changed or tampered with by persons not thoroughly experienced with the burner and fuel system. Service calls caused by "tinkeritis" or poor maintenance procedures are not covered by any "free service" plan.
2. With units firing No. 5 or 6 oil, it is preferable to have continuous operation, rather than shutting the burner down over weekends or similar off periods. Less difficulty will be experienced and a better overall economy obtained.
3. Keep a constant check on the fuel supply. Do not depend on "automatic delivery"—watch the supply yourself. Check fuel gages on the oil tank. Keep track of the supply, and re-order before the tank is empty.
4. Keep the burner clean. Do not allow fuel to leak anywhere—it is dangerous. A clean environment is essential to first class boiler operation.
5. Keep the burner control cabinet door closed. The electrical contacts in the cabinet are very sensitive to dust and dirt.
6. Never close vents supplying air to the boiler room. If cold air currents cause difficulty with other boiler room equipment, air ducts should be installed to direct the flow of fresh air.
7. Repair all leaks promptly. All piping connections to the burner and accessories should be maintained leak-proof because even a minor leak, if neglected, may soon become serious.

B. WEEKLY MAINTENANCE

1. Check all burner linkages to be sure that there has been no change from its original marked position. Tighten if necessary.
2. Note condition of belts on the oil pump, and compressor of air atomizing units. Have spare belts available and replace any cracked belts. Excessive side wear indicates need for realigning sheaves or correcting belt tension.
3. Check compressor oil pressure and maintain at 15 psig. Check oil level and maintain between high and low level marks on the dipstick. Do not overfill with oil.

C. MONTHLY MAINTENANCE

1. Check ignition assembly and electrode. Clean if necessary.
2. Clean oil atomizing nozzle if necessary. Never use a sharp instrument on the nozzle. If nozzle becomes damaged, replace it. On burners firing No. 5 or No. 6

oil, more frequent nozzle cleaning may be necessary.

3. Clean flame detector lens with a soft lint free cloth; check scanner cell.
4. Check air dampers and blower wheel. Remove any accumulation of lint or dirt.
5. Inspect condition of refractory.
6. Clean intake filter element on the air compressor in non-flammable solvent. The frequency of cleaning will depend on air supply conditions. The standard air filter is of sufficient size and design to meet normal conditions. If there is considerable dust, dirt and other contaminants, the standard filter should be replaced with an oil bath filter.
7. Inspect the oil strainer and clean if necessary. The frequency of cleaning will depend upon the frequency of the burner operation, and the quality of oil in use. Be sure the cap gasket is in good order and mating surfaces are clean. A light coat of clean oil will help secure a vacuum-tight joint.
Note: Close the gate valve ahead of the strainer before removing the cap to prevent loss of oil prime.
8. Lubricate motors in accordance with motor manufacturer's instructions.
9. Change compressor oil every 90 days or after 500 hours of operation, whichever comes first. A list of acceptable oils is given in Chapter 5 under "Air Compressor."

D. ANNUAL MAINTENANCE

1. Have the unit inspected and checked by your local Kewanee Service Representative.
2. Replace amplifier module and scanner cell in electronic controls. This replacement is inexpensive insurance against future service calls.
3. Check condition of oil tank. Clean and remove sludge if necessary.
4. Drain and clean sediment and accumulated carbon from electric oil heater and boiler mounted oil heater.
5. If the burner is to be out of service for the summer, be sure to close all valves and break all power connections to the burner and auxiliaries.
6. **CAUTION: Humidity Effects:** To protect against high resistance leakage in the electronic circuit resulting from high humidity, it is recommended that the Flame Safeguard Control be left powered continually even when not in operation. If it is necessary to shut down completely for an extended period, the control should be thoroughly cleaned, and power should be turned on for 48 hours before putting the control back in operation.

E. SPECIAL INSTRUCTIONS - BLOWER WHEEL INSPECTION

CAUTION

It is possible that the blower wheel has a limited life cycle, as do many moving or rotating parts, which means that the wheel could eventually fail. Wheel failures are not uncommon as such, and can be caused by many factors, including the forces that act on the wheel, its operating environment, improper installation, improper maintenance, manufacturing defects, and operation in excess of its design limitations.

Because of the wide range of operating conditions on the burners, some wheels may last indefinitely while others may fail prematurely.

This type of wheel failure is usually preceded by a noticeable vibration to anyone near the burner. If the boiler operator ignores this vibration and continues operation of the boiler, a failure may result. To prevent the possibility of a failure from occurring, the burner should be shut down immediately. Periodic inspection should be made of the wheel for any cracks by the following inspection procedure. If cracks are found, they indicate that the wheel has reached or exceeded its life cycle; the wheel should not be operated again, and must be replaced.

INSPECTION INSTRUCTIONS

No special tools are required. A dental style mirror may allow easier inspection.

1. Disconnect and lock the electrical power off.
2. Remove the burner plenum cover.
3. After the plenum cover is removed, the wheel should be cleaned.
4. After cleaning the wheel, a visual inspection of the wheel should be made by looking down through the fan outlet and turning the wheel manually.
5. An inspection of all the blade attachment points and the blades, (and the front plate, burner sizes KF25-1800 and KF30-1800), should be made, checking for cracks on the wheel.

Cracks may be small (less than $\frac{1}{8}$ " long), so any suspicious point should be thoroughly examined. (Particular attention should be paid to the welds under the trailing edge of each blade, sizes KF25-1800 and KF30-1800).
6. If cracks are found, the burner should not be operated again until a replacement wheel is installed. Such cracks indicate that the wheel has reached or exceeded its life cycle, and continued operation can result in a potentially hazardous condition.
7. If no cracks are found, the plenum cover can be placed back on the burner housing and the burner placed back in operation. This inspection procedure must still be conducted on a regular basis.
8. Any change in vibration requires that the burner be shut off and the wheel re-inspected immediately.
9. If a replacement wheel is necessary, after the replacement wheel has been installed, this inspection must still be conducted on a regular basis.

CHAPTER 5

SERVICE PROCEDURES

ADJUSTMENTS AND REPAIRS

The Service Procedures detailed in this section of the manual are intended as a guide in making certain repairs and adjustments which may be necessary during the operating life of the Kewanee Unit. Many of the repairs can be made by any boiler operator, others should be made by a skilled serviceman. Call your authorized Kewanee service representative for dependable service assistance.

A. GAS-ELECTRIC IGNITER

1. The igniter assembly (See Figs. 5-1 or 5-2, as applicable) should be removed and cleaned regularly. The porcelain insulator should be kept clean and must be replaced if cracked.
2. Maintain a spark gap of $1/16''$ to $1/8''$ between the electrode and the igniter body on an internal gas pilot (Fig. 5-2). The electrode must be centered in the igniter body opening on the external pilot (Fig. 5-1).
3. The high tension wire between the transformer and the igniter electrode should be checked for deterioration.

B. DIRECT SPARK ELECTRIC IGNITER

1. The igniter assembly (See Fig. 5-3) should be removed and cleaned regularly. The porcelain insulators should be kept clean, and must be replaced if cracked.
2. The spark gap must be set in accordance with the dimension shown in Fig. 5-3. Care should be taken to make sure the electrodes are kept farther from the nozzles and nozzle adaptor than the width of the spark gap to prevent arcing.
3. The electrode should not extend closer than $1/8''$ to the spray angle of the nozzle to prevent carboning.
4. The high tension wires and clips between the transformer and igniter electrodes should be checked periodically for deterioration.

C. OIL NOZZLES—GENERAL SERVICE

1. Oil atomizing nozzles should be removed and cleaned regularly.
2. The nozzles should be removed from the nozzle adaptor by use of a box wrench. The nozzles should be disassembled and thoroughly cleaned with a liquid solvent (non-flammable preferred) and a brush.
3. Do not use a screwdriver, wire brush or similar metallic objects to clean nozzles. Damage to orifices or spray slots results in off-center or "sparky" fires.

4. The nozzle should be seated firmly on the nozzle adaptor to prevent leaks.
5. If a nozzle is damaged or burned, replace it.

D. OIL NOZZLES—PRESSURE ATOMIZING

1. On high-low firing burners and on all fully modulating burners, triple variable flow nozzles are used (Fig. 5-4). These nozzles are of the by-pass type and are used with a constant supply pressure of approximately 300 psig. (Note rating stamped on the nozzle is the nominal delivery rate at 100 psig.)

On fully modulating burners, nozzle delivery rate is varied by altering the opening of a metering valve situated in the nozzle return flow line. To reduce nozzle flow rate, the return flow metering valve must be opened and vice versa (Fig. 5-21). Approximate high fire and low fire return line pressures are shown in Fig. 3-1.

On high-low firing burners, the oil metering valve is replaced by a low fire solenoid valve and Webster pressure regulator (Fig. 5-8). At low fire the solenoid valve is open and the nozzle return line pressure is controlled by the pressure regulator (Refer to Fig. 3-1 for recommended pressure settings). At high fire the solenoid valve closes, isolating the pressure regulator, all oil flowing to the nozzle is then injected into the combustion chamber.

2. The spray angle becomes wider as the discharge rate is reduced. Adjust nozzle position to avoid oil impingement on the air diffuser cone, pay special attention to the low fire rate.
3. Smoky fires with apparent large droplet size in the spray are generally caused by reduced supply pressure. Check the pump pressure. Also check the adaptor and the nozzle strainer to be sure that they are not partially plugged.
4. Careless cleaning or handling of the nozzles may damage the orifice, causing heavy streaks in the oil spray. This will show up as large droplets and sparks in the fire.
5. Off-center fires, reduced by-pass line pressure, and safety lockouts due to ignition failure may result from plugged slots in the distributor head, or by one of the triple nozzles becoming plugged.
6. Excessive "after squirt" of oil may be caused by air in the oil, leaking main oil valve, overhead oil lines or fittings, or leaking check valve on the return line from nozzle.

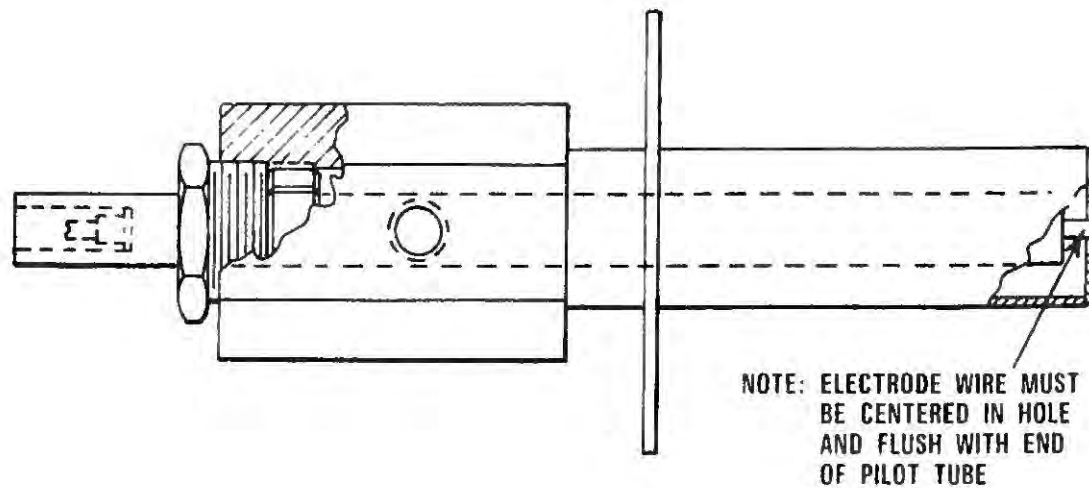
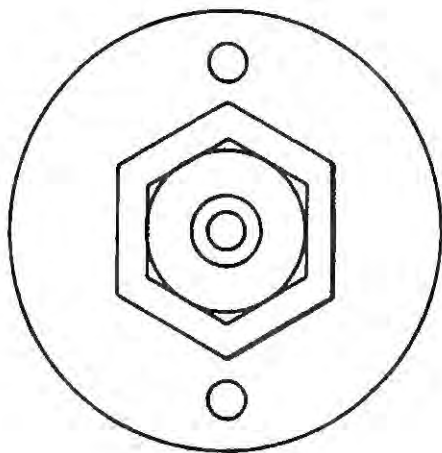


FIG. 5-1 GAS-ELECTRIC IGNITER (EXTERNAL TYPE) - BURNERS 60 THRU 250 HP.

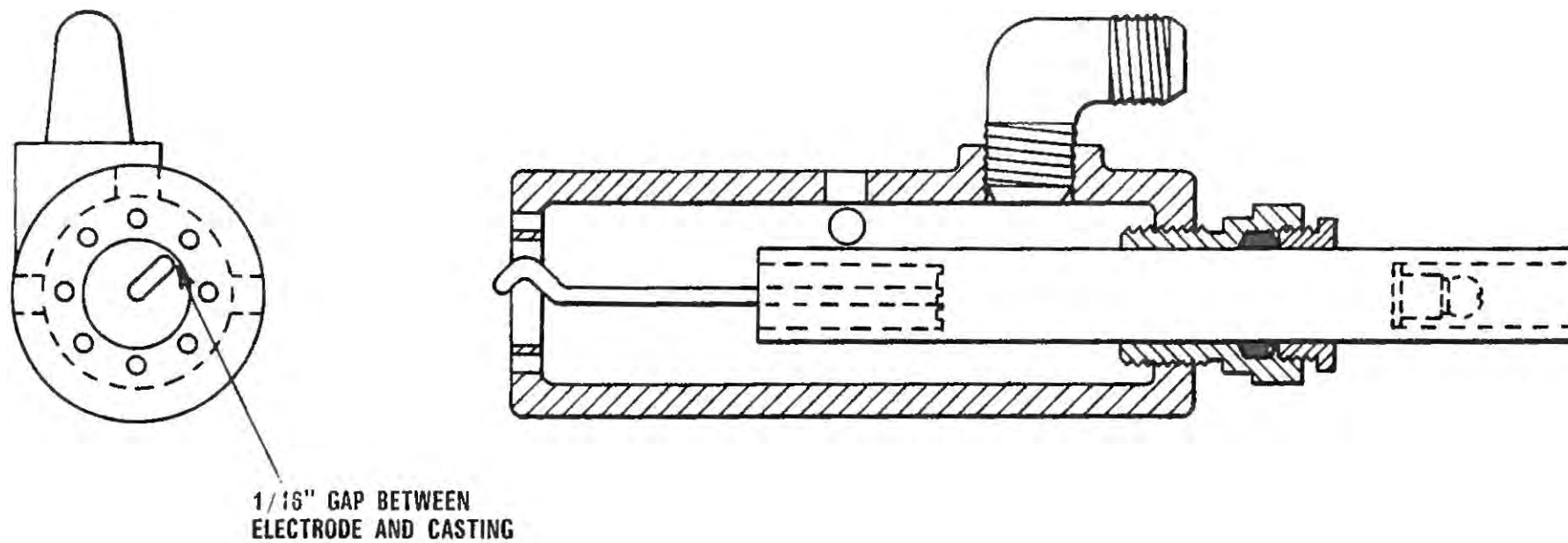


FIG. 5-2 GAS-ELECTRIC IGNITER (INTERNAL TYPE) - BURNERS 300 THRU 750 HP.

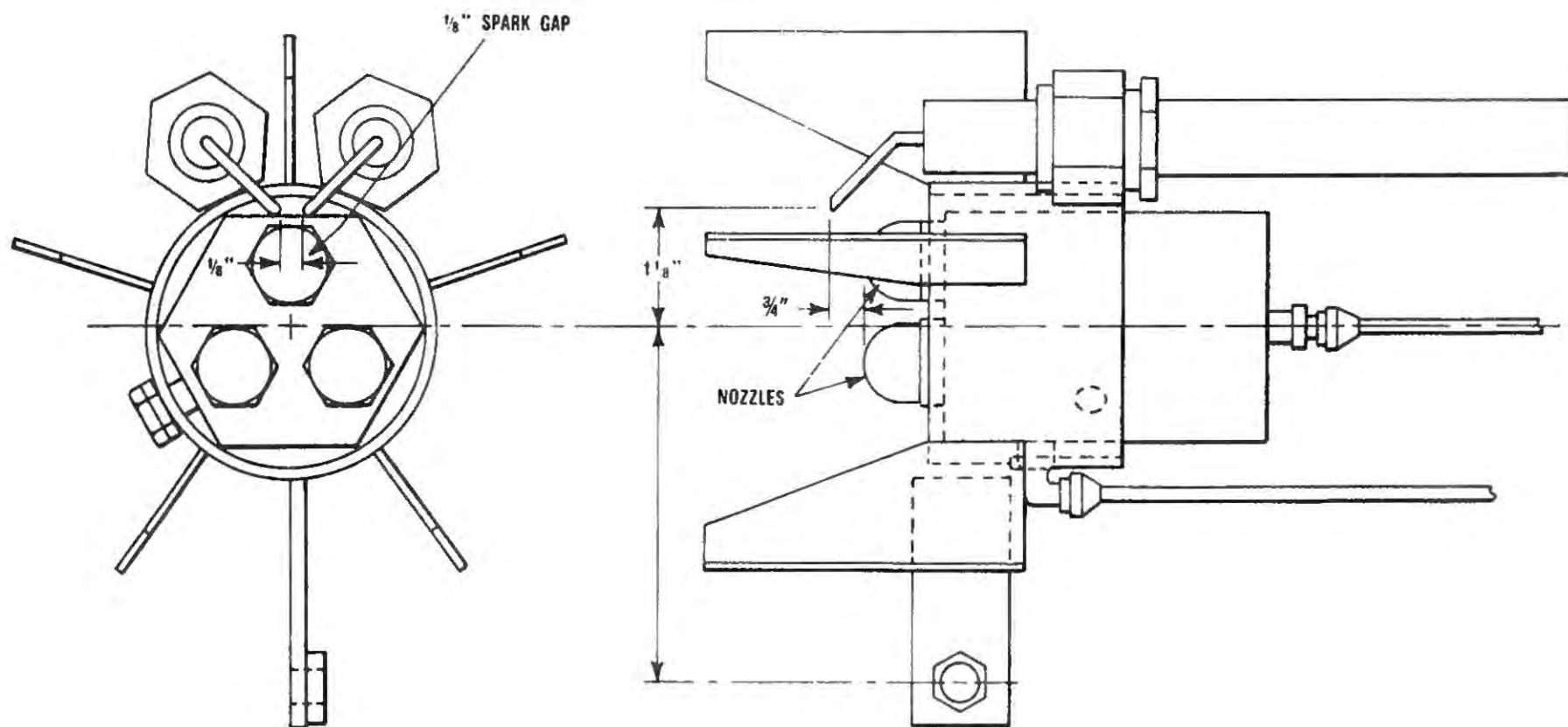


FIG. 5-3 DIRECT SPARK IGNITER - ELECTRODE SETTINGS - TYPICAL

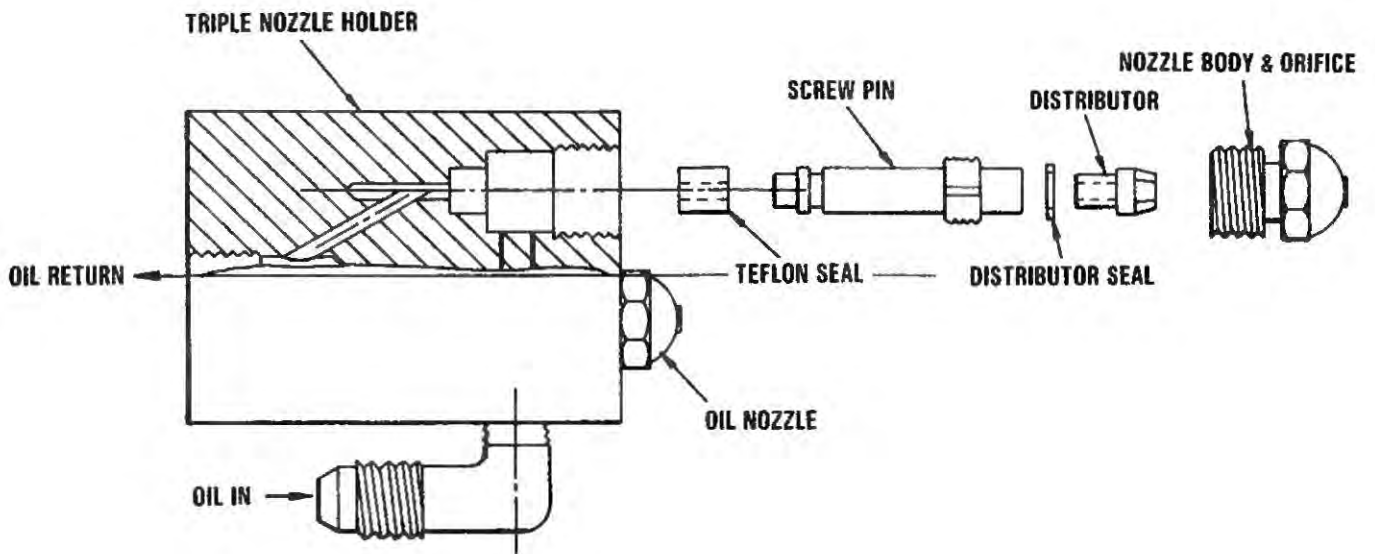


FIG. 5-4 TYPICAL OIL NOZZLE - PRESSURE ATOMIZING

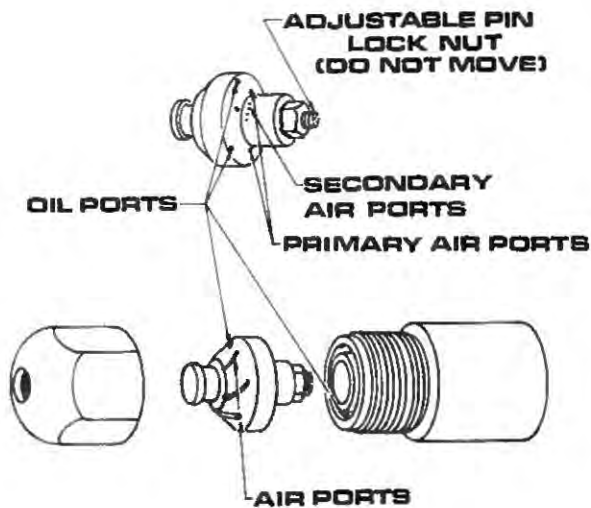


FIG. 5-5 AIR - OIL NOZZLE
MONARCH

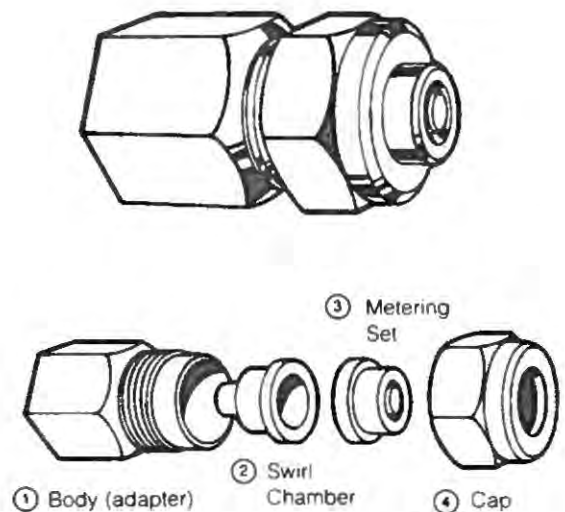


FIG. 5-5A AIR - OIL NOZZLE
DELAVAN

7. The teflon seal stays attached to the screw pin. Should the seal become damaged, the resulting leak will cause an increase in discharge rate, when the metering valve is closed, and in extreme cases will lead to smoky fires. A leak at the seal will not affect the flow at any setting other than high fire.
8. The variable flow nozzles are especially sensitive to accumulation of carbon and dirt within the nozzle. Keep the nozzle clean at all times.

E. OIL NOZZLES—AIR ATOMIZING:

1. The air atomizing nozzle is designed to handle No. 2, No. 4, No. 5, and No. 6 fuels. Air is supplied from the compressor at relatively low pressure to provide the energy for atomization. Oil supply to the nozzle is controlled by the oil metering valve.
2. The air atomizing nozzle is of the internal mixing type. Air and fuel are piped separately to the nozzle and are mixed in the swirl chamber so that a uniform emulsion is discharged through the orifice in a semi-solid cone spray pattern (See Fig. 5-5).
3. The spray angle becomes wider as the volume of secondary air is reduced. Adjust nozzle position to avoid oil impingement on the air diffuser cone and refractory cone.
4. Since the fuel and air passages in this type of nozzle are quite large, clogging is not a serious problem. However, both the air and fuel are filtered to remove lint and large particles of foreign matter. Clogging of air passages or fuel passages will result in off-center fires.
5. Damage to the orifice may result in a streaky fire, or an off-center fire, or drooling.
6. When cleaning and taking nozzle apart, do not force or damage. Soak in light oil or solvent. When reassembling nozzle, put a few drops of oil on inner section to prevent damage to close fitting metal surfaces.

F. FIRING HEAD ADJUSTMENTS

Firing head adjustments are available to optimize burner performance for each individual situation. These adjustments are shown in Fig. 5-6 (Burners 60 thru 80 hp) and Fig. 5-7 (Burners 100 thru 750 hp).

The position of the air diffuser may be adjusted longitudinally with respect to the gas orifice, thus altering the velocity of the combustion air at the mix point, and hence the position of the mix point.

The air diffuser position should be adjusted to produce optimum gas firing (i.e. smooth light-off, no pulsations and good mixing as indicated by CO₂ and CO readings). The position of the air diffuser should be considered the primary adjustment on gas-fired burners.

A secondary adjustment is available on burners 100 thru 750 hp. On these burners the longitudinal position of the gas deflector sleeve may also be adjusted. The position of the deflector sleeve affects mixing rate, quicker mixing rates being obtained as the deflector plate uncovers the gas orifice. It should be noted that quick mixing rates may produce a tendency toward combustion instability, therefore the deflector sleeve should be

positioned to cover as much of the gas orifice as possible, consistent with good firing as indicated by smooth light-off, no pulsations, CO₂ and CO readings, plus general flame appearance.

In oil firing burners the primary firing head adjustment is that of the longitudinal position of the nozzle in relation to the air diffuser choke ring. On burners up to 400 hp the nozzle guide position is adjustable within the air diffuser assembly; the nozzle position within its guide is also adjustable. On burners 300 hp and above, the nozzle may be adjusted within its guide.

In all cases optimum oil firing is usually achieved when the distance between the choke ring and the nozzle tip is at a maximum without there being any tendency for the oil spray to hit the choke ring at low fire. (Nozzle spray angle at low fire will be slightly wider (approximately 5°-10°) than it is at high fire.)

G. OIL PRESSURE REGULATOR ADJUSTMENTS

Four types of oil pressure regulator are used on Kewanee burner oil systems. The Webster RV 2004 regulator used on high-low oil burners controls oil pump discharge pressure and is adjusted only to obtain correct low fire input. See Fig. 5-8 for adjustment procedure and Fig. 2-4 for location.

The Webster RV3002 regulator shown in Fig. 5-8 is typically provided as a safety relief valve located on remote pump sets and set between the limits of 90 to 125 psig.

A Kunkle 200-H relief valve is provided with units equipped for operation with No. 5 and 6 oil to maintain an oil supply pressure between the limits of 2-5 psig. This device is identified on the oil train schematics shown in Fig. 2-5 as Pressure Relief No. 2.

The adjustment of the Cash-Acme pressure regulator used to control supply pressure to the oil metering valve on air atomized units is shown by Fig. 5-9. See oil train schematic Fig. 2-5 for location in oil line.

H. OIL PUMP

1. Oil pumps are internal gear type with rated capacity not less than 125 percent of the burner firing rate. On pressure atomizing units, Webster fuel pumps are used as standard and are rated at 300 psig. From 60 hp to 125 hp, pumps are belt driven from the blower motor at 1750 rpm. From 150 hp to 400 hp, a separate motor pump unit is used operating at 1750 rpm. The relevant belt and oil pressure adjustments for this pump are shown in Fig. 5-10.

Viking pumps rated at 100 psig are standard on air atomizing units.

2. Field replacement of internal parts of any of the pumps, such as the seal, gears, or shaft, is discouraged. A factory overhaul or a complete pump assembly replacement is suggested since failure of one part usually indicates failure in other parts.
3. The following oil pump service problems and possible causes may occur (see Chart - Page 47).

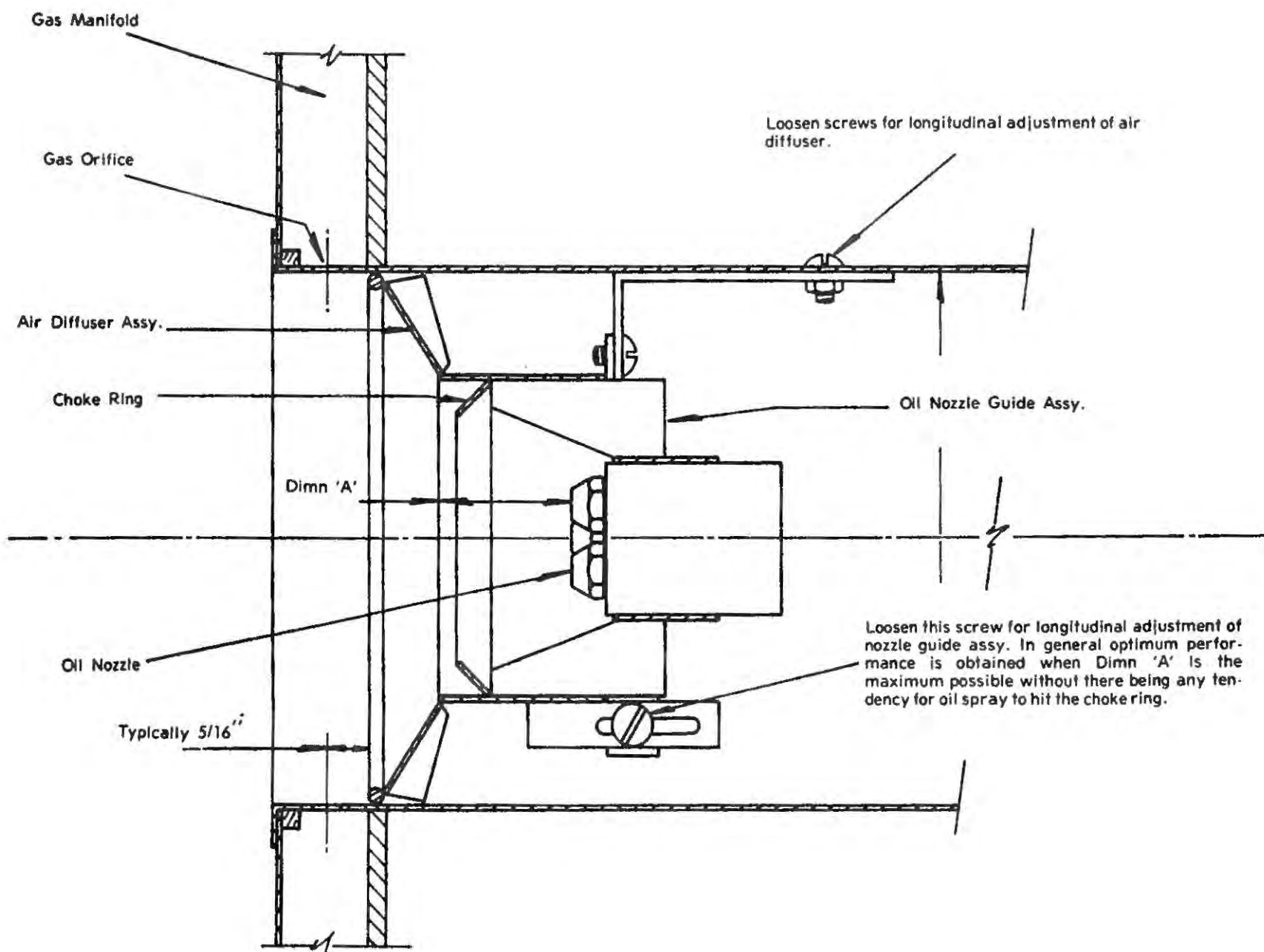


FIG. 5-6 TYPICAL FIRING HEAD ADJUSTMENTS - BURNERS 60 THRU 80 HP.

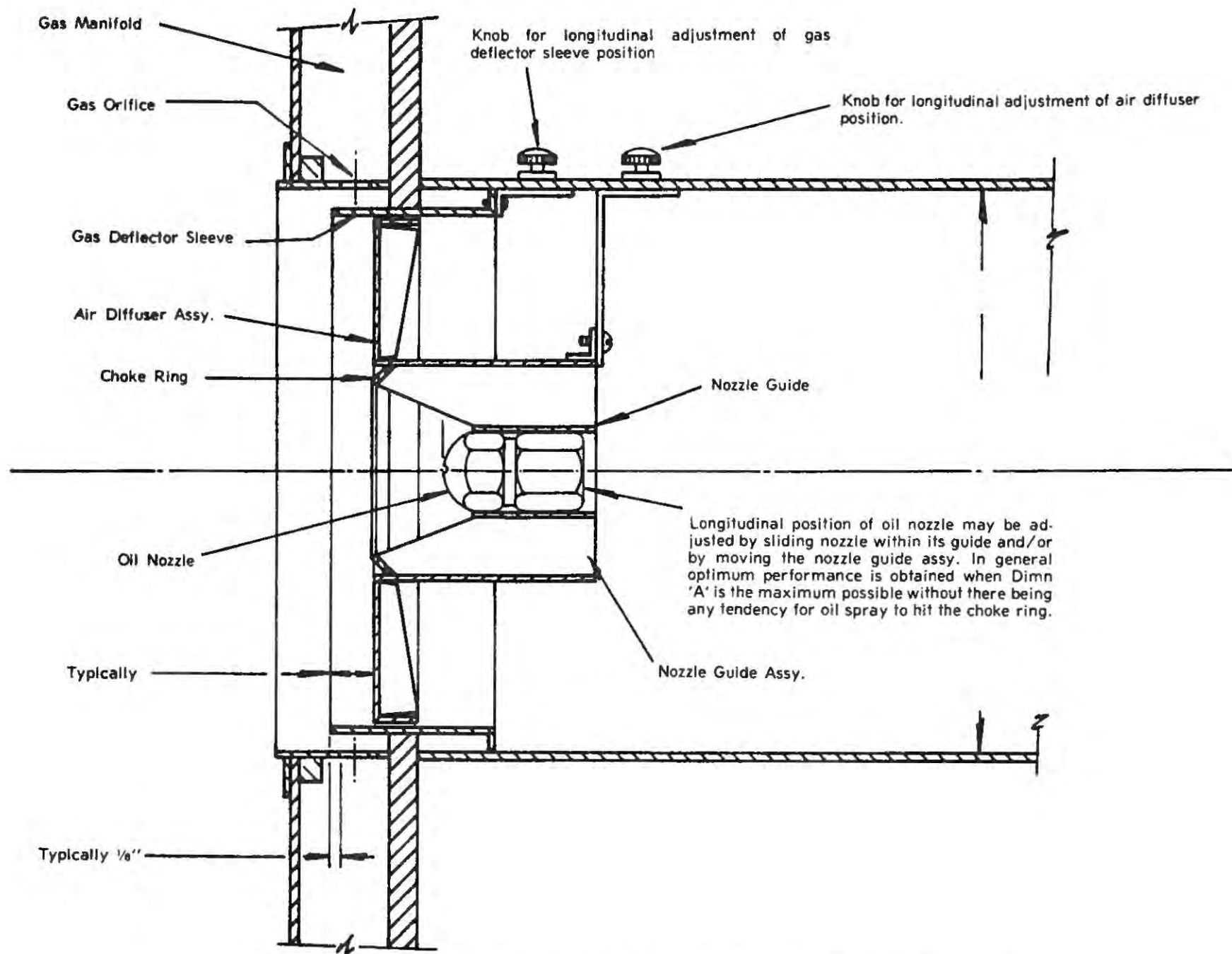
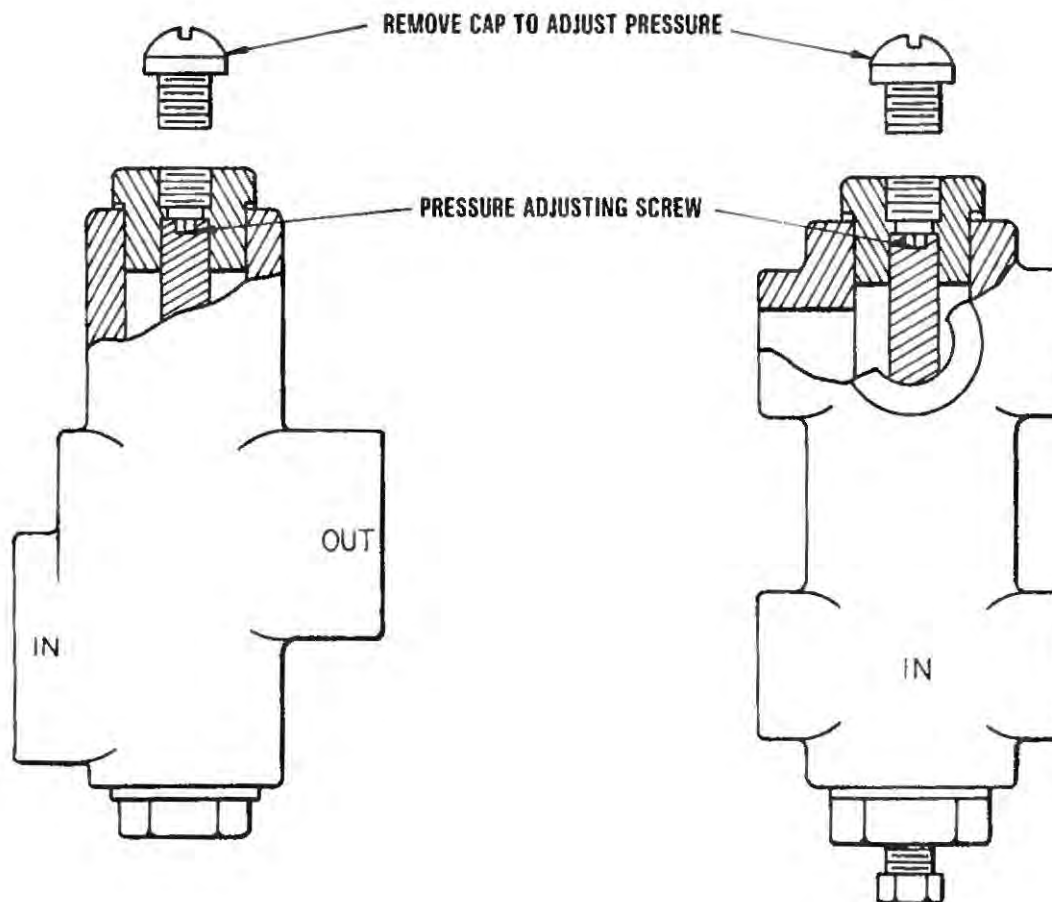


FIG. 5-7 - TYPICAL FIRING HEAD ADJUSTMENTS - BURNERS 100 THRU 750 HP.

WEBSTER RV 3002 RELIEF VALVE USED
ON AIR-OIL AUXILIARY PACKAGE



WEBSTER RV 2004 PRESSURE
REGULATOR USED ON HI-LO
OIL BURNERS

FIG. 5-8 ADJUSTMENT OF WEBSTER PRESSURE REGULATORS

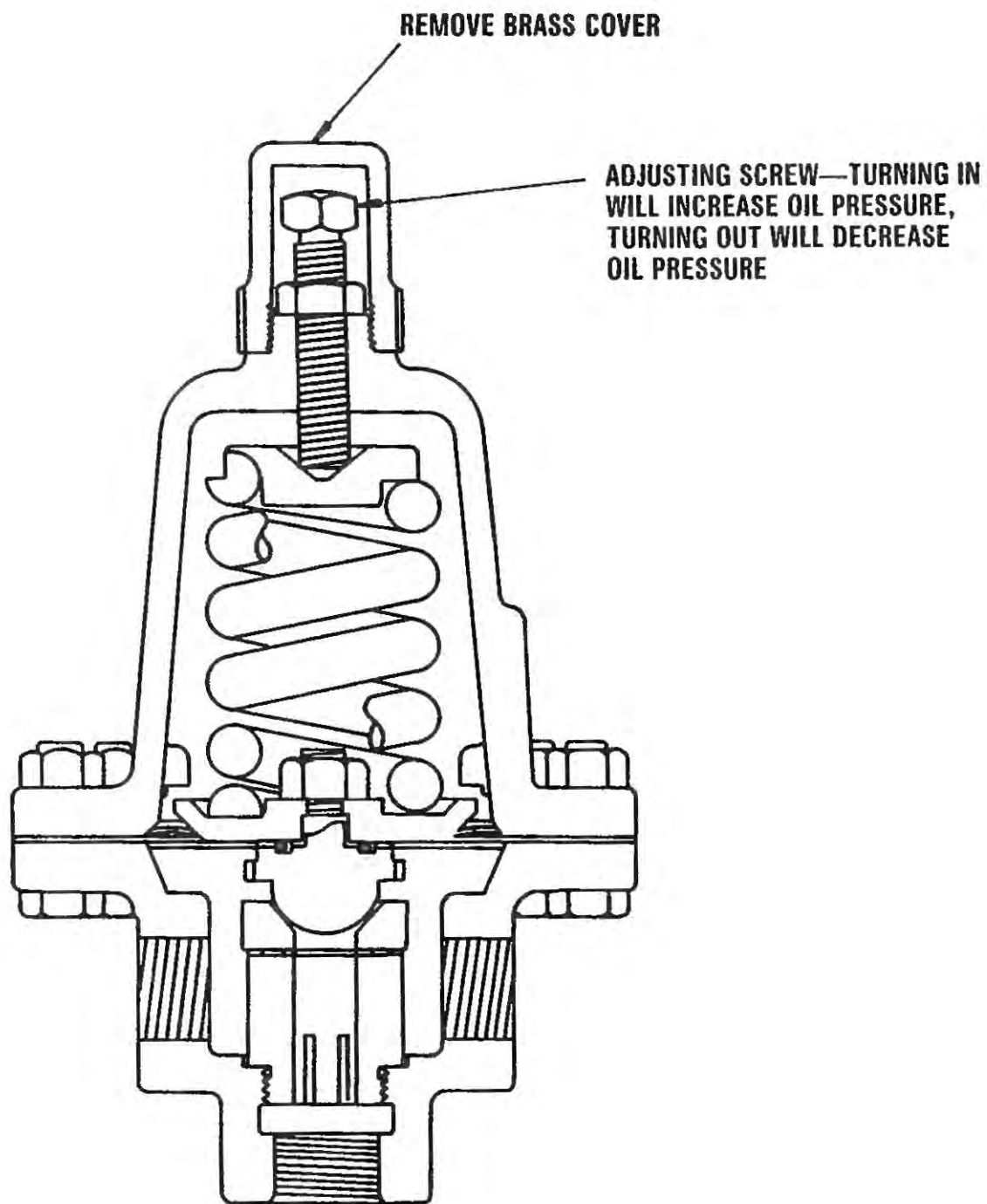


FIG. 5-9 ADJUSTMENT OF CASH-ACME PRESSURE REGULATOR

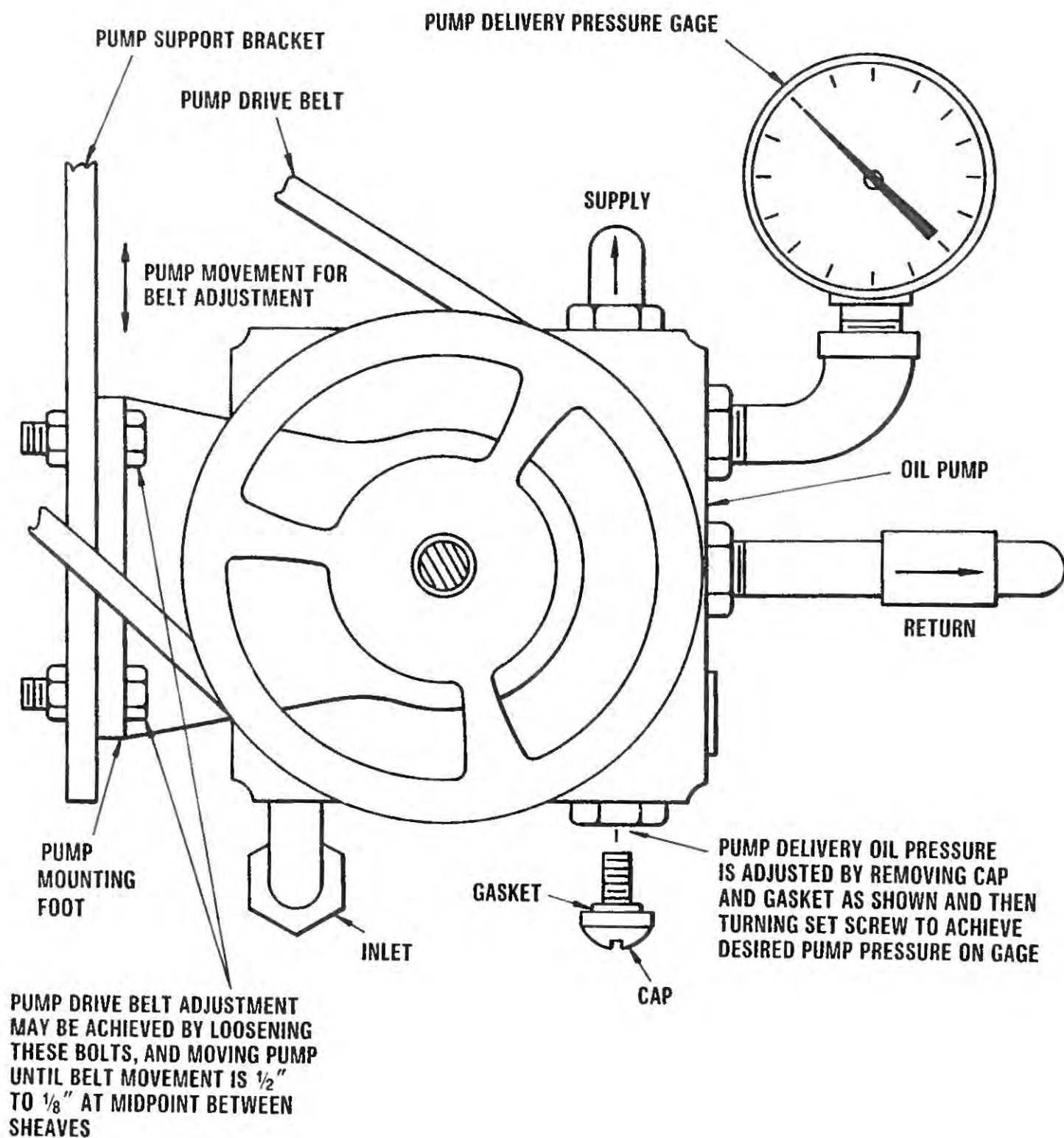


FIG. 5-10 OIL PUMP ADJUSTMENTS - PRESSURE ATOMIZING UNITS

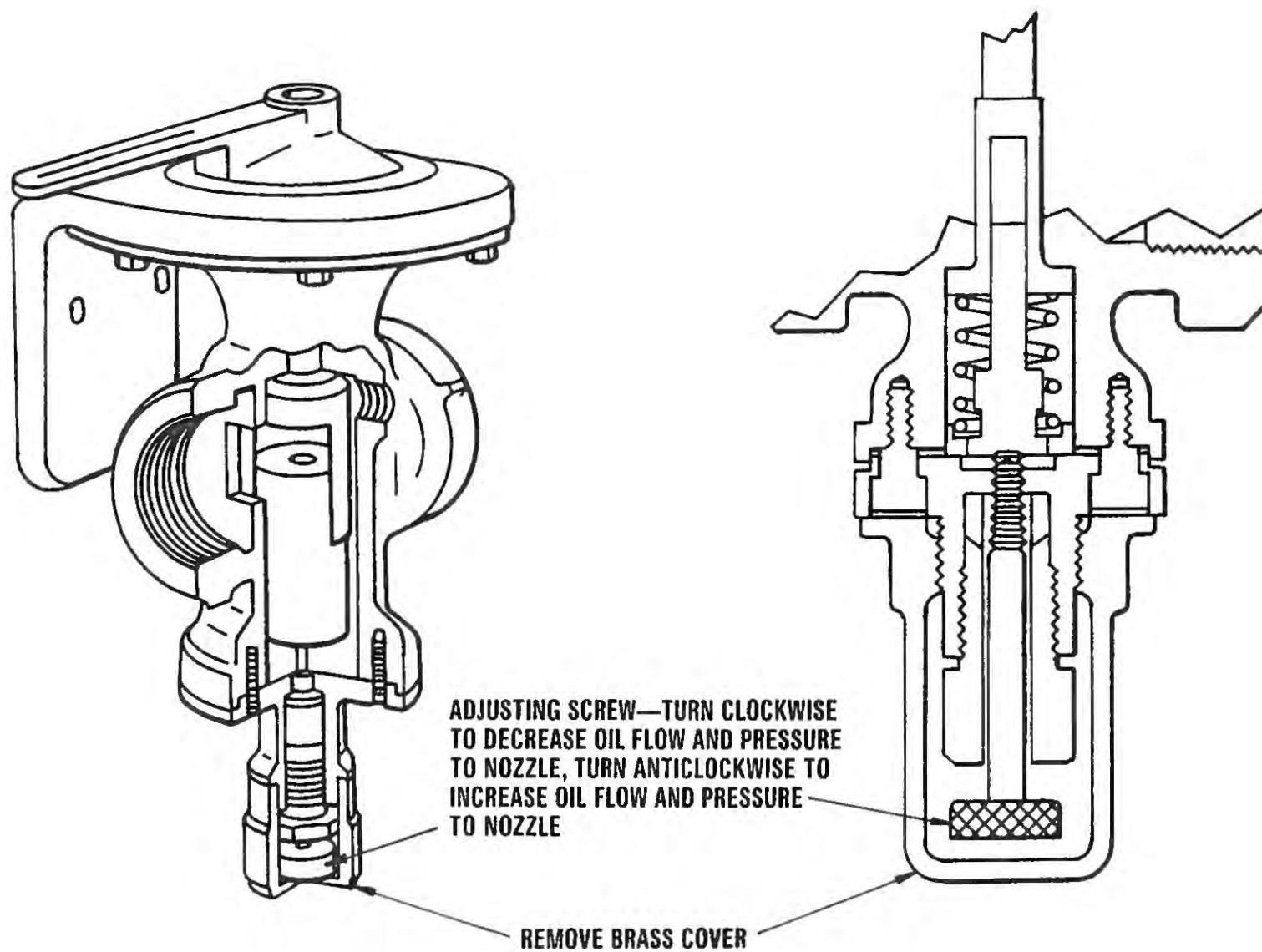


FIG. 5-11 ADJUSTMENT OF ORIFICE - OIL METERING VALVE 500 THRU 750 HP.

PROBLEM	POSSIBLE CAUSE
A. No Oil Delivered	<ol style="list-style-type: none"> 1. Pump not primed 2. Suction lift too high 3. Air leak in suction line 4. Wrong direction of rotation 5. Pump coupling not installed properly 6. Pump gears worn 7. Pump seal leak 8. Broken V-belt 9. Loose sheaves
B. Capacity Too Low	<ol style="list-style-type: none"> 1. Suction lift too high 2. Air leak in suction line 3. Suction line too small 4. Check valve or strainer too small or obstructed 5. Mechanical defects: <ol style="list-style-type: none"> (a) Pump badly worn (b) Seal defective 6. Pump coupling slipping on shaft 7. Belt slippage
C. Pump is Noisy	<ol style="list-style-type: none"> 1. Pump not securely mounted 2. Vibration caused by bent shaft or misalignment 3. Pump overload 4. Air leak in suction line 5. Suction lift so high that vapor forms within the liquid
D. Pump Leaks	<ol style="list-style-type: none"> 1. Cover bolts need tightening; gasket is broken or defective 2. Mechanical seal may be scratched due to dirt 3. Pump bushings and other parts badly worn from abrasives in fuel oil 4. Oil line fittings not tight

I. OIL METERING VALVE

1. *Pressure Atomizing Units*

Standard units 60-80 hp require no metering valve, since change in firing rate is achieved by a direct change in the nozzle return line pressure.

On units 100 thru 400 hp, the metering valve indirectly controls the oil flow by controlling by nozzle return line pressure. When the metering valve is closed, the unit is at high fire. When the metering valve is almost open the unit is at low fire. The valve will be modulated between the high and low fire positions, according to load demand. On burner shut-down, the valve always return to the low fire position.

The metering valve itself is non-adjustable. All adjustments for low fire point, high fire point and rate of change from low to high fire are cam controlled (Ref. Fig. 5-21).

2. *Air Atomizing Units*

On air atomizing units the metering valve directly controls the flow of oil to the nozzle. When the metering valve is open, the unit is at high fire. When the metering valve is nearly closed, the unit is at low fire.

Two basic types of metering valve are used on air atomizing units. On units through 400 hp the non-adjustable type (same as pressure atomizing) is used. From 500 thru 750 hp, a metering valve having an adjustable orifice is used (Ref. Fig. 5-11).

This adjustment essentially provides the low fire setting, the increase in flow required for higher firing rates being obtained from the angular rotation of the metering valve shaft.

3. The oil metering valve for both types of oil units is directly connected to the modutrol motor cam operator.

J. ADJUSTMENT OF LOW-HIGH OIL CHANGEOVER SWITCH

The Low-High oil changeover switch is a SPDT auxiliary switch situated in the damper drive motor, and can be adjusted to operate at any point of the motor rotation. It has a 1-2 degree non-adjustable differential. The switch makes the R-B terminals during the power stroke (motor shaft moves in direction of OPEN arrow on outside of motor case).

The switch should typically be set to operate after 35-40 degrees of motor rotation from the low-fire position, and under NO circumstances should it be adjusted to operate closer than 5 degrees from the ends of the motor stroke.

To check the operating point of the switch, the motor must be powered so that it runs to the OPEN (High-fire) position. (This may be accomplished by disconnecting the wiring from the L₁ and L₂ terminals in the motor, and then connecting a slave 115 V, 60 Hz power supply to the L₁ and L₂ terminals.) Note the point in the motor rotation at which the switch operates (audible click or continuity check across R-B terminals). If the switch needs adjustment, proceed as follows:

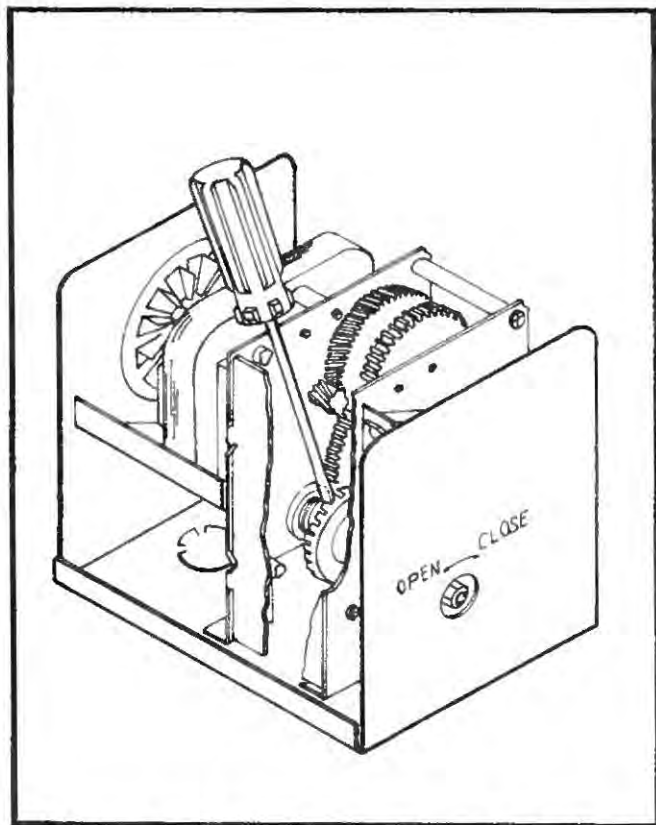
CAUTION: DISCONNECT POWER SUPPLY WHILE ADJUSTING SWITCH CAM

- Insert a screwdriver in a slot in the switch cam (white plastic), located near the center of the motor (Ref. Fig. 5-12). Each slot in the cam equals approximately 20 degrees of motor rotation. To adjust the switch to operate nearer the open (High-fire) position, move the cam in the direction of the CLOSE arrow on the motor case.
- Repower the motor and check the point at which the switch 'makes' and 'breaks.'
- When satisfactory switch operation has been accomplished, disconnect the slave power supply from L₁ and L₂ terminals, and reconnect damper motor wiring in accordance with the relevant wiring diagram. Re-attach motor cover.

NOTE: Minor adjustments to the operating point of the changeover switch may be necessary depending upon local conditions at the installation site—The prime consideration in making adjustments to the operating point is to obtain a smooth changeover from Low to High-fire and vice versa without the flame having any tendency to blow out.

K. FUEL-AIR LINKAGE

- All linkage must move with no stress or binding.
- Adjustment of the amount of travel of the air damper shutters is made by changing the position of the linkage rod on the slotted arm of the air shutter. The travel of the oil metering valve, or the gas butterfly valve, is adjusted by the cam warp plate so that the fuel input at any point from low to high fire will match the air input. For actual details of setting the various linkages used, refer to the following figures, as applicable to your burner:



SCREWDRIVER ADJUSTMENTS OF LO-HI OIL CHANGEOVER SWITCH
FIG. 5-12

- Air Damper Linkage Adjustment - Figures 5-13 thru 5-17
Gas Metering Valve Drive Adjustments - Figures 5-18 thru 5-22
Oil Metering Valve Drive Adjustments - Figures 5-21 thru 5-23
- Change in linkage to reduce valve or louver opening setting or speed is normally accomplished either by moving the ball-joint connector closer to the center of the driving arm; or by moving the ball-joint connector closer to the end of the driven arm.
 - Normal low fire settings are: Oil metering valve on pressure atomizing units approximately $\frac{1}{4}$ closed; oil metering valve on air atomizing units approximately $\frac{1}{4}$ open; butterfly gas valve approximately $\frac{1}{4}$ open; air louvers nearly closed.
 - A manually operated toggle switch is provided on 60-80 hp units to hold the burner in the low fire position when so desired.
 - Set and adjust low fire for good CO₂ and smooth start. Measure louver opening and mark valve settings to permit return to low fire in case settings are changed at high fire. It should be noted that if excessively high turndown ratios are used in combination with high CO₂ readings, the low fuel and air velocities resulting will produce a flame front very close to the air diffuser. If this condition exists for a prolonged period, distortion or deterioration of the air diffuser vanes

may result. It is therefore recommended that low fire fuel flow rates not be set lower than the published figures (Ref. Fig. 1-9), and that low fire CO₂ readings be somewhat lower than high fire CO₂ readings. For example, low fire CO₂ readings on gas should be in the range 6½ to 8 percent, while on oil they may be in the range of 8½ to 10 percent.

7. High fire air and fuel settings should be checked for proper CO₂ and flame conditions. If damper or valve settings are changed in order to provide proper firing conditions or input, linkages must be adjusted so that both the low fire and high fire settings are maintained.
8. All adjustments should be made in small increments, and results tested by orsat. Tighten set screws and lock nuts on all linkages after final setting to prevent slippage.

L. AIR COMPRESSOR

1. The following non-detergent lubricants are recommended for use in the air compressor:

Ambient Temperature at Point of Installation	SAE Viscosity or Equivalent
Below 0° F	SAE 5W
0° F to 32° F	SAE 10 W
32° F to 80° F	SAE 20
Above 80° F	SAE 30

2. Unscrew the wing nut to disassemble the oil bath air filter (if used). Replace oil in the sump with SAE 30 oil. Remove and clean filter element.
3. Occasionally examine the shaft for side or end "play" by moving it manually while compressor is idle.

4. Field replacement of internal parts of compressor should be done only by an experienced service mechanic. Factory overhaul or repair is normally recommended. See compressor manufacturer's instruction manual for specific maintenance and repair procedures.

M. ELECTRIC OIL HEATER

1. DO NOT TURN ON POWER TO HEATER UNLESS ELEMENTS ARE FULLY IMMERSSED IN OIL.
2. Thermostat setting should be as low as is consistent with satisfactory operation. Too high oil temperature may cause irregular oil flow to the nozzle.
3. The thermostat for the oil heater is located under the end cover cap of the heater. Turn the knob as indicated for higher or lower oil temperature.
4. The auxiliary switch operates independently of the thermostat and prevents burner operation if oil is too cold for proper burning.
5. The adjustment for changing the setting of the auxiliary, or cold-oil lockout switch is also under the end cover cap of the heater.
6. The auxiliary switch should close to permit burner operation when the temperature of the oil is approximately 10° F below the average operating temperature of the oil.
7. Allow the oil to flow through the heater for several minutes (preferably at high firing rate) before changing adjustments to insure accurate temperature readings.

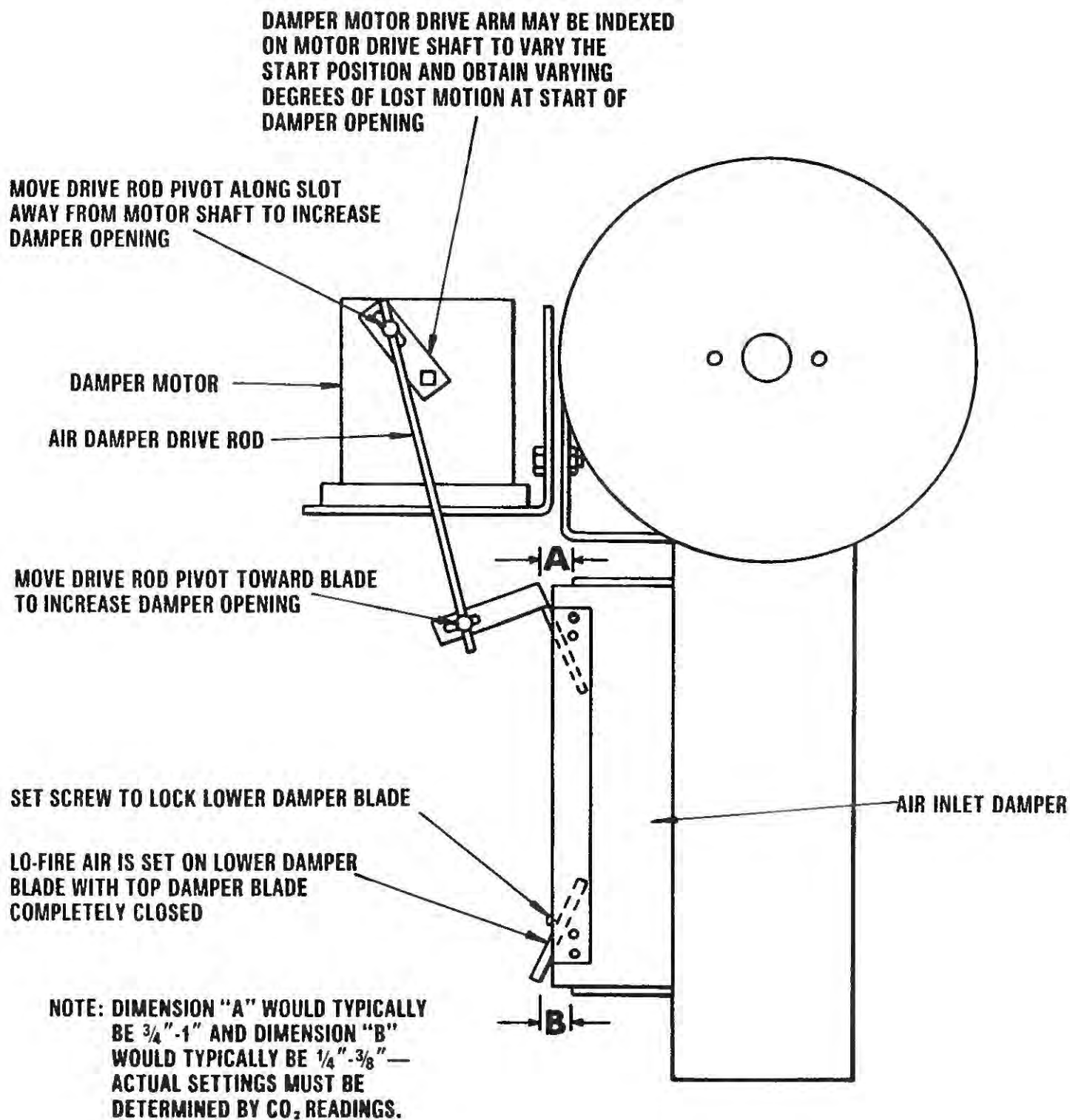


FIG. 5-13 AIR DAMPER ADJUSTMENTS - 60 THRU 80 HP.

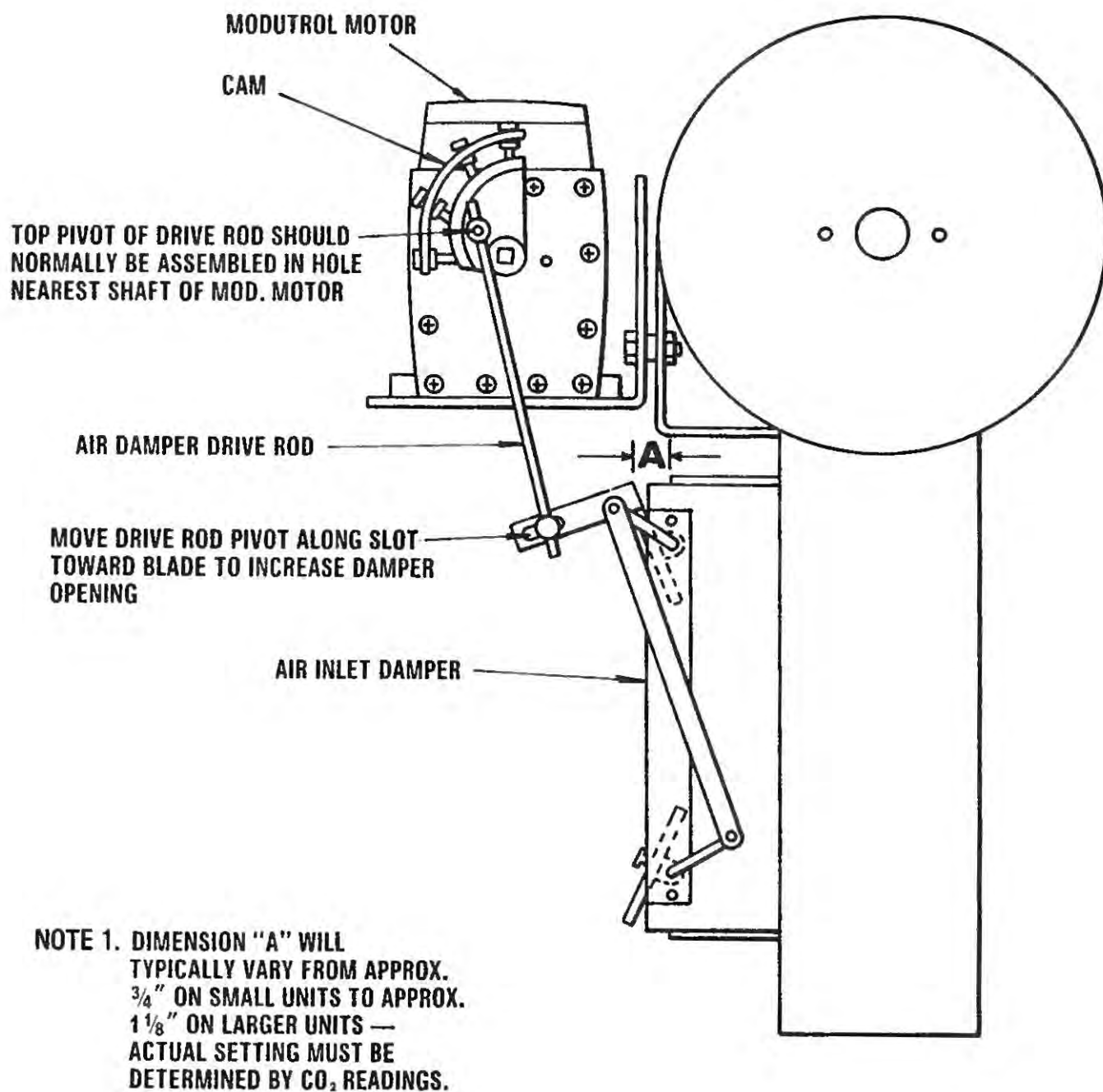


FIGURE 5-14 AIR DAMPER ADJUSTMENTS - 100 THRU 250 HP.

VARYING DEGREES OF LOST MOTION MAY BE OBTAINED IN DAMPER OPENING, BY REMOVING THIS SCREW AND INDEXING DRIVE ARM TO ANOTHER HOLE LOCATION.

MOVE DAMPER DRIVE ROD PIVOT POINT AWAY FROM MOD. MOTOR DRIVE SHAFT TO INCREASE DAMPER OPENING

DAMPER DRIVE ARM AND INDEXING PLATE

GAS METERING VALVE DRIVE CAM

MOD. MOTOR DRIVE SHAFT

DAMPER DRIVE ROD

AIR INLET DAMPER

ROTATION OF DAMPER TO INCREASE AIR

MOVE DRIVE ROD PIVOT POINT TOWARD HUB OF DAMPER TO INCREASE DAMPER OPENING—

LO-FIRE AIR IS SET BY LOOSENING THIS SCREW AND MANUALLY SETTING DAMPER OPENING.— RETIGHTEN WHEN DESIRED SETTING HAS BEEN OBTAINED

FIG. 5-15 AIR DAMPER ADJUSTMENTS - 300 THRU 400 HP.

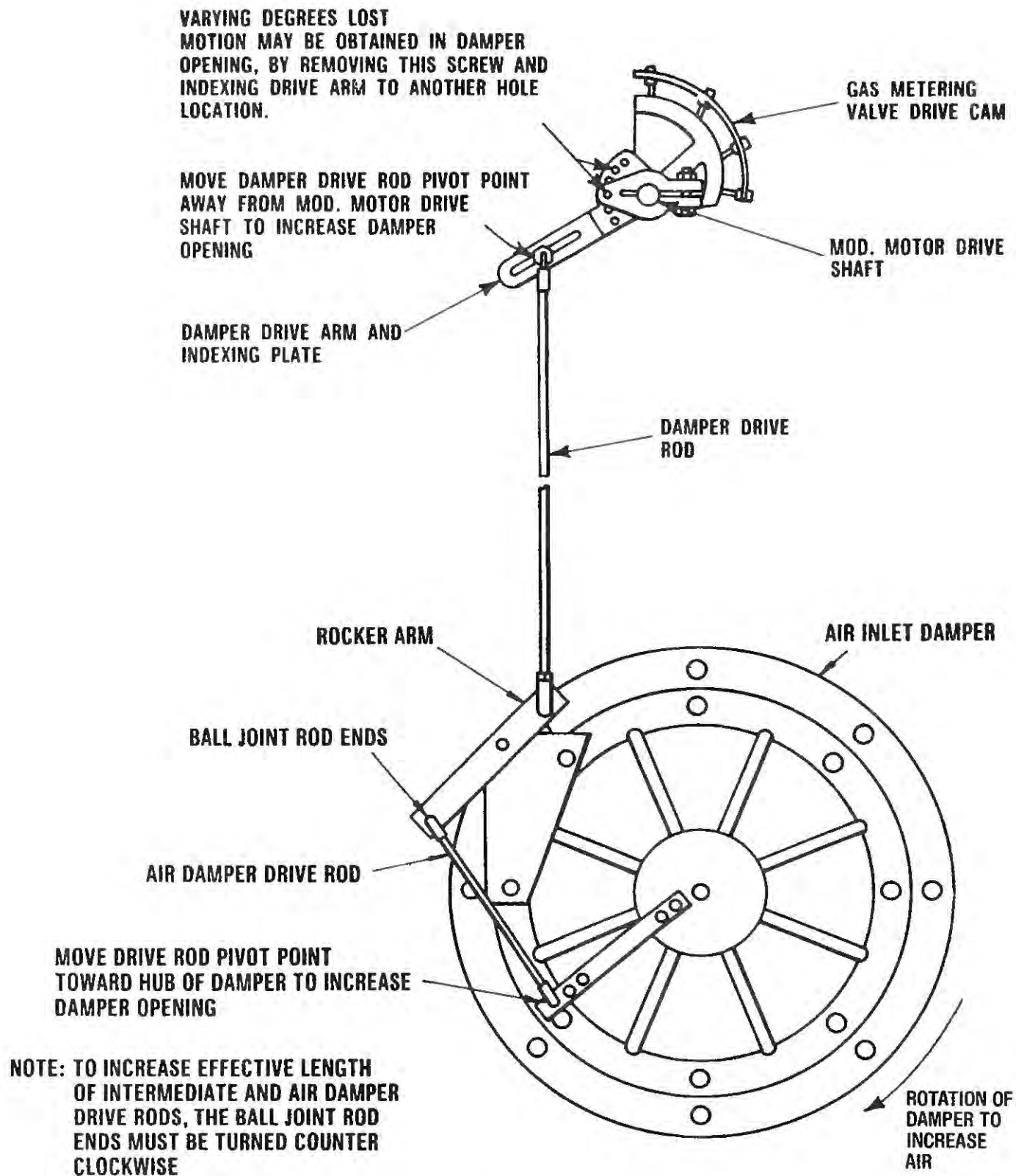


FIG. 5-16 - AIR DAMPER ADJUSTMENTS - 500-600 HP.

VARYING DEGREES OF
MOTION MAY BE OBTAINED IN DAMPER
OPENING, BY REMOVING THIS SCREW AND
INDEXING DRIVE ARM TO ANOTHER HOLE
LOCATION.

MOVE DAMPER DRIVE ROD PIVOT POINT
AWAY FROM MOD. MOTOR DRIVE
SHAFT TO INCREASE DAMPER
OPENING

DAMPER DRIVE ARM AND
INDEXING PLATE

GAS METERING
VALVE DRIVE CAM

MOD. MOTOR DRIVE
SHAFT

DAMPER DRIVE
ROD

AIR INLET DAMPER

ROTATION OF DAMPER ARM TO
INCREASE AIR

MOVE DRIVE ROD PIVOT POINT
TOWARD HUB OF DAMPER TO
INCREASE DAMPER OPENING

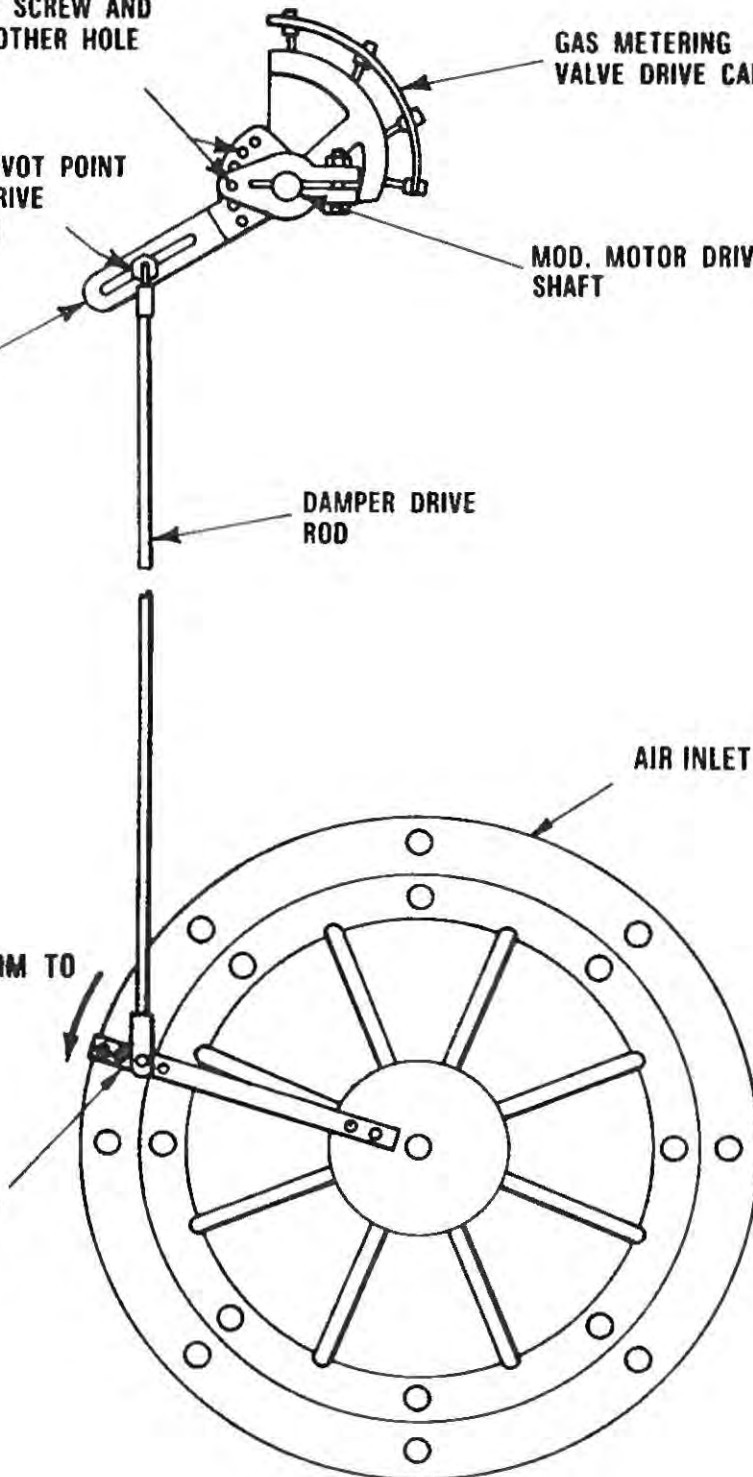


FIG. 5-17 AIR DAMPER ADJUSTMENTS - 750 HP.

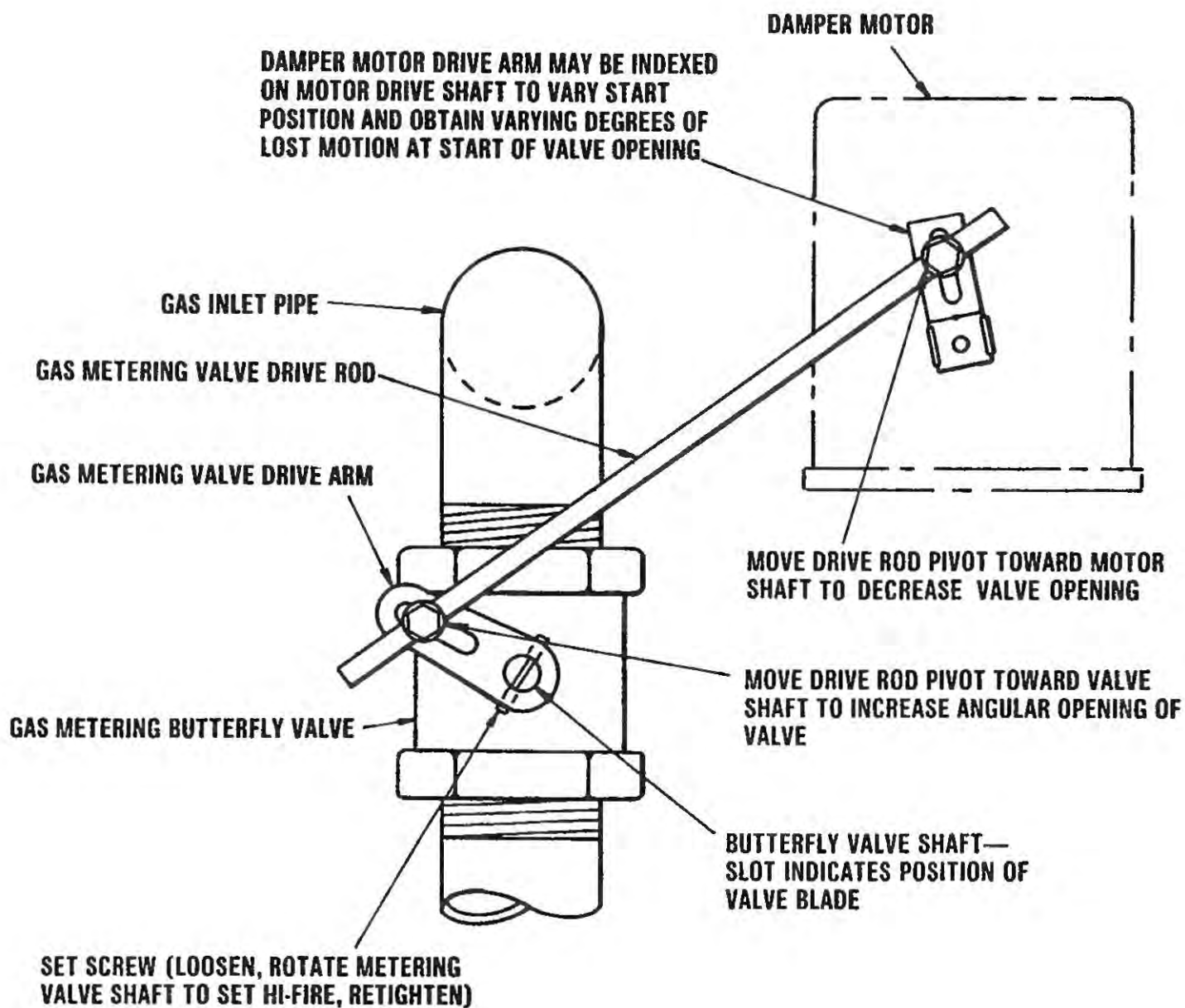


FIG. 5-18 GAS METERING VALVE DRIVE ADJUSTMENTS HI-LO FIRING BURNERS.

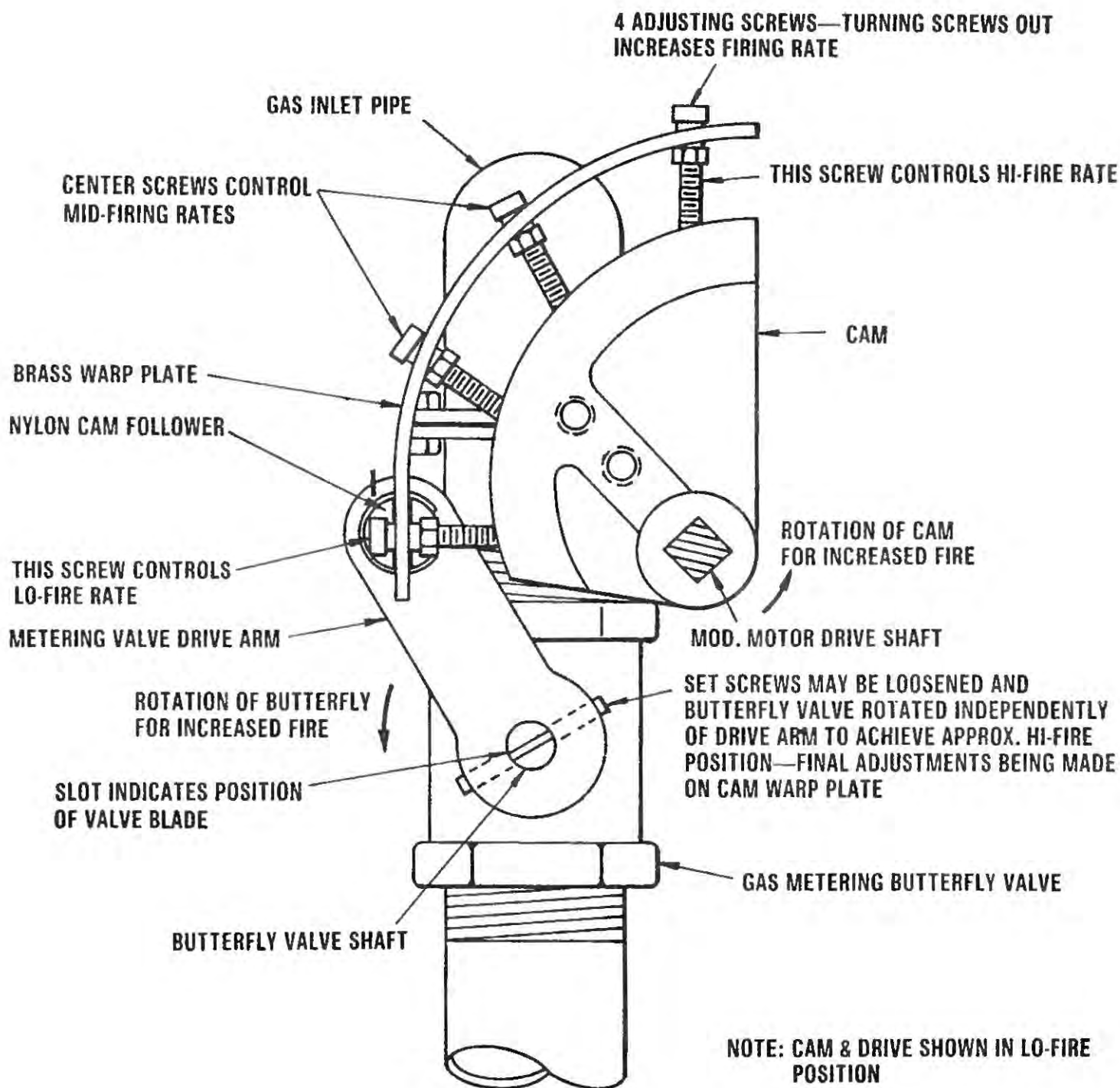


FIG. 5-19 GAS METERING VALVE DRIVE ADJUSTMENTS 100 THRU 400 HP.

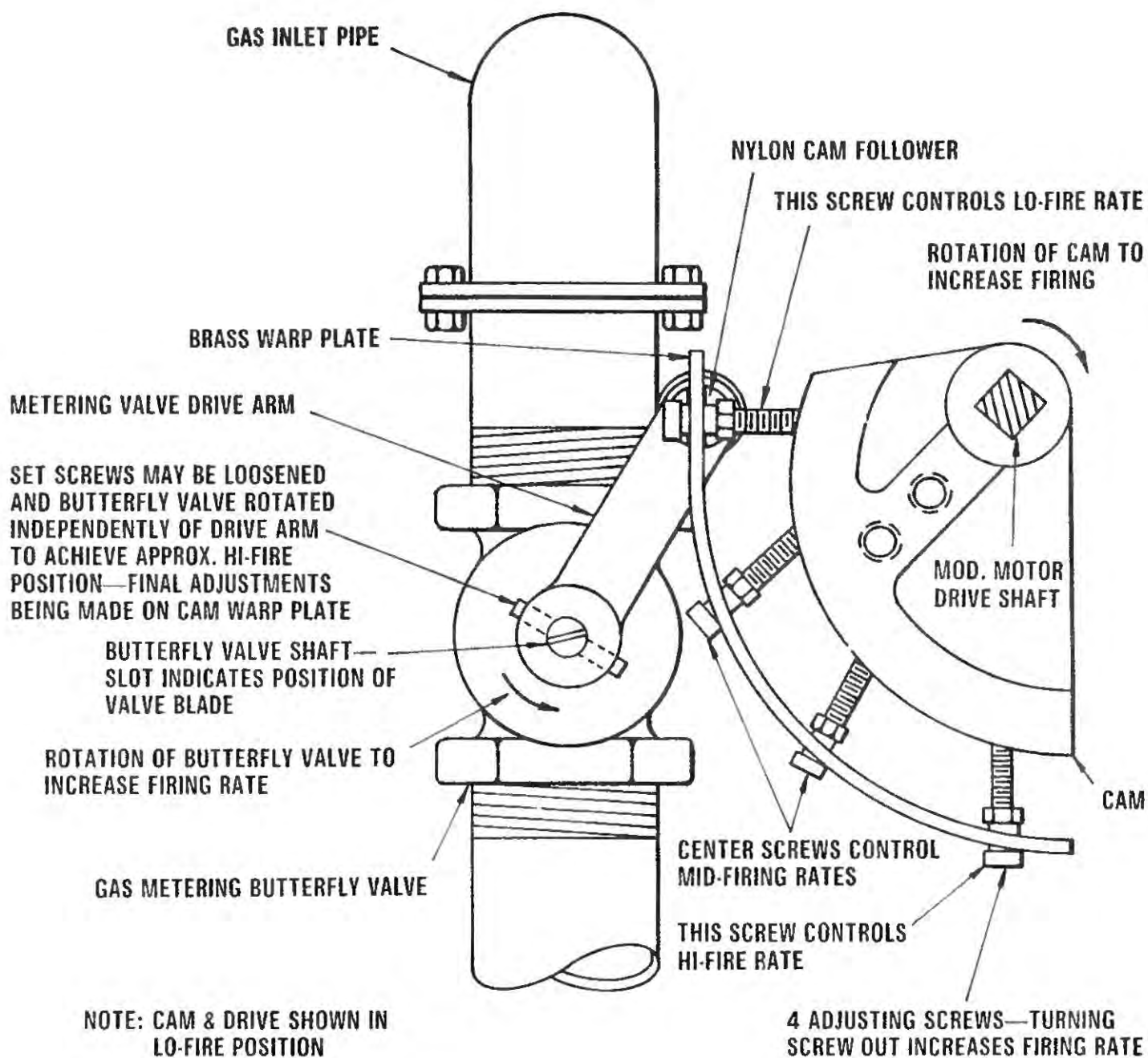


FIG. 5-20 GAS METERING VALVE DRIVE ADJUSTMENTS 500-750 HP.

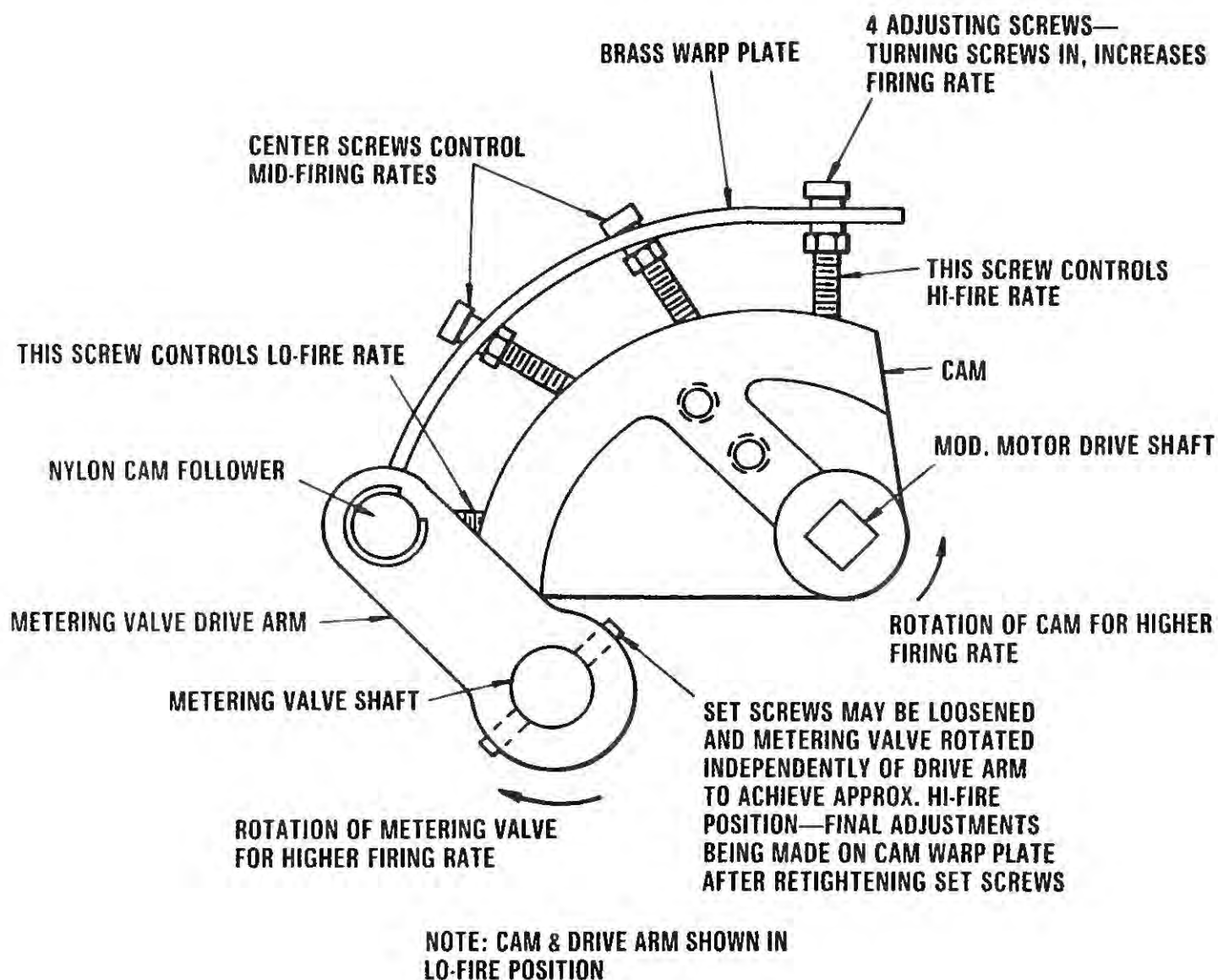


FIG. 5-21 OIL METERING VALVE DRIVE ADJUSTMENTS -
PRESSURE ATOMIZING UNITS 100 - 400 H.P.

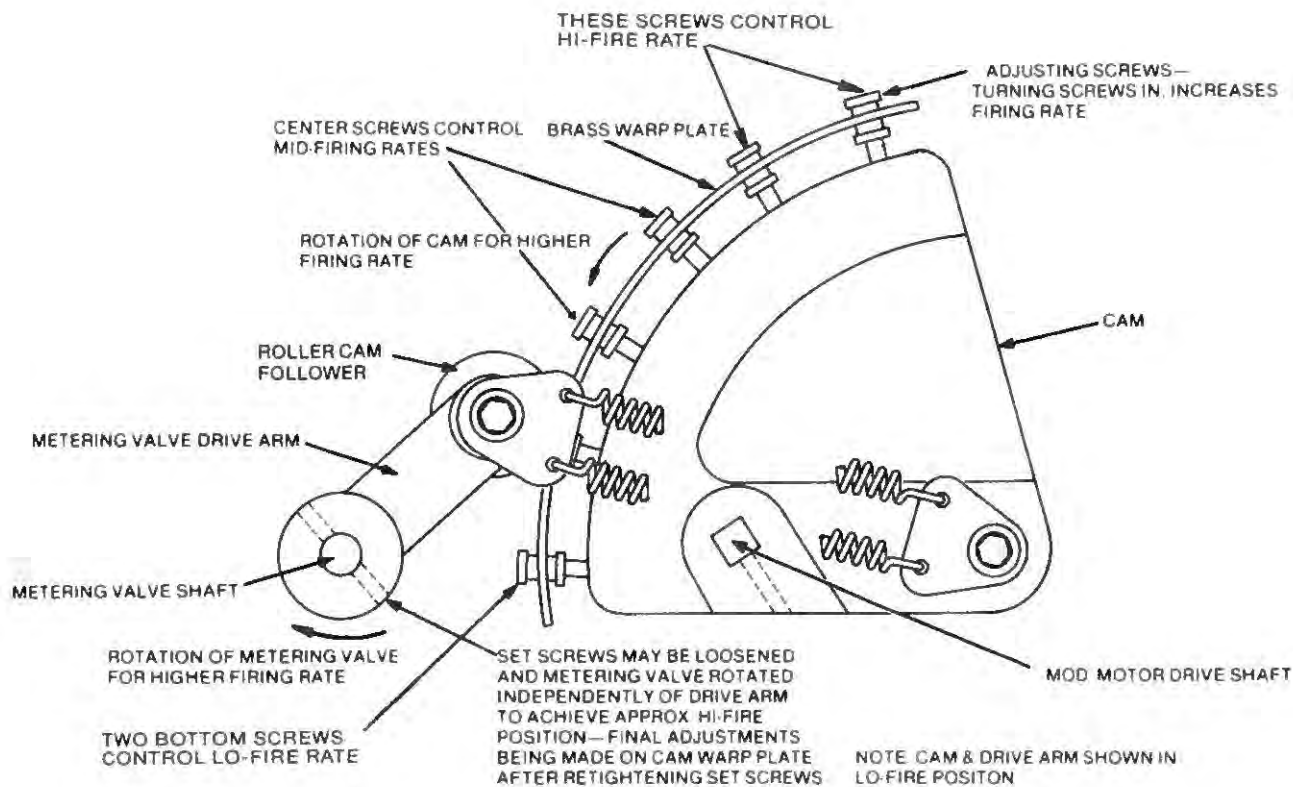


FIG. 5-22 OIL METERING VALVE DRIVE ADJUSTMENTS -
AIR ATOMIZING UNITS 100 THRU 400 H.P.

CHAPTER 6

TROUBLE SHOOTING

The following table includes common service problems, causes and recommended actions to be taken to rectify the problem. These problems are not all inclusive, however, they are general in nature and cause. If the recommended actions do not solve the problem, consult the factory.

Problem	Possible Cause	Recommended Action
A. Motor will not start	1. Line starter tripped (Overload)	1. Reset
	2. Switch "off"	2. Put in "on" position
	3. Blown fuse	3. Replace
	4. Combustion control in safety position	4. Reset
	5. Control circuit open	5. Check limits and operating controls for power to proper terminal of combustion control
	6. Loose wiring connections	6. Check and retighten
	7. Defective motor	7. Replace
	8. Low voltage	8. Minimum operating voltage, 102 V AC if motor nameplate 115/120V AC; 204V AC if 220/240V AC; 408V AC if 440/480V AC; 510V AC if 550/660V AC
	9. Frozen oil pump on direct drive burners	9. Replace with new oil pump. Check coupling for visual signs of undue wear; replace if necessary.
B. Motor starts but pilot does not light	1. No gas to pilot valve	1. Open all manual gas cocks; purge air from gas supply line, tighten fittings
	2. Gas solenoid valve not open	2. Check combustion control and operation of gas valve coil
	3. No ignition spark	3. Check setting of electrodes, cracked electrode insulator, excessive carbon build-up, operation of transformer, high tension wiring
	4. Low or high gas pressure	4. Press downstream of pilot solenoid valve to 6"WC
	5. Air damper open too wide	5. Reset air damper - refer to linkage diagrams.
	6. Running interlocks not closed	6. Check fuel pressure, low fire interlock, high oil temperature, atomizing air interlock for power to terminals. Retighten terminal screws. If control can be reset, do so. If pilot does not light, check for damaged air or fuel lines. Make sure low fire interlock in correct position.
C. Motor starts - Pilot lights but scanner signal reading is low or fluctuating	1. Weak pilot	1. See above - check gas pressure, air damper opening
	2. Obstructed scanner pipe	2. Clean
	3. Dirty or weak scanner cell	3. Clean or replace
	4. Inoperative combustion control	4. Replace tubes, amplifier, or control
	5. Low voltage to combustion control	5. Increase to at least 102V AC
	6. Scanner viewing hot refractory	6. Resight scanner per diagrams in flame safeguard manual.

D. Oil fire does not light	<ol style="list-style-type: none"> 1. No oil pressure or low oil pressure on discharge 2. Oil solenoid valve not opening 3. Excessive combustion air - too little oil 4. Fluctuating oil pressure 5. Atomizing air pressure too low or too high 	<ol style="list-style-type: none"> 1. Check for fuel in tank, open suction line valves, check and clean strainer, check suction line for leaks - use vacuum gauge, reprime pump (see also oil pump trouble shooting guide) 2. Check wiring connections, check and replace solenoid coil. 3. Reset air damper or cam setting on oil valve lever - see linkage diagrams. Dirty nozzle or improperly assembled nozzle. 4. Check for foreign objects in air or fuel line 5. Check air pressure and adjust accordingly.
E. Gas fire does not light (USE CAUTION)	<ol style="list-style-type: none"> 1. Manual gas valve closed 2. Butterfly valve closed 3. Automatic electric gas valves not opening 4. Excessive primary air 	<ol style="list-style-type: none"> 1. Open 2. Readjust - see diagram 3. Check for power to actuator; replace actuator 4. Reset air damper
F. Oil fire smokes	<ol style="list-style-type: none"> 1. Improper air/fuel mixture 2. Insufficient combustion air 3. Unit being overfired 4. Dirty nozzle 5. Oil temperature too high or too low 6. Atomizing air pressure too low or too high 	<ol style="list-style-type: none"> 1. Readjust linkage and cam setting - refer to diagrams, use combustion testing instruments 2. Provide more openings to boiler room 3. Check rating of boiler and firing rate of burner. 4. Clean and reassemble properly - replace if worn out 5. Check oil temperature - reset controls according to chart recommendations 6. Check air pressure and adjust accordingly
G. Gas fire smokes	<ol style="list-style-type: none"> 1. Improper air fuel mixture 2. Insufficient combustion air 3. Unit being overfired 	<ol style="list-style-type: none"> 1. See No. 1 above 2. See No. 2 above 3. See No. 3 above
H. Oil fire noisy or pulsates	<ol style="list-style-type: none"> 1. Fire too lean 2. Excessive atomizing air pressure 3. Excessive oil temperature 4. High or variable draft 	<ol style="list-style-type: none"> 1. Readjust linkage and cam settings to increase rate or reduce air supply 2. Reajust air valve on air compressor or slow down compressor or RPM (ie, adjust pulley size) 3. Readjust control at heater 4. Install draft controls
I. Gas fire noisy or pulsates	<ol style="list-style-type: none"> 1. Fire too lean 2. Fire too rich 3. High or variable draft 	<ol style="list-style-type: none"> 1. Readjust linkage 2. Check boiler rating and reset burner 3. Install draft controls
J. Excessive carbon build-up	<ol style="list-style-type: none"> 1. Oil temperature too low or too high 2. Nozzle setting incorrect 3. Firing tube diameter too small 4. High or variable draft 5. Overfiring boiler 6. Improper heat transfer 7. Uneven airflow through diffuser 	<ol style="list-style-type: none"> 1. Readjust oil temperature controls 2. See diagrams 3. See diagram covering minimum sizes 4. Install draft controls 5. Check boiler rating and reset burner 6. Readjust operating controls to allow boiler to operate at temperature rating 7. Check for diffuser centered in plenum, air diffuser vanes to be opened evenly

PARTS PROCEDURES

A. ORDERING REPLACEMENT PARTS

Where to Order Parts:

Parts for Kewanee units should be ordered from the authorized Kewanee Service Representative who started and adjusted your unit. His name is listed on the first page of this manual or on the Operating Instruction Card. If necessary, parts may be ordered direct from Kewanee Boiler Corporation, 101 Franklin Street, Kewanee, Illinois 61443, or from your local Kewanee Sales Office.

How to Order Parts:

1. Always include nameplate data including order number as shown on the burner.
2. If parts are required for electric controls, motors, pumps, etc., also include complete nameplate data taken from the item for which the parts are required.
3. List the complete name and description of each part included in your order. Refer to the Parts List in this Manual.
4. State quantity desired of each item.
5. State whether shipment is to be made by express, parcel post or freight.

Parts Returned Under Warranty or for Repair:

1. Notify Kewanee Boiler Corporation, Kewanee, Illinois 61443 (or your local Kewanee Sales Office) for the part to be returned; model and serial number of unit from which it was taken; whether the part is being returned for credit, replacement, or repair. A Return Material Tag will be sent to you.

2. *Do not send any part to the Kewanee plant without a Return Material Tag.*
3. Remove usable fittings from the part, drain oil (if any), clean, and attach the appropriate section of the Return Material Tag securely to the part.
4. Pack the part properly to avoid shipping damage and ship *prepaid* to Kewanee Boiler Corporation, 101 Franklin Street, Kewanee, Illinois 61443.

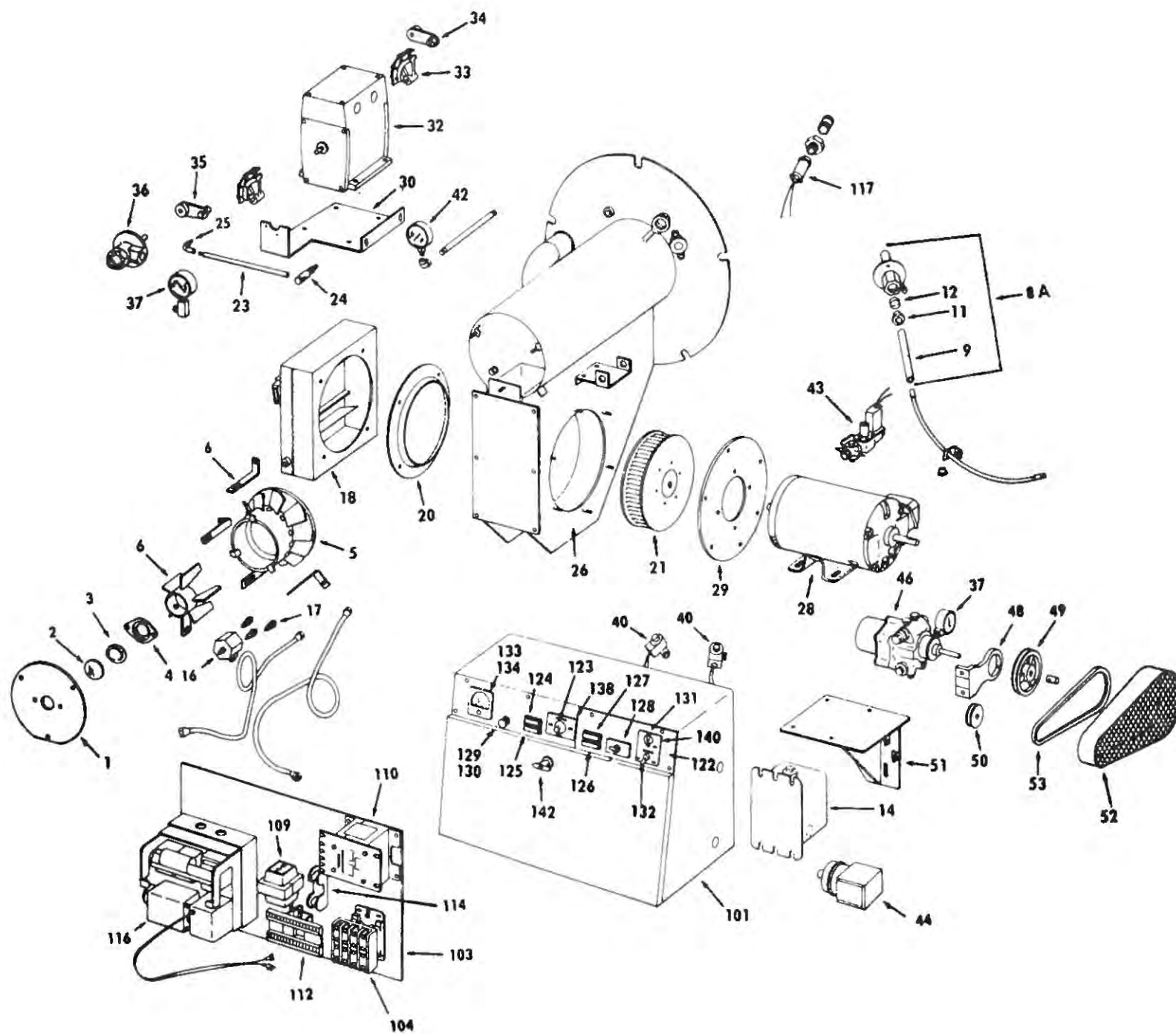
B. REPLACEMENT PARTS INVENTORY

Every boiler plant owner can assure more economical and effective operation by purchasing a small inventory of replacement parts for the use of the operator in maintaining and servicing the boiler unit.

The following suggested list of replacement parts stock is a minimum inventory. Consult your authorized Kewanee service representative for replacement parts stock adequate to meet the full requirements of your particular job.

1. Replacement electrical fuses.
2. Set of plug-in-modules for electronic control.
3. Scanner cell for electronic control.
4. Ignition electrodes and insulators.
5. Ignition cables.
6. Fuel pump coupling, or belt, as applicable.
7. Oil filter gasket and replacement cartridge.
8. Oil atomizing nozzles.
9. Replacement V-belts for oil pump and air compressor.

FIG. 6-1



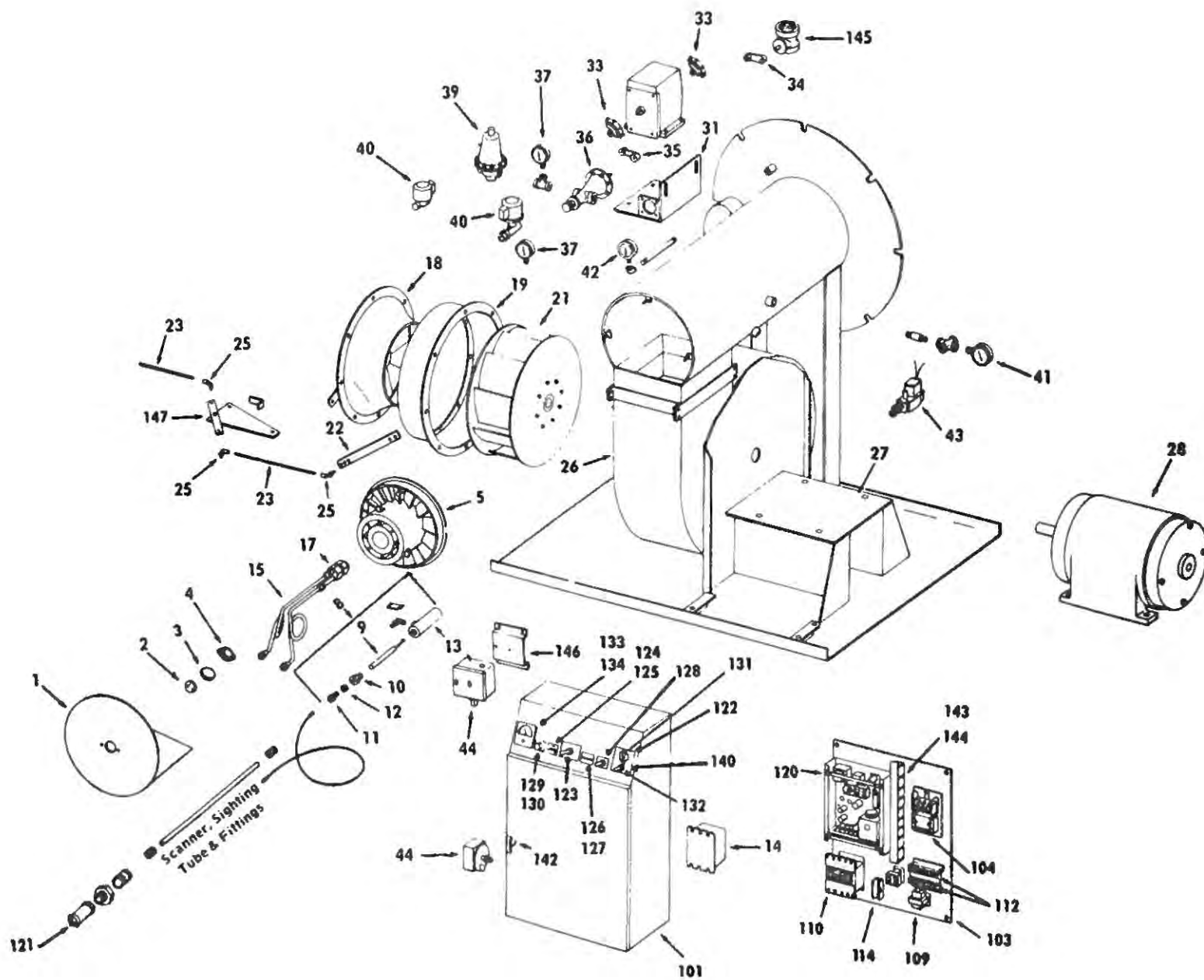


FIG. 6-2

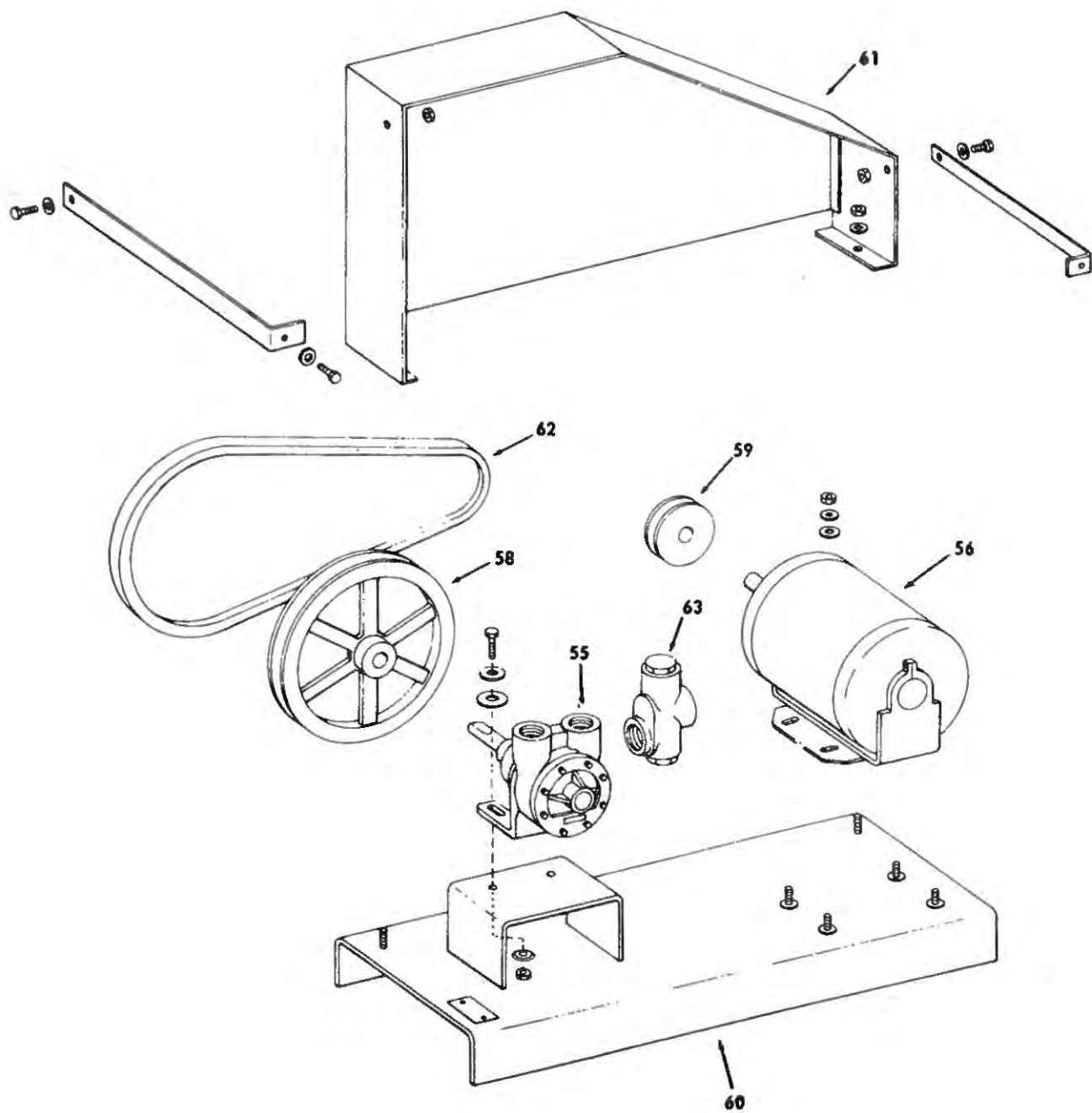


FIG. 6-3

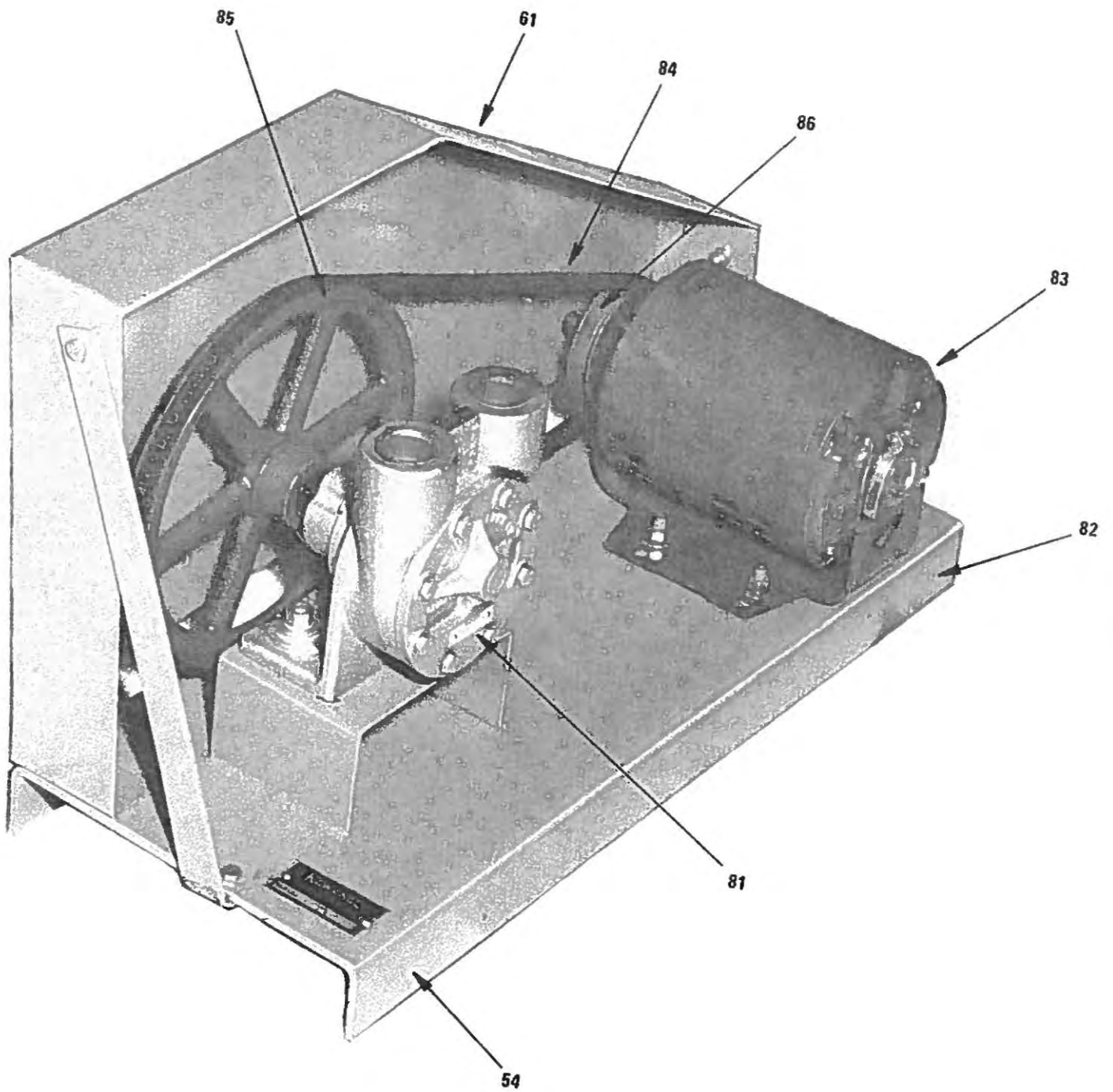


FIG. 6-4

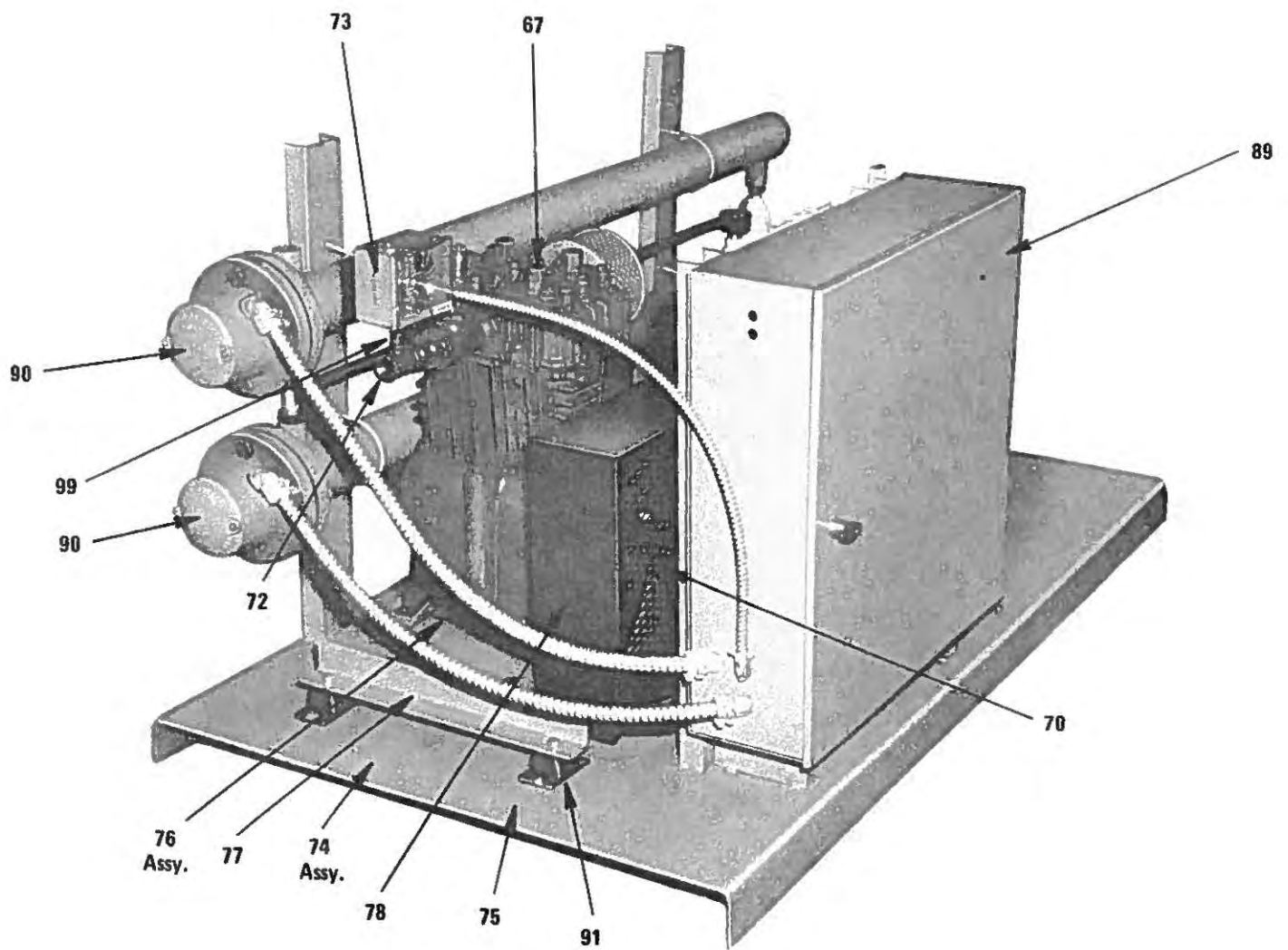
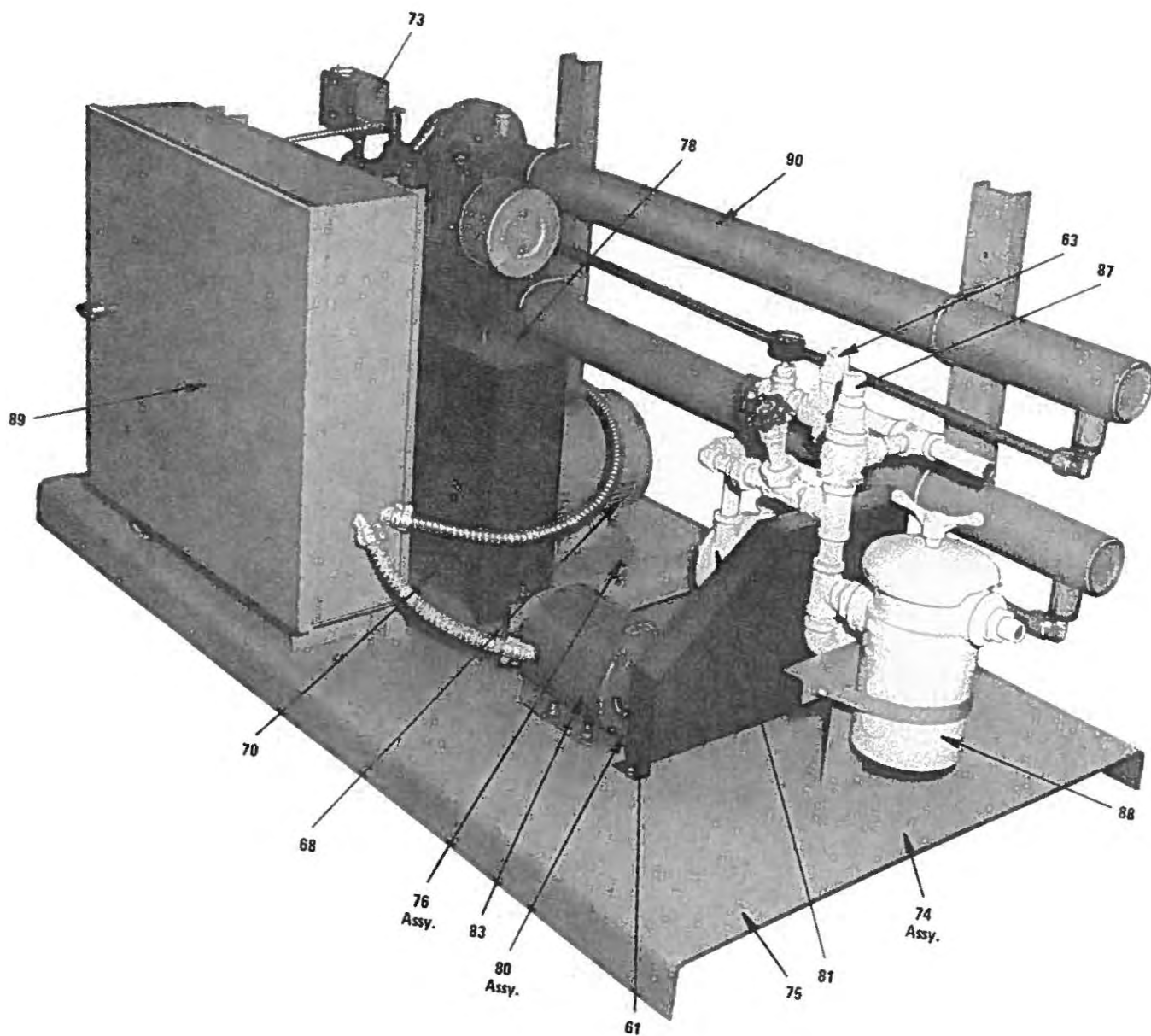


FIG. 6-5



PARTS LIST 60-200

Fig. No.	Item No.	Unit Suffix										Description	
		G	O	O				GO	GO				
				2	4	5	6		2	4	5		6
6-2	1	X	X	X	X	X	X	X	X	X	X	Plenum Cover Plate	
6-3	2	X	X	X	X	X	X	X	X	X	X	Sight Glass	
6-2	3	X	X	X	X	X	X	X	X	X	X	Sight Glass Gasket—2 Req'd	
6-2	4	X	X	X	X	X	X	X	X	X	X	Sight Glass Holder	
6-2	5	X										Diffuser Assembly	
6-2	5a	X					X					Diffuser Assembly	
6-2	5b			X	X	X	X		X	X	X	Diffuser Assembly	
6-2	6	X	X	X	X	X	X	X	X	X	X	Diffuser Retainer	
6-2	7	X										Vane Assembly	
	8	X		X	X	X	X	X	X	X	X	Gas Pilot Assembly	
	8a	X										Pilot Assembly—Direct Spark	
6-2	9	X		X	X	X	X	X	X	X	X	Electrode	
6-2	9a	X										Electrode—Direct Spark	
6-3	10	X		X	X	X	X	X	X	X	X	Holder—Electrode	
6-3	10a	X										Holder—Electrode Direct Spark	
6-2	11	X	X	X	X	X	X	X	X	X	X	Hex Nut—Electrode	
6-2	12	X	X	X	X	X	X	X	X	X	X	Ferrule—Electrode	
6-3	13	X		X	X	X	X	X	X	X	X	Pilot Housing	
6-2	14	X		X	X	X	X	X	X	X	X	Ignition Transformer—6000V	
6-2	14a	X										Ignition Transformer—10000V	
6-3	15			X	X	X	X		X	X	X	Oil Nozzle Assembly	
6-2	16			X	X	X	X		X	X	X	Oil Nozzle Adaptor Assembly	
6-2	16a	X					X					Oil Nozzle Adaptor Assembly	
6-2	16b	X					X					Oil Nozzle Adaptor Assembly	
6-2	17	X					X					Oil Nozzle—Modulating	
6-2	17a	X					X					Oil Nozzle—Hi-Low	
6-2	17b			X	X	X	X		X	X	X	Oil Nozzle—70°	
6-2	18	X	X	X	X	X	X	X	X	X	X	Damper Assembly	
6-3	19	X		X	X	X	X		X	X	X	Damper Housing Assembly	
6-2	20	X	X	X	X	X	X	X	X	X	X	Inlet Cone	
6-2	21	X	X	X	X	X	X	X	X	X	X	Blower Wheel	
6-3	22	X		X	X	X	X		X	X	X	Damper Lever	
6-2	23	X	X	X	X	X	X	X	X	X	X	Damper Rod	
6-2	24	X	X	X	X	X	X	X	X	X	X	Ball Joint Connector—Straight	
6-3	25	X	X	X	X	X	X	X	X	X	X	Ball Joint Connector—90°	
6-2	26	X	X	X	X	X	X	X	X	X	X	Fan Housing Assembly	
6-3	27	X		X	X	X	X		X	X	X	Motor Base Assembly	
6-2	28	X										Fan Motor—230/60/3-Std.	
6-2	28a	X					X					Fan Motor—230/60/3-Std.	
6-2	28b			X	X	X	X		X	X	X	Fan Motor—230/60/3-Std.	
6-2	29	X	X	X	X	X	X	X	X	X	X	Motor Mounting Plate	
	30	X	X				X					Damper Motor Bracket	
6-2	31	X										Modulating Motor Bracket	
6-2	31a	X	X	X	X	X	X	X	X	X	X	Modulating Motor Bracket	
6-2	32	X	X	X	X	X	X	X	X	X	X	Modulating Motor	
6-2	32a	X	X				X					Damper Motor	
6-2	33	X	X	X	X	X	X	X	X	X	X	Modulating Cam Assembly	
6-2	33a	X	X				X					Damper Motor Lever	
6-2	34	X					X	X	X	X	X	Lever Assembly—Gas	
6-2	34a	X					X					Lever—Gas	
6-2	35		X	X	X	X	X	X	X	X	X	Lever Assembly—Oil	
6-2	36		X				X					Oil Metering Valve	

PARTS LIST 60-200

Fig. No.	Item No.	Unit Suffix										Description	
		G	O	O				GO	GO				
				2	4	5	6		2	4	5		6
6-2	36a			X	X	X	X		X	X	X	X	Oil Metering Valve
6-2	37		X					X					Oil Pressure Gauge
6-2	37a			X	X	X	X		X	X	X	X	Oil Pressure Gauge
	38				X	X	X			X	X	X	Thermometer 50—300°
6-3	39		X					X					Oil Regulating Valve
6-3	39a			X					X				Oil Regulating Valve
6-3	39b				X	X	X			X	X	X	Oil Regulating Valve
6-2	40		X					X					Oil Solenoid Valve—N.C.
6-2	40a		X					X					Oil Solenoid Valve—N.O.
6-2	40b			X	X	X	X		X	X	X	X	Oil Solenoid Valve—N.C.
6-2	40c				X	X	X			X	X	X	Oil Solenoid Valve—N.O.
6-3	41			X	X	X	X		X	X	X	X	Air Pressure Gauge
6-2	42	X						X	X	X	X	X	Gas Pressure Gauge
6-2	43	X	X	X	X	X	X	X	X	X	X	X	Comb. Gas Pilot Reg. / Solenoid Valve
6-2	44	X	X	X	X	X	X	X	X	X	X	X	Combustion Air Switch
	45		X					X					Oil Pump Assy.—Pres. Atom
6-2	46		X					X					Oil Pump—Pres. Atom
	47		X					X					Oil Pump—Motor
6-2	48		X					X					Oil Pump—Foot
6-2	49		X					X					Oil Pump—Sheave
6-2	50		X					X					Oil Pump—Motor Sheave
6-2	51		X					X					Oil Pump—Base Assembly
6-2	52		X					X					Oil Pump—Guard
6-2	53		X					X					Oil Pump—Belt
6-5	54			X					X				Oil Pump Assembly A.A.—Tuthill
6-5	54a				X					X			Oil Pump Assembly A.A.—Viking
6-5	54b					X					X		Oil Pump Assembly A.A.—Viking
6-5	54c						X					X	Oil Pump Assembly A.A.—Viking
6-4	55			X					X				Oil Pump A.A.—Tuthill
6-4	55a				X	X	X			X	X	X	Oil Pump A.A.—Viking
6-4	56			X			X		X			X	Oil Pump Motor
6-4	56a				X					X			Oil Pump Motor
6-4	56b					X					X		Oil Pump Motor
	57			X					X				Oil Pump Foot
6-4	58			X	X		X		X	X		X	Oil Pump Sheave
6-4	58a					X					X		Oil Pump Sheave—No. 1
6-4	58b					X					X		Oil Pump Sheave—No. 2
6-4	59			X	X		X		X	X		X	Oil Pump Motor Sheave
6-4	59a					X					X		Oil Pump Motor Sheave
6-4	60			X					X				Oil Pump Base Assembly
6-4	60a				X					X			Oil Pump Base Assembly
6-4	60b					X					X		Oil Pump Base Assembly
6-4	60c						X					X	Oil Pump Base Assembly
6-4	61			X	X		X		X	X		X	Oil Pump Guard
6-4	62			X	X		X		X	X		X	Oil Pump Belt
6-4	62a					X					X		Oil Pump Belt
6-4	63			X	X	X	X		X	X	X	X	Oil Regulating Valve
	64		X	X				X	X				Coupling Motor To Oil Pump
	64a				X					X			Coupling Motor To Oil Pump
	64b					X						X	Coupling Motor To Oil Pump
	65			X	X	X	X		X	X	X	X	Compressor Assembly
	66			X	X	X	X		X	X	X	X	Compressor Base Assembly

PARTS LIST 60-200

Fig. No.	Item No.	Unit Suffix										Description	
		G	O	O				GO	GO				
				2	4	5	6		2	4	5		6
6-6	67			X	X	X	X		X	X	X	X	Compressor—Quincy
6-6	68			X	X	X	X		X	X	X	X	Compressor Motor
	69			X	X	X	X		X	X	X	X	Compressor Motor Sheave
6-6	70			X	X	X	X		X	X	X	X	Compressor Belt
	71			X	X	X	X		X	X	X	X	Compressor Belt Guard
6-2	72			X	X	X	X		X	X	X	X	Compressor Flexible Hose
6-6	73			X	X	X	X		X	X	X	X	Atomizing Air Switch
6-6	74			X					X				Air-Oil Module Assembly
6-6	74a				X					X			Air-Oil Module Assembly
6-6	74b					X					X		Air-Oil Module Assembly
6-6	74c						X					X	Air-Oil Module Assembly
6-6	75			X					X				Air-Oil Module Base Assembly
6-6	75a				X					X			Air-Oil Module Base Assembly
6-6	75b					X					X		Air-Oil Module Base Assembly
6-6	75c						X					X	Air-Oil Module Base Assembly
6-6	76			X	X	X	X		X	X	X	X	Air-Oil Module Compressor Assembly
6-6	77			X	X	X	X		X	X	X	X	Air-Oil Module Compressor Base
6-6	67			X	X	X	X		X	X	X	X	Air-Oil Module Compressor
6-6	68			X	X	X	X		X	X	X	X	Air-Oil Module Compressor Motor
	69			X	X	X	X		X	X	X	X	Air-Oil Module Compressor Motor Sheave
6-6	70			X	X	X	X		X	X	X	X	Air-Oil Module Compressor Belt
6-6	78			X	X	X	X		X	X	X	X	Air-Oil Module Compressor Belt Guard
6-6	78a			X	X	X	X		X	X	X	X	Air-Oil Module Compressor Screen Guard
6-6	72			X	X	X	X		X	X	X	X	Air-Oil Module Compressor Flexible Hose
6-6	79			X	X	X	X		X	X	X	X	Air-Oil Module Switch Flexible Hose
6-6	80			X					X				Air-Oil Module Oil Pump Assembly
6-6	80a				X					X			Air-Oil Module Oil Pump Assembly
6-6	80b					X					X		Air-Oil Module Oil Pump Assembly
6-6	80c						X					X	Air-Oil Module Oil Pump Assembly
6-5	81			X					X				Air-Oil Module Oil Pump
6-5	81a				X		X			X		X	Air-Oil Module Oil Pump
6-5	81b					X					X		Air-Oil Module Oil Pump
6-5	82			X					X				Air-Oil Module Oil Pump Base
6-5	82a				X					X			Air-Oil Module Oil Pump Base
6-5	82b					X					X		Air-Oil Module Oil Pump Base
6-5	82c						X					X	Air-Oil Module Oil Pump Base
6-5	83			X			X		X			X	Air-Oil Module Oil Pump Motor
6-5	83a				X					X			Air-Oil Module Oil Pump Motor
6-5	83b					X					X		Air-Oil Module Oil Pump Motor
6-5	84			X	X		X		X	X		X	Air-Oil Module Oil Pump Belt
6-5	84a					X					X		Air-Oil Module Oil Pump Belt
6-5	85			X	X		X		X	X		X	Air-Oil Module Oil Pump Sheave
6-5	85a					X					X		Air-Oil Module Oil Pump Sheave—No. 1
6-5	85b					X					X		Air-Oil Module Oil Pump Sheave—No. 2
6-5	86			X	X		X		X	X		X	Air-Oil Module Oil Pump Motor Sheave
6-5	86a					X					X		Air-Oil Module Oil Pump Motor Sheave
6-4	61			X	X		X		X	X		X	Air-Oil Module Pump Guard
6-4	63					X	X				X	X	Air-Oil Module Oil Regulating Valve
6-6	87					X	X				X	X	Air-Oil Module Oil Relief Valve
	73			X	X	X	X		X	X	X	X	Air-Oil Module Atomizing Air Switch
6-6	88			X					X				Air-Oil Module Oil Strainer
6-6	88a				X	X	X			X	X	X	Air-Oil Module Oil Strainer

PARTS LIST 60-200

Fig. No.	Item No.	Unit Suffix										Description	
		G	O	O				GO	GO				
				2	4	5	6		2	4	5		6
6-6	89			X	X	X	X		X	X	X	X	Air-Oil Module Cabinet Assembly
6-6	90				X	X	X			X	X	X	Air-Oil Module Electric Oil Heater—200 Volt
6-6	90a				X	X	X			X	X	X	Air-Oil Module Electric Oil Heater—230 Volt
6-6	90b				X	X	X			X	X	X	Air-Oil Module Electric Oil Heater—460 Volt
6-6	91		X	X	X	X			X	X	X	X	Air-Oil Module Compressor Vibration Pad
	92				X	X	X			X	X	X	Electric Oil Heater—200 Volt
	92a				X	X	X			X	X	X	Electric Oil Heater—230 Volt
	92b				X	X	X			X	X	X	Electric Oil Heater—460 Volt
	93						X					X	Steam Oil Heater—Hi & Lo Pressure
	94						X					X	Steam Temperature Regulating Valve
	95						X					X	Steam Strainer
	96						X					X	Steam Regulator—Hi Pressure Steam
	97						X					X	Steam Trap
	98						X					X	Water Oil Heater
	99						X					X	Water Circulating Pump
	100						X					X	Oil Temperature Control—Water
6-2	101	X	X	X	X	X	X	X	X	X	X	X	Control Cabinet Assembly—Main
	102			X	X	X	X		X	X	X	X	Control Cabinet Assembly—Aux.
	102a	X						X					Control Cabinet Assembly—Aux.
	102b	X											Control Cabinet Assembly—Aux.
6-2	103	X	X	X	X	X	X	X	X	X	X	X	Sub Panel—Assembly—Main
6-2	103a	X						X					Sub Panel—Assembly—Aux.
6-2	103b	X											Sub Panel—Assembly—Aux.
6-2	103c			X	X	X	X		X	X	X	X	Sub Panel—Assembly—Aux.
	104	X	X	X	X	X	X	X	X	X	X	X	Starter—Blower Motor
	105			X	X	X	X		X	X	X	X	Starter—Compressor
	106		X	X	X	X	X	X	X	X	X	X	Starter—Oil Pump
	107				X	X	X			X	X	X	Contactor—Electric Oil Heater
	108	X	X	X	X	X	X	X	X	X	X	X	Overload Relay Heaters
	109	X	X	X	X	X	X	X	X	X	X	X	Transformer—Modulation 115/24V
	110	X	X	X	X	X	X	X	X	X	X	X	Transformer—Control 200-230-460/115V
	111		X	X	X	X	X	X	X	X	X	X	Power Block—3 Wire
	112	X	X	X	X	X	X	X	X	X	X	X	Terminal Strip
	113	X	X	X	X	X	X	X	X	X	X	X	(2) Terminal Strip Bracket
	113a	X	X	X	X	X	X	X	X	X	X	X	(1) Terminal Strip Bracket
	114	X	X	X	X	X	X	X	X	X	X	X	Fuses & Fuse Blocks
	115	X	X	X	X	X	X	X	X	X	X	X	Base R4140—Flame Safe Guard
6-2	117	X	X					X					Flame Detector—UV
	118	X	X					X					Amplifier—UV
	119			X	X	X	X		X	X	X	X	Amplifier—Lead Sulfide
	120			X	X	X	X		X	X	X	X	R4140G Flame Safe Guard (UL)
	120a	X	X	X	X	X	X	X	X	X	X	X	R4140L Flame Safe Guard (FIA)
	120b	X	X	X	X	X	X	X	X	X	X	X	R4140L Flame Safe Guard (FM)
	121			X	X	X	X		X	X	X	X	Flame Detector—Lead Sulfide
6-3	122	X	X	X	X	X	X	X	X	X	X	X	Console
6-2	123	X	X	X	X	X	X						Burner Switch—Single Fuel
6-2	123a							X	X	X	X	X	Burner Switch—Dual Fuel
6-2	124	X	X	X	X	X	X	X	X	X	X	X	Light—Ignition
6-2	125	X	X	X	X	X	X	X	X	X	X	X	Light—Main Fuel
6-2	126	X	X	X	X	X	X	X	X	X	X	X	Light—Low Water
6-2	127	X	X	X	X	X	X	X	X	X	X	X	Light—Flame Failure
6-2	128	X	X	X	X	X	X	X	X	X	X	X	Switch—Control—SPST

PARTS LIST 60-200

Fig. No.	Item No.	Unit Suffix										Description	
		G	O	O				GO	GO				
				2	4	5	6		2	4	5		6
6-2	129	X	X	X	X	X	X	X	X	X	X	Fuse Holder—Control	
6-2	130	X	X	X	X	X	X	X	X	X	X	Fuse—Control	
	131	X	X	X	X	X	X	X	X	X	X	Potentiometer	
6-2	132	X	X	X	X	X	X	X	X	X	X	Potentiometer Switch 2PDT	
6-2	133	X	X	X	X	X	X	X	X	X	X	Voltmeter D.C.—When Req'd	
6-2	134	X	X					X				Ammeter—When Req'd	
	135	X	X	X	X	X	X	X	X	X	X	Wire Assembly Red—Voltmeter	
	136	X	X	X	X	X	X	X	X	X	X	Wire Assembly Black—Voltmeter	
	137	X	X					X				Cable Assembly—Ammeter	
6-2	138	X	X	X	X	X	X					Plate Burner Switch	
	138a							X	X	X	X	Plate Burner Switch	
	139	X	X	X	X	X	X	X	X	X	X	Plate Switch Control	
6-2	140	X	X	X	X	X	X	X	X	X	X	Plate Switch Potentiometer	
	141	X		X	X	X	X		X	X	X	Plate Fuse Control	
6-2	142	X	X	X	X	X	X	X	X	X	X	Lock—Control Cabinet	
	143	X		X	X	X	X		X	X	X	Channel—Panel	
	144	X		X	X	X	X		X	X	X	Cover—Panel Channel	
6-3	145	X						X	X	X	X	Butterfly Valve—Gas	
6-3	146											Bracket—Pressure Switch 1	
6-3	147	X		X	X	X	X		X	X	X	Bracket Assembly—Fan Inlet Damper	

PARTS LIST 250-750

Fig. No.	Item No.	Unit Suffix										Description	
		G	O	O				GO	GO				
				2	4	5	6		2	4	5		6
6-2	1	X	X	X	X	X	X	X	X	X	X	Plenum Cover Plate	
6-3	2	X	X	X	X	X	X	X	X	X	X	Sight Glass	
6-2	3	X	X	X	X	X	X	X	X	X	X	Sight Glass Gasket—2 Req'd	
6-2	4	X	X	X	X	X	X	X	X	X	X	Sight Glass Holder	
6-2	5	X										Diffuser Assembly	
6-2	5a	X						X				Diffuser Assembly	
6-2	5b			X	X	X	X		X	X	X	Diffuser Assembly	
6-2	6	X	X	X	X	X	X	X	X	X	X	Diffuser Retainer	
6-2	7	X										Vane Assembly	
	8	X		X	X	X	X	X	X	X	X	Gas Pilot Assembly	
	8a	X										Pilot Assembly—Direct Spark	
6-2	9	X		X	X	X	X	X	X	X	X	Electrode	
6-2	9a	X										Electrode—Direct Spark	
6-3	10	X		X	X	X	X	X	X	X	X	Holder Electrode	
6-3	10a	X										Holder Electrode—Direct Spark	
6-2	11	X	X	X	X	X	X	X	X	X	X	Hex Nut—Electrode	
6-2	12	X	X	X	X	X	X	X	X	X	X	Ferrule Electrode	
6-3	13	X		X	X	X	X	X	X	X	X	Pilot Housing	
6-2	14	X		X	X	X	X	X	X	X	X	Ignition Transformer—6000V	
6-2	14a		X									Ignition Transformer—10000V	
6-3	15			X	X				X	X		Oil Nozzle Assembly—Monarch	
6-3	15a					X	X				X	Oil Nozzle Assembly—Delavan	
6-2	16			X	X	X	X		X	X	X	Oil Nozzle Adaptor Assembly	
6-2	16a							X				Oil Nozzle Adaptor Assembly	
6-2	16b		X									Oil Nozzle Adaptor Assembly	
6-2	17		X					X				Oil Nozzle—Modulating—3 Req'd	
6-2	17a		X					X				Oil Nozzle—Hi-Low	
6-2	17b			X	X				X	X		Oil Nozzle—70°—Monarch	
6-2	17c					X	X				X	Oil Nozzle—Delavan	
6-2	18	X	X	X	X	X	X	X	X	X	X	Damper Assembly	
6-3	19	X		X	X	X	X		X	X	X	Damper Housing Assembly	
6-2	20	X	X	X	X	X	X	X	X	X	X	Inlet Cone	
6-2	21	X	X	X	X	X	X	X	X	X	X	Blower Wheel	
6-3	22	X		X	X	X	X		X	X	X	Damper Lever	
6-2	23	X	X	X	X	X	X	X	X	X	X	Damper Rod	
6-2	24	X	X	X	X	X	X	X	X	X	X	Ball Joint Connector—Straight	
6-3	25	X	X	X	X	X	X	X	X	X	X	Ball Joint Connector—90°	
6-2	26	X	X	X	X	X	X	X	X	X	X	Fan Housing Assembly	
6-3	27	X		X	X	X	X		X	X	X	Motor Base Assembly	
6-2	28	X										Fan Motor—230/60/3-Std.	
6-2	28a		X					X				Fan Motor—230/60/3-Std.	
6-2	28b			X	X	X	X		X	X	X	Fan Motor—230/60/3-std.	
6-2	29	X	X	X	X	X	X	X	X	X	X	Motor Mounting Plate	
	30	X	X					X				Damper Motor Bracket	
6-2	31	X										Modulating Motor Bracket	
6-2	31a		X	X	X	X	X	X	X	X	X	Modulating Motor Bracket	
6-2	32	X	X	X	X	X	X	X	X	X	X	Modulating Motor	
6-2	32a	X	X					X				Damper Motor	
6-2	33	X	X	X	X	X	X	X	X	X	X	Modulating Cam Assembly	
6-2	33a	X	X					X				Damper Motor Lever	
6-2	34	X						X	X	X	X	Lever Assembly—Gas	
6-2	34a	X						X				Lever—Gas	

PART LIST 250-750

Fig. No.	Item No.	Unit Suffix										Description	
		G	O	O				GO	GO				
				2	4	5	6		2	4	5		6
6-2	35		X	X	X	X	X	X	X	X	X	Lever Assembly—Oil	
6-2	36		X				X					Oil Metering Valve	
6-2	36a			X	X	X	X	X	X	X	X	Oil Metering Valve	
6-2	37		X				X					Oil Pressure Gauge	
6-2	37a			X	X	X	X	X	X	X	X	Oil Pressure Gauge	
	38				X	X	X		X	X	X	Thermometer 50—300°	
6-3	39		X				X					Oil Regulating Valve	
6-3	39a			X				X				Oil Regulating Valve	
6-3	39b				X	X	X		X	X	X	Oil Regulating Valve	
6-2	40		X				X					Oil Solenoid Valve—N.C.	
6-2	40a		X				X					Oil Solenoid Valve—N.O.	
6-2	40b			X	X	X	X	X	X	X	X	Oil Solenoid Valve—N.C.	
6-2	40c				X	X	X		X	X	X	Oil Solenoid Valve—N.O.	
6-3	41			X	X	X	X	X	X	X	X	Air Pressure Gauge	
6-2	42	X					X	X	X	X	X	Gas Pressure Gauge	
6-2	43	X	X	X	X	X	X	X	X	X	X	Comb. Gas Pilot Reg./Solenoid Valve	
6-2	44	X	X	X	X	X	X	X	X	X	X	Combustion Air Switch	
	45		X				X					Oil Pump Assembly—Pres. Atom	
6-2	46		X				X					Oil Pump—Pres. Atom	
	47		X				X					Oil Pump—Motor	
6-2	48		X				X					Oil Pump—Foot	
6-2	49		X				X					Oil Pump—Sheave	
6-2	50		X				X					Oil Pump—Motor Sheave	
6-2	51		X				X					Oil Pump—Base Assembly	
6-2	52		X				X					Oil Pump—Guard	
6-2	53		X				X					Oil Pump—Belt	
6-5	54			X				X				Oil Pump Assembly A.A.	
6-5	54a				X				X			Oil Pump Assembly A.A.	
6-5	54b				X					X		Oil Pump Assembly A.A.	
6-5	54c						X				X	Oil Pump Assembly A.A.	
6-4	55			X				X				Oil Pump A.A.	
6-4	55a				X				X			Oil Pump A.A.	
6-4	55b					X	X			X	X	Oil Pump A.A.	
6-4	56			X				X				Oil Pump Motor	
	56a				X				X			Oil Pump Motor	
6-4	56b					X				X		Oil Pump Motor	
6-4	56c						X				X	Oil Pump Motor	
	57			X				X				Oil Pump Foot	
	57a				X	X	X		X	X	X	Oil Pump Foot	
6-4	58			X				X				Oil Pump Sheave	
6-4	58a				X				X			Oil Pump Sheave	
6-4	58b					X				X		Oil Pump Sheave—No. 1	
6-4	58c					X				X		Oil Pump Sheave—No. 2	
6-4	58d						X				X	Oil Pump Sheave	
6-4	59			X				X				Oil Pump Motor Sheave	
6-4	59a				X				X			Oil Pump Motor Sheave	
6-4	59b					X				X		Oil Pump Motor Sheave	
6-4	59c						X				X	Oil Pump Motor Sheave	
6-4	60			X				X				Oil Pump Base Assembly	
6-4	60a				X				X			Oil Pump Base Assembly	
6-4	60b					X				X		Oil Pump Base Assembly	
6-4	60c						X				X	Oil Pump Base Assembly	

PARTS LIST 250-750

Fig. No.	Item No.	Unit Suffix										Description	
		G	O	O				GO	GO				
				2	4	5	6		2	4	5		6
6-4	61			X	X				X	X			Oil Pump Guard
6-4	61a						X					X	Oil Pump Guard
6-4	62			X					X				Oil Pump Belt
6-4	62a				X					X			Oil Pump Belt
6-4	62b					X					X		Oil Pump Belt
6-4	62c						X					X	Oil Pump Belt
6-4	63			X					X				Oil Regulating Valve
	64	X	X					X	X				Coupling Motor To Oil Pump
	64a				X					X			Coupling Motor To Oil Pump
	64b					X						X	Coupling Motor To Oil Pump
	65			X	X	X	X		X	X	X	X	Compressor Assembly
	66			X	X	X	X		X	X	X	X	Compressor Base Assembly
6-6	67			X	X	X	X		X	X	X	X	Compressor—Quincy
6-6	68			X	X	X	X		X	X	X	X	Compressor Motor
	69			X	X	X	X		X	X	X	X	Compressor Motor Sheave
6-6	70			X	X	X	X		X	X	X	X	Compressor Belt—2 Req'd
	71			X	X	X	X		X	X	X	X	Compressor Belt Guard
6-6	72			X	X	X	X		X	X	X	X	Compressor Flexible Hose
6-6	73			X	X	X	X		X	X	X	X	Atomizing Air Switch
6-6	74			X					X				Air-Oil Module Assembly
6-6	74a				X					X			Air-Oil Module Assembly
6-6	74b					X					X		Air Oil Module Assembly
6-6	74c						X					X	Air-Oil Module Assembly
6-6	75			X					X				Air-Oil Module Base Assembly
6-6	75a				X					X			Air-Oil Module Base Assembly
6-6	75b					X					X		Air-Oil Module Base Assembly
6-6	75c						X					X	Air-Oil Module Base Assembly
6-6	76			X	X	X	X		X	X	X	X	Air-Oil Module Compressor Assembly
6-6	77			X	X	X	X		X	X	X	X	Air-Oil Module Compressor Base
6-6	67			X	X	X	X		X	X	X	X	Air-Oil Module Compressor
6-6	68			X	X	X	X		X	X	X	X	Air-Oil Module Compressor Motor
	69			X	X	X	X		X	X	X	X	Air-Oil Module Compressor Motor Sheave
6-6	70			X	X	X	X		X	X	X	X	Air-Oil Module Compressor Belt
6-6	78			X	X	X	X		X	X	X	X	Air-Oil Module Compressor Belt Guard
6-6	78a			X	X	X	X		X	X	X	X	Air-Oil Module Compressor Screen Guard
6-6	72			X	X	X	X		X	X	X	X	Air-Oil Module Compressor Flexible Hose
6-6	79			X	X	X	X		X	X	X	X	Air-Oil Module Switch Flexible Hose
6-6	80			X					X				Air-Oil Module Oil Pump Assembly
6-6	80a				X					X			Air-Oil Module Oil Pump Assembly
6-6	80b					X					X		Air-Oil Module Oil Pump Assembly
6-6	80c						X					X	Air-Oil Module Oil Pump Assembly
6-5	81			X					X				Air-Oil Module Oil Pump
6-5	81a				X					X			Air-Oil Module Oil Pump
6-5	81b					X	X				X	X	Air-Oil Module Oil Pump
6-5	82			X					X				Air-Oil Module Oil Pump Base
6-5	82a				X					X			Air-Oil Module Oil Pump Base
6-5	82b					X					X		Air-Oil Module Oil Pump Base
6-5	82c						X					X	Air-Oil Module Oil Pump Base
6-5	83			X					X				Air-Oil Module Oil Pump Motor
6-5	83a				X					X			Air-Oil Module Oil Pump Motor
6-5	83b					X					X		Air-Oil Module Oil Pump Motor
6-5	83c						X					X	Air-Oil Module Oil Pump Motor

PART LIST 250-750

Fig. No.	Item No.	Unit Suffix										Description	
		G	O	O				GO	GO				
				2	4	5	6		2	4	5		6
6-5	84			X					X				Air-Oil Module Oil Pump Belt
6-5	84a				X					X			Air-Oil Module Oil Pump Belt
6-5	84b					X					X		Air-Oil Module Oil Pump Belt
6-5	84c						X					X	Air-Oil Module Oil Pump Belt
6-5	85			X					X				Air-Oil Module Oil Pump Sheave
6-5	85a				X					X			Air-Oil Module Oil Pump Sheave
6-5	85b					X					X		Air-Oil Module Oil Pump Sheave—No. 1
6-5	85c					X					X		Air-Oil Module Oil Pump Sheave—No. 2
6-5	85d						X					X	Air-Oil Module Oil Pump Sheave
6-5	86			X					X				Air-Oil Module Oil Pump Motor Sheave
6-5	86a				X					X			Air-Oil Module Oil Pump Motor Sheave
6-5	86b					X					X		Air-Oil Module Oil Pump Motor Sheave
6-5	86c						X					X	Air-Oil Module Oil Pump Motor Sheave
6-4	61				X	X			X	X			Air-Oil Module Oil Pump Guard
6-4	61a						X					X	Air-Oil Module Oil Pump Guard
6-4	63					X	X	X		X	X	X	Air-Oil Module Oil Regulating Valve
6-6	87					X	X				X	X	Air-Oil Module Oil Relief Valve
	73			X	X	X	X		X	X	X	X	Air-Oil Module Atomizing Air Switch
6-6	88			X					X				Air-Oil Module Oil Strainer
6-6	88a				X	X	X			X	X	X	Air-Oil Module Oil Strainer
6-6	89			X	X	X	X		X	X	X	X	Air-Oil Module Cabinet Assembly
6-6	90				X	X	X			X	X	X	Air-Oil Module Electric Oil Heater—200 Volt
6-6	90a				X	X	X			X	X	X	Air-Oil Module Electric Oil Heater—230 Volt
6-6	90b				X	X	X			X	X	X	Air-Oil Module Electric Oil Heater—460 Volt
6-6	91			X	X	X	X		X	X	X	X	Air-Oil Module Compressor Vibration Pad
	92				X	X	X			X	X	X	Electric Oil Heater—200 Volt
	92a				X	X	X			X	X	X	Electric Oil Heater—230 Volt
	92b				X	X	X			X	X	X	Electric Oil Heater—460 Volt
	93						X			X			Steam Oil Heater—Hi & Lo Pressure
	94						X			X			Steam Temperature Regulating Valve
	95						X			X			Steam Strainer
	96						X			X			Steam Regulator—Hi Pressure Steam
	97						X			X			Steam Trap
	98						X			X			Water Oil Heater
	99						X			X			Water Circulating Pump
	100						X			X			Oil Temperature Control—Water
6-2	101	X	X	X	X	X	X	X	X	X	X	X	Control Cabinet Assembly—Main
	102			X	X	X	X		X	X	X	X	Control Cabinet Assembly—Aux.
	102a			X				X					Control Cabinet Assembly—Aux.
	102b	X											Control Cabinet Assembly—Aux.
6-2	103	X	X	X	X	X	X	X	X	X	X	X	Sub Panel—Main
6-2	103a		X					X					Sub Panel—Aux.
6-2	103b	X											Sub Panel—Assembly—Aux.
6-2	103c			X	X	X	X		X	X	X	X	Sub Panel—Assembly—Aux.
	104	X	X	X	X	X	X	X	X	X	X	X	Starter—Blower Motor
	105	X	X	X	X	X	X	X	X	X	X	X	Starter—Compressor Motor
	106	X	X	X	X	X	X	X	X	X	X	X	Starter—Oil Pump Motor
	107				X	X	X			X	X	X	Contactor—Electric Oil Heater
	108	X	X	X	X	X	X	X	X	X	X	X	Overload Relay Heaters
	109	X	X	X	X	X	X	X	X	X	X	X	Transformer—Modulation 115/24V
	110	X	X	X	X	X	X	X	X	X	X	X	Transformer—Control 200-230-460/115V
	111		X	X	X	X	X	X	X	X	X	X	Power Block—3 Wire

ON
APPLICATION
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APPLICATION

PARTS LIST 250-750

Fig. No.	Item No.	Unit Suffix										Description		
		G	O	O				GO	GO					
				2	4	5	6		2	4	5		6	
6-2	112	X	X	X	X	X	X	X	X	X	X	X	Terminal Strip	
	113	X	X	X	X	X	X	X	X	X	X	X	(2) Terminal Strip Bracket	
	113a	X	X	X	X	X	X	X	X	X	X	X	(1) Terminal Strip Bracket	
	114	X	X	X	X	X	X	X	X	X	X	X	Fuses & Fuse Blocks	
	115	X	X	X	X	X	X	X	X	X	X	X	Base-Flame Safe Guard-Std.	
	117	X	X					X						Flame Detector—UV
	118	X	X					X						Amplifier—UV
	119			X	X	X	X		X	X	X	X		Amplifier—Lead Sulfide
	120	X	X	X	X	X	X	X	X	X	X	X	X	R4140G Flame Safe Guard (UL)
	120a	X	X	X	X	X	X	X	X	X	X	X	X	R4140L Flame Safe Guard (FIA)
	120b	X	X	X	X	X	X	X	X	X	X	X	X	R4140L Flame Safe Guard (FM)
	121			X	X	X	X		X	X	X	X		Flame Detector—Lead Sulfide
6-3	122	X	X	X	X	X	X	X	X	X	X	X	Console	
6-2	123	X	X	X	X	X							Burner Switch—Single Fuel	
6-2	123a							X	X	X	X	X	Burner Switch—Dual Fuel	
6-2	124	X	X	X	X	X	X	X	X	X	X	X	Light—Ignition	
6-2	125	X	X	X	X	X	X	X	X	X	X	X	Light—Main Fuel	
6-2	126	X	X	X	X	X	X	X	X	X	X	X	Light—Low Water	
6-2	127	X	X	X	X	X	X	X	X	X	X	X	Light—Flame Failure	
6-2	128	X	X	X	X	X	X	X	X	X	X	X	Switch Control—SPST	
6-2	129	X	X	X	X	X	X	X	X	X	X	X	Fuse Holder—Control	
6-2	130	X	X	X	X	X	X	X	X	X	X	X	Fuse—Control	
	131	X	X	X	X	X	X	X	X	X	X	X	Potentiometer	
6-2	132	X	X	X	X	X	X	X	X	X	X	X	Potentiometer Switch 2PDT	
6-2	133	X	X	X	X	X	X	X	X	X	X	X	Voltmeter D.C.—When Req'd	
6-2	134	X	X					X					Ammeter—When Req'd	
	135	X	X	X	X	X	X	X	X	X	X	X	Wire Assembly Red—Voltmeter	
	136	X	X	X	X	X	X	X	X	X	X	X	Wire Assembly Black—Voltmeter	
	137	X	X	X	X	X	X	X	X	X	X	X	Cable Assembly—Ammeter	
6-2	138	X	X	X	X	X							Plate Burner Switch	
	138a							X	X	X	X	X	Plate Burner Switch	
	139	X	X	X	X	X	X	X	X	X	X	X	Plate Switch—Control	
6-2	140	X	X	X	X	X	X	X	X	X	X	X	Plate Switch Potentiometer	
	141	X		X	X	X	X		X	X	X	X	Plate Fuse Control	
6-2	142	X	X	X	X	X	X	X	X	X	X	X	Lock—Control Cabinet	
	143	X		X	X	X	X		X	X	X	X	Channel Panel	
	144	X		X	X	X	X		X	X	X	X	Cover—Panel Channel	
6-3	145	X						X	X	X	X	X	Butterfly Valve—Gas	
6-3	146												Bracket—Pressure Switch	
6-3	147	X		X	X	X	X		X	X	X	X	Bracket Assembly—Fan Inlet Damper	



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