INSTALLATION AND SERVICE MANUAL

For The

ARMSTRONG OIL BURNER

PRESSURE ATOMIZING TYPE

●

Bracket Mounted Models	Pedestal Conversion Models	Flange Mounted Models
D2-1	D2-2	D2-3
D4-1	D4-2	D4-3

ARMSTRONG
FURNACE COMPANY
COLUMBUS, OHIO
DES MOINES, IA.

IMPORTANT

Oil burners shall be installed in accordance with regulations of National Board of Fire Underwriters for the class, which regulations should be carefully followed in all cases. Authorities having jurisdiction should be consulted before installations are made.

All electrical work must be installed in accordance with the rules of the National Electric Code.

Many States and Municipalities have regulations covering the installation of such equipment. If not familiar with local requirements, consult the authorities having jurisdiction.

CHIMNEY CONSTRUCTION

Some time prior to the installation of the oil-designed furnace or conversion burner a thorough inspection of the chimney should be made to determine whether any repairs are necessary, either to make it the correct size (see table below) or to remedy any possible ailments enumerated under "How to Correct Bad Chimney Draft Conditions". The following table may be used as a guide for minimum sizes:

1 GPH - 8" x 8" x 30'
2 GPH - 8" x 12" x 30'
3 GPH - 8" x 12" x 35'

The chimney should be of brick or stone with a tile flue liner. No leaks should be present which may impair the draft. The flue should be free from any obstructions such as sharp bends, offsets or projections where soot may accumulate, and should be free of openings, other than from the furnace or boiler, and cleanout door. The chimney should extend at least 3 feet above a flat roof, 2 feet above the ridges of a peak roof and about 18 inches above all objects within 30 feet.

AIR REQUIREMENTS

To insure the proper supply of fresh air to the burner at all times a fixed air opening into the furnace or boiler room should not be smaller than twice the cross sectional area of the smoke pipe.

OIL BURNER CERTIFICATE

AS REQUIRED BY COMMERCIAL STANDARD CS75-42

ARMSTRONG FURNACE COMPANY • COLUMBUS, OHIO DES MOINES, IOWA

Manufacturer of ARMSTRONG Oil Burner guarantees model .....

The company warrants all equipment manufactured by it and bearing its name plate to be free from defects in workmanship or material under normal use and service. If any part of the equipment herein described, and sold by the company proves to be defective in workmanship or material, and if such part is within 12 months from the date of shipment from the company's factory returned to such factory, transportation charges prepaid, and if the same is found by the company to be defective in workmanship or material, it will be replaced or repaired, free of charge, f. o. b. factory. The company assumes no liability for consequential damages of any kind and the purchaser by acceptance of this equipment will assume all liability for the consequences of its use or misuse by the purchaser, his employees, or others. A defect in the meaning of this warranty in any part of said equipment shall not, when such part is capable of being renewed, repaired or replaced, operate to condemn such equipment. This warranty is expressly in lieu of all other warranties, guarantees, obligations, or liabilities, expressed or implied by the company or its representatives.

This burner bears the seal of the official inspection agency of the oil burner industry evidencing compliance with Commercial Standard CS75-42 as issued by the National Bureau of Standards of the United States Department of Commerce.

This burner is approved for use with fuel oil not heavier than commercial standard grade No. 2 CS12-48

The oil burner installed in Boiler {Name ..... / No. .....} Furnace {Name ..... / No. .....}

with ..... square feet of standing steam ..... radiation plus ..... hot water ..... square feet of additional connected load; or

with ..... square inches cross-sectional area of warm air supply pipes measured at the furnace take off.

Other special data: .....

at ..... (Address) and has been installed by

..... (Name of installer and address)

in accordance with specifications in oil burner manufacturer's instruction manual.

This installation has been installed to comply with all local regulations, codes, and ordinances and required permits have been secured; and has been tested in accordance with test procedure of Commercial Standard CS75-42 and readings taken as follows:

CO_2 {Over fire ..... / At breeching .....} stack temperature at breeching ..... ° F.

Draft {Over fire ..... / At breeching .....} inches H_2O. Firing rate ..... gal/hr.

All controls and limiting devices have been checked for proper operation .....

Fuel used CSG No. .....

The above test results are certified to be true.

..... (Installer)

Date ..... Per ..... (Signature)

24-hour service on this oil-burner installation without charge is guaranteed for a period of 1 year from ..... (Date) by

..... (Installer)

Per ..... (Signature)

Telephone .....

TEAR OUT ALONG THIS LINE

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ARMSTRONG FURNACE COMPANY

Columbus, Ohio - Des Moines, Iowa

THE ARMSTRONG TURBO-REGULATOR OIL BURNER

MODELS D2 AND D4

General Description

The D2 and D4 series oil burners are of the pressure atomizing type listed by Underwriters' Laboratories for use with fuel oil not heavier than grade No. 2 as specified in the United States Commercial Standards CS12-48. The D2 and D4 series burners have been tested and approved under United States Commercial Standards CS75-42 governing the construction and performance of automatic, mechanical draft oil burners and are approved for the following capacities:

MODEL	MIN. G.P.H.	MAX. G.P.H.
D2	1.00	3.00
D4	.75	1.35

The burner consists of a burner housing on which is mounted the motor, fuel pump, transformer, air blast tube and turbo-regulator. Inside the housing is a blower wheel which is attached to the motor shaft. A pump coupling is attached to the pump shaft with the opposite end fitting over the hub of the blower wheel. The electrode and oil pipe assembly consisting of an oil pipe, ignition cables, electrodes, nozzle and strainer, nozzle adapter, turbulator cup and supporting bracket is contained in the blast tube.

The designation D2 and D4 indicates the model of the oil burner. Following D2 or D4 will be a dash followed by a number one, two or three which indicates the type of mounting arrangement with which the burner is equipped. They are as follows:

1. **Bracket Mounted**—This type is used with almost all oil designed furnaces of which the burner is a part. See Figure 3.

2. **Pedestal Mounted** — This type is supplied with the conversion burner, and with certain models of oil designed furnaces. See Figure 6.

3. **Flange Mounted**—This type is used on some special oil designed furnaces of which the burner is a part. See Figure 4.

Description of Component Parts

IGNITION is furnished by a 115-volt primary to 10,000-volt secondary ignition transformer which is mounted to the housing with two screws. This high voltage is conducted from the transformer to the two electrodes by high tension cables equipped with spring terminal clips that will slip onto the transformer terminals. The electrode wires are made of $\frac{1}{8}$" diameter heat resistant stainless steel. This assembly is shown in Figure 1. The electrode insulators are held in position by the electrode support bracket.

BURNER MOTOR is of the split phase type and is rated at $\frac{1}{8}$ H. P. at 115 volts. The full load speed is approximately 1725 R. P. M. The motor may be removed from the housing by removing the two $\frac{8}{10}$" Hex Hd. machine screws in the motor flange. The fan wheel fastened to the motor shaft will be removed at the same time. The motor bearings should be oiled with No. 10 motor oil.

FUEL OIL PUMP is a three-in-one assembly of pump, pressure regulation valve and strainer. Refer to the pump data sheet at the end of this manual for all the necessary information regarding attaching the oil line, servicing, bleeding and the method of pressure adjustment. Each pump is adjusted at the factory to give one hundred pounds per square inch discharge pressure but this pressure may be changed in order to give a slightly different rate of flow. The pump pressure should not be reduced lower than eighty pounds per square inch. The chart, Figure 9, gives the average flow rate for different pressures with the nozzle at room temperature. With the nozzle at normal operating temperature, the flow rate will fall off approximately 6 per cent. These figures are given only as an indication since nozzle temperatures vary with the combustion chamber size.

TURBO-REGULATOR is a combination control that turbulates or swirls the air and at the same time regulates the flow of air to be mixed with the oil spray. The turbo-regulator is made in two pieces consisting of a turbulator and a regulator. The turbulator is a cylinder having a series of long, narrow slots spaced equidistantly around the circumference and having a flange on one end which is fastened to the blower housing. The slots are punched in such a manner so as to form a curved vane under each slot. Air forced through these slots passes over the curved vanes which gives the air turbulation. The regulator is a band formed around the turbulator having a series of long, narrow slots that match the slots in the turbulator. As the regulator is rotated over the turbulator, the solid portion of the regulator band will cover the slots in the turbulator thus regulating the air through the turbulator. A knob on the lower right-hand side of the burner housing operates an adjusting arm connected to the regulator. Turning the knob counter-clockwise increases the air and clockwise will decrease it. When making air adjustments loosen the set screw located in the bottom of the burner housing just under the knob, re-tighten when the desired setting is obtained. To remove the regulator for service, pull out the electrode and oil pipe assembly and then remove the blast tube by removing the four ¼" Hex Hd. machine screws holding the blast tube to the housing. Disengage the adjusting arm from the saddle on the regulator by removing the control knob and adjusting arm assembly from the burner housing. With the four screws and blast tube removed, and the adjusting arm disengaged from the saddle on the regulator, the turbo-regulator can be pulled out of the burner housing.

ELECTRODE AND OIL PIPE ASSEMBLY consists of an oil pipe, ignition cables, porcelain insulators, electrodes, nozzle and strainer, nozzle adapter, turbulator cup and supporting brackets. This entire assembly can readily be removed from the burner by following these steps:

1. Remove the cover plate from the rear of the burner.
2. Disengage the ignition cables from the porcelain receptacles in the transformer.
3. Disconnect the oil line from the oil pipe.
4. Loosen the screw which secures the oil pipe adjusting plate to the side of the burner housing.
5. Remove entire electrode and oil pipe assembly by drawing it out rear of burner.

The recommended electrode and nozzle spacing is shown in figure 8.

NOZZLE is of 80° hollow cone or hollow spray pattern as normally furnished with the burner. This spray angle is recommended for all Turbo-Regulator burner applications. An efficient oil burner must have an angle of diversion of the nozzle spray pattern that matches the angle of diversion of the combustion air pattern. It is only when these patterns are matched that an intimate mixture of fuel and air is accomplished and this intimate mixture is necessary for high combustion efficiency. In some extreme cases such as conversion installations where the combustion chamber may be long and narrow, it will be necessary to use a nozzle with a spray angle less than 80° to obtain a flame shape that more closely fits the shape of the combustion chamber.

NOSE PIECE secured to the end of the blast tube, will either be made of heat resistant stainless steel with an insulating ceramic fill, or heat resistant cast iron. The burners supplied with oil designed furnaces will be equipped with the proper size nose piece to suit the unit. The D2-2 conversion burners are supplied with two nose pieces having inside opening of 2½" or 3" in order to obtain the maximum efficiency at different firing rates. Determine which nose piece should be used by referring to the following table:

NOZZLE SIZE (D2-2 only)	NOSE PIECE (Inside Opening)
1 G.P.H. to 2 G.P.H.	2½"
2 G.P.H. to 3 G.P.H.	3"

The D4-2 conversion burner is supplied with only one nose piece which has the 2½" opening.

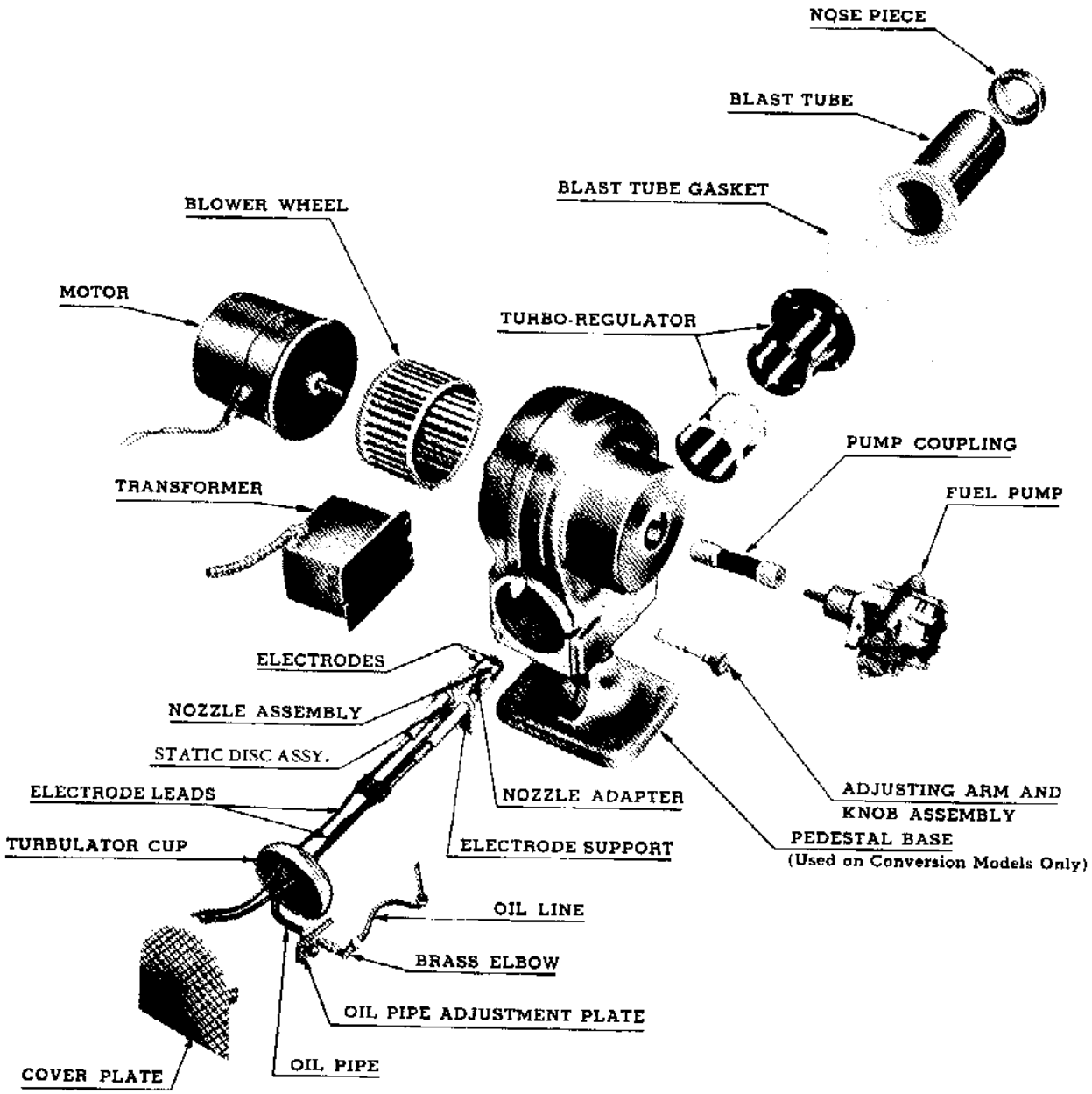
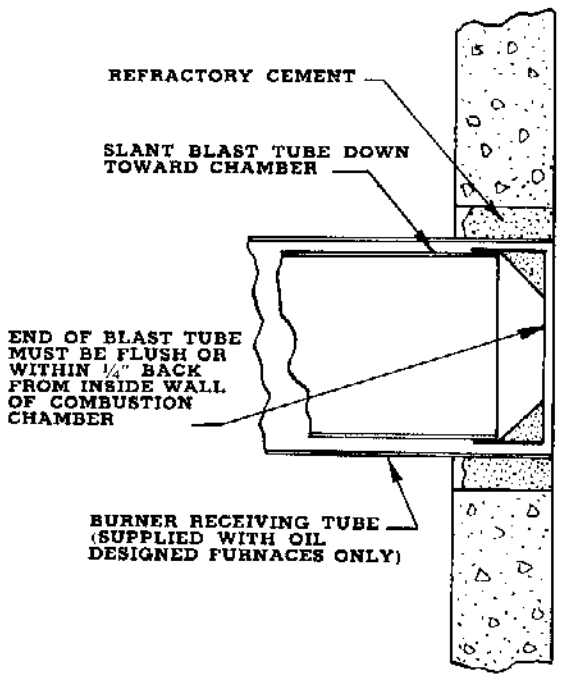


FIGURE 1

INSTALLATION OF BURNER IN ARMSTRONG OIL FURNACE

An important step when installing the burner is to make sure the end of the blast tube is flush with or within ¼" back from the inside wall of the combustion chamber, as shown in Figure 2. Avoid having blast tube extend into the combustion chamber. Should this condition exist, the end of the blast tube would burn off in a short time.

The burner should be level from side to side and the burner blast tube should slant down slightly toward the combustion chamber so that any oil that may drip into the tube will drain into the combustion chamber.



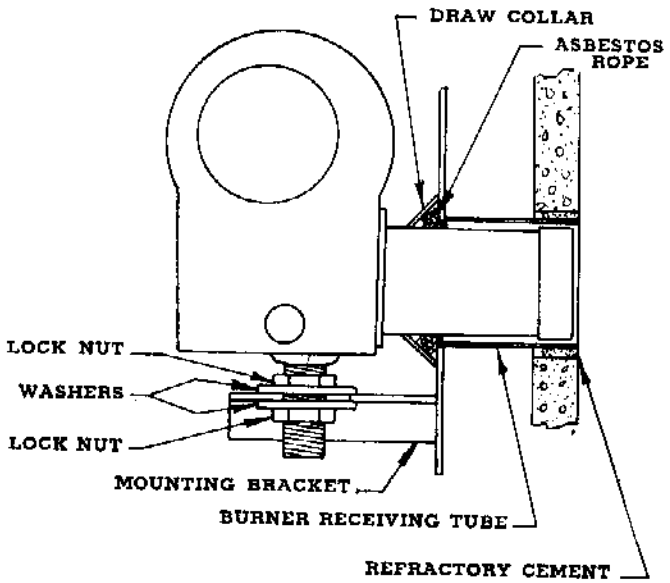
BURNER BLAST TUBE
FIGURE 2

D2-1 and D4-1 BRACKET MOUNTED BURNERS

These models are supplied with most Armstrong oil-designed furnaces. After the furnace is completely assembled with the combustion chamber and mounting bracket properly installed in accordance with the furnace installation instructions, the burner may then be installed.

Slip the blast tube finishing collar over the burner blast tube and insert the burner blast tube through the opening into the combustion chamber, making sure a washer and a lock nut are located both above and below the mounting bracket. Adjust these lock nuts so that the blast tube will be centered in the opening of the combustion chamber.

Slide the burner into position, making sure the end of the blast tube is flush with or within ¼" back from the inside wall of the combustion chamber, then tighten lock nuts. After the burner is in place, wrap wet asbestos rope around the blast tube where it passes through the access plate. Now slide the draw collar up to the mounting plate and draw in tight with a $\frac{3}{16}$" stove bolt through the draw lugs.



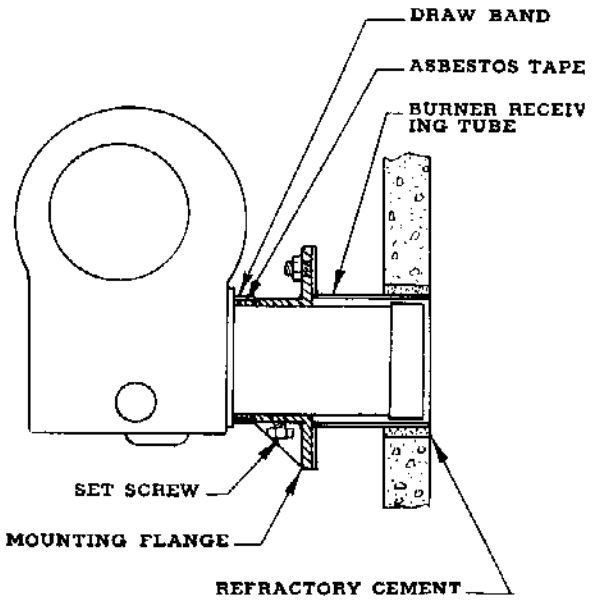
BRACKET MOUNTED BURNER
FIGURE 3

D2-3 and D4-3 FLANGE MOUNTED BURNERS

This type of mounting arrangement is used on some oil-designed furnaces that require a special mounting for the burner. After the furnace is

completely assembled with the combustion chamber, access plate and mounting flange properly installed in accordance with the furnace installation instructions, the burner may then be installed.

Install the burner by sliding it into position, making sure the end of the blast tube is flush with or within ¼" back from the inside wall of the combustion chamber, then tighten the two set screws on the under side of the mounting flange. To seal around the blast tube, where it passes into the mounting flange, wrap a strip of wet asbestos tape around the blast tube and hold in place with a draw collar. Tighten the draw collar and at the same time force the tape against the mounting flange.



FLANGE MOUNTED BURNER
FIGURE 4

INSTALLATION OF CONVERSION BURNER

PREPARATION OF HEATING UNIT FOR CONVERSION

An important step in the installation of an oil burner is the thorough cleaning of the boiler or furnace. After removing the grates, the interior should be scrubbed with a wire brush to remove all scale and carbon. Cleanouts and fire doors should close tightly and other cracks and joints should be repaired to prevent air leaking into boiler or furnace, thus reducing efficiency.

Cast iron furnaces and boilers should have all cemented joints between sections checked for air leaks prior to installation of the oil burner.

The smoke pipe must be removed and thoroughly cleaned. Rusted sections should be replaced so as not to affect the draft on the finished installation. Any dampers in the flue pipe must be removed and discarded. Care should be taken when replacing the flue pipe so that it does not project into the chimney too far and have a tendency to restrict the flow of gases.

BURNER SELECTION AND NOZZLE SIZING

On all conversion installations the oil fire should be sized to the heat loss of the space to be heated regardless of the furnace or boiler size, with the exception of steam boilers which must be fired at a rate that will give quick steam generation. This minimizes over-runs and improves temperature regulation. The heating unit should then be checked to make certain it has sufficient capacity to deliver the required volume of heat as calculated. If the unit is not of adequate size it should be replaced with one that is. In all of the examples listed below the heat loss used is the net loss or the amount of heat required at the registers or radiators.

Gravity Warm Air Installation

After computing the total heat loss of the building in BTU's (net load), the burner capacity in gallons per hour is determined as follows:

$$\frac{\text{BTU Heat Loss (net or register)}}{64{,}000} = \text{GPH nozzle rate.}$$

The above formula includes additional capacity to take care of a 30% basement duct loss and a 10%pick-up factor and assumes the efficiency of

the unit to be 65%. If the efficiency varies from this figure the nozzle rate may be adjusted accordingly.

Example—Assume the calculated heat loss of the space to be heated comes to 100,000 BTU's/hr.

$$\frac{100{,}000}{64{,}000} = 1.56 \text{ GPH nozzle rate.}$$

In this case a 1.50 gallon-per-hour nozzle may be used.

Forced Warm Air Installation

After the net or register heat loss is determined the nozzle size can be obtained by using the following formula:

$$\frac{\text{BTU Heat Loss (net or register)}}{80{,}000} = \text{GPH nozzle rate.}$$

The above formula includes additional capacity to take care of a 20% basement duct loss and a 10% pick-up factor and assumes the efficiency to be 75%. If the efficiency varies from this figure, the nozzle rate may be adjusted accordingly.

Example—Assume the calculated heat loss of the space to be heated comes to 100,000 BTU's/hr.

$$\frac{100{,}000}{80{,}000} = 1.25 \text{ GPH nozzle rate.}$$

In this case a 1.25 gallon-per-hour nozzle may be used.

Hot Water Circulator

After the heat loss of the room has been computed the nozzle size required can be obtained by using the following formula:

$$\frac{\text{BTU Heat Loss (net)}}{68{,}000} = \text{GPH nozzle rate.}$$

The above formula includes additional capacity to take care of ⅓ additional heat loss in basement piping and pick-up and assumes the efficiency to be 65%. If the efficiency varies from this figure the nozzle rate may be adjusted accordingly.

Example—Assume the calculated heat loss of the space to be heated comes to 100,000 BTU's/hr.

$$\frac{100{,}000}{68{,}000} = 1.47 \text{ GPH nozzle rate.}$$

In this case a 1.50 gallon-per-hour nozzle may be used.

Steam Installation

After the BTU heat loss of the space to be heated has been calculated, the nozzle rate may be obtained by using the same formula as shown above for hot water circulator with the exception that if the steam boiler is greatly oversized for the space to be heated, the firing rate must be increased to provide a buildup of steam pressure necessary to vent and fill the system.

COMBUSTION CHAMBER CONSTRUCTION FOR CONVERSION APPLICATION—If a round combustion chamber can be used in a conversion application, we highly recommend using the combustion chamber supplied with our oil-designed furnaces. These chambers are engineered to obtain high efficiency using a good grade of insulating firebrick and having a corbel moulded around the top edge of the chamber. There are four sizes of chambers in our line ranging from a capacity of .60 G.P.H. to 2.25 G.P.H. Refer to the following table recommending the correct size chamber to be used at different rates:

Combustion Chamber	Firing Rate G.P.H.		Outside Chamber Dimensions		
	Min.	Max.	Diameter	Height	Nozzle Height
R14-2	.60	.90	14	14	6¼
R14-1	.90	1.35	14	17¼	7¼
R17-1	1.35	1.65	17	17¼	7¼
R19-1	1.65	2.25	19	19¼	7¾

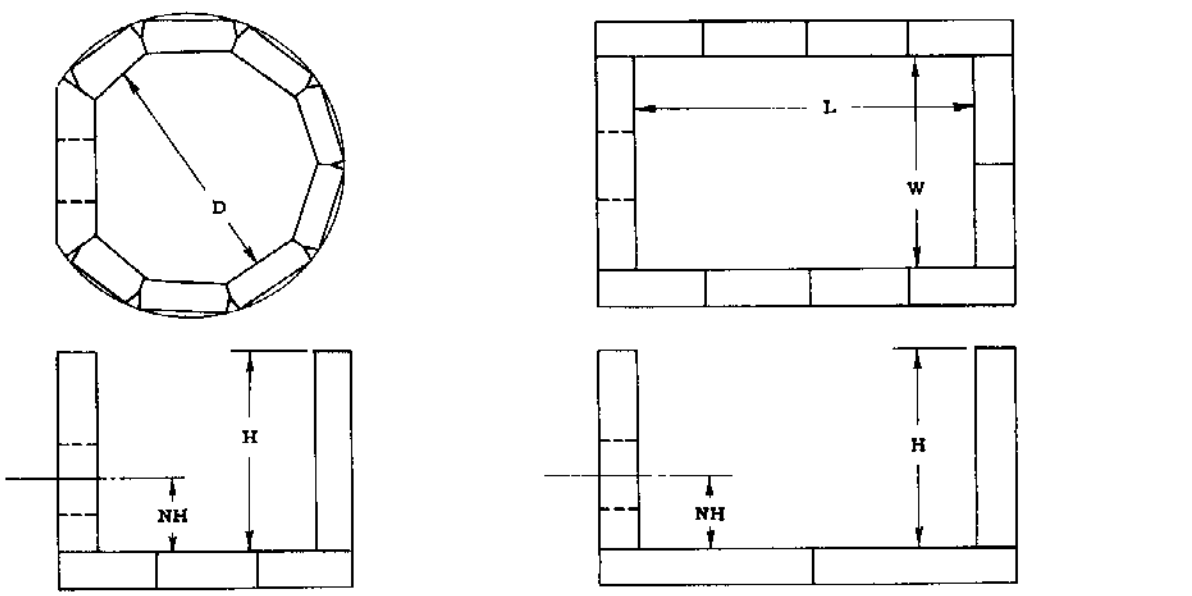
There are several good pre-cast combustion chambers on the market or if the installer so desires or finds it necessary, he can build a chamber of a good grade light-weight insulating refractory. Never use dense heavy firebrick. Lightweight insulating type of refractory usually comes in a

ROUND

G.P.H.	D	H	N.H.
.60	9	14	4½
.65	9	14	4½
.75	10	15	5
.85	10	15	5
1.00	11	16	5½
1.25	11	16	5½
1.35	12	18	6
1.50	12	18	6
1.65	15	18	7
1.75	15	18	7
2.00	16	18	7½
2.25	17	18	7½
2.50	18	18	7½
3.00	20	18	8

SQUARE

G.P.H.	L	W	H	N.H.
.60	9	9	14	4½
.65	9	9	14	4½
.75	10	10	15	5
.85	10	10	15	5
1.00	11	11	16	5½
1.25	11	11	16	5½
1.35	12	12	18	6
1.50	12	12	18	6
1.65	15	15	18	7
1.75	15	15	18	7
2.00	16	16	18	7½
2.25	17	17	18	7½
2.50	18	18	18	7½
3.00	20	20	18	8



COMBUSTION CHAMBER CONSTRUCTION
FIGURE 5

standard size of 2½"x4½"x9" and is most convenient for use in conversion installations since it is easily shaped with a hack saw and a coarse file to provide a close fit between bricks.

Since the burner is designed to operate most efficiently with a hollow spray 80° nozzle, we highly recommend using a round or square combustion chamber so that the shape of the flame more closely resembles the shape of the chamber. Carefully maintain the dimensions shown in Figure 5 when constructing a chamber or using a pre-cast chamber. Be sure to maintain the correct distance from the center line of the blast tube to the floor. If the center line dimension is less than indicated there is danger of wet vapor impinging on the floor thus depositing carbon at this point. This would also be the effect on the side walls of a chamber that is too narrow.

In some extreme cases it might be necessary to install a narrow chamber due to the shape of the boiler or furnace. When this is done, care must be taken to maintain the proper dimensions. The floor area of the chamber should be at least 100 square inches per gallon. It will also be necessary to reduce the spray angle of the nozzle so that the flame shape will fit the shape of the chamber.

To obtain proper and efficient combustion the chamber must not only be of the correct size but it must be well constructed. Each brick must be carefully laid and bonded to the next one with a good quality refractory cement. There should be no air leaks either through cracks in the chamber or around the air tube.

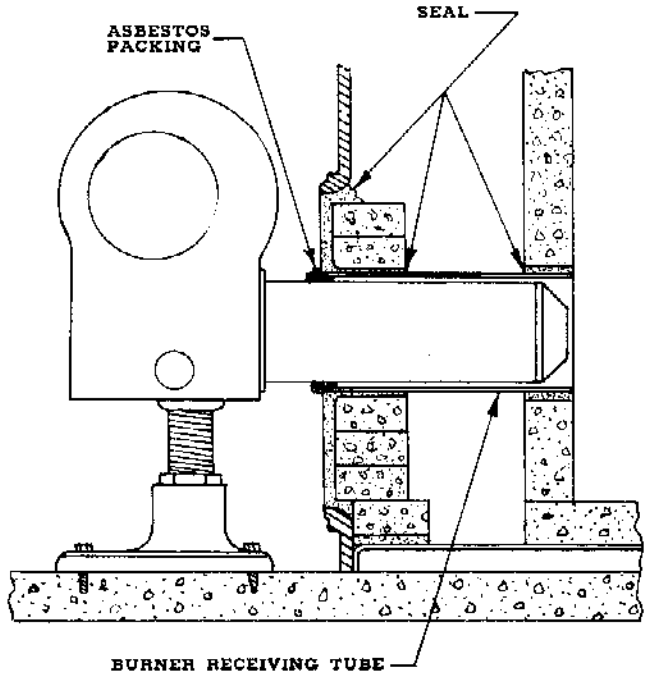
In a forced warm air furnace there need not be a fill between the combustion chamber and the furnace body, but in the case of a gravity warm air installation it may be necessary to install a radiation shield between the furnace body and casing to prevent radiant heat from interfering with cold air circulation. A mica pellet fill between the chamber and furnace wall is recommended to insure good gravity circulation if the radiation shield is not used.

When building a chamber in a hot water or steam boiler, it should be so constructed that the flame does not come in contact with the relatively cold boiler walls.

Further, it is important to protect the bottom of the water leg in which sludge and mud collect. Since these substances are poor conductors of heat any direct contact with flame would build up the temperature of the surface of the boiler at this point with the possibility of cracking the boiler wall. The chamber walls should be well insulated from the boiler sides and bottom, but only up to the water legs of the boiler. A mica pellet fill is ideal for this purpose.

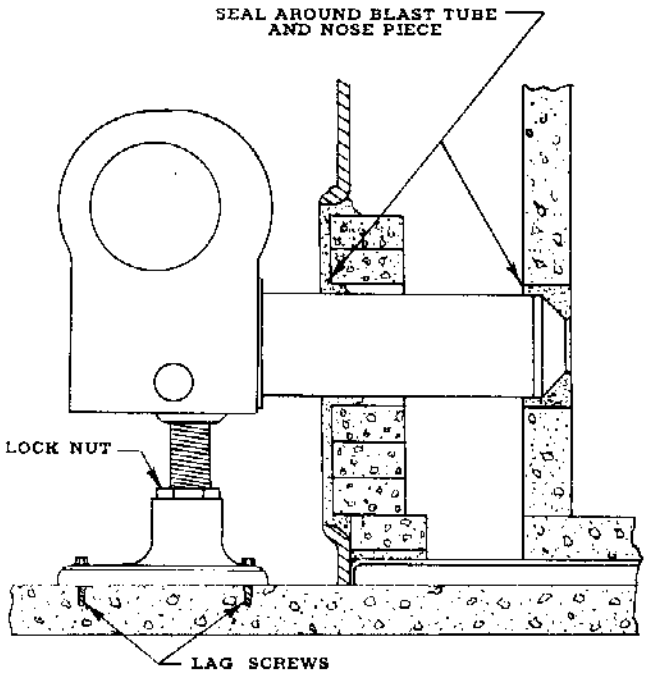
FILL IN ASHPIT DOOR OPENING—After the chamber is installed it will be necessary to fill in the ashpit door opening. One method is to brick up the opening with ordinary building brick, leaving a round opening for the blast tube that is exactly in line with the opening in the combustion chamber. Joint the brick with a mixture of half Portland cement and half refractory cement. After the burner is installed or if a burner receiving tube is used as described below, carefully smooth on over the brick the above mentioned mixture of cement. See figures 6 or 7.

BURNER RECEIVING TUBE—To increase the ease of installing the burner as well as providing an easy means for removing the burner for service, we recommend installing a burner receiving tube between combustion chamber and the bricked-up front. The receiving tube should be 4¾" in diameter and made of 20 or 22 gauge material. Seal the receiving tube in place as shown in figure 6. The use of this tube is optional.



CONVERSION INSTALLATION (With Receiving Tube)
FIGURE 6

INSTALL BURNER (Figures 6 or 7)—It is absolutely necessary that the burner be installed on a level base. Adjust the pedestal so that the blast tube will be centered in the opening to the combustion chamber and then tighten the locknut against the top of the pedestal. Slide the burner into the unit making sure the end of the blast tube is flush with, or within ¼" back from, the inside wall of the combustion chamber. Avoid having the blast tube extend into the combustion chamber. If this condition exists, the end of the blast tube will burn off in a short time. The burner blast tube should slant down slightly toward the combustion chamber, so that any oil that may drip into the tube will drain into the combustion chamber.



CONVERSION INSTALLATION (No Receiving Tube)
FIGURE 7

After the burner is correctly positioned, secure it to the floor with lag screws. Holes are provided in the pedestal for this purpose.

When a burner receiving tube is used, wrap asbestos rope around the blast tube, tucking it into the opening around the blast tube where it passes into the burner receiving tube. If the burner receiving tube is not used, apply refractory cement to seal the gap around the nose piece where it enters the combustion chamber and complete the seal as described in paragraph "Fill in Ashpit Door Opening" above.

ELECTRICAL CONTROLS—The controls furnished with the burner include a primary control (stack switch), room thermostat and warm air limit switch unless otherwise specified. Carefully follow instructions packed with each control for the proper installation. Install the primary control in the smoke pipe as near the unit as possible.

BAROMETRIC DRAFT CONTROL—Install the barometric draft control in the smoke pipe at least 12" beyond the primary control toward the chimney. If there is not sufficient room in the smoke pipe for the draft control, it can be placed in the chimney below the smoke pipe.

WIRE THE FURNACE—Refer to page 16 regarding electrical wiring.

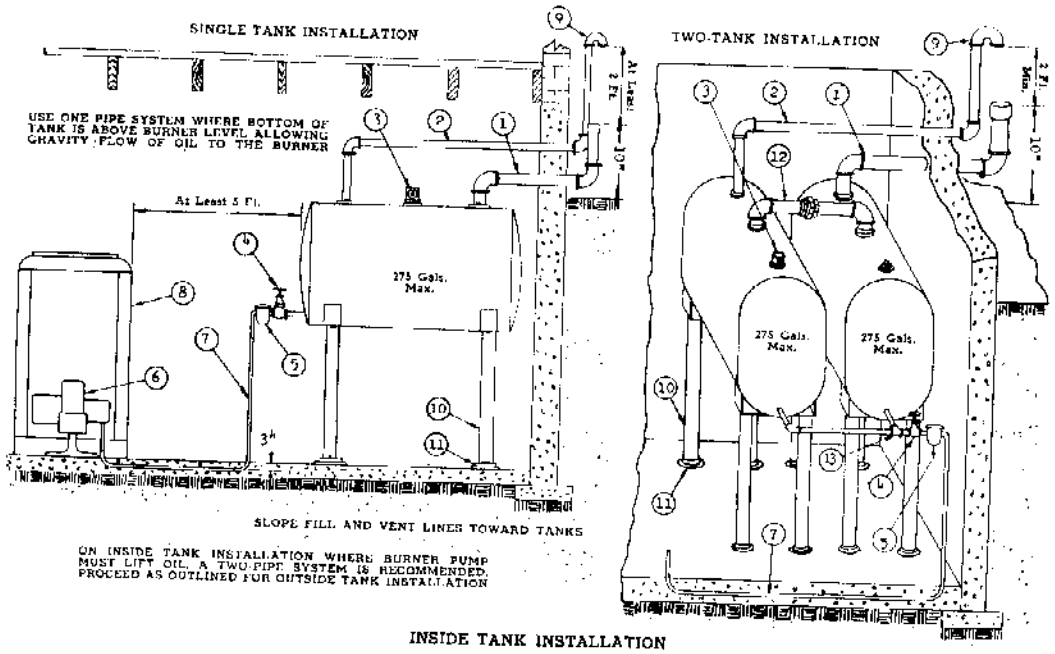
TANKS AND PIPING—Refer to page 15 regarding installation of tanks and running the oil line.

INSTALLATION OF TANKS AND PIPING

Tanks and piping shall be installed in full accordance with the requirements of the National Board of Fire Underwriters and local regulation bodies having authority. There are several different methods of installing tanks which are perfectly acceptable, a few of which may be found in the following diagrams.

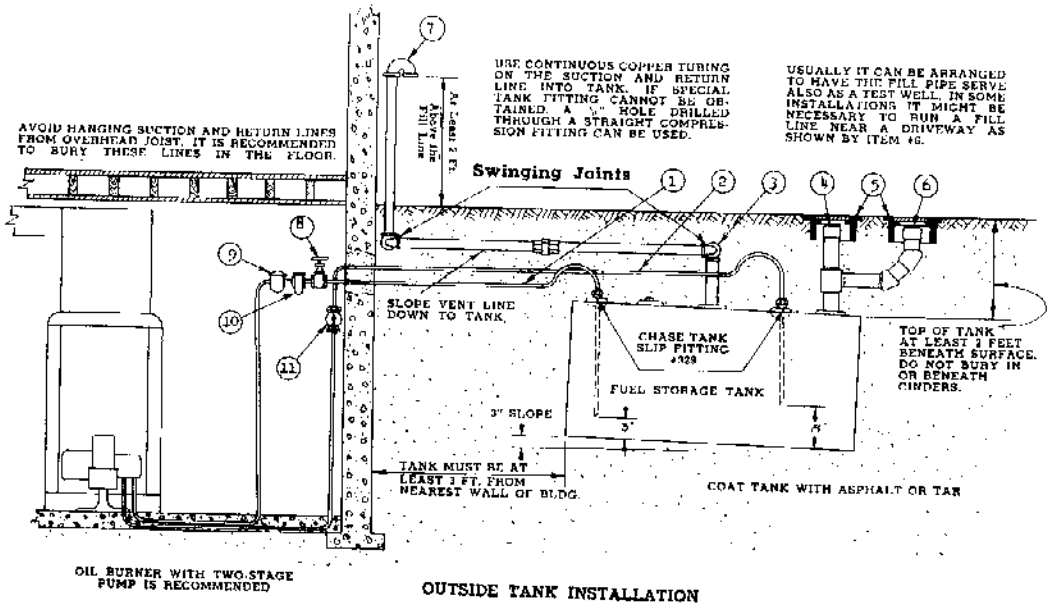
In making oil pipe connections, use a good grade of pipe compound suitable for oil. Never use litharge and glycerine, soap, white lead or paint on oil pipe joints. Apply compound to male threads only. Flared joints must be used on all copper tubing oil line connections since compression fittings are not sufficiently air tight.

IMPORTANT - - Carefully follow the information outlined on the pump manufacturer's data sheet for determining the proper size oil line to be used as well as making the correct oil line hook-up. It is possible to damage the pump if hook-up is improper.



INSIDE TANK INSTALLATION

1—Fill Pipe 2" Galvanized Pipe
2—Vent Pipe 1¼" Min. Galvanized Pipe
3—Tank Gage
4—Shut Off Valve
5—Fuel Filter
6—Oil Burner
7—Oil Feed Line to Heating Unit
8—Heating Unit
9—Return Ell or Approved Vent Line Cap
10—Tank Legs 1¼" Pipe
11—Floor Flange 1¼"x4"
12—Overpass 2" Galv. Pipe
13—Pipe Tee

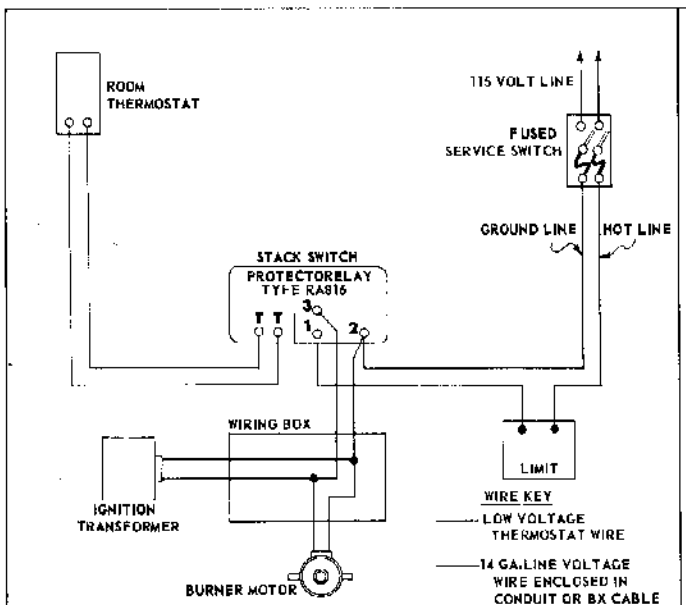


OUTSIDE TANK INSTALLATION

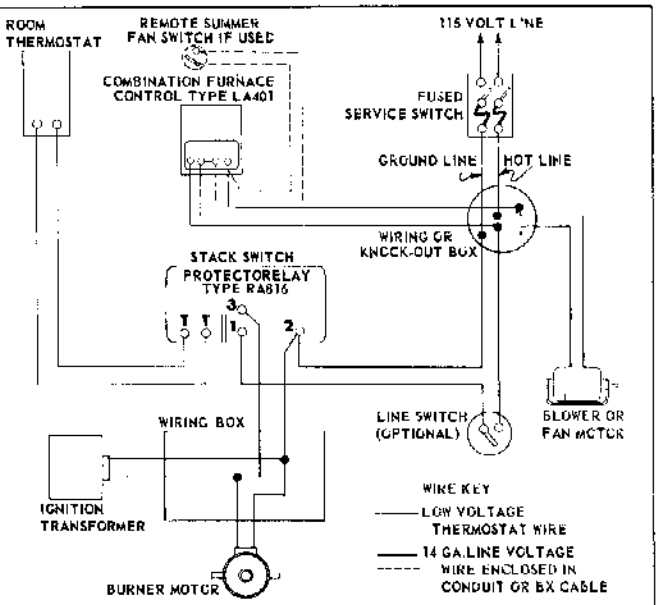
1—Suction Line. Check Pump Mfg. Spec. for Size.
2—Return Line
3—Vent Pipe 1¼" Min. Galvanized Pipe
4—Fill Pipe and Test Well. 2" Galvanized Pipe
5—Flush Box
6—Fill Pipe Located Away from the Tank If Necessary. 2" Galvanized Pipe.
7—Return Ell or Approved Vent Line Cap
8—Globe Shut-Off Valve
9—Filter (Supplied with Burner)
10—Anti-Siphon Valve
11—Check Valve

ELECTRICAL WIRING

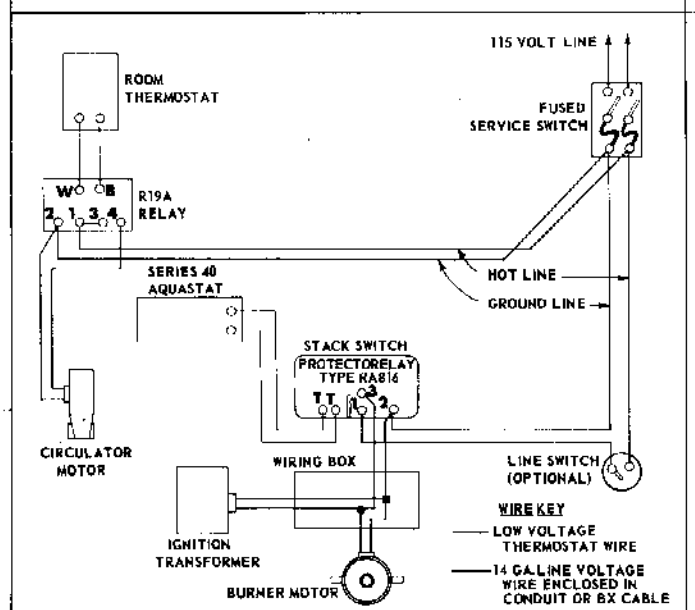
When the D2 and D4 series burners are used in conjunction with an oil-designed furnace the wiring diagram for the installation is given in the installation instructions for the particular unit. However, when the burner is used in conversion application the proper wiring diagram should be followed when wiring the burner controls depending, of course, upon whether installation is gravity warm air, forced warm air, circulating water or steam boiler. In all cases the wiring and control equipment shall be installed in accordance with the rules and regulations of the National Electric Code. All wiring other than the thermostat wiring shall be not less than No. 14 gauge. The power supply to the burner shall be connected directly to the distribution panel and not connected to any existing lines that may already be overloaded. The method of wiring the controls furnished with the burner can be obtained by referring to the wiring diagram enclosed with them.



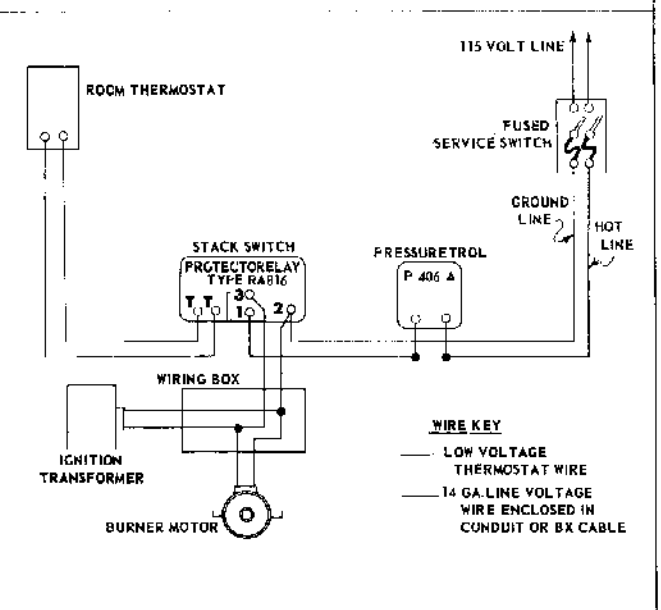
WIRING DIAGRAM FOR GRAVITY WARM AIR INSTALLATION
(MIN. HONEYWELL CONTROLS)



WIRING DIAGRAM FOR FORCED WARM AIR INSTALLATION
(MIN. HONEYWELL CONTROLS)



WIRING DIAGRAM FOR WATER CIRCULATOR
(MIN. HONEYWELL CONTROLS)



WIRING DIAGRAM FOR STEAM INSTALLATION
(MIN. HONEYWELL CONTROLS)

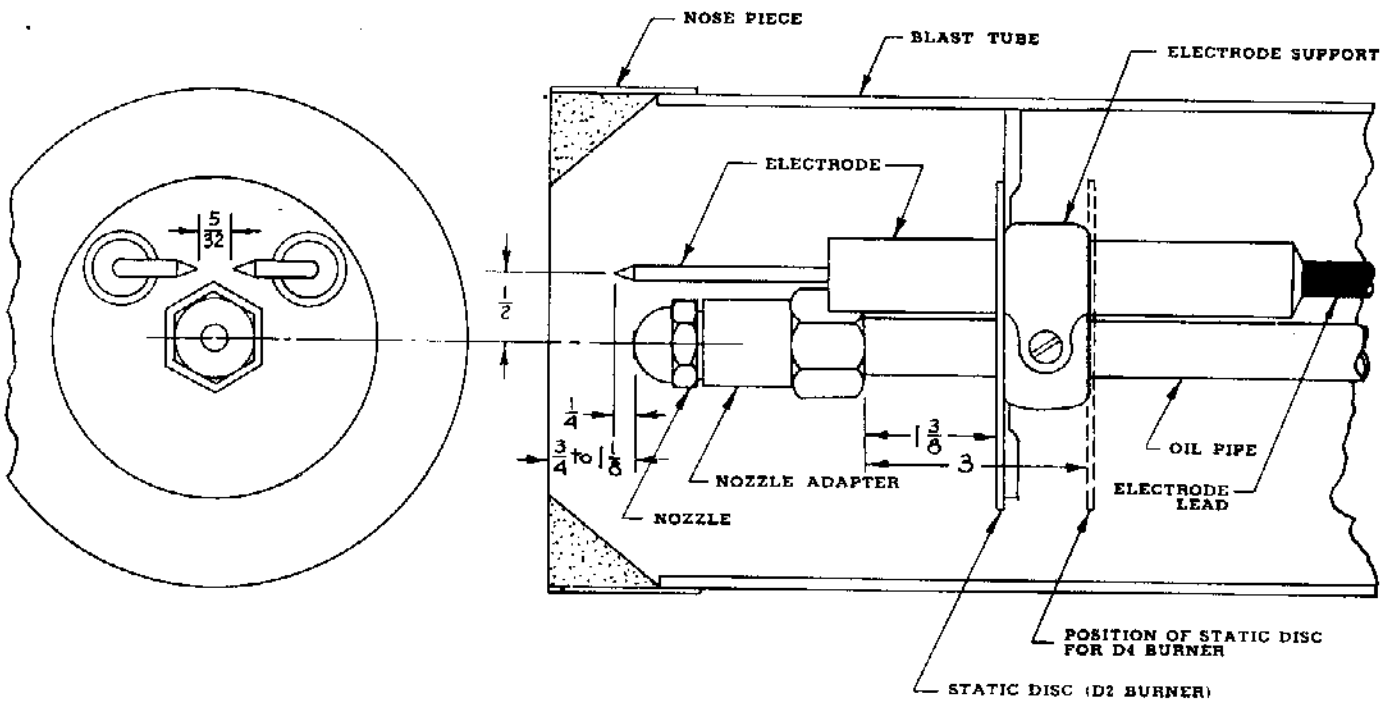
STARTING THE BURNER

Important Precautions Before Starting Burner

FUEL PUMP—Carefully check the pump manufacturer's data sheet regarding the piping hook-up for a single-pipe or two-pipe system depending on which system is used and also the type fuel unit being used. If hook-up is improper, it is possible to damage the pump. Internal by-pass plug **must always** be removed in a single-pipe system.

NOZZLE AND ELECTRODE SETTING—Make certain the nozzle is properly installed in the nozzle adapter. Check the ignition points with relation to the nozzle and spark gap according to the data given in Figure 8. Be sure that the insulators are securely fastened in the bracket to prevent possible movement of the electrodes. The electrode tips must clear the oil spray so carbon will not collect on them and cause flame failure.

AIR REGULATOR—Check the operation of the air regulator to see that it moves freely. The air is controlled by the knurled knob on the lower right hand side of the burner housing. When making air adjustments loosen the set screw located in the bottom of the burner housing just under the knob and turn the knob counter-clockwise to increase the air supply and clockwise to decrease it. A stop will prevent the further rotation of the knob in the wide open or closed position. Tighten the set screw when the desired flame is attained. When changing the rotation of the air control knob to close the air regulator or vice versa, there will be a slight amount of slack that will have to be taken up before there is a noticeable change in the fire.



NOZZLE AND ELECTRODE LOCATIONS
FIGURE 8

Starting Procedure

1. Open the burner switch.
2. Open oil valve in suction line and return line (if used).
3. Open observation door on furnace.
4. Set all controls so they are calling for heat. Press primary control reset button and place contacts in starting position. Refer to instructions packed with the primary control.
5. If a single-pipe installation is used, it will be necessary to bleed the air out of the system. To do this remove the gauge port plug and provide a can or jar to catch oil. Close burner switch and permit burner to run until oil appears in a solid stream free from bubbles. Open switch and install a 0 to 150-lbs. pressure gauge.
6. Close the burner switch and watch for flame in combustion chamber. If an oil fog appears but does not ignite, immediately open burner switch and partially close air regulator. Do not restart burner until after the heat exchanger is cleared of all oil fumes. When flame is established in the combustion chamber adjust the air to a clean fire when door is closed.
7. Discharge pressure at pump should read about 100 lbs. This pressure will normally be suitable for all installations but if it is necessary to obtain a slightly different nozzle rate, adjust the pump pressure to the figure given in the rate-pressure chart Figure 9.

	Nozzle Size															
Pump Pressure	.65	.75	.85	1.00	1.10	1.20	1.25	1.35	1.50	1.65	1.75	2.00	2.25	2.50	2.75	3.00
80#	.58	.67	.76	.90	.98	1.07	1.12	1.21	1.34	1.48	1.57	1.80	2.01	2.24	2.46	2.70
90#	.62	.71	.81	.95	1.04	1.14	1.19	1.28	1.42	1.57	1.66	1.90	2.12	2.38	2.62	2.85
100#	.65	.75	.85	1.00	1.10	1.20	1.25	1.35	1.50	1.65	1.75	2.00	2.25	2.50	2.75	3.00
110#	.68	.79	.89	1.05	1.15	1.26	1.31	1.42	1.58	1.73	1.84	2.10	2.36	2.62	2.88	3.15
120#	.71	.82	.93	1.10	1.21	1.32	1.37	1.48	1.65	1.81	1.92	2.20	2.46	2.74	3.01	3.30
130#	.74	.86	1.08	1.14	1.26	1.37	1.43	1.54	1.71	1.88	2.00	2.28	2.57	2.86	3.14	3.43

RATE-PRESSURE CHART
FIGURE 9

FINAL BURNER ADJUSTMENTS

It should be remembered that all adjustments of this burner are subject to the conditions of the installation and therefore are set only through trial and error to acquire the most satisfactory results. Final adjustments must be made when the combustion chamber is hot, and periodic check-ups should be conducted to make certain these adjustments are maintained.

DRAFT CONTROL — After the combustion chamber is hot and the chimney has had time to warm up, adjust the barometric draft control to give a draft of .03 to .04 inches water column at the flue outlet while the burner is running. The draft over the fire should be around .02 to .03 inches. Refer to instruction sheet packed with draft control when making adjustments.

AIR ADJUSTMENT—Close air regulator until flame tips appear slightly smoky, then open air regulator until the flame tips appear absolutely clean. When final flame setting is made, with correct oil rate, atomizing pressure, draft adjustment and burner air adjustment, the flame should almost fill the combustion chamber. The flame tips may strike the back wall of the combustion chamber but not the side walls. The body of the flame should be uniform and clean, with the flame tips just off haze, i. e., any further reduction of air supply should tend to elongate the flame tips and make them smoky. Combustion should be complete, or practically so, within the combustion chamber. If the flame were set with smoky tips when the chamber was hot, excessive smoke might be present when the burner started in a cold fur-

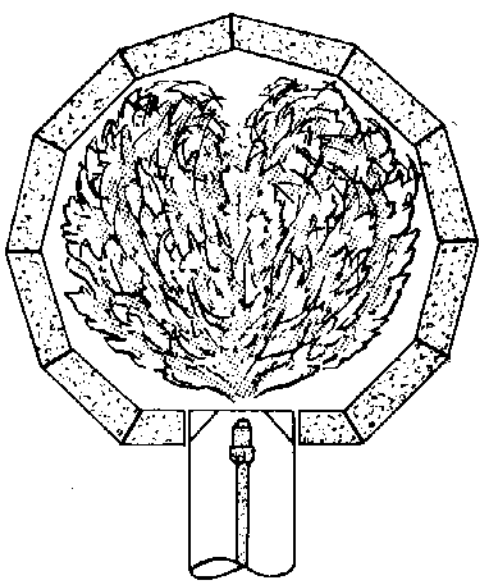
nace or boiler. Check to make sure no smoke is visible at chimney. The combustion should be checked with a flue gas analyzer and should not be less than 8% CO_2 as required by commercial standards. Normally the CO_2 will be around 10 to 12%. If CO_2 is low, check for air leaks and correct same. The flue gas sample should be taken at two different points: 1—at the flue outlet or breeching and 2—over the fire. If there is considerable difference between the two CO_2 readings it indicates an air leak into the heat exchanger or boiler.

OIL PIPE AND NOZZLE ADJUSTMENT—This adjustment regulates the distance between the nozzle tip and the end of the blast tube. The D2 and D4 burners have slightly different methods of adjustment. When making adjustment, then, proceed as outlined below referring to the section pertaining to the type burner being installed.

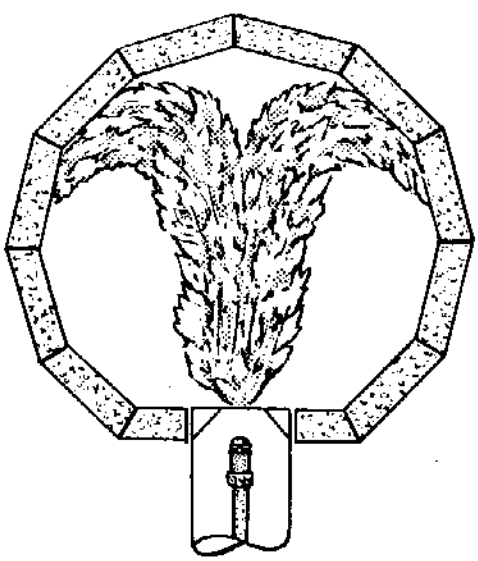
D4 OIL BURNER—To adjust the distance between the nozzle tip and the end of the blast tube, loosen the screw which secures the oil pipe adjustment plate to the side of the burner housing and then slide the assembly in or out until the desired setting is obtained.

D2 OIL BURNER—Follow the same procedure outlined above under D4 Oil Burner with the exception that it will be necessary to move the turbulator cup on the oil pipe forward or backward the same distance that the oil pipe is moved. To do this, loosen the set screw in the turbulator cup and move to the correct position. It is essential that the turbulator cup be correctly positioned in the end of the turbulator to prevent any air leakage into the turbulator at this point.

Before this adjustment is made it must be recognized that there can be no hard and fast rule concerning this adjustment since every installation is subject to a variance of conditions. It may be said in general, however, that for the lower rates such as 0.75 GPH and 1.0 GPH, the nozzle should be set about ¾" from the end of the tube and moved back as rates are increased. The best setting is that which for any given rate allows the flame to burn in a cone shape (See Fig. 10). If the nozzle is adjusted too far back, the rotating air stream will bend the oil spray inward so that a torch-like or mushroom flame results (See Fig. 11). Best adjustment is one where the nozzle is as far back in the tube as is practical and still maintains the proper flame. Be sure, however, that the oil spray does not strike the edge of the nose piece where it will form carbon. The distance the flame burns off the nose piece varies and may be ½" at low rates to 1" on higher rates. The flame should be stable and should not jump in and out. Also, it should not burn back against the nozzle. It will be noticed that burners operating with constant ignition will have a blue flame, produced by the electrode spark, between the nose piece and the oil flame. Do not confuse this ignition spark with the oil flame. The use of a flame mirror is essential in checking the flame pattern and characteristics.



CORRECT FLAME PATTERN
FIGURE 10



1. Air adjustment opened too wide.
2. Nozzle set back too far from end of air deflector.
3. Poor nozzle.

INCORRECT FLAME PATTERN
FIGURE 11

FINAL INSPECTION AND TEST

Final inspection and test of an installation shall be made to determine that the work has been done in full accordance with regulations and according to the highest standards for safety, performance, and appearance. Such an inspection and test should indicate the following, as a minimum:

1. Determine that all parts of the oil storage and circulating system, including tank, piping, and burner, are free from oil leaks. Be sure that no oil discharges from the nozzle when burner is not operating. Piping under vacuum shall be subjected to pressure or vacuum test against air leakage.

2. Be sure that the suction line and pump have been entirely vented of air so that the burner has instantaneous oil shut-off at the nozzle and so that the pump operates without an air noise.

3. Test all boiler doors for tightness and boiler sections for leaks. Also be sure that butterfly dampers are removed or locked in the open position, and that the draft check doors are secured in a closed position. Be sure that the smoke pipe is in good condition, and rigidly in place.

4. Check the flame adjustment to determine that the flame is clear, quiet, free of odor and is of proper size for the load.

5. Test operation of burner from thermostat and check temperature differential of thermostat.

6. Set boiler or furnace limit control at proper setting and test for shut-down from this control under actual operation.

7. Check operation of burner primary control in accordance with manufacturer's instructions included with the control. Following is the method that we recommend in checking the safety switch in the primary control:

   a. With the burner running, loosen lock screw in the mounting bracket and slide the element tube out of the smoke pipe. This will simulate a flame failure.

   b. When the bimetal element cools slightly the hot contacts will open and stop the burner motor.

   c. As the bimetal element continues to cool, the cold contacts will "make" and start the burner. Note the time.

   d. With the absence of heat around the bimetal element, burner should stop on "safety shutdown" in approximately 90 seconds (at rated line voltage.)

8. Test remote control for cutting off burner electrical supply.

9. Go over the posted card of Burner Operating Instructions with building occupants explaining operation and care of burner and how burner service is obtained.

REQUIREMENTS OF UNDERWRITERS' LABORATORIES INC., AND COMMERCIAL STANDARD CS75-42

INSTALLATION REQUIREMENTS — CS75-42 requires that the burner shall be of adequate size for the boiler or furnace and the connected load as recorded on the oil burner certificate by the installer. The oil burner certificate is found in the front of this book.

Following installation of the burner, certain test data shall be obtained and recorded by the installer on the oil burner certificate to be placed with each oil burner installation. The test shall cover the following points: CO_2 in the flue gas by analysis, draft, stack temperature, firing rate, and smoke. The oil burner certificates shall be posted and protected by transparent material.

The standard requirements as approved by the industry are as follows:

1. The CO_2 in the flue gas, by analysis, shall not be less than 8%.

2. The draft shall be in accordance with specifications in the manufacturer's installation manual. An automatic draft regulator or its equivalent is required.

3. The stack temperature shall be measured on the furnace or boiler side of the automatic draft regulator and not more than 12" from the furnace or boiler smoke connection. The stack temperature shall be measured at the certified firing rate. If an automatic draft regulator is built into the boiler or furnace such regulator shall be closed when the stack temperature is measured.

4. Firing rate shall be based on the burner manufacturer's recommendations for the existing total connected load. The burner shall be fired at that rate as a minimum, but not to exceed 25% addition for the maximum rate. The firing rate at which the burner is set shall be within the firing range for which the burner has been approved by the laboratory and not more than the firing rate designated on the boiler, furnace or unit, or designated by the manufacturer of the boiler, furnace or unit.

5. During the above tests there shall be no visible smoke in the chimney.

6. The burner shall be installed in accordance with the manufacturer's installation manual.

EQUIPMENT — The following equipment shall be available on each oil burner installation before the tests are started:

1. A suitable flue gas analyzer for determining the percentage of CO_2 in the flue gases.

2. A suitable draft gauge graduated in .01 inches of water.

3. A suitable thermometer to indicate the flue gas temperatures.

4. Provision for inserting a thermometer into the flue pipe as follows:

   Not more than 12" from the boiler or furnace outlet measured on the centerline of the flue pipe. There shall be a large enough hole located at the side of the pipe on the centerline so that the thermometer may be inserted horizontally. The thermometer is to be placed so that the sensitive element is ¼ of the pipe diameter from the near side of the flue pipe. The opening around the thermometer stem shall be sealed to prevent air leakage. This

same opening may be used for checking draft and sampling flue gases.

5. In addition to the above, provision shall be made on the boiler or furnace for inserting a small tube in the combustion chamber for measuring the draft. The area of the opening shall not exceed that of a ½" diameter round hole.

TEST PROCEEDURE

1. The burner shall be operated and the fuel rate adjusted to that required for the particular installation.

2. The draft then shall be adjusted to meet the burner manufacturer's specifications, both over the fire and at the breeching.

3. Combustion air adjustments are to be made to give the highest CO_2 without visible smoke (unburned carbon) at the chimney. If the minimum required percentage of CO_2 cannot be obtained in the breeching, it will be permissible to take CO_2 over the fire which will be acceptable. In that event, both CO_2 readings shall be recorded on the certificate. A considerable difference between the two CO_2 readings indicates a leak of air into the flue passes or firebox of the boiler or furnace.

4. Stack temperatures shall be recorded after 10 minutes of operation after reaching steaming temperatures for steam boilers or 180° F water temperature for hot water boilers or 125° F. bonnet temperature for warm air furnaces.

5. During the period of operation to permit flue gas temperatures to reach maximum, periodic readings of draft, CO_2 and oil rate shall be taken and the average recorded on this certificate. All controls and limiting devices shall be checked for proper operation.

SERVICE AND FOLLOW-UP INSPECTION

Service and inspection are of the greatest importance when the burner is first put into operation. It is therefore recommended that an inspection be made within 48 hours after the burner is put into service and that thereafter one inspection be made per week for at least the first two weeks. These inspections should in particular serve to check on:

1. Absence of oil leaks.

2. Safety features of automatic controls.

3. Characteristics of fire.

4. Freedom from carbon or soot formation.

5. Cement bonds in combustion chamber.

6. Water level in heating system.

7. Distribution of heat from heating system.

8. Temperature regulation in heated space.

9. Understanding of occupants regarding operating of system.

BURNER MAINTENANCE

An oil burner being a mechanical device will require servicing at times. Although a burner which has been carefully installed is less likely to cause the owner difficulty, certain operations must be performed at regular intervals to assure satisfactory operation. This is best done before each heating season.

A recommended procedure for seasonal checks is as follows:

1. Oil motor with a good grade of motor oil equivalent to a Number SAE 10. A half teaspoon on each bearing is sufficient.
2. Clean pump strainer thoroughly.
3. Remove nozzle and electrode assembly, disassemble nozzle and clean strainer. If screen is very dirty, replace with new. Nozzle orifice and flutes should be cleaned with a sharpened match or toothpick, never with a needle or other piece of metal. When assembling the nozzle, make sure all parts are tight and the nozzle is firmly seated on the brass nozzle adapter.
4. Inspect setting of electrodes for proper gap and location.
5. Check insulators for cracks which may allow the high tension current to break through.
6. Inspect high tension leads for breaks in insulation.
7. Check connections of high tension leads to transformer and electrodes for tightness.
8. Clean any carbon and dirt from electrode assembly, interior of air blast tube and turbulator vanes.
9. Check combustion chamber for cracks and repair with a good grade of high temperature cement.
10. Inspect heating plant for soot formation and leaks.
11. Remove primary control and clean element of soot. Check contacts for dirt.
12. Wipe points of thermostat with hard thin paper. (Not newspaper).
13. Start and stop burner several times checking controls for proper operation, air adjustment and position of flame with respect to air tube as recommended in the section on burner adjustments.

SERVICE PROBLEMS

Probable Cause	Correction
I. BURNER DOES NOT START:	
a. Blown Fuse	a. Replace fuse—also check reason for short circuit or overloaded circuit—check all wiring and splices.
b. Burner switch in "off" position	b. Move switch to "on" position.
c. Primary control safety switch in "off" position or starting contacts out of step.	c. Follow procedure as outlined in checking the primary control.
d. Thermostat setting is below room temperature	d. Raise setting above room temperature.
e. Limit Control is satisfied.	e. Raise setting or check with test light if power is available to limit control.

Probable Cause	Correction
f. Dirty control contacts (thermostat, primary control, etc.)	f. Clean all open type contacts with hard writing paper (do not use abrasive paper).
g. Open motor overload switch.	g. Reset overload and check for cause—bad bearing, open starting switch, bad pump or dry bearings.
h. Low water cut off in "off" position (Boiler Only).	h. Add water to proper level.
II. BURNER CYCLES FREQUENTLY (TURNS ON AND OFF)	
a. Thermostat differential set too close	a. Adjust differential (See Manufacturer's instruction.)
b. Thermostat contacts not closing in proper sequence or wired incorrectly.	b. Adjust contacts—also check red, white and blue wires; they must be wired color to color.
c. Primary control contacts not closing according to proper sequence.	c. Follow Mfgr's instructions before adjusting starting and operating (hot and cold) contacts.
d. Loose wiring or heater coil in thermostat which causes primary control to stop and recycle.	d. Check all connections and heater coil—place jumper wire across red, white and blue contacts to test low voltage circuit.
e. High limit differential set too close.	e. Increase differential between cut in and cut out settings.
f. Air filter plugged.	f. Plugged filters restrict air flow through unit causing burner to shut down on limit quickly.
g. Nozzle too big.	g. An excessive fire will overheat the unit causing it to shut down on limit quickly.
h. Be aware of proper cycling.	h. The excessive re-cycling referred to in this section is re-cycling every few seconds or less than one minute.
III. BURNER "FAILS SAFE" (PRIMARY CONTROL GOES ON SAFETY)	
a. Dirty primary control element.	a. Remove control and clean element.
b. Wrong polarity.	b. Check the polarity as shown on the wiring diagram.
c. Low Voltage—If voltage drops too low it can cause a safety shut-down.	c. If this is suspected, ask power company to put a recording voltmeter on the job for 24 hours.
d. Wrong primary control location.	d. The control should be at least 12 inches from the draft regulator between the furnace and draft regulator.
e. Primary control cooling slots.	e. Refer to Mfgr's. instructions as to when slots should be opened or closed.
f. Relief door open can cool stack gases enough to cause a safety shut-down.	f. Close door.
g. Short scavenger timing of primary control.	g. Refer to primary control instructions when adjusting this scavenger timing.
h. Refer to Sections V and XIII pertaining to "No Oil At Nozzle" and "Ignition Failures" for other items that will cause the burner to fail-safe.	

	Probable Cause	Correction
IV.	BURNER MOTOR WILL NOT STOP AUTOMATICALLY:	
a.	Short circuit in thermostat wiring.	a. Disconnect red, white and blue wires at relay. if burner stops, check entire thermostat control circuit.
b.	Poor thermostat location, near drafty, open windows or on cold wall.	b. Thermostat should be moved to more suitable location.
c.	Improper wiring or nail through thermostat wire.	c. Check wiring — use wiring diagram if unfamiliar with wiring.
d.	Limit control set too high (when operating the burner in place of a thermostat)	d. Check cut in — cut out, and differential of the control.
e.	Wrong Polarity—If the ground line into the primary control is located where the hot line should be (reversed polarity), and the motor develops a ground, the burner will start and none of the controls will stop it. Check wiring.	
V.	NO OIL AT NOZZLE:	
a.	Empty tank.	a. Replenish supply.
b.	Valves closed.	b. Service calls are also caused by this crazy situation. It might be that the foot valve at the bottom of the suction line is also stuck.
c.	Plugged oil filter.	c. Check this carefully and clean or replace.
d.	Nozzle plugged.	d. Clean nozzle and strainer or replace.
e.	Leak in suction line.	e. This, of course, applies to overhead piping where a leak in the suction line will prevent the pump from actually sucking fuel out of the tank.
f.	Pump frozen.	f. This can happen with the coupling slipping so the burners appears to be operating but the pump is not.
g.	Suction line restricted.	g. Inspect carefully for a dented suction line or injury to it that has restricted it in some way.
h.	Correct rotational direction.	h. A fuel unit will not deliver oil if operated backwards. A marking on the pump housing shows the correct direction of rotation.
i.	By-pass plug in two-pipe system.	i. Be sure this by-pass plug is in place on every two-pipe system. Remove it only for one-pipe systems.
j.	System airbound.	j. Loosen the vent plug where the pressure gauge attachs and operate the unit so as to purge all air from the system.
k.	Vent frozen.	k. Check to be sure that the outdoor vent is not frozen so as to create a vacuum in the oil tank which prevents oil from feeding to the burner.
VI.	DELAYED IGNITION (Puff on start)	
a.	Electrode setting wrong.	a. Check spacing and correct according to instructions.

Probable Cause	Correction
b. Excess air.	b. See section on adjusting air.
c. Dirty or partially clogged nozzle.	c. Clean nozzle and strainer or use new nozzle.
d. Air in suction line.	d. Check for air leaks in suction line.
e. Blast tube too close to combustion chamber floor, requiring excess air to burn the oil without smoky fire.	e. Reset blast tube to proper height above floor—pit combustion chamber if necessary — then adjust air.

f. Low Voltage—It is possible to have a condition exist where the voltage is so low that the transformer will not develop enough spark for ignition, however, there would still be enough voltage to operate the burner motor and pump oil vapor into the unit. If the voltage should return to normal before the burner fails-safe, the transformer will then develop a spark and ignite the oil vapors that have collected in the unit.

VII. SMOKY FIRE

a. Not enough air.	a. Increase air regulator opening.
b. Dirty fan.	b. Clean fan.
c. Motor not up to speed.	c. Repair or replace motor.
d. Combustion chamber not high enough.	d. Build up higher combustion chamber walls.
e. Overfiring combustion chamber.	e. Cut down nozzle or increase chamber size.
f. Atomized oil striking floor or side of furnace or chamber may also cause carbon formation.	f. Raise burner blast tube, use narrower angle nozzle spray.
g. Nozzle loose in nozzle adapter.	g. Tighten nozzle in nozzle adapter.
h. Nozzle spinner not seated tightly in nozzle.	h. Check and tighten in nozzle.

VIII. FLAME STRINGY AND DIRTY

a. Nozzle partially plugged.	a. Clean nozzle and strainer or install new nozzle. Try several nozzles if necessary.
b. Excess air.	b. See section on adjusting air.
c. Air in system.	c. Correct any air leak in suction line and purge air from system.
d. Combustion chamber size incorrect.	d. The combustion chamber must be the correct size for the nozzle used. Check instructions pertaining to combustion chamber sizing to be sure it is correct.
e. Nozzle adjustment wrong.	e. The relationship of the nozzle with the end of the blast tube is important. Check instructions pertaining to oil pipe and nozzle adjustment.

f. Air leaks in furnace—Some furnaces, particularly old conversion jobs, have had such great air leakage around the bottom that this extraneous air has drastically diluted combustion gases and even resulted in stringy, dirty oil fires. This is more apt to occur with a shallow refractory pot than with a deep one, but extraneous air leakage will drop efficiency no matter how the oil burner pot is constructed. Be sure the furnace is tight.

IX. OIL ODOR

a. Poor draft.	a. Check smoke pipe, chimney, furnace baffles, etc.

Probable Cause	Correction
b. Overfiring furnace.	b. Cut down nozzle size.
c. Excess air.	c. Close down air regulator opening.
d. Furnace room not ventilated.	d. Provide opening to the outside.
e. Forced warm-air furnace with unconnected returns and insufficient openings into basement.	c. Increase return air openings into basement, or connect returns to unit.
f. Back pressure in furnace.	f. Check baffles, overfiring, plugged chimney. Draft regulator may be opened too much, adjust to give .02 to .03 inches draft over the fire.
g. Oil leaks.	g. Locate and correct.
X. IGNITION POINTS COLLECT CARBON	
a. Nozzle loose in nozzle adapter.	a. Tighten nozzle in adapter.
b. Nozzle partially plugged.	b. Clean nozzle and strainer or install new nozzle. Try several new nozzles if necessary.
c. Poor nozzle cut-off.	c. Check the fuel unit service information sheet in back of book.
d. Nozzle adjustment wrong.	d. The relationship of the nozzle with the end of the blast tube is important. Check instructions pertaining to the oil pipe and nozzle adjustment.
e. Blast tube pulled back so that oil spray strikes hole in combustion chamber.	e. Slide burner into the proper position according to the instructions.
f. Electrode setting wrong.	f. Check spacing and correct according to instructions.
XI. OIL IGNITES BUT GOES OUT WHEN IGNITION GOES OFF (Using intermittent ignition primary control)	
a. Combustion chamber too long.	a. Redesign chamber to more practical proportion. See recommended combustion chamber sizes.
b. Dirty nozzle—flame too small.	b. Clean nozzle and nozzle strainer.
c. Nozzle too small for combustion chamber.	c. Check heat loss and install correct nozzle.
d. Air regulator open too wide for the size nozzle.	d. Close down air regulator to suit nozzle size.
e. Blast tube too close to combustion chamber floor, requiring excess air to burn oil without smoky fire.	e. Reset burner blast tube to proper height above floor—pit combustion chamber if necessary—then close down air shutter opening.
f. Excess draft.	f. Set draft regulator at .02 to .03 in draft over the fire.
g. Water in oil	
XII. HIGH OIL CONSUMPTION	
a. Fan control set too high.	a. Where fan control is set to start the burner at too high a temperature (anything over 120°) the burner has to run too long before the fan can start. In fact, a fan control adjustment that does not allow practically continuous blower operation will usually cause high fuel bills because heat is not carried away from the furnace as rapidly as the burner develops it.

Probable Cause	Correction
b. Bad burner adjustment.	b. The nozzle must be right and the air adjustment must be right as well as the draft adjustment and the relationship between the nozzle and the end of the blast tube. All of these items have been covered in the installation instructions. To be sure that the burner adjustments are right, check these with a CO_2 analyzer, draft gauge and stack thermometer for best information.
c. Nozzle too big.	c. This is a very common source of high fuel bills. A warm air furnace is designed to deliver rating when fired constantly. Too large a fire, which only needs to run part of the time in coldest weather, puts more heat into the furnace than there is heating surface available to absorb. Stack temperature will be excessive. Be sure that the burner input is correct for the house.
d. Wrong refractory pot.	
e. Leak in oil tank.	
f. Air filters plugged.	f. This reduces air circulation over the furnace, therefore, efficiency is reduced. Air filters should be clean and the blower should be set to deliver sufficient air to keep the temperature rise through the furnace down to approximately 100° F. when heating the house in coldest weather.
XIII. IGNITION FAILURES:	
a. Test transformer.	a. Be sure that electricity is reaching the primary terminals of the transformer. Use a test lamp for ascertaining this. Check the secondary by connecting one high tension lead to one high voltage terminal and hold the end of this near the other terminal to see if you get a proper spark.
b. Test ignition cable.	b. Do this by slowly running the exposed end of one high tension cable along the length of the other high tension cable to watch for sparks jumping through any cracks in the insulation on these wires.
c. Cracked electrodes.	c. This is a rather common, as well as elusive, source of ignition failure. Frequently the porcelain insulators are cracked with cracks so fine that they are hardly visible. You can test for this as you tested for insulation cracks on the high tension cable. Run the exposed end of one of the high tension ignition cables slowly over the porcelain insulator of the electrode connected to the other transformer terminal. Where the porcelain leaks you will observe a spark.

Probable Cause	Correction

d. Dirty electrodes.

c. Electrode adjustment wrong.

XIV. BURNER PULSATES

a. Defective Nozzle—Try a new nozzle. It might be necessary to try two or three nozzles of a different make or spray pattern before you get one that exactly suits the job. Just because the nozzle is new does not always mean that it will burn perfectly.

b. Inadequate Draft—Bad chimneys have caused many a pulsation trouble job. Remember that for systems up to about 2.0 GPH, you should have a chimney capable of producing a draft at least as high as .06" water gauge. Set the barometric control for .04" at the furnace flue collar, and this should give about .02" above the fire. If higher draft than this is available, we suggest that you use it and you might relieve a pulsation problem. If there is no draft available on a cold start, introduce secondary air as described in step "i" of this section.

c. Air in Line — Air in the suction line can create an irregular oil flow. Be sure to purge all air from both the suction line and the high pressure nozzle line if you have a pulsation problem.

d. Poor Nozzle Cut-Off — This condition will cause pulsation on the shut down. Refer to service information sheet on fuel pump.

e. Check All Adjustments — The adjustment of the nozzle in relation to the end of the blast tube, and the adjustment of the static disc as to its proper location.

f. Use Correct Combustion Chamber Size — Oil burner combustion chambers that are not the correct size can cause serious pulsation problems. Refer to pot dimensional information and check to be sure that pot size is correct for the nozzle size being used.

g. Furnace Plugged — If an oil burner adjustment has gone rather haywire, it can put an excessive amount of soot inside furnace and this can be enough to substantially plug up the flue passages. Be sure to clean the furnace and check to be sure that there is nothing in the radiator of the furnace that has plugged it at the critical gas passages.

h. Restrict Flue Outlet — Sometimes very unusual pulsation troubles can be cured by reducing the size of the smoke pipe connecting the flue outlet to the chimney. On some jobs, instead of having a direct smoke pipe to the chimney, use a couple of elbows in connecting flue to chimney. Before attempting the above make certain there is sufficient draft.

i. Introduce Secondary Air — We suggest this only as a last resort. If the above remedies have not solved your problem, then you can always relieve pulsation by creating secondary air relief in the heat exchanger.

Before trying to alleviate pulsation by introducing secondary air, make certain that:

1. All burner adjustments are properly made.
2. The chimney flue is the correct size with no obstructions.
3. The radiator passages in the unit are not clogged with soot.

On most oil-designed furnaces there are provisions for introducing secondary air into the unit. Most units that have this provision will have secondary air holes located directly under the burner support. The air entering these ports can be regulated as desired by an adjustable air shutter. When making the secondary air adjustment we advise the shutter be completely closed and then open it just enough to relieve any pulsation.

When attempting to introduce secondary air into a conversion installation, run a piece of 1" or 1¼" pipe out from the combustion chamber to the outside of the furnace.

Probable Cause	Correction

XV. PUMP PROBLEMS:

If any of the pump problems listed below are encountered, refer to the service information sheet on fuel units.

a. Pump fails to deliver oil.

b. Poor nozzle cut-off (pulsation on shut-down)

c. Oil leak

d. High oil pressure

e. Low oil pressure

f. Pulsating pressure

g. Noisy pump

h. Tank hum

XVI. RADIO INTERFERENCE:

a. Weak relay coil in primary control.	a. Replace control.
b. Dirt between relay armature and magnet core.	b. Clean.
c. Dirty contacts, thus causing insufficient contact.	c. Clean.

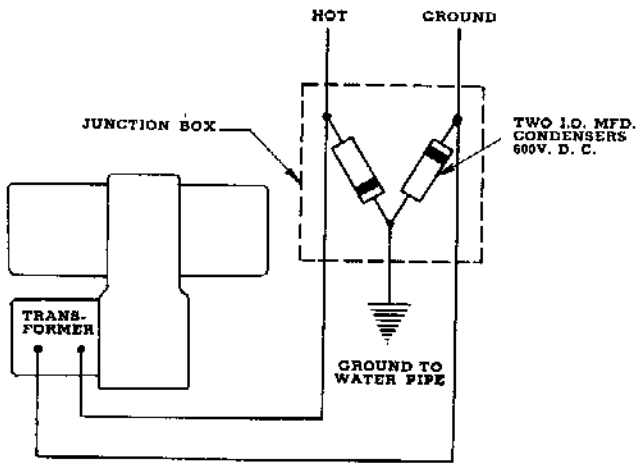
d. Ignition transformer — Radio interference is usually caused by a feed back of high frequency waves from the ignition on an oil burner. These waves pass back through the transformer from the secondary to the primary side and are picked up by the house wiring circuit which acts as an aerial. All of our oil burner transformers are grounded at the mid-point of the secondary coil in order to act as a trap for such waves. However, should the house wiring circuit have more of an aerial effect than this grounded transformer has a trapping effect, then it may be possible for these high frequency waves to pass back into the house wiring circuit and be picked up by the radio.

The first thing to do in attempting to eliminate radio interference is to establish a positive ground for the oil burner. If the burner is so mounted that it is insulated from the main portion of the furnace, there should be a bonding wire which acts as a jumper across the insulating mount for the burner. Make sure this bonding wire is in place. Next, install a positive ground for the burner by soldering a wire to the oil supply line and running it to the water pipe. This will ground the entire burner assembly. If you should find that with this positive grounding, the trouble still persists, then try running a ground wire from the ground terminal of the disconnect switch to a water pipe. Many cases have been found where house wiring circuits are not adequately grounded.

You may find it necessary, also, to run a ground wire from the radio itself, unless the radio instructions caution against this procedure. It is only logical to assume that if a new radio is sensitive enough to pick up distant stations with a built-in aerial and no ground connection, that it can be susceptible to an ignition transformer a few feet away if the instrument is not properly grounded. Try too, reversing the plug in the wall receptacle to change polarity.

If after establishing a positive ground by the above methods, you find that the interference is still present, then the solution lies in the use of condensers attached to the power lead near the transformer itself. In using these condensers, we suggest that you follow Figure 12, BUT BE SURE A POSITIVE GROUND FOR THE BURNER AND CABINET HAVE BEEN ESTABLISHED FIRST.

Please bear in mind that the transformer furnished with the burner is grounded in order to help eliminate normal interference and if interference is persistent enough to cause you to follow all of these corrective measures, then this interference problem can be present with any make of transformer or burner. Stubborn cases of interference can usually be traced to a combination of house wiring attraction for the high frequency waves and sensitivity of the radio.



RADIO INTERFERENCE WIRING DIAGRAM
FIGURE 12

HOW TO CORRECT BAD CHIMNEY DRAFT CONDITIONS

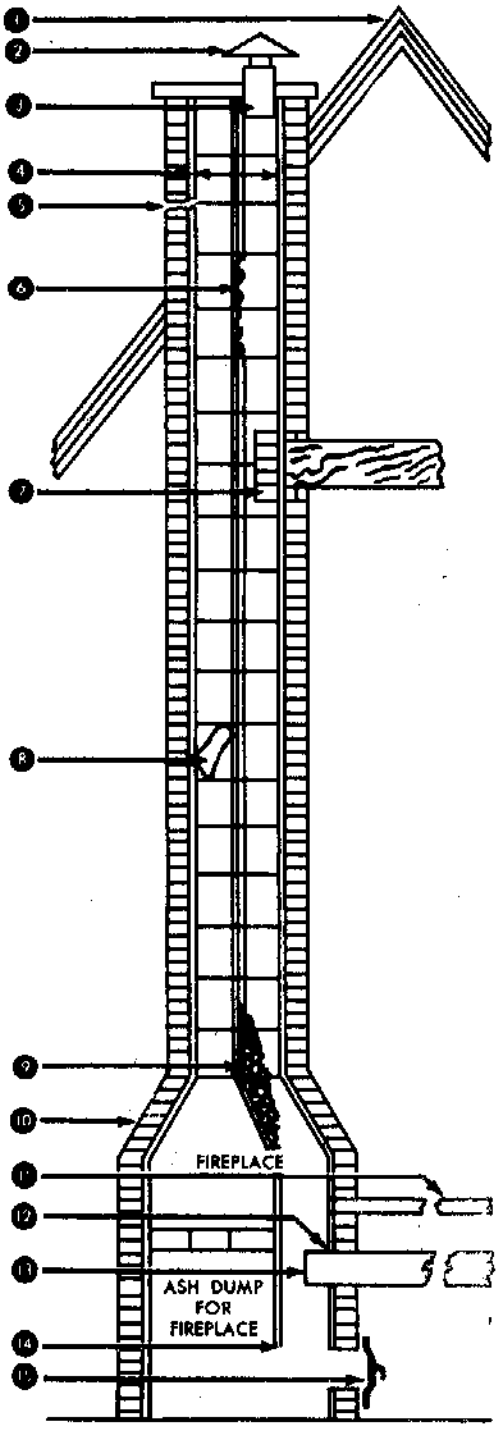


Fig. 1

Cause	Correction
1. Roof peak or surrounding trees, buildings or objects higher than chimney top.	Extend chimney to height required above surrounding objects. Minimum height of chimney is 30 ft.
2. Flue cap on chimney.	Remove after extending chimney.
3. Coping smaller than inside of chimney.	Enlarge to exact size of chimney interior.
4. Inside dimensions of chimney too small.	Chimney should be at least 8 x 12 in. Before making major changes, however, try your present chimney for one season.
5. Brick and mortar loose or fallen out, causing air leaks.	Replace brick, cementing tightly, and seal all joints with mortar.
6. Loose bricks or mortar in inside wall separating double chimney.	Rebuild chimney being sure to make tight connection.
7. Joist protruding into chimney.	Remove to give full clearance.
8. Brick, mortar or other obstruction lodged in chimney.	Loosen by raising and lowering weight in chimney. Remove through cleanout door.
9. Soot accumulation in offset.	Remove.
10. Offset too short.	Straighten or lengthen.
11. More than one heating appliance connected to same chimney flue.	Furnace should have its own flue with no other smoke pipe connections. Permanently seal unused openings with brick and mortar. See Fig. 4.
12. Smoke pipe loose fitting, too long, too many elbows.	Make connection tight with cement, shorten, avoid elbows if possible.
13. Smoke pipe protrudes into chimney or elbow too far (Fig. 2).	Make end flush with inside of chimney. For elbow connection, see Fig. 3.
14. Opening between flues.	Stop up openings permanently.
15. Loose fitting chimney cleanout door.	Keep cleanout door closed tightly. Seal with cement.
Open fireplace.	Seal opening.
Newly built chimney.	Allow 2 to 4 weeks for drying out.
Too much draft.	Install a butterfly hand damper in first length of pipe connected to heater.

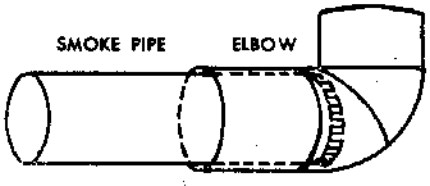


Fig. 2 Pipe pushed too far inside elbow, as shown, interferes with draft.

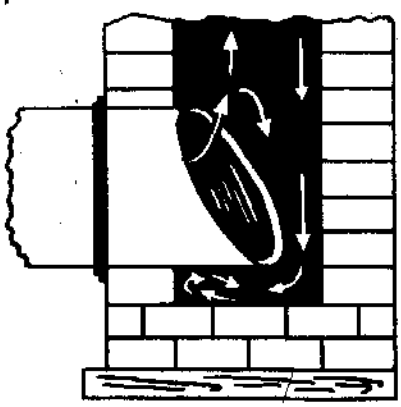


Fig. 3 If chimney ends only a short distance below point where smoke pipe enters, make "toothpick joint," as shown. Remove soot from below flue opening regularly.

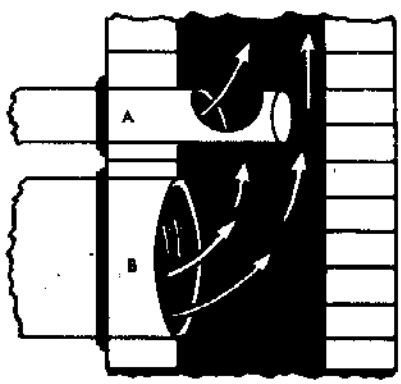


Fig. 4 If more than one heating appliance must be connected to same chimney flue, connect heater smoke pipe to flue as at B. Connect second pipe as at A, cutting into top of pipe and stopping off the end.

Important

INSTALLATION INFORMATION

SUNDSTRAND SINGLE-STAGE FUEL UNITS

MODEL J AND J SOLENOID

NOTE: This unit may be used on either single-pipe or two-pipe systems. It is shipped from the factory with the internal by-pass plug left out and is, therefore, ready to be installed on a single-pipe system.

All Sundstrand fuel units are shipped from the factory with the pressure set at 100 P.S.I. Should it be necessary to change this pressure refer to Figure 1.

Use pipe dope or thread sealer on all fittings and pipe plugs.

SINGLE-PIPE INSTALLATION

CAUTION: The bottom of the tank must be above the pump where a "single-pipe" System is used.

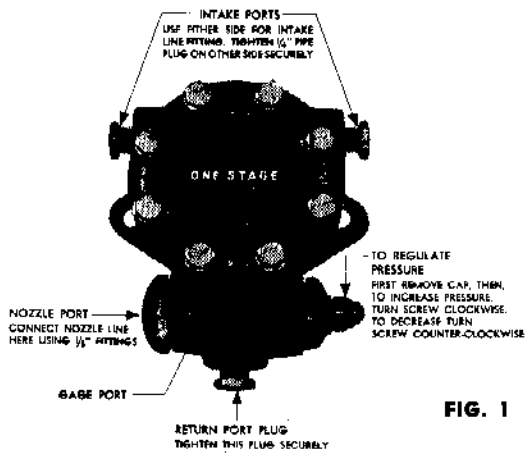


FIG. 1

1. Remove ¼" intake port pipe plug from either side of the unit and assemble intake line fittings.
2. Tighten return port plug and ¼" pipe plug in unused intake port.
3. When starting burner, be sure to bleed air from the system by removing gage port plug allowing oil to flow until it is free of bubbles or foam.

TWO-PIPE INSTALLATION

IMPORTANT: Be sure to insert by-pass plug as outlined below.

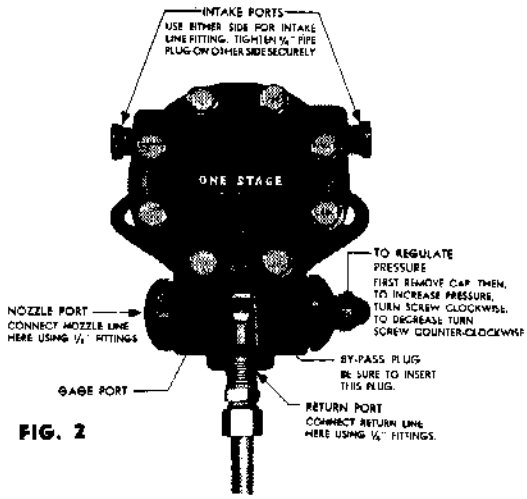


FIG. 2

1. Remove ¼" Intake Port pipe plug from either side of the unit and assemble intake line fittings.
2. Unscrew ¼" return port plug.
3. Remove internal by-pass plug from cloth bag and insert as shown in figure 2.
4. Assemble return line fittings in return port.
5. Tighten ¼" pipe plug in unused intake port.

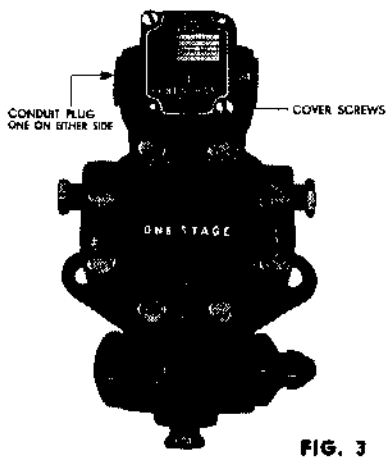


FIG. 3

SOLENOID INSTALLATION

CAUTION: Before wiring solenoid installation be sure that power to burner and motor is off.

1. Loosen two cover screws and remove cover as shown in figure 3.
2. Remove conduit plug from either side and connect solenoid terminals in parallel with the burner motor or as recommended by the burner manufacturer.

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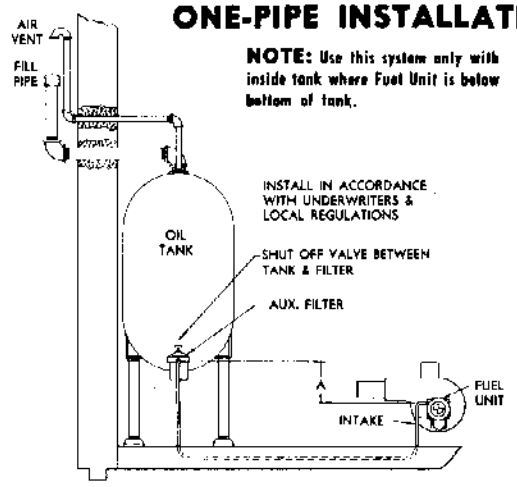
SUNDSTRAND FUEL UNITS

SUNDSTRAND MACHINE TOOL CO.

HYDRAULIC DIVISION, ROCKFORD, ILL.

HOW TO DETERMINE THE CORRECT LINE SIZE FOR SUNDSTRAND FUEL UNITS

ONE-PIPE INSTALLATION



NOTE: Use this system only with inside tank where Fuel Unit is below bottom of tank.

Total Length of INTAKE LINE in feet (Including horizontal and vertical run).

MAX. LENGTH OF ⅜" LINE

Dimension "A"	J2	J3	J4	J5	J6
0'	60	29	19	13	9
1'	75	39	26	17	12
2'	98	49	36	22	15
3'	122	61	40	27	19
4'	140	70	47	31	22
5'	150	84	54	36	24

MAX. LENGTH OF ½" LINE

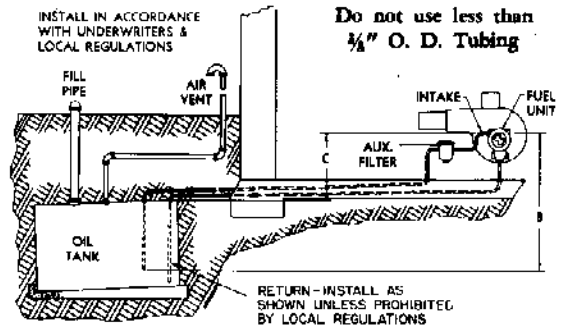
J2	J3	J4	J5	J6
	131	88	57	39
		115	76	54
		146	94	66
	150'		119	85
			136	96
				109

Do not use less than ⅜" O. D. Tubing

If no oil is available at nozzle or sharp cut-off is not obtained, and shaft is rotating in direction indicated by arrow on body, there may be an air leak in the suction line causing the unit to be air bound. To correct this, tighten all fittings and bleed air from the system through the gage port.

TWO-PIPE INSTALLATION

Inside or outside tank Fuel Unit above tank



Do not use less than ⅜" O. D. Tubing

Total length of INTAKE LINE in feet (Including horizontal and vertical run).

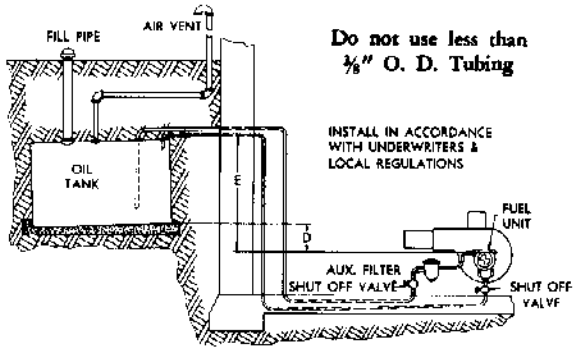
Dimension "B" Intake	MAX. LENGTH ⅜" Tubing J2	J3	J4	J5	J6	MAX. LENGTH ½" Tubing J2	J3	J4	J5	J6
0'	48	48	40	30	24				132	100
1'	46	46	37	28	21	150'			128	94
2'	42	42	34	26	19				115	87
3'	39	39	31	24	17			139	110	78
4'	36	36	28	22	16			127	98	72
5'	32	32	26	19	14	140	140	115	84	65
6'	28	28	22	17	13	128	128	100	75	57
7'	24	24	19	15	11	110	110	87	65	50
8'	21	21	17	12	9	91	91	74	55	42
9'	19	19	14	10		76	76	62	46	36
10'	13	13				60	60	47	36	27
11'						42	42	35	25	19
12'						25	25	20	15	

Total length of RETURN LINE in feet (Including horizontal and vertical run).

Dimension "C" Return	MAX. LENGTH ⅜" Tubing J2	J3	J4	J5	J6	MAX. LENGTH ½" Tubing J2	J3	J4	J5	J6
0'	48	48	40	30	23				132	100
1'	52	52	43	32	27				145	115
2'	54	54	45	34	28				150	125
3'	57	57	48	36	29					130
4'	60	60	50	38	31			150'		140
5'	65	65	54	40	32					145

For values above 5' install return line of same size as intake line.

Inside or outside tank Fuel Unit below tank



Do not use less than ⅜" O. D. Tubing

Total length of INTAKE LINE in feet (Including horizontal and vertical run).

Dimension "D" Intake	MAX. LENGTH ⅜" Tubing J2	J3	J4	J5	J6	MAX. LENGTH ½" Tubing J2	J3	J4	J5	J6
5'	65	65	55	40	31					140
4'	61	61	52	38	30			150'		132
3'	58	58	49	36	28					125
2'	56	56	48	35	27					120
1'	52	52	44	32	25				145	112
—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—

Total length of RETURN LINE in feet (Including horizontal and vertical run).

Dimension "E" Return	MAX. LENGTH ⅜" Tubing J2	J3	J4	J5	J6	MAX. LENGTH ½" Tubing J2	J3	J4	J5	J6
0'	48	48	40	30	23				135	105
1'	45	45	38	28	22				125	96
2'	42	42	36	26	21		150'		115	90
3'	39	39	33	24	19			145	110	85
4'	35	35	29	21	17			130	95	74
5'	32	32	28	19	15			115	85	66

Maximum line lengths shown above are calculated for #2 oil at 60° and 1725 RPM pump speed

Important

INSTALLATION INFORMATION

SUNDSTRAND TWO-STAGE FUEL UNITS

MODEL H AND H SOLENOID

NOTE: This unit may be used on either single-pipe or two-pipe systems. It is shipped from the factory with the internal by-pass plug left out and is, therefore, ready to be installed on a single-pipe system.

All Sundstrand fuel units are shipped from the factory with the pressure set at 100 P.S.I. Should it be necessary to change this pressure refer to Figure 1.

Use pipe dope or thread sealer on all fittings and pipe plugs.

TWO-PIPE INSTALLATION

IMPORTANT: On "two-pipe" system, Model H must be mounted with return port at bottom as shown in Fig. 1.

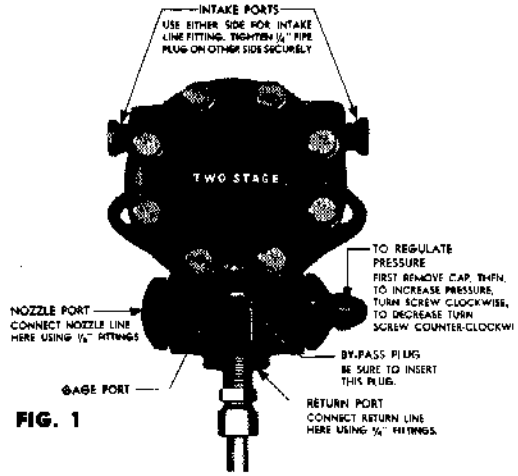


FIG. 1

1. Remove ¼" Intake Port pipe plug from either side of the unit and assemble intake line fittings.
2. Unscrew return port plug.
3. Remove internal by-pass plug from cloth bag and insert as shown in figure 1.
4. Assemble return line fittings in return port.
5. Tighten ¼" pipe plug in unused intake port.
6. On two-pipe system, air bleeding is automatic.

SINGLE-PIPE INSTALLATION

CAUTION: Where a "single-pipe" System is used, the bottom of the tank must be above the pump.

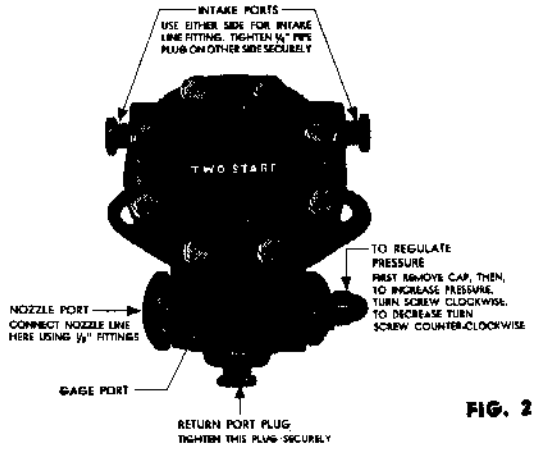


FIG. 2

1. Remove ¼" intake port pipe plug from either side of the unit and assemble intake line fittings.
2. Tighten return port plug and ¼" pipe plug in unused intake port.
3. When starting burner, be sure to bleed air out of the system by removing gage port plug allowing oil to flow until it is free of bubbles or foam.

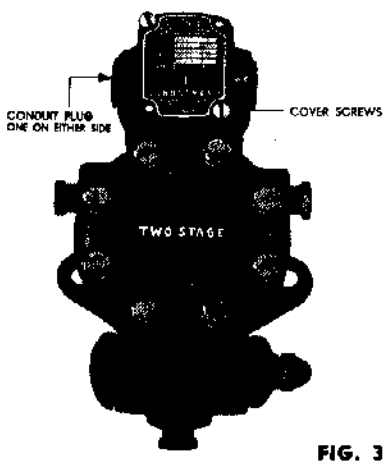


FIG. 3

SOLENOID INSTALLATION

CAUTION: Before wiring solenoid installation be sure that power to burner and motor is off.

1. Loosen two cover screws and remove cover as shown in figure 3.
2. Remove conduit plug from either side and connect solenoid terminals in parallel with the burner motor or as recommended by the burner manufacturer.

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SUNDSTRAND FUEL UNITS

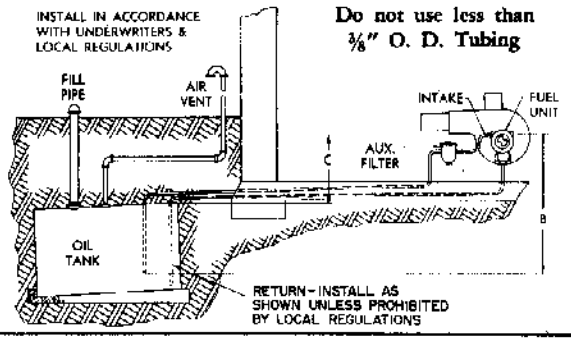
SUNDSTRAND MACHINE TOOL CO.

HYDRAULIC DIVISION, ROCKFORD, ILL.

HOW TO DETERMINE THE CORRECT LINE SIZE FOR SUNDSTRAND FUEL UNITS

TWO-PIPE INSTALLATION

Inside or outside tank Fuel Unit above tank



Total length of INTAKE LINE in feet (Including horizontal and vertical run).*

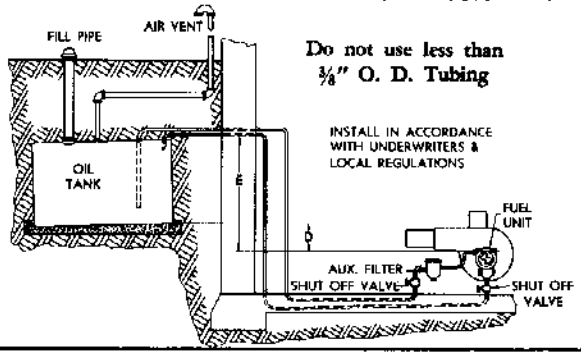
Dimension "B" Intake	MAX. LENGTH ⅜" Tubing H2	H3	H4	H5	H6	MAX. LENGTH ½" Tubing H2	H3	H4	H5	H6
0'	97	87	75	66	56					
1'	94	84	73	64	54					
2'	90	81	70	62	52					
3'	87	78	67	59	50					
4'	83	74	64	56	48			150'		
5'	80	71	62	54	46					
6'	77	68	59	51	44					
7'	73	65	56	48	42					
8'	69	62	53	46	40					
9'	65	58	50	44	38					147
10'	62	55	47	42	36					140
11'	58	51	45	39	34					132
12'	55	48	42	37	32				142	124
13'	51	45	39	34	29				134	114
14'	47	42	36	32	27			140	124	105
15'	43	39	33	29	25		149	130	115	96

Between 15 and 20 feet of lift, use ½" tubing.

Total length of RETURN LINE in feet (Including horizontal and vertical run).*

Dimension "C" Return Line	MAX. LENGTH ⅜" Tubing H2	H3	H4	H5	H6	MAX. LENGTH ½" Tubing H2	H3	H4	H5	H6
0'	56	56	56	56	56					
1'	61	61	61	61	61					
2'	66	66	66	66	66			150'		
3'	70	70	70	70	70					
4'	74	74	74	74	74					
5'	78	78	78	78	78					

Inside or outside tank Fuel Unit below tank



Total Length of INTAKE LINE in feet (Including horizontal and vertical run).*

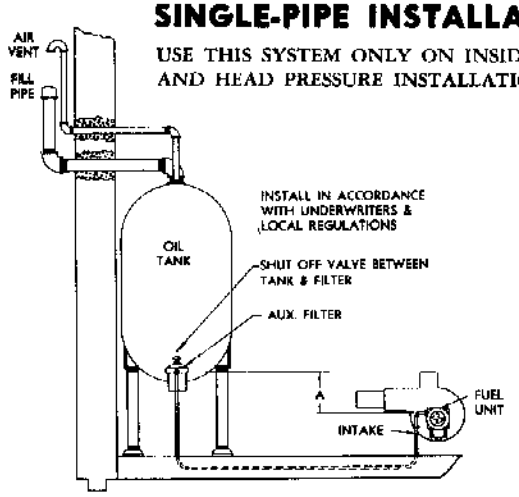
Dimension "D" Intake	MAX. LENGTH ⅜" Tubing H2	H3	H4	H5	H6	MAX. LENGTH ½" Tubing H2	H3	H4	H5	H6
1'	100	90	79	68	59					
2'	105	95	82	72	61			150'		
3'	110	99	84	74	64					
4'	115	102	87	77	66					
5'	119	104	90	79	68					

Total length of RETURN LINE in feet (Including horizontal and vertical run).*

Dimension "E" Return Line	MAX. LENGTH ⅜" Tubing H2	H3	H4	H5	H6	MAX. LENGTH ½" Tubing H2	H3	H4	H5	H6
0'	56	56	56	56	56					
1'	52	52	52	52	52					
2'	48	48	48	48	48			150'		
3'	44	44	44	44	44					
4'	40	40	40	40	40					
5'	35	35	35	35	35	140	140	140	140	140

SINGLE-PIPE INSTALLATION

USE THIS SYSTEM ONLY ON INSIDE TANK AND HEAD PRESSURE INSTALLATION



Total length of intake line in feet (including horizontal and vertical run).*

MAX. LENGTH OF ⅜" LINE

Dimension "A"	H2	H3	H4	H5	H6
0'	75	38	23	17	11
1'	105	53	32	23	16
2'	135	67	39	28	20
3'		82	48	35	24
4'	150'	95	57	41	28
5'		110	66	48	33

MAX. LENGTH OF ½" LINE

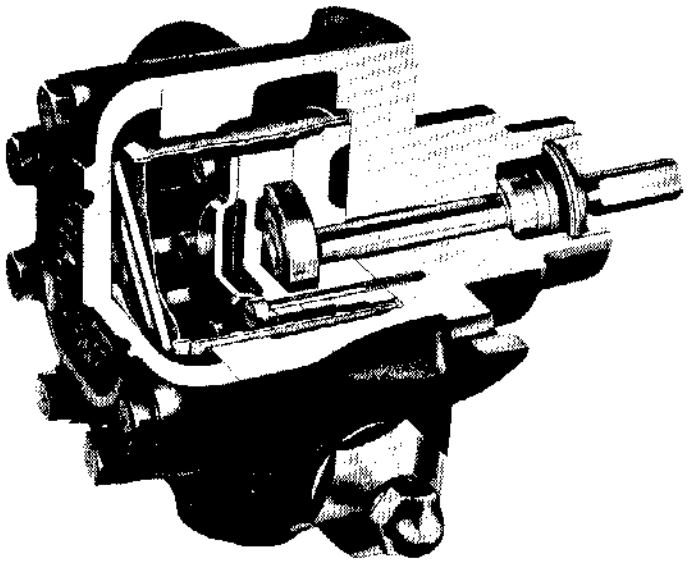
H2	H3	H4	H5	H6
		90	65	45
		125	88	62
			116	78
			138	95
				110
	150'			130

Do not use less than ⅜" O. D. Tubing

* ABOVE LINE LENGTHS FIGURED FOR AN OIL VISCOSITY OF 52 S.S.U. AT 60° F.

SIMPLIFIED FIELD SERVICE FOR "J" AND "H" FUEL UNITS

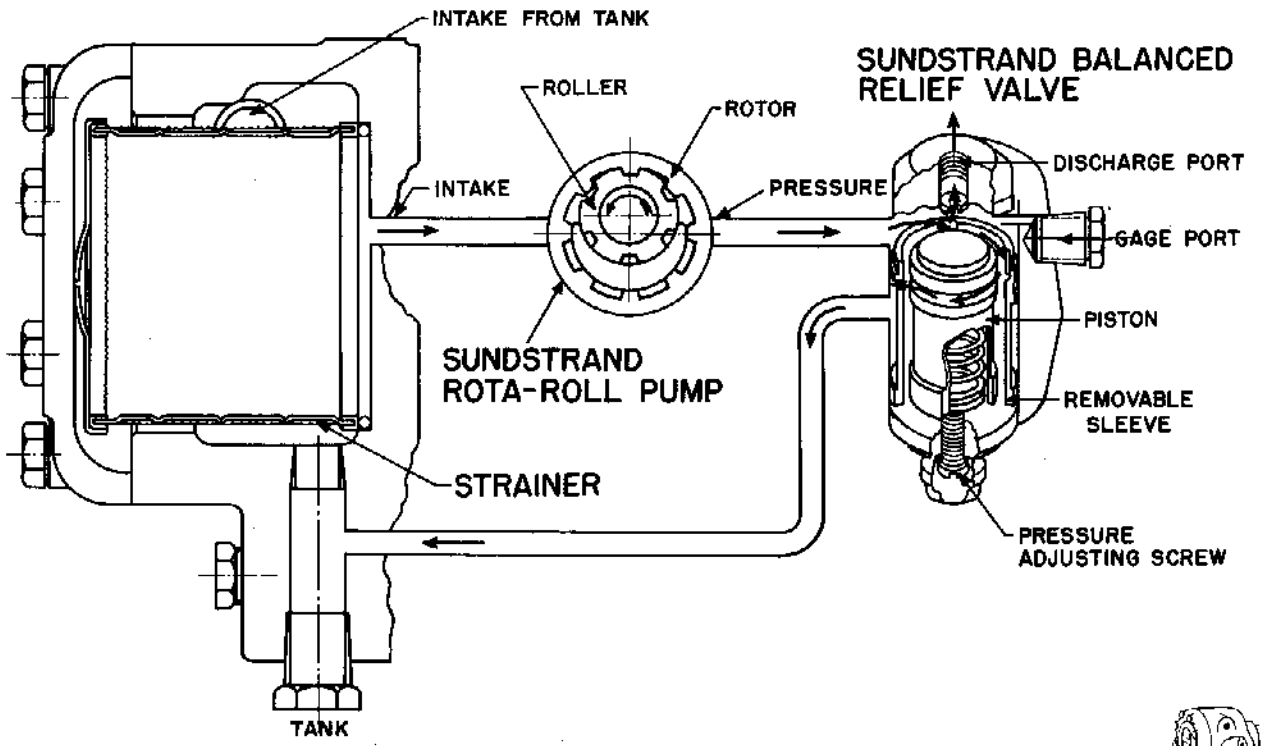
model "J" single-stage



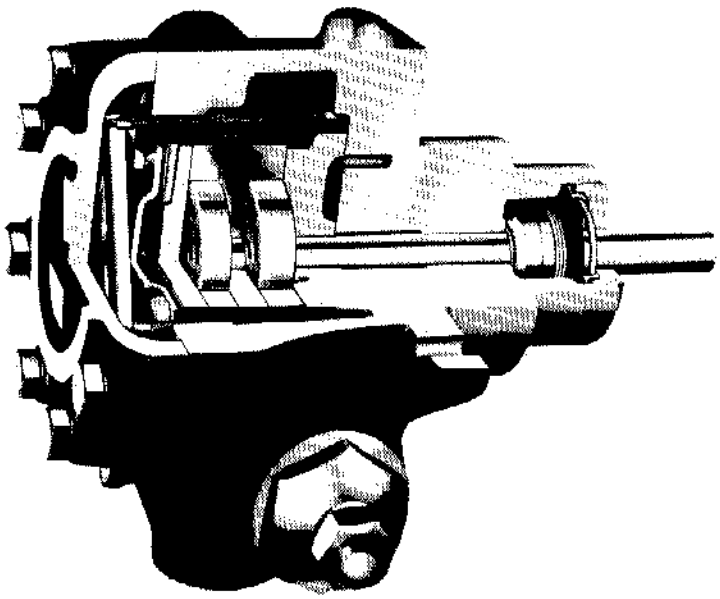
MODEL "J" OPERATION — Using the schematic diagram as a guide, the operation of the Model J Single-Stage Fuel Unit may be explained as follows:

When the oil burner motor starts, oil is drawn from the tank through the intake port into the strainer chamber. The roller and rotor separate on the intake side as they revolve, causing oil to be drawn from the strainer chamber into the segments of the Rota-Roll pumping members. When the roller and rotor revolve toward the pressure side, the separations close, forcing oil through the pressure port to the balanced valve.

Oil flow to the valve is continuous during operation, causing pressure actuation of the valve piston. This oil pressure on the piston forces it from its position on the nozzle cut-off seat allowing oil flow into the nozzle line. Oil in excess of nozzle capacity is by-passed through the valve back to the strainer chamber on a single-pipe system or to tank on a two-pipe system. The pressure at which the valve opens is determined by the setting of the valve spring. Spring tension is controlled by the pressure adjusting screw. Turning the screw to the right increases the pressure; turning it to the left decreases the pressure.



model "H" two-stage

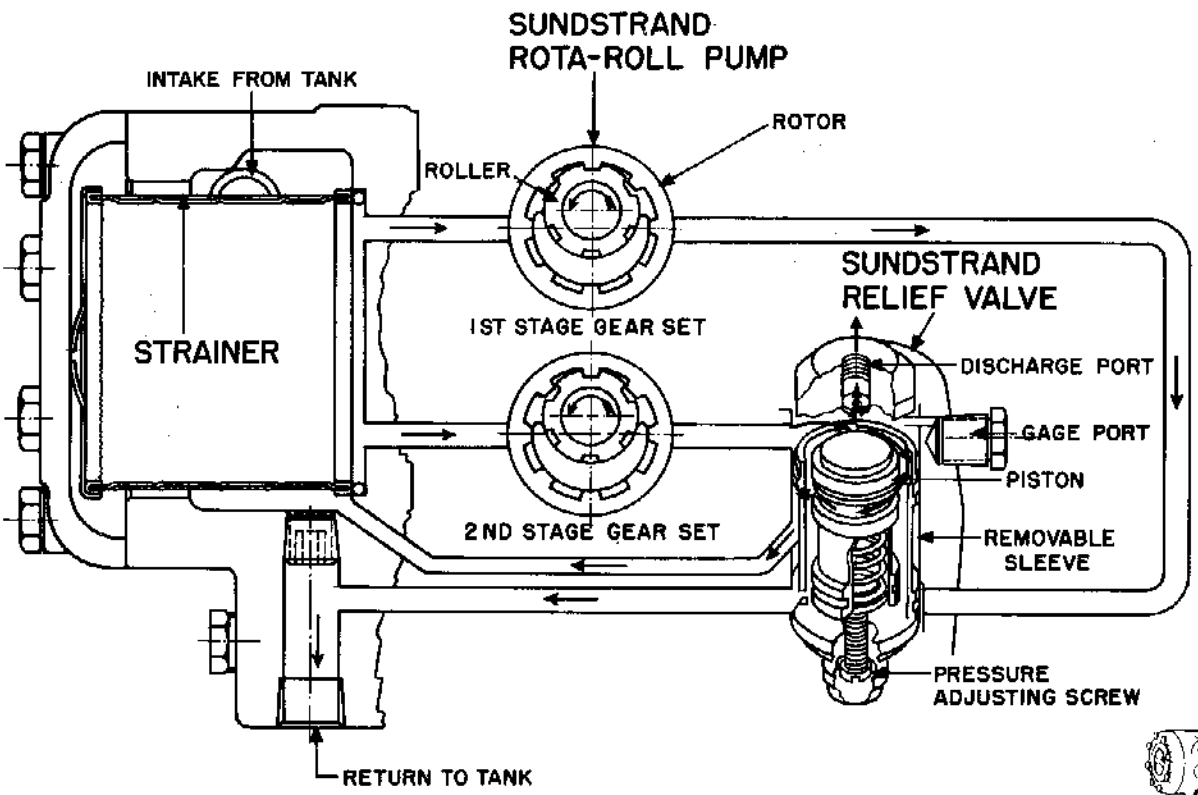


MODEL "H" OPERATION — On long line and high lift installations, a high vacuum condition may exist and air may be drawn into the fuel unit with the oil. To purge this air, the Model H is constructed with two sets of "Rota-Roll" pumping members.

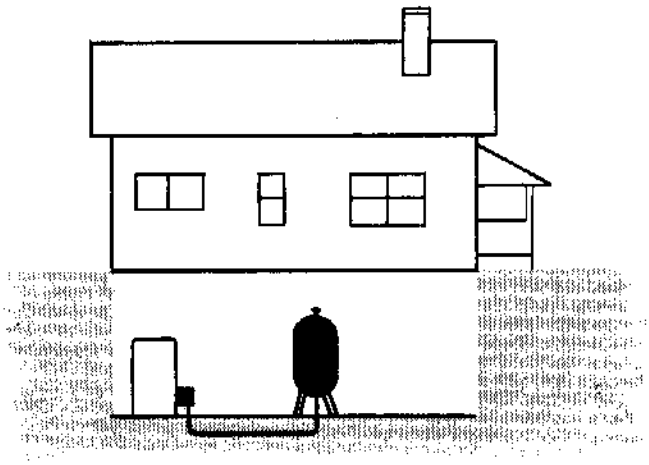
The first stage gear set draws oil from the tank, through the intake port, into the strainer chamber reservoir. All air drawn into the unit rises to the top of the strainer chamber. This air and excess oil is drawn into the first stage gear set and pumped back to tank.

The second stage pump draws only solid air-free oil from the bottom of the strainer chamber reservoir and pumps it under pressure to the valve. Oil pressure acting upon the valve piston, causes it to move from its position on the nozzle cut-off seat, allowing oil flow into the nozzle line. Oil in excess of nozzle capacity is by-passed through the valve to the bottom of the strainer chamber reservoir. For the Model H, pressure is regulated by the pressure adjusting screw in the same manner as the Model J.

The Model H must be mounted with the valve down to purge air as described above.

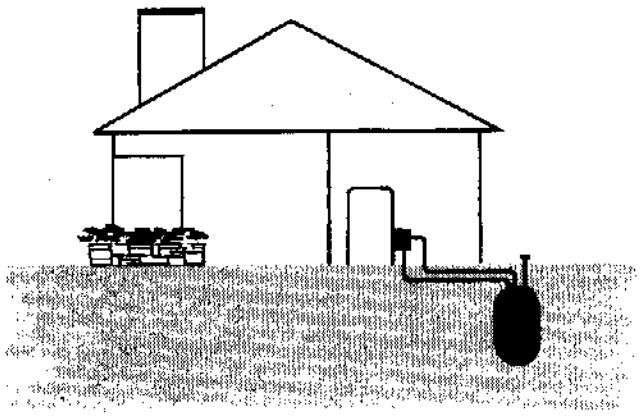


WHEN and HOW to use SUNDSTRAND Single-Stage and Two-Stage Fuel Units



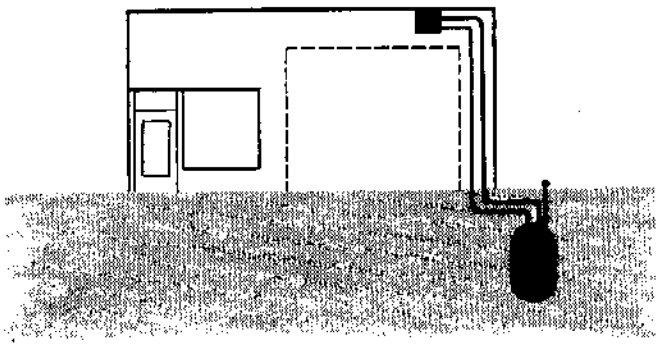
MODEL "J" SINGLE-PIPE — On an inside tank installation when the tank is mounted above the intake ports of the fuel unit, a **single-stage** Model J unit can be used with a single-pipe system. This type of installation is often referred to as a head pressure system, and a return line is not necessary.

The Model J is shipped from the factory with the internal by-pass plug left out; therefore the unit is ready to be installed on a single-pipe system as received. The intake line should be 3/8″ O.D. copper tubing, but when intake lines exceed the recommended lengths for 3/8″ O.D. tubing, 1/2″ O.D. tubing should be used.



MODEL "J" TWO-PIPE — On either an inside or outside tank installation when the intake ports of the fuel unit are above the bottom of the tank, the Model J **single-stage** unit can be used with a two-pipe system where vacuum does not exceed 10″. A vacuum condition will exist when there is lift in the intake line.

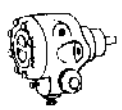
To install the Model J on a two-pipe system, the by-pass plug must be inserted and the intake and return lines connected using 3/8″ or 1/2″ O.D. copper tubing in accordance with Sundstrand's recommendations. Return Line should be inserted in oil as deep as Suction Line.



MODEL "H" TWO-PIPE—The Model H **two-stage** Fuel Unit can be used with either an outside or inside tank installation when the intake ports of the fuel unit are above the bottom of the tank.

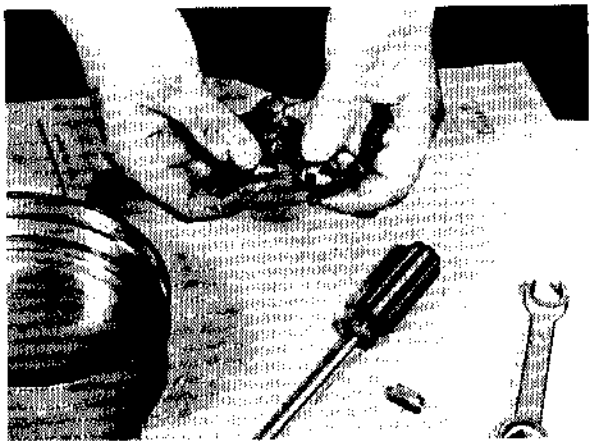
The H is recommended for two-pipe installations having extremely long lines and high lifts with vacuum up to 20″. The Model H can be installed on a single-pipe head pressure system, but it will then function only as a single-stage unit.

To install the Model H on a two-pipe system, the by-pass plug must be inserted in the unit and an intake and return line connected using 3/8″ or 1/2″ tubing in accordance with Sundstrand's recommendations. Return Line should be inserted in oil as deep as Suction Line. **The unit must be mounted with the valve down to assure air purging.**



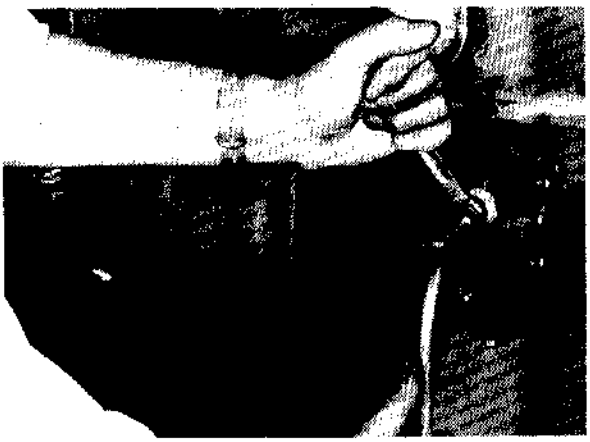
annual performance checks

1. Check Shut-Off Valve and Line Filter. Replace or clean cartridge in line filter if dirty. Be sure to open shut-off valve.

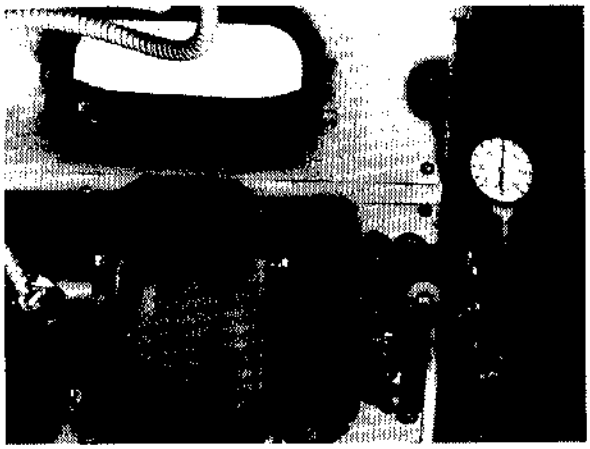


2. Check Nozzle Assembly. Clean the nozzle according to manufacturer's recommendations.

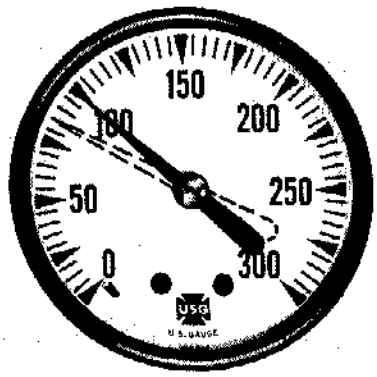
3. Check Strainer. Clean strainer using clean fuel oil or kerosene.



4. Check Connections. Tighten all connections and fittings in the intake line and unused intake port plugs.



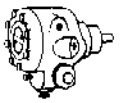
5. Check Efficiency. Insert pressure gage in gage port. Reasonable flame at 150 P.S.I. Reset valve to original setting to prevent over firing.



6. Check Cut-Off. Insert pressure gage in nozzle port. Upon shut down pressure should drop approximately 15 P.S.I. If pressure drops to 0 P.S.I., cut-off seat may be damaged.

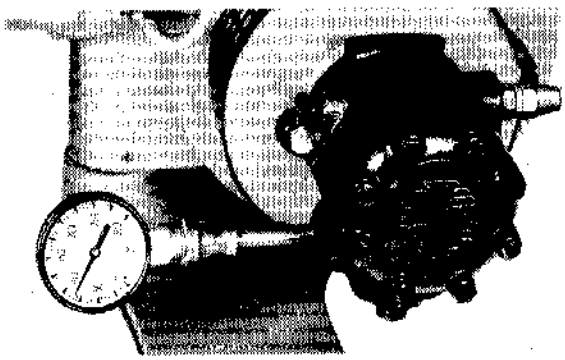
trouble shooting

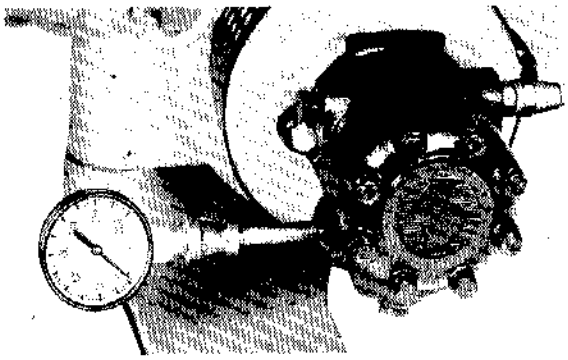
	cause	remedy
NO OIL FLOW	Oil level below intake line in supply tank.	Fill tank with oil.
	Clogged strainer.	Remove and clean strainer.
	Clogged nozzle.	Remove and clean or replace nozzle.
	Air leak in intake line.	Tighten all fittings in intake line. Tighten unused intake port plug. If there are valves in the line, be sure the valve stems are packed solid and tightened securely.
	Restricted intake line. (High Vacuum Reading).	Replace any kinked tubing and check any valves in intake line.
	A two-pipe system that becomes air bound.	Check and insert by-pass plug.
	A single-pipe system that becomes air bound. (Model J unit only.)	Loosen gage port plug and drain oil until foam is gone.
	Slipping or broken coupling.	Tighten or replace coupling.
	Rotation of motor and fuel unit is not the same as indicated by arrow on pad at top of unit.	Install unit with correct rotation.
	Frozen pump shaft.	Return unit to approved service station or Sundstrand factory for repair.
OIL LEAK	Loose plug or fitting.	Dope with good quality thread sealer.
	Leak at pressure adjusting cap.	Brass washer may have been left out after adjustment of valve spring. Replace washer. Threads on screw may be stripped. Replace adjusting screw assembly.
	Blown seal (single-pipe system).	On single-pipe system, check to see if by-pass plug has been left in unit. Remove plug.
	Blown seal (two-pipe system).	Check for kinked tubing or other obstruction in return line.
	Seal leaking.	Remove seal and shaft and examine bronze and steel surfaces for scratches. Check diaphragm for tears or frayed edges. Replace damaged parts.
NOISY OPERATION	Bad coupling alignment.	Loosen fuel unit mounting screws slightly, and shift fuel unit in different positions until noise is eliminated. Retighten mounting screws.
	A gear click may be noticeable if pumping members have been changed.	Continued operation for several hours will usually eliminate this noise.
	Tank hum on a two-pipe system and inside tank.	Add anti-hum device (our part No. 102079) in the return line.



	cause	remedy
PULSATING PRESSURE	Partially clogged strainer.	Remove and clean strainer.
	Air leak in intake line.	Tighten all fittings and valve packings in intake line.
	Air leaking around cover.	Be sure strainer cover screws are tightened securely.

IMPROPER NOZZLE CUT-OFF





To determine the cause of improper cut-off, insert a pressure gage in the nozzle port of the fuel unit. After a minute of operation shut burner down. If the pressure drops approximately 15 P.S.I. from normal operating pressure, the fuel unit is operating properly and air is the cause of improper cut-off. If, however, the pressure drops to 0 P.S.I., one of the following four conditions * is the cause of improper cut-off:

*Piston seat damaged.	Replace piston.
*Piston stuck.	Remove and stone burrs on outside of piston.
*Damaged bronze seat on nozzle plug.	Remove and replace.
*Foreign material in neoprene seat on piston.	Remove piston and clean neoprene seat.
Strainer cover loose.	Tighten 8 screws on cover.
Air pocket between cut-off valve and nozzle.	Run burner stopping and starting until pulsations, smoke and after flame disappear.
Air leak in intake line.	Tighten intake fittings and packing nut on shut-off valve. Tighten unused intake port plug.

LOW OIL PRESSURE	Defective gage.	Check gage against master gage.
	Electric motor not up to rated speed.	Make sure motor is rated for 1725 R.P.M.
	Nozzle capacity is greater than pump capacity.	Replace fuel unit with one of correct capacity..

HIGH OIL PRESSURE	Defective gage.	Pressure gage should be checked against master gage.
	Stuck piston.	Remove piston and stone burrs on outside of piston.
	Piston and sleeve may be assembled backwards.	Remove piston and sleeve and assemble correctly.

SUNDSTRAND

SUNDSTRAND FUEL UNITS

SUNDSTRAND MACHINE TOOL CO.
HYDRAULIC DIVISION, ROCKFORD, ILL.

Form 1317-1

Litho in USA

Hang this Card in the Vicinity of Burner or at Outside Entrance of Basement

ARMSTRONG FURNACE CO.

COLUMBUS OHIO

LISTED BY UNDERWRITERS' LABORATORIES

DES MOINES IOWA

OPERATING INSTRUCTIONS

1. These operating instructions are for the following models: D2-1, D2-2, D2-3, D4-1, D4-2, D4-3.

2. **Fuel:**
Use No. 2 fuel oil Commercial Standard CS 12-48. No. 1 fuel oil can be used if No. 2 is not available.

3. **To Start Burner:**

a. See that sufficient oil is in storage tank.

b. Move indicator on Thermostat a few degrees above room temperature.

c. Open oil valve in suction line to burner.

d. Turn on electrical current at wall switch.

e. If burner does not start, press in on button in front of primary combustion control and release slowly.

f. Bleed air from suction line. All models are equipped with vent plugs which can be removed to permit a rapid removal of air. Operate Burner and replace plug. This procedure applies to installations not having a return line.

4. **To Restart Burner in Case of Ignition Failure.**

a. Open door of heating unit and allow combustion chamber to cool and vapor that has accumulated in heating unit to pass up chimney. When vapor has disappeared, press in button in front of primary combustion control and release slowly.

b. If vapor accumulates in combustion chamber and does not ignite, stop burner by opening wall switch.

c. Failure to ignite is due to a defective transformer or carbon on the electrodes. A service man should be called to remedy this trouble.

d. Failure of oil vapor to appear in combustion chamber indicates a clogged nozzle or air bound pump. Call service man to correct trouble.

5. Should tank run out of oil during heating season, remove air from suction line and start burner as directed in paragraph 3.

6. The adjustment of the oil and air are made by the installation man. These adjustments should not be changed by the owner.

7. **To Shut Off Burner for the Summer:**

a. Turn off electric current at wall switch.

b. Close oil valve in suction line to burner.

8. **To Restart Burner in Fall:**

a. Replace Filter Cartridge.

b. Examine heating plant for leaks.

c. Examine smoke pipe and replace if rusted.

d. Have electric ignition system and all controls checked by service man.

e. Remove air from suction line and start burner as instructed in paragraph 3.

9. Burner can be stopped at any time by shutting off electrical current at wall switch.

10. **Oiling.**
Motor should be oiled twice a year. Oil cups are located at each end of motor.

11. **To Clean Strainers, Proceed as Follows:**

a. Shut off burner at wall switch.

b. Close valve in oil suction line to burner.

c. Remove strainer by removing the screws of fuel unit. Wash strainer in kerosene and replace.

d. Start burner as directed in paragraph 3.

NEVER BURN GARBAGE OR REFUSE IN THE FURNACE

Burner Installed By_____ **Date of Installation**_____

Dealer's Name_____ **Dealer's Address**_____

Phone Number: Day_____ **Night**_____