



**MODEL F66D**

**Spec. No. 3182G02**

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# **OPERATING, MAINTENANCE and SERVICE INSTRUCTIONS with PARTS LIST**

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**Koehring  
Master Division**

# SAFETY RULES

## SAFETY RULES FOR PORTABLE HEATERS

### 1. Know Your Portable Heater

Read and understand the complete owners manual before starting the heater.

### 2. Heater Location

Do not use the heater in the presence of flammable vapors, or within five feet of combustible materials. Gasoline vapors are heavier than air and will accumulate in low areas. The heater must not be used in garages unless the door is kept open and it leads to an adjacent ground or driveway level that is at or below the level of the garage floor.

### 3. Sleeping Quarters

Do not use the heater in sleeping quarters.

### 4. Provide Ventilation

To use the heater in a confined space, provide one square foot of ventilating area per each 100,000 BTU rating.

### 5. Use Only Recommended Fuel

Use ONLY kerosene or No. 1 fuel oil. DO NOT USE GASOLINE.

### 6. Refueling

Do not add fuel while the heater is operating.

### 7. Disconnect Heater

Before servicing, cleaning, moving, etc.

### 8. Keep Unit Grounded

Use the three prong plug provided. If an adapter is used, attach the adapter wire to a known ground. Never remove the third prong. Use only three-conductor extension cords.

### 9. Keep a Fire Extinguisher Accessible...

It is recommended that a Dry Chemical type fire extinguisher be available when the heater is used.

## TUNE UP

To keep your heater in top operating condition, perform the following services at the start of each heater season then at the interval specified below:

|                                        |                                                                                                                                                                                    |
|----------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Clean and flush fuel tank.....         | After every 150 hours operation.                                                                                                                                                   |
| Clean and/or replace fuel filter ..... | Clean at least twice a season. More often if heater performance indicates the need. Replace if necessary.                                                                          |
| Clean or replace air filters .....     | Check air filter frequently. If a film of dust is apparent on the filter, remove and clean it. Replace after each 200 hours of heater operation.                                   |
| Clean fan .....                        | Clean fan after every 500 hours of operation. Clean more frequently if heater is operating in dusty areas or if there is a build-up of dirt on the blades.                         |
| Clean burner nozzle. ....              | Clean the nozzle at least once during the heater season or more often if heater performance indicates the need.                                                                    |
| Clean and adjust spark plug .....      | After every 300 hours of operation, clean and adjust spark plug electrodes. Adjust gap or replace the plug if electrodes have been burned or eroded.                               |
| Clean photo cell .....                 | Clean the photo cell face with a soft cloth at least once during the heater season. If cell face tends to soot up, check with your nearest service station to determine the cause. |

# INTRODUCTION

### A. GENERAL

1. Purpose of Heater. Use this portable heater wherever you need temporary heat. It must be used with adequate ventilation and proper electrical power. DO NOT use the heater in sleeping quarters.

2. Purpose of Manual. This manual contains detailed instructions for operating, maintaining, troubleshooting, and servicing the heater. A service parts list is included at the end of the manual.

## B. PRINCIPLES OF OPERATION

Operation of the heater involves three basic systems. (See figure 1.)

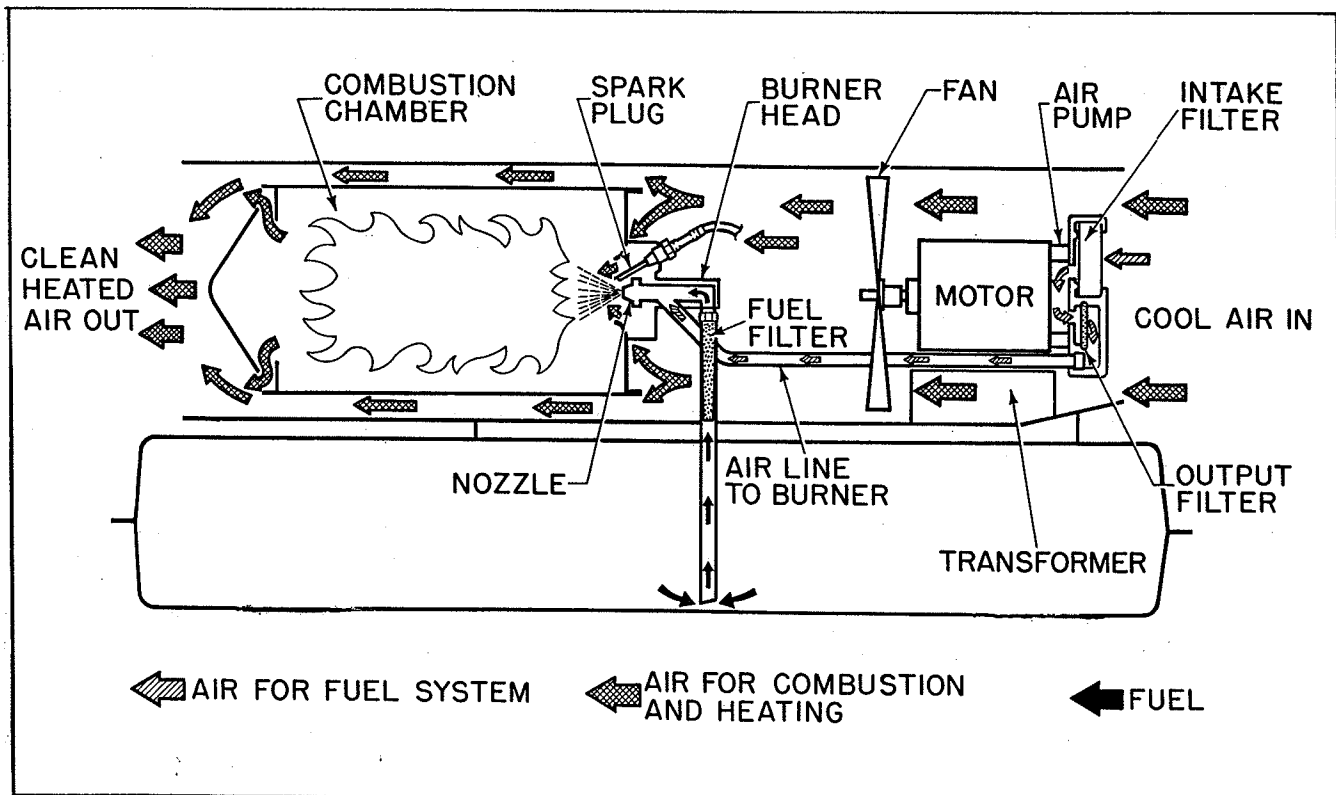
1. Fuel System. An air pump on one end of the motor shaft forces air through the nozzle. The moving air lifts fuel from the tank by a siphon action and car-

ries it into the combustion chamber in a fine spray.

2. Ignition System. An electric arc that fires constantly between a pair of spark plug electrodes while the heater is in operation ignites the mixture of fuel and air.

3. Air System. A fan on the other end of the motor shaft supplies additional air to the heater. Part of this air enters the burner through ports around its outer edge, and helps complete the combustion of the burning fuel-air mixture.

The rest of the air from the fan passes over and around the combustion chamber. At the front of the heater it mixes with the hot air coming from inside the combustion chamber. The air then flows out of the heater as a jet of clean, heated air.



**Figure 1. Schematic Diagram Showing Principles of Heater Operation**

The safety control circuit essentially consists of three parts: a light-sensitive cell (flame sensor), a silicon-controlled rectifier (SRC), and the circuit breaker. The circuit breaker automatically trips if the flame fails, thereby causing the heater to shut down. (See figure 2.)

The flame sensor is used to sense the presence of light due to the flame inside the combustion chamber. It varies its electrical resistance in relation to light rays. When under the influence of light, the cell has very low resistance. The resistance is high when little or no light strikes the light-sensitive surface. The flame sensor's function is to control the trigger voltage of a silicon-controlled rectifier.

The SCR acts as a voltage-operated switch. When the trigger voltage reaches a certain level, the SCR will conduct and allow a current to flow through the heating coil of the circuit breaker. When the voltage drops, such as when the flame sensor senses light and decreases its resistance, the SCR will turn off and block the flow of current.

The circuit breaker is a thermally operated switch. Current flowing through the heating coil will cause it to heat. When a specific temperature of a bi-metal element is reached, the contacts of the breaker will open to interrupt the current flow to the motor and transformer. This action takes approximately 15 seconds at 70 degrees F. The breaker must be manually reset by pressing the red circuit breaker reset button. The flow of current through the heating coil is controlled by the action of the SCR. If ignition takes place before the breaker trips, the flow of current through the coil is virtually stopped, the heating action stops and the contacts remain closed, thus allowing current to continue to flow to the motor and transformer.

The SCR and its circuit are mounted on top of the circuit breaker and is replaceable only as a complete unit.

A thermostat accessory (Model No. HA1200) may be incorporated into the electrical circuit. The accessory can be set to any desired temperature between 35 degrees F. and 95 degrees F. When the temperature of the surrounding air reaches the preset tempera-

ture, the thermostat contacts open to shut down the heater. When the air cools, the contacts close and the heater recycles. To shut down the heater when using the thermostat accessory, place the dial in the "NO HEAT" position.

### C. POWER REQUIREMENTS

The heaters are manufactured for use on 115 volt, 60 cycle power.

### D. SPECIFICATIONS

|                                       |                                 |
|---------------------------------------|---------------------------------|
| Output Rating (BTU per hour) .....    | 63,000                          |
| Amperage (During normal run) .....    | 4.0                             |
| Air Pump Pressure (PSI) .....         | 4 $\frac{1}{4}$                 |
| Weight (Approx.) (Lbs.)               |                                 |
| Shipping .....                        | 60                              |
| Dry (net) .....                       | 47                              |
| Fuel Tank Capacity, U.S. Gallons .... | 4.5                             |
| Fuel Consumption, Approx.             |                                 |
| U.S. Gallons per hour .....           | 0.45                            |
| Electrical Requirements               |                                 |
| Voltage .....                         | 115                             |
| Cycles (Hz) .....                     | 60                              |
| Motor RPM .....                       | 3350                            |
| Fuel .....                            | Kerosene or No. 1 Fuel Oil only |
| Duct .....                            | No Duct Recommended             |

### E. ACCESSORIES

A thermostat control kit, Part No. HA1200 is available as an accessory for use with these heaters. The thermostat can be set for any temperature between 35° and 95° F, and will cycle the heater on and off to maintain the surrounding air at the desired temperature. At its NO HEAT position, the thermostat shuts the heater off.

## SECTION II

### OPERATION

#### A. OPERATING CAUTIONS

1. Use the heater in a well-ventilated area only. A partly-opened door or window near the heater will give enough ventilation. We do not recommend the use of this heater as a source of heat in sleeping quarters.

2. Use ONLY kerosene or No. 1 fuel oil. DO NOT USE GASOLINE, AS IT IS VOLATILE AND DANGEROUS. Do not use No. 2 or No. 3 fuel oil, as they contain tars which will contaminate the heater.

3. Use the heater only on the specified electrical power. This is given on the heater instruction plate.

4. Plug the heater into a grounded receptacle, or

use a grounding adapter. Be sure the heater is grounded whenever it is in operation and whenever you are working on it.

5. Keep the heater at least 5 feet from any combustible material.

6. Do not use the heater in the presence of flammable vapors like those from paint or gasoline.

7. Do not add fuel while the heater is operating.

8. Check spark plug gap after each 300 hours of operation. Make checking the spark plug gap a part of your periodic heater maintenance program.

#### B. EXTENSION CORD WIRE SIZES

Be sure to use an extension cord of the proper size to assure adequate voltage at the heater.

|                       |     |     |     |     |     |
|-----------------------|-----|-----|-----|-----|-----|
| Length of cord (feet) | 100 | 200 | 300 | 400 | 500 |
| Wire size (AWG)       | 14  | 12  | 10  | 8   | 6   |

#### C. FUEL

Be sure the tank is clean. Fill it with clean kerosene or No. 1 fuel oil ONLY. Do not use any other fuel.

When the heater is operated at very low temperatures (beyond 10° F below zero), the fuel may congeal.

To prevent this, add a non-toxic anti-icer to the fuel. Follow the mixing instructions contained on the anti-icer container.

#### D. STARTING

1. Power Supply. Be sure that the power available to the heater matches that shown on the instruction plate, in both voltage and frequency (cycles).

2. Heaters Without Thermostat Accessory. The heater will normally ignite as soon as it is plugged into the outlet.

3. Heaters With Thermostat Accessory. Set the temperature dial of the thermostat accessory to the desired temperature.

a. If the dial is set to a temperature setting, the heater should ignite immediately, providing the surrounding air is cooler than the setting of the dial. The heater will operate until the temperature of the air reaches the dial setting, then will shut off. When the surrounding air temperature falls below the dial setting, the heater will start.

b. If the heater does not ignite, press the red reset button on the rear of the heater. The heater should start immediately.

c. If the heater fails to start, the red button will pop out within 15 to 45 seconds, depending on surrounding temperature. If it pops out, wait from three to five minutes for the control circuit breaker to cool, then press the red button again, after checking for the reason the heater did not start.

d. The heaters will generally restart after they are shut off, without pressing the red reset button.

#### E. STOPPING

To stop the heater, unplug the heater cord from the outlet. (If the heater has a thermostat accessory, set the dial to "NO HEAT" position.

## SECTION III MAINTENANCE

Maintenance consists of the simple operations the owner or user of the heater can perform to keep the heater running and in good condition. If ordinary maintenance fails to return the heater to good operating condition, refer to Section IV in this manual for checking and trouble shooting. See Figure 2 for component identification.

### A. FUEL TANK MAINTENANCE

Drain the fuel tank after every 150 hours of operation, and flush it out with clean fuel. Refill with fresh clean fuel.

### B. AIR FILTERS

1. Check and clean the intake air filter often. The filter needs cleaning if you can see a film of dust on it. It will need cleaning more often if the heater is operated in dusty air. See Figure 3.

2. To clean the intake air filter, simply pull it out of the housing. Wash it with a mild detergent and hot or cold water. Dry it thoroughly, and replace it in the housing.

CAUTION: DO NOT OIL the filter element.

3. Replace the output air filter once each heating season.

4. To reach the output air filter, remove the four screws which attach the filter housing end cover. Remove the output air filter. See Figure 4.

NOTE: Cleaning the output air filter may cause a change in the air pump output pressure. If the heater burns improperly after cleaning, have the air pump pressure checked. See Section V, paragraph L.

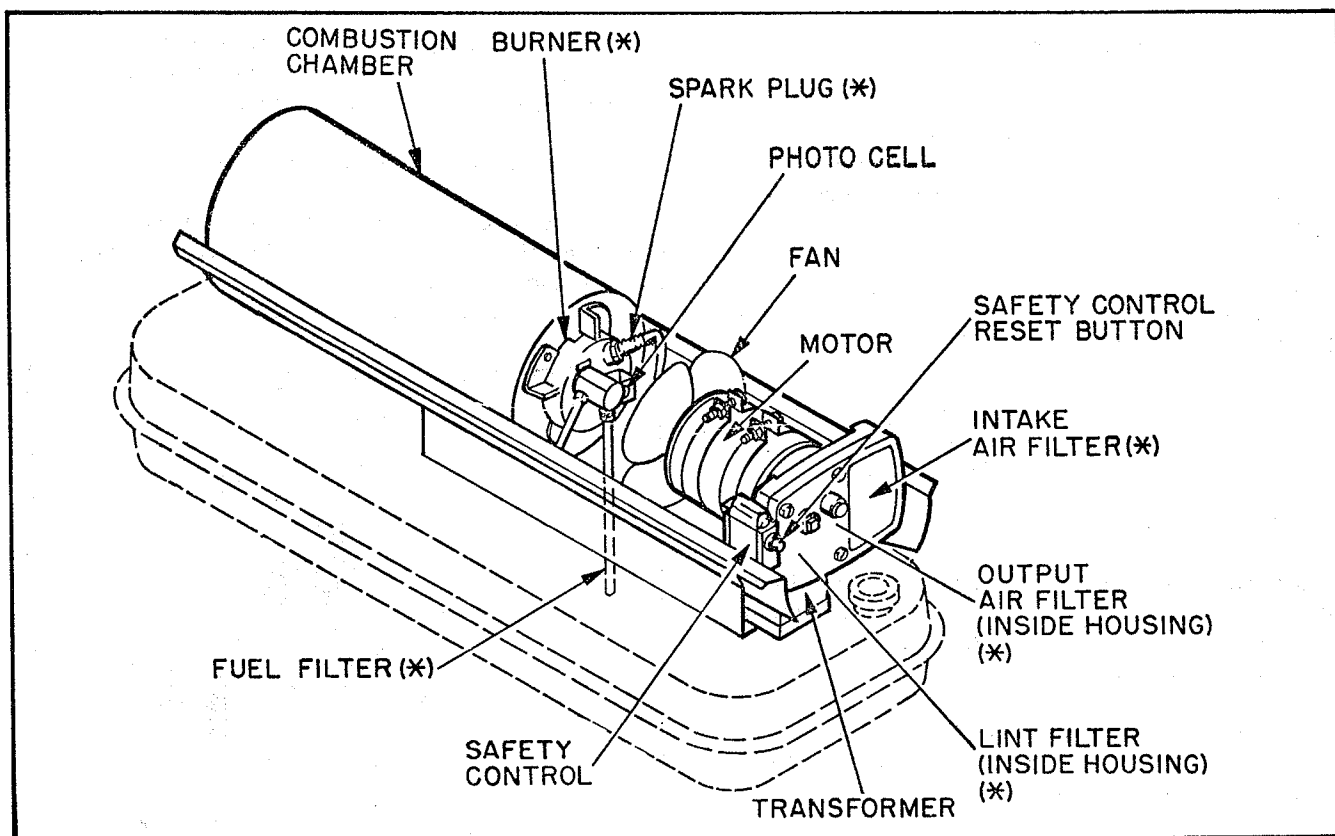


Figure 2. Heater Component Identification

Symbol (\*) indicates parts recommended as replaceable by owner or user of heater.  
(For clarity, heater is shown without tank, wheels and handles, and with upper shell removed)

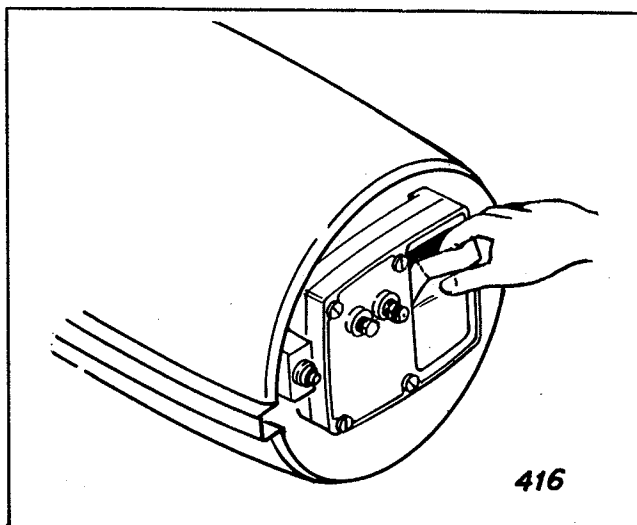


Figure 3. Removing Intake Air Filter

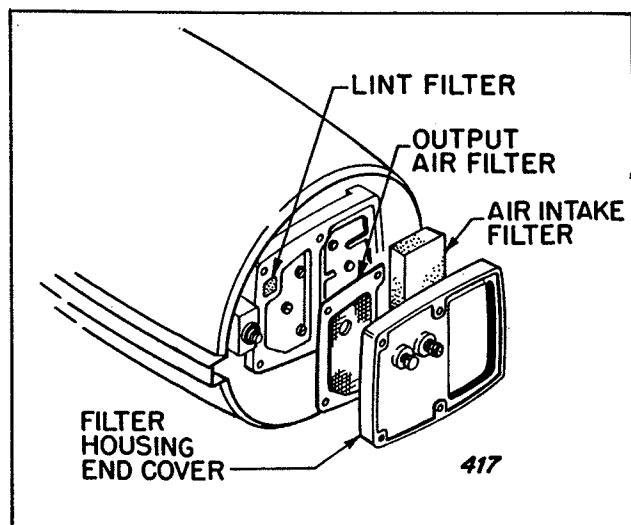


Figure 4. Access to Air Filter for Maintenance

5. When changing the output air filter, clean the lint filter. Pick it out of the housing, wash with mild detergent and hot or cold water. Dry thoroughly. Do not oil.

6. Replace the lint filter, the output air filter, the filter housing end cover, and the screws and washers.

#### C. REMOVING UPPER SHELL

##### WARNING

With the upper shell removed and the service cord plugged in, the heater can be dangerous. Always unplug the heater when performing the following maintenance operations.

Remove the upper shell by removing the eight screws (4 on each side) that hold the upper shell to the lower shell. Lift the upper shell off.

To replace the upper shell, align the eight holes located along its lower edge over the eight speed nuts on the lower shell, and install the screws.

#### D. CLEANING THE FAN

Clean the fan blades after every 500 hours of operation, or whenever you see that they are getting dirty. A build-up of dirt will reduce the air supply and cause faulty operation.

To clean, wipe the blades with a cloth moistened with kerosene or solvent. Be careful not to bend the blades. Dry the fan thoroughly.

#### E. MOTOR LUBRICATION

The ball bearing on the pump-end of the motor is lubricated for the life of the motor. Do not lubricate it.

Oil the sleeve bearing on the fan-end of the motor (See figure 5) once each year with 10 to 20 drops of Mobil DTE-LC or DTE-23 oil.

#### F. SPARK PLUG

##### WARNING

Be sure the heater is not plugged into the outlet. The spark plug wire carries high voltage during heater operation.

1. Disconnect the spark plug wire.
2. Remove the spark plug from the burner head, and check the gap between the electrodes. The gap must be within the limits shown in Figure 6.

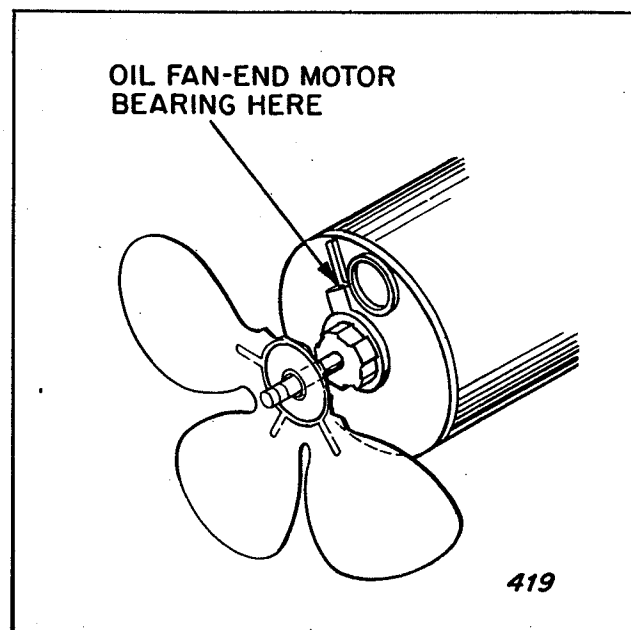


Figure 5. Lubrication of Motor Bearing

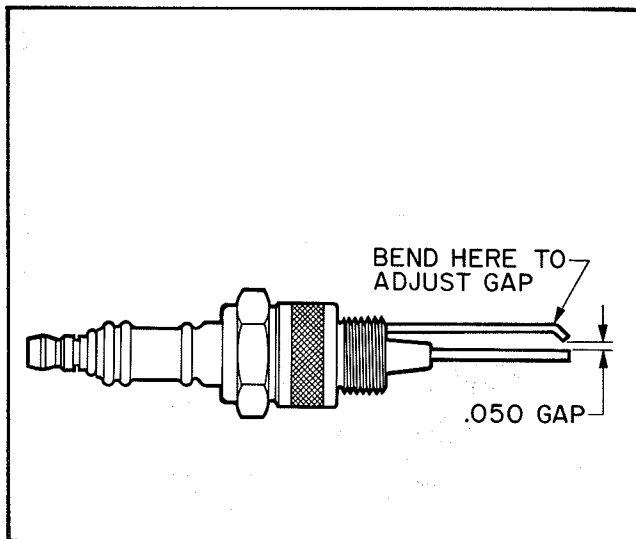


Figure 6. Spark Plug Gap Setting

3. Adjust the gap by bending the outside electrode where shown in figure 6. If you do not install the plug immediately, protect it from damage until it is reinstalled.

4. Install the plug into the burner head, if no further burner head maintenance is required. Make sure the spark plug is seated firmly in the burner head.

#### G. CLEANING THE FUEL FILTER

The fuel filter is in the tube which leads up from the fuel tank to the burner. Clean it twice each season, or if the Trouble Shooting Chart indicates.

1. To remove the fuel filter, loosen the hex nut attaching the filter tube to the burner head.

2. Slide the tube down into the tank so that the tube will clear the male connector in the nozzle adapter. Push the tube to one side. Withdraw the filter element and tube from the fuel tank. Withdraw the filter element out of the tube. Rinse it several times in clean fuel.

3. Blow the element dry, with a gentle stream of compressed air, through the large end. Use care to prevent damaging the filter element with air pressure.

4. If the filter element is damaged or lost, it must be replaced with a new element. NEVER operate the heater without the element in place. Failure to use the filter element may result in clogging and permanent damage to the nozzle.

5. Insert the fuel filter element into the tube making sure that it seats properly in the tube. Install the

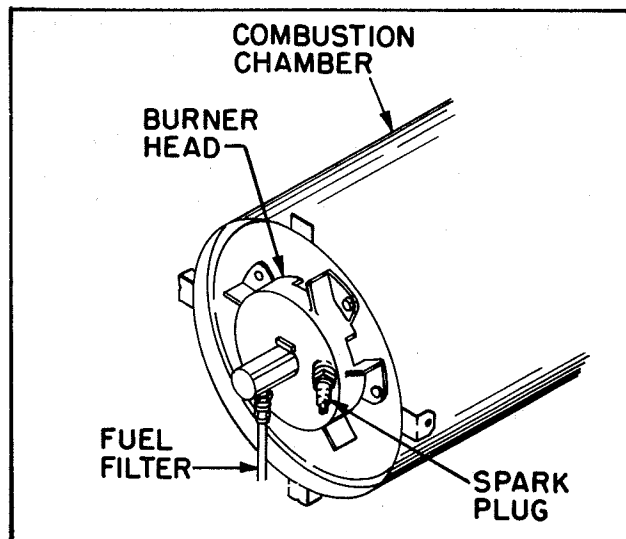


Figure 7. Burner Head, Spark Plug, and Fuel Filter

flared nut onto the tube. Insert the filter element and tube into the fuel tank. Position the filter tube carefully to seat on the male connector and thread the flare nut to secure the filter and tube.

NOTE: If the burner head is to be removed for maintenance, do not reinstall the fuel filter until ready to reinstall the burner.

#### H. BURNER REMOVAL, CLEANING AND REPLACEMENT

1. Be sure the heater cord is unplugged, and remove the lead wire from the spark plug. Remove fuel filter from burner head. Disconnect the air line from the fitting in the right side of the nozzle adapter.

2. Remove the screws that fasten the burner head to the rear of the combustion chamber and remove the burner head.

3. Remove the nozzle carefully, using a socket wrench. Hold the nozzle adapter with another wrench while removing the nozzle.

#### CAUTION

Do not attempt to open the nozzle passage with a steel drill, a wire or any other tool, as you will damage it beyond repair. Protect the nozzle face from damage while the burner is out of the heater. This is important!

4. Soak the remaining parts of the burner head assembly for one hour in non-flammable liquid cleaning agent. (DO NOT use kerosene or fuel oil). Blow dry through the face (OUTLET) end ONLY. See Figure 8.

5. Re-check the spark plug electrode setting after cleaning the burner. See Paragraph F of this Section.

6. When reinstalling the burner, place it on the back of the combustion chamber so the fitting for the fuel filter is down, and the spark plug hole is just above center, on the right. Install the attaching screws and tighten.

7. Connect the fuel filter and the air line to their respective fittings on the nozzle adapter.

8. Install the spark plug (refer to paragraph F, step 4), and snap the spark plug lead onto the terminal. It must snap, or it may not be tight enough to prevent loosening as the heater is moved.

#### I. SAFETY CONTROL SYSTEM

For servicing the safety control system, refer to Section V.

#### J. REASSEMBLY AFTER MAINTENANCE

Put the heater back together in the reverse order of disassembly. Be sure all parts are in place and all screws and electrical connections are tight before attempting to use the heater.

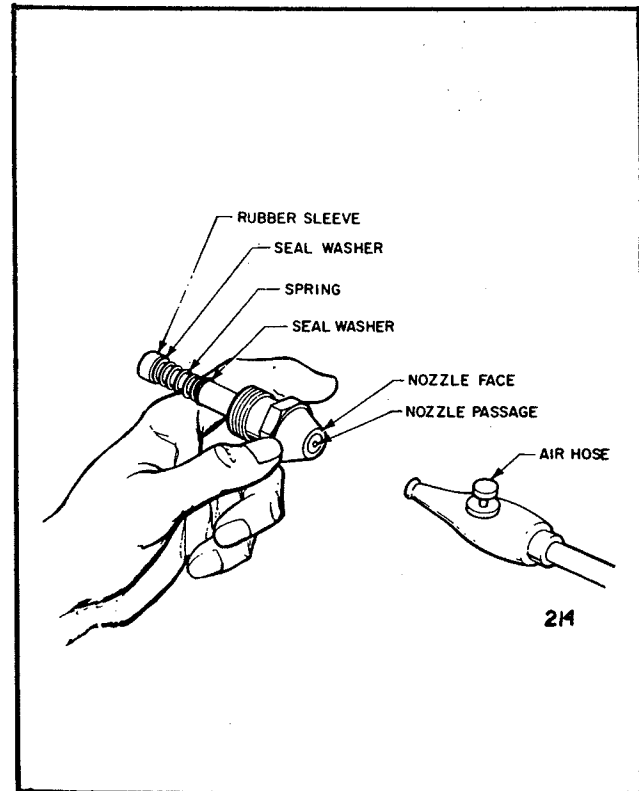


Figure 8. Blowing Out Nozzle With Compressed Air

## SECTION IV

### TROUBLE SHOOTING

#### A. GENERAL

##### WARNING

Always unplug the heater whenever you are servicing it. Use extreme care when performing those service operations which require the heater to be plugged into a power source.

If normal maintenance fails to keep a heater in good operating condition, it probably requires repair or replacement of some parts. Examine it and test-fire it to gain first-hand knowledge of why the service might be needed.

This section tells how to examine and test-fire the heater. It also contains a Trouble Shooting Chart for help in diagnosing heater troubles and finding the remedies.

#### B. EXAMINATION

1. Check the fuel tank for sludge and water. If you find it, expect to find a dirty nozzle and/or fuel filter.

2. Spin the fan to be sure it turns freely. If it is stiff, look for worn or dry bearing on the fan-end of the motor, or for a binding pump rotor.

3. Check the heater for dirt and foreign materials around the pump, fan, and air filters. Be sure the heater is reasonably clean before test-firing it.

4. Check the heater cord for obvious breaks or other unsafe conditions. If the cord is doubtful, repair it or install a new one before test-firing.

#### C. TEST-FIRING

1. Clean the fuel tank and fill it with at least 3

gallons of fuel. A minimum of 3/4 gallon of fuel must be in the tank for proper test-firing.

2. Clean the air intake filter. (See Section III).

3. Check and adjust the air pressure, as described in Section V, paragraph L.

NOTE: It is not possible to test-fire a heater properly if this adjustment cannot be made.

4. Allow the heater to run for 15 minutes. Observe its operation during the test-run.

5. After making the pressure check, adjustment, and test-firing, remove the gage and reinstall the plug.

##### CAUTION

Tighten plug until sealed. Use soapy water to check for sealing. Do not overtighten.

6. If troubles show up during the test-firing, refer to the Trouble Shooting Chart for remedy.

#### D. TROUBLE SHOOTING

The following chart lists problems, "Possible Causes" and "Remedy", to correct the problem or tells you a section and paragraph number where to find detailed instructions for correcting it.

In trouble shooting, remember that the air pump is part of the fuel system, because the air it supplies lifts the fuel from the tank and pushes it through the nozzle.

NOTE: Be sure to follow all cautions and warnings. They will help you prevent damage to the heater or injury to yourself.

# TROUBLE SHOOTING CHART

| PROBLEM                                                                | POSSIBLE CAUSE                                                                 | REMEDY                                                                                                                                                                                                                                                                      | FOR FURTHER DETAILS SEE:                                                                                  |
|------------------------------------------------------------------------|--------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|
| 1. Motor does not start; thermostat (if used) is set to call for heat. | <u>Electrical Troubles</u>                                                     |                                                                                                                                                                                                                                                                             |                                                                                                           |
|                                                                        | a. No power or low voltage at heater.                                          | Be sure power is reaching heater; check condition of heater cord. Repair or replace as needed.<br><br>Use extension cord with wires heavy enough to carry the electrical load of the heater.<br><br>Be sure voltage at outlet is same as shown on heater instruction plate. | Sec. II,<br>Para. B.                                                                                      |
|                                                                        | b. Damaged motor, motor starting relay, binding fan-end bearing; binding pump. | Check motor.<br><br>Replace a defective motor (or motor starting relay).<br><br>Lubricate motor (Fan-end only).<br><br>Rebuild motor.<br><br>Rebuild or replace a binding pump.                                                                                             | Sec. V,<br>Para. F.<br><br>Sec. III,<br>Para. E.<br><br>Motor Mfr's.<br>Instructions.<br>Sec. V, Para. K. |
|                                                                        | c. Thermostat (if used) damaged.                                               | Replace                                                                                                                                                                                                                                                                     |                                                                                                           |
|                                                                        | <u>Mechanical Troubles</u>                                                     |                                                                                                                                                                                                                                                                             |                                                                                                           |
|                                                                        | d. Dry bearing on fan-end of motor.                                            | Lubricate motor.<br><br>If lubrication does not solve problem, check pump.                                                                                                                                                                                                  | Sec. III, Para. E.<br>Sec. V, Para. K.                                                                    |
|                                                                        | e. Pump rotor binding or carbon blades worn out.                               | Rebuild pump.                                                                                                                                                                                                                                                               | Sec. V, Para. K.                                                                                          |
|                                                                        | f. Fan obstructed by mechanical damage or dirt.                                | Check for bent outer shell.<br><br>Check for damaged fan; replace if defective.<br><br>Check for damaged motor mount.                                                                                                                                                       | Sec. V,<br>Para. H.                                                                                       |
|                                                                        |                                                                                |                                                                                                                                                                                                                                                                             |                                                                                                           |
| 2. Heater will not ignite, but motor runs for a short time.            | <u>Fuel System Troubles</u>                                                    |                                                                                                                                                                                                                                                                             |                                                                                                           |
|                                                                        | a. Fuel tank empty, water in fuel, wrong fuel.                                 | Check for water in tank; clean tank and fuel filter if water is found. (Water in the tank will form globules in the bottom, which you can see.)<br><br>Fill tank with fresh, clean kerosene or No. 1 fuel oil.                                                              |                                                                                                           |

# TROUBLE SHOOTING CHART (Continued)

| PROBLEM                                                                    | POSSIBLE CAUSE                                                                                    | REMEDY                                                                                                                                                                       | FOR FURTHER DETAILS SEE: |
|----------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|
| 2. (Continued)<br>Heater will not ignite, but motor runs for a short time. | b. Fuel filter clogged.                                                                           | Remove and wash in clean fuel.<br>Blow dry and replace.                                                                                                                      | Sec. III,<br>Para. G.    |
|                                                                            | c. Nozzle plugged or defective.                                                                   | Clean by blowing compressed air through nozzle from <u>outlet</u> end of nozzle.                                                                                             | Sec. III,<br>Para. H.    |
|                                                                            |                                                                                                   | Replace nozzle if cleaning does not solve the problem.                                                                                                                       | Sec. V,<br>Para. J.      |
|                                                                            | d. Low air pump pressure.                                                                         | Check pressure; adjust, rebuild, or replace air pump as needed.                                                                                                              | Sec. V,<br>Para. K & L.  |
|                                                                            |                                                                                                   | Check rubber sleeve around shank of nozzle; replace if leaking.                                                                                                              |                          |
|                                                                            |                                                                                                   | Check to be sure all air line connections from pump to burner are secure.                                                                                                    |                          |
|                                                                            | e. Air leak at fuel filter.                                                                       | Check to be sure air filter end cover is securely fastened, without air leaks.                                                                                               | Sec. III, Para. B.       |
|                                                                            |                                                                                                   | Be sure air filters are clean.                                                                                                                                               |                          |
|                                                                            | e. Air leak at fuel filter.                                                                       | Check fuel filter for air leaks and for tightness of fitting where filter is connected to burner head.                                                                       |                          |
|                                                                            | <u>Ignition Troubles</u>                                                                          |                                                                                                                                                                              |                          |
|                                                                            | e. Defective spark plug. (Wrong gap, plug wet with fuel or electrodes carboned, or plug damaged.) | Measure gap between electrodes, using thickness of a dime as a gage. Adjust electrode gap.<br><br>Inspect plug for worn or erroded electrodes. Replace a damaged spark plug. | Sec. III, Para. F.       |
|                                                                            | f. Spark plug wire disconnected from plug or from terminal of transformer.                        | <u>Disconnect heater cord!</u><br><br>Check at plug and transformer to be sure wire is tight at both ends.                                                                   |                          |
|                                                                            | g. Defective transformer.                                                                         | Disconnect spark plug wire from transformer, and check transformer for spark; replace if no spark can be obtained.                                                           | Sec. V, Para. E.         |

# TROUBLE SHOOTING CHART (Continued)

| PROBLEM                                                                                                                           | POSSIBLE CAUSE                                                                            | REMEDY                                                                                                                                                                                                                                      | FOR FURTHER DETAILS SEE:                                    |
|-----------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------|
| 3. Heater burns, but puffs of smoke can be seen; heater will not burn steady; heater burns with odor; heater smokes continuously. | <u>Improper Fuel-Air Mixture (Not enough fuel)</u>                                        |                                                                                                                                                                                                                                             |                                                             |
|                                                                                                                                   | a. Heater running out of fuel; water condensation in fuel tank; wrong fuel.               | Shut heater off; check fuel tank. If you can see globules of water in the bottom, drain and flush the tank and filter with clean fuel.<br><br>Refill with fresh, clean kerosene or No. 1 fuel oil.                                          |                                                             |
|                                                                                                                                   | b. Dirty air filters causing reduced air flow through nozzle, resulting in low fuel flow. | Remove and clean the air filters.<br><br>Be sure air intake is not blocked.                                                                                                                                                                 | Sec. III, Para. B.                                          |
|                                                                                                                                   | c. Fuel filter loose, dirty or connection loose.                                          | Remove and wash fuel filter in clean fuel.<br><br>Check condition of connection between fuel filter and burner head.<br><br>Replace with new filter tube, nut, or fitting if connection can't be tightened without leaks.                   | Sec. III Para. G.<br><br>Sec. V, Para. I.                   |
|                                                                                                                                   | d. Dirty nozzle.                                                                          | Remove and clean the burner head.<br><br>Blow compressed air through nozzle from <u>outlet</u> end.<br><br>Never use a drill, wire, or other tool to open a nozzle passage.<br><br>Replace a defective nozzle.                              | Sec. III, Para. H.<br><br><br><br><br>Sec. V, Para. J.      |
|                                                                                                                                   | e. Low pump output pressure. (Low motor speed, worn pump, pump out of adjustment.)        | Check and adjust pump output pressure; repair or replace pump if adjustment cannot be made.<br><br>Check to be sure that no dirt or trash (or dirty fan blades) could be causing motor slowdown.<br><br>Lubricate fan-end bearing of motor. | Sec. V, Paras. K & L.<br><br><br><br><br>Sec. III, Para. E. |
|                                                                                                                                   | f. Loose air output line connections between filter housing and burner.                   | Be sure connections are tight.                                                                                                                                                                                                              |                                                             |

**TROUBLE SHOOTING CHART (Continued)**

| PROBLEM                                                                                                                                          | POSSIBLE CAUSE                                                                                                                  | REMEDY                                                                                                                                                                                                               | FOR FURTHER DETAILS SEE: |
|--------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|
| 3. (Continued)<br>Heater burns, but puffs of smoke can be seen; heater will not burn steady; heater burns with odor; heater smokes continuously. | g. (Remote possibility)<br>Rubber sleeve on shank of nozzle is leaking.                                                         | If heater puffs intermittently, replace the rubber sleeve. (Handle parts carefully to prevent damage, assemble them carefully to preserve airtightness.)                                                             | Sec. V, Para. J.         |
|                                                                                                                                                  | h. (Remote possibility)<br>Combustion chamber not tight against burner head, allowing too much air to enter combustion chamber. | Tighten screws. If parts are warped from heat, replace warped parts. There must be no air gap between face of burner head and back of combustion chamber.                                                            |                          |
| 4. Flames come out front of heater.                                                                                                              | <u>Improper Fuel-Air Mixture</u> (Too much fuel, or not enough air for amount of fuel being supplied.)                          |                                                                                                                                                                                                                      |                          |
|                                                                                                                                                  | a. Dirty fan, or air passageway through heater blocked by dirt or trash.                                                        | Clean the fan. Be sure the air passageway through the heater is clean. Keep the heater clean.                                                                                                                        |                          |
|                                                                                                                                                  | b. Pump output pressure is too high, causing too much fuel to be supplied.                                                      | Check and adjust pump output pressure.                                                                                                                                                                               | Sec. V, Para. L.         |
|                                                                                                                                                  | c. Fan loose or improperly located on shaft.                                                                                    | Check fan; correct if not right.                                                                                                                                                                                     | Sec. V, Para. H.         |
|                                                                                                                                                  | d. Bent or damaged fan.                                                                                                         | Replace. Do not attempt repair of fan.                                                                                                                                                                               |                          |
| 5. Heater cycles intermittently.                                                                                                                 | <u>Electrical System Troubles</u>                                                                                               |                                                                                                                                                                                                                      |                          |
|                                                                                                                                                  | a. Thermostat (if used) set too low.                                                                                            | Set thermostat to a higher temperature for more even operation.                                                                                                                                                      |                          |
|                                                                                                                                                  | b. Defective thermostat (if used).                                                                                              | Replace a defective thermostat.                                                                                                                                                                                      | Sec. V, Para. C.         |
|                                                                                                                                                  | c. Low voltage causing tripout of motor overload protector.                                                                     | Check power line voltage.<br><br>Use extension cord with proper size wire.                                                                                                                                           | Sec. II, Para. B.        |
|                                                                                                                                                  | d. Defective electrical supply or defective connections.                                                                        | Be sure extension cord and heater service cord are in good condition, without intermittent open circuits.<br><br>Check mechanical and electrical soundness of all wiring connections in the heater and service cord. |                          |

# TROUBLE SHOOTING CHART (Continued)

| PROBLEM                                                                              | POSSIBLE CAUSE                                                                 | REMEDY                                                                                                                                              | FOR FURTHER DETAILS SEE: |
|--------------------------------------------------------------------------------------|--------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|
| 6. <u>Control System Troubles</u>                                                    |                                                                                |                                                                                                                                                     | Sec. V, Para. N.         |
| a. Heater ignites, but red button of safety control circuit breaker pops out anyway. | a. Defective photo cell.                                                       | Check to see if glass face of cell is so dirty it can't "see" the flame; clean glass if dirty.<br><br>Replace with a cell that is known to be good. |                          |
|                                                                                      | b. Defective safety control.                                                   | Replace with a control that is known to be good.                                                                                                    |                          |
|                                                                                      | c. Defective electrical connections in circuit through cell and control relay. | Be sure all solder joints and wiring connections are secure. Check wiring diagram.                                                                  |                          |
| b. Safety Control circuit breaker fails to trip when a no-flame condition exists.    | a. Defective circuit breaker.                                                  | Replace with a circuit breaker that is known to be good.                                                                                            |                          |
|                                                                                      | b. Contacts dirty or defective.                                                | Replace defective contacts with one that is known to be good.                                                                                       |                          |
|                                                                                      | c. Photocell electrical leads shorted.                                         | Check photocell leads for shorted leads. Replace photocell if damaged.                                                                              |                          |
| c. Button on safety control circuit breaker won't stay in when pressed.              | a. Resetting is tried too soon after the breaker trips.                        | Wait 5 minutes and try again.                                                                                                                       |                          |
|                                                                                      | b. Defective circuit breaker.                                                  | Replace with a circuit breaker that is known to be good.                                                                                            |                          |
|                                                                                      | c. Photo cell circuit open.                                                    | Check photocell for open condition. Replace if damaged.                                                                                             |                          |

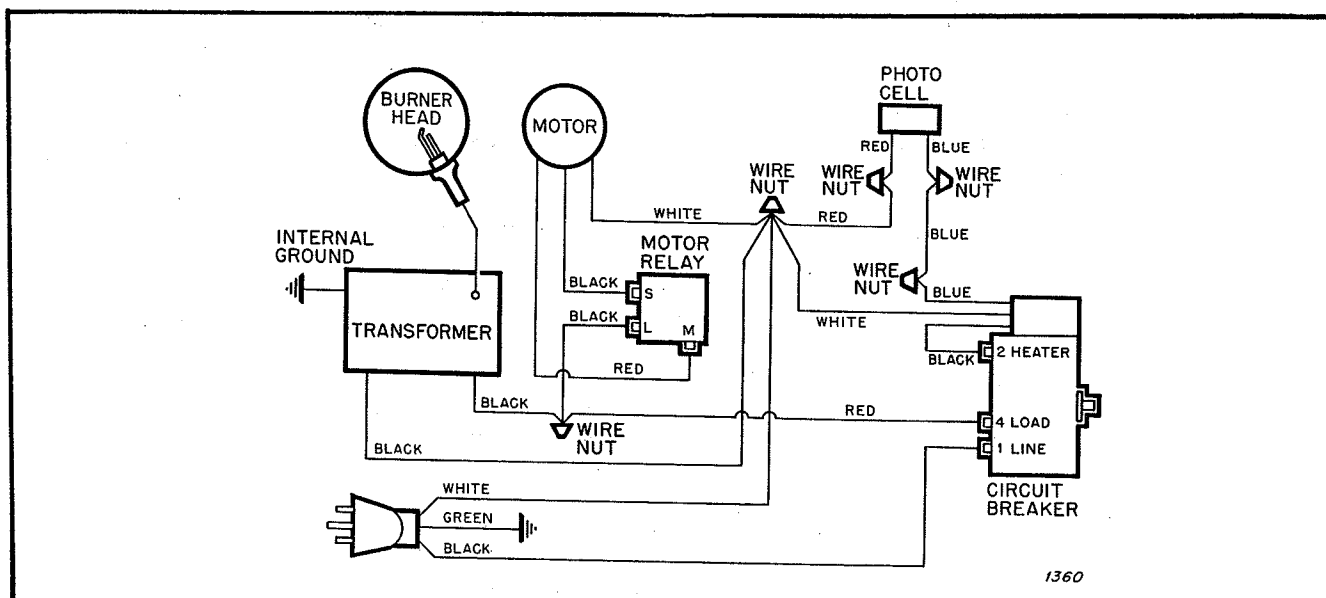


Figure 9. Wiring Diagram

## SECTION V

### SERVICE AND REPAIR

#### A. GENERAL

This section covers replacement of parts, repair and rebuilding of heater components, and the making of adjustments. Check to be sure the maintenance of the heater has been done, before going into the more extensive service operations.

Whenever a part needs to be replaced, you can identify it on the exploded view in the Parts List portion of this book, Section VI. Order any needed part by name and part number.

#### B. SPECIAL TOOLS, EQUIPMENT, AND SUPPLIES

The following tools, equipment and supplies should be available for complete servicing of the heater.

1. Air Gage, Part No. M9148, or any gage with a 15 pound pressure range and 1/4 pound divisions, able to indicate 4-1/4 pounds accurately, plus fittings for installation into a 1/8-inch standard pipe-threaded hole.
2. Oil Burner Nozzle Wrench, or any 5/8-inch socket wrench.
3. Clean fuel, either kerosene or No. 1 fuel oil.
4. Non-flammable, non-toxic liquid cleaning solvent.

#### CAUTION

Fumes given off by solvents may be toxic, therefore use solvents in a well ventilated area.

5. Compressed air is advisable, but not absolutely necessary.

#### C. THERMOSTAT ACCESSORY

1. Turn the knob slowly, through the full range of the thermostat, two or three times. If the heater does not start, proceed as follows:

2. Take the thermostat accessory out of the circuit by unplugging the heater from the thermostat accessory.

3. Plug the heater service cord into an outlet. If the heater operates properly, the thermostat is defective and must be replaced.

#### D. REMOVAL OF UPPER SHELL

It will be necessary to remove the upper shell in order to perform the following service operations on the heater. See Section III, paragraph C.

#### E. TRANSFORMER

##### WARNING

To begin the transformer test, first be sure the heater is not plugged in. Then, when power is required, be **EXTREMELY** careful when checking the transformer. A transformer in good condition produces **VERY** high voltage at the output terminals.

Check the transformer as follows:

1. Connect the transformer lead to a properly gapped spark plug. The gap should be 0.050 inch, plus or minus 0.005 inch. See Figure 6.

2. Establish a good ground between the spark plug and the heater. Be careful not to let any part of your person become a portion of the ground circuit.

3. Plug the heater cord into an outlet of the proper voltage. Observe the spark between the plug's electrodes. If the ground is good and a spark does not jump between the electrodes, the transformer is defective. Replace it.

4. To replace the transformer, take out the two screws which attach it to the motor mounting bracket. Make sure that the new transformer mounting tabs are free of paint, to assure a satisfactory ground.

5. Reinstall the attaching screws, and make wiring connections in accordance with Figure 9.

6. Snap the spark plug lead tightly onto the plug terminal, to prevent its coming loose when the heater is moved.

#### F. CHECKING THE MOTOR STARTING CIRCUITS

In case the motor fails to start when the cord is plugged in, and the thermostat is set to call for heat,

check the motor and its starting circuit components as described in the following paragraphs.

1. Mechanical Check. Spin the motor by turning the fan blades by hand. If the motor turns freely, make the electrical check as described in paragraph 2. Any stiffness of the motor indicates mechanical troubles. See "Motor Service," paragraph G of this Section.

## 2. Electrical Check.

The heaters have 1/8 horsepower motors and separate starting relays. (See the Wiring Diagrams, Figure 9).

### NOTE

The starting relay is "position-sensitive" and must be tested in the same position as when installed in the heater (with the contacts on the bottom).

a. Take the relay out of the heater by taking out the screw which holds its bracket to the left side of the lower shell, near the motor.

### CAUTION

Avoid touching the bare wires on the exposed wire terminals.

b. Take the black motor wire off its terminal of the starting relay. Touch this wire to the terminal of the red motor wire, at the relay. The motor should start. As soon as the motor reaches operating speed, remove the black wire from contact. The motor should continue to run.

c. If the motor starts, install a new relay, and reconnect the wiring according to the Wiring Diagram, Figure 9.

d. Failure of the motor to start could result from either of the following, assuming that all other circuits in the heater are operating correctly.

(1) Internal fault in the motor, such as burned-out stator.

(2) Failure of the starting relay.

e. If the motor fails to start and the relay is found not to be the cause of failure to start, remove the motor and install a new or rebuilt motor. Send the defective motor to the nearest authorized service station for repair, or order a replacement motor from the Master Service Parts Department.

### NOTE

When sending the motor away for repairs, remove the fan, the air filter housing, and the pump end cover. Take out the pump rotor and the carbon blades but do not disturb the pump body, which is the ring attached to the end of the motor. (See paragraph K for pump service instructions).

## G. MOTOR SERVICE

1. Apply a few drops of oil to the fan-end bearing of a stiff motor. If this fails to correct the starting difficulty, rebuild the pump, as described in paragraph K of this section.

2. During rebuilding of the pump, check the motor again for stiffness. If stiffness still exists, rebuild the motor according to the manufacturer's instructions.

3. Whenever a motor has been rebuilt, be sure to check the pump rotor clearance as described in paragraph K-4 of this Section, before reassembling the motor into the heater.

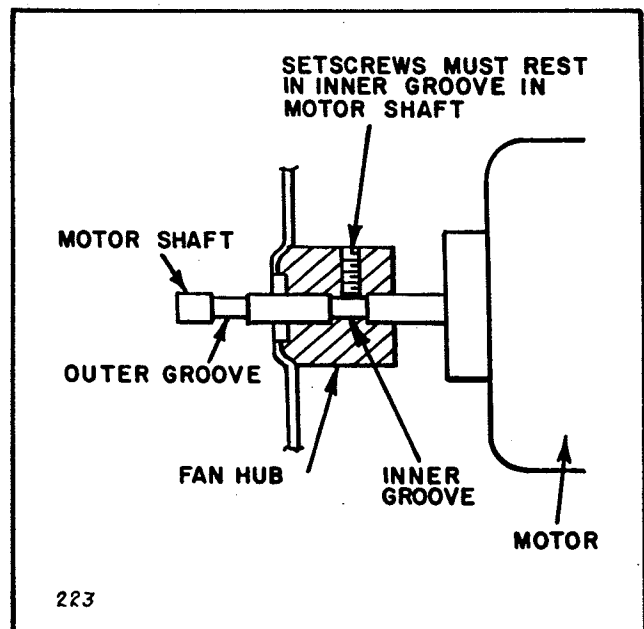


Figure 10. Location of Fan on Motor Shaft

4. When you install the motor, be sure it is not misaligned after tightening the clamps.

#### H. FAN SERVICE

Replace a damaged or bent fan. Do not attempt repair except as a temporary emergency measure. Loosen two setscrews to remove the fan from the motor shaft.

Be sure the replacement fan has the same blade pitch as the fan that was removed. This is important in order to retain the air flow and combustion characteristics of the heater.

Check for proper fan location of the motor shaft. Make sure the fan is in the same position and location as before it was removed. See Figure 10.

#### I. FUEL FILTER SERVICE

1. Remove the fuel filter from the heater and clean it, as described in Section III, paragraph G.

2. Before reinstalling the fuel filter, check the rubber bushing where it enters the fuel tank. Be sure the bushing is in good condition -- not cut or cracked. Replace a damaged bushing.

3. Reinstall the fuel filter according to Section III, paragraph G. Replace with a new filter if the connecting parts will not provide an air tight connection.

#### J. BURNER HEAD SERVICE

1. Take out the spark plug and remove the burner head. Clean the entire burner head, as described in Section III, paragraph H.

2. If there is any sign of damage to the nozzle, or if it is impossible to clean out the nozzle by blowing compressed air into it through the outlet-end, replace with a new nozzle. Always blow a nozzle out thoroughly with air, from the outlet-end, before installing it into the burner.

#### CAUTION

NEVER try to open a nozzle passage with a drill. Any change in the size or shape of the passage will alter the flow characteristics. Protect the passage from damage whenever you work on the burner or nozzle.

3. Always install a new rubber sleeve whenever you install a nozzle into the burner. The sleeve is the part that helps maintain the needed pressure difference between the air and fuel chambers of the burner head. If bubbles have appeared in the fuel tank during opera-

tion, the rubber sleeve is probably leaking and should be replaced.

4. Be sure the seal washer, spring, and second seal washer are in place on the nozzle before you install the rubber sleeve.

5. When seating the nozzle firmly against the burner head, do not apply too much pressure with the wrench, or the nozzle could be distorted.

6. Adjust the spark plug gap as described in Section III, paragraph F.

#### K. AIR PUMP REPAIR

NOTE: Because of the close tolerances and critical positioning of the parts, we recommend that only skilled mechanics attempt any repair of the air pump.

The heater's air pump consists of a rotor with four carbon blades, rotating inside a pump body. The rotor is driven directly by the motor, and is supported by the ball-bearing end of the motor. One of the pump end plates is the motor's back end plate. The other pump end plate is part of the housing for the air intake and outlet filters.

Handle all pump parts with care and keep them clean. The parts are made with close tolerances. Dirt and oil on pump parts will hinder the performance of the pump.

If pump repair is required, you may order a complete pump package, or individual parts, as shown in the Parts List, Section VI.

1. Disassembly.

#### CAUTION

Do not take the pump apart any further than needed to reach the parts which must be replaced.

a. Remove the end cover and take out the intake and outlet air filters and the lint filter. Disconnect the air line from the elbow.

b. Hold a clean, dry cloth under the pump and remove the six screws that hold the end cover to the pump body. Catch the carbon blades in the cloth, if they fall out as the pump body is removed.

c. Take all four carbon blades out of the rotor. Pull the rotor and the insert off the motor shaft.

2. Replacing Carbon Blades.

a. Worn or sticking carbon blades cause

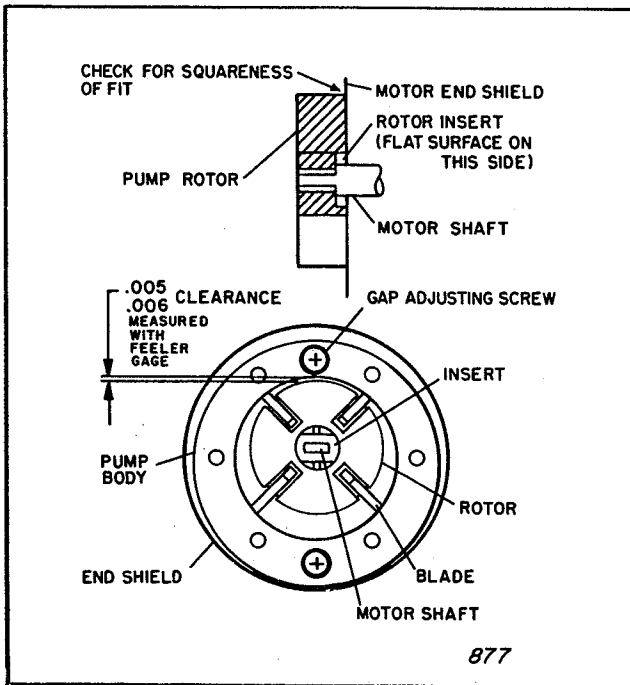


Figure 11. Checking Clearance of Air Pump Rotor

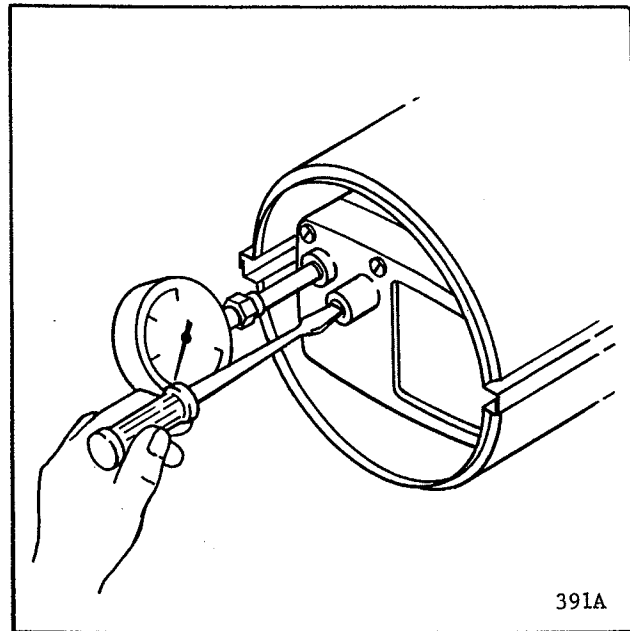


Figure 12. Checking and Adjustment of Air Pump Pressure

loss of air pressure. If the blades are worn, or are sticking in the rotor slots, replace them. (It is not necessary to remove the rotor or the pump body to replace the carbon blades).

b. Install the carbon blades into the slots.

### 3. Replacing the Rotor.

Use a new rotor only if deep grooves or uneven wear appear on the surfaces. Check the insert for wear, and replace it if worn or loose.

To remove the rotor, first remove the pump body.

### 4. Reassembly of Air Pump.

a. Install the insert in the pump rotor as shown in Figure 11, then assemble rotor on the motor shaft. When installing the rotor, take care to keep it perpendicular to the motor shaft. Attach the pump body to the motor with the two recessed screws which were removed to take it off.

b. Adjust the pump body to provide 0.005 to 0.006 inch clearance at the point shown in Figure 11. Measure the clearance with a feeler gage. Spin the motor by hand to be sure the rotor does not rub on the pump body. The proper clearance must be maintained. Be sure the recessed screws are tight after adjusting.

c. Insert carbon blades as described above.

d. Install the end cover, using the six screws which were removed. Reconnect the air line.

## L. ADJUSTMENT OF PUMP PRESSURE

1. Remove the plug from the air filter housing, and install the pressure gage (listed in paragraph B of this Section) into the hole. See figure 12.

2. Remove the upper shell and wire nuts at the photocell connections. Install a jumper lead across the photocell to bypass it. Tape these connections to prevent accidentally grounding against the shell. Reinstall the shell, then start up the heater.

3. Pump pressure must be 4 psi. If the pressure is not within this range, adjust the pressure relief valve.

4. To adjust pump pressure, screw the valve stem in to raise the pressure; out to lower it.

5. Remove shell and disconnect jumper wire from photocell connections. Reinstall wire nuts to electrical leads (see figure 9). Install upper shell, then remove the gage and replace the plug.

## M. REASSEMBLY OF HEATER

1. Put the heater back together in the reverse order of disassembly.

2. Check all wiring to be sure it agrees with the wiring diagram. Be sure all electrical connections are tight.

3. Tighten the connections at both ends of the air line, and tighten the connection where the fuel filter is assembled to the burner head.

4. Make sure the electrode lead is snapped onto the spark plug and the transformer output terminal.

5. Be sure all parts are in place and the screws are tight before attempting to use the heater.

## N. SAFETY CONTROL CIRCUIT

### 1. Testing.

NOTE: The following testing procedures should be performed only if troubles indicate the safety control circuit may be at fault.

Unplug the heater power cord. Disconnect and tape all motor leads from the relay. This will help prevent accidental injury and will prevent fuel from being ejected from the nozzle. Disconnect the red lead from terminal No. 4 of the circuit breaker (Figure 9) and tape the end of the red lead.

Make certain the reset button of the flame sensor control and circuit breaker is pressed in (figure 2). Set the thermostat (if used) to a temperature above the temperature of the surrounding air.

Position the flame sensor, circuit breaker and relay assembly as instructed in the test procedure for the motor and relay, page 15.

Remove the wire nut from the connection point of the white lead of the transformer, the white lead of the motor, the red lead of the flame sensor, the white lead of the power cord, and the white lead of the control and circuit breaker. (See wiring diagram, figure 9.)

Connect a meter or test light between the No. 4 terminal of the circuit breaker and the white wire to the motor and transformer. (See wiring diagram Figure 9.) There should be a voltage reading or the test light should come on between the terminal and the connection point when the power cord is plugged in. If a voltage reading is present or if the test light illuminates, the safety control circuit is functioning properly. If not, continue on with the testing.

### CAUTION

Unplug the power cord before continuing the test.

Check the photo cell (flame sensor) by removing it from the mounting bracket. Take care not to bend the bracket. Hold the rubber hood end of the photo cell against a metal surface such as the side of the shell to block off all light to the flame sensor; then plug the heater power-cord in.

Observe the time between covering the photo cell and the actuation of the circuit breaker. If the tripping of the breaker occurs in approximately 15 seconds, the safety control circuit is operating normally. When

the circuit breaker contacts open, the light will go off or the meter reading will drop to zero.

If the breaker does not trip after 20 to 25 seconds (as indicated by the light staying on or the meter continuing to register voltage), UNPLUG THE POWER CORD and disconnect the blue lead of the photo cell from the blue lead connected to the breaker. Plug the heater in. The breaker should now trip within 15-20 seconds. If it does not, the flame sensor and circuit breaker is faulty and should be replaced. If it does trip within 15-20 seconds, the photo cell is faulty and must be replaced.

UNPLUG THE HEATER. Reconnect the red wire to terminal No. 4 of the circuit breaker. Reconnect all leads in accordance with wiring diagram Figure 9.

Test fire the heater to make sure it will function properly. If it does not, check all wiring connections according to wiring diagram, Figure 9. Repeat the testing procedure if necessary. An alternate method of testing the safety control circuit is to use an ohmmeter. Disconnect the red wire connected to terminal No. 4 and make the following measurements:

Terminal No. 1 to terminal No. 4 of the circuit breaker. (See figure 9.) The reading should be 0 with the breaker unactuated (plunger in). The reading with the breaker actuated (plunger out) should be infinite.

Terminal No. 2 to the connection point of the white wire at the circuit breaker and the safety control flame sensor disconnected, very high (almost infinity).

Terminal No. 2 to the white wire and the cell in the dark, approximately 500,000 ohms.

Terminal No. 2 to the blue wire connection point, approximately 100,000 ohms.

### 2. Replacement.

To replace the photo cell, disconnect the wires at the cell and work the cell out of its bracket. Install replacement in reverse order of removal. Use care to prevent bending bracket when installing cell.

If trigger circuit has been determined to be defective, disconnect black wire from circuit breaker. Detach bracket to which circuit breaker is mounted. Disconnect blue and white leads from electrical circuit, then loosen ring and hex nuts and lift out trigger circuit. Install replacement in reverse order of removal. To replace a defective circuit breaker, remove trigger circuit. Disconnect the two leads to the load and line terminals. Remove ring and hex nut and withdraw the circuit breaker. Install replacement breaker in the reverse order of removal. Check that all wiring conforms to the wiring diagram, then test fire the heater.

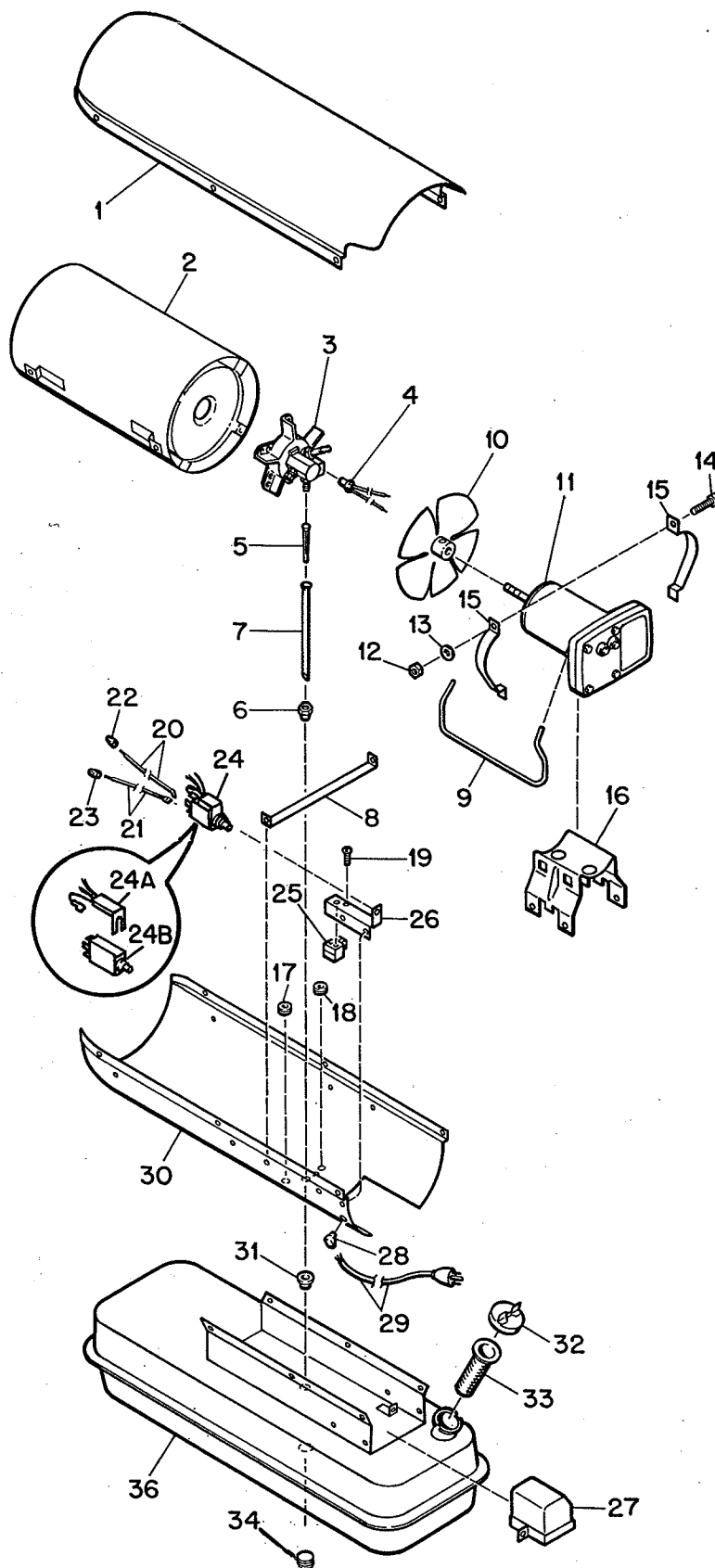


Figure 13. Heater Exploded View