AMOCO STA-WARM®

PORTABLE HEATERS

MODEL AM-140

(Spec. No. 2968G11, 2968G11-1 and 3059G8)

OPERATING, MAINTENANCE and SERVICE INSTRUCTIONS with PARTS LIST

atoMaster BURNER SYSTEM

AMERICAN OIL COMPANY

910 SOUTH MICHIGAN AVENUE CHICAGO, ILLINOIS

Form No. 2645 (8/70)

Litho in U.S.A.

SECTION I
INTRODUCTION

A. GENERAL

1. Purpose of Manual. This Manual gives instructions for operating, maintaining, trouble shooting and servicing the heaters. A complete parts list is included at the end of the manual.

2. Purpose of Heater. Use this heater wherever you need temporary portable heat. It must be used with adequate ventilation and proper electrical power.

B. PRINCIPLES OF OPERATION

Operation of the heater is simple. It 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 carries 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.

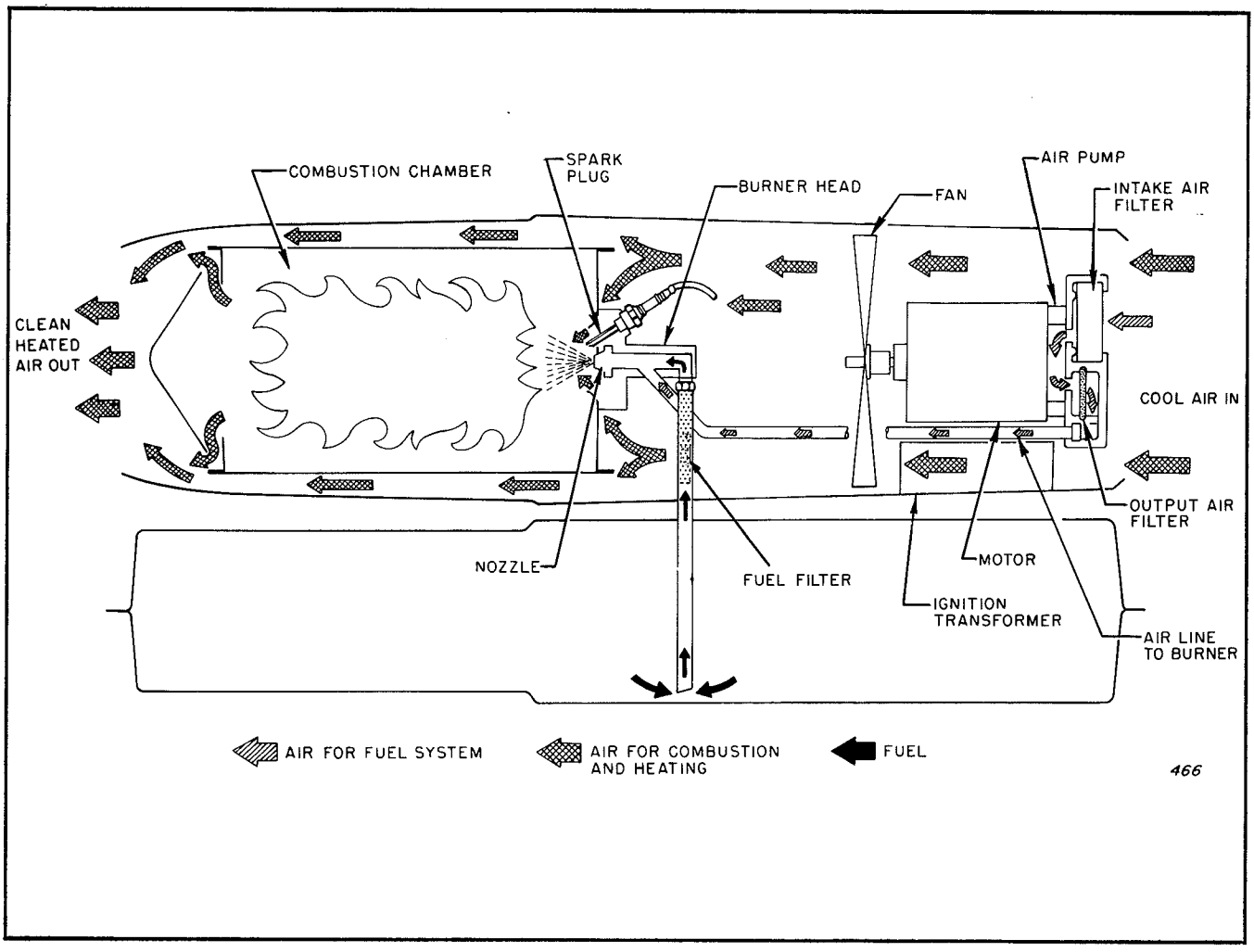

Figure 1. Schematic Diagram Showing Principles of Heater Operation

C. SPECIFICATIONS

Output rating (BTU per hour)	150,000
Air output, approx. (Cu. ft. per minute)	350
Amperage (During normal run)	5.0
Weight, approx. (Pounds) Shipping	90.5
Net (Dry)	76
Fuel	Kerosene or No. 1 fuel oil only.
Fuel tank capacity (U.S. gallons)	13.5
Fuel consumption, approx. (Gallons per hour)	1.0
Voltage and cycles	115/60
Motor RPM	3,450
Duct	No duct recommended.

D. ACCESSORIES

The following accessories are available for use with the heater:

Safety Control Kit, Accessory No. HA-2100

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 the primary 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 four 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.

WARNING

The motor has an automatic thermal overload protector. It may stop due to low voltage or overload, then RESTART automatically. Be sure to disconnect the heater service cord before removing the upper shell or inspecting the motor.

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 Frostex or similar anti-icer to the fuel, about 2 tablespoonfuls of anti-icer to each 5 gallons of fuel.

D. STARTING

Plug the heater cord into an outlet that will give the proper voltage and frequency. Set the thermostat to the desired temperature for automatic temperature control, or to ON for continuous operation. The heater will start operating immediately.

E. STOPPING

To stop the heater unplug the heater cord from the outlet, or set the thermostat to OFF.

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 maintenance points.

A. FUEL TANK MAINTENANCE

Drain the fuel tank after every 150 hours of operation, and flush it out with clean fuel. Refill with new 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. Lift the output air filter out. 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.

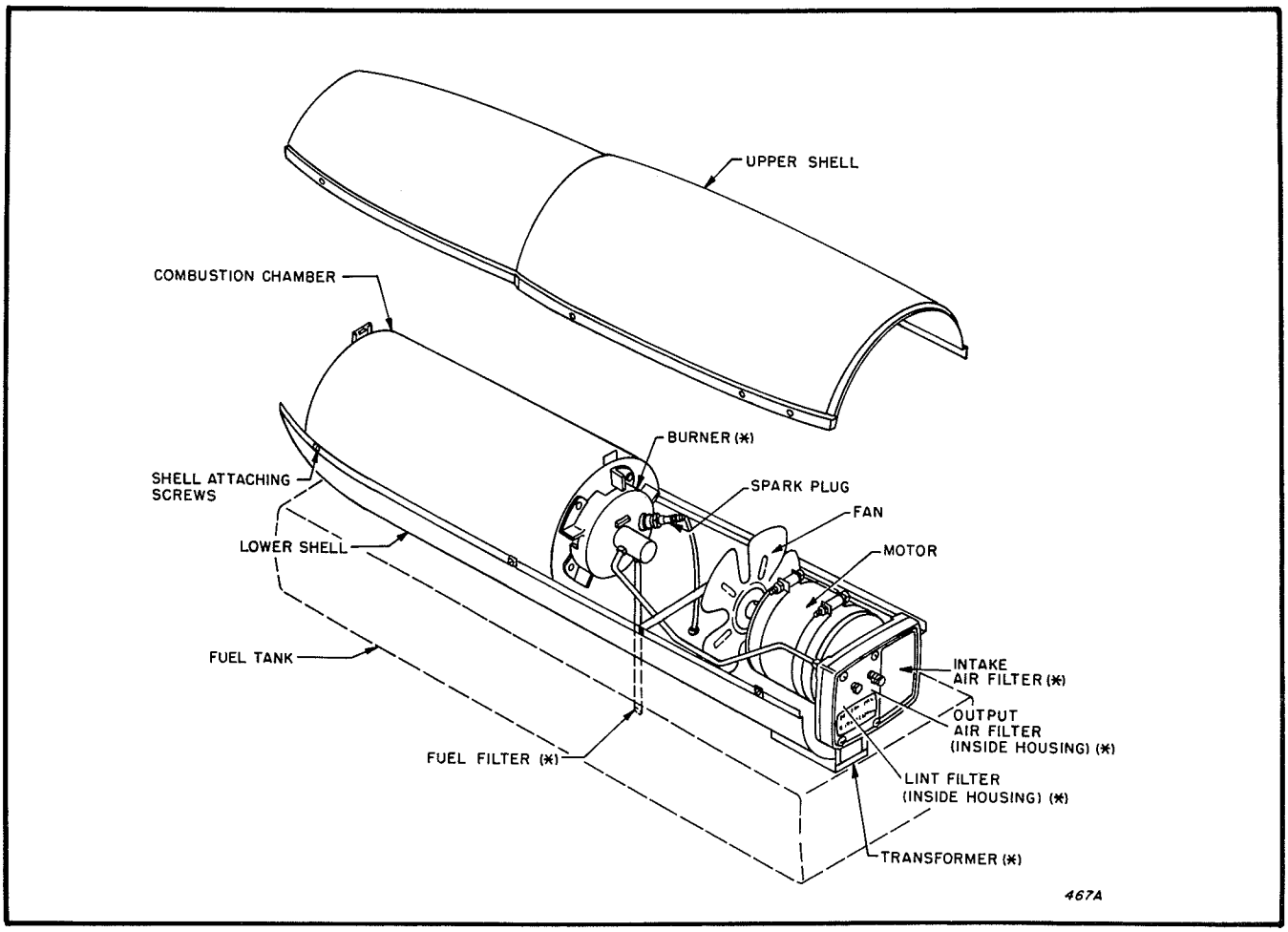

Figure 2. Heater Maintenance Points
Symbol (*) indicates parts recommended as replaceable by owner or user of heater.
(For clarity, heater is shown without tank, wheels and handles, and with upper shell removed.)

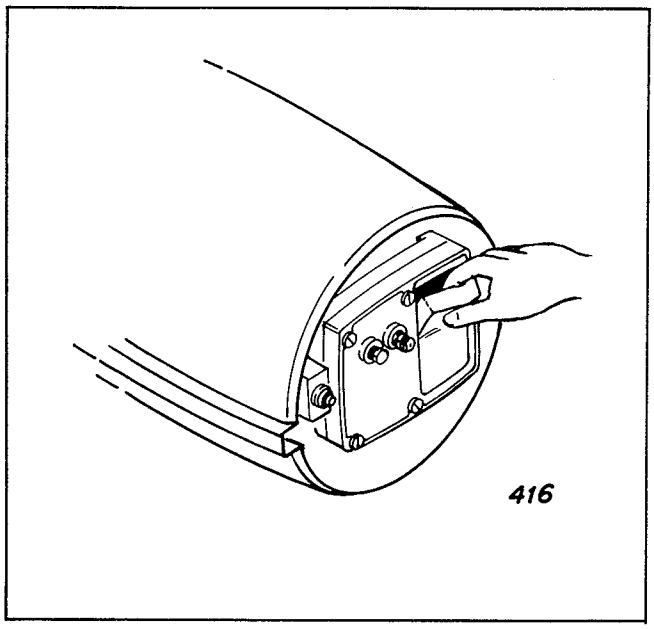

Figure 3. Removing Intake Air Filter

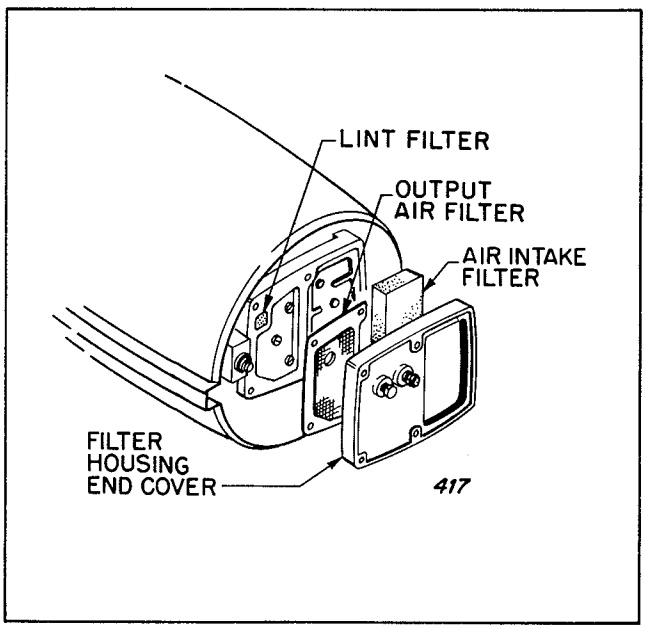

Figure 4. Access to Air Filter for Maintenance

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 six screws (3 on each side) that hold the upper shell to the lower shell. Lift the upper shell off.

To replace the upper shell, align the six holes located along its lower edge over the six 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 heating season with a few drops of No. 30 oil, Arctic C oil, or electric motor oil. Do not over-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. This is the thickness of a dime.

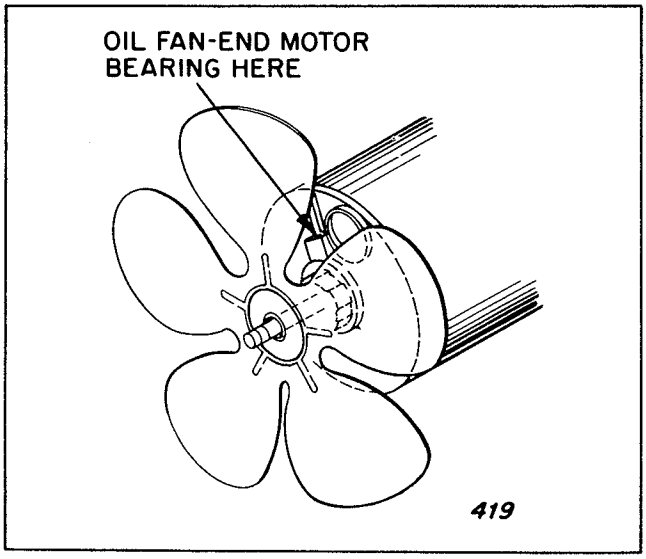

Figure 5. Lubrication of Motor Bearing

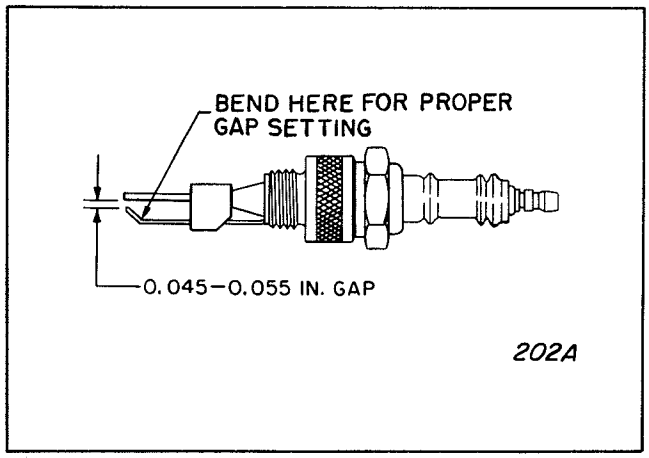

Figure 6. Spark Plug Gap Setting

3. Adjust the gap by bending the outside electrode.

4. Reinstall the spark plug if no further maintenance is needed for the burner head. If you do not install the spark plug immediately, protect it from damage until it is reinstalled.

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 Trouble Shooting Chart indicates.

1. To remove the fuel filter, loosen the hex nut that attaches it to the burner, and slide the nut down on the tube. Slide tube down into the tank so that tube will clear the male connector on the bottom of the burner head.

2. Withdraw the filter element out of the tube, and 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. To install the filter element, slip element into its tube so that it is seated properly in the flared seat. Check to see that the filter element will seat against the male connector installed in the burner. Position the filter tube carefully so that the hex nut will line up with the threads of the fitting. Tighten the nut securely.

NOTE

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

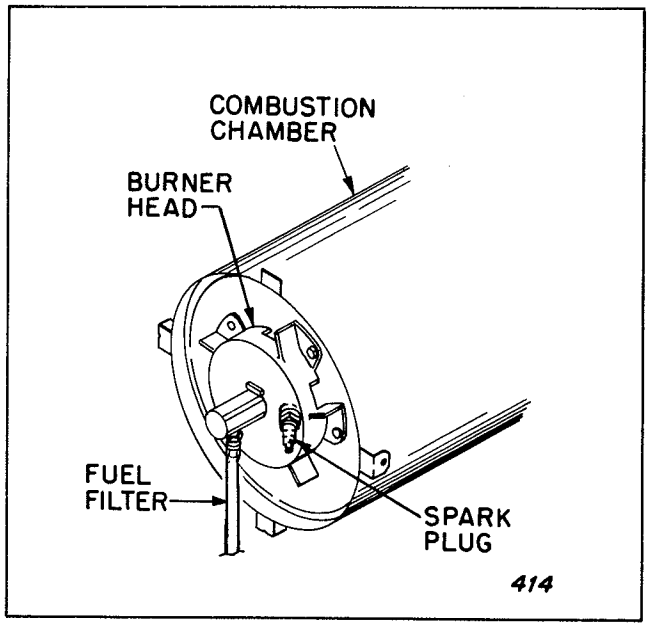

Figure 7. Burner Head, Spark Plug, and Fuel Filter

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. Loosen the screws that fasten the burner head to the rear of the combustion chamber.

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 fittings in rear of burner. Blow the nozzle 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 in 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, 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.

CAUTION

Do not attempt to repair the nozzle, as a part of routine maintenance. If the nozzle needs to be repaired, see Section V of this manual.

I. 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.

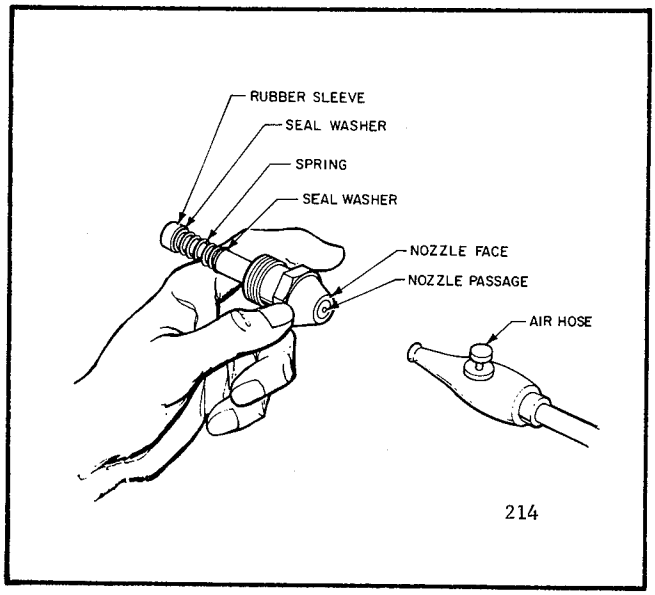

Figure 8. Blowing Out Nozzle With Compressed Air

SECTION IV
TROUBLE SHOOTING

A. GENERAL

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 a 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, paragraph B.)

3. Check and adjust the air pressure, as described in Section V, paragraph L, except that fuel must be used for test-firing.

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.

6. If any troubles show up during the test-firing, refer to the Trouble Shooting Chart to find out how to correct them.

D. TROUBLE SHOOTING

The following chart lists the problems you might find in a heater. For each problem, there is a list of "Possible Causes". The "Remedy" column tells you how to correct the problem, or tells you by means of 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.	Electrical Troubles		
	a. No power or low voltage at heater.	Be sure power is reaching heater; check condition of heater cord. Repair or replace as needed.	
		Use extension cord with wires heavy enough to carry the electrical load of the heater.	Sec. II, Para. B.
		Be sure voltage at outlet is same as shown on heater instruction plate.	

TROUBLE SHOOTING CHART (Continued)

PROBLEM	POSSIBLE CAUSE	REMEDY	FOR FURTHER DETAILS SEE:
1. (Continued) Motor does not start, thermostat (if used) is set to call for heat.	b. Damaged motor, motor starting capacitor, motor starting relay, or motor starting switch; binding fan-end bearing; binding pump.	Check motor.	Sec. V, Para. F.
		Replace a defective motor (or motor starting relay).	Sec. V, Para. F.
		Install a starting capacitor that is known to be good.	
		Lubricate motor (Fan-end only).	Sec. III, Para. E
		Rebuild motor.	Motor Mfr's. Instructions
		Rebuild or replace a binding pump.	Sec. V, Para. K.
	c. Thermostat (if used) damaged.	Replace.	
	Mechanical Troubles		
	d. Dry bearing on fan-end of motor.	Lubricate motor.	Sec. III, Para. E.
		If lubrication does not solve problem, check pump.	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.	Sec. V, Para. H.
		Check for damaged fan; replace if defective.	
		Check for damaged motor mount.	
2. Heater will not ignite, but motor runs.	Fuel System Troubles		
	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.)	
		Fill tank with new, clean kerosene or No. 1 fuel oil.	
	b. Fuel filter clogged.	Remove and wash in clean fuel. Blow dry and replace.	Sec. III, Para. G.
	c. Nozzle plugged or defective.	Clean by blowing compressed air through nozzle from outlet end of nozzle.	Sec. III, Para. H
		Replace nozzle if cleaning does not solve the problem.	Sec. V, Para. J.
	d. Low air pump pressure.	Check pressure; adjust, rebuild, or replace air pump as needed.	Sec. V, Paras. K & L.
		Check rubber sleeve around shank of nozzle; replace if leaking.	Sec. V, Para. J.

TROUBLE SHOOTING CHART (Continued)

PROBLEM	POSSIBLE CAUSE	REMEDY	FOR FURTHER DETAILS SEE:
2. (Continued) Heater will not ignite, but motor runs.	d. Low air pump pressure. (Continued)	Check to be sure all air line connections from pump to burner are secure. Check to be sure air filter end cover is securely fastened, without air leaks. Be sure air filters are clean.	Sec. III, Para. B.
	e. Air leak at fuel filter.	Check fuel filter for air leaks and for tightness of fitting where filter is connected to burner head.	
	Ignition Troubles 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. Inspect plug for broken porcelain or electrodes. Discard a damaged spark plug.	Sec. III, Para. F.
	f. Spark plug wire disconnected from plug or from terminal of transformer.	Disconnect heater cord! 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.
3. Heater burns, but puffs of smoke can be seen; heater will not burn steady; heater burns with odor, heater smokes continuously.	Improper Fuel-Air Mixture (Not enough fuel) 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. Refill with new, 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. Be sure air intake is not blocked.	Sec. III, Para. B.
	c. Fuel filter loose, leaky, or dirty.	Remove and wash fuel filter in clean fuel. Check condition of connection between fuel filter and burner head. Replace with new filter and fitting if connection can't be tightened without leaks.	Sec. III, Para. E. Sec. V, Para. I.

SECTION V

SERVICE AND REPAIR INSTRUCTIONS

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. The heaters can be completely rebuilt and checked in less than one hour.

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 deep 5/8-inch socket wrench.

3. Clean fuel, either kerosene or No. 1 fuel oil.

4. Non-flammable liquid cleaning solvent, such as carbon tetrachloride.

CAUTION: Fumes are poisonous; use with GOOD ventilation.

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

C. THERMOSTAT

If you suspect that thermostat failure is preventing the heater from starting, and the thermostat is set to call for heat, check it as follows:

1. Turn the knob from OFF to ON, slowly, through the full range of the thermostat, two or three times. (The thermostat has positive OFF and ON positions.) If the heater does not start, proceed as follows.

2. Take the thermostat out of the circuit by connecting a jumper into the circuit inside the heater, in place of the thermostat wires.

3. Plug the heater service cord into an outlet. If the heater motor starts, the thermostat is defective and must be replaced. If the motor does not start, the thermostat is probably not the cause.

D. REMOVAL OF UPPER SHELL

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

WARNING

With the upper shell removed and the service cord plugged in, the heater can be dangerous. Be careful to keep away from the transformer leads and the fan when the upper shell is off.

E. TRANSFORMER

Check the transformer as follows:

WARNING

Be EXTREMELY careful when checking the transformer. A transformer in good condition produces VERY high voltage at the output terminals.

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 spark does not jump between the electrodes, and the ground is good, 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 or 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 are built with motor starting circuit which has an external starting relay in addition to the starting capacitor.

a. Failure of the motor to start could result from a failure of the starting capacitor or failure of the motor starting relay or from an internal fault in the motor.

(1) To check the capacitor, replace it with a new one that is known to be good, and try the motor. If the motor starts, the old capacitor was bad. Leave the new capacitor in the circuit. If the motor does not start, check further.

(2) Check the starting relay as described below:

NOTE

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

(3) 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 or the exposed wire terminals.

(4) Take the black motor wire off its terminal on 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.

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

(6) If the motor fails to start, of if it fails to continue running when the black wire is taken away, the motor is defective. Repair or replace it. See paragraph G of this Section.

(b) If the motor fails to start after you determine that the capacitor and/or motor starting relay are not faulty, remove the motor, install a new or rebuilt motor and send the defective motor to the nearest Robbins and Myers service station for rebuilding, or order a replacement motor from the factory.

NOTE

When sending the motor away for repairs, remove the fan, the air filter housing, and the pump end cover. Take out the rotor and carbon blades. (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.

H. FAN SERVICE

Replace a damaged or bent fan. Do not attempt repair except as 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 are damaged to prevent a tight connection.

TROUBLE SHOOTING CHART (Continued)

PROBLEM	POSSIBLE CAUSE	REMEDY	FOR FURTHER DETAILS SEE:
3. (Continued) Heater burns, but puffs of smoke can be seen; heater will not burn steady; heater burns with odor, heater smokes continuously.	d. Dirty nozzle.	Remove and clean the burner head. Blow compressed air through nozzle from outlet end. Never use a drill, wire, or other tool to open a nozzle passage. Replace a defective nozzle.	Sec. III, Para. H. 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. Check to be sure that no dirt or trash (or dirty fan blades) could be causing motor slowdown. Lubricate fan-end bearing of motor.	Sec. V, Paras. K & L. Sec. III, Para. E.
	f. Loose air output line connections between filter housing and burner.	Be sure connections are tight.	
	g. (Remote possibility) 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) 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 tween face of burner head and back of combustion chamber.	
4. Flames come out front of heater.	Improper Fuel-Air Mixture (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.	

TROUBLE SHOOTING CHART (Continued)

PROBLEM	POSSIBLE CAUSE	REMEDY	FOR FURTHER DETAILS SEE
5. Heater cycles intermittently.	Electrical System Troubles 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 trip-out of motor overload protector.	Check power line voltage 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. Check mechanical and electrical soundness of all wiring connections in the heater and service cord.	
	e. Motor overload protector tripping out due to motor trouble or binding pump.	Lubricate fan-end bearing. Keep motor and fan area clean. Replace defective motor or rebuild defective pump. CAUTION: Keep fingers away from fan when heater service cord is plugged in.	Sec. III, Para. D & E. Sec. V, Paras. F, G & K

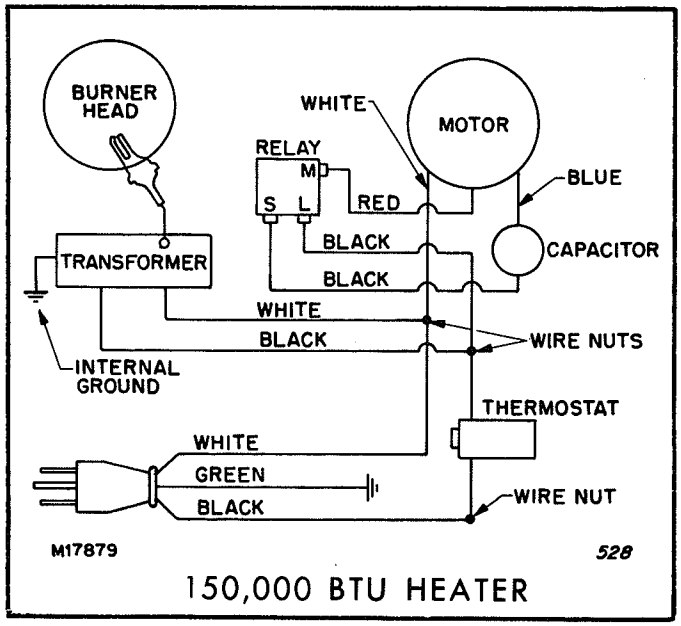

Figure 9. Wiring Diagram

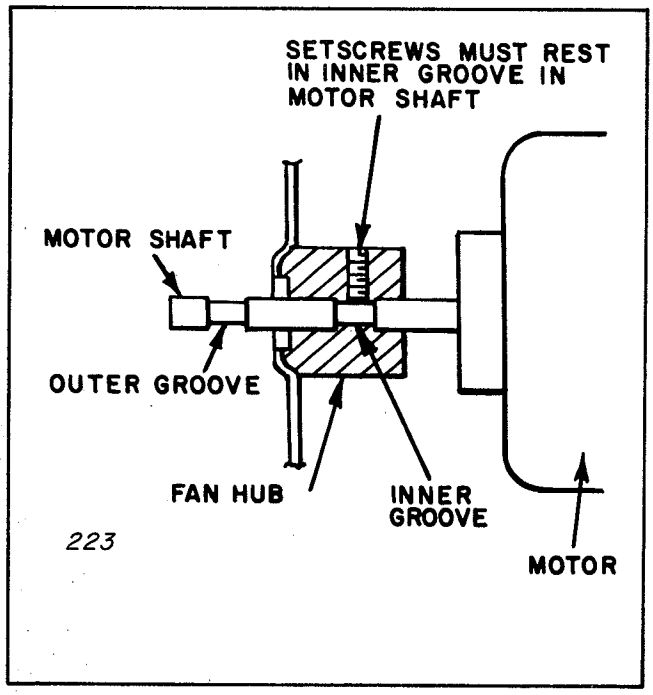

Figure 10. Location of Fan on Motor Shaft

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 damage the nozzle beyond repair. Do not disassemble the nozzle, as flow characteristics are changed by disassembly. 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 operation, 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 explained 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 you need to in order 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 on the remaining portion of the air filter housing.

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 spring off the motor shaft.

2. Replacing Carbon Blades.

a. Worn or sticking carbon blades cause 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. Wash the rotor, end cover, and pump body in non-flammable cleaning solvent and blow them dry before you install new blades.

c. Install the carbon blades into the slots, with the notched ends of the blades inside the slots and the rounded ends toward the outside.

3. Replacing the Rotor.

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

To remove the rotor, first remove the pump body. When installing the rotor, take care to keep it perpendicular to the motor shaft.

4. Reassembly of Air Pump.

a. Install the spring in the pump rotor as shown in Figure 11, then assemble rotor on the motor shaft. Attach the pump body to the motor with the two top and bottom recessed screws which were removed to take it off.

b. Adjust the pump body to provide 0.003 to 0.005 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 screws are tight after adjusting the clearance.

c. Insert carbon blades as described above.

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

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. Start the heater. (You do not need to have fuel in the tank for this pressure check and adjustment.)

3. Pump pressure must be 5 pounds per square inch, plus or minus 1/16 pound. If the pressure is not within this range, adjust the pressure relief valve.

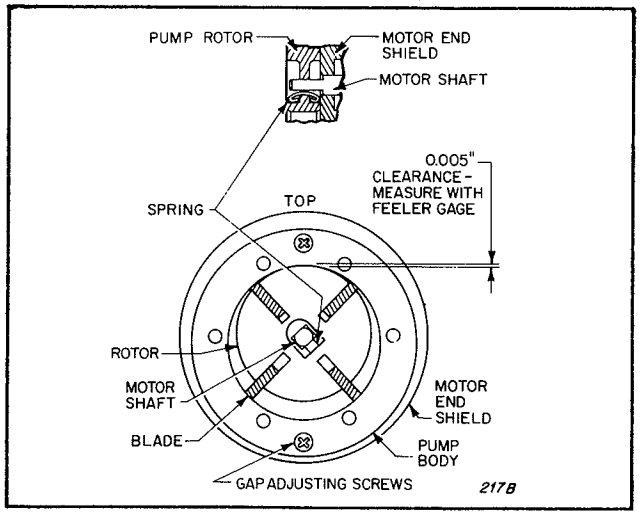

Figure 11. Checking Clearance of Air Pump Rotor

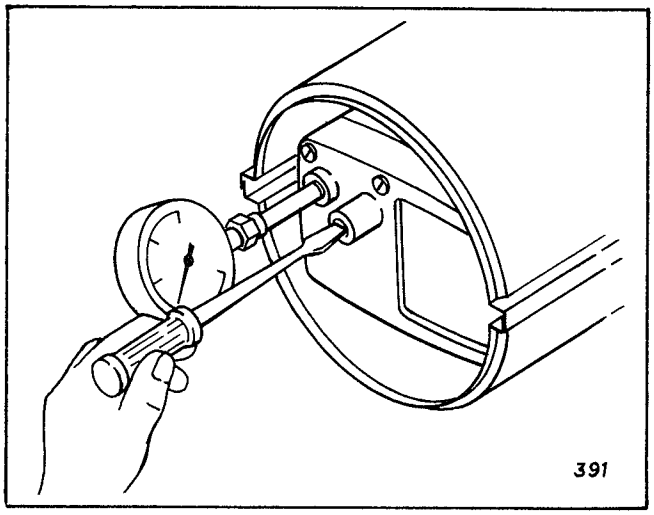

Figure 12. Checking and adjustment of Air Pump Pressure

4. To adjust, back off the locking nut 1/4 turn. Screw the valve stem in to raise the pressure; out to lower it. Tighten the locking nut securely and recheck the pressure.

5. 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 copper air line, and tighten the connection where the fuel filter is assembled to the burner head.

4. Make sure the spark plug lead is snapped onto the terminal.

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

N. FINAL CHECK

Put at least two gallons of fuel in the fuel tank and test-fire the heater for a few minutes, after all service has been completed, to be sure it will operate satisfactorily.

BASIC HEATER ASSEMBLY

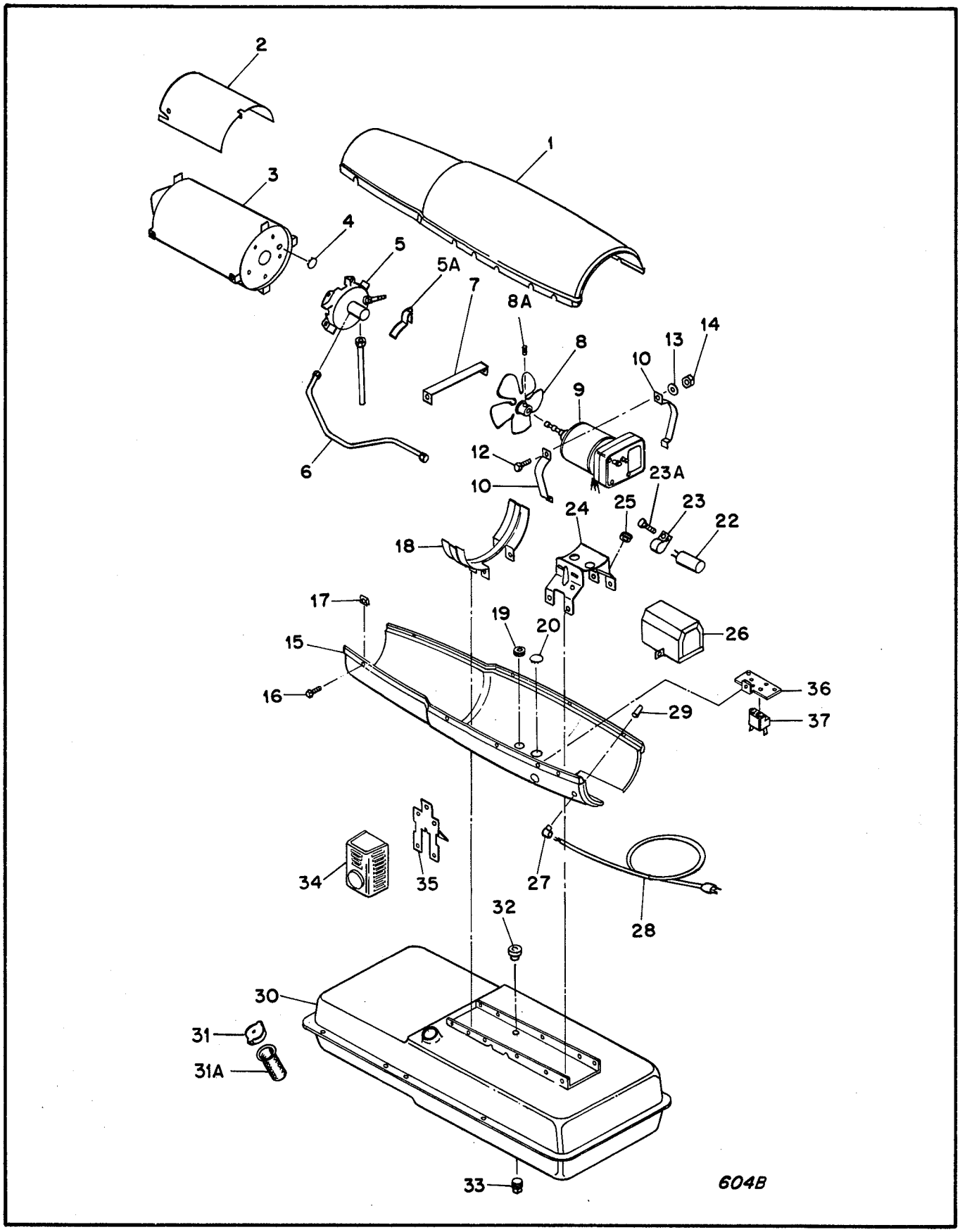

Figure 13. Portable Heater, Exploded View

SECTION VI
ILLUSTRATED PARTS LIST

This section contains a list of all service parts used in the equipment covered by this manual. Standard hardware items are indicated by the symbol (*).

Check the model decal for correct model number of the equipment. Include the model, specification, and serial numbers when ordering parts. Order parts by part name and part number only. Do not use index numbers from the illustration when ordering parts. Specify color when ordering painted parts.

BASIC HEATER ASSEMBLY

Fig.& Index No.	Part Number	Part Name	Qty.
13-1	M17015G1J	Shell, Upper	1
2	M16679	Deflector, Heat	1
3	M16887G4	Combustion Chamber (Spec. 2986G11,G11-1)	1
	M16887G5	Combustion Chamber (Spec. 3059G8)	1
	*M11084-27	Screw (Combustion Chamber attaching front)	2
	*M11084-29	Screw (Combustion Chamber attaching rear)	2
4	M15995	Plug, Button (Combustion Chamber, rear head)	1
5	Ref	Burner Head Assembly (See figure 14)	1
	*M11084-27	Screw (Burner Head attaching)	3
5A	M19488	Limiter, Air	1
6	M16804	Air Line	1
7	M16871	Strap, Retainer	1
	*M11084-27	Screw (Retainer Strap to lower shell)	2
8	M17058	Fan, 16° Pitch	1
8A	SF4-2-1/2K	Setscrew, Socket hd. cup pt. 1/4-28 (Fan to motor shaft)	2
9	Ref	Motor Package Assembly	1
10	M16661	Clamp, Motor	4
11		Not Used	
12	*HC4-10C	Screw, Motor Clamp	2
13	WLM-4	Lockwasher 1/4 in.	2
14	NPC-4C	Nut, Hex, 1/4-20	2
15	M16810J	Shell, Lower	1
16	*M11084-27	Screw (Upper Shell to Lower Shell)	8
17	M11271-6	Nut, Tinnerman (Upper Shell to Lower Shell)	8
18	M12828	Bracket, Shell Support	1
	*M11084-27	Screw (Support Bracket to Lower Shell and Fuel Tank)	6
	M11084-29	Screw (Lower Shell to Support Bracket)	2
19	1000576	Grommet (Ignition cable and thermostat leads thru lower shell)	3
20	M15809	Plug, Button (for 1/2" dia. hole)	1
21		Not Used	
22	M12650-1	Capacitor	1
13-23	M12651	Clamp, Capacitor Mounting	1
23A	*M11084-27	Screw (Capacitor Clamp to Motor Support Bracket)	1
24	M16645	Bracket, Motor Support	1
	*M11084-27	Screw (Motor Support Bracket to Lower Shell and Fuel Tank)	6
25	1000577	Grommet (Motor and Capacitor Leads thru Motor Support Bracket)	2
	*M15823-26	Screw (Service Cord Grounding)	1
26	M16697	Transformer, 5000 volt	1
	*M11084-27	Screw (Transformer to Motor Support Bracket)	2
27	M11954	Bushing, Strain Relief (Service Cord)	1
28	M10813G33	Service Cord (Extension)	1
	M9900G51	Wire Assy (to capacitor)	1
29	M13942-2	Connector, Wire Nut	1
	M13942-4	Connector, Wire Nut	2
	M9900G62	Wire Assembly (To Starting Relay) &&	1
	M9900G77	Wire Assembly (To Capacitor)&&	1
30	M18371G2D	Fuel Tank ++	1
31	M18051	Cap, Fuel Tank ++	1
31A	M18053	Screen, Filler Neck ++	1
32	M10990-3	Bushing, Rubber	1
33	M21040	Plug, Pipe Hex Hd. (Tank Drain)	1
34	Ref	Thermostat Assy (See figure 16)	1
	*M10908-1	Screw (Thermostat to Bracket)	4
35	M15814E	Bracket, Thermostat	1
	*M12461-51	Screw (Thermostat Bracket to Lower Shell)	2
	M12250-1	Nut, Tinnerman (Thermostat Bracket to Lower Shell)	2
	M18598G1	Relay and Bracket Assy	1
36	M11952	. Bracket, Starting Relay Mounting	1
	*M11084-27	. Screw (Mounting Bracket to Lower Shell)	1
37	M12462-6	. Relay, Starting	1
	RC2-2C	. Screw (Relay to Mounting Bracket)	2
	WLI-2	. Lockwasher, No. 8	2

*See listing of standard hardware. Purchase locally.
&&Spec. No. 2968G11-1 and 3059G8
++Indicates parts which replace fuel tanks Part No. M16806G1 and fuel tank cap Part No. 3353 as a set of parts. Cap and screen cannot be used with the old fuel tank.

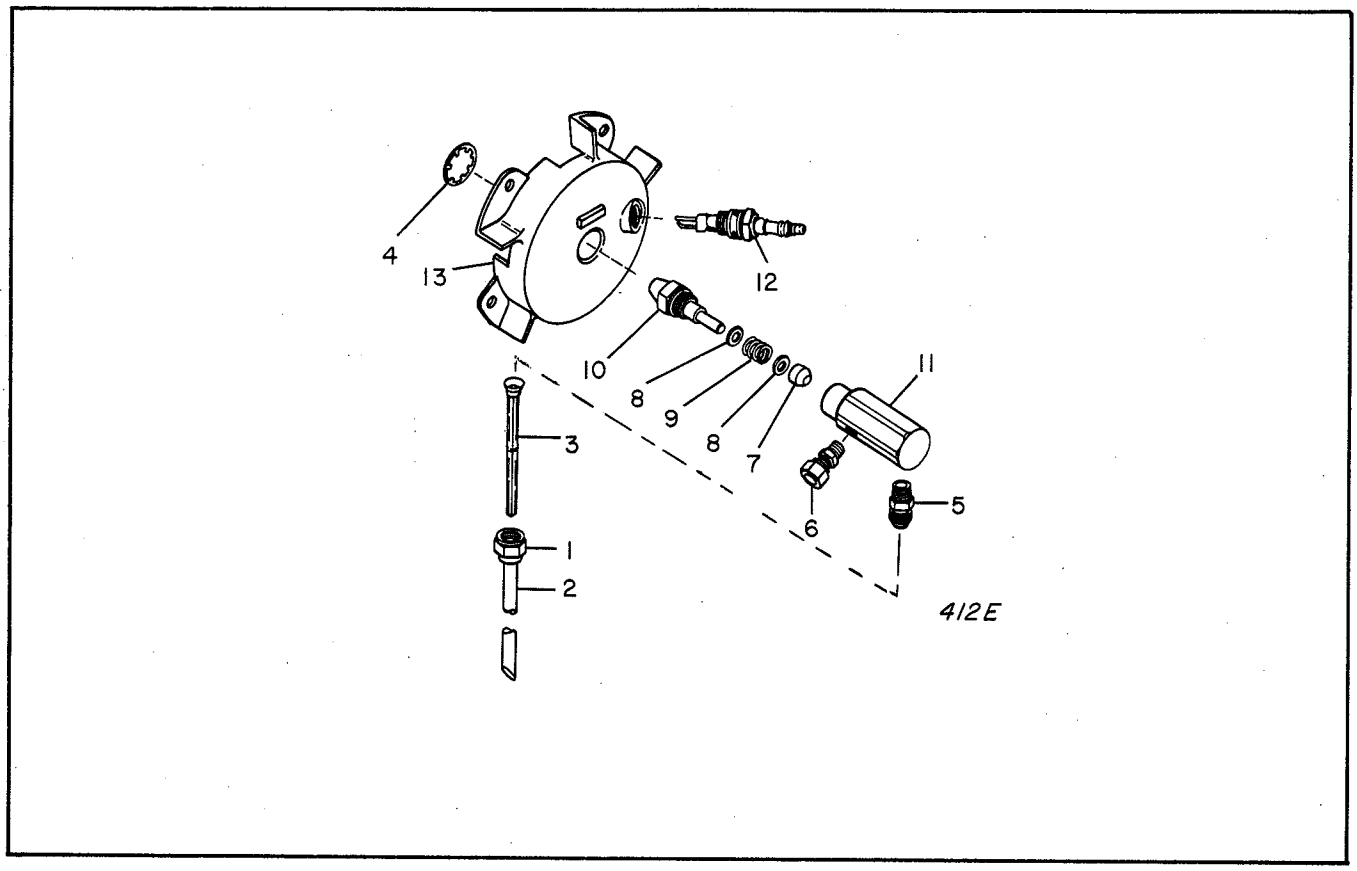

Figure 14. Burner Head Assembly

Fig.& Index No.	Part Number	Part Name	Qty.
14-1	M13849	Nut, Flare	1
2	+M16790-3	Filter Tube	1
3	+M19630	Filter, Fuel	1
	M16803G3	Burner Head Assy	1
4	M16741-18	. Ring, Retaining	1
	M16787G3	. Nozzle Adaptor Assy	1
5	M16791	. . Connector, Male	1
6	M5976	. . Connector, Male	1

Fig.& Index No.	Part Number	Part Name	Qty.
14-7	M8882	. . Sleeve, Nozzle Seal	1
8	M10659-1	. . Washer, Nozzle Seal	2
9	M10809-1	. . Spring, Nozzle Seal	1
10	M18022	. . Nozzle, Aspirating, 1.0 gph	1
11	M16535	. . Adaptor, Nozzle	1
12	M16895G1	. Spark Plug Assy	1
13	M18023	. Body, Burner	1

+ Indicates parts which replace Fuel Filter Assembly Part No. M16789G3. Filter tube Part No. M16790-3 must not be used without Fuel Filter, Part No. M19630.

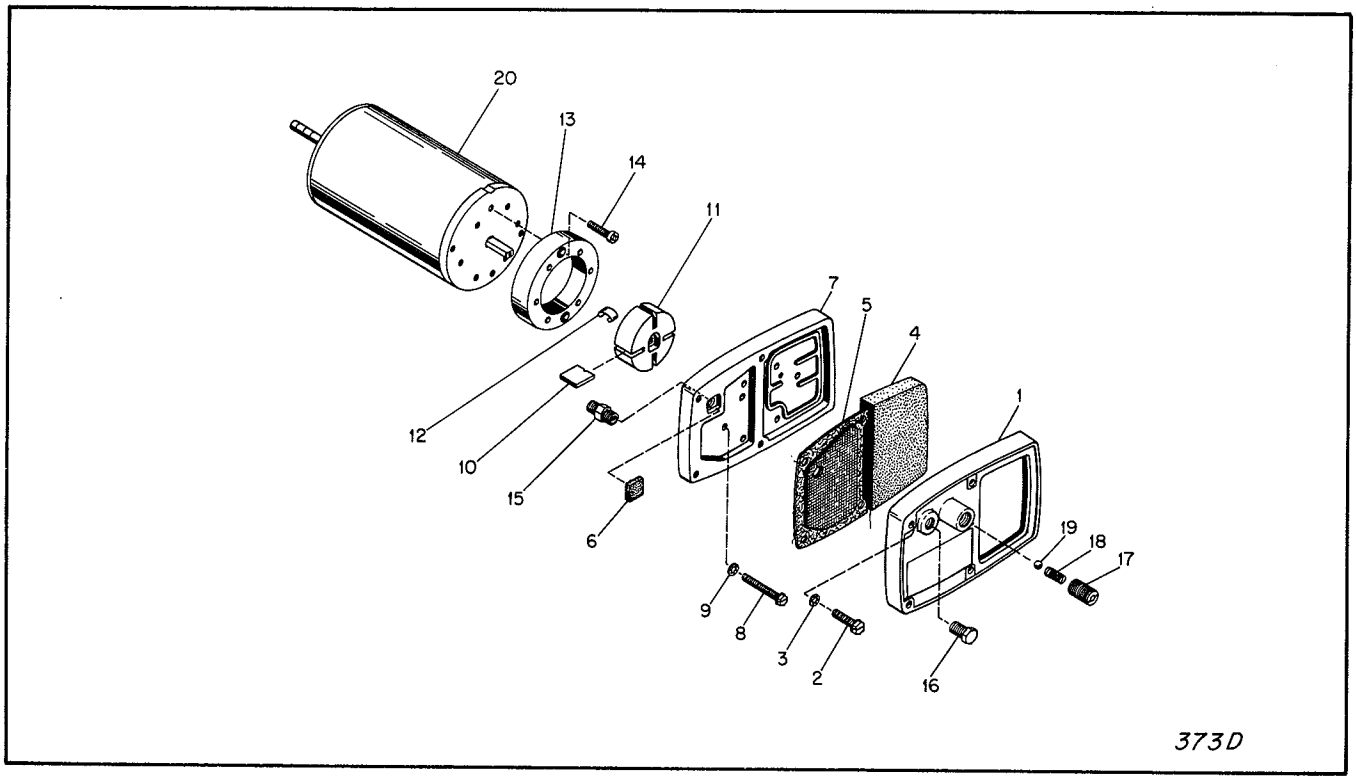

Figure 15. Motor Package Assembly

Fig.& Index No.	Part Number	Part Name	Qty.
15-	M16805G1	Motor Package Assembly (See Figure 13, Index No. 9) @ &	1
	M17875G1	Motor Package Assembly (See Figure 13, Index No. 9) @ & &	1
1	M16545	. End Cover, Filter	1
2	*M12461-31	. Screw (Filter End Cover to Pump End Cover)	4
3	WLI-3	. Lockwasher, Internal No. 10	4
4	M12179	. Intake Air Filter @	1
5	M12244G1	. Output Filter Assy @	1
6	M11637	. Filter, Lint @	1
7	M12233	. End Cover, Pump (Port Plate)	1
8	*M12461-34	. Screw (End Cover to Motor)	6
9	WLI-3	. Lockwasher, Internal No. 10	6
10	M8643-3	. Blade	4
11	M13635-3	. Rotor	1

Fig.& Index No.	Part Number	Part Name	Qty.
15-12	M14856	. Spring	1
13	M8645-3	. Pump Body	1
14	*FHPF3-7C	. Screw (Pump Body to Motor)	2
15	M5976	. Connector, Male	1
16	M10837	. Pipe Plug, Hex hd.	1
17	M10992-1	. Screw, Pressure Adjustment	1
18	M10993-1	. Spring, Compression (Pressure Relief)	1
19	M8940	. Ball, 1/4 in. dia.	1
20	M12811	. Motor &	1
	M17814	. Motor &&	1
	M8608	. End Shield, Motor (Pump-end)	1
	M17316	. End Shield, Front (Fan-end) (For M17814 motors)	1
	M17327	. End Shield, Front (Fan-end) (For M12811 motor only)	1

* See listing of standard screws, purchase locally.
@ Parts recommended for normal replacement by owner or user.
& Spec. 2968G11 heaters only.
&& Spec. 2968G11-1 and 3059G8 heaters only.

Fig.& Index No.	Part Number	Part Name	Qty.
16-	M16143	Thermostat Assy (See Fig. 13, Index No. 34)	1
	M18016G1	. Thermostat Assy (Less Cable)	1
1	M16152	. . Knob, Thermostat	1
2	M16154	. . Spring, Thermostat Knob	1
3	M16147	. . Cover, Thermostat	1
4	M18021G1	. . Thermostat Back and Element Assy	1
5	M11954	. . Bushing, Strain Relief	1
6	M17063G1	. Cable Assy	1

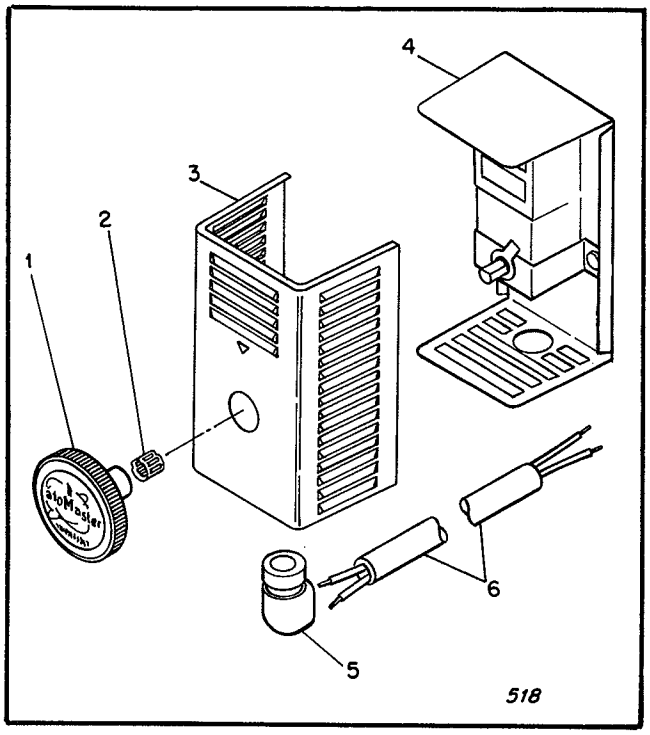

Figure 16. Thermostat Assembly

Fig.& Index No.	Part Number	Part Name	Qty.
17-1	M17879	Decal, Wiring Diagram	1
2	M14994	Decal, Trade Name	1
3	M17159	Decal, Private Label	1
4	M17134	Decal, Nameplate and Operation Instructions	1
	M18050-4	Decal, Model Data @	1
	M18050-9	Decal, Model Data @ @	1
	M21397-8	Decal, Model Data ¢	1
5	M15813	Handle, Rear @ @	1
	M15813-2	Handle, Front and Rear @	1
	M15813A	Handle, Rear ¢	1
6	M15812A	Handle, Front ¢	1
7	M12831-2	Frame, Wheel Support @	1
	M12831B	Frame, Wheel support @@	1
8	M12345-31	Screw	2
9	M12345-34	Screw	8
10	WP-3C	Washer, Flat No. 10	2
11	NTC-3C	Nut, torque lock No. 10-24	10
12	M16802	Hub Cap	2
13	M16741-15	Ring, Retaining	2
14	WP-8C	Washer, Felt, 1/2 inch	2
15	M19294	Wheel	2
16	M16801-2	Axle	1

¢ Spec. 30598G heaters only
@ Spec. 2968G11 heaters only
@ @ Spec. 2968G11-1 heaters only

TOUCH-UP PAINT	
M13386-6	Paint, red, Aerosol can
M13386-7	Paint, White Aerosol can
M13386-8	Paint, black, Aerosol can

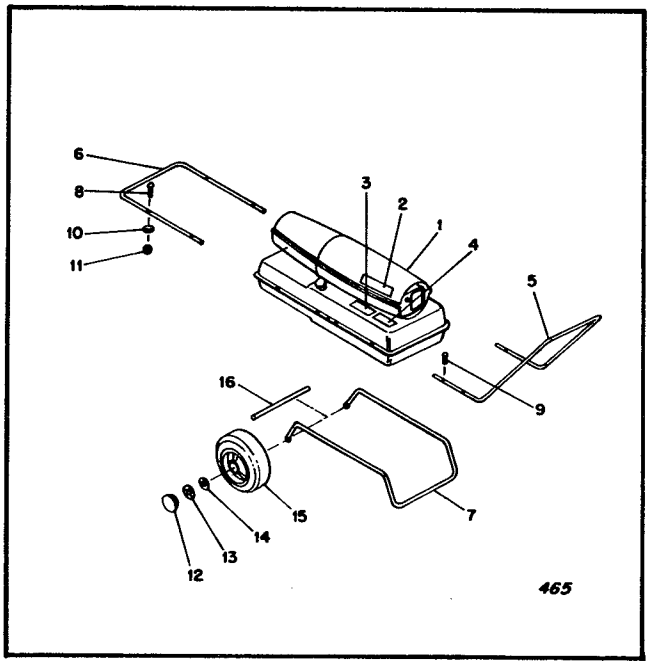

Figure 17. Wheels, Handles, and Markings

STANDARD SCREWS

FHPF3-7C	Screw, Fillister hd, No.10-32 x 7/8 in.
HC4-10C	Screw, Hex hd. machine, 1/4-20 x 1-1/4 in.
M11084-27	Screw, Self-tapping, hex hd. No. 10-12 x 1/2 in., Type "A"
M11084-29	Screw, Self-tapping, hex hd, No. 10-12 x 3/4 in., Type "A"
M12345-31	Screw, Oval hd. machine, No. 10-24 x 1-1/4 in.
M12345-34	Screw, Oval hd. machine, No. 10-24 x 2 in.
M12461-31	Screw, Hex hd., No. 10-32 x 1 in.
M12461-34	Screw, Hex hd., No. 10-32 x 1-1/2 in.
M15823-26	Screw, Self-tapping, hex hd., No. 10-12 x 3/8 in., Type "B"
M10908-1	Screw, Self-tapping hex hd. No. 6-32 x 1/4 in., Type S
M12461-51	Screw, Hex hd., No. 10-24 x 1/2 in.
RC2-2C	Screw, Rd. Hd., 8-32 x 1/4 in.