

MASTERMATIC 4000

MANUAL

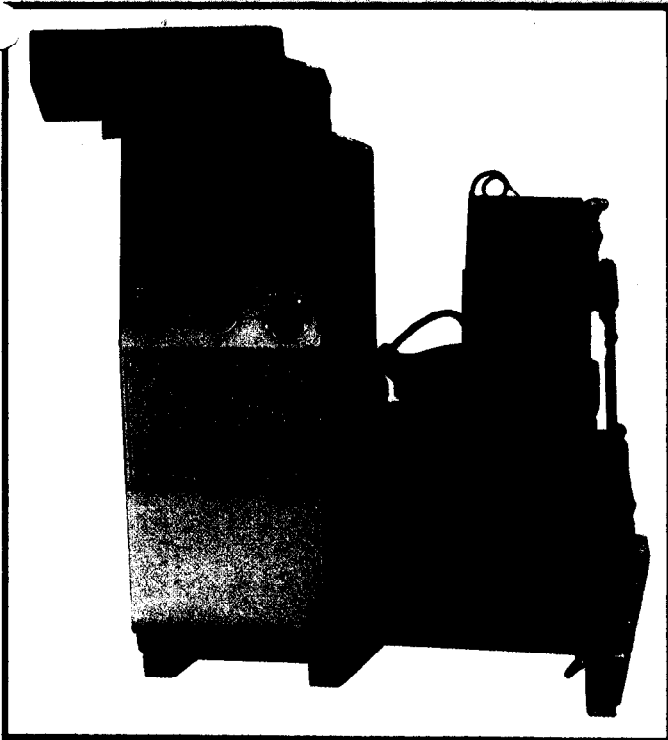


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**STEAM
WAY**



STEAM WAY 4000



MASTER MATIC

STEAM WAY 4000

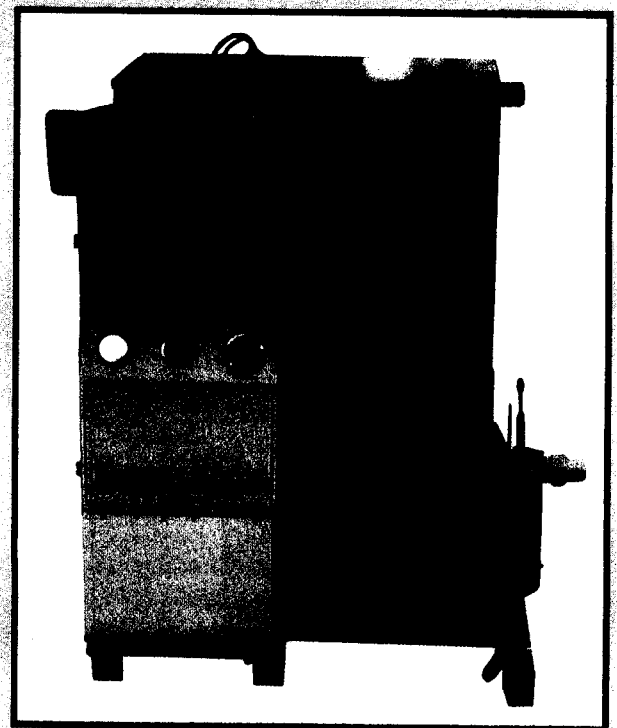
TRUCK MOUNTED CLEANING PLANT

**Residential and Light Commercial
Cleaning Machine**

STEAM WAY'S REPUTATION FOR UNCOMPROMISING QUALITY...

- Compact and Lightweight
- Efficient Fuel Oil Heating
- Reliable and Energy Efficient
- Optimum Cleaning Performance
Compared To Competitive Machines

**"SIMPLY STATED . . .
THE MASTER OF ITS CLASS"**



INTERNATIONAL

MACHINE SPECIFICATIONS FEATURES/BENEFITS

- Kohler Magnum 18 HP engine. Recognized worldwide as the best of all small industrial engines, this Kohler engine provides the needed horsepower for a longer engine life, less maintenance, and a more consistent performance.
- Roots 33RA1 Industrial Blower - operated at optimum factory-recommended speed for longer life and less maintenance. At 10" Hg, the blower develops 150 cfm.
- Cat SF22 Pressure pump produced up to 1,000 P.S.I. for pressure washing. Easy access for maintenance.
- 220,000 BTU Fuel Oil Burner. Can attain and maintain solution temperatures up to 210°F at 1.7 GPM. The higher efficiency of the fuel oil burner allows for maintaining highest allowable solution temperatures.
- 70 Gallon Waste Recovery Tank is manufactured of sturdy aluminum for longer life and prevention of rusting. Easy access for cleaning. Reinforcing baffles prevent flexing and reduce splashing. Detachable. Can be located at most convenient location in vehicle.
- Instrumentation
 - Temperature control allows cleaning technician to adjust solution temperatures in each situation.
 - Glycerin-filled pressure gauge monitors solution pressure output.
 - Hour Gauge - for costing and maintenance scheduling.
 - Temperature Gauge - for accurate monitoring of solution temperature.
 - Heater activation switch and indicator light.
 - Dwyer Visi-Flow chemical valve for accurate metering of chemical into solution.
- Easy Access Pressure Regulator to adjust solution pressures.
- Exhaust Control System takes hot air away from engine for less maintenance and longer life.
- Hinged Coil for access for ease of maintenance and service of heater burner.
- All belts can be removed without engine or blower removal.
- Quiet, simple operation.
- Completely Independent slide in and out operation. Can be moved from one vehicle to another.
- Blower protection system prevents foreign objects from entering and damaging blowers.

BASIC STARTER KIT

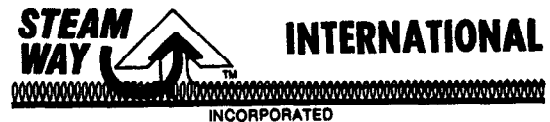
- MASTER-MATIC Cleaning Plant
- 12" Stainless Steel Scrub Wand
- 100' ¼" High Pressure Solution Hose with Q.D.'s
- 100' Vacuum Hose with Cuffs
- 50' Water Hose - Intake with Valve Assembly
- Two Fuel Tanks
- Manual

OPTIONAL ACCESSORIES

- Vacuum and Pressure Hose Roll-up Reels
- Drag Wands
- Upholstery and Stair Cleaning Tools
- Fresh Water Holding Tanks
- Viewmaster Filter
- Magna-Force Waste Disposal System
- High Pressure Washing Guns
- E.P.C. 280 Hood Vent Cleaning Wand
- E.P.C. 380 Hard Surface Cleaning Wand

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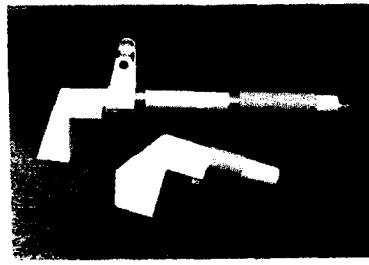
2" Stainless Steel Scrub Wand



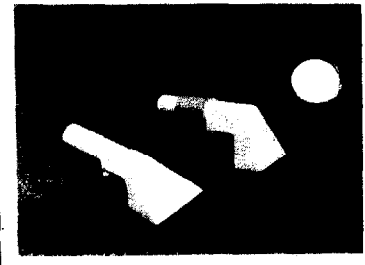
Drag Wands



Stair Tools



Upholstery Tools



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INTRODUCTION

The Steam Way 4000 MASTER-MATIC Cleaning Plant, truck-mounted carpet & upholstery cleaning unit by Steam Way International, Inc., is built for simplicity in ease of operation and maintenance. Even though simple in operation and easy to maintain, it delivers a superb job in carpet & upholstery cleaning along with the ability to perform as a high pressure steam cleaner.

The unit comes equipped with a powerful Magnum 18 HP Kohler engine. The engine has an electronic ignition system known for its maintenance-free, quick-and-easy starting ability. The cylinders are made of cast iron, specially formulated to provide long life and reboring capability for an even longer life.

A carefully selected vacuum blower by Roots, Model 33RA1, develops an enormous CFM at recommended operating speed for fast drying and lifting ability.

The engine is equipped with an oil pressure kill switch to stop the engine in the event of low oil pressure.

Steam Way International has chosen for this unit's high pressure water pump, a pump by Cat, Model SF22, which can deliver up to 1000 PSI of water pressure. Any desired PSI within the range of the pump can be selected by adjusting the regulator for that pressure quickly and easily.

This Model 4000 MASTER-MATIC has as its water heater, a fuel oil burner that produces 220,000 BTU of heat. Its recommended fuel is kerosene with a consumption of approximately one-half gallon per hour.

The heater is thermostatically controlled and has a safety device, the water flow switch, which allows the heater to fire only when water is moving.

The waste recovery tank holds 70 gallons of water. It is made of aluminum and has baffles for reinforcement and reduced splashing. A screen mounted inside the tank insures that no debris can ever enter the vacuum blower. A cut-off switch is installed near the top of the tank to stop the engine when the tank is full to prevent a blowover. To empty the tank, a two-inch dump valve is installed which allows rapid release of the water.

Remember that water does freeze at 32° F; so whether or not the unit is in use, in transit, or parked, it MUST be protected from freezing.

BEFORE OPERATING YOUR MASTER-MATIC 4000, STUDY THIS MANUAL!

SECTION 3

INSTALLATION OF UNIT

In most cases, this unit can be installed near either the rear door or the side door of your vehicle. In either case, pay close attention that the exhaust (burner-engine) is as close as possible to the door, so that the air scoop will expell the hot gases from the vehicle; but, yet, when detached, the door will close.

Close inspection must be made prior to bolting the unit to the vehicle, that all is clear beneath the vehicle. Look for such things as gasoline tanks, brake and gas lines, cross members; and be certain that no damage will result when drilling holes at that spot.

Install your unit in a safe manner, securing the unit so that in the event of an accident, the machine will not advance to the driver or passenger seat. We feel that no less than three 3/8 bolts be used and that large washers be used beneath the floor of the vehicle so that the bolts will not be pulled through the floor in an accident.

Since the waste tank is not attached to the basic unit, its location can be where desired or applicable. It, too, must be secured as described in the previous paragraph for the machine. Other equipment in the vehicle should be stored when the vehicle is in motion.

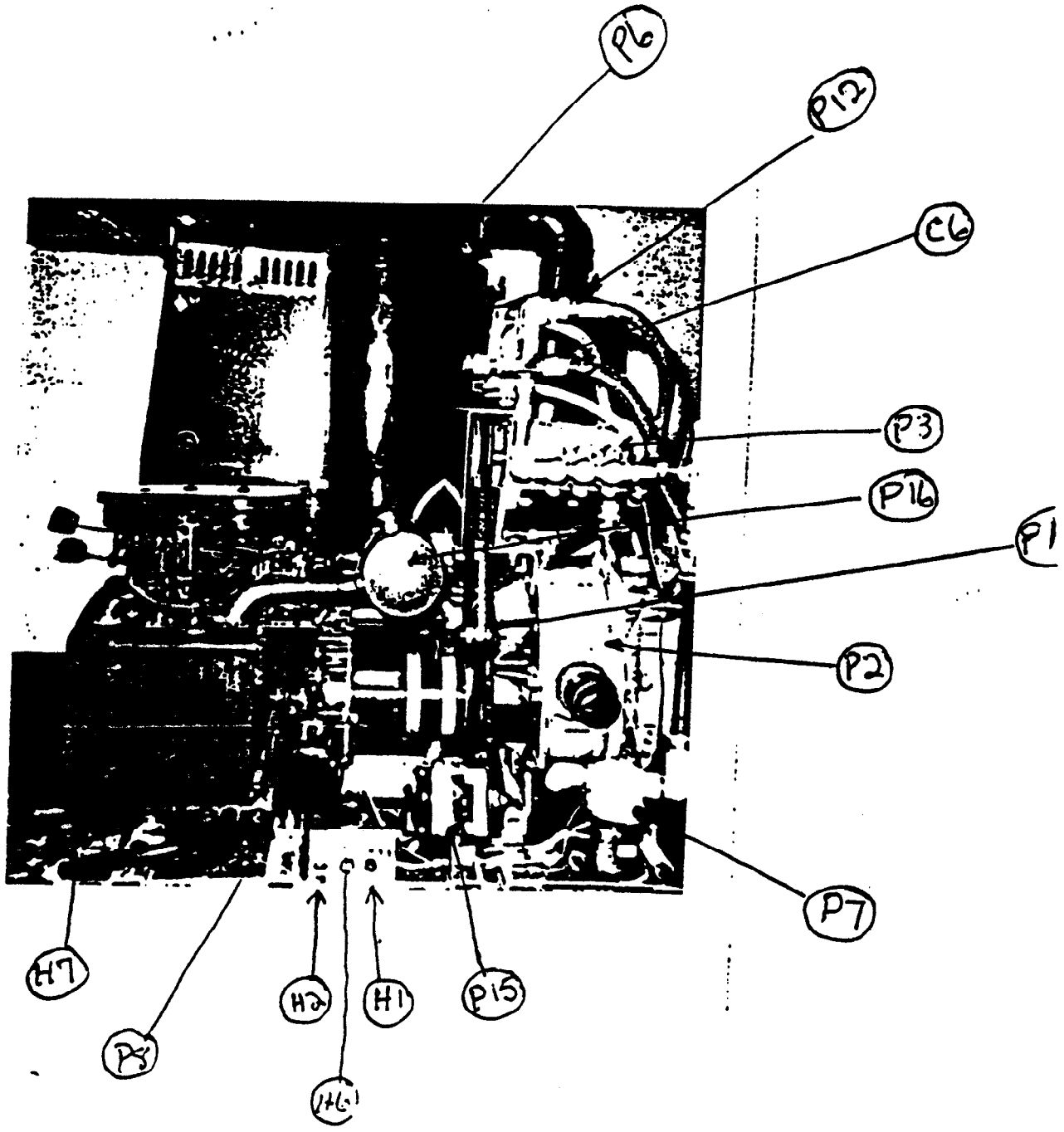
To maintain cooler operating temperatures in the van, a roof vent may be installed. Roof vents are available at Steam Way International.

SECTION 4

PRE OPERATIONAL INSTRUCTIONS

Before starting the Model 4000 MASTER-MATIC, several operations must be complied with:

- 4-1 Fill the gasoline tank (Red) with regular unleaded fuel (Kohler's recommendation). The connecting hose has a female connector that connects to point H-1 (figure 4-1) on the right side of the machine. Fill the kerosene tank (green) with kerosene or #1 diesel fuel. With its connecting hose which goes to Point H-2 (figure 4-1), bleed it by pushing the male connector against something solid; and by pumping the squeeze ball, all air can be dispensed before making connection to female connector H-2 (figure 4-1). A return line from the burner fuel pump to the filler cap on the kerosene tank must always be connected and the cap must be secured.



4-1

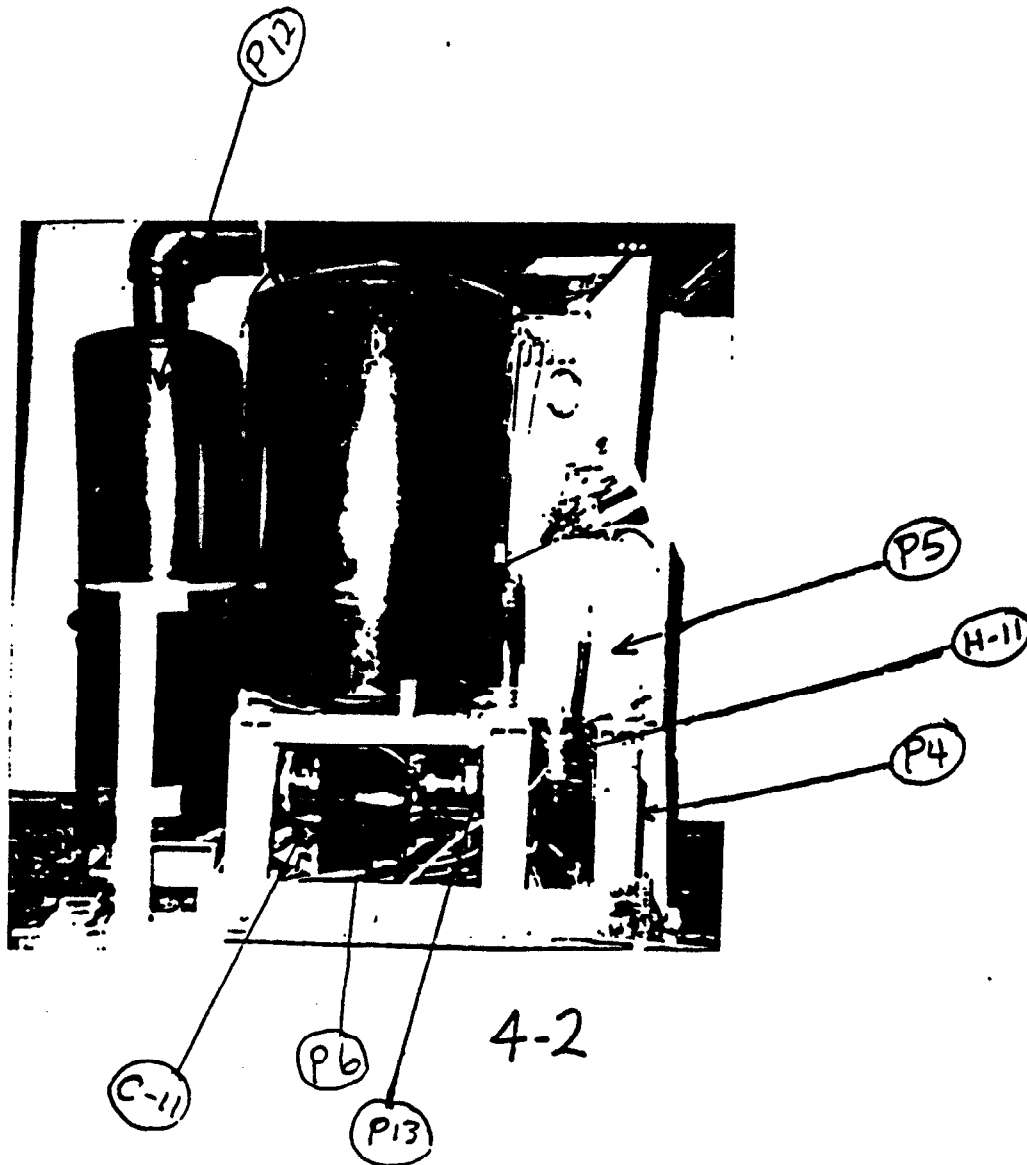
CAUTION

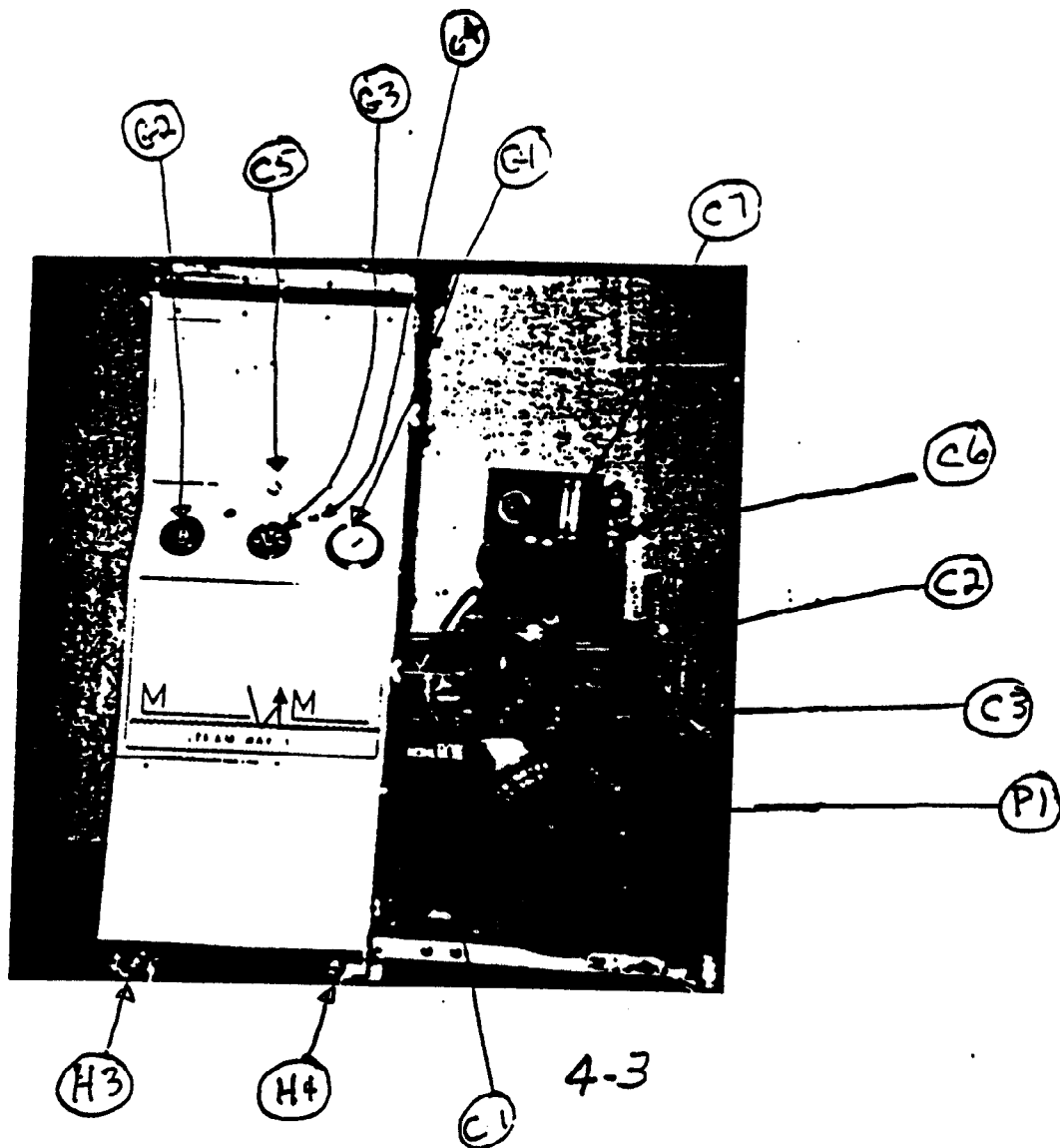
For safety, always leave the supply hoses on the fuel tanks. When it is necessary to remove a tank for filling, remove the hose at the quick disconnect (H-1 or H-2) on the side of the machine. In this way, no incorrect reconnection can be made. Gasoline must never be applied to the heater, nor kerosene to the Kohler engine.

Condensation of water in the burner fuel tank causes a rapid deterioration of the fuel pump. As condensation of water in the fuel tank cannot be prevented, the addition of a fuel additive is suggested. A standard gas-line anti-freeze may be used at a ratio of 2 to 4 ounces per 6 gallons of fuel. The additive is available under many brand names, one of which is Heet. Another very effective method of removing water from the tank is by dumping the fuel occasionally, especially when the tank is very low on fuel; and by rinsing with a pint of clean fuel, this will remove water and debris from the tank.

4-2 FLUSHING PROCEDURE (before first start-up)

Before filling the water holding tank (P-5, Figure 4-2), disconnect quick disconnect (Q.D.) (H-11, Figure 4-2) and connect the input water hose assembly supplied with the machine to the female Q.D. Raise the lower hinged part of the front panel to gain access to another Q.D. in the pressure output line in front of the battery. Disconnect the male portion of the Q.D. and leave it hanging outside the machine. Now, turn the water on with the input valve assembly attached to the garden hose, and water will flush out anti-freeze or stale water that was left in the machine during shipping. Within a few seconds, clean fresh water will be observed at the male Q.D. (H-12, Figure 5-1). When the hoses have been repositioned to the original positions, the flushing procedure is complete.



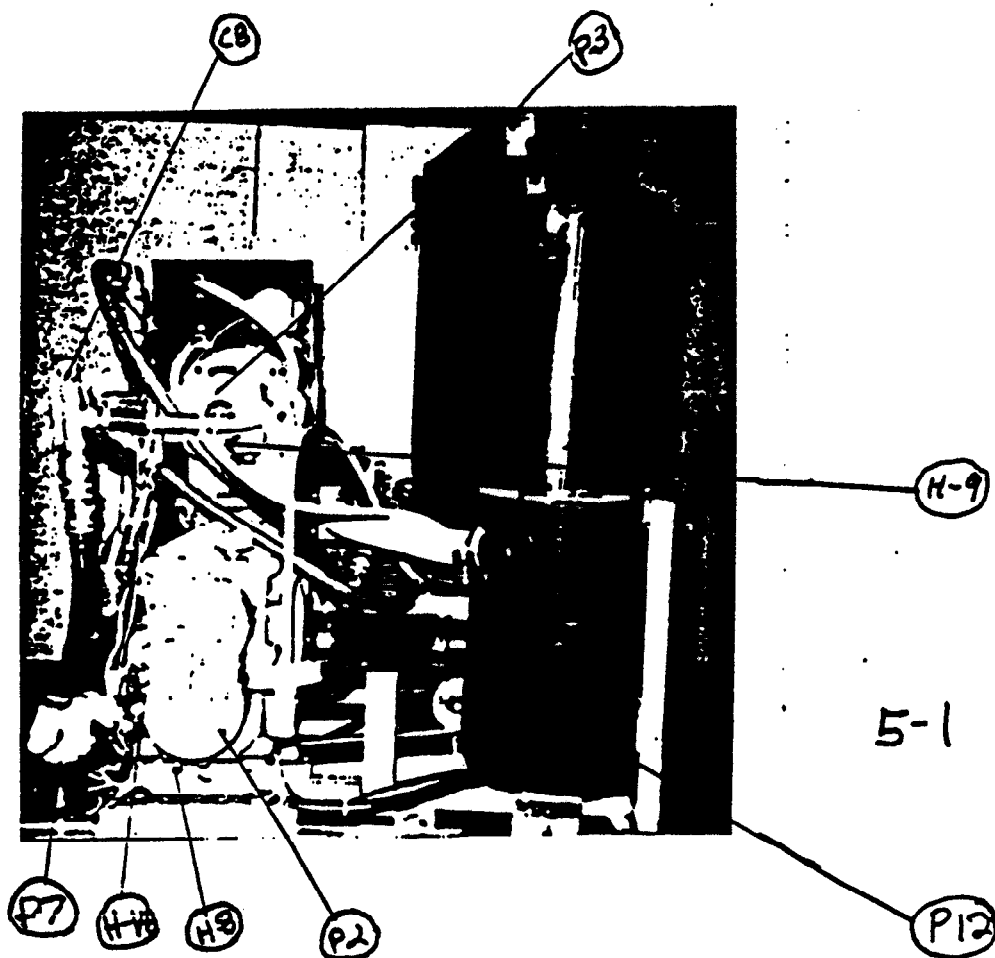


- 4-3 With the input valve assembly and garden hose attached to the water faucet, you now must fill the water holding tank (P-5) by inserting it into H-3 (figure 4-3). When the tank is filled to a predetermined level, the float control valve (C-13) will shut the water off.
- 4-4 Fill the chemical container (P-19) with either a powder cleaning agent, Formula A, or liquid cleaning agent, RS2000, premixed as per chemical manual supplied with your standard basic starter kit.
- 4-5 Snap the hood vent to the UP position. (Never operate with it in the DOWN position.)

OPERATING PROCEDURES

5-1 PRE OPERATIONAL CONTROL SETTINGS

<u>Control</u>	<u>Number</u>	<u>Figure</u>	<u>Set To</u>
Engine Ignition Switch	C-1	4-3	Off
Engine Throttle	C-2	4-3	Closed
Engine Choke	C-3	4-3	In
Heater Switch	C-4	4-3	Off
Temperature Control	C-5	4-3	Low
Dump Valve	H-10	8-1	Closed
Soap Flow Meter	C-7	4-3	As Desired
Pressure Regulator	C-6	4-3	As Desired
Hood Vent	H-13	6-1	Up



5-1.1 Check Engine Oil, Blower Oil and Cat Pump Oil Levels

5-2 STARTING

- 5-2.1 Connect input water to H-3 (figure 4-3) and turn On.
- 5-2.2 Attach vacuum line from H-5 (Figure 8-1) to cleaning tool.
- 5-2.3 Connect high pressure hose from H-4 (figure 4-3) to cleaning tool. If it is the first job of the day, we suggest that special fabricated hose be connected to H-4 (figure 4-3) and left until the unit has run for 2 or 3 minutes to discharge possible rusty water from coils. Flushing procedure in Paragraph 4-2 will accomplish the same.
- 5-2.4 Engine now is ready to start. Open the throttle slightly. Pull the choke closed (if engine is cold). Turn the ignition switch to start position. When engine starts, push the choke back in.
- 5-2.5 Bring engine up to operating speed (throttle against mechanical stop) preset at Steam Way International.
- 5-2.6 If special fabricated discharge hose is connected to H-4 (figure 4-3), the movement of water can be observed and the pump can flush the heater coils. This would constitute water flow and the heater operation could be tested at the same time. The engine will have to be stopped to remove hose and reconnect to normal operation.
- 5-2.7 Re-establish the same condition as Paragraph 5.2-5. Turn the heater switch (C-4) on and select the desired safe cleaning temperature (C-5). (The burner should NOT come on until water is made to flow).
- 5-2.8 The soap solution control (C-7) may have to be reset after the cleaning operation has begun to get the desired results.

5-3 RUNNING

<u>Control</u>	<u>Number</u>	<u>Figure</u>	<u>Position</u>
Engine Ignition Switch	C-1	4-3	ON
Engine Throttle	C-2	4-3	OPEN to mechanical stop
Engine Choke	C-3	4-3	IN
Heater Switch	C-4	4-3	ON for heat
Temperature Control	C-5	4-3	As desired
Pressure Regulator	C-6	4-3	Set for pressure desired:

Pressure Examples

- A. Pressure washing 800 PSI
- B. Carpet Cleaning 425 PSI
- C. Upholstery cleaning 175 PSI

Soap Flow Meter	C-7	4-3	As needed
Dump Valve	H-10		CLOSED
Vacuum Relief Breaker	C-17		13 Hg

- 5-3.1 During the cleaning operation or water recovery operation, if the engine stops suddenly, it is likely that the waste recovery tank has filled and the float switch (C-16) has stopped the engine.
- 5-3.2 Observe closely the fuel quantities during operation, especially during big jobs.
- 5-3.3 Pay close attention to the amount of soap solution in the solution container (P-19). Running out will result in a loss of pressure and could do serious damage to the water pressure pump (P-3).
- 5-3.4 When this unit is used for water extraction ONLY, the pump belt MUST be removed. The belt is removed by forcing the spring loaded idler pulley (P-18, figure 4-1) down. (A wrench on the Nut is suggested).

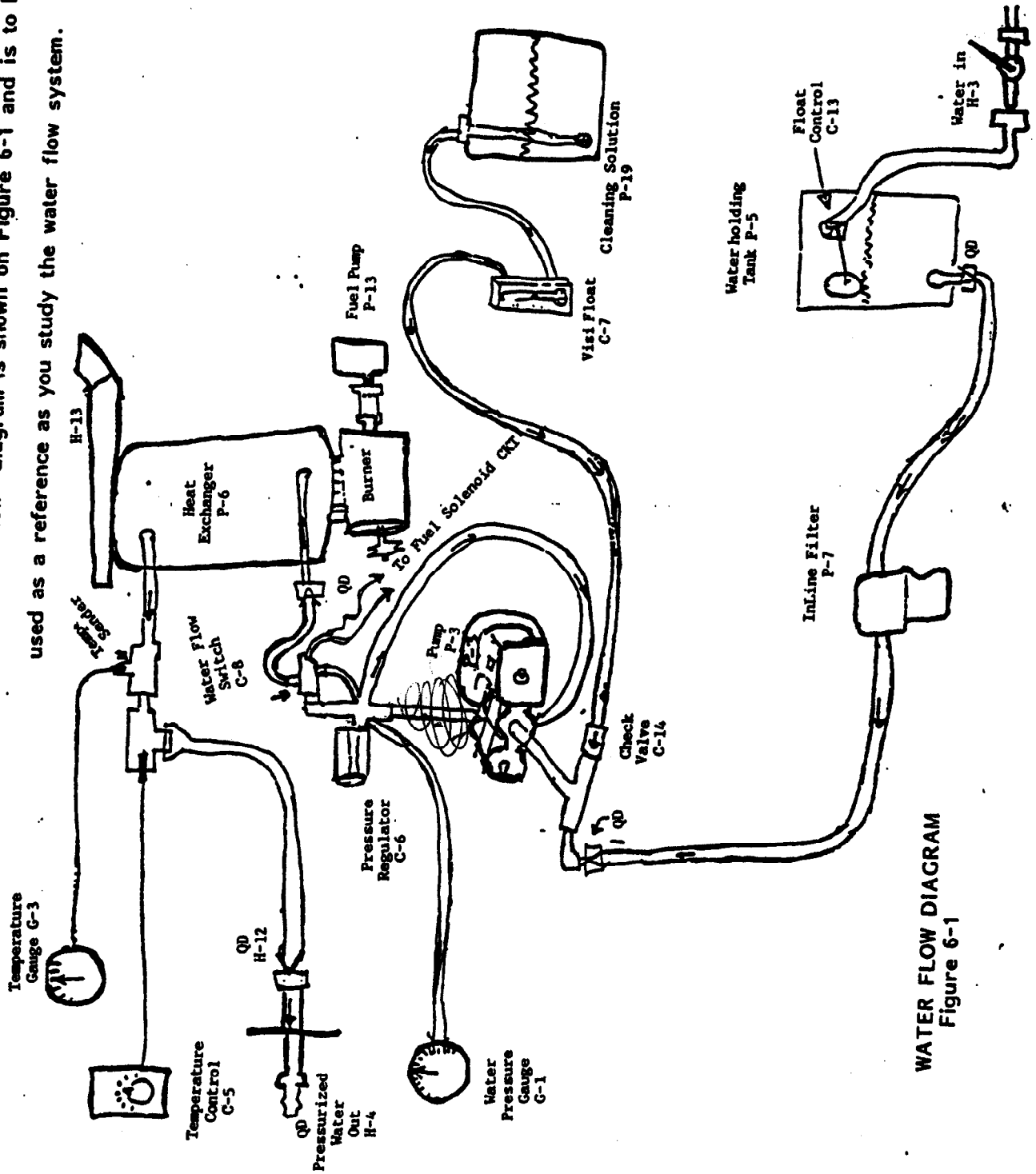
5-4 **SHUT DOWN**

- 5-4.1 Turn heater switch (C-4) off.
- 5-4.2 Move engine throttle control (C-2) to closed.
- 5-4.3 Turn ignition switch (C-1) to Off.
- 5-4.4
 - A. Retrieve tools from job site and store
 - B. Disconnect vacuum hose and place in vehicle.
 - C. Disconnect pressure hose to roll up or store.
- 5-4.5 In cold weather, use the most expedient method to get hoses and tools into the vehicle to keep from freezing.
- 5-4.6 Inspect the waste recovery tank
 - A. Drain when and where appropriate.
 - B. **THOROUGHLY CLEAN THE LINT SCREEN.** This system must be free of lint to do a good cleaning and drying operation.
 - C. Rinse out the waste tank **FREQUENTLY** while the dump valve is open.

Disconnect the water input valve assembly from H-3 to rinse the waste recovery tank while the water input hose is still connected to the water faucet.
 - D. Turn water faucet off, relieve the pressure in the hose, roll up and place in vehicle.
 - E. Re-install pump belt if the unit was being used for water extraction.

WATER SYSTEM

The water flow diagram is shown on Figure 6-1 and is to be used as a reference as you study the water flow system.



WATER FLOW DIAGRAM
Figure 6-1

- 6-1 The water pump (P-3) has two reservoirs of liquids to draw from.
- A. The water holding tank (P-5) which is continuously refilled by the water input hose assembly. The hose assembly is attached to H-3 female Q.D. in front of the machine.
 - B. The cleaning solution container (P-19), which contains the pre-mixed solution of Formula A or RS2000.
- 6-2 When a demand for water by the pump (P-3) is made (cleaning tool turned on), water and solution will be drawn (sucked) from the two tanks mentioned above. The amount of detergent solution is controlled by the visi float control (C-7).
- 6-3 Chemicals and water are mixed in the tee connector just prior to entering the water pump (P-3). Note that a one way check valve (C-14) is installed in the chemical line just before the mixing tee. This will prevent water from backing into the solution container when water is forced into the mixing tee.
- 6-4 As the cat pump (P-3) is being driven by the engine, three plungers are drawing water and solution on the back stroke and are pushing or pressurizing water on the forward stroke. This causes a movement of approximately three gallons of water per minute. Follow the water output of the pump from the discharge manifold which goes to the pressure regulator (unloader) (C-6).
- 6-5 It is very important to note that an oil level sight gauge with a red dot in the center is for checking the oil when the unit is NOT in operation. The oil level should be adjacent to the red dot. The Cat pump (P-3) uses a special cat pump oil.

- 6-6 As the water reaches the pressure regulator (C-6), a back pressure is felt, causing the unneeded water to bypass back to the pump; however, the pressurized usable water is directed into and through the water flow switch (C-8), electrical contacts will be made indicating to the heater circuit (to be studied later) that water is flowing. Note that a gauge line is connected to the water flow switch (C-8) so that the water pressure can be monitored on the water pressure gauge (G-1).
- 6-7 From the flow switch, water is directed into and through the heater coils (P-6) where the water is heated to the desired temperature. With the adjustment lug on the regulator (C-6), you may adjust the pressure to any desired pressure.
- 6-8 As the water leaves the heater coils (P-6), temperature monitors are installed for the temperature gauge (G-3) and temperature control (C-5), the water leaves the machine at the male connector (H-4) and is sent to the cleaning tool via steel braided high pressure hoses.
- 6-9 **CAUTION** When the cleaning tool is not in use (i.e., drying, moving furniture), the pressure regulator is bypassing all of the water causing a rapid increase in water temperature in the pump, which will cause damage to the pump. The Cat pump manufacturer suggests that a time limit of **SIX MINUTES** is maximum for this situation.

SECTION 7

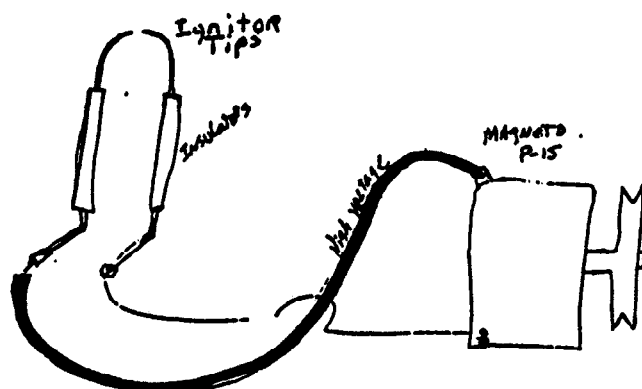
HEATER SYSTEM

7-1 When the engine is running, it drives via a V pulley and belt mechanism two major components for the heating system.

- A. The magneto (see figure 7-1)
- B. The fuel oil burners - fan and fuel pump

7-2 As the engine's throttle is advanced to the operating speed, it causes the magneto (P-15) to produce a very high voltage. This voltage is sent to the ignitor tips where a 1/8 inch gap causes the arc (spark) which ignites the fuel (see figure 7-1).

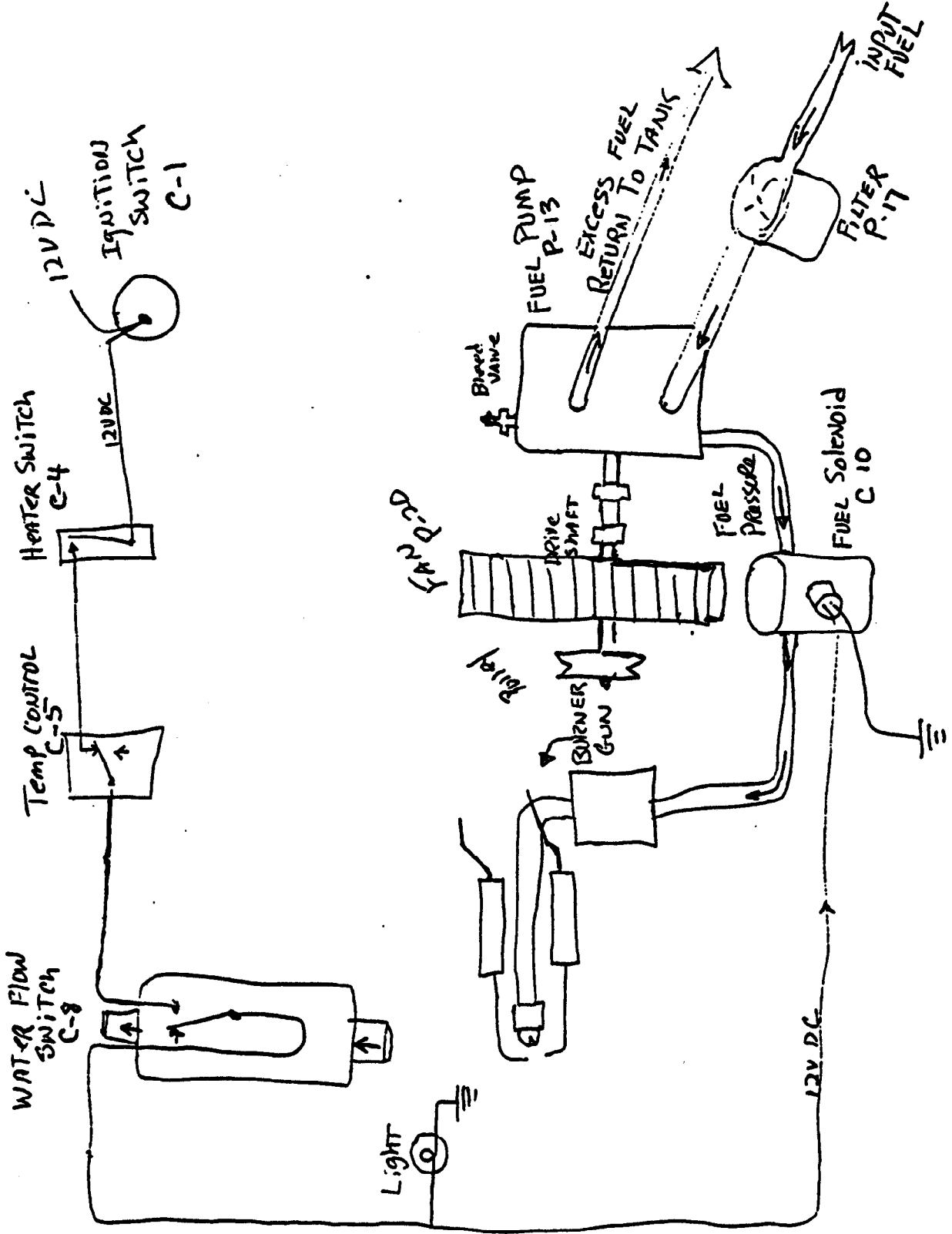
CAUTION: A very high voltage is present in this circuit; use extreme caution when trouble-shooting or repairing.



High Voltage Circuit
7-1

7-3 The same V belt also drives the pulley on the fuel oil burner. This pulley turns a squirrel cage fan (P-20) (see figure 7-2) which produces oxygen necessary to cause ignition of the fuel. Not only does it turn the fan (P-20), but it also drives the burner fuel pump (P-13). The fuel pump draws fuel from the (green) kerosene tank charging the fuel pressure to approximately 100 PSI. When the fuel reaches the solenoid (C-10), it can go no further until certain conditions are met. All excess fuel is returned to the kerosene tank by a bypass line causing the fuel pressure to remain the same at all times.

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FUEL Solenoid Circuit 7-7

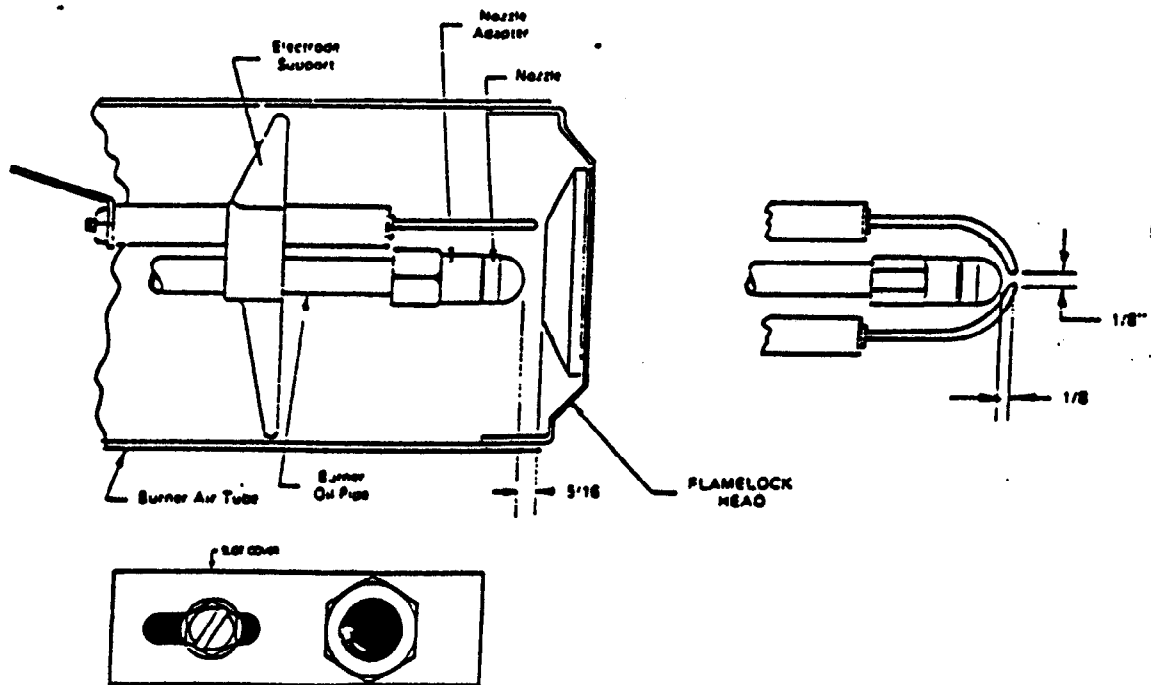
Figure 7-3
BURNER ADJUSTMENT

Removing Gun Assembly: Disconnect the oil line at the fan housing and remove lock nut on copper tube fitting. Remove rectangular plate, gun assembly now can be removed through this opening.

BURNER NOZZLE

Check nozzle size as to conformance to installation requirements. Install nozzle by screwing into hexagon adapter.

Spacing of Electrodes: The electrodes should be spaced $1/8$ inch apart. They should extend $1/8$ inch beyond the end and $1/2$ inch above the center of the nozzle tip as shown in drawing below



Air Adjustment: The air intake is located on the left side of the blower housing and consists of two interlocking bands. To adjust, loosen screw in outer band and position band by rotating to the desired opening. Retighten screw after adjustment to assure permanent adjustment.

Sufficient air should be introduced into the fire until a Number 1 or trace of smoke is obtained. (Check with smoke tester). The screws should then be locked in position.

7-4 Now to get the fuel solenoid (C-10, figure 7-2) open, so that the fuel can pass through enroute to the burner gun, refer to Figure 7-2. The fuel solenoid (C-10) is operated by 12 volts DC which originates at the ignition switch. Follow the circuit from the ignition switch (C-1), to the heater switch (C-4, through the temperature control (C-5), and finally through the water flow switch (C-8). You will observe that all switches must be closed to get voltage to the fuel solenoid.

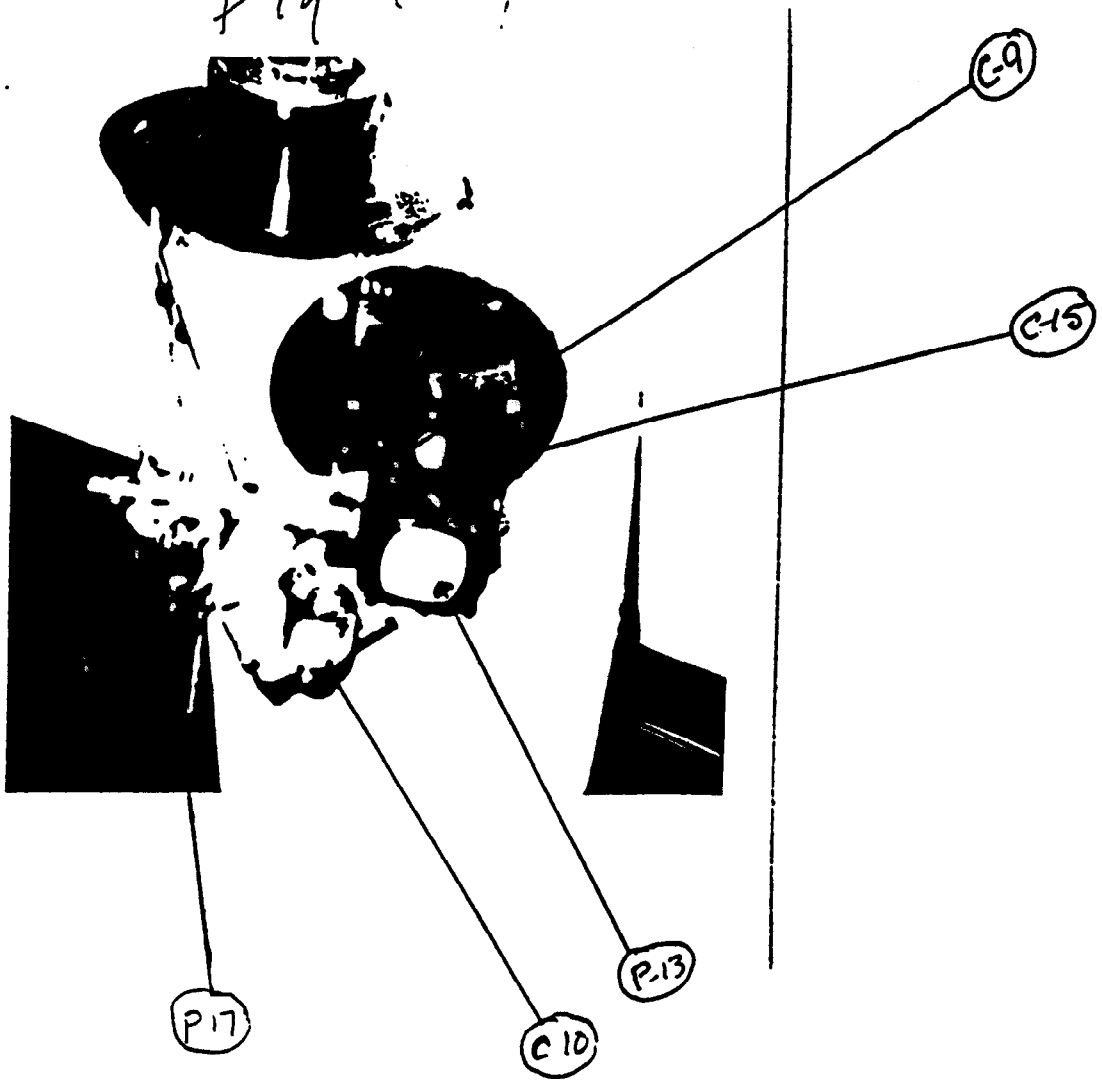
- A. Ignition Switch (C-1) ON
- B. Heater switch (C-4) ON
- C. Temperature Control Switch (C-5) ON (temperature demand)
- D. Water flow switch (C-8) Closed (water moving)

7-5 When the desired water temperature is met, the temperature control (C-5) will turn the fuel solenoid off. When the tool is turned off (no water flowing), the water flow switch (C-8) will turn the fuel solenoid (C-10) off; thus, no more heating of the water in either situation.

7-6 To gain access to the burner assembly, the heat exchanger, hood vent and front panel are mounted on an assembly that is hinged to the lower main frame. Before attempting to lean over the assembly, do the following:

1. Disconnect the gauge line hose (swivel connector)
2. Decouple the high pressure hose to exchanger (Quick Disconnect)
3. Unplug the 12 V DC line near ignition switch
4. Remove water from water holding tank.

Fig 7-4



5. Remove the V belt that runs the burner assembly.
6. Remove two bolts that hold the assemblies together.

CAUTION: This assembly is heavy and much care should be used to ensure safety to equipment and personnel.

7-7 The efficiency of the oil burner can be changed by adjustments on the burner assembly. Fuel pressure can be changed by adjusting (C-15, figure 7-4) fuel pressure. Each 1/4 turn will increase or decrease fuel pressure by approximately 3 to 4 PSI. The air (oxygen) being drawn into the burner may be adjusted by opening or closing the air bands at C-11 (figure 4-2) by small increments of change to increase efficiency of burner when needed. A bleed valve is located on the burner fuel pump (P-13). When the engine is running, turning the bleed valve counter clockwise with a 3/8 inch wrench will allow the air to be disbursed. **CAUTION; MOVING PARTS**

SECTION 8

RECOVERY SYSTEM

- 8-1 If it could be determined specifically which part of the cleaning process (pressure, heat, or vacuum) is the most important one, probably the recovery (vacuum) would head the list. Even with superb water pressure, cleaning agents, and heat, if you can't recover soil that has been dislodged, the cleaning process has NOT been accomplished. A thorough knowledge of the recovery system is very important to keep this system at its peak performance.
- 8-2 The vacuum blower (P-2, figure 8-1) is the heart of the recovery system. As the engine operates, it turns the blower shaft at a 1:1 ratio and at operating speed, causes the Roots 33 positive displacement blower to pull a large volume of air.

- 8-3 As we refer to Figure 8-1, we will find the source of air to be into the cleaning tool, through the connecting vacuum hoses and into the waste recovery tank (P-9). At this point, the water, soil and debris are dropped to the bottom of the tank, but the air continues on and into the vacuum blower (P-2). With the positive displacement action of the blower, the air is pushed out and into the silencer (P-12). The silencer not only receives the air from the blower, but also receives the gases from the Kohler engine. All of the air and gases are expelled through the hood deflector on top of the silencer (P-12) and heater burner assembly (P-6).
- 8-4 A vacuum relief breaker (C-17) is installed on the lid of the waste recovery tank (P-9). The vacuum breaker is preset at the factory and should not have to be reset. The purpose of the vacuum breaker is to relieve the load on the engine and vacuum blower at pre-determined values of Hg.
- 8-5 To check the recovery (vacuum) system to insure peak performance, inspect the following:
- A. Lint screen clean (P-14)
 - B. Dump valve closed (H-10)
 - C. Seal around the lid of waste tank (P-9)
 - D. Condition of vacuum hoses and cuffs.
 - E. Inspect the cleaning tool for clogged air passage.

8-5 After a known blow-over (dirty water being pulled into and through the blower), the impellers should be cleaned and oiled. Remove the screen from the waste recovery tank, remove all loose dirt and lint from the area of the screen. Now with the engine running, shoot a small amount of water into the blower with the input water hose. Let the blower air dry for a few seconds before inserting a very small amount of oil into the blower.

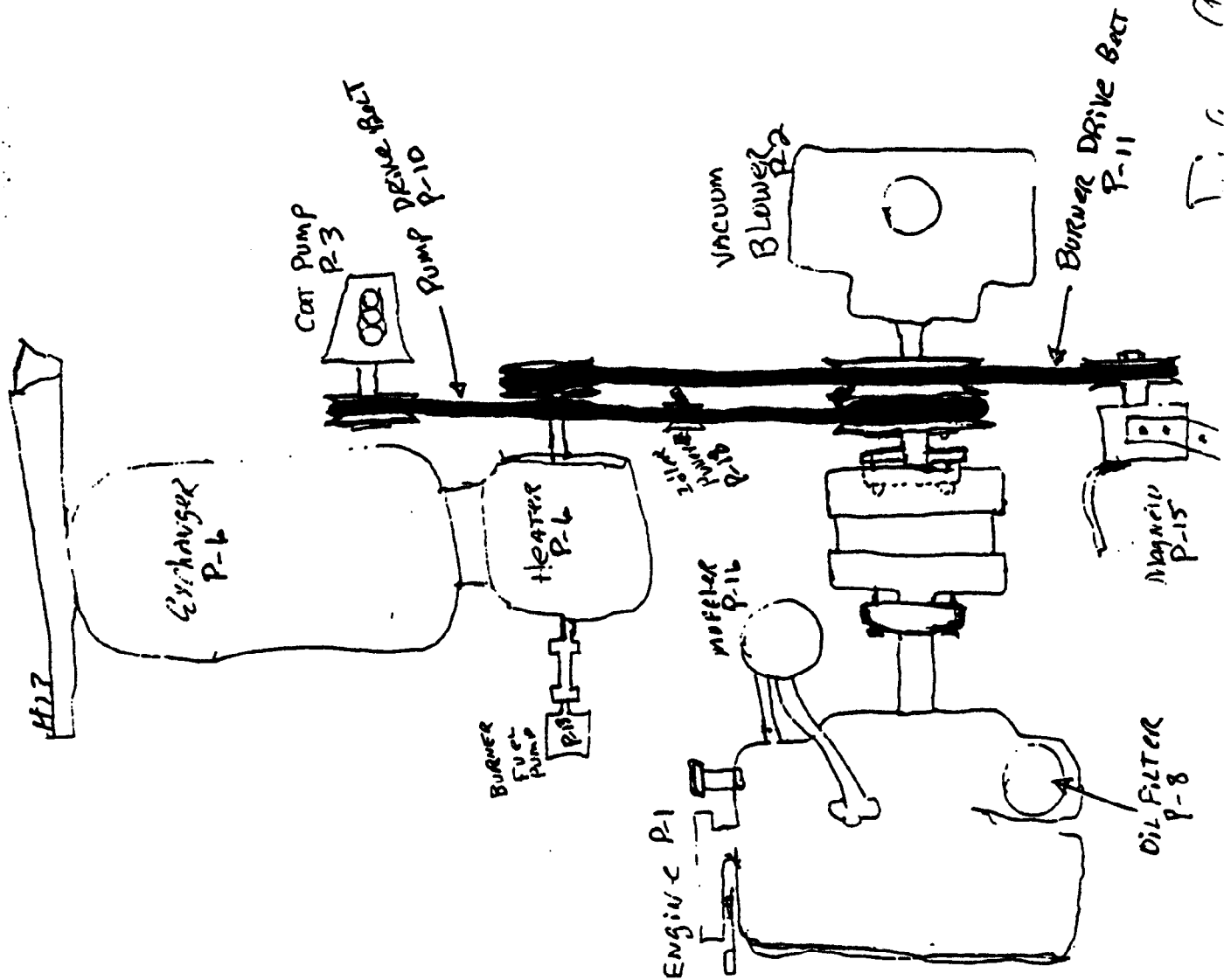
CAUTION: DO NOT LET THE BLOWER PULL ANYTHING INTO THE TUBE (i.e., loose objects, etc.); SERIOUS DAMAGE WILL RESULT.

SECTION 9

BELT AND DRIVE SYSTEM

The belt and drive system consists of an engine to blower coupling device, two V belts, four V pulleys (one is double) and an idler pulley.

- 9-1 The main drive system from the Kohler engine shaft to the vacuum blower shaft is coupled with a flange and tapered bushing (externally locked) on the engine shaft. The blower shaft uses a modified flange and tapered bushing (internally locked). The coupling between the two flanges is made with a 7-JE rubber sleeve. It is imperative that when the engine or blower is installed or repositioned, a perfect alignment between the two components be made. The use of a straight edge at the 3 or 9:00 o'clock positions of the flange will show either correct or incorrect alignment.



T. C. P.

9-2 A double V pulley is installed on the blower shaft that drives two belts. One belt operates the Cat pump (water pressure) and the tension is made constant by the use of an idler pulley (P-18)

CAUTION: Anytime this machine is used for water extraction only, the V belt to the Cat pump (P-3) must be removed. This can be accomplished by inserting a wrench on the nut of the idler pulley (P-18) releasing the tension so that the belt can be easily removed.

9-3 The second V belt is used to drive two components magneto, (P-15) and the kerosene heater (P-6). To change the tension on this belt, two 1/4 inch bolts on the magneto bracket must be loosened so that the magneto (P-15) can be pulled further away from the blower shaft. The components driven by this belt require very little torque; therefore, only a small amount of tension is required.

9-4 Two bearings on the kerosene heater drive shaft are equipped with grease fittings and should be lubricated on a periodic basis.

9-5 When new V belt installation is required, the main drive coupler between the engine and blower must be decoupled. This is accomplished by removing the three bolts on the bushing of the engine flange. Insert the three bolts in the other three holes of the bushing; and as they are tightened, this will release the flange so that it can be slid on the shaft toward the engine. This will allow the rubber coupler to open so that new belts can be inserted over the shaft. Reverse procedure is used for retightening.

(CAUTION: DO NOT OVERTIGHTEN)

DIAGRAM #2
WAYNE BURNER
 (TOP VIEW)

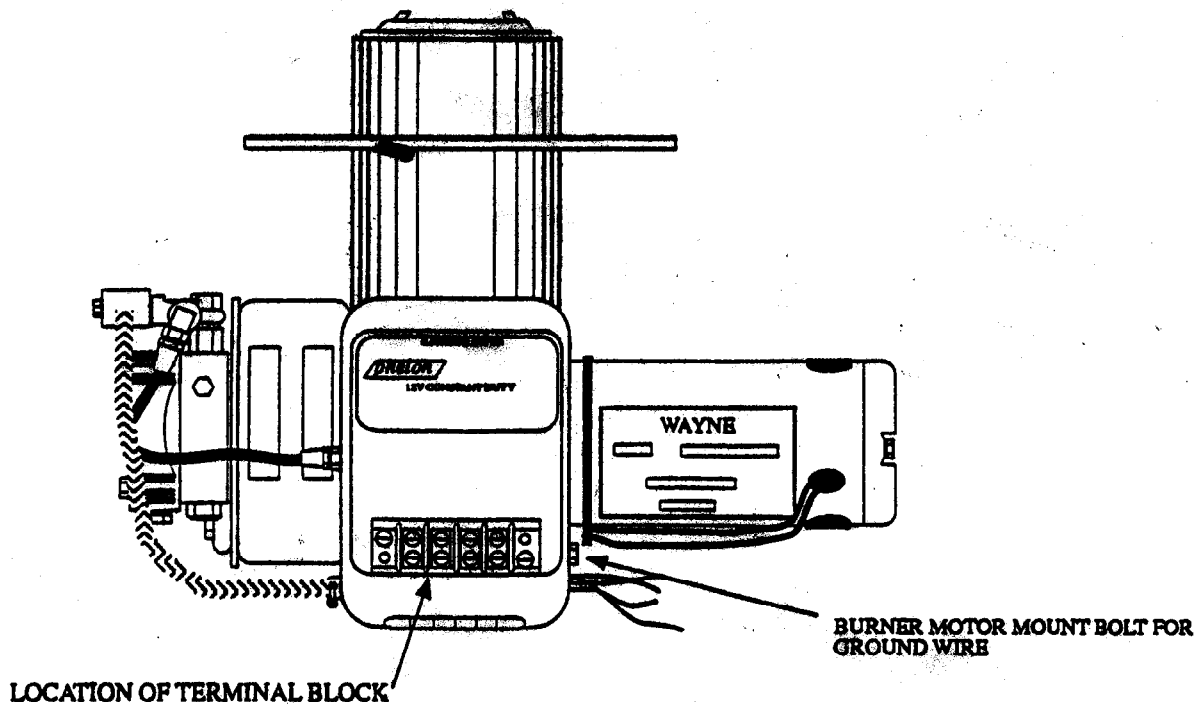
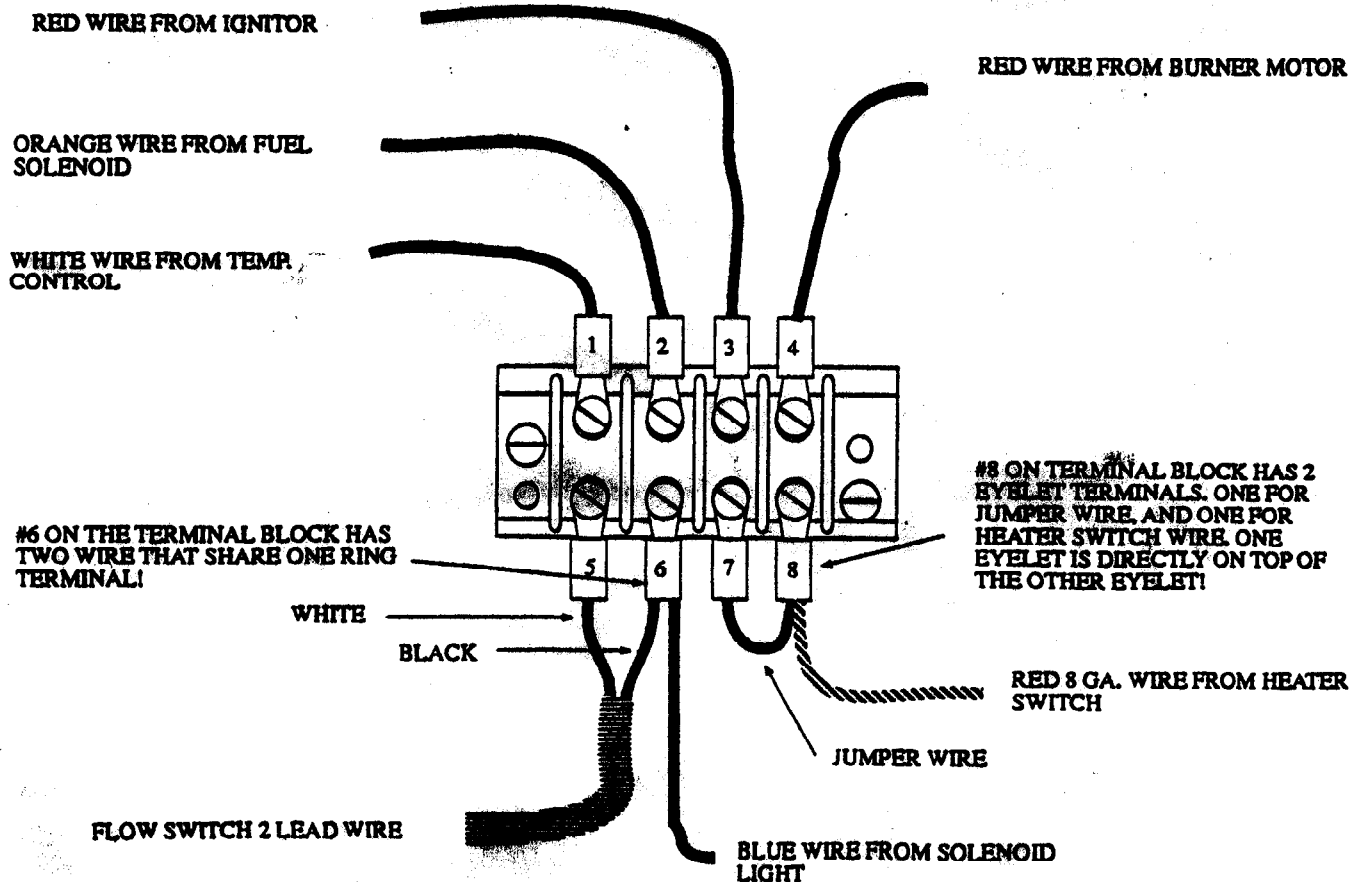


DIAGRAM #3
MAGNIFIED VIEW OF TERMINAL BLOCK



SECTION 10

WIRING DIAGRAM

- 10-1 The various components requiring 12 volts DC receive their voltage from the ignition switch of the Kohler engine. Refer to the wiring diagram, Figure 10-1. The wiring of the Kohler engine is not included in this manual. Information on Kohler engine wiring would have to be obtained through your local Kohler distributor.
- 10-2 The Kohler engine circuits and Master-Matic DC circuits are protected by a 30 amp fuse just behind the ignition switch (C-1) of the Kohler engine.

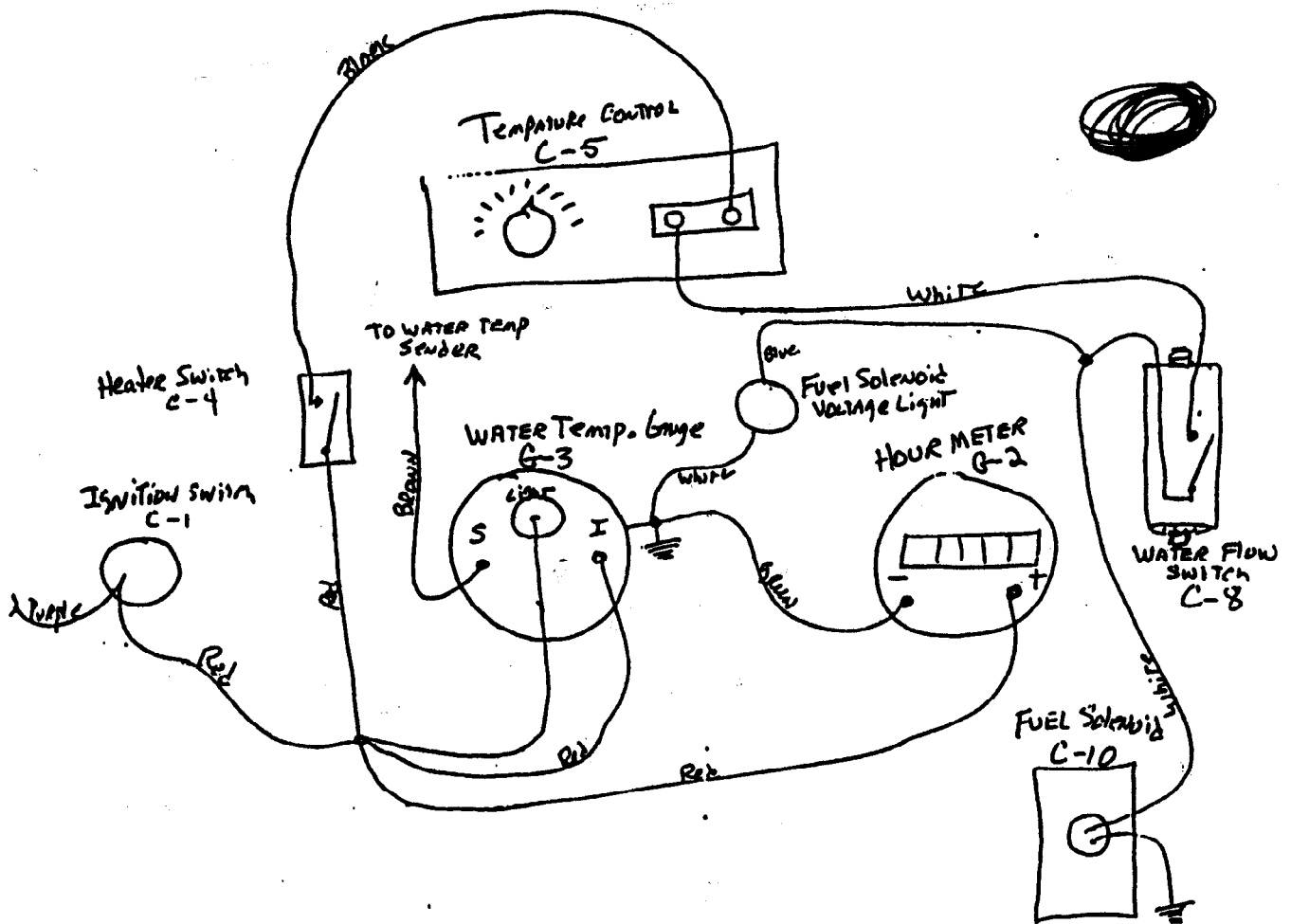


Fig 10-1

SECTION 11

SCHEDULED MAINTENANCE

11-1 Your MASTER-MATIC unit is a machine that has many moving parts; but with proper maintenance they were designed for long life and relatively trouble-free service. The key to this unit, as with any other piece of equipment, depends upon the type of service given it.

When purchase of an automobile, tractor, or any other piece of high tech. equipment, a maintenance schedule comes with it; and interested new owners are eager to perform these procedures to insure good operation and long life of their new investment. It is imperative that you follow the maintenance schedule on Figure 11-1 and become thoroughly familiar with the individual owner's manuals of specific components of this unit, located in the appendix of this manual.

MAINTENANCE CHECK LIST (MASTER MATIC)

ITEM	JOB	DAY	WEEK	6 MONTHS	50 HOURS	100 HOURS	500 HOURS	PRODUCT
LINT SCREEN WASTE TANK	CLEAN							ALL AVAILABLE AT STEAMWAY JOT
KOHLER ENGINE OIL	CHECK		FIRST CHANGE 6 HOURS		CHANGE			STRAIGHT 30 WEIGHT (API 5F)
OIL FILTER					CHANGE			Kohler 57 OSC OIL
CARB PRECLEANER			SERVICE EACH 25 HOURS					
AIR CLEANER ELEMENT								
SPARK PLUGS					CHECK			
VALVE TAPPET CLEARANCE					CHECK			RV 15 YC (CHAMPION)
CYLINDER HEAD SERVICE						CHECK		
STARTER MOTOR DRIVE							SERVICE	USUALLY PERFORMED BY AUTHORIZED MOTOR SERVICE CENTER
CAT PUMP OIL		CHECK					CHANGE	SPECIAL CAT OIL
VAC BLOWER OIL			CHECK		FIRST CHANGE			SPECIAL GREASE
BEARING GREASE						FIRST CHANGE	CHANGE	#4 LUBRICANT
Lub Impellers		LUBE				LUBE		FOR HIGH TEMPERATURE
BURNER FUEL FILTER								GREEN SE-VALVE PIPE HYDROL
BEARING DRIVE			CHECK					
ELECTRODE SPRINGS				CHECK				

Check / Service 7/3

SECTION 12

DESCALING PROCEDURE

12-1 The MASTER-MATIC, like any other unit, has the inherent ability to gain calcium and other mineral deposits within the tubes, hoses and coils which restrict the water flow within the machine. When this condition is noted or suspected, a very simple and inexpensive method of descaling has been established.

12-2 Items needed:

1. A five gallon plastic bucket (45# Formula A container)
2. At least 1/2 gallon Descaler, part number 9951000
3. A Descaler hose, part number 15-8002
4. A high pressure hose or hoses, with the male connector removed from the end of the last hose.

12-3 Procedure

1. Mix 1/2 gallon of descaler solution with five gallons of water in the plastic bucket.
2. Connect the high pressure hose or hoses to pressure out connection H-4 on the machine. (You may desire to descale all hoses during the procedure).
3. Connect the descaler hose (15-8002) to the female connector H-11 left side of the machine with the other end in the bucket of descaling solution.
4. Start the engine and note that the solution has been drawn from the bucket. When approximately 1/2 of the solution has been drawn into the machine, put the high

DESCALING PROCEDURE CONT'D

pressure hose into the bucket so that the bucket will not become empty.

5. After approximately 25 minutes, you should observe that the return flow rate back into the bucket, has increased. This indicates that the procedure has been effective and the descaling procedure is almost complete. (Stop the engine)
6. Now the descaling solution must be removed from the system. This is accomplished by:
 - a. Remove the descaler hose
 - b. Reconnect H-11 to original configuration
 - c. Reinsert the input water supply hose to H-3 water in.
 - d. Start the engine and observe the open high pressure hose (male end removed). When clean water is being dispersed through the hose, the descaling procedure is complete.

CAUTION: The descaling solution is an acid concentrate. Be careful during the operation so that the solution is handled and discarded in a safe manner.

TROUBLE SHOOTING

- 13-1 Kohler Engine Problems - See the Kohler Engine Manual, pages 6 and 7, located in the appendix of this technical manual. A list of Kohler Engine Sales and Service Centers is listed adjacent to the Kohler Manual.
- 13-2 Water Pump Problems - See The Cat Pump Manual (Green Insert), last paragraph, for diagnosis and maintenance for the Cat Pump. The manual is located in the Appendix of this technical manual.
- 13-3 For the information concerning troubleshooting the Roots Blower, see the blower manual located in the Appendix Section of this manual. Refer to page 9 of that manual.
- 13-4 When trouble shooting the water pressure system of the MASTER-MATIC unit, refer to figure 6-1 of this manual.
- 13-5 Remember that the system cannot draw water if an air leak exists in the suction side of the pump. To check for air leaks, insert tap water into the female QD of H-11, figure 6-1, while looking for leaks.
- 13-6 Restriction in the system will result in low or no water pressure.
- 13-7 To trouble shoot the heater system, refer to 7-2 of this manual. Insure that adequate fuel is available, the magneto is developing a spark, and that 12v dc is applied to the fuel solenoid.
- 13-8 Recovery system problems are covered in Section 8 of this manual.

CONTROLS

<u>CONTROL</u>	<u>PART #</u>	<u>NAME</u>	<u>FIGURE #</u>
C-1	KOHLER PART	IGNITION SWITCH	4-3
C-2	KOHLER PART	ENGINE THROTTLE	4-3
C-3	KOHLER PART	ENGINE CHOKE	4-3
C-4	KOHLER PART	HEATER SWITCH	4-3
C-5		TEMPERATURE CONTROL	4-3
C-6		PRESSURE REGULATOR	4-1
C-7	4146130	CHEMICAL CONTROL	4-3
C-8		WATER FLOW SWITCH	5-1
C-9	KEROSENE PUMP PART	BLEED VALVE KEROSENE PUMP	7-4
C-10	FU	FUEL SOLENOID	7-4
C-11	PART OF BURNER ASSEMBLY	LOCK BOLT, AIR CONTROL	4-2
C-12		DUMP VALVE	8-1
C-13		FLOAT CONTROL, WATER HOLDING TANK	6-1
C-14		CHECK VALVE, SOAP FLOW	6-1
C-15	KEROSENE PUMP PART	FUEL PRESSURE, KEROSENE	7-4
C-16		FLOAT SWITCH, ENGINE KILL	8-1
C-17		VACUUM BREAKER	8-1

GAUGES

<u>GAUGE</u>	<u>PART #</u>	<u>NAME</u>	<u>FIGURE #</u>
G-1	44-C010	WATER PRESSURE	4-3
G-2		HOUR METER	4-3
G-3	44-C018	WATER TEMPERATURE	4-3

MAJOR COMPONENTS

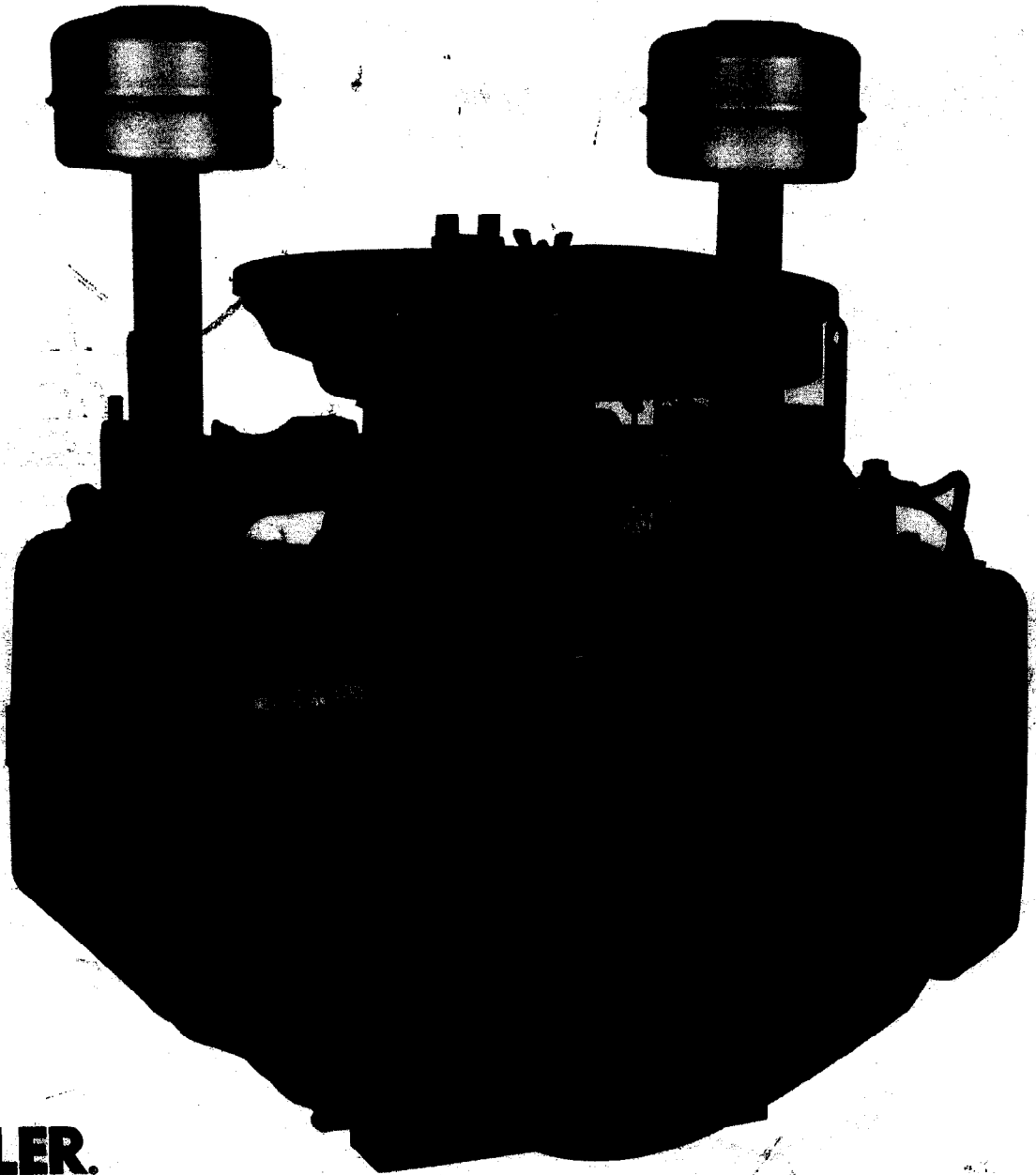
<u>MAJOR COMPONENT</u>	<u>PART #</u>	<u>NAME</u>	<u>FIGURE #</u>
P-1		KOHLER ENGINE	4-3
P-2		VACUUM BLOWER	4-1
P-3		WATER PUMP (CAT)	4-1
P-4		12 V BATTERY	4-2
P-5		WATER HOLDING TANK	4-2
P-6		HEATER BURNER ASSY.	4-2
P-7		INLINE WATER FILTER	4-1
P-8		ENGINE OIL FILTER	4-1
P-9		WASTE RECOVERY TANK	8-1
P-10		PUMP DRIVE BELT	9-1
P-11		BURNER DRIVE BELT	9-1
P-12		SILENCER	5-1
P-13		HEATER FUEL PUMP	7-4
P-14		LINT FILTER, WASTE TANK	8-1
P-15		MAGNETO	4-1
P-16		KOHLER ENGINE MUFFLER	4-1
P-17		KEROSENE FILTER	7-4
P-18		IDLER PULLEY	4-1
P-19		SOLUTION CONTAINER	6-1
P-20		BURNER FAN	7-2

HOOK-UPS AND DRAINS

HOOK-UP POINT	M	PART #	F	NAME	FIGURE #
H-1		4131210	4132210	GASOLINE CONNECTION	4-1
H-2		4131210	4132210	KEROSENE CONNECTION	4-1
H-3		4131660	4132660	WATER IN CONNECTION	4-3
H-4				PRESSURE OUT CONNECTION	4-3
H-5				VACUUM HOSE CONNECTION	8-1
H-6				KEROSENE RETURN LINE	4-1
H-7				ENGINE OIL DRAIN	4-1
H-8				BLOWER OIL DRAIN	5-1
H-9				CAT PUMP OIL DRAIN	5-1
H-10				WASTE TANK DUMP VALVE	8-1
H-11				QUICK DISCONNECT, WATER HOLDING TANK	4-2
H-12				QUICK DISCONNECT, PRESSURE OUT (INSIDE PANEL)	6-1
H-13				HOOD VENT	6-1
H-14				BLOWER OIL LEVEL PLUG	5-1

OWNER'S MANUAL

MAGNUM 18 & 20 HP **HORIZONTAL CRANKSHAFT**



KOHLER.
engines

**BORN
TO RUN™**

Safety Precautions

To insure safe operations please read the following statements and understand their meaning. Also refer to your equipment owner's manual for other important safety information. This manual contains safety precautions which are explained below. Please read carefully.

WARNING

Warning is used to indicate the presence of a hazard that *can* cause *severe* personal injury, death, or substantial property damage if the warning is ignored.

CAUTION



Caution is used to indicate the presence of a hazard that *will* or *can* cause *minor* personal injury or property damage if the warning is ignored.

NOTE

Note is used to notify people of installation, operation, or maintenance information that is important but not hazard-related.



For Your Safety!

These precautions should be followed at all times. Failure to follow these precautions could result in injury to yourself and others.

 WARNING

Explosive Fuel can cause fires and severe burns.
Stop engine before filling fuel tank.



Explosive Fuel!

Gasoline is extremely flammable and its vapors can explode if ignited. Store gasoline only in approved containers, in well ventilated, unoccupied buildings, away from sparks or flames. Do not fill the fuel tank while the engine is hot or running, since spilled fuel could ignite if it comes in contact with hot parts or sparks from ignition. Do not start the engine near spilled fuel. Never use gasoline as a cleaning agent.

 WARNING

Rotating Parts can cause severe injury.
Stay away while engine is in operation.



Rotating Parts!

Keep hands, feet, hair, and clothing away from all moving parts to prevent injury. Never operate the engine with covers, shrouds, or guards removed.

 WARNING

Hot Parts can cause severe burns.
Do not touch engine while operating or just after stopping.

Hot Parts!

Engine components can get extremely hot from operation. To prevent severe burns, do not touch these areas while the engine is running—or immediately after it is turned off. Never operate the engine with heat shields or guards removed.

 CAUTION

Electrical Shock can cause injury.
Do not touch wires while engine is running.

Electrical Shock!

Never touch electrical wires or components while the engine is running. They can be sources of electrical shock.

California Proposition 65 Warning
Engine exhaust from this product contains chemicals known to the State of California to cause cancer, birth defects, or other reproductive harm.



Safety Precautions (Cont.)

 WARNING

Accidental Starts can cause severe injury or death. Disconnect and ground spark plug lead before servicing.



Accidental Starts!

Disabling engine. Accidental starting can cause severe injury or death. Before working on the engine or equipment, disable the engine as follows: 1) Disconnect the spark plug lead(s). 2) Disconnect negative (-) battery cable from battery.

 WARNING

Carbon Monoxide can cause severe nausea, fainting or death. Do not operate engine in closed or confined area.

Lethal Exhaust Gases!

Engine exhaust gases contain poisonous carbon monoxide. Carbon monoxide is odorless, colorless, and can cause death if inhaled. Avoid inhaling exhaust fumes, and never run the engine in a closed building or confined area.

 WARNING

Explosive Gas can cause fires and severe acid burns. Charge battery only in a well ventilated area. Keep sources of ignition away.

Explosive Gas!

Batteries produce explosive hydrogen gas while being charged. To prevent a fire or explosion, charge batteries only in well ventilated areas. Keep sparks, open flames, and other sources of ignition away from the battery at all times. Keep batteries out of the reach of children. Remove all jewelry when servicing batteries.

Before disconnecting the negative (-) ground cable, make sure all switches are OFF. If ON, a spark will occur at the ground cable terminal which could cause an explosion if hydrogen gas or gasoline vapors are present.

Congratulations – You have selected a fine four-cycle, twin cylinder, air-cooled engine. Kohler designs long life strength and on-the-job durability into each engine...making a Kohler engine dependable...dependability you can count on. Here are some reasons why:

- Parts subject to the most wear and tear (like cylinders, crankshaft, and camshaft) are made from precision formulated cast iron. Because the cast iron cylinders can be rebored, these engines can last even longer.
- Kohler engines are easy to service. All routine service areas (like the dipstick and oil fill, air cleaner, spark plugs, and carburetor) are easily and quickly accessible.
- Every Kohler engine is backed by a worldwide network of over 10,000 distributors and dealers. Service support is just a phone call away. Call 1-800-544-2444 (U.S. & Canada) for Sales & Service assistance.

To keep your engine in top operating condition, follow the maintenance procedures in this manual.

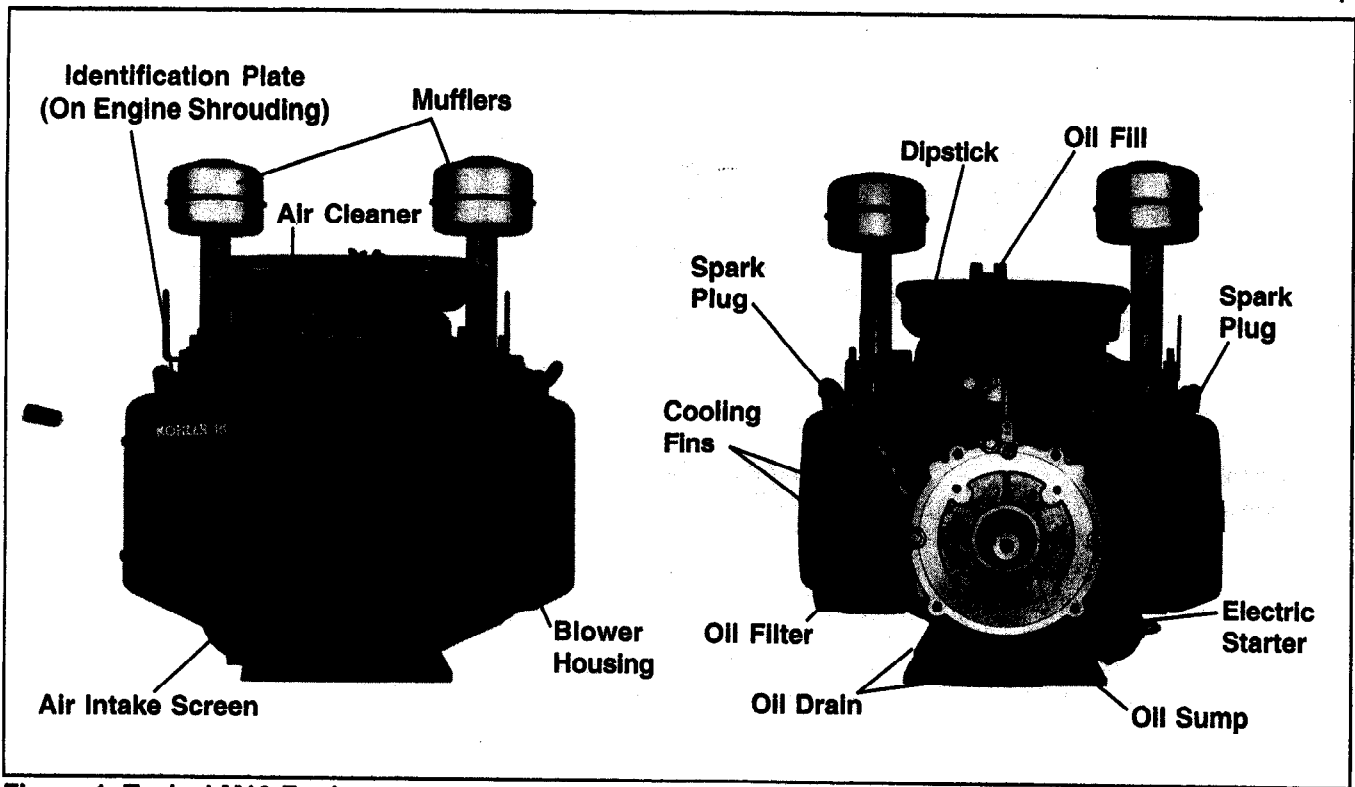


Figure 1. Typical M18 Engine.

Oil Recommendations

Using the proper type and weight of oil in the crankcase is extremely important. So is checking oil daily and changing oil and filter regularly. Failure to use the correct oil, or using dirty oil, causes premature engine wear and failure.

Before each start, make sure the crankcase is filled with proper type and quantity of oil.

Oil Type

Use high quality detergent oil of API (American Petroleum Institute) service class SG, SH, SJ or higher. Select the viscosity based on the air temperature at the time of operation as shown in the following table.

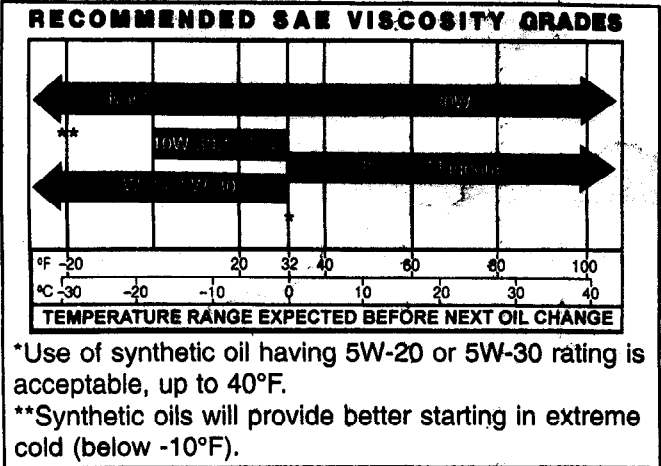


Figure 2. Viscosity Grades Table.

Straight 30-weight (Kohler "Magnum") oil is preferred. SAE 10W-30 oil is not recommended above 32°F. Using this oil substantially increases oil consumption and combustion chamber deposits.

NOTE: Using other than service class SG, SH, SJ or higher oil or extending oil change intervals longer than recommended can cause engine damage.

A logo or symbol on oil containers identifies the API service class and SAE viscosity grade. See Figure 3.

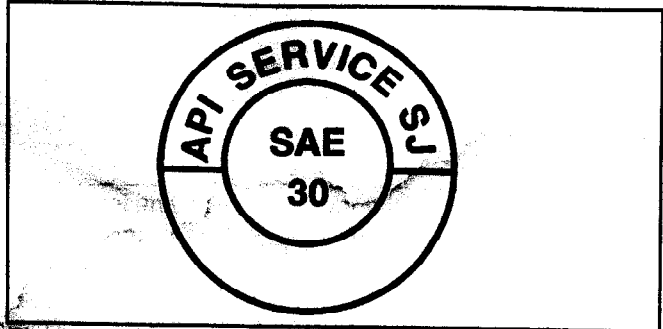


Figure 3. Oil Container Logo.

Refer to "Maintenance Instructions" beginning on page 7 for detailed oil check, oil change, and oil filter change procedures.

Fuel Recommendations



WARNING: Explosive Fuel!

Gasoline is extremely flammable and its vapors can explode if ignited. Store gasoline only in approved containers, in well ventilated, unoccupied buildings, away from sparks or flames. Do not fill the fuel tank while the engine is hot or running, since spilled fuel could ignite if it comes in contact with hot parts or sparks from ignition. Do not start the engine near spilled fuel. Never use gasoline as a cleaning agent.

General Recommendations

Purchase gasoline in small quantities and store in clean, approved containers. A container with a capacity of 2 gallons or less with a pouring spout is recommended. Such a container is easier to handle and helps eliminate spillage during refueling.

Do not use gasoline left over from the previous season, to minimize gum deposits in your fuel system and to insure easy starting.

Do not add oil to the gasoline.

Do not overfill the fuel tank. Leave room for the fuel to expand.

Fuel Type

For best results use only clean, fresh, **unleaded** gasoline with a pump sticker octane rating of 87 or higher. In countries using the Research method, it should be 90 octane minimum.

Unleaded gasoline is recommended as it leaves less combustion chamber deposits. Leaded gasoline may be used in areas where unleaded is not available and exhaust emissions are not regulated. Be aware however, that the cylinder head will require more frequent service.

Gasoline/Alcohol blends

Gasohol (up to 10% ethyl alcohol, 90% unleaded gasoline by volume) is approved as a fuel for Kohler engines. Other gasoline/alcohol blends are not approved.

Gasoline/Ether blends

Methyl Tertiary Butyl Ether (MTBE) and unleaded gasoline blends (up to a maximum of 15% MTBE by volume) are approved as a fuel for Kohler engines. Other gasoline/ether blends are not approved.

Engine Identification Numbers

When ordering parts, or in any communication involving an engine, always give the **Model, Specification, and Serial Numbers** of the engine.

The engine identification numbers appear on decal (or decals) affixed to the engine shrouding. Include letter suffixes, if there are any.

Record your engine identification numbers on the identification label below (Figure 4) for future reference.

<p>MODEL NO. SPEC. NO. DISPL (CC) SERIAL NO.</p> <p>REFER TO OWNER'S MANUAL FOR SAFETY, MAINTENANCE SPECS AND ADJUSTMENTS. FOR SALES AND SERVICE IN US/CANADA CALL: 1-800-544-2444</p> <p>KOHLERengines</p> <p>KOHLER CO. KOHLER, WI USA</p>

Figure 4. Engine Identification Label.

Operating Instructions

Also read the operating instructions of the equipment this engine powers.

Pre-Start Checklist

- Check oil level. Add oil if low. Do not overfill.
- Check fuel level. Add fuel if low.
- Check cooling air intake areas and external surfaces of engine. Make sure they are clean and unobstructed.
- Check that the air cleaner components and all shrouds, equipment covers, and guards are in place and securely fastened.
- Check that any clutches or transmissions are disengaged or placed in neutral. This is especially important on equipment with hydrostatic drive. The shift lever must be exactly in neutral to prevent resistance which could keep the engine from starting.



WARNING: Lethal Exhaust Gases!

Engine exhaust gases contain poisonous carbon monoxide. Carbon monoxide is odorless, colorless, and can cause death if inhaled. Avoid inhaling exhaust fumes, and never run the engine in a closed building or confined area.

Cold Weather Starting Hints

1. Be sure to use the proper oil for the temperature expected. See Figure 2 on page 4.
2. Declutch all possible external loads.
3. Set speed control at part throttle position.
4. A warm battery has much more starting capacity than a cold battery.
5. Use fresh winter grade fuel. NOTE: Winter grade gasoline has a higher volatility to improve starting. Do not use gasoline left over from summer.

Starting

1. **On a Cold Engine** – Place the throttle control midway between the “slow” and “fast” positions. Place the choke control into the “on” position.

On a Warm Engine (Normal Operating Temperatures) – Place the throttle control midway between the “slow” and “fast” positions. Place the choke control into the “off” position.

2. Activate the starter switch. Release the switch as soon as the engine starts.

NOTE: After starting the engine, it may be necessary to leave the choke partially “on” for a few minutes before moving it to the “off” position.

NOTE: Do not crank the engine continuously for more than 10 seconds at a time. If the engine does not start, allow a 60 second cool down period between starting attempts. Failure to follow these guidelines can burn out the starter motor.

NOTE: If the engine develops sufficient speed to disengage the starter but does not keep running (a false start), the engine rotation must be allowed to come to a complete stop before attempting to restart the engine. If the start is engaged while the flywheel is rotating, the starter pinion and flywheel ring gear may clash, resulting in damage to the starter.

If the starter does not turn the engine over, shut off starter immediately. Do not make further attempts to start the engine until the condition is corrected. Do not jump start using another battery (refer to “Battery” below). See your Kohler Engine Service Dealer for trouble analysis.

3. **On a Cold Engine** – Gradually return the choke control to the “off” position after the engine starts and warms up.

Stopping

1. If possible, remove the load by disengaging all PTO attachments.
2. Move the throttle control to the “slow” or “low” idle position. Allow the engine to run at idle for 30-60 seconds; then stop the engine. If the carburetor on the engine is equipped with a fuel solenoid, move the throttle control back up between half and full throttle just before stopping the engine.

Battery

A 12 volt battery is normally used. Refer to the operating instructions of the equipment this engine powers for specific battery requirements.

If the battery charge is not sufficient to crank the engine, recharge the battery (see page 11).

Operating

Optional spark arrestor mufflers are available from your Kohler Engine Service Dealer. Check your local laws and statutes regarding engine spark arrestor muffler requirements.

Angle of Operation

This engine will operate continuously at angles up to 30° in any direction. Check oil level to assure crankcase oil level is at the "F" mark.

Refer to the operating instructions of the equipment this engine powers. Because of equipment design or application, there may be more stringent restrictions regarding the angle of operation.

NOTE: Do not operate this engine continuously at angles exceeding 30° in any direction. Engine damage could result from insufficient lubrication.

Cooling

NOTE: If debris builds up on the grass screen or other cooling air intake areas, stop the engine immediately and clean. Operating the engine with blocked or dirty air intake and cooling areas can cause extensive damage due to overheating.



WARNING: Hot Parts!

Engine components can get extremely hot from operation. To prevent severe burns, do not touch these areas while the engine is running—or immediately after it is turned off. Never operate the engine with heat shields or guards removed.

Engine Speed

NOTE: Do not tamper with the governor setting to increase the maximum engine speed. Overspeed is hazardous and will void the engine warranty.



WARNING: Rope Starting Pulley is not a Drive Pulley!

Do not use backup rope starting pulley as a drive pulley. Using starting pulley as a drive could loosen flywheel fastener, resulting in bodily harm.

Maintenance Instructions



WARNING: Accidental Starts!

Disabling engine. Accidental starting can cause severe injury or death. Before working on the engine or equipment, disable the engine as follows: 1) Disconnect the spark plug lead(s). 2) Disconnect negative (-) battery cable from battery.

Maintenance Schedule

These required maintenance procedures should be performed at the frequency stated in the table. They should also be included as part of any seasonal tune-up.

Frequency	Maintenance Required
As Specified on pages 8 & 9	<ul style="list-style-type: none">• Change oil.• Change oil filter.
Daily or Before Starting Engine	<ul style="list-style-type: none">• Fill fuel tank.• Check oil level⁴.• Check air cleaner for dirty¹, loose, or damaged parts.• Check air intake and cooling areas, clean as necessary¹.
Every 25 Hours	<ul style="list-style-type: none">• Service precleaner element¹.
Every 50 Hours	<ul style="list-style-type: none">• Remove cooling shrouds and clean cooling areas¹.
Every 100 Hours	<ul style="list-style-type: none">• Replace air cleaner element¹.• Check spark plug condition and gap.
Annually or Every 500 Hours	<ul style="list-style-type: none">• Have bendix starter drive serviced².• Have valve and tappet clearance checked².• Have cylinder heads serviced^{2,3}.

¹Perform these maintenance procedures more frequently under extremely dusty, dirty conditions.

²Have a Kohler Engine Service Dealer perform this service.

³250 hours when leaded gasoline is used and/or multiviscosity oil is used.

⁴Twice daily on commercial use.

Check Oil Level

The importance of checking and maintaining the proper oil level in the crankcase cannot be overemphasized. Check oil **BEFORE EACH USE OR TWICE DAILY ON COMMERCIAL USE** as follows:

1. Make sure the engine is stopped level, and is cool so the oil has had time to drain into the sump.
2. To keep dirt, grass clippings, etc., out of the engine, clean the area around the oil fill cap or dipstick before removing it.
3. Remove the dipstick; wipe oil off. Reinsert the dipstick and push it all the way down into the tube.
4. Remove the dipstick and check the oil level.

The oil level should be up to, but not over, the "F" mark on the dipstick. See Figure 5.

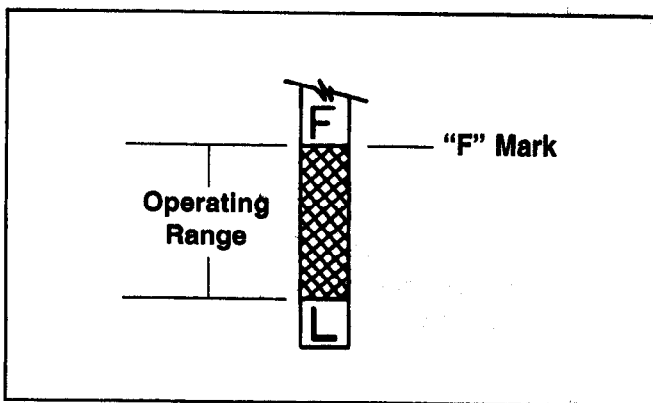


Figure 5. Oil Level Dipstick.

5. If the level is low, add oil of the proper type, up to the "F" mark on the dipstick. (Refer to "Oil Type" on page 4.) Always check the level with the dipstick before adding more oil.

NOTE: To prevent extensive engine wear or damage, always maintain the proper oil level in the crankcase. Never operate the engine with the oil level below the "L" mark or over the "F" mark on the dipstick.

Oil Sentry™

Some engines are equipped with an optional Oil Sentry™ oil pressure switch. If the oil pressure decreases below an acceptable level, the Oil Sentry™ will either shut off the engine or activate a warning signal, depending on the application.

NOTE: Make sure the oil level is checked **BEFORE EACH USE** and is maintained up to the "F" mark on the dipstick. This includes engines equipped with Oil Sentry™.

Change Oil and Oil Filter

Change Oil

Change oil as shown in the "Oil Change Intervals" table.

Oil Change Intervals

Oil Type	Engine Type	Interval
Temperature ABOVE 32° F (0° C)		
SAE 30	With Filter	50 Hours*
	Without Filter	25 Hours
Multiviscosity	With Filter	25 Hours
	Without Filter	25 Hours
Temperature BELOW 32° F (0° C)		
Multiviscosity	With Filter	50 Hours
	Without Filter	25 Hours

*NOTE: 25 hours for continuous and/or heavy duty operation.

Change the oil while the engine is still warm. The oil will flow freely and carry away more impurities. Make sure the engine is level when filling, checking, or changing the oil.

Change the oil as follows:

1. To keep dirt, grass clippings, etc., out of the engine, clean the area around the oil fill cap before removing it.
2. Remove the oil drain plug and oil fill cap. Tilt the engine slightly towards the oil drain to obtain better drainage.
3. Reinstall the drain plug. Make sure it is tightened securely.
4. Fill with new oil of the proper type to the "F" mark on the dipstick. Always check the level on the dipstick before adding more oil.

NOTE: To prevent extensive engine wear or damage, always maintain the proper oil level in the crankcase. Never operate the engine with the oil level below the "L" mark or over the "F" mark on the dipstick.

5. Reinstall the oil fill cap. Make sure it is tightened securely.

Change Oil Filter

Some engines are equipped with an oil filter. Replace the oil filter *every other* oil change, in accordance with the "Oil Change Intervals" table on page 8. Always use a genuine Kohler oil filter, Part No. 52 050 02-S, and replace as follows:

1. Drain the oil from the engine crankcase.
2. Allow the oil filter to drain.
3. Remove the old filter and wipe the filter adapter gasket surface.
4. Place a new replacement filter in a shallow pan with the open end up. Pour new oil of the proper type, in through the threaded center hole. Stop pouring when the oil reaches the bottom of the threads. Allow a minute or two for the oil to be absorbed by the filter material.
5. Put a drop of oil on your fingertip and wipe it on the rubber gasket. Install the replacement oil filter on the engine. Turn the oil filter clockwise until rubber gasket contacts the filter adapter, then tighten filter an additional $1/2$ turn.
6. Reinstall drain plug. Make sure it is tight.
7. Fill the crankcase with new oil of the proper type to the "F" mark on the dipstick. Add an additional $1/2$ pint of oil for the filter capacity. See "Specifications" on page 15.
8. Test run the engine to check for leaks. Stop the engine, allow a minute for the oil to drain down, and recheck the level on the dipstick. Make sure oil level is up to but not over the "F" mark on the dipstick.

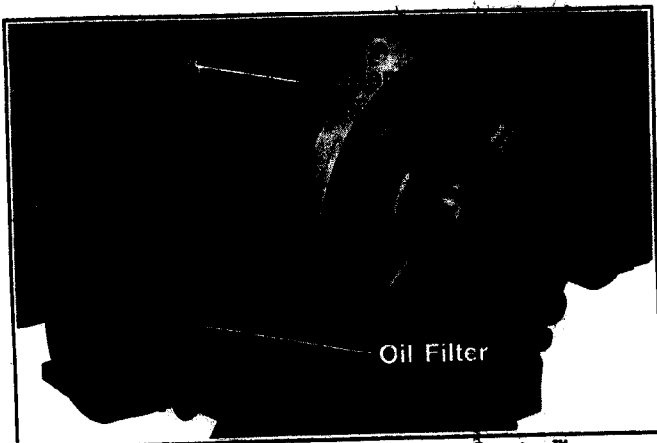


Figure 6. Oil Filter and Optional Oil Sentry™ Switch.

Service Precleaner and Air Cleaner Element

This engine is equipped with a replaceable, high density paper air cleaner element. Some engines are also equipped with an oiled, foam precleaner which surrounds the paper element. See Figure 7.

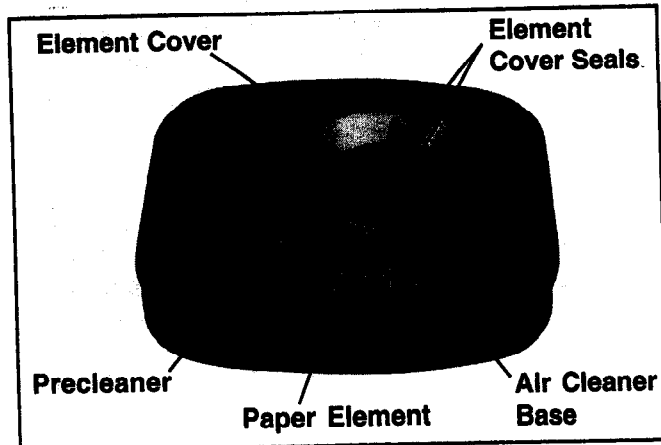


Figure 7. Air Cleaner Housing Components.

Check the air cleaner **daily** or **before starting the engine**. Check for buildup of dirt and debris around the air cleaner system. Keep this area clean. Also check for loose or damaged components. Replace all bent or damaged air cleaner components.

NOTE: Operating the engine with loose or damaged air cleaner components could allow unfiltered air into the engine causing premature wear and failure.

Service Precleaner

If so equipped, wash and reoil the precleaner every **25 hours** of operation (more often under extremely dusty or dirty conditions).

1. Remove wing nut(s), and air cleaner cover.
2. Remove precleaner from paper element.
3. Wash the precleaner in warm water with detergent. Rinse the precleaner thoroughly until all traces of detergent are eliminated. Squeeze out excess water (do not wring). Allow the precleaner to air dry.
4. Saturate precleaner in clean, fresh engine oil and squeeze out excess oil.
5. Reinstall precleaner over paper element.
6. Reinstall air cleaner cover and wing nut(s). Tighten wing nut(s) $1/2$ to 1 full turn after nut contacts cover. Do not overtighten.
7. When precleaner replacement is necessary always use genuine Kohler parts.

Service Paper Element

Every **100 hours** of operation (more often under extremely dusty or dirty conditions), replace the element.

1. Remove wing nut(s), air cleaner cover, seals, and element cover. Remove the air cleaner element with precleaner. Remove the precleaner from the element and service as necessary.
2. Do not wash the paper element or use **pressurized air**, as this will damage the element. Replace a dirty, bent, or damaged element with a genuine Kohler element. Handle new elements carefully; do not use if the sealing surfaces are bent or damaged.
3. With air cleaner disassembled, check the base plate. Make sure it is secured and not bent or damaged. Also check the element cover, seals, and breather tube for damage or improper fit. Replace all damaged components.

NOTE: Operating the engine with damaged or loose components could allow unfiltered air into the engine causing premature wear and failure.

4. Reinstall the paper element.
5. If so equipped, install the precleaner (washed and oiled) over paper element.
6. Reinstall element cover, seals, air cleaner cover and wing nut(s). Tighten wing nut(s) 1/2 to 1 full turn after nuts contacts cover. Do not overtighten.
7. When air cleaner element replacement is necessary always use genuine Kohler parts.

Clean Air Intake/Cooling Areas

To ensure proper cooling, make sure the grass screen, cooling fins, and other external surfaces of the engine are kept clean **at all times**.

Every **50 hours** of operation (more often under extremely dusty, dirty conditions), remove the blower housing and other cooling shrouds. Clean the cooling fins and external surfaces as necessary. Make sure the cooling shrouds are reinstalled.

NOTE: Operating the engine with a blocked grass screen, dirty or plugged cooling fins, and/or cooling shrouds removed, will cause engine damage due to overheating.

Check Spark Plug

Every **100 hours** of operation, remove the spark plugs, check condition, and reset gaps or replace with new plugs as necessary. Use a Champion® type RV17YC (or equivalent) spark plug.

1. Before removing spark plugs, clean the area around base of plugs to keep dirt and debris out of the engine.
2. Remove plugs and check condition. Replace plugs if worn or reuse is questionable.

NOTE: Do not clean the spark plug in a machine using abrasive grit. Some grit could remain in the spark plug and enter the engine causing extensive wear and damage.

3. Check gaps using a wire feeler gauge. Adjust the gaps to **0.035 in. (0.89 mm)** by carefully bending the ground electrode. See Figure 8.
4. Reinstall spark plugs into the cylinder heads. Torque spark plugs to **10-15 ft. lb. (14-20 N·m)**.

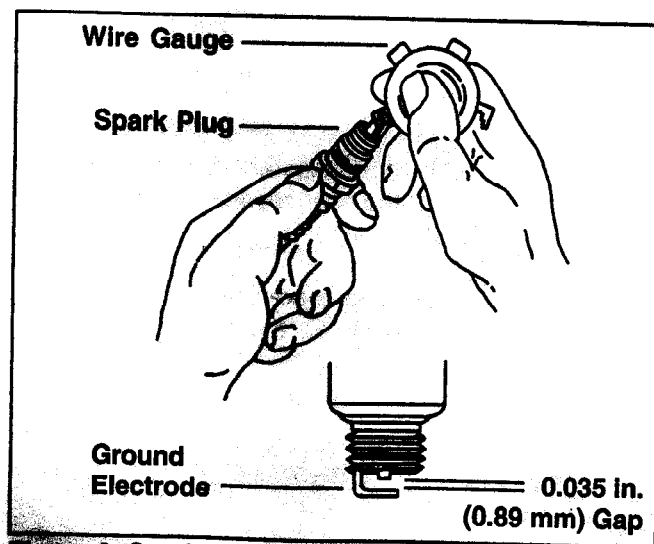


Figure 8. Servicing Spark Plug.

Battery Charging



WARNING: Explosive Gas!

Batteries produce explosive hydrogen gas while being charged. To prevent a fire or explosion, charge batteries only in well ventilated areas. Keep sparks, open flames, and other sources of ignition away from the battery at all times. Keep batteries out of the reach of children. Remove all jewelry when servicing batteries.

Before disconnecting the negative (-) ground cable, make sure all switches are OFF. If ON, a spark will occur at the ground cable terminal which could cause an explosion if hydrogen gas or gasoline vapors are present.

NOTE: Do not apply 12 volt DC to kill terminal of ignition module as module will burn out.

Fuel Filter

Some engines are equipped with an in-line fuel filter. Periodically inspect the filter and replace when dirty. Use a genuine Kohler filter.

Carburetor Troubleshooting and Adjustments

M18 and M20 engines are equipped with one of two basic types of carburetors – Kohler or Walbro – fixed main jet or adjustable main jet.

The carburetor is designed to deliver the correct fuel-to-air mixture to the engine under all operating conditions. The main fuel and idle fuel needles on adjustable jet carburetors are set at the factory and normally do not require further adjustment. On fixed jet carburetors, the low idle fuel needle is also set at the factory and normally does not need further adjustment. The main fuel jet is calibrated and installed at the factory and is not adjustable.*

*NOTE: Engines operating at altitudes above approximately 1830 m (6000ft.), may require a special "high altitude" main jet. See your Kohler Engine Service Dealer for further information.

Troubleshooting

If engine troubles are experienced that appear to be fuel system related, check the following areas before adjusting the carburetor.

- Make sure the fuel tank is filled with clean, fresh gasoline.
- Make sure the fuel tank cap vent is not blocked and that it is operating properly.
- If the fuel tank is equipped with a shut-off valve, make sure it is open.
- If the engine is equipped with an in-line fuel filter, make sure it is clean and unobstructed. Replace the filter if necessary.
- Make sure fuel is reaching the carburetor. This includes checking the fuel lines and fuel pump for restrictions or faulty components, replace as necessary.
- Make sure the air cleaner element is clean and all air cleaner element components are fastened securely.

If, after checking the items listed above, the engine is hard to start, runs roughly, or stalls at low idle speed, it may be necessary to adjust or service the carburetor.

NOTE: Carburetor adjustments should be made only after the engine has warmed up.

Kohler Carburetor Adjustment

1. With the engine stopped, turn the low idle fuel and main fuel adjusting needles in (clockwise) until they bottom lightly.

NOTE: The tip of the idle fuel and main fuel adjusting needles are tapered to critical dimensions. Damage to the needles and the seats in carburetor body will result if the needles are forced.

2. **Preliminary Settings:** Turn the adjusting needles out (counterclockwise) from lightly bottomed to the positions shown in the chart below.

Kohler Adjustable Jet

	Low Idle	Main Fuel
M18	1 turn	2-1/2 turns
M20	1 turn	2-1/2 turns

3. Start the engine and run at half throttle for 5 to 10 minutes to warm up. The engine must be warm before making final settings (steps 4, 5, 6, and 7).

4. **Main Fuel Needle Setting:** This adjustment is required for adjustable main jet carburetors only. If the carburetor is a fixed main jet type, refer to Walbro adjustment.

Place the throttle into the "fast" position. If possible, place the engine underload.

Turn the main fuel adjusting needle **out** (counterclockwise) from the preliminary setting until the engine speed decreases (rich). Note the position of the needle.

Now turn the adjusting needle **in** (clockwise). The engine speed may increase, then it will decrease as the needle is turned in (lean). Note the position of the needle.

Set the adjusting needle **midway** between the rich and lean settings.

5. **Low Idle Speed Setting:** Place the throttle control into the "idle" or "slow" position. Set the low idle speed to **1200 RPM*** (± 75 RPM) by turning the low idle speed adjusting screw **in** or **out**. Check the speed using a tachometer.

*NOTE: The actual low idle speed depends on the application – refer to equipment manufacturers recommendations. The recommended low idle speed for basic engines is 1200 RPM. To ensure best results when setting the low idle fuel needle, the low idle speed must not exceed 1500 RPM.

6. **Low Idle Fuel Needle Setting:** Place the throttle into the "idle" or "slow" position.

Turn the low idle fuel adjusting needle **out** (counterclockwise) from the preliminary setting until the engine speed decreases (rich). Note the position of the needle.

Now turn the adjusting needle **in** (clockwise). The engine speed may increase, then it will decrease as the needle is turned in (lean). Note the position of the needle.

Set the adjusting needle **midway** between the rich and lean settings.

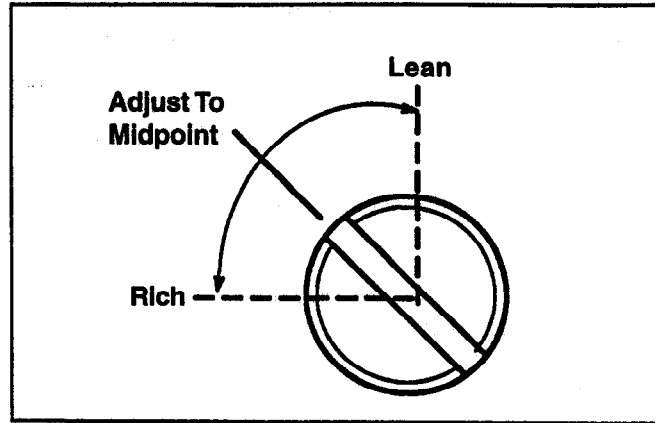


Figure 9.

7. Recheck the idle speed using a tachometer. Readjust the speed as necessary.

Walbro Carburetor Adjustment

In general, turning the adjusting needles **in** (clockwise) decreases the supply of fuel to the carburetor. This gives a *leaner* fuel-to-air mixture. Turning the adjustment needles **out** (counterclockwise) increases the supply of fuel to the carburetor.

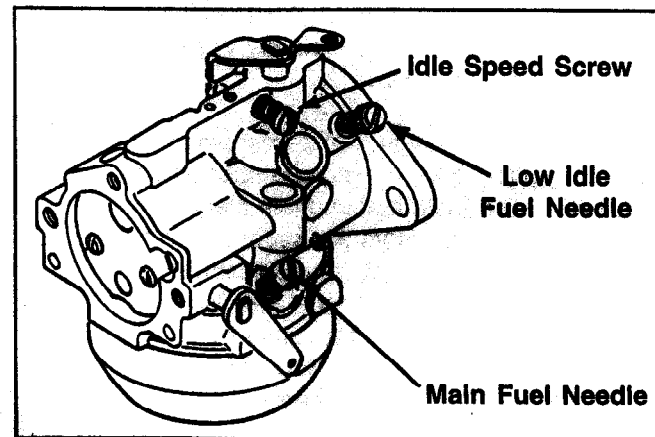


Figure 10.

NOTE: The tip of the low idle fuel and main fuel adjusting needles are tapered to critical dimensions. Damage to the needles and the seats in carburetor body will result if the needles are forced.

1. With the engine stopped, turn the adjusting needle(s) **in** (clockwise) until it bottoms *lightly*.
2. **Preliminary Settings:** Turn the adjusting needle(s) **out** (counterclockwise) from lightly bottomed as shown in the chart or page 13, or to the rich side of adjustment.

Walbro Fixed Jet

	Low Idle
M18	1-1/4 turns
M20	1-1/4 turns

Walbro Adjustable Jet

	Low Idle	Main Fuel
M18	1-1/4 turns	1-1/4 turns
M20	1-1/4 turns	1 turn

- Start the engine and run at half throttle for five to ten minutes to warm up. The engine must be warm before making final settings.
- Main Fuel Needle Setting:** *This adjustment is required only for adjustable main jet carburetors. If the carburetor is a fixed main jet type, disregard this setting.*

Place the throttle into the "fast" position.

Turn the adjusting needle **In** (clockwise). The engine speed may increase, then it will decrease as the needle is turned **In** (lean). Note the position of the needle. Back the needle out approximately 1/8 to 1/4 turn. See Figure 11 below for best main fuel performance.

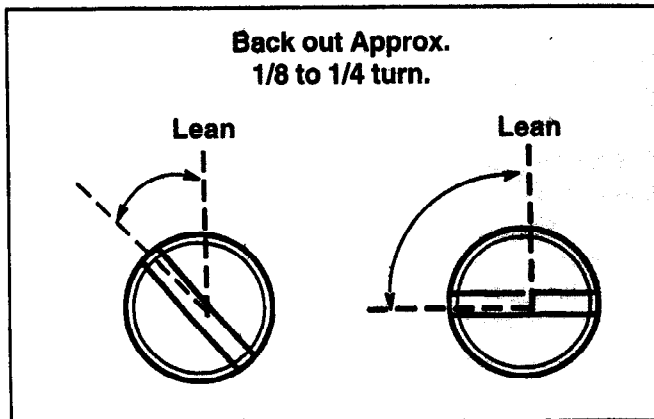


Figure 11. Optimum Main Fuel Setting.

- Low Idle Speed Setting:** Place the throttle control into the "idle" or "slow" position. Set the low idle speed to **1200 RPM* (± 75 RPM)** by turning the low idle speed adjusting screw **In** or **out**. Check the speed using a tachometer.

*NOTE: The actual low idle speed depends on the application. Refer to the equipment manufacturers instructions for specific low idle speed settings. To ensure best results when setting the low idle fuel needle, the low idle speed must not exceed 1500 RPM.

- Low Idle Fuel Needle Setting:** Place the throttle into the "idle" or "slow" position.

Turn the adjusting needle **In** (clockwise). The engine speed may increase, then it will decrease as the needle is turned **In** (lean). Note the position of the needle.

Back the needle out approximately 1/8 to 1/4 turn. See Figure 12 below for best low idle fuel performance.

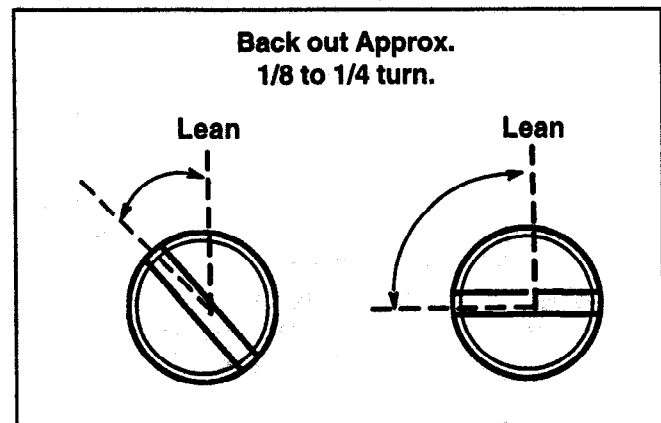


Figure 12. Optimum Low Idle Fuel Setting.