

# 9100 LX MANUAL



The 9100 LX...Annihilate your cleaning problems with a completely new designed and engineered machine from the framework up. Every single component has been CAD designed to work cohesively within the completely engineered framework. The Quadexchange Thermal Accumulator™ Heat Exchange System takes leaps ahead of the competitors on solution heating performance with four phases of heat exchange accumulation producing 220°F consistent solution temperatures, without dumping water into the recovery tank. The solution pressure system is highlighted by an industrial CAT pump. Exhaust emissions are reduced by heating and venting system design, combined with the combustion efficiency of the Kawasaki 22 HP water cooled engine. Why spend thousands more on other water cooled engine machines when the Series 4700 Vacuum Blower System produces 330 cfm at 12" Hg maximized power for carpet cleaning or water removal either way!



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# Section 1

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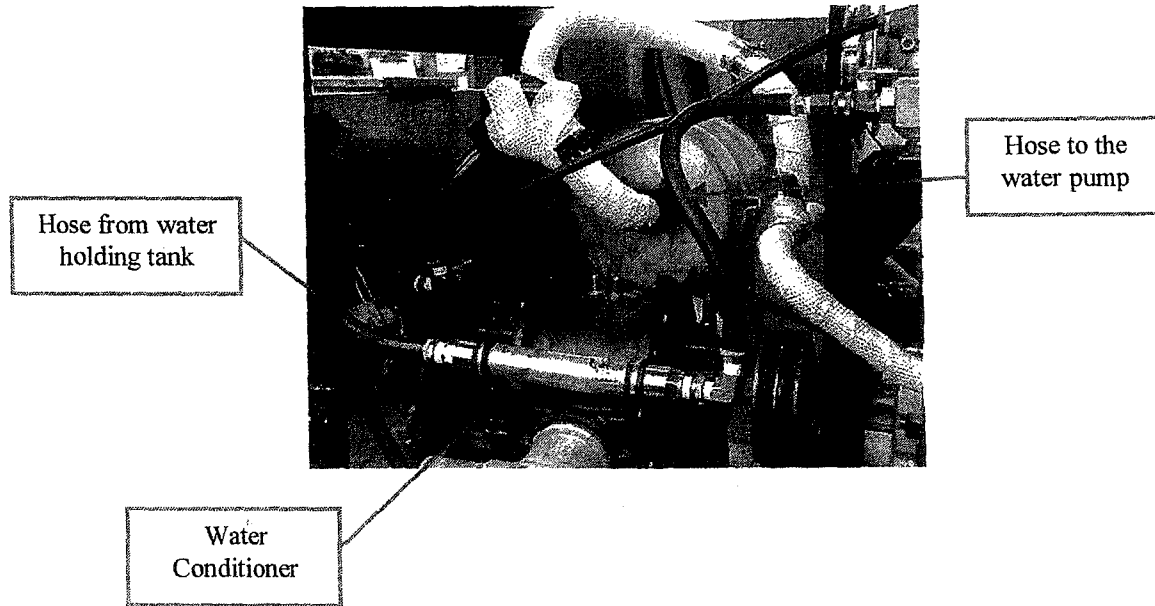
Revision 1 Date - 6/20/01

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**Figure 2-2.4A**

**Water  
Conditioner**



Water conditioners will treat water that has up to 132 grains of hardness. Water softeners will treat water that has more than 125 grains of hardness. To determine the grains of hardness in your water, call your local city water department. In most cases, all water has a minimum of 50 grains of hardness in it. Be sure to check the rating of the water conditioner or softener that you are going to purchase to make sure it will work for you

**Figure 2-2.4B**

**Water Softener Installation**

**This Figure will be available soon**

- 2-3 This unit comes equipped with an excellent instrumentation package that shows the operator all of the vital information needed to know to ensure good cleaning operations.
- 2-4 Safety is always an important subject and never should be taken lightly. Listed in the next portion of this section is safety information that should be strictly adhered to.
- 2-4.1 **Carbon Monoxide** – Carbon monoxide is emitted by all gasoline engines and could become lethal if the unit is operated in a confined area. Carbon monoxide is odorless, colorless and can cause death if inhaled during prolonged exposure. Consider the following
- 1) Location of the vehicle
  - 2) Wind direction which can change during operation and should be checked periodically.
  - 3) Dizziness
  - 4) Unexplained headaches
- 2-4.2 **Hot Exhaust Tubes** – Will cause burns to skin if touched. These are confined to the machine's enclosed area, but when performing maintenance with the protective panels removed, much caution must be used.
- 2-4.3 **Radiator Cap Removal** – To avoid burns, do not remove the engine radiator cap when the engines water is hot. Please refer to the owner's manual pages A1 through A9, section 4 of this manual for many other engine safety warnings.
- 2-4.4 **Moving Parts** – Moving parts can cause serious injuries if safety precautions are ignored. Always keep loose clothing away from pulleys and belts when maintenance procedures must be performed while the machine is operating. Loose clothing can become tangled or caught in the moving parts of the drive system.
- 2-4.5 **Battery**- The battery contains sulfuric acid. To prevent acid burns, avoid contact with the skin, eyes and and clothing. Batteries produce an explosive hydrogen gas while being charged. To prevent a fire or an explosion, charge the battery only in a well ventilated area. Keep sparks, open flames and other sources of ignition away from the battery at all times.
- 2-4.6 **Gas Line** – Gasoline is an explosive fuel. Gasoline is extremely flammable and its vapors can explode if ignited. Do not fill the fuel tank while the engine is running, since fuel vapor could ignite if it comes in contact with a spark or hot exhaust system. Move the fuel tank tank to the outside of the vehicle to fill or vent. Use extreme caution to assure that no lit cigarettes or other live flames or sparks are near. If gasoline comes in contact with the skin, wash it off immediately.
- 2-4.7 **Radiator Cooling Fan** – The radiator cooling fan can cause serious injury to the operator if they come in contact with the fan. Keep other objects away from the fan when the engine is running to prevent damage to the fan, radiator and/or engine.
- 2-4.8 **Defective Pressure Hoses** – Defective pressure hoses, whether on the machine or connecting to the cleaning tool, should be replaced when evidence of wear or damage appear. This will prevent burns from the scalding hot water or damage to surroundings should a hose break or blow out.

2-4.9 **Freezing** - Water will freeze at 32°F. Therefore, a method of keeping the machine from freezing is imperative. During operation of the machine, using good cold weather techniques and operating procedures, the machine can be operated with weather temperatures well below the freezing point. When the 9100LX is not in service, it must be kept from freezing (above 32°F) at all times. Several methods can be used:

- A) Vehicle's heater (transporting between jobs)
- B) Electric heaters (adequate size)
- C) Propane heaters
- D) Permanent or space heater
- E) Heated garage

**NOTE:** Use a thermometer to assure that the external heating device above is sized correctly and is doing job of keeping your machine from freezing.

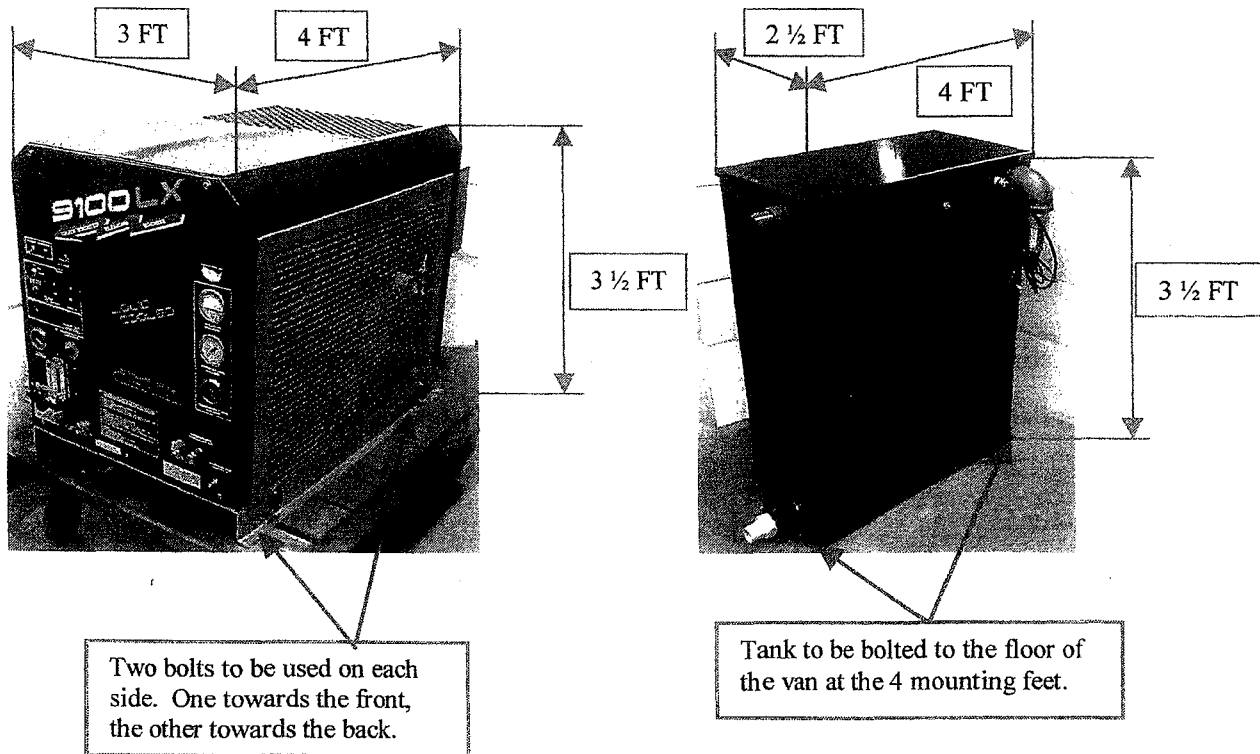
2-4.10 **Waste Water Removal** – It is imperative that the dump valve not be opened while your machine is operating. The air from the open dump valve assembly can cause hot waste water from the waste tank to be sucked into the vacuum system. This water can then be exposed to the high temperature from the engine exhaust. The operator of the machine could be exposed to this hot water, which could burn him/her.

**WARNING:** Do not open dump valve of the waste water tank, while the machine is running.

# Section 3

## Machine Installation

- 3-1 The 9100LX machine can be rear or side mounted into a standard van. When side mounted into a standard van, the load is more evenly distributed about the 4 wheels of the vehicle. This makes it a more desirable installation. The machine must be mounted to the floor of the van securely. Your local Steam Way distributor can perform this procedure for you.
- 3-2 Dimensions of the machine and waste tank are:



When the waste tank is mounted behind the machine, no less that 6" is required between the machine and the waste tank. **NOTE:** The waste tank can be located wherever desired or convenient.

- 3-2 The machine weighs approximately 500 lbs., therefore a fork lift may be required to lift the unit into the vehicle.
- 3-3 An optional drip pan is available and highly recommended to be used to set the machine on. This pan helps to collect spilled water and other lubricants. There are several pre-designed pans available, please consult your local Steam Way distributor to assist you in selecting the one that fits your installation the best. The pan should be secured to the van floor before setting the machine onto it.
- 3-4 **WARNING:** The machine must be bolted through the floor of the vehicle using no less that four 3/8" bolts with large washers (2 1/2" or larger) below the floor of the vehicle. Lock washers and Nylock nuts are suggested so that they will not loosen from vibration over time. Figure 3-2 where the arrows appear, are ideal spots to drill holes for mounting the machine. **CAUTION:** Before drilling holes, inspect to assure that the floor is open beneath the vehicle and that while drilling, no damage will be done to gas or brake lines. Also avoid electrical wiring that would make the vehicle unsafe to operate.
- 3-5 The waste tank must be mounted securely through the floor of the van. (Figure 3-2) shows the four-corners of the tank with tabs that must be bolted to the floor of the vehicle. Use on 3/8" bolt on each corner of the tank with large (2 1/2" or larger) washers as in the mounting of the machine.

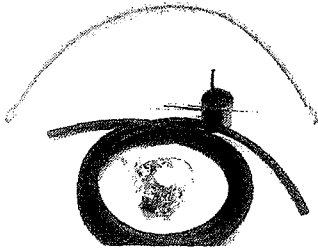
Gasoline can be supplied to the machine in one of two ways. You can purchase an auxiliary fuel line hook up kit, or use a standard floor fuel tank.

- 3-6.1 The auxiliary fuel line hook up comes in two different forms. One is inserted into the filler neck tube while the other is inserted in the breather tube. Please consult your local Steam Way distributor in order to decide which one will work in your vehicle.

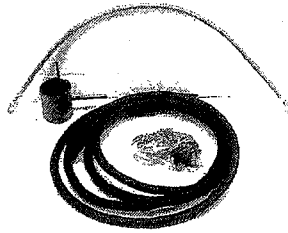
Please make note of figure 3-3 for installation pictures. This installation will be for Chevy and Dodge vans. The filler neck tube is cut, the adapter tube assembly inserted and clamped into place. The flexible stainless steel hose is attached to the adapter tube assembly and runs down the inside of the filler tube into the bottom of the waste tank. The other hose is run from the adapter tube assembly, through the floor of the van and is attached to the gasoline input connection (H-5) (Figure 5-1) on the left side of the machine (Figure 3-3 and 3-4).

**Figure 3-3**

Fuel Line  
Hook Up Kit



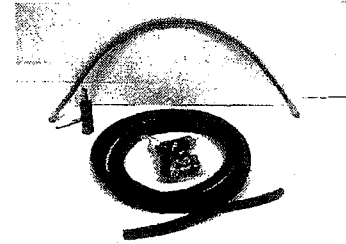
Dodge Inline Fuel  
Hookup Kit  
Part #1909846



Chevy Inline Fuel  
Hookup Kit  
Part #1909855

**Figure 3-4**

Fuel Line  
Hook Up Kit



Ford Inline Fuel  
Hookup Kit  
Part #1909839

Please make note of figure 3-4 for installation pictures. This installation will be for Ford vans, 1992 or later. The breather tube is cut, the adapter tube assembly is inserted and clamped into place. The flexible stainless steel hose is attached to the adapter tube assembly and runs down the inside of the breather tube into the bottom of the waste tank. The other hose is run from the adapter tube assembly, through the floor of the van and is attached to the gasoline input connection (H-5) (Figure 5-1) on the left side of the machine.

- 3-6.2 The standard fuel tank can be used instead of the inline gasoline hook ups. It is suggested that with this setup, you make sure you secure the gas tank in a holding bracket or a gasoline fuel rack in order to avoid spillage of gas throughout the vehicle. The hose from the tank should be secured to the gasoline input connection (H-5) (Figure 5-2) on the left side of the machine. This hose should be secured out of the way so no damage could occur to this line.
- 3-7 **CAUTION:** Do not cut the fuel line that supplies gasoline to the vehicle engine. This line carries high pressure from the vehicles fuel pump in the gasoline tank that would cause damage to the carburetor on the Kawasaki engine. This would also be a fire hazard and would void the warranty for the vehicle.



3-8 After the machine and waste tank are installed, connect the following:

- A) Vacuum hose from the vacuum T to the waste tank input pipe.
- B) The electrical line from the float switch in the waste tank to the electrical cord at the rear of the machine using the male and female bullet connectors on the machine and tank.
- C) Connect the  $\frac{1}{4}$ " push lock hose from the thermal accumulator to the barb on the waste tank.

# Section 4

## POWER PLANT

### (KAWASAKI ENGINE FD661)

- 4-1 The 9100LX machine is powered by a 22HP water cooled engine. This engine is the power source for the following:
- A) The Vacuum Blower
  - B) The Clutch Operated Water Pump
  - C) The Automotive Alternator
  - D) Provides Heat – For heating the water for cleaning (see sections 7 & 8)
- 4-2 Detailed Information about safety, operation and maintenance of this engine is found on pages A1-A9 of the engine manual at the end of this section. The engine trouble-shooting guide is on page A8.
- 4-3 The automotive type alternator (P-16) is installed on the 9100LX to provide adequate DC power when auxiliary equipment is added to the basic package such as pump out systems, transfer pump, DC lights, cooling fans, etc... This alternator keeps the battery (P-17) fully charged for quick engine starts. When running, the alternator will produce approximately 14VDC power. (See section 11 for the circuit diagram).
- 4-4 Gasoline is supplied to the engine via the use of an electric 12VDC fuel pump (P-18). A 6-gallon fuel tank with connecting hose or a inline fuel tank kit is supplied with the machine's basic package. The connecting hose from either type of fuel source is equipped with a female quick disconnect that is attached to a male quick disconnect on (H-5) on the left side of the machine. The gasoline passes through a gasoline filter (P-19) before it reaches the fuel pump. **CAUTION:** See warnings on Page A1 of the engine manual for the safety precautions when handling gasoline. The fuel pump circuit is shown in figure 4-1. When the ignition switch (C-16) is on, power is supplied to the fuel pump via the DC volt meter from contact "B" of the ignition switch.
- 4-5 Engine oil and gasoline recommendations are covered on page A3 of the engine manual. Please refer to the chart to choose the proper gasoline and oil viscosity for the temperature range for the area in which you will be operating the 9100LX machine. Your Kawasaki FD661 engine's oil capacity is 1.6 quarts when the oil filter is not changed. The oil capacity is 1.9 quarts when the oil filter is changed. See Page A4 of the engine manual for more information.
- 4-6 The engine oil drain (H-6) hose is located behind the lower right hand corner of the front panel. The hose is connected to the lower engine block, just below the radiator. The oil drain hose is long enough to be pulled from the engine compartment for easy access. **NOTE:** Drain all of the oil from the engine when the oil is warm. **CAUTION:** Do not over fill the engine. See the engine manual for more information.
- 4-7 Engine cooling is accomplished similar to that of an automobile. When the engine is running, a belt driven fan pulls cool air through the radiator to provide engine cooling. The water pump keeps the water moving through the system, which includes the low pressure pre heater (P-2). The engine's water temperature, is controlled by a 180° thermostat. A thermo switch mounted in the engine block will stop the engine if the water temperature reaches approx. 230°F (226° - 237°).
- 4-7.1 The cooling system, which includes the low pressure pre heater, holds just slightly over a gallon of water/antifreeze mix. **WARNING:** Always allow the engine to cool down before removing the radiator cap. Then remove slowly to prevent burns from the hot water. Even though you should not let your 9100LX freeze, it is still mandatory that you use antifreeze at a ratio of 1:1 which will provide better lubrication and heat transfer. **CAUTION:** When the engine is running, keep fingers clear of the radiator fan.

4-8 The engine ignition system will be covered in a step by step presentation using pages A1-A9 of the engine manual at the end of this section as a reference. The starting point is the battery (P-17). From the battery to the starter Solenoid (P-20), which is a central point to distribute DC power to other power circuits of the machine. At the starter solenoid, power is supplied to the ignition switch (C-16 contact "B" via a 15 amp circuit breaker (C-20).

- 4-8.1 When the ignition switch is turned to the run position, power is distributed to all contacts of the switch except contact "S" which is the start position. Follow the purple lead from Contact "R" of the ignition switch to the "A" relay (C-22) which is above relay "B". Power will normally connect contact 9 of relay "A", to contact 3 because the relay is not energized. Note that in this case, since there is no oil pressure, the oil pressure switch will be grounded providing a way to energize relay "A" which will interrupt the power from 9 to 3. Paragraph 4-8.3 will describe the starting circuit.
- 4-8.2 Picking up the voltage at contact 3 of relay "A" (C-22), a red wire supplies the power to the time delay relay and to the carburetor fuel solenoid to flow fuel into the carburetor. At this time, power will pass through the time delay relay and be supplied to the engine igniter so that it can provide primary power to the coils for each spark plug. The purpose of the time delay relay will follow in paragraph 4-8.4.
- 4-8.3 Starting the engine with ignition switch (C-16) in the start position, power will connect contact "B" to contact "S" only. Two wires are connected to the "S" contact. One white wire goes to the starter motor solenoid to engage the motor to turn the engine for starting and the other white wire goes to the push to start switch (C-21). The power goes through the diode to provide power to contact 3 of the relay "A" (C-22). **NOTE:** Before the engine starts, there is no oil pressure; therefore relay (C-22) is energized which makes it necessary to have an alternate way to bypass relay (C-22).
- 4-8.4 The engine time delay relay will allow the engine to run for 3-5 seconds after the engine is shut off under any of the following conditions:
- 1) Ignition switch is turned off
  - 2) Engine high temperature switch is activated
  - 3) Engine low oil pressure switch is activated
  - 4) Waste tank float switch is activated

By allowing the engine to run for a short period of time after the carburetor fuel solenoid is closed, all of the unburned fuel in the combustion chamber will be burned off. This will eliminate/reduce the possibility of backfiring or pre-ignition.

4-9 Service to the air cleaner and foam element should be performed on a regular interval. See page A7 of the engine manual as well as the maintenance check list figure 12-1, for the recommended interval to check, clean or change this component and other services to be complied with. Oiling the foam element will reduce the life of the oil filter element.



**FD440/FD590/FD620**

**FD501/FD611/FD661**

4-Stroke liquid-cooled V-twin gasoline engine



## **OWNER'S MANUAL**

Part No. 99920-2122-04

### **READ THIS FIRST**

For your safety, read this Owner's Manual and understand it thoroughly before operating this ENGINE.

#### **▲WARNING**

- Never allow children to operate the engine or equipment.
- Keep people and pets out of area where you are using the engine or equipment.
- Never wear loose, torn, or bulky clothing. It may catch on moving parts or controls, leading to the risk of accident.
- Never consume alcohol or drug before or while operating this engine.
- Do not run the engine in a closed area. Exhaust gas contains carbon monoxide, an odorless and deadly poison.
- Gasoline is extremely flammable and can be explosive under certain condition.
  - Stop engine and allow the engine to cool before refueling.
  - Do not smoke. Make sure area is well ventilated and free from any source of flame or sparks including the pilot light of any appliance while refueling, servicing fuel system, draining gasoline and/or adjusting carburetor.
  - Do not fill the tank so the fuel level rises into the filler neck or level surface of level gauge. If the tank is overfilled, heat may cause the fuel to expand and overflow through the vents in the tank cap.
  - Wipe off any spilled gasoline immediately.
- To prevent fire hazard:
  - Keep the engine at least 1 m (3.3 ft) away from buildings, obstructions and other burnable objects.
  - Do not place flammable objects close to the engine.
  - Do not expose combustible materials to the engine exhaust.
  - Do not use the engine on any forest covered, bush covered or grass covered unimproved land unless spark arrester is installed on the muffler.
- To avoid getting an electric shock, do not touch spark plug, plug cap or spark plug lead during engine running.
- To avoid a serious burn, do not touch a hot engine or muffler. The engine becomes hot during operation. Before you service or remove parts, stop engine and allow the engine to cool.
- Do not place hands or feet near moving or rotating parts.
- Do not run engine at excessive speeds. This may result in injury.
- Always remove the spark plug lead from spark plug when servicing the engine to prevent accidental starting.

## SAFETY AWARENESS

Whenever you see the symbols shown below, heed their instructions! Always follow safe operating and maintenance practices.

### WARNING

This warning symbol identifies special instructions or procedures which, if not correctly followed, could result in personal injury, or loss of life.

### CAUTION

This caution symbol identifies special instructions or procedures which, if not strictly observed, could result in damage to, or destruction of equipment.

### NOTE

○ Indicates points of particular interest for more efficient and convenient operation.

## FOREWORD

We wish to thank you for choosing this Kawasaki Engine. Please read this Owner's Manual and understand thoroughly before operating, as it contains information which will be of value in obtaining maximum service from your Kawasaki Engine. To ensure a long, trouble-free life for your engine, give it the proper care and maintenance described in this manual.

○ Due to improvements in design and performance during production, in some cases there may be minor discrepancies between the actual engine and the illustrations or text in this manual.

The right is reserved to make changes at anytime without notice.

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READ THE OPERATING INSTRUCTIONS OF THE EQUIPMENT THIS ENGINE POWERS.

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Fourth Edition (1) Apr. 2000 (M)

2

## EMISSION CONTROL INFORMATION

### Fuel Information

THIS ENGINE IS CERTIFIED TO OPERATE ON UNLEADED REGULAR GRADE GASOLINE ONLY. A minimum of 87 octane of the antiknock index is recommended. This antiknock index is posted on service station pumps in the U.S.A.

### Emission Control Information

To protect the environment in which we live, Kawasaki has incorporated crankcase emission (1) and exhaust emission (2) control systems in compliance with applicable regulations of the United States Environmental Protection Agency and the California Air Resources Board.

#### 1. Crankcase Emission Control System

A sealed-type crankcase emission control system is used to eliminate blow-by gasses. The blow-by gasses are led to a breather chamber through the crankcase and from there to the air cleaner.

Oil is separated from the gasses while passing through the inside of the breather chamber from the crankcase, and then returned to the bottom of the crankcase.

#### 2. Exhaust Emission Control System

The exhaust emission control system applied to this engine consists

of a carburetor and an ignition system having optimum ignition timing characteristics. The carburetor has been calibrated to provide lean air/fuel mixture characteristics and optimum fuel economy with a suitable air cleaner and exhaust system.

### Maintenance and Warranty

Proper maintenance is necessary to ensure that your engine will continue to have low emission levels. This Owner's Manual contains those maintenance recommendations for your engine. Those items identified in the Periodic Maintenance Chart are necessary to ensure compliance with the applicable standards.

As the owner of this Kawasaki Power Product, you have the responsibility to make sure that the recommended maintenance is carried out according to the instructions in this Owner's Manual at your own expense.

The Kawasaki Limited Emission Control System Warranty requires that you return your Kawasaki Power Product to an authorized Kawasaki Power Product dealer for remedy under warranty. Please read the warranty carefully, and keep it valid by complying

with the owner's obligations it contains.

### Tampering with Emission Control Systems Prohibited

Federal law and California State law prohibits the following acts or the causing thereof: (1) the removal or rendering inoperative by any person other than for purposes of maintenance, repair, or replacement, of any device or element of design incorporated into any new engine for the purposes of emission control prior to its sale or delivery to the ultimate purchaser or while it is in use or (2) the use of the engine after such device or element of design has been removed or rendered inoperative by any person.

Among those acts presumed to constitute tampering are the acts listed below:

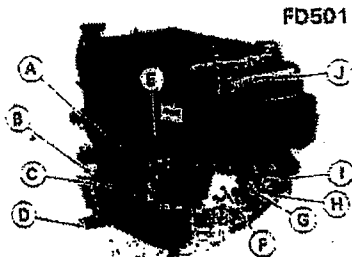
Do not tamper with the original emission related parts.

- Carburetor and internal parts
- Spark plugs
- Magneto or electronic ignition system
- Fuel filter element
- Air cleaner element
- Crankcase
- Cylinder head
- Breather chamber and internal parts
- Intake pipe and tube

3

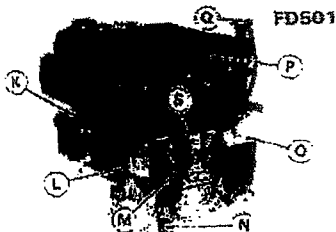
## GENERAL INFORMATION

FD501



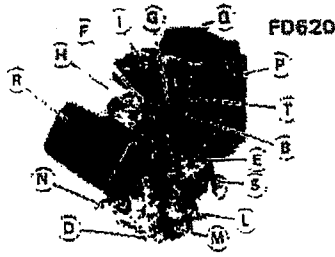
A. Oil Pressure Switch E. Spark Plug  
B. Oil Gauge F. Control Plate  
C. Oil Filter G. Carburetor  
D. Oil Drain Plug

FD501



H. Fuel Shut-off Valve L. Electric Starter  
I. Fuel Pump M. Igniter  
J. Air Cleaner  
K. Coolant Temperature Switch

FD620



N. P.T.O Shaft S. Packard Connector  
O. Overflow Reservoir T. Oil Filter Cap  
P. Radiator Screen  
Q. Radiator Cap  
R. Muffler

Engine Oil Capacity  
See Page 6. Engine Oil

Coolant

Type: Permanent Type of Antifreeze.  
Green Colored.  
Mixed Ratio: 50% mixed  
Freezing Point: -38°C (-31°F)

Coolant Capacity

FD440/501	2.1 L (2.2 U.S. qt)
FD590/611	3.4 L (3.6 U.S. qt)
FD620/661	2.7 L (2.8 U.S. qt)

Engine Serial Number

The engine number is only means of identifying your particular engine from others of the same model type. This serial number is needed by your dealer when ordering parts.

Tune-up Specifications

ITEM	Specification
Valve Clearance (Inlet, Exhaust) FD440, FD501	0.15 mm (0.006 in.)
FD590, FD620 FD611, FD661	0.25 mm (0.009 in.)
Ignition Timing	Unadjustable
High Idle Speed	3600 rpm
Low Idle Speed	1450~1650 rpm
Spark Plug Gap	0.6~0.7 mm (0.024~0.028 in.)
Other Specifications	NO OTHER ADJUSTMENT NEEDED

NOTE

High and low idle speeds may vary depending on each equipment on which the engine is used. Refer to the equipment specification.

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## FUEL AND OIL RECOMMENDATIONS

Fuel

Use only clean, fresh, unleaded regular grade gasoline.

Octane Rating

The octane rating of a gasoline is a measure of its resistance to "knocking". Use a minimum of 87 octane of the antiknock index is recommended. The antiknock index is posted on service station pumps in the U.S.A.

NOTE

If "knocking or pinging" occurs, use a different brand of gasoline or higher octane rating.

CAUTION

Do not mix oil with gasoline.

Oxygenated Fuel

Oxygenates (either ethanol or MTBE) are added to the gasoline. If you use the oxygenated fuel be sure it is unleaded and meets the minimum octane rating requirement.

The following are the EPA approved percentages of fuel oxygenates.

ETHANOL: (Ethyl or Grain Alcohol)  
You may use gasoline containing up to 10% ethanol by volume.

MTBE: (Methyl Tertiary Butyl Ether)  
You may use gasoline containing up to 15% MTBE by volume.

METHANOL: (Methyl or Wood Alcohol)

You may use gasoline containing up to 5% methanol by volume, as long as it also contains cosolvents and corrosion inhibitors to protect the fuel system.

Gasoline containing more than 5% methanol by volume may cause starting and/or performance problems. It may also damage metal, rubber, and plastic parts of your fuel system.

WARNING

After refueling, make sure the tank cap is closed securely. If gasoline is spilled on the fuel tank wipe it off immediately.

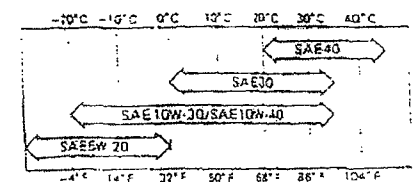
Engine Oil

The following engine oils are recommended.

API Service Classification: SC, SD, SE, SF, SG, or SH.

Oil Viscosity

Choose the viscosity according to the temperature as follows.



NOTE

Using multi grade oils (5W-20, 10W-30, and 10W-40) will increase oil consumption. Check oil level more frequently when using them.

5

A3

15

## PREPARATION

### Fuel

- Level the engine before fueling.
- Remove the fuel tank cap.
- Slowly pour fuel into the tank through the fuel strainer.

#### WARNING

Do not fill the fuel more than level gauge surface of fuel strainer to prevent spill out of the fuel from tank cap.

- Close the tank cap securely by turning it clockwise as far as it will go.

### Engine Oil

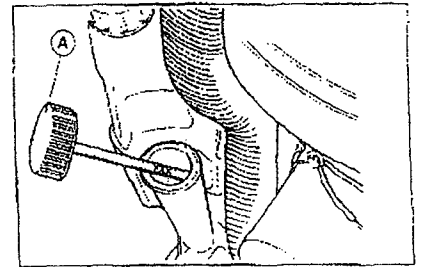
Check the engine oil daily before starting the engine otherwise shortage of the engine oil may cause serious damage to the engine such as seizure.

- Place the engine on level surface. Clean area around the oil gauge before removing it.
- Remove the oil gauge (A) and wipe it with clean cloth.
- Pour the oil slowly to "FULL" mark on the oil gauge.
- Insert the oil gauge into tube (B) **WITHOUT SCREWING IT IN.**
- Remove the oil gauge (A) to check the oil level. Level should be between "ADD" and "FULL" marks. Do not overfill.
- Install and tighten the oil gauge (A).

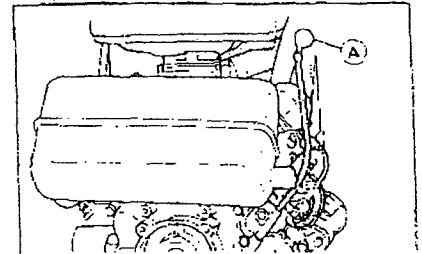
#### Engine Oil Capacity

	FD440/501/620/661	FD590/611
When changing oil filter	1.8 L (1.9 US qt)	2.1 L (2.2 US qt)
New engine and without changing oil filter	1.5 L (1.6 US qt)	1.7 L (1.8 US qt)

### FD440/501/590/611



### FD620/661/501D



#### CAUTION

The engine is shipped without engine oil.

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## STARTING

### Start Engine

#### NOTE

○ Be aware of followings in order to start the engine easily in cold weather.

- Use proper oil for temperature expected (See FUEL AND OIL RECOMMENDATIONS).
- Use fresh gasoline.
- Protect the engine or equipment from direct exposure to weather when not in operation.
- Before starting the engine insure all possible external loads are disconnected.
- Open the fuel valve on the equipment.

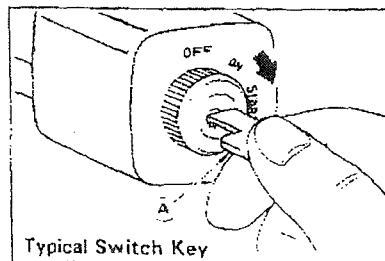
#### Starting by Electric Starter

—except FD620, FD661 and FD501D

- Put the switch key into the engine switch.
- Turn the switch key to the START position on the equipment. Usually engine will start within 3 seconds.

#### CAUTION

Do not run the starter continuously more than 5 seconds, otherwise the battery may discharge quickly. If the engine does not start right away, wait 15 seconds and try again.



Typical Switch Key

For A Cold Engine — Place the throttle lever into "CHOCK" position.

For A Warm Engine (normal operating temperatures) — Place the throttle lever midway between "SLOW" and "FAST" positions.

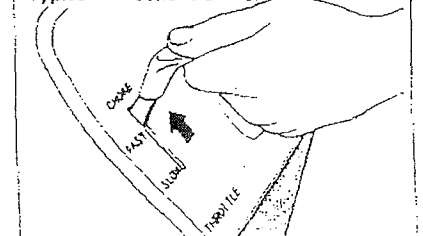
#### CAUTION

Whenever you start engine, make sure warning light is not on in started engine. If warning light comes on, stop engine immediately and check oil level (if equipped).

### Warming Up

After the engine starts, move the throttle lever (A) on the equipment to between "FAST" and "SLOW". To warm up the engine, run it for 3 to 5 minutes with the throttle lever in the same (halfway) position before putting the equipment under load. Then, move the throttle lever (A) on the equipment to its "FAST" position.

#### Typical Throttle Control



#### CAUTION

Keep warming up before loading. This will allow oil to reach all the engine parts, and the piston clearance to reach design specification, before the engine is ready for loading.

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## OPERATING

### Starting by Electric Starter

-FD620, FD661 and FD501D

- Move throttle lever on dash to half throttle position.
- Use full choke when the engine is cold, but in hot weather or when the engine is already warm, use half-choke or leave the choke fully open.
- After starting the engine, gradually return the choke lever to the full open position.

#### NOTE

- When the engine is very warm, or when the engine does not start immediately, DO NOT keep trying to start it with the choke closed as this will cause flooding and make starting more difficult. Instead, fully open the choke and start the engine.

### Anti-engine inclination

This engine will operate continuously at angles up to 25° in any direction.

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.

#### CAUTION

Do not operate this engine continuously at angles exceeding 25° in any direction. Engine damage could result from insufficient lubrication.

## STOPPING

### Ordinary Stop

- Lower the engine speed to an idle. Keep on running at idle for about one minute.

#### CAUTION

Do not stop the engine from high speed loaded operation. It may cause run-on or after burning.

- Turn the key switch to "OFF" position.

### Emergency Stop

- Immediately turn the engine switch or the key switch to "OFF" position.
- Close the fuel valve on the equipment.
- Turn the key switch to "OFF" position.

#### WARNING

Always remove Engine Key from switch when leaving equipment unattended or when equipment is not in use.

## ADJUSTMENT

### Throttle Cable Installation,

Adjustment - except FD620, FD661

Make sure that the throttle lever on the equipment has been linked to the engine with the throttle cable.

- Leave the cable clamp bolt(A) loose.
- Align the hole(B) of speed control lever(C) with the hole(D) of base plate(E) moving the lever(C); insert 6 mm dia. pin (or 6 mm bolt) through two holes.
- Pull up the outer housing(F) of throttle cable until the inner wire(G) has almost no slack, and tighten the cable clamp bolt(A). Remove the 6 mm dia. pin.

Make sure that the carburetor choke valve(H) is closed completely when the throttle lever on equipment is moved to "CHOKE" position. If not, perform "CHOKE ADJUSTMENT".

#### NOTE

There are differences in orientation and appearance between the control panel illustrated and those of FD440, FD501, FD590, FD611 and FD620, FD661, FD501D but it is good to get the knack of adjusting as described.

### Interlocking Choke Adjustment

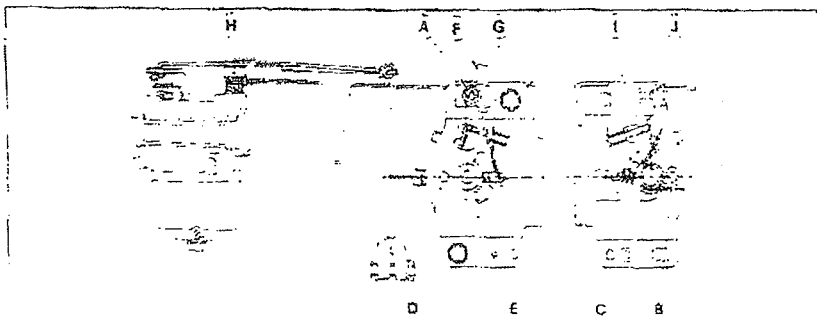
-except FD620, FD661 and FD501D

- Stop the engine.
- Align the hole (B) of speed control lever (C) with the hole (D) of base plate (E) by moving the lever (C); insert 6 mm dia. pin (or 6 mm bolt) through two holes.
- Turn in the choke setting screw (I) until its end just begins to touch tongue of the lever (J). Remove the 6 mm dia. pin or bolt.

### Engine Speed Adjustment

#### NOTE

- Do not tamper with the governor setting or the carburetor setting to increase the engine speed. Every carburetor is adjusted at the factory and a cap or a stop plates were installed on each mixture screw.
- If adjustment is needed, have it performed by your authorized Kawasaki Engine dealer.





# MAINTENANCE

## Periodic Maintenance Chart

### ▲WARNING

Always remove the spark plug cap from spark plug when servicing the engine to prevent accidental starting.

MAINTENANCE	INTERVAL							
	Daily	First 8 hr.	Every 25 hr.	Every 50 hr.	Every 100 hr.	Every 200 hr.	Every 300 hr.	Every 400 hr.
Check and add engine oil.	●							
Check for loose or lost nuts and screws.	●							
Check for fuel and oil leakage.	●							
Check battery electrolyte level.	●							
Check or clean air intake screen.	●							
Tighten nuts and screws	●							
* Clean air cleaner foam element			●					
* Clean air cleaner paper element					●			
Clean fuel filter element				●				
Change engine oil (without oil filter)		●		●				
Change engine oil (with oil filter)		●			●			
Clean and regap spark plug					●			
Change oil filter						●		
* Replace air cleaner paper element							●	
* Clean dust and dirt from cylinder and cylinder head fins							●	
K Clean combustion chamber							●	
K Check and adjust valve clearance							●	
K Clean and lap valve seating surface							●	
K Inspect radiator and hoses						●		
K Check fan belt conditions and tension-FD620/FD661						●		
K Change coolant								●

Note: The service intervals indicated are to be used as a guide. Service should be performed more frequently as necessary by operating condition.

\* Service more frequently under dusty conditions.

K: Have an authorized Kawasaki engine dealer perform these services.

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### Oil Level Check

Check oil level daily and before each time of operation. Be sure oil level is maintained. See PREPARATION.

### Oil Change

Change oil after first 8 hours of operation. Thereafter change oil every 50 hours (without oil filter type) and 100 hours (with oil filter type).

- Run the engine to warm oil.
- Be sure the engine (equipment) is level.
- Stop the engine.
- Remove the oil drain screw and drain the oil to suitable container while engine is warm.

#### ▲WARNING

Be careful with hot oil being drained. It may be hot enough to burn you severely.

- Install the oil drain screw.
- Remove oil gauge and refill with new oil (See FUEL AND OIL RECOMMENDATIONS).
- Check the oil level (see Oil Level Check).

### Oil Filter Change

- Change the oil filter at first 200 hours of operation.

#### ▲WARNING

Stop the engine and be careful with hot oil drained.

- Drain engine oil to suitable containers.

#### CAUTION

Before removing the oil filter, place suitable pan under filter connection.

- Rotate the filter (A) counterclockwise to remove it.
- Coat a film of clean engine oil on seal of new filter.
- Install new filter rotating it clockwise until seal contacts mounting surface (B). Then rotate filter 3/4 turn more by hand.
- Supply engine oil as specified.
- Run the engine for about 3 minutes, stop engine, and check oil leakage around the filter.
- Add oil to compensate oil level down due to oil filter capacity (see PREPARATION for oil level check).



### Air Cleaner Service

#### CAUTION

To prevent excessive engine wear, do not run the engine with the air cleaner removed.

#### ▲WARNING

Clean the elements in a well ventilated area and take care that there are no sparks or flame anywhere near the working area, this includes any appliance with a pilot light.  
Do not use gasoline or low flash-point solvents to clean the element. A fire or explosion could result.

### Foam Element

Clean the foam element (A) every 25 hours.

- Wash the element in detergent and water, and dry it thoroughly.
- Soak the element in a new engine oil and squeeze it to remove excess oil.

### Paper Element

Clean the paper element (B) every 100 hours.

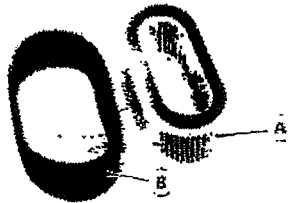
- Clean the element by tapping gently to remove dust. If very dirty, replace the element with a new one.
- Replace with a new paper-element yearly or 300 hours.

#### NOTE

○ Operating in a dusty condition may require more frequent maintenance than above.

#### CAUTION

Do not use petroleum solvent to clean paper-element.  
Do not oil paper-element.  
Do not use pressurized air to clean or dry paper-element.



### Spark Plug Service

#### WARNING

Before checking spark plug, stop the engine and allow it to cool.

Clean or replace the spark plug and reset gap (B) every 100 hours of operation.

- Disconnect the spark plug wire lead and remove the spark plug.
- Clean the electrodes (A) by scraping or with a wire brush to remove carbon deposits and wear.
- Inspect for cracked porcelain or other wear and damage. Replace the spark plug with a new one if necessary.
- Check the spark plug gap and reset it if necessary. The gap must be between 0.6 and 0.7 mm (0.024 and 0.028"). To change the gap, bend only side-electrode, using a spark plug tool.
- Install and tighten the spark plug to 17 Nm (12 ft-lb). Then connect spark plug lead.

#### Spark Plug Recommended

NGK BMR 6A except FD620  
NGK BMR 4A for FD620

### Fuel Filter Service

#### WARNING

Clean the fuel filter element in a well ventilated area, and take care that there are no sparks or flame anywhere near the working area; this includes any appliance with a pilot light. Do not use gasoline or low flash-point solvents to clean the fuel filter element. A fire or explosion could result.

Clean the fuel filter element every 50 hours.

- Close the fuel valve to shut off the fuel flow.
- Loosen the sediment bowl and remove the filter element and gasket.
- Remove any sediment, wipe clean, and reinstall the assembly.

## STORAGE

### Fuel System Draining

Engines to be stored over 30 days should be completely drained of fuel to prevent gum deposits forming on essential carburetor parts, fuel filter and tank.

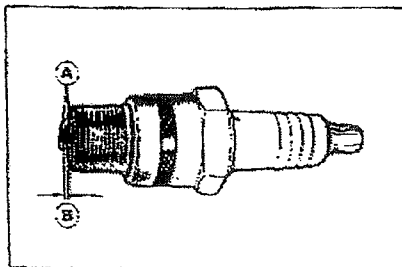
- Clean the every part of the engine.
- Be sure that the engine key switch is positioned at "OFF".
- Close the fuel valve and remove the sediment bowl.
- Put a pan under the fuel valve to receive the drained fuel, and open the fuel valve to drain the fuel from fuel tank completely.
- Install the sediment bowl.
- Put a pan under the carburetor and loosen the drain screw of the carburetor to drain the fuel completely.
- Tighten the drain screw.
- Remove the spark plug and pour approx 1 ~ 2 mL (0.06 ~ 0.1 cu.in) of engine oil through the spark plug hole and then screw the spark plug in after turning the engine a few times. Slowly turning the engine until you feel compression and then leave it there.

○ These blocks the air to come inside the cylinder and prevent the rust inside the engine.

- Change engine oil for next use after period of storage (refer to oil change).
- Wipe the body with oily cloth.
- Wrap the engine with plastic sheeting and store it in a dry place.

#### WARNING

Drain the fuel in a well ventilated area. Keep the drained fuel in a safe area.



### Cooling System Inspection

Inspect the radiator and the hoses every 200 hours of operation.

- Inspect the inlet and outlet tubes for cracks, kinks, dents, and fractured seams. Repair or replace the radiator if necessary.
- Check for dirt and insects that may be lodged in the radiator. Clean them out by using compressed air or a low-pressure washer.

#### CAUTION

Using high-pressure water, as from a car wash facility, could damage the radiator fins and impair the radiator's effectiveness.  
Do not run engine before all cooling system parts reinstalled to keep cooling and carburation as intended.

## TROUBLESHOOTING GUIDE

If the engine malfunctions, carefully examine the symptoms and the operating conditions, and use the table below as a guide to troubleshooting.

Symptom	Probable Cause	Remedy	
Engine will not start or output is Low	<ul style="list-style-type: none"> <li>● Loose spark plug</li> <li>● Loosen cylinder head bolts</li> </ul>	Tighten properly	
Low	No fuel to combustion chamber	<ul style="list-style-type: none"> <li>No fuel in fuel tank</li> <li>● Blocked fuel tube</li> <li>● Blocked air vent in tank cap</li> </ul>	<ul style="list-style-type: none"> <li>Fill fuel tank</li> <li>Clear</li> </ul>
	Spark plug fouled by fuel	Over-rich fuel/air mixture	<ul style="list-style-type: none"> <li>Rotate engine with plug removed to discharge excess fuel</li> <li>Clean spark plug</li> </ul>
		Clogged air cleaner	Clear
		<ul style="list-style-type: none"> <li>● Incorrect grade/type of fuel</li> <li>● Water in fuel</li> </ul>	Change gasoline
	No spark or weak spark	Faulty spark plug	Change spark plug
		Faulty ignition coil	
		Faulty igniter	
Cranking system	Weak or faulty battery	Charge or change battery	
	Faulty starter motor		
Low output	Engine overheats	Clogged air cleaner	Clear
		Clogged Cooling system	
		Loose or slipping fan belt	
		insufficient engine oil	Replenish or change oil
		Poor ventilation around engine	Select a better location
		Lack of coolant	Add coolant to correct level
		Too much oil in crankcase	Correct oil level

\* Have an authorized Kawasaki engine dealer perform these service.

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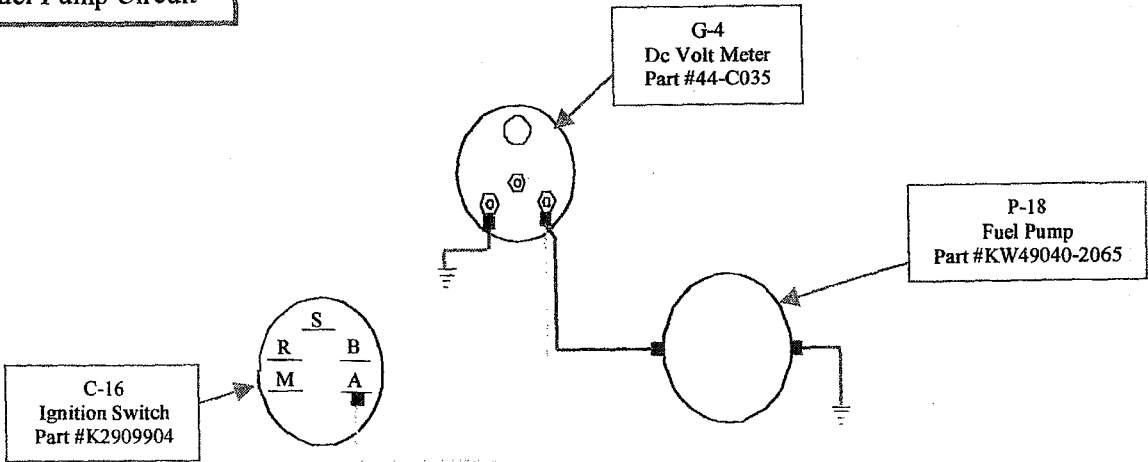
## SPECIFICATIONS

	FD440	FD501	FD590/FD611	FD620/FD661
Type of engine	Liquid-cooled, 4-stroke OHV, V twin gasoline engine			
Bore x Stroke	67 x 62 mm (2.63 x 2.44 in.)		74 x 68 mm (2.91 x 2.68 in.)	76 x 68 mm (2.99 x 2.68 in.)
Displacement	437 mL (26.7 cu.in)		585 mL (35.7 cu.in)	617 mL (37.6 cu.in)
Ignition system	Solid-state ignition			
Direction of rotation	Counterclockwise facing the P.T.O Shaft			
Starting system	Electric starter			
Dry weight	35.2 kg (77.6 lbs)		43.1 kg (95.0 lbs)	41.5 kg (91.5 lbs)

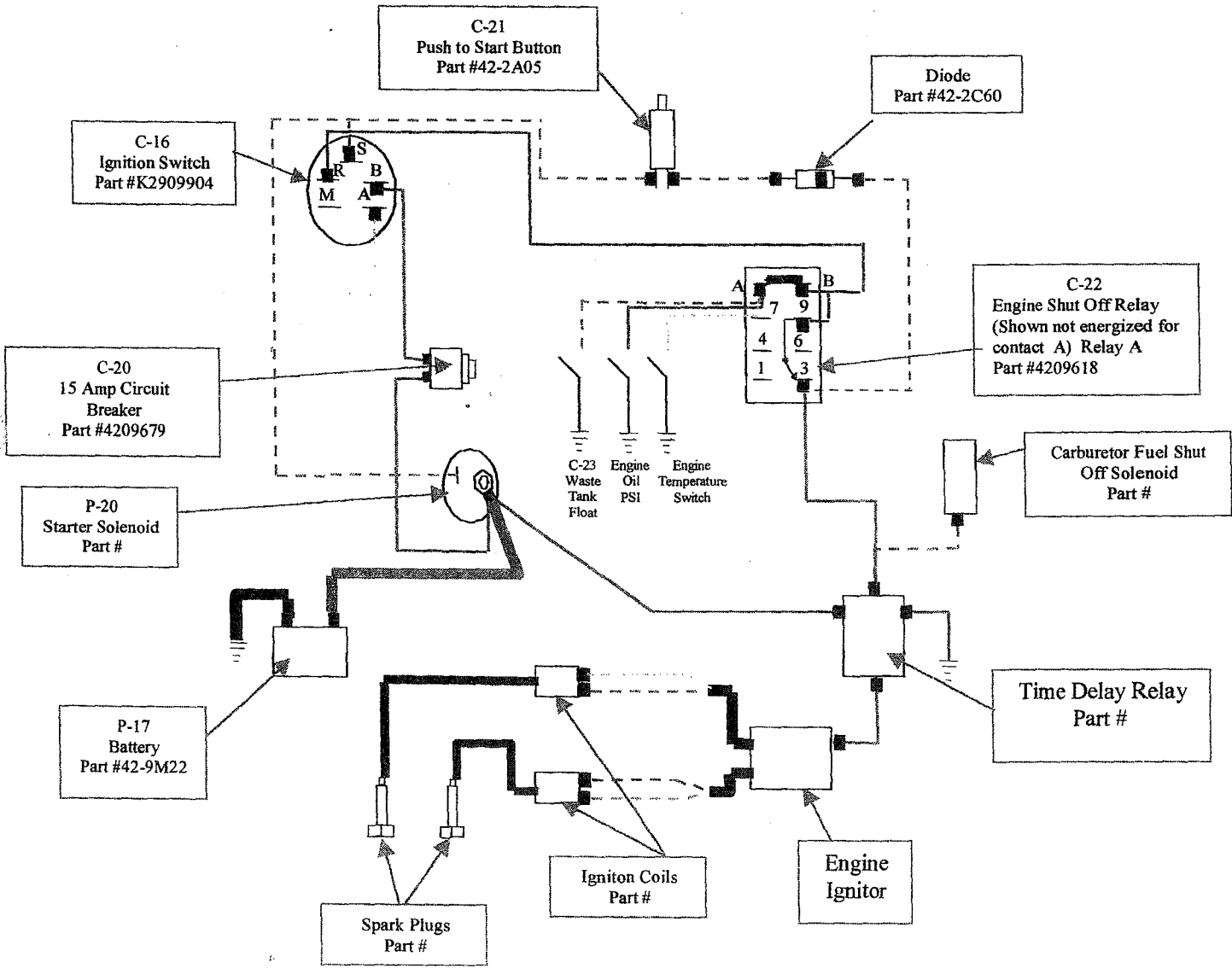
*Specifications subject to change without notice.*



**Figure 4-1**  
Fuel Pump Circuit



**Figure 4-2**  
Engine Ignition System



# Section 5

## Pre Operational Instructions

5-1 Before starting the machine, some pre operational procedures must be complied with. Figure 5-1 through 5-4 in this section describes the location of all hook-up points for the gasoline, water, cleaning solution, vacuum and pressure output connections. This section may also be helpful in identifying many of the components of the machine.

5-2 **Gasoline** – Gasoline with a minimum of 87 octane is recommended (see your engine owner's manual, Page A3 in Section 4). When you purchased your machine, you were offered two options of fuel supply. You could have tapped into the fuel system of the van or you could have had an auxiliary fuel tank. With either choice, you need to hook the female quick disconnect from the gas line to (H-5) (Figure 5-2). If you selected the auxiliary fuel tank, you must take the fuel line squeeze bulb and pump it to evacuate all of the air that has been trapped in that line.

5-3 **Water** – The machine was shipped with all of the water removed from the water pressure and heating components of the machine. This means that the machine must be filled with water before the water pump is turned on. Use the following procedure to prime the system for use:

- 1) Disconnect the male end (H-16) (Figure 7-1) from the pump
- 2) Connect the water input hose assembly to the female connector (H-16)
- 3) Remove the male connector from one of the high-pressure hoses provided in the starter package.
- 4) Connect the female end of the hose to (H-4) (Figure 5-1)
- 5) When the input water hose assembly (garden hose) is connected to a water faucet and turned on, water will be forced through the entire system.
- 6) When a constant flow of clear water comes through the high-pressure hose (hose with male end off) for about one to two minutes, the water can be turned off.
- 7) Now reinstall everything back to the original configuration and apply water from the input hose assembly to (H-1)(Figure 5-1) and allow the water to fill the water box.
- 8) When designing the model 9100LX machine, we made sure that we were getting heat transfer from as many different areas of the machine as possible. The low pressure pre-heater that is attached to the engine takes the heat from the hot water of the Kawasaki water cooled engine and transfers it to the cold water coming into the machine. This water then travels on to the water box located on the back of the machine where it is stored until needed.

The Cat pump then draws the water out of this tank, pressurizes it to the desired pressure and sends this water to the rest of the heating system. Because of this design, the pump is not capable of drawing the water out of the auxiliary water tank mounted in the van on its own.

Therefore, when installing a 9100LX machine into a fresh water tank application, you must install a transfer pump of some sort to transfer water from the fresh water tank to the machine under pressure. This transfer pump must have a small reservoir of stored water to keep the pump from cycling. See you local Steam Way Distributor for more information in regards to the type of pumps recommended in your area.

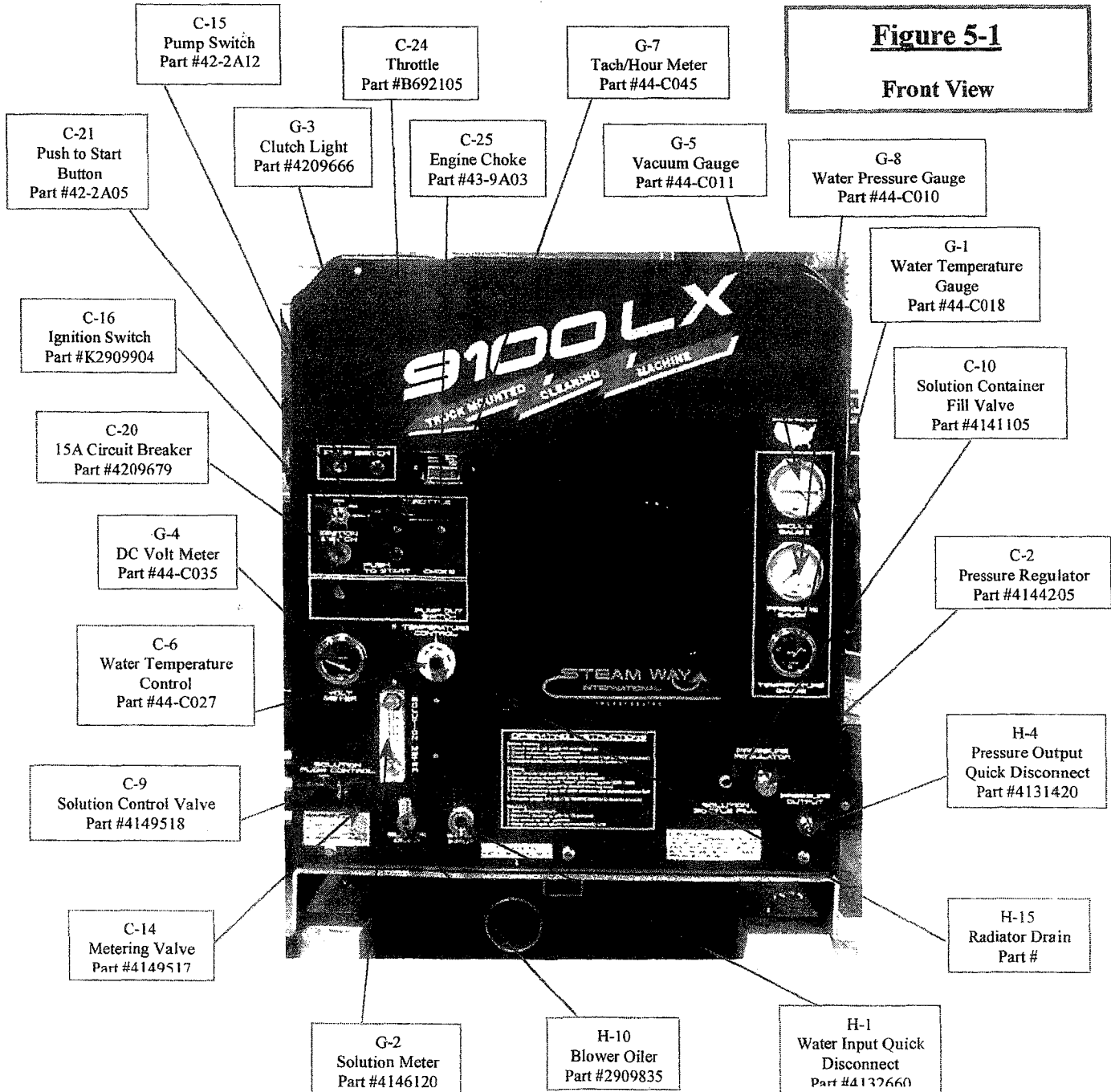
5-4 **Cleaning Solution** – The cleaning solution container (P-10)(Figure 7-1) should be filled prior to use. See your chemical manual for proper mixtures and ratios of chemical vs water. A wide variety of products may be chosen for the task at hand. Follow the procedures below for the hook up and priming of the chemical system.

- 1) Connect the hose from (P-10) the solution container to (H-2)(figure 5-2)
- 2) Connect the hose from (H-3)(Figure 5-2) back to the solution container

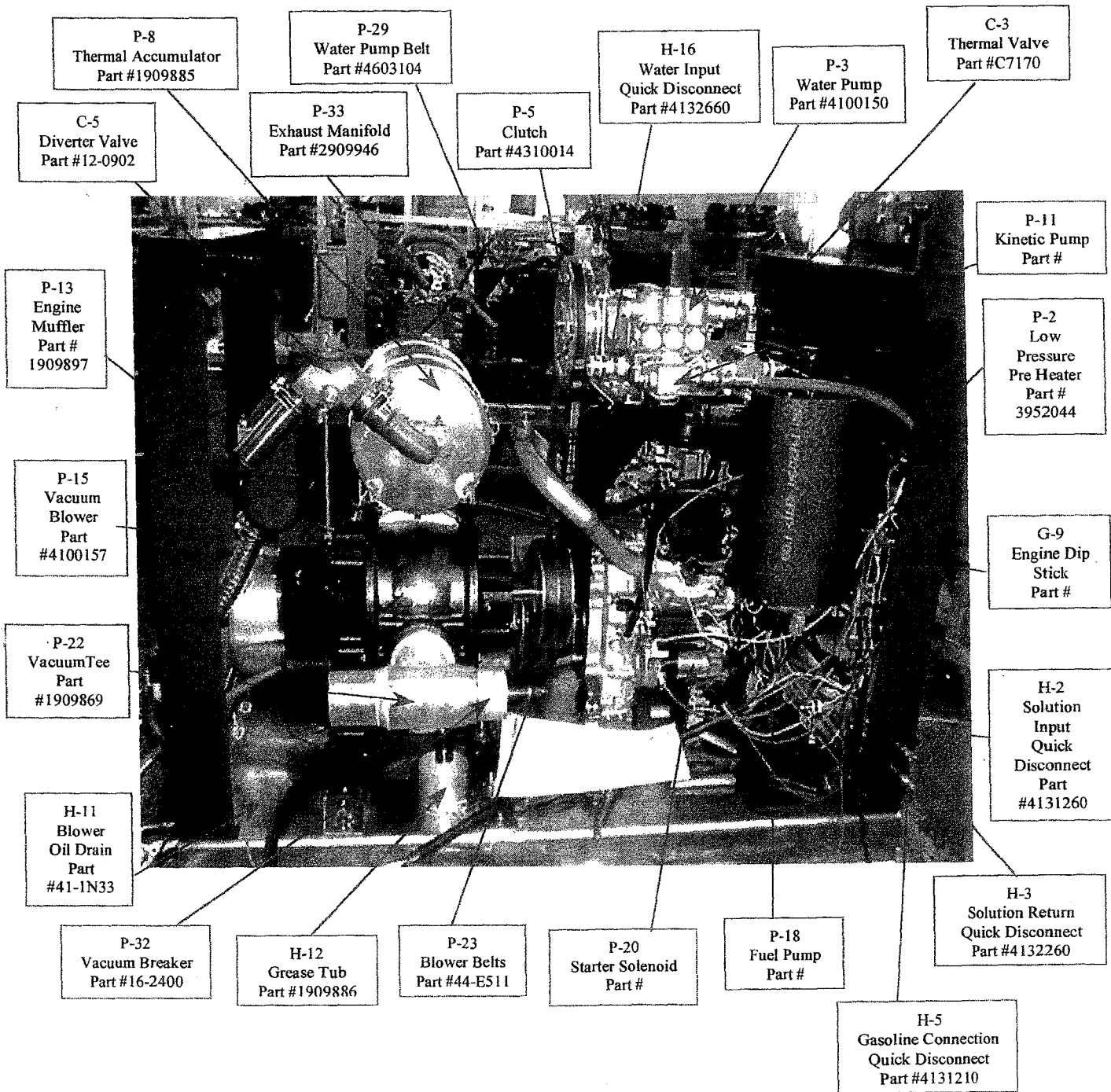
3) After the start up procedure (section 6) has been complied with and the pump switch (C-15) (Figure 5-1) has been turned on, turn the solution control valve (C-9)(Figure 5-1) to the prime position. Observe that the solution meter (when open) registers a GPH reading and that solution is returning to the container (P-10). Turn the control valve (C-9) to either the off or injection position as desired.

5-5 **Vacuum** – The vacuum hose is attached to (H-7)(Figure 9-1) a 2” connection. Segments of hoses may be used as desired by the use of 2” x 2” vacuum connectors. When reducing down to the 1 ½” hose that comes with each machine and attaches to the cleaning tool, use of a 2” x 1 ½” reducer must be used.

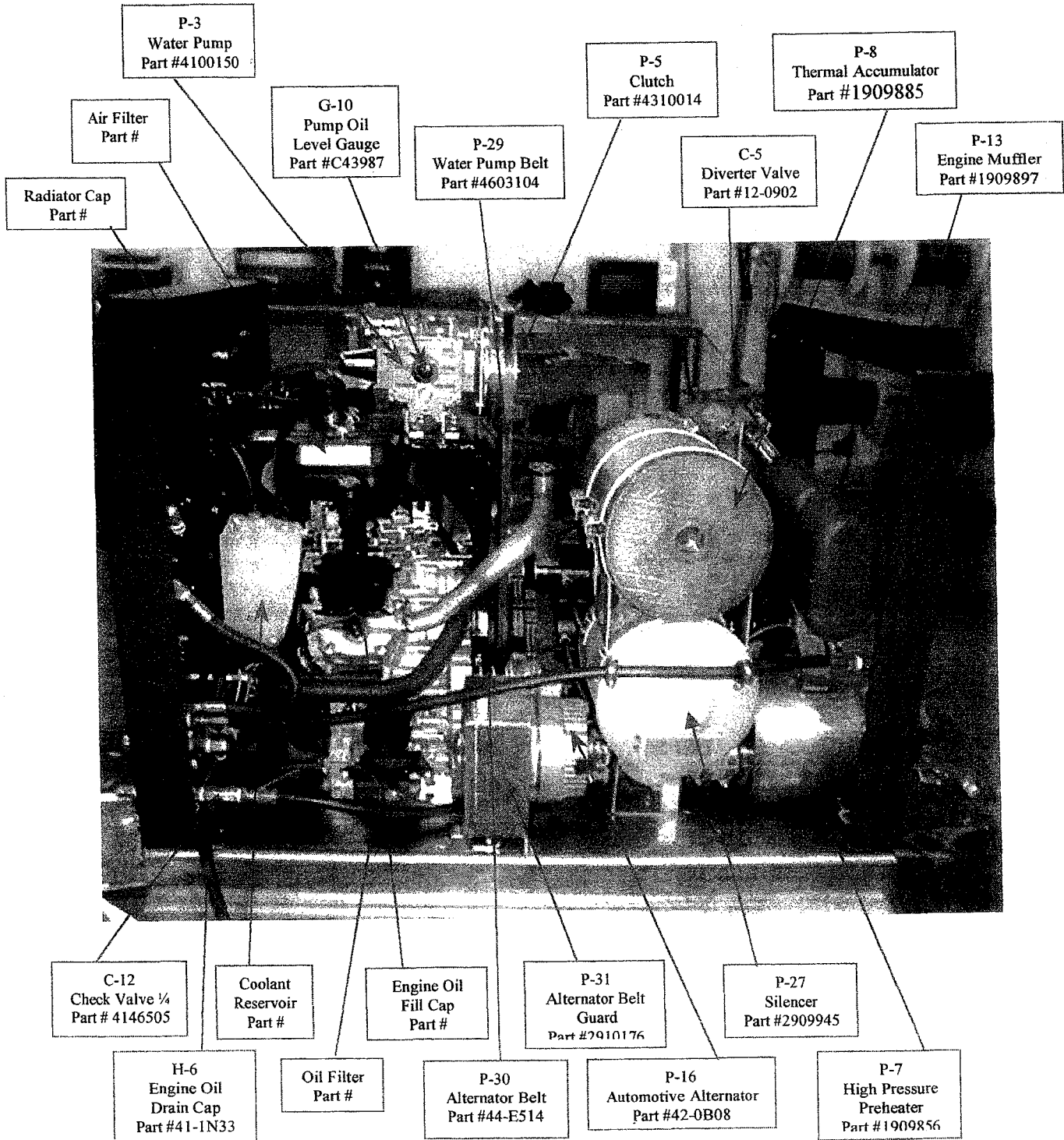
5-6 **Pressure Hoses** – Pressure hoses come in various lengths, the hoses provided with the standard package are three 50’ hoses. The pressure hose is connected to (H-4)(Figure 5-1) the pressure output connection of the machine. The other end of the hose / hoses are attached to the cleaning tool. These hoses use ¼ high-pressure, high-temperature connectors. It is important that the pressure hoses be connected before the pump is turned on, otherwise it will be impossible to connect them because of the tremendous pressure in the line.



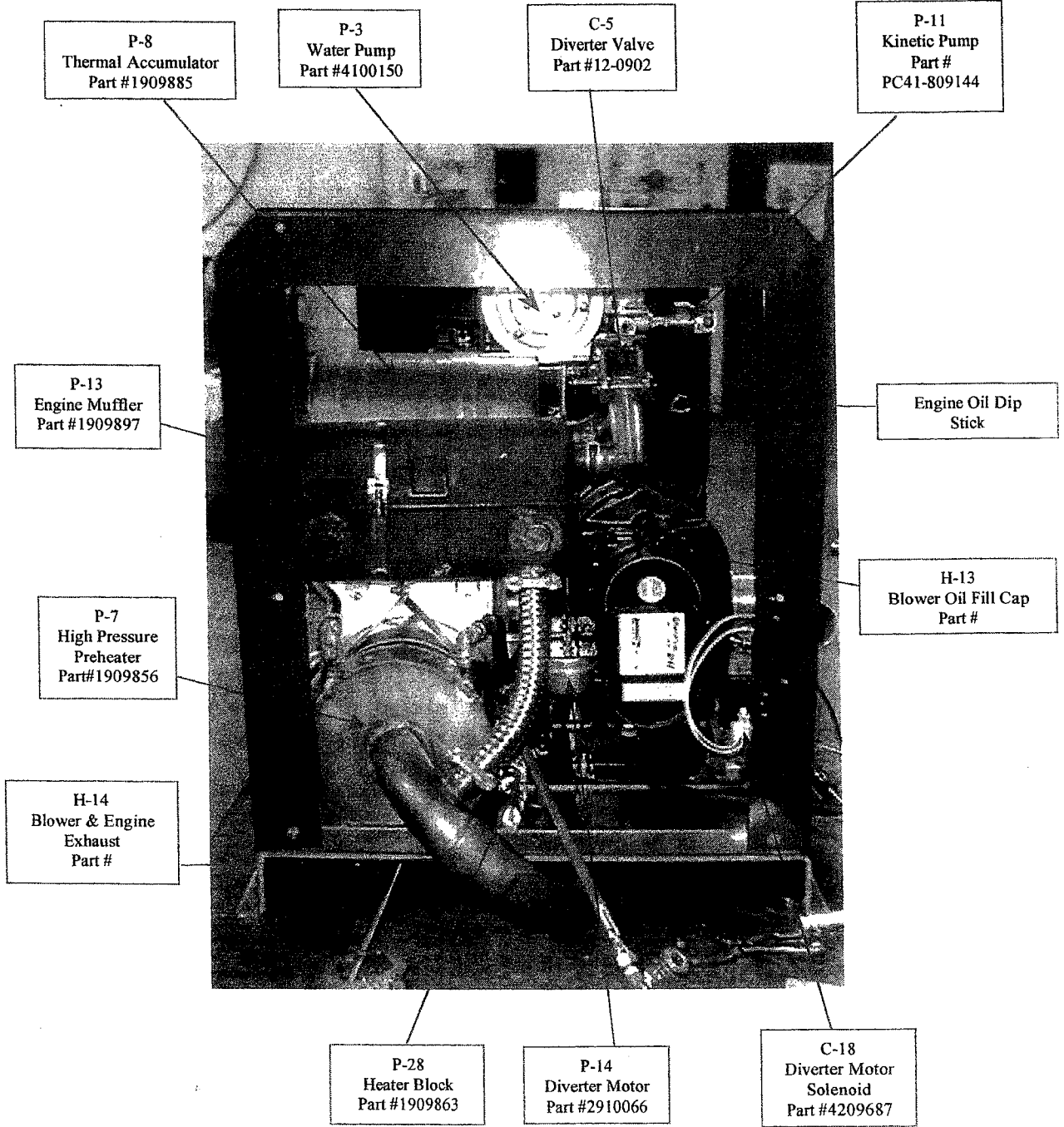




**Figure 5-2**  
Left Side View



**Figure 5-3**  
Right Side View



**Figure 5-4**  
Rear View

# Section 6

## Operating Instructions

### BEFORE STARTING

- 6-1 The instructions in this section are a detailed list of the steps necessary to operate your new Steam Way 9100LX machine.

The following list are the pre-operational settings before starting the machine

Control	Number	Figure #	Setting
Ignition Switch	C-16	5-1	Off
Throttle	C-24	5-1	Slow
Choke	C-25	5-1	In
Pump Switch	C-15	5-1	Off
Temperature Control	C-6	5-1	As desired
Metering Valve	C-14	5-1	As desired
Solution Control Valve	C-9	5-1	Off or injection
Blower Oiler	H-10	5-1	Closed
Solution Container Fill Valve	C-10	5-1	Closed
Pressure Regulator	C-2	5-1	As desired

- 6-1.1 Check engine, blower and Cat pump oil levels
- 6-1.2 Connect the water input hose assembly (garden hose) to the water input connections (H-1) (Figure 5-1) and ensure water is available by turning the valve on and listening for water to fill the water box. If a 100 gallon auxiliary water holding tank is being used (optional equipment) instead of the water input hose assembly to supply water to the machine, refer to paragraph 5-3.8 in section 5 of this manual. Connect the vacuum and pressure hoses as per paragraph 5-5 and 5-6 in the preceding section.
- 6-1.3 The cleaning solution container (P-10) was filled as per paragraph 5-4 in the preceding section for the initial turn on procedure. After the initial turn on, you may use the solution container to fill valve (C-10) to add heated water to the solution container (P-10). CAUTION: Mix the concentrated cleaning solution with water thoroughly before turning the solution control valve to injection or prime position. To use the solution fill valve (C-10), the machine must be running. If the solution container runs empty, the pump will lose its prime and the system will have to be re-primed.
- 6-1.4 Ensure that an adequate amount of gasoline is available in the gasoline tank and that the connecting hose is securely connected. A good rule of thumb is that approximately 1 gallon per hour of gasoline is used.

### Starting Engine

- 6-2 When the above procedures have been done, you may start the engine.
- 6-2.1 Pull the choke (C-25) out if the engine is cold (First job of the day).
- 6-2.2 Press the push to start button (C-21) and hold it in.
- 6-2.3 Move the throttle (C-24) open slightly (approx. ¼ open).

6-2.4 Turn the key switch (C-16) to the start position (Do not exceed 5 seconds). When the engine starts, release the key and follow the next steps listed:

- A) Push the choke in slowly (cold starts).
- B) Release the "Push-to-start button"
- C) Turn the pump switch on (C-15)
- D) Advance the throttle to 2900 RPM  $\pm$ 100 RPM
- E) Set the temperature control (C-6) to the desired temperature
- F) When the cleaning tool is activated, the pressure regulator (C-2) may be set to the desired water pressure. Examples:

Carpet Cleaning	400 – 450PSI
Upholstery Cleaning	150 – 200 PSI
- G) When the cleaning tool is activated, the cleaning solution flow can be set to the values of 1 to 5 GPH with the metering valve (C-14). The GPH can be read on the solution meter (G-2) (Figure 5-1). For detailed information on the solution injection, see paragraphs 7-13 through 7-18.

6-2.5 To enhance the water heating capability, a vacuum load of 6 Hg or more as shown on the vacuum gauge (G-5) is suggested.

6-3 During the cleaning operation, if the engine stops, check the following.

- A) Level of water in the recovery tank (P-6)
- B) Level of gasoline in the tank (p-6)
- C) Engine oil pressure too low
- D) Engine radiator water temperature too hot.

#### Stopping the Engine

6-4 When the job is finished or the engine is to be turned off, follow the instructions below:

- A) Turn the pump switch (C-15) off
- B) Decrease the engine speed with the throttle to idle for 15 seconds
- C) Turn the ignition switch to off (C-16)

6-5 The last job of the day, do the following:

- A) Turn the pump switch off (C-15).
- B) Retard the throttle to  $\frac{1}{2}$  the engine speed.
- C) Open the blower oilier valve (H-10) (Figure 5-1) and allow the blower to draw in a lubricant such as WD-40 or some lightweight oil for 5 to 10 seconds. This will sustain the life of the vacuum blower (P-15) and prevent blower lock-up due to rust.
- D) If the machine has encountered a blow-over, (which is when the float switch in the waste tank (P-6) did not stop the engine, causing dirty water to be sucked through the blower), the following steps should be taken. Apply a small amount of clean water (1 or 2 pints) to the blower through the blower oilier valve (H-10). Allow the blower to air dry for approximately 3 minutes, then insert oil as in 6-4 C above. Close the blower oilier valve (H-10).
- E) Retard the engine speed to idle for 15 seconds.
- F) Turn the ignition switch off.
- G) Retrieve the vacuum, pressure and water hoses as well as all cleaning tools and store safely in the vehicle.
- H) Dump the waste tank water where environmentally safe.
- I) Clean the lint screen (P-24) (Figure 9-1) in the waste tank.

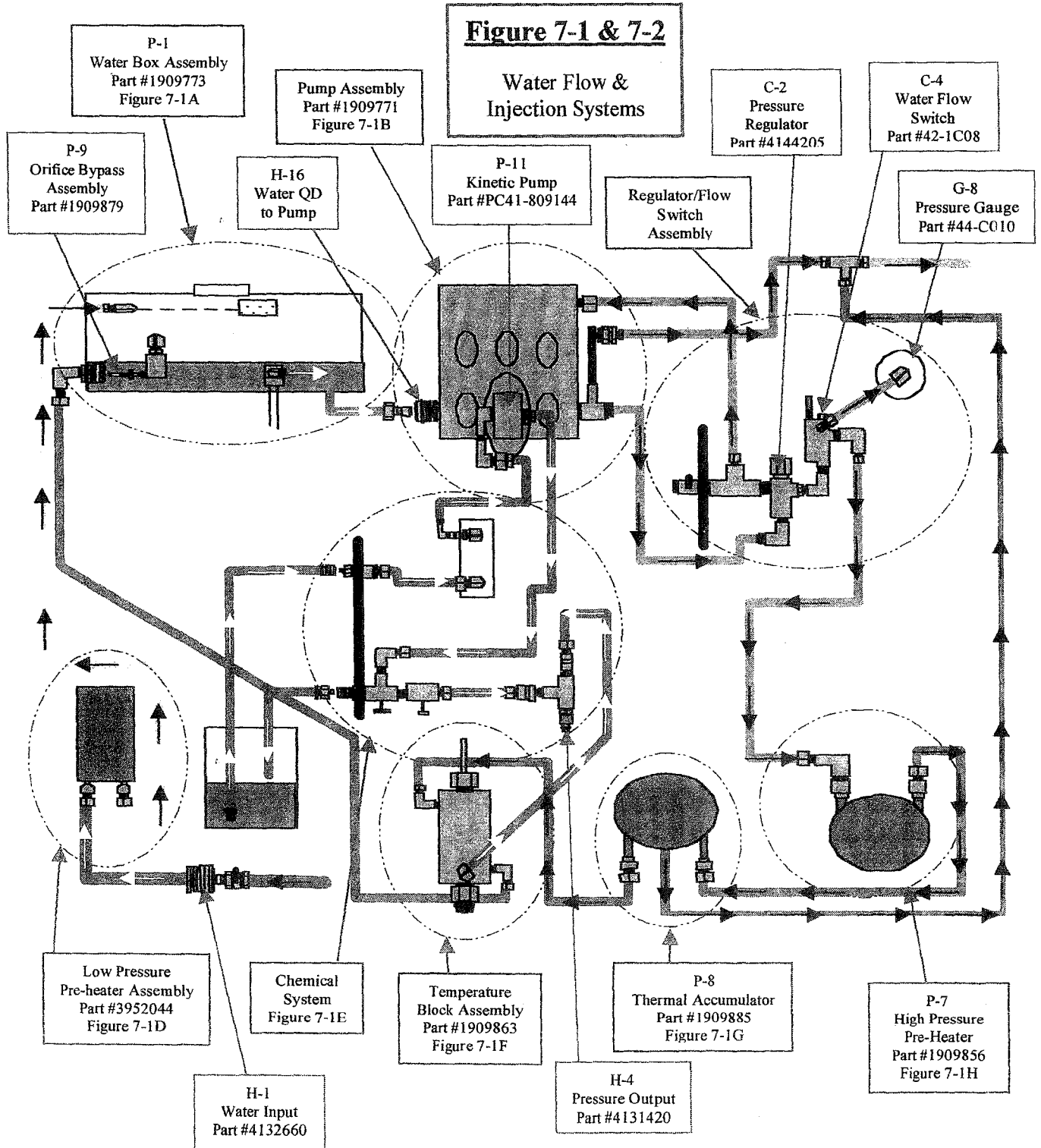
6-6 In cold weather operation, use the most expedient method to get the hoses and tools into the vehicle to prevent them from freezing.

# Section 7

## WATER FLOW & SOLUTION INJECTION SYSTEMS

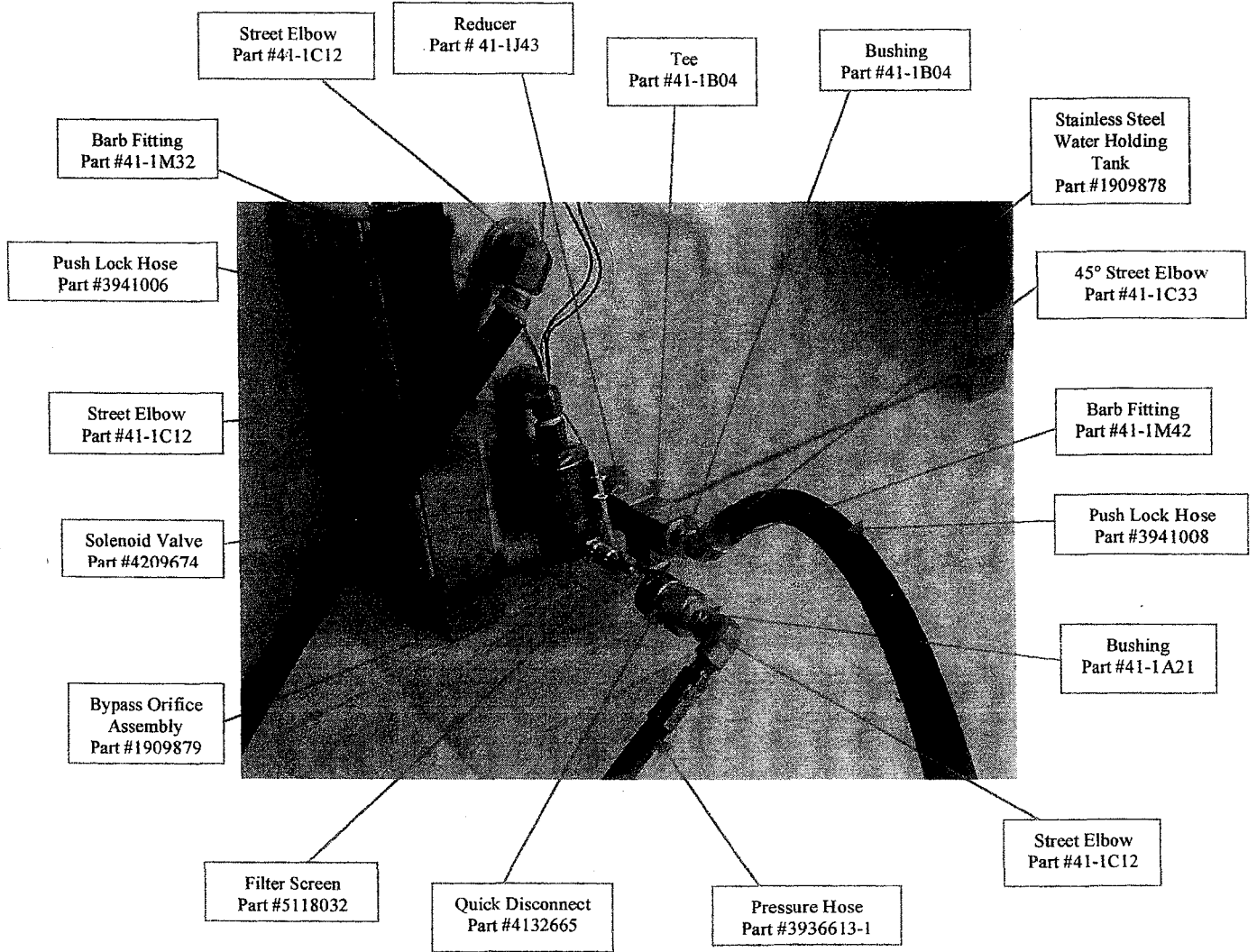
### WATER FLOW SYSTEM

7-1 Use figure 7-1 as you study the system.



# Figure 7-1A

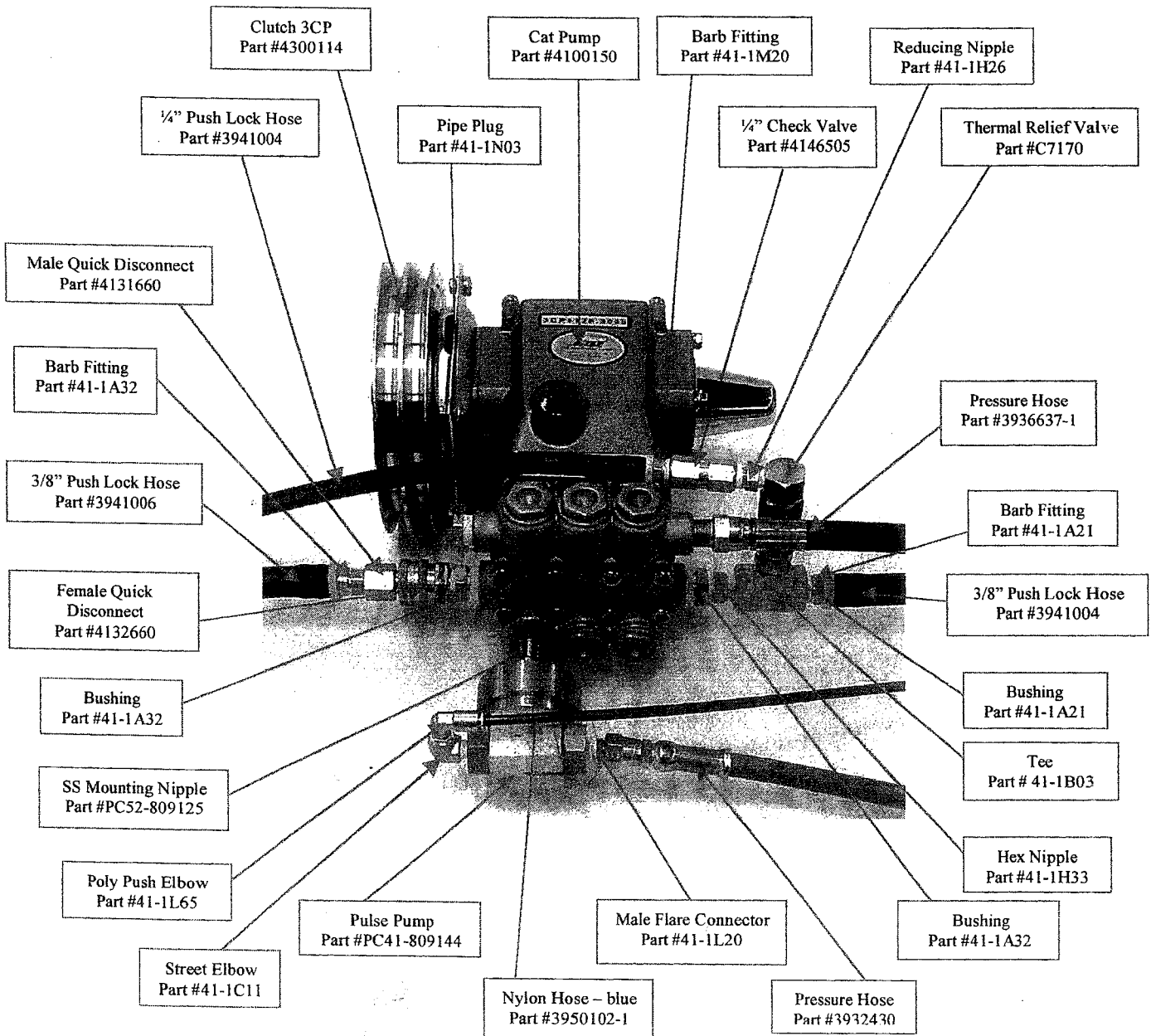
## Water Box Assembly



**Figure 7-1B**

**Pump Assembly**

787  
2000070





**Figure 7-1C**

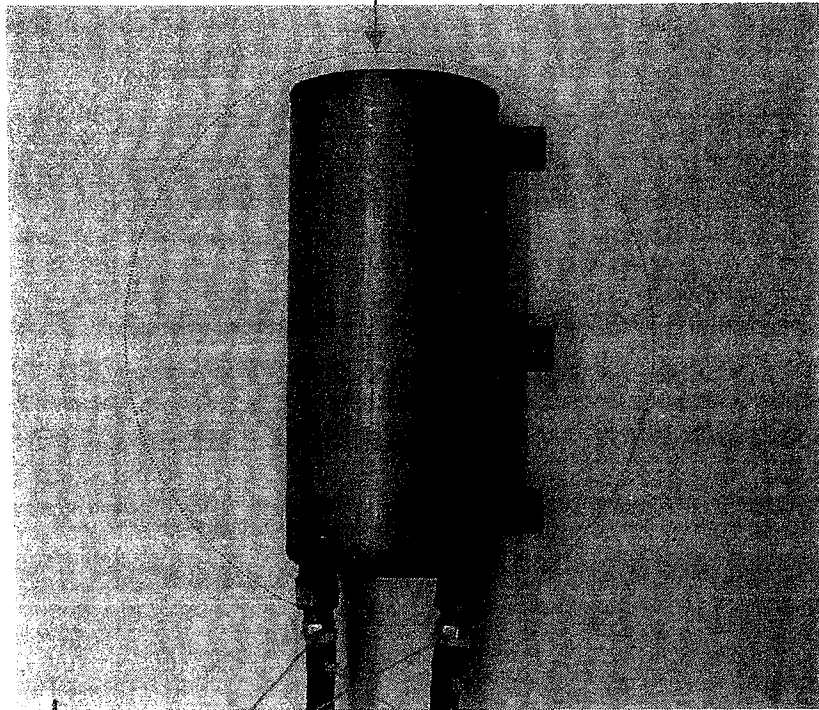
Regulator/Flow Switch Assembly

**This Figure will be available soon**

**Figure 7-1D**

Low Pressure  
Pre-Heater Assembly

Low Pressure  
Preheater Assembly  
Part # 3952044



Barb Fittings  
Part # 41-1M32

3/8" Push Lock Hose  
Part #3941006

**Figure 7-1E**

Chemical System

**This Figure will be available soon**

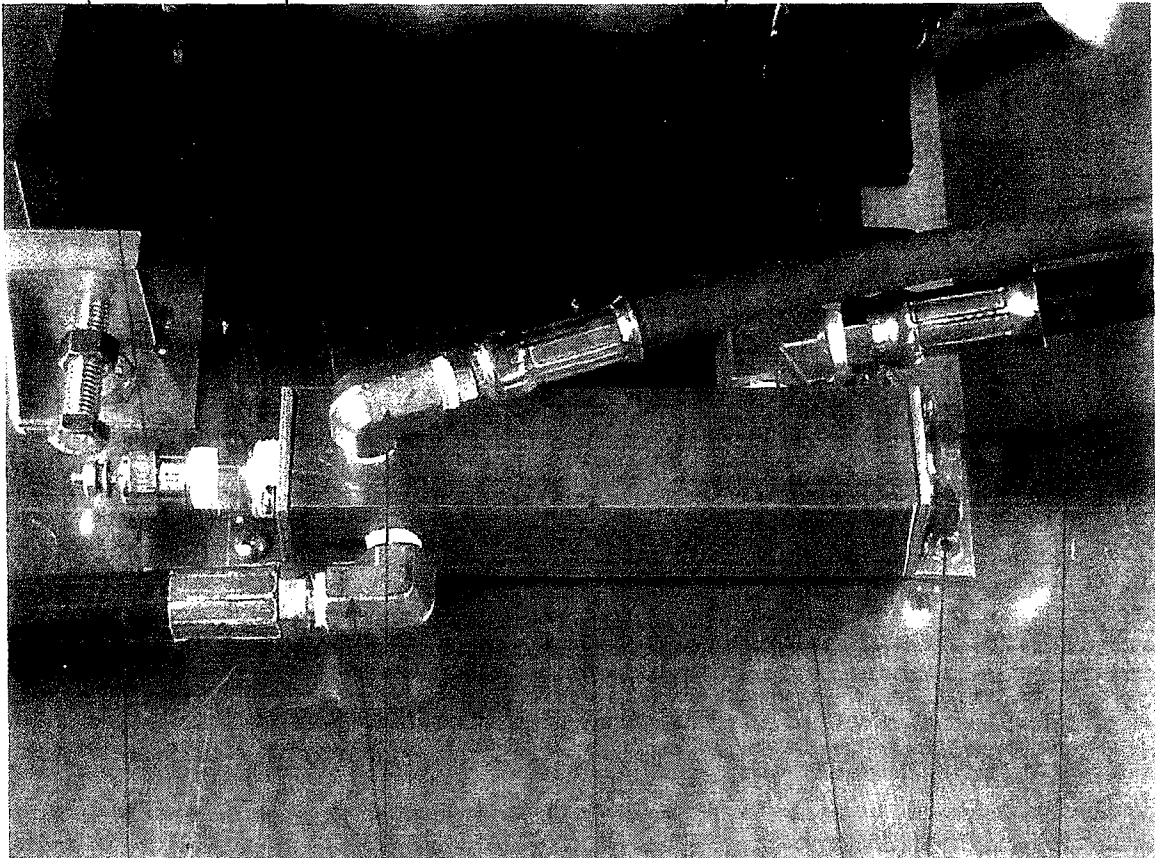
**Figure 7-1F**

**Temperature Block Assembly**

Water  
Temperature  
Sender  
Part #44-C018A

Bushing  
Part #41-1A32

Pressure Hose  
Part #3934423



Pressure Hose  
Part #3934624

Street Elbow 1/4"  
Part #41-1C12

Street Elbow 3/8"  
Part #41-1C13

Output Heater  
Block  
Part #2910032

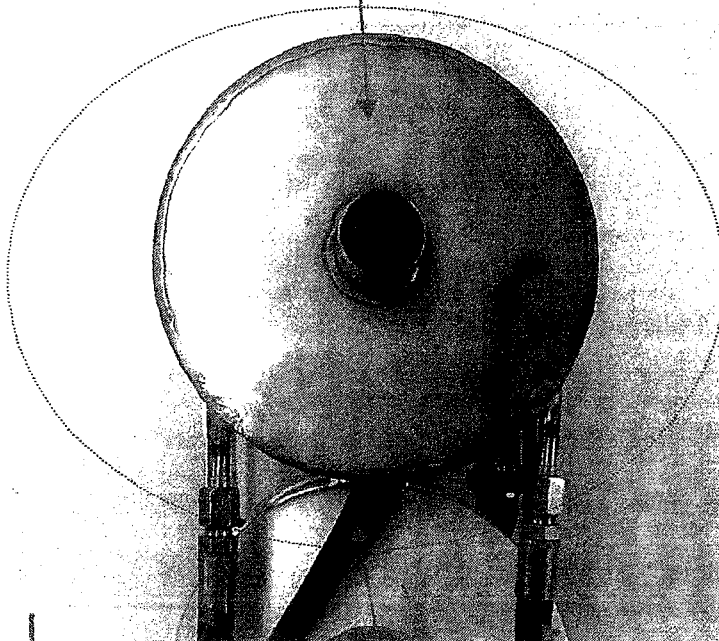
Bushing  
Part #2910213

Pressure Hose  
Part #3936613-1

**Figure 7-1G**

**Thermal Accumulator**

Thermal Accumulator  
Assembly  
Part #1909885



Pressure Hose  
Part #3936613-1

3/8" Push Lock  
Hose  
Part #3941006

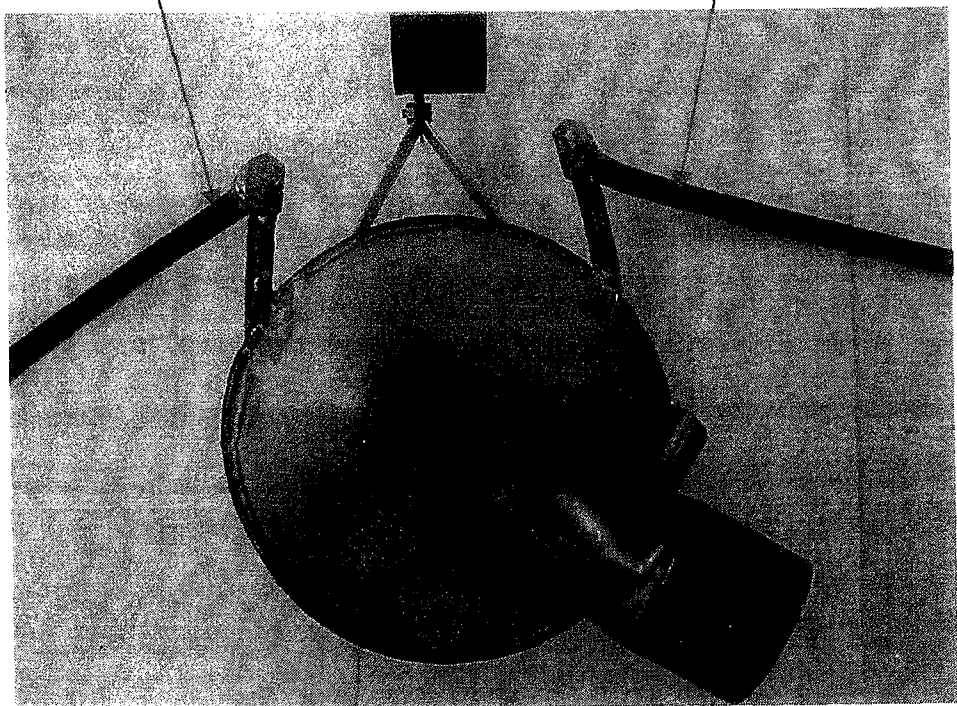
Pressure Hose  
Part #3934621

**Figure 7-1H**

High Pressure Pre-heater

Pressure Hose  
Part #3936637-1

Pressure Hose  
Part #3934621



High Pressure  
Preheater  
Part #1909856

- 7-2 Water is applied to the machine by the (H-1) water input connection of the lower front panel. The garden hose with the water input valve assembly allows water to be supplied to the water box (P-1). The first step in the heating process happens as the water travels through the pre heater (P-2) before filling the water box. When the water box has been filled to the predetermined level, the float control (C-1) will stop the filling process.
- 7-3 Water is drawn from the water box by the water pump (P-3). A screen (P-4) on the inside of the water box protects the water pump from being damaged by debris that could be pulled into the pump.
- 7-4 The pump only turns when the clutch (P-5) is turned on. The pump must never be operated when there is no water present. Running the pump dry in this manner (no water present) will cause serious damage to the seals. A oil bubble sight glass is located on the end of the water pump to monitor the oil level in the pump. The oil should be filled to the red dot in the middle of the gauge. Special Cat pump oil should be used. See the maintenance checklist in this manual (Figure 12-1).
- 7-5 Through the action of the three ceramic plungers and three intake valves, water will be drawn from the water box and be pushed out through the three discharge valves under pressure to the pressure unloader (C-2).
- 7-6 The pressure unloader (C-2) can be adjusted to the desired water pressure needed for the task being done. When the desired water pressure and amount of water have been selected; the remainder of the water/pressure will be unloaded (bypassed) to the input (suction) side of the pressure pump.
- 7-7 The temperature of the returning water is being monitored by the pump thermal protection valve (C-3) which is mounted adjacent to the pump. If an unsafe temperature for the pump is detected, the thermal valve will discharge the hot water into the wastewater tank (P-6). A check valve (C-13) keeps air from being drawn into the water system.
- 7-8 The regulated water pressure from the unloader (C-2) travels through the water flow switch (C-4). The water flow switch does not make water flow nor does it keep water from flowing, but it tells the heat control circuits whether or not water is flowing.
- 7-9 From the water flow switch, the water travels through the high pressure pre-heater (P-7) where the second phase of the heating of water is accomplished.
- 7-10 After the high pressure pre-heater, water travels through the thermal accumulator (P-8) where the third step of heating is accomplished. This step of heating is controlled by the diverter valve (C-5), which will be discussed in section 8 of this manual.
- 7-11 The heated water leaves the thermal accumulator and is sent to the temperature output block (P-28) where the water temperature is monitored by both the water temperature gauge (G-1) and the water temperature control (C-5). A small amount of water is returned to the water box via an orifice bypass and screen assembly (P-9). When bypassing heated water at this point, the water box temperature can be elevated to 165° F. The orifice bypass screen (P-9) should be cleaned frequently (Approx. every 10 hours of operation). This can be done by uncoupling the quick disconnect at the orifice bypass, making it easy to pull out the screen for easy cleaning.
- 7-12 If the water in the water box starts to achieve an unsafe temperature for the water pump, a temperature limit switch (C-7) mounted on the output connection will cause the bypass solenoid (C-8) to close. This will not allow any more hot water back to the water box until a safe reduced temperature is present.

## SOLUTION INJECTION SYSTEM

- 7-13 Solution is drawn from the solution container (P-10) via the solution hose (16-3010) that connects to the machine at (H-2) male quick disconnect. From the male QD, solution is drawn through the solution meter (G-2) where the gallons per hour are monitored. A Kinetic pulse pump (P-11) is connected to the water pump (P-3) that develops a high-pressure output flow to the solution control valve (C-2).
- 7-14 With the solution control valve, there are three choices that can be made:
- 1) Off – When no solution is needed.
  - 2) Prime – To re-prime when a loss of solution flow has occurred, out of solution or air trapped in the system. This system returns solution to the solution container (H-3) through a priming hose (part #16-3011).
  - 3) Injection – When solution is desired to be added to the cleaning operation.
- 7-15 Solution flows through the flow control needle valve when in the injection mode, monitors solution flow through the meter valve (C-14) so the desired amount of solution can be controlled. **CAUTION:** Do not over tighten the needle valve or damage will occur to the needle.
- 7-16 Solution is injected into the high-pressure stream of water at the output “T” connection. Note that two check valves are installed at this point. The larger check valve (C-11) keeps solution from backing into the water flow system and the smaller check valve (C-12) keeps water (high pressure) from entering the solution injection system.
- 7-17 A solution container fill valve (C-10) located on the lower front panel is convenient to use when water is needed to mix cleaning solutions in the cleaning solution container.
- 7-18 The pressure output connection (H-4) on the lower front panel, mixes hot pressure regulated water and injected solution for delivery to the cleaning tool. When re-priming the chemical injection pump and system after the loss of fluid flow to the pump, insert the discharge end of the return priming hose to the vacuum hose from the waste tank and let the vacuum system suck the fluid flow through the pulse pump to re-prime.



# Section 8

## Heat Control System

8-1 Section seven covered the water flow system in which several components contributed to the water heating process.

- 1) P-2 Low Pressure Pre-Heater
- 2) P-1 Water Box - which receives heated water from the temperature output block (P-28)
- 3) P-7 High Pressure Pre Heater
- 4) P-8 Thermal Accumulator

The following paragraphs will explain the operation of each of the above items.

### 8-2 Low Pressure Pre-Heater

Hot water from the engine's radiator passes through the low pressure pre-heater where many turns of stainless steel tube allows the input water to be heated as it travels to the water box (P-1). The radiator water temperature is controlled by a thermostat similar to that in an automobile.

### 8-3 Water Box

During normal operation, the water box receives hot water from the temperature output block through a de-energized solenoid (C-8). If the water in the water box reaches an unsafe temperature for the pump, the temperature limit switch (C-7) will energize. This causes the by-pass solenoid (C-8) to be engaged, which will stop the hot water from returning back to the water box. When the water has cooled down to operating temperature for the water pump, the system will return to normal. See Figure 8-1 for the note, that power connects to the white wire of the temperature limit switch (C-7). When 165° is reached by the thermal switch, power will switch from the red lead to the black lead which will energize the bypass solenoid. This prevents hot water from entering the water box.

### 8-4 High Pressure Pre Heater

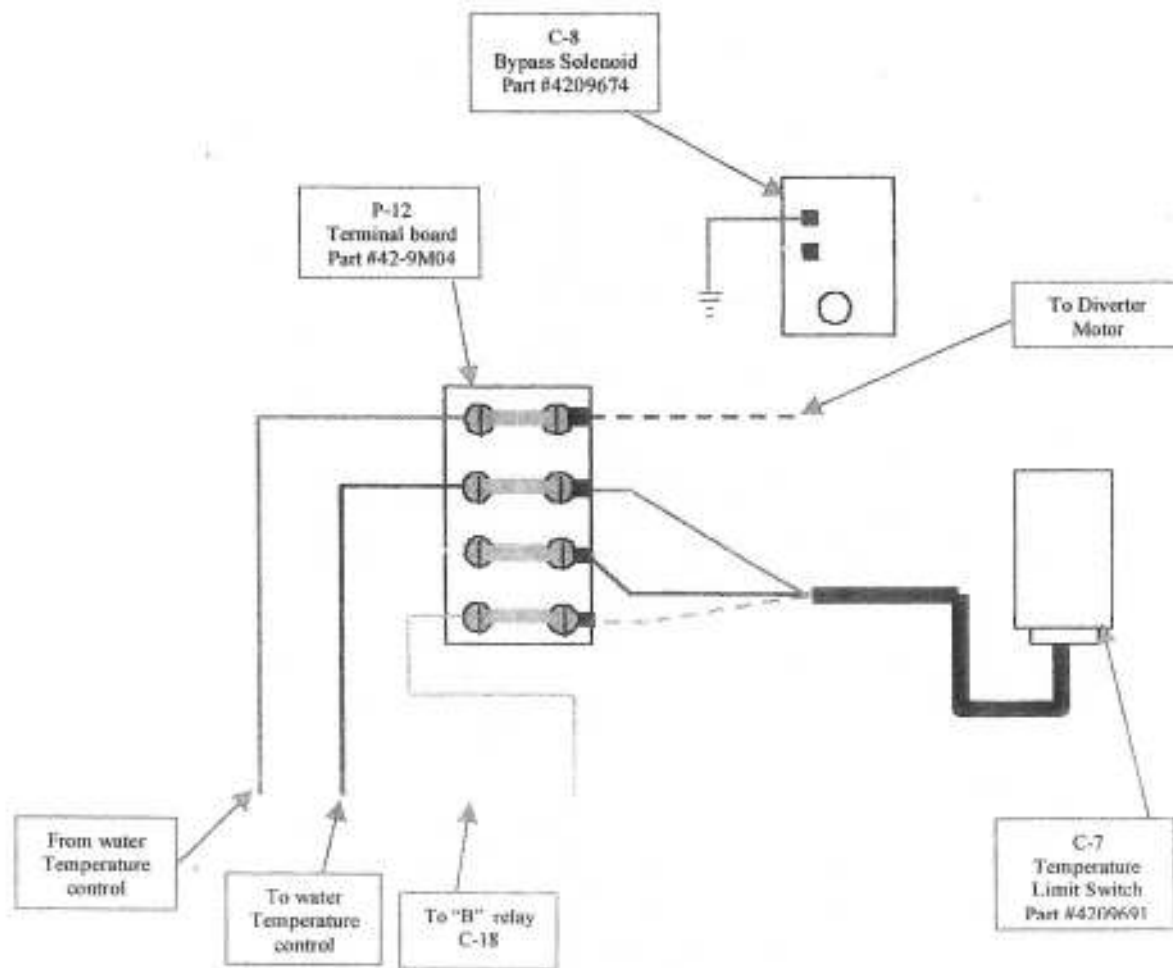
The high-pressure pre heater is a component that has many turns of stainless steel tubes wound inside. As water under pressure passes through this device, hot exhaust gases that have already passed through the thermal accumulator are directed to this component. These gases pass through the silencer where the combination of vacuum blower heat and exhaust gasses create an excellent heating formula. If no heat is required, the diverter valve (C-5) will be in a bypass mode and the exhaust gases pass through the engine's muffler (P-13) and no heating will be achieved.

### 8-5 Thermal Accumulator

The thermal accumulator is responsible for the majority of the heating on this machine. When there is a demand for heat, the diverter valve (C-5) will direct all of the exhaust gases into the thermal accumulator. This is where water is forced through many turns of stainless steel tube. When there is no demand for heat, the diverter valve will move to the by-pass mode, directing the hot gases into the engine muffler. Output of the engine muffler, or the high-pressure pre-heater, is directed into the discharge exhaust system that will disperse the air and gases from the machine.

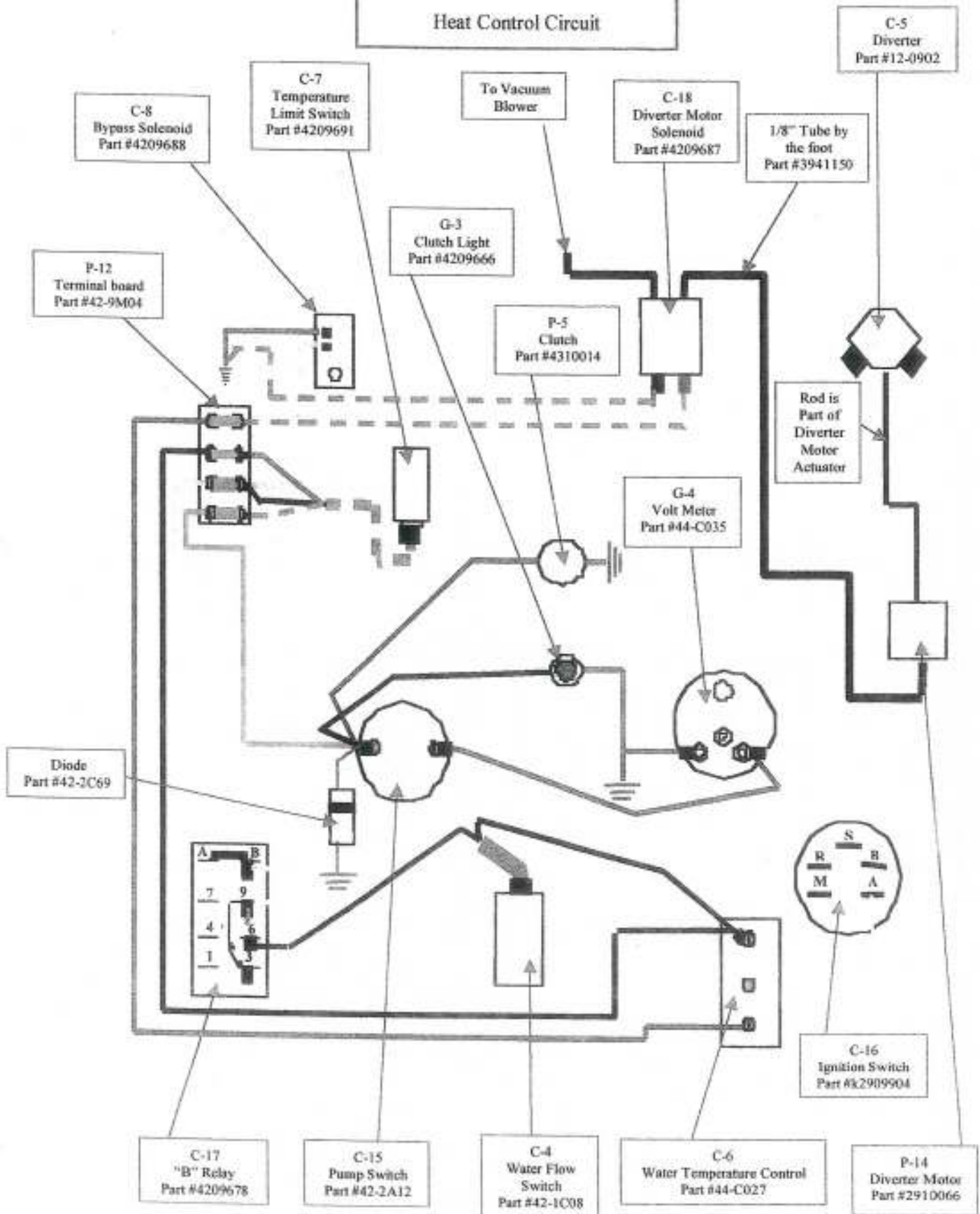
- 8-6.11 The temperature control (C-1) and the water temperature sender (C-19)(Figure 8-3) are continuously monitoring the water temperature in the output block (P-28). The temperature sender does not control the water temperature, but tells the water temperature gauge what to do. The temperature control pickup capillary tube is inserted into the temperature output block and sealed by a series of lead washers. Replacement washers are available (Steam Way Part #44-C027-1)

**Figure 8-1**  
By Pass Solenoid Circuit

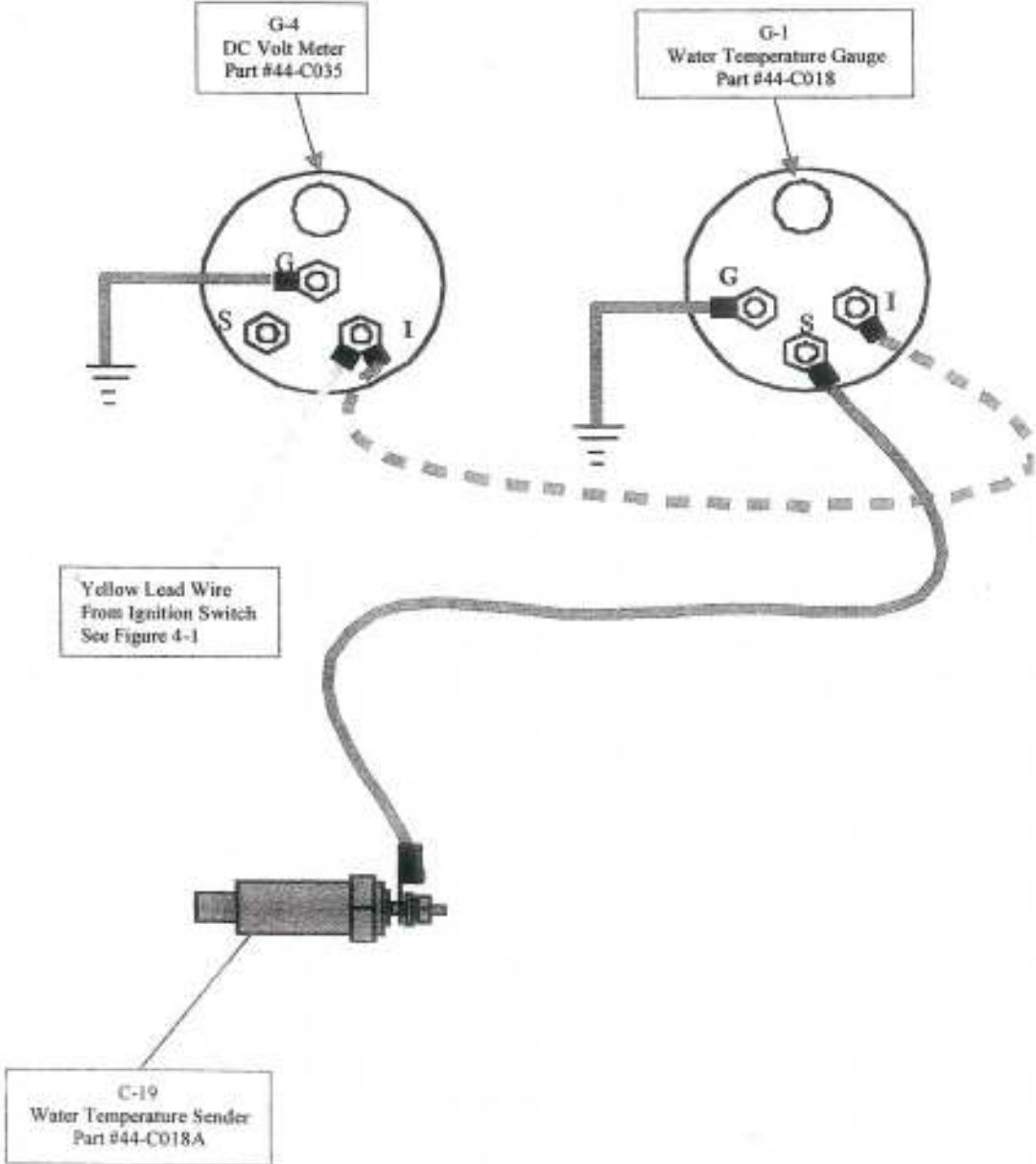


**Figure 8-2**

**Heat Control Circuit**



**Figure 8-3**  
Water Temperature Gauge Circuit



# Section 9

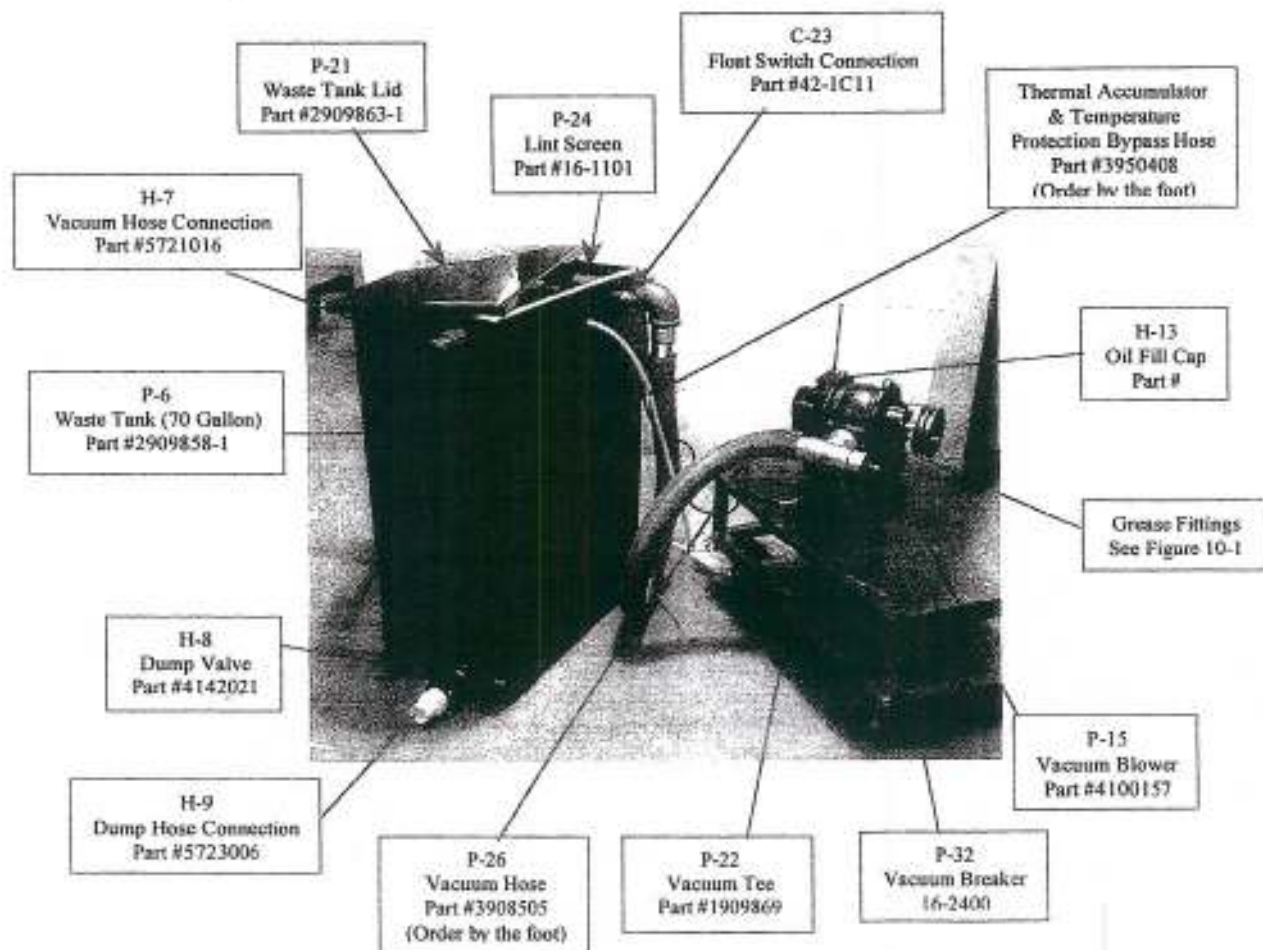
## Water Recover System

- 9-1 The quantity of water and soil removal from the carpet is governed by the efficiency of the recovery system, the operator's cleaning technique and desire to clean and dry the carpet. This section will deal with what is required to keep the recovery system at its peak performance.
- 9-2 The vacuum blower (P-15) operates at approximately the same speed as the engine. The normal recommended engine speed of the 9100LX is 2900 RPM plus/minus 100 RPM. This causes the vacuum blower to draw air in from the vacuum "T" (P-22). Since the vacuum "T" is connected to the waste tank (P-6) with the connecting hose (P-26), air is drawn from the waste tank. The waste tank is completely sealed except for the vacuum connection (H-7) where the vacuum hose or hoses are attached to the cleaning tool. The end result is the blower actually getting all of its air from the carpet being cleaned except for the following situation.
- 9-3 The vacuum relief valve (P-32) is preset to break at approximately 11 Hg (inches of mercury) as read on the vacuum gauge (G-5). As the vacuum load is increased, the Hg value will increase and at a point both the engine and the blower will not need to be overloaded. The vacuum relief valve will begin to open, and no larger load will be felt. To increase the break point, hold the stem of the vacuum relief valve (P-32) and turn the hex nut clockwise to make the spring tighter. To decrease the break point, make the opposite adjustment to make the spring looser. These adjustments must be made when a maximum load is applied to the system. In order to achieve this state, completely close off the waste tank connection or the end of an attached hose.
- 9-4 As water and debris are pulled from the carpet, anything heavier than air falls to the bottom of the waste tank. The air continues through the vacuum blower (P-15) being exhausted into the silencer (P-27). When the waste tank water level reaches a full point, the float switch (C-23) will cause the engine to stop to prevent a blow over of waste water through the vacuum blower. At this point the waste tank must be drained where environmentally safe.  
**WARNING:** Do not open the waste tank ball valve until you have shut the entire machine down.
- 9-5 The lint screen (P-24) inside the waste tank prevents objects from being sucked into the vacuum blower, which could cause serious damage to the vacuum blower. More information about the frequency of service to the lint screen can be found in the maintenance checklist section of this manual. **WARNING:** The lint screen must be clean at all time to maximize your vacuum potential.
- 9-6 The points of service required for the blower are:
- 1) Gearhouse oil level
  - 2) Bearing Grease (See figure 10-1)
  - 3) Impeller Lubrication
- 9-6.1 The gearhouse holds 12.7 oz of lubriplate #4 oil (Steam Way Part# 4810106). It is filled by removing the fill cap (H-13) on the top of the gearhousing. The oil is drained by removing the cap on the drain hose (H-11) (See figure 9-1). Oil drains quicker and more completely when the oil is hot. The oil can be checked by observing the blower oil sight glass (G-6) for a dark indication. This may be hard to see, however, so a more exact way of checking the oil level is suggested by draining the oil into a container and physically observing that 12.7 oz are in fact there. The maintenance check list (Figure 12-1) covers the frequency of checking this oil.

- 9-6.2 The bearing grease is inserted into the bearings at the grease fittings. See (Figure 9-1) for the location of the two fittings. Excess grease will flow into the grease tube (H-12) to keep the deckplate clean. A high speed high temperature grease is recommended (Steam Way Part# 4810102). The Steam Way grease tube requires a special grease gun (Steam Way Part # 4810100). Refer to the maintenance check list (Figure 12-1) for the frequency of this service.
- 9-6.3 Since moist air passes through the vacuum blower, the possibility of rust inside the vacuum chamber and impellers exists. A blower oiler (H-10) has been incorporated into the system to make it easy to lubricate the impellers and the impeller chamber. A small amount of water can be sucked into the blower when the blower oiler (H-10) is opened to rinse grit or other particles from the blower. Only use a pint or two of water to do this. **NOTE:**Damage can result if too much water is used. Next, let the blower run dry for 2-3 minutes before WD-40 or similar lubricant is sprayed into the oiler (H-10). This procedure is advised after any known blow over and at the end of every day. Always close the oiler valve when finished. See (Figure 12-1) for more information.
- 9-7 When there is a reduction in vacuum, check the following:
- 1) Belt tension (P-23)
  - 2) Lint screen condition (P-24)
  - 3) Dump valve closed (H-8)
  - 4) Waste tank lid on securely (P-21)
  - 5) Defective tank lid seal
  - 6) Air passage in the cleaning tool clogged
  - 7) Condition of the vacuum hoses and cuffs
  - 8) Vacuum breaker set too low or is defective (P-32)
  - 9) Blower oiler left open (H-10)
- 9-8 A waste water pump out system is available (optional) to be used for the 9100LX. The mode switch on the front panel gives the operator these options: Off, Automatic or Manual mode.
- 9-8.1 When the off position is selected, the pump out system is not being used. This means that the procedure mentioned in paragraph 9-4 above must be used.
- 9-8.2 When the switch is in the automatic position, the dirty water will be pumped out when it reaches a pre-determined high point level, then pumped out until it reaches a lower level. It will still leave some water in the tank to keep it from running dry.
- 9-8.3 The manual mode is a spring loaded position that will cause the pump to run as long as the operator holds the switch in the manual mode.
- 9-9 The electric diagram for the pump out system is covered in section 11 of this manual.

## Figure 9-1

### Vacuum System Hook Up



## Section 10

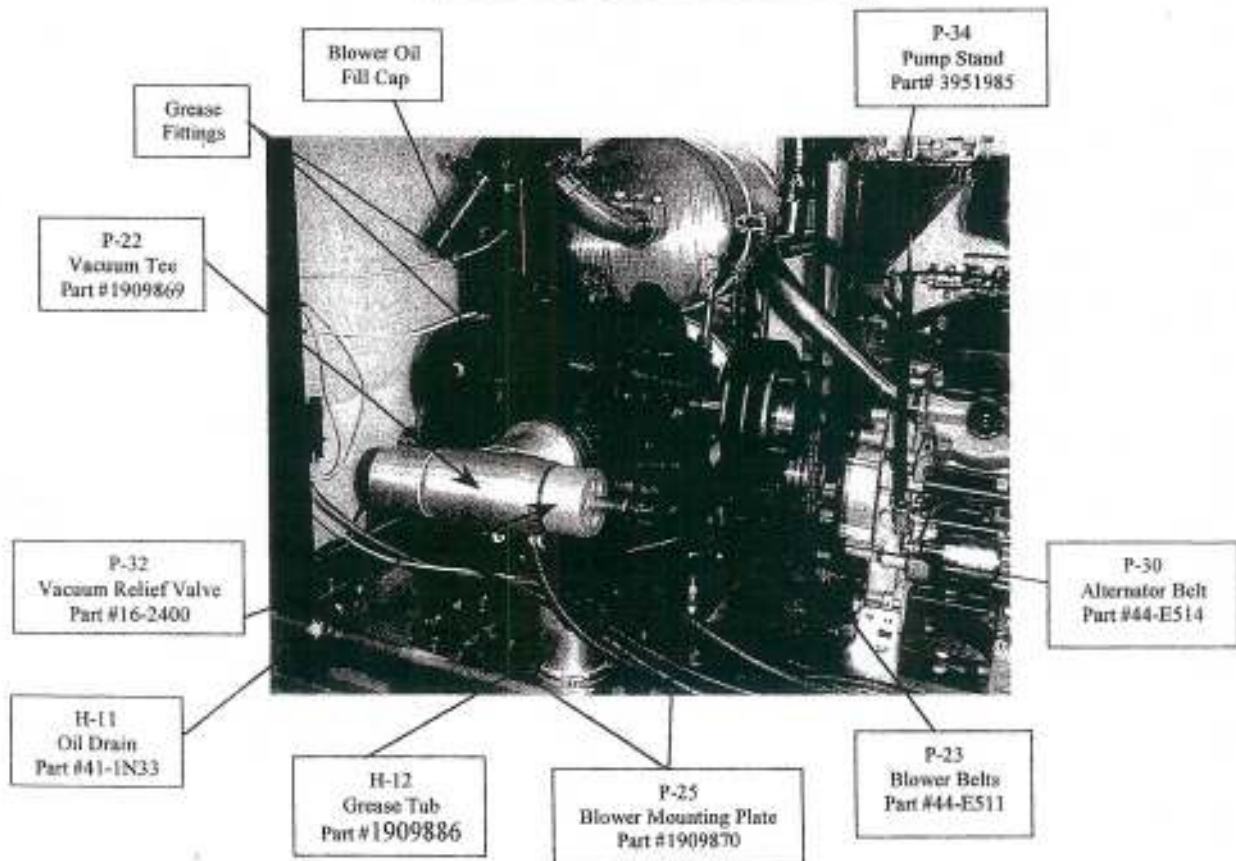
### **Belt and Drive System**

10-1 The belt drive system is a relatively simple system but the belt tension and alignment are very important to sustain the life of the belts and reduce unnecessary loading of the engine power. The following items will be covered in subsequent paragraphs.

- 1) **Blower belt tension and alignment (10-2)**
- 2) **Water pump belt tension and alignment (10-3)**
- 3) **Alternator belt tension (10-4)**
- 4) **Pulley, bushing removal and replacement (10-5)**
- 5) **Belt replacement (10-6)**

**Figure 10-1**

**Belt & Drive System**





- 10-2 **Blower Belt Tension** - This must be accomplished when a visual inspection detects excessive deflection in the belts or if the belts slip under a heavy vacuum load. Only a slight up or down movement is acceptable.

10-2.1 To tighten the belts, the four blower mounting bolts must be loosened but not removed. You will use the two blower adjustment brackets (P-25) (Figure 10-1) to move the blower away the engine. As the adjustment is made, use a straight edge to assure that the blower pulley and the engine pulley are in perfect alignment. As the blower adjustment on the blower nearest the engine is moved out, the opposite blower adjustment will have to be adjusted out at the same rate to keep the alignment perfect. When the tension and alignment are completed, re-tighten the four blower mounting bolts securely and test run the engine to check for proper alignment. If the alignment is not perfect, repeat the above process.

- 10-3 **Water Pump Belt Tension and Alignment** - When it becomes necessary for the pump belt to be tightened.

10-3.1 To tighten pump belt (P-29)(Figure 10-1), loosen the four mounting bolts for the cat pump (P-3)(Figure 5-3) and note that the brackets for the pump are slotted. While pulling the pump away from the engine, the belt tension will become tighter. At this point, hold tension on the belt and observe that the alignment is good while tightening the mounting bolts.

- 10-4 **Alternator Belt Tension**

10-4.1 If the alternator belt (P-30)(Figure 5-3) becomes loose, damage to the belt will occur and the alternator will not produce the electrical power to keep the battery charged. To gain access to the alternator adjustment bracket, remove the alternator belt guard (P-31)(Figure 5-3). Loosen the bolt that goes through the slotted bracket so that the alternator (P-16)(Figure 5-30) can be moved in a manner to make the belt tighter. Then tighten the bolt while holding desired tension. Reinstall the belt guard bracket.

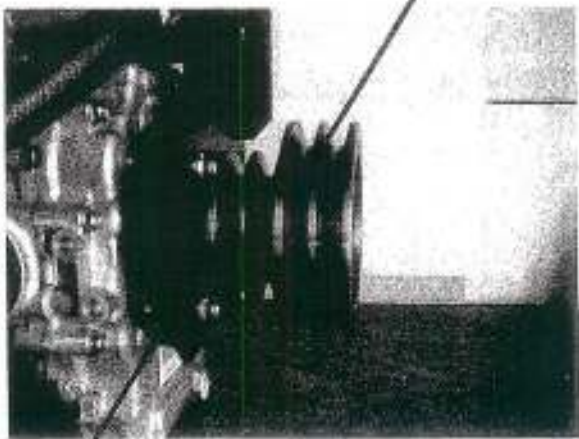
**Figure 10-2**

**Engine Pulley Removal**



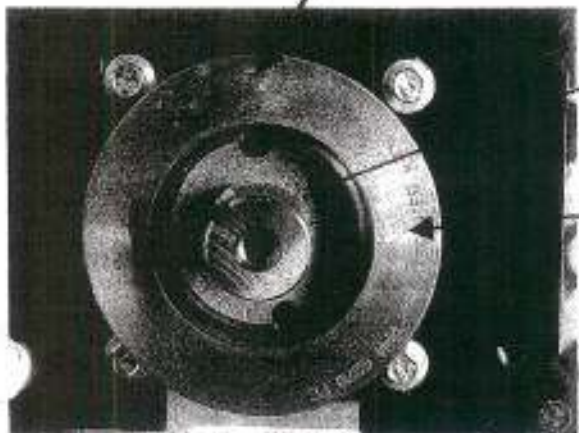
Engine Pulley  
Bushing - 9100  
Part #44-E619

V-Pulley, Engine  
to Blower - 9100  
Part #44-E213



Engine Pulley  
Bushing - 9100  
Part #44-E619

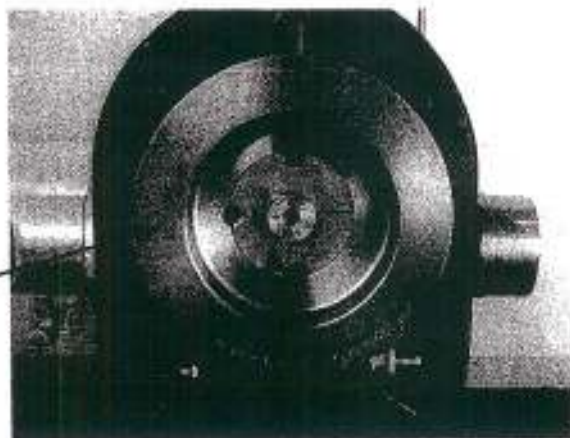
V-Pulley, Engine to  
Alternator - 9100  
Part #4603106



### **Figure 10-3**

#### **Blower Pulley Removal**

V-Pulley, Blower to  
Alternator - 9100  
Part #44-E214



Blower Pulley  
Bushing - 9100  
Part #44-E606

10-5 **Pulley, Bushing Removal and Replacement** – At some time it may become necessary to remove a pulley or bushing from a component like the engine, blower etc. This machine uses tapered pulleys and bushings for maximum stability.

10-5.1 If either of the 3 pulleys and bushings shown in (Figure 10-2 or 10-3) are to be removed, follow these instructions

- A) Make **WRITTEN** note of where they are on the shaft of the component before removal.
- B) Remove the 2 Allen screws shown by the black hole at 12:00 and 6:00 in (Figure 10-2 or 10-3).
- C) Use one of the two screws removed to insert into the single light colored hole at 9:00. By exerting torque on the Allen wrench, this will cause the bushing to separate from the pulley. **NOTE:** A rectangular key is used to keep the pulley and bushing from slipping.

10-5.2 When reinstalling these pulleys on the shaft, follow these instructions.

- A) From the note taken in (10-5, 1A), place the pulley and bushing back onto the shaft to the exact position it was before removal.
- B) Re-insert the key and the two Allen screws back into the tightening holes at the 12:00 and 6:00 positions.
- C) While keeping the pulley and bushing in the proper place on the shaft, tighten the two Allen screws securely. An extension to the Allen wrench may be advisable to gain proper torque.

- 10-5.3 To remove the pulley from the alternator (P-16)(Figure 5-3), the large hex nut will have to be removed so that the pulley can be pulled from the shaft.
- 10-5.4 When the clutch pulley (P-5)(Figure 5-2) is to be removed from the water pump (P-3), the metric bolt and washer must be removed using a 13 mm wrench (1/2" SAE wrench will probably work). Roll the belt off of the pulley so that the pulley can be driven from the pump shaft (a rubber mallet is suggested). A metric key is used to keep the clutch pulley from slipping on the pump shaft. When reinstalling the clutch pulley, do not forget to install the metric key as the pulley is being reinstalled on the pump shaft. The pulley is held onto the pump shaft by a washer and metric bolt. **NOTE:** Do not try to use an American SAE bolt to replace the metric bolt if lost. This will strip the threads of the pump shaft and replacement will be necessary.

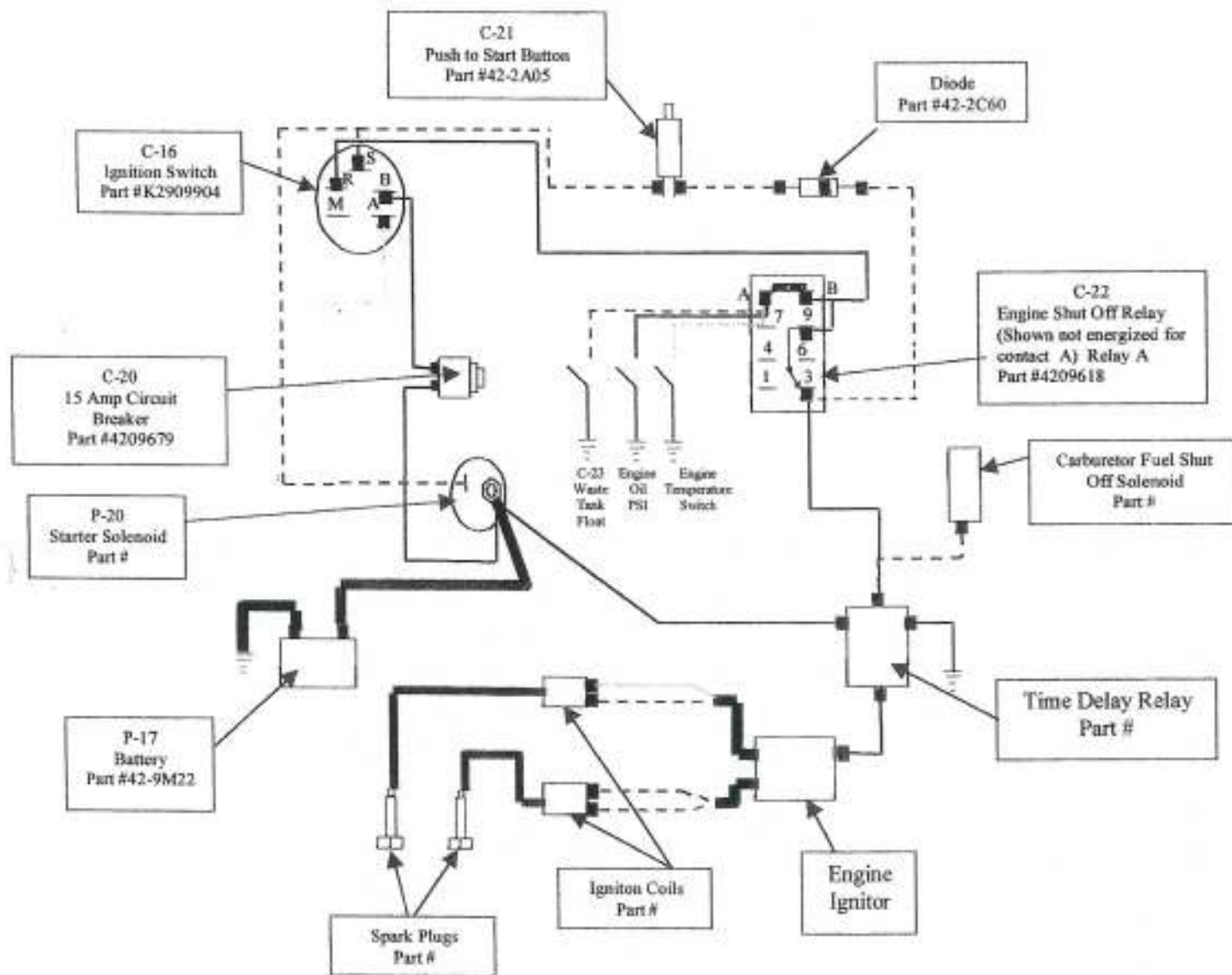
Tighten the bolt securely by:

- A) Turn the ignition switch to run (Do Not Start)
- B) Turn the pump switch (C-15)(Figure 5-1) on. (Clutch will energize)
- C) Grasp the pump belt (P-29) mid way between the pulleys and squeeze together.
- D) Tighten the metric bolt on the clutch pulley securely.

10-6 **Belt Replacement** – When belts show wear

- 10-6.1 When a belt or belts are to be replaced, the information in the proceeding paragraph of this section will have to be complied with. **NOTE:** If the blower belts are to be replaced, the blower will have to be loosened so that the belts can go over the pulleys. Then follow the information in paragraph 10-2 through 10-2.1. The same procedure will have to be complied with if either of the other two belts are to be replaced.

11-1 Explanation of the **Engine Ignition System** was discussed in paragraphs 4-8 through 4-8.4 earlier in this manual. Refer to those paragraphs for a detailed explanation of this circuit.



**Figure 11-1**  
Engine Ignition System

# Section 11

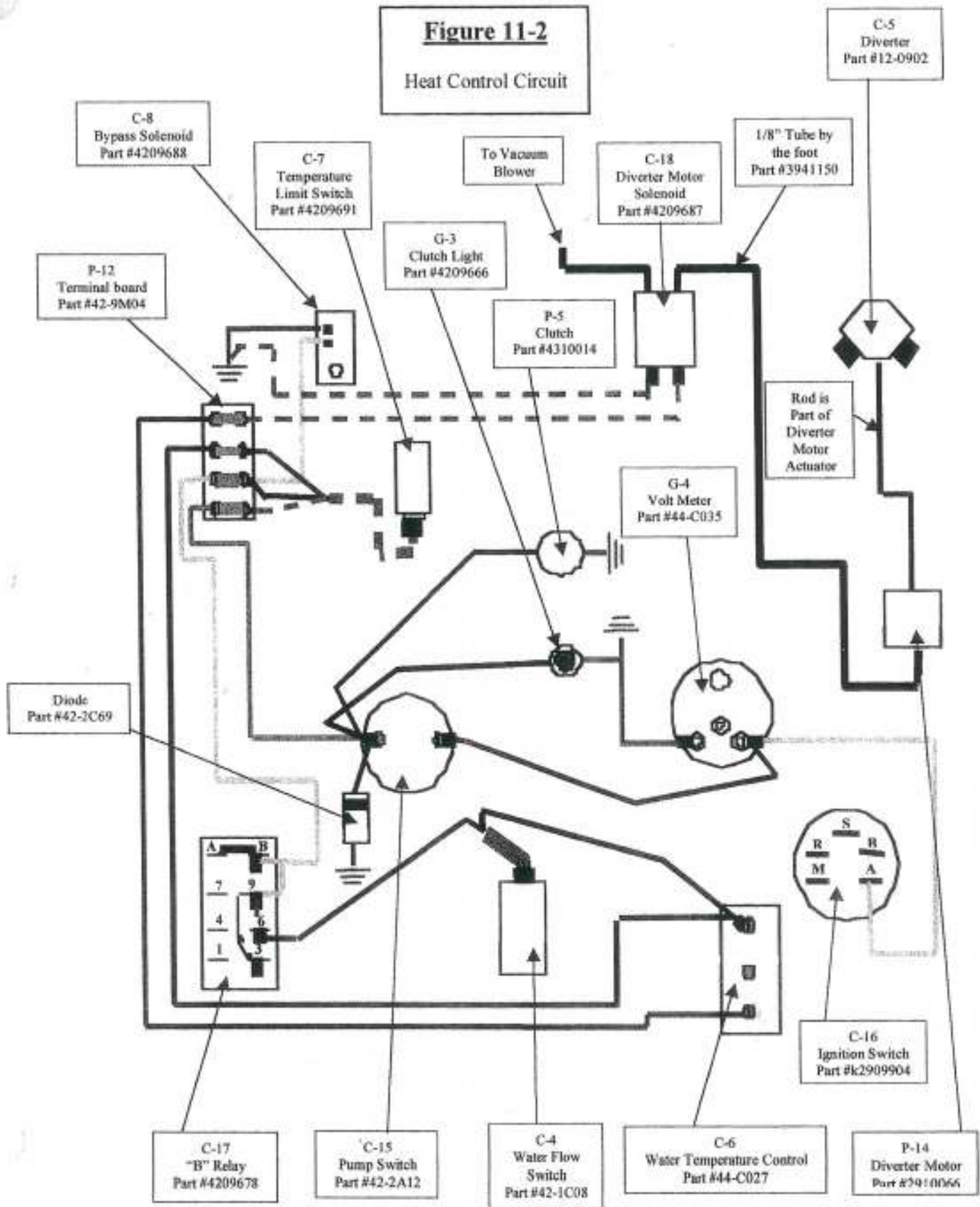
## Wiring Systems

In this section you will find the following diagrams:

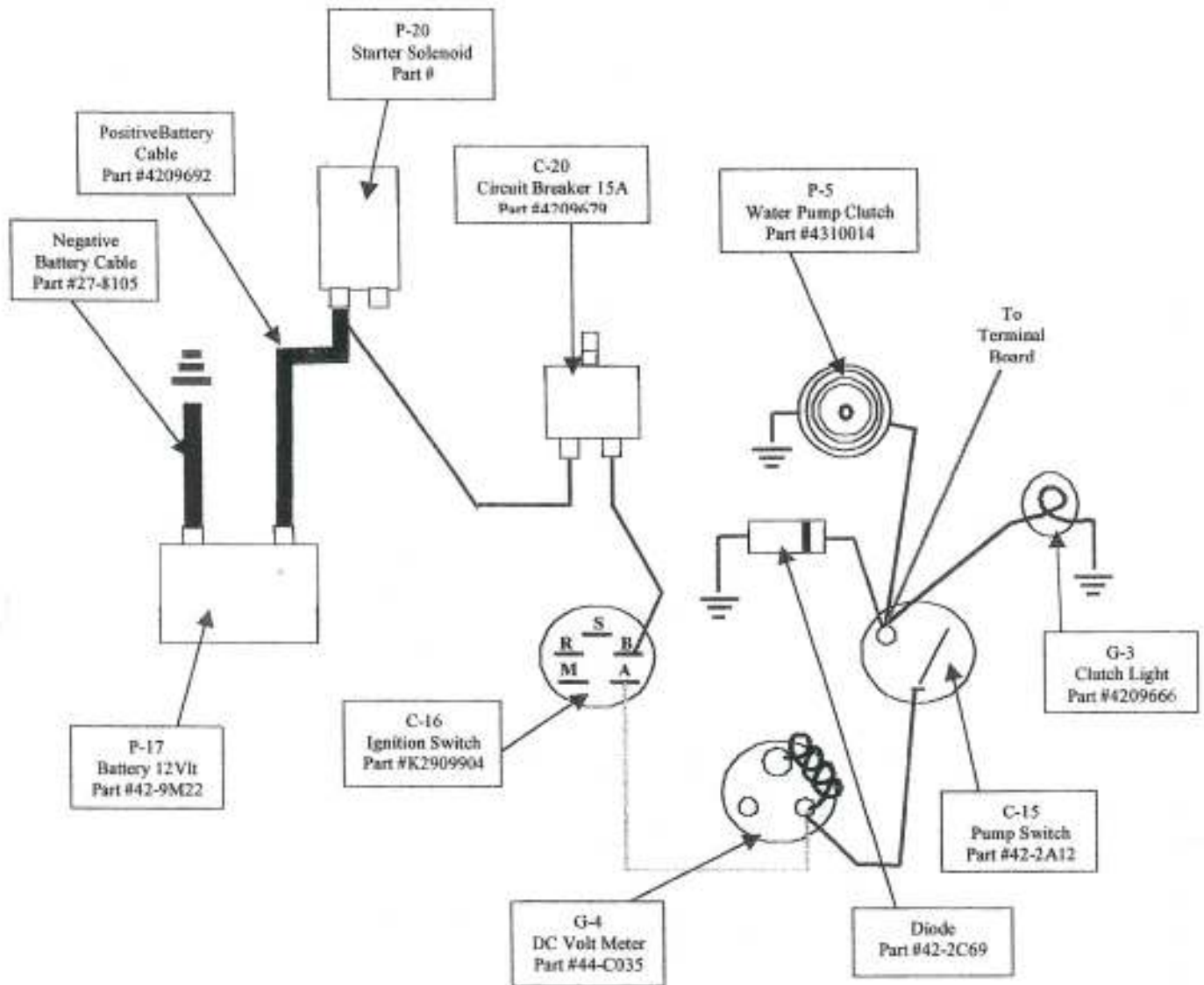
- 1) Engine Ignition System                      **Figure 11-1**
- 2) Heat Control Circuit                      **Figure 11-2**
- 3) Water Pump Clutch Circuit                      **Figure 11-3**
- 4) Battery charging Circuit                      **Figure 11-4**
- 5) Gasoline Fuel Pump Circuit                      **Figure 11-5**
- 6) Water Temperature Gauge Circuit                      **Figure 11-6**
- 7) Tach/hour Meter Circuit                      **Figure 11-7**
- 8) Waste Tank Pump Out Circuit                      **Figure 11-8 (Optional)**

11-2 The **Heat Control Circuit** was covered in a step-by-step explanation in paragraph 8-6 through 8-6.11 in section 8 of this manual.

**Figure 11-2**  
Heat Control Circuit



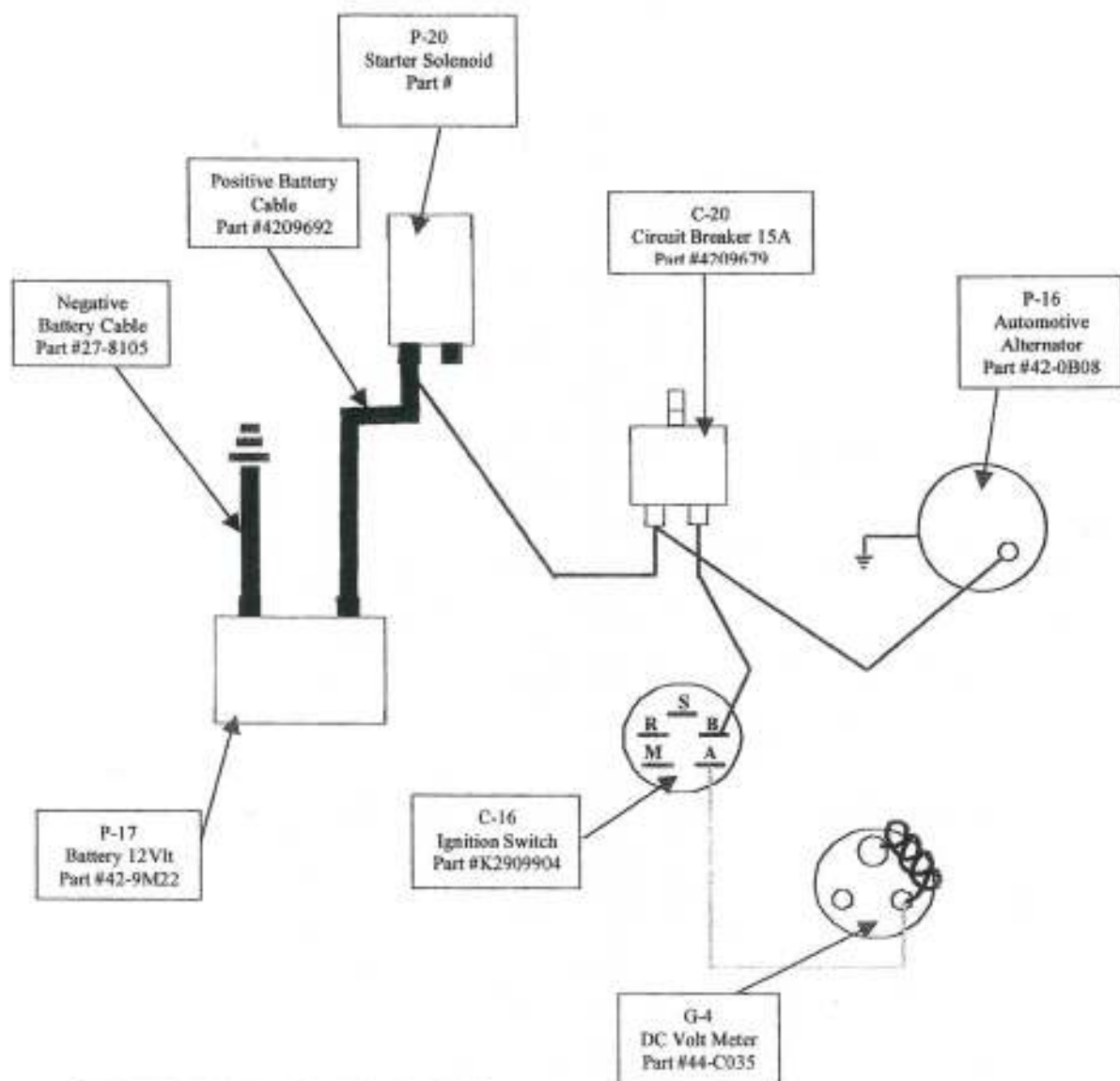
- 11-3 Refer to (Figure 11-3) as you review the **Water Pump Clutch Circuit**. The battery is the power source. Power is connected to the starter solenoid (P-20) where this circuit gets its power. Follow power through the 15A circuit breaker and to the ignition switch contact "B". When the key is in the on position, power is sent to the pump switch (C-15) via the DC voltmeter. When the pump switch is turned on, power is applied to the clutch causing the water pump to turn. A light (G-3) will indicate that the clutch is on. A diode is used to protect contact points in switches and to preserve the life of the light bulbs.



**Figure 11-3**  
Water Pump Clutch Circuit



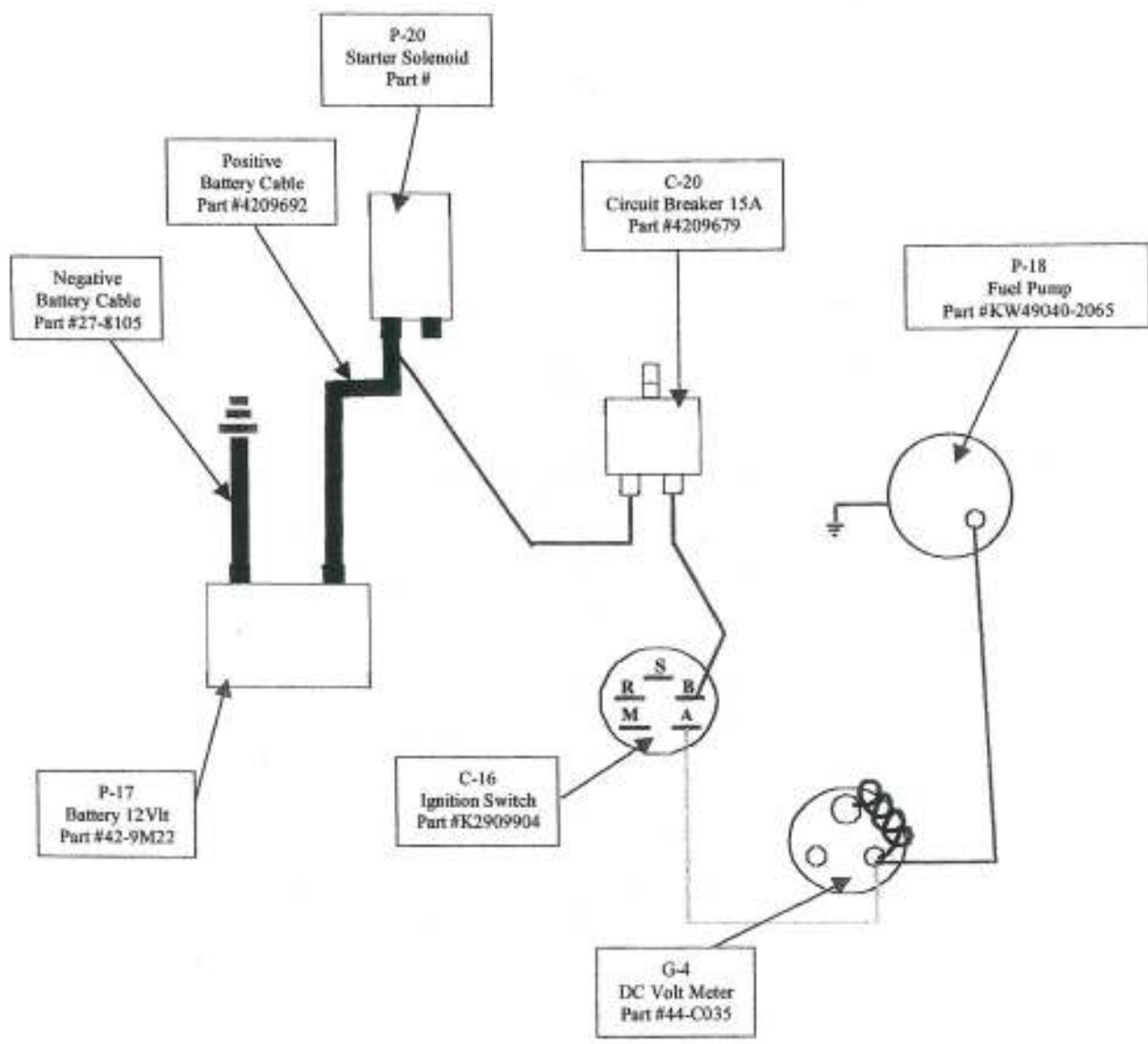
- 11-4 The **Battery Charging Circuit** is almost identical to that of an automobile. When, the alternator is being driven by the engine it will produce approximately 14volts DC power to recharge the battery. Refer to (figure 11-4) and note that the red lead from the alternator goes directly to the positive battery cable attached to the starter solenoid (P-20). A DC voltmeter (G-4) will show the DC power being produced or stored in the battery when the ignition switch is on. The alternator (P-16) contains a voltage regulator to keep it from over charging the battery.



**Figure 11-4**

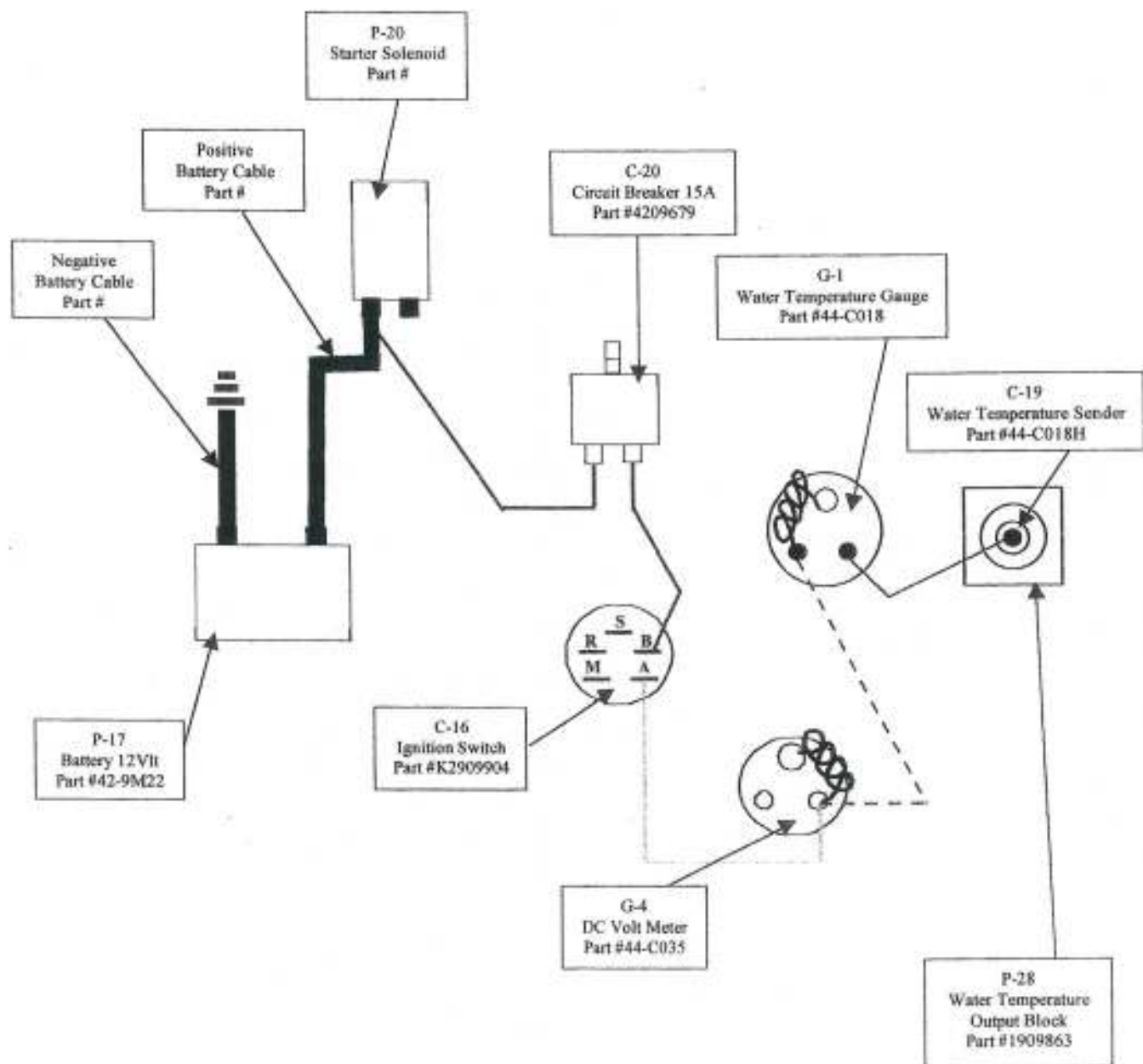
Battery Charging Circuit

11-5 Figure 11-5 the Gasoline Fuel Pump Circuit contains the same input power information as the two preceding diagrams. The power point for the fuel pump (P-18) is the DC voltmeter that has power applied to it anytime the ignition switch (C-16) is on.



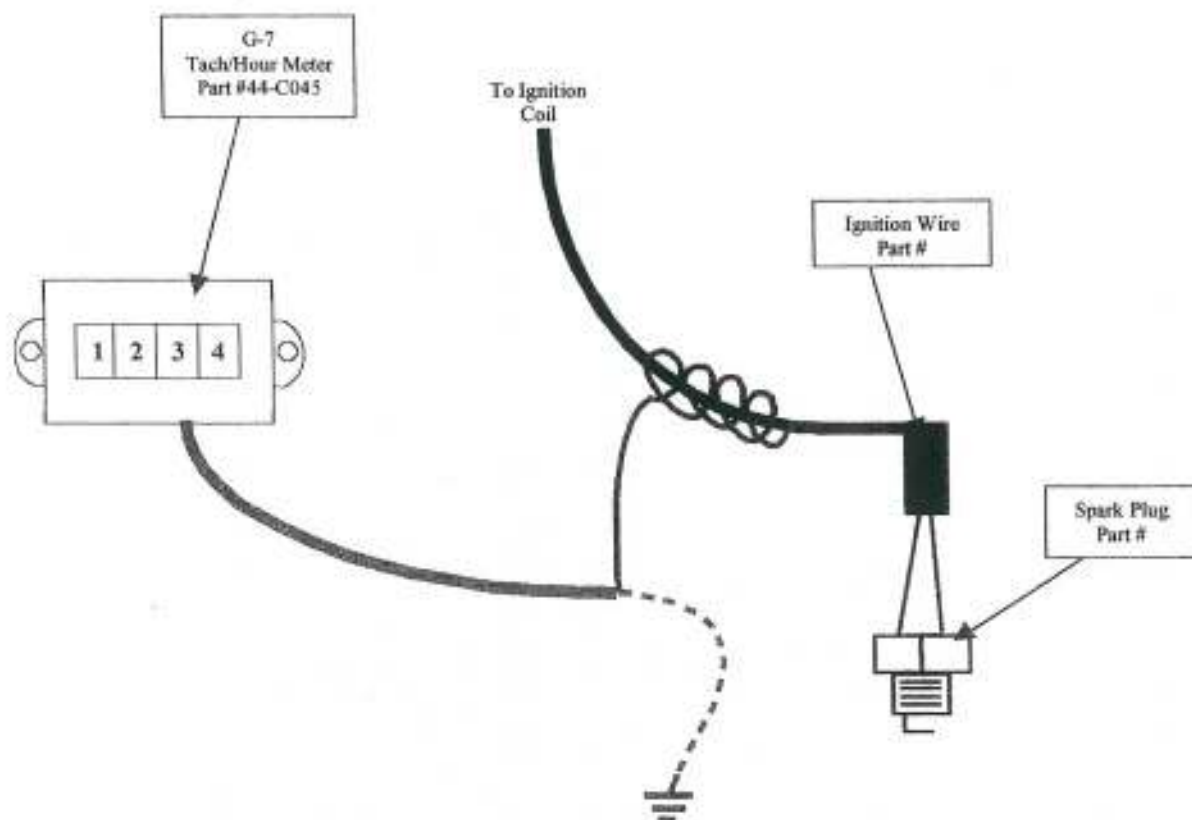
**Figure 11-5**  
Gasoline Fuel Pump Circuit

- 11-6 The **Water Temperature Gauge Circuit** gets its power from the DC volt meter, as in the paragraph above. A white wire connects the battery power to the "I" terminal of the water temperature gauge and to the light bulb for the gauge. The gauge will respond to the signal it gets from the water temperature sender (C-14) via a brown wire attached to the "S" terminal of the water temperature gauge. (Refer to Figure 11-6)



**Figure 11-6**  
Water Temperature Gauge Circuit

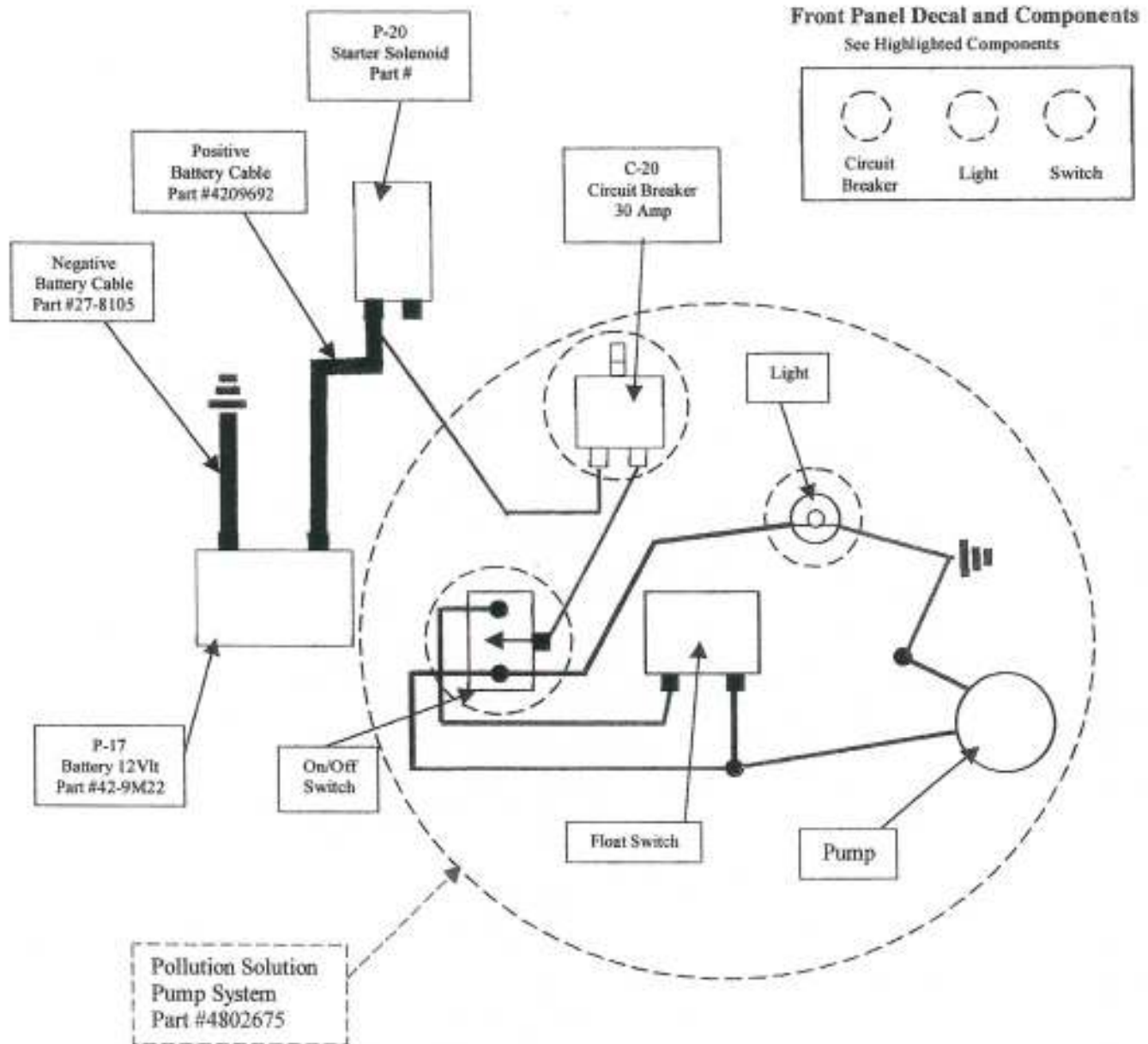
- 11-7 The **Tach/Hour Meter Circuit** (G-7) is shown on (Figure 11-7) only consists of two wires. The white wire is grounded to the engine and the red wire wraps around the spark plug lead wire. When the engine is running, the digital read out shows the RPM of the engine. When the engine is not running, the meter indicates the hours of operation on the machine.



**NOTE:** Reads time on machine when the engine is not running  
Reads RPM of the machine when the engine is running

**Figure 11-7**  
Tach/Hour Meter Circuit

11-8 (Optional) The **Waste Tank Water Pump Out System** when included with this machine is shown on (Figure 11-8). The circuit gets its power from the positive battery cable attached to the starter solenoid (P-20). The DC power is sent to a 30amp circuit breaker for protection against overloads. Power continues to the control switch that has 3 positions, off, automatic and manual. In the automatic position "B", power is sent through the float switch when elevated by water in the waste tank (P-6). This causes the pump to discharge the wastewater from the tank. When a sufficient amount has been pumped out, the float lowers to stop the pump. When the control switch is held (Spring Loaded) in the manual "A" mode, the pump will run until the desired amount of water has been discharged. All parts that are included in the "Pollution solution" system are in the dotted circle.



**Figure 11-8**  
Waste Tank Water Pump-Out System

# Section 12

## Maintenance Schedule

- 12-1 To maintain your 9100 LX carpet and upholstery cleaning machine properly, a maintenance schedule (Figure 12-1) will give you a listing of intervals suggested to service and maintain your machine.
- 12-2 As in any piece of equipment that has an engine drive system, maintenance is imperative for the longevity of the investment. Please be sure to read over the chart (Figure 12-1) in order to be familiar with the suggested maintenance for your machine.
- 12-3 Each of the major components of this machine has its own owner's manual located in the back of this manual.
- 1) Engine Owner's Manual – Section 4 Pages A1 through A9
  - 2) Roots Blower Manual
  - 3) Cat Pump Manual
- 12-4 In (Figure 12-1) the maintenance schedule lists the items that need regular scheduled service in the first column. The interval at which this service is to be performed is covered in the next 11 columns. The last column lists the product and the Steam Way part number for that product for ease of ordering from your local Steam Way Distribution outlet.

Figure 12-1 Maintenance Schedule 9100LX

Item	Every Job	Every Day	2 Wks	25 Hrs	50 Hrs	100 Hrs	200 Hrs	300 Hrs	400 Hrs	500 Hrs	1000 Hrs	Part # & Product						
Waste Tank/Lint Screen	Clean											16-1141 - 2 1/2" Lint Screen						
Orifice Bypass Screen			Clean				See Paragraph 7-11					611602 - Orifice Screen						
<b>Engine - Kawasaki</b>																		
Oil Filter							Change	Change				90W4005-2071						
Engine Oil	Check		(1st Change - 8 Hours)				Change		(See Owners Manual Section 4, Page A3)									
Air Filter - Foam	(Not Used in This Application)																	
Air Filter						Clean		Change										
Spark Plugs			(Change if Needed At Anytime)					Clean & Regap										
Radiator Coolant	Check								Change									
Fuel Filter - Gasoline										Change								
Fuel Belt							Check											
Decarbon & Tune Up	(See Owners Manual Page A8)																	
<b>Vacuum Blower - Roots</b>																		
Bearing Grease	(Fuel Lube - 10 Hours)		LUBE				See Figure 10-1					481032 - Lubriplate Grease						
Gear Oil				Check			1st Change				Change	481035 - Lubriplate 84						
Impeller Lube		Lube		(See Paragraph 9-8.3 Of This Manual)														
Blower Belt Tension						Check	(1/2" Deflection Max.)											
<b>Water Pump - Cat</b>																		
Crank Case Oil		Oil Level At Red Dot			1st Change					Change		481018 - Cat Pump Oil						

# Section 13

## Descaling Procedures

- 13-1 The 9100LX carpet and upholstery cleaning machine is subjected to a great quantity of water over a period of time which has an inherent characteristic of collecting minerals in the coils, tubes and hoses of the machine. When this condition comes about, steps must be taken to eliminate these deposits from the machine.
- 13-2 The following is a list of items needed to perform the descaling of the 9100LX
- 1) 5 gallon plastic container
  - 2) 2 quarts of Steam Way descaler (Part #9950100) sold in quarts only
  - 3) 2 descaling hoses (Part # 15-8002)
- 13-3 Procedure: (See precautions before using)
- 1) Mix 2 quarts of Steam Way descaler with five gallons of water in the 5-gallon plastic container.
  - 2) Connect a high-pressure hose or hoses to (H-4) pressure output connection. Remove the male quick disconnect from the end of the pressure hose. Place the open end of the hose into the gallon plastic container of descaler.
  - 3) Connect on descaling hose (15-8002) to (H-16) quick-disconnect, which is the water input to the water pump. Place the other end of the hose into the container of mixed descaler.
  - 4) Disconnect the orifice bypass (P-9) connector and use the second descaling hose (15-8002) to return the descaler solution back to the 5-gallon plastic container.
  - 5) Turn the solution control valve (C-9) to off.
  - 6) Turn the temperature control (C-6) to its lowest setting, fully clockwise.
  - 7) Start the engine and run at  $\frac{1}{2}$  speed.
  - 8) Turn the pump switch (C-15) on and observe that the descaler is being returned to the 5 gallon container via the pressure hose to assure that the pump is not being run dry and that the descaling procedure is under way.
  - 9) After approximately 25 minutes, you should observe that the flow rate of the descaler solution back into the pail has increased. This indicates that the procedure has been effective and the descaling procedure is almost complete.
  - 10) Turn the pump switch (C-15) off. Remove the descaler hose that was connected to (H-16) in step 3 and hook up the original hose to its normal configuration.
  - 11) Apply water to (H-1) water input connection and allow the water box (P-1) to fill.
  - 12) Turn the pump switch (C-15) back on and run the machine until all of the descaler has been discharged. This should take at least 5 minutes but no longer than 10 minutes. Turn the pump switch off and stop the engine.

- 13) Remove the descaler hose from the orifice bypass Quick Disconnect and reconnect the orifice bypass hose to its original configuration.
- 14) Reinstall the male quick-disconnect on the pressure hose that was removed in step 2.
- 15) Discard the descaler in accordance with state, city or local policies.

#### **Precautions When Using Descaler**

**Caution:**      **Corrosive. Use the following precautions when using descaler on your 9100OX.**

**HARMFUL OR FATAL IF SWALLOWED. CONTAINS HYDROCHLORIC ACID**

Do not mix with other chemicals. Do not use on Aluminum parts. Use only with adequate ventilation. Wear a respirator, goggles and gloves when applying. Dispose of wastes properly. Apply only in well ventilated areas. Avoid breathing spray mist or vapors. Avoid contact with skin. Keep out of the reach of children at all times. Avoid eye contact. As with all chemicals, use only with adequate ventilation. Professional chemicals should always be under the complete control of the technician at all times.

**PLEASE READ THE MATERIAL SAFETY DATA SHEET BEFORE USING THIS PRODUCT.**



# Section 14

## Troubleshooting

14-1 This section addresses four categories for troubleshooting.

- 1) Engine (Paragraph 14-2)
- 2) Vacuum Recovery
- 3) Water Pressure
- 4) Water Heating

14-2 When an engine problem exists, refer to paragraph 4-8.4

### TROUBLESHOOTING GUIDE

If the engine malfunctions, carefully examine the symptoms and the operating conditions, and use the table below as a guide to troubleshooting.

Symptom	Probable Cause	Remedy
Engine will not start or output is Low	<ul style="list-style-type: none"> <li>● Loose spark plug</li> <li>● Loosen cylinder head bolts</li> </ul>	Tighten properly
	No fuel in fuel tank	Fill fuel tank
	<ul style="list-style-type: none"> <li>● Blocked fuel tube</li> <li>● Blocked air vent in tank cap</li> </ul>	Clean
	Over-rich fuel/air mixture	Rotate engine with plug removed to discharge excess fuel Clean spark plug
	Clogged air cleaner	Clean
	<ul style="list-style-type: none"> <li>● Incorrect grade/type of fuel</li> <li>● Water in fuel</li> </ul>	Change gasoline
	Faulty spark plug	Change spark plug
	Faulty ignition coil	
	Faulty igniter	
	Weak or faulty battery	Charge or change battery
	Faulty starter motor	
Low output	Clogged air cleaner	Clean
	Clogged Cooling system	
	Loose or slipping fan belt	
	Insufficient engine oil	Replenish or change oil
	Poor ventilation around engine	Select a better location
	Lack of coolant	Add coolant to correct level
	Too much oil in crankcase	Correct oil level

\* Have an authorized Kawasaki engine dealer perform these service

14-3 When there is a vacuum deficiency, refer to paragraph 9-7 in section 9 of this manual and this troubleshooting check list for vacuum blower problems:

### TROUBLE SHOOTING CHECKLIST

TROUBLE	ITEM	POSSIBLE CAUSE	REMEDY
No Air Flow	1	Speed too low	Check by tachometer and compare with speed shown on Roots Order Acknowledgment. Compare actual rotation with Figure 3. Change driver if wrong. Check piping, screen, valves, silencer, to assure an open flow path.
	2	Wrong rotation	
	3	Obstruction in piping	
Low capacity	4	Speed too low	See item 1. If belt drive, check for slippage and readjust tension. Check inlet vacuum and discharge pressure, and compare these figures with specified operating conditions on Order. See item 3. Check inside of casing for worn or eroded surfaces causing excessive clearances.
	5	Excessive pressure	
	6	Obstruction in piping	
	7	Excessive slip	
Excessive Power	8	Speed too high	Check speed and compare with Roots Order Acknowledgment. See item 5. Inspect outside of cylinder and headplates for high temperatures areas, then check for impeller contacts at these points. Correct blower mounting, drive alignment.
	9	Pressure too high	
	10	Impellers rubbing	
Overheating of Bearings, or Gears	11	Inadequate lubrication	Restore correct oil levels in gearbox and lubricate. Check gear oil level. If incorrect, drain and refill with clean oil of recommended grade. See item 5. Check carefully. Realign if questionable. Readjust for correct tension. Speeds lower than the minimum recommended will overheat the entire blower.
	12	Excessive lubrication	
	13	Excessive pressure rise	
	14	Coupling misalignment	
	15	Excessive belt tension	
	16	Speed too low	
Vibration	17	Misalignment	See item 14. See item 10. Check gear backlash and condition of bearings. Scale or process material may build up on casing and impellers, or inside impellers. Remove build-up to restore original clearances and impeller balance. Tighten mounting bolts securely. Determine whether standing wave pressure pulsations are present in the piping. Refer to Sales Office.
	18	Impellers rubbing	
	19	Worn bearings/gears	
	20	Unbalanced or rubbing impellers	
	21	Driver or blower loose	
	22	Piping resonances	

14-4 If there is a reduction or loss in water pressure, examine the following:

- 1) Insure that there is an adequate supply of water to the machine (Garden Hose)
- 2) Clutch is engaged
- 3) Pressure regulator adjusted properly
- 4) Water Box has adequate level of water
- 5) Pressure gauge shows no water pressure

14-4.1 If the steps above are accomplished and there is not water pressure, do this procedure:

- 1) Disconnect the male quick disconnect from (H-16) at the pump and apply city water pressure with the garden hose to the female connector with the machine not running.
- 2) Look for water leaks all about the pump, regulator, thermal valve and the immediate area.
- 3) If no leaks are found start the machine while the water hose is still inserted into (H-16). Turn the pump switch (C-15) on. If water pressure is regained, turn the pump switch off and reinstall (H-16) and the water input hose to their original configurations. Turn the pump switch on and see if the water pressure is still available. If the Water Pressure goes away again, this indicates an air leak some where on the suction side of the pump or a restriction in the system. There is also a possibility of a defective pump. See the diagnosis and maintenance list below for the 3CP Cat pump.

## DIAGNOSIS AND MAINTENANCE

PROBLEM	PROBABLE CAUSE	SOLUTION
<ul style="list-style-type: none"> <li>• Low Pressure</li> </ul>	<ul style="list-style-type: none"> <li>• Worn nozzle</li> <li>• Belt slippage</li> <li>• Air leak in inlet plumbing</li> <li>• Pressure gauge inoperative or not registering accurately</li> <li>• Relief valve stuck partially plugged or improperly adjusted</li> <li>• Worn seat or valves</li> <li>• Inlet suction strainer clogged or improperly sized</li> <li>• Worn seals. Abrasives in pumped fluid, severe cavitation; inadequate water supply, stressful inlet conditions</li> <li>• Fouled or dirty inlet or discharge valves</li> <li>• Worn inlet or discharge valves</li> <li>• Leaky discharge hose</li> </ul>	<ul style="list-style-type: none"> <li>• Replace nozzle of proper size.</li> <li>• Tighten or replace; use correct belt.</li> <li>• Use PTFE liquid or tape</li> <li>• Check pressure with new gauge and replace as needed.</li> <li>• Clean and reset relief valve to system pressure and correct by-pass. Check supply tank for contamination.</li> <li>• Clean or replace with valve kit.</li> <li>• Use adequate size for inlet pump connection and fluid being pumped. Clean frequently.</li> <li>• Install and maintain proper filter, check line size and flow available to pump. Install a C.A.T.</li> <li>• Clean inlet and discharge valve assemblies.</li> <li>• Replace with valve kit.</li> <li>• Replace hose. Check connections.</li> </ul>
<ul style="list-style-type: none"> <li>• Pulsation, pump runs extremely rough, pressure low</li> </ul>	<ul style="list-style-type: none"> <li>• Faulty Pulsation Damper</li> <li>• Restricted inlet or air entering inlet plumbing</li> <li>• Stuck inlet or discharge valve</li> </ul>	<ul style="list-style-type: none"> <li>• Check precharge (should be 30-50%) of system pressure or replace as needed.</li> <li>• Check filters and clean as needed. Check fittings and use PTFE liquid or tape for airtight connection.</li> <li>• Clean or replace valve. Check supply tank for contamination.</li> </ul>
<ul style="list-style-type: none"> <li>• Water leakage from under the manifold *Slight leakage</li> </ul>	<ul style="list-style-type: none"> <li>• Worn Lo-Pressure, Hi-Pressure seals or V-packings</li> </ul>	<ul style="list-style-type: none"> <li>• Replace with seal kit.</li> <li>• Check inlet pressure and system temperature.</li> <li>• Use Thermo Valve in by pass line.</li> <li>• Use inlet pressure regulator in inlet line.</li> </ul>
<ul style="list-style-type: none"> <li>• Oil leak between crankcase and pumping section</li> </ul>	<ul style="list-style-type: none"> <li>• Worn crankcase seals</li> </ul>	<ul style="list-style-type: none"> <li>• Replace crankcase seals.</li> </ul>
<ul style="list-style-type: none"> <li>• Oil leaking in the area of crankshaft</li> </ul>	<ul style="list-style-type: none"> <li>• Worn crankshaft seal</li> <li>• Bad bearing</li> </ul>	<ul style="list-style-type: none"> <li>• Replace damaged seals.</li> <li>• Replace bearing.</li> </ul>
<ul style="list-style-type: none"> <li>• Excessive play in the end of the crankshaft</li> </ul>	<ul style="list-style-type: none"> <li>• Worn bearing</li> </ul>	<ul style="list-style-type: none"> <li>• Replace bearing.</li> </ul>
<ul style="list-style-type: none"> <li>• Water in crankcase</li> </ul>	<ul style="list-style-type: none"> <li>• Humid air condensing into water inside of the crankcase</li> <li>• Leaking of crankcase seals or seals installed backward</li> </ul>	<ul style="list-style-type: none"> <li>• Change oil every 3 months or 500 hour intervals using special CAT PUMP Premium Grade Oil, PN 06100 (Case) 6107 (Bottle), (other approved oil every month or 300 hours)</li> <li>• Replace seals. Follow proper installation procedure. Contact Cat Pumps supplier for crankcase servicing.</li> </ul>
<ul style="list-style-type: none"> <li>• Oil leaking at the rear portion of the crankcase</li> </ul>	<ul style="list-style-type: none"> <li>• Damaged or improperly installed oil gauge, crankcase cover or drain plug O-ring</li> </ul>	<ul style="list-style-type: none"> <li>• Replace oil gauge, crankcase cover or drain plug O-ring. Thread in oil gauge and drain plug hand tight to avoid extruding o-ring.</li> </ul>
<ul style="list-style-type: none"> <li>• Loud knocking noise in pump</li> </ul>	<ul style="list-style-type: none"> <li>• Pulley loose on crankshaft</li> <li>• Worn bearing, connecting rod or crankshaft</li> <li>• Stressful inlet conditions</li> </ul>	<ul style="list-style-type: none"> <li>• Check key and tighten set screw.</li> <li>• Consult Cat Pumps supplier for crankcase servicing.</li> <li>• Install C.A.T.</li> </ul>
<ul style="list-style-type: none"> <li>• Frequent or premature failure of the packing</li> </ul>	<ul style="list-style-type: none"> <li>• Stored plungers</li> <li>• Over pressure to inlet manifold</li> <li>• Abrasive material in the fluid being pumped</li> <li>• Excessive pressure and/or temperature of fluid being pumped</li> <li>• Running pump dry</li> </ul>	<ul style="list-style-type: none"> <li>• Replace plungers.</li> <li>• Reduce inlet pressure per instructions.</li> <li>• Install proper filtration on pump inlet plumbing</li> <li>• Check pressure and inlet fluid temperature. Be sure they are within specified range.</li> <li>• <b>DO NOT RUN PUMP WITHOUT WATER.</b></li> </ul>
<ul style="list-style-type: none"> <li>• Strong surging at the inlet and low pressure</li> </ul>	<ul style="list-style-type: none"> <li>• Foreign particles in the inlet or discharge valve or worn inlet and/or discharge valves</li> </ul>	<ul style="list-style-type: none"> <li>• Check for smooth surfaces on inlet and discharge valve seats. Replace with kit if pitted or worn.</li> <li>• Check supply tank for contamination, install and regularly clean filter. Do not pump abrasive fluids.</li> </ul>

- 14-4.2 If the water pressure gauge shows good water pressure but output is low, this usually indicates restrictions in the system which can usually be restored by descaling the machine. See section 13 of this manual for that procedure. Restrictions can exist in the pressure hoses between the machine and the cleaning tool as well as the nozzle in the tool.
- 14-5 If the machine's water heating is not functioning properly, listed below are some items to check:

#### **-Under Heating-**

- 1) Orifice bypass screen (P-9).
- 2) Diverter valve - Open/Close completely (C-5).
- 3) Diverter valve not responding to temperature demand (Temperature control) (C-6).
- 4) Wrong size or worn jet in cleaning tool (too much water flow).
- 5) Thermal protection valve (C-3) stays open.
- 6) Low vacuum load (6Hg or more required).
- 7) Vacuum tube to diverter motor solenoid (C-17) not connected.
- 8) Refer to paragraph 8-6.1 through paragraph 8-6.6 for complete troubleshooting theory.

#### **-Over Heating-**

- 14-6 When an overheating condition exists, check the following:
- 1) Water temperature control (C-6) defective or out of calibration.
  - 2) Defective temperature limit switch (C-7).
  - 3) Diverter valve (C-5) stuck in heat mode (Diverter motor rod up).
  - 4) Clean the orifice bypass screen (P-9)
  - 5) During a water box overheat condition, the water flow switch (C-4) should activate or deactivate the diverter valve if there is a temperature demand when the wand is turned on or off.
- 14-7 Included in this technical manual is a reference manual for all the carpet and upholstery wands and hand tools located following section 15.

# Section 15

15-1 This section contains a list of the major components vital to the operation of the 9100LX. You will find four tables listed :

Table 15-1 List of controls

Table 15-2 List of gauges

Table 15-3 List of hook-ups & drains

Table 15-4 List of major components

15-2 Each table contains in a column:

- 1) Item reference numbers
- 2) Part number of that item
- 3) Name of component
- 4) Figure number to refer to a picture or diagram where these are found.

15-3 Following this section are the manufacturers manuals for Cat Pump and Roots Blower.

15-4 The engine owner's manual is in section 4

## Part Number Reference Lists

Table 15-1  
Controls

Item	Part #	Name	Figure#
C-1	4143110	Float Control	7-1
C-2	4144205	Pressure Regulator	5-1, 7-1
C-3	C7170	Thermal Valve	5-2, 7-1
C-4	42-1C08	Water Flow Switch	5-3, 7-1
C-5	12-0902	Diverter Valve	5-2, 5-3
C-6	44-C027	Water Temperature Control	5-1, 8-2
C-7	4209691	Temperature Limit Switch	7-1, 8-1, 8-2
C-8	4209674	Bypass Solenoid	7-1, 8-1, 8-2
C-9	4149518	Solution Control Valve	5-1, 7-1
C-10	4141105	Solution Container Fill Valve	5-1, 7-1
C-11	4146506	Check Valve 3/8"	7-1
C-12	4146505	Check Valve 1/4"	7-1
C-13	4146505	Check Valve 1/4"	7-1
C-14	4149517	Metering Valve	5-1, 7-1
C-15	42-2A12	Pump Switch (Clutch)	5-1, 8-2
C-16	K2909904	Ignition Switch	5-1, 11-1
C-17	4209678	"B" Relay ( Heat Control )	11-2
C-18	4209687	Diverter Motor Solenoid	8-2, 11-2
C-19	44-C018A	Water Temperature Sender	8-3, 11-6
C-20	4209679	15 Amp Circuit Breaker	5-1, 11-1
C-21	42-2A05	Push To Start Button	4-2, 5-1
C-22	4209678	"A" Relay (Engine Shut Off)	4-2, 11-1
C-23	42-1C11	Float Switch (Waste Tank)	4-2, 11-1
C-24	B692105	Throttle	5-1
C-25	43-9A03	Engine Choke	5-1

Table 15-2  
Gauges

G-1	44-C018	Water Temperature Gauge	5-1, 8-3
G-2	4146120	Solution Meter	5-1, 7-1
G-3	4209666	Clutch Light	5-1, 11-3
G-4	44-C035	DC Volt Meter	5-1, 11-4
G-5	44-C011	Vacuum Gauge	5-1
G-6		Blower Oil Sight Glass	9-1
G-7	44-C045	Tach/Hour Meter	5-1, 11-7
G-8	44-C010	Water Pressure Gauge	5-1, 7-1
G-9		Dip Stick - Engine Oil	5-4, 5-2
G-10	C43987	Cat Pump Bubble Oil Gauge	5-3

## Table 15-3 Hook-ups & Drains

H-1	4132660	Water Input	5-1, 7-1
H-2	4131260	Solution Input	5-2
H-3	4132260	Solution Return	5-2
H-4	4131420	Pressure Output	5-1, 7-1
H-5	4131210	Gasoline Connection	5-2
H-6	41-1N33	Engine Oil Drain (Cap)	5-3
H-7	5721016	Vacuum Hose Connection (PVC Barb)	9-1
H-8	4142021	Dump Valve, Waste Tank	9-1
H-9	5723006	Dump Hose Connection	9-1
H-10	2909835	Blower Oiler	5-1
H-11	41-1N33	Blower Oil Drain (Cap)	5-2
H-12	1909886	Grease Tub	5-2, 9-1
H-13		Blower Oil fill Cap	5-4, 9-1
H-14	1909860	Blower & Engine Exhaust	5-4
H-15		Radiator Drain	5-1
H-16	4132660	Water Input Quick Disconnect to Cat Pump	7-1, 5-2

## Table 15-4 Major Components

P-1	1909773	Water box	7-1
P-2	3952044	Low Pressure Pre Heater	5-2, 7-1
P-3	4100150	Water Pump	5-2, 5-3, 7-1
P-4	41-5C14	Water Box Screen	7-1
P-5	4310014	Clutch	5-2, 5-3, 11-3
P-6	2909858-3	Waste Tank	9-1
P-7	1909856	High Pressure - Pre Heater	5-3, 5-4, 7-1
P-8	1909885	Thermal Accumulator	5-2, 5-3, 7-1
P-9	5118032	Orifice Bypass Screen	7-1
P-10	9980010	Solution Container	7-1
P-11	PC41-809144	Kinetic Pump	5-2, 5-4, 7-1
P-12	42-9M04	Terminal Board	8-1, 8-2, 11-1
P-13	1909897	Engine Muffler	5-4
P-14	2910066	Diverter Motor	5-4, 8-2, 11-1
P-15	4100157	Vacuum Blower	5-2, 5-4, 9-1
P-16	42-0B08	Automotive Alternator	5-3, 11-4
P-17	42-9M22	12V Battery	11-4
P-18	KW49040-2065	Fuel Pump (Gasoline)	5-2, 11-5
P-19		Filter (Gasoline)	
P-20		Starter Solenoid	4-2, 5-2, 11-1
P-21	2909863-1	Waste Tank Lid	9-1
P-22	1909869	Vacuum Tee	5-2, 9-1
P-23	44-E511	Blower Belts	5-2, 10-1
P-24	16-1101	Lint Screen - Waste Tank	9-1
P-25	1909870	Blower Adjustment Brackets	10-1
P-26	3908505	Vacuum Hose Assembly	9-1
P-27	2909945	Silencer Assembly	5-3
P-28	1909863	Water Temperature Output Block	5-4, 7-1
P-29	4603104	Water Pump Belt	5-2, 5-3, 10-1



P-30	44-E514	Alternator Belt	5-3, 10-1
P-31	2910176	Alternator Belt Guard	5-3
P-32	16-2400	Vacuum Breaker	5-2, 9-1, 10-1
P-33	2909946	Exhaust Manifold	5-2
P-34	3951985	Pump Stand	10-1
P-35	1909778	Engine Assembly	5-2