1 Overview

Purpose

This chapter introduces you to the *StingRay Standard Turntable Power Washer*. Read it to gain a general understanding of your power washer *before* you attempt to install, operate, or maintain the washer.

Prerequisites

You will find it helpful to have read the introductory material, especially *"Welcome",* so that you understand how this manual is organized.

What You Will Learn In This Chapter

In this chapter you will learn about the following:

- Your new StingRay Parts Washer
- Materials and Components
- Theory of Operation
- Washer Inspection

1. Your New StingRay Parts Washer

Your new StingRay Parts Washer is an engineered state-of-the-art machine designed to exacting standards in order to give you the highest-quality cleaning. Your washer incorporates the many technological and engineering advances we have made at StingRay in our ongoing research-and-development program.

Read this section for a general understanding of the washer's purpose, usage, and manufacturing information. This section also shows you a diagram of the washer with principal parts labeled.

1.1. Getting Acquainted

StingRay Parts Washers are non-solvent-based cleaning systems. They are designed to clean parts in a wide range of industrial settings, for example, in the rebuilding of engines and brake systems, electric motors, and during manufacturing assembly.

All StingRay Parts Washers operate automatically. With reasonable care and maintenance, your washer will give you years of top-quality cleaning.

1.2. Major Components

The following figure shows the StingRay Standard Turntable Power Washer. The principal parts are labeled. Major features of the power washer are explained in the next several sections.

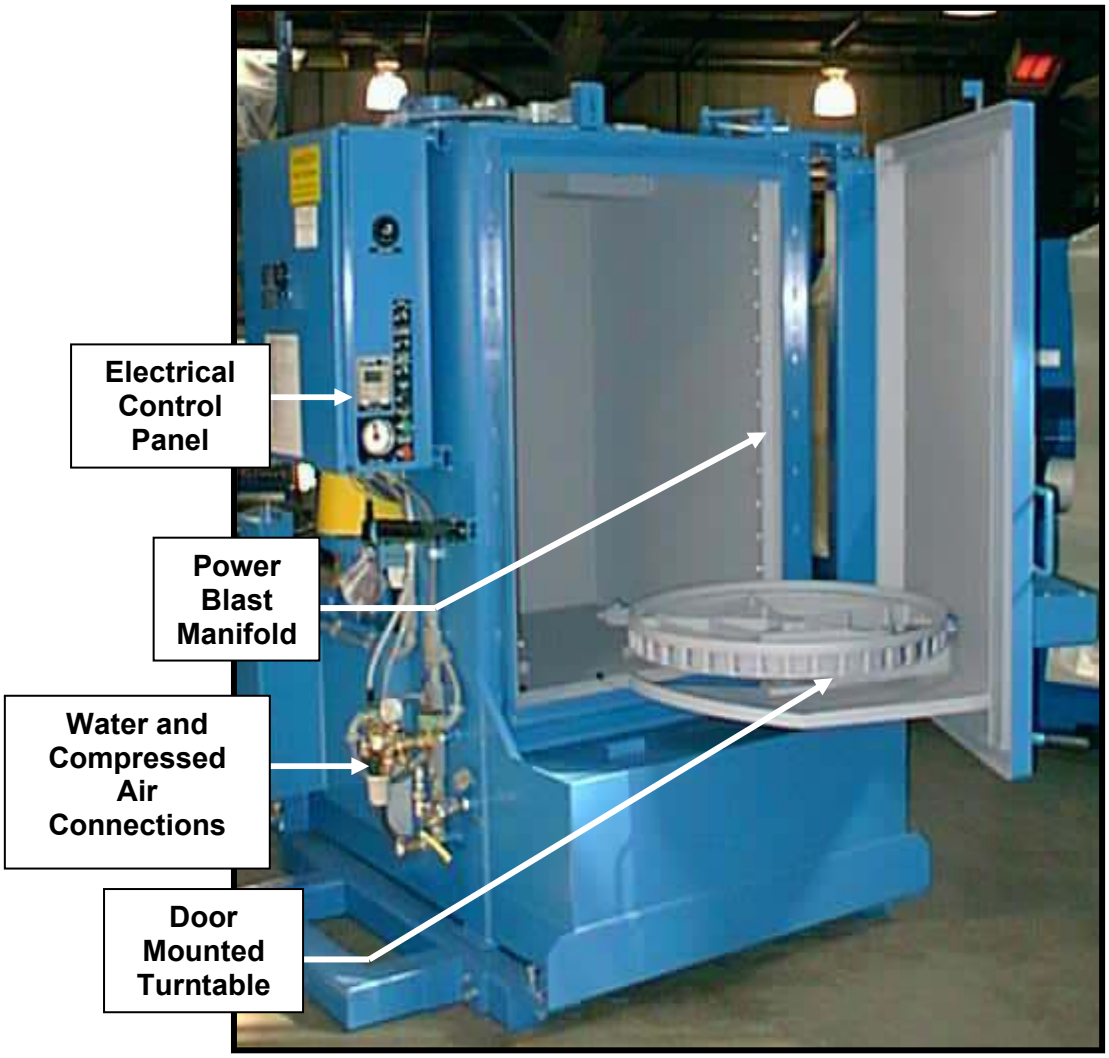


Fig. 1 - 1: Standard Turntable Power Washer, View 1

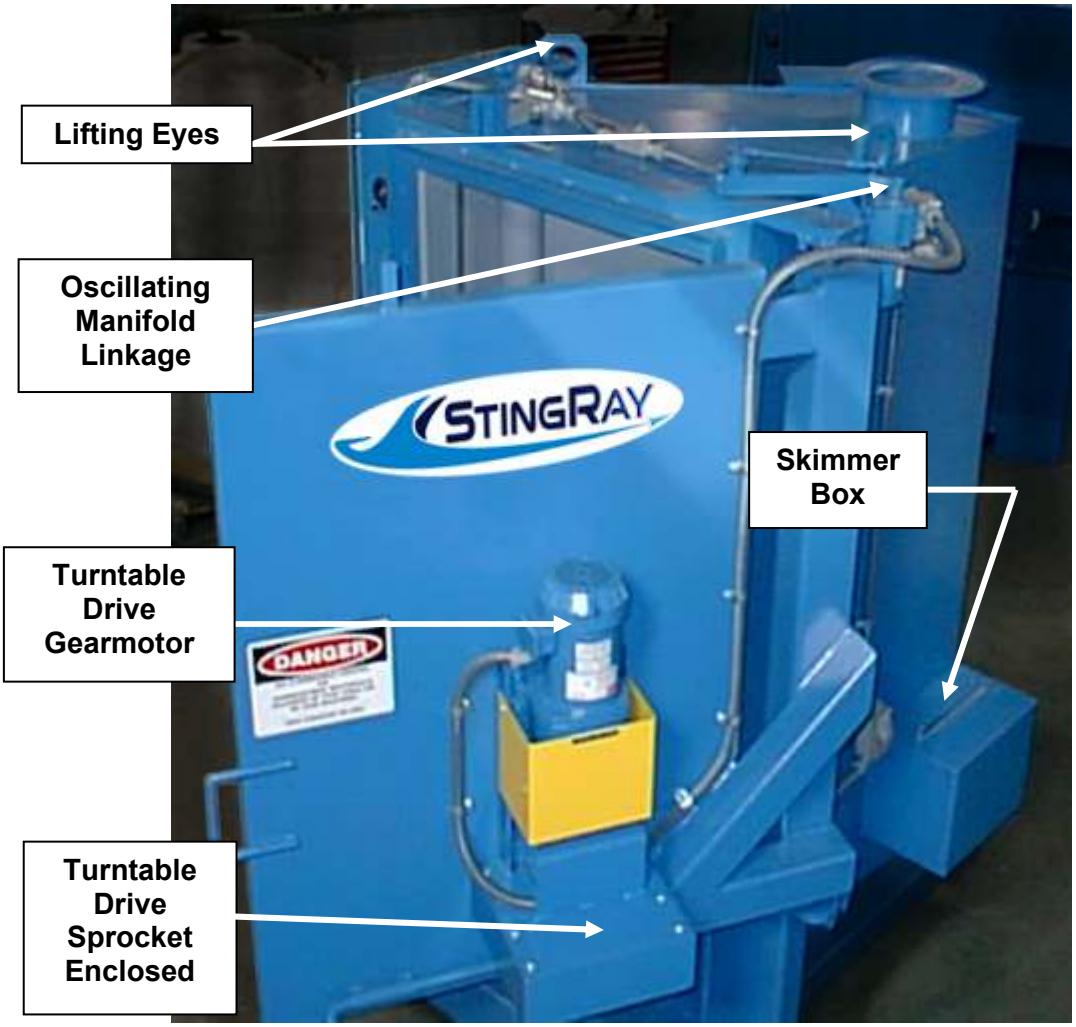


Fig. 1 - 2: Standard Turntable Power Washer, View 2

2. Materials, Components & Standards of Construction

All StingRay Parts Washers are American-made, using high quality, industrial-grade materials and components. The machine and control system is designed and built to meet the stringent standards of ANSI/NFPA-79 (American National Standards Institute/National Fire Protection Agency) electrical standards for industrial machinery.

2.1. Electrical Standards

All electrical components are UL approved.

Wiring is numbered and color-coded THHN 14-gauge minimum with thermoplastic insulation.

A power disconnect interlocked with the electrical-control-panel enclosure door is available on all StingRay power washers.

Nameplates identify each electrical device (*for example*, pump, turntable and skimmer motors; solenoid valves) outside the electrical control panel. All electrical devices (*for example*, timers, relays, motor starters) inside the electrical control panel are clearly labeled.

Separate temperature-compensated overloads are provided for each motor load. Each motor has a separate ground-wire pulled through a conduit and attached to the back panel of the electrical control panel to ensure a positive earth-ground without relying on the machine structure to supply the grounding path.

A transformer provides control power and allows for a single source of power to the machine.

All fusing is rated at 200,000 AMP interrupt capability.

All operator controls are oil-tight, providing reliable operation under the harshest environmental conditions.

2.2. Cabinet Construction

Cabinets are built of boilerplate sheet steel, with seams continuously MIG-welded for superior strength. Box tubing and angle have 1/4-inch-thick to 1-inch-thick (6mm - 25 mm) walls. All exterior surfaces are primed and coated with a two-part Polyamide-Epoxy.

3. Theory of Operation

StingRay defines the term *to clean* as *to overpower the soils*. The StingRay Parts Washer is a high-impact pressure, high-temperature, water-based cleaning system that uses a combination of the following factors to achieve cleaning results:

Power x Temperature x Chemical x Time = Clean

The relationship of these variables can be varied in an infinite number of ways to achieve the same level of cleanliness. Your own needs determine the relative value of each variable. Keep in mind that the StingRay Parts Washer provides one of the highest blasting powers in the cleaning industry, allowing you to reduce wash-cycle times to a minimum. Additionally, the high blasting power allows you to operate the washer at lower cleaning temperatures, thus saving energy and using less chemical than spray washers.

The *exact* combination of the factors must be determined for your application, based on the types of soils to be removed, the degree of cleanliness required, the cycle time required, the types of parts to be cleaned, and so on.

3.1. How the Power Washer Works

The power washer operates on a timed cycle. The operator places the parts to be cleaned in the washer on the turntable, closes and latches the door, and then starts the timed cleaning cycle.

During the cleaning cycle, a high-temperature, high-pressure, water-and-detergent cleaning solution blasts soils from the parts.

After the cycle has stopped and the steam has exhausted, the operator removes the cleaned parts.

The power washer utilizes closed loop, waste minimization technology, continuously reusing its cleaning solution and effectively reducing pollution potential. Because the washer is fully enclosed, it is safe for the operator, since the high-pressure, high-temperature spray is locked inside the cabinet.

In order to better understand how the four factors affect cleaning, let's look at each one more closely:

- ***Power***
- ***Temperature***
- ***Chemical***
- ***Time***

3.1.1. Power

The first key factor in the power washer's ability to clean is *power* -- the blasting power required to strip even the toughest soils from parts.

Pressure and Flow = Power

Power means the physical forces that remove the soils. The following formula expresses in horsepower (HP) the "cutting power" of the solution blasted from each nozzle tip:

HP = (GPM x PSI) / 1714

GPM (gallons per minute)	=	flow per nozzle
PSI (pounds per square inch)	=	pressure

In general, StingRay systems blast with four to 100 times more "cutting power", depending on pump size, than jet spray systems.

What really counts, however, is ***impact pressure*** -- the force of the spray at the target surface. It is impact pressure that most directly affects how quickly and effectively the soils are removed. The impact per square inch of a given nozzle depends on the following:

- **Flow and pressure produced by the pump**
- **Type of nozzle**
- **Spray pattern distribution**
- **Spray angle**

StingRay cleaning systems achieve an optimal balance of these factors to provide the highest impact pressure at the part surfaces.

Closed-Loop System and Grit-Blasting

The StingRay Parts Washer is a closed-loop system. This means that none of the washing or rinsing solution is discharged. Therefore, as soils are removed from parts, a patented feature reclaims the grit and blasts it back at the wash load to provide a vigorous scouring action, without any damage to parts. Thus, the grit becomes a valuable cleaning medium and actually acts to increase the impact pressure.

Note: **In applications where the wet grit blast is not desired, StingRay can provide fine filtration, including sub-micron filtration, to remove it.**

In terms of results, wet grit blasting means that the dirtier the power washer gets, the faster it cleans. This feature is desirable for most rebuilding applications and some manufacturing ones.

3.1.2. Temperature

As temperature increases, greases and oils become more fluid; in other words, their viscosity decreases. Since grease is the primary binder that holds and contains the soils on the parts, higher washing temperatures above 160° F (71° C) generally produce better cleaning results.

Secondly, chemical is more aggressive at higher temperatures. As a general rule, for every 10° F (-5.6° C) rise in temperature above 160° F, a chemical reaction doubles in speed.

3.1.3. Chemical

Chemical is the third key factor in overpowering soils and removing them from the surface of parts. While chemicals are necessary to enhance the cleaning process, your StingRay Parts Washer does not rely primarily on chemical concentration. This is because your StingRay sales technician worked with you to determine your cleaning needs, such as:

- Required degree of cleanliness
- Nature of the soils to be removed
- Pump size and performance requirements
- Size, shape, and surface of the parts to be cleaned
- Applications and usage of the power washer in your shop

Because your StingRay Parts Washer's configuration has been customized specifically to meet your requirements, the washer will successfully meet your cleaning standards when charged with a *light* chemical concentration, as compared to conventional washers. In general, this means that a 2-5% concentration by volume of a quality non-foaming chemical compound will give excellent cleaning results. However, like temperature and power, the exact type and amount of chemical are subjective and depend on your shop's needs.

Chemical cleaners fall into three general categories:

- **Organic solvents**
- **Emulsion cleaners**
- **Aqueous (water-based) alkaline cleaners**

StingRay systems use an aqueous (water-based) alkaline cleaner, not a solvent, so you don't have to deal with solvent vapors or hazardous-waste contaminants. Generally, the water-based alkaline cleaner is composed of water, an alkali source, a sequestrate, a surfactant package, and corrosion inhibitors.

A *sequestrate* is a binding agent that prevents undesirable chemical reactions, such as those that would form insoluble products like hard-water soap scum. The *surfactant* is a substance that lowers surface tension in order to penetrate and loosen soils. It coats oil droplets to prevent them from recombining. A *corrosion inhibitor* slows down the rate of chemical reaction that produces rust.

The water-based alkaline cleaner works by undercutting the soil, then "popping" it from the part surface. Light oils float to the solution surface, where they can be skimmed or filtered off. Heavier soils sink to the bottom and can be filtered or removed as sludge.

A key feature of this type of cleaner is that you only have to dispose of the *contaminants* as waste -- the washer can recycle the *liquid until the saturation point.* As the wash solution is used it will become increasingly more contaminated. At some point, the solution will become fully saturated and it will become necessary to change the wash solution and recharge the washer with new water and chemical.

Call StingRay Manufacturing for information on recycling technologies.

Removal of Soils

The water-based alkaline cleaner readily removes the following soils:

- Cutting oils
- Shop dirt
- Low-melt waxes
- Rust preventatives
- Finger prints
- Paint
- Cosmoline
- Varnish
- Grease
- Mill markings
- Diesel carbon
- Carbon dust
- Coolants
- Road soils
- Oil and chips

Applications

The water-based alkaline cleaner has many applications. It is successfully used, for example, in the following ways:

- Pre-clean
- Before teardown cleaning
- Before anodizing
- Before Re-assembly
- At the finishing process before packaging
- Before painting
- During in-process
- Before plating

Usage

When you work with a water-based alkaline cleaner, remember these points:

1. Most parts "flash"-dry within a minute or two after removal from the washing cabinet.

2. Parts that sit for some time before the next in-process operation are protected by a layer of corrosion inhibitor.

3. You can easily remove the layer of corrosion inhibitor by a water rinse. StingRay can provide an optional Auto Rinse Cycle (ARC) for your washer that will remove chemicals and oils with heated fresh water to "flash"-dry parts without rusting.

4. If you need to dry the parts quickly, StingRay can provide an air or heated drying phase.

5. All parts and materials washed in a StingRay Parts Washer are clean and generally paintable without further preparation.

6. In cleaning parts, you will have to periodically adjust the chemical concentration.

3.1.4. Time

Time lets power, temperature, and chemical do their work in overpowering soils and removing them from parts. If soils are heavy and built-up, for example, setting a longer wash-cycle time will clean the parts.

StingRay Parts Washer wash-cycle times are more efficient than those of conventional washers, due to the greater power of the system. This power comes from the following:

- StingRay pump technology, and

- StingRay oscillating Power Blast Manifold

3.1.5. General Information and Conclusion

This section, "*Theory of Operation*", has given you an overview of how the StingRay Parts Washer operates.

StingRay defines the term *to clean* as *to overpower the soils*. *Cleanliness* is proportional to the combination of the following factors:

- ***Power***
- ***Temperature***
- ***Chemical***
- ***Time***

The *exact* combination of these factors is variable and depends on your cleaning standards and operating requirements for the materials that you are cleaning. Since cleaning standards vary from shop to shop, through testing you can achieve an optimal balance of these four factors to meet your cleaning standards.

3.2. Operating Principles of Key Features

This section describes the key features of the standard turntable power washer and their operating principles. The features are presented in general functional order. As you read, you may wish to refer to Figs. 1-1 and 1-2.

3.2.1. Pumping System

The pumping system is the heart of the power washer. StingRay's inventive pump suction/discharge allows pumps to operate at blast pressures far higher than those of conventional power washers.

Pump Assembly: A flexible coupling joins the pump and electric-motor shafts. The pump is barrel-mounted and seal-less, without bearings or other metal-to-metal contact in the "wet end". The pump and the motor are mounted on a structural steel baseplate. Principal pump components are a casing, shaft, impeller, backhead or suction head, baseplate, discharge piping, bearing frame, and bearings.

Basic Pump Function: The pump draws solution through the 5/32-inch - diameter (4 mm) openings of the pump suction filter. The solution is drawn through the suction tube to the pump inlet. Finally, the solution leaves the pump under pressure and travels through piping to the Power Blast Manifold (PBM). The pump is capable of handling hot alkaline cleaners and can pass solids and grit up to 1/2-inch (13 mm) in diameter.

Pump Motor: Pump motors are industrial grade TEFC with a minimum 1.15 Service Factor, Class "F".

3.2.2. Power Blast Manifold (PBM)

After the cleaning solution leaves the pump, it travels through piping to the Power Blast Manifold (PBM), where it is distributed to the spray nozzles. U.S. Patent 4,741,351 protects the PBM's unique design.

PBM Assembly: The PBM is supported and rotates between the upper bearing at the cabinet roof and the (sealed) swivel joint near the cabinet floor. The *sealed swivel joint* affords the best connection between a *stationary* pipe and a *rotating* assembly because the joint allows high-pressure, high-temperature flow into the PBM assembly as it rotates on bearings. The swivel joint makes it possible to hard-connect steel pipe to steel pipe and still be able to rotate the assembly.

Nozzles: The opening diameter of the nozzles is larger than the 5/32-inch (4 mm) openings in the pump suction filter. Therefore, grit that will pass through the filter will also go through the manifold assembly and the nozzles. The result is that the entire system is virtually self-cleaning.

Basic PBM Function: The PBM pivots on its vertical axis, driven by a gear motor through a crank-and-arm linkage that produces a 46° angle of oscillation and return throughout the wash cycle. The sweep and speed of the PBM are not synchronized to the turntable, so the wash load is blasted from a different angle with each pass at the nozzles. The offset upper and lower PBM arms allow each nozzle to blast on its own plane without deflecting the blast from other nozzles in the manifold -- this ensures that virtually all the blasting force reaches the parts.

The rotating PBM offers several advantages over a fixed manifold. In terms of cleaning results, the most important advantage is that the non-synchronous rotation of the PBM relative to the turntable rotation blasts the wash loads from different angles with each turntable pass by the wash nozzles. The recesses and pockets that would be hidden to a fixed manifold are accessible to the oscillating PBM. This means cleaner parts.

Nozzles: Nozzle placement evenly distributes blasted solution throughout the wash cabinet: From the bottom up, across the cabinet, and from the top downward. This ensures that each portion of the wash load comes clean at about the same time in a single wash cycle.

3.2.3. Door-Mounted Turntable

The turntable is designed and engineered to the highest safety standards. It is capable of supporting loads from 1,700 lbs. (770 kg) to 40,000 lbs. (18140 kg), depending on power washer size.

Turntable Assembly: The turntable is mounted on the inside of the cabinet door on the turntable support arm. The turntable swings fully out of the cabinet when the operator opens the door. This allows easier loading, including the use of an overhead crane. The turntable uses the highest quality industrial bearings that, with scheduled greasing, should last the life of the power washer. During loading, the turntable may be rotated for easier placement of parts by pressing the "jog" button on the control panel.

Basic Turntable Function: During the wash cycle the turntable rotates at approximately 29 feet (8.9 m) per minute. The rotation is not synchronized to the sweep and speed of the PBM. The turntable is driven by the turntable drive system.

3.2.4. Turntable Drive System

This system rotates the turntable and controls its speed. It also serves as a clutch to allow table slippage, if a wash load shifts and jams the turntable.

Turntable Drive System Assembly: The drive motor assembly mounts onto a small box on the door of the cabinet. The assembly's key features are a gear motor, a slip-clutch shaft coupling, two flange mount bearings, the plastic drive sprocket, and a sprocket support plate. The slip clutch is located just below the drive motor and couples the motor shaft to the sprocket jackshaft. The sprocket is mounted on the end of the jackshaft.

Basic Turntable Drive System Function: The drive system uses a plastic drive sprocket to engage and drive the sprocket teeth on the turntable. If factory-preset torque is exceeded, the slip clutch functions as a torque limiter, and slips.

3.2.5. Automatic Steam Exhaust (ASE)

The automatic steam exhaust (ASE) system is designed to remove steam from the power washer cabinet *during* the wash cycle and the optional automatic rinse cycle (ARC); and for a timed period *after* the rinse cycle.

The ASE serves two purposes:

1. It reduces the amount of steam that leaks into the shop area during the wash cycle and when the door is opened.

2. It makes room for rinse water to be used as makeup water, when the ASE is used in conjunction with the optional ARC. (See "*Automatic Rinse System" (ARC)* section below).

Basic ASE Function: The ASE is a draft-induced system. A fan creates a nominal negative pressure inside the cabinet to pull steam out of the cabinet through the steam-exhaust piping. The nominal negative pressure ensures that minimum vapor and heat energy losses occur during power washer operation.

3.2.6. Automatic Rinse System (ARC)

The automatic rinse system (ARC) is a fresh-water rinsing system. It uses waterline pressure to rinse parts after the wash portion of a cleaning cycle. An optional chemical injector pump in the system provides for application of rust inhibitor during the rinse cycle. This chemical injector pump allows adjustment of the flow rate of chemical injected into the rinse water. The pressure regulator and gauge allows the operator to adjust the rinse spray characteristics of flow and pressure.

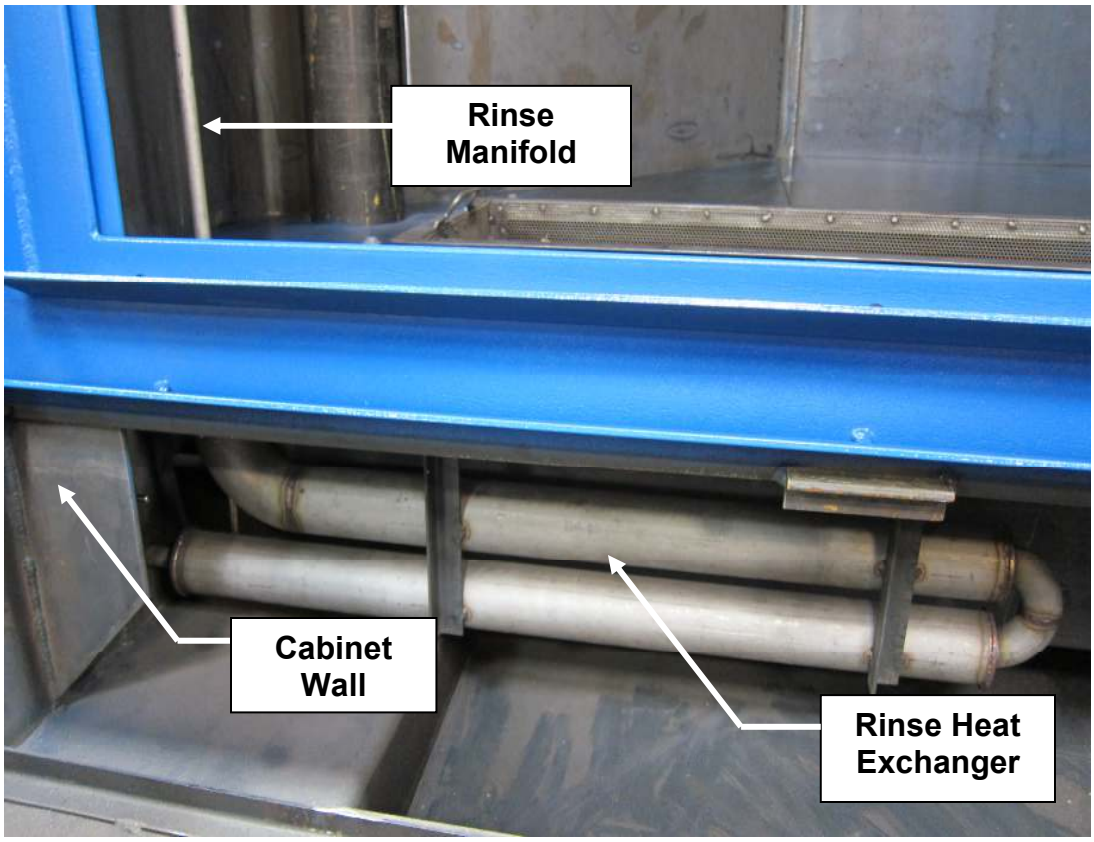


Fig. 1 - 3: Rinse System

All rinse-system components in the washer cabinet are made of stainless steel. External parts are made of corrosion-resistant materials.

Rinse time is controlled by two factors:

- The amount of water that can be made up, due to water loss through steam-exhaust evaporation or drag-out;

- or -

- The rinse timer inside the control panel.

In terms of rinse cycle time, water loss takes priority: The amount of required makeup water determines the maximum rinse time allowed.

Basic ARC Function: Rinse water is filtered and its pressure is regulated before it reaches the rinse solenoid valve. When a rinse cycle begins, the solenoid valve opens, allowing fresh water to enter the rinse system. As the water enters through the valve, the optional chemical injector pump pumps rust inhibitor into the rinse water. Next, the water is heated as it travels through a heat exchanger mounted in the wash-solution reservoir. From there the water flows into the fixed rinse manifold and sprays out through nozzles onto the parts.

Rinse water becomes makeup water, so no solution is discharged outside the cabinet. This also improves chemical management because all rinsed chemical remains in the reservoir.

3.2.7. Heating System

There are three types of heating systems available for the power washer:

- **Gas (natural gas or propane)**
- **Electric**
- **Steam**

First, let's look at general operating principles that apply to all the systems. Following that we'll take a closer look at principles specific to each system.

Note: **The discussions of heating-system operating principles assume that the 7-day clock is set to allow heating to occur.**

Basic Heating System Function: A thermocouple measures wash solution temperature. It is connected to the electronic temperature controller, which turns the heating device on or off, depending on the *set point*. (The temperature controller is located on the face of the control panel.)

Specific Systems

Gas Burner: The forced-air gas burner fires into an immersion-tube heat exchanger. Exhaust gases are removed through the flue pipe.

Electric: Immersion heating elements are threaded into couplings in the cabinet wall, suspending them in the solution. An electrical contactor in the control panel supplies power to the elements.

Steam: This type of system contains a control valve, a plate-coil heat exchanger, and a steam trap. When heat is required, the valve opens, and pressurized steam flows into the heat exchanger. Steam condensate is released from the heat exchanger through the steam trap.

3.2.8. Water-Level Control System

The float system supplies water-level information for the rinse, water-fill, and heating systems. The principal features of the system are:

- Additional available rinse water through the rinse bank.
- Low solution level detection that provides system protection for both the wash pumps and the heating system.
- High-level indication that can be used to initiate a maximum/overfill warning light or alarm.
- High-level shut-off of water fill.

Basic Solution-Level Control System Function: The float system is able to detect four water levels via two limit switches and a torpedo-shaped cam. A relay in the control panel is connected to each limit switch. With the various combinations of the ON and OFF positions of the two limit switches, the system is able to detect the following four water level conditions:

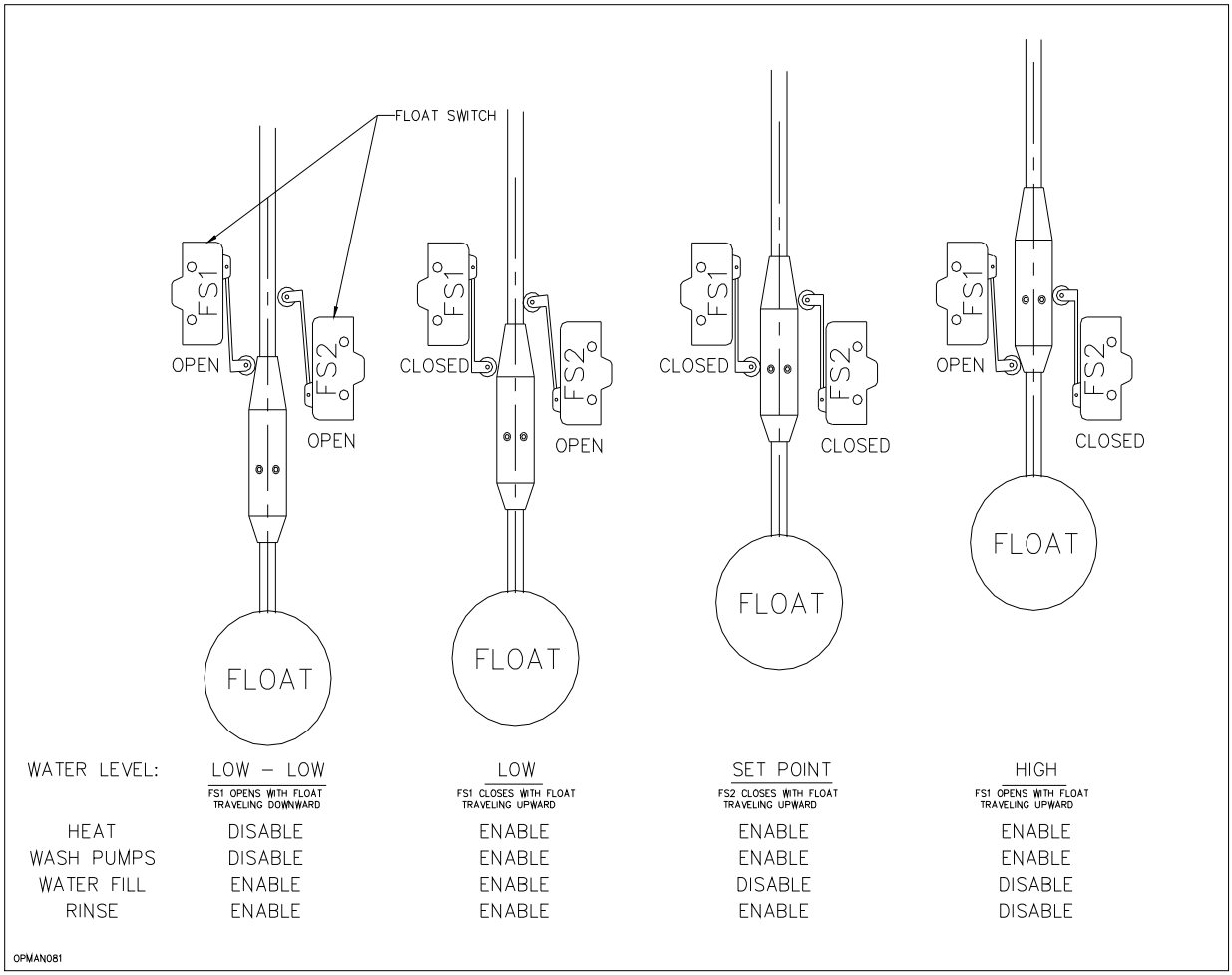
LOW-LOW: The wash pump and heating systems are disabled to prevent damage to these systems. When the water level is below LOW-LOW, neither the heating system nor the wash pumps will function. The water-fill valve will be open to provide water-fill.

LOW: This is the minimum safe operating condition. The heat exchanger should be fully submerged and the pump suction filter screen should be fully submerged. Once the water level reaches the LOW position, the heating system and the wash pumps will be enabled. The washer can operate at this condition. When the machine is not in a cleaning cycle (wash, rinse, hot-air blow-off, and ASE), the water-fill valve will open and fill the machine to the SET POINT.

SET POINT: This is the minimum water level when the machine is not in a cleaning cycle. The machine will automatically fill to this level. Reservoir volume between the SET POINT and HIGH is called the ***rinse-bank***.

HIGH: Whenever water level is above the HIGH level, the water-fill and rinse are disabled. This is the maximum water level possible for operation of the machine.

The following figure shows the four different levels detected by the float system and the positions of the two limit switches at each level. Below each diagram is a table that shows which systems are enabled or disabled at each level.



WATER LEVEL:	LOW – LOW (FS1 OPENS WITH FLOAT TRAVELING DOWNWARD)	LOW (FS1 CLOSES WITH FLOAT TRAVELING UPWARD)	SET POINT (FS2 CLOSES WITH FLOAT TRAVELING UPWARD)	HIGH (FS1 OPENS WITH FLOAT TRAVELING UPWARD)
HEAT	DISABLE	ENABLE	ENABLE	ENABLE
WASH PUMPS	DISABLE	ENABLE	ENABLE	ENABLE
WATER FILL	ENABLE	ENABLE	DISABLE	DISABLE
RINSE	ENABLE	ENABLE	ENABLE	DISABLE

Fig. 1 - 4: Float-Level Mechanics

The ***rinse-bank*** is the amount of space available in the reservoir for additional rinse water. Since the water-fill system only fills to the SET POINT, the ***rinse-bank*** allows accumulation of available rinse volume during:

- Wash cycles
- *Between* wash cycles
- Parts loading *and* unloading
- Heat-up
- Overnight

This allows longer rinses than would be possible with a simple single set-point/water-fill and rinse system:

- With the single set-point system, only water evaporated or discharged from the machine cabinet during a cleaning cycle makes room for rinse water.

- With the rinse-bank system, by contrast, any time water is evaporated or removed (via drag-off) it increases the ***rinse-bank***. This water permits *longer* rinse cycles and is available for *added* rinse time.

The following figure shows the water level dimensional differences between each water-level position detected by the float system *(Low-Low*, *Low, Set-point, High)*.

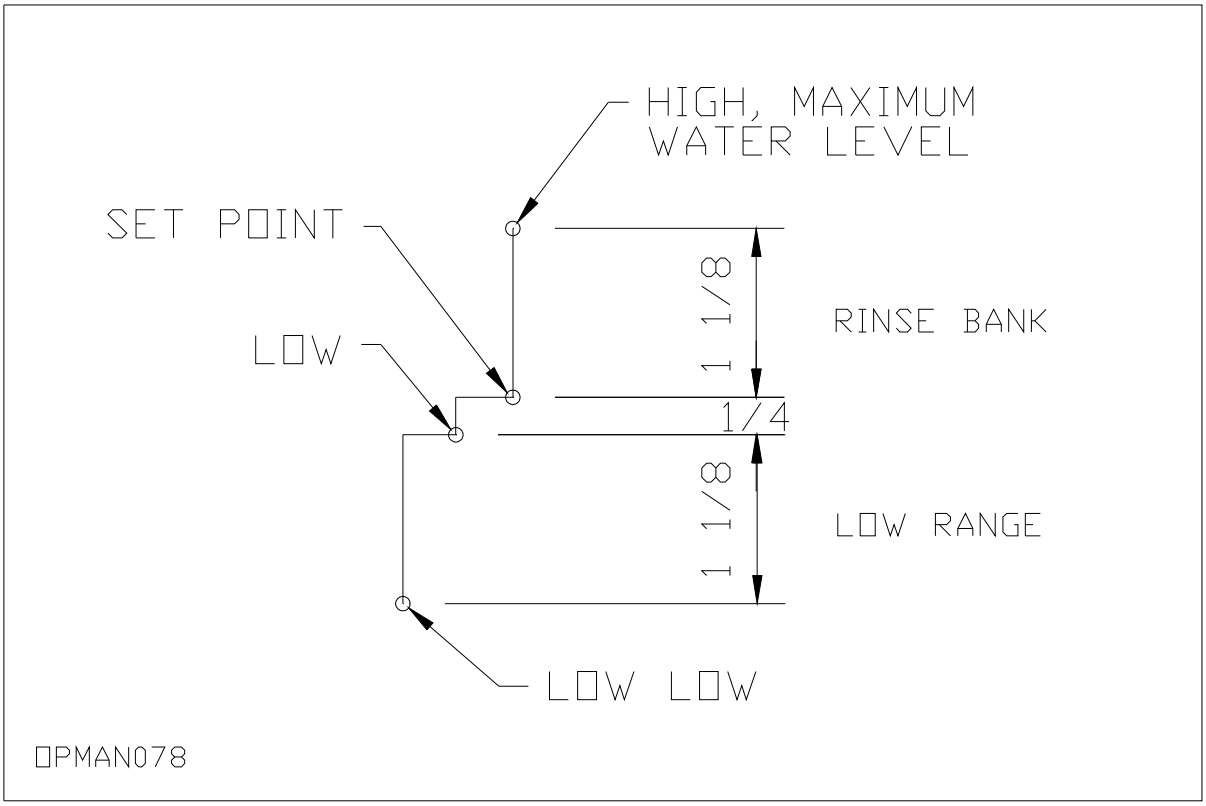


Fig. 1 - 5: Water Level Differences at Four Positions

3.2.9. Power Washer Control System

This section discusses the power-washer control system and sequence of operation when powered up for a wash cycle. Operator controls are located on

the outside of the (electrical) control panel to the left side of the door. Major system controls are housed inside the electrical panel. A number of system features are logically interdependent in order to help ensure safe operation of the washer.

This section is divided into the following parts:

- Operator controls
- Major components
- Sequence of washer operation
- Interdependent system features
- Electrical schematics

See chapters on "*Installation"* and *"Advanced Operations: Process-Control"* for more detailed information on using the control system.

Operator Controls

The operator uses these controls in day-to-day wash-cycle operations. They are located on the outside of the (electrical) control panel to the left side of the door, and include:

Hour Meter	Monitor the total number of hours of washer cycle time for scheduled maintenance procedures from *start* to the *end* of cycle.
Rinse off/auto	Set the rinse switch to *AUTO* to enable the rinse cycle; OFF bypasses the rinse cycle.
7-Day Dual-Circuit Clock	Program *circuit #1* to control heat-up days and start/stop times for heat and water-fill; program *circuit #2* to control the "auto" runtime for the optional Clean Machine or Oil Skimmer.
Wash Cycle Timer	Set 0-30 minute wash cycle, resets after each wash cycle
7 Day Clock	Select *BYPASS* to override the 7-day clock. Select *ON* to enable the 7-day clock control.
Turntable Jog	Press the *TURNTABLE JOG* button to rotate the turntable for easier loading/unloading.
Start (Run Light)	Press the *START* button to begin the wash cycle. The green run light illuminates indicating cycle running.

***Note**:* The start circuit is interlocked with the door closed limit switch. The opening and closing of the washer door resets the start circuit.

Stop/*Reset* Press the *STOP* button to stop washer operations (heat source and water-fill functions are not affected). The green “Run Light” extinguishes indicating cycle terminated.

> ***NOTE:*** If you have purchased any options, such as Oil Skimmer or Conductivity Controller, their operator controls will appear on the control panel, if applicable. Refer to chapter *"Options"* for more information.

> ***NOTE:*** If you specified any custom features, your control panel may differ slightly from the standard panel.

For more detailed information on operator controls and their usage, refer to chapter *"Basic Operations".* For more information on installing, operating, and maintaining options, refer to chapter *"Options".*

Major Components

The power washer is delivered with a factory pre-wired control transformer. It automatically reduces line voltage to single-phase 120 Volt AC control voltage.

Controls inside the electrical control panel are used to set up basic washer operating logic. These controls include:

- Timers and relays that control the cycle logic such as Rinse and ASE cycle time.
- 7-day clock
  A programmable device that allows the operator to preset the days of the week and time of day for the washer to heat up. The clock also allows the operator to set the days of the week and time of day when the washer is in normal "shut-down" mode. In conjunction with "shut-down" mode settings, the operator can, for example, set the controls to begin automatic operation of skimmers and the optional Clean Machine, based on clock "end-of-day."
- Motor starters with overloads
- Fusing

Sequence of Washer Operation

The operator initiates a cycle by closing and latching the door and depressing the start button. The wash cycle begins and the following sequence of operation occurs automatically. The Automatic Pressure Equalization (APE) process is the first step insuring washer start-up without water hammer. Water hammer results from the rapid expansion of the air inside the washer cabinet that is heated from ambient to wash temperature from the solution blasting from the wash manifold.

APE/Wash-Delay *Single Pump-* 20 HP, 30HP & 40HP pumps are started via a motor Softstarter. This AC electrical device reduces the electric current surge of the motor during power up ramping the motor speed from zero to full speed over a 10 second time period. The gradual speed increase prevents water hammer.

Or

Duplex Pumps only: The booster pump starts first and pre-heats the air in the cabinet for 10 seconds to 60 seconds, depending on the wash-delay timer setting. Then the timer activates the main wash-pump power-up circuit. Never set the timer to less than 10 seconds.

Wash Pump The main wash pump motor *starter* engages, activating the main wash pump motor. The power blast manifold (PBM), the turntable drive motor and the auto steam exhaust (ASE) blower motor also start. This begins the wash cycle. When the 0 to 30-minute wash cycle timer times out, the wash pump starter and power blast manifold (PBM) stop operating. This ends the wash cycle.

Rinse System *(optional)* The rinse solenoid opens, and the auto rinse cycle (ARC) begins. When the ARC timer times out, the rinse cycle has finished.

ASE Blower Motor After the rinse cycle finishes, the auto steam exhaust (ASE) blower motor continues, until the ASE timer times out, ending the ASE cycle. The turntable drive motor stops and the cycle is complete.

Interdependent System Features

Some washer system features are linked to others, in terms of control logic. Here is a list of principal interdependent features:

Door-Limit Safety Switch: The loading door must be shut before the wash cycle can begin.

Door-Limit Safety Switch verification: The door limit switch is interlocked with the start circuit, which verifies the proper operation of this switch. Opening and closing the wash door resets the start circuit allowing a wash cycle to begin.

Water and Heating System: The heating system functions *only* if there is sufficient water in the washer to activate the circuit. See *"Water-Level Control System"* section above.

Makeup Water and Rinse System: The rinse system functions *only* when there is a need for makeup water or when the ***rinse-bank*** is low. See sections *"Water-Level Control System"* and *"Automatic Rinse System (ARC)" above*.

7-Day Clock and Heating System: The 7-day clock controls daily heating periods, *unless* the operator uses the clock-override switch to bypass the 7-day clock.

Wash Pumps and Start-Up System (APE): Air in the cabinet is pre-heated in order to prevent rapid expansion (water hammer) when the wash pump starts. How this works depends on whether you have a single-pump or a duplex-pump system.

Single-Pump System: All 20-, 30-, and 40-horse power systems – use an AC electrical soft-starter. The soft-starter continuously controls the three-phase motor's voltage supply during the power-up phase to gradually accelerate the pump motor from zero RPM to full speed over 10 seconds to prevent water hammer.

Duplex-Pump System: The booster pump starts first and pre-heats the air for 10 seconds to 60 seconds, depending on your wash delay timer setting. Then the timer initiates the main wash-pump power-up.

WARNING! Do not disable the APE (automatic pressure equalization) wash-delay timer! -- Water hammer could occur, resulting in severe damage or injury! The wash-delay timer should never be set to less than 10 seconds.

Electrical Schematics

Provided Electrical Schematics show the ladder logic diagram of the washer operation, the wire numbers and color codes. The provided electrical layout diagram shows the location of all electrical components in the electrical enclosure. Please refer to the electrical schematics provided with your washer.

4. Washer Inspection

When you receive your new StingRay Parts Washer, inspect it for freight damage –

Do this before installation!

Here are some tips:

Inspect:		***For:***
Entire cabinet, including the top	➔	*dents or scrapes*
Electrical wire conduits	➔	*breakage*
Cabinet door	➔	*dents or scrapes; Misalignment*
Water hoses and pipes	➔	*breaks or cracks*
Solenoid valves	➔	*breakage*
Electrical control panel door	➔	*dents and scrapes*
Motors	➔	*damage*
Pump frame	➔	*cracked; loose bolts*
External gauges	➔	*damage*

Fig. 1 - 6: Washer Inspection before Installation

Record any damage
on the bill of lading.
Report any damage to StingRay.