TENNANT

432

Operator Manual

MM155

This manual is furnished with each new TENNANT® Model 432. It provides necessary operating and preventive maintenance instructions. Read this manual completely and understand the machine before operating or servicing it.

This manual covers all machine variations and standard accessories. The instruction portion of the manual consists of the Specification, Operation, Maintenance, and Appendix sections. The parts portion consists of the Standard Model Parts, Accessories, Electrical Components, and Customer Documents sections.

All right side and left side references to the machine are determined by facing the direction of forward travel. All hardware considered to be of a common nature or locally available has been omitted from the parts sections. Be aware that this machine may contain metric hardware. Make sure you use equivalent hardware when replacement becomes necessary.

This machine will provide excellent service. However, the best results will be obtained at minimum costs if:

- The machine is operated with reasonable care.
- The machine is maintained regularly – per the maintenance instructions provided.
- The machine is maintained with Tennant Company supplied or equivalent parts.

Parts and supplies may be ordered by phone or mail from any Tennant Company parts and service center, distributor, or from any of the Tennant Company subsidiaries. Before ordering parts or supplies, be sure to have your machine model number and serial number handy. Fill out the data block below for future reference. The telephone numbers, telex numbers, mailing addresses, and locations of those outlets are listed in the Customer Documents section of the manual.

MACHINE DATA

Please fill out at time of installation.

Machine Serial Number – _____

Engine Serial Number – _____

Sales Representative – _____

Customer Number – _____

Date of Installation – _____

Manual Number – MM155

Revision: 07

Published: 10–88

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SAFETY PRECAUTIONS

The following symbols are used throughout this manual as indicated in their descriptions:

DANGER: To warn of immediate hazards which will result in severe personal injury or death.

WARNING: To warn of hazards or unsafe practices which could result in severe personal injury or death.

CAUTION: To warn of hazards or unsafe practices which could result in minor personal injury.

ATTENTION! To warn of unsafe practices which could result in extensive equipment damage.

NOTE: To give important information or to warn of unsafe practices which could result in equipment damage.

The following information signals potentially dangerous conditions to the operator or equipment. Read this manual carefully. Know when these conditions can exist. Locate all safety devices on the machine. Then, take necessary steps to train the machine operating personnel. Report machine damage or faulty operation immediately.

WARNING: Do not operate the machine until you have read and understood the operating instructions and are properly trained. Failure to do so could result in severe personal injury

WARNING: Keep cigarettes, sparks, and open flame away from lead acid batteries. Batteries emit highly explosive hydrogen gas that can be ignited by fire or electrical arcing.

CAUTION: Always disconnect batteries-to-machine connector before working on machine electrical components to prevent electrical shock.

WARNING: Avoid moving parts of the unit. Do not wear loose jackets, shirts or sleeves when working on machine because of the danger of becoming caught in moving parts. Make sure all nuts and bolts are secure. Keep shields and guards in position. If adjustments must be made while the unit is running, use extreme caution around moving parts.

NOTE: When spraying the machine off with water spray, avoid the instrument panel area.

WARNING: Do not use flammable or combustible cleaning agents when scrubbing. They can burn or explode and cause serious injury.

CAUTION: Always place the master power switch in the "off" position before working on the machine to prevent machine from creeping or electrical shock.

WARNING: Keep the machine cover open when charging batteries to prevent the build up of explosive hydrogen gas that can be ignited by fire or electrical arcing.

WARNING: Avoid contact with battery acid. Battery acid can cause severe burns. Wash immediately and get medical attention if contact with battery acid occurs.

WARNING: Do not operate machine in flammable or explosive environment. Machine is not designed for such an environment. It could cause ignition of flammable or explosive materials.

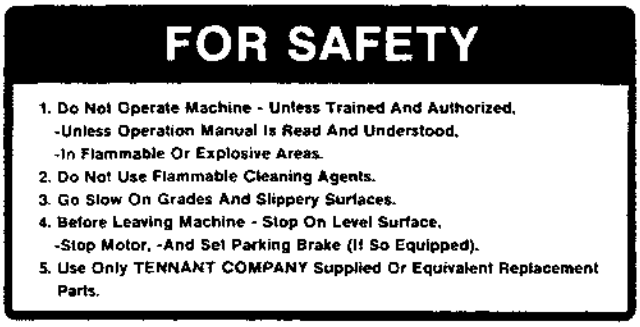
WARNING: Do not operate the machine with a full solution tank on grades steeper than 5°, the maximum rated ramp angle. Operating the machine on steeper grades may cause the machine to become unstable.

WARNING: Always travel slowly on grades to prevent machine instability. Do not exceed maximum rated ramp climb and descent angles.

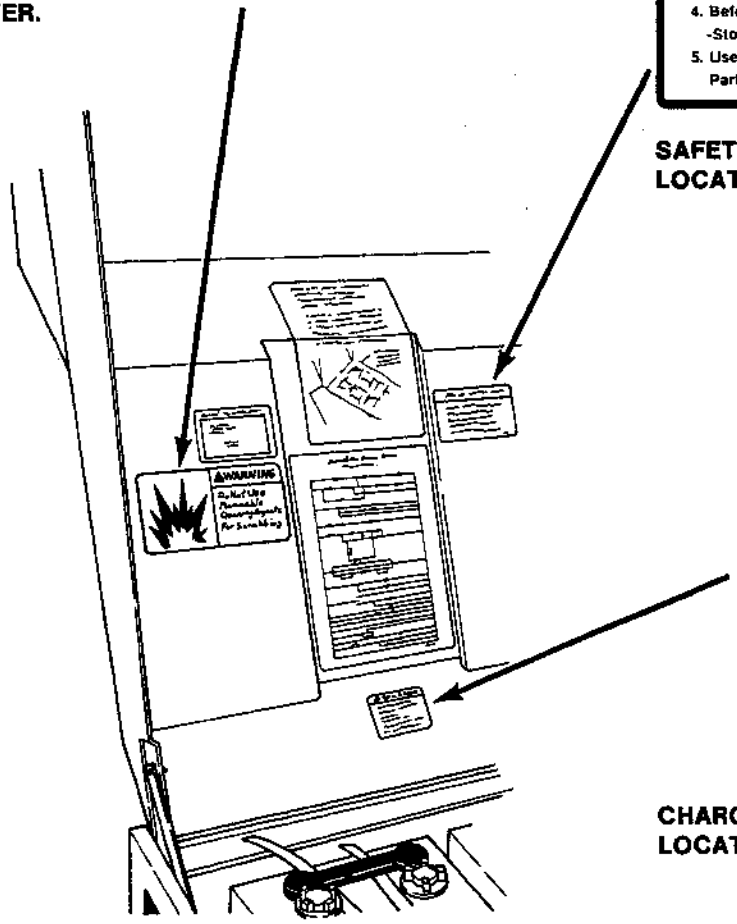
WARNING: Always follow safety and traffic rules of the area in which the machine is being operated to prevent serious injury.

The following safety decals are mounted on the machine in the locations indicated. If these, or any, decal becomes damaged or illegible, install a new decal in its place.

CLEANING AGENTS DECAL (TENNANT® PART NO. 63963) LOCATED ON THE INSIDE OF THE MACHINE COVER.



SAFETY DECAL (TENNANT® PART NO. 32784) LOCATED ON THE INSIDE OF THE MACHINE COVER.



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CHARGING DECAL (TENNANT® PART NO. 32514) LOCATED ON THE INSIDE OF THE MACHINE COVER.

GENERAL INFORMATION

CONTENTS

CONTENTS

SECTION 1
SPECIFICATIONS

CONTENTS

MACHINE SPECIFICATIONS

MODEL 432 POWER SCRUBBER

POWER TYPE

Electric propelling motor-
nominal voltage 36 VDC
0.45 hp (0.34 kw) @ 320 rpm, 7 A

Scrub brush drive motor,
standard-nominal voltage 36 VDC
0.45 hp (0.34 kw) @ 360 rpm, 8 A
heavy duty-nominal voltage 36 VDC
0.75 hp (0.56 kw) @ 360 rpm, 8 A

Vacuum fan drive motor,
standard-nominal voltage 36 VDC
0.75 hp (0.56 kw) @ 13,000 rpm, 11 A
heavy duty-nominal voltage 36 VDC
1.25 hp (0.93 kw) @ 10,500 rpm, 26 A

Batteries,
standard (6)-6 V, 220 A/h @ 20 hour rate
heavy duty (6)-6 V, 305 A/h @ 20 hour rate
battery charger-36 VDC 23 A, 120 VAC input

POWER TRAIN

Propelling - clutch, mechanical slip
Drive axle (2) - chain driven
Scrub brush (2) - direct drive
Vacuum fan - direct drive

STEERING

Type - individually clutch driven front wheels (2)

SUSPENSION SYSTEM

Front (2) - 4.10/3.50 x 5 tube-type tires
Rear (2) - 5 in (125 mm) diameter wheel casters

GENERAL MACHINE DIMENSIONS - CAPACITIES

Length - 61.75 in (1570 mm)
Length - 72 in (1830 mm) w/Pre-Sweep
Width - 37.60 in (955 mm)
Height - 43.25 in (1100 mm)
Track, front - 19.75 in (500 mm)
rear - 17.39 in (440 mm)
Wheel base - 16 in (405 mm)
Scrub brush (2) diameter - 16.5 in (420 mm)
Scrub path width (total) - 32 in (815 mm)
Rear squeegee path width - 37.5 in (955 mm)
Solution tank capacity - 26.5 gal (100 L)
Recovery tank capacity - 29.5 gal (110 L)

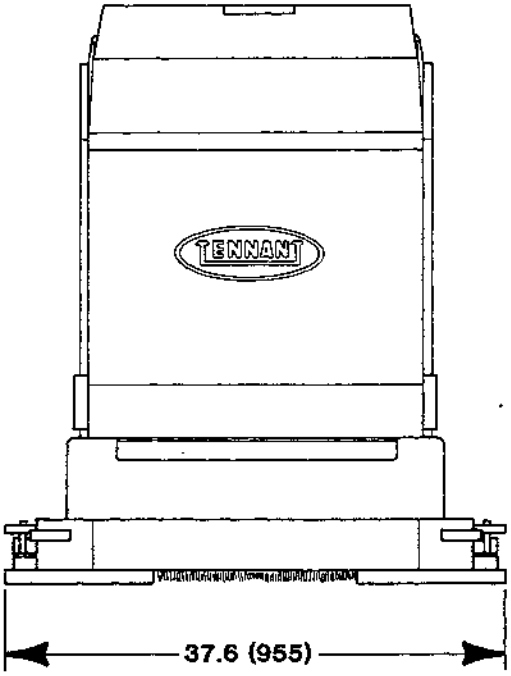
MACHINE WEIGHT

Net weight - 985 lb (445 kg)
GVWR - 1550 lb (705 kg)

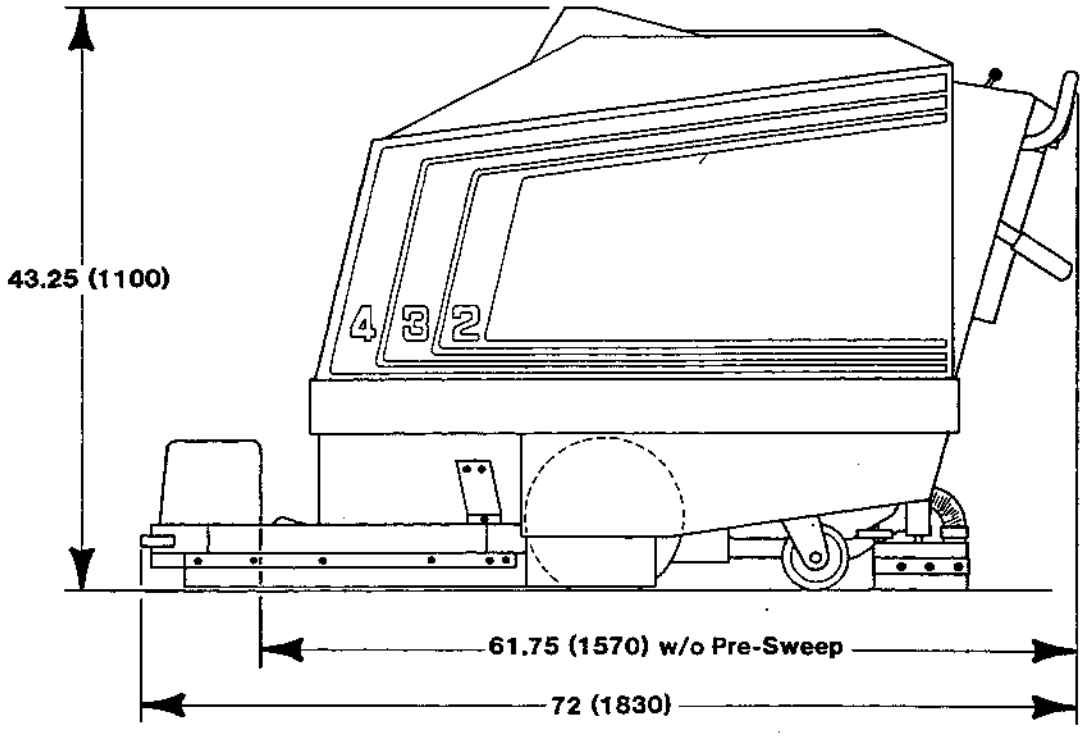
GENERAL MACHINE PERFORMANCE

Maximum forward speed - 2.4 mph (3.8 km/h)
Turning radius - 35 in (890 mm)
Turning radius - 44 in (1120 mm) w/Pre-Sweep

MACHINE DIMENSIONS



FRONT VIEW



SIDE VIEW

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NOTE: The first number is in inches; the second number in parenthesis is in millimeters.

SECTION 2
OPERATION

CONTENTS

PREPARATION FOR OPERATION

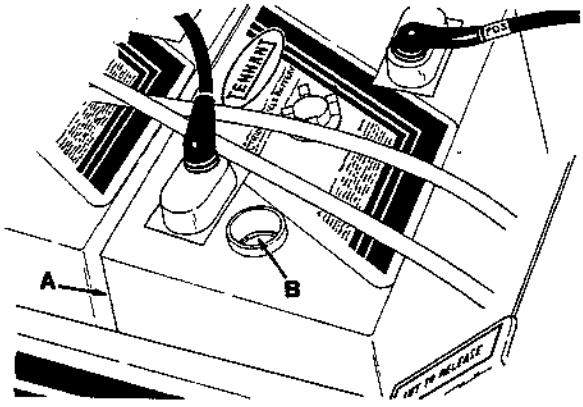
1. Uncrate the machine as described in the Model 432 Uncrating Instructions leaflet attached to the machine.
2. Check the machine for shipping damage. Report any damage to the carrier at once.

NOTE: Some parts may have been shipped loose inside of the solution tank.

3. Read and understand this manual before operating the machine.

⚠ WARNING: Do not operate the machine until you have read and understood the operating instructions and are properly trained. Failure to do so could result in severe personal injury.

4. Open the machine cover.
5. Check the batteries. If they are of the wet-type, check the electrolyte level as described in Batteries. If they are of the dry-type, activate them as described in Activating Dry-Type Batteries in the Maintenance section.



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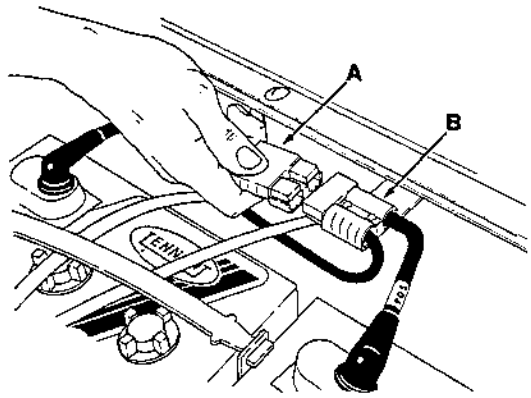
CHECKING BATTERY ELECTROLYTE LEVEL

A. Battery
B. Electrolyte Indicator Ring

⚠ WARNING: Avoid contact with battery acid. Battery acid can cause severe burns. Wash immediately and get medical attention if contact with battery acid occurs.

6. Check the battery specific gravity to determine the state of charge as described in Batteries in the Maintenance section. Charge the batteries if necessary.
7. Install the scrub brushes as described in Scrub Brushes in the Maintenance section.
8. Pre-Sweep machines: Adjust Pre-Sweep hopper as described in To Mount Pre-Sweep in the Operation section.
9. Connect the batteries-to-machine connector.



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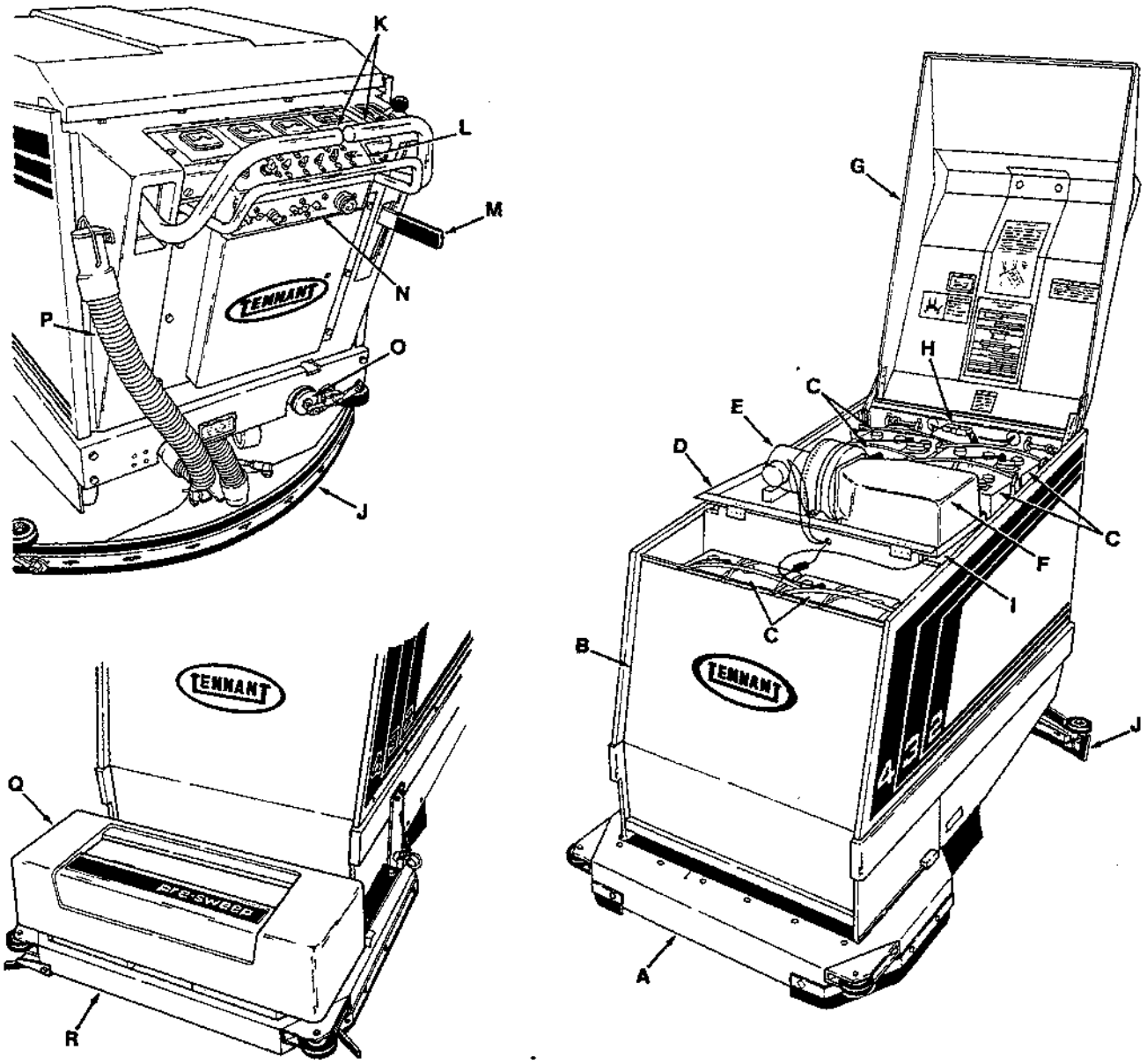
CONNECTING BATTERIES-TO-MACHINE CONNECTOR

A. Machine Connector
B. Batteries Connector

10. Drive the machine to the machine filling area.
11. Operate the machine as described in Machine Operation in the Operation section.

OPERATION OF CONTROLS



MACHINE COMPONENTS

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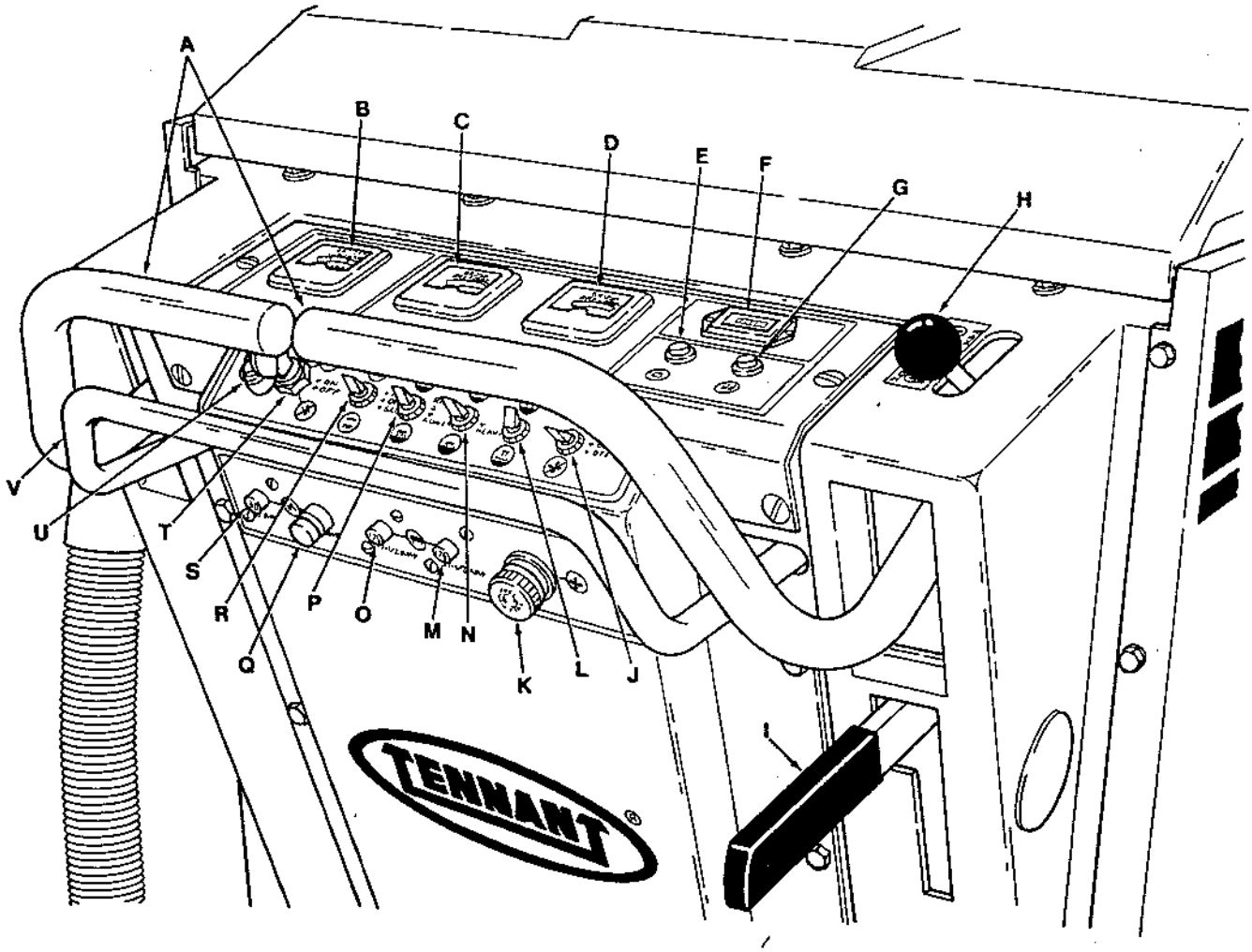
A. Scrub Head Cover
B. Front Access Panel
C. Battery
D. Solution Tank
E. Vacuum Fan
F. Vacuum Fan Housing
G. Machine Cover
H. Batteries-to-Machine Connector
I. Recovery Tank
J. Squeegee Assembly
K. Steering Control Handle
L. Instrument Panel
M. Parking Brake Lever
N. Fuse Panel
O. Solution Tank Drain
P. Recovery Tank Drain Hose
Q. Pre-Sweep Hopper
R. Pre-Sweep Frame



CONTROLS AND INSTRUMENTS

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A. Steering Control Handle
B. Battery Condition Gauge
C. Left Brush Pressure Gauge
D. Right Brush Pressure Gauge
E. ES® System Lamp
F. Hour Meter
G. Recovery Tank Full Lamp
H. Solution Control Lever
I. Parking Brake Lever
J. Vacuum Fan Switch
K. Vacuum Fan Fuse
L. Squeegee Control Switch
M. Right Brush Circuit Breaker
N. Heavy Brush Pressure Switch
O. Left Brush Circuit Breaker
P. Scrub Head Position Switch
Q. Master Power Fuse
R. Brush Speed Switch
S. Master Power Circuit Breaker
T. Master Power Switch
U. Master Power Indicator Lamp
V. Stationary Handle

STEERING CONTROL AND STATIONARY HANDLES

The steering control handles operate linkages which control the wheel drive clutches.

The clutches propel and turn the machine. The stationary handle is used to help control the steering control handles.

To move the machine straight forward, evenly press both steering control handles until the desired speed is achieved.

To stop the machine, release the steering control handles.

To turn the machine, press the control handle opposite the direction of the turn. Press the left control handle to turn right. Press the right control handle to turn left.

If the machine is moving and a turn is to be made, release pressure on the control handle on the same side as the direction of the turn.

To move the machine backward, raise both control handles. Do not travel backward for too long a distance as steering in reverse is not possible. If only one control handle is raised, the machine will stop.

BATTERY CONDITION GAUGE

The battery condition gauge indicates the present state of charge of the batteries. The gauge needle should be in the white zone of the gauge movement when the batteries are fully charged. As the batteries discharge, the gauge needle will move into the green zone and then into the red zone. The batteries should be recharged when the gauge needle enters the red zone.

NOTE: Do not charge the batteries more often than is necessary to prolong the life of the batteries. Do not allow the batteries to become fully discharged as this will also damage the batteries. See Batteries in the Maintenance section.

BRUSH PRESSURE GAUGES

The left brush pressure gauge indicates how hard the left brush drive motor is working. The right brush pressure gauge indicates how hard the right brush drive motor is working.

Under normal operating conditions, the brush pressure gauge needles should be in the white zone of the gauge movements.

Under harsh operating conditions, the brush pressure gauge needle will be in the red zone of the gauge movement, indicating excessive brush pressure. Excessive brush pressure will cause the brush drive circuit breaker to trip. If the brush drive circuit breaker trips or the brush pressure meter needle is in the red zone of the meter movement, lighten the brush down pressure by raising the scrub head.

ES® SYSTEM LAMP

The ES® system lamp is present on machines equipped with the ES® accessory. The lamp lights whenever the solution control handle has been placed in the "ES®" position, operating the solution recycling system.

HOUR METER

The hour meter records the number of hours the machine has been operated. This information is useful in determining when to service the machine.

RECOVERY TANK FULL LAMP

The recovery tank full lamp lights a short time before the recovery tank is full. This gives the machine operator an indication that the tank will soon be full, so the operator can plan to return to a dumping location.

SOLUTION CONTROL LEVER

The solution control lever operates a solution control valve, which controls the flow of solution to the surface being cleaned. The solution flow rate is variable. To start solution flow, push the control lever forward slightly into the "on" position. To increase solution flow to maximum, push the lever forward all of the way. On ES® machines, the extreme forward lever position, the "ES®" position, starts the solution recycling system and lights the ES® system lamp. To stop solution flow, pull the control lever back into the "off" position.

PARKING BRAKE LEVER

The parking brake lever is present on machines with the parking brake accessory. It is located on the left rear of the machine. The parking brake lever operates a brake cable which controls the disc brake caliper on each of the wheel drive sprockets.

To engage the parking brake, lift the lever up and to the left. To disengage the parking brake, lift the lever up, to the right, and lower the lever.

Always engage the parking brake when parking the machine or leaving the machine unattended.

VACUUM FAN SWITCH

The vacuum fan switch controls the vacuum fan. To start the vacuum fan, flip the switch toggle all of the way forward to the "on" position. To stop the vacuum fan, flip the switch toggle backward to the "off" position.

The vacuum fan may be operated with or without the master power switch in the "on" position. This allows the vacuum wand accessory to be used without operating the entire machine.

SQUEEGEE CONTROL SWITCH

The squeegee control switch operates an electric relay that controls an electric motor which raises and lowers the rear squeegee.

To raise the rear squeegee, flip the switch toggle forward to the "raise" position. To lower the rear squeegee, flip the switch toggle backward to the "lower" position. The squeegee will not lower until the steering control handles have been pressed to propel the machine forward.

The rear squeegee will automatically rise when the steering control handles are pulled up to the stop or propel the machine in reverse. The rear squeegee will then return to the "lower" position when the steering control handles are pressed down.

Always place the rear squeegee in the "raised" position when traveling to a scrubbing site and when parking the machine for any length of time.

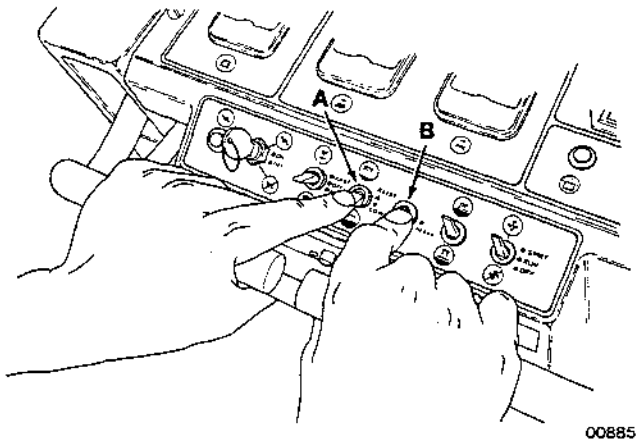
HEAVY SCRUB BRUSH PRESSURE SWITCH

The heavy scrub brush pressure switch allows the machine operator to apply extra heavy scrub brush pressure on compacted dirt and debris.

The switch controls the scrub head actuator, which, in conjunction with the scrub head position switch, determines the height of the scrub head and controls scrub brush pressure.

To apply extra heavy brush pressure, hold the heavy scrub brush pressure switch toggle and the scrub head position switch toggle back.

NOTE: Prolonged use of heavy scrub brush pressure may trip the brush circuit breakers.



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ENGAGING HEAVY SCRUB BRUSH PRESSURE

A. Scrub Head Position Switch
B. Heavy Scrub Brush Pressure Switch

SCRUB HEAD POSITION SWITCH

The scrub head position switch controls the scrub head actuator, which raises and lowers the scrub head and controls scrub brush pressure.

To raise the scrub head, push the switch toggle forward to the "raise" position. To lower the scrub head, pull the switch toggle backward to the "lower" position. The center switch position is the "hold" position.

Keep the scrub head in the "raised" position whenever transporting, storing, or parking the machine.

SCRUB BRUSH SPEED SWITCH

The scrub brush speed switch controls the speed of the scrub brushes. The scrub brushes may be operated at "fast" or "slow" speed. To operate the scrub brushes in "fast" speed, flip the switch toggle forward into the "fast" position. To operate the scrub brushes in "slow" speed, flip the switch toggle backward into the "slow" position. The center switch toggle position is the "off" position.

NOTE: Avoid switching the scrub brush speed switch from "fast" to "slow" to "fast" brush speed and similarly from "slow" to "fast" to "slow" brush speed too quickly, as it may damage the switching contactors.

When scrubbing on a rough floor, or if too much scrub brush pressure is applied, the scrub brush circuit breakers may trip. If the circuit breakers trip, wait until they cool before resetting them.

MASTER POWER SWITCH AND INDICATOR LAMP

The master power switch controls most of the machine power. Only the vacuum fan and power pump accessory may be operated independently of the master power switch.

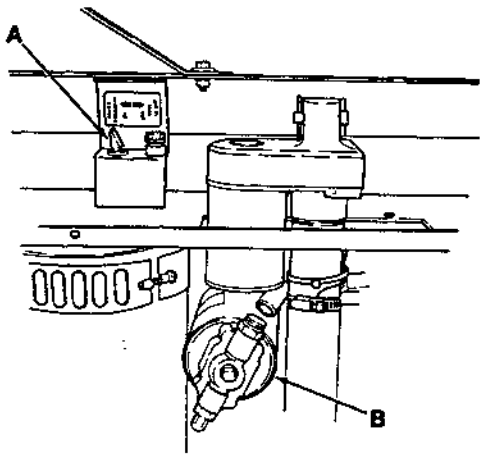
To start the propelling motor and provide power for the machine, turn the key switch to the "on" position. To stop the propelling motor and all machine power except for the vacuum fan motor and the power pump accessory, turn the key switch to the "off" position.

Whenever the master power switch is in the "on" position, the indicator lamp will light.

POWER PUMP SWITCH

The power pump switch is present on machines with the power pump accessory. It is located under the front access panel. It controls the power pump, which pumps dirty solution out of the recovery tank.

To start the power pump, flip the switch toggle backward into the "on" position. To stop the power pump, flip the switch toggle forward into the "off" position.



POWER PUMP SWITCH 02650

A. Switch
B. Power Pump

FUSES AND CIRCUIT BREAKERS

Fuses are a one-time circuit protection device designed to stop the flow of current in the event of a circuit overload. Never substitute higher value fuses than those specified in this manual.

Circuit breakers are reusable circuit protection devices designed to stop the flow of current in the event of a circuit overload. Once tripped, circuit breakers must be manually reset.

If the overload which caused the circuit breaker to trip is still present in the circuit, the circuit breaker will continue to stop current flow until the overload is corrected. The following chart shows the various fuses and circuit breakers, the electrical components they protect, and their locations in the machine.

PROTECTIVE DEVICE	RATING	CIRCUIT PROTECTED	LOCATION
FU-1	15A	Vacuum Fan, Standard	Instrument Panel
FU-1	25A	Vacuum Fan, Heavy Duty	Instrument Panel
FU-2	10A	Master Power Switch	Instrument Panel
FU-3	30A	Brush Drive, Slow Speed	Instrument Panel
FU-4	10A	Power Pump	Power Pump Switch
FU-5	30A	Brush Drive, High Speed	Rear Frame Panel
CB-1	30A	Propelling Motor	Instrument Panel
CB-2	17.5A	Left Brush Motor, Standard	Instrument Panel
CB-2	25A	Left Brush Motor, Heavy Duty	Instrument Panel
CB-3	17.5A	Right Brush Motor, Standard	Instrument Panel
CB-3	25A	Right Brush Motor, Heavy Duty	Instrument Panel

MACHINE OPERATION

NORMAL SCRUBBING OPERATION

A normal scrubbing operation involves making a single scrubbing pass over the surface to be cleaned. A single scrubbing pass will remove routine accumulations of dirt and spills. In areas where excessive dirt or spills accumulate, double scrubbing may be necessary.

A normal scrubbing operation consists of six typical operations which are: pre-operation checks, filling solution tank, scrubbing, draining recovery tank, stopping machine, and post-operation checks.

Pre-Operation Checks list things to check before operating the machine.

To Fill Solution Tank lists steps needed to fill the solution tank.

To Scrub lists things to keep in mind before and during the scrubbing operation.

To Drain Recovery Tank lists steps needed to empty the recovery tank.

To Stop Machine lists steps needed to stop and maintain the machine at the end of each work shift.

Post-Operation Checks list things to check after stopping the machine.

PRE-OPERATION CHECKS

- Solution control lever in "off" position.
- Squeegee position switch in "raise" position.
- Recovery tank drain hose in storage location on recovery tank or drain toggle clamp closed.

TO FILL SOLUTION TANK

1. Stop the machine next to the filling station.
2. Place the master power switch in the "off" position.

⚠ CAUTION: Always place the master power switch in the "off" position before working on the machine to prevent machine from creeping or electrical shock.

3. Place the solution control lever in the "off" position.
4. Open the machine cover and lift the vacuum fan assembly.
5. Remove the solution tank cover.
6. Fill the solution tank with hot water.

NOTE: Water temperature should not exceed 120° F (49° C).

NOTE: On ES® machines and whenever the soap basket accessory is present, and powdered detergent is being used, place the detergent in the soap basket; fill the solution tank with water through the soap basket to dissolve the detergent; remove the soap basket; and place the water hose below the water level and continue filling the solution tank until it is full. This will aid mixing the solution and will avoid excessive foaming.

7. Add detergent and stir the solution.
8. Replace the solution tank cover.
9. Lower the vacuum fan assembly and the machine cover.

TO SCRUB

Plan the scrubbing in advance. Try to arrange long runs with minimum stopping and starting. Do an entire floor or section at one time.

Pick up debris before scrubbing. Pick up pieces of wire, twine, string, etc., which could become entangled in brush or brush plugs.

Allow a few inches overlap of brush paths.

Try to scrub as straight a path as possible. Avoid bumping into posts or scraping the sides of the machine.

Adjust the scrub brush pressure and speed, and solution flow as required. Use minimum scrub brush pressure and solution flow required for the best scrubbing results.

About 5 to 10 ft (1525 to 3050 mm) before stopping the machine, shut off the solution flow to eliminate any standing water or solution.

When the recovery tank is almost full, the recovery tank full lamp will light. Drain the recovery tank and clean the vacuum fan screen and filter as described in To Empty Recovery Tank. Refill the solution tank with clean water and detergent. Then continue scrubbing.

1. Place the master power switch in the "on" position.
2. Drive the machine to the area to be cleaned.
3. Place the squeegee position switch in the "lower" position to lower the squeegee.

NOTE: The squeegee will not lower until the machine steering handles have been pressed to propel the machine.

4. Place the vacuum fan switch in the "on" position to start the vacuum fan.

5. Place the scrub brush speed control switch in the "fast" or "slow" position to start the scrub brushes rotating.

6. Hold the scrub head position switch toggle in the "lower" position until the scrub brushes contact the floor.

7. Place the solution control lever in the desired position to start solution flowing.

NOTE: ES® machine operators may select the standard or ES® mode of operation at any time while scrubbing. The ES® mode of operation provides a full rate of solution to the floor at all times. When the ES® mode of operation is selected, the ES® system lamp will light, and the solution pump will operate as required.

8. Scrub as required.

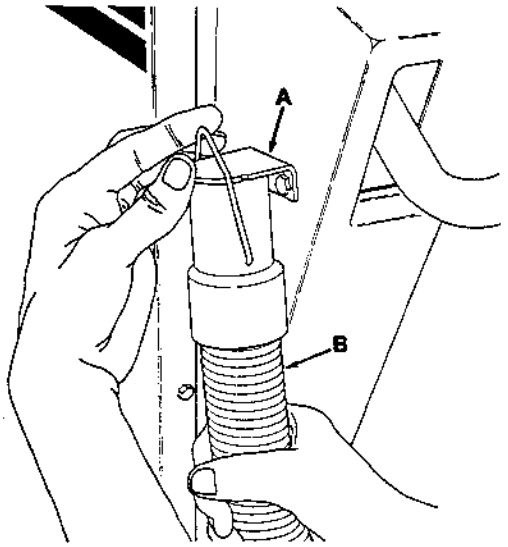
TO DRAIN RECOVERY TANK

1. Stop the machine next to a floor drain.

2. Place the master power switch in the "off" position.

⚠ **CAUTION: Always place the master power switch in the "off" position before working on the machine to prevent machine from creeping or electrical shock.**

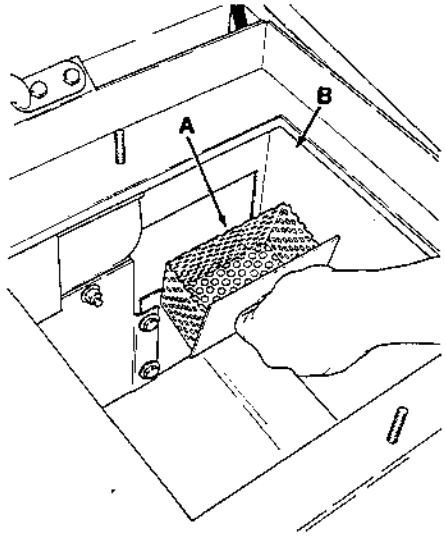
3. Remove the recovery tank drain hose from its retaining tab. Slowly lower the drain hose to the floor drain to drain the tank. Rinse the recovery tank out if excess sediment has collected.



REMOVING RECOVERY TANK DRAIN HOSE 00886

A. Retaining Tab
B. Drain Hose

4. ES® machines: Remove, clean and replace the debris basket.



REMOVING DEBRIS BASKET 02643

A. Debris Basket
B. Recovery Tank

5. Replace the drain hose on its retaining tab after the tank has drained.

TO STOP MACHINE

1. Place the solution control lever in the "off" position.

2. Hold the scrub head position switch in the "raise" position until the scrub head is fully raised.

3. Place the scrub brush speed control switch in the "off" position.

4. Place the squeegee switch in the "raise" position.

5. Place the vacuum fan switch toggle in the "off" position.

6. Place the master power switch in the "off" position.

7. Clean the squeegee; rinse the squeegee suction hose and solution tank.

8. Drain the recovery tank, clean the vacuum fan screen and filter.

   ES® machines: Clean the debris basket and screen filter as described in To Drain Recovery Tank.

   Pre-Sweep machines: Empty the Pre-Sweep hopper.

POST-OPERATION CHECKS

- Scrub brushes free of tangled string or wire.
- Rear squeegee free of rips or tears.
- Rear squeegee securely mounted to frame.
- Batteries charged or on charger.

DOUBLE SCRUBBING OPERATION

Double scrubbing is a method of removing heavy accumulations of dirt, wax, or spills.

It involves making two passes over the area to be cleaned. To double scrub, make a single scrubbing pass over the surface being cleaned with the squeegee in the "raised" position, the vacuum fan "off," and the solution control lever in the "full flow" position; allowing the solution to soak on the floor for 15 to 20 minutes. Then make a second scrubbing pass over the surface with the squeegee in the "lowered" position and vacuum fan "on"—scrubbing in the normal manner.

NOTE: On ES® machines, the solution control lever must be in the "ES®" position during the second scrubbing pass to avoid totally draining the solution tank.

⚠ CAUTION: Use care when driving on wet surfaces to avoid loss of machine control.

OPERATION ON GRADES

The maximum rated ramp angle for machine operation is 5°. Do not operate the machine beyond this limit.

⚠ WARNING: The machine may become unstable if operated on grades more than 5°

When descending ramps, control machine speed by slowly raising both steering handles. This reverses the drive motor and provides a braking action. The parking brake accessory may also be used to control machine speed. Backing the machine down ramps and slowly pressing the steering handles also is a good means of descending ramps.

When climbing ramps, if the drive motor circuit breaker trips, hold the steering handles down. This utilizes the braking ability of the clutches, allowing the machine to be walked down the ramp to a level surface where the circuit breaker may be reset. The parking brake accessory may also be used to control machine speed while walking it down to a level where the circuit breaker may be reset.

SOLUTION TANK

The machine solution tank supplies the scrub brushes with a water and detergent solution. The solution tank is mounted on the right side of the machine.

Access to the solution tank is gained by opening the machine cover and lifting the vacuum fan assembly forward. For specific filling instructions, see To Fill Solution Tank. To drain the solution tank, open the drain toggle clamp at the rear of the machine. For specific cleaning instructions, see Solution Supply System in the Maintenance section.

DETERGENT RECOMMENDATIONS

Floor conditions, water condition, amount of soilage, type of soilage, brush action, and squeegee action all play an important role in determining the type and the concentration of detergent to be used. For specific recommendations, call the local Tennant Company Representative.

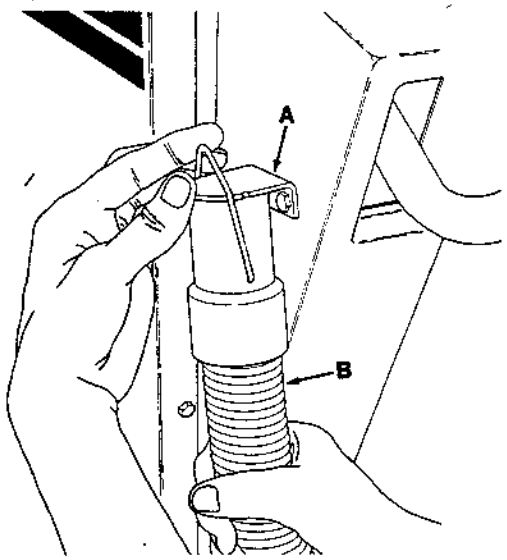
ATTENTION! Do not use solvents or highly abrasive detergents in the solution system as they will destroy the solution pump on ES® or power pump equipped machines.

⚠ WARNING: Do not use flammable or combustible cleaning agents when scrubbing. They can burn or explode and cause serious injury.

RECOVERY TANK

The machine recovery tank stores the water solution picked up by the machine squeegee and vacuum fan. The recovery tank is located on the left side of the machine.

Access to the recovery tank is gained by opening the machine cover and lifting the vacuum fan assembly forward. To drain the recovery tank, remove the recovery tank drain hose from its retaining tab and lower the hose to a floor drain. The tank will then empty. For specific draining instructions, see To Drain Recovery Tank.



00886

REMOVING RECOVERY TANK DRAIN HOSE

A. Retaining Tab
B. Drain Hose

The recovery tank may also be drained with the recovery tank fast discharge or power pump accessory. For specific accessory instructions and their use, see Accessories Operation.

To clean the recovery tank, see Solution Recovery System in the Maintenance section.

ACCESSORIES OPERATION

POWER PUMP

The power pump accessory allows the water solution in the recovery tank to be emptied into a sink or similar facility, which is above the normal recovery tank outlet.

TO DRAIN RECOVERY TANK WITH POWER PUMP

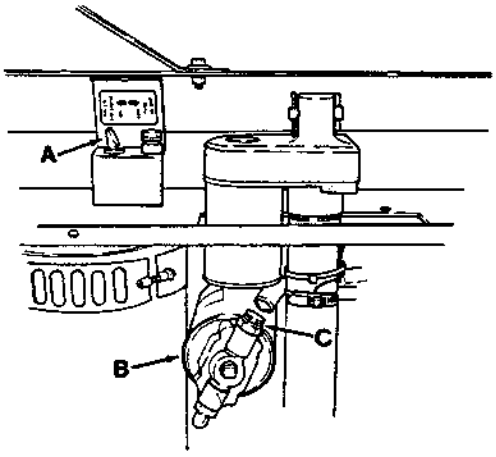
1. Stop the machine within an arm's reach of the sink.

NOTE: The power pump drain hose will reach approximately 84 in (2135 mm) from the machine.

2. Place the master power switch in the "off" position.

⚠ CAUTION: Always place the master power switch in the "off" position before working on the machine to prevent machine from creeping or electrical shock.

3. Open the machine cover and lift the vacuum fan assembly forward.
4. Unwrap the power pump drain hose from the top of the solution tank cover.
5. Open the front access panel.
6. Position one end of the drain hose in the sink. Connect the other end of the drain hose to the fitting on the power pump.



POWER PUMP 02650

A. Power Pump Switch
B. Power Pump
C. Fitting

7. Place the power pump switch in the "on" position to start the power pump.

NOTE: The power pump should drain a full recovery tank in ten to fifteen minutes. Do not leave the power pump operating for a long period of time after the recovery tank is empty, as it will deplete the battery charge.

8. Place the power pump switch in the "off" position when the recovery tank is empty.
9. Rinse the recovery tank out if excess sediment has collected.
10. Place the power pump switch in the "on" position to start the power pump. Place the power pump switch in the "off" position when the recovery tank is empty.
11. Remove and wrap the drain hose on the solution tank cover.
12. Lower the front access panel, the vacuum fan assembly, and the machine cover.

RECOVERY TANK FAST DISCHARGE DRAIN

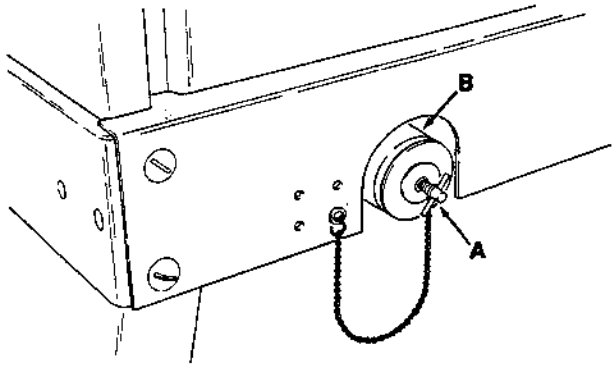
The recovery tank fast discharge drain accessory eliminates the standard recovery tank drain hose. A large diameter sealing toggle clamp takes the place of the drain hose.

TO DRAIN RECOVERY TANK WITH FAST DISCHARGE DRAIN

1. Stop the rear of the machine over the floor drain.
2. Place the master power switch in the "off" position.

⚠ CAUTION: Always place the master power switch in the "off" position before working on the machine to prevent machine from creeping or electrical shock.

3. Drain the recovery tank by pulling the drain arm out on old style machines or by turning the drain plug handle counterclockwise and removing plug on new style machines.



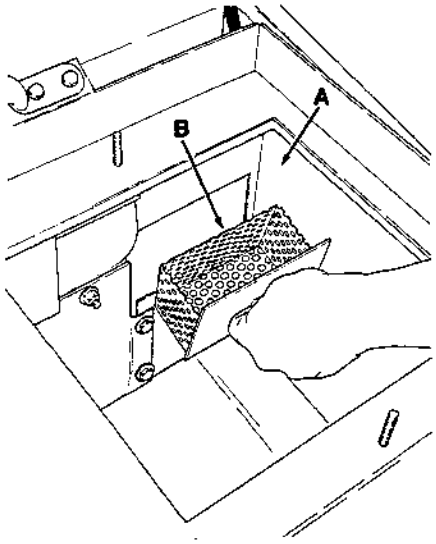
00890

RECOVERY TANK DRAIN PLUG

A. Drain Plug
B. Recovery Tank Drain Outlet

POWER SCRUBBER - 432 MM155 (5-86) LITHO IN U.S.A.

4. ES® machines: remove, clean, and replace the debris basket.



REMOVING DEBRIS BASKET 02643

A. Recovery Tank
B. Debris Basket

5. Close the recovery tank drain by pushing the drain arm in on old style machines or by placing the plug in the outlet and turning the handle clockwise on new style machines.

VACUUM WAND

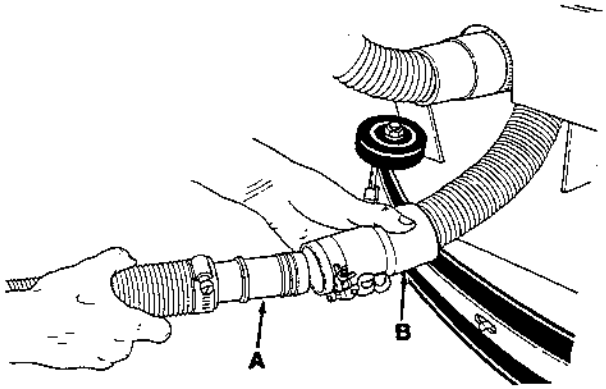
The vacuum wand accessory gives the machine the added flexibility of picking up spills not accessible by the machine. An 84 in (2135 mm) hose and wand utilize the machine vacuum system.

TO OPERATE VACUUM WAND

1. Stop the machine near the spill to be picked up.
2. Place the master power switch in the "off" position.

⚠ CAUTION: Always place the master power switch in the "off" position before working on the machine to prevent machine from creeping or electrical shock.

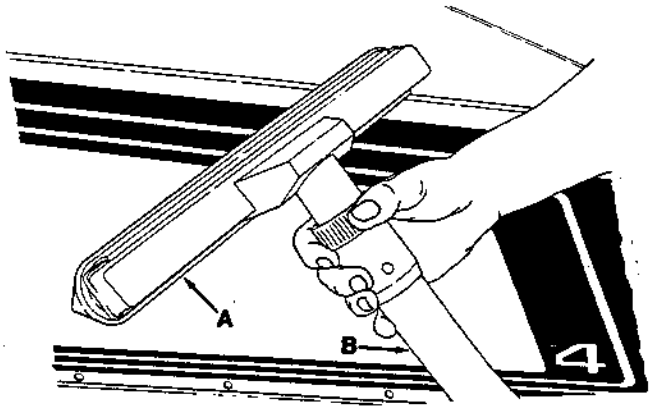
3. Place the vacuum fan switch in the "off" position.
4. Remove the vacuum wand and hose from their storage locations on the machine cover.
5. Loosen the rear squeegee suction hose worm-drive clamp at the squeegee frame.
6. Remove the rear squeegee suction hose from the squeegee frame.
7. Insert the wand hose coupling into the end of the rear squeegee suction hose.



CONNECTING WAND HOSE 00891

A. Wand Hose Coupling
B. Rear Squeegee Suction Hose

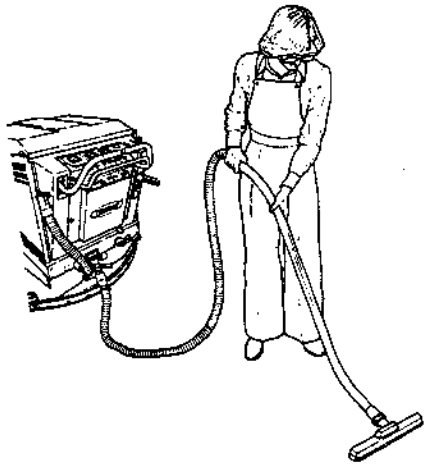
8. Assemble the vacuum wand to the wand hose.
9. Tighten the knurled vacuum wand end to fix the nozzle position.



ASSEMBLING VACUUM WAND NOZZLE 00892

A. Vacuum Wand Nozzle
B. Vacuum Wand

10. Place the vacuum fan switch in the "on" position.
11. Operate the vacuum wand as required.



OPERATING VACUUM WAND 00893

12. When finished, place the vacuum fan switch in the "off" position.
13. Loosen the knurled vacuum wand end.
14. Disconnect the vacuum wand from the wand hose.
15. Disconnect the wand hose from the rear squeegee suction hose.
16. Push the rear squeegee hose onto the rear squeegee frame hose coupling.
17. Tighten the rear squeegee suction hose wormdrive clamp.
18. Clean and rinse the vacuum wand and wand hose as required.
19. Store the vacuum wand and wand hose on the machine cover.

HEAVY DUTY BUMPER

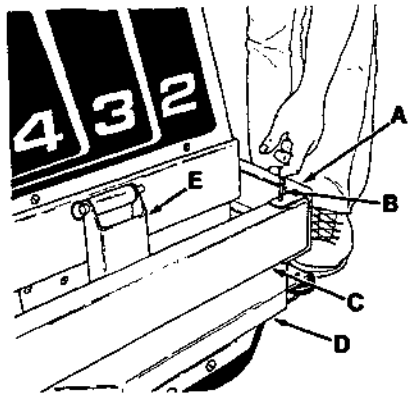
The heavy duty bumper accessory provides the machine with an extra amount of front and side protection. The front bumper must be removed to gain access to the scrub brushes. The side bumpers can be removed or swung up and secured to the machine sides with the chains provided.

TO CHAIN UP OR REMOVE HEAVY DUTY BUMPERS

1. Place the master power switch in the "off" position.

⚠ CAUTION: Always place the master power switch in the "off" position before working on the machine to prevent machine from creeping or electrical shock.

2. Pull the two front bumper retaining pins.



REMOVING FRONT BUMPER PINS 00895

A. Front Bumper
B. Retaining Pin
C. Side Bumper
D. Scrub Head Cover
E. Side Bumper Bracket

3. Slide the front bumper off the side bumpers.
4. To chain up: Swing each side bumper up and secure in "raised" position with chain and hook.

   To remove: Pull the two side bumper retaining pins, holding each side bumper in place, and remove the bumper.

TO REPOSITION OR REINSTALL HEAVY DUTY BUMPERS

1. Place the master power switch in the "off" position.

⚠ CAUTION: Always place the master power switch in the "off" position before working on the machine to prevent machine from creeping or electrical shock.

2. To reposition: Unhook and lower the two side bumpers.

   To reinstall: Hold each side bumper in place and insert the two retaining pins which secure each bumper to the machine.
3. Slide the front bumper onto the front ends of the side bumpers.
4. Insert the two front bumper retaining pins through the front bumper and each of the side bumpers.

PRE-SWEEP

The Pre-Sweep gives the machine the added ability to pick up debris. It is mounted on the front of the machine. Both of the scrub brushes rotate clockwise. The left side scrub brush deflects debris in front of the right side scrub brush which sweeps the debris into the debris hopper. Periodically empty the Pre-Sweep hopper as it fills with debris.

The machine may be operated with or without the Pre-Sweep. If desired, the standard scrub head cover may be used to control water spray when operating the machine without the Pre-Sweep. To mount the standard scrub head cover, remove the Pre-Sweep hopper, frame, and both mounting brackets and install the standard scrub head cover on the machine side pins as normally done.

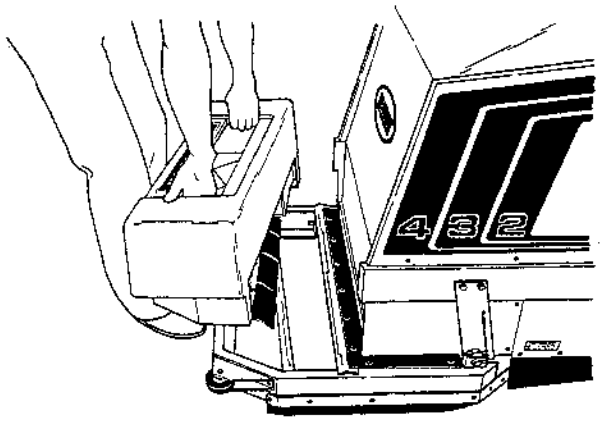
Check the Pre-Sweep adjustments if the Pre-Sweep interferes with a scrub brush or has difficulty picking up debris.

TO REMOVE PRE-SWEEP

1. Position the scrub head in the "raised" position.
2. Place the master power switch in the "off" position.

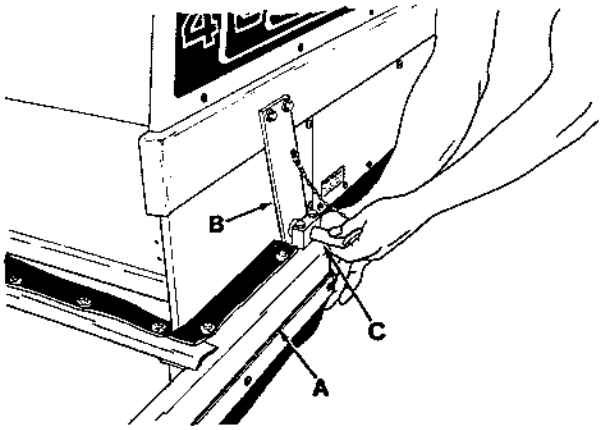
⚠ CAUTION: Always place the master power switch in the "off" position before working on the machine to prevent machine from creeping or electrical shock.

3. Lift the Pre-Sweep hopper out of the Pre-Sweep frame.



REMOVING PRE-SWEEP HOPPER 01342

4. Disconnect the scrub brushes from their drive magnets and slide them out from under the Pre-Sweep frame.
5. Remove the two frame locking pins.



REMOVING LOCKING PIN 01341

A. Pre-Sweep Frame
B. Mounting Bracket
C. Locking Pin

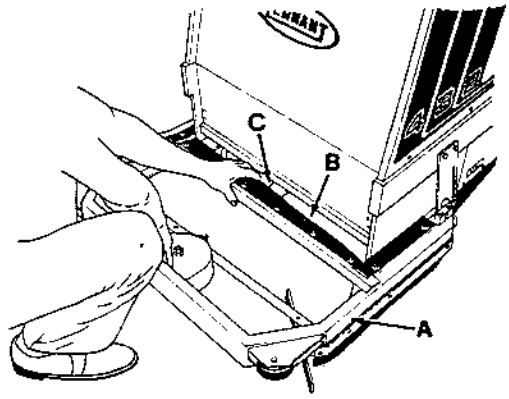
6. Slide the Pre-Sweep frame away from the machine.
7. Position the Pre-Sweep hopper on the Pre-Sweep frame for safe storage.

TO MOUNT PRE-SWEEP

1. Position the scrub head in the "raised" position.
2. Place the master power switch in the "off" position.

⚠ CAUTION: Always place the master power switch in the "off" position before working on the machine to prevent machine from creeping or electrical shock.

3. Remove the two scrub brushes.
4. Remove the Pre-Sweep hopper from the Pre-Sweep frame.
5. Slide the Pre-Sweep frame into position on the front of the machine with the top rubber flap over the metal tab.

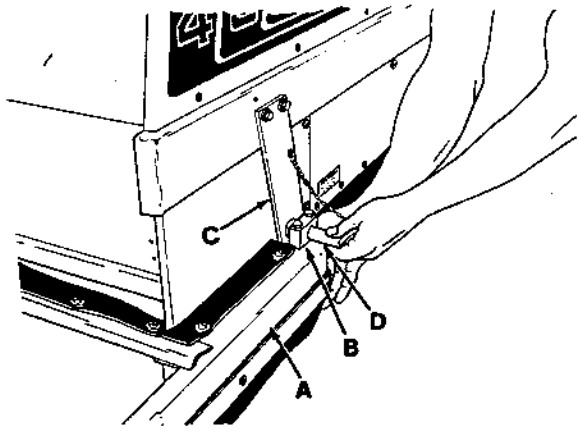


01340

SLIDING PRE-SWEEP FRAME INTO POSITION

A. Pre-Sweep Frame
B. Top Rubber Flap
C. Metal Tab

6. Line up the Pre-Sweep frame block holes and the mounting bracket holes.
7. Insert a locking pin through the holes on each side.

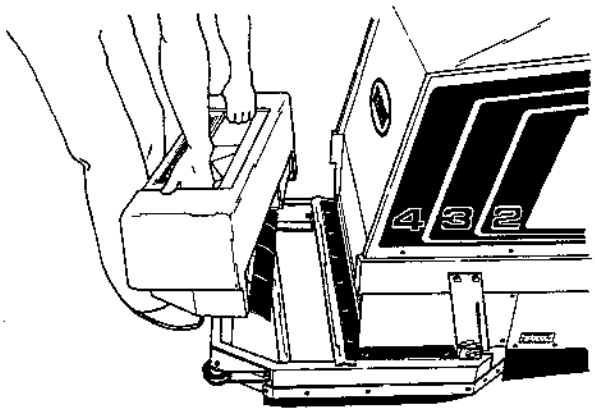


INSERTING LOCKING PIN 01341

A. Pre-Sweep Frame
B. Frame Block
C. Mounting Bracket
D. Locking Pin

8. Lift the front of the Pre-Sweep frame; slide the scrub brushes into position and attach them to the scrub brush drive magnets.

9. Install the Pre-Sweep hopper by tilting the rear of the hopper down and sliding it into position on the Pre-Sweep frame.



INSTALLING PRE-SWEEP HOPPER 01342

POWER SCRUBBER - 432 MM155 (11-84) LITHO IN U.S.A.

MACHINE TROUBLESHOOTING

Problem	Cause	Remedy
Trailing water—poor or no water pickup	Worn rear squeegee	Rotate or replace rear squeegee
	Rear squeegee out of adjustment	Adjust rear squeegee
	Squeegee switch in "raise" position	Place squeegee switch in "lower" position
	Vacuum hose clogged	Flush vacuum hose
	Recovery tank full	Drain tank
	Float switch stuck, shutting off vacuum	Clean float mechanism
	Vacuum fan filter clogged	Clean vacuum fan filter
	Debris caught on squeegee	Remove debris
	Rear squeegee will not lower—clutch bellcrank wing nuts not properly adjusted	Adjust bellcrank wing nuts
	Seal between vacuum fan and fan housing not making contact	Adjust position of vacuum fan and fan housing
	Rear squeegee will not lower—electrical problem	See Electrical System Troubleshooting—Rear squeegee will not lower
	Vacuum fan operates slowly or not at all	See Electrical System Troubleshooting—Vacuum fan operates slowly or not at all
	Foam filling recovery tank	Empty recovery tank; change detergent
	Vacuum hose to rear squeegee disconnected or damaged	Reconnect or replace vacuum hose
Little or no solution flow to floor	Solution tank empty	Fill solution tank
	Solution control cable broken or out of adjustment	Replace and/or adjust cable
	Solution supply lines clogged	Flush solution supply lines
	ES® machines: Solution outlet filter in recovery tank clogged	Spray filter clean
	ES® machines: Solution pump clogged, broken	Clean and inspect pump
	ES® machines: Solution pump operates slowly or not at all—electrical problem	See Electrical System Troubleshooting—ES® solution pump operates slowly or not at all
	Solution outlet filter clogged	Clean solution tank and outlet filter

Problem	Cause	Remedy
(Little or no solution flow to floor - continued)	ES® machines: Switch at water valve handle not being actuated when solution control lever is fully forward in "ES®" position	Adjust switch bracket
	ES® machines: Float switch not plugged into connectors at recovery tank	Plug connectors together
	ES® machines: Float switch mechanism stuck in "down" position	Clean parts and be sure float is free
	ES® machines: Not enough water in recovery tank to move float switch mechanism fully up	Solution pump will not turn on until float has been almost fully raised
Poor scrubbing performance	Scrub head out of adjustment	Adjust scrub head
	Debris caught on scrub brushes or drive mechanism	Remove debris
	Worn scrub brushes	Replace scrub brushes
	Scrub brushes out of adjustment	Adjust scrub brushes
	Improper detergent or brushes used	Check with Tennant Company Representative for advice
	Pre-Sweep machines: Debris hopper full	Empty hopper
	Scrub brush motors operate slowly or not at all—electrical problem	See Electrical System Troubleshooting—Scrub brush motors operate slowly or not at all
Machine moves slowly or not at all	Parking brake engaged	Disengage parking brake
	Batteries discharged	Charge batteries
	Battery cables loose or damaged	Clean, inspect and secure cables to batteries
	Drive motor operates slowly or not at all—electrical problem	See Electrical System Troubleshooting—Drive motor operates slowly or not at all
	Clutch(es) out of adjustment	Adjust clutch(es)
	Clutch failure	Repair or replace clutch(es)
Machine will not go in reverse	Reversing switches out of adjustment	Adjust switches
	Clutch bellcrank wing nuts out of adjustment	Adjust wing nuts

MACHINE STORAGE

STORING MACHINE

When storing the machine for extended periods of time, the following procedures must be done to lessen the chance of rust, sludge, and other undesirable deposits from forming:

1. Place the scrub brushes and squeegee in the "raised" position.
2. Empty and clean the solution and recovery tanks.
3. Fully charge the batteries.
4. Disconnect the batteries-to-machine connector.
5. Raise the machine off the floor to prevent the tires from flat spotting.

POWER SCRUBBER - 432 MM155 (11-84) LITHO IN U.S.A.

SECTION 3
MAINTENANCE

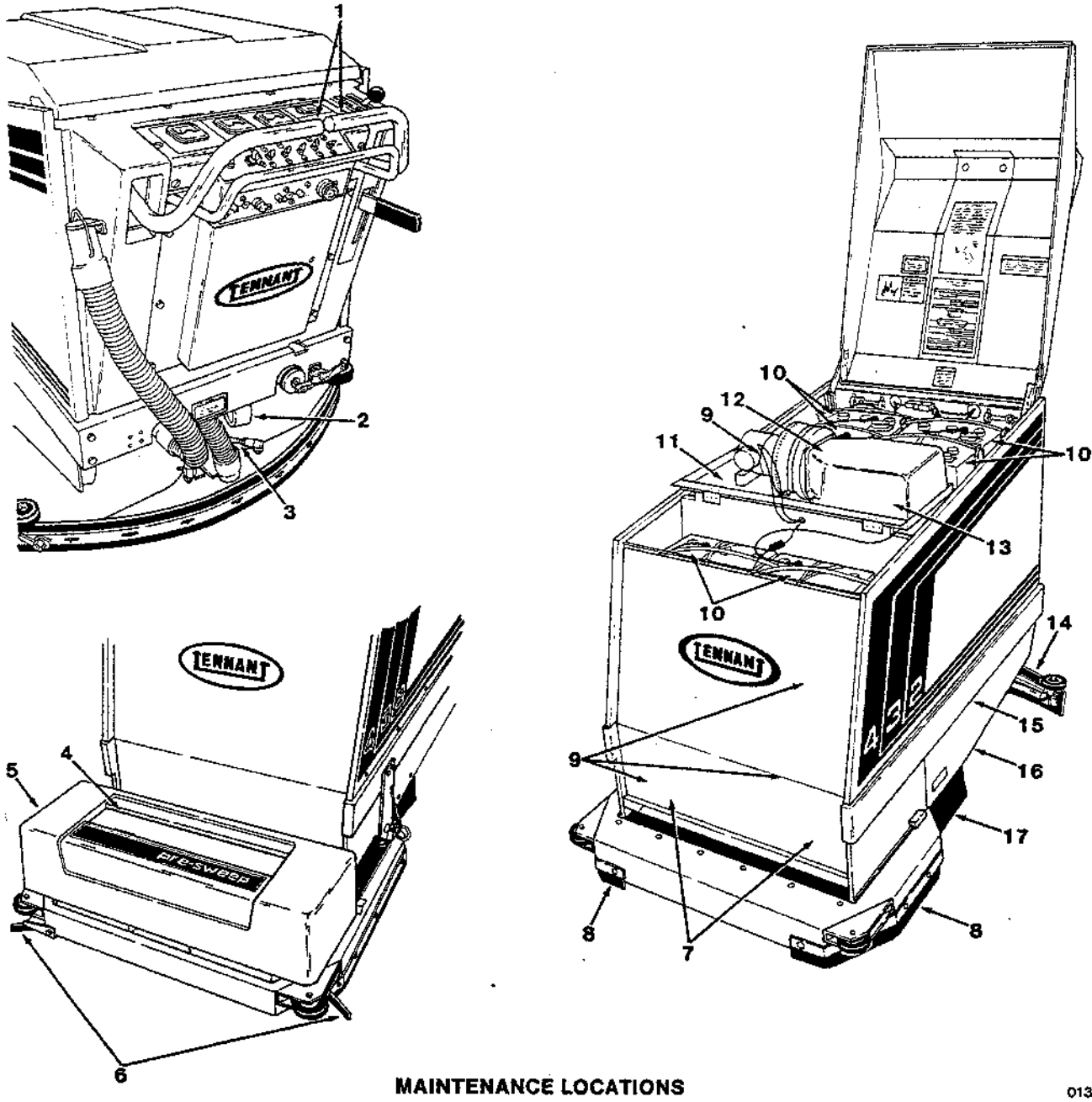
CONTENTS

RECOMMENDED FIRST 20-HOUR MACHINE INSPECTION

After the first 20-hours of operation, perform the following procedures:

1. Check the squeegee down pressure adjustment.
2. Check the specific gravity of the batteries.
3. Check the battery cable connections.
4. Check the drive chain tension.
5. Check the steering control handles/clutch linkage adjustment.
6. Check the floor skirts to floor clearance.
7. Check the pressure in the drive wheel tires.

MAINTENANCE CHART



MAINTENANCE LOCATIONS

01339
00881
00882

MAINTENANCE CHART

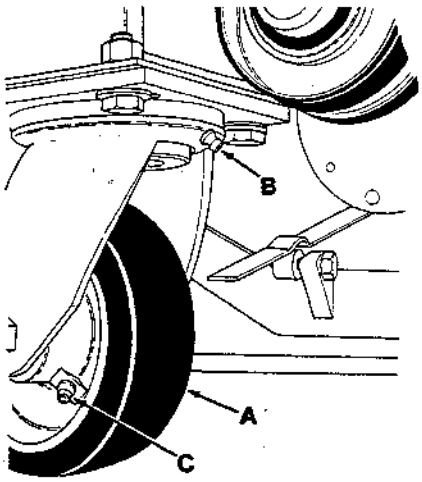
Interval	Key	Description	Procedure	Lubricant	No. of Service Points
Daily	7	Scrub brushes	Check for tangled wire, string, damage, or wear	-	2
			Check scrub brush overlap	-	2
	11	ES® solution supply system	Flush and clean	-	1
	12	Vacuum fan screen and filter	Clean	-	1
	13	Solution recovery system	Flush and clean	-	1
	16	Drive wheel tires	Check air pressure	-	2
	14	Squeegee assembly	Check for wear or damage	-	1
Weekly or 20 Hours	10	Battery cables	Check for loose or corroded connections	-	7
	10	Batteries	Check specific gravity	-	6
			Check electrolyte level	-	6
	14	Squeegee assembly	Adjust down pressure	-	1
	6	Pre-Sweep windrow flaps	Check for wear or damage	-	2
	4	Pre-Sweep hopper slit skirt	Check for wear or damage	-	1
Monthly or 80 Hours	8	Scrub head floor skirts	Check for wear or damage and adjustment	-	2
	10	Batteries	Clean battery tops	-	6
	11	Solution supply system	Flush and clean	-	1
	15	Wheel drive chains	Lubricate	MPGM	2
	17	Tire floor skirts	Check for wear or damage and adjustment	-	2
	1	Steering control handles/ clutch linkage	Adjust linkage	-	2
	2	Rear casters	Lubricate axle and swivel	MPGM	2
	3	Squeegee steering arm	Adjust tracking	-	1
	—	Parking brake	Inspect and lubricate	DL	2
Bi-Monthly or 160 Hours	15	Wheel drive chains	Check tension	-	2
	15	Parking brake cables	Check tension	-	2
	5	Pre-Sweep hopper	Check adjustments	-	3
	9	Electric motors	Inspect brushes	-	3

MPGM - Multipurpose, water resistant, lithium base, moly-disulphide EP grease
DL - Dry lubricant

LUBRICATION

REAR CASTER

There are two rear casters that support the weight of the rear of the machine. Two grease fittings have been provided on each caster for lubrication purposes. One grease fitting is located on each caster axle. Another grease fitting is located on the swivel of each caster. Lubricate the swivels and axles with a grease gun containing a multi-purpose, water-resistant lithium base, moly-disulphide EP grease after every 80 hours of operation. The caster axle is full when grease appears between the caster wheel and the fork. The caster swivel is full when grease appears through the o-ring.

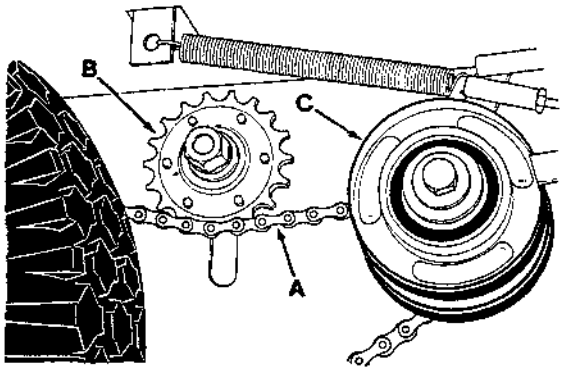


REAR CASTER SWIVEL 00896

A. Rear Caster
B. Swivel Grease Fitting
C. Axle Grease Fitting

WHEEL DRIVE CHAINS

There is one wheel drive chain on each side of the machine. Lubricate each of the chains by brushing a multi-purpose, water-resistant lithium base, moly-disulphide EP grease on the chains after every 80 hours of operation.



WHEEL DRIVE CHAIN 00898

A. Chain
B. Chain Idler
C. Clutch

BATTERIES

The six 6-volt machine batteries provide all of the energy used by the machine. The standard batteries are rated at 220 amp/hours at a 20-hour rate. The heavy duty batteries are rated at 305 amp/hours at a 20-hour rate. They require regular maintenance to keep them operating their best.

Do not allow batteries to remain in discharged condition for any length of time.

Do not operate machine if batteries are in poor condition or discharged beyond 80%, specific gravity below 1.120.

Check the battery cables for loose connections and corrosion after every 20 hours of operation.

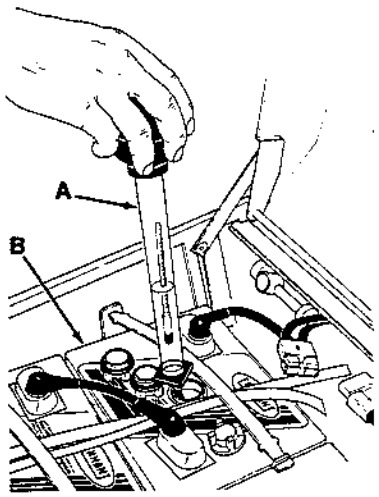
Clean the top surface and the terminals of the batteries after every 80 hours of operation. Use a strong solution of baking soda and water. Brush the solution sparingly over the battery top, terminals, and cable clamps. Do not allow any baking soda solution to enter the battery. Use a wire brush to clean the terminal posts and the cable connectors. After cleaning, apply a coating of clear petroleum jelly to the terminals and the cable connectors. Keep the tops of the batteries clean and dry.

Keep all metallic objects off the top of the batteries, as they may cause a short circuit. Replace worn or damaged wires.

Check the electrolyte level in each battery cell after every 20 hours of operation. The electrolyte level must always be above the battery plates. Add distilled water to maintain solution at the correct level above the plates, but do not overfill. Never add acid to batteries, only water. Keep vent plugs firmly in place at all times, except when adding water or taking hydrometer readings.

⚠ WARNING: Avoid contact with battery acid. Battery acid can cause severe burns. Wash immediately and get medical attention if contact with battery acid occurs.

Use a hydrometer to check the electrolyte specific gravity after every 20 hours of operation.



00899

CHECKING BATTERY SPECIFIC GRAVITY

A. Hydrometer
B. Battery

If one or more battery cells tests lower than the other battery cells, (0.050 or more) the cell is damaged, shorted, or is about to fail.

NOTE: Do not take readings immediately after adding water—if the water and acid are not thoroughly mixed, the readings may not be accurate. Check the hydrometer readings against this chart:

SPECIFIC GRAVITY at 80° F (27° C)	BATTERY CONDITION
1.260 - 1.280	100% charged
1.230 - 1.250	75% charged
1.200 - 1.220	50% charged
1.170 - 1.190	25% charged
1.110 - 1.130	Discharged

NOTE: If the readings are taken when the battery electrolyte is any temperature other than 80°F (27° C), the reading must be temperature corrected.

To determine the corrected specific gravity reading when the temperature of the battery electrolyte is other than 80° F (27° C):

Add to the specific gravity reading 0.004, 4 points, for each 10° F (6° C) above 80° F (27° C).

Subtract from the specific gravity reading 0.004, 4 points, for each 10° F (6°C) below 80° F (27° C).

BATTERY CHARGING

The machine batteries are specially made for this machine application. They are unique in that they hold their power for long periods of time, but they can only be recharged a certain number of times. To get the most life from the batteries, charge them when 80% of their power has been used.

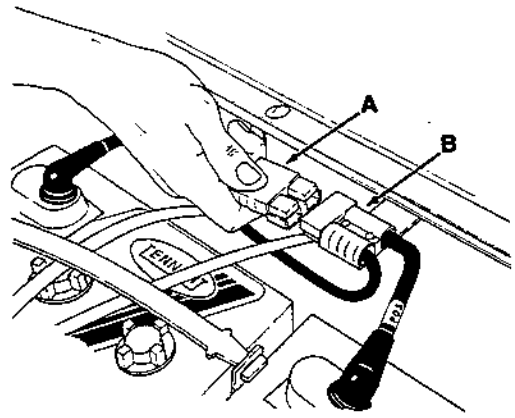
Do not expose the battery charger to water. Do not touch uninsulated battery terminals or unnecessarily expose any portion of your body to the batteries when making electrical connections.

TO CHARGE BATTERIES

1. Stop the machine on a flat, dry surface next to an electrical outlet and the battery charger.
2. Place the master power switch in the "off" position.
3. Lift and lock the machine cover in the "open" position.

⚠ WARNING: Keep machine cover open, do not smoke or allow spark-producing equipment to operate when charging batteries. Batteries give off an explosive gas when being charged.

4. Disconnect the batteries-to-machine connector.



00880

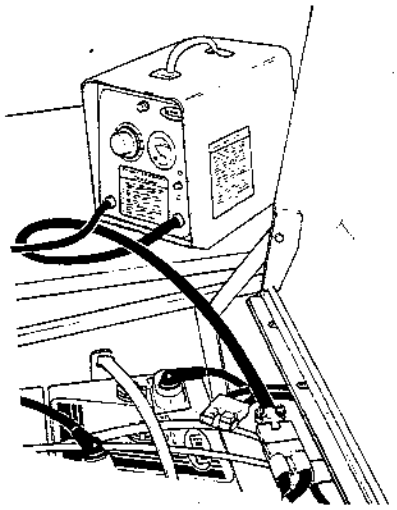
DISCONNECTING BATTERIES-TO-MACHINE CONNECTOR

A. Machine Connector
B. Batteries Connector

5. Check the electrolyte level in the batteries. Before charging, add just enough distilled water to cover the plates. Then, after charging is completed, add enough water to bring the electrolyte up to the indicator mark. If the water level is topped off before charging, normal expansion of the electrolyte may cause an overflow, resulting in loss of acid balance and acid damage to the machine area around the batteries.

⚠ WARNING: Do not charge defective or frozen batteries as they may explode causing serious personal injury.

6. Unplug the battery charger from its power source.
7. Turn the battery charger to the "off" position.
8. Plug the charger output into the machine batteries connector.
9. Plug the battery charger into its power source.
10. Turn the battery charger to the "start" position. The pilot light and ammeter will indicate the charger is operating.

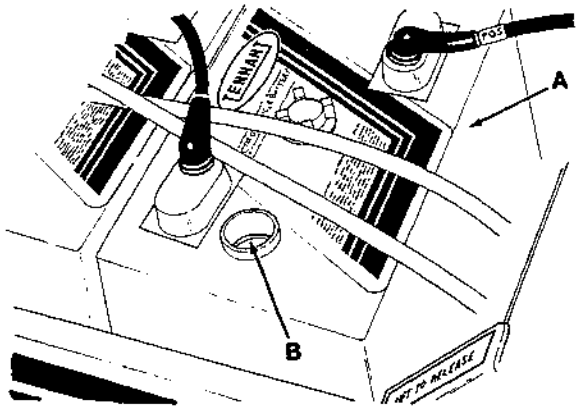


CHARGING BATTERIES 00900

11. The batteries will be fully charged when the timer reads "off" or the battery specific gravity is 1.280 to 1.260.
12. Turn the timer to "off" position.
13. Disconnect the battery charger from its power source.

⚠ CAUTION: Disconnect battery charger power source before disconnecting the battery charger to battery connector to prevent electrical arcing or shock.

14. Disconnect the battery charger from the batteries connector.
15. Check the electrolyte level of the batteries; it should be up to the indicator mark.
16. Reconnect the batteries-to-machine connector.



00879

CHECKING BATTERY ELECTROLYTE LEVEL

A. Battery
B. Electrolyte Indicator Ring

17. Lower the machine cover.

ACTIVATING DRY-TYPE BATTERIES

Some new batteries are supplied in a dry-type form. These batteries need to be activated by filling them with electrolyte before they can be put into service.

TO ACTIVATE DRY-TYPE BATTERIES

1. Extinguish all cigarettes, fire, and spark-producing equipment in the area.

⚠ WARNING: Keep cigarettes, sparks, and open flame away from batteries. Batteries emit a highly explosive gas that may be ignited by cigarettes, fire, or electrical arcing.

2. Remove the batteries from the shipping crate or the machine and place on a level surface.
3. Remove and save the battery vent caps; or if ventless plugs were provided, remove and discard them.
4. Carefully fill each battery cell with battery grade sulfuric acid to 0.38 in (10 mm) above the battery plates.
5. Check the specific gravity of the batteries. Charge the batteries until the specific gravity is 1.28 to 1.26 temperature corrected.
6. Add battery acid if necessary to 0.38 in (10 mm) above the battery plates.
7. Insert battery vent caps in the vent holes.
8. Clean the battery posts and cables.
9. Install the batteries in the machine.
10. Connect the battery cables to the batteries. See Battery Group in the Parts section or Battery Group, Heavy Duty in the Accessories section for correct cable connections.
11. Fill the batteries with water, if necessary, up to the electrolyte indicator rings. Do not add battery acid to the batteries after inserting the vent caps.

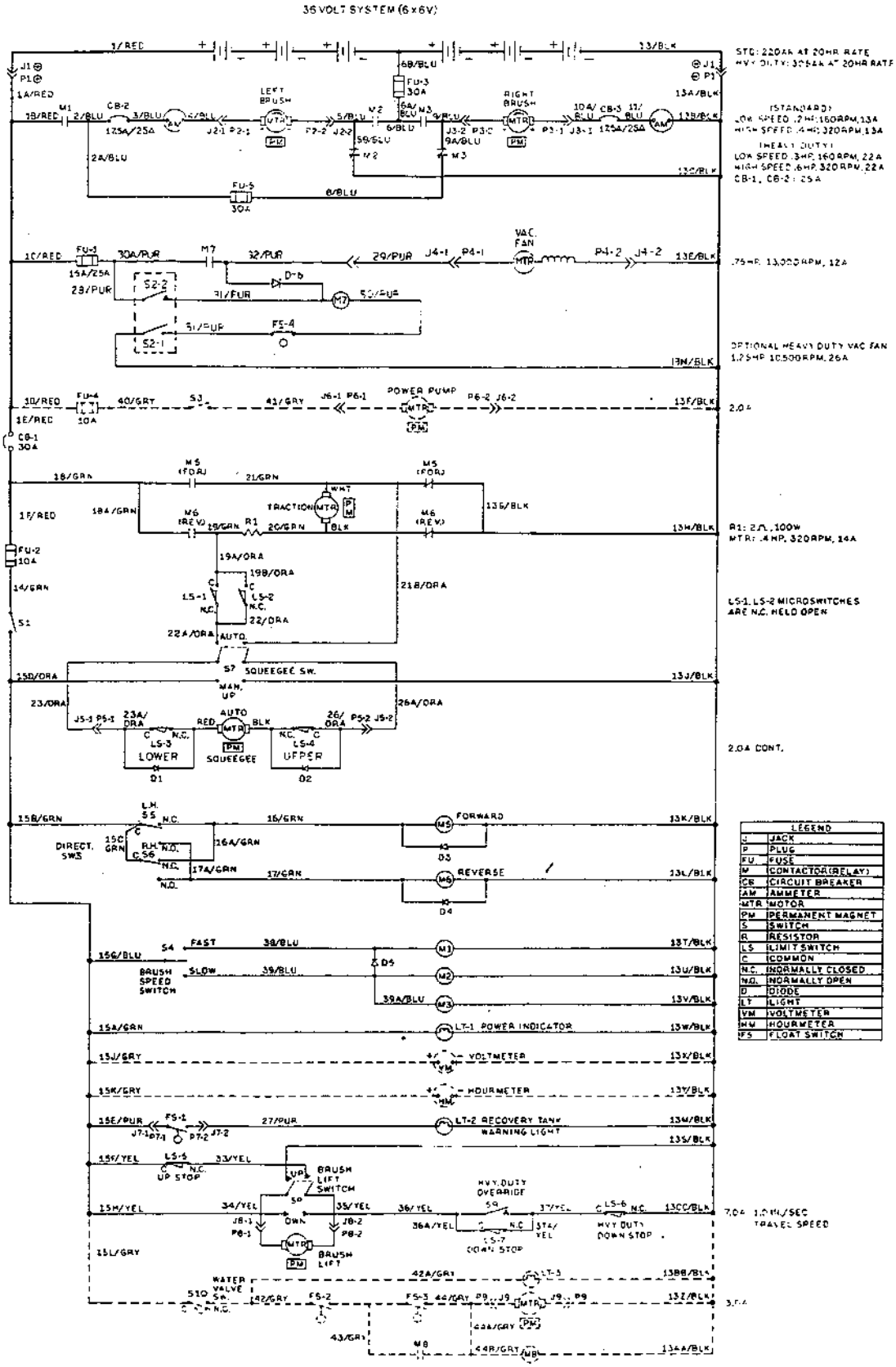
ELECTRIC MOTORS

There are six repairable electric motors on the machine—one propelling motor, two scrub brush motors—standard and heavy-duty models, one vacuum fan motor—standard and heavy-duty models, one squeegee lift motor, and on ES® model machines, one solution pump motor.

Blow out the dust and inspect the motor brushes in each of these motors after every 160 hours of operation.

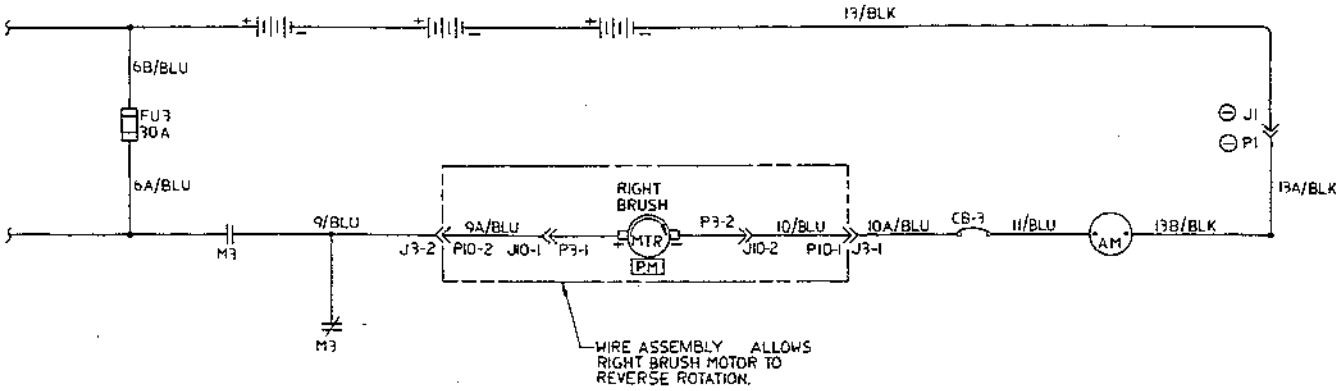
If the brushes have been worn to less than 0.38 in (10 mm) in length, replace them.

If the commutator is worn or rough, the motor armature should be removed and serviced.



ELECTRICAL SCHEMATIC

02630



PRE-SWEEP WIRING

ELECTRICAL SCHEMATIC 02630

ELECTRICAL SYSTEM TROUBLESHOOTING

Problem	Cause	Remedy
Rear squeegee will not lower	Motor failure	Repair or replace motor
	Fuse, FU-2, blown	Replace fuse
	Defective wire or electrical connector	Trace circuits, identify and replace defective wire or connector
Scrub brush motors operate slowly or not at all	Motor failure	Repair or replace motor
	Circuit breakers, CB-2 or CB-3, tripped	Reset circuit breakers
	Defective wire or electrical connector	Trace circuits, identify and replace defective wire or connector
	Defective relay, M-1 or M-2	Replace relay
Drive motor operates slowly or not at all	Defective wire or electrical connector	Trace circuits, identify and replace defective wire or connector
	Defective relay, M-5 or M-6	Replace relay
	Defective switch, LS-1 or LS-2	Replace switch
	Circuit breaker, CB-1, tripped	Reset circuit breaker
	Motor failure	Repair or replace motor
Vacuum fan operates slowly or not at all	Fuse, FU-1, blown	Replace fuse
	Defective wire or electrical connector	Trace circuits, identify and replace defective wire or connector
	Motor failure	Repair or replace motor
	Defective switch, FS-4, S-2	Replace switch
ES® solution pump operates slowly or not at all	Pump head is mounted incorrectly—possible only with no water flow	Rotate pump head so arrow points to solution tank hose
	Fuse, FU-2, blown, stopping power to solution pump	Replace fuse
	Solution pump motor failure	Repair or replace motor
	Water pump wiring not plugged into connector	Plug in
	Defective switch, FS-2, FS-3, S-10	Replace switch

ELECTRICAL SYSTEM TESTING

The first thing to do before testing the machine electrical system is to check the condition of the machine batteries as described in Batteries. Only batteries in good condition will allow the machine to perform as it was designed.

Pinpointing electrical problems is done by measuring the current flow or amp draw of each electrical component. Once an electrical component is identified as drawing an excessive amount of current, check any mechanical linkage, bearing, chain, or adjustment that is related to the operation of the electrical component. Recheck the current flow of the component and if the current flow is still excessive, the component is most likely in need of repair or replacement.

All current flow measurements should be made with an ammeter of 0 to 100 amp range connected in series between the batteries and the machine electrical connectors.

The ammeter readings presented here are average readings to be expected. There are many variables that come into play. Two variables are rough floors and battery condition. Poor ammeter readings may point to a possible future problem.

The individual machine component amp draws can be added to determine the total machine amp draw.

The total machine amp draw while normally scrubbing on smooth level floor is summed up as follows:

Machine Component	Standard Machine	Heavy Duty Machine
Scrub Brush Motor	20	25
Vacuum Fan Motor	11	23
Propelling Motor	10	10
Total Amp Draw	41 amps	58 amps

TO CHECK VACUUM FAN MOTOR AMP DRAW

1. Place the master power switch in the "off" position.

⚠ CAUTION: Always place the master power switch in the "off" position when working on the machine to prevent machine creeping or electrical shock.

2. Place the vacuum fan motor switch in the "on" position. Note the ammeter reading.
3. Remove the pickup hose from the rear squeegee frame.
4. Plug the end of the pickup hose and note the ammeter reading.
5. Place the vacuum fan switch in the "off" position.
6. Compare the ammeter readings with the following chart.

Test Condition	Standard Vacuum Fan Amp Draw	Heavy Duty Vacuum Fan Amp Draw
Pick-up hose blocked	8	16
Pick-up hose open	11-12	23-24

If the readings were higher than specified, there may be leaks in the pickup hose, the vacuum fan may not have been secured to the recovery tank cover or the vacuum fan may need to be repaired or replaced.

If the readings were lower than specified, there may be blockages in the pickup hose, or the vacuum fan screen and filter may be plugged.

TO CHECK SCRUB BRUSH MOTOR AMP DRAW

NOTE: Each of the scrub brush motors are measured individually.

1. Place the master power switch in the "off" position.

⚠ CAUTION: Always place the master power switch in the "off" position before working on the machine to prevent machine creeping and electrical shock.

2. Open the front access cover.
3. Loosen the scrub brush pivot plate wing nut.
4. Pull the scrub brush pivot plate lever to the outside of the machine.
5. Disconnect one of the scrub brush drive motor electrical connectors located behind the motors.
6. Prop one of the steering control handles up to prevent the propelling motor from operating.
7. Place the master power switch in the "on" position.
8. Place the scrub brush control switch in the "slow" speed position with the scrub head in the raised position. Note the ammeter reading.
9. Place the scrub brush control switch in the "fast" speed position with the scrub head in the raised position. Note the ammeter reading.
10. Lower the scrub head.
11. Place the scrub brush control switch in the "slow" speed position and note the ammeter reading.

12. Place the scrub brush control switch in the "fast" speed position and note the ammeter reading.
13. Hold the heavy scrub brush pressure switch and the scrub head position switches down and note the ammeter reading.
14. Place the scrub brush control switch in the "off" position and raise the scrub head.
15. Place the master power switch in the "off" position.
16. Reconnect the scrub brush drive motor electrical connector. Disconnect the electrical connector for the other motor.
17. Repeat steps 7 through 15.
18. Compare the ammeter readings with the following chart.

Test Condition	Standard Scrub Brush Motor Amp Draw	Heavy Duty Scrub Brush Motor Amp Draw
Scrub brush "raised":		
"slow" speed	2	2
"fast" speed	4	4
Scrub brush "lowered":		
"slow" speed	5-8	5-8
"fast" speed	8-12	8-12
Scrub brush "lowered" with "heavy scrub brush pressure"	18-20	24-26

If the readings were higher than specified, check the scrub brush drive assembly for binding or the motor may have to be repaired or replaced.

19. Adjust the scrub brush overlap as described in To Check and Adjust Scrub Brush Overlap.

TO CHECK PROPELLING MOTOR AMP DRAW

1. Place the master power switch in the "on" position.
2. Note the ammeter reading with only the propelling motor operating.
3. Operate the machine at maximum forward speed with the scrub head and squeegee up. Note the ammeter reading.
4. Lower the scrub head and squeegee.
5. Operate the machine at maximum forward speed and note the ammeter reading.
6. Compare the readings with the following chart.

Test Condition	Propelling Motor Amp Draw
Machine stationary	2-3
Level surface, full forward:	
Brushes/squeegee up	5-7
Brushes/squeegee down	8-10

If the readings are higher than specified, the propelling system components may be binding or locking up, the parking brake may be dragging, or the motor may have to be repaired or replaced.

WHEEL DRIVE CHAINS

The two wheel drive chains transfer power from the wheel drive clutches to the drive wheels. Lubricate the chains by brushing on lithium base moly-disulphide EP grease on them after every 80 hours of operation.

Adjust the tension of the wheel drive chains after every 160 hours of operation.

TO CHECK AND ADJUST WHEEL DRIVE CHAIN TENSION

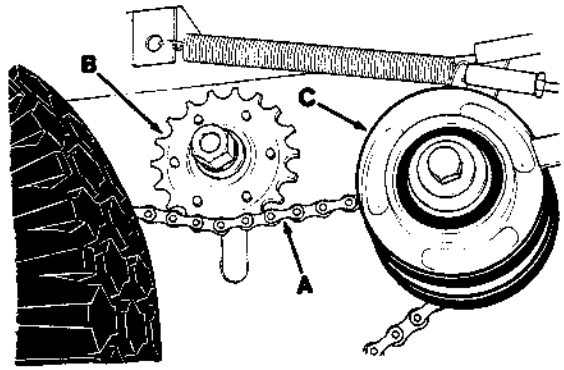
1. Place the master power switch in the "off" position.

⚠ CAUTION: Always place the master power switch in the "off" position before working on the machine to prevent machine creeping and electrical shock.

2. Open the machine cover.
3. Disconnect the batteries-to-machine connector.

⚠ CAUTION: Always disconnect the batteries-to-machine connector before working on the machine clutch or electrical components to prevent machine start-up or electrical shock.

4. Remove the two lower side access panels.
5. Check the drive chain slack between the drive wheel sprocket and the clutch sprocket. It should be 0.12 to 0.56 in (3 to 15 mm).



WHEEL DRIVE CHAIN 00698

A. Chain
B. Chain Idler
C. Clutch

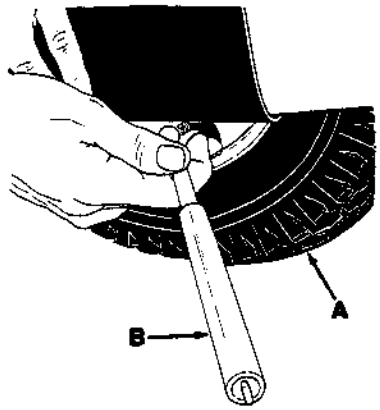
To adjust the chain tension, loosen the chain idler sprocket nut; slide the chain idler up to loosen the chain or slide the chain idler down to tighten the chain and tighten the chain idler sprocket nut.

6. Replace lower side access panels.
7. Reconnect the batteries-to-machine connector.

DRIVE WHEEL TIRES

The two drive wheel tires support the front of the machine and propel the machine. Check the tire air pressure daily before operating the machine. The correct air pressure is 40 to 45 psi (275 to 310 kPa) when the machine is equipped with standard batteries, and 60 to 65 psi (415 to 450 kPa) when the machine is equipped with heavy duty batteries.

Clean the tires after every work shift when the machine is operated in areas where solvents, oils, and other petroleum-base fluids may contact the tires. This will greatly prolong the life of the tire.



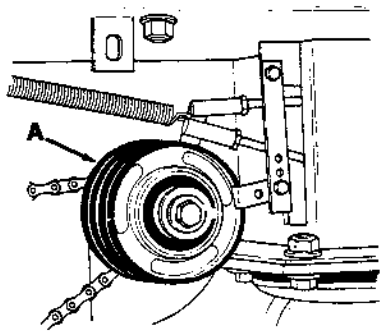
CHECKING TIRE AIR PRESSURE 00901

A. Tire
B. Air Pressure Gauge

WHEEL DRIVE CLUTCHES

The two wheel drive clutches require no regular maintenance; only the clutch and steering control handle linkages need periodic adjustment as described in Steering Control Handles and Clutch Linkage Adjustment.

After a period of time, the clutch drive plates wear out and there is no linkage adjustment left. The clutch must then be rebuilt or replaced.



WHEEL DRIVE CLUTCH 00905

A. Clutch

STEERING CONTROL HANDLES AND CLUTCH LINKAGE

The steering control handles operate linkages which control the wheel drive clutches. The steering control handle linkage and the clutch linkage must be properly adjusted to ensure smooth clutch operation. Check the linkages adjustment after every 80 hours of operation and after replacing any linkage or clutch component.

The following steering/propelling symptoms also indicate a need for clutch adjustment.

- Machine turns one direction only, or pulls in one direction when both handles are fully depressed.
- Propelling speed too slow, or loss of power to climb ramp when handles are fully depressed, and batteries are fully charged.
- Clutches are "grabbing or sticking." Machine creeps or continues to propel when handles are released.

TO CHECK AND ADJUST STEERING CONTROL HANDLES AND CLUTCH LINKAGES

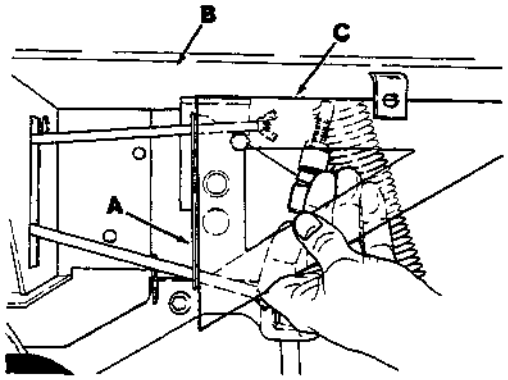
1. Place the master power switch in the "off" position.

⚠ CAUTION: Always place the master power switch in the "off" position before working on the machine to prevent machine creeping or electrical shock.

2. Disconnect the batteries-to-machine connector.

⚠ CAUTION: Always disconnect the batteries-to-machine connector before working on the machine clutch or electrical components to prevent machine start-up or electrical shock.

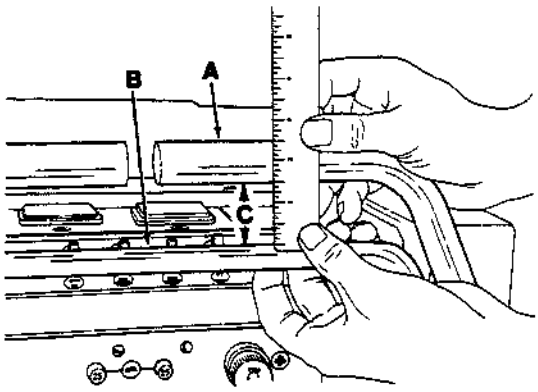
3. Remove the left and right side lower access panels.
4. Position the clutch bellcranks so they are perpendicular to the bottom of the machine frame. This can be done with a triangle or framing square.



PERPENDICULAR BELLCRANK 00902

A. Bellcrank
B. Machine Frame
C. Triangle

5. Check the steering handles adjustment by measuring the distance from the bottom of each of the steering control handles to the top of the stationary handle. The distance should be 1.5 in (40 mm).

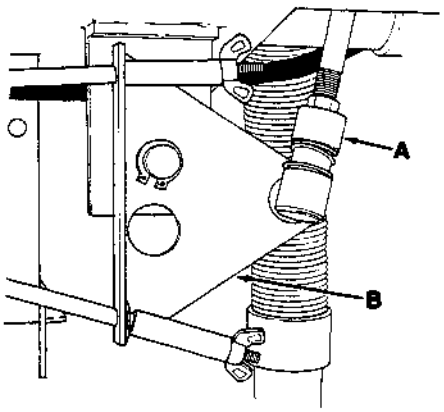


00903

MEASURING STEERING CONTROL HANDLE HEIGHT

A. Steering Control Handle
B. Stationary Handle
C. 1.5 in (40 mm)

a. To adjust steering control handle height, disconnect the lower steering linkage ball joint from the bellcrank by pulling back and out on the ball joint sleeve.



STEERING LINKAGE BALL JOINT 00904

A. Ball Joint
B. Bellcrank

b. Remove the relay access panel.

c. Loosen each of the steering control handle ball joint jam nuts.

d. Rotate each of the steering control rods to adjust the steering control handles to the proper height.

e. Tighten the ball joint jam nuts.

f. Make sure the steering control rod springs are not compressed or the spring retaining ring is not off the spring bracket. If the spring is compressed or the retaining ring is off the spring bracket, there may be binding in the control system and the height adjustment is incorrect. Readjust if necessary.

g. Reinstall relay access panel.

h. Thread the lower steering linkage ball joint into or off the threaded rod to line up the ball joint and the ball joint stud.

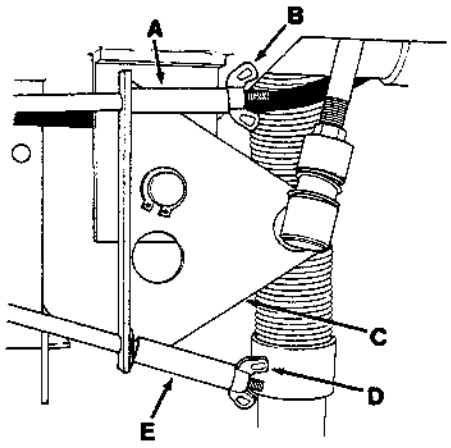
i. Reconnect the ball joint to the bellcrank by pulling the ball joint sleeve back, sliding the ball joint onto the bellcrank ball joint stud, and releasing the ball joint sleeve.

NOTE: If adjustments are made to the steering control rods, check the adjustment of the steering control rod switches as described in To Check and Adjust Steering Control Rod Switches.

6. Adjust clutches as follows:

a. Turn the master switch to "off" position.

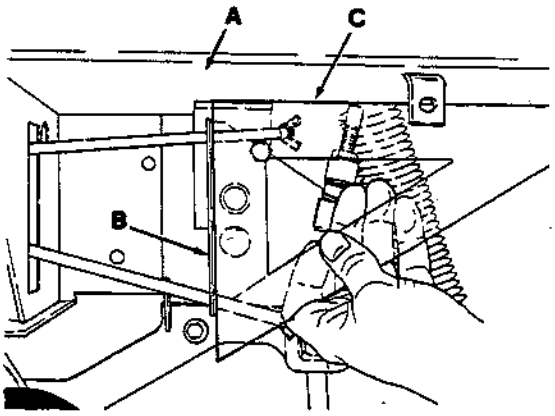
b. Loosen the wingnuts on both sides of the machine until the sleeves are not applying any pressure on the bellcrank.



CLUTCH ADJUSTMENT WING NUTS 00904

A. Sleeve
B. Upper Wing Nut
C. Bellcrank
D. Lower Wing Nut
E. Sleeve

c. At this time the bellcrank should be perpendicular to the machine frame. If it is not perpendicular to the frame, go to step 4.



PERPENDICULAR BELLCRANK 00902

A. Machine Frame
B. Bellcrank
C. Triangle

d. Tighten the wingnuts until the sleeves just "touch" the bellcrank, but do not apply pressure to the clutch rods.

NOTE: The bellcrank must remain perpendicular to the frame.

e. If clutch adjustment is not correct, the machine may move when the master switch is turned on. Before testing be sure area around the machine is clear and be prepared to shut off the master switch if the machine moves.

If the machine moves, recheck adjustments in steps a through d. If the machine continues to move without depressing handles, repair or replace clutch as required.

f. Depress the left steering control handle until there is a 0.62 to 0.75 in (15 to 20 mm) gap between it and the stationary, lower, handle. At this handle position, the machine will be starting to pull to the right slowly. If the machine does not attempt to move, tighten the upper and lower wing nuts evenly on the left side of the machine only, until the machine starts to move slowly to the right. If the machine moves before the handle is depressed to the 0.75 in (20 mm) maximum gap, loosen the upper and lower wing nuts evenly on the left side of the machine only, until the gap is achieved.

NOTE: The bellcrank must remain perpendicular to the frame when the handles are returned to neutral.

g. Repeat step f for the right steering control handle and clutch. Motion of the machine will be the left.

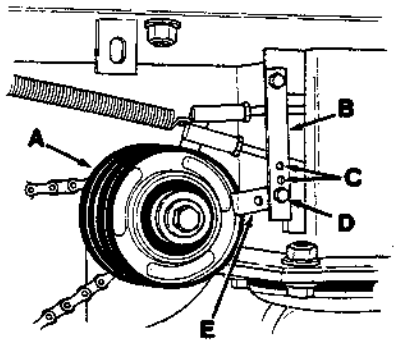
h. When the adjustments are completed, the two upper steering control handles should be in line with each other when in neutral.

If tightening the wing nuts fails to provide proper propelling, further adjustments are needed.

i. Turn the master switch to "off."

j. Loosen the wing nuts completely.

k. Disconnect the clutch stationary arm from the support and remount it to the support in the next hole up.



CLUTCH STATIONARY ARM 00905

A. Clutch
B. Stationary Arm Support
C. Adjustment Holes
D. Mounting Screw (Nut must be on the outside)
E. Clutch Stationary Arm

l. Repeat steps c through h.

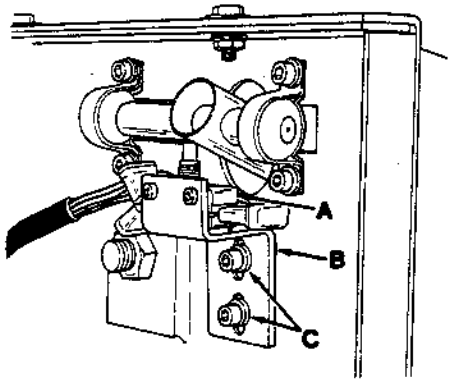
NOTE: When the mounting screw is in the upper most hole, the nut must be to the outside or it will interfere with the ball joints.

m. If the clutch still fails to operate satisfactorily, and the top hole of the stationary arm support has been used, check for linkage binding. If the linkage is working satisfactorily, the clutch then will have to be rebuilt or replaced.

7. Open the machine cover.

8. Check the reverse engagement switches to see that by raising either steering control handle 0.25 in (5 mm), the switch related to that control handle is tripped.

To adjust the switch, loosen the switch mounting bracket retaining screws, slide the switch and bracket up or down to the correct position, and tighten the switch mounting bracket retaining screws.



REVERSE ENGAGEMENT SWITCH 00907

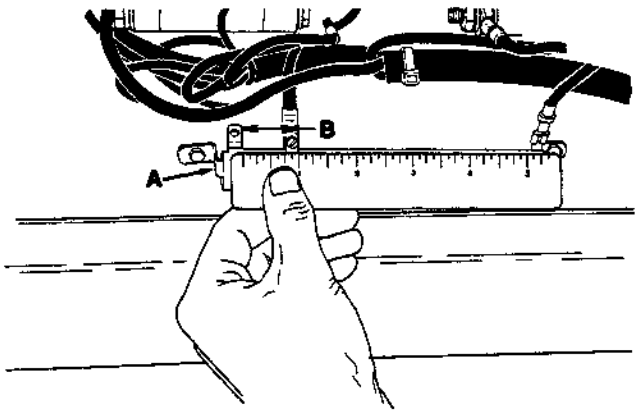
A. Switch
B. Switch Mounting Bracket
C. Retaining Screws

9. Close the machine cover.

10. Replace the right and left side lower access panels.

REVERSE SPEED ADJUSTMENT

Reverse machine speed is determined by adjusting a variable resistor located under the control panel on the rear frame of the machine. Reverse speed is set by placing wire 58 approximately 1 in (25 mm) from the end of the resistor. Reverse speed should be approximately 1.5 mph (1.4 km/h).



ADJUSTING REVERSE SPEED RESISTOR 00909

A. Resistor
B. 1 in (25 mm)

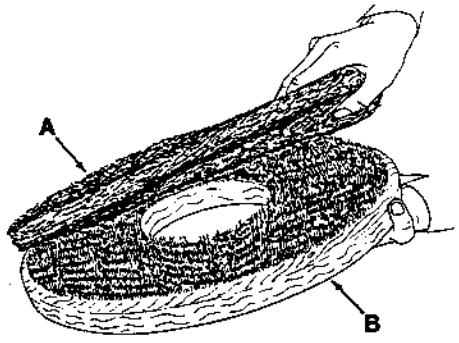
SCRUB HEAD

SCRUB BRUSHES

Two disc-type scrub brushes are used to scrub the floor surface. Each scrub brush is driven by a separate electric motor. The scrub brushes are connected to the motor through a floating drive assembly. Part of each floating drive assembly is three magnets. These magnets hold the scrub brushes to the floating drive assembly.

There are many variations of brushes and cleaning pads to choose from. There is a brush or cleaning pad available for almost any application.

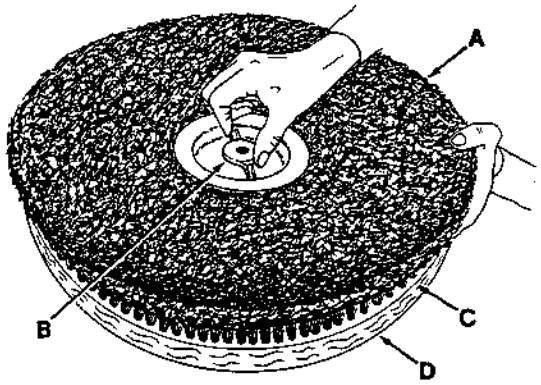
Scrub brushes are ready for use when they are equipped with a brush drive plate. Cleaning pads must be placed on pad drives equipped with brush drive plates before they are ready for use. There are two kinds of cleaning pad drives. Cleaning pads cling to one type pad drive through the use of Insta-Lok fibers.



INSTA-LOK CLEANING PAD DRIVE 00910

A. Cleaning Pad
B. Pad Drive

The other type pad is held in place by a pad holder.



CLEANING PAD HOLDER DRIVE 00911

A. Cleaning Pad
B. Wing Nut
C. Pad Holder
D. Pad Drive

Scrub brushes or cleaning pads should be checked daily for tangled wire or string wear damage. Scrub brushes should be replaced if large portions of the brush bristles are missing or if the remaining brush bristle length is less than 0.50 to 0.25 in (15 to 5 mm).

Cleaning pads should be cleaned when soilage or wax clog the pads. Cleaning pads should be replaced when they become damaged or when the pads cannot be cleaned enough to produce acceptable cleaning results.

The scrub brush overlap is adjusted by pivoting the left scrub brush motor mounting plate. Check the scrub brush overlap daily and after replacing the scrub brushes.

The scrub brush down pressure is regulated by three limit switches on the scrub head. Check the scrub brush limit switches adjustment after every 160 hours of operation.

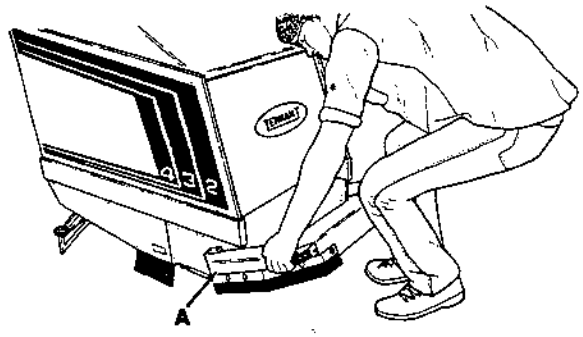
TO REMOVE SCRUB BRUSHES

1. Push the scrub head position switch forward into the "raise" position until the scrub head is fully raised.
2. Place the master power switch in the "off" position.

⚠ CAUTION: Always place the master power switch in the "off" position when working on the machine to prevent machine from creeping or electrical shock.

3. Standard machines: Pull up the front of the scrub head cover until the cover pins snap out of the cover latches. Then lift the scrub head cover up and out.

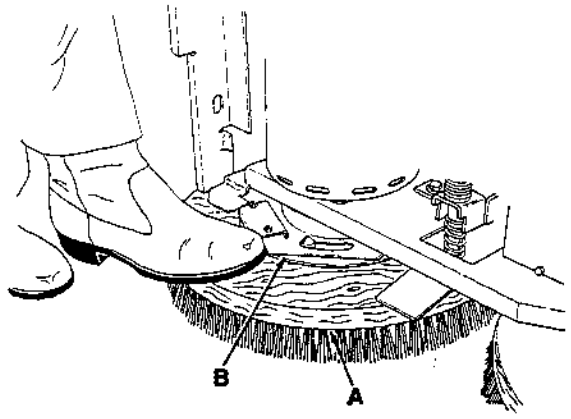
   Pre-Sweep machines: Remove Pre-Sweep hopper.



REMOVING SCRUB HEAD COVER 00376

A. Scrub Head Cover

4. Push the scrub brushes down to disconnect them from the brush drive assembly.



REMOVING SCRUB BRUSH 00912

A. Scrub Brush
B. Brush Drive Assembly

5. Standard machines: Slide the scrub brushes out from under the machine.

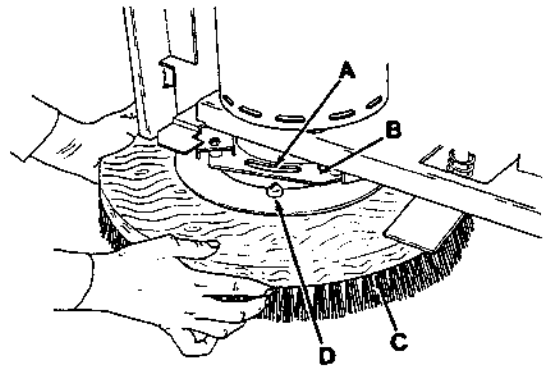
   Pre-Sweep machines: Lift Pre-Sweep frame and slide scrub brushes out.

TO INSTALL SCRUB BRUSHES

1. Standard machines: Slide the scrub brushes under the scrub brush drive assemblies.

   Pre-Sweep machines: Lift Pre-Sweep frame, and slide the scrub brushes under the scrub brush drive assemblies.

2. Line up the scrub brush drive pins with the drive slots on the scrub brush drive assembly.

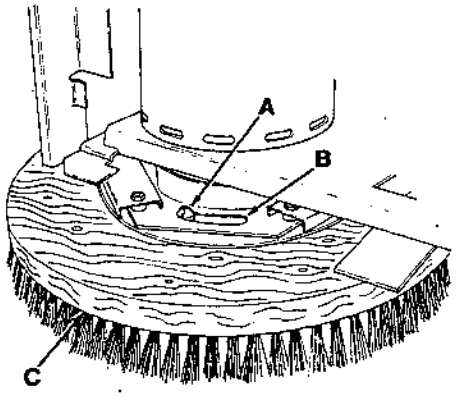


INSTALLING SCRUB BRUSH 00913

A. Drive Slot
B. Scrub Brush Drive Assembly
C. Scrub Brush
D. Drive Pin

3. Lift the scrub brush into the drive assembly. The magnets will hold the scrub brushes in place.

4. Rotate the scrub brushes to make sure all three of the scrub brush drive pins are in the drive slots.



DRIVE PINS IN DRIVE SLOTS 00914

A. Drive Pin
B. Drive Slot
C. Scrub Brush

5. Check the scrub brush pattern for proper brush overlap; see To Check and Adjust Scrub Brush Overlap.

TO CHECK AND ADJUST SCRUB BRUSH OVERLAP

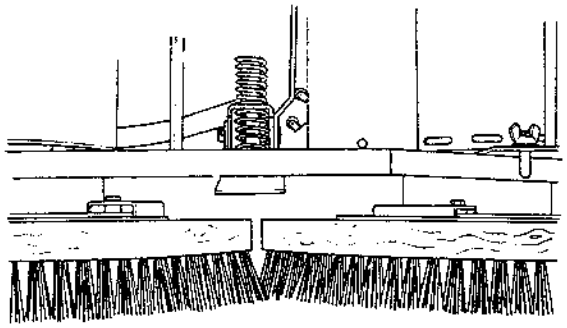
1. Place the master power switch in the "off" position.

⚠ CAUTION: Always place the master power switch in the "off" position before working on the machine to prevent machine from creeping or electrical shock.

2. Standard machines: Pull up the front of the scrub head cover until the cover pins snap out of the cover latches. Then lift the scrub head cover up and out.

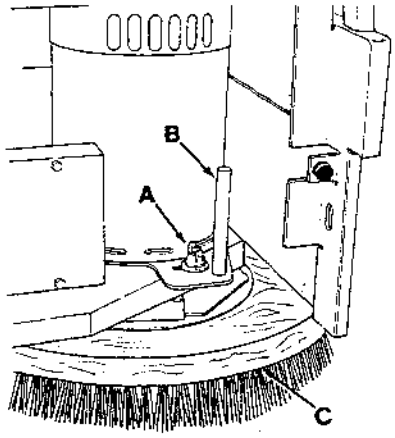
   Pre-Sweep machines: Remove debris hopper.

3. Open the front access panel.
4. Look between the scrub brushes. The brushes should interfere or overlap slightly.



SCRUB BRUSH OVERLAP 00915

To adjust scrub brush overlap, loosen the scrub brush motor pivot plate wing nut, move the scrub brush motor pivot plate to get the scrub brushes to slightly interfere or overlap, and tighten the pivot plate wing nut.



SCRUB BRUSH MOTOR PIVOT PLATE 00916
A. Wing Nut
B. Pivot Plate Arm
C. Scrub Brush

5. Lower the front access panel.
6. Standard machines: Slide the scrub head cover in and down onto the locating pins on the sides up the machine. Make sure the pins snap into the catches.

   Pre-Sweep machines: Replace hopper.

TO CHECK AND ADJUST SCRUB BRUSH LIMIT SWITCHES

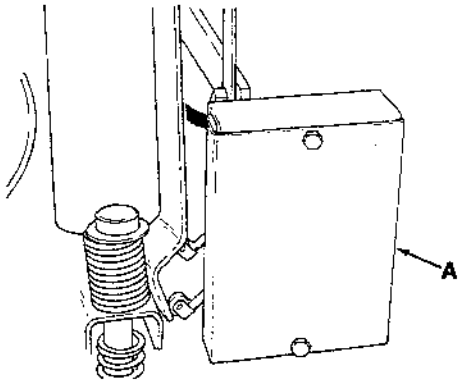
The following adjustments will provide 60 to 85 lb (25 to 40 kg) brush pressure in the light setting and 145 to 165 lb (65 to 75 kg) in the heavy setting with standard scrub brush motors; and will provide 65 to 90 lb (30 to 40 kg) brush pressure in the light setting and 190 to 210 lb (85 to 95 kg) in the heavy setting with heavy duty scrub brush motors.

1. Place the master power switch in the "off" position.

⚠ CAUTION: Always place the master power switch in the "off" position before working on the machine to prevent machine from creeping or electrical shock.

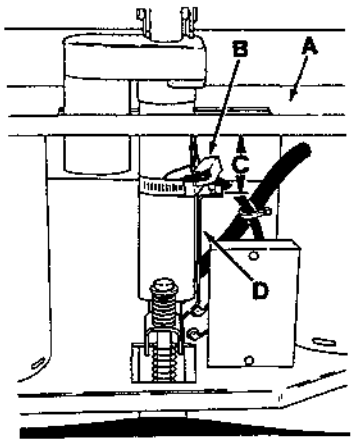
2. Fill the solution tank with water and check the tire pressure.
3. Standard machines: Remove the scrub head cover by pulling the front of the scrub head cover up until the cover pins snap out of the cover latches. Then lift the scrub head cover up and out.

   Pre-Sweep machines: Remove hopper.
4. Open the front access panel.
5. Remove the limit switch cover plate.



LIMIT SWITCH COVER PLATE 00918
A. Cover Plate

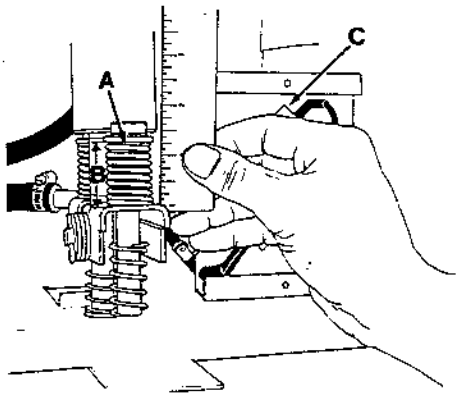
6. Place the master power switch in the "on" position.
7. Raise the scrub head to the "fully raised" position.
8. Place the master power switch in the "off" position.
9. Remove the scrub brushes from their drive assemblies.
10. Pull each scrub brush out from under its drive assembly. The brush drive pins should just clear the drive assembly. Adjust the height of the upper limit switch to adjust scrub brush drive pin clearance. There should be approximately 3.25 in (80 mm) between the bottom of the flat portion of the main frame and the bottom of the upper limit switch.



UPPER LIMIT SWITCH 02644
A. Main Frame
B. Upper Limit Switch
C. 3.25 in (80 mm)
D. Headlift Bracket

11. Replace the scrub brushes.
12. Place the master power switch in the "on" position.

13. Lower the scrub head until the height of the upper spring measures 1.31 ±0.03 in (35 ±1 mm) on machines with standard scrub brush motors and 1.06 ±0.03 in (25 ±1 mm) on machines with heavy duty scrub brush motors.

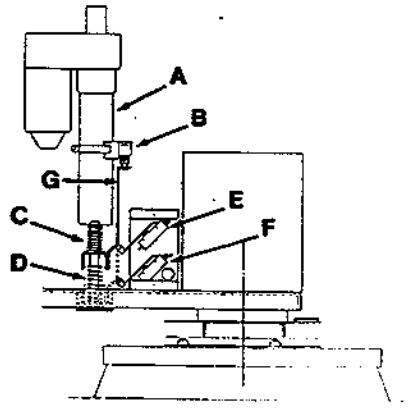


MEASURING UPPER SPRING 00917
A. Upper Spring
B. Spring Length
C. Free Float Switch

14. Place the master power switch in the "off" position.

15. Loosen the free float switch mounting screws, adjust the switch position so the trip bracket will trip the switch when it reaches this position. Then retighten the switch mounting screws, lower6and raise the scrub head, and recheck the spring length. Readjust if necessary.

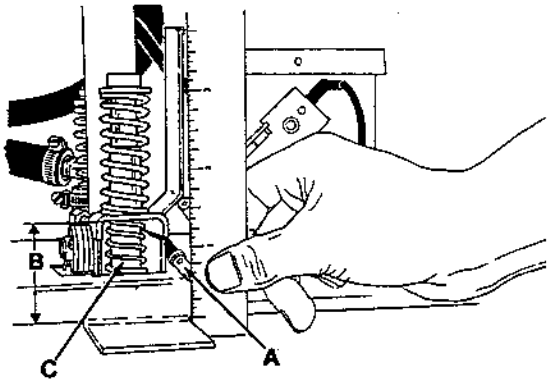
NOTE: The switch position may have to be slightly above, 0.06 in (2 mm), the point where it is when the spring is correctly compressed. This will compensate for actuator overtravel.



SCRUB HEAD POSITION COMPONENTS 00147
A. Actuator
B. Upper Limit Switch
C. Upper Spring
D. Lower Spring
E. Free Float Switch
F. Lower Limit Switch
G. Trip Bracket

16. Place the master power switch in the "on" position.

17. Raise the scrub head. Then lower the scrub head until the lower spring measures 1.44 ±0.03 in (35 ±1 mm).



MEASURING LOWER SPRING 00919
A. Lower Limit Switch
B. 1.44 ± 0.03 in (35 ± 1 mm)
C. Lower Spring

18. Place the master power switch in the "off" position.

19. Loosen the lower limit switch mounting screws. Adjust the switch position so the trip bracket will trip the switch when it reaches this position. Then retighten the switch mounting screws, lower and raise the scrub head, and recheck the spring length. Readjust if necessary.

NOTE: The switch position may have to be slightly above, 0.06 in (2 mm), the point where it is when the spring is correctly compressed. This will compensate for actuator overtravel.

20. Replace the limit switches cover plate.

21. Close the front access panel.

22. Standard machines: Replace the scrub head cover by sliding the scrub head cover in and down onto the locating pins on the side of the machine. Make sure the pins snap into the catches.

    Pre-Sweep Machines: Replace the hopper.

SOLUTION SUPPLY AND RECOVERY SYSTEMS

SOLUTION SUPPLY SYSTEM

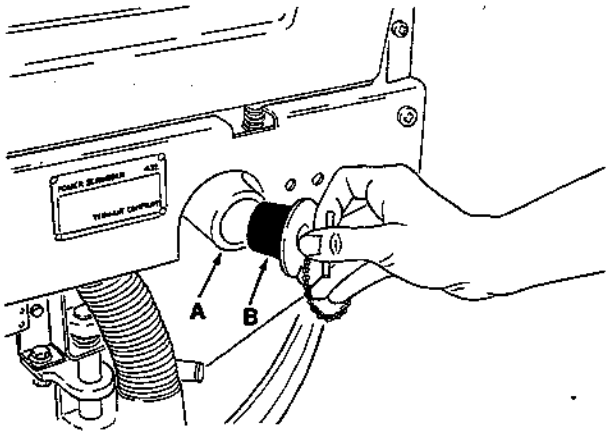
The solution supply system consists of the solution tank and the solution supply hoses and control valve. Under normal operating conditions, the solution tank and the solution supply hoses and control valve should be cleaned after every 80 hours of operation. When the machine is operated in the ES® mode, the solution tank and the solution supply hoses and control valve should be cleaned after each work shift.

TO CLEAN SOLUTION SUPPLY SYSTEM

1. Stop the rear of the machine next to a floor drain.
2. Place the master power switch in the "off" position.

⚠ CAUTION: Always place the master power switch in the "off" position before working on the machine to prevent machine from creeping or electrical shock.

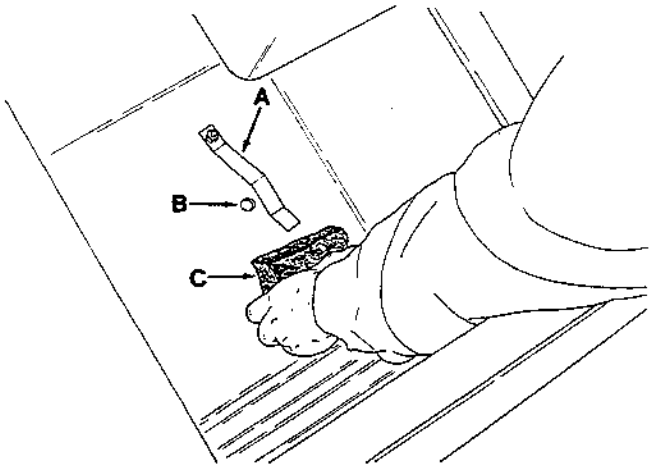
3. Drain the solution tank by pulling the drain arm out on old style machines or by turning the drain plug handle counterclockwise and removing plug on new style machines.



DRAINING SOLUTION TANK 00920

A. Solution Tank Outlet
B. Drain Plug

4. Open the machine cover. Tilt the vacuum fan assembly forward.
5. Lift the solution tank cover assembly forward off the solution tank.
6. Push the solution control lever into the "on" position to open the solution control valve.
7. Hose out the interior of the solution tank.
8. Standard machines: Lift the filter retainer and remove the solution tank outlet filter.



REMOVING TANK OUTLET FILTER 00921

A. Filter Retainer
B. Tank Outlet
C. Outlet Filter

9. Direct a stream of clean water at the tank outlet to flush the solution supply hoses and control valve.
10. Standard machines: Rinse and replace the solution tank outlet filter.
11. Close the solution tank drain by pushing the drain arm in on old style machines or placing the plug in the outlet and turning the handle clockwise on new style machines.
12. Replace the solution tank cover on the solution tank. Lower the vacuum fan assembly.
13. Close the machine cover.
14. Pull the solution control lever back into the "off" position to close the solution control valve.

SOLUTION RECOVERY SYSTEM

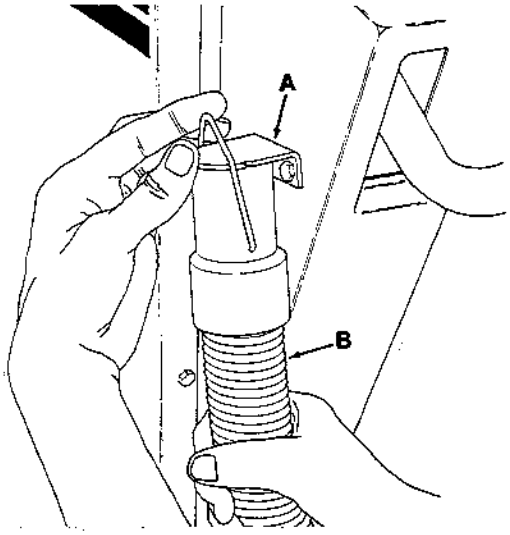
The solution recovery system consists of the recovery tank, the vacuum fan, the solution pickup hose, and the rear squeegee assembly. Under normal operating conditions, the solution recovery system should be cleaned daily.

TO CLEAN SOLUTION RECOVERY SYSTEM

1. Stop the rear of the machine next to a floor drain.
2. Place the master power switch in the "off" position.

⚠ CAUTION: Always place the master power switch in the "off" position before working on the machine to prevent machine from creeping or electrical shock.

3. Remove the recovery tank drain hose from its retaining tab. Slowly lower the drain hose to the floor drain to empty the tank.

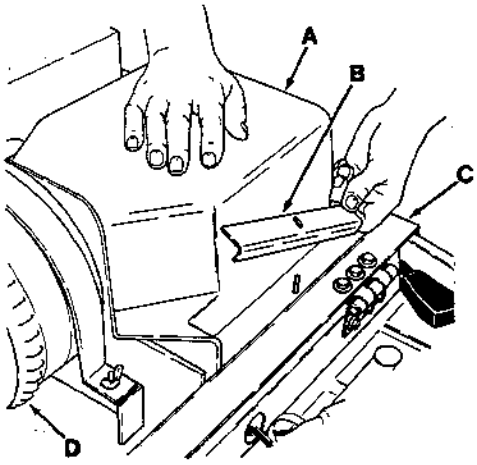


REMOVING RECOVERY TANK DRAIN HOSE 00886

A. Retaining Tab
B. Drain Hose

4. Open the machine cover.

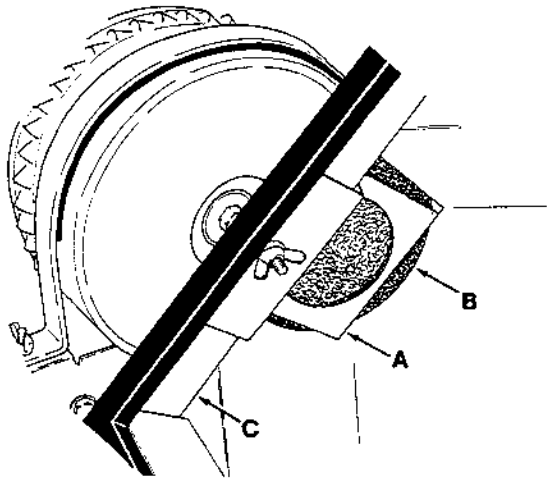
5. Remove the two wing nuts and brackets holding the vacuum housing. Remove the vacuum housing from the fan and housing base.



REMOVING VACUUM FAN HOUSING 02645

A. Housing
B. Housing Bracket
C. Base
D. Vacuum Fan

6. Remove the wing nut holding the vacuum fan screen and filter bracket. Remove the bracket, screen, and filter from the housing.



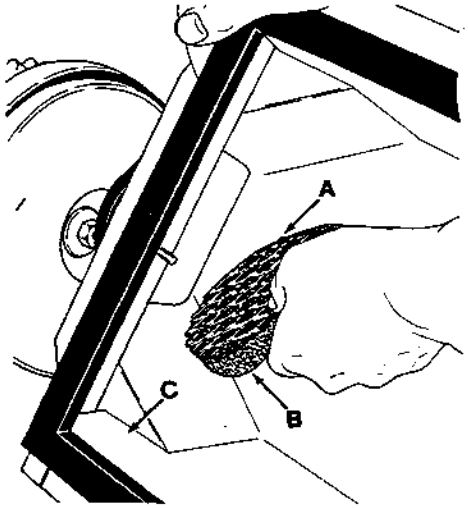
VACUUM FAN SCREEN AND FILTER 02646

A. Bracket
B. Filter
C. Housing

7. Rinse and clean the vacuum fan screen and filter.

8. Reinstall screen and filter in housing. Secure with bracket and wing nut.

NOTE: Position the screen and filter in the housing with the screen on the vacuum fan side of the filter.



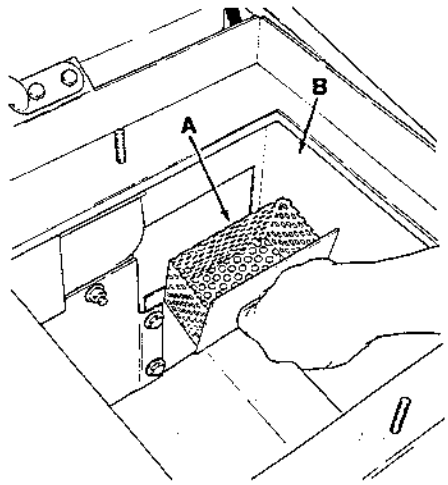
INSTALLING SCREEN AND FILTER 02647

A. Screen
B. Filter
C. Housing

9. Reinstall vacuum fan housing on fan and housing base. Secure with brackets and wing nuts.

10. Lift the vacuum fan assembly.

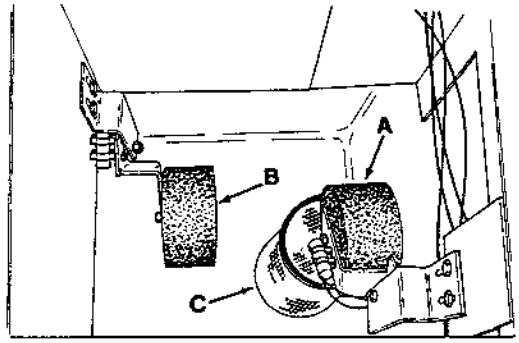
11. ES® machines: Remove, clean, and replace the debris basket.



REMOVING DEBRIS BASKET 02643

A. Debris Basket
B. Recovery Tank

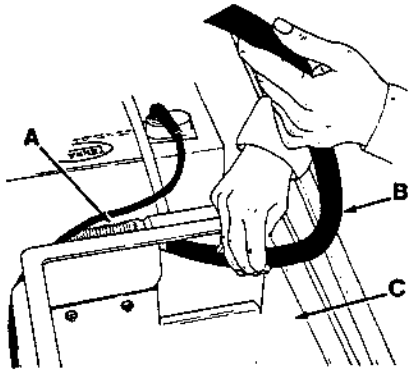
12. Hose out the interior of the recovery tank.



RECOVERY TANK 02648

A. Vacuum Fan Shut Off Float
B. ES® Float
C. ES® Screen Filter

13. Direct the flow of water into the solution pickup hose to backflush the hose.



BACKFLUSHING PICKUP HOSE 00922

A. Pickup Hose
B. Water Hose
C. Recovery Tank

14. Lower the vacuum fan assembly and machine cover.

15. Replace the recovery tank drain hose on its retaining tab.

SQUEEGEE ASSEMBLY

The squeegee assembly is made up of a front squeegee blade and blade retainer, a squeegee frame and a rear squeegee blade, backup strip and blade retainer. The front squeegee blade channels water into the center of the squeegee frame. The rear squeegee blade wipes the floor nearly dry.

The squeegee assembly can be removed easily for loading and unloading on trailers or to allow the machine to pass through narrow doorways or passageways.

Check the squeegee blades for wear or damage daily. Replace the front squeegee blade if it is damaged or if the squeegee blade has worn to less than 1.88 in (50 mm) in height.

The rear squeegee blade has four edges which may be used to wipe the floor. Rotate end-for-end, or flip the squeegee blade when approximately one-half of the squeegee blade width has worn. Replace the squeegee blade when all four edges have worn.

The squeegee assembly should be adjusted for proper down pressure after every 20 hours of operation. The squeegee assembly steering arm assembly must be adjusted for proper squeegee tracking after every 80 hours of operation.

The squeegee lift assembly is controlled by two limit switches. The limit switches are normally operated by the squeegee control switch on the instrument panel. When the machine is propelled backward, two steering control rod switches are activated which cause the squeegee to rise. The limit switches are not adjustable. The steering control rod switches are factory set and should not require adjustment unless due to parts replacement—they do not function properly.

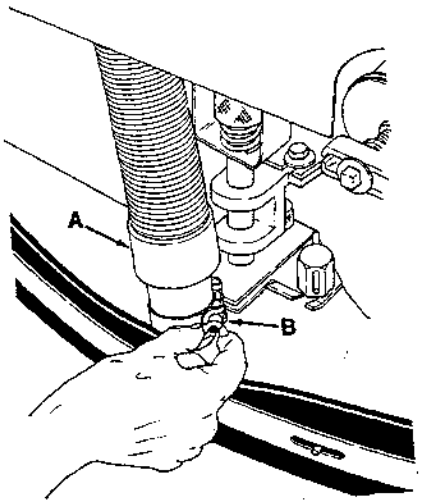
TO REMOVE SQUEEGEE ASSEMBLY

1. Place the squeegee control switch in the "raise" position to raise the squeegee assembly.

2. Place the master power switch in the "off" position.

⚠ CAUTION: Always place the master power switch in the "off" position before working on the machine to prevent machine from creeping or electrical shock.

3. Loosen the squeegee suction hose wormdrive clamp.

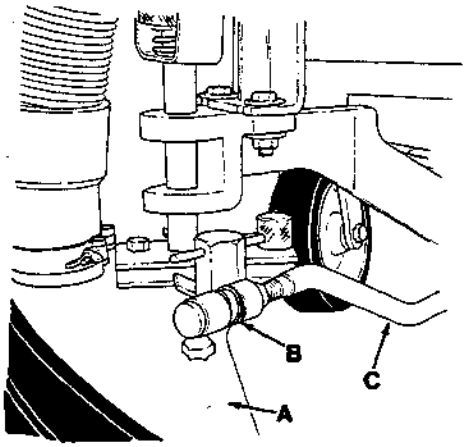


LOOSENING SUCTION HOSE CLAMP 00923

A. Suction Hose
B. Wormdrive Clamp

4. Pull the squeegee suction hose off the squeegee frame.

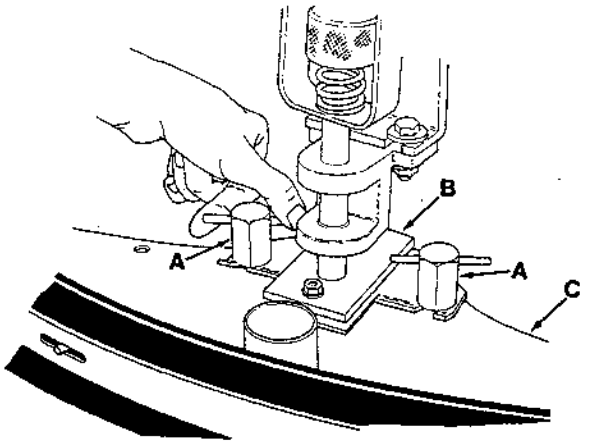
5. Disconnect the squeegee steering arm ball joint from the squeegee frame by pulling the ball joint sleeve back and up.



STEERING ARM BALL JOINT 00924

A. Squeegee Frame
B. Ball Joint
C. Steering Arm

6. Loosen the two squeegee tie-down knobs.



00925

LOOSENING SQUEEGEE TIE-DOWN KNOB

A. Tie-Down Knob
B. Squeegee Mounting Pad
C. Squeegee Frame

7. Slide the squeegee assembly off the squeegee mounting pad.

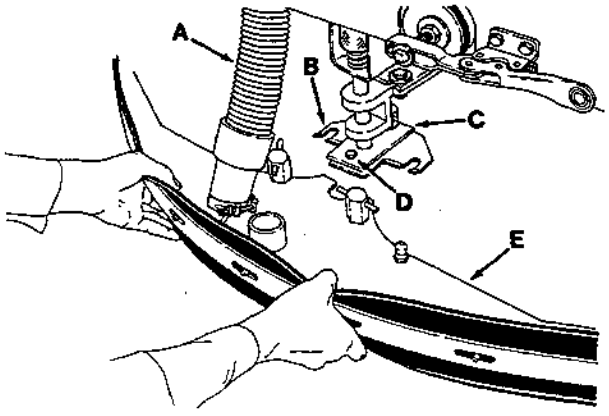
TO INSTALL SQUEEGEE ASSEMBLY

1. Place the squeegee control switch in the "raise" position to lift the squeegee mounting pad.

2. Place the master power switch in the "off" position.

⚠ CAUTION: Always place the master power switch in the "off" position before working on the machine to prevent machine from creeping or electrical shock.

3. Slide the squeegee assembly into position on the squeegee mounting pad.



00926

SLIDING SQUEEGEE ASSEMBLY INTO POSITION

A. Suction Hose
B. Squeegee Mounting Pad
C. Pivot Plate
D. Rubber Washer
E. Squeegee Assembly

4. Tighten the two tie-down knobs.

NOTE: Make sure the rubber washer is present between the pivot plate and the squeegee mounting pad. If the washer is missing or there is a gap of less than 0.12 in (3 mm), the squeegee will not pivot from side to side.

5. Connect the squeegee steering arm and ball joint to the squeegee frame by pulling the ball joint sleeve back, sliding the ball joint onto the squeegee frame ball joint stud, and releasing the ball joint sleeve.

6. Push the squeegee suction hose onto the squeegee frame hose connection.

7. Tighten the suction hose wormdrive clamp.

TO REPLACE FRONT SQUEEGEE BLADE

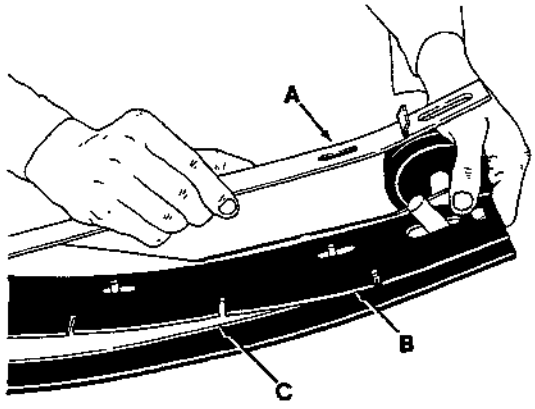
1. Remove the squeegee assembly from the machine.

2. Turn the front squeegee levered cam clockwise to relieve tension on the squeegee retention band.

3. Remove the squeegee retention band stationary cam and levered cam.

4. Remove the front squeegee from the squeegee frame.

5. Position the new front squeegee blade on the squeegee frame pins.

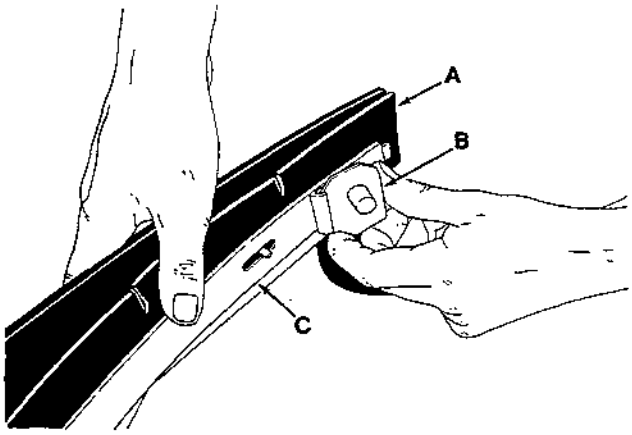


00927

INSTALLING FRONT SQUEEGEE BLADE AND BAND

A. Retention Band
B. Front Squeegee Blade
C. Squeegee Frame

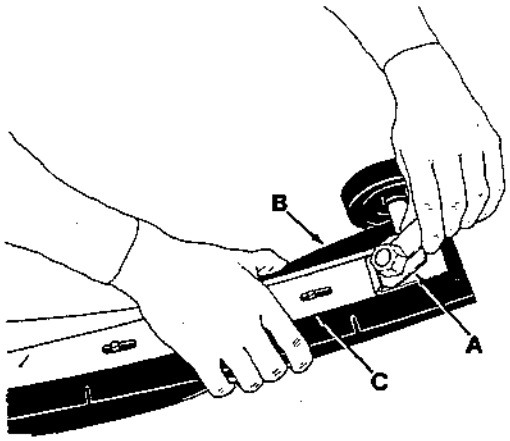
6. Position the stationary squeegee cam and retention band over the squeegee blade.



INSTALLING STATIONARY CAM 00928

A. Front Squeegee Blade
B. Stationary Cam
C. Retention Band

7. Position the levered cam on the squeegee retention band with the lever down.



INSTALLING LEVERED CAM 00929

A. Levered Cam
B. Front Squeegee Blade
C. Retention Band

8. Pull the levered cam lever up to tighten the front squeegee in place.

NOTE: If the levered cam is too loose to clamp the squeegee blade, rotate the stationary cam to the next flat edge and retighten the levered cam. Overtightening the levered cam may damage the squeegee frame and retention band.

9. Reinstall the squeegee assembly on the machine.

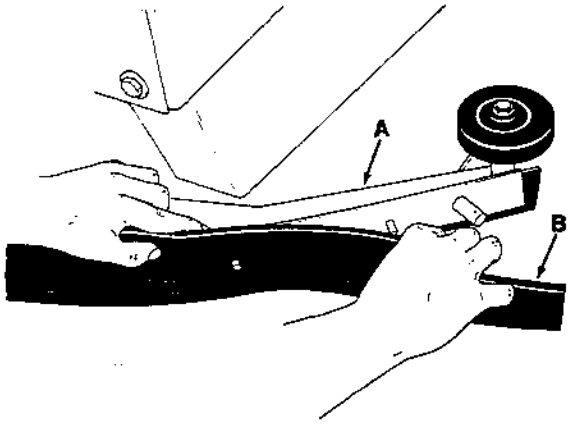
TO REPLACE REAR SQUEEGEE BLADE

1. Place the squeegee controls switch in the "raise" position to raise the squeegee assembly.

2. Place the master power switch in the "off" position.

⚠ CAUTION: Always place the master power switch in the "off" position before working on the machine to prevent machine from creeping or electrical shock.

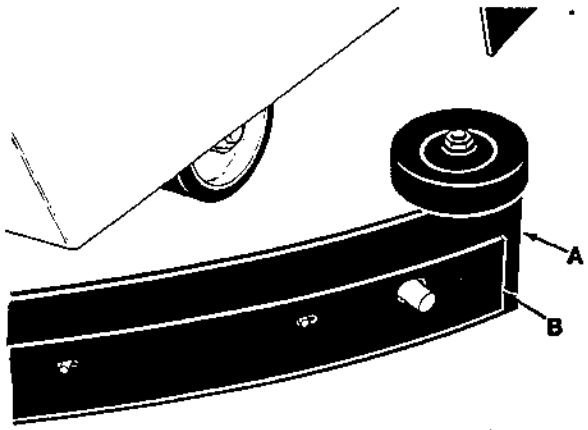
3. Turn the rear squeegee levered cam clockwise to relieve tension on the squeegee retention band.
4. Remove the squeegee retention band, stationary cam, and levered cam.
5. Remove the backup strip and rear squeegee from the squeegee frame.
6. Rotate end-for-end or flip the rear squeegee blade to use an unused edge of the squeegee blade, or discard the old squeegee and replace it with a new squeegee blade.
7. Position the rear squeegee blade on the squeegee frame pins.



INSTALLING SQUEEGEE BLADE 00930

A. Squeegee Frame
B. Rear Squeegee Blade

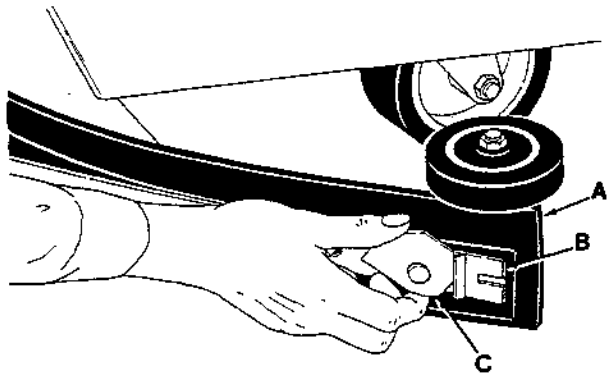
8. Position the squeegee backup strip over the rear squeegee with the long side down.



INSTALLING BACKUP STRIP 00931

A. Rear Squeegee Blade
B. Backup Strip

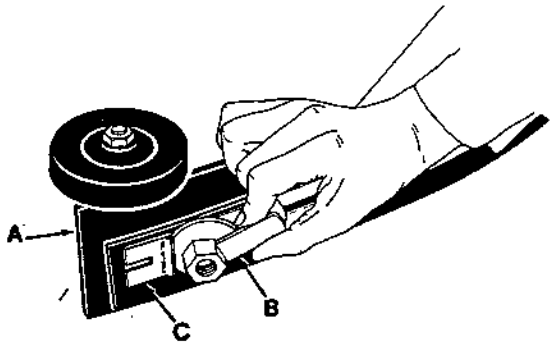
9. Position the stationary cam and the retention band over the backup strip.



POSITIONING STATIONARY CAM 00932

A. Rear Squeegee Blade
B. Retention Band
C. Stationary Cam

10. Position the levered cam on the squeegee retention band with the lever down.



INSTALLING LEVERED CAM 00933

A. Rear Squeegee Blade
B. Levered Cam
C. Retention Band

11. Pull the levered cam lever up to tighten the rear squeegee in place.

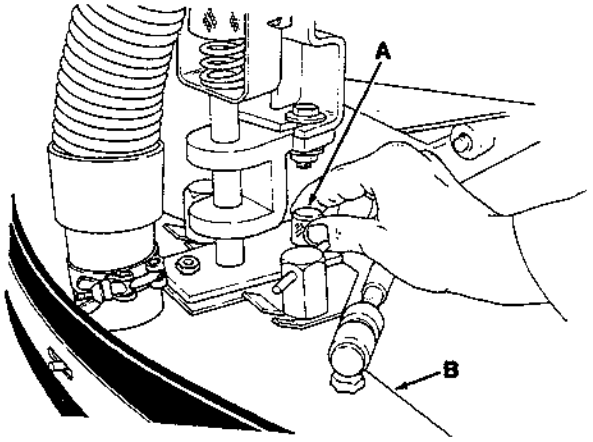
NOTE: The cam lever should be above the horizontal axis to keep from possibly scratching the floor. If the levered cam is too loose to clamp the squeegee blade, rotate the stationary cam to the next flat edge and retighten the levered cam. Overtightening the levered cam may damage the squeegee frame and retention band.

TO ADJUST SQUEEGEE ASSEMBLY DOWN PRESSURE

1. Place the master power switch in the "on" position.
2. Place the squeegee control switch in the "lower" position.

3. Operate the machine in a forward direction to lower the squeegee assembly and deflect the squeegee blade.

4. Observe the squeegee blade deflection. The squeegee blade should be evenly deflected from one end to the other. If the squeegee tips are deflecting less than the middle of the squeegee, turn the squeegee tips adjusting knob counterclockwise. If the squeegee tips are deflecting more than the middle of the squeegee, turn the squeegee tips adjusting knob clockwise. Raise and lower the squeegee, operate the machine, and recheck the squeegee tips deflection if an adjustment was made.



00934

ADJUSTING SQUEEGEE TIPS DEFLECTION

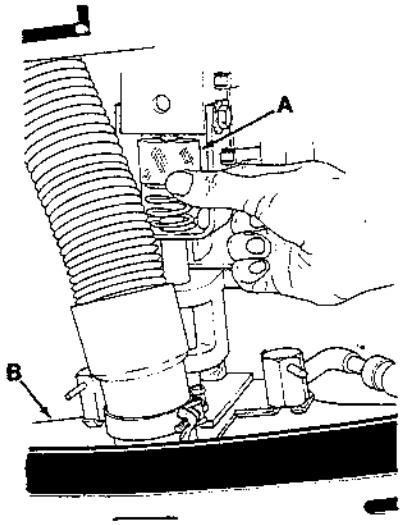
A. Squeegee Tips Adjusting Knob
B. Squeegee Assembly

5. Operate the machine in a forward direction with the squeegee down to deflect the squeegee blades.

6. Check the rear squeegee blade deflection. The rear squeegee should deflect approximately 0.5 in (15 mm). If the squeegee is deflecting less than this, turn the squeegee down pressure knob clockwise.

   If the squeegee is deflecting more than this, turn the squeegee down pressure knob counterclockwise. Raise and lower the squeegee, operate the machine, and recheck the squeegee deflection if an adjustment was made.

NOTE: On smooth floors with a new squeegee blade, it may be difficult to adjust for adequate down pressure. If this happens, remove the rear squeegee backup strip.



ADJUSTING SQUEEGEE DEFLECTION 00935

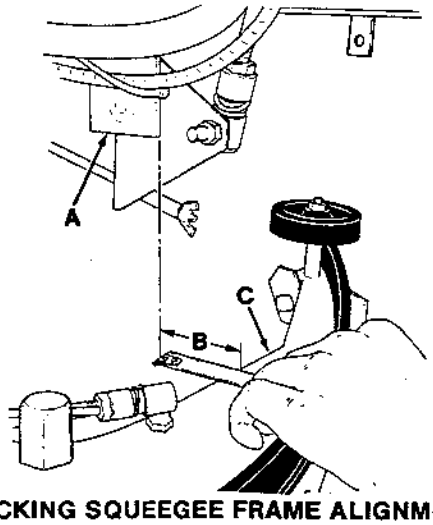
A. Squeegee Down Pressure Knob
B. Squeegee Assembly

TO ADJUST SQUEEGEE TRACKING

1. Place the rear squeegee switch in the "raise" position to raise the rear squeegee.
2. Place the master power switch in the "off" position.

⚠ CAUTION: Always place the master power switch in the "off" position before working on the machine to prevent machine from creeping or electrical shock.

3. Line up the rear squeegee frame straight behind the machine.
4. Measure the distance between the front edge of the squeegee frame on each side of the squeegee pulling arm and the rear edge of the bellcrank bracket. The two distances should be equal within 0.06 in (2 mm).

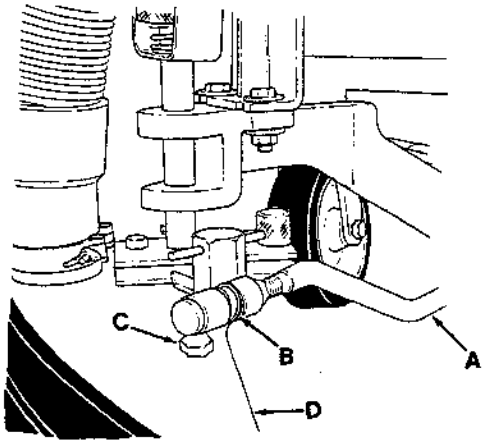


00936

CHECKING SQUEEGEE FRAME ALIGNMENT

A. Rear Edge of Bellcrank Bracket
B. Distance Measured
C. Squeegee Frame

To adjust the squeegee frame alignment, disconnect the squeegee steering arm ball joint from the squeegee frame; thread the ball joint in or out on the steering arm; reconnect the ball joint to the squeegee frame, and recheck the squeegee frame alignment. Repeat the procedure as required.

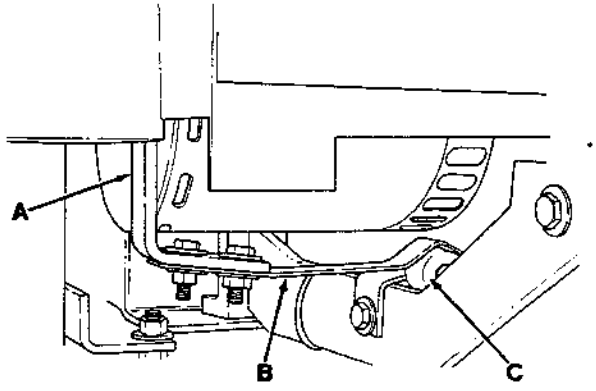


00924

SQUEEGEE FRAME ALIGNMENT BALL JOINT

A. Steering Arm
B. Ball Joint
C. Ball Joint Stud
D. Squeegee Frame

5. Compare the squeegee frame center line to the machine centerline. They should be centered to within 0.12 in (3 mm). To adjust the squeegee frame, adjust the squeegee frame centering cam centering spring. The cam centering spring is adjusted by loosening the two spring mounting bolts, sliding the centering spring to the right or left to center the squeegee frame, and tightening the mounting bolts.



SQUEEGEE FRAME CENTERING SPRING 00938

A. Centering Spring Mounting Bracket
B. Centering Spring
C. Centering Cam

6. Operate the machine along a straight path with water on the floor. Observe the squeegee motion. The squeegee should follow straight—not swing back and forth. To eliminate back and forth motion, loosen the centering spring mounting bracket bolts, slide the mounting bracket down slightly, and retighten the mounting bolts. Recheck the squeegee motion.

   Operate the machine through a series of turns with water on the floor. Observe the squeegee motion. The squeegee should follow the wet scrubbed path. If it does not, loosen the centering spring mounting bolts, slide the mounting bracket up slightly, and retighten the mounting bolts. Recheck the squeegee motion.

TO CHECK AND ADJUST STEERING CONTROL ROD SWITCHES

1. Place the master power switch in the "on" position.

2. Place the squeegee control switch in the "lower" position.

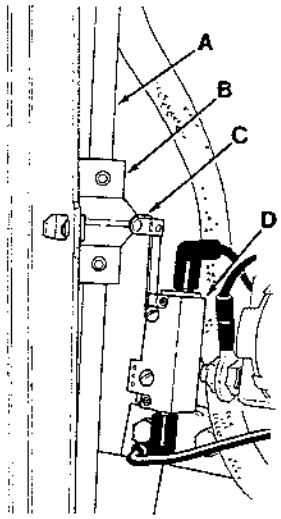
3. Lightly press the steering control handles to lower the rear squeegee. Slowly raise the control handles to raise the rear squeegee. The squeegee should respond before the machine begins to move. If the machine moves before the squeegee responds, the squeegee activating switches or cams must be adjusted.

4. To adjust squeegee activating switches or cams, place the master power switch in the "off" position.

⚠ CAUTION: Always place the master power switch in the "off" position before working on the machine to prevent machine from creeping or electrical shock.

NOTE: Before adjusting switches, be sure the clutch bellcranks are in a "perpendicular" position. If one of the wing nuts is tightened more than the other, the bellcrank will move out of the "perpendicular" position causing the control rods to be in the wrong position relative to the control rod switches.

5. Check the position of the switch rollers on the cams. They should be on the lower edge of the cam. Loosen, readjust, and tighten the cams as necessary.



CONTROL ROD SWITCH AND CAM 00937

A. Control Rod
B. Cam
C. Switch Roller
D. Switch

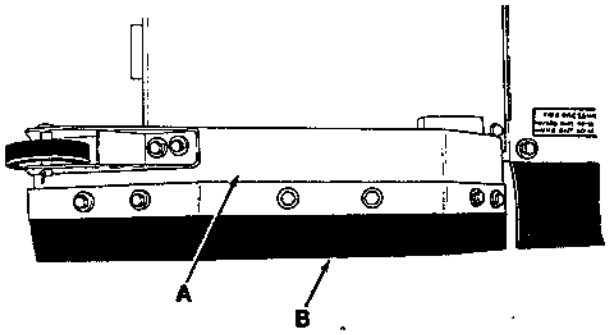
6. Move the steering control handles 0.25 in (5 mm) up or down from the "neutral" position and observe the squeegee activating switches. They should be activated by the movement of the cams. Loosen the switch mounting, adjust the switch position, and retighten the switch mounting to adjust as required.
7. Replace the rear access panel.

SKIRTS

SCRUB HEAD FLOOR SKIRTS

The scrub head cover is equipped with a floor skirt on its left and right sides. Check the floor skirts for wear or damage daily.

To check floor skirt floor clearance, the solution or recovery tank must be full of water and the scrub head must be in the maximum "lowered" position. The floor skirts should be adjusted so there is a maximum of 0.06 in (2 mm) space between the floor and the floor skirt. Check the floor skirt floor clearance after every 80 hours of operation.



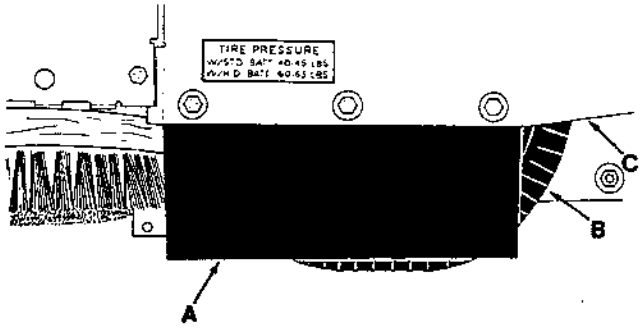
SCRUB HEAD FLOOR SKIRT 00941

A. Scrub Head Cover
B. Scrub Head Floor Skirt

TIRE FLOOR SKIRTS

Each lower side access panel is equipped with a wheel skirt. Check the wheel skirts for wear or damage daily.

To check the wheel skirt floor clearance, the solution or recovery tank must be full of water, and the scrub head must be in the maximum "lowered" position. The wheel skirts should be adjusted so there is a maximum of 0.06 in (2 mm) space between the floor and the wheel skirt. Check the wheel skirt floor clearance after every 80 hours of operation.



TIRE FLOOR SKIRT 00942

A. Tire Floor Skirt
B. Tire
C. Lower Side Access Panel

PARKING BRAKE

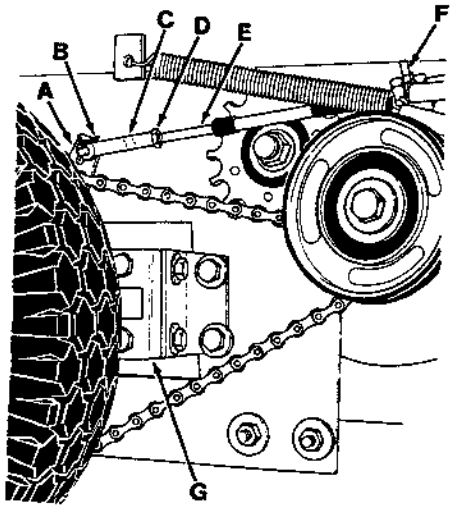
The parking brake is controlled by the parking brake lever. The lever operates two brake cables which control brake calipers on the two drive wheels. The parking brake cable tension should be adjusted after every 160 hours of operation. Inspect and lubricate each brake lever pivot and push pins with a dry lubricant after every 80 hours of operation.

TO CHECK AND ADJUST PARKING BRAKE CABLE TENSION

1. Place the master power switch in the "off" position.

⚠ CAUTION: Always place the master power switch in the "off" position before working on the machine to prevent machine from creeping or electrical shock.

2. Place the parking brake lever in the "engaged" position.
3. Remove the plugbutton from the right side of the rear shroud.
4. Measure the compressed spring length. If the dimension is greater than 1.5 ± 0.06 in (40 ± 2 mm), the brake cables must be adjusted.
5. Remove the lower right and left side access panels.
6. Measure the distance from the back of the brake clevis to the front of the brake cable mounting bracket.



BRAKE CABLE 01345

A. Brake Lever
B. Clevis Pin
C. Brake Clevis
D. Jam Nut
E. Brake Cable
F. Brake Cable Mounting Bracket
G. Brake

7. Loosen the brake clevis jam nuts.
8. Remove the cotter pin and clevis pins from each side brake clevis.
9. Thread the brake clevis onto the brake cable a distance equal to the difference between the measured compressed spring length from step 4, and 1.5 in (40 mm). For example, if the spring length measured in step 4 was 1.75 in (65 mm), the clevis should be threaded onto the brake cable 0.25 in (5 mm).

NOTE: Be sure to adjust both the right and left side brake clevises equally.

10. Tighten the brake clevis jam nuts against the brake clevises.
11. Reinstall the clevis pins and cotter pins.
12. Replace the lower right and left side access panels.
13. Replace the rear shroud plugbutton.

PRE-SWEEP

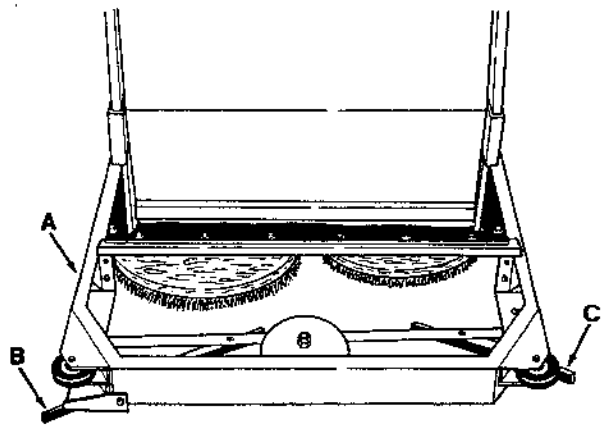
The Pre-Sweep allows the machine to pick up debris. It has four areas which require maintenance. Those are the two windrow flaps, the two side skirts, the hopper, and the slit skirt.

Make all adjustments with correct tire pressure, scrub head in the "lowered" position, and the casters positioned as when the machine is moving forward.

PRE-SWEEP WINDROW FLAPS

The windrow flaps direct the flow of debris into the path of the scrub brushes which deflect the debris into the hopper. Check floor contact of the windrow flaps after every 20 hours of operation.

The total length of the windrow flaps should equally contact the floor and may deflect up to 0.25 in (5 mm).



WINDROW FLAPS 01346

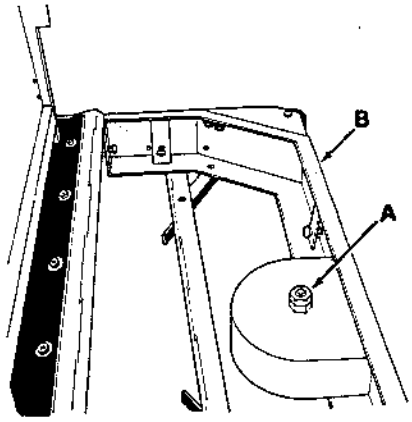
A. Pre-Sweep Frame
B. Right Side Windrow Flap
C. Left Side Windrow Flap

TO ADJUST WINDROW FLAPS

1. Place the master power switch in the "off" position.

⚠ CAUTION: Always place the master power switch in the "off" position before working on the machine to prevent machine from creeping or electrical shock.

2. Remove the debris hopper from the Pre-Sweep frame.
3. Loosen the front caster lock nut.



PRE-SWEEP FRAME 01347
A. Front Caster Lock Nut
B. Pre-Sweep Frame

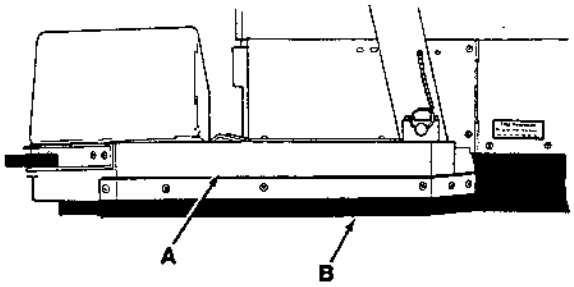
4. Thread the caster stud up or down so the bottom of the Pre-Sweep frame is approximately 1.25 in (30 mm) from the floor. Then adjust so the lower edge of the windrow flaps touch evenly on a straight, level floor. If necessary, add washers between the windrow flaps and the Pre-Sweep frame.
5. Tighten the caster lock nut.
6. After making these adjustments, the windrow flaps should equally contact the floor and deflect up to 0.25 in (5 mm). If they do not, they should be replaced.

PRE-SWEEP SIDE SKIRTS

The Pre-Sweep side skirts control water spray. Check the skirts for wear or damage daily.

The Pre-Sweep side skirts should be adjusted so there is a maximum of 0.03 in (1 mm) space between the floor and the bottom of the skirt and 0.06 in (2 mm) skirt deflection. Check the side skirt clearance after every 80 hours of operation.

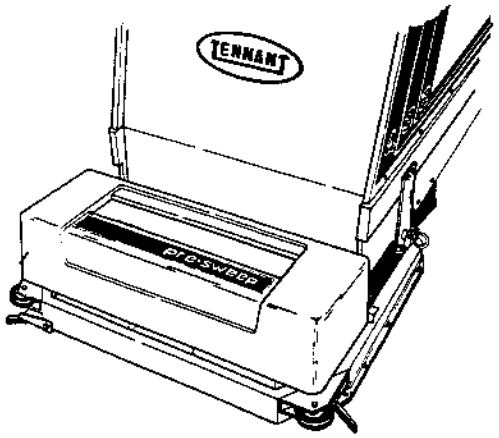
NOTE: Be sure the front caster is properly adjusted before adjusting the side skirts.



PRE-SWEEP SIDE SKIRTS 01348
A. Pre-Sweep Frame
B. Side Skirt

PRE-SWEEP HOPPER

The Pre-Sweep hopper collects debris directed into it by the scrub brushes. Empty the hopper as it fills with debris and after every work shift. Rinse the hopper interior clean when necessary.



PRE-SWEEP HOPPER 01339

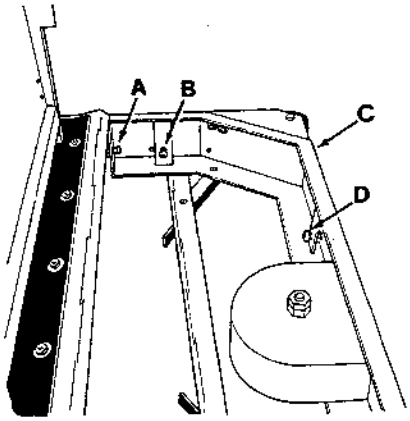
The Pre-Sweep hopper adjustment should be checked after every 160 hours of operation.

TO CHECK AND ADJUST HOPPER

1. Place the master power switch in the "off" position.

⚠ CAUTION: Always place the master power switch in the "off" position before working on the machine to prevent machine from creeping or electrical shock.

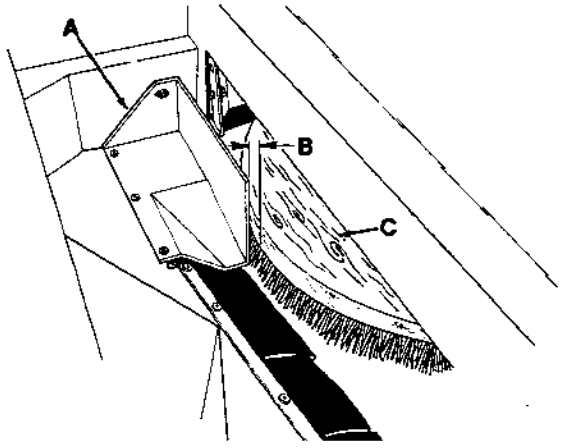
2. The hopper should be centered side-to-side on the Pre-Sweep frame with 0.02 to 0.06 in (1 to 2 mm) clearance between the hopper and the side adjustment bolts. To adjust, loosen the side adjustment bolt jam nuts, adjust the adjustment bolts, and retighten the jam nuts.



HOPPER ADJUSTMENT BOLTS 01347

A. Rear Adjustment Bolt
B. Side Adjustment Bolt
C. Pre-Sweep Frame
D. Front Adjustment Bolt

3. With the hopper in the "operating" position, the debris chute should be 0.12 to 0.18 in (3 to 5 mm) away from the scrub brush back when the scrub brush is rotated by hand. When the brush rotates electrically, the scrub brush back should not hit the debris chute, but the scrub brush bristles may. To adjust debris chute clearance, loosen the front and rear adjustment bolt jam nuts, adjust the adjustment bolts, and retighten the jam nuts.



DEBRIS CHUTE CLEARANCE 01349

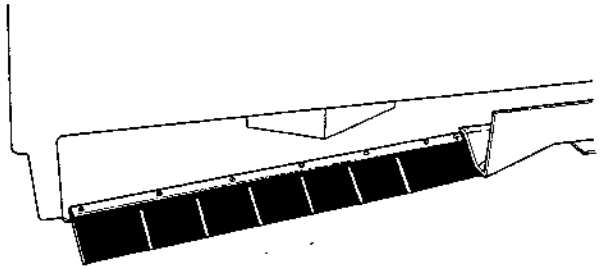
A. Debris Chute
B. Clearance
C. Scrub Brush Back

4. With the hopper in the "operating" position, the bottom edge of the debris chute should be 0.07 $\pm$ 0.01 in (2 $\pm$ 0.5 mm) off the floor or should rest on the edge of the slit skirt. To adjust debris chute height, turn the adjustment bolt clockwise to lower the chute; or counterclockwise to raise the chute.

   Shims also may be required between the side of the hopper and the side of the debris chute.

HOPPER SLIT SKIRT

The hopper slit skirt helps direct debris into the hopper. It is located on the bottom rear of the hopper. The rear lip of the slit skirt should always lie flat and contact the floor. Check the skirt for damage or wear after every 20 hours of operation.



HOPPER SLIT SKIRT 01350

SECTION 4
APPENDIX

CONTENTS

HARDWARE INFORMATION

The following charts state torque ranges for normal assembly applications of standard plated hardware. Decrease the specified torque by 20% when using a thread lubricant. Do not substitute lower grade hardware for higher grade hardware. If higher grade hardware than specified is substituted, tighten only to the specified hardware torque value to avoid damaging the threads of the part being threaded into, as when threading into speed nuts or weldments.

STANDARD BOLT TORQUE CHART

Thread Size	SAE Grade 2 Torque ft lb (Nm)	SAE Grade 5 Torque ft lb (Nm)	SAE Grade 8 Torque ft lb (Nm)
0.25 in	5-6 (7-8)	7-10 (9-14)	10-13 (14-18)
0.31 in	9-12 (12-16)	15-20 (20-27)	20-26 (27-35)
0.38 in	16-21 (22-28)	27-35 (37-47)	36-47 (49-64)
0.44 in	26-34 (35-46)	43-56 (58-76)	53-76 (72-103)
0.50 in	39-51 (53-69)	65-85 (88-115)	89-116 (121-157)
0.62 in	80-104 (108-141)	130-170 (176-231)	117-265 (159-359)
0.75 in	129-168 (175-228)	215-280 (291-380)	313-407 (424-552)
1.00 in	258-335 (350-454)	500-650 (678-881)	757-984 (1026-1334)

NOTE: Decrease torque by 20% when using a thread lubricant.

METRIC BOLT TORQUE CHART

Thread Size	Class 8.8 Torque ft lb (Nm)	Class 10.9 Torque ft lb (Nm)	Class 12.9 Torque ft lb (Nm)
M4	2 (3)	3 (5)	4 (6)
M5	4 (7)	6 (9)	7 (11)
M6	7 (11)	10 (16)	11 (19)
M8	18 (27)	25 (38)	29 (45)
M10	32 (53)	47 (74)	56 (87)
M12	58 (91)	83 (128)	100 (154)
M14	94 (145)	133 (204)	159 (244)
M16	144 (222)	196 (313)	235 (375)
M20	260 (434)	336 (610)	440 (732)
M24	470 (750)	664 (1050)	794 (1270)

NOTE: Decrease torque by 20% when using a thread lubricant.

BOLT IDENTIFICATION

Identification Grade Marking	Specification and Grade
	SAE-Grade 5
	SAE-Grade 8
	ISO-Grade 8.8
	ISO-Grade 12.9

01395