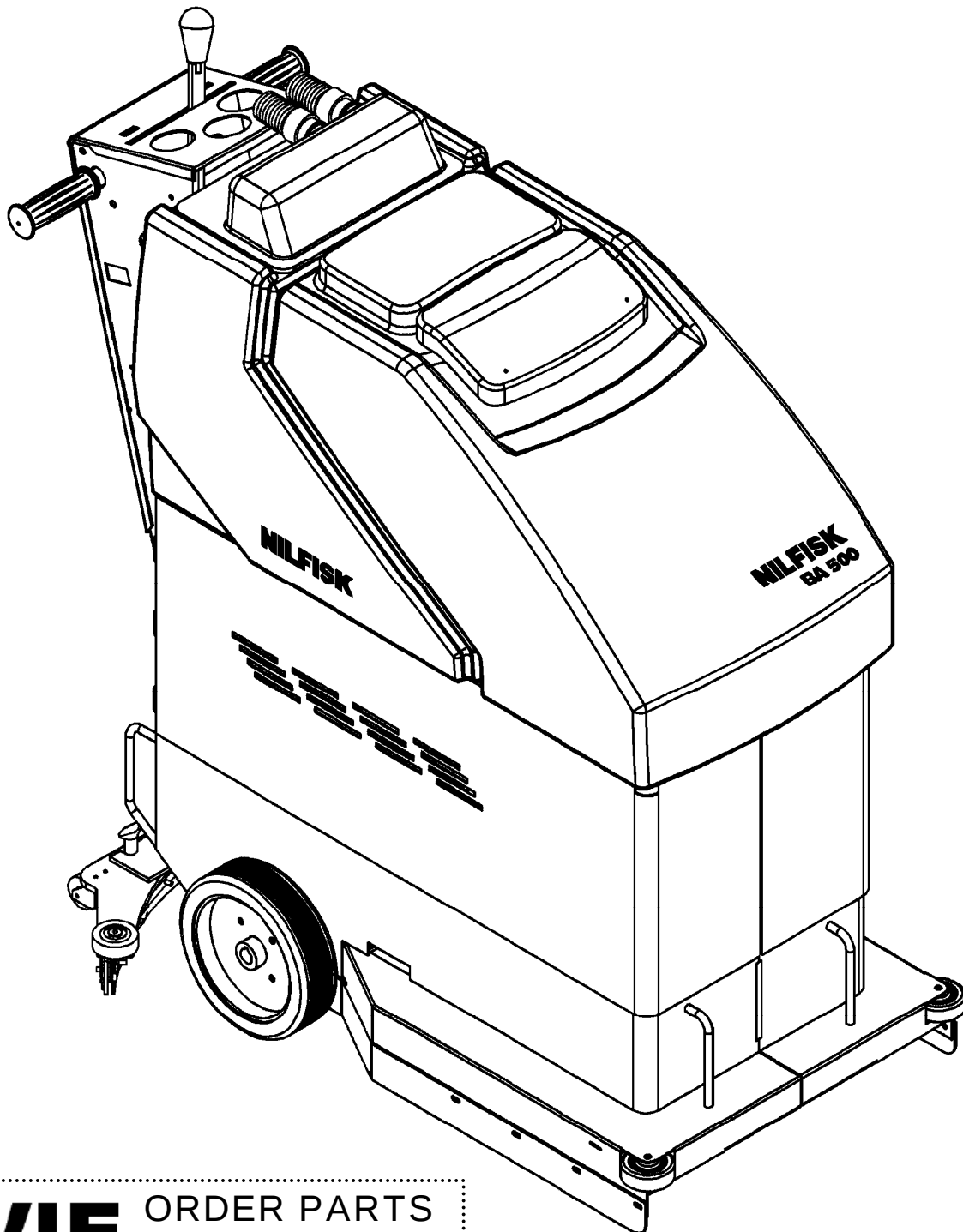


NILFISK BA 500

Service Manual



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Note: All references to right, left, front, or rear in this manual are as seen from the operator's stand-point.

SAFETY

SYMBOLS

Nilfisk uses the symbols below to signal potentially dangerous conditions. Always read this information carefully and take the necessary steps to protect personnel and property.

DANGER!

Is used to warn of immediate hazards that will cause severe personal injury or death.

WARNING!

Is used to call attention to a situation that could cause severe personal injury.

CAUTION!

Is used to call attention to a situation that could cause minor personal injury or damage to the machine or other property.

GENERAL SAFETY INSTRUCTIONS

WARNING!

Keep sparks, flame and smoking materials away from the batteries. Explosive gases are vented during normal operation.

Remove all jewelry when working near electrical components.

Disconnect one of the battery terminals when servicing electrical components.

Never work under a machine without safety stands or blocks to support the machine.

CAUTION!

Carefully read all instructions pertaining to a service function before performing that function.

Take precautions to prevent hair, jewelry, or loose clothing from becoming caught in moving parts.

SPECIFICATIONS**Dimensions****English (Metric)**

Scrub Brush Diameter	20 inches (51 cm)
Scrub Brush Path	20 inches (51 cm)
Scrub Brush Pressure	70 lbs (32 kg)
Scrub Brush Speed	190 rpm (190 rpm)
Squeegee Size	25.5 inches (65 cm)
Machine Length	44 inches (112 cm)
Machine Width	21.75 inches (55 cm)
Machine Height	43.5 inches (110 cm)
Drive Wheel	8 inch (20 cm) soft ride wheels
Solution Tank Capacity	12 gal (45i)
Recovery Tank Capacity	12 gal (45i)
Coverage Rate	7,500 sq ft (697 m ²) per hour
Machine Weight	266 lbs (121 kg) net w/o batteries 558 lbs (253 kg) w/four 244 AH batteries 376 lbs (175 kg) w/two 93 AH batteries 350 lbs (159 kg) shipping weight

General Specifications

Brush Motor	24 volt, 1/2 hp dc motor
Wheel Drive Motor	24 volt, 1/4 hp dc motor
Vacuum Motor	24 volt, 3/4 hp dc motor
Brush Drive	Belt drive
Sound Level	68.2 db (A) @ 3 ft (.9m) using pads 68.9 db (A) using prolene scrub brushes
Squeegee Type	4 sided, curved, pivot type
Speed Control	Electronic, fully variable forward/reverse
Batteries	(4) 6 volt 244 AH (std) (2) 12 volt 93 AH (opt)

MAINTENANCE

MAINTENANCE CHART

MAINTENANCE ITEM	Daily	Once a Week	Once a Month	Once a Year
Clean and inspect the tanks and hoses	X			
Clean the brushes and pads	X			
Clean the squeegee	X			
Charge the batteries	X			
Check battery water level		X		
Lubrication			X	
Vacuum motor carbon brushes				X

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MAINTENANCE

The solution system should be thoroughly flushed once a week. To flush the solution system...

- 1 Empty the solution tank, using the clear plastic drain hose on back of machine. This automatically flushes loose dirt from solution filter.
- 2 Put clean, warm water into the solution tank and let it drain through the drain hose.
- 3 Put the plug in the drain hose and put about 2 inches of clean water in the solution tank.
- 4 Put the machine controls in the following positions:
 - Key Switch - ON
 - Solution Switch (on left side of handle) - ON
 - Brush drive lowered
 - Twist Grips - Forward
 - Flow control lever (on right side of control handle) UP
- Let all of the clean water flow from the tank. This will flush dirt and soap residue from the electric solenoid valve and the flow control valve.

SOLENOID VALVE REMOVAL

- 1 Remove the vacuum motor. See Vacuum System chapter for instructions.
- 2 Disconnect the solution valve and mercury switch wiring connectors.
- 3 See Figure 1. Remove hoses "A" and "B".
- 4 Remove (2) bolts "C" and remove the solution valve and bracket from the machine.

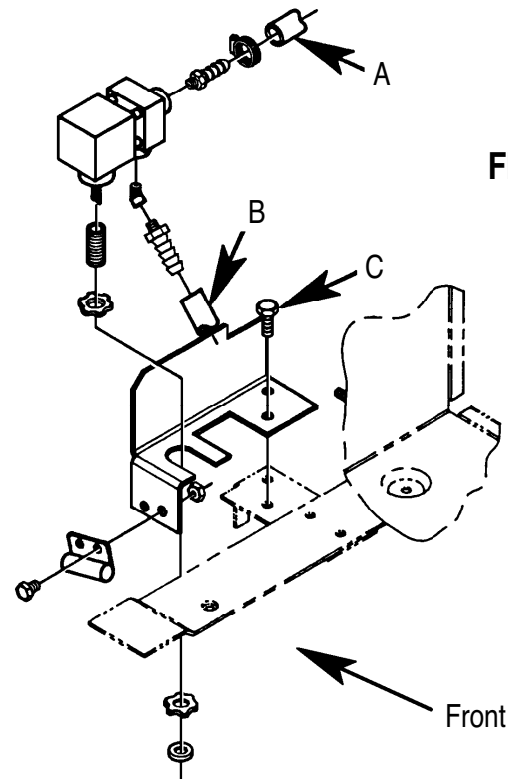


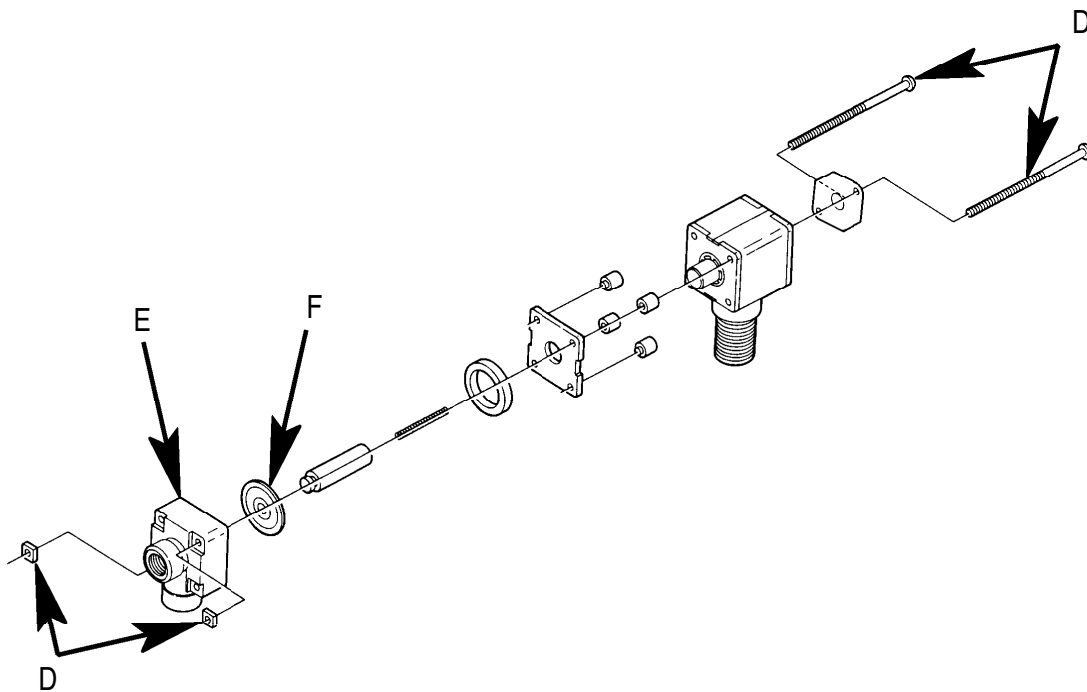
FIGURE 1

SOLUTION SYSTEM

SOLENOID VALVE DISASSEMBLY AND CLEANING

- 1 Remove the solenoid valve. See the Solenoid Valve Removal section for instructions.
- 2 See Figure 2. Remove the (2) "D" screws and nuts and disassemble the valve (be careful not to lose any internal parts).
- 3 Thoroughly wash dirt from block "E" and diaphragm "F".
- 4 After reassembling, test the solenoid valve for proper operation.

FIGURE 2



TROUBLESHOOTING

Problem: No solution flow

Possible Cause and Remedy:

- 1 Machine controls not positioned properly. In order for solution to flow, the controls must be positioned as follows:
 - Key Switch - ON
 - Solution Switch (on left side of handle) - ON
 - Brush drive lowered
 - Twist Grips - Forward
 - Flow control lever (on right side of control handle) UP
- 2 Clogged Solution Filter. Drain solution tank, using the clear plastic drain hose on back of machine. This automatically flushes loose dirt from solution filter. If solution still does not flow, remove and disassemble the tee-fitting (under the solution tank), remove and clean the filter thoroughly.
- 3 Clogged Solenoid Valve. Remove, disassemble, and clean the solenoid valve. See the Solenoid Valve Disassembly and Cleaning section for instructions.
- 4 Defective Speed Control. Replace speed control.

Problem: Solution leaks in "OFF" position

Possible Cause and Remedy:

- 1 Dirt in solenoid valve. Remove, disassemble, and clean the solenoid valve. See the Solenoid Valve Disassembly and Cleaning section for instructions.
- 2 Defective solenoid valve. Replace the solenoid valve. See the Solenoid Valve Removal section for instructions.

BRUSH DRIVE SYSTEM

MAINTENANCE

Once every six months...

- 1 Check the belt tension, adjust if necessary.

Once a year...

- 1 Check the carbon brushes in the brush motor. Replace the brushes if they are worn to a length of 3/8 inch (10 mm) or less.

BELT ADJUSTMENT OR REPLACEMENT

- 1 Drain the solution and recovery tanks.
- 2 See Figure 1. Tip the machine back as shown and place a jack stand under the front end.
- 3 See Figure 2. Turn nut "A" counterclockwise to loosen the belt tension.

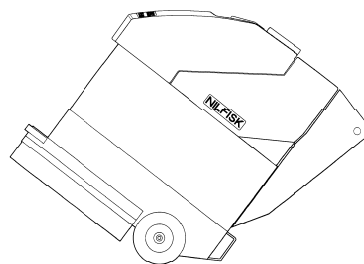


FIGURE 1

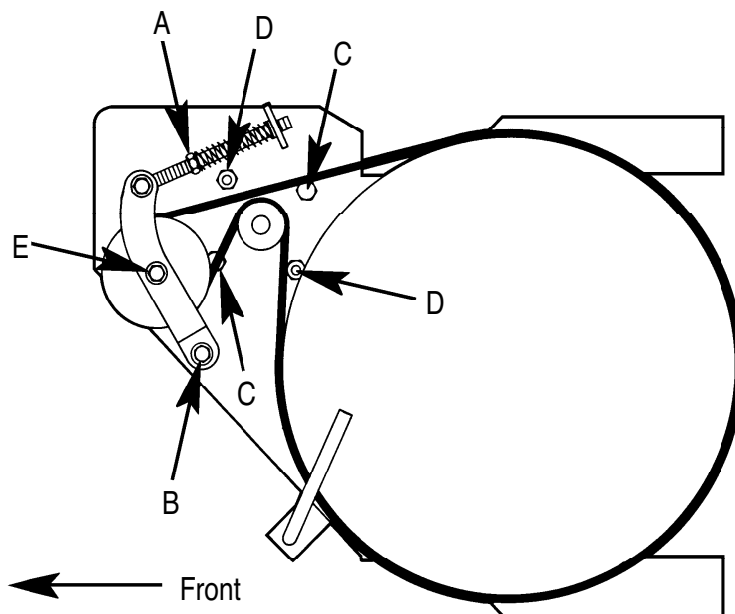


FIGURE 2

- 4 Remove screw "B" and remove the idler assembly and the belt from the machine. Remove "E" bolts, and remove the belt from the idler.
- 5 Follow steps in reverse order to reassemble. Tighten nut "A" until the tension spring is 2 1/2 inches (63.5 mm) long. Test the brush drive system to make sure it operates properly.

BRUSH DRIVE MOTOR - CARBON BRUSH INSPECTION

- 1 Remove the brush drive motor. See the Brush Drive Motor Replacement section for instructions.
- 2 See Figure 3. Place the brush drive motor in a vice as shown. Be careful not to damage the pulley.

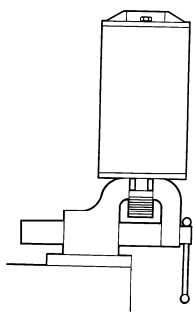


FIGURE 3

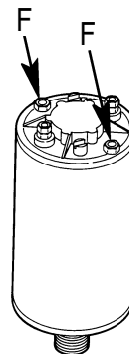


FIGURE 4

- 3 See Figure 4. Remove (2) "F" nuts and remove the end bell from the motor.
- 4 Remove and measure the carbon brushes. If they are worn to 3/8 inch (9.66 mm) or shorter, replace both carbon brushes. Remove all loose carbon and dirt from the inside of the motor.
- 5 Follow steps 1-3 in reverse order to reassemble.
- 6 Test the motor to make sure it operates properly.

BRUSH DRIVE MOTOR REPLACEMENT

- 1 Drain the solution and recovery tanks and remove the solution tank from the machine.
- 2 Tip the recovery tank to the side and disconnect the batteries.
- 3 Remove the vacuum motor. See the Vacuum System section for instructions.
- 4 Disconnect the wires from the brush drive motor. Take note of which wire color goes to each terminal for reassembly.

BRUSH DRIVE SYSTEM

BRUSH DRIVE MOTOR REPLACEMENT, (continued)

- 5 See Figure 5. Tip the machine back as shown and place a jack stand under the front end.

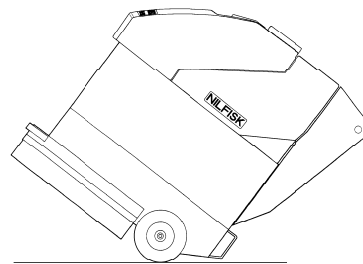


FIGURE 5

- 6 See Figure 6. Turn nut “G” counterclockwise to loosen the belt tension.

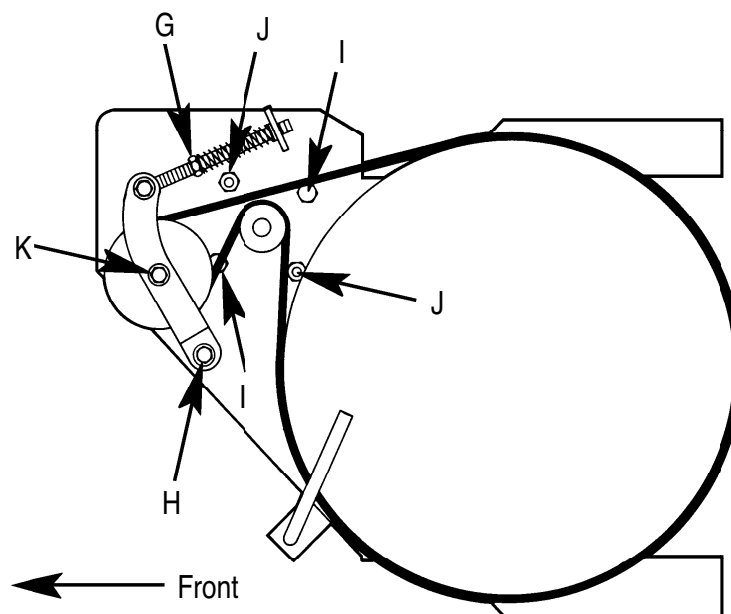


FIGURE 6

- 7 Remove screw “H”, the idler assembly and the belt from the machine.
- 8 Remove (2) “I” bolts and (2) “J” nuts. Set the front of the machine back on the floor and pull the brush drive motor up and out of the machine.
- 9 Remove the pulley from the old motor and install it on the new one.
- 10 Follow steps 1-7 in reverse order to reassemble. Tighten nut “G” until the tensioning spring is 2 1/2 inches (63.5 mm) long.
- 11 Test the brush drive system.

TROUBLESHOOTING

Problem: Squealing noise when brush is lowered.

Possible Cause and Remedy:

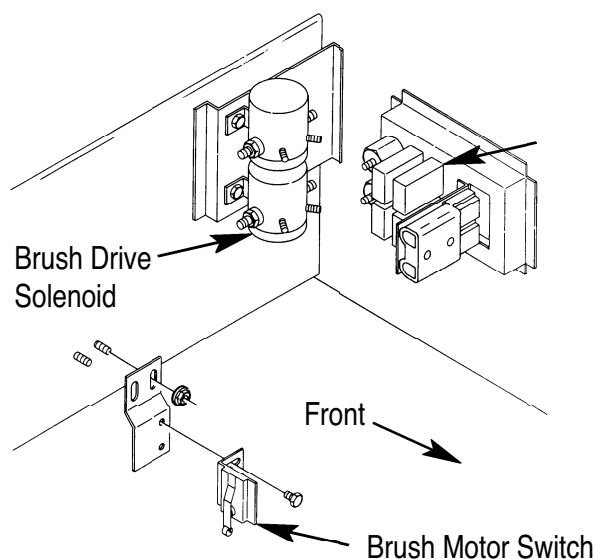
- 1 Loose belt — adjust belt tension.

Problem: Brush motor will not start when twist grips are turned.

Possible Cause and Remedy:

- 1 Tripped brush motor circuit breaker (see Figure 7) — press the reset button, check circuit breaker for continuity.
- 2 Defective brush motor solenoid (see Figure 7) — replace solenoid.
- 3 Defective brush motor switch (see Figure 7) — replace switch.
- 4 Defective brush motor — remove motor, repair or replace.
- 5 Defective speed control or potentiometer — replace speed control or potentiometer.

FIGURE 7



VACUUM SYSTEM

MAINTENANCE

Whenever the vacuum system does not perform properly, the entire system should be cleaned and inspected, following the maintenance checklist below.

- 1 Remove the squeegee from the machine and clean it thoroughly.
- 2 Inspect the squeegee blades. If the wiping edge of the rear blade is damaged or worn to a radius, turn it around or over so a new edge with a sharp corner faces toward the front of the machine.
- 3 See Figure 1. Disconnect squeegee hose "A" from **left side** of recovery tank cover "B". Park the machine outside or near a floor drain and use a garden hose to "back flush" dirt down and out of squeegee hose "A".

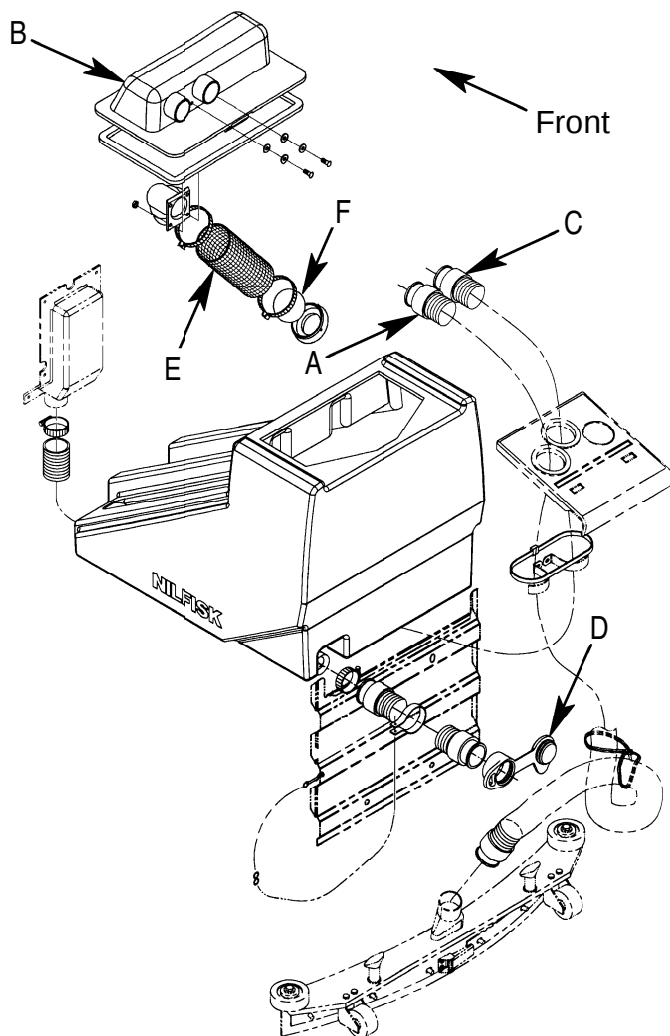
CAUTION!

Do not flush hose "C" unless it is disconnected from the vacuum motor.

- 4 Remove cover "B" from the recovery tank (see Figure 1). Rinse all dirt from cage "E" and ball "F".
- 5 Check the gasket on recovery tank cover "B". It must seal air-tight against the top of the tank.
- 6 Check drain hose cap "D". Replace the cap if it does not seal air-tight.

If the machine still does not pick up after completing this checklist, see the Troubleshooting section of this chapter for additional information.

FIGURE 1



VACUUM MOTOR REMOVAL

FIGURE 2

- 1 Drain the recovery tank, and tip it to the side of the machine.
- 2 Drain the solution tank, disconnect the hose from the bottom of the tank and remove the tank from the machine.
- 3 Disconnect one of the battery cables.
- 4 See Figure 2. Remove the (4) "G" screws and lift cover "H" off of the machine, along with bracket "I".
- 5 See Figure 3. Remove the (4) "J" screws.
- 6 Disconnect the vacuum motor wiring connector.
- 7 Disconnect hose "K" from the vacuum motor assembly and remove the motor from the machine.

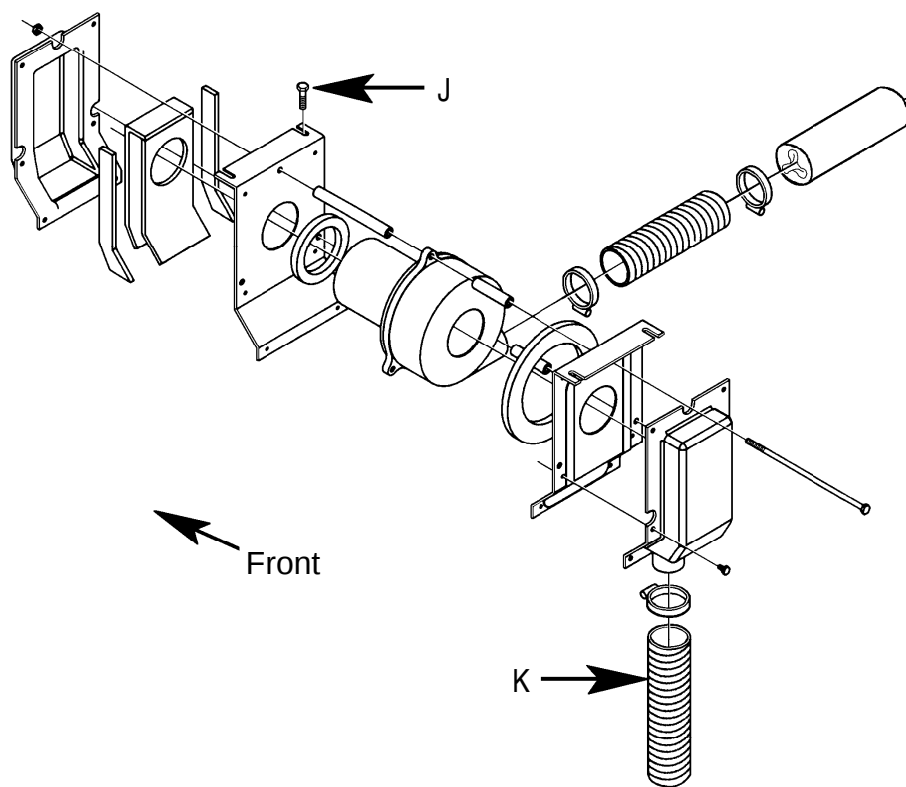
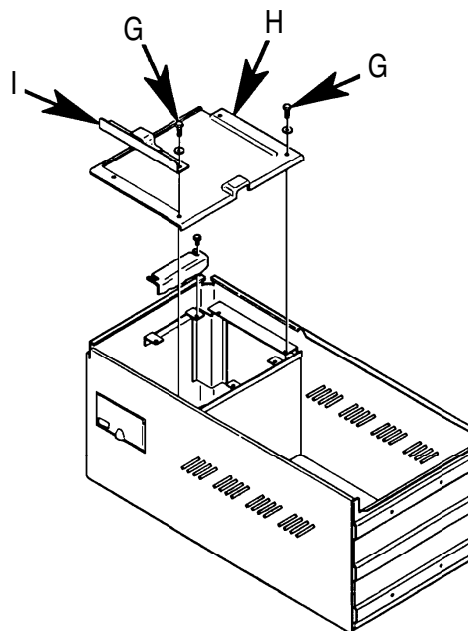


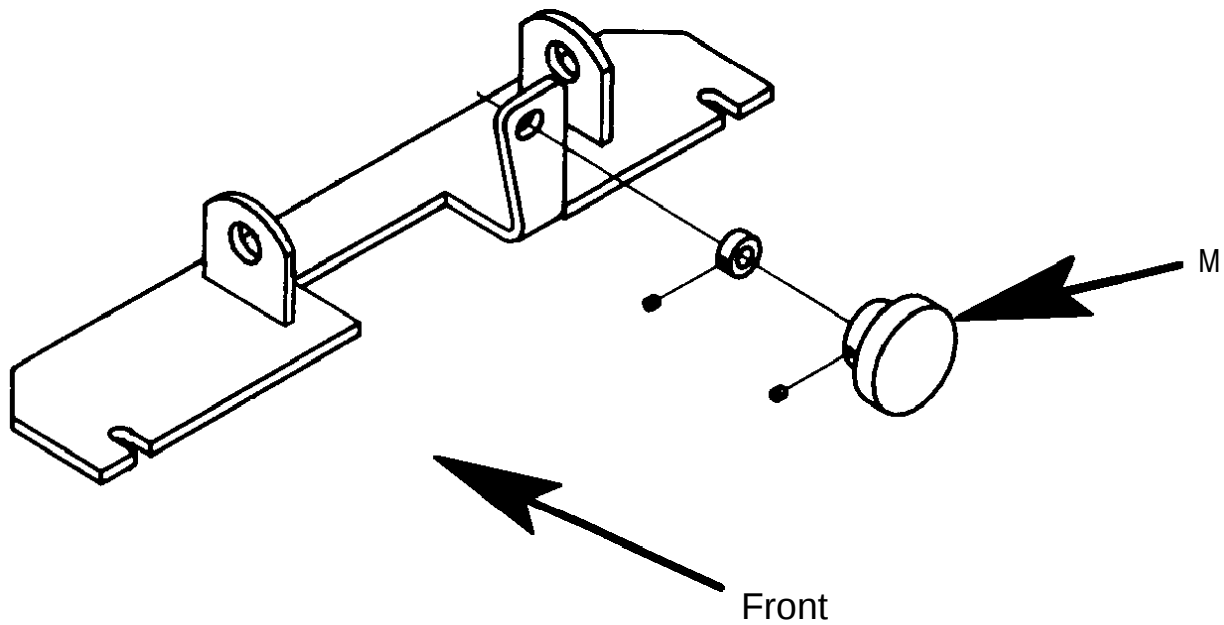
FIGURE 3

VACUUM SYSTEM

SQUEEGEE ADJUSTMENT

- 1 Adjust the large knob "M" on the back of the squeegee mount until both front and rear blades touch the floor equally.

FIGURE 4



TROUBLESHOOTING

Problem: Machine will not pick up water, water flows around ends of squeegee.

Possible Cause and Remedy:

- 1 Cap for recovery tank drain hose not sealing air-tight — install cap properly or replace if damaged.
- 2 Recovery tank cover not installed properly — push cover down all the way, so it seals air-tight against the top of the tank.
- 3 Damaged gasket on recovery tank cover — replace gasket.
- 4 Low battery voltage — charge or replace batteries.
- 5 Vacuum motor defective — repair or replace vacuum motor.

Problem: Water in vacuum motor

Possible Cause and Remedy:

- 1 Operator using high-sudsing detergent — use low-sudsing detergent or add a defoaming chemical to the recovery tank.
- 2 Vacuum leak in recovery tank drain hose or cap — replace hose or cap.
- 3 Vacuum shut-off float ball not closing — clean or replace float ball and cage (mounted on recovery tank cover).

Problem: Float closes before tank is full

Possible Cause and Remedy:

- 1 Foam in recovery tank — advise operator to use low-sudsing detergent or add a defoaming chemical to the recovery tank.
- 2 Cage around vacuum shut-off float clogged — disconnect hoses from recovery tank cover, remove the cover and clean or replace the float cage.

VACUUM SYSTEM

TROUBLESHOOTING, (continued)

Problem: Vacuum motor will not run when squeegee is lowered

Possible Cause and Remedy:

- 1 Tripped vacuum motor circuit breaker (see Figure 5) — press reset button, check circuit breaker for continuity.
- 2 Defective vacuum switch (see Figure 6) — remove cover panel from back of control handle, adjust or replace switch.
- 3 Defective vacuum motor — remove motor, repair or replace.
- 4 Defective vacuum motor solenoid — replace solenoid.

FIGURE 5

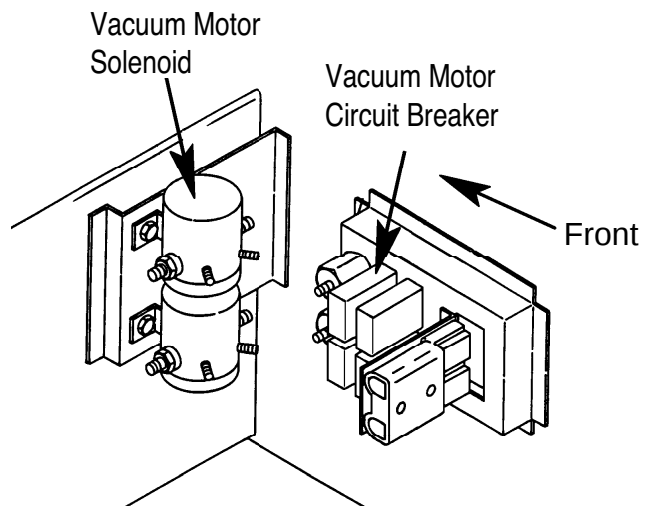
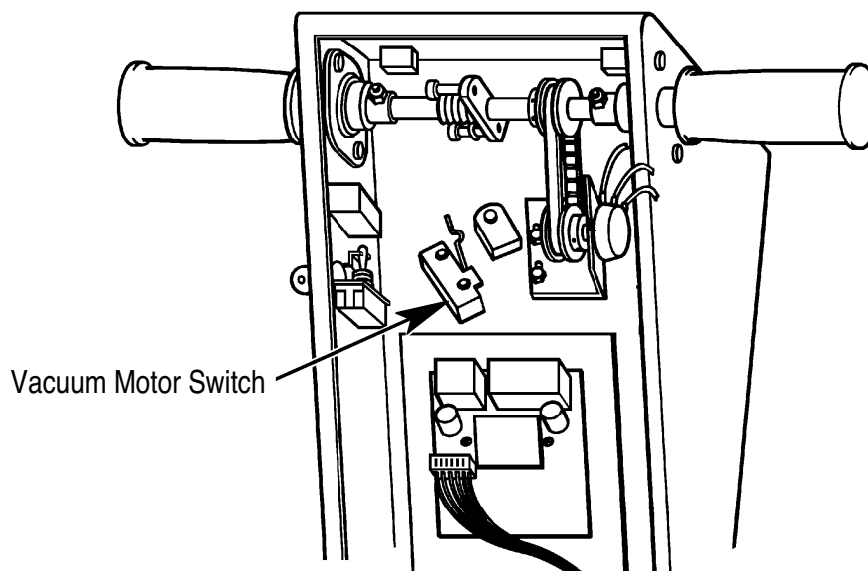


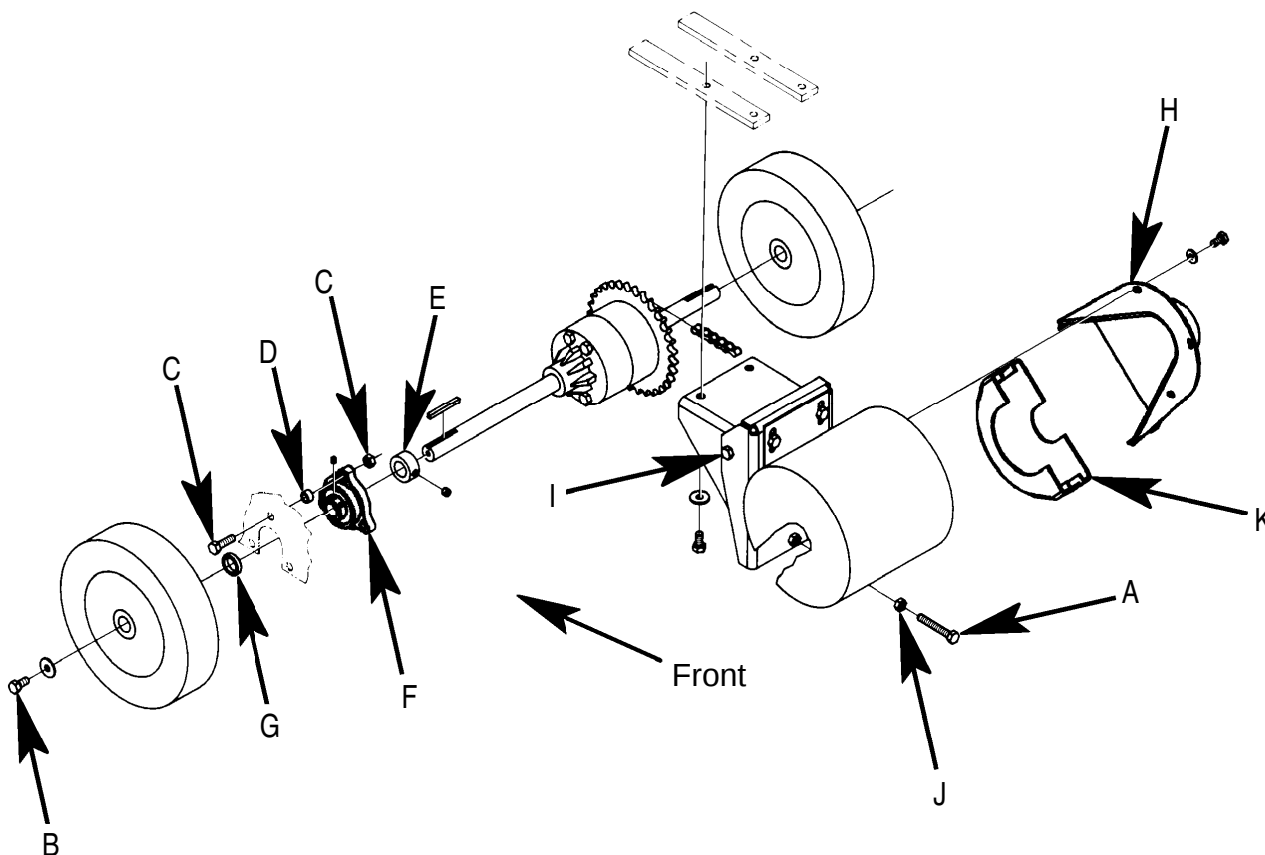
FIGURE 6



DIFFERENTIAL REPLACEMENT

- 1 Drain the tanks, remove the batteries and tip the machine up on it's nose.
- 2 See Figure 1. Remove chain guard "K" (snaps in place). Loosen the chain tensioning bolt "A".
- 3 Disconnect the master link in the chain and remove the chain.

FIGURE 1



- 4 Remove the "B" bolts and remove the wheels.
- 5 Remove the (6) "C" differential mounting bolts and nuts and "D" bushings. Remove the differential from the machine.
- 6 Remove the sprocket, "E" collars, "F" bearings, and "G" bushings from the old differential and install them on the new one, (take note of the location of the "E" collars on the axles for reassembly).
- 7 Follow steps 1-5 in reverse order to reassemble. (Refer to the Drive Chain Replacement Or Adjustment section for proper chain tension).
- 8 Test the drive system for proper operation.

WHEEL DRIVE SYSTEM

DRIVE MOTOR REPLACEMENT

- 1 Drain the tanks, remove the batteries and tip the machine up on it's nose.
- 2 Disconnect the squeegee lift cable and the squeegee hose.
- 3 See Figure 1. Remove chain guard "K" (snaps in place).
- 4 Loosen lock nut "J" and turn bolt "A" to loosen the chain tension (On reassembly, refer to the Drive Chain Adjustment section for proper chain tensioning).
- 5 Disconnect the master link on the chain and remove the chain.
- 6 Disconnect the drive motor from the wiring harness.
- 7 Remove the (2) "I" bolts and nuts and remove the drive motor from the machine.
- 8 Remove the old drive motor from the motor mount and install the new motor on the mount.
- 9 Remove the chain guard "H" from the old motor and install it on the new one.
- 10 Follow steps 1-6 in reverse order to reassemble.
- 11 Test the drive system for proper operation.

DRIVE CHAIN REPLACEMENT OR ADJUSTMENT

Replacement:

- Refer to steps 1, 3 & 4 of the Drive Motor Replacement section for instructions. Follow these steps in reverse order to reassemble.

Adjustment:

- See Figure 1. Loosen the lock nut "J", turn bolt "A" to tighten or loosen the chain. There should be about 1/2 inch (12 mm) of deflection between the sprockets when moderate pressure is applied to the chain.
- After replacing or adjusting the chain, test the drive system for proper operation.

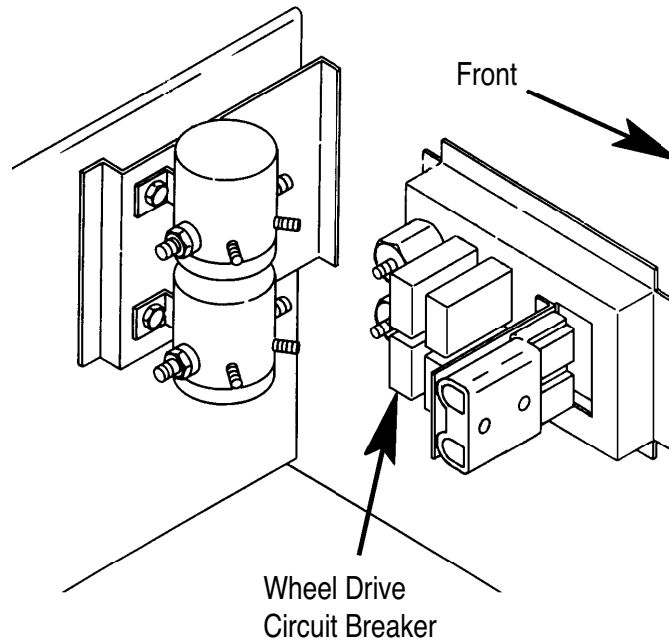
TROUBLESHOOTING

Problem: No wheel drive - forward or reverse

Possible Cause & Remedy:

- 1 Tripped wheel drive circuit breaker (see Figure 2) - press reset button, if wheel drive still doesn't work, check circuit breaker for continuity.

FIGURE 2



- 2 Defective wheel drive motor - follow instructions below.
 - Jack up the rear of the machine to lift the drive wheels off the floor.
 - Remove back panel from control handle.
 - Remove the plastic cover from the speed control.
 - Disconnect the brown/yellow and the white/brown wires from the speed control and connect them to a battery, using jumper wires.
 - If the wheel motor turns, go to step 3. If the wheel motor does not turn, remove the tanks and batteries, tip the machine up on its nose and repair or replace the wheel drive motor.

WHEEL DRIVE SYSTEM

TROUBLESHOOTING, (continued)

- 3 Defect in potentiometer mechanism - follow instructions below.
- Make sure that the orange, yellow and green wires are firmly connected to the potentiometer (see Figure 3).
 - See Figure 3. Check for loose set screws in pulley "B" or "C".
 - If the wires and set screws are both secure, follow steps below.
 - Remove the plastic cover from the speed control.
 - Disconnect plug "A" from the speed control.
 - Connect an ohmmeter to the green and orange wires. **NOTE:** inserting the ends of paper clips into the plug will help in the attachment of the test leads. The meter should read 2400 - 2600 ohms in neutral and increase to 5000 ohms when the twist grips are turned to the full-forward position. If you **do not** get these readings, follow potentiometer adjustment instructions. If you **do** get these readings, go to the next test.
 - Connect an ohmmeter to the green and yellow wires. The meter should read 2400 - 2600 ohms in neutral and decrease to 100 - 300 ohms when the twist grips are turned to the full forward position. If you **do not** get these readings, follow potentiometer adjustment instructions. If you **do** get these readings, the potentiometer is OK - replace the speed control.

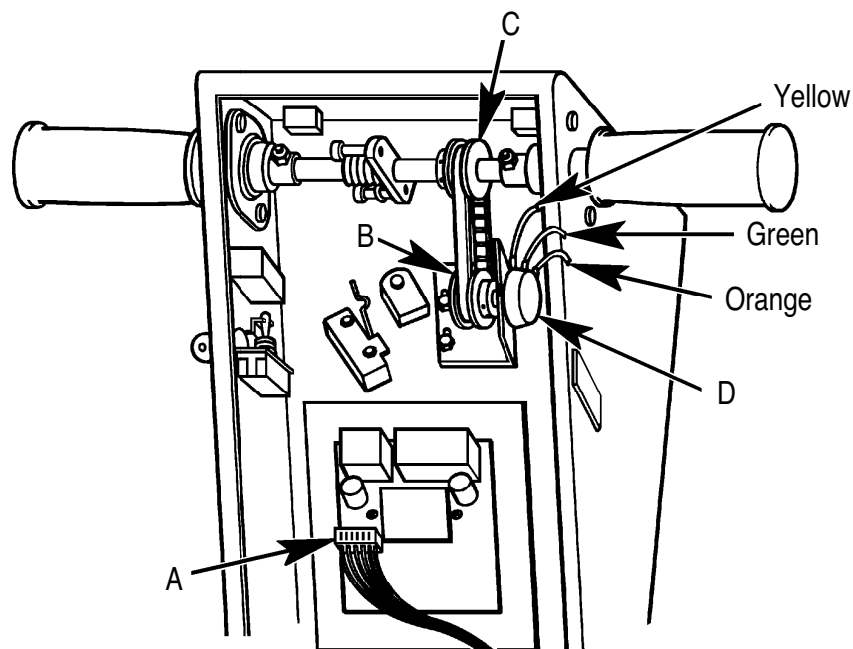


FIGURE 3

POTENTIOMETER ADJUSTMENT

Adjust the potentiometer if the machine has no drive, or if it moves with the twist grips in neutral. To adjust the potentiometer...

- 1 Remove the back panel from the control handle.
- 2 See Figure 3. Loosen the (2) set screws in pulley "B".
- 3 Remove the plastic cover from the speed control.
- 4 Carefully pull connector "A" off the speed control (pull toward back of machine).
- 5 Connect an ohmmeter (on 0 x 100 scale) to the green and yellow wires at the connector.
- 6 Turn the potentiometer shaft until the meter reads between 2400 and 2600 ohms.
- 7 Without turning the potentiometer shaft, tighten the set screws in pulley "B".
- 8 Test the drive system for proper operation before installing speed control cover and handle cover.

BATTERIES

WARNING!

Use extreme caution when working with batteries. Sulfuric acid in batteries can cause severe injury if allowed to contact skin or eyes.

Explosive hydrogen gas is vented from inside the battery caps. This gas can be ignited by any electrical arc, spark, or flame.

When working with batteries:

- Remove all jewelry
- Wear safety glasses
- Do not smoke
- Do not allow tools to touch more than one battery terminal at a time
- Work in a well ventilated area

BATTERY MAINTENANCE

Proper maintenance of electric vehicle batteries can greatly extend their life.

There are 3 simple rules for good battery maintenance:

- **Maintain Proper Electrolyte Level** - Use distilled water in batteries whenever possible. If batteries are discharged, add just enough water to cover the plates in each cell. If batteries are fully charged, fill each cell to the bottom of the filler tube. **Do not over-fill the batteries! Do not add acid to batteries!**
- **Keep the Batteries Charged** - Batteries should be charged each time that a machine is used for more than 1 hour. Machine operators should tip the solution tank forward and the recovery tank to the side of the machine for charging, to avoid a concentrated build-up of hydrogen gas. Operators should follow the instructions provided with their specific battery charger, to determine how long the batteries should be charged. Even when a machine is stored, the batteries should be charged once a month to prevent the batteries from “sulfating”. Almost all battery caps are vented, so there’s no need to loosen or remove them for charging.

BATTERY MAINTENANCE, (continued)

- **Keep the Batteries Clean** - Use a damp cloth to wipe dirt and liquid from the top of the batteries. Battery terminals must be clean and tight. If the top of the batteries are wet after charging, the batteries have probably been over-filled.

BATTERY TESTING

A battery problem is usually recognized by the machine operator, as a decrease in the machine's running time. This condition is usually caused by one (or more) "dead cell(s)" in the battery system- that is, one (or more) cell(s) that is putting out less voltage than the other cells.

Note: Always charge batteries before testing.

There are 2 ways to find a dead cell:

- Use a hydrometer to check the specific gravity (or "state of charge") of the fluid in each cell. A dead cell is one that reads 50 points (or more) lower than the other cells.
- Use a volt meter to check the voltage of each battery with the brush and vac motors running. The battery with the dead cell will read 1 or 2 volts lower than the other batteries in the system.

If the batteries in the machine are more than 1 year old, it's usually best to replace the whole set, rather than replacing just one battery.