



275

Operator Manual

MM151



This manual is furnished with each new TENNANT® Model 275. 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 tabbed instruction portion of the manual consists of the Specification, Operation, Maintenance, and Appendix sections. The tabbed parts section consists of the Low Dump Model Parts; LPG Parts; Multi-Level Dump Model Parts; Accessories; Hydraulic Components; Engine Parts 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 | |
|---|-------|
| <i>Please fill out at time of installation.</i> | |
| Machine Serial Number - | _____ |
| Engine Serial Number - | _____ |
| Sales Representative - | _____ |
| Date of Installation - | _____ |
| Manual Number - | MM151 |
| Revision: | 07 |
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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 practices which could result in extensive equipment damage.


NOTE: To give important information or to warn of 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 machine operating personnel how to use those safety devices. Report machine damage or faulty operation immediately to personnel responsible for the repair of the machine. Do not use the machine if it is not in proper operating condition.


 **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:** Before operating the machine, make sure all safety devices are in place and operate properly. Check the foot and parking brakes and the steering control for proper operation. Do not start machine unless you are in operator's seat, with foot on the brake pedal or operational parking brake engaged and the directional pedal in the "neutral" position. Failure to do so could allow machine to move immediately upon start-up, resulting in severe personal injury.


 **WARNING:** If an LPG fuel leak is found, close the service valve immediately and notify the appropriate personnel to avoid fire or explosion.


 **WARNING:** Provide adequate ventilation when operating machine to prevent buildup of engine exhaust gases. Improper or inadequate ventilation will cause asphyxiation. Check exhaust system regularly for leaks.


 **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 machine in areas with possible falling objects unless machine is equipped with overhead guard.


 **WARNING:** Dirt, dust, and debris may be thrown by the machine when in operation. Safety glasses or goggles must be worn by the machine operator to protect eyes. Failure to do so could cause serious eye injury.


 **WARNING:** Excessive noise may be generated by the machine when it is operated in certain confined or noisy areas or in certain conditions of disrepair. Hearing protection should be worn under such conditions to avoid hearing loss.


 **WARNING:** Do not carry riders on machine. Machine is designed to carry one operator; riders could fall off and become seriously injured.


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


 **WARNING:** Use care when backing machine to prevent injury to bystanders.

 **WARNING:** Do not drive the machine for any great distance or at high speed with the hopper raised. A raised hopper reduces machine stability.

 **WARNING:** Be sure adequate vertical clearance is available before attempting to high dump the hopper. Failure to do so could cause overhead objects to fall or could cause electrical shock if overhead wiring is contacted.

 **WARNING:** Do not fill the fuel tank while the engine is operating. Always be sure the fuel container and the machine are electrically connected before pouring fuel. Failure to electrically connect the fuel container to the machine may allow a static electricity spark to ignite the fuel, resulting in a fire or explosion.

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

 **WARNING:** Machine should not creep when the directional control pedal is in the "neutral" position. Adjust control pedal linkage to stop machine creeping.

⚠ WARNING: Always engage the hopper safety bar before working under a raised hopper or scrub attachment. Do not rely on the machine hydraulic system to keep the hopper in the "raised" position. The hydraulic system may leak internally, allowing the hopper to lower, crushing anything under it.

⚠ WARNING: Avoid moving parts of the machine. Do not wear loose jackets, shirts, or sleeves when working on machine because of the danger of becoming caught in moving parts. Keep shields and guards in position. Wear approved eye protection. If adjustments must be made while the engine is running, use extreme caution around hot manifolds, moving parts, belts, etc.

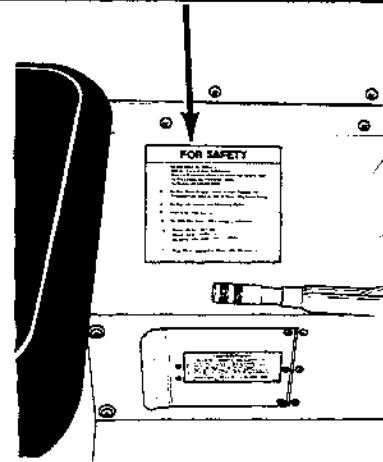
⚠ WARNING: Always park the machine on a level surface, stop the engine and engage the parking brake before working on the machine to keep it from rolling.

⚠ WARNING: No smoking or open flame should be allowed when the fuel system is being repaired or serviced. The area should be properly ventilated. Improper handling of fuel or fuel fumes could result in an explosion or fire.

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

FOR SAFETY

1. Do Not Operate Machine - Unless Trained And Authorized.
-Unless Operation Manual Is Read And Understood.
-In Flammable Or Explosive Areas.
2. Do Not Use Flammable Cleaning Agents.
3. Go Slow On Grades And Slippery Surfaces.
4. Before Leaving Machine - Stop On Level Surface.
-Stop Motor, -And Set Parking Brake (If So Equipped).
5. Use Only TENNANT COMPANY Supplied Or Equivalent Replacement Parts.

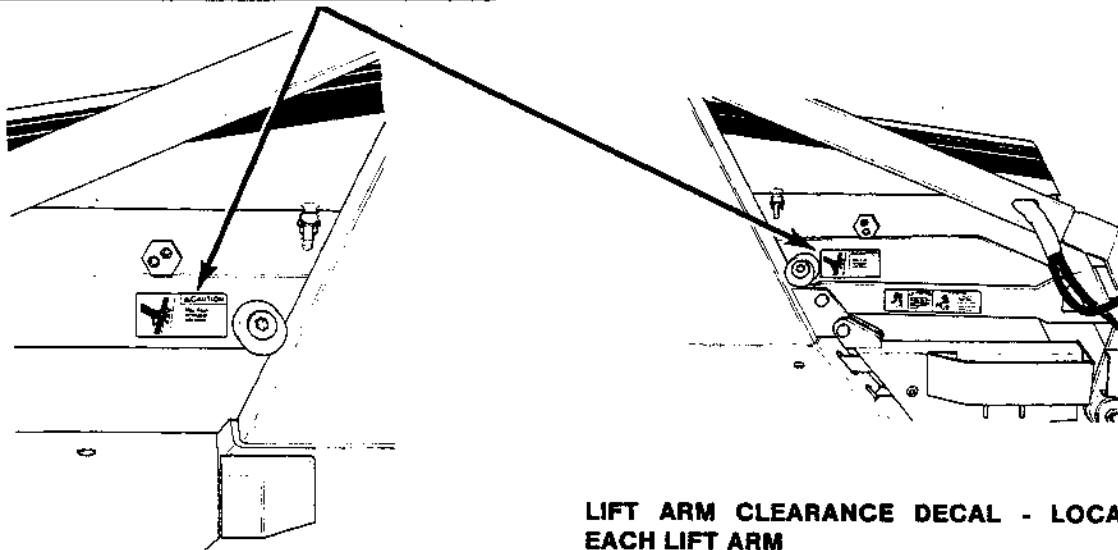


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SAFETY DECAL - LOCATED ON LEFT SIDE OF OPERATOR COMPARTMENT.

⚠ CAUTION

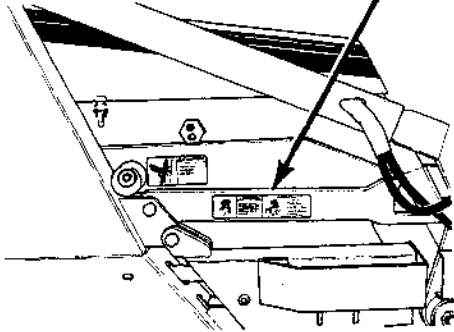
Stay Clear of Hopper Lift Arms.



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LIFT ARM CLEARANCE DECAL - LOCATED ON EACH LIFT ARM

| | | |
|---|--|--|
|  | <p>⚠ WARNING</p> <p>Engage Safety Support Bar per Instructions Before Working Under Hopper.</p> | <p>INSTRUCTIONS</p> <p>To Engage Safety Support Bar:</p> <ol style="list-style-type: none">1. Lift Hopper to Extreme Up Position.2. Raise Safety Support Bar.3. Lower Hopper Against Stop.4. Shut Off Engine.  |
|---|--|--|



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HOPPER SAFETY SUPPORT BAR DECAL - LOCATED ON SAFETY SUPPORT BAR

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MACHINE SPECIFICATIONS

POWER TYPE

Engine type - piston
Ignition - breaker-type spark
Cycle - 4
Aspiration - natural
Cylinders - 4
Bore - 3.19 in (81 mm)
Stroke - 3.06 in (78 mm)
Displacement - 98 cu in (1600 cc)
Net power - 33 hp (25 kw) @ 2200 rpm, governed
38.5 hp (28.7 kw) @ 2650 rpm, governed
47.5 hp (35 kw) @ 3600 rpm, maximum
Fuel - gasoline, 91 RON octane minimum, unleaded or LPG
Cooling system - water/ethylene glycol antifreeze
Electrical system - 12 V nominal, 37 A alternator
12 V nominal, 51 A alternator,
SE model

Engine type - piston
Ignition - diesel
Cycle - 4
Aspiration - natural
Cylinders - 3
Bore - 3.25 in (85 mm)
Stroke - 3.23 in (82 mm)
Displacement - 85 cu in (1395 cc)
Net power - 27 hp (20 kw) @ 2200 rpm governed
31 hp (23 kw) @ 2650 rpm governed
32 hp (24 kw) @ 2800 rpm maximum
Fuels - No. 1 or No. 2 diesel fuel
Cooling system - water/ethylene glycol antifreeze
Electrical system - 12 V nominal, 37 A alternator

POWER TRAIN

Propelling - hydraulic drive motor, rear wheel
Main brush - hydraulic drive motor
Side brush - hydraulic drive motor
Vacuum fan - hydraulic drive motor

STEERING

Type - rear wheel controlled, automotive worm and sector gear
Power source - manual

HYDRAULIC SYSTEM

Function - operates propelling, hopper lift, hopper dump, main brush drive, side brush drive, and vacuum fan drive.

Control valve, low dump model, side brush drive, hopper lift - open center type, single spool.

Control valve, multi-level dump model, side brush drive, hopper lift, hopper dump - open center type, two spool.

Control valve, vacuum fan drive, main brush drive - open center type, single spool, solenoid operated.

Pump, propelling - variable displacement piston type, 1.24 cu in (20 cc) maximum displacement per revolution, 11.8 gpm (45 L/min) @ 2200 rpm, 14.2 gpm (54 L/min) @ 2650 rpm

Propelling system relief pressure - 4000 psi (27,850 kPa)

Pump, accessories - gear type, 0.84 cu in (14 cc) displacement, 9.5 gpm (36 L/min) @ 2200 rpm, 12.3 gpm (47 L/min) @ 2650 rpm.

Side brush and lift cylinder system relief pressure - 1900 psi (13,100 kPa)

Vacuum fan and main brush motor system relief pressure - 2150 psi (14,825 kPa)

Motor, propelling - internal gear type, 18.6 cu in (305 cc) displacement per revolution, 4500 psi (31,030 kPa) maximum rated pressure.

Motor, main brush - internal gear type, 4.5 cu in (75 cc) displacement per revolution, 2500 psi (17,240 kPa) maximum rated pressure

Motor, side brush - internal gear type, 3 cu in (50 cc) displacement per revolution, 2500 psi (17,240 kPa) maximum rated pressure

Motor, vacuum fan - internal gear type, 0.26 cu in (5 cc) displacement per revolution, 3000 psi (20,685 kPa) maximum rated pressure

Cylinder, hopper lift, low dump model - single action type, 2.5 in (65 mm) bore x 6 in (150 mm) stroke, 1.12 in (29 mm) diameter rod, 2500 psi (17,240 kPa) maximum rated pressure

Cylinder, hopper lift, multi-level dump model - single action type, 3.5 in (90 mm) bore x 8 in (205 mm) stroke, 1.25 in (32 mm) diameter rod, 2500 psi (17,240 kPa) maximum rated pressure

Cylinder, hopper dump, multi-level dump model - double action type, 2 in (50 mm) bore x 5.38 in (135 mm) stroke, 1 in (25 mm) diameter rod, 2500 psi (17,240 kPa) maximum rated pressure

BRAKING SYSTEM

Service brakes - mechanical drum brakes (2), one per front wheel, linkage actuated

Parking brakes - utilize service brakes, linkage actuated

SUSPENSION SYSTEM

Front - two 4 x 16 semi-pneumatic tires, low dump model
two 4 x 16 solid tires, multi-level dump model

Rear - one 5.70 x 8 pneumatic tire
one 5.00 x 8 solid tire with solid tire accessory

SYSTEM FLUID CAPACITIES

Engine cooling system - radiator 4 qt (3.8 L)
total system N/A qt (N/A L)

Engine lubricating oil - 3.5 qt (3.3 L) with filter,
gasoline, LPG
7 qt. (6.7 L) with filter, diesel

Fuel tank - 7.8 gal (30 L) gasoline, diesel
33 lb (15 kg) LPG

Hydraulic system - reservoir 5 gal (19 L)
total system 6.3 gal (24 L)

GENERAL MACHINE DIMENSIONS/CAPACITIES

Length - 97 in (2465 mm) low dump model
Width - 56 in (1420 mm) low dump model
59 in (1500 mm) multi-level dump model
Height - 52 in (1320 mm)
79 in (2005 mm) with overhead guard
85 in (2160 mm) with overhead guard and
hazard lamp

Track - 46 in (1170 mm)

Wheelbase - 38 in (965 mm)

Main brush - diameter 14 in (355 mm)
length 42 in (1065 mm)

Side brush - diameter 21 in (535 mm)

Sweeping path width - 42 in (1065 mm)
53 in (1345 mm) with side
brush

Hopper capacity - 1000 lb (455 kg)
14 cu ft (0.4 m³)

Dust filter area - 110 sq ft (10.2 m²)

MACHINE WEIGHTS

Net weight - 2150 lb (975 kg) low dump model
2800 lb (1270 kg) multi-level dump model

GVWR - 3200 lb (1450 kg) low dump model
3800 lb (1725 kg) multi-level dump model

GENERAL MACHINE PERFORMANCE

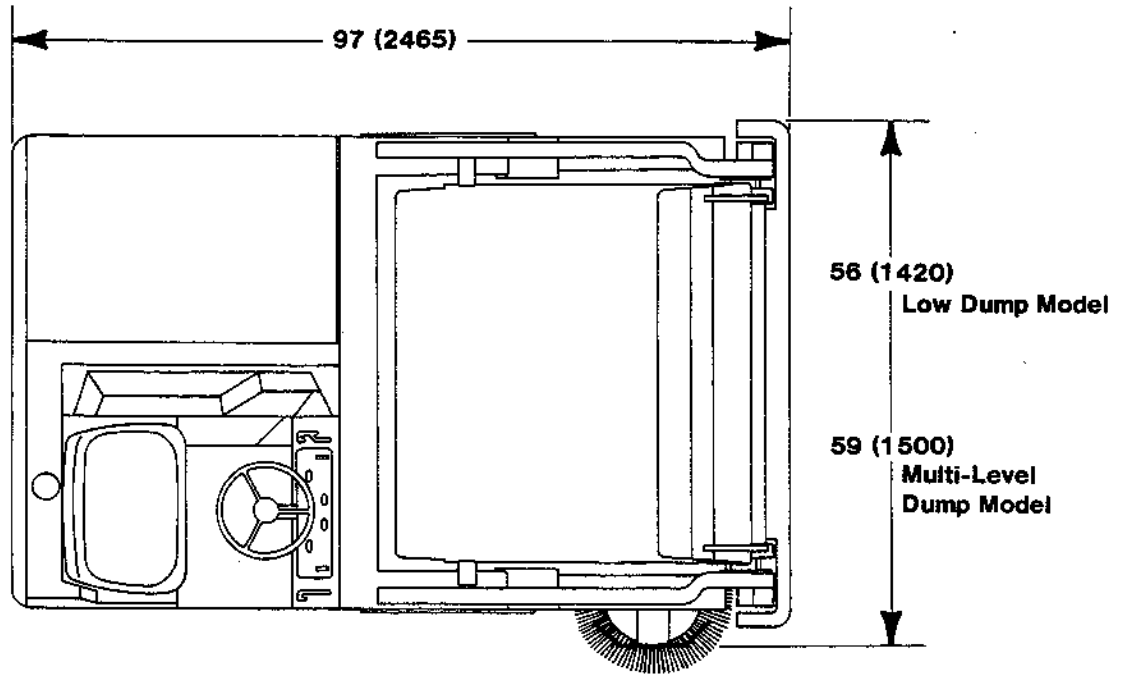
Maximum forward speed - 8.5 mph (13.7 km/h)

Maximum reverse speed - 4.2 mph (6.8 km/h)

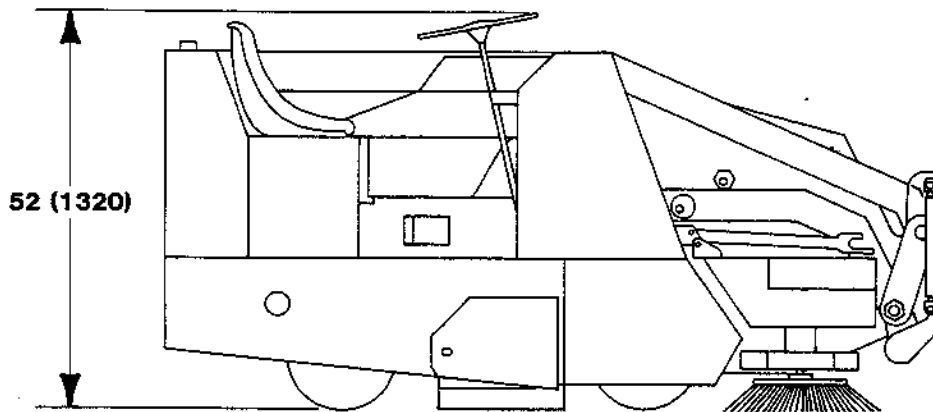
Turning radius - right, 159.5 in (4050 mm)
left, 107.5 in (2730 mm)

Minimum aisle turn width - 108 in (2745 mm)

MACHINE DIMENSIONS



TOP VIEW



SIDE VIEW

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NOTE: The first dimension is in inches, the second dimension in parentheses is in millimeters.

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PREPARATION FOR OPERATION

AFTER UNLOADING AND BEFORE OPERATING THE MACHINE:

1. Check the machine for shipping damage.
2. Read this manual carefully before operating or servicing 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.

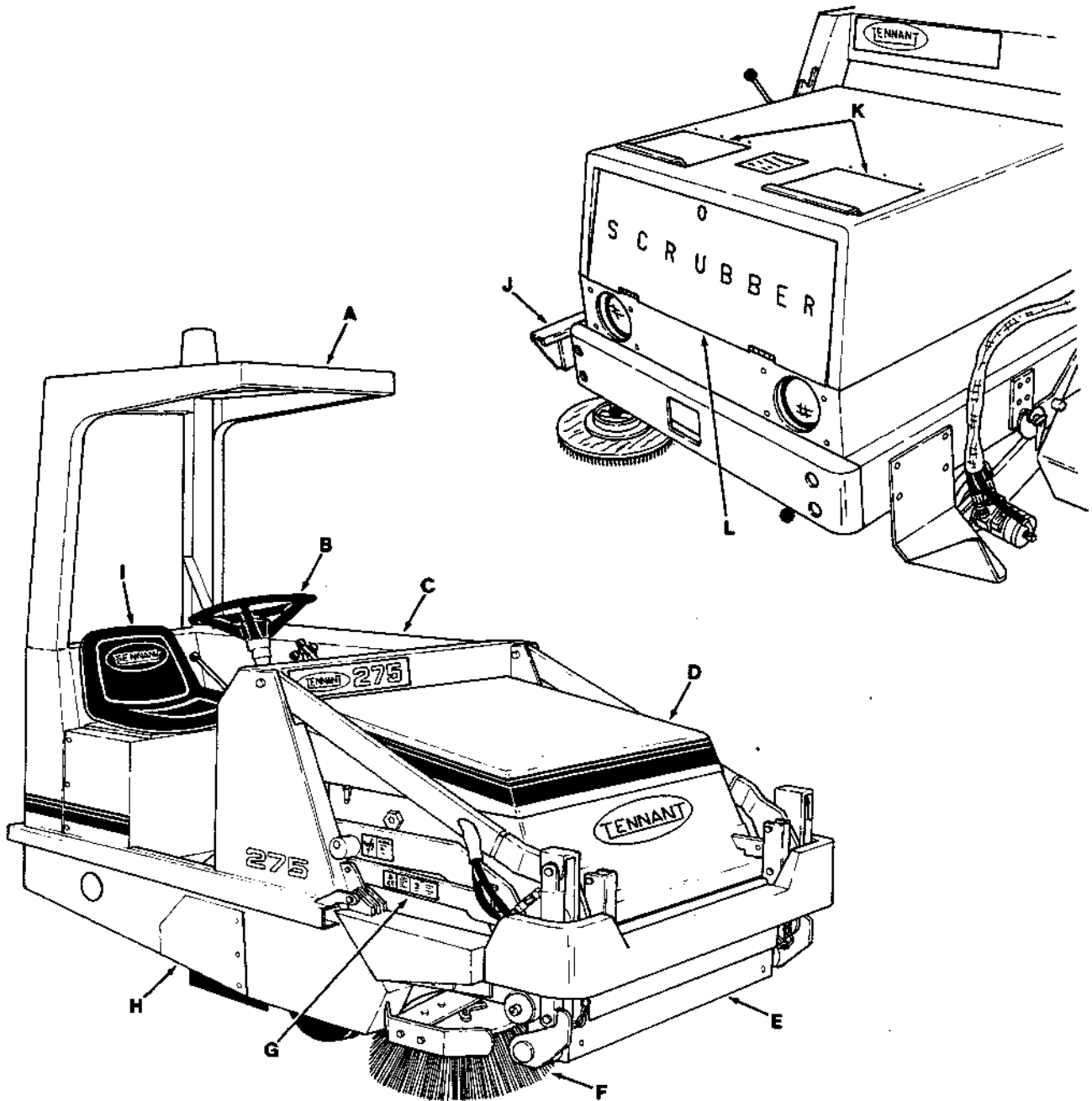
3. Check the hydraulic fluid level in the hydraulic fluid reservoir, using the dipstick provided. TENNANT® hydraulic fluid is recommended. If TENNANT® hydraulic fluid is not available, use only new, approved hydraulic fluid. See Hydraulics in the Maintenance section.
4. Check the engine oil level.
5. Check the radiator coolant level.

⚠ WARNING: If the coolant is hot or if the engine has been operating, let the engine cool. Hot coolant can scald or cause severe burns. If in doubt, let the coolant cool before releasing pressure in the cooling system.

6. Check the air pressure of the rear tire.
7. Check the main brush adjustment, as described in Brushes in the Maintenance section.
8. Fill the fuel tank, or install an LPG fuel tank on the machine.

⚠ WARNING: Do not fill the fuel tank while the engine is operating. Always be sure the fuel container and the machine are electrically connected before pouring fuel. Failure to electrically connect the fuel container to the machine may allow a static electricity spark to ignite the fuel, resulting in a fire or explosion.

OPERATION OF CONTROLS

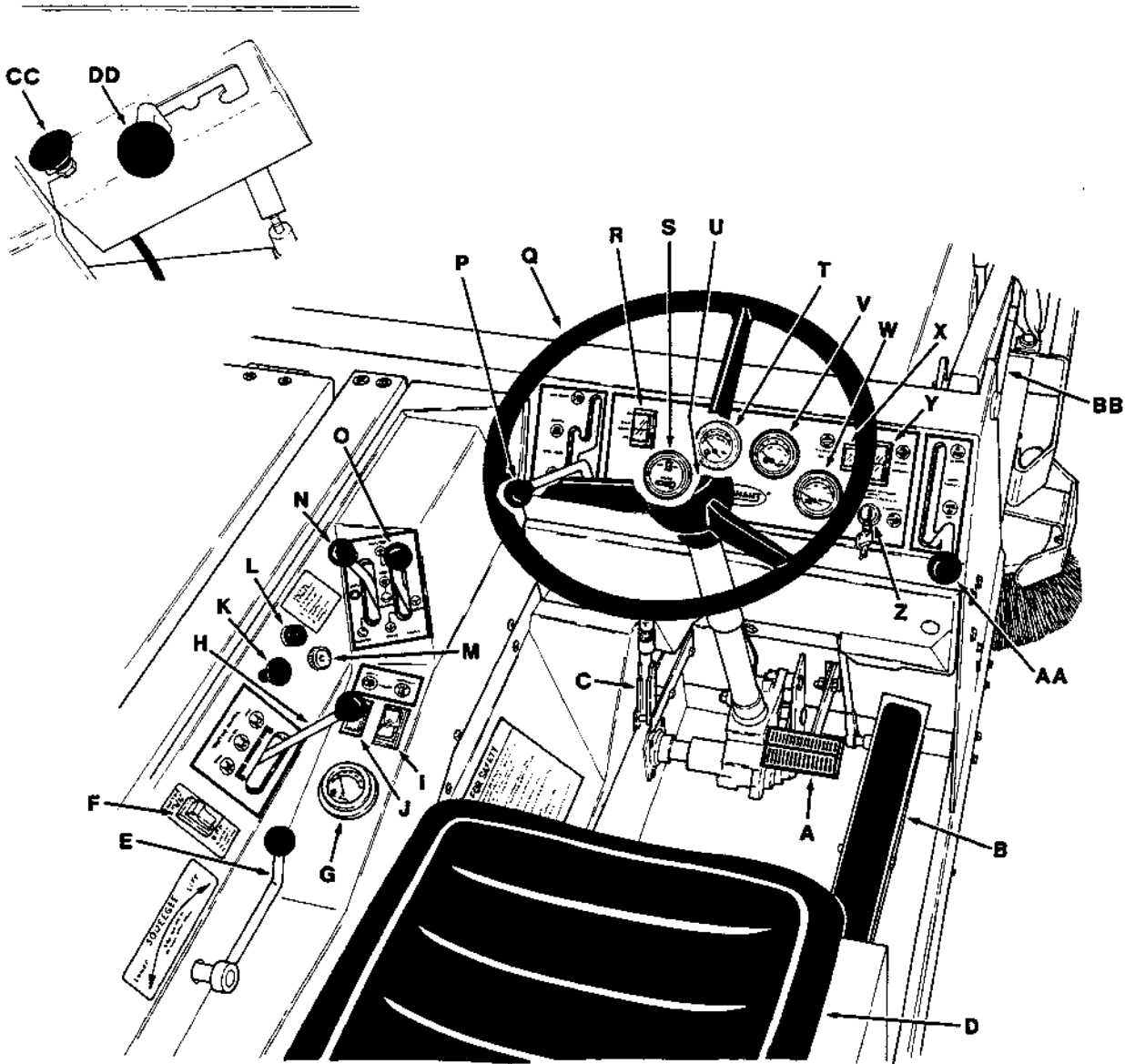


MACHINE COMPONENTS

- | | |
|-------------------|------------------------------|
| A. Overhead Guard | G. Hopper Safety Support Bar |
| B. Steering Wheel | H. Main Brush Access Door |
| C. Engine Cover | I. Operator Seat |
| D. Hopper Cover | J. Scrub Attachment |
| E. Hopper Door | K. Solution Tank Cover |
| F. Side Brush | L. Front Access Door |

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CONTROLS AND INSTRUMENTS

02454
02747

- | | |
|---|---|
| A. Brake Pedal | Q. Steering Wheel |
| B. Directional Control Pedal | R. Main Brush and Vacuum Fan Control Switch |
| C. Parking Brake Lever | S. Engine Hour Meter |
| D. Operator Seat | T. Engine Coolant Temperature Gauge |
| E. Squeegee Control Lever | U. Horn Button |
| F. Solution Flow Control Switch | V. Engine Oil Pressure Gauge |
| G. Fuel Level Gauge | W. Battery Condition Gauge |
| H. Throttle Control Lever | X. Clogged Filter Lamp |
| I. Hazard Lamp Switch | Y. Filter Shaker Switch |
| J. Drive Lamps Switch | Z. Ignition Switch |
| K. Engine Choke Knob | AA. Side Brush Position Control Lever |
| L. Diesel Preheat Pushbutton | BB. Hopper Safety Support Bar |
| M. Diesel Preheat Indicator | CC. Scrub Brush Position Control Lever |
| N. Hopper Dump Control Lever | DD. Solution Flow Control Knob |
| O. Hopper Lift and Side Brush Control Lever | |
| P. Main Brush Position Control Lever | |

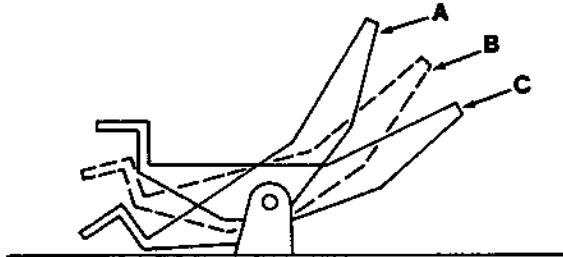
BRAKE PEDAL

The brake pedal operates the mechanical drum brakes on the two front wheels.

To stop the machine, return the directional control pedal to neutral; then apply pressure to the brake pedal.

DIRECTIONAL CONTROL PEDAL

A single foot pedal controls the hydraulic propelling drive. The foot pedal is used to select the direction of travel and the propelling speed of the machine.



DIRECTIONAL CONTROL PEDAL 00116

- A. "Reverse" Position
- B. "Neutral" Position
- C. "Forward" Position

To travel forward, press the "toe" portion of the pedal; to travel backward, press the "heel" portion of the pedal. The propelling speed of the machine is regulated by varying the pressure on the pedal.

If the machine creeps when the pedal is in the "neutral" position, adjust the pedal linkage as directed in Directional Control Pedal in the Maintenance section.

WARNING: Always use the brake pedal for normal stopping and controlling machine speed on downgrades to prevent loss of machine control.

PARKING BRAKE LEVER

The parking brake lever controls two brake rods which control the drum brakes on the two front wheels. To engage the parking brake, push the parking brake handle down. To disengage the parking brake, pull the brake handle up. Always park on a level surface, stop the engine, and engage the parking brake before leaving the machine unattended and before working on the machine.

OPERATOR SEAT

The operator seat is of a fixed back style with a forward-backward adjustment. To adjust the seat, remove the seat mounting bolts, slide the seat to the position desired, and reinstall and tighten the bolts. The operator seat also tilts forward to allow access to the gasoline or diesel fuel tank.

SQUEEGEE CONTROL LEVER

The squeegee control lever is present on machines equipped with the rear squeegee or scrub attachment accessories. The squeegee control lever operates a linkage which controls the position of the rear squeegee.

To raise the rear squeegee, push the control lever forward into the "lift" position. To lower the rear squeegee, pull the control lever back into the "lower" position.

SOLUTION FLOW CONTROL SWITCH

The solution flow control switch is present on machines equipped with the scrub attachment accessory. The solution flow control switch operates a solenoid valve which controls solution flow to the floor. The solution flow control knob mounted on the scrub attachment operates a valve which controls the solution flow rate to the floor. To start solution flow to the floor from the scrub attachment solution tank, press the top half of the control switch into the "on" position.

To stop solution flow to the floor, press the bottom half of the control switch into the "off" position.

FUEL LEVEL GAUGE

The fuel level gauge is present on all SE models, diesel-powered machines, and machines with the fuel level gauge accessory. It indicates how much fuel is left in the fuel tank. Machines without the instrument panel mounted fuel level gauge have a mechanical gauge built into the fuel tank cap.

THROTTLE CONTROL LEVER

The throttle control lever operates a cable which controls the engine governed speed. To slow the engine to idle speed, push the lever forward into the "idle" position. To pick up normal debris, speed the engine to the normal governed speed by lifting and pulling the lever back into the "normal" position. To pick up light litter, speed the engine to the maximum governed speed by pulling the lever into the "litter" position.

HAZARD LAMP SWITCH

The hazard lamp switch is present on machines with the rotating or flashing lamp accessory. To operate the lamp, press the front half of the rocker switch into the "on" position. To stop lamp operation, press the rear half of the rocker switch into the "off" position.

DRIVE LAMPS SWITCH

The drive lamps switch is present on machines with the operating lamps accessory. It controls the head lamps, tail lamps, and side brush spot lamp. To operate the lamps, press the front half of the rocker switch into the "on" position. To stop lamp operation, press the rear half of the rocker switch into the "off" position.

ENGINE CHOKE KNOB

The engine choke knob operates a cable which controls the engine choke. To close the choke for cold starting, pull the choke knob out. To open the choke, push the knob in.

DIESEL PREHEAT PUSHBUTTON AND INDICATOR

The diesel preheat pushbutton and indicator are present on diesel powered machines. The pushbutton controls the engine preheaters. The indicator glows brightly when the preheaters are up to starting temperature.

To use engine preheaters, push and hold the preheat pushbutton until the indicator glows brightly - usually fifteen to thirty seconds. Then release pushbutton and start engine.

HOPPER DUMP CONTROL LEVER

The hopper dump control lever is present on multi-level dump model machines. It operates a hydraulic valve which controls the hopper dump cylinders. To dump the hopper, raise the hopper to the desired height with the hopper lift and side brush control lever, then push the hopper dump control lever forward into the "dump" position. To hold the hopper in the "dump" position, release the hopper dump control lever into the "hold" position. To return the hopper to its operating position, pull the hopper dump control lever back into the "return" position; release the lever into the "hold" position when the hopper has fully rotated back. Lower the hopper with the hopper lift and side brush control lever.

HOPPER LIFT AND SIDE BRUSH CONTROL LEVER

The hopper lift and side brush control lever operates a hydraulic valve which controls the hopper lift cylinder and the side brush drive motor. To lift the hopper, pull the control lever back into the "raise" position until the desired height is reached. Be sure adequate vertical clearance is available before raising the hopper.

To hold the hopper up, pull the lever into the "hold" position. Do not rely on the hydraulic system to keep the hopper up if work is to be done on the machine. Always engage the hopper safety support bar.

⚠ WARNING: Always engage the hopper safety bar before working under a raised hopper. Do not rely on the machine hydraulic system to keep the hopper in the "raised" position. The hydraulic system may leak internally, allowing the hopper to lower, crushing anything under it.

To lower the hopper, push the lever into the "lower" position. To start side brush rotation, push the lever into the "on" position. To stop side brush rotation, pull the lever back into the "off" position.

MAIN BRUSH POSITION CONTROL LEVER

The main brush position control lever operates a linkage which controls the position of the main brush. The main brush may be operated in the "normal" or "free-float" position. Use the "normal" position for most sweeping conditions. It will result in longer brush life. Use the "free-float" position when encountering extremely uneven areas.

To lower the main brush into the "normal" position, pull the control lever back, to the left, and lower it into the "normal" position.

To lower the main brush into the "free-float" position, pull the lever back, to the left, and lower it into the "free-float" position.

To raise the main brush, pull the lever back and to the right into the "raise" position.

NOTE: Always place the main brush control lever in the "raise" position when the main brush is not in operation. This will prevent the main brush from getting a flat spot.

STEERING WHEEL

The steering wheel operates a steering gear assembly which controls the rear wheel through an arm and tie rod. The machine is very responsive to steering wheel movements. Use care until you become more experienced in guiding the machine.

A horn button is located in the center of the steering wheel.

MAIN BRUSH AND VACUUM FAN CONTROL SWITCH

The main brush and vacuum fan control switch operates an electric solenoid valve which controls hydraulic fluid flow to the main brush and vacuum fan motors. The switch also controls the scrub brush motor when the machine is equipped with the scrub attachment, and the snow broom motor when the machine is equipped with the snow broom accessory.

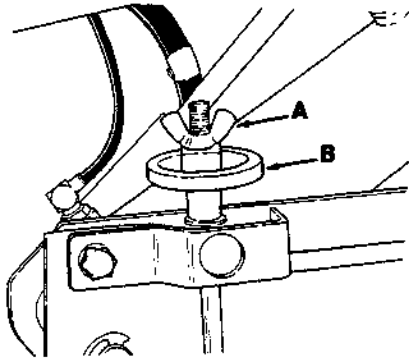
To start main brush rotation and vacuum fan suction, press the top half of the rocker switch into the "on" position.

To stop main brush rotation and vacuum fan suction, press the bottom half of the rocker switch into the "off" position.

MAIN BRUSH HEIGHT ADJUSTMENT KNOB

The main brush height adjustment knob is located behind an access door next to the operator's left foot. It limits how close to the ground the main brush will operate when the main brush position control lever is in the "normal" position.

To raise the main brush and reduce the main brush floor contact, loosen the wing nut and thread the knob clockwise. To lower the main brush and increase main brush floor contact, loosen the locking knob and thread the knob counterclockwise. Retighten the wing nut after making any adjustment.



00563

MAIN BRUSH HEIGHT ADJUSTMENT KNOB

- A. Wing Nut
- B. Adjustment Knob

ENGINE HOUR METER

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

ENGINE COOLANT TEMPERATURE GAUGE

The engine coolant temperature gauge registers the engine coolant temperature. Normal engine coolant temperatures range up to 200° F. (93° C). Temperatures above this level indicate an over-heating engine. This condition may arise due to a low coolant level, a clogged radiator, a loose fan belt, a defective thermostat, or other engine malfunctions. Engine over-heating will always cause a coolant loss. If coolant loss does not occur, check for malfunction of the temperature sending unit.

ENGINE OIL PRESSURE GAUGE

The engine oil pressure gauge registers the engine oil pressure. Normal engine oil pressure ranges from 20 to 35 psi (140 to 240 kPa) at full engine throttle. If the gauge registers an oil pressure reading below 7 psi (50 kPa), stop the engine immediately and determine the cause. Failure to stop the engine will result in engine damage.

NOTE: The engine is equipped with an oil pressure switch that will stop the engine if oil pressure drops below 5 psi (35 kPa).

BATTERY CONDITION GAUGE

The battery condition gauge indicates the present voltage potential of the battery when engine is not operating. Normal battery voltage is 10 to 14 volts. When the engine is operating, the gauge registers alternator output voltage. If the voltage exceeds 14 volts, it may be overcharging. If the voltage falls below 10 volts, it may not be accepting or getting a charge from the alternator. Overcharging and undercharging are indications that one or more electrical components are in need of repair.

CLOGGED FILTER LAMP

The clogged filter lamp is present on SE models and on machines with the shaker timer accessory. The lamp lights when the hopper dust filter is clogged. To unclog the filter, shake it with the filter shaker; see Filter Shaker Switch. If the filter shaker does not clean the filter enough to turn the lamp off, clean the filter as described in Hopper Dust Filter in the Maintenance section.

FILTER SHAKER SWITCH

The filter shaker switch operates the filter shaker motor which is mounted on top of the hopper dust filter. It is used to shake excess dust from the dust filter.

To shake the dust filter, the hopper lift and side brush control lever, and the main brush and vacuum fan control switch must be in the "off" position. Then, press and hold the top half of the rocker switch in for 10 to 15 seconds to shake the dust filter. Machines equipped with the shaker timer automatically shake the dust filter for 15 seconds after the shaker push-button switch has been pressed.

IGNITION SWITCH

The key-operated ignition switch has four positions: "accessories," "off," "on," and "start." To start the engine, turn the key fully clockwise to the "start" position. Release the key as soon as the engine starts and the key will place itself in the "on" position. To stop the engine, turn the key to the vertical "off" position.

⚠ WARNING: Before operating the machine, make sure all safety devices are in place and operate properly. Check the foot and parking brakes and the steering control for proper operation. Do not start machine unless you are in operator's seat, with foot on the brake pedal or operational parking brake engaged and the directional control pedal in the "neutral" position. Failure to do so could allow the machine to move immediately upon start-up, resulting in severe personal injury.

SIDE BRUSH POSITION CONTROL LEVER

The side brush position control lever operates a cable which controls the position of the side brush. To lower the side brush, pull the control lever back, to the left, and lower it into the "down" position. To raise the side brush, pull the lever back and to the right, into the "up" position.

NOTE: Always place the side brush control lever in the "raise" position when the side brush is not in operation.

HOPPER SAFETY SUPPORT BAR

The hopper safety support bar is located on the operator's side of the hopper. It holds the hopper in a "raised" position to allow work to be done under the hopper. Do not rely on the machine hydraulic system to keep the hopper raised.

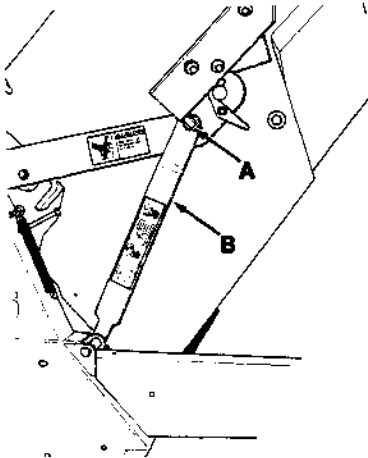
⚠ WARNING: Always engage the hopper safety support bar before working under a raised hopper. Do not rely on the machine hydraulic system to keep the hopper in the "raised" position. The hydraulic system may leak internally, allowing the hopper to lower, crushing anything under it.

TO ENGAGE HOPPER SAFETY SUPPORT BAR

1. Engage the machine parking brake and start the engine.

⚠ WARNING: Always park on a level surface and engage the parking brake before working on the machine to keep it from rolling.

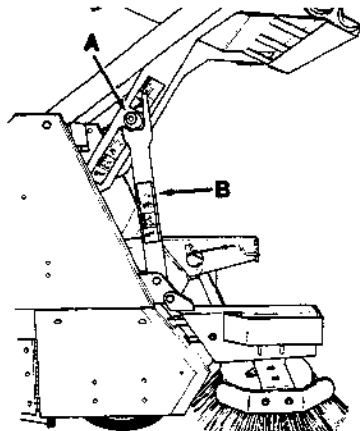
2. Raise the hopper to the "fully raised" position.
3. Lift and position the hopper safety support bar under the hopper lift arm pin on low dump models, or hopper lift arm cam on multi-level dump models.



02488

ENGAGED HOPPER SAFETY SUPPORT BAR - LOW DUMP MODEL

- A. Lift Arm Pin
- B. Safety Support Bar



02467

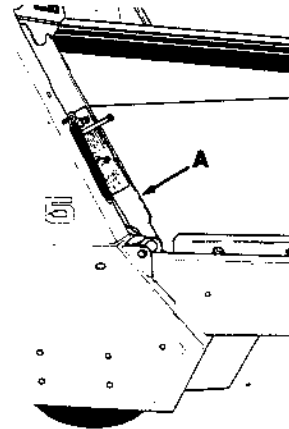
ENGAGED HOPPER SAFETY SUPPORT BAR - MULTI-LEVEL DUMP MODEL

- A. Lift Arm Cam
- B. Safety Support Bar

4. Slowly lower the hopper so the lift arm pin or cam rests on the safety support bar.
5. Turn the engine off.
6. Check the safety support bar to make sure it is securely engaged.

TO DISENGAGE HOPPER SAFETY SUPPORT BAR

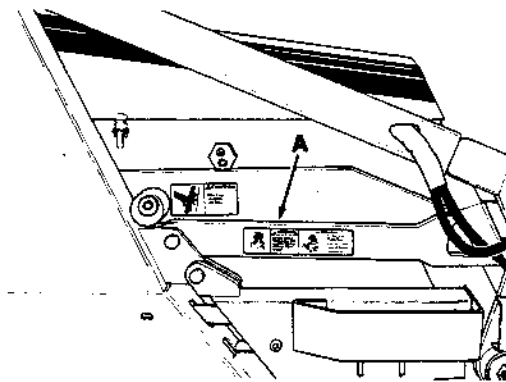
1. Start the engine.
2. Place the engine throttle lever in the "normal" position.
3. Raise the hopper to the "fully raised" position.
4. Place the safety support bar in its storage position.



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DISENGAGED HOPPER SAFETY SUPPORT BAR - LOW DUMP MODEL

- A. Safety Support Bar



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DISENGAGED HOPPER SAFETY SUPPORT BAR - MULTI-LEVEL DUMP MODEL

- A. Safety Support Bar

5. Lower the hopper.
6. Turn the engine off.

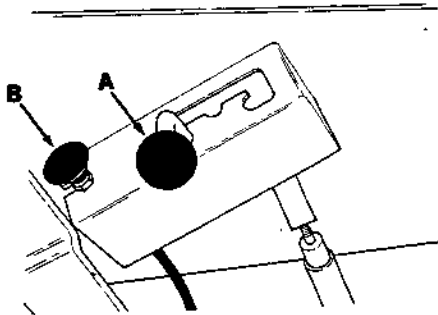
SCRUB BRUSH POSITION CONTROL LEVER

The scrub brush position control lever is located on the right side of the scrub attachment. The lever operates a linkage which controls the position of the scrub brush.

The scrub brush may be positioned in either the "raised," "normal," or "restricted down" positions. The "raised" position is used when the scrub attachment is not in use. The "normal" position is for general scrubbing. The "restricted down" position is used to remove compacted soilage.

To raise the scrub brush, pull the lever back and to the right into the "raised" position.

To lower the scrub brush, pull the lever back and lower it into the "normal" position or push it forward into the "restricted down" position.



02747

SCRUB BRUSH POSITION CONTROL LEVER

- A. Control Lever - "Raised" Position
- B. Solution Flow Control Knob

SOLUTION FLOW CONTROL KNOB

The solution flow control knob operates a valve which controls the solution flow rate to the floor. The solution flow control switch is used to start and stop solution flow.

To increase solution flow, pull the control knob out. To decrease solution flow, push the control knob in. Pushing the knob all of the way in may stop solution flow.

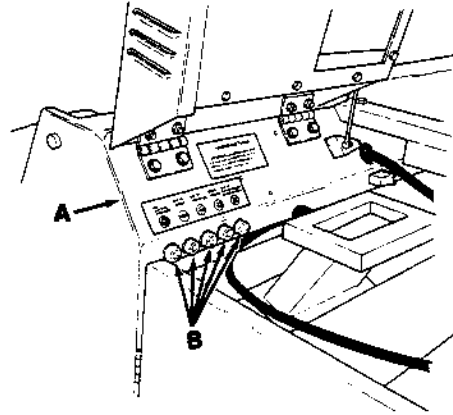
CIRCUIT BREAKERS

Circuit breakers are resettable 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 circuit breakers are located on the lintel, under the engine cover.

The following chart shows the various circuit breakers and the electrical components they protect.

| PROTECTIVE DEVICE | RATING | CIRCUIT PROTECTED |
|-------------------|--------|---------------------------------------|
| CB-1 | 15 A | Filter Shaker |
| CB-2 | 15 A | Horn |
| CB-3 | 15 A | Engine Ignition |
| CB-4 | 15 A | Operating Lights, Scrub Attachment |
| CB-5 | 15 A | Hazard Light, Cab |



CIRCUIT BREAKERS

- A. Lintel
- B. Circuit Breakers

02902

MACHINE OPERATION

NORMAL SWEEPING OPERATION

A normal sweeping operation consists of seven typical operations: pre-start checklist, starting machine, sweeping, dumping hopper, post operation checklist — engine operating, stopping machine, and post operation checklist — engine stopped.

The Pre-Start Checklist lists things to check before starting the machine.

To Start Machine lists the steps required to start the machine.

To Sweep lists things to keep in mind before and during the sweeping operation.

To Dump Hopper lists the steps required to dump the hopper.

Post Operation Checklist — Engine Operating lists things to check before stopping the machine engine.

To Stop Machine lists the steps required to stop the machine.

Post Operation Checklist — Engine Stopped lists things to check after stopping the machine engine.

PRE-START CHECKLIST

Check under machine for leak spots.

Check engine lubricating oil level.

Check fuel level.

Check for LPG odor or frosting on hoses or components indicating a leak.

Check brakes and controls for proper operation.

Check service records to determine service requirements.

TO START MACHINE

NOTE: Before starting machine, perform the pre-start checks.

1. LPG powered machines: Slowly open the liquid service valve.

NOTE: Opening the service valve too quickly may cause the service valve check valve to stop the flow of LPG fuel. If the check valve stops the flow of fuel, close the valve, wait a few seconds, and slowly open the valve once again.

Diesel powered machines: Push the diesel preheat pushbutton until the preheat indicator glows brightly.

2. The machine operator must be in the operator's seat with the directional control pedal in the "neutral" position and with a foot on the brake pedal or with the parking brake engaged.

⚠ WARNING: Before operating the machine, make sure all safety devices are in place and operate properly. Check the foot and parking brakes and the steering control for proper operation. Do not start the machine unless you are in the operator's seat with a foot on the brake pedal or have the parking brake engaged and the directional control pedal in the "neutral" position. Failure to do so could result in severe personal injury.

3. Gasoline powered machines: When the engine is cold, pull out the choke knob about three-fourths of the way. Push choke in after the engine has started and is running smoothly.

LPG powered machines: When the engine is cold and exposed to cold temperatures, open the engine cover, press the primer button on the LPG vaporizer, close the engine cover.

4. Move the throttle control lever to the "idle" position.
5. Turn the ignition switch key to the "start" position until the engine starts. Do not operate the starter for more than a few seconds at a time or after the engine has started.

NOTE: Do not operate the starter motor for more than 10 seconds at a time or after the engine has started. Allow the starter to cool between starting attempts. The starter motor may be damaged if it is operated incorrectly.

6. Allow the engine and hydraulic system to warm up three to five minutes.
7. Disengage the machine parking brake.
8. Move the throttle control lever to the "normal" position, and drive the machine to the area to be swept.

TO SWEEP

Plan the sweeping in advance. Try to arrange long runs with minimum stopping and starting. Sweep debris from very narrow aisles into main aisles ahead of time. Do an entire floor or section at one time.

Pick up oversize debris before sweeping. Flatten or remove bulky cartons from aisles before sweeping. Pick up pieces of wire, twine, string, etc., which could become entangled in brush or brush plugs. Overlap brush paths.

Avoid turning the steering wheel too sharply when the machine is in motion. The machine is very responsive to the movement of the steering wheel. Avoid sudden turns, except in emergencies.

Sweep as straight a path as possible. Avoid bumping into posts or scraping the sides of the sweeper.


Speed up the engine from "normal" to "litter" when light litter is to be picked up. This will improve both litter pickup and hopper loading. Do not overuse the "litter" speed as the machine may dust and clog the hopper filters in dusty environments. Normal debris is best picked up with the engine operating in the "normal" position.

1. Push the hopper lift and side brush control lever and the main brush and vacuum fan control switch into the "on" position.
2. Move the main brush position control lever into the "normal" position and the side brush position control lever into the "down" position.
3. Sweep as required.

TO DUMP HOPPER

1. Pull the main brush position control lever back into the "raise" position.
2. Press the bottom half of the main brush and vacuum fan control switch into the "off" position.
3. Pull the side brush position control lever back into the "up" position.
4. Press and hold the top half of the filter shaker switch in for 10 to 15 seconds to shake the dust filter.
5. Slowly drive the machine up to the dump site or dumpster.
6. Low dump model machines: Pull the hopper lift and side brush control lever back into the "raise" position to dump the hopper. Pull the lever into the "hold" position to keep the hopper in the "dump" position.

Multi-level dump model machines: Pull the hopper lift and side brush control lever back into the "raise" position to lift the hopper to the desired height. Be aware: The minimum hopper clearance needed to high dump the hopper is 108 in (2745 mm).

 **WARNING:** Be sure adequate overhead clearance is available before attempting to high dump the hopper to avoid falling objects or electrical shock hazards.

Pull the lever back into the "hold" position to keep the hopper at the desired height; then push the hopper dump control lever into the "dump" position to dump the hopper.

NOTE: Lowering the hopper into the dumpster may help to control flying dust.

Pull the hopper dump control lever into the "return" position to return the hopper to its normal angle, then release lever.


7. Push the hopper lift and side brush control lever into the "lower" position to return the hopper to its operating position.
8. Slowly back the machine away from the dump site or dumpster.

POST OPERATION CHECKLIST - ENGINE OPERATING

Check brush patterns for width and evenness.

TO STOP MACHINE

1. Return the directional control pedal to the "neutral" position. Apply the brake.
2. Pull the main brush position control lever into the "raise" position and the side brush position control lever into the "up" position.
3. Place the hopper lift and side brush control lever, and the main brush and vacuum fan control switch in the "off" position.
4. Turn the operating lamps off if used.
5. Gasoline and LPG powered machines: Place the throttle control lever in the "idle" position.
Diesel powered machines: Place the throttle control lever in the "stop" position.
6. Engage the machine parking brake.
7. Turn the ignition switch key to the "off" position. Remove the key from the ignition switch.

 **WARNING:** Always park on a level surface, stop the engine, and engage the parking brake before leaving the machine unattended to keep it from creeping or rolling.

8. LPG powered machines: Close the LPG tank liquid service valve.

POST OPERATION CHECKLIST - ENGINE STOPPED

Check skirts for damage, wear, and adjustment.

Check for wire or string tangled on brushes.

Check to make sure LPG tank service valve is closed.

Check for LPG odor or frost on LPG hoses and components, indicating a leak.

Check for leaks.

NORMAL SCRUBBING OPERATION

A normal scrubbing operation consists of seven typical operations: pre-start checklist, starting machine, scrubbing, draining recovery tank and emptying hopper, post operation checklist - engine operating, stopping machine, and post operation checklist - engine stopped.

Pre-Start Checklist lists things to check before starting the machine.

To Start Machine lists the steps required to start the machine.

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

To Drain Recovery Tank and Empty Hopper lists the steps required to empty the debris hopper and the recovery tank.

Post Operation Checklist - Engine Operating lists things to check before stopping the machine engine.

To Stop Machine lists the steps required to stop the machine.

Post Operation Checklist - Engine Stopped lists things to check after stopping the machine engine.

PRE-START CHECKLIST

Check under machine for leak spots.

Check engine lubricating oil level.

Check fuel level.

Check for LPG odor or frosting on hoses or components indicating LPG fuel leak.

Check brakes and controls for proper operation.

Check service records to determine service requirements.

TO START MACHINE

1. LPG powered machines: Slowly open the liquid service valve.

NOTE: Opening the service valve too quickly may cause the service valve check valve to stop the flow of LPG fuel. If the check valve stops the flow of fuel, close the valve, wait a few seconds, and slowly open the valve once again.

Diesel powered machines: Push the diesel preheat pushbutton until the preheat indicator glows brightly.

2. The machine operator must be in the operator's seat with the directional control pedal in the "neutral" position and with a foot on the brake pedal or with the parking brake engaged.

⚠ WARNING: Before operating the machine, make sure all safety devices are in place and operating properly. Check the foot and parking brakes and the steering control for proper operation. Do not start machine unless you are in operator's seat, with a foot on the brake pedal, or have the parking brake engaged and the directional pedal in the "neutral" position. Failure to do so could allow the machine to move immediately upon start-up, resulting in severe personal injury.

3. Gasoline powered machines: When the engine is cold, pull out the choke button about three-fourths of the way. Push choke in after the engine has started and is running smoothly.

LPG powered machines: When the engine is cold and exposed to cold temperatures, open the engine cover, press the primer button on the LPG vaporizer, close the engine cover.

4. Move the throttle control lever to the "idle" position.

5. Turn the ignition switch key to the "start" position until the engine starts. Do not operate the starter for more than a few seconds at a time or after the engine has started.

NOTE: Do not operate the starter motor for more than 10 seconds at a time or after the engine has started. Allow the starter to cool between starting attempts. The starter motor may be damaged if it is operated incorrectly.

6. Allow the engine and hydraulic system to warm up three to five minutes.
7. Disengage the machine parking brake.
8. Move the throttle control lever to the "normal" position and drive the machine to the solution filling site.

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 oversize debris before scrubbing. Remove bulky debris from aisles 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.

Do not turn steering wheel too sharply when the machine is in motion. It is very responsive to the movement of the steering wheel. Avoid sudden turns, except in emergencies.

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

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

⚠ WARNING: Do not use flammable or combustible cleaning agents when scrubbing to prevent fire or explosion and serious injury.

The recovery tank should be drained after the solution tank is empty and whenever the ball float rises and stops water vacuum. The recovery tank may fill before the solution tank empties if standing water is picked up in addition to the solution put down by the machine.

For best scrubbing results, reduce speed to one-half maximum machine speed. Shut off solution flow to floor 5 ft (1525 mm) before making turns. Always raise the rear squeegee before backing machine. Adjust solution flow to floor with solution flow control knob to match floor conditions.

1. Stop the engine and engage the parking brake before filling solution tanks.

⚠ WARNING: Always park on a level surface, stop the engine, and engage the parking brake before working on the machine to keep it from rolling.

2. Open the solution tank covers.
3. Pour the required amount of detergent into the tanks. Fill the tanks with water.
4. Start and drive the machine to the area to be scrubbed.
5. Push the hopper lift and side brush control lever and the main brush and vacuum fan control switch into the "on" position.
6. Move the main brush and scrub brush position control levers into the "normal" position and the side brush position control lever into the "down" position.
7. Press the solution flow control switch into the "on" position.
8. Pull the squeegee control lever back into the "lower" position.
9. Scrub as required. Adjust the solution flow to match floor conditions. When the recovery tank ball float stops vacuum, return to the solution dump/filling site. Drain the recovery tank, empty the hopper, and refill the solution tank.

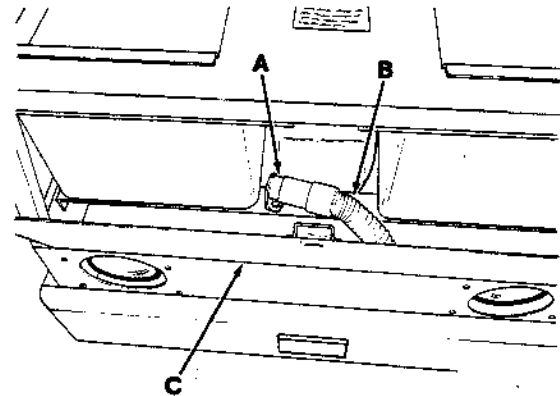
TO DRAIN RECOVERY TANK AND EMPTY DEBRIS HOPPER

1. Park the machine next to a floor drain. Stop the engine and engage the parking brake.

⚠ WARNING: Always park on a level surface, stop the engine, and engage the parking brake before working on the machine to keep it from rolling.

2. Open the front access door.
3. Remove the recovery tank drain hose from its retention plug. Lower the hose to the floor drain to drain the tank.

NOTE: The tank will not empty with the vacuum fan operating.



RECOVERY TANK DRAIN HOSE

02748

- A. Plug
- B. Drain Hose
- C. Access Door

4. Replace the hose on the retention plug after the tank is empty.
5. Close the front access door.
6. Start the engine and move the hopper lift and side brush control lever to the "raise" position to empty the debris hopper.
7. Move the hopper lift and side brush control lever to the "lower" position to lower the scrub attachment.

POST OPERATION CHECKLIST - ENGINE OPERATING

Check scrub brush pattern for width and evenness.
Check squeegees for proper deflection.

TO STOP MACHINE

1. Return the directional control pedal to the "neutral" position. Apply the brake.
2. Press the solution flow control switch into the "off" position.
3. Pull the main brush position control lever into the "raise" position and the side brush position control lever into the "up" position.
4. Place the hopper lift and side brush control lever, and the main brush and vacuum fan control switch in the "off" position.
5. Push the squeegee control lever into the "lift" position.
6. Turn the operating lamps off if used.
7. Gasoline and LPG powered machines: Place the throttle control lever in the "idle" position.
Diesel powered machines: Place the throttle control lever in the "stop" position.
8. Engage the machine parking brake.

- Turn the ignition switch key to the "off" position. Remove the key from the ignition switch.

⚠ WARNING: Always park on a level surface, stop the engine, and engage the parking brake before leaving the machine unattended to keep it from creeping or rolling.

- LPG powered machines: Close the LPG tank liquid service valve.

POST OPERATION CHECKLIST - ENGINE STOPPED

Check skirts for damage, wear, and adjustment.
 Check for wire or string tangled on brushes.
 Drain and clean recovery tank.
 Check vacuum hoses for debris or obstructions.
 Check to make sure LPG tank service valve is closed.
 Check for LPG odor or frost on LPG hoses and components, indicating a leak.
 Check for leaks.

DOUBLE SCRUBBING OPERATION

Double scrubbing is a method of removing heavy accumulations of soilage, dirt, wax, or spills. It involves making two passes over the area to be cleaned. To double scrub, make a single pass over the surface being cleaned with the rear squeegee raised. Allow the solution to soak on the floor for 15 to 20 minutes. Then make a second scrubbing pass in the normal manner with the rear squeegee lowered.

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

OPERATION ON GRADES

Drive the machine slowly on grades. Use the service brakes to control machine speed.

⚠ CAUTION: Always travel slowly on grades to prevent machine from becoming unstable. When going down a grade, use service brakes to control speed. Do not operate machine on greater than maximum rated climb and descent angles.

The maximum rate ramp climb and descent angle is 15° with an empty hopper, and 10° with a full hopper.

VACUUM WAND

The vacuum wand accessory gives the machine the added flexibility of picking up debris not accessible by the machine. A 120 in (3050 mm) hose utilizes the machine vacuum system.

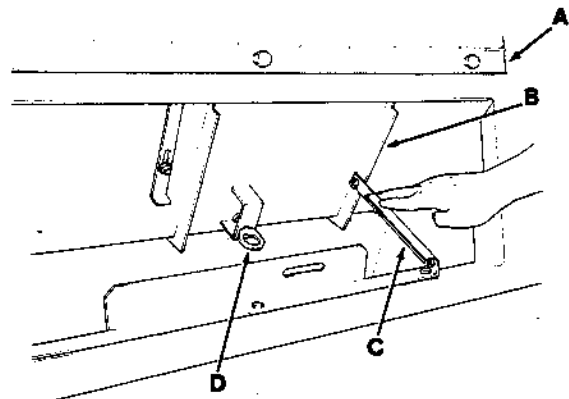
TO OPERATE VACUUM WAND

- Stop the machine close to the area to be cleaned.
- Place the main brush and side brush position control levers in the "raise" position.

- Stop the engine and engage the machine parking brake.

⚠ WARNING: Always park the machine on a level surface, stop the engine and engage the parking brake before working on the machine to keep it from rolling.

- Open the hopper inspection door.
- Low dump models: Unlatch the vacuum door retainer. Press the vacuum door arms down to close the vacuum door.

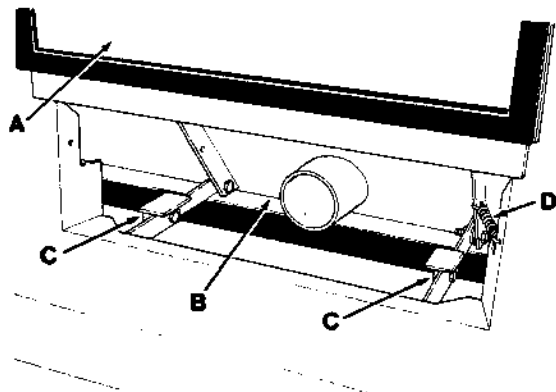


CLOSING VACUUM DOOR

02749

- A. Inspection Door
- B. Vacuum Door
- C. Door Arm
- D. Retainer

Multi-level dump models: Press the vacuum door arms down to close the vacuum door.



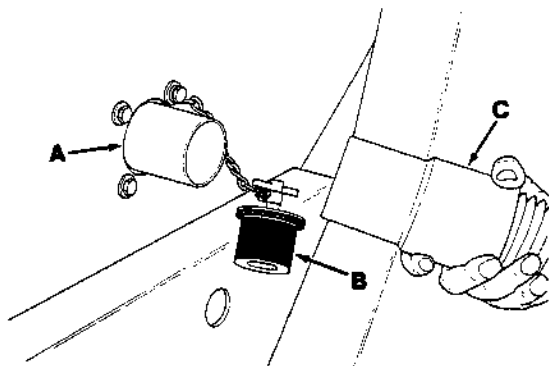
CLOSED VACUUM DOOR

02801

- A. Inspection Door
- B. Vacuum Door
- C. Door Arm
- D. Spring

- Low dump models: Remove the vacuum plug from the side of the hopper.

- Assemble the vacuum wand to the vacuum hose.
- Connect the hose to the vacuum connection.



02750

CONNECTING VACUUM HOSE—LOW DUMP MODEL

- A. Vacuum Connection
- B. Vacuum Plug
- C. Hose

- Start the engine and move the throttle control lever to the "normal" position.
- Place the main brush and vacuum fan control switch in the "on" position.
- Vacuum the area as required.
- When finished, stop the engine and place the main brush and vacuum fan control switch in the "off" position.
- Disassemble the vacuum wand and hose. Place them in their storage locations.
- Low dump models: Replug the vacuum connection.
- Pull the vacuum door arms up to open the fire door.
- Low dump models: Pull the door retainer through the door brackets and latch to hold the vacuum door open.
Multi-level dump models: Pull the vacuum door open. The spring will hold it open.
- Close the hopper inspection door.

HOPPER DOLLY

The hopper dolly accessory makes the job of removing the low dump model debris hopper easy. It also is used to store the hopper when it is not mounted on the machine.

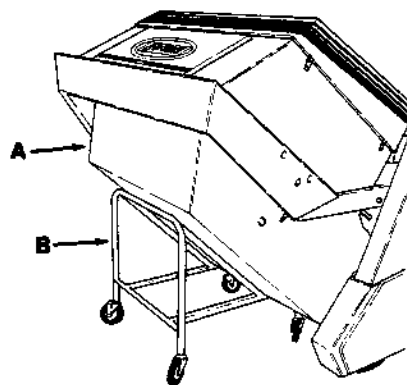
TO REMOVE HOPPER WITH DOLLY

- Empty debris hopper.

- Stop the engine and engage the machine parking brake.

WARNING: Always park the machine on a level surface, stop the engine and engage the parking brake before working on the machine to keep it from rolling.

- Lift the front bumper with the help of an assistant. Secure bumper with chain.
- Disconnect all wires and vacuum hoses between the hopper and the machine.
- Start the engine, raise the hopper, and place the hopper lift and side brush control lever in the "hold" position.
- Stop the engine.
- Roll the hopper dolly under the hopper so the lip on the short end of the dolly is behind the bottom edge of the hopper.

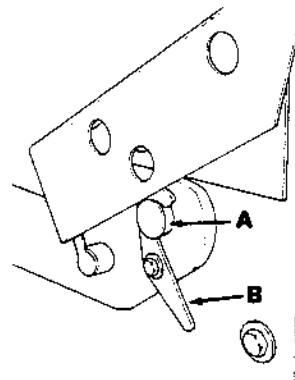


HOPPER DOLLY

02751

- A. Hopper
- B. Dolly

- Tilt the lift arm hooks back away from the lift arm pins.



LIFT ARM HOOK

02752

- A. Pin
- B. Hook

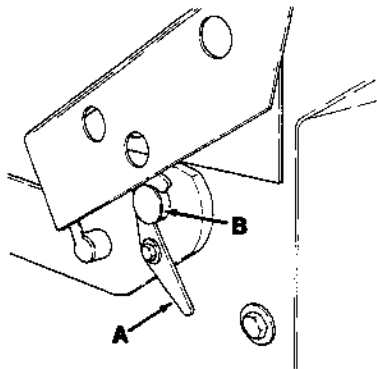
9. Place the hopper lift and side brush control lever in the "lower" position to lower the hopper onto the dolly.
10. Push the lift arms down to clear the lift arm pins and roll the hopper away from the machine.

TO INSTALL HOPPER WITH DOLLY

1. Stop the engine and engage the machine parking brake.

⚠ WARNING: Always park the machine on a level surface, stop the engine and engage the parking brake before working on the machine to keep it from rolling.

2. Roll the hopper into position in the machine.
3. Position the lift arm pins in the lift arm slots. Push the lift arm hooks over the pins.



LIFT ARM HOOK

02752

- A. Hook
- B. Pin

4. Start the engine, raise the hopper, and place the hopper lift and side brush control lever in the "hold" position.
5. Stop the engine.
6. Roll the hopper dolly away from the machine.
7. Place the hopper lift and side brush control lever in the "lower" position.
8. Unlatch and remove the hopper cover.
9. Connect the wire harness connectors and the vacuum hose(s) between the hopper and the machine.
10. Reposition and latch the hopper cover on the hopper. Lower the front bumper with the help of an assistant.

SCRUB ATTACHMENT

The scrub attachment accessory gives the machine the added flexibility to scrub floors. It consists of three groups of parts - the scrub attachment, the side scrub brush and squeegee, and the rear squeegee.

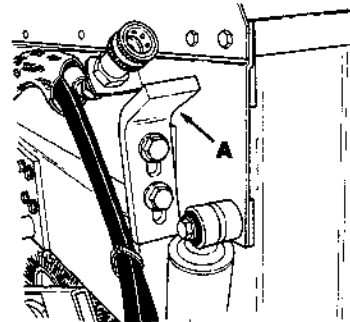
The scrub attachment and side scrub brush and squeegee are to be removed when sweeping. The rear squeegee may be left on the machine in the "raised" position. The scrub attachment takes the place of the sweeping hopper. The side scrub brush and squeegee take the place of the side sweep brush. The main sweeping brush is also exchanged for a scrubbing brush in the conversion.

TO MOUNT SCRUB ATTACHMENT

1. Remove debris hopper with hopper dolly as described in To Remove Hopper With Dolly.
2. Stop the engine and engage the machine parking brake.

⚠ WARNING: Always park on a level surface, stop the engine, and engage the parking brake before working on the machine to keep it from rolling.

3. Lift the front bumper with the help of an assistant. Secure bumper with chain.
4. Position top lift arm cams vertically.
5. Position the scrub attachment rear left cam locking bracket in the "top" position.



LOCKING BRACKET

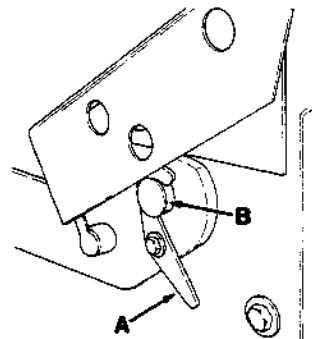
02756

- A. Locking Bracket

6. Roll the scrub attachment into position in the machine until it contacts bottom lift arm cams.

⚠ WARNING: The solution and recovery tanks must be empty during scrub attachment installation and removal to avoid personal injury.

7. Position the lift arm pins in the lift arm slots. Push the lift arm hooks over the pins.

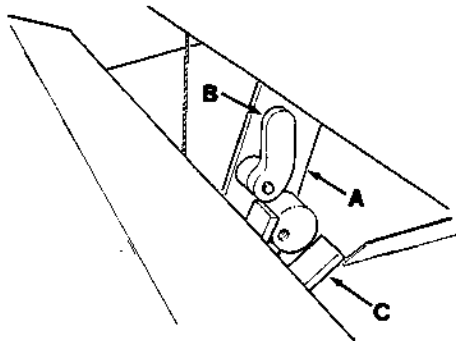


LIFT ARM HOOK

02752

- A. Hook
- B. Pin

- Turn the top lift arm cams, one on each side, so they overlap the scrub attachment brackets. Tighten the cam bolts.



TOP LIFT ARM CAM

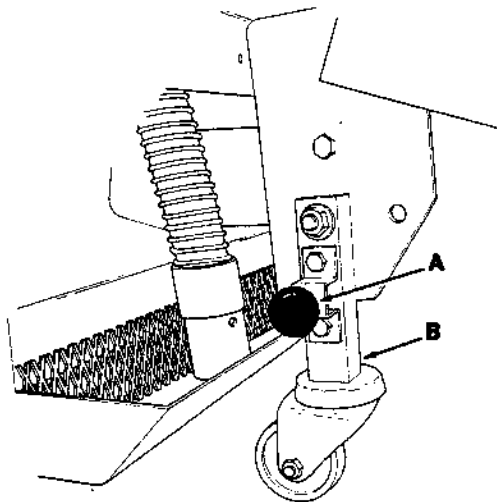
02753

- A. Lift Arm
- B. Top Cam
- C. Bracket

- Start the engine, raise the scrub attachment, and engage the hopper safety support bar.

WARNING: Always engage the hopper safety support bar before working under a raised hopper. Do not rely on the machine hydraulic system to keep the hopper in the "raised" position. The hydraulic system may leak internally, allowing the hopper to lower, crushing anything under it.

- Pull the scrub attachment leg locking knobs out, swing the legs up into the "raised" position, and release the knobs.



SCRUB ATTACHMENT LEG

02754

- A. Locking Knob
- B. Leg

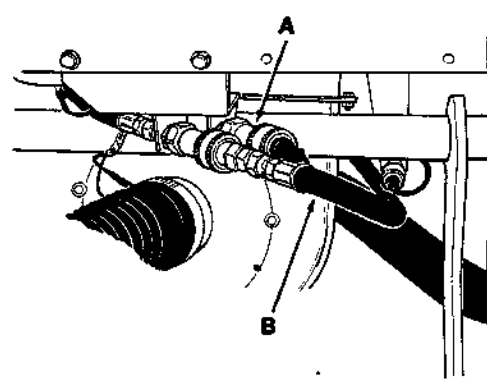
- Start the engine, raise the hopper, place the hopper safety support bar in its storage location, and lower the scrub attachment. Stop the engine.

- Lower the front bumper with the help of an assistant.

WARNING: Always use two people to raise or lower the front bumper to avoid personal injury.

- Push the rear of the scrub attachment down so the right side cam locking bracket contacts the bottom lift arm cam. Snug the top lift arm cam up to the locking bracket and tighten the cam bolt.
- Push the rear of the scrub attachment down so the left side cam locking bracket contacts the bottom lift arm cam. Snug the top lift arm cam up to the locking bracket and tighten the left-hand threaded cam bolt.
- Connect the wire harness connectors and vacuum hoses between the scrub attachment and the machine.
- Disconnect the hydraulic hose from the front of the quick-disconnect station and connect it to the quick-disconnect fitting mounted on the scrub attachment.

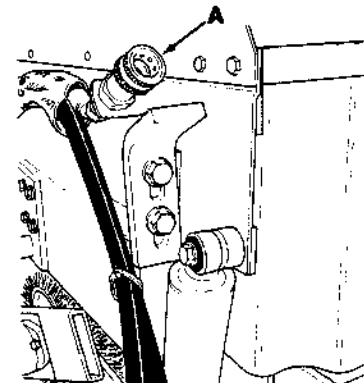
NOTE: Wipe all dirt and oil from couplings before making connections to avoid hydraulic system contamination.



QUICK-DISCONNECT STATION

02755

- A. Quick-Disconnect Station
- B. Hydraulic Hose



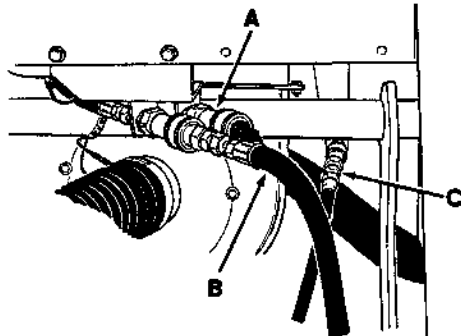
SCRUB ATTACHMENT QUICK-DISCONNECT FITTING

02756

- A. Quick-Disconnect Fitting

POWER SWEEPER - 275 MM151 (8-85) LITHO IN U.S.A.

17. Connect the large diameter hose from the scrub attachment to the quick-disconnect station port the previous hose was connected to.
18. Connect the small diameter hose from the scrub attachment to the quick-disconnect fitting below the quick-disconnect station.

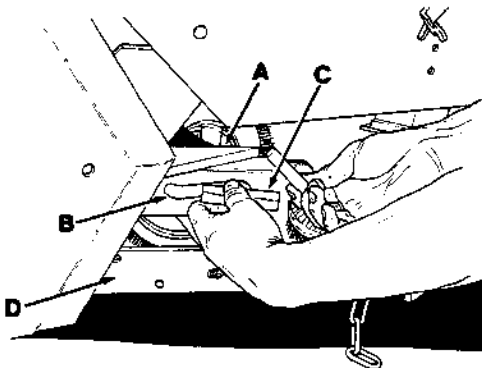


02810

CONNECTED SCRUB ATTACHMENT HOSES

- A. Quick-Disconnect Station
- B. Large Diameter Hose
- C. Small Diameter Hose

19. Slide the side brush squeegee assembly into position in the squeegee bracket.
20. Slide the two squeegee retaining pins through the bracket and squeegee assembly.
21. Pull the pin keeper out, turn the squeegee retaining pins so they are under the pin keeper, and release the keeper.

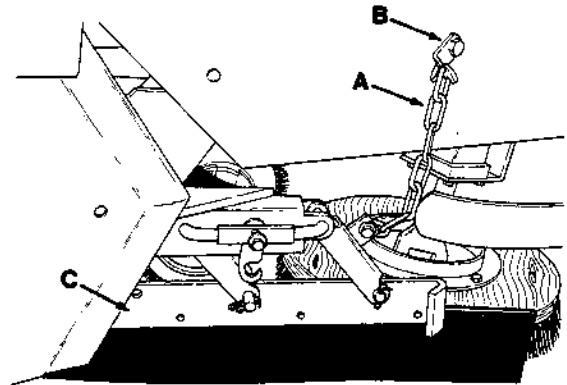


02757

SECURING SQUEEGEE RETAINING PINS

- A. Bracket
- B. Retaining Pin
- C. Pin Keeper
- D. Squeegee Assembly

22. Connect the squeegee assembly chain to the chain hook.



SQUEEGEE ASSEMBLY CHAIN

02758

- A. Chain
- B. Hook
- C. Squeegee Assembly

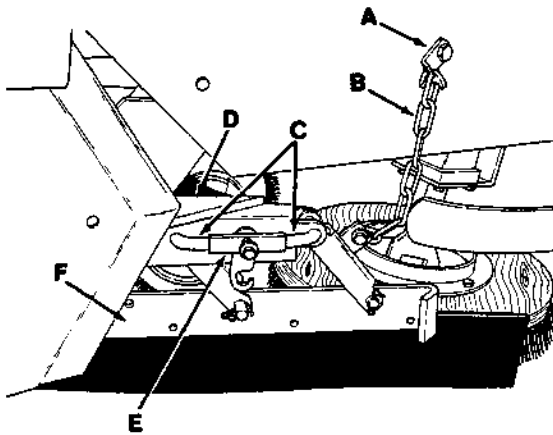
23. Replace the side brush with a scrubbing side brush as described in To Replace Side Brush.
24. Mark the angular location of the motor mounting bracket on the curve-slotted bracket. Reposition the motor mounting bracket to place the side brush flat on the floor.
25. Replace the main brush with a scrubbing main brush as described in To Replace Main Brush.

TO REMOVE SCRUB ATTACHMENT

1. Drain the scrub attachment solution and recovery tanks.

WARNING: The solution and recovery tanks must be empty during scrub attachment installation and removal to avoid personal injury.

2. Drive the machine to the scrub attachment storage area.
3. Disconnect the squeegee assembly chain from the chain hook.



SQUEEGEE ASSEMBLY

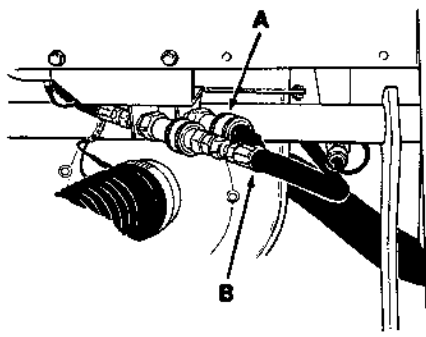
02758

- A. Hook
- B. Chain
- C. Retaining Pin
- D. Bracket
- E. Pin Keeper
- F. Squeegee Assembly

4. Pull the retaining pin keeper out and remove the two squeegee assembly retaining pins. Release the pin keeper.
5. Slide the squeegee assembly out from the machine.
6. Disconnect the small diameter hose from the quick-disconnect coupling on the machine. Replace the coupling plug.

NOTE: Wipe all dirt and oil from couplings before making connections to avoid hydraulic system contamination.

7. Disconnect the large diameter hose from the quick-disconnect station. Replace the coupling plug.
8. Disconnect the large diameter hose from the quick-disconnect coupling on the side of the scrub attachment. Reconnect it to the operator side port of the quick-disconnect station.



RECONNECTED HOSE

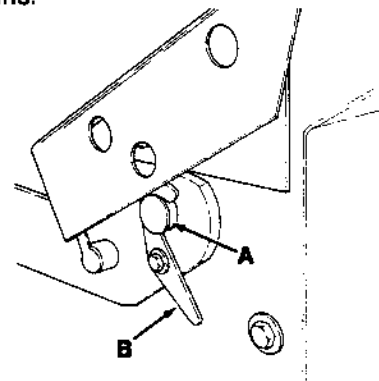
02755

- A. Quick-Disconnect Station
- B. Hydraulic Hose

9. Disconnect the wire harness connectors and vacuum hoses between the scrub attachment and the machine.
10. Start the engine, raise the scrub attachment, and engage the hopper safety support bar.

⚠ WARNING: Always engage the hopper safety bar before working under a raised hopper. Do not rely on the machine hydraulic system to keep the hopper in the "raised" position. The hydraulic system may leak internally, allowing the hopper to lower, crushing anything under it.

11. Lift the front bumper with the help of an assistant. Secure bumper with chain.
12. Pull the scrub attachment leg locking knobs out, swing the legs down into the "down" position, and release the knobs.
13. Start the engine, raise the scrub attachment, place the hopper safety support bar in its storage location, and lower the scrub attachment. Stop the engine.
14. Loosen the top lift arm cam bolts, one on each side, to free scrub attachment.
15. Tilt the lift arm hooks back away from the lift arm pins.



LIFT ARM HOOK

02752

- A. Pin
- B. Hook

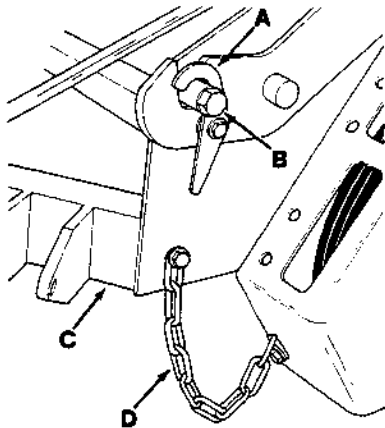
16. Push the lift arms down to clear the lift arm pins.
17. Roll the scrub attachment out of the machine to its storage location.
18. Replace the side scrub brush with a sweeping variety side brush as described in To Replace Side Brush.
19. Reposition the side brush motor mounting bracket so the side brush is angled inward 5°.
20. Replace the main brush with a sweeping variety main brush as described in To Replace Main Brush.

SNOW BLADE

The snow blade accessory gives the machine the added flexibility to remove snow from walks and driveways. It consists of two groups of parts - the mounting frame and the blade assembly. The mounting frame is used to mount either the snow blade or snow broom assembly to the machine. The blade assembly may be positioned to push snow straight ahead, to the left, or to the right of the machine at various angles.

TO INSTALL SNOW BLADE

1. Remove hopper as described in To Remove Hopper With Dolly.
2. Remove the front bumper with the help of an assistant. Raise and chain up the side brush arm.
3. Position the blade mounting frame lift pins in the lift arm slots. Push the lift arm hooks over the pins.

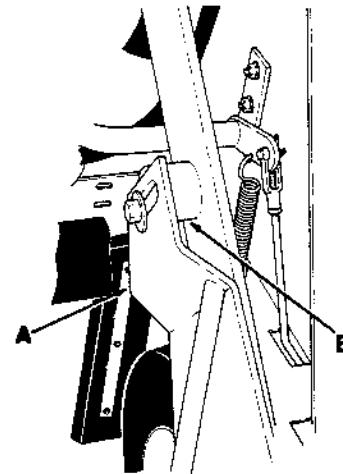


LIFT ARM HOOK

02759

- A. Hook
- B. Pin
- C. Mounting Frame
- D. Limiting Chain

4. Position the upper ends of the mounting frame over the cams.
5. Secure each upper end of the mounting frame to the cam with a spacer and bolt provided with the accessory.

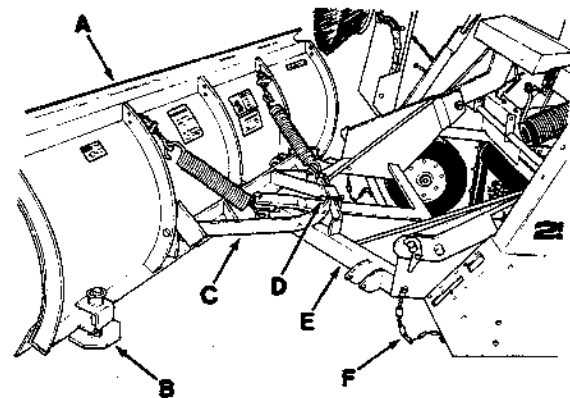


02760

SECURE MOUNTING FRAME UPPER END

- A. Upper End
- B. Cam

6. Connect the two limiting chains between the mounting frame and the machine.
7. Connect the snow blade quadrant assembly to the mounting frame with the king pin and the sector pin.



SNOW BLADE INSTALLATION

02761

- A. Snow Blade
- B. Runner Spindle
- C. Quadrant Assembly
- D. Sector Pin
- E. Mounting Frame
- F. Limiting Chain

TO OPERATE SNOW BLADE

Operate the machine as normally done using the hopper lift and side brush control lever to raise and lower the snow blade.

The main brush and side brush position control levers should be in the "raise" position. The main brush and vacuum fan switch should be in the "off" position.

Begin plowing early when snow reaches 1 to 4 in (25 to 100 mm). Do not allow snow to accumulate.

Heavy, wet snow can create hazards at even a 1 in (25 mm) accumulation. In heavier amounts, snow can be extremely difficult to handle.

Do not allow snow to become packed and frozen. Crusted snow can hinder traction in future plowing.

Choose the proper plowing speed. The heavier the snow, the slower the speed.

The snow blade should be set at the best angle for rolling the snow sideways and in the desired direction. Snow of any considerable depth cannot be pushed straight ahead for more than a short distance.

For best operation, the bottom edge of the snow blade should be slightly above the ground. If adjustments are needed, they can be made by adding flat washers to the runner spindles. Place additional washers under the runner bracket to raise the blade. Remove washers to lower the blade.

To change the angle of the blade, raise the blade as far as the limiting chain will permit. Pull out the sector pin and the blade can be moved to the desired angle. Then replace the sector pin. The sector pin is designed to be a shear pin. If the plow strikes a solid, immovable object, the pin will shear, allowing the blade to swing away from the object before the equipment is damaged. The blade assembly is mounted on the lift arms of the machine which are free to float upward if necessary.

Under some conditions, snow can be pushed to unused areas and stacked to a considerable height. To do this, place the blade in a straight-on position. Push the snow forward by raising the plow as you move into the pile.

Stack snow only with the blade in a straight-on position. Do not create a vertical wall, but slope the piles so that later snow may be pushed up the slope.

Clearing large open areas can be done best by using a combination of snow removal equipment, such as a snow blade and snow blower or loader of some type. The snow can be plowed into windrows or piles and then blown into or loaded onto trucks and carried away. However, if only a blade is available, the area can be cleared by using the proper technique and common sense.

As a guide to help determine how much snow the plow can handle, remember that with a 6 in (150 mm) snowfall, the plow can easily move that amount of snow in two passes. With more snow, it will handle less; with less snow, more.

A suggested method of plowing is as follows:

Make the first pass one blade width in from the outside edge.

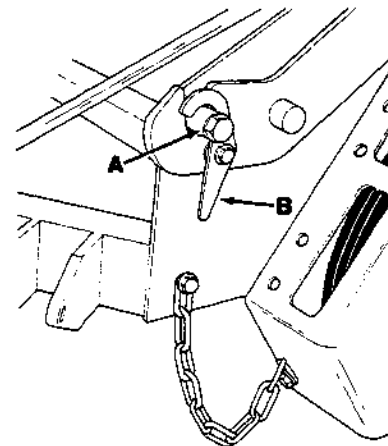
Make the second pass around the outside edge, moving the snow to the edge of the area, then keep moving in. Double the blade width from edge of the snow covered area and move this amount to the outside edge.

TO REMOVE SNOW BLADE

1. Drive the machine to the snow blade storage area.
2. Stop the engine and engage the machine parking brake.

⚠ WARNING: Always park the machine on a level surface, stop the engine and engage the parking brake before working on the machine to keep it from rolling.

3. Lower the snow blade.
4. Disconnect the two limiting chains from the machine frame.
5. Remove the upper ends of the mounting frame from the lift arm cams.
6. Tilt the lift arm hooks back away from the lift arm pins.



LIFT ARM HOOK

02759

- A. Pin
- B. Hook

7. Push the lift arms down to clear the lift arm pins.
8. Start the engine, release the parking brake, and back the machine away from the snow blade assembly.

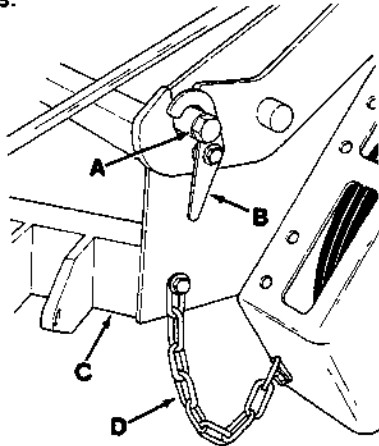
SNOW BROOM

The snow broom accessory gives the machine the added flexibility to remove snow from walks and driveways. It consists of two groups of parts - the mounting frame and the broom frame and drive assembly. The mounting frame is used to mount either

the snow blade or snow broom assembly on the machine. The broom frame and drive assembly may be positioned so as to sweep snow to the left or right of the machine. Check the snow broom for tangled string or wire after each use.

TO INSTALL SNOW BROOM ASSEMBLY

1. Remove hopper as described in To Remove Hopper With Dolly.
2. Remove the front bumper with the help of an assistant. Raise and chain up the side brush arm.
3. Position the broom mounting frame lift pins in the lift arm slots. Push the lift arm hooks over the pins.

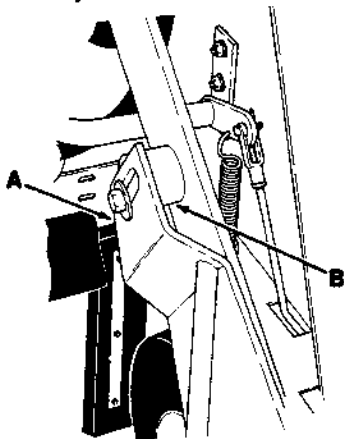


LIFT ARM HOOK

02759

- A. Pin
- B. Hook
- C. Mounting Frame
- D. Limiting Chain

4. Position the upper ends of the mounting frame over the cams.
5. Secure each upper end of the mounting frame to the cam with a spacer and bolt provided with the accessory.

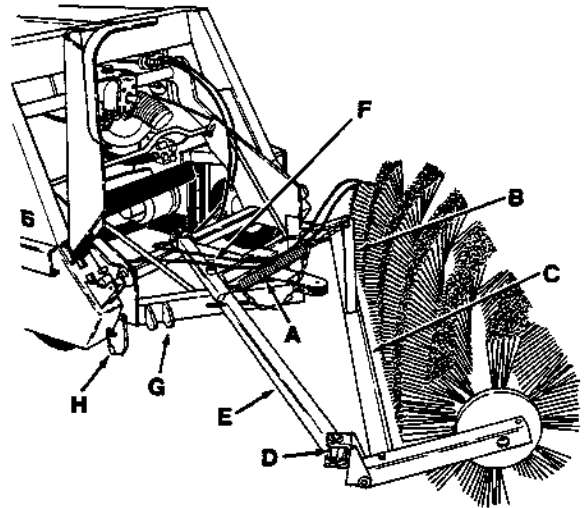


SECURED MOUNTING FRAME UPPER END

02760

- A. Upper End
- B. Cam

6. Connect the two limiting chains between the mounting frame and the machine.
7. Connect the snow broom support arm to the center rear hole in the mounting frame.
8. Connect the snow broom frame to either the right or left side of the mounting frame with a clevis pin depending upon which direction the snow should be swept.
9. Connect the tension chain between the top of the upright arm and the peg on the support arm. The tension chain helps raise or lower the snow broom.

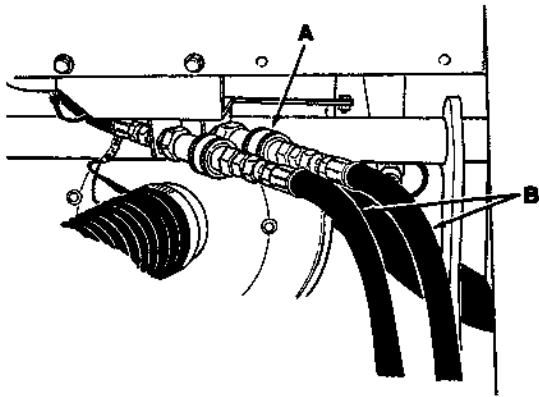


SNOW BROOM INSTALLATION

02762

- A. Tension Chain and Spring
- B. Upright Arm
- C. Support Arm
- D. Clevis Pin
- E. Snow Broom Frame
- F. Square Headed Set Screw
- G. Mounting Frame
- H. Limiting Chain

10. Disconnect the hydraulic hose from the front of the quick-disconnect station.
11. Connect the hoses from the snow broom to the quick-disconnect station ports—upper hose on snow broom to the engine-side port, lower hose to operator-side port.



CONNECTED SNOW BROOM HOSES 02781

- A. Quick-Disconnect Station
- B. Snow Broom Hoses

12. Measure the distance between the floor surface and the snow broom pivots at the ends of the broom. These two distances should be equal.

To adjust, loosen the mounting frame upper end bolts, reposition the frame, and tighten the bolts. Recheck and adjust as necessary.

TO OPERATE SNOW BROOM

Operate the machine as normally done using the hopper lift and side brush control lever to raise and lower the snow broom. The main brush and side brush position control levers should be in the "raise" position. The main brush and vacuum fan switch should be in the "on" position to drive the snow broom. The main brush and vacuum fan will not operate. The hydraulic fluid normally used to drive them is being diverted to the snow broom.

Begin sweeping early and often. Do not allow snow to accumulate or to become packed and frozen.

The snow broom becomes ineffective in snow deeper than 4 in (100 mm).

Slow down in deep snow. Snow is thrown at an angle. The deeper the snow, the steeper the angle. When the snow is deep, it is carried over the top of the broom. Although this snow can be swept, slow down so the broom can catch up.

The brush bristles should contact the surface without being bent under. Adjust the tension chain and spring to control contact. The square headed set screw on the support arm can be adjusted to raise or lower the snow broom.

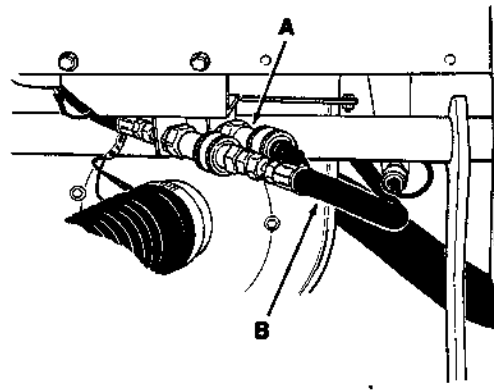
In heavy snow, the broom may stall out. The hydraulic system will bypass the snow broom to protect itself. When this occurs, back the machine away and allow the broom to start rotating again. Do not let the snow broom stall for more than 30 seconds. Stalling causes overheating in the hydraulic system. This can seriously damage the hydraulic system.

TO REMOVE SNOW BROOM ASSEMBLY

1. Drive the machine to the snow broom storage area.
2. Stop the engine and engage the machine parking brake.

WARNING: Always park the machine on a level surface, stop the engine and engage the parking brake before working on the machine to keep it from rolling.

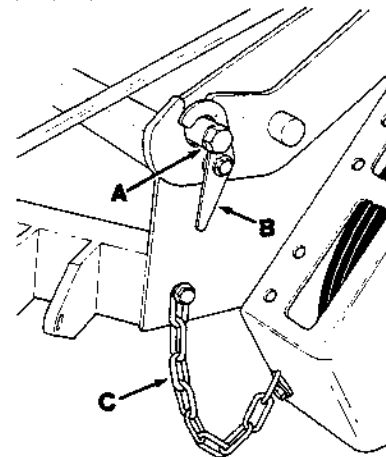
3. Lower the snow broom.
4. Disconnect the hoses from the quick-disconnect station. Replace the coupling caps.
5. Reconnect the hose from the machine to the operator-side port of the quick-disconnect station to reengage the main brush motor.



RECONNECTED HOSE 02755

- A. Quick-Disconnect Station
- B. Hydraulic Hose

6. Disconnect the two limiting chains from the machine frame.



LIMITING CHAIN 02759

- A. Lift Arm Pin
- B. Lift Arm Hook
- C. Limiting Chain

7. Remove the upper ends of the mounting frame from the lift arm cams.
8. Tilt the lift arm hooks back away from the lift arm pins.
9. Push the lift arms down to clear the lift arm pins.
10. Start the engine, release the parking brake, and back the machine away from the snow broom assembly.

MACHINE TROUBLESHOOTING

| Problem | Cause | Remedy |
|--|--|--|
| Excessive dusting | Dust skirts and seals worn, damaged, not adjusted properly | Replace or adjust skirts or seals |
| | Dust filter clogged | Shake and/or clean or replace filter |
| | Engine operating at "litter" speed | Operate engine at "normal" speed |
| | Vacuum wand door closed | Open vacuum wand door |
| | Vacuum hose damaged | Replace vacuum hose |
| | Vacuum fan failure | See Hydraulic System Troubleshooting: Poor or no vacuum to brush compartment |
| Poor sweeping performance | Brush bristles worn | Replace brushes |
| | Brushes not adjusted properly | Adjust brushes |
| | Debris caught in brush drive mechanism | Free mechanism of debris |
| | Main brush drive failure | See Hydraulic System Troubleshooting: Main brush turns slowly or not at all |
| | Side brush drive failure | See Hydraulic System Troubleshooting: Side brush turns slowly or not at all |
| | Hopper not adjusted properly | Adjust hopper floor clearance |
| | Hopper full | Empty hopper |
| | Hopper floor skirts worn, damaged | Replace skirts |
| Trailing water - poor or no water pickup | Worn rear squeegee | Rotate or replace rear squeegee blade |
| | Rear squeegee out of adjustment | Adjust rear squeegee |
| | Vacuum hose clogged | Flush vacuum hoses |
| | Recovery tank full | Drain tank |
| | Ball float stuck shutting off vacuum | Clean ball float and float guide |
| | Engine not operating at governed speed | Speed up engine to "full" speed and readjust governor |

| Problem | Cause | Remedy |
|--|--|---|
| Trailing water - poor or no water pickup (Con't) | Debris caught on squeegee | Remove debris |
| | Debris hopper full | Empty hopper |
| | Foam filling recovery tank | Empty recovery tank; change detergent |
| | Vacuum hose to rear squeegee disconnected or damaged | Reconnect or replace vacuum hose |
| | Vacuum fan to recovery tank hose damaged | Replace 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 and spreader tube clogged | Flush solution supply lines, spreader tube |
| Poor scrubbing performance | Debris caught on scrub brushes | Remove debris |
| | Improper detergent or brushes used | Check with TENNANT® representative for advice |
| | Worn scrub brushes | Replace scrub brushes |
| | Scrub brushes out of adjustment | Adjust scrub brushes |
| | Scrub brush drive failure | See Hydraulic System Troubleshooting - Main brush turn slowly or not at all |
| | Debris hopper full | Empty hopper |

NOTE: For more specific electro-hydraulic system troubleshooting information, see *Hydraulic System Troubleshooting* in the Maintenance section.

TRANSPORTING MACHINE

PUSHING OR TOWING MACHINE

The machine may be pushed from the front or rear. It may be towed only from the rear.

Place a dolly under the rear wheel to travel distances greater than 1 mile (1 km) or speeds over 1 mph (1 km/h).

ATTENTION! Do not push or tow the machine without placing the rear wheel on a dolly; the machine hydraulic system may be damaged.

MACHINE JACKING

The machine may be jacked up for service at the designated locations. Use a jack of adequate capacity and good working condition. Always stop the machine on a flat, level surface and block the tires before jacking the machine up. The front jacking locations are on the flat bottom edge of the machine frame next to the front tires.

The rear jacking location is the middle flat bottom edge of the rear bumper.

TO JACK UP MACHINE

1. Empty the debris hopper.
2. Stop the engine and engage the machine parking brake.

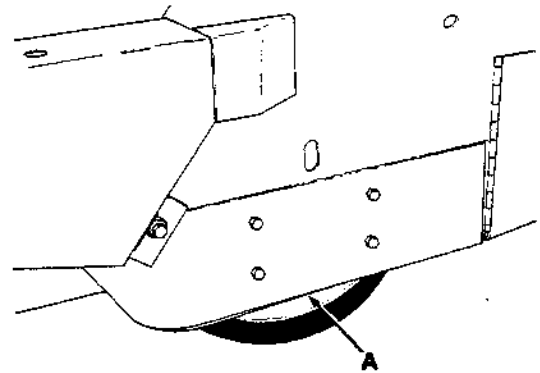
WARNING: Always park on a level surface, stop the engine, and engage the parking brake before working on the machine to keep it from creeping or rolling.

3. Block the tires, which are not being jacked up, in order to secure the machine position.

WARNING: Always block the machine tires before jacking the machine up to keep it from rolling off jack.

4. Use a jack of adequate capacity to raise the machine. Jack up the machine only at the designated locations.

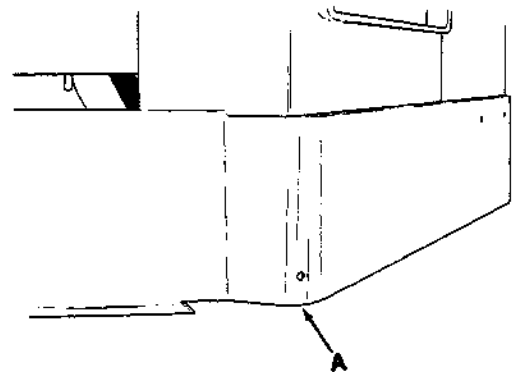
WARNING: Jack machine up only at the designated locations to keep it from tipping.



FRONT JACKING LOCATION

A. Jacking Location

00559



REAR JACKING LOCATION

A. Jacking Location

00571

5. Block machine up with jack stands or similar devices in the designated locations to secure the machine.

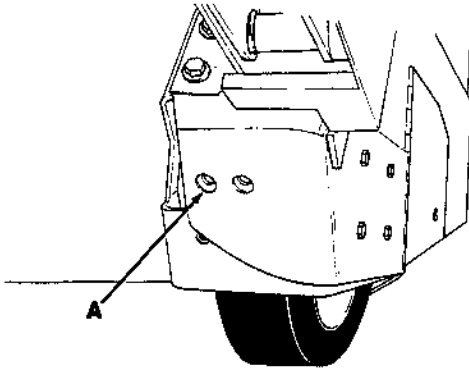
WARNING: Always use jack stands or similar devices to hold the machine up. Scissors, ratchet, cable, or hydraulic-type jacks may slip or leak internally, allowing the machine to lower or fall, crushing anything under it.

6. Lower the machine onto the jack stands.
7. Check to make sure the machine is secure.
8. Service the machine as required.
9. When finished servicing the machine, raise the machine off the jack stands.
10. Remove the jack stands from under the machine.
11. Lower the machine.
12. Remove the blocks from the tires.

MACHINE TIE-DOWNS

The machine may be tied down at each of the corners of the main frame at the locations specified.

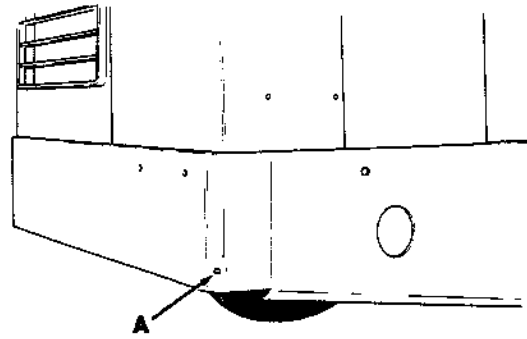
To tie the machine down, use the holes near the front tires and the holes in the lower rear machine frame.



FRONT TIE-DOWN LOCATION

A. Tie-Down Hole

00572



REAR TIE-DOWN LOCATION

A. Tie-Down Hole

00558

When transporting the machine on a trailer or in a truck, be sure to engage the machine parking brake and block the machine tires to prevent the machine from rolling. If the machine is transported on a regular basis, consider installing the hood latch and tie-down kit.

MACHINE STORAGE

STORING MACHINE

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

1. Empty the debris hopper.
2. Change the engine oil.
3. Place the main brush and side brush position control levers in the "raise" position.
4. Park the machine on a level surface in a cool, dry area.
5. Stop the engine and engage the machine parking brake.
6. Fill the hydraulic reservoir with hydraulic fluid to the full mark on the dipstick to prevent excessive condensation from forming in the reservoir.
7. Gasoline and LPG powered machines: To store the machine 30 to 90 days:
 1. Remove the spark plugs.
 2. Pour 3 oz (90 cc) of clean engine oil into each spark plug hole.
 3. Remove the ignition coil high tension wire. Operate the engine starter motor for at least a dozen revolutions. This distributes the oil over the cylinder walls.

NOTE: Before preparing the engine for storage, allow it to cool down to the surrounding temperature. Oil adheres to cold metal surfaces much better than hot surfaces.

4. Replace the high tension coil wire and spark plugs.
5. Drain the gasoline from the carburetor bowl by removing the carburetor anti-diesel solenoid.
6. Replace the carburetor drain plug.

To store the machine 90 days to 6 months also:

1. Drain the coolant from the radiator and engine block.
2. Close the engine cooling system drain cocks.
3. Seal the air cleaner inlet and the exhaust outlet with weatherproof masking tape.
4. Tighten the engine oil filler cap, the fuel tank cap, and the radiator cap to make certain they are securely in place.

SECTION 3 MAINTENANCE

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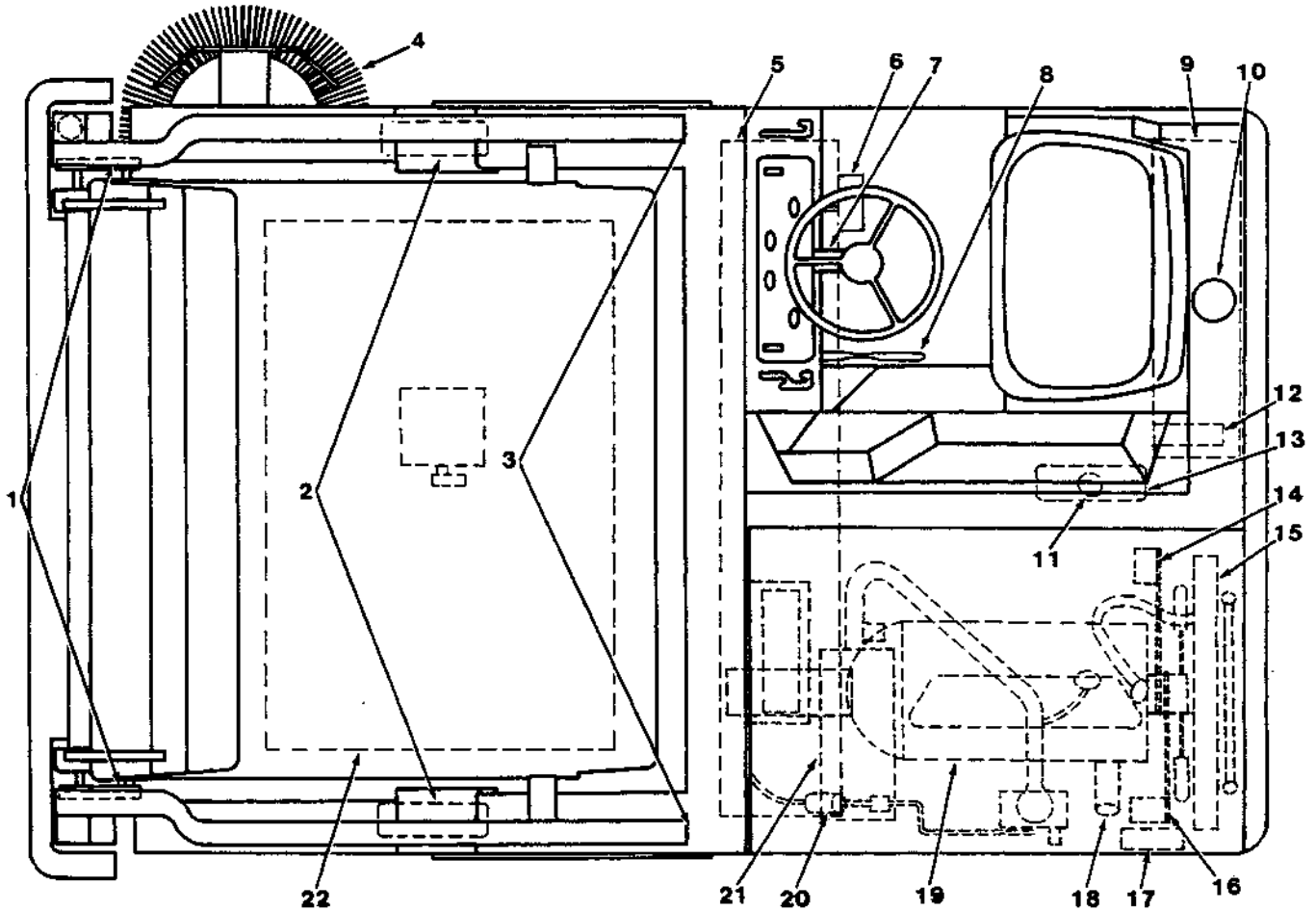
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RECOMMENDED FIRST 50-HOUR MACHINE INSPECTION

After the first 50 hours of operation, the following procedures are recommended:

1. Check the brush pattern for correct brush adjustment.
2. Change the hydraulic fluid filter.
3. Check engine ignition timing.
4. Torque the cylinder head bolts to the proper specification.
5. Replace the fuel filter element on gasoline powered machines.
6. Perform all 50-hour interval lubrication and maintenance procedures listed in the Maintenance chart.
7. Gasoline and LPG powered machines: After the first 150 hours of operation, check and adjust the engine valve tappet clearance.

MAINTENANCE CHART



MAINTENANCE LOCATIONS

02455

| Interval | Key | Description | Procedure | Lubricant | No. of Service Points |
|----------|-----|--------------------------------|--|-----------|-----------------------|
| Daily | 21 | Engine air filter | Empty dust cap and check restriction indicator | - | 1 |
| | 19 | Engine crankcase | Check oil level | EO | 1 |
| | 15 | Radiator core exterior | Check for debris and clean | - | 1 |
| | 5 | Brush skirts | Check for damage, wear and adjustment | - | 5 |
| | 5 | Main brush | Check for damage, wear, and adjustment | - | 1 |
| | 4 | Side brush | Check for damage, wear, and adjustment | - | 1 |
| | 20 | Fuel water trap-filter, diesel | Drain | - | 1 |

| Interval | Key | Description | Procedure | Lubricant | No. of Service Points |
|-----------|-----|---|--|--------------|-----------------------|
| 50 Hours | 19 | Engine crankcase | Change oil | EO | 1 |
| | 18 | Engine oil filter | Change filter element | - | 1 |
| | 5 | Main brush | Rotate end-for-end | - | 1 |
| 100 Hours | 22 | Hopper dust filter | Inspect, clean or replace | - | 1 |
| | 15 | Radiator | Check coolant level | WG | 1 |
| | 9 | Hydraulic fluid reservoir | Check fluid level | HYDO | 1 |
| | 13 | Rear tire | Check pressure | - | 1 |
| | 5 | Dust seals | Check for damage or wear | - | 8 |
| 200 Hours | 14 | Alternator and fan belt | Check tension | - | 1 |
| | 16 | Governor belt | Check tension | - | 1 |
| | 1 | Hopper door latches, multi-level dump model | Lubricate | MPGM or MPGP | 2 |
| | 8 | Parking brake | Check adjustment | - | 1 |
| | 11 | Rear wheel support bearing | Lubricate | MPGP | 1 |
| | 3 | Hopper lift arm pivots | Lubricate | MPGM or MPGP | 2 |
| | - | Scrub attachment leg casters | Lubricate | MPGM or MPGP | 4 |
| | - | Scrub attachment debris hopper | Lubricate | MPGM or MPGP | 2 |
| 400 Hours | 7 | Brake pedal | Check and adjust travel | - | 1 |
| | 19 | Engine, gasoline, LPG | Check and adjust valve clearance | - | 8 |
| | | | Check and adjust idle speed | - | 1 |
| | | | Check and adjust idle mixture | - | 1 |
| | | | Clean or replace and adjust spark plugs | - | 4 |
| | | | Clean or replace and adjust distributor points. Lubricate felt | - | 1 |
| | | | Check and adjust timing | EO | 1 |
| | | | Replace PCV valve. Clean PCV hoses, tubes, and fittings | - | - |
| | 9 | Hydraulic fluid reservoir | Change hydraulic fluid | HYDO | 1 |
| | 17 | Hydraulic fluid filter | Change filter element | - | 1 |
| | 6 | Steering gear case | Check grease level | MPG | 1 |
| | 20 | Fuel filter, diesel | Replace element | - | 1 |
| | 2 | Front wheel bearings | Inspect and lubricate | MPGP | 2 |
| 800 Hours | 19 | Engine, gasoline, LPG | Torque intake manifold bolts | - | 4 |
| | 15 | Cooling system | Flush | WG | 1 |
| | 10 | Hydraulic reservoir breather cap | Replace | - | 1 |
| | 12 | Hydraulic reservoir suction strainer | Replace | - | 1 |

EO - Engine oil

HYDO - Tennant Company or approved hydraulic fluid

MPG - Multipurpose, calcium soap base grease

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

MPGP - Multipurpose grease, paraffin base with organic thickener.

WG - Water and permanent-type ethylene glycol antifreeze, one-to-one ratio

NOTE: More frequent intervals may be required in extremely dusty conditions.

LUBRICATION

ENGINE

Check the engine oil level daily. Change the engine oil and oil filter after every 50 hours of operation. Use only SAE-SE rated engine oil.

Gasoline and LPG powered engines should be lubricated with SAE-SE/SF rated engine oil.

The following oil grades are recommended for engines operating in the ambient temperatures listed.

MULTI-VISCOSITY OILS

| | | | |
|---------------------------|--------------------------------|--|-----------------------------|
| Below 32°F (Below 0°C) | -10° to 90°F (-23° to 32°C) | -10° to above 90°F (-23° to above 32°C) | Above 10°F (Above -12°C) |
| 5W 30 | 10W 30 | 10W 40 | 20W 40 |

SINGLE VISCOSITY OILS

| | | | |
|-------------------------------|-------------------------------|-----------------------------|----------------------------|
| -10° to 32°F (-23° to 0°C) | 10° to 60°F (-12° to 16°C) | 32° to 90°F (0° to 32°C) | Above 60°F (Above 16°C) |
| 10W | 20W 20 | 30 | 40 |

The engine oil capacity is 3.5 qt (3.3 L) including the oil filter. Add three drops of oil to the distributor shaft felt after every 400 hours of operation.

Diesel powered engines should be lubricated with SAE-CC/CD rated engine oil.

The following oil grades are recommended for engines operating in the ambient temperatures listed.

| | | |
|---------------------------|-------------------------------|------------------------------|
| Below 32°F (Below 0°C) | 32° to 77° F (0° to 25° C) | Above 77° F (Above 25° C) |
| 10W 10W 30 | 20 30 | 30 |

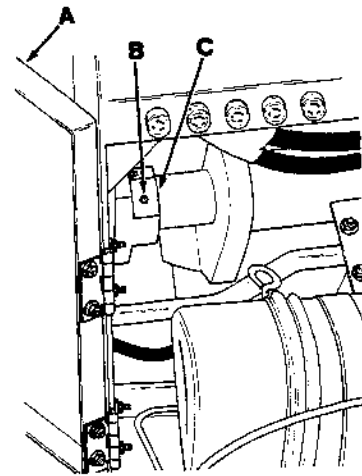
The engine oil capacity is 7 qt (6.7 L) including the oil filter.

HOPPER LIFT ARM PIVOTS

The hopper lift bearings support the lift arm pivots. Two grease fittings are used to lubricate the hopper lift bearings. One grease fitting is located on each of the hopper lift bearings.

Access to the left side grease fitting is through the left side access door. The right side grease fitting is exposed to the operator compartment through an access hole in the front dash panel.

Lubricate the bearings with a grease gun after every 200 hours of operation. Use a multipurpose, water resistant, lithium base, moly-disulphide EP grease, or a paraffin base grease with organic thickener.



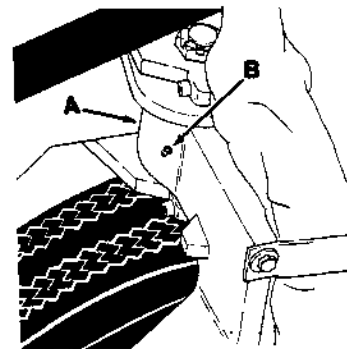
LEFT SIDE HOPPER LIFT BEARING

02478

- A. Left Side Access Door
- B. Grease Fitting
- C. Lift Bearing

REAR WHEEL SUPPORT

The rear wheel support pivots the rear wheel. A grease fitting has been provided on the support bracket for lubrication purposes. Lubricate the rear wheel support bearing with a grease gun after every 200 hours of operation. Use a multipurpose, water resistant, paraffin base grease with organic thickener.



REAR WHEEL SUPPORT

02456

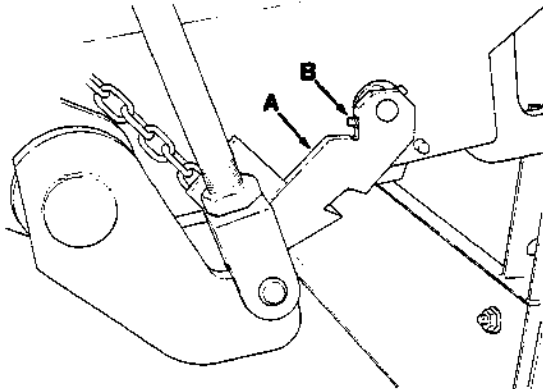
- A. Rear Wheel Support
- B. Grease Fitting

HOPPER DOOR LATCHES

The hopper door latches latch the hopper door on multi-level dump model machines. Two grease fittings are used to lubricate the hopper door latches. One grease fitting is on each of the latches.

To gain access to the latch grease fittings, place the hopper in the "dump" position.

Lubricate the latches with a grease gun after every 200 hours of operation. Use a multipurpose, water resistant, lithium base, moly-disulphide EP grease, or a paraffin base grease with organic thickener.



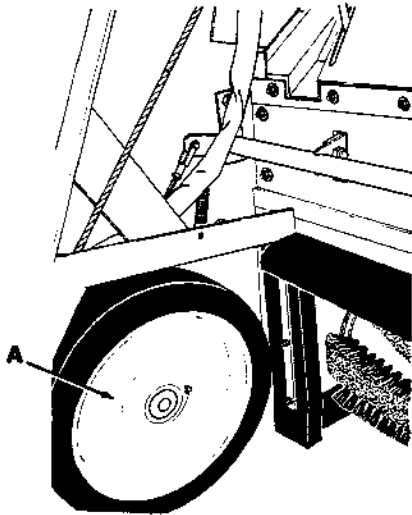
HOPPER DOOR LATCH

00550

- A. Hopper Door Latch
- B. Grease Fitting

FRONT WHEEL BEARINGS

The front wheel bearings support the front half of the machine. Inspect the bearings for contamination, seal damage, and repack after every 400 hours of operation. Use a multipurpose, water resistant, paraffin base grease with organic thickener.



FRONT WHEEL

02457

- A. Wheel

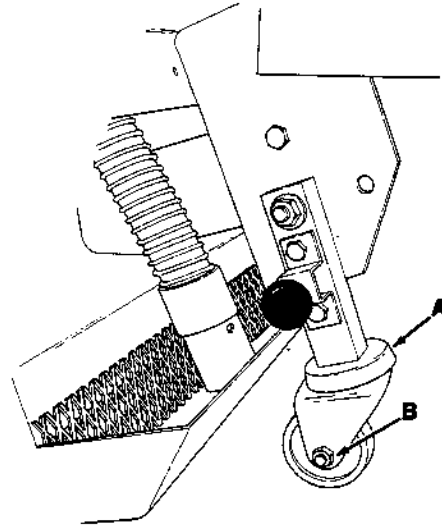
STEERING GEAR

The steering gear controls the steering arm. A square head plug has been provided on the left side of the steering gear to check the grease level and to allow filling.

Check the steering grease level after every 400 hours of operation. Fill the unit with a calcium base soap grease.

SCRUB ATTACHMENT LEG CASTERS

The scrub attachment casters support the scrub attachment when it is not mounted to the machine. A grease fitting is mounted to the axle of each of the four casters. Lubricate the casters with a grease gun after every 200 hours of operation. Use a multi-purpose, water resistant, lithium base, moly disulphide EP grease, or a paraffin base grease with organic thickener.



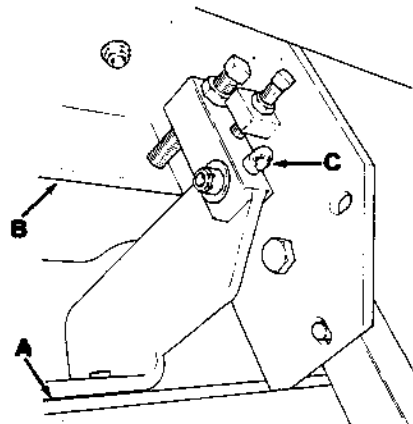
LEG CASTER

02754

- A. Leg
- B. Grease Fitting

SCRUB ATTACHMENT DEBRIS HOPPER

The scrub attachment debris hopper collects debris picked up by the scrub brushes. The debris hopper pivots on two bearings. Each bearing is equipped with a grease fitting. Lubricate the bearings with a grease gun after every 200 hours of operation. Use a multipurpose, water resistant, lithium base, moly disulphide EP grease, or a paraffin base grease with organic thickener.



DEBRIS HOPPER

02764

- A. Hopper
- B. Scrub Attachment Frame
- C. Grease Fitting

HYDRAULICS

HYDRAULIC FLUID

Hydraulic fluid drives most of the moving components of the machine. The quality and condition of the hydraulic fluid play a very important role in how well the machine operates. Tennant Company has developed its own hydraulic fluid to meet the special needs of its machines.

TENNANT® Hydraulic Fluid is a specially compounded oil with the following features not found in many hydraulic fluids:

1. Flat viscosity curve.
2. Additives to prevent corrosion.
3. Additives to prevent oxidation.
4. Rust inhibitors.
5. Foam suppressors.

These features restrict foaming of the hydraulic fluid and provide a high standard of lubrication to the components.

TENNANT® HYDRAULIC FLUID VISCOSITY SPECIFICATIONS

| | TENNANT® Hyd. Fluid No. 32397 (HP1040) | TENNANT® Hyd. Fluid No. 32398 (HP2060) |
|----------------------|---|---|
| SUS @ 100° F (38° C) | 404-445 | 940-1010 |
| SUS @ 210° F (99° C) | 78-84 | 122-130 |

TENNANT® Hydraulic Fluids have a very flat viscosity curve (synonymous with "high viscosity index"). The flat viscosity curve means that the thickness of the fluid is very constant over wide temperature ranges.

Hydraulic fluid with the viscosity rating of HP1040 should be used in machines that are operated in areas which have ambient temperatures up to 90° (32° C). Use the HP2060 rated hydraulic fluid in areas which have ambient temperatures above 90° (32° C).

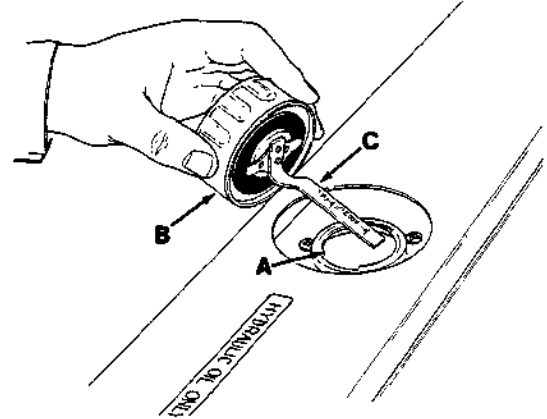
ATTENTION! If a locally-available hydraulic fluid is preferred, or if products of only one oil company are used, the hydraulic fluid used must match closely the viscosity specifications given in the chart for TENNANT® Hydraulic Fluid, as well as the other features described. Do not substitute automatic transmission fluid for hydraulic fluid.

ATTENTION! Hydraulic components depend on system hydraulic fluid for internal lubrication. If dirt or other contaminants are allowed to enter the hydraulic system, malfunctions, accelerated wear, and damage will result.

HYDRAULIC FLUID RESERVOIR

Hydraulic fluid is stored in the hydraulic fluid reservoir. The reservoir holds 5 gal (19 L) of hydraulic fluid. The reservoir is located behind the operator seat.

A breather-filler cap and fluid level dipstick is mounted on top of the reservoir. See Hydraulic Fluid Reservoir Breather for breather service information.



HYDRAULIC FLUID RESERVOIR BREATH-FILLER CAP

- A. Reservoir
- B. Breather-Filler Cap
- C. Dipstick

02458

The hydraulic fluid level dipstick is built into the breather-filler cap. The end of the dipstick is marked with "full" and "add" levels. This indicates the level of hydraulic fluid in the reservoir.

Check the hydraulic fluid level after every 100 hours of operation. It should be above the "add" marks on the dipstick, but not above the "full" mark when the hydraulic fluid is warm.

Do not overfill the hydraulic fluid reservoir. Hydraulic fluid expands as it heats to its normal operating temperature. Always allow for expansion when filling the reservoir.

ATTENTION! Do not overfill the hydraulic fluid reservoir or operate the machine with a low level of hydraulic fluid in the reservoir. Damage to the machine hydraulic system may result.

Drain, flush, and refill the hydraulic fluid reservoir with hydraulic fluid after every 400 hours of operation.

A reservoir outlet strainer is built into the reservoir to filter hydraulic fluid before it enters the system. Replace the strainer after every 800 hours of operation.

TO DRAIN HYDRAULIC FLUID RESERVOIR

1. Stop the engine and engage the machine parking brake.

WARNING: Always park on a level surface, stop the engine, and engage the parking brake before working on the machine to keep it from creeping or rolling.

2. Allow the hydraulic fluid to cool.

WARNING: Always allow the hydraulic fluid to cool before draining. Hot fluid can cause severe burns.

3. Remove the reservoir drain plug located on the bottom of the reservoir to drain the hydraulic fluid. Discard the used hydraulic fluid.

NOTE: Always change the hydraulic fluid filter when draining the hydraulic fluid reservoir.

4. Flush the reservoir with clean hydraulic fluid or suitable solvent. Do not use gasoline, kerosene, or diesel fuel.
5. Replace the reservoir drain plug.

TO FILL HYDRAULIC FLUID RESERVOIR

1. Remove the reservoir breather-filler cap.
2. Pour 5 gal (19 L) of new, approved hydraulic fluid through a 200 mesh screened funnel and into the reservoir filler neck.

ATTENTION! Use only new, approved hydraulic fluid to fill the hydraulic fluid reservoir.

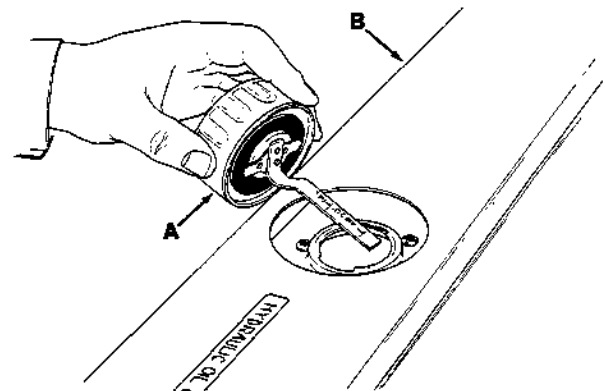
3. Check the hydraulic fluid level in the reservoir with the reservoir dipstick.
4. Add hydraulic fluid until the level in the reservoir is between the "add" and the "full" range. Do not overfill.

NOTE: Do not overfill the hydraulic fluid reservoir. As hydraulic fluid heats to its normal operating temperature, it expands. Always allow for this expansion when filling the hydraulic fluid reservoir.

5. Place the reservoir breather-filler cap securely on the reservoir filler neck.
6. Start engine and operate all of the hydraulic components. Then recheck the hydraulic fluid level.

HYDRAULIC FLUID RESERVOIR BREATHER

The hydraulic fluid reservoir is equipped with a breather. The breather relieves excess pressure in the reservoir. The breather is mounted on top of the hydraulic fluid reservoir and seat support. The breather should be replaced after every 800 hours of operation.



RESERVOIR BREATHER-FILLER CAP

02458

- A. Breather-Filler Cap
- B. Seat Support

HYDRAULIC FLUID FILTER

The machine hydraulic system is kept clean to a level of 10 microns by a hydraulic fluid filter. The hydraulic fluid filter is located in the left rear of the machine engine compartment.

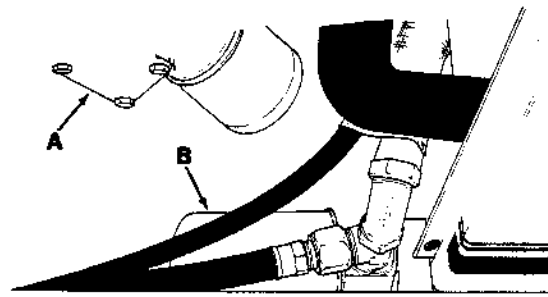
Replace the hydraulic fluid filter element after the first 50 hours of operation and then after every 400 hours of operation.

TO REPLACE HYDRAULIC FLUID FILTER ELEMENT

1. Stop the engine and engage the machine parking brake.

WARNING: Always park on a level surface, stop the engine and engage the parking brake before working on the machine to keep it from creeping or rolling.

2. Open the side engine access door.



HYDRAULIC FLUID FILTER

02459

- A. Engine
- B. Filter Element

3. Unthread and discard the hydraulic fluid filter element.

NOTE: Be aware the hydraulic filter is located below the reservoir. Some hydraulic fluid will drain from the reservoir hose. Discard all hydraulic fluid drained from the system. Drained hydraulic fluid may contain foreign material harmful to the hydraulic system.

4. Apply a thin coat of hydraulic fluid to the seal of the new hydraulic fluid filter element.
5. Thread and hand tighten the new hydraulic fluid filter element on the filter head.
6. Operate the machine and check for leaks. Correct any leaks found.
7. Check the hydraulic fluid reservoir level and fill as required.
8. Close the side engine access door.

HYDRAULIC PUMPS

The machine propelling pump is a variable displacement hydraulic piston pump. It is driven by the engine via a chain coupling.

The machine accessories pump is a hydraulic gear pump. It is tandem mounted to the hydraulic piston pump.

After repairing or replacing a hydraulic pump, or when system contamination is likely, change the hydraulic fluid in the reservoir and the hydraulic fluid filter. Then the proper start and break-in procedure must be followed to prevent possible damage to the pump. Replace the hydraulic fluid filter after the first hour of operation. To Start and Break-In Hydraulic Pump outlines the procedure.

TO START AND BREAK-IN HYDRAULIC PUMP

1. Stop the engine, engage the machine parking brake and block the front tires of the machine.

⚠ WARNING: Always park the machine on a level surface, stop the engine, engage the parking brake and block the machine tires before jacking the machine up to keep it from rolling or falling off jack.

2. Jack up the rear of the machine at the designated locations.

⚠ WARNING: Jack the machine up only at the designated locations to keep it from falling off jack.

3. Block up the machine with jack stands in the designated locations. Make sure the rear tire clears the floor by 2 in (50 mm) and all obstacles within a 24 in (610 mm) radius.
4. Fill the hydraulic fluid reservoir with 5 gal (19 L) of new, approved hydraulic fluid.
5. Fill the hydraulic pump through the case drain port with hydraulic fluid.
6. Remove the engine coil wire from the engine distributor.
7. Operate the engine starter motor for three 10 second periods.
8. Replace the engine coil wire.
9. Start the engine and operate it at a low idle for two minutes.

10. Press the directional control pedal one-half of its travel in the "forward" direction while also operating the main brush and side brush for one minute.
11. Adjust the directional control pedal as described in To Adjust Directional Control Pedal Linkage.
12. Stop the engine.
13. Raise the rear of the machine, remove the jack stands, and lower the machine.
14. Fill the hydraulic fluid reservoir with new, approved hydraulic fluid.
15. Check the hose routings to be sure the hoses do not contact any moving, hot, or sharp surfaces.
16. Replace the hydraulic fluid filter after the first hour of operation.

DIRECTIONAL CONTROL PEDAL

The directional control pedal controls the flow of hydraulic fluid to the hydraulic drive motor. The pedal has three positions—"forward," "neutral," and "reverse." The "forward" and "reverse" positions send hydraulic fluid to the drive motor to propel the machine.

The "neutral" position is the position in which the propelling pump sends no hydraulic fluid to the propelling motor. The machine should not creep when the "neutral" position is correctly adjusted. Adjust the control pedal linkages, as described in To Adjust Directional Control Pedal Linkage, whenever the machine creeps or after replacing the hydraulic propelling pump or pump linkages. The control pedal linkages should also be adjusted whenever the reverse speed seems excessive or inadequate.

TO ADJUST DIRECTIONAL CONTROL PEDAL LINKAGE

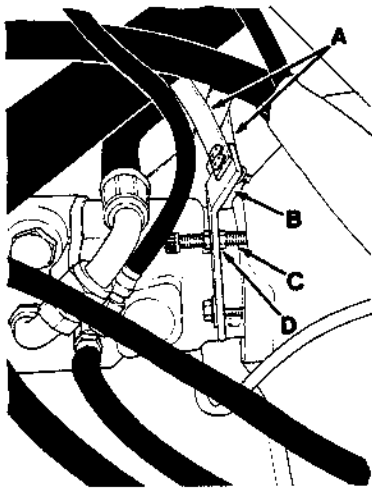
1. Stop the engine and engage the machine parking brake.

⚠ WARNING: Always park on a level surface, stop the engine, and engage the parking brake before working on the machine to keep it from creeping or rolling.

2. Block the machine tires and jack up the rear of the machine at the designated location.

⚠ WARNING: Jack up the machine only at the designated locations to keep it from falling off jack.

3. Block up the machine with jack stands in the designated locations. Make sure the rear tire clears the floor by 2 in (50 mm) and all obstacles within a 24 in (610 mm) radius.
4. Loosen the centering spring bracket adjustment bolt jam nuts.

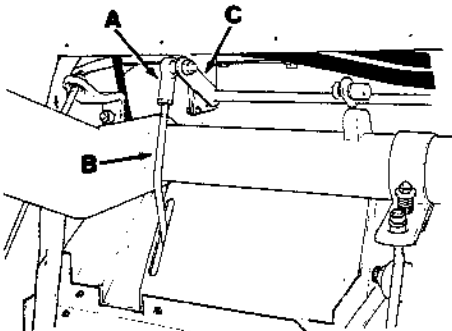


CENTERING SPRINGS

02486

- A. Centering Springs
- B. Spring Bracket
- C. Adjustment Bolt
- D. Jam Nut

5. Start the engine.
6. Move the directional control pedal into the "forward" position and release it. The rear wheel should stop rotating as soon as the pedal is released. Stop the engine and adjust the spring bracket as required.
7. Move the directional control pedal into the "reverse" position and release it. The rear wheel should stop rotating as soon as the pedal is released. Stop the engine and adjust the spring bracket as required.
8. Tighten the jam nuts.
9. Raise the rear of the machine, remove the jack stands, and lower the machine.



DIRECTIONAL CONTROL PEDAL LINKAGE

02483

- A. Ball Joint
- B. Pump Control Linkage
- C. Link

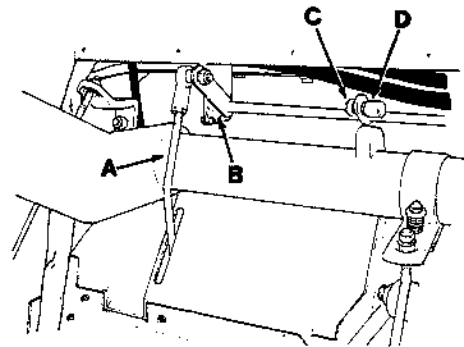
10. Adjust the position of the directional control pedal ball joints so the link contacts the lintel when the directional control pedal is pressed backward. The backward travel should be restricted so the machine will not travel faster than 3.5 mph (5.6 km/h) "normal" speed, and 4.5 mph (7.2 km/h) "litter" speed in reverse.
11. Tighten the directional control pedal ball joints and jam nuts.

LIFT ARM SPEED LIMITER

The lift arm speed limiter is present on multi-level dump model machines. It limits the forward speed the machine can travel when the hopper is raised. The speed limiter should be adjusted whenever the pump control linkage is adjusted. The machine should not travel more than 2 mph (3.2 km/h) with the hopper raised.

The speed limiter consists of a roller bearing which is mounted on the directional control linkage, and a cam on the lift arm. When the hopper is raised, the lift arm turns, placing the cam under the roller bearing. This limits how far the directional control pedal can be pressed, limiting the machine speed.

To adjust the maximum limited speed, loosen the roller bearing nut, reposition the roller bearing in its mounting slot and tighten the nut.



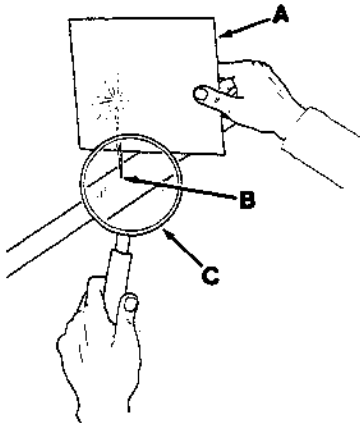
SPEED LIMITER BEARING

02483

- A. Pump Control Linkage
- B. Speed Limiter Bearing
- C. Retaining Nut
- D. Lift Arm Cam

HYDRAULIC FLUID LEAKS

Fluid escaping at high pressure from a very small hole can be almost invisible and can cause serious injuries. Use a piece of cardboard or wood, rather than hands, to search for suspected leaks.



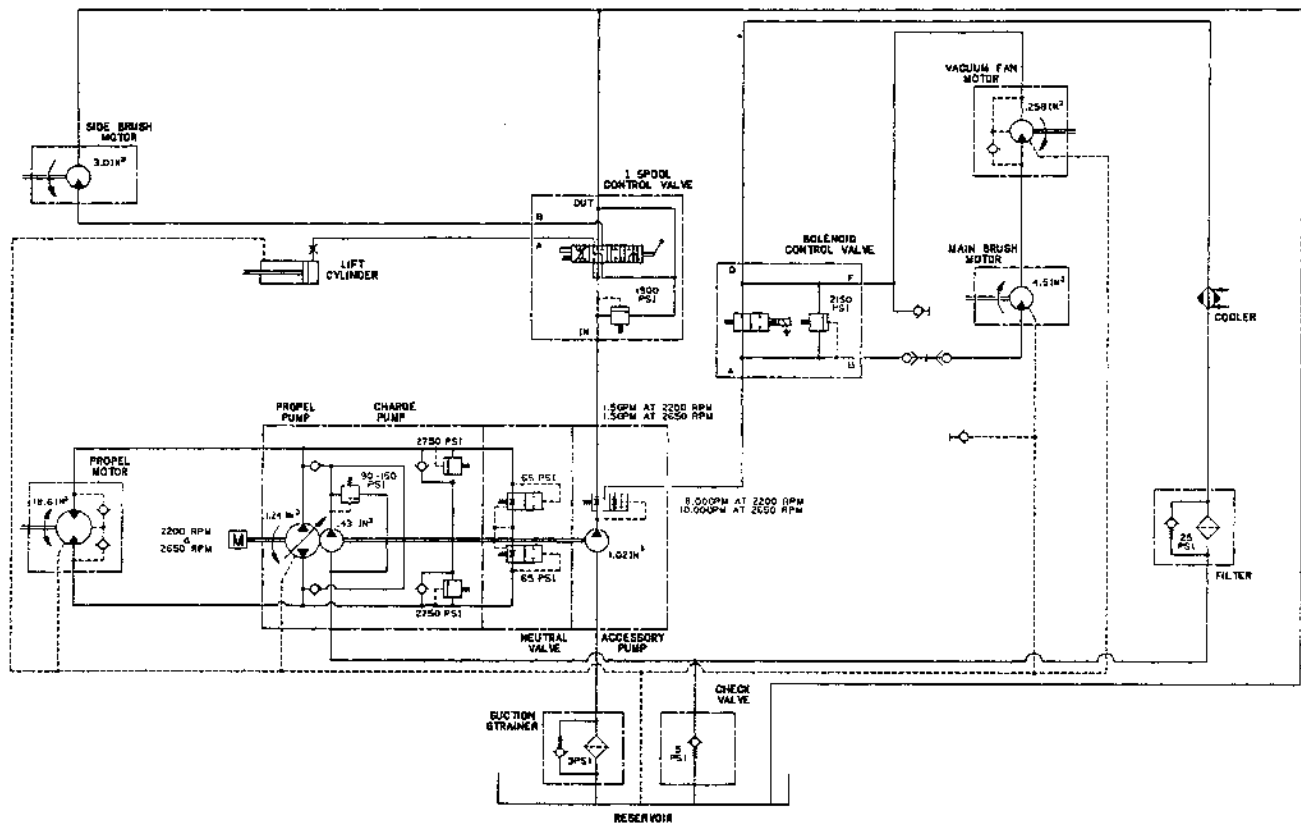
HYDRAULIC PINHOLE LEAK

00002

- A. Cardboard
- B. Pinhole Leak
- C. Magnifying Glass

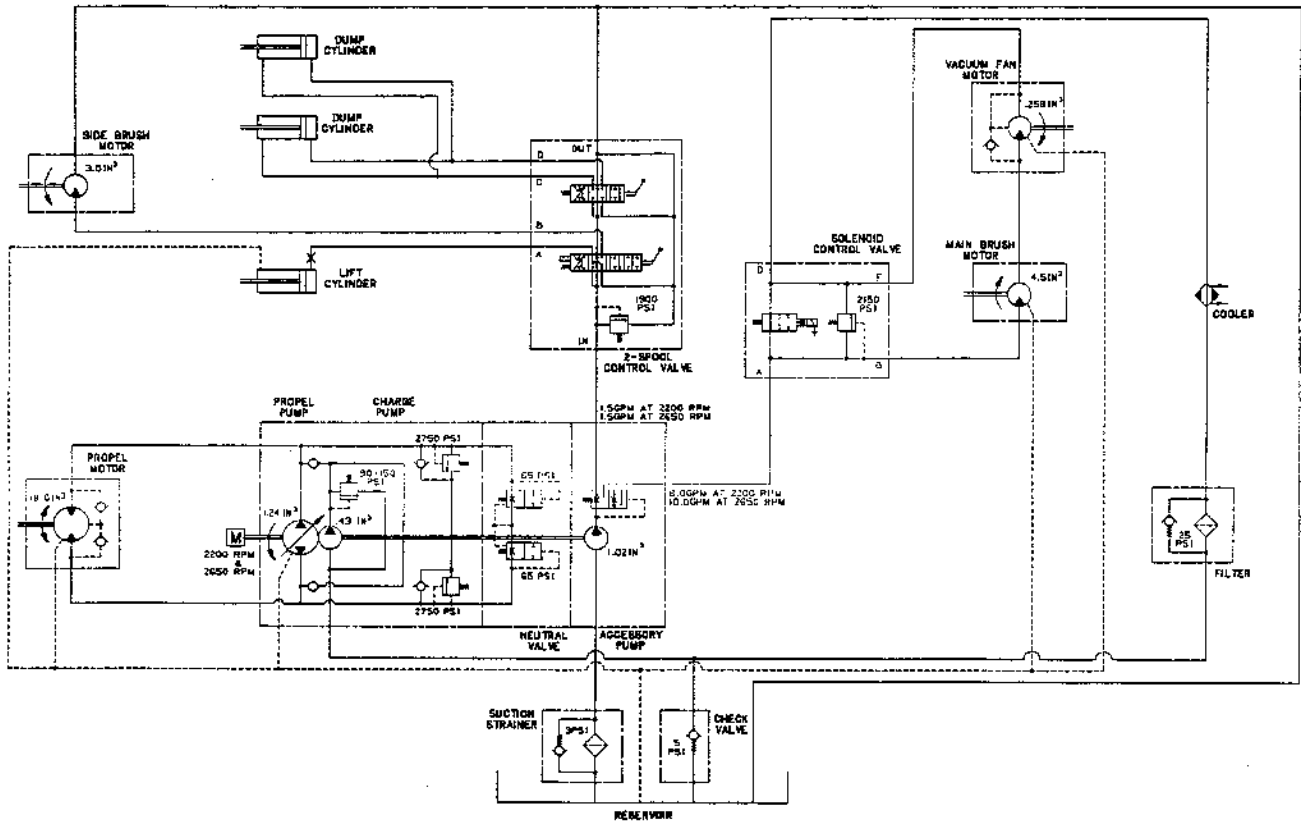
If injured by escaping hydraulic fluid, see a doctor at once. Serious infection or reaction can develop if proper medical treatment is not administered immediately.

⚠ WARNING: Escaping hydraulic fluid under pressure can have sufficient force to penetrate the skin, causing serious personal injury. Before starting engine, be sure all connections are tight and that lines, pipes, and hoses are not damaged.



HYDRAULIC SCHEMATIC, LOW DUMP MODEL

02462



HYDRAULIC SCHEMATIC, MULTI-LEVEL DUMP MODEL

02477

HYDRAULIC SYSTEM TROUBLESHOOTING

| Problem | Cause | Remedy |
|--|---|--|
| Machine travels slowly or not at all | Parking brake engaged | Release parking brake |
| | Control linkage broken or not adjusted properly | Replace and/or adjust linkage |
| | Relief valve stuck open (leaking) | Clean or replace relief valve - one forward valve, one reverse valve |
| | Motor failure | See Hydraulic Components Troubleshooting |
| | Pump failure | See Hydraulic Components Troubleshooting |
| | Hydraulic fluid level low | Fill hydraulic fluid reservoir |
| Main brush turns slowly or not at all | Circuit breaker tripped | Reset circuit breaker |
| | Electric switch S-4 failure | Replace switch |
| | Hydraulic control valve failure | See Hydraulic Components Troubleshooting |
| | Hydraulic motor failure | See Hydraulic Components Troubleshooting |
| | Gear pump failure | See Hydraulic Components Troubleshooting |
| Side brush turns slowly or not at all | Hydraulic control valve failure | See Hydraulic Components Troubleshooting |
| | Hydraulic motor failure | See Hydraulic Components Troubleshooting |
| | Relief valve in control valve sticking | Clean or replace relief valve |
| | Gear pump failure | See Hydraulic Components Troubleshooting |
| Poor or no vacuum to brush compartment | Circuit breaker tripped | Reset circuit breaker |
| | Electric switch S-4 failure | Replace switch |
| | Hydraulic control valve failure | See Hydraulic Components Troubleshooting |
| | Hydraulic motor failure | See Hydraulic Components Troubleshooting |
| | Gear pump failure | See Hydraulic Components Troubleshooting |

| Problem | Cause | Remedy |
|--------------------------|--|--|
| Hopper will not lift | Hydraulic control valve failure | See Hydraulic Components Troubleshooting |
| | Hydraulic orifice at lift cylinder plugged | Replace orifice |
| | Lift cylinder failure | See Hydraulic Components Troubleshooting |
| | Gear pump failure | See Hydraulic Components Troubleshooting |
| | Hopper overloaded | Empty hopper |
| | Lift arms binding | Replace and/or adjust lift arm linkage |
| Hopper will not lower | Hydraulic control valve failure | See Hydraulic Components Troubleshooting |
| | Lift cylinder failure | See Hydraulic Components Troubleshooting |
| | Gear pump failure | See Hydraulic Components Troubleshooting |
| | Lift arms binding | Replace and/or adjust lift arm linkage |
| Hopper will not roll out | Hydraulic control valve failure | See Hydraulic Components Troubleshooting |
| | Lift cylinder failure | See Hydraulic Components Troubleshooting |
| | Gear pump failure | See Hydraulic Components Troubleshooting |
| | Lift arms binding | Replace and/or adjust lift arm linkage |

HYDRAULIC COMPONENTS TROUBLESHOOTING

| Problem | Cause | Remedy |
|----------------------------------|-----------------------------------|-----------------------------------|
| Hydraulic cylinder failure | Piston seals leaking | Install seal kit |
| | Barrel worn or rod bent | Replace cylinder rod |
| Hydraulic control valve failure | Valve seals leaking | Install seal kit |
| | Relief valve stuck open (leaking) | Clean or replace relief valve |
| Solenoid valve failure | Valve leaking | Install seal kit |
| | Solenoid failure | Replace solenoid coil |
| | Solenoid spool sticking | Replace valve |
| | Relief valve stuck open (leaking) | Clean or replace relief valve |
| Hydraulic motor failure | Motor leaking | Install seal kit |
| | Drive link failure | Replace drive link |
| | Gerotor worn | Replace gerotor set |
| | Output shaft failure | Replace output shaft and bearings |
| Hydraulic gear pump pump failure | Pump leaking | Install seal kit |
| | Gear set failure | Replace gear set |
| | Shaft failure | Replace gear set |
| | Flow divider failure | Replace back plate assembly |
| | Engine-to-pump coupling failure | Replace coupling |
| Hydraulic piston pump failure | Pump leaking | Install seal kit |
| | Relief valve stuck | Clean or replace relief valve |
| | Integral charge pump failure | Replace charge pump |
| | Rotating group worn | Replace rotating group |
| | Shaft failure | Replace shaft |
| | Backplate worn | Replace backplate |
| | Engine-to-pump coupling failure | Replace coupling |

ENGINE

ENGINE LUBRICATION

Check the engine oil level daily. Change the engine oil and oil filter after every 50 hours of operation.

Gasoline and LPG powered engines should be lubricated with SAE-SE/SF rated engine oil.

The following oil grades are recommended for engines operating in the ambient temperatures listed.

MULTI-VISCOSITY OILS

| | | | |
|---------------------------|--------------------------------|---|-----------------------------|
| Below 32°F (Below 0°C) | -10° to 90°F (-23° to 32°C) | -10° to above 90°F (-23 to above 32°C) | Above 10°F (Above -12°C) |
| 5W 30 | 10W 30 | 10W 40 | 20W 40 |

SINGLE VISCOSITY OILS

| | | | |
|-------------------------------|-------------------------------|-----------------------------|----------------------------|
| -10° to 32°F (-23° to 0°C) | 10° to 60°F (-12° to 16°C) | 32° to 90°F (0° to 32°C) | Above 60°F (Above 16°C) |
| 10W | 20W 20 | 30 | 40 |

The engine oil capacity is 3.5 qt (3.3 L) including the oil filter. Add three drops of oil to the distributor shaft felt after every 400 hours of operation.

Diesel powered engines should be lubricated with SAE-CC/CD rated engine oil.

The following oil grades are recommended for engines operating in the ambient temperatures listed.

| | | |
|---------------------------|-----------------------------|----------------------------|
| Below 32°F (Below 0°C) | 32° to 77°F (0° to 25°C) | Above 77°F (Above 25°C) |
| 10W 10W 30 | 20 | 30 |

The engine oil capacity is 7 qt (6.7 L) including the oil filter.

COOLING SYSTEM

Maintaining cooling system efficiency is important. Engine temperatures must be brought up to and maintained within the satisfactory range for efficient operation. However, the engine must be kept from overheating in order to prevent damage to the valves, pistons, and bearings. Check the radiator coolant level after every 100 hours of operation.

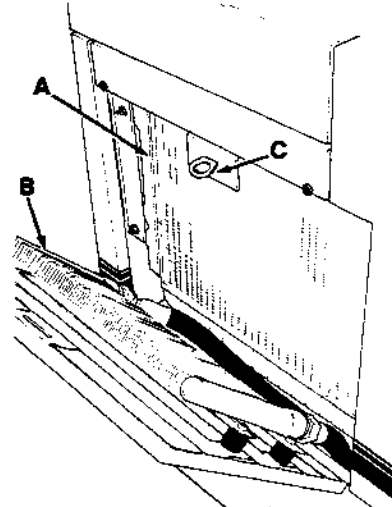
Use soft, clean water mixed with permanent-type, ethylene glycol antifreeze in a one-to-one ratio to fill the cooling system. Deposits of sludge, scale, and rust prevent normal heat transfer. Flush the radiator and the cooling system after every 800 hours of operation, using a dependable cleaning compound. Follow the mixing procedure recommended by the compound manufacturer. This is important because of the difference in concentration and composition of the cleaning compounds. After cleaning, flush the system with clean water.

Whenever a cooling system is badly rust-clogged, as indicated by overflow loss or abnormally high operating temperatures, corrective cleaning by reverse flow flushing will most effectively remove the heavy deposits of sludge, rust, and scale. The reverse flow flushing should be performed immediately after draining the cleaning solution. Flush the radiator first, then the engine, to allow the engine to cool as much as possible.

Engine overheating may also be caused by dirty radiator fins. The exterior fins of the radiator can be cleaned with an air or water hose. Check the radiator core exterior daily for debris.

CAUTION: Always wear eye protection when using air or water hoses to prevent eye injury.

Blow or rinse all dust, which may have collected on the radiator, in through the grill and radiator fins, opposite the direction of normal air flow. The grill and hydraulic cooler may be tilted back for easier cleaning. Use care not to bend the cooling fins when cleaning. Clean thoroughly to prevent caking dust. Clean the radiator and cooler only after the radiator has cooled to avoid cracking.



RADIATOR ACCESS

02468

- A. Radiator**
- B. Hydraulic Fluid Cooler**
- C. Retainer**

The engine is equipped with a 180°F (82°C) thermostat. Normal engine temperature is 200°F (93°C). Temperatures up to 220°F (104°C) are allowable. Temperatures over 200°F (93°C) indicate a problem exists.

A pressure cap is used on the radiator to prevent overflow loss of water during normal operation. The spring-loaded valve in the cap closes the outlet to the overflow pipe of the radiator and thus seals the system.

Pressure developing within the system raises the boiling point of the coolant and allows higher temperatures without overflow loss from boiling. The pressure valve opens at 15 psi (100 kPa), allowing steam and water to pass out the overflow pipe.

⚠ WARNING: If the coolant is hot or if the engine has been operating, let the engine cool. Hot coolant could scald or cause severe burns. If in doubt, let the coolant cool before releasing pressure in the cooling system.

ATTENTION! Never pour cold water or cold anti-freeze into the radiator of an overheated engine. Allow the engine to cool to avoid cracking the cylinder head or block. Keep the engine running while adding water.

AIR INTAKE SYSTEM

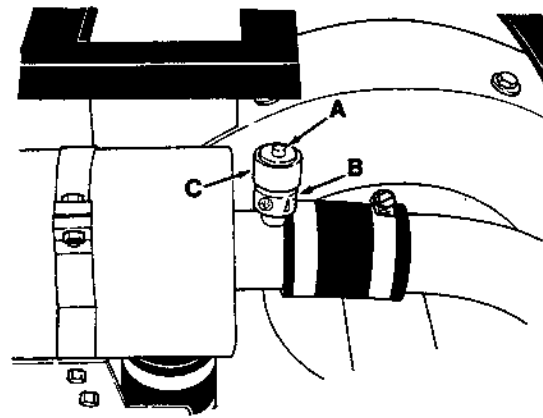
The importance of maintaining an air filter cannot be overemphasized. Dirt ingested through improperly installed, improperly serviced, or inadequate air filter elements wears out more engines than long hours of operation. Even a small amount of dirt will wear out a set of piston rings in just a few hours. Operating with a clogged air filter element also causes the fuel mixture to be richer, which can lead to formation of harmful sludge deposits in the engine. Always cover the air intake when the air filter is removed for servicing. Do not neglect servicing the air filter. Use only approved replacement parts. Keep all other air intake components such as hoses and clamps secure and in good condition to prevent entrance of unfiltered air.

Overmaintenance can cause more damage than good. Removing the air filter element more often than is needed allows contaminants to enter the engine unnecessarily. Clean or replace the air filter element only when the restriction indicator indicates excessive restriction in the system.

AIR FILTER RESTRICTION INDICATOR

The air filter restriction indicator signals when to clean or replace the air filter element. Check the restriction indicator daily. The colored indicator gradually becomes visible as the air filter element loads with dirt. Do not clean or replace the air filter element until the colored indicator reaches the top of the service indicator and reads 20 in (500 mm). The indicator may return to the "no restriction" position when the engine is shut off. It will return to the "visible" position when the engine is started.

Clean or replace the filter element when the yellow indicator reads 20 in (500 mm). After cleaning or replacing the air filter element, reset the service indicator by pushing the "reset" button on the end of the indicator.



AIR FILTER RESTRICTION INDICATOR

- A. Indicator Reset Button
- B. Indicator Window
- C. Restriction Indicator

02172

AIR FILTER

The engine air filter housing includes a dust cap and a dry cartridge-type air filter element. The dust cap must be emptied of dirt daily. The air filter element must be cleaned and inspected or replaced whenever the colored indicator of the air filter restriction indicator reads 20 in (500 mm). The filter element must be replaced if it is damaged or has been cleaned three times.

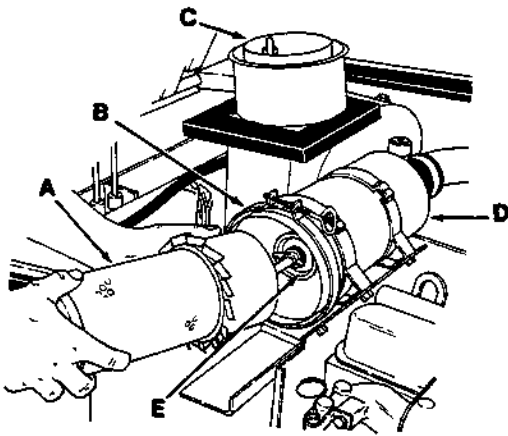
Service the air filter element only when the restriction indicator indicates excessive restriction in the system. Do not remove the air filter element unless it is restricting air flow.

TO REPLACE AIR FILTER ELEMENT

1. Stop the engine and engage the machine parking brake.

⚠ WARNING: Always park on a level surface, stop the engine, and engage parking brake before working on the machine to keep it from creeping or rolling.

2. Open the left side and top engine access doors.
3. Unscrew the clamp ring on the filter.
4. Remove the dust cap.
5. Empty the dust cap.
6. Remove the filter wing nut.
7. Gently pull the filter element out of the filter housing.



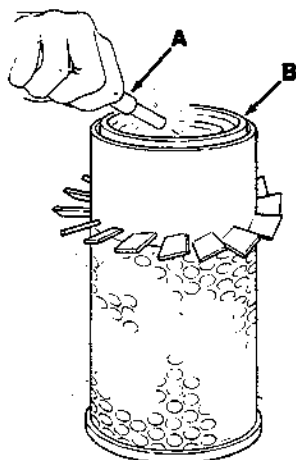
REMOVING AIR FILTER ELEMENT 02173

- A. Filter Element
- B. Clamp Ring
- C. Dust Cap
- D. Filter Housing
- E. Heavy-Duty Air Filter Element

NOTE: SE model machines and machines with heavy-duty air cleaner accessory have a safety element. The safety element should be replaced, not cleaned, after the regular element has been damaged or has been serviced three times.

8. Clean the interior of the air cleaner housing with a damp cloth. Clean the element housing sealing surfaces.
9. Using an air hose, direct dry, clean air maximum 30 psi (205 kPa) up and down pleats on the inside of the filter. Do not rap, tap, or pound dust out of the element.

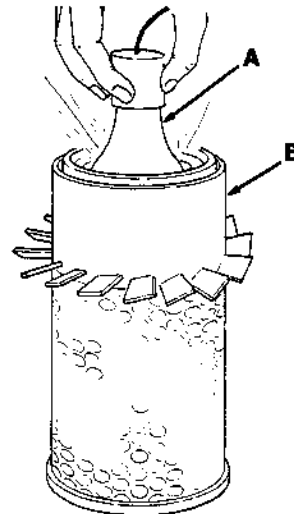
WARNING: Wear approved eye protection when using air or water hoses to prevent eye injury.



CLEANING AIR FILTER ELEMENT 00051

- A. Air Hose
- B. Filter Element

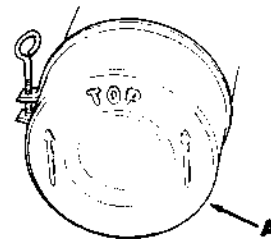
10. After cleaning the air filter element, inspect it for damage by placing a bright light inside. The slightest rupture requires replacement of the filter. Clean and inspect the ends of the element. They should be unbroken and flexible. Remember, the element must be replaced after it has been cleaned three times.



INSPECTING AIR FILTER ELEMENT 03500

- A. Bright Light
- B. Filter Element

11. Install the new or cleaned filter element so the fins on the element are at the intake end of the air cleaner. Use care so the fins are not damaged. Tighten the wing nut attaching the element.
12. Install the dust cap with the arrows pointing up. Tighten the clamp ring to hold it in place. Check all intake hose connections for leaks or abrasion.



DUST CAP 02492

- A. Dust Cap

13. Reset the air filter restriction indicator.
14. Close the access doors.

FUEL SYSTEM - GASOLINE

FUEL FILTER

The fuel filter traps fuel impurities. It is located below the air filter. Replace the filter element after the first 50 hours of operation and then as required.

CARBURETOR

The carburetor has two basic adjustments. Those adjustments are idle fuel mixture and idle speed. Check and adjust idle fuel mixture and idle speed after every 400 hours of operation. The idle fuel mixture is controlled by a screw located on the front of the carburetor. Turning the screw in, clockwise, leans the fuel mixture. Turning the screw counterclockwise, richens the fuel mixture.

WARNING: Always wear eye protection and stay clear of engine fan and drive belts when working in the engine compartment with the engine operating to avoid severe personal injury.

The idle speed is controlled by a screw located on the side of the carburetor next to the throttle linkage. Turning the screw clockwise increases engine speed. Turning the screw out, counterclockwise, decreases engine speed. Proper idle speed is 950 ± 50 rpm with all accessories in the "off" position.

WARNING: No smoking or open flame should be allowed when the fuel system is being repaired or serviced. The area should be properly ventilated. Improper handling of fuel or fuel fumes could result in an explosion or fire.

FUEL SYSTEM - LPG

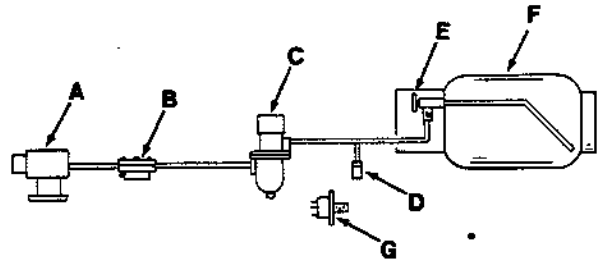
LPG FUEL SYSTEM

The liquid withdrawal LPG fuel system is made up of five components which are: the LPG fuel tank, pressure relief valve, fuel filter lock, vaporizer-regulator, and the carburetor.

Liquid LPG fuel flows from the LPG tank, under its own pressure, to the pressure relief valve. This valve is normally closed, preventing LPG fuel from escaping into the atmosphere. The valve opens to relieve pressure if the fuel pressure exceeds system limits. From the pressure relief valve, the liquid LPG fuel is piped to the fuel filter lock. The fuel filter lock filters unwanted tank scale and deposits out of the LPG fuel. The fuel filter lock also stops the flow of LPG fuel when the engine is not operating. The oil pressure switch controls the fuel filter lock. When the engine oil pressure is 4 psi (30 kPa) or greater, the oil pressure switch permits an electrical current to open the fuel filter lock which allows LPG fuel to flow on to the vaporizer-regulator. The oil pressure switch is bypassed when the engine is being started, allowing LPG fuel to flow.

The vaporizer section of the vaporizer-regulator converts the liquid LPG fuel into a gaseous LPG fuel. From the vaporizer section, the gaseous LPG fuel is sent to the primary regulator section of the vaporizer-regulator. The primary regulator section reduces the pressure of the LPG fuel. The secondary regulator section reduces the LPG fuel pressure to

the level required by the carburetor. From the vaporizer-regulator, the LPG fuel is sent to the carburetor where it is finally metered into the air flow which is sent to the engine combustion chamber.



LPG FUEL SYSTEM

03511

- A. Carburetor
- B. Vaporizer-Regulator
- C. Fuel Filter Lock
- D. Pressure Relief Valve
- E. Tank Service Valve
- F. LPG Fuel Tank
- G. Oil Pressure Switch

Never operate an LPG powered machine if the LPG fuel system is leaking, or if any component in the fuel system is malfunctioning. Operating the machine under either of these conditions may cause a fire or explosion.

Check for frosting. If frosting occurs on or near any LPG component, there is a possibility of an LPG fuel leak or a malfunctioning component. To locate the leak, apply a soapy water solution to the suspected area. Watch for bubbles forming in a confined area. This area may have an LPG fuel leak. Repair or replace the part. Use Loctite brand Stainless Steel PST thread sealant when reassembling. This epoxy-type sealant is not affected by aging or high humidity. Be sure to follow application directions and apply proper torque when reconnecting fittings. Never bypass safety components except to test. If they are defective, replace them before operating the machine.

Check routings of all LPG hoses. Keep them away from sharp edges, exhaust manifolds, or other hot surfaces. Check for signs of abrasion or deterioration. Replace hoses found to be worn or damaged.

FUEL TANKS

The LPG fuel tanks should be inspected for sharp dents, gouges, leaks, and broken protecting rings whenever the tanks are refilled. All tank valves must be inspected for leaks using a soap solution. Valves must also be checked for dirt, paint, or other debris in the valve openings. The following specific checks must also be made:

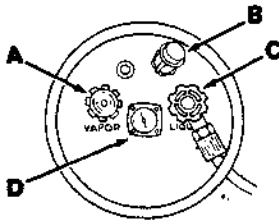
Filler Valve - Check for proper functioning and the presence of the handwheel. Valve must be closed except during filling.

Vapor and Liquid Service Valves - Check for proper functioning and presence of the handwheel. The valve must be closed except when in service.

Tank Service Valve Coupling - Check for proper functioning, thread condition, and damaged or missing washers or o-rings.

Safety Relief Valve - Check for damage. Check for the presence of the relief valve elbow and the proper direction of the elbow. If the rain cap is missing, check for foreign matter and replace cap. Do not tamper with the relief valve setting.

Magnetic Liquid Level Gauge - Check operation against the maximum filling point as determined by weight.



03485

TYPICAL LPG LIQUID WITHDRAWAL FUEL TANK

- A. Filler Valve
- B. Safety Relief Valve
- C. Liquid Service Valve
- D. Liquid Level Gauge

An LPG fuel tank with any of the stated defects must be removed from service and be repaired or destroyed accordingly.

If an LPG fuel tank is damaged or leaking, it should be removed to a designated safe area, and the proper personnel should be notified. Do not attempt to make repairs to the tank, regardless of condition. Repairs or disposal must only be made by qualified personnel.

The care an LPG fuel tank receives has a direct bearing on how long that tank can be used safely. LPG fuel tanks must not be dropped or dragged across any surface. To move LPG fuel tanks, use a hand truck or roll the tank on its foot ring while it is being held in a position slightly off vertical.

Whether the storage is inside or outside, fuel tanks should not be stored in the vicinity of combustible materials or high temperature sources such as ovens and furnaces, since the heat may raise the pressure of the fuel to a point where the safety relief valves would function. Care should be taken to insure that the tanks are stored in such a manner that if the safety relief valves do function, they will relieve vapor, rather than liquid.

Valves on empty tanks must be closed during storage and transportation.

Similar precautions should be taken in storing machines fitted with LPG fuel tanks. They may be stored or serviced inside buildings, provided there are no leaks in the fuel system and the tanks are not over-filled. While machines are being repaired inside a building, the shut-off valve on the tank must be closed, except when the engine must be operated.

The tank changing operation presents an opportunity for the machine operator to carefully observe the tank, fittings, and the fuel lines and fittings for his own satisfaction. If abnormal wear is detected, the operator should report his findings to his supervisor for appropriate action.

TO CHANGE AN LPG FUEL TANK

1. Park the machine in a designated safe area.

WARNING: No smoking or open flame should be allowed when the fuel system is being repaired or serviced. The area should be properly ventilated. Improper handling of fuel or fuel fumes could result in an explosion or fire.

2. Close the tank service valve.
3. Operate the engine until it stops from lack of fuel, then engage the machine parking brake.

WARNING: Always park on a level surface, stop the engine, and engage the parking brake before working on the machine to keep it from creeping or rolling.

4. Put on gloves and remove the quick-disconnect tank coupling.

CAUTION: Always wear gloves when disconnecting the tank coupling to prevent escaping LPG fuel from freezing hands.

5. Inspect the LPG fuel lines for wear or damage.
6. Remove the empty LPG fuel tank from the machine.
7. Check the tank for damage or wear.
8. Store the tank in a designated safe area.
9. Select a filled LPG fuel tank and inspect it for damage or leaks.

NOTE: Make sure the LPG fuel tank matches the fuel system (liquid tank with liquid system).

10. Carefully place the LPG tank in the machine so that the tank centering pin enters the aligning hole in the tank collar.

NOTE: If the pin cannot be engaged, make sure you have the correct LPG fuel tank and then adjust the pin locator in or out.

11. Fasten the tank hold-down clamp to lock the tank in position.
12. Connect the LPG fuel line to the tank service coupling. Make sure the service coupling is clean and free of damage. Also make sure it matches the machine service coupling.
13. Open the tank service valve slowly and check for leaks.

⚠ WARNING: If an LPG leak is found, close the service valve immediately and notify the appropriate personnel.

14. If no leaks are found, the engine is ready to start.

FUEL FILTER LOCK

The fuel filter lock filters the LPG fuel. It also stops the flow of LPG fuel to the engine when the engine is not operating or when the engine oil pressure is less than 4 psi (30 kPa).

Replace the filter pack with the filter pack replacement kit if diminished gas flow indicates the filter is clogged. A drain plug is provided for purging the filter bowl. Clean out the bowl when replacing the filter pack.

⚠ WARNING: Do not bypass the fuel filter lock unless testing is being done. Reconnect the fuel filter lock when testing is complete. A potential fire hazard may be created if the fuel filter lock is bypassed after testing.

To check the fuel filter lock for proper operation:

Start the engine. Remove the wire going to the solenoid section of the fuel filter lock. This should cause the solenoid to close, shutting off the fuel supply and stopping the engine. If the engine continues to operate, replace the fuel filter lock.

If the engine stopped as it should, allow the machine to stand with the LPG tank valve open and the wire removed from the fuel filter lock. After 10 minutes, operate the starter motor. If the engine starts or fires, LPG fuel has leaked by the fuel filter lock and the fuel filter lock should be replaced. If the engine just turned over, the fuel filter lock is operating correctly.

VAPORIZER-REGULATOR

If any malfunction is noted, completely disassemble the vaporizer-regulator. Clean all of the parts in alcohol. Inspect all of the parts and replace where needed. Carefully reassemble the vaporizer-regulator with the seal repair kit.

After reinstalling vaporizer-regulator in machine, perform the following checks: Turn on the ignition switch, short out the oil pressure switch leads, open the radiator cap, and check the coolant for bubbles. If bubbles are present, the vaporizer may have a leaking gasket or may have developed a pinhole leak, allowing LPG fuel to enter the cooling system.

Check for proper operation. Use a pressure gauge to check the output of the regulator to make sure it is working per specifications.

CARBURETOR

If any malfunction is noted, completely disassemble the carburetor. Clean all of the parts in alcohol.

Inspect all of the parts and replace when needed. Carefully reassemble the carburetor with the seal repair kit.

OIL PRESSURE SWITCH

The engine oil pressure switch requires no regular maintenance. Never bypass the oil pressure switch as this is a safety feature which prevents LPG fuel from flowing when the engine is not operating properly.

⚠ WARNING: Never bypass the oil pressure switch unless testing of other components is being done. Reconnect the switch when testing is complete. A fire hazard may be created if the oil pressure switch is bypassed after testing.

To check the oil pressure switch:

Turn the ignition switch to the "on" position. If a click in the fuel filter lock is heard, the oil pressure switch is not operating properly. If no click is heard, remove the wire from the "c" terminal and touch it to the "no" terminal. This shorts the switch out. The fuel filter lock should click when the switch is shorted out if the switch is working properly.

LPG FUEL TROUBLESHOOTING

| Problem | Cause | Remedy |
|--|--|---|
| Engine will not start | Out of fuel | Replace fuel tank with full one |
| | Service valve opened too quickly - engaging safety valve | Close valve and reopen slowly |
| | Plugged fuel filter | Replace filter |
| | Kinked or restricted fuel line | Straighten or replace fuel line |
| | Engine out of tune | Tune-up engine |
| | Oil pressure switch failure | Replace oil pressure switch |
| | Fuel lock valve failure | Repair or replace fuel filter lock |
| | Vaporizer-regulator failure | Repair or replace vaporize - regulator |
| Engine runs unevenly or lacks power | Wrong type of fuel tank - vapor withdrawal tank | Replace vapor withdrawal tank with liquid withdrawal tank |
| | Plugged fuel filter | Replace filter |
| | Kinked or restricted fuel line | Straighten or replace fuel line |
| | Engine out of tune | Tune-up engine |
| | Restricted air filter | Clean or replace air filter element |
| | Vaporizer - regulator maladjusted | Adjust vaporizer - regulator |

FUEL SYSTEM - DIESEL

DIESEL FUEL SYSTEM

The diesel fuel system is made up of five basic components which are: fuel tank, fuel water trap-filter, fuel pump, injection pump, and injectors.

Fuel flows from the fuel tank through the fuel water trap-filter. The water trap-filter separates water and impurities from the fuel. From the fuel water trap-filter, fuel is drawn through the electric fuel pump and pumped to the injection pump. The injection pump pressurizes and sends fuel to the injectors. The injectors atomize and inject proper amounts of fuel into the combustion chamber at the proper times. Excess fuel is returned to the fuel tank through an overflow pipe.

FUEL WATER TRAP-FILTER

The fuel water trap-filter separates water and impurities from the fuel. It is located next to the engine bellhousing. The bottom portion of the unit is the water trap. The middle portion is the filter element.

Drain the water trap of water daily. To drain the water trap, loosen the drain knob on the bottom of the unit. First water, then diesel fuel will drain. Tighten the drain knob when diesel fuel appears.

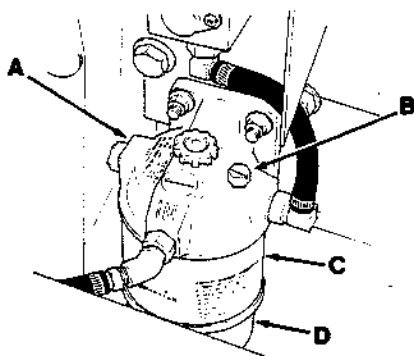
Replace the fuel filter element and clean the water trap after every 400 hours of operation.

TO REPLACE FUEL FILTER ELEMENT

1. Stop the engine and engage the machine parking brake.

⚠ WARNING: Always park and level surface, stop the engine, and engage parking brake before working on the machine to keep it from creeping or rolling.

2. Open the side and top engine access doors.
3. Loosen the unit vent plug and open the water trap drain to drain diesel fuel.



FUEL WATER TRAP-FILTER

02765

- A. Filter Head
- B. Vent Plug
- C. Filter Element
- D. Water Trap Bowl

4. Remove the filter element and the water trap from the filter head.
5. Remove the water trap bowl from the filter element.
6. Clean the water trap bowl.
7. Lubricate the o-ring and spin the water trap bowl onto the new filter element.
8. Lubricate the o-ring and spin the filter element and water trap onto the filter head.
9. Bleed the fuel lines of air as described in To Prime Fuel System.
10. Close the side and top engine access doors.

PRIMING FUEL SYSTEM

Priming the fuel system removes pockets of air in the fuel lines and fuel components. Air in the fuel system will prevent smooth engine operation.

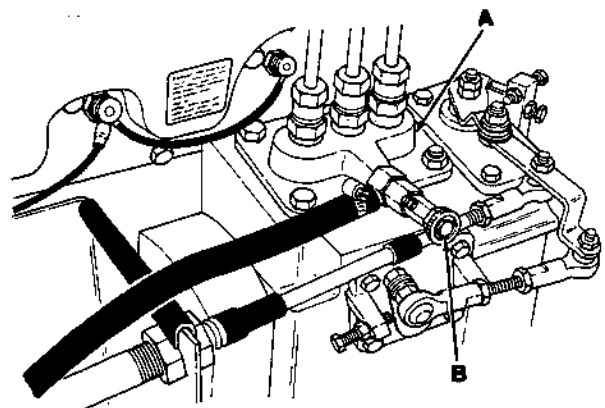
Prime the fuel system after running out of fuel, changing fuel filter elements or repairing a fuel system component.

TO PRIME FUEL SYSTEM

1. Stop the engine and engage the machine parking brake.

⚠ WARNING: Always park on a level surface, stop the engine, and engage the parking brake before working on the machine to keep it from rolling or creeping.

2. Fill the fuel tank.
3. Open the side and top engine access doors.
4. Open the air vent on top of the fuel injection pump.



FUEL INJECTION PUMP

02766

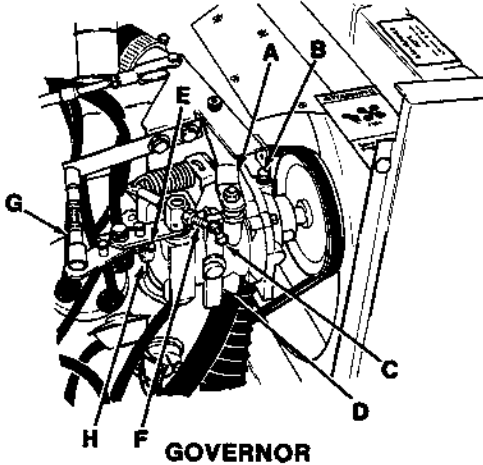
- A. Injection Pump
- B. Air Vent

5. Start the engine, operate it for one minute, then stop it; or operate the starter motor in ten-second intervals until a steady stream of fuel flows from the vent.
6. Close the air vent.
7. Close the access doors.

GOVERNOR - GASOLINE, LPG

The governor controls engine speed. It is driven by a belt which spans the crankshaft sheave.

The governor is oil filled. It requires no regular inspections. Change the oil when performing major engine work. Use an SAE rated 10W30 or 10W40 engine oil.



GOVERNOR

02460

- A. High Speed Stop Screw
- B. Oil Fill Plug
- C. Low Speed Stop Screw
- D. Governor
- E. Surge Screw
- F. Regulation Screw
- G. Throttle Rod
- H. Oil Level Plug

The governor is factory set and should not be adjusted unless the engine speed varies from the specification or if the engine surges. The governor should be set so the engine operates at 2200 ± 50 rpm at "normal" speed setting under load and at 2650 ± 50 at "litter" speed setting under load. A surge screw has been provided to compensate for surging — adjust it with care or governor damage may result. The regulation screw has been factory set and should not be tampered with.

TO ADJUST GOVERNOR

1. Operate the engine until it reaches normal operating temperature.
2. Park on a level surface, stop the engine, and engage the machine parking brake.

WARNING: Always park on a level surface, stop the engine, and engage the parking brake before working on the machine to keep it from rolling.

3. Check the governor belt tension as described in Governor Belt.
4. Place the throttle control lever in the "normal" position. There should be a 0.03 to 0.06 in (1 to 2 mm) space between the carburetor lever and the lever stop. Adjust the throttle rod as required.
5. Move the throttle control lever to the "idle" position. Start the engine and adjust the engine idle speed screw so the engine operates at 950 ± 50 rpm.
6. Place the throttle control lever in the "litter" position. Turn the side brush and main brushes on, and adjust the high speed stop screw so the engine operates at 2600 rpm. On new governors, adjust the surge screw so the engine operates at 2650 rpm with the brushes off. Tighten all locknuts.

WARNING: Use extreme caution when working around an operating engine to prevent personal injury.

7. Place the throttle control lever in the "normal" position. Adjust the low speed stop screw so the engine operates at 2200 ± 50 rpm.
8. Stop the engine.
9. Check and adjust the throttle cable position and the throttle lever stops to allow full linkage movement.

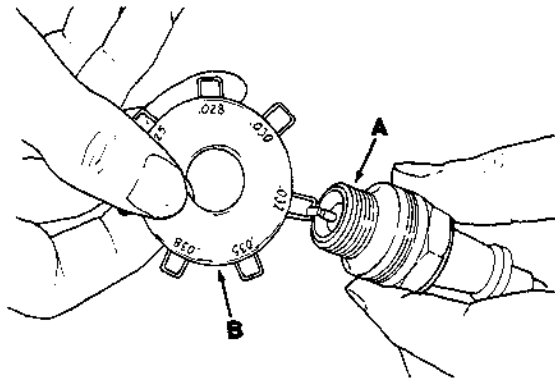
WARNING: Avoid moving parts of the machine. Do not wear loose jackets, shirts, or sleeves when working on machine because of the danger of becoming caught in moving parts. Keep shields and guards in position. Wear approved eye protection. If adjustments must be made while the engine is running, use extreme caution near hot manifolds, moving parts, belts, etc.

IGNITION SYSTEM - GASOLINE, LPG

SPARK PLUGS

Clean or replace and adjust spark plugs after every 400 hours of operation. Spark plug gaps are best checked with a wire gauge unless the plug is dressed to obtain a correct reading with a flat gauge. The adjustment should always be made on the side electrode and never on the center electrode, which may cause a broken porcelain.

"Gapping" the electrode tip is more easily done with the proper tools.



GAPPING SPARK PLUG

01174

- A. Spark Plug
- B. Gapping Tool

The proper spark plug gap is 0.032 in (0.8 mm).

Spark plugs must be correctly installed in order to obtain good performance. It is a simple but important matter to follow these procedures when installing plugs:

1. Clean the spark plug seat in the cylinder head.
2. Use a new seat gasket and screw the plug in by hand.
3. Tighten the spark plugs to 22 to 28 ft lb (30 to 40 Nm) with a socket wrench of the correct size.

DISTRIBUTOR

The distributor operation is vital to the operation of the engine. The following items should be carefully inspected after every 400 hours of normal operation; however, dirt, dust, water, and high speed operation may cause more rapid wear and necessitate more frequent inspections:

1. Remove the distributor cap. Clean the cap and examine for cracks, carbon runners, or corroded terminals. If the vertical faces of the inserts are burned, install a new cap. If the horizontal faces of the inserts are burned, replace the cap and the rotor as this condition is caused by the rotor being too short.
2. Check the centrifugal advance mechanism for "freeness" by turning the breaker cam in the direction of rotation and then releasing it. The advance springs should return the cam to its original position.
3. Lubricate the shaft felt, advance mechanism, breaker cam, and pivot. Make sure the breaker arm moves freely on its hinge. Special grease with Moly should be used sparingly on the breaker cam.

NOTE: Avoid excessive lubrication. Excess lubricant may get on the contact points and cause burning.

POWER SWEEPER - 275 MM151 (1-85) LITHO IN U.S.A.

4. Clean and check or replace the ignition points and gap. If the points are pitted, burned, or worn to an unserviceable condition, install a new set of points. Badly pitted points may be caused by a defective or improper condenser capacity.

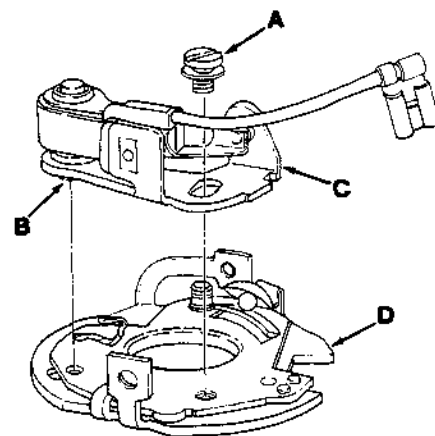
If the points are serviceable, they should be dressed down with a fine cut stone or point file. The file must be clean and sharp; never use emery cloth to clean contact points.

After filing, check the point gap and reset to 0.025 in (0.6 mm), 48° to 52° dwell. The breaker arm must be resting on the high point of the cam during this operation.

When replacing points, make sure they are aligned and make full contact. Bend the stationary arm to obtain proper alignment; do not bend the breaker arm.

TO REPLACE IGNITION POINTS

1. Remove the distributor cap and the rotor.
2. Disconnect the condenser wire from the ignition point assembly.



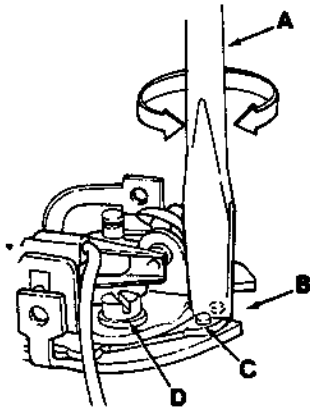
INSTALLING IGNITION POINTS

00694

- A. Retaining Lockscrew
- B. Pin
- C. Ignition Point Assembly
- D. Advance Plate

3. Remove the ignition points attaching screw and lift out the ignition point assembly.
4. Remove the condenser by removing the screw attaching the condenser to the distributor plate.
5. Install the new condenser.

6. Position the new ignition points on the advance plate and install the attaching screw.
7. Connect the condenser wire to the ignition points.
8. Adjust the ignition points to 0.025 in (0.6 mm). The dwell angle is 48° to 52°.



ADJUSTING IGNITION POINTS

00695

- A. Screwdriver
- B. Slot
- C. Boss
- D. Lockscrew

ENGINE IGNITION TIMING

The engine ignition timing must be checked with a timing light, using the timing points located on the front of the engine and the timing marks located on the crankshaft pulley. Distributor ignition timing should be checked after the first 50 hours of operation and after every 400 hours of operation thereafter.

To check and adjust the ignition timing with a scope, refer to the scope manufacturer's instructions. To check and adjust the timing with a timing light, proceed as follows:

TO CHECK AND ADJUST IGNITION TIMING

NOTE: Dwell angle must be correct or timing will not be accurate.

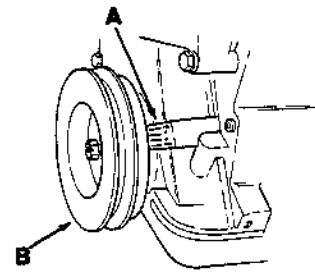
1. Stop the engine and engage the machine parking brake.

WARNING: Always park on a level surface, stop the engine, and engage the parking brake before working on the machine to keep it from creeping or rolling.

2. Clean and mark the timing marks.

NOTE: Painting a white line on the front pulley timing marks will make them more visible under the timing light.

3. Disconnect and plug the vacuum hose from the distributor.



ENGINE TIMING MARKS

00696

- A. Timing Pointer
- B. Crankshaft Pulley

CAUTION: Do not hold ignition wires with bare hands as electrical shocks or other injuries can result.

4. Connect the timing light to the no. 1 cylinder spark plug wire. Connect a tachometer to the engine.

WARNING: Always wear eye protection and stay clear of engine fan and drive belts when working in the engine compartment with the engine operating to avoid severe personal injury.

5. Start the engine and reduce the idle speed to 600 rpm to be sure that the centrifugal advance is not operating. Adjust the initial ignition timing to 10° to 12° BTDC on gasoline engines, and 12° to 14° BTDC on LPG engines.

To advance the timing, turn the distributor body clockwise. To retard the timing, turn the distributor body counterclockwise.

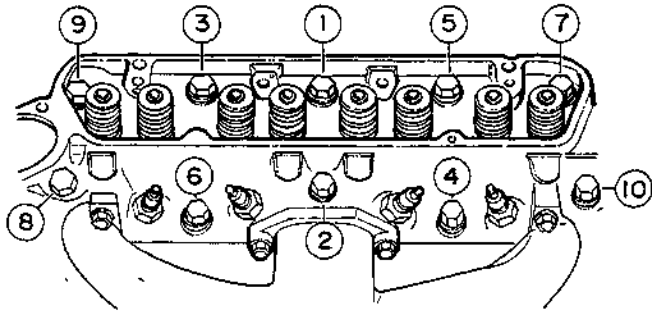
6. Check the centrifugal advance for proper operation by starting the engine and accelerating it to approximately 2000 rpm. If the ignition timing advances, the centrifugal advance mechanism is functioning properly. Note the engine speed when the advance begins and the amount of total advance. Stop the engine.
7. Unplug the vacuum line and connect it to the distributor vacuum advance unit. Start the engine and accelerate it to approximately 2000 rpm. Note the engine speed when the advance begins and the total amount of advance. Advance of the ignition timing should begin sooner and advance farther than when checking the centrifugal advance alone. Stop the engine.
8. If the vacuum advance is not functioning properly, remove the distributor and check it on a distributor tester.
9. After adjusting timing, be sure to increase the engine idle speed to its normal setting.

CYLINDER HEAD - GASOLINE, LPG

CYLINDER HEAD

The cylinder head must be properly torqued after servicing to ensure proper operation. A three-stage torque procedure should be used. Snug down the cylinder head bolts in the proper sequence: first to one-third, then two-thirds, and then to the full torque specification of 65 to 70 ft lb (90 to 95 Nm).

Retighten the cylinder head bolts after the first 50 hours of operation and seasonally thereafter.



00697

CYLINDER HEAD BOLT TIGHTENING SEQUENCE

The cylinder head bolts must be retorqued after the engine is put into operation and brought up to proper operating temperatures. To retorqued head bolts, follow the correct sequence. Loosen one head bolt at a time one-quarter turn, 90 degrees; then retorqued it to the correct value.

NOTE: Power wrench torque limit must be held at least 10 ft lb (15 Nm) below hand torque specification; then hand torque to the specification.

Tighten the intake manifold bolts to 15 to 18 ft lb (20 to 25 Nm) after every 800 hours of operation.

VALVE CLEARANCE

The valve clearance must be checked and adjusted if necessary after the first 150 hours and then after every 400 hours of operation and after retorquing the cylinder head bolts.

To set the valve clearance without the engine operating, rotate the crankshaft until no. 1 cylinder is at the top of the compression stroke. Check the timing marks. It should read 0 or TDC. Both valves on no. 1 cylinder are now closed. Set the valve clearance on both valves. Next, rotate the crankshaft 180°, and set the valve lash on both valves on no. 2 cylinder. Again rotate the crankshaft 180°, and set the valve lash on both valves on no. 4 cylinder. Rotate the crankshaft another 180°, and set the valve lash on both valves on no. 3 cylinder.

Check and adjust the intake valve clearance from 0.008 to 0.010 in (0.20 to 0.25 mm) and the exhaust valve clearance from 0.018 to 0.020 in (0.45 to 0.50 mm) while the engine is cold.

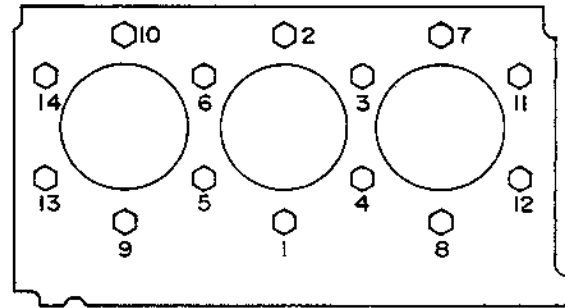
POWER SWEEPER - 275 MM151 (1-87) LITHO IN U.S.A.

CYLINDER HEAD - DIESEL

CYLINDER HEAD

The cylinder head must be properly torqued after servicing to ensure proper operation. A three-stage torque procedure should be used. Snug down the cylinder head bolts and nuts in the proper sequence; first to one-third, then two-thirds, and then to the full torque specification of 55 to 60 ft lb (75 to 80 Nm). Retighten the bolts and nuts after operating the engine for 30 minutes.

NOTE: Power wrench torque limit must be held at least 10 ft lb (15 Nm) below torque specification. Hand tighten to specification.



02767

CYLINDER HEAD BOLT TIGHTENING SEQUENCE

VALVE CLEARANCE

The valve clearance must be properly adjusted after servicing or retorquing the cylinder head bolts to ensure proper operation. Measure valve clearance with a feeler gauge after aligning each cylinder on the compression top dead center stroke.

Adjust them with the engine cool to 0.0071 to 0.0087 in (0.18 to 0.22 mm) in the firing order 1-2-3.

CRANKCASE VENTILATION SYSTEM - GASOLINE, LPG

Clean the crankcase ventilation hoses, tubes, and fittings and replace the PCV valve after every 400 hours of operation.

| TUNE-UP CHART - GASOLINE, LPG | |
|-------------------------------------|---|
| Idle speed, no load | 950 ± 50 rpm |
| "Normal" governed speed, under load | 2200 ± 50 rpm |
| "Litter" governed speed, under load | 2650 ± 50 rpm |
| Spark plug gap | 0.032 in (0.8 mm) |
| Ignition point gap | 0.025 in (0.6 mm) |
| Dwell angle | 48° to 52° |
| Timing | 10° to 12° BTDC @ 600 rpm, gasoline 12° to 14° BTDC @ 600 rpm, LPG |
| Firing order | 1-2-4-3, counterclockwise rotation |
| Valve clearance, cold | 0.008 to 0.010 in (0.20 to 0.25 mm) intake 0.018 to 0.020 in (0.45 to 0.50 mm) exhaust |

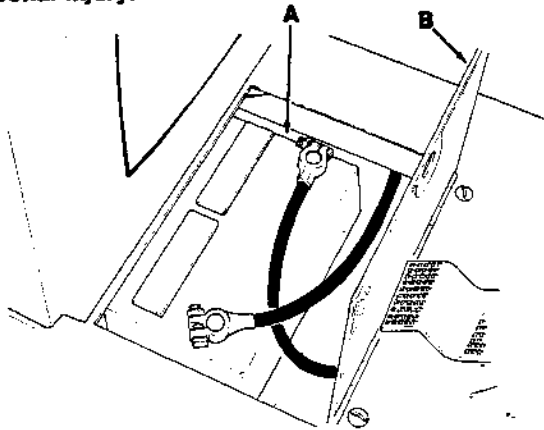
ELECTRICAL SYSTEM

BATTERY

The battery used in the machine is a low maintenance battery. It has been constructed with special materials and has extra electrolyte to reduce or eliminate maintenance. Its design reduces electrolyte loss and contamination. Do not add water, remove the battery vent plugs, or check the battery specific gravity. For specific instructions, see the battery label.

The battery is a 12 V, 60 A/h at a 20-hour rate. It is located under the operator foot plate. When removing battery cables, remove the negative (-) cable before the positive (+) cable.

CAUTION: Always remove the negative (-) battery cable before the positive (+) battery cable to prevent accidental electrical shorting and personal injury.



BATTERY
A. Battery
B. Floor Plate

00586

Do not allow the battery to remain in discharged condition for any length of time. Do not operate the machine if the battery is in poor condition or discharged beyond 80%, specific gravity below 1.120.

Clean the top surface and the terminals of the battery periodically. 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 top of the battery clean and dry.

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

The electrolyte level in regular nonsealed batteries can be checked. It 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.

If when checking battery specific gravity, 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:

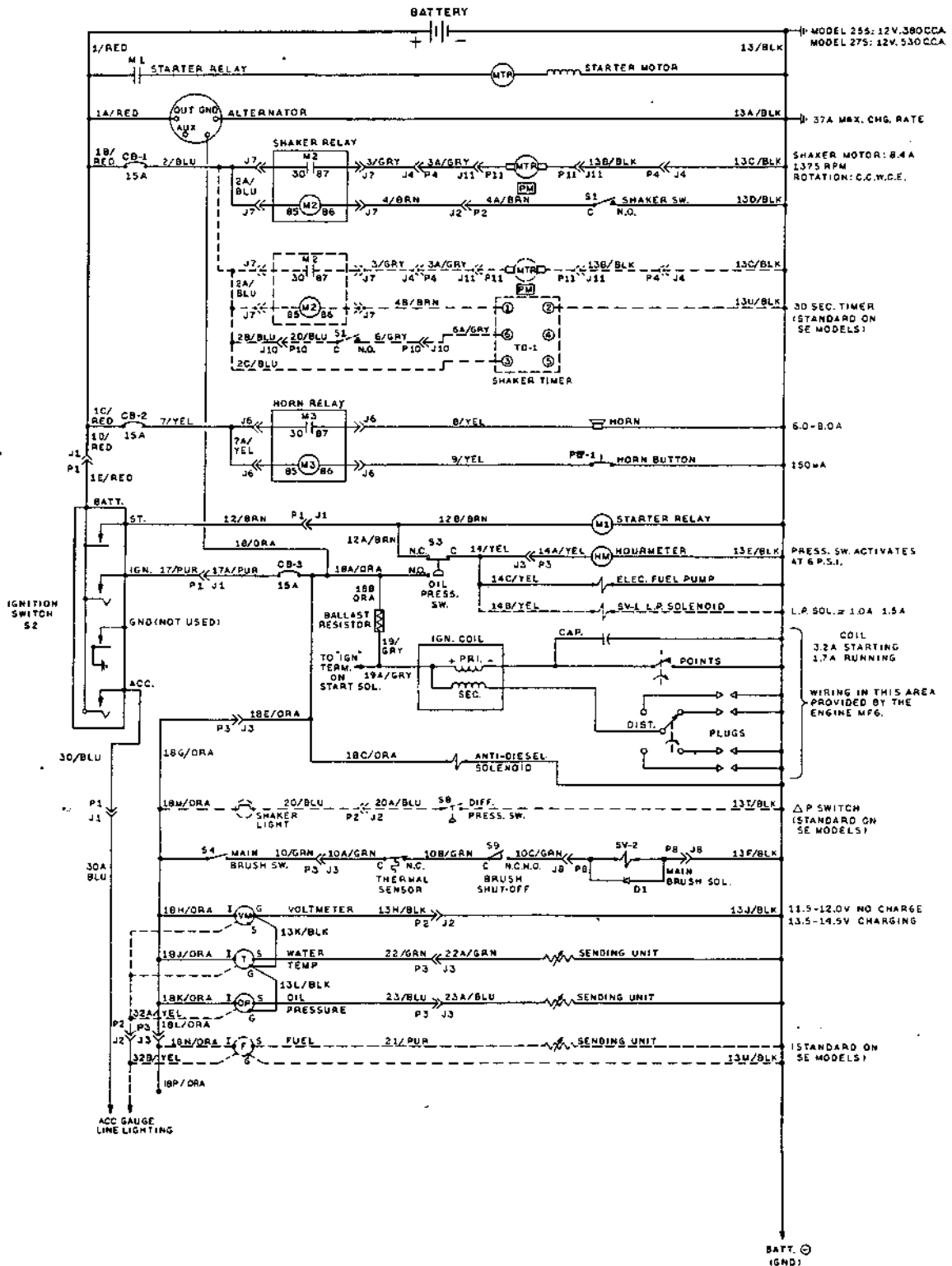
| SPECIFIC GRAVITY AT 80° F (27° C) | BATTERY CONDITION |
|--------------------------------------|----------------------|
| 1.260 - 1.280 | 100% charged |
| 1.230 - 1.250 | 75% charged |
| 1.200 - 1.220 | 50% charged |
| 1.170 - 1.190 | 25% charged |
| 1.110 - 1.130 | Discharged |

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):

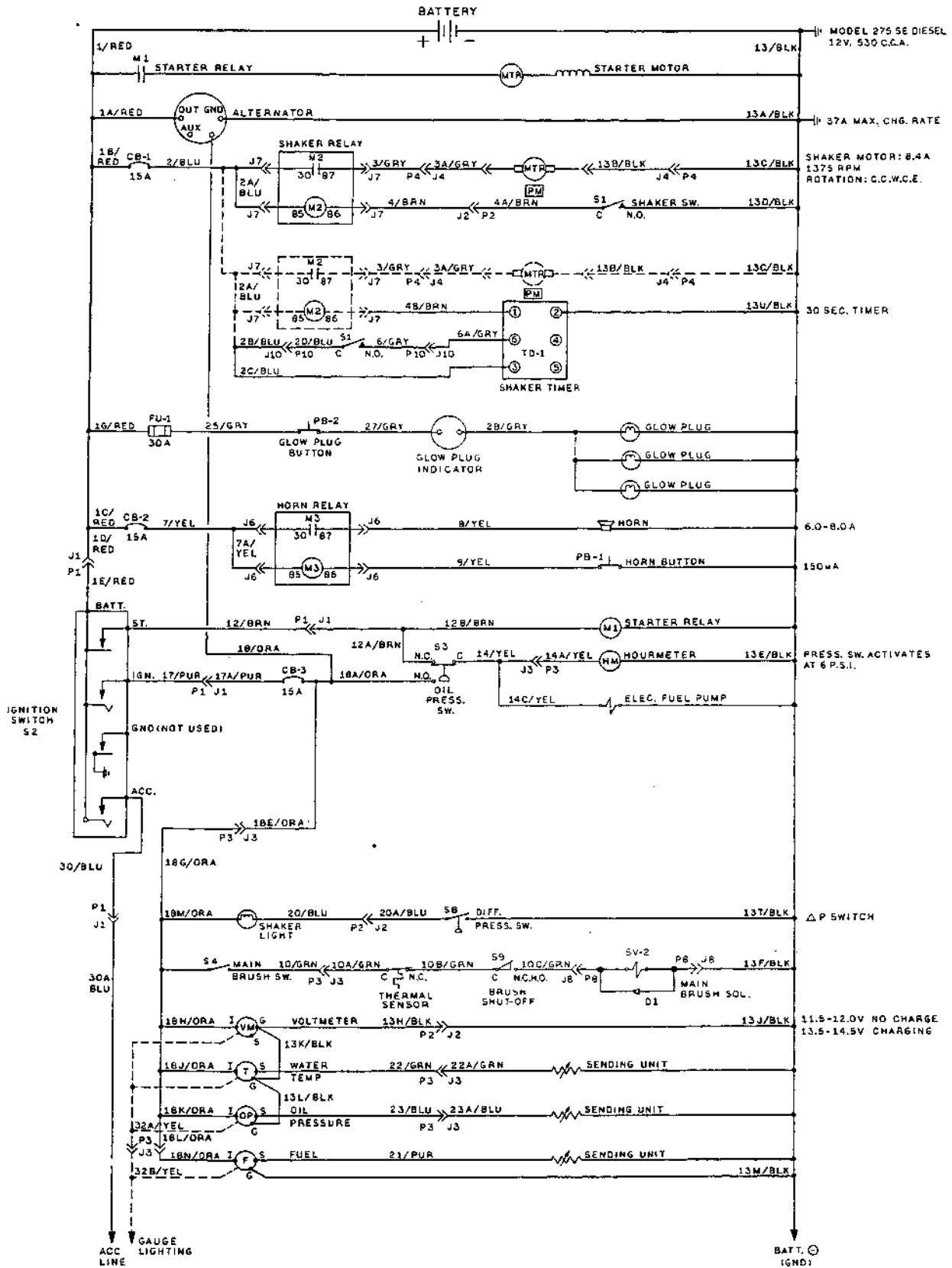
Add to the specific gravity reading 0.004 (4 points) for each 10° F (6° C) above 80° F (27° C).

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



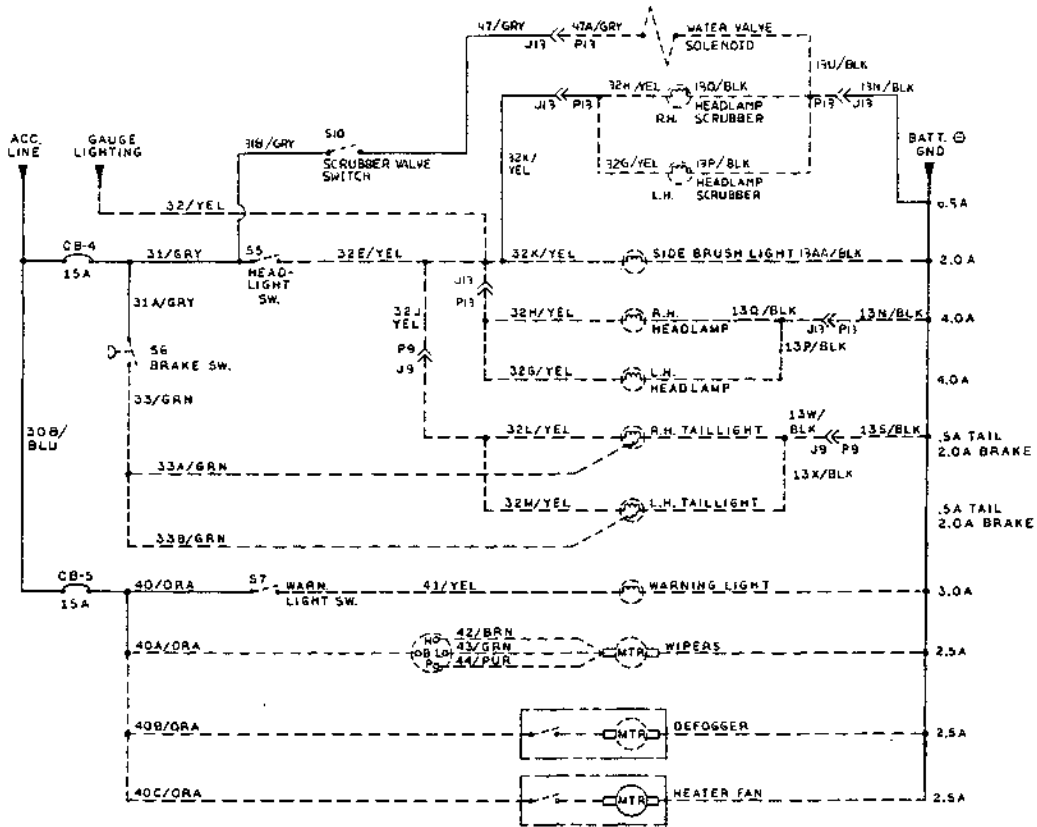
ELECTRICAL SCHEMATIC - GASOLINE, LPG

02461



ELECTRICAL SCHEMATIC - DIESEL

02768



| LEGEND | | | |
|--------|------------------|------|-------------------|
| M | POWER RELAY | HM | HOURMETER |
| MTR | MOTOR | SV | SOLENOID VALVE |
| CB | CIRCUIT BREAKER | TD | DIODE |
| PM | PERMANENT MAGNET | BATT | BATTERY |
| S | SWITCH | ST | START |
| PB | PUSHBUTTON | IGND | GROUND |
| J | JACK | IACC | ACCESSORY |
| P | PLUG | IGN | IGNITION |
| C | COMMON | VM | VOLTMETER |
| N.O. | NORMALLY OPEN | T | TEMPERATURE GAUGE |
| N.C. | NORMALLY CLOSED | OP | PRESSURE GAUGE |
| FU | FUSE | F | FUEL GAUGE |

ELECTRICAL SCHEMATIC

02461

BELTS AND CHAINS

ENGINE FAN BELT

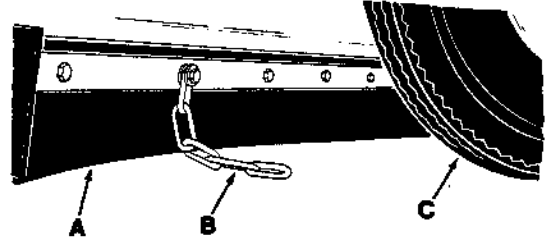
The engine fan belt is driven by the engine crankshaft sheave and drives the engine fan and alternator sheaves. Check and adjust the belt tension after every 200 hours of operation.

To adjust belt tension, loosen the alternator mounting bolts and pull the alternator away from the engine until the belt is snug; then tighten the bolts. Do not use a pry bar on the alternator as it will damage the alternator. Proper belt tension is obtained when the belt deflects 0.5 in (15 mm) from a force of 10 to 12 lb (4 to 5 kg) applied at the midpoint of the longest span.

GOVERNOR BELT

The governor belt on gasoline and LPG powered machines is driven by the crankshaft sheave and spans the fan drive sheave. Check and adjust the belt tension after every 200 hours of operation.

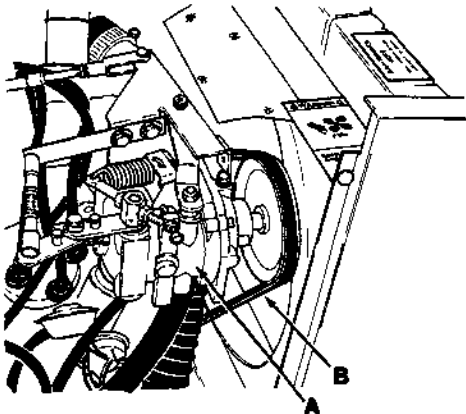
To adjust belt tension, loosen the governor mounting bolts and pull the governor away from the machine until the belt is snug; then tighten the bolts. Do not use a pry bar as it may damage the governor. Proper belt tension is obtained when the belt deflects 0.5 in (15 mm) from a force of 10 to 12 lb (4 to 5 kg) applied at belt midpoint of the longest span.



STATIC DRAG CHAIN

00588

- A. Rear Dust Skirt
- B. Static Drag Chain
- C. Rear Tire



GOVERNOR BELT

02460

- A. Governor
- B. Belt

STATIC DRAG CHAIN

A static drag chain is provided to prevent the buildup of static electricity in the machine. The chain is attached to the machine by a rear brush skirt retaining bolt.

The chain should make contact with the floor at all times.

DEBRIS HOPPER

HOPPER DUST FILTER

The dust filter filters the air which is drawn up from the main brush compartment through the hopper. The dust filter is equipped with a shaker motor to remove the accumulated loose dust particles. The dust filter shaker motor is operated by the filter shaker switch. Shake the dust filter before dumping the hopper and at the end of every work shift. Inspect and clean or replace the dust filter after every 100 hours of operation.

To clean the dust filter, use one of the following methods:

- **TAPPING** - Tap the filter gently on a flat surface with the dirty side down. Do not damage the edges of the filter element or the filter will not seat properly in the filter frame.
- **AIR** - Blow compressed air, 35 psi (240 kPa) maximum, through the dust filter opposite the direction of the arrows. This may be done with the dust filter in the machine. Always wear eye protection when using compressed air.
- **WATER** - Soak the dust filter in a water and mild detergent solution. Rinse the dust filter until it is clean. The maximum water pressure allowable is 40 psi (275 kPa). Air dry the wet dust filter; do not use compressed air.

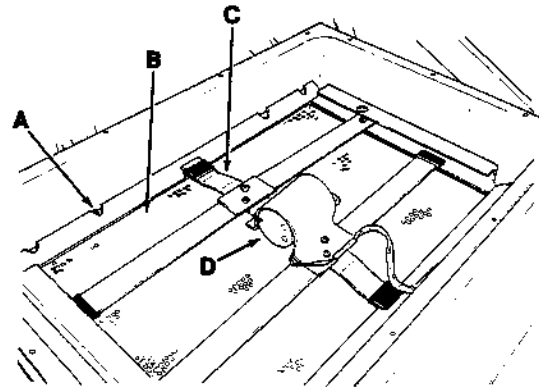
NOTE: Be sure the dust filter is dry before reinstalling it in the machine.

TO REMOVE HOPPER DUST FILTER

1. Stop the engine and engage the machine parking brake.

⚠ WARNING: Always park on a level surface, stop the engine, and engage the parking brake before working on the machine to keep it from creeping or rolling.

2. Release the four hopper cover latches and remove the hopper cover.
3. Disconnect the shaker motor wire connectors.
4. Remove the four shaker frame nuts and shaker frame from the filter frame.



DUST FILTER SHAKER ASSEMBLY

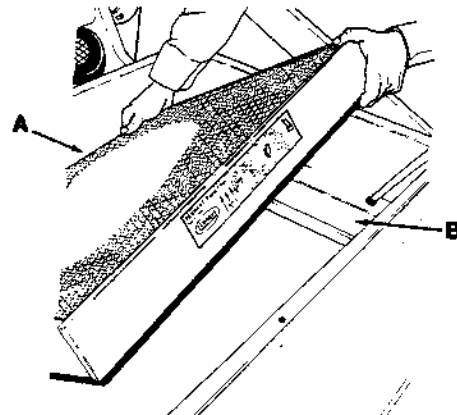
02463

- A. Frame Nut
- B. Dust Filter
- C. Shaker Frame
- D. Filter Shaker Motor

5. Lift the dust filter element out of the dust filter frame.
6. Clean or discard the dust filter as required.

TO INSTALL HOPPER DUST FILTER

1. Place the cleaned or new dust filter in the hopper dust filter frame with the arrows pointing up.



INSTALLING DUST FILTER

02464

- A. Dust Filter
- B. Dust Filter Frame

2. Position the shaker frame on top of the filter frame.
3. Replace and tighten the shaker frame nuts. Reconnect shaker motor wire connectors.
4. Position and secure the hopper cover on the hopper with the cover latches.

DEBRIS HOPPER

The debris hopper collects the debris swept up by the machine. The low dump model hopper has one adjustment — floor clearance. The multi-level dump model hopper has five adjustments: lift linkage, lift cylinder, floor clearance, dump cylinders, and dump door latches. All of the adjustments have been made at the factory and require no regular maintenance. If the hopper components are repaired or replaced, the hopper must be readjusted for best performance.

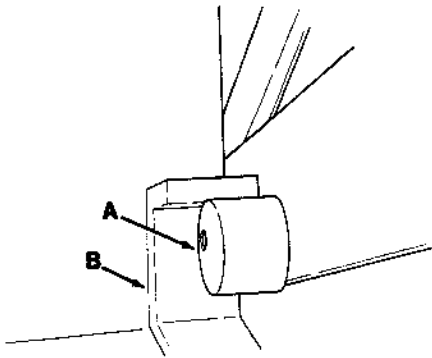
The hopper adjustments must be made in the order given. Make all adjustments with the engine off and parking brake engaged. If the adjustments are made with the hopper raised, be sure to engage the hopper safety support bar.

TO ADJUST LOW DUMP MODEL HOPPER

NOTE: Empty the debris hopper before making adjustments.

1. FLOOR CLEARANCE ADJUSTMENT

- A. Slide a 0.75 to 0.88 in (20 to 25 mm) thick block under each of the rear metal corners of the hopper.
- B. Check and adjust the cams on the lift arms so the hopper brackets rest on the cams.



HOPPER CAM

02479

- A. Cam
- B. Hopper Bracket

TO ADJUST MULTI-LEVEL DUMP MODEL HOPPER

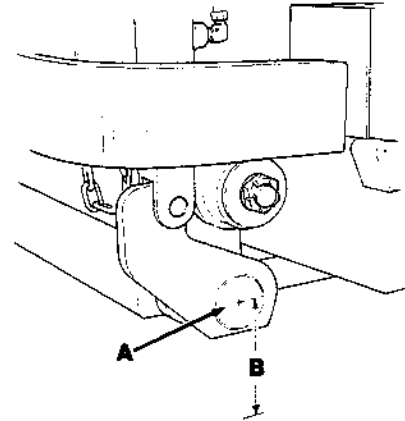
NOTE: Empty the debris hopper before making adjustments.

1. HOPPER LIFT LINKAGE ADJUSTMENT.

- A. Stand clear and cycle the hopper up and down. Watch for signs of binding, sloppiness, or misalignment of the lift arm linkage. Reshim to remove binding, sloppiness, or misalignment of the linkage as necessary.

WARNING: Stand clear of hopper and hopper linkage whenever the hopper is raised or in motion.

- B. Measure the distance from the center of each of the torque shafts to the floor with the hopper in the "operating" position.

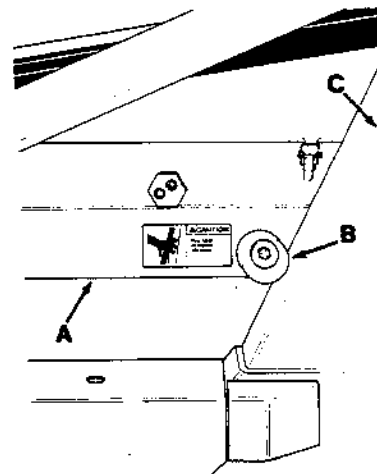


TORQUE SHAFT HEIGHT

00593

- A. Torque Shaft
- B. Measured Distance

The distance measured should be 6.43 ± 0.12 in (160 ± 5 mm). To adjust the height, remove one or both of the splined lift arm cams and rotate it or them until the proper dimension is achieved. The cams must rest on the sloping edge of the lintel.



LIFT ARM CAM

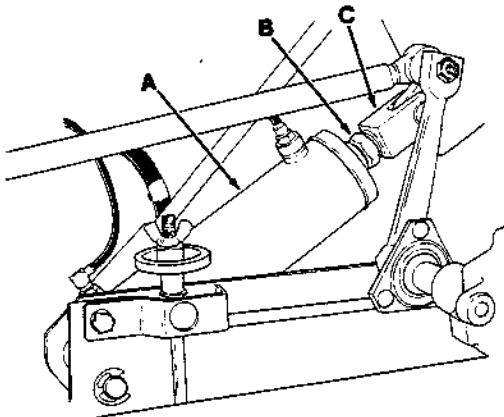
02451

- A. Lift Arm
- B. Lift Arm Cam
- C. Lintel

- C. Tighten the lift arm cam bolt(s).

2. HOPPER LIFT CYLINDER ADJUSTMENT

- A. Loosen the clevis jam nut on the cylinder rod.



HOPPER LIFT CYLINDER

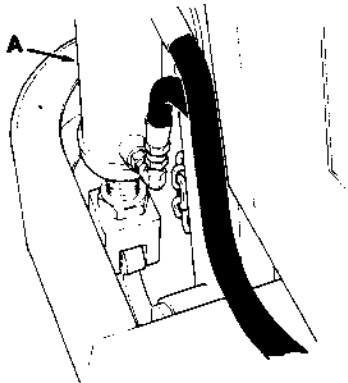
00563

- A. Hopper Lift Cylinder
B. Jam Nut
C. Cylinder Clevis

- B. Adjust the cylinder clevis so the cylinder is fully retracted by inserting a pin through the cylinder rod and rotating it.
C. Tighten the clevis jam nut against the clevis.

3. HOPPER FLOOR CLEARANCE ADJUSTMENT

- A. Remove the clevis pins connecting the clevis of the hopper dump cylinders to the torque arms.



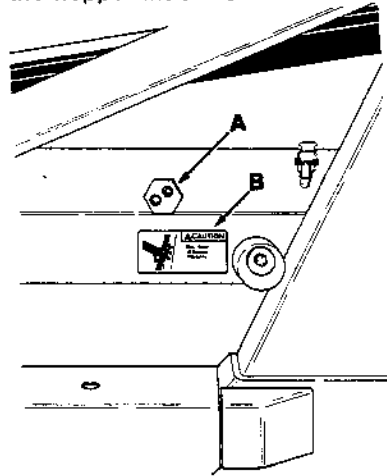
HOPPER DUMP CYLINDER

00595

- A. Hopper Dump Cylinder

- B. Disconnect the dump cylinder clevis ends from the torque arms.
C. Place a 3.43 ± 0.12 in (90 ± 5 mm) block under each of the rear sides of the hopper.

- D. Check and adjust, if necessary, the hexagon hopper cams on each side of the hopper so they contact the top surface of the hopper lift arms.



HEXAGON HOPPER CAM

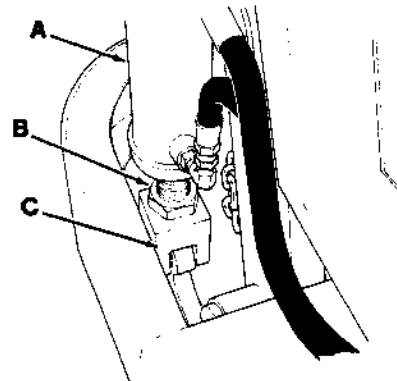
02451

- A. Hexagon Hopper Cam
B. Hopper Lift Arm

- E. Tighten the hexagon hopper cam bolts.
F. Reconnect the dump cylinder clevises to the torque arms with the clevis pins removed earlier.

4. DUMP CYLINDERS ADJUSTMENT

- A. Start the engine and completely retract the dump cylinders.
B. Stop the engine.
C. Loosen the cylinder clevis jam nuts.



HOPPER DUMP CYLINDER

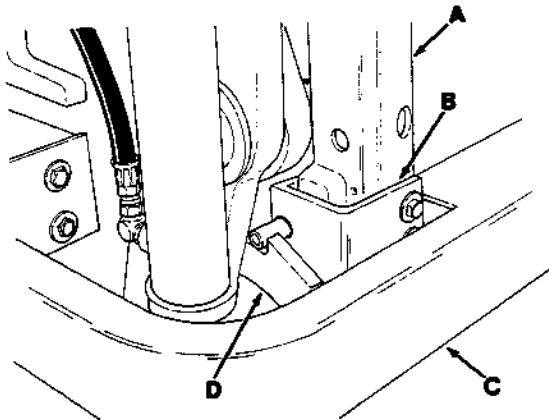
00595

- A. Hopper Dump Cylinder
B. Jam Nut
C. Cylinder Clevis

- D. Adjust the cylinder clevis so the dump cylinder clevis and torque arm, and the clevis pin holes align and allow the clevis pin to pass freely through them.
- E. Tighten the clevis jam nuts.
- F. Secure the clevis pins in place with their retaining rings.

5. DUMP DOOR LATCHES ADJUSTMENT

- A. Start the engine and dump the hopper.
- B. Return the hopper to the "operating" position. Stop the engine.

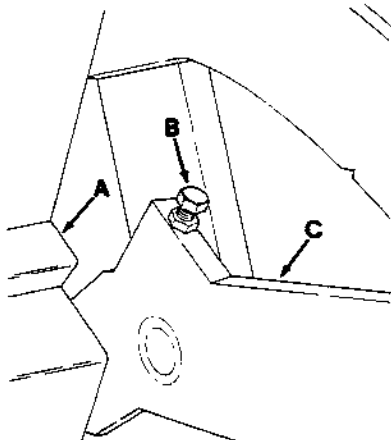


HOPPER DUMP DOOR LATCH

00597

- A. Hopper Door
- B. Latching Bracket
- C. Bumper
- D. Hopper Dump Door Latch

- C. Check the hopper door latches to be sure they are fully engaged and the hopper door is closed tightly. Adjust latching action by adjusting latch stop bolt.



LATCH STOP BOLT

02484

- A. Hopper
- B. Stop Bolt
- C. Lift Arm

- D. Shim the hopper door latching brackets to adjust the hopper door latch engagement and hopper door seal compression.
- E. Start the engine.
- F. Dump the hopper and observe the unlatching of the hopper door. The latches should release at the same time within the first 15° to 20° of hopper rollout. Adjust the latch chain eyebolts if necessary.

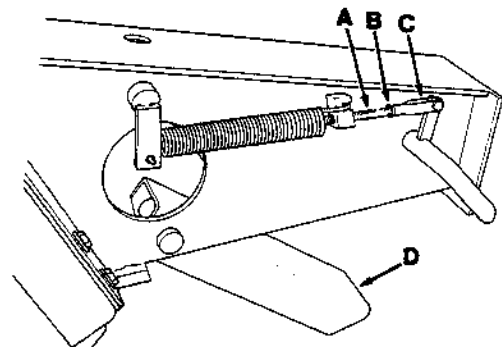
6. STABILIZER LEG

The machine stabilizer leg is a safety device which, when the machine is being high dumped, projects forward to act as an anti-tipping device. It retracts when the hopper is lowered into the "operating" position. Check the stabilizer leg to be sure it is projecting forward when the machine is being high dumped and is fully retracted when the hopper is in the "operating" position. To adjust stabilizer leg:

- A. Raise the hopper, engage the hopper safety support bar, and stop the engine.

WARNING: Always engage the hopper safety bar, before working under a raised hopper. Do not rely on the machine hydraulic system to keep the hopper in the "raised" position. The hydraulic system may leak internally, allowing the hopper to lower, crushing anything under it.

- B. Loosen the clevis jam nut.



STABILIZER LEG

00598

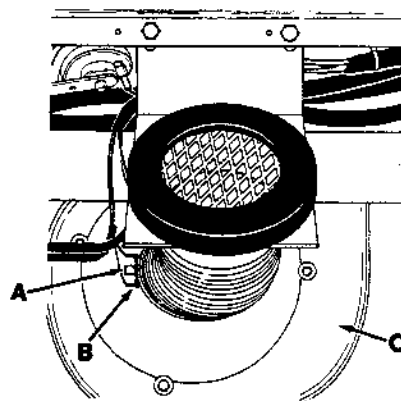
- A. Threaded Rod
- B. Jam Nut
- C. Clevis
- D. Stabilizer Leg

- C. Thread the clevis onto the threaded rod to raise the stabilizer leg or thread the clevis off the threaded rod to lower the stabilizer leg.

- D. Tighten the jam nut against the clevis.
- E. Raise the hopper, disengage the hopper safety bar and lower the hopper.
- F. Check the position of the stabilizer leg. Readjust as required.

THERMO-SENTRY™

The Thermo-Sentry™ is a thermostat that senses the temperature of the air drawn into the vacuum fan from the hopper. It controls the solenoid valve which directs hydraulic fluid to the main brush and vacuum fan motors. In the event of a fire in the hopper, the high air temperature would cause the thermostat to trip, stopping electric current from flowing to the solenoid valve. This would stop the main brush and vacuum fan motors, cutting off air flow to the fire. After the thermostat has tripped, it must be manually reset by pushing in its reset button.



THERMO-SENTRY™

- A. Reset Button**
- B. Thermo-Sentry™**
- C. Vacuum Fan**

02465

BRUSHES

MAIN BRUSH

The main brush is tubular and spans the width of the machine, sweeping debris into the debris hopper. It should be inspected daily for wear or damage. Remove any string or wire found tangled on the main brush, main brush drive hub, or main brush idler hub.

Rotate the main brush end-for-end after every 50 hours of operation for maximum brush life and best sweeping performance.

The main brush pattern should be checked daily. It should be 2 to 2.5 in (50 to 65 mm) wide with the main brush in the "normal" position. Main brush pattern adjustments are made by turning the height adjustment knob behind the side shroud next to the operator's left leg.

The main brush should be replaced when the remaining bristles measure 1.25 in (30 mm) or less in length.

TO REPLACE MAIN BRUSH

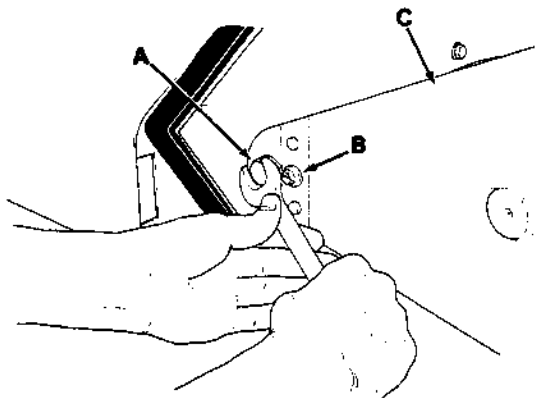
1. Stop the engine and engage the machine parking brake.

⚠ WARNING: Always park on a level surface, stop the engine, and engage the parking brake before working on the machine to keep it from creeping or rolling.

2. Place the main brush position control lever in the "free-float" position.

⚠ CAUTION: Wear gloves to protect your hands when replacing the main brush. Brush bristles and trapped debris may injure hands.

3. Open the right side main brush door.
4. Remove the brush idler arm retaining bolt from the arm hub.



REMOVING BRUSH IDLER ARM

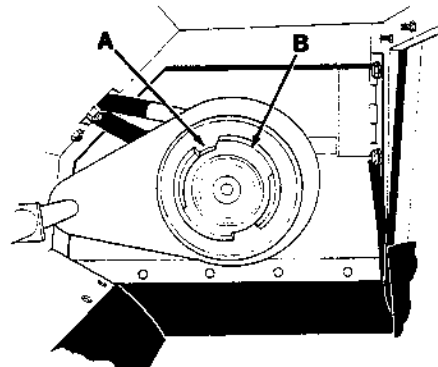
00599

- A. Arm Retaining Bolt
- B. Plastic Screw
- C. Brush Idler Arm

5. Pull the brush idler arm off the arm hub.

NOTE: If the brush idler arm does not come off easily, remove the plastic screw located next to the brush idler arm retaining bolt. Thread the brush idler arm retaining bolt into the threaded hole where the plastic screw was mounted. Tighten the retaining bolt until it forces the brush idler arm loose. Remove the brush idler arm retaining bolt and reinstall the plastic screw.

6. Grasp the main brush; pull it off the brush drive plug and out of the main brush compartment.
7. Place the new or rotated end-for-end main brush on the floor next to the access door.
8. Align the main brush drive slots with the drive keys on the main brush drive.



MAIN BRUSH DRIVE SLOTS

00600

- A. Drive Slot
- B. Brush Drive Hub

9. Slide the main brush into the brush compartment and onto the drive plug. Make sure the drive slots and keys mate.
10. Align the main brush idler plug slots with the main brush keys.
11. Slide the main brush idler plug onto the main brush.
12. Slide the brush idler arm onto the arm hub.
13. Thread the brush idler arm retaining bolt through the idler arm and into the arm hub. Tighten the retaining bolt.
14. Close the right side main brush door.
15. Check and adjust the main brush pattern as described in To Check and Adjust Main Brush Pattern.

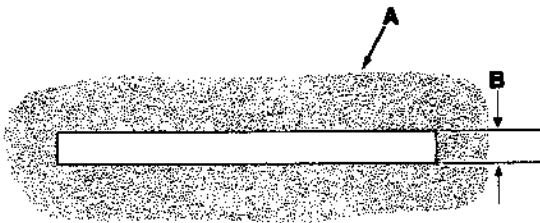
TO CHECK AND ADJUST MAIN BRUSH PATTERN

1. Apply chalk, or some other material that will not blow away easily, to a smooth, level floor.

2. With the side brush and main brush position control levers in the "up" and "raise" positions, position the main brush over the chalked area.
3. Place the hopper lift and side brush control lever, and the main brush and vacuum fan control switch in the "on" positions.
4. Place the main brush position control lever in the "normal" position for 15 to 20 seconds while keeping a foot on the brakes to keep the machine from moving. This will lower the rotating main brush.
5. Place the main brush position control lever in the "raise" position.

NOTE: If chalk or other material is not available, allow the brushes to spin on the floor for two minutes. A polish mark will remain on the floor.

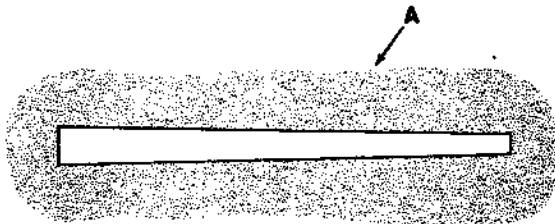
6. Drive the machine off the test area.
7. Observe the width of the brush pattern. The proper brush pattern width is 2 to 2.5 in (50 to 65 mm).



NORMAL MAIN BRUSH PATTERN

00582

- A. Main Brush Pattern
- B. 2 to 2.5 in (50 to 65 mm)



TAPERED MAIN BRUSH PATTERN

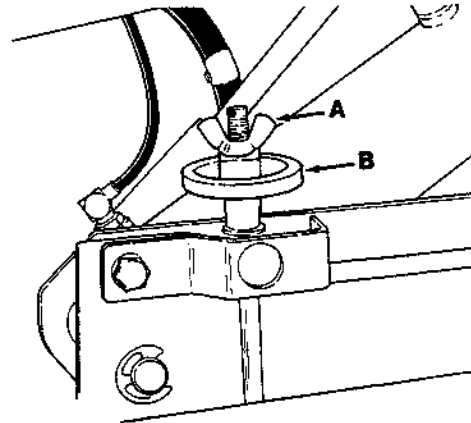
00601

- A. Main Brush Pattern

If the main brush pattern is tapered on a flat, level surface, loosen the main brush left cross shaft bearing mounting brackets and the bearing flanges. Pivot the bearing mounting bracket to level the cross shaft. Tighten the bearing mounting bracket and the bearing flanges. Check the main brush pattern and readjust as necessary. Then adjust the width of the main brush pattern.

To widen the main brush pattern, loosen the locking wing nut and turn the adjustment knob counterclockwise from the top. To reduce the width of the main brush pattern, loosen the locking wing nut and turn the adjustment knob clockwise from the top.

Tighten the locking wing nut and recheck the main brush pattern. Repeat the procedure until the main brush pattern is within the specified range.



00563

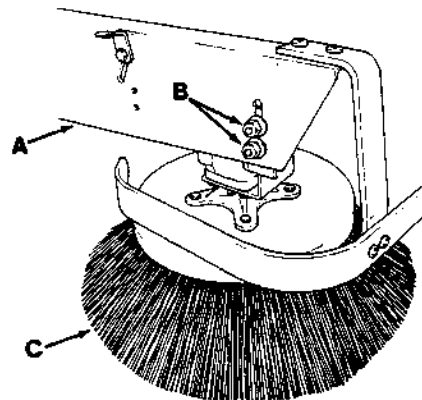
MAIN BRUSH HEIGHT ADJUSTMENT KNOB

- A. Wing Nut
- B. Height Adjustment Knob

SIDE BRUSH

The side brush sweeps debris from curbs or gutters into the path of the main brush. It should be inspected daily for wear or damage. Remove any string or wire found tangled on the side brush or side brush drive hub.

The side brush pattern should be checked daily. Between one-third and one-half of the side brush bristles should contact the floor when the brush is in motion. The side brush pattern adjustment on low dump model machines is made by loosening the two nuts on the side brush arm, repositioning the side brush assembly, and retightening the nuts.

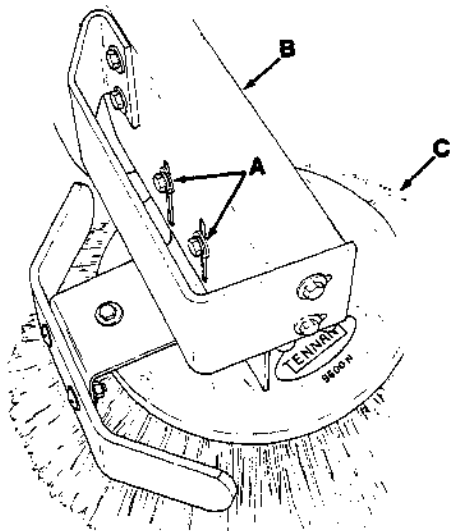


SIDE BRUSH ADJUSTMENT NUTS

02485

- A. Side Brush Arm
- B. Nut
- C. Side Brush

The side brush pattern adjustment on multi-level dump model machines is made by loosening the two bolts on the side brush arm, repositioning the side brush assembly, and retightening the bolts.



SIDE BRUSH ADJUSTMENT BOLTS

00603

- A. Bolt
- B. Side Brush Arm
- C. Side Brush

The side brush should be replaced when the remaining brush bristle measures 2.5 in (65 mm) in length.

TO REPLACE SIDE BRUSH

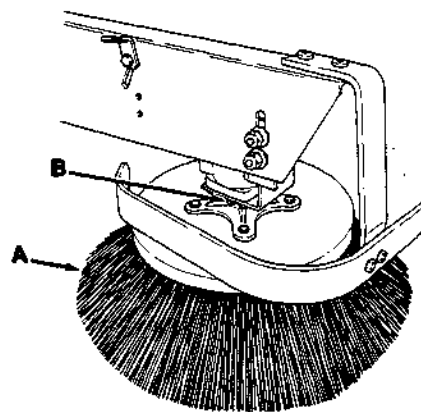
1. Empty the debris hopper.
2. Raise the hopper, engage the hopper safety support bar, and lower the hopper onto the support bar.

⚠ WARNING: Always engage the hopper safety support bar before working under a raised hopper. Do not rely on the machine hydraulic system to keep the hopper in the "raised" position. The hydraulic system may leak internally, allowing the hopper to lower, crushing anything under it.

3. Stop the engine and engage the machine parking brake.

⚠ WARNING: Always park on a level surface, stop the engine, and engage the parking brake before working on the machine to keep it from creeping or rolling.

4. Place the side brush position control lever in the "up" position.
5. Remove the side brush retaining bolt from the side brush hub and shaft.



SIDE BRUSH

02485

- A. Side Brush
- B. Retaining Bolt

6. Slide the side brush off the side brush drive shaft.
7. Slide the new side brush onto the side brush drive shaft.
8. Insert the side brush retaining bolt through the side brush hub and shaft.
9. Thread a nut onto the threads of the bolt. Tighten the nut and bolt to secure the side brush.
10. Adjust the side brush height as described in Side Brush Height Adjustment.
11. Disengage the hopper safety support bar and lower the hopper.

SKIRTS AND SEALS

HOPPER LIP SKIRTS

The hopper lip skirts are located on the bottom rear of the hopper. They float over debris and help deflect that debris into the hopper. The hopper lip skirts are made up of five bottom lip segments and two additional side lip segments on multi-level dump model machines.

The hopper lip skirts should be inspected for wear or damage daily.

TO REPLACE HOPPER LIP SKIRTS

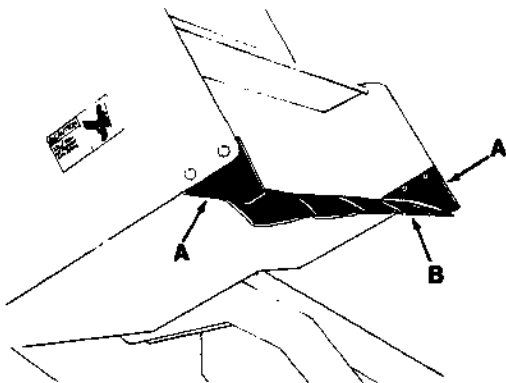
1. Empty the machine debris hopper.
2. Stop the machine on a level surface and engage the machine parking brake.
3. Raise the hopper, engage the hopper safety support bar, and lower the hopper onto the hopper safety support bar.

⚠ WARNING: Always engage the hopper safety support bar before working under a raised hopper. Do not rely on the machine hydraulic system to keep the hopper in the "raised" position. The hydraulic system may leak internally, allowing the hopper to lower, crushing anything under it.

4. Stop the engine.

⚠ WARNING: Always park on a level surface, stop the engine, and engage the parking brake before working on the machine to keep it from creeping or rolling.

5. Remove the hopper lip retaining strip mounting bolts.



HOPPER LIP SKIRTS

- A. Hopper Lip Side Skirt
- B. Hopper Lip Skirts

00604

6. Remove the hopper lip retaining strip and worn or damaged hopper lip.
7. Thread the retaining strip mounting bolts through the retaining strip, the hopper lip segment, and into the hopper.
8. Tighten the mounting bolts.
9. Start the engine.
10. Raise the hopper, lower the hopper safety support bar, and lower the hopper.
11. Stop the engine.

BRUSH DOOR SKIRTS

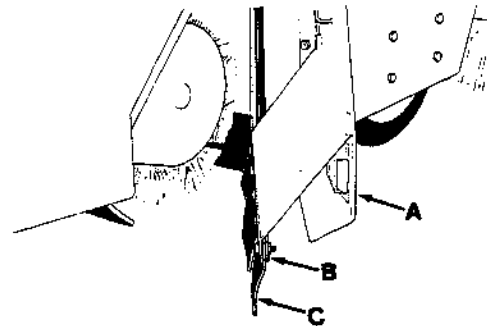
The brush door skirts are located on the bottom of each of the two main brush doors. They seal the main brush compartment. The skirts should be inspected for wear or damage and adjustment daily.

TO REPLACE AND ADJUST BRUSH DOOR SKIRTS

1. Stop the machine on a smooth, level surface.
2. Stop the engine and engage the machine parking brake.

⚠ WARNING: Always park on a level surface, stop the engine, and engage the parking brake before working on the machine to keep it from creeping or rolling.

3. Open the main brush doors.
4. Remove the brush door skirt retaining bolts.



BRUSH DOOR SKIRT

00570

- A. Brush Door
- B. Skirt Retaining Strip
- C. Brush Door Skirt

5. Remove the skirt retaining strip and the door skirt.
6. Position the new door skirt and skirt retaining strip on the brush door.

7. Thread the skirt retaining bolts through the brush door, the door skirt, and into the skirt retaining strip.

NOTE: The brush door skirts have slotted holes to allow for a ground clearance adjustment. The door must be closed for proper adjustment.

8. Slide the brush door skirt up or down so that the skirt clears the floor 0.12 to 0.25 in (3 to 6 mm).
9. Tighten the skirt retaining bolts.
10. Close the brush doors.

REAR SKIRTS

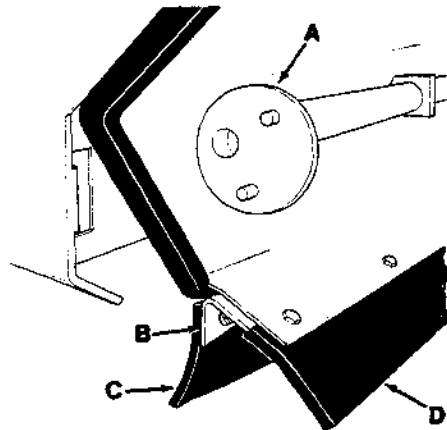
The rear skirts are located on the bottom rear of the main brush compartment. They seal the main brush compartment. The seals should be inspected for wear or damage and adjustment daily.

TO REPLACE AND ADJUST THE REAR SKIRTS

1. Stop the machine on a smooth, level surface.
2. Stop the engine and engage the machine parking brake.

⚠ WARNING: Always park on a level surface, stop the engine, and engage the parking brake before working on the machine to keep it from creeping or rolling.

3. Open the main brush doors.
4. Remove the main brush as described in To Replace Main Brush.



REAR SKIRTS

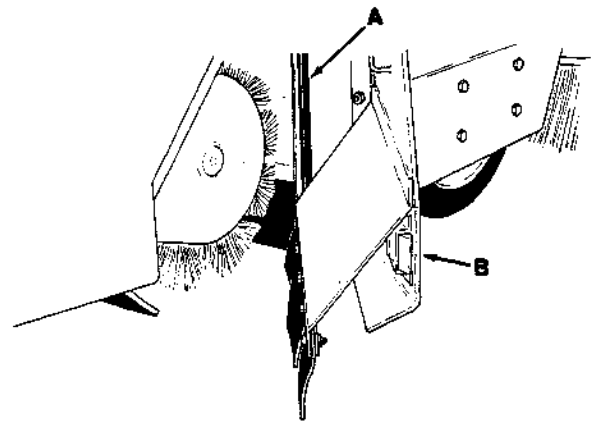
- A. Brush Idler Arm Hub
- B. Skirt Mounting Bracket
- C. Rear Floor Skirt
- D. Brush Contact Skirt

00606

5. Remove the skirt mounting bracket and the brush contact skirt.
6. Remove the rear floor skirt from the skirt mounting bracket.
7. Thread the rear floor skirt retaining strip mounting bolts through the retaining strip, the new rear floor skirt, and into the skirt mounting bracket.
8. Do not tighten the mounting bolts at this time.
9. Thread the retaining bolts through the skirt mounting bracket, the brush contact skirt, and into the machine frame.
10. Tighten the retaining bolts.
11. Slide the rear floor skirt up or down so that the skirt clears the floor 0.12 to 0.25 in (3 to 6 mm).
12. Tighten the rear floor skirt mounting bolts.
13. Reinstall the main brush.

MAIN BRUSH DOOR SEALS

The main brush door seals are located on both main brush doors and on corresponding portions of the main frame. They seal the main brush compartment. The seals should be inspected for wear or damage after every 100 hours of operation.



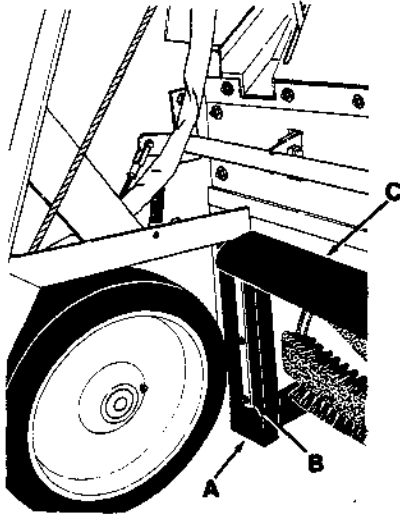
BRUSH ACCESS DOOR SEALS

00570

- A. Door Seals
- B. Brush Access Door

HOPPER SEALS

The hopper seals are located on the top and side portions of the machine frame which contacts the hopper. They seal the main brush compartment. The seals should be inspected for wear or damage after every 100 hours of operation.



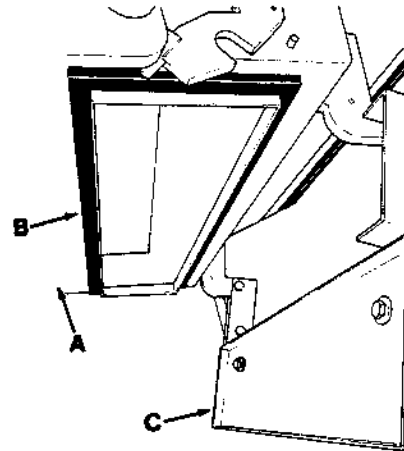
HOPPER SEALS

- A. Side Seal
- B. Seal Retaining Strip
- C. Top Seal

02457

HOPPER DOOR SEALS

The hopper door seals are located around the hopper door opening on multi-level dump model machines. They seal the hopper door. The seals should be checked for wear or damage after every 100 hours of operation.



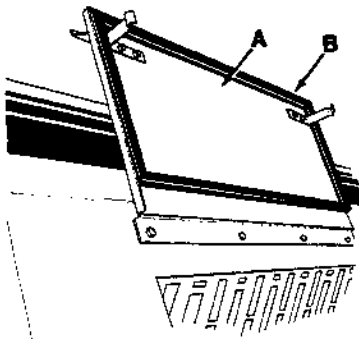
HOPPER DOOR SEALS

- A. Hopper
- B. Seal
- C. Hopper Door

02481

HOPPER INSPECTION DOOR SEAL

The hopper inspection door seal is located on the hopper inspection door on low dump model machines. It seals the front of the debris compartment. The seal should be checked for wear or damage after every 100 hours of operation.



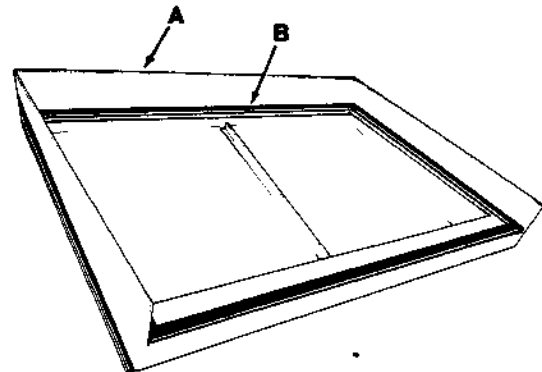
HOPPER INSPECTION DOOR SEAL

- A. Hopper Inspection Door
- B. Door Seal

02480

HOPPER COVER SEAL

The hopper cover seal is located on the top edges of the hopper. It seals the hopper filter compartment. The seal should be checked for wear or damage after every 100 hours of operation.



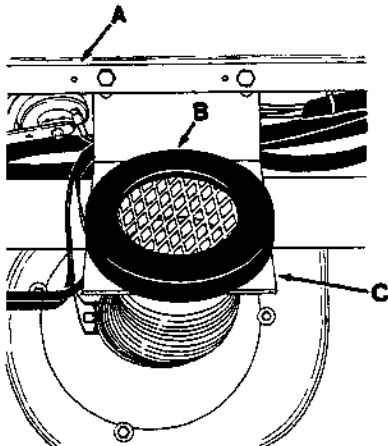
HOPPER COVER SEAL

- A. Hopper Cover
- B. Cover Seal

02482

HOPPER VACUUM FAN SEAL

The hopper vacuum fan seal is mounted to the lintel on multi-level dump model machines. It seals the hopper filter compartment to the vacuum fan intake bracket. The seal should be checked for wear or damage after every 100 hours of operation. Check to make sure that the seal is making good contact with the hopper. The seal should be compressed 0.12 in (5 mm) by the contact.



HOPPER VACUUM FAN SEAL

02465

- A. Lintel
- B. Seal
- C. Bracket

To adjust seal contact, loosen the vacuum fan intake bracket mounting bolts. Pivot the bracket into the correct position and retighten the bolts.

BRAKES AND TIRES

SERVICE BRAKES

The mechanical service brakes are located on the front wheels. They are operated by the foot brake pedal and connecting linkages.

The brake pedal should not travel more than 1 in (25 mm) to fully engage the brakes. Blow the accumulated dirt from between the brake shoes and the hub with compressed air through the slots on the side wheel pockets. Check the brake adjustment after every 200 hours of operation.

TO ADJUST BRAKE LINKAGE

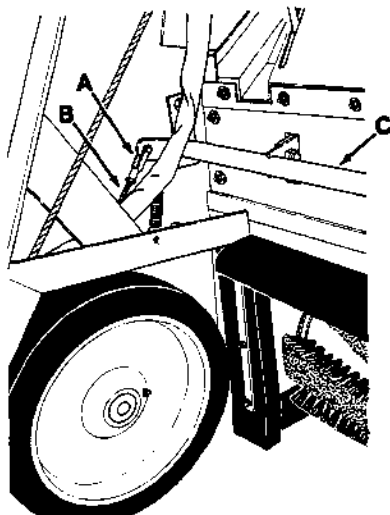
1. Empty the debris hopper.
2. Raise the hopper, engage the hopper safety support bar, and lower the hopper onto the support bar.

⚠ WARNING: Always engage the hopper safety support bar before working under a raised hopper. Do not rely on the machine hydraulic system to keep the hopper in the "raised" position. The hydraulic system may leak internally, allowing the hopper to lower, crushing anything under it.

3. Stop the engine and block the machine tires.

⚠ WARNING: Always park on a level surface, stop the engine, and block the tires before working on the machine to keep it from creeping or rolling when adjusting the brakes.

4. Remove the clevis pins from the left and right side brake clevises.



BRAKE CLEVIS

02457

- A. Brake Adjusting Clevis
- B. Threaded Rod
- C. Brake Cross Shaft

5. Thread the clevis out to decrease brake pedal height, or in to increase brake pedal height. Both clevises must be turned the same amount.
6. Adjust the brake linkage so that the brake pedal travels no more than 1 in (25 mm) to fully engage the brakes. If the brake pedal travels more than 1 in (25 mm), it indicates the brake clevises are not adjusted the same. Readjust as necessary.
7. Reinstall the brake clevis pins.
8. Start the engine and raise the hopper.
9. Lower the hopper safety bar.
10. Lower the hopper and stop the engine.
11. Remove the machine tire blocks.

PARKING BRAKES

The parking brakes are engaged by the parking brake lever which activates the service brake linkage.

The parking brakes should be adjusted whenever it becomes very easy to engage the parking brake, when the machine rolls after engaging the parking brake, and after every 200 hours of operation. The parking brake may be routinely tightened by turning the knurled knob on the end of the parking brake clockwise. If the knob adjustment is inadequate, fully loosen the knob and adjust the brake linkage as described in To Adjust Brake Linkage. Adjust the parking brake so it will hold the machine on a smooth 8° ramp.

TIRES

The standard front machine tires are solid.

The standard rear machine tire is pneumatic.

Check the tire pressure after every 100 hours of operation. The proper tire air pressure is 80 ± 5 psi (550 ± 35 kPa). When the machine is equipped with a scrub attachment, the proper air pressure is 70 ± 5 psi (480 ± 35 kPa).

A solid rear tire is available as an accessory.

SCRUB ATTACHMENT

SCRUB ATTACHMENT

The scrub attachment accessory gives the machine the added flexibility to scrub floors. It consists of three groups of parts - the scrub attachment, the side scrub brush and squeegee, and the rear squeegee. The scrub attachment includes two solution tanks, a solution distribution system, three scrub brushes, a recovery tank, and a debris hopper.

SOLUTION TANKS

The two solution tanks supply the scrub brush with a water and detergent solution. They are located in the top right and left sides of the scrub attachment.

Access to the tanks is through the solution tank covers on the top of the scrub attachment.

The solution tanks require no regular maintenance. If detergent cakes on the bottom of the tank, remove the deposits with a strong blast of water.

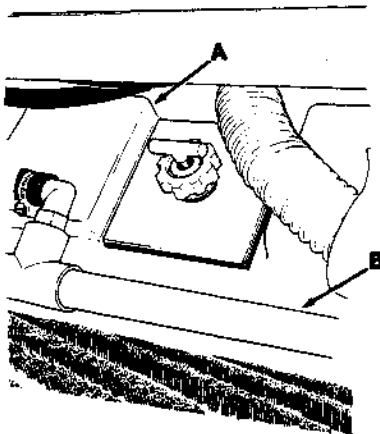
SOLUTION DISTRIBUTION SYSTEM

The solution distribution system consists of feed lines from the solution tanks to an on-off solenoid valve, to a cable controlled flow-rate valve, then to a solution spreader tube.

The solution spreader tube distributes scrub solution to the scrub brushes. It may be flushed out if it becomes clogged with soap or other debris. A drain plug is located on each end of the spreader tube.

Before cleaning the solution spreader tube, make sure that the cable controlled flow-rate valve is opening fully when the solution flow control knob is pulled out.

A brush and hot water may be needed to remove stubborn clogs. A sharp instrument may be used to clear the small distribution holes in the spreader tube.



SPREADER TUBE

- A. Recovery Tank
- B. Spreader Tube

02769

SCRUB BRUSHES

Three scrub brushes are utilized by the scrub attachment - the side brush, the main brush, and a scrub brush located in the scrub attachment. The side brush scrubs and deflects debris into the path of the scrub brush. The scrub brush scrubs and deflects debris backward, the main brush scrubs and deflects debris into the debris hopper.

The brushes should be inspected daily for damage or wear. Remove any string or wire found tangled on the scrub brushes, drive, or idler hubs.

Replace the scrub brushes when the brush bristle is 0.5 in (15 mm) or less in length. To replace the side brush, see To Replace Side Brush. To replace the scrub brush, see To Replace Scrub Brush. To replace the main brush, see To Replace Main Brush.

The scrub brush patterns should be checked daily. They should be 2 to 3 in (50 to 75 mm) wide. The scrub brush pattern is adjusted by changing the position of the clevis on the threaded stud of the lift linkage. See To Check and Adjust Scrub Brush Pattern.

TO REPLACE SCRUB BRUSH

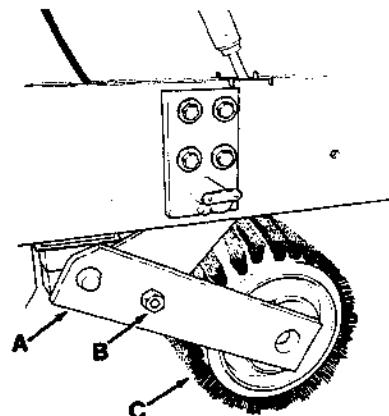
1. Start the engine, raise the scrub attachment, and engage the hopper safety support bar.

⚠ WARNING: Always engage the hopper safety bar before working under a raised hopper. Do not rely on the machine hydraulic system to keep the hopper in the "raised" position. The hydraulic system may leak internally, allowing the hopper to lower, crushing anything under it.

2. Stop engine and engage parking brake.

⚠ WARNING: Always park on a level surface, stop the engine, and engage the parking brake before working on the machine to keep it from rolling.

3. Remove the brush idler arm nut.

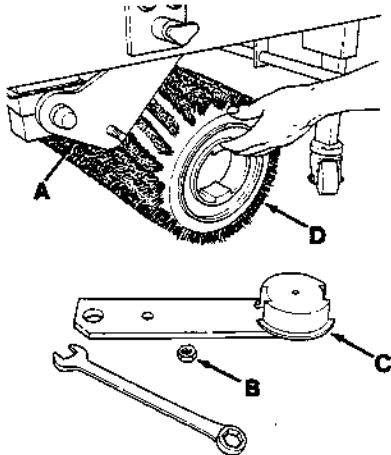


IDLER ARM

- A. Idler Arm
- B. Nut
- C. Scrub Brush

02778

4. Pull the brush idler arm off the arm bracket.
5. Pull the scrub brush off the drive hub.



REMOVING SCRUB BRUSH

02770

- A. Bracket
- B. Nut
- C. Idler Arm
- D. Scrub Brush

6. Align the scrub brush drive slots with the drive keys on the drive nuts.
7. Slide the scrub brush onto the drive hub.
8. Slide the idler hub onto the scrub brush and arm bracket.
9. Secure the idler arm with nut.
10. Check and adjust scrub brush pattern as described in To Check and Adjust Scrub Brush Pattern.

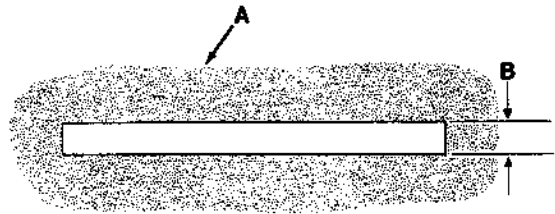
TO CHECK AND ADJUST SCRUB BRUSH PATTERN

1. Apply chalk, or some other material that will not blow away easily, on a smooth, level floor.
2. With the scrub brush position control lever in the "raised" position, move the scrub attachment over the test area. Engage the parking brake.
3. Place the main brush and vacuum fan control switch in the "on" position.
4. Place the scrub brush position control lever in the "normal" position for 15 to 20 seconds, then return the lever to the "raised" position.

NOTE: If no chalk or other material is available, allow the brushes to spin approximately two minutes.

5. Place the main brush and vacuum fan control switch in the "off" position.
6. Release the parking brake and remove the machine from the test area.

7. The scrub brush pattern should be 2 in (50 mm) across the full length of the brush.

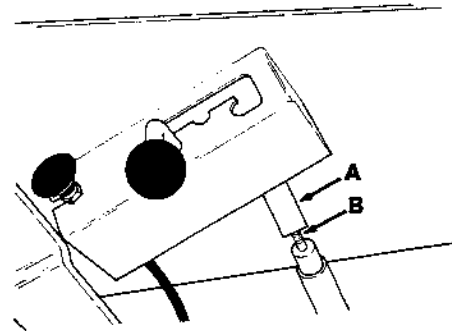


NORMAL SCRUB BRUSH PATTERN

00582

- A. Scrub Brush Pattern
- B. 2 in (50 mm)

To adjust the width of the pattern, adjust the position of the lift linkage clevis on the threaded stud. Thread the stud into the clevis to decrease the width. Thread the stud out of the clevis to increase the width.

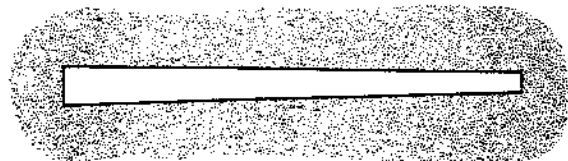


LIFT LINKAGE

02747

- A. Clevis
- B. Stud

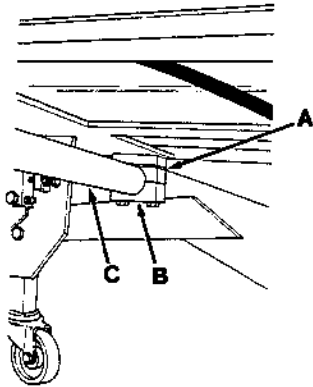
If the brush pattern is tapered more than 0.25 in (5 mm), the scrub brush must be checked to see if it is cone shaped.



TAPERED SCRUB BRUSH PATTERN

00601

If the brush is not cone shaped, the scrub brush drive mechanism must be leveled by adding or removing shims between the scrub brush cross shaft bearing blocks and the scrub attachment frame.



CROSS SHAFT SHIM

02771

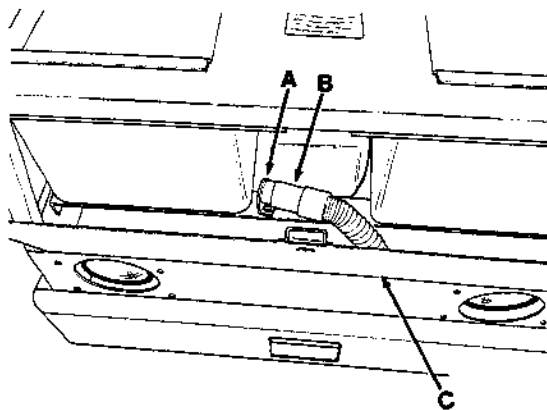
- A. Shim
- B. Bearing Block
- C. Cross Shaft

RECOVERY TANK

The machine recovery tank stores the water solution picked up by the machine squeegee and vacuum fan. The recovery tank is located under the solution tanks.

The recovery tank should be drained after the solution tank is empty and whenever the ball float rises and stops the water vacuum.

To drain the recovery tank, stop the engine, engage the parking brake, open the front access door, and remove the drain hose from its retention plug. Lower the hose to a floor drain to drain the tank. The tank will not empty with the vacuum fan operating. Clean the recovery tank after every work shift.

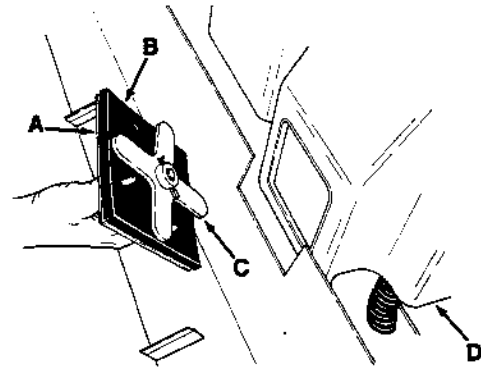


DRAIN HOSE

02748

- A. Retention Plug
- B. Drain Hose
- C. Front Access Door

Two clean-out doors have been provided to make the tank cleaning job easier. One door is located at the rear of the recovery tank. The other door is located at the front of the recovery tank. To open the clean-out doors, loosen the lock knob, turn the door handle, and pull the door away from the recovery tank. To close the clean-out doors, position the door against the recovery tank, turn the door handle so the four fingers line up behind the tank wall, and tighten the lock knob.



REAR CLEAN-OUT DOOR

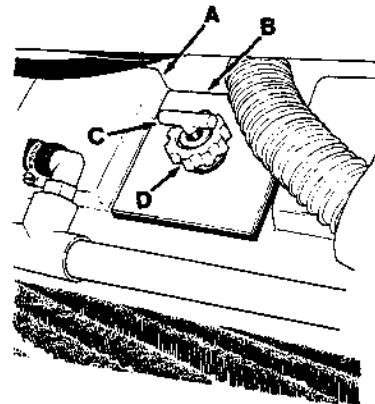
02772

- A. Clean-Out Door
- B. Door Seal
- C. Door Fingers
- D. Recovery Tank

Spray the inside of the tank with clean water. Remove all sludge and debris from the bottom of the tank, out the clean-out doors.

Spray the ball float. Make sure the float guides are free of dirt and debris which may cause the float to stick.

Keep vacuum hoses and nozzles clean. Clogged hoses are a common cause of poor water pickup.



FRONT CLEAN-OUT DOOR

02769

- A. Recovery Tank
- B. Clean-Out Door
- C. Door Handle
- D. Lock Knob

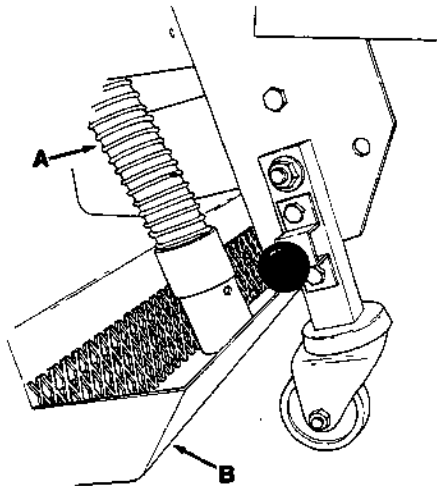
DEBRIS HOPPER

The debris hopper collects debris picked up by the scrub brushes. It is located behind the scrub brushes.

A vacuumized debris screen is located on the bottom of the debris hopper to draw water solution out of the debris collected in the hopper.

The debris hopper should be emptied whenever the recovery tank is drained. It should be sprayed clean daily.

To empty the debris hopper, raise the scrub attachment with the hopper lift and side brush control lever. The debris will empty as the unit is lifted and tilted back.

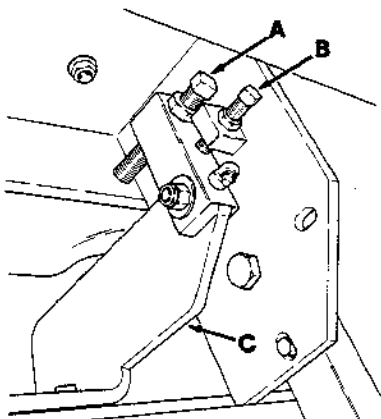


DEBRIS HOPPER

- A. Vacuum Hose
- B. Debris Hopper

02754

The debris hopper is mounted by two pivoting points to allow it to float over large debris. It is equipped with float limiters. The lower limit bolt should be adjusted so the hopper has 0.3 in (10 mm) clearance with the floor. The upper limit bolt should be set so the hopper will travel up to a maximum of 1 in (25 mm) clearance.



DEBRIS HOPPER LIMIT BOLTS

- A. Lower Limit Bolt
- B. Upper Limit Bolt
- C. Debris Hopper

02764

SIDE SQUEEGEE

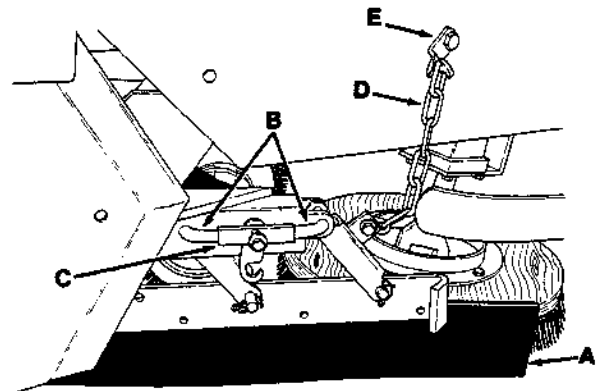
The side squeegee controls water spray and channels water into the path of the rear squeegee. Check the side squeegee for damage, wear and adjustment daily. Replace the squeegee blade whenever it becomes damaged or loses its shape or resiliency.

TO REPLACE SIDE SQUEEGEE BLADE

1. Stop the engine and engage the machine's parking brake.

WARNING: Always park on a level surface, stop the engine, and engage the parking brake before working on the machine to keep it from rolling.

2. Disconnect the squeegee assembly chain from the chain hook.



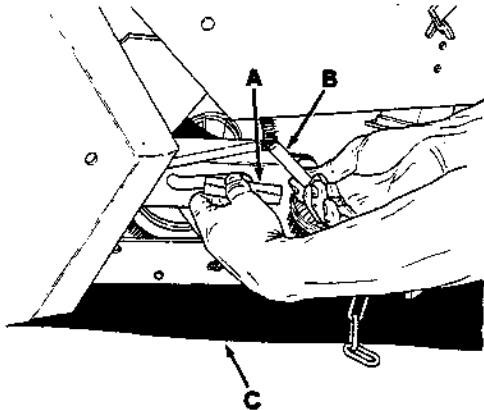
SIDE SQUEEGEE ASSEMBLY

02758

- A. Squeegee Blade
- B. Retaining Pin
- C. Pin Keeper
- D. Chain
- E. Hook

3. Pull the pin keeper out and remove the two squeegee assembly retaining pins. Release the pin keeper.
4. Slide the squeegee assembly out of the machine.
5. Remove the five squeegee retaining bolts from the squeegee assembly.
6. Remove the squeegee blade from the squeegee frame.
7. Position a new squeegee blade on the squeegee frame.
8. Secure the blade with the blade retainer and retaining bolts.

9. Slide the squeegee assembly into position in the squeegee bracket.
10. Slide the two squeegee retaining pins through the bracket and squeegee assembly.



02757

SECURING SQUEEGEE RETAINING PINS

- A. Pin Keeper
- B. Pin
- C. Squeegee Assembly

11. Pull the pin keeper out, turn the squeegee retaining pins so they are under the pin keeper, and release the keeper.
12. Connect the squeegee assembly chain to the chain hook.

REAR SQUEEGEE

The rear squeegee assembly channels water into the vacuum fan suction. The front squeegee blade channels the water, and the rear blade wipes the floor. Check the rear squeegee assembly for damage, wear, and adjustment daily.

Rotate or replace the front or rear blade of the rear squeegee if its leading edge is worn one-half of the way through the thickness of the blade.

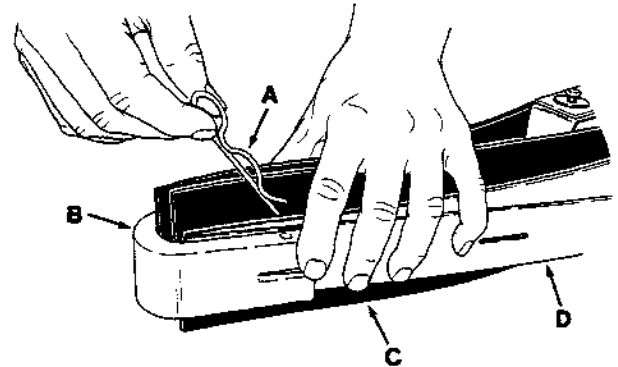
Each front and rear blade has four wiping edges. To use them all, start with one wiping edge. To use the next wiping edge, swap the squeegee end-for-end. To use the next wiping edge, rotate the top edges down, bottom edges up. To use the last edge, swap the squeegee end-for-end. Replace the back-up strips if they become damaged, or if they lose their resiliency.

TO REPLACE OR ROTATE REAR BLADE

1. Pull the squeegee control lever into the "lower" position.
2. Stop the engine and engage the machine parking brake.

WARNING: Always park on a level surface, stop the engine, and engage the machine parking brake before working on the machine to keep it from rolling.

3. Remove the four squeegee end pins to each side from the end brackets. Remove the end brackets.

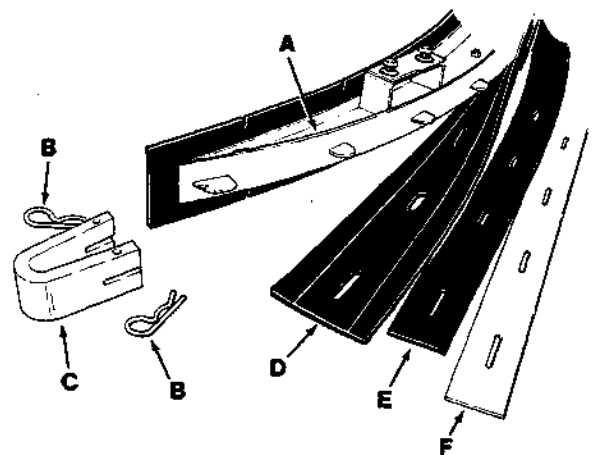


REMOVING END PINS

02773

- A. Pin
- B. End Bracket
- C. Squeegee Blade
- D. Band

4. Open the rear band clamp and remove the squeegee back-up strip and the squeegee blade.
5. Replace or rotate the rear blade to allow a new edge of the blade to face the front of the machine.



DISASSEMBLED REAR SQUEEGEE

02774

- A. Frame
- B. Pin
- C. End Bracket
- D. Blade
- E. Back-Up Strip
- F. Band

6. Place the squeegee blade over the pins of the squeegee frame.
7. Place the squeegee back-up strip on the pins.
8. Position the squeegee retaining bands over the back-up strip.
9. Latch the retaining band clamp.

NOTE: Make sure the band is snug to the squeegee and back-up strips - adjust if necessary.

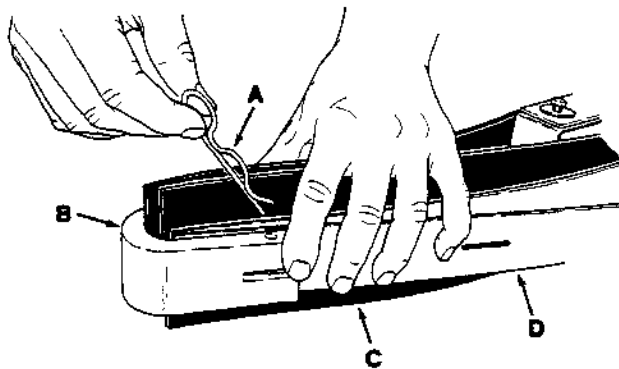
10. Replace the end brackets. Secure with the end pins.
11. Adjust the rear squeegee as described in To Adjust Rear Squeegee.

TO REPLACE OR ROTATE FRONT BLADE

1. Stop the engine and engage the machine parking brake.

WARNING: Always park on a level surface, stop the engine, and engage the parking brake before working on the machine to keep it from rolling.

2. Pull the squeegee control lever into the "lower" position.
3. Disconnect the rear squeegee suction hose from the squeegee frame.
4. Loosen the four squeegee frame bolts and slide the squeegee assembly off the squeegee caster platforms.
5. Remove the four squeegee end pins, two each side, from the end brackets. Remove the end brackets.

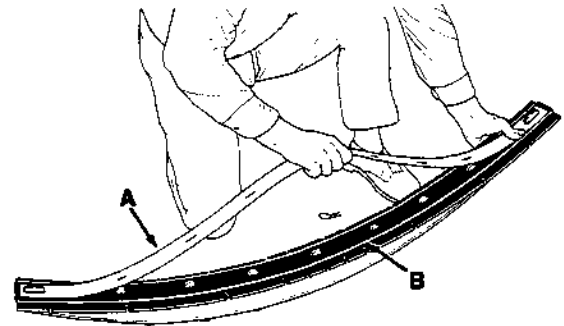


REMOVING END PINS

02773

- A. Pin
- B. End Bracket
- C. Squeegee Blade
- D. Band

6. Remove the center pin from the center of the front retaining band.
7. Pull the retaining band, back-up strip, and squeegee blade off the squeegee frame.
8. Replace or rotate the front blade to allow a new edge of the blade to face the front of the machine.
9. Place the squeegee blade over the pins on the squeegee frame.
10. Place the back-up strip on the pins.
11. Position the ends of the retaining band in the slots at the ends of the squeegee frame.
12. Press the center of the retaining band into place.

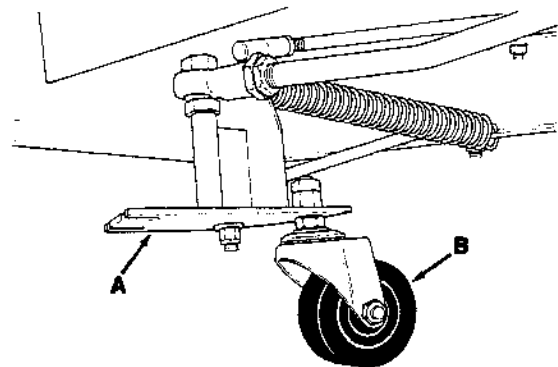


INSTALLING RETAINING BAND

02775

- A. Retaining Band
- B. Squeegee

13. Secure the retaining band with the center pin removed earlier.
14. Replace the end brackets. Secure with the end pins.
15. Slide one end of the squeegee frame onto its caster platform. Tighten its two bolts.



CASTER PLATFORM

02776

- A. Platform
- B. Caster

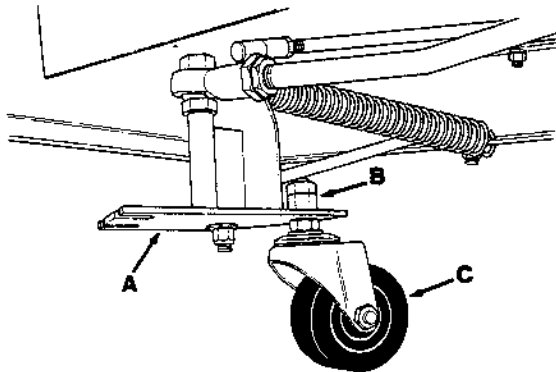
16. Slide the other end of the squeegee assembly onto its caster platform. Tighten its two bolts.
17. Reconnect the squeegee suction hose to the squeegee frame.

TO CHECK AND ADJUST REAR SQUEEGEE

1. Start the engine.
2. Lower the squeegee and move the machine forward.
3. Stop the engine and engage the machine parking brake.

⚠ WARNING: Always park on a level surface, stop the engine, and engage the parking brake before working on the machine to keep it from rolling.

4. Check the squeegee. It should contact the floor evenly side-to-side and deflect 0.5 in (10 mm). If not, continue with step 5.
5. Disconnect the rear squeegee suction hose from the squeegee frame.
6. Loosen the four rear squeegee mounting bolts and slide the squeegee assembly off the squeegee caster platforms.
7. Loosen and oil the caster mounting nuts. Thread both caster studs into the caster platforms to loosen them for easier adjustment.



SQUEEGEE CASTER

02776

- A. Platform
- B. Nut
- C. Caster

8. Replace the squeegee assembly on the squeegee frame.

NOTE: The squeegee blades must be new or have a new wiping edge contacting the floor to correctly adjust the squeegee.

9. Place the squeegee control lever in the "lower" position.
10. Adjust the four squeegee links so the squeegee is making even contact with the floor. To lower the squeegee tips, shorten the top rods or lengthen the lower rods. To raise the squeegee tips, lengthen the top rods or shorten the lower rods. Loosen the jam nuts on both ends of the rods before making adjustments. Tighten the jam nuts after making any adjustments.

NOTE: If one end of the squeegee is up and the other end down, check the lift cable to make certain that it is centered on the tie rod and it rolls freely.

11. Start the engine, release the parking brake, and move the machine forward to deflect the squeegee blades.
12. Stop the engine and engage the parking brake.
13. Adjust the casters so the squeegees deflect 0.5 in (10 mm). Tighten the caster mounting nuts.
14. Check the squeegee lift cable. It should be slack when the squeegee control lever is in the "lower" position. The squeegee should clear the floor when the control lever is in the "lift" position.

SNOW BROOM

SNOW BROOM

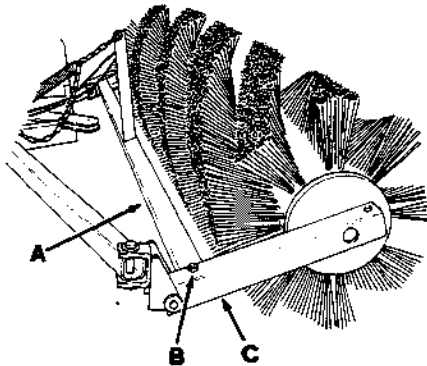
The snow broom accessory gives the machine the added flexibility to remove snow from walks and driveways. It consists of two groups of parts: The mounting frame, and the broom frame and drive assembly. The mounting frame is used to mount either the snow blade or snow broom assembly to the machine. The broom frame and drive assembly may be positioned so as to sweep snow to the left or right of the machine. Check the snow broom for tangled string or wire after each use. Replace the snow broom when the remaining bristles measure 1.25 in (30 mm) or less in length.

TO REPLACE SNOW BROOM

1. Stop the engine and engage the machine parking brake.

⚠ WARNING: Always park on a level surface, stop the engine, and engage the parking brake before working on the machine to keep it from rolling.

2. Remove the bolt holding the idler arm to the cross shaft.



IDLER ARM

02763

- A. Cross Shaft
- B. Bolt
- C. Idler Arm

3. Pull the idler plug out of the snow broom.
4. Pull the snow broom off the drive plug.
5. Slide the new snow broom onto the drive plug, making sure the drive keys and slots line up.
6. Slide the idler plug into the snow broom.
7. Secure the idler arm to cross shaft with the bolt.

SECTION 4 APPENDIX

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HARDWARE INFORMATION

The following charts state standard plated hardware tightening ranges for normal assembly applications. 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 5 Torque ft lb (Nm) | SAE Grade 8 Torque ft lb (Nm) |
|-------------|----------------------------------|----------------------------------|
| 0.25 in | 7-10 (9-14) | 10-13 (14-38) |
| 0.31 in | 15-20 (20-27) | 20-26 (27-35) |
| 0.38 in | 27-35 (37-47) | 36-47 (49-64) |
| 0.44 in | 43-56 (58-76) | 53-76 (72-103) |
| 0.50 in | 65-85 (88-115) | 89-116 (121-157) |
| 0.62 in | 130-170 (176-231) | 117-265 (159-359) |
| 0.75 in | 215-280 (291-380) | 313-407 (424-552) |
| 1.00 in | 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) |
|-------------|--------------------------------|---------------------------------|
| M4 | 2 (3) | 3 (4) |
| M5 | 4 (5) | 6 (8) |
| M6 | 7 (9) | 10 (14) |
| M8 | 18 (24) | 25 (34) |
| M10 | 32 (43) | 47 (64) |
| M12 | 58 (79) | 83 (112) |
| M14 | 94 (127) | 133 (180) |
| M16 | 144 (195) | 196 (265) |
| M20 | 260 (352) | 336 (455) |
| M24 | 470 (637) | 664 (900) |





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

Exceptions to the above chart:

Rear wheel hub nut – 150 – 175 ft lb
(200 – 240 Nm)

Rear wheel lug nuts – 85 – 95 ft lb
(115 – 130 Nm)

BOLT IDENTIFICATION

| Identification Grade Marking | Specification and Grade |
|--|----------------------------|
|  | SAE-Grade 5 |
|  | SAE-Grade 8 |
|  | ISO-Grade 8.8 |
|  | ISO-Grade 10.9 |

01395

THREAD SEALANT AND LOCKING COMPOUNDS

Thread sealants and locking compounds may be used on this machine. They include the following:

Loctite 515 sealant – gasket forming material. TENNANT® Part No. 75567, 15 oz (440 ml) cartridge.

Loctite 242 blue – medium strength thread locking compound. TENNANT® Part No. 32676, 0.5 ml tube.

Loctite 271 red – high strength thread locking compound. TENNANT® Part No. 19857, 0.5 ml tube.

HYDRAULIC FITTING INFORMATION

HYDRAULIC TAPERED PIPE FITTING (NPT) TORQUE CHART

NOTE: Ratings listed are when using teflon thread seal.

| Size | Minimum Torque | Maximum Torque |
|---------|------------------|--------------------|
| 1/4 NPT | 10 ft lb (14 Nm) | 30 ft lb (41 Nm) |
| 1/2 NPT | 25 ft lb (34 Nm) | 50 ft lb (68 Nm) |
| 3/4 NPT | 50 ft lb (68 Nm) | 100 ft lb (136 Nm) |

HYDRAULIC TAPERED SEAT FITTING (JIC) TORQUE CHART

| Tube O.D. (In) | Thread Size | Maximum Torque |
|----------------|-------------|-------------------|
| 0.25 | 0.44-20 | 9 ft lb (12 Nm) |
| 0.38 | 0.56-18 | 20 ft lb (27 Nm) |
| 0.50 | 0.75-16 | 30 ft lb (41 Nm) |
| 0.62 | 0.88-14 | 40 ft lb (54 Nm) |
| 0.75 | 1.12-12 | 70 ft lb (95 Nm) |
| 1.0 | 1.31-12 | 90 ft lb (122 Nm) |

HYDRAULIC O-RING FITTING TORQUE CHART

| Tube O.D. (In) | Thread Size | Minimum Torque | Maximum Torque |
|----------------|-------------|-------------------|-------------------|
| 0.25 | 0.44-20 | 6 ft lb (8 Nm) | 9 ft lb (12 Nm) |
| 0.38 | 0.56-18 | 13 ft lb (18 Nm) | 20 ft lb (27 Nm) |
| 0.50 | 0.75-16 | *10 ft lb (14 Nm) | 12 ft lb (16 Nm) |
| | | 20 ft lb (27 Nm) | 30 ft lb (41 Nm) |
| 0.62 | 0.88-14 | *21 ft lb (28 Nm) | 24 ft lb (33 Nm) |
| | | 25 ft lb (34 Nm) | 40 ft lb (54 Nm) |
| 0.75 | 1.12-12 | 45 ft lb (61 Nm) | 70 ft lb (95 Nm) |
| 1.0 | 1.31-12 | 60 ft lb (81 Nm) | 90 ft lb (122 Nm) |

NOTE: Do not use sealant on o-ring threads.

*Aluminum bodied components