MM 133
5-84

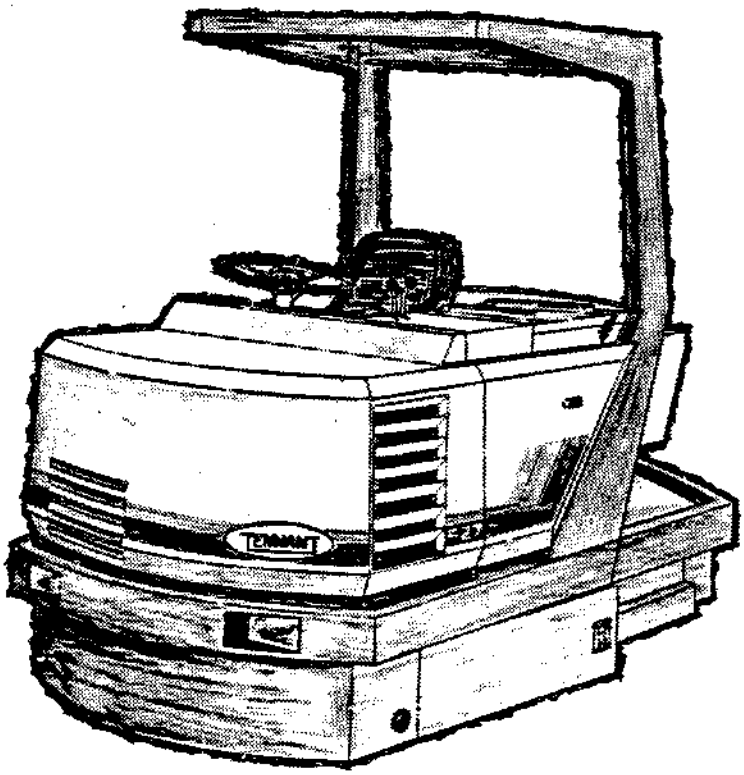
TENNANT®

527

POWER SCRUBBER

Operation, Maintenance and Parts Manual

(Operator Manual)



SPECIALIZED MAINTENANCE EQUIPMENT
SWEEPERS • SCRUBBERS • SCARIFIERS • FLOOR COATINGS

527

POWER SCRUBBER

This manual is furnished with each new TENNANT® Model 527. The machine operators will easily learn how to operate the machine and understand its mechanical functions by following the directions and absorbing the information in the Operation section.

This machine will give excellent service and scrubbing results, and save maintenance expenses. However, as with all specially engineered mechanical equipment, best results are obtained at minimum costs if:

- The machine is operated with reasonable care and
- The machine is maintained regularly — per the maintenance instructions provided.
- Components used in this machine have been carefully selected for performance and safety. Use only 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.

The telephone, telex, mailing addresses, and locations are listed on the last page of the manual.

MANUAL NO. MM133
Published: 5-84

TENNANT COMPANY WARRANTY POLICY

Tennant Company warrants to the original purchaser, for the period of one (1) year from the date of delivery, that goods manufactured by it will be free from defects of workmanship and material, provided such goods are installed, operated, and maintained in accordance with Tennant Company written manuals or other instructions.

Tennant Company's sole obligation, and Purchaser's sole remedy under this warranty for all claims arising out of the purchase and use of the goods, shall be limited to the repair or replacement, at Tennant Company's option, of parts that do not conform to this Warranty.

For thirty (30) days from date of installation, Tennant Company will, at its option, provide labor for repair, pay for outside repair service, or pay the customer straight time in accordance with Tennant Company's flat rate schedule for particular warranty repairs. Thereafter, Tennant Company's sole obligation shall be limited to the repair or replacement, at Tennant Company's option, of parts that do not conform to this Warranty.

Repair parts supplied by Tennant Company are warranted for the period of thirty (30) days following installation. Tennant Company's obligation is limited to the replacement of the warranted part, and Tennant Company shall not be obligated to provide labor in installing such part.

Battery and tires will be replaced if failure occurs due to defective material or workmanship within 90 days from date of purchase. Thereafter, a pro rata adjustment from date of purchase to 12 months will be made. The pro rata adjustment price of the new battery and/or the new tire will be the Tennant Company current price as of the adjustment request less 1/12th of that price for each month remaining in the 12-month period. All warranty applies only to batteries and tires purchased from Tennant Company and installed in vehicles used in normal service.

Brushes that fail due to defective material or workmanship will be replaced on a pro rata basis within the first 12 months of purchase. The replacement price will be calculated by multiplying the current Tennant Company price by the percentage of usable bristle remaining at the time of adjustment.

No Warranty is made with respect to items made by others when such items are warranted by their respective makers or when they are supplied by Tennant Company on special order.

This Warranty shall not cover:

A. Floor materials or application, and models 140 and 140E.

B. Maintenance items, adjustments, or installation of machines.

C. Repairs required as a result of failure due to normal wear, accidents, misuse, abuse, negligence, or improperly installed repair parts.

D. Products altered or modified in a manner not authorized by Tennant Company in writing.

THIS WARRANTY IS EXPRESSLY IN LIEU OF ALL OTHER EXPRESSED OR IMPLIED WARRANTIES INCLUDING THE WARRANTIES OF MERCHANTABILITY AND FITNESS AND OF ALL OTHER OBLIGATIONS AND LIABILITIES ON THE PART OF TENNANT COMPANY, INCLUDING LIABILITIES FOR DIRECT, IMMEDIATE, SPECIAL, INDIRECT, OR CONSEQUENTIAL DAMAGES ARISING OUT OF THE FAILURE OF ANY MACHINE OR PART OF IT TO OPERATE PROPERLY, INCLUDING THE COST OR EXPENSE OF PROVIDING SUBSTITUTE EQUIPMENT OR SERVICE DURING PERIODS OF MALFUNCTION OR NON-USE.

This Warranty cannot be extended, changed, or modified by any representative of Tennant Company.

Dear Customer,

Keeping you as a satisfied customer is our primary concern. If for any reason you are not satisfied, please contact anyone of the persons listed below.

One of the addresses is your local engine dealer. We will handle replacements on all parts of our equipment but this dealer probably carries a more complete stock of engine parts than we do and should be able to give you faster service in this area. Try him first for engine parts. Also, your engine dealer should be contacted first for warranty claims pertaining to the engine.

If you find that you need an experienced mechanic, please contact anyone listed below and he will be happy to recommend a mechanic to you.

To get maximum trouble free service from your machine, you must perform maintenance checks as specified in the machine manual and arrange for maintenance on a regular basis. Remember that breakdowns are directly related to maintenance.

TENNANT COMPANY	TENNANT COMPANY REPRESENTATIVE	ENGINE DEALER	
Tennant Company			
P. O. Box 1452			
Minneapolis, MN 55440			
(612) 540-1200			

ENGINE WARRANTY - GASOLINE AND LPG

TELEDYNE CONTINENTAL MOTORS
Industrial Products Division
industrial and material handling engines

Teledyne Continental Motors warrants each new engine or power unit manufactured by same to be free from defects in material and workmanship for a period of one (1) year of service or 1500 hours of service, whichever shall first occur.

The obligation of the Company, under this warranty, is limited to repairing or replacing with new or remanufactured parts, as the Company may elect, any part or parts which shall have been returned to a Distributor or licensee of the Company authorized to handle the engine covered by this warranty, and which upon examination is disclosed, to the Company's satisfaction, to have been defective in material or workmanship. Such repair or replacement of any part shall not extend this warranty beyond the original warranty coverage stated above.

This Warranty does not obligate the manufacturer to bear the cost of labor or transportation charges in connection with the replacement or repair of defective parts, nor shall it apply to an engine upon which repair or alterations have been made unless authorized by the manufacturer.

The manufacturer makes no Warranty in respect to trade accessories, such being subject to the Warranties of their respective manufacturers.

THIS WARRANTY, AND THE COMPANY'S OBLIGATION THEREUNDER IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, and all other obligations or liabilities, including consequential damages or contingent liabilities arising out of the failure of any engine or part to operate properly, and no person is authorized to give any other warranty or to assume any additional obligation on the Company's behalf unless made in writing and signed by an officer of the company.

Before consideration can be given to requests for adjustments covering field service and alleged defective material, the buyer shall furnish Teledyne Continental Motors with the following data:

Owner's name and address
Engine Model, Specification number and Serial number
Date actually placed in service
Accumulated days, hours, or miles of service
Information as to the nature of the trouble

TELEDYNE CONTINENTAL MOTORS
INDUSTRIAL PRODUCTS DIVISION
950 ARTHUR AVENUE, ELK GROVE VILLAGE, ILLINOIS 60007
PHONE: (312) 593-2000

ENGINE WARRANTY - DIESEL

PERKINS ENGINES INC.
industrial warranty

1. DURATION OF WARRANTY

   Perkins Engines, Inc. (hereinafter called Perkins) warrants each new engine sold under the trademark "Perkins," and operated in the United States of America or Canada to power industrial or agricultural applications to the first retail purchaser thereof for a period of 12 months or 1,800 hours, whichever event shall first occur, to be free from defects in workmanship and material from the date of delivery to such purchaser

2. REPLACEMENT OF PARTS UNDER WARRANTY

   The responsibility of Perkins is limited to repairing or replacing, as its option, any part or parts of such engines that are returned to Perkins or any authorized Perkins distributor or dealer, with transportation charges prepaid, and which upon examination by Perkins shall disclose to Perkins' satisfaction to have been thus defective.

3. PAYMENT OF REPAIR LABOR COST UNDER WARRANTY

   During the first 12 months or 1,800 hours of engine operation, whichever event shall occur first, from the date of delivery to the first purchaser, Perkins or any authorized Perkins distributor or dealer will cover the cost of reasonable labor required to repair any engine or replace any parts found by Perkins to be defective.

4. Perkins' obligation under this Warranty shall not apply to: (a) Starters, Generators, Transmissions, Clutches, Radiators or any other proprietary fittings not manufactured by Perkins. These are warranted by their respective manufacturers, and not by Perkins. (b) Any engine which shall have been subject to negligence, misuse, accident, misapplication or overspeeding. (c) Any engine that has been repaired or altered by anyone in a manner which, in Perkins' sole judgement, adversely affects its performance or reliability. (d) Any engine which has been fitted with or repaired with parts or components not manufactured or approved by Perkins which, in Perkins' sole judgement, adversely affects its performance or reliability. (e) Engine tune-ups, normal maintenance services including but not limited to valve adjustment, normal replacement of service items, fuel and lubricating oil filters, lubricating oil, fan belts, antifreeze, etc. (f) Damages caused by prolonged or improper storage of the engine after shipment from a Perkins factory. (g) Loss of operating time to the user while the engine or engine driven equipment is out of operation and damage to equipment powered by the engine.

5. This warranty and the obligation of Perkins Engines, Inc. thereunder is in lieu of all other warranties, express or implied, including without limitations, the implied warranties of merchantability and fitness for particular purposes, all other representations to the purchaser and all other obligations or liabilities including liability for incidental and consequential damages on part of the manufacturer.

SPECIAL NOTE

Perkins engines are marketed throughout the world to many manufacturers of original equipment. In order to meet the special requirements of these, engines may on occasion be covered by specific warranties applicable to the driven equipment. In these instances, the warranty extended by Perkins to said manufacturer supersedes the above warranty.

HOME OFFICES

U.S.A.
24175 Research Drive
Farmington, Michigan 48024
Phone: (313) 477-3900

CANADA
7 Meridian Road
Rexdale, Ontario
Phone: (416) 677-4960

Perkins reserves the right to make changes or add improvements to its products at any time without incurring any obligation to make such changes to products manufactured previously. Perkins or its distributors accept no responsibility for variations which may be evident in the actual specifications of its products and the statements and descriptions contained in this publication.

POWER SCRUBBER - 527 MM133 (5-82) LITHO IN U.S.A.

SAFETY PRECAUTIONS

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

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

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

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

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

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

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

WARNING: Keep cigarettes, sparks, and open flame away from lead acid batteries. Batteries emit a highly explosive hydrogen gas.

WARNING: Disconnect battery terminals before servicing electrical components. Only qualified personnel should work inside panels or on electrical system when the battery is connected to the machine.

CAUTION: Avoid moving parts of the unit. Loose jackets, shirts or sleeves should not be permitted when working on the machine because of the danger of becoming caught in moving parts. Keep shield and guards in position. If adjustments must be made while the unit is running, use extreme caution around moving parts, v-belts, etc.

WARNING: Check brakes and steering control for proper operation. Do not start machine unless you are in driver's seat, with foot on brake pedal and directional pedal in neutral. Parking brake must be engaged and ignition key removed before leaving the machine.

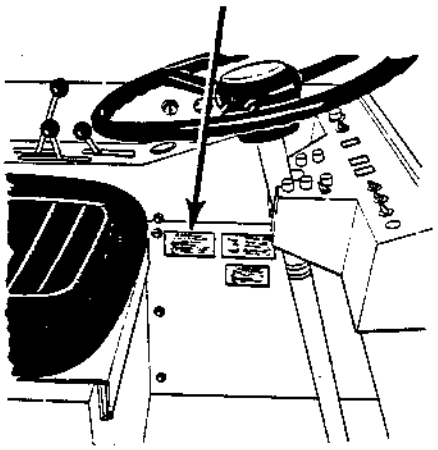
WARNING: Lock scrubbing head in "raised" position, and block it up securely before working under head. See instructions on head lock. Keep hands and feet away when lowering or raising the scrub head or the rear squeegee.

WARNING: Keep hands away from powerful vacuum fan suction or fan intake. Do not remove safety guard on fan intake housing.

CAUTION: Read and understand the manual before operating the machine.

POWER SCRUBBER - 527 MM133 (12-81) LITHO IN U.S.A.

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



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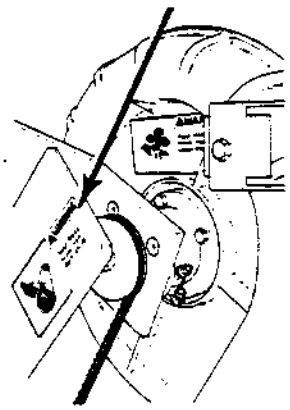
SAFETY DECAL (TENNANT PART NO. 32308) LOCATED ON LEFT SIDE PANEL OF OPERATOR COMPARTMENT.



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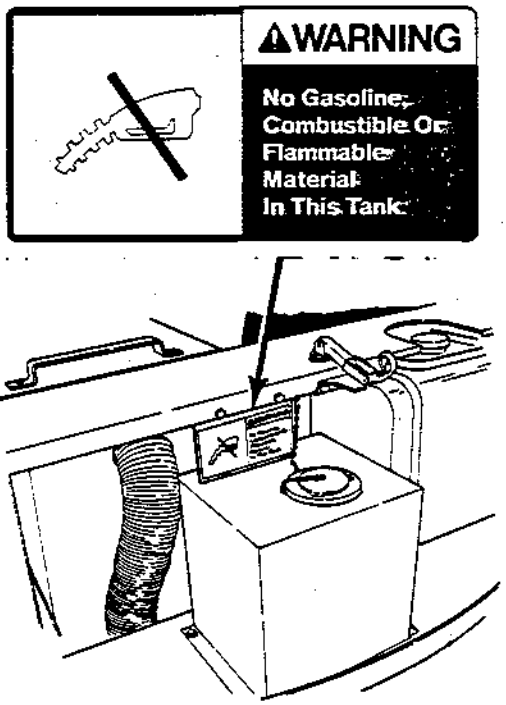
FAN BELT DECAL (TENNANT PART NO. 69709) LOCATED ON VACUUM FAN BELT GUARD.



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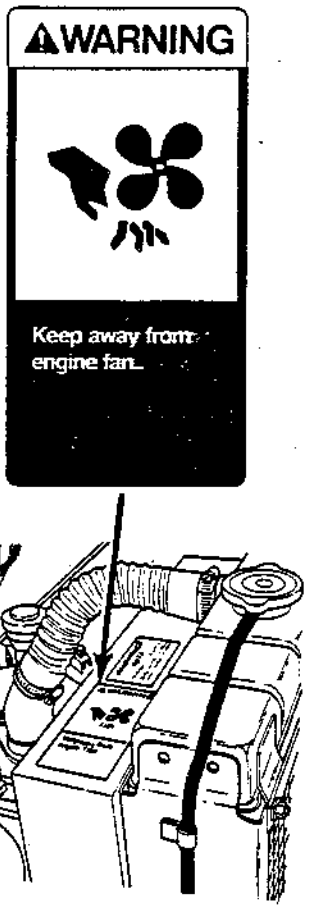
SRS MACHINES ONLY - CLEANING SOLUTION TANK DECAL (TENNANT PART NO. 69708) LOCATED NEXT TO CLEANING SOLUTION TANK.



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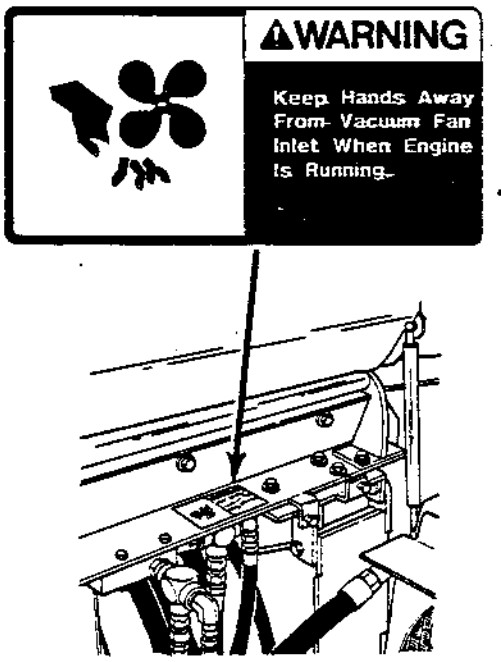
ENGINE FAN BELT DECAL (TENNANT PART NO. 68962) LOCATED ON RADIATOR FAN SHROUD.



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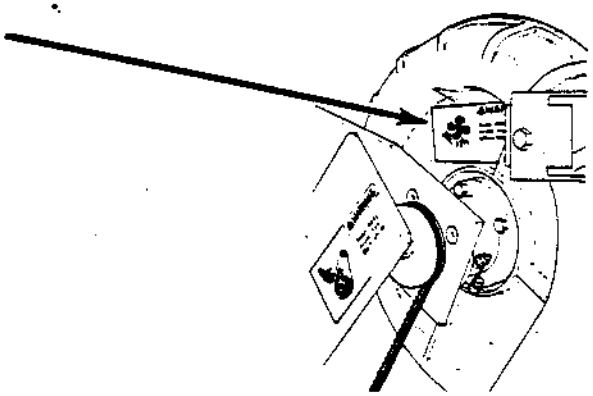
VACUUM FAN SUCTION DECAL (TENNANT PART NO. 63507) LOCATED ON MACHINE LINTEL.



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VACUUM FAN SUCTION DECAL (TENNANT PART NO. 63507) LOCATED ON VACUUM FAN HOUSING.

REPLACEMENT BRUSHES

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KEY	TENNANT® PART NO.	MACHINE SERIAL NUMBER	DESCRIPTION	QTY.
	56363	(-)	BRUSH, Scrub, polypropylene	2
	56879	(-)	BRUSH, Scrub, abrasive bristle, heavy	2
	56876	(-)	BRUSH, Scrub, aggressive	2

RECOMMENDED GENERAL MAINTENANCE ITEMS

00520

KEY	TENNANT® PART NO.	MACHINE SERIAL NUMBER	DESCRIPTION	QTY.
	59486	(-)	REPLACEMENT PARTS PACKAGE	1
	64818	(-)	BLADE, Front, rear squeegee	1
	59776	(-)	BLADE, Rear, rear squeegee	1
	59775	(-)	STRIP, Back-up, rear squeegee	2
	59609A	(-)	BLADE, Side squeegee	2
	59610A	(-)	STRIP, Back-up, side squeegee	2
	59617	(-)	FLAP, Deflector	2
	64899	(-)	BELT, Drive, engine to jackshaft	1
	64900	(-)	BELT, Drive, jackshaft to vacuum fan	1
	62739-1	(-)	ELEMENT, Hydraulic fluid filter	1
	51885	(-)	FILTER, Hydraulic sump	1
	53431	(-)	ELEMENT, Hydraulic reservoir breather	1
	51561	(-)	ELEMENT, Engine air filter	1
	53055-2	(-)	ELEMENT, Engine oil	1
	55994	(-)	SPARK PLUGS, Engine	4
	45631	(-)	CONDENSER, Distributor	1
	37420	(-)	POINT SET, Distributor	1
	37421	(-)	ROTOR, Distributor	1
	01433-1	(-)	GREASE, High speed, vacuum fan	1
	45662	(-)	BELT, Drive, alternator, gasoline, LPG	1
	76942	(-)	CASTER, Rear squeegee	1
	75050	(-)	BUSHING, Spanner, rear squeegee caster	1
	62050	(-)	ELEMENT, Gasoline fuel line	1
	45387	(-)	FUSE, 30A	1
	14215	(-)	FUSE, 20A	1
	07423	(-)	FUSE, 15A	1
	45595	(-)	FUSE, 10A	2
	44938	(-)	FUSE, 5A	1
	64320	(-)	HOSE, Rear squeegee	1
	64768	(-)	HOSE, Debris screen	1
	64317	(-)	HOSE, Scrubber head to tank	1
	69250	(-)	HOSE, Tank to vacuum fan	1
	32904	(-)	BELT, Drive, alternator, diesel	1
	79424	(-)	ELEMENT, Filter, solution (SRS®)	1
	19960	(-)	REPAIR KIT, Solution pump, SRS®	1
	63921	(-)	REPLACEMENT KIT, Bellows, cleaning solution pump, SRS®	1
	32397-5	(-)	HYDRAULIC FLUID, TENNANT®, 10W-40, 5 gal (18.9 L)	1
	32398-5	(-)	HYDRAULIC FLUID, TENNANT®, 20W-60, 5 gal (18.9 L)	1
	52770-5	(-)	ELEMENT, Filter, engine oil, diesel	1
	52770-9	(-)	ELEMENT, Filter, fuel, diesel	1
	52770-8	(-)	WATER TRAP, Fuel, diesel	1

POWER SCRUBBER - 527 MM133 (5-82) LITHO IN U.S.A.

GENERAL INFORMATION

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SECTION 1
SPECIFICATIONS

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MACHINE SPECIFICATIONS

MODEL 527 POWER SCRUBBER

POWER TYPE

Engine type - piston
Ignition - breaker type spark
Cycle - 4
Aspiration - natural
Cylinders - 4
Bore - 3.09 in (78.5 mm)
Stroke - 3.50 in (88.9 mm)
Displacement - 112 cu in (1800 cc)
Net power 34 hp (25.3 kw) @ 2000 rpm governed
39 hp (29 kw) @ 2800 rpm maximum
Fuels - gasoline, 86 octane, leaded or unleaded
LPG
Cooling system - water
Electrical system - 12 V nominal, 35 A alternator
Engine type - piston
Ignition - diesel
Cycle - 4
Aspiration - natural
Cylinders - 4
Bore - 3.125 in (79.4 mm)
Stroke - 3.5 in (88.9 mm)
Displacement - 108 cu in (1770 cc)
Net power - 35 hp (26 kw) @ 2300 rpm governed
43 hp (32 kw) @ 3000 rpm maximum
Fuels - #1 or #2 diesel fuel
Cooling system - water
Electrical system - 12 V nominal, 42 A alternator

POWER TRAIN

Propelling - hydraulic drive motors (2)
Scrub brush - hydraulic drive motors (2)
Vacuum fan - belt driven

STEERING

Type - front wheel
Power source - manual
Emergency steering - manual

HYDRAULIC SYSTEM

Function - operates propelling, scrub head lift, squeegee lift, scrub brush drive.

Control valve, scrub brush drive, squeegee lift, scrub head lift - open center, two spool.

Control valve, squeegee position - two position, electrical solenoid actuated.

Propelling pump - variable displacement piston pump, 17.4 gpm (65.9 L/m) @ 2000 rpm.

Propelling system rated pressure - 2500 psi (17235 kPa)

Accessories pump - vane pump, 8.6 gpm (32.6 L/m) @ 2000 rpm.

Accessories system rated pressure - 2200 psi (15169 kPa).

Propelling pump, diesel - variable displacement piston pump, 24.7 gpm (93 L/m) @ 2300 rpm

Propelling system rated pressure, diesel - 2500 psi (17238 kPa)

Accessories pump, diesel - gear pump, 8.4 gpm (32 L/m) @ 2300 rpm

Accessories system rated pressure, diesel - 2200 psi (15169 kPa)

Propelling motors (2) - internal gear motor, 8.6 cu in (0.14 L) per revolution, 4500 psi (31028 kPa) maximum rated pressure.

Scrub brush drive motors (2) - internal gear motor, 4.5 cu in (0.07 L) per revolution, 2200 psi (15169 kPa) maximum rated pressure

Scrub head lift cylinder - single action, 2 in (51 mm) bore x 9 in (229 mm) stroke, 1 in (25 mm) diameter rod, maximum rated pressure 2500 psi (17238 kPa).

Squeegee lift cylinder - single action, 2 in (51 mm) bore x 9 in (229 mm) stroke, 1 in (25 mm) dia rod, maximum rated pressure 2500 psi (17238 kPa).

BRAKING SYSTEM

Service brakes - mechanical drum brakes (2) one per rear wheel, cable actuated.
Parking brake - utilizes service brake and service brake cable.

SUSPENSION SYSTEM

Front - one 12 in (305 mm) x 4 in (102 mm) solid tire
Rear - two 12 in (305 mm) x 4.5 in (114 mm) solid tires

SYSTEM FLUID CAPACITIES

Cooling system - radiator 5 qt (4.7 L)
total system 9 qt (8.5 L)
Cooling system, diesel - radiator, diesel 4.8 qt (4.6 L)
total system, diesel 8.4 qt (7.9 L)
Fuel tank - gasoline 8.3 gal (31.4 L)
LPG 33 lb (14.9 kg)
diesel 8.3 gal (31.4 L)
Engine lubricating oil - 3.5 qt (3.3 L) w/o filter
4.0 qt (3.8 L) w/filter
Engine lubricating oil, diesel - 5 qt (4.7 L) w/o filter
5.5 qt (5.2 L) w/filter
Hydraulic system - reservoir 5.7 gal (21.6 L)
total system 7.5 gal (28.4 L)

GENERAL MACHINE DIMENSIONS/CAPACITIES

Length - 108.5 in (2756 mm)
Width - 51.4 in (1306 mm)
Height - 54.0 in (1372 mm) less overhead guard
84.0 in (2134 mm) with overhead guard

Track, rear - 40.5 in (1029 mm)
Wheel base - 36.75 in (927 mm)
Standard solution tank capacity - 65 gal (247 L)
Standard recovery tank capacity - 68 gal (258 L)
SRS scrub solution tank capacity - 122 gal (463 L)
SRS cleaning solution tank capacity - 5 gal (19 L)
Scrub brush path width - 43 in (1092 mm)
Scrub brush diameter - 11 in (279 mm)
Rear squeegee path width - 45 in (114 mm)
Debris hopper capacity- 1.5 cu ft (42.5 L)

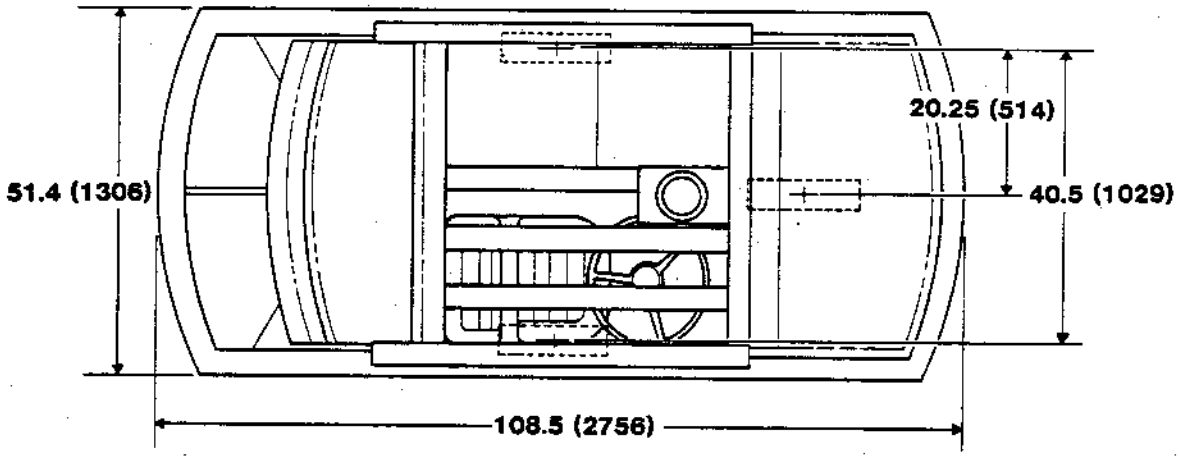
MACHINE WEIGHTS

Standard net weight, less solutions, brushes - 3040 lb (1379 kg)
Standard net weight, diesel, less solutions, brushes - 3070 lb (1392 kg)
Standard net weight, with solutions, brushes - 3630 lb (1647 kg)
Standard net weight, diesel, with solutions, brushes - 3660 lb (1660 kg)
SRS net weight, less solutions, brushes - 3080 lb (1379 kg)
SRS net weight, diesel, less solutions, brushes - 3110 lb (1411 kg)
SRS net weight, with solutions, brushes - 4100 lb (1860 kg)
SRS net weight, diesel, with solutions, brushes - 4130 lb (1873 kg)

GENERAL MACHINE PERFORMANCE

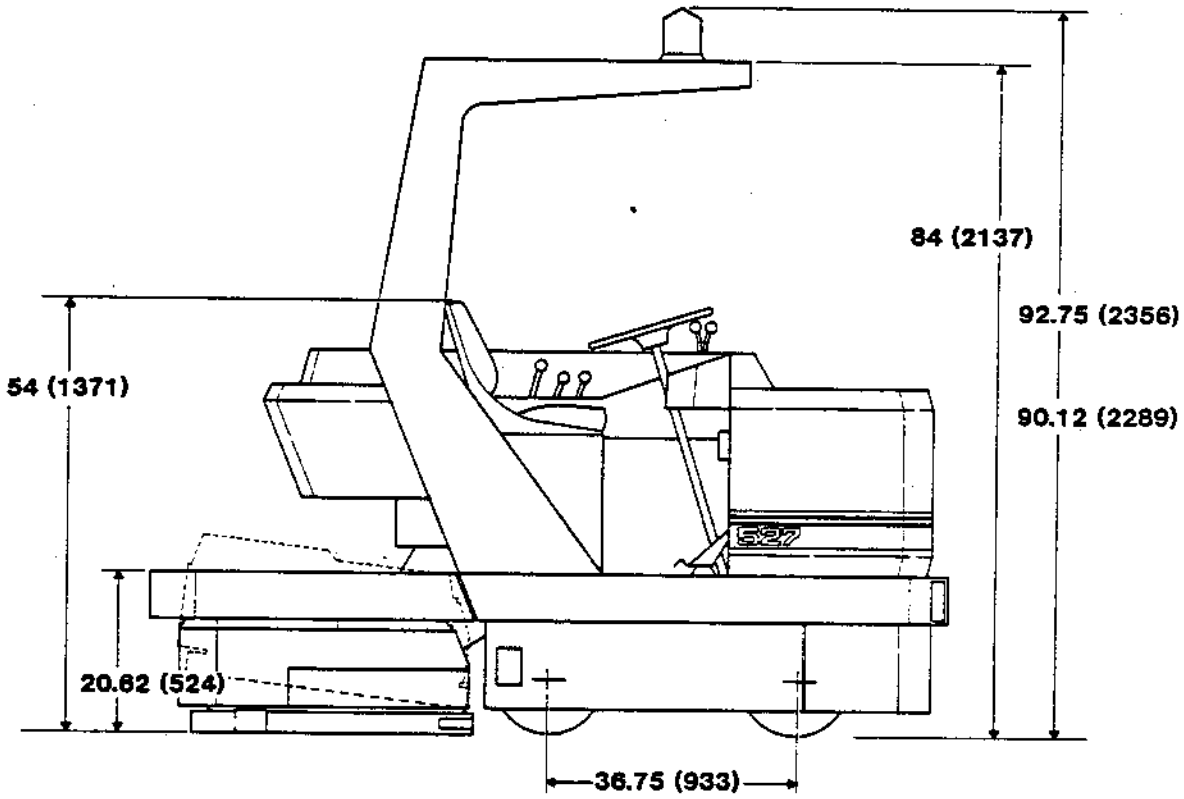
Maximum forward travel speed - 7.5 mph (12 km/h)
Maximum reverse speed - 4.0 mph (6.4 km/h)
Cleaning speed - 0 to 4 mph (0 to 6.4 km/h)
Turning radius - right, 129 in (3277 mm)
left, 132.5 in (3366 mm)

MACHINE DIMENSIONS



TOP VIEW 00092

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



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SIDE VIEW

SECTION 2
OPERATION

CONTENTS

PREPARATION FOR OPERATION

AFTER UNCRATING AND BEFORE OPERATING THE MACHINE:

1. Check the machine for shipping damage.
2. Check the hyraulic fluid level in the hydraulic fluid reservoir using the sight gauge provided. TENNANT® hydraulic fluid is recommended. If TENNANT® hydraulic fluid is not available, use only new-approved hydraulic fluid. See the Hydraulic Section.
3. Check the engine oil level.
4. Check the radiator coolant level.
5. Check the scrubber head and brush adjustment, as described in Maintenance sections.
6. Check the rear and side squeegees for correct adjustment.
7. Please read this manual carefully before operating the machine.

OPERATION OF CONTROLS

BRAKE PEDAL

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

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

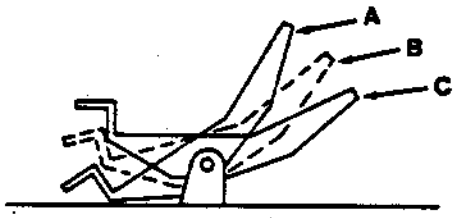
PARKING BRAKE

The parking brake is built into the service brake pedal. To engage the parking brake, press the brake pedal as far as possible while applying pressure to the lower portion of the brake pedal. As the parking brake engages, the brake pedal will ratchet and lock in the engaged position.

To disengage the parking brake, apply pressure to the top portion of the brake pedal and allow the brake pedal to return to the normal position.

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 as shown below.



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DIRECTIONAL CONTROL PEDAL

A. Reverse
B. Neutral
C. Forward

Gradually press the "toe" portion of the pedal for forward travel or the "heel" portion of the pedal for reverse travel. 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 as directed in Adjusting Directional Control Pedal in the Maintenance section.

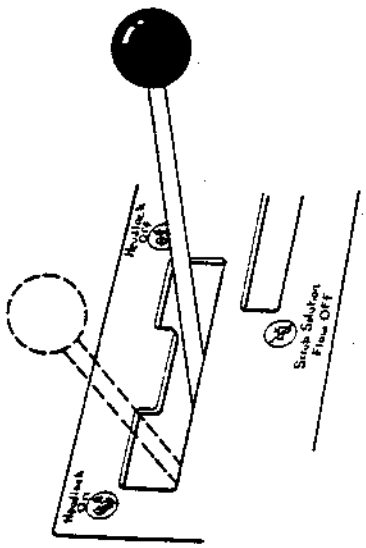
The hydraulic drive may be used to slow the machine speed by moving the directional control pedal through the neutral position to the opposite direction of travel position. When the machine has stopped, return the pedal to the neutral position.

NOTE: Always use the brake pedal for normal stopping and controlling machine speed on down grades.

SCRUB HEAD LOCK

This lever operates a cable which controls the scrub head lock mechanism. Pulling back on the lever when the scrubber head is in the fully "raised" position locks the scrub head, preventing it from lowering. Pushing the lever forward when the scrub head is in the "raised" position unlocks the scrubber head.

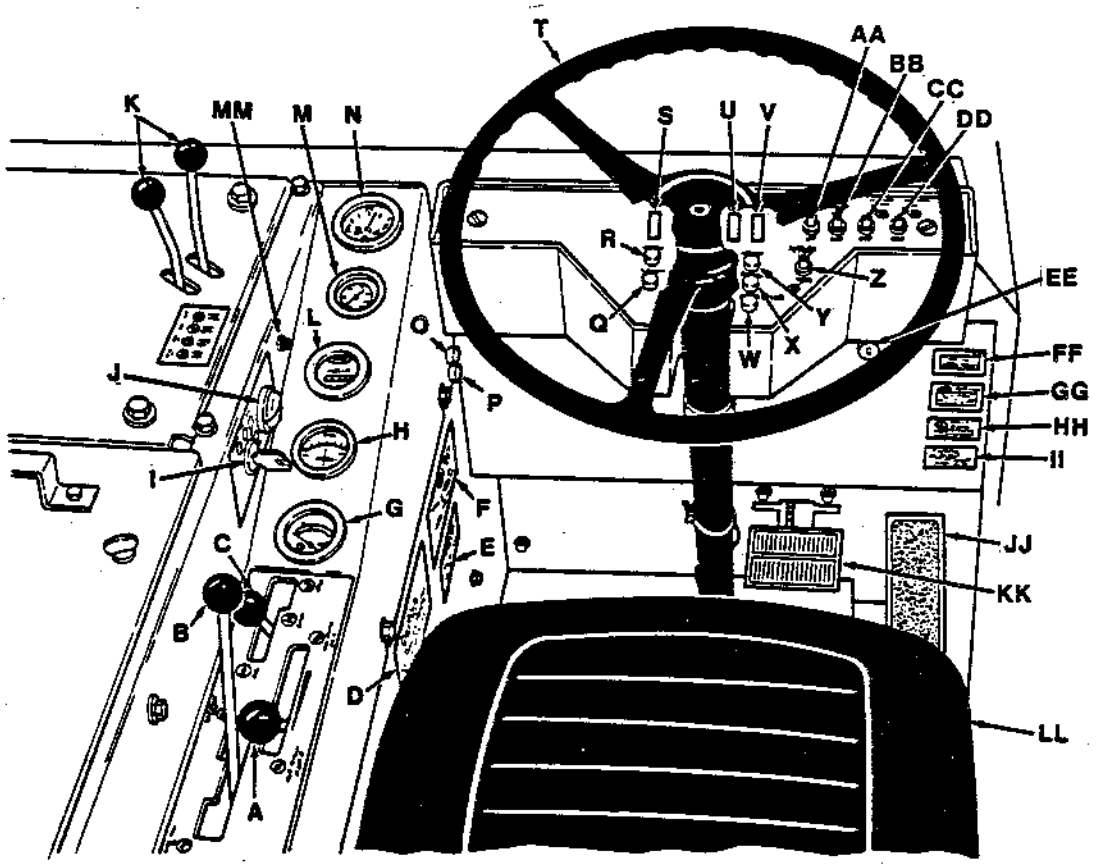
To engage or disengage the scrubber head lock, the scrub head must be fully raised hydraulically.



00077

SCRUB HEAD LOCK

The scrub head lock is to be used primarily as a safety feature. Always engage the scrub head lock before working under the scrubber head. The scrub head lock must also be engaged whenever the machine will not be



00083

MODEL 527 LOCATION OF INSTRUMENTS AND CONTROLS

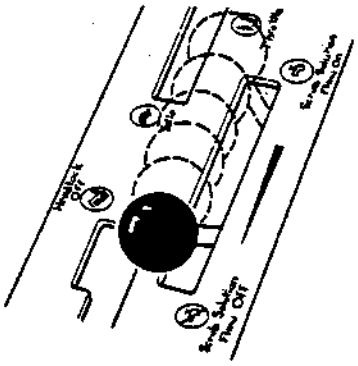
A. Scrub Solution Flow Control
B. Scrub Head Lock
C. Throttle Control Lever
D. Caution Decal
E. Alternator Decal
F. Parking Brake Decal
G. Engine Water Temperature Gauge
H. Ammeter
I. Ignition Switch
J. Panel Lamp
K. Scrubbing Control Levers
L. Hour Meter
M. Engine Oil Pressure Gauge
N. Fuel Level Gauge
O. Horn Fuse
P. Ignition Fuse
Q. Revolving Lamp Fuse
R. Flashing Lamp Fuse
S. Recovery Tank Full Indicator
T. Steering Wheel
U. Scrub Solution Tank Low
V. Scrub Solution Tank Empty
W. Squeegee Raising Fuse
X. Level Sensing Fuse
Y. Operating Lamps Fuse
Z. Squeegee Switch
AA. Flashing Lamp Switch
BB. Revolving Lamp Switch
CC. Back-up Lamp Switch
DD. Operating Lamps Switch
EE. Engine Choke Knob
FF. Factory Mutual Label Plate
GG. Machine Data Plate
HH. Machine Patent Data Plate
II. Machine U.L. Label Plate
JJ. Directional Control Pedal
KK. Brake Pedal
LL. Operator Seat
MM. Fuel Level Pushbutton

used for an extended period of time, overnight for example. Flat spots on the brushes will appear if the scrub head is left down for an extended period of time.

⚠ WARNING: Always engage the scrub head lock and block the scrub head up securely before working under the scrubber head. Do not rely on the hydraulic cylinder to keep the scrub head up. The hydraulic cylinder may leak internally, allowing the scrub head to lower and crush anything under it.

SCRUB SOLUTION FLOW CONTROL

This lever operates a cable which controls the variable solution control valve. Pulling the lever back slows and will stop the flow of scrubbing solution. Pushing the lever forward opens the control valve, allowing scrubbing solution to flow.

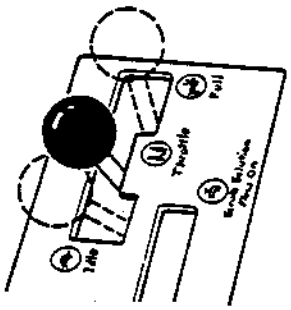


00062

SCRUB SOLUTION FLOW CONTROL LEVER

THROTTLE CONTROL LEVER

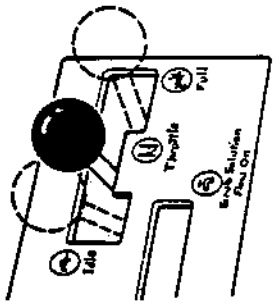
On gasoline or LPG powered machines, the throttle control lever operates a rod which controls the engine speed. Pulling the lever back to the "idle" position slows the engine to idle speed. Pushing the lever forward and to the right to the "full" position, speeds the engine to the maximum governed speed.



00077

THROTTLE CONTROL LEVER - GASOLINE, LPG

On diesel powered machines, the throttle control lever operates a rod and spring assembly which controls the engine speed. Pulling the lever back to the "stop" position stops the flow of diesel fuel to the engine stopping the engine. Pushing the lever forward and to the right to the "full" position, speeds the engine to the maximum governed speed.



THROTTLE CONTROL LEVER - DIESEL 00077

Note: The machine must always be operated with the throttle control lever in the "full" position. Damage to the engine and the hydraulic pump may result if not operated as such.

ENGINE WATER TEMPERATURE GAUGE

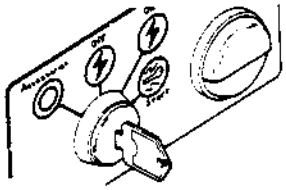
This gauge registers the engine water temperature. Normal engine water temperatures range up to 210°F (99°C). Temperatures above this level indicate an overheating engine. This condition may arise due to a low coolant level, a clogged radiator, a loose fan belt, a defective thermostat, or other engine malfunctions. Engine overheating will always cause a coolant loss. If coolant loss does not occur, check for a malfunction of the temperature sending unit.

AMMETER

The ammeter registers the charging current which is being passed to the battery by the alternator. It also registers a discharge of current being used by the machine when the alternator is not charging.

IGNITION SWITCH

The key-operated ignition switch has four positions. Those positions are "accessories," "off," "on," and "start." To operate any electrical accessory without operating the engine, turn the switch to the "accessories" position. To start the engine, turn the key to the "start" position. Do not engage the starter for more than ten seconds at a time, or after the engine has started, as the starter may be damaged. To stop the engine, turn the key to the "off" position.



IGNITION SWITCH 00024

PANEL LAMP

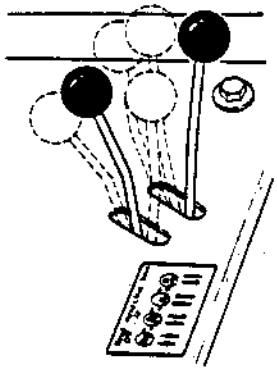
This lamp is present on machines with the headlights accessory. The lamp lights whenever the headlights switch toggle is flipped up to turn the headlights on.

SCRUBBING CONTROL LEVERS

The scrubbing control levers operate a double spool hydraulic control valve which controls the scrub head position, the rear squeegee position, and the scrub brushes rotation. There are four lever positions which are used to operate the previously mentioned equipment. The following describes each of the four lever variations.

"HEAD UP"

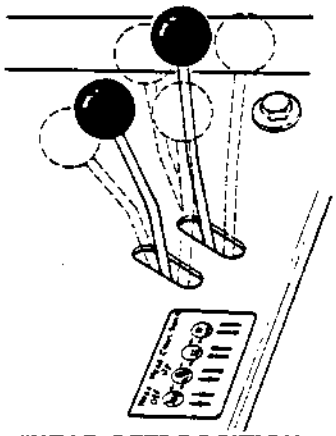
The "head up" position is used to raise the scrub head off the floor when finished scrubbing. It is also used to allow the scrub head lock to be engaged or disengaged. When the scrubbing control levers are in this position, the scrub brushes are motionless and the scrub head is raised.



"HEAD UP" POSITION 00071

"HEAD OFF"

The "head off" position is used when the machine is to be parked for a period of time: for example, overnight or during lunch breaks. This position is also used when the machine is traveling to the area to be scrubbed. The scrub head should be raised and the scrub head lock engaged whenever the scrubbing control valves are in this position. When the scrubbing control levers are in this position, the scrub brushes are motionless.

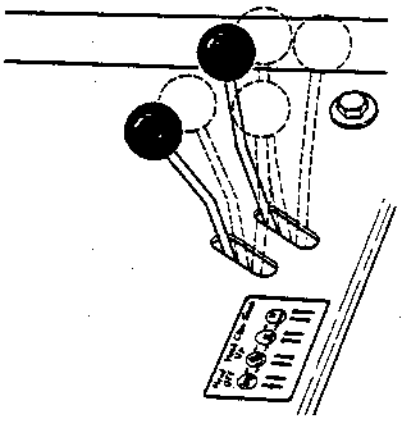


"HEAD OFF" POSITION 00071

"CLEAN"

The "clean" position is used when scrubbing. When the scrubbing control levers are in this position, the front scrub brush rotates counter-clockwise, the rear scrub brush rotates clockwise, the rear squeegee is down, and the scrub head is down.

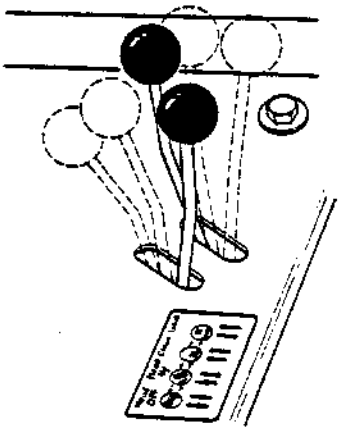
Note: Scrub brush rotation is as viewed from the scrub brush idler side of the machine.



"CLEAN" POSITION 00072

"SOAK"

The "soak" position is used when double scrubbing. When the scrubbing control levers are in this position, both scrub brushes rotate in a counter-clockwise direction, the rear squeegee is up, and the scrub head is down.



"SOAK" POSITION 00072

HOUR METER

The hour meter records the number of hours the machine has been operated.

ENGINE OIL PRESSURE GAUGE

This gauge registers the engine oil pressure. Normal engine oil pressure ranges from 7 psi (48 kPa) at idle, to 35 psi (241 kPa) at full engine throttle. If the gauge registers an oil pressure reading below 7 psi (48 kPa), stop the engine immediately and determine the cause. Failure to stop the engine will result in severe engine damage.

FUEL LEVEL GAUGE

The fuel level gauge is present on all diesel powered machines and on gasoline powered machines with the fuel level gauge accessory. It indicates how much fuel is left in the fuel tank.

FUSES

The machine's electrical fuses are located in three main areas. These areas are: the front panel, the side panel, and the engine firewall. Fuses are a one-time circuit protection device designed to stop the flow of current in the event of a circuit overload. Never substitute higher value fuses than those specified in this manual. The chart below shows the various fuses and the electrical components they protect.

PROTECTIVE DEVICE	RATING	CIRCUIT PROTECTED	LOCATION
FU-1	10 A	Ignition, Oil pressure switch	Side Panel
FU-2	10 A	Horn	Side Panel
FU-3	5 A	Level Sensing	Front Panel
FU-4	10 A	Squeegee Circuit	Front Panel
FU-5	20 A	Operating Lamps	Front Panel
FU-6	10 A	Flashing Lamp	Front Panel
FU-7	10 A	Revolving Lamp	Front Panel
FU-8	15 A	SRS System	Front Panel
FU-9	30 A	Entire Machine	Fire Wall, (engine side)

RECOVERY TANK FULL INDICATOR

This indicating lamp lights when the recovery tank is nearly full. Depending on the scrubbing conditions, there may be 10 to 15 minutes of scrubbing time left before the vacuum shut-off ball float stops the water vacuum.

STEERING WHEEL

The automotive-type steering wheel operates a steering gear assembly which controls the front caster wheel through an arm and tie rod arrangement. The machine is very responsive to the movement of the steering wheel. The operator should use care until he or she becomes more experienced in guiding the machine.

SCRUB SOLUTION TANK LOW

This indicating lamp lights when the solution tank is nearly empty. Depending on the scrubbing conditions, there may be 10 to 20 minutes of scrubbing time remaining before the solution tank is empty. The operator should plan to return to the machine filling/dumping site.

SCRUB SOLUTION TANK EMPTY

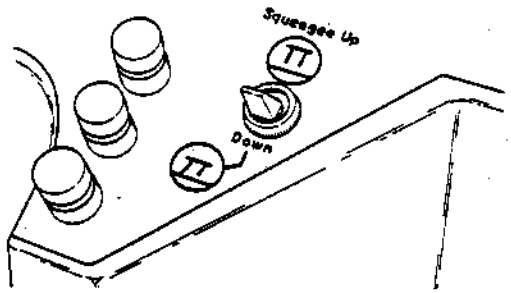
This indicating lamp lights when the solution tank is empty. The operator should return to the filling/dumping site. Continued scrubbing will be ineffective and will cause excessive wear to the brushes and brush drive components.

SQUEEGEE SWITCH

This switch, in conjunction with a hydraulic flow sensing device, and the scrubbing control levers, control the position of the rear squeegee.

Flipping the switch toggle forward places the rear squeegee in the "up" position. The "up" position is used to gain access to the side squeegees. This position cannot be overridden by the hydraulic flow sensing device.

Flipping the switch toggle back places the rear squeegee in the "down" position when traveling in the forward direction. When traveling in the reverse direction, the hydraulic flow sensing device overrides the squeegee switch and raises the rear squeegee. This prevents the rear squeegees from being damaged when traveling in reverse. The squeegee switch should always be in the "down" position when scrubbing.



SQUEEGEE SWITCH LOCATION 00045

FLASHING LAMP SWITCH

This switch is present on machines with the flashing lamp accessory. Flip the switch toggle forward to turn the lamp on. Flip the switch toggle back to turn the lamp off.

REVOLVING LAMP SWITCH

This switch is present on machines with the revolving lamp accessory. Flip the switch toggle forward to turn the lamp on. Flip the switch toggle back to turn the lamp off.

OPERATING LAMPS SWITCH

This switch is present on machines with the operating lamps accessory. It controls the headlamps, taillamps, and the instrument panel lamp. Flip the switch toggle forward to turn the lamps on. Flip the switch toggle back to turn the lights off.

BACKUP LAMPS SWITCH

This switch is present on machines with the operating lamps accessory. Flip the switch toggle forward to turn the lamps on. Flip the switch toggle back to turn the lamps off. The backup lamps are also activated by moving the directional control pedal into the "reverse" position.

ENGINE CHOKE

This knob operates a cable which controls the engine choke. Pulling out on the knob closes the choke, aiding in the cold starting of the engine. Pushing in on the knob opens the choke, allowing the engine to turn normally at its operating temperature and speed. It is not necessary to choke a warm engine.

OPERATOR SEAT

The operator seat is of a fixed back style with a forward-backward adjustment. To adjust the seat, loosen the seat mounting bolts, slide the seat to the position desired, and tighten the bolts.

SEAT BELT

An automotive type seat belt is provided as an accessory to secure the machine operator in the operator's seat. To lock the seat belt, insert the belt tongue into the belt buckle. To adjust seat belt, pull on the belt tail until the seat belt is snug. To release the seat belt, pull up on the seat belt buckle.

FUEL LEVEL PUSHBUTTON

The fuel level pushbutton is present on all diesel powered machines. It is provided to check the fuel level in the fuel tank without starting the engine.

NOTE: Do not empty the fuel tank on diesel machines as the fuel system must then be bled free of air.

NORMAL SCRUBBING OPERATION

TO START A GASOLINE OR DIESEL POWERED MACHINE

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

PRE-START CHECKLIST

Check under machine for leak spots.
Check hydraulic fluid level using sight gauge.
Check engine lubricating oil level.
Check engine air filter.
Check engine coolant level.
Check fuel level.
Check brakes and controls for proper operation.

1. 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: Do not attempt to start the machine unless the operator is in the operator seat with the directional control pedal in the neutral position and with a foot on the brake pedal or with the parking brake engaged.

2. Cold gasoline engines: Pull out the choke button about three-fourths of the way. Push choke in after the engine has started and is running smoothly.
3. Move the throttle control lever to the "idle" position.
4. 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 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.

5. Allow the engine and hydraulic system to warm up three to five minutes.
6. Disengage the machine parking brake.
7. Drive the machine to the solution filling site.
8. Fill the machine with water and detergent.
9. Drive the machine to the area to be scrubbed.
10. Move the scrub head lock control lever to the "unlock" position.
11. Move the scrubbing control levers to the "head up" position to disengage the scrub head lock.
12. Move the scrubbing control lever to the "clean" position.
13. Place the squeegee switch in the "down" position.
14. Move the scrub solution flow control lever to the desired position.
15. Scrub as required.

TO STOP A GASOLINE OR DIESEL POWERED MACHINE

NOTE: Before leaving the machine, perform the post operation checks.

POST OPERATION CHECKLIST - ENGINE OPERATING

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

1. Return the directional control pedal to the neutral position. Apply the brake.
2. Move the solution flow control lever to the "off" position.
3. Move the scrub head lock lever to the "lock" position.
4. Move the scrubbing control levers to the "head up" position to engage the scrub head lock.

⚠ CAUTION: Make sure the scrub head lock has engaged before leaving the machine.

5. Move the scrubbing control levers to the "head off" position.
6. Place the squeegee switch in the "up" position.
7. Turn the operating lamps off if used.
8. Place the throttle control lever in the "idle" position on gasoline machines, "stop" position on diesel machines.
9. Engage the machine parking brake.
10. Turn the ignition key switch to the "off" position. Remove the key from the ignition switch.

⚠ CAUTION: Always engage the parking brake before leaving the machine.

POST OPERATION CHECKLIST - ENGINE STOPPED

Check for wire or string tangled on scrub brushes.
Check squeegees for wear or damage.
Empty and clean debris hopper.
Drain and clean recovery tank.
Check vacuum hoses for debris or obstructions.
Fill fuel tank.
Check for leaks.

TO START AN LPG POWERED MACHINE

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

PRE-START CHECKLIST

Check under machine for leak spots.
Check hydraulic fluid level using sight gauge.
Check engine lubricating oil level.

Check engine air filter.
Check engine coolant level.
Check fuel level.
Check for LPG odor indicating a leak.
Check for frosting on LPG hoses and components.
Check to make sure liquid withdrawal LPG tank is to be used.
Check brakes and controls for proper operation.

1. Check LPG fuel tank gauge to see if there is an adequate fuel supply.
2. 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.

3. The machine operator must be in the operator 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: Do not attempt to start the machine unless the operator is in the operator seat with the directional control pedal in the neutral position and with a foot on the brake pedal or with the parking brake engaged.

4. Cold engines: Pull out the choke button about three-fourths of the way. Push choke in after the engine has started and is running smoothly.
5. Move the throttle control lever to the "idle" position.
6. Turn the ignition switch key to the "start" position until the engine starts. Do not operate the starter for more than 10 seconds at a time or after the engine has started.

NOTE: Do not operate the starter motor for more than a few 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.

7. Allow the engine and hydraulic system to warm up three to five minutes.
8. Disengage the machine parking brake.
9. Drive the machine to the solution filling site.
10. Fill the machine with water and detergent.
11. Drive the machine to the area to be scrubbed.
12. Move the scrub head lock control lever to the "unlock" position.
13. Move the scrubbing control lever to the "head up" position to disengage the scrub head lock.
14. Move the scrubbing control levers to the "clean" position.
15. Place the squeegee switch in the "down" position.
16. Move the scrub solution flow control lever to the desired position.
17. Scrub as required.

TO STOP AN LPG POWERED MACHINE

NOTE: Before stopping the machine, perform the post operation checks.

POST OPERATION CHECK LIST - ENGINE OPERATING

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

1. Return the directional control pedal to the neutral position. Apply the brake.
2. Move the solution flow control lever to the "off" position.
3. Move the scrub head lock lever to the "lock" position.
4. Move the scrubbing control levers to the "head up" position to engage the scrub head lock.

⚠ CAUTION: Make sure the scrub head lock has engaged before leaving the machine.

5. Move the scrubbing control levers to the "head off" position.
6. Place the squeegee switch in the "up" position.
7. Turn the operating lamps off if used.
8. Place the throttle control lever in the "idle" position.
9. Engage the machine parking brake.

⚠ CAUTION: Always engage the parking brake before leaving the machine unattended.

10. Turn the ignition key switch to the "off" position. Remove the ignition key from the ignition switch.
11. Close the LPG tank liquid service valve.

POST OPERATION CHECKLIST - ENGINE STOPPED

Check for wire or string tangled on scrub brushes.
Check squeegees for wear or damage.
Empty and clean debris hopper.
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 indicating a leak.
Check for frosting on LPG hoses and components.
Check for leaks.

DOUBLE SCRUBBING OPERATION

Double-pass scrubbing should be necessary only for heavy soilage and buildup of dirt, wax, etc. Operate the machine with the scrubbing control levers in the "soak" position. This dispenses solution and allows both

brushes to rotate counter-clockwise with the rear squeegee up. Spread solution over the area to be double scrubbed. 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 scrubbing control levers in the "clean" position.

CAUTION: Use care when driving on wet surfaces.

OPERATION ON GRADES

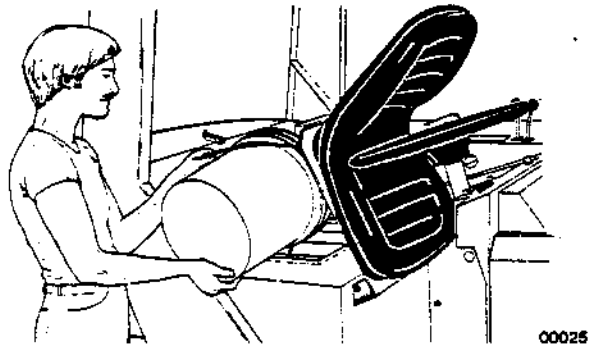
Drive the machine slowly on grades. Use the brake to control machine speed.

CAUTION: Always travel slowly on grades.

The maximum rated ramp climb and descent angle is 10° with empty solution and recovery tanks, and 8° with full solution and recovery tanks.

FILLING SOLUTION TANK AND ADDING DETERGENT

1. Close solution flow control valve.
2. Lift the hinged operator seat.
3. Fill the solution tank one-half full with warm water.
4. Add detergent to the solution tank. See Detergent Recommendations for detergent amounts.



ADDING DETERGENT TO SOLUTION TANK

5. Fill the solution tank with warm water to 1 in (25.4 mm) below the solution tank opening.
6. Lower the operator seat.

DETERGENT RECOMMENDATIONS

TENNANT DETERGENTS	601	602	651	652
Maintenance Clean	4 lbs (1.8 kg)	4 lbs (1.8 kg)	2 qt (1.9 L)	2 qt (1.9 L)
General Clean	8 lbs (3.6 kg)	8 lbs (3.6 kg)	1 gal (3.8 L)	1 gal (3.8 L)
Moderate Buildup	12 lbs (5.4 kg)	12 lbs (5.4 kg)	1.5 gal (5.6 L)	1.5 gal (5.6 L)
Heavy Buildup	16 lbs (7.2 kg)	16 lbs (7.2 kg)	2.0 gal (7.6 L)	2.0 gal (7.6 L)

The soap basket will hold 5 lbs (2.3 kg) of powder detergent.

WARNING: Do not use flammable or combustible cleaning agents.

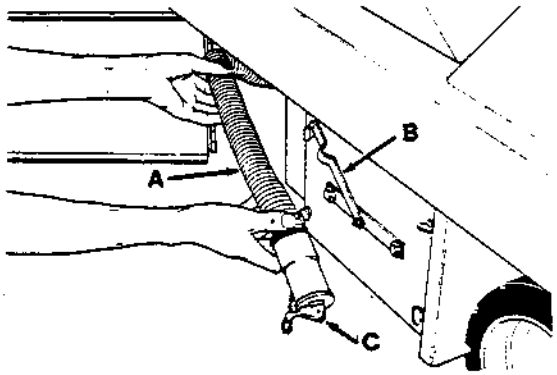
The above chart is only a general guide. Floor conditions, amount of soilage, type of soilage, brush action, and squeegee action all play an important role in determining the type and concentration of detergent to be used. For specific recommendations, consult with the local Tennant Company Representative.

DRAINING THE RECOVERY TANK

1. Drive the machine to the floor drain, positioning the left side of the machine next to the drain.
2. Stop the engine.
3. Engage the parking brake.

CAUTION: Always stop the engine and engage the parking brake before working on the machine.

4. Open the left side recovery tank access door.
5. Remove the recovery tank drain hose from the retaining clip.



DRAINING RECOVERY TANK

A. Drain Hose
B. Hose Retaining Clip
C. Hose Plug

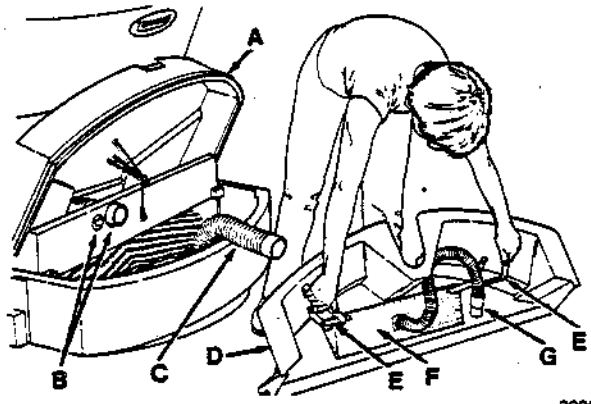
6. Place the end of the hose at the drain opening.
7. Unlock and remove the rubber drain hose plug.
8. Allow the tank to drain completely.
9. At the end of each shift, the recovery tank must be cleaned as described in the Maintenance section.

DEBRIS HOPPER DUMPING AND CLEANOUT

1. Lower the scrub head.
2. Stop the engine.
3. Engage the parking brake.

CAUTION: Always stop the engine and engage the parking brake before working on the machine.

4. Unlatch and raise the scrub head cover.
5. Disconnect the rear squeegee vacuum hose from the squeegee suction tube.
6. Disconnect the debris hopper screen suction hose from the suction tube.



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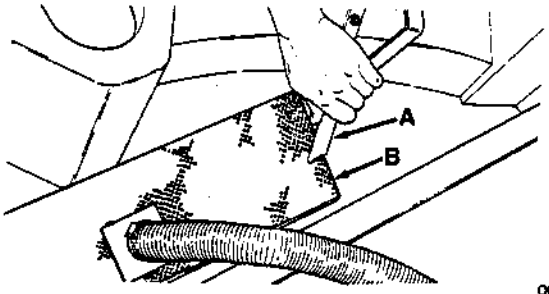
REMOVING DEBRIS HOPPER

A. Scrub Head Cover
B. Suction Tube
C. Squeegee Suction Hose
D. Debris Hopper
E. Debris Hopper Handles
F. Debris Screen
G. Debris Screen Suction Hose

7. Grasp the two debris hopper handles and lift out the debris hopper.
8. Empty the debris hopper.
9. Slide the debris screen retainers aside and remove the debris screen.



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REMOVING DEBRIS SCREEN

A. Debris Screen Retainer
B. Debris Screen

10. Hose off the debris hopper, screen and suction hose.
11. Replace the debris hopper.
12. Place the screen in the debris hopper.
13. Reconnect the rear squeegee and debris screen suction hoses.
14. Close the scrub head cover.

ACCESSORIES OPERATION

VACUUM WAND

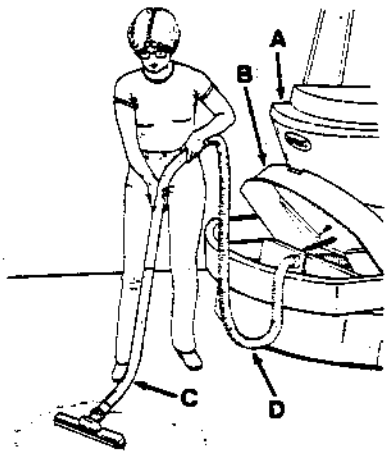
The vacuum wand accessory gives the machine the added flexibility of picking up spills not accessible by the machine. An 84 in (2137 mm) hose utilizes the machine vacuum system.

TO OPERATE THE VACUUM WAND

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

CAUTION: Always engage the parking brake before operating the vacuum wand.

2. Open the rear storage door and remove the vacuum wand equipment.
3. Open the scrub head cover.
4. Remove the large diameter squeegee suction hose from its scrub head frame connection.
5. Push the vacuum wand hose on the scrub head frame connection.
6. Assemble the wand and hose.
7. Start the engine.
8. Place the throttle control in the "full" position.
9. Utilize the vacuum wand as required.
10. When finished, shut off the engine.
11. Remove the vacuum wand hose from the scrub head connection.



00046

OPERATING THE VACUUM WAND

A. Rear Storage Door
B. Scrub Head Cover
C. Wand
D. Hose

12. Reconnect the squeegee suction hose.
13. Clean and rinse off the squeegee wand and equipment as required.
14. Store the squeegee wand equipment in the proper locations.

POWER SCRUBBER - 527 MM133 (5-82) LITHO IN U.S.A.

TRANSPORTING MACHINE

PUSHING THE MACHINE

To push the machine from the front, push on the front bumper. To push from the rear, push only on the rear bumper. Pushing on the scrubber head will damage the linkage.

ATTENTION! The maximum allowable machine towing distance is 0.5 mile (0.8 km) at up to 1 mph (1.6 km/h). Further distance or greater speed may damage the hydraulic components.

MACHINE JACKING INSTRUCTIONS

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

CAUTION: Always engage the machine parking brake before working on the machine.

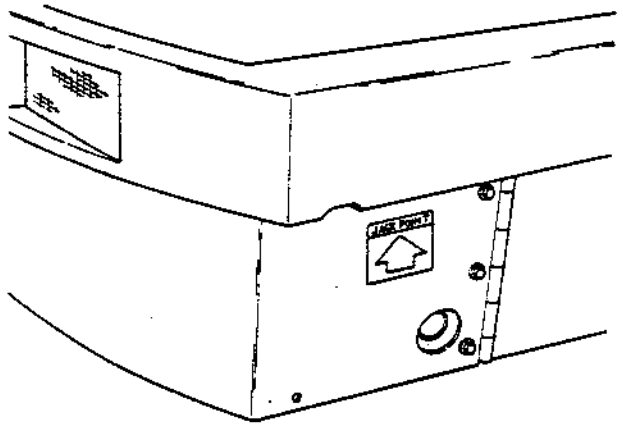
2. Empty the solution and recovery tanks before attempting to jack the machine up.
3. Block the tires which are not being jacked up to secure the machine's position.

CAUTION: Always block the machine tires before jacking the machine up.

4. Use a scissors or hydraulic type jack to raise the machine. Jack up the machine only at the designated locations.

CAUTION: Jack machine up only at the designated locations.

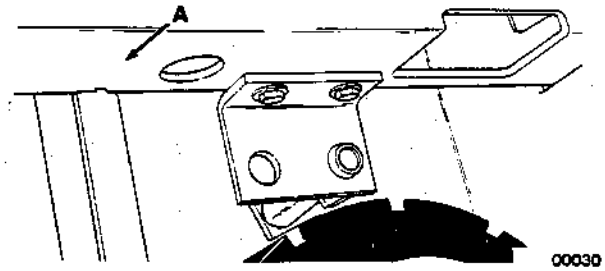
The front jack locations are near the front corner of the machine frame. Place the jack on the underside of the bumper.



00029

FRONT LEFT JACKING LOCATION

The rear jack locations are next to the rear wheels. The lower access doors must be open to allow the jack to contact the underside of the bumper.



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REAR JACKING LOCATION (LEFT SIDE SHOWN)

A. Rear Jack Location

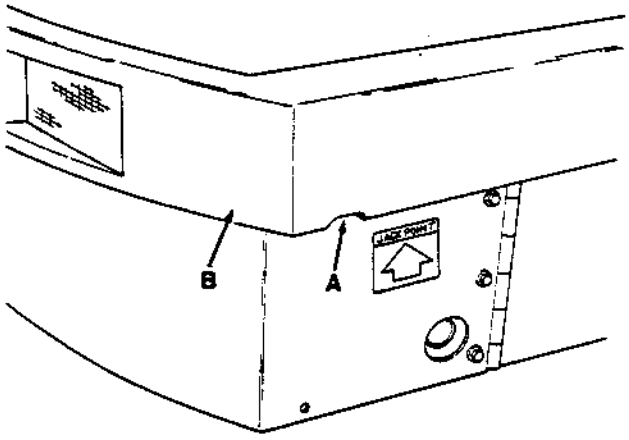
5. Block machine up with jack stands or similar devices to make sure machine is secure.

WARNING: Always use jack stands or similar devices to hold the machine up. Scissors or hydraulic type jacks may slip or "leak down" 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 up 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-DOWN INSTRUCTIONS

To tie the front of the machine down, use the tie-down slots provided. The front tie-down slots are located in the front corner of the machine frame.



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FRONT LEFT TIE-DOWN SLOT

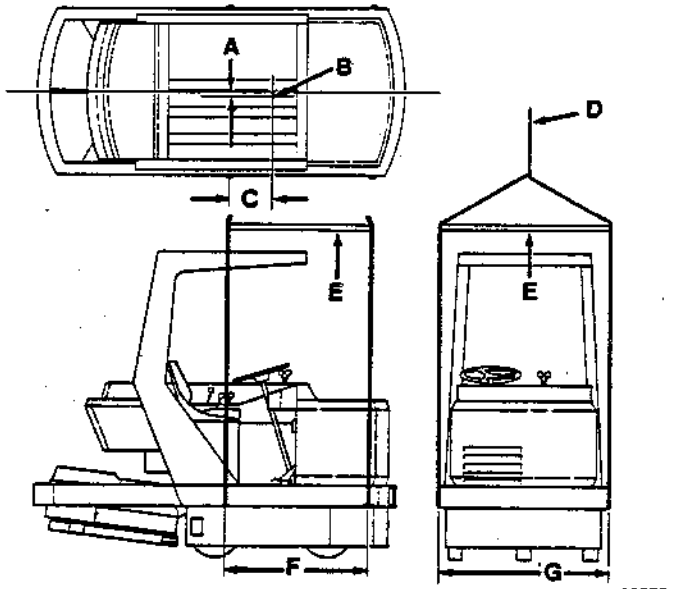
A. Tie-Down Slot
B. Machine Bumper

To tie the rear of the machine down, wrap chains around each corner of the rear bumper. Then secure the other end of the chain to the trailer on truck bed tie-downs.

MACHINE LIFTING INSTRUCTIONS

1. Make sure the chain and the lifting crane are of adequate capacity to lift the machine.
2. Empty the solution and recovery tanks.
3. Lock the scrub head in the "raised" position.
4. Use a chain and lifting bar arrangement similar to the one illustrated.
5. Attach the lifting chains in the front notches at each front corner.
6. When lifting the machine, be sure that the chains or cables do not rest against any fiberglass shrouding. The chains may damage the fiberglass shrouding. Lift at the center of gravity to avoid an uneven load.
7. Open and secure the lower access doors.
8. Attach the lifting chains to the side bumper above each rear wheel.
9. Stand clear of the machine when lifting.

WARNING: Always stand clear of the machine when it is being lifted.



LIFTING MACHINE

A. 1.6 in. (41 mm)
B. Lifting Center of Gravity
C. 13.6 in (345 mm)
D. Lifting Chain
E. Chain Separator
F. 46.1 in (1171 mm)
G. 51.4 in (1306 mm)

MACHINE STORAGE

STORING MACHINE

When storing the machine for extended periods of time, the following procedures must be followed to lessen the chance of rust, sludge, and other undesirable deposits to form.

1. Change engine oil.
2. Drain and clean out the solution recovery and cleaning solution tanks; whichever the machine is equipped with.
3. Park the machine in a cool and dry area.
4. Raise and lock the scrub head in the "raised" position.
5. Stop the engine.
6. Fill the hydraulic reservoir with hydraulic fluid, to the full mark on the sight gauge, to prevent excessive condensation from forming in the reservoir.

GASOLINE AND LPG POWERED MACHINES

To store the machine 30 to 90 days:

1. Remove the spark plugs.
2. Pour 3 oz (0.09 L) 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.
4. Replace the high tension coil wire and spark plugs.
5. Drain the gasoline from the carburetor bowl by removing the carburetor bowl drain plug.
6. Replace the carburetor drain plug.

To store the machine 90 days to 6 months:

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.

1. Remove the spark plugs.
2. Pour 3 oz (0.09 L) of SAE 30 or SAE 40 engine oil into each of the spark plug holes.
3. Remove the ignition coil high tension wire. Operate the engine starter for at least a dozen revolutions. This distributes the oil over the cylinder walls. Replace the spark plugs.
4. Drain the engine oil from the engine oil pan.
5. Drain the engine cooling system, the radiator, and the engine block of coolant.
6. Close the drain cocks.
7. Drain gasoline from the carburetor, fuel tank, and the fuel lines.
8. Seal the air cleaner inlet, the exhaust outlet, and the crankcase breather tube with weather proof masking tape.
9. Tighten the engine oil filler cap, the fuel tank cap, and the radiator cap to make certain they are securely in place.

DIESEL POWERED MACHINES

1. Thoroughly clean all external parts of the engine. Clean the radiator by spraying high pressure water in the opposite direction of the normal flow of air.

2. Drain all fuel from the tank and filters. Pour at least one gallon of new #1 diesel fuel into the fuel tank.

   Prime the fuel system thoroughly in the normal manner.

   Start the engine and run it until the oil has circulated thoroughly through the pump, pipes, and injectors; approximately 15 minutes at half maximum speed.

   Stop the engine.

   Seal the air vent in the fuel tank cap with waterproof tape.

3. Drain the water by removing the radiator cap and opening all the drain cocks both on the cylinder block and the radiator. To ensure complete draining, remove the drain cocks entirely and check that the holes are not blocked by scale. Wire the drain cocks to the engine to prevent losing them. Replace the radiator cap.

4. Remove the injectors and pour a small amount of pure castor oil into the cylinder bores. The use of castor oil assures complete protection to the cylinder walls during the lay-up period.

5. Replace the injectors, using new copper sealing washers, and slowly rotate the crankshaft one complete revolution to evenly distribute the lubricant. Do not rotate the crankshaft further as this may destroy the protective film on the bore walls.

6. Remove the air cleaner and carefully seal the intake orifice with waterproof tape or some other suitable substance.

7. Remove the exhaust pipe and seal the manifold outlet.

8. Remove the valve rocker cover, lubricate the rocker gear with engine oil, and replace cover. Make sure that the gasket is correctly fitted.

9. Clean the engine breather pipe. Seal the end with waterproof tape or a cork.

10. Remove any v-belts fitted to the engine and keep them for future use. Attach the v-belts to the engine to prevent loss.

SECTION 3
MAINTENANCE

CONTENTS

CONTENTS

RECOMMENDED FIRST 50-HOUR MACHINE INSPECTION

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

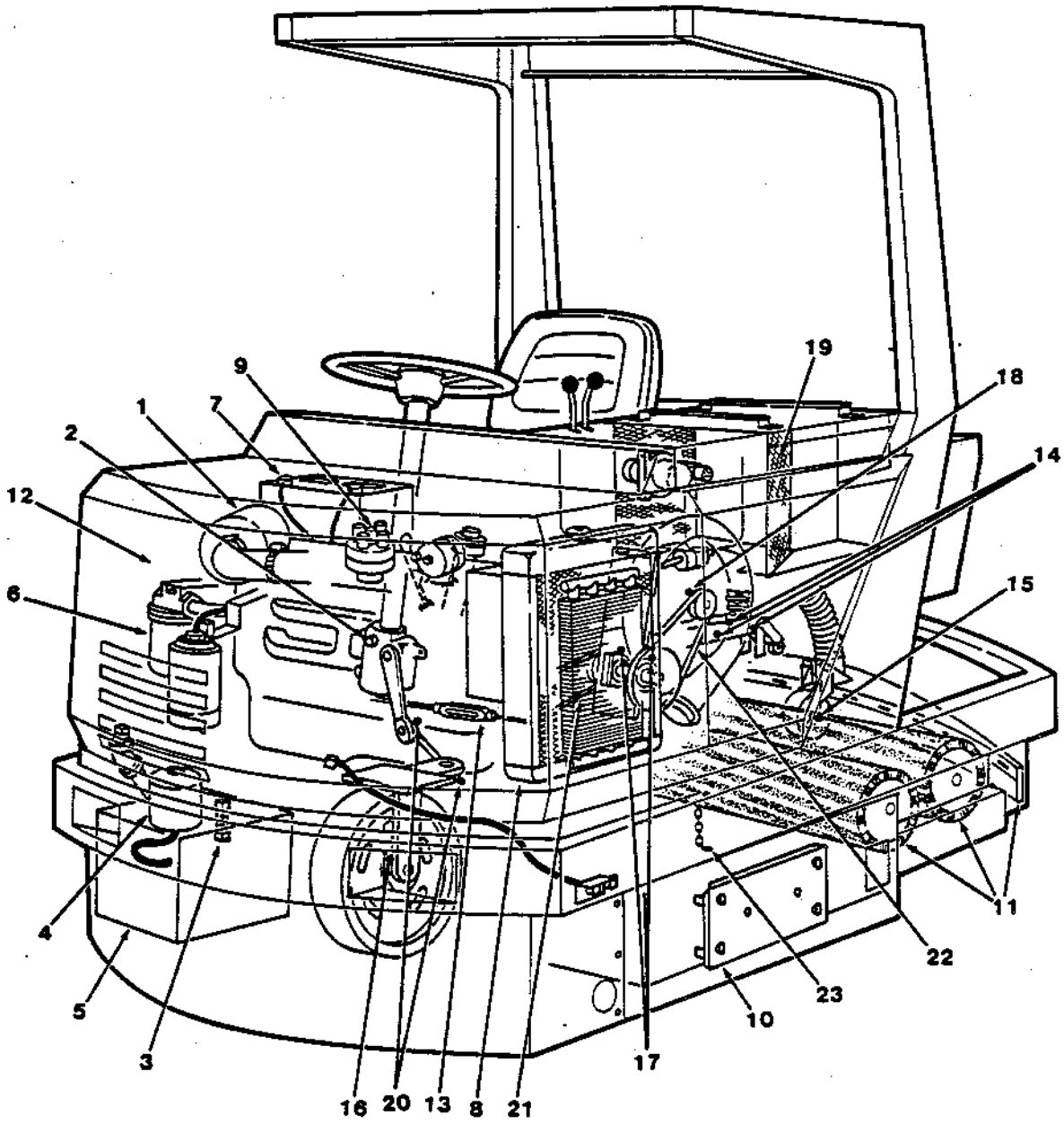
1. Perform the brush pattern test to check for correct brush adjustment.
2. Check the scrubber head side squeegee blades for wear or damage.
3. Check the rear squeegee for worn or damaged blades or for incorrect adjustment.
4. Check the vacuum fan v-belt for correct tension adjustment.
5. Check the vacuum hoses for damage or loose connections.
6. Perform all remaining 50-hour lubrication and maintenance procedures listed in the Maintenance Chart.

GASOLINE AND LPG POWERED MACHINES:

1. Check engine valve tappet clearance.
2. Check engine spark plug gap.
3. Check engine breaker point gap.
4. Check engine ignition timing.
5. Torque down cylinder head bolts.
6. Check engine idle speed.

DIESEL POWERED MACHINES:

1. Remove the rocker assembly and tighten the cylinder head nuts in the correct sequence and to the correct torque.
2. Reset the valve tip clearance.



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MAINTENANCE CHART

MAINTENANCE CHART

Index No.	Description	Procedure	Interval (Hours) 8	50	100	150	250	400	500	2400
1	Engine air cleaner	Clean element		X						
		Replace element					X			
2	Steering gear box	Check level, add grease							X	
3	Hydraulic fluid reservoir sight gauge	Check fluid level gauge	X							
4	Hydraulic fluid reservoir breather filter	Clean element							X	
5	Hydraulic reservoir	Change hydraulic fluid, clean hydraulic reservoir							X	
6	Hydraulic fluid filter	Change filter element							X	
7	Battery	Check electrolyte level		X						
		Clean battery top			X					
8	Radiator	Check coolant level	X							
		Flush coolant system							X	
9	Engine - gasoline, LPG	Check engine oil level	X							
		Change engine oil and oil filter		X						
		Clean gasoline fuel filter				X				
		Replace gasoline fuel filter							X	
		Replace LPG fuel filter pad						X		
		Disassemble and clean LPG vaporizer-regulator						X		
		Clean spark plugs					X			
		Check points, set gap					X			
		Check ignition wires					X			
		Lubricate distributor cam and shaft					X			
		Clean PCV system					X			
		Adjust valve tappets							X	
		Check hoses and clamps					X			
		Check fan belt tension		X						
	Engine - diesel	Check engine oil level	X							
		Check engine oil and oil filter				X				
		Check fan belt tension				X				
		Clean fuel water trap				X				
		Replace fuel filter						X		
		Check valve tip clearances								X
		Service fuel injectors								X
10	Recovery tank, vacuum hose, etc.	Clean out	X							
11	Brushes and squeegees	Inspect for damage, adjustment and wear	X							
12	Miscellaneous linkages	Lightly oil					X			
13	Brake adjustment	Adjust brake cable tension					X			
		Adjust parking brake striker clearance					X			
14	Scrub head	Apply grease to fittings (3)		X						
15	Rear squeegee roller	Apply grease to fitting		X						
16	Front caster wheel	Apply grease to fittings (2)		X						
17	Fan jackshaft bearings	Apply grease to fittings (2)		X						
18	Vacuum fan	Apply grease to fitting		X						
19	Recovery reservoir filter screen	Clean screen	X							
20	Steering arm	Apply grease to fittings (2)		X						
21	Engine to jackshaft belt	Check tension					X			
22	Jackshaft to vacuum fan belt	Check tension					X			
23	Static drag chain	Check for wear					X			

ENGINE - GASOLINE, LPG

Check the engine oil level after every 8 hours of operation. Change the engine oil and oil filter after every 50 hours of operation. Use an engine oil meeting the SAE requirements rating SE.

The following SAE oil grades are general recommendations for engines during changing seasonal temperatures:

SEVERE WINTER BELOW 0°F. (-17°C)	NORMAL WINTER 0° to 32°F. (-17° to 0°C)	SPRING-FALL 32° to 75°F (0° to 24°C)	SUMMER ABOVE 75°F (24°C)
5W-20	10W	20W	30

The multi-grade oil used should cover the single grade recommendation for the temperatures involved; SAE 10W-30 covers SAE -10W, SAE-20W, SAE 20 and SAE 30.

The engine oil capacity is 4 qt (3.8 L) including oil filter. Add 3 to 5 drops of engine oil to the distributor shaft oil wick every 250 hours.

Lightly grease the distributor cam with distributor cam grease whenever the points are replaced.

ENGINE - DIESEL

Check the engine oil level after every 8 hours of operation. After the first 50 hours of operation, change the engine oil and engine oil filter. Then, after every 150 hours of operation, change the engine oil and engine oil filter. Change the engine oil more frequently if the operating environment is extremely dusty.

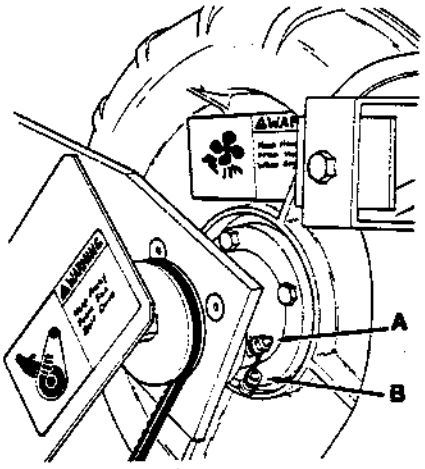
Use an engine oil meeting the SAE requirements rating CC. The following SAE oil grades are general recommendations for engines during the changing seasonal temperatures.

0° to 45°F (-17° to 7°C)	45° to 80°F (7° to 27°C)	Above 80°F (Above 27°C)
10W	20W/20	30

Multi-grade oil should cover the single grade recommendation for the temperatures involved. The engine oil capacity is 5 qt (4.7 L).

VACUUM FAN

Grease the vacuum fan and jackshaft bearings after every fifty hours of operation. The vacuum fan grease fitting is covered with a plastic cap. Snap the cap open and pump the fan housing full so that grease appears between the sheave and the bearing. Use only Chevron "SRI" #2 or Lubriplate "EMB" (TENNANT® Part No. 01433-1). Wipe off all excess grease around the sheave. Replace the grease fitting cap.

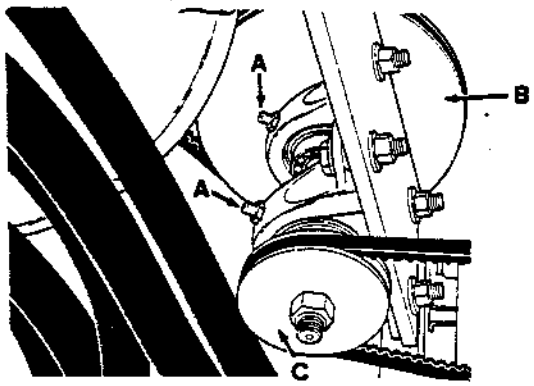


00063

VACUUM FAN LUBRICATION

A. Vacuum Fan Grease Fitting
B. Grease Fitting Cover

The two jackshaft grease fittings are to be pumped with a general purpose, water resistant, lithium base, moly-disulfide grease.



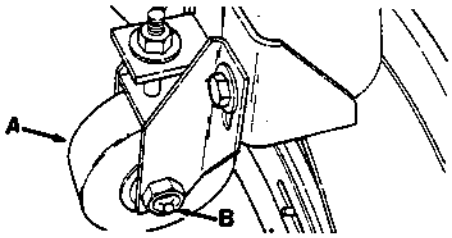
00006

JACKSHAFT LUBRICATION (AS SEEN FROM THE ENGINE SIDE OF THE JACKSHAFT.)

A. Grease Fitting
B. Vacuum Fan Drive Sheave
C. Jackshaft Drive Sheave

REAR SQUEEGEE CASTER

Grease the rear squeegee caster after every 50 hours of operation. Use a general purpose, water resistant, lithium base, moly-disulfide grease. Spin the caster to make sure it turns freely.



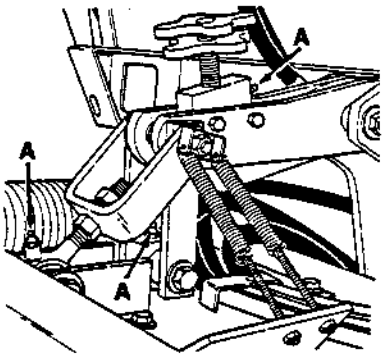
00022

REAR SQUEEGEE CASTER LUBRICATION

A. Caster
B. Caster Grease Fitting

SCRUB HEAD

Grease the three brush pressure adjustment grease fittings after every 50 hours of operation. Use a general purpose, water resistant, lithium base, moly-disulfide grease.



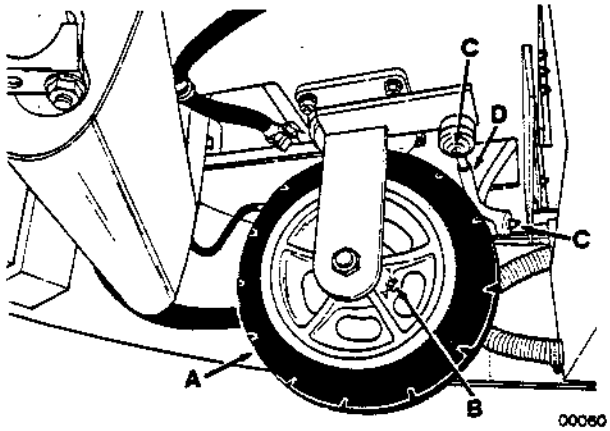
00089

SCRUB HEAD LUBRICATION

A. Grease Fittings

FRONT CASTER WHEEL

Grease the front caster wheel and swivel after every 50 hours of operation. Use a general purpose water resistant, lithium base, moly-disulfide grease.



00060

FRONT WHEEL AND STEERING ARM LUBRICATION

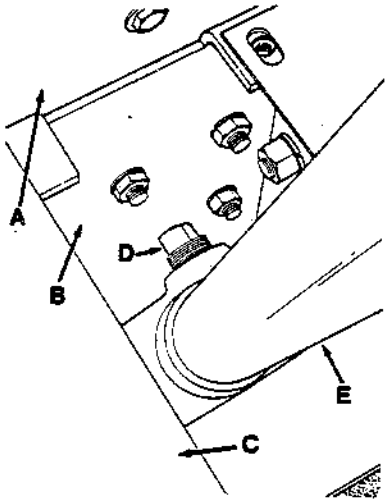
A. Front Wheel
B. Front Wheel Grease Fitting
C. Steering Arm Grease Fitting
D. Steering Arm
E. Steering Arm Swivel Grease Fitting

STEERING ARM

Grease the two steering arm grease fittings after every 50 hours of operation. Use a general purpose water resistant, lithium base, moly-disulfide grease.

STEERING GEAR

Check the steering gear grease level after every 500 hours of operation. Fill if required with grease that meets S.S.G. spec 5676630.



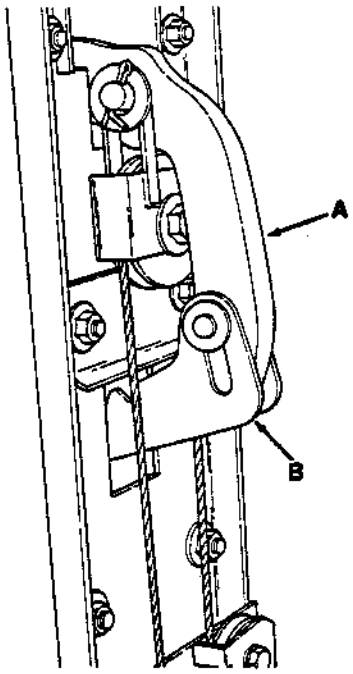
00013

STEERING GEAR LUBRICATION

A. Firewall
B. Access Door Removed
C. Floor
D. Steering Gear Lubrication Plug
E. Steering Column

BRAKE LINKAGE

Lightly oil the area between the parking brake ratchet and the brake pedal after every 250 hours of operation.

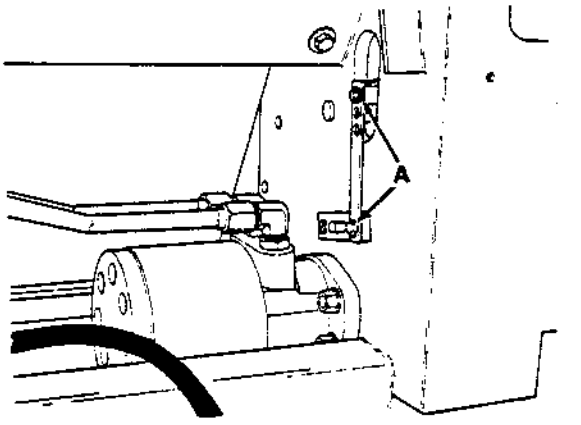


PARKING BRAKE LUBRICATION 00009

A. Brake Pedal
B. Parking Brake Ratchet

Lightly oil all brake linkage pivots after every 500 hours of operation.

NOTE: Do not allow any grease or oil to reach the brake lining.



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BRAKE LINKAGE LUBRICATION (right side shown)

A. Brake Linkage Pivot

RECOMMENDED HYDRAULIC FLUID

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 (10W40)	TENNANT® Hyd. Fluid No. 32398 (20W60)
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 quite constant over wide temperature ranges.

ATTENTION! If a locally-available hydraulic fluid is preferred, or if products of only one oil company are used, the hydraulic oil 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.

Change the hydraulic fluid and clean out the hydraulic fluid reservoir after every 500 hours of service.

HYDRAULIC FLUID RESERVOIR

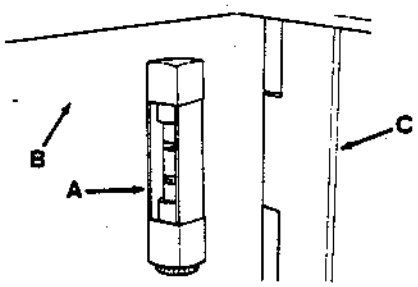
Hydraulic fluid is stored in the hydraulic fluid reservoir. The reservoir holds up to 5.7 gal (21.6L) of hydraulic fluid. The reservoir is located in the lower front corner of the machine.

Check the hydraulic fluid level daily.

The hydraulic fluid level should be between the "high" and "low" marks on the sight gauge. Do not overfill the reservoir.

ATTENTION! Do not overfill the hydraulic fluid reservoir or operate the machine with a low level of hydraulic fluid in the reservoir. Either one may cause damage to the machine hydraulic system.

Drain and clean out the hydraulic fluid reservoir after every 500 hours of operation.



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HYDRAULIC RESERVOIR SIGHT GAUGE

A. Sight Gauge
B. Hydraulic Reservoir
C. Right Access Door

The reservoir is equipped with a breather, a filler neck, and a sight gauge. The reservoir breather and filler neck are located inside the engine compartment. See Hydraulic Fluid Reservoir Breather for breather service information. The filler neck has a square head plug on top to prevent dirt or debris from contaminating the fluid. The sight gauge is located inside the lower right access door. The sight gauge is provided to indicate the level of hydraulic fluid in the reservoir.

TO DRAIN THE HYDRAULIC FLUID RESERVOIR

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

⚠ CAUTION: Always stop the engine and engage the parking brake before working on the machine.

2. Open the engine hood and the lower right access door.
3. Drain the hydraulic fluid by removing the reservoir drain plug located on the lower rear of the reservoir. Discard the used hydraulic fluid.
4. Remove the access cover on top of the reservoir.
5. Remove and clean the reservoir sump screen filter.
6. Clean the inside of the reservoir.
7. Reinstall the sump filter screen and access cover.
8. Reinstall the reservoir drain plug.

TO FILL THE HYDRAULIC FLUID RESERVOIR

1. Remove the filler neck plug.
2. Pour the new hydraulic fluid into the hydraulic fluid reservoir through a 200 mesh screened funnel. Watch the hydraulic fluid level on the sight gauge. Do not overfill the reservoir.

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

3. When the reservoir is full, replace the filter neck plug.
4. Lower the engine hood.

HYDRAULIC FLUID RESERVOIR BREATHER

The hydraulic fluid reservoir is equipped with a breather. The breather maintains atomospheric pressure in the reservoir. The breather should be replaced after every 500 hours of operation.

HYDRAULIC FLUID FILTER

The hydraulic system is kept clean to a level of 10 microns by a hydraulic fluid filter. The hydraulic fluid filter should be changed after every 500 hours of operation.

TO REPLACE HYDRAULIC FLUID FILTER ELEMENT

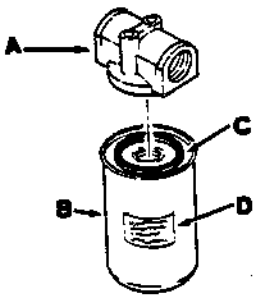
1. Park the machine on a flat surface and engage the machine parking brake.

⚠ CAUTION: Always engage the parking brake before working on the machine.

2. Raise the engine hood.
3. Rotate the filter element counter-clockwise from the bottom, to remove the filter element.
4. Discard the removed filter element.

NOTE: Discard all hydraulic fluid drained from the system. Drained hydraulic fluid may contain foreign material harmful to the hydraulic system.

5. Apply a thin coat of hydraulic fluid to the o-ring of the new filter element.
6. Thread the new filter element onto the filter head. Hand tighten the filter element.
7. Operate the machine and check for leaks. Correct any leaks found.



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HYDRAULIC FLUID FILTER

A. Filter Head
B. Filter Element
C. O-Ring
D. Element Part Number

HYDRAULIC PUMPS

On gasoline and LPG powered machines, the propelling hydraulic pump is a variable displacement piston pump. It is driven by the engine via a chain coupling. The accessories hydraulic pump is a vane pump. It is gear driven by the engine. The accessories pump is located next to the engine governor.

On diesel powered machines, the propelling hydraulic pump is a variable displacement piston pump. It is driven off the engine crankshaft. The accessories hydraulic pump is a vane pump. It is a piggy-back mounted to the propelling pump.

When replacing the propelling hydraulic pump, the new or rebuilt pump must be primed with hydraulic fluid before it can be put into service. Before the machine is started:

1. The pump housing must be full of hydraulic fluid.
2. The pintle arm must be placed at a position exceeding 40% of the full stroke.
3. The rear wheels must be jacked up and secured with jackstands.

Start the engine with the rear wheels jacked up. Let the engine run at low speed for five minutes to warm up. Operate the machine in reverse for two minutes at full speed and full engine throttle. Lower the machine.

When replacing the accessories hydraulic pump, the new or rebuilt pump must be primed before it can be put into service. To prime the pump, remove the inlet line and add 1 pt (0.5 L) of hydraulic fluid to the pump port. Then replace the inlet line. Be sure to check the drive belt tension after installing the pump.

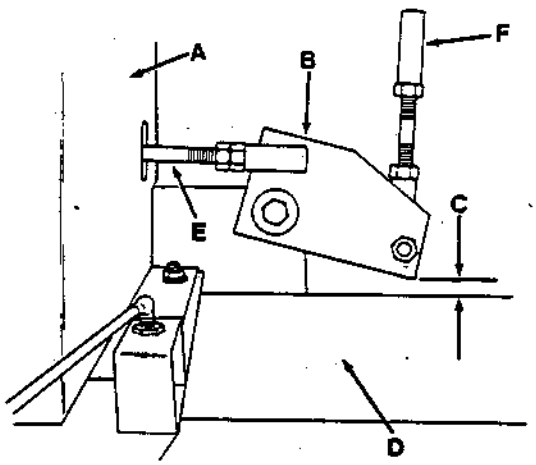
PROPELLING PUMP LINKAGE ADJUSTMENT

After replacing the pump or pump linkages, the pump linkage must be adjusted as follows:

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

⚠ CAUTION: Always stop the engine and engage the machine parking brake before making adjustments. Make adjustments by trial and error.

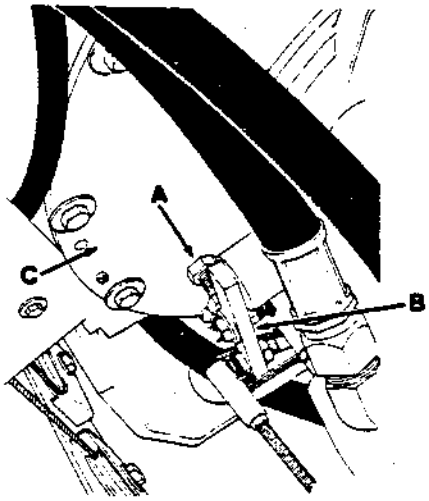
2. Hold the directional control pedal in the reverse position.
3. Adjust the control rod between the directional control pedal and the bellcrank to give 0.38 ± 0.06 in (9.6 ± 1.5 mm) clearance between the frame and the corner of the bellcrank.



PUMP LINKAGE ADJUSTMENT 00043

A. Engine Firewall
B. Bellcrank
C. 0.38 ± 0.06 in (9.6 ± 1.5 mm)
D. Frame
E. Control Rod from Pedal
F. Control Rod to Pump

4. Adjust the pump control rod ball joints between the bellcrank and the pump to give the machine a reverse speed of 4 mph (6.4 km/h). Make sure the adjustment also gives a full stroke in the forward speed.
5. Diesel powered machines: Adjust pump pintle arm stop bolt to stop the pump pintle arm at a machine speed of 8 mph (12.9 km/h).

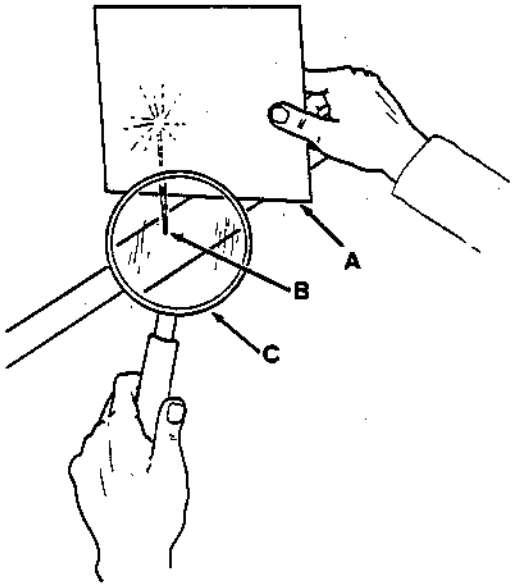


PUMP PINTLE ARM 01230

A. Stop Bolt
B. Pintle Arm
C. Pump Mounting Plate

HYDRAULIC FLUID LEAKS

Fluid escaping from a very small hole can be almost invisible. Use a piece of cardboard or wood, rather than hands, to search for suspected leaks.

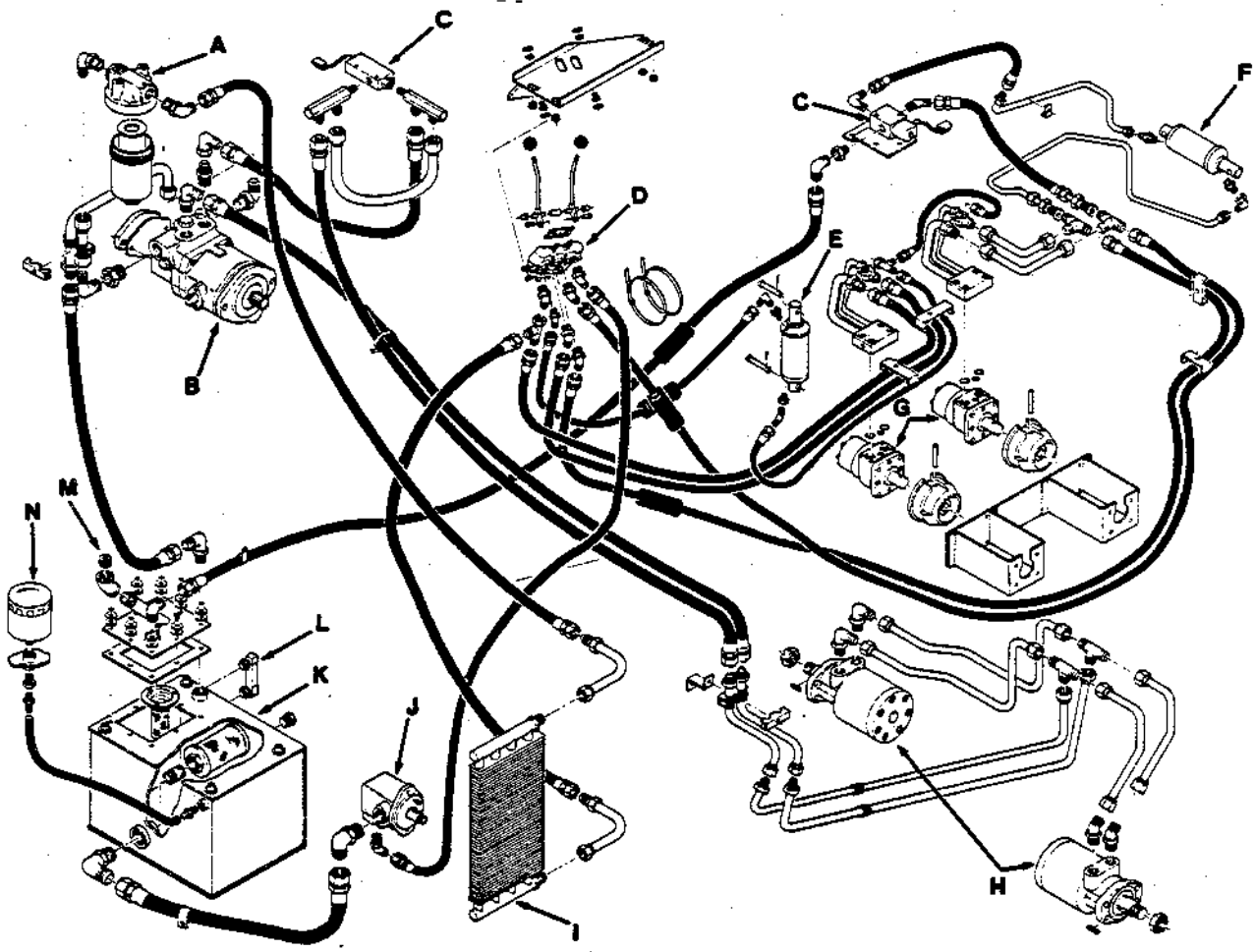


HYDRAULIC PIN HOLE LEAK 00002

A. Cardboard
B. Pin Hole Leak
C. Magnifying Glass

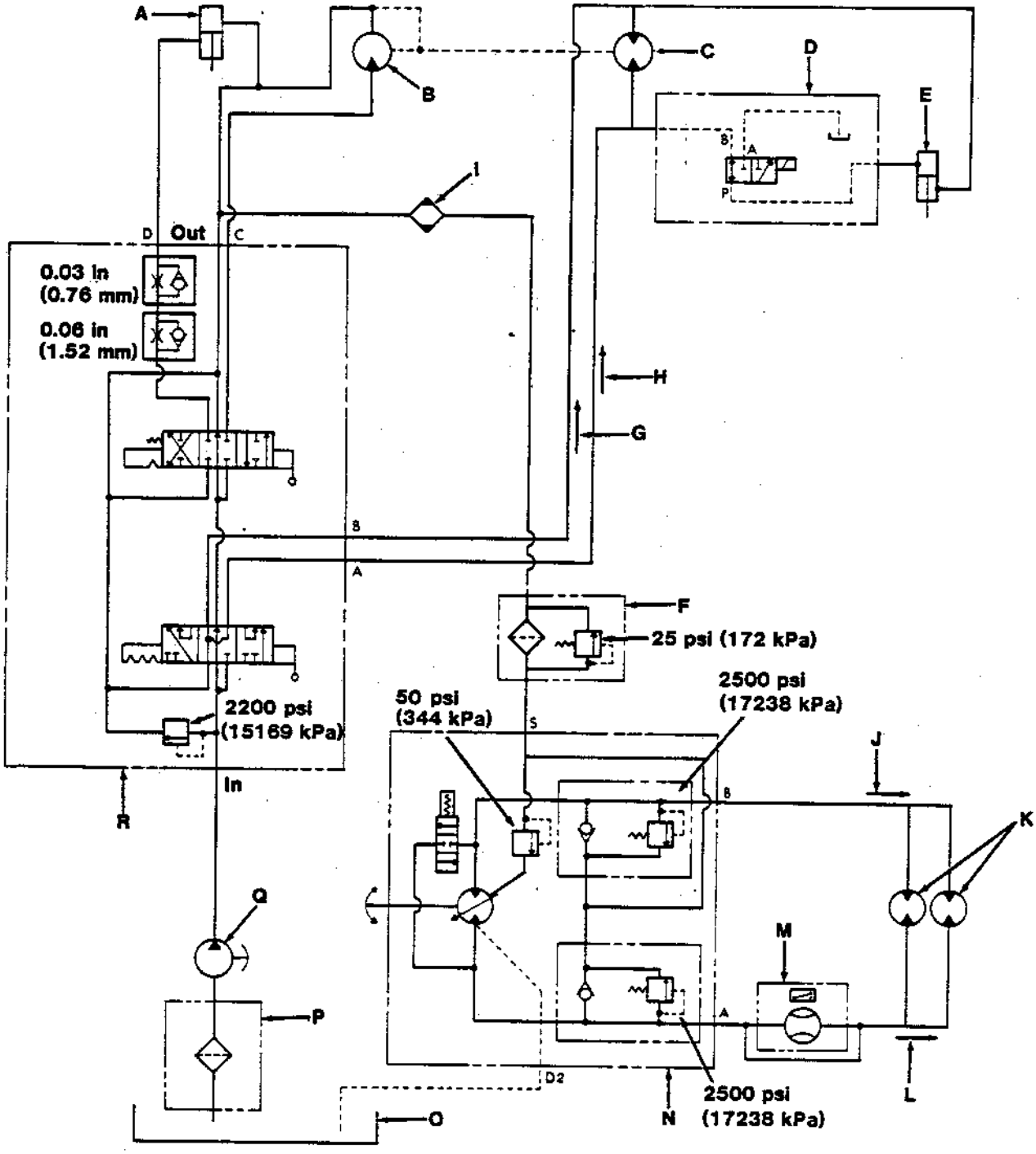
If injured by escaping fluid, see a doctor at once. Serious infection or reaction can develop if proper medical treatment is not administered immediately.

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



HYDRAULIC SYSTEM PICTORIAL DIAGRAM - GASOLINE, LPG 00098

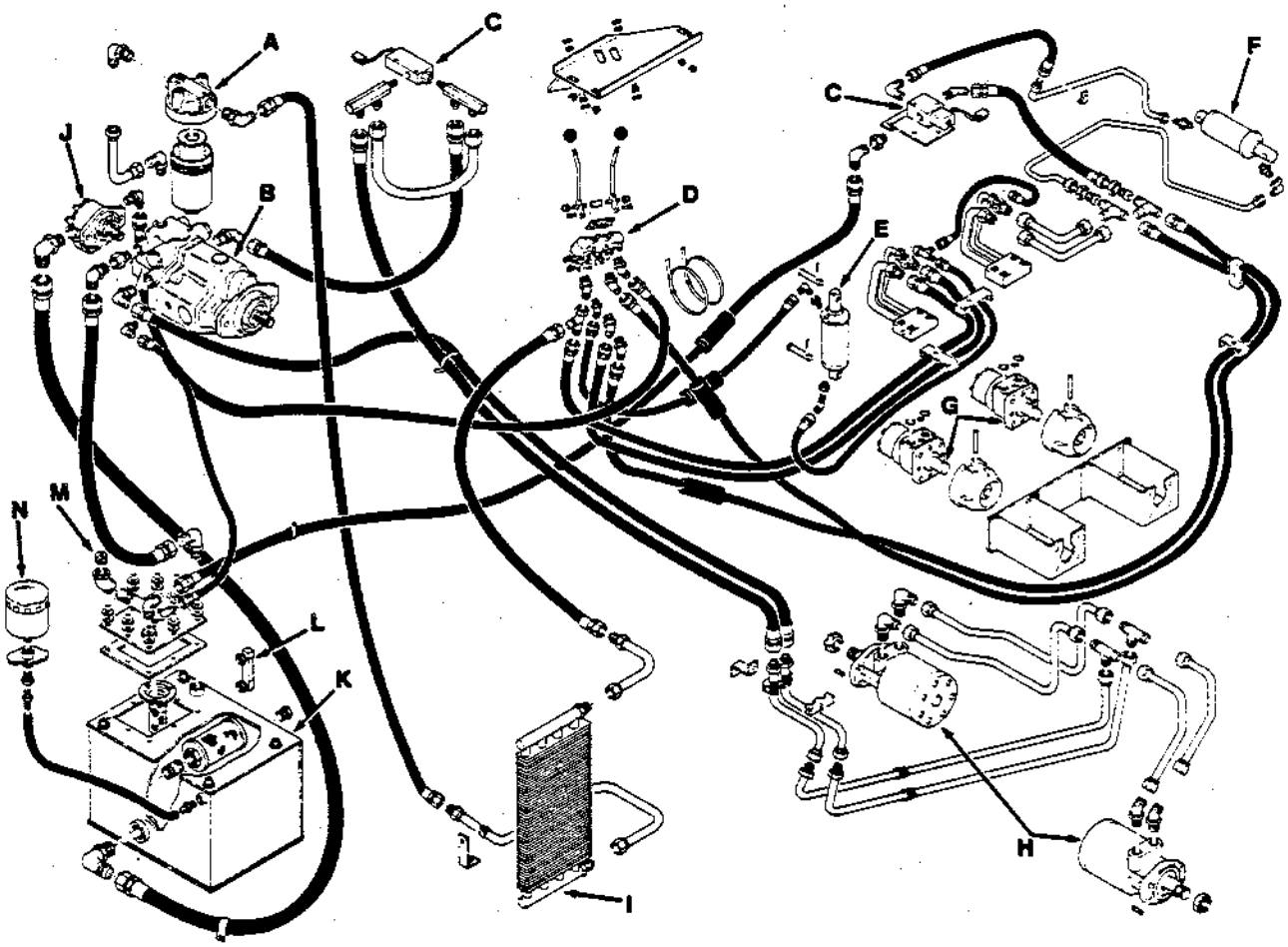
A. Hydraulic Fluid Filter
B. Hydraulic Propelling Pump
C. Hydraulic Sensing Block
D. Hydraulic Control Valve
E. Scrub Head Lift Cylinder
F. Rear Squeegee Lift Cylinder
G. Scrub Brush Drive Motor
H. Propelling Motor
I. Heat Exchanger
J. Hydraulic Accessory Pump
K. Hydraulic Fluid Reservoir
L. Hydraulic Fluid Level Sight Gauge
M. Hydraulic Fluid Reservoir Fill Plug
N. Hydraulic Fluid Reservoir Breather



00081

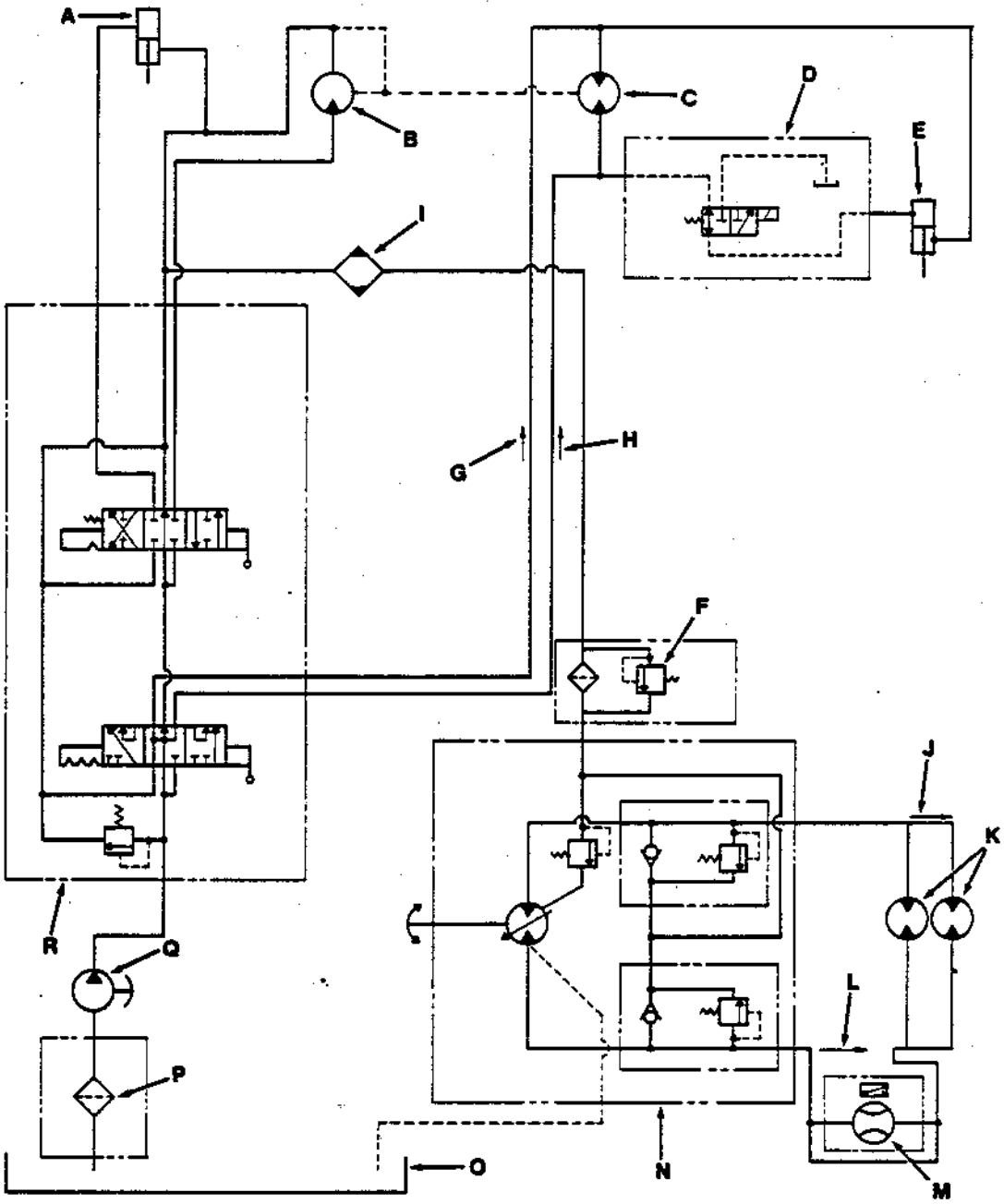
HYDRAULIC SYSTEM SCHEMATIC DIAGRAM - GASOLINE, LPG

A. Scrub Head Cylinder
B. Front Scrub Brush Motor
C. Rear Scrub Brush Motor
D. Squeegee Lift Solenoid Valve
E. Squeegee Lift Cylinder
F. Hydraulic Filter
G. Double Scrubbing
H. Normal Scrubbing
I. Hydraulic Fluid Cooler
J. Forward Propelling Flow
K. Drive Motor
L. Reverse Propelling Flow
M. Flow Sensing Device
N. Propelling Pump
O. Hydraulic Fluid Reservoir
P. Hydraulic Sump Filter
Q. Accessory Pump
R. Main Control Valve



HYDRAULIC SYSTEM PICTORIAL DIAGRAM - DIESEL 01233

A. Hydraulic Fluid Filter
B. Hydraulic Propelling Pump
C. Hydraulic Sensing Block
D. Hydraulic Control Valve
E. Scrub Head Lift Cylinder
F. Rear Squeegee Lift Cylinder
G. Scrub Brush Drive Motor
H. Propelling Motor
I. Heat Exchanger
J. Hydraulic Accessory Pump
K. Hydraulic Fluid Reservoir
L. Hydraulic Fluid Level Sight Gauge
M. Hydraulic Fluid Reservoir Fill Plug
N. Hydraulic Fluid Reservoir Breather



HYDRAULIC SYSTEM SCHEMATIC DIAGRAM - DIESEL

01234

A. Scrub Head Cylinder
B. Front Scrub Brush Motor
C. Rear Scrub Brush Motor
D. Squeegee Lift Solenoid Valve
E. Squeegee Lift Cylinder
F. Hydraulic Filter
G. Double Scrubbing
H. Normal Scrubbing
I. Hydraulic Fluid Cooler
J. Forward Propelling Flow
K. Drive Motor
L. Reverse Propelling Flow
M. Flow Sensing Device
N. Propelling Pump
O. Hydraulic Fluid Reservoir
P. Hydraulic Sump Filter
Q. Accessory Pump
R. Main Control Valve

ENGINE LUBRICATION

Check the engine oil level after every 8 hours of operation. Change the engine oil and oil filter after every 50 hours of operation. Change the engine oil more frequently if the environment is extremely dusty. Use an engine oil meeting the SAE requirements rating SE. The engine oil drain is located behind the lower left access door.

The following SAE oil grades are general recommendations for engines during the changing seasonal temperatures.

SEVERE WINTER BELOW 0°F (BELOW -17°C)	NORMAL WINTER 0°-32°F (-17° to 0°C)	SPRING-FALL 32°-75°F (0° to 24°C)	SUMMER ABOVE 75°F (24°C)
5W-20	10W	20W	30

Multi-grade oil should cover the single grade recommendation for the temperatures involved. The engine oil capacity is 4 qt (3.8 L) with filter.

Add 3 to 5 drops of engine oil to the distributor shaft oil wick every 250 hours.

Lightly grease the distributor cam with distributor cam grease whenever the points are replaced.

COOLING SYSTEM

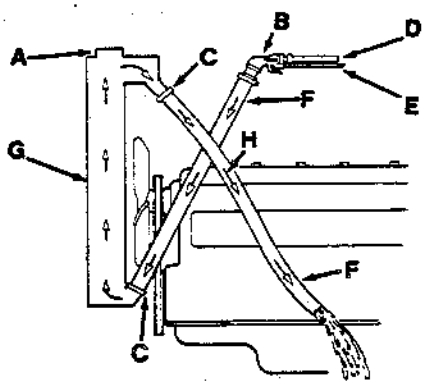
Maintaining cooling system efficiency is important. Engine temperatures must be brought up to and maintained within the satisfactory range for efficient operation. However, the engine must be kept from overheating in order to prevent damage to the valves, pistons, and bearings.

Use soft, clean water mixed with permanent-type, ethylene glycol antifreeze in a one-to-one ratio. Deposits of sludge, scale, and rust prevent normal heat transfer. Flush the radiator and the cooling system after every 500 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.

TO REVERSE FLUSH THE RADIATOR

1. Disconnect the hoses at the engine.
2. Put the radiator cap on tight.
3. Clamp the flushing gun in the lower hose with a hose clamp.
4. Turn on the water and let it fill the radiator.



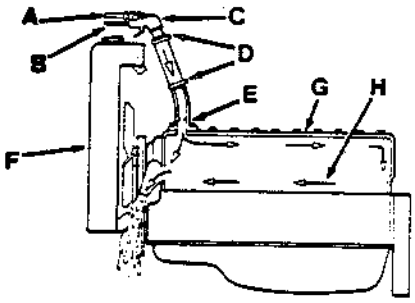
REVERSE FLUSHING RADIATOR 00007

A. Closed Radiator Cap
B. Flushing Gun
C. Clamp
D. Water Input
E. Air Input
F. New Hose
G. Radiator
H. Water and Air Flow

5. Apply air pressure gradually to avoid radiator damage.
6. Shut off the air, again fill the radiator with water and apply air pressure—repeat until the flushing stream runs out clear.
7. Clean and inspect the radiator cap.

TO REVERSE FLUSH THE ENGINE WATER JACKET

1. Remove the thermostat.
2. Clamp the flushing gun in the upper hose.
3. Partly close the water pump opening to fill the engine jacket with water before applying the air.
4. Follow the same procedure outlined above for the radiator by alternately filling the water jacket with water and blowing it out with air 80 psi (551 kPa) until the flushing stream is clear.



REVERSE FLUSHING ENGINE 00007

A. Water Input
B. Air Input
C. Flushing Gun
D. Clamp
E. Thermostat Removed
F. Radiator
G. Engine Block
H. Water and Air Flow

POWER SCRUBBER - 527 MM133 (5-82) LITHO IN U.S.A.

Engine overheating may also be caused by dirty radiator fins. The exterior fins of the radiator can be cleaned with an air hose. Blow out all dust, dirt, etc., between the fins. This should be done only after the radiator has cooled off to avoid cracking caused by uneven cooling.

Before cleaning, remove the fan shroud from the radiator, then blow out all dust from outside the machine into the engine compartment (this is the opposite direction from normal air flow). After the radiator fins are clean, replace the fan shroud.

Engine thermostats begin to open at 180°F (82°C) and are fully open at 202°F (94°C). Operation of the engine in this temperature range is not harmful. However, temperature gauges are not always accurate and may sometimes indicate higher than actual temperature. This can lead operators to believe the engine is overheating when it is actually operating normally.

NOTE: Overheating is always accompanied by loss of coolant water. In case of doubt, this should be checked.

REPLACING AND TESTING THERMOSTAT

Remove the water elbow and the thermostat. Before testing, clean and examine the bellows for rupture or distortion. If the valve can be pulled or pushed off its seat with only a slight effort when cold, or it does not seat properly, the unit is defective and should be replaced.

The thermostat can be checked in the following manner:

1. Hang the thermostat by its frame in a container of water so that the thermostat does not touch the bottom of the container.
2. Heat the container of water and check the temperature with a thermometer.
3. If the valve does not start to open at temperatures of 180°-200°F (82°-93°C) or if it opens well before the 180° (82°C) point is reached, the thermostat should be replaced.

When replacing the thermostat in the water outlet elbow, be sure the counterbore and all machined surfaces are clean.

Assemble the new water outlet elbow mounting gasket. The thermostat flange must seat in the counterbore with the gasket sealing the flange and the cylinder head.

When installing a new thermostat in the water outlet tube, make sure that the temperature sensing unit faces toward the cylinder head.

RADIATOR PRESSURE CAP

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 (103 kPa) allowing steam and water to pass out the overflow pipe; however, the boiling point of the coolant at this pressure is 230°F (110°C) at sea level.

⚠ CAUTION: If the coolant is hot or if the engine has been running, loosen the pressure cap to the first stop and let the pressure out of the cooling system before removing the radiator cap.

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

ENGINE FAN BELT TENSION

When tightening fan belts, loosen the alternator adjusting bolts and pull out on the alternator by hand until the belt is just snug. Under no circumstances should a pry bar be used on the alternator to obtain fan belt tension or damage to the bearings will result.

Proper belt deflection is obtained when the belt deflects 0.5 in (12.7 mm) from a force of 10 to 12 lbs (4.5 to 5.4 kg) applied at the midpoint of the longest span.

WATER PUMP

The water pump is located in the front of the cylinder block and is driven by the fan belt from the crankshaft pulley. The inlet of the water pump is connected to the lower radiator connection and the outlet flow from the pump is through integral passages cast in the block.

No lubrication of the pump is required as the bearings are permanently sealed with a special lubricant for the life of the bearing.

AIR INTAKE SYSTEM

The importance of maintaining an air filter in proper condition cannot be overemphasized. Dirt induced 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 cleaner is removed for servicing. Do not neglect servicing the air cleaner. Use only correct parts for replacement. Keep all other air intake components such as hoses, clamps, etc., secure and in good condition to prevent entrance of unfiltered air.

AIR FILTER

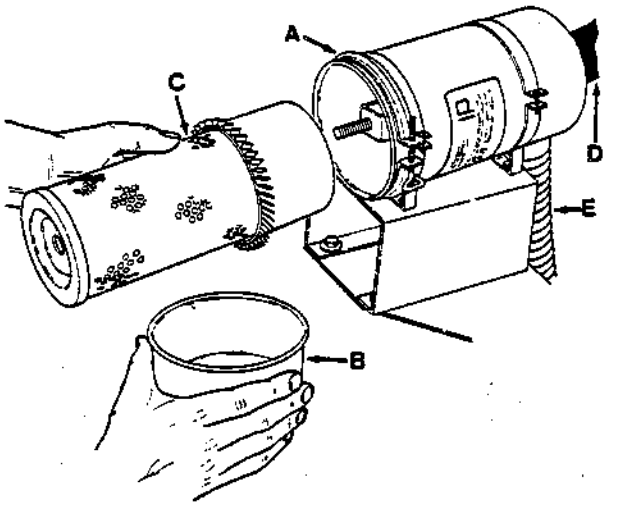
The engine air filter element is a dry cartridge-type filter. The air filter element must be cleaned and inspected after every 50 hours of operation. It must be replaced after it has been damaged, cleaned six times, or after 250 hours of operation.

TO REPLACE AIR FILTER ELEMENT

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

CAUTION: Always engage the parking brake before working on the machine.

2. Raise the engine hood.
3. Unscrew the clamp ring on the filter.



00044

AIR FILTER ELEMENT REPLACEMENT

A. Clamp Ring
B. Dust Cap
C. Filter Element
D. Air Filter Hose
E. Air Intake Hose

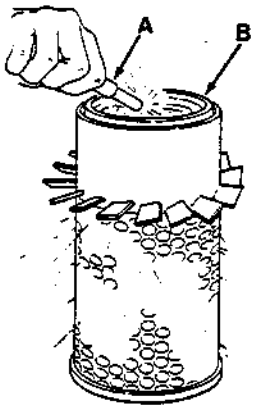
4. Remove the dust cup.
5. Remove the wing nut.
6. Pull the element out of the filter housing.
7. Clean out the dust cup and interior of the air cleaner housing.
8. Install the new or cleaned filter element so that the fins on the element are at the intake end of the air cleaner. Use care so that the fins are not damaged. Tighten the wing nut attaching the element.
9. Install the dust cup and tighten the clamp ring to hold it in place. Check all intake hose connections for leaks.
10. Close the engine hood.

TO CLEAN AND INSPECT AIR FILTER ELEMENT

1. Using an air hose, direct dry, clean air up and down pleats on the inside of the filter.

CAUTION: Air pressure at nozzle must not exceed 100 psi (689 kPa). Maintain reasonable distance between nozzle and filter.

2. After cleaning the air filter element, inspect it for damage by placing a bright light inside. The slightest rupture requires replacement of the filter.



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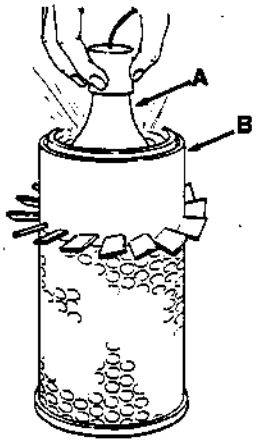
CLEANING AIR FILTER ELEMENT

A. Air Hose
B. Filter Element



00051

INSPECTING AIR FILTER ELEMENT

A. Bright Light
B. Filter Element

FUEL SYSTEM - GASOLINE

FUEL

Use clean, leaded or non-leaded gasoline of at least 86 octane.

FUEL TANK

The fuel tank is located under the rear shroud. Fill the fuel tank at the end of each day's operation to prevent condensation from forming in the fuel tank.

FUEL FILTER

The in-line fuel filter is located under the fuel tank.

Change the fuel filter after every 500 hours of operation.

CARBURETOR CHOKE

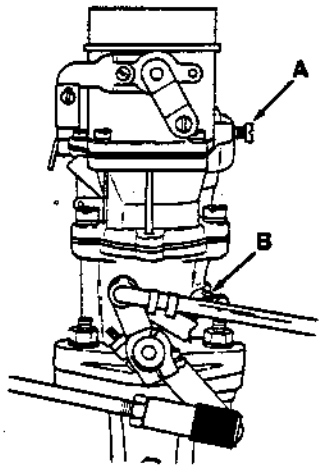
The manually operated choke is operated by a flexible cable control located below the front instrument panel. It is important that the operator have the choke valve in wide open position when the engine operating temperature is reached.

NOTE: Do not use the choke to stop the engine. This causes raw fuel to wash lubricant from the cylinder walls.

CARBURETOR

The carburetor has the following adjustments:

1. Idle Fuel-Air Adjusting Needle - The idle fuel-air adjusting needle controls the amount of fuel-air mixture discharged into the air stream. Turning the idle adjusting needle (in) results in a leaner mixture. Turning the idle adjusting needle (out) results in a richer mixture.
2. Fixed High Speed Jet - The high speed jet is not adjustable. For high altitude it may be exchanged for reduction in size to lean the fuel to compensate for the lighter, thin air. The size must be carefully determined first by testing a smaller jet with 0.001 to 0.002 in (0.025 to 0.050 mm) smaller passage, depending on the elevation.



CARBURETOR ADJUSTMENTS 00052

A. Idle Mixture Adjustment Needle
B. Idle Speed Adjustment

ATTENTION! Improper adjustment of the main jet could lead to engine damage.

3. Idle Speed Adjusting Screw - Turn (in) clockwise until throttle valve is slightly open. Adjustment to recommended idle speed can be made after installation to engine. Turn screw clockwise to increase speed or counter-clockwise to lower the rpm.

MECHANICAL FUEL PUMP

Fuel pump pressure may be measured by installing a pressure gauge between the fuel pump and the carburetor. Fuel pump pressure at 1800 rpm should be 3-5 psi (21-34 kPa).

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

When pressures are below the pressure range, the pump should be disassembled and reconditioned with the special overhaul kits available.

Fuel pump trouble is of only two kinds—either the pump is supplying too little gas or, in rare cases, too much.

If the pump is supplying too little gas, the engine either will not run or it will cough and falter. If the pump is supplying too much gas, the engine will not idle smoothly and gas may drip from the carburetor.

If there is little or no flow of gas, check the following:

1. Look for a leaky bowl gasket or line connections —tighten them.
2. Remove and clean the gas strainer or screen inside the pump bowl with solvent.
3. Look for a clogged fuel line and blow it out with compressed air.
4. Make sure that all pump cover screws and external plugs are tight.
5. Inspect the flexible fuel line for deterioration, leaks, chafing, kinks, or cracks. If none of these items restores proper flow, remove the pump for replacement.

If it is getting too much gas, it is generally caused by trouble other than the fuel pump, so first check the following:

1. Excessive use of the hand choke.
2. Loosely connected fuel line or loose carburetor assembly screws.
3. Punctured carburetor float.
4. Defective carburetor needle valve.
5. Improper carburetor adjustment.

If none of these items corrects flooding, remove the fuel pump for replacement.

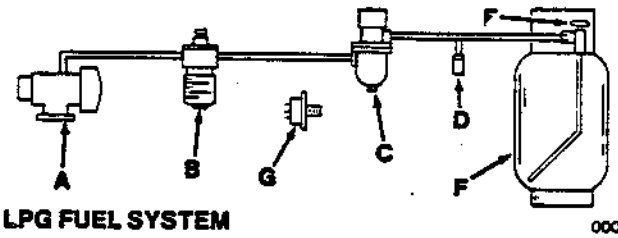
FUEL SYSTEM - LPG

LPG FUEL SYSTEM OPERATION

The liquid withdrawal LPG fuel system is made up of six 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 tanks, under its own pressure, to the pressure relief valve. This valve is normally closed, preventing LPG fuel from escaping into the atmosphere. 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 or being started. The oil pressure switch controls the fuel filter lock. When the engine oil pressure is 4 psi (27.6 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. The oil pressure switch is bypassed when the engine is started, allowing LPG fuel to flow.

The vaporizer converts the liquid LPG fuel into a gaseous LPG fuel. From the vaporizer, the gaseous LPG fuel is sent to the primary regulator. The primary regulator reduces the pressure of the LPG fuel and makes the flow more constant. The secondary regulator reduces the LPG gas pressure to the level required by the carburetor. From the secondary regulator, the LPG gas is sent to the carburetor where the LPG gas is finally metered into the air flow which is sent to the combustion chamber.



LPG FUEL SYSTEM 00085

- **A. Combination Carburetor & Secondary Regulator**
- **B. Combination Water Heated Vaporizer and Primary Regulator**
- **C. Combination Fuel Line Filter & Electric Lock-Off Valve**
- **D. Pressure Relief Valve**
- **E. Tank Service Valve**
- **F. LPG Fuel Tank**
- **G. Oil Pressure Switch**

LPG MAINTENANCE AND SAFETY TIPS

To ensure safer operation of LPG equipment, regular maintenance and frequent inspections are important. Listed below are some suggested maintenance tips, as well as general tips, to promote added safety and efficiency in the operation of an LPG machine:

- Check for frosting. If frosting occurs on any LPG component or object near an LPG component, there is a possibility of an LPG fuel leak. To locate the leak, apply a soapy water solution to the suspected area. Watch for bubbles forming in a confined area. This area will contain a pin hole. Replace the part which contains the pin hole.
- Check the vaporizer for proper operation.

  Turn on the ignition switch, short out the oil pressure switch leads, and 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 pin hole leak, allowing LPG fuel to enter the cooling system.
- Check all components for proper operation. Replace LPG components when needed. Never bypass defective safety components.
- 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.
- 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 have, 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 it should be replaced. If the engine just turned over, the fuel filter lock is operating correctly.
- Check for gas odor before and during starting operations. If gas odor is noticed, stop and check for leaks or component malfunction.
- Never use a match or open flame when searching for an LPG fuel leak. Always use the soap bubble method.
- Replace electrical wiring if insulation shows signs of abrasion or deterioration.
- Make sure the LPG tank is free of dents or gouges.
- Make sure the service coupling is clean and free of damage. Make sure the service coupling of the tank matches the machine service coupling.
- Perform regular maintenance as recommended.
- Every 400 hours or 3 months, whichever comes first, or if any malfunction is noted:

  Completely disassemble the vaporizer-regulator. See machine manual for instructions and replacement parts.

  Clean all parts in alcohol.

  Inspect parts and replace where needed.

  Carefully reassemble and reinstall them in the machine.

  Check for proper operation as follows:

  Remove the LPG hose in which LPG fuel exits from the regulator. Using a monometer or pres-

sure gauge, check the output of the regulator, making sure that it is working according to its proper output specifications. Then, after checking and adjusting or replacing a defective regulator or regulator components, carefully replace the removed LPG hose.

- 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.

- Every 400 hours, replace the filter in the fuel filter lock. See machine manual for instructions and replacement parts.
- Keep the engine properly tuned.
- Make sure the LPG tank matches the fuel system (liquid tank with liquid system).

LPG FUEL TANKS

The LPG fuel tanks should be inspected for sharp dents, gouges, leaks, and broken protecting rings whenever they 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:

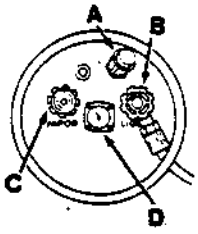
Filler Valve - Check for proper functioning and the presence of the handwheel. Valve must be closed except during filling.

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

Cylinder 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.



00115

TYPICAL LPG LIQUID WITHDRAWAL FUEL TANK

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

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

If an LPG 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 cylinder, regardless of condition. Repairs must be made by qualified personnel.

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

CHANGING MACHINE LPG TANKS

Refueling machines with LPG tanks is an important function. Refueling is accomplished by replacing the empty LPG tank with a full one.

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

CAUTION: Always stop the engine and engage the parking brake before working on the machine.

3. Close the tank service valve.
4. Remove the quick-disconnect tank coupling.
5. Inspect the LPG fuel lines for wear or damage.
6. Remove the empty LPG tank from the machine.
7. Check the LPG tank for damage or wear.
8. Store the LPG tank in a designated safe area.
9. Select a filled LPG tank and inspect it for damage or leaks.
10. Carefully place the LPG tank in the machine so that the tank centering pin enters the aligning hole in the tank collar.
11. Fasten the tank hold-down clamps to lock the tank in position.
12. Connect the LPG fuel line to the tank service coupling.
13. Open the tank service valve slowly and check for leaks.

CAUTION: If a leak is found, close the valve immediately and notify the appropriate personnel.

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

STORAGE OF LPG FUEL TANKS

Whether the storage is inside or outside, 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 cylinders 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 overfilled. 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.

LPG FUEL FILTER LOCK

A drain plug is provided for purging the filter bowl. Clean out the bowl when necessary. Replace the filter pack after every 400 hours of operation or when diminished gas flow indicates the filter is clogged.

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

TO REPLACE FILTER PACK

DISASSEMBLY:

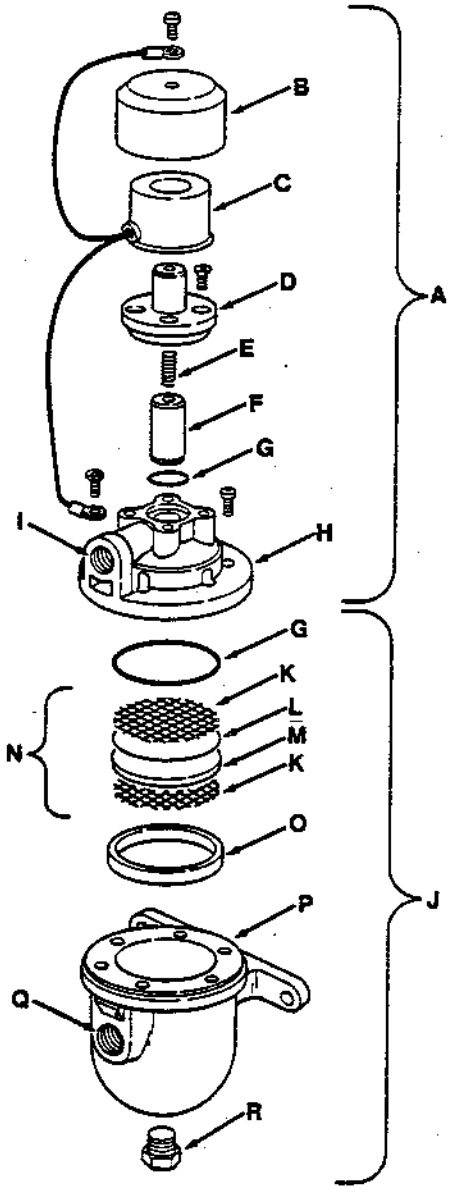
1. Shut off the fuel supply and operate engine to empty fuel lines and filter.
2. Disconnect the outlet fuel line from the upper fuel valve section.
3. Remove the six screws attaching the filter bowl to the top section.
4. Lift off the top valve of the fuel filter lock section.
5. Carefully pull out the filter retainer ring, o-ring, and filter pack.
6. Discard the o-ring and the filter pack.
7. Clean out the filter bowl and all parts in solvent. Dry the parts with compressed air. Check parts for damage. Replace parts which are found to be defective.

REASSEMBLY:

1. Install the new filter pack in the recess in top section.

NOTE: Install the filter pack with chamois side up—see illustration.

2. Place retainer ring in position and gently tap it with a soft-faced hammer. Position the retainer as shown in section drawing.
3. Install the new o-ring gasket around the retainer ring as shown in section drawing.



LPG FUEL FILTER LOCK PARTS 00088

A. Fuel Lock Section
B. Coil Case
C. Coil
D. Plunger Housing
E. Spring
F. Plunger
G. O-ring
H. Base
I. Outlet
J. Filter Section
K. Screen
L. Chamois Pad
M. Felt Pad
N. Filter Pack Assembly
O. Filter Retainer Ring
P. Filter Base
Q. Inlet
R. Drain Plug

4. Place the spring in bowl with large open end of the spring down. The small end of the spring fits into the retainer ring, as shown in the section drawing.
5. With all parts in their correct relative position, press the top valve section down to compress the spring in the bowl. Then insert the six screws attaching the top section to the bowl and tighten.

NOTE: When installing the top section, make sure that the inlet and outlet ports are in the same relative position they were in before disassembly.

6. Connect the outlet line to the top valve section outlet port.
7. Open the gas valve and check all disturbed connections for leaks.

TO REPAIR THE FUEL FILTER LOCK

A. To Replace Coil

1. Remove the single screw retaining the coil case and the single screw holding the coil lead to the terminal post (see exploded view and cross section drawing).
2. Lift the case and coil off the fuel filter lock plunger housing.
3. Pull the old coil from the case and insert the new coil.

NOTE: Make sure proper voltage coil is used (12-volt).

4. Replace the case, the coil, and the screws.

NOTE: The coil may have an insulated terminal on one lead only. This lead is attached to the terminal post. Be sure the other coil lead is grounded to the fuel filter lock assembly with a case retaining screw.

B. To Replace Plunger

1. Remove the case and coil.
2. Remove the four flat Phillips head screws retaining the plunger housing on the casting. Lift off the plunger housing and remove the plunger and the spring.

NOTE: Spring is small and can easily be dropped and lost.

Be sure there is no fuel pressure in the filter bowl before loosening the plunger housing screws.

3. Clean the housing and spring. Discard the oil o-ring seal around base of the housing. Inspect the orifice for dirt, nicks, or other damage.
4. Locate the new o-ring on the housing. Install the spring in the new plunger and slide "upward" into housing. Place housing and plunger assembly into position on fuel filter lock casting, insert and tighten the four screws.
5. Test the assembly for leaks by applying air pressure at the filter bowl inlet and using soap solution over all disturbed points.
6. Replace the coil case assembly.

LPG VAPORIZER-REGULATOR

Every 400 hours or 3 months, whichever comes first, or if any malfunction is noted, completely disassemble the vaporizer-regulator. Clean all of the parts in alcohol.

Inspect all of the parts and replace when needed. Carefully reassemble the vaporizer-regulator and reinstall in the machine.

DISASSEMBLY

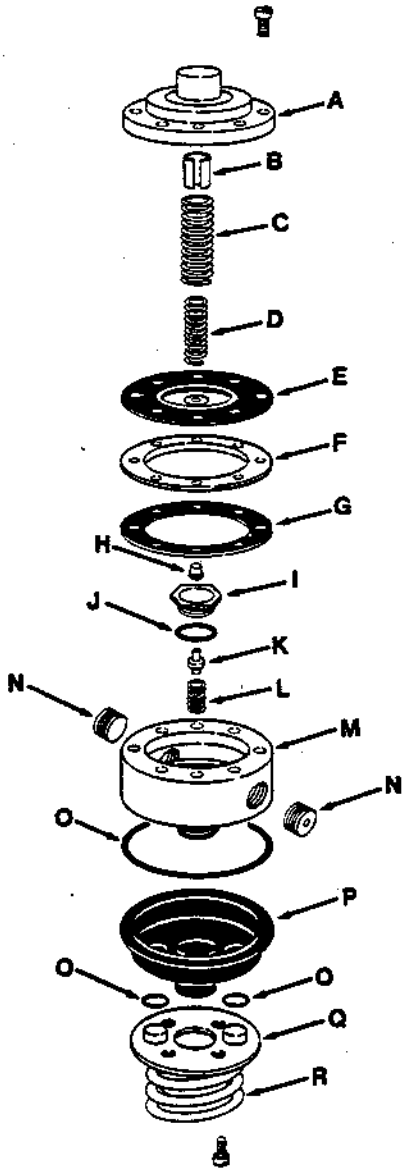
The first step in servicing the vaporizer is to remove the vaporizer assembly from its water casting. To avoid damaging thread in the aluminum vaporizer body, it is important to proceed as follows:

1. Take out the assembly bolt and gasket. Loosen the vaporizer assembly and remove it from the water casting.
2. Remove the four screws that secure the vaporizer coil and mounting plate to the vaporizer body. Discard the vaporizer coil o-rings and the water casting o-ring.
3. Remove diaphragm cover screws as follows:

   Select any four opposite cover screws and remove them; then insert C161-195 studs in their place. Maintain pressure on the diaphragm cover while taking out the remaining four screws.
4. Release pressure on the diaphragm cover and remove cover, diaphragm springs and vibration damper; then remove the C161-195 studs. Next, remove the diaphragm baffle plate, baffle plate gasket and fuel valve cap.
5. Remove the valve seat with a 1 in socket wrench and discard the valve seat o-ring. Also remove the fuel valve assembly together with the fuel valve spring. Clean all parts in alcohol (isopropyl). Do not use any of the carburetor cleaning solvents to clean any part of the vaporizer. This type of cleaner will destroy the impregnation used in the casting and the coating on the coil. Check for wear or damage and discard all imperfect parts.

REASSEMBLY

1. Place the fuel valve spring over the boss in the center of the vaporizer body and place the fuel valve on the spring with the shortest stem toward the casting. Make sure the top of the spring is resting on the machined shoulder of the fuel valve.
2. Place a new valve seat o-ring on the valve seat and install the valve seat in the vaporizer body. Tighten the valve seat with a 1 in socket wrench.
3. Place the fuel valve cap on the fuel valve stem.
4. Install four C161-195 studs in alternate holes in the top of the vaporizer body and then install a new baffle plate gasket, baffle plate, (recessed



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LPG VAPORIZER - REGULATOR PARTS

A. Cover
B. Vibration Damper
C. Outer Diaphragm Spring
D. Inner Diaphragm Spring
E. Diaphragm
F. Baffle Plate
G. Gasket
H. Cap
I. Valve Seat
J. Valve O-ring
K. Fuel Valve
L. Spring
M. Body
N. Plug
O. O-ring
P. Seal
Q. Heat Exchanger
R. Coil

side down), and diaphragm (flanged disc up). Use C161-195 studs to align parts.

NOTE: Make sure the fuel valve cap enters the hole in the center of the baffle plate.

5. Place the vibration dampener inside of the outer diaphragm spring. Place the inner spring over the center of the diaphragm plate and position the outer spring over the inner diaphragm spring. Install and depress the diaphragm cover far enough to start and seat lightly the four opposite diaphragm cover screws.
6. Remove C161-195 studs and install the remaining four diaphragm cover screws. Tighten the screws evenly and moderately tight.
7. Place a new water casting o-ring on the vaporizer body and two new o-rings over ends of the vaporizer coil on top of the mounting plate.

NOTE: If the four holes in the coil mounting plate fail to line up with the threaded holes in the vaporizer body, turn the vaporizer coil assembly one-half turn. The attaching screw holes will not line up until the vaporizer coil assembly is properly positioned. Install and tighten the four mounting plate attaching screws.

This completes the assembly of the vaporizer.

PRESSURE TESTS

1. Connect a 0 to 30 psi (0 to 207 kPa) gauge to one of the three vaporizer outlets. Close the remaining outlets with 0.25 in pipe plugs.
2. Connect the vaporizer inlet to a source of compressed air or tank vapor. Loosen the gauge connection until it leaks; then retighten and read the pressure. The gauge should register a pressure of between 9 and 11 psi (62 and 76 kPa) and remain steady. If the gauge reading creeps up, it indicates that the vaporizer valve or valve seat is leaking. If a leak is indicated, eliminate the leak by cleaning or replacing the valve parts as necessary.

LEAK TESTS

1. Cover the vent hole in the diaphragm cover with a bubble solution. If bubbles form at this point, the diaphragm is leaking. Replace the diaphragm and recheck for leak.
2. Check with bubble solution for leaks around the diaphragm cover. If bubbles form, replace the baffle plate gasket.
3. Check for leaks at pipe plugs. If bubbles form, apply pipe plug compound and tighten the plugs.
4. Check for leaks of the vaporizer coil mounting plate. If bubbles form, replace the o-rings.

LPG VAPORIZER-REGULATOR QUICK CHECK

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.

LPG CARBURETOR

Service information on the LPG carburetor is very limited. The carburetor manufacturer prefers to have their equipment serviced only by trained and qualified personnel. Do not attempt to service an LPG carburetor unless you are trained and have adequate experience.

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. A fire hazard may be created if it is bypassed.

LPG FUEL TROUBLESHOOTING

	Will Not Start	Runs Unevenly & Lacks Power	Stops During Operation
(1) Fuel Tank	Check fuel tank type and fuel supply (vapor tank for vapor withdrawal system). Be sure tank hand valve is open (always open valve slowly). If hand valve is opened too fast, shut-off valve in tank will automatically shut off fuel supply. If this happens, close the hand valve and then re-open it slowly.	Out of fuel Check fuel tank type and fuel supply (liquid tank for liquid withdrawal system).	Tank valve not opened sufficiently. Check fuel tank type and fuel supply (liquid tank for liquid withdrawal system).
(2) Fuel Lines	Check hoses, connections, leaks, etc., using soap bubble test method. When changing LPG fuel tanks, always be sure fuel is getting into carburetor. Crank engine briefly and push primer button until vapor fumes are smelled or are visible at carburetor, or around air filter. Check fuel tank and lines for frosting up. To relieve frosting, open shut-off valve slowly (approximately one-fourth open). Start engine and idle until warm. Then open tank valve completely before loading the engine. If frost forms on connection fittings, check for fuel leakage, kinked lines, or restriction at frost points. Check fuel filter. Remove and clean it if dirty filter is restricting fuel line. Check quick-disconnect fitting at LPG tank: if LPG tank valve is not properly seated, no fuel will flow through the line. A broken fuel line or loose connection could cause the tank shut-off valve to close.	Broken fuel line or loose fuel line connection could cause tank internal shut-off valve to close automatically and shut off the fuel supply.	*NOTE: Always check through the LPG fuel system in order of numerical sequence.*

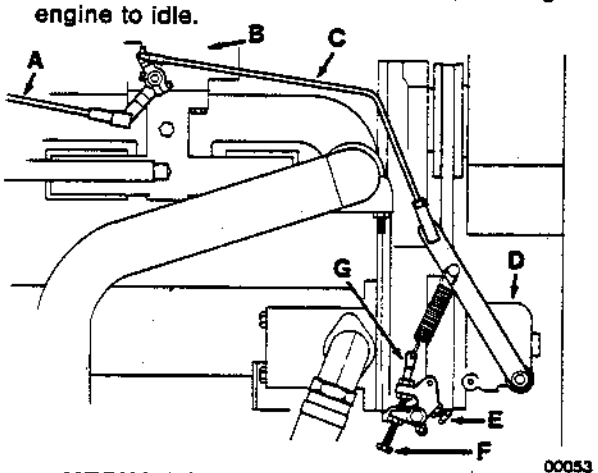
	Will Not Start	Runs Unevenly & Lacks Power	Stops During Operation
(3) Ignition System	Remove and check spark plug to be sure it is the correct type with proper gap. Check ignition points and condenser. Check ignition coil. Check ignition switch. Check wiring for loose connections or wire breakage. Check battery terminals for corrosion or loose ground cable. Check for possible shorts in wiring. Battery dead. No current to filter-fuelock solenoid valve or possible defective solenoid.	Check electrical system for loose connections or intermittent shorts. Check spark and electrical system for malfunction of condenser, points, etc. Check for broken wires or defective relay. Relay can be checked by bypassing relay and directly energizing the solenoid valve in filter-fuelock.	Check ignition for poor connections or weak or worn ignition parts.
(4) Carburetor	Always check carburetor for proper settings before tampering with regulator adjustment. Flooded carburetor - Shut off LPG tank valve with ignition switch "on"; crank engine through a few times. If the engine starts, then slowly open tank valve to provide fuel flow through line. If engine does not start before opening fuel tank valve, then choke engine and use standard starting procedure.	Restricted air cleaner. Clean or replace filter element.	Check carburetor setting. Check ignition system.
(5) Regulator	Be sure carburetor is properly adjusted before attempting to adjust regulator setting. Check vaporizer regulator. Be sure it is functioning properly. In troubleshooting, be sure all of the previous five check points have been checked thoroughly before making any adjustment to regulator.	Only after checking the carburetor setting should the regulator be checked (too rich or too lean). Could very definitely affect operation if carburetor adjustment is correct.	Could be improper setting. Allow too rich or too lean mixture to carburetor. Check and adjust only after checking carburetor adjustment.
(6) Engine	Under ordinary circumstances, an engine should start easily if the components previously mentioned have been checked through and properly adjusted. On an older engine, if proper adjustment on other components are correct, it is possible that major repairs may be required to the basic engine.		

GOVERNOR

CHECKING AND ADJUSTING GOVERNOR LINKAGE

The following is a step-by-step procedure to follow in checking and adjusting the governor linkage:

1. With the engine stopped and spring tension about normal, the governor should hold the throttle in the open position. The governor to carburetor control rod should be adjusted in length so the throttle stop lever is 0.01 to 0.03 in (0.2 to 0.8 mm) off the pin.
2. Make certain that all linkage is movable with the governor spring attached at operating tension. Disconnect the governor spring and check movement of levers and rods.
3. The hinged lever governor eliminates the need for a spring loaded throttle lever on the carburetor. As the carburetor lever is forced to idle position by the speed control lever, this in turn pivots the top half of the governor arm forward, slowing the engine to idle.



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MECHANICAL GOVERNOR LINKAGE

- **A. Throttle to Carburetor Rod**
- **B. Carburetor**
- **C. Carburetor to Governor Rod**
- **D. Governor**
- **E. Locking Screw**
- **F. Speed Adjustment Screw**
- **G. Sensitivity Screw**

GOVERNOR ADJUSTMENT

1. Engage the machine parking brake.

CAUTION: Always engage the parking brake before working on the machine.

2. Start the engine and allow it to warm up.
3. With the engine warmed up, adjust the idle speed approximately 150 rpm higher than the required speed under load, by turning the speed screw in or out, thus either increasing or decreasing pull on the spring.
4. Apply the desired load and readjust the speed screw in order to obtain the required speed under load.

   Release load and note rpm at which the engine settles out.

   Again apply load and observe the drop in rpm before the governor opens throttle to compensate.
5. The range of a governor's action is indicated by the differential between rpm under load and that under no load.

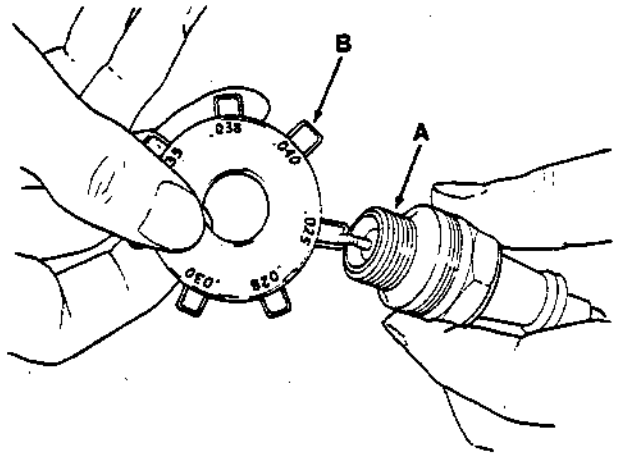
   This can be varied and the sensitivity of the governor is changed by changing the length of the sensitivity screw.
6. To broaden the range of the governor and produce a more stable action, lengthen the sensitivity screw and compensate for this change by turning the speed screw in to restore the speed.
7. To narrow the range and increase the sensitivity of the governor, reverse the procedure outlined in step 5. (Changing the length of the sensitivity screw has the same effect as using a stronger or weaker spring.)
8. With the governor adjusted for desired performance, release the load and allow the engine to run at governed speed with no load. If a surge is noted, lengthen the sensitivity screw at spring anchor and readjust the speed screw to obtain desired no load rpm
9. When governor adjustment is completed, make sure that all lock nuts are tight in order to maintain the adjustment.

ELECTRICAL SYSTEM

SPARK PLUGS

Spark plug gaps are best checked with a wire gauge unless the points are 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.



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GAPPING THE SPARK PLUG

- **A. Spark Plug**
- **B. Gapping Tool**

The proper spark plug gap is 0.025 in (0.635 mm).

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

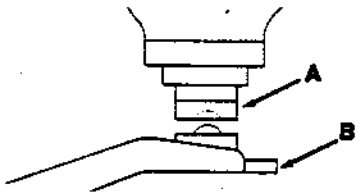
1. Clean the spark plug seat in the cylinder head.
2. Use a new seat gasket and screw the plug in by hand.
3. Tighten all 18 mm plugs to 35 ft lbs (47 Nm) with a socket wrench of the correct size.

DISTRIBUTOR MAINTENANCE

The distributor operation is vital to the operation of the engine and the following items should be carefully inspected every 250 hours of normal operation; however, dirt, dust, water and high speed operation may cause more rapid wear and necessitate more frequent inspections:

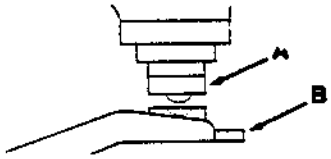
1. Remove the distributor cap. Clean the cap and examine for cracks, carbon runners, or corroded terminals. If the vertical faces of the inserts are burned, install a new cap. If the horizontal faces of the inserts are burned, replace the cap and the rotor as this condition is caused by the rotor being 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. Inspect the breaker 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 condenser capacity is too high, a crater (depression) will form in the positive contact; and, if the condenser is too low, a crater will form in the negative contact.



OVER CAPACITY CONDENSER 00003

A. Contact Bracket
B. Breaker Arm



UNDER CAPACITY CONDENSER 00003

A. Contact Bracket
B. Breaker Arm

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 .020 in (0.50 mm). 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 that they make full contact. Bend the stationary arm to obtain proper alignment; do not bend the breaker arm.

4. Lubrication is required at the shaft, advance mechanism, breaker cam, and pivot. The shaft may be either oil or grease cup lubricated and should be given attention after every 250 hours of operation. Make sure the breaker arm moves freely on its hinge. Apply a drop of light oil or a trace of ball bearing lubricant to the breaker arm hinge after every 250 hours of operation.

   Special moly-grease should be used sparingly on the breaker cam unless the breaker cam is lubricated by a felt wick, which is lubricated with a couple drops of oil after every 250 hours of operation.

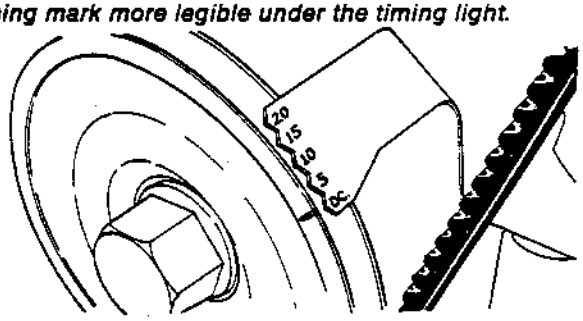
NOTE: Avoid excessive lubrication. Excess lubricant may get on the contact points and cause burning.

DISTRIBUTOR IGNITION TIMING
WITH TIMING LIGHT

There are two methods of checking ignition timing: with or without a timing light.

The preferred method is to use a timing light in the following sequence:

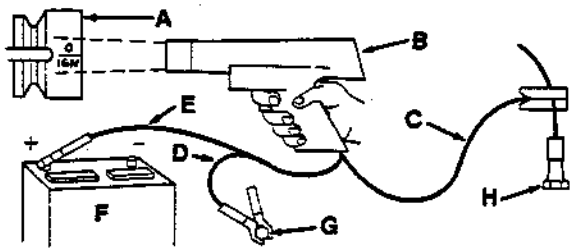
NOTE: Painting a line on the front pulley will make the timing mark more legible under the timing light.



CRANKSHAFT PULLEY TIMING MARK 00054

CAUTION: Do not hold ignition wires with bare hands since shocks or other injuries can result. Sparks or flames near a battery could cause an explosion or fire. Battery acid can cause corrosive burns. Always wear eye protection.

1. Clip the blue secondary lead of light to the #1 spark plug. Leave the spark plug wire on the plug.
2. Connect the primary positive lead (red) to the positive terminal of the battery.



TIMING LIGHT HOOKUP 00059

A. Crankshaft Pulley
B. Timing Light
C. Blue
D. Black
E. Red
F. Battery
G. Head Bolt
H. Spark Plug

3. Connect the primary negative lead (black) to the cylinder head cap screw or the alternator bracket.
4. Start the engine and run it at idle speed, 400 rpm or lower, so the automatic advance of the distributor is completely retarded.

NOTE: The engine must be operating at or below 400 rpm to obtain the correct engine timing.

5. Direct the timing light on the crankshaft pulley and note the timing marks as the light flashes.
6. Timing is TDC at engine idle.
7. To advance the timing, turn the distributor body clockwise. To retard the timing, turn the distributor body counter-clockwise.
8. When the timing is correct, tighten the distributor clamp screw securely. Then recheck timing again with the light.
9. This operation is best performed in a shaded area so the timing light is visible.

DISTRIBUTOR IGNITION TIMING
WITHOUT TIMING LIGHT (EMERGENCY METHOD)

For breaker-type ignition an alternative method, without timing light, is as follows:

1. Remove #1 Spark Plug - put your thumb over the spark plug hole and crank the engine by hand until air is exhausting.
2. Set piston on top dead center by slowly cranking until "DC" mark on crankshaft pulley will line up with the pointer on the gear cover.
3. Loosen the distributor clamp bolt and rotate the distributor body until the contact points just start to open.

This may be more accurately checked by means of a test lamp connected between the distributor primary lead and the negative terminal of the battery. When the points are closed, the light will be "on" and as soon as the points break, the light will go "off."

ALTERNATOR

Precautions to be observed when testing or servicing the alternator system:

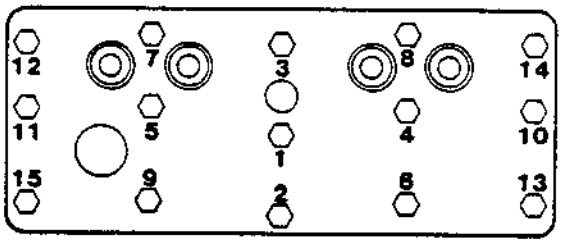
1. Disconnect the battery before connecting or disconnecting test instruments (except voltmeter) or before removing or replacing any unit or wiring. Accidental grounding or shorting at the alternator, ammeter, or accessories will cause severe damage to the units and/or wiring.
2. The field circuit must never be grounded on this system between the alternator and the regulator. Grounding of the field terminal either at the alternator or regulator will damage the regulator.
3. The alternator must not be operated on open circuit with the rotor winding energized.
4. Do not attempt to polarize the alternator—no polarization is required. Any attempt to do so may result in damage to the alternator, regulator, or circuits.
5. Grounding of the alternator output terminal may damage the alternator and/or circuit and components.
6. Reversed battery connections may damage the rectifiers, wiring, or other components of the charging system. Battery polarity should be checked with a voltmeter before connecting the battery.
7. If a booster battery or fast charger is used, its polarity must be connected correctly to prevent damage to the electrical system components (positive to positive, negative to negative).

CYLINDER HEAD

CYLINDER HEAD TIGHTENING

A three-stage torque procedure should be used when reassembling the cylinder head. The cylinder head cap screws and risers must be tightened in the proper sequence after the first 50 hours of operation:

1. Snug down cap screws and risers in the proper sequence.
2. Tighten the cap screws and risers to one-half of the specified value.
3. Torque to 45 to 48 ft lbs (61 to 65 Nm).



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CYLINDER HEAD BOLT TIGHTENING SEQUENCE

The cylinder head cap screws and risers must be retorqued after the engine is put into operation and brought up to proper operating temperatures. To retorque cap screws, follow the correct sequence. Loosen one head cap screw or riser at a time one quarter turn

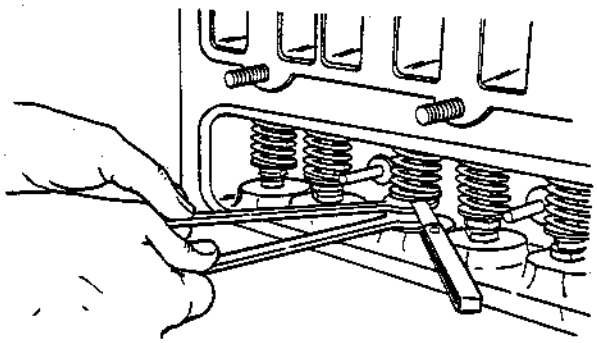
(90 degrees); then re-torque it to the correct value.

NOTE: Power wrench torque limit must be held at least 10 ft lbs (14 Nm) below hand torque specification; then hand torque to the specifications.

VALVE TAPPET CLEARANCE ADJUSTMENT

The valve tappet clearance must be checked after the first 50 hours of operation and after every 500 hours of operation.

Check and adjust the intake valve tappets to 0.12 in (0.3 mm) clearance and the exhaust valve tappets to 0.020 in (0.5 mm) clearance when the engine is warm.



00061

ADJUSTING VALVE TAPPET CLEARANCE

PCV SYSTEM

Check the PCV system after every 250 hours of operation.

Check all connections. They are to be airtight.

To service the system, clean the PCV valve and the air inlet. Check all hoses for wear or plugging.

PREVENTIVE MAINTENANCE

DAILY

A. Overall visual inspection of the engine for water or oil leaks.
B. Check the engine oil level.
C. Check the radiator coolant level.
D. Fill the fuel tank.
E. Check the air cleaner element.
F. Listen for any unusual noises.

EVERY 50 HOURS

A. Repeat the daily operations.
B. Change the engine oil.
C. Check the fan belt tension.
D. Check the battery.
E. Torque down the cylinder head bolts to specifications.

EVERY 250 HOURS

A. Repeat the daily and 50-hour operations.
B. Clean the exterior of the engine.
C. Check, clean, and lubricate the governor control linkages.
D. Clean the spark plugs.
E. Check the distributor and inspect the cap, rotor and the points.
F. Inspect the ignition wires and connections.
G. Replace the air cleaner element.
H. Service the PCV system.

EVERY 500 HOURS

A. Repeat the daily, 50-hour, and 250-hour operations.
B. Check and clean the radiator core, inspect the water pump and hoses for leaks, check the fan and the accessory drive belts.
C. Adjust the valve tappet clearance.
D. Clean the carburetor exterior, adjust the carburetor air and idle adjustments.
E. Replace the in-line fuel filter.

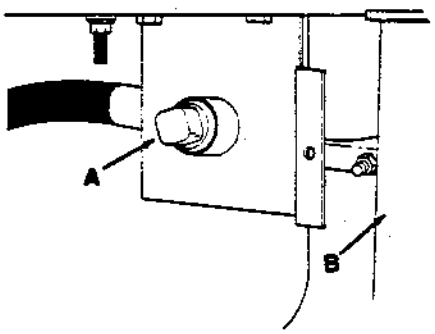
PUMP MOUNTING PLATE ALIGNMENT

Due to the pump to engine coupling configuration, whenever the engine on the pump mounting plate is replaced, the pump mounting plate must be aligned to the engine. This is done to prevent unnecessary vibration and wear on the pump coupling.

1. Remove all burrs from the mounting surfaces of the flywheel housing and the pump.
2. Clean both of the mounting surfaces.
3. Mount the flywheel adapter to the flywheel. Tighten the mounting bolts to 35-40 ft lbs (241-276 Nm).
4. Mount the pump mounting plate to the flywheel housing. Do not tighten the bolts.
5. Clean the boxes of the flywheel adapter and the pump mounting plate.
6. Dial indicate the pump mounting plate bore to the flywheel adapter bore. Adjust the pump mounting plate until the total indicator reading does not exceed 0.003 in (0.076 mm).
7. Tighten the pump mounting plate bolts to 27-35 ft lbs (186-241 Nm).
8. Recheck the dial indicator reading. Repeat the procedure if the reading does not meet the specifications.
9. Drill two 0.281 in (7.137 mm) diameter holes through the flywheel housing using the holes in the pump mounting plate as a template.
10. Ream the two 0.281 in (7.137 mm) holes to 0.312 in (7.925 mm) diameter.
11. Install a roll pin in each of the two holes.
12. Lubricate the coupling sprockets with grease and assemble the pieces together with the coupling chain.
13. Lubricate both halves of the coupling spline with Moly grease and assemble the pump to the pump mounting plate.

ENGINE LUBRICATION

Check the engine oil level after every 8 hours of operation. After the first 50 hours of operation, change the engine oil and engine oil filter. Then, after every 150 hours of operation, change the engine oil and engine oil filter. Change the engine oil more frequently if the operating environment is extremely dusty. The engine oil drain is located behind the lower left access door.



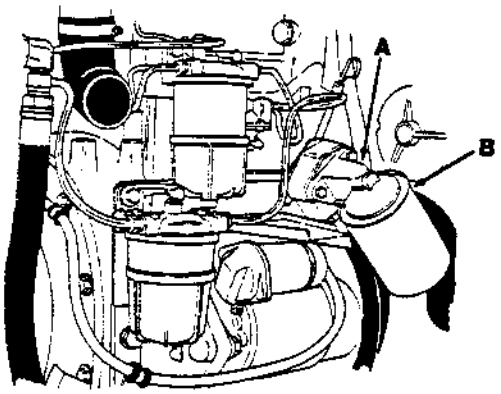
ENGINE OIL DRAIN PLUG 01231

A. Drain Plug
B. Solution Tank

Use an engine oil meeting the SAE requirements rating CC. The following SAE oil grades are general recommendations for engines during the changing seasonal temperatures.

0° to 45°F (-18° to 7°C)	45° to 80°F (7° to 27°C)	Over 80°F (Over 27°C)
10W	20W/20	30

Multi-grade oil should cover the single grade recommendation for the temperatures involved. The engine oil capacity is 5 qt (4.7 L).



OIL FILTER 01232

A. Oil Filter Head
B. Filter Element

TO REPLACE SPIN-ON TYPE OIL FILTER:

1. Unscrew the old canister from the filter head.
2. Discard the old canister.
3. Clean the filter head.
4. Lubricate the top seal of the replacement canister with clean engine oil.
5. Fill the new canister with clean lubricating oil, allowing time for the oil to filter through the element.
6. Screw the replacement canister onto the filter head until the seal just touches the head. Then tighten the filter to 15 ft lb (20 Nm).
7. Operate the engine and check for leaks.

COOLING SYSTEM

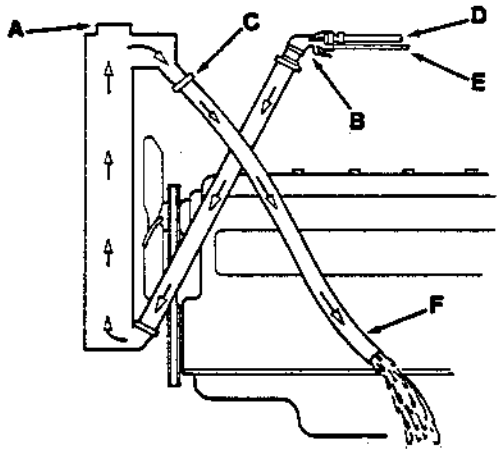
Maintaining the cooling system efficiency is important, as engine temperatures must be brought up to and maintained within a satisfactory range for efficient operation; however, the engine must be kept from overheating in order to prevent damage to the pistons and bearings.

Use soft, clean water mixed with permanent-type, ethylene glycol antifreeze in a one-to-one ratio. Deposits of sludge, scale, and rust prevent normal heat transfer. Flush the radiator and the cooling system after every 500 hours of operation with a dependable cleaning compound. Follow the precedure 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. It is advisable to flush the radiator first, allowing the engine to cool as much as possible.

TO REVERSE FLUSH THE RADIATOR:

1. Disconnect the hoses at the engine.
2. Put the radiator cap on tight.
3. Clamp the flushing gun in the lower hose with a hose clamp.
4. Turn on the water and let it fill the radiator.
5. Apply air pressure gradually to avoid radiator damage.



REVERSE FLUSHING RADIATOR 00007

A. Cap Closed
B. Flushing Gun
C. Clamp
D. Water
E. Air
F. New Hose

6. Shut off the air, again fill the radiator with water and apply air pressure—repeat until the flushing stream runs out clear.

7. Clean and inspect the radiator cap.

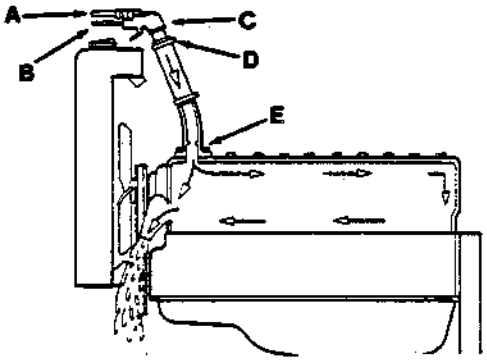
TO REVERSE FLUSH THE ENGINE WATER JACKET

1. Remove the thermostat.

2. Clamp the flushing gun in the upper hose.

3. Partly close the water pump opening to fill the engine jacket with water before applying the air.

4. Follow the same procedure outlined above for the radiator by alternately filling the water jacket with water and blowing it out with air until the flushing stream is clear.



REVERSE FLUSHING ENGINE 00007

A. Water
B. Air
C. Flushing Gun
D. Clamp
E. Thermostat Removed

Engine overheating may also be caused by dirty radiator fins. The exterior fins of the radiator can be cleaned with an air hose. Blow out all dust, dirt, etc., between the fins. This should be done only after the radiator has cooled off to avoid cracking caused by uneven cooling.

Before cleaning, remove the fan shroud from the radiator, then blow out all dust from the outside of the machine into the engine compartment (this is the opposite direction from normal air flow). After the radiator fins are clean, replace the fan shroud.

Thermostats begin to open at 180°F (82°C) and are fully open at 202°F (94°C). Operation of the engine in this temperature range is not harmful. However, temperature gauges are not always accurate and may sometimes indicate higher than actual temperature. This can lead operators to believe the engine is overheating when it is actually operating normally.

NOTE: Overheating is always accompanied by loss of coolant water. In case of doubt, this should be checked.

REPLACING AND TESTING THERMOSTAT

Remove the water elbow and the thermostat. Before testing, clean and examine the bellows for rupture or distortion. If the valve can be pulled or pushed off its seat with only a slight effort when cold or it does not seat properly, the unit is defective and should be replaced.

The thermostat can be checked in the following method:

1. Hang the thermostat by its frame in a container of water so that the thermostat does not touch the bottom of the container.
2. Heat the container of water and check the temperature with a thermometer.
3. If the valve does not start to open at temperatures of 180°-200°F (82°-93°C) or if it opens well before the 180° (82°C) point is reached, the thermostat should be replaced.

When replacing the thermostat in the water outlet elbow, be sure the counterbore and all machined surfaces are clean.

Assemble the new water outlet elbow mounting gasket. The thermostat flange must seat in the counterbore with the gasket sealing between the water outlet elbow and the cylinder head.

RADIATOR PRESSURE CAP

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 (103 kPa) allowing steam and water to pass out the overflow pipe.

CAUTION: If the coolant is hot or if the engine has been running, loosen the pressure cap to the first stop and let the pressure out of the cooling system before removing the radiator cap.

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

ENGINE FAN BELT TENSION

When tightening fan belts, loosen the alternator adjusting bolts and pull out on the alternator by hand until the belt is just snug. Under no circumstances should a pry bar be used on the alternator to obtain fan belt tension or damage to the bearings will result.

Proper belt deflection is obtained when the belt deflects 0.38 in (10 mm) at the midpoint of the longest span.

WATER PUMP

The water pump is located in the front of the cylinder block and is driven by the fan belt from the crankshaft pulley. The inlet of the water pump is connected to the lower radiator connection and the outlet flow from the pump is through integral passages cast in the block.

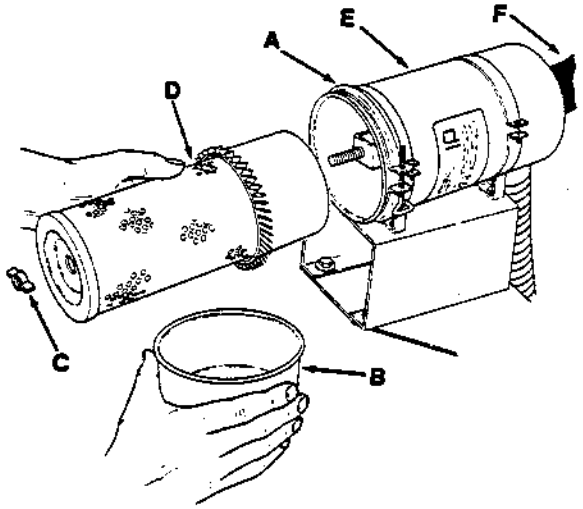
No lubrication of the pump is required as the bearings are permanently sealed with a special lubricant for the life of the bearing.

AIR INTAKE SYSTEM

The importance of maintaining an air filter in proper condition cannot be overemphasized! Dirt induced through improperly installed, improperly serviced or inadequate 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 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 air cleaner is removed for servicing. Do not neglect servicing the air cleaner and use only correct parts for replacement. Keep other air intake components such as hoses, clamps, etc., secure and in good condition to prevent entrance of unfiltered air.

AIR FILTER

The engine air filter element is a dry cartridge-type filter. The air filter element must be cleaned and inspected after every 50 hours of operation. It must be replaced after it has been damaged, cleaned six times or after 250 hours of operation.



REPLACING AIR FILTER ELEMENT 00044

A. Clamp Ring
B. Dust Cap
C. Wing Nut
D. Filter Element
E. Air Filter Housing
F. Air Intake Hose

TO REPLACE AIR FILTER ELEMENT

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

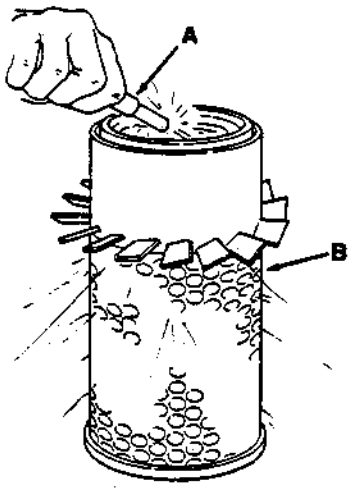
CAUTION: Always engage the parking brake before working on the machine.

2. Raise engine hood.
3. Unscrew clamp ring on filter.
4. Remove dust cup.
5. Remove wing nut.
6. Pull element out of filter housing.
7. Clean out dust cup and interior of air cleaner housing.
8. Install new or cleaned filter element so that fins on the element are at the intake end of the air cleaner. Use care so that fins are not damaged. Tighten wing nut attaching element.
9. Install dust cup and tighten clamp ring to hold it in place. Check all intake hose connections for leaks.
10. Close engine hood.

TO CLEAN AND INSPECT FILTER ELEMENT

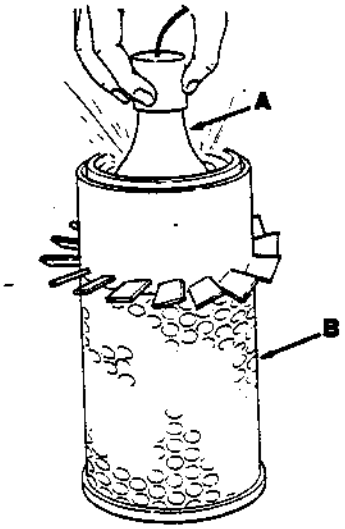
1. Using an air hose, direct dry, clean air up and down pleats on the inside of the filter.

CAUTION: Air pressure at nozzle must not exceed 100 psi (689 kPa). Maintain reasonable distance between nozzle and filter.



CLEANING AIR FILTER ELEMENT 00051

A. Air Hose
B. Filter Element



INSPECTING AIR FILTER ELEMENT 00051

A. Bright Light
B. Filter Element

2. After cleaning, inspect for damage by placing a bright light inside the filter. The slightest rupture requires replacement of the filter.

FUEL SYSTEM

FUEL

Fuels used to operate this engine must meet the guidelines of the following requirements:

ASTM Classification Grades	D-975-66T No. 1 or No. 2
Federal (U.S.) Specification Grades	VV-F-800 DF-A (artic), DF-1, or DF-2
Cetane No. (ignition quality)	45 minimum

FUEL TANK

The fuel tank is located under the rear shroud. Fill the fuel tank at the end of each day's operation to prevent condensation from forming in the fuel tank.

FUEL LIFT PUMP

Fuel lift pump pressure may be measured by installing a pressure gauge between the fuel lift pump outlet and the final fuel filter. Fuel lift pump delivery pressure should be 5-8 psi (34-55 kPa).

Observe the time required for the pressure to drop to half the figure obtained when cranking. If the pressure drops in less than 30 seconds, reject the pump.

FUEL INJECTION PUMP

The fuel injection pump controls the engine speed.

The maximum speed screw is set and sealed by the manufacturers and must not be altered in any way unless factory authority is first obtained. Any adjustments should be carried out by experienced fuel pump technicians. The unauthorized removal of any seals on the pump may render the guarantee void.

ATTENTION! Unless proper test equipment and trained technicians are available, adjustment or maintenance of the fuel injection pump should not be attempted.

When a fuel pump is supplied as a direct replacement, the governor maximum speed is set to a nominal figure only and final adjustment must be made after the pump is fitted to the engine. In order to establish the correct setting which varies according to application, reference must be made to the setting code symbol, stamped on the plate fastened to the pump body.

For the purpose of setting the maximum speed stop, the last four figures shown on the fuel pump setting code is the maximum no load engine speed. Warm the engine and run up until this figure is reached; the maximum speed stop should then be set at this figure.

FUEL INJECTORS

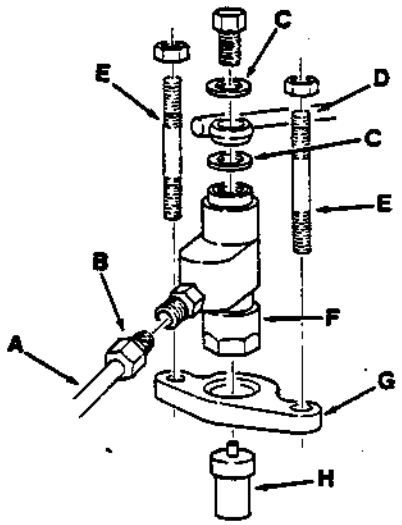
A faulty injector may show itself as an intermittent or consistent misfire and can be detected by running the engine at a fast idling speed and loosening each injector pipe union in turn, taking particular notice of the operating condition of the engine. The faulty injector will have little or no effect upon the engine operating condition as the union becomes loose. Replace with a known good injector. Don't forget to replace the washer on which the injector seats in the cylinder head.

⚠ CAUTION: Keep hands and face from coming into contact with atomiser spray, as the working pressure will cause fuel oil to penetrate the skin.

FUEL INJECTOR REPLACEMENT

Never bend the high pressure pipe between the injector and the fuel injection pump. Remove the pipe completely. Fit the replacement injector as square as possible into the head by pulling down with the securing nuts a little at a time, each side in turn. After installing the injector and the pipe, operate the engine and listen for any "blowing" from the injector seat. This indicates that the injector is not square with the cylinder head. Carefully ease off the injector securing nuts in turn and retighten until the blowing stops. Check for fuel leaks at the pipe unions.

⚠ WARNING: Do not start the engine with loose injector securing nuts; this may result in the injector flying out.



FUEL INJECTOR 00210

A. Fuel Inlet Pipe from Pump
B. Union
C. Washer
D. Pipe
E. Stud
F. Holder
G. Flange
H. Nozzle

BLEEDING THE FUEL SYSTEM

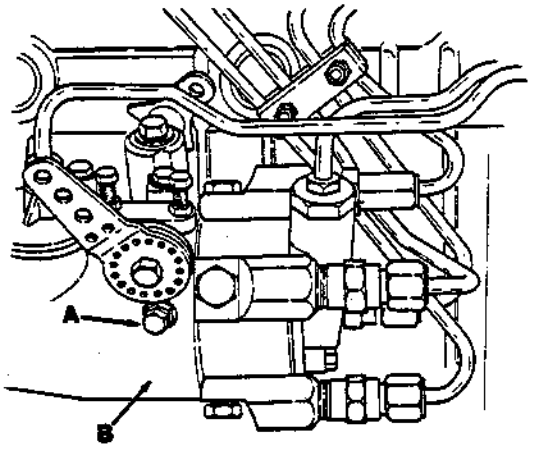
Air in the fuel system can cause difficult starting, erratic running and loss of power.

Air can enter the fuel system as the result of running out of fuel, leaks in the system, changing filter or pipes, or any disturbance of any fuel connection.

Bleed the system as follows:

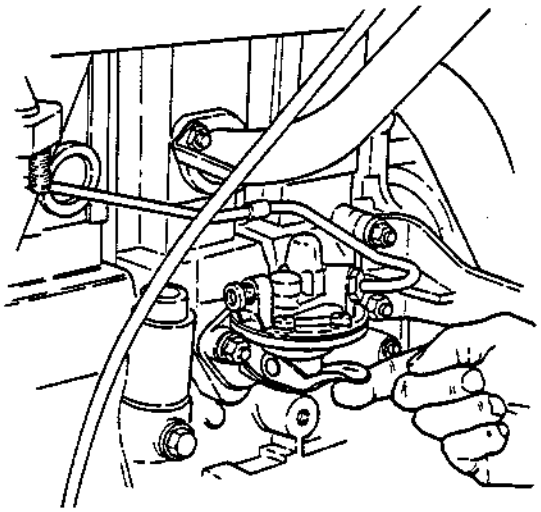
⚠ CAUTION: No smoking or open flame should be allowed any time the fuel system is repaired or serviced. The area should be properly ventilated. Improper handling of fuel could result in an explosion or fire.

1. Unscrew the fuel pipe on top of the fuel filter cover, not the fuel return pipe to the tank, two or three turns.
2. Slacken the vent screw on the hydraulic head locking screw on the side of the fuel injection pump body.
3. Slacken the air vent screws near the side of the governor housing on the fuel injection pump.
4. Operate the priming lever of the fuel lift pump.



VENT SCREW ON GOVERNOR HOUSING 00207

A. Vent Screw
B. Governor Housing



OPERATING THE HAND PRIMER ON THE FUEL LIFT PUMP 00209

It may not be possible to operate the priming lever if the driving cam is in the maximum lift position. To rectify this condition, turn the engine one complete revolution until fuel, free from air bubbles, bleeds from each vent point.

Tighten the connections in the following order:

1. Filter cover fuel pipe.
2. Head locking screw on fuel injection pump.
3. Governor vent screw on fuel injection pump.

Slacken the pipe union nut at the fuel injection pump inlet. Operate the priming lever on the lift pump and retighten the pipe union when the fuel, free from air bubbles, bleeds from around the threads.

The entire operation must be carried out completely. No action to tighten connections must be made until all signs of air bubbles have disappeared. Unless care is taken with this operation, and this could take some four or five minutes of hand priming, failure to start will result.

Slacken the unions at the injector ends of the high pressure fuel pipes.

Set the accelerator in the fully-open position and ensure that the stop control is in the "run" position.

Rotate the engine with the starter motor until fuel oil, free from air bubbles, issues from all fuel pipes. 30 to 60 seconds of rotation may be necessary before this condition is reached. The time will depend upon the speed of rotation and the effectiveness of the bleeding operation described above. A fully-charged battery in a temperate or warm climate will rotate the engine approximately 280 rpm. Under these conditions, the remaining air should be expelled in under 30 seconds. Cold conditions or partially discharged batteries may take longer.

Tighten the unions on the fuel pipes and the engine is ready for starting.

If, after bleeding the fuel system, the engine starts and runs satisfactorily, but after a few minutes stops, then it can be assumed that air is trapped in the fuel injection pump and the bleeding procedure should be repeated. At the same time check for air leaks on the suction side, such as loose or faulty connections.

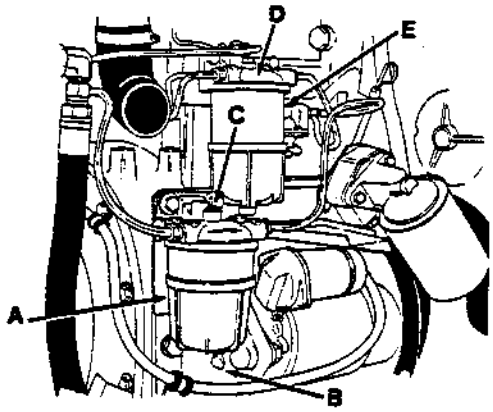
FUEL WATER TRAP

The fuel water trap is located on the front right engine mounting bracket. The water trap should be drained of water weekly . To drain the water trap, unscrew the spigot on the bottom of the water trap. Drain the water trap of water. As fuel appears, tighten the spigot to stop the flow. It may be necessary to bleed the fuel system of air after draining the water trap.

After every 150 hours of operation, the water trap must be cleaned as described in To Clean The Water Trap.

TO CLEAN THE WATER TRAP:

1. Thoroughly clean the exterior of the water trap.
2. Unscrew the bowl retaining bolt in the center of the water trap head.



WATER TRAP AND FUEL FILTER 01232

A. Water Trap
B. Drain Spigot
C. Bowl Retaining Bolt
D. Fuel Filter
E. Filter Element

3. Lower the bowl from the water trap head.
4. Thoroughly clean the water trap bowl in cleaning fluid.

NOTE: Do not use gasoline to clean the bowl.

5. After cleaning the water trap bowl, fill the bowl with clean fuel. Hold the water trap bowl in position under the water trap head.
6. Secure the bowl retaining bolt.
7. Bleed the fuel system as described in Bleeding the Fuel System.

FUEL FILTER

The fuel filter is mounted on the top right side of the engine. The fuel filter should be replaced after every 400 hours of operation.

TO REPLACE THE FUEL FILTER

1. Thoroughly clean the exterior of the fuel filter assembly.
2. Unscrew the filter bolt in the center of the head.
3. Lower the filter bowl and element (see illustration) and discard the fuel, together with the old element.
4. Thoroughly clean the filter bowl in cleaning fluid.

NOTE: Do not use gasoline as a cleaning fluid.

5. Place the new element and sealing rings in position, fill with clean fuel and push the bowl up firmly and squarely so that the top rim of the filter element locates centrally against the sealing ring in the filter head.
6. Hold in this position while the securing bolt is located and tightened. If the bowl is located correctly, no excessive tightening will be required to obtain a leak-proof seal.

   After the fuel filter has been reassembled, it is necessary to remove air from the fuel system. See Bleeding the Fuel System.

ENGINE STARTING AIDS

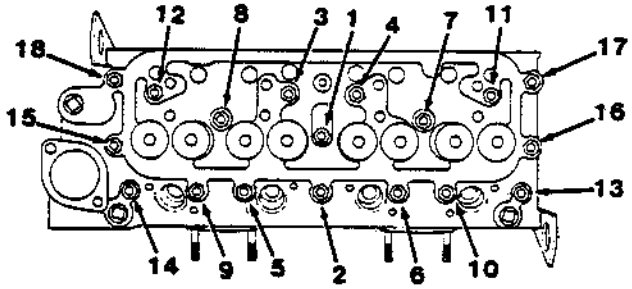
Only Perkins Engine Company-approved starting aids may be used to aid in starting a Perkins diesel engine. Use of ether or other starting aids not recommended by Perkins Engines voids the engine warranty and may cause severe engine damage.

Contact the local Perkins Engine repair center for information.

CYLINDER HEAD

CYLINDER HEAD NUT TIGHTENING

After the first 50 hours of operation, the cylinder head nuts must be retorqued to 55 to 60 ft lbs (74 to 81 Nm). The cylinder head nuts must be tightened in the proper sequence as shown to prevent cylinder head warpage.



01235

CYLINDER HEAD NUTS TIGHTENING SEQUENCE

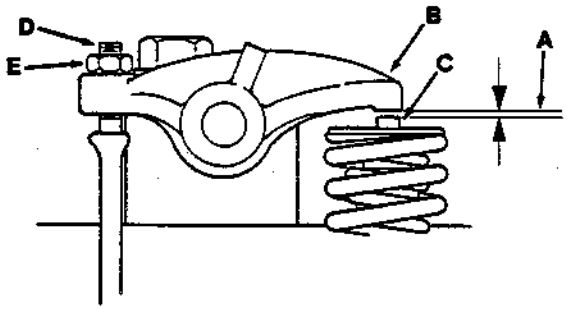
VALVE TIP ADJUSTMENT

Valve tip clearance should be checked after the first 50 hours of service and then after every 2,400 hours of service. The clearance is to be measured between the top of the valve stem and the rocker arm. The clearance should be 0.012 in (0.3 mm) with the engine cold.

Setting valve clearances as follows:

1. With the valves rocking on No. 4 cylinder (i.e., the period between the opening of the intake valve and the closing of the exhaust valve), set the valve clearances on No. 1 cylinder.
2. With the valves rocking on No. 2 cylinder, set the valve clearances on No. 3 cylinder.
3. With the valves rocking on No. 1 cylinder, set the valve clearance on No. 4 cylinder.
4. With the valves rocking on No. 3 cylinder, set the valve clearances on No. 2 cylinder.

With the engine running at fast idle, check that the oil flow to the rocker assembly is satisfactory.



SETTING VALVE CLEARANCE 00007

A. Valve Clearance
B. Rocker Arm
C. Valve Stem Top
D. Adjusting Screwdriver
E. Locknut

PREVENTIVE MAINTENANCE

Maintenance procedures must be done after the correct time period has elapsed or earlier if necessary.

DAILY

Check coolant level.
Check engine oil level.
Check oil pressure.
In extreme dust conditions, clean air filter element.

AFTER FIRST 50 HOURS OF SERVICE:

Drain the lubricating oil pan and refill to the correct level with clean new oil. Do not overfill. Use correct temperature grade and specification. Change engine oil filter.

Remove the rocker assembly; tighten the cylinder head nuts in the correct sequence and to the correct torque.

Reset the valve tip clearance.

Check the tension of the fan belt.

Check the tightness of all external nuts, setscrews, mountings, etc.

Start the engine and check for any fuel, coolant, or lubricating oil leaks. Check oil feed to rockers.

AFTER EVERY 150 HOURS OF SERVICE

Change engine oil and engine oil filter.
Clean air filter element.
Check drive belt tension.
Check for oil, water, or fuel leaks.
Clean fuel water trap.

AFTER EVERY 400 HOURS OF SERVICE

Change fuel filter element.
Check hoses and clamps.

AFTER EVERY 800 HOURS OF SERVICE

Change final fuel filter elements.

AFTER EVERY 2,400 HOURS OF SERVICE

Examine and service equipment, such as starter motor or alternator.

Service injectors.

Check and adjust valve clearance.

GENERAL DIESEL ADVICE

Never use gasoline to clean any parts of the fuel system, such as filter bowls.

Regularly maintain the fuel filters to keep the fuel free of water or foreign material which might damage the fuel injection pump.

Never leave fuel stored in a container exposed to atmosphere as water and dust will be absorbed by the fuel.

Never store fuel in a galvanized container as a chemical reaction will take place between the fuel and the galvanized coating, contaminating the fuel.

Air in sufficient quantity must be allowed to reach the compression chambers to mix with the finely atomised fuel so ignition can take place. If there is not sufficient air reaching the cylinders for compression, the result could be:

(a) black exhaust smoke
(b) erratic running
(c) loss of power
(d) bad starting

Air entering the engine must always be adequately filtered, otherwise dust and dirt can enter the internals of the engine and cause accelerated wear conditions on the piston rings, bores, bearing surfaces and journals, shortening the life of the engine.

Do not store clean engine oil in open containers, as condensation and dust will contaminate the oil.

Regularly wipe the engine over with a non-fluffy rag or properly steam clean at the time the machine is cleaned. With the engine running hot, check all pipe unions, joints, etc., for leaks and remedy where necessary.

The fuel system from the tank to the lift pump is known as the suction side; from the lift pump to the fuel injection pump is the low pressure side; and from the fuel injection pump to the atomisers or injectors is the high pressure side.

Fuel leaks from the low or high pressure pipes or unions can be detected with the engine running, but leaks on the suction side are not so easily detected as they allow air to enter the point of leakage, causing misfiring. Suction side leaks can sometimes be seen as a weep when the engine is not running, or in bad cases the drain of fuel can be detected under the engine after overnight parking.

Watch for pipes chafing and wearing away where the fretting is taking place.

A bad leak on the suction side can cause involuntary stopping of the engine; always beware of a low level of fuel in the tank, which can cause the engine to stop.

Fault	Possible Cause
Low cranking speed	1, 2, 3, 4
Will not start	5, 6, 7, 8, 9, 10, 12, 13, 14, 15, 16, 17, 18, 19, 20, 22, 31, 32, 33.
Difficult starting	5, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 18, 19, 20, 21, 22 24, 29, 31, 82, 33.
Lack of power	8, 9, 10, 11, 12, 13, 14, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 31, 32, 33.
Misfiring	8, 9, 10, 12, 13, 14, 16, 18, 19, 20, 25, 26, 28, 29, 30, 32.
Excessive fuel consumption	11, 13, 14, 16, 18, 19, 20, 22, 23, 24, 25, 27, 28, 29, 31, 32, 33.
Black exhaust	11, 13, 14, 16, 18, 19, 20, 22, 24, 25, 27, 28, 29, 31, 32, 33.
Blue/white exhaust	4, 16, 18, 19, 20, 25, 27, 31, 33, 34, 35, 45, 56.
Low oil pressure	4, 36, 37, 38, 39, 40, 42, 43, 44, 58.
Knocking	9, 14, 16, 18, 19, 22, 26, 28, 29, 31, 33, 35, 36, 45, 46, 59.
Erratic running	7, 8, 9, 10, 11, 12, 13, 14, 16, 20, 21, 23, 26, 28, 29, 30, 33, 35, 45, 59.
Vibration	13, 14, 20, 23, 25, 26, 29, 30, 33, 45, 47, 48, 49.
High oil pressure	4, 38, 41.
Overheating	11, 13, 14, 16, 18, 19, 24, 25, 45, 50, 51, 52, 53, 54, 57.
Excessive crankcase pressure	25, 31, 33, 34, 45, 55.
Poor compression	11, 19, 25, 28, 29, 31, 32, 33, 34, 46, 59.
Starts and stops	10, 11, 12.

KEY TO FAULT FINDING CHART

1. Battery capacity low.
2. Bad electrical connections.
3. Faulty starter motor.
4. Incorrect grade of lubricating oil.
5. Low cranking speed.
6. Fuel tank empty.
7. Faulty stop control operation.
8. Blocked fuel feed pipe.
9. Faulty fuel lift pump.
10. Choked fuel filter.
11. Restriction in air cleaner.
12. Air in fuel system.
13. Faulty fuel injection pump.
14. Faulty atomisers or incorrect type.
15. Incorrect use of cold start equipment.
16. Faulty cold starting equipment.
17. Broken fuel injection pump drive.
18. Incorrect fuel pump timing.
19. Incorrect valve timing.
20. Poor compression.
21. Blocked fuel tank vent.
22. Incorrect type or grade of fuel.
23. Sticking throttle or restricted movement.
24. Exhaust pipe restriction.
25. Cylinder head gasket leaking.
26. Overheating.
27. Cold running.
28. Incorrect tappet adjustment.
29. Sticking valves.
30. Incorrect high pressure pipes.
31. Worn cylinder bores.
32. Pitted valves and seats.
33. Broken, worn, or sticking piston ring/s.
34. Worn valve stems and guides.
35. Overfull air cleaner or use of incorrect grade of oil.
36. Worn or damaged bearings.
37. Insufficient oil in sump.
38. Inaccurate gauge.
39. Oil pump worn
40. Pressure relief valve sticking open.
41. Pressure relief valve sticking closed.
42. Broken relief valve spring.
43. Faulty suction pipe.
44. Choked oil filter.
45. Piston seizure/pick up.
46. Incorrect piston height.
47. Damaged fan.
48. Faulty engine mounting (housing).
49. Incorrect aligned flywheel housing or flywheel.
50. Faulty thermostat.
51. Restriction in water jacket.
52. Loose fan belt.
53. Choked radiator.
54. Faulty water pump.
55. Choked breather pipe.
56. Damaged valve stem oil deflectors (if fitted).
57. Coolant level too low.
58. Blocked sump strainer.
59. Broken valve spring.

SMOKE DIAGNOSIS CHART

COLOR BLACK OR DARK GREY

SYMPTOM	PROBABLE DIAGNOSIS	CURE
Smoke at full load at any engine speed, but particularly at highest and lowest speeds, and power at least normal.	Maximum fuel setting of injection pump too high.	Remove pump, have reset to engine maker's maximum flow figure (or loss) by authorized service agent if own equipment not available.
	Excess fuel device not tripping automatically to normal after starting.	Have repaired by authorized agent - removal of pump may be necessary.
Smoke at full load particularly at high and medium speeds, engine quieter than normal.	Pump timing retarded (or advance device not installed correctly).	Correct timing according to engine maker's instructions, taking up pump drive backlash (or rectify advance device if fitted).
Smoke at full load particularly at low and medium speeds, engine noisier than normal.	Pump timing too advanced.	
Smoke at full load particularly at high and medium speeds, probably with loss of power.	Injector nozzle hole(s) wholly or partially blocked.	Replace injectors by reconditioned set, or clean and recondition with proper equipment.
Smoke at full load at higher speeds only.	Air cleaner restricted due to blockage with dirt, or damage.	Clean or replace air cleaner element according to type.
Intermittent or puffy exhaust smoke sometimes with white or blue tinge, usually coupled with knocking.	Injector nozzle valve stuck open intermittently.	Have injectors examined for sticking valve, broken spring, or grossly low opening pressure, or sign of cross-binding in cylinder head. Replace as necessary.
Smoke at full loads at high speed, engine running faster than normal when on governor.	Governor speed setting considerably above engine maker's maximum.	With mechanical or hydraulic governors, reduce governor speed adjustment and seal stops, or remove pump for attention.
Smoke at most speeds and loads, tending to blue or white when cold and when starting.	Nozzle sprays impinging on cylinder head, due to incorrect fitting of injector into cylinder head.	Examine for number of washers between injector and cylinder head - only one required at most (some engines none required - ref. instruction book).
Smoke at higher loads and speeds, not necessarily at maximum.	Injector nozzle valve lift excessive, due to repeated valve or seat refacing, without lift correction.	Can be rectified by proper equipment during reconditioning.
Smoke at all speeds at high loads, mostly low and medium speeds and probably coupled with poor starting.	Loss of cylinder, compression due to stuck rings, bore wear, valve wear or burning, sticking valves, incorrect valve setting.	Engine requires top overhaul at least: reringing or sleeving: piston renewal if wear indicates.
Smoke at full load, either at lower or higher speeds only, but in some cases at all speeds.	Incorrect nozzle type fitted, or mixed types, or out of date type, or type for different duty.	Will be automatically corrected if injectors are reconditioned by an authorized agent, but it is essential to quote exact details of engine type and application.
Smoke at full load, mostly at medium and high speeds, probably coupled with low power.	Injection high pressure pipes of incorrect length or bore, or having badly closed in bore at ends, or due to sharp bends.	Fit only the engine maker's listed pipe. Check ends for closing in.

COLOR: BLUE OR BLUISH GREY
OR GREYISH WHITE

SYMPTOM	PROBABLE DIAGNOSIS	CURE
Blue or whitish smoke, particularly when cold and at high speeds and light load, but reducing or changing to black when hot and at full load, and with loss of power at least at high speeds.	Pump timing retarded (or advance device not correct if fitted).	Reset timing (or rectify advance device if fitted).
Blue or whitish smoke when cold, particularly at light loads, but persisting when hot, probably with knocking.	Injector nozzle valve stuck open, or tip broken off nozzle.	Examine for sticking valve or broken spring, but suspect handling of injectors out of engine if tip is found broken.
Blue smoke at all speeds and loads, hot or cold.	Engine oil being passed by piston rings due to sticking rings or worn bores.	Engine recondition indicated.
Blue smoke, particularly when accelerating from period of idling, tending to clear with running.	Engine oil being passed by inlet valve guides due to wear, or valve guide oil shields misplaced.	Recondition cylinder head and make certain that guide oil shields (if any) are in place.
Light blue smoke at high speed light loads or running downhill, usually with acrid odor.	Engine running too cold, thermostat stuck or not fitted.	Replace thermostat.

ENGINE IDENTIFICATION

ENGINE SERIAL NUMBER INTERPRETATION

EXAMPLE: 154 2 UA 251 L

1. The first three digits represent the volumetric capacity of the engine in cubic inches, and thus the engine type, e.g.,

   154 Cu In = Type 4.154 Engine

2. A fourth digit may now appear indicating a derivation of a standard engine type with special features, e.g.,

   154 2 = Later Version 4.154 Engine

3. Following the first group of digits is a letter to identify the country in which the engine was built, e.g.,

A = Argentina
B = Brazil
C = Australia
E = Spain
F = France
J = Japan
L = Italy
M = Mexico
S = India
U = United Kingdom

4. A second letter may appear next, denoting:

   A = an engine built exclusively for Massey-Ferguson.
   R = a factory reconditioned engine.
   S = standard options scheme engine.

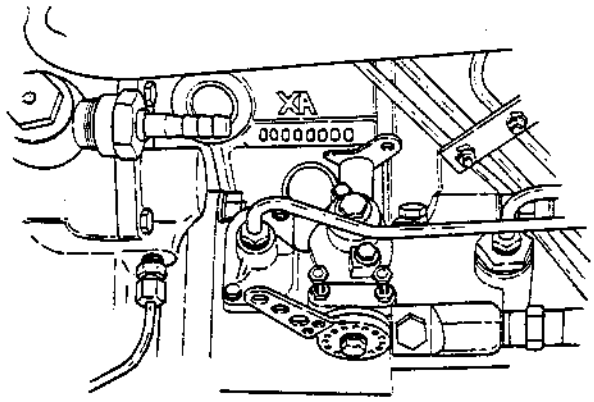
5. The serial number now appears, the first number in each series commencing 251.

   a) For major customers as specified in paragraph 3, there will be a separate sequential series commencing at 251 for each engine type within country of origin.

   b) For all other customers, one sequential series commencing at 251 for each engine type.

6. The final letter or group of letters, if any should appear, will denote the following supplementary information:

   C = engine fitted with chrome plated cylinder liners.
   D = denotes direct injection engine, only where an indirect injection engine of the same model is available.
   H = horizontal engine.
   T = turbocharged engine.
   HT = horizontal turbocharged engine.
   L = lip type rear crankshaft oil seal.



LOCATION OF ENGINE SERIAL NUMBER 00208

RECOMMENDED TORQUE

The following torque figures will apply with the components lightly oiled before assembly:

	ft lb	Nm
Cylinder Head Nuts	60	81
Connecting Rod Setscrews	42	57
Main Bearing Setscrews	85	115
Flywheel Setscrews	60	81
Idler Gear Hub Setscrews	36	49
Crankshaft Pulley Setscrews	150	203
Atomiser Securing Nuts	12	16
High Pressure Fuel Pipe Nuts	15	20
Dynamo Pulley Retaining Nut	20	27
Alternator Pulley Retaining Nut	30	41
Thermostart Unit	10	13
Thermostart Insulating Adaptor	10	13

BATTERIES

IMPORTANT NOTES ON BATTERY CARE

- Raise the engine hood during charging for maximum ventilation.
- Keep vent plugs firmly in place at all times, except when adding water, taking hydrometer readings, or charging the batteries.
- Keep flame and sparks away from the batteries when charging as they may ignite the gas given off by the batteries.
- Keep all metallic objects off the top of the battery as they may cause a short circuit.
- Keep the top of the battery clean and dry.
- Keep the electrolyte level above the plates at all times.
- Add water only and avoid overfilling.
- Keep electrolyte from coming in contact with the eyes, skin, clothing, or any other material which it might damage.
- Do not discharge battery below specific gravity of 1.140.
- Do not allow batteries to remain in discharged condition for any length of time.

BATTERY INSPECTION AND MAINTENANCE

Check the battery cables for loose connections to the battery terminals. Inspect the cables for corrosion or damage.

Clean the battery top surface and the terminals once every 100 hours. 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 solution to enter the battery. Use a wire brush to clean terminal posts and cable connectors. After cleaning, rinse with clean water, dry top of battery, and apply a coating of clear petroleum jelly to the terminals and cable connectors.

Check electrolyte level in each cell after every 50 hours of operation for a regular battery, or after every four months for a reduced maintenance battery. Electrolyte level must always be above the plates. Add distilled water to maintain solution at correct level above the plates, but do not overfill.

Use a hydrometer to check the electrolyte specific gravity.

NOTE: If the readings are taken when the electrolyte is any temperature other than 80° F (26.6° C), the reading must be temperature corrected.

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 the following:

SPECIFIC GRAVITY AT 80°F (26.6°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	(Recharge at this point) 25% charged
1.140-1.160	Very little capacity remaining
1.110-1.130	Discharged

If the variation in readings between the battery cells is more than 0.050, 50 points, the battery is damaged, shorted, or is about to fail.

SPECIFIC GRAVITY TEMPERATURE CORRECTION

The hydrometer specific gravity reading must be corrected when the battery electrolyte is any temperature other than 80° F (26.6° C).

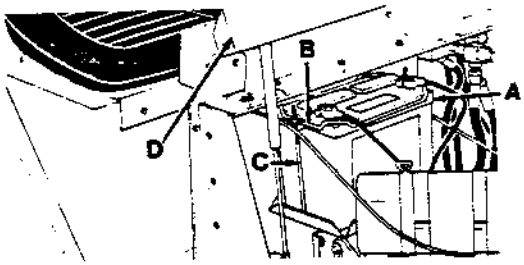
To determine the corrected specific gravity reading when the temperature of the electrolyte is other than 80° F (26.6° C):

Add to the hydrometer reading 0.004, 4 points, for each 10° F (5.5° C) above 80° F (26.6° C).

Subtract from the hydrometer reading 0.004, 4 points, for each 10° F (5.5° C) below 80° F (26.6° C).

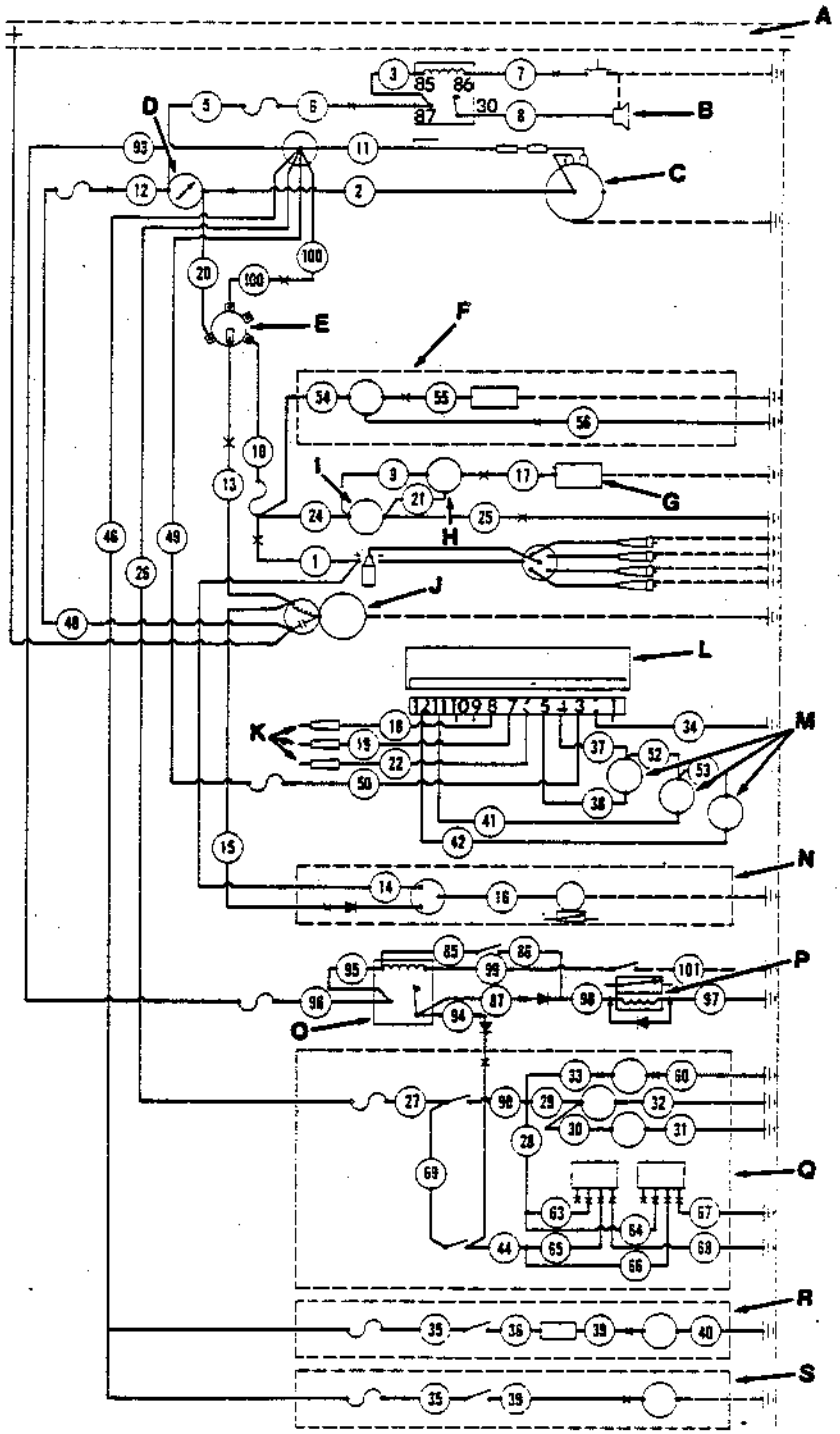
BATTERY REPLACEMENT

The standard battery is a 12-Volt, 84-A/h battery. It is located on the top right side of the engine compartment along the firewall. The battery is held in position by a rubber-coated bracket and two threaded studs.



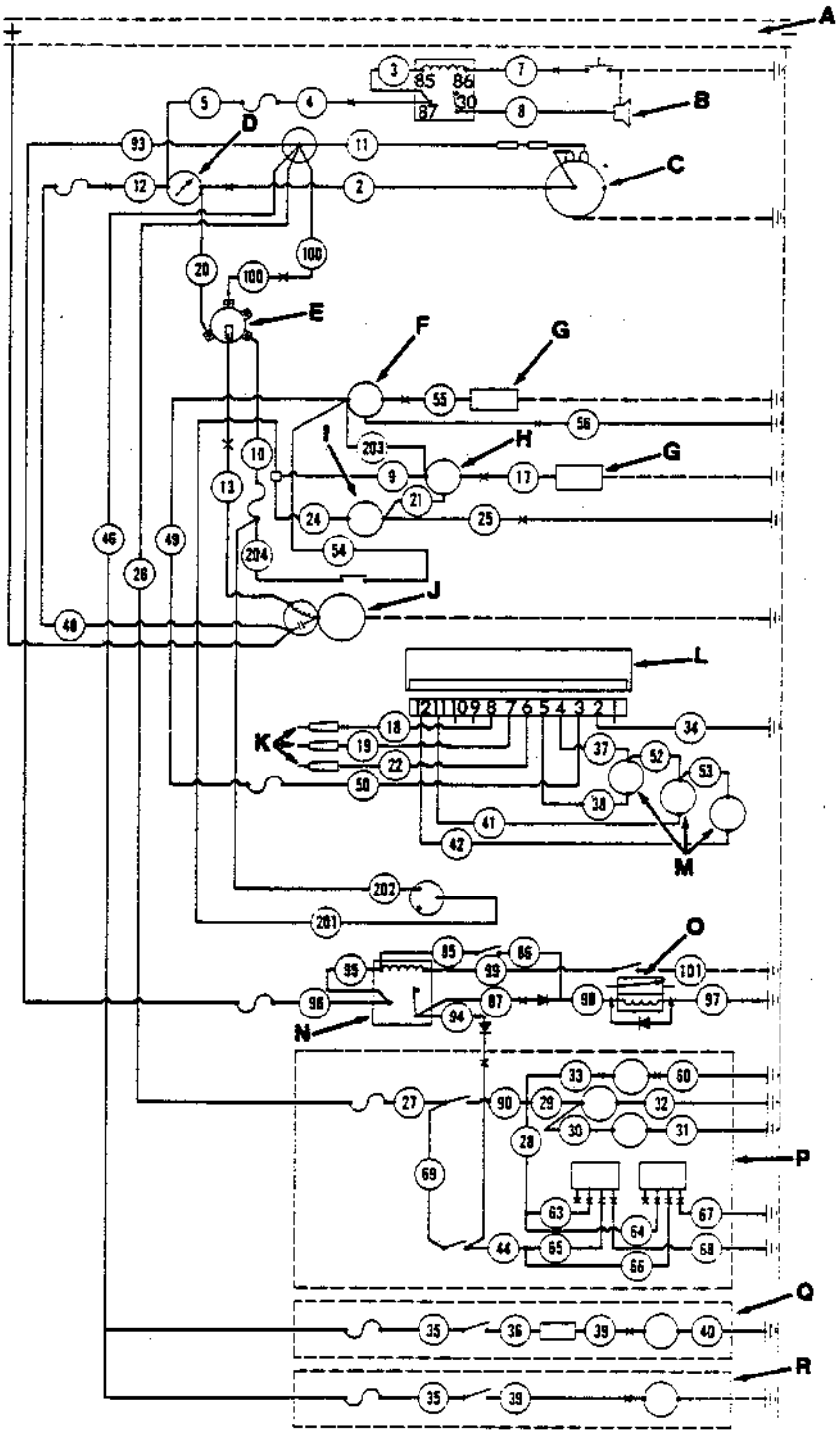
BATTERY LOCATION 00050

A. Battery
B. Rubber-Coated Bracket
C. Threaded Stud
D. Engine Hood (Open Position)



ELECTRICAL SCHEMATIC, GASOLINE, LPG 00103

A. Battery
B. Horn
C. Alternator
D. Ammeter
E. Ignition Switch
F. Fuel Gauge
G. Sending Unit
H. Engine Temperature Gauge
I. Hour Meter
J. Engine Starter Motor
K. Liquid Level Sensing Probe
L. Circuit Board
M. Indicator Lamp
N. LPG Components
O. Auto Squeegee Relay
P. Solenoid Valve
Q. Head and Taillight Kit
R. Flashing Light Kit
S. Rotating Light Kit



ELECTRICAL SCHEMATIC, DIESEL 01158

A. Battery	G. Sending Unit	M. Indicator Lamp
B. Horn	H. Engine Temperature Gauge	N. Auto Squeegee Relay
C. Alternator	I. Hour Meter	O. Solenoid Valve
D. Ammeter	J. Engine Starter Motor	P. Head and Taillight Kit
E. Ignition Switch	K. Liquid Level Sensing Probe	Q. Flashing Light Kit
F. Fuel Gauge	L. Circuit Board	R. Rotating Light Kit

SCRUB BRUSH REPLACEMENT

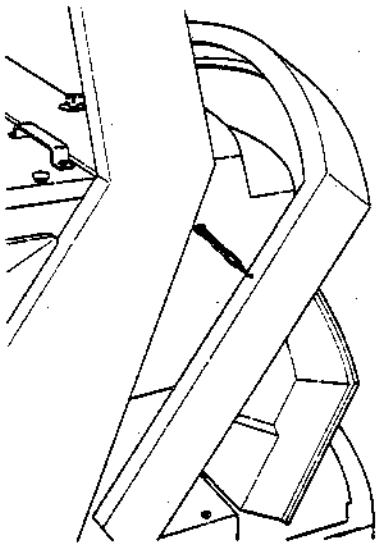
Replace scrub brushes when there is 0.5 in (13 mm) of brush bristle left. Always replace scrub brushes in pairs.

TO REMOVE BRUSHES:

1. Stop the machine on level ground and engage the machine parking brake.

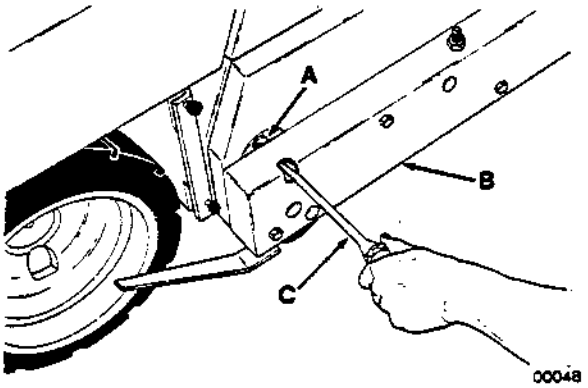
CAUTION: Always engage the parking brake before working on the machine.

2. Raise the scrub head so the scrub brushes are 0.12 in (3 mm) off the floor.
3. Turn the engine off.
4. Raise and chain up the rear bumper.



CHAINING UP REAR BUMPER 00004

5. Open the lower left access door and the left scrub head access door with a screwdriver. The door fastener head has a screwdriver slot.

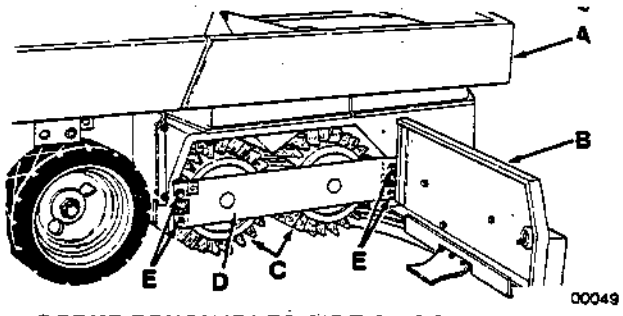


00048

OPENING LEFT SCRUB HEAD ACCESS DOOR

- **A. Door Fastener**
- **B. Side Squeegee Cover**
- **C. Screwdriver**

6. Remove the four brush end plate bolts.



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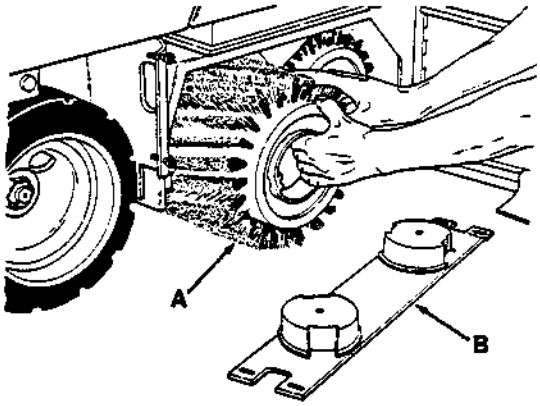
SCRUB BRUSH IDLER SIDE OF SCRUB HEAD

- **A. Rear Bumper**
- **B. Left Side Access Door**
- **C. Brush**
- **D. Brush Idler End Plate**
- **E. Brush End Plate Bolts**

7. Remove the brush end plate.
8. Pull out the front brush and then the rear brush.



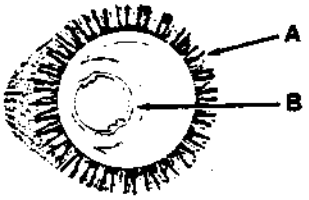
REMOVING FRONT SCRUB BRUSH 00058

- **A. Front Scrub Brush**
- **B. Brush Idler Plate**

NOTE: Brush life may be increased by periodically interchanging the front and rear brushes. The brushes cannot be turned end-for-end.

TO INSTALL BRUSHES:

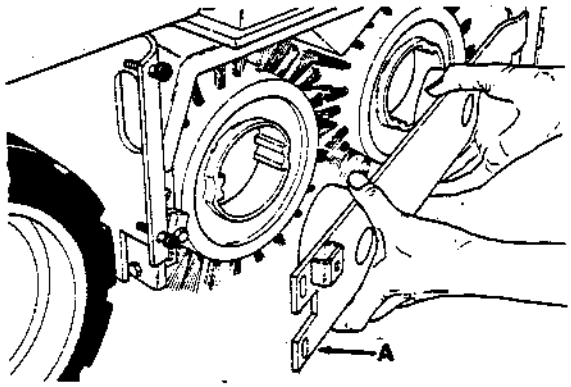
1. Place the scrub brush drive control levers in the "clean" position with the engine off. This locks the brush drive plugs in one position.
2. Determine which is the drive end of the scrub brush. The drive end of the brush has its drive plug recessed approximately 6.37 in (162 mm).



DRIVE END OF BRUSH 00047

- **A. Brush**
- **B. Recessed Brush Drive Socket**

3. Line up the drive end socket of the brush with the rear brush drive plug lugs.
4. Slide the scrub brush into the rear brush drive plug.
5. Line up the drive end socket of the brush with the front brush drive plug lugs.
6. Slide the scrub brush into the front brush drive plug.
7. After the two brushes have engaged the drive plugs, slide the brush end plate into position.

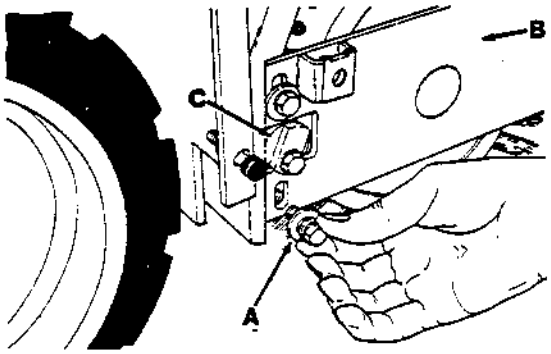


BRUSH END PLATE INSTALLATION 00055

A. Brush End Plate

NOTE: Do not force the brush end plate onto the brushes. The brush end plate will easily slip into place if the brushes and brush drive plugs are aligned properly.

8. Install the four end plate mounting bolts.



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INSTALLING BRUSH END PLATE MOUNTING BOLTS

A. Brush End Plate Mounting Bolt
B. Brush End Plate
C. Adjusting Cam

9. Adjust the brush pattern as described in Scrub Brush Pattern Adjustments.

SCRUB HEAD ADJUSTMENTS

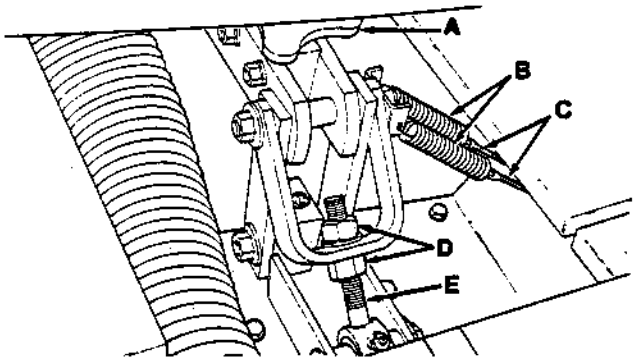
SCRUB HEAD LEVELING

1. Park the machine on a smooth level floor.
2. Stop the engine.
3. Engage the machine parking brake.

⚠ CAUTION: Always engage the machine parking brake before working on machine.

NOTE: The scrub head must be adjusted with new side and rear squeegees, and new scrub brushes.

4. Center the rear squeegee tip adjusting block bolts in their slots.
5. Check to make sure the rear squeegee link pivots and lift pivot rotate freely.
6. Loosen the rear squeegee frame lift stud balljoint jam nuts.
7. Thread the two balljoints onto the stud as far as possible.
8. The front blade of the rear squeegee should be 0.25 ± 0.06 in (6 ± 2 mm) off the floor when the rear blade is resting on the floor uncurled.
9. Adjust the side squeegee adjusting bolts so that the dimensions from the top of the bolt to the top of the squeegee frame is 1.5 ± 0.06 in (38 ± 1.5 mm).
10. Adjust the spray deflector upward until it contacts the scrub head.
11. Loosen the four brush idler plate mounting bolts.
12. Set both of the brush adjusting cams to the center position (rectangular position of cam horizontal).
13. Tighten the four brush idler bolts.
14. Lower the scrub head to the floor so the rear squeegee rests on the floor but is not curled.
15. Adjust the rear squeegee caster down to the floor. Make sure it is squarely positioned on the floor and tighten the adjusting bolts.
16. Start the engine, release the parking brake and move the machine forward to deflect the squeegee blades.
17. Place the scrub brushes control levers in the "clean" position.
18. The scrub head should be parallel to the floor from side to side within 0.12 in (3 mm). If the head is too high on the left side, evenly increase the tension on the head leveling springs. If the scrub head is too high on the right side, evenly decrease the tension on the head leveling springs.



SCRUB HEAD ADJUSTMENTS 00070

A. Head Adjustment Knob
B. Leveling Spring
C. Spring Adjuster
D. Jam Nut
E. Adjustable Yoke

19. The scrub head should be parallel to the floor from the front to the rear within 0.25 in (6 mm). If the head is too high in the front, shorten the adjustable yoke. If the head is too low in the front, lengthen the adjustable yoke. Retighten the yoke jam nut.

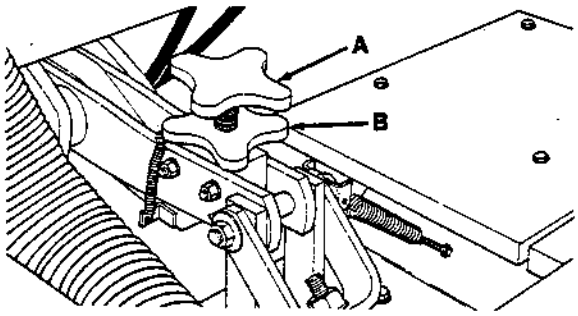
SCRUB BRUSH PATTERN ADJUSTMENTS

1. Apply chalk, or some other material that will not blow away easily, on a smooth, level floor.
2. With the scrub head up, position the machine scrub head over the test area.
3. Start the scrub brushes rotating, while keeping a foot on the brakes.
4. Lower the scrub head, allowing the brushes to spin in one spot for 15 to 20 seconds.

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

5. Raise the scrub head after 15 to 20 seconds, and remove the machine from the test area.
6. Loosen the lock knob and adjust the head adjustment knob to get a 2 in (5 mm) brush pattern across the full length of the brush. Turn the knob counter-clockwise to increase the pattern. Turn the knob clockwise to decrease the pattern. Tighten the lock knob after adjusting the brush pattern.

NOTE: If either brush pattern is cone shaped, adjust the brush adjusting cams before attempting to get a full length brush pattern to avoid damaging the brushes.



HEAD ADJUSTMENT KNOB 00018

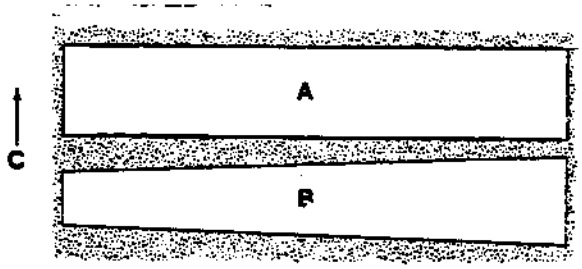
A. Head Adjustment Knob
B. Lock Knob

7. If one or both of the brush patterns are tapered, the brush adjusting cam positions must be adjusted.

Turning the cam lobe up raises the idler side of the brushes. Turning the cam lobe down lowers the idler side of the brushes. Adjust the brushes to give an even brush pattern over the length of each of the brushes.

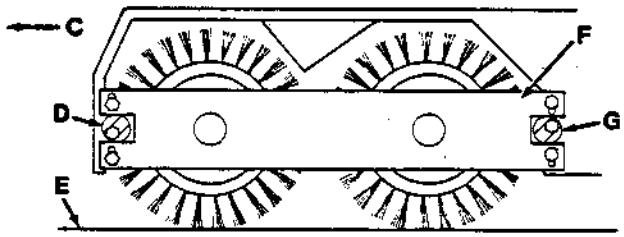
NOTE: Each cam has more of an influence on the closest brush. However, it does have an influence on the other brush. Take this into consideration when adjusting the cams. Adjust by trial and error. Make an adjustment with the engine off and the parking brake engaged. Tighten the adjustment and run a test pattern. Check the test pattern and readjust the cam(s), if it is necessary, again with the engine off and the parking brake engaged.

CAUTION: Always make adjustments with the engine off and the parking brake engaged.



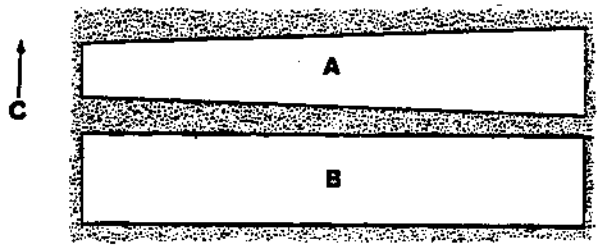
00082

To correct this condition: Adjust the front cam lobe up, adjust the rear cam lobe down.



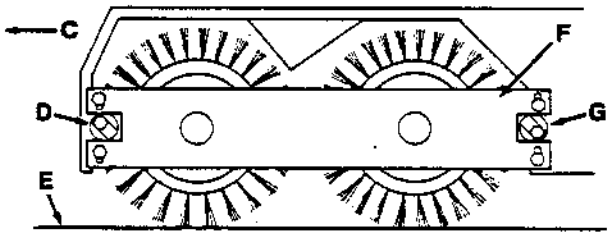
00069

A. Front Brush Pattern
B. Rear Brush Pattern
C. Front of Machine
D. Front Cam
E. Floor
F. Idler Plate
G. Rear Cam



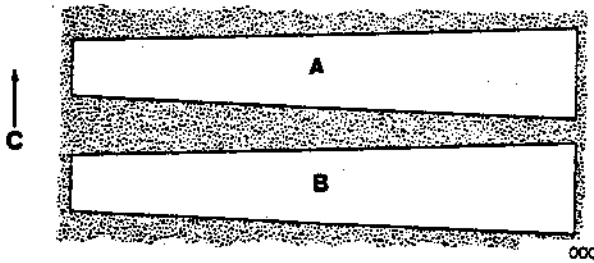
00082

To correct this condition: Adjust the front cam lobe down, adjust the rear cam lobe up.



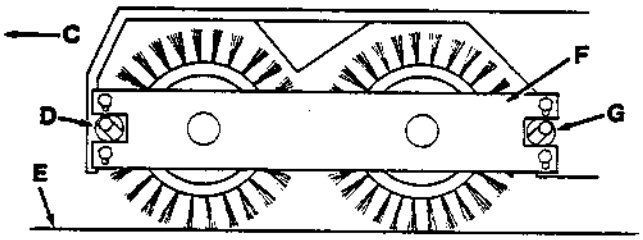
00069

A. Front Brush Pattern
B. Rear Brush Pattern
C. Front of Machine
D. Front Cam
E. Floor
F. Idler Plate
G. Rear Cam



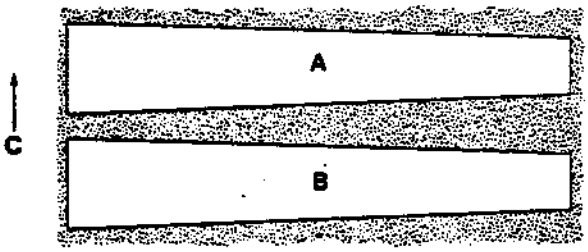
00082

To correct this condition: Adjust brush cam lobes down.



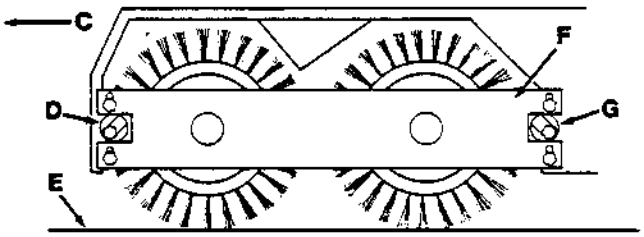
00068

A. Front Brush Pattern
B. Rear Brush Pattern
C. Front of Machine
D. Front Cam
E. Floor
F. Idler Plate
G. Rear Cam



00082

To correct this condition: Adjust both cam lobes up.



00068

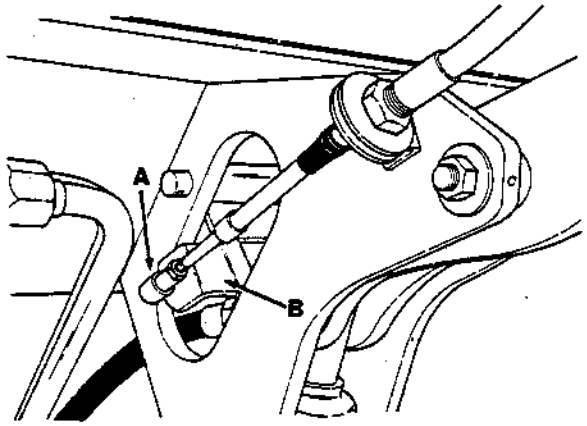
A. Front Brush Pattern
B. Rear Brush Pattern
C. Front of Machine
D. Front Cam
E. Floor
F. Idler Plate
G. Rear Cam

NOTE: If the front and rear brush patterns are not equal in width, the head must be readjusted as described in step 15 of Scrub Head Leveling.

SCRUB HEAD LOCK ADJUSTMENT

The scrub head lock mechanism must lock the scrub head up in the locked position and must allow the scrub head to move up or down when the scrub head lock is in the unlocked position.

To adjust the scrub head lock linkage, adjust the ball joint located on the head lock mechanism near the front of the scrub head.

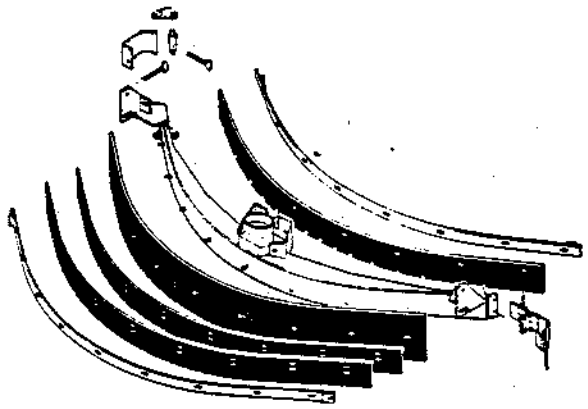


SCRUB HEAD LOCK ADJUSTMENT 00019

A. Balljoint
B. Scrub Head Lock Mechanism

REPLACEMENT OF REAR BLADE OF REAR SQUEEGEE

Replace the rear blade of the rear squeegee if the leading edge of the squeegee is worn half-way through the thickness of the blade. Replace the back-up strips if they become damaged or if they lose their resiliency.



00080

REAR SQUEEGEE

Each 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.

TO REMOVE REAR SQUEEGEE BLADE

1. Lower the rear squeegee.
2. Raise the scrub head. Lock the headlock in the "raised" position.

⚠ CAUTION: Always lock the scrub head in the "raised" position before working under the scrub head. Do not rely on the machine hydraulics as they may "leak down," lowering the scrub head crushing objects beneath it.

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

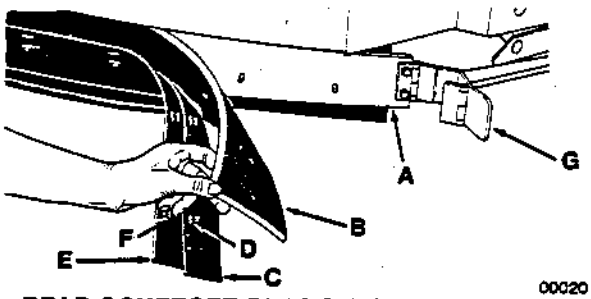
⚠ CAUTION: Always stop the engine and engage the machine parking brake before working on the machine.

4. Open the rear band clamp and remove the two squeegee back-up strips and the squeegee blade.

TO INSTALL REAR SQUEEGEE BLADE

NOTE: Each rear squeegee has four usable edges.

1. Place the squeegee blade over the pins of the squeegee frame.
2. Place the squeegee back-up strips on the pins; inner strip using top holes, outer strip using lower holes.



00020

REAR SQUEEGEE BLADE INSTALLATION

- **A. Squeegee Frame**
- **B. Rear Squeegee Blade**
- **C. Inner Back-up Strip**
- **D. Top Hole**
- **E. Outer Back-up Strip**
- **F. Lower Hole**
- **G. Retaining Band Clamp**

3. Position the squeegee retaining band over the outer back-up strip.
4. Engage the retaining band clamp.

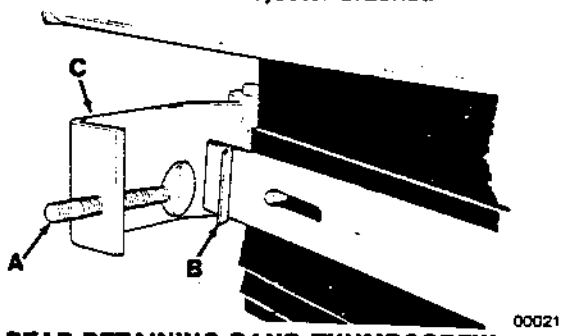
NOTE: Make sure the band is snug to the squeegee and the back-up strips.

5. Adjust the rear squeegee as described in Rear Squeegee Adjustment.

REAR RETAINING BAND CLAMP ADJUSTMENT

To tighten the rear retaining band, unthread the thumbscrew out of the rear adjuster bracket.

To loosen the rear retaining band, thread the thumbscrew into the rear adjuster bracket.



00021

REAR RETAINING BAND THUMBSCREW

- **A. Thumbscrew**
- **B. Squeegee Retaining Band**
- **C. Rear Adjuster Bracket**

REPLACEMENT OF FRONT BLADE OF REAR SQUEEGEE

The function of the front blade of the rear squeegee is to channel water into the rear squeegee blade which wipes the floor nearly dry.

Replace the front blade of the rear squeegee whenever the blade has become damaged or when the blade no longer contacts the floor.

TO REMOVE FRONT SQUEEGEE BLADE

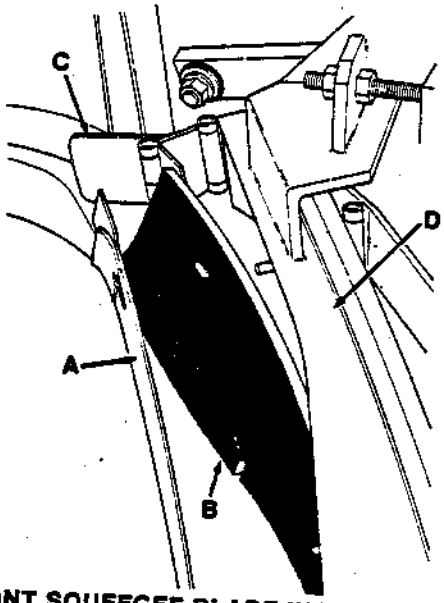
1. Lower the rear squeegee.
2. Lower the scrub head so the rear squeegee is just off the floor.
3. Stop the engine and engage the machine parking brake.

CAUTION: Always stop the engine and engage the parking brake before working on the machine.

4. Disconnect the rear squeegee and debris screen suction hoses from the scrubber head frame vacuum connection.
5. Remove the debris hopper.
6. Open the front band clamp and remove the front squeegee blade.

TO INSTALL THE FRONT SQUEEGEE BLADE

1. Place the squeegee over the pins of the squeegee frame.
2. Position the squeegee retaining band over the squeegee on the pins of the squeegee frame.



00017

FRONT SQUEEGEE BLADE INSTALLATION

A. Retaining Band
B. Front Blade of Rear Squeegee
C. Retaining Band Clamp
D. Squeegee Frame

3. Engage the retaining band clamp.

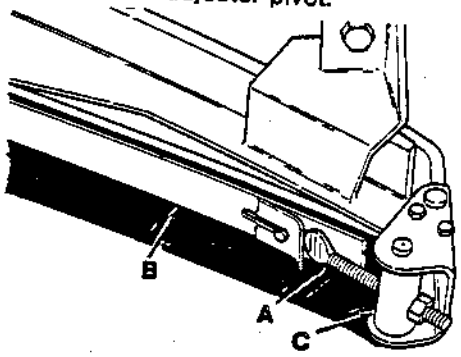
NOTE: Make sure the band is snug to the squeegee.

4. Adjust the rear squeegee as described in Rear Squeegee Adjustment.

FRONT RETAINING BAND CLAMP ADJUSTMENT

To tighten the front retaining band, unthread the thumbscrew out of the adjuster pivot.

To loosen the front retaining band, thread the thumbscrew into the adjuster pivot.



00018

FRONT RETAINING BAND THUMBSCREW

A. Thumbscrew
B. Front Retaining Band
C. Adjust Pivot

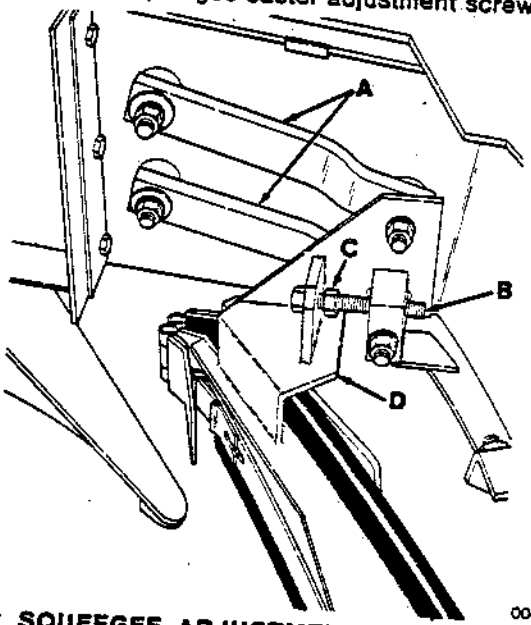
REAR SQUEEGEE ADJUSTMENT

The rear squeegee adjustment should always be checked after changing the rear squeegee blades or after adjusting the scrub head.

1. Lower the scrub head and the rear squeegee.
2. Stop the engine and engage the machine parking brake.

CAUTION: Make all adjustments with the engine off and the machine parking brake engaged. Make the adjustments by trial and error.

3. Loosen the four squeegee tip adjuster lock nuts and the squeegee caster adjustment screws.

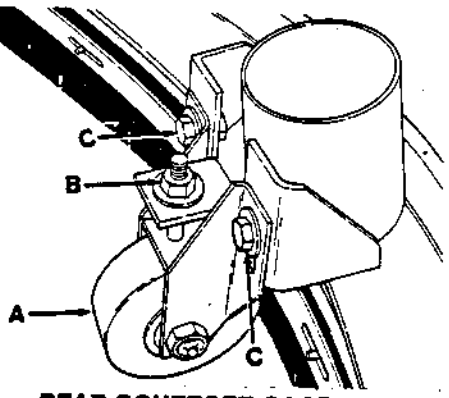


00011

REAR SQUEEGEE ADJUSTMENTS (RIGHT SIDE SHOWN)

A. Parallel Arms
B. Squeegee Tip Adjusting Screw
C. Tip Adjuster Lock Nut
D. Squeegee Frame

POWER SCRUBBER - 527 MM133 (5-82) LITHO IN U.S.A.



REAR SQUEEGEE CASTER 00022

A. Caster Wheel
B. Caster Adjustment Screw
C. Locking Screw

4. Position the squeegee so the blade just touches the floor from end to end. To do this, adjust the squeegee tip adjusting screws to raise or lower the squeegee tips; tightening the screws brings the tips down; loosening the screws brings the tips up.
5. Tighten the four squeegee tip adjusting locknuts.
6. Slide a 0.50 in (12.7 mm) thick block under the squeegee caster.
7. Position the squeegee so the blade just touches the floor. Tighten the squeegee caster screws.
8. Remove the block from under the squeegee caster.
9. Start the engine and disengage the parking brake.
10. Move the machine forward with the rear squeegee down, the brushes on, and the scrub head down.
11. Stop the engine with the scrub head down.
12. Engage the machine parking brake.
13. Inspect the rear squeegee blade deflection. The squeegee blade should be evenly deflected 0.62 ± 0.12 in (16 ± 3 mm). The squeegee ends should have a gap between the front blade and the rear blade of 0.12 ± 0.06 in (3 ± 1.5 mm).
14. If the squeegee blade is deflected too much at the center, lower the caster accordingly. If the center is deflected too little, raise the caster accordingly.
15. If the squeegee blade tips are too high or too low, loosen the squeegee tip locknuts and adjust the squeegee tips, adjusting screws accordingly.
16. Check the scrub brush pattern after making any adjustments.

SIDE SQUEEGEE BLADE REPLACEMENT

The side squeegees channel water into the path of the rear squeegee.

Replace the side squeegee blades and back-up strips whenever they become damaged or whenever they lose their shape or resiliency.

TO REMOVE A SIDE SQUEEGEE BLADE

1. Raise the scrub head.
2. Place the squeegee switch in the "up" position.
3. Stop the engine and engage the machine parking brake.

⚠ CAUTION: Always stop the engine and engage the machine parking brake before working on the machine.

4. Open the side squeegee latch and remove the side squeegee parts.

TO INSTALL A SIDE SQUEEGEE BLADE

1. Place the side squeegee blade over the pins of the squeegee frame.
2. Place the squeegee back-up strip on the pins over the squeegee blade.
3. Position the blade bridge on the squeegee frame pins. Be sure the tapered edge is facing the front of the machine.
4. Clip the rear of the retaining band over the rear of the squeegee and the squeegee bridge.
5. Engage the side squeegee latch.

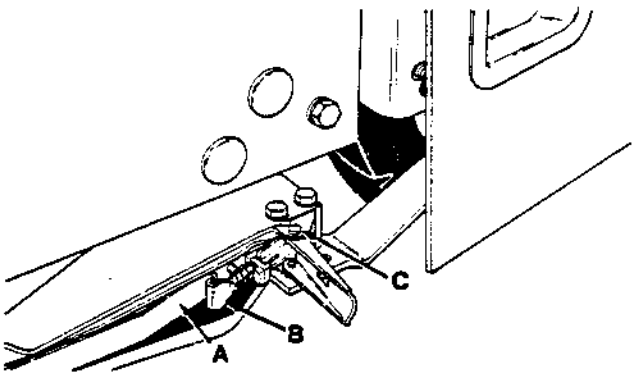
NOTE: Make sure the band is snug to the squeegee, the back-up strip, and the squeegee bridge.

6. Adjust the side squeegee as described in Side Squeegee Adjustment.

SIDE SQUEEGEE LATCH ADJUSTMENT

To tighten the side squeegee retention band, thread the latch hook into the latch pivot.

To loosen the side squeegee retention band, unthread the latch hook out of the latch pivot.



00065

ADJUSTING SIDE SQUEEGEE LATCH (RIGHT SIDE SHOWN)

A. Squeegee Retention Band
B. Latch Hook
C. Latch Pivot

SIDE SQUEEGEE ADJUSTMENT

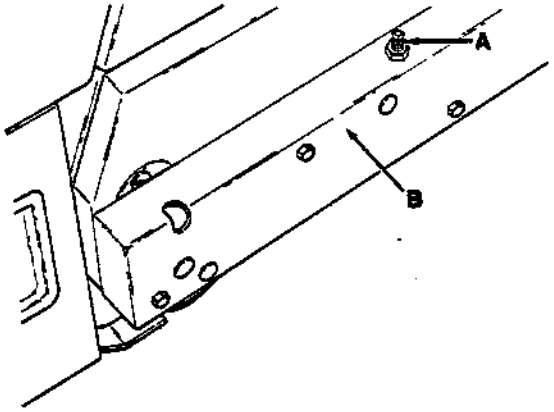
The side squeegee adjustment should always be checked after changing the side squeegees.

1. Lower the scrub head and move the machine forward.
2. Stop the engine and engage the machine parking brake.

⚠ CAUTION: Make all adjustments with the engine off and the machine parking brake engaged. Make the adjustments by trial and error.

3. Check the squeegee blade deflection.
4. To adjust squeegee blade deflection, loosen the lock nut. To increase squeegee blade deflection, thread the down pressure adjustment screw into the assembly.

   To decrease squeegee blade deflection, unthread the down pressure adjustment screw from the assembly.



00084

SIDE SQUEEGEE BLADE ADJUSTMENT

A. Down Pressure Adjustment Screw
B. Side Squeegee Frame

NOTE: A side squeegee benchmark adjustment is as follows: Adjust the down pressure adjustment screw so that the distance from the top of the screw to the top of the side squeegee frame is 1.5 ± 0.06 in (38 ± 1.52 mm). The side squeegees can be adjusted as required after the initial setting.

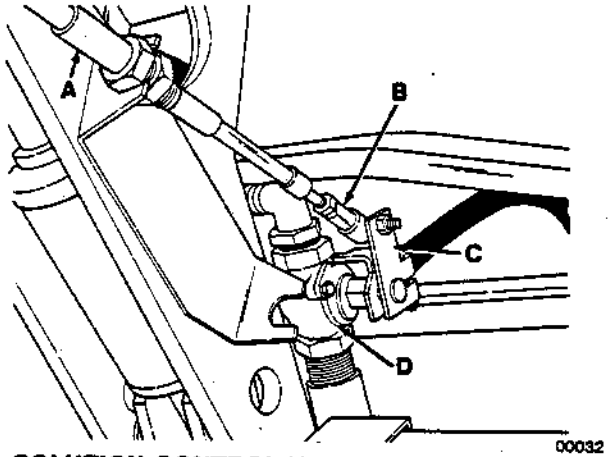
SOLUTION AND RECOVERY TANK

SOLUTION TANK

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

SOLUTION CONTROL VALVE ADJUSTMENT

The water control valve linkage should give the valve fully open and fully closed positions. To adjust the linkage, adjust the balljoint on the water valve lever located on the valve.



SOLUTION CONTROL VALVE ADJUSTMENT

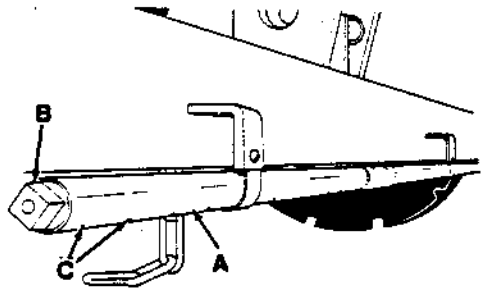
- **A. Control Cable**
- **B. Ball joint**
- **C. Water Valve Lever**
- **D. Water Valve**

SOLUTION SPREADER TUBE

The solution spreader tubes may be flushed out if they become 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 solution control valve is opening fully when the solution flow control lever is moved to the "open" position.

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.



SOLUTION SPREADER TUBE

- **A. Spreader Tube**
- **B. Tube Plug**
- **C. Distribution Holes**

RECOVERY TANK

The recovery tank should be drained whenever the ball float stops the water vacuum and after every working shift.

TO DRAIN THE RECOVERY TANK

1. Stop the machine with the left side near a floor drain.
2. Engage the machine parking brake.

⚠ **CAUTION: Always engage the parking brake before working on machine.**

3. Stop the engine.
4. Open the bottom left side access door.
5. Remove the drain hose from storage clips.
6. Lower the hose to the floor drain.
7. Remove the hose plug and drain the tank.
8. When finished draining the tank, replace the hose plug in the hose.
9. Place the drain hose in the storage clips.
10. Close and secure the access door.

CLEANING RECOVERY TANK

The recovery tank should be cleaned after every scrubbing shift. Two doors have been provided to make the job easier. One door is located on top of the recovery tank. The other door is located behind the lower left side access door.

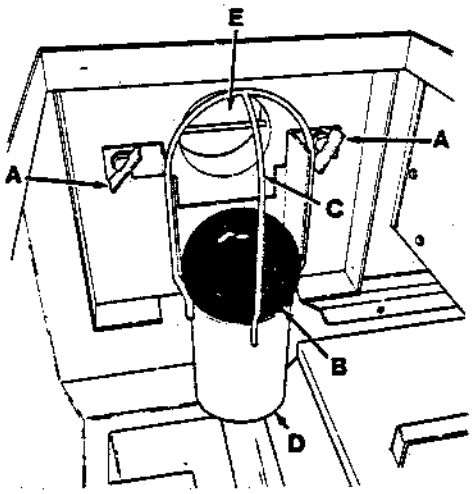
TO CLEAN THE RECOVERY TANK

1. Stop the machine with the left side near a floor drain.
2. Engage the machine parking brake.

⚠ **CAUTION: Always engage the parking brake before working on machine.**

3. Stop the engine.
4. Open the bottom left side access door.
5. Drain the recovery tank as described in Draining Recovery Tank.
6. Leave the drain hose open on the floor drain.
7. Open the top access door and the bottom clean-out door.
8. Spray the inside of the tank with clean water. Remove all sludge from the bottom of the tank out the bottom clean-out door.
9. Spray the ball float. Make sure the float guides are free of dirt and debris which may cause the float to stick.

POWER SCRUBBER - 527 MM133 (5-82) LITHO IN U.S.A.



00014

RECOVERY TANK BALLFLOAT

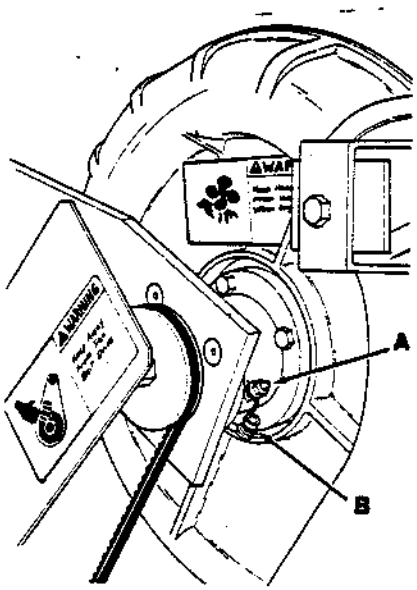
A. Thumbscrew
B. Ball Float
C. Ball Float Guide
D. Ball Float Screen on Bottom of Ball Float Guide
E. Vacuum Fan Inlet

10. When finished, plug the drain hose.
11. Close the bottom clean-out door.
12. Store the drain hose in the storage clips.
13. Close and secure the access door.

VACUUM SYSTEM

VACUUM SYSTEM MAINTENANCE

The vacuum fan is located on the left side of the machine. The vacuum fan bearings must be lubricated every 50 hours with special Chevron "SRI" or Lubriplate "EMB" (TENNANT Part No. 01433-1) grease. Failure to lubricate the vacuum fan will cause premature failure of the high speed bearings.



VACUUM FAN LUBRICATION

A. Grease Fitting
B. Grease Fitting Cap

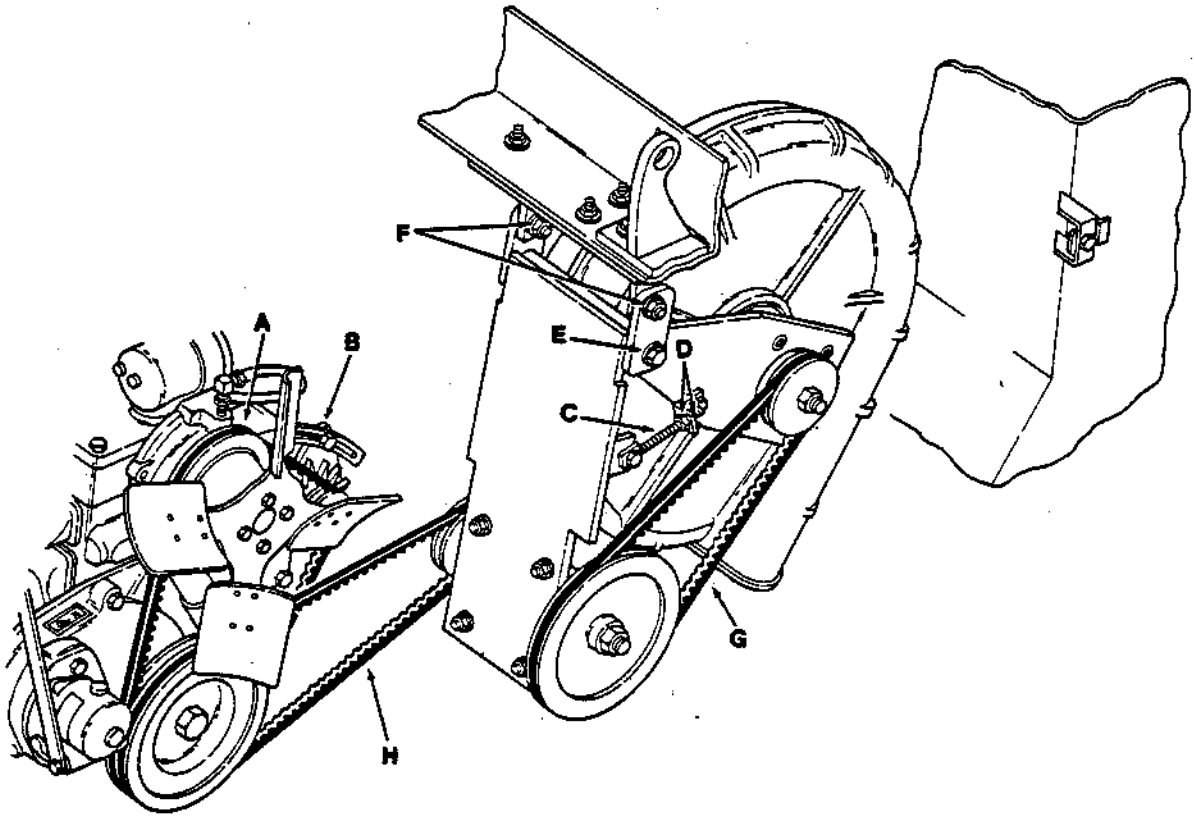
The following are vacuum system maintenance notes:

NOTE: Keep vacuum pick-up nozzles and hoses clean! Clogged nozzles and hoses are a common cause of poor water pick-up.

A. If a hose becomes clogged, it can be back-flushed.

B. The vacuum fan drive belts may loosen or stretch. See Belt Tension Adjustments.

⚠ WARNING: Fan suction is very strong. Never operate the vacuum fan with the vacuum line removed from the fan of the recovery tank. Keep hands away from vacuum fan intake.



GASOLINE AND LPG BELT SYSTEM 00074

A. Engine Fan Belt
B. Alternator
C. Adjusting Stud
D. Lock Nut
E. Vacuum Fan Pivot Bolt
F. Jackshaft Pivot Bolt
G. Jackshaft to Vacuum Fan Belt
H. Engine to Jackshaft Belt

ENGINE FAN BELT - GASOLINE, LPG

To tighten the fan belt, loosen the alternator adjusting bolts and pull out on the alternator by hand until the belt is just snug. Under no circumstances should a pry bar be used on the alternator to obtain fan belt tension, as damage to the bearings will result. Then tighten the alternator adjusting bolts.

Check the fan belt tension after every 50 hours of operation.

Proper belt deflection is obtained when the belt deflects 0.5 in (12.7 mm) from a force of 10 to 12 lbs (4.5 to 5.4 kg) applied at the midpoint of the longest span.

ENGINE FAN BELT - DIESEL

When tightening fan belts, loosen the alternator adjusting bolts and pull out on the alternator by hand until the belt is just snug. Under no circumstances should a pry bar be used on the alternator to obtain fan belt tension or damage to the bearings will result.

Proper belt deflection is obtained when the belt deflects 0.38 in (10 mm) at the midpoint of the longest span.

ENGINE TO JACKSHAFT BELT

To adjust the engine to jackshaft belt, the jackshaft to vacuum fan belt must first be correctly tensioned. After adjusting the jackshaft to vacuum fan belt:

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

⚠ CAUTION: Always stop the engine and engage the parking brake before working on the machine.

2. Loosen the jackshaft assembly pivot bolts.
3. Adjust the turnbuckle to vary the engine to jackshaft belt tension.
4. Tighten the jackshaft assembly pivot bolts.

Check the belt tension after every 250 hours of operation.

Tension the belt initially from 60 to 65 lb (27 to 29 kg) static tension. The drive must maintain 40 to 44 lb (18 to 20 kg) static tension after initially stretching.

JACKSHAFT TO VACUUM FAN BELT

TO ADJUST THE JACKSHAFT TO VACUUM FAN BELT

1. Stop the engine and engage the parking brake before working on the machine.

⚠ CAUTION: Always stop the engine and engage the parking brake before working on the machine.

2. Loosen the vacuum fan pivot bolts.
3. Loosen the adjusting stud locking nut.
4. Adjust the lower adjusting nut to vary the belt tension.
5. Tighten the adjusting stud lock nut.
6. Tighten the vacuum fan pivot bolts.

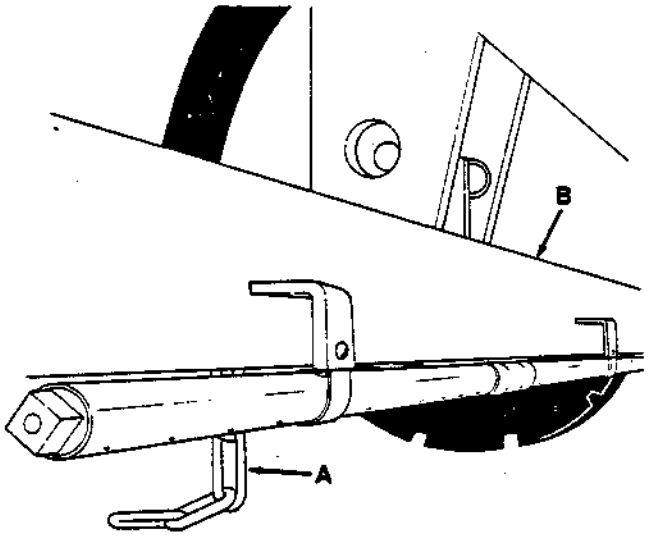
Check the belt tension after every 250 hours of operation.

Tension the belt initially from 60 to 65 lb (27 to 29 kg) static tension. The drive belt must maintain 40 to 44 lb (18 to 20 kg) static tension after initially stretching.

STATIC DRAG CHAIN

A static drag chain is provided to prevent the buildup of static electricity in the machine. The chain is attached on the rear of the machine frame and drags on the floor.

Check the chain for wear after every 250 hours of operation. Make sure that it is making contact with the floor at all times.

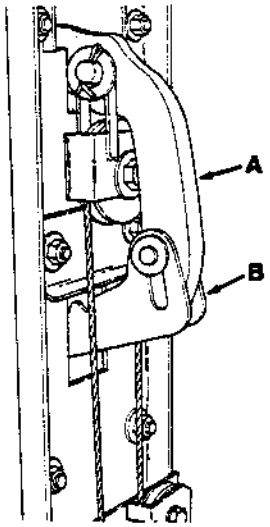


STATIC DRAG CHAIN 00033

A. Static Drag Chain
B. Machine Frame

BRAKE SYSTEM LUBRICATION

Lightly oil the area between the parking brake ratchet and the brake pedal after every 250 hours of operation.



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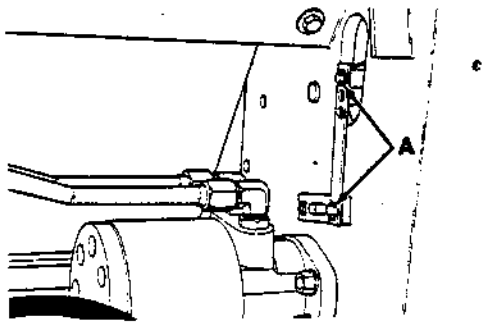
PARKING BRAKE LUBRICATION

A. Brake Pedal Arm
B. Parking Brake Ratchet

Lightly oil the brake linkage pivots located in front of the scrub head after every 250 hours of operation.



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BRAKE LINKAGE LUBRICATION (RIGHT SIDE SHOWN)

A. Brake Linkage Pivot

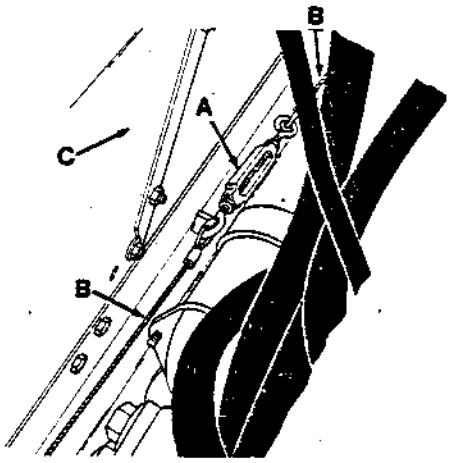
BRAKE ADJUSTMENTS

After every 250 hours of operation, check, and adjust if necessary, the brake cable tension and parking brake striker clearance.

BRAKE CABLE TENSION

CAUTION: Always stop the engine and block the tires before adjusting brakes.

The brake cable tension is adjusted by a cable turnbuckle located behind the engine. The best access to the turnbuckle is from just behind the top of the engine.



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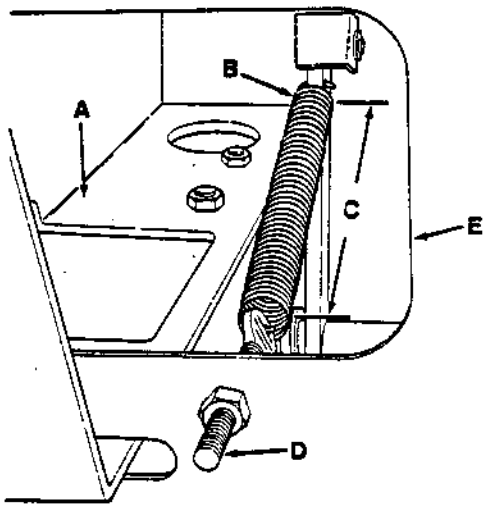
BRAKE TURNBUCKLE

A. Turnbuckle
B. Brake Cable
C. Engine Firewall

The correct cable tension allows the brake pedal to be pressed 1.12 ± 0.12 in (28 ± 3 mm) before the brake engages. Make sure the locknuts on the turnbuckle are tightened after the cable is adjusted. The cable is also spring loaded. The springs are located, one on each side of the machine, just inside the frame next to the tires. The springs should both be 6 ± 0.12 in (152 ± 3 mm) long when the brake pedal is at rest. To adjust the spring length, loosen the locknut on the eyelet to which the springs are attached.



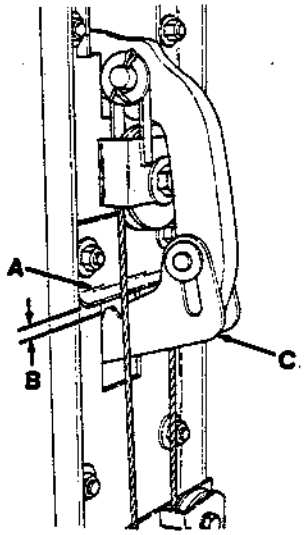
00034

ADJUSTING BRAKE TENSION SPRING (LEFT SIDE SHOWN)

A. Left Side Frame
B. Tension Spring
C. 6 in (152 mm)
D. Adjusting Eyelet
E. Access Slot in Rear of Machine Frame

PARKING BRAKE STRIKER ADJUSTMENT

The striker plate must have 0.12 to 0.19 in (3 to 5 mm) clearance to the parking brake pedal ratchet when the service brake is engaged. The striker plate is equipped with slots. To adjust, slide the striker plate up or down to get the required clearance.



00009

PARKING BRAKE STRIKER ADJUSTMENT

- **A. Striker**
- **B. 0.12 to 0.19 in (3 to 5 mm)**
- **C. Parking Brake Ratchet**

BRAKE LINING REPLACEMENT

1. Park the machine in a flat area.
2. Block the front tire and jack up the machine. Place the jack stand or blocks under the machine.

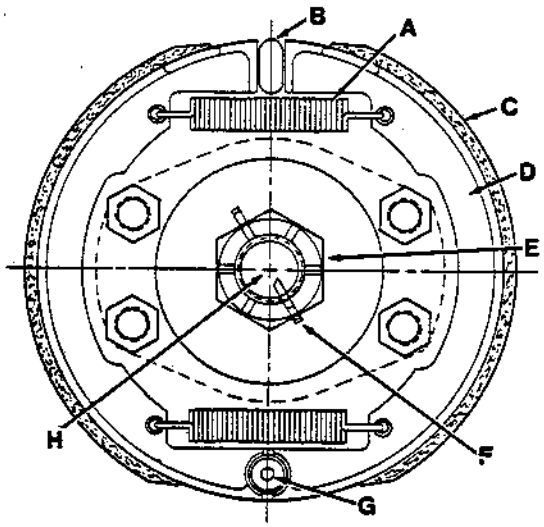
⚠ WARNING: Always use jack stands to block the machine up. Do not rely on scissors, automotive, or hydraulic jacks.

NOTE: The parking brake must be disengaged.

3. Remove the cotter pin and nut from the end of the wheel shaft.
4. Pull the tire and wheel assembly off the tapered wheel shaft. It may be necessary to use a wheel puller.

NOTE: Do not strike the end of the tapered shaft to remove the wheel. This may damage the drive motor.

5. Remove the two brake shoe retracting springs.
6. Remove the existing brake shoes.
7. Inspect the brake actuator for wear. Replace it if it is worn or damaged.
8. Clean the brake area and the brake drum.
9. Inspect the brake drum.
10. Install the new brake shoes with the lower ends of the brake shoes on the anchor pin.



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BRAKE COMPONENTS

- **A. Retracting Spring**
- **B. Brake Actuator**
- **C. Brake Lining**
- **D. Brake Shoe**
- **E. Nut**
- **F. Cotter Pin**
- **G. Shoe Anchor Pin**
- **H. Hydraulic Motor Drive Shaft**

11. Install the two retracting springs.
12. Inspect the shaft key for damage. Replace if necessary.
13. Install the tire and wheel assembly on the shaft with the brake shoes in the relaxed position.
14. Thread the nut on the wheel shaft.
15. Tighten the nut to 200 ft lbs (271 Nm).
16. Tighten the nut further to align a slot in the nut with the hole in the shaft.

ATTENTION! The maximum allowable wheel shaft nut torque is 250 ft lbs (339 Nm).

17. Install a new cotter pin through the nut and the wheel shaft. Bend the end of the cotter pin over to keep the pin in place.
18. Check the brake cable tension.

ENGINE HOOD LATCH ADJUSTMENT

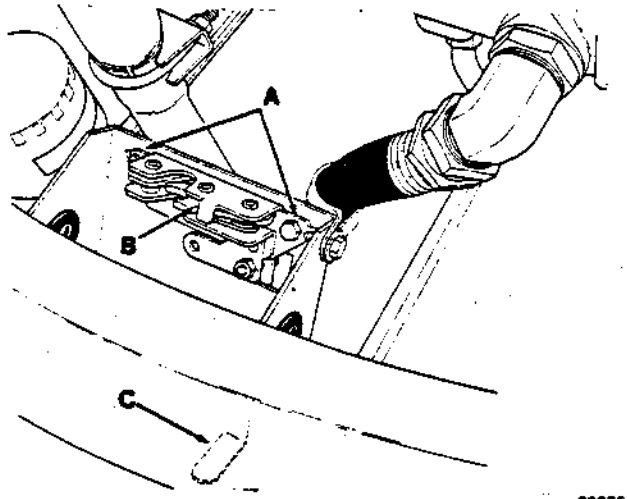
1. Stop the engine and engage the machine parking brake.

CAUTION: Always stop the engine and engage the parking brake before working on the machine.

2. Open the engine hood.

NOTE: All guides and gaskets are to be in place and adjusted before adjusting the latch.

3. Center the hood latch in the adjusting slots.



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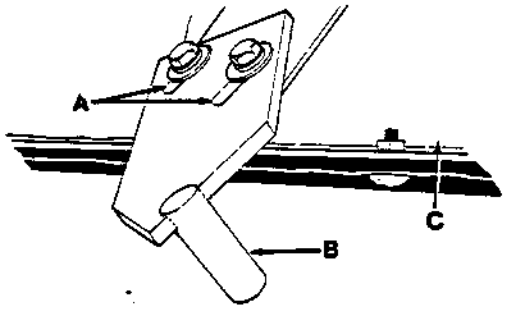
ADJUSTING ENGINE HOOD LATCH

A. Adjusting Slot
B. Latch
C. Release Lever

4. Check the latch release lever for proper operation. Slide the latch sideways if additional clearance between the bumper and lever is necessary. Tighten the bolts securely.
5. Loosely tighten the striker retaining bolts to the engine hood.



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ADJUSTING ENGINE HOOD LATCH STRIKER

A. Adjustment Slot
B. Striker Pin
C. Engine Hood

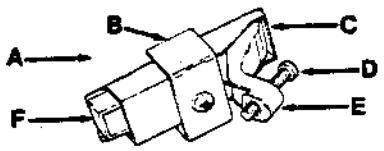
6. Hold the engine hood 3 in (76 mm) open and position the striker pin over the latch opening.
7. Slide the striker all of the way down in the slots.
8. Close and push down on top of the engine hood.
9. Release the latch, open the hood, and tighten the two striker retaining bolts.
10. Close the engine hood. Lift up on the hood. If the shroud moves more than 0.06 in (1.5 mm), the striker plate must be slid up slightly in the mounting slots.

LEFT SIDE DOOR LATCH ADJUSTMENT

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

CAUTION: Always stop the engine and engage the parking brake before working on the machine.

2. Open the left side door.
3. Remove the adjusting screw from the latch arm.



LEFT SIDE DOOR LATCH

A. Left Side Door
B. Latch Retention Bracket
C. Latch
D. Adjustment Screw
E. Latch Arm
F. Mounting Slot

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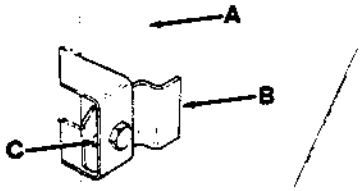
4. Slide the catch plate forward or backward to provide clearance for the latch arm.



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LEFT SIDE DOOR LATCH CATCH

A. Recovery Tank
B. Latch Catch
C. Adjustment Slot

5. Tighten the catch plate nut.

NOTE: Any contact with the latch arm may cause the latch to slide in the mounting slot and will cause binding of the latch.

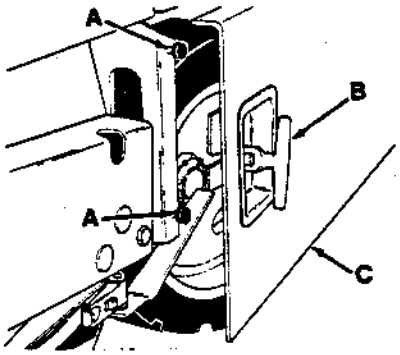
6. Reinstall the adjustment screw and tighten it until the latch closes with the door shut.

LOWER SIDE ACCESS DOOR LATCH ADJUSTMENT

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

CAUTION: Always stop the engine and engage the parking brake before working on the machine.

2. Open the lower access door.



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LEFT SIDE ACCESS DOOR LATCH AND BUMPERS

A. Adjustable Bumper
B. Door Latch
C. Left Side Door

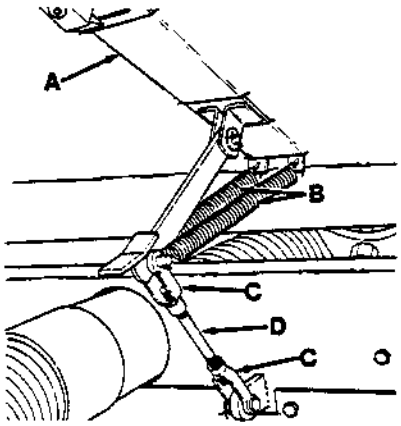
3. Loosen the jam nuts of the door bumpers.
4. Thread the door bumpers in or out enough to allow the door latch to engage snugly.
5. Tighten the door bumper jam nuts.
6. Close and latch the access door.

SCRUB HEAD COVER LATCH ADJUSTMENT

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

CAUTION: Always stop the engine and engage the parking brake before working on the machine.

2. Open the scrub head cover.



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SCRUB HEAD COVER LATCH

A. Scrub Head Cover
B. Spring
C. Clevis End
D. Tie Bar

3. Disconnect the scrub head cover latch springs.

CAUTION: Remove cover latch springs to prevent them from becoming projectiles.

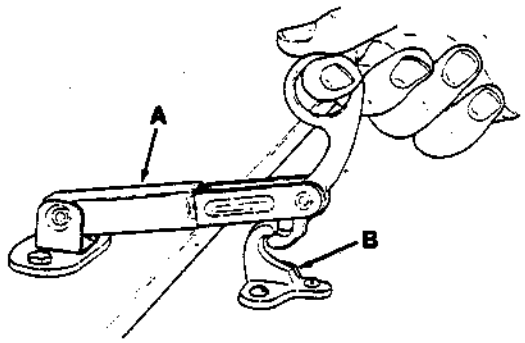
4. Loosen the jam nuts on the clevis ends.
5. Shorten the tie bar length by turning the clevis ends. Turn them until the latching arm will not hook in the latch when the cover is closed.
6. Lengthen the tie bar one-half turn at a time until the latch engages with the latching arm.
7. Reconnect the springs to the latching arm.
8. Tighten the jam nuts on the clevis ends.

REAR SHROUD LATCH ADJUSTMENT

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

CAUTION: Always stop the engine and engage the parking brake before working on the machine.

2. Close and latch the rear shroud to align the latch and the catch.



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REAR SHROUD LATCH

A. Catch
B. Latch

3. Open the rear shroud and tighten the latch mounting screws.
4. Slide the catch 0.38 ± 0.06 in (9.6 ± 1.5 mm) toward the front of the machine.
5. Tighten the catch mounting screws.

FIBERGLASS REPAIR

To repair the fiberglass engine hood, a special fire retardant fiberglass which meets U.L. requirement 94VE-0 or 94VE-1, must be used.

A fiberglass repair kit which meets this requirement is available from the Tennant Company. The TENNANT® Part Number is SK2480.

NOTE: All other fiberglass repairs may be done with a common polyester resin fiberglass material.

To repair the fiberglass gel-coat damage, a repair kit is available from the Tennant Company which matches the original color. The TENNANT® Part Number is SK2479.

REQUIRED MATERIALS AND TOOLS

- Fiberglass
- Fiberglass hardener
- Precolored gel-coat
- Cab-o-sil (changes the gel-coat into a putty-like mixture).
- Gel-coat hardener
- Rubbing compound - automotive power buffing
- Buffing compound - clean and glaze or fill and glaze.
- Sandpaper - 60, 100, 220, 320, 360, 400, 600, grits
- Putty knife
- Wood rasp or file
- Air or electrical powered right angle drive disc grinder with 3 to 5 in (76 to 127 mm) diameter disc
- Air or electrical powered buffer

GENERAL FIBERGLASS AND GEL-COAT REPAIR

The maximum working time with these materials is 10 to 20 minutes. Best results are obtained when the mixture is used within 5 minutes. Exceeding the limit may produce pin holes in the repaired areas.

The hardener is a highly-flammable liquid which does not evaporate. Store it with other flammable liquids. Any spillage should be diluted with water and wiped up.

If too little hardener is mixed with the resin, the required airing time will increase to as much as 5 to 8 hours.

If too much hardener is mixed with the resin, the repaired area may become discolored by a yellowish tint.

If too much hardener, 2% or more, is mixed with the resin, the repaired area may not harden but may become rubber-like.

If too much hardener is mixed with the resin, the mixture may get very hot. This could present a fire hazard. Cool the hot mixture off with water and allow it to cool before discarding. An indication of too much hardener is the presence of a strong pungent odor.

TO REPAIR A BLEMISH OR SCRATCH GREATER THAN 0.005 IN (0.127 mm) IN DEPTH, BUT NOT THROUGH THE PART, USING A GEL-COAT PREPARATION:

1. Break and remove loose chips and scale from area to be repaired.
2. Rough up the area to be repaired with 60 grit sandpaper. Make sure that the bonding surface is free of wax.
3. Mix the pre-colored gel-coat with cab-o-sil into a paste in a ratio of one to one by volume.
4. Add hardener to the paste mixture in a ratio of 1% hardener to 99% paste by weight.
5. Apply the paste to the area to be repaired with a putty knife. Make sure that the paste overlaps the area to be repaired. Also make sure that the area is built up higher than the surrounding surfaces.
6. Allow the new material to cure (harden). Normal curing time is one to one and one-half hours. Curing time can be shortened by adding heat such as sunlight, heat lamp, or heat blower to the curing material.

   Do not apply additional heat for more than 20 minutes.
7. After the material has cured, use a rasp, file, or disc grinder to remove rough corners and edges from the cured material.
8. Sand the new surface with 60 grit sandpaper. Be careful not to remove too much material, creating a low spot.

NOTE: Always use a flat block behind the sandpaper when hand sanding. Sanding only with fingers or a hand as support will leave an uneven surface.

9. Sand with increasingly finer grit sandpaper (100 grit, then 200 grit, then 320 grit, then 400 grit, then 600 grit) until the desired surface smoothness is achieved. Water may be used on the 400 and 600 grit sandpapers to minimize material builtup on the sandpaper.
10. Buff the surface with rubbing compound.
11. Buff the surface to a high luster with buffing compound.

POWER SCRUBBER - 527 MM133 (5-82) LITHO IN U.S.A.

SECTION 4
SRS OPERATION

CONTENTS

PREPARATION FOR OPERATION - SRS -

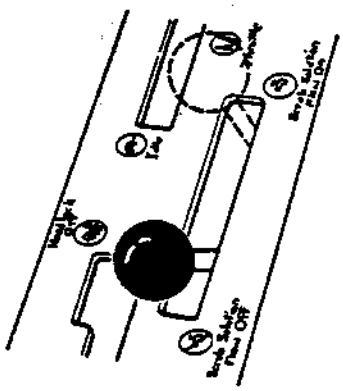
AFTER UNCRATING AND BEFORE OPERATING THE MACHINE:

1. Check the machine for shipping damage.
2. Check the hydraulic fluid level in the hydraulic tank using the sight gauge provided. TENNANT® hydraulic fluid is recommended. If TENNANT® hydraulic fluid is not available, use only new approved hydraulic fluid. See the Hydraulics section.
3. Check the engine oil level.
4. Check the radiator coolant level.
5. Check the scrubber head height and brush adjustment as described in Scrub Head Adjustments of the Maintenance section.
6. Check the rear and side squeegees for correct adjustment as described in the Squeegees segment of the Maintenance section.
7. Use only cleaning solutions approved for use in the SRS application.
8. Carefully read this manual before operating the machine.

OPERATION OF CONTROLS - SRS

SCRUB SOLUTION FLOW CONTROL LEVER

This lever operates a cable which controls the solution control valve and the solution pumps. Pulling the lever back stops the flow of solution. Pushing the lever forward starts the flow of solution.



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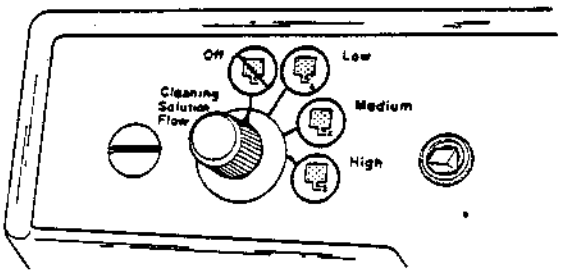
SCRUB SOLUTION FLOW CONTROL LEVER

CLEANING SOLUTION FLOW CONTROL

This is a rotary selector switch which controls the cleaning solution flow into the scrubbing solution. The switch has four positions. These positions are: "off" - no cleaning solution flow, "low" - light duty cleaning solution flow, "medium" - medium duty cleaning solution flow, "high" - heavy duty cleaning solution flow.

The cleaning solution flow can be varied at any time during the scrubbing operation.



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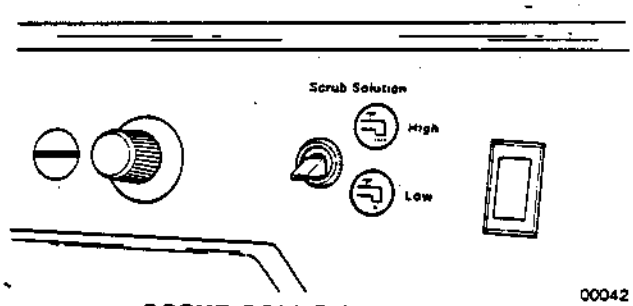
CLEANING SOLUTION FLOW CONTROL KNOB

SCRUB SOLUTION FLOW CONTROL SWITCH

This switch controls the scrub solution pumps. Flipping the switch toggle forward gives the scrub brushes a high rate of solution flow, approximately 5 gpm (18.9 L/m). Flipping the switch toggle back gives the scrub brushes a low rate of solution flow, approximately 2.5 gpm (9.5 L/m).



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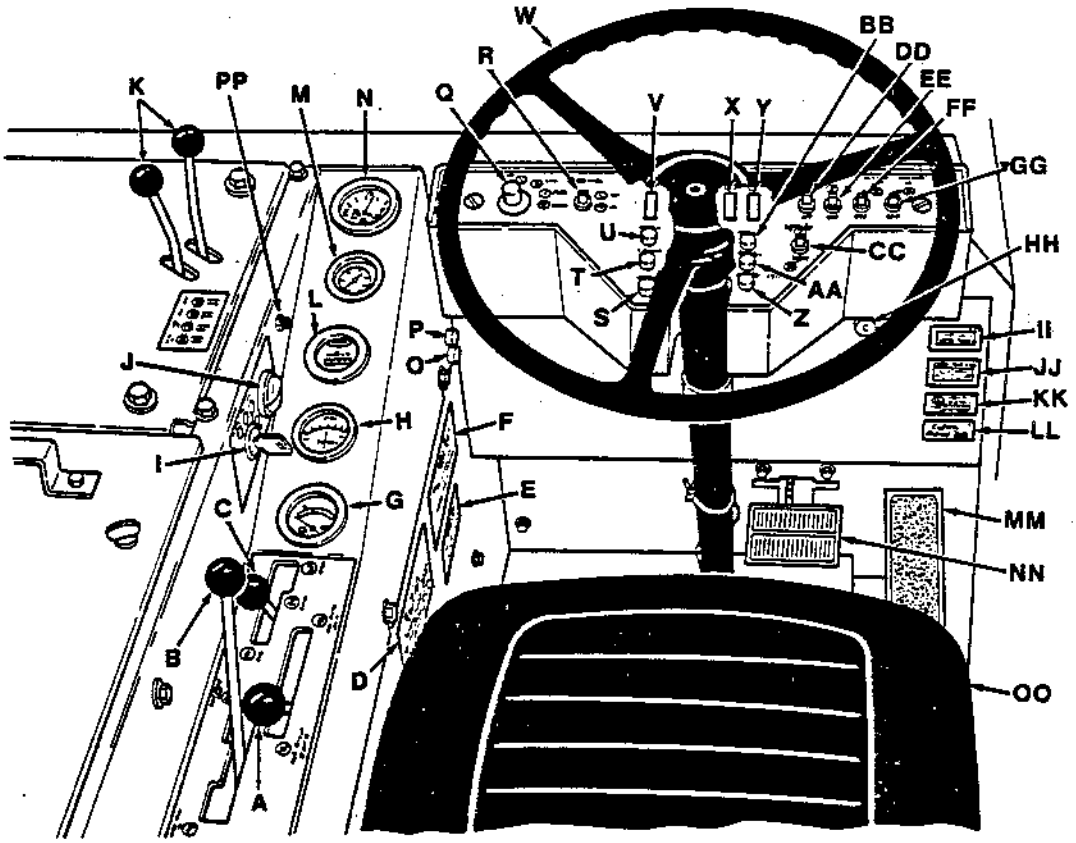
SCRUB SOLUTION SWITCH

CLEANING SOLUTION TANK LOW

This indicating lamp lights when the cleaning solution level in the cleaning solution tank is low. The operator should plan on adding additional cleaning solution soon.

SCRUB SOLUTION TANK LOW

This indicating lamp lights when the solution level in the solution tank is low. The operator should return to the filling/dumping site and dump the existing solution or add as much water as is required.



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MODEL 527 SRS LOCATION OF INSTRUMENTS AND CONTROLS

A. Scrub Solution Flow Control Lever
B. Scrub Head Lock
C. Throttle Control Lever
D. Caution Decal
E. Alternator Decal
F. Parking Brake Decal
G. Engine Water Temperature Gauge
H. Ammeter
I. Ignition Switch
J. Panel Lamp
K. Scrubbing Control Levers
L. Hour Meter
M. Engine Oil Pressure Gauge
N. Fuel Level Gauge
O. Horn Fuse
P. Ignition Fuse
Q. Cleaning Solution Flow Control
R. Scrub Solution Flow Control Switch
S. SRS Circuit Fuse
T. Revolving Lamp Fuse
U. Flashing Lamp Fuse
V. Recovery Tank Full Indicator
W. Steering Wheel
X. Cleaning Solution Tank Low
Y. Scrub Solution Tank Low
Z. Squeegee Raising Fuse
AA. Level Sensing Fuse
BB. Operating Lamps Fuse
CC. Squeegee Switch
DD. Flashing Lamp Switch
EE. Revolving Lamp Switch
FF. Back-up Lamp Switch
GG. Operating Lamps Switch
HH. Engine Choke Knob
II. Factory Mutual Label Plate
JJ. Machine Data Plate
KK. Machine Patent Data Plate
LL. Machine U.L. Label Plate
MM. Directional Control Pedal
NN. Brake Pedal
OO. Operator Seat
PP. Fuel Level Pushbutton

NOTE: Refer to the following pages for explainations of SRS controls. Controls other than those specifically for the SRS are explained in Operation of Controls.

NORMAL SCRUBBING OPERATION - SRS -

TO START A GASOLINE OR DIESEL POWERED MACHINE:

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

PRE-START CHECK LIST

Check under machine for leak spots.
Check hydraulic fluid level using sight gauge.
Check engine lubricating oil level.
Check engine air filter.
Check engine coolant level.
Check fuel level.
Check brakes and controls for proper operation.

1. 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: Do not attempt to start the machine unless the operator is in the operator seat with the directional control pedal in the neutral position and with a foot on the brake pedal or with the parking brake engaged.

2. Cold gasoline engines: Pull out the choke button about three-fourths of the way. Push choke in after the engine has started and is running smoothly.
3. Move the throttle control lever to the "idle" position.
4. Turn the ignition switch key to the "start" position until the engine starts. Do not operate the starter for more than 10 seconds at a time or after the engine has started.

NOTE: Do not operate the starter motor for more than a few 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.

5. Allow the engine and hydraulic system to warm up three to five minutes.
6. Disengage the machine parking brake.
7. Drive the machine to the solution filling site.
8. Fill the machine with water and cleaning solution.
9. Drive the machine to the area to be scrubbed.
10. Move the scrub head lock control lever to the "unlock" position.
11. Move the scrubbing control levers to the "head up" position to disengage the scrub head lock.
12. Move the scrubbing control levers to the "clean" position.
13. Place the squeegee switch in the "down" position.
14. Move the cleaning solution flow control switch to the desired flow rate.
15. Move the scrub solution flow control lever to the "on" position.
16. Scrub as required.

TO STOP A GASOLINE OR DIESEL POWERED MACHINE:

NOTE: Before stopping machine, perform the post-operation checks listed.

POST OPERATION CHECK LIST - ENGINE OPERATING

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

1. Return the directional control pedal to the "neutral" position. Apply the brake.
2. Move the scrub solution flow control to the "off" position.
3. Move the scrub head lock lever to the "lock" position.
4. Move the scrubbing control lever to the "head up" position to engage the scrub head lock.

⚠ CAUTION: Make sure the scrub head lock has engaged before leaving the machine.

5. Move the scrubbing control lever to the "head off" position.
6. Place the squeegee switch in the "up" position.
7. Raise the scrub head and squeegees.
8. Turn the operating lamps off if used.
9. Place the throttle control lever in the "idle" position on gasoline machines, "stop" position on diesel machines.
10. Engage the machine parking brake.

⚠ CAUTION: Always engage the parking brake before leaving the machine.

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

POST OPERATION CHECKLIST - ENGINE STOPPED

Check for wire or string tangled on scrub brushes.
Check squeegees for wear or damage.
Empty and clean debris hopper.
Drain and clean recovery tank filter screen.
Hose off laminar filter and solution screen filter.
Clean recovery tank.
Check vacuum hoses for debris or obstructions.
Fill fuel tank.
Check for leaks.

TO START AN LPG POWERED MACHINE

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

PRE-START CHECK LIST

Check under machine for leak spots.
Check hydraulic fluid level using sight gauge.
Check engine lubricating oil level.
Check engine air filter.
Check engine coolant level.
Check fuel level.
Check for LPG odor indicating a leak.
Check for frosting on LPG hoses and components.
Check to make sure liquid withdrawal LPG tank is to be used.
Check brakes and controls for proper operation.

1. Check LPG fuel tank gauge to see if there is an adequate fuel supply.
2. 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.

3. 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: Do not attempt to start the machine unless the operator is in the operator seat with the directional control pedal in the neutral position and with a foot on the brake pedal or with the parking brake engaged.**

4. Cold engines: Pull out the choke button about three-fourths of the way. Push choke in after the engine has started and is running smoothly.
5. Move the throttle control lever to the "idle" position.
6. Turn the ignition switch key to the "start" position until the engine starts. Do not operate the starter for more than 10 seconds at a time or after the engine has started.

NOTE: Do not operate the starter motor for more than a few 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.

7. Allow the engine and hydraulic system to warm up three to five minutes.
8. Disengage the machine parking brake.
9. Drive the machine to the solution filling site.
10. Fill the machine with water and cleaning solution.
11. Drive the machine to the area to be scrubbed.
12. Move the scrub head lock lever to the "unlock" position.
13. Move the scrubbing control levers to the "head up" position to disengage the scrub head lock.
14. Move the scrubbing control levers to the "clean" position.
15. Place the squeegee switch in the "down" position.
16. Move the cleaning solution flow control switch to the desired flow rate.
17. Move the scrub solution flow control lever to the "on" position.
18. Scrub as required.

TO STOP AN LPG POWERED MACHINE

NOTE: Before stopping the machine, perform the post-operation checks.

POST OPERATION CHECK LIST - ENGINE OPERATING

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

1. Return the directional control pedal to the "neutral" position. Apply the brake.
2. Move the scrub solution flow control lever to the "off" position.
3. Move the scrub head lock lever to the "lock" position.
4. Move the scrubbing control lever to the "head up" position to engage the scrub head lock.

⚠ **CAUTION: Make sure the scrub head lock has engaged before leaving the machine.**

5. Move the scrubbing control levers to the "head off" position.
6. Place the squeegee switch in the "up" position.
7. Turn the operating lamps off if used.
8. Place the throttle control lever in the "idle" position.
9. Engage the machine parking brake.

⚠ **CAUTION: Always engage the parking brake before leaving the machine.**

10. Turn the ignition key switch to the "off" position.
11. Close the LPG tank liquid service valve.

POST OPERATION CHECKLIST - ENGINE STOPPED

Check for wire or string tangled on scrub brushes.
Check squeegees for wear or damage.
Empty and clean debris hopper.
Drain and clean recovery tank.
Hose off laminar filter and solution screen filter.
Check vacuum hoses for debris or obstructions.
Check to make sure LPG tank service valve is closed.
Check for LPG odor indicating a leak.
Check for frosting on LPG hoses and components.
Check for leaks.

POWER SCRUBBER - 527 MM133 (5-82) LITHO IN U.S.A.

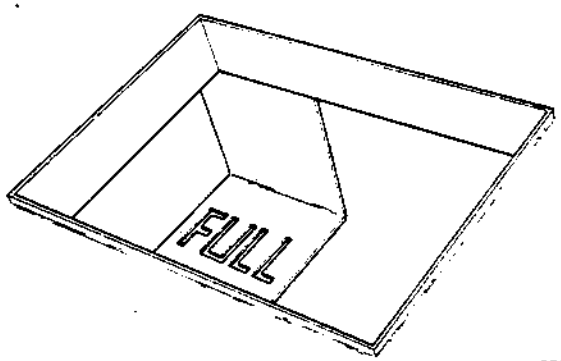
DOUBLE SCRUBBING OPERATION

Double-pass scrubbing should be necessary only for heavy soilage and buildup of dirt, wax, etc. Operate the machine with the scrubbing control levers in the "soak" position. This dispenses solution and allows both brushes to rotate counter-clockwise with the rear squeegee up. Spread solution over the area to be double scrubbed. Allow the solution to soak on the floor 15 to 20 minutes. Then make a second scrubbing pass in the normal manner with the scrubbing control levers in the "clean" position.

⚠ CAUTION: Use care when driving on wet surfaces.

FILLING THE SOLUTION TANK

1. Close the solution flow control valve.
2. Lift the hinged operator seat.
3. Fill the solution tank with warm water up to the "full" mark.



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SOLUTION TANK FULL INDICATOR

NOTE: If standing water is to be picked up in addition to the solution put down by the machine, do not fill the tank up to the "full" mark. This will allow more water to be picked up before the ball float shut-off is actuated.

4. Lower the operator seat.

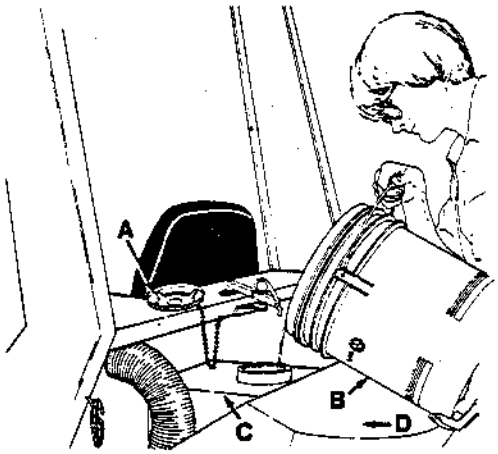
NOTE: Do not deposit any detergent in the solution tank. Place cleaning solution in the cleaning solution tank as described in Filling the Cleaning Solution Tank.

FILLING THE CLEANING SOLUTION TANK

1. Open the upper rear access door.
2. Unthread and remove the cleaning solution tank cap.
3. Pour the cleaning solution into the cleaning solution tank.

NOTE: Do not use powdered detergent or any other detergent not specifically designed for the SRS application.

4. Replace the cleaning solution tank cap.
5. Close and latch the upper rear access door.



00079

FILLING CLEANING SOLUTION TANK

A. Tank Cover
B. Cleaning Solution
C. Cleaning Solution Tank
D. Rear Access Cover

CLEANING SOLUTION RECOMMENDATIONS

Two cleaning solutions are approved for use in the SRS application. These cleaning solutions are TENNANT® Cleaning Solutions 657 and 658.

TENNANT® 657 is a medium duty cleaning solution. It is used in industrial traffic areas, garages, and other facilities where grease and oil deposits are a problem.

TENNANT 658 is a heavy duty cleaning solution. It is used where there are extra heavy buildups of grease and oil.

DRAINING THE SOLUTION TANK

The tank should be drained whenever the ball float stops the water vacuum and after every working shift.

TO DRAIN THE TANK:

1. Stop the machine near a floor drain.
2. Engage the machine parking brake.

⚠ CAUTION: Always engage the parking brake before working on machine.

3. Stop the engine.
4. Open the bottom left and right side doors.
5. Remove the drain hoses from their storage clips.
6. Lower the hoses to the floor drain.
7. Remove the hose plugs and drain the tank.
8. When finished draining the tank, replace the hose plugs in the hoses.
9. Place the drain hoses in their storage clips.
10. Close and secure the access doors.

SECTION 5
SRS MAINTENANCE

CONTENTS

RECOMMENDED FIRST 50-HOUR MACHINE INSPECTION

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

1. Perform the brush pattern test to check for correct brush adjustment.
2. Check the scrubber head side squeegee blades for wear or damage.
3. Check the rear squeegee for worn or damaged blades or for incorrect adjustment.
4. Check the vacuum fan v-belt for correct tension adjustment.
5. Check the vacuum hoses for damage or loose connections.
6. Perform all remaining 50-hour lubrication and maintenance procedures listed in the Maintenance Chart.

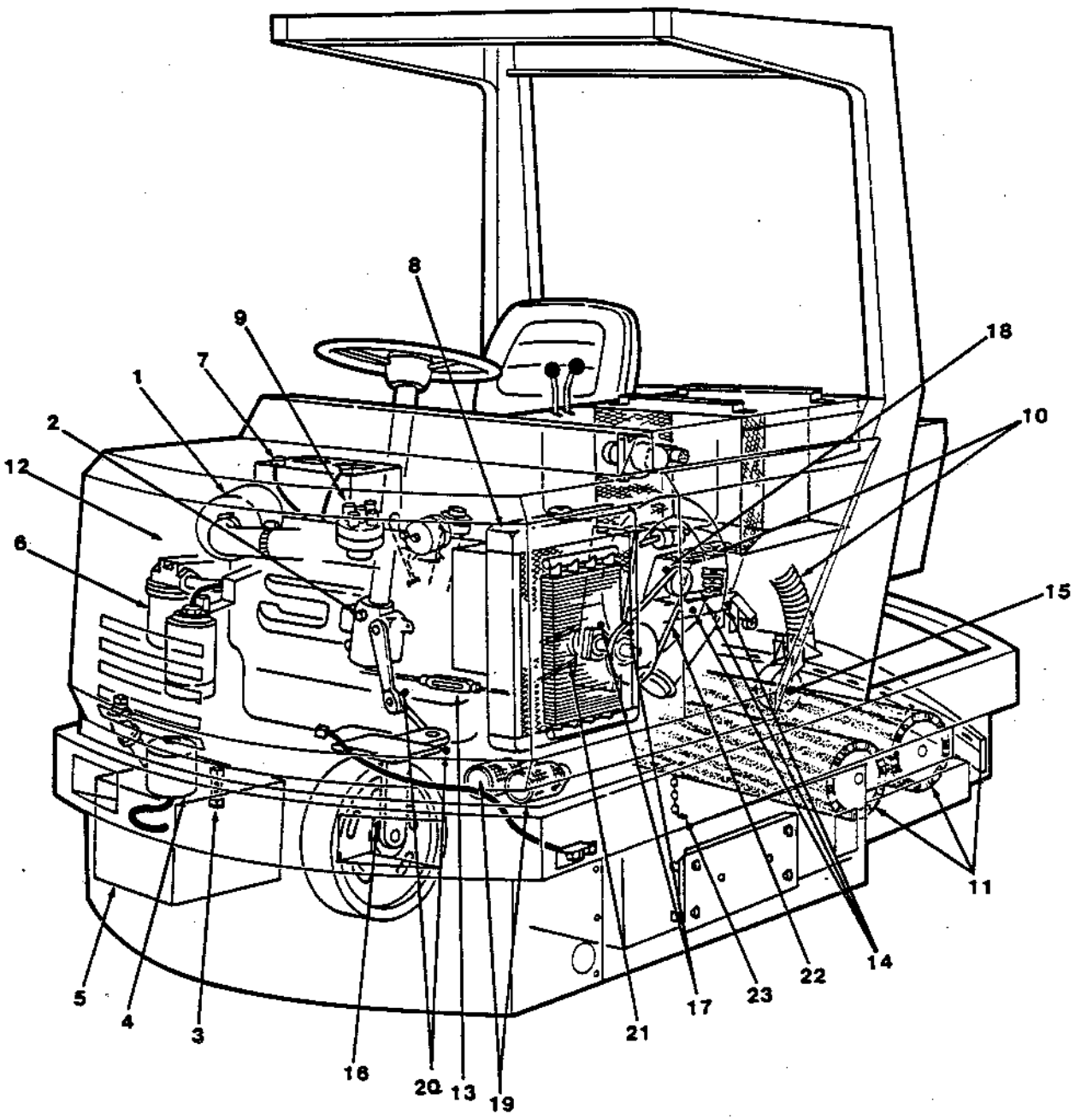
GASOLINE AND LPG POWERED MACHINES:

1. Check engine valve tappet clearance.
2. Check engine spark plug gap.
3. Check engine breaker point gap.
4. Check engine ignition timing.
5. Torque down cylinder head bolts.
6. Check engine idle speed.

DIESEL POWERED MACHINES:

1. Remove the rocker assembly and tighten the cylinder head nuts in the correct sequence and to the correct torque.
2. Reset the valve tip clearance.

SRS SOLUTION TANK



SRS MAINTENANCE CHART

MAINTENANCE CHART

Index No.	Description	Procedure	Interval (Hours) 8	50	100	150	250	400	500	2400
1	Engine air cleaner	Clean element		X						
		Replace element					X			
2	Steering gear box	Check level, add grease							X	
3	Hydraulic fluid reservoir sight gauge	Check fluid level gauge	X							
4	Hydraulic fluid reservoir breather filter	Clean element							X	
5	Hydraulic reservoir	Change hydraulic fluid, clean hydraulic reservoir							X	
6	Hydraulic fluid filter	Change filter element							X	
7	Battery	Check electrolyte level		X						
		Clean battery top			X					
8	Radiator	Check coolant level	X							
		Flush coolant system							X	
9	Engine - gasoline, LPG	Check engine oil level	X							
		Change engine oil and oil filter		X						
		Clean gasoline fuel filter				X				
		Replace gasoline fuel filter							X	
		Replace LPG fuel filter pad						X		
		Disassemble and clean LPG vaporizer-regulator						X		
		Clean spark plugs					X			
		Check points, set gap					X			
		Check ignition wires					X			
		Lubricate distributor cam and shaft					X			
		Clean PCV system					X			
		Adjust valve tappets							X	
		Check hoses and clamps					X			
		Check fan belt tension		X						
	Engine - diesel	Check engine oil level	X							
		Check engine oil and oil filter				X				
		Check fan belt tension				X				
		Clean fuel water trap				X				
		Replace fuel filter						X		
		Check valve tip clearances								X
		Service fuel injectors								X
10	Recovery tank, vacuum hose, etc.	Clean out	X							
11	Brushes and squeegees	Inspect for damage, adjustment and wear	X							
12	Miscellaneous linkages	Lightly oil					X			
13	Brake adjustment	Adjust brake cable tension					X			
		Adjust parking brake striker clearance					X			
14	Scrub head	Apply grease to fittings (3)		X						
15	Rear squeegee roller	Apply grease to fitting		X						
16	Front caster wheel	Apply grease to fittings (2)		X						
17	Fan jackshaft bearings	Apply grease to fittings (2)		X						
18	Vacuum fan	Apply grease to fitting		X						
19	Recovery reservoir filter screen	Clean screen	X							
20	Steering arm	Apply grease to fittings (2)		X						
21	Engine to jackshaft belt	Check tension					X			
22	Jackshaft to vacuum fan belt	Check tension					X			
23	Static drag chain	Check for wear					X			

SRS SOLUTION TANK MAINTENANCE

DRAINING THE TANK

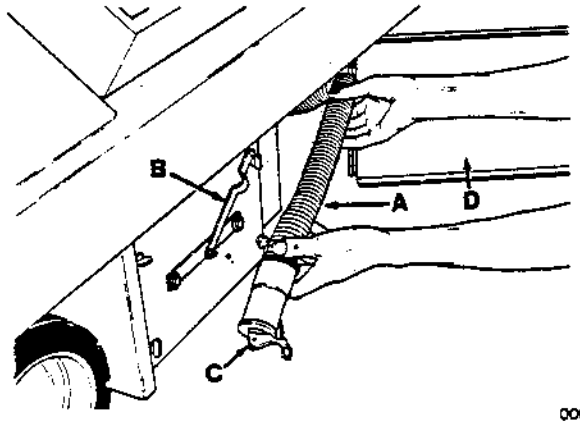
The tank should be drained whenever the ball float stops the water vacuum and after every working shift.

TO DRAIN THE TANK:

1. Stop the machine near a floor drain.
2. Engage the machine parking brake.

⚠ CAUTION: Always engage the parking brake before working on machine.

3. Stop the engine.
4. Open the bottom left and right side doors.
5. Remove the drain hoses from their storage clips.
6. Lower the hoses to the floor drain.
7. Remove the hose plugs and drain the tank.
8. When finished draining the tank, replace the hose plugs in the hoses.
9. Place the drain hoses in their storage clips.
10. Close and secure the access doors.



00067

DRAINING SOLUTION TANK (RIGHT SIDE SHOWN)

A. Drain Hose
B. Hose Storage Clip
C. Hose Plug
D. Lower Right Side Access Door

CLEANING THE TANK

The tank should be cleaned after every scrubbing shift. Four doors have been provided to make the job easier. One door is located under the seat; this is also the water fill door. The second door is located on top of the tank next to the machine operator. The third door is located behind the bottom left side access door. The fourth door is located behind the bottom right side access door.

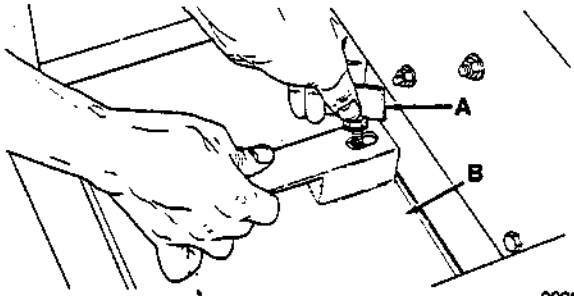
TO CLEAN THE TANK:

1. Stop the machine near a floor drain.
2. Engage the machine parking brake.

⚠ CAUTION: Always engage the parking brake before working on the machine.

3. Stop the engine.
4. Open the bottom right and left side access doors.
5. Drain the tank as described in Draining the Tank.
6. Leave the drain hoses open on the floor drain.
7. Open the bottom right and left side clean-out doors.
8. Open the top access doors under the operator seat and next to the operator seat.
9. Spray the inside of the tank with clean water. Remove all sludge from the bottom of the tank.
10. Remove the laminar filter cover and spray the filters clean.

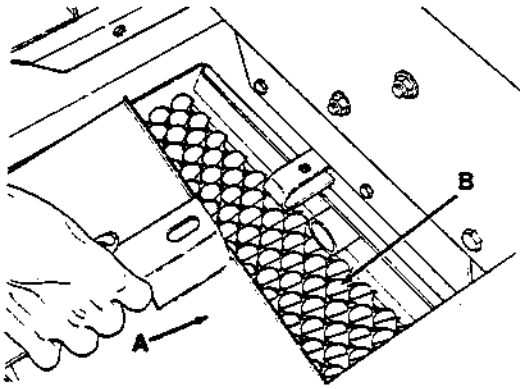
NOTE: The laminar filter may be removed from the tank by removing the wing bolt holding the filter in place. Then lift the filter straight up.



00066

REMOVING LAMINAR FILTER COVER THUMBSCREW

A. Thumbscrew
B. Laminar Filter Cover



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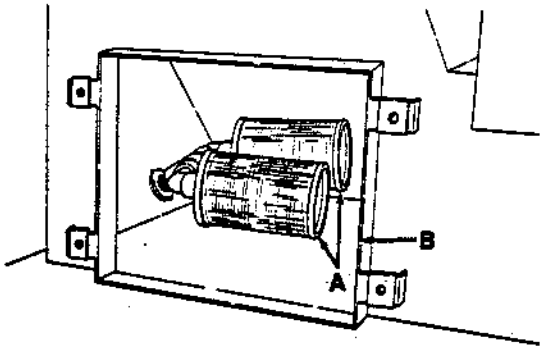
REMOVING LAMINAR FILTER COVER

A. Laminar Filter Cover
B. Laminar Filter Tubes

11. Replace the laminar filter cover.
12. Spray the wire mesh solution outlet clean of dirt and debris.

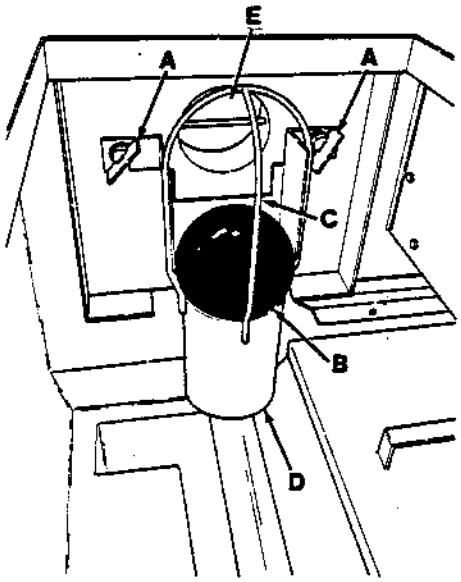


00001

SOLUTION OUTLET SCREENS

A. Outlet Screens
B. Lower Right Access Door

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



00014

RECOVERY TANK BALLFLOAT

A. Thumbscrew
B. Ball Float
C. Ball Float Guide
D. Ball Float Screen on Bottom of Ball Float Guide
E. Vacuum Fan Inlet

14. Check the hoses for clogging or damage.

NOTE: Reinstall the laminar filter if it was removed from the tank.

15. When finished, plug the drain hoses.
16. Store the drain hoses in the storage clips.
17. Close and secure the access doors and lower the operator seat.

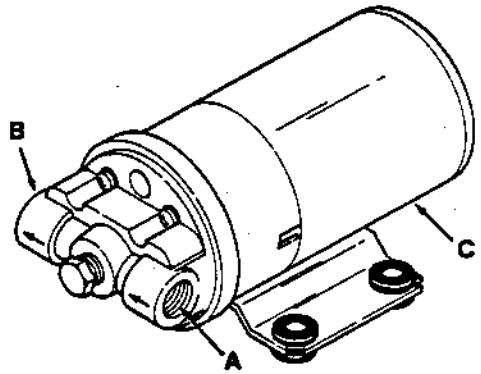
SRS SOLUTION SUPPLY SYSTEM

RECYCLING SOLUTION PUMP

There are two recycling solution pumps located under the left front top panel covering the scrub head.

The recycling solution pump is a diaphragm variety which requires no regular maintenance. If the pump output slows or stops, there may be a clog in the solution supply line or there may be a clog in the pump diaphragm.

See Recycling Solution Pump Troubleshooting for additional problem-solving information.



00113

RECYCLING SOLUTION PUMP

A. Pump Inlet Port
B. Pump Outlet Port
C. Solution Pump

TO CHECK THE PUMP DIAPHRAGM

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

⚠ CAUTION: Always engage the machine parking brake before working on the machine.

2. Drain the tank as described in Draining the Tank.
3. Remove the left scrubber head cover bolted to the top of the scrubber head to gain access to the pumps.
4. Remove the four pump head screws.
5. Remove the pump diaphragm cartridge.
6. Clean the pump head and cartridge.
7. Inspect the diaphragm cartridge for wear or damage. Replace if it is defective.
8. Install the diaphragm cartridge in the pump head.
9. Secure the pump head screws.
10. Close the tank drains.
11. Partially fill the tank with water.
12. Operate the pump and check for proper operation.
13. Check for leaks. Repair if found.
14. Replace the left scrubber head cover.

RECYCLING SOLUTION PUMP TROUBLESHOOTING

Pulsating Flow - Pump Cycling on and off

1. Pump filters in tank plugged.
2. Restricted pump delivery. Check discharge lines, fittings, valves and spray nozzle for clogging.

Failure to Prime - Motor operates, but no pump discharge

1. Start pump with machine engine off.
2. Restricted intake or discharge line. Open all line valves, check for "jammed" check valve poppets, and clean clogged lines.
3. Air leak in intake line.
4. Punctured pump diaphragm.
5. Defective pump check valve.
6. Crack in pump housing.

Motor Fails to Turn on

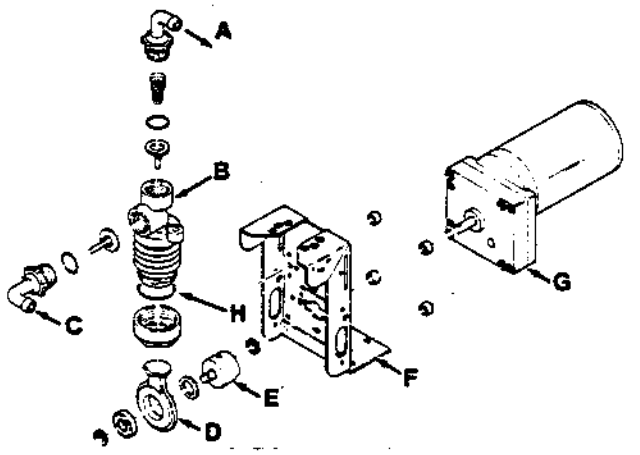
1. Loose wiring connection.
2. Defective motor

Low Flow and Pressure

1. Pump filters in tank plugged.
2. Air leak at pump intake.
3. Accumulation of debris inside pump and plumbing.
4. Worn pump bearing (excessive noise).
5. Punctured pump diaphragm.
6. Defective motor.

CLEANING SOLUTION PUMP

The cleaning solution pump is located inside of the rear access panel next to the operator seat.



00112

CLEANING SOLUTION PUMP

A. Flow Out
B. Pump Bellows
C. Flow In
D. Bearing
E. Pump Eccentric
F. Pump Bracket
G. Electric Pump Motor
H. O-Ring

The cleaning solution pump is of a bellows variety which requires no regular maintenance.

If the pump output slows or stops, there may be a clog in the cleaning solution supply line. See Cleaning Solution Pump Troubleshooting for additional problem-solving information.

CLEANING SOLUTION PUMP TROUBLESHOOTING

Low Flow

1. Poppet valves dirty, dried cleaning solution residue on valves.
2. Restriction in cleaning solution lines.
3. Air leak at pump intake.
4. Defective wiring or motor.

Motor Fails to Turn On

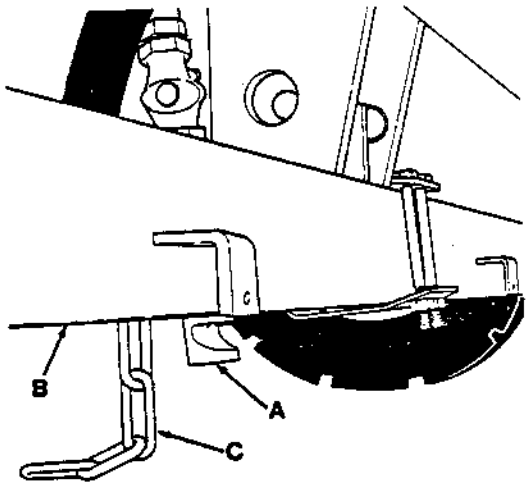
1. Loose wiring connection.
2. Defective motor.

Motor Operates, But No Pump Discharge

1. Damaged bellows.
2. Restriction in cleaning solution lines.
3. Air leak in intake line.

SOLUTION SPRAY NOZZLE

The solution spray nozzle requires no regular maintenance. The spray nozzle should be adjusted so that the spray is centered across the front brush.



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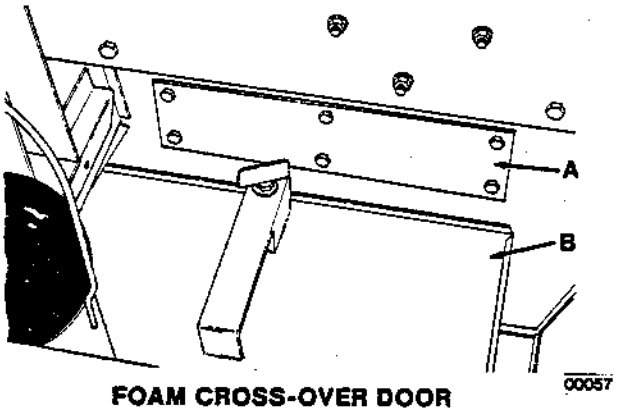
SOLUTION SPRAY NOZZLE

A. Solution Spray Nozzle
B. Machine Frame
C. Static Drag Chain

FOAM CROSS-OVER DOOR

The foam cross-over door has been provided in the event that an unusually large amount of foaming occurs. This large amount of foaming flows out of the vacuum fan. With the foam cross-over door removed, this foam is dissipated into the tank.



FOAM CROSS-OVER DOOR

A. Foam Cross-Over Door
B. Laminar Filter Cover

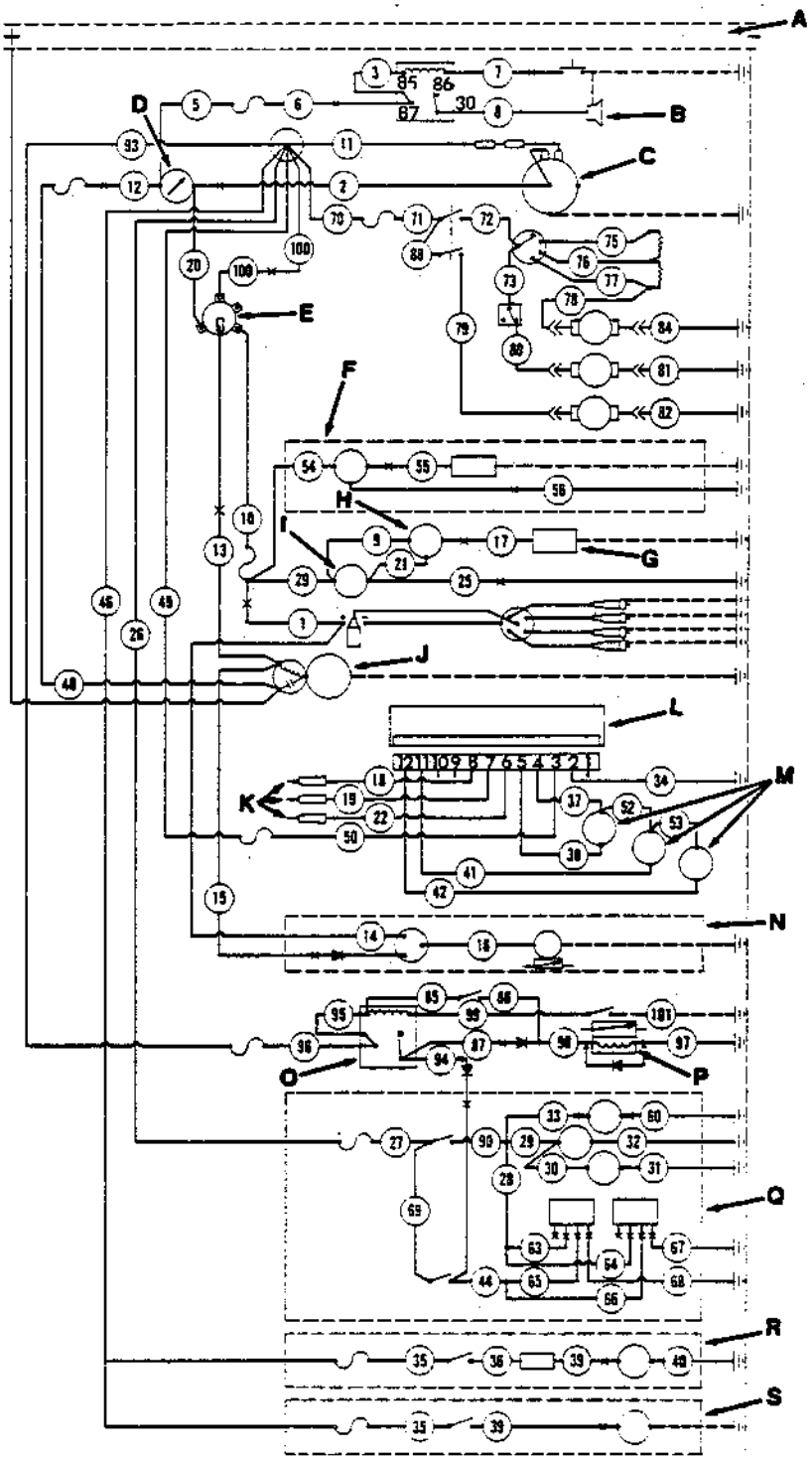
TO REMOVE THE FOAM CROSS-OVER DOOR

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

CAUTION: Always engage the parking brake before working on the machine.

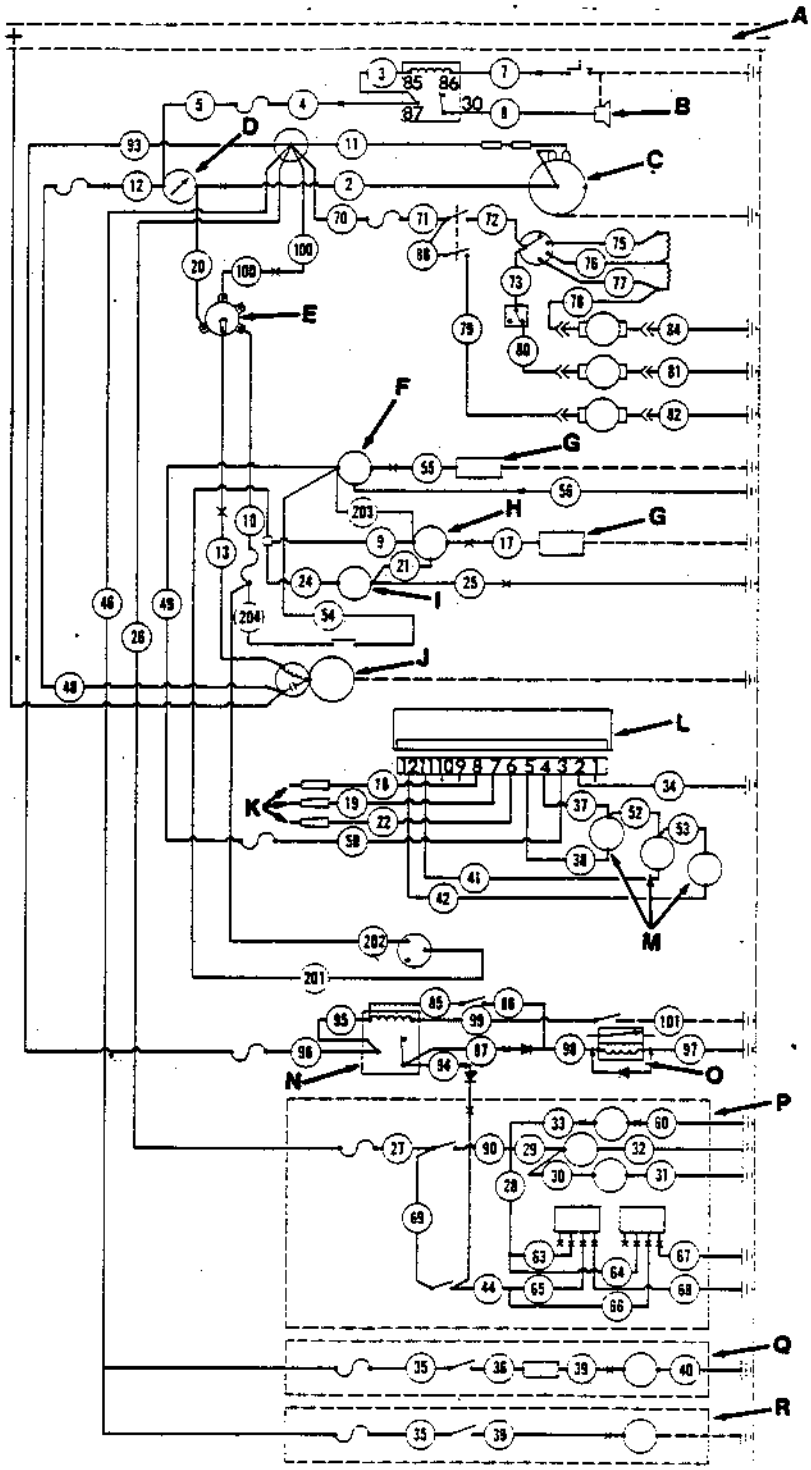
2. Drain the tank as described in Draining the Tank.
3. Remove the tank access door located to the left of the operator seat.
4. Remove the laminar filter.
5. Remove the six bolts holding the cross-over door in place.
6. Remove the cross-over door.
7. Replace the laminar filter.
8. Replace the tank access cover.

NOTE: When operating the machine with the cross-over door removed, the solution tank must not be filled with water above the two cross-over tubes located under the cross-over door.



SRS ELECTRICAL SCHEMATIC, GASOLINE, LPG 00103

A. Battery
B. Horn
C. Alternator
D. Ammeter
E. Ignition Switch
F. Fuel Gauge
G. Sending Unit
H. Engine Temperature Gauge
I. Hour Meter
J. Engine Starter Motor
K. Liquid Level Sensing Probe
L. Circuit Board
M. Indicator Lamp
N. LPG Components
O. Auto Squeegee Relay
P. Solenoid Valve
Q. Head and Taillight Kit
R. Flashing Light Kit
S. Rotating Light Kit



SRS ELECTRICAL SCHEMATIC, DIESEL 01116

A. Battery
B. Horn
C. Alternator
D. Ammeter
E. Ignition Switch
F. Fuel Gauge
G. Sending Unit
H. Engine Temperature Gauge
I. Hour Meter
J. Engine Starter Motor
K. Liquid Level Sensing Probe
L. Circuit Board
M. Indicator Lamp
N. Auto Squeegee Relay
O. Solenoid Valve
P. Head and Taillight Kit
Q. Flashing Light Kit
R. Rotating Light Kit

SECTION 6
APPENDIX

CONTENTS

DECIMAL - METRIC CONVERSION TABLE

1/2	1/4	1/8	1/16	1/32	1/64	Decimals	Millimeters
					1	0.015625	0.396875
				1		0.031250	0.793750
					3	0.046875	1.190625
			1			0.062500	1.587500
				3	5	0.078125	1.984375
						0.093750	2.381250
					7	0.109375	2.778125
		1				0.125000	3.175000
					9	0.140625	3.571875
				5		0.156250	3.968750
					11	0.171875	4.365625
			3			0.187500	4.762500
					13	0.203125	5.159375
				7		0.218750	5.556250
					15	0.234375	5.953125
	1					0.250000	6.350000
					17	0.265625	6.746875
				9		0.281250	7.143750
					19	0.296875	7.540625
			5			0.312500	7.937500
					21	0.328125	8.334375
				11		0.343750	8.731250
					23	0.359375	9.128125
		3				0.375000	9.525000
					25	0.390625	9.921875
				13		0.406250	10.318750
					27	0.421875	10.715625
			7			0.437500	11.112500
					29	0.453125	11.509375
				15		0.468750	11.906250
					31	0.484375	12.303125
1						0.500000	12.700000
					33	0.515625	13.096875
				17		0.531250	13.493750
					35	0.546875	13.890625
			9			0.562500	14.287500
					37	0.578125	14.684375
				19		0.593750	15.081250
					39	0.609375	15.478125
		5				0.625000	15.875000
					41	0.640625	16.271875
				21		0.656250	16.668750
					43	0.671875	17.065625
			11			0.687500	17.462500
					45	0.703125	17.859375
				23		0.718750	18.256250
					47	0.734375	18.653125
	3					0.750000	19.050000
					49	0.765625	19.446875
				25		0.781250	19.843750
					51	0.796875	20.240625
			13			0.812500	20.637500
					53	0.828125	21.034375
				27		0.843750	21.431250
					55	0.859375	21.828125
		7				0.875000	22.225000
					57	0.890625	22.621875
				29		0.906250	23.018750
					59	0.921875	23.415625
			15			0.937500	23.812500
					61	0.953125	24.209375
				31		0.968750	24.606250
					63	0.984375	25.003125
2	4	8	16	32	64	1.000000	25.400000

HARDWARE INFORMATION

STANDARD BOLT TORQUE CHART

STANDARD TIGHTENING REQUIREMENTS FOR NORMAL ASSEMBLY APPLICATIONS

Bolt Thread Size (in)	SAE Gr. 5 Minimum Torque ft lb (Nm) Plain	SAE Gr. 5 Minimum Torque ft lb (Nm) Plated	SAE Gr. 8 Minimum Torque ft lb (Nm) Plain	SAE Gr. 8 Minimum Torque ft lb (Nm) Plated	Carr Bolts and B RH SSQ Bolts Minimum Torque ft lb (Nm)
0.25	8(11)	7(10)	12(16)	10(14)	4(5)
0.31	18(24)	15(20)	26(35)	21(29)	8(11)
0.38	31(42)	25(34)	48(65)	39(53)	15(20)
0.44	53(72)	43(58)	75(102)	60(81)	26(35)
0.50	82(111)	66(90)	115(156)	92(125)	38(52)
0.56	170(231)	140(190)	235(319)	190(258)	70(95)
0.75	290(393)	230(312)	415(563)	330(448)	130(176)
0.88	430(583)	340(461)	600(814)	480(651)	140(190)
1.0	640(868)	510(692)	900(1220)	720(976)	210(285)

NOTE: Decrease the torque by 20% when using engine oil or chassis grease as a thread lubricant.

EXCEPTIONS TO TORQUE CHART:

Motor axle nuts: 200 ft lb (271 Nm)

Scrub brush motor porting block socket head bolts: 18-20 ft lb (24-27 Nm)

Diesel hydraulic pump flywheel adapter: 27-35 ft lb (37-47 Nm)

BOLT IDENTIFICATION

Identification Grade Marking	Specification and Grade
	SAE-Grade 5 ASTM-A 449
	SAE-Grade 8 ASTM-A 354 Grade BD

All hardware is of grade 5 unless specifically stated otherwise.

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	20 ft lb (27 Nm)	30 ft lb (41 Nm)
0.62	0.88"-14	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.