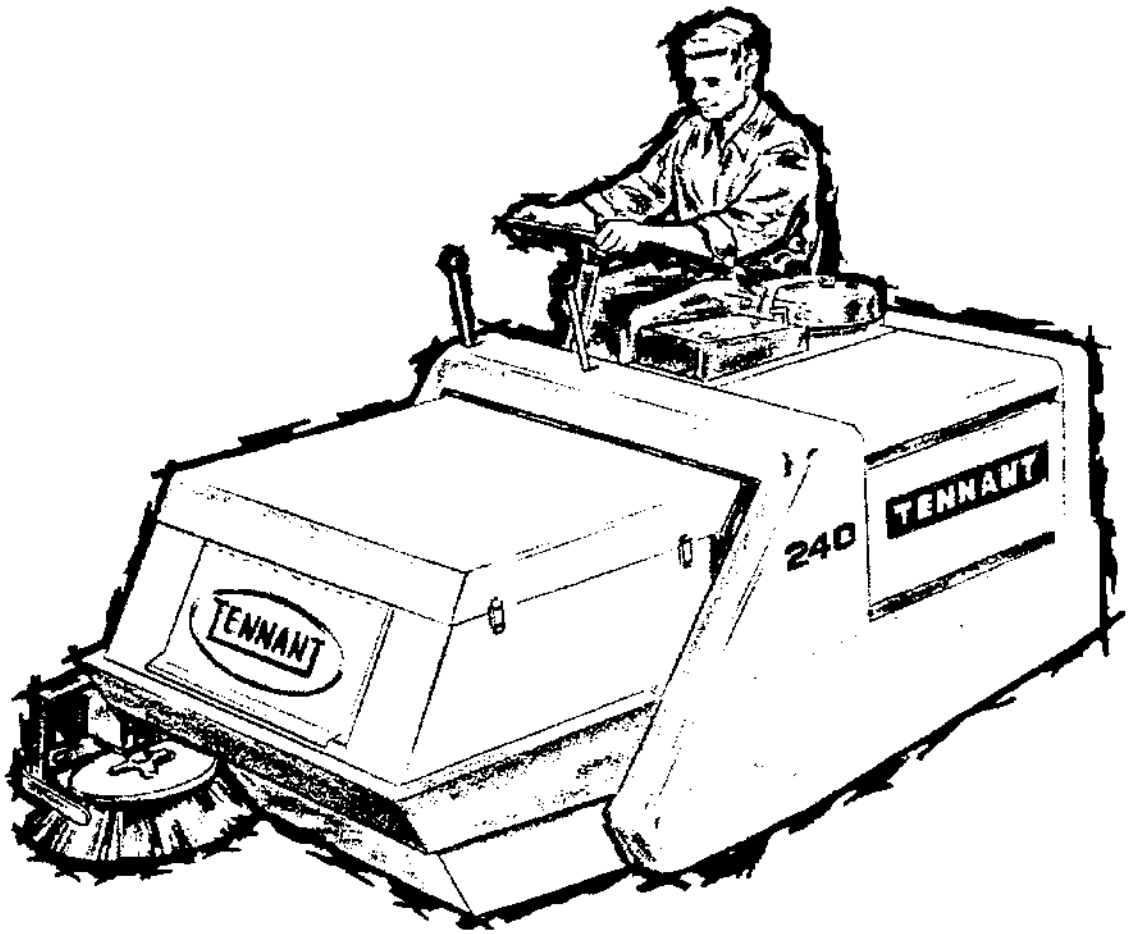
MM101
8–85

240

(Operator Manual)

POWER SWEEPER

Operation, Maintenance, and Parts Manual
Including High Dump Model



TENNANT

SPECIALIZED
MAINTENANCE SYSTEMS

SWEEPERS • SCRUBBERS • SCARIFIERS • FLOOR COATINGS

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240

POWER SWEEPER

This manual is furnished with each new TENNANT® Model 240. 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 sweeping 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. MM101
Published: 8-85

⚠ SAFETY PRECAUTIONS

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 fuel tank. Refuel in designated areas only. Do not fill fuel tank with engine running. Make sure fuel container and machine are electrically connected when refueling. Do not overfill LP tank. Check for odor of escaping gas before and during starting LPG engines.

⚠WARNING Provide adequate ventilation system to properly expel discharged gases. Check exhaust system regularly for leaks. Carbon Monoxide is dangerous.

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

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

⚠WARNING Lock hopper in "UP" position, using Safety Lock, before changing brushes or working under hopper. See instructions on lock.

⚠CAUTION Disconnect battery terminal before servicing electrical components.

⚠CAUTION Check brakes and steering control for proper operation. Do not start machine unless you are in driver's seat, with foot on brake pedal, or parking brake engaged, and directional pedal in neutral. Stop engine and set parking brake before leaving machine.

⚠CAUTION This machine is steered by means of the rear wheel, and is very responsive. Become familiar with this type of steering system. Travel slowly and use care on grades and slippery surfaces.

⚠WARNING Never operate in areas of overhead danger unless machine is equipped with overhead guard.

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.

REPLACEMENT BRUSHES

SWEEPING BRUSHES

TENNANT Part No.	Descriptions	Size
53063	HIGH DENSITY COMBINATION, natural fiber & crinkle wire-adds stiffness, increases brush life.	42 in.-24 row
53231	NATURAL FIBER, ideal for sweeping average soilage	42 in.- 8 row
53065	CRINKLE WIRE, provides maximum cleaning action for heavy semi-impacted soilage & hard-to-sweep dirt.	42 in.- 8 row
53067	COMBINATION, crinkle wire & natural fiber	42 in.- 8 row
53068	NYLON, combines long life with excellent sweeping qualities.	42 in.- 8 row
53069	PATROL, nylon for outside, med/lght bulky debris	42 in.- 5 row
53070	HIGH DENSITY NYLON	42 in.-24 row
53221	PROEX & WIRE, resilient bristles for sweeping medium heavy soilage	42 in.- 8 row
09600P	POLYPROPYLENE-Side sweeper	21 in. dia
09600N	NYLON-Side sweeper	21 in. dia
10712K	FLAT WIRE-Side sweeper	
43708 P	POLYPROPYLENE-Side sweeper (with adaptor)	
43708N	NYLON-Side sweeper (with adaptor)	
43708K	WIRE-Side sweeper (with adaptor)	
43708J	WIRE & FIBER-Side sweeper (with adaptor)	

SCRUBBING BRUSHES

TENNANT Part No.	Descriptions	Size
43424	POLYPROPYLENE, stiff - front	38 in. -24 row
43592	POLYPROPYLENE, medium stiff - front	38 in. -24 row
43428	STAINLESS STEEL - front	38 in. -20 row
43393	ABRASIVE ROLL, stripping - front	38 in. - strip
53155	NYLON, Rear	42 in. - 8 row
43148	FIBER, stiff - side scrubber	14 in. dia
43593	FIBER, medium stiff - side scrubber	14 in. dia
43417	STAINLESS STEEL - side scrubber	14 in. dia
46857	POLYPROPYLENE - side scrubber (with U-Joint) stiff	
46858	POLYPROPYLENE - side scrubber (with U-Joint) medium stiff	
46859	STAINLESS STEEL - side scrubber (with U-Joint)	
43680	ABRASIVE, bristle, heavy, .050 ga	38 in. 24 row

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COMMONLY USED MAINTENANCE ITEMS AND REPAIR KITS

Note: These items also appear in the parts lists, but they are grouped here for your convenience. You may not wish to stock all of the items listed.

TENNANT Part No.	Description	Qty.
59463	REPLACEMENT PARTS PACKAGE	1
23792	ELEMENT, Air filter (Fram)	2
23275	SKIRT, Shroud, Left and right	2
23382	SEAL, Pan, side	2
23386	SEAL, Pan, top	1
48060	LIP, Rubber	5
53137	SKIRT	1
53298	SKIRT	1
24908	ELEMENT, Air (Purolator)	1
47352	ELEMENT, Oil (Fram)	2
SK1511	FUSIBLE LINK	1
45770-5	SPARK PLUG	2
38644	POINT SET	1
49795-3	CONDENSER	1
67718-2	ELEMENT, Oil (Deluxe)	1
SK1140A	SEAL KIT for Ross rear wheel hydraulic motor	1
SK1600	SEAL KIT for Char-Lynn side & main brush motors	1
SK1694	SEAL KIT for Ross side & main brush motors	1
SK1540	SEAL KIT for Victor-Dukes control valve	1
SK1842	SEAL KIT for Cross control valve	1
SK1695	SEAL KIT for Gresen side brush valve 48289	1
SK1288	SEAL KIT for Gresen side brush valve 48108A	1
SK1806	SEAL KIT for Victor-Dukes side brush valve	1
SK1769	SEAL KIT for Oilgear hydraulic propelling pump.	1
SK1739	SEAL KIT for Vickers accessory pump	1
SK2561	SEAL KIT for vacuum fan motor	1
32397-5	TENNANT Hydraulic oil (10-W-40)	1
53259	BAG, Filter	1
43323	BLADE, Squeegee, rear	1
43324	BACKING, Squeegee blade rear	1
43292	BLADE, Squeegee, side	
SK1444	FILTER-FUELOCK REPAIR KIT (LP only)	1
14215	FUSE, 20 A	1
26771	BATTERY, 12V, 40 A	1
29830-9	CABLE, Battery, positive	1
29831-3	CABLE, Battery, negative	1
53819	TIRE, Rear wheel	1
53819-1	TUBE, Rear wheel	1
53819-2	FLAP, Rear wheel	1
47094	TIRE, Front	2
59472	REPLACEMENT PARTS PACKAGE - SCRUBBER	1
60113	BLADE, Squeegee, 69.5"	2
43324	BLADE, Back-up	1
60014	BLADE, Squeegee, 26"	2
43322	BLADE, Front, rubber, 68"	2

COMMONLY USED MAINTENANCE ITEMS AND REPAIR KITS (continued)
REPLACEMENT PARTS FOR HI-DUMP ONLY

TENNANT Part No.	Description	Qty.
SK1951	SEAL KIT for Ross rear wheel hydraulic motor	1
SK1842	SEAL KIT for roll-out valve	1
SK1870	SEAL KIT for hopper lift cylinder	1
SK1869	SEAL KIT for roll-out cylinder	1
29831-4	CABLE, Battery, negative	1
24120	TIRE, Front, solid	2
37061	GASKET KIT, Hopper dump door	1
35607	LIP, Hopper, rubber	5

DECIMAL EQUIVALENTS

INCH-MILLIMETER CONVERSION TABLE

1/2	1/4	1/8	1/16	1/32	1/64	Decimals	Millimeters
					1	.015625	.396875
				1		.031250	.793750
					3	.046875	1.190625
			1			.062500	1.587500
				3	5	.078125	1.984375
						.093750	2.381250
					7	.109375	2.778125
		1				.125000	3.175000
				5	9	.140625	3.571875
						.156250	3.968750
					11	.171875	4.365625
			3			.187500	4.762500
				7	13	.203125	5.159375
						.218750	5.556250
					15	.234375	5.953125
	1					.250000	6.350000
				9	17	.265625	6.746875
						.281250	7.143750
					19	.296875	7.540625
			5			.312500	7.937500
				11	21	.328125	8.334375
						.343750	8.731250
					23	.359375	9.128125
		3				.375000	9.525000
				13	25	.390625	9.921875
						.406250	10.318750
					27	.421875	10.715625
			7			.437500	11.112500
				15	29	.453125	11.509375
						.468750	11.906250
					31	.484375	12.303125
1						.500000	12.700000
				17	33	.515625	13.096875
						.531250	13.493750
					35	.546875	13.890625
			9			.562500	14.287500
				19	37	.578125	14.684375
						.593750	15.081250
					39	.609375	15.478125
		5				.625000	15.875000
				21	41	.640625	16.271875
						.656250	16.668750
					43	.671875	17.065625
			11			.687500	17.462500
				23	45	.703125	17.859375
						.718750	18.256250
					47	.734375	18.653125
	3					.750000	19.050000
				25	49	.765625	19.446875
						.781250	19.843750
					51	.796875	20.240625
			13			.812500	20.637500
				27	53	.828125	21.034375
						.843750	21.431250
					55	.859375	21.828125
		7				.875000	22.225000
				29	57	.890625	22.621875
						.906250	23.018750
					59	.921875	23.415625
			15			.937500	23.812500
				31	61	.953125	24.209375
						.968750	24.606250
					63	.984375	25.003125
2	4	8	16	32	64	1.000000	25.400000

STANDARD BOLT TORQUE CHART

STANDARD TIGHTENING REQUIREMENTS FOR NORMAL ASSEMBLY APPLICATIONS

Bolt Thread Size (in)	SAE Gr. 5 Minimum Torque Ft Lbs (Nm) Plain	SAE Gr. 5 Minimum Torque Ft Lbs (Nm) Plated	SAE Gr. 8 Minimum Torque Ft Lbs (Nm) Plain	SAE Gr. 8 Minimum Torque Ft Lbs (Nm) Plated	Carr Bolts & B RH SSQ Bolts Minimum Torque Ft Lbs (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: Increase the torque by 20% when using engine oil or chassis grease as a thread lubricant.

EXCEPTIONS TO THE ABOVE STANDARD:

Motor axle nuts: 200-250 ft lbs (271-339 Nm)
Scrub brush motor porting block socket head bolts: 18-20 ft lbs (24-27 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 TAPERED SEAT FITTING (JIC) TORQUE CHART

Tube O.D. (in)	Thread Size	Maximum Torque
0.25	0.44"-20	9 ft lbs (12 Nm)
0.38	0.56"-18	20 ft lbs (27 Nm)
0.50	0.75"-16	30 ft lbs (41 Nm)
0.62	0.88"-14	40 ft lbs (54 Nm)
0.75	1.12"-12	70 ft lbs (95 Nm)
1.0	1.31"-12	90 ft lbs (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 lbs (8 Nm)	9 ft lbs (12 Nm)
0.38	0.56"-18	13 ft lbs (18 Nm)	20 ft lbs (27 Nm)
0.50	0.75"-16	20 ft lbs (27 Nm)	30 ft lbs (41 Nm)
0.62	0.88"-14	25 ft lbs (34 Nm)	40 ft lbs (54 Nm)
0.75	1.12"-12	45 ft lbs (61 Nm)	70 ft lbs (95 Nm)
1.0	1.31"-12	60 ft lbs (81 Nm)	90 ft lbs (122 Nm)

NOTE: Do not use sealant on o-ring threads.

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 lbs (14 Nm)	30 ft lbs (41 Nm)
1/2 NPT	25 ft lbs (34 Nm)	50 ft lbs (68 Nm)
3/4 NPT	50 ft lbs (68 Nm)	100 ft lbs (136) Nm)

SPECIFICATIONS

FOR

TENNANT MODEL 240 POWER SWEEPER

(NOTE: When standard machine and Hi-Dump machine specifications are different, then exceptions are noted)

SWEEPING PATH WIDTH	53 in. (1346mm)
SWEEPING SPEED (Std Machine)	0 to 6 mph (0 to 9.6 km/h)
SWEEPING SPEED (Hi-Dump Machine)	0 to 5 mph (0 to 8.05 km/h) Hi-Dump machines have automatic speed limitation during dumping.
AISLE TURN WIDTH (Std Machine)	Left - 8 ft. 8 in. (2641mm) Right - 11 ft. 10 in. (3601mm)
AISLE TURN WIDTH (Hi-Dump Machine)	Left - 8 ft. 10 in. (2690mm) Right - 12 ft. 9 in. (3930mm)
DIMENSIONS	SEE "DIMENSION DRAWINGS"
WEIGHT (Std Machine)	Net (with battery and standard brushes) - 1875 lbs (850 kg)
WEIGHT (Hi-Dump Machine)	Net (with battery and standard brushes) - 2790 lbs (1266 kg)

MECHANICAL DATA

FRAME	.185" electrically - welded steel plate, reinforced at stress points
ENGINE	(See "Engine Specifications" in "Engine Section")
HYDRAULIC TANK	Tank capacity: 5 gallons (19 liters)

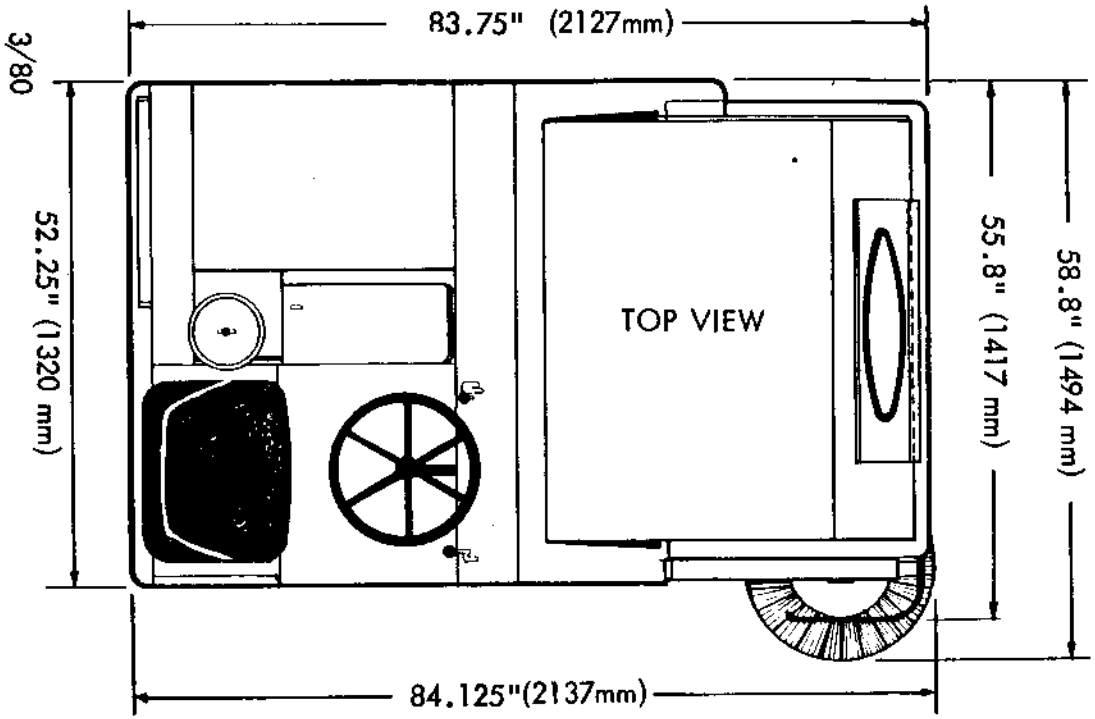
SPECIFICATIONS (Continued)

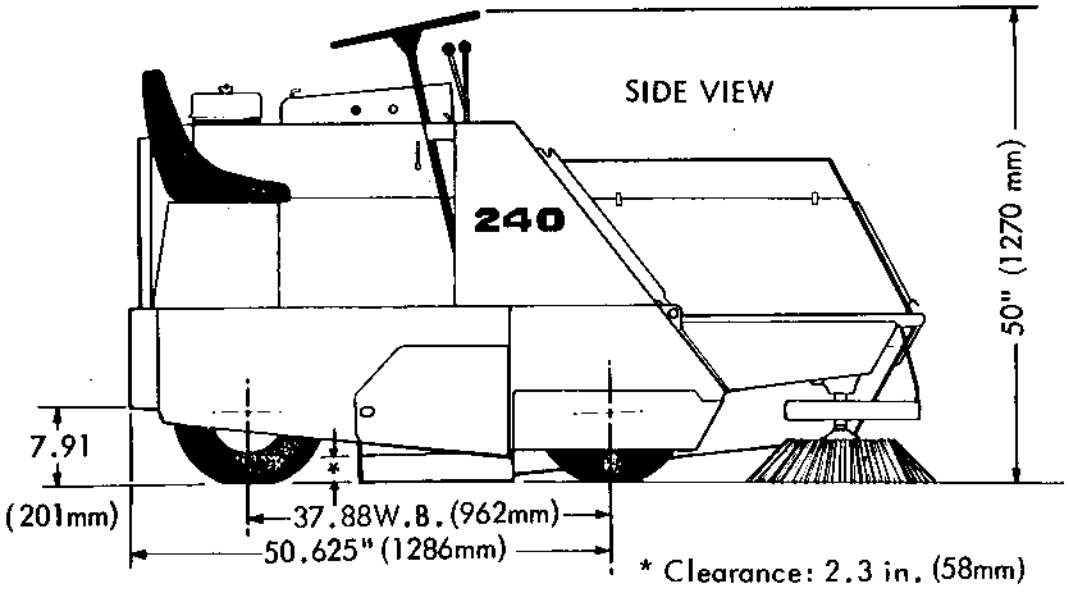
GAS TANK	8 gal (30 liter) capacity (located under seat)
BATTERY	12 volt, automotive - type lead - acid, 41 amp (located under floor panel)
PROPELLING DRIVE	Direct - coupled, engine - driven, variable - volume, piston pump. Pump provides infinitely variable flow to direct rear - wheel - mounted hydraulic motor. Engine runs at constant speed.
BRUSH AND VACUUM FAN DRIVE	Hydraulic - motor - driven vacuum fan, main sweeping brush, and side brush. All motors are on single "on-off" control. Hydraulic motors driven by direct mounted pump on the engine.
MAIN BRUSH	42" (1067 mm) tubular, one-piece disposable unit. 14" (356 mm) outside diameter. Brush can be operated in either "Free Float or "Restricted Down" position. Brushes available in various bristle combinations to suit the sweeping conditions.
BRUSH COMPARTMENT	Brush completely enclosed by heavy .185" sheet steel, rigidly braced, sealed against dust leakage. Replaceable oil resistant rubber skirts with plastic fiber-ply reinforcement provide dust seal to floor. Dust sealed access doors are provided on both sides. A rear rubber strip deflector prevents loss of swept material carried over the brush. Rear brush suspension provides automatic clearance adjustment to this deflector as brush wears.
SIDE BRUSH	Rotary, disposable type, 21" (533 mm) diameter (across outer bristle ends). Brush can be raised when not in use. The brush is protected by a rigid bumper. Other side brushes are available.
FILTER AREA	Enclosed type filter system includes multiple dust filters to provide a total filtering area of 71 sq. ft.* Filter system is in separate compartment above debris hopper, and has a shut - off door, controlled by a fusible link, to close off air flow in case of a fire in the debris area. Filters are cleaned through vibration of an eccentric weight on a motor fixed to steel rods on the bottom of each filter envelope. *$6.6m^2$

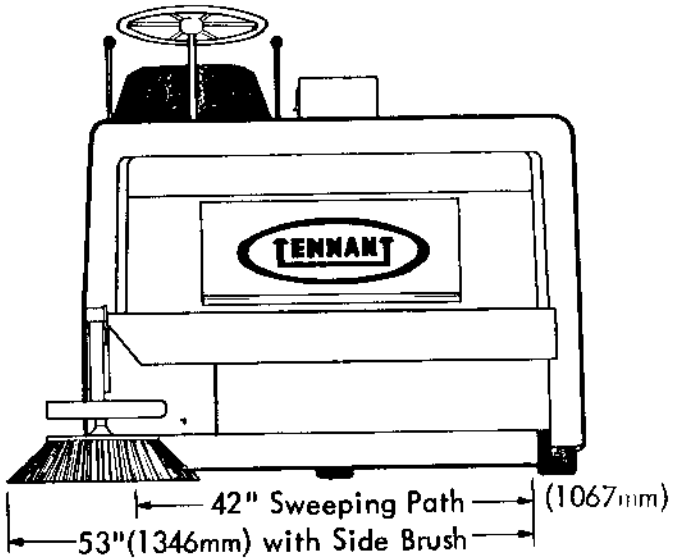
VACUUM CONTROL	High volume 9" (229 mm) diameter fan-driven by hydraulic motor. Fan shuts off with brushes.
HOPPER	14 cu. ft. (0.40m^3) hopper holds over one-half ton of soilage. Hopper is constructed of heavy steel with spill-resistant opening. Standard machine has a front access opening for hand loading of bulky objects and for checking loading. Hopper dumps hydraulically. Hopper can be held in up position with hydraulic control in "HOLD" position. A mechanical safety support arm is provided if work is being done under the hopper or lift arms. Hi-Dump machine has a stabilizer leg which lowers when hopper is dumped. Standard machine hopper is designed to allow "floating" action which allows hopper vertical movement for passing over objects to 2" (51 mm) above floor level.
STEERING	Automotive, recirculating - ball type with single rear wheel steering. A 100 degree steering angle provides narrow isle turns. A horn button is provided on the steering wheel.
PROPELLING CONTROL	One foot pedal controls rate of travel and directs instant forward or reverse motion.
BRAKES	Mechanical service brakes and mechanically actuated parking brakes on the front wheels. A separate foot pedal is provided for the mechanical service brakes.
BRUSH AND FAN CONTROL	A 4 - position hydraulic valve provides: 1. Hopper raise 2. Hopper hold 3. Hopper down and brush & fan motors off 4. Brush and fan motors on
LUBRICATION	All ball bearings on rotating shafts are lubricated for life and sealed.
TIRES	REAR: Pneumatic 5.00 - 8, 8 ply, 18.46 in. (406 mm) diameter, steel guard insert. FRONT: 2 zero pressure, heavy service rubber, 16" (40.6 cm) diameter. (Hi-Dump front tires are solid)

DIMENSIONS

(For dimensions peculiar to Hi-Dump Model, see next page)

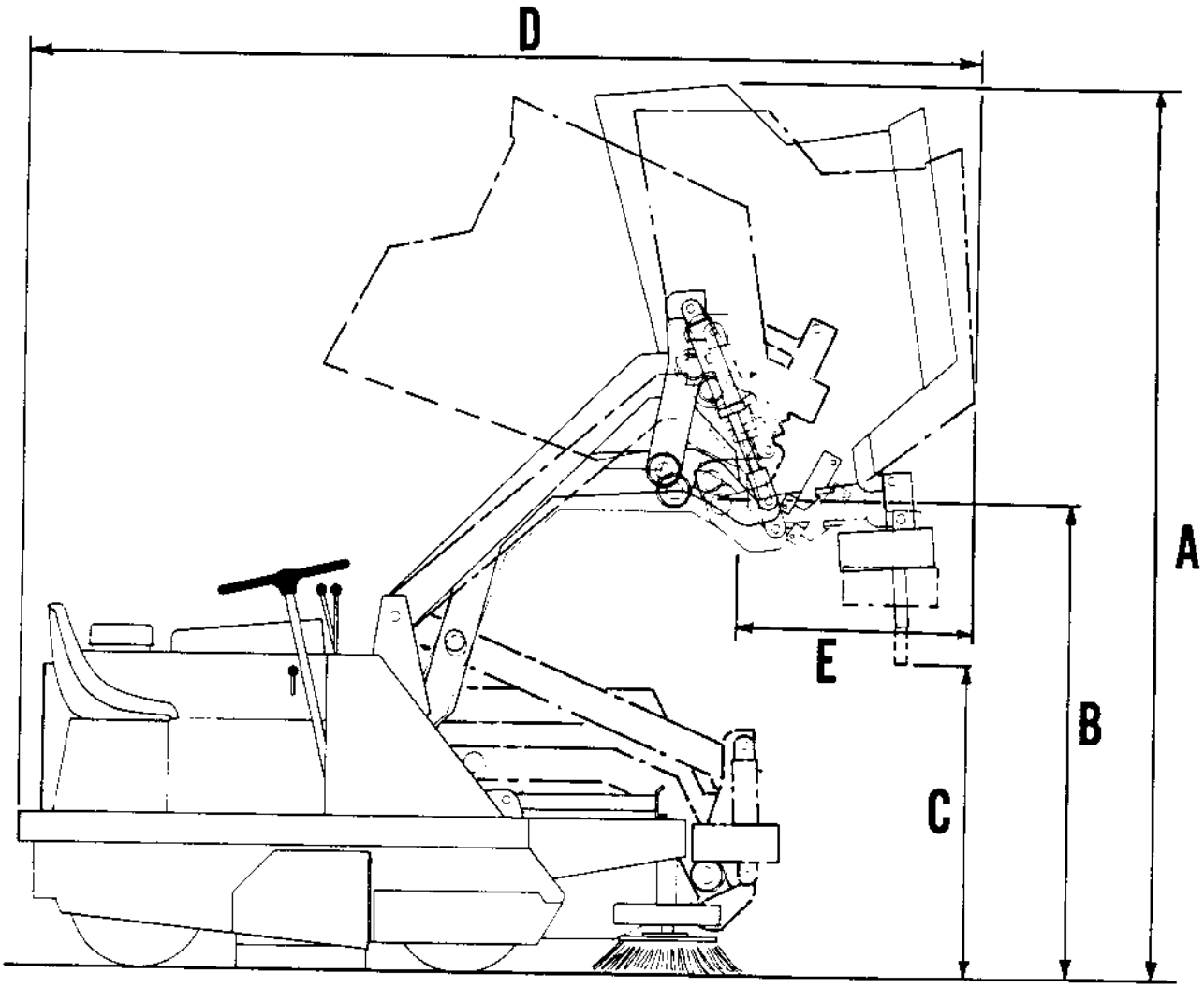






FRONT VIEW

HI-DUMP MODEL DIMENSIONS



A Maximum height (ceiling clearance during maximum lift rollout): 112 in. (2845 mm).

B Maximum receptacle height clearance (without rollout): 60 in. (1524 mm) with maximum load in hopper.

C Minimum door open height (at maximum height and maximum rollout): 44 in. (1118 mm).

D Maximum length (with maximum rollout): 101.5 in. (2578 mm).

E Forward dump clearance (receptacle width): 21 in. (533 mm).

LIFTING INSTRUCTIONS:

1. The approximate location of the three recommended lifting points are shown in the diagram below.
2. Use lifting hooks or install eye-bolts at the location shown in the diagram. A small notch cut into the frame will prevent the lifting hooks from slipping.
3. Lift the machine from only the bottom of the bumper and side frame, not from the upper frame.
4. Use a spreader bar to prevent the lifting chains from pressing inward on the machine and damaging it.
5. The center of the lifting chain must be directly above the machine center of gravity.
6. The location of the center of gravity is based on a machine with hopper empty, no operator and hydraulic tank full.

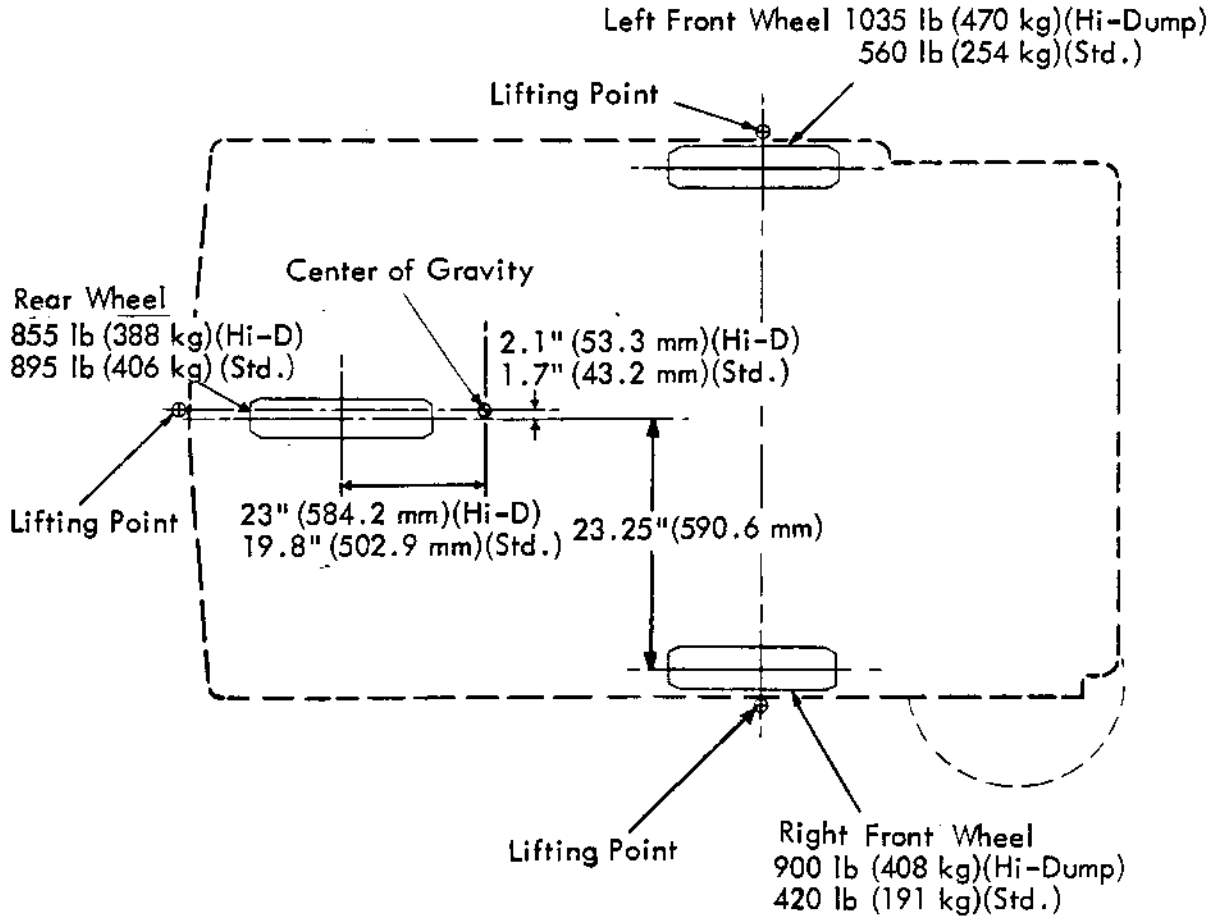


Diagram of center of gravity and weight distribution. The location of the center of gravity is based on an empty hopper, no operator, and hydraulic tank full. Wheel loadings and center of gravity are given for both Standard and Hi-Dump machines.

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POWER SWEEPER

operation & maintenance

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MAINTENANCE

PREPARATION FOR OPERATION

Your TENNANT Company power sweeper has been shipped complete. Do not operate the machine until the operating instructions are read and understood and you are trained and authorized.

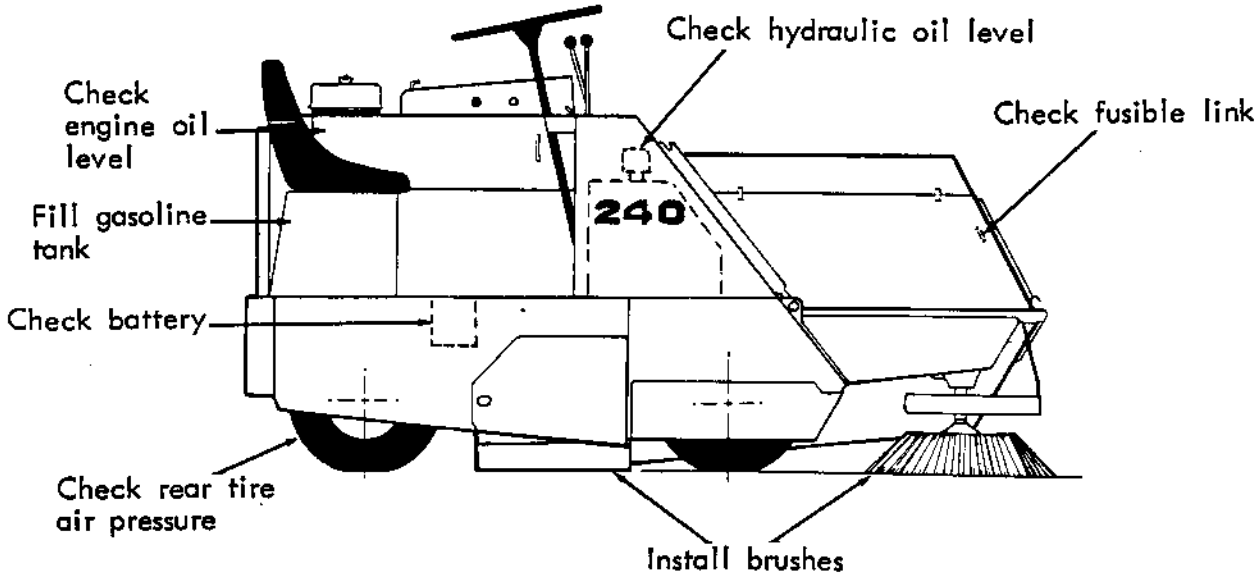
AFTER UNCRATING: (SEE DRAWING BELOW)

1. Check to see if battery is installed and connected to cables. Battery is located under floor cover below operator's feet.
2. Check oil level in hydraulic oil tank. The tank filler cap is located under cover located just to the left of the operator's seat. Hydraulic oil should always be visible in the screened filler opening below the cap. TENNANT Hydraulic Oil is recommended. Capacity of the hydraulic oil tank is five gallons (19 liters).
3. Check to be sure that the fusible link on the filter box fire door has not been broken in shipment. See section titled "Fusible Link Replacement" in Maintenance Section for replacement procedure.
4. Fill fuel tank.

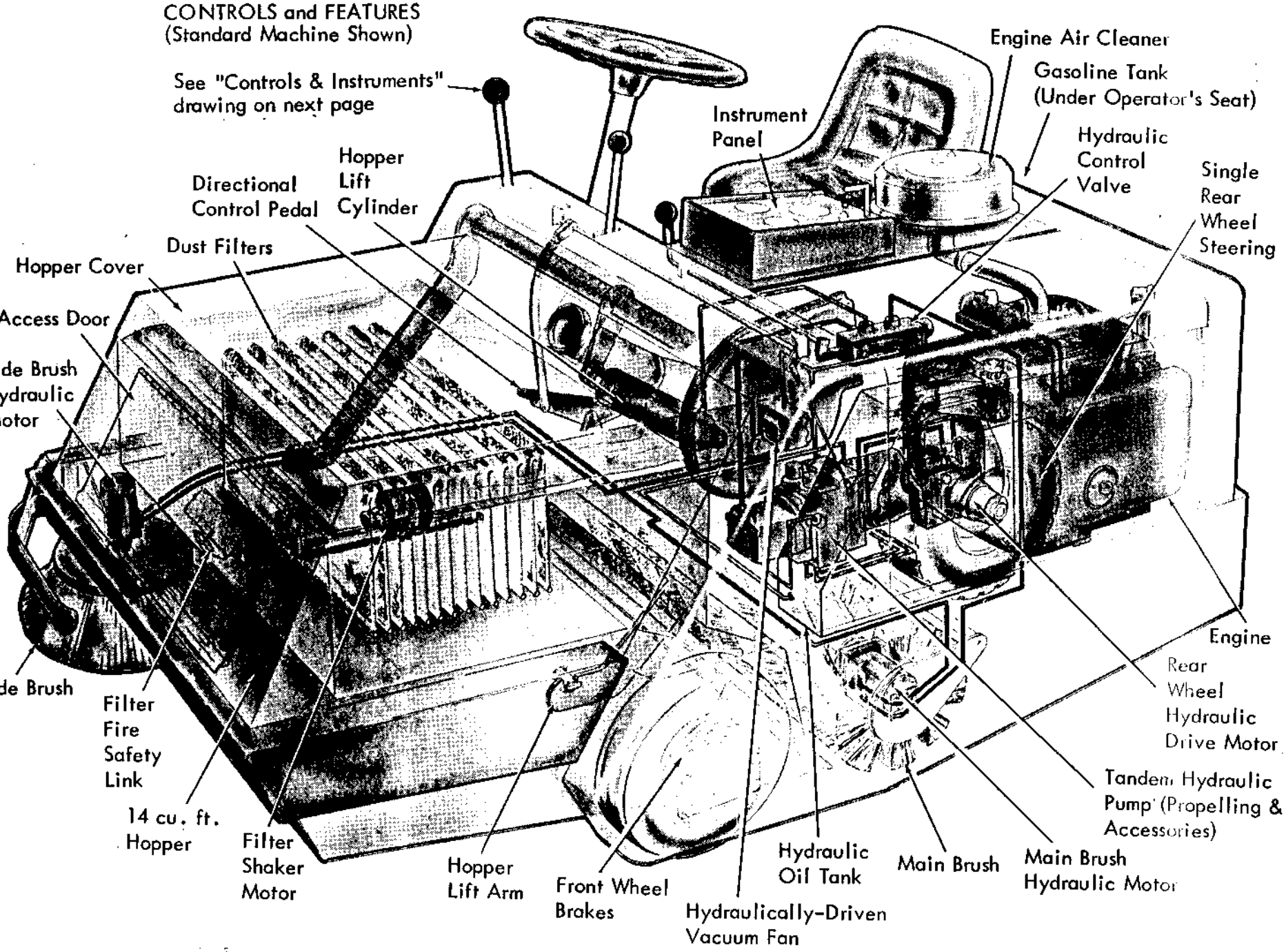
⚠WARNING Never fill tank while engine is running. Always be sure gasoline container and machine are electrically connected before pouring gasoline. This can easily be done by using an insulated wire (permanently attached to container) with a battery clip on the other end.

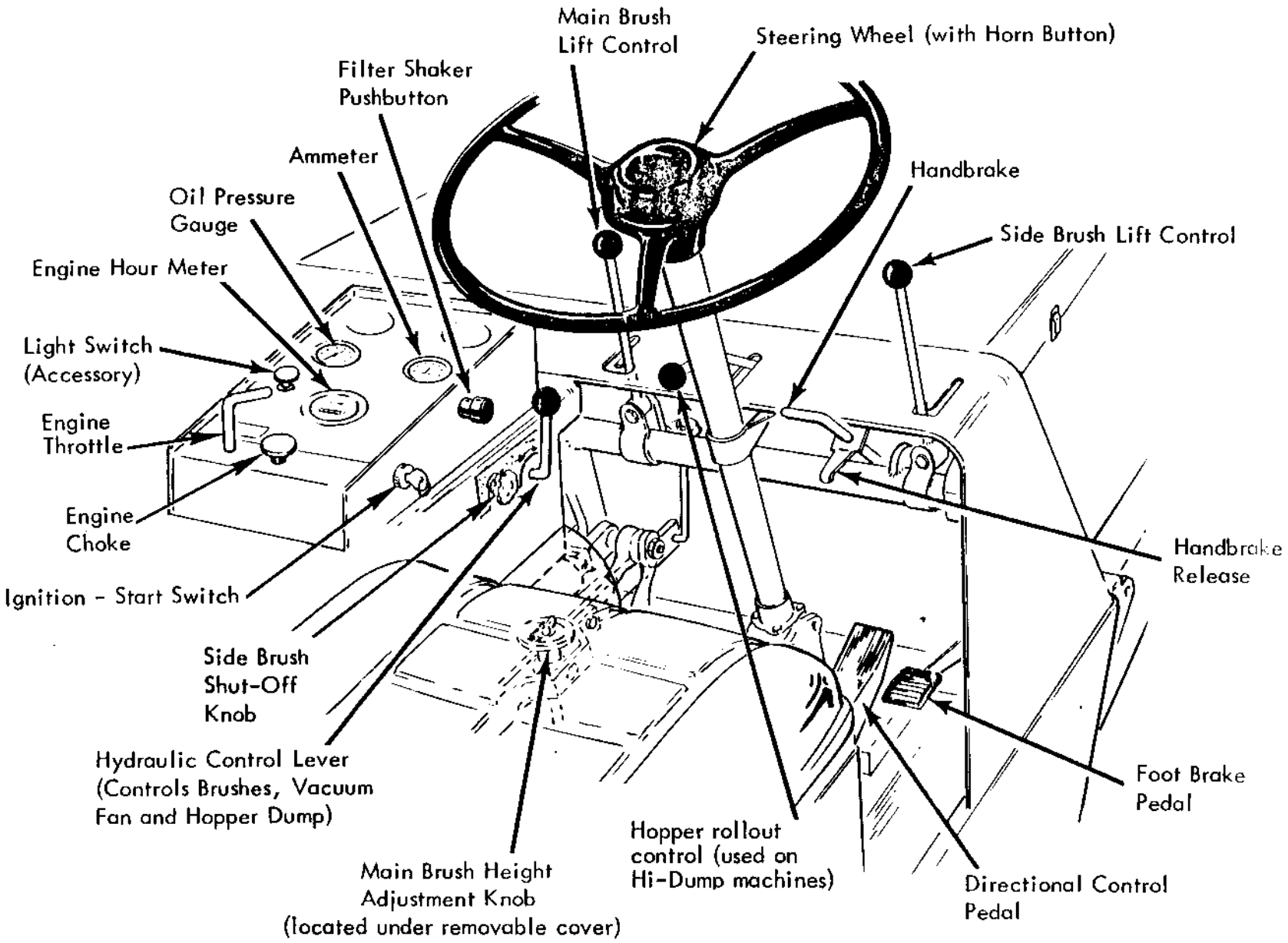
5. Check rear tire air pressure: 80 to 85 psi (552 to 586 kPa) for sweeper and Hi-Dump machine, and 70 to 75 psi (483 to 517 kPa) for scrubbers.
6. Install brushes.
7. Check engine oil level.
8. Please read this manual carefully before attempting to operate your machine.

PREPARATION FOR OPERATION (Standard machine shown)



CONTROLS and FEATURES
(Standard Machine Shown)





DETAIL VIEW OF CONTROLS AND INSTRUMENTS ON A STANDARD MACHINE

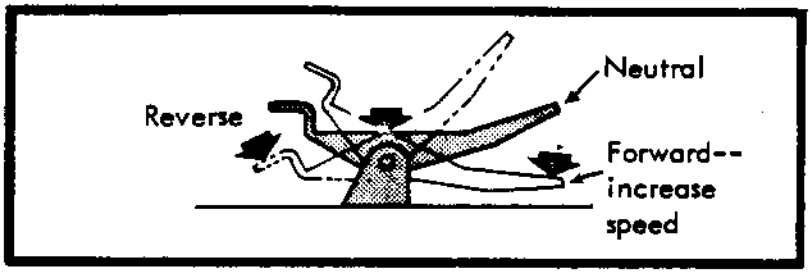
OPERATION OF CONTROLS

BRAKE PEDAL

The brake pedal operates the brakes on the two front wheels. To stop, return the direction control pedal to neutral, then apply pressure to the brake pedal.

DIRECTION CONTROL

A single foot pedal controls the hydraulic propelling drive and is used to select direction of travel and propelling speed of the machine, as shown on sketch.



Positions Of The Directional Control Pedal

Gradually depress the "toe" portion of the pedal for forward travel or the "heel" portion, for reverse travel. Regulate the machine speed by varying pressure on the pedal.

If machine creeps when the pedal is in neutral position, see "Adjusting Directional Control Pedal Neutral Position" in Maintenance Section.

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

ENGINE THROTTLE

The engine throttle has only two positions: "closed" and "open". In the "open" position the governor controls engine speed.

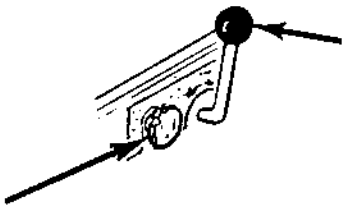
ATTENTION! The machine must always be operated with the engine at full "open" throttle. If not, there is danger of over-loading the engine and causing damage.

KEY-OPERATED IGNITION SWITCH

The ignition switch is located on the side of the instrument panel. Turn the key momentarily in order to start the engine. Do not operate the starter for more than 10 seconds at one time.

HYDRAULIC CONTROL LEVER

The Hydraulic Control Lever operates a manual directional control valve. The lever has four positions: "Brushes and Vacuum Fan On", Off", "Hopper Up" and "Hopper Hold".



The hopper will remain up when the control lever is placed in "Hopper Hold" position. (If it is necessary to reach under hopper, be sure to engage safety lock.)

The "Brushes and Vacuum Fan On" position of the lever will start both main and side brush, as well as the vacuum fan.

If the standard machine is equipped with the Scrubbing Attachment, the Brushes and Vacuum Fan On" position of the control will also start the scrubber main brush and side brush rotation.

SIDE BRUSH SHUT OFF HYDRAULIC CONTROL

A separate control knob is provided for stopping side brush rotation.

HI-DUMP HOPPER ROLLOUT CONTROL

Use the Hopper Rollout Control to dump the hopper after it has been raised to the desired height. The control has two positions (forward rollout and reverse) with a spring - loaded return to neutral. The hopper can be rolled out at any height; but to avoid damage, the hopper must be at least 12 inches (305 mm) off the floor before being fully dumped.

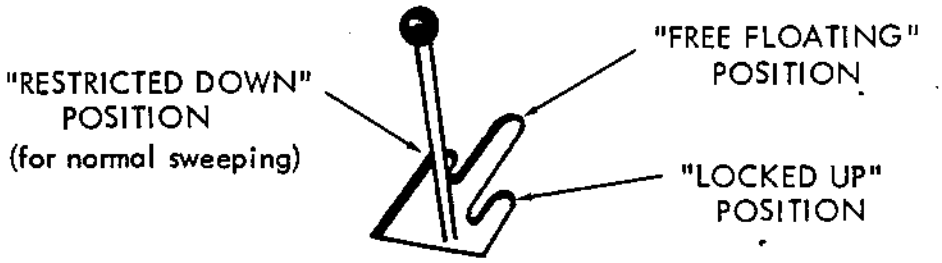
STEERING WHEEL

The automotive - type steering wheel controls the single rear wheel through an arm and tie rod arrangement. Since the machine is very responsive to movement of the steering wheel, the operator should use care until he becomes more experienced in guiding the machine.

MAIN BRUSH LIFT LEVER

The main sweeping brush lever has three positions: "Brush Locked Up", "Restricted Down" (for normal sweeping) and "Free Floating".

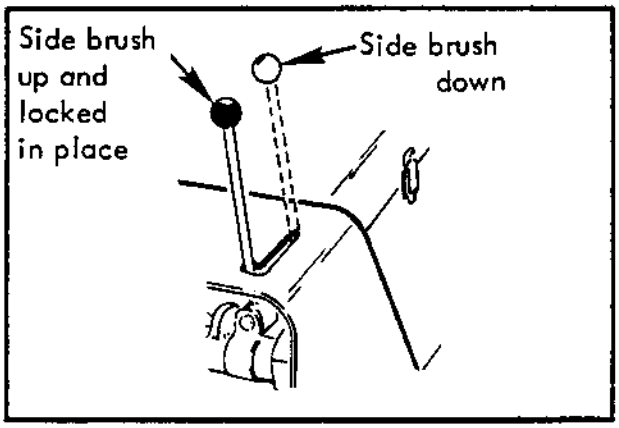
To lower the main sweeping brush, pull the lever back, then move the lever to the left and into either one of the two slots. To raise the brush, pull the lever back, then to the right and into the small slot where it will be locked in place (see sketch).



You may operate the main brush in either the "RESTRICTED DOWN" or "FREE FLOATING" positions; HOWEVER, the "RESTRICTED DOWN" position should be used for normal sweeping and will result in much longer brush life. The "FREE FLOATING" position should be used only when sweeping extremely uneven areas where unrestricted brush movement allows the brush to follow surface contours.

SIDE BRUSH LIFT LEVER

To raise and lock up the side brush, pull the lever back, then move the lever to the left so that is is locked in place in the small slot, see sketch.



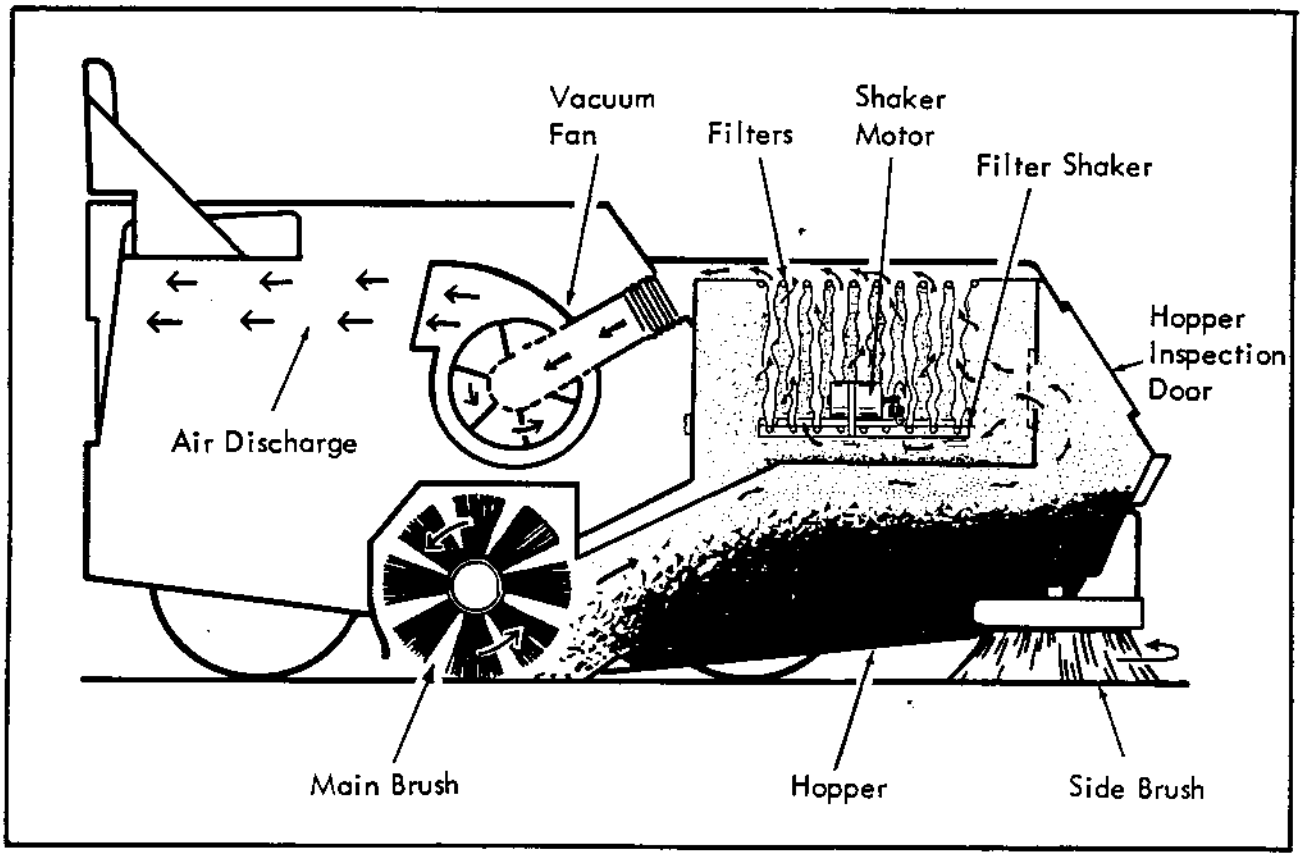
Side Brush Lift Lever

To lower the side brush, pull the lever back, then move it to the right and allow it to move through the long slot until the brush is down. Whenever the side brush is not needed, or when transporting the machine, be sure to raise and lock up the side brush.

FILTER SHAKER SWITCH

Press button to actuate shaker motor. Keep button depressed for 10 to 15 seconds -- or longer as needed to shake filter clean.

NOTE Activate shaker switch only with brushes and vacuum shut off and hopper in "DOWN" position. Vacuum must always be shut off when shaking filters (if not, dust will be drawn back into filter envelopes).



Vacuum fan, filter shaker and hopper design.
(Standard machine shown)

VACUUM FAN

The high - volume, 9 inch (229 mm) diameter vacuum fan is driven by a hydraulic motor. The fan runs whenever the brushes are operating. Exhaust air from the fan is directed over a cooling coil located in the hydraulic lines. The vacuum fan and brushes should be stopped whenever operating the filter shaker.

HANDBRAKE LEVER

The handbrake lever is attached to the same linkage as the foot brake pedal. Pull the lever up to lock the front wheels. Pull the small tab to release the hand-brake. Be sure to engage the handbrake whenever parking the machine.

HOPPER SAFETY SUPPORT ARM (Standard Machine)

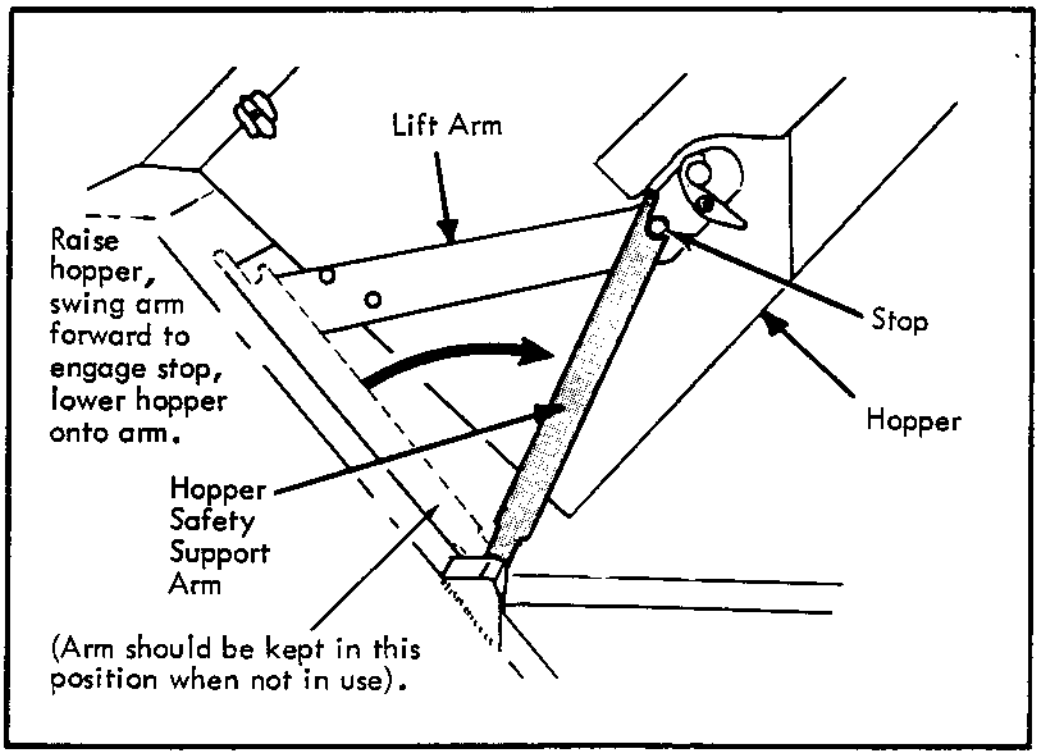
⚠WARNING Never reach under the upraised hopper without first engaging the safety arm.

To Engage Hopper Safety Support Arm:

1. Lift hopper to extreme "up" position. Safety arm should be in raised position (see sketch) against frame.
2. Move safety support arm forward until it engages stop on hopper.
3. Lower hopper until it is supported by arm.
4. Shut engine off.

To Disengage Hopper Safety Support Arm:

1. Lift hopper to extreme "up" position.
2. Return safety support arm to unused position.
3. Lower hopper.



Standard Machine Hopper Safety Support Arm

HOPPER SAFETY SUPPORT ARM (Hi-Dump Machines)

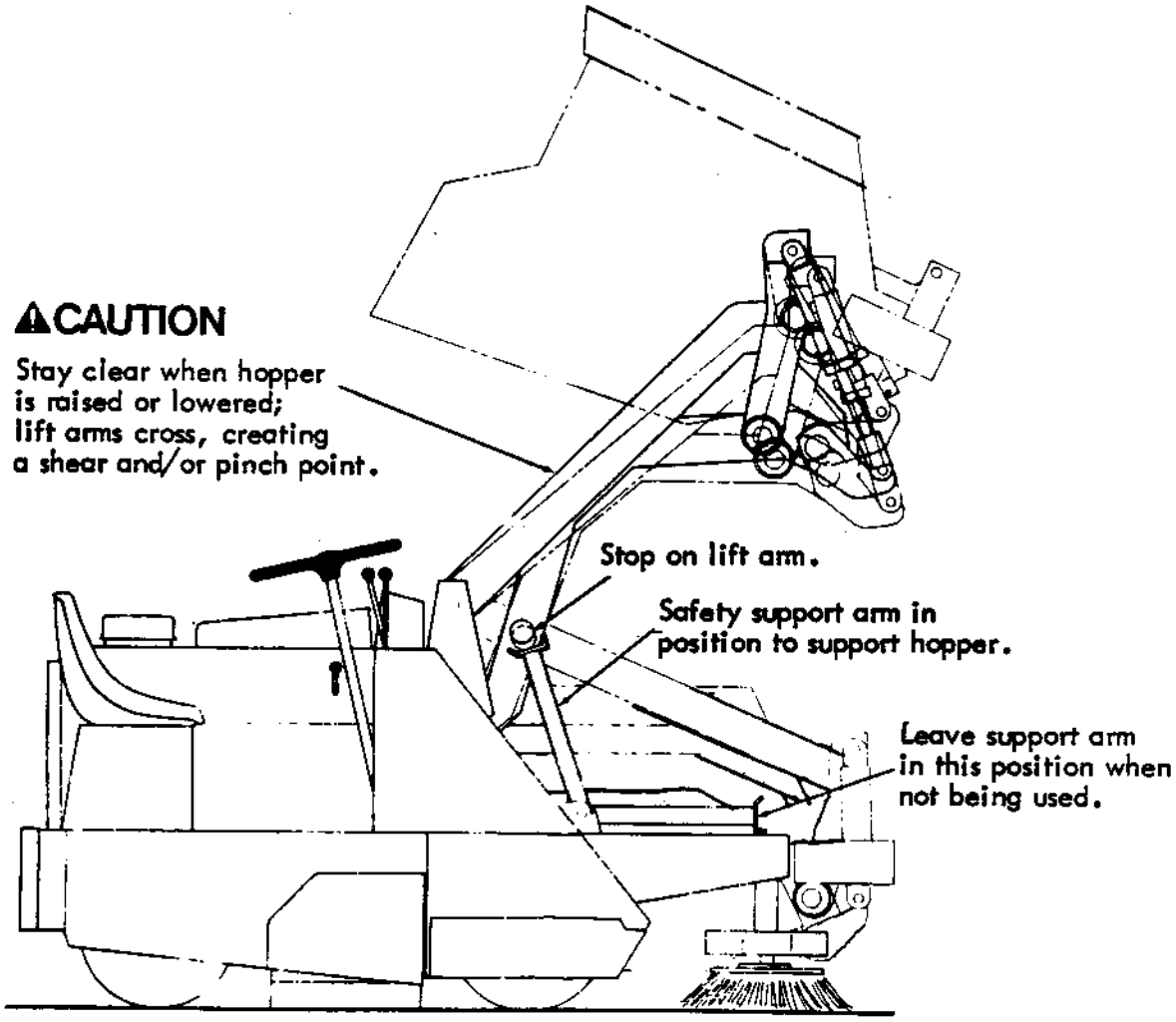
⚠WARNING Never reach under upraised hopper without first engaging the safety arm. When hopper is raised or lowered, lift arms cross, creating a pinch point. Stay clear.

To Engage Hopper Safety Support Arm:

1. Lift hopper to extreme "up" position.
2. Raise and swing back safety arm until it engages stop on hopper (see sketch).
3. Lower hopper until it is supported by arm.
4. Shut engine off.

To Disengage Hopper Safety Support Arm:

1. Lift hopper to extreme "up" position.
2. Swing safety arm forward and down (see sketch).
3. Lower hopper.



OPERATION

TO START GASOLINE ENGINE (FOR LPG ENGINE, SEE "LPG SECTION")

1. **⚠WARNING** Do not attempt to start machine unless you are in the driver's seat, with foot on brake pedal or hand brake engaged and with directional pedal in neutral position.

2. If engine is cold, pull up choke button (three fourths choke). Set throttle at "Open" position.

3. Turn starter key switch to "start" momentarily until motor starts. Release key as soon as motor starts. Never operate starter for more than a few seconds.

PUSHING OR TOWING MACHINE

ATTENTION! Never attempt to tow or push machine for a long distance. To do so may cause damage to the hydraulic system

WARM-UP: Allowing engine and hydraulic system to warm-up before operation will prolong machine components life.

TO DRIVE SWEEPER

1. Start engine (engine should be set at full throttle).

2. Release parking brake.

3. Start brush rotation and vacuum fan.

4. Lower main and side brushes to floor. (Brush position should be set correctly.)

5. Gently depress directional control pedal - with toe for forward direction, or with heel for reverse.

6. Vary your foot pressure on pedal to obtain desired travel speed.

7. Be sure to follow "General Operating Instructions"information in next section.

TO STOP SWEEPER

1. Return directional pedal to neutral (centered) position.

2. Apply foot brake.

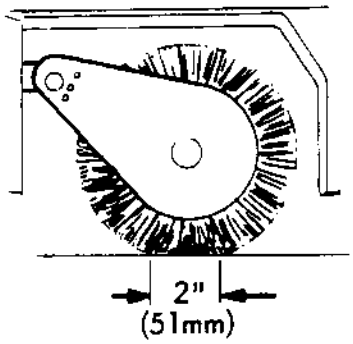
3. Raise brushes and stop brush rotation.

4. Apply parking brake.

BRUSH HEIGHT ADJUSTMENT

The "Restricted Down" position of the brush can be adjusted to compensate for wear, changing conditions, etc. This is done by turning the adjustment knob shown in the "Location of Controls" illustration.

Correct brush height will make a "polished" mark on the floor about two inches wide.



The brush height adjustment knob is set to restrict the brush down position, as follows: The best method for checking the brush adjustment is to park the machine on a level surface, (with the brush up), then lower the brush to "Restricted Down" position and allow it to rotate against the floor for about one minute. Raise the brush and drive the machine off of the test area. The brush should leave a "polished mark" (see sketch) on the floor about two inches wide (51 mm) for the full length of the brush. If not, adjust the "Brush Height Knob". (Clockwise rotation of the knob raises brush.)

Various sweeping conditions and special brushes with stiffer bristles may require a different adjustment.

GASOLINE TANK

The 8 gal (30 liter) capacity gasoline tank is located under the operator's seat. Tilt the seat forward to gain access to the tank. Regular gasoline of at least 90 octane is recommended. Unleaded gas may be used.

⚠WARNING Gasoline container and machine must be electrically connected before pouring gasoline. Connect insulated wire between the machine and the container. Never fill tank while the engine is running

LPG FUEL TANK

Complete instructions for the capacity and replacement of the LPG Fuel Tank are located in the "LPG" Section" of this manual.

TO REPLACE MAIN BRUSH

A. To Remove Brush

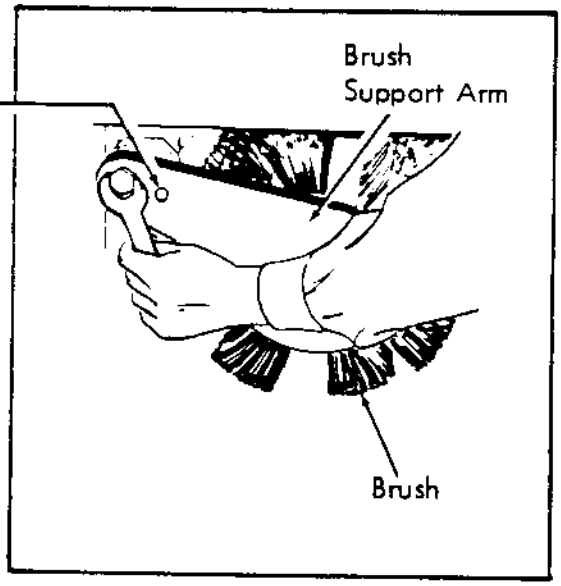
⚠CAUTION To protect your hands, be sure to wear gloves. This is especially important when changing brushes which contain wire bristles.

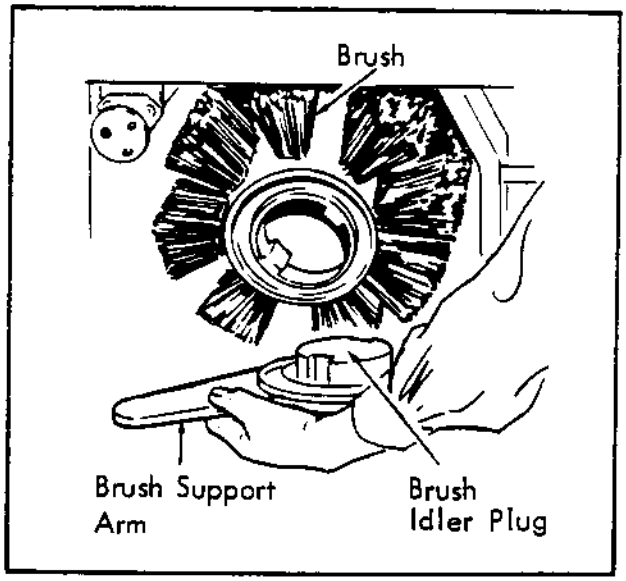
1. Lower main brush to floor with lift handle.
2. Open brush access door.
3. Using the wrench provided, remove the hex head screw which attaches the brush support arm.
4. Pull out and remove the support arm and brush idler plug from the end of the brush.

⚠CAUTION If the support arm does not come off easily, insert the arm screw into the tapped hole in the arm. Remove plastic plug in the hole. Turn the screw in with a wrench to force the arm off; at the same time, pull and wiggle the arm to help it come loose. Do this very carefully to avoid injuring your hands if the arm should suddenly come off.

5. Grasp the brush and pull it off the opposite (drive) plug, then out the brush access door. (If the brush support arm idler plug is stuck in the brush, it may be easier to pull out both arm and brush at same time.)

NOTE If arm does not come off easily, remove plastic plug from this hole and screw in arm attaching screw to force arm off.





(continued on next page)

TO REPLACE MAIN BRUSH (continued)

B. To Install Brush

1. With brush lever in "Down" position, insert one end of brush through access opening and push in brush until it touches opposite brush plug.

2. Sight through brush tube (or align brush keys by "feel") to align brush keys with, and onto keyways on left side brush plug.

3. Replace right side brush support arm, with plug into open brush end. (To prevent the arm from sticking in place, apply a little grease to the arm pins.)

4. Insert hex screw with washer to hold support arm. Tighten screw securely.

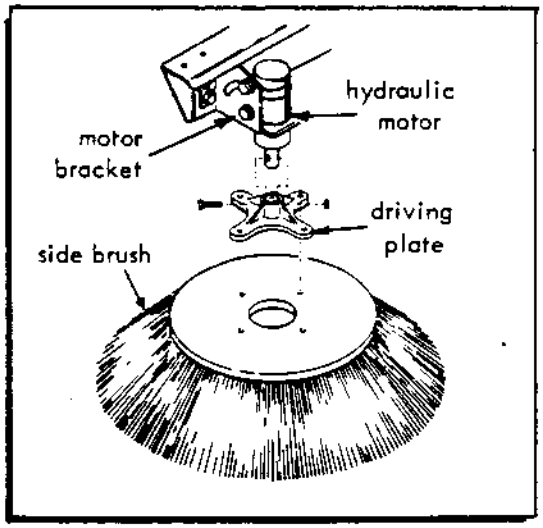
TO REPLACE SIDE BRUSH

A. To Remove Brush

1. Be sure hydraulic control lever is in "OFF" position.
2. Raise side brush with side brush lift lever.
3. Remove bolt from brush drive shaft. (Brush can then be lowered and removed.)

B. To Install Brush

1. With side brush still raised, slide brush onto drive shaft. Insert and tighten screw.
2. Using lift lever, lower side brush to sweeping position.
3. Loosen adjusting lug holding motor bracket to side brush arm. Slide motor and brush up or down until about one half of the bristles touch the floor.
4. Readjust if dust streak is left by side brush, or if bristles are severely bent when sweeper is operated. (See "Side Brush Adjustments".)



The side sweeping brush assembly.

HOPPER (STANDARD MACHINE ONLY - NOT HI-DUMP)

Hopper capacity is 14 cubic feet (0.40 m^3). The hopper has a "floating" action which allows it to pivot slightly so that objects up to two inches(51 mm) in height can pass under the hopper and then be swept into the pan by the brush.

On the standard machine, an access door is provided at the front of the hopper so that the operator can inspect hopper contents. The door can also be used for inserting items which are too large for sweeping, or for flushing out the hopper.

A fusible link, located inside the hopper behind the access door, will open if hopper debris should catch fire. The opening of this link allows a spring to close the fire door, which shuts off vacuum air flow through the hopper, thus preventing the ingestion of the fire into the filters.

Hopper floor clearance adjustments and fusible link replacement are covered in the Maintenance Section.

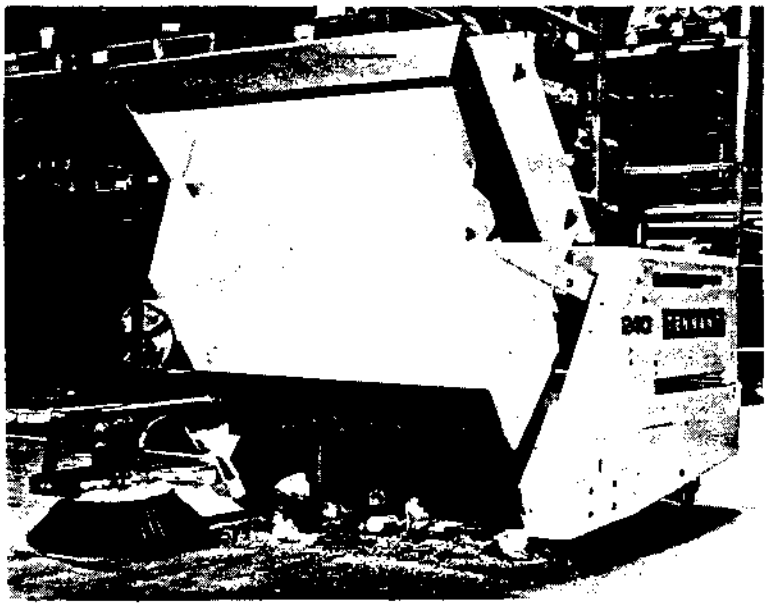
TO DUMP HOPPER (STANDARD MACHINE ONLY - NOT HI-DUMP)

1. Turn off brushes and vacuum fan. Raise both main and side brushes.
2. Push filter shaker button to clean filter.
3. Turn hydraulic control lever to "Hopper Up" position (engine full throttle).
4. After hopper is emptied, back sweeper away and turn to left so that side brush will clear dirt pile.

⚠WARNING Never reach under upraised hopper without first engaging safety arm.

5. Lower hopper to sweeping position by moving hydraulic control lever to "Off".

NOTE The hopper will lower much faster if the engine speed is dropped down to idle. Return engine speed to full after dumping.



THE HI-DUMP HOPPER

The Hi-Dump Model hopper has the same capacity as the standard machine 1000 lbs (455 kg) for conventional "low-dumping". However, for high dumping up to a maximum of 60 in. (1524mm), capacity is reduced to 500 lbs (226.8 kg) maximum lift. Ceiling clearance height of the fully raised hopper is 9 ft. 4 in. (2845mm).

A separate hand control lever is used to roll the hopper forward for dumping. The hopper door unlatches and opens automatically during rollout, and closes when the hopper is returned to its normal position.

When the hopper has been raised approximately 11 in (279 mm) a stabilizer leg is automatically lowered at the left front of the machine to provide machine stability.

In addition, when the hopper is raised to a height of 36 in (914 mm), an automatic speed limiter is engaged which limits machine forward speed to no more than 2 mph (3.22 km/hr).

The Hi-Dump Hopper is provided with a fire safety fusible link, which will open if the hopper debris should catch fire.

Hopper replacement and adjustments are described in the Maintenance Chapter.

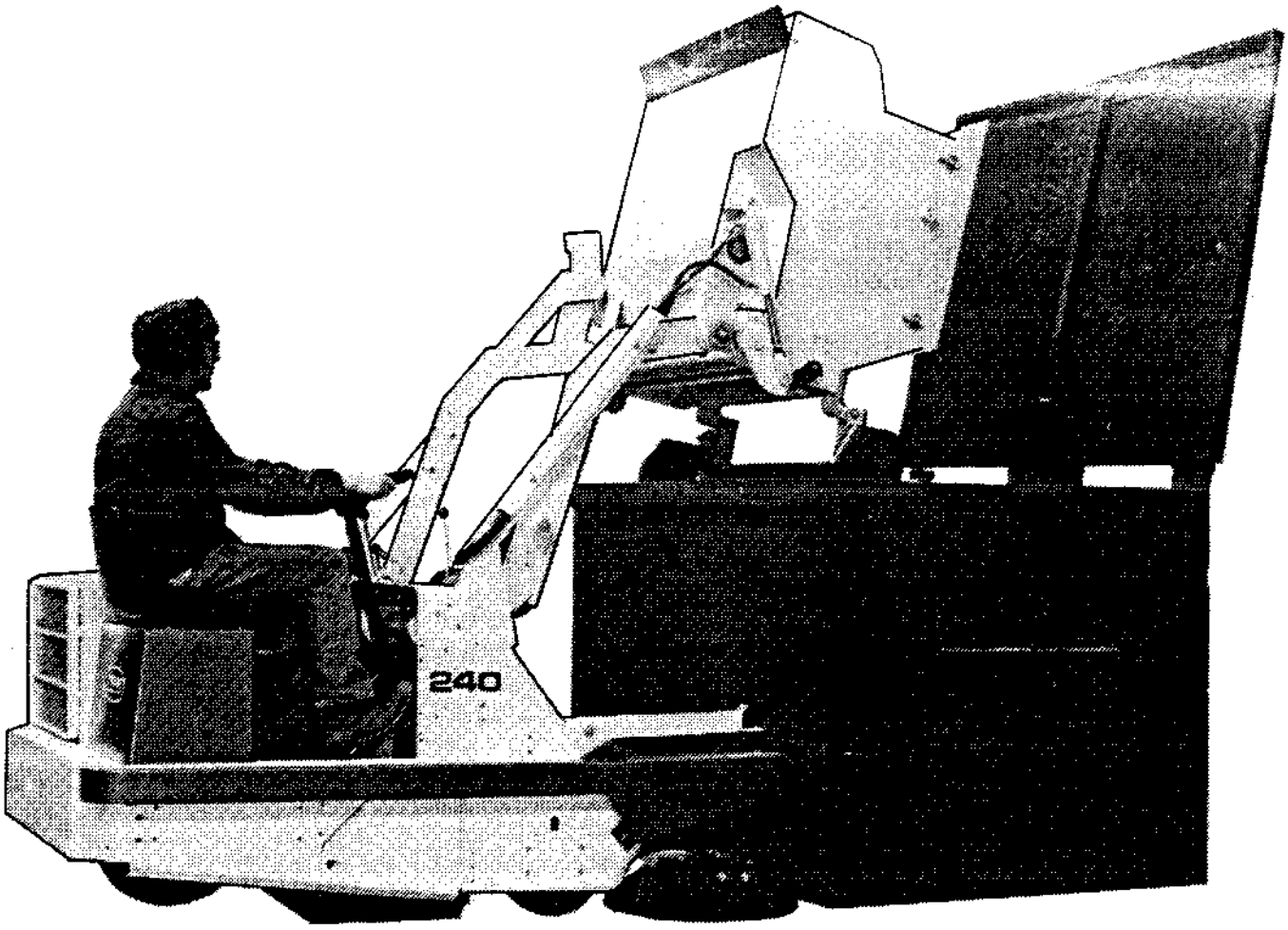
There are certain cautions to be observed when dumping the Hi-Dump Hopper:

1. Before raising the hopper, make sure that there is sufficient clearance to lift the hopper and roll it forward (clearances are shown in the "Dimensions" drawing).

2. Remember that to avoid damage, the hopper must be at least 12 in (305 mm) off the floor before rollout (hopper door or shear pin may be damaged).

3. Don't attempt to drive the machine any distance with the hopper raised (because of reduced visibility, danger of striking overhead objects, possibility of catching lowered stabilizer leg on rough floor).

4. When dumping off the edge of a loading dock, make sure that the stabilizer leg is contacting floor (with front wheels at edge of dock, stabilizer leg could be beyond edge of dock).



TO DUMP HI-DUMP HOPPER

1. Turn off brushes and vacuum fan. Raise both main and side brushes.
2. Turn hydraulic control lever to "Hopper Up" position (engine full throttle).
3. Push filter shaker button to clean filter.
4. Raise hopper enough to clear waste receptacle during forward rollout.
   ⚠WARNING When hopper is raised or lowered, lift arms cross, creating a shear point - STAY CLEAR OF ARMS.
5. Drive machine carefully forward so that hopper is in position to dump properly into waste receptacle.
6. Move hopper rollout control to "Roll Out"; hopper will move forward and dump.
7. Move hopper rollout control to "Roll In". After hopper returns to normal position, release control.
8. Back machine away from receptacle.
9. Lower hopper to sweeping position.

GENERAL OPERATING SUGGESTIONS

1. Plan your sweeping in advace. Try to arrange long runs with minimum stopping and starting. Sweep debris from narrow aisles out into main aisle ahead of time.

2. Do an entire floor, or section at one time.

3. Pick up oversize debris before sweeping. Flatten or remove bulky cartons, etc., from aisles before sweeping. Avoid sweeping up wire which could become entangled in brushes.

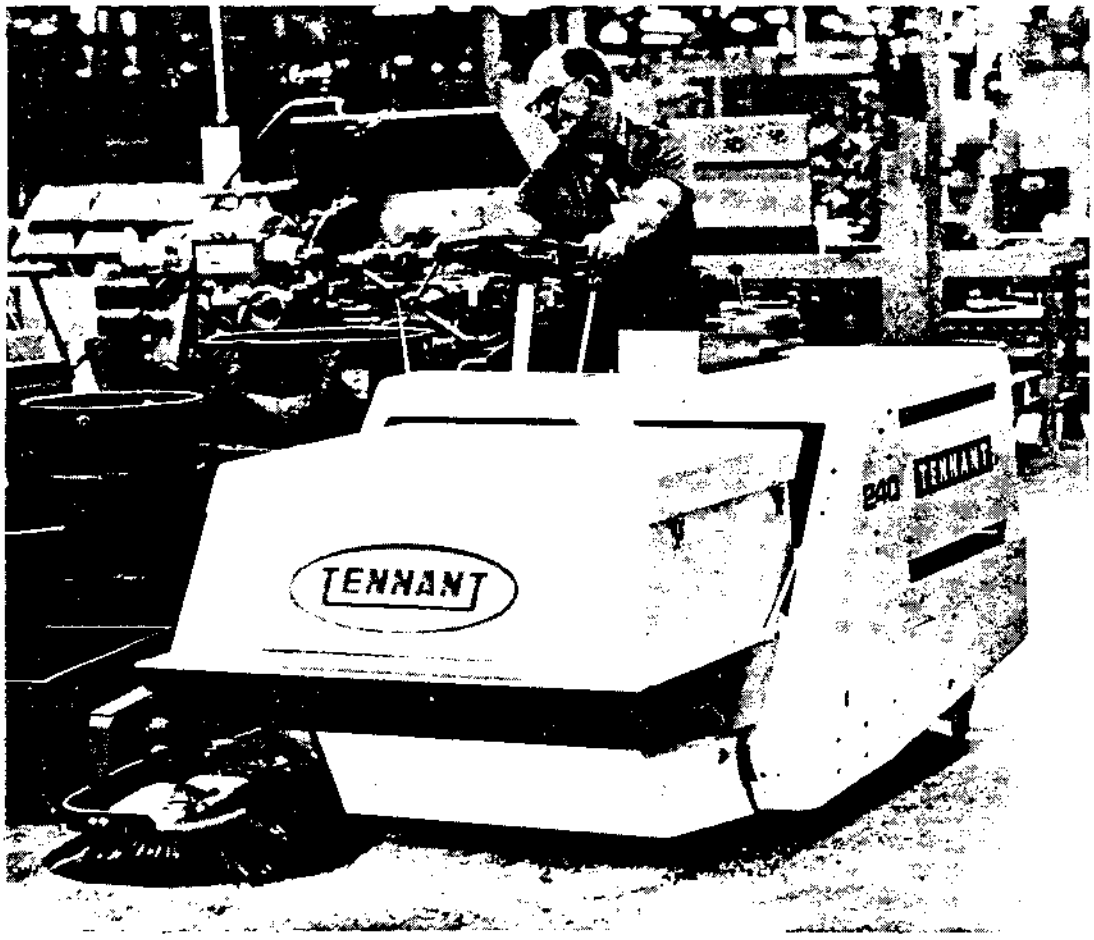
4. Allow a few inches overlap of brush paths. This will eliminate leaving dirty patches.

5. Don't turn steering wheel too sharply when machine is in motion. Your sweeper is very responsive to movement of the steering wheel -- avoid sudden turns, except in emergencies.

⚠WARNING Avoid driving sweeper with hopper removed. Removing the hopper changes the machine center of gravity and affects balance.

⚠CAUTION Do not back machine down ramps.

6. Try to sweep as straight a path as possible. Avoid bumping into posts or scraping sides of sweeper.



MAINTENANCE

MODEL 240

LUBRICATION AND MAINTENANCE CHART

Index No. on Chart	Description	Procedure	Interval (Hours)
1	Hopper lift bearings(2)	Apply chassis grease	50
2	Engine Air Cleaner	Clean element	50**
3	Steering gear box	Check level, (add grease*)	500
4	Hydraulic tank	Check oil level	8
	Hyd. tank breather filter	Replace filter element	500
	Hydraulic tank (Use TENNANT Hyd. oil)	Change hydraulic oil, clean tank (Tank capacity: 5 gals. (19 liters)	500
5	Hydraulic oil filter	Change filter element	500
6	Battery	Check electrolyte level	8
7	Engine oil filter	Change filter element	100
8	Engine crankcase	Change oil	100
		Check oil level	8
9	Spark plugs & points	Check gap	100
10	Check eng. ign. timing	(See Engine Manual)	200
11	Check eng. valve tappet clr.	(See Engine Manual)	500
12	Service fuel filter (Located under tank)	Clean filter element	200
13	Rear Tire Pressure		8
14	Miscellaneous pivots, hinges, etc.	Apply SAE 20 Oil	50
15	Pump drive coupling (not shown)	Apply grease to fitting. (Wipe off excess grease on outside)	200
	Scrubber attachment:		
16	Lower trough pivots (2)	Grease fitting	8
	Caster wheels (4)	Grease fitting	200
	Recovery tank, hose, etc.	Clean out	(as req.)
17	Rear wheel pivot bearing	Hand pack with Lithium EP multi-grease	500

** Under normal conditions, clean element every 50 hrs., replace it every 200 hrs. In extremely dirty and dusty surroundings, clean element daily and replace every 100 hrs. Clean element by gently tapping on flat surface. See instructions in this chapter.

RECOMMENDED LUBRICANTS

*1. Use Saginaw Steering Gear Lubricant (Specification: SSG5676630, SSG Code 4009).

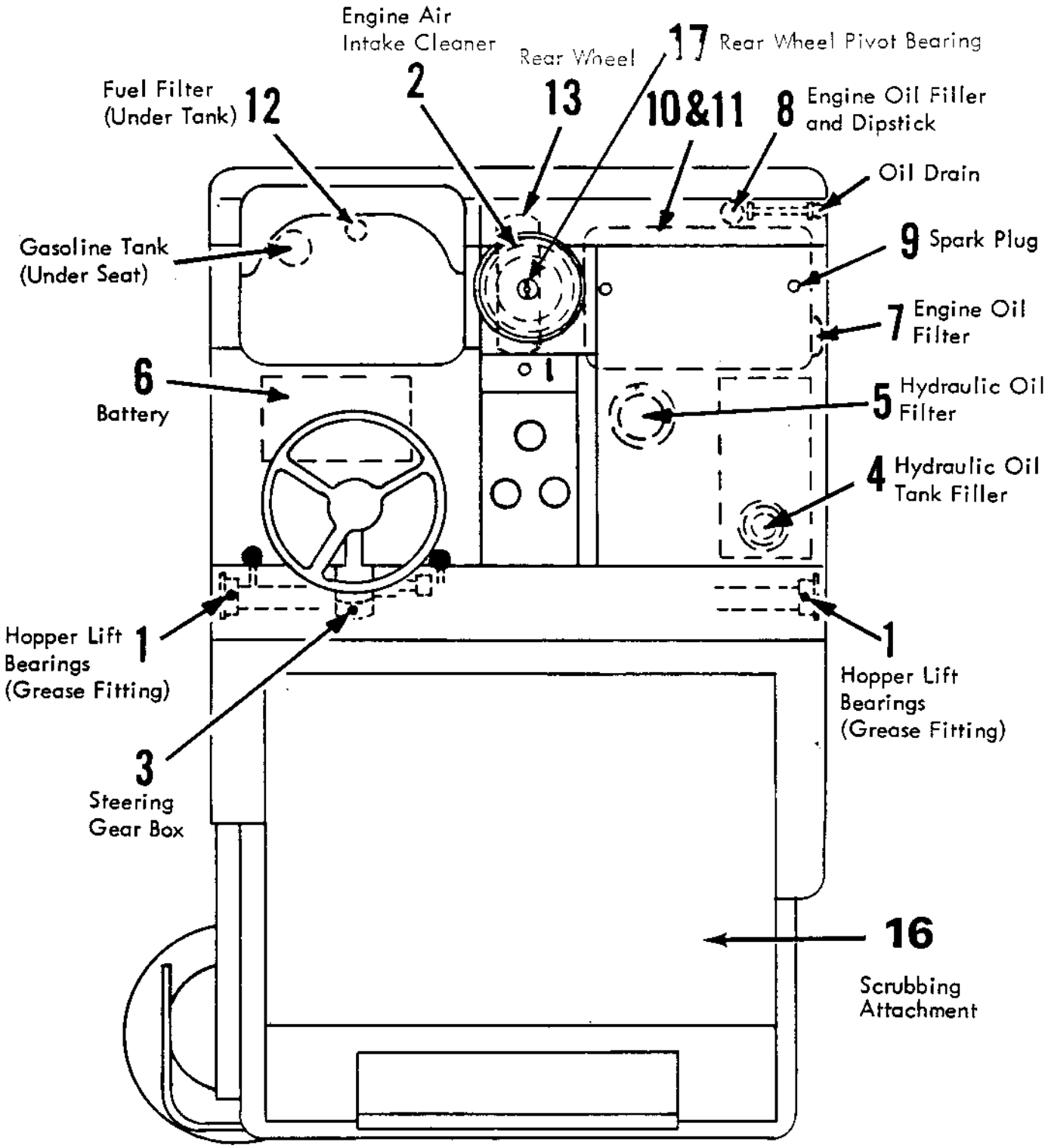
2. All grease fittings: Lithium-Moly E.P. grease. (TENNANT NO. 1401)

3. Engine Oil: SAE #30, API type "SE" for above 30° F (-1°c). See "Engine Section".

4. Hydraulic Oil: TENNANT Hydraulic oil, Part No. 32397, 10W-40. (See "Recommended Hydraulic Fluid" section.)

5. Pivot points without grease fittings: SAE #20 general purpose oil.

LUBRICATION AND GENERAL MAINTENANCE DIAGRAM



IMPORTANT

RECOMMENDED 50 - HOUR INSPECTION

After the first 50 hours of operation, the following procedures are recommended (See "Engine Manual" for engine adjustments):

1. Change engine oil and filter.
2. Check valve tappet clearance: intake, .008" to .010"(.203 to .254 mm); exhaust, .017" to .020" (.432 to .508 mm).
3. Check spark plug gap: .035" (.889 mm) for gasoline; .018" (.457 mm) for LPG.
4. Check point gap: .020" (.508 mm).
5. Check engine timing (see engine manual).
6. Torque down cylinder head (see engine manual for correct torque and sequence).
7. Retorque wheel drive hydraulic motor shaft nut to 200-250 ft. lbs (271 to 339 Nm).

MAINTENANCE OF THE ENGINE COOLING SYSTEM

Engine cooling is accomplished by the flow of air over the cylinder and head cooling fins. The combination fan and flywheel draws air in through the motor grill, directs it over the engine and out through openings on the side.

ATTENTION! Keep all cooling fins clean at all times. Use an air hose, if available, to clean the cooling fins of all dirt, lint, oil, etc. A dirty engine with clogged fins is the greatest single cause of overheating and engine damage. (If air will not clean fins, use steam cleaning.)

ATTENTION! Never operate the engine with any of the engine shrouding removed. This shrouding is designed to circulate the air correctly over the engine and provide even cooling of all parts.

ENGINE OIL SELECTION

Use a good quality heavy-duty oil with the new API "SE" designation. (Do not use an oil with DS designation). When adding oil between changes, always use same brand of oil. Use the proper grade oil for the expected temperature range to be encountered: (Straight weight oils are recommended, but if not available, multi-viscosity oils can be used).

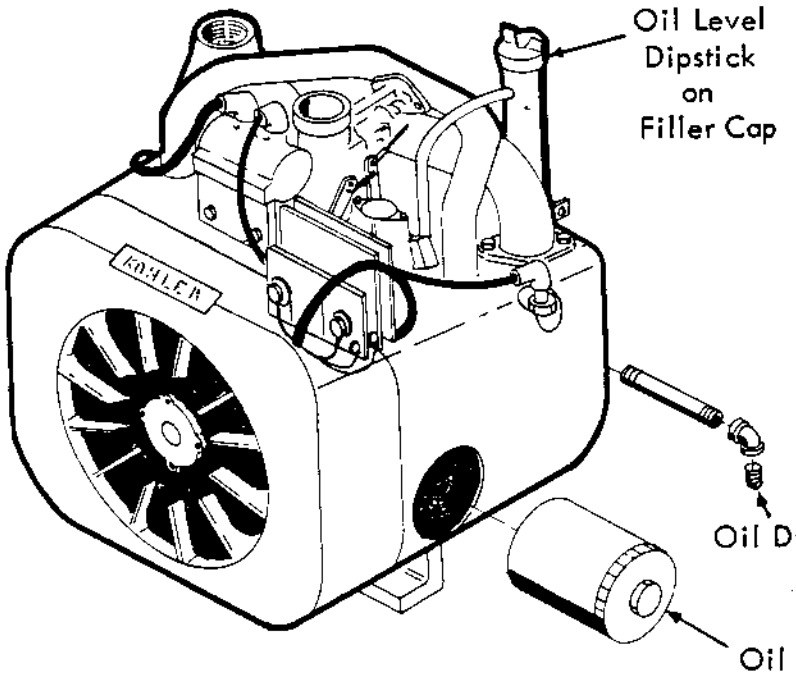
TEMPERATURE	GRADE
Below 0° F (-18° C).	SAE 5W-20 or 5W-30
0° to 30° F (-18° to -1°C). . .	SAE 10 or 5W-30, 10W-30, 10W-40
30° to 90° F (-1° to 32°C) . .	SAE 30 or 10W-30, 10W-40

CHANGING ENGINE OIL

CHECK ENGINE OIL LEVEL DAILY.

CHANGE ENGINE OIL EVERY 100 HOURS under normal operating conditions (if environment is extremely dusty - change oil every 50 hours).

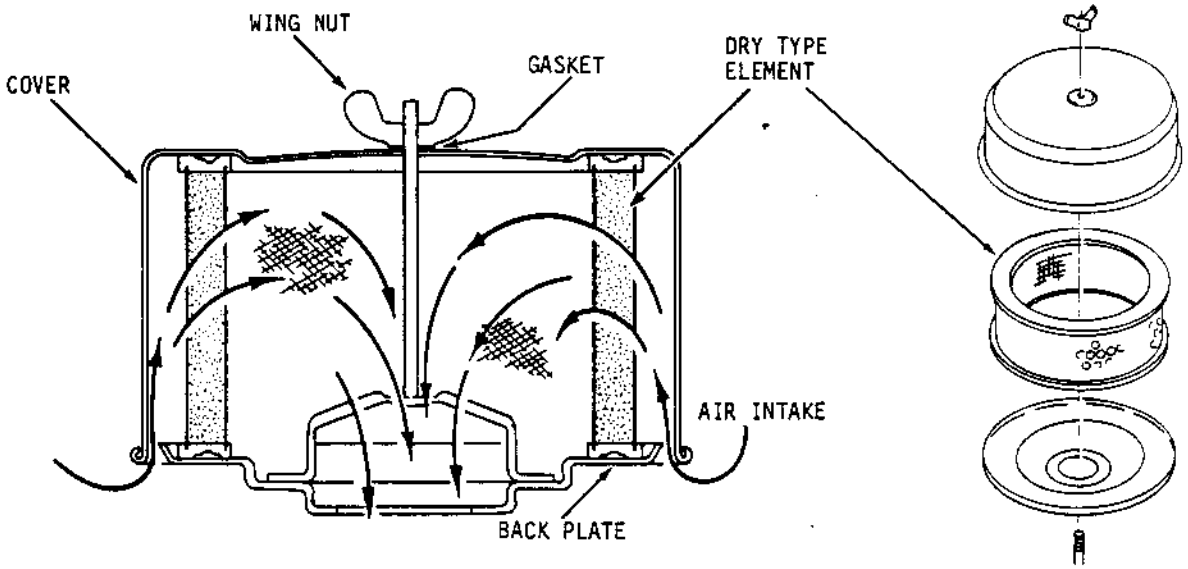
Engine oil should always be drained when the engine is warm. Remove the crankcase pipe plug to drain engine oil.



Engine crankcase oil capacity is three quarts, (plus a small additional amount for the oil filter). Fill engine crankcase to the "Full" mark on the dipstick.

SERVICING ENGINE AIR INTAKE CLEANER

The importance of maintaining an air cleaner in proper condition cannot be overemphasized! Dirt induced through improperly installed, improperly serviced or inadequate elements, wears out more engines than does long hours of operation. Even a small amount of dirt will wear out a set of piston rings in just a few hours. Furthermore, operating with a clogged element causes the fuel mixture to be richer which can lead to formation of harmful sludge deposits in the engine. Always cover air intake when air cleaner is removed for servicing. Do not neglect servicing air cleaner at recommended intervals 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.



Under normal operating conditions, disassemble and service air cleaner components every 50 hours of operation. Do this more frequently (even daily) if extremely dusty or dirty conditions prevail. The dry type element is cleaned by gently tapping on a flat surface -- when doing this, be careful not to damage gasket surfaces on element. Do Not attempt to clean dry type elements in any liquid or with compressed air as this will damage paper filter material. Wipe dirt or dust accumulation from cover and base plate.

Dry type elements should be replaced after each 100 to 200 hours -- replace at 100 hours if engine is operated under dirty conditions -- replace every 200 hours under good clean air conditions. Replace element sooner if engine loses power due to clogged filter.

Handle new element carefully -- do not use it if gasket surfaces are bent or twisted. Not only must the right filter be used but it must be properly installed to prevent unfiltered air from entering the engine. Gasket surfaces of element must be flat against cover and base plate to seal effectively. Wing nuts must be firmly tightened with fingers -- do not overtighten by using pliers. Check rubber gaskets under air cleaner base and wing nut.

ENGINE ALTERNATOR

The engine on this machine is equipped with a flywheel alternator. To avoid damage to the alternator, please observe these rules:

1. Do not operate engine without connection to battery.
2. The negative post of the battery must be connected to ground, or the alternator will be damaged.
3. When using a battery charger, disconnect both battery cables from battery.
4. If it is necessary to do any arc welding on the machine, disconnect both battery cables first.
5. If a booster battery is used to start the machine, connect batteries positive-to-positive and negative-to-negative.

ENGINE SPEED

The engine operates at a constant, factory-set governor-controlled engine speed.

ATTENTION! Engine speed should never be set higher. If engine speed exceeds factory-set speed, the hydraulic pump may be damaged.

The engine throttle control must be set at full throttle whenever operating the machine. Recommended engine speed is 2500 to 2550 rpm at full throttle, side brush on and down, main brush up (for machines modified for grade climbing, (2750 to 2850 rpm). Idle speed: 1500 to 1600 rpm.

OUT-OF-SERVICE PROTECTION FOR ENGINE

Protect an engine that is to be out-of-service for more than 30 days as follows:

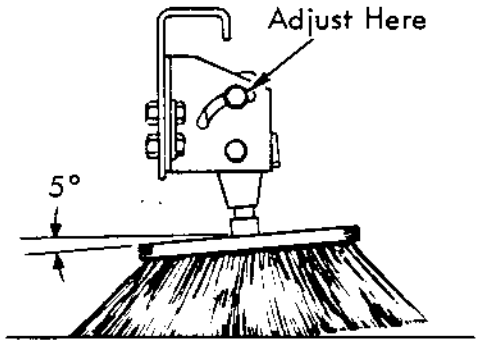
1. Run engine until thoroughly warm.
2. Turn off fuel supply and run until engine stops.
3. Drain oil while still warm. Refill and attach a warning tag stating oil viscosity used.
4. Remove each spark plug. Pour one ounce (0.03 liters) of rust inhibitor (or SAE #50 oil)into each cylinder. Crank engine slowly (by hand) several times. Install spark plugs.
5. Service air cleaner.
6. Clean governor linkage and protect by wrapping with a clean cloth.
7. Plug exhaust outlet to prevent entrance of moisture, dirt, bugs, etc.
8. Wipe entire unit. Coat rustable parts with a light film of grease or oil.
9. Disconnect battery and follow standard battery storage procedure.

SIDE BRUSH ADJUSTMENTS

Brush Height Adjustment

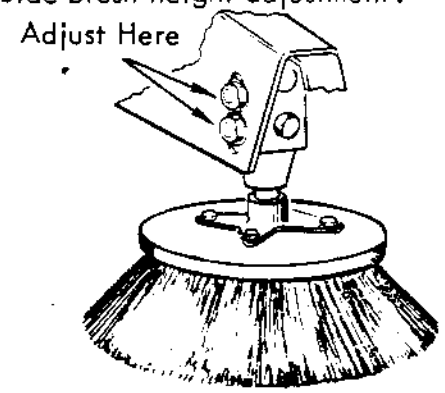
Height adjustment has been made at the factory. However, if you replace the lift cable, be sure to adjust the cable length properly. Proper cable adjustment should allow the full weight of the brush unit on the floor when brush lift lever is in "Down", or sweeping position -- but sufficient cable tension to allow clearance off the floor when the brush unit is lifted and not used for sweeping. (See sketch.)

Brush Contact Angle -- should be adjusted as indicated in sketch. Approximately five degrees is the angle normally used. Special conditions may require changing the brush angle.



Side brush angle adjustment
(Standard - Not Hi-Dump)

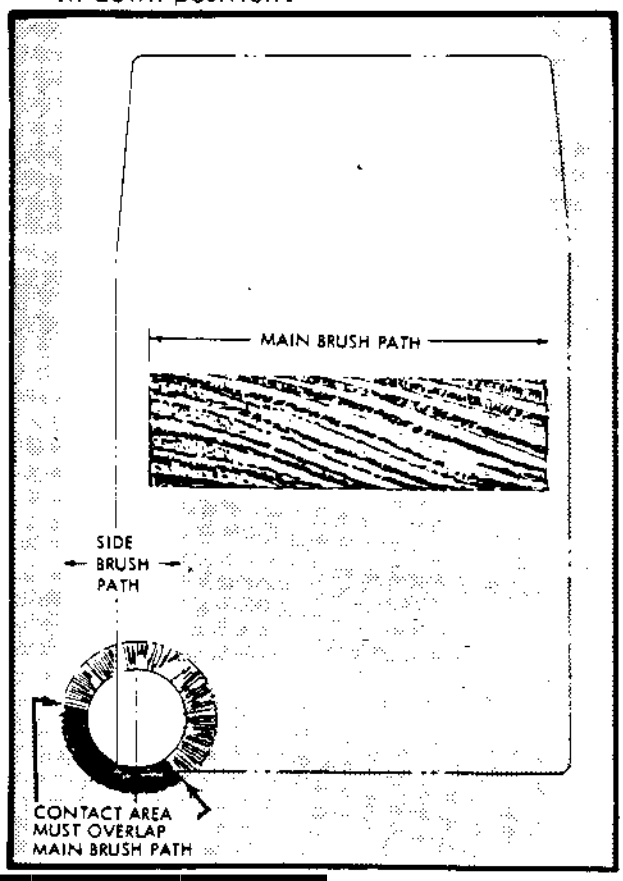
Side brush height adjustment.



About 1/2 to 2/3 of brush should be in contact with floor when brush is in down position.

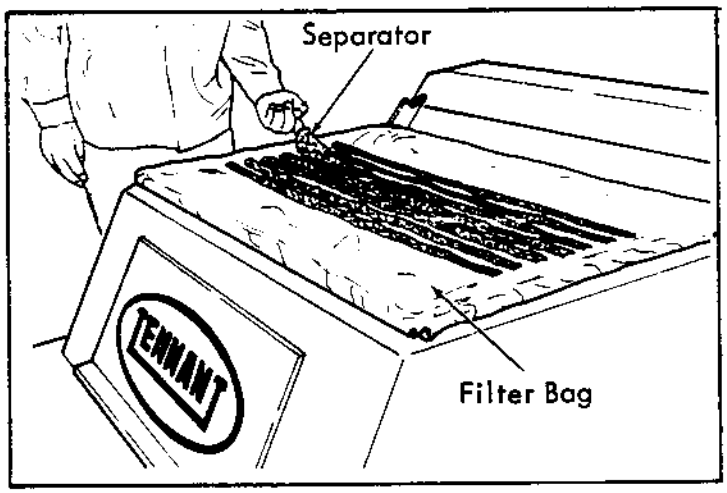
NOTE

Side brush mounting shown here is for Standard machine. Hi-Dump machine side brush is mounted differently, but slots are provided for height and other adjustments. The angle adjustment is fixed on Hi-Dump machines.



TO REMOVE AND REPLACE FILTERS

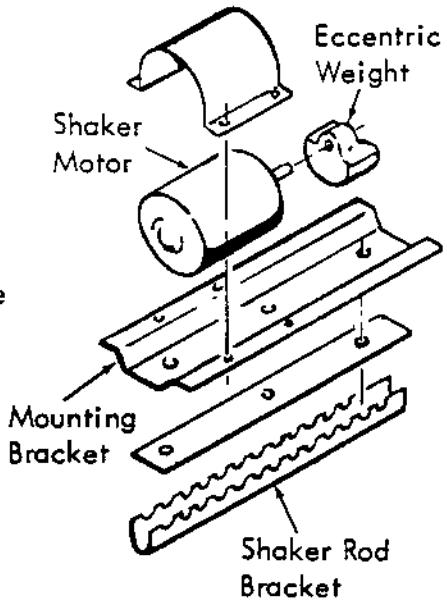
1. Push shaker button to clean filters.
2. Remove filter box cover.
3. Lift out filter complete with filter rack.
4. Replace filter and all other parts in same position as they were originally installed. Be sure all parts are assembled compactly and neatly in place to prevent leakage around cover.

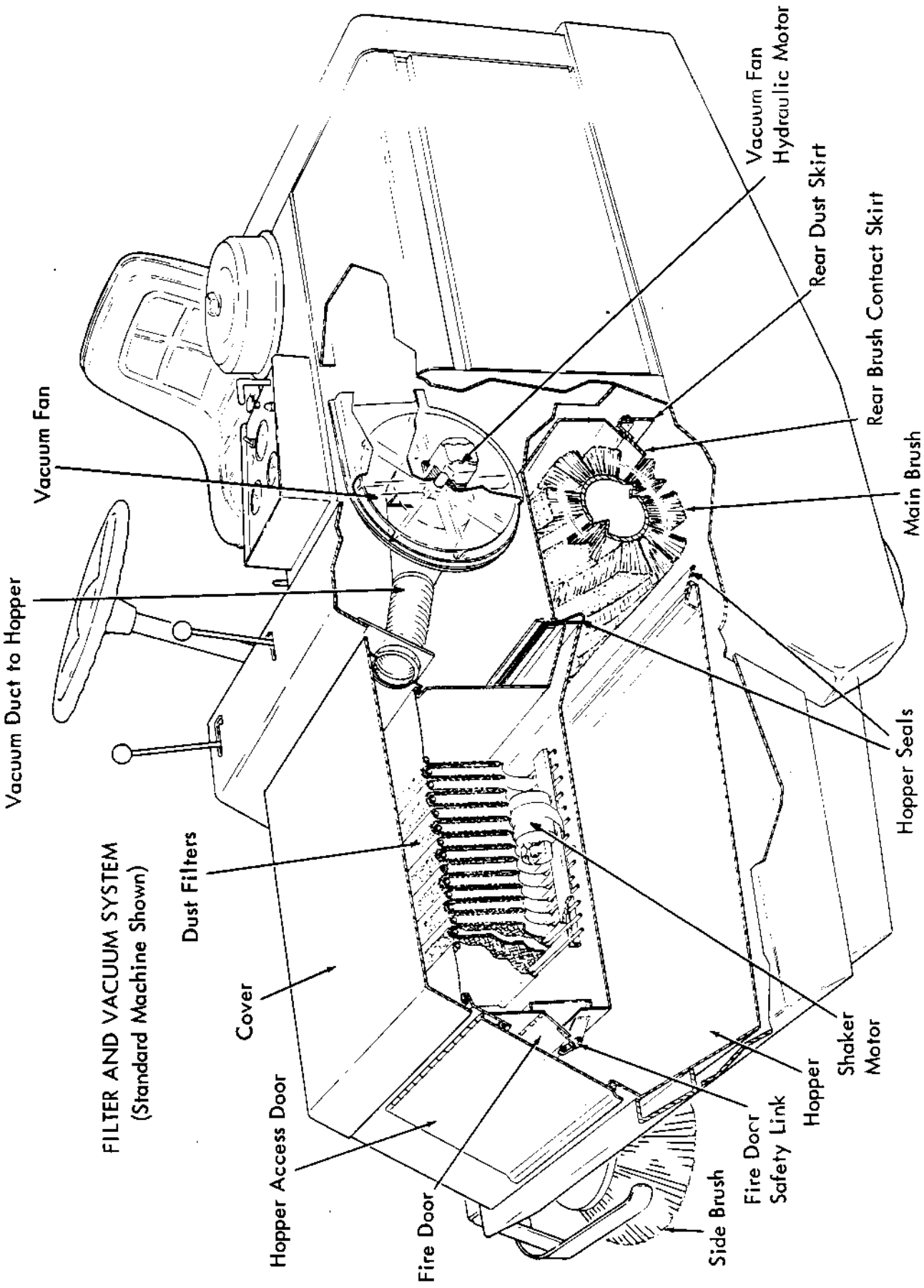


When replacing new or cleaned Filter bag, make sure that the Separators are in place between filter bag envelopes.

FILTER SHAKER MOTOR REPLACEMENT

As shown in the drawings, the shaker motor is mounted at the bottom center of the filter bags. The motor is attached to its bracket by a strap which fits over the motor. The motor and bracket are attached to the rods which pass through the bottom edges of the filter bags. An eccentric weight, attached to the motor shaft, provides the vibration for shaking the filter bags.





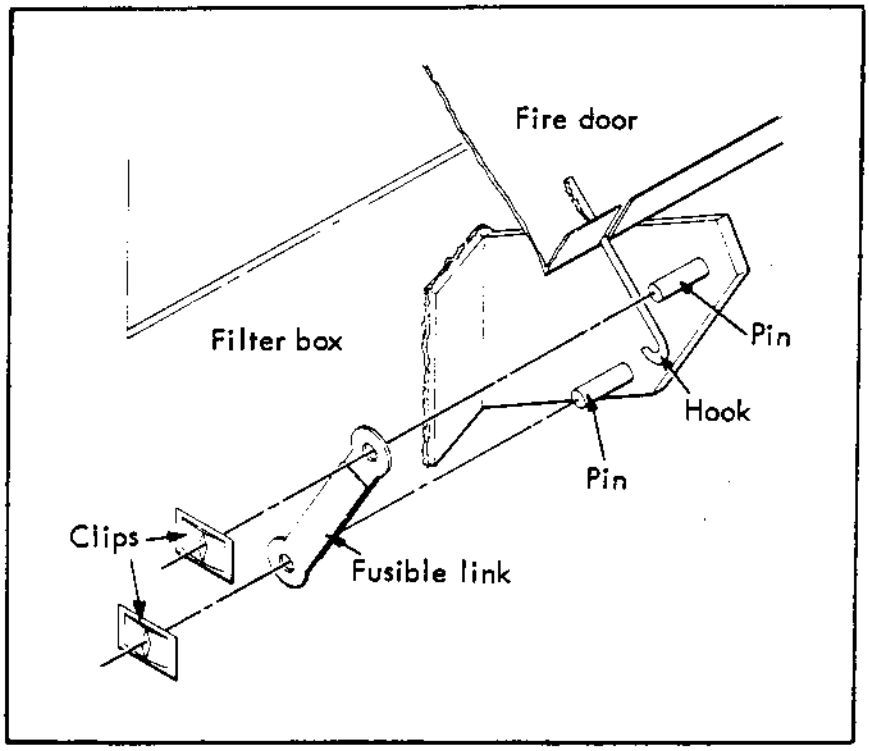
FUSIBLE LINK REPLACEMENT

NOTE The filter system in your sweeper is protected, in the event of a fire in the hopper, by a fusible link. This will automatically prevent the passage of air through the filter system if the temperature exceeds the limit of the fuse.

If loss of dust control is noticed, check the fusible link for breakage or failure due to heat. On the standard machine, the fusible link is accessible through the hopper front access door.

On Hi-Dump machines, the fusible link is accessible through the hopper dump door opening.

To replace the link, engage hook on fire door with body of link, and slide link onto pins, hold link in place with clips.



FUSIBLE LINK REPLACEMENT
(Standard Machine Shown)

ATTENTION! If fire door is closed because of link breakage, or if the door opening is clogged with debris, hydraulic oil over-heating will result.

TO REMOVE SWEEPING HOPPER (Standard Machine)

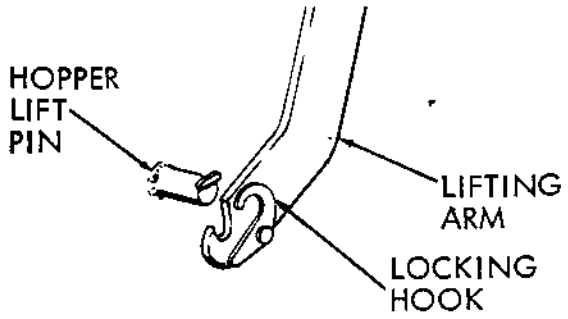
1. Start engine.

2. Raise hopper all the way.

⚠WARNING Engage mechanical safety lock on hopper lift arm.

3. Place dolly (accessory) under hopper. (If dolly is not available, block up hopper).

4. Swing open locking hooks which hold hopper lifting pins to the lift arms (see sketch).



5. Raise the hopper, disconnect lift arm safety lock, and lower hopper onto dolly. Stop the engine. Place hydraulic control in "OFF" position. Push down hopper lift arms until they clear the hopper lift pins.

TO REMOVE HI-DUMP HOPPER

1. The hopper should be supported off the floor.

2. Disconnect the filter shaker motor lead at the point where it enters the hopper (bottom of hopper near side brush).

3. Pull pin at rod end of rollout cylinder (both sides).

4. Remove two bolts which attach right and left torque shaft to hopper.

5. Disconnect the door latch chains (at clevis pin).

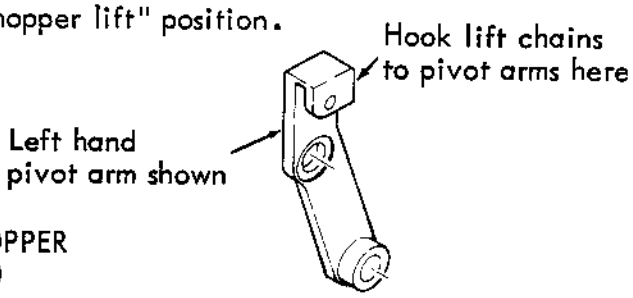
6. Pull torque arms out of hopper.

7. Remove hopper.

MANUAL METHOD OF RAISING HI-DUMP HOPPER

If it is necessary to raise the hopper and the hydraulic pump is not operating, use an overhead chain hoist to lift the hopper, as follows:

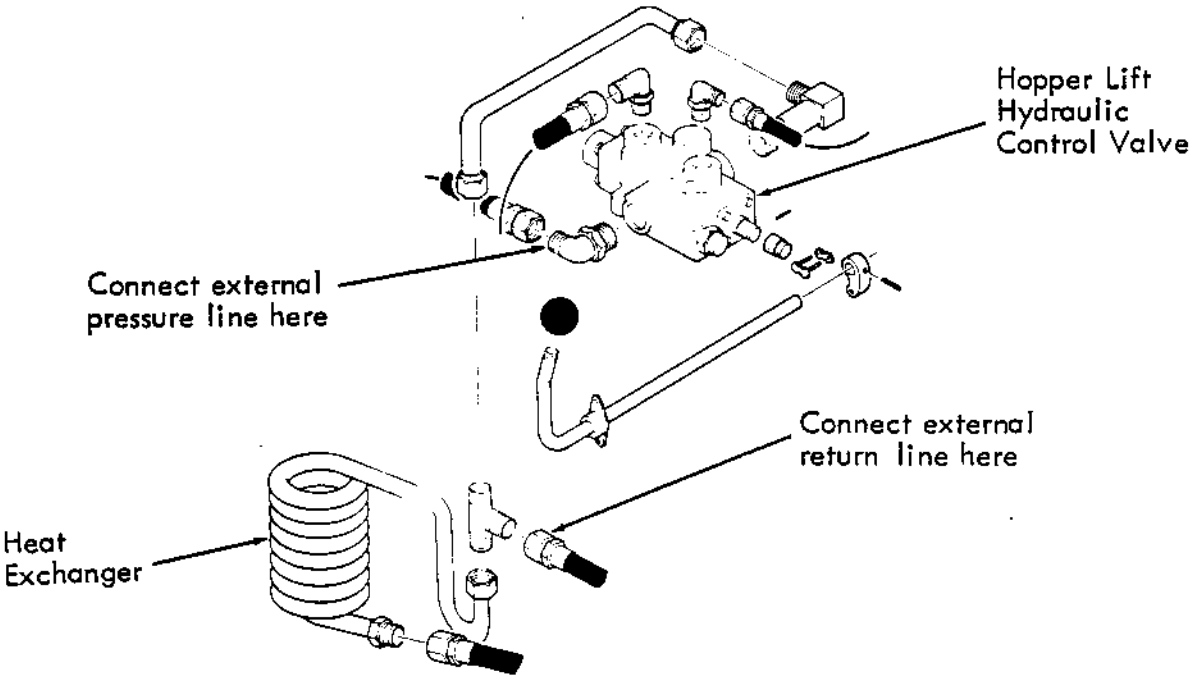
1. Hook the chain to the left and right front pivot arms on the hopper lift arms.
2. Place the hydraulic control valve handle in "hopper lift" position.
3. Use the chain hoist to raise the hopper.
4. Use the safety arm to support the hopper.



HYDRAULIC METHOD OF RAISING HI-DUMP HOPPER (USING EXTERNAL HYDRAULIC POWER SOURCE)

If the machine hydraulic pump is not operating, and it is desired to raise the hopper, it is possible to hook up an external hydraulic power source to provide pressure for raising the hopper.

1. Use a hydraulic pump capable of from one to 10 gpm (39 L/min). The machine hydraulic valve contains a built-in relief valve set at 1900 to 2100 psi (13,100 to 14,480 kPa).
2. Connect the external source pressure line to the machine at the "in" port of the hydraulic valve as shown in the drawing at point "A".
3. Connect the external source return line at point "B" at the upper connection to the heat exchanger.
4. You can now raise the hopper and roll it out if desired. Be sure to use the safety arm to support the hopper before working under it.



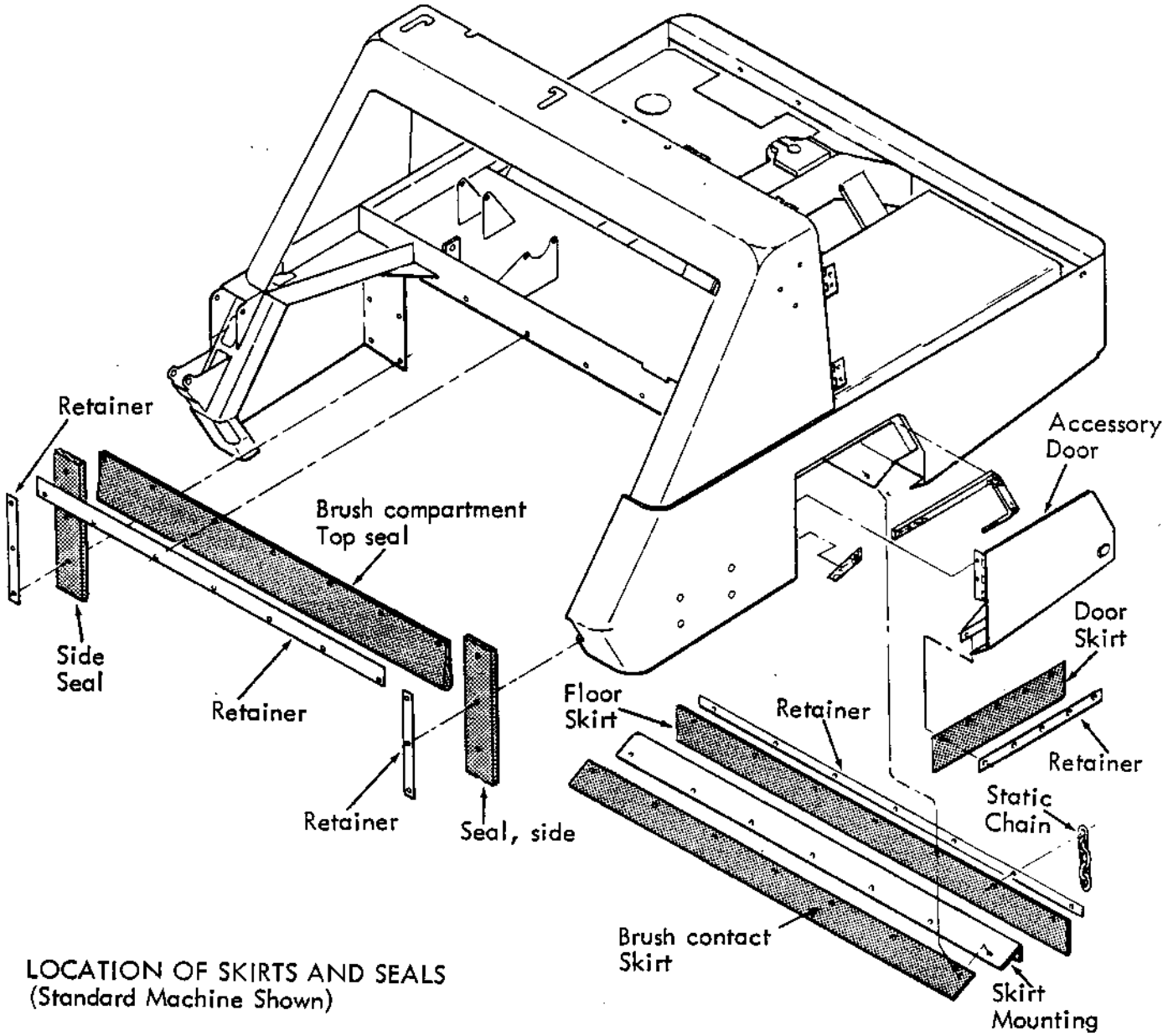
STATIC DRAG CHAIN

A static drag chain is provided to prevent the build-up of static electricity in the machine. This chain is attached below the machine frame.

Check the chain periodically for wear. Make sure that it is making contact with the floor at all times.

DUST SKIRTS AND SEALS

All dust skirts have slotted screw openings to provide adjustment for skirt clearance from floor. This clearance should be adjusted to allow .125"(3.2 mm) between skirt edge and floor (operator is not on machine). Be sure when making this, or other floor clearance adjustments, that you have machine on a level surface. Inspect seals occasionally and replace if worn or damaged.

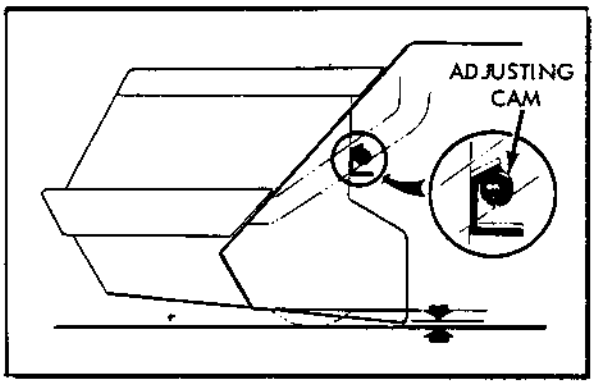


LOCATION OF SKIRTS AND SEALS
(Standard Machine Shown)

STANDARD MACHINE HOPPER CLEARANCE ADJUSTMENT

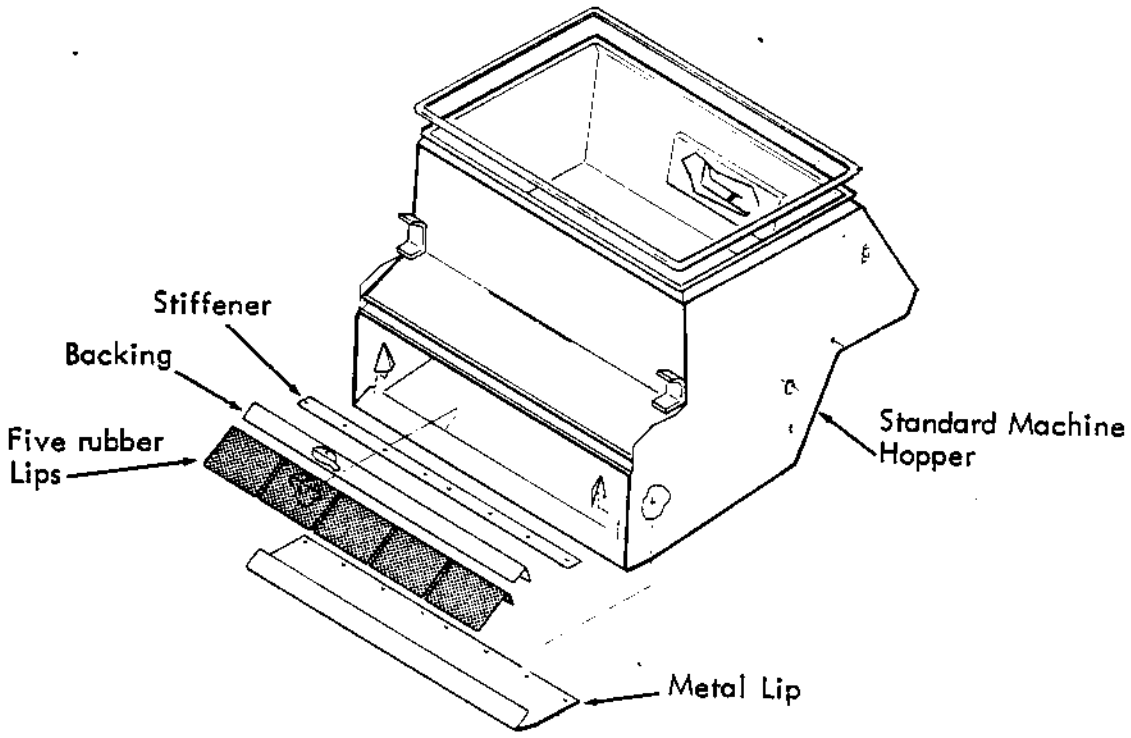
The hopper has been factory adjusted so that it is level and has the correct clearance from the floor. If the hopper is out of adjustment, or is replaced, you can adjust horizontal leveling by turning eccentric adjusting cams on lift arms (see sketch). Make adjustments with the hopper empty.

The metal lip should be .75" to .87" (19 to 22 mm) from the floor.



HOPPER LIP REPLACEMENT

Both the Standard machine and the Hi-Dump model hoppers have five replaceable rubber lips which should be checked occasionally and replaced if worn or damaged.



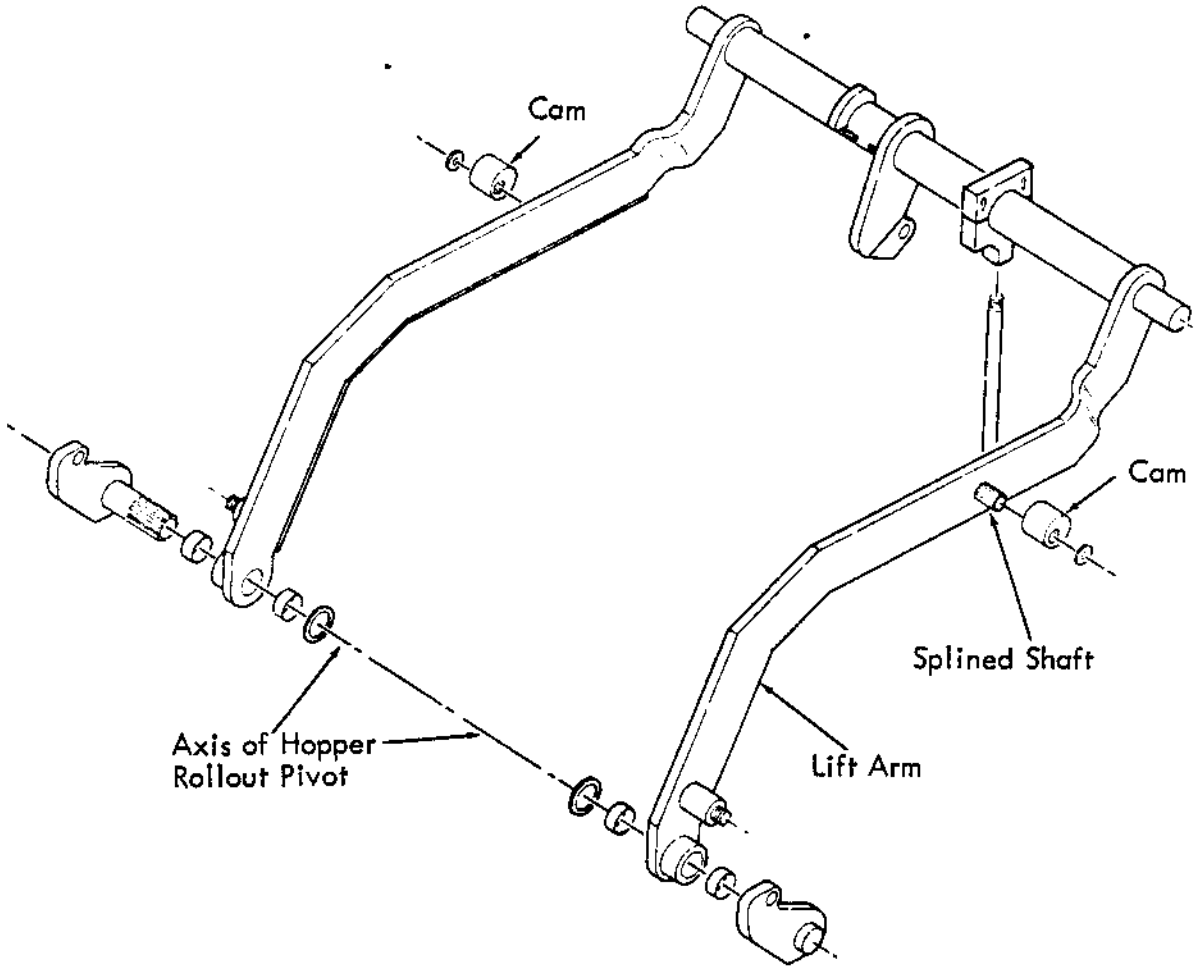
HI-DUMP MACHINE ADJUSTMENTS

The following are factory adjustments which should be necessary only if the hopper, lift arms, or other parts have been replaced or repaired. The adjustments should be performed in the following order:

HOPPER LIFT ARM ADJUSTMENT

1. The axis of the hopper rollout pivot should be 6.625" ± .125" (168.3 mm ± 3.2 mm) from the floor (both sides).

2. When the hopper is at the required dimension, adjust the two cams on the main lift arms so that they contact the front, sloping edge of the main frame. The cams are mounted on splined shafts and, once they are adjusted, should not require readjustment.



MAIN LIFT CYLINDER

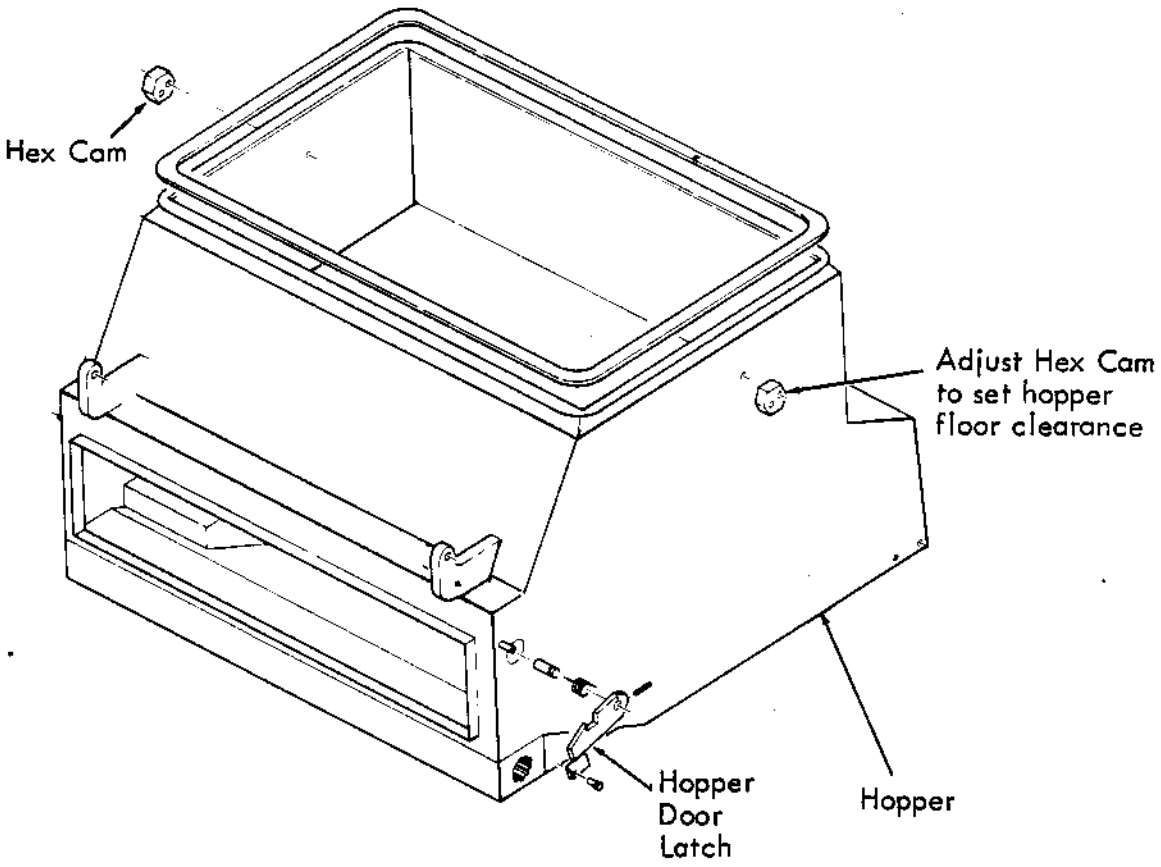
1. After the lift arm has been adjusted as described above, adjust the clevis on the main lift cylinder so that the cylinder is fully retracted. To do this, loosen the jam nut on the cylinder piston rod, then turn the rod by means of a pin inserted through the hole in the rod.

HOPPER ADJUSTMENT FOR FLOOR CLEARANCE

1. After performing the adjustments described above, disconnect the rollout cylinders at their lower pivot point.

2. Level the hopper and position it so that the rear hopper bottom is 3" ± .125" (76.2 mm ± 3.2 mm) from the floor.

3. At this point, adjust the hex cam (one on each side of the hopper) so that they make contact with the top surface of the main lift arms.



ROLLOUT CYLINDER ADJUSTMENT

After above adjustments are completed, adjust the rollout cylinders as follows: Retract the cylinders completely. Then adjust each cylinder clevis until the .75" (19mm) dia. pin can be inserted through the clevis and torque arm. Lock the clevis in place with the jam nut.

SPEED LIMITER ADJUSTMENT

Adjust the speed limiter cam position so that it restricts forward speed to 1.5 - 2 mph (2.4 to 3.2 km /hr) when the hopper is raised to any point over 36" (914.4 mm) from the floor.

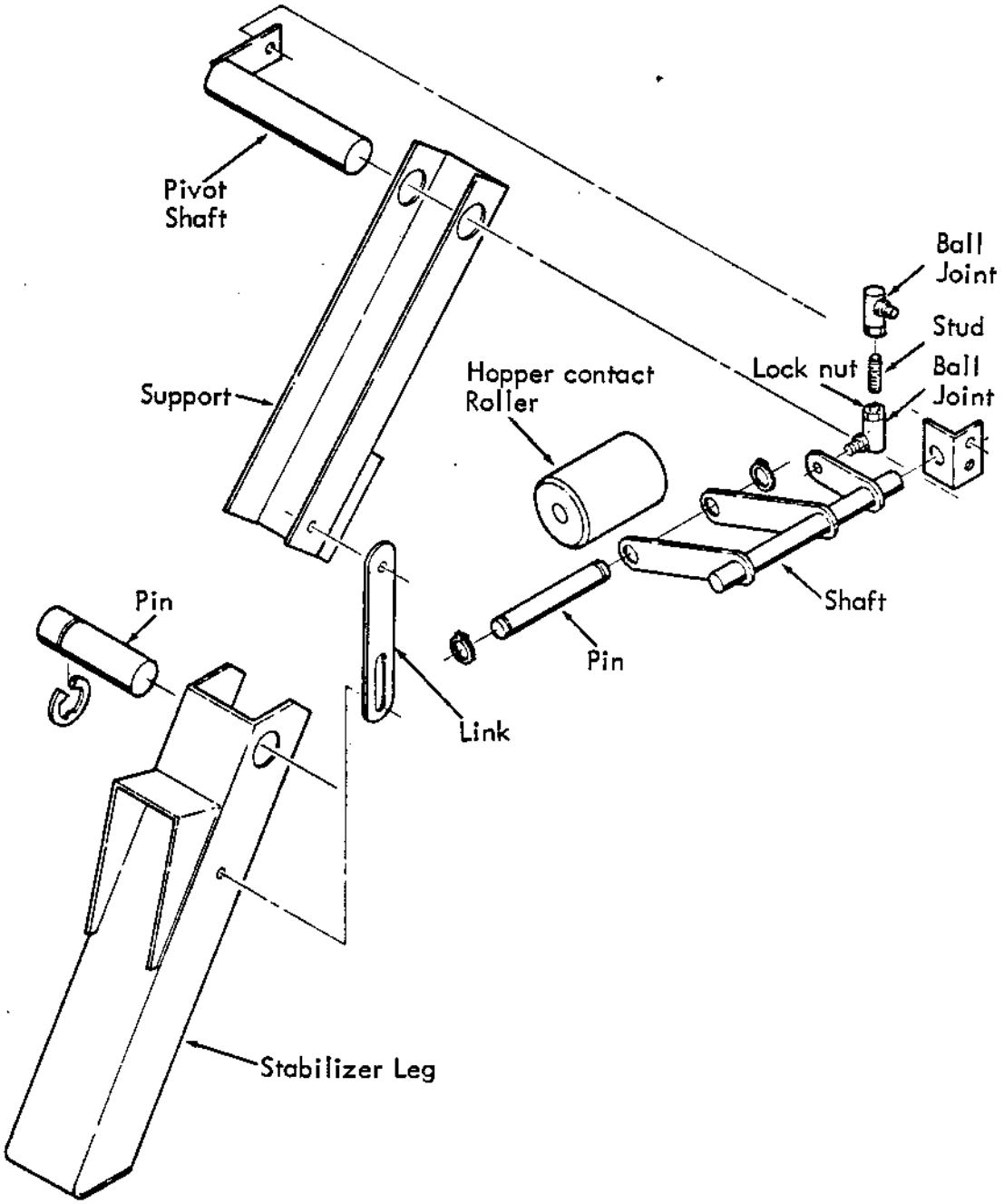
HI-DUMP HOPPER DOOR LATCHES ADJUSTMENT

A. The latching bracket should be shimmed so that when the door is slammed shut, the latches will fully engage and hold the door closed tightly.

B. When the hopper is fully raised and rolled in, the latches should be fully engaged. Adjustment is made by means of eye-bolts at end of each chain. The latches should release at the same time.

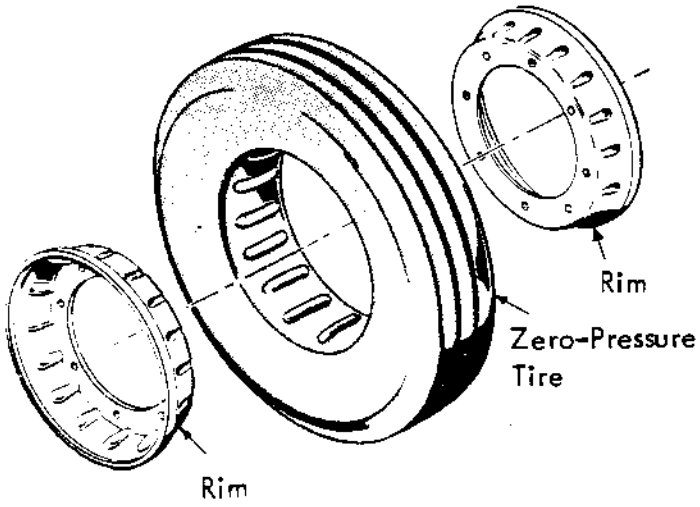
HI-DUMP MACHINE STABILIZER LEG ADJUSTMENT

When the Hi-Dump hopper is down, the stabilizer leg should be tucked up inside of bumper and not exposed. Adjustment is made by turning stud between ball joints. After adjustment is made, tighten lock nut on stud.

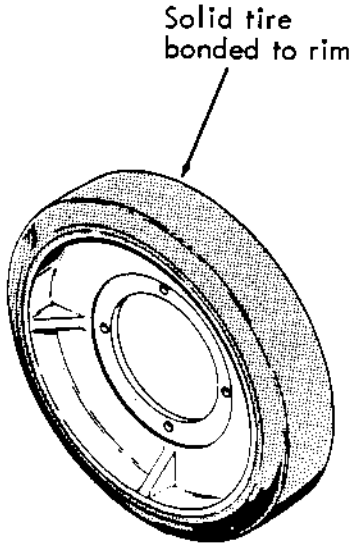


REPLACING FRONT WHEELS OR TIRES

1. Raise and block up front of machine.
2. Raise or remove hopper. (If hopper is raised, use safety arm.)
3. Remove bolts attaching tire and rim assembly to hub.
4. Remove old tire and rim assembly.
5. Standard Machine: Front tires are zero-pressure tires, clamped between two rims. The rims are shaped to fit the tires - do not pound on them when replacing tire.
   Hi-Dump Machine (and Standard Machine equipped with scrubber): Front tires are solid and are bonded to their rims. Both tire and rim must be replaced together.
6. Install tire and rim assembly on wheel hub. Tighten mounting bolts to 85 to 95 foot pounds (115 to 129 Nm).



Standard machine front tire and rim assembly

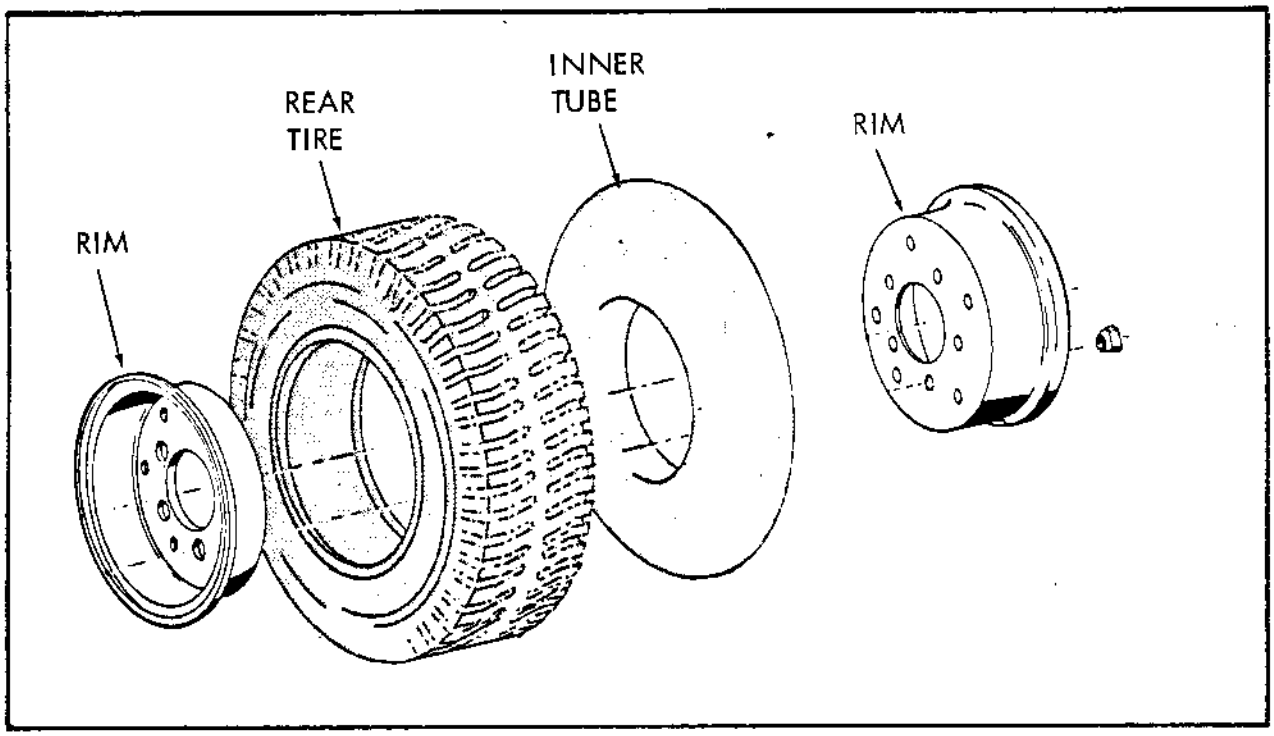


Hi-Dump machine (and scrubber) front tire and rim assembly

REPLACING REAR WHEEL OR TIRE

⚠WARNING Deflate tire before separating tire rim halves to reduce the chance of the rim halves separating uncontrolled.

1. Raise and block up rear of machine.
2. Remove wheel from hub.
3. Remove bolts holding wheel rims together. Separate rims.
4. Replace tire and/or tube.
5. Bolt rims together. Inflate tire to 80 to 85 psi (552 to 586 kPa) - Sweeper; 70 to 75 psi (483 to 517 kPa) - Scrubber.
6. Bolt wheel to hub.



TO REPLACE SIDE BRUSH LIFT CABLE

1. Remove old cable by disconnecting lower and upper cable ends. Lower cable end has clevis and pin located just in front of front wheels. Remove lower cable end first.

2. Upper cable end is threaded through adjusting nuts. Remove adjusting nuts from upper cable end to free cable.

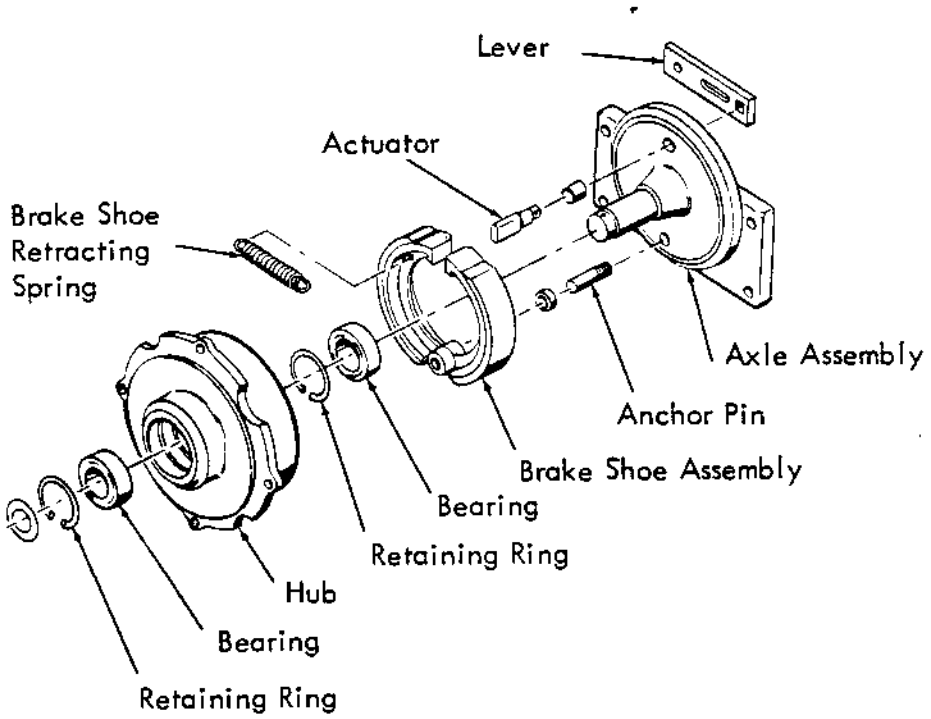
   NOTE Adjust cable, loosening adjusting nut at upper cable end.

TO REPLACE FRONT WHEEL BRAKE SHOES

1. Raise machine and block up securely.
2. Remove retaining ring and washer on axle.
3. Remove wheel and hub.

ATTENTION! Keep wheel bearings clean.

4. Disconnect and remove brake shoe retracting spring.
5. Remove brake shoes.
6. Inspect brake shoe actuator for wear and replace if necessary.
7. Clean brake assembly and brake drum.
8. Position new brake shoes on anchor pin and install shoe retracting spring.
9. Position wheel on axle and install washers and retaining ring.



BRAKE ADJUSTMENT

The mechanical, drum-type front wheel brakes are operated by a foot pedal, and also by a handbrake lever for parking.

To Adjust Brakes

1. Raise and block up sweeper so that the front wheels are off the floor. Raise hopper and engage safety lock.
2. Adjust the brakes by turning the adjustment rod for each wheel (see drawing). Adjust each rod an equal amount.
3. Check to be sure brake shoes are not dragging by spinning each wheel.
4. Periodically, use air hose to blow dirt from between brake shoes and wheel. A hole is provided for this purpose on the outside of the machine next to each wheel.

HYDRAULIC SYSTEM

This TENNANT Sweeper is equipped with a hydraulic drive system. The propelling pump is a variable displacement piston type which drives a hydraulic motor mounted at the rear wheel.

The accessory pump is a vane-type pump which drives the main and side brush motors and the hopper dump cylinder. It is mounted in tandem on the propelling pump.

The hydraulic pumps and motors require no periodic maintenance; BUT MAKE SURE hydraulic oil level is adequate and that oil is clean.

The hydraulic tank has a capacity of five gallons. (System capacity is 6.5 gal (24.6 L) An external in-line filter is provided. For average operating temperature up to 90°F(32°C), use TENNANT Hydraulic Fluid 32397 (10W-40). For ambient temperature above 90° F (32°C), use TENNANT 32398 (20W-60).

The "Hydraulic Components" Section of this manual gives parts breakdowns and service information for the pumps and motors used in this machine.

RECOMMENDED HYDRAULIC OIL

TENNANT Hydraulic Oil is recommended for use in your machine.

TENNANT Hydraulic Oil is specially compounded with the following features not found in many hydraulic oils:

1. FLAT VISCOSITY CURVE
2. Additives to prevent corrosion
3. Additives to prevent oxidation
4. Rust inhibitors
5. Foam suppressors

TENNANT Hydraulic Oil Viscosity Specifications

	Tennant No. 32397 (10W40)	Tennant No. 32398 (20W60)
SUS 100°F(38°C)	404-445	940-1010
SUS 210°F(99°C)	78-84	122-130

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

TENNANT Hydraulic Oil, part 32397 , is 10W40 hydraulic oil. TENNANT Hydraulic Oil, part 32398 , is a 20W60 hydraulic oil.

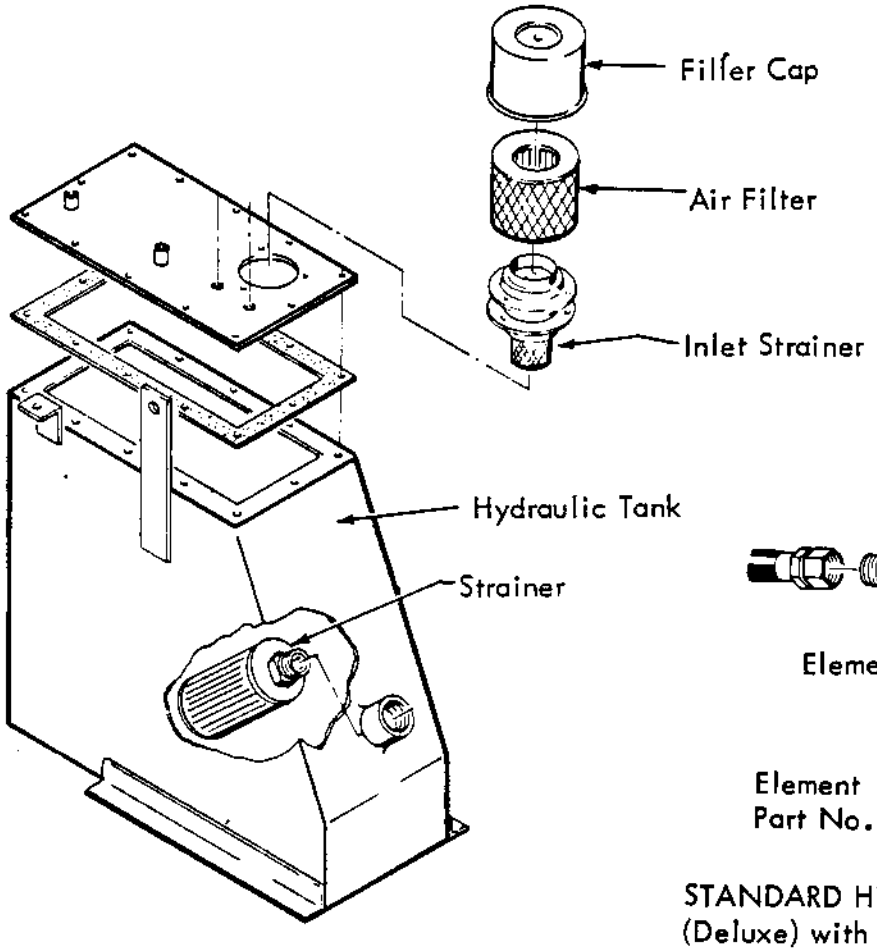
TENNANT Hydraulic Oils have a very flat viscosity curve (synonymous with "high viscosity index"). The flat viscosity curve means that the thickness of the oil is quite constant over wide temperature ranges.

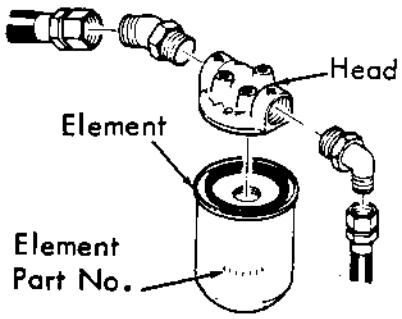
ATTENTION! If you prefer to use a locally available brand of hydraulic oil, or if you have standardized on one brand of oil for all machines, the hydraulic oil used must match closely the specifications of TENNANT Hydraulic Oil listed above. Do not use automatic transmission fluid.

TO CHECK HYDRAULIC OIL LEVEL AND REFILL TANK

The hydraulic tank filler cap is located under the engine cover. To check oil level, remove the filler cap (the cap covers an air filter). Hydraulic oil must be visible in the filler screen -- if not, add oil to tank to bring level up to the required point. Capacity of hydraulic tank is 5 gal (19 liters); system capacity is 6.5 gal (24.6 liters).

ATTENTION! Before filling tank, always clean the filler cap and the area around the cap. Use a funnel with 200-mesh screen and container for the hydraulic oil. 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.



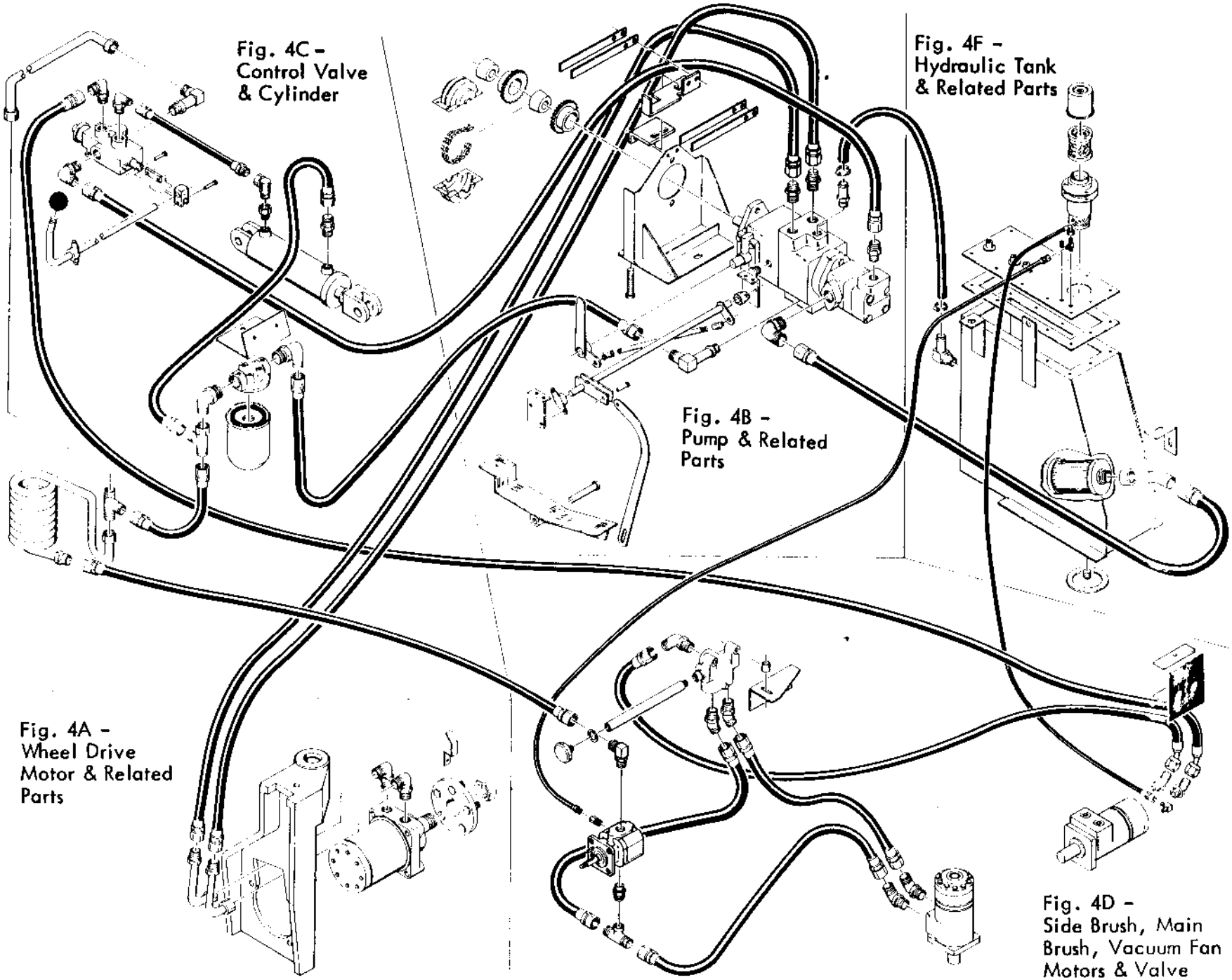


STANDARD HYDRAULIC OIL FILTER (Deluxe) with spin-on element.

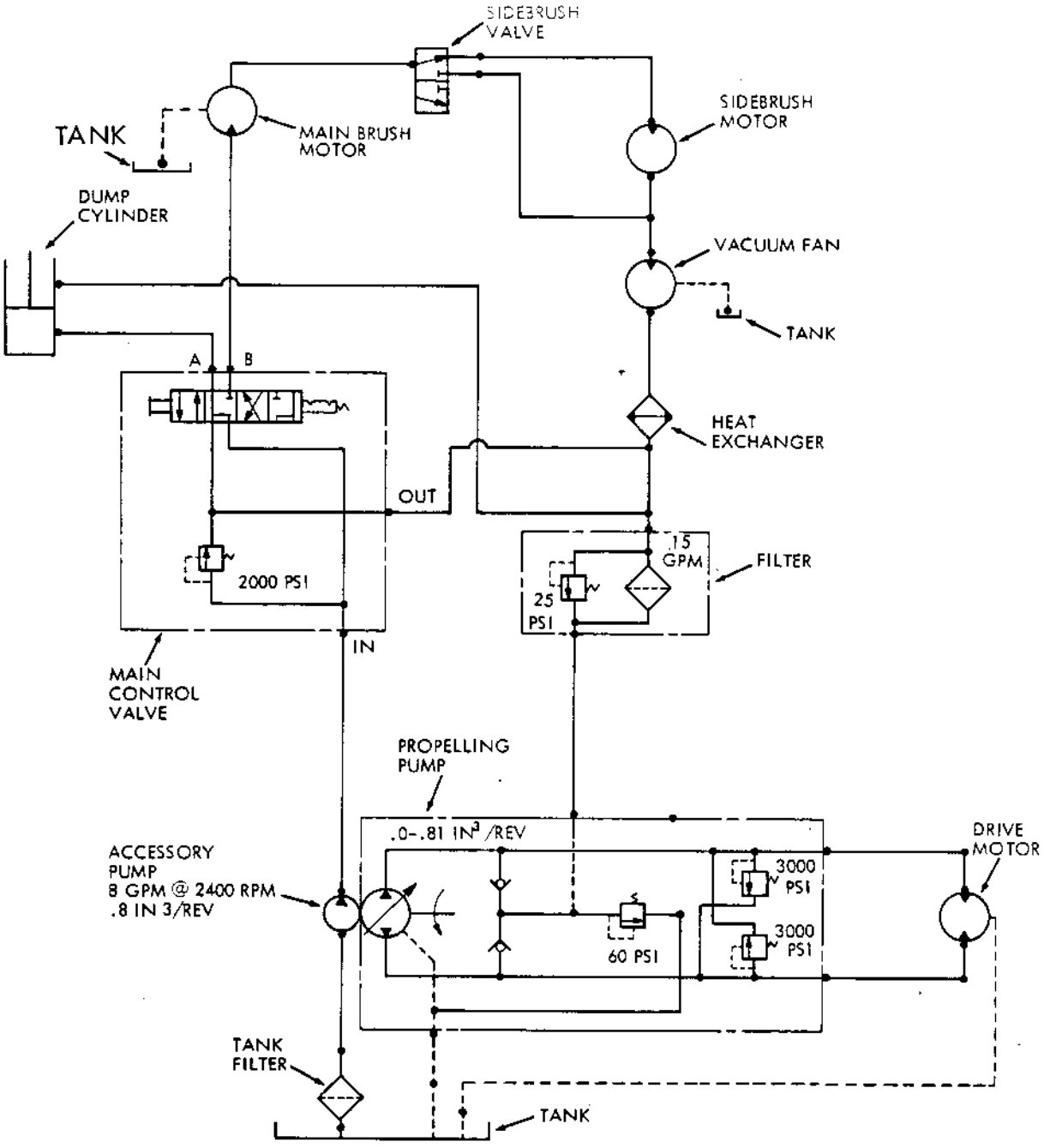
CHANGING HYDRAULIC OIL FILTER

Change hydraulic oil and replace oil filter element after every 500 hours or operation. The hydraulic oil filter is located below the engine compartment cover.

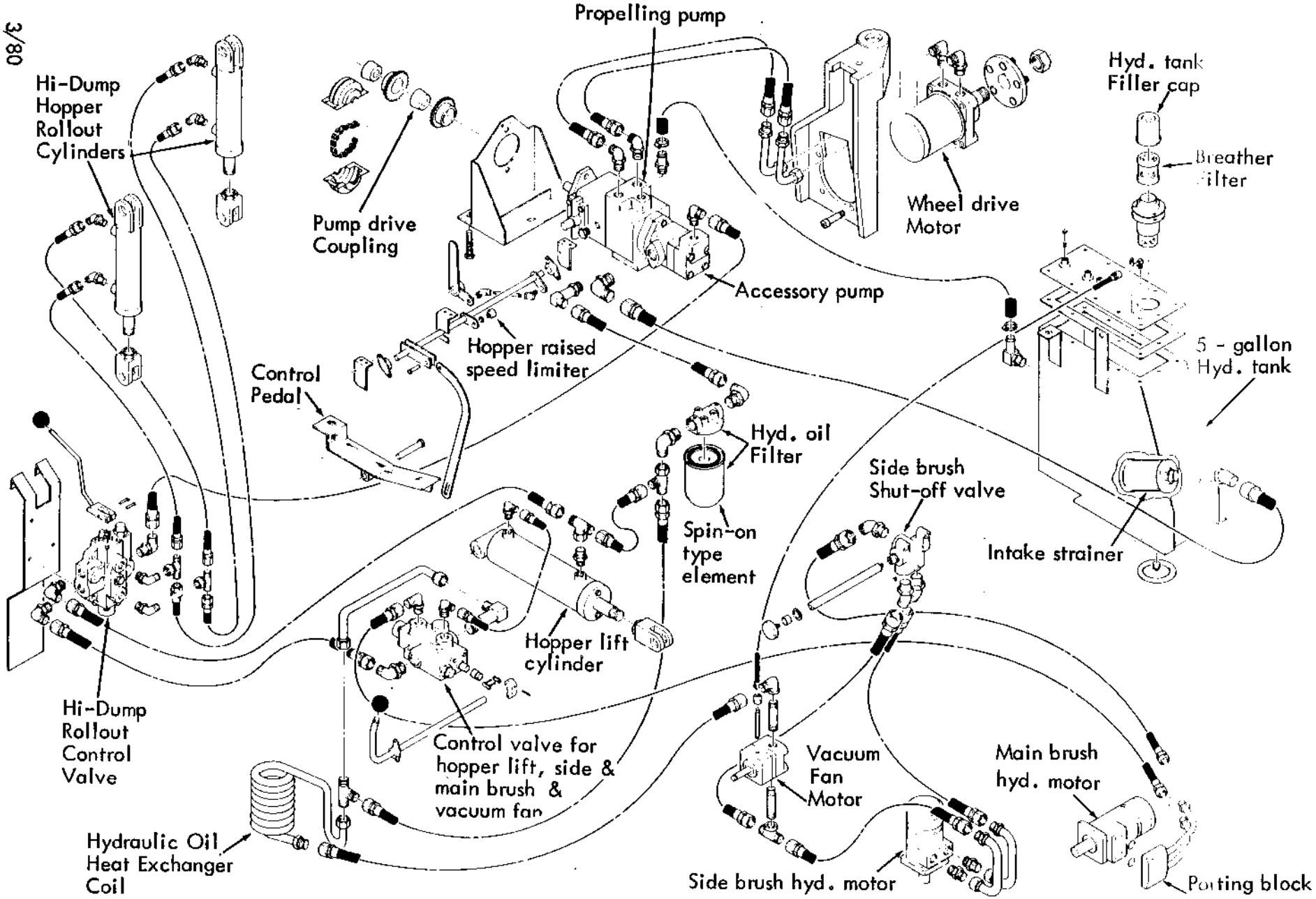
NOTE Several different makes of hydraulic filters are used, check for correct part number on the element.



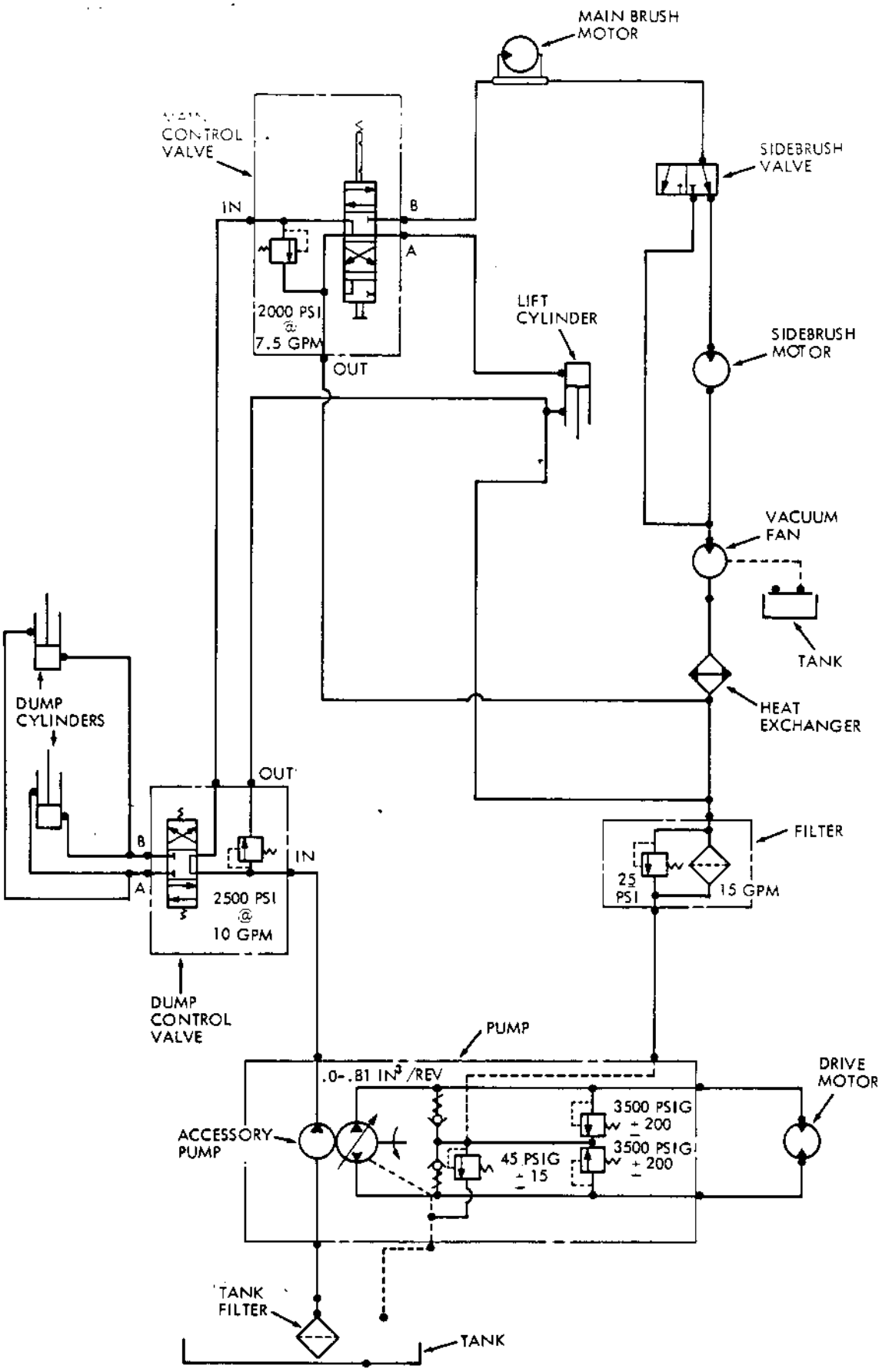
MODEL 240 STANDARD SYSTEM PICTORIAL



MODEL 240 STANDARD HYDRAULIC SCHEMATIC



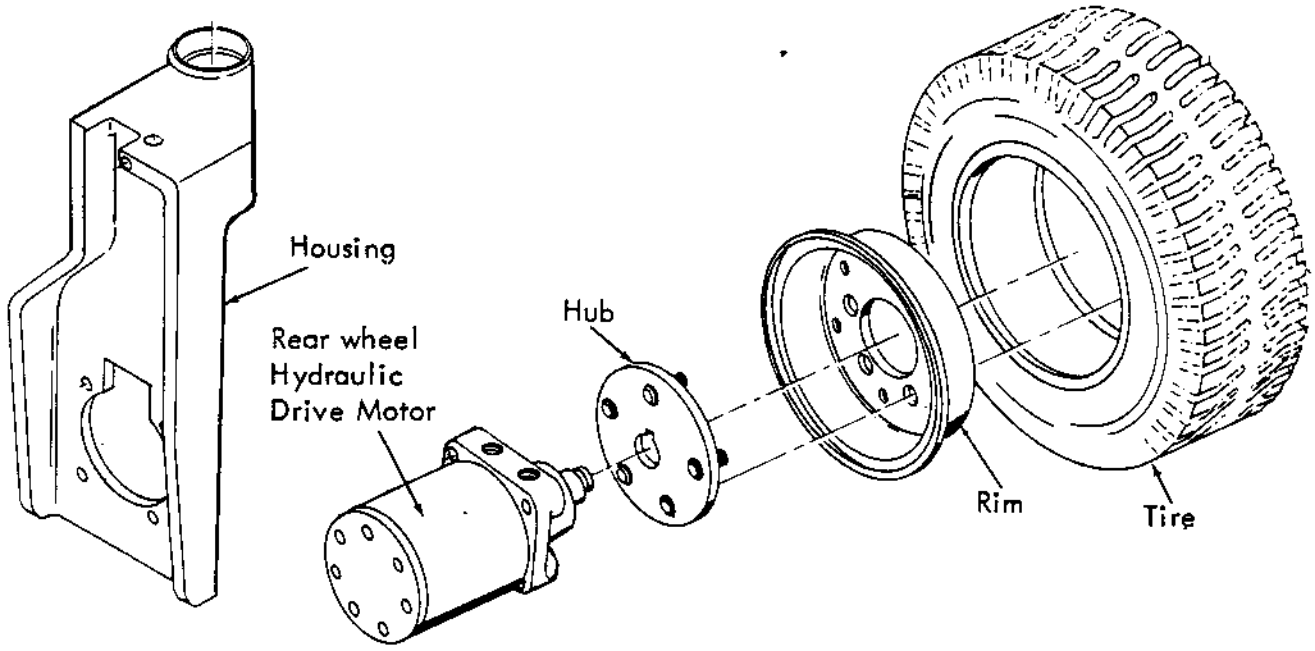
MODEL 240 HI-DUMP HYDRAULIC SYSTEM PICTORIAL



MODEL 240 HI-DUMP HYDRAULIC SCHEMATIC

REPLACING REAR WHEEL HYDRAULIC DRIVE MOTOR

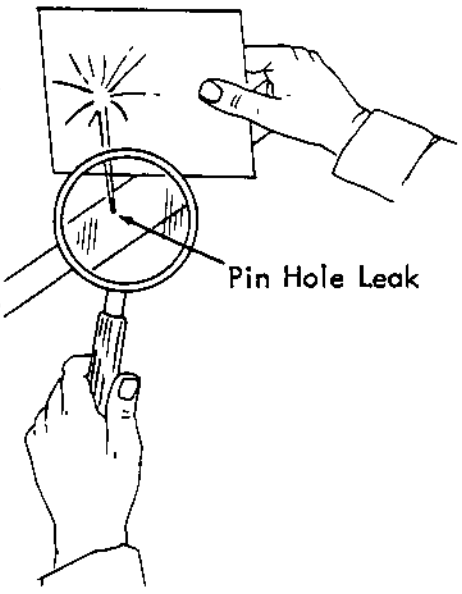
1. Raise and block up rear of machine.
2. Disconnect and cap hydraulic lines to rear wheel drive motor. Mark lines for correct assembly. Plug ports in motor.
3. Remove screws attaching hydraulic drive motor to housing (see exploded view drawing for arrangement of parts).
4. Carefully remove wheel and motor.
5. Remove wheel from motor shaft. Use wheel puller if removal of wheel from motor tapered shaft is difficult. (See "Hydraulic Components" Section for hydraulic motor parts illustration and repair information.)
6. When installing wheel on new or repaired motor, tighten wheel hub nut on axle to 300 to 400 ft lb (407 to 542 Nm)



⚠WARNING Escaping hydraulic oil under pressure can have sufficient force to penetrate the skin, causing serious personal injury. Before checking for hydraulic oil leaks, be sure all connections are tight and that hoses and fittings are not damaged.

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.

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



HYDRAULIC PUMP REPLACEMENT

1. Disconnect and cap hydraulic hoses and fittings connected to old pump.
   ATTENTION! Note the location of each fitting and hose; mark it so that it will be installed in the correct location on the new pump.

2. Disconnect foot pedal linkage from pump control arm.

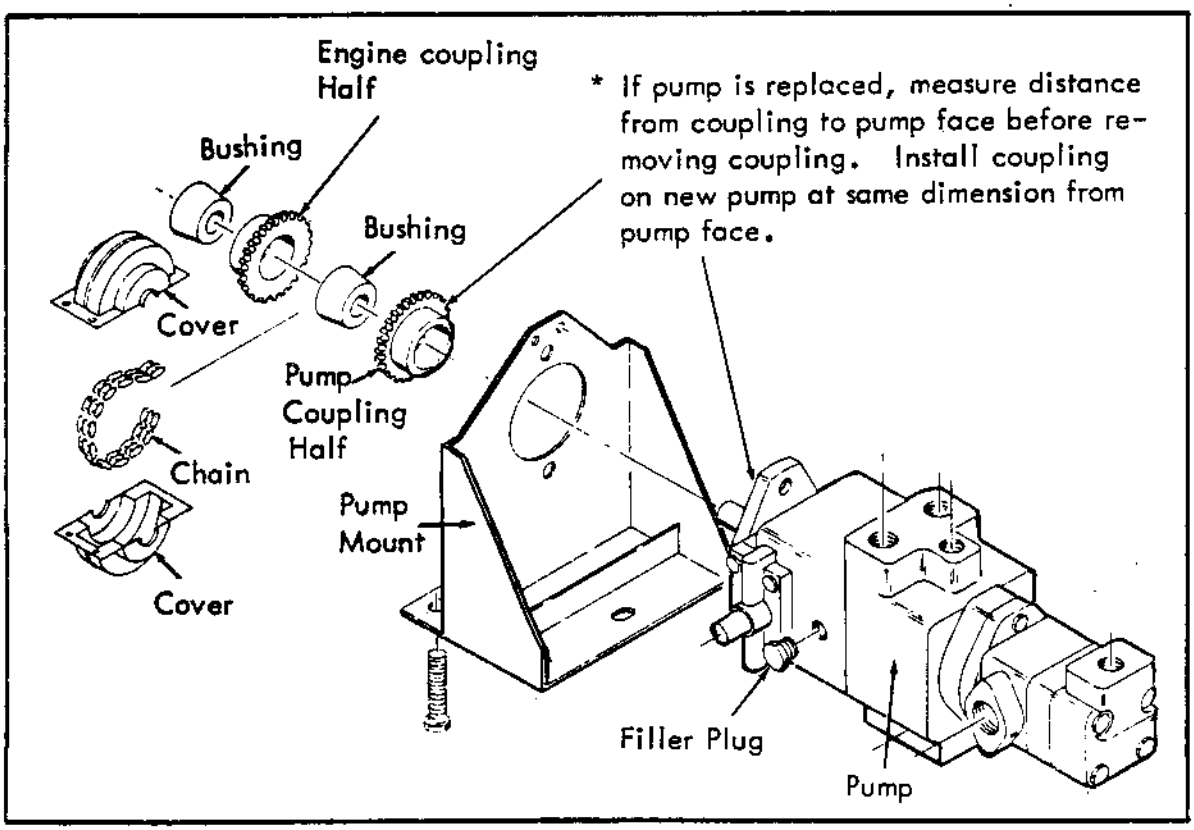
3. Separate and remove the split covers on the pump drive chain coupling.

4. Disconnect one chain link and remove the coupling chain.

5. Remove the bolts attaching the pump to its mounting bracket.

6. Remove the pump. Leave the coupling half attached to the adapter on the engine flywheel.

7. Carefully measure the distance from the pump mounting flange to the edge of the teeth of the coupling half as shown in sketch. Then, remove and save the coupling half from the old pump shaft. Make a note of the dimension, so that the coupling half will be correctly positioned on the new pump shaft.



(continued on next page)

HYDRAULIC PUMP REPLACEMENT (continued)

8. Install the pump coupling half on the new or repaired pump at exactly the dimension measured in step #7.

9. Turn the pump on its side, remove the plug, and fill the pump with hydraulic oil. Replace the plug.

10. Install all hoses and fittings on the pump. Install the pump control arm on the pump in the same position as on the old pump.

11. Install the pump on the mounting bracket.

12. Connect the two coupling halves with the chain. Install the split coupling cover (pack with Lithuim-Moly E.P. grease before assembling).

13. Connect the hydraulic hoses to the pump, following markings made in step #1. **ATTENTION!** Hydraulic connections must be clean.

START-UP PROCEDURE AFTER REPLACING HYDRAULIC PUMP

1. Check hydraulic oil level in tank.

2. Jack rear wheel off the floor .25" to .50" (6.3 to 12.7 mm)

3. Disconnect spark plug wires and crank engine for 30 seconds with foot pedal in neutral.

4. Re-connect spark plug wires, start engine and run with throttle in "idle" position. Check for correct operation of foot pedal. Adjust centering springs if necessary.

5. Depress foot pedal one fourth to one third stroke and run for 30 seconds.

6. Continue holding the foot pedal and turn on all brushes and run for 1 minute.

7. While continuing to hold the foot pedal, raise and lower the hopper 3 times.

8. Then depress foot pedal fully for 30 seconds and release to neutral.

9. Stop engine and lower rear wheel on floor.

10. Check hydraulic tank and refill to proper level, if necessary.

11. Start engine and run idle for 30 seconds.

12. Advance throttle and run machine on floor for 30 seconds.

13. For Hi-Dump machine: Crack fittings at roll out cylinder and operate roll out valve in both directions several times until no air bubbles are noticed. Tighten fittings.

14. If the above procedure did not bleed all air from the lines, it may be necessary to "crack" or loosen some fittings or hoses.

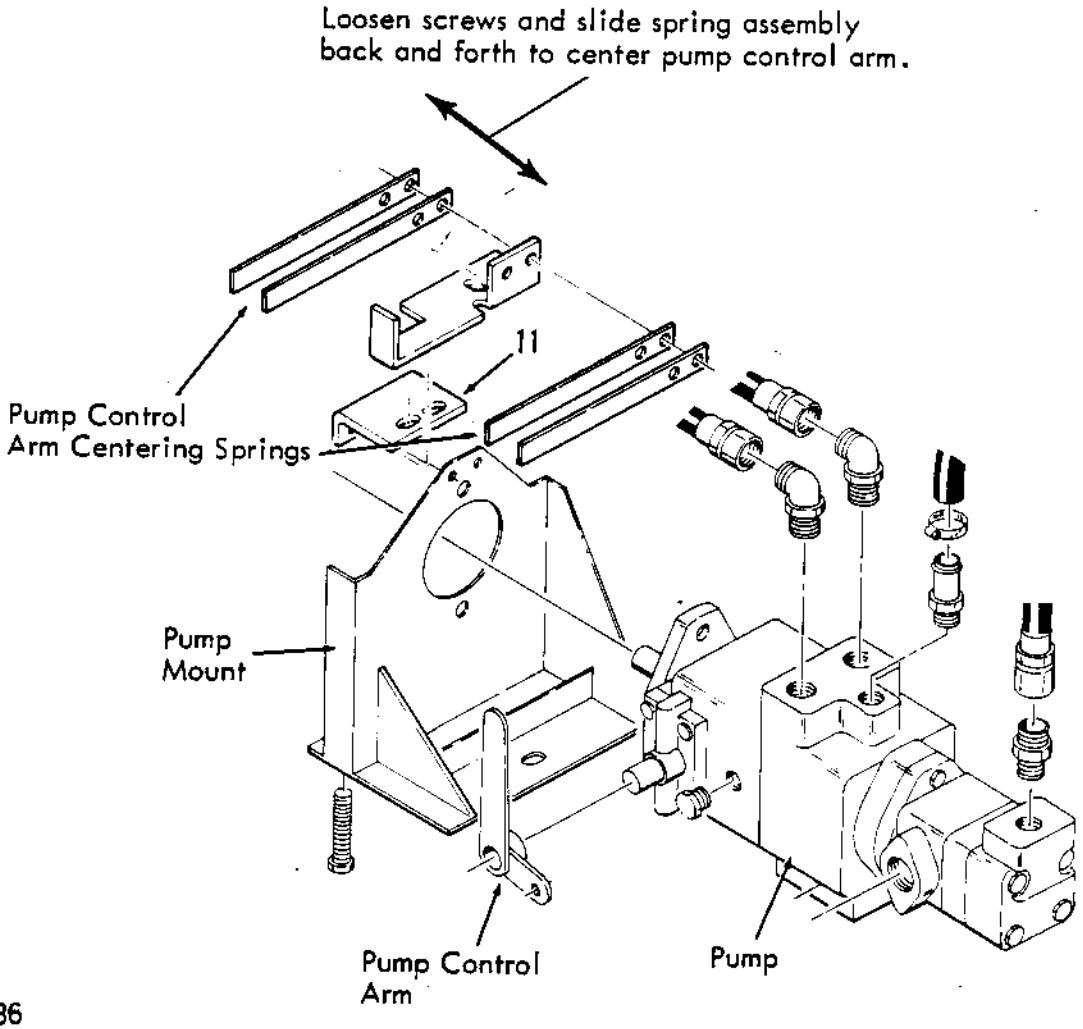
ADJUSTING DIRECTIONAL CONTROL PEDAL NEUTRAL POSITION

1. Park machine on smooth, level floor surface. (With motor running, machine should not "creep" in either direction when operator's foot is off the pedal).

2. To prevent creep of the machine when the pedal is in the neutral position, the neutral setting of the propelling pump control arm must be adjusted. This is done by adjusting the centering springs mounted above the pump.

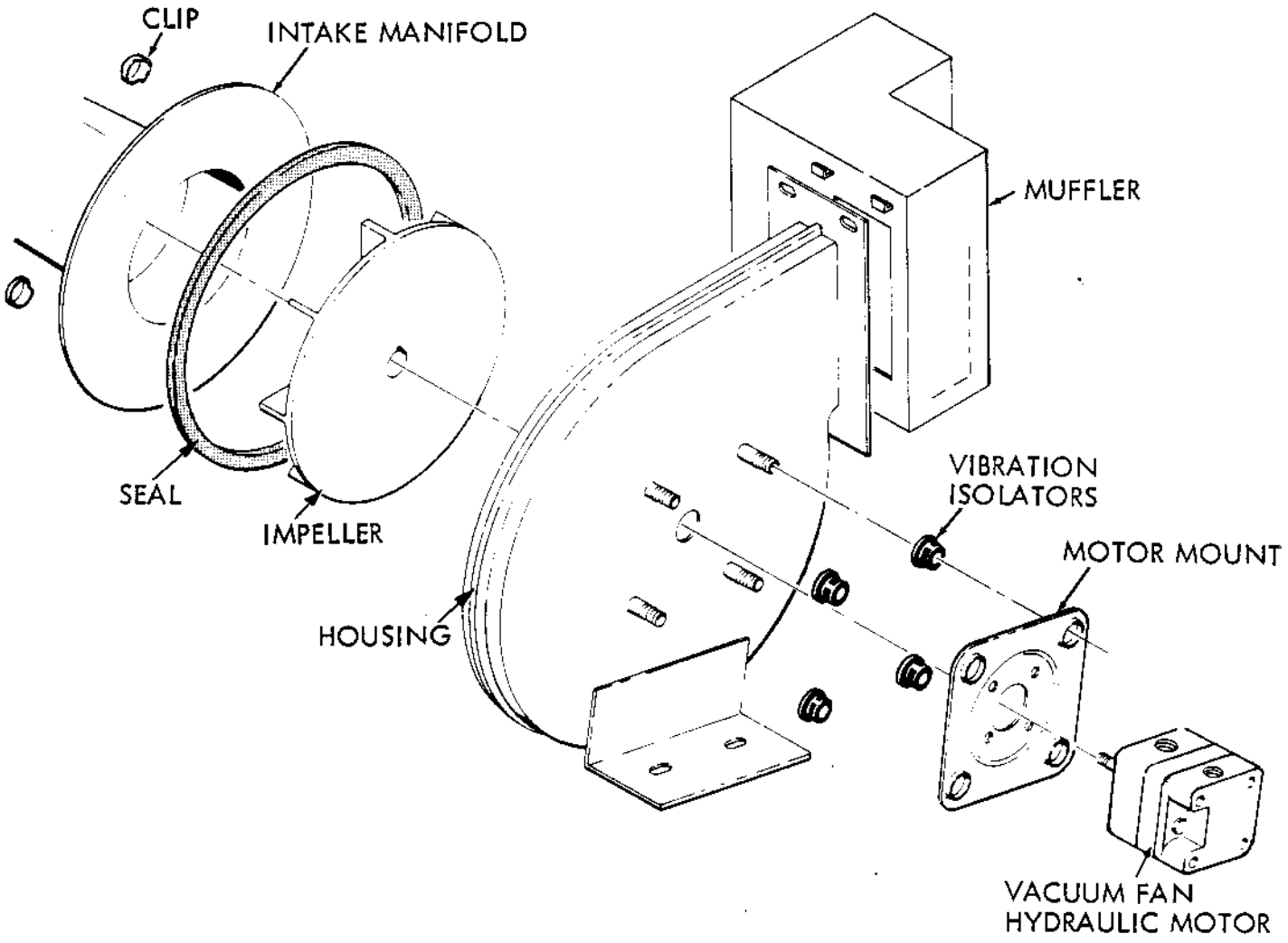
3. Adjust the springs until the machine does not "creep" in either direction.

ATTENTION! Either jack up rear wheel or make adjustments with motor off. Make the adjustments in small increments and check by trial and error until the correct adjustment is obtained.



VACUUM FAN HYDRAULIC MOTOR REPLACEMENT

1. Disconnect and cap hydraulic hoses connected to motor--be sure to mark the hoses and motor for correct reassembly.
2. Disconnect duct from fan housing intake manifold. Remove manifold.
3. Remove nut attaching fan impeller to motor shaft.
4. Remove noise suppression cover from motor.
5. Remove screws attaching motor to housing.
5. Remove motor and install new or repaired motor on housing. Replace motor cover.
6. Attach impeller (with key) on motor shaft with nut. Tighten to 20 ft lbs (27 Nm).
7. Replace intake manifold.
8. Connect hydraulic lines, following markings made in step (1).



BATTERY REPLACEMENT

The battery is located below an access panel in the floor. The standard battery is a wet-cell, 12-volt, 40-ampere hour type (TENNANT Part No. 26771).

When installing new battery, be sure to connect ground cable to negative terminal of battery.

BATTERY INSPECTION AND MAINTENANCE

Every 100 hours inspect the battery as follows:

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

2. Check the battery negative cable ground connection.

3. Clean the battery top surface and terminals. 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, apply a coating of clear petroleum jelly to the terminals and cable connectors.

4. Check to make sure that battery mounting is holding battery securely.

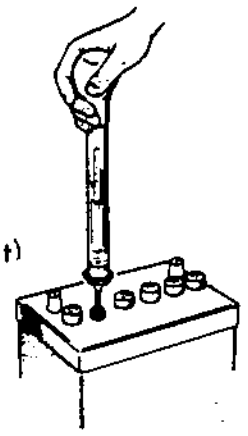
Checking Battery Electrolyte

1. Check electrolyte level in each cell often. Electrolyte level must always be above the plates. Add distilled water to maintain solution about 0.375"(9.5 mm) above the plates, but do not overfill.

2. Every 100 hours use a hydrometer to check the electrolyte specific gravity.

NOTE Do not take readings immediately after adding water; if the water and acid are not thoroughly mixed, readings may not be accurate. Check hydrometer readings.

SPECIFIC GRAVITY at 80°F (25°C)	BATTERY CONDITION
1.260 - 1.280.....	100% charged
1.230 - 1.250.....	75% charged
1.200 - 1.220.....	50% charged
1.170 - 1.190.....	25% charged (Recharge at this point)
1.140 - 1.160.....	Very little useful capacity remaining
1.110 - 1.130.....	Discharged



If one or more cells tests .025 or more lower than the other cells, the cell is damaged, or shorted or is about to fail.

CHARGING BATTERIES

The recommended charger should be fully automatic in that the charge rate tapers off by itself as the battery is charged.

ATTENTION! Before charging battery in the machine, disconnect the battery cables. This will protect the alternator.

⚠WARNING Do not smoke or light matches, or bring open flame into area when battery is being charged. Keep cover open over battery. Provide adequate ventilation.

IMPORTANT NOTES ON BATTERY CARE

+ Provide maximum ventilation during battery charging.
+ Keep vent plugs firmly in place at all times, except when adding water or taking hydrometer readings.
+ Keep flames and sparks away from the batteries as they may ignite gas during charging.
+ 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.

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

+ Add water only, and avoid over-filling.
+ Keep electrolyte from coming in contact with the eyes, skin, clothing, or any other material which it might damage.

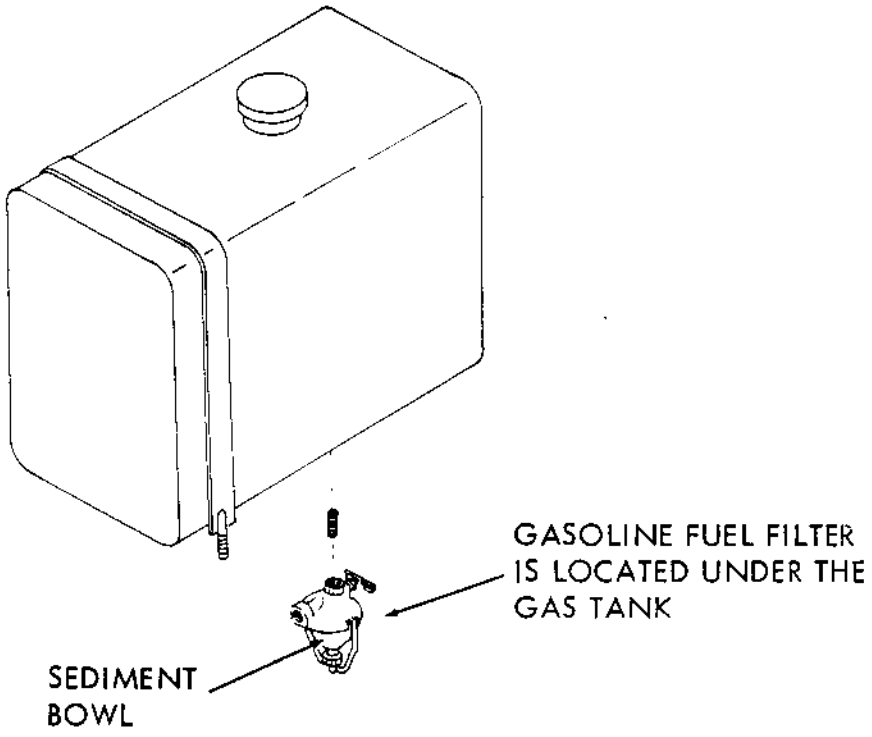
LOCATION OF FUSES

A fuse panel is located inside the instrument panel enclosure. Other fuses are located on the back side of the light switches. To replace fuses, remove the screw attaching the instrument panel, move the panel forward, then lift it up.

⚠WARNING Disconnect the positive battery terminal before removing the instrument panel. A fuse is used in the shaker motor circuit. Fuses are used to protect the accessory circuits such as the headlights, flashing lights, hour meter, etc. Before replacing a blown fuse, try to determine the cause.

FUEL SYSTEM MAINTENANCE

Empty the carburetor and gasoline fuel filter sediment bowls of any accumulated sediment. Reassemble and check for leaks. If your engine is equipped for operation on LP Gas, see the LPG Section of this manual for instructions in cleaning the Filter-Fuelock unit.



RECOMMENDED ASSEMBLY TORQUES

Rear Wheel Hub Nut

Nut holds rear wheel hub on rear axle - 300 to 400 ft lb (407 to 542 Nm).

Rear Wheels

Rear wheel mounting nuts - 85 to 95 ft. lbs (115 to 128 Nm).

Rear Wheel King Pin

Tighten rear king pin nut until resistance is felt. (Turn rear casting when steering is disconnected.) Back off nut to first slot but no more than one-twelfth of a turn.

Main Brush Drive Porting Block

Tighten Allen head capscrews attaching motor to porting block 18-20 ft lb (24 to 27 Nm).

Vacuum Fan Impeller

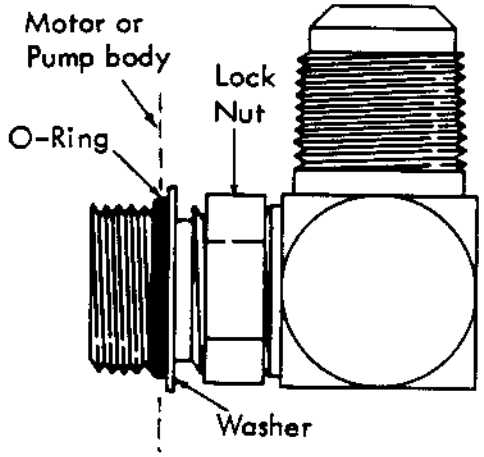
When fastening fan impeller to the hydraulic motor, limit torque on nut to 20 ft lbs (27 Nm) maximum.

Hi-Dump Front Vertical Arm Nuts

Tighten nuts to 30-40 ft lbs (41-54 Nm); then back off to 5-15 ft lbs (7-20 Nm) and install cotter pin.

"O-Ring" Type Hydraulic Fittings:

These fittings have straight threads. Sealing is accomplished by means of an O-Ring which contacts the body of the motor, valve, pump, etc. Turn the fitting into the component until the O-Ring is against the body, then tighten the nut until the O-Ring is compressed enough to seal the connection. Much less torque is required than with pipe thread fittings.



TROUBLE SHOOTING

TROUBLE	PROBABLE CAUSE	REMEDY
No vacuum–poor dust pick-up.	1. Dust skirts worn or not adjusted correctly.	1. Check dust skirts, adjust to clear floor by .125" (3 mm)
	2. Fusible link on filter box fire door may have failed	2. Replace fusible link.
	3. Dust filters clogged.	3. Clean filters.
	4. Failure in fan drive such as key broken, or hydraulic motor worn.	4. Check and repair.
Poor Sweeping.	1. Sweeping brush not adjusted correctly.	1. See "Side & Main Brush Adjustment"
	2. Sweeping brushes worn.	2. Replace brushes
	3. Dust skirts not adjusted or worn.	3. Replace or adjust dust skirts.
	4. Filters clogged	4. Clean Filters.
	5. Main brush drive hydraulic motor worn or damaged.	5. Check motor.
	6. Side brush hydraulic motor worn.	6. Check motor.
	7. Brush driving plugs worn or damaged.	7. Check Plugs.

TROUBLE	PROBABLE CAUSE	REMEDY
Motor runs, but machine will not move.	1. Foot pedal and/or linkage jammed or not adjusted.	1. Check pedal linkage.
	2. Front wheels jammed or brakes locked.	2. Check wheels.
	3. Hydraulic pump trouble, such as relief valve failure, leakage, etc.	3. Check & repair.
	4. Rear wheel hydraulic motor trouble such as broken shaft key, broken shaft, etc.	4. Check motor.
Machine moves slowly.	1. Low hydraulic oil level.	1. Add oil.
	2. Front wheels: Brakes dragging, wheels jamming, tires softened from contact with oil or solvent.	2. Check wheels, repair or replace. See Maintenance Instructions.
	3. Hydraulic oil temperature too high - oil is too thin. May be caused by: operating with excessive load or drag, prolonged ramp climbing, high temperature operation, or worn pump.	3. Use TENNANT 32398 - 20W60 hydraulic oil. Check pump.
	4. Worn hydraulic pump or rear drive wheel motor.	4. Check pump or motor.
Hopper dumps slowly or will not dump.	1. Load in hopper too heavy.	1. Empty more often.
	2. Lift arms or hopper binding.	2. Check for binding or obstructions.
	3. Wear or failure in manually-operated control valve.	3. Check valve.
	4. Defective dump cylinder, seals leaking.	4. Repair cylinder.
	5. Accessory portion of tandem hydraulic pump worn or damaged.	5. Check pump

TROUBLE	PROBABLE CAUSE	REMEDY
Hydraulic Motor leaks at shaft.	1. Worn or cut shaft seal.	1. Replace shaft seal. (Polish shaft at seal area--check for rough areas or burrs.)
Leak between flange and housing in side brush or main brush Hydraulic motor.	1. Loose flange screws. 2. O-Ring worn or damaged. 3. Housing plug O-Ring leaking.	1. Tighten screw. 2. Replace O-Ring. 3. Replace plug O-Ring.
Leak between housing and plate or plate and gerotor in side brush or main brush Hydraulic motor.	1. End cap screws loose. 2. O-Rings worn or damaged.	1. Tighten end cap screws. 2. Replace O-Rings.
Leak between gerotor and end cap, in side brush or main brush motor.	1. Dirt between surfaces. 2. Scratches, nicks, burrs. 3. O-Ring worn or damaged.	1. Disassemble, clean parts. 2. Polish parts. 3. Replace O-Rings.
Char - Lynn motor turns in wrong direction	1. Hose connections wrong. 2. If Char-Lynn motor is not assembled correctly, wrong "timing" will cause reverse rotation.	1. Reverse connections.

TROUBLE	PROBABLE CAUSE	REMEDY
Hydraulic pump making excessive noise.	1. Partially clogged pump inlet line.	1. Check the inlet line to pump and tank inlet. If oil is dirty, drain system and flush throroughly. Refill with clean TENNANT Hydraulic fluid.
	2. Air leak at pump intake line connections.	2. Pour fluid on connections to check for leaks--listen for change in pump sound level. Tighten connections which are loose.
	3. Air bubbles in hydraulic fluid.	3. Check for low hydraulic fluid or loose connections in hydraulic lines.
	4. Hydraulic pump is worn or damaged.	4. Check pump.
Hydraulic Motor operates slowly.	1. Worn pump.	1. Repair or replace pump.
	2. Worn Hydraulic motor.	2. Replace seals and repair motor.
	3. High hydraulic oil temperature.	3. Change to higher viscosity oil.
	4. Clogged hydraulic oil filter.	4. Change filter cartridge.
Hydraulic Motor will not turn over.	1. Shaft seized in housing.	1. Replace housing and shaft assembly.
	2. Large contaminating particles in hydraulic oil.	2. Flush out system, change oil and filter element.
	3. Broken shaft.	3. Replace shaft.
Hydraulic Motor runs without turning shaft.	1. Broken parts in motor.	1. Disassemble motor and check parts.

MM101

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POWER SWEEPER

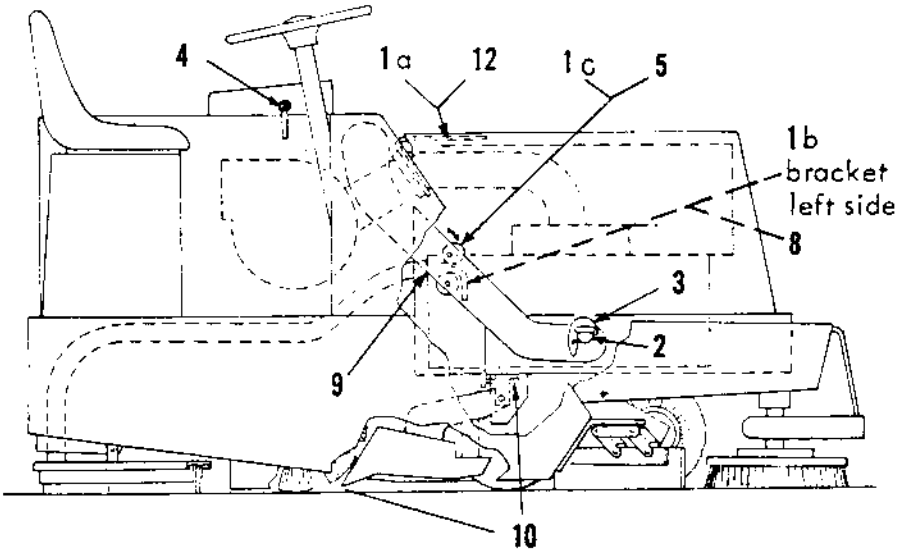
scrubber section

CONTENTS:	PAGE:

Note: For Scrubber Parts, see "Scrubber Parts Section"

INITIAL ALIGNMENT OF NEW SCRUBBING UNIT TO MACHINE

ATTENTION! Scrubbing units may require alignment to the machine. Follow these instructions carefully:



ALIGNING SCRUBBING UNIT TO MACHINE:

1. Loosen vacuum connection bracket in top center of scrubber and move all the way to front of scrubber in slots.
   Loosen bracket on left rear side of scrubber
   Loosen top cam on the right hand lift arm and rotate back.
   ATTENTION! Do not loosen lower cam.

2. Move scrubber into place and connect hydraulic hoses to unit. Line up lift pins over slots in lifting arms.

3. Start engine and let idle. Engage lift pins on lift arms and swing locking hooks over pins.

4. Operate hydraulic control to lift scrubber all the way up.
   ⚠WARNING Engage the safety lock.

5. Rotate top cam on right hand lift arm to contact ear of scrubber and tighten bolt.

6. Fold up the four support legs by pulling out the locking knob and swinging each leg up.
   ⚠WARNING Do not work under scrubber unless safety lock is engaged.

7. Release safety lock and lower scrubber to down position.

8. Lower bracket on left hand rear side of scrubber to contact cam on arm and tighten bolts.

9. Connect vacuum hose to scrubber from squeegee.

(continued on next page)

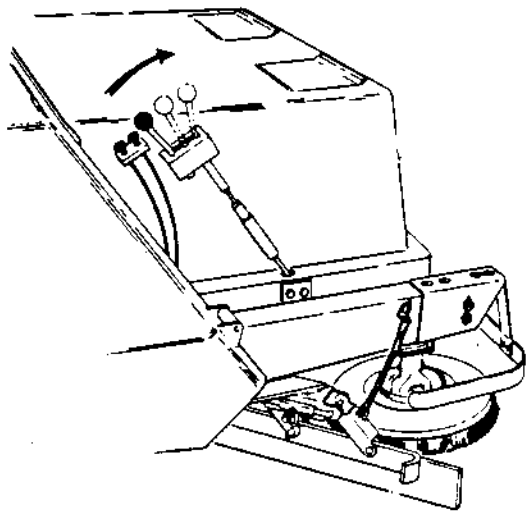
TROUGH ADJUSTMENT:

10. The correct clearance of the trough lip is from .375" to .50" (9.5 to 12.7 mm) from the floor. Adjust by turning .50" square head set screws.

11. The correct clearance of the trough in the up position is from1" to 1.12" (25.4 to 28.5 mm) from the floor. Adjust by turning .375" square head set screws.

VACUUM CONNECTION:

12. Move bracket at top center of scrubber rearward to contact seal on lintel and tighten bolts sufficiently to hold bracket in place.
Rap bolts sharply to move bracket from .06" to .12" (1.6 to 3.2 mm), compressing the sponge rubber seal on lintel, and tighten bolts.



BRUSH ADJUSTMENT:

13. Release brush lift handle and allow brush to rest on floor.

14. Turn cylinder and cylinder end until handle is opposite center notch of bracket. Tighten jam nut on cylinder end.

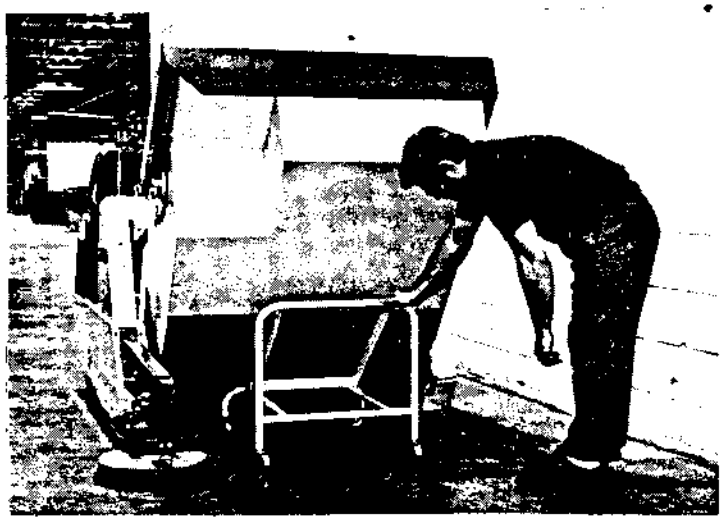
INSTRUCTIONS FOR FACTORY-INSTALLED SCRUBBING ATTACHMENT
(Assuming that machine is modified to accept scrubbing attachment)

A. TO REMOVE SWEEPING HOPPER (BEFORE INSTALLING SCRUBBER)

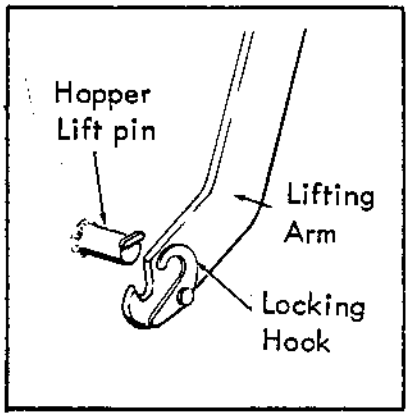
1. Start motor.

2. Raise hopper all the way.
   ⚠WARNING Engage mechanical safety lock on hopper lift arm.

3. Place dolly under hopper.



Use dolly to support hopper.



Disconnect hopper from lifting arms by moving locking hooks away from hopper lift pins.

4. Swing aside locking hooks which attach hopper lifting pins to the lift arms.

5. Raise the lift arms, disconnect the lift arm safety lock, and lower hopper onto dolly. Stop the motor. Place hydraulic control in "OFF" position. Push down hopper lift arms until they clear the hopper lift pins.

6. Move hopper out from machine slightly and disconnect the wire to the shaker motor mounted on the hopper. Complete the removal of the hopper.

7. Remove the side sweeping brush by removing the bolt attaching it to the motor shaft. The brush will drop down to the floor.

8. Remove main sweeping brush.

B. TO INSTALL SCRUBBING UNIT (After Removing Sweeping Hopper)

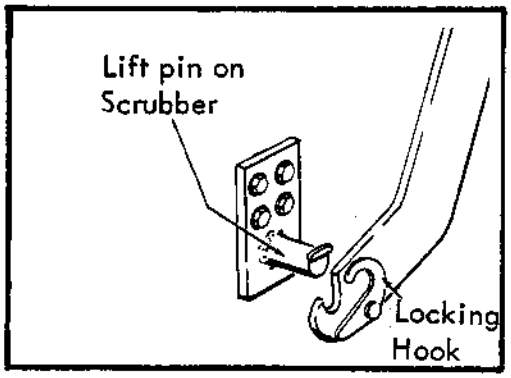
1. **NOTE** Do not fill scrubber tank before installing scrubber on machine. The scrubber unit is mounted on folding support legs equipped with wheels. Carefully roll the scrubber into position between the lift arms, but allow enough room between the machine and the scrubber so that the hydraulic hoses can be connected in the next step.

2. Disconnect the coupling on the hydraulic hose located in one of the lines to the hydraulic control valve.

ATTENTION! Clean both coupling halves

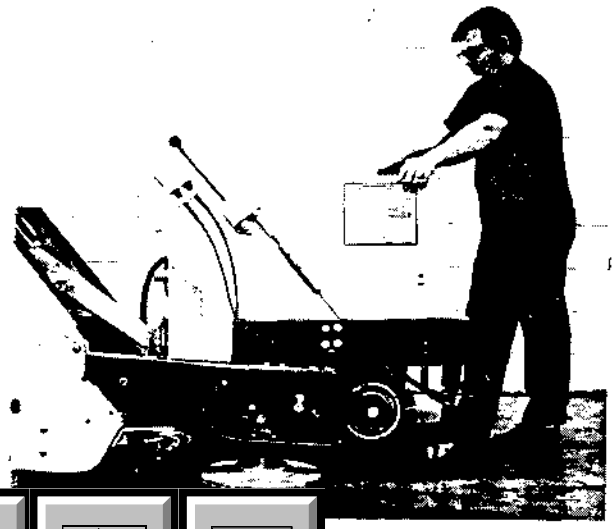
Cam Lock

Connect the separated halves of the coupler to the two hoses located on the side of the scrubber.



Use Locking Hooks to Lock Scrubber to Lift Arms

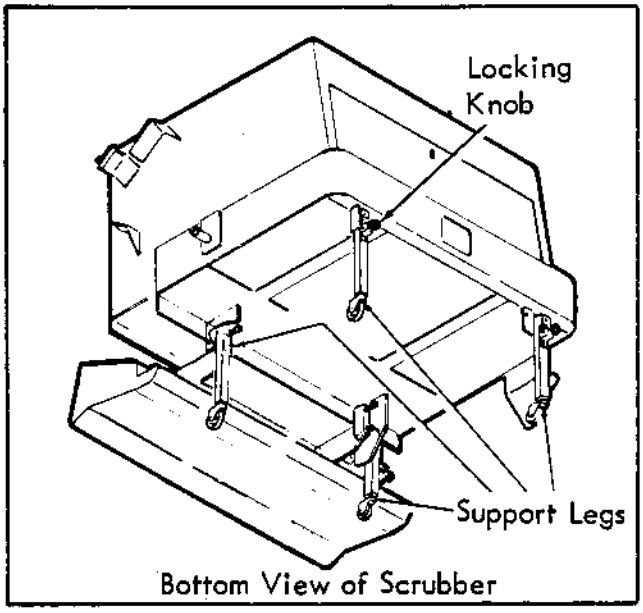
3. With lift arms lowered, carefully move scrubber into position so that lifting pins on scrubber will engage their sockets on the lift arms. Swing locking hook on each arm over scrubber lifting pins, locking them onto lift arms.
4. Start motor and operate hydraulic control to lift scrubber.



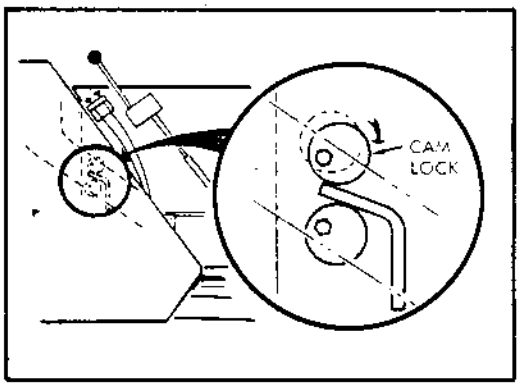
NOTE With the folding support legs down, the scrubber can be rolled into position.

5. Fold up the four support legs by pulling out the locking knob and swinging each leg up.

⚠WARNING Engage the safety lock on lift arm before reaching under scrubber.



Bottom View of Scrubber



Rotate the cam lock to the down position as shown here. This is the correct position of the lock when the scrubber is installed.

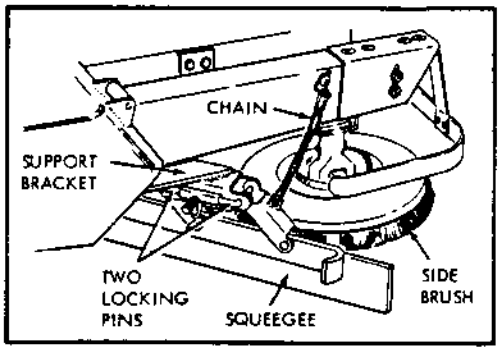
6. Loosen bolt attaching cam lock to right-hand lift arm and rotate cam into position against lip on scrubber. Use wrench provided for removing main brush. This cam lock will prevent scrubber from tilting forward.

7. Make sure that end of suction hose is in pick-up trough located at bottom of scrubber.

8. Start engine and lift scrubber enough so that safety lock on lift arm can be released. Lower the scrubbing unit.

9. Install side brush squeegee assembly on support bracket and lock in place by inserting two locking pins. Turn ends of pins under the clamp which is held in place by a spring.

NOTE Install the side brush squeegee on the support bracket as shown here.



10. Attach chain from squeegee to side brush arm. Adjust chain so that squeegee is lif

INSTALLING SCRUBBING UNIT (continued)

11. Position side scrubbing brush on motor shaft and lock in place with bolt and nut.

12. If necessary, adjust motor height until full weight of the arm is on the brush when the side brush lift is fully released.

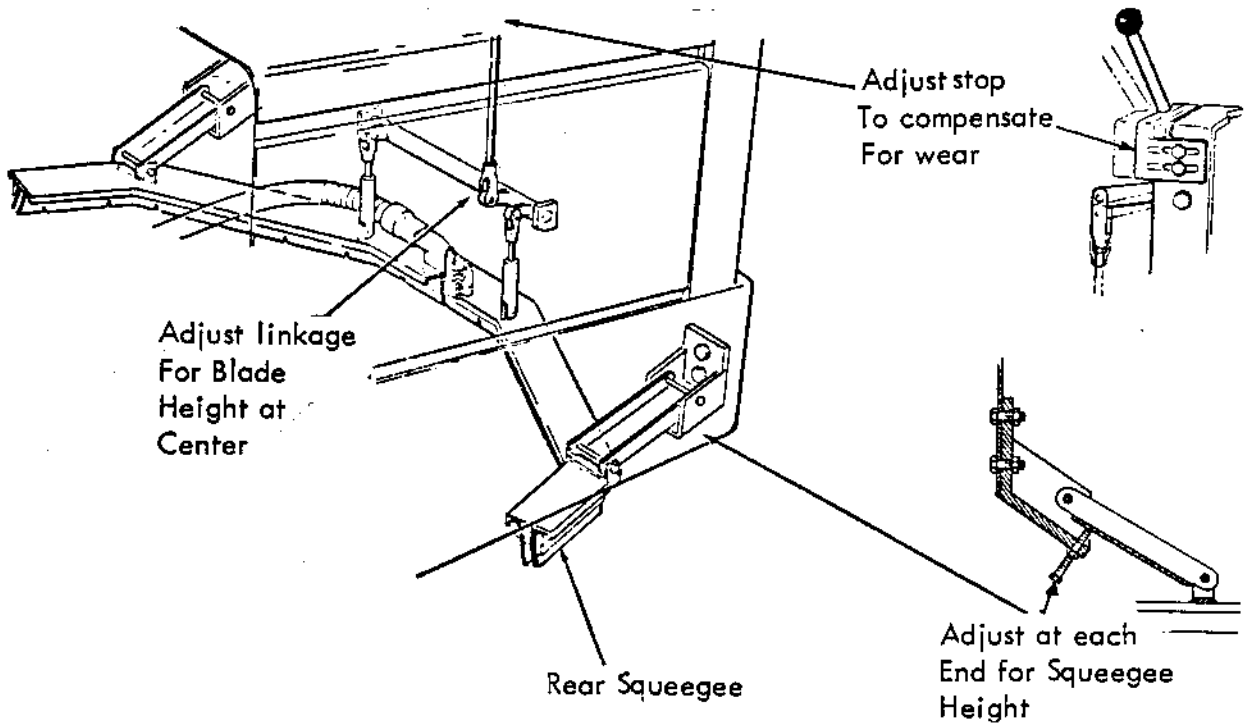
13. If side squeegee is not level with floor, adjust as described in Maintenance Instructions.

14. Attach hose from squeegee to recovery tank inlet as shown in drawing.

15. Check condition of rear squeegee rubber blade and replace it if necessary. See Maintenance Instructions. If rear squeegee blade assembly is not on machine, install it as shown in drawing. The squeegee is attached to the two outboard pivot brackets and the center lift mechanism by means of pins and cotter pins.

16. Install the main scrubbing brush (also called rear pick-up brush) in the same manner as a sweeping brush is installed.

17. The Scrubber is now completely installed. Please refer to "Scrubber Operating Instructions" next.

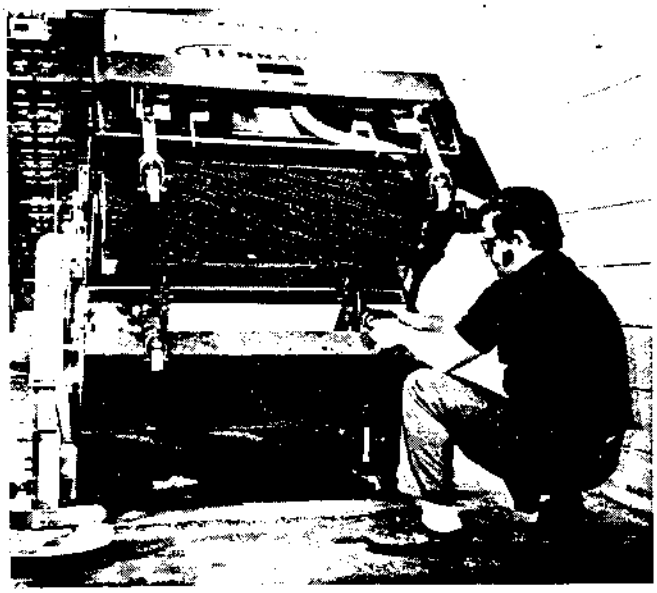


C. TO REMOVE SCRUBBING UNIT FROM MACHINE

1. Drain recovery tank as explained in "Operating Instructions".
2. Remove rear main scrubbing brush in same manner as sweeping brush is removed.
3. Remove side scrubbing brush by removing bolt attaching it to the motor shaft.
4. Remove side brush squeegee by pulling out the two lock pins and unhooking chain. Leave squeegee mounting bracket attached to machine.
5. Start motor and raise scrubbing unit.

⚠WARNING Engage lift arm safety lock before reaching under the unit.

6. Swing down the four scrubber support legs -- make sure they are locked in place.



Raise Scrubber and Lower the Four Support Legs

7. Loosen bolt attaching the cam lock to the right-hand lift arm, and swing lock away from lip on scrubber. Tighten lock attaching bolt.
8. Operate hydraulic control to lift scrubber. Release safety lock, then lower scrubber to floor. Stop motor. Place hydraulic control in "OFF" position.
9. Swing aside locking hooks which hold scrubber lifting pins to lift arms.
10. Push lift arms down and carefully roll scrubber away from machine for a short distance so that hydraulic hoses can be disconnected.
11. Disconnect the two hydraulic hoses between scrubber and machine. Disconnect rear squeegee suction hose from scrubber (end of hose can be placed in clip under seat).
12. Connect the two machine hydraulic hoses together (check to be sure that couplers are clean).

NOTE Machine will not operate properly if these lines are not connected.

13. The rear squeegee can remain attached to machine in "UP" position during sweeping -- provided that machine is not used over rough surfaces which could damage the squeegee rubber blade. To remove squeegee, pull out the attach[illegible]

D. TO INSTALL SWEEPING HOPPER AFTER REMOVING SCRUBBER

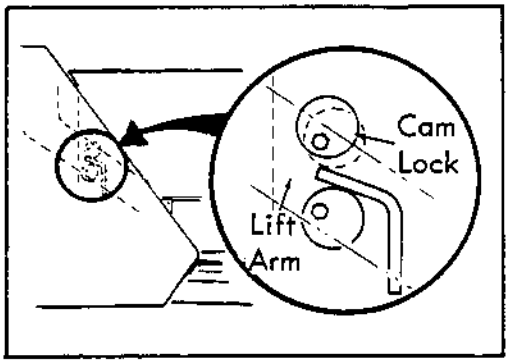
1. Position hopper on dolly between lift arms near machine, but allow enough room to connect the wire to the shaker motor. Connect the shaker wire. Move hopper up to the machine.

2. Start motor and raise lift arms so that lift pins on hopper will contact their sockets on the lift arms.

3. Close the locking hooks over the lifting pins.

NOTE The cam lock on right-hand arm must be positioned away from the hopper so that it does not restrict hopper movement.

NOTE When the sweeping Hopper is used, the Cam lock must be Set at the "up" position.



4. Raise hopper.

⚠WARNING Engage safety lock.

5. Remove dolly from under the hopper.

6. Raise hopper slightly in order to release safety lock, then lower hopper to floor.

7. Install main sweeping brush.

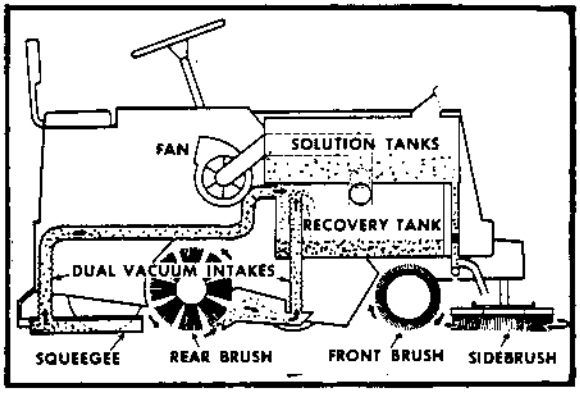
SCRUBBER OPERATING INSTRUCTIONS

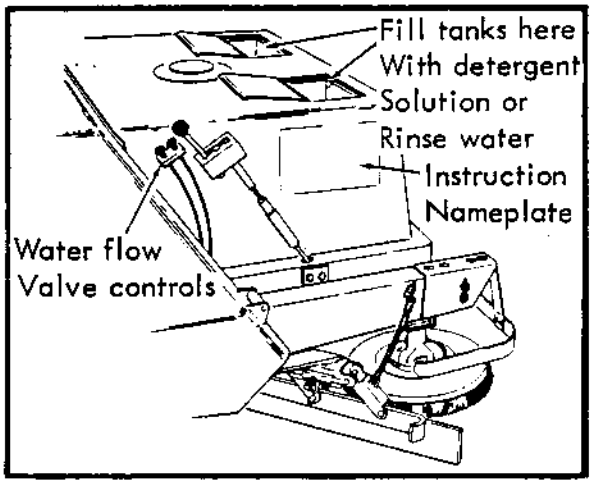
Filling the Tanks:

1. The solution mixture required will depend upon the condition of the floor. Recommendations for detergent dilution are given on the TENNANT detergent container and on the nameplate mounted on the scrubber. TENNANT liquid detergents are recommended.

2. Shut off the water flow with the valve controls located on the right side of tank.

3. There are two separate upper tanks. One or both tanks may be used for detergent solution or rinse water. Fill both tanks with hot water when using both tanks for detergent solution; or fill one tank with solution and one with cold rinse water. The water flow can be approximately doubled by using both tanks at the same time, but this, of course, will require more frequent refilling.





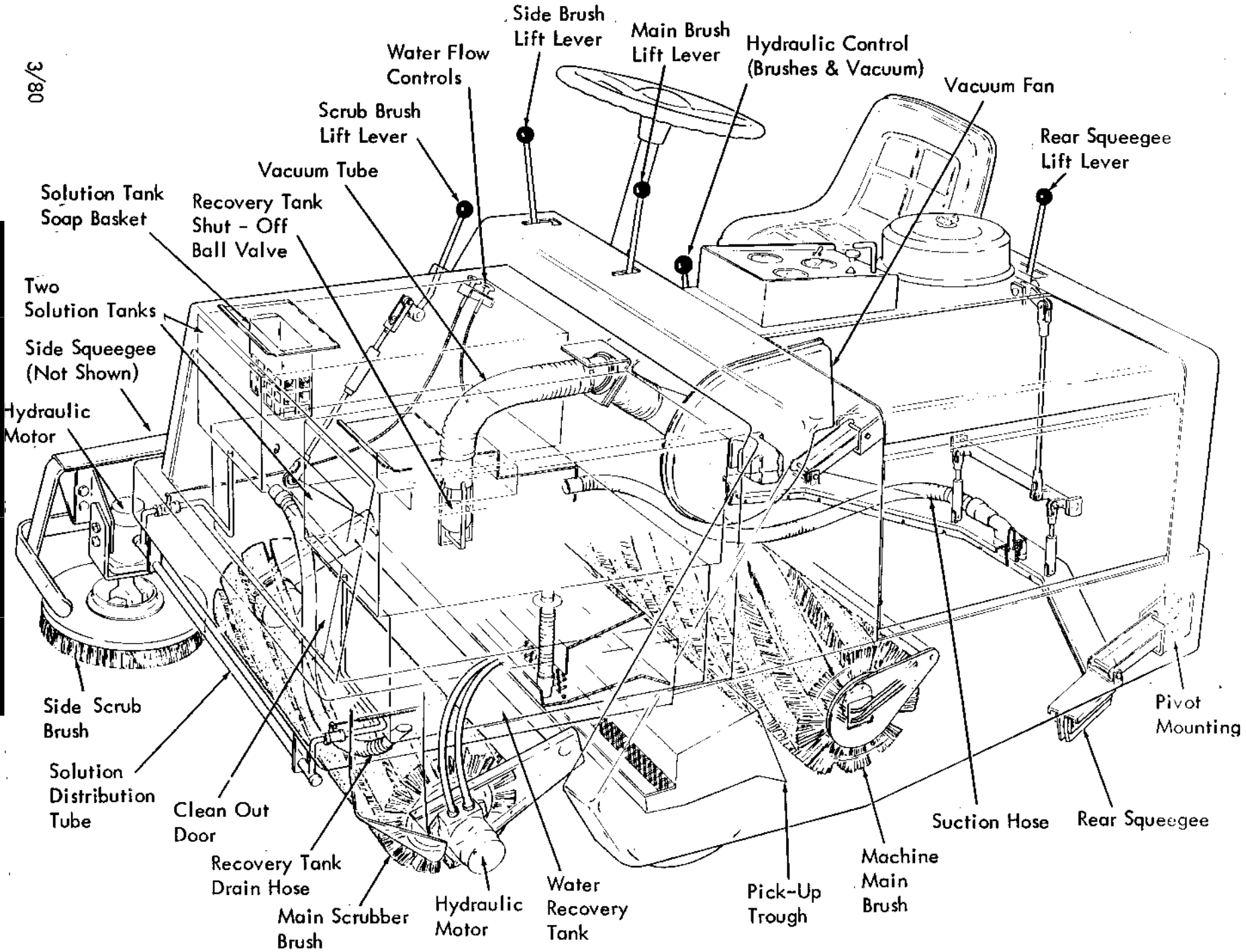
4. To avoid foaming, fill the tanks with hot water first, then add detergent and stir the solution.

5. The two water flow control valves may be used to combine the flow or to open either tank.

6. The rate of flow and the consumption of either detergent or rinse water is dependent upon scrubbing conditions and rate of travel.

TIRE CARE

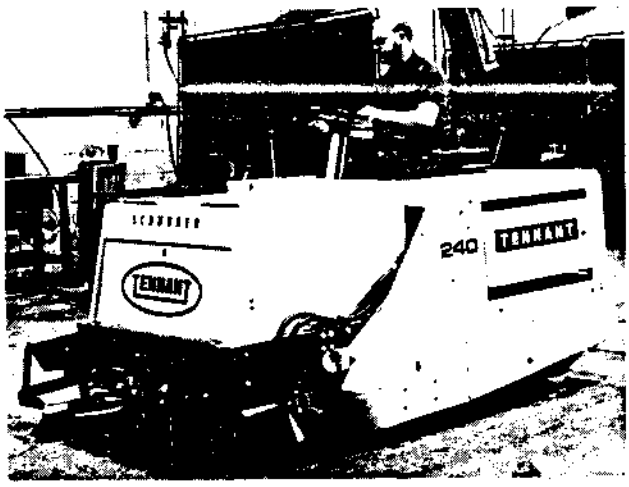
If the machine is operated in areas where solvents, oils and other petroleum-base fluids may contact the tires, it is strongly recommended that the tires be cleaned after use. This will greatly prolong the life of the tires.



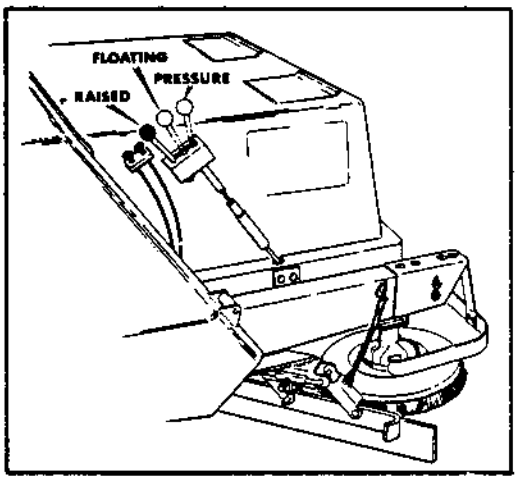
SCRUBBER FEATURES & CONTROLS

TYPICAL SCRUBBING CONTROL OPERATION SEQUENCE

1. Start the motor. Set throttle at full engine speed.
2. Move hydraulic control lever to "Brushes and Vacuum Fan On" position. This starts rotation of all brushes and vacuum fan.
3. Lower the machine main brush to the "Restricted Down" position.
4. Lower the scrubber brush to the down position, using the brush lift lever on the scrubber.



Operating Scrubber Attachment



Position of Scrub Brush Lever

5. Lower the side brush -- the side squeegee will also lower with the brush. Lower side squeegee if it is locked in up position.
6. Open the water flow control valves. The two control valves may be used to combine the flow or to open either tank.
7. Lower the rear squeegee and place the lever in the "Pressure" down position.

NOTE Always raise squeegee before reversing machine.

8. Depress the accelerator pedal and begin scrubbing.

NOTE For best scrubbing results, reduce machine speed to about one-half of the normal sweeping speed.

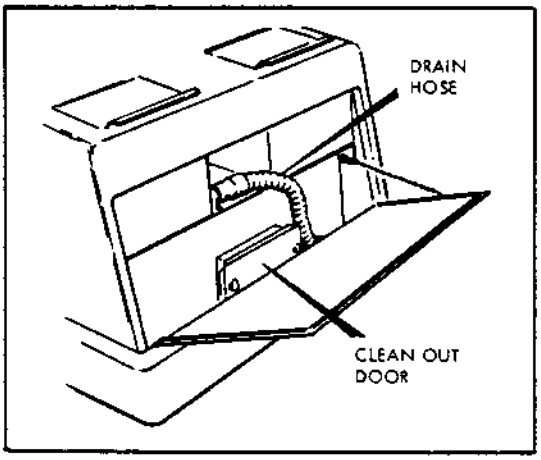
9. Shut off the solution about 5 feet (1524 mm) before making a turn.
10. After the scrubbing operation is completed, raise all the brushes. Allow brushes to revolve for 30 seconds or more to throw off excess water.

SOME NOTES ON SCRUBBING OPERATIONS

1. **NOTE** Never use main sweeping brush for scrubbing - always replace main sweeping brush with the brush designed especially for scrubbing.
2. The front cylindrical brush performs the bulk of the scrubbing. The side brush is provided in order to scrub close to walls. The main (rear) brush provides secondary scrubbing and also sweeps light debris and water into the shallow trough located under the scrubber. A hose vacuums the water from this trough into the recovery tank in the scrubber. The rear squeegee provides a "vacuum cleaner" pick-up on smooth floors and erases tire tracks.
3. Extremely dirty floors may require soaking with the detergent for a period of time. Apply the solution with the front and side scrub brushes down (the main brush, side squeegee and rear squeegee should be up). After soaking, pass over the same area with the main brush and squeegees down.
4. If rinsing is desired after scrubbing the floor, apply plain cold rinse water, scrub and pick-up.
5. When scrubbing very rough floors, it may be desirable to raise the rear squeegee in order to prevent damage to the rubber blade. The main brush will provide adequate water pick-up in this case.

DRAINING AND CLEANING RECOVERY TANK

1. Position front of scrubber adjacent to large floor drain or 40 gallon (151 liter) tank below the floor level.
2. Pull upper end of drain hose, (see sketch) off the plug and lower in the direction of the floor drain.
3. Open the clean out door to which the drain hose is attached and flush out any sludge accumulation.
4. Raise scrubber on dump arms and engage safety lock so that the lower trough may be cleaned and inspected

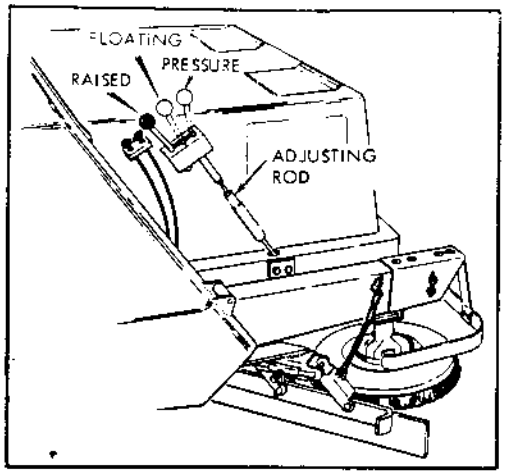


SCRUBBER TROUBLE SHOOTING

TROUBLE	PROBABLE CAUSE	REMEDY
Poor water pick-up at squeegees.	1. Side or rear squeegees are worn or damaged.	1. Examine squeegee rubber blades and back-up strips for cuts or worn areas. Replace blades if necessary.
	2. Clogging in water pick-up trough of rear squeegee or in suction hose to recovery tank.	2. Clean out rear squeegee and hose.
	3. Air leaks in suction hose and connections.	3. Repair or replace hose and connections.
	4. Poor vacuum.	4. Check vacuum fan.
Water spills from side of scrubber.	1. Side squeegee blades worn or damaged.	1. Replace squeegee blades.
	2. Too much solution being applied.	2. Cut down solution flow 5 to 10 feet (1524 to 3048 mm) before making turns.
Little or no vacuum suction at rear squeegee.	1. Clogged suction hose or pick-up trough in rear squeegee.	1. Disconnect suction hose from squeegee, wash squeegee and hose thoroughly.
	2. Loose connections between squeegee and suction hose or between suction hose and tank.	2. Check all hose connections for looseness or damage. Check suction hose for damage.
	3. Scrubber vacuum fan not operating.	3. Check for suction at suction hose to recovery tank. Next, check for air discharge from vacuum fan. If no air discharge, impeller, hydraulic motor, or pump are at fault.
Poor scrubbing action.	1. Worn scrubbing brushes.	1. Inspect brushes. If bristles are badly worn, replace brush.
	2. Incorrect method of operation.	2. Check scrubbing procedures, brush pressure adjustment, solution flow, etc. If floor is extremely dirty, two passes may be needed.
	3. Wrong detergent or mixture.	3. Use TENNANT Detergents.
Poor solution distribution.	1. Clogged outlet holes in distribution tube.	1. Clean out tube and outlet holes.
	2. Clogged or pinched hose from solution tank to valve.	2. Check hose.
	3. Jammed solution valve or cable to valve.	3. Check cable and valve for free operation.

SCRUBBER MAINTENANCE INSTRUCTIONS

FRONT SCRUB BRUSH ADJUSTMENT



Back - To raise Front Brush.

Center - "Float" scrubbing position (also used for adjustment).

Forward - "Pressure-down" scrubbing position.

An adjustment for brush wear is provided on the lift rod beneath the brush control handle. Lossen the jam nut on the clevis and turn the adjusting rod just below it until the control handle is in the "Center" position when the brush is resting on floor.

NOTE Be sure jam nut against lower clevis is tight to prevent drift of adjustment.

FRONT SCRUB BRUSH REPLACEMENT

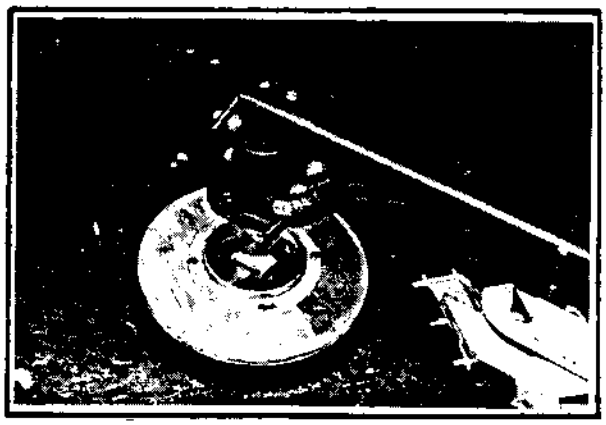
The front brush is removed and replaced in the same manner as the main sweeping brush. See "To Replace Main Brush" in "Maintenance Instructions" Section of this manual.

WATER SPREADER TUBE

The small holes in the water spreader tube may become clogged. Loosen set screw of tube hanger and remove hoses. Slide tube out of hangers and clean with hot water and brush.

SIDE SCRUB BRUSH REPLACEMENT

The side brush is adjusted for wear in the same manner as the side sweeping brush. See "To Replace Side Brush" in "Maintenance Instructions".



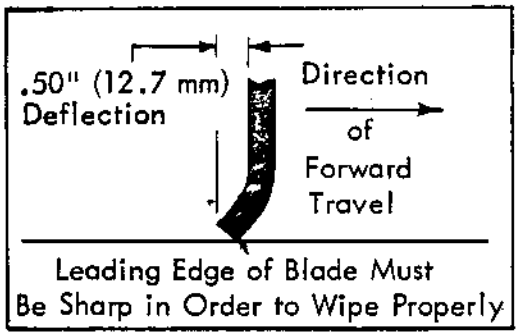
The Side Brush Used For Scrubbing

REAR SQUEEGEE MAINTENANCE

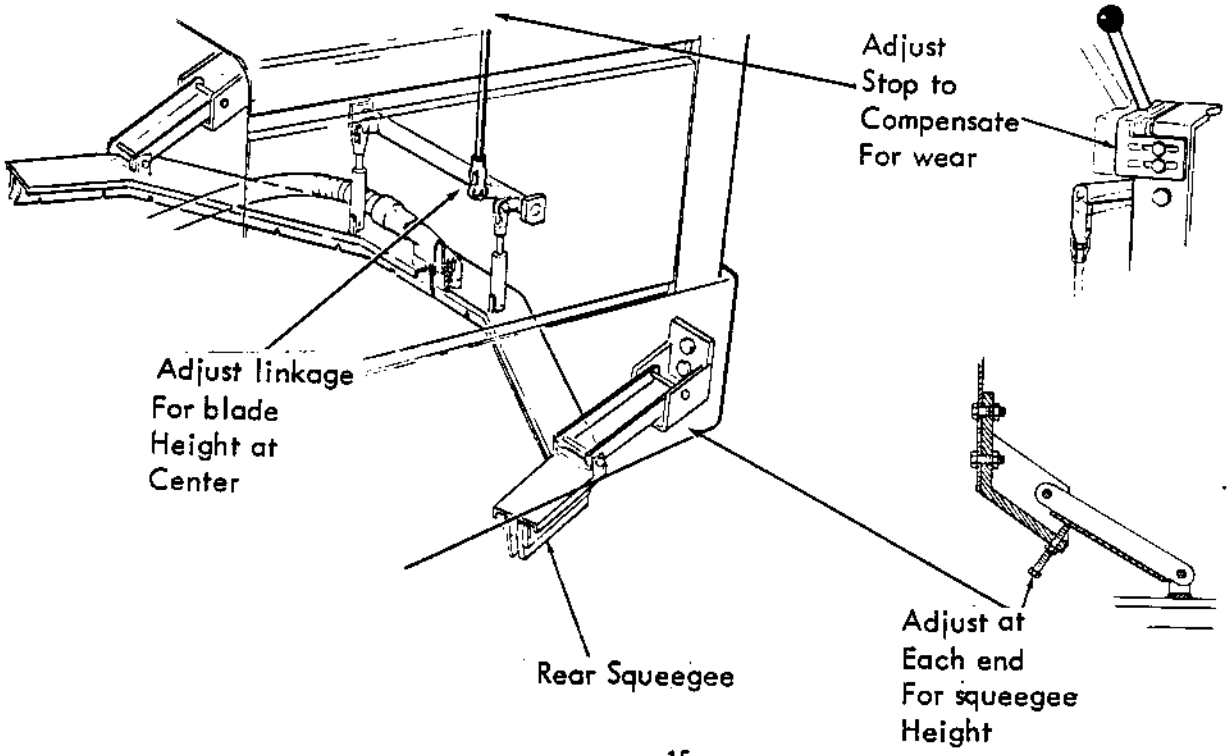
To Check and adjust Rear Squeegee Rubber Blade:

As shown in sketch, the leading edge of the squeegee rubber does the entire wiping job. If this edge is worn, the rubber must either be replaced, or turned around if the opposite edge is not worn. Adjusting a worn blade to a lower position will not improve wiping action.

NOTE The Squeegee Rubber Blade Must Be Adjusted As Shown Here

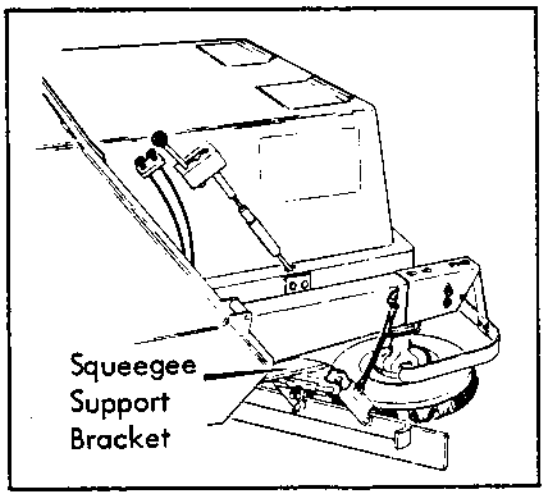


In order to work properly, the rubber squeegee blade must be deflected about.50"(12.7 mm) as it moves across the floor -- this is shown in sketch. This deflection should be uniform across the full length of the squeegee. The deflection of the blade is set by adjusting the stops and linkage as shown below. This adjustment is correctly made at the factory and should not normally be required again. In the "up" position the squeegee should just touch the frame at three places; the rear and two ends.



SIDE SQUEEGEE LEVELING ADJUSTMENT:

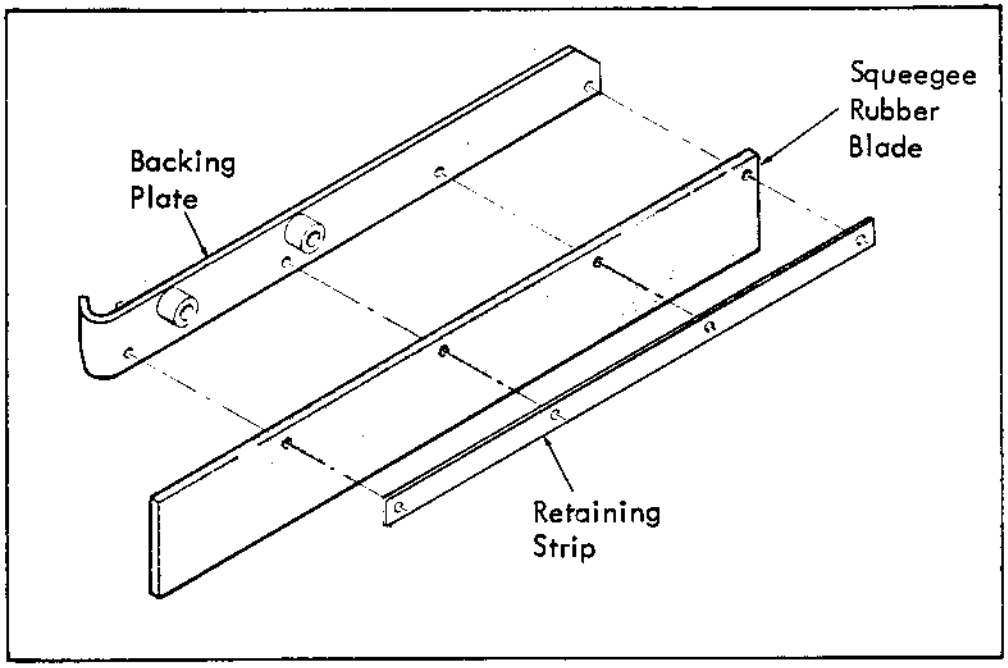
Check to be sure that the squeegee blade is level with the floor. If adjustment is required, loosen the two support bracket mounting screws and twist the bracket slightly until the blade is level. Then tighten mounting screws.



Level the side squeegee By loosening the support Bracket screws and Moving the bracket.

SIDE SQUEEGEE RUBBER REPLACEMENT:

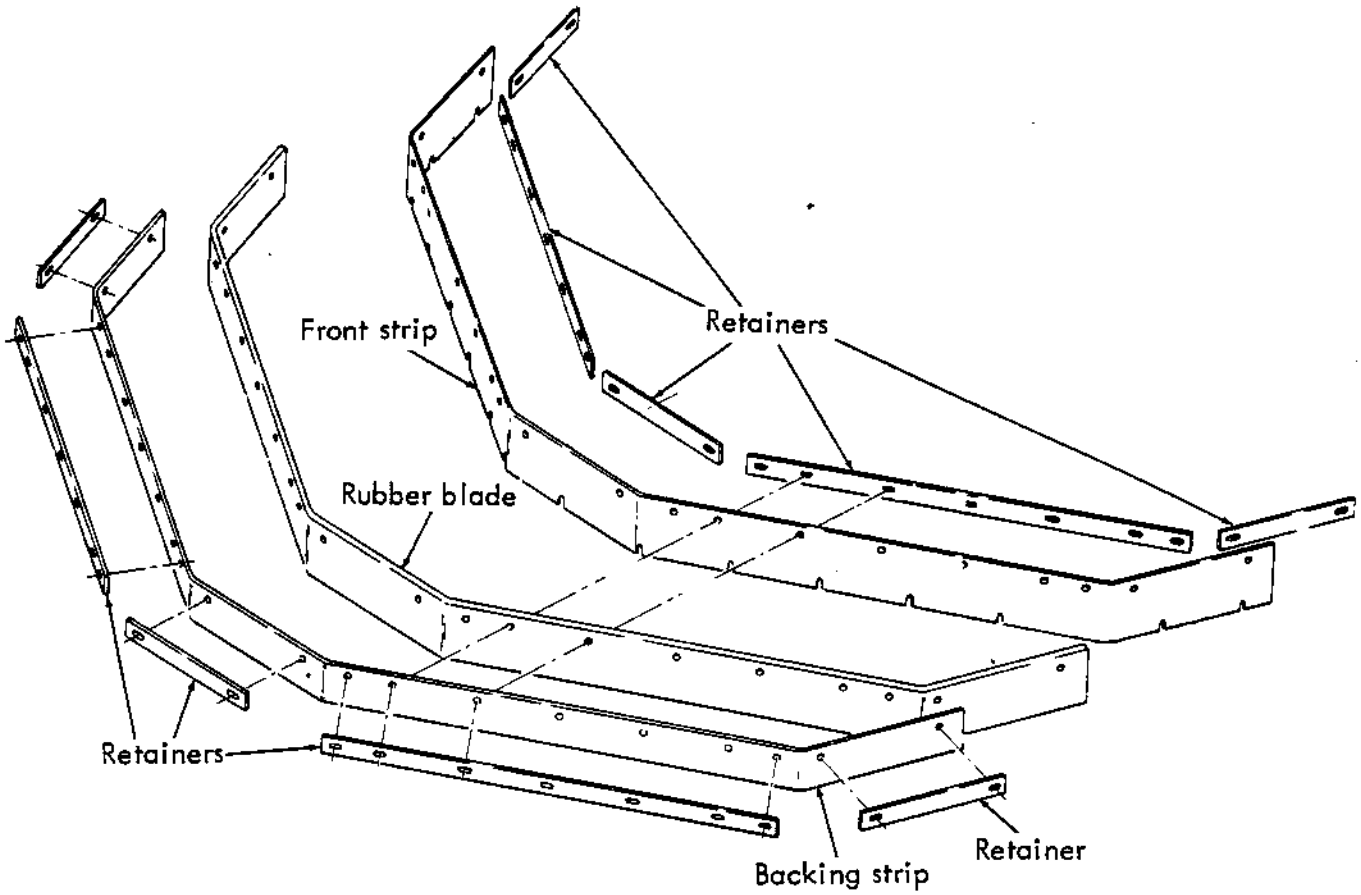
Remove five retaining clamp bolts, install new rubber strip, and replace retaining clamp. Replace the rubber when the leading edge is worn and is no longer wiping floor correctly.



Side Squeegee Blade Replacement

REPLACING REAR SQUEEGEE BLADE

To replace or reverse the rubber blade, refer to exploded view for the arrangement of parts. Note that a special front strip and a backing strip are used on each side of the rubber blade. Replace the front strip if it is worn.



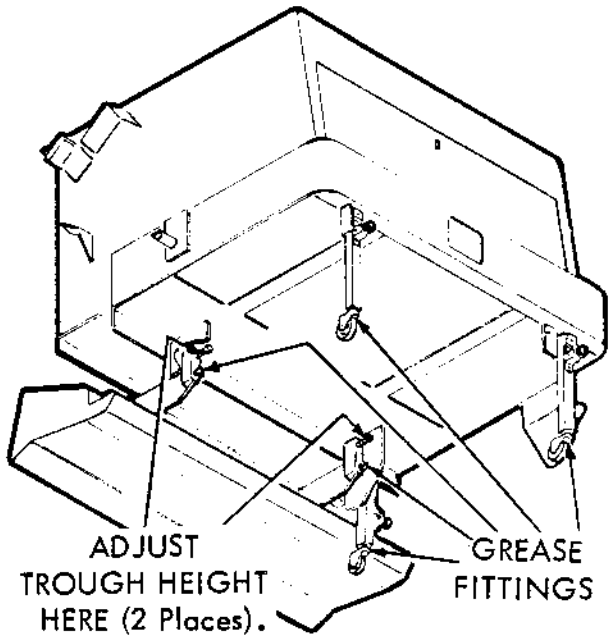
Exploded View Of Rear Squeegee Rubber Blade And Mounting Parts

LUBRICATION OF SCRUBBER

Grease Fittings	Location	Lube Period
2	Lower trough pivot	8 hours
4	Caster wheels	200 hours

Apply light grease to threads on front brush lift rod every 200 hours.

⚠WARNING Never reach under up-raised scrubber attachment without engaging the safety lock.

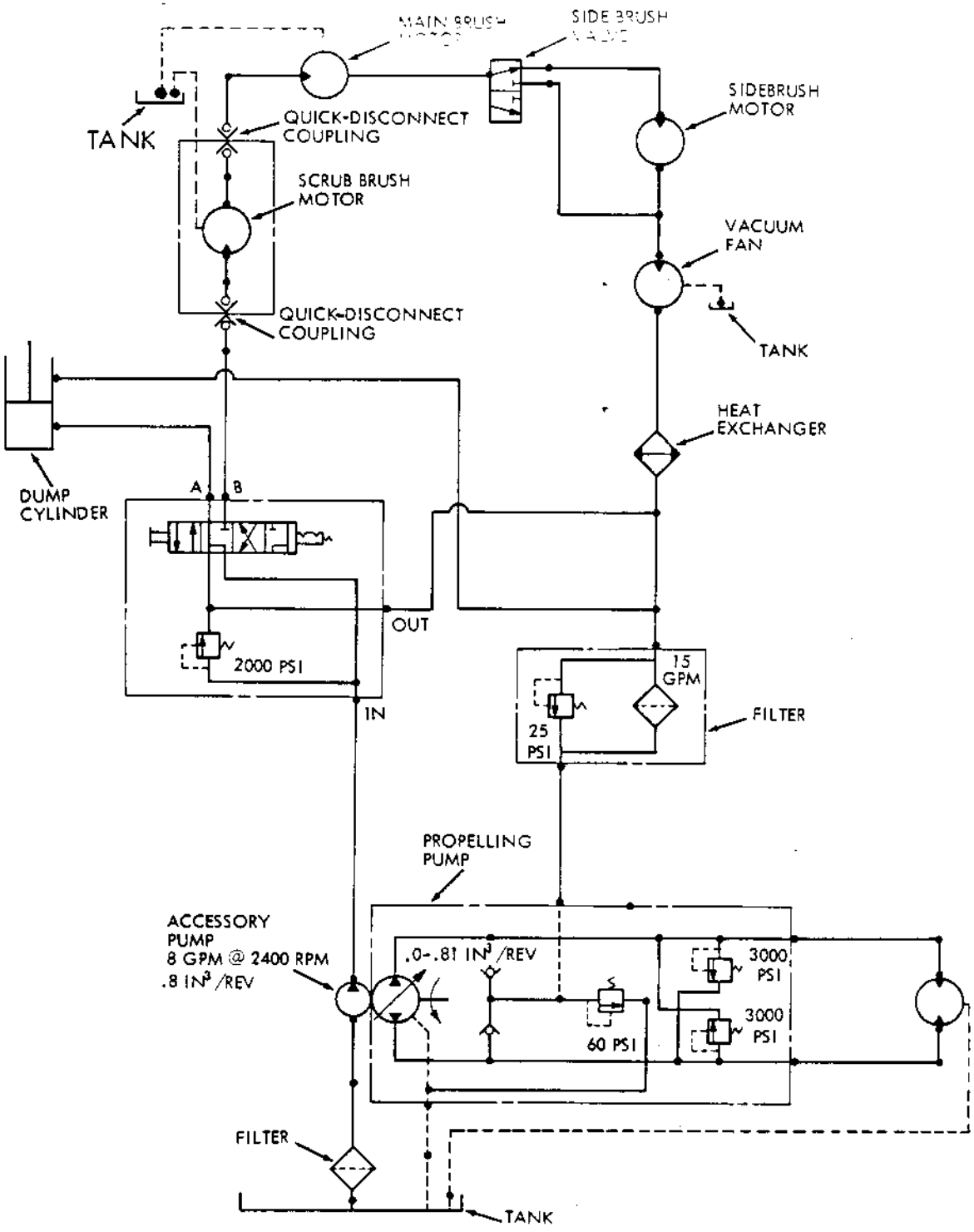


TO ADJUST PICK-UP TROUGH HEIGHT:

1. Park machine on smooth level surface.
2. Check clearance between lip of pick-up trough and floor. Clearance is .375"(9.5 mm).
3. If adjustment is required:
   (a) Raise scrubber attachment to extreme "up" position and engage lift cylinder safety lock.
   (b) Referring to drawing, loosen lock nut and adjust bolts until correct clearance is obtained. Then tighten lock nuts.

NOTE After each adjustment is made, it will be necessary to lower scrubber attachment to check clearance.

ATTENTION! Be sure that lip of the trough is never allowed to touch floor, or needless wear to the trough will result.



MODEL 240 SCRUBBER HYDRAULIC SYSTEM

240
POWER SWEEPER

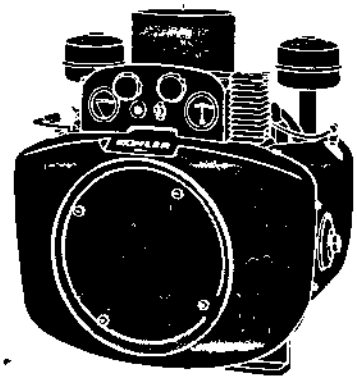
THIS SERVICE MANUAL COVERS BOTH KOHLER MODEL K532S & K582S ENGINES

CONTENTS:

engine section

3/80

KOHLER



model K532S, K582S

gas - gasoline

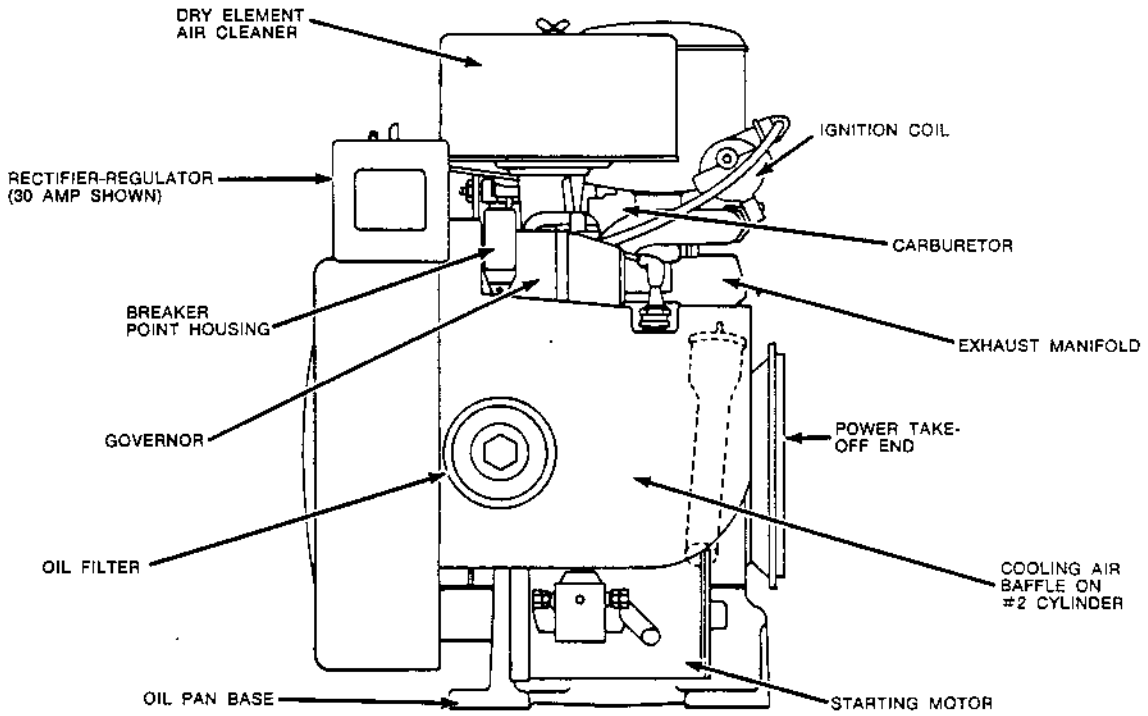
ENGINE SERVICE MANUAL

SPL - 102/714

3/80

KOHLER CO. KOHLER, WISCONSIN 53044

This section covers the Kohler two cylinder-opposed, 4 stroke-cycle L head gas/gasoline Model K532S and K582S engines. Both feature pressure type lube system with full-flow oil filter. Please take a few moments to familiarize yourself with the engine through the material in this manual. Carefully follow all service recommendations to keep your engine in top condition and also to attain longest engine life. Some of the general specifications are listed below--refer to the appropriate service section for specific details, especially when an adjustment is involved.



#2 CYLINDER SIDE VIEW OF TYPICAL TWO CYLINDER MODEL

GENERAL SPECIFICATIONS

On gasoline fueled models use clean fresh REGULAR grade of leaded or non-leaded gasoline with octane rating of at least 85. The non-leaded (or low lead) fuels offer the advantage of reducing the amount of deposits which build up in the combustion chamber. Do not add oil to the gasoline.

SPECIFICATION	K532S	K582S
BORE X STROKE	3-3/8 x 3"	3-1/2 x 3"
DISPLACEMENT	53.7 cu. in.	57.7 cu. in.
WEIGHT (APPROXIMATE)	187 lbs.	187 lbs.
OIL REFILL CAPACITY (U.S. STANDARD MEASUREMENT)	3 quarts*	3 quarts*
SPARK PLUG SIZE	14mm	14mm
SPARK PLUG TIGHTENING TORQUE	22 ft. lbs.	22 ft. lbs.
SPARK PLUG GAP (GASOLINE)	.035"	.035"
SPARK PLUG GAP (LPG)	.018"	.018"
BREAKER POINT GAP	.020"	.020"
BATTERY (ELECTRIC START)	12 volt	12 volt

**Plus additional pint when oil filter changed.*

SAFETY PRECAUTIONS

Power mowers, garden tractors, snowblowers, and other machines powered by air-cooled engines have become so commonplace that we may forget the potential dangers involved in servicing and operation of such equipment. In the interest of safety, some general precautions are presented below as safety reminders. Remember that the best safeguard against accidents is the use of good common sense!

- **WARNING — LETHAL EXHAUST GAS!** An engine discharges carbon monoxide when operating, which causes death if inhaled for even a short period of time — operate only where deadly exhaust gases can be safely dissipated.
- **WARNING — DANGEROUS FUELS!** Use extreme caution when storing, handling and using fuels — they are highly volatile and explosive in vapor state. Store only in approved containers in well ventilated area away from spark or flame producing equipment. Never add fuel to tank while engine is running — stop engine and allow it to cool thoroughly to prevent fuel from igniting on contact with hot parts or ignition spark. Don't store gasoline inside occupied building.
- **WARNING — MOVING, HOT PARTS!** Imprudent operation of power equipment creates hazards to life and limb — never operate with safety guards removed, keep hands, feet, clothing away from moving and hot parts. Remember that an engine gets hot while running, and exhaust system components get extremely hot. Know how to make emergency stops — don't allow inexperienced persons to operate your equipment. Always disconnect or remove spark plug to prevent unintentional starting while working on equipment. Never tamper with governor setting to gain more power — the governor establishes safe operating limits. Overspeed not only shortens engine life but can be extremely hazardous. Keep people safely away from the operating area and be especially watchful for children. Stop the engine whenever you leave the equipment — don't allow it to idle unattended.
- **WARNING — GENERAL PRECAUTIONS!** Handle starting batteries carefully — they are filled with acid which can eat thru clothing, burn skin, and cause blindness. Keep in mind that a battery gives off highly flammable hydrogen gas while being charged — charge only in well ventilated area. While electrical energy produced in an engine ignition system may not be strong enough to cause injury, reaction to shock produced could cause you to pull away and into contact with hot or moving parts — keep away from ignition system while operating. Never operate without adequate muffler or with faulty exhaust system — exposure to excessive noise is not only tiring but can lead to impairment of hearing.

PRE-START CHECKS

Check oil level before each start-up and bring level up to, but not over, Full mark.

Check Cooling Air intake screens and clean as necessary to insure unobstructed flow of cooling air.

Replenish Fuel in tank with clean, fresh supply of Regular Grade, leaded or non-leaded gasoline.

Check oil level in driven equipment to make sure adequate lubrication is available.

Check safety guards to make sure all are in place and secure.

START PROCEDURE

For the exact starting procedure for your engine, refer to the equipment manufacturer's instructions. The following procedure applies to most applications.

STEP 1. Pull throttle valve about half way open for starting.

STEP 2. On engines with manual choke control close choke valve with cold engine- if restarting warm engine, little or no choking required.

STEP 3. Turn ignition switch on if unit so equipped or move key and hold in Start position until engine starts--released key will automatically return to run position. With push button starting, press and hold switch until engine starts.

STEP 4. Return Choke gradually to open position as engine warms up.

GENERAL SERVICES

SERVICE SCHEDULE

SERVICE AT INTERVALS INDICATED	DAILY (PRE-START)	EVERY 50 HOURS	EVERY 100 HOURS	EVERY* 500 HOURS*
CLEAN AIR INTAKE SCREEN	X			
CHECK OIL LEVEL	X			
REPLENISH FUEL SUPPLY	X			
SERVICE AIR CLEANER		X		
CLEAN EXTERNAL SURFACES OF UNIT		X		
CHANGE LUBE OIL		X		
CHANGE LUBE OIL FILTER			X	
SERVICE FUEL FILTER			X	
SERVICE OR REPLACE SPARK PLUGS			X	
REPLACE ELEMENT - DRY AIR CLEANER			X	
CHECK AND SERVICE BREAKER POINTS*				X
CHECK IGNITION TIMING*				X
CHECK VALVE - TAPPET CLEARANCE*				X
SERVICE CYLINDER HEADS*				X

**Have these services (500 hour) done only by qualified engine specialist.*

NOTE: Intervals stated are for good, clean operating conditions only--service items more frequently (even daily) if extremely dusty or dirty conditions prevail.

COOLING SYSTEM SERVICE

On engines with the standard forced air cooling system, rotation of the blades or fins on the flywheel causes cooling air to be drawn in through the rotating air screen where it is forced through the blower housing and baffles past the cooling fins on cylinder block and heads where it is finally ejected as heated air toward the rear of the engine. In all applications, recirculation of the heated air must be avoided--make sure air heated by the engine cannot be drawn back into the air intake.

The rotating air screen and cooling fins must be kept clean and unobstructed at all times. DO NOT operate engine with blower housing, baffles or any other cooling shrouds removed as this will result in improper circulation past the cooling fins and overheating.

Other external surfaces of an engine should also be kept free of oil and dirt accumulation. This should be done not only for safety and appearance but because poor cooling efficiency results from dirty external surfaces on engine and components.

AIR CLEANER SERVICE

Under normal operating conditions, disassemble and service air cleaner components every 50 hours of operation. Do this more frequently (even daily) if extremely dusty or dirty conditions prevail. The dry type element is cleaned by gently tapping on a flat surface--when doing this, be careful not to damage gasket surfaces on element. Do not attempt to clean dry type elements in any liquid or with compressed air as this will damage paper filter material. Wipe dirt or dust accumulation from cover including base plate where used.

Dry type elements should be replaced after each 100 to 200 hours--replace at 100 hours if engine operated under dirty conditions--replace every 200 hours under good clean air conditions. Replace element sooner if engine loses power due to clogged filter.

The importance of maintaining an air cleaner in proper condition cannot be overemphasized! Dirt induced through improperly installed, improperly serviced or inadequate elements, wears out more engines than does long hours of operation. Even a small amount of dirt will wear out a set of piston rings in just a few hours. Furthermore, operating with a clogged element causes the fuel mixture to be richer which can lead to formation of harmful sludge deposits in the engine. Always cover carburetor or air intake horn when air cleaner is removed for servicing. Do not neglect servicing air cleaner at recommended intervals and use only genuine Kohler parts for replacement. Keep other air intake components such as adapters, hoses, clamps, etc. secure and in good condition to prevent entrance of unfiltered air.

LUBRICATION

CAUTION: New engines are usually shipped from factory with dry sump--check to make sure proper amount of oil is in the engine or added before engine is started for the first time. (Also add oil as needed to driven equipment such as wet type clutch.)

The lubricating oil level must be maintained in the "safe" operating range at all times. Oil level must be between the L (low) and F (full) marks on the dipstick. Always clean area around dipstick so that dirt does not fall into engine when dipstick is removed. Check daily and add oil as necessary to maintain proper level--DO NOT OVERFILL--oil level must not exceed the F mark.

OIL CHANGE: The oil must be changed every 50 hours when operating under normal conditions or more frequently under dirty, dusty conditions. On a new engine, change oil after the first 5 hours and thereafter at 50 hour intervals. Drain oil while it is hot for it will then flow more freely and thus carry away more impurities. Change the oil filter at every other oil change (every 100 hours).

After completely draining old oil, reinstall drain plug then remove oil filler cap and add 3 quarts of oil to begin with--check the oil level on the dipstick before adding more--bring the level up in the safe range but do not exceed the full mark. If the oil filter has been changed, add one more pint (half quart) of oil to start with. Select oil weight and type according to outside temperature from the chart below.

Straight weight is recommended, if available.

AIR TEMPERATURE	OIL VISCOSITY	OIL TYPE
ABOVE 30°F (-1.1°C)	SAE 30 or 10W-30 or 10W-40	API SERVICE SE
30°F(-1.1°C) to 0°F(-17.7°C)	SAE 10 or 5W-30, 10W-30	API SERVICE SE
BELOW 0°F (-17.7°C)	SAE 5W-20 or 5W-30	API SERVICE SE

Change oil every 50 hours--Filter every 100 hours

On new or overhauled engines or those rebuilt with new short blocks or miniblocks, use a single viscosity non-detergent oil during the first 5 hours of operation to promote seating of the piston rings. After the initial run-in period, change to the oils listed above.

OIL PRESSURE: When operating at normal temperature and with the proper weight of oil in the engine, pressure should be within the following range:

IDLE	LOAD
40-50psi	45-60psi

If pressure is lower than the minimum stated, this could indicate worn bearings or a faulty oil pump. If pressure builds up too high, this may indicate dirty restricted oil lines or filter or an improperly adjusted oil pressure relief valve. If readjustment is called for, the adjustment is located on the crankcase just forward of the #1 cylinder. To adjust, loosen the jam nut and lock nut then turn the adjusting screw in or out as needed to get the pressure within limits--make sure engine temperature is up to normal and that it has the proper weight of oil when making this adjustment. Retighten jam nut to lock the screw in the new position.

OIL FILTER: Failure to change oil and oil filter elements at the recommended intervals can lead to serious damage to the engine. This is especially true when using detergent oils which have the ability to hold a specific amount of unfilterable impurities in suspension; however, when a saturation point is reached, the oil may suddenly break down to form a gelatin-like substance which seriously impairs and can even stop flow of lube oil. An oil filter does a very effective job; however, it must be replaced each 100 hours of operation (every other oil change) under normal conditions or more often if the engine is subject to extremely dirty conditions.

After the proper amount of lubricating oil is added to engine (additional pint required when filter replaced) and after the engine is restarted and again placed in operation, check area around cartridge for evidence of oil leakage--correct if necessary by turning cartridge tighter into adapter (clockwise direction).

FUEL SYSTEM

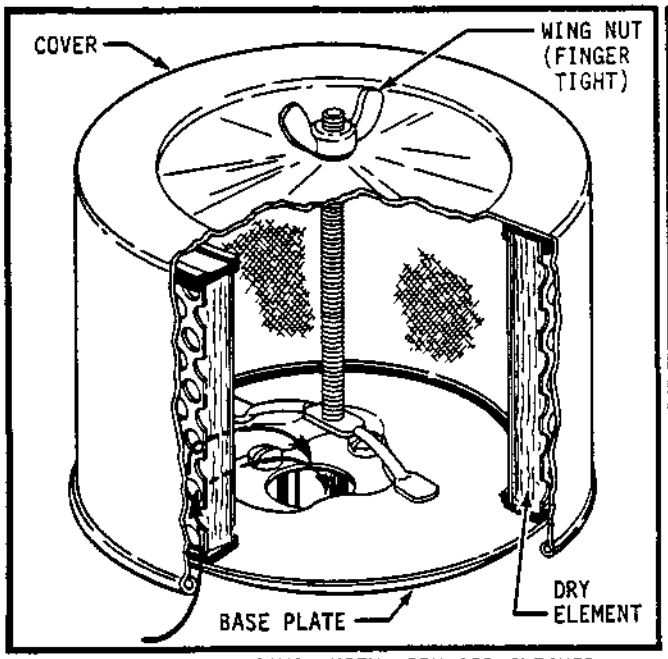
CARBURETOR

Carburetors are adjusted in the factory and should not have to be reset. If, however, one of the following conditions is noted, readjust carburetor immediately as continued operation with incorrect setting can lead to fouled spark plugs, overheating, excessive valve wear or other problems. If black exhaust smoke is noted, check the air cleaner first--an "overrich" mixture is usually caused by a poorly serviced, clogged air cleaner element, not an improperly adjusted carburetor.

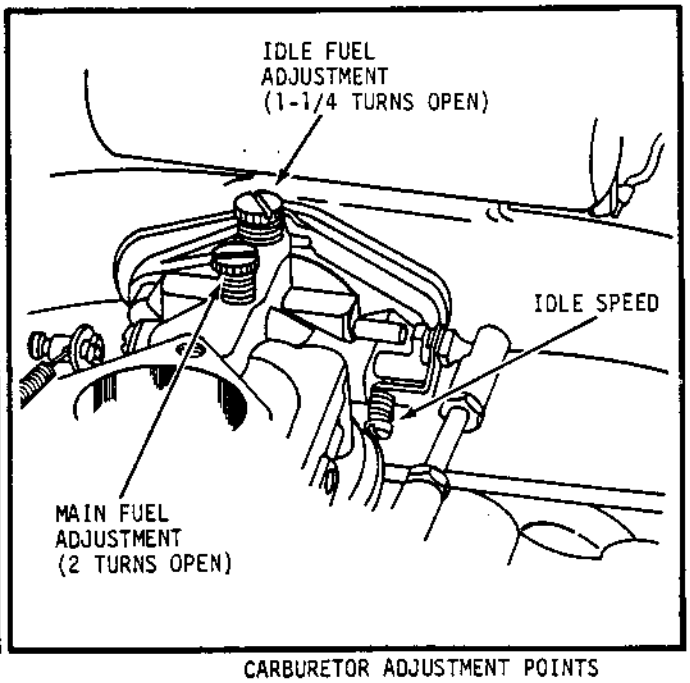
	CONDITION		POSSIBLE CAUSE/PROBABLE REMEDY
A.	Black, sooty exhaust smoke, engine sluggish.	A.	Mixture too rich - readjust main fuel needle.
B.	Engine misses and backfires at high speed.	B.	Mixture too lean - readjust main fuel needle.
C.	Engine starts, sputters and dies under cold weather starting.	C.	Mixture too lean - turn main fuel adjustment 1/4 turn counterclockwise.
D.	Engine runs rough or stalls at idle speed.	D.	Idle speed too low or improper idle adjustment - readjust speed then idle fuel needle if needed.

If readjustment becomes necessary, stop the engine, then turn the MAIN and IDLE fuel adjusting screws all the way in until they bottom lightly--don't force them closed as this will damage the needle valves. For preliminary setting, turn MAIN fuel screw out (counterclockwise) 2 full turns and the IDLE 1-1/4 turns. For final adjustments, start engine and allow it to warm up then operate at full throttle and under load, if possible. Turn MAIN fuel in until engine slows down (lean side) then out until it slows down again from overrich setting--note positions of screw at both settings, then set it about halfway between the two. The IDLE fuel setting can then be adjusted in the same manner for smoothest idle. Rough idle is often due to the idle speed being set too low--check this also.

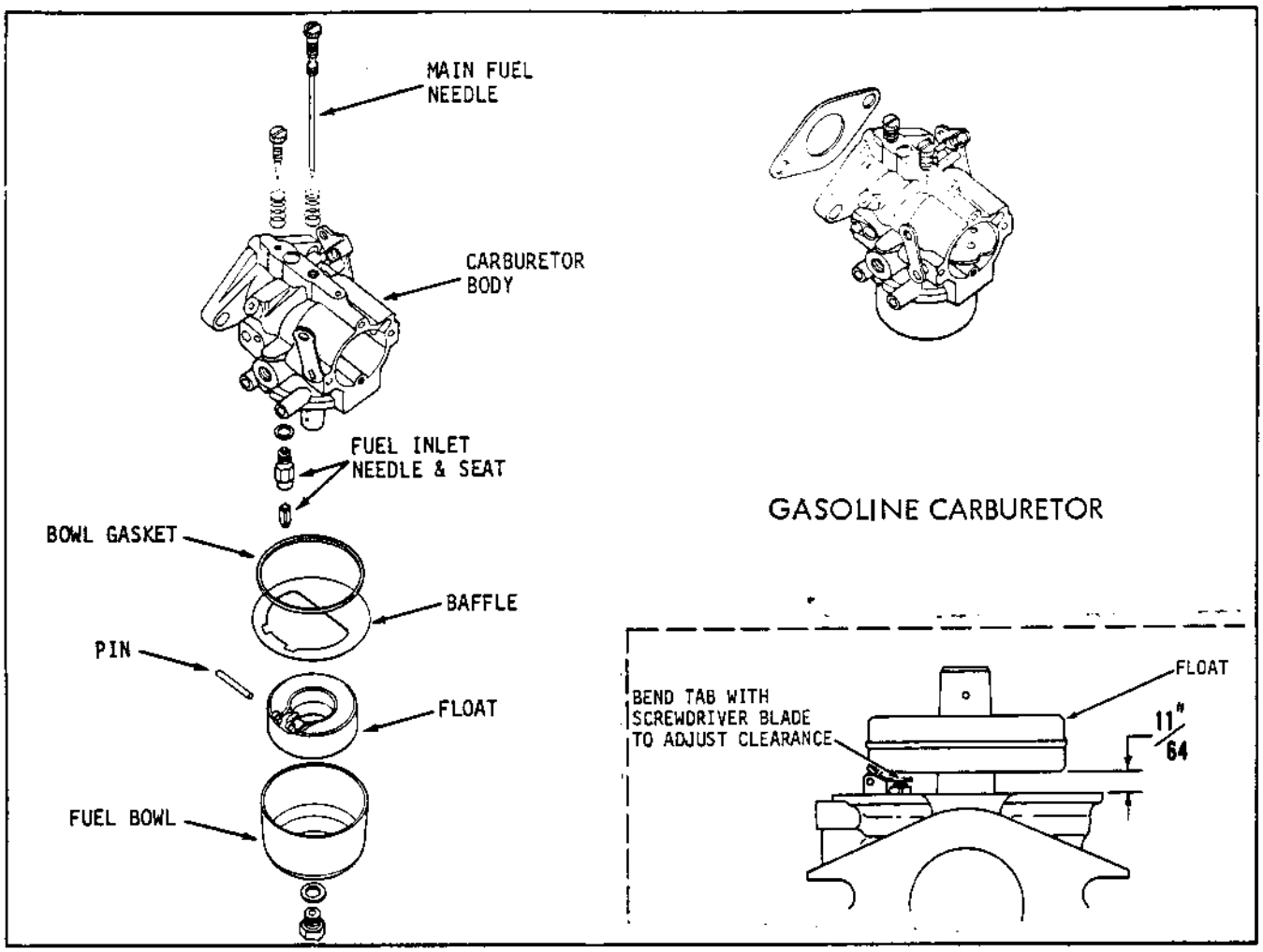
Carburetor Reconditioning: Hard starting, loss of power and rough idle are some of the problems that can be attributed to improper adjustment or dirt, gum or varnish deposits within the carburetor. If a problem still exists after carburetor is readjusted, the carburetor should be disassembled and thoroughly cleaned. This should also be done as a regular pre-season service after engine has been stored for a considerable length of time.



CUTAWAY VIEW--DRY AIR CLEANER



CARBURETOR ADJUSTMENT POINTS



DISASSEMBLED VIEW -- SIDEDRAFT CARBURETOR

All parts should be cleaned in solvent. Gum is easily removed with alcohol or acetone solvent. Be sure carbon deposits are removed from bore especially in area where throttle plate seats in casting. Blow out all passages with compressed air. DO NOT use wire brush or drill to clean out jets. Replace all worn and damaged parts. Always use new gaskets. Carburetor repair kits are available for most carburetors--kits include bowl nut gaskets (when required) bowl ring gasket, float pin, bowl baffle gasket, and fuel inlet needle and seat.

Disassembly - Side Draft Carburetor

1. After removing carburetor from engine, remove bowl nut and separate bowl from carburetor body. Remove and discard bowl ring and bowl baffle gaskets.
2. Remove float pin and float. Check for dents, leaks and excessive wear on float in needle valve contact area. Check pin brackets for wear. Replace float as necessary.
3. Remove and discard fuel inlet needle, needle seat and gasket. Any wear on needle or seat can cause improper fuel level--always use new parts.
4. Remove idle and main fuel adjusting needles and springs. Inspect needle points--replace needle if chipped or grooved.
5. DO NOT REMOVE choke and throttle plates and shafts. If these parts are worn or damaged, replace carburetor.
6. Thoroughly clean carburetor per instructions in reconditioning paragraph.

Reassembly - Side Draft Carburetor

1. Install new fuel inlet needle seat, gasket and fuel inlet needle.
2. Install float and float pin. Invert casting so that float lip rests lightly against fuel inlet needle. There should be 11/64" (plus or minus 1/32") clearance between machined surface of casting and free end of float (side opposite needle seat). Adjust clearance by carefully bending float lip with needle nose pliers.
3. Install new baffle gasket, bowl ring gasket then install bowl and secure with bowl nut (with bowl nut gasket in place and centered properly).
4. Install idle fuel and main fuel needles and springs. Turn needles in until they bottom gently then back out 2 turns on main fuel needle and 1-1/4 turns on idle fuel needle for preliminary adjustment. DO NOT use force on needles.

KOHLER LPG GAS CARBURETOR (MODEL PC2-10) GAS CARBURETOR

The model PC2-10 can be classified a diaphragm type carburetor although it also uses a venturi. The diaphragm arrangement provides final regulation of the fuel which is received from the primary regulator (or vaporizer-regulator) at a pressure of about 8 psi. This pressure setting must not exceed 12 psi. The PC2 serves two functions--as a carburetor and as the secondary regulator.

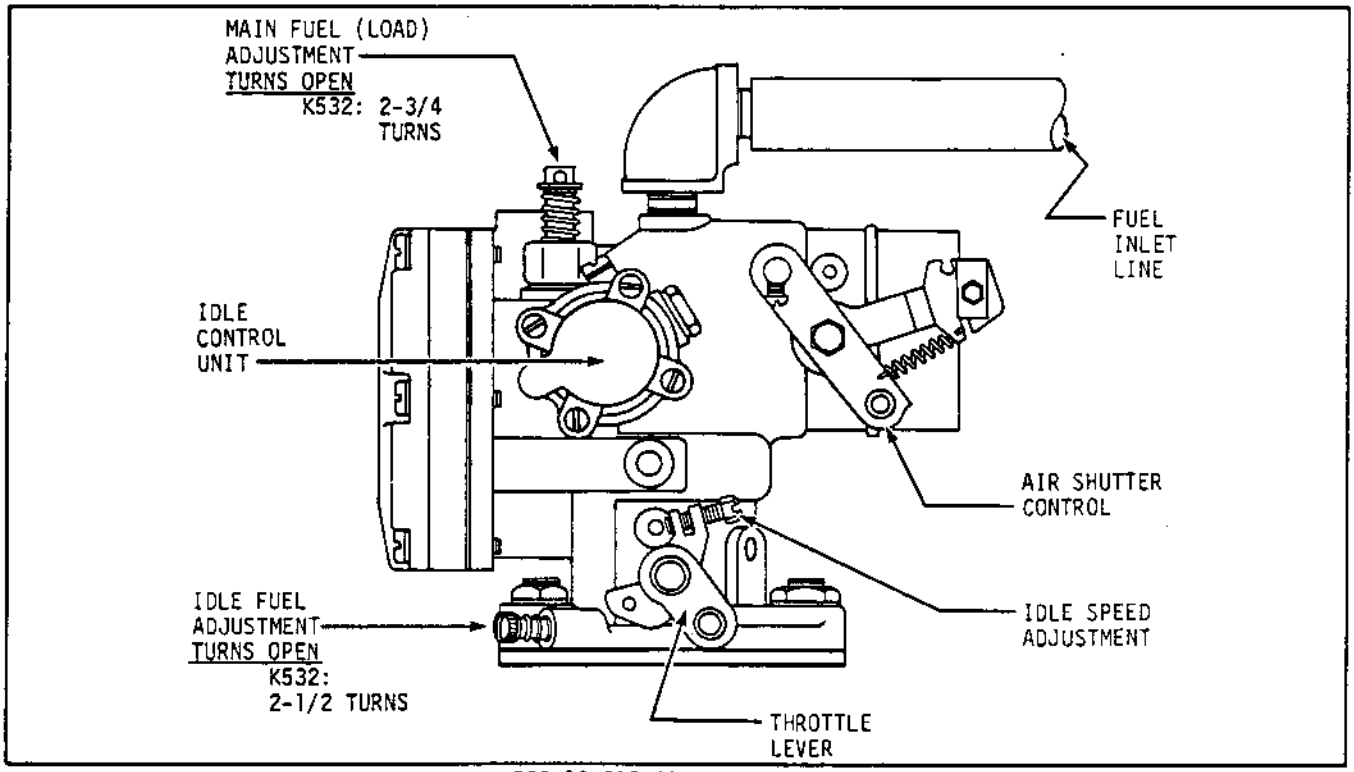
Operation: Fuel is supplied to the carburetor at above atmospheric pressure--as long as inlet pressure does not exceed 20 psi, the regulator segment will block off fuel and prevent leakage into the engine when it is not operating. Briefly, when the engine is in operation, flow of air thru the carburetor causes pressure differences which act upon diaphragms which, in turn, activate a fuel lever to admit fuel according to engine demand. When the engine is at low idle speeds, the fuel is directed into the engine thru separate idle discharge jets which permit operation even when flow of air through the venturi would be too low to draw sufficient fuel to sustain operation. The carburetor also features a back suction type of "economizer" which meters an economy mixture of fuel during part throttle and part load operation. At full throttle and full load operation, the position of the throttle plate is such that maximum fuel is metered to the engine. The maximum amount of fuel allowed is determined by setting of the main fuel (load) adjustment.

Adjustment: For preliminary adjustment of carburetor refer to the illustration below. Turn screws in lightly against seats--before opening--do not force closed. Final adjustments are made as follows:

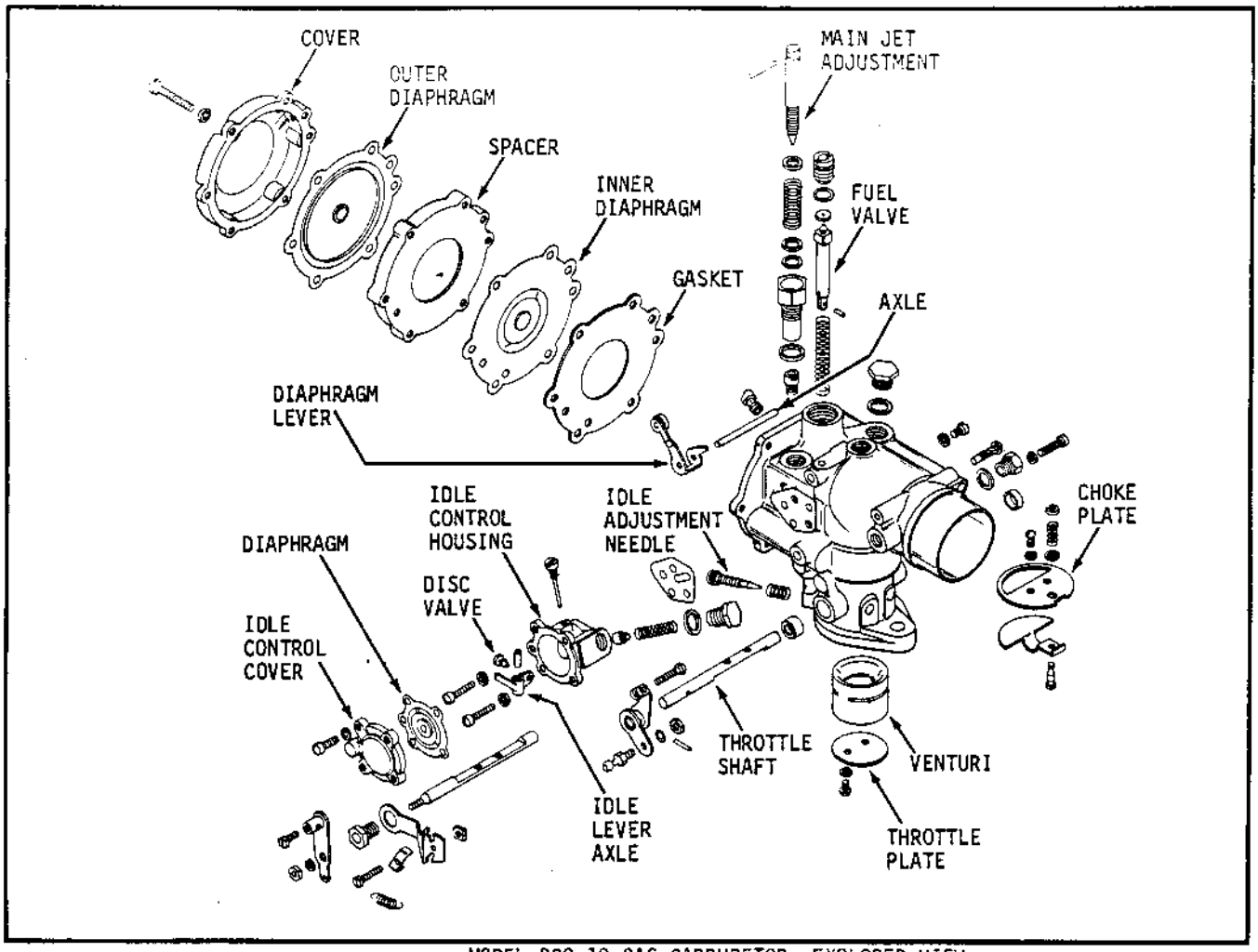
Idle: Start engine, move throttle to idle position, adjust idle speed to proper range. Move idle fuel adjusting screw in and out until smoothest idle is attained.

Load: Allow engine to warm up, then open throttle and place under normal load. Move main fuel adjustment in until engine starts to slow down from lean mixture then turn adjustment in the opposite direction until engine speed increases then starts to slow down again from overrich mixture. Move adjustment halfway between lean and overrich settings for best mixture under normal load.

Reconditioning: The PC2 does not require service at regular intervals. If carburetor troubles occur that cannot be remedied by readjustment, the carburetor should be completely disassembled and reconditioned. Replace all diaphragms, gaskets, O-rings and dust seals when reconditioning. Use the Kohler Repair Kit (see parts manual) for this carburetor when reconditioning. The following special tools are required for satisfactory overhaul: Main Jet Wrench (#C161-193), Fuel Valve Lever Gauge (#C161-194), Aligning Studs (#C166-52 set).



PC2-10 GAS CARBURETOR



MODEL PC2-10 GAS CARBURETOR, EXPLODED VIEW

The following sequence is suggested for reconditioning PC2 carburetor after it has been disconnected and removed from engine:

Disassembly

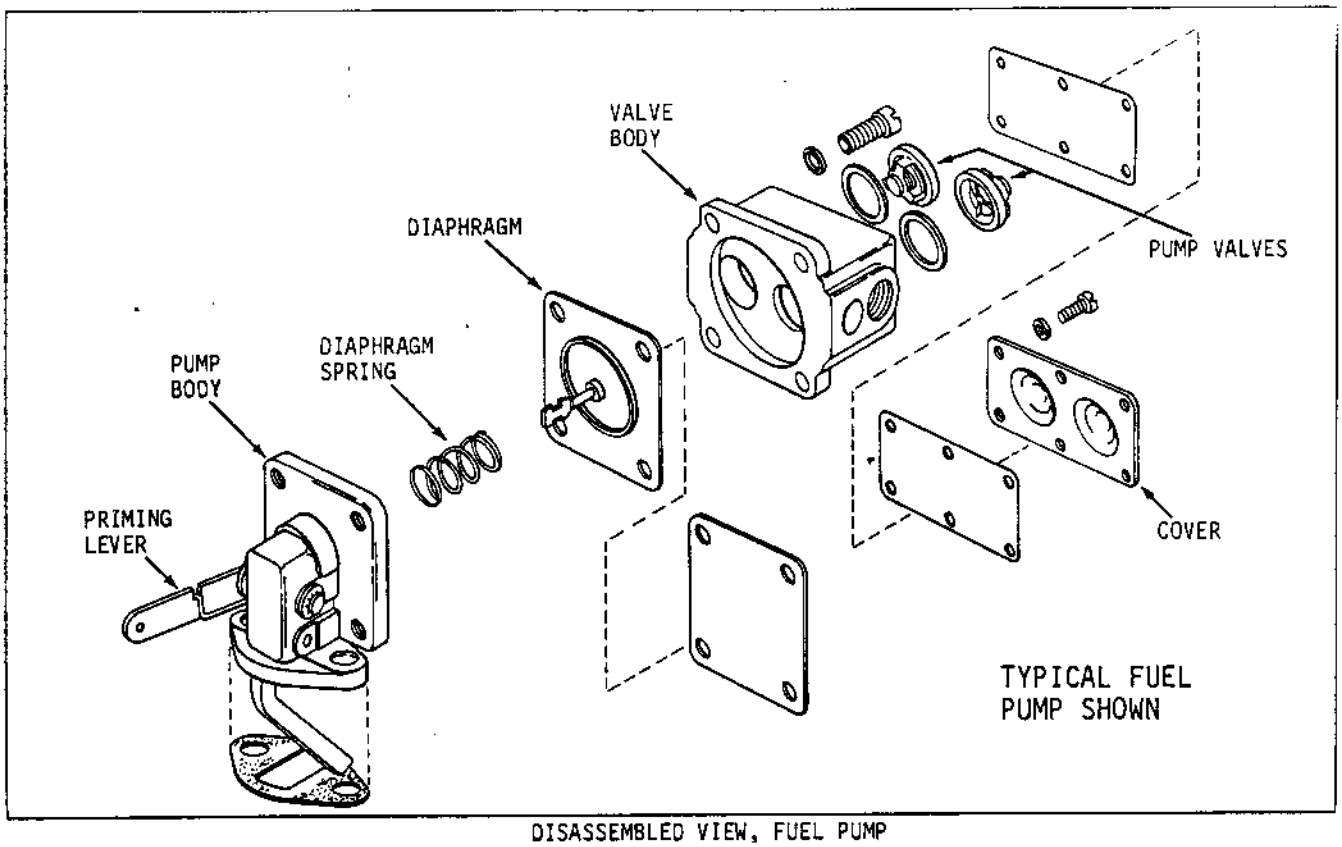
1. Throttle: Turn throttle stop screw to left until plate is fully closed. Remove screws and throttle plate. Remove economizer valve plug and valve then throttle shaft and seal retainers and seals.
2. Venturi: Remove venturi retaining screw then slip venturi out of carburetor throat.
3. Choke: Remove choke plate screws, choke plate and choke shaft.
4. Idle Diaphragm: Remove idle adjusting needle and spring. Remove four cover screws on idle control unit, remove cover, diaphragm, control channel plug, fibre washer and spring. Remove idle lever axle, lever and rubber disc valve. Remove the two housing screws then remove idle diaphragm housing and gasket.
5. Regulator Diaphragm: Remove four cover screws then remove regulator diaphragm as a unit. Separate components, discard used diaphragms.
6. Main Fuel Valve: Remove fuel valve axle retainer, axle and valve lever. Loosen inlet orifice setscrew (8-32 Allen) then remove orifice. Remove inlet valve stem and spring. Remove main fuel adjusting needle. Use 5/8" socket wrench to remove main jet body. Use C161-193 tool to remove main jet.

Reconditioning

Discard all diaphragms, gaskets, O-rings and throttle shaft seals. Thoroughly clean all parts in carburetor cleaner, blow out all passages. Make sure all gasket material is removed from surfaces. Inspect parts for wear or damage--especially needles and seats--replace defective parts.

FUEL FILTER

A sediment bowl type fuel filter is usually used to trap any solid impurities in the gasoline. Before servicing, turn fuel off at valve located on top of filter assembly, then loosen retaining bail at bottom of fuel bowl, remove and clean bowl. If filter element is used, swish element in clean solvent. After reinstalling and opening fuel valve, use primer (if so equipped) on fuel pump to pump fuel back into bowl.



DISASSEMBLED VIEW, FUEL PUMP

FUEL PUMPS

All Kohler Two Cylinder Engines have a mounting pad and provision on top of crankcase for a mechanically operated fuel pump. The mechanical pump operates off a cam on the camshaft. The fuel pump lever rides on the cam and transmits this mechanical action to a diaphragm within the pump body. Most mechanical pumps have an external lever for priming. Repair kits are available for reconditioning fuel pumps.

Reconditioning Procedure

1. Remove fuel lines and mounting screws holding pump to engine.
2. With a file, make an indicating mark across a point at the union of fuel pump body and cover. This is a positive marking to assure proper reassembly. Remove assembly screws and remove cover.
3. Turn cover over and remove valve plate screw and washer. Remove valve retainer, valves, valve springs and valve gasket, noting their position. Discard valve springs, valves and valve retainer gasket.
4. Clean fuel head thoroughly with solvent and a fine wire brush.
5. Holding pump cover with diaphragm surface up, place new valve gasket into the cavity. Now assemble the valve spring and valves into the cavity and reassemble valve retainer and lock in position by inserting and tightening fuel pump valve retainer screw.
6. Place pump cover assembly in a clean place and rebuild the lower diaphragm section.
7. Holding mounting bracket, press down on the diaphragm to compress spring under it, then turn bracket 90° to unhook diaphragm so it can be removed.
8. Clean mounting bracket with a solvent and a fine wire brush.
9. Replace the diaphragm operating spring, stand new spring in casting, position diaphragm and press down on diaphragm to compress spring and turn it 90° to reconnect diaphragm.
10. Hold mounting bracket, then place the pump cover on it (make sure that indicating marks are in line) and insert the screws. DO NOT TIGHTEN. With the hand on the mounting bracket only, push the pump lever to the limit of its travel and hold in this position while tightening the four screws. This is important to prevent stretching the diaphragm.
11. Mount the fuel pump on engine, using the new mounting gaskets. Reconnect the fuel lines.

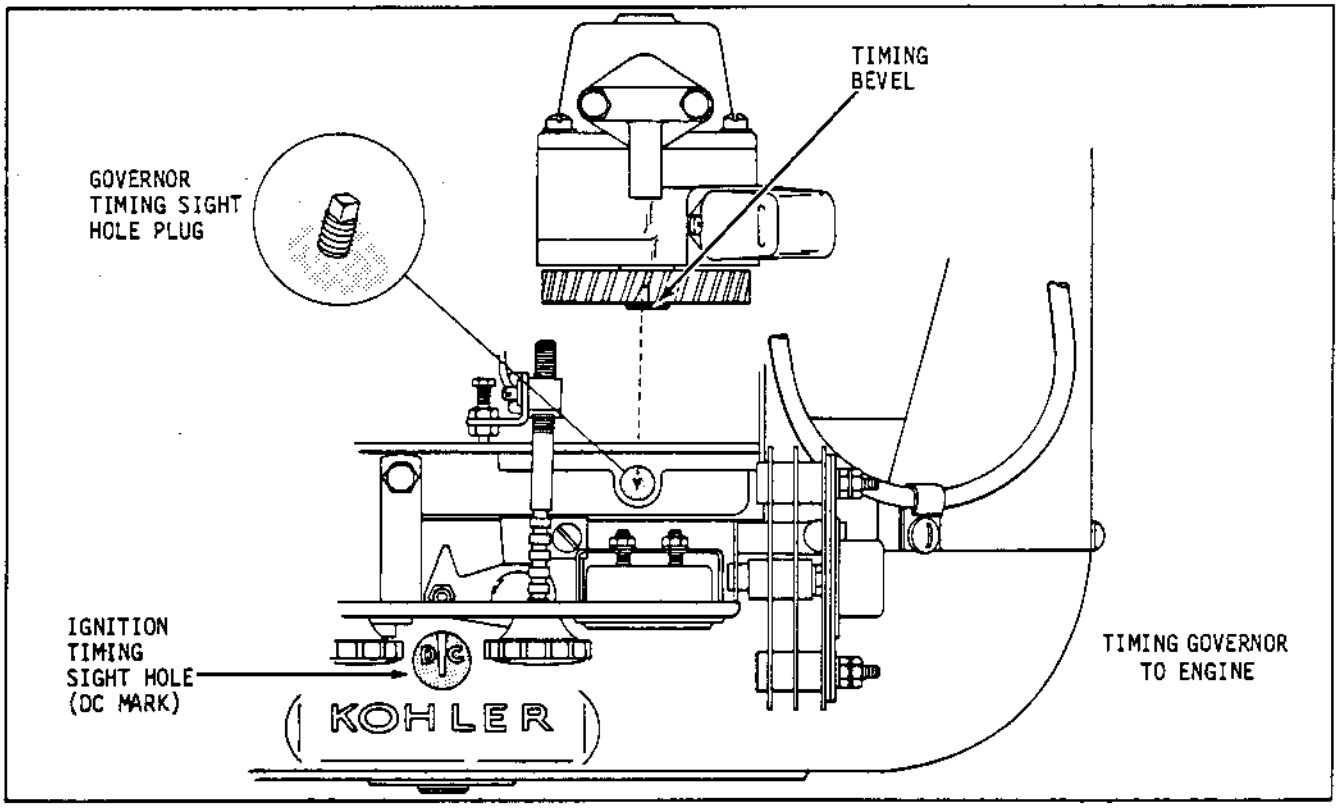
GOVERNOR

These 2 cylinder engines are equipped with centrifugal flyweight type mechanical governors which are externally mounted at the rear of the gear cover and driven off the camshaft gear. The governors are self-contained units except that lubrication is provided through an external oil line which connects the engine lubrication system to the governor. Always make sure linkage between governor and carburetor moves freely. If governor is out of adjustment, engine speed will surge or hunt with changing load or speed will drop considerably when a normal load is applied. Governors also function to establish safe operating speed limits--these must not be exceeded.

The breaker points are mounted on the governor and are activated by the breaker rod which rides on a cam on the governor drive shaft on this engine. For this reason, it is necessary to retime this governor to the engine if removed. This is initially done during assembly of the engine and it will not have to be done again unless governor has been removed from the engine. Timing should be done only at an authorized service center.

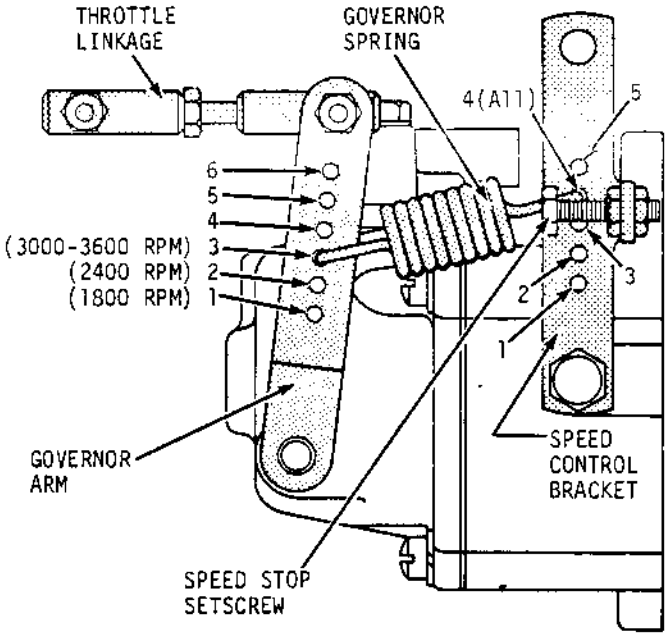
Installation and Timing: Use the following procedure to install and retime the governor to the engine:

1. Uncover ignition timing sight hole on blower housing and also remove sight hole plug located at top of gear cover.
2. Turn engine over until Top Dead Center (DC) mark on flywheel is centered in ignition timing sight hole.
3. One of the teeth on the governor gear has a special timing bevel or deep chamfer--turn gear so that this tooth is in the approximate 12 o'clock position or where it can be observed in the gear cover sight hole after governor is installed.



4. Install gasket and governor then secure to gear cover with two capscrews. Before closing gear cover sight hole with plug, check to make sure beveled tooth on cam can be observed in hole.
5. Ignition timing must be readjusted after governor is installed--see Ignition Timing instructions for exact details.

Governor Sensitivity Adjustment: If the governor is too sensitive, speed surging will occur with change in load. If a big drop in speed occurs when normal load is applied, the governor should be set for greater sensitivity. Sensitivity can be adjusted by repositioning the governor spring in different holes in the governor arm. Normal hole settings for different operating speeds are shown above. To make governor control more sensitive, move spring hook into holes higher up on the governor arm. To make governor control less sensitive, move spring hook in holes spaced further apart. Move spring one hole at a time and recheck sensitivity and speed after each move.



VARIABLE SPEED GOVERNOR

SPEED ADJUSTMENT:

1. Start engine and operate at full throttle (no load).
2. Check engine speed with hand tachometer--if within 50 RPM of specified limit, readjustment is not absolutely necessary.
3. Loosen locking nuts on speed stop setscrew--turn screw out or in as necessary to attain specified top speed. Retighten locking nuts to secure stop at new setting.

NOTE Maximum speed is set at 2500 RPM no load.
Recommended engine operating speed is 2400 RPM under load.

IGNITION TIMING PROCEDURE

The breaker point assembly is mounted externally on the governor. The breaker rod rides on a cam on the governor drive shaft. The governor is therefore timed to the engine and must be retimed if it has been removed for any reason (refer to Governor Instructions). The governor also incorporates an automatic spark advance-retard mechanism.

Several different types of timing lights are available--follow the manufacturer's instructions for the particular type of timing light used. The following procedure can be used with most timing lights. Rotating the governor advances or retards the timing depending on which way the unit is turned.

1. If boot type lead is used, remove boot at #1 cylinder (nearest flywheel) then wrap one end of a short piece of fine wire around spark plug terminal. Reconnect boot to terminal so that free end of the wire can protrude under the boot. (Step 1 applies to timing lights having alligator clips.)
2. Connect one of the timing light leads to the wire protruding from under the boot.
3. Connect second timing light lead to hot (ungrounded) side of battery--see timing light instructions for proper battery size, wire connections, etc.
4. Connect third timing light lead to common ground.
5. Before starting, rotate engine until "SP" mark is observed in timing sight hole--chalk mark the line for easy reading.
6. Start engine and operate at 1200 RPM or above. Aim timing light into sight hole--light should flash just as "SP" mark is centered in sight hole. If light flashes before mark is centered, timing is overadvanced. If light flashes after mark is centered, timing is retarded.
7. To adjust, loosen (do not remove) governor flange mounting capscrews and shift or rotate until timing mark is exactly centered as light flashes. Retighten flange mounting screws after exact timing is achieved.

IGNITION SYSTEM

Engine skip, hard starting, poor performance is most often due to incorrect plug gap or breaker point gap. These symptoms may also appear when the plug is fouled or in poor condition or when the points are burned or pitted. The following service recommendations apply to all systems except, of course, the breakerless system which does not have breaker point or condenser as discussed.

SPARK PLUG: Check condition and reset gap at about 100-hour intervals. The gap gradually widens as the electrodes wear under normal conditions. Always clean area around plug before removing to prevent dirt from falling into the head as the plug is removed. Carefully check condition of electrodes after removing the plug as this usually offers a good indication of operating conditions. If the plug has a light coating of gray or tan, this usually indicates normal conditions. A dead white blistered coating may indicate overheating while black coating usually comes from operating with overrich fuel mixture which can be caused by clogged air cleaner or carburetor out of adjustment.

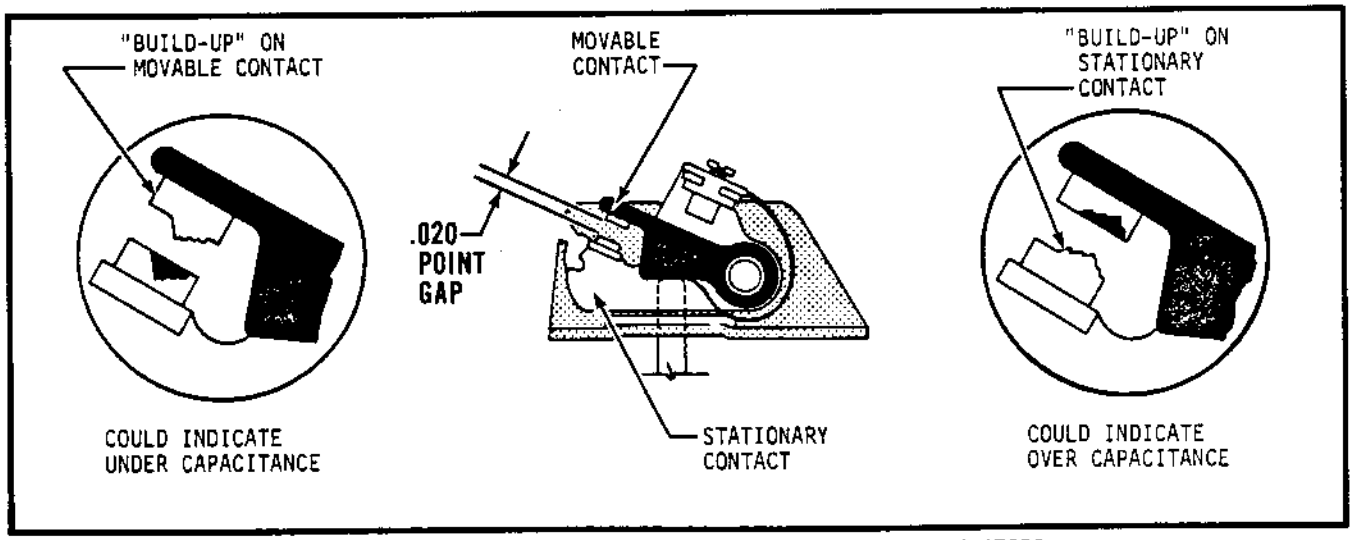
Do not sandblast, wire brush, scrape or otherwise attempt to service a plug that is badly fouled or in poor condition--best results are obtained with a new plug. Before installing plug, set gap at .035" for gasoline operation, then tighten the spark plug with a torque wrench to 22 foot pounds.

	SIZE	STANDARD GASOLINE	SPARK GAP	TORQUE
SPARK PLUG	14MM	H10 OR EQUIVALENT	.018" (LPG) .035" (Gasoline)	22 FT. LBS.

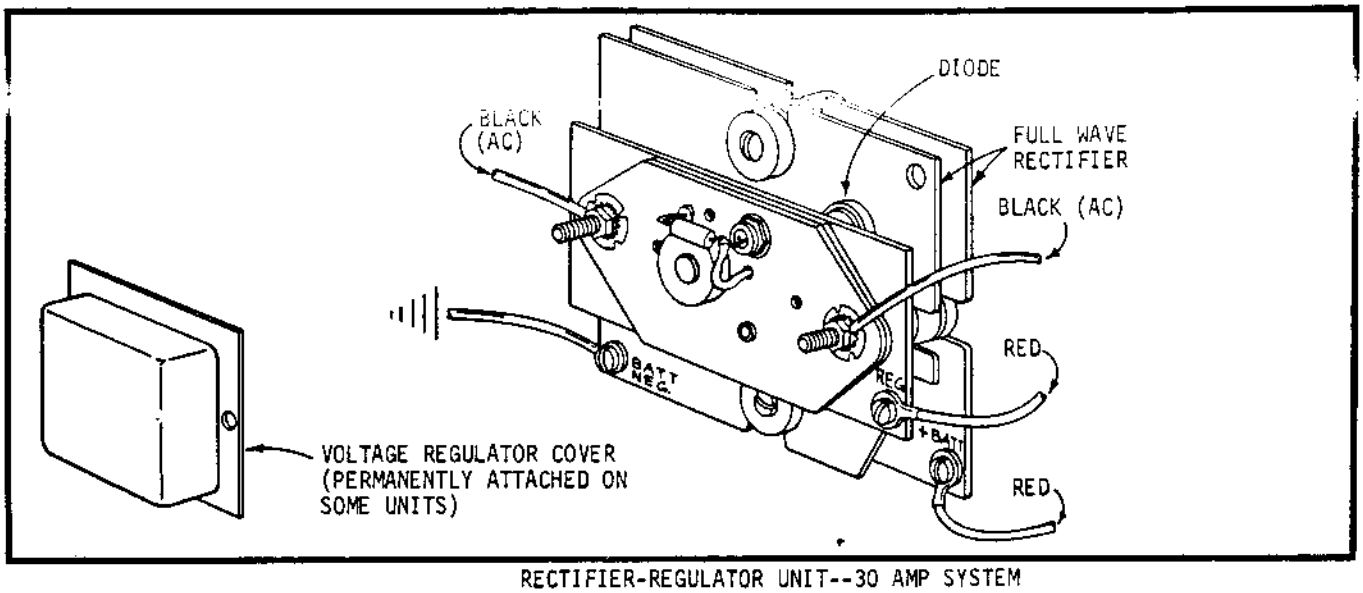
BREAKER POINTS: Every 500 hours breaker points should be inspected and serviced. If oxidized, dirty or oily, lean with coarse cloth--do not use emery cloth or sandpaper. Slightly pitted points can be dressed with point file--replace badly pitted or burned points. The gap must be adjusted whenever points are serviced or replaced since this setting establishes ignition timing. To adjust, turn crankshaft until points are wide open or at maximum separation then check with feeler gauge. If gap is not .020", loosen adjusting screw and shift movable plate until correct gap of .020" is obtained. After retightening screw, check to make sure gap is still properly set as this sometimes alters the setting slightly.

CONDENSER: If the condenser shorts out, the coil will be unable to function at all. If it opens and decreases in capacitance, the output voltage will be greatly reduced and the ignition points will burn excessively. If condenser has too little capacitance, metal will transfer from the stationary contact to the movable contact. If capacitance is too great, the metal will build up on the stationary contact. Make sure the condenser is the correct one for your engine.

IGNITION COIL: These coils do not require servicing on a regular basis; however, they should be kept in clean condition and the terminals and connections must be tight to provide good electrical contact. The rubber nipple on the high tension terminal must be in good condition to prevent leakage of current across exposed surfaces.



BREAKER POINT GAP - POINT CONDITION INDICATORS



RECTIFIER-REGULATOR UNIT--30 AMP SYSTEM

30 AMP ALTERNATOR SYSTEM

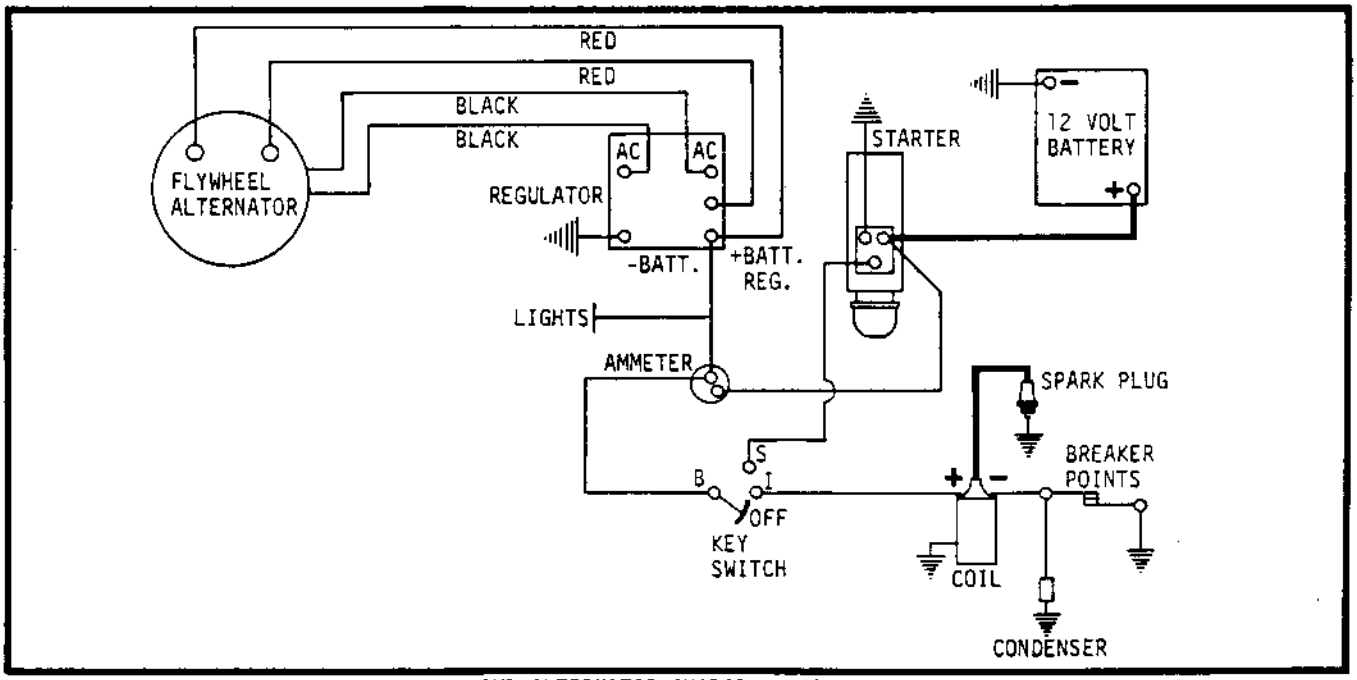
The main components of this system are:

1. Permanent magnet ring
2. Alternator stator
3. Rectifier-Regulator

The magnet ring is inside the flywheel, the stator is assembled to the bearing plate or gear housing and the rectifier-regulator is mounted on the outside of the engine or, in some cases, on the equipment powered by the engine.

Operation: As the magnets rotate around the stator, an Alternating Current (AC) is induced in the primary windings of the stator. This current is carried thru the two black leads to the full wave rectifier segment of the rectifier-regulator where it is converted to Direct Current (DC) for charging the battery.

Regulation is provided by the solid state (no moving parts) electronic devices in the rectifier-regulator. These "sense" battery voltage and allow a bucking current to flow in the secondary or regu-



30 AMP ALTERNATOR CHARGING--BATTERY IGNITION SYSTEM

TROUBLE ANALYSIS - 30 AMP ALTERNATOR SYSTEM

CONDITION	POSSIBLE FAULT	TEST AND CORRECTIVE ACTION
NO OUTPUT	A. Faulty windings in stator	A. Remove four input leads from Rectifier - Regulator. Check resistance on RX1 scale of Ohmmeter. Replace stator if readings not at test values. Test 1 - Connect Ohmmeter leads to 2 red leads - about 2.0 ohms resistance should be noted. Test 2 - Connect Ohmmeter leads to 2 black leads - about 0.1 ohms should be noted.
	B. Defective diode(s) in rectifier	B. With engine stopped, connect leads of flashlight type continuity tester between BAT-NEG and one of the AC terminals then reverse these leads--lamp should turn ON one way and OFF the other. Repeat procedure on the other AC terminal. If lamp indication is the same both ways, diode is faulty.
NO CHARGE (When load applied to battery)	A. Faulty regulator winding	A. Remove red lead from "REG." terminal on Rectifier - Regulator. Start engine and operate at full speed. With regulator winding disconnected, alternator should charge at full output. Replace stator if full output of at least 30 amps is not attained.
FULL CHARGE - NO REGULATION	A. Faulty regulator winding	A. Remove 2 red leads from Rectifier - Regulator -- connect these two leads together then start engine and operate at full speed. A maximum 4 amp charge should be noted if stator is OK.
	B. Defective regulator	B. If stator checks out, trouble is in regulator portion of Rectifier - Regulator. Replace unit.

lator windings of the stator when the voltage reaches a specific level. Above this level, any increase in battery voltage brings about a corresponding increase in current flow in the regulator windings. As current increases in the regulator windings, its magnetic field bucks that of the primary winding which, in turn, decreases AC output to a corresponding degree.

Service: With the exception of the magnet ring, the 30 amp system has no moving parts and is, therefore, virtually service free. The only requirement is an occasional check to make sure that all connections are tight and that the leads are in good condition. If problems do occur, refer to the accompanying trouble shooting guide to pinpoint the cause.

Precautions: The following precautions must be taken to avoid damaging components of the 30 amp alternator system.

1. Battery polarity must be correct--negative (-) battery terminal is connected to ground.
2. Rectifier-regulator must be in common ground with engine and battery.
3. Make sure that no fuses, resistors or wires smaller than #10 AWG are in connection from battery to rectifier.
4. Disconnect wire at terminal marked "BATT. NEG." if arc welding is done on equipment in common ground with engine.
5. Disconnect battery to regulator lead when battery is being recharged.
6. DO NOT operate engine with battery disconnected from Alternator System.
7. Make sure AC leads are prevented from being grounded at all times.

ELECTRIC START

STARTING-MOTOR SYSTEM: These starters are pre-lubricated during assembly and do not require further lubrication or service under normal conditions. Starter service should be performed only at authorized repair shops.

Precautions: In the event of a "false start" (engine gets up sufficient speed to disengage starter but fails to continue running), the engine must be completely stopped before another starting attempt is made. If the flywheel is still rotating, the drive pinion and ring gear will clash and be damaged. Limit cranking (continuous) to a period of 30 seconds to prevent overheating of the starter. If cranked for 30 seconds, starter should not be operated again for 60 seconds to allow time for cooling.

Trouble Analysis: If starter fails to energize, first check wiring, starting switch or solenoid and condition of battery. Clean or replace badly corroded or dirty contacts--replace wires if frayed or cracked. Bypass start switch or solenoid with jumper wire--if starter cranks normally, replace defective switch or solenoid. If starter turns too slowly and battery is in good condition, check for dirty brushes or commutator. Further trouble analysis will require special test equipment available only at authorized repair stations.

BATTERY: Use 12 volt negative battery (- terminal ground) with amp hour rating of at least 32 for best results. When battery is in good condition, each cell contributes approximately 1.95 to 2.08 volts. If the charge is low and less than 0.05 volt difference is noted between the cells having the highest and lowest readings, the battery should be recharged. If the difference is more than .05 volts, this could indicate a cracked plate or other damage which could call for replacement of the battery.

To maintain a battery in top condition, check and perform the following services at frequent intervals:

1. Regularly check level of electrolyte--add water as necessary to maintain level above plates --do not overfill as this can cause poor performance or early failure due to loss of electrolyte.

2. Keep terminals and top of battery clean. Wash with baking soda and rinse with clear water. Do not allow soda solution to enter cells as this will destroy the electrolyte.

ENGINE STORAGE PROCEDURE

If engine is to be out of service for a considerable length of time during an off season period, for example, the following procedure is recommended to prepare the engine for storage:

1. Drain oil from crankcase while engine is still hot and flush with clean, light oil. Refill crankcase.

2. Drain fuel tank and carburetor. (Don't use stale fuel)

3. Remove, clean and replace sediment bowl.

4. Clean exterior surfaces of engine.

5. Spread a light film of oil over any exposed metal surfaces of engine that are subject to corrosion.

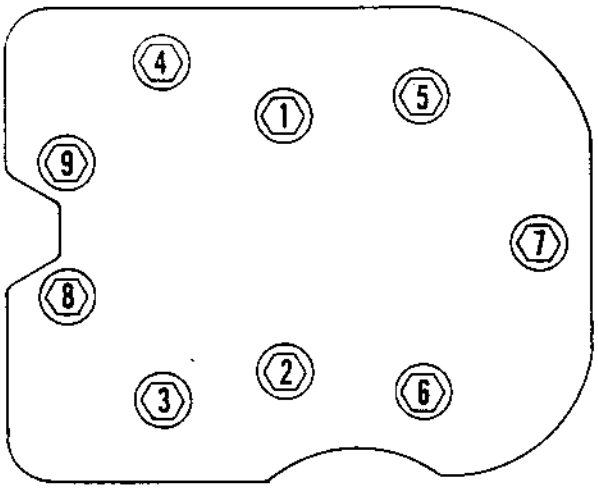
6. Pour tablespoon of oil into each spark plug hole, crank engine slowly by hand and replace spark plugs.

7. Store in clean, dry place.

PREVENTIVE MAINTENANCE

In addition to the routine services listed in this manual, there are other important preventative maintenance steps that should be taken to keep engine in top condition. Usually, the tools and instruments required for these additional steps are not available to the engine owner. For this reason, the engine should be returned periodically to an authorized Service Center for complete servicing and tune-up. The benefits of such service will not only be noted immediately in improved performance but, most important, in continued satisfactory operation during a long, trouble free service life.

ENGINE-GENERAL SERVICES



HEAD TIGHTENING SEQUENCE

TORQUE SPECIFICATIONS

Screw, connecting rod	300 in. lb.
Screw, cylinder head	35 ft. lb.
Screw, closure plate	30 ft. lb.
Screw, oil pan	30 ft. lb.
Nut, camshaft	40 ft. lb.
Nut, flywheel	115 ft. lb.
Spark, plug	18-22 in. lb.
Screw, manifold	300 in. lb.

CYLINDER HEAD SERVICE

After each 500 hours* of operation, the cylinder heads should be taken off the engine and serviced. Remove carbon deposits from combustion chamber in head. Scrape and remove carbon with a sharp piece of wood--wood or similar material is suggested to avoid scratching aluminum surfaces of head. Always use new cylinder head gaskets, make sure head bolts are tightened in the proper sequence and to the torque value stated in the opposite specifications.

*NOTE: Under certain operating conditions, such as continued light load or relatively constant speed, carbon may build up much more rapidly. If there are early indications of this, such as heavy deposits of carbon on spark plug electrodes, service the heads much more frequently. 250-hour intervals are suggested under these conditions.

TROUBLE SHOOTING

If trouble occurs, don't overlook causes that seem too obvious to be considered such as an empty fuel tank--check for the simplest causes first. To operate, an engine must have fuel, a good ignition spark and, of course, good compression--keep this in mind when trying to pinpoint the cause of a problem. The following is offered as a guide for correcting some of the problems that are possible with a 4 stroke cycle engine.

HARD STARTING OR LOSS OF POWER

a. Faulty ignition.
   1. Leads grounded or loose.
   2. Breaker points faulty or improperly gapped.
   3. Spark plug faulty or improperly gapped.
   4. Coil or condenser defective.
b. Faulty carburetion.
   1. Fuel line clogged (dirt-gum)
   2. Fuel pump faulty.
   3. Carburetor dirty or improperly adjusted.
c. Poor compression.
   1. Head loose or gasket leaking.
   2. Valves sticking or leaking.
   3. Piston rings worn.

OPERATING ERRATICALLY

a. Clogged fuel line.
b. Water in fuel.
c. Vent in gas cap plugged.
d. Faulty fuel pump.
e. Gasket leaking (carb.-manifold)
f. Governor improperly set.
g. Carburetor improperly adjusted.

KNOCKING

a. Fuel octane too low.
b. Ignition timing wrong
c. Carbon build-up in combustion chamber.
d. Engine overheated.

OCCASIONAL "SKIP" AT HIGH SPEED

a. Spark plug fouled, faulty or gap too wide.
b. Ignition timing wrong
c. Carburetor improperly adjusted.

OVERHEATING

a. Air intake screen or fins clogged.
b. Oil level too high (or low).
c. Fuel mixture too lean
d. Ignition timing wrong
e. Engine overloaded.
f. Tappet clearance too close.

IDLES POORLY

a. Idle Speed too low.
b. Idle Fuel improperly adjusted.
c. Gasket leaking (carb.-manifold)
d. Spark plug gap too close.

BACKFIRING

a. Carburetor set too lean (Main Fuel).
b. Breaker points improperly gapped (timing).
c. Valve sticking.

CRANKCASE BREATHER

The breather functions as a one-way valve to allow pressure to be expelled from the crankcase and also to block or prevent air from being drawn back into the crankcase. A proper functioning breather system thus helps maintain a slight vacuum within the crankcase.

Most of these models use a closed or positive type breather system. On these, a nonserviceable breather valve is pressed into the breather housing which is assembled to the governor. If the valve is faulty, replace breather-housing as a unit. A tube connects the breather to air inlet side of the carburetor. The flow of air to the carburetor thus creates a vacuum on the tube which pulls air (and fumes) from the crankcase to maintain vacuum. Keep tube connections tight.

VALVE SERVICE

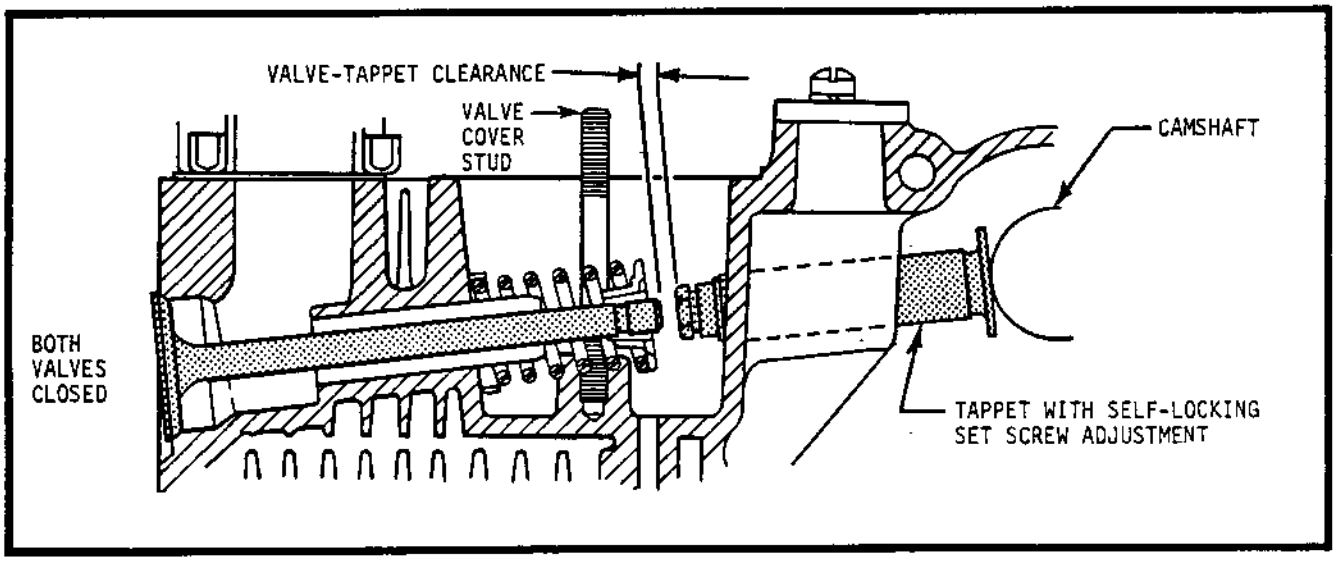
After each 500 hours (or sooner if a loose valve is detected), check clearance between the valve stems and tappets. The engine must be stopped and cooled to normal ambient temperatures to accurately gauge and adjust valve clearances. Use the following procedure to adjust:

1. Turn engine over until piston in #1 cylinder (closest to flywheel) is at Top Dead Center on compression--in this position, both valves will be closed and cam will have no affect on tappet.
2. Measure clearance between valve stem and tappet with a feeler gauge. To adjust, turn adjusting screw on tappet in or out until proper clearance is attained.

COLD CLEARANCE

INTAKE .008-.010" EXHAUST .017-.020"

3. After adjusting valve-tappet clearance on #1 cylinder, turn engine over until #2 cylinder is at TDC on compression and repeat adjustment on this cylinder.
4. After valves are in proper adjustment, position new head gaskets and reinstall cylinder heads. Make sure head bolts are tightened in the proper sequence and to the torque value specified



CUTAWAY VIEW SHOWING VALVE - TAPPET CLEARANCE

CLEARANCES & WEAR TOLERANCES (all dimensions in inches unless stated otherwise)

SPECIFICATION	K532	K582
CYLINDER BORE		
New Diameter	3.375	3.500
Wear Diameter (Maximum)	3.3785	3.503
Taper (Maximum)	0.0015	0.0015
Out-Of-Round (Maximum)	0.005	0.005
CRANKSHAFT		
End Play	0.004-0.010	0.004-0.010
Crankpin - New Diameter	1.625	1.625
Crankpin - Maximum Out-Of-Round	0.0005	0.0005
Crankpin - Maximum Taper	0.001	0.001
CAMSHAFT		
End Play	0.017-0.038	0.017-0.038
Shaft to Bearing Clearance	0.0005-0.0035	0.0005-0.0035
CONNECTING ROD		
Big End - Maximum Wear Diameter	1.627	1.627
Rod to Crankpin - Maximum Clearance	0.0035	0.0035
Small End - New Diameter	0.87585	0.87585
Rod to Piston Pin - Clearance	0.0003-0.0008	0.0003-0.0008
Side Play on Crankpin	0.005-0.014	0.005-0.014
PISTON, PIN & RINGS		
Thrust Face* - Maximum Wear Diameter	3.7025	3.4945
Thrust Face* to Bore - Maximum Clearance	0.0065-0.0095	0.007-0.010
Ring - Maximum Side Clearance	0.006	0.006
Ring - End Gap in Used Bore	0.030	0.030
Pin to Boss Clearance (Loose)	0.0005	0.0005
Pin to Rod Clearance	0.0003-0.0008	0.0003-0.0008
VALVES, GUIDES, TAPPETS		
Intake Valve to Tappet - Cold Clearance	0.008-0.010	0.008-0.010
Exhaust Valve to Tappet - Cold Clearance	0.017-0.020	0.017-0.020
Valve Lift - Zero Lash	0.324	0.324
Intake Valve Stem to Guide - Max. Clear	0.0045	0.0045
Exhaust Valve Stem to Guide - Max. Clear	0.0065	0.0065
Tappet Clearance in Guide	0.0012-0.0023	0.0012-0.0023
Guide Interference Fit in Block	0.0005-0.002	0.0005-0.002
Guide Ream Diameter	0.312-0.313	0.312-0.313

**Measured just below oil ring at right angles to pin.*

IGNITION SPECIFICATIONS

Spark plug gap, Gasoline	0.035
Spark plug gap, LP Gas	0.018
Breaker point gap	0.020
Spark run	22-1/2° BTDC
Spark retard	13 BTDC

240
POWER SWEEPER

CONTENTS

lpg section

11/80

SAFETY AND MAINTENANCE TIPS

Safety of fuel systems on machines cannot be taken for granted. There have been reports of increased amounts of oil being present in L.P. fuel in certain areas. Added precautions must be taken. To ensure safer operation of your L.P.G. equipment, regular maintenance and frequent inspection is important.

Listed below are some suggested maintenance tips as well as general tips to promote added safety in the operation of your Tennant machine.

- Keep cigarettes, sparks, and open flame away when working on L.P. equipment, when inspecting for gas leaks, or when L.P. tanks are present.
- Check all components for proper operation. Replace L.P. components when needed. Never by-pass defective safety components.
- Check routings of all L.P. hoses. Keep them away from sharp edges, exhaust manifolds, or other hot surfaces. Check for signs of abrasion or deterioration.
- Every 400 hours or 3 months (whichever comes first) or if any malfunction is noted:
  a. Completely disassemble the vaporizer-regulator (liquid withdrawal system). See machine manual for instructions and replacement parts.
  b. Clean all parts in alcohol.
  c. Inspect parts and replace where needed.
  d. Carefully reassemble and reinstall in machine.
  e. Check for proper operation.
- Check for gas odor before and during starting operations. If gas odor is noticed, stop and check for leaks or component malfunction.
- Replace electrical wiring if insulation shows signs of abrasion or deterioration.
- Make sure L.P. tank is free of dents or gouges.
- Make sure service coupling is clean and free of damage. Make sure service coupling of tank matches machine service coupling.
- Keep the engine properly tuned.
- Make sure the L.P. tank matches the fuel system (vapor tank with vapor system, liquid tank with liquid system).
- Make sure L.P. tank is securely mounted on the machine and with the locating pin in position.
- Park the machine in a shaded, cool area when not in use.
- Keep the L.P. tank service valve closed when the machine is not in use.
- Never overfill L.P. tank. Fill the L.P. tank to the recommended weight stamped on the tank.

- Use care in handling L.P. tanks. Never drop or drag them.
- Always store and transport L.P. fuel tanks with the safety relief valve in the "Up" position.
- Every 400 hours replace the filter in the filter fuelock. See machine manual for instructions and replacement parts.
- Avoid personal contact with L.P. fuel to avoid frostbite.
- When the machine is to stand unused for a period of time, overnight for example, park the machine in a designated area, shut off the service valve at the tank and operate the engine until the remaining fuel is comsumed. Then, turn off the ignition switch.
- Perform regular maintenance as recommended in the machine manual.

QUICK CHECK LIST

This is a small list of checks that can be made quickly and often. Be sure to make all of the checks listed in the service and maintence list and those in the manual.

- To check regulator

  Place ignition switch in the on position. Remove the wire from the "C" terminal of the oil pressure switch and touch it to the "NO" terminal. This shorts out the oil pressure switch and opens the fuelock allowing L.P. fuel to flow to the primary regulator. Check the carburetor for L.P. fuel. If L.P. fuel is flowing, the regulator is malfuctioning and must be repaired or replaced. If no L.P. fuel is present, turn the ignition switch off and replace the wire from the "C" terminal to the "C" terminal.

- Check the oil pressure switch

  Turn the ignition switch to "On". If a click in the filter fuelock 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 filter fuelock should click when the switch is shorted out if the switch is working properly.

- Check the filter-fuelock for proper operation:

  Start the engine.

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

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

OPERATING INSTRUCTIONS
FOR
MODEL 240 SWEEPER
EQUIPPED FOR LPG OPERATION

PREPARING MACHINE FOR OPERATION

Follow the instructions given in "Preparing Machine for Operation" at the beginning of this manual. Fill or replace the LP tank. The tank is a LIQUID WITHDRAWAL, 33-lb. CAPACITY type. The tank is equipped with a visible gauge and an automatic shut-off valve. Always close the hand valve when the machine is not in use.

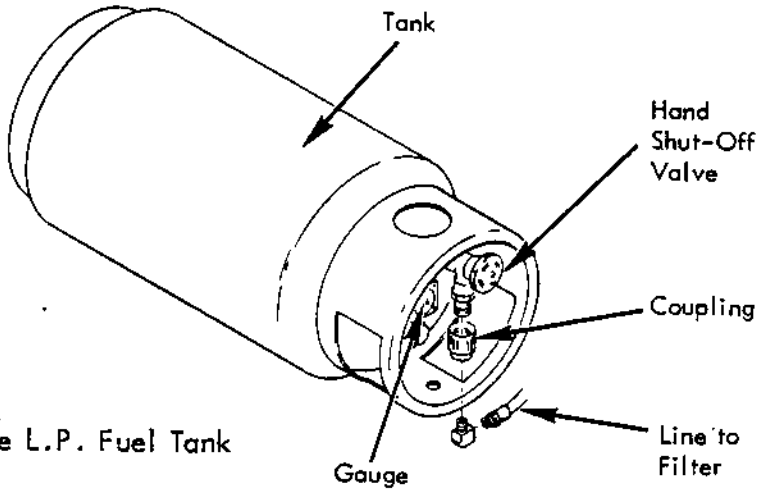
TO START LPG EQUIPPED ENGINE

1. **⚠WARNING** Do not attempt to start engine unless you are in driver's seat, with foot on brake pedal or hand brake engaged, and with directional pedal in neutral position.

2. Check gauge on LP tank to make sure there is sufficient fuel.
3. SLOWLY open the tank hand valve. (If valve is opened suddenly, automatic shut-off may stop fuel flow.)
4. Insert ignition key and turn to "Start" position momentarily until engine starts. Release key as soon as engine starts. Do not operate starting motor continuously for more than 10 seconds at a time.
5. If engine does not start after several attempts, refer to "LP Gas Trouble Shooting" in a following section. See the Engine Manual for more information.

LPG FUEL TANK

The 33 lb (15 kg) capacity tank is mounted on top of the machine. The tank is a liquid-withdrawal type equipped with a visible gauge which measures the percent of fuel left in the tank. Always fill the tank by weight capacity, 33 lbs (15 kg) plus the "tare" weight (TW) which is marked on the tank.

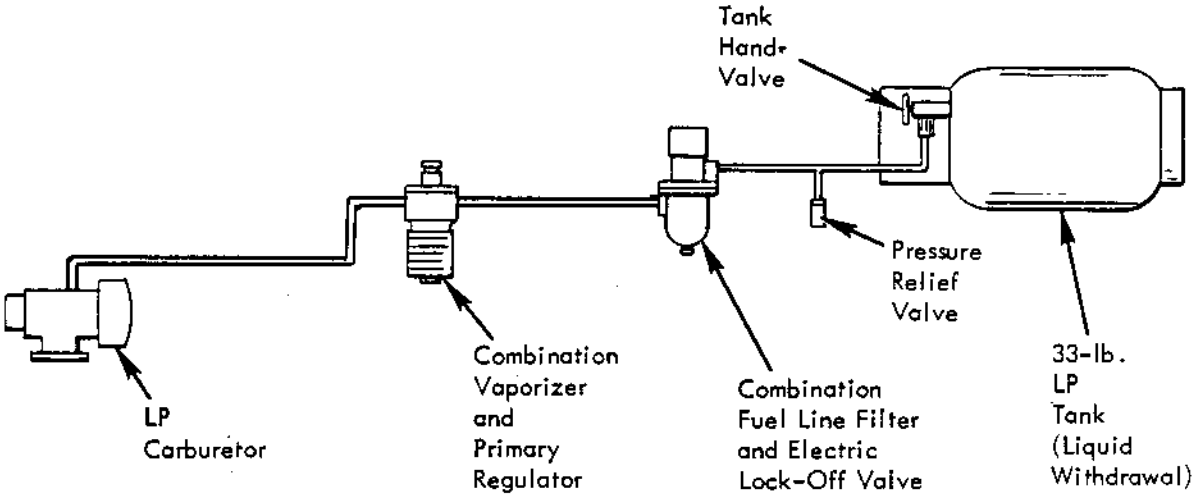


⚠WARNING Do not overfill the L.P. Fuel Tank

The tank must be mounted in one position only. Do not turn the tank in its mounting--this will affect the liquid withdrawal process, because of the shape of the discharge tube inside the tank.

If the tank shut-off valve is opened too quickly, the automatic shut-off valve will close. Open the hand valve slowly to just crack the valve, then close the valve and open slowly.

Always double check to be sure that you have the correct type of tank: This machine requires a liquid withdrawal type of tank.



HOW THE LP SYSTEM OPERATES

1. Opening valve slowly permits the liquid fuel to pass through the fuel line to the combination fuel line filter and electric lock-off valve (called "Filter-Fuelock").
2. Excessive fuel line pressure will pass through the pressure relief valve.
3. Fuel line filter is required on liquid withdrawal systems because the fuel is drawn from the bottom of the tank where impurities could accumulate.
4. The solenoid (electric lock-off valve) is activated by the ignition switch during starting, allowing fuel flow through the valve. Engine oil pressure operated switch holds solenoid valve open after the engine has been started.
5. After passing through the combination filter and solenoid valve, the liquid fuel enters the vaporizer and primary regulator combination unit. At this point, the liquid fuel is changed to vapor as hot air from the engine is directed past the vaporizer part of this combination unit.
6. The vapor fuel passes through the primary regulator part of this combination unit and is reduced in pressure to 7 psi (48 kPa) at the regulator outlet.
7. The fuel is then metered into the carburetor in small amounts as required and controlled by the carburetor.

L.P. FUEL TANKS

Standard D.O.T. L.P. fuel tank sizes have 14, 20, 33.5, and 43.5 lb capacities. The liquid volume permitted in these containers is less than the total volume of the cylinder, to provide for expansion of the L.P. fuel should the temperature increase a normal amount. Excessive heat may cause the fuel to expand too much, causing the safety relief valve to vent some L.P. fuel, relieving internal tank pressure.

Each tank is marked showing the type of construction (liquid or vapor), the manufacturer, the date of manufacture, the capacity, the tare weight, and the date of re-qualification. D.O.T. L.P. fuel tanks must be re-qualified (checked) periodically. This re-qualification must be recorded and maintained for the life of the container.

L.P. fuel tanks are equipped with the following approved valves and fittings:

A. Safety Relief Valve - This is a spring-loaded valve that relieves excessive pressures which might develop in the tank due to unusual conditions.

B. Service Valve - The L.P. fuel tank may have a vapor service valve or a liquid service valve. The type of equipment burning the fuel would determine the type of service valve to be used.

C. Filler Valve - This valve is optional. If this valve is not present, the tank is filled through the service valve. The filler valve may be either a double back pressure valve, or a positive shutoff valve with an internal back pressure check valve. The filling tube ends in the vapor space of the tank to reduce pressure build-up during filling.

1. Vapor Service Valve - Vapor is withdrawn from the tank through this valve. The L.P. tank may be filled through this valve if the tank is not equipped with a filler valve.

2. Liquid Service Valve - Liquid is withdrawn from the tank through this valve. The tank outlet is fitted with a special coupling. The coupling utilizes spring-loaded check valves to provide a means of quickly connecting or disconnecting the fuel line with a minimum loss of L.P. fuel. The L.P. tank may be filled through this valve if the tank is not equipped with a filler valve.

3. Excess Flow Valve - This valve is part of the vapor service and liquid service valves previously mentioned. It is mounted inside of the tank and prevents L.P. fuel from leaving the L.P. tank in the event of accidental breakage of external fittings or hoses. It permits flow in either direction, but stops outward flow if that flow becomes excessive. The valve is made up of a check that is held in position by a spring. The spring pressure is overcome when there is excess L.P. fuel flow out through the service valve. It will not return to the open position until the pressures are equalized on both sides of the valve. After the flow has been stopped, a small weep-hole allows a small amount of L.P. fuel to bleed across the valve, equalizing the pressures.

D. Liquid Level Gauge - This gauge is optional. It is usually a magnetic float gauge with an indicating dial. These gauges will function properly only when the tank is in its normal operating position, unless otherwise indicated.

(continued on next page)

USE & CARE OF L.P. FUEL TANKS

FILLING L.P. TANKS

L.P. fuel tanks are to be filled at regular cylinder filling plants or at designated areas meeting all applicable regulations. Proper L.P. tank filling is of the utmost importance. The person filling the containers must be trained in the safe handling of L.P. fuel

L.P. fuel tanks are to be filled by weight. Magnetic float gauges must not be used as a means of determining the amount of liquid in the container during filling operations. Do not overfill L.P. tanks. An air space must be present inside the tank to allow for expansion of the fuel. Fill tanks to their designated weight.

Whenever an L.P. tank is filled, the tank should be inspected for sharp dents, gouges, leaks, or broken protecting rings. All of the valves must be inspected for leaks, using a soap solution. They also must 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.

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

If an L.P. 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 conditions. Repairs must be made by qualified personnel.

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

CHANGING MACHINE L.P. TANKS

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

The tank changing operation presents an opportunity for the machine operator to observe, carefully, the tank, 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 begin the tank changing operation, park the machine in a designated safe area and stop the engine. Next, close the tank valve, then remove the quick-disconnect coupling from the tank valve. Observe the machine fuel lines and the quick-disconnect couplings for damage or abnormal wear.

Then, remove the empty tank from the cradle holding device and observe the tank and tank fittings for damage or abnormal wear. Handle the tank carefully; it must not be dropped or mishandled.

Store the L.P. tank in a designated safe area. Select a filled L.P. tank and observe it for damage or leaks. Carefully install the filled tank in the machine so that the tank centering pin enters the aligning hole in the tank collar. This assures that the tank is positioned properly so the safety relief valve, liquid level gauge, and service valves will operate properly. Fasten the tank hold-down clamp (s) so that the tank is locked into position. Reconnect the fuel line to the tank service coupling. Open the service valve slowly and check for leaks. If a leak is found, close the valve immediately and notify the appropriate personnel. If no leaks are found, the engine is ready to start. Do not start the engine unless the operator is in the operator's position with a foot on the brake pedal or parking brake engaged, with the directional control pedal in neutral position.

STORAGE OF L.P. FUEL TANK

Whether the storage is inside or outside, it should not be 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 L.P. 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 tanks must be closed, except when the engine must be operated.

While a large amount of safety has been designed into the equipment to make it as "foolproof" as possible, it is necessary for the operator and maintenance personnel to apply a few basic safe practices to assure a good safety record.

This is not unique to L.P. fuel alone. It applies equally well to any mechanical equipment and any fuel.

SERVICE/MAINTENANCE OF L.P. FUEL COMPONENTS

To ensure safe operation of your L.P. 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 your Tennant machine.

- Check for frosting. If frosting occurs on any L.P. component or object near an L.P. component, there is a possibility of an L.P. 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 filter-fuelock for proper operation:

  Start the engine

  Remove the wire going to the solenoid section of the fuelock. This should cause the solenoid to close, shuting off the fuel supply; stopping the engine. If the engine continues to operate, replace the filter fuelock.

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

- Check all components for proper operation. Replace L.P. components when needed. Never by-pass defective safety components.

- Check routings of all L.P. hoses. Keep them away from sharp edges, exhaust manifolds, or other hot surfaces. Check for signs of abrasion or deterioration.

- Check for gas odor before and during starting operations. If gas odor is noticed, stop and check for leaks or component malfunction.

- Replace electrical wiring if insulation shows signs of abrasion or deterioration.

- Make sure L.P. tank is free of dents or gouges.

- Make sure service coupling is clean and free of damage. Make sure service coupling of tank matches machine service coupling.

- Perform regular maintenance as recommended in the machine manual.

- Never use a match or open flame when searching for an L.P. fuel leak. Always use the soap bubble method.

- There are L.P. fuel sensors available for under $30 which can sense fuel leaks. These sensors are equipped with meters or alarms to indicate the presence of L.P. fuel.

(continued on next page)

. Every 400 hours or 3 months (whichever comes first) or if any malfunction is noted:

Completely disassemble the vaporizer-regulator (liquid withdrawal system). See machine manual for instructions and replacement parts.

Clean all parts in alcohol.

Inspect parts and replace where needed.

Carefully reassemble and reinstall in machine.

Check for proper operation as follows:

Remove the L.P. hose in which L.P. exits from the regulator. Using a monometer or pressure 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 component, carefully replace the removed L.P. hose.

. Check the oil pressure switch

Turn the ignition switch to "On". If a click in the filter fuelock 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 filter fuelock should click when the switch is shorted out if the switch is working properly.

. Every 400 hours, replace the filter in the filter fuelock. See machine manual for instructions and replacement parts.

. Keep the engine properly tuned.

. Make sure the L.P. tank matches the fuel system (vapor tank with vapor system, liquid tank with liquid system).

The following service instructions can be performed by most equipment maintenance personnel. Noted are the repair kit part numbers. If individual repair part numbers are needed, refer to the machine parts manual.

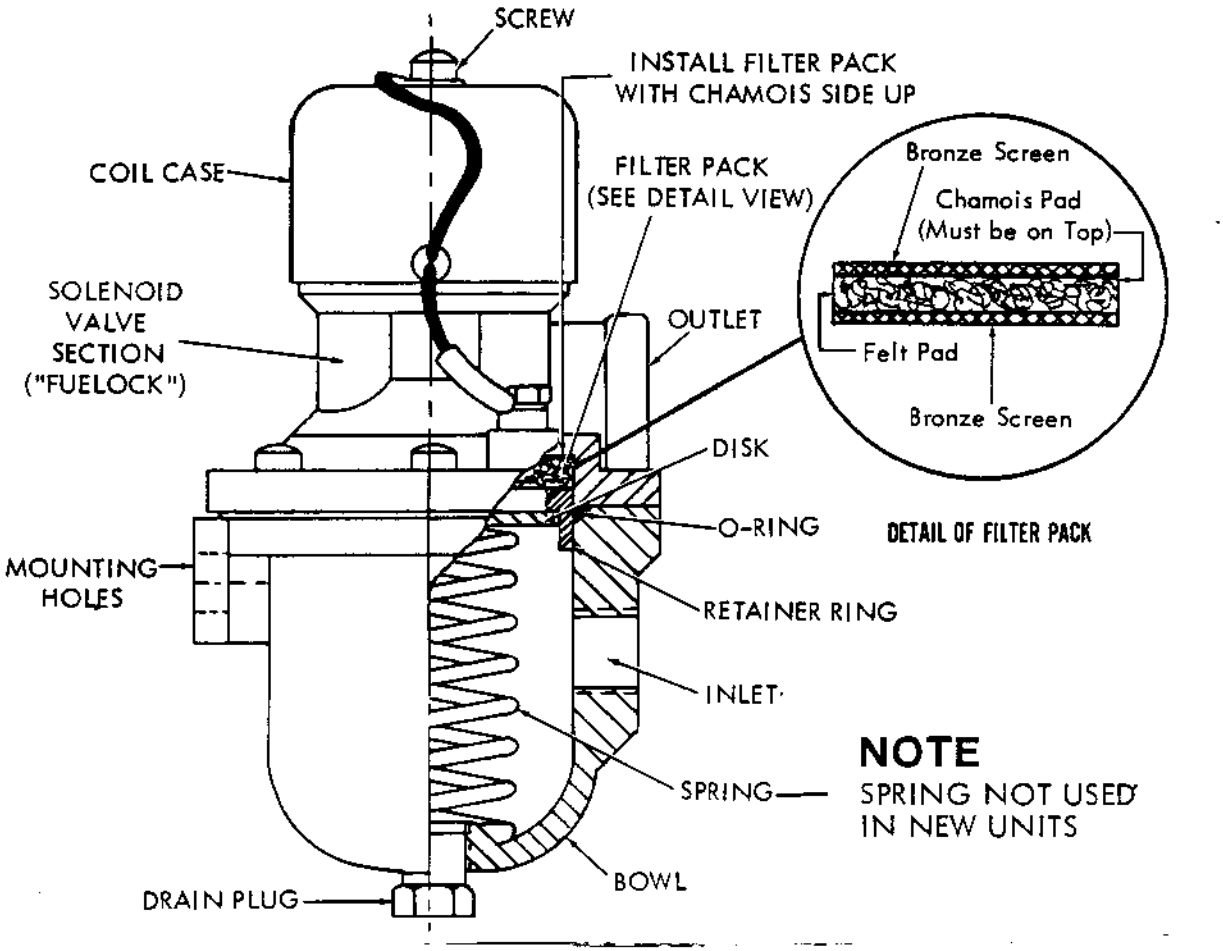
THE FILTER-FUELOCK
(COMBINATION FUEL FILTER AND SOLENOID LOCK-OFF VALVE)

The "Fuelock" is a safety valve which shuts off the fuel flow whenever the engine is turned off.

This unit also filters impurities from the liquid fuel. The filter is necessary because in a liquid withdrawal system the liquid is drawn from the bottom of the tank.

THE FILTER SECTION

In this assembly, fuel enters the bowl casting through inlet port in the side of the bowl. Large solid particles, such as tank scale, fall out of the fuel stream and remain in the bowl while the fuel continues to travel upward through the filter pack, where remaining solids are stopped. A drain plug is provided for purging the filter bowl. Clean out the bowl when necessary. Replace the filter pack every 400 hours or when diminished gas flow indicates filter is clogged.



CROSS SECTION DRAWING OF THE FILTER-FUELOCK UNIT, SHOWING CORRECT ARRANGEMENT OF PARTS

REPLACING FILTER PACK

DISASSEMBLY:

1. Shut off fuel supply and run engine to empty fuel lines and filter.
2. Disconnect outlet fuel line from upper fuelock valve section.
3. Remove six screws attaching filter bowl to top section.

⚠CAUTION Spring inside filter bowl may suddenly push up the top section when the screws are removed. New units do not have springs.

4. Lift off the top valve section (called "Fuelock" section).
5. Carefully pull out the filter retainer ring, O-Ring, and filter pack (see section drawing and exploded view to identify parts).
6. Discard O-Ring and filter pack.
7. Clean out filter bowl and all parts in solvent. Dry parts with compressed air. Check parts for damage.

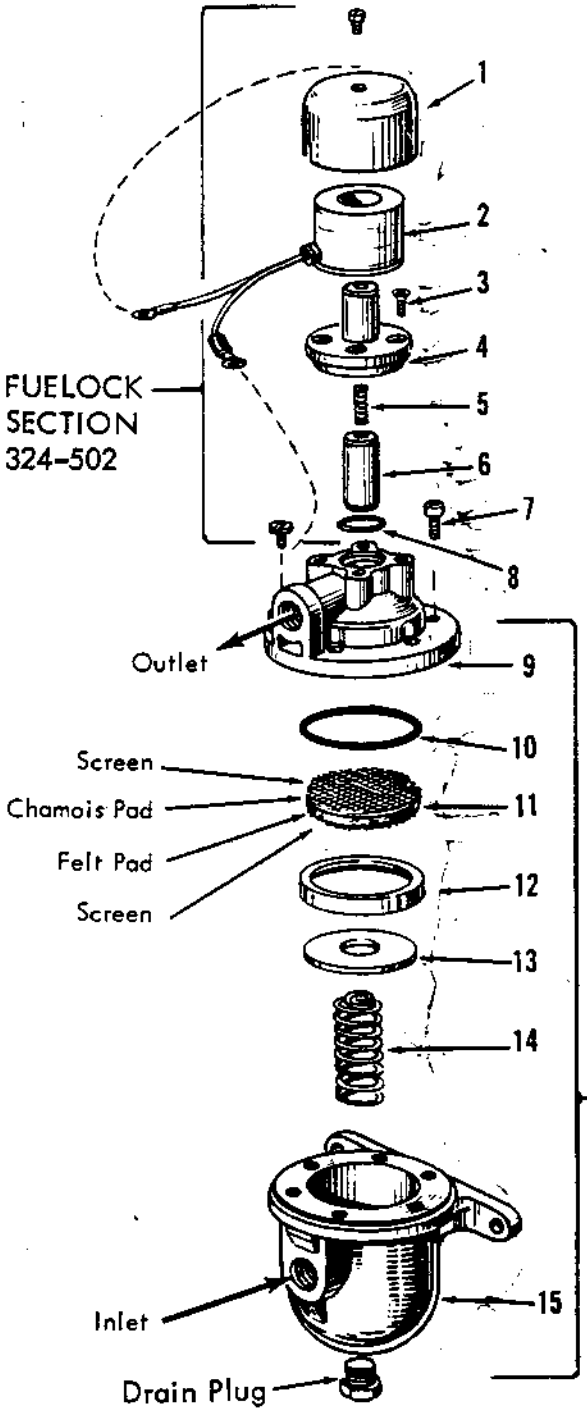
ASSEMBLY:

1. Install new filter pack in recess in top section.
   NOTE Install filter pack with chamois side up, as shown in drawings.
2. Place retainer ring in place and gently tap into position with soft-faced hammer. Position retainer as shown in section drawing.
3. Install new O-Ring gasket around retainer ring as shown in section drawing.
4. Place spring in bowl with large open end of 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 as they were in before disassembly.

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

PARTS LIST FOR FILTER-FUELOCK



Ref. No.	Marvel-Schebler Part No.	Description
1	184-79	CASE, Coil
2	323-526	COIL, 12 volt
3	15-A351	*SCREW
4	154-526	HOUSING, Plunger
5	24-A394	*SPRING
6	194-667	*PLUNGER
7	15-A350	*SCREW
8	44-147	*O-RING
9	91-541	BASE
10	44-210	*O-RING
11	44-504	*FILTER PACK ASS'Y.
12	55-A128	RING, Retainer, Filter
13	78-A143	DISK
14	24-B83	+ SPRING
15	159-503	BASE, Filter (includes drain plug)

* Indicates repair kit parts included in Tennant part no. SK 1444.

\+ Spring not used in new units.

Frost or condensation on any part of the filter assembly indicates a clogged condition or a fuel requirement greater than the capacity of the filter pack. This condition will most frequently be encountered early in the fall of the year on the first cold morning. Under low temperatures, tank pressure is reduced and fuel flow through the filter will decrease considerably. If it is restricted, the frost or condensation will form due to expansion of the fuel as it passes by the restriction.

Any apparent shortage of fuel shoud result in an immediate inspection of the filter to assure that it is not responsible. This is best done by temporarily bypassing the filter and running the engine to see if the problem is eliminated.

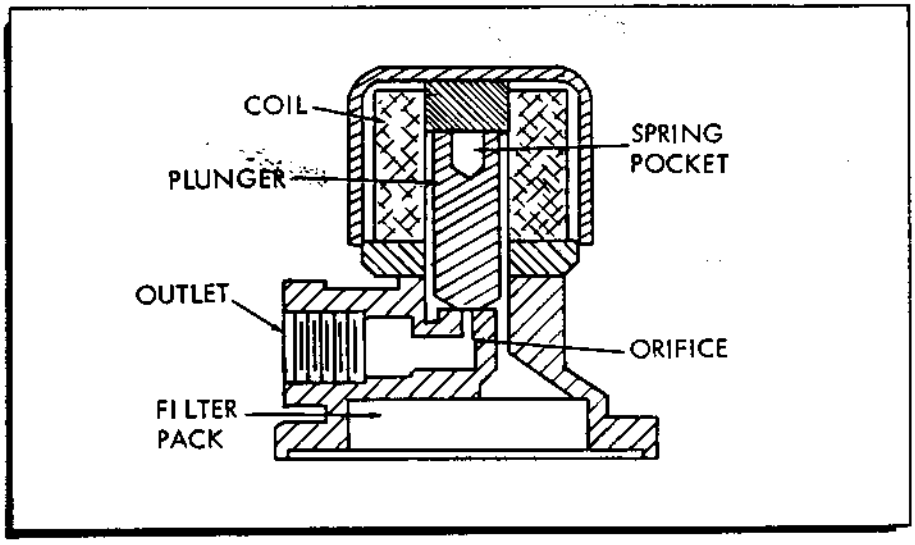
⚠WARNING Do not continue the operation without correcting the cause and connecting the filter back into the fuel system.

THE FUELOCK SECTION (SOLENOID-OPERATED LOCK-OFF VALVE)

OPERATION:

Fuelock plunger is held against orifice by a combination of weak spring pressure and fuel tank pressure which surrounds the plunger by appearing in the entire plunger housing. (See cross section drawing of Fuelock section.)

When battery voltage is applied to the coil a strong magnetic field is formed and draws the plunger away from the orifice, thus allowing fuel to flow out through outlet port.



CROSS SECTION OF THE FUELOCK (SOLENOID-OPERATED VALVE)

REPAIR OF THE FUELOCK SECTION

A. To Replace Coil

1. Remove single screw retaining coil case and single screw holding coil lead to terminal post (see exploded view and cross section drawing).
2. Lift case and coil off fuelock plunger housing.
3. Pull old coil from case and insert new coil.
   ATTENTION! Make sure proper voltage coil is used (12 volt).
4. Replace case and coil and screws.
   NOTE Coil may have insulated terminal on one lead only. This lead is attached to the terminal post. Be sure other coil lead is grounded to fuelock assembly with case retaining screw.

B. To Replace Plunger

1. Remove case and coil (see exploded view).
2. Remove four flat Phillips head screws retaining plunger housing on casting. Lift off plunger housing and remove plunger and spring.
   NOTE Spring is small and can be easily dropped and lost.
   ⚠CAUTION Be sure there is no fuel pressure in filter bowl before loosening plunger housing screws.
3. Clean housing and spring. Discard oil "O" ring seal around base of housing. Inspect orifice for dirt, nicks or other damage.
4. Locate new "O" ring on housing. Install spring in new plunger and slide UPWARD into housing. Place housing and plunger assembly into position on fuelock casting and insert and tighten four screws.
5. Test assembly for leaks by applying air pressure at filter bowl inlet and using soap solution over all disturbed points.
6. Replace coil and case assembly.

When servicing any fuelock assembly, make certain that it is preceded by a good, clean filter. Foreign material which can reach the fuelock valve area will result in leakage and possibly sticking problems. A complete repair kit, is available to service STF filter fuelock assemblies. All normally serviceable parts are included (no coil) as well as a filter pack, pack retainer and filter bowl gasket.

The function of the vaporizer is to take liquid L.P. fuel, reduce its pressure, vaporize it, and flow the gas to the motor. If the vaporizer is doing these thing, and is not freezing up or leaking, it is working properly.

QUICK CHECK

Apply air pressure of at least 60 psi to bushing marked "Inlet" in the vaporizer. If a regulator is installed with the vaporizer, it should not leak gas and should not burst a soap bubble at regulator outlet. If a pressure carburetor is used, the carburetor should not leak gas. Vaporizer outlet pressure should be 3 psi.

A slight suction applied to the regulator outlet or a light puff or push to the regulator diaphragm should cause gas to flow a moment and then shut off tightly. For pressure carburetors, remove the balance line and blow lightly into the diaphragm vent.

Take the vaporizer out of casting by loosening tie bolt two or three turns and tapping on the tie bolt and vaporizer head until O-ring works loose.

PRESSURE CHECK

With at least 60 psi air pressure or L.P. gas pressure at the vaporizer "Inlet" bushing, insert a pressure gauge which allows accurate reading in the 5 to 10 psi range, into "Outlet" bushing. It is best to use a .25" pipe tee. This test can sometimes be made before removing the vaporizer from the vehicle by using a .375" copper tubing or large I.D. gas hose for the pressure gauge.

Set the pressure adjusting bonnet on the vaporizer so that pressure gauge reads 10 psi at outlet. A .187" hole drilled in .25" pipe plug makes a good test orifice. Cover this orifice with your thumb, then release air flow. Pressure reading should drop to 4 to 5 psi, and when flow is shut off with thumb, pressure reading should return every time to 10 psi (+ 1 psi). Erratic readings or creeping pressure readings indicate the vaporizer must be serviced. Low pressure readings indicate the the test pressure is less than 60 psi, the air line is too long or too small, or that the regulator is failing to open properly.

Using a soap solution, or by immersing the vaporizer in water, check for gas leaks around the plug screw, O-ring, and the diaphragm cover.

To remove the bellows, clamp the vaporizer head (not the bellows) in a vise and use a 1.25" socket wrench to remove the plug screw. Bellows will then slip out. The orifice must first be pulled, then the piston and seat will come out the top.

To remove the orifice, if the square piston and seat have come out the bottom, remove bonnet and spring. Otherwise, leave bonnet in place to hold the seat away from the orifice while pulling orifice. Remove inlet bushing and aluminum washer. The orifice is tapped for .25" bolt threads. Pull orifice straight out, using a .25" - 20 stud, or stove bolt and nut with a large washer. Do not turn it as there is a keyway in top of the orifice. Remove the six screws and take off diaphragm cover.

Pull diaphragm plate to lift out the round piston and diaphragm and O-ring as needed, especially if they are dry and cracked or swollen and spongy. If the square piston has not been removed, it will come out. Inspect the black seat in top of the square piston. Replace it if seat is hard or cut, or has imbedded foreign particles. Clean out pin hole

(continued on next page)

PRESSURE CHECK (continued)

vent in vaporizer body and diaphragm cover. Remove O-ring.

NOTE Clean all parts carefully.

REASSEMBLY (Assemble as follows):

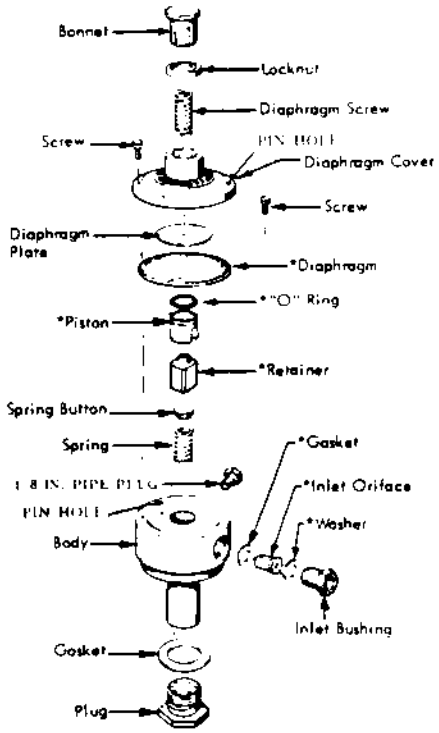
1. Square piston and spring
2. Round piston and diaphragm
3. Diaphragm cover
4. Spring and spring bonnet
5. Orifice and bushing
6. Bellows and plug screw

Place spring button on smaller spring and the two inside the square piston. Slip into vaporizer bore. Place diaphragm assembly in vaporizer bore, with round piston aligned as shown in Fig. 21 so that the orifice can go in. Look for dowel pin in the vaporizer inlet which keeps orifice true, and push orifice straight in without turning. Use a .25" screw and a small hammer. Drop aluminum washer in hole, and insert inlet bushing with torque wrench to 45 ft. lbs.

ATTENTION! Tighten carefully. Excessive torque can shear off dowel pin and rotate orifice so that it does not seat squarely.

Place O-ring on end brass bellows, and wet with oil. Press bellows into vaporizer head. Wet the red fiber gasket with oil for better sealing. Insert plug screw and tighten with socket wrench to 50 ft. lbs. torque.

Connect air hose and pressure gauge and set the high pressure regulator to 10 psi with bonnet, and lock with lock nut. Check diaphragm cover and bellows for leaks with a soap solution or by dipping in water. Check flow as before , through a .187" orifice to see that full flow is obtained and shut-off pressure is steady at 10 psi (± 1 psi).



VAPORIZER REGULATOR

* Parts Included in Diaphragm/Seal Repair Kit No. W-10-RK (J & S Carburetor Part No.)

L.P. FUEL TROUBLESHOOTING

	Won't Start	Stops During Operation	Runs Unevenly-Lacks Power
(1) Fuel Tank	Check fuel tank type and fuel supply (vapor tank for vapor with-drawal 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, shut hand valve and then re-open it slowly.	Out of fuel Check fuel tank type and fuel supply (liquid tank for liquid with-drawal system)	Tank valve not opened sufficiently. Tank could be overfilled, allowing liquid withdrawal and "freeze-up" of system (vapor system only). Check fuel tank type and fuel supply (liquid tank for liquid withdrawal system.
(2) Fuel Lines	Check lines, connections, leaks, etc., using soap bubble test method. When changing 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 if dirty filter is restricting fuel line. Check quick-disconnect fitting at tank: if tank valve is not properly seated, no fuel will flow through the line. 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.	

(continued on next page)

	Won't Start	Stops During Operation	Runs Unevenly-Lacks Power
(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 coil. Check ignition switch. Check wiring for loose connections or wire breakage. Check battery terminals for corrosion or loose ground cable. Check 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 by-passing 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 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. (Liquid system only). In trouble shooting, 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.

L.P. FUEL TROUBLESHOOTING (continued)

	Won't Start	Stops During Operation	Runs Unevenly-Lacks Power
(6) Engine	Under ordinary circumstances a new 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.	Check Engine Trouble-Shooting Chart in Machine Manual.	See Engine Trouble-Shooting Chart in Machine Manual

NOTE Always check through L.P. Fuel system in order of numerical sequence.