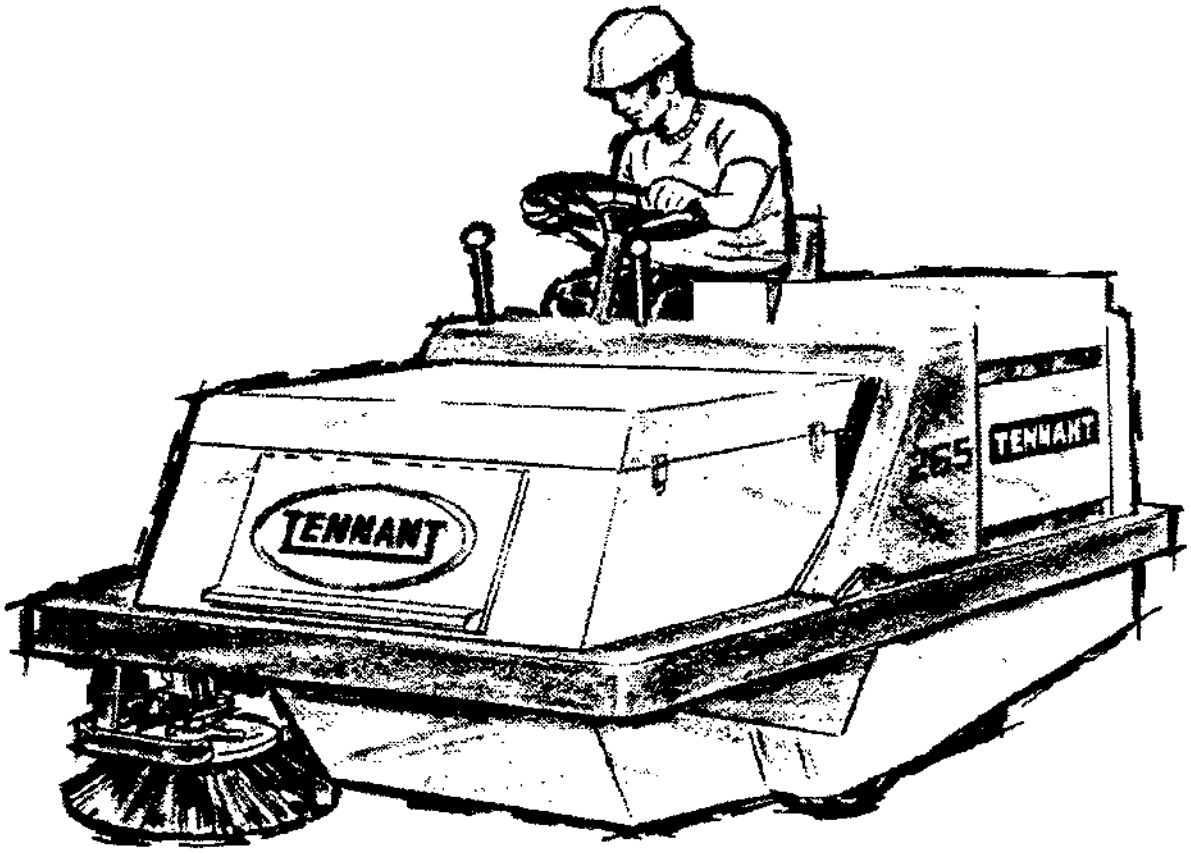
MM114
1–84

265

POWER SWEEPER

Operation, Maintenance, and Parts Manual
Including High Dump Model, First Serial Number 2391

Operator Manual



TENNANT

SPECIALIZED
MAINTENANCE SYSTEMS

SWEEPERS • SCRUBBERS • SCARIFIERS • FLOOR COATINGS

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265
POWER SWEEPER

This manual is furnished with each new TENNANT® Model 265. 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.

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⚠ SAFETY PRECAUTIONS

The following information signals potentially dangerous conditions to the operator or equipment. Read this manual carefully. Know when these conditions can exist. Then, take necessary steps to train machine operating personnel.

⚠WARNING Do not fill gasoline fuel tank with engine running. Do not smoke or use open flame near the fuel tank. Do not overfill LP tank. Make sure fuel container and machine are electrically connected when refueling.

⚠WARNING Lead acid batteries emit a highly explosive hydrogen gas that can be ignited by electrical arcing or by smoking.

⚠WARNING Provide adequate ventilation system to properly expel discharged gases. Check exhaust system regularly for leaks. Ensure that exhaust manifolds are secure and not warped.

⚠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. Make sure all nuts and bolts are secure. Keep shields and guards in position. If adjustments must be made while the unit is running, use extreme caution around hot manifolds, moving parts, V-Belts, etc.

⚠WARNING Lock hopper in 'UP' position using Safety Arm before working under hopper. See instructions on arm. When Hi-Dump is raised or lowered, the lift arms cross, creating a shear or pinch point. Stay clear of arms.

⚠CAUTION Disconnect positive battery terminal before removing instrument panel.

⚠CAUTION Do not start machine unless you are in driver's seat, with foot on brake pedal, or hand brake engaged, and directional pedal in neutral position.

⚠CAUTION Remember that the machine is steered by means of the rear wheel, and is very responsive. Take time to become familiar with this type of steering system. Reduce machine speed when scrubbing or when operating on grades.

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

TENNANT Part No.	Descriptions	Size
53063	HIGH DENSITY COMBINATION, natural fiber & crinkle wire-adds stiffness, increases brush life.	42 in.-24 row
53064	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 (lasts about 2 1/2 times longer than natural fiber)	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	

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
43680	ABRASIVE, bristle, heavy, .050 ga	38 in. 24 row

TABLE OF CONTENTS

STANDARD MODEL 265 MAINTENANCE ITEMS

The following repair items, also listed in the parts lists, are grouped here for your convenience. You may not wish to stock all the items. See the following page for maintenance items used on Hi-dump machines.

TENNANT Part No.	Description	Qty.
59469	REPLACEMENT PARTS PACKAGE	1
SK1511	FUSIBLE LINK, Hopper fire safety door	1
23792	ELEMENT, Air filter (large)	2
27313	ELEMENT, Air filter (small)	2
53431	ELEMENT, Hydraulic tank breather	1
50353	FILTER, Engine oil	2
44561	V-BELT, Alternator & water pump	1
53137	SKIRT, Rubber, rear, floor contact	1
53298	SKIRT, Rubber, brush contact	1
23275	SKIRT, Rubber, side (left & right)	2
23386	SEAL, Pan, top	1
23382	SEAL, Pan, side	2
48060	LIP, Rubber, Hopper pan	5
27179	V-BELT, Radiator fan	1
45770-8	SPARK PLUG	4
37356	POINTS	1
37408	CONDENSER	1
67718-2	ELEMENT, Oil filter (Deluxe)	1
53348-1	ELEMENT, Oil filter (Ripley)	1
10414	SHOE, Brake, front wheel	4
47094	TIRE, Front, Standard machines only	2
54106	MOTOR, Filter shaker	1
53259	BAG, Filter	1
53819-2	FLAP, Rear tire	1
53819-1	TUBE, Rear tire, inner	1
47828-3	TIRE, Rear	1
45582	INSULATION KIT, Vacuum fan	1
32397-5	HYDRAULIC FLUID, Tennant company (5 gallons)	1
SK1345	SEAL KIT, Shaft, Vickers pump	1
SK1344	SEAL KIT, Vickers pump	1
SK1140A	SEAL KIT, Propelling motor 53032, Standard machine	1
SK1600	SEAL KIT, Side & main brush motor (Char-Lynn)	1
SK1694	SEAL KIT, Side & main brush motor (Ross)	1
SK1288	SEAL KIT, Side brush valve (Gresen)	1
SK1806	SEAL KIT, Side brush valve (Victor-Dukes)	1
SK1863	SEAL KIT, Control valve (Victor-Dukes)	1
SK1842	SEAL KIT, Control valve (Cross)	1

HI-DUMP MODEL 265 MAINTENANCE ITEMS

TENNANT Part No.	Description	Qty.
59470	REPLACEMENT PARTS PACKAGE	1
SK1511	FUSIBLE LINK, Hopper fire safety door	1
23792	ELEMENT, Air filter (large)	2
27313	ELEMENT, Air filter (small)	2
53431	ELEMENT, Hydraulic tank breather	1
50353	FILTER, Engine oil	2
44561	V-BELT, Alternator water pump	1
53137	SKIRT, Rubber, rear, floor contact	1
53298	SKIRT, Rubber, brush contact	1
23275	SKIRT, Rubber, side (left & right)	2
23386	SEAL, Pan top	2
23382	SEAL, Pan side	2
35607	LIP ASSEMBLY, Hopper	5
37021	LIP, Side	2
27179	V-BELT, Radiator fan	1
45770-8	SPARK PLUG	4
37356	POINTS	1
37408	CONDENSER	1
67718-2	ELEMENT, Oil filter (Deluxe)	1
36925	BACKING, Pan seal	1
35646	SEAL, Pan	1
36989	PAD, Rubber, rollout cylinder hose clamp	4
24120	TIRE, Front	2
40681-1	CABLE, Battery, negative	1
29830-9	CABLE, Battery, positive	1
SK1140A	SEAL KIT, Ross propelling motor 37041	1
37061	SEAL KIT, Hopper dump door	1
SK1842	SEAL KIT, Hydraulic rollout valve	1
SK1805	SEAL KIT, Hopper lift cylinder	1
SK1869	SEAL KIT, Rollout cylinder	2

SCRUBBER ATTACHMENT MAINTENANCE ITEMS

TENNANT Part No.	Description	Qty.
43323	BLADE, Squeegee	1
43324	BACKING, Squeegee	1
43292	BLADE, Squeegee, side brush	1
43322	STRIP, Rear squeegee	1

MODEL 265 ENGINE MAINTENANCE LIST

TENNANT Part No.	Description	Qty.
45770-8	PLUG, Spark	4
37356	IGNITION CONTACT POINT SET	1
37408	CONDENSER, Ignition	1
37310	ROTOR, Distributor	1
37311	CAP, Distributor	1
54911-11	COIL, Ignition	1
37359	BRUSH KIT, Starter	1
32453	STARTER	1
58536	ALTERNATOR	1
54915-2	REGULATOR, Voltage	1
54912-3	CARBURETOR, Gasoline	1
54929	CARBURETOR, LPG	1
54912-2	PUMP, Fuel, gasoline	1
50353	ELEMENT, Engine oil filter	1

ELECTRICAL MAINTENANCE ITEMS

TENNANT Part No.	Description	Qty.
44078	SWITCH, Filter shaker motor	1
24576	FLASHER, Flashing light accessory	1
62530	SWITCH, Ignition	1
54180	AMMETER	1
68222	LIGHT, Oil pressure indicating	1
37351	SWITCH, Oil pressure sending	1
51805	SWITCH, Oil pressure safety (LP only)	1
54911-15	RESISTOR	1
14215	FUSE, 20 amp	5
SK2460	SOLENOID, Starter	1
29830-9	CABLE, Battery (positive)	1
40681-1	CABLE, Battery (negative)	1
37183	BATTERY	1
54121	MOTOR, Filter shaker	1
78005-2	SENDING UNIT, Temperature	1
50330	GAUGE, Temperature	1
14137	SWITCH, Light (accessory)	1
47472	GAUGE, Fuel	1
47473	SENDING UNIT, Fuel	1

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

12/80

SPECIFICATIONS

FOR

TENNANT MODEL 265 POWER SWEEPER

(Both Standard and High Dump Models)

SWEEPING PATH WIDTH	53 in (1346 mm)
SWEEPING SPEED (St'd. Machine)	0 to 10 mph (0 to 16 km/hr)
SWEEPING SPEED (High Dump Machine).	0 to 10 mph (0 to 16 km/hr)
ISLE WIDTH TURN (St'd. Machine)	Left - 8ft. 10 in (2692 mm) Right - 13 ft (3962 mm)
ISLE WIDTH TURN (High Dump)	Left - 9 ft. 1 in (2769 mm) Right - 12 ft. 4 in (3759 mm)
DIMENSIONS	(See dimension drawings)
WEIGHT (St'd. Machines)	Net (with battery & standard brushes) 2,290 lbs (1,040 kg)
WEIGHT (High Dump)	2,925 lbs. (1327 kg)

MECHANICAL DATA

FRAME	Electrically - welded steel plate, reinforced at stress points, with frame bumper.
ENGINE	(See "Engine Specifications")
HYDRAULIC TANK	Tank capacity: 5 gallons (19 liter) approx.

MECHANICAL DATA

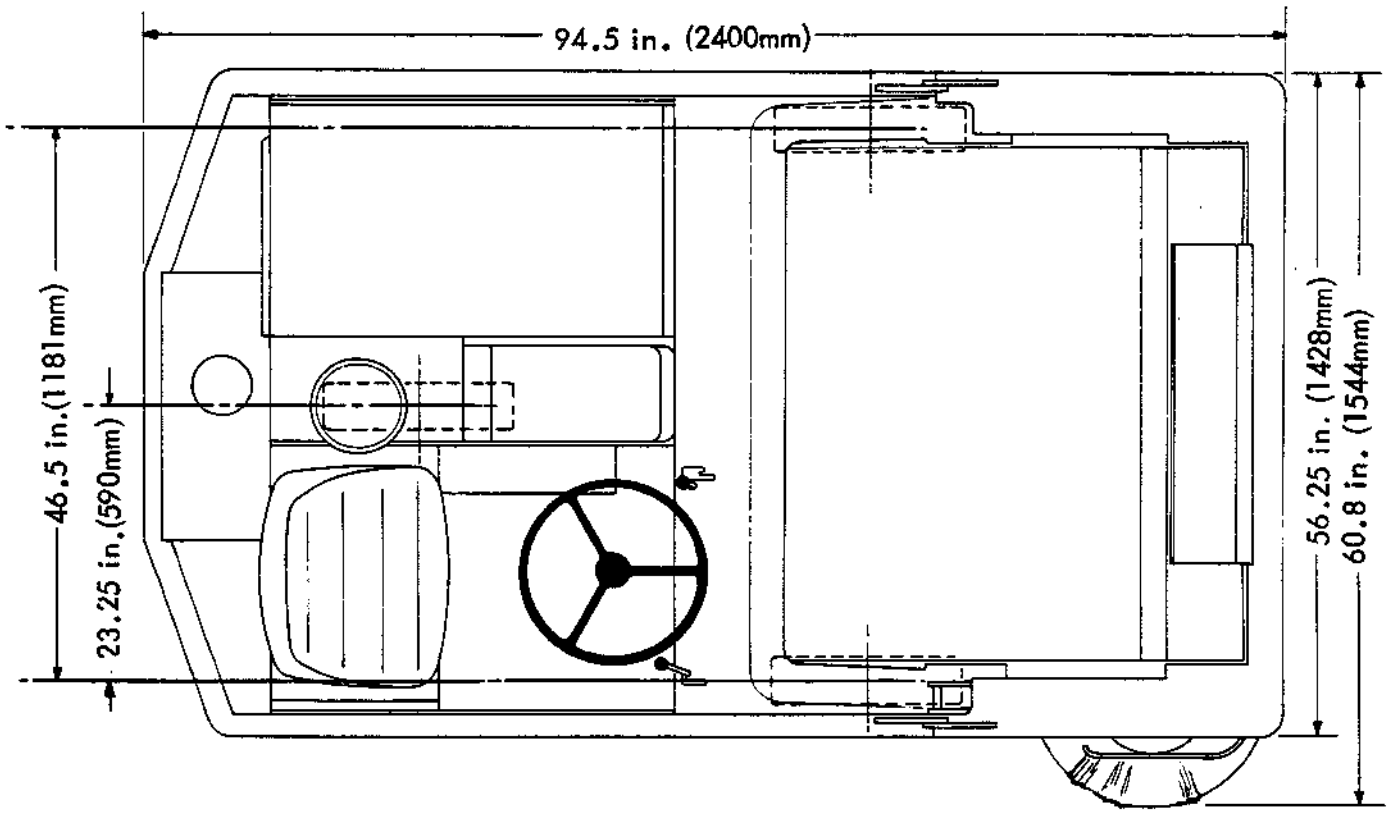
GAS TANK	8 gallon (30 liter) capacity (located under seat)
BATTERY	12 volt, automotive - type lead - acid, 84 amp/hr (located under floor panel)
PROPELLING DRIVE	Direct - coupled, engine - driven, variable - volume, piston pump. Pump provides infinitely variable flow to direct rear - wheel - mounted hydraulic motor. Engine runs at constant speed.
BRUSH AND VACUUM FAN DRIVE	Hydraulic - motor - driven vacuum fan, main sweeping brush, and side brush. Hydraulic motors driven by direct mounted pump on the engine.
MAIN BRUSH	42" (355 mm) tubular, one-piece disposable unit. 14" (35.5 cm) 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 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 the 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 (6.6 m^2). 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.
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 to check 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 the 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 FRONT: 2 zero pressure, heavy service rubber (Hi-dump front tires are solid)

ENGINE SPECIFICATIONS

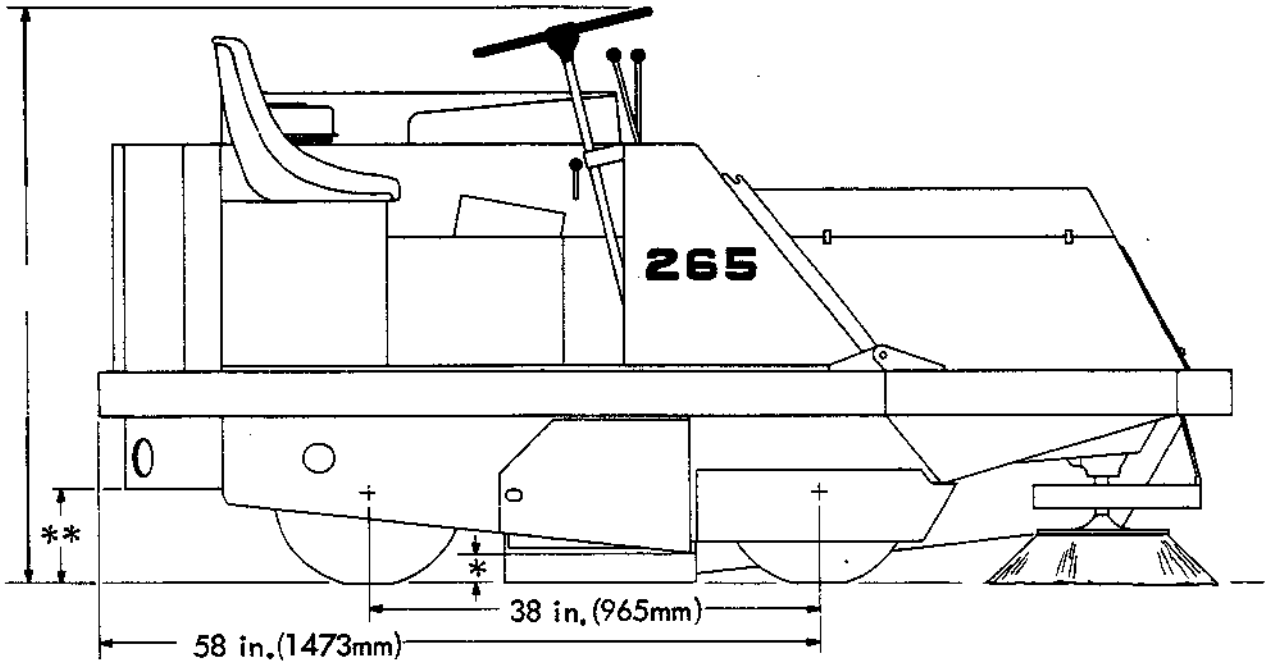
ENGINE MANUFACTURER	FORD INDUSTRIAL ENGINES
NUMBER OF CYLINDERS	4
DISPLACEMENT	98 cu in. (1600 cc)
CYLINDER BORE	3.188 in. (80.98 mm)
PISTON STROKE	3.056 in. (77.62 mm)
FIRING ORDER	1-2-4-3
HORSEPOWER (NOMINAL)	35 @ 2400 rpm
COMPRESSION RATIO	8:1
OIL CAPACITY - less filter OIL CAPACITY - with filter	5.35 pts (3.0 liters) 6.25 pts (3.5 liters)
VALVE CLEARANCE (Hot)	Intake .010 in.(0.25 mm) Exhaust .020 in. (0.50 mm)
BREAKER POINT GAP	0.025 in (0.64 mm)
SPARK PLUG GAP	*0.023 in (0.58 mm) Gasoline & LPG
IGNITION TIMING	See "Tune-up Specs" in Engine Section
BATTERY	12 volt, 84 amp
ALTERNATOR	Motorola, 12 volt, 32 amp
REGULATOR-RECTIFIER	SOLID-STATE TYPE
ENGINE SPEED	2400 rpm ± 50 Governor Controlled
IDLE SPEED	950 ± 50 rpm
STARTER	12 volt, solenoid shift
CHOKE (gasoline only)	Remote manual type
SPARK PLUG TORQUE (ft lbs)	22

*0.032 in. (0.81 mm) if resistor plugs are used.



DIMENSIONS

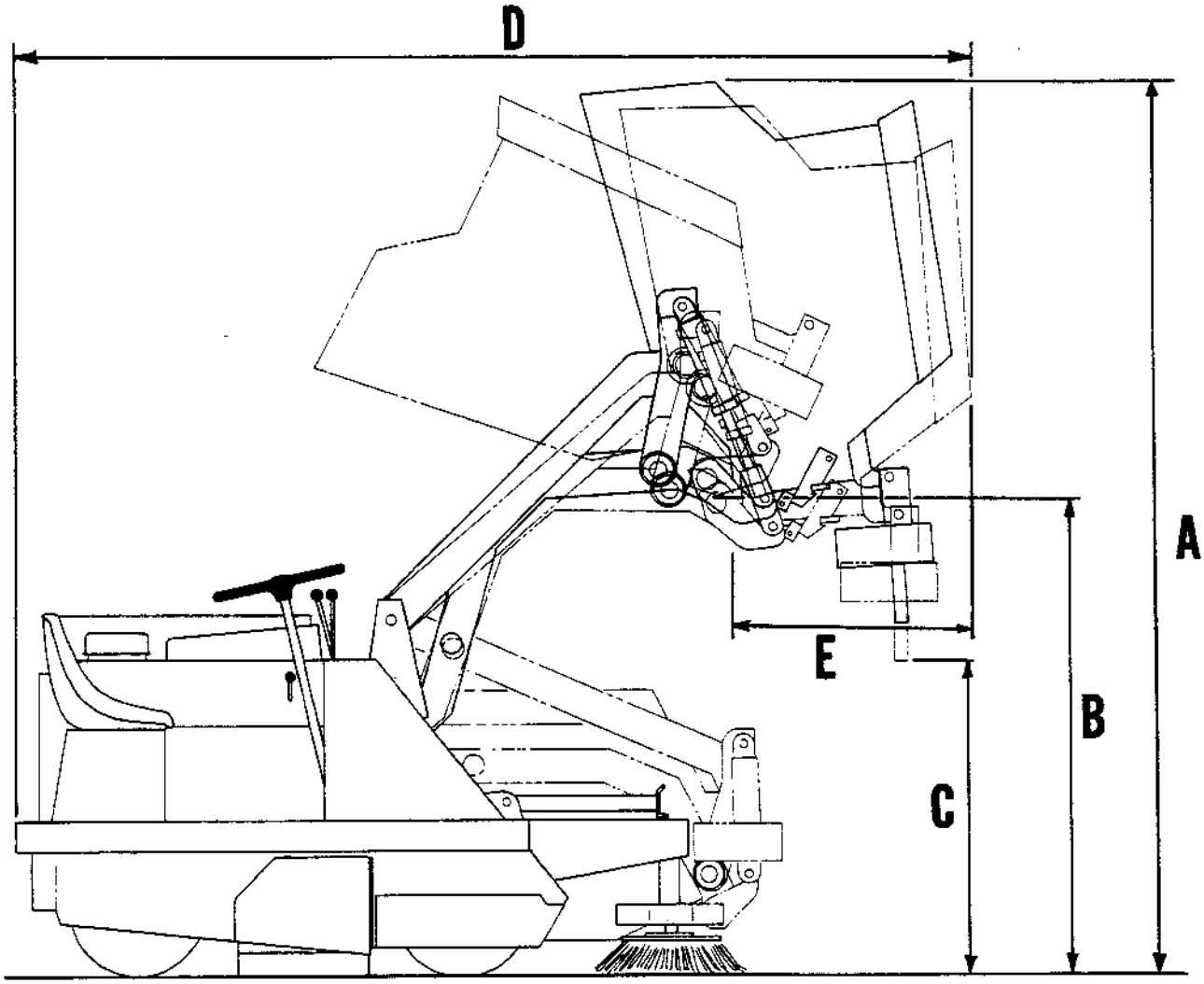
(Hi-Dump Dimensions shown on next page)



* 2.38 in (60.4mm) clearance, frame to floor

**8 in (203 mm) curb clearance.

HI-DUMP MODEL DIMENSIONS



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

B Maximum receptacle height clearance (without rollout): 62 in. (1575 mm).

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

D Maximum length (with maximum rollout): 107 in. (2718 mm).

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

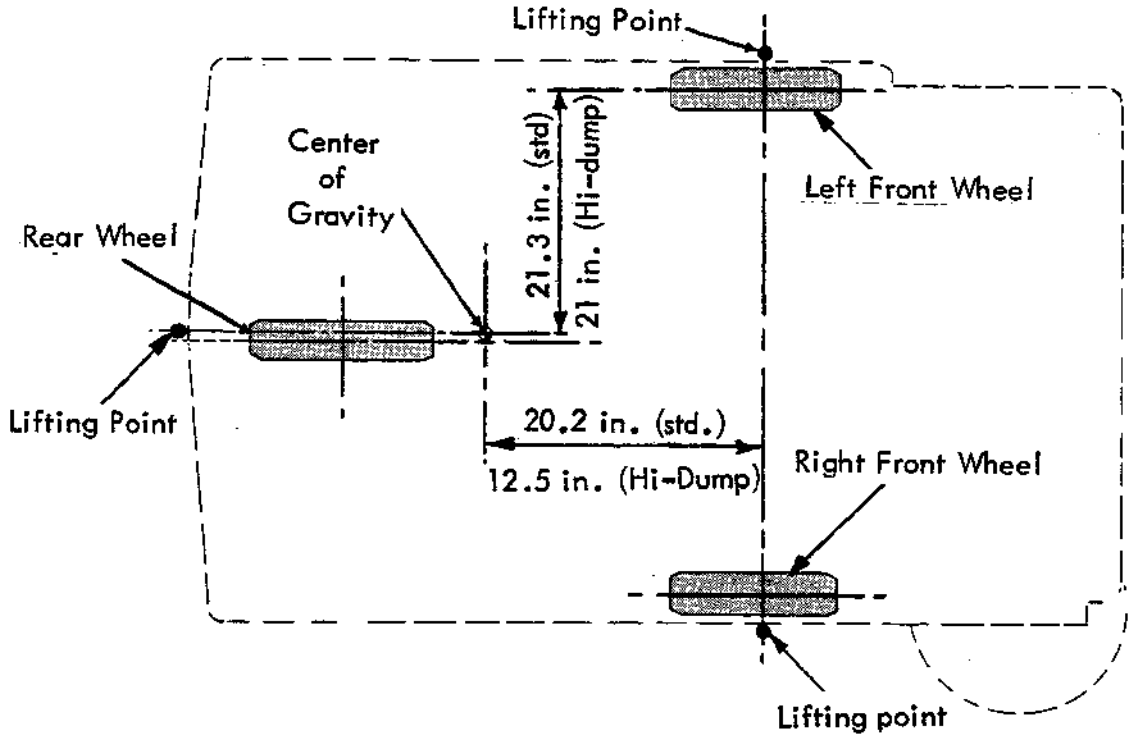


Diagram of center of gravity and lifting points. The location of the center of gravity is based on a dry machine with batteries installed, hopper empty, no operator.

LIFTING INSTRUCTIONS:

1. The approximate location of the three recommended lifting points are shown in the lifting diagram,
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 dry machine with hopper empty and no operator.

PREPARATION FOR OPERATION

Your TENNANT Power Sweeper has been shipped complete. You can operate your machine after following these directions:

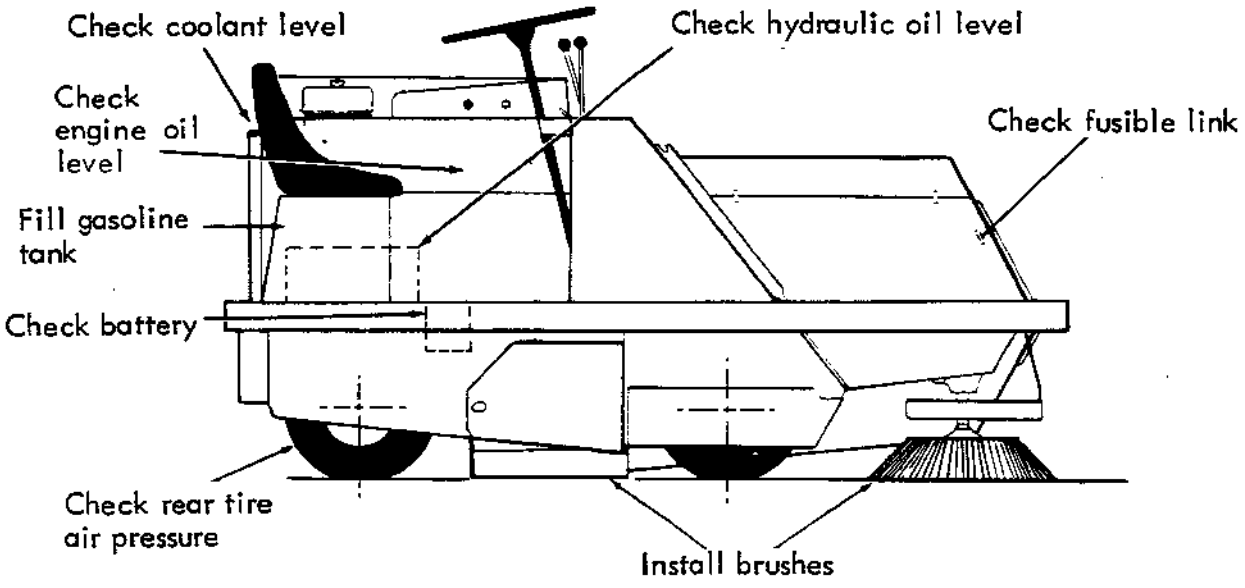
AFTER UNCRATING: (SEE DRAWING BELOW)

1. Check to see if battery is installed and connected to cables. Battery is located under floor cover below operator's seat.
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 the 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 pressure: 80 to 85 psi (552 to 586 kPa) for sweeper and Hi-Dump machines; 70 to 75 psi (483 to 517 kPa) for scrubbers.
6. Install brushes.
7. Check engine oil level.
8. Check radiator coolant level.
9. Please read this manual carefully before attempting to operate your machine.

PREPARATION FOR OPERATION (Standard machine shown)



265
POWER SWEEPER

operation of controls

CONTENTS:

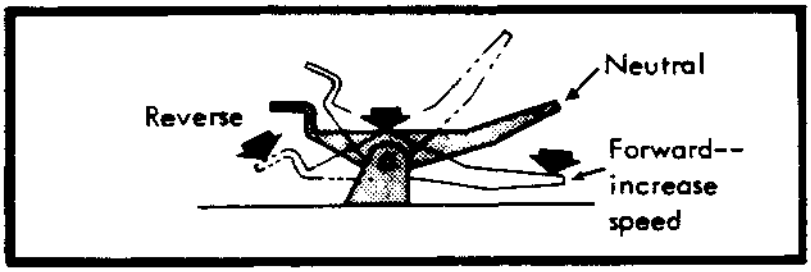
OPERATION OF CONTROLS

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.

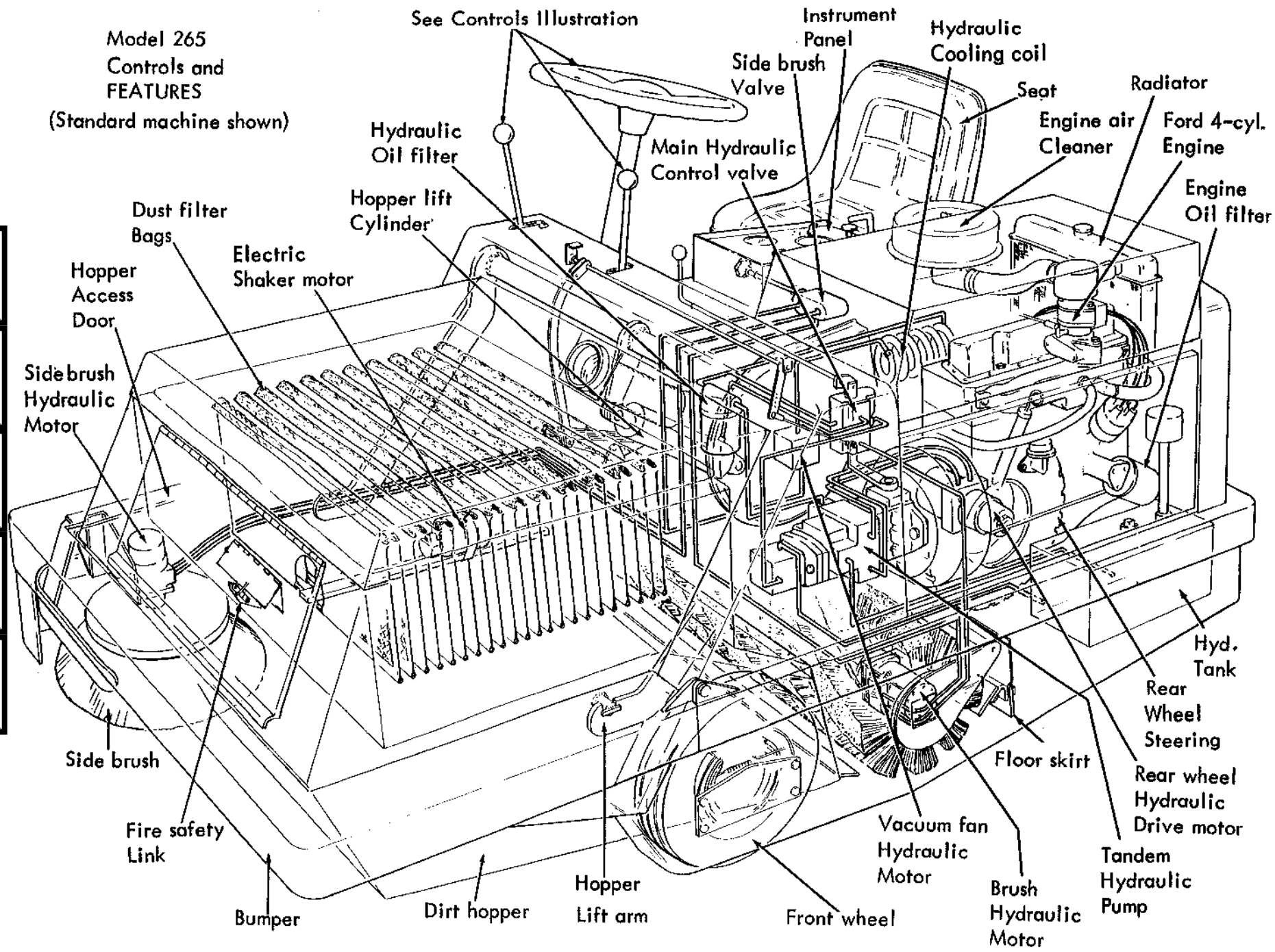
ATTENTION! The machine must always be operated with the engine at full "open" throttle. If not, there is danger of over-loading the engine and causing damage.

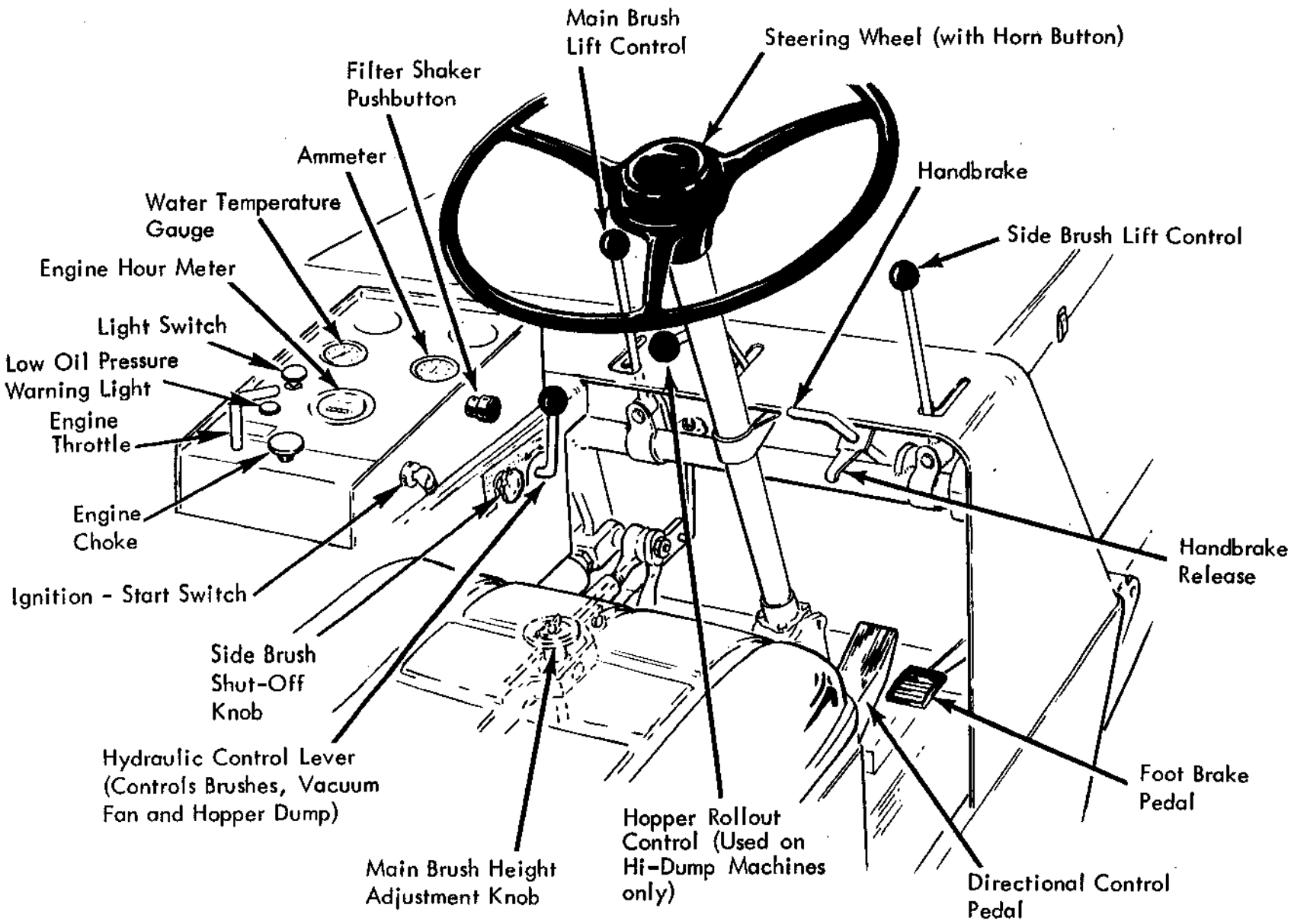
KEY-OPERATED IGNITION SWITCH

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.

Model 265 Controls and FEATURES

(Standard machine shown)

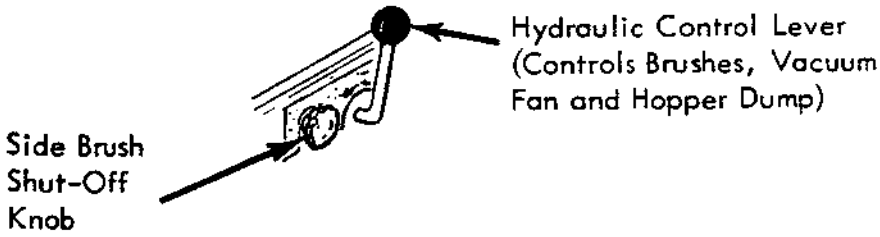




CONTROLS AND INSTRUMENTS

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 in (305 mm) off the floor before being fully dumped.

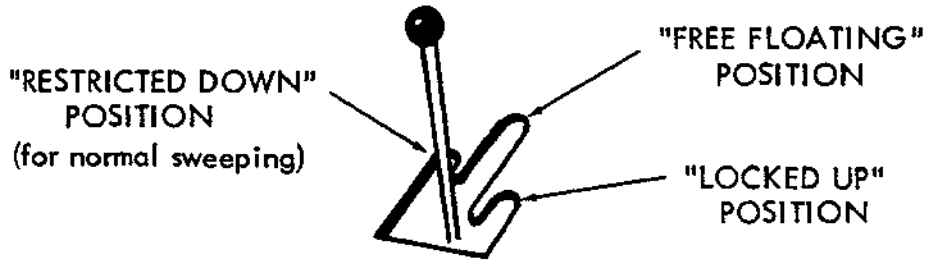
STEERING WHEEL

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".

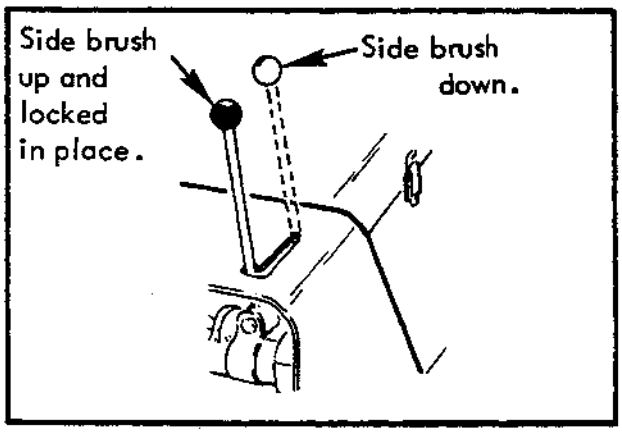
To lower the main sweeping brush, pull the lever back, then move the lever to the left and into either one of the two slots. To raise the brush, pull the lever back, then to the right and into the small slot where it will be locked in place (see sketch).



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.



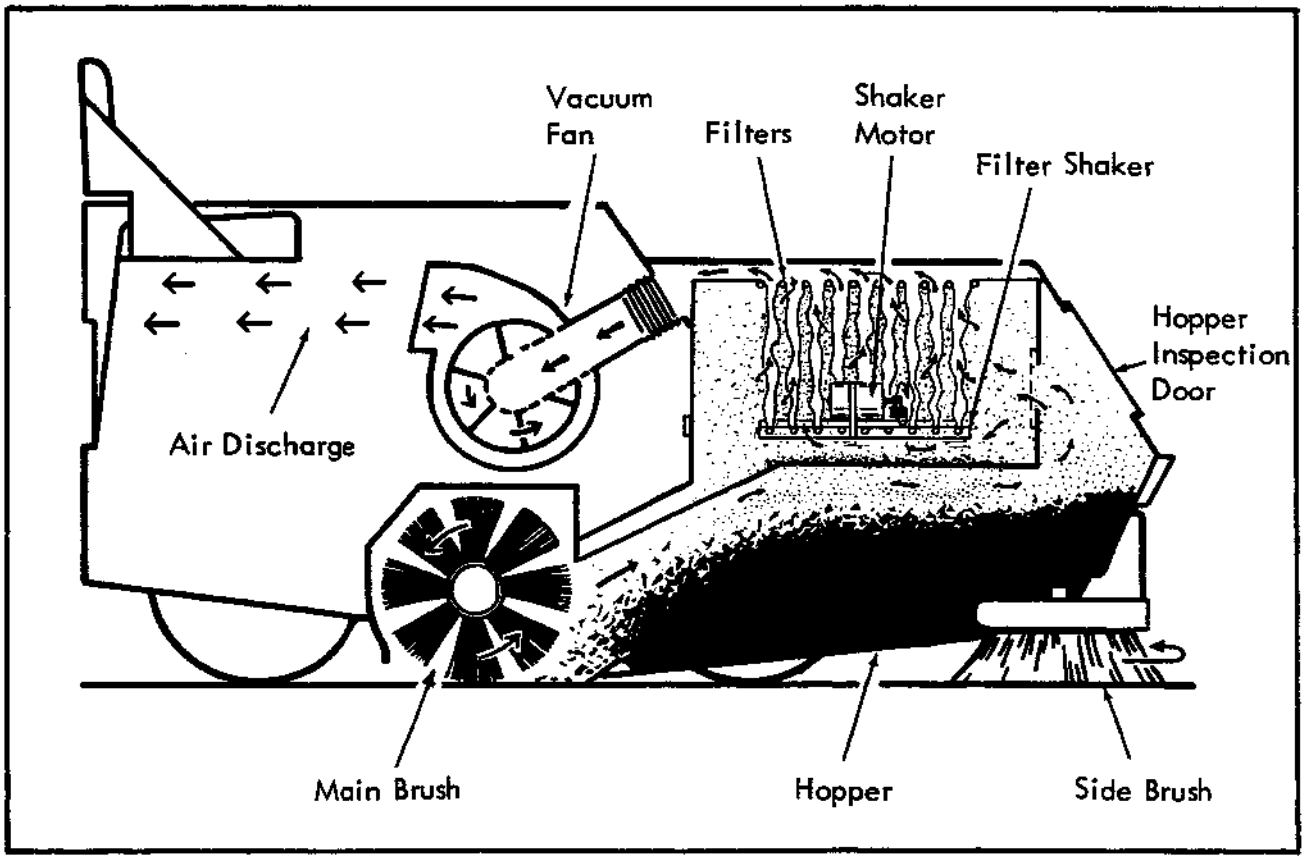
SI DE BRUSH LIFT LEVER

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

VACUUM FAN

The high volume 9 in (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 line. 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 handbrake. Be sure to engage the handbrake whenever parking the machine.

265

POWER SWEEPER

CONTENTS:

operation

OPERATION

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

1. **⚠CAUTION** 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 (about 3/4 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 hydraulic drive system.

WARM-UP

Allowing engine and hydraulic system to warm-up before operation will prolong machine component's life.

NOTE The engine may surge until it reaches operating temperature, 5-10 minutes operating time. If the engine is put under a load while it is cold, the surging may become more aggravated.

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.

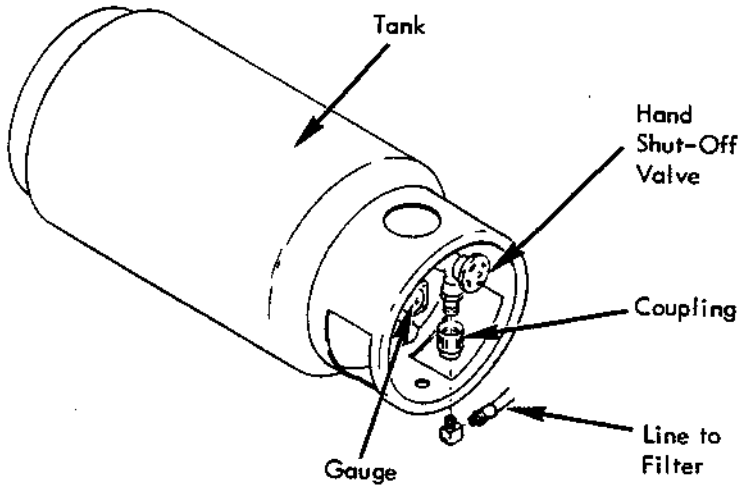
GASOLINE

The eight-gallon (30 liters) 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 machine and container.) NEVER FILL TANK WHILE ENGINE IS RUNNING.

LPG FUEL

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



LP FUEL TANK AND COMPONENTS

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.

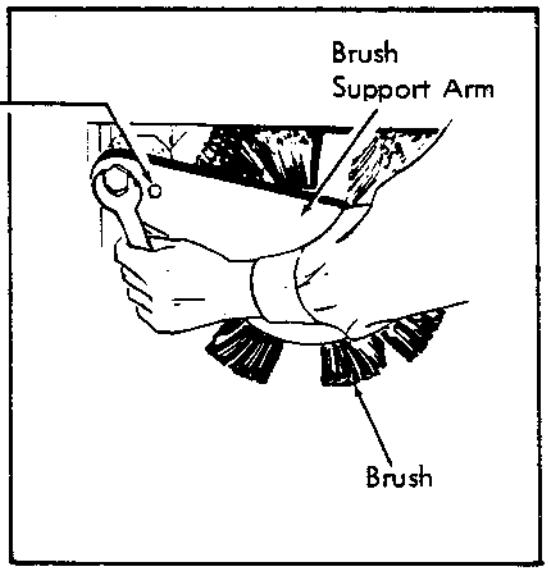
3. Using the wrench provided, remove the hex head screw which attaches the brush support arm.

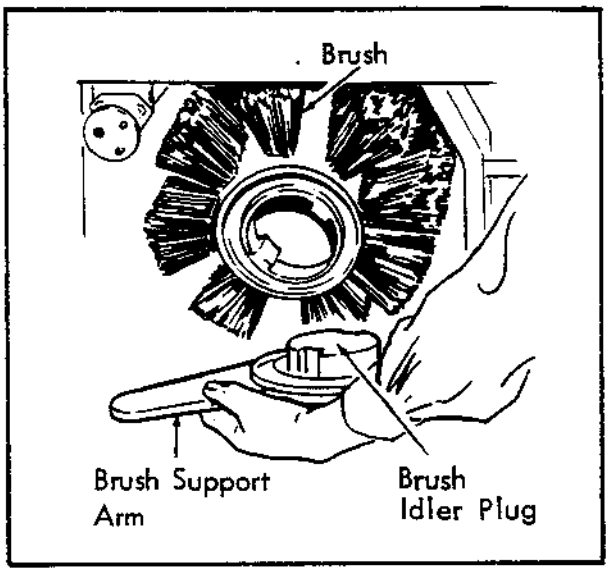
4. Pull out and remove the support arm and brush idler plug from the end of the brush.

NOTE 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.)

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.

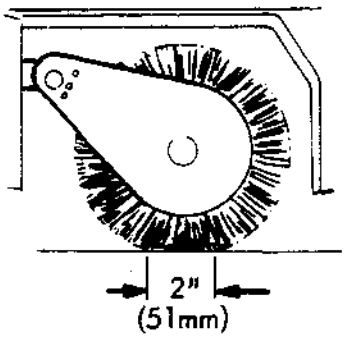
3. Replace right side brush support arm, with plug into open brush end. (To prevent the arm from sticking in place, apply a little grease to the arm pins.)

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

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 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.

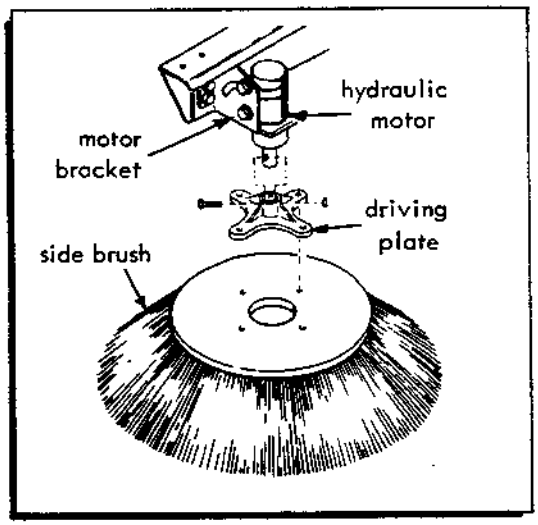
TO REPLACE SIDE BRUSH

A. To Remove Brush

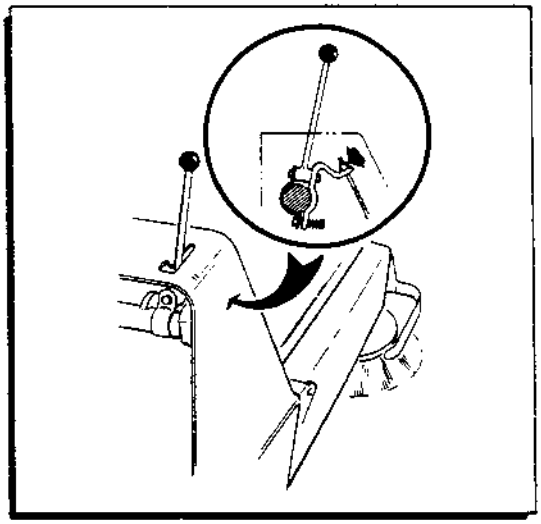
1. Be sure hydraulic control lever is in "OFF" position.
2. Raise side brush with side brush lift lever.
3. Remove bolt from brush drive shaft. (Brush can then be lowered and removed.)

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 1/2 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".)



SIDE SWEEPING BRUSH ASSEMBLY



SIDE BRUSH LIFT CABLE ADJUSTMENT

TO REPLACE OR ADJUST 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.

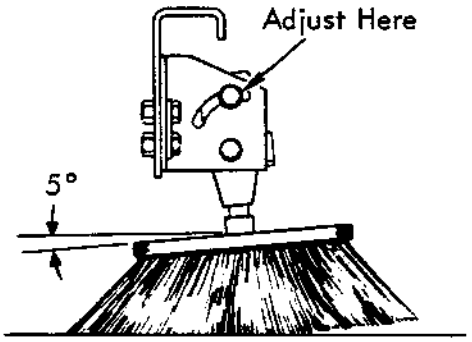
NOTE Adjust the cable, loosening adjusting nut at upper cable end. (See drawing).

SIDE BRUSH ADJUSTMENTS

Brush Height Adjustment

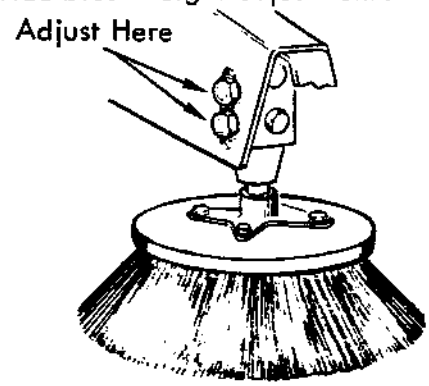
Height adjustment has been made at the factory. However, if you replace the lift cable, be sure to adjust the cable length properly. Proper cable adjustment should allow the full weight of the brush unit on the floor when brush lift lever is in "Down", or sweeping position -- but sufficient cable tension 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

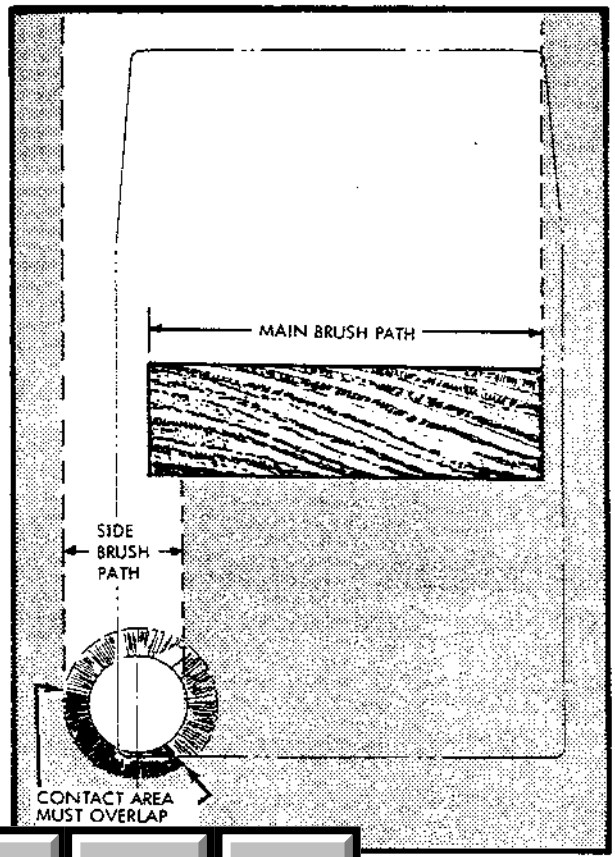
Side brush height adjustment.



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.



This sketch shows the relationship between the main brush and side brush sweeping paths.

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 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 (1/2 ton, 455 kg). Ceiling clearance height of the fully raised hopper is 9ft. 4 in. (2845 mm).

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), and 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).

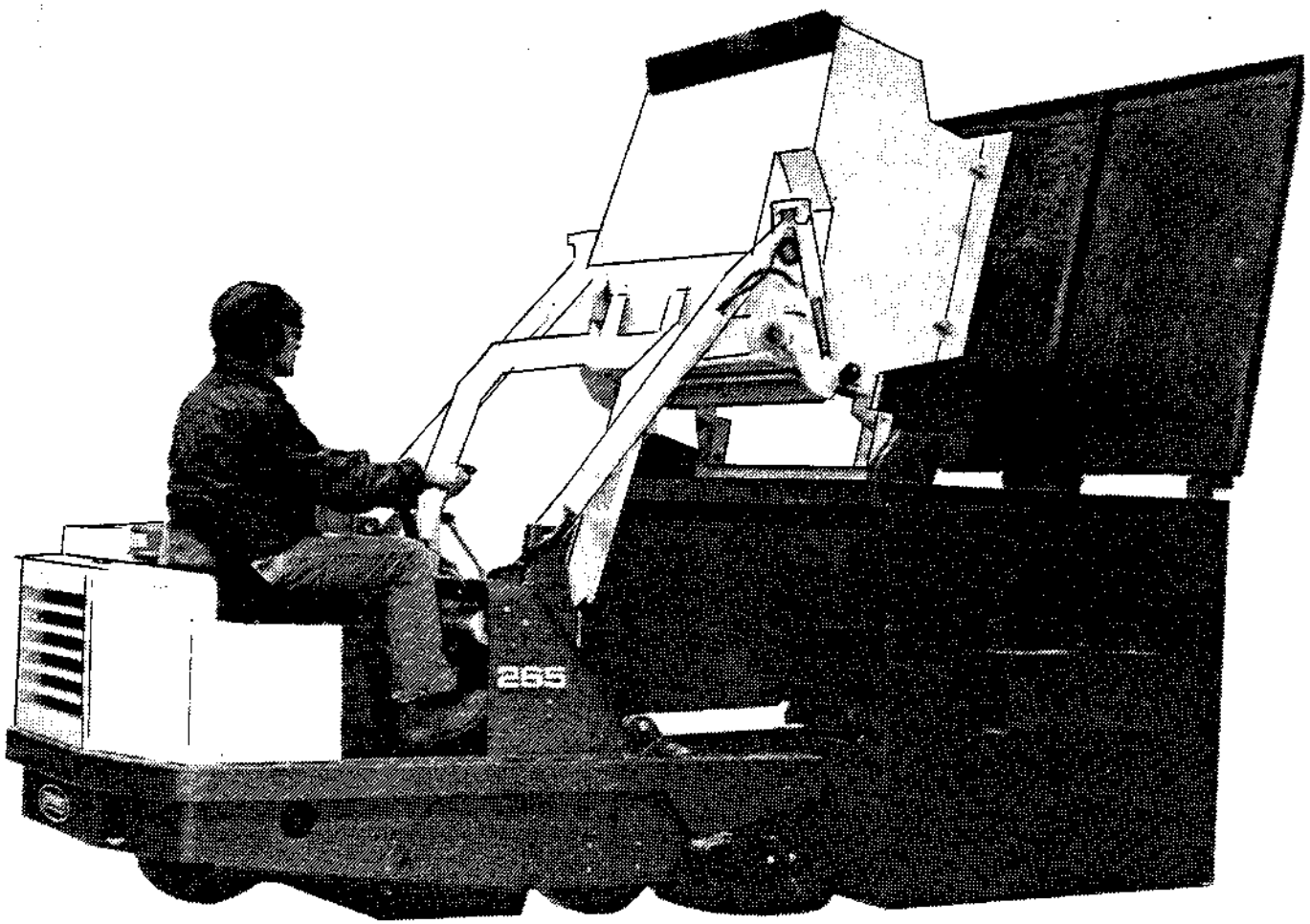
2. Remember that to avoid damage, the hopper must be at least 12 in (305 mm)off the floor before rollout (hopper door or shear pin may be damaged).

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. Push filter shaker button to clean filter.
3. Turn hydraulic control lever to "Hopper Up" position (engine full throttle).
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.



HOPPER SAFETY SUPPORT ARM (Standard Machine)

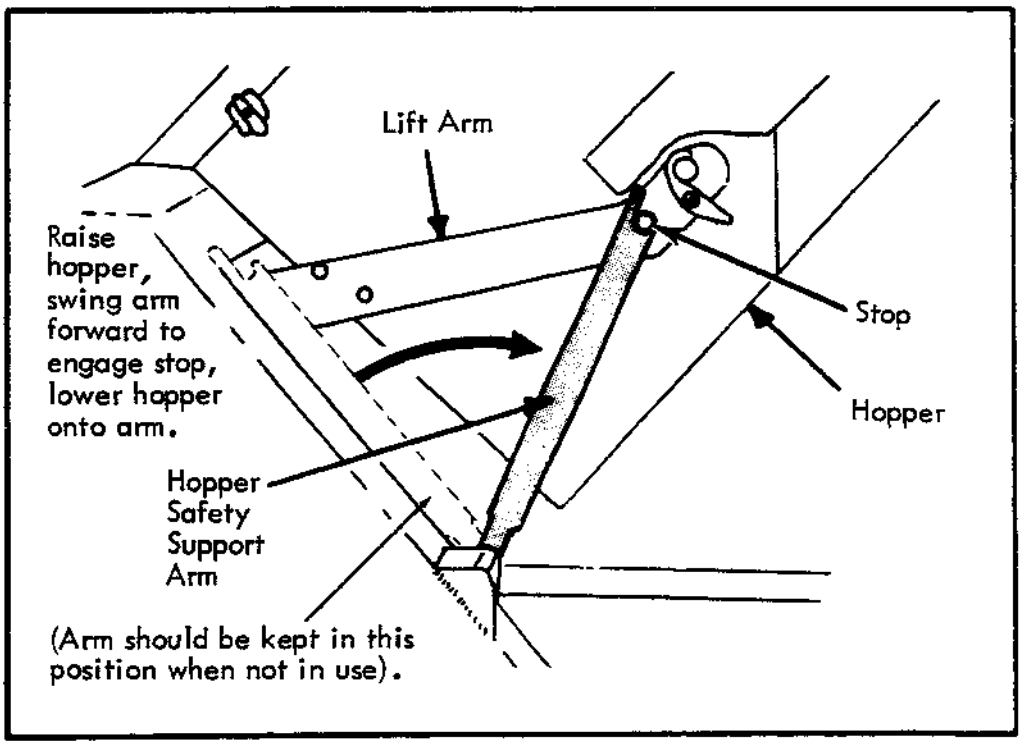
⚠WARNING NEVER REACH UNDER THE UPRAISED HOPPER WITHOUT FIRST ENGAGING THE SAFETY ARM.

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)

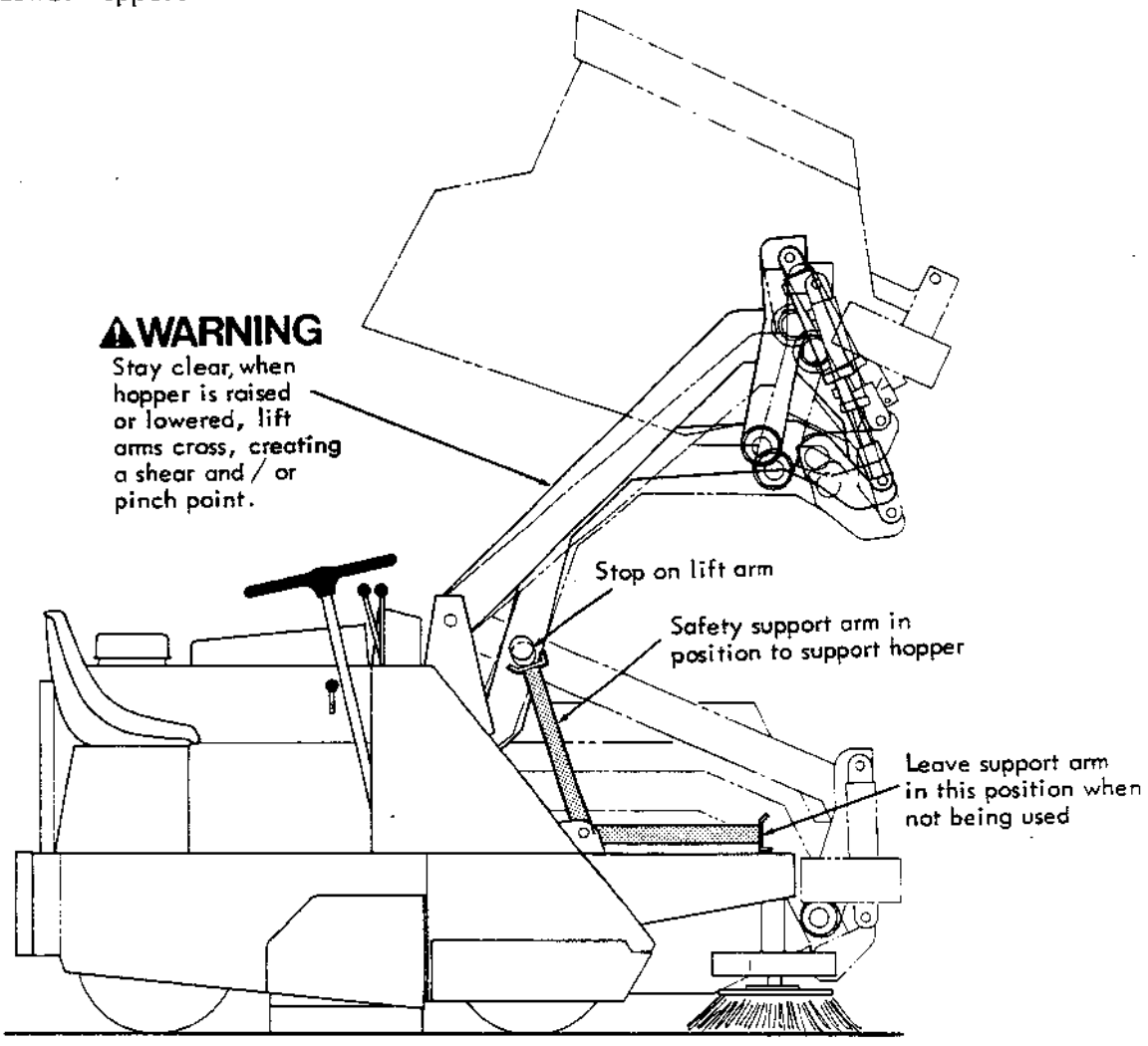
⚠WARNING NEVER REACH UNDER UPRAISED HOPPER WITHOUT FIRST ENGAGING THE SAFETY ARM. WHEN HOPPER IS RAISED OR LOWERED, LIFT ARMS CROSS, CREATING A PINCH POINT - STAY CLEAR!

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.



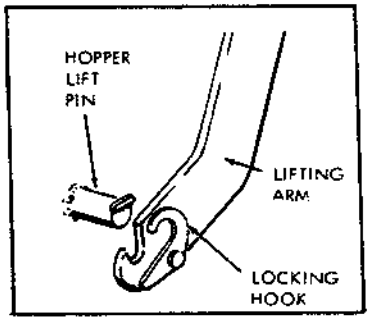
TO REMOVE SWEEPING HOPPER (standard machine)

1. Raise bumper and latch in place with chains.

2. Start engine. Raise hopper and engage safety lock.

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 the 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.

MANUAL METHOD OF RAISING HI-DUMP HOPPER

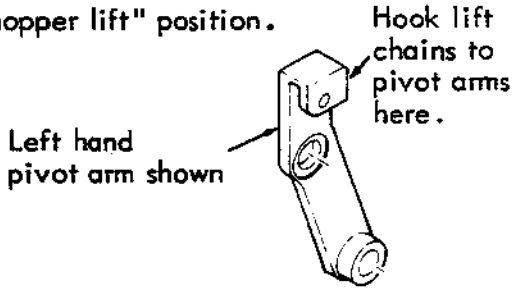
If it is necessary to raise the hopper and the hydraulic pump is not operating, use an overhead chain hoist to lift the hopper, as follows:

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.



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.

GENERAL OPERATING SUGGESTIONS

1. Plan your sweeping in advance. 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.

   ⚠CAUTION Avoid driving sweeper with the hopper removed. Removing the hopper changes the machine center of gravity and affects balance. Do not back the machine down ramps.

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

7. Hi-Dump machines: Observe cautions described under "The Hi-Dump Hopper." Reduce machine travel speed when driving up or down inclines.

8. Scrubber: Reduce machine speed when driving on wet and soapy floors.

265
POWER SWEEPER

maintenance

CONTENTS:

ENGINE OIL SELECTION

Use a good quality heavy-duty oil with the API designation "SE", SAE #10W-40 When adding oil between changes, always use same brand of oil. Use the proper grade oil for the expected temperature range to be encountered:

TEMPERATURE

Below 0° (-17.7° C)	. . . . SAE 5W-20	
0° to 32° (-17.7 to 0° C)	. . . . SAE 10W	SAE - or #10W-40
32° to 75° (0 to 24° C)	. . . . . SAE 20W	
Above 75° (24°C)	. . . . . SAE 30	

CHANGING ENGINE OIL

CHECK ENGINE OIL LEVEL DAILY.

CHANGE ENGINE OIL EVERY 50 HOURS. Under normal operating conditions (if environment is extremely dusty - change oil more often). Change engine oil filter element every 100 hours.

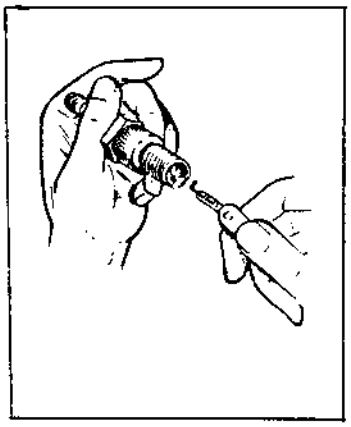
Engine oil should always be drained when the engine is warm. Remove the crankcase pipe plug to drain engine oil.

IMPORTANT

RECOMMENDED INITIAL 50 - HOUR MACHINE INSPECTION

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

1. Change engine oil and filter.
2. Check valve tappet clearance.*
3. Check spark plug gap.*
4. Check point gap.*
5. Check engine timing.*
6. Check cylinder head bolts and retorque if necessary.*
7. Retorque wheel drive hydraulic motor shaft nut to 300-400 ft lb (407-542 Nm.)



* See Engine Manual for "Tune-up Specs."

LUBRICATION & MAINTENANCE

MODEL 265 - ROUTINE MAINTENANCE & LUBRICATION

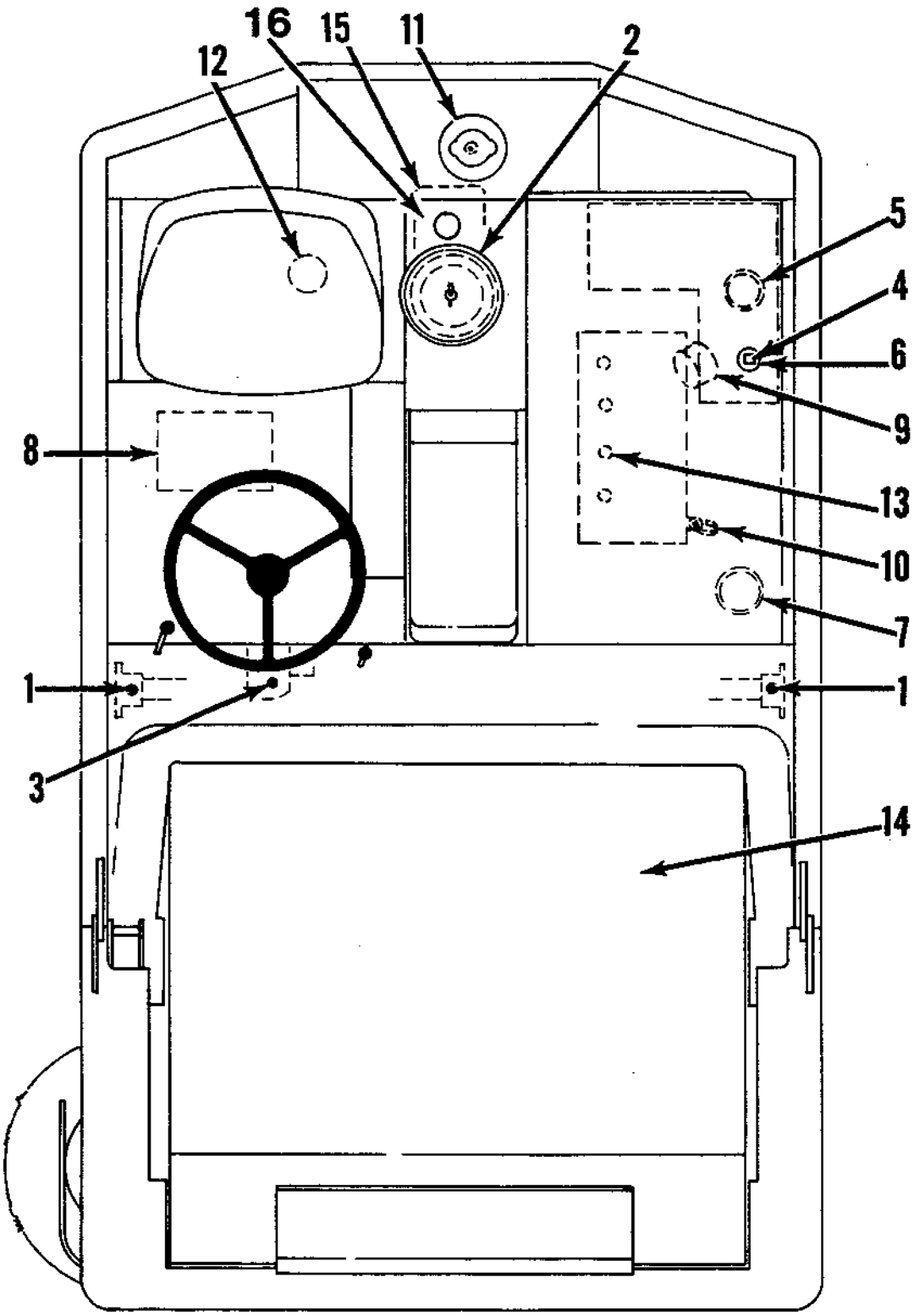
	Description	Procedure	Interval (hours) 8	50	100	250	500
1.	Hopper Lift Arm Bearings	Apply grease to fitting		X			
2.	Engine Air Cleaner	*Clean element	X	or X			
3.	Steering gear box	Check level, add grease					X
4.	Hydraulic tank	Check oil level	X				
5.	Hydraulic tank breather filter	Clean element					X
6.	Hydraulic tank	**Change hyd. oil, clean tank					X
7.	Hydraulic oil filter	Change filter element					X
8.	Battery	Check electrolyte level		X			
9.	Engine oil filter	Change filter element			X		
10.	Engine crankcase	Check oil level with dipstick	X				
		Change oil		X			
11.	Radiator	Check coolant level	X				
12.	Gasoline Fuel Filter (under tank)	Clean filter					X
13.	Engine Miscellaneous (see Engine Manual)	Clean spark plugs, set gap				X	
		Check points, set gap				X	
		Lubricate distributor cam				X	
		Check, adjust timing				X	
		Check fan belt tension		X			
		Adjust valve tappets					X
	Oil all miscellaneous linkages					X	
	Check LP Filter - replace filter pad						X
14.	Scrubber only:		X				
	Clean out recovery tank, squeegees, vacuum hose, etc.						
	Inspect squeegee blades for wear, damage, & adjustment.						
15.	Check rear tire: Sweeper 80-85 psi, scrubber 70-75 psi.			X			
16.	Front Wheel Bearing (2): Hand pack with Lithium EP multi-purpose grease						X

* Under normal conditions, clean two elements every 50 hours, in extremely dusty applications every 8 hours. Replace outer element every 200 hours. Replace inner element at every third outer element change.

** Change hydraulic oil filter after first 100 hours, thereafter at every 500 hours.

RECOMMENDED LUBRICANTS

1. All grease fittings: Lithium-Moly E.P. grease.
2. Steering gear: GM SSG4009 or equal steering gear grease.
4. Engine oil: (see Engine Manual).
5. Hydraulic Oil: TENNANT Part No. 32397, 10W-40 Hydraulic Oil.

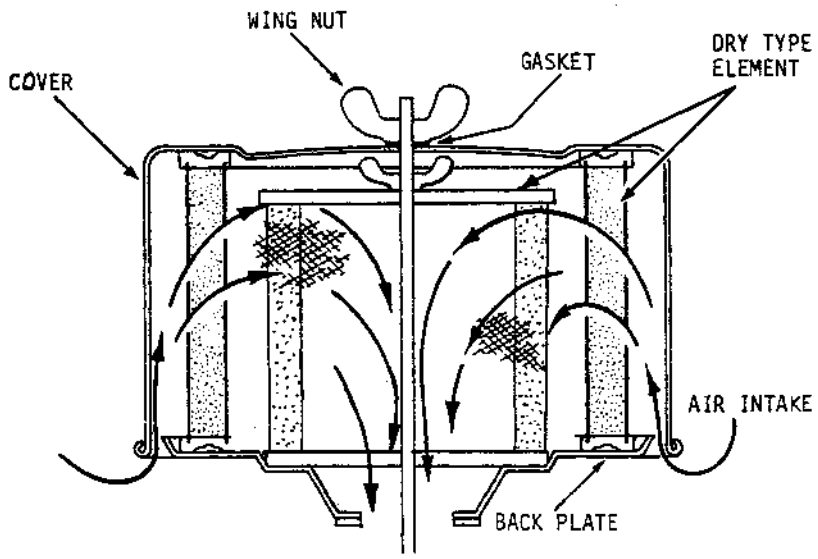


(NOTE: See Scrubber Instruction Section For Scrubber Lubrication & Maintenance)

LUBRICATION AND MAINTENANCE CHART
Model 265

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.

RADIATOR MAINTENANCE

Use soft, clean water mixed with a permanent-type, ethylene glycol antifreeze in a 1 to 1 ratio.

Deposits of sludge, scale and rust will prevent normal heat transfer. Flush out the radiator after every 500 hours of operation. Instructions for flushing out the radiator are given in the "Cooling System" section of the engine manual. A 190-degree thermostat is furnished.

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

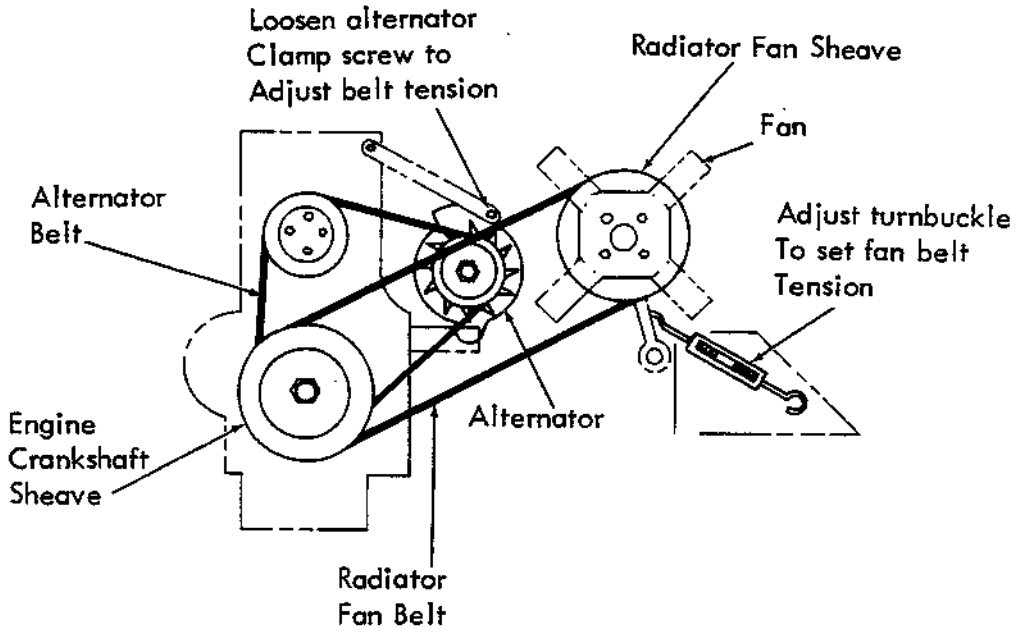
Before cleaning, remove the fan shroud from the radiator, then blow out all dust from outside the machine, into the engine compartment (this is the opposite direction from normal air flow). After the radiator fins are clean, replace the fan shroud.

ALTERNATOR BELT TENSION

Loosen adjusting screw on alternator and pull out on alternator to tighten belt. When adjusted correctly, the belt should have about 0.09 in (2.3 mm) deflection from 7 to 10 lbs (3.2 to 4.5 kg) force applied at midpoint on top span (see sketch below).

RADIATOR FAN BELT TENSION

Deflection should be 0.25 in (6.35 mm) from one to two lbs (0.45 to 0.9 kg) force. Adjust by means of turnbuckle. (see sketch).



ENGINE SPEED & GOVERNOR ADJUSTMENT

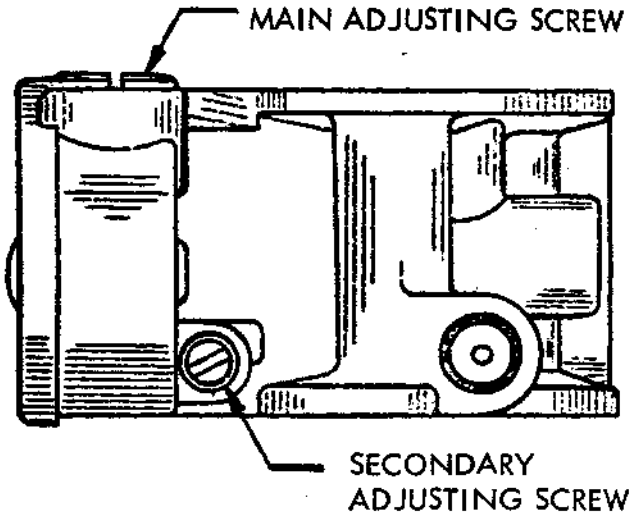
The engine operates at a constant, factory-set governor-controlled engine speed. The governor is factory-adjusted and sealed.

The engine throttle control must be set at full throttle whenever operating the machine. Recommended engine speed is 2400 ± 50 rpm with all brushes on and down. Idle speed should be 950 ± 50 rpm with all accessories off.

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

The governor should be adjusted only when engine speed is not at the recommended 2400 ± 50 rpm. To adjust governor, first remove lock wire.

For higher speed turn main adjusting screw clockwise; for lower speed, counter-clock wise. Always turn governor up to desired speed setting. If setting is too fast, turn back to below desired setting - then up to it. When desired speed is reached, install seal.

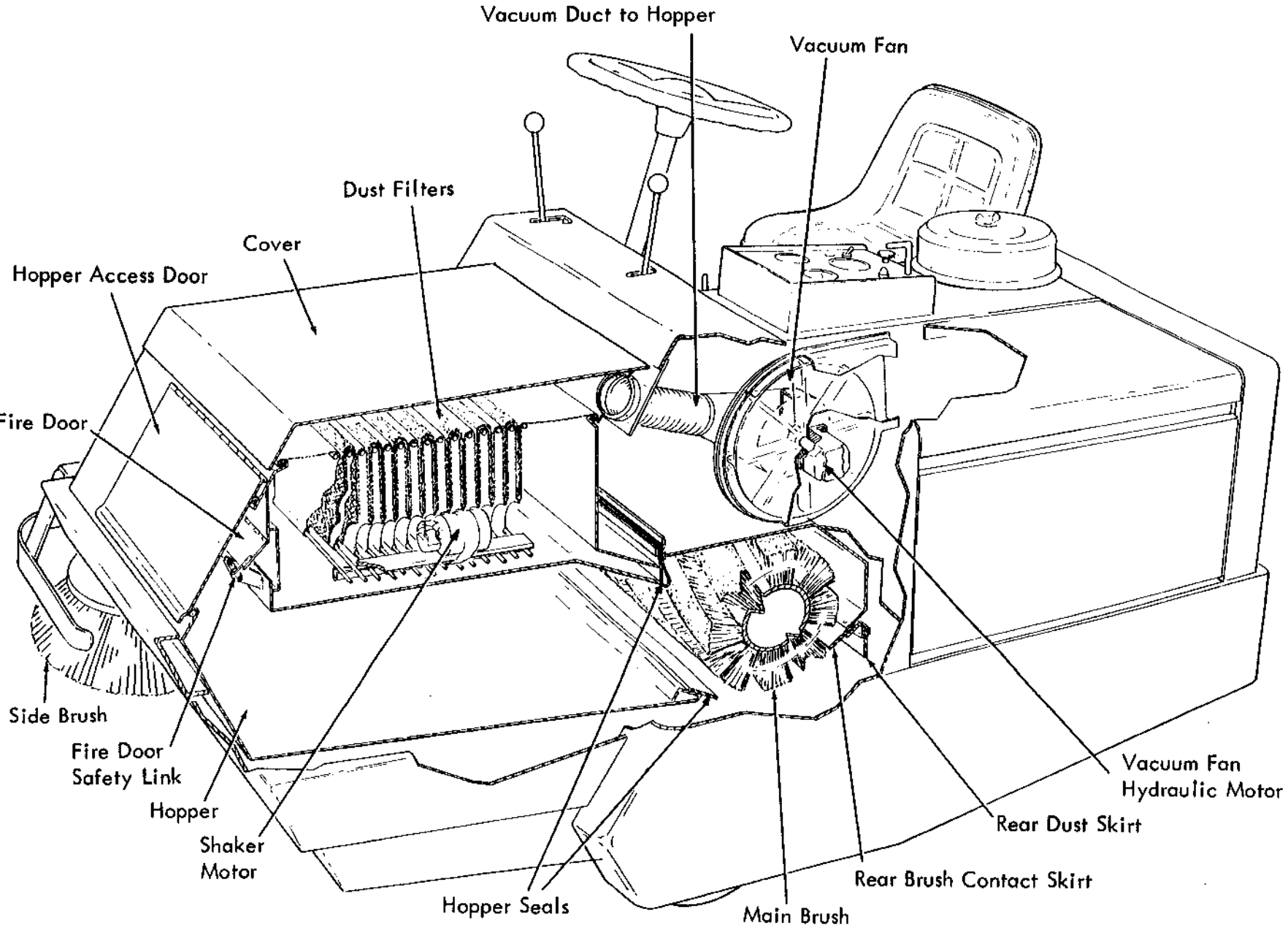


The secondary adjusting screw is factory set to cover a wide range of engine speeds. In setting the governor to desired road or engine speed use main adjusting screw only. If governor control is too sharp or not sharp enough, follow instructions below. Only in rare instances need the secondary adjustment be changed.

Drill welch plug covering secondary adjusting screw with a 0.06 in (1.5 mm) drill. Insert a 0.06 in (1.5 mm) rod in drilled hole and pry off welch plug.

1. IF GOVERNOR CONTROL IS TOO SHARP WHICH CAUSES SURGING OR HUNTING: Turn secondary adjusting screw clockwise 1/4 turn at a time. Turn main adjusting screw counter clockwise approximately one turn for every 1/4 turn of secondary screw to bring speed adjustment back to normal.

2. IF GOVERNOR CONTROL IS NOT SHARP ENOUGH, WHICH CAUSES TOO GREAT A VARIATION IN SPEED BETWEEN LOAD AND NO LOAD: Turn secondary adjusting screw counter clockwise 1/4 turn at a time. Turn main adjusting screw clockwise approximately one turn for each 1/4 turn of secondary screw to bring the speed back to normal.



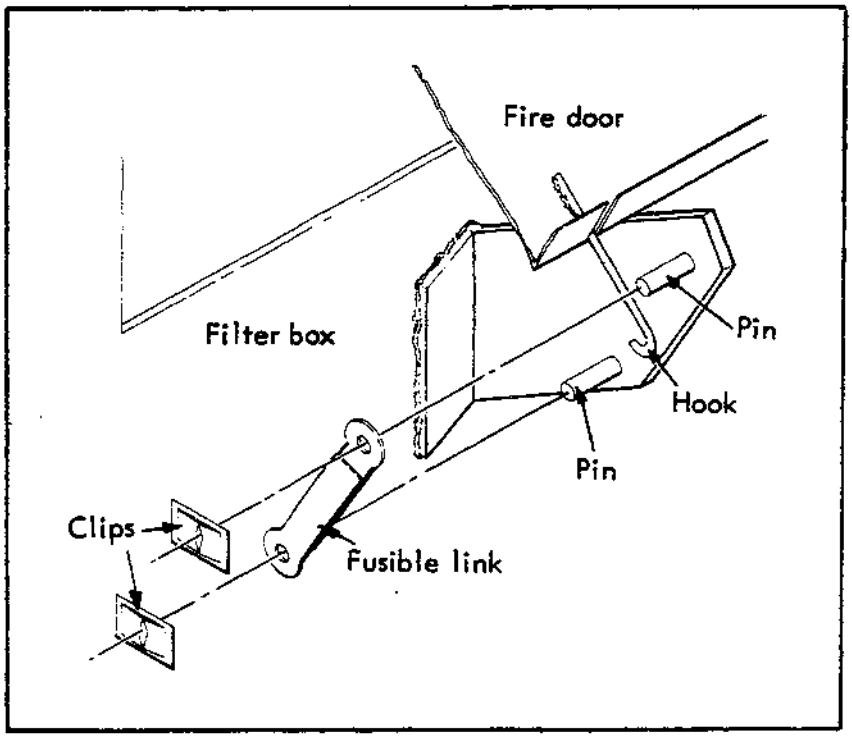
FILTER AND VACUUM SYSTEM

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.

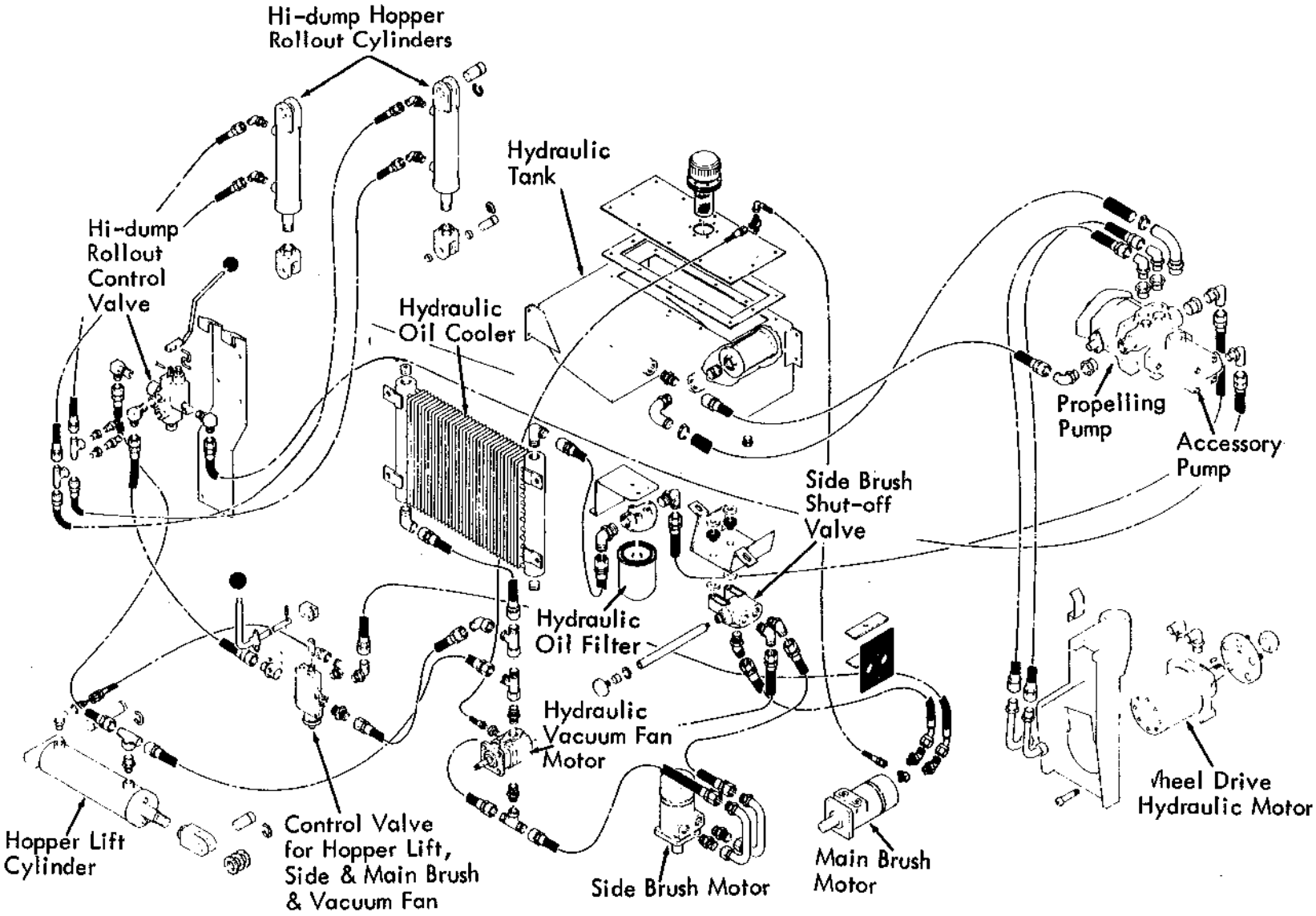
To replace the link, engage hook on fire door with body of link, and slide link onto pins, hold link in place with clips.



FUSIBLE LINK REPLACEMENT
(Standard Machine Shown)

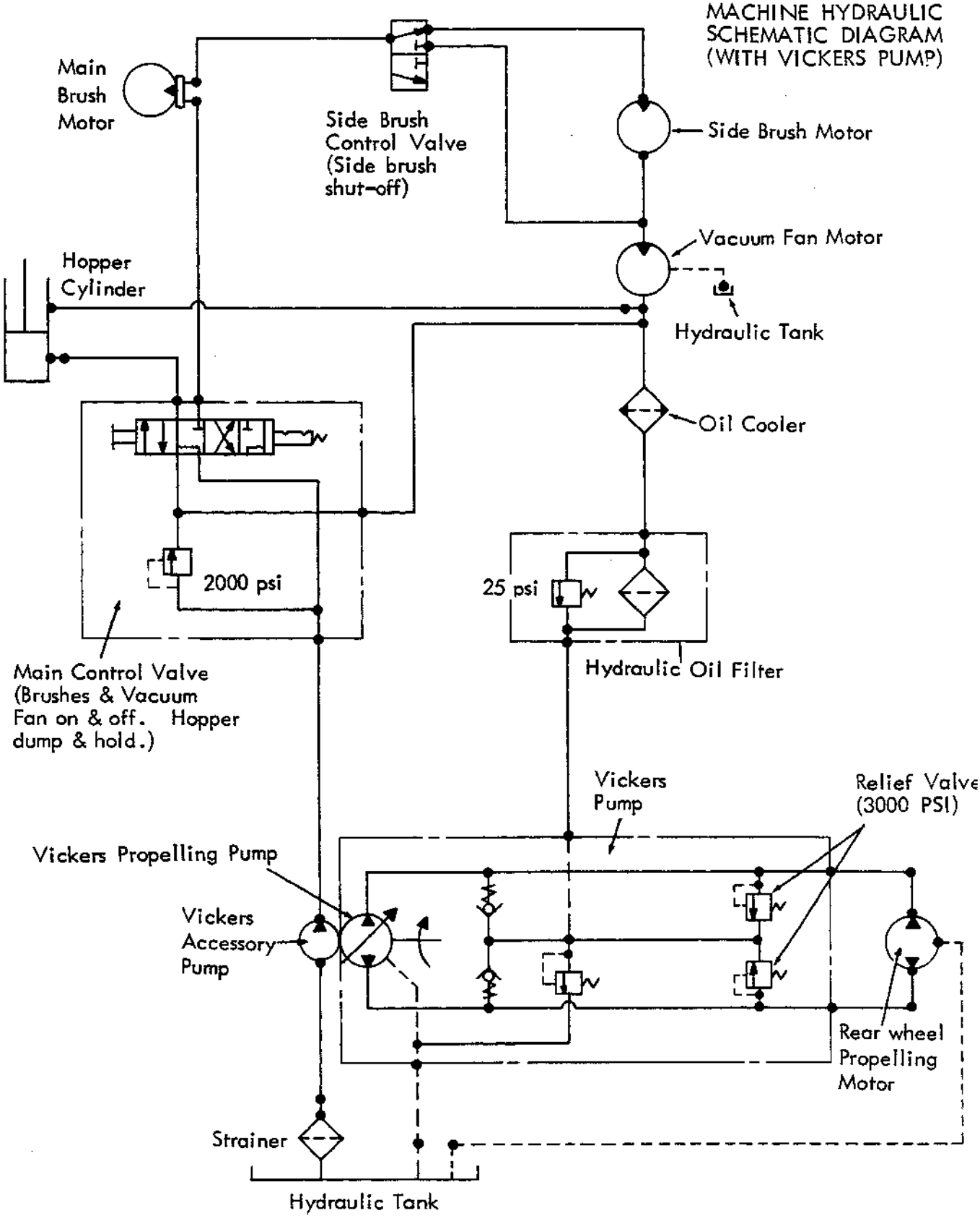
ATTENTION!

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

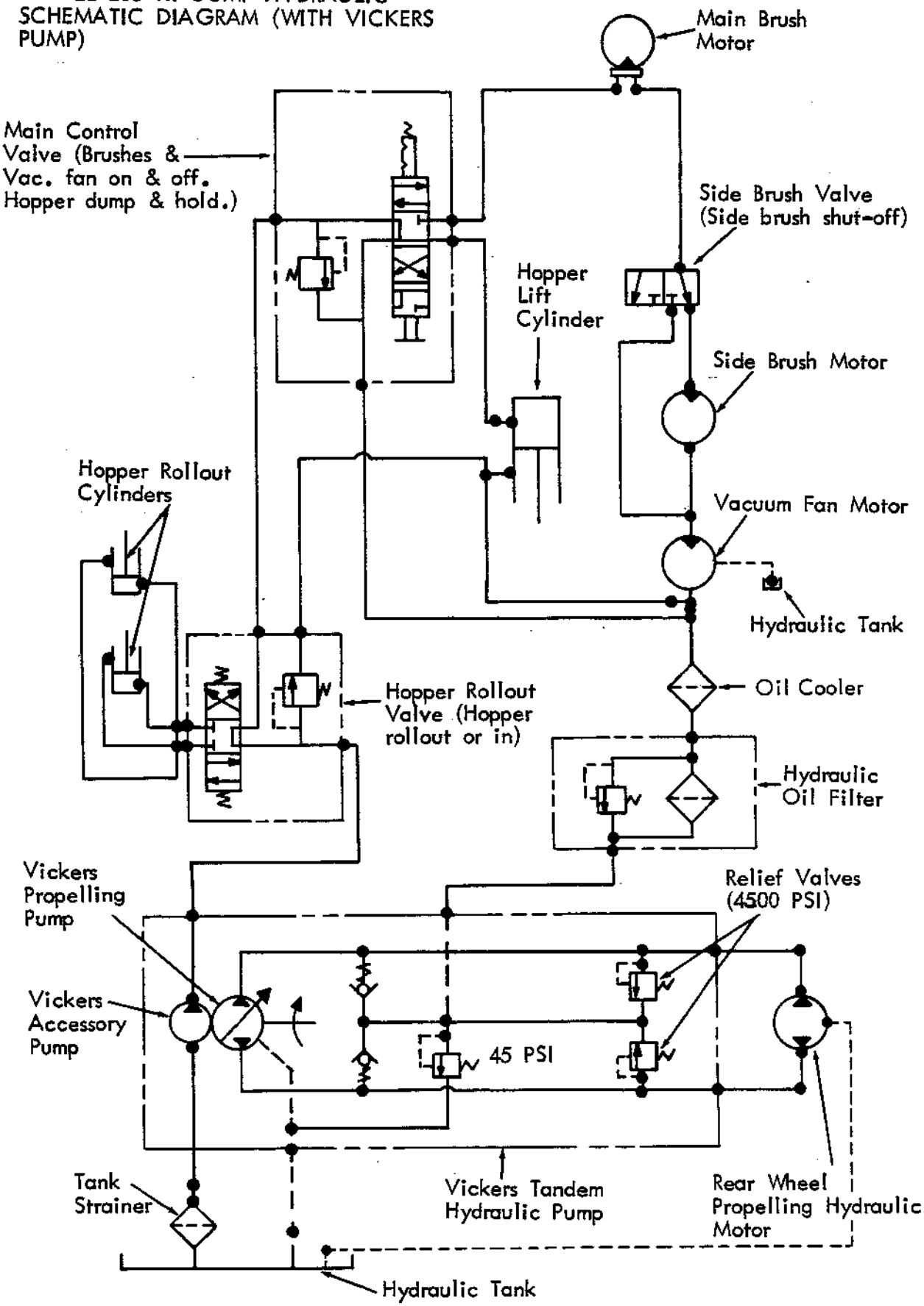


TYPICAL HYDRAULIC SYSTEM COMPONENTS (Hi-dump machine shown)

MODEL 265 STANDARD MACHINE HYDRAULIC SCHEMATIC DIAGRAM (WITH VICKERS PUMP)



MODEL 265 HI-DUMP HYDRAULIC SCHEMATIC DIAGRAM (WITH VICKERS PUMP)



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RECOMMENDED HYDRAULIC FLUID

TENNANT Hydraulic Fluid is a specially compounded oil 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

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

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

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

ATTENTION! If a locally available hydraulic fluid is preferred, or if you have standardized on the products of one oil company, the hydraulic oil used must match closely the viscosity specifications given in the chart for TENNANT hydraulic fluid, ad well as the other features described.

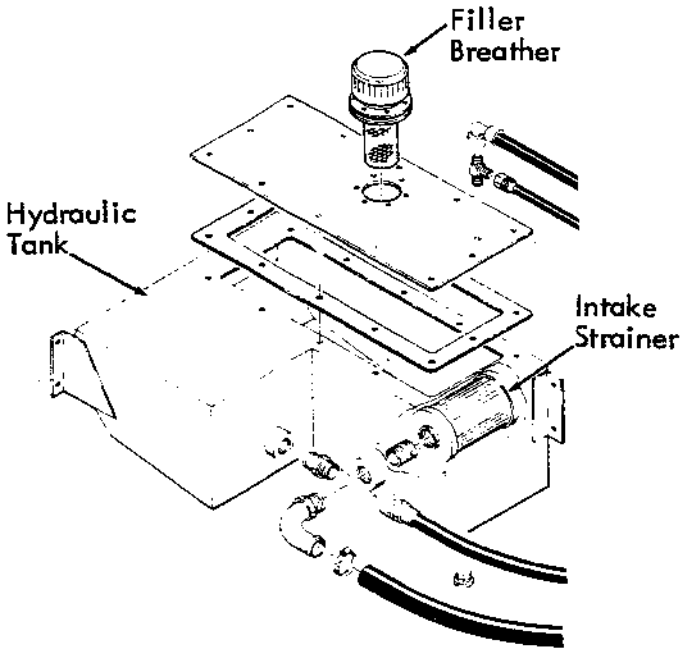
TO CHECK HYDRAULIC OIL LEVEL AND REFILL TANK

Open the top engine cover and side door. To check hydraulic oil level, unscrew filler plug in top of tank. The correct hydraulic oil level is 0.88 in (22.4 mm below top of filler opening. It is very important that the level be exactly as shown; either too much or too little hydraulic oil will cause problems.

Tank capacity is approximately 5 gallons (18.93 liters). Use TENNANT Hydraulic Oil (see "Hydraulic Oil Specifications" page).

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.



CHANGING HYDRAULIC OIL FILTER ELEMENT

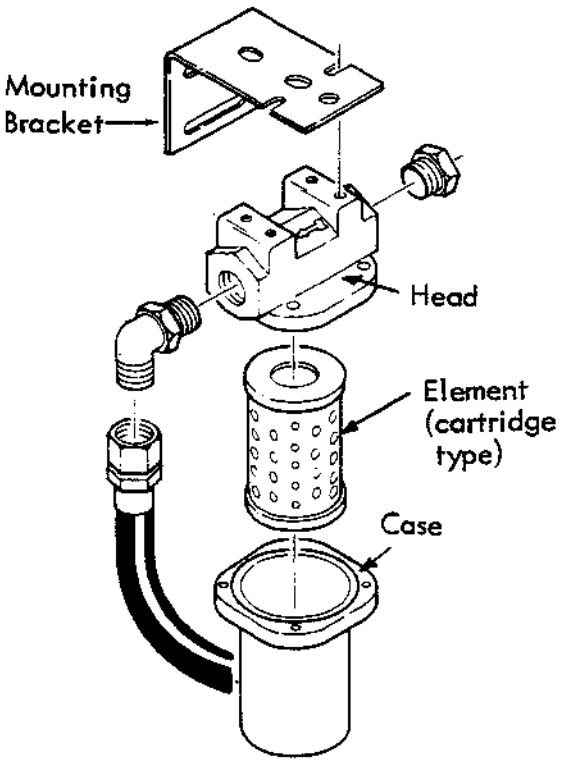
NOTE Several different hydraulic oil filters have been used. Please check your machine for correct element part number before ordering. The element part number is on the filter.

1. Alternate (Ripley):

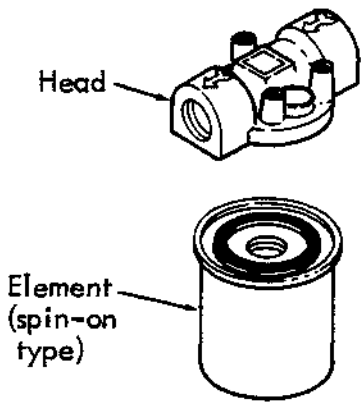
   "Cartridge-Type" Filter Element: Remove screws, remove filter case and remove old element. Clean out case and install new element.

2. Standard (Deluxe):

   "Spin-on" Type Filter Element: Turn filter element counter-clockwise to remove. Wipe a thin film of oil on the new element gasket, then screw on the element, using only hand pressure (no wrench).



ALTERNATE FILTER
(Ripley)



STANDARD FILTER
(Deluxe)

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.

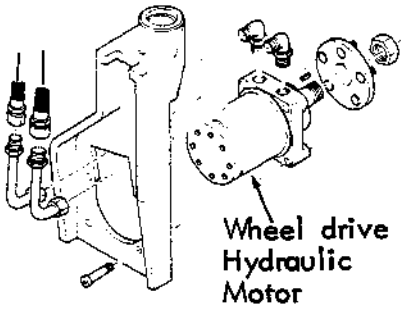
3. Remove screws attaching drive hydraulic motor to housing (see exploded view drawing for arrangement of parts).

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).

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).

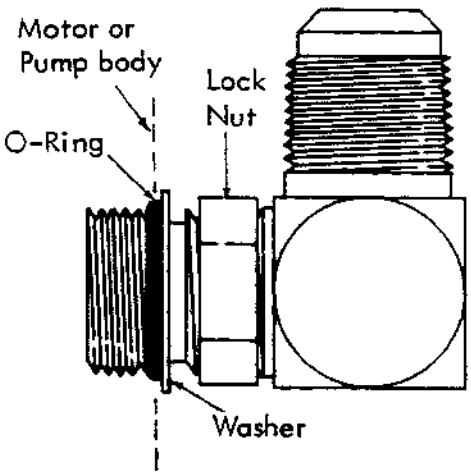
NOTE After the first 50 hours, re-check nut tightness



INSTALLING "O-RING" TYPE HYDRAULIC FITTINGS

(Used on most hydraulic components, such as pumps, motors, valves, etc.)

This type of fitting has straight threads. An O-Ring is used to seal the connection and prevent leaks. To install, turn the fitting in until the O-Ring contacts the component body, then tighten the lock nut up against the washer.



HYDRAULIC PUMP REPLACEMENT

1. Disconnect and cap hydraulic lines to pump. Mark lines for correct reassembly.

2. Disconnect foot pedal linkage from pump control arm (see drawing).

3. Remove two screws attaching pump to housing which is attached to engine.

4. Remove pump by carefully pulling straight out from housing.

5. The pump splined drive shaft should slip out of the coupling which is attached to the flywheel adapter. It should not be necessary to disassemble the pump coupling.

6. If the pump is to be repaired, pump parts lists are provided in the "Hydraulic Components" Section of this manual.

7. If a new pump is to be installed, remove the speed adjustment bracket and the two control arms from the old pump and install them on the new pump. Make sure that the speed adjustment screws are not removed: they will have to be adjusted for correct forward and reverse speeds.

8. The new or repaired pump should be filled with hydraulic oil. Apply grease to splined end of pump shaft.

9. Mount new or repaired pump on drive housing. The pump splined drive shaft should slip into coupling on engine. The drive housing will align the pump correctly with the engine.

10. Connect the directional pedal linkage to the pump control arm.

11. Connect hydraulic lines to pump, following markings made during disassembly to insure correct connections.
    ATTENTION! Hydraulic connections must be kept clean.

12. Set hand brake. Check oil level in hydraulic tank.

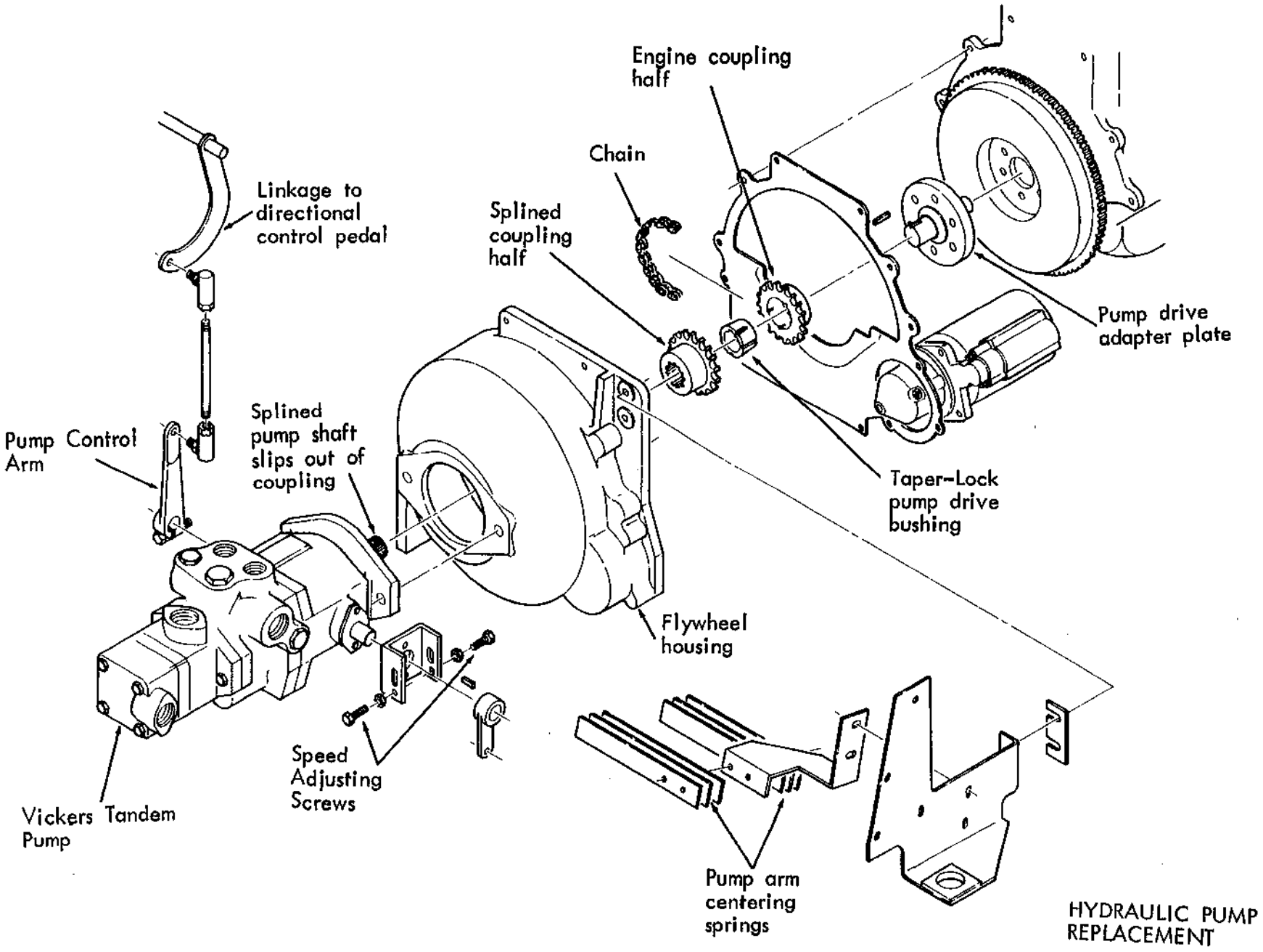
13. Jack rear wheel off the floor 0.25 to 0.50 in (6.35 to 12.7 mm)

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

15. Re-connect spark plug wires, start engine and run with throttle in "idle" position. Maintain throttle in idle position thru step #19.

16. Depress foot pedal 1/4 to 1/3 stroke and run for 30 seconds.

(Copy continued on page following illustration)



HYDRAULIC PUMP REPLACEMENT

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

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

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

20. Stop engine and lower rear wheel on floor.

21. Check reservoir and refill to proper level.

    NOTE For Hi-Dump only: Crack fittings at roll-out cylinders and operate roll-out valve until all air has been bled from lines, then tighten the fittings.

22. Start engine and run at idle for 30 seconds.

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

24. If the above procedure does not remove all air from the system, it will be necessary to "crack" hose or fitting connections to bleed air.

25. Check for correct operation and adjust pump control arm centering springs if necessary.

26. If necessary, adjust the speed adjustment screws to obtain a forward speed of 10 mph, and a reverse speed of 5 mph.

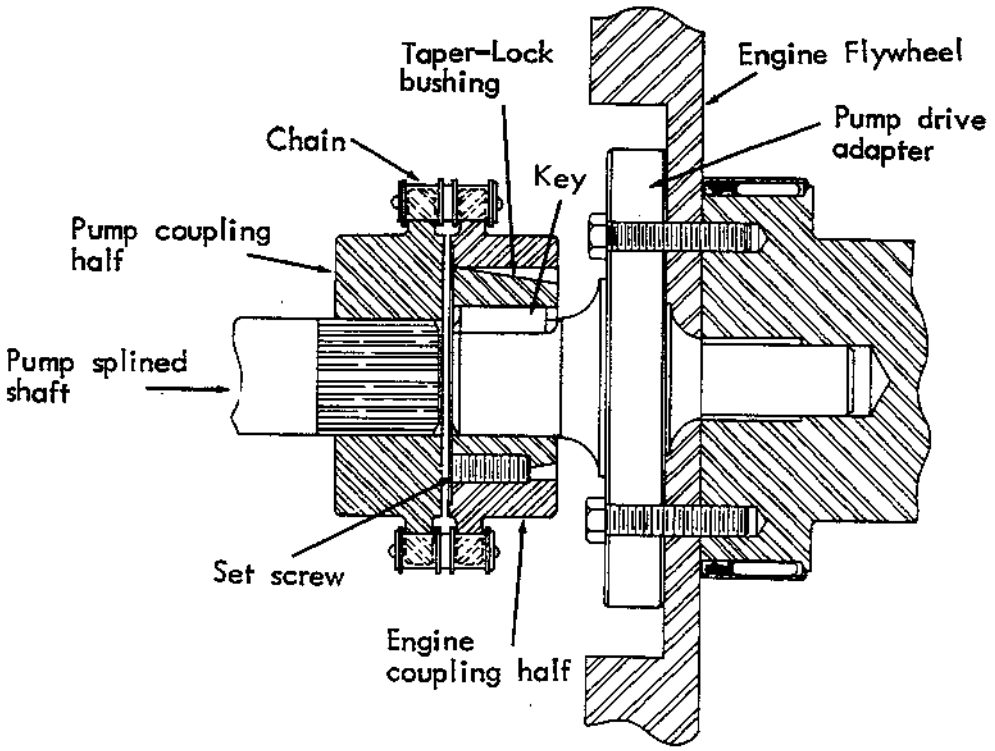
HOW TO INSTALL TAPER-LOCK PUMP DRIVE BUSHING

The Taper-Lock bushing attaches the "engine-half" of the chain coupling to the adapter bolted to the engine flywheel, as shown in the sketch. It should not be necessary to remove the bushing, unless the adapter is being replaced. To install the bushing:

1. Clean the bushing, adapter and coupling half.
2. Place the bushing in the coupling half and align the screw holes (not threads).
3. Oil threads and points of screws and loosely place in holes which are threaded on coupling side.
4. Mount the assembled coupling and bushing on the adapter shaft (with key in place). The end face of the bushing should be flush with the end of the adapter shaft.
5. Alternately tighten the screws, using a torque wrench, to 280 in lbs (31.6 Nm) of torque.
6. Alternately tap on the bushing (using hammer and drift) and tighten screw until specified torque no longer turns screws.

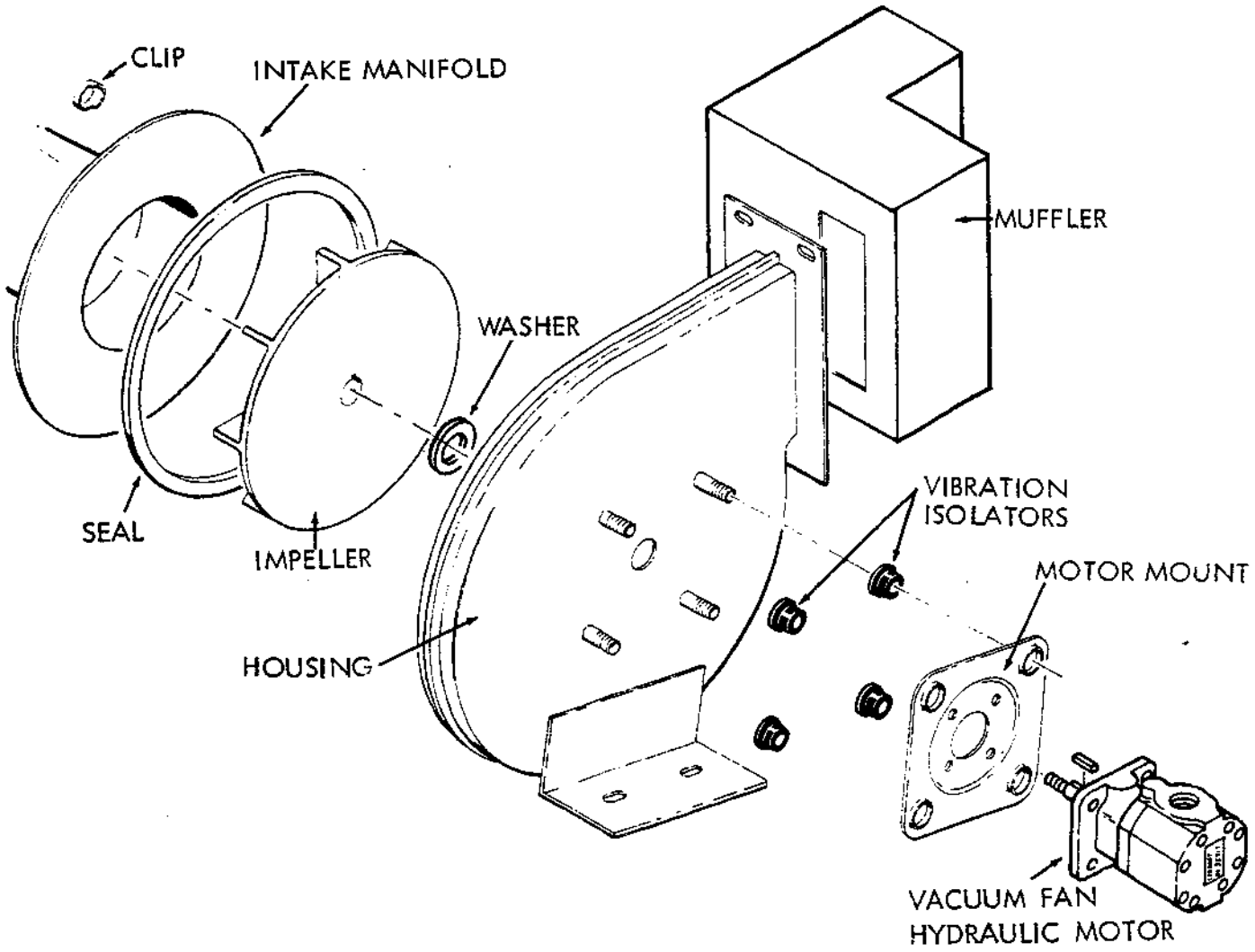
HOW TO REMOVE TAPER-LOCK PUMP DRIVE BUSHING

1. Referring to sketch, remove all set screws from bushing and coupling half.
2. Insert one screw in hole which is threaded on bushing side.
3. Tighten screw until bushing comes loose.



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, 20 ft lbs (27 Nm).
7. Replace intake manifold.
8. Connect hydraulic lines, following markings made in step (1).



TO REMOVE SWEEPING HOPPER (Standard Machine)

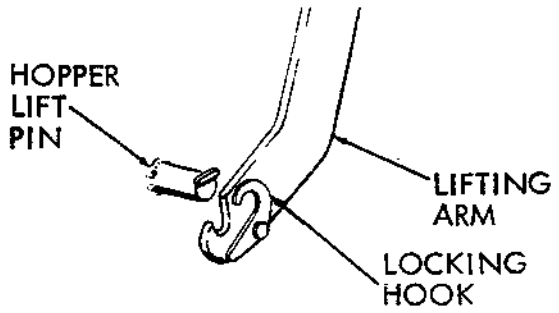
1. Start engine.

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).

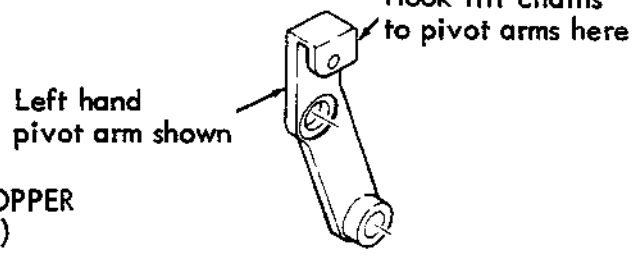
6. Pull torque arms out of hopper.

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:

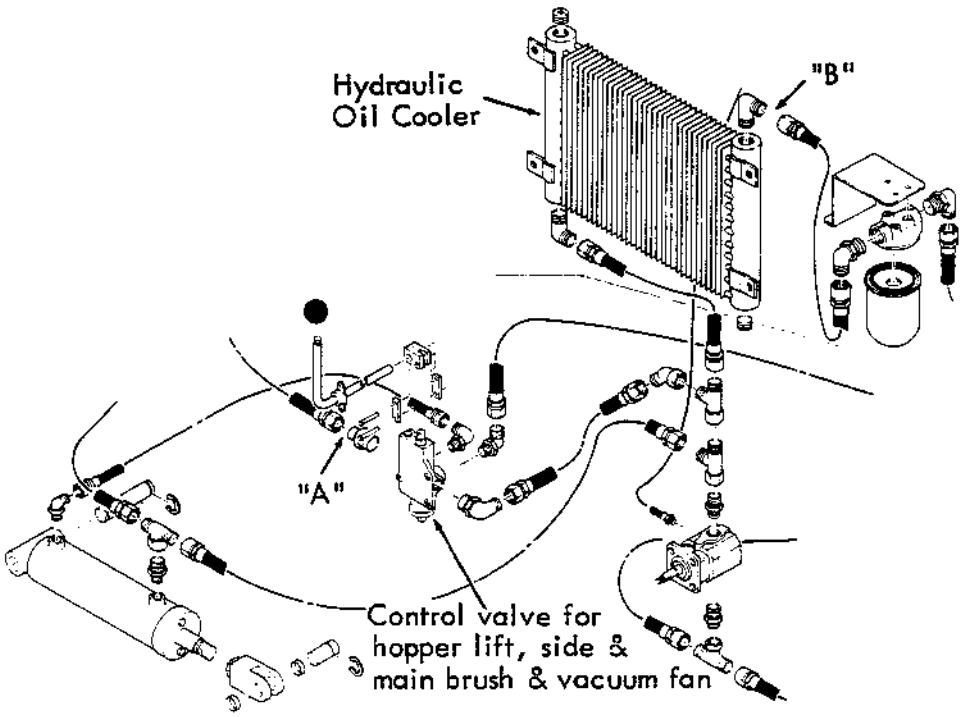
1. Hook the chain to the left and right front pivot arms on the hopper lift arms.
2. Place the hydraulic control valve handle in "hopper lift" position.
3. Use the chain hoist to raise the hopper.
4. Use the safety arm to support the hopper.



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. The machine hydraulic valve contains a built-in relief valve set at 1900 to 2100 psi (13100 to 14480 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 hydraulic oil cooler.
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.

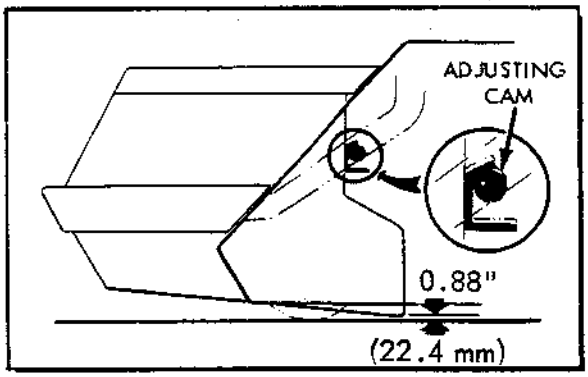


Connect external source hydraulic lines at points "A" and "B".

STANDARD MACHINE HOPPER CLEARANCE ADJUSTMENT

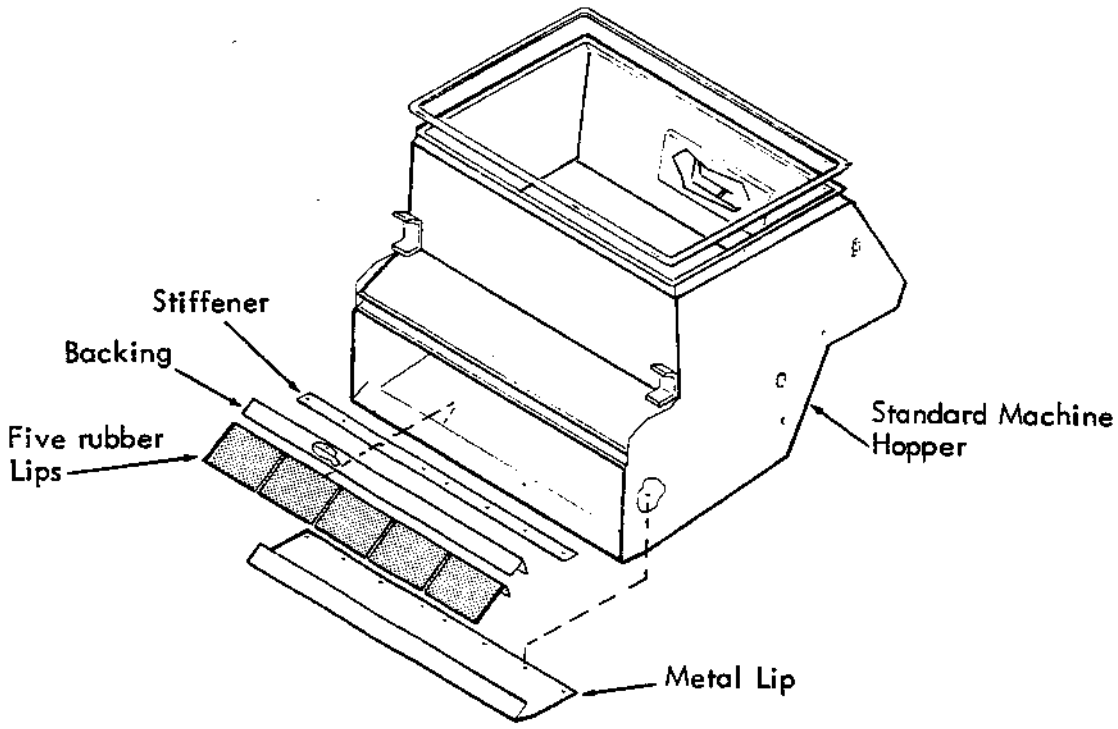
The hopper has been factory adjusted so that it is level and has the correct clearance from the floor. If the hopper is out of adjustment, or is replaced, you can adjust horizontal leveling by turning eccentric adjusting cams on lift arms (see sketch). Make adjustments with the hopper empty.

The metal lip should be 0.75 in to 0.88 in (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.



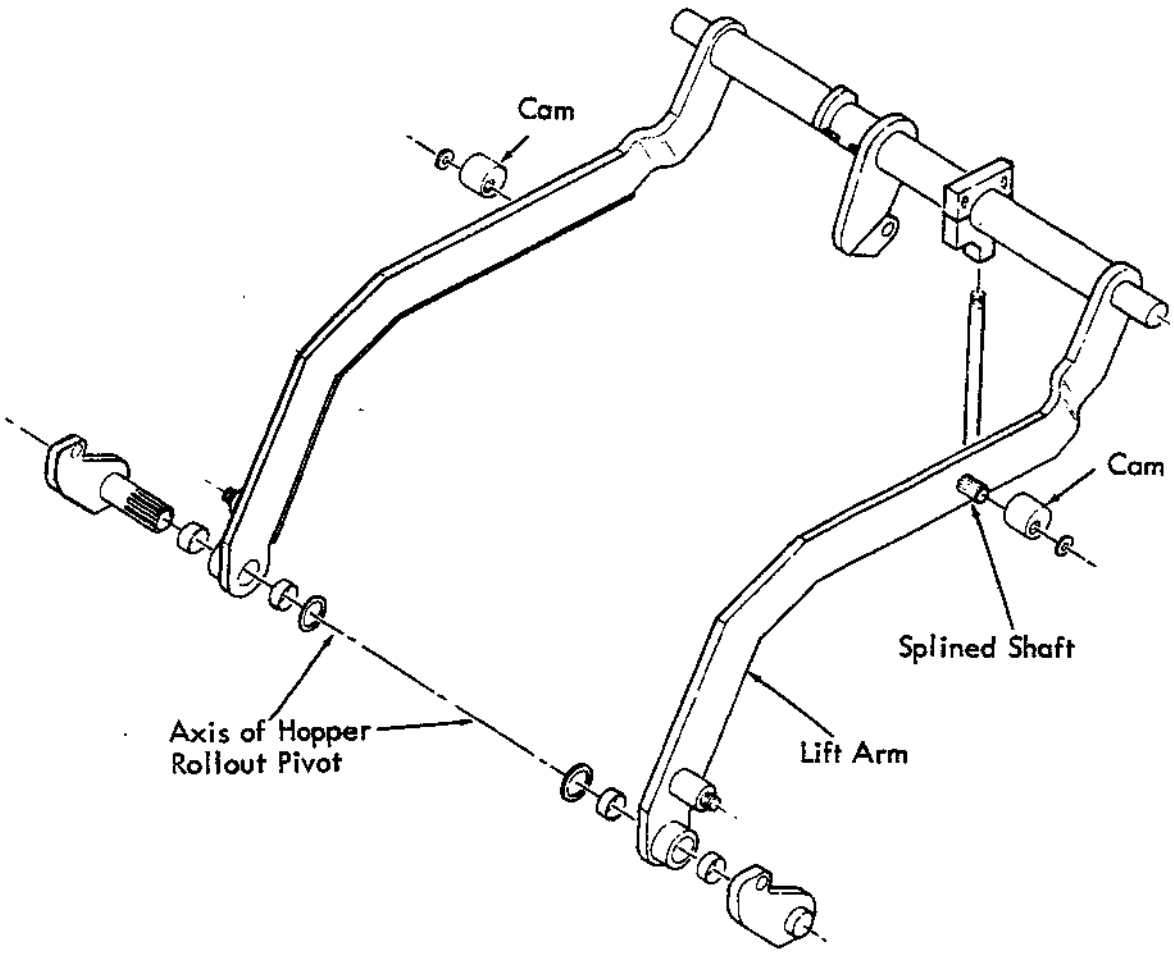
HI-DUMP MACHINE ADJUSTMENTS

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 6.6 ± 0.13 in (168 ± 3.3 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

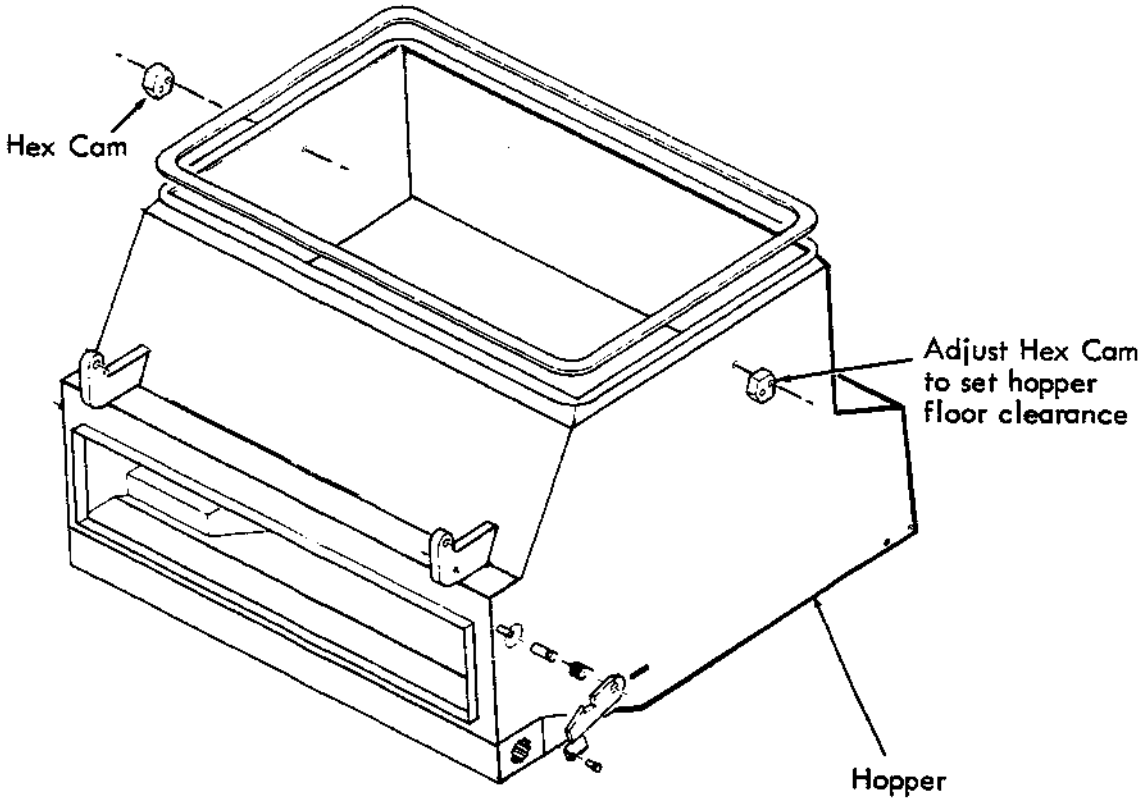
1. After the lift arm has been adjusted as described above, adjust the clevis on the main lift cylinder so that the cylinder is fully retracted. To do this, loosen the jam nut on the cylinder piston rod, then turn the rod by means of a pin inserted through the hole in the rod.

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 in. ± 0.13 in (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 0.75 in 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 when the hopper is raised to any point over 36 in (914 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 the 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 the bumper and not exposed. To adjust the stabilizer leg:

1. Raise hopper, engage hopper safety arm, and lower the hopper onto the safety arm.

⚠WARNING Always engage the hopper safety arm before working under a raised hopper.

2. Loosen the clevis jam nut.

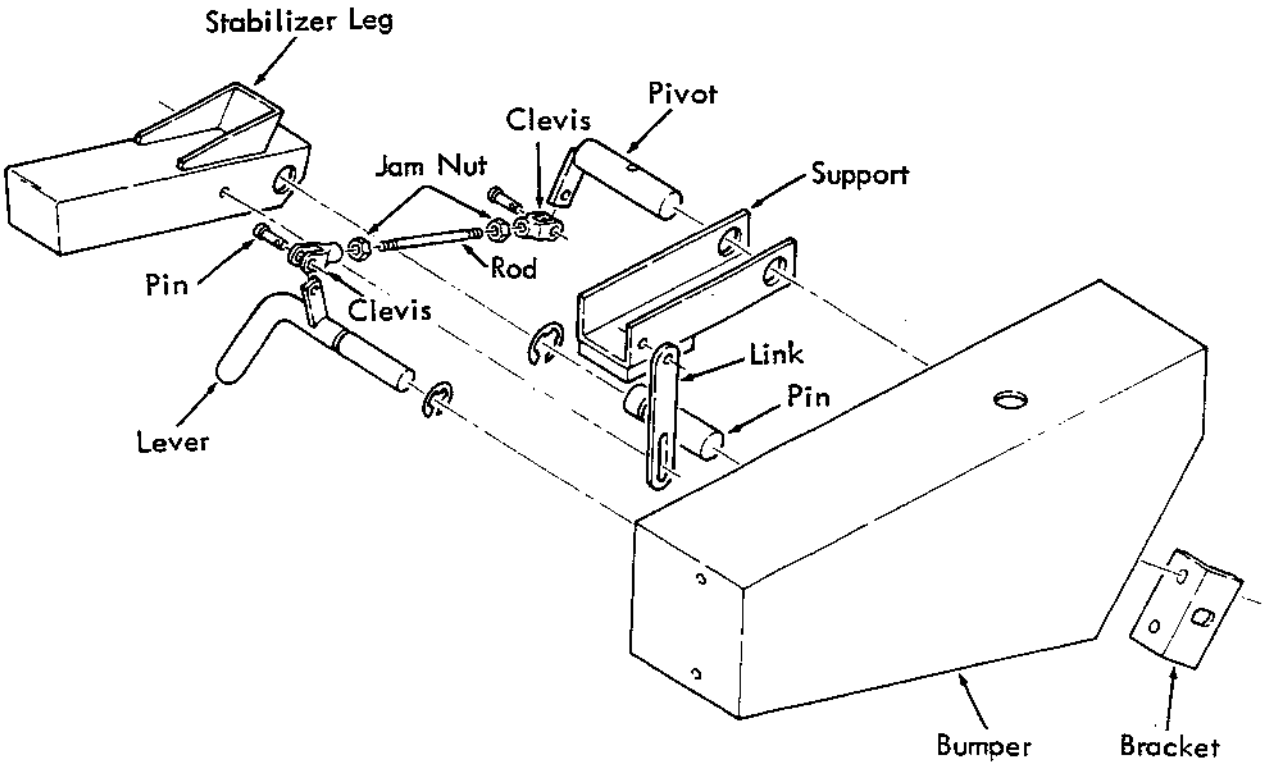
3. Thread the clevis into the threaded rod to raise the stabilizer leg. Thread the clevis out of the threaded rod to lower the stabilizer leg.

4. Tighten the jam nut against the clevis.

5. Raise the hopper, disengage and lower the hopper safety arm, and lower the hopper.

6. Check the position of the stabilizer leg.

7. Readjust the stabilizer leg as required.



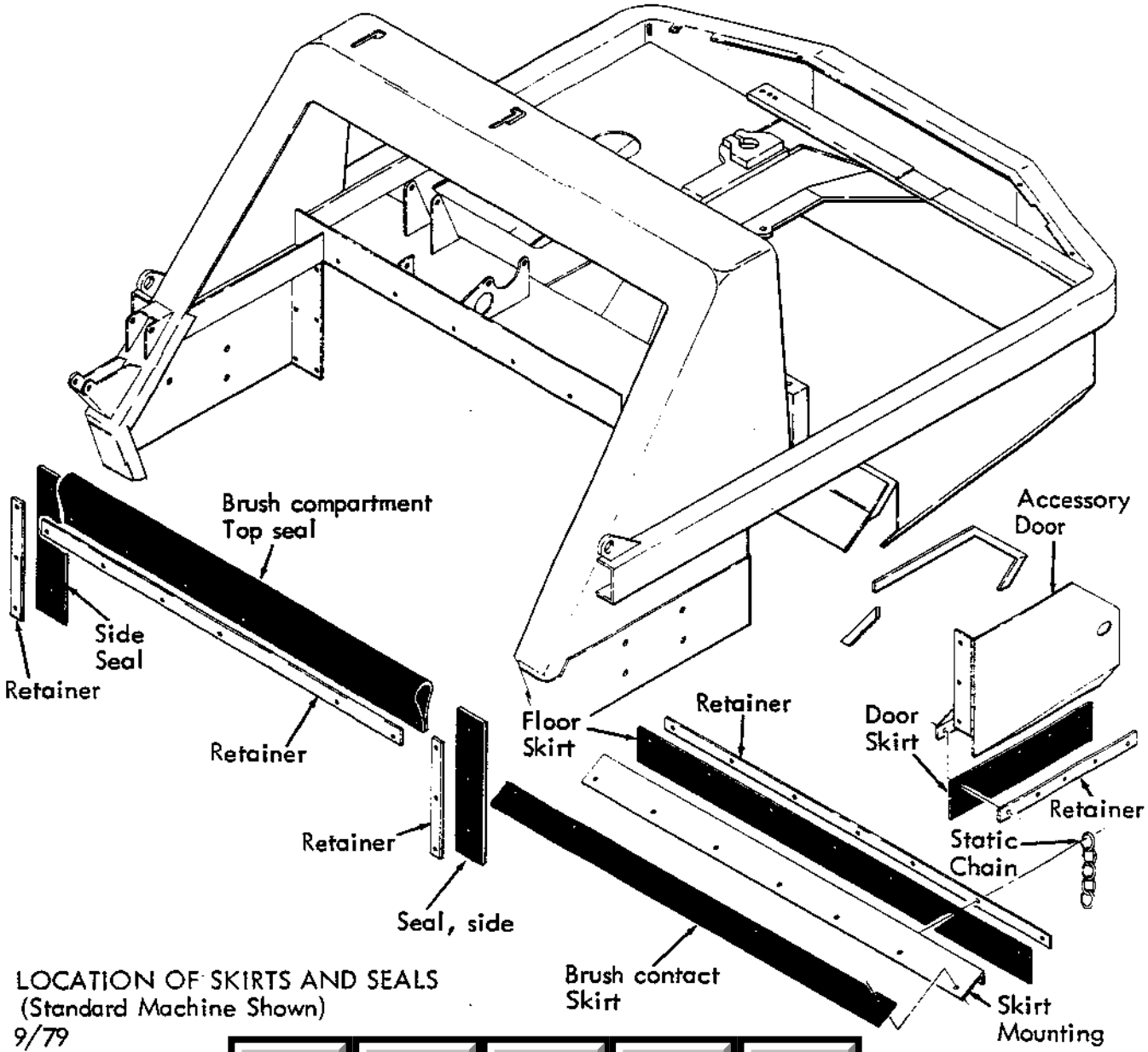
STATIC DRAG CHAIN

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 0.13 in (3.3 mm) between skirt 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.

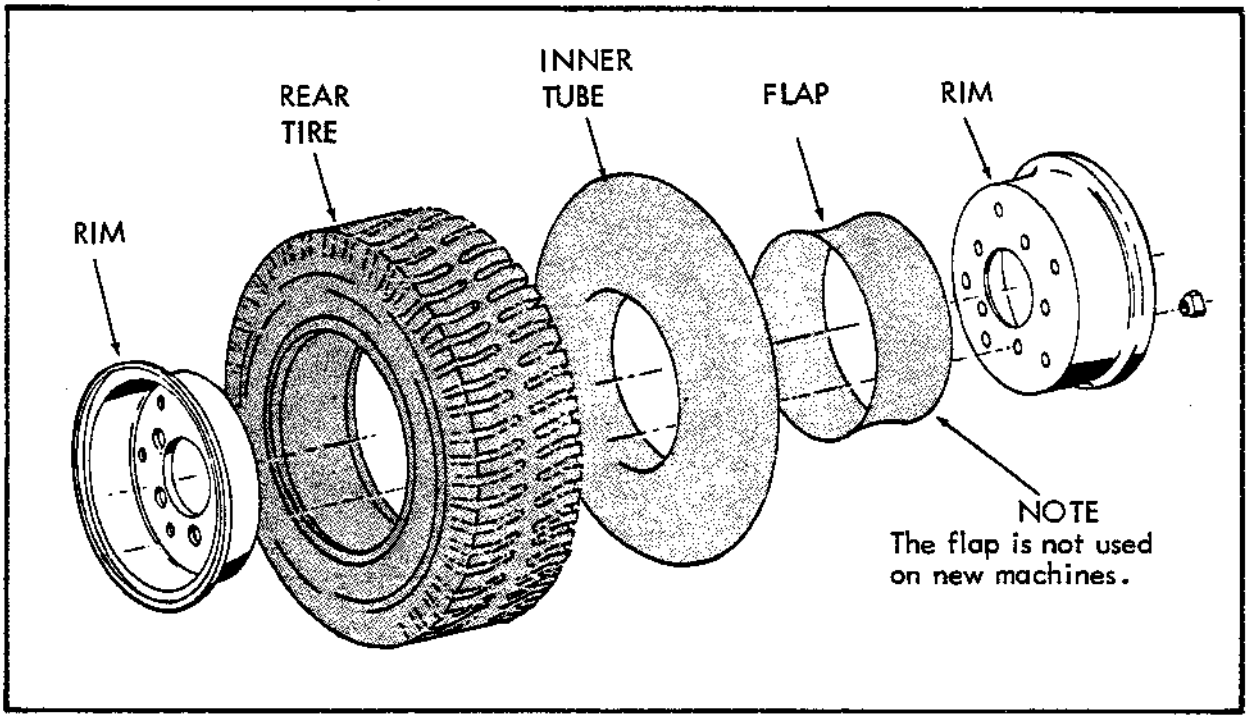


LOCATION OF SKIRTS AND SEALS
(Standard Machine Shown)
9/79

REPLACING REAR WHEEL OR TIRE

⚠WARNING Deflate tire before separating tire rim halves to reduce the possibility of rim halves separating uncontrollably.

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.
6. Bolt wheel to hub. Torque 85 to 95 ft lb (115 to 129 Nm)
7. Inflate sweeper tire to 80 to 85 psi (552 to 586 kPa); scrubber tire 70 to 75 psi (483 to 517 kPa).

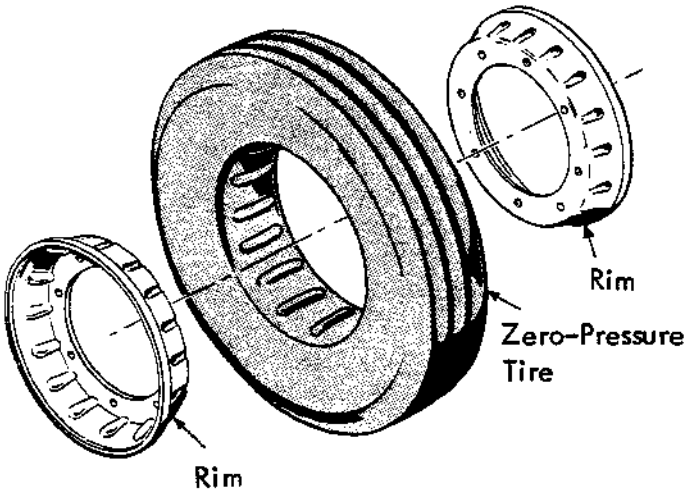


REPLACING FRONT WHEELS OR TIRES

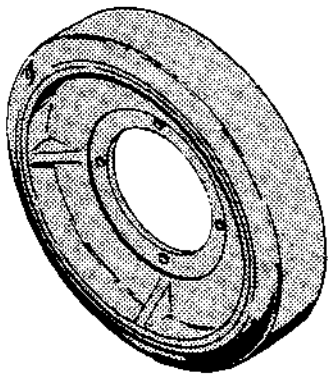
1. Raise and block up front of machine.
2. Raise or remove hopper. (If hopper is raised, use safety lock.)
3. Remove bolts attaching tire and rim assembly to hub.
4. Remove old tire and rim assembly.
5. Remove bolts holding rims together and separate rims.
6. Replace old tire with new one.
7. Bolt rims together -- rims are shaped to fit tire, do not pound on rims.
8. Install tire and rim assembly on wheel hub.

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



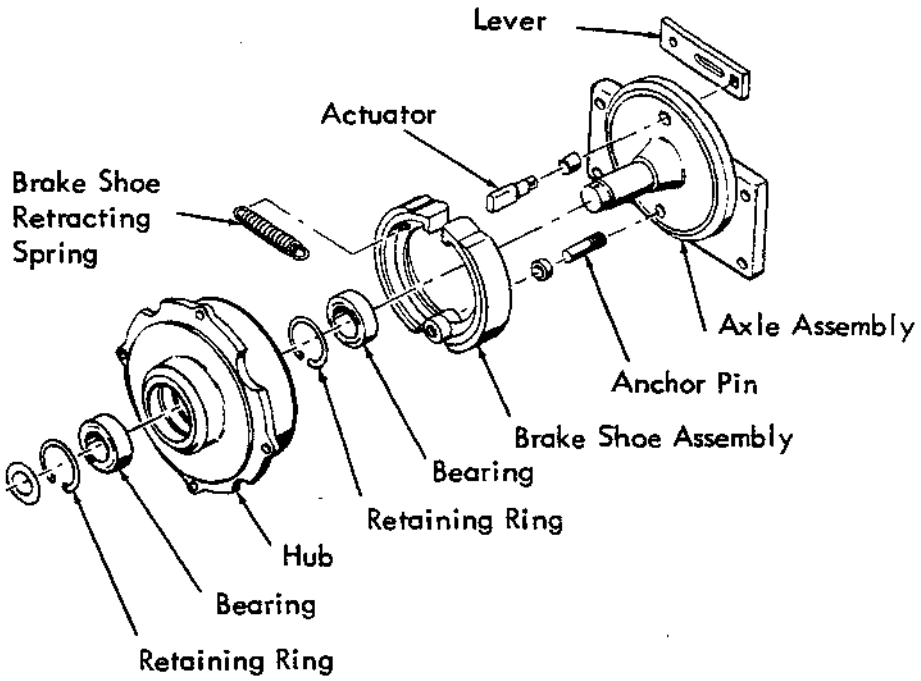
Hi-Dump machine (and scrubber) front tire and rim assembly

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.

NOTE 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. 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- hole is provided for this purpose on the outside of the machine next to each wheel.

BATTERY REPLACEMENT

The battery is located below an access panel in the floor. The standard battery is a wet-cell, 12 volt, 60 amp/hr type. When installing new battery, be sure to connect ground cable to negative terminal of the battery.

BATTERY INSPECTION AND MAINTENANCE

Inspect the battery as follows:

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

2. 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.

Checking Battery Electrolyte

1. Check electrolyte level in each cell daily. Electrolyte level must always be above the plates. Add distilled water to maintain solution at correct level above the plates, but do not overfill.

2. Use a hydrometer to check the electrolyte specific gravity.

NOTE Do not take readings immediately after adding water. The reason for this is, if the water and acid are not thoroughly mixed, readings may not be accurate. Check hydrometer readings against this chart;

SPECIFIC GRAVITY at 80° F (26.7°C)	BATTERY CONDITION
1.260 - 1.280	100% charged
1.230 - 1.250	75% charged
1.200 - 1.220	50% charged
1.170 - 1.190 (Recharge at this point)	25% charged
1.140 - 1.160	Very little useful capacity remaining
1.110 - 1.130	Discharged

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

HYDROMETER TEMPERATURE CORRECTION

The hydrometer specific gravity reading must be corrected when the batter electrolyte is any temperature other than 80° F (26.7°C). To determine the corrected specific gravity reading when temperature of the electrolyte is other than 80°F (26.7°C):

Add to the hydrometer reading 0.004, 4 points, for each 10°F (5.5°C) above 80°F(26.6°C). Subtract from the hydrometer reading 0.004, 4 points, for each 10°F(5.5°C) below 80°F (26.7°C).

CHARGING BATTERIES

NOTE Before charging battery in machine, disconnect the battery cables (this will protect the alternator).

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

⚠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

+ Raise cover of battery during charge, for maximum ventilation.
+ 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.
+ 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.
+ Do not discharge battery below specific gravity of 1.140.
+ Do not allow battery to remain in discharged condition for any length of time.

LOCATION OF FUSES AND CIRCUIT BREAKERS

A fuse panel is located inside the instrument panel enclosure.

⚠CAUTION Disconnect battery positive terminal before opening up instrument panel. To replace fuses, remove the screw attaching the instrument panel, move the panel forward, then lift it up.

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.

ADJUSTING DIRECTIONAL CONTROL PEDAL NEUTRAL POSITION

1. With engine running and control pedal in neutral, the machine should not move in either direction (Some slight movement may occur -- always apply foot brake when parking machine).

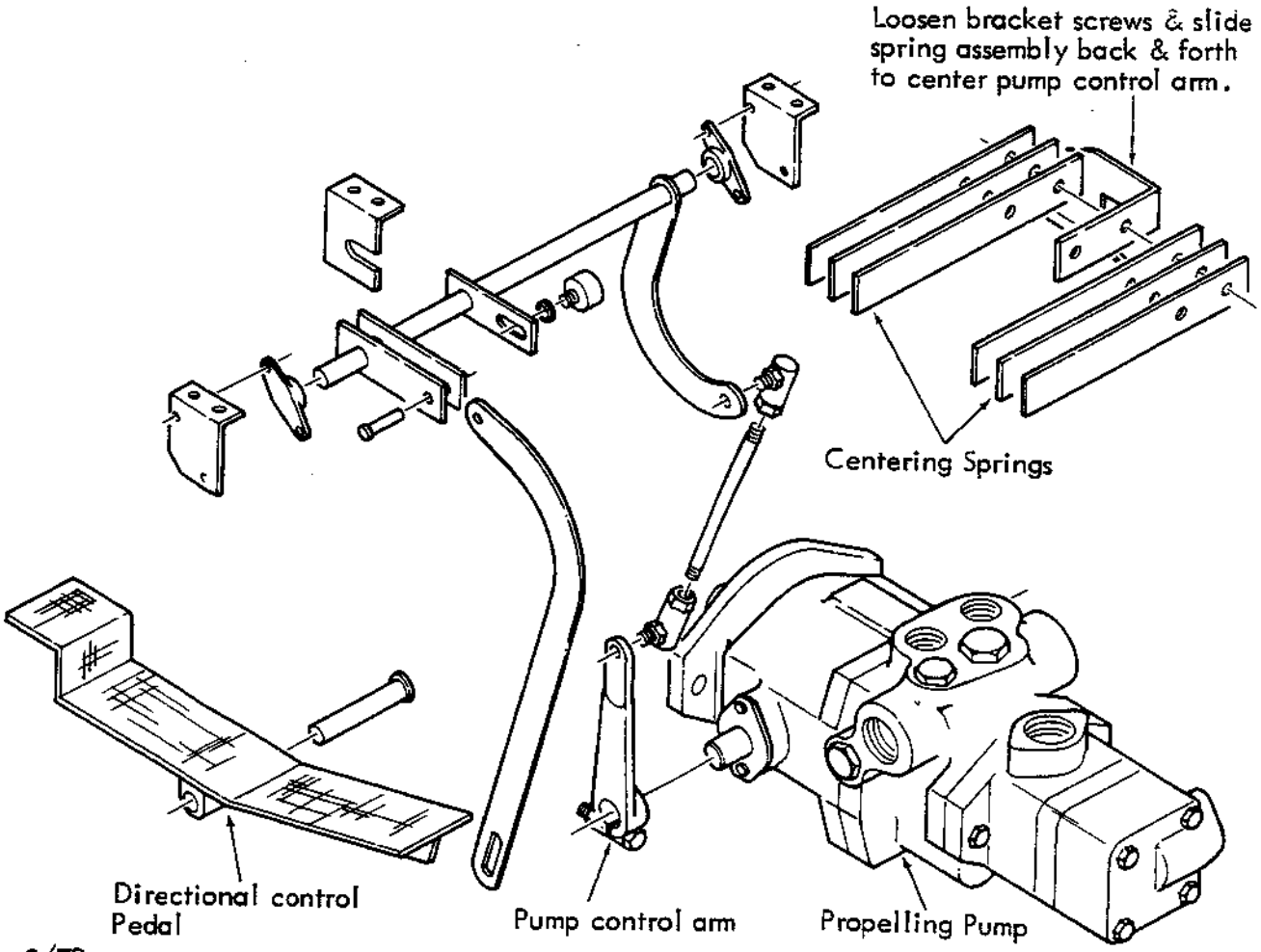
2. If adjustment is required, stop engine.

3. To prevent excessive movement of the machine when the pedal is in the neutral position, the neutral setting of the propelling pump control arm must be adjusted. The neutral position of the pump control arm is set by adjusting the bracket with the spring arms which is located next to the pump.

4. Loosen the two hex screws which attach the bracket to the engine bellhousing.

5. Shift the centering bracket in slotted holes until machine does not move in either direction. Then tighten bracket mounting bolts.

⚠CAUTION Do not make adjustment with engine running. Move the centering bracket in small increments and check by trial and error until correct adjustment is obtained.

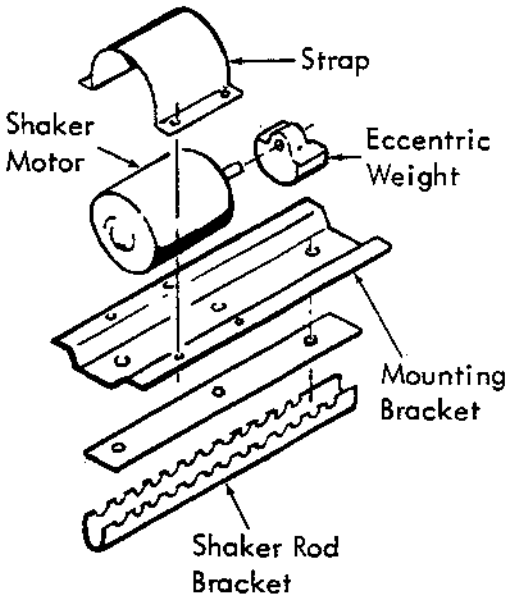


9/79

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.

NOTE The shaker motor is sealed with a dust and waterproofing compound and cannot be repaired.



RECOMMENDED ASSEMBLY TORQUES

1. Rear Wheel Hub Nut
   Nut holds rear wheel hub on rear axle - 300 to 400 ft lb (407 to 542 Nm).
   NOTE After first 50 hours, recheck tightness of nut with a torque wrench.

2. Rear Wheels
   Rear wheel mounting nuts - 85 to 95 ft. lbs (115 to 129 Nm).

3. 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 1/12th of a turn.

4. Vacuum Fan Blade to Hydraulic Motor: Tighten nut to 20 ft. lbs (27 Nm) maximum.

5. Engine Crankshaft Pulley: Tighten capscrew to 24 to 28 ft. lbs (32.5 to 38 Nm).

6. Pump Drive Adapter and Flywheel to Crankshaft: 30 to 35 ft. lbs (40.7 to 47.5 Nm).

7. Main Brush Motor Porting Block: Allen head cap screws to 18 to 20 ft. lbs (24.4 to 27 Nm

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 1/8".
	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 -- see "Hydraulic Motor Trouble Shooting"
	7. Brush driving plugs worn or damaged.	7. Check Plugs.
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. See "Hydraulic Components" Section

TROUBLE	PROBABLE CAUSE	REMEDY
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 -- See "Hydraulic Components" Sec.
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. See "Hydraulic Components" Section.
	4. Rear wheel hydraulic motor trouble such as broken shaft key, broken shaft, etc.	4. See "Hydraulic Components" Section.
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 thoroughly . Refill with clean TENNANT Hydraulic fluid 32397.
	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. See "Hydraulics Components" Section.

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 Char-Lynn Hydraulic motor.	1. End cap screws loose. 2. O-Rings worn or damaged.	1. Tighten end cap screws alternately to 15 to 40 in lb (1.7 to 4.5 Nm) first, check to make sure O-Rings are seated, then tighten to 175 to 200 in lb (19.7 to 22.7 Nm). 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. 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.

MM114

265

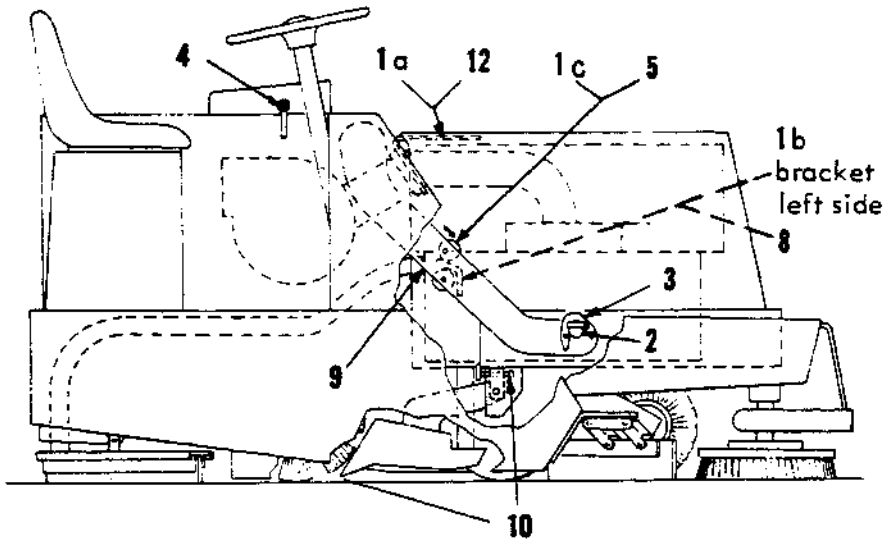
POWER SWEEPER

scrubber

CONTENTS

INITIAL ALIGNMENT OF NEW SCRUBBING UNIT TO MACHINE

NOTE New Scrubbing Units may require alignment to the machine. Follow these instructions carefully.



ALIGNING SCRUBBING UNIT TO MACHINE:

1 a Loosen vacuum connection bracket in top center of scrubber and move all the way to front of scrubber in slots.

b Loosen bracket on left rear side of scrubber.

c Loosen top cam on the right hand lift arm and rotate back. 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. ENGAGE 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.

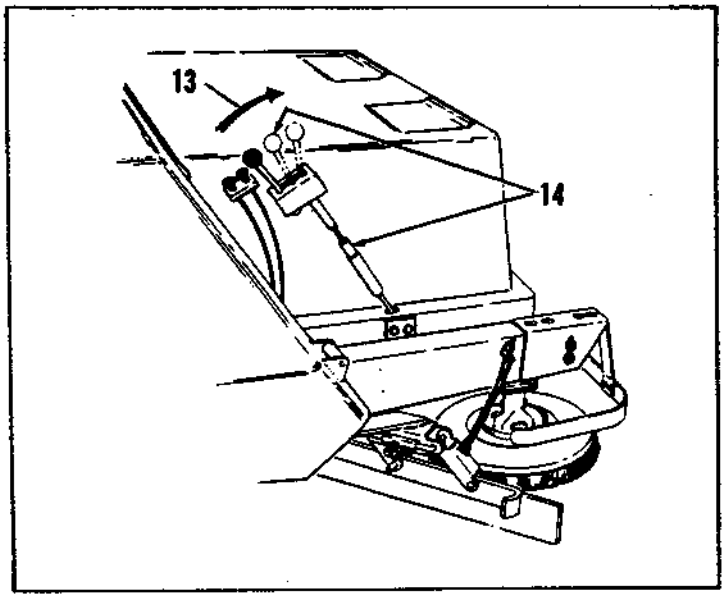
(Continued)

TROUGH ADJUSTMENT:

10 The correct clearance of the trough lip is from 0.38 in to 0.50 in (9.65 to 12.7 mm) from the floor. Adjust by turning 0.50 in (12.7 mm) square head set screws. The correct clearance of the trough in the up position is from 1 in (25.4 mm) to 1.13 in (28.7 mm).

VACUUM CONNECTION:

12 Move bracket at top center of scrubber rearward to contact seal on the lintel and tighten bolts sufficiently to hold bracket in place. Rap the bolts sharply to move bracket from 0.06 in to 0.13 in (1.52 to 3.3 mm), compressing 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.

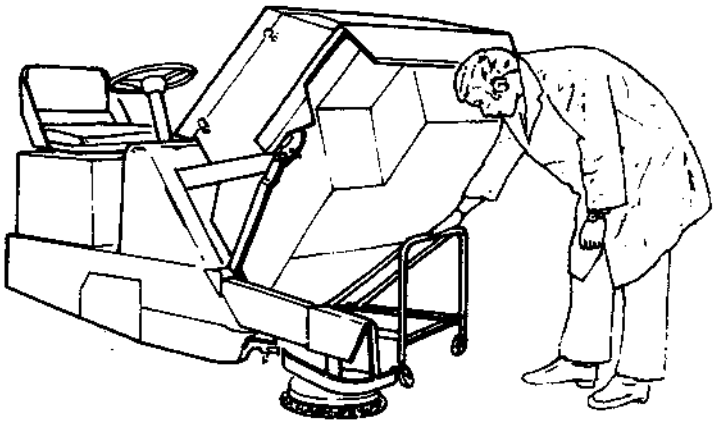
INSTRUCTIONS FOR FACTORY-INSTALLED SCRUBBING ATTACHMENT
(Assuming that machine is modified to accept scrubbing attachment)

A. TO REMOVE SWEEPING HOPPER (BEFORE INSTALLING SCRUBBER)

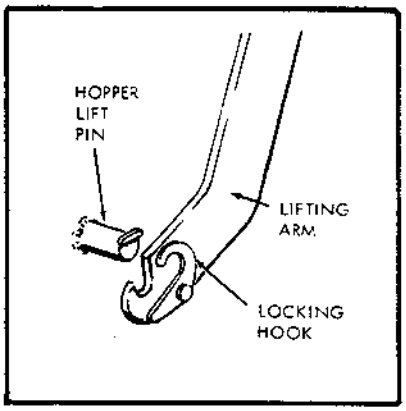
1. Start motor.

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.

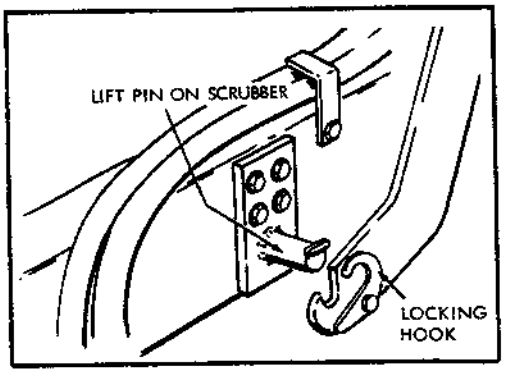
B. TO INSTALL SCRUBBING UNIT (AFTER REMOVING SWEEPING HOPPER)

1. **NOTE** Do not fill scrubber tank before installing scrubber on machine. The scrubbing unit is mounted on folding support legs equipped with wheels. Raise bumper. 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.

NOTE Clean both coupling halves.

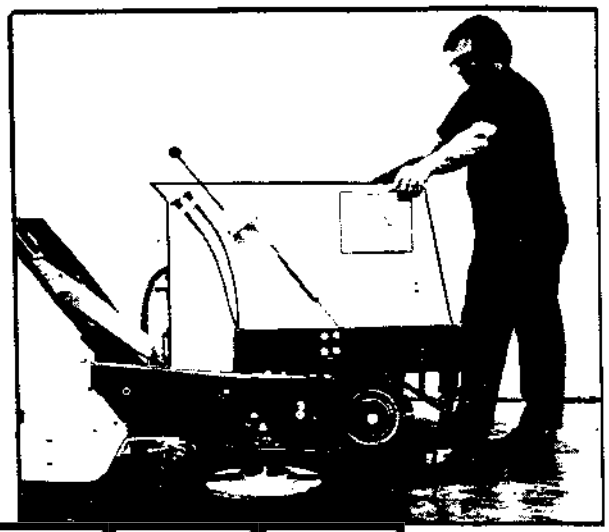
Connect the separated halves of the coupler to the two hoses located on the side of the scrubber.

Use locking hooks to lock the scrubber to the lift arms.



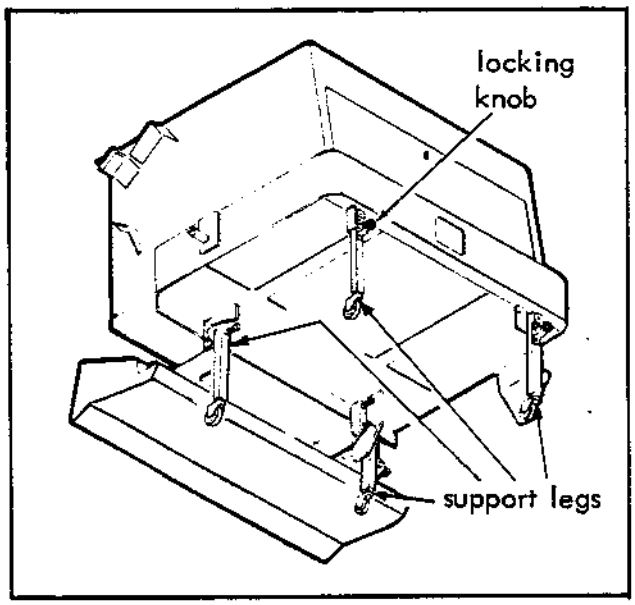
3. With lift arms lowered, carefully move scrubber into position so that lifting pins on scrubber will engage their sockets on the lift arms. Swing locking hook on each arm over scrubber lifting pins, locking them onto lift arms.
4. Start motor and operate hydraulic control to lift scrubber.

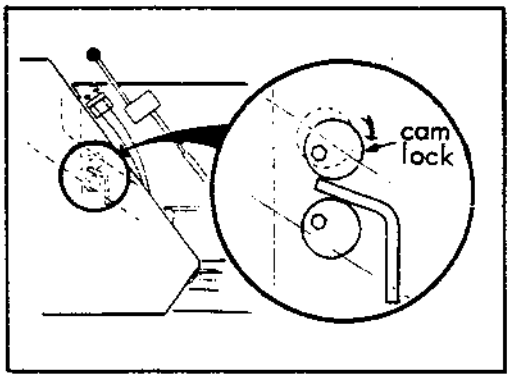
With the folding support legs down, the scrubber can be rolled into position.



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

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

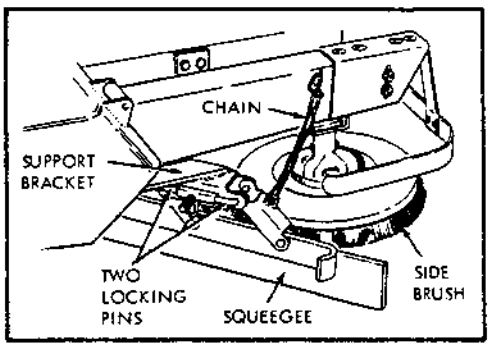
6. Loosen bolt attaching cam lock to right-hand lift arm and rotate cam into position against lip on scrubber. Use wrench provided for removing main brush. This cam lock will prevent scrubber from tilting forward.

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. Lower bumper.

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.

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 lifted when side brush is lifted.

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

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 on a following page. 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 unit.

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

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).

(continued on next page)

C. TO REMOVE SCRUBBING UNIT...(continued)

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 attaching pins.

D. TO INSTALL SWEEPING HOPPER AFTER REMOVING SCRUBBER

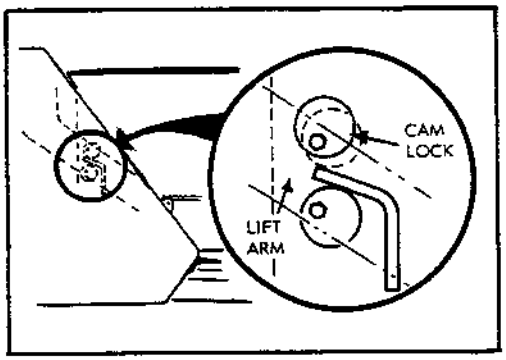
1. Raise bumper. Position hopper on dolly between lift arms near machine, but allow enough room to connect the wire to the shaker motor. Connect the shaker wire. Move hopper up to the machine.

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.

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. Lower bumper. Install main sweeping brush.

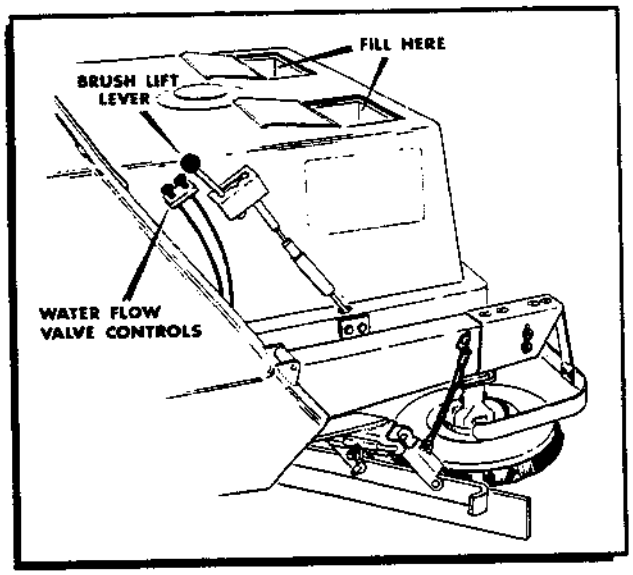
TYPICAL SCRUBBING CONTROL OPERATION SEQUENCE

1. Start the motor.

2. Engage the main scrubbing brush by means of the hydraulic control lever.

3. Lower the main scrubbing brush (also called the rear pick-up brush) to the "down" position used for normal sweeping.

4. Lower the front scrubbing brush to the "down" position.



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.
⚠CAUTION Always reduce machine speed when scrubbing, especially when on wet, slippery floors.

9. Shut off the solution about five feet 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.

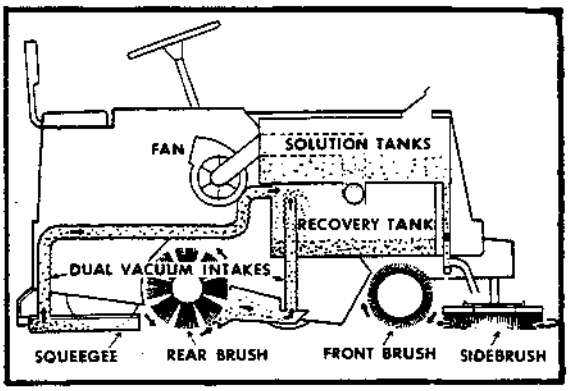
SCRUBBER OPERATING INSTRUCTIONS

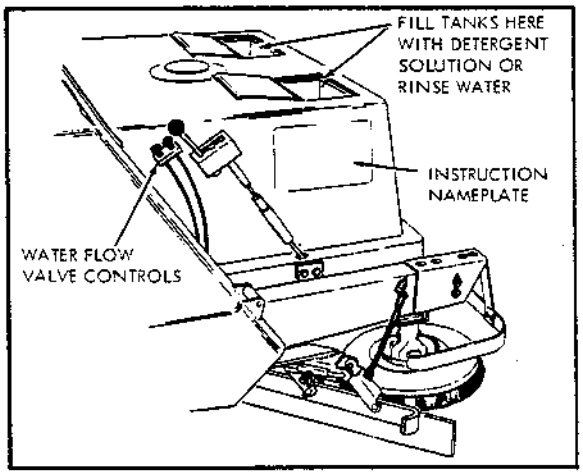
Filling the Tanks:

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 powder or liquid 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.





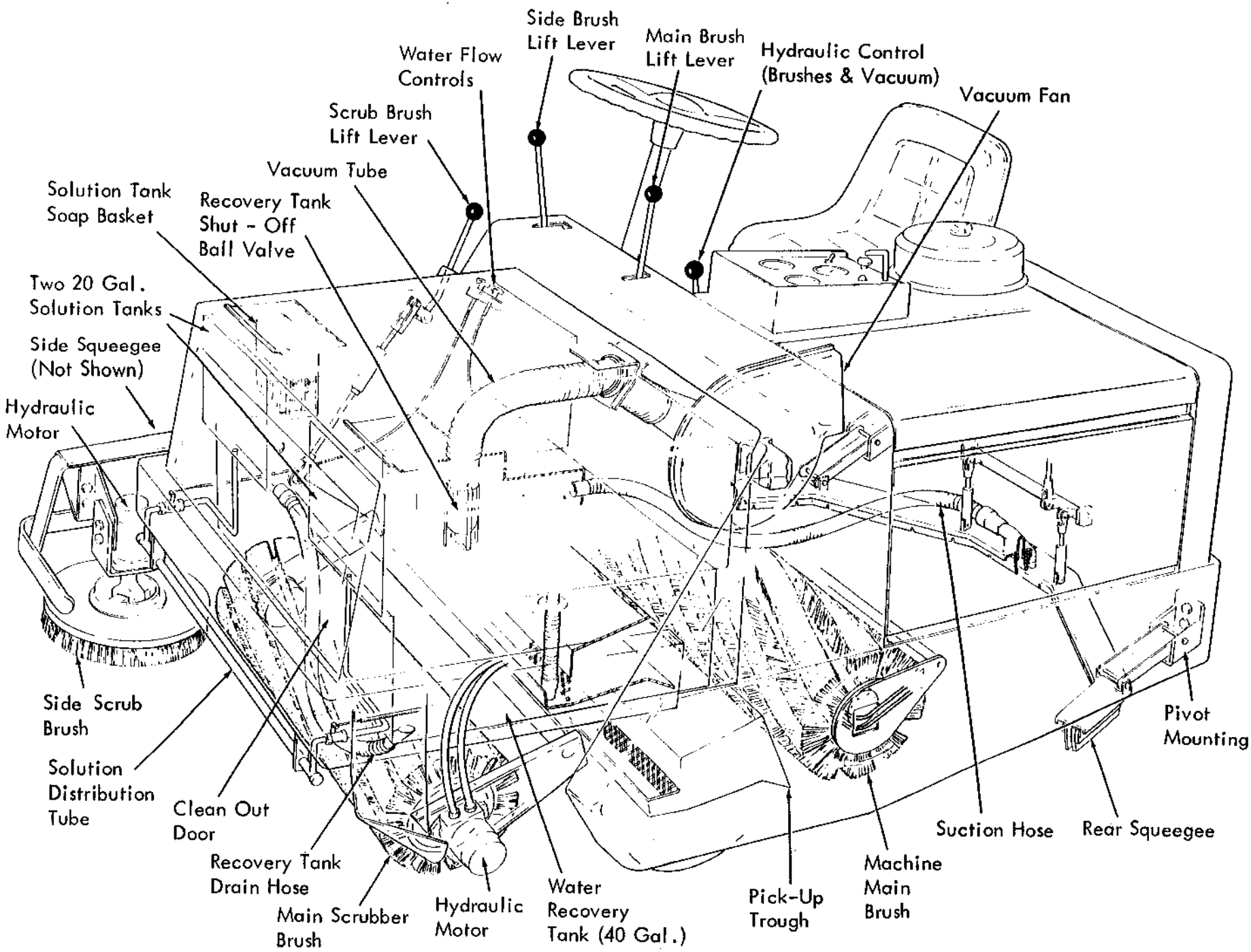
4. To avoid foaming, fill the tanks with hot water first, then add detergent and stir the solution.

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.



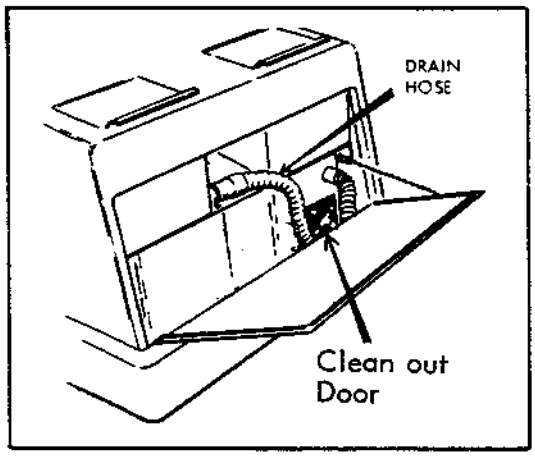
SCRUBBER FEATURES & CONTROLS

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 gal (151 L) 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

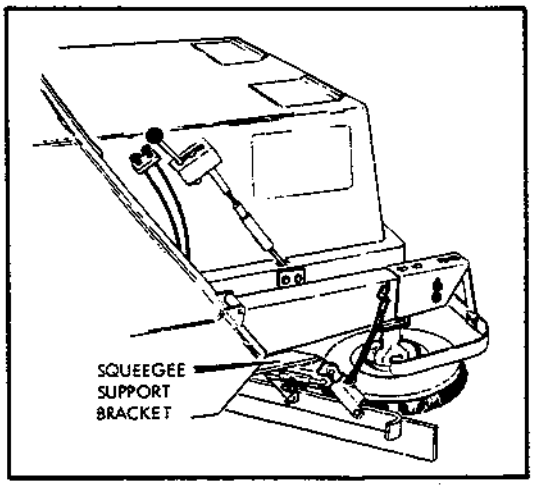


SCRUBBER TROUBLE SHOOTING

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 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.

SIDE SQUEEGEE LEVELING ADJUSTMENT:

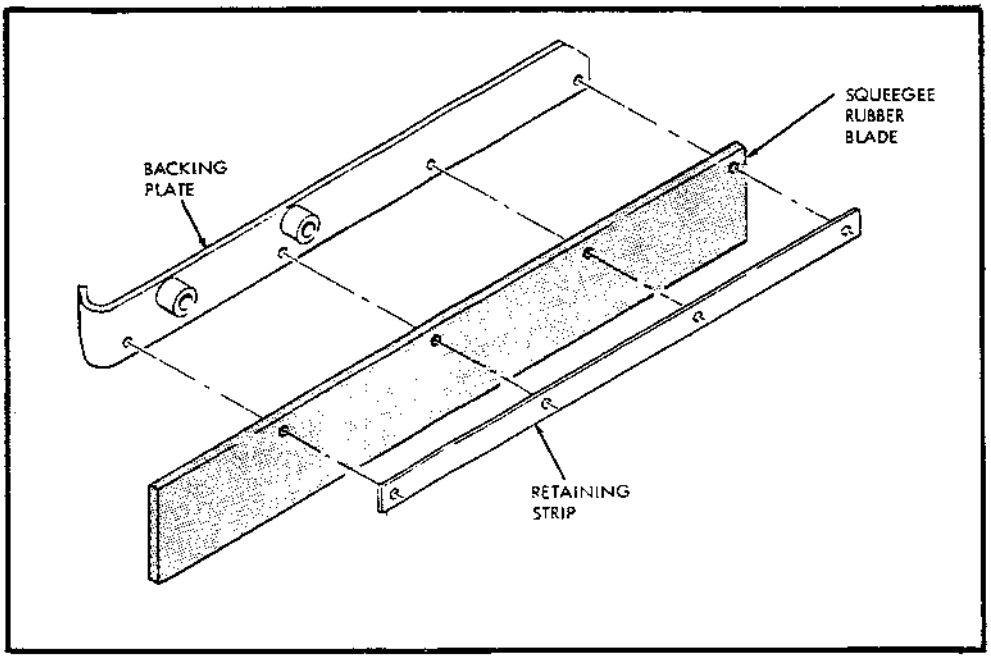
Check to be sure that the squeegee blade is level with the floor. If adjustment is required, loosen the two support bracket mounting screws and twist the bracket slightly until the blade is level. Then tighten mounting screws.



Level the side squeegee by loosening the support bracket screws and moving the bracket.

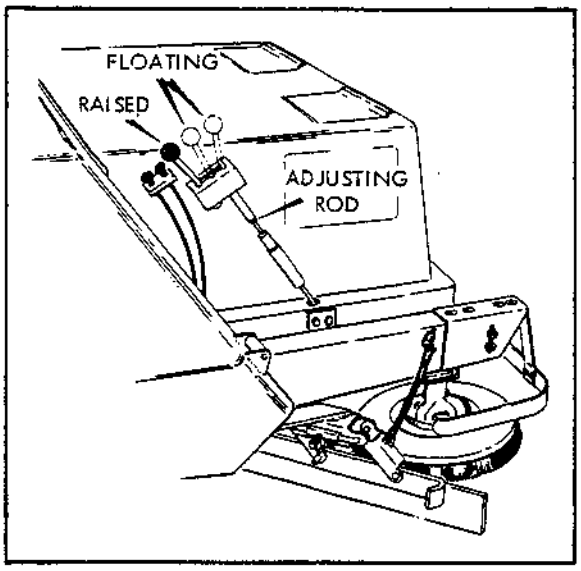
SIDE SQUEEGEE RUBBER REPLACEMENT:

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

FRONT SCRUB BRUSH ADJUSTMENT



The front brush control has two positions

Back - To raise Front Brush.

Forward - Lowers brush to scrubbing position.

An adjustment for brush wear is provided on the lift rod beneath the brush control handle. Loosen the jam nut on the clevis and turn the adjusting rod just below it until the control handle is in the "down" 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

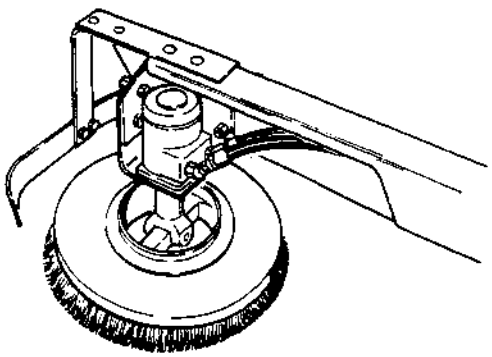
The front brush is removed and replaced in the same manner as the main sweeping brush. See "To Replace Main Brush" in Maintenance Instructions Section of this manual.

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



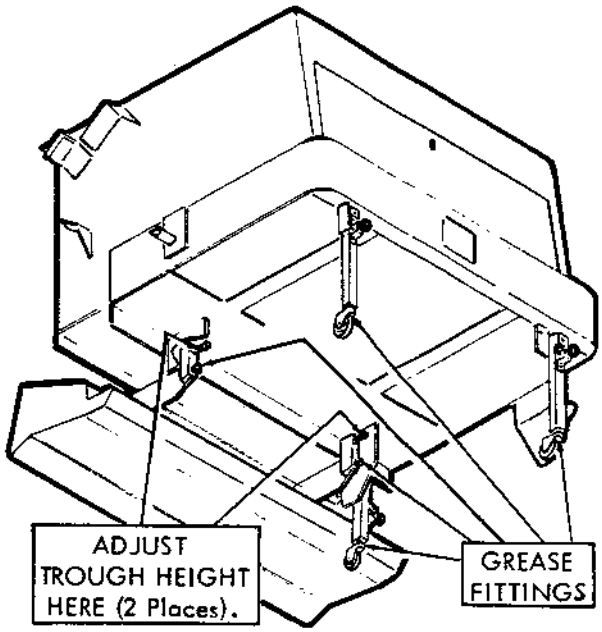
The side brush used for scrubbing.

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 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. It should be 0.38 in (9.65 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.

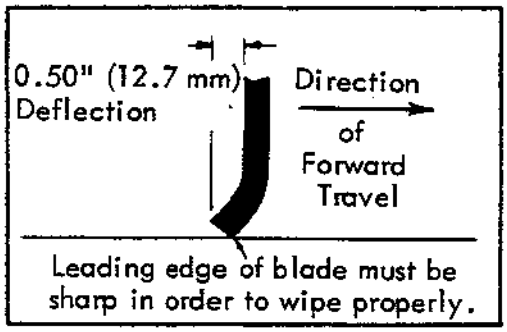
NOTE After each adjustment is made, it will be necessary to lower scrubber attachment to check clearance.

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

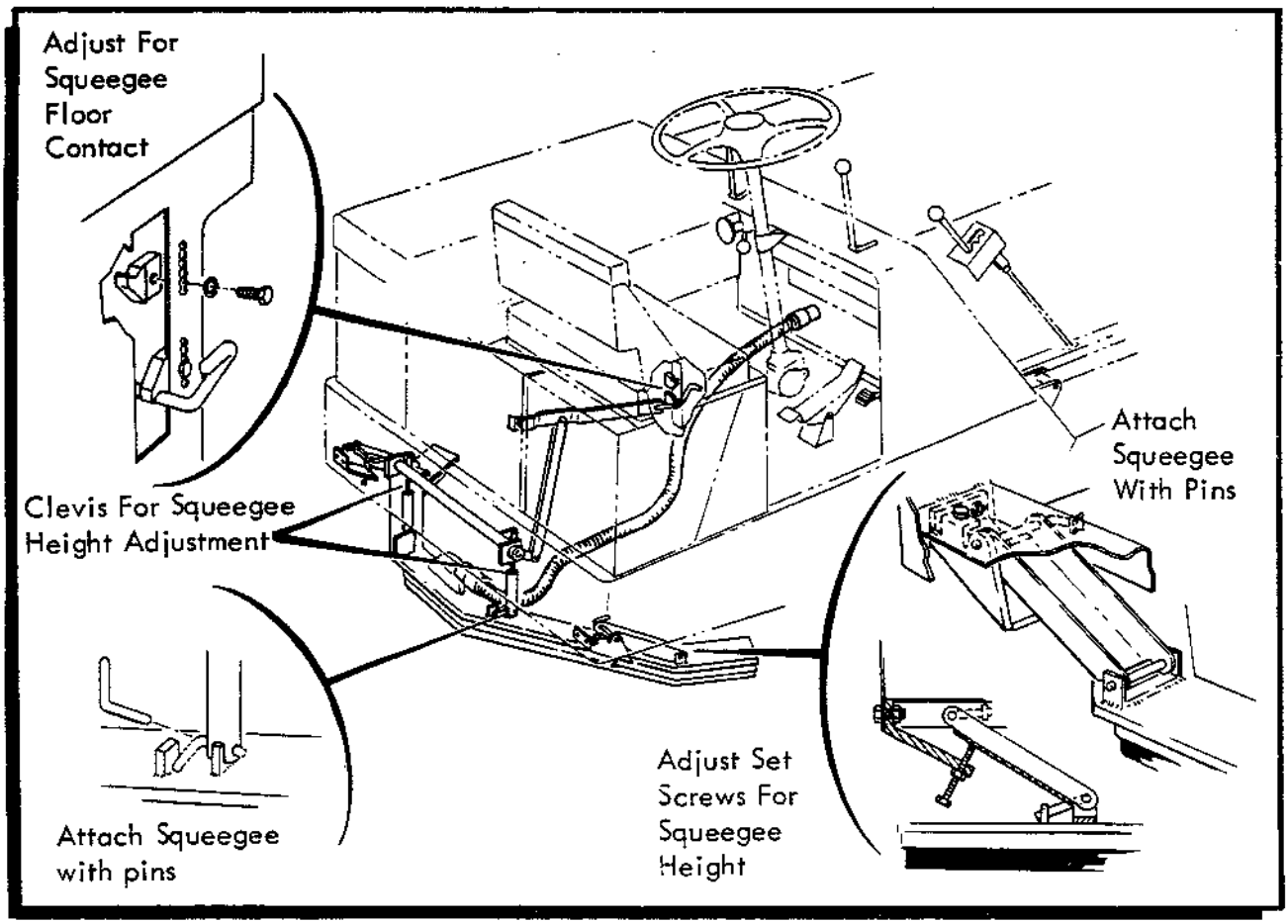
REAR SQUEEGEE MAINTENANCE

In order to work properly, the rubber squeegee blade must be deflected 0.50 in (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.

The squeegee rubber blade must be adjusted as shown here.



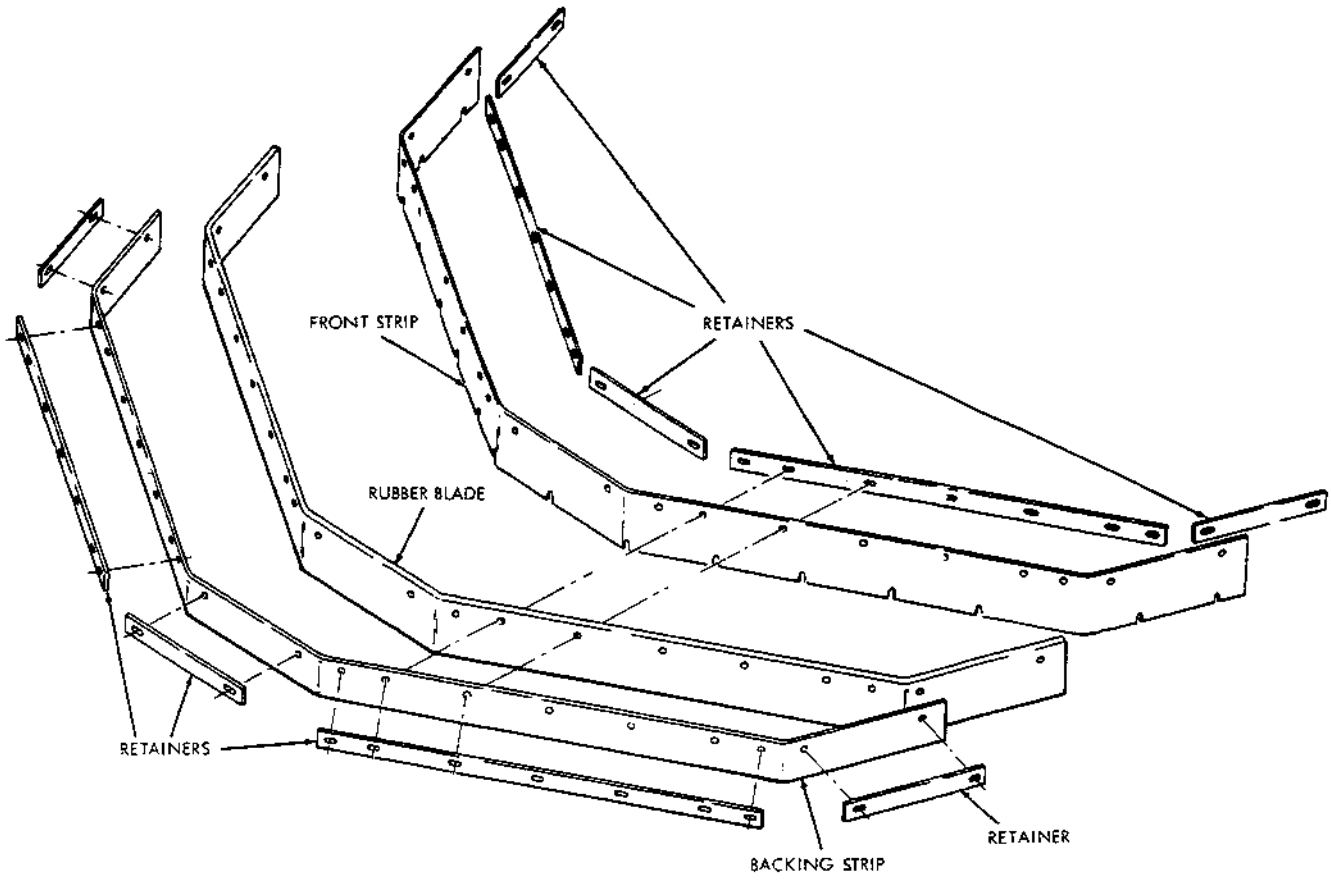
As shown in sketch, the leading edge of the squeegee rubber does the entire wiping job. If this edge is worn, the rubber must either be replaced, or turned around if the opposite edge is not worn. Adjusting a worn blade to a lower position will not improve wiping action.



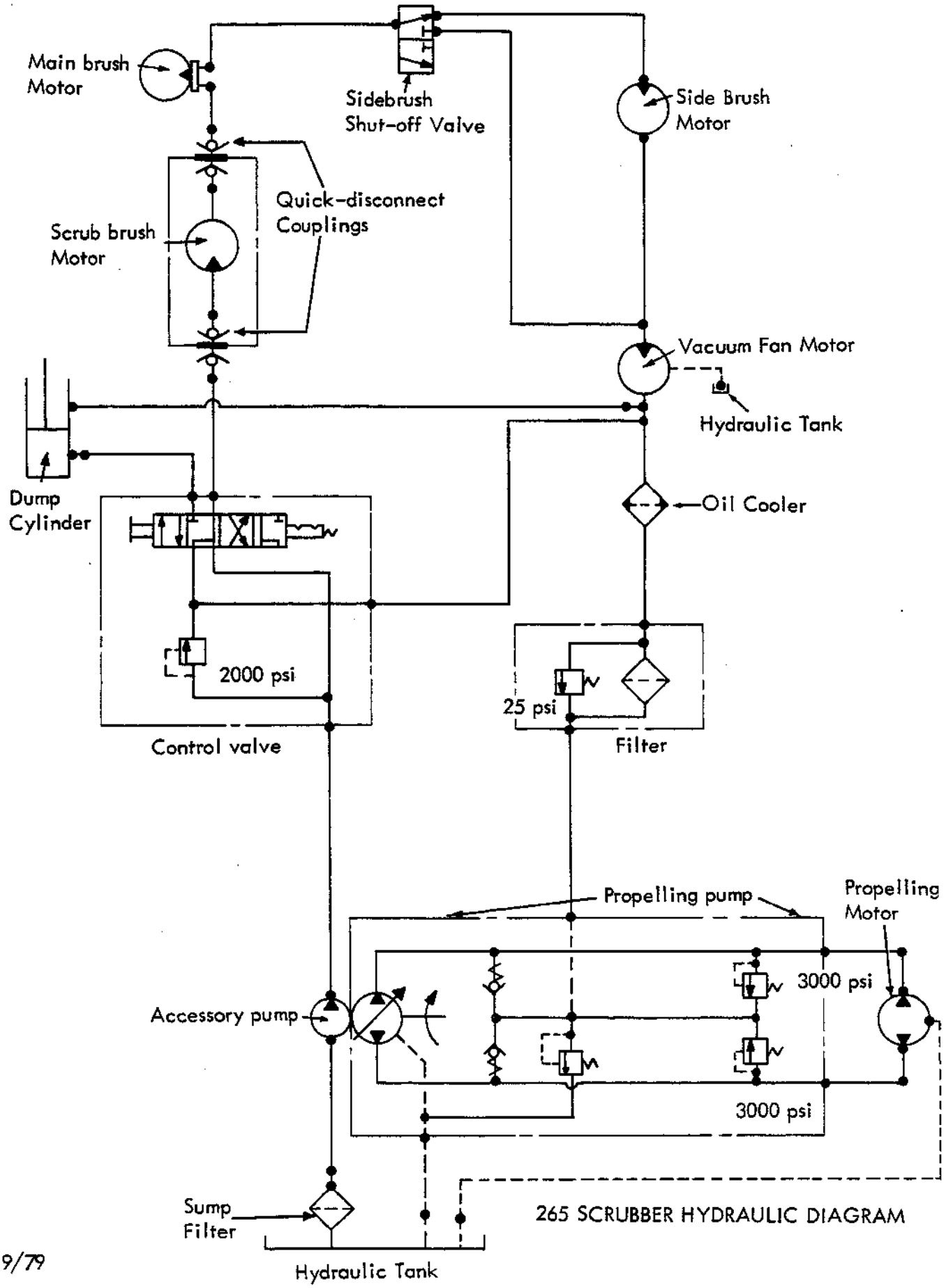
REAR SQUEEGEE ADJUSTMENTS

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



265 SCRUBBER HYDRAULIC DIAGRAM

9/79

265

POWER SWEEPER

CONTENTS

lpg

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.

- Check the vaporizer for proper operation (liquid withdrawal systems only-water heated)

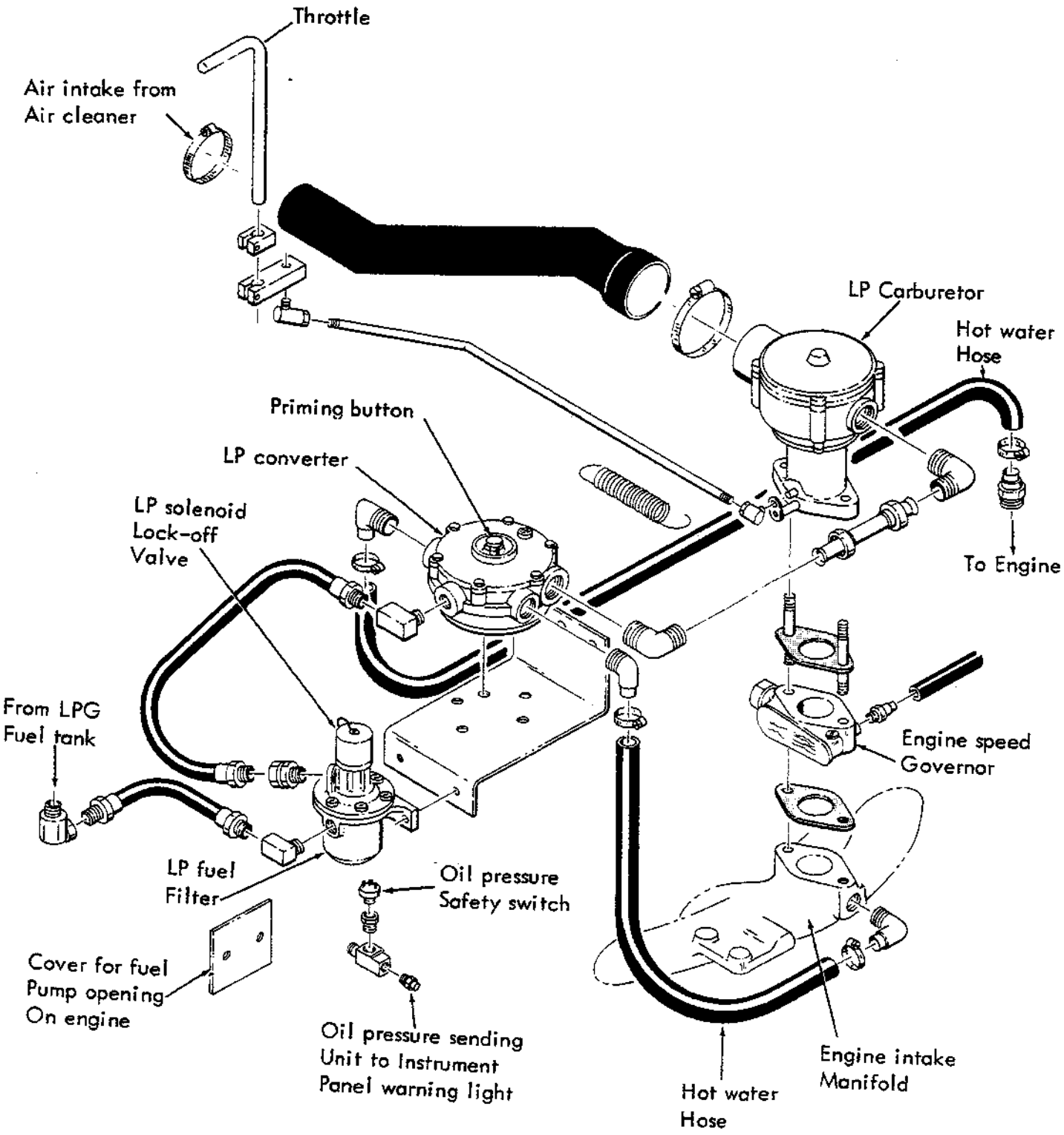
  Turn on the ignition switch, short out the oil pressure switch leads and open the radiator cap and check the coolant for bubbles. If bubbles are present, the vaporizer may have a leaking gasket or may have developed a pin hole leak, allowing L.P. fuel to enter the cooling system.

L.P. LIQUID WITHDRAWAL SYSTEM

Liquid withdrawal L.P. fuel systems are made up of six components which are: the L.P. fuel tank, pressure relief valve, filter fuelock, vaporizer, regulator, and the carburetor. There are many variations and combinations of the basic components.

Liquid L.P. fuel flows from the L.P. tanks, under its own pressure, to the pressure relief valve. This valve is normally closed, preventing L.P. fuel from escaping into the atmosphere. From the pressure relief valve, the liquid L.P. fuel is piped to the filter fuelock. The filter fuelock filters unwanted tank scale and deposits out of the L.P. fuel. The filter fuelock also stops the flow of L.P. fuel when the engine is not operating or being started. The oil pressure switch controls the fuelock. When the engine oil pressure is 4 psi or greater, the oil pressure switch permits an electrical current to open the fuelock which allows L.P. fuel to flow on to the vaporizer. The oil pressure switch is bypassed when the engine is started, allowing L.P. fuel to flow.

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



LPG FUEL SYSTEM
(Parts peculiar to LP System only are shown)

L. P. FUEL COMPONENTS

L.P. FUEL

Liquified petroleum fuel (L.P. fuel) is made up of a mixture of flammable hydrocarbons which are in a gaseous state and are compressed into a liquid form. As the liquified fuel escapes into the atmosphere, it expands back into a gaseous state. Propane and butane are two such fuels. Both of them are mixed together to get the L.P. fuel that L.P. fueled machines burn. The mixture of these two basic fuels varies according to the particular climate in which they are to be used. Northern L.P. fuel is made of mostly propane. Southern L.P. fuel is made of mostly butane. Propane becomes a gas at -44° F (-44° C) at atmospheric pressure. Butane becomes a gas at 32° F (0° C) at atmospheric pressure. Butane would not vaporize into a gas in the northern regions in winter, when temperatures fall below 32°. Propane is harder to handle in the southern regions where temperatures are higher.

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

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 the vaporizer for proper operation

  Turn on the ignition switch, short out the oil pressure switch leads and open the radiator cap and check the coolant for bubbles. If bubbles are present, the vaporizer may have a leaking gasket or may have developed a pin hole leak, allowing L.P. fuel to enter the cooling system.

- 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.

. 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.

TO START LPG EQUIPPED ENGINE

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

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.)

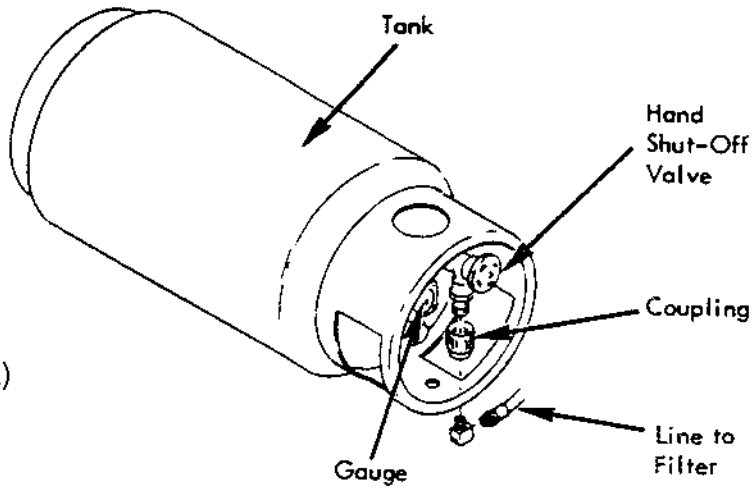
4. Insert ignition key and turn to "Start" position momentarily until engine starts. Release key as soon as engine starts. Do not operate starting motor continuously for more than 10 seconds at a time.

5. If engine does not start after several attempts, refer to "LP Fuel Trouble Shooting."

NOTE The engine may surge until it reaches operating temperature, 5-10 minutes operating time. If the engine is put under a load while it is cold, the surging may become more aggravated.

LPG FUEL TANK

The 33 lb (15 kg) capacity tank is mounted in the compartment behind the driver's seat. 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 lb (15 kg) plus the "tare" weight(TW) which is marked on the 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.

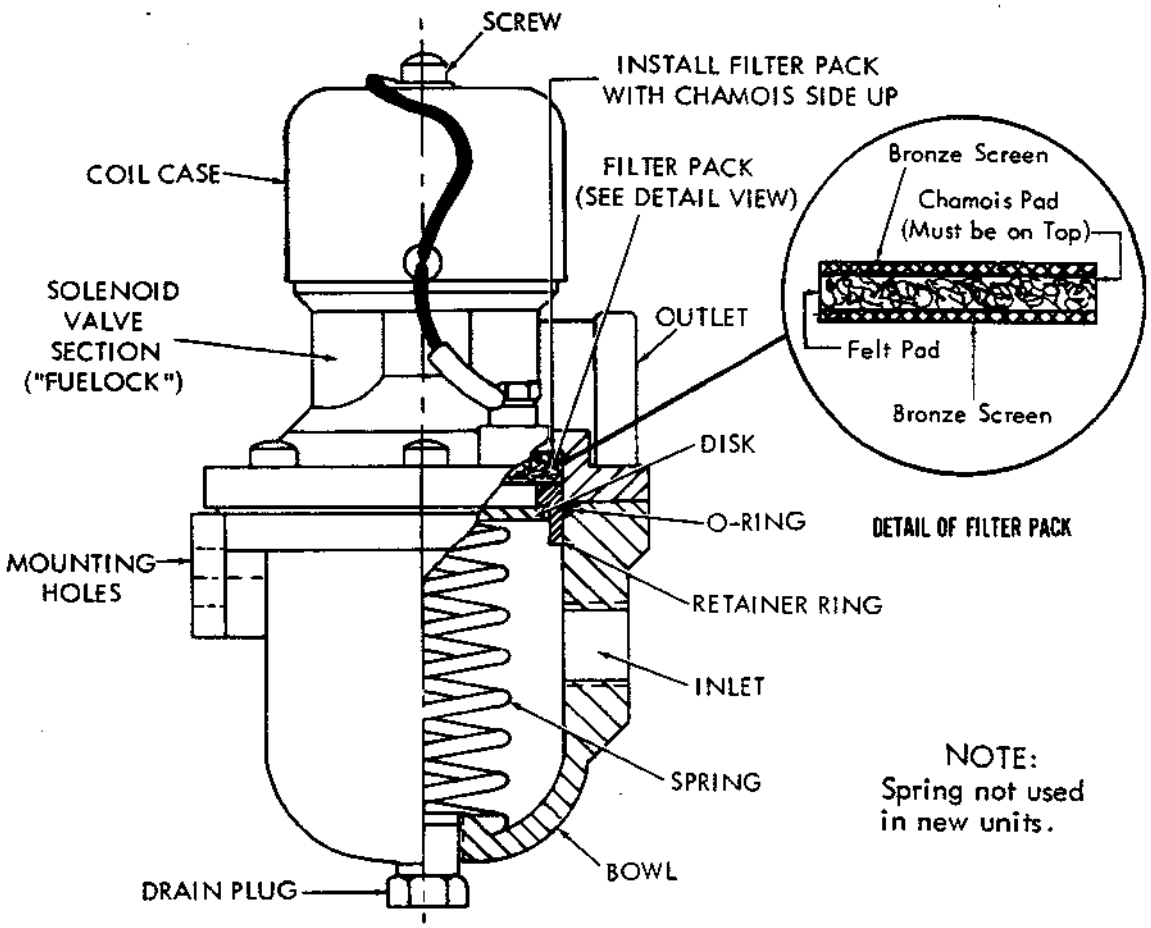
THE FILTER-FUELOCK
(COMBINATION FUEL FILTER AND SOLENOID LOCK-OFF VALVE)

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.

A. 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 500 hours or when diminished gas flow indicates filter is clogged.



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

12/80

REPLACING FILTER PACK

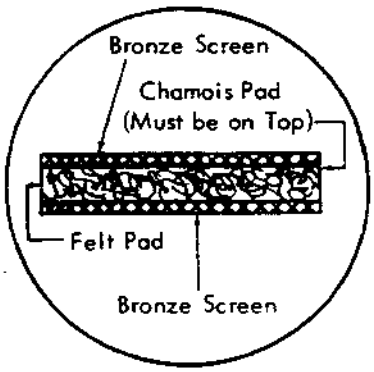
DISASSEMBLY:

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 The spring inside the filter bowl may suddenly push up the top section when the screws are removed.

4. Lift off the top valve section (called "Fuelock" section). Remove the flat disk and spring in the bowl 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.

INSTALL FILTER PACK
WITH CHAMOIS SIDE UP

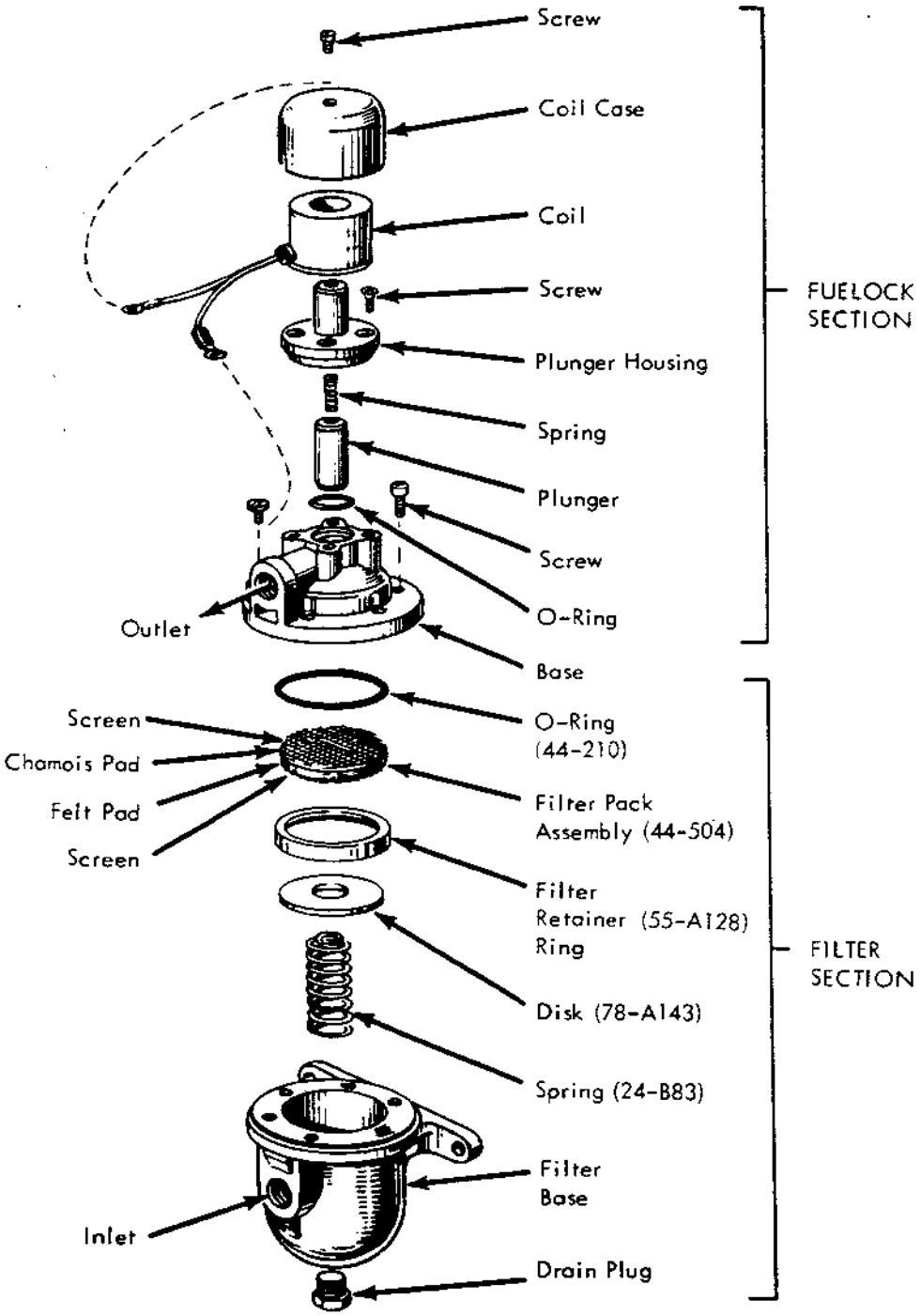


ASSEMBLY:

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



EXPLODED VIEW OF THE FILTER-FUELOCK

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.

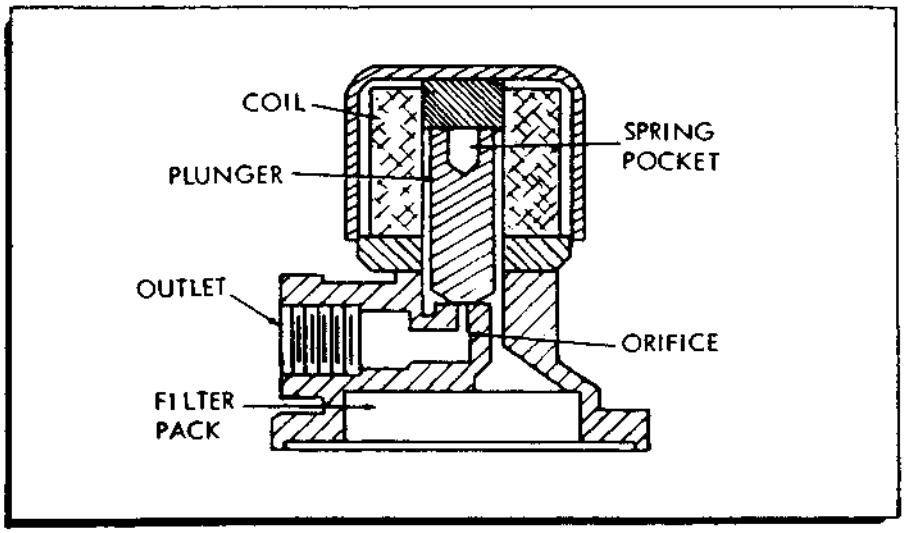
Any apparent shortage of fuel should result in an immediate inspection of the filter to assure that it is not responsible. This is best done by temporarily bypassing the filter and running the engine to see if the problem is eliminated. DO NOT CONTINUE THE OPERATION WITHOUT CORRECTING THE CAUSE AND CONNECTING THE FILTER BACK INTO THE FUEL SYSTEM.

B. 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 singlescrew 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

NOTE 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 terminal post. Be sure other coil lead is grounded to the fuelock assembly with case retaining screw.

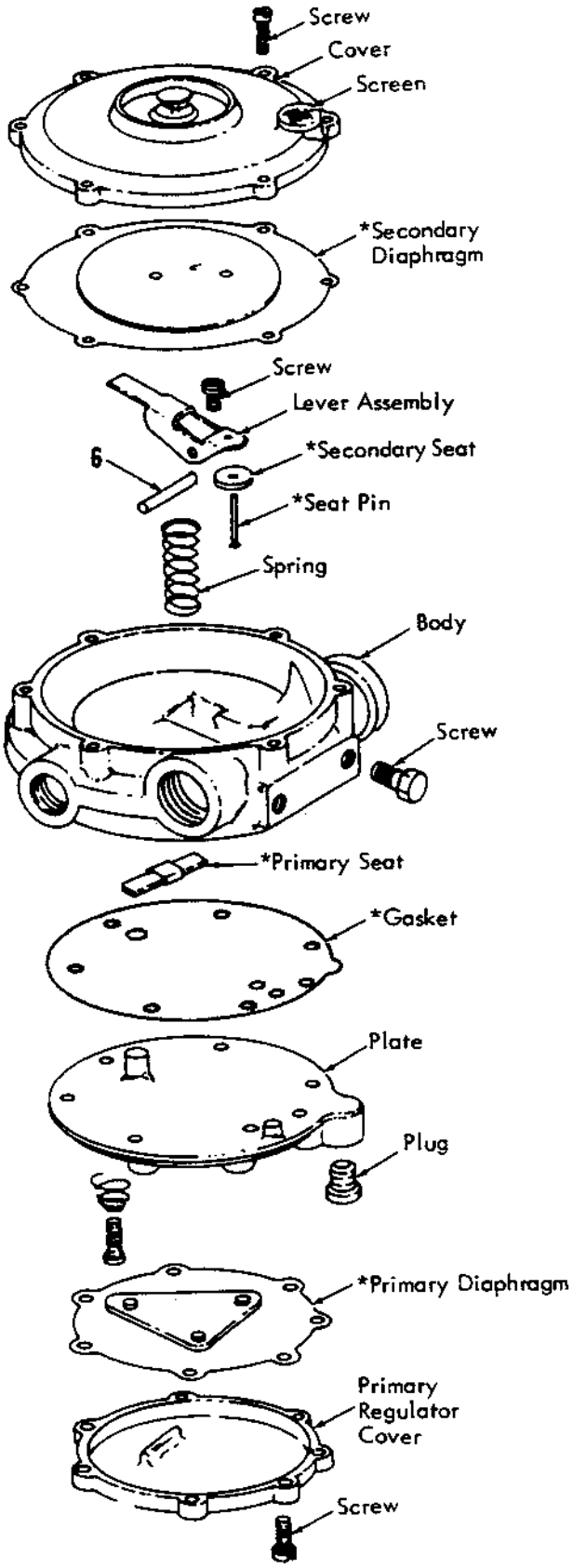
B. To Replace Plunger

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

NOTE Spring is small and can easily be dropped and lost

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.



VAPORIZER REGULATOR

LPG CONVERTER - #54930

* Parts Included in Diaphragm/Seal Repair Kit No. RJK-2 (Impco Part No.)

L.P. FUEL VAPORIZER-REGULATOR (CONVERTER)

TENNANT No. 54930

SERVICING THE VAPORIZER- REGULATOR(CONVERTER)

Installation of the complete kit should be necessary only at time of major overhaul or when converter has been out of service for some time. Gaskets and diaphragms deteriorate if the converter is stored after being used.

1. Start dis-assembly by removing the secondary cover assembly. Take out six screws to loosen cover.

2. Break cover loose by tapping with a plastic screw driver handle.

3. Remove secondary diaphragm assembly. Diaphragm assembly must be moved toward L.P. gas inlet to disengage the diaphragm link from the lever assembly.

4. Lever is still engaged in the link slot. Move diaphragm ahead to clear slot.

5. Remove the cover and diaphragm assembly.

6. Remove the screw to disassemble secondary lever from converter body.

7. Note locating tabs for spring at each side of the lever. These, plus tab punched through top of lever, position spring correctly and prevent it from slipping out from under the lever.

8. Remove primary regulator cover. Take out six screws to loosen cover.

9. Cover and primary diaphragm assembly is removed. Note triangular lever riveted to diaphragm. This lever is supported on the upper side by a fulcrum to depress primary valve pin and spring. Pencil points to sensing port for pressure regulation.

10. The Primary valve is operated by the primary valve pin in the primary regulator spring moving through a boss in the converter body cover plate. This isolates the diaphragm from contact with liquid propane and prevents the diaphragm stiffening due to refrigeration.

11. Removal of the cover plate and gasket shows serrated vaporizing chamber in the body and heat exchange labyrinth which heats fuel.

13. Remove gasket from converter body cover plate.

14. Viton seat is bonded to aluminum alloy backing of the primary regulator valve.

15. With the gasket in place and the converter body cover plate positioned, insert primary valve pin in place thru the primary regulator spring.

16. Lift Diaphragm lever to show fulcrum cast in the cover over which the lever rocks to operate the primary valve pin.

17. With the primary regulator cover, diaphragm assembly, and the converter body cover plate in place, turn seven screws in until they touch the cover. Then tighten screws from one side to the other until all screws are solidly tightened.

(continued on next page)

18. Note that the primary regulator cover has a cast-in lettering indicating L.P. gas inlet, water inlet and outlet, and the primary pressure check plug. The small orifice below lower lettering is atmospheric vent to the primary diaphragm.

19. Bend or straighten the old secondary seat pin and remove the old seat. Replace with new secondary regulator seat and secondary seat pin.

20. Draw pin through secondary regulator lever assembly.

21. Draw pin through with enough force to seal the head against the seat, but leave pin loose enough so seat can tilt for alignment with the secondary jet.

22. Bend pin to retain seat in place.

23. Clip off excess pin.

24. Place secondary blue spring in place on body. The secondary regulator lever assembly, ready for replacement, attaches with screw. An alternate orange spring is installed when converter is used with a CA300A mixer or with another make of venturi carburetor.

25. Hold lever assembly with the fulcrum pin in place in its locating groove, fasten in place by replacing the screw.

26. Tighten screw solidly to retain the lever assembly.

27. Secondary diaphragm assembly is now ready for reassembly. Place diaphragm link slot over end of the lever. Gap from which link is punched should be located toward the L.P. gas inlet.

28. With the diaphragm assembly in place, replace secondary cover assembly using six screws.

29. First, tighten screws in until they touch cover.

30. Tighten screws solidly, alternating from side to side until all of the screws are solidly seated.

ATTENTION! Use only brass fittings in the water inlet and outlet passages. Steel fittings will cause the casting to deteriorate due to electrolysis.

NOTE Check completed converter under pressure with soap suds or testing solution to detect possible leaks.

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. 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)

L.P. FUEL TROUBLESHOOTING (Continued)

	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.

(continued on next page)

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.

MM114

265

POWER SWEEPER

FORD

98 CID - 1600 cc
INDUSTRIAL 4 - CYLINDER
ENGINE

engine

Ford Power Products

FORD MOTOR COMPANY
INDUSTRIAL ENGINE OPERATIONS
FORD PARTS DIVISION
P.O. BOX 1796
DEARBORN, MICHIGAN 48121

TABLE OF CONTENTS

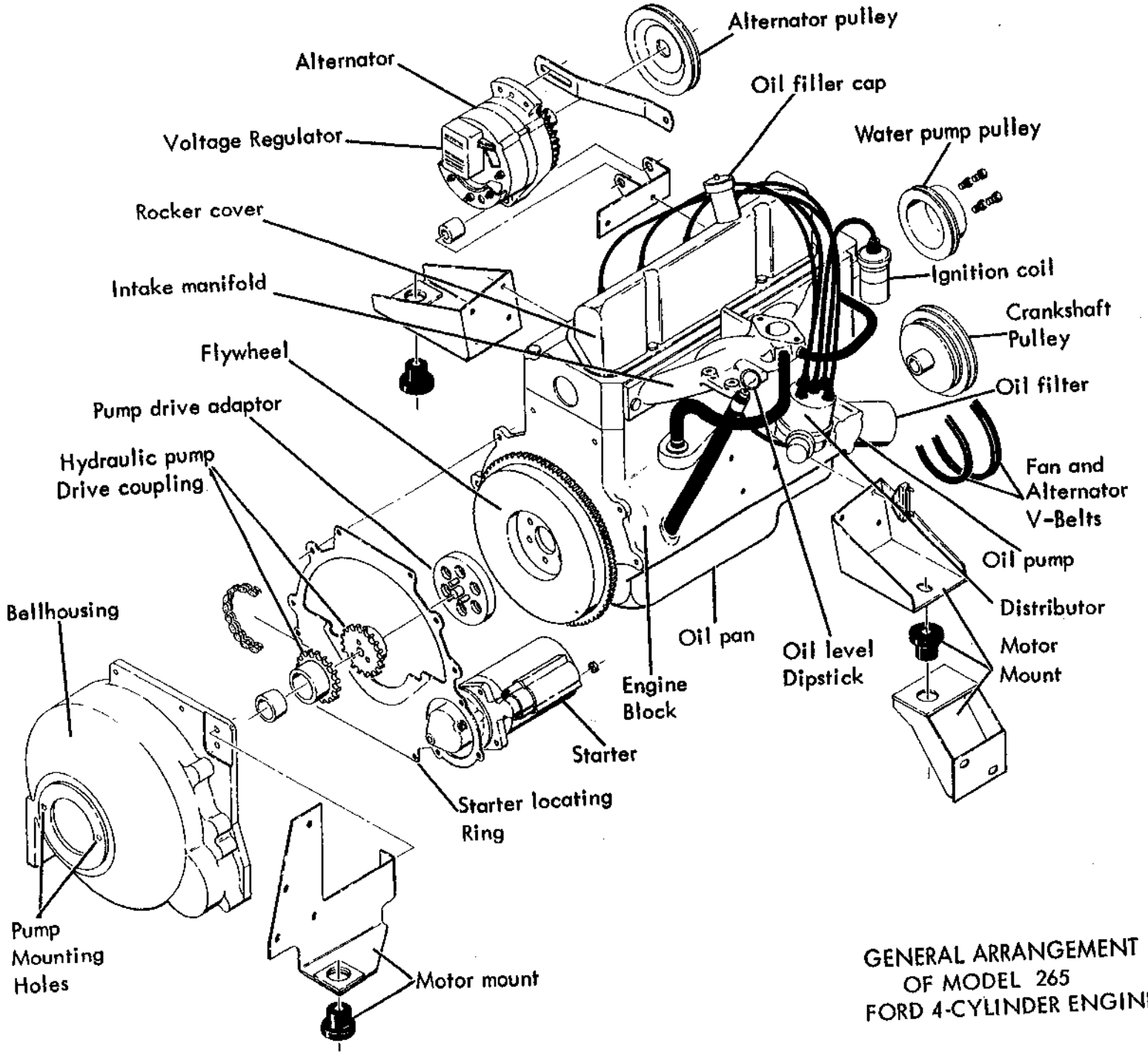
FORD INDUSTRIAL ENGINE WARRANTY

STATEMENT OF WARRANTY APPLICABLE TO 1.6 LITRE GASOLINE
AND LPG ENGINES SOLD BY FORD INDUSTRIAL ENGINE OPERATIONS
TO TENNANT

Ford Motor Company (Ford) warrants to Tennant Company to whom it sells a new Ford Industrial Engine that each part of such engine will be free under normal use and service from defects in material and workmanship for a period of one year or 1500 hours, whichever occurs first, from the date of delivery to the original retail purchaser. Tennant Company shall extend and shall require any of its Dealers re-selling any such engine or power unit to extend, each on his own behalf only, a similar warranty to his customer. Ford's obligation under this warranty is limited to free replacement of, including related labor (other than labor required to remove, replace or gain or close access to the engine or unit), by an authorized Dealer, or credit for, such parts as shall be returned to Ford (or such others) with transportation pre-paid and as shall be acknowledged by Ford to be defective. Tennant Company shall notify Ford of any such defective part within 20 days after obtaining knowledge thereof.

This warranty shall not apply to any Ford Industrial Engine (i) if it has been subject to misapplication, abuse, misuse, negligence or accident, or (ii) if parts not made or supplied by Ford have been used in connection with it if in the sole judgement of Ford such use affects its performance, stability or reliability, (iii) if it has been altered or repaired outside of a Ford location in a manner which, in the sole judgement of Ford affects its performance, stability or reliability or (iv) if it shows evidence of participation in racing or other competitive activities. This warranty shall not apply to normal maintenance services (such as engine tune-up and fuel system cleaning) or to normal replacement of service items (such as filters, spark plugs and ignition points). This warranty shall also not apply to any engine normally operated outside the United States or Canada; in such case the engine will be provided the warranty authorized for the country where used. This warranty is expressly IN LIEU OF any other express or implied warranty on any Ford Industrial Engine Unit or any part thereof, including any implied WARRANTY OF MERCHANTABILITY OR FITNESS and of any other obligation or liability on the part of Ford Motor Company. No person is authorized to make any representations beyond those herein expressed.

Ford reserves the right to make changes in the design of and other changes in its products at any time and from time to time without notice and without incurring any obligation with respect to any product theretofore ordered from it or sold or shipped by it or otherwise.



GENERAL ARRANGEMENT
OF MODEL 265
FORD 4-CYLINDER ENGINE

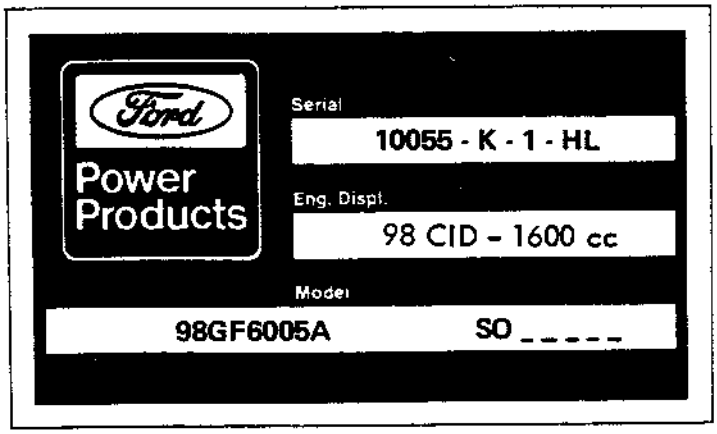
GENERAL INFORMATION AND DESCRIPTION

Ford 98 CID Engines are tested and inspected before leaving the factory. However, certain checks should be made before putting them into regular operation. Read the instructions under Preparation for Operation and Start-Up. If it is planned to store the unit before use, read the instructions under the section on Storage.

PARTS, SERVICE AND ENGINE IDENTIFICATION

Ford 98 CID Engines are available through Industrial Engine Operations, Ford Parts Division, Ford Motor Company, Dearborn, Michigan, and also from Ford Power Products Distributors and Dealers in the United States, and from Ford Internation Division's Branches and Dealers in principal foreign countries.

A decal is affixed to each engine. The decal contains the serial number indicating engine type, the engine displacement number, and the model number indicating optional equipment. When ordering parts, or carrying on correspondence concerning the engine, all three numbers should be mentioned.



MODEL 265 ENGINE:

Engine Identification Decal

The "SO" number is the Special Option number which identifies the special parts used in the engine .

Replacement parts can be obtained through the local Ford Industrial Products Distributor and/or Dealer in your area.

DESCRIPTION

The 1600 cc engine is a four cylinder, in-line, overhead valve unit operating on the four stroke cycle with cross-flow cylinder head and bowl-in-piston combustion chambers. The engine has a compression ratio of 8.0:1.

The cylinder bores are machined directly in the cast iron cylinder block, which is cast integral with the upper half of the crankcase, and are provided with full length water jacketing.

The cast iron crankshaft runs in five large diameter main bearings fitted with steel-backed copper/lead or lead/bronze bearing liners.

End-float and thrust are controlled by half-thrust washers located in the cylinder block on either side of the center main bearing.

Seals pressed in the front cover and the rear oil seal carrier prevent oil leaks from the front and rear of the crankshaft. The front seal runs on the pulley hub while the rear seal runs on the crankshaft flange itself. A caged needle roller pilot bearing is pressed into the rear end of the crankshaft.

The connecting rods are H section forgings having separate big end caps retained by two bolts and located by hollow dowel pins. Connecting rod bushing liners are steel backed copper/lead or aluminum/tin. The piston pin ends have steel-backed bronze bushings.

Solid skirt aluminum alloy pistons with two compression and one oil control ring situated above the piston pin bore are used. The combustion chamber is machined in the piston crown. The piston pins are fully floating and are retained in position by eyelet type snap rings installed in grooves at each end of the piston bore.

The camshaft is driven at half engine by a single row chain and sprockets from the crankshaft. This timing chain is automatically tensioned by a cam bearing against a pivoted tensioner arm. A helical gear and an eccentric, machined integral with the camshaft, drive the distributor, oil pump and the fuel pump. A thrust plate bolted to the cylinder block front face and located between the front bearing journal and the sprocket flange retains the camshaft.

Overhead valves are mounted perpendicular to the cast iron cylinder head in integral valve guides and are operated by rockers, push rods and tappets from the camshaft. The rockers are mounted on a shaft supported by four mounting posts bolted to the cylinder head. Valve clearances are adjusted by means of self-locking screws provided in the rocker arms.

A cast iron flywheel is mounted on the crankshaft flange. The drive for the starter motor is provided by a steel ring gear shrunk onto the flywheel periphery.

The oil pan is a steel stamping and has a sump for the lubricating oil. The engine lubrication system is the force feed type incorporating a full flow oil filter. The oil pump is mounted externally on the engine. The pump incorporates a non-adjustable, plunger-type relief valve.

An oil filter cap is located in the rocker cover. Crankcase ventilation is controlled by a closed positive system.

GENERAL DATA FOR TUNE-UP

Type	4 Cylinder in line with direct Flow head (Combustion Chamber in Piston)
Bore and Stroke	3.188 in.(80.98 mm) x 3.056 in (77.62 mm)
Displacement	97.6 cu. in. (1599 cc)
Compression Ratio	8:1
Firing Order	1,2,4,3
Valve Clearance (Hot)	
Intake	0.010 in.(0.25 mm)
Exhaust	0.020 in.(0.50 mm)
Fuel System	
Carburetor	down-draft
Recommended Fuel	Regular (90-94 Octane)
Lubrication System	
Oil Pressure	35 to 40 psi (2.5 to 2.8 kg/cm^2)
Oil Capacity	less filter-5.35 pts (3.0 liters) with filter-6.25 pts (3.5 liters)
Cooling System	
Capacity of Radiator	3.8 qts (3.6 liters)
Block and Head Capacity	6.2 pints (3.53 liters)
Thermostat	starts to open 185°F to 192°F 85°C to 89°C, fully open 210°F to 216°F (99°C to 102°C)
Electrical System	
Ground	negative
Spark plugs	AG 22 - 14 mm
Plug gap	0.026 in (0.66 mm)
Contact Breaker Point Gap	0.025 in. (0.64 mm)
Ignition Timing (gasoline engine)	10°-12° BTDC @ 600 rpm
Ignition Timing (LPG engine)	12°-14° BTDC
Idle Speed	900 - 1000 rpm
Engine Speed	2400 rpm(governed)

PREPARATION FOR OPERATION AND START-UP

Before placing your new engine in operation, perform a thorough inspection to make sure it is not externally damaged, and all wiring and hoses are properly connected.

1. Coolant:

   Check the coolant level. After the engine has run a few minutes, check the level and add coolant as necessary. Fill to one inch below the bottom of the filler neck. Use a 50-50 mixture of water and permanent-type anti-freeze.

2. Oil Level:

   Check the crankcase oil level and add oil of the correct grade and viscosity, as required. See engine oil recommendations.

   Certain precautions should be followed during the first few hours of operation to make sure the engine will not be damaged. Check the oil level often (at least every two or three hours), until an oil consumption pattern is established. The top compression rings are hard chrome-plated and usually take longer to seat than regular cast iron rings. During this period, oil consumption will be greater than normal. Add make-up oil as required to maintain the proper level between the "Full" and "Add Oil" marks on the dipstick. Use oil of the type and seasonal viscosity recommended.

3. Distributor

   Check point gap and initial spark advance. Reset if necessary.*

4. Timing

   Check engine timing and adjust if required.*

5. Carburetor

   Set idle speed and idle mixture.*

6. Cylinder Head Torque

   Check, torque cylinder head bolts to specifications, if necessary.

7. Miscellaneous

   Check for external coolant, fuel and/or engine oil leaks and repair as required. Check all nuts and bolts for correct torque. Torque specifications are listed in the Specifications Section of this engine manual.

* See "Tune-Up" Data

Operation

STARTING THE ENGINE

Cold Starts: Hard starting is the most common difficulty in cold weather. A complete tune-up and winterization of the engine should minimize or eliminate starting difficulties. To start the engine:

1. For gasoline engine - pull out the choke all the way (If engine is warm, pull out choke about 1/3). For LP fuel engine, there is no choke provided. If engine is difficult to start, press priming button on LP converter located in engine compartment.

2. **NOTE** If the engine is hot or flooded with fuel and does not start promptly, push the choke in all the way. Crank the engine until it starts. If the engine is at normal operating temperature, push the choke in all the way.

3. Turn the ignition switch to the "Start" position.

4. Release the key immediately when the engine starts.

ATTENTION! Never operate the starter for more than 30 seconds at any one attempt to start the engine. This procedure will help extend the life of the battery and starter.

5. Push the choke in after engine warm-up. (gasoline engine only).

ENGINE WARM-UP

The greatest amount of engine wear occurs when a cold engine is first started. This increased wear is caused by the lack of oil on the moving parts. Engine oil does not flow freely or lubricate properly until it has reached normal operating temperature. Therefore, wear will be greatly increased if the engine is run at high rpm or put under heavy load when it is cold. The greatest damage will be done to the cylinder walls and pistons.

NOTE The engine may surge until it reaches operating temperature, 5-10 minutes operating time. If the engine is put under a load while it is cold, the surging may become more aggravated.

STOPPING THE ENGINE

1. Decrease the engine speed to an idle after normal operation

2. Shut the engine down by turning off the ignition switch.

NOTE If the engine has been running hot, let it run at idle speed for a few minutes. This low speed running will allow the excess heat to dissipate.

3. Check the engine oil level after the engine has been stopped for about two minutes. Add oil of the proper grade and viscosity to the required level.

4. Check the radiator coolant level. Fill as required with the proper coolant to within about two inches of overflowing.

   Under abnormally overheated conditions, due to a loss of coolant, it is best to stop the engine immediately. Check the coolant and oil levels.

⚠WARNING Use extreme care when removing the radiator cap from an overheated engine. Use a heavy rag or glove for protection and turn the cap to the first notch only. This will allow the steam and excess pressure to escape. After the pressure and steam have stopped escaping, remove the cap.

Add engine oil of the correct grade and viscosity, as required. Then start the engine and slowly add coolant to the radiator until the cooling system is full.

ATTENTION! Never add cold water to the radiator of an overheated engine. Cold water can cause the engine cylinder block to crack.

MAINTENANCE AND LUBRICATION SCHEDULE

Operation	Initial Start-Up	Daily Care	Each 100 Hours	Each 200 Hours	Each 400 Hours	Each 800 Hours	Seasonal Or As Required
Check Oil Level	X	X					
Check Radiator Coolant Level	X	X					
Change Engine Oil *							X
Change Engine Oil Filter			X				X
Clean and Refill Air Cleaner			X				X
Check Battery State-of-Charge and Water Level	X		X				
Inspect and Clean Exterior of Radiator				X			
Check for External Coolant and Oil Leaks, Correct as Required	X	X			X		
Clean, Adjust and Test Spark Plugs					X		
Replace Spark Plugs				X			
Check Cylinder Compression						X	
Tighten Intake Manifold Bolts	X					X	
Check and Tighten Fan and Alternator Drive Belt Tension	X			X			X
Clean Distributor and Check Points					X		
Replace Distributor Points				X			X
Check and Adjust Ignition Timing	X			X			
Check and Adjust Idle Speed RPM	X			X			X
Check and Adjust Idle Mixture	X				X	X	
Check and Tighten Cylinder Head Torque	X						X
Check Bolt and Nut Tightness	X						X
Check Intake Manifold Vacuum							X
Adjust Throttle and Governor	X						X
Clean Battery Cables				X			X
Clean Fuel Sediment Bowl				X			

* Each 50 hours.

CHECK RADIATOR COOLANT LEVEL

The engine must operate at the correct temperature to obtain maximum efficiency and service life. The engine depends on the cooling system for operating temperture control. Therefore, the cooling system should be kept filled with clear water and permanent-type anti-freeze solution. Use a 50-50 mixture of water and anti-freeze.

Remove the radiator cap and check the level of the coolant.

⚠CAUTION The cooling system is under pressure. Therefore, it is dangerous to remove the radiator cap while the system is hot. Always turn the cap slowly to the first stop and allow the pressure to escape before removing the cap completely.

Add coolant to a level of 1 to 1.50 in (25.4 to 38.1 mm) below the bottom of the filler neck.

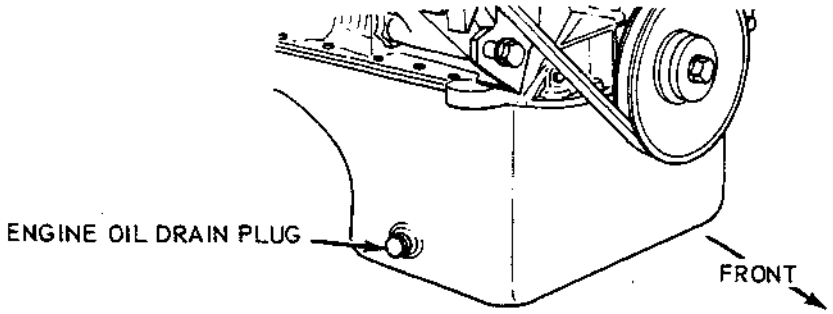
CHANGING ENGINE OIL & OIL RECOMMENDATIONS

Drain the engine oil with the engine at normal operating temperature. Fill the crankcase with the proper quantity and viscosity of oil.

The oil used must meet Ford Spec. No. M2C101-C. Oil that meets this specification is normally marked so on the can. If engine oils are used which do not meet these specifications, it will be necessary to change oil more frequently than specified to obtain satisfactory engine life and operation. The oil must be API Grade "SE".

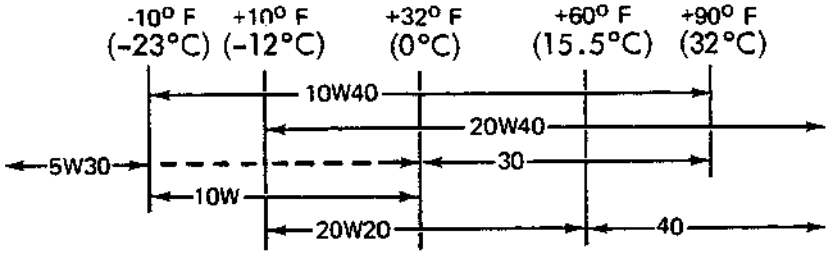
NOTE Oil must be changed every 50 hours.

NOTE Solvents such as kerosene should not be used as flushing oils. Dilution of the fresh refill oil supply can occur which may be detrimental.



ENGINE OIL RECOMMENDATIONS

Ambient Temperatures



(Normally, SAE 10W-40, API Grade "SE" should be used)

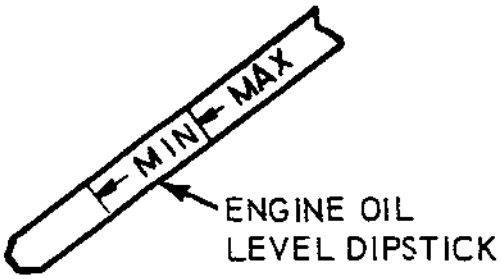
CHECKING FOR EXTERNAL COOLANT AND OIL LEAKS

Check the radiator, radiator hoses and drain cocks for coolant leaks. Also, check all engine gasket areas where coolant or oil leaks can occur. Check the oil pan drain plug, the oil filter and valve cover gasket for engine oil leaks. Repair these areas as required to stop any coolant or oil leakage.

MAINTENANCE AND LUBRICATION

CHECKING ENGINE OIL LEVEL

Before engine start-up, check the engine oil level and add engine oil of the correct grade and viscosity as required. If the engine is running and an oil level check is required, shut the engine off and wait a few minutes before checking the oil level. The waiting period allows the oil from the head and other areas of the engine to drain back into the crankcase. The dipstick is located on the right side of the engine.



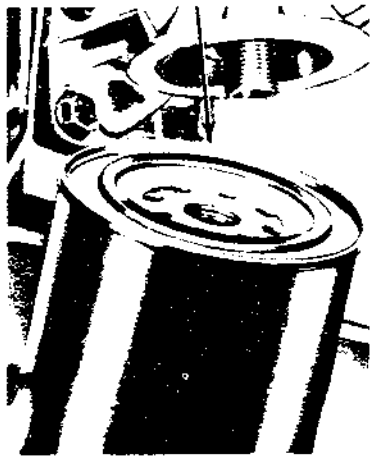
CHANGING ENGINE OIL FILTER

The engine oil filter is important in preserving the internal condition of your engine. Your engine is equipped with a Motorcraft Oil Filter which should be changed every 100 hours or whenever the engine oil is changed. For reliable service, you should always use a genuine Ford replacement filter. It is designed to protect your engine by filtering out all harmful abrasive or sludgy particles without clogging up and blocking the flow of oil. To replace the "spin-on" type oil filter, place a drip pan under the filter assembly and unscrew the filter case from the adaptor. Clean the adapter filter recess.

Coat the gasket on a new filter with oil and place the filter in position on the adaptor. Hand tighten the filter until the gasket contacts the adaptor face, then advance it one-half (1/2) turn. Do not over-tighten.

Fill the crankcase with the specified amount of oil and run the engine to check for leaks.

COAT GASKET WITH ENGINE OIL



MAINTENANCE AND LUBRICATION

LUBRICATING THE THROTTLE AND CHOKE LINKAGE

Lubricate all wear points of the throttle and choke linkage with SAE 30 engine oil. One or two drops of oil at each point will provide sufficient lubrication.

CLEANING BATTERY AND CABLES

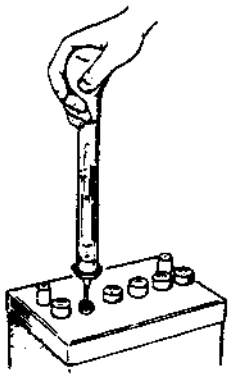
Disconnect the battery cables and wash the battery in cold water with a stiff bristle brush. Dry off excess water before reconnecting battery. Clean the battery posts for better electrical contact.

Inspect the battery cables for corrosion, fraying or damage, replace if required. Clean the battery cables for better electrical contact. Connect the battery cables to the proper battery posts and tighten the battery cable clamps. Apply petroleum jelly to the battery cable ends to reduce corrosion.

CHECKING BATTERY STATE OF CHARGE

The state-of-charge of the battery is indicated by specific gravity of the battery electrolyte or water solution. Check the specific gravity with a hydrometer and compare the reading to the figures in the chart to determine the battery's state of charge. A battery which is used in tropical climates, where freezing rarely occurs, is supplied with a weaker acid solution, which results in lower specific gravity readings. A high specific gravity provides the best protection against freezing. A difference in specific gravity readings between battery cells of 20-25% indicates battery trouble and the possiblility of early failure, especially in cold weather.

Rapid loss of battery electrolyte, or battery boiling, is an indication that the battery is being overcharged. The alternator and alternator regulator should be checked and adjusted, as required, to provide the specified output.



SPECIFIC GRAVITY CHART

Specific Gravity Temperate Climates	State-of-Charge	Specific Gravity Tropical Climates
Above 1.280	Fully Charged	Above 1.225
1.230	75% Charged	1.180
1.180	50% Charged	1.135
1.130	25% Charged	1.090
1.100	Limited Useful Capacity	1.060
1.080 or less	Discharged	1.040 or less

Minor Repairs and Adjustments

RADIATOR CAP

A pressure of approximately 15 psi (103 kPa) is maintained in the cooling system by a pressure-type valve in the radiator filler cap. Coolant under pressure does not boil as quickly as coolant which is open to the atmoshere. With a pressure of 15 psi (103 kPa) boiling point of the engine coolant is raised approximately 21°F (-6°C).

When the pressure in the system exceeds 7 psi (103 kPa), the pressure valve in the radiator cap is forced open. When the pressure valve is open the excess pressure in the cooling system is allowed to escape down the overflow tube. The radiator cap also contains a vacuum valve which allows atmospheric pressure to enter the system as the engine cools after being stopped.

All the air which enters or leaves the cooling system, when the radiator cap is installed and working properly, must pass through the overflow tube. Therefore, the overflow tube must be kept free of kinks and obstructions. Run a wire through the overflow tube occasionally or blow it out with compressed air, to keep it clean.

Periodically inspect the radiator cap to be sure it is in good working condition and be sure the vacuum valve is free to work and not gummed up. Replace the radiator cap if its condition is doubtful. Make sure the rubber radiator cap seal is in good condition and free of foreign deposits at all times.

THERMOSTAT

The thermostat is located in the coolant outlet connection in the front of the cylinder head.

When the engine is cold, the thermostat shuts off the flow of coolant to the radiator, allowing rapid engine warm-up. A recirculating by-pass allows the coolant to circulate within the engine whenever the thermostat shuts off the coolant flow to the radiator.

NOTE Do not remove and discard the thermostat in an attempt to improve engine cooling. Without a thermostat the engine may run below normal operating temperature resulting in excessive engine wear.

Immerse the thermostat in water and gradually heat it to test the thermostat. Continue heating the water until the thermostat is fully open. Note the temperature of the water when the thermostat opens and when it is fully open. A properly working thermostat will begin to open at 188°F(87°C) and will be fully open at 212°F(100°C).

To replace the thermostat, clean the gasket surfaces of the coolant outlet connection on the cylinder head and elbow. Coat a new gasket with water resistant sealer and place the gasket in position on the cylinder head.

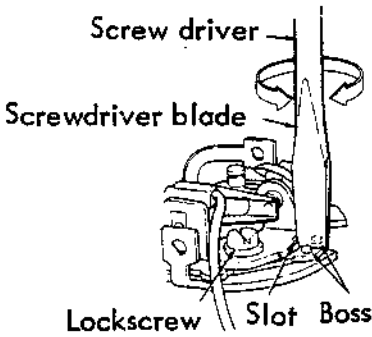
Place the new thermostat in position in the cylinder head with the spring end of the thermostat in the cylinder head. Install the coolant outlet elbow and connect the upper radiator hose.

MINOR REPAIRS AND ADJUSTMENTS

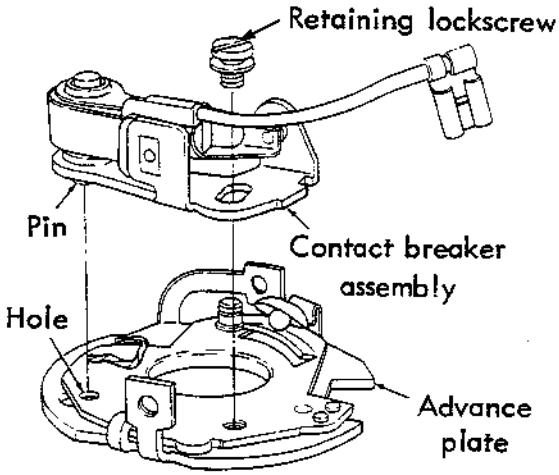
SERVICING DISTRIBUTOR POINTS

REMOVAL

1. Remove the distributor cap and the rotor.
2. Disconnect the condenser wire from the breaker point assembly.
3. Remove the single breaker point attaching screw and lift out the breaker point assembly (see drawing)
4. If the condenser is to be replaced, remove the screw attaching the condenser to the distributor body. Work the wire grommet out of the distributor body and disconnect the ignition wire at the coil.



Adjusting Breaker Points



Installing Breaker Points - Bosch

Installation

1. If the condenser was removed, thread the breaker point lead into the distributor and install the grommet. Install the condenser attaching screw. Connect the ignition wire to the coil.
2. Position the breaker points to the advance plate and install the attaching screw.
3. Connect the condenser wire to the breaker points.
4. Adjust the breaker points to 0.025 in. (0.64 mm).
5. Install the rotor and the distributor cap.
6. Check the dwell and initial ignition timing and correct if necessary.

IGNITION TIMING

Timing Mark Locations

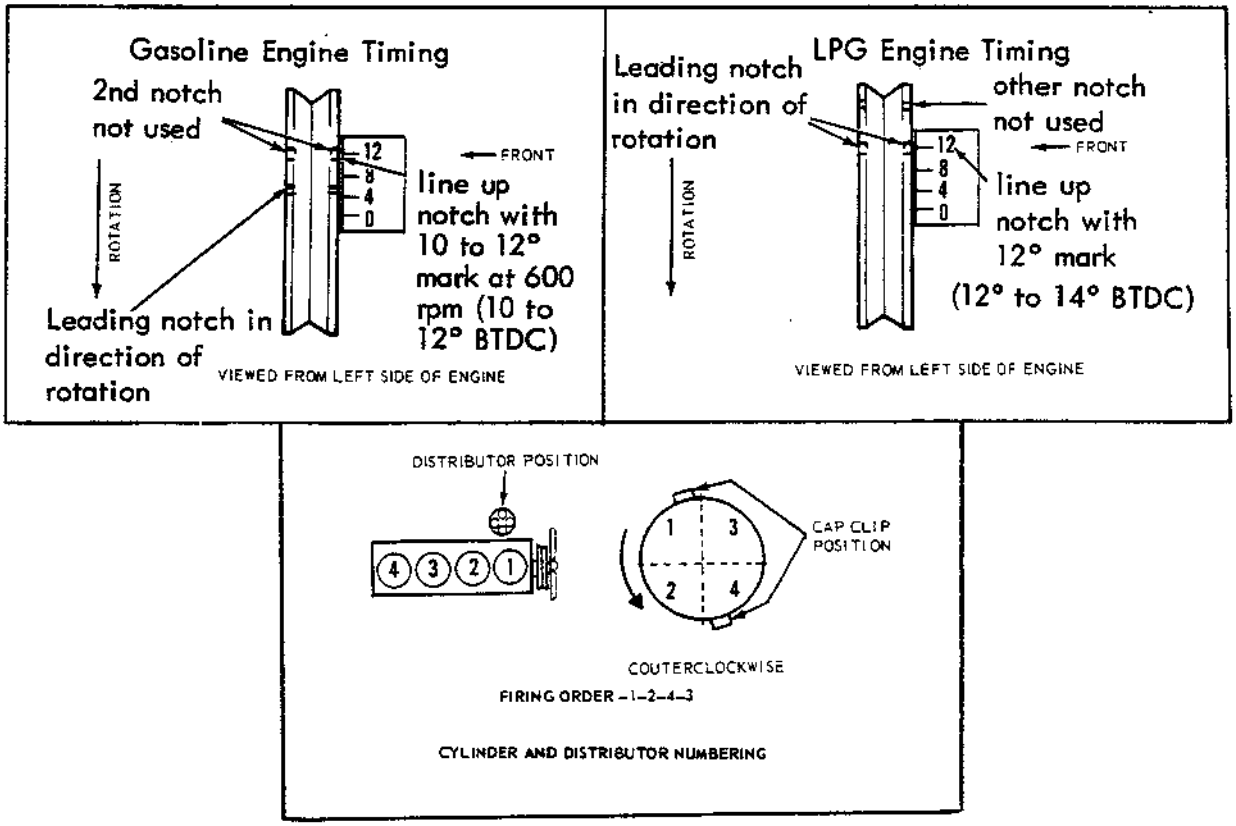
The timing marks and their location are illustrated in the sketch.
For checking and adjusting the ignition timing with a scope refer to the scope manufacturer's instructions. To check and adjust the timing with a timing light, proceed as follows:

Initial Ignition Timing

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

1. Clean and mark the timing marks.

2. Disconnect and plug the vacuum line.



3. Connect a timing light to the No. 1 cylinder spark plug wire. Connect a tachometer to the engine.

4. Start the engine and reduce the idle speed to 600 rpm to be sure that the centrifugal advance is not operating. Adjust the initial ignition timing to specifications listed in "Tune-Up Chart" (gasoline: 10 to 12° BTDC, LP; 12 to 14° BTDC.)

5. Check the centrifugal advance for proper operation by starting the engine and accelerating it to approximately 2000 rpm. If the ignition timing advances, the centrifugal advance mechanism is functioning properly. Note the engine speed when the advance begins and the amount of total advance. Stop the engine.

6. Unplug the vacuum line and connect it to the distributor vacuum advance unit. Start the engine and accelerate it to approximately 2000 rpm. Note the engine speed when the advance begins and the total amount of advance. Advance of the ignition timing should begin sooner and advance farther than when checking the centrifugal advance alone. Stop the engine.

8. If the vacuum advance is not functioning properly, remove the distributor and check it on a distributor tester.

   The distributor can only be calibrated on a distributor testing machine. Your Ford Industrial Products Dealer is qualified to properly calibrate your distributor and he has the tools and equipment to do this operation for you. If you are equipped to do this operation yourself, the distributor advance specifications are listed in the Specifications Section.

NOTE: After adjusting timing, be sure to increase engine idle speed to rpm recommended in "Tune-Up Chart". (900 ± 50 rpm).

ADJUSTING IDLE SPEED RPM

With the engine at normal operating temperature, push the choke control all the way in before attempting to adjust the idle speed. A stop screw at the throttle lever flange of the carburetor controls the idle speed. Turn the screw outward (counterclockwise) to increase the engine idle speed, and inward (clockwise) to decrease the engine idle speed. Correct idle speed is given in the "Tune-up Chart". (900 ± 50 rpm)

CHECKING CYLINDER COMPRESSION PRESSURE

A cylinder compression test aids in determining the condition of the valves, rings, and head gaskets. This test should always be performed at the recommended intervals to help determine if any major engine repairs are necessary.

Be sure the battery is good. Operate the engine until normal operation temperature is reached. Turn the ignition switch off. Loosen the spark plugs, blow out any dirt in the spark plug wells, then remove the plugs.

Set the throttle in the wide open position and be sure the choke is wide open. Remove the coil high tension lead at the distributor, and ground it securely to the engine. Install a compression gauge in number 1 cylinder. Crank the engine until the gauge registers a maximum reading and record the reading. Note the number of compression strokes required to obtain this reading. Repeat the test on each cylinder, cranking the same number of times to obtain the maximum reading on number 1 cylinder.

The indicated compression pressures are considered normal if the lowest reading cylinder is within 75% of the highest. Refer to the following Compression Pressure Limit Chart.

If one or more cylinders read low, squirt approximately one tablespoon of engine oil on top of the pistons in the low reading cylinders. Repeat compression pressure check on these cylinders.

1. If compression improves considerably, the piston rings are at fault.

2. If compression does not improve, valves are sticking or seating poorly. If two adjacent cylinders indicate low compression pressures and squirting oil on the pistons does not increase the compression, the cause may be a cylinder head gasket leak between the cylinder. Engine oil and/or coolant in the cylinders could result from this problem.

It is recommended the following quick reference chart be used when checking cylinder compression pressures. The chart has been calculated so that the lowest reading number is 75% of the highest reading.

For example: After checking the compression pressures in all cylinders, it was found that the highest reading obtained was 196 psi. The lowest pressure reading was 155 psi. By locating 196 in the maximum column it is seen that the lowest allowable pressure is 155 psi. Since the lowest cylinder reading was 155 psi, the engine is within specifications and the compression is considered satisfactory.

See chart on next page.

Compression Pressure Limits

Maximum PSI	Minimum PSI	Maximum PSI	Minimum PSI	Maximum PSI	Minimum PSI
134	101	174	131	214	160
136	102	176	132	216	162
138	104	178	233	218	163
140	105	180	135	220	165
142	107	182	136	222	166
144	108	184	138	224	168
146	110	186	140	226	169
148	111	188	141	228	171
150	113	190	142	230	172
152	114	192	144	232	174
154	115	194	145	234	175
156	117	196	147	236	177
158	118	198	148	23	178
160	120	200	150	240	180
162	121	202	151	242	181
164	123	204	153	244	183
166	124	206	154	246	184
168	126	208	156	248	186
170	127	210	157	250	187
172	129	212	158		

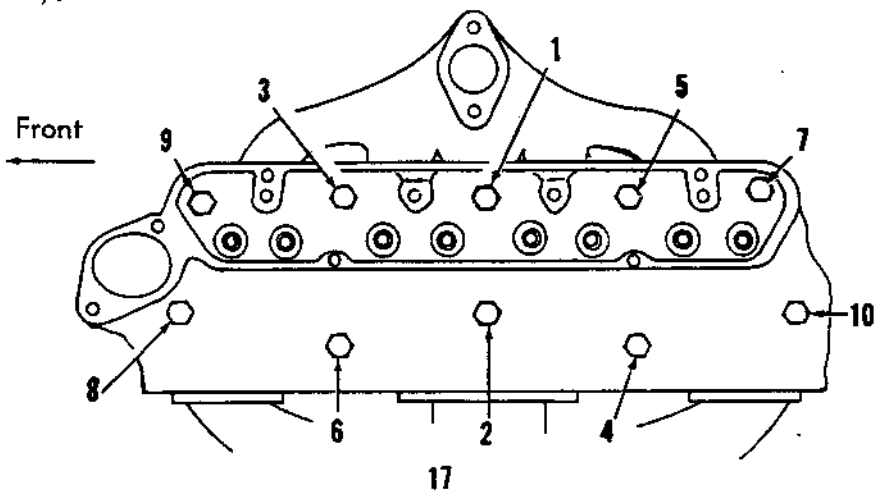
During the compression test, if the pressure fails to climb steadily and remains the same during the first two successive strokes, but climbs higher on the succeeding strokes, or fails to climb during the entire test, it indicates a sticky or stuck valve.

CHECKING ALL BOLT AND NUT TIGHTNESS

Check all nuts and bolts for correct torque. The various torque specifications are listed in the Specifications section of this manual.

TIGHTENING CYLINDER HEAD TORQUE

The cylinder head bolts are tightened in three progressive steps, starting with the center bolts and working outward (see illustration). Tighten all bolts working out to 20-30 ft lb (27-41 Nm) then to 50-55 ft lb (68-75 Nm), and finally 65-70 ft lb (88-95 Nm).



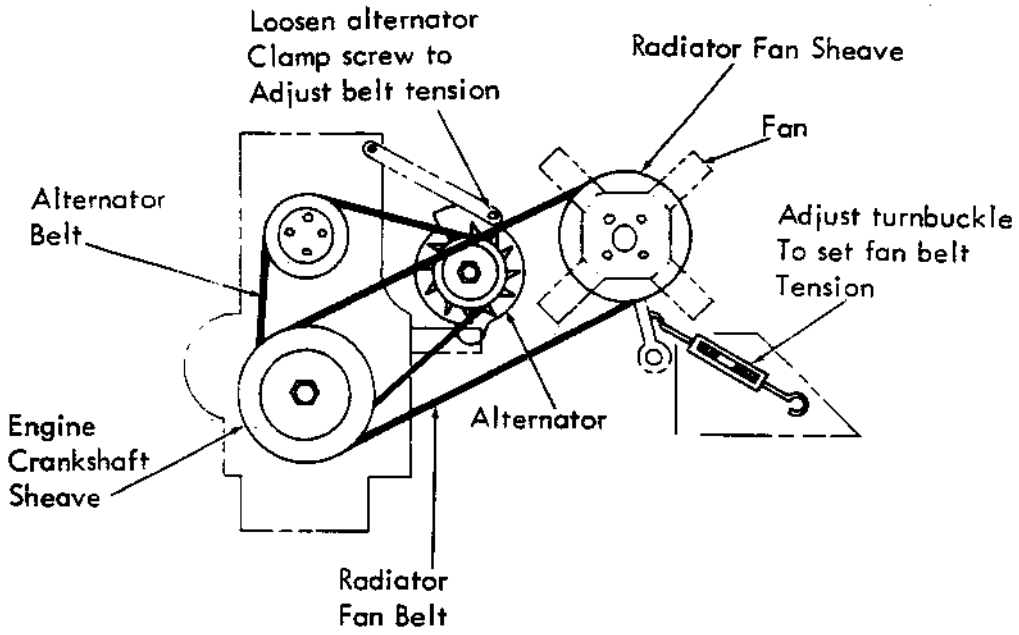
MINOR REPAIRS AND ADJUSTMENTS

ALTERNATOR BELT TENSION

Loosen adjusting screw on alternator and pull out on alternator to tighten belt. When adjusted correctly, the belt should have about 0.09 in (2.4 mm) deflection from 7 to 10 lbs (3.2 to 4.5 kg) force applied at midpoint on top span (see sketch below).

RADIATOR FAN BELT TENSION

Deflection should be 0.25 in (6.4 mm) from one to two lbs (0.45 to 0.9 kg) force. Adjust by means of turnbuckle. (see sketch).



CHECKING INTAKE MANIFOLD VACUUM

Operate the engine at 1200 rpm until normal operating temperature is reached. Install an accurate vacuum gauge on the intake manifold vacuum line or on the fitting in the intake manifold. Operate the engine at idle rpm with the load disengaged. Compare the vacuum reading to the conditions defined in the Manifold Vacuum Gauge Readings chart as shown on the next page:

MINOR REPAIRS AND ADJUSTMENTS

MANIFOLD VACUUM GAUGE READINGS

Gauge Reading (Inches Hg)	Engine Condition
16	Normal
Low and steady.	Loss of power in all cylinders caused possibly by late ignition or valve timing, or loss of compression due to leakage around the piston rings.
Very low.	Manifold, carburetor, or cylinder head gasket leak.
Needle fluctuates steadily as speed increases.	A partial or complete loss of power in one or more cylinders caused by: a leaking valve; cylinder head or intake manifold gasket leak; a defect in ignition system; or a weak valve spring.
Gradual drop in reading at engine idle.	Excessive back pressure in the exhaust system.
Intermittent fluctuation.	An occasional loss of power possibly caused by a defect in the ignition system or a sticking valve.
Slow fluctuation or drifting of the needle.	Improper idle mixture adjustment, carburetor or intake manifold gasket leak.

Don't jump to conclusions when analyzing an abnormal vacuum reading, because abnormal gauge readings may indicate more than one factor. These factors are: carburetor adjustment; valve timing; condition of the valves; cylinder compression; and leaks at the intake manifold, carburetor or cylinder head gaskets. For example, if the vacuum gauge reading is low, the correction of one item may not increase the vacuum reading enough to indicate the problem has been corrected. Therefore each item related to an abnormal reading should be investigated, and further tests conducted if necessary, to be sure the problem has been diagnosed and corrected. NOTE: The engine vacuum will decrease with an increase in altitude. Therefore, make allowance for the effect of your altitude on the vacuum gauge reading. Those readings suggested in the chart are for sea level.

SERVICING SPARK PLUGS

ATTENTION! Plugs on a constant-speed engine are more subject to fouling. Check often.

Do Not pull the spark plug wire. Pry the protective boot from the spark plug and then pull the boot.

Remove the spark plug with a spark plug socket. Inspect the spark plug for a damaged insulator, fouling and excessive electrode erosion. Test the plug and clean with sand-blasting equipment, if desired. Gap the plug to 0.026 in (0.66 mm) with a wire gauge. Install the spark plug and torque to 22-28 ft lb (30-38 Nm). Wipe away any oil, grease , or dirt from the outside of the plug and the plug wire or boot. Connect the plug wire to the plug and firmly press the protective boot over the plug.

MINOR REPAIRS AND ADJUSTMENTS

VALVE CLEARANCE ADJUSTMENTS

To check valve clearances rotate the crankshaft until number 1 valve is completely depressed. Valves are numbered from 1 to 8 with number 1 closest to the radiator. Number 8 will be farthest away.

NOTE To rotate the crankshaft, place a rag around the fan blade and turn the fan clockwise. If you cannot rotate the crankshaft with the fan, place a 0.63 in (16 mm) open end wrench on the crankshaft damper attaching bolt and turn bolt clockwise.

When number 1 valve is depressed valves 3 and 8 can be adjusted. Insert a go-nogo feeler gauge between the rocker arm and the valve. If the clearance is incorrect, use a 0.44 in (11 mm) box-end wrench and turn the adjustment in or out as required to obtain the specified clearance. Do not use an open-end wrench.

1600 cc ENGINE – SET HOT

Valve Depressed	Valves to Adjust to .010	.017
No. 1	No. 3	No. 8
No. 2	No. 7	No. 5
No. 3	No. 6	No. 1
No. 5	No. 2	No. 4

Valve Clearance Chart

IDLE FUEL MIXTURE AND IDLE SPEED ADJUSTMENTS

To adjust the idle fuel mixture and idle speed proceed as follows:

1. Operate the engine at a fast idle speed until normal operating temperature is reached.
2. Disengage engine load.
3. Set throttle at minimum speed. Be sure the throttle linkage does not control idle speed. The idle speed adjustment screw must be contacting the throttle lever.
4. Adjust the idle speed adjusting screw to obtain specified engine idle rpm. (See "Tune-up Chart")
5. Turn the idle mixture adjustment screw inwards until the engine speed begins to drop due to the lean mixture. Turn the screw outward until the engine speed begins to drop due to a rich mixture. Then turn the screw inwards between these two extremes for maximum engine smoothness and rpm.
6. If necessary, readjust idle speed screw to obtain specified idle rpm.

Engine Storage

The following instructions are applicable to the storage of a new or used engine.

FOR ONE MONTH

1. Run the engine at 1500 rpm and treat the upper cylinders by spraying an engine preservative oil (SAE 10) into the carburetor air intake for about two minutes. Open the throttle for a short burst of speed, then shut off the the ignition and allow the engine to come to a stop while continuing to spray the oil into the carburetor air intake. Disconnect and remove battery.

2. Leave the spark plugs installed and cover all engine openings with dust-proof caps or shields.

3. Drain the oil, water and gasoline.

4. Spray the flywheel and ring gear with a 1-1 mixture of an anti-rust bodied oil and Stoddard Solvent.

FOR INDEFINITE PERIOD

1. Drain the crankcase completely and refill with an engine preservative oil (SAE 10).

2. Run the engine until it is completely out of gasoline, then restart and run it on an unleaded, undyed gasoline for at least 10 minutes. Run the engine at 1500 rpm and treat the upper cylinders by spraying an engine preservative oil (SAE 10) into the carburetor air intake for about two minutes. Open the throttle for a short burst of speed, shut off the ignition and allow the engine to come to a stop while continuing to spray the oil into the carburetor air intake.

3. Disconnect and remove battery.

4. Drain the oil, and gasoline. Drain the water at the bottom of the radiator and both sides of the block.

5. Remove all grease and oil from the exterior surfaces of the engine.

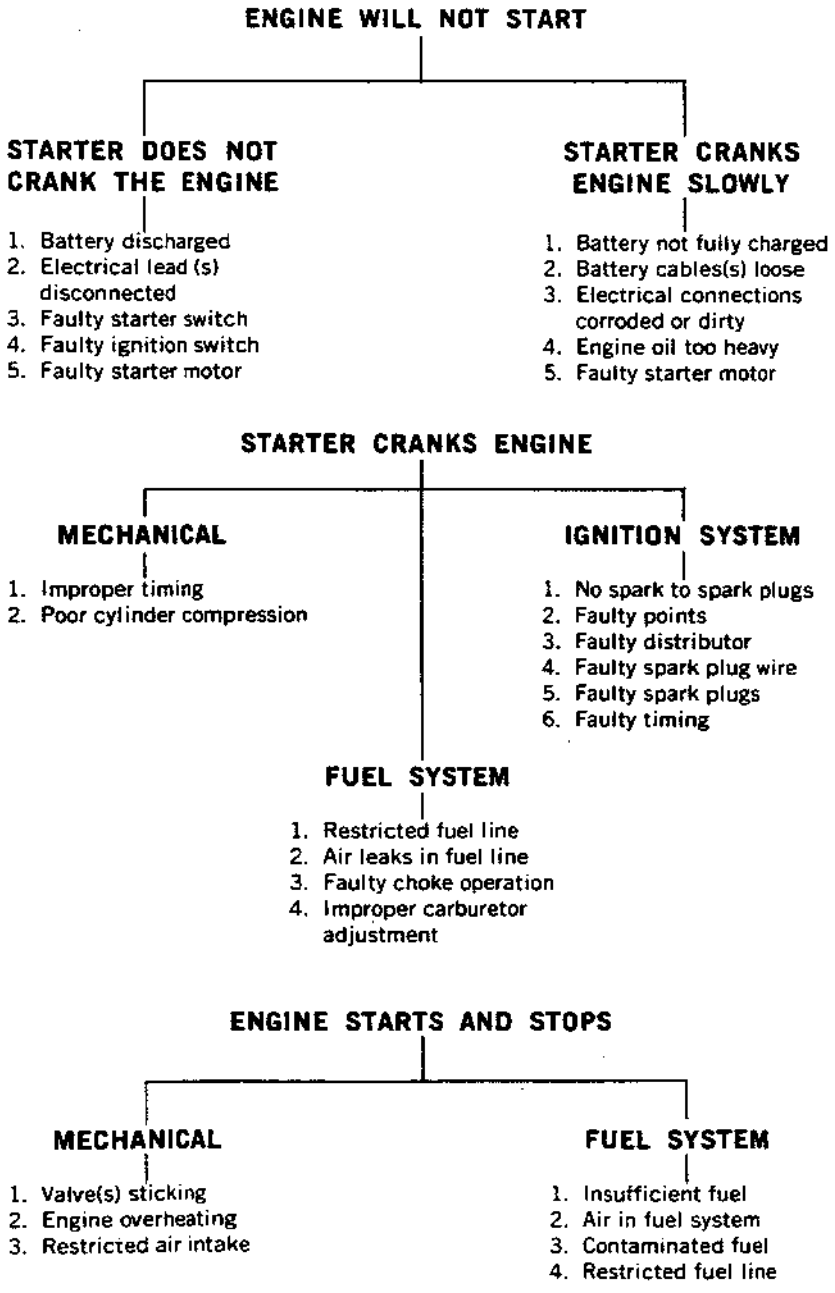
6. Leave the spark plugs installed.

7. Seal all engine openings and accessories with water resistant adhesive tape. Mask off all areas to be used for electrical contact.

8. Make sure all surfaces are dry, then spray all taped openings, all engine accessories including ignition wiring, and all exterior surfaces of the engine with an ignition insulation compound.

TROUBLE SHOOTING

The following diagnosis guides will assist you to quickly isolate the probable cause(s) of engine difficulty.



DIAGNOSIS GUIDE

ROUGH ENGINE IDLE

MECHANICAL

1. Sticking valve(s)
2. Broken valve spring
3. Incorrect valve timing
4. Incorrect ignition timing

FUEL SYSTEM

1. Insufficient fuel
2. Air in fuel system
3. Dirty carburetor
4. Improper idle speed stop screw adjustment

ENGINE MISFIRES

MECHANICAL

1. Valve(s) sticking
2. Piston ring(s) sticking
3. Ignition timing off
4. Faulty spark plugs
5. Improper valve timing

FUEL SYSTEM

1. Air in fuel system
2. Contaminated fuel
3. Improper carburetor adjustment

ENGINE DOES NOT GIVE FULL POWER

MECHANICAL

1. Restricted air intake
2. Low coil voltage
3. Improper point dwell or gap
4. Faulty ignition timing
5. Worn or bent push rods
6. Faulty valve(s)
7. Improper valve timing
8. Blown or burned head gasket
9. Low cylinder compression

FUEL SYSTEM

1. Carburetor out of adjustment
2. Contaminated fuel
3. Air in fuel

DIAGNOSIS GUIDE

ENGINE OVERHEATS

MECHANICAL

1. Insufficient oil in crankcase
2. Fan belt loose or broken
3. Internal engine leakage
4. Exhaust gas leakage into cooling system
5. Cylinder head gasket improperly installed
6. Extended engine idling

COOLING SYSTEM

1. Insufficient water in cooling system
2. Plugged radiator
3. Thermostat stuck
4. Faulty water pump
5. Radiator leaking
6. Air in cooling system
7. Hot spots in engine due to poor coolant circulation

ENGINE KNOCKS

MECHANICAL

1. Excessive crankshaft end play
2. Flywheel runout is excessive
3. Excessive connecting rod or main bearing clearance
4. Bent or twisted connecting rod
5. Crankshaft journals out-of-round
6. Excessive piston-to-cylinder bore clearance
7. Excessive piston ring slide clearance
8. Broken rings
9. Excessive piston pin clearance
10. Piston pin retainer loose or missing
11. Excessive camshaft end play
12. Worn timing gear teeth
13. Excessive timing gear backlash
14. Valve rocker (s) sticking
15. Valve spring broken

LUBRICATION SYSTEM

1. Diluted or thin oil
2. Insufficient oil supply
3. Low oil pressure

Specifications

GENERAL

Compression Ratio	8.0:1
Bore and Stroke	3.188x3.056
Oil Pressure – Hot @ 2000 R.P.M.	35-60
Firing Order	1-2-4-3
Belt Tension (Ft-Lbs (All belts)	New 140, Used 110
Compression Pressure PSI (Sea Level)	
at Cranking Speed	Lowest 75% of Highest

CYLINDER HEAD

Combustion Chamber Volume	Combustion Chamber in Piston
Valve Guide	
Bore Diameter (Standard Intake and Exhaust)	0.3113-0.3125
Valve Seat Width	
Intake	0.050-0.065
Exhaust	0.070-0.085
Valve Seat Angle	45^{o}
Valve Seat Runnout (Maximum)	0.002
Valve Arrangement (Front in Rear)	EIIEEIIE
Gasket Surface Flatness	
(Head Gasket Surface Finish R M S)	0.0015 in any 12 inches

VALVE ROCKER ARMS, ROCKER ARM SHAFT, PUSHRODS AND TAPPETS

Rocker Arm Shaft O D	0.623-0.624
Rocker Arm to Rocker Shaft Clearance	
Wear Limit 0.0060	0.001-0.0035
Rocker Arm Bore Diameter	0.6250-0.6265
Rocker Arm Follower Ratio	1.54:1
Valve Push Rod (Maximum Runout)	0.012
Valve Tapper	
Standard Diameter	0.5150-0.5155
Clearance To Bore (Wear Limit 0.005)	0.0005-0.002

VALVE SPRINGS

Valve Spring Pressure	
Lbs. at Specified Lenght Pressure	47.5-52.5 at 1.263
Wear Limit	.42 at 1.63
Intake 117.5-127.5 at .957 – Wear Limit	.104 at .957
Exhaust 117.5-127.5 at .954 – Wear Limit	.104 at .954
Valve Spring Free Length Approximate	1.48
Valve Spring Assembled Height Pad to Retainer	1.263
Valve Spring Out-of-Square (Maximum)	1/16

SPECIFICATIONS

VALVES

Valve Stem to Valve Guide Clearance
Intake 0.008-0.0027
Exhaust 0.0017-0.0036
Valve Stem to Rocker Arm or Follower to Cam Clearance
Intake . . . . . 0.010 Hot
Exhaust . . . . . 0.017 Hot
Valve Head Diameter
Intake 1.502
Exhaust 1.239
Face Angle . . . . . 44°
Valve face runout . . . . . Maximum 0.0020
Standard Valve Stem Diameter
Intake 0.3098-0.3105
Exhaust 0.3089-0.3096
Valve Stem Diameter 0.003 Oversize
Intake 0.3128-0.3135
Exhaust 0.3119-0.3126
Valve Stem Diameter 0.015 Oversize
Intake 0.3248-0.3255
Exhaust 0.3229-0.3246
Valve Stem Diameter 0.030 Oversize
Intake 0.3398-0.3405
Exhaust 0.3389-0.3396

CAMSHAFT

Lobe Lift
Maximum allowable lobe lift loss 0.005
Intake 0.2108
Exhaust 0.2176
Theoretical Valve Lift at Zero Lash
Intake 0.2967
Exhaust 0.3199
Camshaft
End Play 0.0025-0.0075
Wear Limit 0.009
Camshaft Journal to Bearing Clearance 0.0010-0.0023
Wear Limit 0.006
Timing Chain Deflection (Maximum) 0.500
Camshaft Journal Diameter
Standard Nos. 1,2,3 Bearing 1.5597-1.5605
Camshaft Bearings Inside Diameter
Bearing Nos. 1,2,3 . . . . . 1.5615-1.5620
Camshaft Bearings Location No. 1 Bearing 0.010
Distance in inches that the front edge of the bearing is installed towards the rear from the front face of the cylinder block.
Camshaft Journal Maximum Runout 0.003
Camshaft Journal Maximum Out-of-Round 0.003
Camshaft Valve Timing Events
Intake Valve Opens (BTDC) . . . . . 0.010 @ 17°
Intake Valve Closes (ABDC) . . . . . 0.010 @ 51°

Exhaust Valve Opens (BBDC)	.017 @ 51°
Exhaust Valve Closes (ATDC)	.017 @ 17°

CYLINDER BLOCK

Cylinder Bore Diameter	3.1869-3.1893
Maximum out of round	0.0015
Wear Limit	0.005
Cylinder Bore surface finish RMS	15-35
Maximum Taper	0.001 in 6 inches
Wear Limit	0.010
Tappet Bore Diameter	0.516-0.517
Main Bearing Bore Diameter	2.2710-2.2715
Head Gasket Surface Flatness	.003 in 6"
	0.006 overall
Head gasket surface finish RMS	120 Max.

CRANKSHAFT AND FLYWHEEL

Main Bearing Journal Diameter	2.1253-2.1261
Main Bearing Journal Out-of-Round Maximum	0.0004
Main Bearing Journal Runout-Maximum	0.002
Main Bearing Journal Thrust Face Runout	0.001
Main Bearing Journal Taper Max	0.0003
Thrust Bearing Journal Length	1.247-1.249
Main Bearing Surface Finish RMS Maximum	
Journal	12
Thrust Face	20
Connecting Rod Journal Diameter	1.9368-1.9376
Connecting Rod Bearing	
Journal Maximum Taper	0.0003
Crankshaft Free End Play	0.003-0.011
Flywheel Clutch Face Runout	0.005
Flywheel OD Runout	0.025

CRANKSHAFT BEARINGS

Connecting Rod Bearings	
To Crankshaft Clearance – Desired	0.0004-0.0015
To Crankshaft Clearance – Allowable	0.0004-0.0024
Wall Thickness Standard	0.0719-0.0722
0.002 U.S. Thickness Add 0.001 to Standard Thickness	
Main Bearings	
To Crankshaft Clearance – Desired	0.0005-0.0015
To Crankshaft Clearance – Allowable	0.0005-0.0016
Wall Thickness Standard	0.0719-0.0724
0.002 U.S. Thickness Add 0.0010 to Standard Thickness	

CONNECTING ROD

Piston Pin Bore or Bushing ID	0.8121-0.8125
Connecting Rod Bearing Bore Diameter	2.0825-2.0830

Connecting rod bearing bore maximum out-of-round and taper . 0.0004
Connecting Rod Length Center to Center 4.965-4.9295
Connecting Rod Alignment Maximum Total Difference
Twist 0.004
Bend 0.004
Pin bushing and crankshaft bearing bore must be parallel and in the same vertical plane within the specified total difference at ends of 8-inch long bar measured 4 inches on each side of rod.
Connecting Rod Assembly
(Assembled to Crankshaft) Side Clearance 0.004-0.010

PISTON

Standard Diameter 3.1853-3.0874
Measured at 2.25 in. below dome and at 90° to the pin bore.
Piston To Cylinder Bore Clearance
No. 1,2, & 3 Bore 0.0016-0.0022
No. 4 Bore 0.0019-0.0024
Piston Pin Bore Diameter 0.8117-0.8121
Ring Groove Width
Upper Compression Ring 0.0615-0.0625
Lower Compression Ring 0.0796-0.0806
Oil Ring 0.1578-0.1588

PISTON PIN

Length 2.800-2.810
Diameter – Standard 0.8119-0.8123
To Piston Clearance 0.0001-0.0003
Wear Limit 0.0008
To Connecting Rod Bushing Clearances ..... .0.0001-0.0003 (Loose)

PISTON RINGS

Ring Width Compression Ring Bottom 0.077-0.078
Side Clearance Compression Ring Bottom 0.0016-0.0036
Side Clearance Oil Ring 0.0018-0.0038
Wear Limit 0.006
Ring Gap Width Compression Ring Bottom 0.009-0.014
Ring Gap Width – Oil Ring 0.009-0.014

OIL PUMP

Rotor Type Oil Pump Relief Valve
Spring Tension Lbs. @ Specified Length ..... 7.5-8.5 @ 1.04
Drive Shaft To Housing Bearing Clearance 0.0015-0.003
Relief Valve Clearance 0.001-0.003
Rotor Assembly End Clearance 0.001-0.004
Outer Race To Housing (Radial Clearance) 0.005-0.0075

APPROXIMATE OIL PAN CAPACITIES

Includes 1/2 quart with filter replacement
U.S. Measure ..... 3.5 Qt.
Imperial Measure 2-7/8

SPECIFICATIONS

TORQUE SPECIFICATIONS

ITEM	THREAD SIZE	TORQUE FT.LB
Camshaft Sprocket to Camshaft Bolt	5/16 18 UNC	12-15
Camshaft Thrust Plate Bolts	1/4 20 UNC	2.5-3;5
Connecting Rod Bolts	3/8 24 UNF	30-35
Cylinder Head Bolts		
Step One		5
Step Two		20-30
Step Three		50-55
Step Four		65-70
Crankshaft Pulley Bolt	7/16 20 UNF	24-28
Crankcase Ventilation Adaptor to Manf.	1/4-18 NPTF	8-12
Cyl. Front Cover Bolts	1/4-20 UNC	5-7
Clutch Pressure Plate to Flywheel	5/16-18 UNC	12-15
Carburetor Attaching Nuts	5/16-24 UNF	12-15
Chain Tension Support to Cyl. Block	1/4-20 UNC	5-7
Distributor to Cyl. Block	1/4-20 UNC	5-7
Distributor Clamp	1/4-20 UNC	25-30 IN-LB
Exhaust Manifold to Cylinder Head Studs	5/16-18 UNC	9-12
Exhaust Manifold to Cylinder Head Nuts	5/16-24 UNF	15-18
Separator Clamping Bolt	1/4-20 UNC	6-9
Fan to Hub	M8	Metal 5-7 Plastic 7-9
Flywheel to Crankshaft Bolts	3/8-24 UNF	50-55
Fuel Pump to Cyl. Block	5/16-18 UNC	12-15
Fuel Pump Outlet Connection Assy.	1/2-20 UNF	8-10
Alternator Mounting to Cyl. Block Bolts	3/8-18 UNC	20-25
Intake Manifold to Cyl. Head Bolts	5/16-18 UNC	12-15
Intake Manifold to Cyl Head Nuts	5/16-24 UNF	12-15
Intake Manifold to Cyl. Head Studs	5/16-18 UNC	9-12
Main Bearing Cap Bolts	7/16-14 UNC	65-70
Manifold Vacuum Connector	1/4-NPTF	8-12
Oil Pump to Cyl Block	5/16-18 UNC	13-15
Oil Filter Center Bolt	3/8-24 NPTF	12-15
Oil Gallery (Main)	1/4-18 NPTF	18-22
Oil Gallery (Transverse)	1/8-27 NPTF	9-11
Oil Sender Unit to Block	1/4-18 NPTF	9-11
Oil Drain Plug	1/2-20 UNF	20-25
Oil Pan to Cyl. Block Bolts		
Step One		Finger Tighten Corner Bolts
Step Two		Tighten All Bolts Sufficiently to Clamp Gasket
Step Three		6-8

TORQUE SPECIFICATIONS—CONT'D

ITEM	THREAD SIZE	TORQUE FT.LB
Oil Pump Cover to Oil Pump Bolts	1/4-20 UNC	5-7
Rear Oil Seal Retainer to Cyl Block	5/16-18 UNC	12-15
Rocker Cover to Cyl. Head Screws	1/4-20 UNC	2.5-3.5
Rocker Shaft Support Bolt	3/8-16 UNC	25-30
Spark Plug to Cyl. Head	14MMx1.25MM	22-28
Lifter Adjuster Self Lock Screws	SPECIAL	10-25
Temp. Sender Unit To Head	1/8-27 NPTF	9-11
Water Jacket Drain Plug	1/4 NPTF	12-15
Water Outlet Connection to Cyl. Head	5/16-18 UNC	12-15
Water Pump to Cyl. Block	1/4-20 UNC	5-7
Water Pump to Cyl. Block	5/16-18 UNC	12-15
Vacuum Adaptor to Intake Manifold	1/8-27 NPTF	4-5
Oil Filter		1/2 turn after initial seating

BOLTS & NUTS	TORQUE FT.LB.
1/4-20	5-7
5/16-18	12-15
5/16-24	12-15
3/8-16	17-22
3/8-24	22-27
7/16-14	30-35
7/16-20	40-45
1/2-13	45-50
1/2-20	50-60
9/16-12	60-70
9/16-18	65-75
5/8-11	75-85
5/8-18	100-110

For non-critical and not otherwise mentioned applications, the above general assembly torques will apply.

Lube Oil Specifications

LUBE OIL SPECIFICATIONS

Ford Motor Company lubricant recommendations are based on experience with current lubricants of various types and give consideration to the commercial lubricants presently available.

Ford industrial engines have given optimum performance and experienced the longest service with oils which meet Ford Specification ESE-M2C101-C for gasoline and ESN-M2C121-A for diesel engines. Contact a reliable oil supplier and obtain his assurance that his product has been tested and given good performance in Ford industrial engines. You may wish to request the oil supplier to show the performance results of his product in Ford industrial engines.

Operators should be urged to use the highest viscosity oil compatible with their requirement for cold starting, e.g., when 80° F+ ambients prevail, a 10W-40 oil should not be used for severe service; instead, 20W-40 or SAE-30 minimum should be used. For temperatures consistently between 32° and 80° F however, that recommendation should now be modified to exclude multi-viscosity oils and to specify the use of SAE-30 only. Units that are subjected to oil temperatures of 270° F or higher for a sustained period of time are prone to rapid oxidation of their engine lubricating oils. Oxidation from heat will eventually turn the lubricating oil into a gell-like substance. When this occurs, lubrication of components ceases - engine fails.

It is recommended that new engines be started with 50-hour oil change periods. The drain interval may then be gradually increased, or decreased with experience on a specific lubricant while also considering the recommendations of the oil change period for the particular service has been established.

Solvents should not be used as flushing oils in running engines. Dilution of the fresh refill oil supply can occur which may be detrimental.

Heavy sludge deposits found on the oil filter elements at the time of oil change must be taken as an indication that the detergency of the oil has been exhausted. When this occurs, the oil drain interval should be shortened. Since abrasive dust, metal particles and carbon material accumulate in the lubricating oil during engine operation, the oil filter elements must be replaced each time the oil is changed. It is recommended that only oil filters that meet Ford Specification ESE-C8AF-6714A, or C be used. Oil filters that state on the filter or container that they are acceptable for engine manufacturer's warranty coverage replacement are acceptable to Ford Industrial Engine and Turbine Division.

The importance of adhering to the foregoing recommendation - particularly in service applications - cannot be over-emphasized. Operators should be cautioned that failure to adhere to Ford Lubrication system recommendations can void their warranty coverage.