



Electronic Service Manuals

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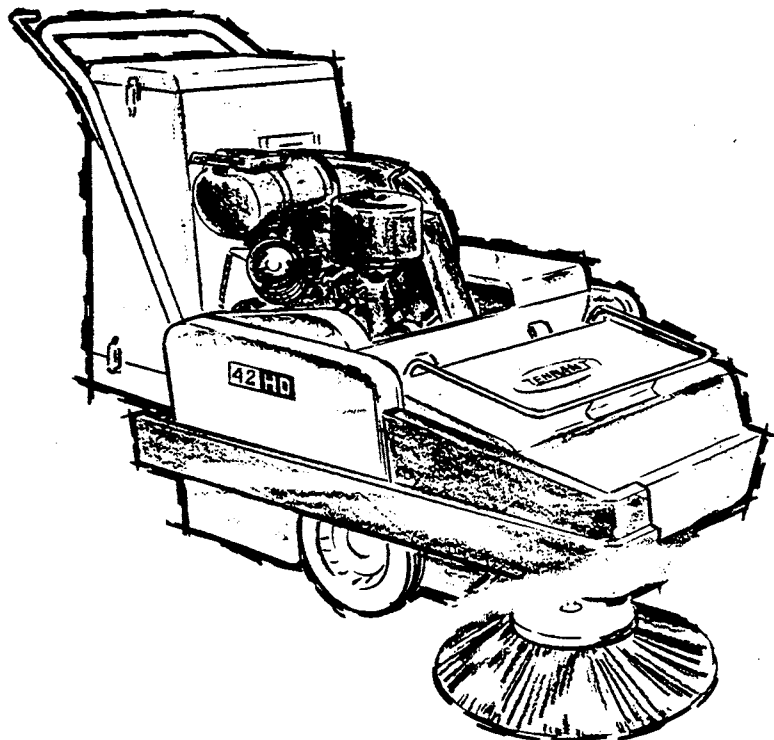
MM078

2-86

42HD

POWER SWEEPER

Operation, Maintenance, and Parts Manual



SPECIALIZED MAINTENANCE EQUIPMENT

SWEEPERS • SCRUBBERS • SCARIFIERS • FLOOR COATINGS



42HD

POWER SWEEPER

This manual is furnished with each new TENNANT® Model 42HD. 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 symbols are used throughout this manual as indicated in their descriptions:

- | | |
|-------------------|--|
| ▲ DANGER | To warn of immediate hazards which will result in severe personal injury or death. |
| ▲ WARNING | To warn of hazards or unsafe practices which could result in severe personal injury or death. |
| ▲ CAUTION | To warn of hazards or unsafe practices which could result in minor personal injury. |
| ATTENTION! | To warn of unsafe practices which could result in extensive equipment damage. |
| NOTE | To give important information or to warn of unsafe practices which could result in equipment damage. |

The following information signals potentially dangerous conditions to the operator or equipment. Read this manual carefully. Know when these conditions can exist. 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.
- ⚠ CAUTION** Disconnect positive battery terminal before removing instrument panel.
- ATTENTION!** Observe these limitations when operating on grades.
Maximum Rated Ramp Angles: Climbing Descending

15° 7°

GENERAL INFORMATION

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SECTION 1

SPECIFICATIONS

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MACHINE SPECIFICATIONS

STANDARD MODEL 42HD

GENERAL INFORMATION

SWEEPING PATH 34" (864 mm)

SWEEPING SPEED 0-3 mph (0-4.8 km/hr)

DIMENSIONS Length: 65.50" (1664 mm) (overall)
 Width: 34.25" (876 mm) with side brush
 Height: 38.50" (978 mm)

WEIGHT Net, complete with side brush and
 battery: 420 lb. (191 kg). Shipping weight, with side brush and
 battery: 475 lb. (216 kg).

STANDARD EQUIPMENT Shipped with one 17" (432 mm) dia. synthetic fiber side brush. 12-volt, 24 amp hour battery. Electric filter shaker, wrap-around side brush bumper.

MECHANICAL DATA

FRAME 11 gauge (3 mm) welded steel plate. Reinforced stress points.

ENGINE Kohler, electric start, 8 h.p. (6 kw) single cylinder, dust protected 4 cycle air-cooled engine. Heavy-duty industrial type with cast iron cylinder and crankcase. Built in sealed flywheel alternator. 1 gallon (3.8 liter) gas tank.

Special dust-protection features:

- . Totally enclosed electric starter
 - . Air cleaner dry type, extra large for extra duty
 - . Automotive type ignition
 - . Stellite exhaust valve and rotator
 - . Float feed (automotive-type) carburetion
 - . Precision oil-bathed fly-wheel governor with external adjustment
- LP machine includes horizontal vapor withdrawal, 20 lb. (9.1 kg) ICC tank and Rego fittings.

BATTERY 12-volt, 24 amp hour lead acid battery. Steel cover plate.

DRIVES Propelling drive to front wheels through roller chains from belt driven differential countershaft. Main brush drive and vacuum fan are belt driven.

MAIN BRUSH 26" (660 mm) tubular, one-piece disposable unit with hard fiber core; 10" (254 mm) outside diameter; 2.50" (63mm) long bristles arranged in curved row. Available in various bristle combinations. Convenient hand lever raises, lowers brush. Adjustable brush down pressure. Entire brush mount is full-floating for sweeping uneven surfaces. Time needed to change brush: 1 minute. (Main brush not included with the sweeper).

STANDARD MODEL 42 HD SPECIFICATIONS (CONTINUED)

BRUSH COMPARTMENT	Encloses main brush. Heavy 11 gauge (3 mm) sheet steel, rigidly braced. Hinged door on left for easy access to brush. Reinforced rubber skirting seals compartment to prevent escape of turbulent dust.
SIDE BRUSH	Engine driven, rotary, disposable type, 17" (432 mm) dia. synthetic fiber. V-Belt brush drive engages automatically when brush arm is lowered into "operation" position.
FILTER AREA & VACUUM CONTROL	Enclosed type filter system includes multiple dust filter envelopes to provide a total filtering area of 5,000 sq. inches (3.22 sq. m). High volume - low pressure, 9" (229 mm) diameter, belt driven fan. Filters cleaned by one electric filter shaker motor.
DIRT HOPPER	3.2 cubic feet (.09 cu. m); holds up to 150 lb. (68 kg) of soilage. Heavy steel construction with spill-resistant opening; fits snugly into brush compartment. Balanced hopper "floats" easily over humps and other irregularities. Neoprene rubber lip forms seal to floor, increasing effectiveness of vacuum dust control. Hopper pivots in machine for easy dumping, or it can be lifted out for dumping when desired.
STEERING	Bail type handle
CONTROLS	All within easy reach of operator. Press down on rod to engage clutch and move forward. Automatic safety feature disengages drive when operator releases rod. In addition, these controls are provided: throttle control, ignition switch, starter button, brush lift handle, and filter shaker switch.
BEARINGS	All rotating parts are equipped with anti-friction bearings and are either prelubricated shielded and sealed, or are provided with grease fittings for periodic flushing to remove foreign materials.
TIRES	Front: 10" x 2.00" (254 mm x 51 mm) heavy-service zero pressure (2). Rear: 5" x 1.50" (127 mm x 38 mm) caster type.
OPTIONAL EQUIPMENT	L.P. Gas system, Engine hour meter, protectoseal gas cap, Scrubber attachment.

SCRUB ATTACHMENT SPECIFICATIONS

GENERAL INFORMATION

SCRUBBING PATH	with Side Scrubbing Brush: 30" (762 mm) without Side Scrubbing Brush: 26" (660 mm)	
SCRUBBING SPEED	Variable - 0 to 3 mph (0.4-8 km/hr)	
DIMENSIONS	<u>Attachment Only</u>	<u>Sweeper and Attachment</u>
	Length: 19 (482 mm)	55" (140 mm)
	Width: 31.50" (800 mm)	35" (890 mm)
	Height: 26.50" (673 mm)	38" (965 mm)
WEIGHTS	Tanks, Front and Rear Squeegee Assemblies	104 lbs. (47.2 kg)
	Dolly for Removing Tanks	15 lbs. (6.8 kg)
	TOTAL	119 lbs. (54 kg)
STANDARD	Shipped complete with Stainless Steel Solution and Recovery Tanks, Water Spreader Tube with Flow Control, Removable Pick-Up Tray for Collecting Debris, Side Brush Right Angle Reducer, Rear and Side Squeegee Assemblies, Main and Side Scrubbing Brushes.	
	<u>MECHANICAL DATA</u>	
SOLUTION TANK	14.5 gallon (55 liter) capacity, 16 gauge stainless steel, all welded construction.	
RECOVERY TANK	17.5 gallon (66 liters) capacity. 16 gauge stainless steel, all welded construction. Flexible 24" hose permits convenient dumping in floor drain. Water tight door on side of tank can be opened to clean out sludge.	
SCRUBBING BRUSHES	Main brush: Cylindrical, 26" (660 mm) long, 8" (203 mm) diameter. Polypropylene fiber 1.50" (38 mm) bristle. Side Brush: Disc type, 10" (254 mm) diameter, Polypropylene fiber.	
SQUEEGEES	Rear: 35" (890 mm) wide, "V" type. Self energizing action. Front: (Side Brush) self-energizing action. Directs water into path of rear squeegee.	
VACUUM PICK-UP	Flexible tube connects to center of rear squeegee and recovery tank. Fluid is drawn through the tube to the tank. A second vacuum tube draws fluid from tray to recovery tank.	
CONTROLS	Solution Tank: Flow regulated by push-pull control located on side of filter box. Rear Squeegees: Raised and lowered by foot pedal.	

ENGINE SPECIFICATIONS

MAKE	KOHLER
MODEL	K1815
SPECIFICATION NUMBERS	30560D - Gas & 30561D - LPG
NUMBER OF CYLINDERS	1
DISPLACEMENT (cubic inches)	18.6 (305 cc)
BORE (nominal)	2 - .937" (74.6 mm)
STROKE (nominal)	2 - .75" (70 mm)
WEIGHT (approximate)	63 lbs. (28.6 kg)
OIL CAPACITY	1 qt. (.95 liters)
RECOMMENDED OIL	API Type SC Detergent
SPARK PLUG GAP	Gasoline: .025" (.635 mm) LPG: .018" (.457 mm)
SPARK PLUG TYPE	J - 8 or equivalent
BREAKER POINT GAP	.020" (.508 mm)
ALTERNATOR	15 - amp, Flywheel Type

Torque Specifications:

Governor Arm Lock Screw	35 in. lbs. (4 Nm)
Cylinder Head (Lubricate with oil at assembly)	15 - 20 ft. lbs. (20 - 27 Nm)
Connecting Rod (Lubricate with oil at assembly)	200 in. lbs. (23 Nm)
Flywheel Nut	50 - 60 ft. lbs. (68 - 81 Nm)
Spark Plug	18 - 22 ft. lbs. (24 - 30 Nm)

SECTION 2 OPERATION

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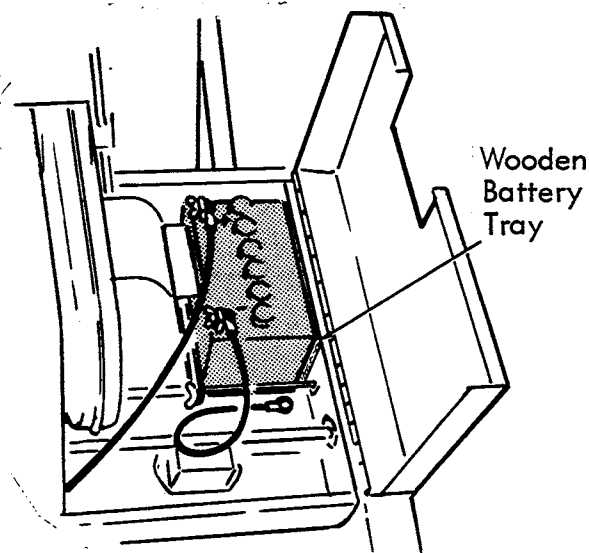
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PREPARATION FOR OPERATION

DO NOT attempt to operate machine without following these instructions:

1. Uncrate the machine and install battery, attaching cables (negative ground) as shown in sketch. Use the hardware provided in plastic bag in battery compartment.

- a. Place wooden battery pad between battery and side of the machine.
- b. Slide the two 0.25" - 20 x 6.50" bolts through side of the machine. Attach the 0.19" clamping bar, using the two 0.25" - 20 wing nuts. Tighten securely.
- c. Attach battery cables, using two 0.25" - 20 x 0.75" bolts, four 0.25" - 20 flat washers, two 0.25" - 20 lock washers, and two 0.25" wing nuts.



BATTERY INSTALLATION

2. Fill tank with Regular Grade gasoline. (Use leaded or non-leaded).

⚠ 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.

NOTE For LPG machine, see "LPG" Section.

3. Check engine crankcase oil level. Although properly lubricated at factory, check before starting. Engine oil capacity is one quart. Use oil with API classification "SC" for air temperatures above 30°F (-1.1°C)
4. Check to be sure that air cleaner unit is mounted securely to carburetor. This will prevent loosening and resulting air leakage. Regular inspection of air cleaner after each 8 hour shift will prevent undue wear to internal engine components.
5. Install main sweeping brush.
6. Install and adjust the height of the side sweep brush, using one 0.25" - 20 x 1.25" filister screw, one 0.25" - 20 lock washer, and one 0.25" wing nut. This hardware is also provided in the plastic bag.

OPERATION OF CONTROLS

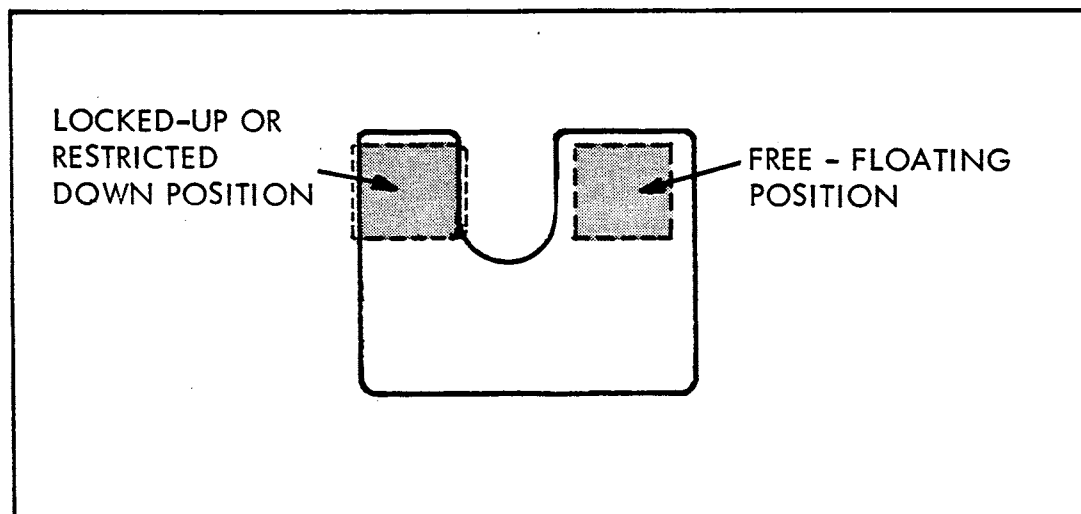
CLUTCH CONTROL

To Engage Clutch: Push down on clutch handle. Clutch will automatically disengage when handle is released.

MAIN BRUSH LIFT HANDLE

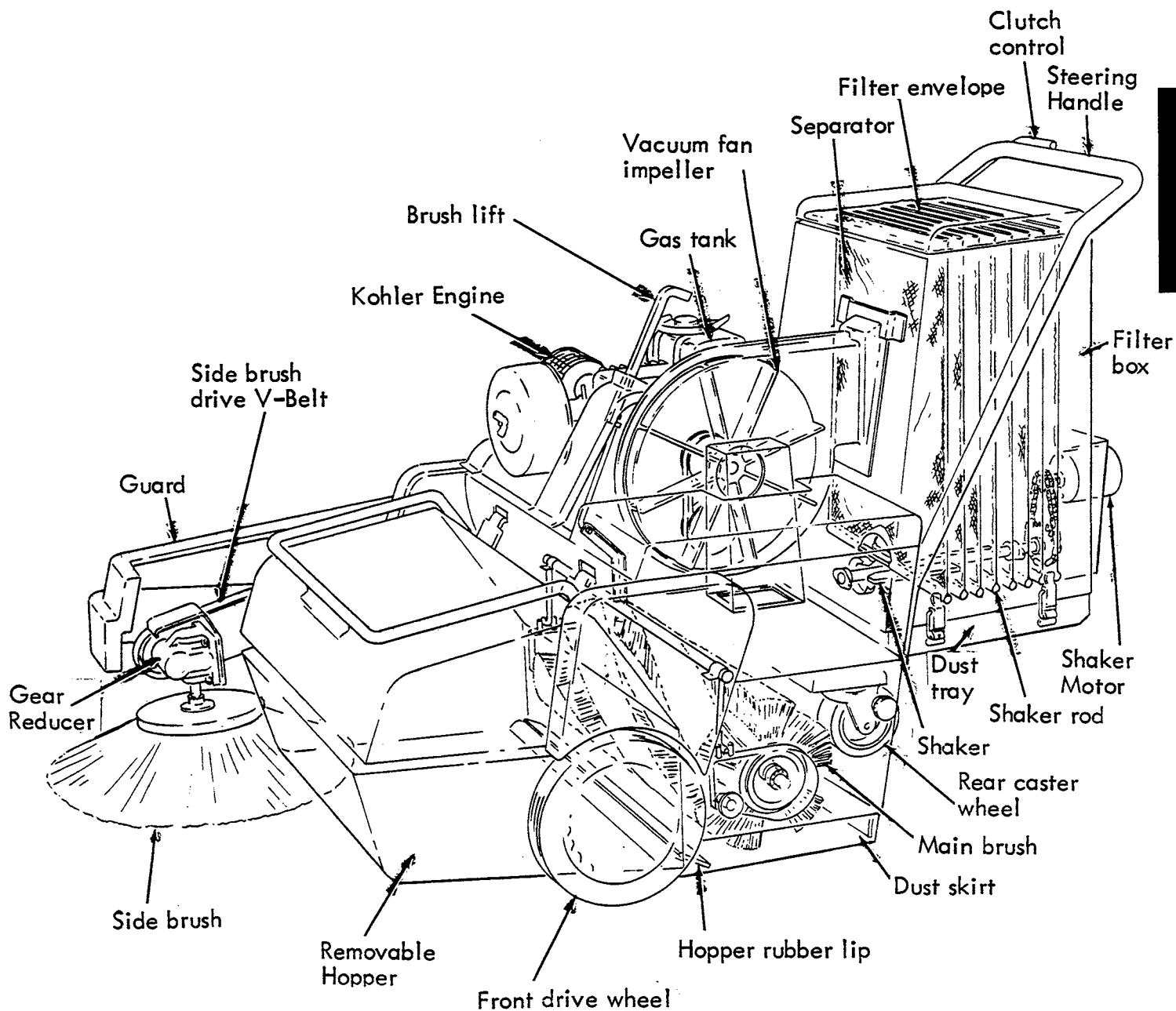
The main brush lift handle can be set in two sweeping positions and one locked-up position.

1. Sweeping - Free - Floating: In this position the brush is free to "float" up or down over uneven surface contours. The free - floating position should be used only when sweeping extremely uneven areas. Move the handle to the wide right hand slot for the free - floating position.
2. Sweeping - Restricted - Down: This position is used for most normal sweeping. Move the handle to the left and push down until the upper groove in the handle can engage the left hand slot. *
3. Locked - up: This position raises the brush and locks it in place. The brush should always be locked in the up position when the machine is not being used or is being transported. Raise the brush also when starting the engine. To place the handle in locked-up position, pull the handle up until the lower groove in the handle will engage the left hand slot.



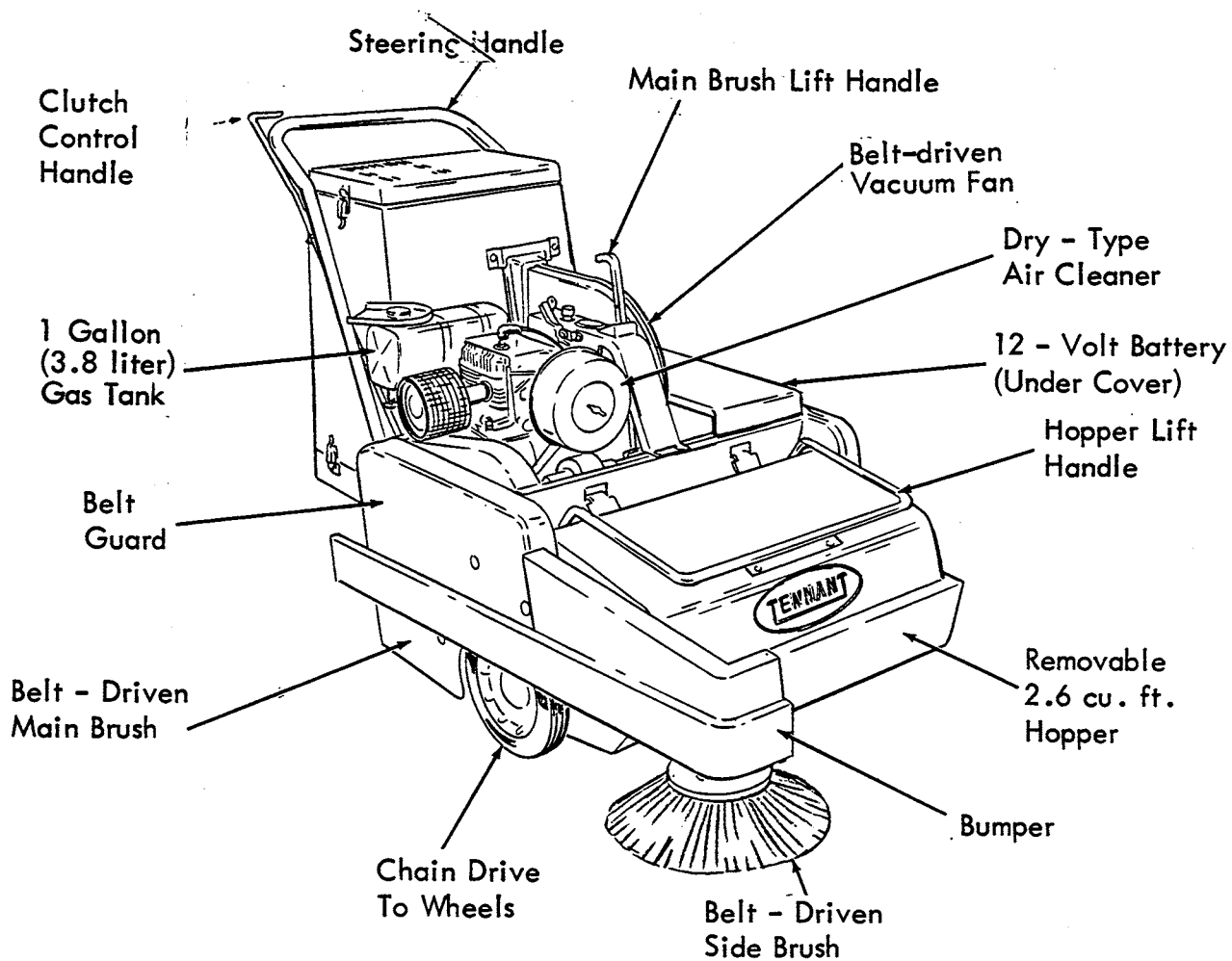
POSITIONS OF THE MAIN BRUSH LIFT HANDLE

NOTE The brush down position should be adjusted as the brush wears. Turn brush lift handle to adjust brush position. With machine not moving, rotate brush against floor to obtain a 1.50" (38 mm) wide brush contact pattern on the floor.

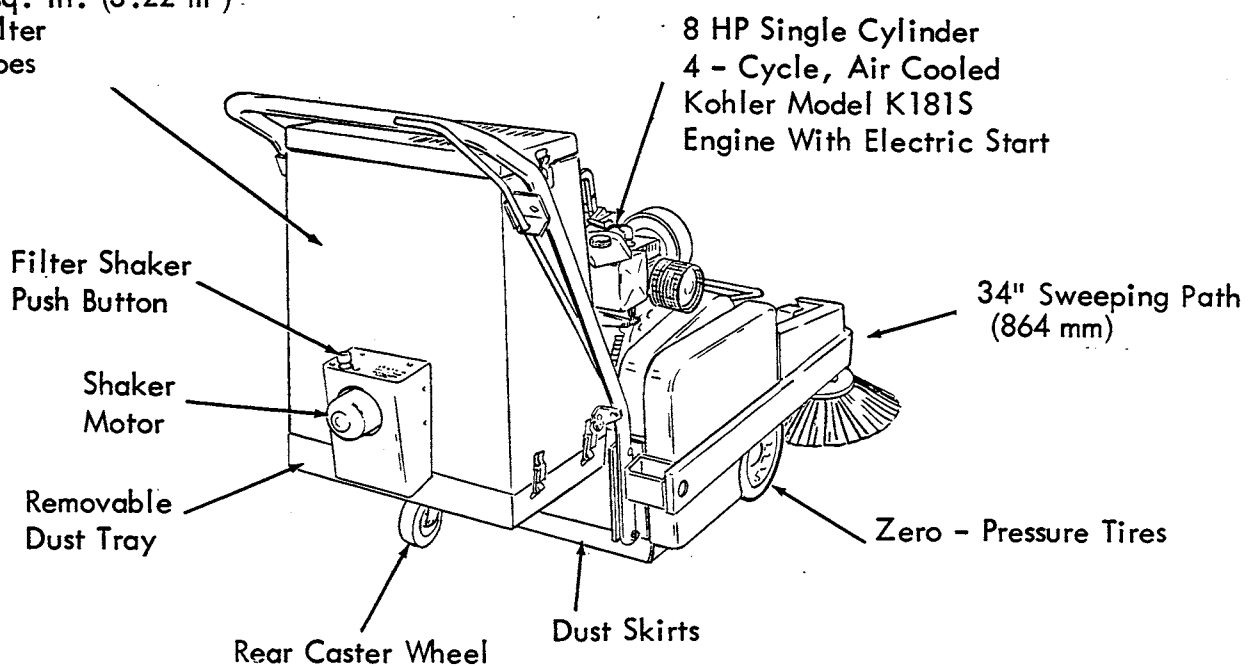


PHANTOM VIEW OF MODEL 42HD

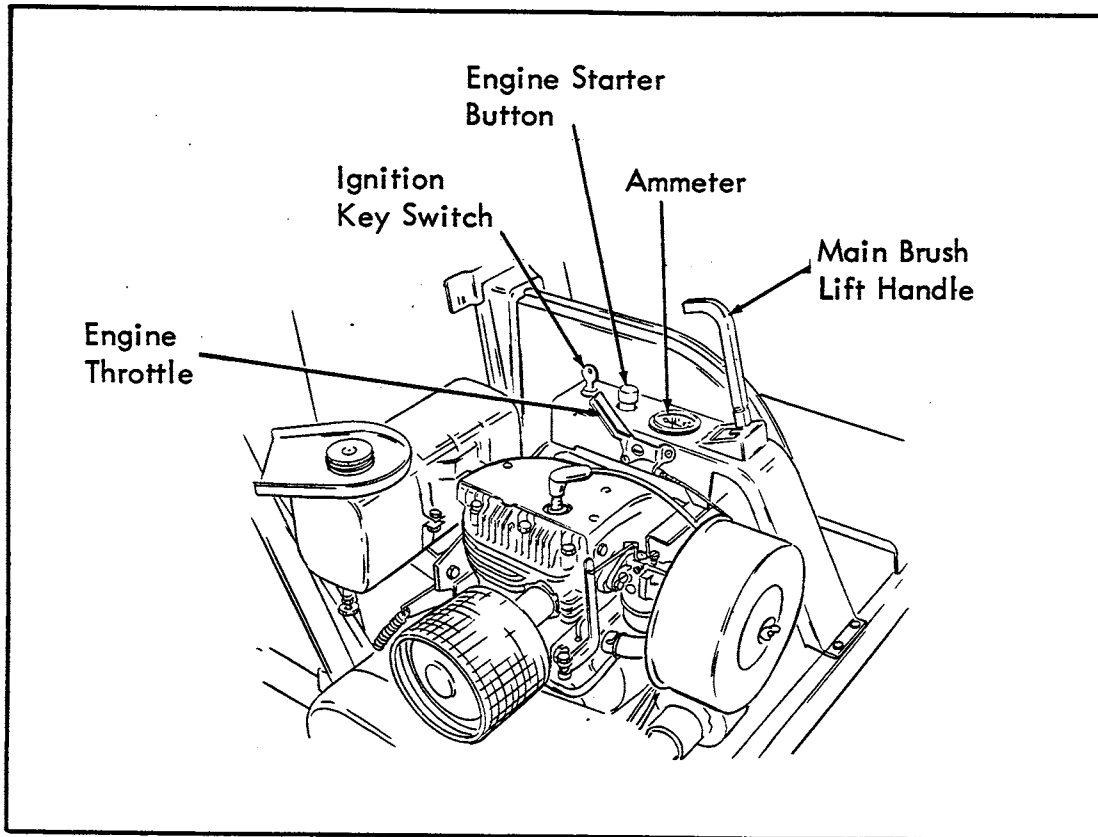
(See following pages for additional detail views of machine features and controls)



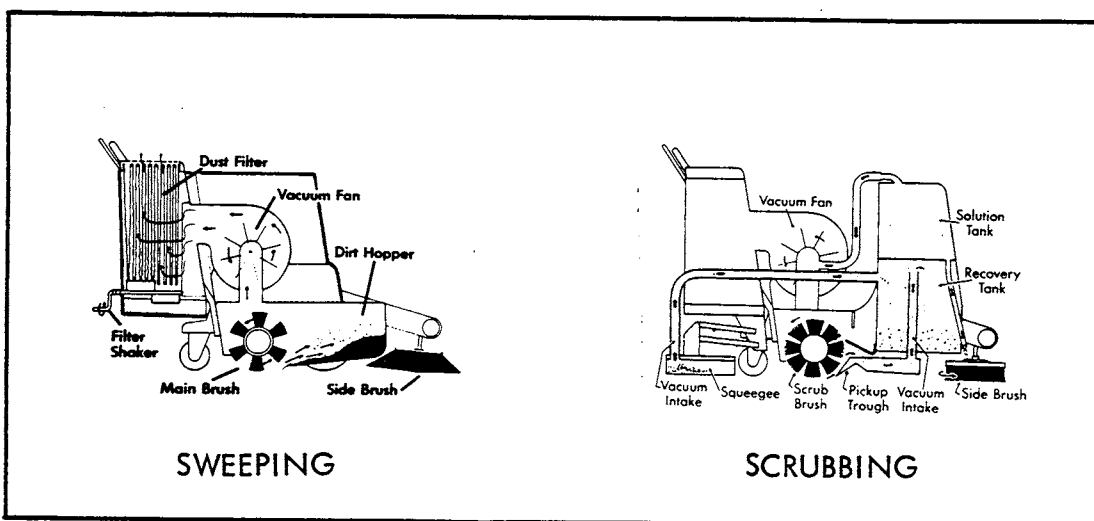
5,000 sq. in. (3.22 m²)
Dust Filter
Envelopes



FEATURES AND CONTROLS OF MODEL 42 HD



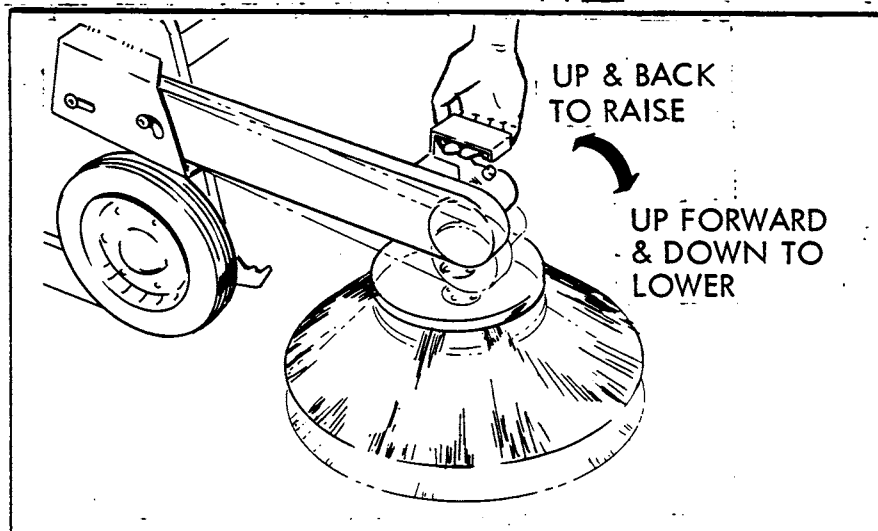
CONTROLS



THESE DIAGRAMS ILLUSTRATE SWEEPING & SCRUBBING SYSTEMS

SIDE BRUSH CONTROL

To Raise Side Brush: As shown in the drawing, grasp handle above side brush unit and lift up. Then push in toward machine until adjusting nut rests against frame stop. This will disengage belt and lock brush in "UP" (non-rotating) position.



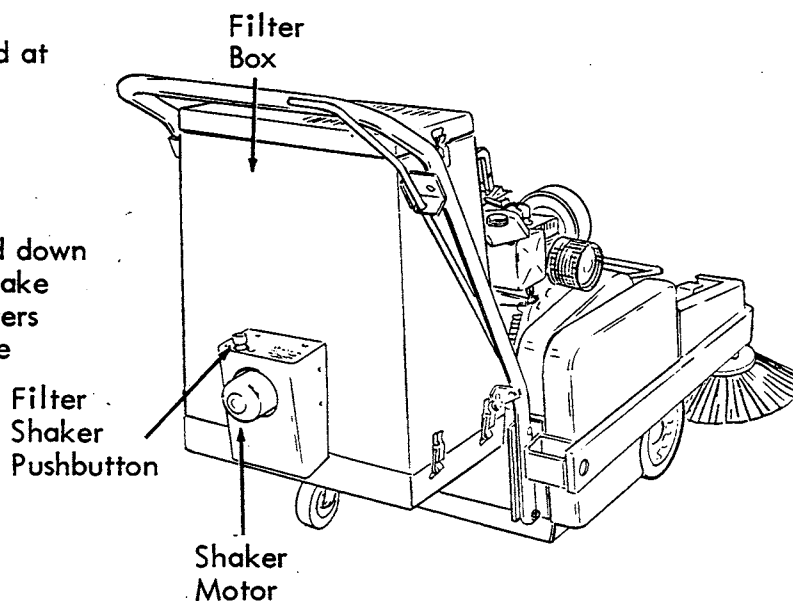
To Lower Side Brush: Grasp handle above side brush, lift and pull out to engage drive belt. Then lower brush to floor.

FILTER SHAKER

The Filter Shaker pushbutton is located at the rear of the filter box.

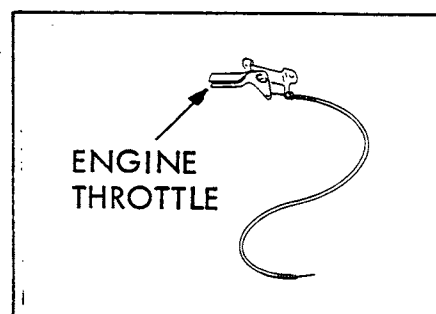
To operate the shaker:

1. Shut off engine.
2. Push shaker switch button and hold down for approximately 10 seconds to shake filters clean. See cleaning of filters and vacuum system in Maintenance Section.



ENGINE THROTTLE

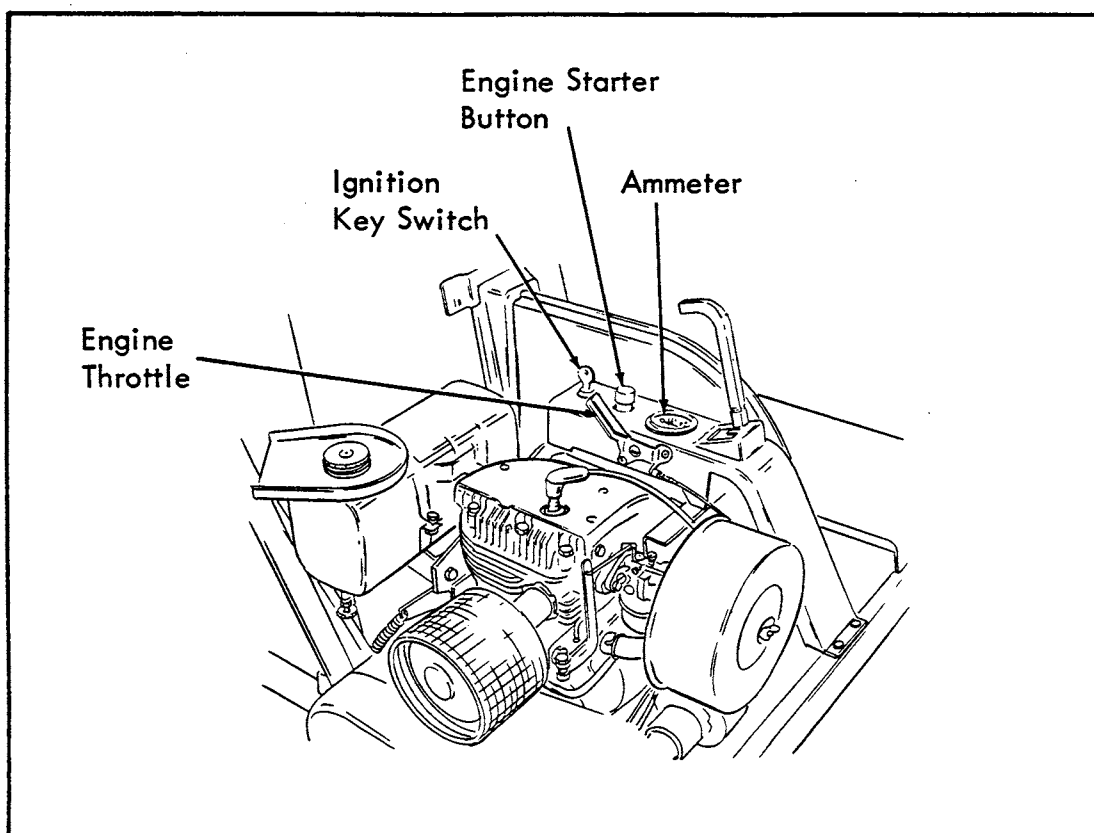
Pull up on lever to open throttle, push down to idle.



OPERATION

TO START ENGINE

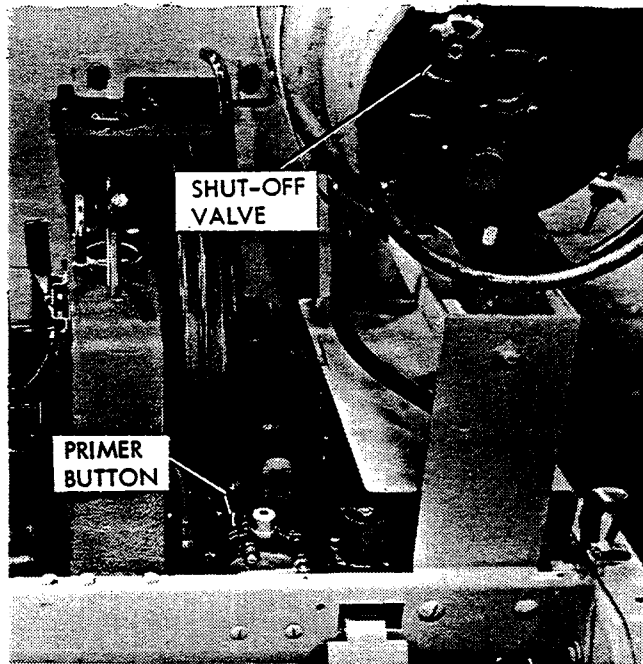
1. Lift both sweeping brushes off floor.
2. Open fuel shut-off valve located under gasoline tank.
3. Turn ignition switch to "ON".
4. Close choke but only if engine is cold.
5. Adjust throttle to about 1/2 open position.
6. Press starter button.
7. When engine starts, place choke in "OFF" position.



ENGINE EMERGENCY STOPPING PROCEDURE

If the engine cannot be stopped by the standard method (turning ignition key to "OFF"), stop the engine by placing the choke "ON" and opening throttle. Engine will flood and stop within a few revolutions.

ATTENTION! DO NOT stop the engine by pulling the high tension lead off the spark plug. This will burn out the ignition coil.



TO START LPG ENGINE

1. Lift both brushes off floor.
2. Slowly open hand-valve on tank.

NOTE Valve should always be closed when machine is not in use.

3. Check gauge on tank to make sure there is fuel in the tank.
4. IMPORTANT: Keep throttle lever in closed position.
5. On cold starts, with switch "OFF":
 - (a) Crank engine once very briefly.
 - (b) Push primer button, on LP regulator (see photo), down for about two seconds.
6. Turn key switch to "ON".
7. Press starter button. (Choke at carburetor is not needed because of primer button.)
8. When engine starts, open throttle lever as needed.

NOTE If engine does not start after following the above procedure, refer to LP Gas Trouble Shooting.



TO PROPEL SWEEPER (After Engine is Running)

1. Adjust hand throttle to regulate forward travel and brush speed.

NOTE Do not attempt to run engine too slowly. This will cause insufficient vacuum and loss of dust control.

2. Lower brushes to floor.
3. Depress clutch handle to place the machine in motion.

NOTE Disengage clutch on corners for easier turning.

TO STOP SWEEPER

1. Release the clutch handle.
2. Turn ignition key to "OFF".
3. Raise brushes from floor.
4. Close fuel valve if machine is to be parked for several hours OR any time machine is parked in hazardous area.

GENERAL OPERATING SUGGESTIONS

1. Plan your sweeping in advance. Try to arrange long runs with minimum turning and stopping.
2. Sweep debris from aisles too narrow for sweeper out into main aisle ahead of time. Do an entire floor, or section at one time.
3. PICK UP OVERSIZE DEBRIS BEFORE SWEEPING.
4. Allow a few inches overlap of brush paths to avoid missing patches.
5. Sweep as straight a path as possible. Avoid bumping into posts or scraping sides of sweeper.

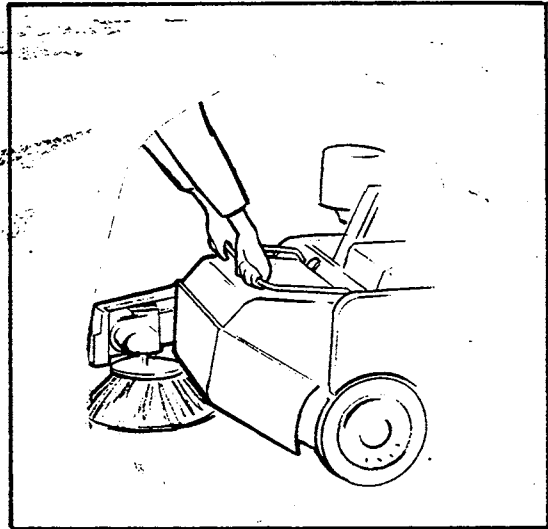
⚠ WARNING

ALWAYS PROVIDE ADEQUATE VENTILATION WHEN OPERATING THIS MACHINE. Carbon monoxide is a poisonous gas, present in the exhaust of all internal combustion engines. If you are operating the machine in a confined area, be sure the area is well ventilated.

TO EMPTY HOPPER

1. As shown in sketch, grasp handles and swing hopper upward. (With hopper in "DUMP" position, push machine back and away from pile of sweepings.)
2. Return hopper to operating position.

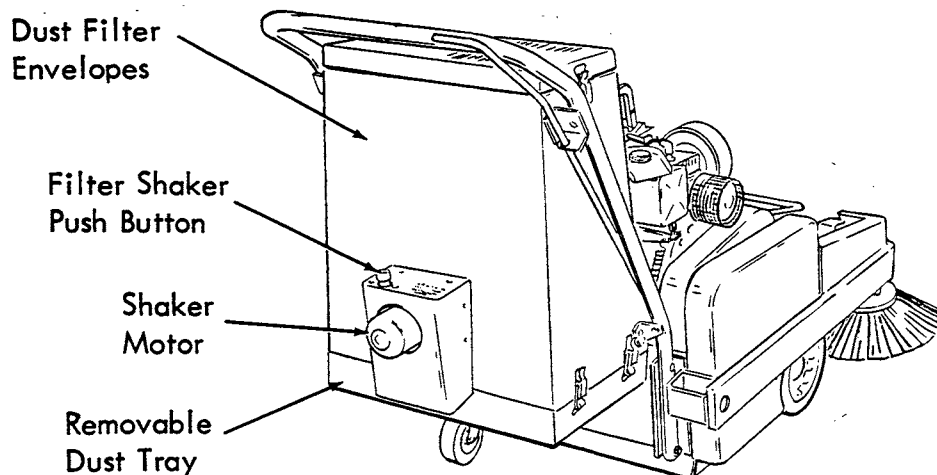
NOTE If you wish to empty hopper directly into trash box, push down on front edge to disengage upper hangers from frame. Then lift the hopper out.



TO EMPTY DUST TRAY

1. Unlatch tray retaining clamps on bottom of filter box.
2. Remove and empty tray.

NOTE The dust tray need only be emptied periodically, not each time hopper is emptied. (For filter system maintenance, see Maintenance Section. (USE CARE WHEN HANDLING TRAY TO PREVENT DAMAGE TO SEALS.))





SCRUB ATTACHMENT

When the Scrubbing Attachment is used, the dirt hopper, dust, side brush assembly and speed reducer unit are removed and replaced by the tank assembly, rear squeegee, side scrub brush and scrubber speed reducer unit.

The main sweeping brush is replaced by a scrubbing brush.

The scrubbing speed reducer unit drives the side scrubbing brush at twice the speed of the standard sweeping brush to provide a more effective cleaning action. A new mounting plate is furnished for the side sweep speed reducer. This plate attaches the speed reducer to the hinged side brush arm with a stud and wing nut to provide a faster method of interchanging the sweeping and scrubbing speed reducer units. The hinged side brush arm is used for both sweeping and scrubbing operations.

Water is swept into a trough located directly in front of the cylindrical brush. A hose from the vacuum tank draws the water from the trough. The remaining water is picked up by a V-shaped squeegee at the rear of the machine. An additional vacuum hose picks up the water drawn into the center of the rear squeegee. Water left by the side brush is directed into the path of the main brush by a small squeegee located behind the side brush.

SCRUBBER SECTION (continued)

Vacuum is provided by the sweeper fan. The engine must always be operated at full governed throttle to obtain adequate fan speed. A hand operated valve closes the normal air intake from the main brush chamber and directs the suction through a hose to the water recovery tank. A float valve in the tank automatically shuts off the air flow when the tank is full.

A drain hose is attached to a clean-out door on the left side of the recovery tank. This door can be removed for periodic tank cleaning. The trough which collects the debris swept up by the main brush, must be removed and cleaned whenever the tank is drained. It is convenient to use the flow from the drain hose to flush out the trough.

The detergent tank is filled through the door in the top. Flow is controlled by a hand operated valve located on the right hand side of the filter box.

TO CONVERT MACHINE FROM SWEEPING TO SCRUBBING:

1. Swing the bumper back out of the way.
2. Hinge the brush arm outward by releasing the latch as shown in Fig. 1.
3. Remove the dirt hopper.
4. Remove the speed reducer unit along with side sweeping brush by removing the wing nut and slipping the drive belt off the speed reducer sheave.
5. Remove the main sweeping brush and install the scrubbing brush.
6. Using the cart, roll the scrubber unit into position as shown in Fig. 2. The lower tank support studs must be placed in the inner notch on the support brackets. (The outer notches are used to support the hopper). Then flip the retainers over the upper tank support studs. Make sure that scrubber unit is held firmly against machine on both sides.
7. Connect the vacuum hose to top of tank as shown in Fig. 3.
8. Attach the scrubbing speed reducer and brush, tighten wing nut and hinge arm to "operating position". (See Fig. 1). Then swing bumper down into place.
9. Attach side brush squeegee assembly by sliding it onto pins as shown in Fig. 5.

NOTE For side brush squeegee height adjustment, see "To Operate Side Squeegee".

10. Remove the filter box cover and lift out the filter envelope assembly. The filters must be removed while scrubbing; failure to do so will result in moisture damage to the cloth envelopes. Some detergents may also contain chemical properties damaging to cloth. Water pick-up ability will also be impaired if filters are left in while scrubbing.

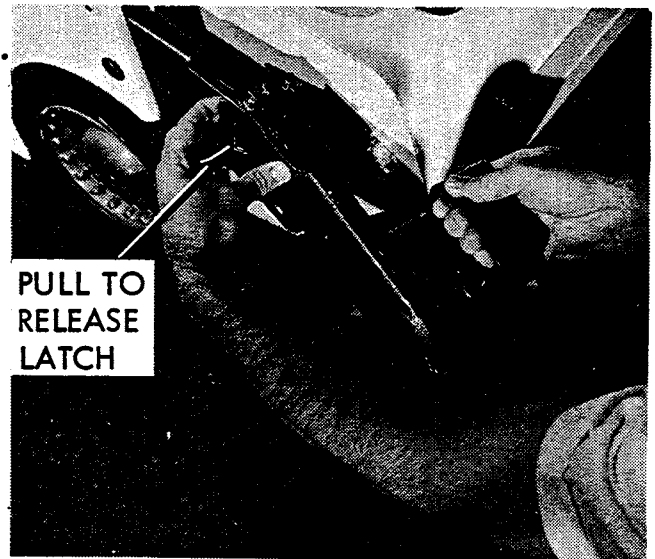


FIG. 1

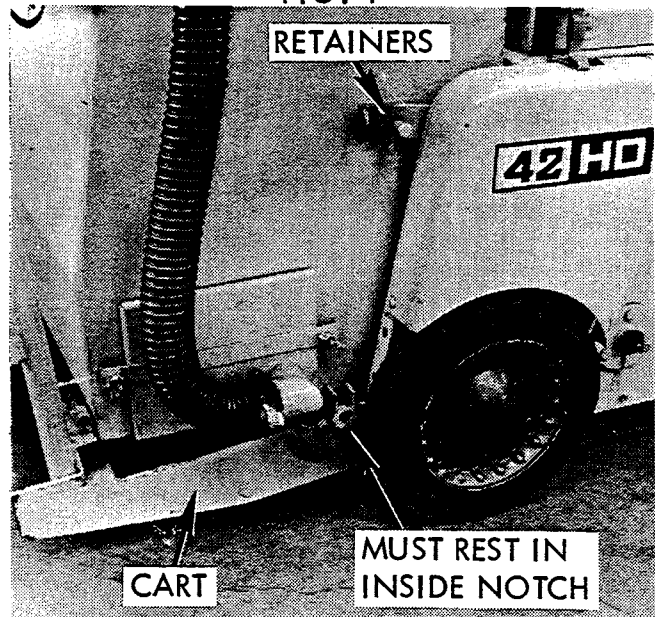


FIG. 2

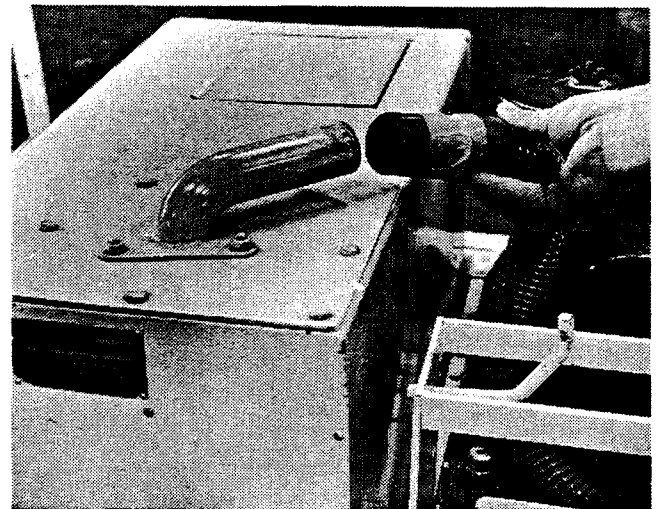


FIG. 3

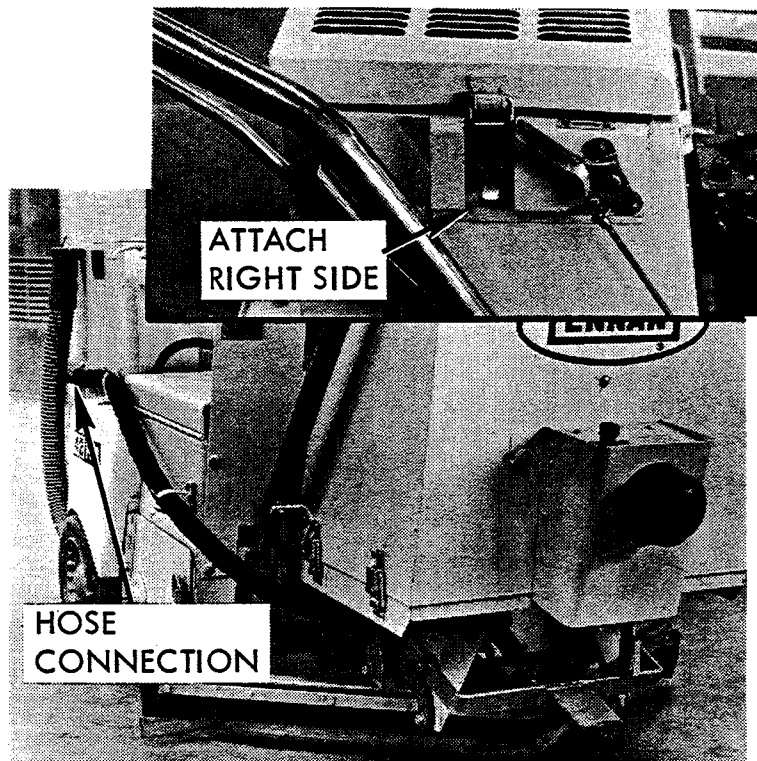


FIG. 4

11. Refer to Fig. 4, and place the valve control bracket over the right edge of the filter box.
12. Remove the dust tray and install the rear squeegee assembly as shown in Fig. 4,
13. Lift up on the vacuum control handle shown in Fig. 6 to shut off the air intake from the brush chamber and direct it through the hose from the water recovery tank.

NOTE The handle must be lowered for sweeping and raised for scrubbing. Your scrubber is now ready for operation.

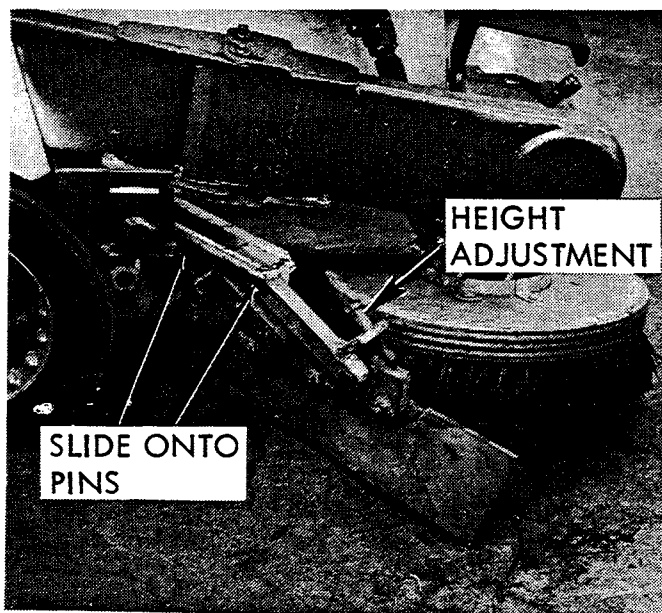


FIG. 5

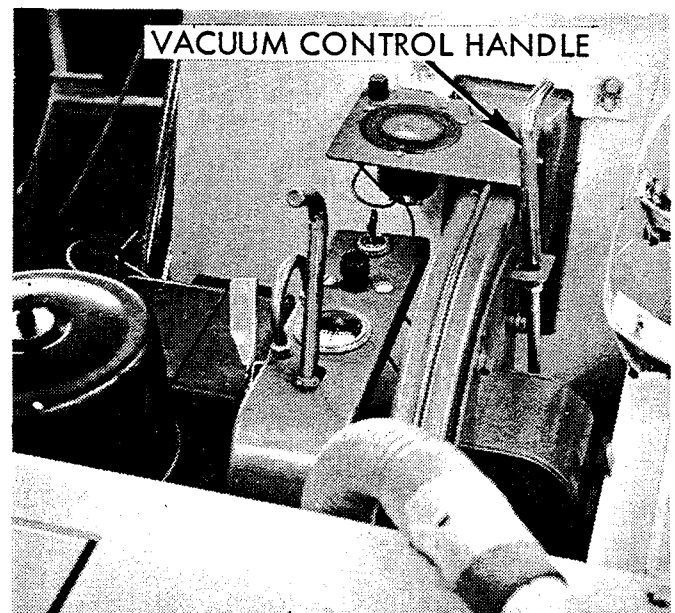
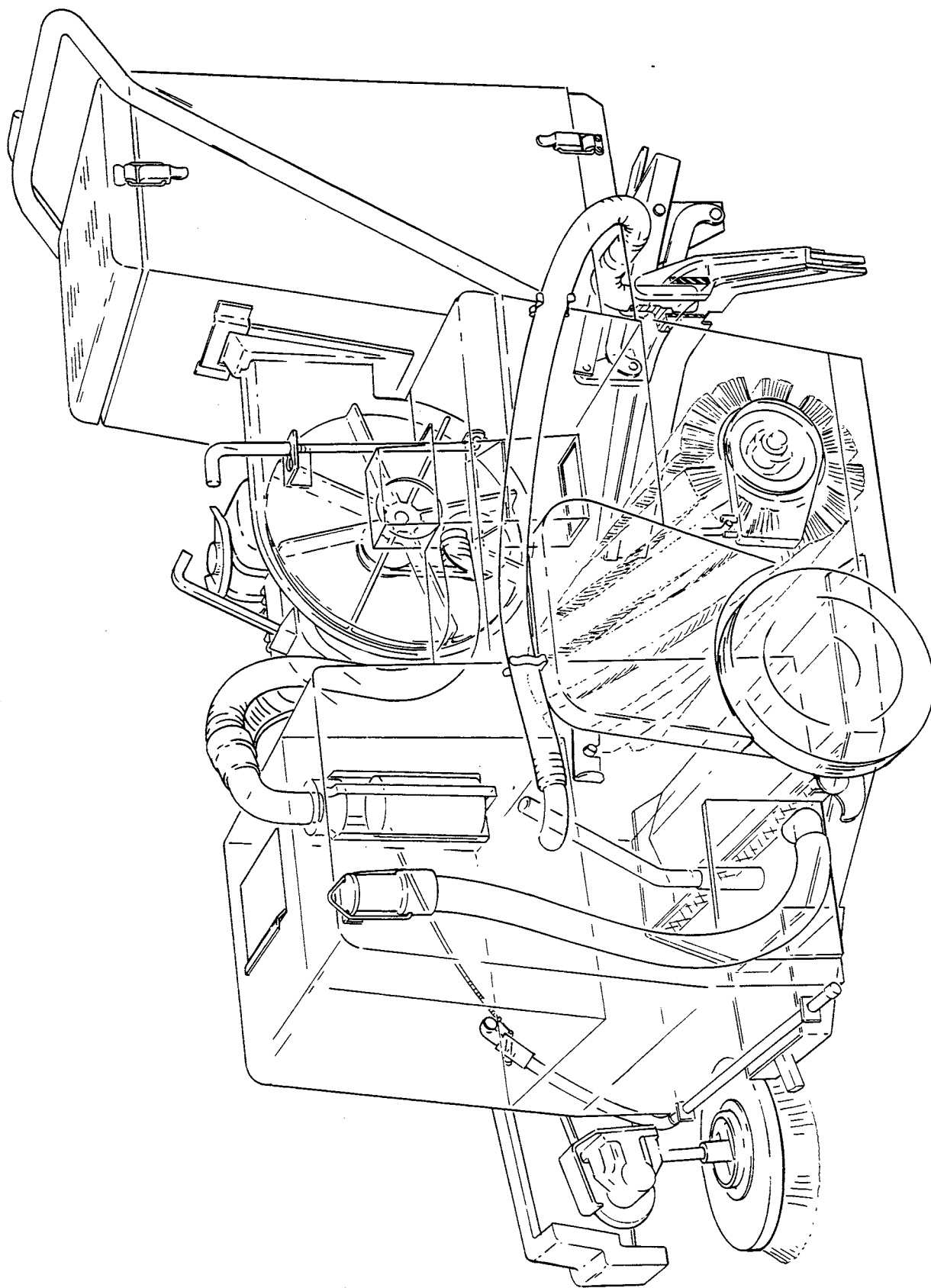


FIG. 6

Phantom View of the Scrubbing Attachment Installed on a Model 42HD.



OPERATING INSTRUCTIONS

To Fill the Scrubber Tank:

1. Make sure detergent flow control valve is in "Off" position.
2. Fill the tank with detergent solution through hinged door in top of scrubber unit. Capacity of tank is 14.5 gallons (55 liters.)

NOTE When using powdered detergents, BE SURE to mix the solution in a separate container, allowing it to dissolve completely before pouring it into the tank. This will prevent clogging of the distribution system.

NOTE Always run engine at full governed speed while scrubbing. Adequate vacuum is essential for water pick-up and full speed of vacuum fan must be maintained. Forward travel may be regulated independent of engine speed by "throttling" clutch control lever.

To Operate Side Squeegee:

Lower the side brush squeegee to floor.

NOTE Use adjustment screw on squeegee support to obtain correct height. (See Fig. 5) Correct height is indicated when, at the point of floor contact, the side of the squeegee blade forms an angle of approximately 45° with the floor.

To Operate Rear Squeegee: (Figure 7)

To lower squeegee, step on small pedal (right side) while machine is moving forward.

To raise squeegee, step on large pedal (center).

The action of the rear squeegee depends upon its own weight bearing on the blade and no height adjustment is required.

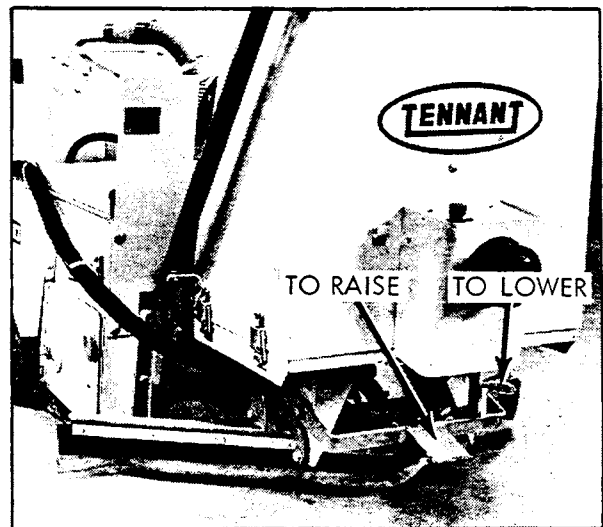


Fig. 7

OPERATING INSTRUCTIONS (continued)

To Adjust Rear Squeegee:

1. Park machine on smooth, level floor.
2. Refer to Fig. 8 and loosen bolts attaching lift pedal weldment to frame.
3. Lower rear squeegee.
4. Propel the machine forward a few feet to allow squeegee to level itself on floor; then tighten bolts indicated in step 2.

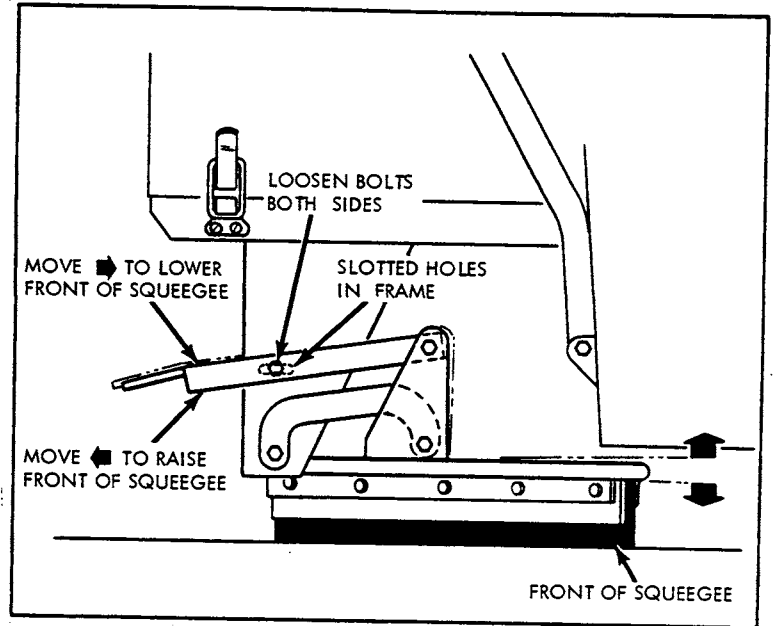


Fig. 8

To Regulate the Detergent Flow Control:

Use control lever mounted on right side of filter box to regulate flow as required for different scrubbing jobs.

NOTE Make sure all the holes in the spreader bar are open to obtain even distribution of detergent solution.

To Empty Return Tank:

Remove hose from storage plug on top of tank and allow water to run out. At the end of each operating shift, remove the clean out door and flush the tank with clean water,

To Empty and Clean the Pick-Up Tray:

Pull straight back on handle to remove tray (Fig. 9).

It is convenient to use the discharged water from the return tank to flush the tray clean.

To replace tray, position the support bolts (Fig. 9) in rails on underside of scrubber unit and slide forward into place.

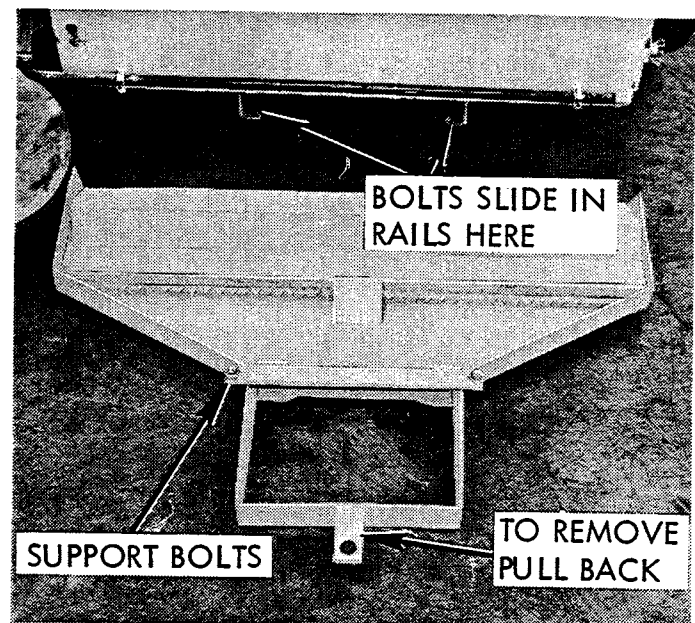


Fig. 9

GENERAL OPERATING SUGGESTIONS

1. Try to arrange long runs with a minimum of short turns.
2. To operate the machine for scrubbing only, with no water pick-up, remove pick-up tray and raise both squeegees.
3. Always run the engine at full governed speed while scrubbing. Forward speed can be controlled with clutch handle for slow-down or turns or if a more vigorous scrubbing action is desired.
4. Always store scrubber attachment on cart to prevent damage to pick-up hose connected to underside of tank.
5. To assure top performance from your scrubber periodically check the following components:
 - (A) Height adjustment of pick-up tray.
 - (B) Height adjustment of front water pick-up hose.
 - (C) Seal around clean out door and hose fitting on door. (Any leakage at these points greatly decreases the water pick-up ability).
 - (D) Height adjustment of rear water pick-up hose.
 - (E) Obstructions in the water spreader tube and bar.
6. If, at any time during the scrubbing operation, poor water pick-up is experienced, check the following areas:
 - (A) If the lip of the water pick-up tray is too low, water will build up ahead of it and spill over beyond the reach of the rear squeegee. If the lip is too high, the brush will have difficulty sweeping the water into the tray. (See tray adjustment.)
 - (B) If either pick-up hose is too high, the vacuum is not capable of lifting the water, too low will cut off water pick-up because a mixture of water and air must be drawn through the hose. (See hose adjustment.)

TROUBLE SHOOTING

PROBLEM	CAUSE	REMEDY
Engine does not run .		See "ENGINE SECTION".
Side brush does not operate .	Drive belt slipping or damaged .	Tighten or replace .
Main brush does not operate .	Belt from engine to intermediate drive slipping .	Check spring on tension idler and and replace if needed .
	Intermediate drive belt damaged .	Replace .
	Extreme drag on main brush .	Check for obstruction in brush compartment. Check for string or wire wound around brush or brush end plugs.
Sweeper will not propel .	Flat drive belt slipping .	Check clutch adjustment. Replace belt if damaged. Check linkage from control lever to clutch .
Sweeper will not pick up dirt .	Hopper full or large debris caught between brush and hopper lip .	Empty or free obstructions .
	Main brush worn out .	Replace .
	Main brush locked up .	Check brush control lever and linkage .
	Brush arms hung up on excessive dirt accumulation on sides of brush compartment .	Clean brush compartment .
	Hopper lip height incorrect .	Adjust .
	Main brush not turning .	See above .

TROUBLE SHOOTING PROCEDURE (Continued)

PROBLEM	CAUSE	REMEDY
Sweeper dusting.	Engine running too slowly.	Increase R.P.M.
	Hopper full.	Empty.
	Skirt height incorrect.	Adjust.
	Dust filter dirty.	Push shaker button or remove filters and clean.
	Dust tray full.	Empty and clean filters.
	Vacuum intake screen clogged.	Clean.
	Vacuum fan drive belt broken or slipping.	Replace or adjust.
	Filter bag or rack not in correct position.	Check to see if bag or rack have slipped down into filter box. Rack must support bag properly.

SECTION 3 MAINTENANCE

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SECTION 3-MAINTENANCE

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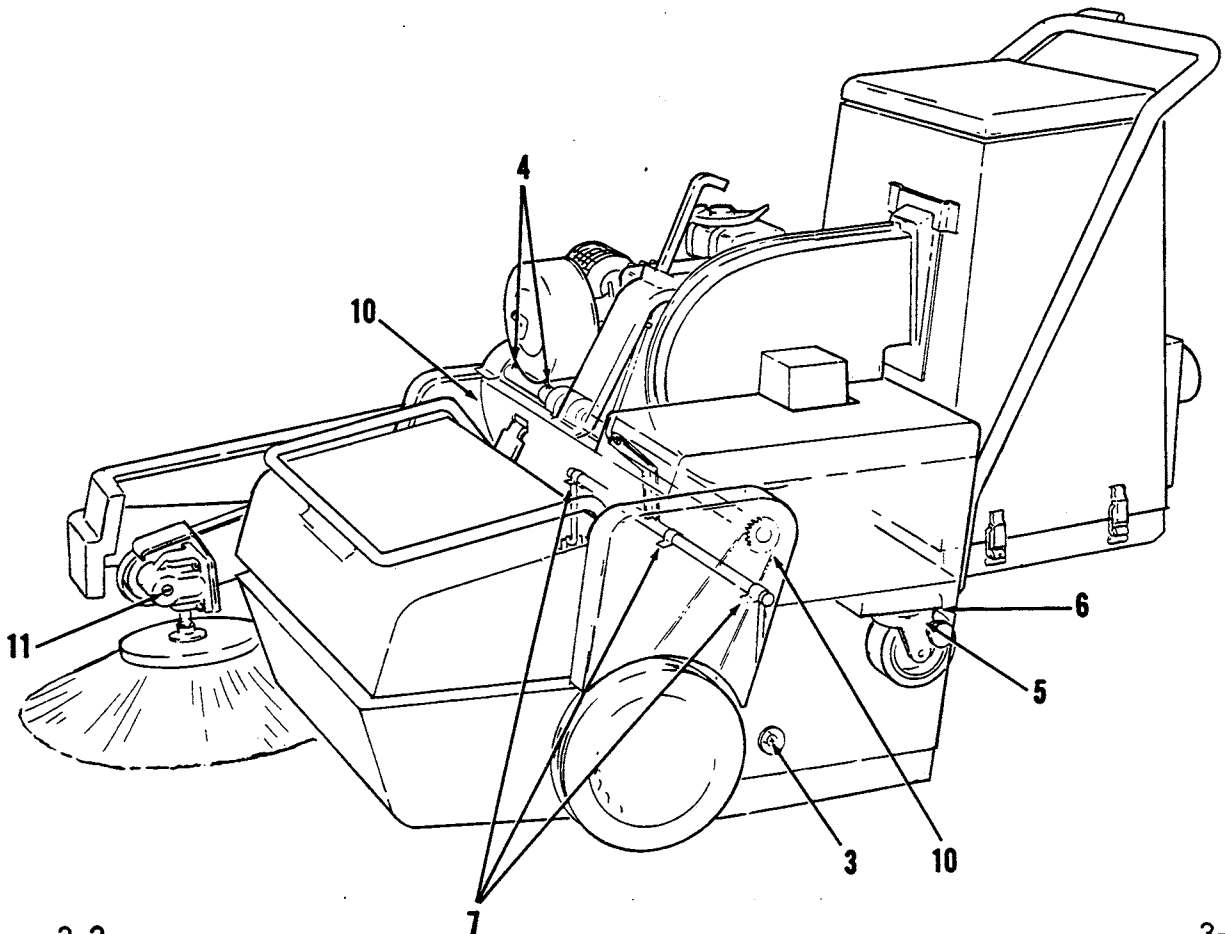
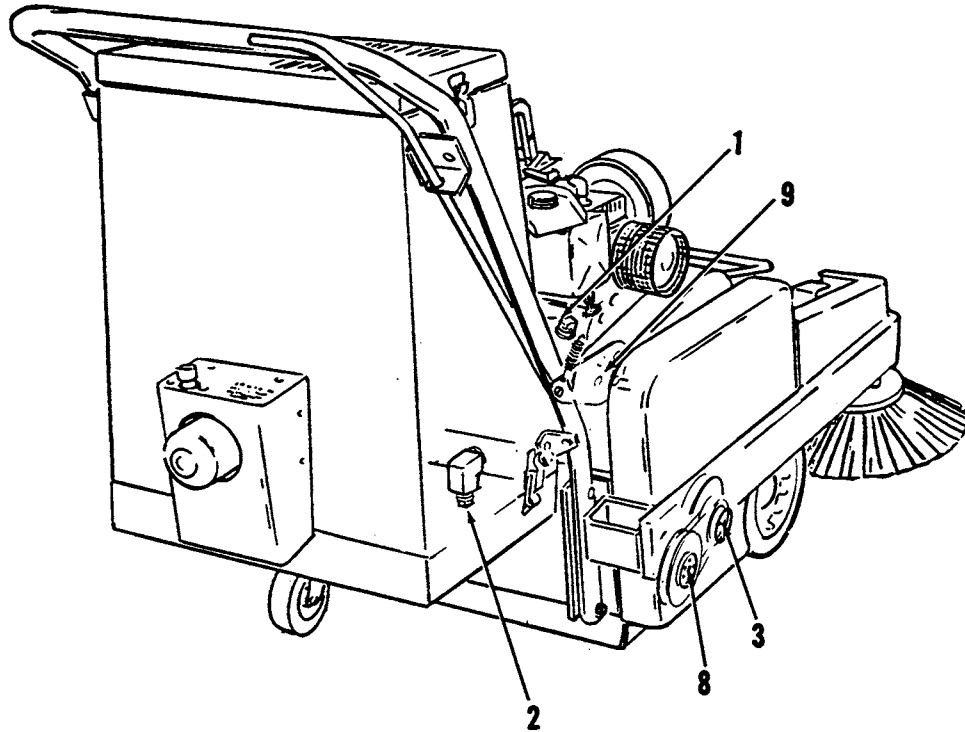
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RECOMMENDED FIRST 5-HOUR MACHINE INSPECTION

After The first 5 hours of operation, perform the following procedures.

1. Change the engine oil.
2. Check the floor skirts to floor clearance.
3. Check the main brush and side brush patterns.

LUBRICATION LOCATIONS



LUBRICATION CHART

REF. NO.	DESCRIPTION	LUBRICATION FORM	HOURS				
			8	25	50	100	400
1	Check Engine Oil Level	SAE #30	X				
2	Change Engine Oil	API Type SC Oil		X			
3	Brush Arm Pivot (2)	Grease-Gun			X		
4	Differential (2)	Grease-Gun			X		
5	Rear Caster Wheel	Grease-Gun			X		
6	Rear Caster Swivel	Grease-Gun			X		
7	Brush Lift Shaft (3)	Light Machine Oil				X	
8	Self Adjusting Sheave Shaft	Light Machine Oil				X	
9	Clutch Plate, Between Plate and Engine	Light Machine Oil				X	
10	Drive Chains (2)	Brush on a Mixture of 10 oz (.031 kg) Powdered Graphite and 1 qt (0.95 L) #40 Oil			X		
11	Side Brush Speed Reducer- Check Oil Level Change Oil	SAE #140 Gearlube				X	X
	Replace LP Filter-fuelock Filter Pad						X

MAINTENANCE

1. Check engine oil level daily. Change engine oil after first five hours of operation, thereafter every 25 hours.
2. Give special attention to instructions concerning air cleaner service procedure as indicated in "Engine section". The air cleaner must not be neglected. Lack of proper service will result in costly repairs. Check and clean air filter element every 100 to 200 hours, depending on conditions.
3. Always clean off filler spout before adding gasoline to prevent dirt from falling into the tank. If the cleanliness of your fuel source is questionable, pour gasoline through a strainer when filling tank.
4. Clean off your machine after each operating shift by use of air hose or other thorough cleaning method.
5. Periodically, blow dust out of brush chamber and from around brush drives, drive belts, and all other moving parts. Remove any wire or string wound up on the brush or brush drives.
6. Conduct a general inspection of your machine at least once a week. Replace all worn or damaged parts, make necessary adjustments and tighten any loose nuts or screws.
7. Keep regular replacement items in stock for emergency repairs, to avoid costly "down" time. See "Recommended General Maintenance Items".

ENGINE

SERVICE SCHEDULE

PERFORM SERVICE AT INTERVALS INDICATED (X)	EACH DAY	EVERY 25 HOURS	EVERY 50 HOURS	EVERY 100 HOURS	EVERY 500 HOURS
CHECK OIL LEVEL (maintain in safe operating range) ----	X				
CLEAN AIR INTAKE SCREEN (plus other external surfaces) -	X				
REPLENISH FUEL SUPPLY (Use clean, fresh fuel) -----	X				
CHANGE OIL (Use API Service SC of proper weight) -----		X			
SERVICE FUEL FILTER (remove and clean sediment bowl) -----		X			
SERVICE AIR CLEANER (per instructions) -----		X			
CHECK AIR CLEANER ELEMENT (dry type only) -----			X		
SERVICE SPARK PLUG -----				X	
SERVICE BREAKER POINTS (gap .020") -----					X
NOTE: Intervals stated are for good, clean operating conditions--perform services more frequently if dusty or dirty conditions prevail.					

LUBRICATION

OIL LEVEL: With the splash system, the oil level must be maintained on the "Safe" operating range at all times--this is between the F (full) and L (low) mark on the dipstick. Check the level daily and add oil as needed. DO NOT OVERFILL--oil level must not exceed F mark.

On engines with the threaded type plug-dipstick, turn the plug all the way out of crankcase, wipe oil off dipstick then re-insert--do not turn plug in to check oil--shoulder plug on top of hole then remove to observe level. After checking oil, turn plug all the way into crankcase. With the extended oil fill tube and dipstick, push dipstick all the way down on tube then take reading. Engine must be level for accurate reading.

OIL REFILL CAPACITY

K181
1 quart (.9 L)

OIL TYPE: Oils meeting the requirements of the American Petroleum Institute's (API) Service classification SC are suitable for use in Kohler Air Cooled Engines. Service SC oils are detergent type oils. Oil viscosity (weight) is selected according to the anticipated ambient temperatures. The temperature-viscosity recommendations are:

AIR TEMPERATURE	OIL VISCOSITY
Above 30°F (-1°C)	SAE 30
0 to 30°F (-18 to -1°C)	SAE 10W-30
Below 0°F (-18°C)	SAE 5W-20

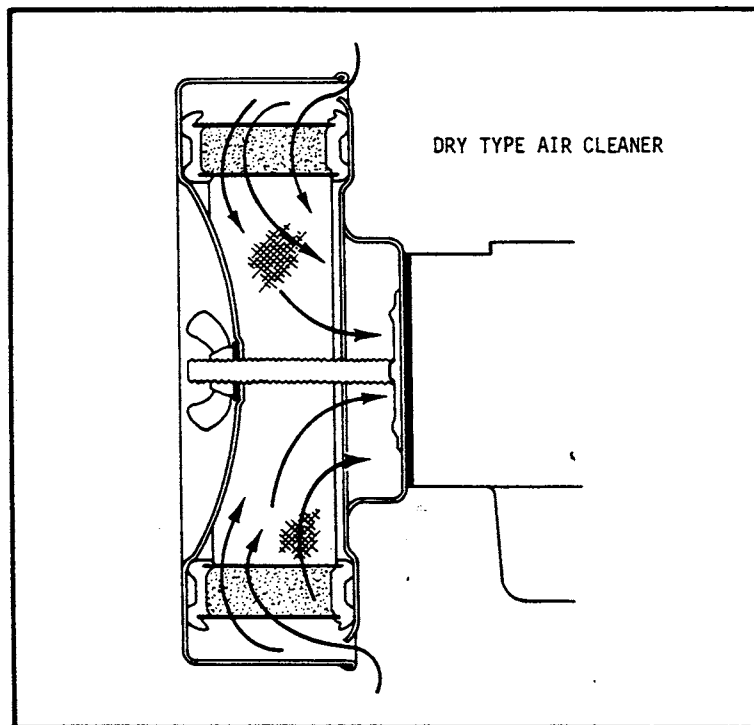
OIL CHANGE: On new or rebuilt engines, the oil should be changed after the first five hours of operation--thereafter each 25 hours of operation under normal conditions. If extremely dusty or dirty conditions prevail, change oil more frequently. If possible, run engine just prior to changing oil--the oil will flow more freely and carry away a greater amount of contamination when it is hot.

AIR CLEANER

Dirt induced through improperly installed, poorly serviced or inadequate air cleaner 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 a few hours. Also, a clogged element causes a richer fuel mixture which may lead to formation of harmful sludge deposits.

SERVICE - REPLACEMENT: Dry type elements should be replaced after 100 to 200 hours if engine is operated under good clean air conditions--service and replace element more frequently under extremely dusty or dirty conditions. Dry elements should be cleaned after about each 50 hours of operation--remove element and tap lightly on a flat surface to remove loose surface dirt. Replace element if dirt does not drop off easily. Do not wash dry elements in any liquid or attempt to blow dirt off with air hose as this will puncture filter element. When replacing element, use only genuine Kohler elements. Carefully handle new element--do not use if gasket surfaces bent or twisted. Check the following when installing new or serviced element:

1. Back plate must be securely tightened to carburetor. Replace back plate if bent or cracked.
2. Gasket surfaces of element must be flat against back plate and cover to seal effectively.
3. Wing nut must be finger tight--don't overtighten.



SAFETY PRECAUTIONS

- Do not add fuel while engine is running. Stop engine and, if possible, allow cooling period to prevent spilled fuel from igniting on contact with hot engine parts.
- Always disconnect spark plug cable to prevent unintentional starting before making any adjustments on equipment powered by engine.
- Make sure all safety guards on engine and driven equipment are in proper position and secure.
- Make sure hands, feet, and clothing are at a safe distance from any movable parts prior to starting.
- Do not tamper with governor settings. The governor establishes safe operating limits. These limits must not be exceeded.

FUEL, FUEL SYSTEMS

With the gasoline fuel system, use clean fresh REGULAR grade of leaded or non-leaded gasoline with octane rating of at least 90. The non-leaded (or low lead) fuels offer the advantage of reducing the amount of deposits which build up in the combustion chamber. Do not add oil to the gasoline on these 4-cycle engines. Use name brand gasoline purchased from popular stations to prevent use of stale gasoline or fuel not adjusted to seasonal changes. Gasoline becomes "stale" after about 6 months and tends to form gum deposits which clog the fuel system especially small passages in the carburetor. When placing an engine in storage, completely drain fuel lines, tanks and carburetor bowl or use a fuel stabilizer which prevents formation of gum in the gasoline. On gravity feed systems, turn the fuel valve off whenever the engine is to be out of service for any length of time--this will prevent seepage of gasoline into the engine. Keep the vent hole in the gas filler cap open--if it becomes plugged, flow of fuel will be impaired.

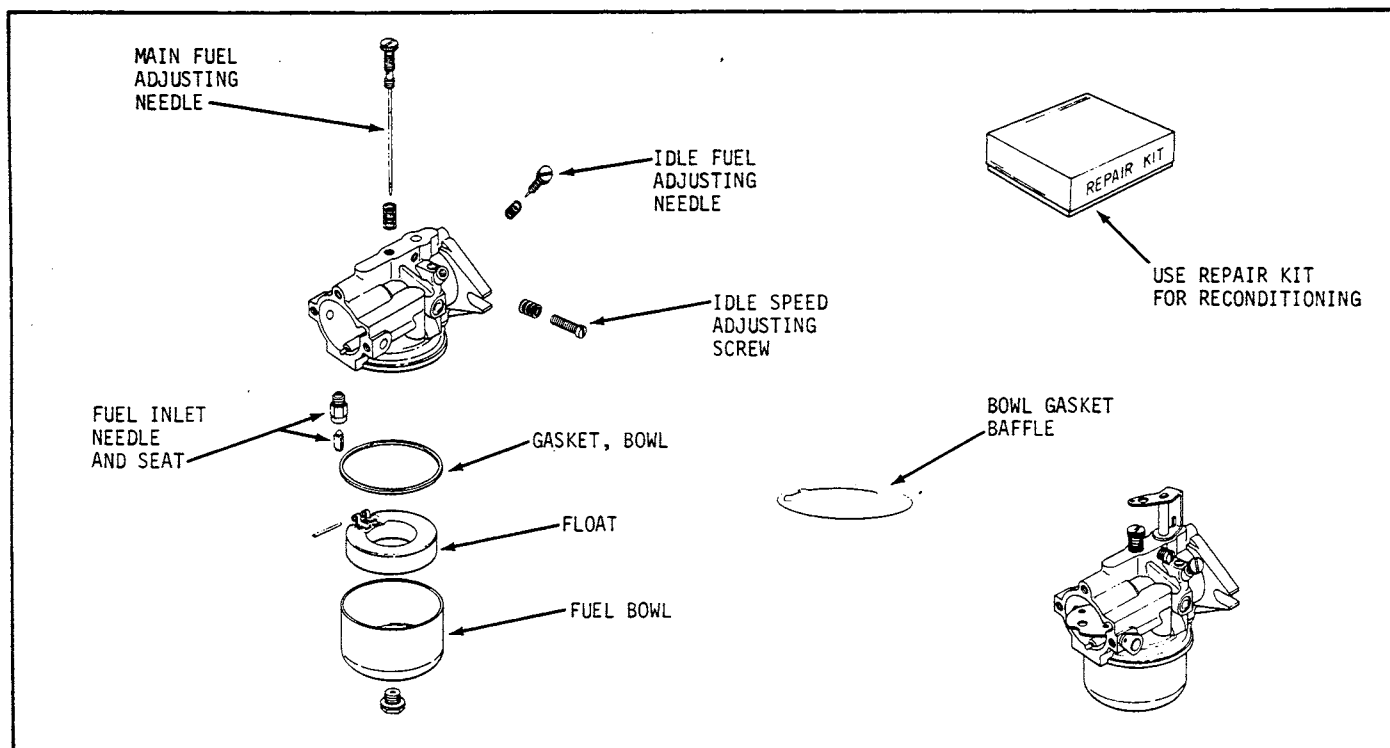
CARBURETOR (GASOLINE TYPE)

Lack of power accompanied by black, sooty exhaust smoke usually indicates that fuel mixture is too rich. An "overrich" mixture may also be caused by a clogged air cleaner--check this before readjusting carburetor. Main Fuel may be set too lean if engine "skips" or backfires at high speed. The following procedure applies to the standard gasoline carburetor.

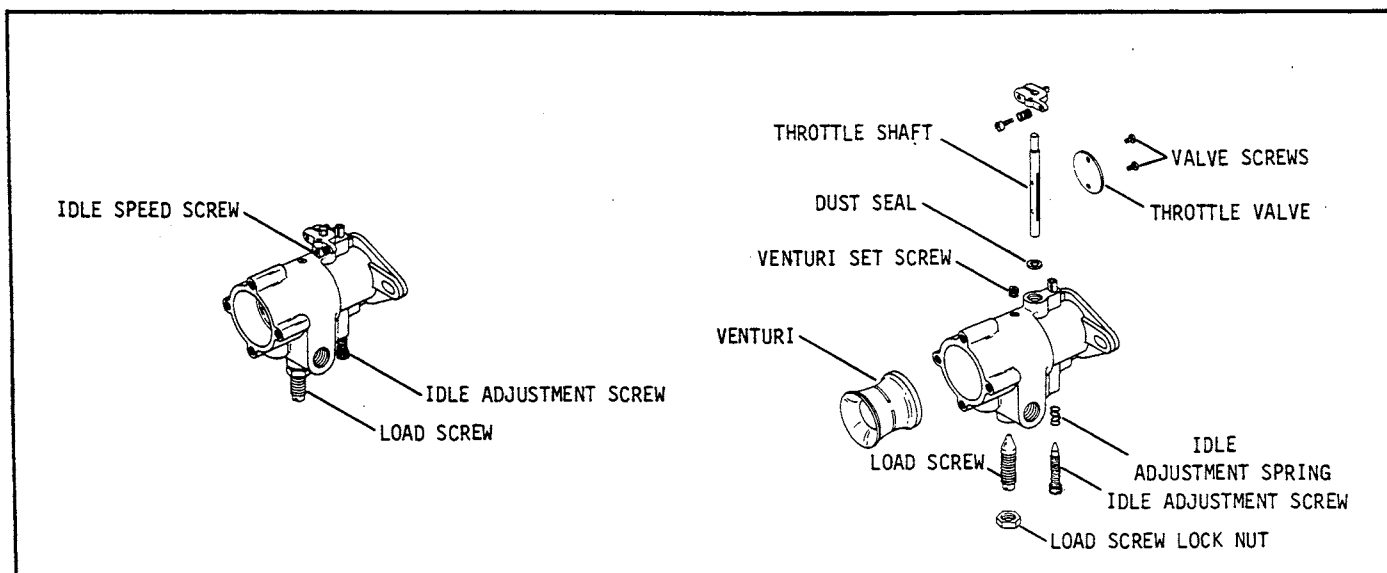
MAIN FUEL ADJUSTMENT: For preliminary setting, turn MAIN FUEL screw in clockwise direction until it bottoms lightly (do not force) then back out 2 turns. With engine thoroughly warmed up and running at full throttle and full load (when possible), turn MAIN FUEL screw in until engine slows down (lean setting) then turn screw back out until engine regains speed and then starts to slow down again (overrich setting)--turn screw back in until it is positioned halfway between lean and overrich settings--

when properly adjusted, engine will accelerate smoothly and operate with steady governor action.

IDLE ADJUSTMENT: Rough idle is usually caused by the idle speed being set too low. Turn IDLE SPEED screw in (clockwise direction) to increase speed. If engine still idles poorly after speed is increased, stop engine and turn IDLE FUEL screw all the way in (clockwise) until it bottoms lightly (do not force screw) then back out 1-1/4 turns. Restart engine and check idle--turn needle in or out (1/4 turn at a time) until smoothest idle is achieved.



GASOLINE CARBURETOR



LP GAS CARBURETOR

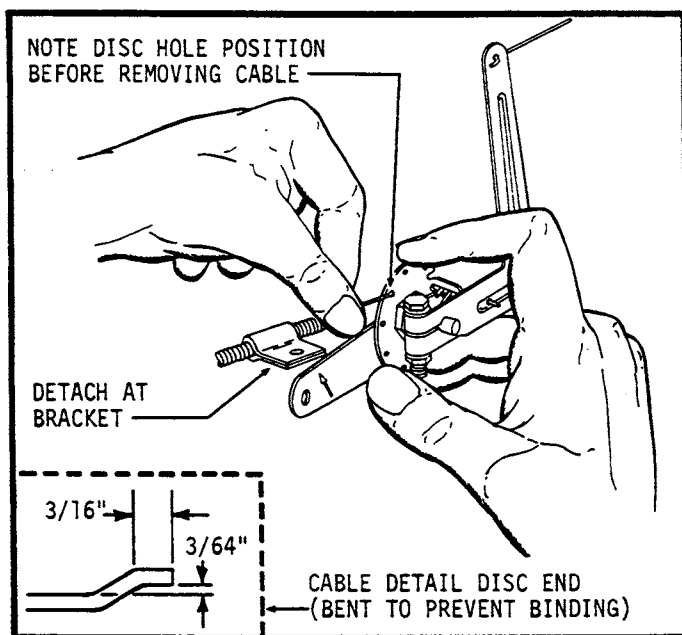
GAS CARBURETOR

Description: Gas carburetors used on Kohler Engines are the horizontal type. The carburetors either have the venturi cast in the body making it an integral part or a replaceable venturi. Due to simplicity in design and few moving parts, the gas carburetor rarely needs attention. A gas carburetor therefore serves to control the ratio of gas to air under varying load and speed conditions.

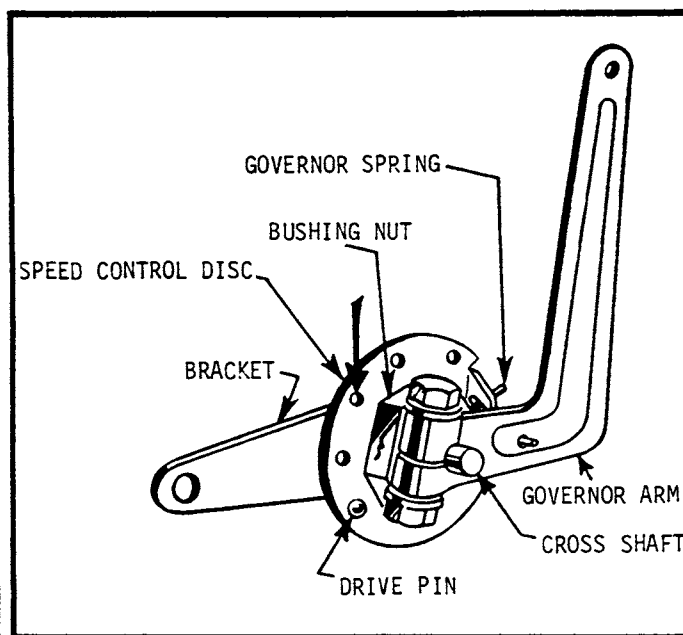
Operation: As the engine is cranked, gas enters the carburetor and passes through the fuel inlet where a load adjustment screw controls the flow of fuel to the venturi nozzle. Air enters the air horn and mixes with the gas entering the venturi at the nozzle. The mixing point of gas and air is located at the point of greatest pressure drop inside the venturi. This creates a suction within the nozzle that varies with the changing rate of air flow and thus meters a greater volume of gas at heavier loads and a decreased value at lighter engine loads. The volume of gas/fuel mixture entering the engine is controlled by the throttle valve (disc).

Adjustment:

1. Check the throttle shaft to make sure it turns freely from closed to open position.
2. Mount carburetor on engine attaching fuel line, governor linkage and air cleaner.
3. Turn in the idle stop adjusting screw approximately 2 turns, so that the throttle valve is held slightly open.
4. Using a screwdriver, close the idle fuel adjusting screw completely.
5. Completely close the load adjustment screw. Open load adjustment screw approximately 5 turns
6. Start engine.
7. Adjust load adjustment screw until engine runs smoothly at governed speed and no load.
8. If engine is required to idle, slowly return the engine speed to idle and adjust the idle adjustment screw for best or smoothest idle. Set the idle stop adjustment for the proper idle speed. Do not attempt to control the idle speed with the idle fuel adjustment.
9. If the engine is not required to idle, leave the idle fuel adjustment screw completely closed. The idle stop adjusting screw on the throttle arm may then be used to adjust for the minimum speed desired.
10. Put the engine under its normal load and readjust the load screw for maximum engine RPM. Tighten load adjustment lock nut if used. Use tachometer if possible for this final load adjustment.



THROTTLE CABLE



GOVERNOR COMPONENTS

GOVERNOR

The governor controls engine speed under changing load conditions and also acts as a speed limiting device. The position of the throttle bracket determines speed range of the engine (arrow indicates direction to decrease speed). The hole in the control disc into which the throttle cable is inserted is also important as this establishes degree of governor control. It is a good idea to permanently mark the exact position of the throttle bracket (scribe mark on crankcase) and also mark the control disc hole used in case linkage becomes disconnected or bushing or arm retaining nuts work loose. When this is done, the governor can be quickly reconnected or reset to the original position.

INITIAL ADJUSTMENT: This is made with engine stopped as follows: Loosen (do not remove) governor arm retaining nut, grasp end of cross shaft in pliers and turn in counterclockwise direction until shaft stops internally. Hold cross shaft in this position, then pull governor arm all the way away from carburetor (with updraft type carburetor, lift arm as far as it will go) and retighten arm nut to complete initial adjustment.

CABLE INSTALLATION: If throttle cable becomes disconnected, use following procedure: Bend end of throttle wire exactly as shown--if carelessly hooked or looped, wire will bind on control disc and cause poor governor control. Move throttle control handle to open position then insert wire into control disc hole nearest to throttle bracket.

SPEED ADJUSTMENT: After readjusting governor, restart engine then move throttle to open position and check top speed with hand tachometer.

1. Loosen the governor bushing just enough to allow the control bracket to be moved.
2. If the speed is to be increased, move the control bracket in the clockwise direction--or in counterclockwise direction to lower the maximum speed.
3. After the desired top speed is attained, retighten the governor bushing--avoid over-tightening for this may cause binding of the cross shaft or it may collapse the bushing threads.

Operating Engine Speed: 2500 + 100 rpm with mainbrush down with a 1 to 1.5 in (25.4 to 38.7 mm) pattern and sidebrush down and propelling engaged.

Idle Engine Speed: 1050 + 100 rpm with brushes up and propelling disengaged.

IGNITION SYSTEM

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

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

Do not sandblast, wire brush, scrape or otherwise attempt to service a plug that is badly fouled or in poor condition--best results are obtained with a new plug. Before installing plug, set gap at .025" for gasoline operation, then tighten the spark plug with a torque wrench to 22 foot pounds.

SPARK PLUG GAP:

Gasoline: .025" (.635 mm)

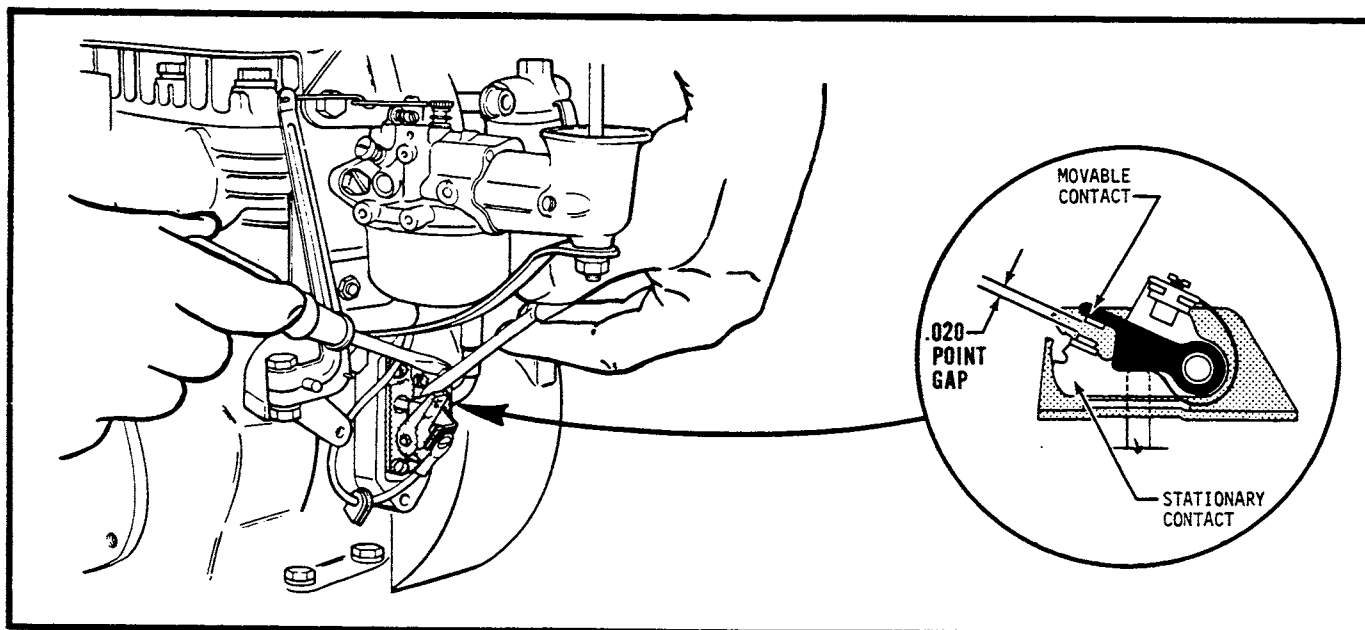
LPG: .018" (.457 mm)

SPARK PLUG TYPE: J-8 or equivalent

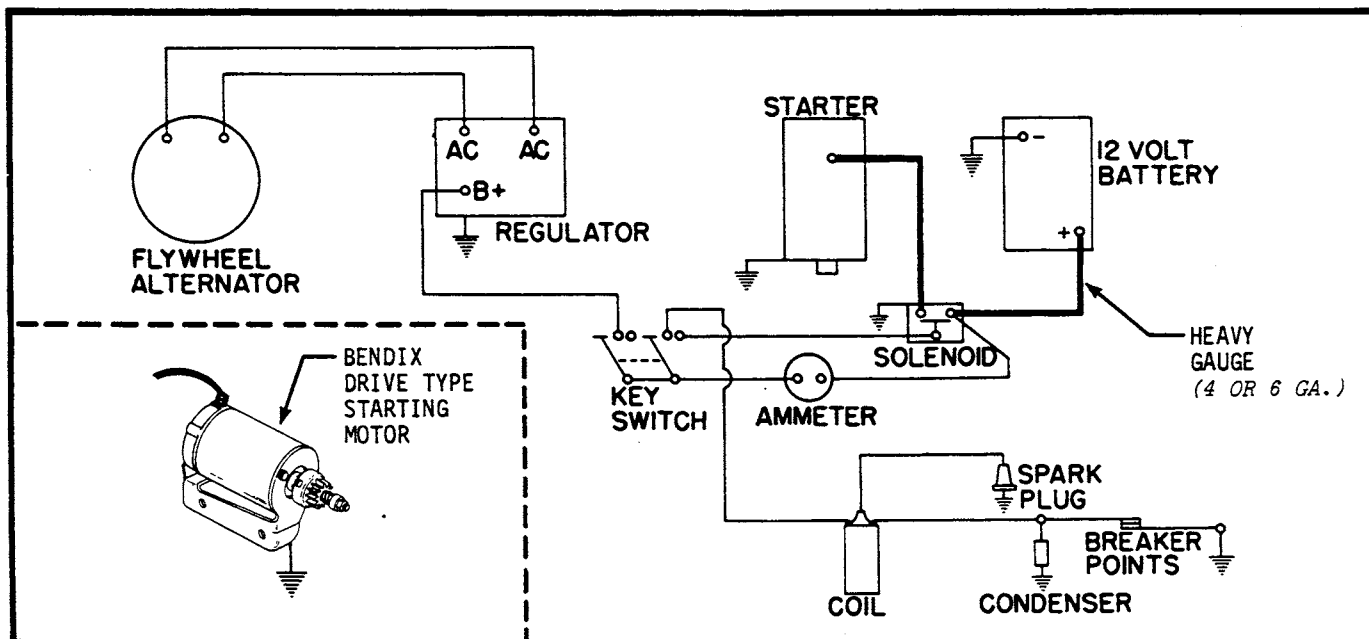
BREAKER POINTS: Every 500 hours breaker points should be inspected and serviced. If oxidized, dirty or oily, lean with coarse cloth--do not use emery cloth or sandpaper. Slightly pitted points can be dressed with point file--replace badly pitted or burned points. The gap must be adjusted whenever points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

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

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



ADJUSTING BREAKER POINT GAP



ALTERNATOR CHARGING SYSTEM WITH STARTING MOTOR AND BATTERY IGNITION CIRCUIT

ELECTRIC START

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

Precautions: In the event of a "false start"; that is, if the engine gets up sufficient speed to disengage the starter but then fails to continue running, the engine must be allowed to come to a complete halt before a restart attempt is made. If the flywheel is still rotating when the starter is engaged, the pinion and ring gear may clash and damage the teeth. Continuous cranking time should be limited to 60 seconds. If an engine fails to start after this length of time, it may be out of fuel, flooded, have poor ignition or there is some other condition preventing it from starting. Make sure the special shouldered capscrews (and lock washers) are used when installing starter. These special capscrews properly align the pinion to the ring gear on the engine--use of ordinary capscrews will allow the starter to shift and result in clashing of the gears. Keep these mounting capscrews tight.

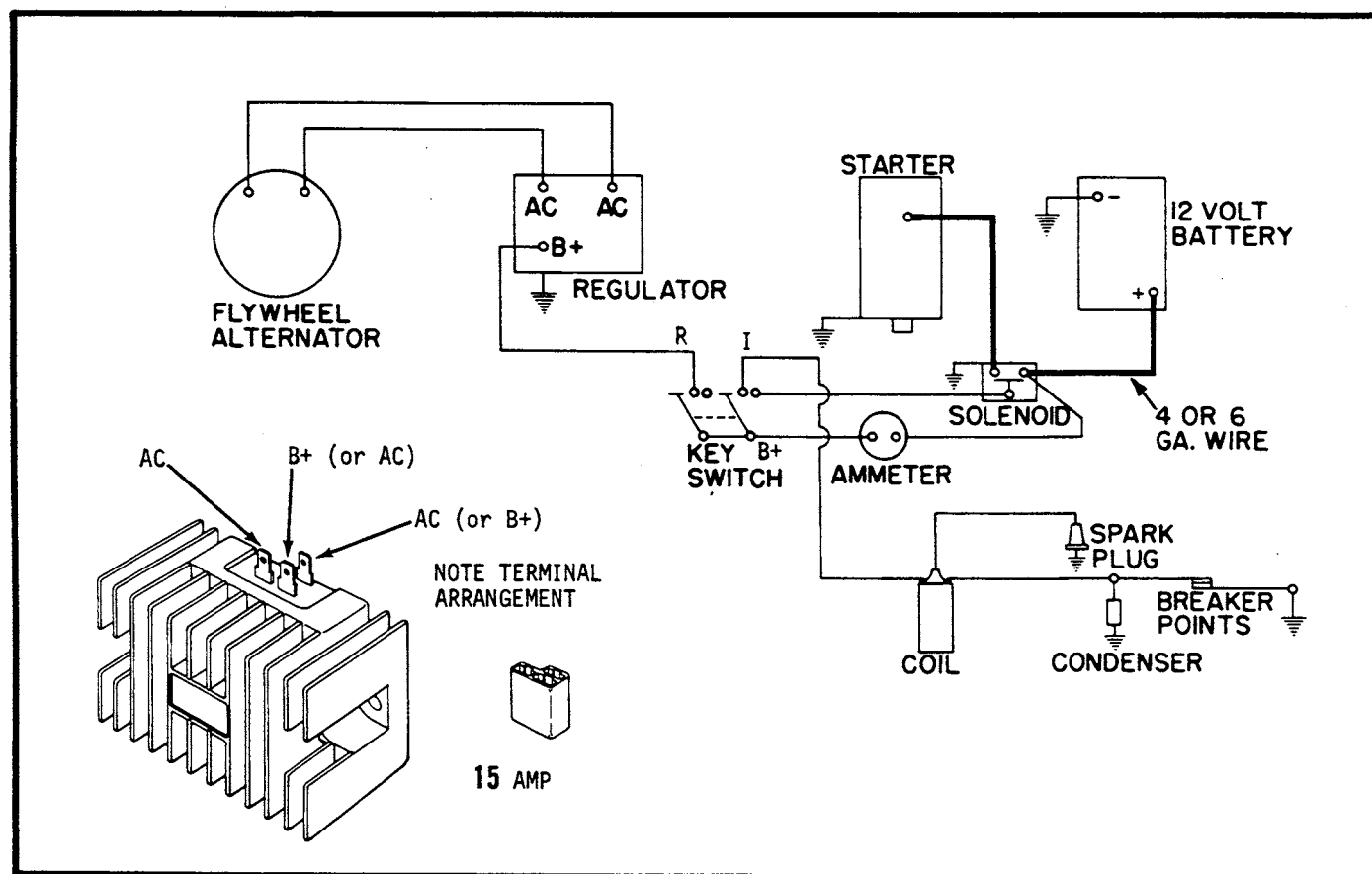
Rectifier-Regulator: The rectifier-regulator unit used with the starting motor system is a solid-state device and is non-serviceable. This unit will be damaged if the engine is operated for any length of time without the battery in the system--also, to protect this unit, disconnect the leads before doing any welding on equipment in common ground with it.

TEST PROCEDURE - STARTER ON ENGINE	
CONDITION	POSSIBLE FAULT AND CORRECTION
A. STARTER FAILS TO ENERGIZE	A-1 Wiring: Check for badly corroded or loose connections, also broken or frayed insulation. Clean and tighten connections, replace wires in poor condition. A-2 Starting Switch or Solenoid: Bypass the switch or solenoid with jumper wire - if starter cranks normally, replace defective part. A-3 Battery: Check specific gravity of battery - if low, recharge or replace battery as necessary.
B. STARTER ENERGIZES BUT TURNS TOO SLOWLY	B-1 Battery: Check condition of battery (See A-3). B-2 Brushes: Remove end cap, check for unevenly worn or dirty brushes and commutator. Use a coarse cloth (not emery paper) to clean. Replace brushes if excessively or unevenly worn. See brush replacement procedure.

15 AMP ALTERNATOR

The 15 amp alternator circuit includes three major components which are: a ceramic magnet ring which is permanently affixed to an inner rim of the flywheel, the alternator stator mounted on the bearing plate of the engine and a rectifier-regulator unit which is mounted either on the engine or on equipment powered by the engine. Terminals on the 15 amp rectifier-regulator are positioned in a different pattern than those on the 10 amp rectifier-regulator to prevent the two systems from being hooked up in error. The 15 amp rectifier-regulator has different solid-state components and therefore cannot be used with any other charging system. The 15 amp unit is slightly larger, physically, than the 10 amp unit. Other main differences are found in the ceramic magnet ring and the alternator stator with more posts and windings which accounts for the higher output than the 10 amp system.

The ceramic ring is permanently assembled with roll pins and compression locking pins on the flywheel first and is then charged magnetically. Because of this and the fact that special tools are required to install the ring, it cannot be ordered or serviced as a separate item. The ceramic material allows better and more complete alignment of magnetic poles of the electrons which thus produces an extremely high strength magnetic field. While ceramic magnets are very strong, the material is brittle and can crack or break if struck with a hard object or when dropped. If the magnets are badly damaged, a new flywheel, complete with new ceramic ring is required--the replacement flywheel must be charged on special equipment at the factory just prior to shipment. When working on engines with this system, avoid any metallic chips or objects that could be attracted to and stick on the magnets.



ALTERNATOR CHARGING-BATTERY IGNITION SYSTEM

Service: No adjustments are possible on the alternator system and field service is not recommended. The faulty part should be replaced by a new part. The Trouble Analysis Chart can be used to pinpoint the faulty part on a 15 amp system.

Tests: There are only a few tests that can be applied to the charging circuit. If the battery is not being charged, check out the battery first for cracked cells, etc., --if the battery proves to be in good condition, that is, the tests reveal it is able to hold charge, the trouble is either in a faulty rectifier-regulator

or in the stator windings. Check stator per test procedures outlined in the accompanying trouble shooting chart.

The ignition circuit functions the same as previously described breakerless and/or battery ignition circuits and should be tested or serviced the same way.

Since the rectifier-regulator will not work (SCR's cannot turn on) without a battery in the system, there are no actual tests that can be performed on this unit with equipment in the field--it will either regulate as required or it will not function at all. If it is not working, check to make sure that a good ground contact is made between rectifier and vehicle or engine--often paint causes poor electrical path here.

Precautions--15 Amp Systems

1. Battery polarity must be correct. Negative ground systems are used with Kohler Engines.
2. Prevent alternator leads (AC) from touching or shorting. This could permanently damage the stator.
3. Disconnect leads at rectifier-regulator before electric welding is done on equipment in common ground with engine.
4. Do not operate for any length of time without a battery in the system.

Pre-Service Procedure

1. Check to make sure that a good ground is provided between the rectifier-regulator unit and the equipment. This must be in common ground with the engine and battery. (See wiring diagram)
2. Check for and correct poor connections or broken wires.

TROUBLE SHOOTING - 15 AMP SYSTEM

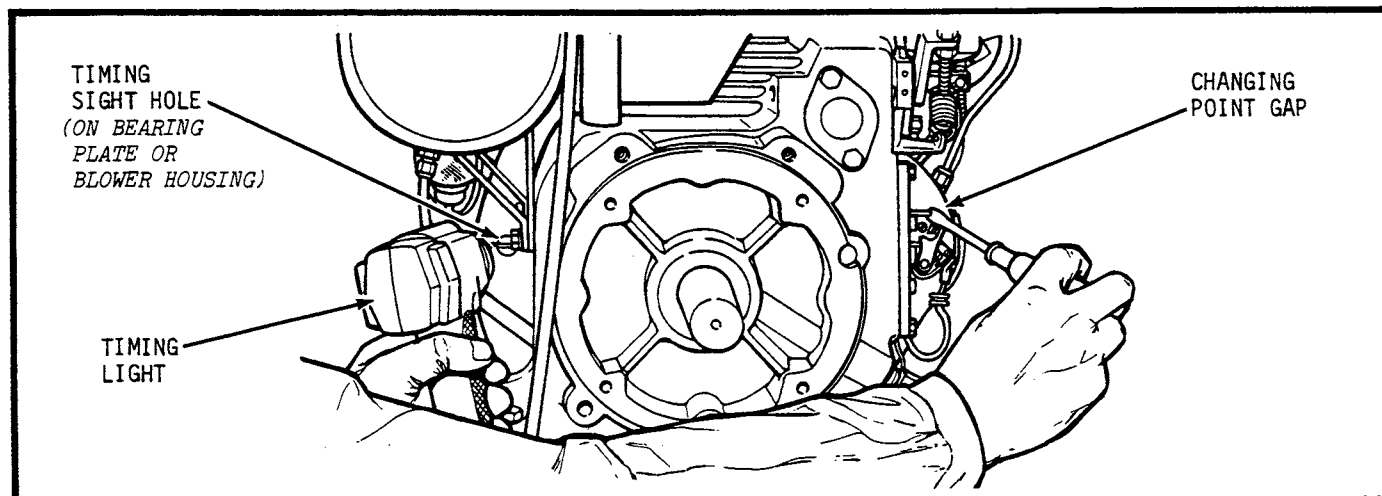
TEST WITH ENGINE RUNNING AT 3600 RPM - NO LOAD

CONDITION: NO CHARGE TO BATTERY	POSSIBLE FAULT/REMEDY
TEST A -- With B+ cable connected, check B+ (at terminal on rectifier-regulator) to ground with DC Voltmeter. If 13.8 volts or higher, place minimum load of 5* amps on battery to reduce voltage: A-1 -- If charge rate increases. A-2 -- If charge rate does not increase.	A-1 -- Indicates alternator system OK, battery was fully charged. A-2 -- Check for defective stator or rectifier-regulator (TEST B).
TEST B -- Unplug leads at rectifier-regulator, connect VOM (multimeter) across AC leads, check AC voltage: B-1 -- If less than 28 volts. B-2 -- If more than 28 volts.	B-1 -- Defective stator, replace with new assembly. B-2 -- Defective rectifier-regulator, replace with new unit.
CONDITION: BATTERY CONTINUOUSLY CHARGES AT HIGH RATE	POSSIBLE FAULT/REMEDY
TEST C -- Check B+ to ground with DC Voltmeter: C-1 -- If over 14.7 volts. C-2 -- If under 14.7 volts.	C-1 -- Rectifier-regulator not functioning properly. Replace with new unit. C-2 -- Alternator system OK. Battery unable to hold charge. Check specific gravity of battery. Replace if necessary.

*Turn lights on if 60 watts or more or simulate load by placing a 2.5 ohm 100 watt resistor across battery terminals.

IGNITION TIMING

Timing is permanently set on breakerless ignition systems--the following adjustment procedure does not pertain to these engines. Engines are equipped with a timing sight hole in either the bearing plate or in the blower housing. A snap button may cover the hole on some--the button is easily pried loose with a screw driver so that the timing marks can be observed. Two timing marks are stamped on



USING TIMING LIGHT FOR CHECKING IGNITION TIMING

the flywheel--the T mark indicates Top Dead Center (TDC) while the S or SP mark indicates the Spark or Spark Run point which is 20° before top dead center.

The same timing procedure is used for both the magneto ignition and battery ignition systems. Two methods can be used for timing--the timing light method is the more precise way of achieving exact timing. The timing light can be used with magneto ignition systems; however, a storage battery will have to be used per timing light manufacturer's instructions.

METHOD 1 - STATIC TIMING: Remove breaker point cover and remove spark plug lead to prevent unintentional starting. Rotate engine by hand in direction of normal rotation (clockwise when viewed from front or flywheel end). Points should just begin to break as the S or SP mark (T mark on K91 and pre-ACR models) appears in the center of the timing sight hole. Continue rotating engine until points reach maximum opening. Measure gap with feeler gauge--gap should be .020" fully open. If necessary, loosen point gap adjustment screw and readjust gap to .020" full open. Maximum gap setting can vary a few thousandths (.018-.022") to achieve smoothest running. Securely tighten adjusting screw after timing.

METHOD 2 - TIMING LIGHT: Several different types of timing lights are available--follow manufacturer's instructions for type used. The following timing procedure can be used with most timing lights:

- A. Remove high tension lead at spark plug--wrap one end of a short piece of fine wire around spark plug terminal. Reconnect lead to terminal--free end of wire must protrude from under boot. (Note: Step A for timing lights with alligator clips--some lights have sharp prongs on spark lead--on these simply push prong thru boot until it contacts metal connector.)
- B. Connect one timing light lead to the wire that has just been wrapped around spark plug terminal.
- C. Connect second timing light lead to hot (ungrounded) side of battery--see timing light instructions for battery size, wiring, etc.
- D. Connect third timing light lead to ground.
- E. Remove snap button, rotate (by hand) engine until S mark visible--chalk S line for easy reading.
- F. Start engine, run at 1200 - 1800 RPM, aim timing light into sight hole--light should flash just as S mark is centered in sight hole or even with center mark on bearing plate or blower housing.
- G. If timing is off--remove breaker point cover, loosen gap adjusting screw, shift breaker plate until S mark is exactly centered. Retighten adjusting screw before replacing breaker point cover.

TROUBLE SHOOTING

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

TROUBLE SHOOTING GUIDE

<u>HARD STARTING OR LOSS OF POWER</u> a. Faulty ignition. 1. Leads grounded or loose. 2. Breaker points faulty or improperly gapped. 3. Spark plug faulty or improperly gapped. 4. Coil or condenser defective. b. Faulty carburetion. 1. Fuel line clogged (dirt-gum) 2. Fuel pump faulty. 3. Carburetor dirty or improperly adjusted. c. Poor compression. 1. Head loose or gasket leaking. 2. Valves sticking or leaking. 3. Piston rings worn.	<u>OPERATING ERRATICALLY</u> a. Clogged fuel line. b. Water in fuel. c. Vent in gas cap plugged. d. Faulty fuel pump. e. Gasket leaking (carb.-manifold) f. Governor improperly set. g. Carburetor improperly adjusted. <u>KNOCKING</u> a. Fuel octane too low. b. Ignition timing wrong c. Carbon build-up in combustion chamber. d. Engine overheated. <u>OCCASIONAL "SKIP" AT HIGH SPEED</u> a. Spark plug fouled, faulty or gap too wide. b. Ignition timing wrong c. Carburetor improperly adjusted.	<u>OVERHEATING</u> a. Air intake screen or fins clogged. b. Oil level too high (or low). c. Fuel mixture too lean d. Ignition timing wrong e. Engine overloaded. f. Tappet clearance too close. <u>IDLES POORLY</u> a. Idle Speed too low. b. Idle Fuel improperly adjusted. c. Gasket leaking (carb.-manifold) d. Spark plug gap too close. <u>BACKFIRING</u> a. Carburetor set too lean (Main Fuel). b. Breaker points improperly gapped (timing). c. Valve sticking.
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COOLING & EXTERNAL SURFACES

Air is drawn into the cooling shroud by fins provided on the flywheel. The rotating air screen and the cooling fins on the block and cylinder head must be kept clean and unobstructed at all times. Never operate engine with blower housing or cooling shrouds removed. These direct air flow past cooling fins. Removal results in improper air circulation and overheating. External surfaces must be in clean condition free of any oil and dirt accumulation.

STORAGE INSTRUCTIONS

Use the following procedure to preserve engine before placing in storage. Drain oil from crankcase (while hot) then flush with clean light oil. Refill crankcase after flushing. Drain fuel from tank, sediment bowl and carburetor. Clean exterior of engine then spread light film of oil over surfaces subject to corrosion (unpainted metal surfaces). Pour tablespoon of oil into spark plug hole, turn engine over several times by hand then reinstall plug. Cover engine and store in dry place.

INSPECTION-DISASSEMBLY

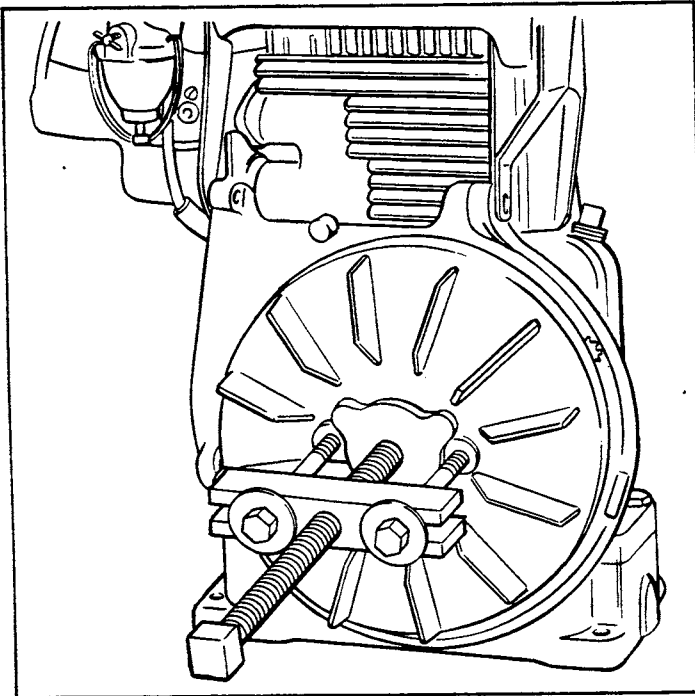
When disassembling an engine, carefully inspect and note the physical appearance of each of the components. Often the appearance of parts will indicate operation under other than ideal conditions. In observing these indicators, you may be able to suggest improved service and operating techniques which will result in prolonged engine service life. Some of the things to look for are:

1. Excessive sludge and varnish formation.
2. Scoring of the cylinder walls.
3. Severe piston damage.
4. Evidence of external oil leakage.

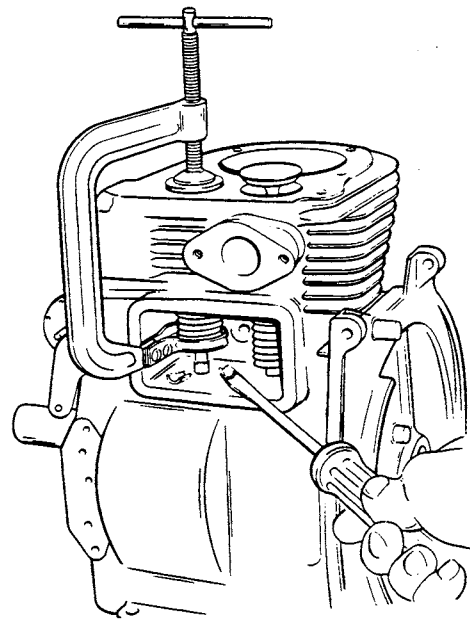
Sludge is a natural by-product of combustion and a small accumulation is normal. Excessive sludge formation could indicate several things. The most common cause is perhaps too infrequent lubricating oil changes. It can also indicate operation with improper ignition timing or overrich carburetor adjustment or a poorly serviced clogged air cleaner which restricts air intake and also results in an overrich mixture.

Scoring of the Cylinder Wall

Unburnt fuel not only adds to sludge formation but can, in severe cases, cause scuffing and scoring of the cylinder walls. As raw fuel seeps down the cylinder walls, it washes the necessary lubricating oils off the piston and cylinder walls so that the piston rings make metal to metal contact with the walls. Scoring of the cylinder walls can also be caused by localized hot spots resulting from blocked cooling fins or from inadequate or contaminated lubrication.



REMOVE FLYWHEEL WITH PULLER



USING VALVE COMPRESSOR

Severe Piston Damage

Major damage to pistons and rings can take various forms. The top of the piston ring may be burned through or the top groove may be excessively worn and the ring broken or stuck in the groove. This can be attributed to abnormal combustion. If ignition timing is overadvanced, ignition will occur while the piston still has a long distance to travel on its compression stroke. As a result, the combined heat of compression plus the heat of pre-ignited fuel raises temperatures to values comparable to that of an acetylene torch. This, of course, acts mainly on the top land and top ring of the piston and results in early failure.

Evidence of External Oil Leakage

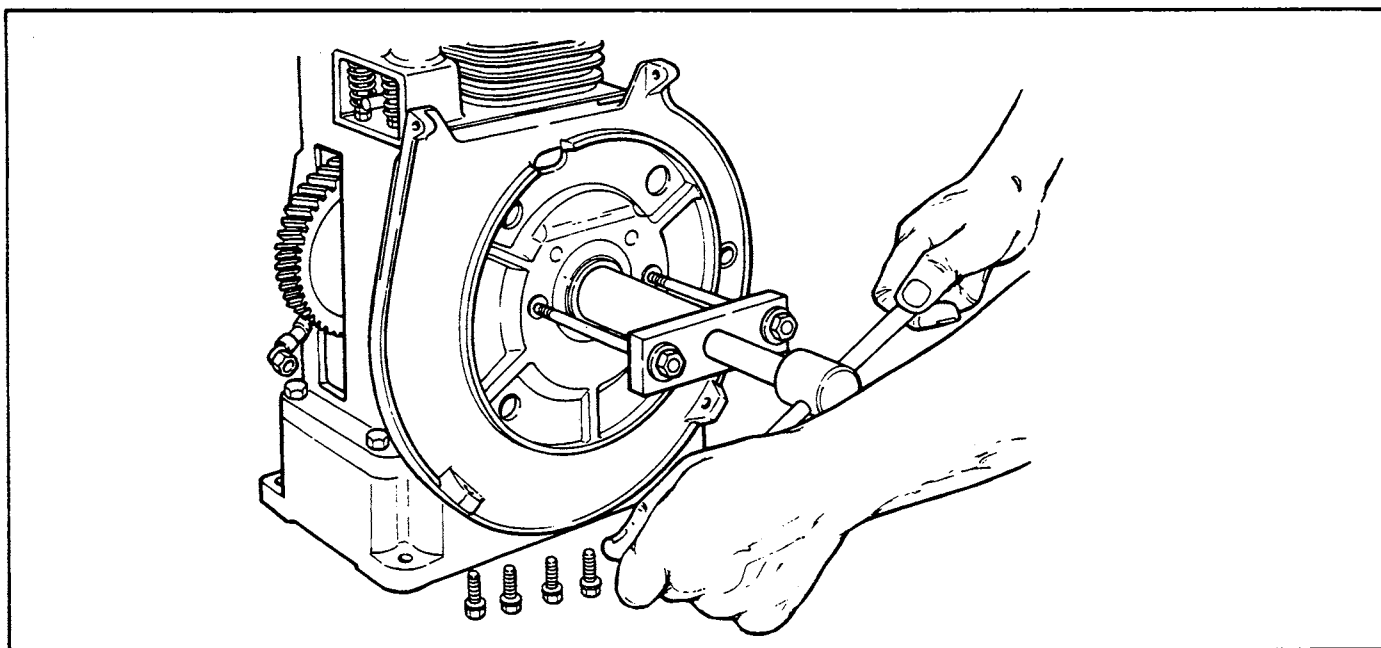
If excessive oil leakage is evident, this may indicate improperly serviced breather systems. Normally, an engine operates internally at pressures under atmospheric or, in other words, with a negative crankcase pressure. If positive pressures build up within the crankcase from a clogged breather or from piston blow-by, oil will be forced out of an engine at oil seals, gaskets or any other available spot.

These are just a few of the more common indicators. Numerous others exist and are obvious to the experienced mechanic. Often the cause will become apparent in view of the particular condition of the part. Always look for these signs when disassembling an engine prior to reconditioning.

DISASSEMBLY PROCEDURE

The following is intended as a guide to disassembly of the standard engine models -- the sequence may have to be varied slightly to facilitate removal of special equipment or accessory items such as motor - generators, starters, instrument panels, etc.

1. Disconnect lead and remove spark plug.
2. Close valve on sediment bowl, remove fuel line at carburetor.
3. Remove air cleaner from carburetor intake.
4. Remove carburetor.
5. Remove fuel tank. Sediment bowl and brackets remain attached to tank.
6. Remove blower housing, cylinder baffle and head baffle.
7. Remove rotating screen and starter pulley.
8. Flywheel is mounted on tapered portion of the crankshaft. Use of a puller is recommended for removing flywheel. Bumping end of crankshaft with hammer to loosen flywheel should be avoided as this can damage crankshaft.
9. Remove breaker point cover, breaker point lead, breaker assembly and push rod.
- 10.
11. Remove valve cover and breather assembly.
12. Remove cylinder head.
13. Raise valve springs with a spring compressor and push valve keepers off valve stems. Remove valve spring retainers, springs and valves.
14. Remove oil base and unscrew connecting rod cap. Remove piston assembly from cylinder block.
15. Remove crankshaft, oil seals and, if necessary, antifriction bearings. It may be necessary to press crankshaft out of cylinder block. Bearing plate should be removed first if this is done.
16. Turn cylinder block upside down and, using a small punch, drive camshaft pin out from power-take-off side of engine. Pin will slide out easily after it is driven free of block.
17. Remove camshaft and valve tappets.
18. Loosen and remove governor arm from governor shaft.
19. Unscrew governor bushing nut and remove governor shaft from inside of cylinder block.
20. Loosen (do not remove) screw located to lower right of governor bushing nut until governor gear is free to slide off stub shaft.



-- REMOVING BEARING PLATE WITH PULLER

ENGINE RECONDITIONING

All parts should be thoroughly cleaned--dirty parts cannot be accurately gauged or inspected properly for wear or damage. There are many commercially available cleaners that quickly remove grease, oil and grime accumulation from engine parts. If such a cleaner is used, make sure that all trace of the cleaner is removed before the engine is reassembled and placed in operation. Even small amounts of these cleaners quickly break down the lubricating properties of engine oils.

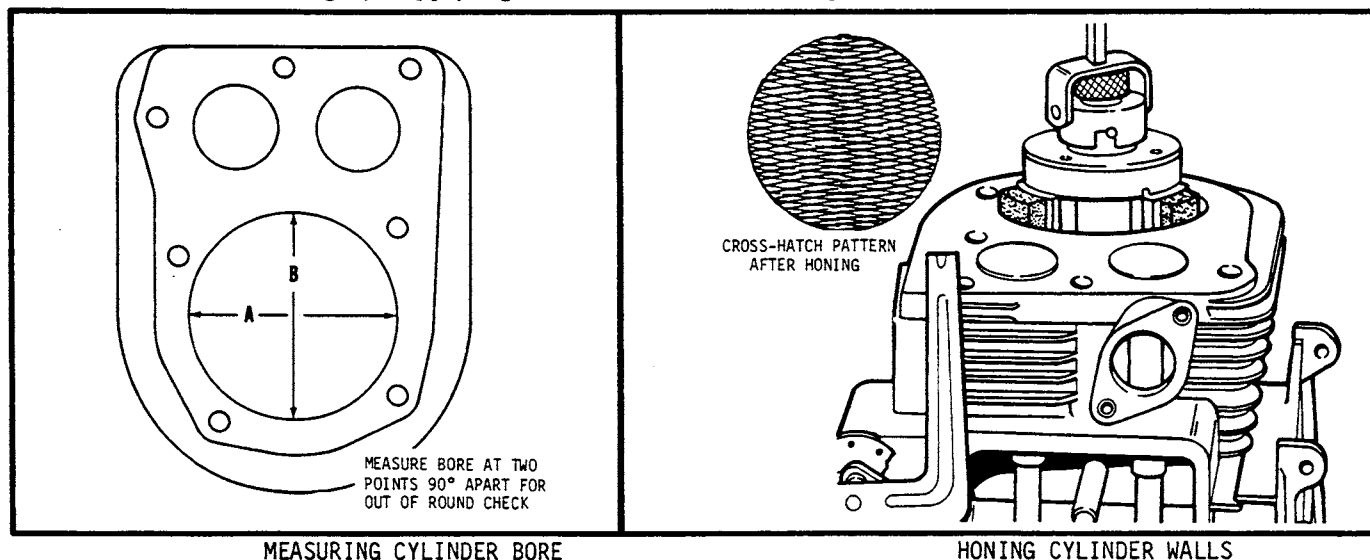
CYLINDER BLOCK

1. INSPECTION

- A. Gasket surfaces - Check all surfaces to make sure that they are free of gasket fragments and sealer materials. Surfaces must also be free of deep scratches or nicks.
- B. Bearings - (Crankshaft) - One bearing is pressed into the cylinder block--the other is located in the bearing plate. Do not remove bearings unless they show signs of damage and are to be replaced. (See Reconditioning - Cylinder Block.) If the bearings turn easily and noiselessly and there is no evidence of scoring or grooving on the races, the bearings can be reused.
- C. Cylinder bore - If badly scored, excessively worn or tapered or out of round more than .005, reboring is necessary. Use an inside micrometer to determine amount of wear (See Fits and Clearance Section). If cylinder bore is not damaged and is within tolerances, only light deglazing may be necessary.

2. RECONDITIONING - CYLINDER BLOCK

- A. Remove old oil seal from block but do not install new seal until after crankshaft is reinstalled.
- B. Reboring procedure - See Clearance Section for original cylinder bore size. Use an inside micrometer to measure wear then select nearest suitable oversize of either .010, .020 or .030". Reboring to one of these oversizes will allow usage of the available oversize piston and ring assemblies. While most commercially available cylinder bores can be used with either portable drills or drill presses, the use of a low speed drill press is preferred as it facilitates more accurate alignment of the bore in relation to the crankshaft crossbore. Reboring is best accomplished at drill speed of about 600 RPM. After installing coarse stones in hone, proceed as follows:
 - B1 - Lower hone into bore and after centering, adjust so that stones are in contact with walls. Diesel fuel oil or kerosene can be applied to the stones as a cutting-cooling agent.
 - B2 - With the lower edge of each stone positioned even with the lowest edge of the bore, start drill and honing process. Move hone up and down while reboring to prevent formation of cutting ridges. Check size frequently.
 - B3 - When bore is within .0025 of desired size, remove coarse stones and replace with burnishing stones. Continue with burnishing stones until within .0005 of desired size then use finish stones and polish to final size.
 - B4 - After reboring, carefully clean cylinder wall with soap and water, then after drying thoroughly, apply light coat of SAE 10 oil to prevent rust.



CRANKSHAFT

1. **Keyways--Gears** - If keyways for flywheel are badly worn or chipped, replacement of the crankshaft may be necessary. Broken or badly worn cam gear teeth will also necessitate replacement of shaft.
2. **Crankpin** - Inspect crankpin for score marks or metallic pickup. Slight score marks can be cleaned with crocus cloth soaked in oil. If wear limits, as stated in Clearance Section, are exceeded by more than .002", it will be necessary to either replace crankshaft or regrind the crankpin to .010" undersize. If wear is moderate, the .010" undersize connecting rod (big end) must then be used to achieve proper running clearance.

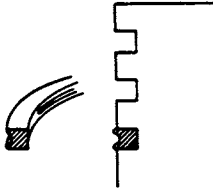
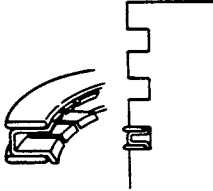
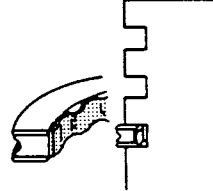
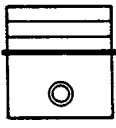
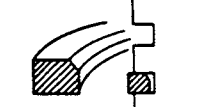
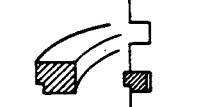
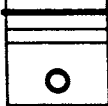
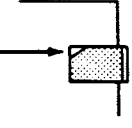
CONNECTING ROD

1. Check bearing area (big end) for excessive wear, score marks, running and side clearance. Replace rod and cap if worn beyond limits stated.
2. Connecting rods with bearing area .010" undersize are available for use with reground crankpin.

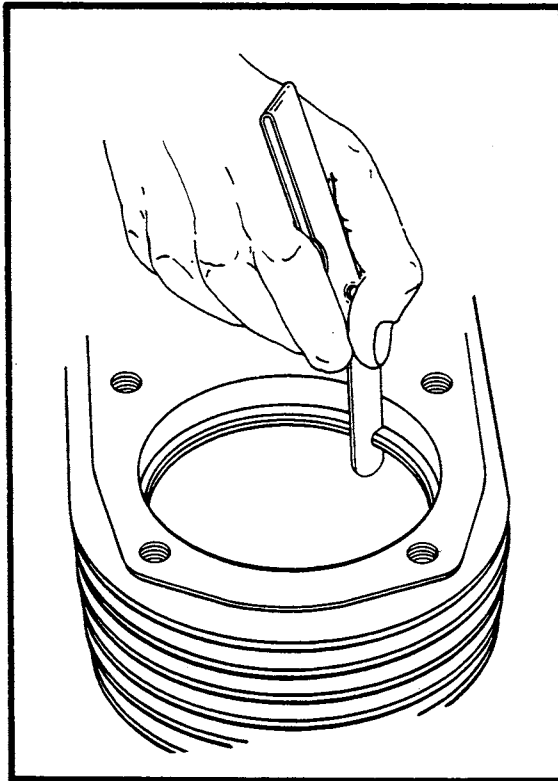
PISTON — PISTON RINGS

Production type and service type ring replacement sets are available in the standard size plus .010", .020" and .030" oversize sets. The production standard type set is used only when cylinder is not worn or out of round. Production oversize sets are used only when cylinder has been rebored to the corresponding oversize. Service type sets are used when cylinder is worn but within wear and out of round limits (wear limit .005" oversize, out of round limit .004"). Service sets usually include expanders or other arrangement to provide uniform pressure on ring and better conformity to cylinder wall regardless of wear. Cylinder bore must be deglazed before service ring sets are used. Chrome plated rings, when used, should be installed in the top groove.

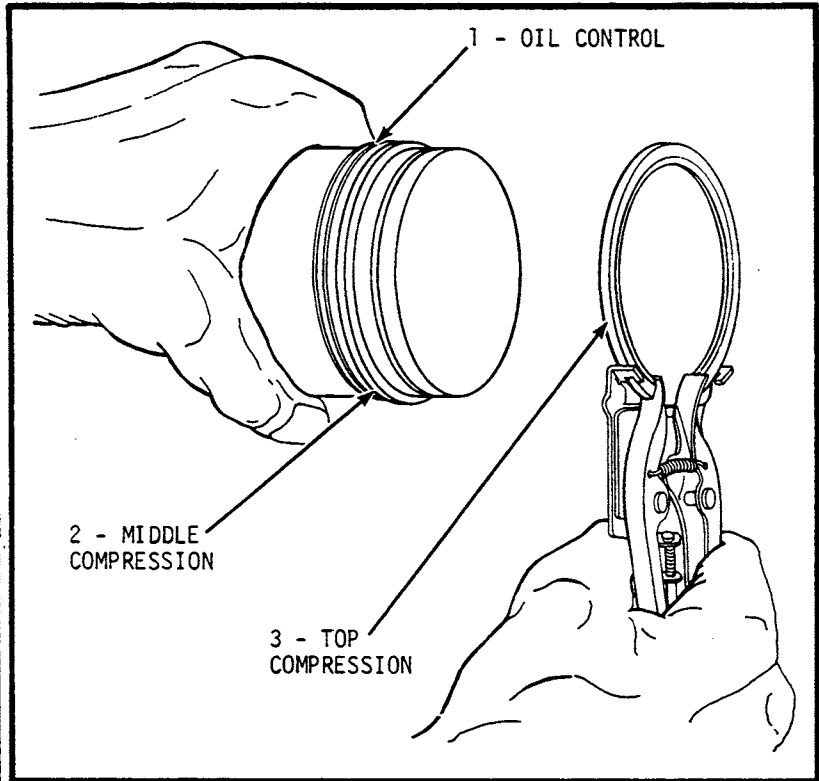
1. If the cylinder block does not need reboring and if the old piston is within wear limits and free of score or scuff marks, it may be reused. Never reuse old rings, however.
2. Remove old rings and clean up grooves.
3. Before installing new rings on piston, place each ring in turn in its running area in cylinder bore and check end clearance.
4. Rings must be installed according to markings on rings. Generally compression rings must be installed with groove or bevel up when this is on inside diameter of ring. The chrome ring, when

BOTTOM GROOVE	PROD. (SINGLE) 	PROD. (3 PIECE) 	SERVICE (4 PIECE) 	INSTALL BOTTOM RING FIRST 
MIDDLE GROOVE	PROD. TYPE 	PROD. TYPE 	PROD. TYPE 	SERVICE (3 PIECE) 
TOP GROOVE	INSTALL TOP RING LAST 	INSIDE BEVEL  RING WITH INSIDE BEVEL UP OR WITH "TOP" MARKING UP		

-- PRODUCTION TYPE AND SERVICE TYPE RINGS



MEASURING PISTON RING END GAP



RING INSTALLATION SEQUENCE

used, must be installed in the top groove. When bevel is on outside of ring, install in down position or toward skirt. Ring installation instructions are usually included with new ring sets. Follow instructions carefully. Use ring expander to install rings and check side clearance of each ring after installation.

PISTON - ROD ASSEMBLY

Normally very little wear takes place in the piston boss-piston pin area. If the original piston and connecting rod can be reused after reconditioning, the pin will usually not have to be replaced. A new piston pin should be used when a new connecting rod is used with the original piston. After checking pin, rod and piston boss to make sure proper clearances are available, lubricate pin then assemble piston to rod with pin (light interference to loose fit) and lock pin with new retainers--make sure retainers are fully engaged in grooves.

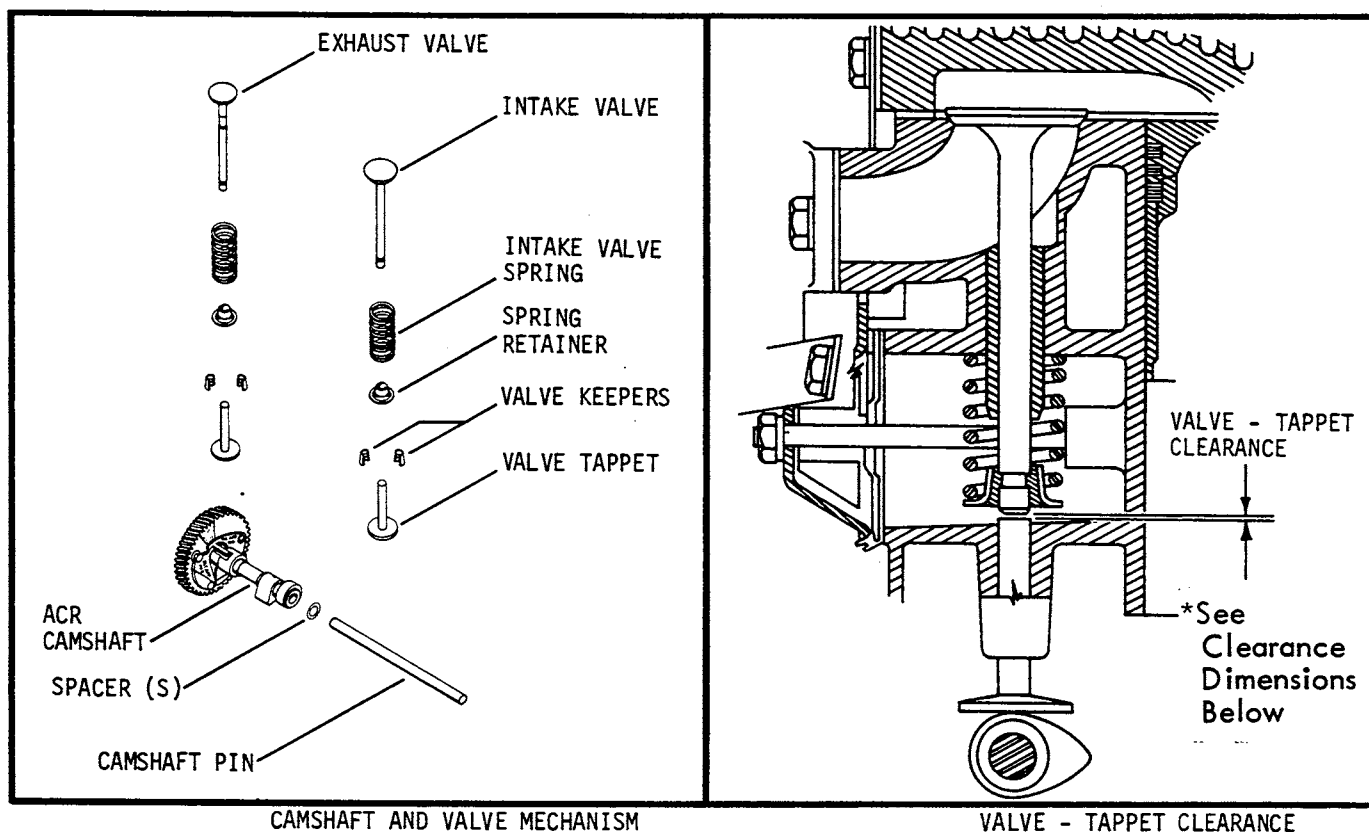
VALVES - VALVE MECHANISM

Carefully inspect valve mechanism parts. Check valves and valve seat area or inserts for evidence of deep pitting, cracks or distortion. Check clearance of valve stems in guides--refer to page 15.4 for valve details.

Guides: Guides must be replaced if worn sufficiently to allow valve stem-guide clearance to exceed limits stated in the Wear Tolerance Chart

Valve guides are not used on K91 models. To remove, press guide down into valve chamber and carefully break protruding end until guide is completely removed--be careful not to damage block when removing old guide. Use an arbor press to install new guides--press to depth specified then use a valve guide reamer and ream new guide to specified I. D.

Valves and Valve Seats: Consult parts manual for correct valve numbers when replacing valves. Some applications require special hard faced valves for both intake and exhaust valves. Exhaust valves are always hard faced. Intake valve seats are usually machined into block although inserts are used in certain applications. Exhaust valves seat on special hardened inserts. Seating surfaces should be held as close as possible to 1/32" width. Seats with more than 1/16" must be reconditioned with 45° and 15° cutters to obtain proper width. Reground or new valves must be lapped in to provide proper fit. Use a hand valve grinder with suction cup for final lapping. Lightly coat valve face with "fine" grade of grinding compound then rotate valve on seat with grinder. Continue grinding until smooth surface is obtained on seat and on valve face.



Valve Clearance: Valve clearance must be checked after resurfacing and lapping in. Install valves in guides, rotate camshaft to position where cam has no effect on tappet--hold valve firmly on seat and check clearance between valve stem and tappet (See Clearance Section). If clearance is insufficient, it will be necessary to grind end of valve stem until correct clearance is attained. Make sure stem is ground perfectly flat.

*Valve stem to tappet clearance: Intake .006" to .008 (.152 to .203 mm)
Exhaust .015" to .017" (.381 to .432 mm)

CYLINDER HEAD

Blocked cooling fins often cause localized "hot spots" which can result in "blown" cylinder head gaskets. If gasket fails in area surrounding one of the retaining capscrews, high temperature combustion bases can burn away portions of aluminum alloy head. If no evidence of this is found, head should be checked for flatness. A slightly warped head can be resurfaced by simply rubbing it on a piece of sandpaper positioned on a flat surface. Carefully clean carbon deposits from cylinder head if it is to be reused--use putty knife or similar blade to scrape deposits. Be careful not to nick or scratch aluminum, especially in gasket seat area.

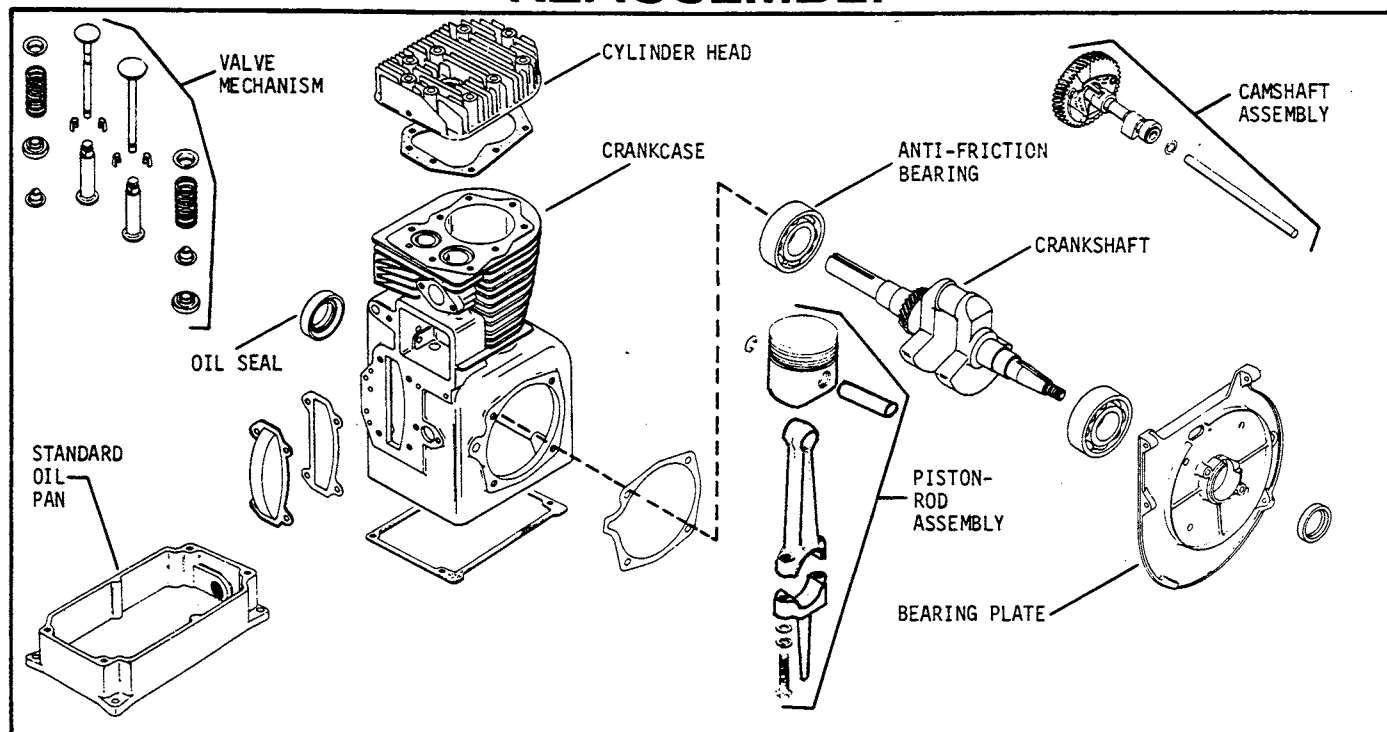
RING GEAR

If inspection of the ring gear reveals broken, excessively worn or otherwise damaged teeth, the ring gear must be replaced. The ring gear is press fitted into a recess on the outer perimeter of the flywheel. The flywheel must be off the engine for ring gear replacement.

Several methods may be used to remove the damaged ring gear. One method is to break the gear with a cold chisel and/or a hack saw. Another way is to heat the ring gear with a torch, then drive the gear off the flywheel. If the latter method is used, the flywheel will also absorb some heat and it must be allowed to cool before the new ring gear can be installed.

The new gear must be expanded with heat before installation. This can be done by submerging the gear in hot oil or heating in oven to about 400 to 450° F. Position the heated gear on the flywheel, then after making sure it is not cocked, either press the gear on with an arbor press or drive it on with a soft-head hammer. As the gear cools, it will contract to form a tight press fit on the flywheel. Be sure to tighten the flywheel retaining nut to the proper torque value after reinstalling the flywheel on the engine.

REASSEMBLY



EXPLODED VIEW, MAJOR COMPONENTS OF TYPICAL ENGINE

1. Rear Main Bearing

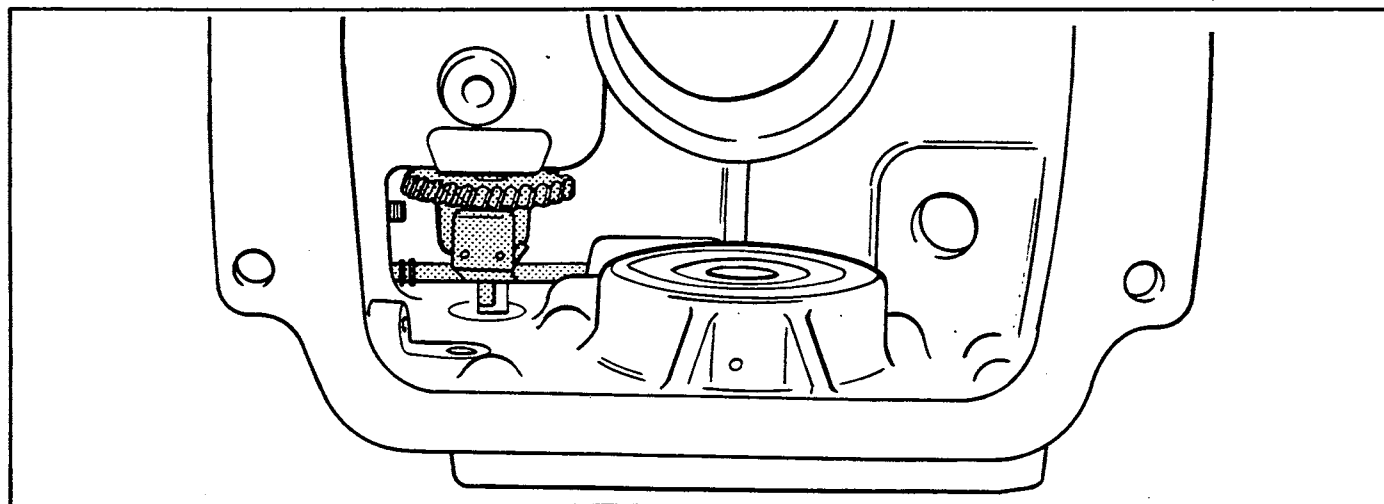
- a. Install rear main bearing by pressing it into cylinder block with shielded side facing toward inside of block--if using unshielded type bearing, either side can face inside.

2. Governor Shaft

- a. Most engines have a cross shaft with an extension riveted in place to line up with governor gear. A needle bearing or bushing on later models is provided in block to hold cross shaft in alignment.

3. To Install Governor

- a. Place cylinder block on its side. Slide governor shaft into place from inside of block. Place speed control disc on governor bushing nut and thread bushing nut into block, clamping throttle bracket into place.
- b. The governor shaft can be adjusted for end clearance by moving needle bearing in block. Set bearing to allow a slight back-and-forth movement of the shaft.
- c. Place space washer on stub shaft and slide governor gear assembly into place.
- d. Tighten holding screw from outside of cylinder block. Screw prevents governor gear from sliding off stub shaft during assembly.
- e. Rotate governor gear assembly to be sure holding screw does not contact weight section of gear.



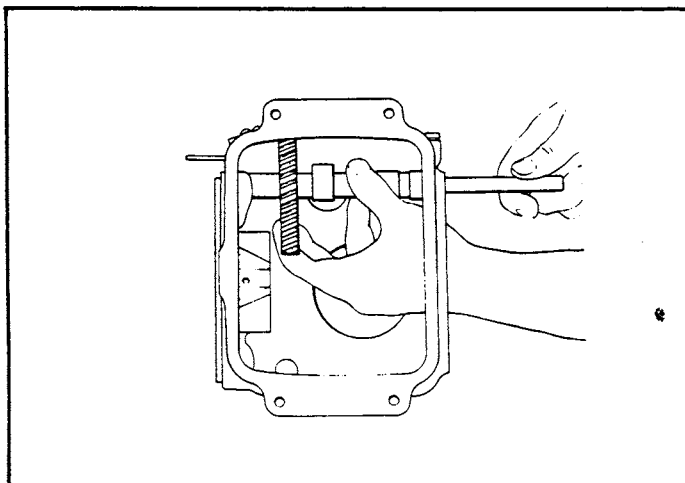
GOVERNOR GEAR ASSEMBLY IN CRANKCASE

4. Camshaft Installation

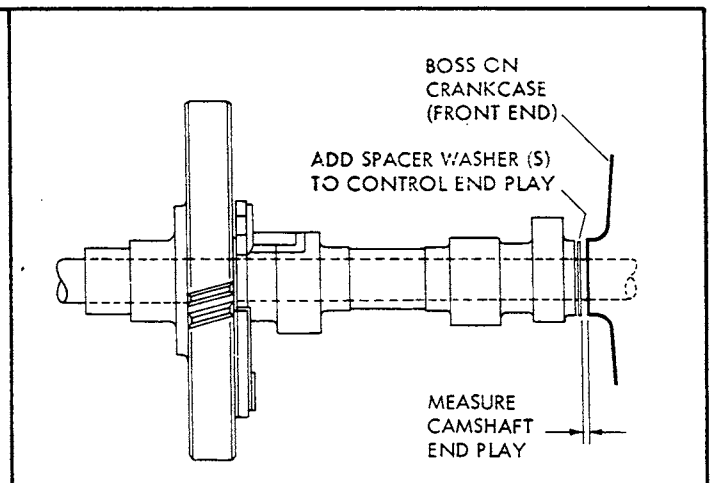
- a. Turn cylinder block upside down.
- b. Tappets must be installed before camshaft is placed. Lubricate and insert tappets in valve guides -- on K141, K161, K181 ACR engines make sure shorter tappet is installed in exhaust valve guide.
- c. Position camshaft inside block. Note: On pre-ACR models with the automatic spark advance camshaft, spread actuators and insert cam -- align timing marks on cam and on gear as shown.
- d. Lubricate rod then insert into block (bearing plate side). Before pushing rod through camshaft, slip one .005" washer (end play) between end of camshaft (opposite gear end) and block. Push rod through camshaft and tap lightly until rod just starts into bore at P.T.O. end of block. Check end play with feeler gauge -- if within tolerance press rod into final position or remove rod and add (or subtract) .005 and .010" thick washers as necessary to attain proper end play (See Fits and Clearance Section).
- e. While rod is a tight press fit at P.T.O. end of block, a light to loose fit is necessary at the bearing plate end. New bearing plate gaskets have notch to allow any oil that may leak past to drain back into block. If gasket is not notched, apply gasket sealer around end of rod (outside block) to seal when bearing plate and gaskets are installed.

5. Crankshaft Installation

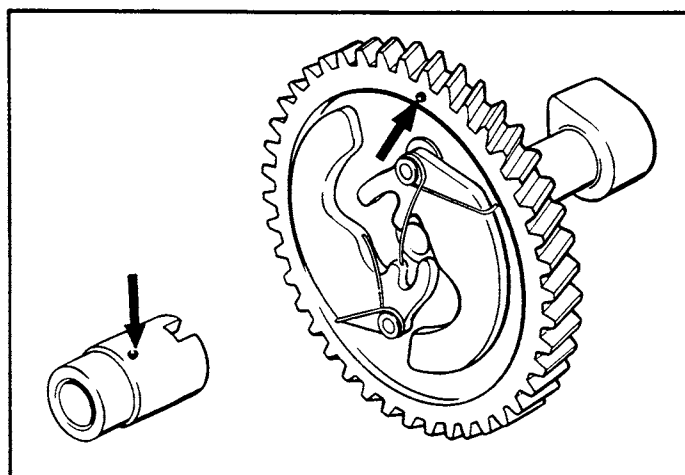
- a. Place block on base of arbor press and carefully insert tapered end of crankshaft through inner race of antifriction bearing
- b. Turn crankshaft and camshaft until timing mark on shoulder of crankshaft lines up with mark (dot) on cam gear as shown
- c. When marks are aligned, press crankshaft into bearing -- make sure gears mesh as shaft is pressed into bearing. After shoulder bottoms against inner race, recheck timing mark to make sure they are still aligned.
- d. Crankshaft end play is controlled by the thickness of gaskets used between the bearing plate and block. End play must be checked after bearing plate is installed -- directions stated in Step 6.



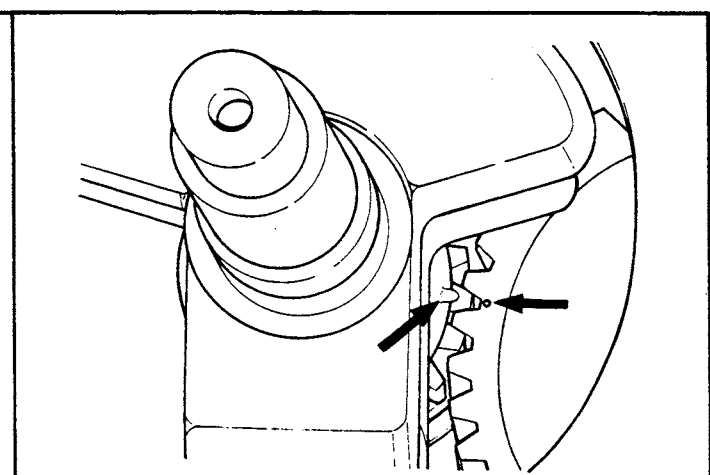
INSTALLING CAMSHAFT



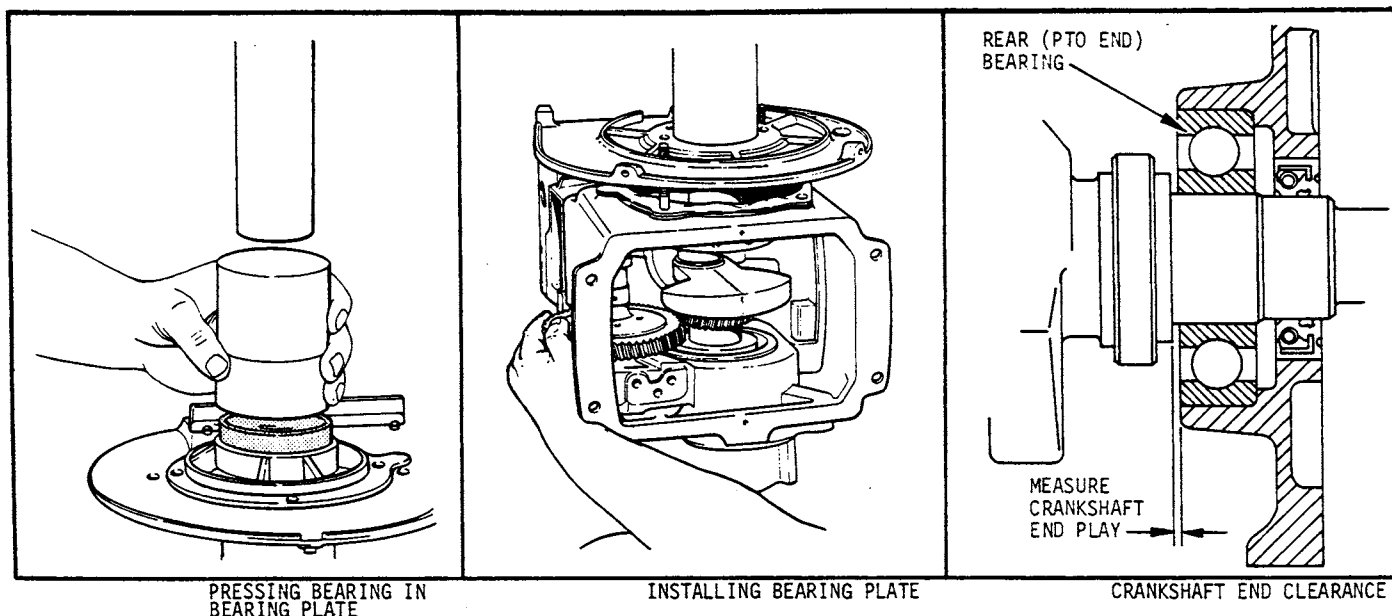
CAMSHAFT END PLAY



TIMING MARKS ON AUTOMATIC SPARK
ADVANCE CAMSHAFT



TIMING MARKS ON CRANKSHAFT AND CAMSHAFT

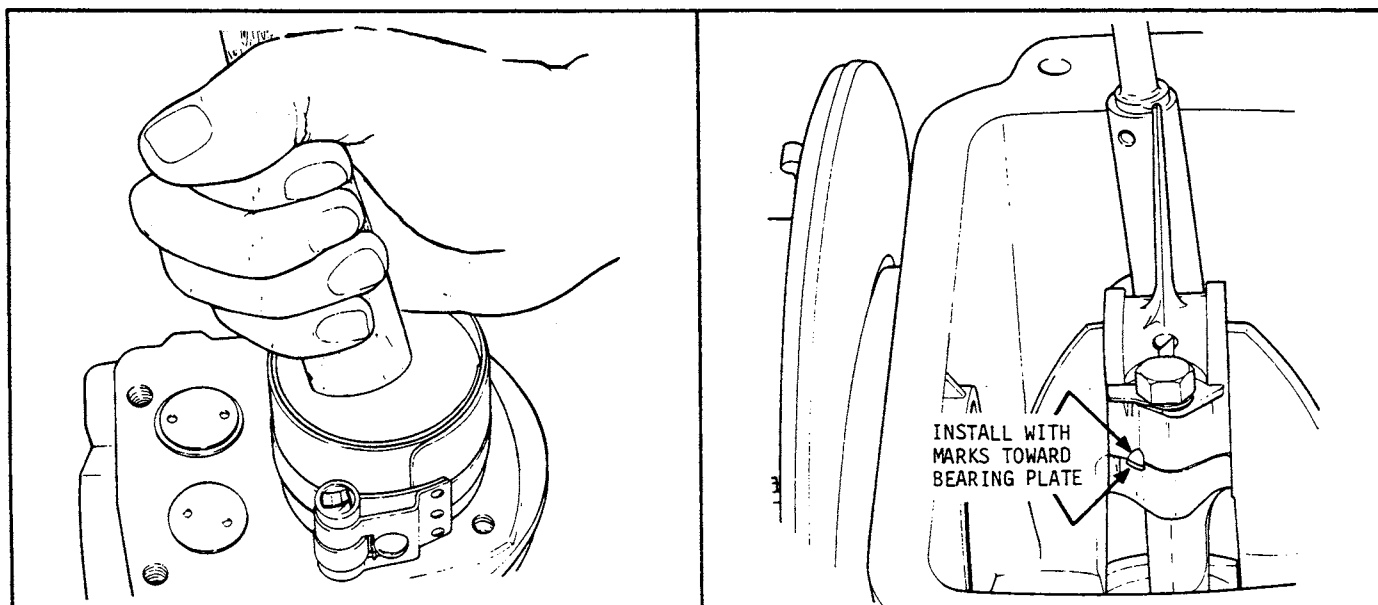


6. Bearing Plate

- Press front main bearing into bearing plate. Make sure bearing is straight and true in bore and bottomed properly. If cocked, crankshaft end play will be adversely affected.
- Crankshaft end play is determined by thickness of gaskets used between block and bearing plate. Initial use of one .020" and one .010" gasket should bring end play within limits -- this must be checked after bearing plate is installed.
- Install gaskets with thicker gasket next to block, place bearing plate on crankshaft and carefully press plate onto shaft and into position on block. Install cap screws with copper washers and secure bearing plate to block. Draw screws up evenly to avoid distortion of bearing plate.
- Crankshaft end play is measured (with feeler gauge) between inner race of rear bearing (P. T. O. end) and shoulder on crankshaft. If end play is not within tolerance as stated in Clearance Section, remove bearing plate and add or subtract gaskets to achieve proper clearance.
NOTE: Crankshaft end play is especially critical on gear reduction engines.

7. Piston and Rod Assembly

- Lubricate pin then assemble piston to connecting rod and secure piston pin with retainer rings. Always use new retainer rings. Be sure retainer rings are fully engaged in grooves in piston bosses.
- After making sure rings are in proper position in correct grooves, oil complete assembly, stagger ring gaps so they are not in line and insert complete assembly into cylinder bore. Be sure connecting rod marking is toward flywheel side of engine. Use a ring compressor to prevent ring breakage during installation. Gently push piston into bore with hammer handle -- do not pound.



INSTALLING PISTON - RING ASSEMBLY

INSTALLING CONNECTING ROD CAP SCREW

8. Attaching Rod to Crankshaft

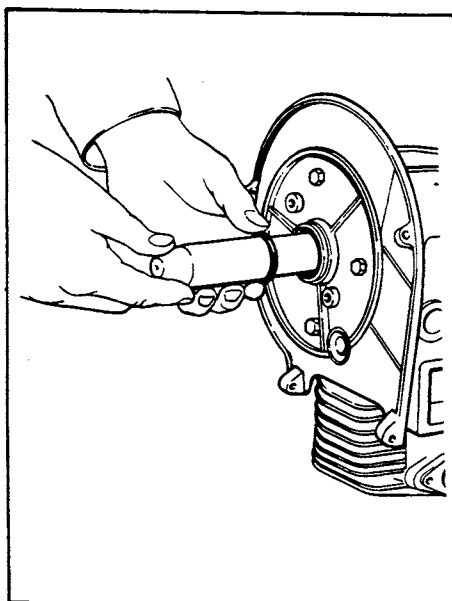
- After piston assembly is installed, place block on end and oil connecting rod big end and crank pin.
- It is important that marks on connecting rod and cap line up and face flywheel end of engine.
- Rod cap, lock or lock washers and cap screws are then attached to connecting rod. Use a torque wrench to tighten cap screws to proper torque value as stated in Clearance Section.
- If locking tabs are used, bend tabs to lock cap screws.

9. Installation of Oil Seals on Crankshaft

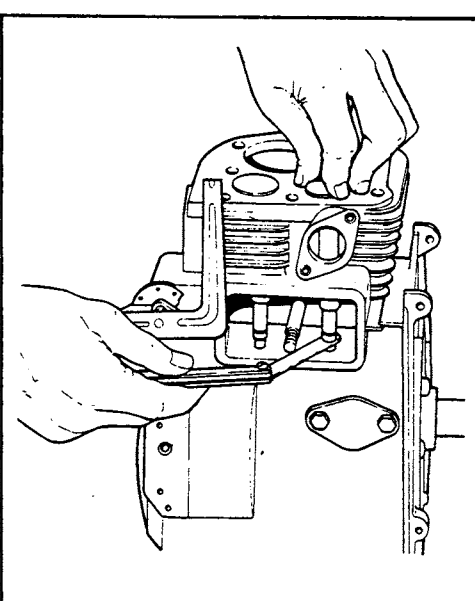
- Apply grease to lip then guide oil seals into position on crankshaft without damaging lips of seals. Any foreign matter on knifelike edge or any bending of seal may cause damage and an oil leak can result.
- After oil seals are started on shaft, place block on its side. The oil seals may now be driven squarely into bearing plate and cylinder block.

10. Oil Base

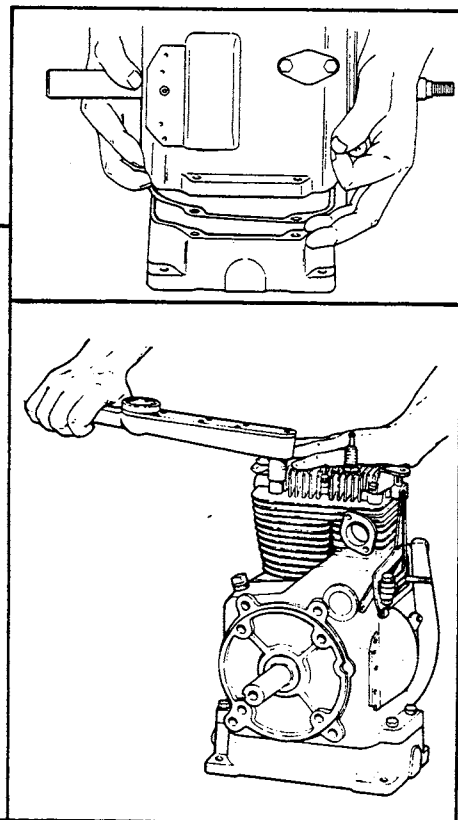
- Use pilot studs to align cylinder block, gasket and oil base.
- A new gasket must be used to prevent oil leakage.
- Assemble oil base to block with four screws.
- Torque pan bolts.



INSTALLING OIL SEALS
WITH SLEEVE



CHECKING VALVE - TAPPET
CLEARANCE



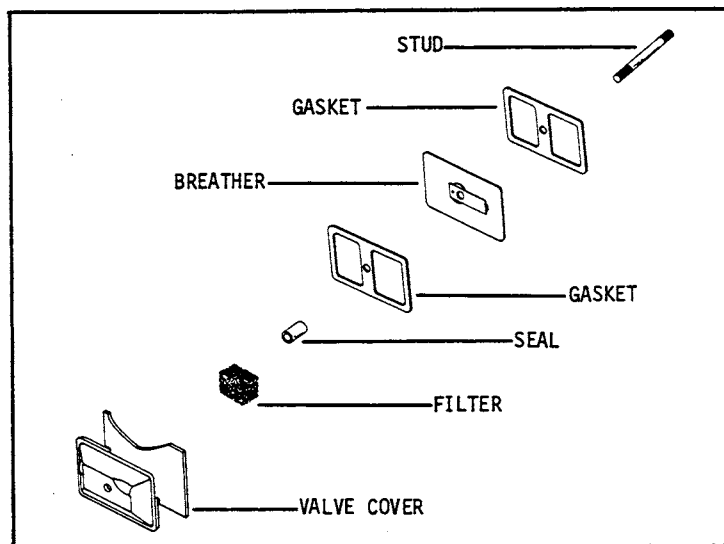
TIGHTENING CYLINDER HEAD
CAPSCREWS

11. Installing and Setting Valves

- Valves, valve seats and ports should be thoroughly cleaned. Valves should be ground and lapped-in to obtain a good valve seat. Keep valve seat from $1/32''$ to $1/16''$ in width.
- Valve clearance should be checked cold. On K91, K141, K161, K181 with incorrect valve clearance, the valves must be removed and ends ground until proper clearance is obtained. ENDS MUST BE GROUND SQUARE AND ALL BURRS MUST BE REMOVED.
- After correct clearance is obtained, remove valves and install valve springs and retainers and rotators if used. Lubricate stems then replace valves, compress springs and place locking keys (pins on K91) in grooves of valve stems.

12. Cylinder Head

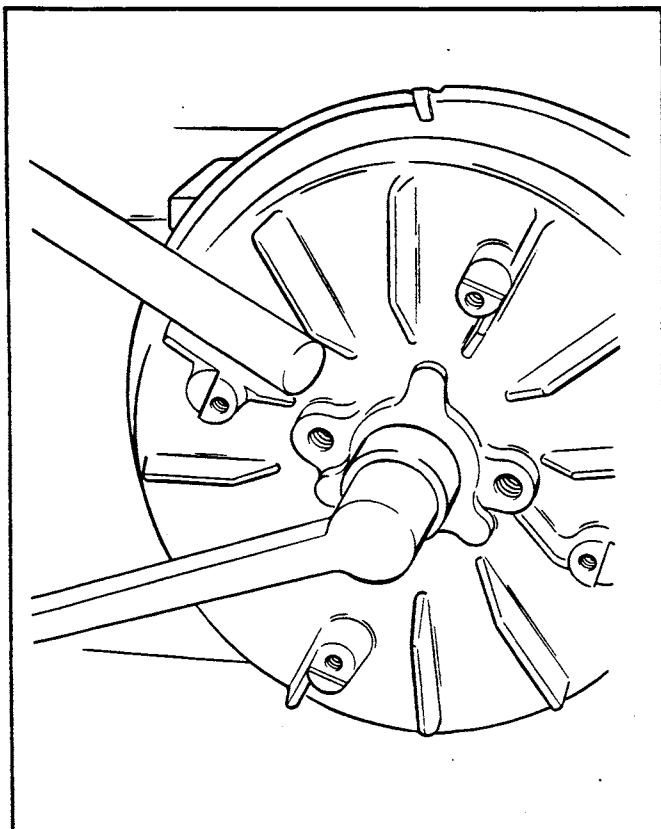
- Always use a new gasket when head has been removed for service work.
- Check cylinder head on face plate to be sure gasket surfaces make good contact at all points.
- It is important that head cap screws be lubricated then tightened evenly and in sequence until proper torque is reached.
- Install new spark plug and tighten to specified torque. Spark plug gap should be .025 or .020 for radio shielded spark plugs or .018'' for gas operation.



TYPICAL CRANKCASE BREATHER

13. Breather Assembly

- Reed type breathers are used to maintain slight vacuum in crankcase. All parts must be clean and in good condition. Use new gaskets, reed and filter for reconditioned engine.
- Several different breather types are used. The accompanying illustrations show the correct order of assembly for two of the more common types. Most other types are assembled in the same general sequence. Make sure reed valve is installed properly.
- Cover must be securely tightened to prevent oil leakage.



INSTALLING FLYWHEEL

14. Flywheel

- Place wave washer on crankshaft and place flywheel in position. The square key holds flywheel on shaft.
- Install starter pulley, lock washer and holding nut. Insert a bar between flywheel fins and tighten holding nut to torque value specified in Clearance Section.
- The rotating screen is fastened to starter pulley with either screws and spacers or a wire retainer.

15. Breaker Points

- Install push rod.
- Fasten breaker in place with two screws.
- Place cover gasket in position and attach magneto lead.
- Set breaker gap at .020 full open. For ignition setting, refer to Ignition System Service.
- Make preliminary adjustments before installing breaker point cover. Be sure breaker lead grommet is in place.

16. Carburetor

- Insert a new gasket and assemble carburetor to intake port with two screws.
- Refer to Service Section on carburetor adjustment procedure.

(Continued on next page)

17. Governor Arm and Linkage

- a. Insert carburetor linkage in throttle arm.
- b. Connect governor arm to carburetor linkage and slide governor arm onto governor shaft.
- c. Position governor spring in speed control disc.
- d. Before tightening clamp bolt, turn shaft counterclockwise as far as possible with a pair of pliers, pull arm as far as possible to left (away from carburetor), tighten nut and check for freedom of movement.

18. Blower Housing and Fuel Tank

- a. The engine is now ready for (1) head baffle, (2) cylinder baffle, and (3) blower housing -- assembled in sequence stated. These parts are fastened to engine by cap screws which attach to cylinder head and bearing plate. Caution: Shorter screws go into lower portion of blower housing.
- b. Gasoline fuel tank and brackets (if used) are installed at the same time as baffles and shrouds.
- c. Connect fuel line between filter and carburetor.

FINAL ADJUSTMENTS

Follow instructions in Service Procedure Section for final adjustment of engine.

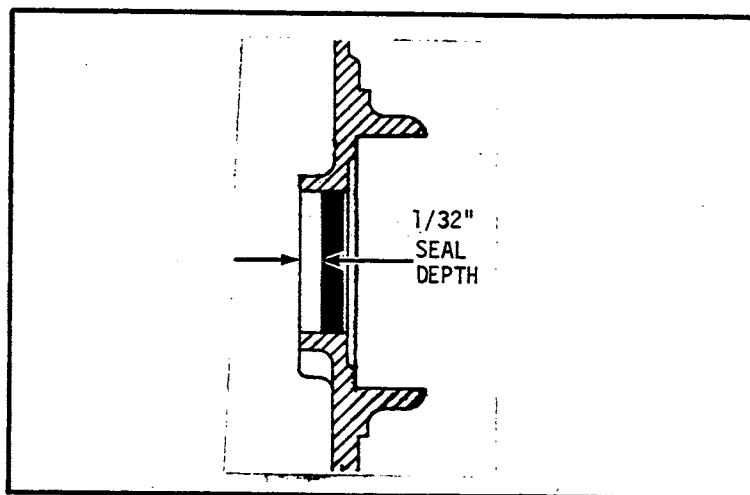
RUN-IN PROCEDURES (RECONDITIONED ENGINES)

After an engine has been reconditioned and reassembled, it must be "run-in" on non-detergent oil and under load for a period of about 5 hours. This should be sufficient time to seat the piston rings.

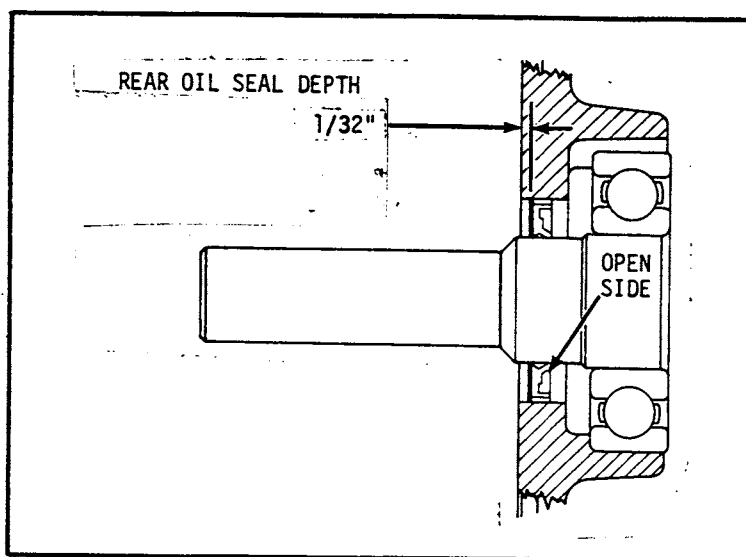
After the initial run-in period, drain the non-detergent type oil and refill with detergent type API Service SC oil of proper weight. Do not continue using non-detergent oil after the first 5 hours of operation.

OIL SEAL INSTALLATION

When installing new oil seals, apply a liberal amount of light grease such as lubriplate on the seal lip area. Use seal driver and seal sleeve of appropriate size and install carefully to prevent the seal lip from rolling and creasing. Press against outer edges of seal--press squarely into position and to the depth specified.



FRONT OIL SEAL LOCATION



REAR OIL SEAL DEPTH: 1/32"

crankcase face at PTO end.

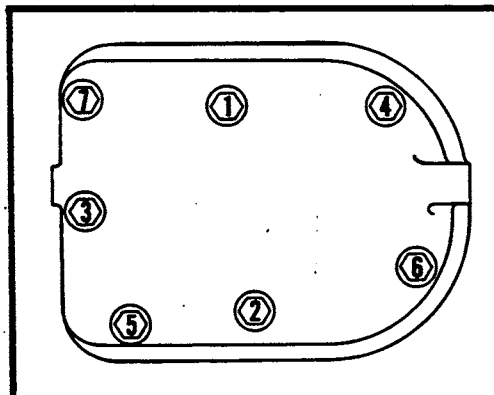
TORQUE SPECIFICATIONS

STANDARD BOLTS, SCREWS & NUTS

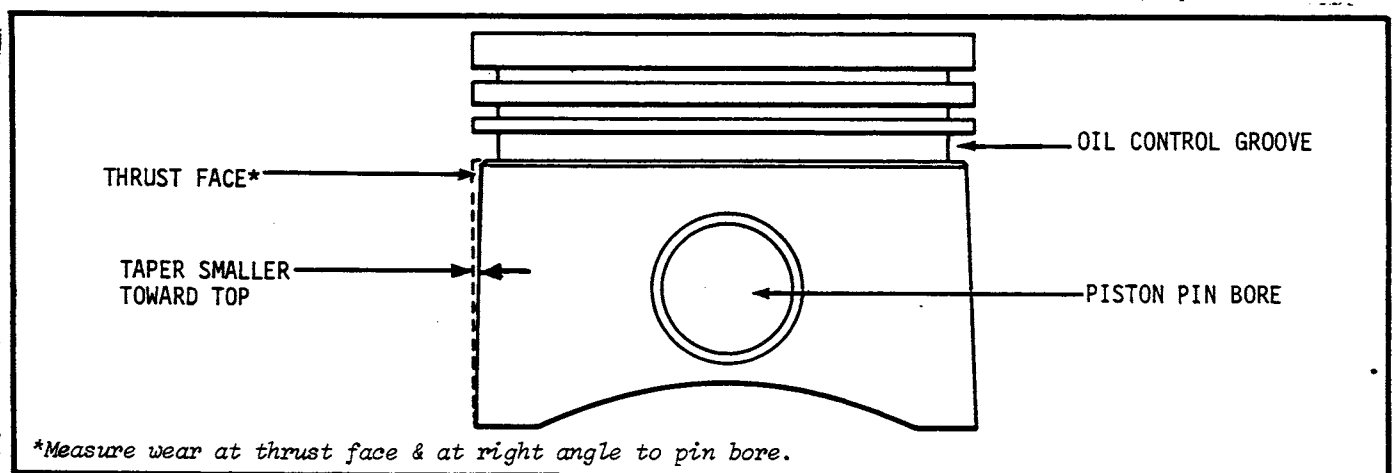
Size	Tightening Torque		
	Grade 2 	Grade 5 	Grade 8 
1/4-20	70 in. lb.	115 in. lb.	165 in. lb.
1/4-28	85 in. lb.	140 in. lb.	200 in. lb.
5/16-18	150 in. lb.	250 in. lb.	350 in. lb.
5/16-24	165 in. lb.	270 in. lb.	30 ft. lb.
3/8-16	260 in. lb.	35 ft. lb.	50 ft. lb.
3/8-24	300 in. lb.	40 ft. lb.	60 ft. lb.
7/16-14	35 ft. lb.	55 ft. lb.	80 ft. lb.
7/16-20	45 ft. lb.	75 ft. lb.	105 ft. lb.
1/2-13	50 ft. lb.	80 ft. lb.	115 ft. lb.
1/2-20	70 ft. lb.	105 ft. lb.	165 ft. lb.
9/16-12	75 ft. lb.	125 ft. lb.	175 ft. lb.
9/16-18	100 ft. lb.	165 ft. lb.	230 ft. lb.
5/8-11	110 ft. lb.	180 ft. lb.	260 ft. lb.
5/8-18	140 ft. lb.	230 ft. lb.	330 ft. lb.
3/4-10	150 ft. lb.	245 ft. lb.	350 ft. lb.
3/4-16	200 ft. lb.	325 ft. lb.	470 ft. lb.

CONVERSION TABLE (INCH LBS. TO FOOT LBS.)

FOOT LBS.	5	10	15	20	25	30	35	40	45	50
INCH LBS.	60	120	180	240	300	360	420	480	540	600



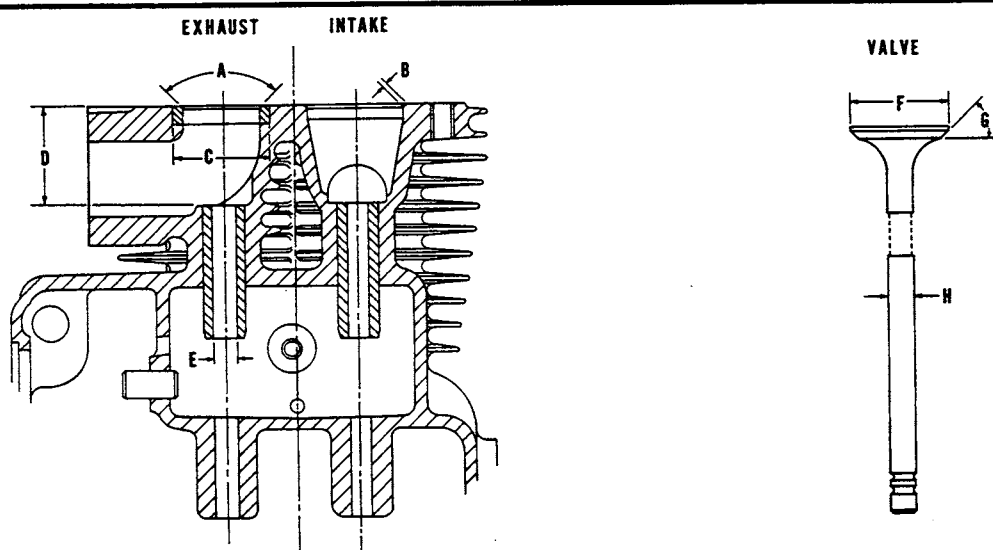
CYLINDER HEAD TIGHTENING SEQUENCE



PISTON WEAR MEASUREMENT DETAILS

VALVE DETAILS

DIMENSION	MODEL K181	
	INTAKE	EXHAUST
A SEAT ANGLE	89°	89°
B SEAT WIDTH	.037/.045	.037/.045
C INSERT O. D.	-----	1.2535/1.2545
D GUIDE DEPTH	1-5/16	1-5/16
E GUIDE I. D.	.312/.313	.312/.313
F VALVE HEAD DIAMETER	1-3/8	1-1/8
G VALVE FACE ANGLE	45°	45°
H VALVE STEM DIAMETER	.3105/.3110	.3090/.3095



VALVE DETAIL DRAWING -- LOCATION

WEAR TOLERANCES & CLEARANCES (MAX.)

VALVE STEM - TO - TAPPET Clearance

Intake: .006" to .008"
(.152 to .203 mm)

Exhaust: .015" to .017"
(.381 to .432 mm)

SPECIFICATION (INCHES) *	K181
CYLINDER BORE	
Maximum Oversize Diameter	2.9405
Maximum Allowable Taper	.0025
Maximum Out of Round	.005
CRANKSHAFT CRANKPIN	
Maximum Out of Round	.0005
Maximum Taper	.001
CONNECTING ROD	
Maximum Wear Diameter-Big End	1.1885
Rod to Crankpin-Max. Clear.	.0035
PISTON - THRUST FACE	
Maximum Wear Diameter	2.9305
PISTON RING	
Maximum Side Clearance	.006
VALVE STEM TO GUIDE**	
Exhaust - Maximum Clearance	.006
Intake - Maximum Clearance	.0045

*Maximum allowable before replacement, reboring, regrinding--

**Measure at top of guide with valve closed.

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.
- . 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.
- . 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.

(continued on next page)

(continued)

- 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 consumed. 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 maintenance 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 fuelcock 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 malfunctioning 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 fuelcock 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 fuelcock should click when the switch is shorted out if the switch is working properly.

- Check the filter-fuelcock for proper operation:

Start the engine.

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

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 fuelcock. After 10 minutes, operate the starter motor. If the engine starts or fires, L.P. fuel has leaked by the fuelcock and the fuelcock should be replaced. If it just turned over, the fuelcock is operating correctly.

L.P. FUEL TANKS

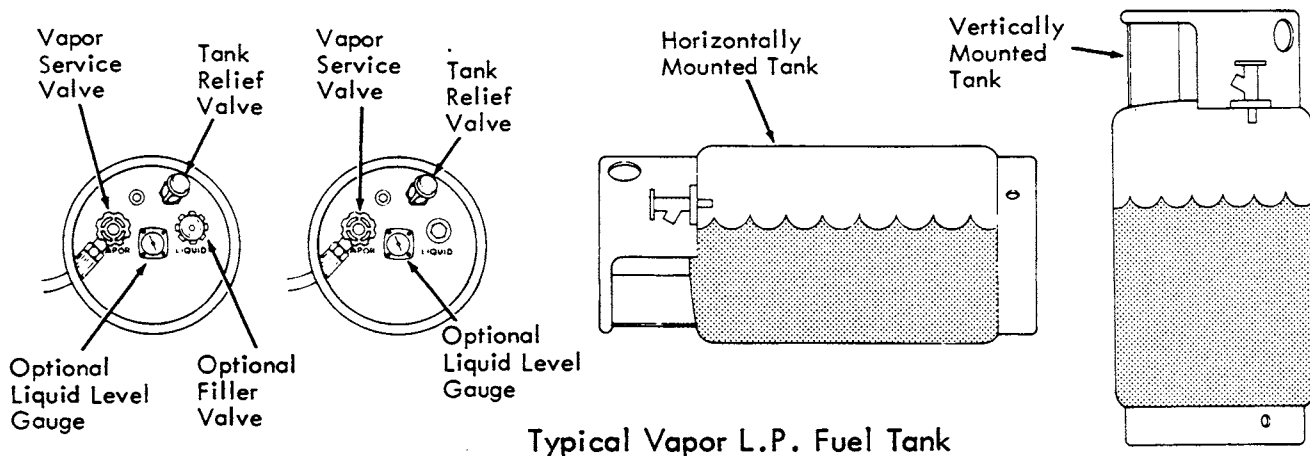
Standard D.O.T. L.P. fuel tank sizes have 14, 20, 33.5, and 43.5 lb capacities. The liquid volume permitted in these containers is less than the total volume of the cylinder, to provide for expansion of the L.P. fuel should the temperature increase a normal amount. Excessive heat may cause the fuel to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

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

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

- A. Safety Relief Valve - This is a spring-loaded valve that relieves excessive pressures which might develop in the tank due to unusual conditions.
- B. Service Valve - The L.P. fuel tank may have a vapor service valve or a liquid service valve. The type of equipment burning the fuel would determine the type of service valve to be used.
- C. Filler Valve - This valve is optional. If this valve is not present, the tank is filled through the service valve. The filler valve may be either a double back pressure valve, or a positive shutoff valve with an internal back pressure check valve. The filling tube ends in the vapor space of the tank to reduce pressure build-up during filling.
 - 1. Vapor Service Valve - Vapor is withdrawn from the tank through this valve. The L.P. tank may be filled through this valve if the tank is not equipped with a filler valve.
 - 2. Liquid Service Valve - Liquid is withdrawn from the tank through this valve. The tank outlet is fitted with a special coupling. The coupling utilizes spring-loaded check valves to provide a means of quickly connecting or disconnecting the fuel line with a minimum loss of L.P. fuel. The L.P. tank may be filled through this valve if the tank is not equipped with a filler valve.
 - 3. Excess Flow Valve - This valve is part of the vapor service and liquid service valves previously mentioned. It is mounted inside of the tank and prevents L.P. fuel from leaving the L.P. tank in the event of accidental breakage of external fittings or hoses. It permits flow in either direction, but stops outward flow if that flow becomes excessive. The valve is made up of a check that is held in position by a spring. The spring pressure is overcome when there is excess L.P. fuel flow out through the service valve. It will not return to the open position until the pressures are equalized on both sides of the valve. After the flow has been stopped, a small weep hole allows a small amount of L.P. fuel to bleed across the valve, equalizing the pressures.
- D. Liquid Level Gauge - This gauge is optional. It is usually a magnetic float gauge with an indicating dial. These gauges will function properly only when the tank is in its normal operating position, unless otherwise indicated.

(continued)



Typical Vapor L.P. Fuel Tank

Vapor L.P. fuel tanks , when in their operating position, allow only L.P. fuel in a gaseous state to flow.

OIL PRESSURE SWITCH

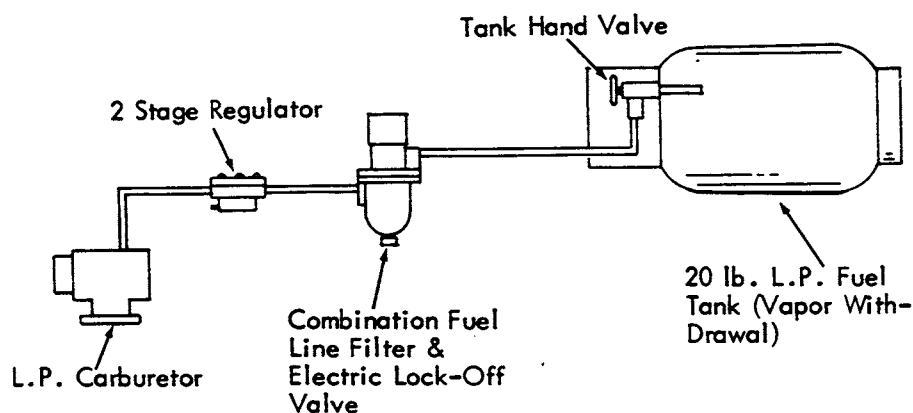
The oil pressure switch, or L.P. fuel module, is an electrical switch which is controlled by the engine oil pressure. The oil pressure switch is electrically connected before the fuelock. This means that the oil pressure switch controls the fuelock. The fuelock needs an electrical current to keep the fuelock solenoid open to allow L.P. fuel to flow. When the engine is not operating, or when the engine has less than 4 psi oil pressure, the electrical contacts are open, not allowing electrical current to flow. When the engine oil pressure exceeds 4 psi, the electrical contacts close allowing an electrical current to flow. When the engine is being started, the switch is bypassed to allow L.P. fuel to flow.

Oil pressure switches are used on L.P. engines to make sure that when the engine is not operating, or is being shut down, that L.P. fuel is no longer being sent through the fuelock on to the engine , creating a potential fire hazard.

L.P. VAPOR WITHDRAWAL SYSTEM

Vapor withdrawal L.P. fuel systems are made up of basically four components. Those components are: the L.P. tank, filter-fuellock, regulator, and the carburetor. There are many variations of the basic components. See Fig. 12

Vapor withdrawal fuel tanks bleed off L.P. fuel in a gaseous state. This L.P. gas is then piped to a filter-fuellock. The filter fuellock filters unwanted tank scale and deposits out of the L.P. gas. The filter-fuellock also stops the flow of L.P. gas when the engine is not operating. The oil pressure switch controls the fuellock. When the engine oil pressure is 4 psi or greater, the oil pressure switch permits an electrical current to open the fuellock which allows L.P. fuel to flow on to the primary regulator. The oil pressure switch is bypassed when the engine is started to allow L.P. fuel to flow. The primary regulator reduces the L.P. fuel pressure and makes it more constant. The secondary regulator reduces L.P. gas pressure to the level required by the carburetor. From the secondary regulator, it is piped to the carburetor where the L.P. fuel is finally metered into the air flow which is sent to the combustion chamber.



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.

(continued on next page)

(continued)

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.

(continued on next page)

(continued)

- 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 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.
- 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).

L.P. FUEL TROUBLESHOOTING

(1)
Fuel
Tank

Won't Start	Stops During Operation	Runs Unevenly-Lacks Power
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	Tank valve not opened sufficiently. Tank could be overfilled, allowing liquid withdrawal and "freeze-up" of system
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.	

(2)
Fuel
Lines

(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-Fuel-lock"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.	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.

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L.P. FUEL TROUBLESHOOTING (continued)

(6)
Engine

Won't Start	Stops During Operation	Runs Unevenly-Lacks Power
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.

FILTER SYSTEM

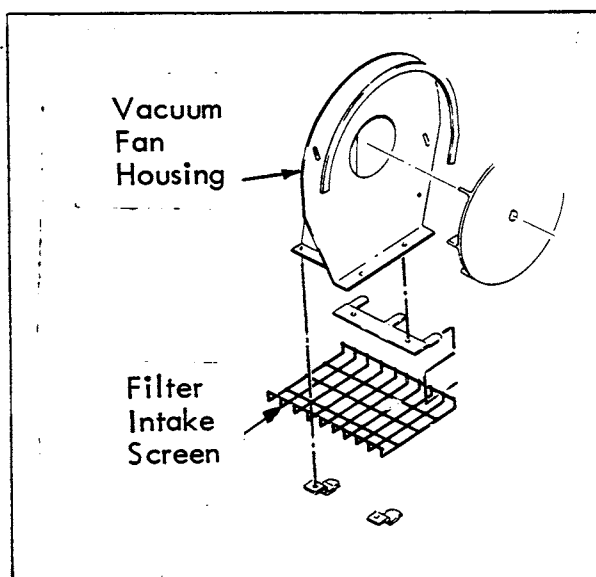
▲WARNING ALWAYS stop engine before making any repairs or adjustments to filter system.

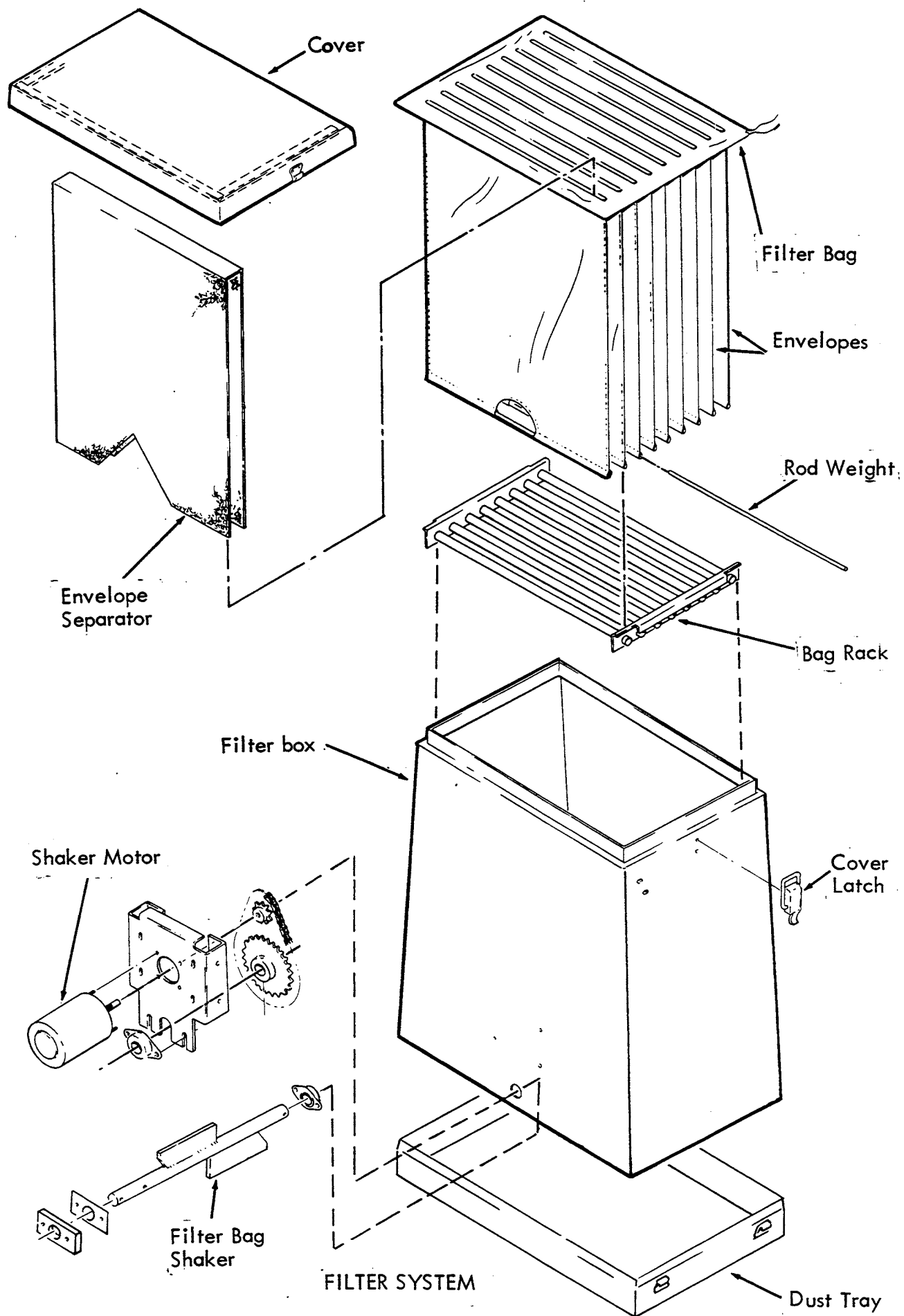
To Clean Filter System: (See drawing on next page)

1. Stop engine.
2. Push shaker button for several seconds to shake filter clean.
3. Unlatch dust tray and remove and empty it.
4. Remove filter box cover and filter envelopes, then clean envelopes thoroughly.
5. Inspect filter bag envelopes for holes or other damage. Replace if required.
6. Install envelopes. Make sure that rod weights are in the bottom pockets of each envelope. See drawing. The separators must be in place between filter bag envelopes. When installing the filter bag, check to make sure that it is supported properly by the rack, and that the rack is in place at the top of the filter box.
7. Install cover and dust tray.

To Clean Vacuum Assembly:

1. Shut off engine.
2. Remove all dirt accumulations from fan housing.
3. Clean fan intake screen (located inside brush compartment). Make sure opening is free of debris to assure maximum vacuum pick-up. The screen can be removed without removing clips by sliding it forward and then down.





DUST SKIRTS

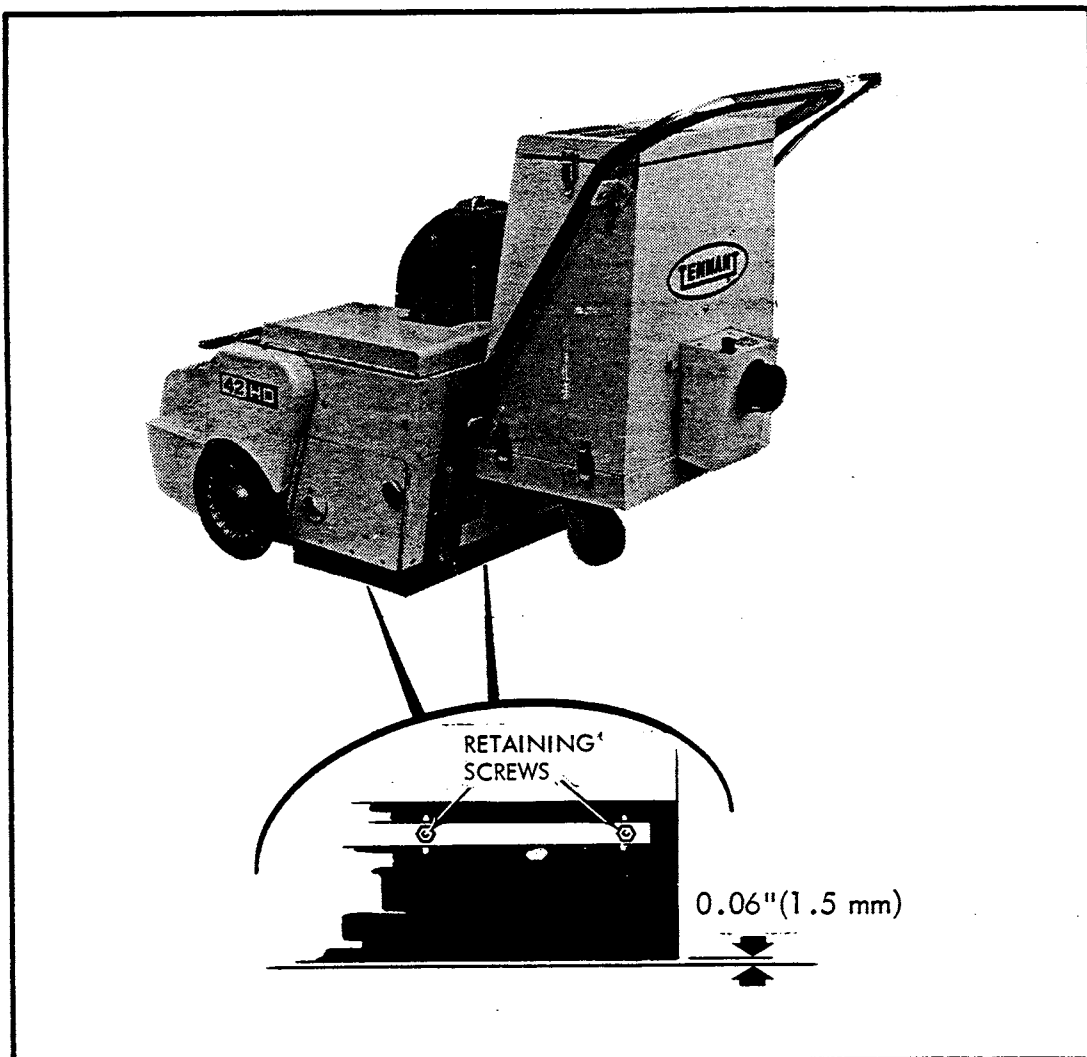
To Adjust Dust Skirt Height:

1. Loosen retaining screws.
2. Adjust skirts to approximately 0.06" (1.5 mm) clearance between bottom of skirt and floor (see drawing.)
3. Tighten retaining screws.

NOTE Replace skirt if worn or damaged.

To Remove and Replace Dust Skirts:

1. Remove retaining screws and metal backing strip.
2. Install new skirts, being sure to adjust to proper height.

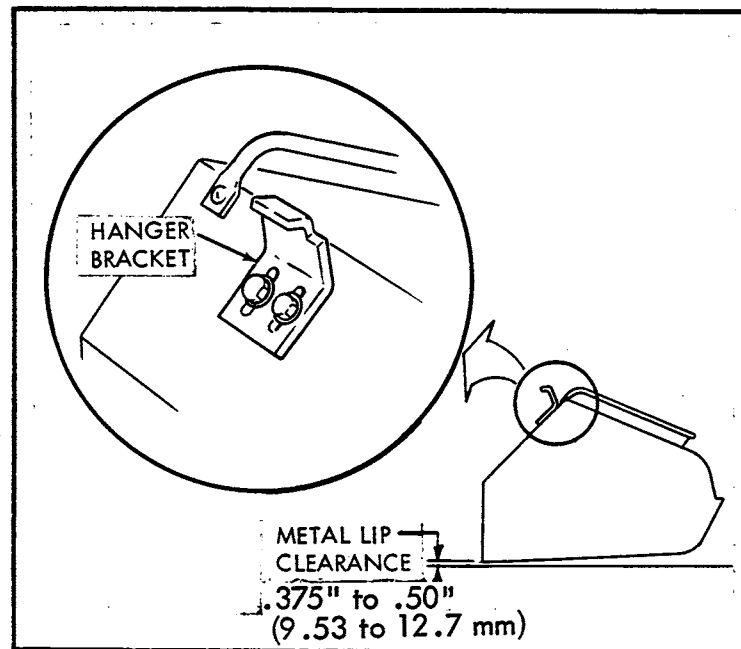


ADJUST DUST SKIRTS FOR 0.06" (1.5 mm) CLEARANCE FROM FLOOR

HOPPER

To Adjust Hopper Floor Clearance:

1. Empty hopper and park machine on smooth, level floor.
2. Refer to sketch to check hopper clearance. Metal edge should clear floor by .375" to .50" (9.53 to 12.7 mm)



HOPPER FLOOR CLEARANCE ADJUSTMENT

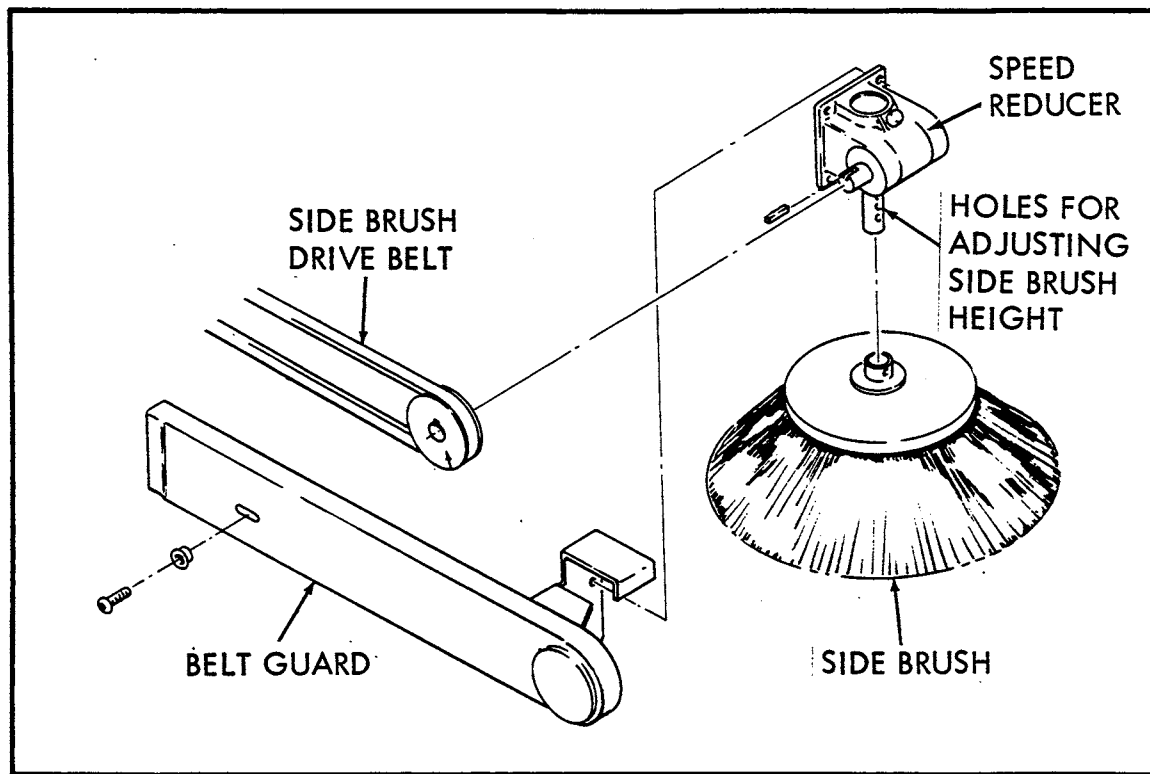
3. If adjustment is required, loosen four hanger bracket bolts and slide hopper up or down until correct adjustment is obtained.

MAKE SURE hopper is level from side to side. Then tighten bolts.

NOTE Metal lip of hopper must be adjusted properly; too low will cause dirt to be piled up rather than allowed to enter the brush compartment. If too high, rubber lip on hopper will also be too high and dusting will result. If rubber lip is worn badly or damaged, replace it.

SIDE BRUSH

Check brush regularly and adjust to compensate for wear. Replace it when bristles are worn to point of inefficient sweeping at maximim "Down" adjustment.



SIDE BRUSH ADJUSTMENTS

To Adjust Side Brush Height:

1. Stop engine.
2. Place side brush unit in sweeping position.
3. Remove adjusting bolt and slide brush down shaft to desired adjustment hole. Lowering the brush one or two holes is usually sufficient.
4. Replace bolt and tighten securely.
4. Operate machine to test brush.

NOTE After adjusting brush, it may be necessary to adjust tension of side brush drive belt.

To Maintain Side Brush Unit:

1. Keep belt guard in good condition to avoid belt binding and consequent wear.
2. Check speed reducer occasionally. Be sure to keep mounting bolts tight. (For lubrication instruction, see "Maintenance Chart".)

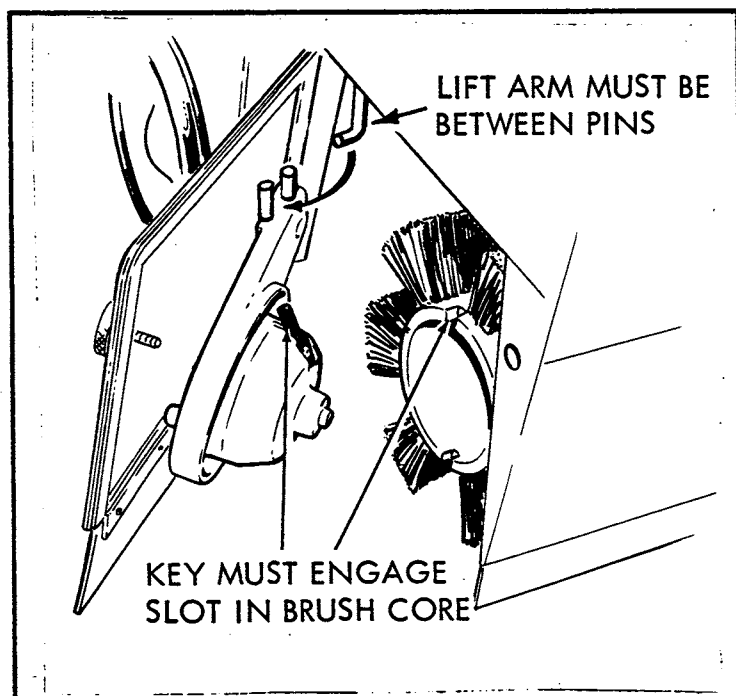
MAIN BRUSH

The brush furnished with your machine can be easily replaced. (See Parts List for brush types that are available.)

Replace the main brush when bristles no longer provide efficient sweeping. The length of the bristles at this point will vary as to floor conditions and type of brush.

To Remove Main Brush:

1. Stop engine.
2. Lower brush to floor.
3. Open brush compartment door and pull brush out through open door.



To Replace Main Brush:

1. Remove hopper.
2. Slide brush through open door and onto drive hub. If necessary, move the brush control lever slowly to help position brush on drive hub.
3. Turn the brush slowly on hub until slots in brush core engage keys on hub. See drawing. You can easily feel when the brush slides into position.

NOTE DO NOT force brush on hub. It will slide on easily when in correct position.

4. With brush lift lever in lower position, close brush compartment door, making sure that end of brush lift arm (extending down from lift shaft) is positioned between pins in brush arm mounted on door (see drawing).

NOTE Always keep brush plugs free from dirt, string or other accumulations.

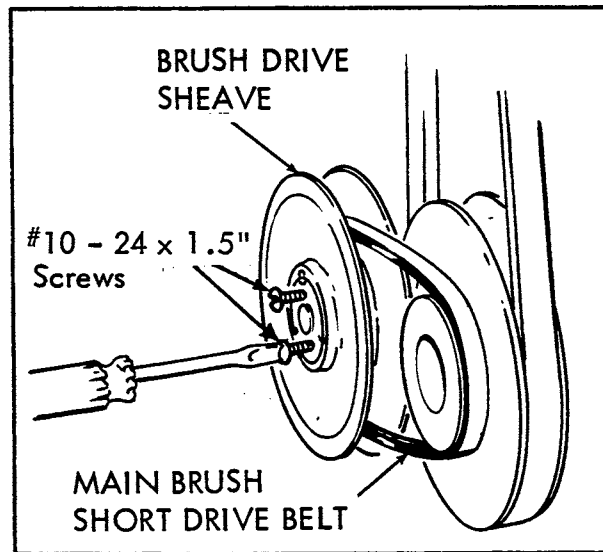
5. Adjust brush height by turning brush lift handle.

MAIN BRUSH REPLACEMENT

DRIVE BELTS

General Maintenance Principles for V-Belts:

1. The best tension for a V-belt drive is the lowest tension at which the belt will not slip under the highest load conditions. Too much tension shortens belt and bearing life.
2. Check the tension on a new drive belt frequently during the first day of operation and periodically thereafter.
3. Keep belts and sheaves free from any foreign material which may cause slippage or binding.
4. If a belt slips, tighten it immediately, as any slippage will ruin the belt if permitted to continue.
5. Check all belts regularly for possible wear and proper tension.



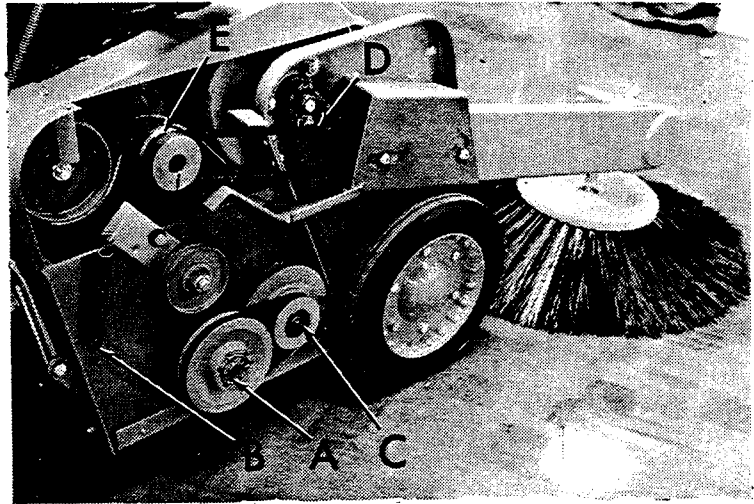
TO REMOVE SHORT BELT, INSERT SCREWS TO EXPAND SHEAVE

REPLACING MAIN BRUSH SHORT DRIVE BELT

1. Remove panel on right side of machine to expose belt.
2. Insert two 10 - 24 screws in threaded holes in face of brush drive sheave. Tighten screws (evenly) until sheave expands to allow easy removal of old belt (see drawing).
3. Install new belt.
4. Remove screws. (Belt will automatically tighten and retain proper tension when machine is operated.)
5. Replace side panel.

REPLACING MAIN BRUSH LONG DRIVE BELT

1. Remove side panel and short belt.



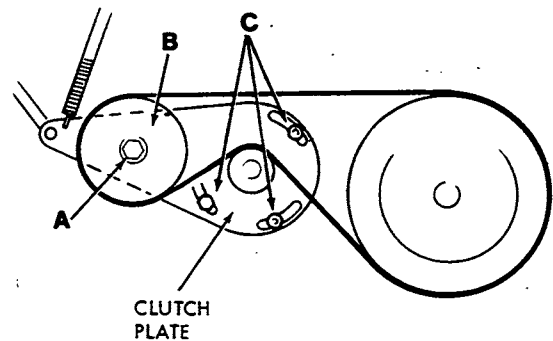
REPLACING MAIN BRUSH LONG DRIVE BELT

2. Refer to photo.
3. Remove self-adjusting sheave "A" by loosening set screw in hub.
4. Unhook lower end of idler spring "B" to loosen belt.
5. Remove retaining ring "C" holding 2-step sheave. Then slide sheave out just far enough to permit removal of belt. (Do not remove sheave completely.)
6. Slip side brush drive belt "D" off outer groove of engine sheave "E".
7. Remove main brush drive belt from machine.
8. Replace with new belt by reversing the above procedure.

NOTE Tension on this belt is obtained from spring "B" on idler arm and no further adjustment is required.

TO ADJUST FLAT BELT (See Drawing)

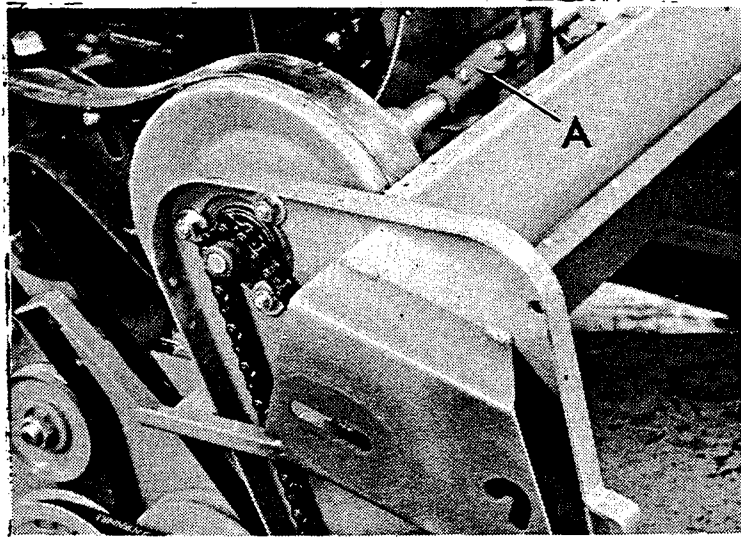
1. Remove right side panel and flat belt guard.
2. Push down on the clutch handle until clutch plate is in position shown in the drawing titled "Adjusting Flat Belt Tension". Center screws "C" + 0.125" (3.2 mm) in slots. At this point, the flat belt should be tight. If the flat belt is not tight, proceed to adjust by loosening carriage bolt "A" and shifting idler sheave "B" until the belt is tight. Then tighten bolt "A".



ADJUSTING FLAT BELT TENSION

TO REPLACE FLAT BELT

1. Remove right side panel and flat belt guard.
2. Slip belt off idler sheave.
3. Refer to photo and remove coupler "A" in cross shaft to allow belt to be slipped over differential and end of shaft.



TO REPLACE FLAT BELT, REMOVE COUPLER "A"

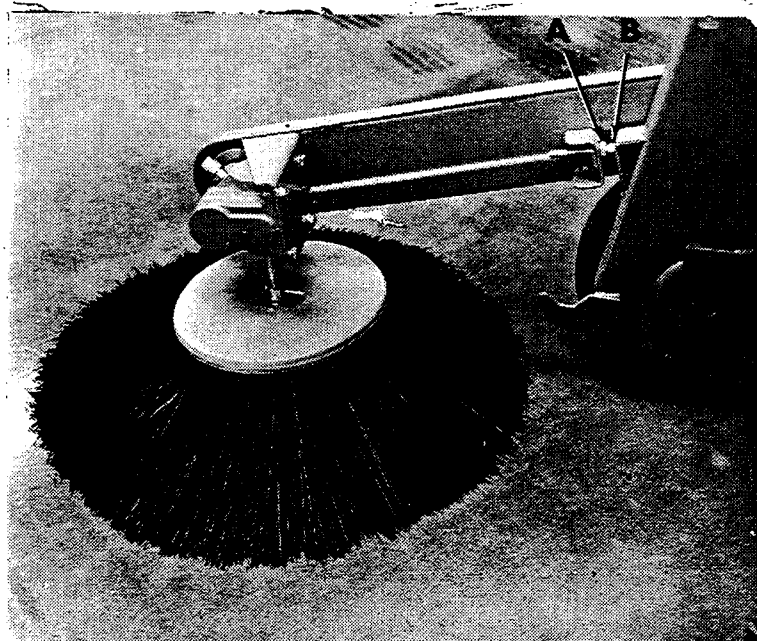
4. Install new belt. Be sure belt is routed over engine sheave as shown in drawing "Adjusting Flat Belt Tension". This is very important because it is the downward pressure of the clutch plate and pulley which forces belt against engine sheave to obtain drive.
5. Adjust belt tension.
6. Replace belt guard and side panel.

FLAT BELT ALIGNMENT

If the flat belt does not track correctly on its sheaves, check the alignment of the two sheaves. It is possible to adjust the engine sheave by placing a socket over the sheave attaching bolt and slightly bending the bolt until the belt tracks correctly.

TO ADJUST SIDE BRUSH DRIVE BELT

1. Place side brush in "DOWN" position.
2. Remove hopper.
3. Stop engine and swing bumper out of the way.
4. Refer to photo and loosen lock nut "A".



Lock nut "A" and screw "B" are used to adjust side brush belt tension.

5. Turn adjusting screw "B" counter-clockwise to tighten belt, clockwise to loosen. Adjust to obtain $0.75" + 0.063"$ ($10.1 + 1.6$ mm) deflection from a 6 lb (2.72 kg) force applied nine inches (228.6 mm) from motor shaft.
6. When adjustment is obtained, tighten lock nut "A".
7. Swing bumper back down to operating position and replace hopper.
8. Operate machine to check for proper adjustment and re-adjust if necessary.

⚠ CAUTION Do not attempt to adjust belt while engine is running.

TO REPLACE SIDE BRUSH DRIVE BELT

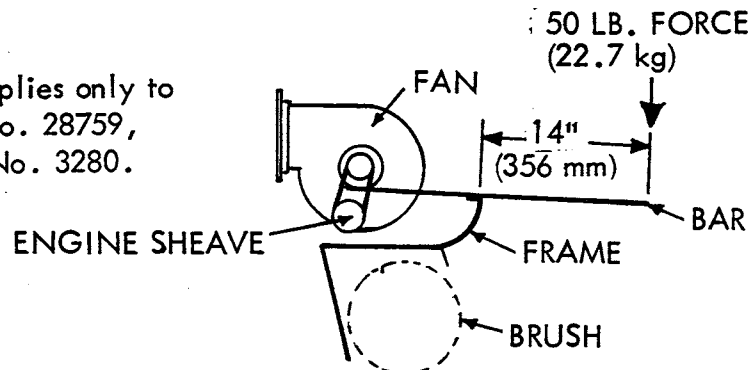
1. Remove side panel and hopper.
2. Remove four retaining bolts to detach reducer unit from support arm.
3. Remove old belt, install new belt and replace speed reducer.
4. Adjust belt tension. Then replace hopper and side panel.

TO ADJUST VACUUM FAN DRIVE BELT

1. Refer to photo and loosen only screws "A" and "B".
2. For new belt 28755 used on machines with serial number 3281 and above:
Slide fan housing upward to tighten belt. Tension the belt so that a 6 lb (2.72 kg) force applied to the belt midpoint will deflect the belt about 0.063" + 0.031" (1.6 + 0.8 mm) deflection. Tighten the fan housing screws "A" and "B" to hold the housing in place.

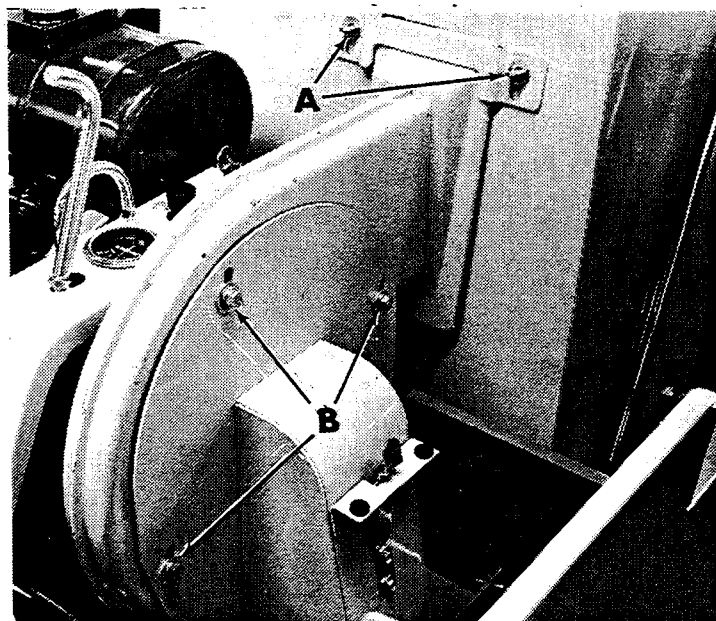
NOTE

This belt tension applies only to obsolete fan belt No. 28759, used before serial No. 3280.



TO REPLACE VACUUM FAN DRIVE BELT

1. Loosen screws "A" and "B" holding fan housing in place.
2. Push downward on fan housing to loosen belt.
3. Slip belt off both sheaves to remove.
4. Install new belt and adjust tension as indicated above.



Loosen Screws "A" and "B" When Replacing or Tightening Vacuum Fan Belt

DRIVE CHAINS

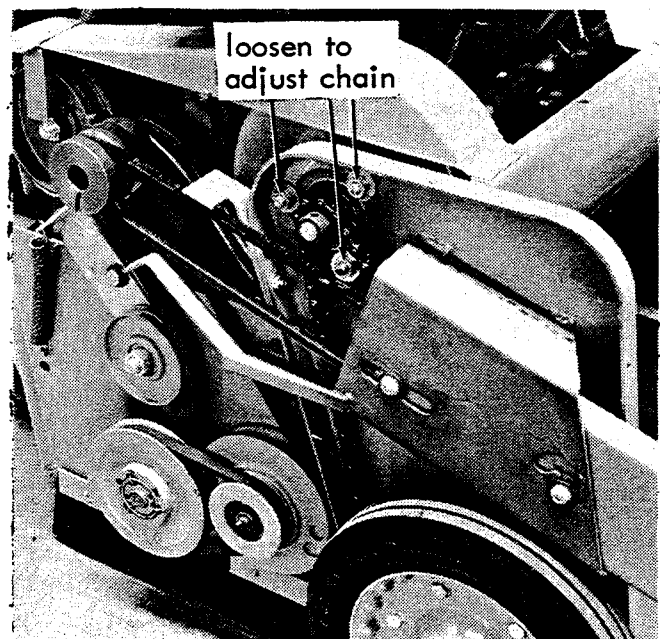
These chains run at a rather low speed and do not require periodic or close tolerance adjustment. Normal maintenance consists of periodic chain lubrication, (see Maintenance Chart) and tension adjustment in extreme cases of wear.

To Adjust Drive Chains:

1. Remove the right and left side panels.
2. Loosen the three mounting bolts on both flanges as indicated in photo.
3. Lift up on the intermediate drive shaft to obtain desired chain tension.

NOTE Do not over-tighten chain. It is not necessary and will cause excessive wear to chain, sprockets and bearings.

ADJUSTING DRIVE CHAIN



To Replace Drive Chains:

1. Remove all belt and chain guards.
2. Remove right and left side panels.
3. Loosen the flange bearing mount screw.
4. Turn the wheels to bring the connecting link of each chain to the top for easy removal.
5. Check condition of sprockets.
6. Install new chains, being sure to adjust tension as described above and lubricating chains per "Maintenance Chart".
7. Check tension of flat belt.
8. Replace all other parts.

SCRUB ATTACHMENT

To Adjust Front Pick-up Hose Height:

1. Park machine on smooth level floor.
2. Refer to Figure 10, Check distance between end of hose and bottom of pick-up tray. The distance should be 0.13" to 0.25" (3.2 to 6.4 mm).
3. If adjustment is needed, tip scrubber attachment forward (using cart), loosen hose clamp and adjust as required.
4. Re-check height after adjustment is made.

(continued on next page)

To Adjust Pick-up Tray Height:

1. Park machine on smooth level floor.
2. Remove main scrubbing brush to check distance between tray lip and floor. Correct height is 0.13" to 0.25" (3.2 to 6.4 mm). Tray must be level.
3. If adjustment is required, remove tray and refer to Figure 10 to shift the wheel mounts as needed to obtain adjustment.

NOTE You may check for correct height as described in #2 above or check the lip height with the tray out of the machine by propping front of tray at the same height as it would be when installed.

4. If any adjustment is made in lip height, **BE SURE** to check the front pick-up hose height. (See "To Adjust Front Pick-up Hose Height," above).
5. Replace main brush.

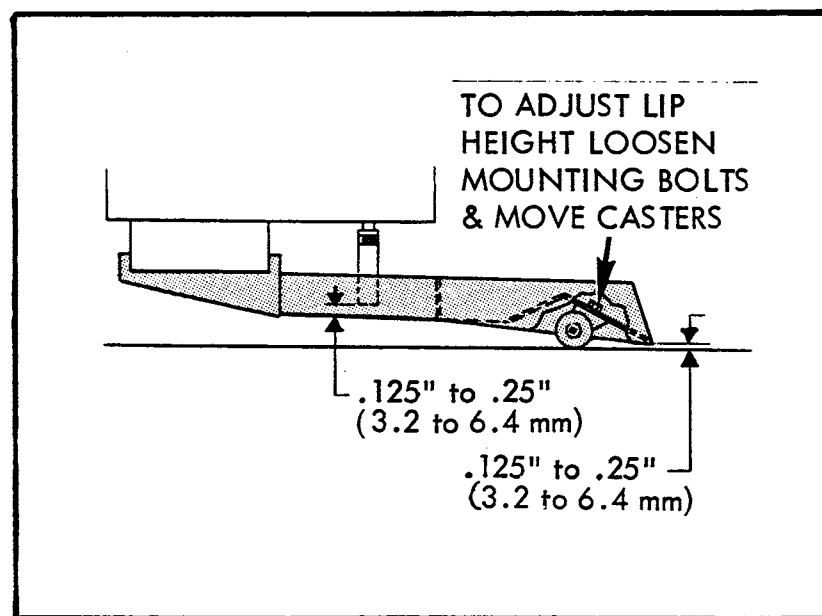


Fig. 10

To Adjust Squeegees:

1. See "To Operate Side Brush Squeegee".
2. The rear squeegee relies on its own weight to apply pressure on rubber lip and no adjustment is required.

To Adjust Rear Pick-Up Hose Height:

1. Refer to Figure 11 and check hose height. (Correct adjustment is obtained when end of hose is 0.25" (6.4 mm) off the floor surface with squeegee down.)
2. Loosen clamp and slide hose up or down to obtain correct adjustment. (Always position slit in hose end at side or rear.)

NOTE If the hose is too high off the surface, the vacuum is not sufficient for pick-up.

If the hose is too low (pushed into the surface of the water), water pick-up is impaired also, because the vacuum must pick up a mixture of water and air. Since it is possible to have a wedge of water .25" or more deep at the "V" in the rear squeegee, the slit is provided in the hose to permit some passage of air even under this condition. As mentioned in item 2, the slit in the hose should always be positioned to side or rear to prevent clogging with debris.

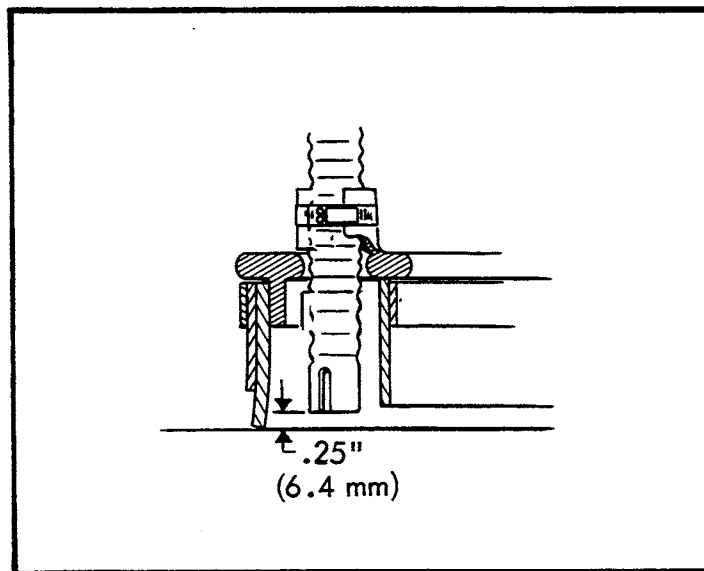


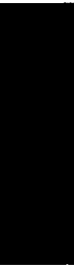
Fig. 11

SECTION 4

APPENDIX

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Exceptions to the Standard	
Torque Chart.....	4-1
Bolt Identification.....	4-1



HARDWARE INFORMATION

The following charts state torque ranges for normal assembly applications of standard plated hardware. Decrease the specified torque by 20% when using a thread lubricant. Do not substitute lower grade hardware for higher grade hardware. If higher grade hardware than specified is substituted, tighten only to the specified hardware torque value to avoid damaging the threads of the part being threaded into, as when threading into speed nuts or weldments.

STANDARD BOLT TORQUE CHART

Thread Size	SAE Grade 2 Torque ft lb (Nm)	SAE Grade 5 Torque ft lb (Nm)	SAE Grade 8 Torque ft lb (Nm)
0.25 in	5-6 (7-8)	7-10 (9-14)	10-13 (14-18)
0.31 in	9-12 (12-16)	15-20 (20-27)	20-26 (27-35)
0.38 in	16-21 (22-28)	27-35 (37-47)	36-47 (49-64)
0.44 in	26-34 (35-46)	43-56 (58-76)	53-76 (72-103)
0.50 in	39-51 (53-69)	65-85 (88-115)	89-116 (121-157)
0.62 in	80-104 (108-141)	130-170 (176-231)	117-265 (159-359)
0.75 in	129-168 (175-228)	215-280 (291-380)	313-407 (424-552)
1.00 in	258-335 (350-454)	500-650 (678-881)	757-984 (1026-1334)

NOTE: Decrease torque by 20% when using a thread lubricant.

METRIC BOLT TORQUE CHART

Thread Size	Class 8.8 Torque ft lb (Nm)	Class 10.9 Torque ft lb (Nm)	Class 12.9 Torque ft lb (Nm)
M4	2 (3)	3 (5)	4 (6)
M5	4 (7)	6 (9)	7 (11)
M6	7 (11)	10 (16)	11 (19)
M8	18 (27)	25 (38)	29 (45)
M10	32 (53)	47 (74)	58 (87)
M12	58 (91)	83 (128)	100 (154)
M14	94 (145)	133 (204)	159 (244)
M16	144 (222)	196 (313)	235 (375)
M20	260 (434)	336 (610)	440 (732)
M24	470 (750)	664 (1050)	794 (1270)

NOTE: Decrease torque by 20% when using a thread lubricant.

BOLT IDENTIFICATION

Identification Grade Marking	Specification and Grade
	SAE-Grade 5
	SAE-Grade 8
	ISO-Grade 8.8
	ISO-Grade 12.9

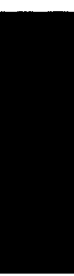
01395

SECTION 5 STANDARD PARTS

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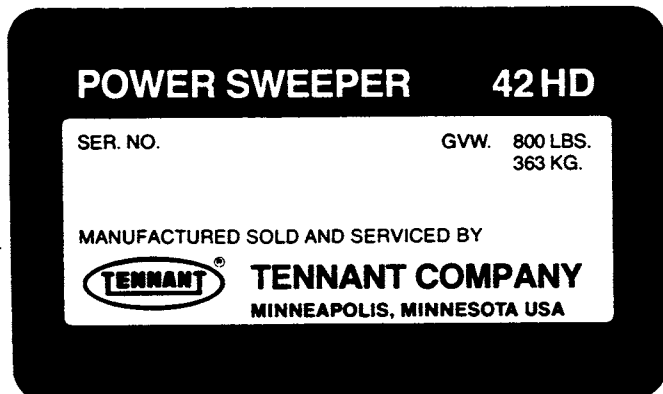
NOTE: Section 5, Standard Parts, lists every repair part of a standard Model 42HD.



ORDERING REPAIR PARTS

To avoid errors or delays in filling parts orders, please furnish all of the following information.

1. Always specify the machine model number and the machine serial number shown on the machine data plate.



2. Give the part number, description, and the quantity needed of each item on the order. Do not order by reference number or the figure number of the illustrated parts.
3. Indented items indicate parts of assemblies. Standard hardware is furnished only when part of a purchased assembly. Please order hardware from a local hardware supplier.
4. If the old part cannot be identified, send it to us with the quantity needed specified on the order.
5. State definite shipping instructions to include the shipping address and/or the billing address if there is a difference. Any claim for loss or damage to a shipment in transit should be filed promptly against the transportation company making the delivery. Shipments will be complete unless the packing list or order acknowledgement indicate items back ordered.

If parts received are suspected to be incorrect or defective, please write, wire, or phone the Tennant Company representative from whom you ordered the part. They will give authorization for return and/or handle replacement shipments when required.

SI (INTERNATIONAL SYSTEM) UNITS OF MEASURE

Metric equivalents have been included, where applicable, throughout this parts catalog.

BOLT AND CAP SCREW STRENGTH IDENTIFICATION

Bolts and cap screws required to have high-strength qualities equivalent to SAE Grade 8 are identified throughout this catalog by the description GR 8. Unless identified by this description, all standard bolts and cap screws are SAE Grade 5.

SERIAL NUMBER INFORMATION EXPLANATION

Serial number information is listed parenthetically to show on which machines each part can be used. These listings are explained by the following examples:

(-) The part can be used on all machines.

(0000001234-) The part can be used on all machines beginning with the serial number listed.

(0000000000-0000001234) The part can be used on all machines up to and including serial number listed.

(0000001234-0000005678) The part can be used on all machines between and including the serial numbers listed.

Where XXXXX's are listed in place of a serial number, it indicates a serial number change was made but the exact serial number had not been established when the catalog went to press.

(Specifications and design subject to change without notice.)

FIG. 1 - RECOMMENDED GENERAL MAINTENANCE ITEMS

02843

KEY	TENNANT® PART NO.	MACHINE SERIAL NUMBER	DESCRIPTION	QTY.
	59456	(-)	REPLACEMENT PARTS PACKAGE	1
	28141	(-)	BELT	2
	28714	(-)	V-BELT	1
	28755	(-)	V-BELT	1
	28168	(-)	V-BELT	2
	28712	(-)	V-BELT	1
	27313	(-)	FILTER, Air	2
	28068	(-)	SKIRT, Top pan	1
	28069	(-)	SEAL	1
	28139	(-)	SEAL	1
	28072	(-)	SKIRT, Side	2
	28071	(-)	SKIRT, Rear	1
	28081	(-)	LIP ASSEMBLY, Pan	2
	28073	(-)	LIP, Pan	1
	45770-6	(-)	SPARK PLUG	1
	38644	(-)	BREAKER POINTS AND PUSH ROD KIT	1
	28637	(-)	COIL, Ignition	1
	49795-3	(-)	CONDENSER	1
	59457	(-)	REPLACEMENT PARTS PACKAGE, Scrub	1
	29539	(-)	BLADE, Squeegee	1
	29540	(-)	BLADE, Backup	1
	29383	(-)	BLADE, Squeegee	1
	29601	(-)	HOSE	1

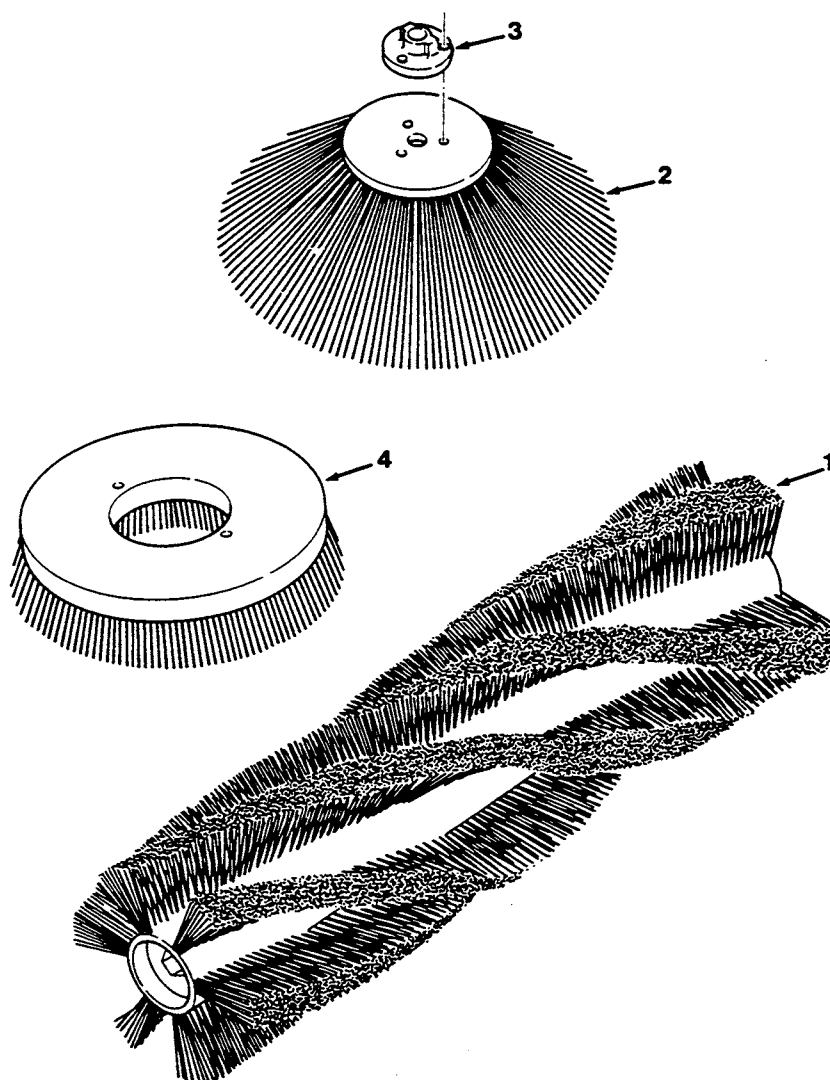


FIG. 2 - REPLACEMENT BRUSHES

02842

KEY	TENNANT® PART NO.	MACHINE SERIAL NUMBER	DESCRIPTION	QTY.
1	28002	(-)	MAIN BRUSH, 6 Row, wire and fiber	1
1	28006	(-)	MAIN BRUSH, 6 Row, union mix	1
1	28006N	(-)	MAIN BRUSH, 6 Row, herox	1
1	28007P	(-)	MAIN BRUSH, 6 Row, polypropylene	1
1	28172	(-)	MAIN BRUSH, 18 Row, natural fiber	1
1	28234	(-)	MAIN BRUSH, 50 Row, tampico	1
1	28235	(-)	MAIN BRUSH, 18 Row, wire and fiber	1
1	28660	(-)	MAIN BRUSH, 6 Row, brite wire	1
1	29006	(-)	MAIN BRUSH, Scrubbing, 18 row, stainless steel	1
1	29408	(-)	MAIN BRUSH, Scrubbing, 24 row, polypropylene	1
2	28096P	(-)	SIDE BRUSH AND ADAPTOR ASSEMBLY, Polypropylene	1
3	45154	(-)	HUB, Side brush	1
	28096N	(-)	SIDE BRUSH AND ADAPTOR ASSEMBLY, Perlon	1
	45154	(-)	HUB, Side brush	1
4	29406	(-)	SIDE BRUSH, Scrubbing, polypropylene	1

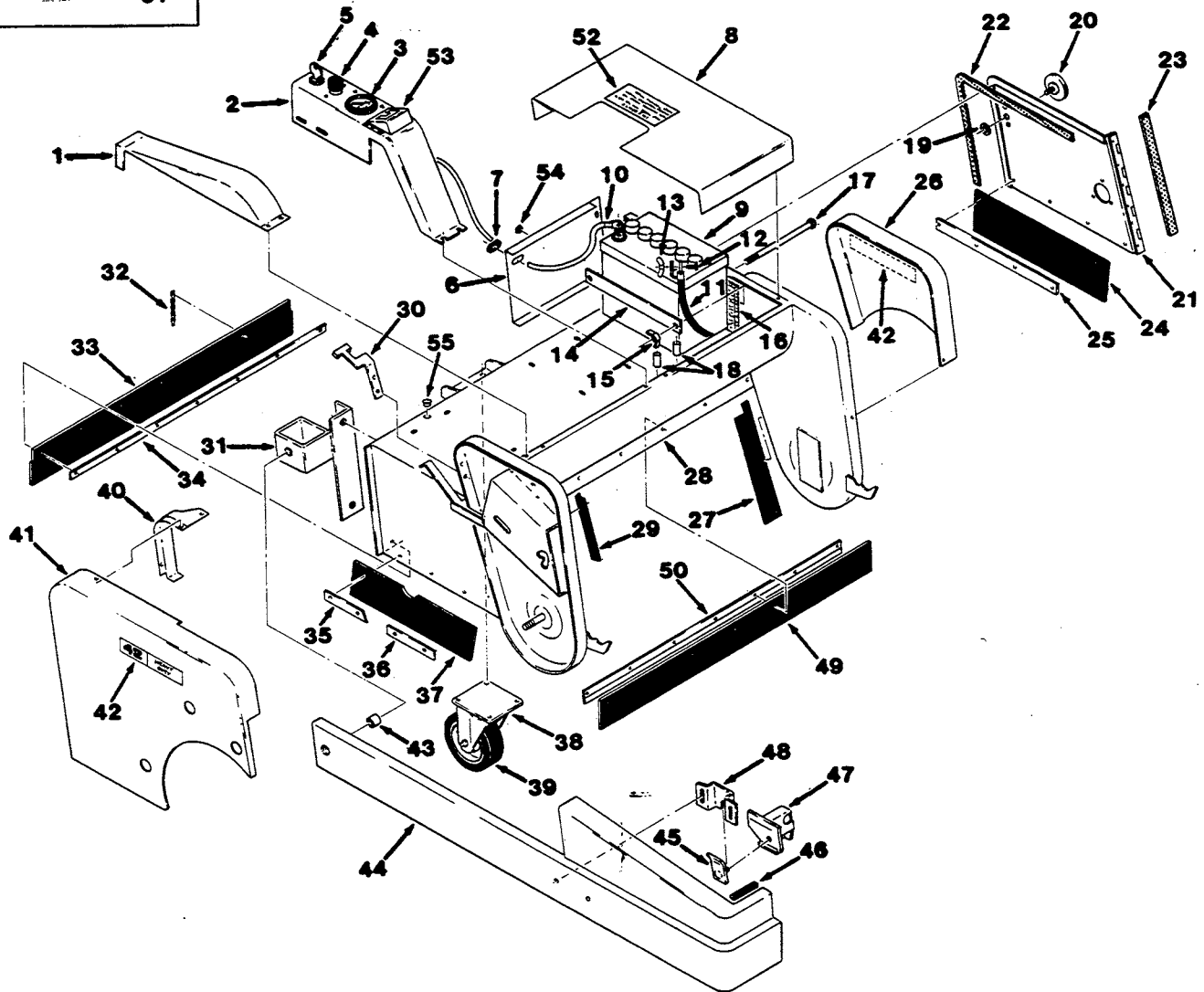
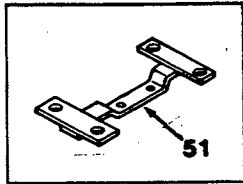


FIG. 3 - MAIN FRAME GROUP

FIG. 3 - MAIN FRAME GROUP

02830

KEY	TENNANT® PART NO.	MACHINE SERIAL NUMBER	DESCRIPTION	QTY.
1	28178	(-)	GUARD	1
2	28753	(-)	PANEL, Instrument	1
3	14127	(-)	AMMETER	1
4	44078	(-)	SWITCH, Push button	1
5	09334	(-)	SWITCH, Ignition	1
	09336	(-)	KEY, Switch	1
	28795	(-)	WIRE KIT	1
6	29077A	(-)	PANEL, Back, L.H.	1
7	10632-4	(-)	GROMMET	1
8	28737	(-)	COVER	1
9	28972	(-)	BATTERY	1
10	19979	(-)	CABLE, Positive battery	1
11	29840-1	(-)	CABLE, Negative battery	1
12	25046	(-)	SCREW, Hex	2
13	39270	(-)	NUT, Wing	2
14	29095	(-)	STRIP	1
15	26509	(-)	NUT, Wing	2
16	28973	(-)	PAD, Battery	1
17	29096	(-)	SCREW, Hex	2
18	51562	(-)	SLEEVE	2
19	26015	(-)	FASTENER	1
20	29982	(-)	KNOB	1
21	28904-1	(-)	DOOR ASSEMBLY	1
22	28277-1	(-)	SEAL	1
23	28277-2	(-)	SEAL	1
24	28072	(-)	SKIRT, Side door	1
25	28025	(-)	RETAINER	1
26	28088-2	(-)	SHROUD ASSEMBLY, L.H.	1
27	28069	(-)	SEAL	1
28	28801	(-)	FRAME, Main	1
29	28139	(-)	SEAL	1
30	28726	(-)	SHOE, Upper	1
31	29904	(-)	BRACE, Bumper	1
32	28499	(-)	CHAIN	1
33	28071	(-)	SKIRT, Rear	1
34	28067	(-)	STRIP	1
35	28250	(-)	RETAINER, Rear skirt, R.H.	1
36	28026	(-)	STRIP	1
37	28072	(-)	SKIRT, Side	1
38	47728	(0000000000-0000008299)	CASTER ASSEMBLY	1
	30094-1	(0000000000-0000008299)	CASTER, Tire	1
38	47728A	(0000008300-	CASTER	1
39	47728-1	(0000008300-	CASTER, Tire	1
	SK2167	(0000008300-	BEARING KIT, Caster	1
40	28920	(-)	PANEL, Back, R.H.	1
41	28648-2	(-)	SHROUD ASSEMBLY, R.H.	1
42	31016	(-)	DECAL, 42HD	2
43	29894	(-)	BUSHING, Sleeve	1
44	29890	(-)	BUMPER	1
45	29884	(-)	KEEPER	1

KEY	TENNANT® PART NO.	MACHINE SERIAL NUMBER	DESCRIPTION	QTY.
46	62595-18	(-)	MOLDING, Rigid	1
47	29918	(-)	BRACKET, Bumper	1
48	29880	(-)	LATCH, Bumper	1
49	28068	(-)	SKIRT, Top pan	1
50	28437	(-)	RETAINER, Top pan	1
51	SK2438	(-)	REPLACEMENT KIT, Bracket	1
52	48242	(-)	DECAL, Alternator	1
53	29295	(-)	DECAL, Brush lift	1
54	33807	(-)	PLUGBUTTON	2
55	33806	(-)	PLUGBUTTON	10

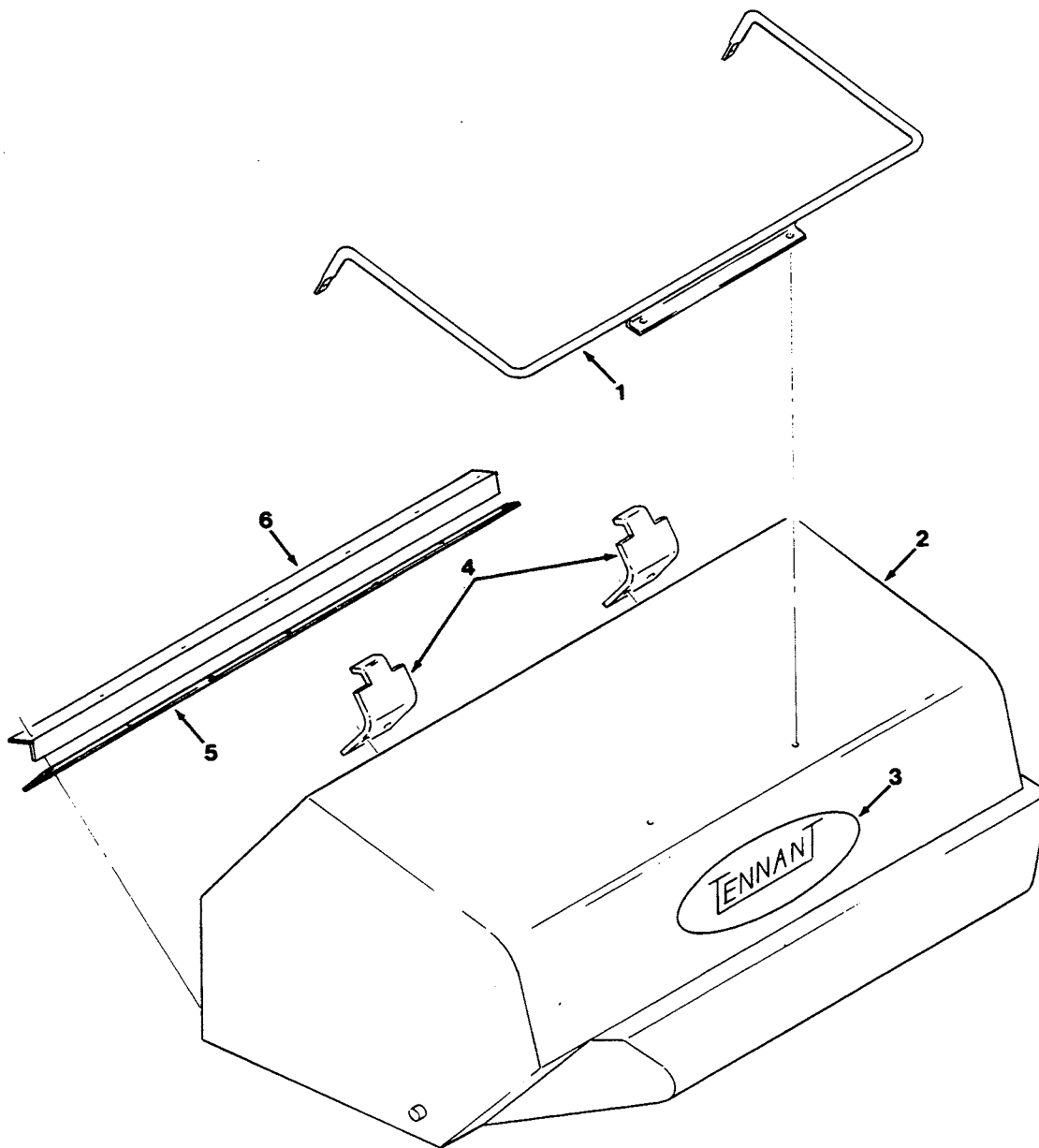


FIG. 4 - HOPPER ASSEMBLY

02238

KEY	TENNANT® PART NO.	MACHINE SERIAL NUMBER	DESCRIPTION	QTY.
	29902	(-)	HOPPER ASSEMBLY	1
1	29896	(-)	HANDLE, Hopper	1
2	29969	(-)	HOPPER	1
3	28613-2	(-)	DECAL, TENNANT® Oval	1
4	29998	(-)	BRACKET	2
5	28081	(-)	LIP ASSEMBLY, Pan	1
6	31025	(-)	RETAINER	1

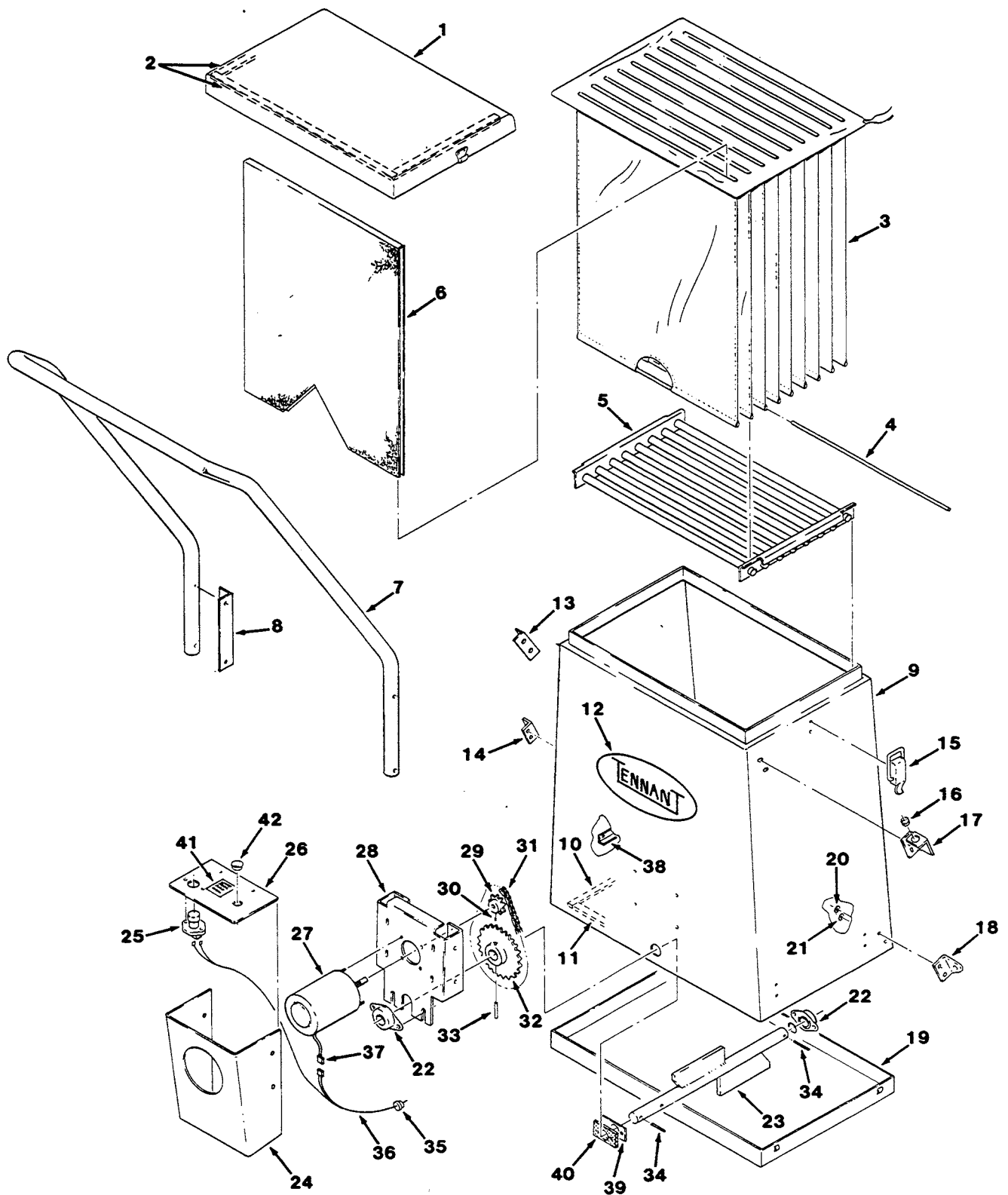


FIG. 5 - FILTER BOX ASSEMBLY

FIG. 5 - FILTER BOX ASSEMBLY

02832

KEY	TENNANT® PART NO.	MACHINE SERIAL NUMBER	DESCRIPTION	QTY.
1	28934A-1	(-)	COVER ASSEMBLY, Filter box	1
2	28935	(-)	SEAL KIT, Cover	1
3	28810	(-)	FILTER	1
4	29903	(-)	WEIGHT, Bag	9
5	29208	(-)	RACK ASSEMBLY, Bag	1
6	47800	(-)	SEPARATOR	5
7	29907	(-)	HANDLE	1
8	29906-1	(-)	BRACE, Handle, L.H.	1
	28732-1	(-)	FILTER BOX ASSEMBLY	1
9	28732	(-)	FILTER BOX	1
10	28950-1	(-)	SEAL	1
11	28950-2	(-)	SEAL	1
12	28613-2	(-)	DECAL, TENNANT® oval	1
13	28912	(-)	BRACKET	1
14	29910-1	(-)	BRACE, Handle, L.H.	1
15	23709	(-)	CATCH, Draw pull	6
16	29991	(-)	BUSHING, Flange	1
17	29911	(-)	BRACE, Handle	1
18	29910	(-)	BRACE, Handle, R.H.	1
19	29221	(-)	PAN, Dust	1
20	29570	(-)	WASHER	6
21	29570-1	(-)	WASHER, Clipped	2
	29993	(-)	SHAKER ASSEMBLY	1
22	26663	(-)	BEARING, Flange	2
23	30000	(-)	SHAKER	1
24	29996	(-)	SHROUD	1
25	44078	(-)	SWITCH, Pushbutton	1
26	29995	(-)	PLATE, Switch	1
27	SK2730	(0000000000-0000011191)	REPLACEMENT KIT, Motor	1
27	27321	(0000011192-	MOTOR	1
28	29994	(-)	BRACKET, Mounting motor	1
29	23626	(-)	SPROCKET	1
30	39327	(-)	SCREW, Set	1
31	33719	(-)	CHAIN ASSEMBLY	1
32	23628	(-)	SPROCKET	1
33	23146	(-)	PIN, Roll	1
34	28290	(-)	PIN, Roll	2
35	10632-16	(-)	GROMMET	2
36	29999	(-)	WIRE ASSEMBLY, Shaker	1
37	29978	(-)	LEAD, Shaker	1
38	29919	(-)	COVER, Wire	1
39	29933	(-)	PLATE, Seal	1
40	29740	(-)	SEAL, Shaft	1
41	36309	(-)	DECAL, Filter shaker	1
42	56992	(-)	PLUGBUTTON	1

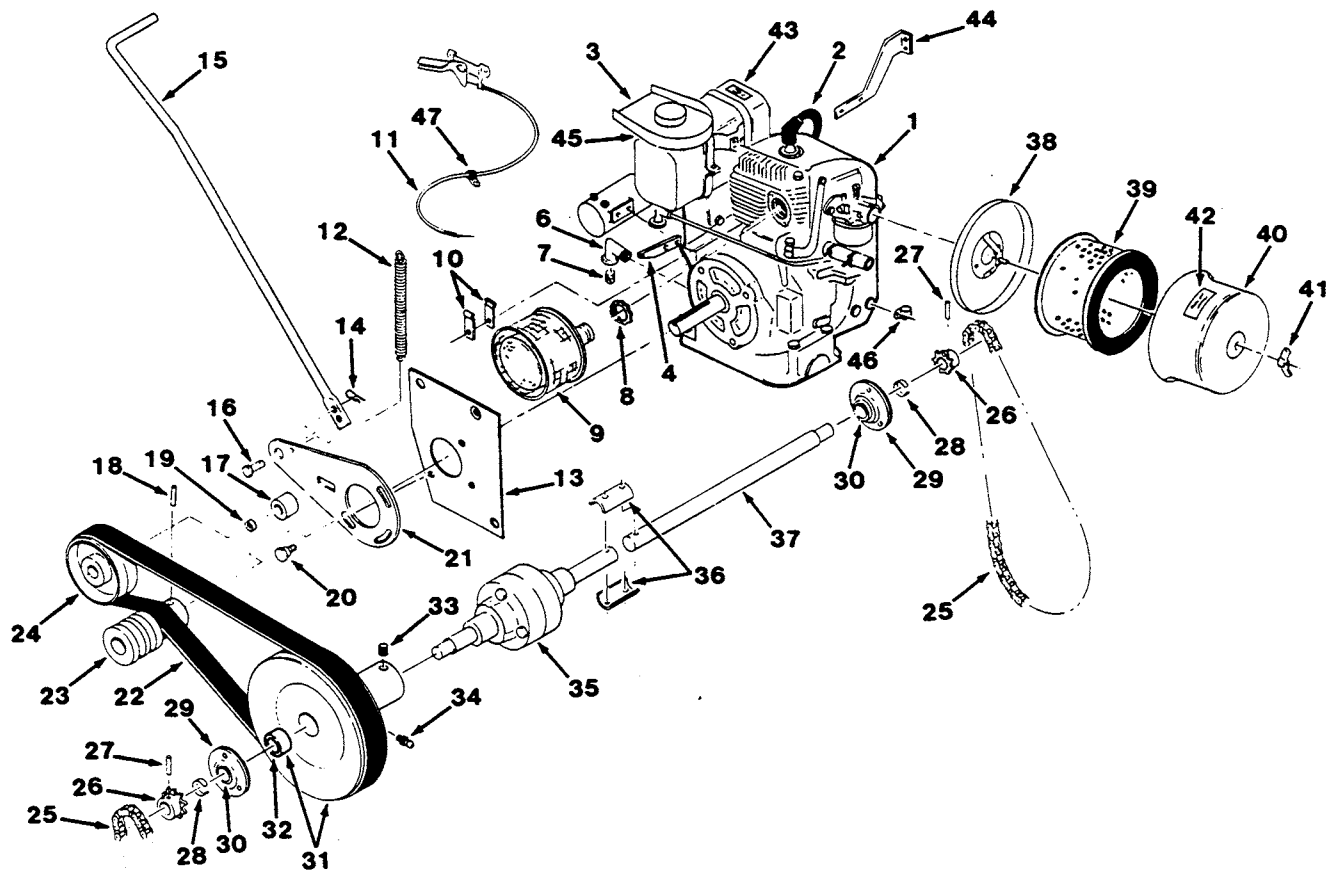
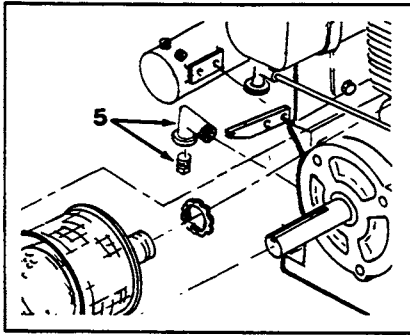


FIG. 6 - ENGINE GROUP

FIG. 6 - ENGINE GROUP

02252

KEY	TENNANT® PART NO.	MACHINE SERIAL NUMBER	DESCRIPTION	QTY.
1	28756-1	(-)	ENGINE	1
2	28656	(-)	CABLE ASSEMBLY	1
3	28792	(-)	TROUGH, Spill	1
4	27325	(-)	BRACKET, Clutch spring	1
5	SK1866	(-)	REPLACEMENT KIT, Oil drain fitting	1
6	47803	(-)	FITTING, Elbow	1
7	17521	(-)	FITTING, Plug	1
8	28763	(-)	NUT, Lock	1
9	27311	(-)	MUFFLER	1
10	27318	(-)	CLIP, Fuel line	2
11	28793A	(-)	CABLE ASSEMBLY	1
12	29545	(-)	SPRING, Tension	1
13	28706	(-)	PLATE, Engine	1
14	44906	(-)	PIN, Cotter	1
15	29898	(-)	HANDLE, Clutch	1
16	26341	(-)	PIN, Clevis	1
17	29089	(-)	SPACER, Boss	1
18	26315	(-)	PIN, Roll	1
19	29091	(-)	SLEEVE	1
20	29087	(-)	SCREW, Shoulder	3
21	29086	(-)	PLATE, Clutch	1
22	28141	(-)	BELT	1
23	28707-1	(-)	SHEAVE	1
24	28709	(-)	PULLEY	1
25	33683	(-)	CHAIN ASSEMBLY	2
	29872	(-)	SHAFT ASSEMBLY, Drive	1
26	28143	(-)	SPROCKET	2
27	39028	(-)	PIN, Spring	2
28	28679	(-)	SPACER	2
29	51137	(-)	FLANGE, Bearing	4
30	23624	(-)	BEARING AND COLLAR	2
31	30017-1	(-)	PULLEY ASSEMBLY	1
32	29876	(-)	BUSHING, Sleeve	1
33	39336	(-)	SCREW, Set	2
34	07259	(-)	FITTING, Grease	1
35	29873	(-)	DIFFERENTIAL AND SHAFT	1
36	28861	(-)	COUPLING	2
37	29877	(-)	SHAFT, Counter	1
	27309	(-)	FILTER ASSEMBLY	1
38	27312	(-)	BASE, Air filter	1
39	27313	(-)	FILTER, Air	1
40	27314	(-)	COVER, Air filter	1
41	26509	(-)	NUT, Wing	1
42	29695	(-)	DECAL, Dry filter	1
43	19048	(-)	DECAL, Gasoline only	1
44	27326	(-)	SUPPORT, Instrument panel	1
45	28642	(-)	SEAL, Trough	1
46	49287	(-)	CLAMP, Cab'e	1
47	46236	(-)	CLAMP, Cable	1

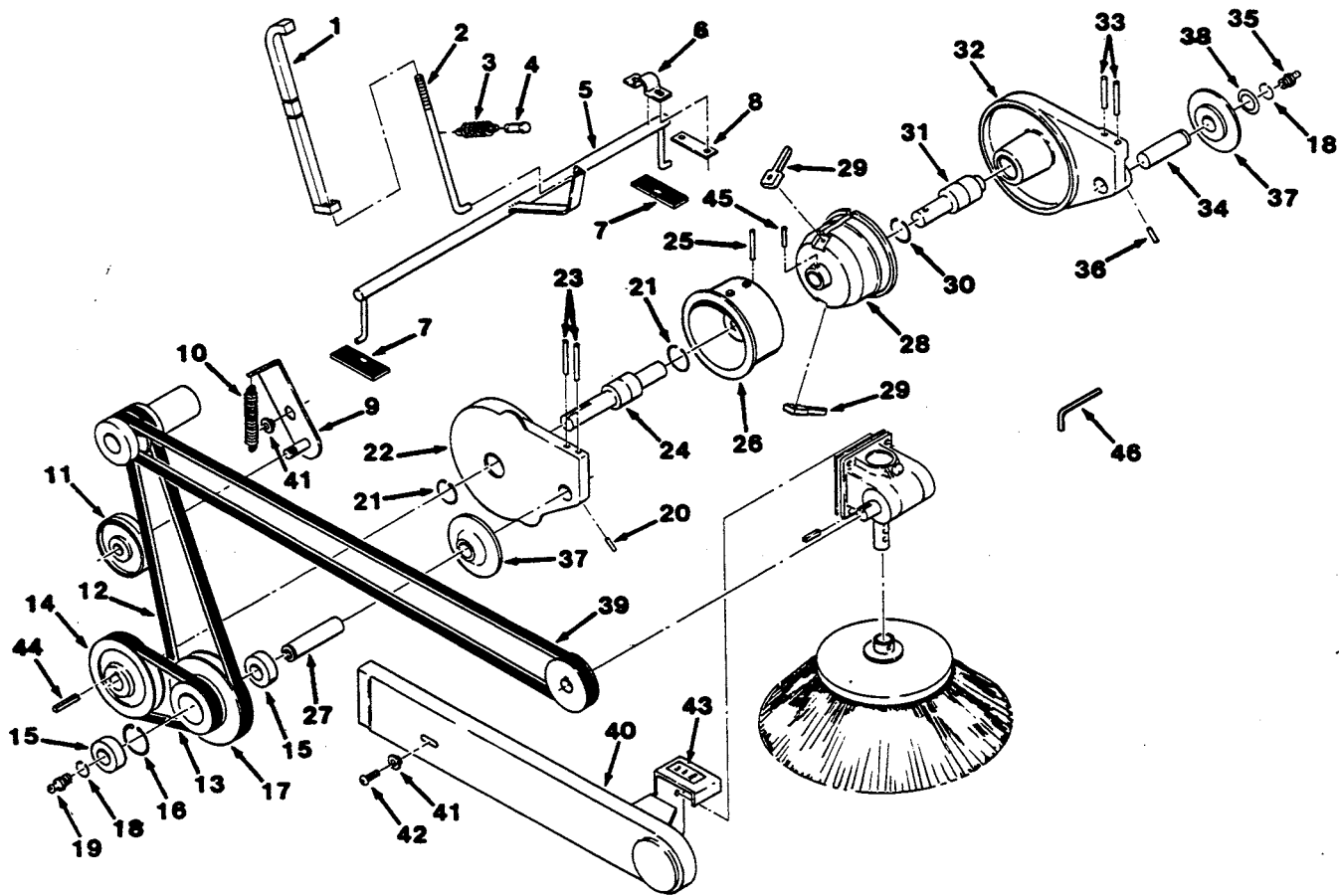


FIG. 7 - BRUSH DRIVE GROUP

FIG. 7 - BRUSH DRIVE GROUP

01012

KEY	TENNANT® PART NO.	MACHINE SERIAL NUMBER	DESCRIPTION	QTY.
1	28742	(-)	HANDLE	1
2	28784	(-)	ROD, L	1
3	09087	(-)	SPRING, Tension	1
4	28296	(-)	PIN, Clevis	1
5	28886	(-)	SHAFT, Brush lift	1
6	28074	(-)	CLAMP, Conduit	1
7	29005	(-)	SEAL	2
8	28066	(-)	STRIP	3
	29267	(-)	ARM AND SHEAVE ASSEMBLY, Idler	1
9	28241	(-)	ARM AND SHAFT ASSEMBLY	1
10	26212	(-)	SPRING, Tension	1
11	28223	(-)	PULLEY ASSEMBLY	1
12	28167	(0000000000-0000001231)	V-BELT	1
12	28714	(0000001232-	V-BELT	1
13	28168	(-)	V-BELT	1
14	28979	(-)	SHEAVE ASSEMBLY, Adjustable	1
	18276	(-)	PIN, Dowel	2
	28387	(-)	SPRING, Tension	3
	28388	(-)	RETAINER	2
	39330	(-)	SCREW, Set	2
	29266	(-)	SHEAVE ASSEMBLY, Brush	1
15	28010	(-)	BEARING, Ball	2
16	01513	(-)	RING, Retaining	1
17	28845A	(-)	SHEAVE, Step	1
18	18136	(-)	RING, Retaining	2
	28974A	(-)	ARM AND PLUG ASSEMBLY	1
19	07259	(-)	FITTING, Grease	1
20	26103	(-)	PIN, Roll	1
21	23217	(-)	RING, Retaining	2
22	28840	(-)	ARM	1
23	20050	(-)	PIN, Roll	2
24	28867	(-)	BEARING AND SHAFT	1
25	26239	(-)	PIN, Roll	1
26	28976	(-)	PLUG AND PIN ASSEMBLY	1
	03319	(-)	PIN	4
27	28849-1	(-)	SHAFT, Long	1
28	28844	(-)	PLUG, Brush idler	1
29	28852	(-)	FINGER	2
30	23217	(-)	RING, Retaining	1
31	28868	(-)	BEARING AND SHAFT	1
32	28841	(-)	ARM	1
33	20050	(-)	PIN, Roll	2
34	28850A	(-)	SHAFT, Short	1
35	07259	(-)	FITTING, Grease	1
36	26103	(-)	PIN, Roll	1
37	28847-1	(-)	BUSHING	2
38	28862	(-)	WASHER, Thrust	1
39	28712	(-)	V-BELT	1
40	28118-1A	(-)	ARM, Side sweep	1
41	28008	(-)	RETAINER	2
42	28614	(-)	SCREW, Button, nylon	1
43	29976	(-)	DECAL, Brush lift	1
44	00911	(-)	KEY, Square	1
45	26239	(-)	PIN, Roll	1
46	02983	(-)	WRENCH, Allen	1

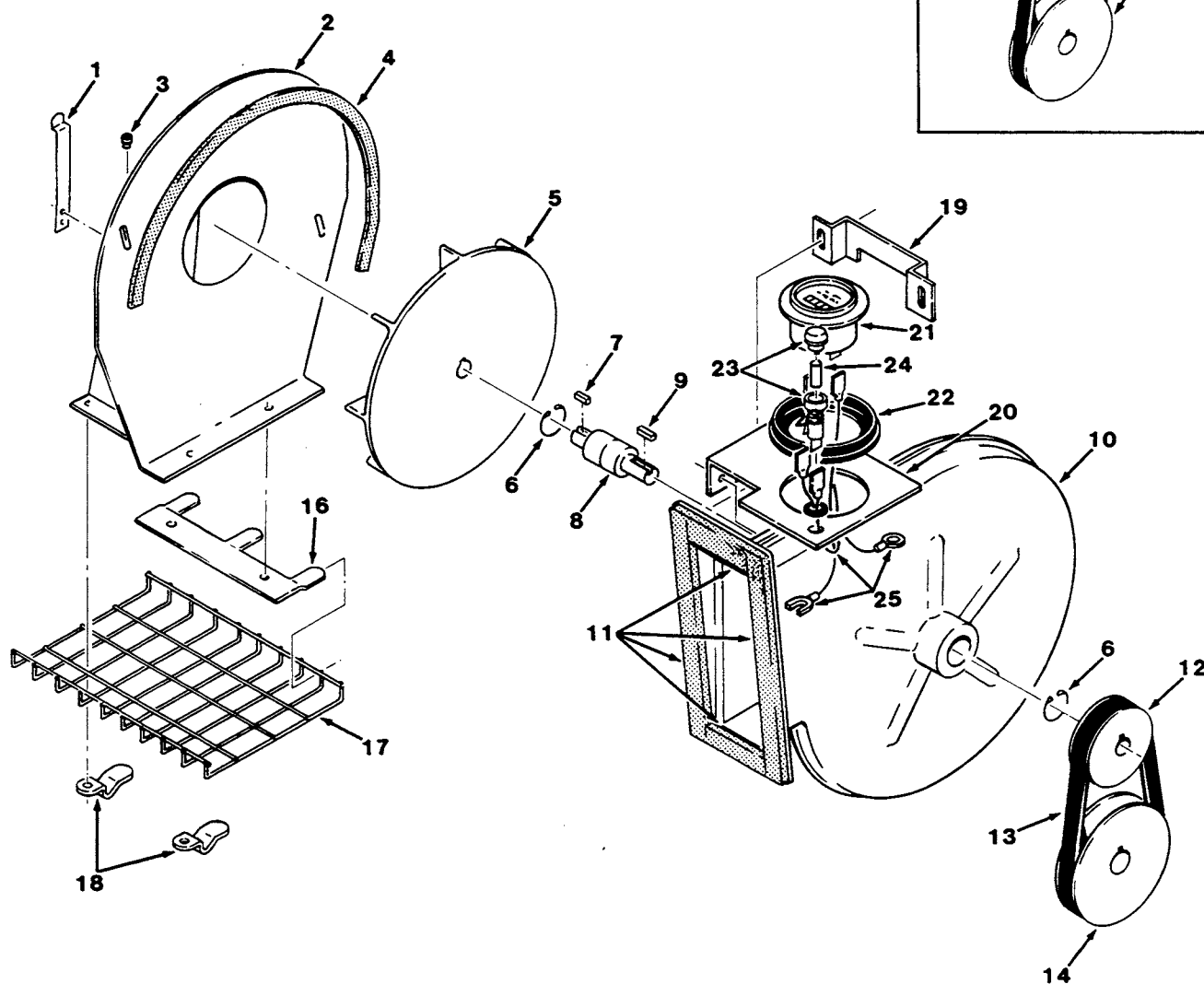


FIG. 8 - VACUUM FAN ASSEMBLY

FIG. 8 - VACUUM FAN ASSEMBLY

01009

KEY	TENNANT® PART NO.	MACHINE SERIAL NUMBER	DESCRIPTION	QTY.
	28761	(-)	DUCT AND HOUSING ASSEMBLY	1
	31057	(-)	DUCT ASSEMBLY	1
1	29073	(-)	CATCH	1
2	28729-1	(-)	SUPPORT AND DUCT ASSEMBLY, Fan	1
3	29233	(-)	BUMPER	2
4	28938-1	(-)	SEAL	1
	31059	(-)	HOUSING ASSEMBLY	1
5	23444	(-)	IMPELLER	1
	39329	(-)	SCREW, Set	1
	39328	(-)	SCREW, Set	1
6	23217	(-)	RING, Retaining	2
7	00910	(-)	KEY, Square	1
8	27315	(-)	BEARING AND SHAFT	1
9	00954	(-)	KEY, Square	1
10	28906-1	(-)	IMPELLER HOUSING ASSEMBLY	1
11	28988	(-)	SEAL KIT	1
12	28760	(0000003280-)	SHEAVE	1
13	28755	(0000003280-)	V-BELT	1
14	28785	(0000003280-)	SHEAVE	1
15	SK1337	(0000000000-0000003279)	FAN DRIVE KIT	1
16	29245	(-)	RETAINER, Front screen	1
17	28877	(-)	SCREEN	1
18	28217	(-)	CLIP, Fan screen	2
19	28658	(-)	BRACKET, Clamp	1
20	28876A	(0000012009-)	BRACKET, Hour meter	1
21	24518	(0000012009-)	METER, Engine hour	1
22	28838	(0000012009-)	DAMPENER, Hour meter	1
23	07422	(0000012009-)	FUSE HOLDER	1
24	07423	(0000012009-)	FUSE, 15 A	1
25	29090A	(0000012009-)	WIRE KIT, Hour meter	1

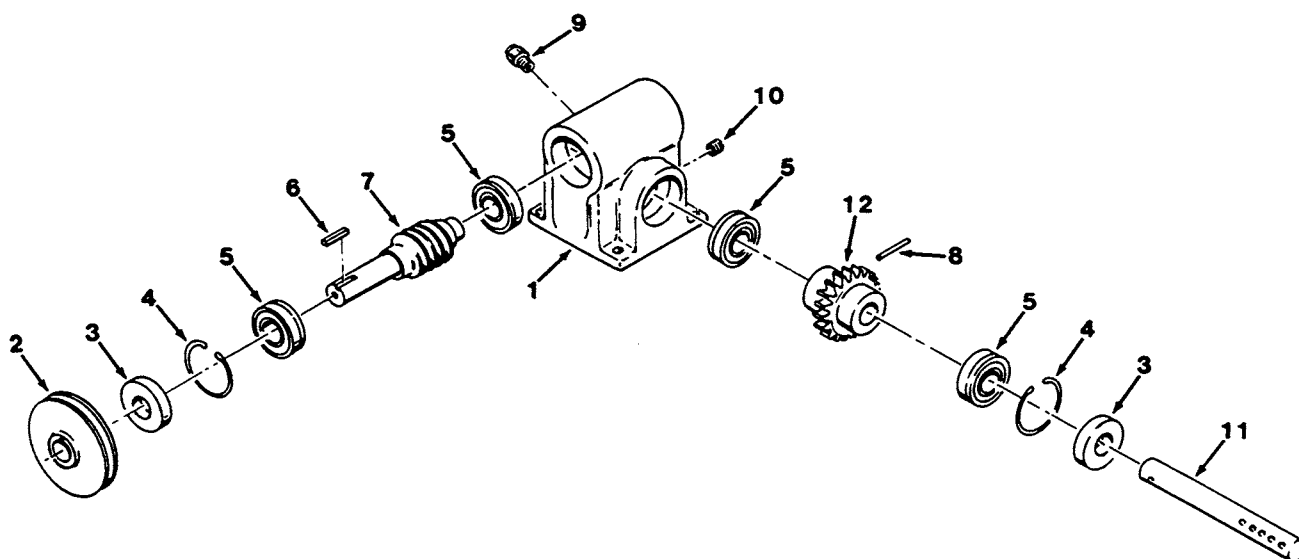


FIG. 9 - SIDE BRUSH SPEED REDUCER, SWEEPER

02227

KEY	TENNANT® PART NO.	MACHINE SERIAL NUMBER	DESCRIPTION	QTY.
1	28119-1	(-)	REDUCER ASSEMBLY, Gear	1
2	28121	(-)	SHEAVE	1
3	28084	(-)	SEAL, Oil	2
4	01513	(-)	RING, Retaining	2
5	28011	(-)	BEARING, Ball	4
6	00911	(-)	KEY, Square	1
7	28194	(-)	WORM	1
8	28144	(-)	PIN, Roll	1
9	07316-15	(-)	BREATHER	1
10	02246	(-)	FITTING, Plug	1
11	28041	(-)	SHAFT, Reducer	1
12	28195	(-)	GEAR	1

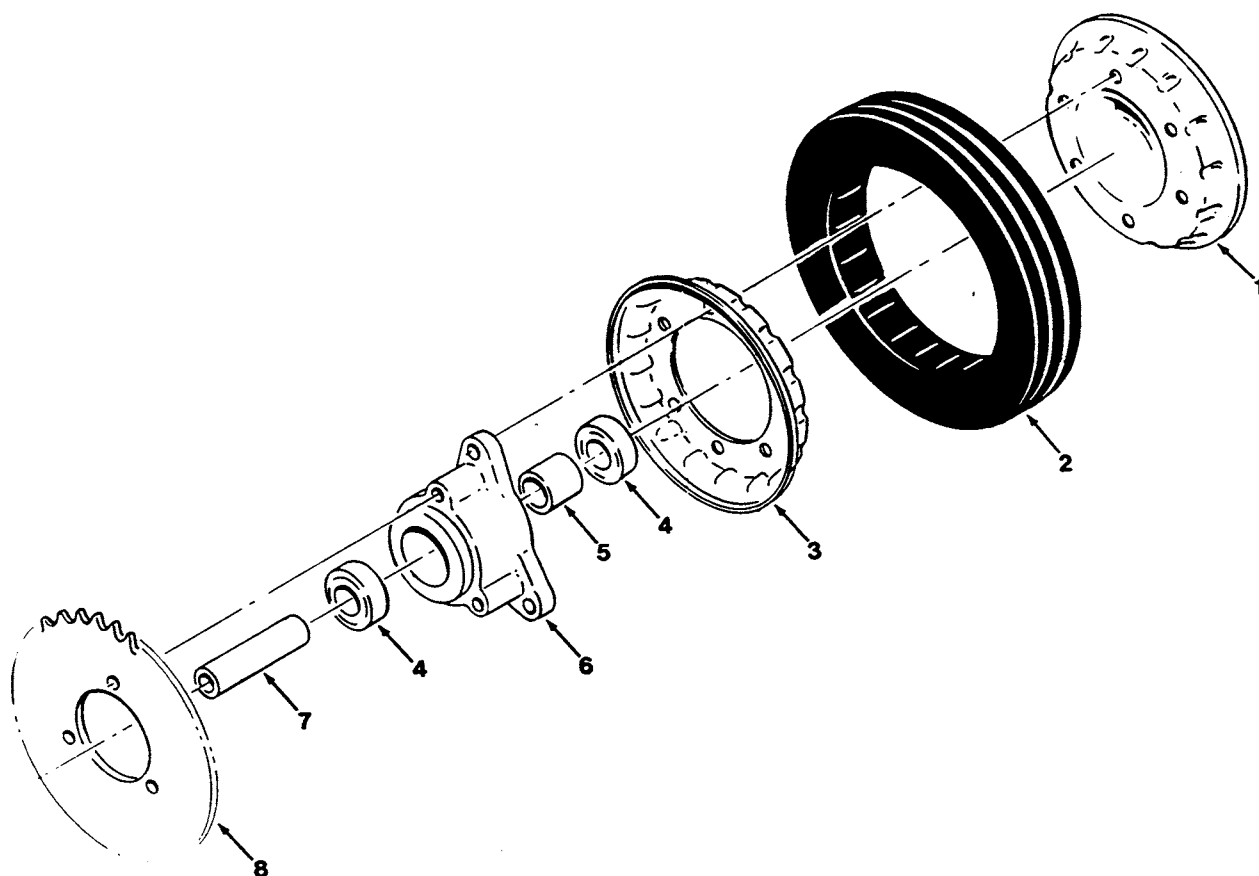


FIG. 10 - WHEEL AND HUB ASSEMBLY

02831

KEY	TENNANT® PART NO.	MACHINE SERIAL NUMBER	DESCRIPTION	QTY.
	28061	(-)	WHEEL AND TIRE ASSEMBLY	2
1	28128	(-)	WHEEL, Half, outside	1
2	28546	(-)	TIRE	1
3	28211	(-)	WHEEL, Half, inside	1
	28805	(-)	HUB ASSEMBLY	2
4	28010	(-)	BEARING, Ball	2
5	28014A	(-)	SLEEVE	1
6	28842	(-)	HUB, Wheel	1
7	28226	(-)	SLEEVE	1
8	28865	(-)	SPROCKET	1

SECTION 6 LPG PARTS

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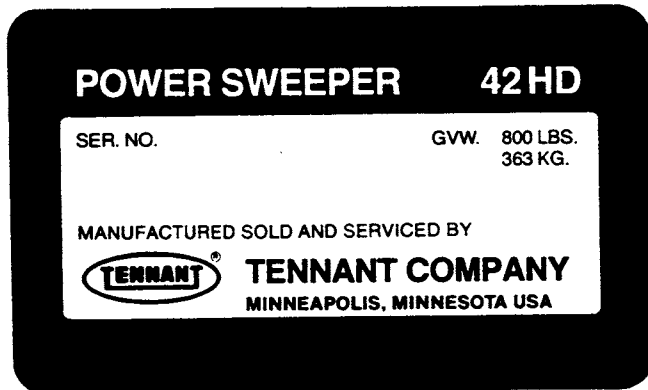
NOTE: Section 6, LPG Parts, lists every repair part for an LPG powered machine.



ORDERING REPAIR PARTS

To avoid errors or delays in filling parts orders, please furnish all of the following information.

1. Always specify the machine model number and the machine serial number shown on the machine data plate.



2. Give the part number, description, and the quantity needed of each item on the order. Do not order by reference number or the figure number of the illustrated parts.
3. Indented items indicate parts of assemblies. Standard hardware is furnished only when part of a purchased assembly. Please order hardware from a local hardware supplier.
4. If the old part cannot be identified, send it to us with the quantity needed specified on the order.
5. State definite shipping instructions to include the shipping address and/or the billing address if there is a difference. Any claim for loss or damage to a shipment in transit should be filed promptly against the transportation company making the delivery. Shipments will be complete unless the packing list or order acknowledgement indicate items back ordered.

If parts received are suspected to be incorrect or defective, please write, wire, or phone the Tennant Company representative from whom you ordered the part. They will give authorization for return and/or handle replacement shipments when required.

SI (INTERNATIONAL SYSTEM) UNITS OF MEASURE

Metric equivalents have been included, where applicable, throughout this parts catalog.

BOLT AND CAP SCREW STRENGTH IDENTIFICATION

Bolts and cap screws required to have high-strength qualities equivalent to SAE Grade 8 are identified throughout this catalog by the description GR 8. Unless identified by this description, all standard bolts and cap screws are SAE Grade 5.

SERIAL NUMBER INFORMATION EXPLANATION

Serial number information is listed parenthetically to show on which machines each part can be used. These listings are explained by the following examples:

(-) The part can be used on all machines.

(0000001234-) The part can be used on all machines beginning with the serial number listed.

(0000000000-0000001234) The part can be used on all machines up to and including serial number listed.

(0000001234-0000005678) The part can be used on all machines between and including the serial numbers listed.

Where XXXXX's are listed in place of a serial number, it indicates a serial number change was made but the exact serial number had not been established when the catalog went to press.

(Specifications and design subject to change without notice.)

FIG. 1 - FUEL TANK GROUP, LPG

02839

KEY	TENNANT® PART NO.	MACHINE SERIAL NUMBER	DESCRIPTION	QTY.
1	28144	(-)	PIN, Roll	4
2	47077	(-)	STRAP, Tank	2
3	26367	(-)	BOLT, Eye	4
4	29253	(-)	BRACKET, Tank mount	1
5	28739	(-)	COVER, LPG	1
6	26496	(-)	COUPLING, Quick disconnect	1
7	10756	(-)	HOSE, LPG	1
8	27048	(-)	FITTING, Elbow	2
9	49250	(-)	MODULE, Control, LPG	1
10	53395-4	(-)	FUEL FILTER LOCK ASSEMBLY	1
	SK1444	(-)	REPAIR KIT, Fuel filter lock	1
11	SK2028	(0000000000-xxxxxxxxxx)	REGULATOR KIT, LPG	1
11	47935	(xxxxxxxxxx-)	REGULATOR, LPG	1
	37666	(xxxxxxxxxx-)	REPAIR KIT	1
12	22642	(-)	HOSE, LPG	1
13	11442-23	(0000000000-0000009976)	FITTING, Straight	1
13	23301	(0000009977-)	FITTING, Elbow, 45°	1
	28767-1	(-)	ENGINE	1
	28794	(-)	WIRE KIT, LPG	1
	32468	(-)	WIRE KIT, LPG	1
	15006	(-)	TERMINAL, Quick disconnect	1

SECTION 7 ACCESSORIES

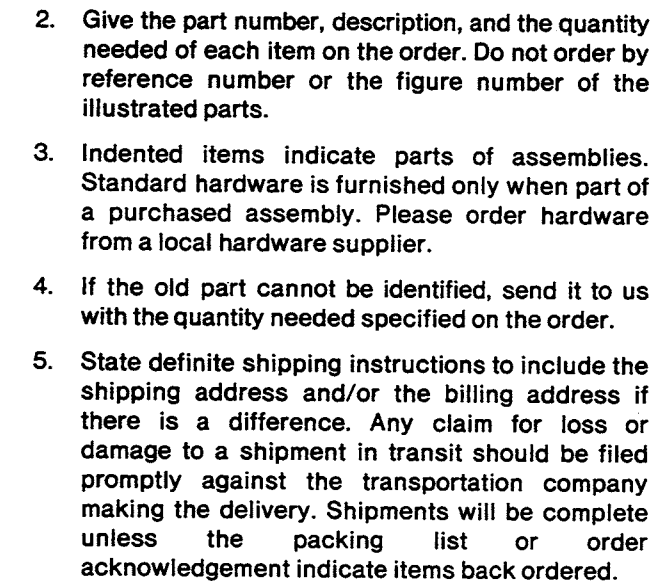
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NOTE: Section 7, Accessories, lists repair parts included as part of the available accessories.

1996, 1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, 2023, 2024, 2025, 2026, 2027, 2028, 2029, 2030, 2031, 2032, 2033, 2034, 2035, 2036, 2037, 2038, 2039, 2040, 2041, 2042, 2043, 2044, 2045, 2046, 2047, 2048, 2049, 2050, 2051, 2052, 2053, 2054, 2055, 2056, 2057, 2058, 2059, 2060, 2061, 2062, 2063, 2064, 2065, 2066, 2067, 2068, 2069, 2070, 2071, 2072, 2073, 2074, 2075, 2076, 2077, 2078, 2079, 2080, 2081, 2082, 2083, 2084, 2085, 2086, 2087, 2088, 2089, 2090, 2091, 2092, 2093, 2094, 2095, 2096, 2097, 2098, 2099, 2100, 2101, 2102, 2103, 2104, 2105, 2106, 2107, 2108, 2109, 2110, 2111, 2112, 2113, 2114, 2115, 2116, 2117, 2118, 2119, 2120, 2121, 2122, 2123, 2124, 2125, 2126, 2127, 2128, 2129, 2130, 2131, 2132, 2133, 2134, 2135, 2136, 2137, 2138, 2139, 2140, 2141, 2142, 2143, 2144, 2145, 2146, 2147, 2148, 2149, 2150, 2151, 2152, 2153, 2154, 2155, 2156, 2157, 2158, 2159, 2160, 2161, 2162, 2163, 2164, 2165, 2166, 2167, 2168, 2169, 2170, 2171, 2172, 2173, 2174, 2175, 2176, 2177, 2178, 2179, 2180, 2181, 2182, 2183, 2184, 2185, 2186, 2187, 2188, 2189, 2190, 2191, 2192, 2193, 2194, 2195, 2196, 2197, 2198, 2199, 2200, 2201, 2202, 2203, 2204, 2205, 2206, 2207, 2208, 2209, 2210, 2211, 2212, 2213, 2214, 2215, 2216, 2217, 2218, 2219, 2220, 2221, 2222, 2223, 2224, 2225, 2226, 2227, 2228, 2229, 2230, 2231, 2232, 2233, 2234, 2235, 2236, 2237, 2238, 2239, 2240, 2241, 2242, 2243, 2244, 2245, 2246, 2247, 2248, 2249, 2250, 2251, 2252, 2253, 2254, 2255, 2256, 2257, 2258, 2259, 2260, 2261, 2262, 2263, 2264, 2265, 2266, 2267, 2268, 2269, 2270, 2271, 2272, 2273, 2274, 2275, 2276, 2277, 2278, 2279, 2280, 2281, 2282, 2283, 2284, 2285, 2286, 2287, 2288, 2289, 2290, 2291, 2292, 2293, 2294, 2295, 2296, 2297, 2298, 2299, 2300, 2301, 2302, 2303, 2304, 2305, 2306, 2307, 2308, 2309, 2310, 2311, 2312, 2313, 2314, 2315, 2316, 2317, 2318, 2319, 2320, 2321, 2322, 2323, 2324, 2325, 2326, 2327, 2328, 2329, 2330, 2331, 2332, 2333, 2334, 2335, 2336, 2337, 2338, 2339, 2340, 2341, 2342, 2343, 2344, 2345, 2346, 2347, 2348, 2349, 2350, 2351, 2352, 2353, 2354, 2355, 2356, 2357, 2358, 2359, 2360, 2361, 2362, 2363, 2364, 2365, 2366, 2367, 2368, 2369, 2370, 2371, 2372, 2373, 2374, 2375, 2376, 2377, 2378, 2379, 2380, 2381, 2382, 2383, 2384, 2385, 2386, 2387, 2388, 2389, 2390, 2391, 2392, 2393, 2394, 2395, 2396, 2397, 2398, 2399, 2400, 2401, 2402, 2403, 2404, 2405, 2406, 2407, 2408, 2409, 2410, 2411, 2412, 2413, 2414, 2415, 2416, 2417, 2418, 2419, 2420, 2421, 2422, 2423, 2424, 2425, 2426, 2427, 2428, 2429, 2430, 2431, 2432, 2433, 2434, 2435, 2436, 2437, 2438, 2439, 2440, 2441, 2442, 2443, 2444, 2445, 2446, 2447, 2448, 2449, 2450, 2451, 2452, 2453, 2454, 2455, 2456, 2457, 2458, 2459, 2460, 2461, 2462, 2463, 2464, 2465, 2466, 2467, 2468, 2469, 2470, 2471, 2472, 2473, 2474, 2475, 2476, 2477, 2478, 2479, 2480, 2481, 2482, 2483, 2484, 2485, 2486, 2487, 2488, 2489, 2490, 2491, 2492, 2493, 2494, 2495, 2496, 2497, 2498, 2499, 2500, 2501, 2502, 2503, 2504, 2505, 2506, 2507, 2508, 2509, 2510, 2511, 2512, 2513, 2514, 2515, 2516, 2517, 2518, 2519, 2520, 2521, 2522, 2523, 2524, 2525, 2526, 2527, 2528, 2529, 2530, 2531, 2532, 2533, 2534, 2535, 2536, 2537, 2538, 2539, 2540, 2541, 2542, 2543, 2544, 2545, 2546, 2547, 2548, 2549, 2550, 2551, 2552, 2553, 2554, 2555, 2556, 2557, 2558, 2559, 2560, 2561, 2562, 2563, 2564, 2565, 2566, 2567, 2568, 2569, 2570, 2571, 2572, 2573, 2574, 2575, 2576, 2577, 2578, 2579, 2580, 2581, 2582, 2583, 2584, 2585, 2586, 2587, 2588, 2589, 2590, 2591, 2592, 2593, 2594, 2595, 2596, 2597, 2598, 2599, 2600, 2601, 2602, 2603, 2604, 2605, 2606, 2607, 2608, 2609, 2610, 2611, 2612, 2613, 2614, 2615, 2616, 2617, 2618, 2619, 2620, 2621, 2622, 2623, 2624, 2625, 2626, 2627, 2628, 2629, 2630, 2631, 2632, 2633, 2634, 2635, 2636, 2637, 2638, 2639, 2640, 2641, 2642, 2643, 2644, 2645, 2646, 2647, 2648, 2649, 2650, 2651, 2652, 2653, 2654, 2655, 2656, 2657, 2658, 2659, 2660, 2661, 2662, 2663, 2664, 2665, 2666, 2667, 2668, 2669, 2670, 2671, 2672, 2673, 2674, 2675, 2676, 2677, 26

1. Always specify the machine model number and the machine serial number shown on the machine data plate.



SI (INTERNATIONAL SYSTEM) UNITS OF MEASURE

POWER SWEEPER - 42HD MM078 (3-85) LITHO IN U.S.A.

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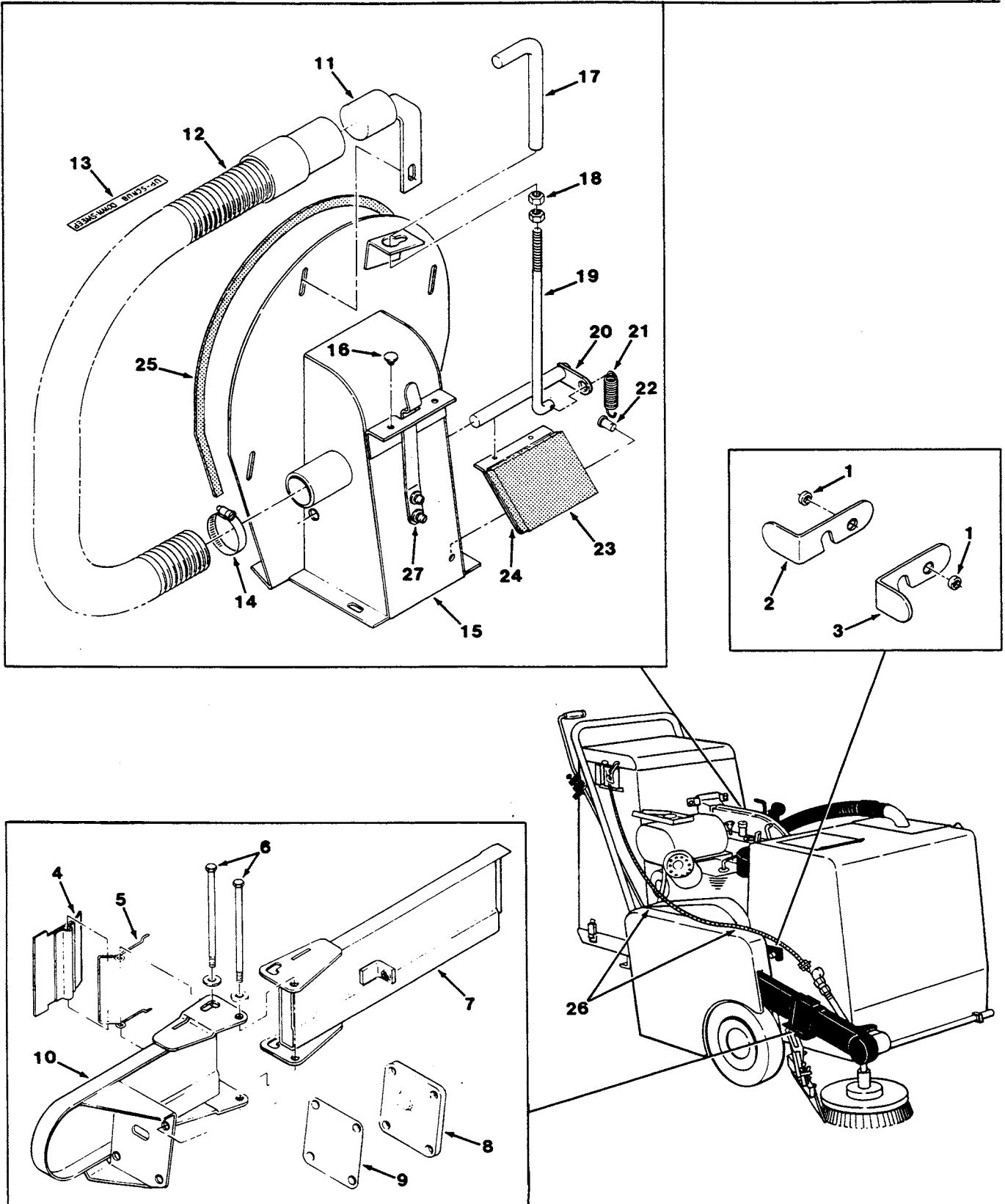


FIG. 1 - PREP FOR SCRUB GROUP

FIG. 1 - PREP FOR SCRUB GROUP

01007

NOTE: Scrub Attachment, TENNANT® Part Number 29970, Includes Fig. 1, 2, 3, 4, 5, 6, and 7.

KEY	TENNANT® PART NO.	MACHINE SERIAL NUMBER	DESCRIPTION	QTY.
	28775	(-)	PREP FOR SCRUB	1
1	29534	(-)	SLEEVE	2
2	29983	(-)	CATCH, Scrubber tank, L.H.	1
3	29984	(-)	CATCH, Scrubber tank, R.H.	1
4	28563	(-)	SHIELD ASSEMBLY	1
5	28564	(-)	SPRING, Torsion	1
6	33263	(0000000000-0000011596)	REPLACEMENT KIT, Pin	2
6	48418	(0000011597-	SCREW, Hex	2
7	28566A	(-)	ARM, Rear	1
8	29629	(-)	PLATE, Gear head	1
9	28078	(-)	GASKET	1
10	29728A	(-)	ARM, Side	1
11	29652	(-)	PLUG	1
12	29693	(-)	HOSE AND CUFF ASSEMBLY	1
13	29640	(-)	DECAL	1
14	29696	(-)	CLAMP, Worm drive	1
15	28723	(-)	SUPPORT, Fan duct	1
16	29233	(-)	BUMPER	2
17	28888	(-)	HANDLE	1
18	32522	(-)	NUT	1
19	29525	(-)	ROD	1
20	27310	(-)	SUPPORT, Baffle	1
21	53091	(-)	SPRING, Tension	1
22	28296	(-)	PIN, Clevis	1
23	28724	(-)	SEAL, Baffle	1
24	28718	(-)	BAFFLE, Fan duct	1
25	28938-1	(-)	SEAL, Felt	1
26	33236	(-)	CLIP, Tension	2
27	29073	(-)	CATCH	1
	28712	(-)	V-BELT	1

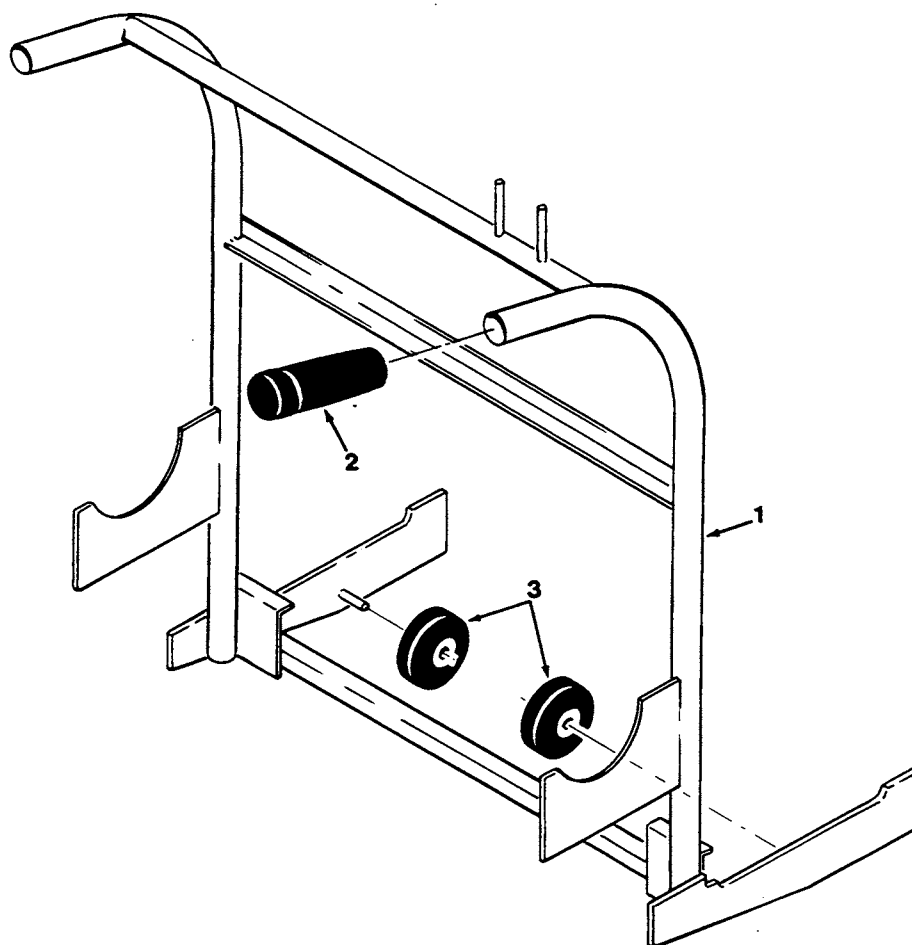


FIG. 2 - SCRUB ATTACHMENT CART GROUP

02250

NOTE: Scrub Attachment, TENNANT® Part Number 29970, Includes Fig. 1, 2, 3, 4, 5, 6, and 7.

KEY	TENNANT® PART NO.	MACHINE SERIAL NUMBER	DESCRIPTION	QTY.
	29844	(-)	SCRUBBER CART	1
1	29808	(-)	CART	1
2	28162	(-)	GRIP, Handle	2
3	29653	(-)	WHEEL	2

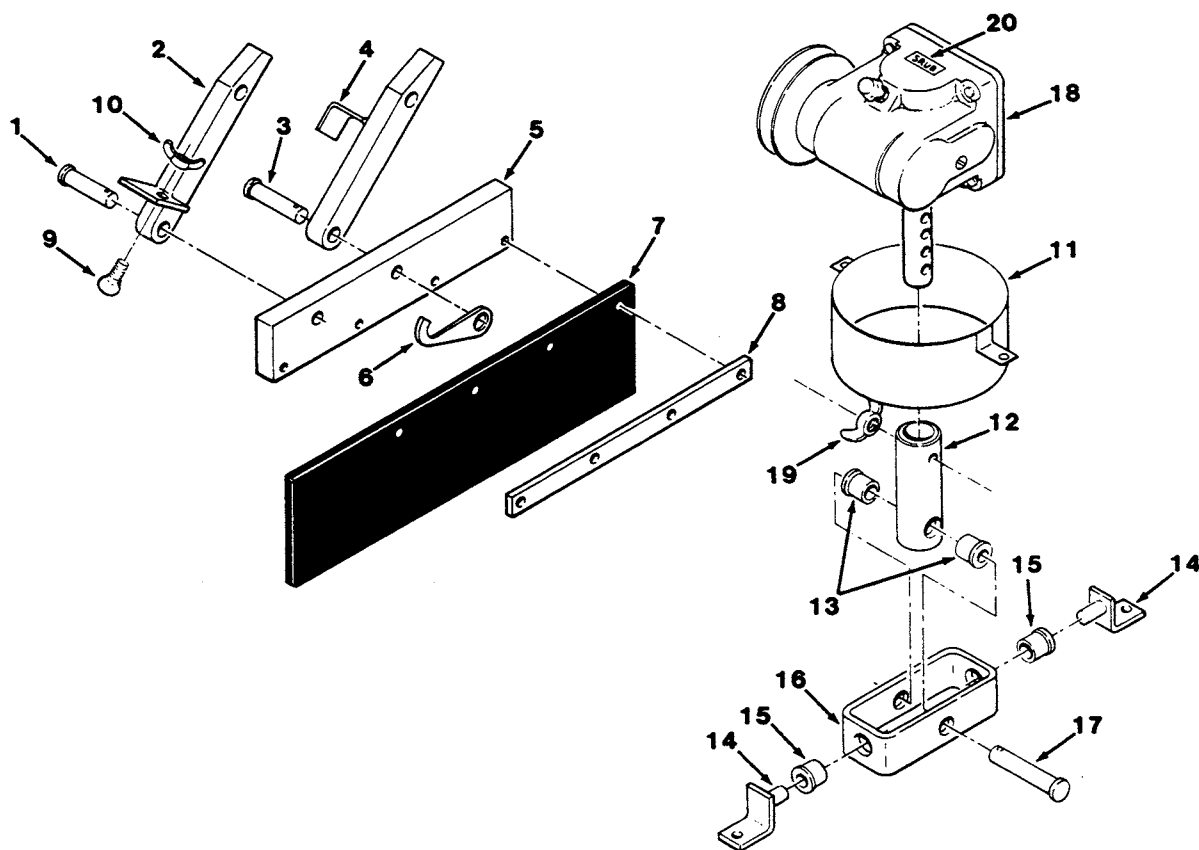


FIG. 3 - SIDE BRUSH AND SQUEEGEE ASSEMBLY

01013

NOTE: Scrub Attachment, TENNANT® Part Number 29970, Includes Fig. 1, 2, 3, 4, 5, 6, and 7.

KEY	TENNANT® PART NO.	MACHINE SERIAL NUMBER	DESCRIPTION	QTY.
	29893	(-)	SIDE SQUEEGEE ASSEMBLY	1
1	29557	(-)	PIN, Clevis	1
2	29555	(-)	LINK	1
3	29558	(-)	PIN, Clevis	1
4	29567	(-)	LINK	1
5	29552	(-)	ARM	1
6	43206	(-)	CATCH	1
7	29383	(-)	BLADE, Squeegee	1
8	29380	(-)	RETAINER	1
9	39362	(-)	SCREW, Thumb	1
10	39272	(-)	NUT, Wing	1
	29897	(-)	REDUCER AND SWIVEL ASSEMBLY,	
			Scrub	1
11	29592	(-)	RING	1
12	29586	(-)	TUBE, Hub	1
13	29585	(-)	BUSHING, Flange	2
14	31039	(-)	PIVOT	2
15	29585	(-)	BUSHING, Flange	2
16	31037	(-)	TUBE, Swivel box	1
17	29584	(-)	PIN, Clevis	1
18	29535	(-)	REDUCER, Gear	1
19	26509	(-)	NUT, Wing	1
20	29868	(-)	DECAL, Scrub	1

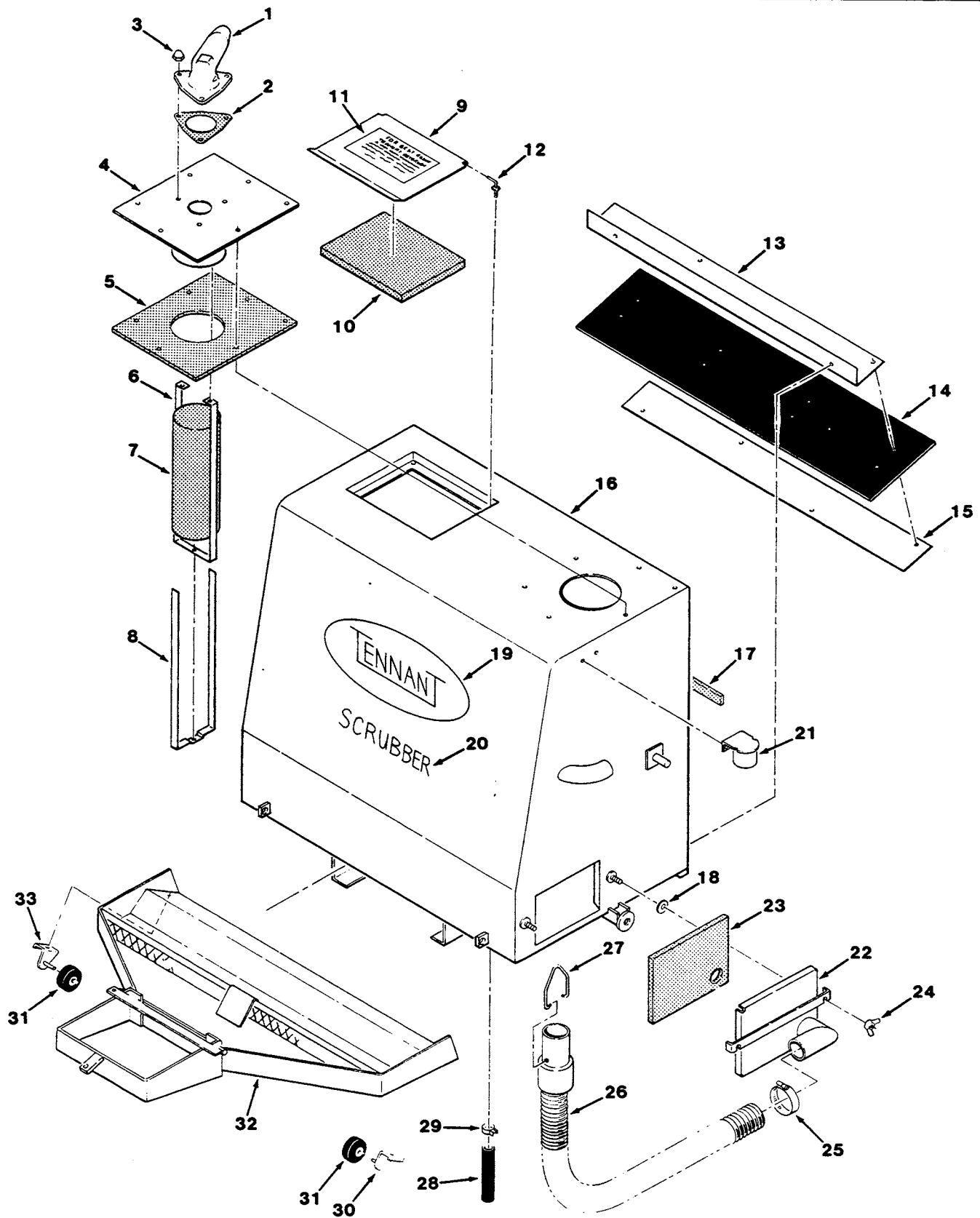


FIG. 4 - TANK GROUP

FIG. 4 - TANK GROUP

02833

NOTE: Scrub Attachment, TENNANT® Part Number 29970, Includes Fig. 1, 2, 3, 4, 5, 6, and 7.

KEY	TENNANT® PART NO.	MACHINE SERIAL NUMBER	DESCRIPTION	QTY.
1	29663	(-)	ELBOW	1
2	29664	(-)	GASKET	1
3	41127	(-)	NUT, Low crown	3
4	29550	(-)	TUBE, Shut off	1
5	29548	(-)	GASKET, Plate bolting	1
6	29333	(-)	STRAP, Float mounting	1
7	29923	(-)	FLOAT ASSEMBLY	1
8	29334	(-)	STRAP, Float retainer	1
9	29685	(-)	TANK LID ASSEMBLY	1
10	29531	(-)	GASKET, Lid	1
11	46847	(-)	DECAL, Detergent recommended	1
12	22133	(-)	FASTENER	2
13	29648	(-)	DEFLECTOR	1
14	29649	(-)	SKIRT, Deflector	1
15	29665	(-)	RETAINER	1
16	29506	(-)	TANK ASSEMBLY, Scrubber	1
17	29620	(-)	SEAL	1
18	40632	(-)	WASHER	2
19	28613-2	(-)	DECAL, TENNANT® oval	1
20	24556-1	(-)	DECAL, Scrubber	1
21	20215	(-)	PLUG	1
22	29684	(-)	DOOR ASSEMBLY	1
23	29522	(-)	SEAL, Door clean out	1
24	26509	(-)	NUT, Wing	2
25	29696	(-)	CLAMP, Worm drive	1
26	29693	(-)	HOSE AND CUFF ASSEMBLY	1
27	20267	(-)	CLIP, Hose retainer	1
28	29605	(-)	HOSE	1
29	11399	(-)	CLAMP, Worm drive	1
	29683	(-)	TRAY ASSEMBLY	1
30	29936	(-)	BRACKET, Caster, L.H.	1
31	01847	(-)	WHEEL	2
32	29524A	(-)	TRAY, Pick up	1
33	29937	(-)	BRACKET, Caster, R.H.	1

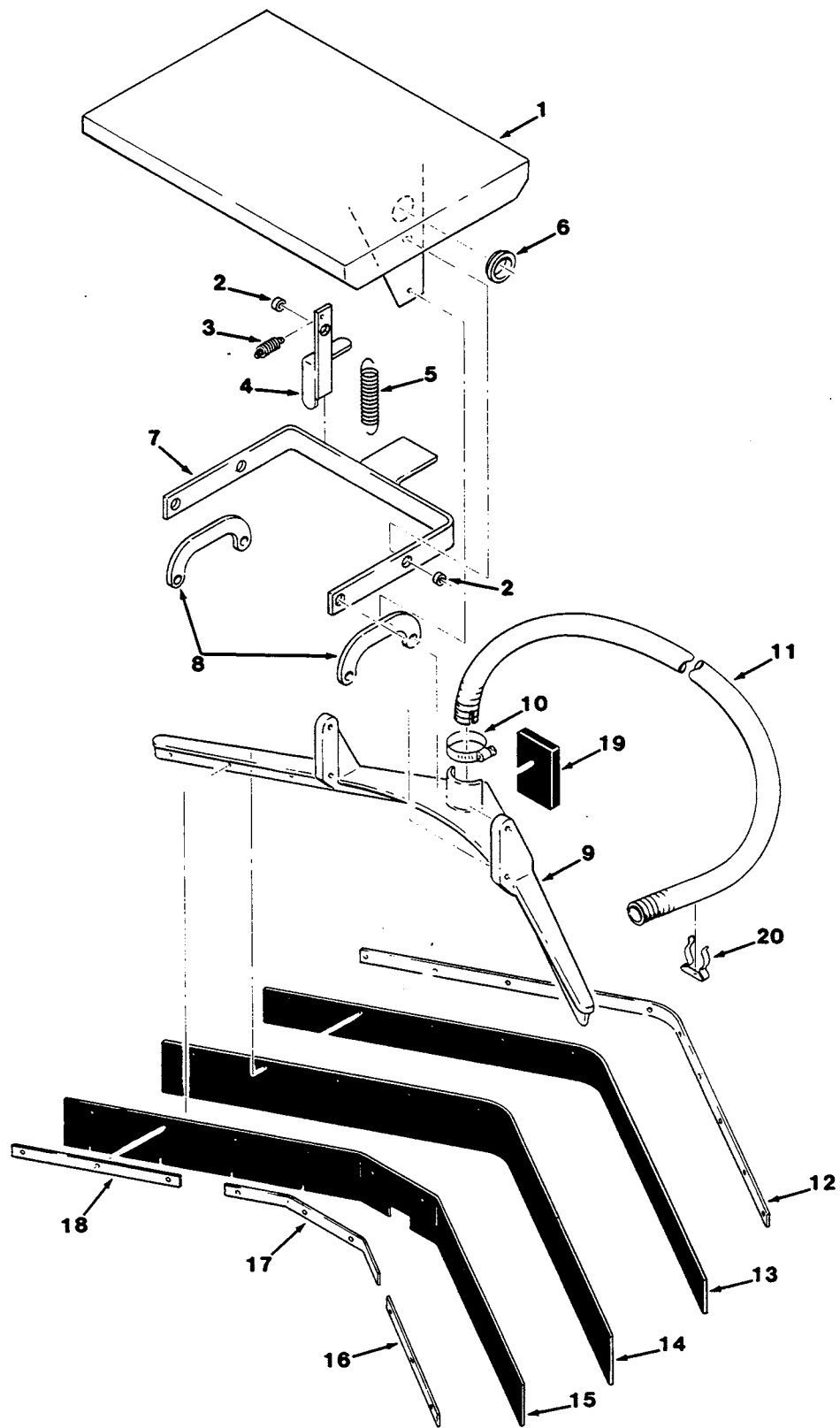


FIG. 5 - REAR SQUEEGEE ASSEMBLY

FIG. 5 - REAR SQUEEGEE ASSEMBLY

01019

NOTE: Scrub Attachment, TENNANT® Part Number 29970, Includes Fig. 1, 2, 3, 4, 5, 6, and 7.

KEY	TENNANT® PART NO.	MACHINE SERIAL NUMBER	DESCRIPTION	QTY.
	29892	(-)	SQUEEGEE ASSEMBLY, Rear	1
1	29958	(-)	BASE, Squeegee	1
2	20318	(-)	SLEEVE	9
3	09087	(-)	SPRING, Tension	1
4	29953	(-)	SUPPORT	1
5	13352	(-)	SPRING, Tension	1
6	47080	(-)	GROMMET	1
7	29957	(-)	PEDAL	1
8	29945	(-)	LINK, Squeegee	2
9	29538	(-)	SQUEEGEE	1
10	29696	(-)	CLAMP, Wormdrive	1
11	29474	(-)	HOSE, Rubber	1
12	29541	(-)	RETAINER	1
13	29540	(-)	BLADE, Back up	1
14	29539	(-)	BLADE, Squeegee	1
15	29931	(-)	STRIP, Front	1
16	29929	(-)	RETAINER	1
17	29930	(-)	RETAINER	1
18	29927	(-)	RETAINER	1
19	29662	(-)	BAR, Rubber	1
20	29883	(-)	CLIP, Finger grip	2

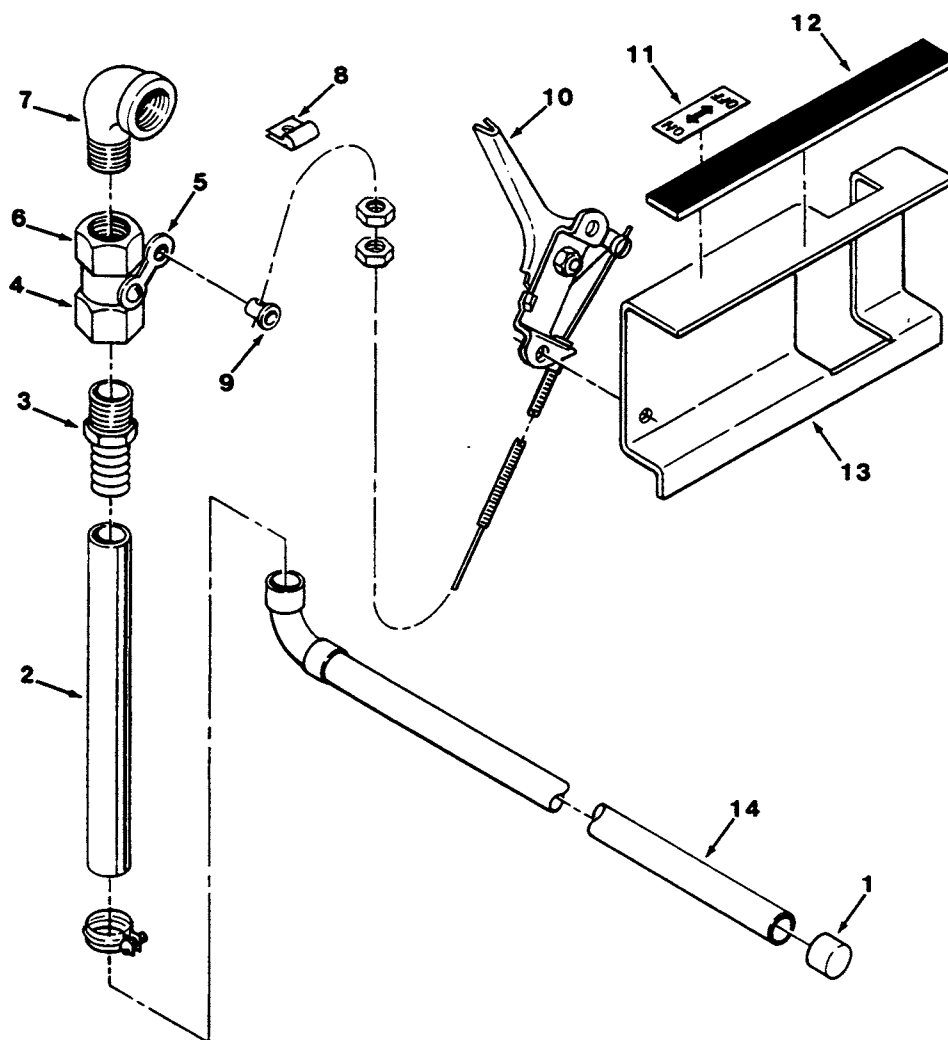


FIG. 6 - SOLUTION CONTROL GROUP

01008

NOTE: Scrub Attachment, TENNANT® Part Number 29970, Includes Fig. 1, 2, 3, 4, 5, 6, and 7.

KEY	TENNANT® PART NO.	MACHINE SERIAL NUMBER	DESCRIPTION	QTY.
1	47639	(-)	CAP, Rubber	1
2	29601	(-)	HOSE, Vinyl	1
3	43246	(-)	CONNECTOR	1
4	43379-1	(-)	VALVE ASSEMBLY	1
5	20347	(-)	ARM	1
6	20350	(-)	SEAL, O-ring	1
7	29600	(-)	FITTING, Elbow	1
8	26414	(-)	CLAMP, Cable	1
9	43242	(-)	SWIVEL	1
10	SK1838	(0000000000-xxxxxxxxxx)	REPLACEMENT KIT, Cable	1
10	27354	(xxxxxxxxxx-)	CABLE ASSEMBLY, Control	1
11	29638	(-)	DECAL, On-off	1
12	29233	(0000000000-xxxxxxxxxx)	BUMPER	1
13	29589	(-)	BRACKET, Cable	1
14	31042	(-)	SPREADER, Water	1
15	43274	(0000000000-xxxxxxxxxx)	CLAMP	1

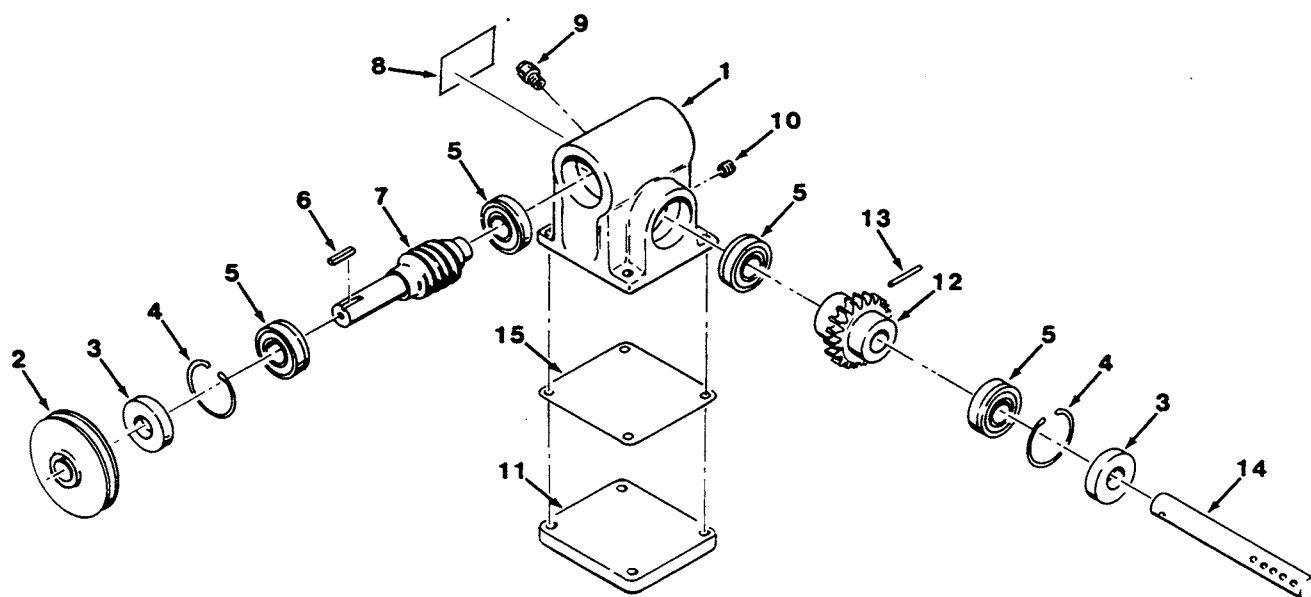


FIG. 7 - SIDE BRUSH SPEED REDUCER GROUP

02248

NOTE: Scrub Attachment, TENNANT® Part Number 29970, Includes Fig. 1, 2, 3, 4, 5, 6, and 7.

KEY	TENNANT® PART NO.	MACHINE SERIAL NUMBER	DESCRIPTION	QTY.
1	29535	(-)	REDUCER, Gear	1
2	28121	(-)	SHEAVE	1
3	28084	(-)	SEAL, Oil	2
4	01513	(-)	RING, Retaining	2
5	28011	(-)	BEARING, Ball	4
6	00911	(-)	KEY, Square	1
7	29661	(-)	WORM	1
8	29868	(-)	DECAL, Scrub	1
9	07316-15	(-)	BREATHER	1
10	02246	(-)	FITTING, Plug	1
11	29629	(-)	PLATE, Gear head	1
12	26493	(-)	GEAR	1
13	28144	(-)	PIN, Roll	1
14	28041	(-)	SHAFT, Reducer	1
15	28078	(-)	GASKET	1

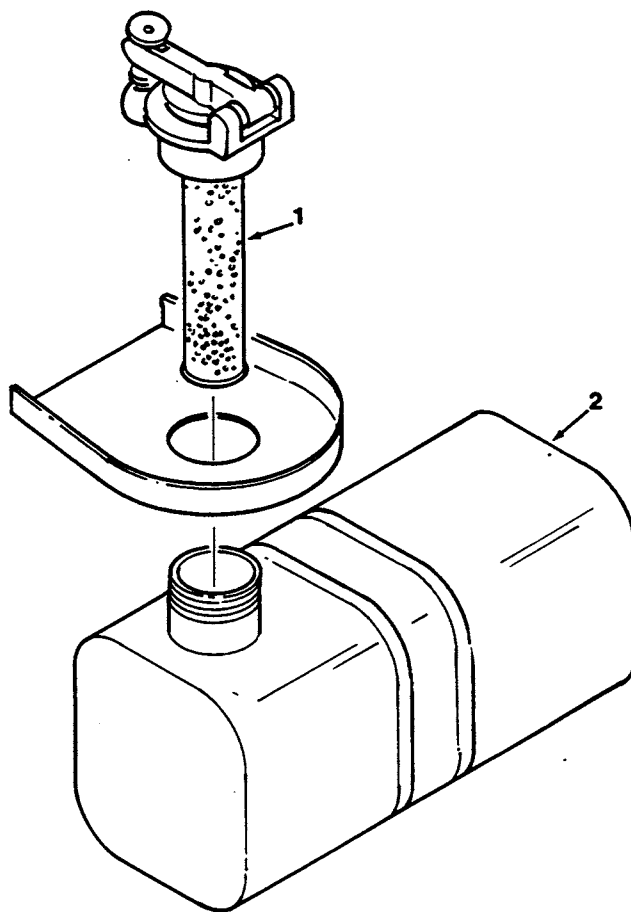


FIG. 8 - PROTECTOSEAL FUEL TANK CAP KIT

02838

KEY	TENNANT® PART NO.	MACHINE SERIAL NUMBER	DESCRIPTION	QTY.
	27307	(-)	PROTECTOSEAL FUEL TANK CAP KIT	1
1	29176	(-)	CAP, Protectoseal	1
2	27306	(-)	TANK, Fuel	1

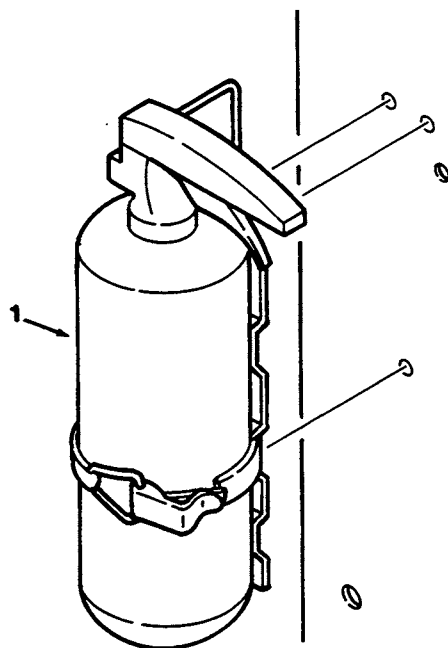


FIG. 9 - FIRE EXTINGUISHER KIT

00713

KEY	TENNANT® PART NO.	MACHINE SERIAL NUMBER	DESCRIPTION	QTY.
1	46938	(-)	EXTINGUISHER KIT, Fire	1
	25312	(-)	EXTINGUISHER, Fire	1

FIG. 10 - DUAL TIRE KIT

02253

KEY	TENNANT® PART NO.	MACHINE SERIAL NUMBER	DESCRIPTION	QTY.
	28500	(-)	TIRE KIT, Dual	1
	47807	(-)	TIRE AND WHEEL ASSEMBLY, Non marking	4
	28211	(-)	WHEEL HALF	1
	28128	(-)	WHEEL HALF	1
	28311	(-)	TIRE	1
	27028	(-)	CASTER	1
	27055	(-)	SLEEVE	6
	19881	(-)	PANEL, Filler	1
	19884	(-)	BRACE	1
	19887	(-)	EXTENSION	1

FIG. 11 - WATER MUFFLER KIT

02835

KEY	TENNANT® PART NO.	MACHINE SERIAL NUMBER	DESCRIPTION	QTY.
	28782	(-)	WATER MUFFLER KIT	1
	47690A	(-)	BRACKET, Water muffler	1
	29193	(-)	GUARD, Muffler	1
	02546	(-)	FITTING, Pipe	1
	07479	(-)	FITTING, Elbow	3
	23695	(-)	FITTING, Pipe	1
	37342	(-)	SEAL, Oil	1

FIG. 12 - BRAKE KIT

02836

KEY	TENNANT® PART NO.	MACHINE SERIAL NUMBER	DESCRIPTION	QTY.
	27328	(-)	BRAKE KIT	1
	27327	(-)	ARM, Brake	1
	20318	(-)	SLEEVE	1
	28862	(-)	WASHER, Thrust	2
	27336	(-)	SHOE, Brake	1
	22143	(-)	SLEEVE	1
	27337	(-)	LINK	1
	28008	(-)	RETAINER	1

FIG. 13 - BATTERY KIT

02844

KEY	TENNANT® PART NO.	MACHINE SERIAL NUMBER	DESCRIPTION	QTY.
	28972-1	(-)	BATTERY, 12V, 24AH	1

FIG. 14 - LPG FUEL TANK KIT

02837

KEY	TENNANT® PART NO.	MACHINE SERIAL NUMBER	DESCRIPTION	QTY.
	10752-2	(-)	TANK, LPG vapor	1
	10752-3	(-)	TANK ASSEMBLY, LPG vapor	1
	46798	(-)	VALVE, Filler	1

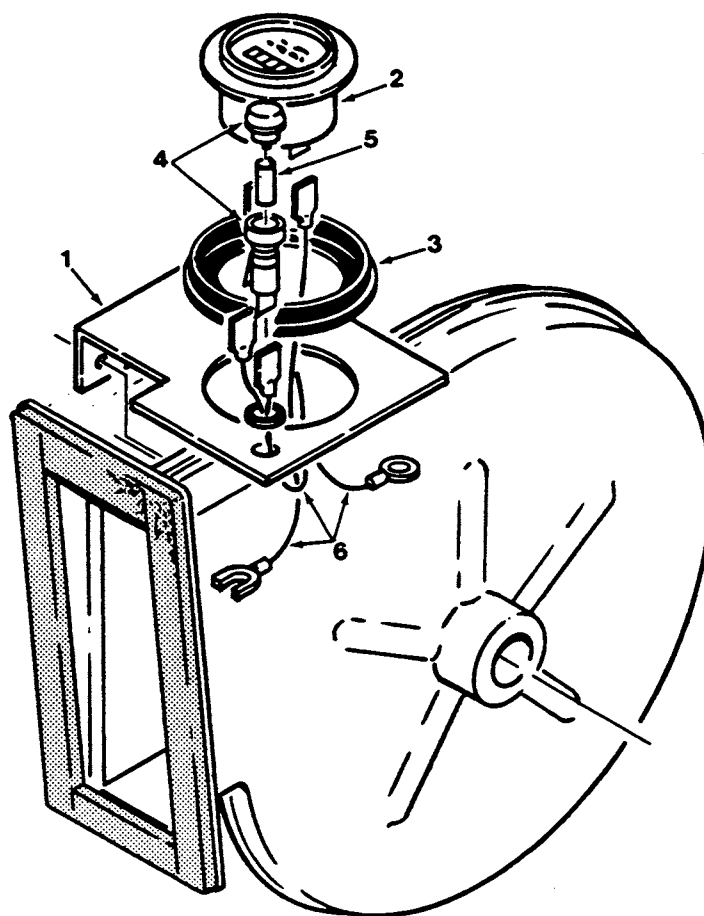


FIG. 15 - HOUR METER KIT

02850

KEY	TENNANT® PART NO.	MACHINE SERIAL NUMBER	DESCRIPTION	QTY.
	29026	(0000000000-0000012008)	HOUR METER KIT	1
1	28876A	(0000000000-0000012008)	BRACKET, Hour meter	1
2	24518	(0000000000-0000012008)	METER, Engine hour	1
3	28838	(0000000000-0000012008)	DAMPENER, Hour meter	1
4	07422	(0000000000-0000012008)	FUSE HOLDER	1
5	07423	(0000000000-0000012008)	FUSE 15 A	1
6	29090A	(0000000000-0000012008)	WIRE KIT, Hour meter	1

SECTION 8 ENGINE PARTS

CONTENTS

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Ordering Repair Parts.....	8-1
Fig. 1 - Engine Breakdown	8-2
Fig. 2 - Starter Breakdown.....	8-6

NOTE: Section 8, Engine Parts, lists the repair parts for the gasoline or LPG powered engine.



ORDERING REPAIR PARTS

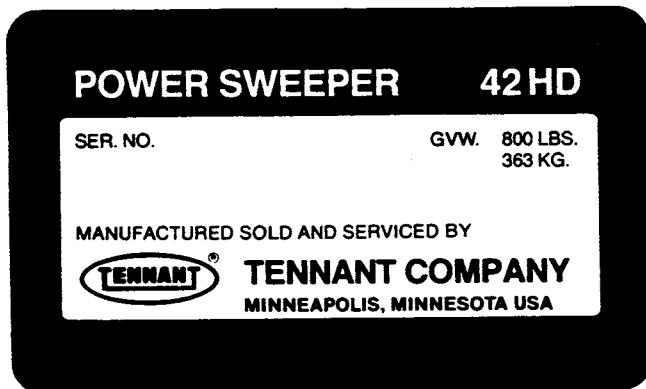
FOR ENGINES TENNANT® PART NO. 28756-1 GASOLINE, 28767-1 LPG

The components used in this machine have been carefully selected for performance and safety. Use only Tennant Company supplied or equivalent parts.

To receive prompt service in filling your parts orders, please direct all parts orders with Tennant Company part numbers to the Tennant Company, and all parts orders with vendor part numbers to the local supplier of the respective vendor.

To avoid errors or delays in filling your parts orders, please furnish all of the following information.

1. Refer to Tennant Company data plate. Always specify the machine model number and the machine serial number shown on the machine data plate.



2. Refer to the vendor part data plate. Always specify the model number and serial number shown on the data plate.
3. Give the part number, description, and the quantity needed of each item on the order. Do not order by reference number or the figure number of the illustrated parts.
4. Indented items indicate parts of assemblies. Standard hardware is furnished only when part of a purchased assembly. Please order hardware from a local hardware supplier.
5. If the old part cannot be identified, send it to us with the quantity needed specified on the order.
6. State definite shipping instructions to include the shipping address and/or the billing address if there is a difference. Any claim for loss or damage to a shipment in transit should be filed promptly against the transportation company making the delivery. Shipments will be complete unless the packing list or order acknowledgement indicate items back ordered.

If parts received are suspected to be incorrect or defective, please write, wire, or phone the parts supplier from whom you ordered the part. They will give authorization for return and/or handle replacement shipments when required.

SI (INTERNATIONAL SYSTEM) UNITS OF MEASURE

Metric equivalents have been included, where applicable, throughout this parts catalog.

BOLT AND CAP SCREW STRENGTH IDENTIFICATION

Bolts and cap screws required to have high-strength qualities equivalent to SAE Grade 8 are identified throughout this catalog by the description GR 8. Unless identified by this description, all standard bolts and cap screws are SAE Grade 5.

SERIAL NUMBER INFORMATION EXPLANATION

Serial number information is listed parenthetically to show on which machines each part can be used. These listings are explained by the following examples:

(-) The part can be used on
all machines.

(0000001234-) The part can be used on all machines beginning with the serial number listed.

(0000000000-0000001234) The part can be used on all machines up to and including serial number listed.

(0000001234-0000005678) The part can be used on all machines between and including the serial numbers listed.

Where XXXXX's are listed in place of a serial number, it indicates a serial number change was made but the exact serial number had not been established when the catalog went to press.

(Specifications and design subject to change without notice.)

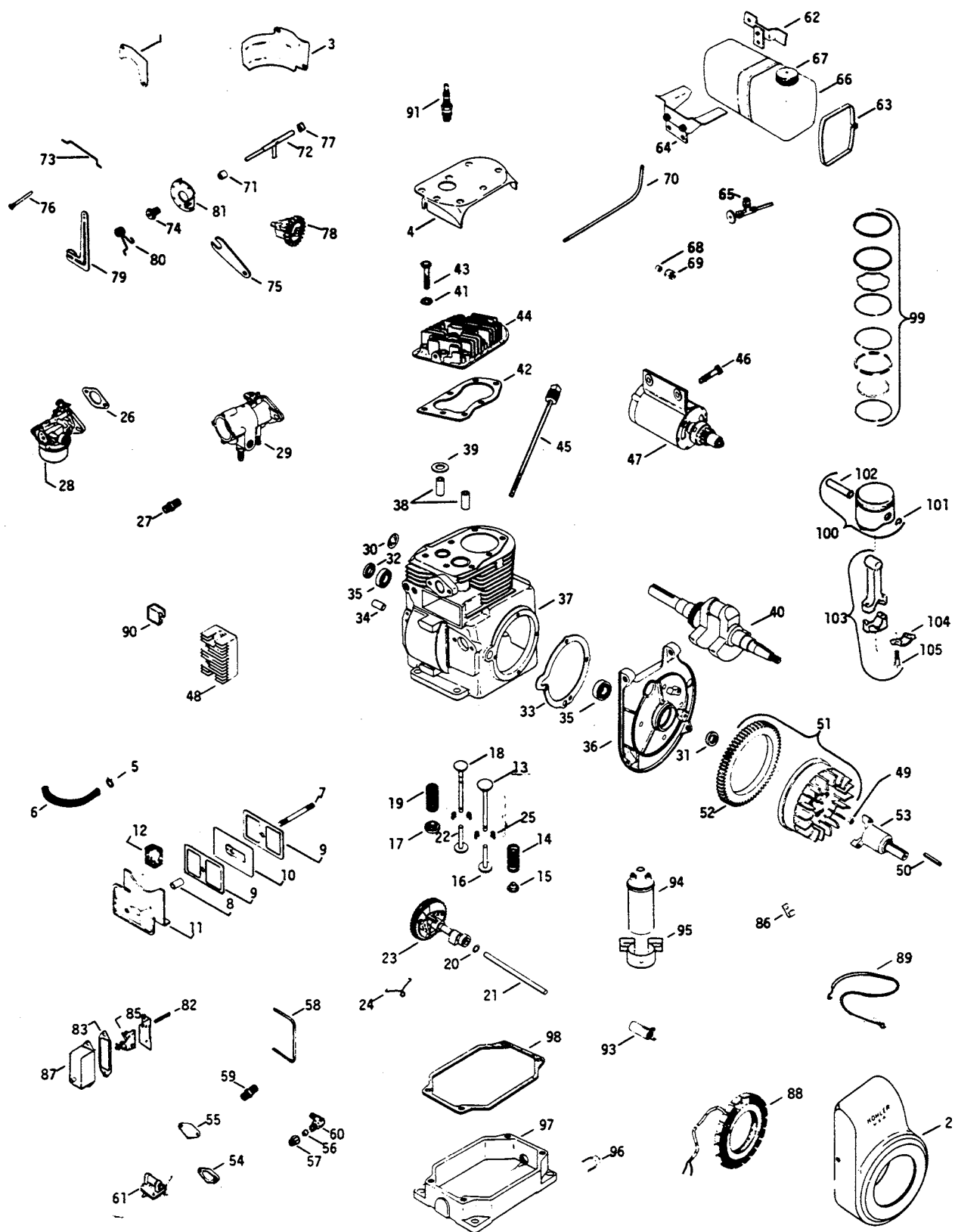


FIG. 1 - ENGINE BREAKDOWN

FIG. 1 - ENGINE BREAKDOWN

02840

KEY	TENNANT® PART NO.	KOHLER PART NUMBER	ENGINE SERIAL NUMBER	DESCRIPTION	QTY.
1		230757	(-)	BAFFLE, Side air	1
2		234315	(-)	HOUSING, Blower	1
3		234795	(-)	BAFFLE, Cylinder	1
4		234796	(-)	BAFFLE, Head	1
5		X 309 11	(-)	CLAMP, Hose	2
6		X 386 13	(-)	HOSE, Breather	1
7		230043	(-)	STUD, Valve cover	1
8		230046	(-)	SEAL, Breather	1
9		230048	(-)	GASKET, Valve cover	2
10		230066	(-)	BREATHER	1
11		41 254 01	(-)	COVER, Valve	1
12		231419	(-)	FILTER	1
13		230008	(-)	VALVE, Intake	1
14		230010	(-)	SPRING, Valve	1
15		230011	(-)	RETAINER, Spring	1
16		230013	(-)	TAPPET, Valve	1
17		230020	(-)	ROTATOR, Valve	1
18		230027	(-)	VALVE, Exhaust	1
19		230168	(-)	SPRING, Exhaust valve	1
20		230293	(-)	SPACER, Camshaft 0.005"	A.R.
20		230294	(-)	SPACER, Camshaft 0.010"	A.R.
21		230053	(-)	PIN, Camshaft	1
22		232777	(-)	TAPPET, Exhaust valve	1
23		B 232797	(-)	CAMSHAFT ASSEMBLY	1
24		232770	(-)	SPRING, Actuating	1
25	37251	41 755 10	(-)	KEEPER, Spring	4
26	31055	210223	(-)	GASKET, Carburetor	1
27		231509	(-)	CONNECTOR, Gasoline	1
28		C 231738	(-)	CARBURETOR ASSEMBLY, Gasoline	1
		231555	(-)	REPAIR KIT	1
29		A 230694	(-)	CARBURETOR ASSEMBLY, LPG	1
30		X 230 11	(-)	PLUG, Expansion	1
31		X 583 1	(-)	SEAL, Front oil	1
32		X 583 2	(-)	SEAL, Rear oil	1
33		230071	(-)	GASKET	1
34	37918	230125 S	(-)	SHAFT, Governor	1
35		231625	(-)	BEARING, Ball	2
36		234594	(-)	PLATE, Bearing	1
37		234989	(-)	BLOCK, Cylinder	1
38		230007-S	(-)	GUIDE, Valve	2
39		230170	(-)	INSERT, Exhaust valve	1
40	37241	41 014 02	(-)	CRANKSHAFT	1
41		220534	(-)	WASHER	7
42		230024	(-)	GASKET, Head	1
43		230175	(-)	SCREW, Hex 0.312 - 18 x 1.5	7
44		41 015 02	(-)	HEAD, Cylinder	1
45		230092	(-)	DIPSTICK	1
46		234379	(-)	SCREW, Hex 0.375 - 16, gasoline	2
46		234664	(-)	SCREW, Hex 0.375 - 16 x 1, LPG	2
47	38055	41 098 03	(-)	STARTER	1
48	SK2166		(-)	REGULATOR-RECTIFIER	1
49		X 119 14	(-)	NUT, Lock 0.312 - 18	1
50		X 286 15	(-)	KEY	1

KEY	TENNANT® PART NO.	KOHLER PART NUMBER	ENGINE SERIAL NUMBER	DESCRIPTION	QTY.
51		41 025 04	(-)	FLYWHEEL ASSEMBLY	1
52		232649	(-)	GEAR, Ring	1
53	37249	41 144 01	(-)	SHAFT, Front drive	1
54		47 041 01	(-)	GASKET, Pump pad	1
55	54229-1	240282	(-)	COVER, Pump pad, LPG	1
56	28645	220547	(-)	SLEEVE, Gasoline	2
57	28646	220786	(-)	NUT, Gasoline	2
58		230140	(-)	LINE, Fuel, gasoline	1
59		231509	(-)	CONNECTOR, Gasoline	1
60		231510	(-)	ELBOW, Gasoline	1
61		A 231796	(-)	PUMP, Fuel, gasoline	1
62		A 234177	(-)	BRACKET, Upper tank, gasoline	1
63		A 234873	(-)	STRAP, Tank, gasoline	2
64		A 234875	(-)	BRACKET, Lower tank, gasoline	1
65	27308-2	210392 1	(-)	VALVE, Shut-off, gasoline	1
66	27308	231747	(-)	TANK, Fuel, gasoline	1
67		236655	(-)	CAP, Tank, gasoline	1
68	28645	220547	(-)	SLEEVE, Gasoline	2
69	28646	220786	(-)	NUT, Gasoline	2
70	38259	41 353 01	(-)	LINE, Fuel, gasoline	1
71		X 400 81	(-)	SPACER	1
72	37947	230540S	(-)	SHAFT, Governor cross	1
73		230078	(-)	LINKAGE, Governor	1
74		230476	(-)	BUSHING, Governor	1
75		230557	(-)	BRACKET, Speed control	1
76		231355	(-)	PIN, Governor stop	1
77		234866	(-)	BEARING, Needle	1
78		A 237031	(-)	GEAR, Governor	1
79		A 234178	(-)	LEVER, Governor	1
80		232617	(-)	SPRING, Governor	1
81		220766	(-)	DISC, Regulating	1
82	38024	X 489 2	(-)	ROD, Breaker	1
83		220174	(-)	GASKET, Cover	1
85	37262	47 150 01	(-)	POINTS, Breaker	1
86		230249	(-)	CLIP	1
87		232535	(-)	COVER, Breaker	1
88		237878	(-)	STATOR	1
89		A 237418	(-)	LEAD, Breaker	1
90		237429	(-)	CONNECTOR	1
91	45770-6	270321 S	(-)	PLUG, Spark	1
93	49795-3	230722	(-)	CONDENSER	1
94	28637	237256	(-)	COIL	1
95		231879	(-)	BRACKET, Coil	1
96		X 75 28	(-)	PLUG, Pipe	1
97		230021	(-)	PAN, Oil	1
98	37244	41 041 03	(-)	GASKET, Pan	1
99		232575	(-)	RING SET, Standard	1
	38040	232576	(-)	RING SET, 0.010"	1
		232577	(-)	RING SET, 0.020"	1
		232578	(-)	RING SET, 0.030"	1
100		A 234950	(-)	PISTON ASSEMBLY, Standard	1
		A 234954	(-)	PISTON ASSEMBLY, 0.010"	1
		A 234956	(-)	PISTON ASSEMBLY, 0.020"	1
		A 234958	(-)	PISTON ASSEMBLY, 0.030"	1

KEY	TENNANT® PART NO.	KOHLER PART NUMBER	ENGINE SERIAL NUMBER	DESCRIPTION	QTY.
101		230004	(-)	RETAINER, Pin	1
102		231956	(-)	PIN, Piston, standard	1
		231954	(-)	PIN, Piston, 0.005"	1
		231955	(-)	PIN, Piston, 0.010"	1
103		A 231801	(-)	CONNECTING ROD ASSEMBLY, Standard	1
		A 231801 10	(-)	CONNECTING ROD ASSEMBLY, 0.010" U.S.	1
104	38038	230525	(-)	LOCK, Connecting rod	1
105		230526	(-)	SCREW	2
	37434	41 755 06	(-)	GASKET SET, Overhaul, includes seals	1
	37240	41 004 01	(-)	GASKET SET, without seals	1

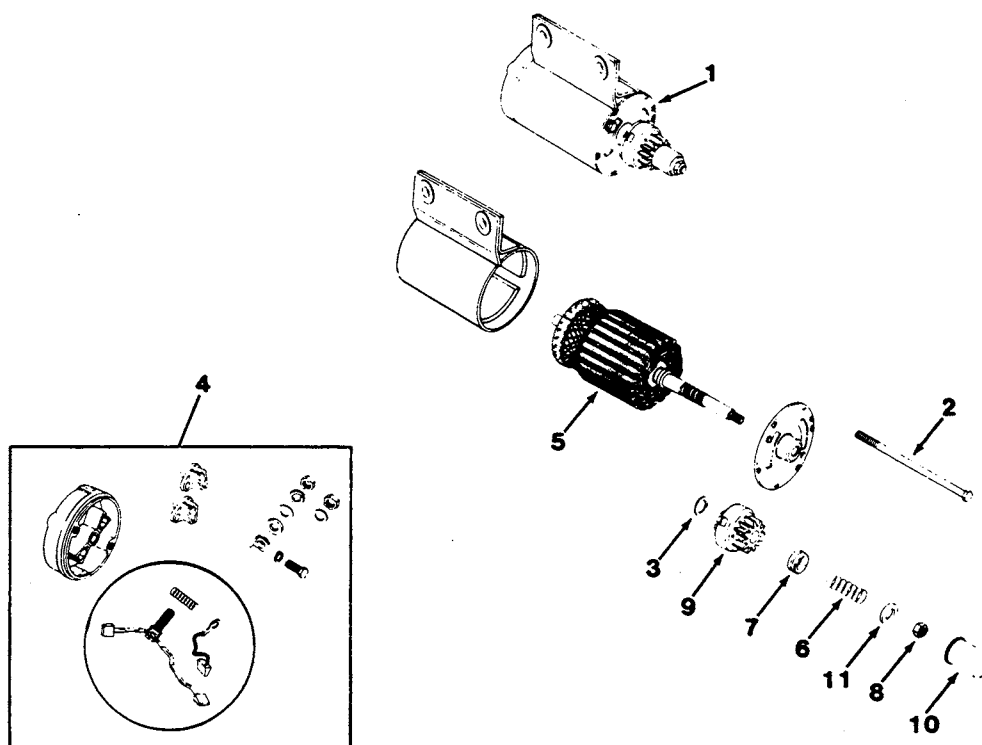


FIG. 2 - STARTER BREAKDOWN

02841

KEY	TENNANT® PART NO.	KOHLER PART NUMBER	ENGINE SERIAL NUMBER	DESCRIPTION	QTY.
1	38055	41 098 03	(-)	STARTER ASSEMBLY	1
2		237649	(-)	BOLT	2
3		237363	(-)	WASHER, Armature thrust	1
4		47 755 12	(-)	KIT, Commutator cap assembly	1
5		237364	(-)	ARMATURE	1
6		45 089 03	(-)	SPRING	1
7		237645	(-)	SPACER, Stop gear	1
8		237644	(-)	NUT, Stop	1
9		41 171 01	(-)	DRIVE	1
10		41 096 01	(000000-xxxxxx)	COVER, Dust	1
11		237647	(-)	SPACER, Dust cover	1

