MM106

6-84

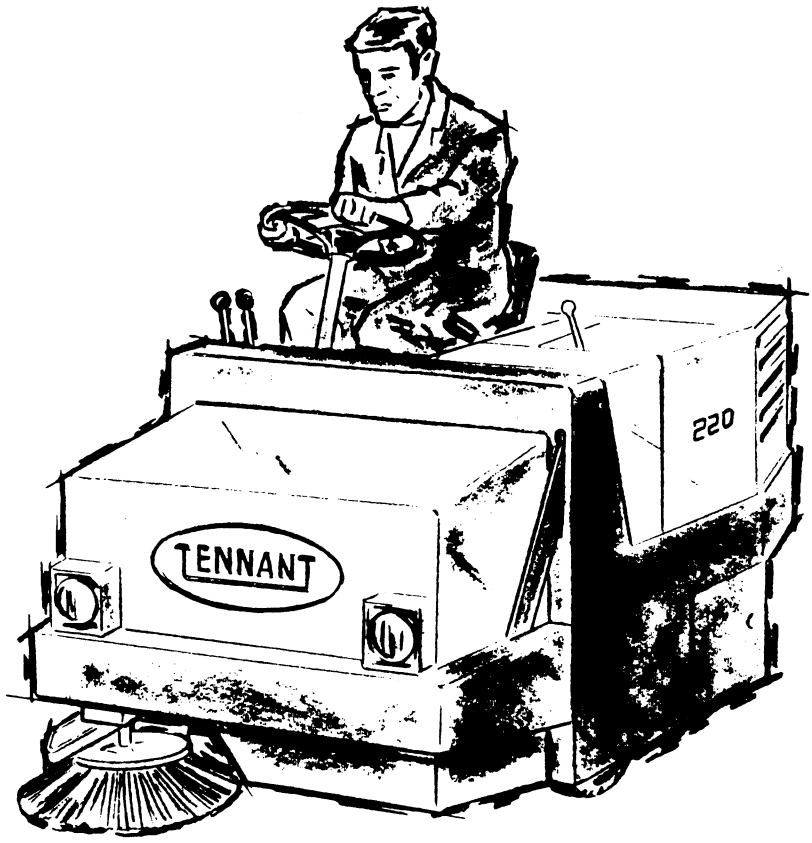
TENNANT®

220

POWER SWEEPER

Operation, Maintenance, and Parts Manual

EQUIPPED WITH OIL-GEAR HYDRAULIC PUMP



SPECIALIZED MAINTENANCE EQUIPMENT

SWEEPERS • SCRUBBERS • SCARIFIERS • FLOOR COATINGS

220
POWER SWEEPER

This manual is furnished with each new TENNANT® Model 220. 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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Published: 6-84

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TENNANT COMPANY WARRANTY POLICY

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

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

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

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

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

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

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

This Warranty shall not cover:

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

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

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

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

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

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

Dear Customer,

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

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

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

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

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

⚠ SAFETY PRECAUTIONS

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

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

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

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

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

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

⚠CAUTION Disconnect positive battery terminal before removing instrument panel.

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

⚠CAUTION Remember that the machine is steered by means of the rear wheel, and is very responsive. Take time to become familiar with this type of steering system.

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.

TABLE OF CONTENTS

REPLACEMENT BRUSHES

Part No.	Description
	SIDE SWEEPING BRUSHES
09600N	Side Brush, nylon
09600P	Side Brush, poly
10712K	Side Brush, wire
43708J	Side Brush, wire
43708P	Side Brush, poly
43708N	Side Brush, nylon
43708K	Side Brush, wire
	MAIN SWEEPING BRUSHES
10741A	Brush, natural fiber - standard density
10741N	Brush, nylon
10741P	Brush, poly-fiber
10745	Brush, wire
10812	Brush, combination wire & fiber standard density
10813	Brush, combination wire & fiber high density

RECOMMENDED GENERAL MAINTENANCE ITEMS

Part No.	Description	Qty.
59462	REPLACEMENT PARTS PACKAGE	1
49396	SKIRT, Brush wrap	1
49402	SKIRT, Brush door (right hand)	1
49490	SKIRT, Brush door (left hand)	1
24035	V-BELT	1
49318	V-BELT	1
69026	BELT, Positive drive	1
49453	LIP, Rubber	2
49198	ELEMENT, Air cleaner	2
38463	POINTS	1
49795-3	CONDENSER	2
45770-5	SPARK PLUG	1
49197	PRE-CLEANER	1
67718-2	ELEMENT, Oil filter (Deluxe)	1
32397-5	HYDRAULIC FLUID, TENNANT (5 gal)	1
49420	TIRE	1
49421	TUBE, Tire	1
23681	MUFFLER	1
14215	FUSE, 20 A	1
53348-1	ELEMENT, Oil filter (Ripley)	1
26771	BATTERY, 12 V, 40 A	1

DECIMAL EQUIVALENTS
INCH-MILLIMETER CONVERSION TABLE

1/2	1/4	1/8	1/16	1/32	1/64	Decimals	Millimeters
					1	.015625	.396875
				1		.031250	.793750
					3	.046875	1.190625
			1			.062500	1.587500
				3	5	.078125	1.984375
						.093750	2.381250
					7	.109375	2.778125
		1				.125000	3.175000
				5	9	.140625	3.571875
						.156250	3.968750
			3		11	.171875	4.365625
						.187500	4.762500
				7	13	.203125	5.159375
						.218750	5.556250
					15	.234375	5.953125
	1					.250000	6.350000
					17	.265625	6.746875
				9		.281250	7.143750
					19	.296875	7.540625
			5			.312500	7.937500
				11	21	.328125	8.334375
						.343750	8.731250
					23	.359375	9.128125
		3				.375000	9.525000
					25	.390625	9.921875
				13		.406250	10.318750
					27	.421875	10.715625
			7			.437500	11.112500
				15	29	.453125	11.509375
						.468750	11.906250
					31	.484375	12.303125
1						.500000	12.700000
					33	.515625	13.096875
				17		.531250	13.493750
					35	.546875	13.890625
			9			.562500	14.287500
				19	37	.578125	14.684375
						.593750	15.081250
					39	.609375	15.478125
		5				.625000	15.875000
					41	.640625	16.271875
				21		.656250	16.668750
					43	.671875	17.065625
			11			.687500	17.462500
				23	45	.703125	17.859375
						.718750	18.256250
					47	.734375	18.653125
	3					.750000	19.050000
					49	.765625	19.446875
				25		.781250	19.843750
					51	.796875	20.240625
			13			.812500	20.637500
				27	53	.828125	21.034375
						.843750	21.431250
					55	.859375	21.828125
		7				.875000	22.225000
					57	.890625	22.621875
				29		.906250	23.018750
					59	.921875	23.415625
			15			.93750C	23.812500
				31	61	.953125	24.209375
						.968750	24.606250
					63	.984375	25.003125
2	4	8	16	32	64	1.000000	25.400000

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POWER SWEEPER

operation & maintenance

PREPARATION FOR OPERATION

1. Connect and tighten battery cables (battery in right rear corner of engine compartment on gasoline models or under seat on LPG machines).

2. Check engine crankcase oil level. (See Engine Section of this Manual.)

NOTE Engine is shipped with special oil that MUST be drained after 25 operating hours and replaced with recommended weight oil. Engine crankcase capacity is 2 quarts (1.9 liters). Use SAE 10W-30.

KEEP OIL FILLER CAP TIGHT to prevent dirt from entering crankcase and to avoid oil being thrown out filler opening.

3. Fill tank with REGULAR GRADE GASOLINE. (Tank is located under operator's seat.) Tilt seat forward to expose tank.

⚠ WARNING

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

NOTE If your machine is equipped for LPG operation, see special instructions in LPG section of this manual.

4. Check oil level in hydraulic reservoir, (located in engine compartment) by removing breather cap. Maximum oil fill is two inches from top of filler opening. Oil must always be visible in screened filter, or about 2 inches (51mm) from tank top. TENNANT HYDRAULIC OIL IS RECOMMENDED (32397-5).

5. Check the rear tire pressure. It should be 60 psi (414 kPa). The front tires are solid.

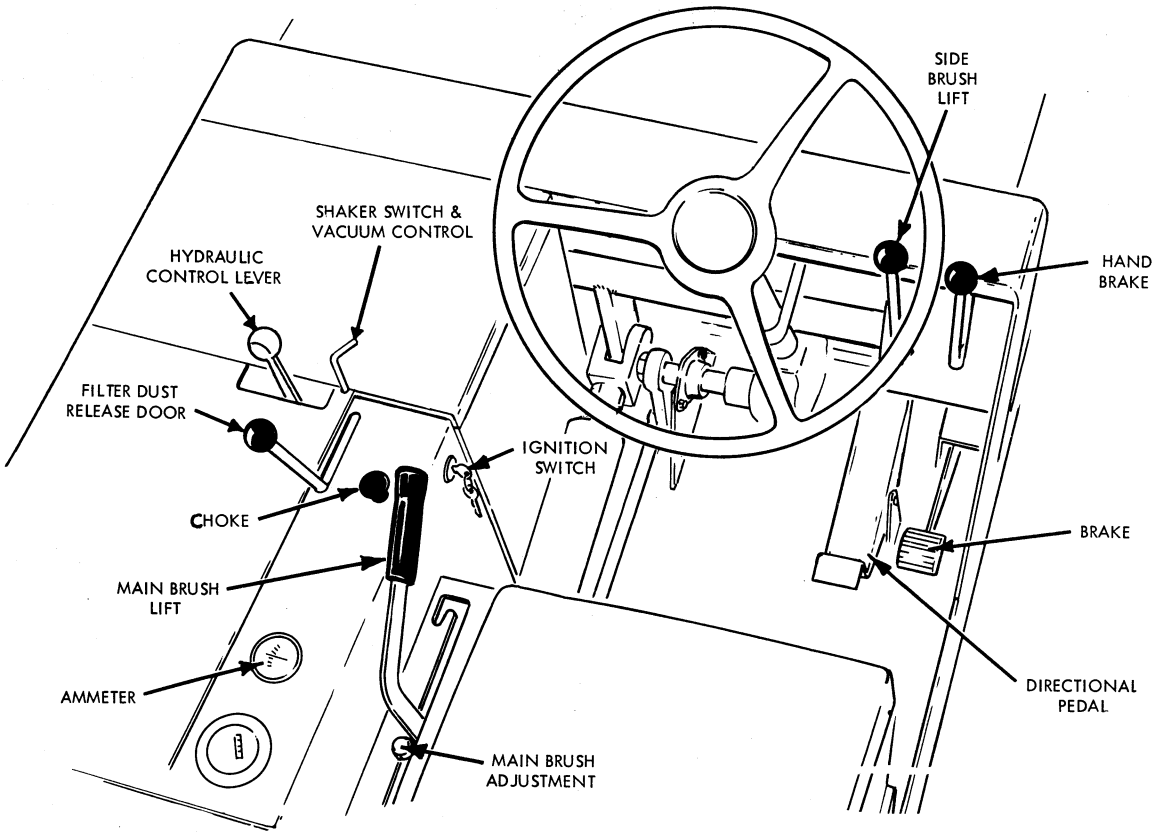
⚠ WARNING:

PROVIDE ADEQUATE VENTILATION WHEN OPERATING THIS MACHINE.

All internal combustion engines emit carbon monoxide in exhaust.

Failure to provide adequate ventilation can be harmful to health.

OPERATION OF CONTROLS

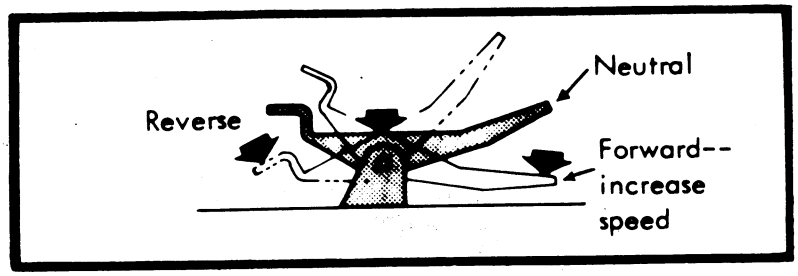


BRAKE PEDAL

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

DIRECTION CONTROL

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



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

If the machine creeps when the pedal is in neutral position, see "To Adjust Neutral Setting of Pump Control Arm" in the Maintenance Section.

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

HAND BRAKE

The hand brake (parking brake) also controls the mechanical brakes and provides a means of locking the front wheels when parking the sweeper.

ENGINE CONTROLS

The only control to the engine is the choke (See "To Start Engine". Pull out to "choke".) There is no throttle control. The engine starts and operates at a fixed, governed speed at all times. LP fuel machines do not have a choke. The Zenith LP Regulator has a priming button which should be pressed before starting the engine.

MAIN BRUSH LEVER

To lower brush, grasp control lever and push forward to clear slot, then back until it strikes stop. (For brush height adjustment, see "Maintenance" Section).

To raise brush, push control lever forward and engage in "hold" slot. (If engine is running, brush rotation will automatically stop when it is raised.)

NOTE Brush should be raised while dumping hopper.

To rotate brush, start engine and lower brush. Rotation begins automatically when brush is lowered.

NOTE: When machine is parked, be sure to have brush in "up" position to avoid bristles taking "set" from pressing against floor.

SIDE BRUSH LIFT LEVER

To lower brush, disengage control lever from latch and release.

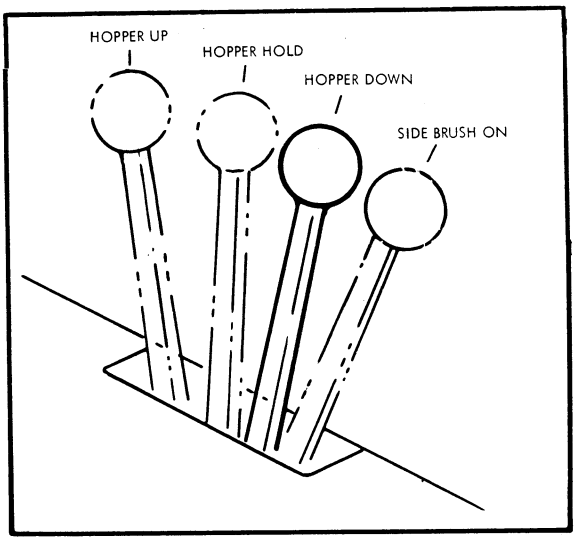
To raise brush, pull control lever down. The latch will automatically engage.

To start side brush rotation, turn hydraulic control lever to "side brush on".

NOTE When transporting and parking machine or when side brush is not needed, make sure rotation is stopped and brush is up.

HYDRAULIC CONTROL LEVER

There are four positions. Moving the lever toward the operator they are: "Hopper Up", "Hopper Hold", "Hopper Down", and "Side Brush On".



VACUUM AND SHAKER CONTROL LEVER

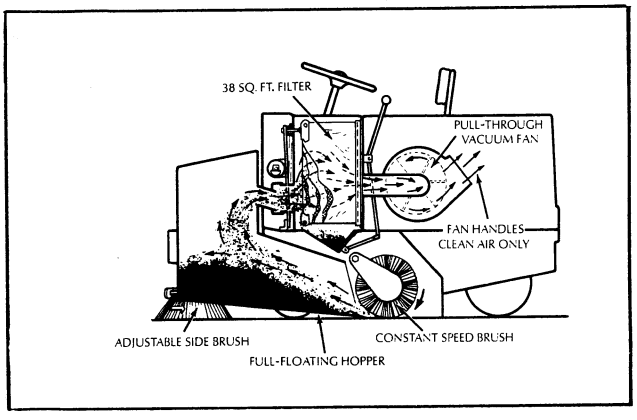
To shut off vacuum and activate shaker motor, turn handle counter-clockwise. Hold the lever in this position for 10-15 seconds to shake filters clean.

To turn on vacuum, allow lever to spring all the way back.

FILTER DUST RELEASE DOOR LEVER

To open, push lever forward.

To close, allow lever to spring backward.



OPERATION

TO START ENGINE:

1. Be sure propelling drive foot pedal is in neutral position. Do not attempt to start engine unless you are in the operator's seat.

2. Pull choke, if used, if starting cold engine. Do not choke a hot engine. (Note: LP machines do not have a choke. Zenith LP regulator has a priming button).

3. Turn key to "start" position.

   NOTE If machine has been stored in cold temperature, run engine with machine standing still for three to five minutes to warm up the hydraulic oil.

4. If engine fails to start after following this procedure, refer to "Trouble Shooting Chart".

TO PROPEL SWEEPER:

1. Start engine.

   NOTE Engine will automatically run at full governed speed. Propelling speed is controlled by the "Accelerator and Directional Control Pedal".

2. Release parking brake.

3. Lower main and side brushes to floor.

4. Engage side brush motor.

5. Gently depress foot control, with toe for forward direction or with heel for reverse.

6. Regulate foot pressure on pedal to obtain desired travel speed.

TO STOP SWEEPER:

1. Allow accelerator and directional control pedal to return to neutral (centered) position. Pedal will automatically return to neutral when foot pressure is removed. To adjust pump control arm, see "Maintenance " Section.

   NOTE The control pedal should be used for braking in an emergency situation only. Use the brake for normal stops or when going down ramps.

2. Apply foot brake.

3. Shut off engine.

TO DUMP DIRT HOPPER:

1. Raise brushes from floor.

2. Stop side brush rotation. Main brush rotation will automatically stop when it is raised.

3. Shut off engine.

4. Open filter dust release door and activate shaker for 10 - 15 seconds.

5. Start engine and move hydraulic control lever to "Hopper Up" position.

6. After hopper is emptied, back sweeper away to clear dirt pile.

⚠ WARNING

Never reach under hopper when in "up" position without first engaging safety lock. See "To Engage Safety Lock".

TO REMOVE HOPPER:

1. Start engine.

2. Raise hopper to full "UP" position.
   ⚠CAUTION Engage mechanical safety locks on both hopper lift arms.

3. Block up hopper for added safety.

4. Disconnect and cap the two hydraulic hoses on the side brush motor. Coil the hoses upward and tie them together.

5. Cut the two nylon ties that hold electrical wires to the left hand side lift arm; disconnect the wires at the lintle.

6. Remove the hex-head screw located on under side of the bumper near the side brush. Remove the screw on left hand side. This will release the hopper from the lift arms.

7. Remove blocks.

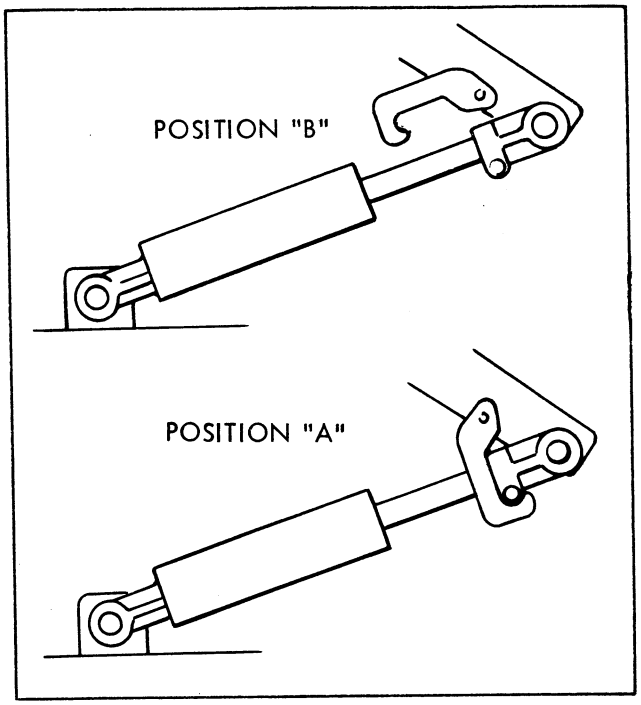
8. Disengage one of the hopper safety locks and pull that side of hopper out of track. Carefully lower to floor. Repeat for the other side.

TO ENGAGE HOPPER SAFETY LOCK:

1. Raise hopper to extreme "UP" position.
2. Refer to drawing and place lock in position "A".
3. Lower hopper against lock.

TO DISENGAGE HOPPER SAFETY LOCK:

1. Raise hopper to extreme "UP" position.
2. Refer to drawing and place lock in position "B".
3. Lower hopper.



NOTE: During normal dumping of hopper, lock will remain in position "B". Engage the lock to position "A" only if you must reach under hopper.

GENERAL OPERATING SUGGESTIONS:

1. Plan your sweeping in advance. Try to arrange long runs with minimum stopping and starting. Sweep debris from very narrow aisles into main aisles ahead of time. Do an entire floor or section at one time.
2. Pick up oversize debris before sweeping. Flatten or remove bulky cartons from aisles before sweeping.
3. Allow a few inches overlap of brush paths.
4. Do not turn steering wheel too sharply when machine is in motion. Your sweeper is very responsive to movement of the steering wheel -- so avoid sudden turns, except in emergencies.
5. Try to sweep as straight a path as possible. Avoid bumping into posts or scraping sides of sweeper.
6. When placing sweeper in motion or when climbing ramps, avoid pushing the directional control pedal all the way down. This is equivalent to operating in "high gear" and puts needless strain on the engine and drive system.
7. Always allow sweeper to warm up before operating in cold temperatures (below 30°F).
8. Periodically turn the main sweeping brush end for end to prevent bristles from "setting" in one direction.

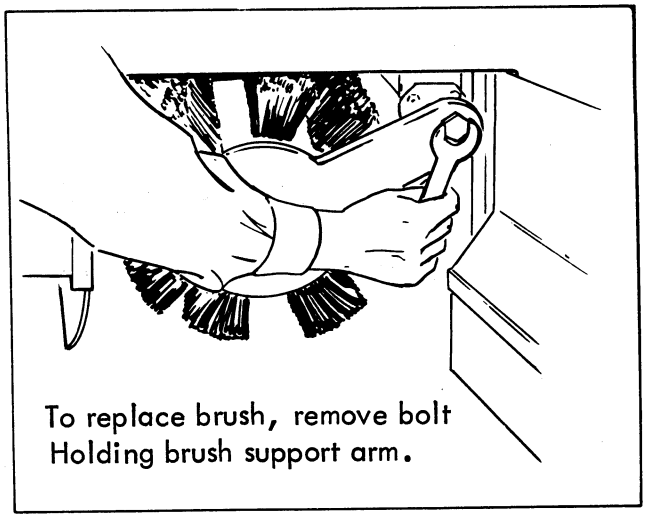
NOTE Replace brush when bristles are worn to 1" length or less. To order replacement brushes, see "Parts List" Section.

⚠CAUTION Always shut off engine and set hand brake before leaving operator's seat or before making repairs and adjustments.

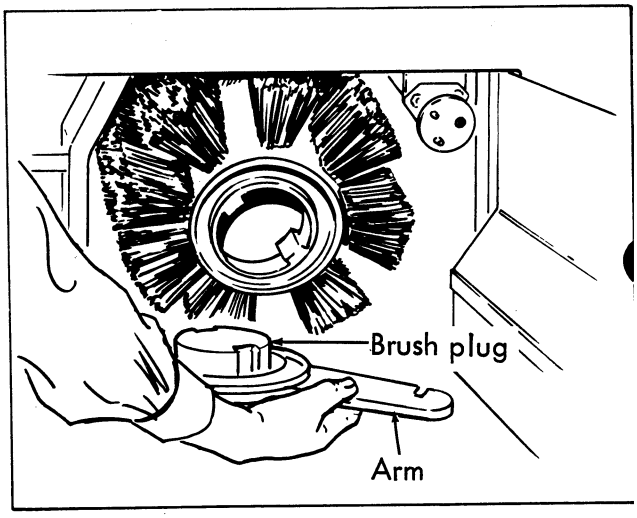
MAINTENANCE

TO INSTALL MAIN BRUSH

1. Shut off engine.
2. Place brush lift control lever in "down" position.
3. Open brush compartment access door. (On right side of machine.)
4. Refer to drawing and remove right brush plug and arm assembly.
5. Insert brush through open door and push until it touches left brush plug.
6. Sight through brush tube (or align brush keys on left plug with slots in brush tube. Then push brush onto left plug.
7. Install right support arm and plug assembly.
8. Move brush lift control lever to "UP" position.



To replace brush, remove bolt Holding brush support arm.



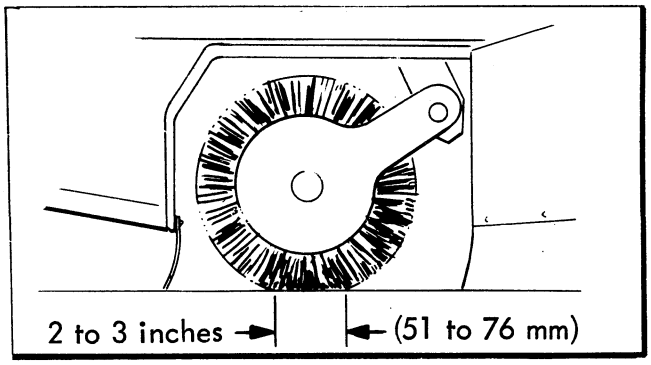
TO REMOVE MAIN BRUSH

1. Shut off engine.
2. Open brush compartment access door.
3. Lower brush to floor.
4. Refer to drawing and remove right brush plug and arm assembly.
5. Grasp brush and pull it from left side brush plug and out through access door.

TO ADJUST MAIN BRUSH CONTACT

1. Park sweeper on a smooth, level surface.

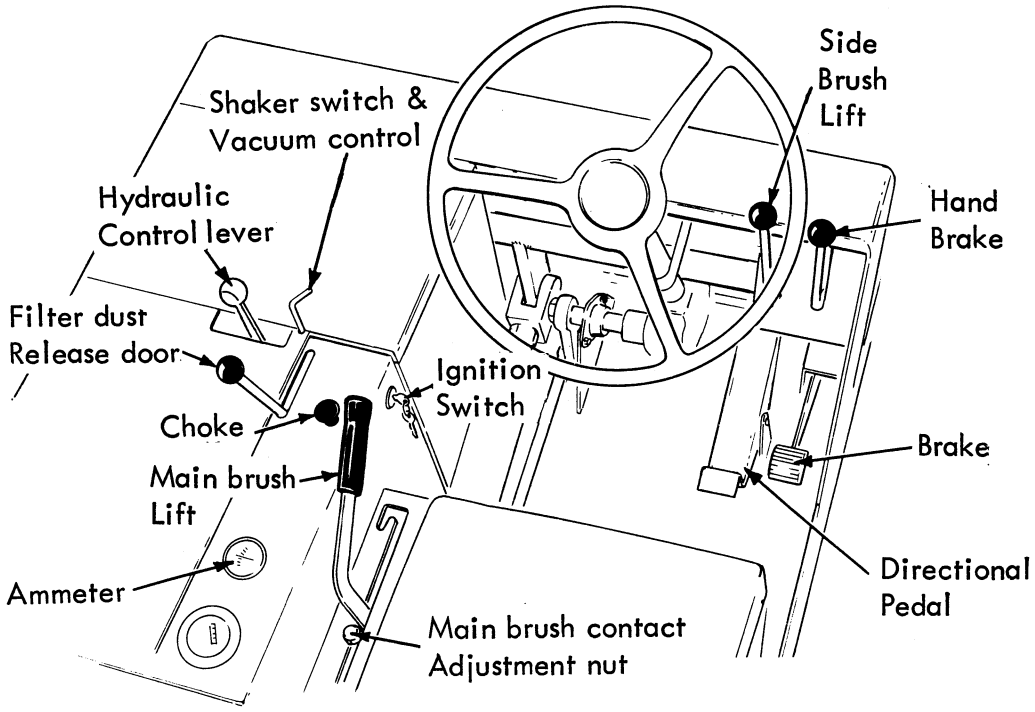
2. Test for correct bristle contact by starting engine and allowing main brush to rotate with the machine in a stationary position for 2 - 3 minutes. Move the sweeper off the test area. The brush should leave a polished mark 2 - 3 inches (51 to 76 mm), wide, the full length of the brush for normal sweeping conditions.



3. If adjustment is required, loosen main brush adjustment nut (see sketch below) and slide in slot until correct polish mark is obtained.

NOTE If the main brush drive belt jumps off its sheave when the brush is raised, the stop bolt shown in drive belt tension sketch should be adjusted.

NOTE Under extremely uneven floor conditions, stop nut may be slid to rear of slot, to allow full free float of brush. (This will allow brush to follow contour of very rough floors but will decrease life of brush.) Replace brush if bristle length is less than one inch (25.4mm).



TO INSTALL SIDE BRUSH

1. If a new or different side brush is to be installed, remove the driving adapter from the old brush and install in like manner on the replacement.

2. Place side brush lift control in "UP" position.

3. Slip brush over drive motor shaft, insert screw and tighten.

TO INSTALL SIDE BRUSH (continued)

4. See "To Adjust Side Brush Height".

TO REMOVE SIDE BRUSH

1. Raise side brush to "UP" position.

2. Remove screw from brush motor shaft. Brush will drop to floor.

TO ADJUST SIDE BRUSH ANGLE

Refer to sweeping path sketch to determine if adjustment is required. If adjustment is needed, refer to adjustment drawing and procede as follows:

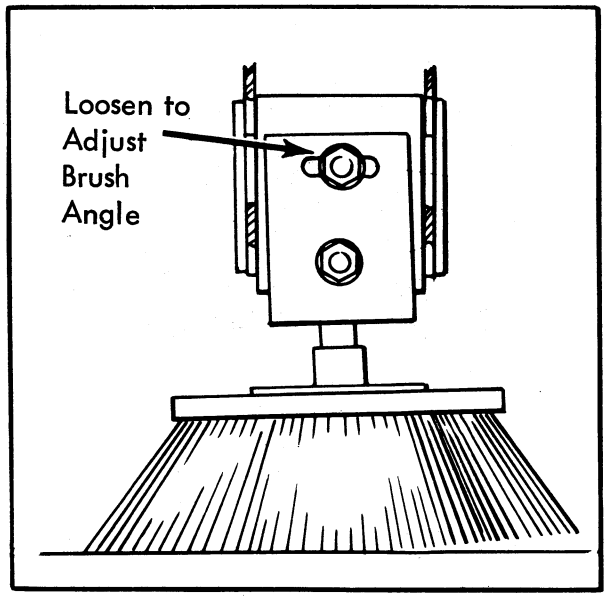
1. Loosen the locking bolts.

2. Swing drive motor right or left until correct contact pattern, as indicated in sweeping path sketch, is obtained.

   NOTE The brush tilt from front to rear is fixed at approximately 5° and no adjustment is required.

3. Tighten locking bolts.

4. Re-check brush contact with floor. Contact area of approximately 1/3 of brush is preferred .



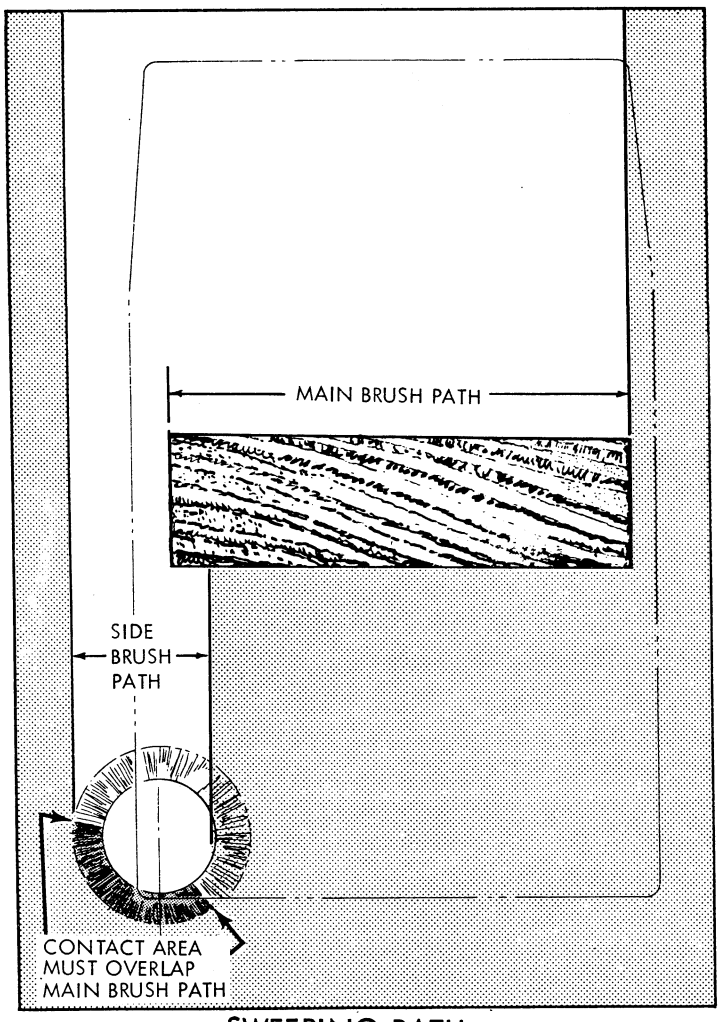
Adjusting Side Brush Angle

TO ADJUST SIDE BRUSH HEIGHT

Height adjustment of side brush is automatically maintained by spring loaded suspension. This system allows brush to ride lower as bristles wear.

NOTE

The spring tension on the brush lift can be varied by attaching the spring in different holes in the suspension bar. Less tension will allow the brush to float lower to permit contact if the brush bristles are very short. This should only be necessary in cases of extreme bristle wear.



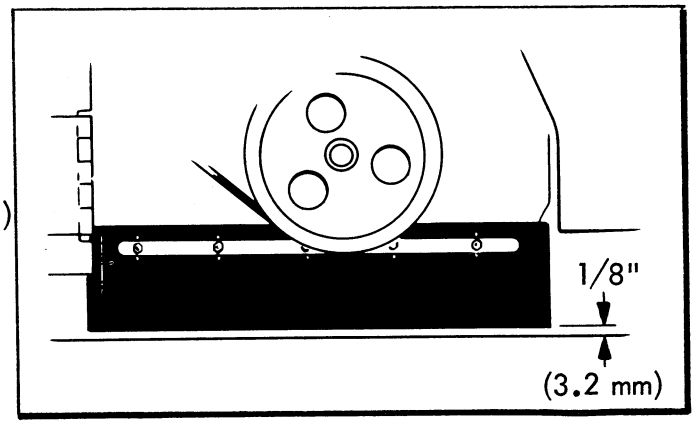
SWEEPING PATH

TO ADJUST DUST SKIRT HEIGHT

1. Park machine on a smooth level surface (concrete or flooring).

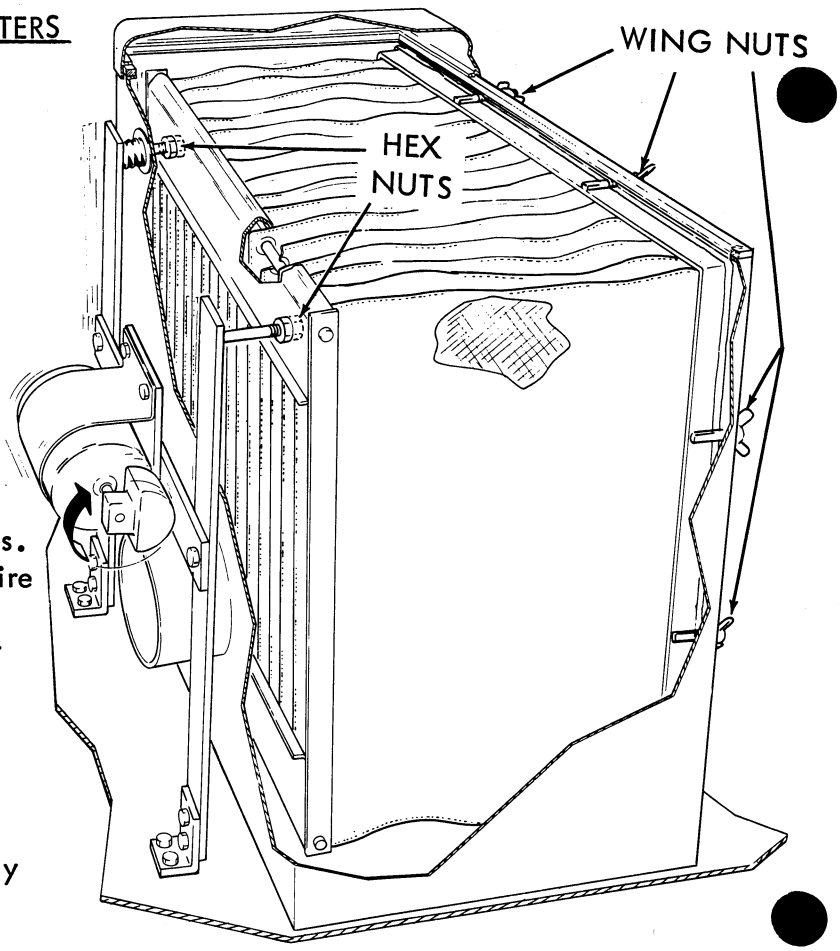
2. Refer to sketch and measure distance between bottom edge of rubber skirts and floor. Clearance should be 0.13" (3.2mm)

3. If adjustment is required, loosen the skirt mounting screws and adjust as required. Then tighten screws.



ADJUSTING DUST SKIRT FLOOR CLEARANCE

TO REMOVE OR REPLACE DUST FILTERS



1. Shut off engine.
2. Activate shaker for 10 - 15 seconds.
3. Open filter dust release door.
4. Remove eight wing nuts, and two hex nuts as indicated in sketch, then lift out filters and filter rack.
5. Replace or clean filter envelopes. NOTE: To prevent leakage, wire frame of filter envelope must fit evenly against frame, and under cover.
6. After installing filter parts, run engine to check for leakage around filter edges. Be sure all parts are assembled compactly and neatly in place.

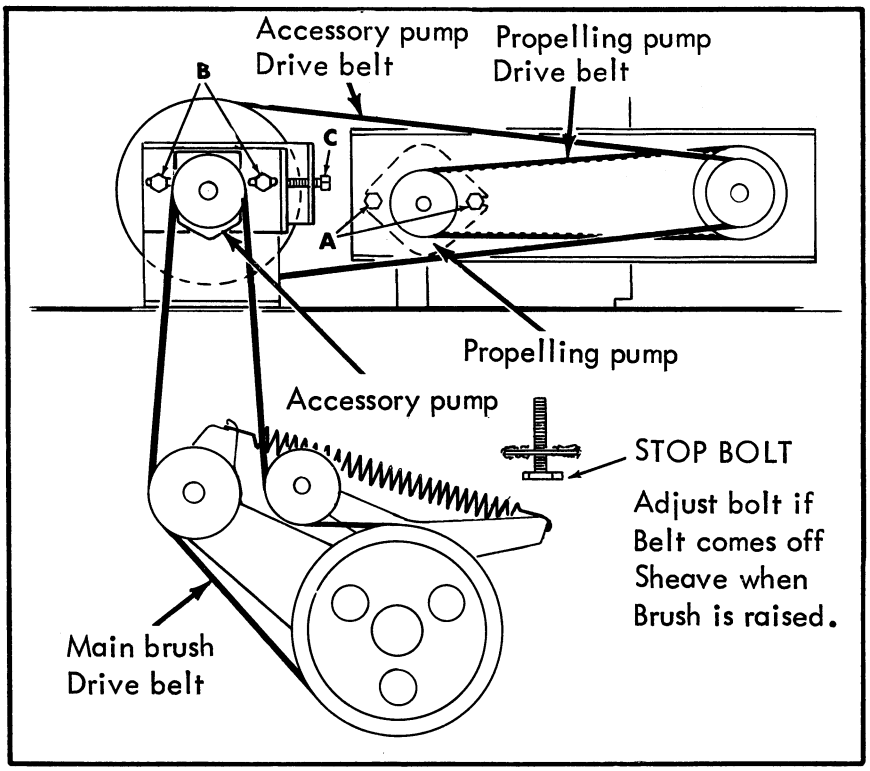
NOTE The filters should periodically be cleaned with a brush or air gun by removing the filter box cover. This will remove heavy accumulation. The frequency of this cleaning will depend on dust conditions and the amount of moisture in the air being drawn through the filter envelopes. Normally, activating the power shaker frequently during operation and whenever the dirt hopper is dumped will prevent dirt build-up on the filter surfaces.

DRIVE BELTS

The drive belt system on your power sweeper consists of:

1. The positive drive belt which drives the propelling pump.
2. Three separate V-Belts that drive the accessory pump, main sweeping brush and vacuum fan.

(see next page)



ADJUSTING PROPELLING PUMP DRIVE BELT TENSION

1. Correct propelling pump belt tension will produce a deflection of 0.34 inch ± 1/32 inch (4.37 mm ± 0.787 mm) from a force of 4 to 5 lbs (1.8 kg to 2.3 kg) applied at belt mid-point.

2. If adjustment is required, loosen pump mounting bolts, "A" and shift in slots to obtain correct tension. Then tighten bolts and re-check belt tension.

NOTE Do not over-tighten belt. Sight over sheaves to make sure they are properly aligned. Over-tightening belt or mis-aligning sheaves will cause belt to climb or crowd against side of sheaves, resulting in belt failure.

TO REMOVE AND REPLACE PROPELLING PUMP DRIVE BELT

1. Loosen accessory pump drive belt and remove it from engine sheave.

2. Referring to sketch, loosen propelling pump mounting bolts "A" and shift pump toward engine to remove belt.

3. Install replacement belt. (See "To Adjust Tension of Propelling Pump Drive Belt".)

4. Install accessory pump drive belt and adjust to correct tension. (See "To Adjust Accessory Pump Drive Belt".)

MAIN BRUSH FINAL DRIVE BELT

The main brush drive belt is tensioned by an idler assembly and no adjustment is required.

TO REMOVE AND REPLACE MAIN BRUSH FINAL DRIVE BELT

1. Open brush compartment access door on left side.
2. Place main brush control in "UP" position to release tension on belt.
3. Slip belt from sheaves.
4. Install replacement belt. Be Sure belt is routed under idler as shown in belt tension sketch.

VACUUM FAN DRIVE BELT

The vacuum fan assembly is attached to a hinged mounting that is spring loaded to provide constant belt tension. No adjustment is required.

TO REMOVE AND REPLACE THE VACUUM FAN DRIVE BELT

1. Pull the fan assembly toward the engine to release tension from belt.
2. Slip the belt from fan and engine sheaves.
3. Install the new belt by reversing steps 1 and 2 above.

GENERAL TENSIONING PROCEDURES FOR V-BELTS

1. The best tension for a V-belt drive is the lowest tension at which it will not slip, under the highest load condition.
2. Do not over-tighten belt. This will shorten belt and bearing life.
3. Check the tension on a new drive belt frequently during the first day of operation and periodically thereafter.
4. Keep belts and sheaves free of any foreign material which may cause slip.

DRIVE BELT TROUBLE SHOOTING CHART

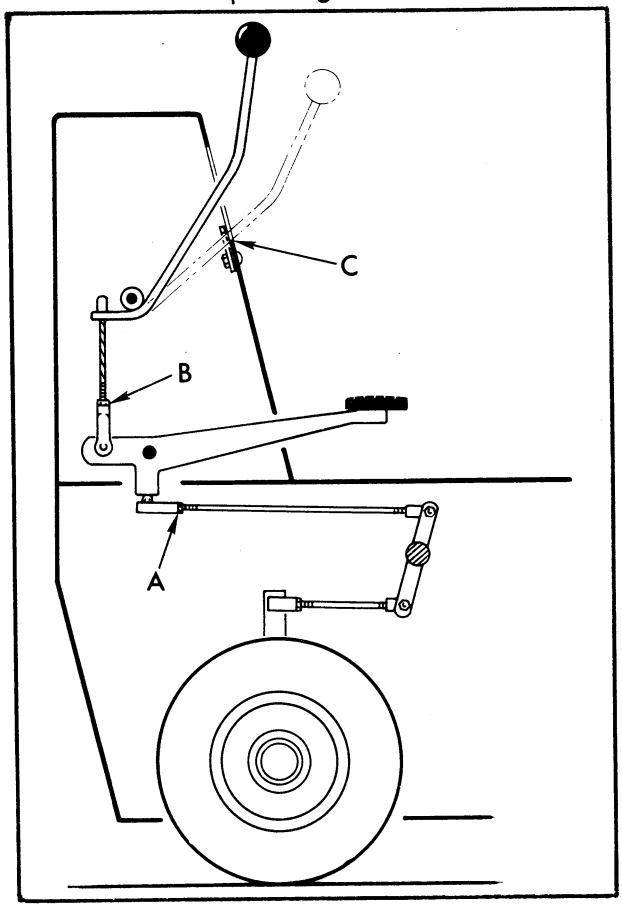
Trouble	Cause	Correction
Belt Slipping	A. Not enough tension. B. Drive over-loaded. C. Oily drive.	A. Tighten. B. Check for excessive load on system. C. Correct the condition.
Belt Squealing	A. Drive overloaded. B. Heavy starting load.	A. Check for excessive load on system. B. Increase tension.
Repeated Belt Breakage Or Turned-Over Belt	A. Broken cords from manually running belt onto sheaves. B. Not enough tension.	A. Reduce distance between sheave centers when installing belt. B. Increase tension.
Rapid Wear	A. Worn sheave grooves. B. Sheave misalignment. C. Belt slipping.	A. Replace sheaves. B. Align. C. Tighten belt.
Underside Cracked Or Belt Hardened	A. Excessive heat.	A. Eliminate slippage.

BRAKE SYSTEM

The brakes on your machine are located on both front wheels. They are mechanical and are operated by a foot pedal during travel and a hand lever for parking.

TO ADJUST BRAKES:

1. Block up sweeper so both front wheels are off floor.
2. Raise dirt hopper and engage safety lock. NEVER reach under raised hopper for any reason without engaging safety lock.
3. Check to be sure brake shoes are not dragging by spinning each wheel.
4. Loosen connector "A" and adjust until slight pressure on pedal locks both wheels. (see drawing).
5. Adjust linkage at "B" to set hand brake. When hand brake lever contacts latch "C", there should be sufficient tension to lock wheels.
6. When correct adjustment is obtained, lock nuts at points "A" & "B".



HYDRAULIC TANK

The hydraulic fluid level should be between the "high" and "low" marks on the fluid level sight gauge when the fluid is at room temperature. As the hydraulic fluid heats up to its normal operating temperature, it expands. Always allow for this expansion when filling the hydraulic fluid reservoir. Do not overfi!!.

Be sure the hydraulic fluid level is correct and the fluid is clean. Tennant Company hydraulic fluid 32397-5 is recommended.

The hydraulic tank has a capacity of 3.5 gallons, (13.2 liters). It is equipped with an external in-line oil filter and a breather filter mounted in the filler cap. Correct hydraulic oil level is about 2 inches (51mm) from top of tank. Change oil every 250 hours of operation

HYDRAULIC OIL FILTER (See Parts Section for filter element part number)

A. STANDARD DELUXE FILTER WITH SPIN-ON ELEMENT:

If replacement is required, turn filter element counter-clockwise to loosen, and install new filter. (It is not necessary to drain any oil from the system.)

ATTENTION! Install the filter element hand-tight. Do not use wrench.

B. ALTERNATE RIPLEY OIL FILTER:

This filter has a cartridge located inside the filter case.

TO SERVICE THE HYDRAULIC TANK BREATHER FILTER ELEMENT

Service the filter element, (inside filler cap), after every 500 hours of operation. The element can be cleaned by flushing it in mineral spirits or gasoline and allowing to dry. If this does not clean it adequately, or if the filter is damaged in any way, replace it.

TO ADJUST NEUTRAL SETTING OF PUMP CONTROL ARM

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

2. If adjustment is required, stop engine.

3. Loosen hex screws holding the centering assembly mounting bracket.

4. Shift the centering assembly in slotted holes until machine does not "creep" in either direction. Then tighten bracket mounting bolts.

ATTENTION!

Do not make adjustment with engine running. Move the centering assembly in small increments and check by trial and error until correct adjustment is acquired.

RECOMMENDED HYDRAULIC FLUID

TENNANT Hydraulic Fluid is recommended for use in your machine.

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

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

TENNANT Hydraulic Fluid Viscosity Specifications		
	Tennant Hyd. Fluid 32397 (10W40)	Tennant Hyd. Fluid 32398 (20W60)
SUS @ 100°F(37.8°C)	404-445	940-1010
SUS @ 210°F (98.9°C)	78-84	122-130

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

TENNANT Hydraulic Fluid, part #32397 is a 10W40 hydraulic oil. TENNANT Hydraulic Fluid, part #23825, is a 20W60 hydraulic oil.

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

ATTENTION!

If you prefer to use a locally - available brand of hydraulic oil; or if you have standardized on one brand of oil for all machines; the hydraulic oil used MUST match closely the specifications of TENNANT Hydraulic Oil listed above.

DO NOT SUBSTITUTE AUTOMATIC TRANSMISSION FLUID FOR HYDRAULIC FLUID

BATTERY INSPECTION AND MAINTENANCE

Inspect the battery as follows:

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

2. Clean the battery top surface and terminals. Use a strong solution of baking soda and water. Brush the solution sparingly over the battery top, terminals and cable clamps (do not allow any solution to enter the battery). Use a wire brush to clean terminal posts and cable connectors. After cleaning, apply a coating of clear petroleum jelly to the terminals and cable connectors.

Checking Battery Electrolyte

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

2. Use a hydrometer to check the electrolyte specific gravity. NOTE: Do not take readings immediately after adding water - the reason for this is, if the water and acid are not thoroughly mixed, readings may not be accurate. Check hydrometer readings against this chart:

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

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

CHARGING BATTERIES

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

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

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

IMPORTANT NOTES ON BATTERY CARE

+ Raise cover of battery during charge, for maximum ventilation.

+ Keep vent plugs firmly in place at all times, except when adding water or taking hydrometer readings.

+ Keep flames and sparks away from the batteries as they may ignite gas during charging.

+ Keep all metallic objects off the top of the battery, as they may cause a short circuit.

+ Keep the top of the battery clean and dry.

+ Keep the electrolyte level above the plates at all times.

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

+ Add water only, and avoid over-filling.

+ Keep electrolyte from coming in contact with the eyes, skin, clothing or any other material which it might damage.

+ Do not discharge battery below specific gravity of 1.140.

+ Do not allow battery to remain in discharged condition for any length of time.

ENGINE

Maintain and lubricate engine per "Engine Operating Section", and "Maintenance Chart".

Clean the engine occasionally with air hose or other means.

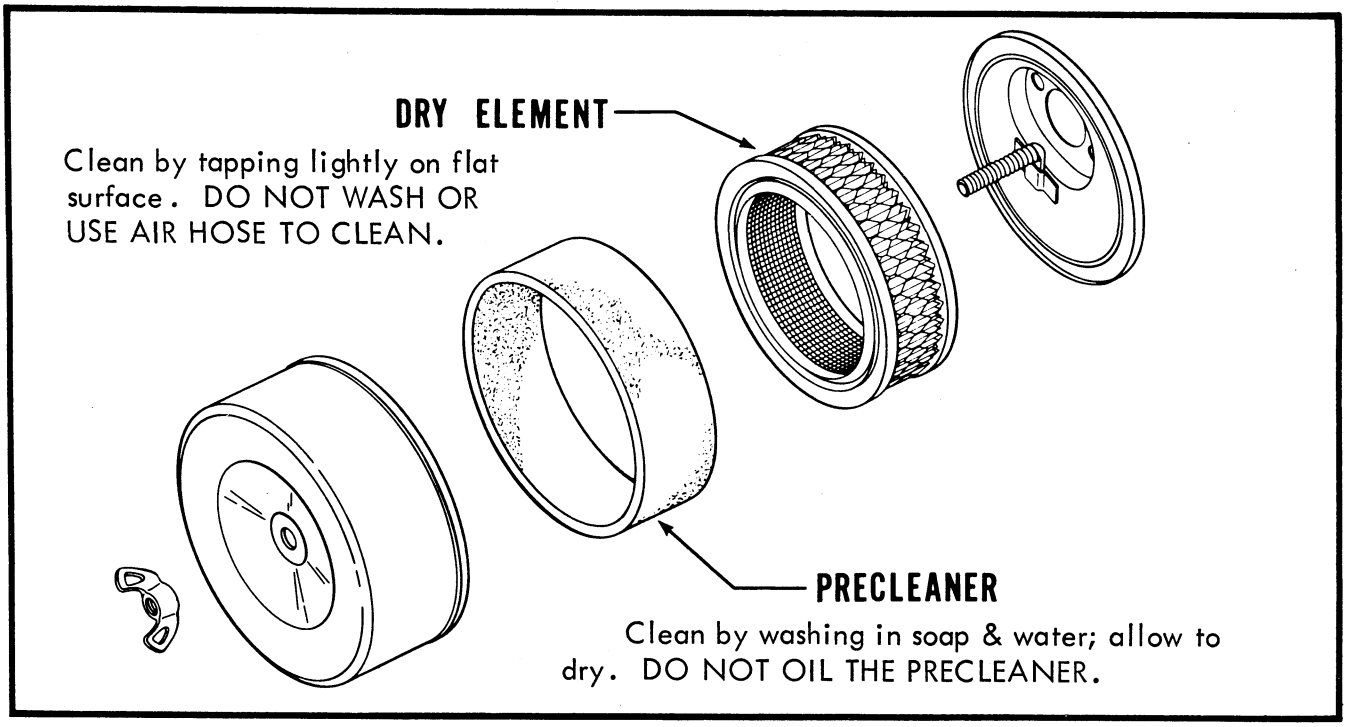
Never allow dust and dirt to accumulate in engine cooling fins.

Engine speed is constant and set at factory at 2750 to 2800 RPM with propelling drive in neutral and brushes in "OFF" position.

ATTENTION! Never attempt to start engine by towing machine. Towing may damage the drive system.

ENGINE TUNE-UP SPECIFICATIONS

SPARK PLUG GAP (Gasoline Fuel): .025 in (0.6mm)
SPARK PLUG GAP (LP Fuel): .018 in (0.46mm)
SPARK PLUG TYPE: J-8 or equivalent
IGNITION POINT GAP: .020 in (0.51mm)
ENGINE RPM: 2750 to 2800
ENGINE OIL CAPACITY: 2 quarts (1.9 Liters)



TO SERVICE ENGINE AIR CLEANER

The engine is equipped with a two-stage air cleaner.

The first stage consists of a poly foam band around the outer perimeter of the unit. Most of the dirt is filtered out by this material. The air is then directed through the second filter element where the remaining particles are removed.

The only service required for the air cleaner is as follows:

1. Every 50 hours, remove the first-stage material and wash with soap and water. Then allow to dry before re-installing. If the filter material is torn or damaged in any way, replace it.

2. Every 100 hours, replace the second stage filter. Do not attempt to wash this element.

   For further information regarding operation, service and maintenance of the engine see "Engine Section" in this manual.

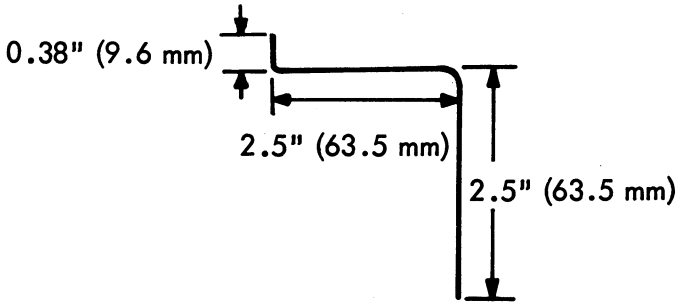
IGNITION SWITCH

Occasionally the ignition switch may jam because of having objects other than the key inserted into the key slot. Jamming may also be caused by not fully inserting the key before turning it. Either of the above may cause the tumblers to rotate preventing the machi ne from being operated.

To unjam the ignition switch, first disconnect the battery cables from the battery.

⚠CAUTION Always disconnect the battery cables from the battery before working on machine electrical components.

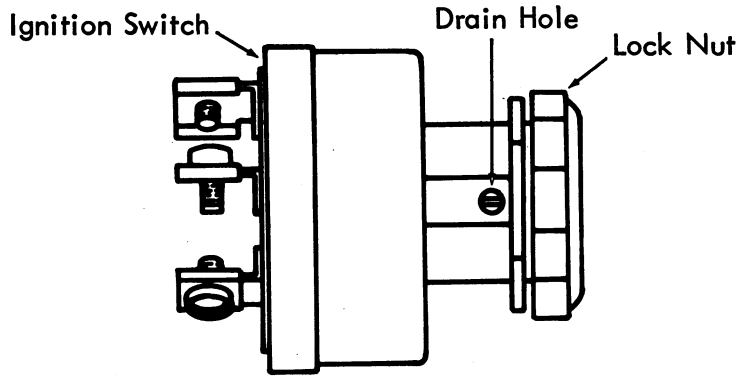
Make an unjamming tool as shown with a piece of wire or a paper clip.



UNJAMMING TOOL

Insert the 0.38 in (9.6 mm) end of the unjamming tool into the ignition switch. Turn the tool to the right or left until a click is heard. Remove the unjamming tool from the ignition switch. Try the ignition key in the ignition switch. Repeat the procedure if necessary.

NOTE When the switch tumblers are properly aligned, a slot will be visible in the switch drain hole.



IGNITION SWITCH DRAIN HOLE

NOTE Never insert foreign material into the ignition switch. Only use the ignition key provided.

MAINTENANCE CHART

LOCATION	PROCEDURE	HOURS 8	25	50	100	250
ENGINE CRANKCASE	CHECK OIL LEVEL CHANGE OIL (SEE ENGINE MANUAL)	*	*			
ENGINE AIR CLEANER	(SEE ENGINE MANUAL)			*	*	
GASOLINE SEDIMENT BOWL	CHECK AND CLEAN				*	
BATTERY AND CABLES	CHECK AND CLEAN				*	
TIRE PRESSURE (REAR)	CHECK, 60 psi (414 kPa)			*		
HYDRAULIC TANK	(1) CHECK FLUID LEVEL & BREATHER (2) CHANGE (3) CHANGE IN-LINE FILTER	*	*			* *
BELTS	CHECK TENSION			*		
ENGINE COOLING FINS	CLEAN AND CHECK		*			

MM106

220

POWER SWEEPER

standard parts

CONTENTS

NOTE

THIS PARTS SECTION COVERS ALL THE PARTS IN A STANDARD MODEL 220 WITH A GASOLINE ENGINE. IF YOUR MACHINE HAS AN LP FUEL SYSTEM, SEE THE "LPG SECTION" FOR ALL LP PARTS.

INSTRUCTIONS FOR ORDERING REPAIR PARTS

To avoid errors or delay in filling your parts orders, please furnish all information requested.

1. Refer to TENNANT data plate. Always specify the model number and serial number.

2. Give part number, description and quantity needed of each item on order. Do NOT order only by reference number of illustrated figure numbers.

3. Indented items indicate parts of assemblies. Standard hardware is furnished only when part of purchased assembly. In other cases, we suggest ordering common hardware from your local hardware supplier.

4. If old part cannot be identified, send it to us with quantity needed specified on order.

5. State definite shipping instructions to include shipping address and/or billing address if there is a difference.

6. We shall be glad to quote on any part or group of parts at your specific request.

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 our Customer Services Department, Minneapolis Office. They will give you authorization for return and/or handle replacement shipments when required.

DIRECT ORDER PHONE NO. IS (612-540-1315)

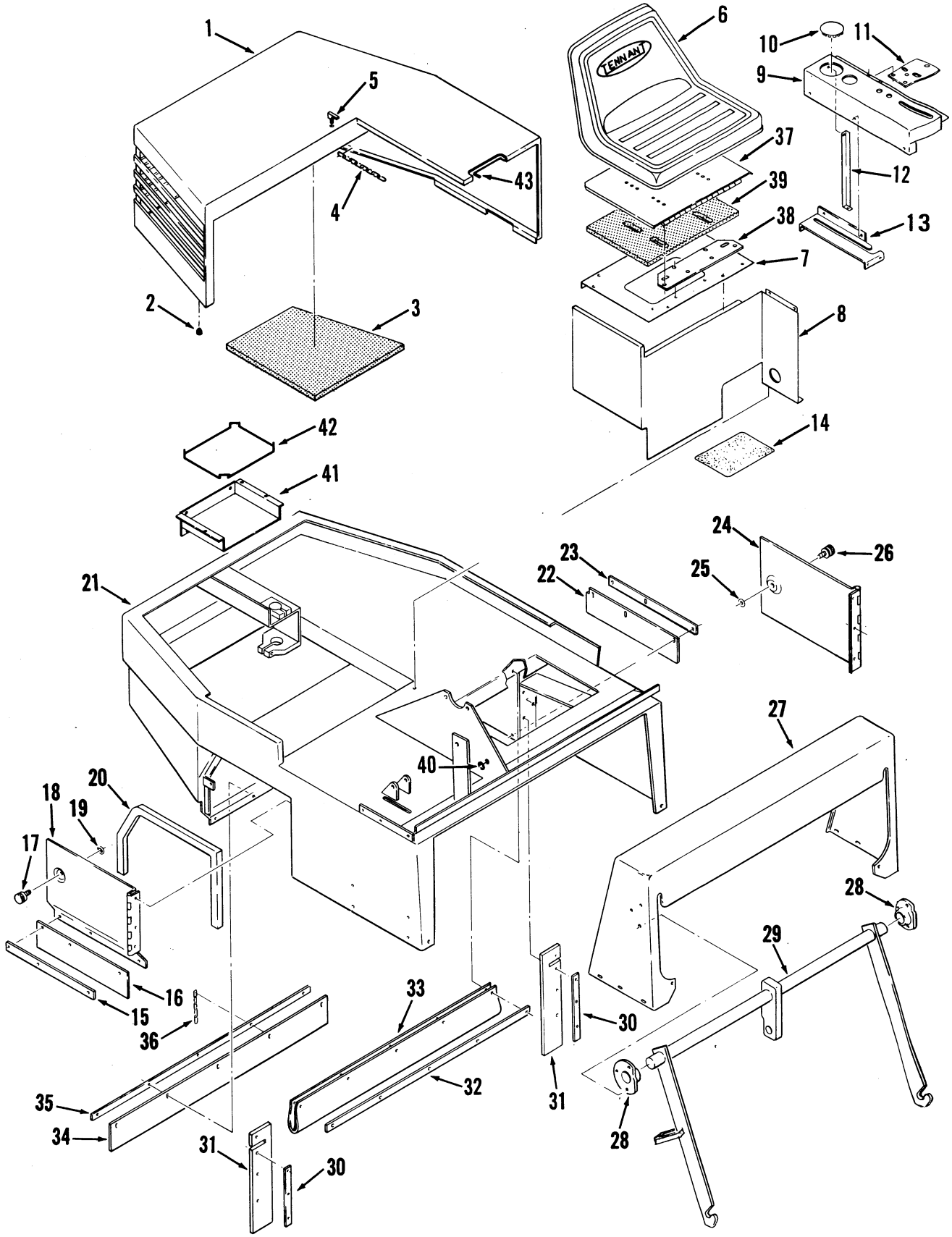


Fig. 1 - MAIN FRAME AND RELATED PARTS

Fig. 1 - MAIN FRAME & RELATED PARTS

Ref. No.	TENNANT Part No.	Description	Qty.
1	49865	COVER, Engine	1
2	29233	BUMPER, Rubber	3
3	49712	INSULATION, Engine cover	1
4	43500	CHAIN	1
5	49302	LATCH, Engine cover	1
6	**82342	SEAT ASSEMBLY	1
7	49271	SUPPORT, Seat, top	1
8	49590	SUPPORT, Seat	1
9	*49330A	PANEL, Instrument, w/Pollak ignition switch	1
10	24520-1	PLATE, Hole cover	1
11	69179	BRACKET, Oil filter	1
12	49923	BRACE, Instrument panel	1
13	49968	LOCKING PLATE, Main brush	1
14	32646	TREAD, Floor	1
	49315	DOOR ASSEMBLY, Brush, R.H.	1
15	49491	RETAINER, Skirt, brush	1
16	49402	SKIRT, Brush door	1
17	28164	SCREW	1
18	49399	DOOR, Brush	1
19	26015	WASHER	1
20	49395	SEAL KIT, Brush door	1
21	49636	FRAME, Main	1
22	49490	SKIRT, Brush door, L.H	1
23	49491	RETAINER, Skirt, brush door	1
	49316	DOOR ASSEMBLY, Brush, L.H.	1
24	49494	DOOR, Brush	1
25	26015	WASHER	1
26	28164	SCREW	1
27	49850	LINTEL	1
28	49224	BEARING, Torque tube (set of 2)	1
29	49423	ARM, Lift	1
30	49412	RETAINER, Pan side seal	2
31	49228	SEAL, Pan side (set of 2)	1
32	49410	RETAINER, Pan top seal	1
33	49409	SEAL, Pan top	1
34	49396	SKIRT, Brush wrap	1
35	49397	RETAINER, Brush wrap skirt	1
36	09342	CHAIN	1
	13016	BRACKET, Battery hold down (includes 2 clips)	1
	49847	TRAY, Battery	1
37	82346	MOUNT, Seat	1
38	31252	PLATE, Seat mount	1
39	31255	INSULATION, Foam	1
40	01574	GROMMET	1
41	49847	TRAY, Batterry	1
42	13016	BRACKET, Battery (includes two clips)	1
	56992	PLUGBUTTON, 0.50"	1
43	49282	MOLDING, Rigid	1

* To replace previous panel 49330, order SK1812.

** To replace previous seat assembly used on machines with serial number up to and including 2878, order replacement kit 01675.

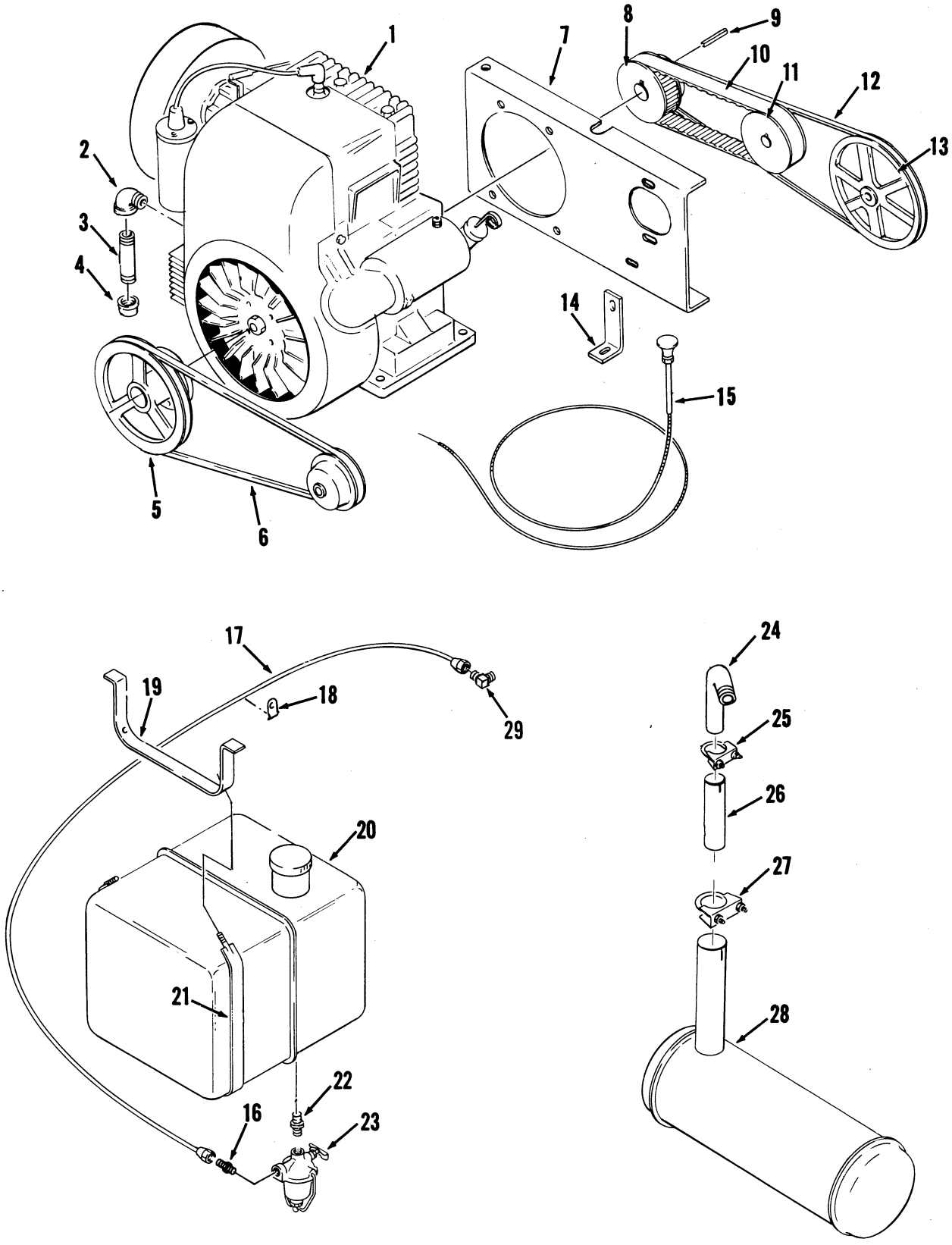


Fig. 2 - ENGINE, FUEL TANK, MUFFLER, & RELATED PARTS

Fig. 2 - ENGINE, FUEL TANK, MUFFLER, & RELATED PARTS

Ref. No.	TENNANT Part No.	Description	Qty.
1	49702-1	*ENGINE, Kohler, 12 hp	1
2	07482	ELBOW	1
3	15108	NIPPLE	1
4	49908	CAP, Pipe	1
5	49844	SHEAVE, Fan drive	1
6	24035	V-BELT	1
7	69025	MOUNT, Pump	1
8	49819	SHEAVE, Accessory drive	1
9	00932	KEY, 0.25" x 2"	1
10	69026	BELT, Positive drive	1
11	49554	SHEAVE, Propelling pump	1
12	49550	V-Belt	1
13	49855	SHEAVE	1
14	49765	BRACE, Pump support	1
15	47313A	CONTROL, Choke	1
16	22383	CONNECTOR	1
17	47336	GAS LINE ASSEMBLY	1
18	09092-1	CLIP	1
19	49824	BRACKET, Gas tank	2
20	49176	TANK, Fuel	1
21	49606	STRAP, Gas tank	2
22	47566	NIPPLE	1
23	04601	STRAINER, Fuel	1
24	49275	PIPE, Exhaust, curved	1
25	23694	CLAMP	1
26	49276	PIPE, Exhaust, straight	1
27	24012	CLAMP	1
28	23681	MUFFLER	1
29	06507	ELBOW	1

* For engine parts see "Engine Section

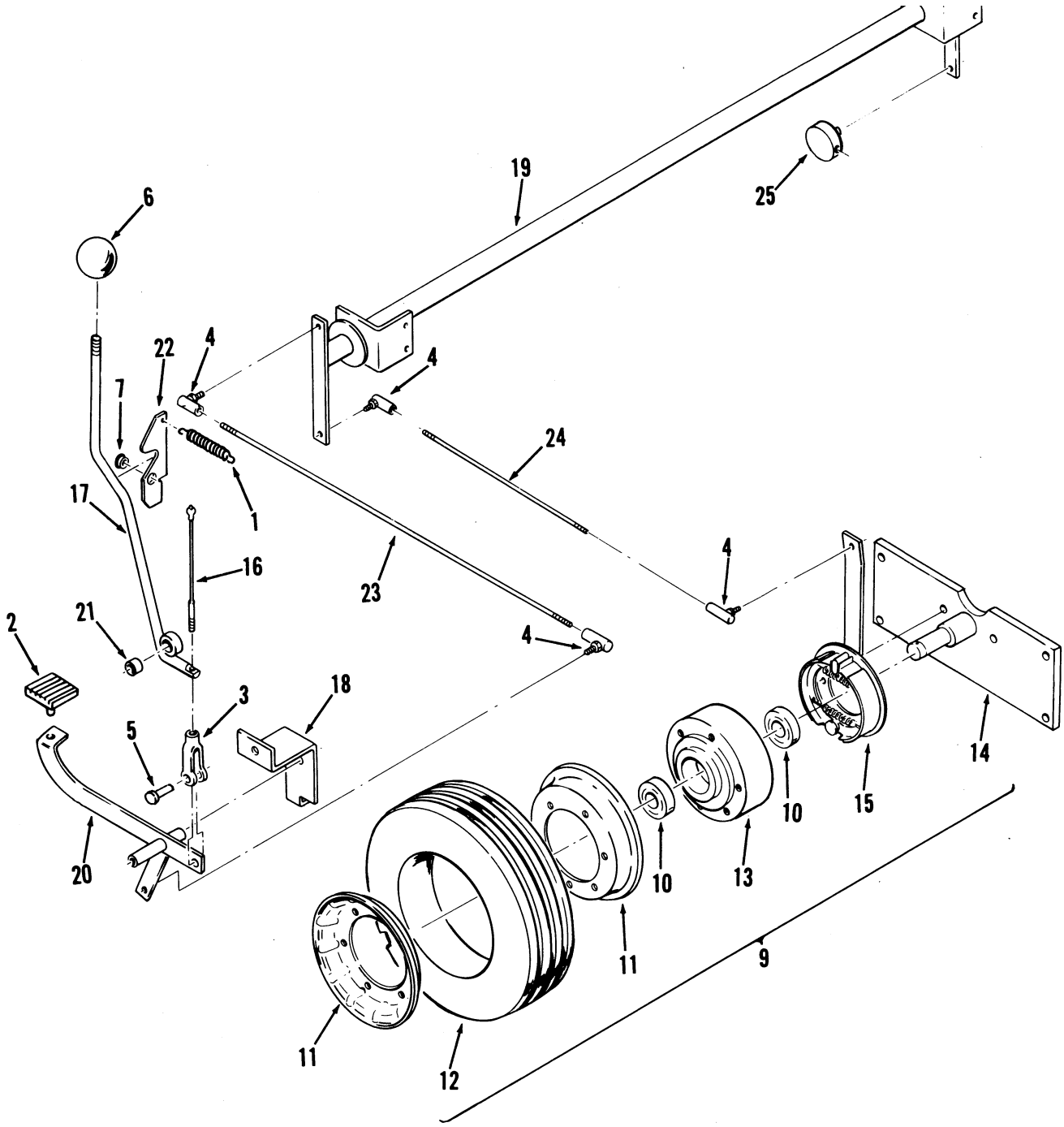


Fig. 3 - FRONT WHEELS & BRAKE PARTS

Fig. 3 - FRONT WHEELS & BRAKE PARTS

Ref. No.	TENNANT Part No.	Description	Qty.
1	01076	SPRING, Tension	1
2	07142	PAD	1
3	14595-1	CLEVIS, Adjusting	1
4	14601	BALL JOINT	4
5	14605	PIN, Clevis	1
6	26156	KNOB	1
7	28008	SLEEVE	2
	29233	BUMPER, Rubber grommet (not shown)	2
9	49334	WHEEL & BRAKE ASSEMBLY, Front (left or right)	2
10	07107	BEARING	2
11	49227	WHEEL DISC ASSEMBLY (set of 2)	1
12	09027	TIRE	1
13	49379	HUB, Front wheel	1
14	49383	SUPPORT, Front wheel	1
15	49471	BRAKE	1
16	49457	CABLE, Hand brake	1
17	49458	LEVER, Hand brake	1
18	49488	SUPPORT, Brake pedal	1
19	50189	SHAFT, Brake	1
20	50194	LEVER, Brake	1
21	50200	SPACER	1
22	50204	RETAINER, Brake lever	2
23	50205	ROD, Brake	1
24	50206	ROD, Brake	2
25	03756	PIN	2

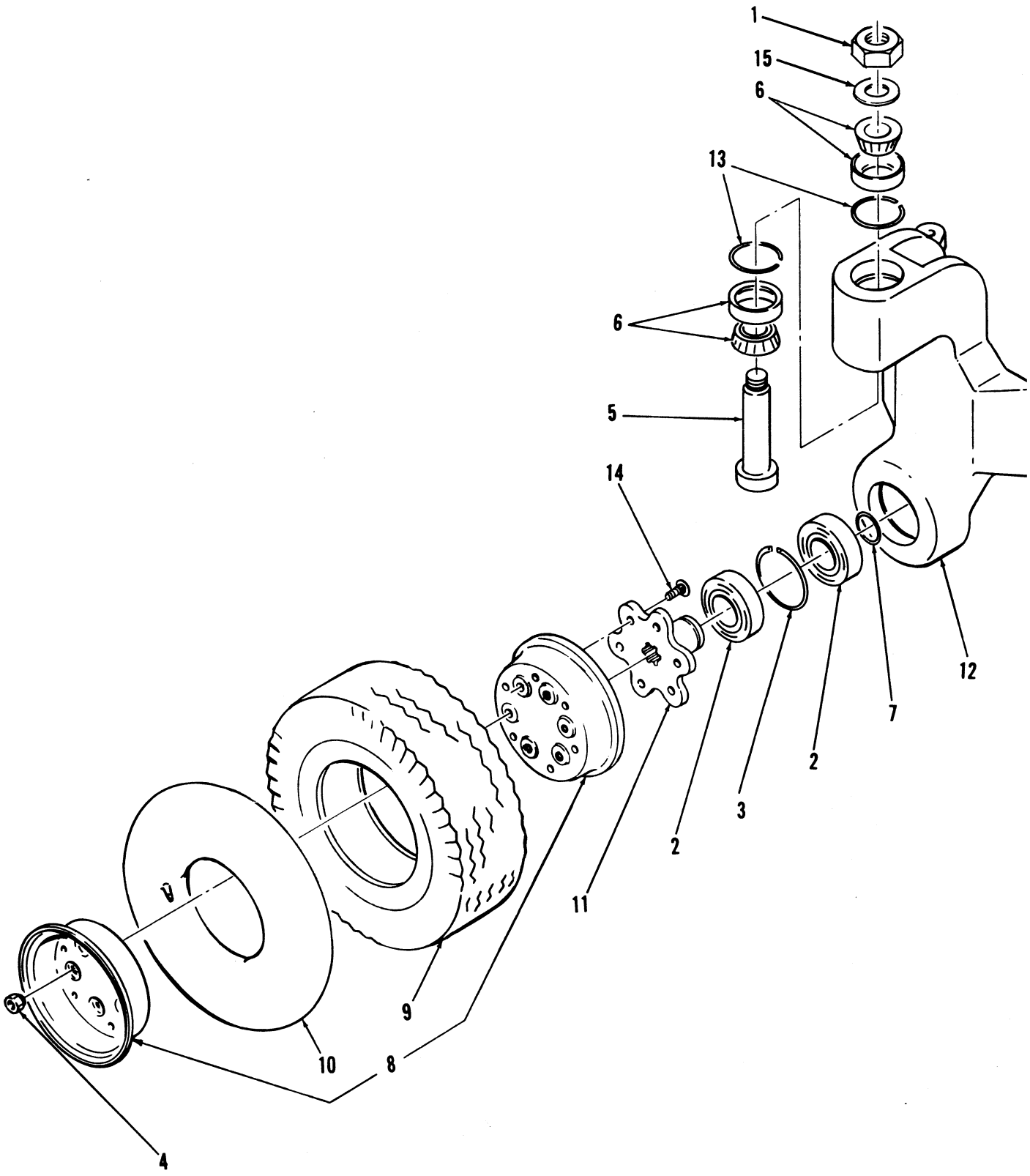


Fig. 4 - REAR WHEEL AND SUPPORT

Fig. 4 - REAR WHEEL & SUPPORT

Ref. No.	TENNANT Part No.	Description	Qty.
1	14242	NUT	1
2	17753	BEARING	2
3	44054	RING, Retaining, external	1
4	24339	NUT, Wheel	6
5	24984	PIN, Support	1
6	49225	BEARING, Cone & cup assembly(incl. 2 cups & 2 cones)	1
7	17757	RING, Retaining	1
	49332	WHEEL & RIM ASSEMBLY, Rear	1
	45786	CAP, Valve stem	1
8	49223	WHEEL SHELL ASSEMBLY	1
9	49420	TIRE	1
10	49421	TUBE, Tire	1
11	49267	HUB ASSEMBLY, Rear wheel (includes six studs #49376)	1
12	*49394A	SUPPORT, Rear wheel	1
13	49451	RING, Retaining	2
14	49376	STUD	6
15	47719	WASHER, Thrust (on top of upper bearing)	1
	45786	CAP, Valve, tube	1

* NOTE: Previous support did not use thrust washer. To replace this support, order SK1799.

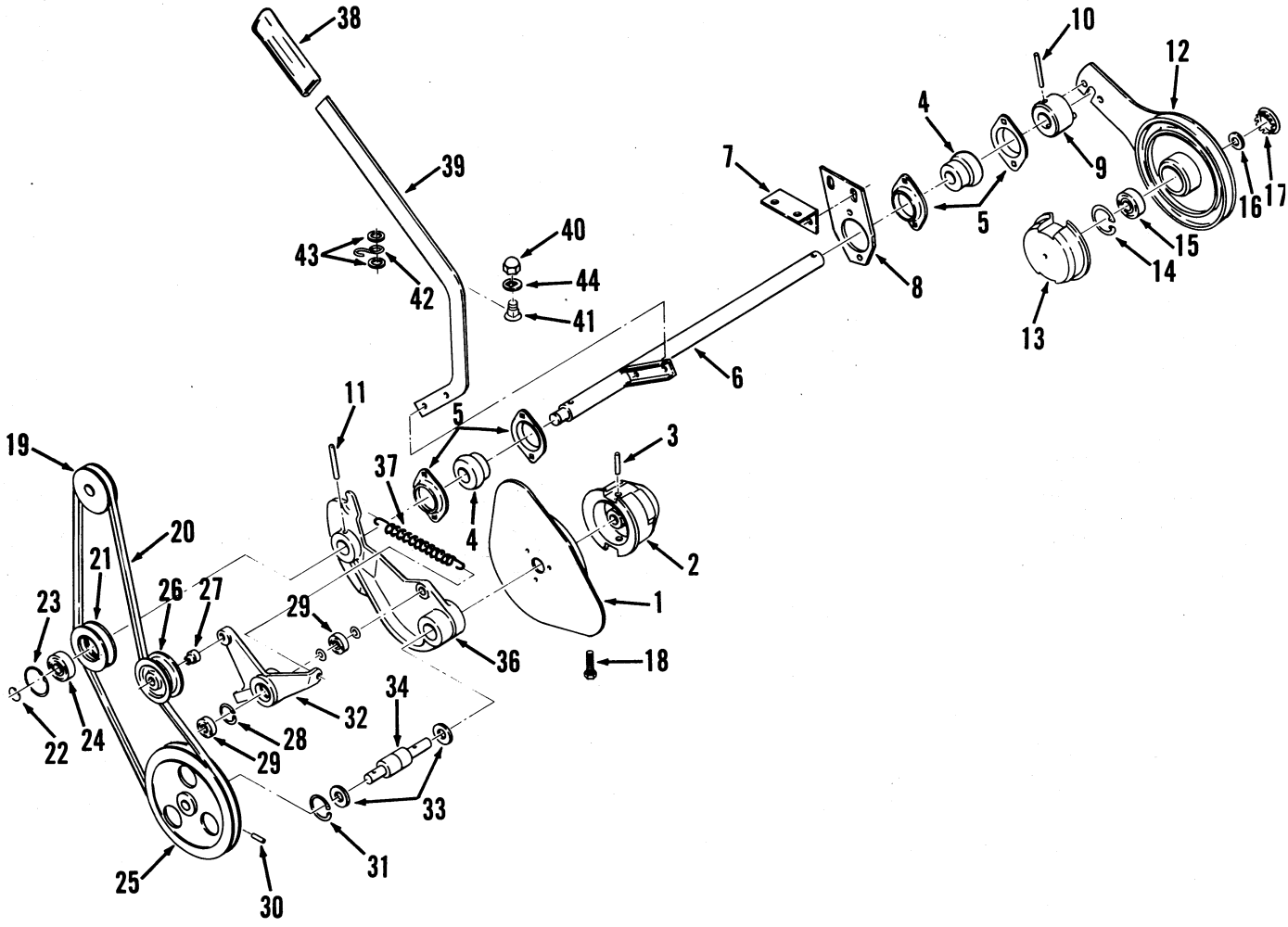


Fig. 5 - MAIN BRUSH PARTS

Fig. 5 - MAIN BRUSH PARTS

Ref. No.	TENNANT Part No.	Description	Qty.
1	23173	PLATE	1
2	23196A	BRUSH PLUG	1
3	01866	PIN, Roll	1
4	24835	BEARING, With collar	2
5	23222-2	FLANGE, Bearing	4
6	49551	"C" SHAFT, Brush	1
7	50952	*PLATE, Bearing mounting	1
8	50951	*SUPPORT	1
9	23221	BRUSH LIFT HUB ASSEMBLY	1
10	20050	PIN, Roll	2
	23213	BRUSH ARM & PLUG ASSEMBLY, R.H.	1
12	23666	ARM, Brush	1
13	07037	PLUG, Brush	1
14	10464	RING, Retaining	1
15	46390	BEARING	1
16	07026	WASHER	1
17	47178-13	PLUG BUTTON	1
18	50010	SCREW, Adjusting	1
19	49906	SHEAVE	1
20	49318	BELT	1
21	49495	SHEAVE, "C" shaft	1
22	23225	RING, Retaining, external	1
23	23224	RING, Retaining	1
24	01844	BEARING	1
	49553	ARM ASSEMBLY, Brush idler	1
25	49439	SHEAVE, Brush drive	1
26	27081	PULLEY, Idler	1
27	49317	SPACER, Idler	1
28	20020	RING, Retaining	1
29	01845	BEARING	2
30	01866	PIN, Roll	1
31	23217	RING, Retaining	1
32	46185-1	ARM, Idler	1
33	24435	SEAL , Felt	2
34	49438	BEARING, Main brush	1
	46277	WASHER	3
	46800	PIN, Clevis	1
36	46186	ARM, Idler	1
37	46785	SPRING, Tension	1
38	16447	GRIP, Handle	1
39	49562	ARM, Brush lift	1
40	26201	NUT	1
41	26249	BOLT	1
42	49189	HOOK, Brush lever	1
43	29854	WASHER, Nylon	2
44	07059	WASHER	2

* Note: To replace old style support 23204 with the new two piece support 50951 and 50952, order SK2520.

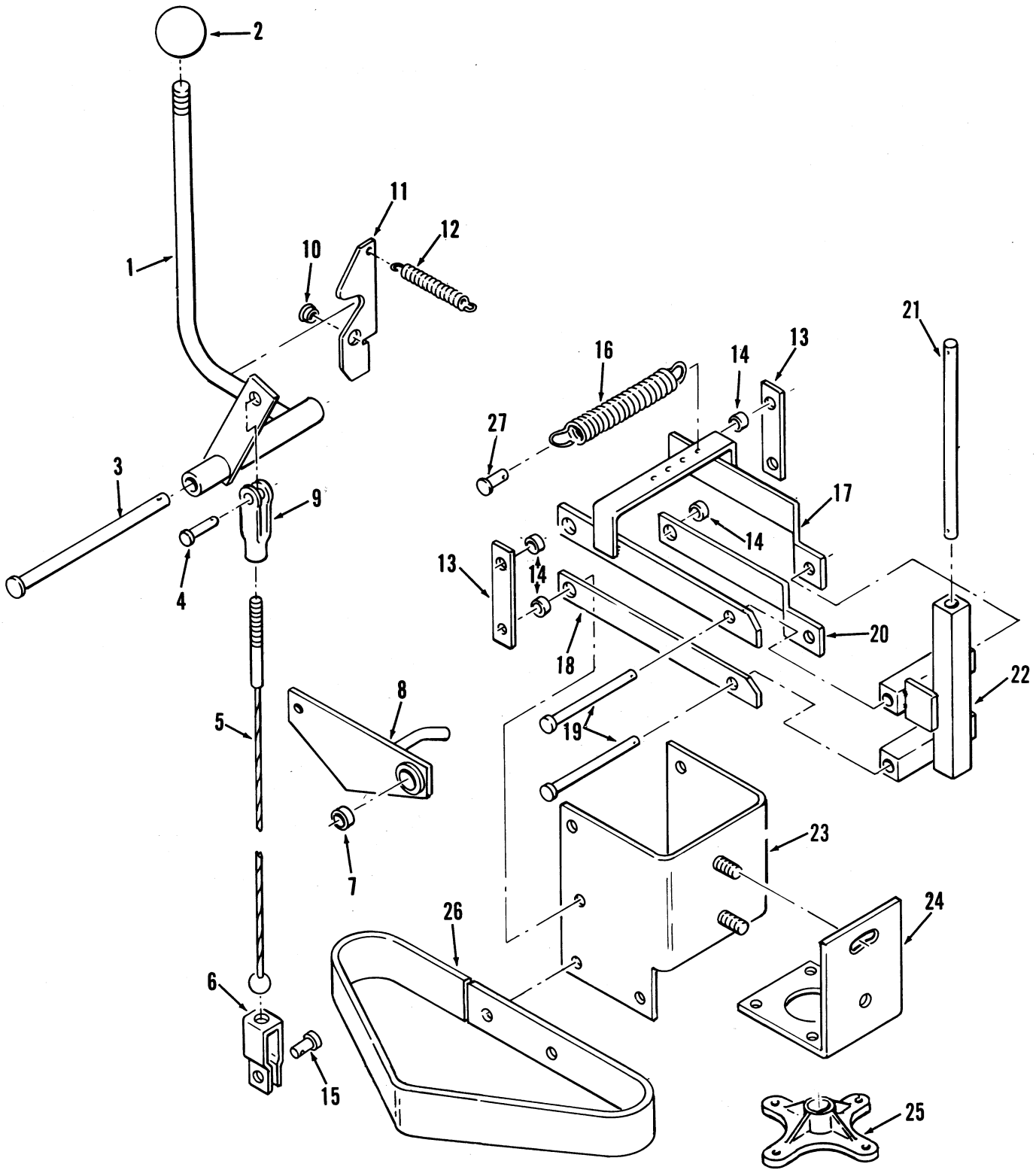


Fig. 6 - SIDE BRUSH PARTS

Fig. 6 - SIDE BRUSH PARTS

Ref. No.	TENNANT Part No.	Description	Qty.
1	49218	LEVER ASSEMBLY, Side Brush	1
2	26156	KNOB, Side brush	1
3	49924	PIN, Clevis	1
4	14605	PIN, Clevis	1
5	46217	CABLE	1
6	49286	CLEVIS, Cable end fitting	1
7	49628	BEARING, Lift arm	1
8	49778	LEVER, Side brush lift	1
9	14595-1	CLEVIS	1
10	28008	SLEEVE	2
11	50204	RETAINER, Brake lever	1
12	01053	SPRING	1
13	49571	LINK, Locking	2
14	49566	SPACER, Swing bracket	4
15	10120	PIN, Clevis	1
16	01274	SPRING, Tension	1
17	49989	LINK	1
18	49569	LINK	1
19	49914	PIN, Clevis	2
20	49911	LINK	1
21	49893	PIN, Straight	1
22	49619	BRACKET, Swing	1
23	49294	BRACKET, Side brush motor	1
24	49293	BRACKET, Mounting, side brush motor	1
25	SK1108	ADAPTER, Brush	1
26	49572	BUMPER, Side	1
27	46800	PIN, Clevis	1

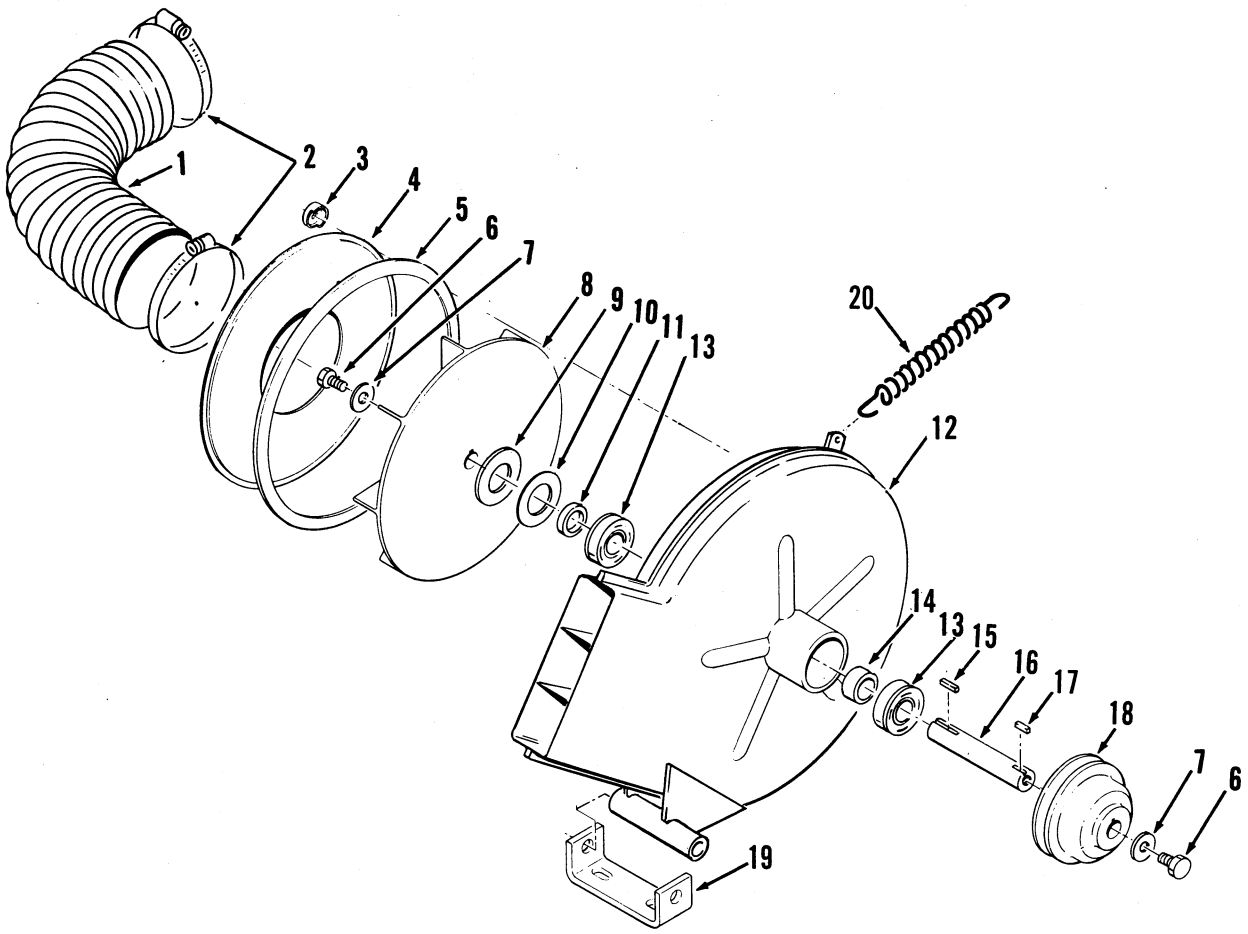


Fig. 7 - VACUUM FAN PARTS

Ref. No.	TENNANT Part No.	Description	Qty.
1	49888	DUCT, Flexible	1
2	23498	CLAMP	2
3	03467A	CLIP	4
4	18158-1	DUCT	1
5	23542	SEAL	1
	49273	FAN ASSEMBLY, Vacuum	1
6	T5846	SCREW, Hex	2
7	46940	WASHER, Special	2
8	46988A	IMPELLER	1
9	48681	SPACER	1
10	48680	WASHER	1
11	46983	SLEEVE	1
12	49219	HOUSING, Fan	1
13	07107	BEARING	2
14	46985	SPACER	1
15	00913	KEY	1
16	46981	SHAFT, Fan	1
17	00910	KEY, 0.19" x 0.63"	1
18	46989	SHEAVE, Fan	1
19	23569-2	BRACKET, Mounting	1
20	29499	SPRING, Tension	1

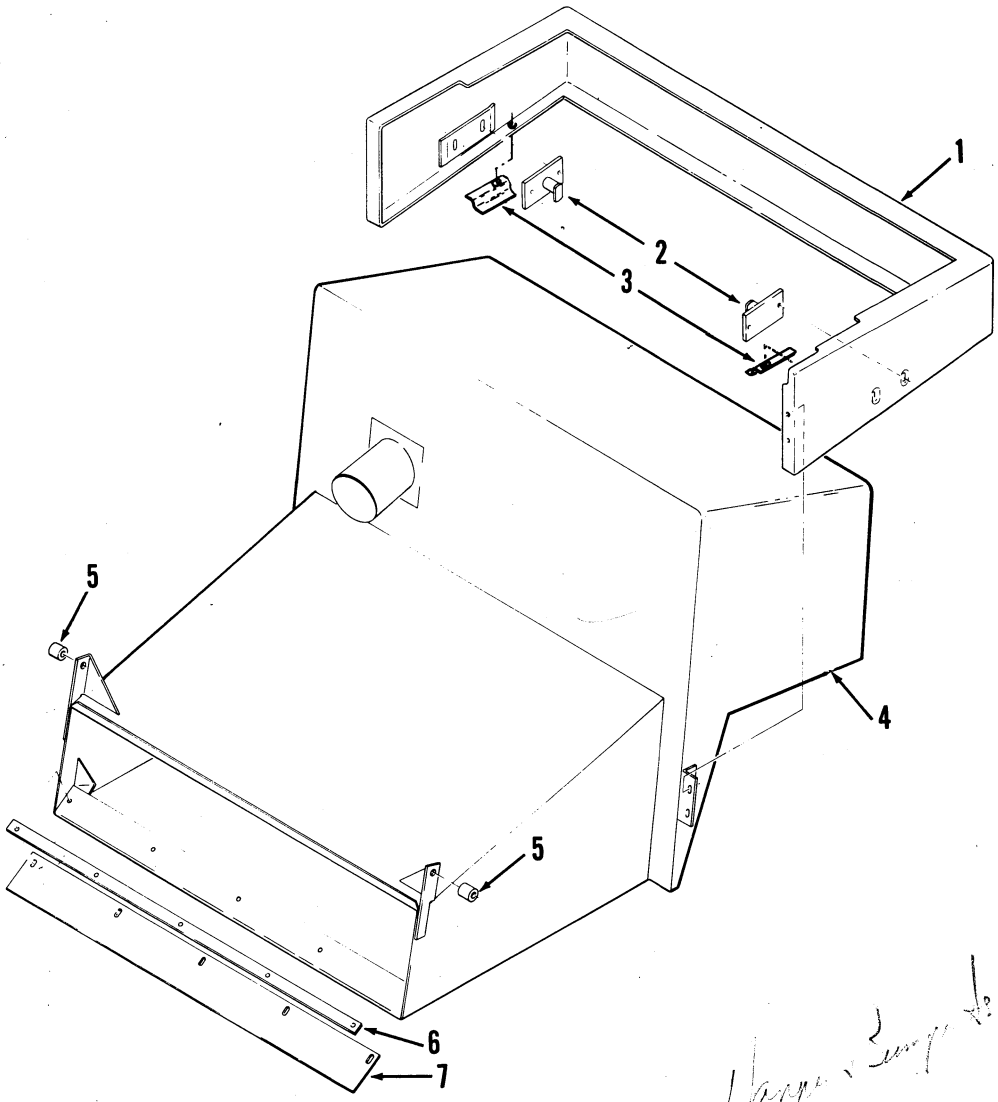


Fig. 8 - HOPPER & RELATED PARTS

Ref. No.	TENNANT Part No.	Description	Qty.
1	49475	BUMPER	1
2	49427	SUPPORT, Hopper	2
3	50005	RETAINER	2
4	49437	HOPPER	1
5	49319	ROLLER	2
6	49454	RETAINER, Hopper lip	1
7	49453	LIP, Rubber	1

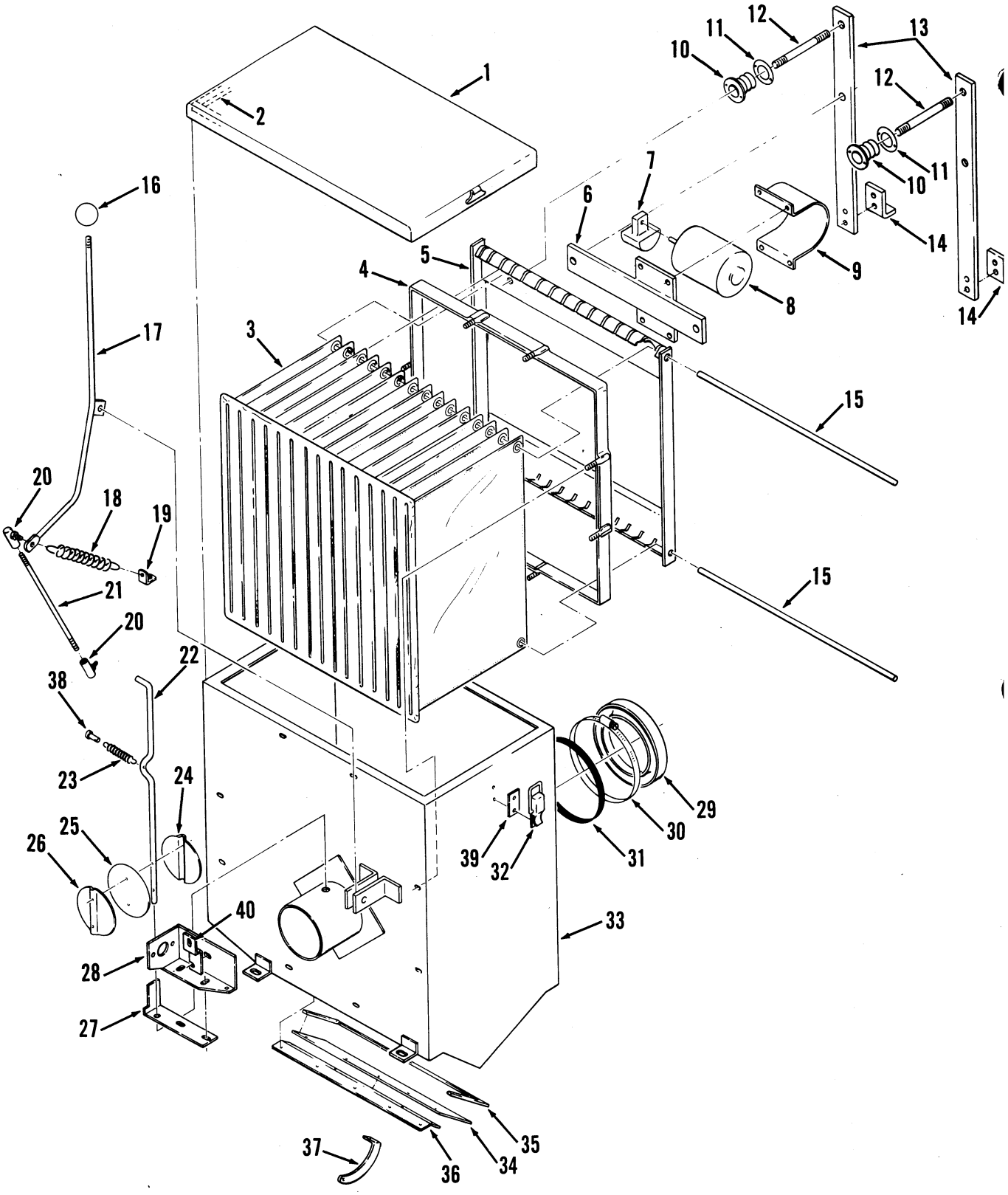


Fig. 9 - FILTER SYSTEM

Fig. 9 - FILTER SYSTEM

Ref. No.	TENNANT Part No.	Description	Qty.
1	49221	COVER ASSEMBLY, Filter box	1
2	47962	SEAL KIT, Cover	1
3	49841	BAG ASSEMBLY, Filter	1
4	49283	RETAINER	1
5	49837	SUPPORT, Bag	1
6	49637	MOUNT, Motor	1
7	49732	WEIGHT, Oscillating	1
8	54121	*MOTOR, Shaker	1
9	50012	SUPPORT, Motor	1
10	49516	BOOT, Flexible	2
11	49633	RETAINER, Boot	2
12	49654	ROD, Support	2
13	49641	SPRING, Flat	2
14	49644	MOUNT, Spring	2
15	49653	SUPPORT, Bag	2
16	26156	KNOB	1
17	49607	LEVER, Dump door	1
18	01274	SPRING, Tension	1
19	18188	BRACKET	1
20	14601	BALLJOINT	2
21	49611	ROD, Filter box door	1
22	49870	ROD, Damper control	1
23	09087	SPRING, Tension	1
	49222	DAMPER PLATE ASSEMBLY	1
24	49300	DAMPER	1
25	49261	SEAL	1
26	46140	PLATE	1
27	49174	BRACKET, Damper rod	1
28	49173	BRACKET, Shaker switch	1
29	49581	SEAL	1
30	49891	CLAMP, Hose	1
31	49349	TRIM, Duct	1
32	23709	CATCH	1
33	49352	BOX, Filter	1
34	49220	DOOR ASSEMBLY, Filter box	1
35	49350	SEAL KIT, Dump door	1
36	49366	HINGE	1
37	49667	ARM, Filter box door	1
38	28296	PIN, Clevis	1
39	23515	STRIP	1
40	49827	SUPPORT, Instrument panel	1
	49287	CLAMP, Cable, 0.75"(19 mm)	1
	09384	CLAMP, Cable, 0.17"(4 mm)	1
	09385	CLAMP, Cable, 0.43"(11 mm)	1
	06777	CLAMP, Cable, 0.50"(13 mm)	1

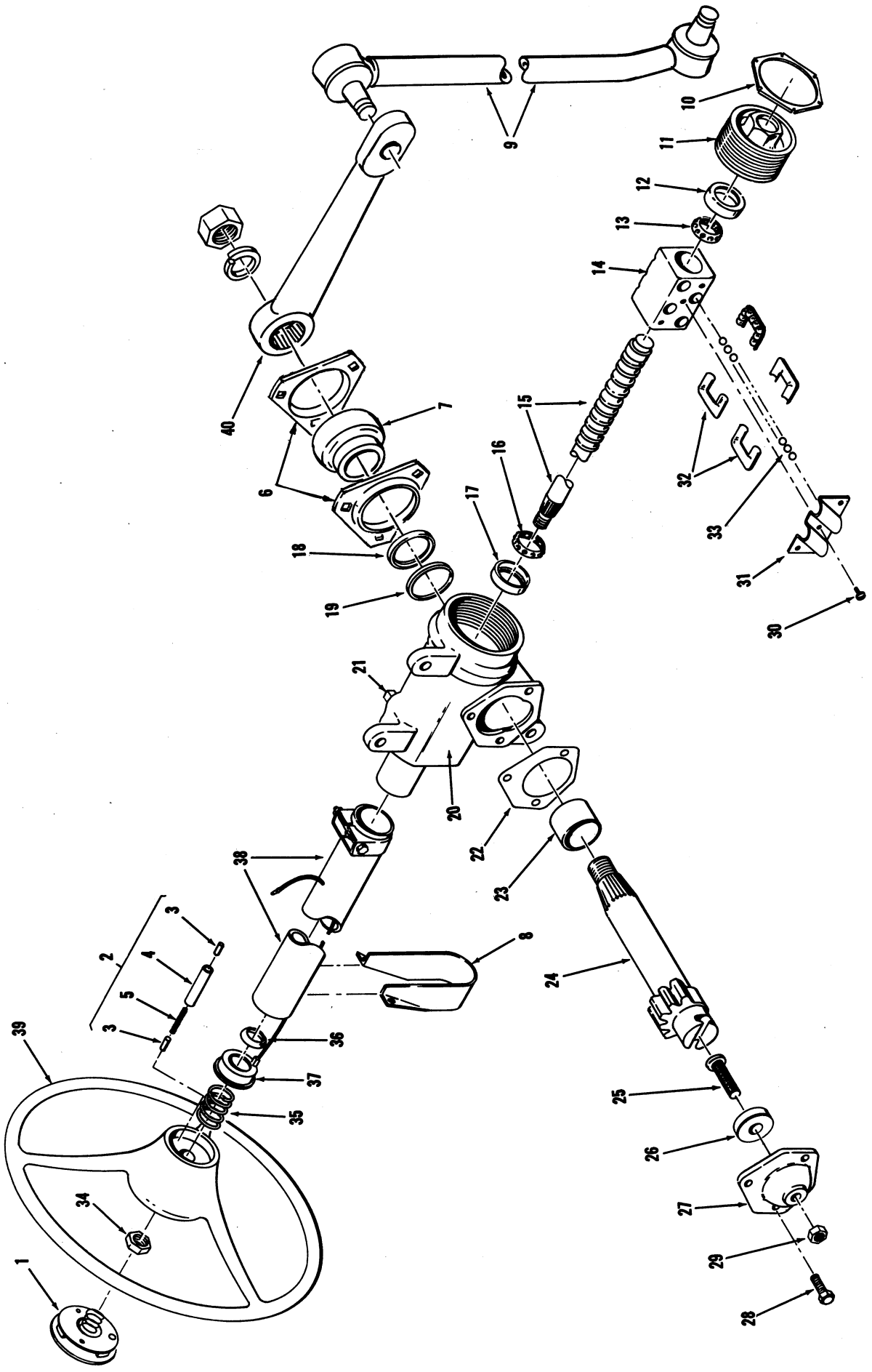


Fig. 10 - STEERING SYSTEM

Fig. 10 - STEERING SYSTEM

Ref. No	TENNANT Part No.	Description	Qty.
1	47010	HORN BUTTON	1
2	47011	BRUSH UNIT, Horn (assembly, includes the following)	1
3	43611	BRUSH, Horn	1
4	46312	SLEEVE	1
5	46313	SPRING	1
6	51449	RETAINER, Bearing	2
7	48050	BALL BEARING WITH COLLAR	1
8	49444	SUPPORT, Steering column	1
9	49447	DRAG LINK	1
	49449	STEERING GEAR ASSEMBLY	1
	49452	COLUMN & GEAR ASSEMBLY (following parts list in this assembly are Saginaw)	1
10	5676217	Worm bearing adjuster lock nut	1
11	5666682	Worm bearing adjuster	1
12	5666683	Lower worm bearing cup	1
13	5666693	Lower ball bearing	1
14	5666886	Ball nut	1
15	7806038	Wormshaft	1
16	5666693	Upper ball bearing	1
17	5666683	Upper worm bearing cup	1
18	5670325	Packing retainer	1
19	5670325	Packing	1
20	5692534	Housing	1
21	103868 - 444746	Filler plug	1
22	5666734	Gasket	1
23	266316	Sector shaft bushing	1
24	5677096	Sector and shaft	1
25	266678	Lash adjuster	1
26	266903, 5, 7, 9	Lash adjust shim	1
27	5666722	Housing side cover and bushing assembly	1
28	179837	Side cover bolts	1
29	114496	Lash adjuster lock nut	1
30	187375	Ball guide clamp screw	1
31	5666888	Ball guide clamp	1
32	5666887	Ball guide	1
33	266800	Balls	1
34	114496	Nut, steering wheel	1
35	264832	Spring	1
36	7806036	Bearing & cable assembly	1
37	264831	Seat, spring	1
38	7806041	Column	1
39	47008	WHEEL, Steering	1
40	49450	ARM, Steering (front)	1

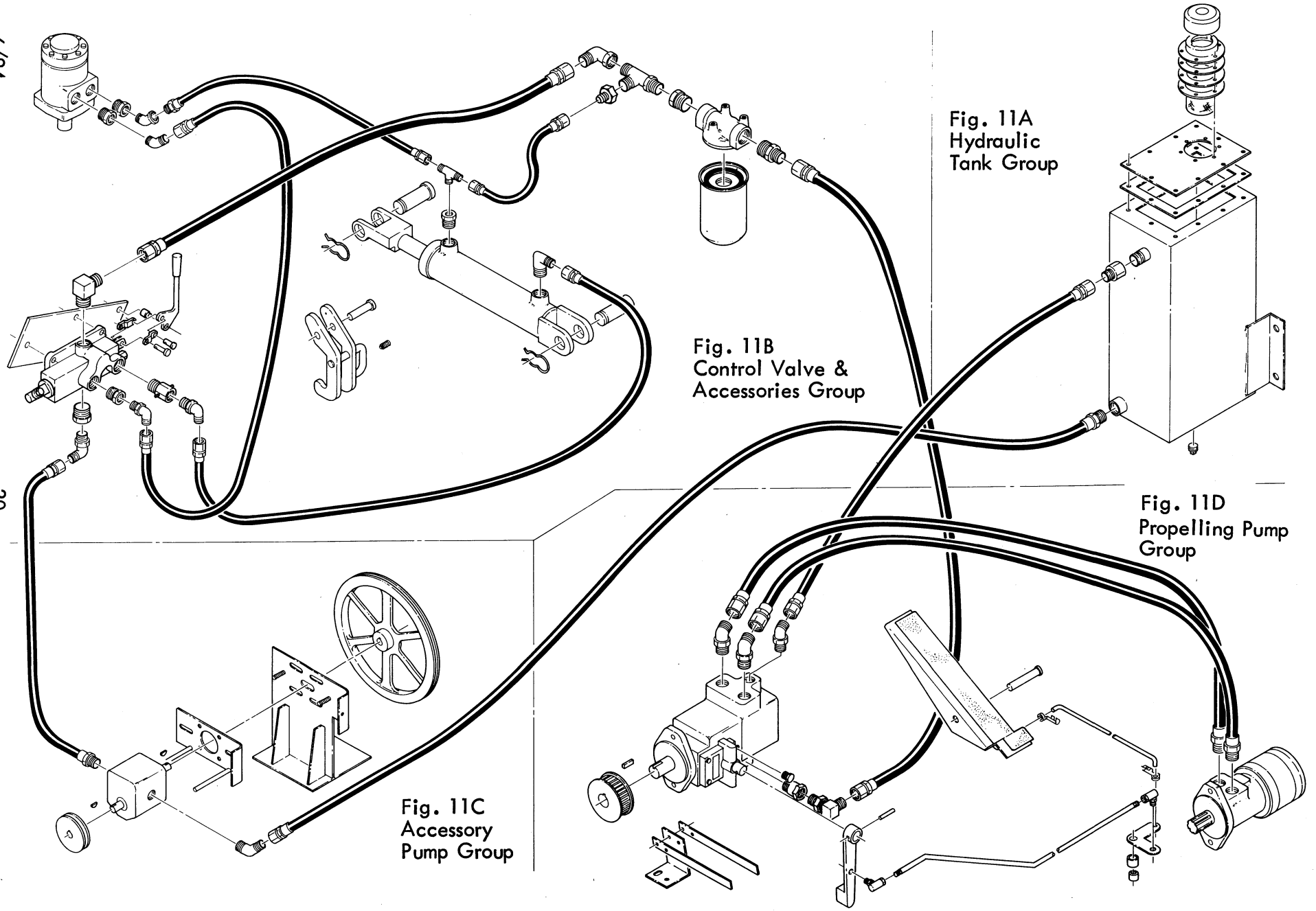


Fig. 11 - MODEL 220 HYDRAULIC DIAGRAM

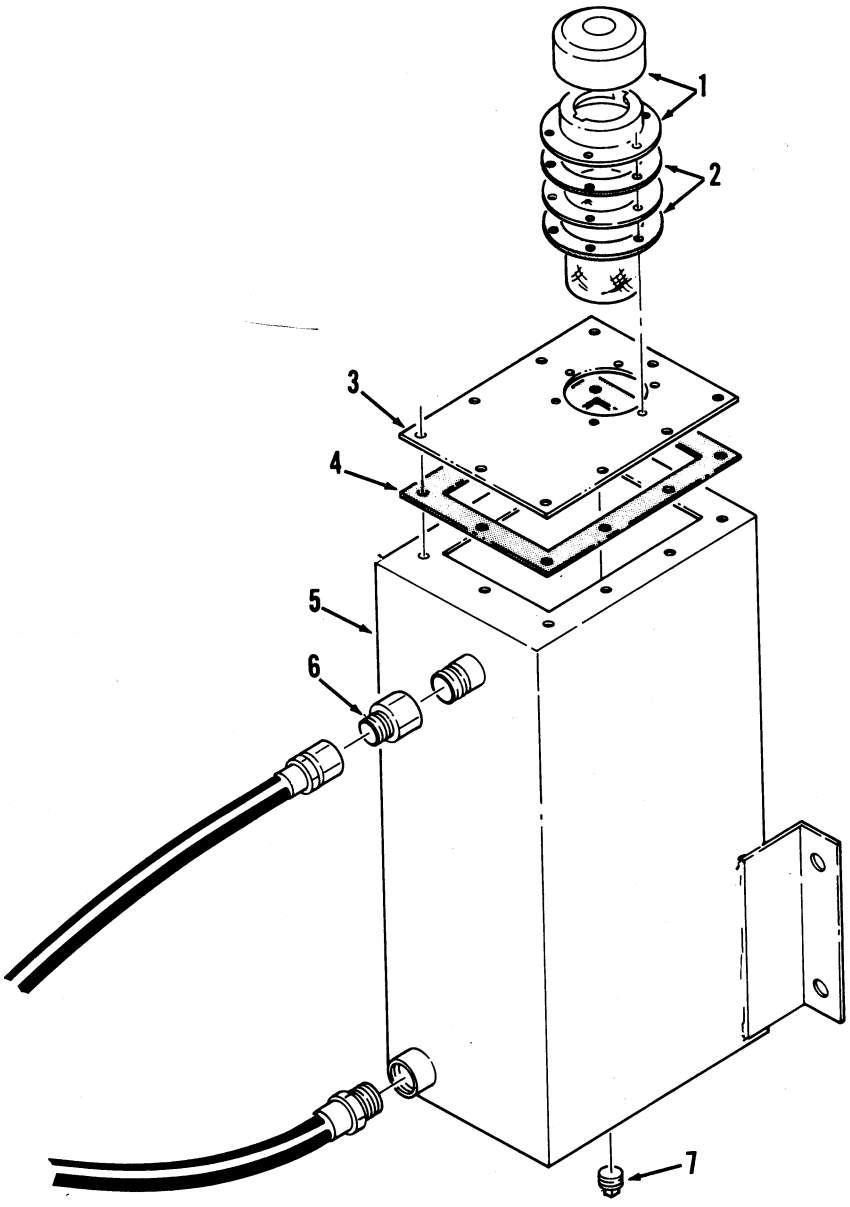


Fig. 11A - HYDRAULIC TANK GROUP

Fig. No.	TENNANT Part No.	Description	Qty.
	69167	TANK ASSEMBLY, Hydraulic fluid	1
1	49305	FILLER & BREATHER ASSEMBLY	1
2	23686	*GASKET	2
3	49724	COVER, Tank	1
4	49759	GASKET, Tank cover	1
5	69115	TANK, Hydraulic fluid	1
6	46484	CONNECTOR	1
7	46107	PLUG, Magnetic drain	1
	32397	FLUID, Hydraulic	1

*Note: Not used in newer design machines.

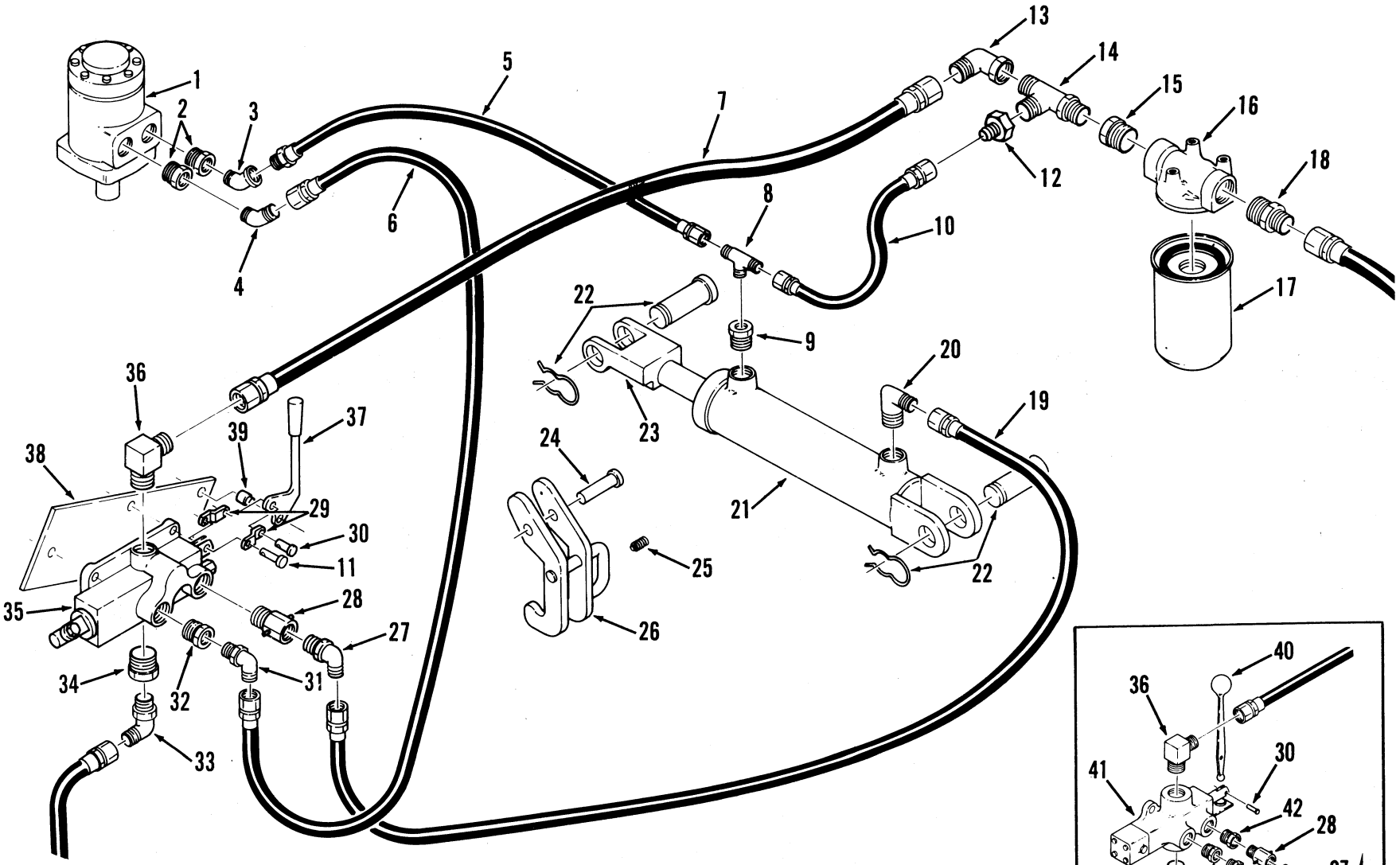
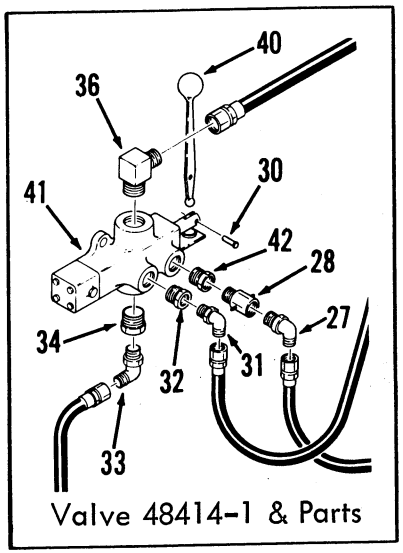


Fig. 11B - CONTROL VALVE & ACCESSORIES GROUP



Valve 48414-1 & Parts

Fig. 11B- CONTROL VALVE & ACCESSORIES GROUP

Ref. No.		TENNANT Part No.	Description	Qty.
1		47650-3	MOTOR, Side Brush (Char-Lynn)	1
		SK1600	SEAL KIT	1
2		47721	CONNECTOR	2
3		47720	ELBOW, 45°	1
4		47722	ELBOW, 45°	1
5		49958	HOSE	1
6		49957-1	HOSE	1
7		52908	HOSE	1
8		49940	TEE	1
9		49296	CONNECTOR	1
10		49942	HOSE	1
11		51727	PIN, Clevis	1
12		47754	CONNECTOR (replaces tube nut 47499)	1
13		54194	ELBOW	1
14		56694	TEE	1
15		47516	CONNECTOR	1
16		67718	**FILTER, Hydraulic fluid (Deluxe-standard)	1
		53348B	**FILTER, Hydraulic fluid (Ripley-alternate)	1
17		67718-2	ELEMENT (for 67718)	1
		53348-1	ELEMENT (for 53348B)	1
18		42227	CONNECTOR	1
19		49943	HOSE	1
20		49934	ELBOW	1
21		48339	CYLINDER, Lift (Green)	1
		SK1738	SEAL KIT	1
22		*859	PIN, And clip set	2
23		*C-3544	CLEVIS, Cylinder	1
24		06279	PIN, Clevis	1
25		49949	PLUNGER, Spring	1
26	***	49946A	LOCK, Cylinder	1
27		47512	ELBOW	1
28		45536-1	CONNECTOR, Line-throttle	1
29		32388	LINK, Valve actuator	2
30		14605	PIN, Clevis	1
31		47638	ELBOW	1
32		47637	CONNECTOR	1
		+57727	CONNECTOR (Alternate)	1
33		56820	ELBOW	1
		+47512	ELBOW (Alternate)	1
34		57727	CONNECTOR	1
		+ 47519	CONNECTOR (Alternate)	1
35		32391	VALVE, Control, Victor-Dukes	1
		SK2571	Seal Kit	

(continued on next page)

Fig. 11B - CONTROL VALVE & ACCESSORIES GROUP (cont.)

Ref. No.	TENNANT Part No.	Description	Qty.
36	51782	ELBOW	1
	+53076	ELBOW	1
37	32393	HANDLE	1
38	32389	PLATE	1
39	32387	SPACER	1
40	+17999	HANDLE	1
41	+48414-1	VALVE, Control (Gresen)	1
	+SK1705	SEAL KIT	1
	+48414-4	BRACKET (for 48414-1 valve)	1
42	+47552	CONNECTOR	1
	49287	CLAMP, Cable, 0.75" dia	1

* Green Manufacturing part number

** Either standard or alternate hydraulic oil filters may be used. Check filter before ordering parts or element. #67718-2 Deluxe Element is a "Spin-on" type. #53348-1 Ripley Element is a cartridge-type element located inside the filter case. O'Ring for Ripley filter is #DH1004

***Note: Before Serial #1997, Lock, Cylinder was #49946

\+ Note: These parts are used with alternate valve 48414-1 (Gresen).

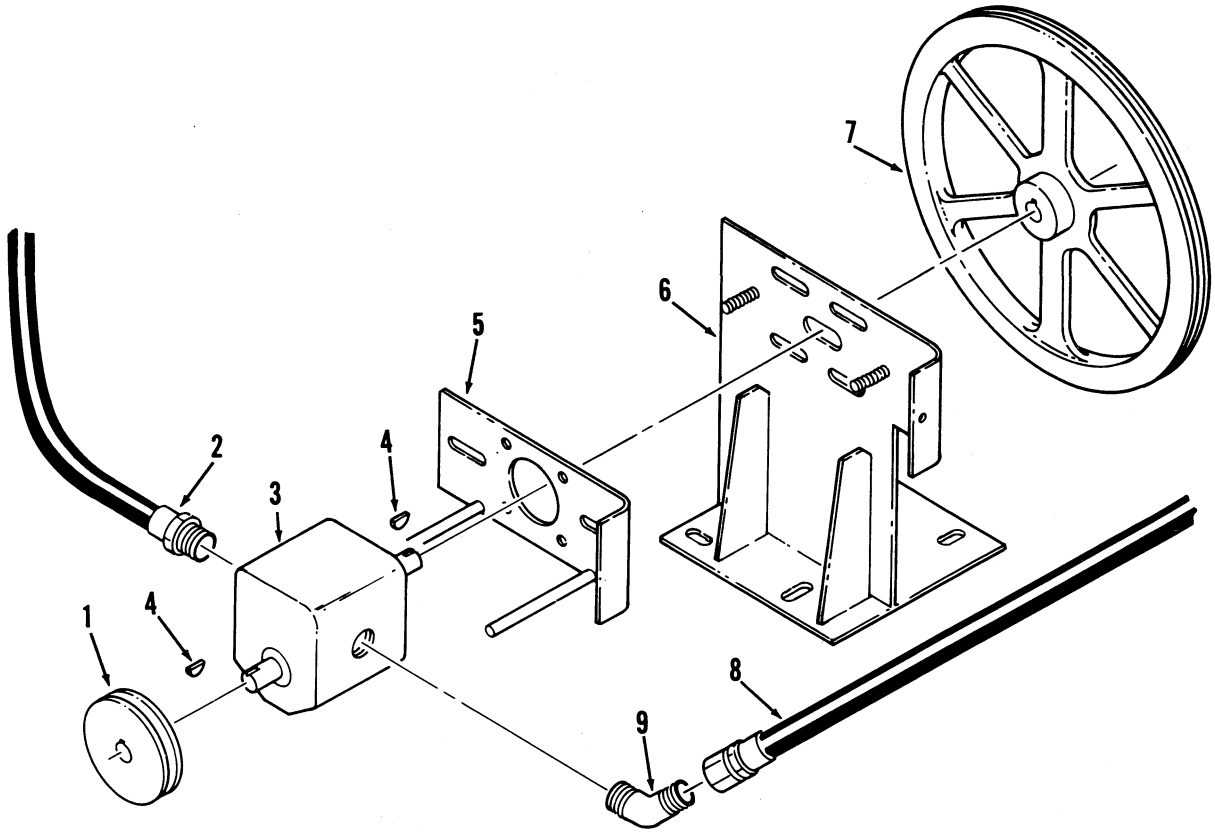


Fig. 11C - ACCESSORY PUMP GROUP

Ref. No.	TENNANT Part No.	Description	Qty.
1	49906	SHEAVE, Brush drive	1
2	49944	HOSE	1
3	49796	PUMP, Accessory	1
	SK1112	SEAL KIT	1
4	00500-1	KEY	1
5	49264	MOUNT, Accessory pump	1
6	49971	SUPPORT, Pump mounting	1
7	49855	SHEAVE, Accessory pump	1
8	49298	HOSE	1
9	49937	ELBOW, 45°	1
	49188	WASHER, Lock	4
	50011	SCREW, 0.25" - 20 x 0.38"	4

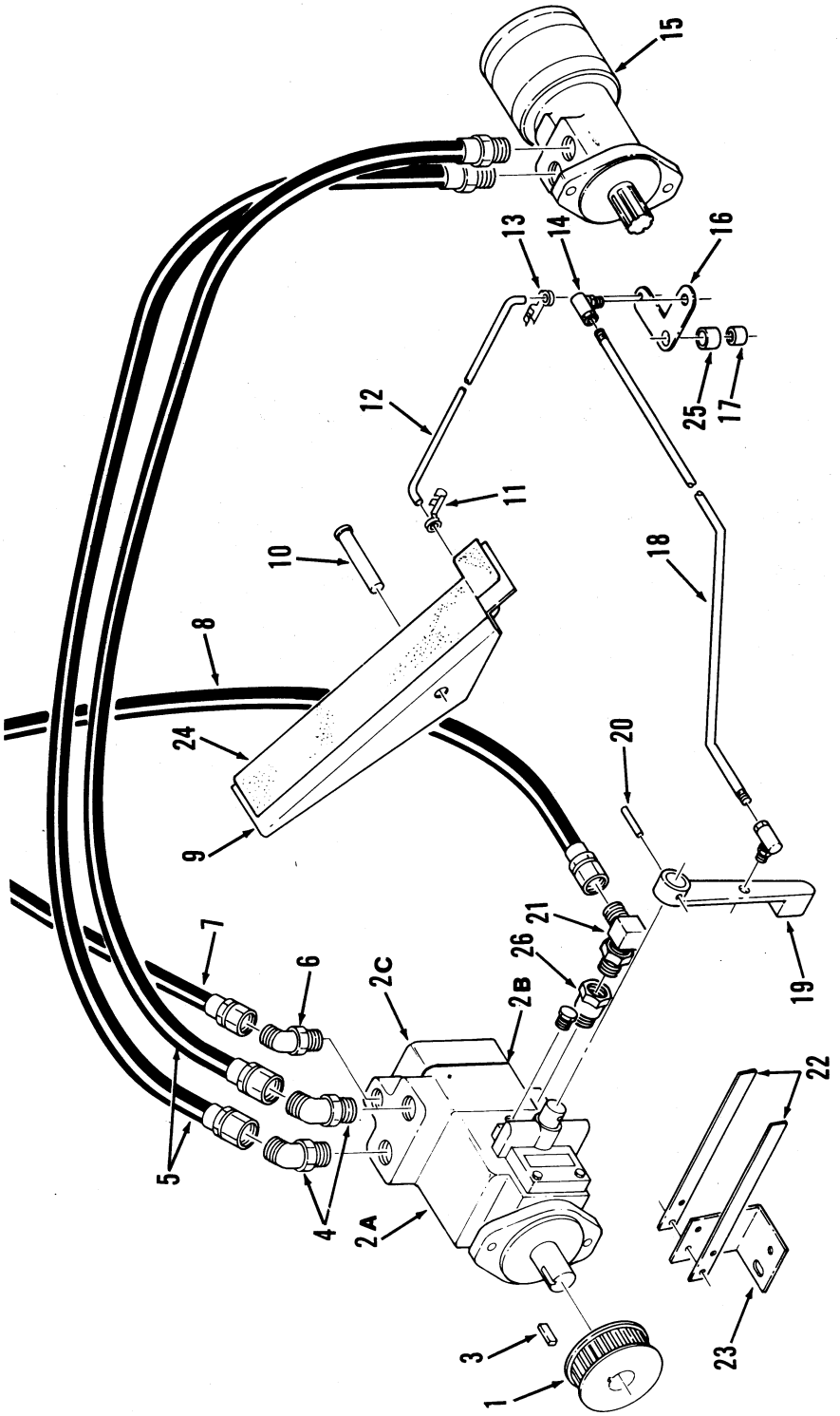


Fig. 11D - PROPELLING PUMP GROUP

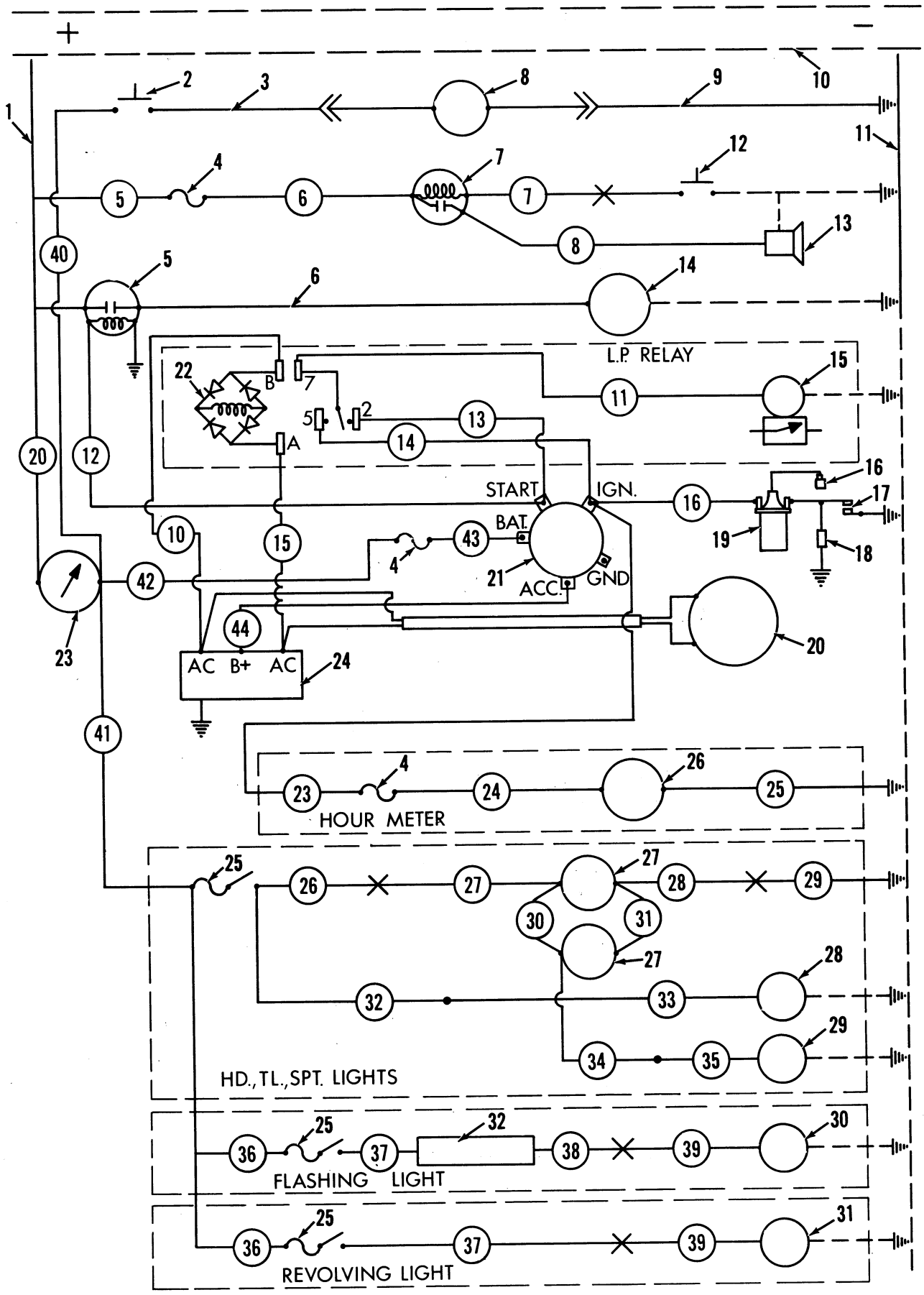


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Fig. 12B - MODEL 220 ELECTRICAL SCHEMATIC

MODEL 220 - ELECTRICAL SYSTEM (See Schematic and Pictorial Diagram)

Ref. No.	TENNANT Part No.	Description	Qty.
1	29830-3	CABLE, Positive battery (gasoline)	1
	29830-5	CABLE, Positive battery (L.P.)	1
2	44078	SWITCH, Shaker	1
3	24108-3	LEAD, Shaker motor	2
4	14215	FUSE, 20 AMP	5
	44080	BLOCK, Fuse	1
5	47356	SOLENOID, Starter	1
6	29832-3	CABLE (24" x 6 gauge)	1
7	32300	RELAY, Horn	1
8	54121	MOTOR, Shaker	1
9	24108-3	LEAD, Shaker motor	1
10	26771	BATTERY	1
11	29831-6	CABLE, Negative battery (gasoline)	1
	29831-5	CABLE, Negative battery (L.P.)	1
12	47010	SWITCH, Horn	1
13	14138A	HORN	1
14	*A-237131	MOTOR, Starter	1
15	33554	FILTER-FUELOCK	1
16	45770-5	SPARK PLUG (Champion J-8)	1
17	38463	POINTS, Ignition	1
18	49795-3	CONDENSER	1
19	28637	COIL	1
20		ALTERNATOR, Flywheel (part of engine)	1
21	62530	SWITCH, Ignition	1
	62530-1	KEY, Ignition switch	1
22	49250	MODULE, LP control	1
23	14127	AMMETER	1
24	*237335	REGULATOR	1
25	14137	SWITCH, Light	3
	14215	FUSE, 20 A	1
26	24518	METER, Hour	1
	28838	DAMPER, Hour meter	1
27	46108	HEADLIGHT ASSEMBLY	2
	10801	BULB, Headlight	1
28	49898	TAILLIGHT ASSEMBLY	1
	GE#1895	BULB, Taillight	1
29	22465	SPOTLIGHT ASSEMBLY	1
	32827	BULB, Spotlight	1
30	47535	LIGHT ASSEMBLY, Flashing	1
	22640	BULB, Flashing light	1
31	SK2711	LIGHT ASSEMBLY, Revolving	1
	45670	BULB, Revolving light	1
32	24576	FLASHER	1
	24576-1	BRACKET, Flasher mounting	1
	49687A	WIRE KIT, Model 220	1

* Kohler part number

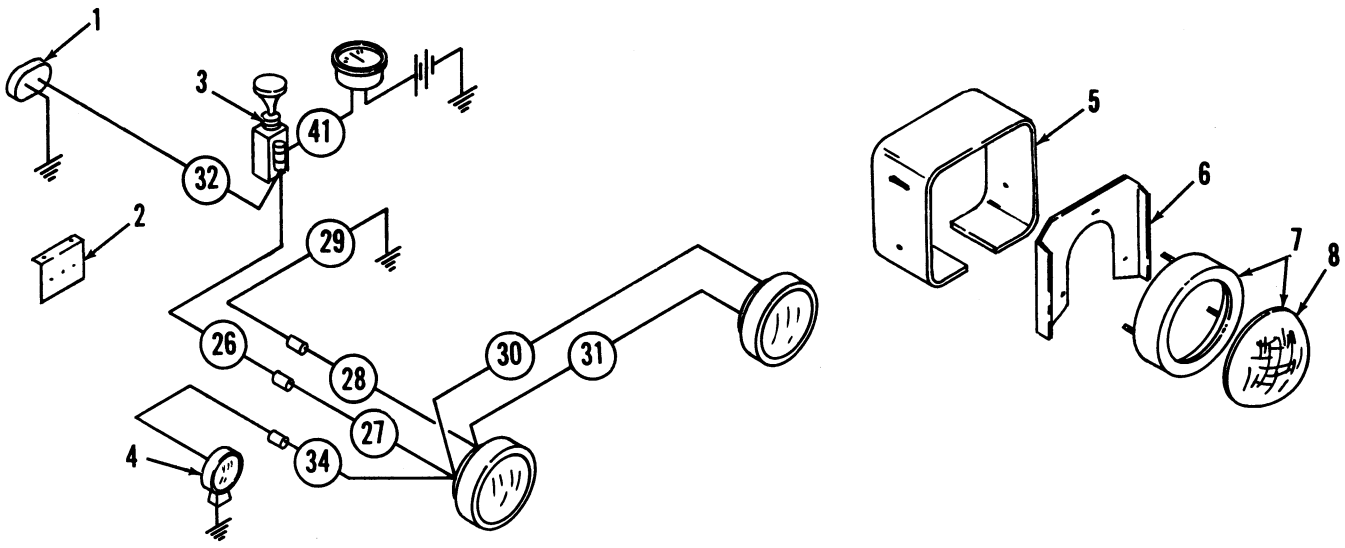
MODEL 220 LIST OF DECALS

TENNANT Part No.	Description	Qty.
33662	DECAL REPLACEMENT KIT	1
49953	DECAL, Disposal door	1
49952	DECAL, Main brush, up-down	1
49217	DECAL, Warning-vertical LP tank	1
19048	DECAL, Gasoline only	1
48242	DECAL, Alternator	1
49951	DECAL, Parking brake	1
49983	DECAL, Caution, pan lock	1
49274-1	DECAL, 220, white letters	1
49274	DECAL, 220, blue-green letters	1
35518	DECAL, Caution, stay clear	1
45851	DECAL, Hydraulic oil	1
45579	DECAL, Factory mutual, type gas	1
45580	DECAL, Factory mutual, type LP	1
32399	DECAL, Hydraulic fluid	1
36603	DECAL, Patent-power sweeper	1
32394	DECAL, Hydraulic control	1

MM106

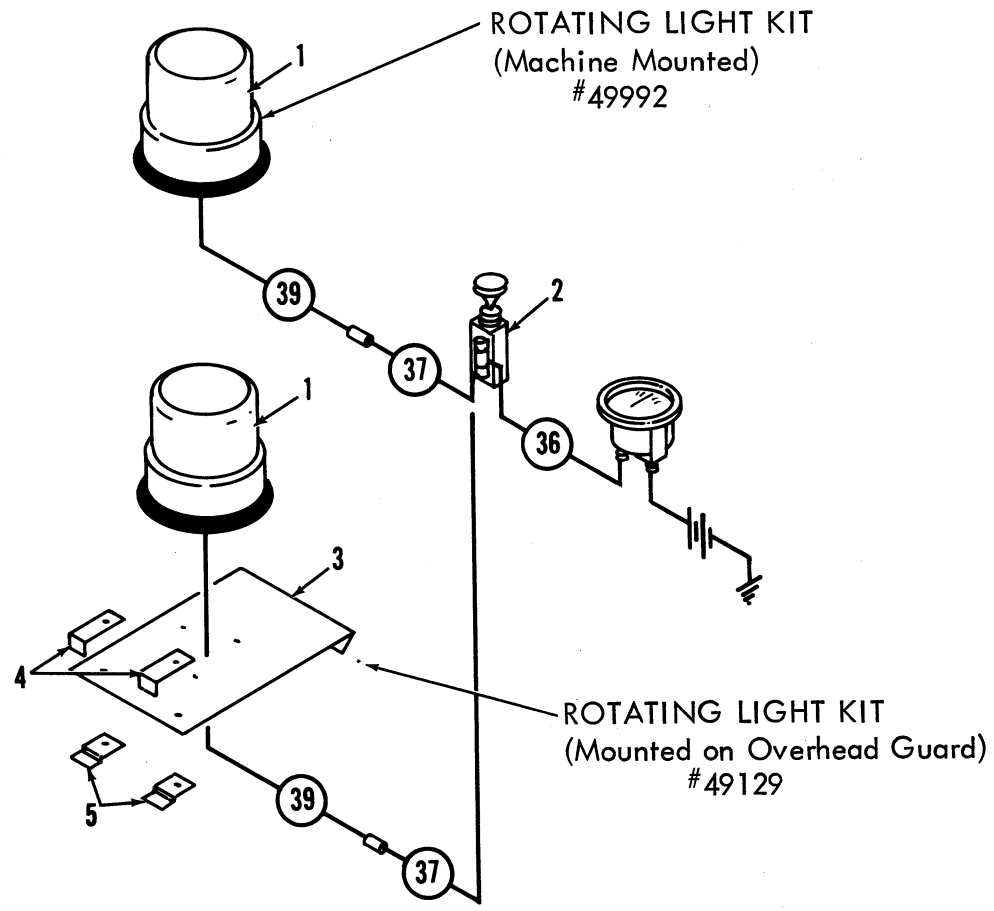
220
POWER SWEEPER

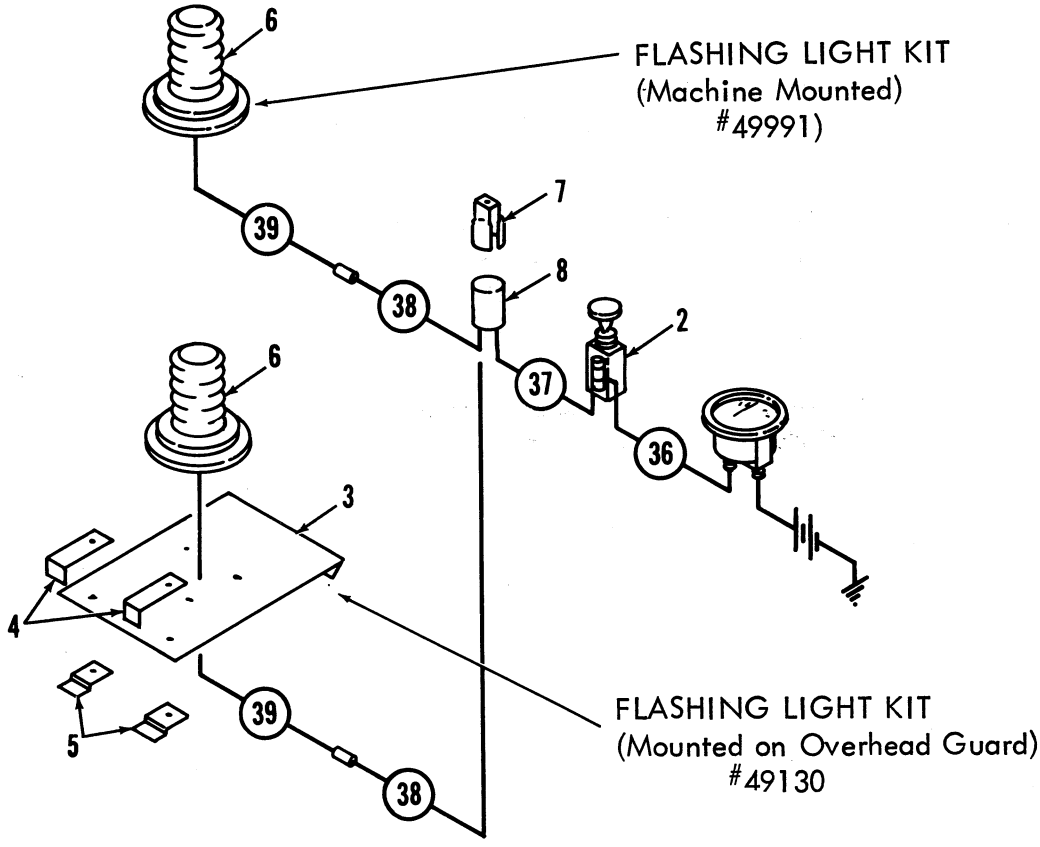
accessories



HEADLIGHT, TAILLIGHT, & SPOTLIGHT Kit #49975

Ref. No.	TENNANT Part No.	Description	Qty.
1	49898	TAILLIGHT ASSEMBLY	1
	GE #1895	BULB	2
2	49862	PLATE, Taillight	1
3	14137	SWITCH	1
4	22465	SPOTLIGHT ASSEMBLY	1
	32827	BULB	1
5	49894	WRAP, Headlight	1
6	49896	PLATE, Headlight	1
7	46108	HEADLIGHT ASSEMBLY	2
8	10801	HEADLIGHT	1
	51798	GROMMET	1
	49691	WIRE KIT	1
	49262	CLAMP, Conduit	3
	49263	TIE, Cable	2


ROTATING LIGHT KIT
(Machine Mounted)
#49992
1
39
2
37
1
36
3
4
ROTATING LIGHT KIT
(Mounted on Overhead Guard)
#49129
5
39
37

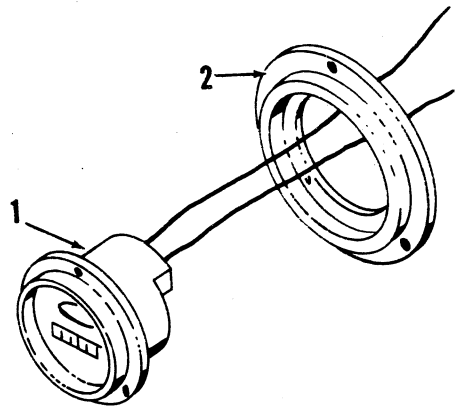

6
FLASHING LIGHT KIT
(Machine Mounted)
#49991)
39
7
8
38
2
6
37
36
3
4
FLASHING LIGHT KIT
(Mounted on Overhead Guard)
#49130
5
39
38

COMPLETE ROTATING & FLASHING LIGHT KITS

49992	ROTATING LIGHTS (MACHINE MOUNTED)
49129	ROTATING LIGHTS (ON OVERHEAD GUARD)
49991	FLASHING LIGHTS (MACHINE MOUNTED)
49130	FLASHING LIGHTS (ON OVERHEAD GUARD)

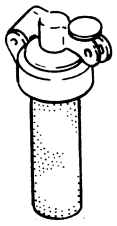
Ref. No.	TENNANT Part No.	Description	Qty.
1	SK2711	ROTATING LIGHT ASSEMBLY, Complete	1
	45670	BULB (For rotating lights)	1
	46928-1	*LENS, Dome, red	1
	46928-2	*Lens, Dome, blue	1
	46928-3	*Lens, Dome, amber	1
2	14137	SWITCH, Light, on-off	1
3	56525-1	PLATE, Mounting, overhead guard	1
4	62149	BRACKET, 'L', overhead guard	2
5	62045	CLIP, Mounting, overhead guard	2
	46314	GROMMET	1
	09384	CLAMP, Cable (3/16" dia)	2
	46236	CLAMP, Cable (1/4" dia)	2
	01574	GROMMET	3
6	47535-2	LIGHT ASSEMBLY, Flashing red	1
	47535-1	*Lens, Dome, red	1
	47536-2	LIGHT ASSEMBLY, Flashing amber	1
	47536-1	*Lens, Dome, amber	1
	47537-2	LIGHT ASSEMBLY, Flashing blue	1
	47537-1	*Lens, Dome, blue	1
	22640	BULB (For flashing lights)	1
8	24576	FLASHER	1
7	24576-1	BRACKET, Flasher	1
	49994	WIRE KIT, Rotating	1
	49128	WIRE KIT, Rotating, overhead guard	1
	49993	WIRE KIT, Flashing light	1
	49131	WIRE KIT, Flashing light, overhead guard	1

* Be sure to select color of Dome Lens desired.

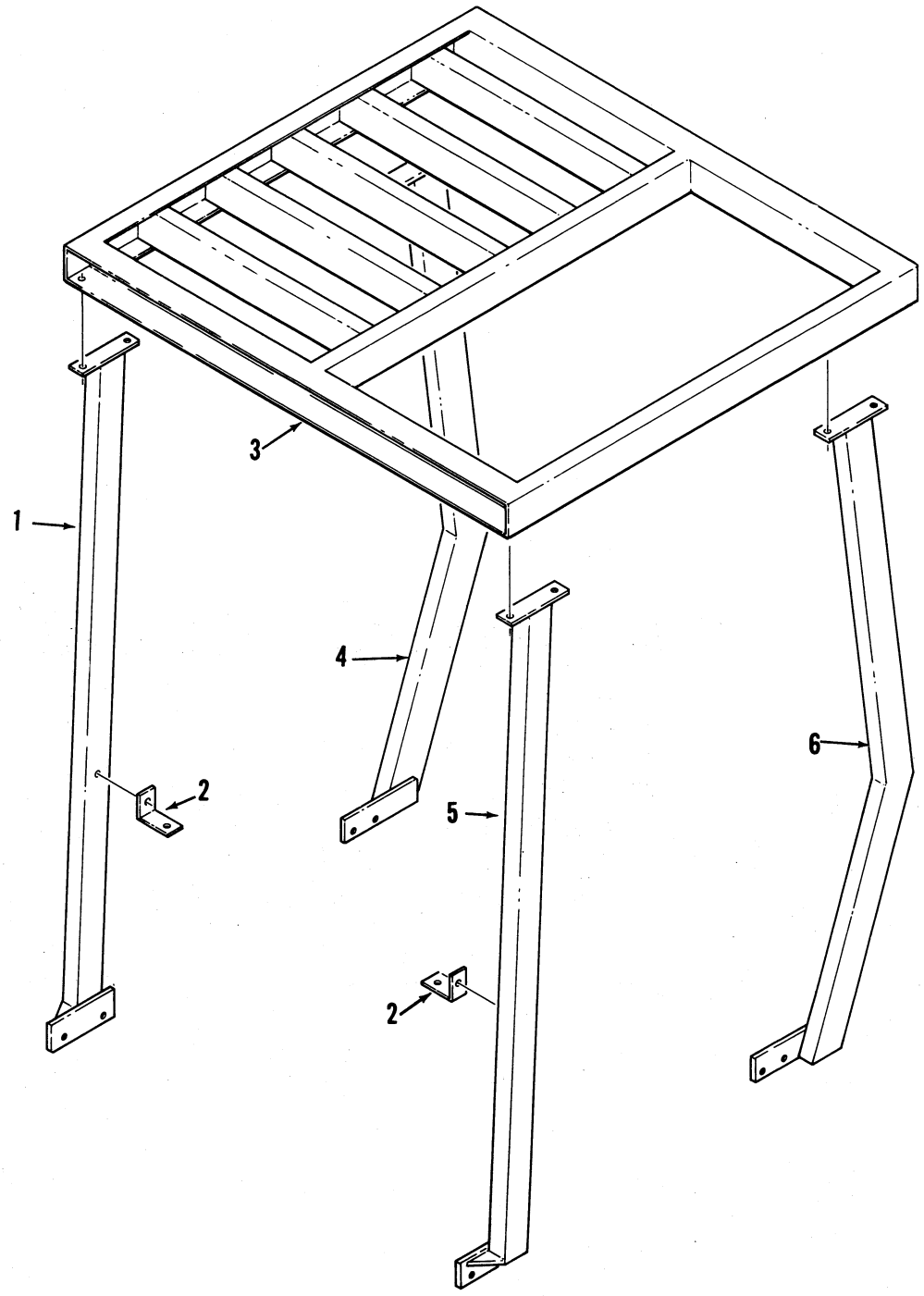


ENGINE HOUR METER KIT #49981

Ref. No.	TENNANT Part No.	Description	Qty.
1	24518	METER, Hour	1
2	28838	DAMPER, Hour meter	1
	49707	WIRE KIT	1
	14215	FUSE, 20 amp	1

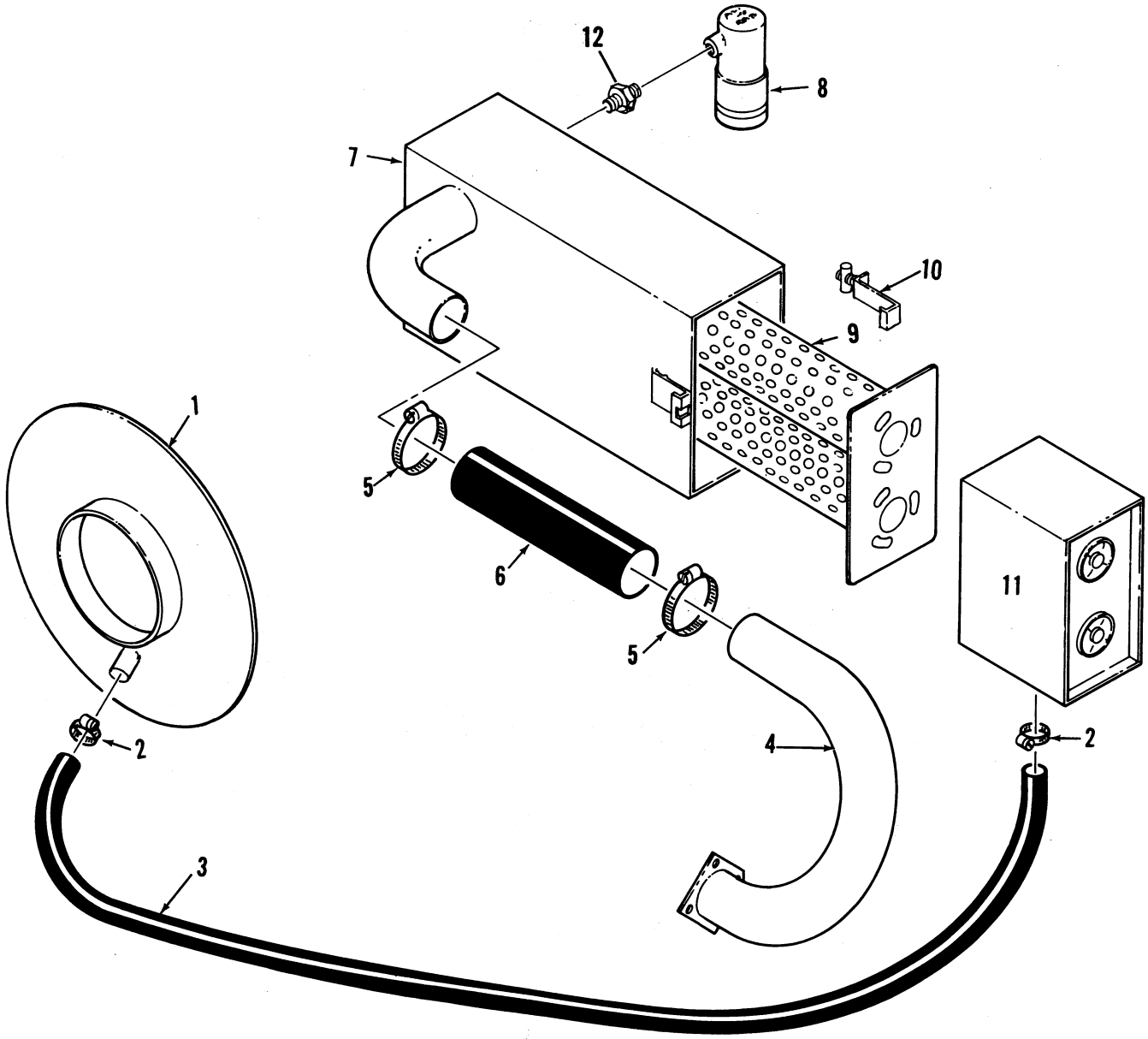


02506-6	GAS CAP, Protectoseal	1



OVERHEAD GUARD KIT #50031

Ref. No.	TENNANT Part No.	Description	Qty.
1	50027	LEG, Front right	1
2	50033	BRACKET, 'L'	2
3	50032	FRAME, Overhead	1
4	50029	LEG, Rear right	1
5	50028	LEG, Front left	1
6	50030	LEG, Rear left	1



FARR AIR CLEANER KIT #45589

Ref. No.	TENNANT Part No.	Description	Qty.
1	52924	DUCT, Fan intake	1
2	54333	CLAMP, Wormdrive	2
3	49199	HOSE	1
4	49208	TUBE, Carburetor	1
5	11531	CLAMP, Wormdrive	2
6	49132	HOSE	1
7	49211	HOUSING, Air cleaner	1
8	48088-4	INDICATOR, Restirction	1
9	49206	ELEMENT, Filter	1
10	49195	FASTENER, Pre-cleaner	2
11	49202	PANEL, Pre-cleaner	1
12	51560-5	FILTER, Service indicator	1

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ACCESSORIES NOT ILLUSTRATED

TENNANT Part No.	Description	Qty.
49984	TIRE ASSEMBLY, Solid Rear	1
49258	TIRE KIT, Front	1
49843	SHELL, Wheel half	4
49918	TIRE	2
50035	TIRE ASSEMBLY, Foam filled rear	1
49332	TIRE ASSEMBLY	1
49420	TIRE	1
49421	TUBE	1
49223	SHELL ASSEMBLY, Wheel	1
49377	SHELL, Outer wheel	1
49378	Shell, Inner wheel	1
45786	CAP, Valve stem	1

MM106

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POWER SWEEPER

KOHLER MODEL 301S

engine

SINGLE CYLINDER SERVICE MANUAL

WARRANTY

We warrant each new engine sold by us to be free from manufacturing defects in normal service for a period of one (1) year commencing with delivery of the engine to the original user.

OUR OBLIGATION UNDER THIS WARRANTY IS EXPRESSLY LIMITED TO THE REPLACEMENT OR REPAIR AT KOHLER CO., KOHLER, WISCONSIN, OR AT A POINT DESIGNATED BY US, OF SUCH PART OR PARTS AS SHALL APPEAR TO US TO HAVE BEEN DEFECTIVE.

WE SHALL NOT BE LIABLE FOR CONSEQUENTIAL LABOR COSTS OR TRANSPORTATION CHARGES IN CONNECTION WITH THE REPLACEMENT OR REPAIR OF DEFECTIVE PARTS.

THIS WARRANTY DOES NOT APPLY TO AN ENGINE UPON WHICH REPAIRS OR ALTERATIONS HAVE BEEN MADE BY OTHERS EXCEPT WITH OUR PRIOR WRITTEN APPROVAL.

WE MAKE NO WARRANTY WITH RESPECT TO TRADE ACCESSORIES. THEY ARE SUBJECT TO THE WARRANTIES OF THEIR MANUFACTURERS.

WE SHALL NOT BE LIABLE FOR CONSEQUENTIAL DAMAGES OR CONTINGENT LIABILITIES NOR FOR THE FITNESS OF ANY ENGINE FOR ANY PARTICULAR PURPOSE.

WE MAKE NO OTHER EXPRESS, IMPLIED OR STATUTORY WARRANTY, NOR IS ANYONE AUTHORIZED TO MAKE ANY IN OUR BEHALF.

KOHLER CO.
Kohler, Wis. 53044

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MODEL K301S ENGINE SPECIFICATIONS

MAKE	KOHLER
MODEL	K301S
SPECIFICATION NUMBERS	47413B, 47413D, 47414B & 47414D
NUMBER OF CYLINDERS	1
DISPLACEMENT	29.07 cu. in. (476cc)
BORE (nominal)	3-3/8 in (85.8mm)
STROKE (nominal)	3-1/4 in. (79.3mm)
WEIGHT (approximate)	116 lbs. (52.6kg)
OIL CAPACITY	2 quarts (1.9 liters)
RECOMMENDED OIL	API Type SE Detergent
SPARK PLUG GAP, Gasoline	.025 in. (0.6mm)
SPARK PLUG GAP, LP	.018 in. (0.46mm)
SPARK PLUG TYPE	J-8 or equivalent
BREAKER POINT GAP	.020 in. (0.51mm)
ALTERNATOR	15-amp, Flywheel Type

Torque Specifications

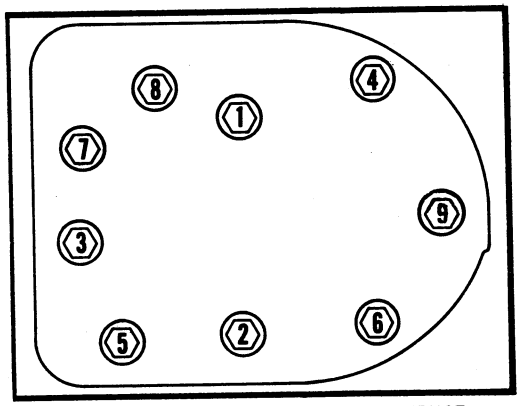
Governor Arm Lock Screw	35in. lbs.
Cylinder Head (Lubricate with oil at assembly)	15-20 ft. lbs.
Connecting Rod (Lubricate with oil at assembly)	200in. lbs.
Flywheel Nut	50-60 ft. lbs.
Spark Plug	18-22 ft. lbs.

TORQUE SPECIFICATIONS

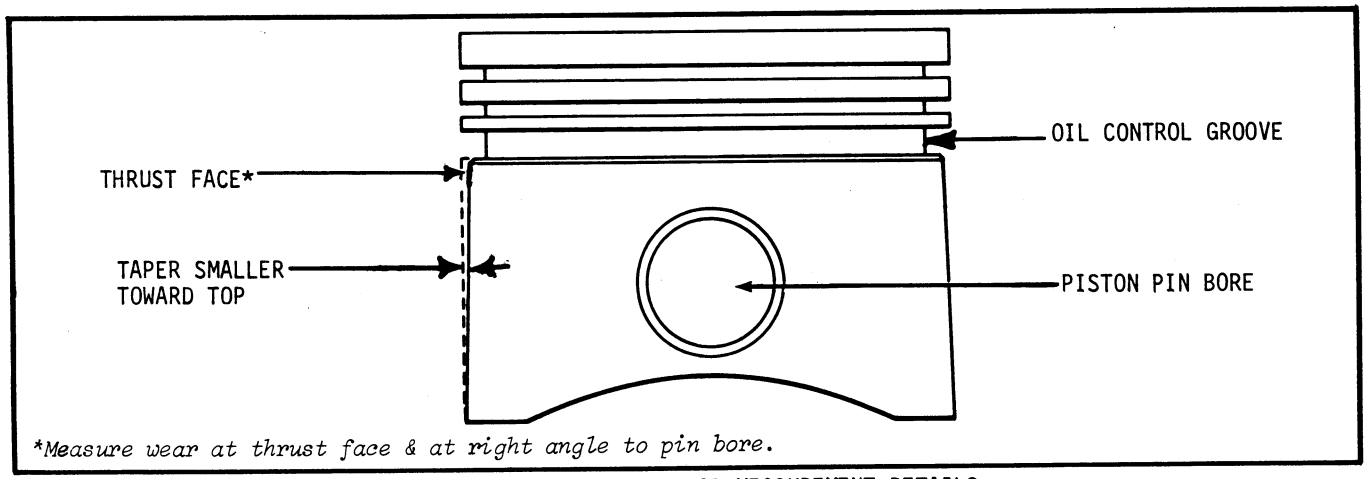
STANDARD BOLTS, SCREWS & NUTS

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

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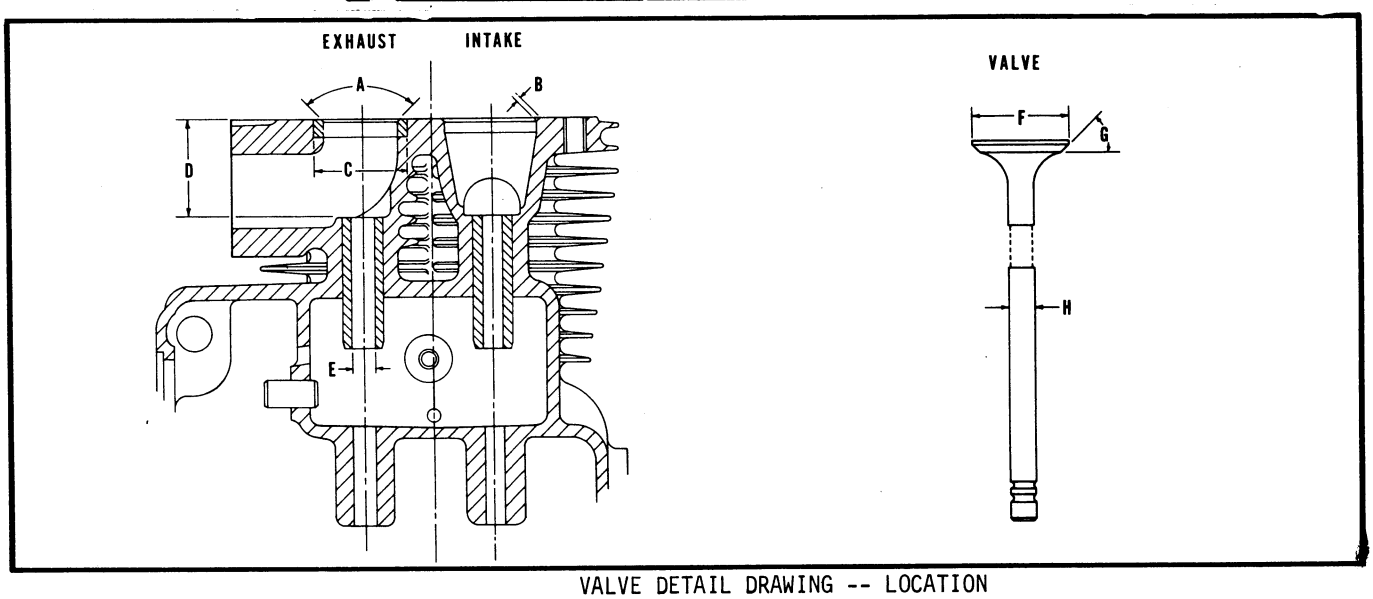
VALVE DETAILS

DIMENSION		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	1-15/32	1-15/32
E	GUIDE I. D.	.312/.313	.312/.313
F	VALVE HEAD DIAMETER	1.370/1.380	1.120/1.130
G	VALVE FACE ANGLE	45°	45°
H	VALVE STEM DIAMETER	.3105/.3110	.3090/.3095



VALVE DETAIL DRAWING -- LOCATION

WEAR TOLERANCES & CLEARANCES (MAX.)

SPECIFICATION (INCHES)*	
CYLINDER BORE	
Maximum Oversize Diameter	3.3785
Maximum Allowable Taper	.0015
Maximum Out of Round	.005
CRANKSHAFT CRANKPIN	
Maximum Out of Round	.0005
Maximum Taper	.001
CONNECTING ROD	
Maximum Wear Diameter-Big End	1.5025
Rod to Crankpin-Max. Clear.	.0035
PISTON - THRUST FACE	
Maximum Wear Diameter	3.7025
PISTON RING	
Maximum Side Clearance	.006
VALVE STEM TO GUIDE**	
Exhaust - Maximum Clearance	.0065
Intake - Maximum Clearance	.0045

Exhaust - .017" to .020"
(.432 to .508mm)
Intake - .008" to .010"
(.203 to .254mm)

Maximum allowable before replacement, reboring, regrinding.
***Measure at top of guide with valve closed.*

SERVICE - ADJUSTMENT

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

K301S
2 quarts

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.	SAE 30
30° F. to 0° F.	SAE 10 W - 30
Below 0° F.	SAE 5 W - 20

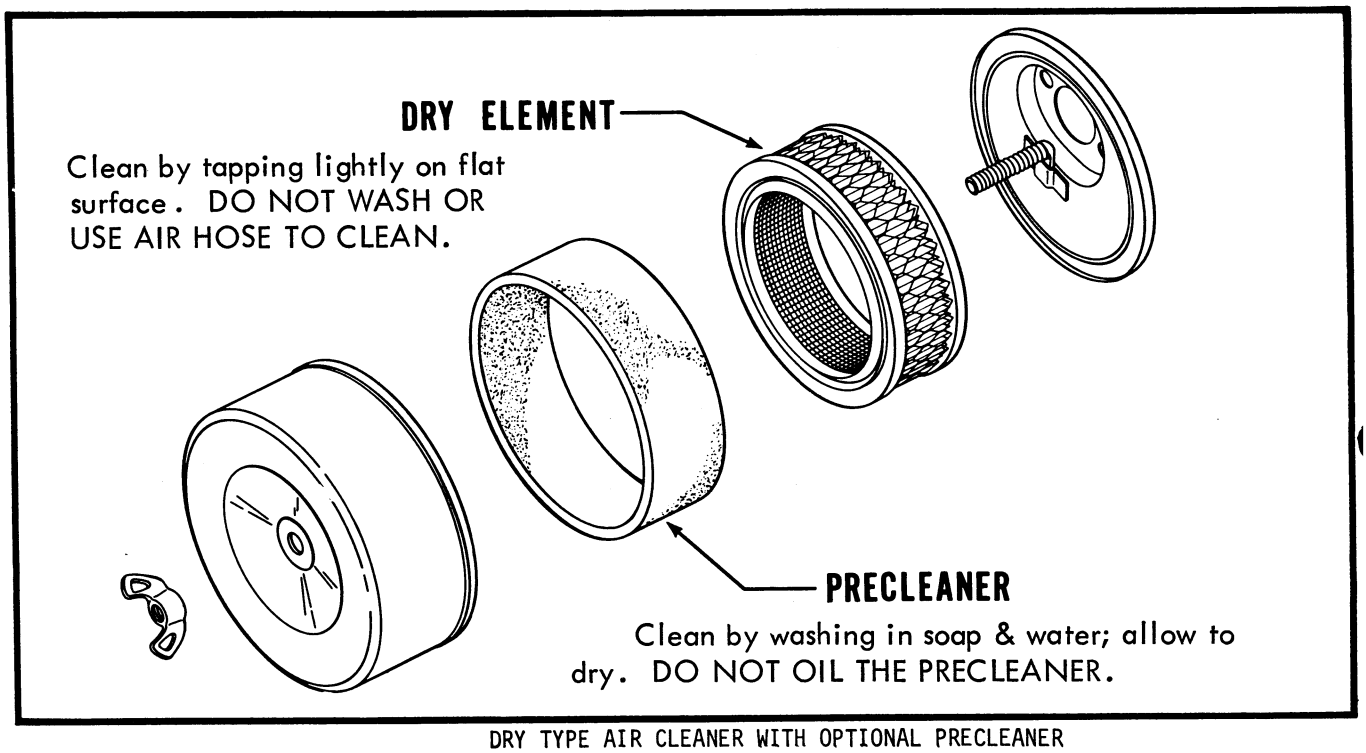
OIL CHANGE: On new or rebuilt engines, the oil should be changed after the first five hours of operation--thereafter each 25 hours of operation under normal conditions. If extremely dusty or dirty conditions prevail, change oil more frequently. If possible, run engine just prior to changing oil--the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

AIR CLEANERS

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.



DRY TYPE AIR CLEANER WITH OPTIONAL PRECLEANER

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.

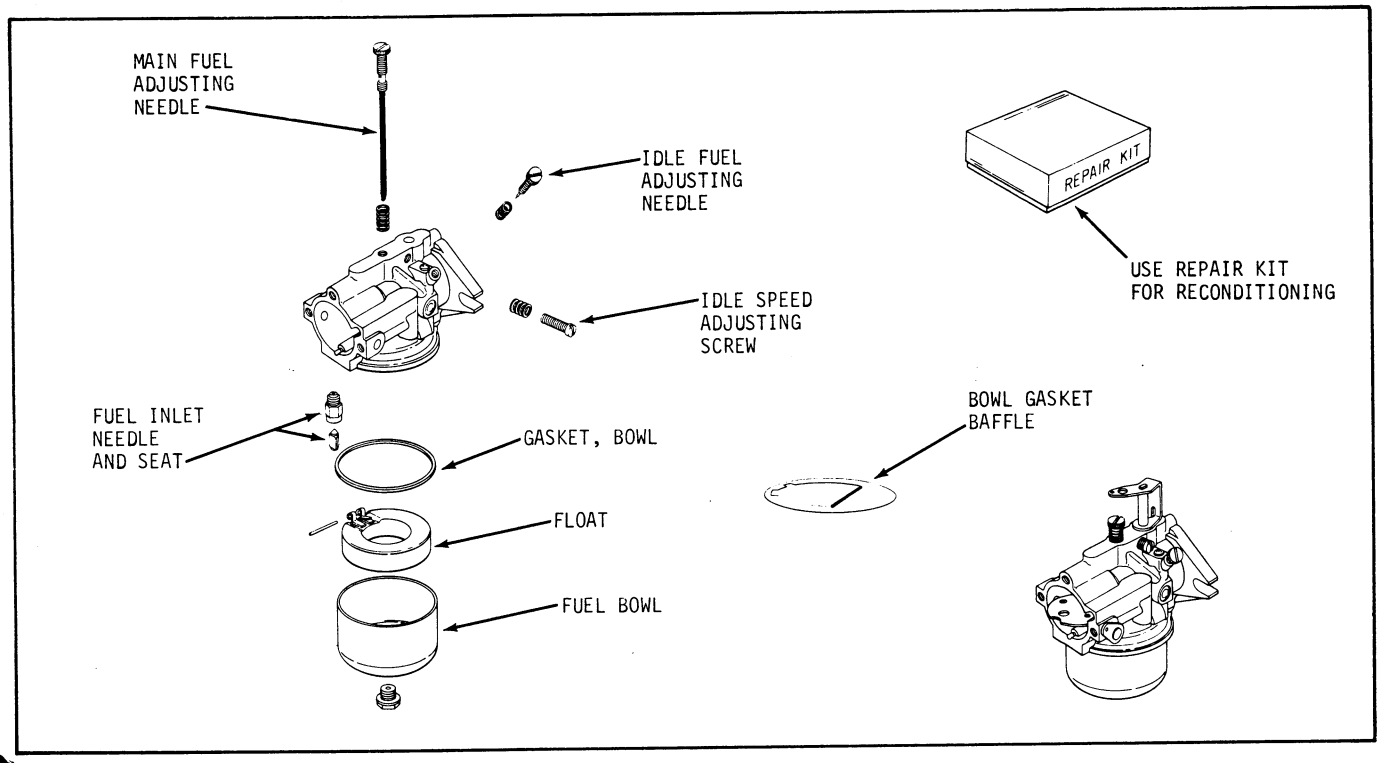
CARBURETOR (GASOLINE TYPE)

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

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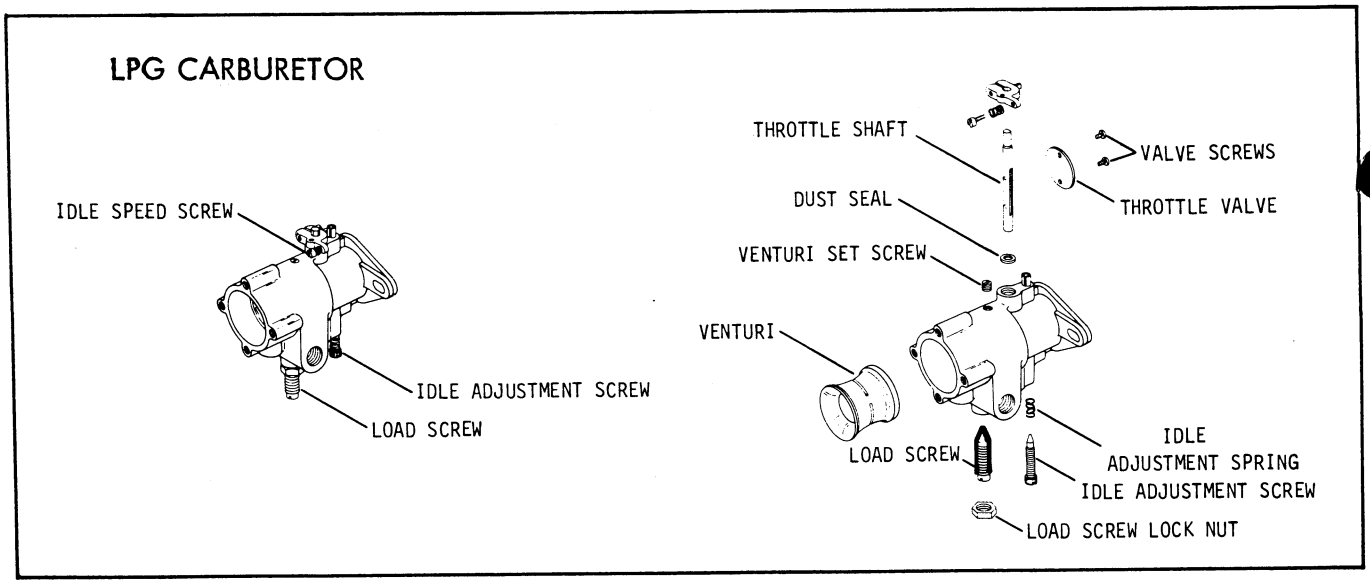


LP GAS CARBURETOR

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.

NOTE: SEE "LPG SECTION" FOR MORE INFORMATION

GOVERNOR SYSTEMS

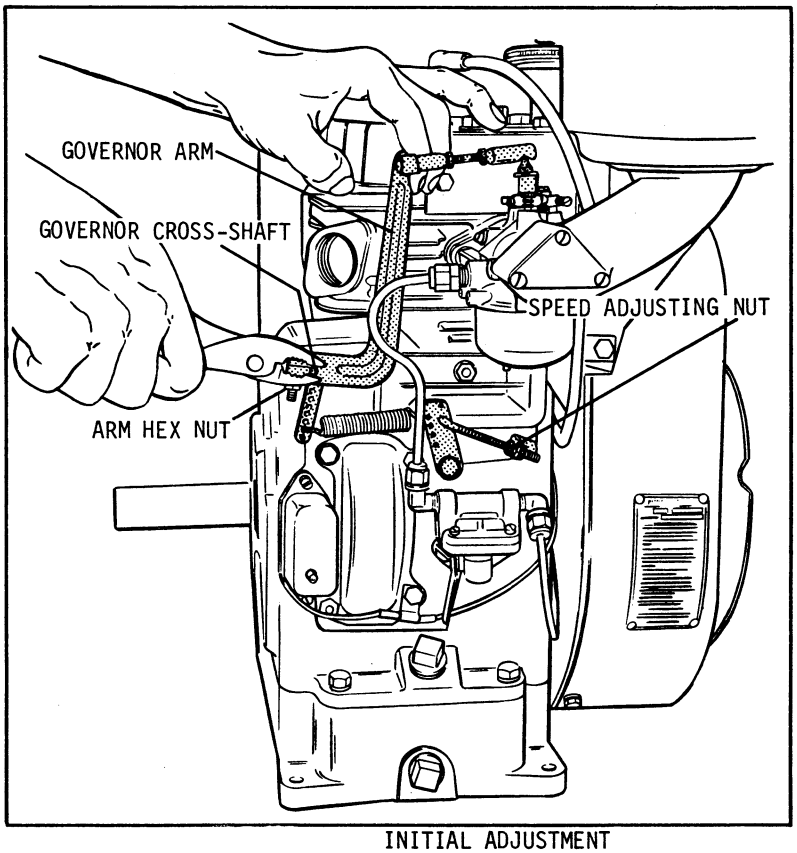
All Kohler Single Cylinder Engines are equipped with centrifugal flyweight mechanical type governors. The governor gear--flyweight mechanism is mounted within the crankcase and driven off a gear on the camshaft.

OPERATION: In operation, centrifugal force causes the flyweights to move outward with increase in speed and inward with decreasing speed. As the flyweights move outward, they force the rod portion of the assembly to push outward. Tension of the governor spring pulls the flyweights back inward with decrease in engine speed. The rod, in turn, contacts a tab on the governor cross shaft causing it to rotate with changing speed. One end of the cross shaft protrudes through the side of the crankcase. Through external linkage, the action of the cross shaft is transmitted to the throttle (or butterfly) valve in the carburetor. When the engine is at rest, the tension of the governor spring should hold the throttle valve in open position.

When a normal load is applied and engine (and governor) speed tends to decrease, the resulting rotation of the cross shaft acts against the governor spring to open the throttle valve wider which, in turn, admits more fuel and restores engine speed. With governor properly adjusted, this action takes place so rapidly that a reduction in speed is hardly noticed. As speed again reaches governed setting, the shaft rotates to either open or close the throttle valve to maintain speed at a relatively constant level.

Governed speed may be at a fixed point as on constant speed type settings or variable as determined by the throttle lever on variable speed type governor settings.

ADJUSTMENT: Governors are adjusted at the factory and further adjustment should not be necessary unless governor arm or linkage works loose and becomes disconnected. Governor readjustment may be indicated if engine speed surges or hunts with changing load or if speed drops considerably when normal load is applied.



INITIAL ADJUSTMENT

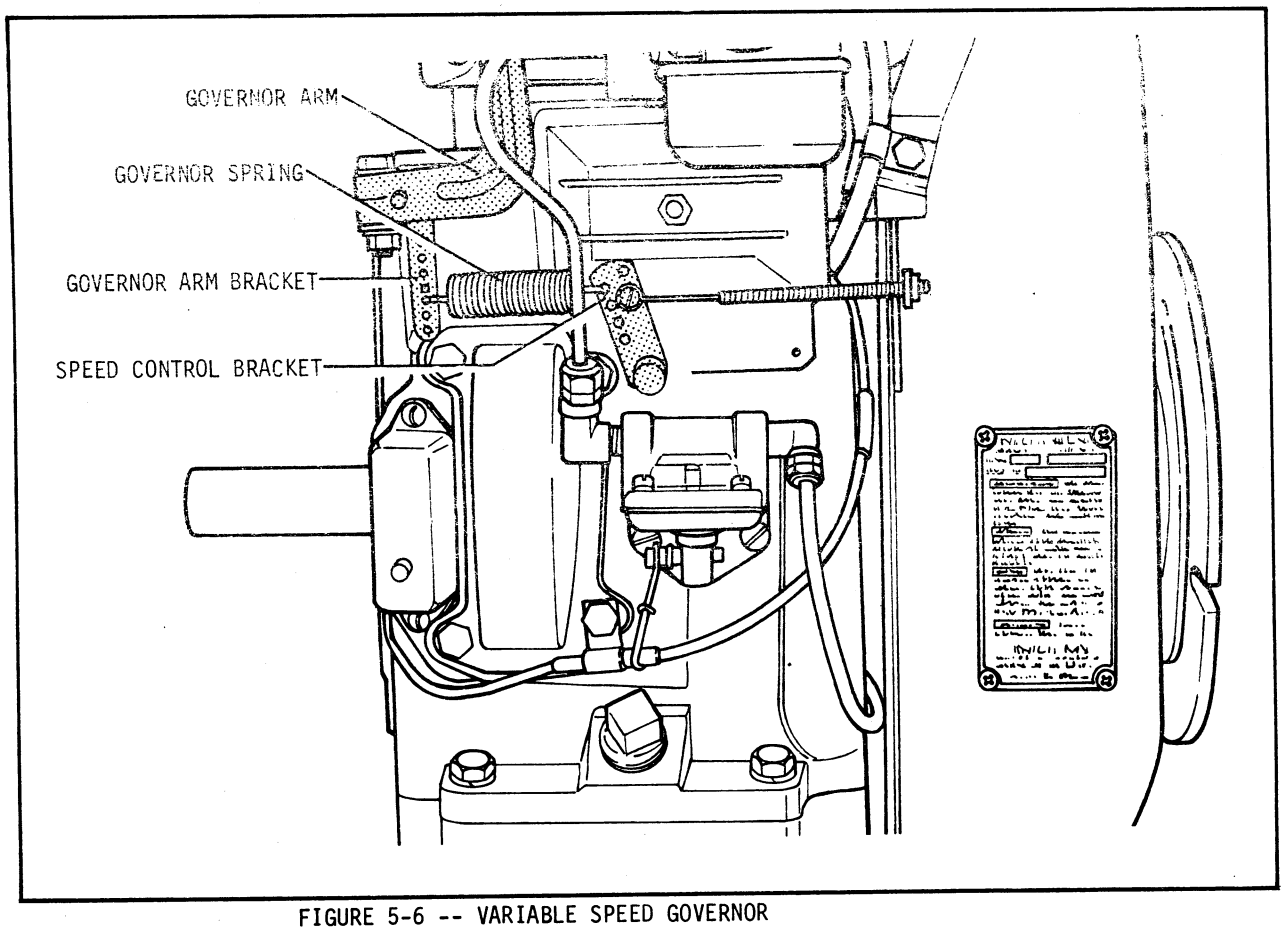


FIGURE 5-6 -- VARIABLE SPEED GOVERNOR

Initial Adjustment: The following procedure can be used on all models for the initial setting. Make this setting with engine stopped.

STEP 1: Loosen (do not remove) nut which holds governor arm to the governor cross shaft.

STEP 2: Grasp end of cross shaft with pliers and turn in counterclockwise direction as far as possible (tab on cross shaft will stop against rod on governor gear assembly).

STEP 3: Pull governor arm all the way away from carburetor then retighten nut holding governor arm to shaft.

SPEED ADJUSTMENT

After making initial adjustment and hooking up throttle wire on variable speed applications, start engine and check operating speed with hand tachometer.

Note: Engine speed is factory set at 2750 to 2800 rpm.

Constant Speed: To increase engine speed, tighten governor adjusting screw until correct speed is attained. To decrease speed, loosen adjusting screw.

SENSITIVITY ADJUSTMENT

On the K241, K301 and K321, governor sensitivity can be adjusted by repositioning the governor spring in the holes on the governor arm and speed control brackets. If set too sensitive, speed surging will occur with change of load. If a big drop in speed occurs when normal load is applied, the governor should be set for greater sensitivity.

Normally, the governor spring is placed in the third hole from bottom on the governor arm bracket and in the second hole from top on speed control bracket. To make governor control more sensitive, increase tension on spring by moving spring into holes spaced further apart. Conversely, decreasing spring tension allows broader governor control but less sensitivity.

IGNITION SYSTEM SERVICE

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.

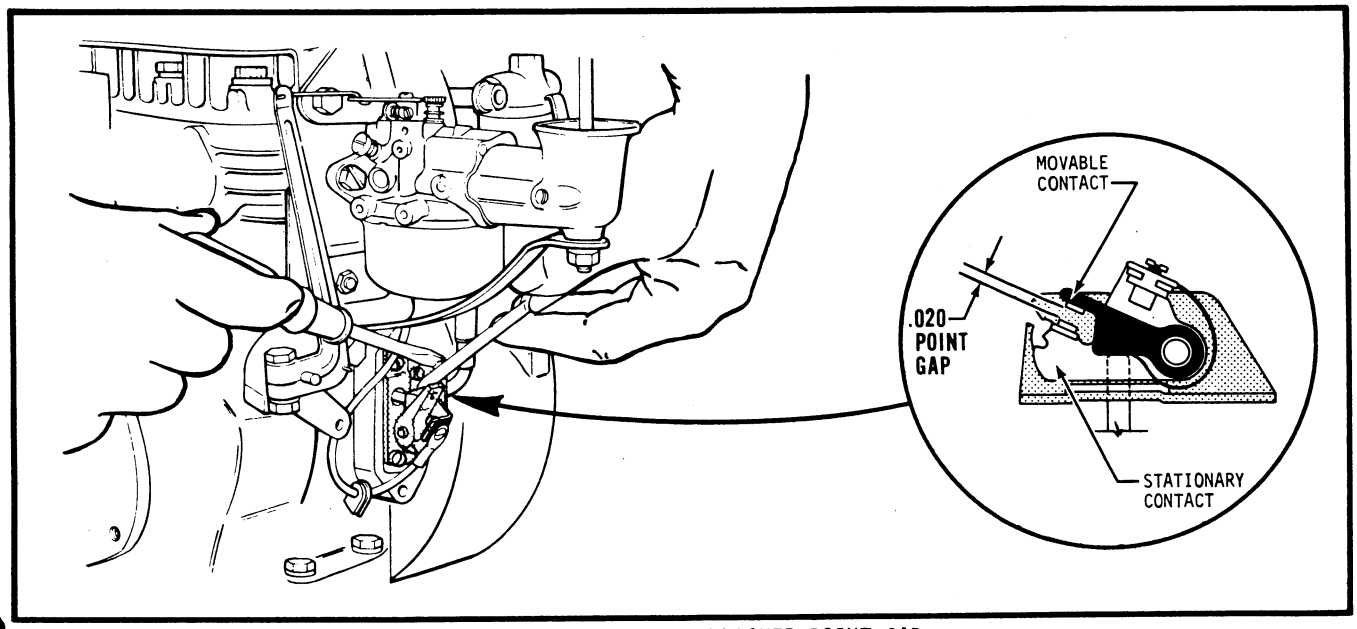
SPARK PLUG GAP: .025" Gasoline, .018" Gas

SPARK PLUG TYPE: use J-8 or equivalent

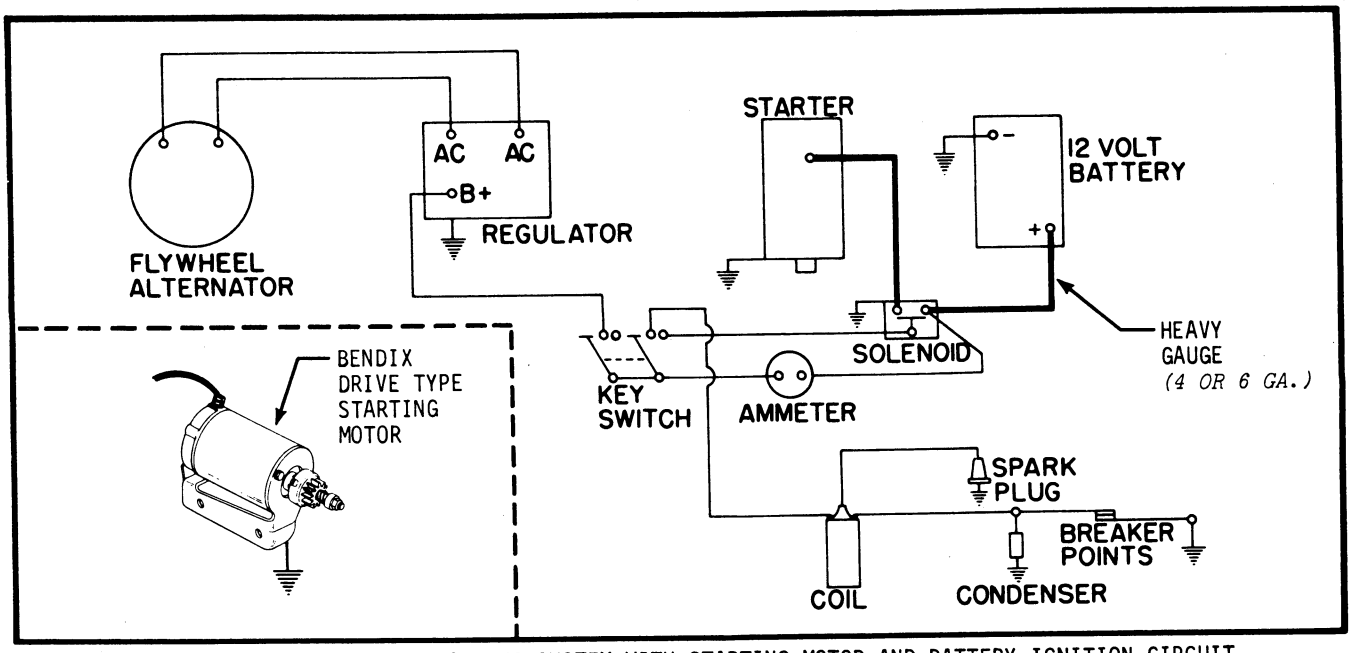
BREAKER POINTS: Every 500 hours breaker points should be inspected and serviced. If oxidized, dirty or oily, clean with coarse cloth--do not use emery cloth or sandpaper. Slightly pitted points can be dressed with point file--replace badly pitted or burned points. The gap must be adjusted whenever points 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.

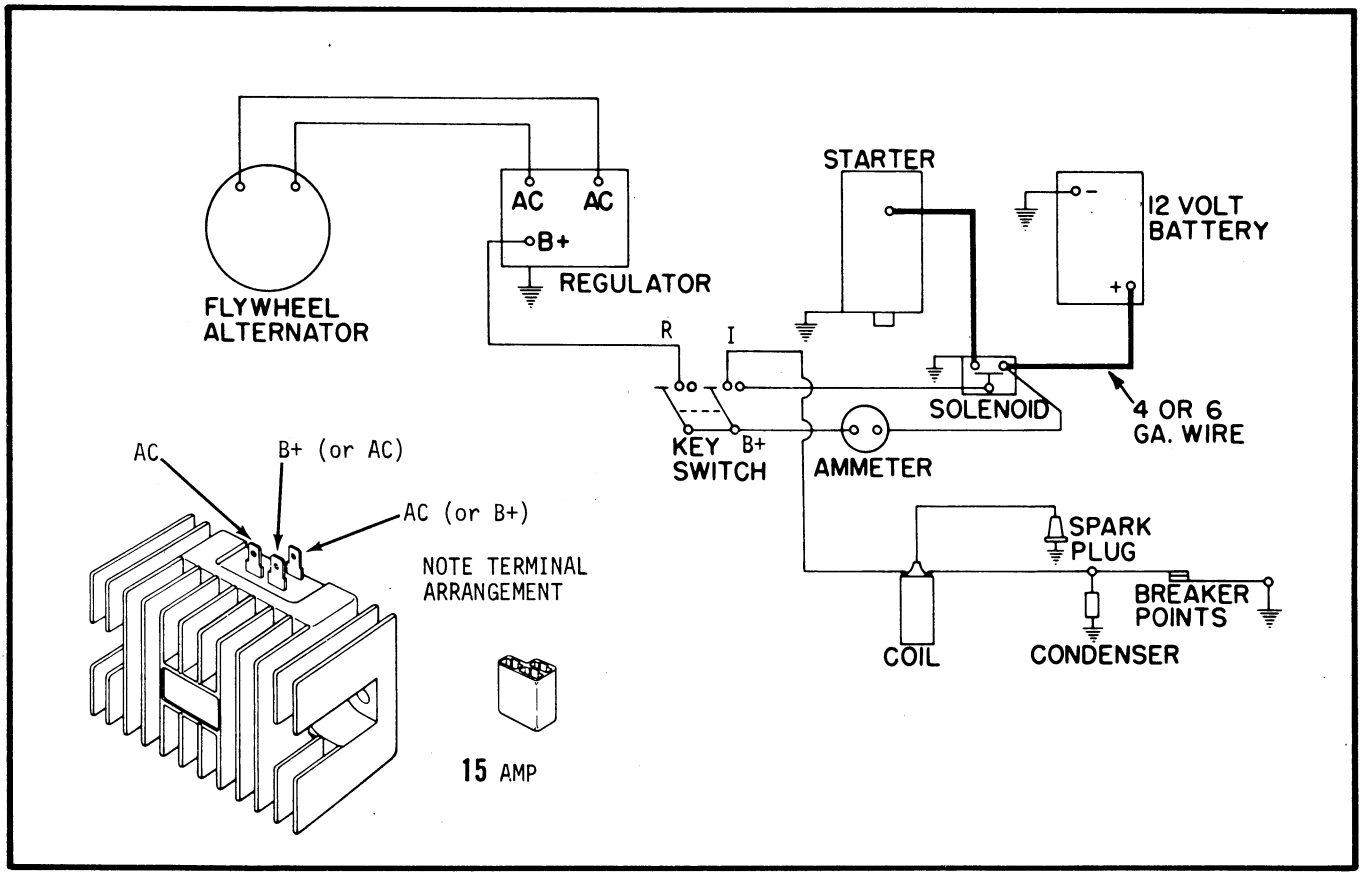
Rectifier-Regulator: The rectifier-regulator unit used with the starting motor system is a solid-state device and is non-serviceable. This unit will be damaged if the engine is operated for any length of time without the battery in the system--also, to protect this unit, disconnect the leads before doing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

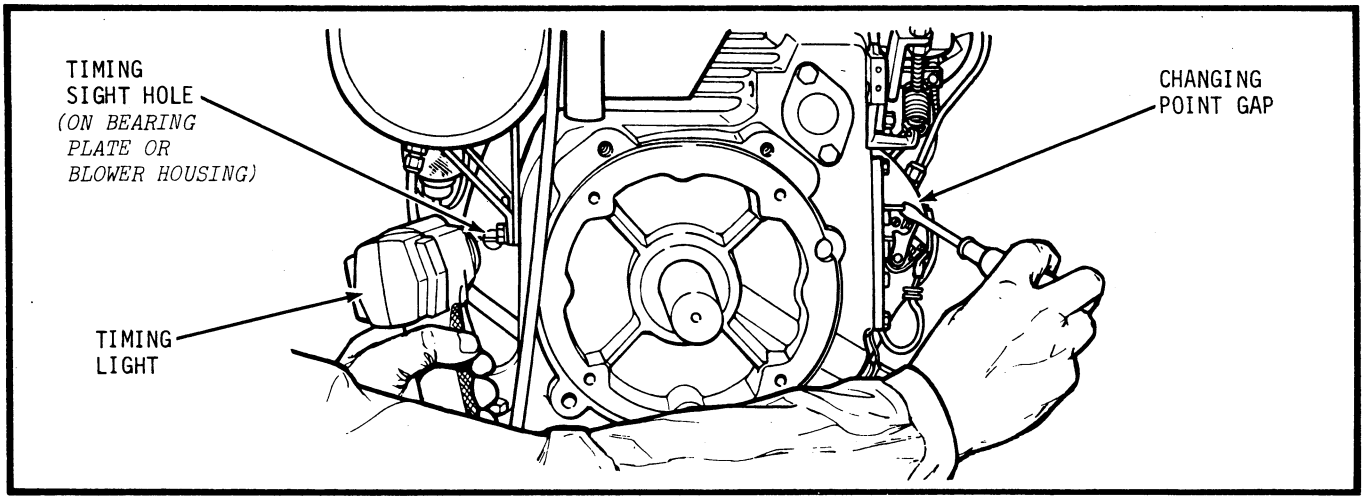
TEST WITH ENGINE RUNNING AT 3600 RPM - NO LOAD

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 PROCEDURE

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 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

HARD STARTING OR LOSS OF POWER

a. Faulty ignition.
   1. Leads grounded or loose.
   2. Breaker points faulty or improperly gapped.
   3. Spark plug faulty or improperly gapped.
   4. Coil or condenser defective.

b. Faulty carburetion.
   1. Fuel line clogged (dirt-gum)
   2. Fuel pump faulty.
   3. Carburetor dirty or improperly adjusted.

c. Poor compression.
   1. Head loose or gasket leaking.
   2. Valves sticking or leaking.
   3. Piston rings worn.

OPERATING ERRATICALLY

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

KNOCKING

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

OCCASIONAL "SKIP" AT HIGH SPEED

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

OVERHEATING

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

IDLES POORLY

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

BACKFIRING

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

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 sub ject 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

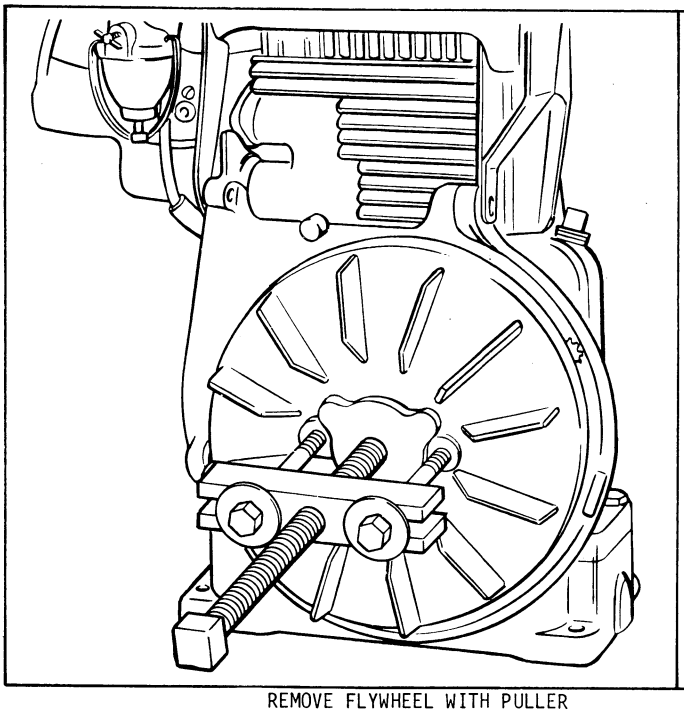
When disassembling an engine, carefully inspect and note the physical appearance of each of the components. Often the appearance of parts will indicate operation under other than ideal conditions. In observing these indicators, you may be able to suggest improved service and operating techniques which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

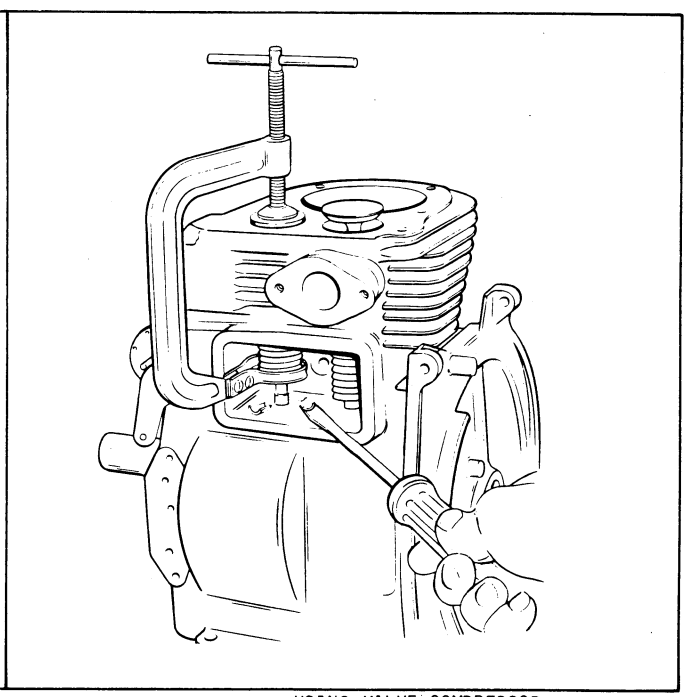
Sludge is a natural by-product of combustion and a small accumulation is normal. Excessive sludge formation could indicate several things. The most common cause is perhaps too infrequent lubricating oil changes. It can also indicate operation with improper ignition timing or overrich carburetor adjustment 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

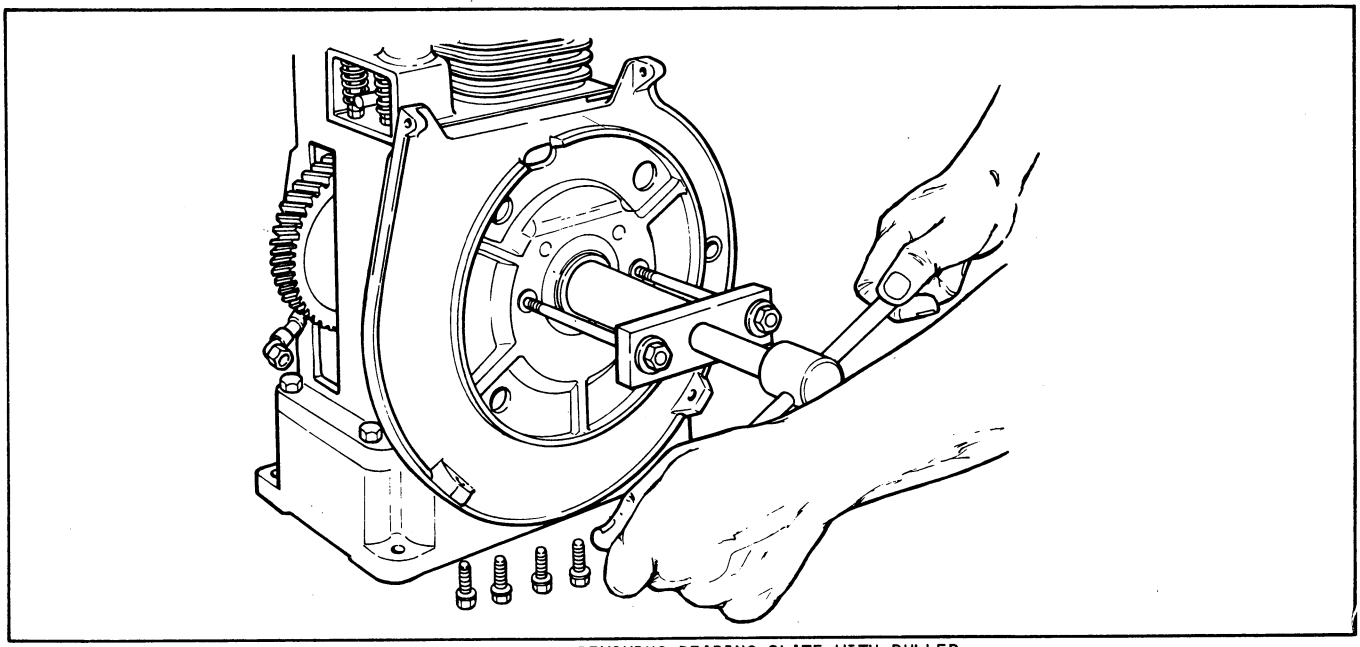
If excessive oil leakage is evident, this may indicate improperly serviced breather systems. Normally, an engine operates internally at pressures under atmospheric or, in other words, with a negative crankcase pressure. If positive pressures build up within the crankcase from a clogged breather or from 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.

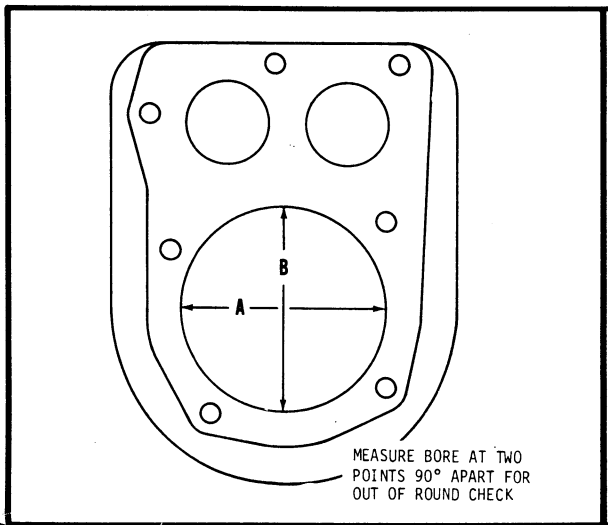
   B. Reboring procedure - See Clearance Section for original cylinder bore size. Use an inside micrometer to measure wear then select nearest suitable oversize of either .010, .020 or .030". Reboring to one of these oversizes will allow usage of the available oversize piston and ring assemblies. While 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.

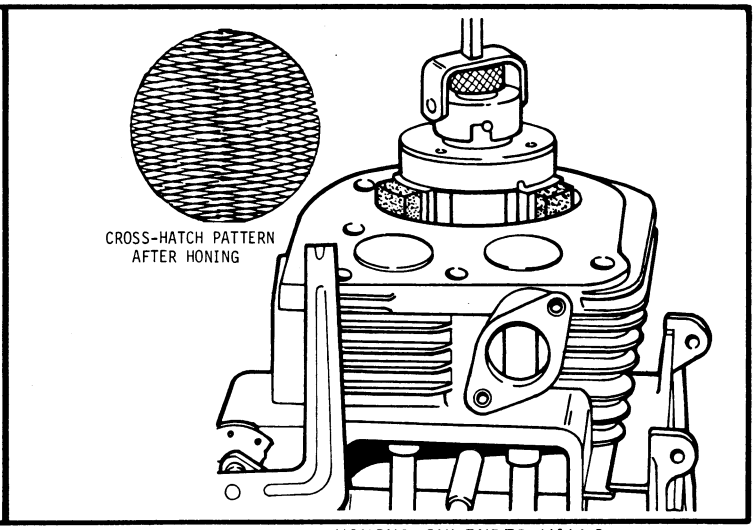
   B2 - With the lower edge of each stone positioned even with the lowest edge of the bore, start drill and honing process. Move hone up and down while reboring to prevent formation of cutting ridges. Check size frequently.

   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.



MEASURING CYLINDER BORE



HONING CYLINDER WALLS

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

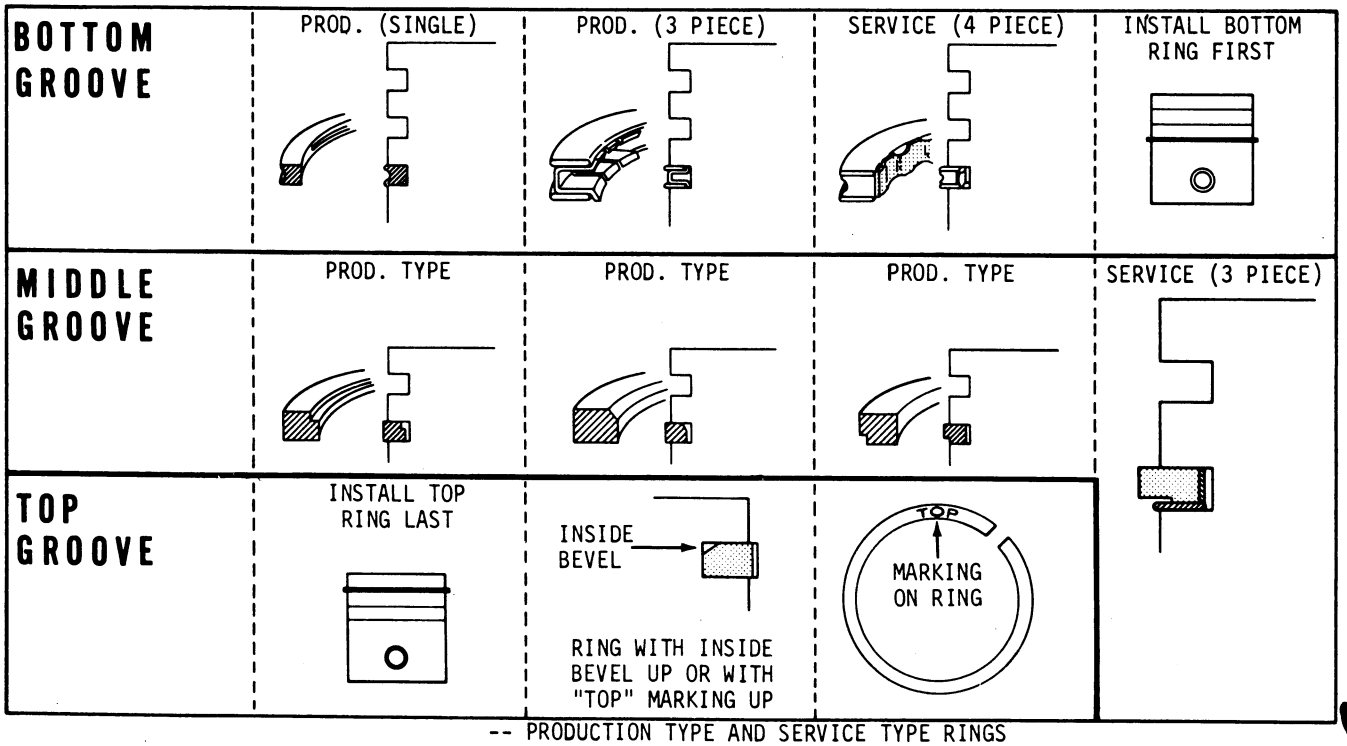
1. Check bearing area (big end) for excessive wear, score marks, running and side clearance. Replace rod and cap if worn beyond limits stated.

2. Connecting rods with bearing area .010" undersize are available for use with reground crankpin.

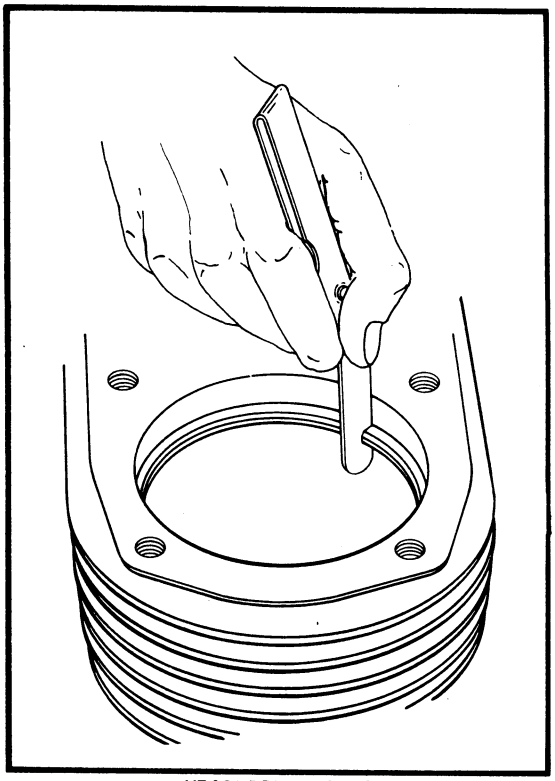
PISTON — PISTON RINGS

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.

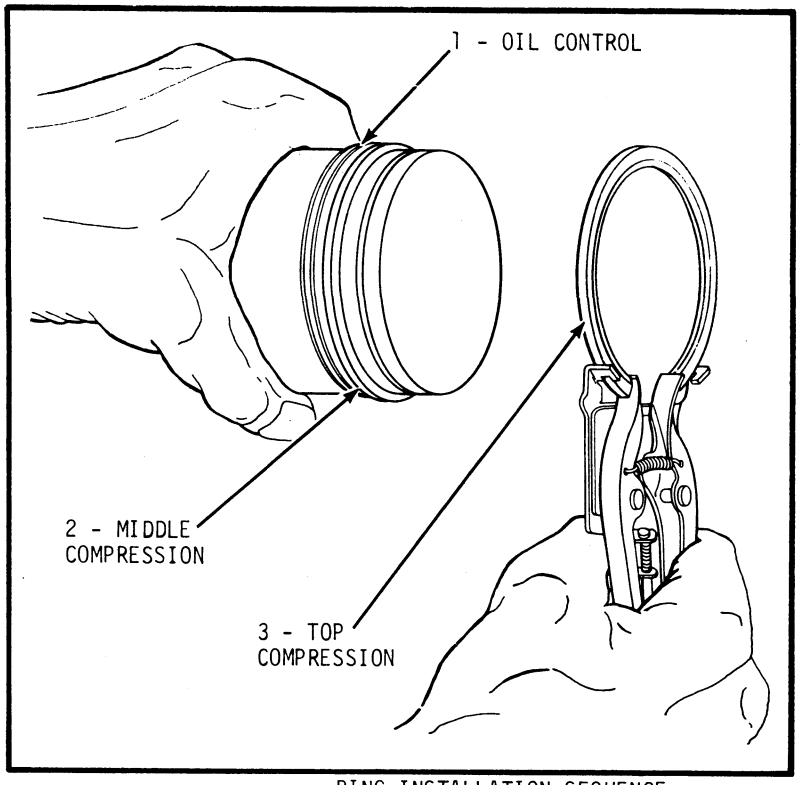
1. If the cylinder block does not need reboring and if the old piston is within wear limits and free of score or scuff marks, it may be reused. Never reuse old rings, however.
2. Remove old rings and clean up grooves.
3. Before installing new rings on piston, place each ring in turn in its running area 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



-- 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

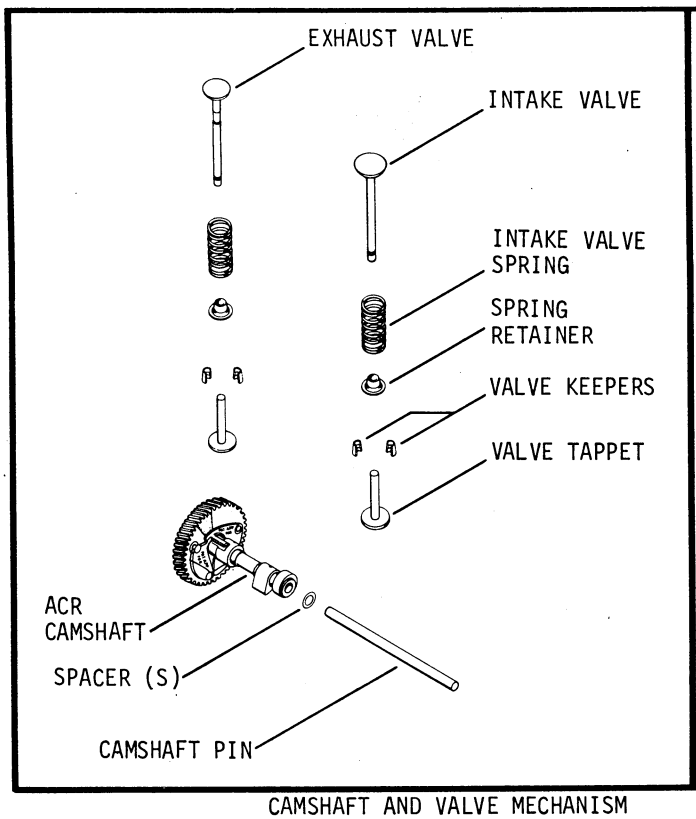
Normally very little wear takes place in the piston boss-piston pin area. If the original piston and connecting rod can be reused after reconditioning, the pin will usually not have to be replaced. A new piston pin should be used when a new connecting rod is used with the original piston. After checking 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

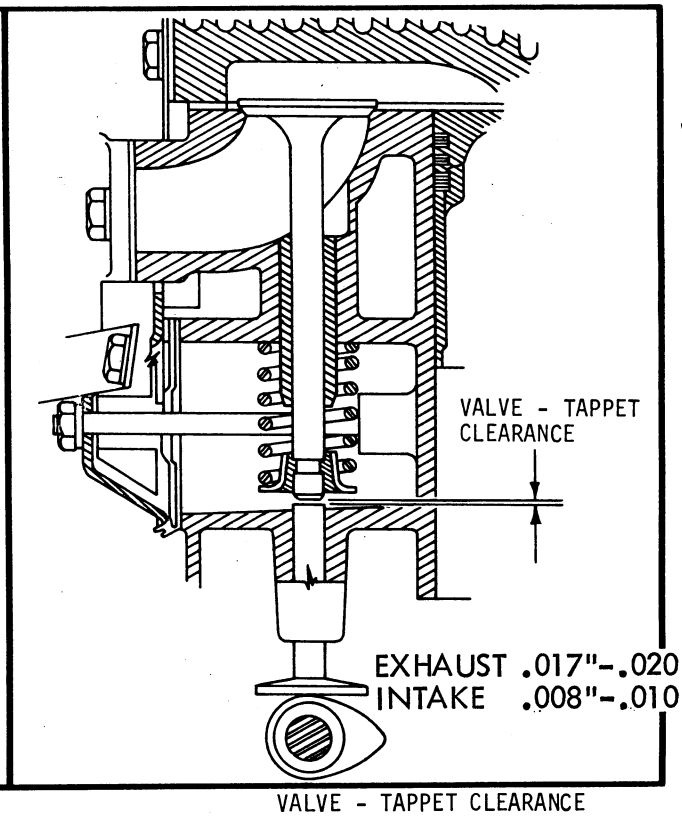
Carefully inspect valve mechanism parts. Check valves and valve seat area or inserts for evidence of deep pitting, cracks or distortion. Check clearance of valve stems in guides--refer to page 15.4 for valve details.

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.



CAMSHAFT AND VALVE MECHANISM



VALVE - TAPPET CLEARANCE

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 TAPPET CLEARANCE: Exhaust: .017" to .020" (.432 to .508mm)
Intake: .008" to .010" (.203 to .254mm)

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.

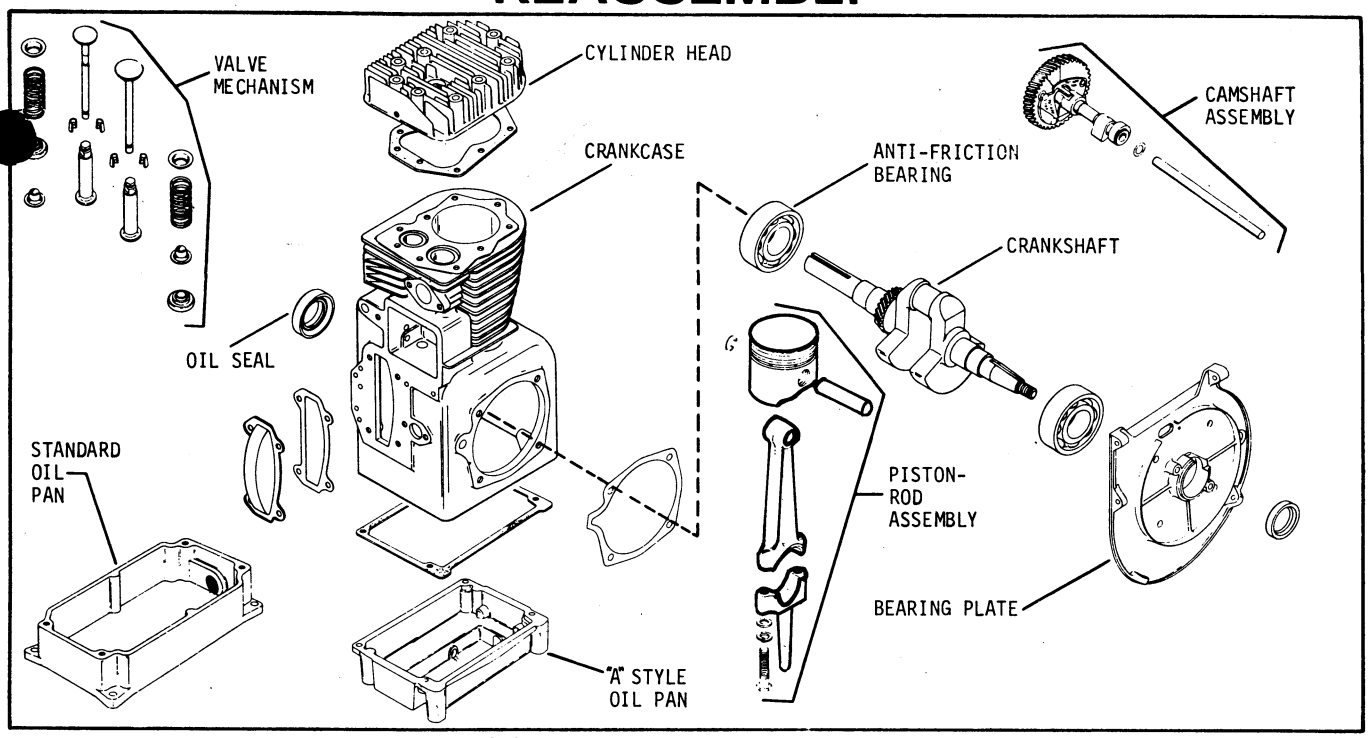
RING GEAR

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.

   b. To Install Governor

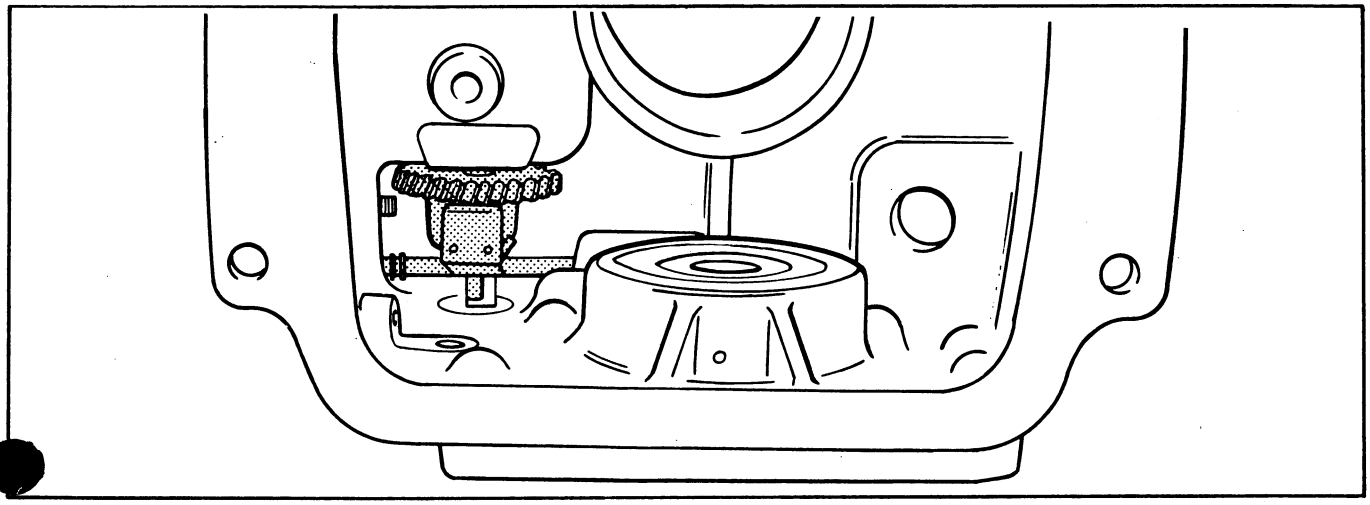
   a. Place cylinder block on its side. Slide governor shaft into place from inside of block. Place speed control disc on governor bushing nut and thread bushing nut into block, clamping throttle bracket into place.

   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

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.

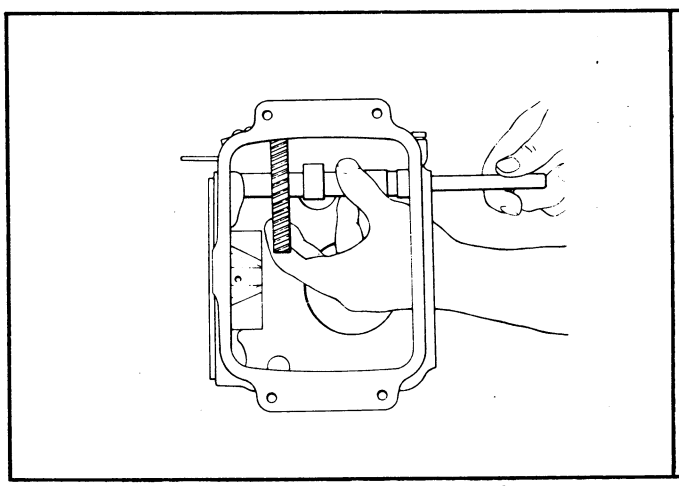
5. Crankshaft Installation

a. Place block on base of arbor press and carefully insert tapered end of crankshaft through inner race of antifriction bearing

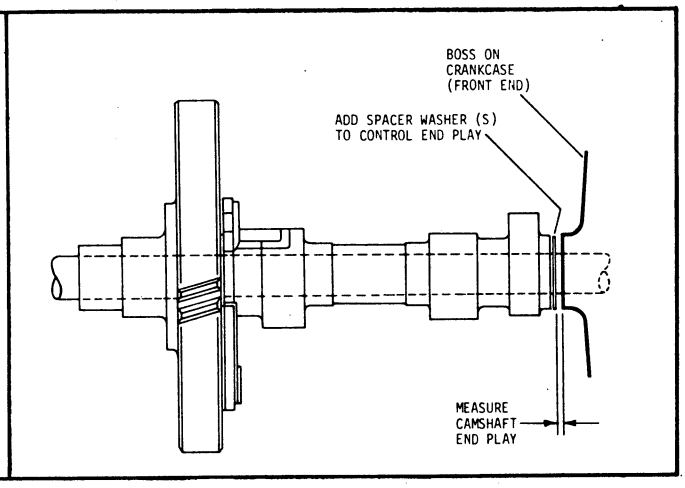
b. Turn crankshaft and camshaft until timing mark on shoulder of crankshaft lines up with mark (dot) on cam gear as shown.

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.

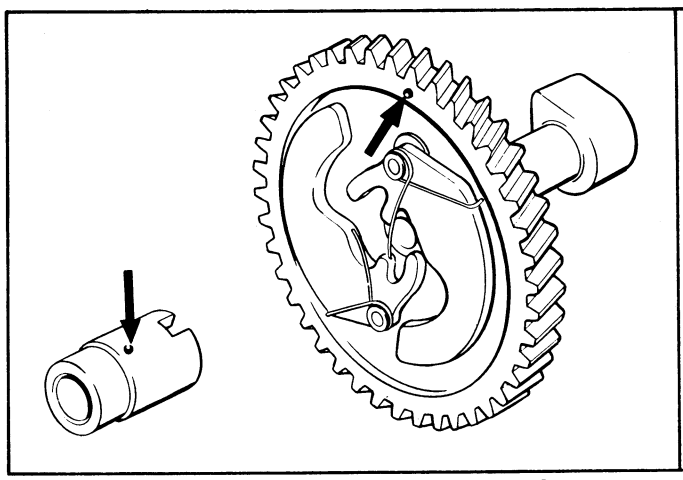
d. Crankshaft end play is controlled by the thickness of gaskets used between the bearing plate and block. End play must be checked after bearing plate is installed -- directions stated in Step 6.



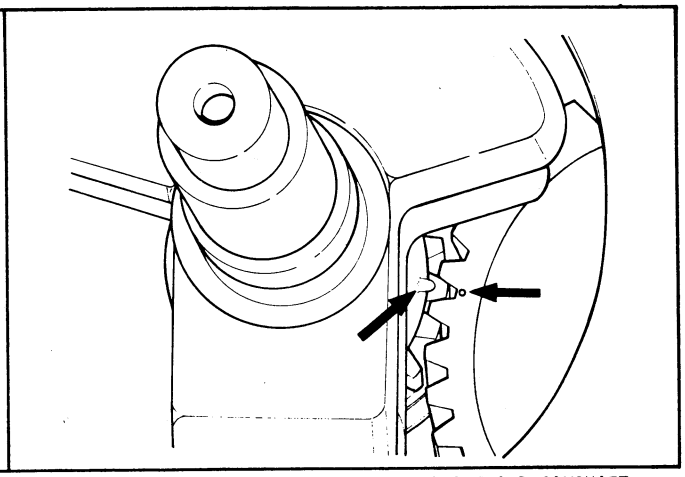
INSTALLING CAMSHAFT



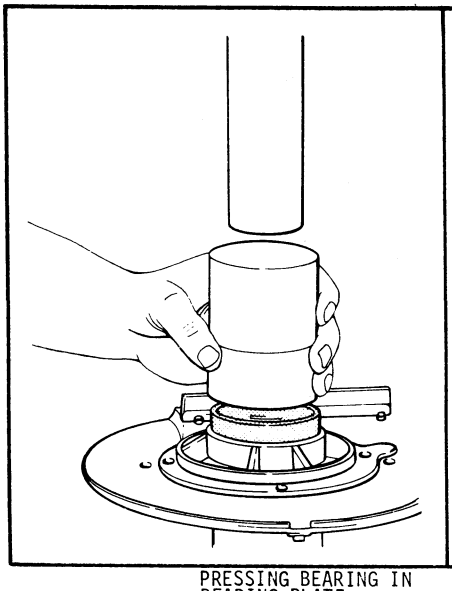
CAMSHAFT END PLAY



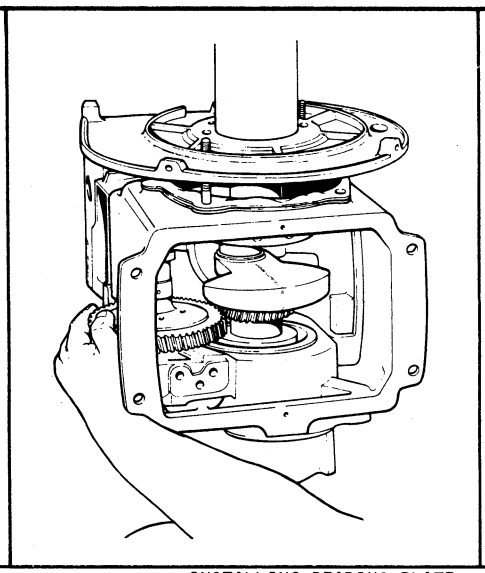
TIMING MARKS ON AUTOMATIC SPARK ADVANCE CAMSHAFT



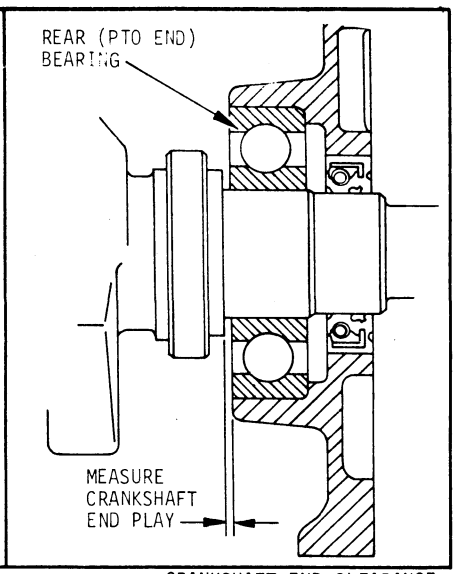
TIMING MARKS ON CRANKSHAFT AND CAMSHAFT



PRESSING BEARING IN BEARING PLATE



INSTALLING BEARING PLATE



CRANKSHAFT END CLEARANCE

6. Bearing Plate

a. 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.

b. 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.

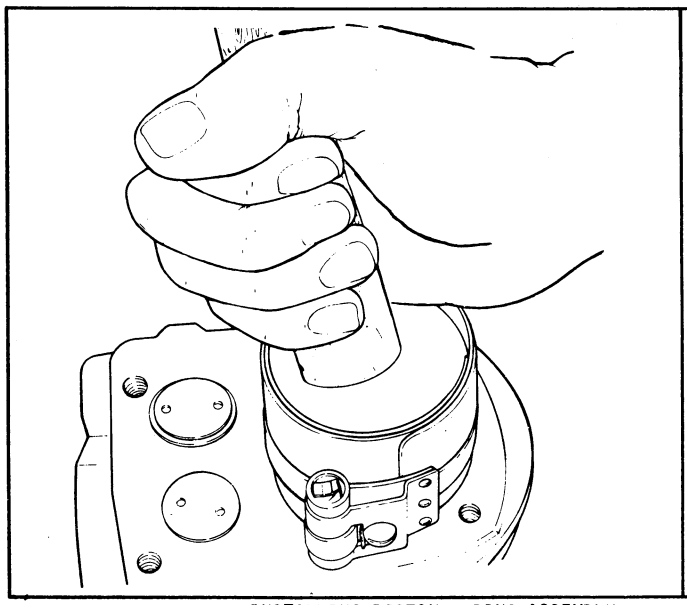
c. Install gaskets with thicker gasket next to block, place bearing plate on crankshaft and carefully press plate onto shaft and into position on block. Install cap screws with copper washers and secure bearing plate to block. Draw screws up evenly to avoid distortion of bearing plate.

d. 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.

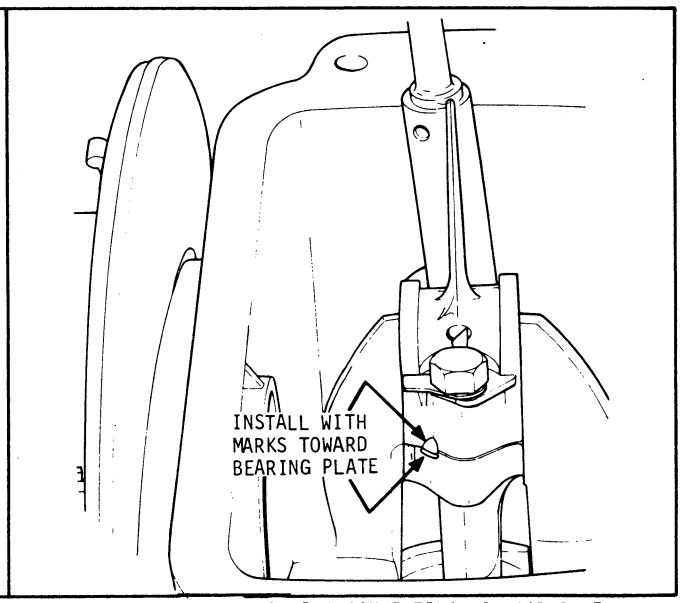
7. Piston and Rod Assembly

a. 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.

b. 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

a. After piston assembly is installed, place block on end and oil connecting rod big end and crank pin.

b. It is important that marks on connecting rod and cap line up and face flywheel end of engine.

c. 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.

d. If locking tabs are used, bend tabs to lock cap screws.

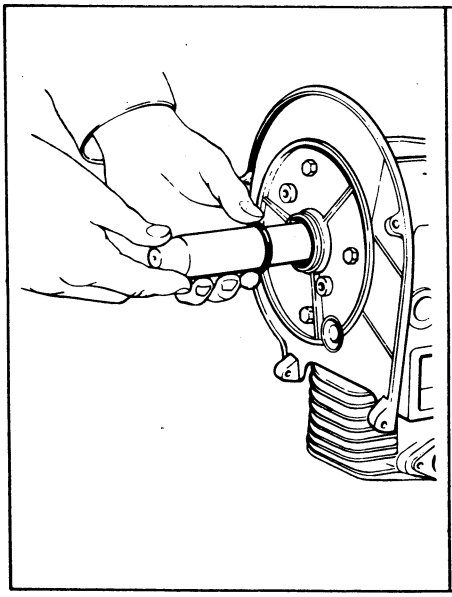
9. Installation of Oil Seals on Crankshaft

a. 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.

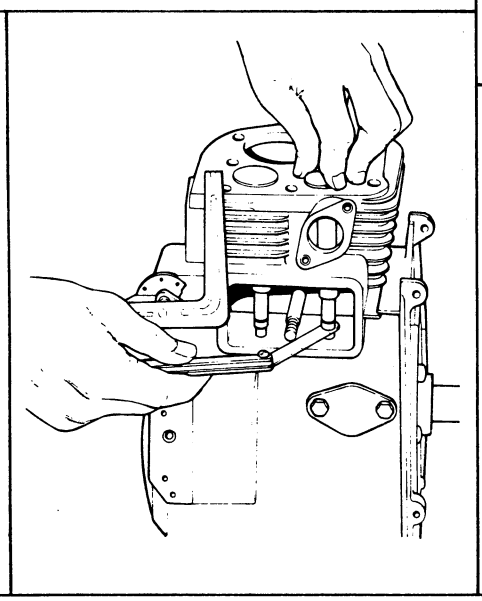
b. After oil seals are started on shaft, place block on its side. The oil seals may now be driven squarely into bearing plate and cylinder block.

10. Oil Base

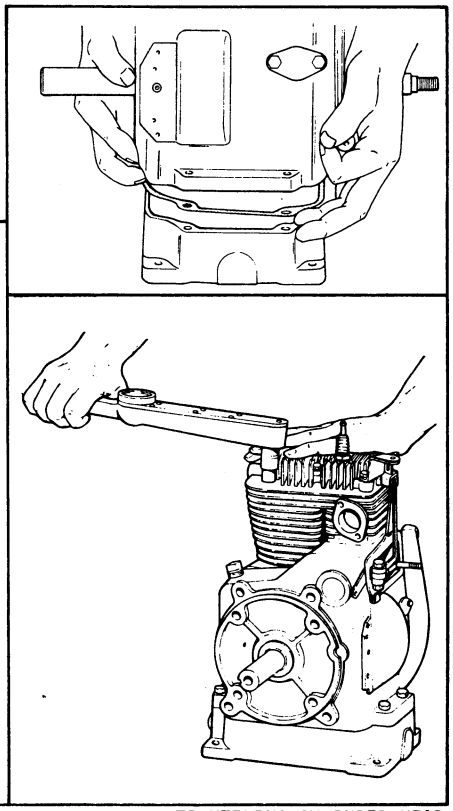
a. Use pilot studs to align cylinder block, gasket and oil base.
b. A new gasket must be used to prevent oil leakage.
c. Assemble oil base to block with four screws.
d. Torque pan bolts.



INSTALLING OIL SEALS WITH SLEEVE



CHECKING VALVE - TAPPET CLEARANCE



TIGHTENING CYLINDER HEAD CAPSCREWS

11. Installing and Setting Valves

a. 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.

b. Valve clearance should be checked cold.

c. 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.

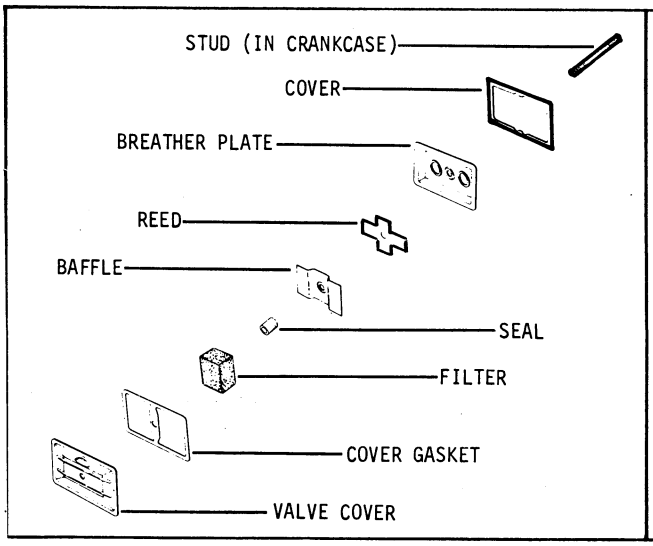
12. Cylinder Head

a. Always use a new gasket when head has been removed for service work.

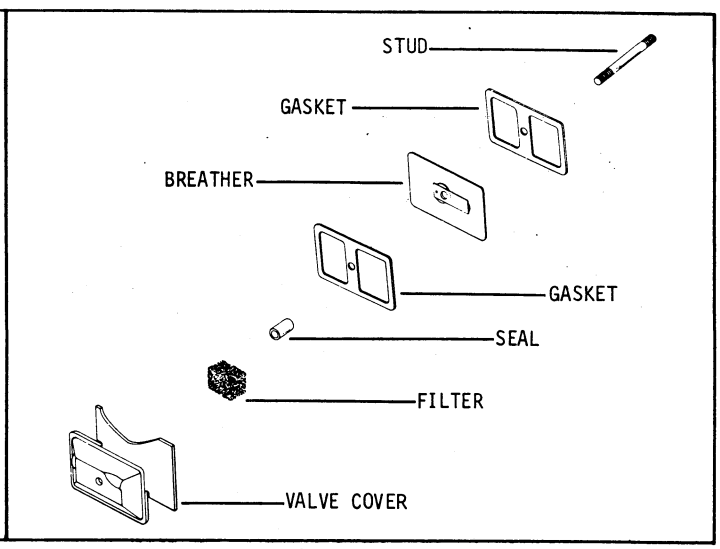
b. Check cylinder head on face plate to be sure gasket surfaces make good contact at all points.

c. It is important that head cap screws be lubricated then tightened evenly and in sequence until proper torque is reached.

d. 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



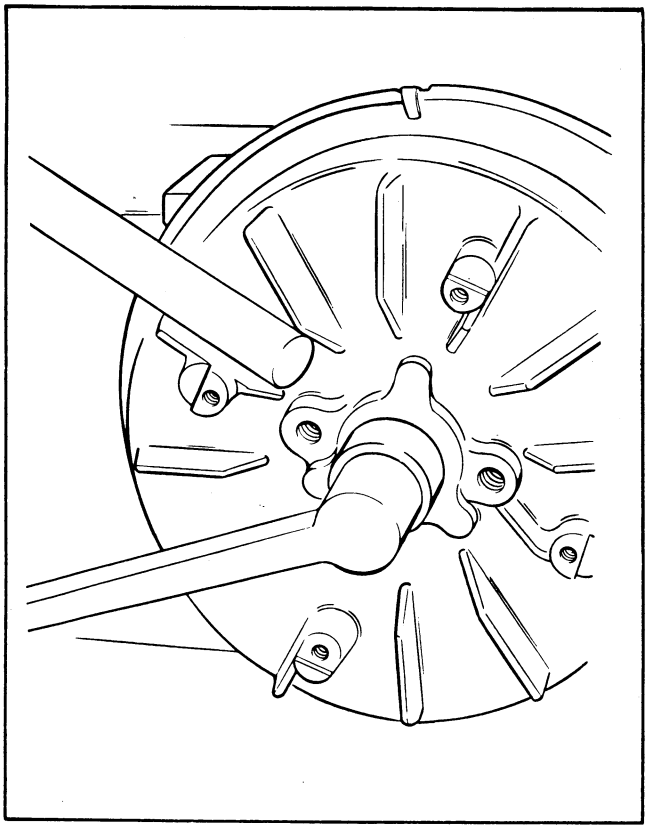
TYPICAL CRANKCASE BREATHER

13. Breather Assembly

a. 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.

b. 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.

c. Cover must be securely tightened to prevent oil leakage.



INSTALLING FLYWHEEL

14. Flywheel

a. Place wave washer on crankshaft and place flywheel in position. The square key holds flywheel on shaft.

b. 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.

c. The rotating screen is fastened to starter pulley with either screws and spacers or a wire retainer.

15. Breaker Points

a. Install push rod.

b. Fasten breaker in place with two screws.

c. Place cover gasket in position and attach magneto lead.

d. Set breaker gap at .020 full open. For ignition setting, refer to Ignition System Service.

e. Make preliminary adjustments before installing breaker point cover. Be sure breaker lead grommet is in place.

16. Carburetor

a. Insert a new gasket and assemble carburetor to intake port with two screws.

b. Refer to Service Section on carburetor adjustment procedure.

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.

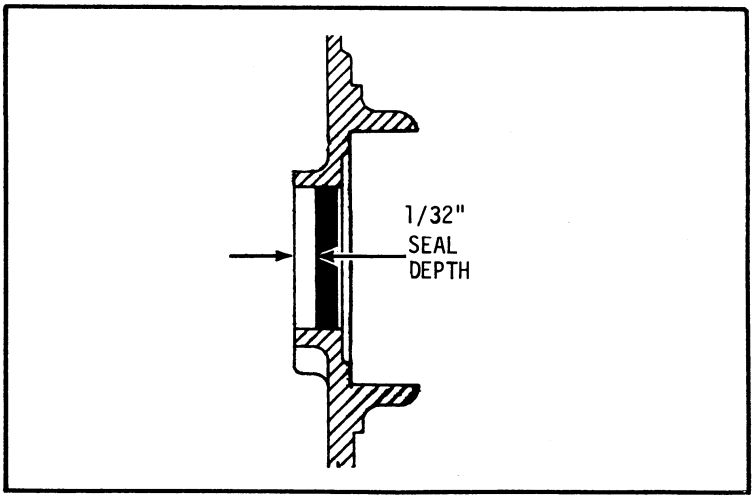
RUN-IN PROCEDURES (RECONDITIONED ENGINES)

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.

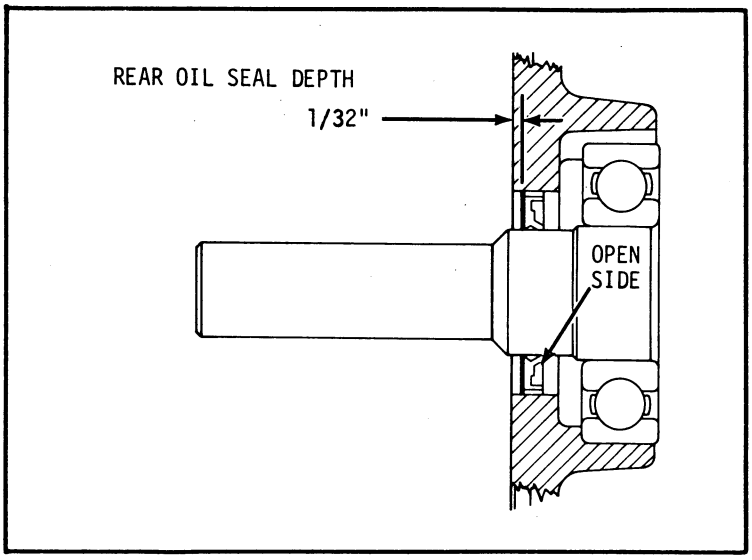
After the initial run-in period, drain the non-detergent type oil and refill with detergent type API Service SC oil of proper weight. Do not continue using non-detergent oil after the first 5 hours of operation.

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"

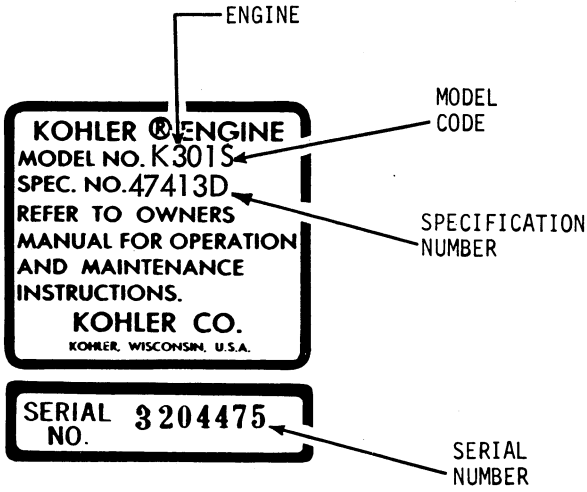
Depth measured in from crankcase face at PTO end.

PARTS CATALOG

KOHLER K301S ENGINE

(Gasoline engine specification number 47413B & 47413D)
(LPG engine specification number 47414B & 47414D)

This parts catalog covers KOHLER Model K301S Engine only.



The model, specification and serial number of your engine can be found on the engine nameplate. When ordering replacement parts, always include:

1. Engine Model Number, which is K301S. The number 301 is a code indicating that the displacement is approximately 30 cubic inches, and the engine has one cylinder. The "S" stands for electric start.

2. Specification Number, which indicates the model variation of the engine.

3. Serial Number, which lists the order in which the engine was built. The first digit in the serial number indicates the year in which the engine was built, following this code:
(1) - 1969, (2) - 1970, (3) - 1971, (4) - 1972, (5) - 1973, etc.

4. Give the part number, description and quantity needed for each item. Do not order by illustration reference number.

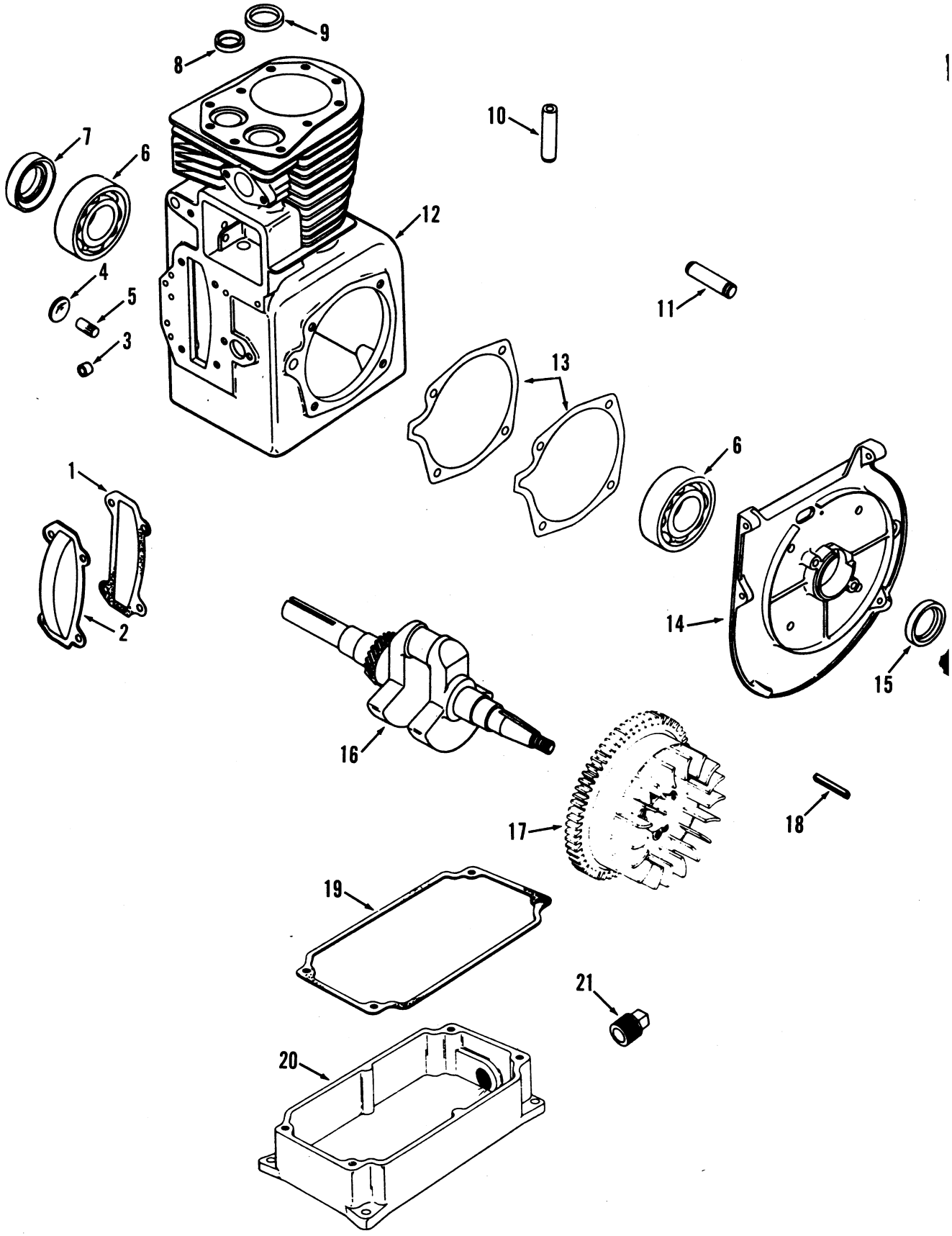


FIG. 1 - CRANKCASE GROUP

FIG. 1 - CRANKCASE GROUP

Ref. No.	TENNANT Part No.	Kohler Part No.	Engine Serial No.	Description	Qty.
1	-	235025	(-)	GASKET, Cover	1
2	-	235026	(-)	COVER, Camshaft	1
3	-	234866	(-)	BEARING	1
4	-	X23011	(-)	PLUG	1
5	-	235125S	(-)	SHAFT, Governor	1
6	-	235376	(-)	BEARING	2
7	-	X3799	(-)	SEAL, Rear oil	1
8	-	230170	(-)	INSERT, Exhaust valve	1
9	-	230265	(-)	INSERT, Intake valve	1
10	-	235007	(-)	GUIDE, Valve	2
11	-	236559	(-)	SHAFT, Balance gear	2
12	10400-	D237530	(-)	SHORT BLOCK ASSEMBLY, includes: block, piston, rod, rings, crankshaft, front plate, camshaft, and valves	1
12	-	C237416	(-)	MINIBLOCK ASSEMBLY, Gas includes: block, piston, rod, rings, camshaft, and valves	1
12	-	B237865	(-)	MINIBLOCK ASSEMBLY, LPG includes: block, piston, rod, rings, camshaft, and valves	1
13	-	235070	(-)	GASKET, Plate, 0.010	AR
13	-	235757	(-)	GASKET, Plate	1
14	-	4515601	(Suffix B -)	PLATE, Bearing	1
14	-	4515602	(Suffix D -)	PLATE, Bearing	1
15	-	X27130	(-)	SEAL, Front oil	1
16	-	B235805	(-)	CRANKSHAFT	1
17	-	4702528	(-)	FLYWHEEL	1
18	-	X28617	(-)	KEY	1
19	-	235057	(-)	GASKET, Pan	1
20	-	235115	(-)	PAN, Oil	1
21	-	X756	(-)	PLUG, Drain	1

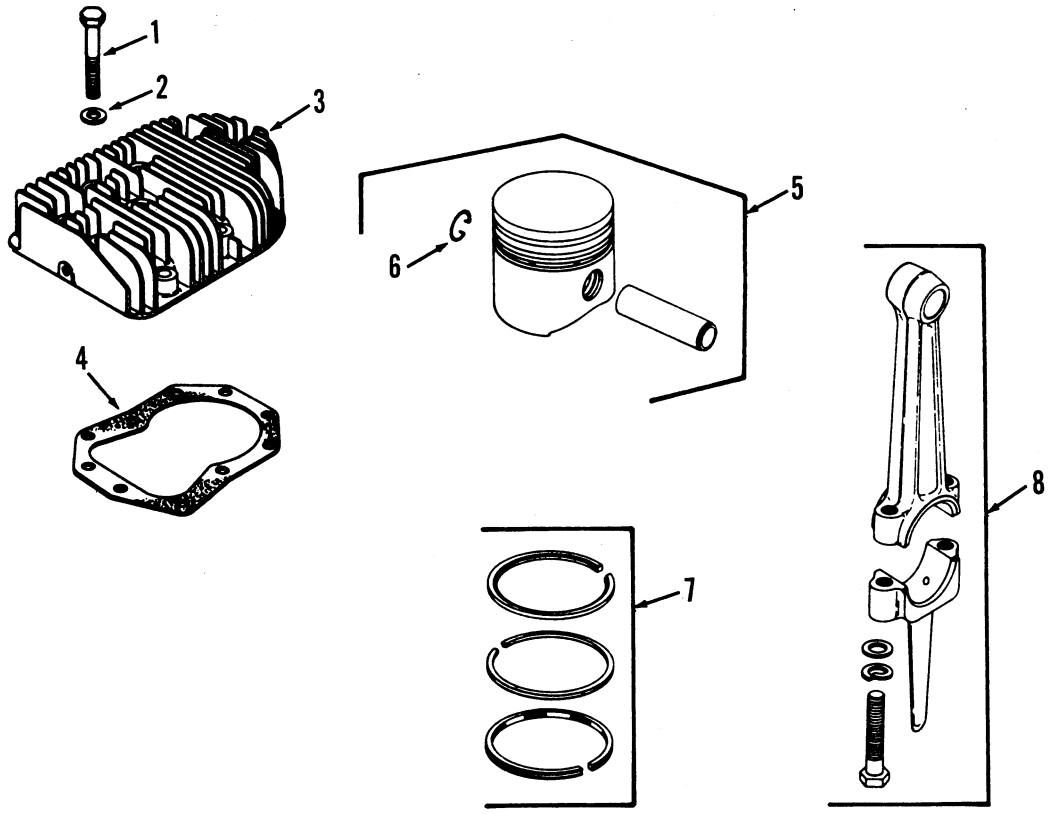


FIG. 2 - CYLINDER HEAD AND PISTON GROUP

Ref. No.	TENNANT Part No.	Kohler Part No.	Engine Serial No.	Description	Qty.
1	-	270158	(-)	SCREW, Hex	9
2	-	270889	(-)	WASHER	9
3	-	237829	(00000000 -3184999)	HEAD, Cylinder, gasoline	1
3	-	237827	(3185000 -)	HEAD, Cylinder, gasoline	1
3	-	237670	(Suffix D -)	HEAD, Cylinder, gasoline	1
3	38043	237560	(-)	HEAD, Cylinder, LPG	1
3	37772	237714	(Suffix D -)	HEAD, Cylinder, LPG	1
4	37862	237658	(-)	GASKET, Head	1
5	-	4707416	(-)	PISTON ASSEMBLY, Std.	1
5	-	4707417	(-)	PISTON ASSEMBLY, 0.003	1
5	38057	4707418	(-)	PISTON ASSEMBLY, 0.010	1
5	38058	4707419	(-)	PISTON ASSEMBLY, 0.020	1
5	38425	4707420	(-)	PISTON ASSEMBLY, 0.030	1
6	-	235004	(-)	RETAINER, Pin	2
7	-	235889	(-)	RING SET, Std. and 0.003	1
7	-	235890	(-)	RING SET, 0.010	1
7	-	235891	(-)	RING SET, 0.020	1
7	-	235892	(-)	RING SET, 0.030	1
8	-	A237344	(-)	ROD, Connecting	1
8	37781	A23734410	(-)	ROD, Connecting, 0.010, U.S.	1

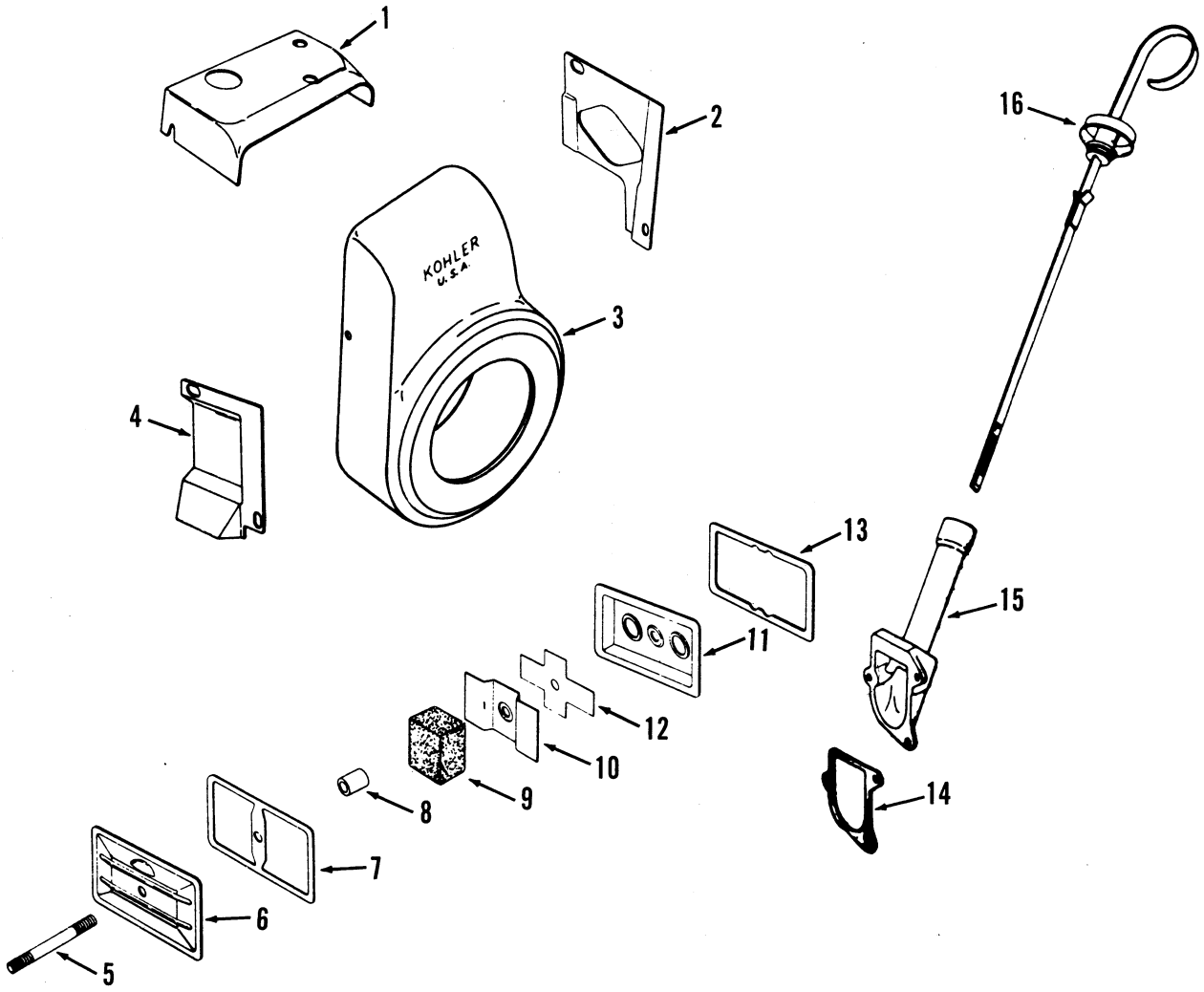


FIG. 3 - HOUSING, PCV AND OIL FILL GROUP

Ref. No.	TENNANT Part No.	Kohler Part No.	Engine Serial No.	Description	Qty.
1	-	237520	(-)	BAFFLE, Head	1
2	-	235652	(-)	BAFFLE, Side	1
3	-	237110	(-)	HOUSING, Blower	1
4	-	236676	(-)	BAFFLE, Cylinder	1
5	-	275220	(-)	STUD, Valve cover	1
6	37921	275143	(-)	COVER, Valve	1
7	-	275144	(-)	GASKET, Cover	1
8	-	231032	(-)	SEAL	1
9	37830	235118	(-)	FILTER	1
10	-	235117	(-)	BAFFLE	1
11	37920	235631	(-)	PLATE, Breather	1
12	-	235047	(-)	REED, Breather	1
13	-	235048	(-)	GASKET	1
14	-	237064	(-)	GASKET	1
15	-	236960	(-)	TUBE, Oil fill	1
16	-	237015	(-)	DIPSTICK	1

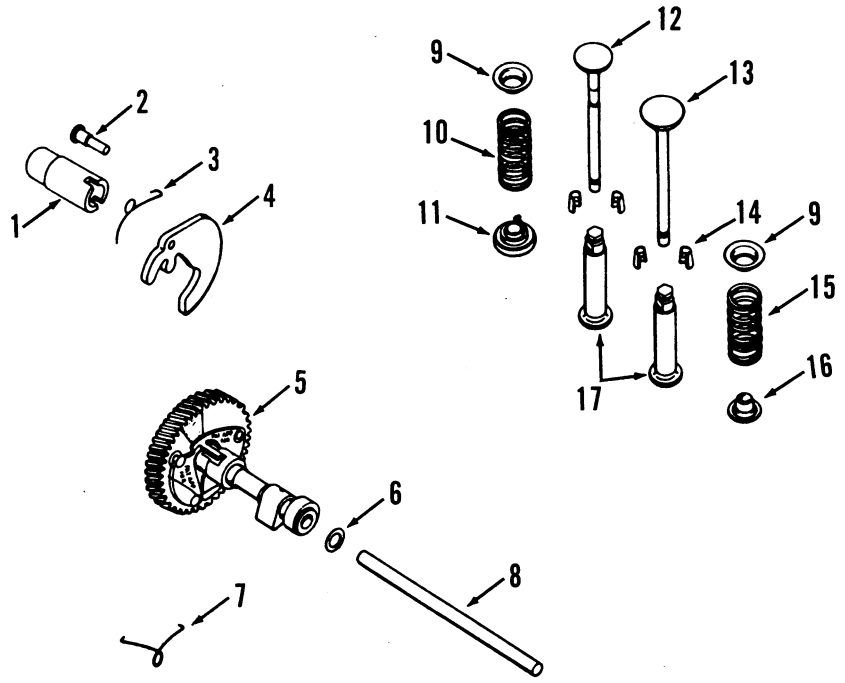


FIG. 4 - CAMSHAFT AND VALVES GROUP

Ref. No.	TENNANT Part No.	Kohler Part No.	Engine Serial No.	Description	Qty.
1	-	235690	(-)	CAM, Ignition	1
2	-	230080	(-)	PIN, Flywright	2
3	-	275267	(-)	SPRING, Governor	2
4	-	230087	(-)	FLYWEIGHT	2
5	-	J235646	(-)	CAMSHAFT, Gasoline	1
5	-	J237562	(-)	CAMSHAFT, LPG	1
6	-	275066	(-)	SPACER, 0.005	AR
6	-	275067	(-)	SPACER, 0.010	AR
7	-	4708901	(-)	SPRING, Actuating	1
8	-	235053	(-)	PIN, Camshaft	1
9	-	235011	(-)	RETAINER, Upper	2
10	-	235168	(-)	SPRING, Exhaust valve	1
11	-	230020	(-)	ROTATOR	1
12	-	235826	(-)	VALVE, Exhaust	1
13	-	235008	(-)	VALVE, Intake	1
14	-	4175510	(-)	RETAINER KIT	2
15	-	235010	(-)	SPRING, Intake valve	1
16	-	230011	(-)	RETAINER, Intake spring	1
17	-	D235327	(-)	TAPPET	2

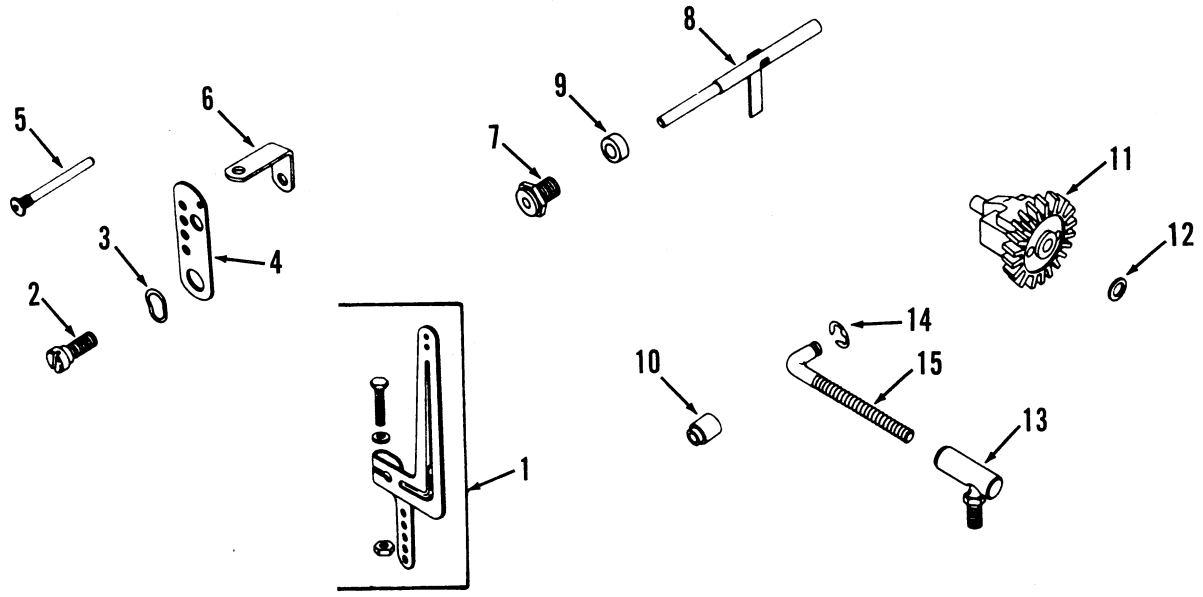


FIG. 5 - GOVERNOR GROUP

Ref. No.	TENNANT Part No.	Kohler Part No.	Engine Serial No.	Description	Qty.
1	-	A237653	(-)	LEVER, Governor	1
2	-	235477	(-)	SCREW, Shoulder	1
3	-	275690	(-)	WASHER, Tension	1
4	-	235086	(-)	BRACKET, Speed control	1
5	-	231355	(-)	PIN, Governor stop	1
6	-	235084	(-)	BRACKET, Adjusting screw	1
7	-	235476	(-)	BUSHING	1
8	-	A235256	(-)	SHAFT, Cross	1
9	-	A40080	(3173783 -)	SPACER	1
10	-	235085	(-)	SPACER	1
11	-	A235743S	(-)	GEAR, Governor	1
12	-	237022	(-)	WASHER, Thrust	1
13	-	237130	(-)	BALLJOINT	1
14	-	235278	(-)	RETAINER, Rod	1
15	-	235277	(-)	ROD	1

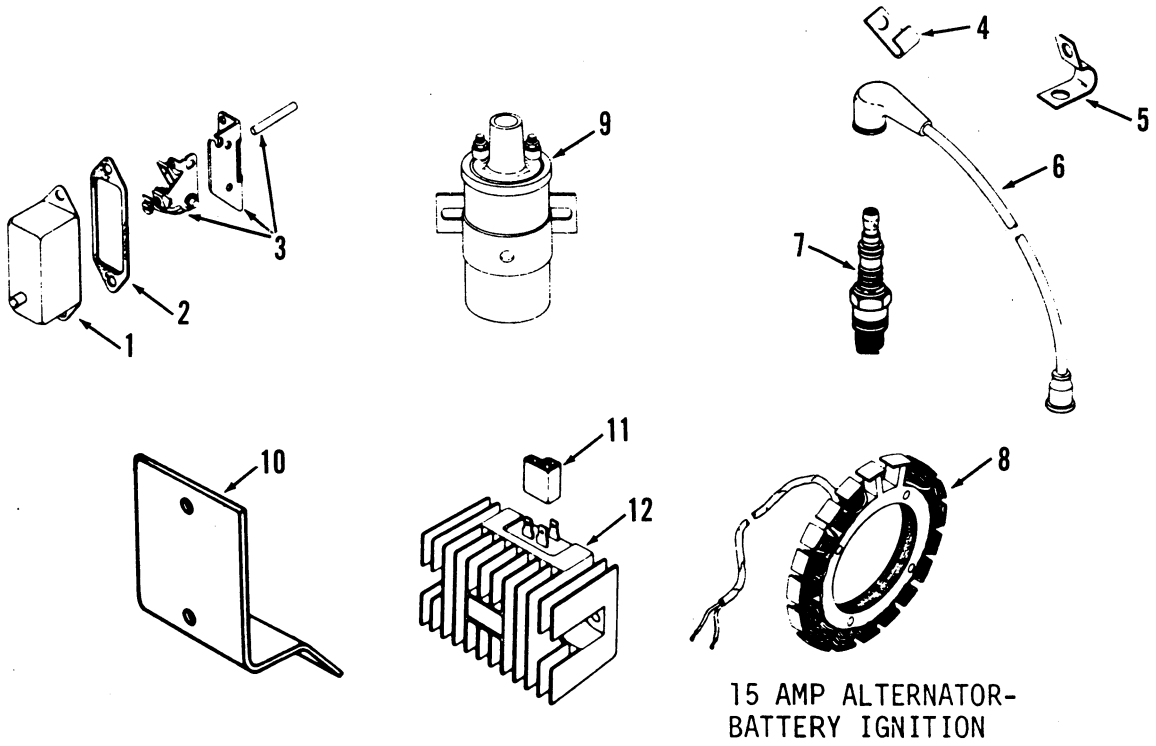


FIG. 6 - ELECTRICAL GROUP

Ref. No.	TENNANT Part No.	Kohler Part No.	Engine Serial No.	Description	Qty.
1	-	A220136	(-)	COVER, Breaker	1
2	38489	5204111	(-)	GASKET, Cover	1
3	38463	-	(-)	POINTS SET, Ignition	1
	-	4715003	(-)	POINT SET, Ignition	1
	-	4741104	(-)	ROD, Breaker	1
4	-	275303	(-)	CLIP	1
5	-	X7281	(-)	CLIP	1
6	-	238057	(-)	WIRE, High tension	1
7	45770-5	235040S	(-)	SPARK PLUG	1
8	-	237878	(-)	STATOR	1
9	28637	231281	(-)	COIL	1
10	-	237045	(-)	BRACKET, Regulator	1
11	-	237429	(-)	CONNECTOR	1
12	27222-2	237335	(-)	RECTIFIER-REGULATOR	1

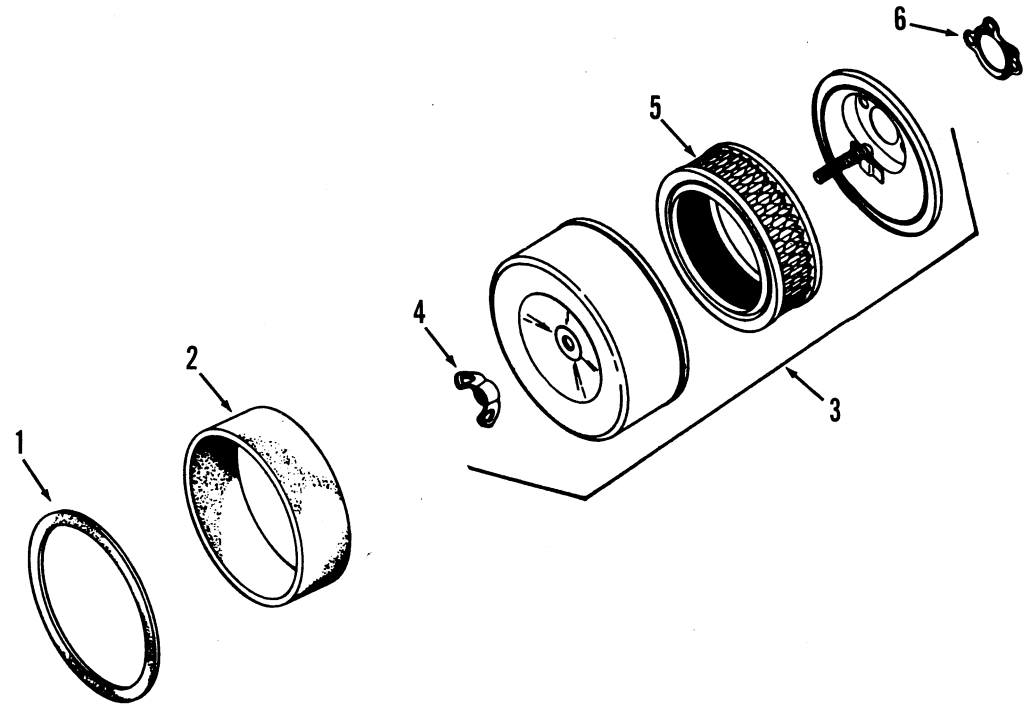


FIG. 7 - AIR CLEANER GROUP

Ref. No.	TENNANT Part No.	Kohler Part No.	Engine Serial No.	Description	Qty.
1	-	237423	(-)	SEAL	1
2	49197	237421	(-)	PRE-CLEANER	1
3	-	A235100	(-)	AIR CLEANER ASSEMBLY	1
4	-	X2767	(-)	NUT, Wing	1
5	49198	235116	(-)	ELEMENT, Filter	1
6	-	275341	(-)	GASKET	1

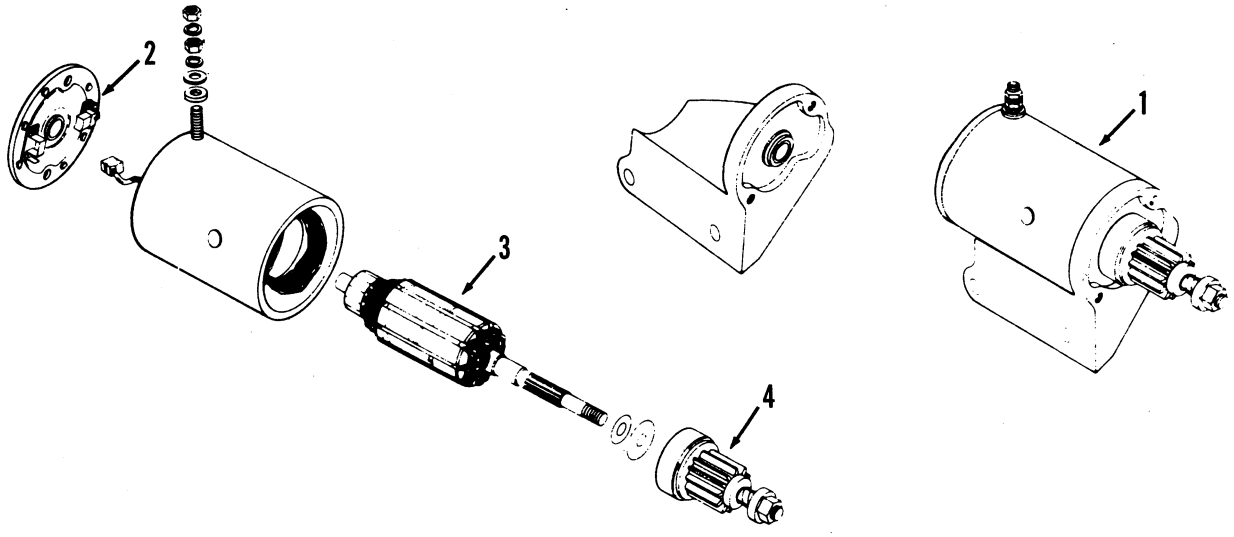


FIG. 10 - STARTER BREAKDOWN

Ref. No.	TENNANT Part No.	Kohler Part No.	Engine Serial No.	Description	Qty.
1	52455	A236396	(00000000 - 0172451)	STARTER	1
2	-	236576	(00000000 - 0172451)	BRUSH AND SPRING	1
3	-	236571	(00000000 - 0172451)	ARMATURE	1
4	-	236562	(00000000 - 0172451)	DRIVE	1

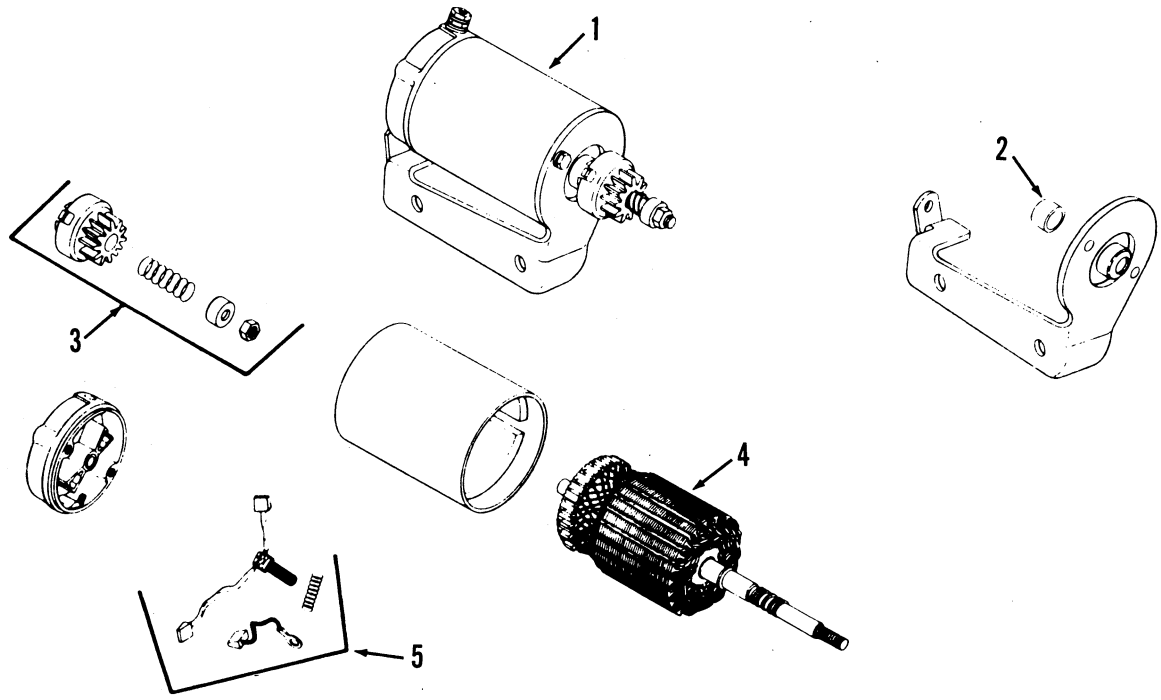


FIG. 11 - STARTER BREAKDOWN

Ref. No.	TENNANT Part No.	Kohler Part No.	Engine Serial No.	Description	Qty.
1	-	~~A237131~~	(0172452 -03224985)	STARTER	1
2	-	4103001	(0172452 -03224985)	BEARING	1
3	37264	4775507	(0172452 -03224985)	DRIVE KIT	1
4	38543	4717001	(0172452 -03224985)	ARMATURE	1
5	38504	4875515	(0172452 -03224985)	BRUSH KIT	1

~~A237510~~

52455 — A237530

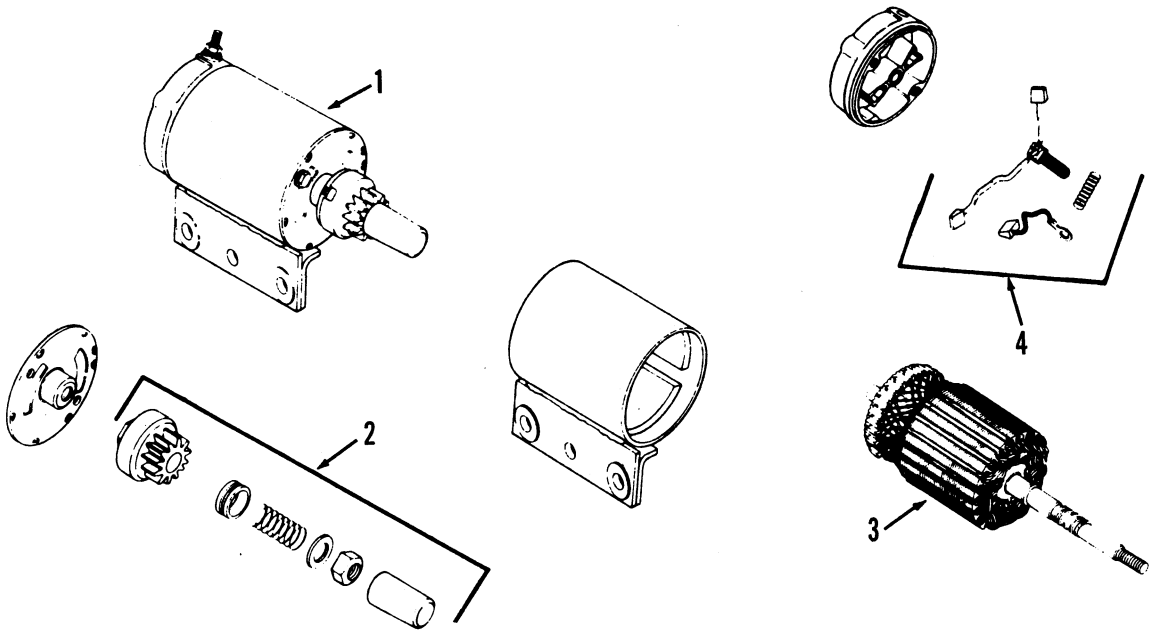


FIG. 12 - STARTER BREAKDOWN

Ref No.	TENNANT Part No.	Kohler Part No.	Engine Serial No.	Description	Qty.
1	-	A237534	OBS repl by (03224986 -)	STARTER	1
2	37264	4775507	(03224986 -)	DRIVE KIT	1
3	38543	4717001	(03224986 -)	ARMATURE	1
4	38504	4875515	(03224986 -)	BRUSH KIT	1

52455 ← A 236396-5

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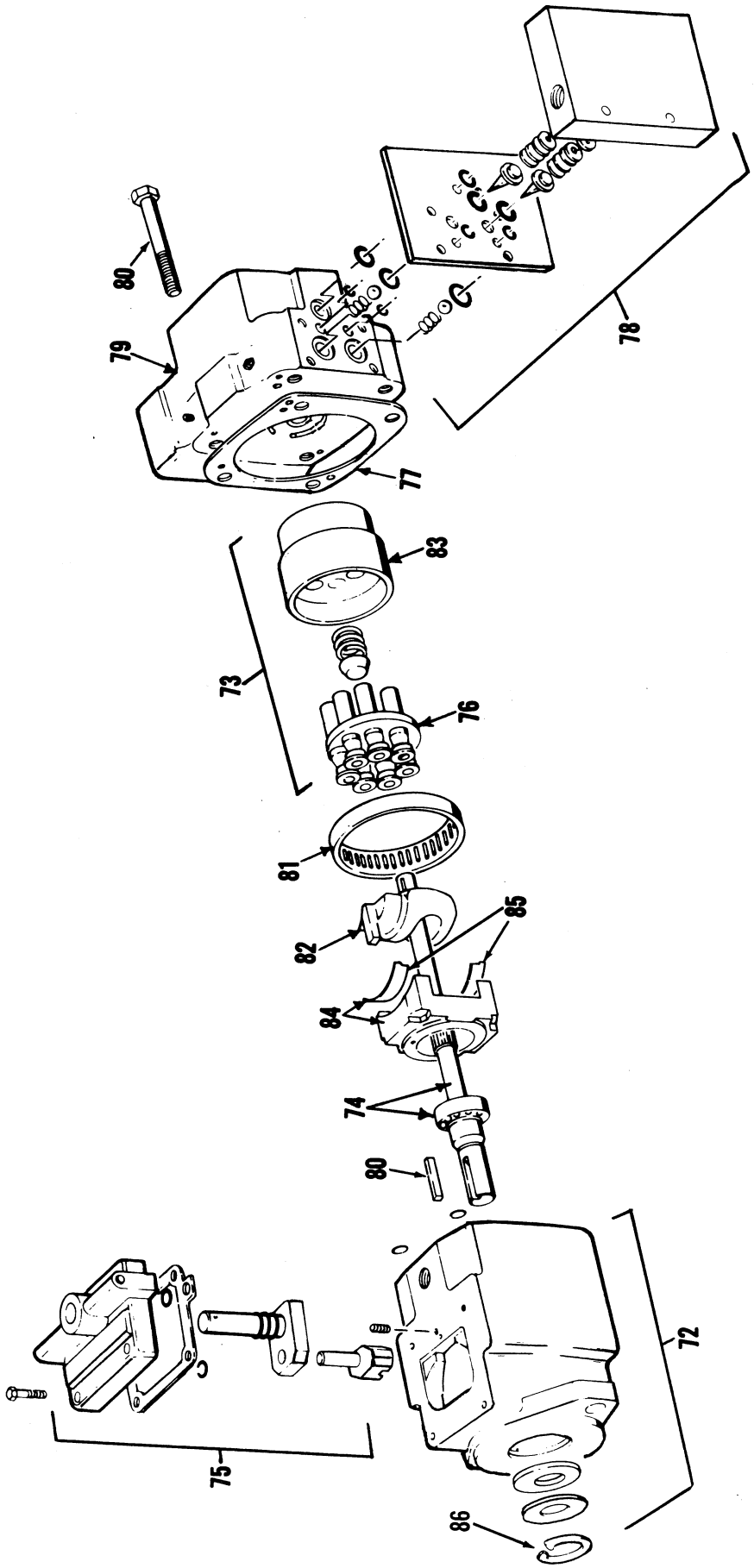
220
POWER SWEEPER

hydraulic components

CONTENTS



EXPLODED VIEW OF #50500 OILGEAR PROPELLING HYDRAULIC PUMP (See parts list)

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REPAIR KIT LIST FOR OILGEAR HYDRAULIC PUMPS

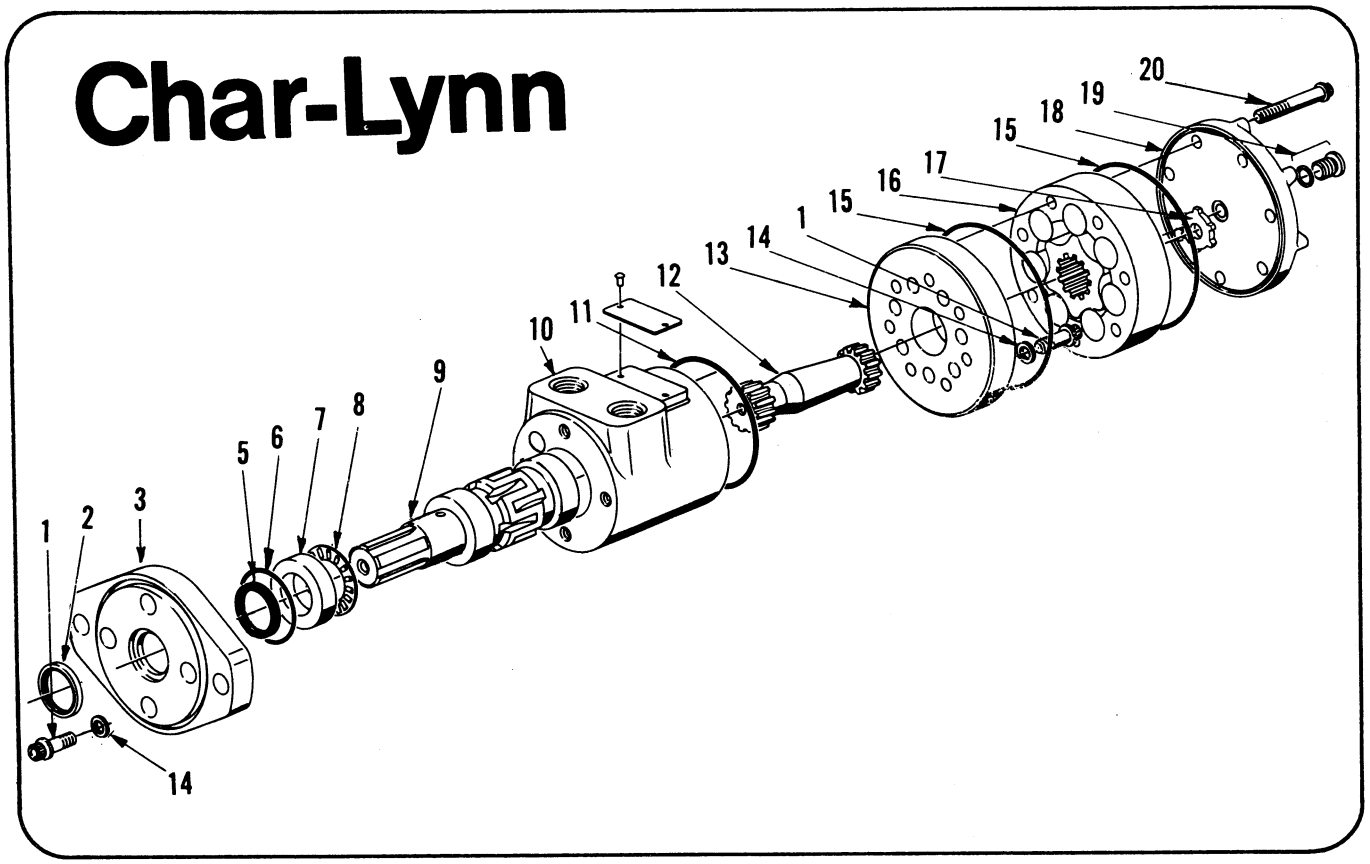
REF. NO.	DESCRIPTION		OILGEAR PUMPS #69188	#45697	#47888	#50500
			REPAIR KIT NUMBERS			
72	HOUSING & PINS KIT, incl:		SK2171	SK2171	SK2171	SK2171
	RING, Retaining	(1)				
	SEAL, Shaft	(1)				
	PIN, Dowel	(1)				
	PIN, Spring	(2)				
	HOUSING, Pump	(1)				
	RETAINER, Shaft seal	(1)				
73	ROTATING GROUP KIT, incl:		SK1678	SK1678	SK1678	SK1678
	RETAINER, Shoe	(1)				
	BALL	(1)				
	RETAINER, Spring	(1)				
	CYL. BARREL & SLEEVE	(1)				
	PISTON & SHOE ASSEMBLY	(1)				
74	SHAFT & BEARING KIT, incl:		SK1992	SK1992	SK1991	SK1991
	BEARING	(1)				
	SHAFT	(1)				
	RING, Retaining	(1)				
75	CONTROL KIT, includes:		SK1993	SK1993	SK1993	SK2187
	O-RING	(2)				
	PLUG	(2)				
	BLOCK, Control	(1)				
	GASKET	(1)				
	CLEVIS & PIN ASSEMBLY	(1)				
	ARM & PINTLE ASSEMBLY	(1)				
76	SET OF PISTONS KIT, incl:		SK1994	SK1994	SK1994	SK1994
	PISTON & SHOE ASS'Y.	(7)				
77	GASKET & SEAL KIT, includes all seals and gaskets	(1)	SK1769	SK1769	SK1769	SK1769
78	HYDRASTATIC MODULE KIT,		SK2040	SK2040	SK2040	SK2040
	POPPET	(2)				
	PLATE, Seal	(1)				
	PLUNGER	(1)				
	SPRING	(5)				
	BLOCK	(1)				
	CAP & BUSHING ASS'Y.	(1)				
	BALL	(2)				
	O-RING	(8)				
	GASKET	(1)				
79	VALVE PLATE ASSEMBLY, incl:		SK2042	SK2042	SK1996	SK1996
	PLUG	(3)				
	BEARING	(1)				
	PLATE	(1)				
	PLUG	(2)				
	O-RING	(2)				
80	SCREWS, SHAFT KEY, AND NAME TAG KIT	(1)	SK1997	SK1997	SK1997	SK1997
81	ROTATING GROUP BEARING:		SK1998	SK1998	SK1998	SK1998
	BEARING, Roller	(1)				
	RING, Retaining	(1)				

(continued on next page)

REPAIR KIT LIST (continued)
FOR OILGEAR HYDRAULIC PUMPS

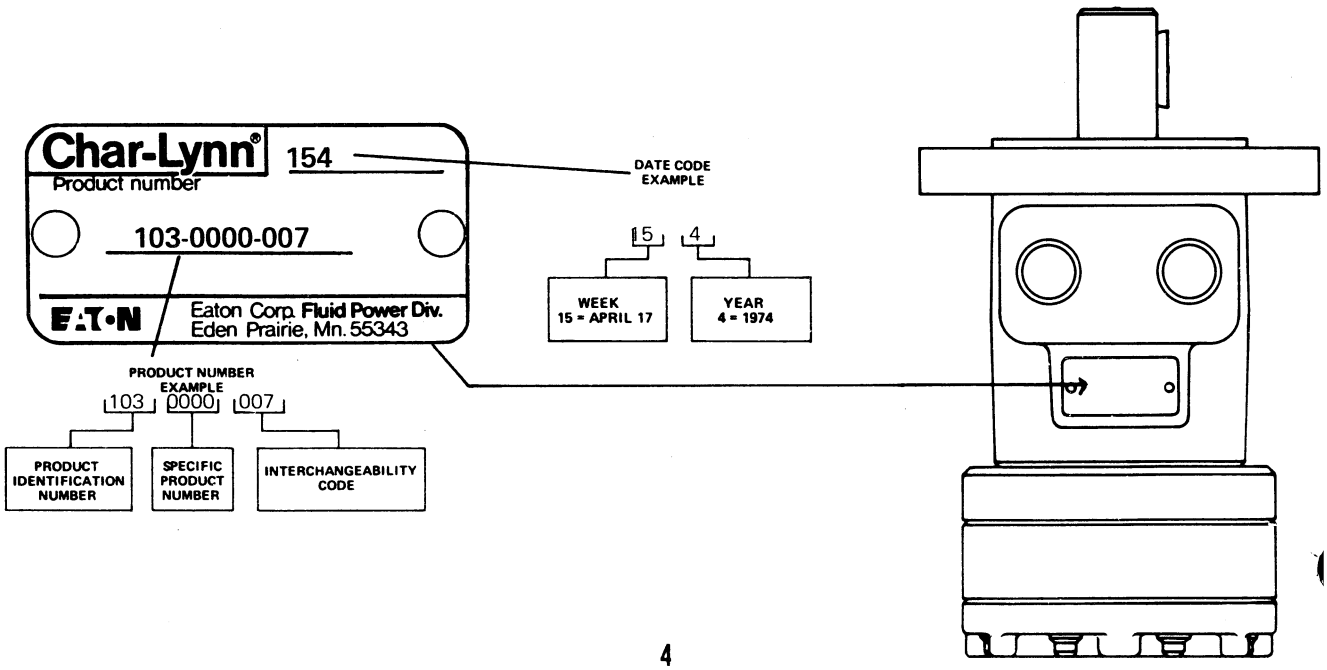
REF. NO.	DESCRIPTION		OIL GEAR PUMPS #69188	#45697	#47888	#50500
			REPAIR KIT NUMBERS			
82	SWASH BLOCK KIT	(1)	SK1999	SK1999	SK1999	SK2188
83	BARREL & SLEEVE KIT, incl:		SK2000	SK2000	SK2000	SK2000
	BARREL, Cylinder	(1)				
	BEARING, Sleeve	(1)				
84	SADDLE KIT, includes:		SK2189	SK2189	SK2189	SK2189
	BEARING, Saddle	(2)				
	SADDLE	(1)				
85	SADDLE BEARING KIT, incl:		SK2002	SK2002	SK2002	SK2002
	BEARING, Saddle	(2)				
86	SHAFT SEAL KIT	(1)	SK1656	SK1656	SK1656	SK1656

NOTE: Gasket & Seal Kit No. SK1769 includes all seals and instructions.
All repair kits include instructions.



MODEL 220

OBSOLETE REAR WHEEL DRIVE MOTOR 47651-2

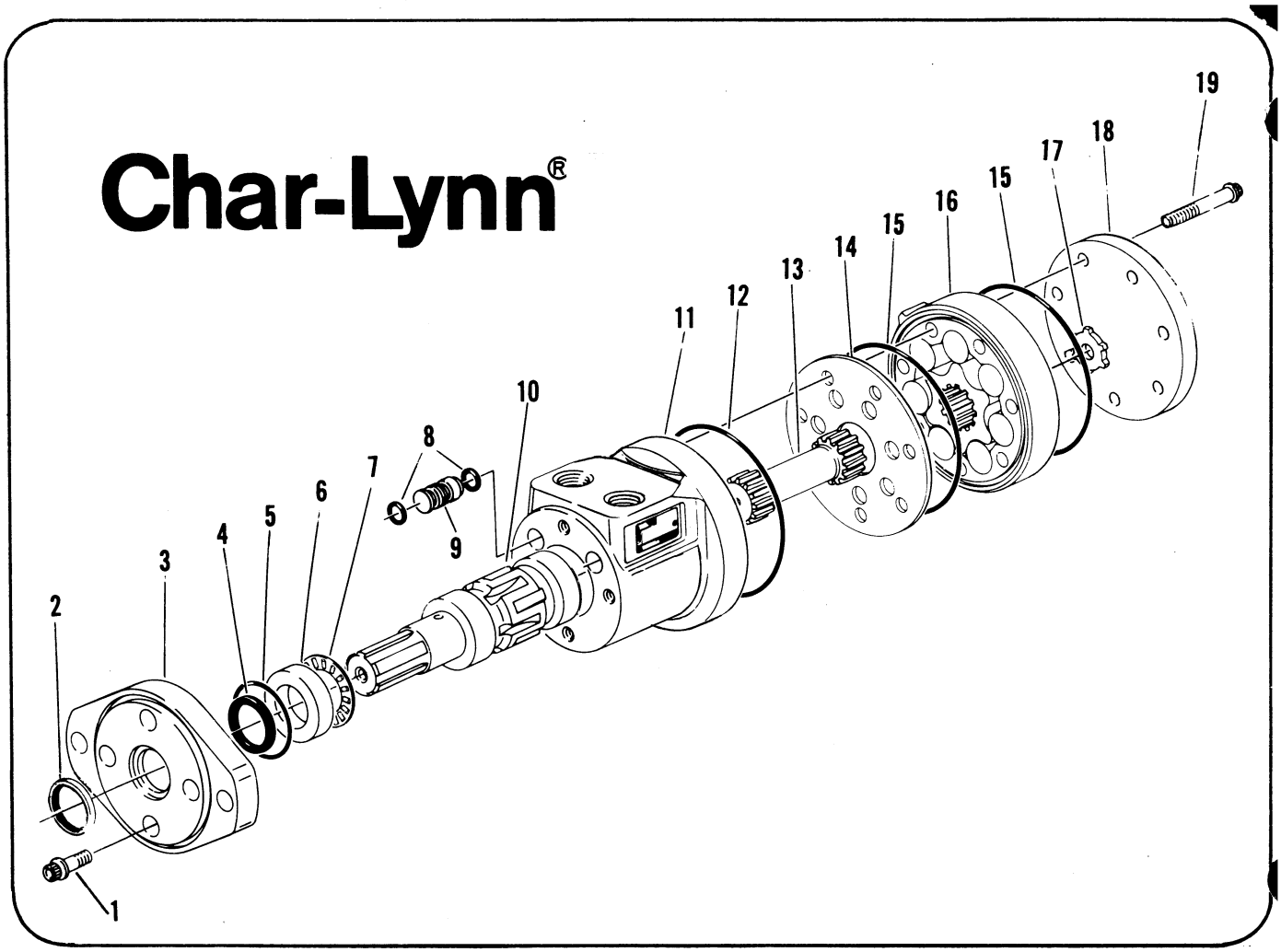


MODEL 220

OBSOLETE REAR WHEEL DRIVE MOTOR 47651-2

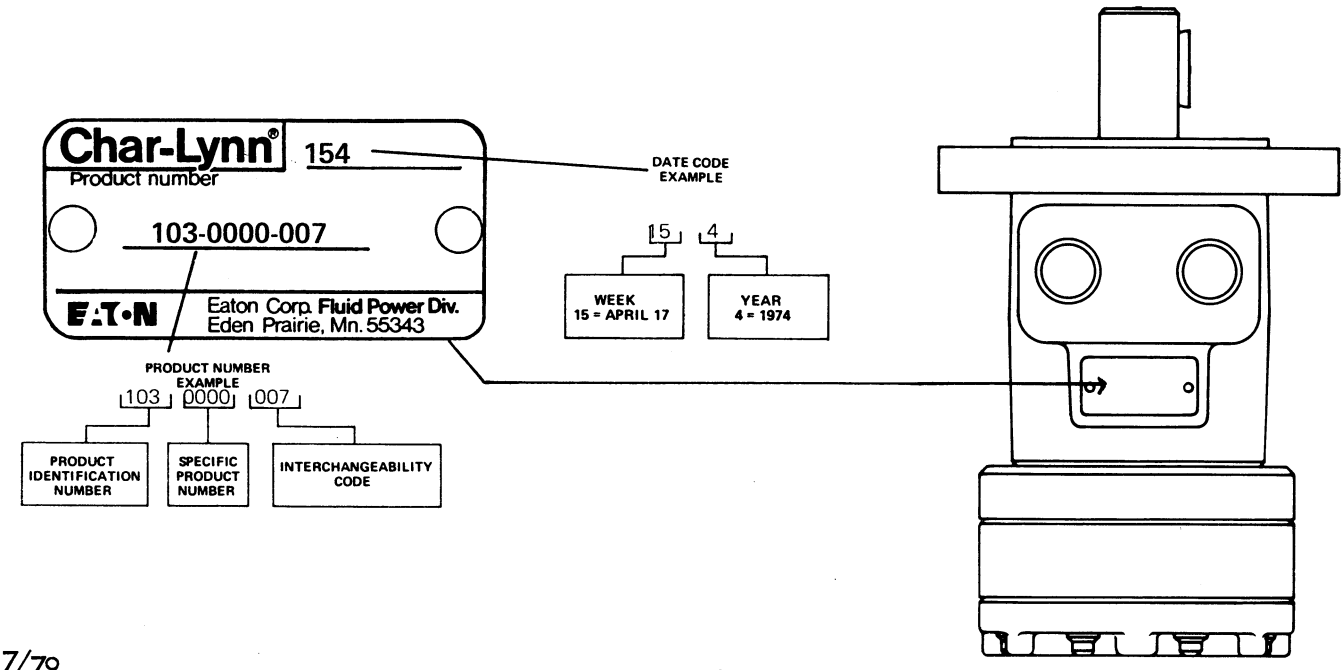
Ref. No.	Part No.	Description	Qty.
1	37555	SCREW, Cap	11
2*		SEAL, Dust	1
3	7620	FLANGE, Mounting	1
4	(not shown)	WASHER, Backup	1
5*		SEAL, Shaft (alternate seal & backup washer may be used)	1
6*		O-RING	1
7	16695	RACE, Thrust bearing	1
8	45628	BEARING, Thrust	1
9	7360-2	SHAFT, Output	1
10	7359-2	HOUSING	1
11*		O-RING	1
12	6612	DRIVE	1
13	7458	PLATE, Spacer	1
14	5417	WASHER, Lock	11
15*		O-RING	2
16	6606-6	GEROLER ASSEMBLY (includes ring, star & rollers)	1
17	6901-2	SPACER	1
18	6797	CAP, End	1
19	6833	PLUG ASSEMBLY	1
20	5389-4	SCREW, Cap	7
(not shown)	43942	O-RING, Housing plug	1
(not shown)	20817	PLUG, Housing	1

* Indicates items included in Seal Kit No. SK1601



MODEL 220

CURRENT STYLE REAR WHEEL DRIVE MOTOR 48618-2

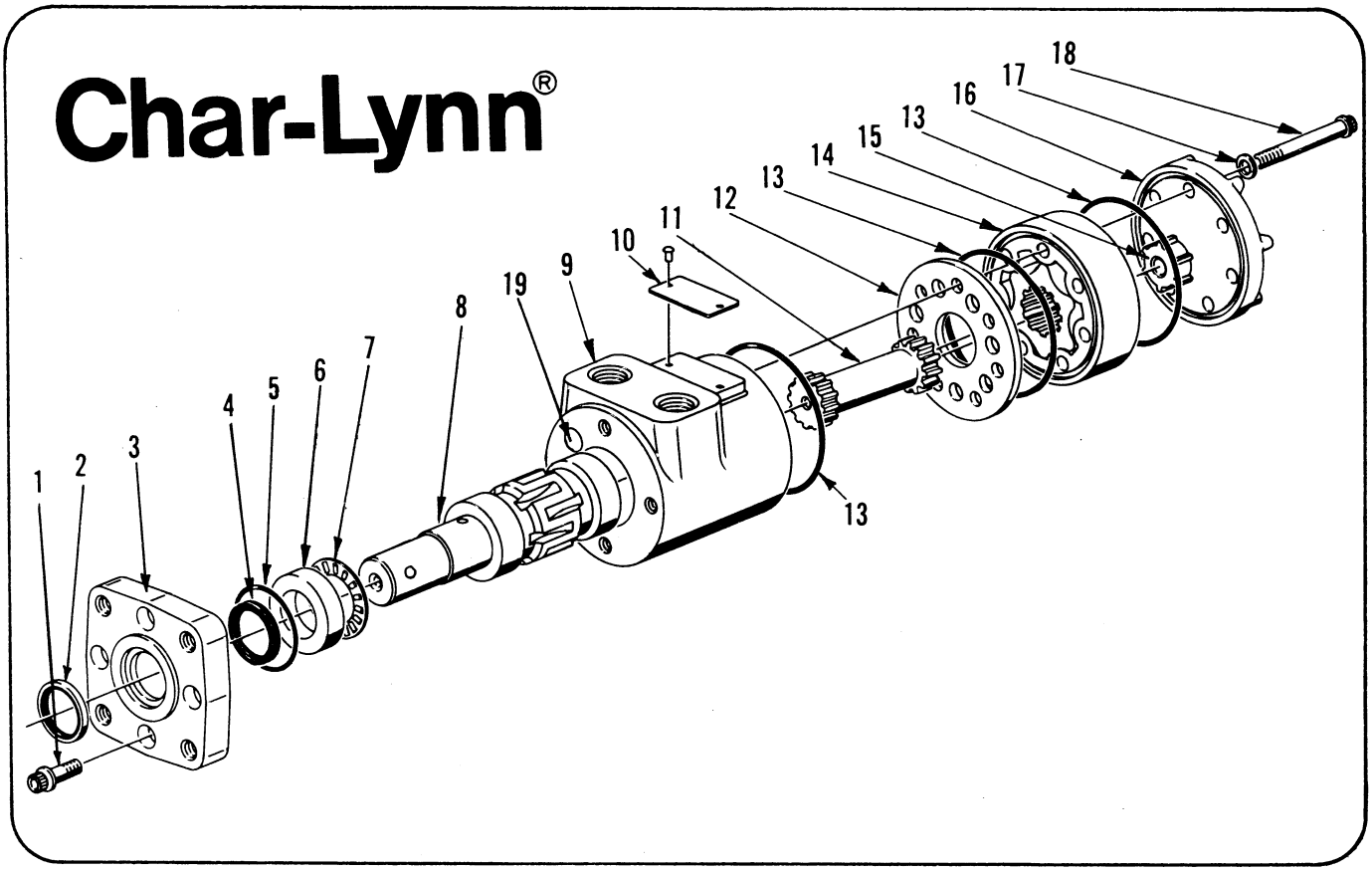


MODEL 220

CURRENT STYLE REAR WHEEL DRIVE MOTOR 48618-2

Ref. No.	CHARLYNN Part No.	Description	Qty.
1	37555	SCREW, Cap	1
2	*	SEAL, Dust	1
3	7620	FLANGE, Mounting	1
4	*	SEAL, Shaft pressure	1
5	*	SEAL	1
6	7462	RACE, Thrust bearing	1
7	7537	BEARING, Thrust, needle	1
8	*	SEAL, Check ball	1
9	6567	BALL CHECK, Sub-assembly	1
10	7360-2	SHAFT, Straight	1
11	8631-2	HOUSING	1
12	*	SEAL,	1
13	8664	DRIVE	1
14	8636	PLATE, Spacer	1
15	*	SEAL	2
16	8632-6	GEROLER	1
17	6901-2	SPACER	1
18	8635-1	CAP, End	1
19	5389-18	SCREW, Cap	7

*Included in Seal Kit SK2305



MODEL 220

SIDE BRUSH MOTOR 47650-3

MODEL 220

SIDE BRUSH MOTOR 47650-3

Ref. No.	Char-Lynn Part No.	Description	Qty.
1	37555	SCREW, Cap	4
2 *		SEAL, Dust	1
3	34174	FLANGE, Mounting	1
4 *		SEAL, Shaft (alternate seal & back-up ring may be used)	1
5 *		O-RING	1
6	16695	RACE, Thrust bearing	1
7	45628	BEARING, Thrust needle	1
8	7360-12	SHAFT, Output	1
9	7359-2	HOUSING	1
10	9029-1	NAMEPLATE	1
11	34176	DRIVE	1
12	7358	PLATE, Spacer	1
13 *		O-RING	3
14	7357-1	GEROTOR ASSEMBLY (includes ring & star)	1
15	-	SPACER (not used in this motor)	1
16	7461	CAP, End	1
17 *		WASHER, Seal	7
18	5389-1	SCREW, Cap	7
19	20817	PLUG, Housing	1
*		O-RING, Housing plug (not shown)	1

NOTES:

(1) * Indicates parts of Seal Kit No. SK1600

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POWER SWEEPER

CONTENTS

lpg

SAFETY AND MAINTENANCE TIPS

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

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

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

. Use care in handling L.P. tanks. Never drop or drag them.

. Always store and transport L.P. fuel tanks with the safety relief valve in the "Up" position.

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

. Avoid personal contact with L.P. fuel to avoid frostbite.

. When the machine is to stand unused for a period of time, overnight for example, park the machine in a designated area, shut off the service valve at the tank and operate the engine until the remaining fuel is comsumed. Then, turn off the ignition switch.

. Perform regular maintenance as recommended in the machine manual.

QUICK CHECK LIST

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

· To check regulator

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

· Check the oil pressure switch

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

· Check the filter-fuelock for proper operation:

Start the engine.

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

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

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 other wise indicated.

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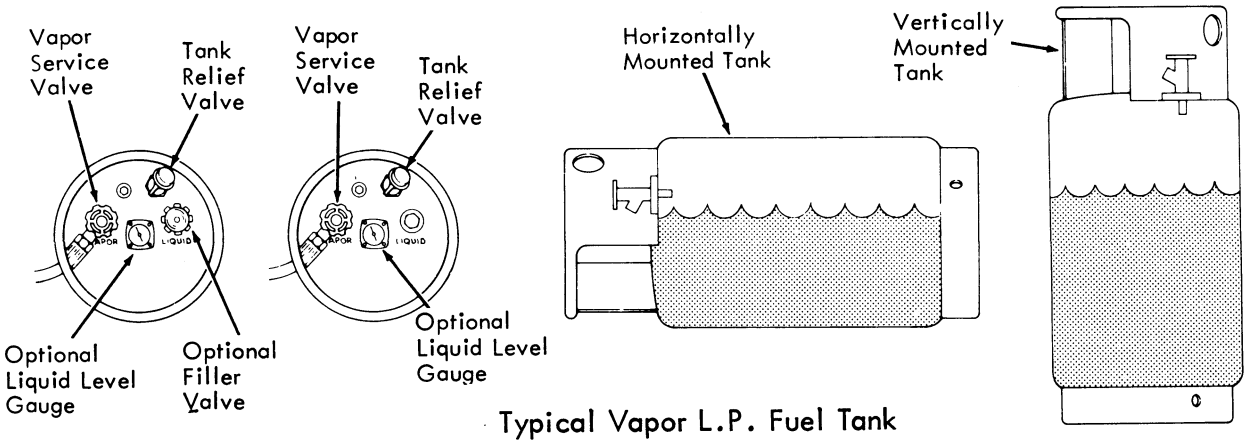


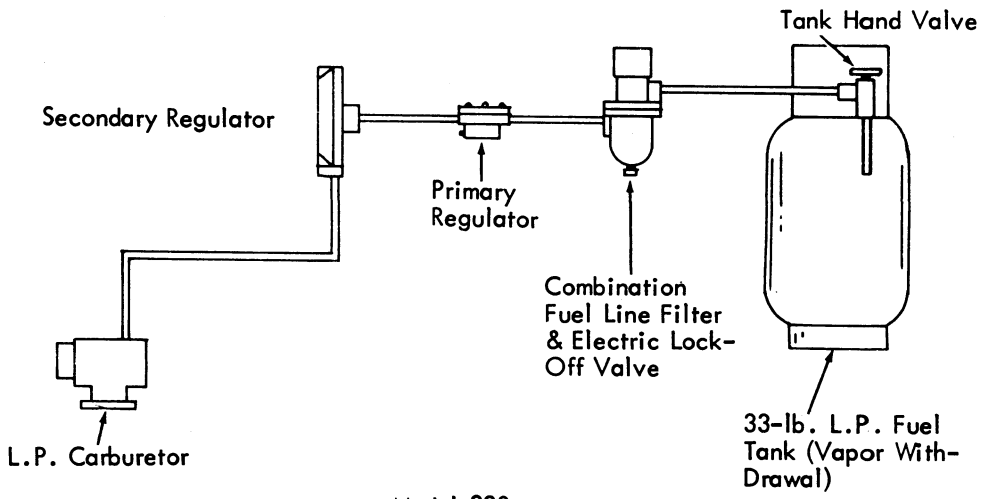
Typical Vapor L.P. Fuel Tank

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.



Model 220

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-fuelock, regulator, and the carburetor. There are many variations of the basic components.

Vapor withdrawal fuel tanks bleed off L.P. fuel in a gaseous state. This L.P. gas is then piped to a filter-fuelock. The filter fuelock filters unwanted tank scale and deposits out of the L.P. gas. The filter-fuelock also stops the flow of L.P. gas when the engine is not operating. The oil pressure switch controls the fuelock. When the engine oil pressure is 4 psi or greater, the oil pressure switch permits an electrical current to open the fuelock which allows L.P. fuel to flow on to the 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.

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

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

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

STORAGE OF L.P. FUEL TANK

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

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

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

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

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

SERVICE/MAINTENANCE OF L.P. FUEL COMPONENTS

To ensure safe operation of your L.P. equipment, regular maintenance and frequent inspections are important. Listed below are some suggested maintenance tips as well as general tips to promote added safety and efficiency in the operation of your Tennant machine.

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

- Check the filter-fuelock for proper operation:

  Start the engine

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

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

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

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

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

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

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

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

- Perform regular maintenance as recommended in the machine manual.

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

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

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

  Completely disassemble the regulator.

  Clean all parts in alcohol.

  Inspect parts and replace where needed.

  Carefully reassemble and reinstall in machine.

  Check for proper operation as follows:

  Remove the L.P. hose in which L.P. exits from the regulator. Using a monometer or pressure gauge, check the output of the regulator making sure that it is working according to its proper output specifications. Then, after checking and adjusting or replacing a defective regulator or regulator component, carefully replace the removed L.P. hose.

- Check the oil pressure switch

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

- Every 400 hours, replace the filter in the filter fuelock.

- 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).

OPERATING INSTRUCTIONS
FOR
MODEL 220 SWEEPER

EQUIPPED FOR LPG OPERATION

TO START LPG EQUIPPED ENGINE

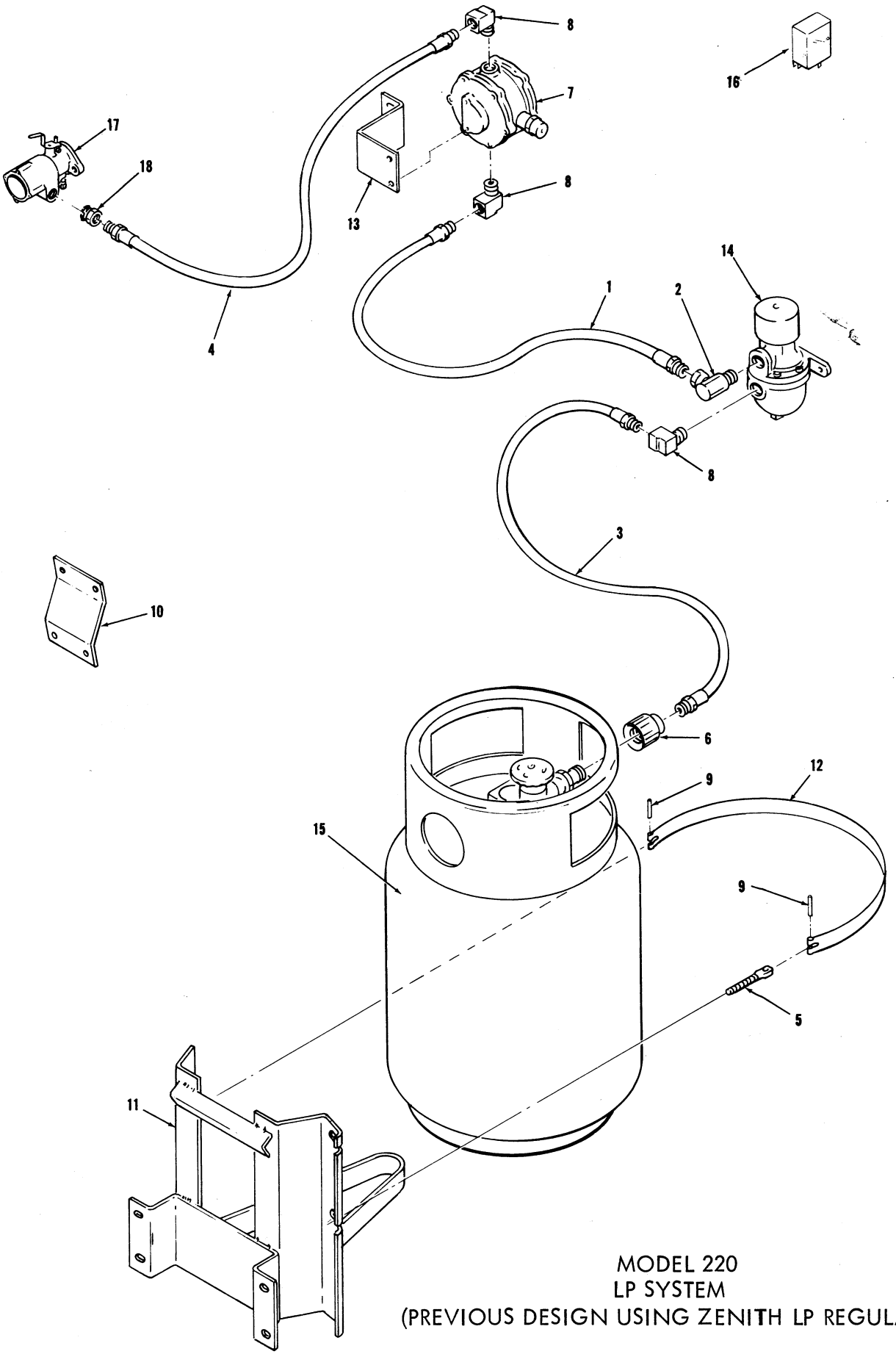
1. **⚠WARNING** Do not attempt to start engine unless you are in driver's seat, with foot on brake pedal or hand brake engaged, and with directional pedal in neutral position.

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

FILLING THE LP TANK

(This is a vertical vapor withdrawal tank, with a capacity of 20 lbs.)

ATTENTION! Tank must be filled by weight. Do not overfill the tank. Overfilling will allow liquid withdrawal which can cause "freeze-up" in the system. The total tank weight after filling should equal full tank capacity (20 lbs) plus the "tare" weight (TW) of the tank which is marked on the tank. The tank may be removed from the machine by uncoupling the "quick dis-connect" fitting and loosening the wing nuts on the tank bracket. The tank must always be mounted vertically.



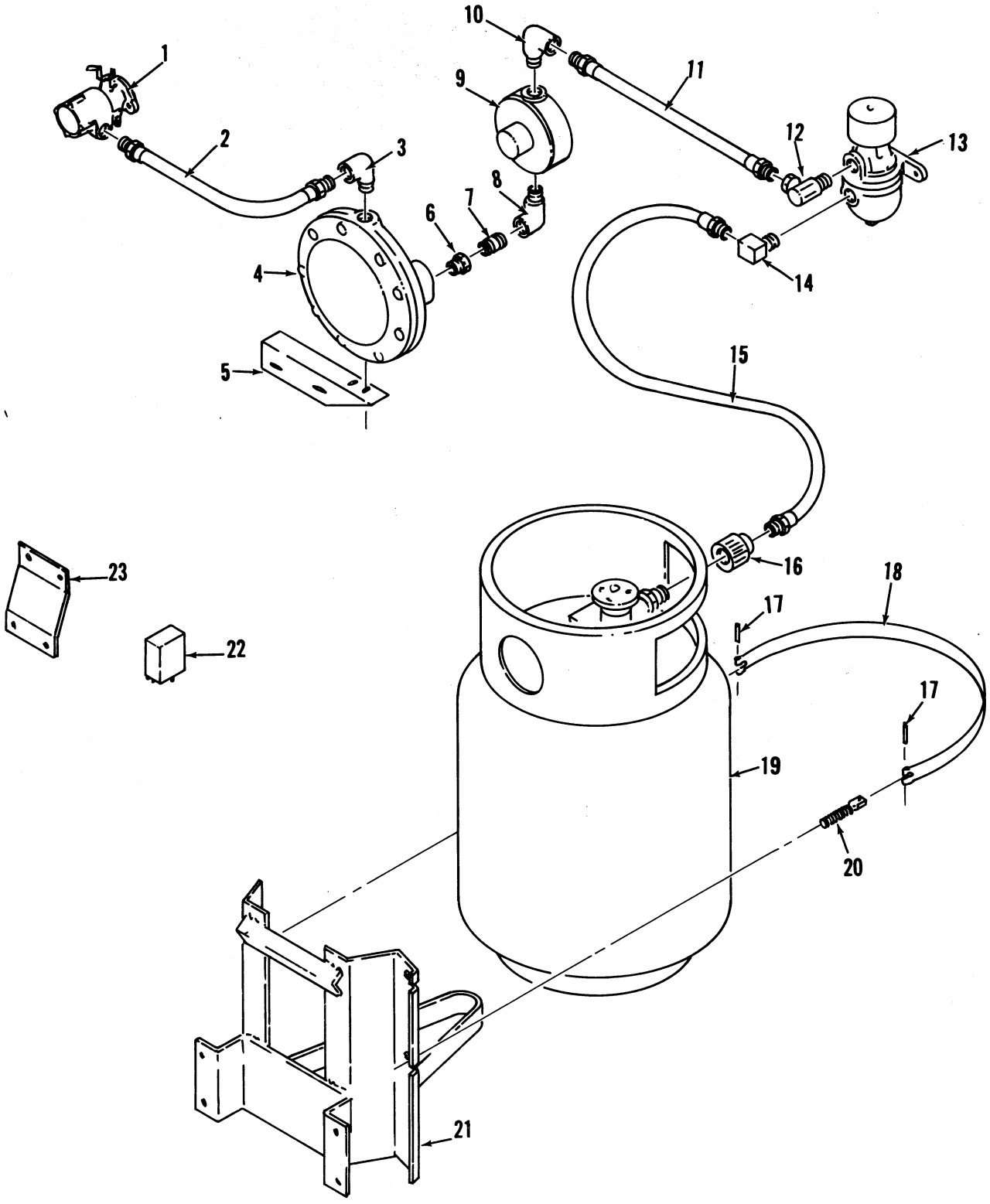
MODEL 220
LP SYSTEM
(PREVIOUS DESIGN USING ZENITH LP REGULATOR)

MODEL 220 LPG COMPONENTS PARTS LIST

(Note: This Parts List Covers Only the LP System Using the Zenith LP Regulator)

Ref. No.	TENNANT Part No.	Description	Qty.
1	22308	HOSE	1
Not shown	10769	PLATE, Data	1
2	11442-1	ELBOW	1
3	22308	HOSE	1
4	22642	HOSE	1
5	26367	STUD	2
6	26496	COUPLING, rego	1
7	26632A	* LP REGULATOR, Two stage (Zenith)	1
9	28144	PIN, Roll	4
Not shown	29830-5	CABLE, Battery positive	1
Not shown	29830-3	CABLE, Battery negative	1
10	49243	BRACKET, Coil LP	1
Not shown	49271	TOP, Seat support	1
Not shown	49690-A	WIRING KIT (LP only)	1
Not shown	49725	TRAY, Battery	1
11	49729	BRACKET, Tank	1
12	49730	STRAP, LP tank	2
Not shown	49758	EXTRUSION	1
13	50036	BRACKET, Regulator	1
Not shown	49795	ENGINE, Kohler, K301S, 12.0 HP/LPG	1
Not shown	49865-1	COVER, LP engine	1
14	53395-1	FILTER-FUELOCK	1
15	49245	TANK, LP Vapor	1
16	49250	CONTROL MODULE, LP Fuel shut off	1
17 Kohler#	A-236448	CARBURETOR, LP	1
18	50018	FITTING	1

*To replace Regulator #26632A with new Garretson Primary and Secondary Regulators, order SK1840.



MODEL 220

LPG SYSTEM USI NG GARRETSON PRI MARY AND SECONDARY REGULATORS

220 LP SYSTEM PARTS LIST

USI NG GARRETSON PRI MARY & SECONDARY REGULATORS

Ref. No.	TENNANT Part No.	Description	Qty.
1	37851	CARBURETOR, LP	1
2	47757	HOSE	1
3	14680	ELBOW	1
4	47759	REGULATOR, Secondary, Garretson	1
5	47756	BRACKET, Secondary regulator mounting	1
6	17400-22	CONNECTOR	1
7	05499	NIPPLE	1
8	15552	ELBOW	1
9	47758	REGULATOR, Primary, Garretson	1
10	27048	ELBOW	1
11	22308-6	HOSE	1
12	11442-1	ELBOW	1
13	33554	FILTER-FUELLOCK	1
14	27048	ELBOW	1
15	22308	HOSE	1
16	26496	COUPLING, Tank	1
17	28144	PIN, Roll	4
18	49730	STRAP, LP Tank	2
19	49245	TANK, LP Vapor	1
20	26367	STUD	2
21	49729	BRACKET, Tank mounting	1
22	49250	MODULE, LP control	1
23	49243	BRACKET, LP coil	1
		PARTS NOT SHOWN:	
	29830-5	CABLE, Battery positive	1
	29831-3	CABLE, Battery negative	1
	49041	ENGINE ASSEMBLY, LP (Kohler K301S, 12.0 hp)	1
	49865-1	COVER, Engine, (LP only)	1
	49271	TOP, Seat support	1
	49725	TRAY, Battery	1
	49690A	WIRING KIT, (Model 220 LP only)	1

* Kohler Part No.

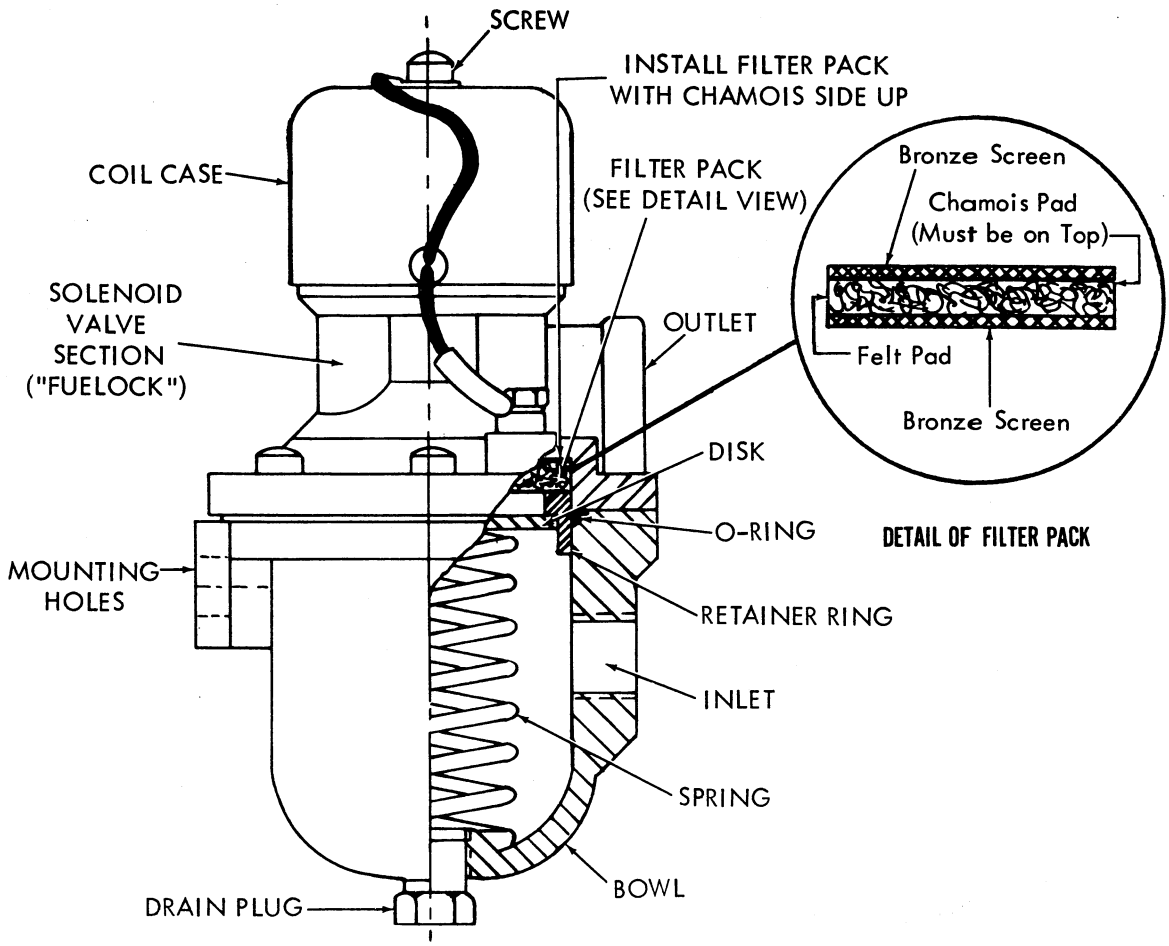
THE FILTER-FUELOCK
(COMBINATION FUEL FILTER AND SOLENOID LOCK-OFF VALVE)

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

This unit also filters impurities from the liquid fuel.

A. THE FILTER SECTION

In this assembly, fuel enters the bowl casting through inlet port in the side of the bowl. Large solid particles, such as tank scale, fall out of the fuel stream and remain in the bowl while the fuel continues to travel upward through the filter pack, where remaining solids are stopped. A drain plug is provided for purging the filter bowl. Clean out the bowl when necessary. Replace the filter pack every 500 hours or when diminished gas flow indicates filter is clogged.



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

REPLACING FILTER PACK

DISASSEMBLY:

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

NOTE SPRING INSIDE FILTER BOWL MAY SUDDENLY PUSH UP THE TOP SECTION WHEN THE SCREWS ARE REMOVED.

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

ASSEMBLY:

1. Install new filter pack in recess in top section. NOTE: INSTALL FILTER PACK WITH CHAMOIS SIDE UP, AS SHOWN IN DRAWINGS.
2. Place retainer ring in place and gently tap into position with soft-faced hammer. Position retainer as shown in section drawing.
3. Install new O-Ring gasket around retainer ring as shown in section drawing.
4. Place spring in bowl with large open end of spring down. The small end of the spring fits into the retainer ring, as shown in the section drawing.
5. With all parts in their correct relative position, press the top valve section down to compress the spring in the bowl. Then insert the six screws attaching the top section to the bowl and tighten.

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

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

L.P. FUEL TROUBLESHOOTING

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

(continued on next page)

L.P. FUEL TROUBLESHOOTING (Continued)

	Won't Start	Stops During Operation	Runs Unevenly-Lacks Power
(3) Ignition System	Remove and check spark plug to be sure it is the correct type with proper gap. Check ignition points and condenser. Check coil. Check ignition switch . Check wiring for loose connections or wire breakage. Check battery terminals for corrosion or loose ground cable. Check possible shorts in wiring Battery dead. No current to "Filter-Fuelock"solenoid valve or possible defective solenoid.	Check electrical system for loose connections or intermittent shorts. Check spark and electrical system for malfunction of condenser, points etc. Check for broken wires or defective relay. Relay can be checked by by-passing relay and directly energizing the solenoid valve in "Filter-Fuelock"	Check ignition for poor connections or weak or worn ignition parts.
(4) Carburetor	Always check carburetor for proper settings before tampering with regulator adjustment. Flooded carburetor - shut off tank valve with ignition switch "On", crank engine through a few times. If the engine starts, then slowly open tank valve to provide fuel flow through line. If engine does not start before opening fuel tank valve, then choke engine and use standard starting procedure.	Restricted air cleaner Clean or replace filter element.	Check carburetor setting. Check ignition system.
(5) Regulator	Be sure carburetor is properly adjusted before attempting to adjust regulator setting. In trouble shooting, be sure all of the previous five check points have been checked thoroughly before making any adjustment to regulator.	Only after checking the carburetor setting, should the regulator be checked (too rich or too lean). Could very definitely affect operation if carburetor adjustment is correct.	Could be improper setting. Allow too rich or too lean mixture to carburetor. Check and adjust only after checking carburetor Adjustment.

(continued on next page)

L.P. FUEL TROUBLESHOOTING (continued)

	Won't Start	Stops During Operation	Runs Unevenly-Lacks Power
(6) Engine	Under ordinary circumstances a new engine should start easily if the components previously mentioned have been checked through and properly adjusted. On an older engine, if proper adjustment on other components are correct it is possible that major repairs may be required to the basic engine.	Check Engine Trouble-Shooting Chart in Machine Manual.	See Engine Trouble-Shooting Chart in Machine Manual

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

TENNANT COMPANY, TENNANT COMPANY SUBSIDIARIES, AND MAJOR PARTS AND SERVICE LOCATIONS DIRECTORY

LOCATION	PHONE	TELEX
NORTH AMERICA		
U.S.A.		
CALIFORNIA Los Angeles Parts and Service Center 1080 N. Kraemer Place P. O. Box 66066 Anaheim, CA 92806	(714) 630-0800	183-014
GEORGIA Atlanta Parts and Service Center 5805 Peachtree Corners E. Rd. Norcross, GA 30092 Toll free in - FL, MS, AL, TN, KY, NC, SC	(404) 447-1500 (800) 241-8964	70-7415
ILLINOIS Chicago Parts and Service Center 2670 United Lane P. O. Box 725 Elk Grove Village, IL 60007	(312) 595-1770	726-368
MICHIGAN Detroit Parts and Service Center 5601 Enterprise Dr. P. O. Box 927 Warren, MI 48090	(313) 573-6600	23-5627
MINNESOTA Tennant Company, World Headquarters Minneapolis Factory Customer Services 701 N. Lilac Dr. Minneapolis, MN 55422 Mailing Address: P. O. Box 1452 Minneapolis, MN 55440	(612) 540-1315	29-0451
PENNSYLVANIA Philadelphia Parts and Service Center 855 Bethel Avenue P. O. Box G Pennsauken, NJ 08110	(609) 665-2231	834-430
TEXAS Dallas/Ft. Worth Parts and Service Center 1025 Santerre Drive Grand Prairie, TX 75050 Mailing Address: P. O. Box 5584 Arlington, TX 76011	(214) 647-0801	—
CANADA		
ONTARIO Toronto Parts and Service Center 7575 Kimbel St., Unit 1, Mississauga Ontario, Canada L5S 1C8	(416) 677-8070	06-983504
SOUTH AMERICA		
BRAZIL Equipamentos Tennant Limitada Av. Dona Ruyce Ferraz Alvim, 2056 Caixa Postal 226 Diadema - SP - Brazil CEP 09900	456-2655	Cable TENBRACO

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TENNANT COMPANY, TENNANT COMPANY SUBSIDIARIES, AND MAJOR PARTS AND SERVICE LOCATIONS DIRECTORY (CONTINUED)

LOCATION	PHONE	TELEX
ASIA		
JAPAN Fuji-Tennant, Ltd. Shinjuku Building 8-1, Nishi-Shinjuku, 1-chome Shinjuku-ku, Tokyo, Japan	342-8681	781-232-2268 RCA ATTN: Fuji-Tennant
AUSTRALIA		
AUSTRALIA Tennant Australia 55 Salisbury Road Hornsby, New South Wales 2077 Australia	476-5893	AA27393
EUROPE		
NETHERLANDS Tennant N.V. Industrielaan 6 5400 AA Uden, N.B., Netherlands	(4132) 63955	844 50079
UNITED KINGDOM Tennant Maintenance Systems, Ltd. Pool Road East Molesey Surrey KT 8 ONH United Kingdom	941-5585	8953787
WEST GERMANY Tennant N.V. Zweigniederlassung Remscheid Walter Freitagstr. 39 5630 Remscheid 12 West Germany	02191-53087	08 513 478 TENV D.

This is a listing of *major* Tennant Company parts and service centers. Parts and service are also available at many other Tennant Company centers or distributors located around the world. To determine your nearest Tennant Company representative, phone or write the Tennant Company World Headquarters.