John Deere
Service Manual
110 Lawn and Garden Tractor
(Serial No. 250,001 -)
SM-2101-(Jan-74)

John Deere Horicon Works
SM2101 (Jan-74)
LITHO IN U.S.A.
ENGLISH

110 LAWN AND GARDEN TRACTOR
(Serial No. 250,001-)
Service Manual
SM-2101-(Jan-74)

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(All information, illustrations, and specifications contained in this service manual are based on the latest information available at the time of publication. The right is reserved to make changes at any time without notice.)

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INTRODUCTION

This service manual contains service and maintenance information for the John Deere 110 Lawn and Garden Tractor (Serial No. 250,001-).

The manual is divided into sections. Each section pertains to a certain component or operational system of the tractor. The information is divided into groups within each section.

Emphasis is placed on diagnosing malfunctions, analysis and testing. Diagnosing malfunctions includes possible troubles, their causes and how to correct them. Under specific components these troubles are analyzed to help you understand what is causing the problem. In this way, you can eliminate the cause rather than just replace parts and have the same problem keep recurring.

Specifications and special tools are found in the last group of each section.

This manual can be kept in its own cover or it can be filed in your service manual rack or in your Consumer Products Service Information Binder.

Whenever new or revised pages are provided, insert them into your manual as soon as you receive them. Your service manual will always be up-to-date and be a valuable asset in your service department.

This safety alert symbol identifies important safety messages in this manual. When you see this symbol, be alert to the possibility of personal injury and carefully read the message that follows.

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SERIAL NUMBERS

Tractor

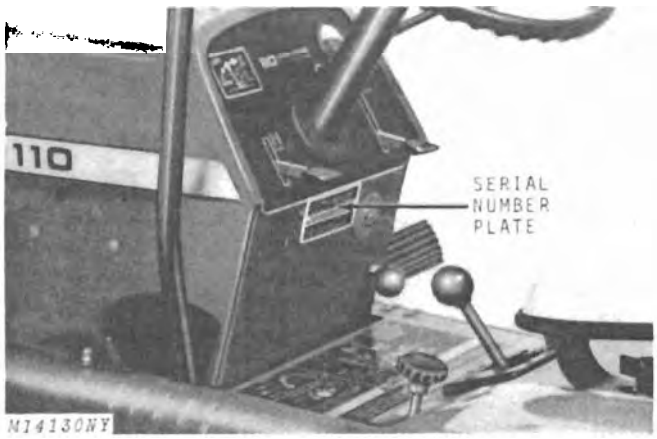

Fig. 1-Tractor Serial Number Plate

The tractor serial number, Fig. 1, is located on the pedestal below the steering wheel.

Engine

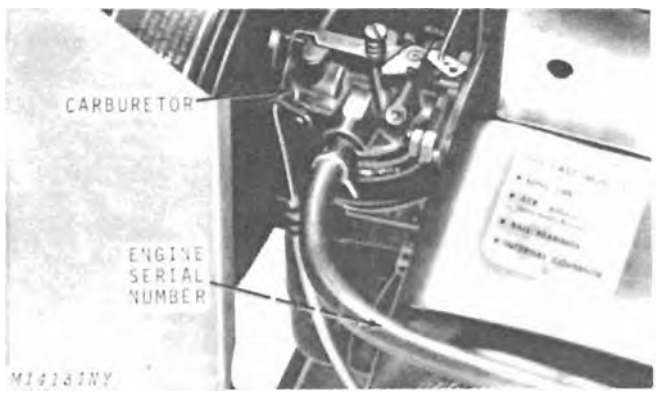

Fig. 2-Engine Serial Number Plate

The engine serial number, Fig. 2, is located on the front of the engine shroud.

VINTAGE INFORMATION

Year Manufactured	110 Tractor (8 hp) Tractor Serial No.	110 Tractor (10 hp) Tractor Serial No.
1972	(250,001-260,000)	(260,001-272,000)
1973	(272,001-285,000)	(285,001-310,000)
1974	(310,001-320,000)	(320,001-)

IDENTIFICATION CODES

Tire Codes

John Deere 110 Tractors are available with three different combinations of tires as follows:

Tire Code	Size Front	Size Rear	Tread
GT-3	16x6.50-8	23x8.50-12	High-Flotation
GT-4	4.80/4.00-8	------	Studded
	------	23x8.50-12	Traction
GT-5	16x6.50-8	23x10.50-12	High-Flotation
GT-8 Bar Tread	16x6.50-8 or 4.80/4.00-8	------	High-Flotation
	------	23x10.50-12	Traction

Tractor Codes

Four identification codes are used for 110 Lawn and Garden Tractors Serial Number 250,001 and above. See the chart below for the codes, type of lift and serial numbers for each group of tractors.

Tractor	Serial No.	Manual Lift	Hydraulic Lift	Electric Lift
8 hp	250,001-260,000	0643M		
8 hp	272,001-285,000	0643M		
8 hp	310,001-320,000	0643M		
10 hp	260,001-272,000	0631M	0632M	
10 hp	285,001-310,000	0631M		0633M
10 hp	320,001-	0631M		0633M

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Group 10
SPECIFICATIONS

TRACTOR SPECIFICATIONS

Item	8 hp	10 hp
CAPACITIES		
Fuel Tank	1.75 U.S. Gallons	1.75 U.S. Gallons
Crankcase	2-1/2 U.S. Pints	3 U.S. Pints
Transaxle	3-1/2 U.S. Pints	3-1/2 U.S. Pints
Hydraulic System	. . . . .	2 U.S. Pints
TRANSMISSION		
Type	Transaxle	Transaxle
Gear Selections	4 forward - 1 reverse	4 forward - 1 reverse
TRAVEL SPEEDS - @3600 rpm		
1st Gear (Variable)	.4 to 1.0 mph	.4 to 1.0 mph
2nd Gear (Variable)	1.3 to 2.9 mph	1.3 to 2.9 mph
3rd Gear (Variable)	2.4 to 5.0 mph	2.4 to 5.0 mph
4th Gear (Variable)	3.4 to 7.4 mph	3.4 to 7.4 mph
Reverse (Variable)	1.8 to 3.3 mph	1.8 to 3.3 mph
DIMENSIONS		
Wheelbase	46 in.	46 in.
Overall Length	66-3/4 in.	66-3/4 in.
Overall Height	41 in.	41 in.
Overall Width (maximum)	41-1/2 in.	41-1/2 in.
WHEEL TREAD		
Front	31 in.	31 in.
Rear (GT-3 Tires)	27 in. or 33 in.	27 in. or 33 in.
(GT-5 Tires)	28-1/2 in. or 31 in.	28-1/2 in. or 31 in.
BRAKES		
Type	Band, pedal-operated	Band, pedal-operated
Parking	Hand lock foot brake	Hand lock foot brake
CLUTCH	V-belt system	V-belt system
PTO CLUTCH	Manual	Manual
STEERING	Enclosed gear	Enclosed gear
LIFT	Manual	Manual, Electric, Hydraulic
SHIPPING WEIGHT (GT-3 TIRES)	691 lbs.	759 lbs. - Manual lift 774 lbs. - Electric lift 770 lbs. - Hydraulic lift

ENGINE SPECIFICATIONS

Item	8 hp	10 hp
Engine Model No.	K181S	K241AS
Manufacturer	Kohler	Kohler
Cylinders	One	One
Stroke/Cycle	Four	Four
Bore	2.94 in.	3.25 in.
Stroke	2.75 in.	2.875 in.
Displacement	18.63 cu. in.	23.9 cu. in.
Speeds (fast) No-Load	3600 to 3900 rpm	3600 to 3900 rpm
Speeds (idle)	1650 to 1950 rpm	1650 to 1950 rpm
Horsepower*	8 @3600 rpm	10 @ 3600 rpm
Normal Compression	110 to 120 psi	110 to 120 psi
Valve Clearance		
Intake (Cold)	0.007 in.	0.010 in.
Exhaust (Cold)	0.016 in.	0.020 in.
Ignition**	Magneto	Battery
Spark Plug	J-8-Champion 45-M-AC 14-7 Prestolite	H-10-Champion 45-L-AC 14-L7B-Prestolite
Spark Plug Gap	0.020 in.	0.020 in.
Breaker Point Gap	0.020 in.	0.020 in.
Charging System***	Alternator	Alternator
Starter	12-Volt	12-Volt
Air Filter	Dry-type	Dry-type

**The horsepower rating shown is established by the engine manufacturer in accordance with Standard Internal Combustion Engine Institute procedure. It is corrected at 60°F. and 29.22 in. Hg. Barometer and is developed from laboratory test engines equipped with standard air cleaner and muffler.*

***Magneto ignition is used on 8 hp tractors through Serial No. 252,832. Battery ignition is used on 8 hp and 10 hp tractors beginning with Serial No. 252,833.*

****See page 40-5-3 for a listing of tractors with 10 amp or 15 amp alternators.*

TIRE SPECIFICATIONS

Tire Code	Location	Size	Tubeless	Ply-Rating	Tread	Tire Inflation Pressure (PSI)
GT-3	Front Rear	16x6.50-8 23x8.50-12	Yes* Yes*	2 2	High- Flotation	6 to 16 5 to 10
GT-4	Front Rear	4.80/4.00-8 23x8.50-12	No Yes*	4 2	Studded Traction	12 to 40 5 to 10
GT-5	Front Rear	16x6.50-8 23x10.50-12	Yes* Yes*	2 2	High- Flotation	6 to 16 5 to 10
GT-8 Bar Tread	Front** Rear	16x6.50-8 23x10.5-12	Yes* Yes*	2 2	High- Flotation Traction	6 to 16 5 to 10

*Tubes available for service. See your parts catalog.
**Use 4.80/4.00-8 front tires with front-end loaders.

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BATTERY SPECIFICATIONS

Tractor	Battery
8 hp	John Deere, 12 Volt, (AM30094), BCI Group U1, 135 cold cranking amps at 0°F., 30-minute reserve capacity.
10 hp	John Deere, 12 Volt, (AM31186), BCI Group 22F, 255 cold cranking amps at 0°F., 55-minute reserve capacity

REAR WHEEL WEIGHT BOLT SIZE CHART

Tire/Wheel Option	Wheel Position	No. of Weights	Bolt Size
GT-3 or GT-4	Narrow	1	1/2x5-1/2
GT-3 or GT-4	Narrow	2	1/2x7-1/2
GT-3 or GT-4	Wide	1	1/2x5-1/2
GT-3 or GT-4	Wide	2	1/2x7-1/2
GT-5	Narrow	1	1/2x5-1/2
GT-5	Narrow	2	1/2x8
GT-5	Wide	1	1/2x5-1/2
GT-5 or GT-8	Wide	2	1/2x7-1/2
Adjustable	Not Reversible	1	1/2x2-1/2
Adjustable	Not Reversible	2	1/2x4-3/4

BOLT TORQUE CHART

Grade of Bolt		SAE-2	SAE-5	SAE-8		
Min. Tensile Strength		64,000 PSI	105,000 PSI	150,000 PSI		
Grade Marking on Bolt					Socket or Wrench Size	
U.S. Standard		TORQUE IN FOOT POUNDS			U.S. Regular	
Bolt Dia.	U.S. Dec. Equiv.				Bolt Head	Nut
1/4	.250	6	10	14	7/16	7/16
5/16	.3125	13	20	30	1/2	1/2
3/8	.375	23	35	50	9/16	9/16
7/16	.4375	35	55	80	5/8	11/16
1/2	.500	55	85	120	3/4	3/4
9/16	.5625	75	130	175	13/16	7/8
5/8	.625	105	170	240	15/16	15/16
3/4	.750	185	300	425	1-1/8	1-1/8
7/8	.875	*160	445	685	1-5/16	1-5/16
1	1.000	250	670	1030	1-1/2	1-1/2

Multiply Readings by 12 for inch pound values.

** "B" Grade bolts larger than 3/4-inch are sometimes formed hot rather than cold which accounts for the lower recommended torque.*

NOTE: Allow a tolerance of plus or minus 10% on all torques given in this chart.

SET SCREW SEATING TORQUE CHART

Screw Size	Cup Point	Square Head
	Torque In Inch Pounds	
#5	9	—
#6	9	—
#8	20	—
#10	33	
1/4	87	212
5/16	165	420
3/8	290	830
7/16	430	—
1/2	620	2100
9/16	620	—
5/8	1225	4250
3/4	2125	7700

Divide Readings by 12 for foot pound values
NOTE: Allow a tolerance of plus or minus 10% on all torques given in this chart.

Group 15
TUNE-UP AND ADJUSTMENT

PRELIMINARY ENGINE TESTING

Operation	Specification	Reference
Cylinder compression	110 to 120 psi (reverse rotation)	Section 20, Group 5
Crankcase vacuum	Idle speeds: 10 to 15 inches of water column Full speed: Approx. 5 inches of water column	Section 20, Group 5

MINOR TUNE-UP GUIDE

Operation	Specification	Reference
Change oil	Summer above 32°F. SAE 30 Winter below 32°F. SAE 5W-20	Section 10, Group 20
Clean and regap spark plug	Clean electrodes and insulator. Set gap at 0.020 in. (8 hp) and 0.020 in. (10 hp).	Section 40, Group 15 or 20
Remove air cleaner and clean by tapping lightly against flat surface.	Check air cleaner condition Replace if necessary	Section 30, Group 15
Adjust carburetor	High-speed mixture needle Idle mixture needle Idle stop screw Speed (idle) - 1650 to 1950 rpm	Section 30, Group 10
Adjust governor speed	Speed (fast - no load) 3600 to 3900 rpm	Section 20, Group 10
Check and clean fuel tank and fuel shut off strainer.	Regular non-leaded gasoline with an octane rating of 90 or higher.	Section 30, Group 20
Battery hydrometer test	1.260 to 1.280 specific gravity 100% charged at 80°F.	Section 40, Group 10

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MAJOR TUNE-UP GUIDE

IMPORTANT: Major tune-up should include all items listed for "Minor Tune-Up" on page 10-15-1 in addition to the following:

Operation	Specification	Reference
Recondition carburetor	Install carburetor repair kit	Section 30, Group 10
Inspect and clean breather assembly	Replace parts as necessary. Install new gaskets. Check crankcase vacuum after assembly.	Section 20, Group 10
Remove shrouding, clean cylinder and cylinder head fins	.....	Section 20, Group 10
Test condenser	.....	Section 40, Group 15 or 20
Test coil	.....	Section 40, Group 15 or 20
Replace breaker points	Point gap 0.020 ± 0.002 in.	Section 40, Group 15 or 20
Retime ignition	"S" mark on flywheel at 1200 to 1800 rpm	Section 40, Group 15 or 20

COMMON ADJUSTMENTS

NOTE: The following common adjustments are recommended after engine tune-up is completed.

Adjustment	Specification	Reference
Variator	.....	Section 50, Group 10
Steering linkage	.....	Section 70, Group 5
Brakes	.....	Section 50, Group 10

Group 20
FUEL AND LUBRICANTS

FUEL

Always use fresh, clean "regular" grade gasoline having an octane rating of 90 or higher. We recommend non-leaded gasoline because it reduces cylinder head deposits. Low-lead or leaded "regular" grades are acceptable if the octane rating is 90 or higher.

DO NOT use premium, ethyl or white gasoline or regular gasoline having an octane rating below 90. Never use special additives such as carburetor cleaners, de-icers, or moisture-removing liquids in your gasoline.

IMPORTANT: Do not mix oil with gasoline.

Avoid using stale gasoline or gasoline that has been stored a long time. Stale gasoline does not vaporize properly and causes hard starting.

IMPORTANT: Do not permit dirt or other foreign matter to enter the fuel system which may cause hard starting, poor performance and engine damage. Always use clean gasoline storage cans and funnels.

LUBRICANTS

Effective use of lubricating oils and greases is perhaps the most important step toward low up-keep cost, long tractor life, and satisfactory service. The charts on this page indicate capacity, type of lubricant, and service intervals.

John Deere Torq-Gard Supreme Engine Oil is recommended because of its superior lubricating qualities. If oil other than Torq-Gard Supreme is used, it must conform to one of the following specifications:

SINGLE-VISCOSITY OILS

API Service CD/SE, CD/SD, CC/SD or SD
MIL-L-46152 or MIL-L2104C*

MULTI-VISCOSITY OILS

API Service CC/SE, CC/SD, or SD
MIL-L-46152

**As further assurance of quality, the oil should be identified as suitable for API Service Designation SD.*

IMPORTANT: Never put additives in the crankcase. Additives could reduce rather than help oil's lubricating ability.

CAPACITIES

Fuel Tank ..... 1-3/4 U.S. gallons
Crankcase
8 hp ..... 2-1/2 U.S. pints
10 hp ..... 3 U.S. pints
Transaxle ..... 3-1/2 U.S. pints
Hydraulic System (optional equip.) ..... 2 U.S. pints

TYPE OF LUBRICANT

Crankcase

Depending on the expected prevailing temperature for the fill period, use oil of viscosity as shown in the following chart.

Air Temperature	John Deere Torq-Gard Supreme Oil	Other Oils	
		Single Viscosity Oil	Multi-Viscosity Oil
Above 32°F.	SAE 30	SAE 30	Not recommended
−10°F. to 32°F.*	SAE 10W-20	SAE 10W	SAE 10W-30
Below −10°F.	SAE 5W-20	SAE 5W	SAE 5W-20

**SAE 5W-20 oil may also be used to insure optimum lubrication at starting, particularly when engine is subjected to −10°F. or lower temperatures for several hours.*

Some increase in oil consumption may be expected when SAE 5W-20 or SAE 5W oils are used. Check oil level more frequently.

Transaxle ..... John Deere AM30200 Transmission Lubricant or SAE 90 Gear Lubricant. Also an equivalent SCL Multipurpose-Type Gear Oil

Tractor Grease Fittings ..... John Deere Multipurpose Lubricant SAE (Seasonal grade) or equivalent Multipurpose-Type Grease

Hydraulic System (Optional Equipment) ..... John Deere All-Weather Hydrostatic Fluid or an equivalent Type A or F Automotive Automatic Transmission Fluid.

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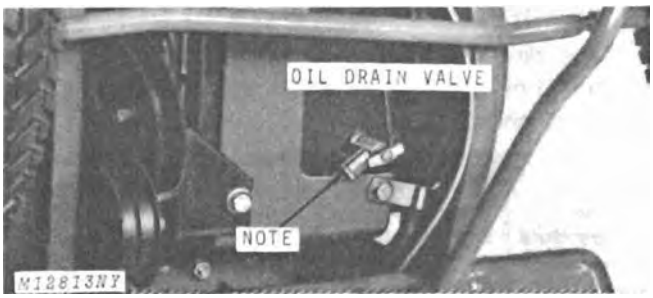
SERVICE INTERVALS

Crankcase (Oil Change)
- Break-in ..... First 2 hours
- Regular ..... Every 25 hours
- Dusty Conditions ..... Every 8 hours

Transaxle (Oil Change) .....200 hours or 2 years
Tractor Grease Fittings
(See page 10-20-3 and 10-20-4 for locations)
Spring and Fall Season
Hydraulic System (Optional Equip) ..... Every 25 hours check level

CHANGING CRANKCASE OIL



10 hp Tractor Illustrated

Fig. 1-Draining Oil

8 hp Tractor *10 hp Tractor*

Fig. 2-Dipstick and Oil Fill Tube

Drain crankcase when oil is hot and all dirt and foreign material is in suspension.

NOTE: For convenience, a suitable length of 5/8-inch garden hose or plastic tubing may be installed on the drain valve to allow oil to drain into a container away from the tractor. See Figure 1.

Remove drain plug or open oil drain valve, Fig. 1, and allow oil to drain into a container.

Install plug or close valve. Fill crankcase with oil, Fig. 2, of the proper viscosity (page 10-20-1) to "F" mark on dipstick. Crankcase capacity is approximately 3 U.S. pints.

IMPORTANT: Check dipstick reading before pouring in the last 1/2 pint. Fill only to "F" mark. Overfilling can cause engine overheating resulting in permanent damage to the engine.

NOTE: Change oil every eight hours when working in extremely dusty conditions.

CHANGING TRANSAXLE OIL

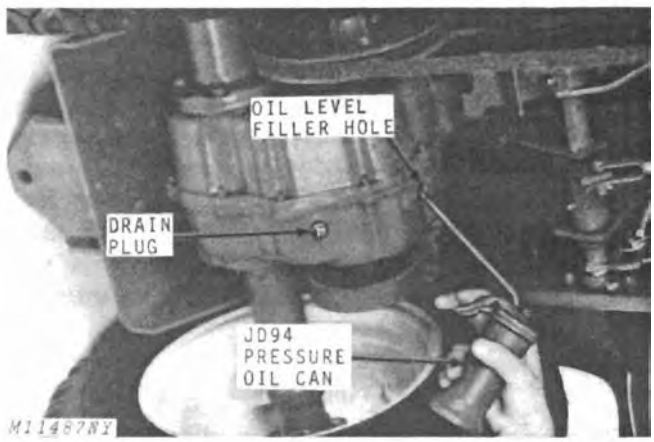


Fig. 3-Adding Oil to Transaxle

Every 2 years or 200 hours of operation, remove the transaxle drain plug and drain all oil into a shallow container. Wipe the drain plug clean and replace it in the transaxle.

Add seven 1/2-pint cans of John Deere AM30200 Transmission Oil or its equivalent through the filler hole, Fig. 3. The transaxle holds 3-1/2 U.S. pints of oil.

CHECKING HYDRAULIC LIFT SYSTEM FLUID LEVEL (Optional Equipment)

Every 25 hours of operation check to see that the fluid level is from 1-1/2 to 2 inches from the top of the reservoir.

When required, add John Deere All-Weather Hydrostatic Fluid or an equivalent Type A or F Automotive Automatic Transmission Fluid. Add only enough to keep the reservoir filled to the proper level.

IMPORTANT: Do not allow dirt or foreign material to enter the reservoir. Do not overfill.

LUBRICATING GREASE FITTINGS
110 Tractors (Serial No. -272,000)

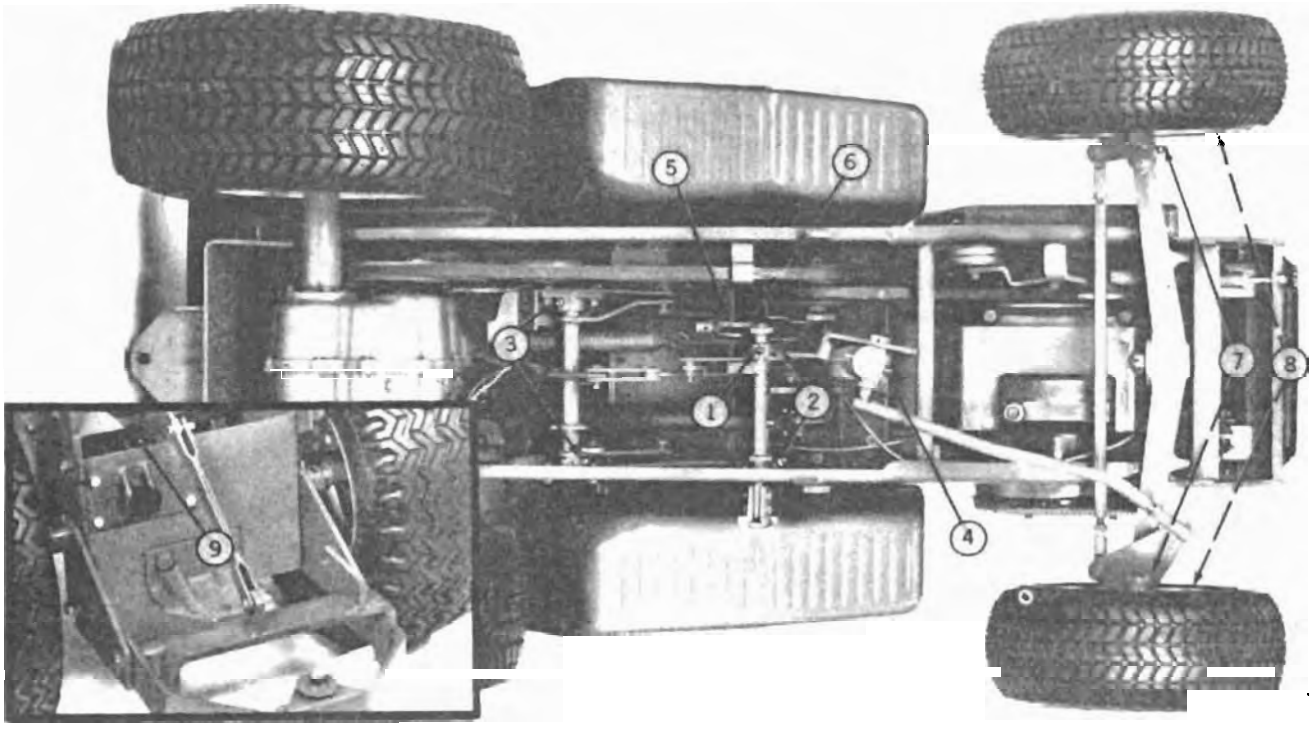


Fig. 4-Grease Fitting Locations on 110 Tractor (Serial No. -272,000)

Each spring and fall lubricate the following 13 grease fittings, (14 with extra equipment integral hitch shown in inset) Fig. 4, with John Deere Multi-Purpose Lubricant or an equivalent SAE multipurpose-type grease:

1. Clutch-brake shaft (two fittings).
2. Primary lift shaft (two fittings).
3. Secondary lift shaft (two fittings).
4. Steering gear
5. Clutch over-ride.
6. Variator pivot.
7. Front wheel spindles (two fittings).
8. Front wheel bearings (two fittings).
9. Integral hitch (extra equipment).

NOTE: Do not overlubricate steering gear fitting. Only 3 to 4 strokes with a hand grease gun or John Deere Pisto-Luber are necessary. Do not use a high-pressure grease gun on this fitting (4).

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LUBRICATING GREASE FITTINGS—Continued
110 Tractors (Serial No. 272,001-)

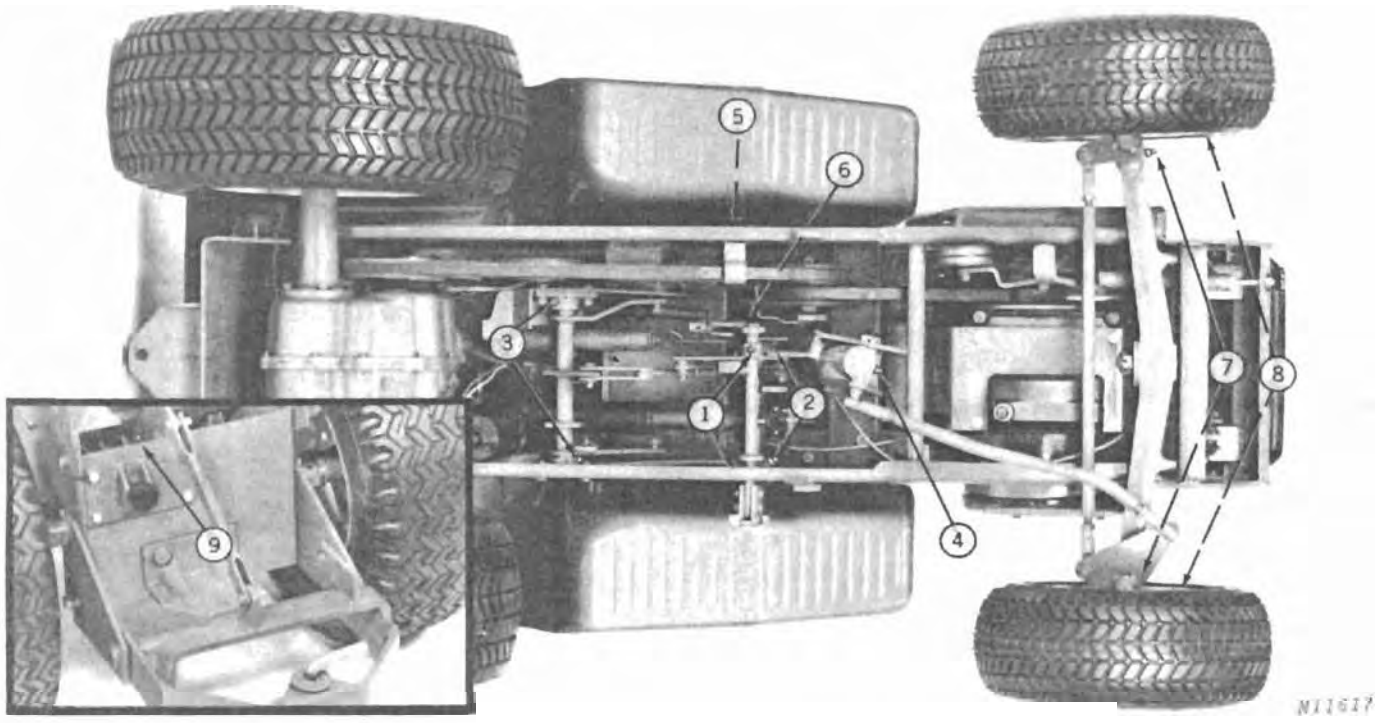

Fig. 5-Grease Fitting Locations on 110 Tractor (Serial No. 272,001-)

Each spring and fall lubricate the 13 grease fittings (14 with extra equipment integral hitch shown in inset) Fig. 5, with John Deere Multi-Purpose Lubricant or an equivalent SAE multipurpose-type grease.

1. Clutch pedal shaft (two fittings).
2. Primary lift shaft (two fittings).
3. Secondary lift shaft (two fittings).
4. Steering gear.
5. Brake pedal shaft.
6. Variator pivot.
7. Front wheel spindles (two fittings).
8. Front wheel bearings (two fittings).
9. Integral hitch (extra equipment).

NOTE: Do not overlubricate steering gear fitting. Only 3 to 4 strokes with a hand grease gun or John Deere Pisto-Luber are necessary. Do not use a high-pressure grease gun on this fitting (4).

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Section 20
ENGINE

Group 5
GENERAL INFORMATION

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DESCRIPTION

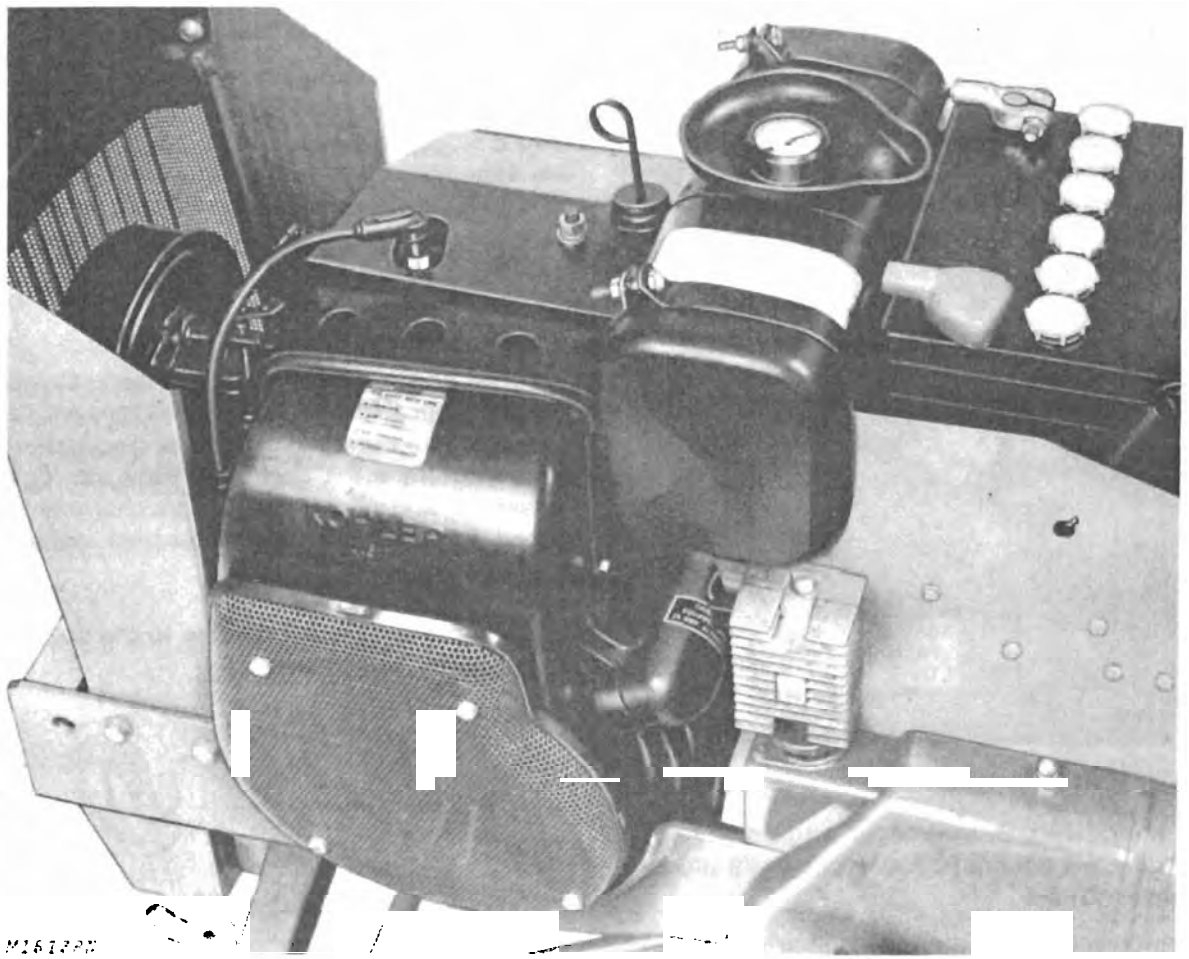


Fig. 1-Kohler K241AS Engine

The 8 hp tractor is equipped with a Kohler K181S engine and the 10 hp tractor is equipped with a Kohler K241AS engine, Fig. 1.

The K181S and K241AS are both four-cycle, L-head, single-cylinder, internal-combustion engines. Each engine has a cast-iron block with a large bore and short stroke.

The engines are air-cooled, with anti-friction ball bearings, oil bath lubrication and internal flyweight governor.

Other features are an alternator charging system and battery-coil ignition.

NOTE: 8 hp tractors (Serial No. 250,001-252,832) are equipped with magneto-alternator ignition systems. Beginning with Serial No. 252,833 8 hp tractors have battery-ignition systems.

ENGINE ANALYSIS

PRELIMINARY ENGINE CHECKS

A complete diagnosis guide of engine malfunctions begins on page 20-5-6. However, the majority of engine trouble reports are of a minor non-chronic nature and are usually due to electrical or fuel system difficulties. First make the checks listed below to isolate the majority of engine problems.

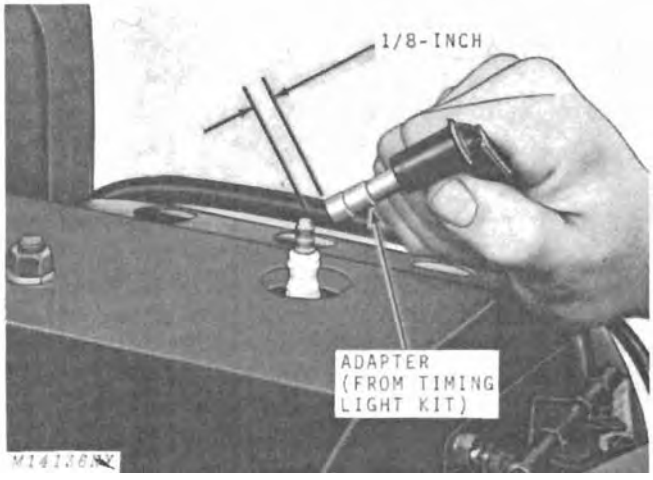


Fig. 2-Checking Spark At Plug

Check spark, Fig. 2, whenever engine will not start. If engine will not crank, follow diagnosis procedure on page 20-5-6.

Remove ignition cable from spark plug and install adaptor or ordinary paper clip. Hold approximately 1/8 inch away from spark plug terminal while cranking the engine.

If there is good spark between the adaptor and the spark plug terminal, the problem is in the fuel-air system. If gas tank is full, check shut-off valve under gas tank and gas lines to carburetor to be certain gas is getting to carburetor. Connect high tension wire to spark plug and crank engine. Choke as necessary. If engine still does not start, refer to "Diagnosing Malfunctions" to check for internal difficulties.

If there is no spark at the adaptor or a weak spark, the trouble is in the electrical system. If the battery and spark plug are good and all electrical connections are tight, the trouble most likely is in the breaker points or condenser. Clean or replace points and adjust gap. If breaker points are burned, replace the condenser also.

If the engine still does not start, or starts but does not run properly, make the compression test on this page and the vacuum test on page 20-5-5.

PRELIMINARY ENGINE TESTS

The following preliminary engine tests are recommended to detect and isolate possible malfunctions before proceeding with further diagnosis. These tests are especially important when the engine is burning oil, losing power or running erratically and when carburetion and ignition adjustments do not correct the condition.

Compression Test

Kohler engines have ACR (Automatic Compression Release Camshaft). Because ACR relieves compression pressure during lower cranking speeds, it is important to crank the engine at 1000 rpm or more to obtain an accurate test. ACR mechanism is disengaged when engine speed reaches approximately 650 rpm.

When the engine is operable in the tractor, check compression as follows.

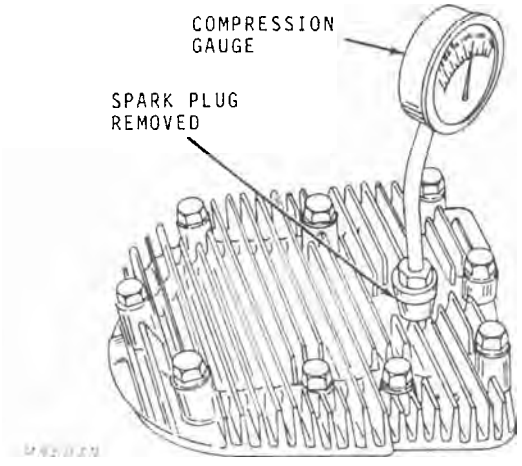


Fig. 3-Testing Engine Compression

Depress clutch-brake pedal or brake pedal and set parking brake. Be sure oil in crankcase is at proper level and battery is properly charged.

NOTE: Be sure tractor drives are all disengaged. Run engine until warm, then stop the engine.

Remove spark plug. Also remove air filter for most accurate test.

Set throttle and choke valve in wide open position by raising throttle lever, and lowering choke lever.

Hold compression gauge firmly in spark plug opening, Fig. 3. Crank engine at 1000 rpm and observe reading. Repeat test to verify readings.

A starter rope can be used if 650 rpm or more cannot be reached by using the electric starter.

To use starter rope procedure, wind a number of turns of 1/4-inch rope around PTO sheave opposite the direction of engine rotation. Pull rope firmly and observe reading. Repeat test until readings are consistent.

Test Conclusions

An engine in top operating condition will read 110 to 120 psi when engine is cranked approximately 1000 rpm.

A compression test above 120 psi, indicates excessive carbon deposits in the combustion chamber or on the piston.

A reading lower than 100 psi indicates leakage at the cylinder head gasket, piston rings or valves. *The engine should be reconditioned if compression falls below 90 psi.*

To determine whether the rings or the valves are at fault, pour about one tablespoonful of heavy oil into the spark plug hole. Crank the engine several revolutions to spread the oil and repeat the compression test.

The oil will temporarily seal leakage around the piston rings. If the same approximate compression reading is obtained, the rings are satisfactory, but the valves are leaking or the piston is damaged. If the compression has increased considerably over the original readings, there is leakage past the rings.

Crankcase Vacuum Test

The crankcase breather maintains a partial vacuum in the crankcase when the engine is operating properly.

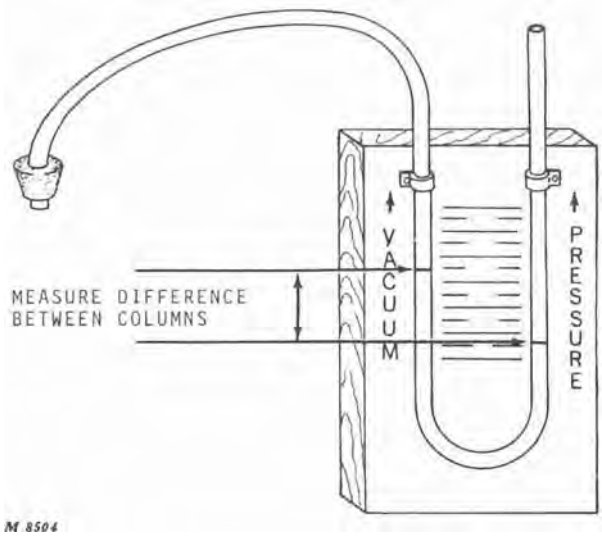


Fig. 4-Checking Crankcase Vacuum

Connect a water U-tube manometer, Fig. 4, to cylinder block oil filler tube. Tester must hang vertically. Start and run engine at 1200 to 1700 rpm. Allow engine to warm up and observe reading on scale. Follow manufacturer's recommendations for installation, testing and compensation for the effect of altitude on the gauge reading.

Test Conclusions

Proper crankcase vacuum for the K181S and K241AS engines is a 5 to 10-inch water column on the manometer gauge.

A crankcase vacuum reading lower than specified is most likely due to a leaking breather valve or improperly assembled breather. See page 20-10-9 and carefully reassemble all breather parts. A low vacuum reading may also be caused by leaky valves, engine blow-by or worn crankshaft oil seals.

If the crankcase is found to be pressurized rather than have a vacuum, chances are that the breather plate has been assembled backwards or the breather filter is plugged.

Engines with zero vacuum or a pressurized crankcase will likely be pumping oil into the combustion chamber or out the breather or oil seals. This can be detected by watching for excessive exhaust smoke, engine overheating or oil leakage outside the engine.

DIAGNOSING MALFUNCTIONS

Engine Will Not Crank

Transaxle not in neutral.

Battery discharged or defective.

Neutral-start switch and bracket loose or not properly adjusted.

PTO drive engaged.

Defective safety switch(es).

Defective starter.

Defective solenoid.

Loose electrical connections.

Defective key switch.

Engine seized.

Engine Starts Hard

Spark plug pitted or fouled.

Breaker points worn, pitted or out of adjustment.

High tension wire shorted.

High tension wire loose at spark plug or coil.

Loose electrical connections.

Restricted gas tank vent.

Clogged fuel line or air lock.

Broken choke cable.

Throttle cable not properly adjusted.

Dirt or water in fuel system.

High speed and idle mixture needles not properly adjusted.

Wrong valve clearance.

Leaking head gasket.

Restricted exhaust system.

Low compression.

Engine Starts But Fails To Keep Running

Restricted gas tank vent.

High speed and idle mixture needles not properly adjusted.

Broken choke cable.

Dirt or water in fuel system.

Carburetor float not properly adjusted or float valve leaking.

High tension wire loose at spark plug or coil.

High tension wire shorted.

Breaker points not properly adjusted.

Loose electrical connections.

Faulty condenser.

Excessive engine load.

Engine Cranks But Will Not Start

Empty gas tank.

Restricted gas tank vent.

Fuel shut-off valve closed (valve below gas tank).

Clogged, restricted or air-locked fuel line.

Breaker points worn or pitted.

Spark plug fouled or pitted.

Incorrect spark plug.

Battery not fully charged.

Loose electrical connections.

High speed and idle mixture needles not porperly adjusted.

Faulty condenser.

Defective ignition coil.

Dirt in fuel system.

Frayed electrical wire(s) causing ground(s).

Engine Runs But Misses

High tension wire loose from spark plug or coil.

Breaker points out of adjustment or worn and pitted.

Spark plug fouled, pitted or gap incorrect.

Incorrect spark plug.

Loose electrical connections.

Carburetor float not properly adjusted or float valve leaking.

Dirt or water in fuel system.

Wrong valve clearance.

Faulty coil.

Engine Misses Under Load

Spark plug fouled, pitted or gap incorrect.

High speed and idle mixture needles not properly adjusted.

Incorrect spark plug.

Breaker points out of adjustment or worn and pitted.

Ignition out of time.

Dirt or water in fuel system.

Stale fuel.

Engine Will Not Idle

Idle speed too low.

High speed and idle mixture needles not properly adjusted.

Dirt or water in fuel system.

Restricted gas tank vent.

Spark plug fouled, pitted or gap incorrect.

Wrong valve clearance.

Low engine compression.

Engine Misses When Advancing Throttle

Cold engine.

High speed and idle mixture needles not properly adjusted.

Spark plug fouled, pitted or gap incorrect.

Linkage misaligned (throttle arm-to-governor).

Engine Loses Power

Crankcase low on oil.

Engine shrouding plugged.

Excessive engine load.

Restricted air filter.

Dirt or water in fuel system.

High speed and idle mixture needle not properly adjusted.

Spark plug fouled, pitted, or gap incorrect.

Too much oil in crankcase.

Low engine compression.

Worn cylinder bore.

Engine Overheats

Dirty or plugged shrouding and engine fins.

High speed and idle mixture needles not properly adjusted.

Too much oil in crankcase.

Worn valve stem and/or guides.

Crankcase low on oil.

Excessive engine load.

Faulty breather causing low crankcase vacuum.

Engine Knocks

Engine out of time.

Stale fuel.

Excessive engine load.

Crankcase low on oil.

Engine Backfires

High speed and idle mixture needles not properly adjusted (lean mixture).

Loose cylinder head or blown head gasket.

Intake valve sticking in guide.

Ignition out of time.

Engine Low On Power At Full Throttle

Restricted air filter.

Spark plug fouled, pitted or gap incorrect.

Incorrect spark plug.

Restricted exhaust.

Breaker points out of adjustment, worn and pitted.

Clogged fuel line or air lock.

Broken choke cable.

Clogged breather assembly.

Defective ignition coil.

Governor malfunctioning.

Engine Does Not Maintain Constant Speed (Surges)

High speed and idle mixture needles not properly adjusted.

Spark plug gap incorrect.

Throttle-to-governor linkage not properly assembled.

Breaker points out of adjustment, worn or pitted.

Dirt of water in fuel system.

Sensitive governor.

Engine Uses Excessive Amount Of Oil

Clogged breather assembly.

Breather not assembled properly.

Worn or broken piston rings.

Worn cylinder bore.

Clogged oil holes in piston.

Wrong size piston rings.

Worn valve stems and/or valve guides.

Incorrect oil viscosity.

Faulty breather causing low crankcase vacuum.

Engine Runs Erratically

Dirt or water in fuel system.

High speed and idle mixture needles not properly adjusted.

Idle speed too low.

Spark plug fouled, pitted, or gap incorrect.

Poor compression.

Faulty breather causing low crankcase vacuum.

Carburetor leaking at gaskets or at fuel connections.

Restricted gas tank vent.

Throttle-to-governor linkage incorrectly assembled.

Sensitive governor.

Gasoline In Crankcase

Carburetor float not properly adjusted or leaking.

Worn float valve and/or seat.

Group 10
CYLINDER HEAD, VALVES AND BREATHER

GENERAL INFORMATION

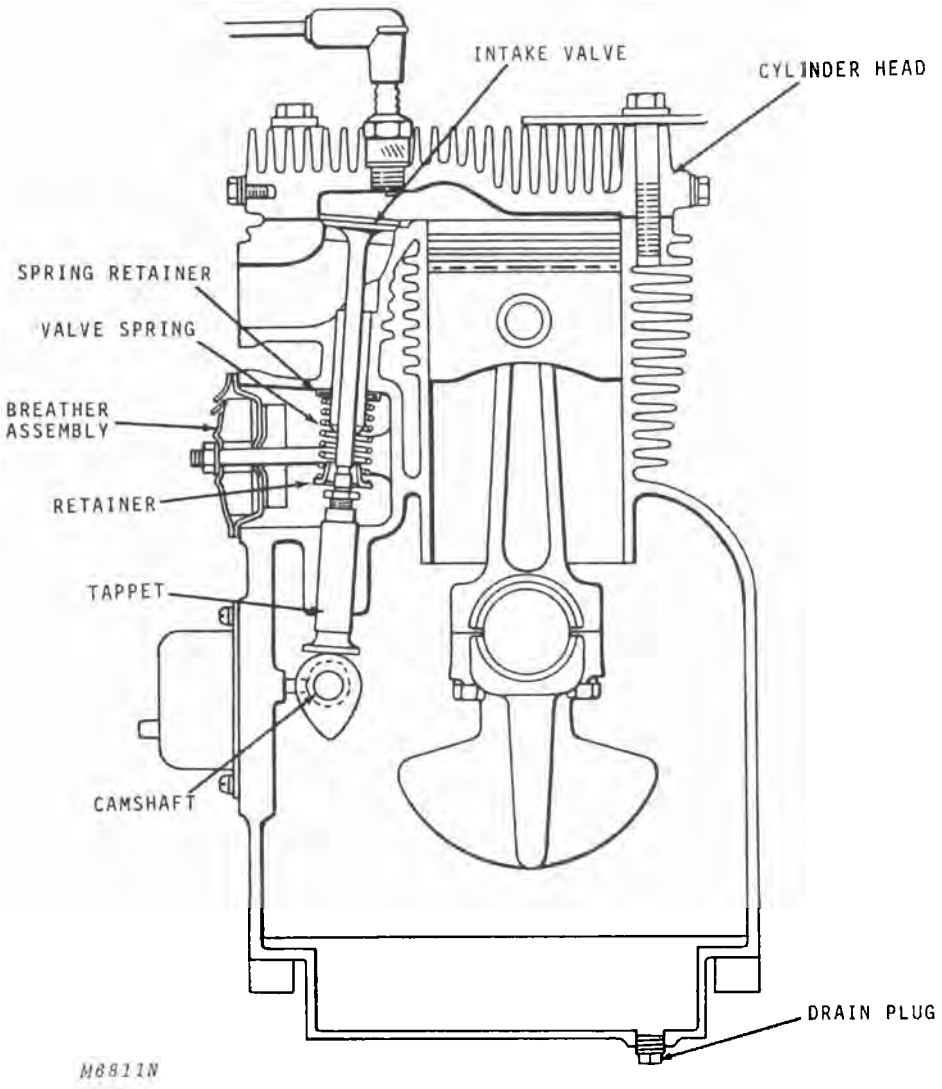


Fig. 1-Schematic View of Valves and Tappets

It is not necessary to remove the engine from the tractor to grind valves and valve seats or to service the breather assembly.

The exhaust valve insert is press fitted into the block and can be replaced. The intake valve seat is machined into the block.

Valve guides can be replaced when wear tolerances are exceeded.

The breather assembly, Fig. 1, is mounted in front of the valve spring chamber below the carburetor.

VALVE ANALYSIS

Fig. 2-Lead Deposits on Leaky Intake Valve

Lead deposits on the intake valve, Fig. 2, consist mostly of lead and some metal which comes from the lubricating oil. It is caused by a small amount of exhaust gas leakage into the intake port area. This indicates that the valve is not sealing properly. Grind the valve and reface the seat to correct this condition.

NOTE: Be sure to correct valve-to-tappet clearance after grinding valves. See page 20-10-8.

Fig. 3-Valve Stem Corrosion

Valve stem corrosion, Fig. 3, is caused by moisture finding its way into the engine. Moisture in the fuel-air mixture can condense inside the engine when the engine is stopped prior to warm up.

Valve corrosion can also occur during storage when the engine has been idle for some time. Fogging or pouring oil in the combustion chamber before storing will prevent valve corrosion.

Corroded and pitted valves tend to collect deposits which in turn cause valve sticking. Always replace badly corroded or pitted valves with new valves.

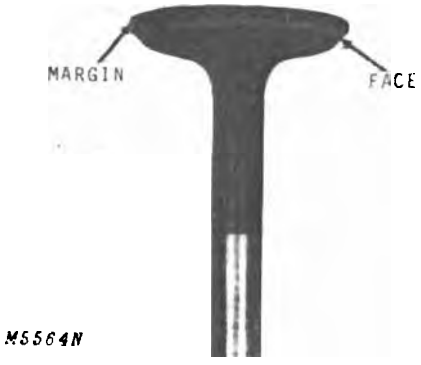


Fig. 4-Exhaust Valve Running Too Hot

Exhaust valves are designed to function in temperatures exceeding 5000° F. However, when operating at this temperature for long periods of time, valve burning occurs, Fig. 4. Tell-tale signs of valves running too hot is the dark discoloration of the valve stem down into the area protected by the valve guide. Another indication is distortion of the valve margin and valve face. Valve inserts may also begin to burn away.

The most common cause of an overheated engine and valves is poor cooling due to dirt or obstructions inside the intake shrouding. Remove and clean shrouding and all cooling fins on the engine if this condition is noticed.

NOTE: Never run engine with shrouding removed.

Also check for improper valve timing by checking and correcting valve clearance.

Worn valve guides or valve springs can also cause overheated valves.

Valves running hot also can be caused by an improper spark plug, a lean fuel mixture, or overheated spark plug, which causes pre-ignition.

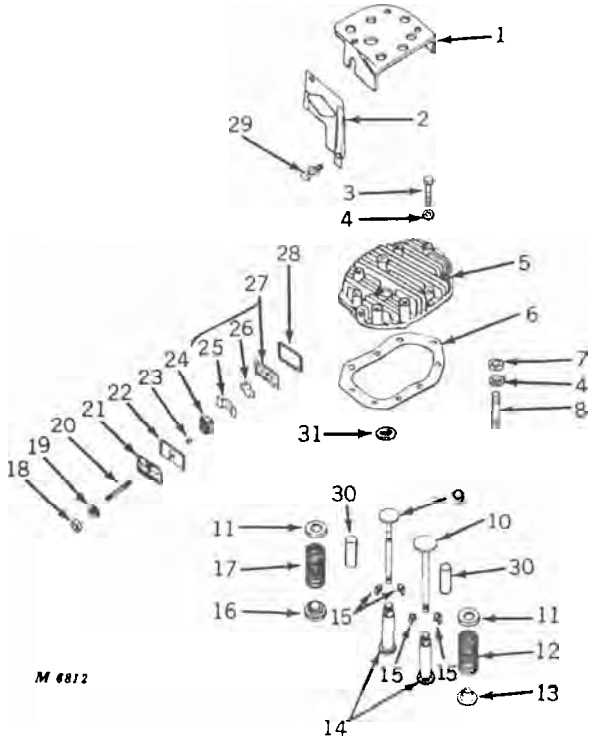
Fig. 5-Gummy Valve Causing Valve to Stick

Using gasoline which has been left in the tank a long time is a common cause of sticking valves, Fig. 5.

Sometimes this gummy substance can be seen on the valve. When this condition is found, it is also likely that the carburetor also contains gum deposits and will require a complete cleaning.

Advise customer always to use fresh gasoline and always to drain gas from all fuel lines and carburetor before storing tractor.

REPAIR



1—Head Baffle
2—Side Baffle
3—Cap Screw (7 used)
4—Washer (10 used)
5—Cylinder Head
6—Head Gasket
7—Hex. Nut (2 used)
8—Stud (2 used)
9—Exhaust Valve
10—Intake Valve
11—Upper Spring Retainer
12—Intake Valve Spring
13—Lower Spring Retainer
14—Tappet (2 used)
15—Spring Keeper (4 used)
16—Exhaust Valve Rotator (K241AS)
17—Exhaust Valve Spring
18—Hex. Nut
19—Lock Washer
20—Stud
21—Cover
22—Outer Gasket
23—Seal
24—Filter
25—Baffle
26—Reed
27—Breather Plate Assembly
28—Inner Gasket
29—Cap Screw (4 used)
30—Valve Guides (2 used)
31—Exhaust Valve Insert

Fig. 6-Exploded View of Cylinder Head, Valves and Breather

REPAIR—Continued

It is not necessary to remove the engine from the tractor when servicing the cylinder head, head gasket, muffler, breather assembly, valves and valve seats.

IMPORTANT: On tractors equipped with hydraulic lift, do not disconnect the hydraulic lines. Remove the pump, valve and reservoir unit from the top of the engine and lower it to the ground with the hydraulic lines still attached. This procedure avoids the possibility of dirt entering the system.

Disconnect choke conduit and cable at carburetor. Remove carburetor, breather assembly, head baffle, cylinder head and head gasket.

Removing Valves

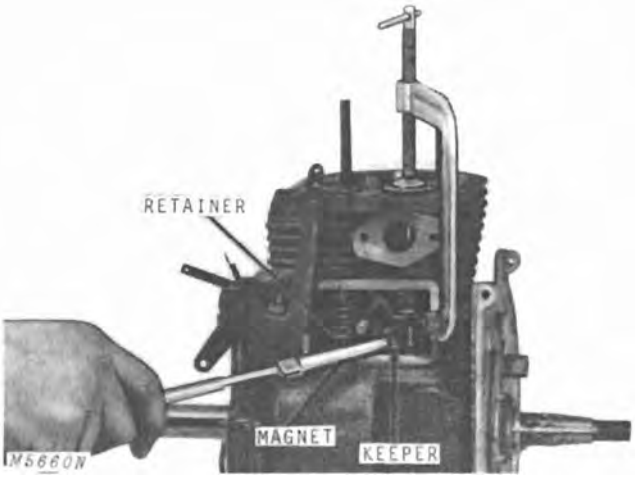


Fig. 7-Removing Valves

Use a valve spring compressor to compress valve springs, Fig. 7. Remove keepers from valve stem and lift valves from engine block.

Remove valve spring retainers and valve springs from valve chamber.

Inspecting Cylinder Head

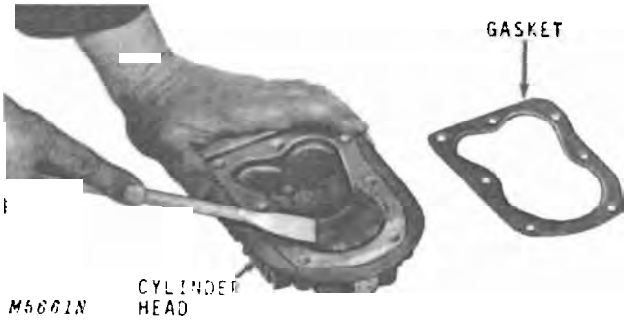


Fig. 8-Cleaning Cylinder Head

Remove all deposits from combustion chamber and gasket surface of head with a scraper, Fig. 8, and a wire brush.

Be careful not to damage the cylinder head gasket surface. Use a safe cleaning solvent to remove dirt, grease and other deposits.

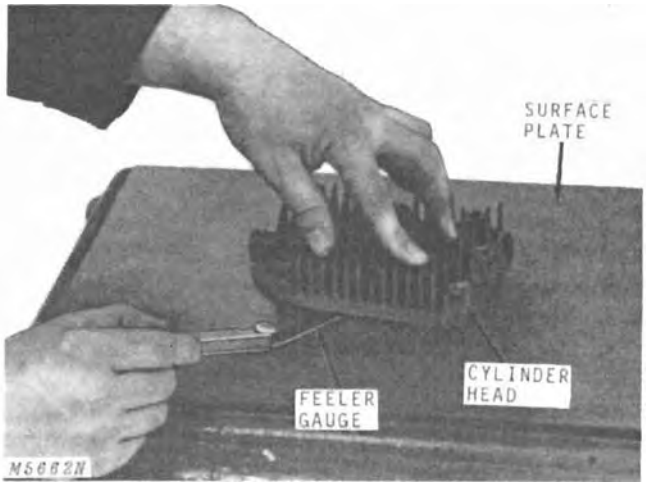


Fig. 9-Checking Surface of Cylinder Head

Check the cylinder head for cracks or broken cooling fins and inspect the gasket surface for burrs and nicks. Replace the head if any of these conditions are found.

When replacing a head gasket, always check the cylinder head for warpage. Use a surface plate and a 0.0015-inch ribbon feeler gauge in the manner shown in Fig. 9. The feeler gauge should drag at all points when drawn from between the head and surface plate.

NOTE: Whenever the cylinder head is removed, discard the head gasket. Always use a new head gasket when installing the cylinder head.

Inspecting Breather

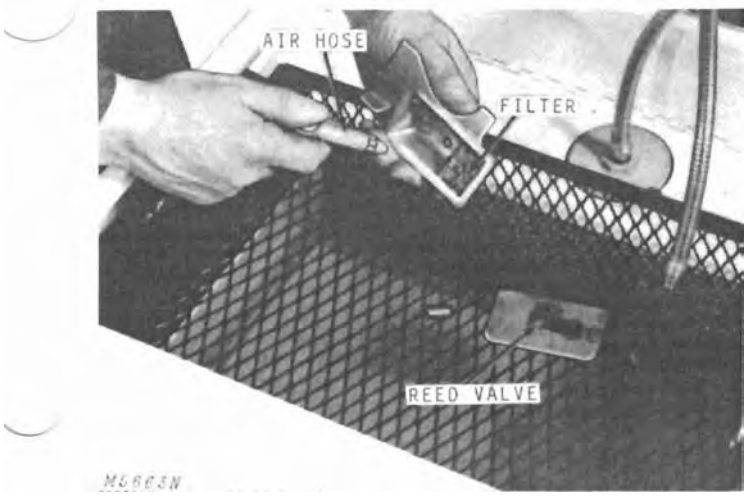


Fig. 10-Cleaning Breather Filter

Clean all breather parts in solvent, Fig. 10. Blow out filter contamination with compressed air or replace with new filter as necessary.

Inspect reed valve on breather to be certain it covers all of breather hole. When depressed in the center, the valve should close over the hole with a snap. Replace valve plate having weak tension.

Be sure small drain hole in breather plate is not clogged.

Testing Valve Springs

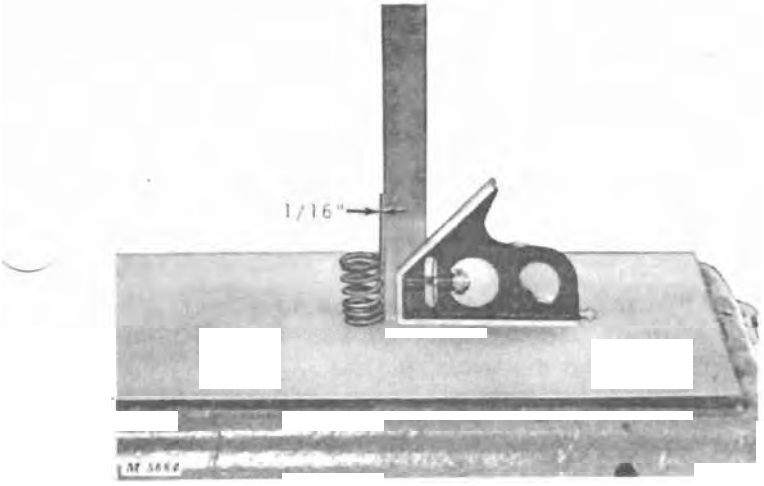


Fig. 11-Valve Spring Squareness

Check valve spring for squareness, using a steel square and a surface plate, Fig. 11. Stand the spring and square on end on the surface plate. Slide the spring up to the square. Revolve the spring slowly and observe the space between the top coil of the spring and the square. See Specifications, page 20-25-2, for out-of-square limits.

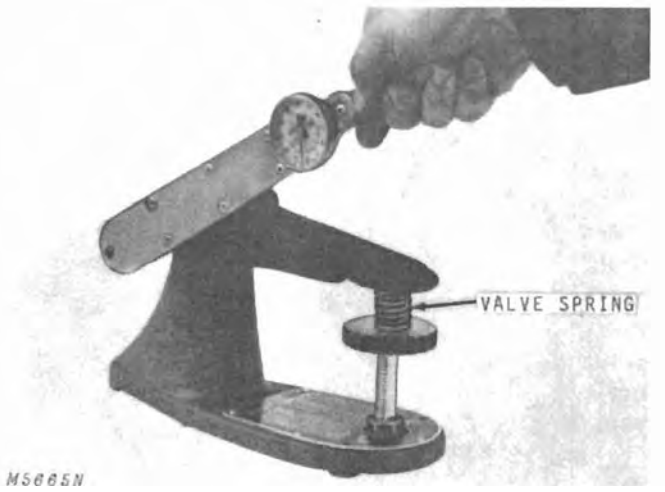


Fig. 12-Valve Spring Tension

Check valve spring for proper pressure, Fig. 12. Refer to Specifications, page 20-25-2, for free length of the spring and the pressure in pounds that the spring should exert when it is compressed to a measured length.

Inspecting Valves

Remove carbon from valve head, face, and stem with a power-operated wire brush. Be sure carbon is removed and not merely burnished. Any carbon left on the stem will affect accurate alignment in the valve refacer collet.

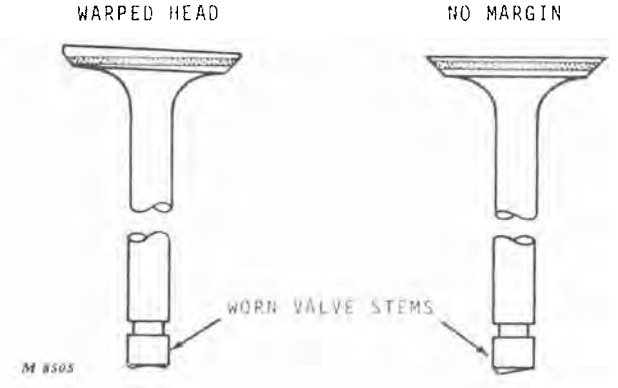


Fig. 13-Faulty Valves

Inspect valve faces, heads and stems for distortion, pitting, and burning, Fig. 13. Recondition valves that appear acceptable. Distorted valves will be evident when refacing operation is performed. Replace all valves with less than 1/32-inch margin or those having a questionable appearance.

Grind valve stems square prior to installation and resetting of valve tappet clearance.

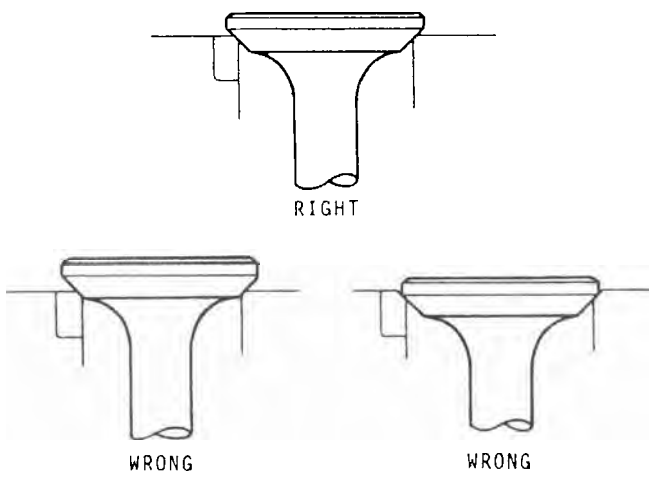


Fig. 17-Valve and Seat Relationship

When matching valves to seats, be sure valve seat is very nearly centered on the valve face, Fig. 17. The position of the valve in the seat is clearly evident after lapping the valve, Fig. 18.

Valve Lapping

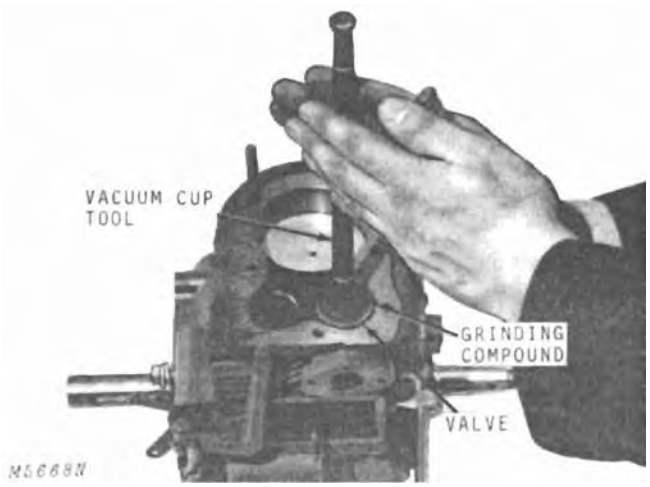


Fig. 18-Lapping Valves

Coat face of valve sparingly with a fine grade of valve grinding compound. Use a vacuum cup tool, Fig. 18, to grip top of valve and rotate valve in a circular motion on valve seat.

Lift valve from seat every eight or ten strokes to keep compound equalized on surface of valve seat. Continue valve lapping operation until a uniform lapping ring appears around entire surface of valve face. When a good surface is attained, wash all parts with solvent to remove all traces of lapping compound. Dry parts thoroughly.

Note position of valve seat marked on valve face. The lapping mark made by the seat after lapping should appear on or near the center of the valve face.

Replacing Valve Guides

If valve guide clearance exceeds maximum tolerance, 0.003 inch, replace the guide.

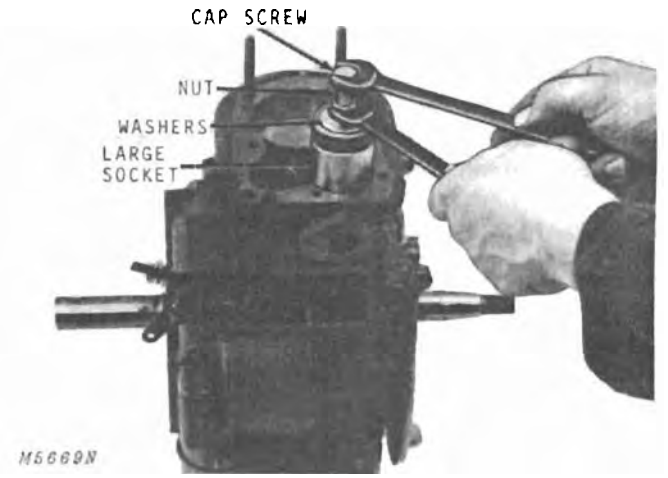


Fig. 19-Removing Valve Guides

Tap the valve guide its full length using a 3/8-inch N.C. tap and tapping compound or oil to prevent tap from breaking off in valve guide.

Thread a 3/8-N.C. x 6-inch cap screw its full length.

Install a nut, washer and spacer on the cap screw; then, turn the cap screw into the valve guide the full length of the valve guide.

Hold cap screw and keep turning nut against washer until valve guide is completely free from cylinder block, Fig. 19.

NOTE: Valve guides can also be removed by driving them down into the valve spring chamber and carefully breaking them. Use care not to damage the cylinder block.

INSTALLATION

Installing Valve Springs, Retainers and Keepers

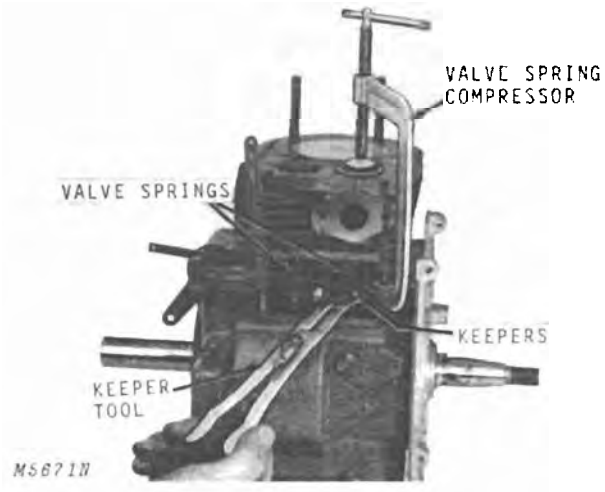


Fig. 23-Installing Valve Springs, Retainers and Keepers

Place valve spring and retainer in valve spring chamber. Install valves in guides working them back and forth to make sure they slip through the guides easily. Using a spring compressor, compress the springs and install keepers on valve stem with keeper tool, Fig. 23. If tool is not available, apply grease to keepers to hold them on the valve stem and insert them by hand.

Assembling Breather

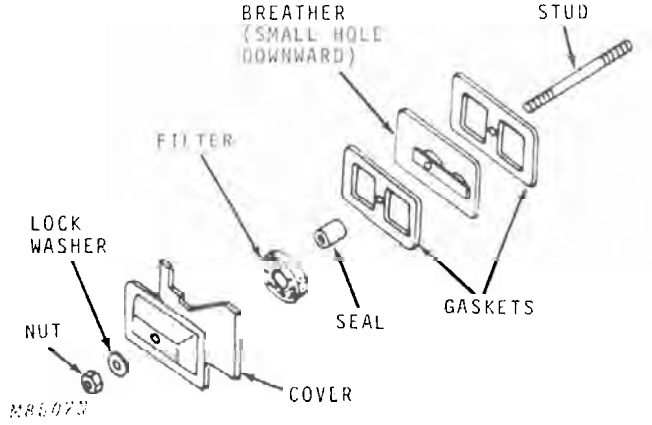


Fig. 24-Breather Parts (K181S Engine)

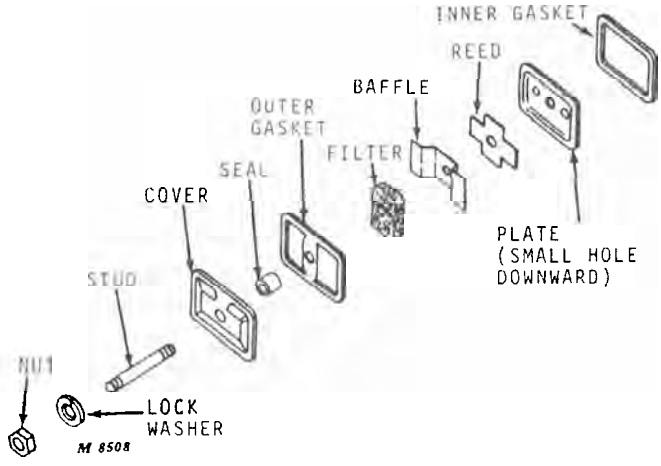


Fig. 25-Breather Parts (K241AS Engine)

The correct order of breather assembly is very important. For correct assembly, refer to Fig. 24 and 25. Always use new gaskets. Place breather plate so that reed is facing away from engine, and small hole at bottom of plate is down. If breather plate is reversed, engine will pump oil out of the breather chamber and engine damage will soon occur.

Installing Cylinder Head

Always install a new head gasket when the head has been removed for service. This will assure a gas-tight fit.

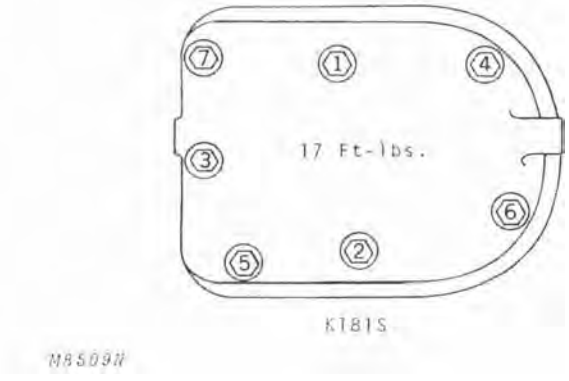


Fig. 26-Cylinder Head Bolt Tightening Sequence (K181S Engine)

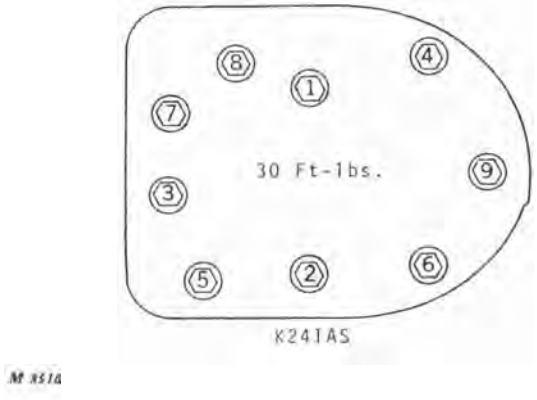


Fig. 27-Cylinder Head Bolt Tightening Sequence (K241AS Engine)

It is important to tighten all cylinder head bolts with an even pressure and in their correct sequence, Figs. 26 or 27, so that uneven stresses will not set up in cylinder wall. Refer to "Specifications," page 20-25-2, for proper cylinder head bolt torque.

Installing Carburetor

K181S Engine

Connect throttle linkage in proper holes on governor arm and throttle shaft arm, Fig. 28. Using new gasket, mount carburetor to engine block and tighten bolts firmly. Connect fuel line to carburetor and install head baffle.

K241AS Engine

Mount carburetor, Fig. 29, to engine block using a new gasket, tighten bolts firmly. Connect fuel line to carburetor and install head baffle. Install adjustable throttle linkage. Basic overall length of throttle linkage is 3-5/8 inches. To obtain this dimension, loosen lock nuts and turn adjustable ends on or off threaded link.

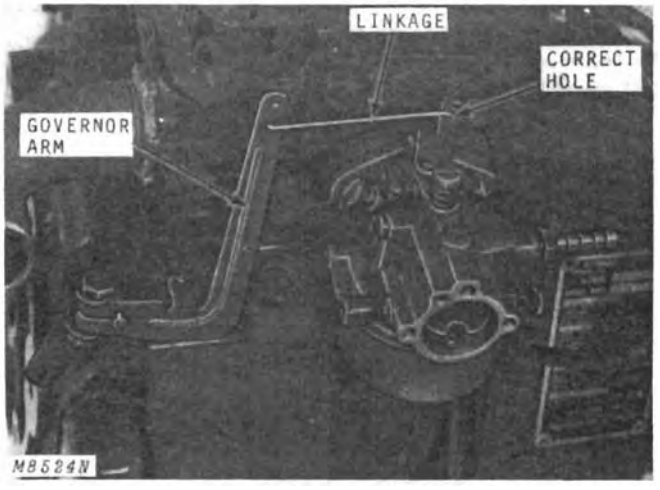


Fig. 28-Carburetor Assembly (K181S Engine)

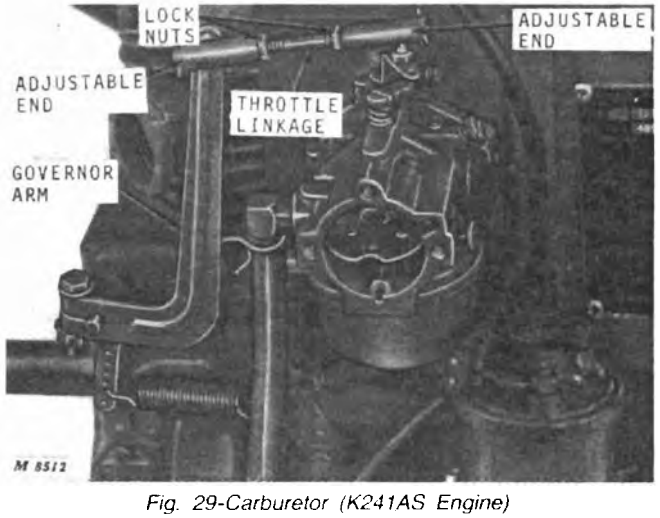


Fig. 29-Carburetor (K241AS Engine)

Checking Air Filter

Be sure air filter is clean. Remove filter and tap out dust or replace if necessary. See Section 30, Group 15.

Checking Spark Plug Gap

Refer to "Specifications," page 20-25-1, for proper spark plug gap. See Section 40, "Electrical System," for spark plug testing.

Checking Breaker Point Gap

Refer to Section 40, "Electrical System," and set breaker point gap.

Group 15
PISTON, CRANKSHAFT, MAIN BEARINGS AND FLYWHEEL

GENERAL INFORMATION

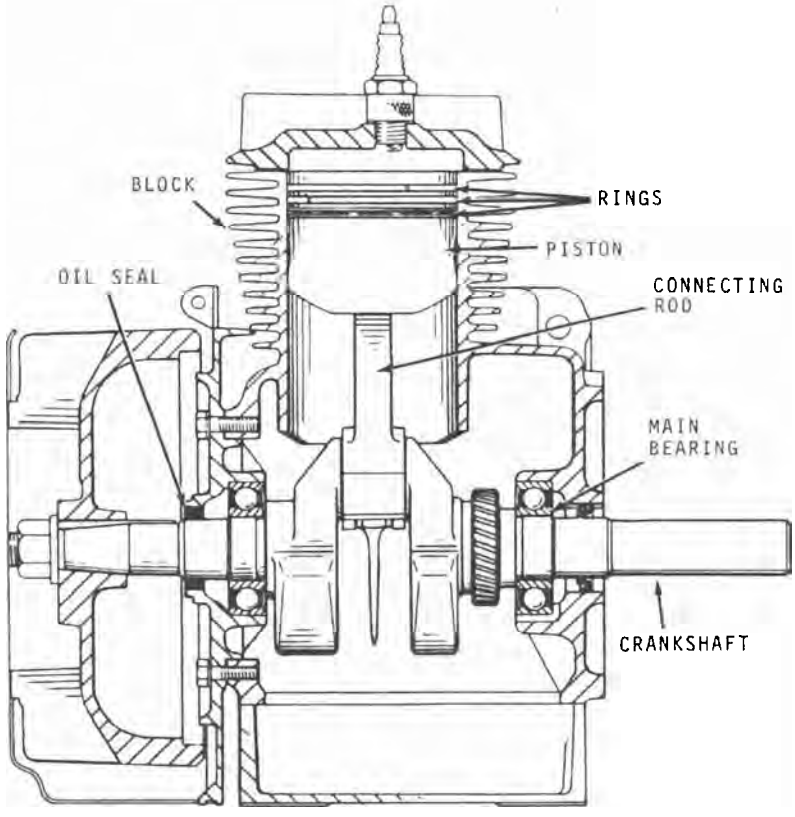
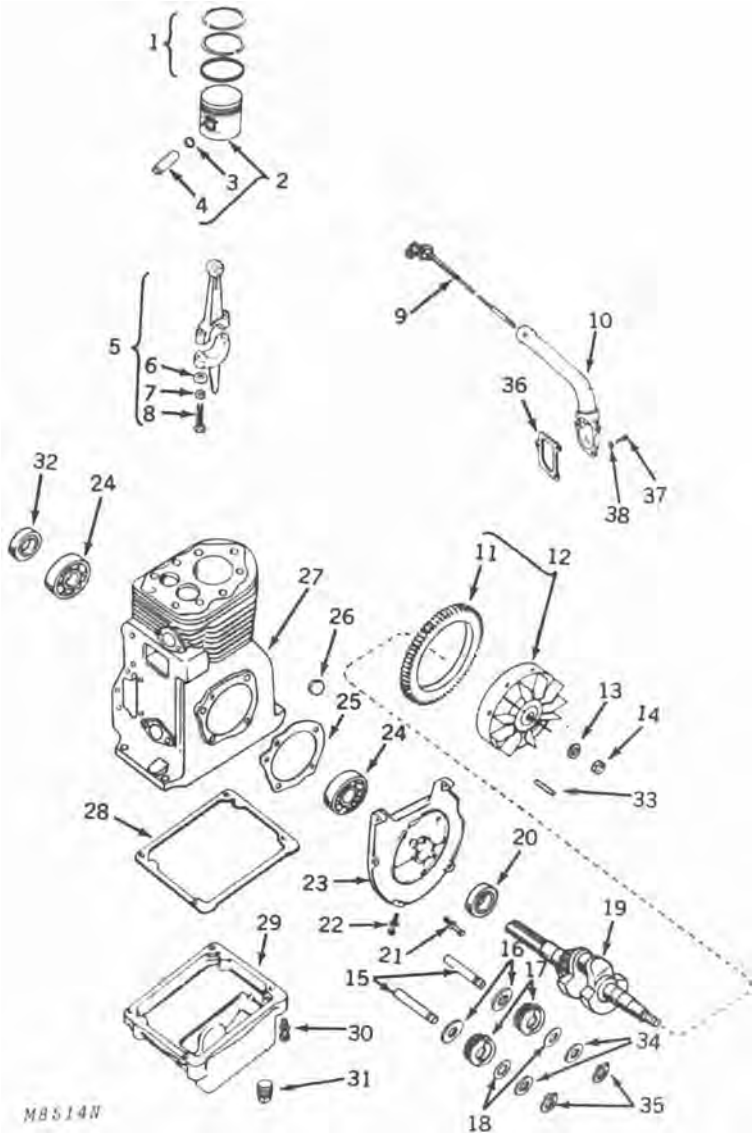


Fig. 1-Cutaway View of Kohler K181S Engine

Oversize pistons and rings are available for K181S, Fig. 1, and K241AS Kohler Engines. One undersize connecting rod is also available for each engine.

A short block assembly is available. It is complete with cylinder block, crankshaft, bearings and seals, connecting rod with piston, internal governor parts with regulating disk, bearing plate, stellite exhaust valve, compression release camshaft and head studs.

REPAIR



1—Ring Set
2—Piston Assembly
3—Retainer (2 used)
4—Piston Pin
5—Rod Assembly
6—Washer (2 used)
7—Lock Washer (2 used)
8—Screw (2 used)
9—Dipstick
10—Oil Fill Tube
11—Ring Gear
12—Flywheel with Ring Gear
13—Washer
14—Hex. Nut
*15—Shaft, Stub (2 used)**
*16—Spacer (2 used)**
*17—Gear, Balance (2 used)**
*18—Shim (2 used)**
19—Crankshaft
20—Oil Seal, 2" O.D.
21—Cap Screw (8 used)
22—Cap Screw (6 used)
23—Bearing Plate
24—Ball Bearing (2 used)
25—Bearing Plate Gasket
26—Plug Button
27—Cylinder Block
28—Oil Pan Gasket
29—Oil Pan
30—Cap Screw (4 used)
31—Pipe Plug
32—Oil Seal, 2-3/8" O.D.
33—Key, 1/4" x 3/16" x 1-3/8"
34—Spacer (2 used)
*35—Ring, Snap (2 used)**
36—Gasket, Fill Tube
37—Screw, Machine, 10-24 x 1/2" (3 used)
38—Washer, Lock, No. 10

**Used only on 10 hp Tractors (Serial No. -264,713)*

Fig. 2-Exploded View Showing Piston, Connecting Rod, Crankshaft, Flywheel, Main Bearings and Oil Seals

Removing Engine from Tractor

1. Drain crankcase oil.

2. Remove tractor hood.

3. Remove front grille

4. Shut off gas at fuel shut-off valve. Remove gas line from carburetor and drain. Remove gas tank.

5. Disconnect ground wire on engine and coil wire.

6. Disconnect choke and throttle control cables at the engine.

7. Remove hydraulic pump and bracket if tractor is so equipped

NOTE: Do not disconnect hydraulic lines unless hydraulic system is to be repaired.

8. Remove shielding from right-hand side of tractor and remove four engine base bolts. Lift out engine.

Disassembling Kohler K181S Engine

Remove engine shrouding, starter motor, coil and carburetor.

Remove cylinder head, breather assembly and valves. See Group 10 of this section.

Break flywheel nut loose with a shock tool or use a long handle nut spinner and a strap wrench. The flywheel is mounted on a tapered shaft and should be removed with a puller, Fig. 3.

Remove oil pan and dipstick. Turn engine upside down and remove connecting rod, cap screws, lock and rod cap.

IMPORTANT: Use proper tools to prevent oil slinger damage when removing rod cap screws.

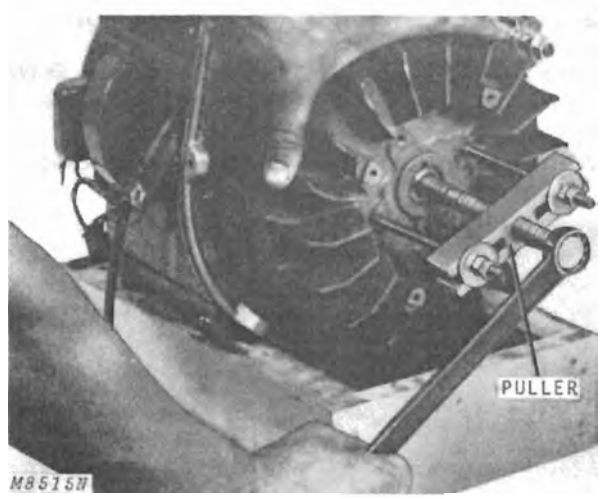


Fig. 3-Removing Flywheel

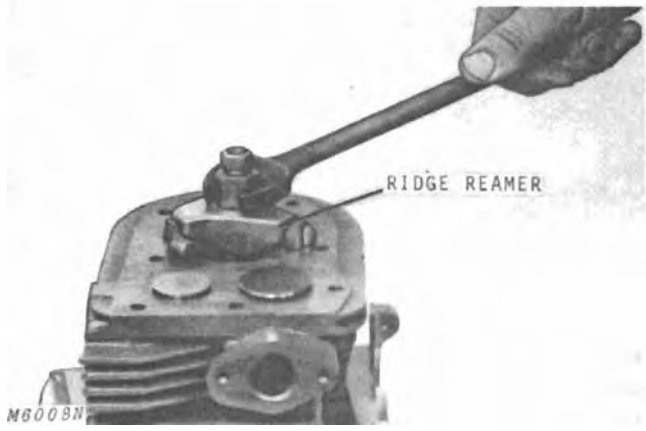


Fig. 4-Removing Ridge with Ridge Reamer

Before removing piston, check for carbon or ridge at top of cylinder bore. Remove carbon and ridge with ridge reamer, Fig. 4. Push piston and rod out top of block.

Remove bearing plate (23, Fig. 2). Be sure key is removed from end of crankshaft before removing plate.

Remove crankshaft by using a press or a soft metal mallet.

Disassembling Kohler K241AS Engine

Remove blower housing, flywheel, bearing plate, and oil pan. Remove connecting rod cap and piston.

Removing Crankshaft and Balance Gears

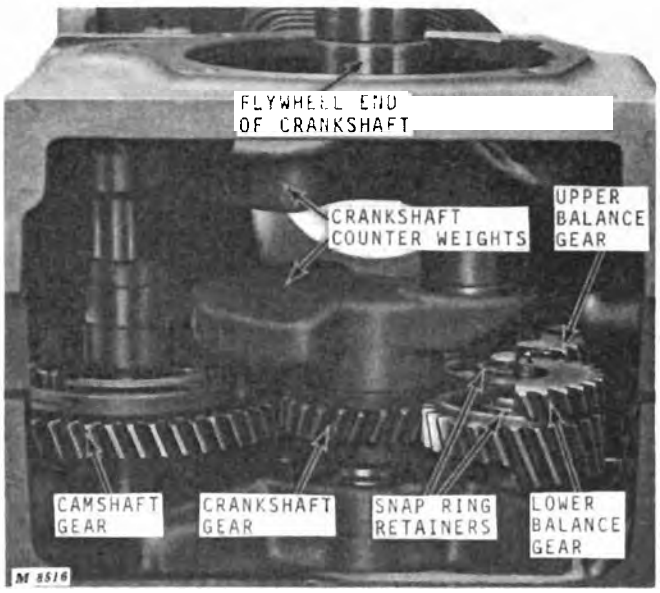


Fig. 5-Removing Crankshaft and Balance Gears

10 hp Tractors (Serial No. -264,713) are equipped with balance gears. Tractors above this serial number have isolated engines instead. Using a small snap ring pliers, remove snap ring from lower balance gear, if so equipped. Be careful not to lose spacer washers. Remove lower balance gear.

Remove crankshaft. Remove snap ring, spacer washers and upper balance gear, Fig. 5. If stub shafts are scored or damaged they may be pressed out of block. Needle bearings are serviceable and can be pressed from balance gears.

Inspecting Balance Gear and Shafts

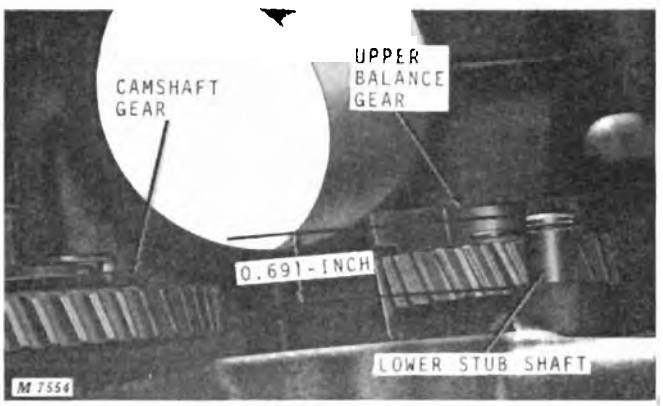


Fig. 6-Installing Stub Shafts

If new stub shafts are required, press old shafts from the outside in. To install new shafts, press into place from the inside out until 0.691 inch of shaft remains, Fig. 6.

If camshaft or governor must be removed, see Group 20 of this section.

Fig. 7-Installing Needle Bearing in Gear

Inspect balance gear and bearing for wear or damage. If either condition exists, replace as required.

Balance gear bearings are replaceable and may be pressed into gear as shown in Fig. 7.

Removing Piston Rings

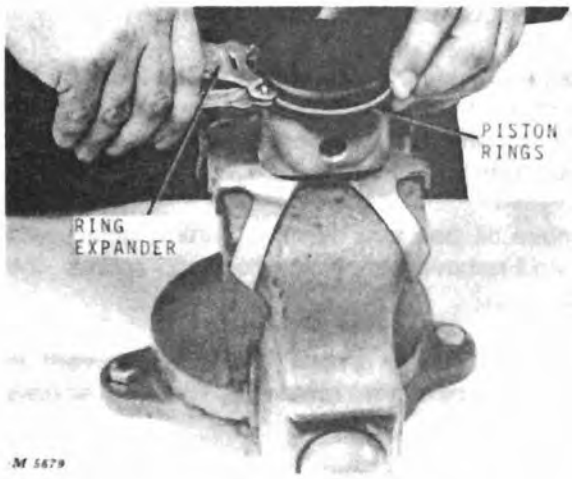


Fig. 8-Removing Piston Rings

Clamp the connecting rod in a vise that has soft metal jaws.

IMPORTANT: Tighten vise just enough to hold rod assembly. Excessive tightening will bend connecting rod.

Use ring extractor to remove rings, Fig. 8. Discard old rings.

Remove retainers from each end of piston pin and push pin out of piston and connecting rod.

Litho in U.S.A.

Analyzing Piston Ring Wear

Light scuffing or scoring of both rings and piston occurs when unusually high friction and combustion temperatures approach the melting point of the piston material, Fig. 9.

When this condition is found check and correct the following probable causes:

1. Dirty cooling shroud and cylinder head.
2. Lack of cylinder lubrication.
3. Improper combustion.
4. Wrong bearing or piston clearance.
5. Too much oil in crankcase causing fluid friction.

Fig. 9-Scored Piston and Rings

Fig. 10-Piston Rings with Improper End Gap

Rings of the wrong size or rings having improper end gap. Fig. 10, cannot conform to the shape of the cylinder. This results in high oil consumption and excessive blowby. This could also be caused by end gaps being in alignment.

Ring end gaps should be staggered on the piston during installation.

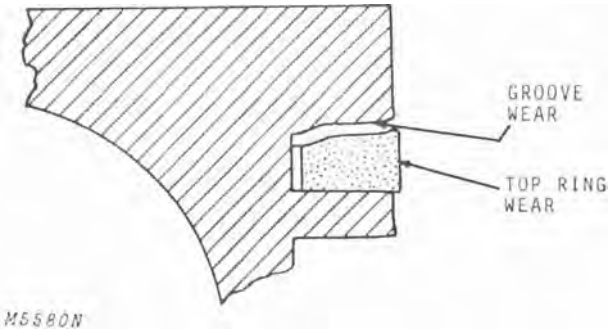


Fig. 11-Top Ring and Groove Side Wear

Check wear of ring grooves carefully, especially the top groove, Fig. 11. The top ring and groove is exposed to combustion temperature and pressure as well as airborne abrasives which enter the combustion chamber.

Fig. 12-Piston Rings Stuck and Broken Because of Lacquer, Varnish and Carbon Build-Up

Any condition which causes the engine to operate at abnormally high temperatures may cause varnish and lacquer gum deposits as well as carbon deposits to form in the piston grooves causing the rings to stick, Fig. 12. When this happens excessive oil consumption and compression loss will occur.

Engine heating and ring sticking are most often caused by:

1. Overloading.
2. Pre-ignition detonation.
3. Incorrect fuel mixture.
4. Dirty cooling fins.
5. Incorrect oil.
6. Low oil supply.
7. Stale fuel.

Analyzing Piston Ring Wear—Continued

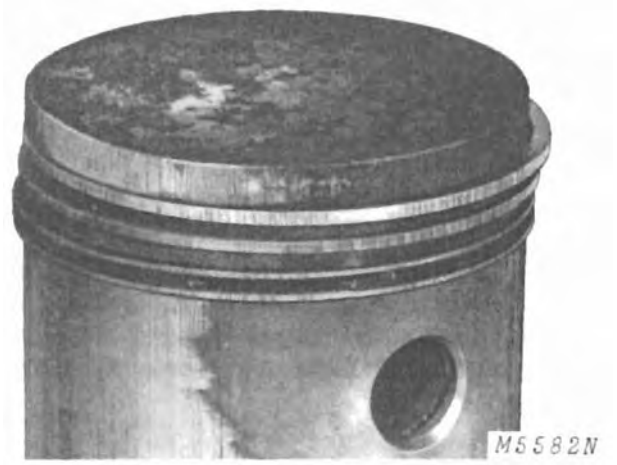


Fig. 13-Scratched Ring Faces Caused by Abrasives in the Engine

Vertical scratches across the faces of piston rings, Fig. 13, are the result of an abrasive entering the engine. Abrasives may be airborne, may have been left in during overhaul, or are loose lead and carbon deposits.

When this condition is found, always check and correct the source of abrasives to prevent premature ring failure.

Common causes for abrasives in the engine are:

1. Damaged, collapsed or improperly installed air filter.
2. Loose connection or damaged gasket between air filter and carburetor.
3. Air leak around carburetor to block gasket.
4. Air leakage around throttle shaft.
5. Failure to properly clean cylinder bore after reconditioning engine.

Fig. 14-Worn Oil Rings Which Cannot Provide Oil Control

Rails of the oil ring are worn down to the oil drain holes, Fig. 14. This can only come from cylinder wall contact after much use and possible entry of abrasives. Compression rings will also be worn thin.

Badly worn oil rings will have:

1. Extra large gap.
2. Low tension.

Inspecting Piston

Remove deposits from piston surfaces. Clean gum and varnish from the piston skirt.

Do not use a caustic cleaning solution or a wire brush to clean pistons.

Be sure the oil ring drain holes in piston are clean.

Clean carbon from piston ring grooves with a ring groove cleaner. If cleaning tool is not available, break an old ring and use it to clean groove, Fig. 15.

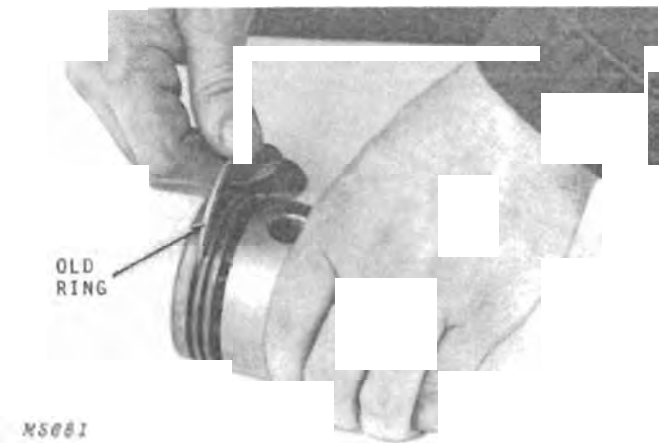


Fig. 15-Cleaning Ring Grooves

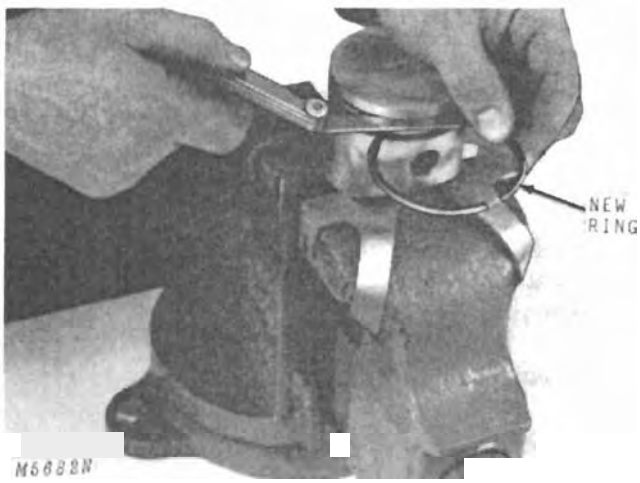


Fig. 16-Measuring Ring Clearance

Check ring grooves for excessive wear by inserting a **new** ring in the proper groove at several points around the piston. Measure clearance between ring and groove with a feeler gauge, Fig. 16. Refer to "Specifications," page 20-25-1, for ring groove side clearance. Replace piston having ring clearance beyond wear limits.

Inspect piston for fractures at the ring lands, skirts and ring bosses and for rough or scored skirts.

Analyze the condition of the piston by studying the illustrations beginning on page 20-15-8. Replace faulty pistons.

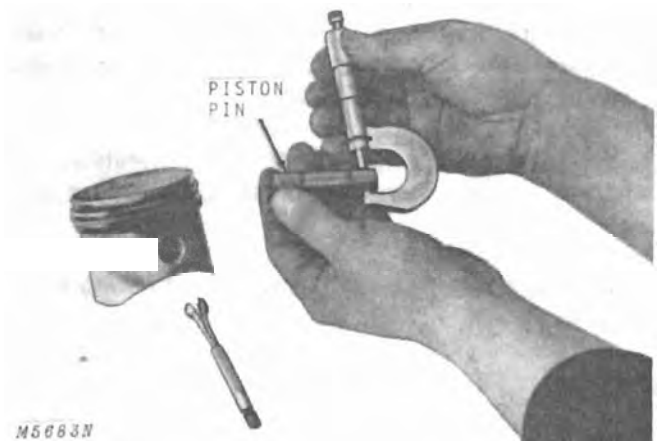


Fig. 17-Measuring Piston Pin and Piston

Measure piston pin-to-piston clearance with a micrometer, Fig. 17. Ream out piston and rod and install oversize piston pins when necessary. See "Specifications," page 20-25-1. Oversize piston pins are available for service.

Fig. 18-Measuring Piston

Check the piston-to-cylinder bore clearance by measuring the piston and bore diameters, Figs. 18 and 23.

Measure the outside diameter of the piston with a micrometer at the centerline of the piston pin bore and at 90° to the pin bore axis.

If piston-to-cylinder bore clearance is 0.005-inch or less, deglaze the cylinder walls and install a set of new rings.

Inspecting Piston—Continued

If cylinder-to-bore clearance is more than 0.005-inch, the cylinder will have to be rebored and oversize piston and rings installed.

Oversize pistons and rings are available in 0.010-inch, 0.020-inch and 0.030-inch sizes for service.

See page 20-15-10 for deglazing and boring information.

Analyzing Piston Wear

Fig. 19-Piston Top Land Burning Caused by Detonation

Detonation, Fig. 19, is a form of abnormal combustion causing excessive temperature and pressure in the combustion chamber. Commonly called carbon knock, spark knock or timing knock, detonation occurs as compressed air-fuel mixture ignites spontaneously to interrupt the normal ignition flame front. When detonation is detected check and correct the following possible causes:

1. Lean fuel mixtures.
2. Low octane fuels.
3. Over-advanced ignition timing.
4. Engine lugging.
5. Build-up of carbon deposits on piston and cylinder head causing excessive compression.
6. Wrong cylinder head or milling of head increasing compression ratio.

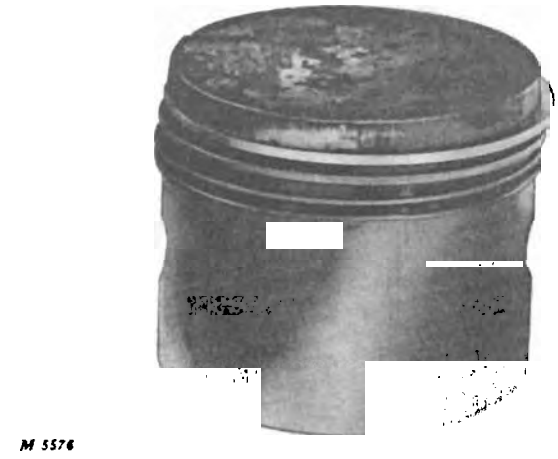


Fig. 20-Diagonal Piston Wear Pattern Caused by Bent or Twisted Connecting Rod

Check rod and piston alignment when a piston shows a diagonal wear pattern extending across the skirt of the piston, Fig. 20. Contact with cylinder wall shows on bottom of skirt at left and ring lands on the right.

A cylinder bored at an angle to the crankshaft could also cause improper ring contact with the cylinder wall.

This condition can cause:

1. Rapid piston wear.
2. Uneven piston wear.
3. Excessive oil consumption.

Fig. 21-Hole Burned in Piston Caused by Pre-Ignition

Pre-ignition is the igniting of the fuel-air mixture prior to the regular ignition spark. Pre-ignition causes severe internal shock resulting in pings, vibration, detonation and power loss. Severe damage to piston, Fig. 21, rings and valves results from pre-ignition.

When pre-ignition is suspected and detected, check and correct the following possible causes:

1. Internal carbon deposits which remain incandescent.
2. Incorrect spark plug (high heat range).
3. Broken ceramic in spark plug.
4. Sharp edges on valves or elsewhere in the combustion chamber.

Fig. 22-Piston Damage Caused by Piston Pin Retainer Coming Loose

In, Fig. 22, a piece of the retainer found its way into the oil ring.

Pin retainers loosen or break due to:

1. Rod misalignment.
2. Excessive crankshaft end play.
3. Crankshaft journal taper.
4. Weak pin retainers.
5. Pin retainers incorrectly installed.

Inertia can cause a pin retainer or loose object inside the piston pin to fly around and damage both the piston and cylinder wall.

Inspecting and Repairing Block

After thoroughly cleaning the block, check it for cracks. Cracks not visible to the naked eye may be detected by coating the suspected area with a mixture of 25% kerosene and 75% light engine oil.

Wipe the part dry and immediately apply a coating of zinc oxide dissolved in wood alcohol. If a crack is present, the coating will become discolored at the defective area. Replace the block if cracked.

NOTE: A short block is available for service.

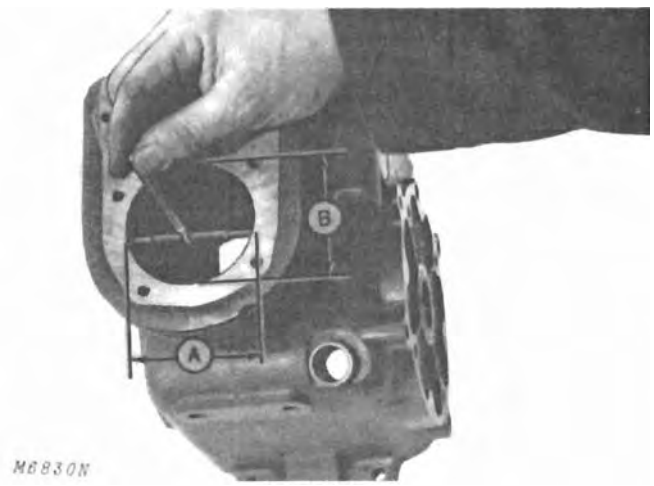


Fig. 23-Measuring Cylinder Bore

Use a telescoping gauge and micrometer to measure bore in two places at top and bottom of ring travel area, Fig. 23. Out-of-round dimension is the difference between dimensions A and B. Cylinder wall taper is the difference between dimension A at the top and dimension A at the bottom of cylinder bore. See "Specifications," page 20-25-1, for wear tolerance.

Deglazing Cylinder Bore

Deglazing is not intended to remove any appreciable amount of metal from the bore, but rather to clean up and provide the proper surface. A proper bore surface feels smooth but has a cross-hatch pattern of micro-scratches which can be seen. This finish will allow the new rings to seat or run-in properly. This finish also retains a small film of oil to provide ring lubrication for the ring surface and prevents scoring.

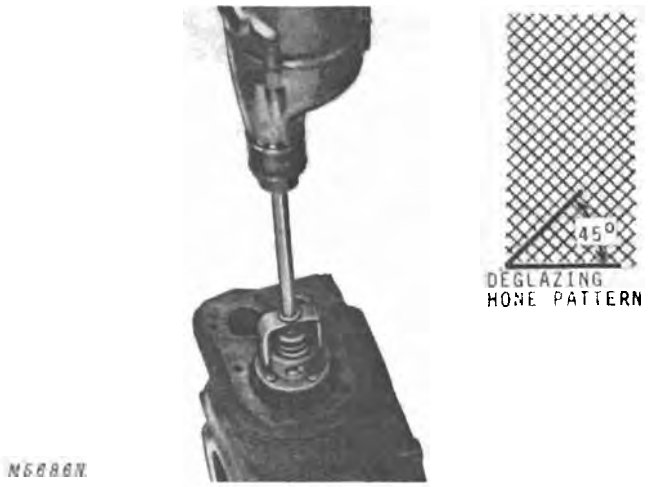


Fig. 24-Deglazing Cylinder Bore

Use a deglazing tool to break glaze, Fig. 24. Follow manufacturers recommendations.

A 200-280 grit tool is generally preferred for deglazing. A cross hatch pattern of approximately 45 degrees should be obtained while operating the tool vertically during deglazing.

Boring Cylinder Block

If block is to be bored as determined on page 20-15-8, clean and dry block thoroughly. Boring can be done by machining at a reliable automotive repair shop or by using an electric drill and honing tool. See "Special Tools," page 20-25-3.

Honing to 0.010-inch oversize to accommodate oversize piston and rings can also be done with a coarse stone in the deglazing tool, Fig. 24, and finishing with finer grit stone(s).

IMPORTANT: If block is jigged in a drill press for honing, be sure honing tool and block are in alignment.

Inspecting Crankshaft

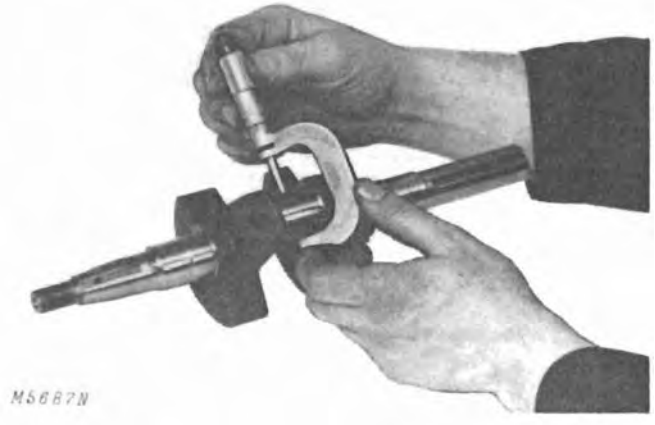


Fig. 25-Measuring Crankshaft Journal

Wipe crankshaft dry and check journal condition. Clean up threads on end of shaft if necessary. If crankshaft journal indicates wear, Fig. 25, beyond specified limits or if journal is scored, take the crankshaft to a competent machine shop to turn the journal down 0.010-inch. An undersize connecting rod and cap must then be installed. THIS IS IMPORTANT. Do not just replace a crankshaft having a bad journal. Turning down the journal and installing a new rod will likely be the least expensive method of repair.

Analyzing Connecting Rod and Cap Wear

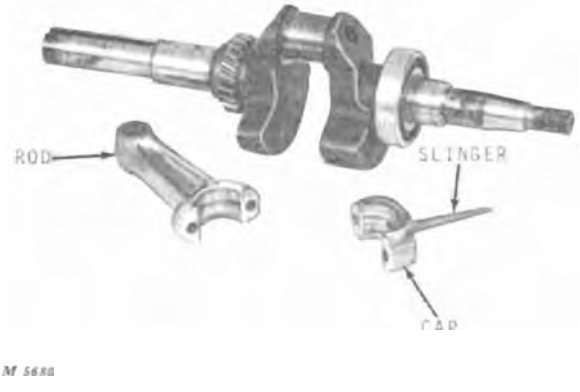


Fig. 26-Crankshaft Connecting Rod and Cap

After cleaning and drying parts, check rod, Fig. 26, and cap for signs of bending, cracking or unusual wear patterns.

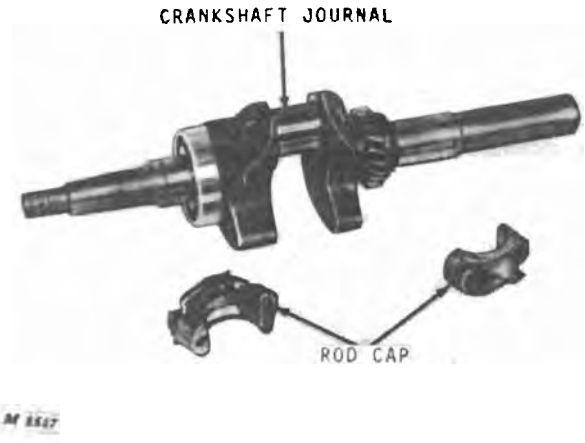


Fig. 27-Scored and Galled Crankshaft Journal and Rod Cap Caused by Lack of Lubrication

Lack of lubrication or improper lubrication, Fig. 27, can cause the connecting rod and cap to seize to the crankshaft and may even cause rod particles to become imbedded in the hardened steel crankshaft. When the rod and cap seize to the crankshaft, the connecting rod and piston may both break with shattering force causing other interior damage. When this happens inspect block carefully for cracks and breakage before rebuilding engine.

Crankshaft and connecting rod damage can result from:

1. Engine run low on oil or without oil.
2. Oil slinger broken off bearing cap.
3. Oil hole in connecting rod plugged.
4. Oil not changed regularly.
5. Bearing cap installed incorrectly.

Note especially the condition of the rod and cap bearing area. Evidence of score marks on these areas indicates impurities in the oil or engine run without oil. Replace rod showing scratch marks or deep scores in the bearing area. Bent rods can be straightened with a rod aligner. Be sure slinger on rod cap is intact - not cracked, bent or chipped. THIS IS IMPORTANT.

NOTE: New rods and caps are available only as a matched set for service. If either is damaged, both must be replaced.

Analyzing Connecting Rod and Cap Wear—Continued

Measure fit of rod and cap to crankshaft journal. Also measure fit of piston pin in piston and rod. See "Specifications," page 20-25-1.

An undersize rod and cap (0.010-inch) is available for service.

NOTE: Connecting rod and crankshaft journal must be clean and meet specifications or a failure will reoccur.

Inspecting Main Bearings

Main bearings turn in an oil mist and will not normally require replacing. Check for unusual signs of wear such as race turning with bearing or bearing deflection caused by excessive engine lugging. Refer to "Bearing Analysis" below.

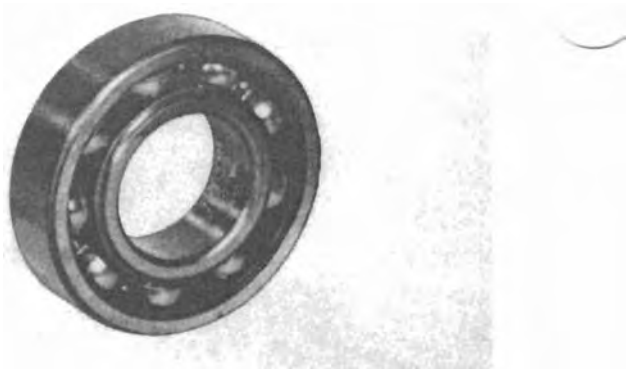
Analyzing Bearing Wear

The causes of bearing failure must be identified and understood in order to apply the proper corrective measures.

M 1384

Fig. 28-Broken Races Caused by Misaligned Bearing During Installation

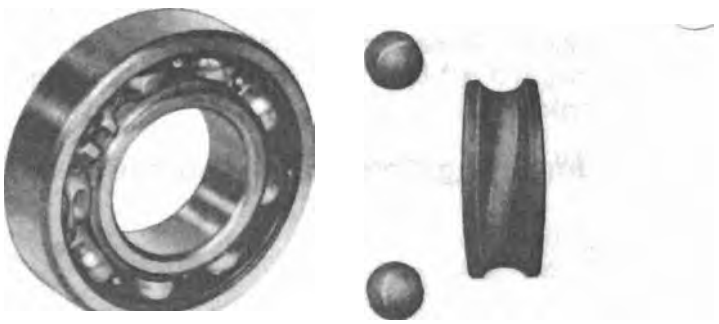
Bearings allowed to cock while inserting or pressing them over a burr may cause the bearing to crack, Fig. 28. Always use a bearing driver tool and remove burrs before installing bearings.



M 5585

Fig. 29-Bearing Wear Caused by Crack or Looseness on Shaft

If inner ring is a loose fit on the rotating shaft, rotation of the shaft within the inner ring can scuff loose small particles of metal. These eventually get into the bearing causing wear on the balls and races. This makes for noisy operation and shortened bearing life and failure. The condition is easily identified by scoring or abrasion on the bore of inner ring, Fig. 29.



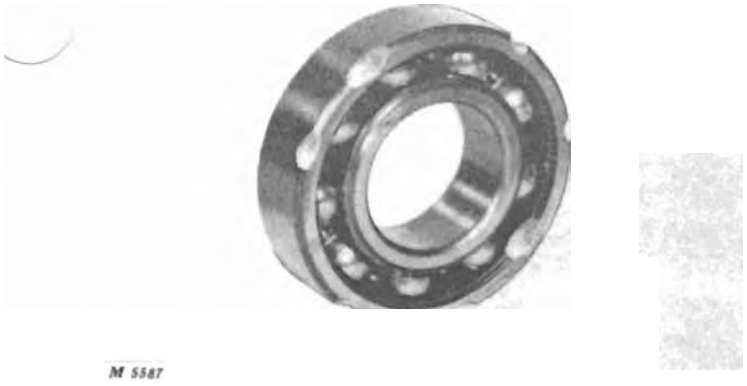
M 5586

Fig. 30-Bearing Wear Caused by Misalignment

Misaligned bearings cause undue wear, heat by friction and eventual failure, Fig. 30.

Note the crooked ball paths in the raceways and the oval appearance of the balls and wear on the separator caused by rubbing against the race.

Figs. 31 and 32 show bearing damage caused by careless installation.



M 5587

Fig. 31-Nicks in Outer Race Caused by Using Chisel or Driftpin to Remove or Install Bearing

Fig. 32-Oil Seal Damage Caused by Careless Installation with Sharp Tool

Inspecting Camshaft

Check camshaft for broken or cracked gear teeth. Check operation of ACR assembly making sure all parts are intact and operate freely. Check condition of flyweight springs. If camshaft needs attention, see Group 20 for camshaft and governor service.

ASSEMBLY

Installing Balance Gears

10 hp Tractors (Serial No. -264,713) are equipped with engine balance gears. Tractors above this serial number feature an isolated engine.

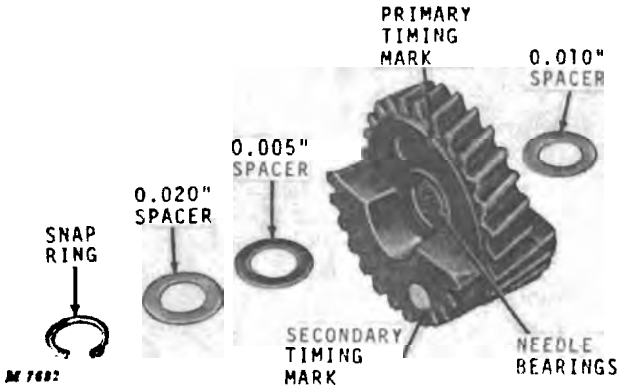


Fig. 33-Balance Gear Assembly

If engine has balance gears, slip one 0.010-inch spacer on upper stub shaft and install upper balance gear. Be sure timing marks are toward flywheel side of engine. Next place a 0.010-inch spacer on stub shaft, followed by a 0.005 and 0.020-inch spacer, and install snap ring, Fig. 33.

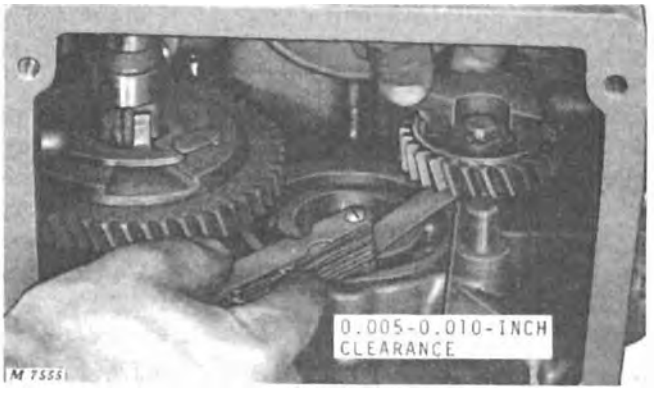
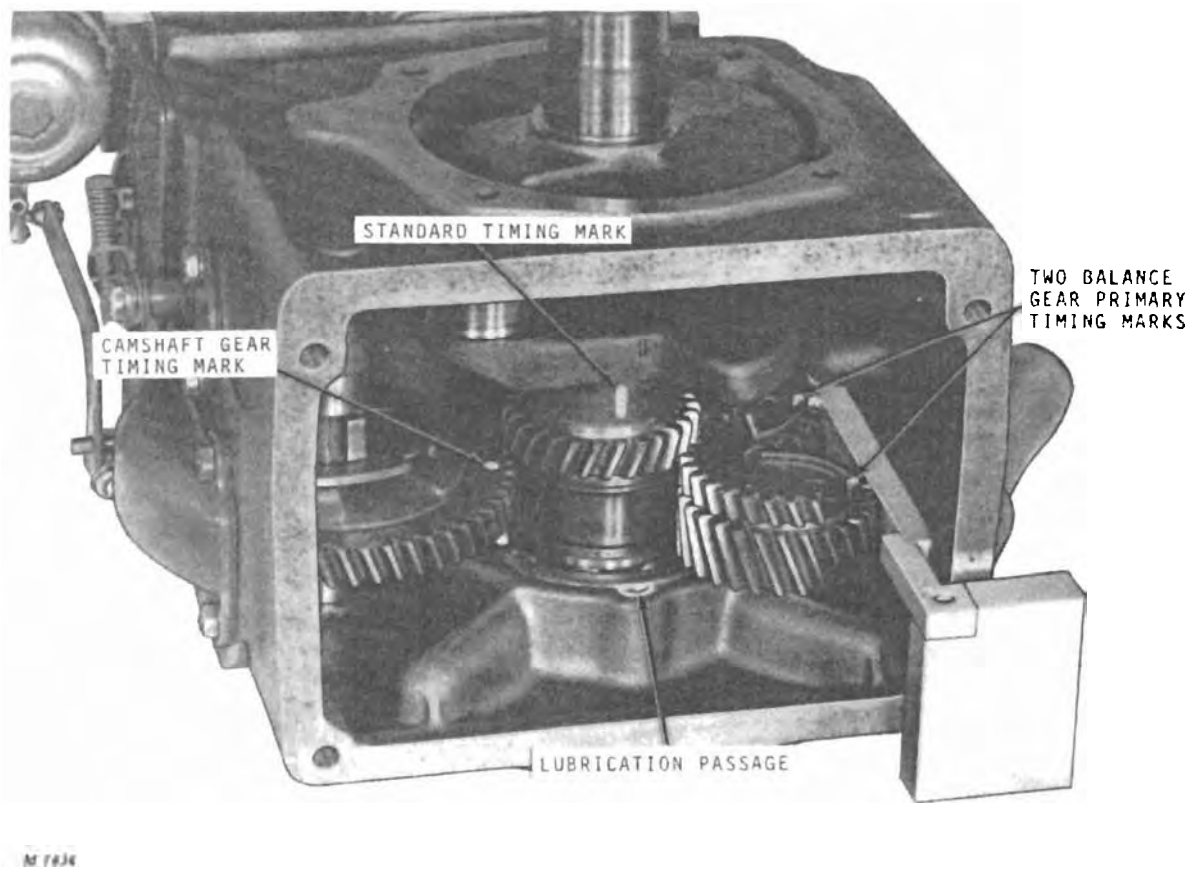


Fig. 34-Checking Balance Gear End Play

Check end play of balance gear and adjust to 0.005 to 0.010 inch by adding or removing 0.005-inch spacers, Fig. 34.

NOTE: If you are going to use a timing tool when installing the crankshaft, page 20-15-14, install both upper and lower balance gears prior to installing crankshaft. If you are not going to use a timing tool when installing the crankshaft, page 20-15-15, install only the upper balance gear at this time.

Installing Crankshaft and Balance Gears with Timing Tool (Kohler K241AS Engine) 10 hp Tractors (Serial No. -264,713)



M 7834

Fig. 35-Timing Balance Gears with Special Tool (10 hp, Serial No. -264,713)

NOTE: The special balance gear timing tool, Fig. 35, makes precision installation of the crankshaft more accurate. See "Special Tools," page 20-25-3.

Install special tool, as shown above, so two teeth on tool line up with primary timing marks on balance gears.

Install crankshaft so that counterweights are toward balance gear side of engine, Fig. 35. Turn crankshaft so that standard timing mark on crankshaft is in line with lubrication passage in engine block, Fig. 35.

Drive crankshaft 1/16 inch into the wide side of balance gears. Remove tool and turn crankshaft until standard timing mark on crankshaft aligns with timing mark on camshaft gear.

Engage crankshaft gear and camshaft gear. Tap crankshaft into place with plastic hammer.

Gears now should be in proper alignment. When properly timed, balance gears will form a straight line when counterweights are to either side, as in Fig. 5, page 20-15-4.

Installing Crankshaft and Balance Gears without Timing Tool (Kohler K241AS Engine) 10 hp Tractors (Serial No. -264,713)

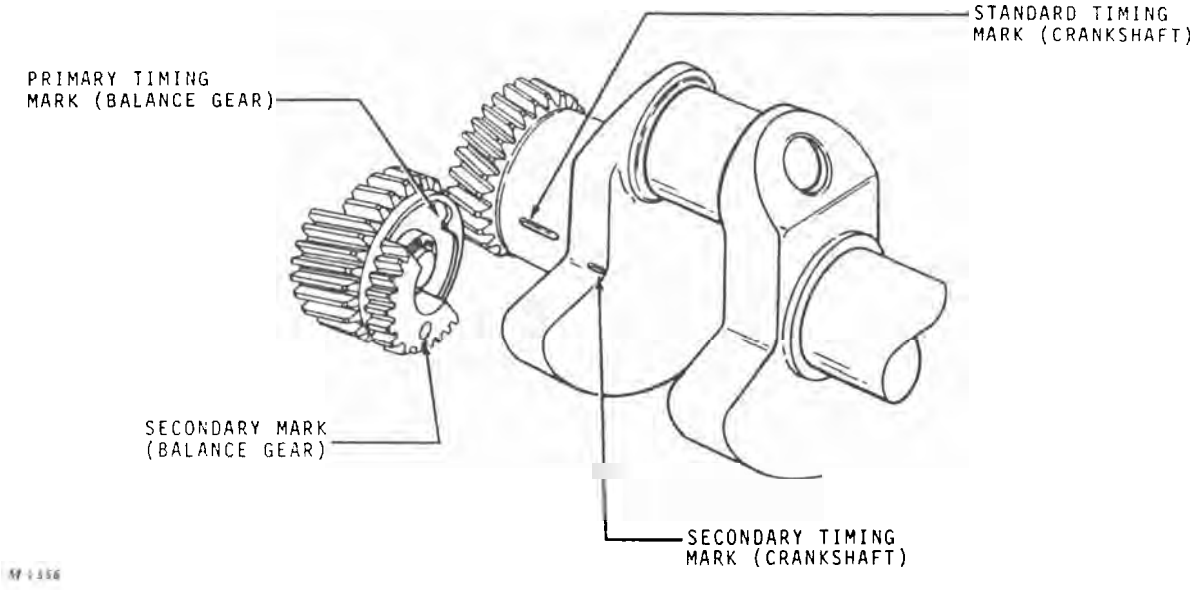


Fig. 36-Timing Marks for Installing Dynamic Balance Gears

Align crankshaft so the primary timing mark on top balance gear, Fig. 36, lines up with standard timing mark on the crankshaft.

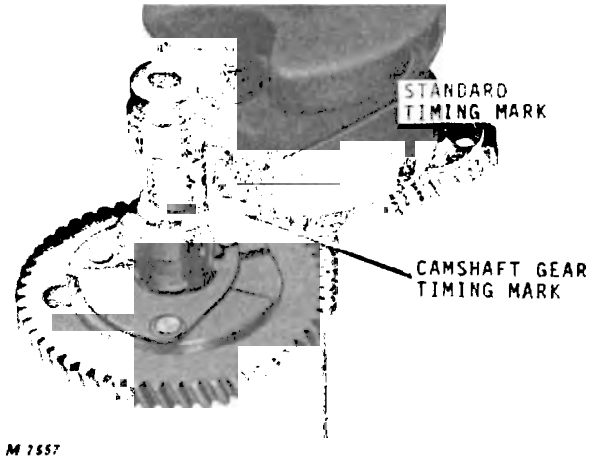


Fig. 37-Aligning Crankshaft and Camshaft Gears

Slide the crankgear approximately 1/16 inch into the wide side of the upper balance gear. Rotate the crankshaft to align standard timing mark next to crankgear with dot (timing mark) on face of camshaft gear, Fig. 37. Press crankshaft remainder of the way into block. Camshaft, crankshaft and upper balance gear are now correctly aligned.

Rotate crankshaft until it is approximately 15 degrees past bottom dead center. Slip one 0.010-inch spacer over lower stub shaft, and install lower balance gear.

Align secondary mark, Fig. 36, on lower balance gear with the secondary timing mark on the crankshaft counterweight. Gears will turn slightly as they engage, causing the lower balance gear's secondary timing mark to line up with the standard timing mark of the crankshaft.

NOTE: Turn crankshaft until counterweight is in position indicated in Fig. 5, page 20-15-4. A straight line should be formed by the half-moon sections of the balance gears, Fig. 5, page 20-15-4. If this line is not straight, one of the balance gears was inserted into the wrong tooth of the crankshaft gear. Review timing procedure described above if the straight line is not formed and correct the timing.

When balance gears are properly timed to crankshaft, install spacers and snap ring on lower balance gear stub shaft. See page 20-15-13, using same procedure as for upper balance gear

Installing Crankshaft on all Kohler K181S Engines and K241AS Engines used in 10 hp Tractors (Serial No. 264,714-)

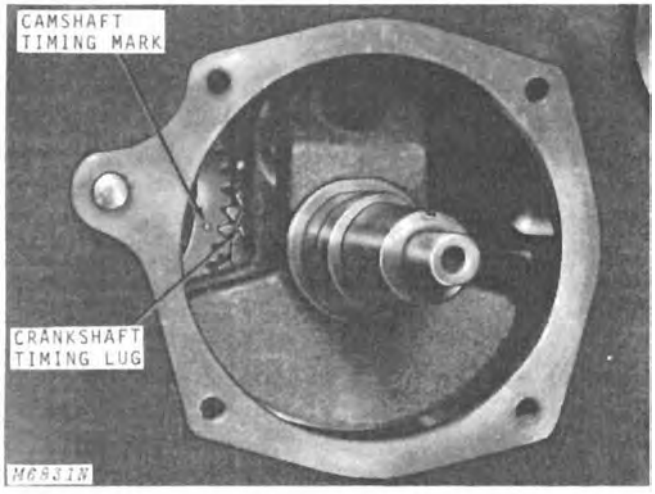


Fig. 38-Timing Marks on Crankshaft and Camshaft

Cover keyway in PTO end of crankshaft with a strip of scotch tape to prevent cutting seal if seal has been left in block.

Slip power take-off end of crankshaft into bearing in cylinder block.

NOTE: Proper crankshaft and camshaft gear timing is important.

Timing marks are provided on crankshaft and camshaft gear for correct engine timing. When in place, mark between teeth on camshaft must be directly in line with lug on shoulder of crankshaft, Fig. 38. Chalk timing mark positions for ease of viewing during assembly.

Assembling Bearing, Bearing Plate and Oil Seals (Kohler K181S Engine)

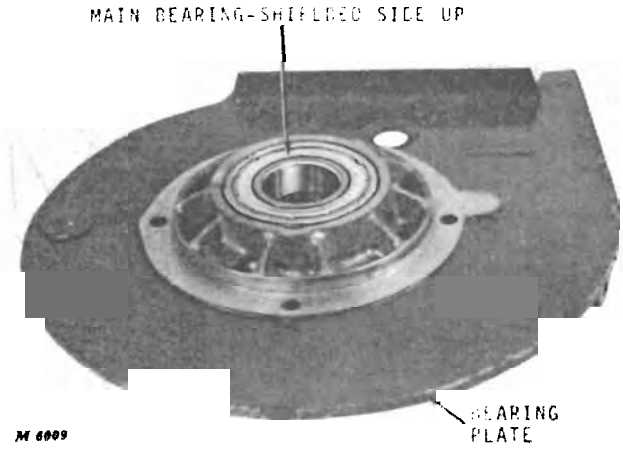


Fig. 39-Installing Main Bearing in Bearing Plate

With bearing plate properly supported, press main bearing, shielded side up, Fig. 39, into bearing plate until bearing bottoms in bearing bore.

NOTE: Be sure shielded side is up. Ball bearings must not be exposed to engine crankcase oil.

Assembling Bearing, Bearing Plate and Oil Seals (Kohler K241AS Engine)

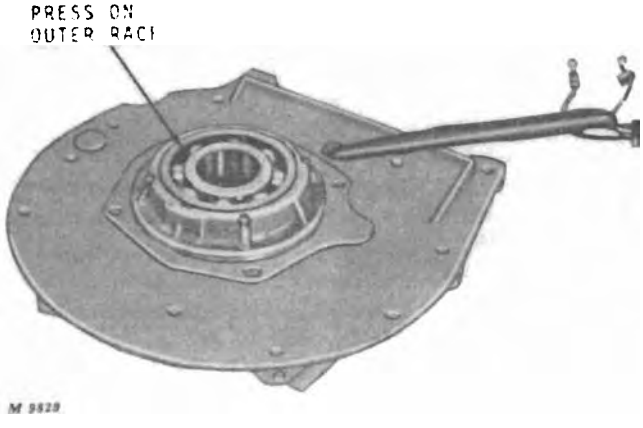


Fig. 40-Installing Main Bearing in Bearing Plate

With bearing plate properly supported and ball bearings facing direction shown, press main bearing, Fig. 40, into bearing plate until bearing bottoms in bore.

NOTE: Press on outer race only, so as not to damage main bearing.

Installing Bearing, Bearing Plate and Oil Seals

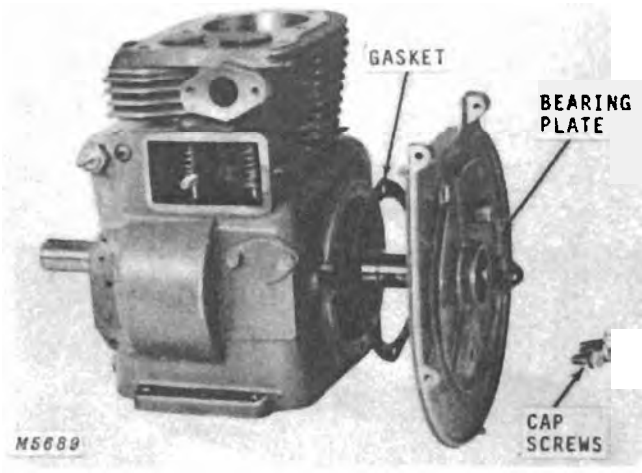


Fig. 41-Installing Bearing Plate with Bearing on Cylinder Block

Install gasket and bearing plate over crankshaft. Using two 3/8 x 1-3/4-inch cap screws, draw bearing plate toward block. Insert two of the four 3/8 x 1-inch cap screws in other two holes in plate. Remove the two long cap screws and replace with shorter screws provided, Fig. 41. Draw cap screws up evenly until correct torque is obtained. See "Torque Chart," Section 10.

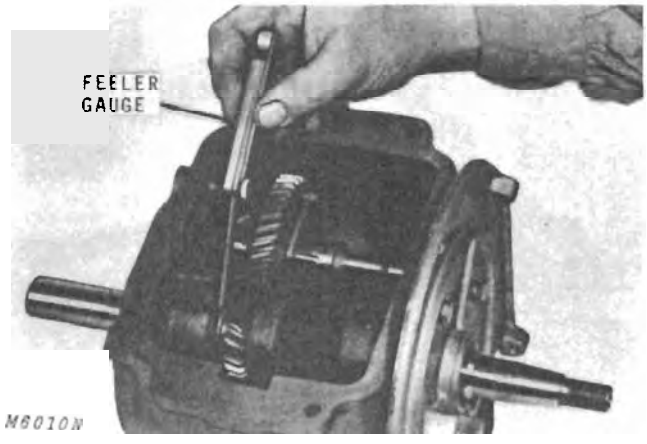


Fig. 42-Checking Crankshaft End Play

Seat the bearings by first tapping the tapered end of crankshaft with a mallet. Then tap PTO end of crankshaft. Check distance between bearing ring and crankshaft shoulder with a feeler gauge, Fig. 42. Refer to "Specifications," page 20-25-1, for crankshaft end play. Use gaskets as required to obtain correct crankshaft end play.

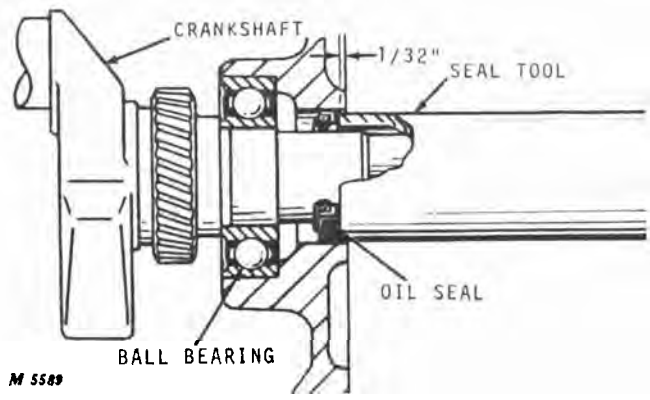


Fig. 43-Oil Seal Installation

Install oil seals with lip facing inward. Use a seal tool to protect seal from being damaged during installation. Drive seal in seal bore until outer face of seal is flush or 1/32-inch beyond flush of engine exterior, Fig. 43. (K181S Engine only.)

On the Kohler K241AS engine, place seal outside main bearing. Drive seal flush with housing.

Assembling Connecting Rod and Piston

Support connecting rod in a bench vise and slip piston down over connecting rod. Coat piston pin with a light film of oil. Insert piston pin through piston bore and connecting rod and on into opposite piston bore. A properly fitted piston pin can be pressed into position with hand pressure. Install retainer in both ends of piston pin bore, making sure that rings are securely seated in retainer grooves in piston.

Use a commercial rod aligner to check rod and piston alignment. Follow manufacturers recommendations for checking and correcting alignment.

Checking Piston Ring End Gap

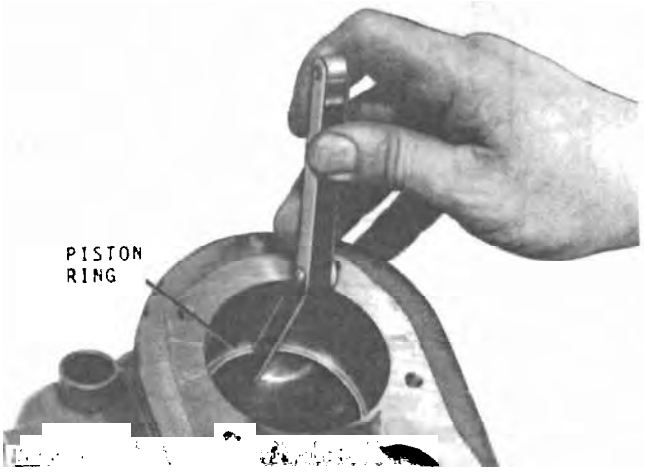


Fig. 44-Checking Ring End Gap

Before installing rings on piston, insert each ring into the cylinder bore to check ring end gap, Fig. 44.

Always check ring end gap whenever new rings are installed. Use an inverted piston without rings to push the ring squarely to a point in the bore which is approximately the center of piston ring travel.

Measure the ring end gap by inserting a feeler gauge between the ends of the ring, Fig. 44. See "Specifications," page 20-25-1, for correct ring gap.

Minor increase in gap clearance can be made by filing the ends of the ring but this must be done accurately on equipment made for this purpose.

Too much end clearance indicates that wrong rings are being used or cylinder is bored too large.

Installing Rings and Piston

After checking ring side clearance and end gap, use a ring expander to position all rings exactly as shown, Fig. 45 and 46. Regular set of rings do not have rails and expander on oil ring.

Note position of chamfer on top ring, under cut on center ring and expander of lower ring.

When installing heavy-duty rings, be sure to install chrome-edged ring in top piston groove.

Stagger the piston ring gaps by moving each ring until the gaps are out of alignment as much as possible **THIS IS IMPORTANT.**

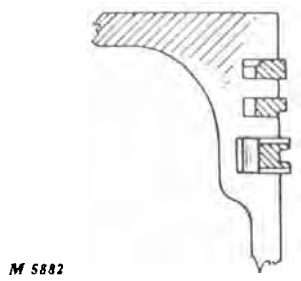


Fig. 45-Piston Ring Assembly

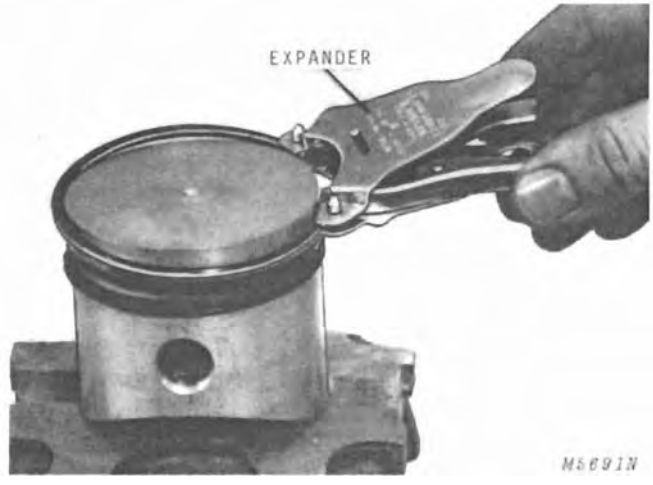


Fig. 46-Installing Rings

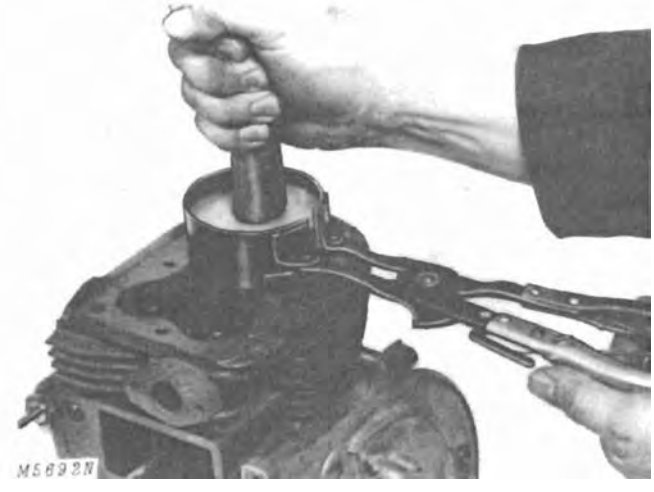


Fig. 47-Installing Piston in Cylinder

Coat piston and ring generously with light oil and insert complete assembly into cylinder bore using ring compressor, Fig. 47.

NOTE: Be sure match marks on connecting rod and rod cap are aligned and face flywheel side of engine, Fig. 48.

Attaching Rod to Crankshaft

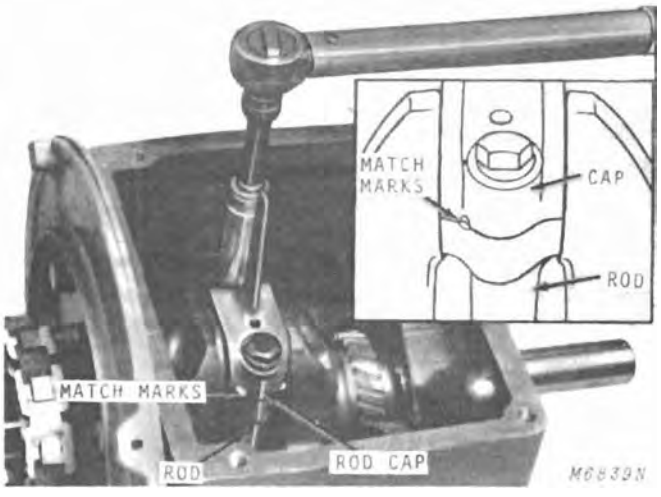


Fig. 48-Rod and Crankshaft Assembly

After piston assembly is installed, place block on end and oil connecting rod and crankshaft journal. Be sure that match marks on connecting rod and cap, Fig. 48, are aligned and face flywheel side of engine.

Attach connecting rod cap, lock plate (if used) and cap screws to the connecting rod. Torque to specifications listed on page 20-25-2.

IMPORTANT: Bend lips of lock plate to rod cap screw heads to prevent screws from loosening.

Installing Oil Pan On Block

Place a new gasket on oil pan. Position oil pan to match cylinder block, Fig. 49. Install cap screws and torque to specification listed in "Torque Chart" in Section 10.

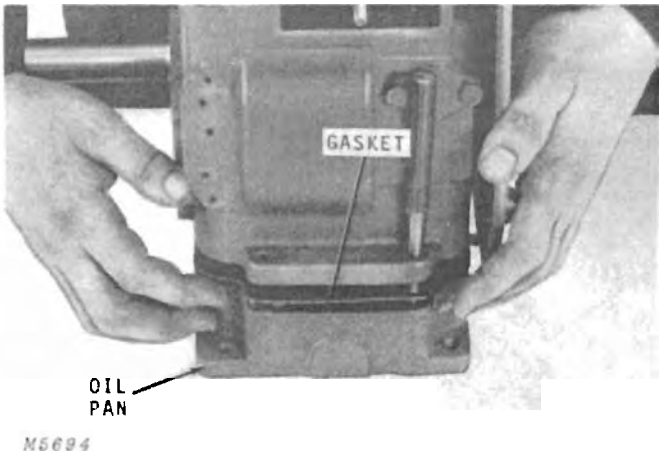


Fig. 49-Oil Pan and Gasket Assembly

Installing Flywheel

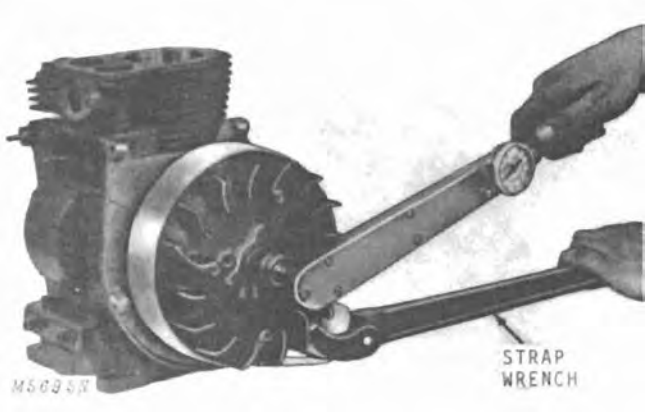


Fig. 50-Flywheel Assembly

Place square key in crankshaft keyway.

Assemble flywheel, washer and nut on end of crankshaft and tighten nut.

Place bar between flywheel fins or use strap wrench, Fig. 50, while torquing nut. See "Torques for Hardware," page 20-25-2 for proper flywheel nut torque.

Refer to Group 10 of this section and install valves, breather and cylinder head.

Installing Shrouding

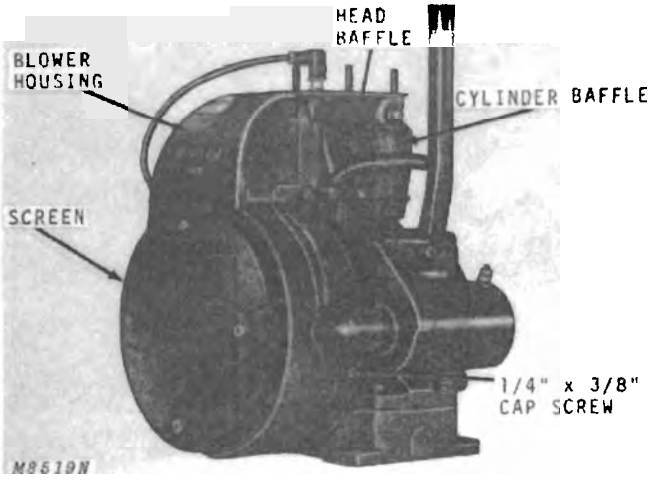


Fig. 51-Installing Engine Shrouding (K181S Engine)

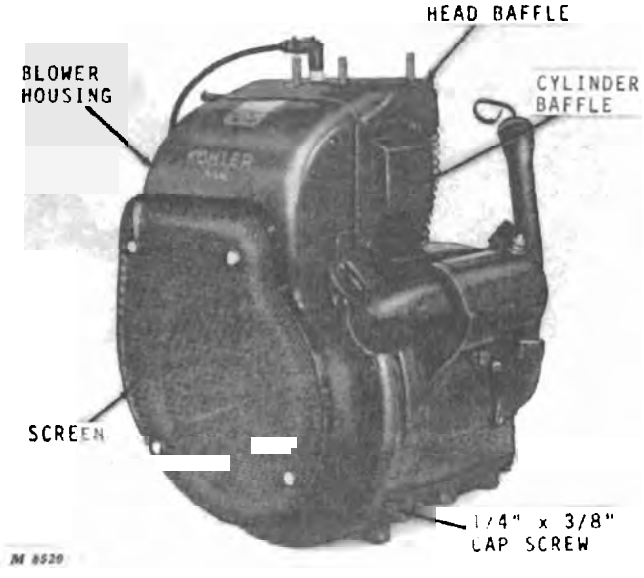


Fig. 52-Installing Engine Shrouding (K241AS Engine)

Install blower housing, cylinder baffle, head baffle and air intake screen. Tighten all cap screws firmly.

IMPORTANT: Be sure to install the 1/4 x 3/8-inch cap screw in the position shown in Figs. 51 and 52. A longer cap screw will strike the flywheel.

Installing Exterior Components

Install coil and condensor. Attach leads to their respective terminals. See Section 40, Electrical System.

Be sure breaker point push rod is in place. Also inspect, clean and adjust breaker points if necessary. See Section 40, Electrical System.

Refer to page 20-20-6 for proper carburetor and governor arm assembly. See adjustments and adjust accordingly.

Group 20
CAMSHAFT, TAPPETS AND GOVERNOR

GENERAL INFORMATION

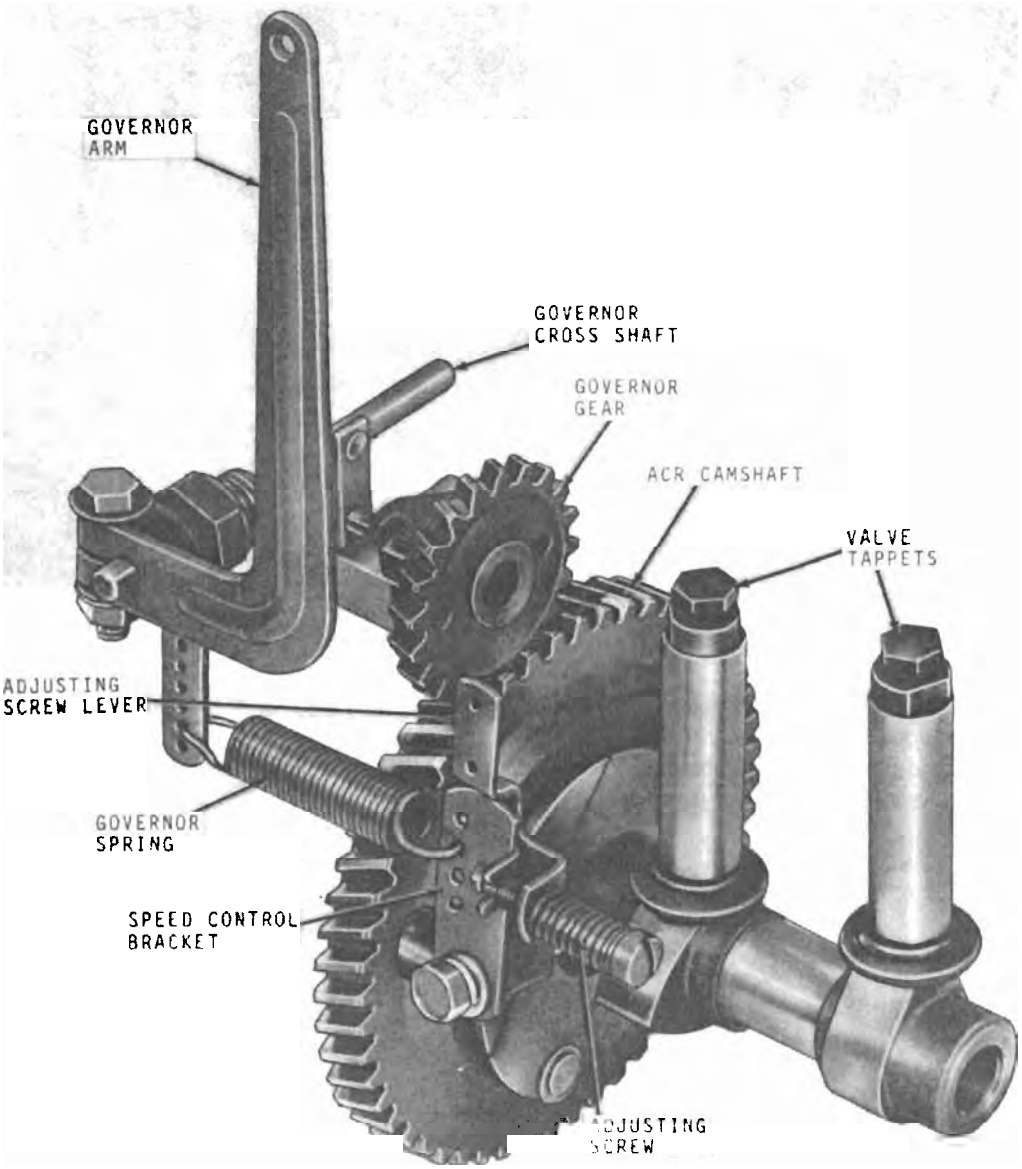
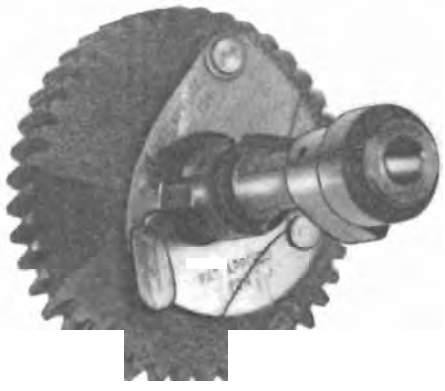


Fig. 1-Assembled View of Camshaft, Tappets and Governor

The camshaft-driven governor, Fig. 1, maintains constant engine speed under varying loads and serves as a top speed limiting device.

The Kohler K181S and K241AS Engines feature an automatic compression release camshaft which is explained in detail on the following page.

Automatic Compression Release Camshaft

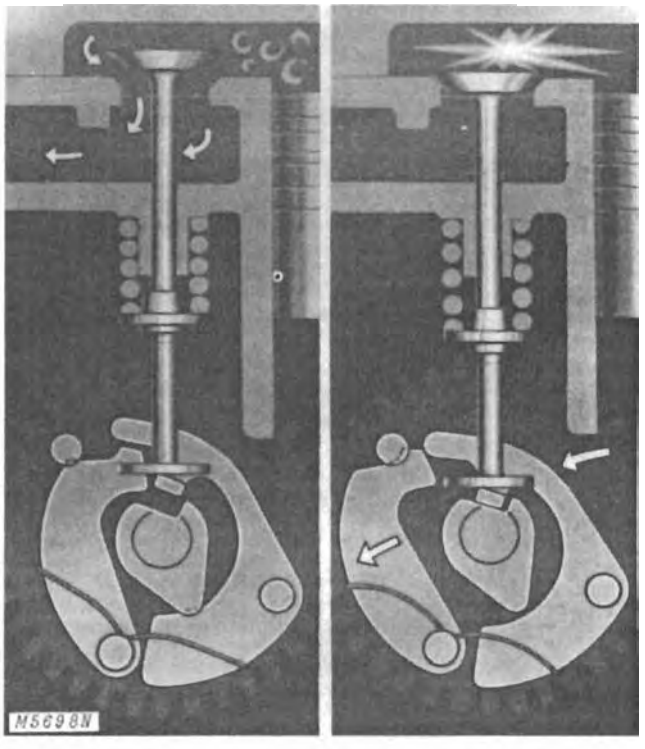


M6012N

Fig. 2-Automatic Compression Release Camshaft (ACR)

Automatic compression release, Fig. 2, provides a reduction in cranking effort by holding the exhaust valve open slightly during the first part of the compression stroke. This allows part of the fuel-air mixture to escape, lowering the compression pressure, Fig. 3. This feature is especially valuable during cold weather starting.

By releasing compression, the pressure of the burning mixture is reduced sufficiently for the flywheel to carry the engine over top dead center. This prevents "kick-back" and eliminates the need for the spark retard mechanism.

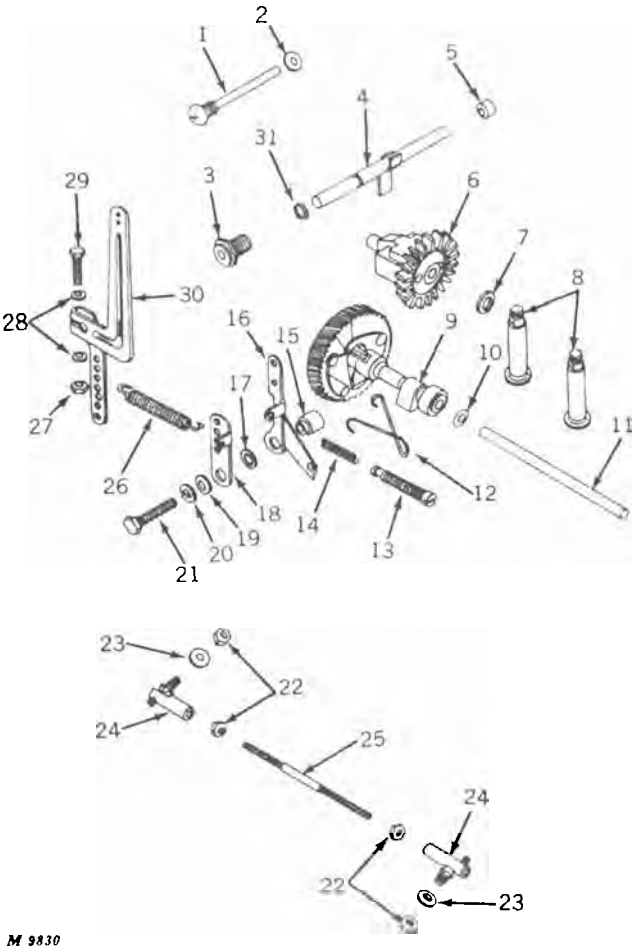


M5698N

Fig. 3-ACR Operation

When the engine speed reaches approximately 650 rpm, centrifugal force disengages the automatic compression release allowing the engine to operate in the usual manner at all higher speeds, with no loss of power.

REPAIR



1—Governor Stop Pin
2—Governor Shaft Washer
3—Governor Bushing
4—Governor Cross Shaft
5—Needle Bearing
6—Governor Gear
7—Thrust Washer
8—Tappets (2 used)
9—ACR Camshaft
10—Spacer (0.005 or 0.010 inch as required)
11—Camshaft Pin
12—ACR Camshaft Spring
13—Adjusting Screw
14—Adjusting Screw Spring
15—Spacer
16—Adjusting Screw Lever
17—Tension Washer
18—Speed Control Bracket
19—Washer
20—Lock Washer
21—Cap Screw
22—Hex. Nut (4 used)
23—Washer (2 used)
24—Ball Joint (2 used)
25—Throttle Rod
26—Governor Spring
27—Hex. Nut
28—Washer (2 used)
29—Cap Screw
30—Governor Arm
31—Snap Ring

Fig. 4-Exploded View of Camshaft and Governor (K241AS Engine)

Removing Camshaft and Tappets

Fig. 4 is an exploded view of camshaft and governor of K241AS engine

Remove engine and all component parts covered in Group 15.

Use a blunt punch to drive camshaft pin out of block, Fig. 5

IMPORTANT: Drive pin out from power take-off side of cylinder block only. Pin will slide out easily after it is driven free from this side of block, Fig. 5. Removing or installing pin incorrectly will damage engine block.

Lift out camshaft

IMPORTANT: If the original camshaft is to be reinstalled, use the same number of camshaft shims as removed.

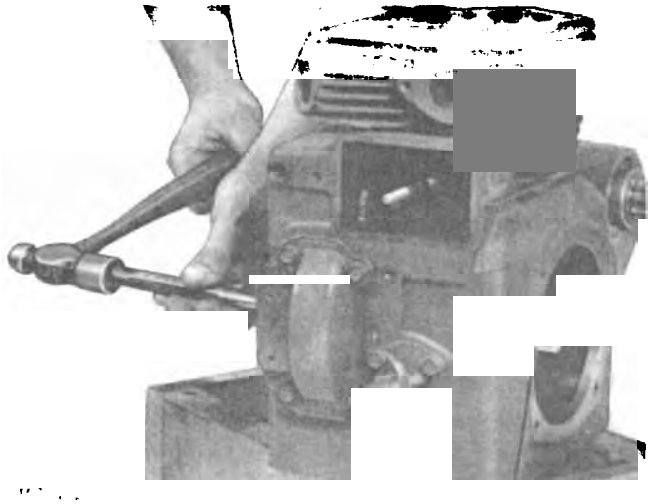


Fig. 5-Removing Camshaft Pin

Removing Governor

Loosen nut on governor cross shaft and slide off all external parts.

NOTE: Do not attempt to remove governor cross shaft from outside of engine. It must be removed from the inside.

Turn block upside down and remove governor stop pin (1, Fig. 4) and copper washer. Governor assembly, brass washer, and cross shaft (4, Fig. 4) may now be removed.

Inspecting Camshaft

Wash governor and camshaft in a safe cleaning solvent and wipe parts dry.

Check camshaft for cracked, worn or broken gear teeth.

Check operation of ACR camshaft and weights, making sure all parts are intact and operate freely.

Inspecting Governor Gear

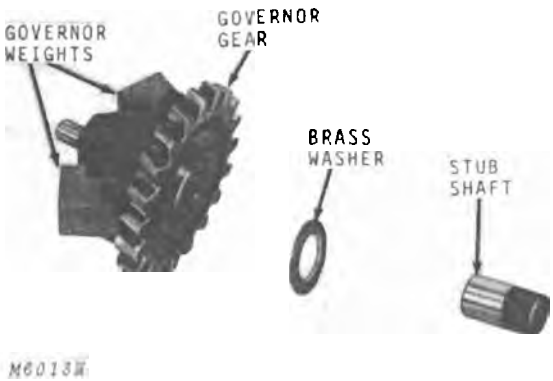


Fig. 6-Governor Gear Assembly

The governor gear assembly, Fig. 6, will not normally show much wear. Be sure weights and governor center pin operate freely and that gears and teeth are in good condition.

The stub shaft is replaceable. Remove expansion plug from block and press replacement shaft into block until it protrudes 11/32 inch from the boss area.

Be sure cross shaft arm is not loose on shaft and is positioned perpendicular to shaft, Fig. 7. This is important. If arm is loose, install new cross shaft.

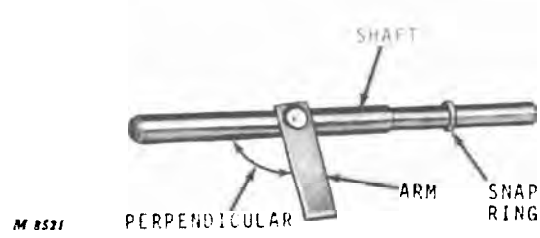


Fig. 7-Governor Cross Shaft

INSTALLATION

Installing Governor

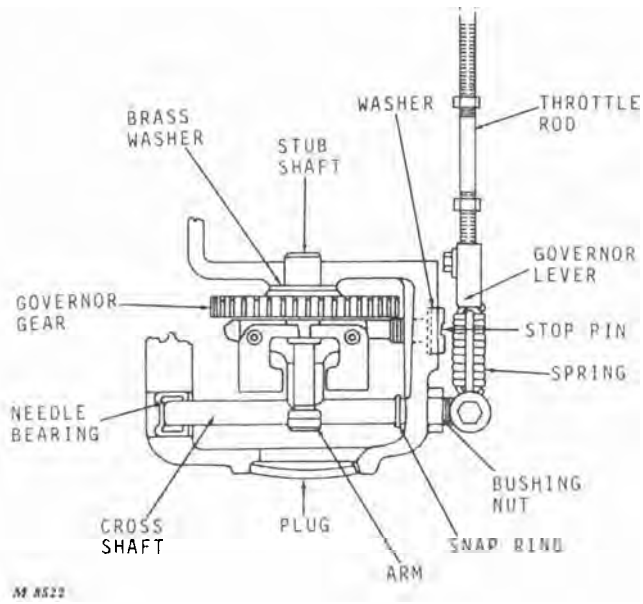


Fig. 8-Cross-Section of Governor Assembly (K241AS Engine)

Place cylinder block on its side. Place brass or steel washer (see chart below) and governor gear on stub shaft. Install cross shaft from inside of block. Be sure snap ring, Fig. 8, is in place on cross shaft.

Place washer on stop pin and turn in from outside of engine block.

Thread bushing nut into block. Tighten nut slightly.

Engine	Gear Type	Washer
K181S	Steel	Brass
K181S	Nylon	None required
K241AS	Steel	Brass
K241AS	Nylon	Two Steel

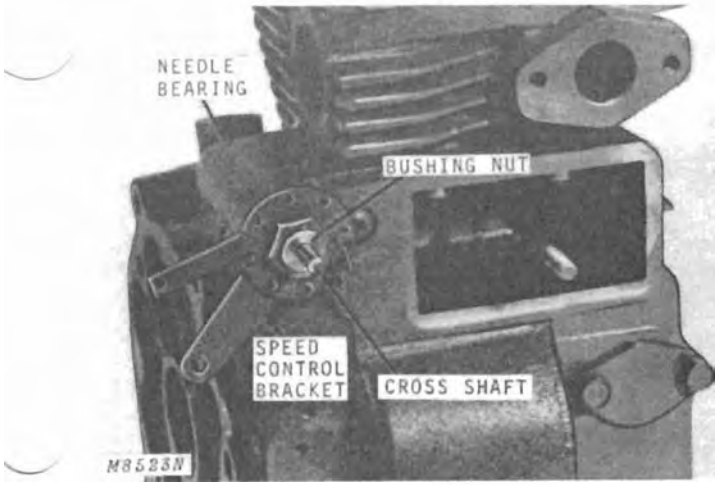


Fig. 9-External Governor Parts (K181S Engine)

Grasp end of cross shaft and work cross shaft in and out to determine end clearance. Cross shaft should be free to move in and out approximately 1/64 to 1/32 inch. Adjust for more or less end clearance by tapping needle bearing either in or out of block, Fig. 9. See Specifications, page 20-25-2.

NOTE: To prevent damage, tap needle bearing at depressed center area only.

Spin the governor gear assembly to be sure it rotates freely.

Installing Camshaft

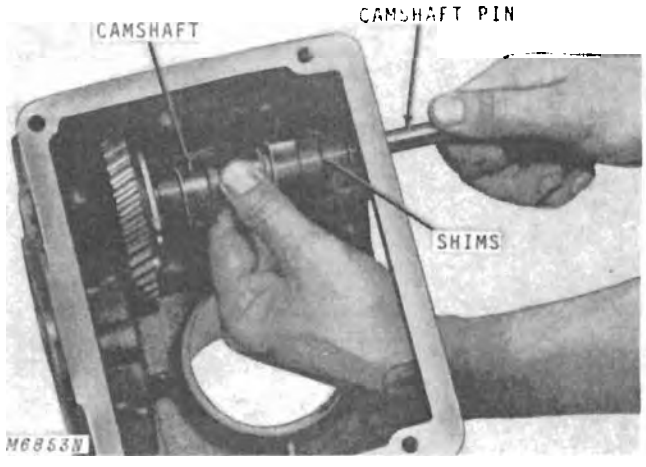


Fig. 10-Installing Camshaft

Install tappets in holes from which removed

While holding camshaft assembly, Fig. 10, insert camshaft pin. Be sure to install thin shim washer(s) on shaft next to bearing plate side of block. Drive pin into block until end of pin is flush with block exterior (flywheel side of block).

Use feeler gauge to check camshaft end clearance. See "Specifications," page 20-25-1. Use 0.005 to 0.010-inch spacer washers as required to obtain correct clearance.

Spin camshaft to be sure governor and camshaft turn freely.

Connecting Governor Arm to Carburetor

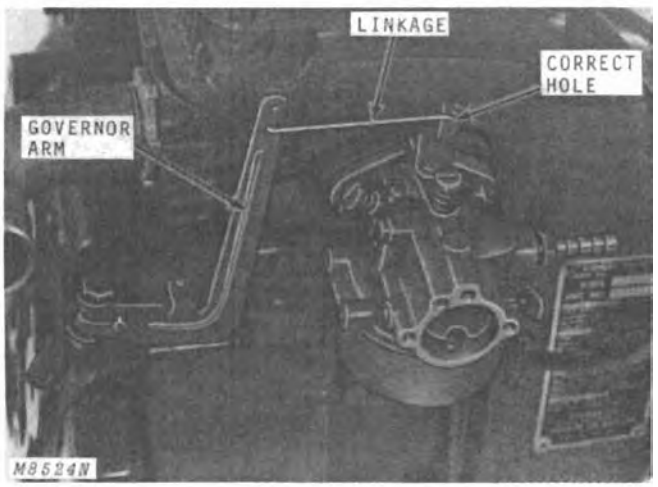


Fig. 11-Governor-to-Carburetor Linkage (K181S Engine)

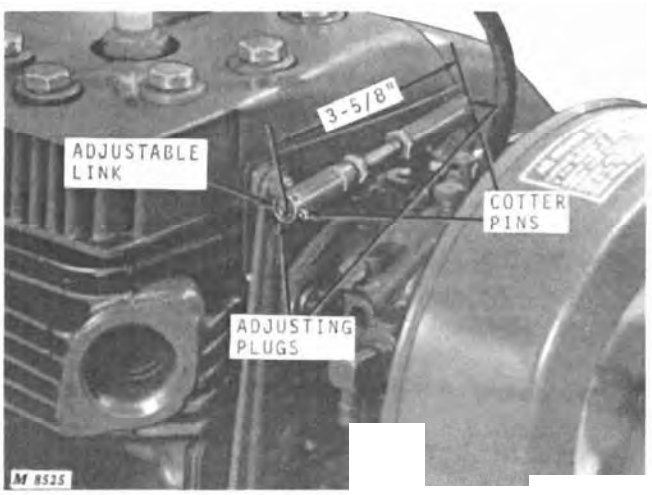


Fig. 12-Governor-to-Carburetor Linkage (K241AS)

Connect linkage between governor arm and carburetor in correct holes as indicated, Fig. 11, for the K181S Engine.

On K241AS Engines, install the adjustable link as shown in Fig. 12. Be sure that the link is 3-5/8-inch long before attempting to complete governor arm adjustment. To obtain this dimension, loosen lock nuts and turn ends on or off threaded rod until correct length is reached. Tighten lock nuts.

Whenever looseness is noticed in the throttle linkage, Fig. 12, remove cotter pins and turn adjusting plugs inward until tight against ball joints. Be sure, however, there is no binding. Tighten plugs and insert cotter pins.

Installing Governor Arm

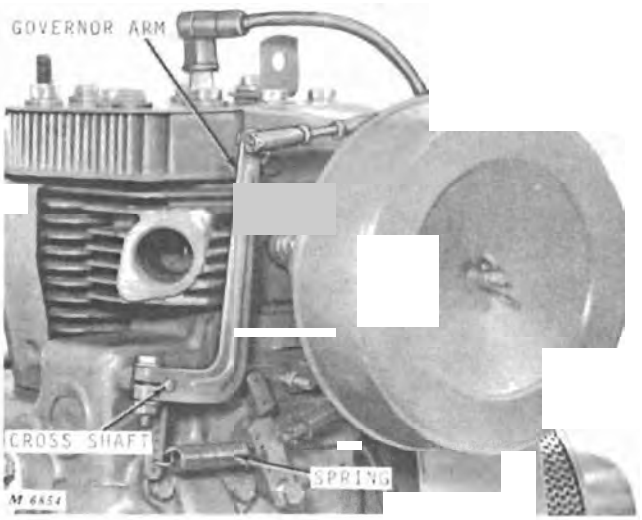


Fig. 13-Positioning Governor Arm

Turn block upright and slide governor arm and bolt assembly on end of cross shaft, Fig. 13.

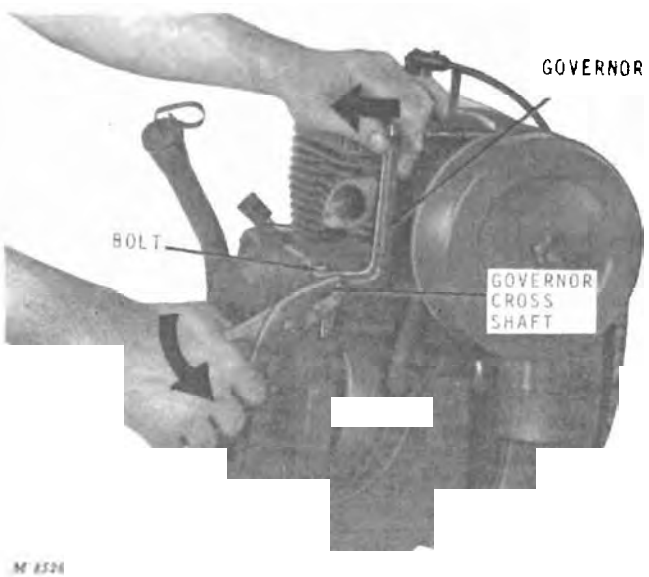


Fig. 14-Adjusting Governor Arm

Before tightening bolt on cross shaft, turn governor shaft counterclockwise as far as possible. While holding governor arm to the left (away from block) tighten bolt, Fig. 14. Move governor through its full arc of travel to be sure it operates loosely. Relieve pressure on bushing nut if too tight.

Governor arm adjustment is the same for both the K181S and K241AS Engines, Fig. 14.

ADJUSTMENT

Governor Speed Adjustment (Kohler K181S Engine)

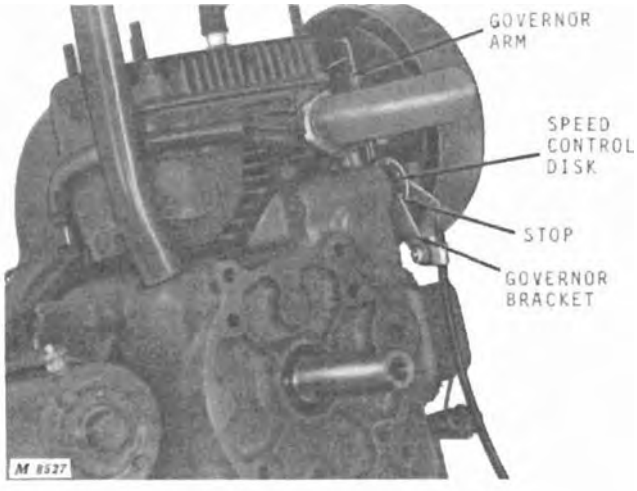


Fig. 15-Adjusting Governor Speed

Governor speed is regulated by the position of the governor bracket. The bracket acts as a stop limiting the rotation of the speed control disk.

After engine is operable, start engine and check engine speed at full throttle. Move governor bracket up or down, Fig. 15, as required until maximum engine speed is 3800 rpm on a tachometer with all drives disengaged. See "Special Tools," page 20-25-3. Tighten bushing nut but AVOID EXCESSIVE PRESSURE. Governor arm must operate loosely.

Governor Speed Adjustment (Kohler K241AS Engine)

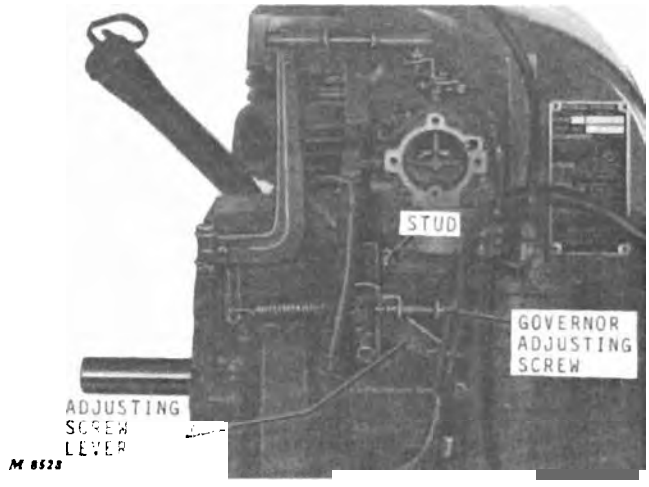


Fig. 16-Adjusting Governor Speed

To adjust governor, Fig. 16, stop engine and set throttle control in run (high speed) position. Position cable so that side of adjusting screw lever strikes breather stud.

Start engine. Turn governor adjusting screw clockwise to decrease maximum rpm. Turn screw counterclockwise to increase maximum rpm.

Check engine rpm using a tachometer. See "Special Tools," page 20-25-3.

IMPORTANT: Engine speed should not exceed 3800 rpm at no load.

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Group 25
SPECIFICATIONS AND SPECIAL TOOLS

SPECIFICATIONS

Item	Kohler K181S Engine	Kohler K241AS Engine	Wear Tolerance
Engine compression	110 to 120 psi	110 to 120 psi	
Spark plug gap	0.020 in.	0.020 in.	
Bore and stroke	2-15/16 x 2-3/4 in.	3-1/4 x 2-7/8 in.	
Bore diameter, new	2.9375 in.	3.250 in.	
Crankshaft end play	0.002 to 0.023 in.	0.003 to 0.020 in.	
Crankshaft journal-to-connecting rod side clearance	0.0005 to 0.016 in.	0.007 to 0.016 in.	
Crankshaft journal length	1.1860 to 1.1855 in.	1.5000 to 1.4995 in.	
Crankshaft journal diameter, new	1.125 in.	1.187 in.	
Connecting rod journal size	1.181 in.	1.575 in.	
Connecting rod-to-crankshaft journal running clearance	0.001 to 0.002 in.	0.001 to 0.002 in.	
Connecting rod-to-piston pin clearance	0.0006 to 0.0011 in.	0.0003 to 0.0008 in.	
Piston pin-to-piston boss	0.0001 in. interference to 0.0003 in. loose	0.0000 to 0.0003 in. Select fit	
Piston-to-cylinder bore (thrust face)	0.0045 to 0.0070 in.	0.003 to 0.004 in.	
Piston-to-cylinder bore (top of skirt)	0.006 to 0.008 in.	0.0075 to 0.0085 in.	
Piston pin bore size	0.62565 in.	0.85975 in.	
Piston pin diameter	0.625 in.	0.86 in.	
Ring side clearance, top ring	0.0025 to 0.0040 in.	0.002 to 0.004 in.	
Ring side clearance, middle ring	0.0025 to 0.0040 in.	0.002 to 0.004 in.	
Ring side clearance, oil ring	0.001 to 0.0025 in.	0.001 to 0.003 in.	
Ring end gap	0.007 to 0.017 in.	0.010 to 0.020 in.	
Ring width, inches, top ring	0.093 in.	0.093 in.	
Ring width, inches, middle ring	0.093 in.	0.093 in.	
Ring width, inches, oil ring	0.187 in.	0.187 in.	
Camshaft pin-to-camshaft clearance	0.0010 to 0.0035 in.	0.001 to 0.0035 in.	
Camshaft pin-to-block (bearing plate end)	0.0005 to 0.0020 in.	0.0005 to 0.0020 in.	
Camshaft pin-to-block (power take-off end) (interference)	0.0015 to 0.0030 in.	0.0015 to 0.0030 in.	
Camshaft pin-to-breaker cam	0.0010 to 0.0035 in.	0.0010 to 0.0025 in.	
Camshaft end play	0.005 to 0.010 in.	0.005 to 0.010 in.	
Valve stem clearance in guide, intake	0.0010 to 0.0025 in.	0.0010 to 0.0025 in.	
Valve stem clearance in guide, exhaust	0.0025 to 0.0040 in.	0.0025 to 0.0040 in.	
Valve guide in block (interference)	0.0005 to 0.0020 in.	0.0005 to 0.0020 in.	
Valve seat in block (exhaust) (interference)	0.002 to 0.004 in.	0.003 to 0.005 in.	
Valve clearance, intake (cold)	0.006 to 0.008 in.	0.008 to 0.010 in.	
Valve clearance, exhaust (cold)	0.015 to 0.017 in.	0.017 to 0.020 in.	
Valve seat angle	44.5°	44.5°	
Valve face angle	45°	45°	
Valve seat width	0.037 to 0.045 in.	0.037 to 0.045 in.	
Valve tappet clearance in block	0.0005 to 0.0020 in.	0.0008 to 0.0023 in.	
Valve guide, I.D.	0.312 to 0.313 in.	0.312 to 0.313 in.	
Valve guide, depth	1-5/16 in.	1-15/32 in.	
Valve stem, O.D. (intake)	0.3105 to 0.3110 in.	0.3105 to 0.3110 in.	
Valve stem, O.D. (exhaust)	0.3090 to 0.3095 in.	0.3090 to 0.3095 in.	

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SPECIFICATIONS—Continued

Item	Kohler K181S Engine	Kohler K241AS Engine	Wear Tolerance
Valve seat width	1/32 in.	1/32 in.	5/64 in.
Valve face width	3/32 in.	3/32 in.	———
Valve margin	1/16 in.	1/16 in.	1/32 in.
Valve spring squareness	1/32 to 1/16 in.	1/32 to 1/16 in.	1/32 in.
Valve spring compressed (intake)	18 to 22 lbs. at 1-5/16 in. length	43 to 49 lbs. at 1-5/16 in. length	———
Valve spring compressed (exhaust)	18 to 22 lbs. at 1-5/16 in. length	43 to 49 lbs. at 1-5/16 in. length	———
Valve spring free length (intake)	1-3/4 in.	1-13/16 in.	———
Valve spring free length (exhaust)	1-3/4 in.	1-7/8 in.	———
Governor bushing-to-governor cross shaft clearance	0.0005 to 0.0020 in.	0.001 to 0.0025 in.	———
Governor gear-to-governor shaft	0.0025 to 0.0055 in.	0.0005 to 0.0020 in.	———
Ball bearing-to-cylinder block (interference)	0.0014 to 0.0029 in.	0.0006 to 0.0022 in.	———
Ball bearing-to-bearing plate (interference)	0.0014 to 0.0029 in.	0.0012 to 0.0028 in.	———
Ball bearing-to-crankshaft (interference to loose)	0.0005 to 0020 in.	0.0004 to 0.0005 in.	———

TORQUES FOR HARDWARE

Location	Torque	
	K181S	K241AS
Cylinder head bolts	17 ft-lbs	30 ft-lbs.
Connecting rod cap screws	200 in-lbs	300 in-lbs
Flywheel nut	50 to 60 ft-lbs	60 to 70 ft-lbs
Spark plug (cold)	27 ft-lbs	27 ft-lbs
Misc. hardware	Refer to torque chart Section 10	

SPECIAL TOOLS

Name	Part No.	Use
Extractor	K.O. LEE R95	To remove exhaust valve seat insert.
Adjustable Reamers	QUICK SET 43	Ream valve guides after installation.
Valve Spring Tester	STURDEDANT Model SPT	To check valve spring pressure.
Valve Grinding Compound	B-K 1896	To lap valve seat and valve face.
Valve Keeper Replacer	KD 608	To install keepers on valve stem.
Valve Lifter	SNAP ON CF19	To compress valve springs.
Valve Seat Cutter Kit for Kohler Engines	NEWAY No. 102S Kit, NEWAY Sales Inc., Corunna, Michigan	Recondition valve seat.
Strap Wrench	Ridgid-5	To remove flywheel.
Micrometer 1-inch	Starrett 230 RL	Check piston pin diameter.
Micrometer 2-inch	Starrett 2 RL	Check crankshaft journal diameter
Micrometer 3-inch	Starrett 436 XRL	Check piston diameter.
Micrometer 4-inch	Starrett 436 XRL	Check piston diameter.

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Name	Part No.	Use
Inside telescoping gauge 5/16 - 6-inch	Starrett S579H	Check cylinder bore.
Feeler gauge	OTC 860 A	Check end clearances.
Cylinder hone	AMMCO 500	Deglazing and boring engine block.
Ring groove cleaner	OTC 846	Clean piston grooves.
Fine-Stone for AMMCO 500 cylinder hone	AMMCO 621	Finish cut.
Finishing-Stone for AMMCO 500 cylinder hone	AMMCO 3933	Finish and deglazing.
Medium-Stone for AMMCO 500 cylinder hone	AMMCO 620	Semi-finish.
Coarse-Stone for AMMCO 500 cylinder hone	AMMCO 619	For roughing cylinder (primary cut).
Piston ring band handle	KD 850	Tighten piston ring compressor.
Piston ring compressor	KD 850 B-1	To compress piston rings.
Ridge/Reamer	AMMCO Model 2100	To remove top ridge from cylinder bore.
Balance Tool	Service Tools Inc. 1901 Indiana Avenue Chicago, Illinois 60616	Timing balance gears to crankshaft gear.
Treysit Vibrator Engine Tachometer	670156 Lauson Power Products, Parts Depot, Grafton, Wisconsin 53024	Measure engine rpm.

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Section 30
FUEL SYSTEM
Group 5
GENERAL INFORMATION

TABLE OF CONTENTS

Litho in U.S.A.

PRINCIPLE OF OPERATION

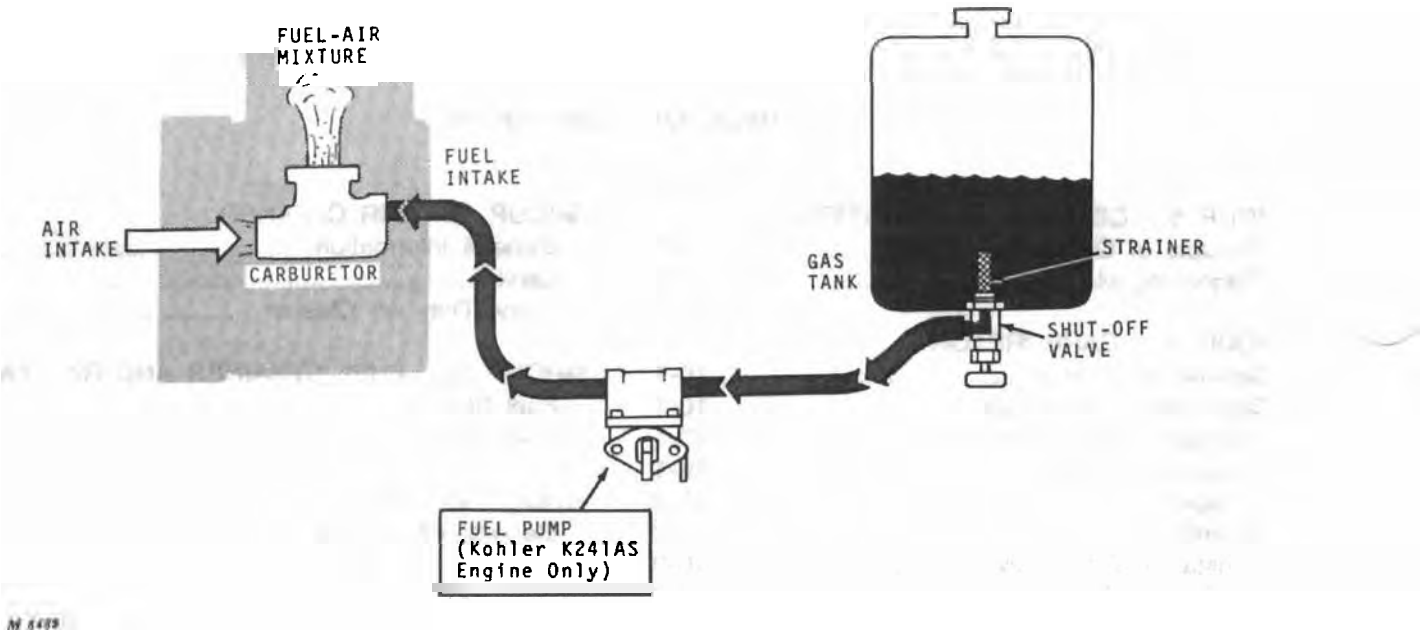


Fig. 1-Fuel System for 110 Tractors (Serial No. 250,001-)

Gasoline flows from the fuel tank through a strainer and shut-off valve to the carburetor, Fig. 1. On the 8 hp tractor this is a gravity feed system. On the 10 hp tractor the carburetor is mounted slightly higher than the bottom of the fuel tank, making a fuel pump necessary. The fuel pump operates off a cam on the camshaft.

The side-draft, float-type carburetor used on the 110 Tractor has three external adjustments: high-speed needle, idle mixture needle and idle stop screw.

A replaceable dry-type air cleaner element is used to filter incoming air.

DIAGNOSING MALFUNCTIONS

Hard Engine Starting

Engine flooded.

Gas tank vent restricted.

High-speed and idle mixture needles not properly adjusted.

Fuel inlet needle sticking to seat.

Choke not operating properly.

Fuel shut-off valve closed.

Water, rust or stale fuel in gas tank.

Carburetor gummed.

Air lock in fuel line.

Air filter element restricted.

Faulty fuel pump.

Engine Stalling

High-speed and idle mixture needles not properly adjusted

Dirt, water, or ice in fuel system.

Gas tank vent restricted.

Fuel line restricted.

Fuel strainer plugged.

Air lock in fuel line.

Air filter element restricted.

Faulty fuel pump.

Rough Idle

High-speed and idle mixture needles not properly adjusted.

Air leakage past damaged carburetor-to-engine gasket.

Air leakage past worn throttle plate shaft or bearing surfaces.

Float setting incorrect.

Air filter element restricted.

Dirt, water, or ice in fuel system.

Poor Acceleration

High-speed and idle mixture needles not properly adjusted.

Air filter element restricted.

Throttle cable not adjusted properly.

Sticky fuel inlet needle.

Dirty or damaged high-speed mixture needle.

Governor not adjusted properly.

Dirt or paint on throttle return spring.

8 hp tractors: Arm loose on governor cross shaft.

10 hp tractors: Check condition of governor spool.

Engine Surging

High-speed and idle mixture needles not properly adjusted.

Dirt or paint on throttle return spring.

Fuel strainer plugged.

Faulty fuel pump.

Governor linkage not adjusted properly.

Too low on fuel.

DIAGNOSING MALFUNCTIONS—Continued

Flooding or Leaking Carburetor

Sticking fuel inlet needle.

Float setting incorrect.

Float leaking.

Fuel line or fitting loose.

No Fuel Reaches Carburetor

Shut-off valve closed.

Gas tank empty.

In-line strainer clogged.

Gas tank vent restricted.

Fuel line clogged.

Faulty fuel pump.

Group 10
CARBURETOR

GENERAL INFORMATION

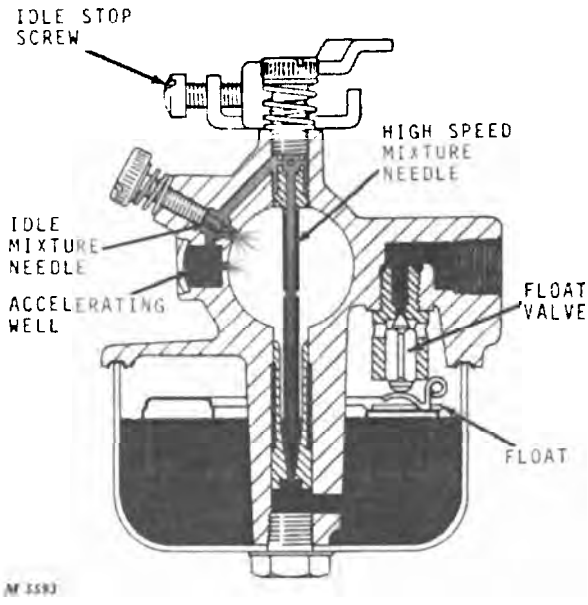


Fig. 1-Cutaway View of Carburetor

Fuel enters the bowl through a valve controlled by the float, Fig. 1. Air entering the carburetor is controlled by the choke valve when starting. The air-fuel mixture entering the engine is regulated by the throttle valve which maintains uniform engine speed under varying loads, by increasing or decreasing air-fuel flow.

Whenever the throttle is opened quickly to give extra power for a sudden load, an extra amount of fuel is required for a momentarily rich air-fuel mixture. The accelerating well, Fig. 1, provides the extra fuel.

The carburetor has two mixture needles (one for high-speed and the other for low or idle speeds, Fig. 1) and an idle stop screw.

The high-speed mixture needle controls the amount of fuel entering the venturi at high engine speeds.

The idle mixture needle controls the amount of fuel entering the engine when idling or at partial throttle settings.

The idle stop screw controls the throttle setting for correct idle speed.

DISASSEMBLY AND REPAIR

When diagnosis indicates the carburetor should be cleaned, disassemble the carburetor before placing it in the cleaning solution to make sure the solution reaches all surfaces and parts.

Always install all the parts in the repair kit when the carburetor needs servicing. Always install new gaskets whenever the carburetor is disassembled.

Disassembling Carburetor

Remove governor throttle linkage from carburetor throttle lever. Disconnect fuel line. Remove choke cable.

Remove air cleaner from carburetor and carburetor from engine.

Remove fuel bowl, float valve, and seat.

Remove high-speed and idle mixture needles.

NOTE: Do not attempt to remove choke or throttle valves because screws holding valves to shafts are peened. Should valves require service, it is less expensive to replace the carburetor body than to repair the valves.

Cleaning Carburetor

Clean all parts in carburetor cleaning solvent.

IMPORTANT: Never clean holes or passages with small drill bits or wire, because a slight enlargement or burring of these holes will change the performance of the carburetor. No method of cleaning other than solvent should be used.

Place carburetor parts in a suitable basket and immerse basket in a container of carburetor cleaning solution.

NOTE: Good carburetor cleaning solutions can be obtained from most jobbers. Agitating the basket up and down in the solution will speed up action of the solvent and aid in dissolving deposits in small drilled passages.

DISASSEMBLY AND REPAIR—Continued

Cleaning Carburetor—Continued

Allow parts to remain in the solution for one or two hours. Then remove and rinse parts with fresh cleaning solvent. Dry parts with compressed air, making sure all holes are open and free of carbon and dirt. Never use rags or waste paper to dry the parts. Any lint may plug jets or channels and affect operating efficiency of carburetor.

IMPORTANT: Never use compressed air to clean a completely assembled carburetor. To do so may cause the float to collapse.

Inspecting Carburetor

Inspect float and float valve assembly for defects or wear. If either is noticed, replace parts as required.

Float valves and seats are available only as matched sets and should never be interchanged.

For a positive leak test, immerse the float in hot water. Any leak can be detected at once by air bubbles escaping from the float. Do not attempt to repair the float if it leaks. Replace it.

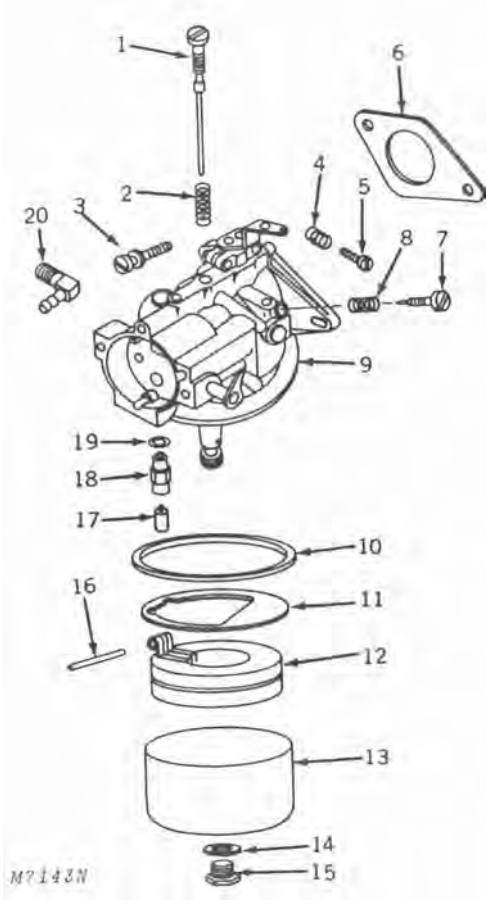
Check float pin and replace if worn.

Inspect tapered ends of mixture needles. If a ring has been cut in the tapered surface because the needle has been turned too tightly against the seat, replace the needle.

The seats for the high-speed and idle mixture adjusting needles are an integral part of the carburetor body casting and therefore cannot be removed or replaced.

Inspect carburetor body casting and fuel bowl for cracks or damaged sealing surface. Examine threaded holes for damaged threads.

Inspect choke and throttle shafts and bearing surfaces in carburetor body for excessive wear. Air leakage would result in poor engine performance and allow unfiltered air to enter the engine.



1—High-Speed Mixture Needle
2—Spring
3—Cap Screw
4—Spring
5—Idle Stop Screw
6—Gasket
7—Idle Mixture Needle
8—Spring
9—Carburetor Body
*10—Bowl Ring Gasket**
*11—Bowl Gasket**
12—Float
13—Bowl
*14—Bowl Screw Gasket**
15—Bowl Screw
*16—Float Pin**
*17—Float Valve**
*18—Seat**
*19—Gasket**
20—Fuel Line Connector

* Repair Kit Components

Fig. 2-Exploded View of Carburetor

IMPORTANT: Never clean holes or passages with small drill bits or wire. Dissolve all particles with carburetor solvent only.

Inspect throttle and choke valves for bends, cracks, or other damage. Replace carburetor if damaged.

ASSEMBLY

Install the carburetor repair kit whenever the carburetor is disassembled for service and parts show wear. The kit consists of items marked with an asterisk in Fig. 2.

Installing Float Valve

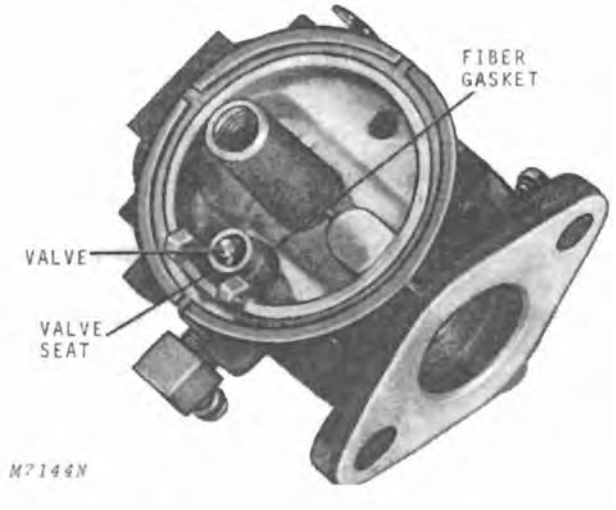


Fig. 3-Installing Float Valve Seat and Valve

The valve seat, valve, and fiber gasket are packaged together for service. Never replace one part without replacing the other parts.

Screw valve seat assembly, with gaskets, into carburetor housing. Tighten securely. Insert valve with tapered end against valve seat, Fig. 3.

Installing Float and Fuel Bowl

Assemble float (12, Fig. 2), to carburetor housing with float pin (16, Fig. 2). Invert carburetor, Fig. 4. With float resting lightly on float valve, the distance between float and machined surface of carburetor body should be 11/64-inch ± 1/32-inch. To increase or decrease the distance, bend lip on float. Dimension should be made on free end of float (opposite valve seat), Fig. 4.

Install bowl ring gasket (10, Fig. 2) in groove of carburetor body.

Position bowl gasket (11, Fig. 2), fuel bowl (13, Fig. 2), bowl screw gasket (14, Fig. 2), and bowl screw (15, Fig. 2). Tighten screw firmly, being certain bowl is centered on gasket.

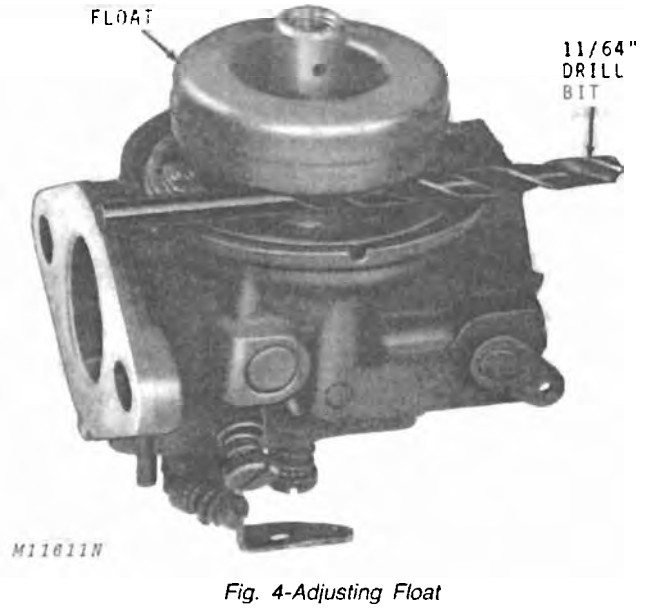


Fig. 4-Adjusting Float

Install idle mixture needle (7, Fig. 2) through spring (8, Fig. 2) and high-speed mixture needle (1, Fig. 2) into carburetor body.

Carefully turn mixture needles clockwise until lightly seated. Back out high-speed mixture needle 2 turns and idle mixture needle 2-1/2 turns. These are preliminary adjustments only.

NOTE: Do not tighten mixture needles too firmly against seats or damage will result.

INSTALLATION

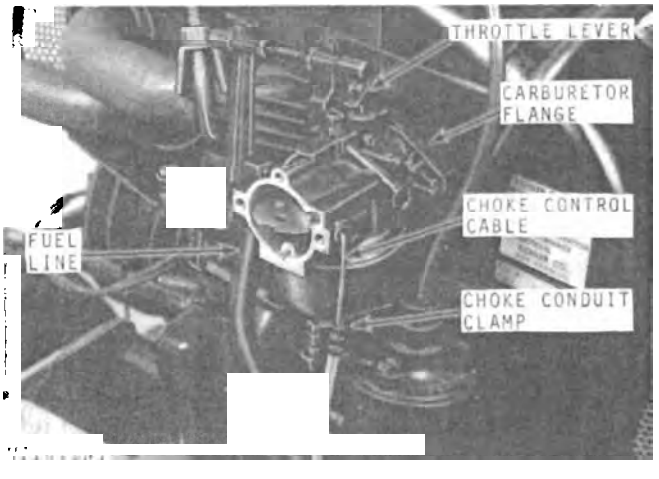


Fig. 5-Installing Carburetor Assembly on Engine

Place new gasket between carburetor flange and cylinder block. Bolt carburetor to cylinder block Fig. 5. Install throttle linkage ball joint to throttle lever.

INSTALLATION—Continued

NOTE: On 8 hp tractors, connect governor linkage in bottom hole of governor arm and in hole closest to throttle shaft in throttle arm.

Attach fuel line and choke control cable to carburetor. Secure choke conduit clamps to supporting bracket, being certain choke plate opens completely when choke control on dash panel is down.

Place new gasket on carburetor body and attach air cleaner base to carburetor.

Place filter element on base making sure it seats tightly around base. Install cover and tighten wing nut finger tight.

ADJUSTMENT

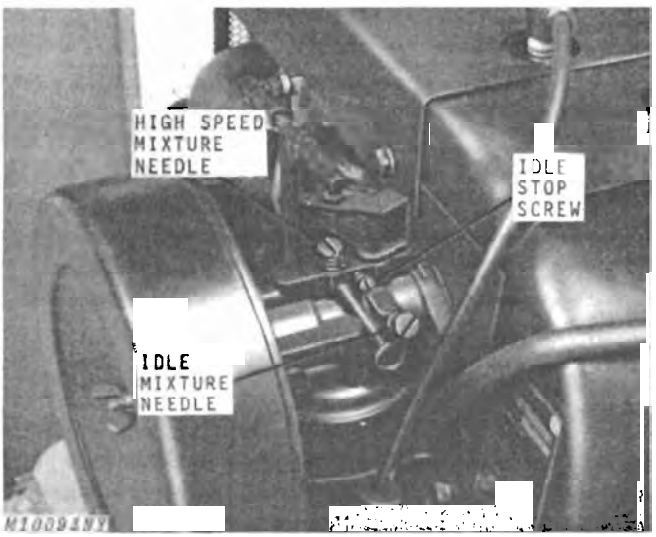


Fig. 6-Carburetor Adjustments

Idle adjustment and high-speed adjustment must be made at the same time as each affects the other. Adjust as follows:

1. Carefully seat both mixture needles; then, back off high-speed needle 2 turns and idle mixture needle 2-1/2 turns. Start engine and allow it to warm up.

2. Raise throttle control on dash panel to fast position. Turn-high speed mixture needle 1/8 turn each time, clockwise or counterclockwise until engine runs smoothly at full throttle. Keep needle position slightly on the rich side (open) when operating tractor with power-driven equipment such as the mower or snow thrower.

3. Move throttle lever to "slow" position and turn idle mixture screw 1/8 turn each time, clockwise or counterclockwise until engine idles smoothly.

4. Set the idle stop screw so engine idles between 1650 and 1950 rpm. Readjust idle mixture needle if necessary.

5. Advance throttle lever quickly to check for uniform acceleration. If engine misses, gas-air mixture may be too lean. Turn high-speed mixture needle counterclockwise until positive acceleration can be obtained.

Float Damper Spring

NOTE: When tractors are driven over exceptionally rough ground, bobbing of the carburetor float allows excessive fuel into the carburetor which results in engine flooding. To prevent this condition, install a carburetor float damper spring (M47422).

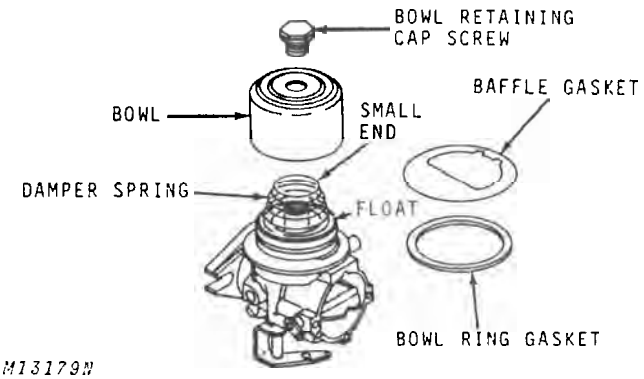


Fig. 7-Installing Float Damper Spring (Carburetor Upside Down)

To install the float damper spring, close fuel shutoff valve below gas tank and remove the carburetor from the engine. Then turn it upside down as shown in Fig. 7. Remove the bowl, baffle gasket and bowl ring gasket. Check float level and adjust if needed. Refer to float adjustment Fig. 4, page 30-10-3. Reinstall bowl and new baffle gasket, then place damper spring on the float as shown and reinstall carburetor bowl. Install carburetor to engine.

Governor and Throttle

Instructions for adjusting the governor and throttle are found beginning on page 20-20-6.

Group 15
AIR CLEANER

GENERAL INFORMATION

Fig. 1-Air Cleaner

The air cleaner, Fig. 1, consists of the base mounted on the carburetor, an air filter element and a cover that fits over the filter element. The filter element is made of treated paper with a soft sealing edge.

Care of the air cleaner is important since all the air that enters the engine goes through the air filter element. A clogged air filter element restricts air flow and reduces engine efficiency. A damaged air filter element allows dirt to enter the engine and causes immediate damage to internal working parts.

SERVICING AIR CLEANER

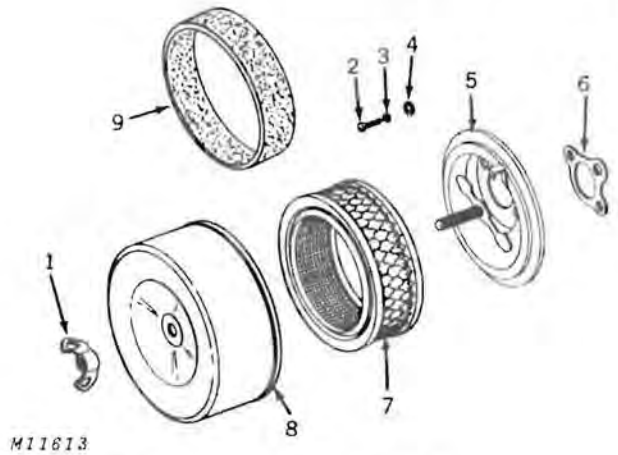
The most damaging engine wear can be traced to entry of dirt or dust through an improperly serviced air filter element.

Cleaning

Under normal conditions the air filter element should be cleaned every 25 hours of operation. However, under extremely dusty conditions, it should be cleaned every 5 hours of operation.

Tap the filter lightly against a flat surface and brush out dust. Do not clean filter with a liquid cleaner or compressed air.

Replace filter if it is bent, crushed, damaged or extremely dirty. Under extremely dusty conditions, replace filter every 100 hours of operation. When in doubt, replace filter.



1—Wing Nut
2—Machine Screw
3—Lock Washer
4—Plain Washer
5—Base
6—Air Cleaner Gasket
7—Air Filter Element
8—Air Filter Cover
9—Polyurethane Pre-cleaner (Extra Equipment)

Fig. 2-Exploded View of Air Cleaner Components

IMPORTANT: Never run engine with air filter element removed.

Wipe air cleaner base and inside of air cleaner cover with a clean cloth dampened with water. Install air filter element making sure it seats around base. Install cover and tighten wing nut finger tight, Fig. 2.

Pre-Cleaner

A polyurethane band pre-cleaner (9, Fig. 2) is available as extra equipment, and should be recommended to customers operating in extremely dry and dirty conditions. This pre-cleaner will increase air filter element life four to eight times under these conditions.

The pre-cleaner fits over the element and inside the air filter cover.

To service the pre-cleaner, wash it in a water and detergent solution and squeeze dry.

IMPORTANT: Never soak pre-cleaner in oil. The pre-cleaner must be used dry.

A heavy-duty air cleaner is also available as extra equipment. See page 30-15-2 for service procedures.

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HEAVY-DUTY AIR CLEANER
(110 Tractors, Serial No. 260,001-)

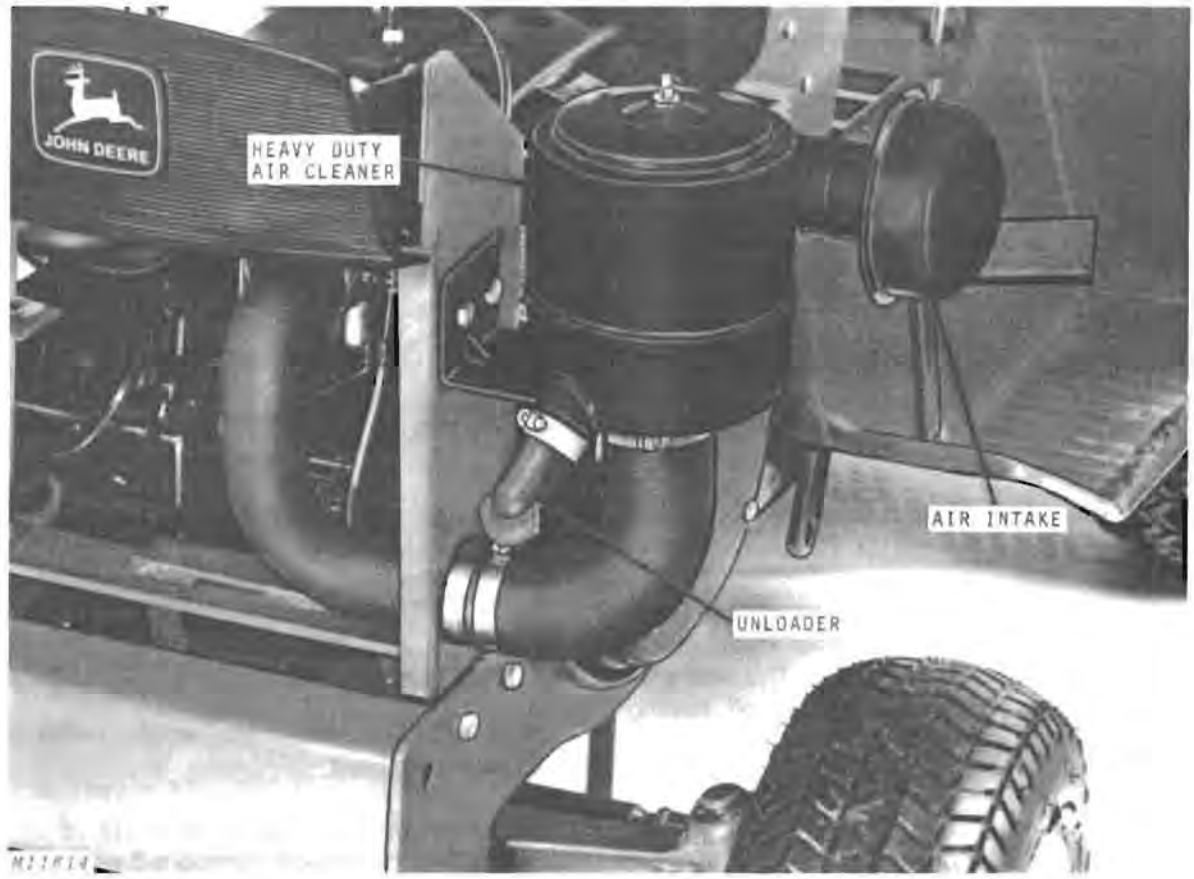

Fig. 3-Heavy-Duty Air Cleaner (Hood and Grille Removed For Illustration Purposes only)

General Information

The heavy-duty air cleaner is available as extra-equipment for customers operating in extremely dusty conditions.

The air cleaner features a large capacity cleanable filter element, a self-unloader for dirt accumulation discharge, and turbo-air flow design.

Service

Under normal conditions the element should be cleaned every 50 hours.

Clean element by tapping it gently on a flat surface or clean with water until water runs clear. Shake off excess water and dry element. Wipe out inside of air cleaner housing with a clean damp cloth.

Replace element after 10 cleanings or after 1 year of service, whichever comes first. Replace element at any time damage is noted.

Inspect gasket between support and air cleaner housing and replace if damaged. Check hose clamp connections and gasket and screws securing carburetor adapter to carburetor, Fig. 3. Check unloader for obstructions or damage and clean if necessary. Install element and tighten wing bolt by hand.

Litho in U.S.A.

Group 20
FUEL STRAINER AND GAS TANK

FUEL STRAINER

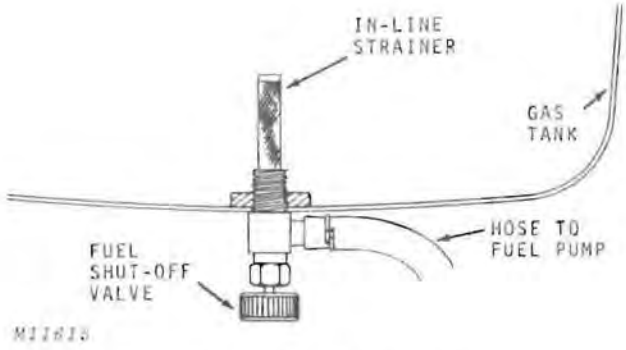

Fig. 1-In-Line Fuel Strainer

An in-line fuel strainer, Fig. 1, is used to prevent foreign particles from entering the carburetor. Should the strainer become plugged, it can be removed for cleaning.

Shut off fuel by turning thumb screw on fuel shut-off valve. Remove gas line from fuel pump, open fuel shut-off valve, and drain gas tank.

Unscrew fuel shut-off valve and strainer assembly from tank. Clean strainer with gasoline and compressed air. Replace in tank. Fill tank with gasoline. Open fuel shut-off valve and bleed air from fuel line. Attach fuel line to fuel pump (10 hp tractors) or carburetor (8 hp tractors).

GAS TANK

Fig. 2-Gas Tank

Clean gas tank, Fig. 2, and fuel strainer whenever gum deposits are detected in gas tank or when dirty fuel has obviously been used.

Do not attempt to solder the gas tank unless proper precautions are taken. Because of the size of the tank (1.75 U.S. gal.), it may be more desirable to replace the tank rather than attempt to repair it.

Litho in U.S.A.

Group 25
FUEL PUMP

GENERAL INFORMATION

M116161

Fig. 1-Fuel Pump

NOTE: The fuel pump is used on 10 hp tractors only.

The mechanical fuel pump, Fig. 1, operates off a cam on the camshaft. The actuating lever rides on the cam and transmits this mechanical action to the diaphragm within the pump body.

A repair kit is available for reconditioning the pump. The kit includes the necessary gaskets, seals, and check valve components.

REPAIR

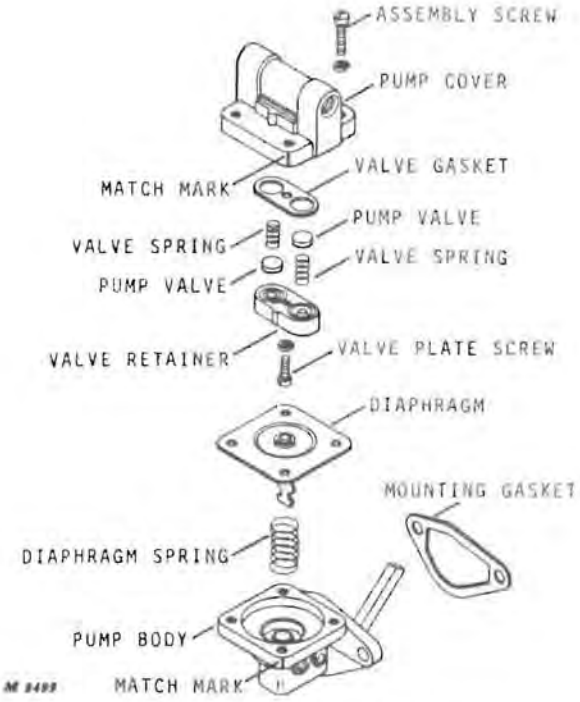

Fig. 2-Exploded View of Fuel Pump

Remove fuel lines and mounting screws holding pump to engine. With a file, make match marks across the pump cover and the pump body, Fig. 2. This will insure that the pump is reassembled correctly. Remove assembly screws and cover. Turn cover over and remove valve plate screw and washer.

Remove valve retainer, valves, valve springs, and valve gasket, noting their positions. Discard valve springs, valves, and valve gasket. See Fig. 2.

Clean pump cover thoroughly with a safe solvent.

Holding pump cover with diaphragm mounting surface up, place a new valve gasket into cavity. Assemble new valve springs and valves into their respective cavities.

NOTE: Valve springs and valves are in opposite relationship to each other. See Fig. 2.

Install valve retainer and lock in position with valve plate screw and washer.

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REPAIR—Continued

To rebuild the lower, diaphragm section of the pump, hold the pump body and press down on the diaphragm to compress diaphragm spring. Turn bracket 90 degrees to unhook and remove diaphragm. Clean pump body with a safe solvent.

Install new diaphragm spring into cavity in pump body. Install new diaphragm by positioning, pressing, and turning 90 degrees to allow diaphragm to be hooked into actuating lever.

Hold pump body. Attach cover to body (match marks aligned) with four assembly screws. DO NOT TIGHTEN. With hand on pump body only (not on cover), push the actuating lever to the limit of its travel.

Hold it in this position while tightening the four assembly screws. This is important to prevent stretching the diaphragm.

Mount fuel pump on engine, using the new mounting gasket. Connect the fuel lines. Start engine and check for leaks.

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Group 30
SPECIFICATIONS

SPECIFICATIONS

Item	Dimension	Page Reference
Float Setting	11/64-inch ± 1/32-inch	30-10-3
Speeds:		
Idle (No load)	1650 to 1950 rpm	30-10-4
High-Speed (No load)	3600 to 3900 rpm	20-20-7
Mixture Needles:		
(Preliminary Adjustments)		
Idle mixture needle	2 turns	30-10-4
High-speed mixture needle	2-1/2 turns	30-10-4

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Section 40
ELECTRICAL SYSTEM
Group 5
GENERAL INFORMATION

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Litho in U.S.A.

PRINCIPLE OF OPERATION

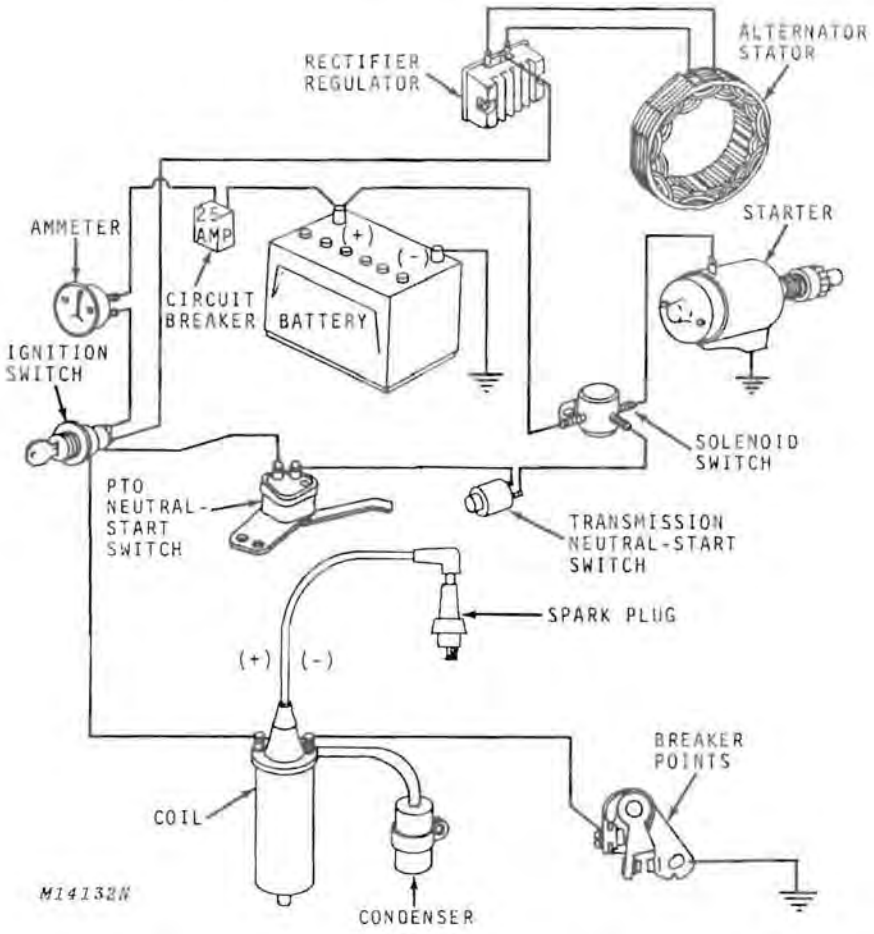

Fig. 1-Battery-Coil Ignition, Cranking and Charging Systems

The 110 Tractor features a 12-volt electrical system. The systems of the 8 hp and 10 hp tractors are basically alike, Fig. 1. Only minor differences exist between the ignition systems of these tractors.

The chart below identifies the type of ignition and charging system used, with a tractor serial number range for each system.

The battery is charged with either a 10 or 15 ampere alternator. A solid-state rectifier-regulator converts AC current to DC current and controls the charging rate to suit battery needs. See Group 20 for additional information.

A wiring diagram and "Diagnozing Malfunctions" are included in this group to assist you in understanding and diagnosing electrical system malfunctions.

Tractor	Serial No.	Ignition System	Charging System	Engine
8 hp	(-252,832)	Magneto	10 amp-Alternator	K181S
8 hp	(252,833-)	Battery-Coil	15 amp-Alternator	K181S
10 hp	(-264,713)	Battery-Coil	10 amp-Alternator	K241AS
10 hp	(264,714-)	Battery-Coil	15 amp-Alternator	K241AS

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WIRING DIAGRAM
Magneto Ignition
8 hp Tractors (Serial No. -252,832)

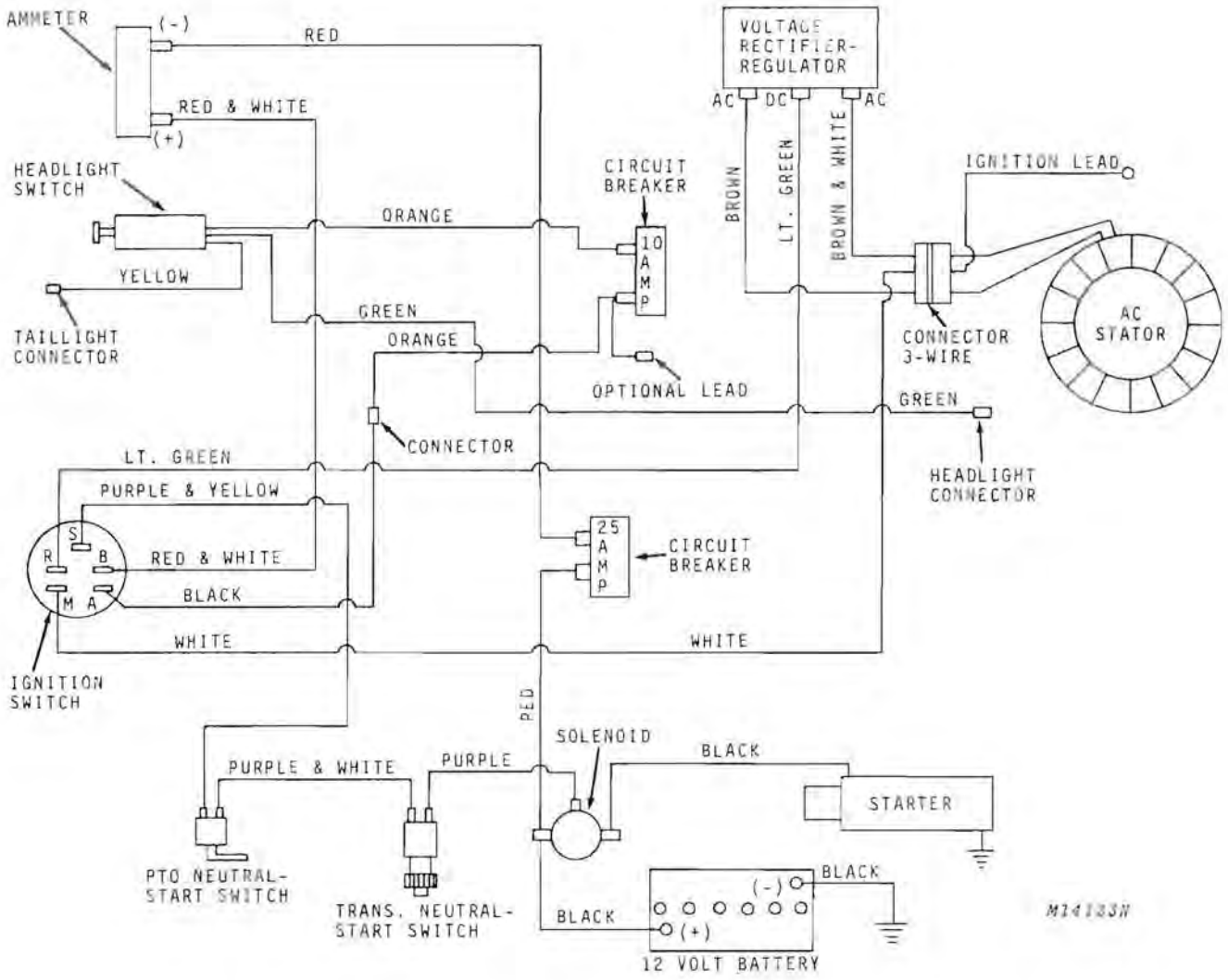

Fig. 2-Schematic of Electrical System With Headlights

NOTE: All 10-hp tractors and 8 hp tractors (Serial No. 252,833-) are equipped with battery-coil ignition. See wiring diagram on page 40-5-5.

WIRING DIAGRAM

Battery-Coil Ignition

8 hp Tractors (Serial No. 252,833-) and all 10 hp Tractors

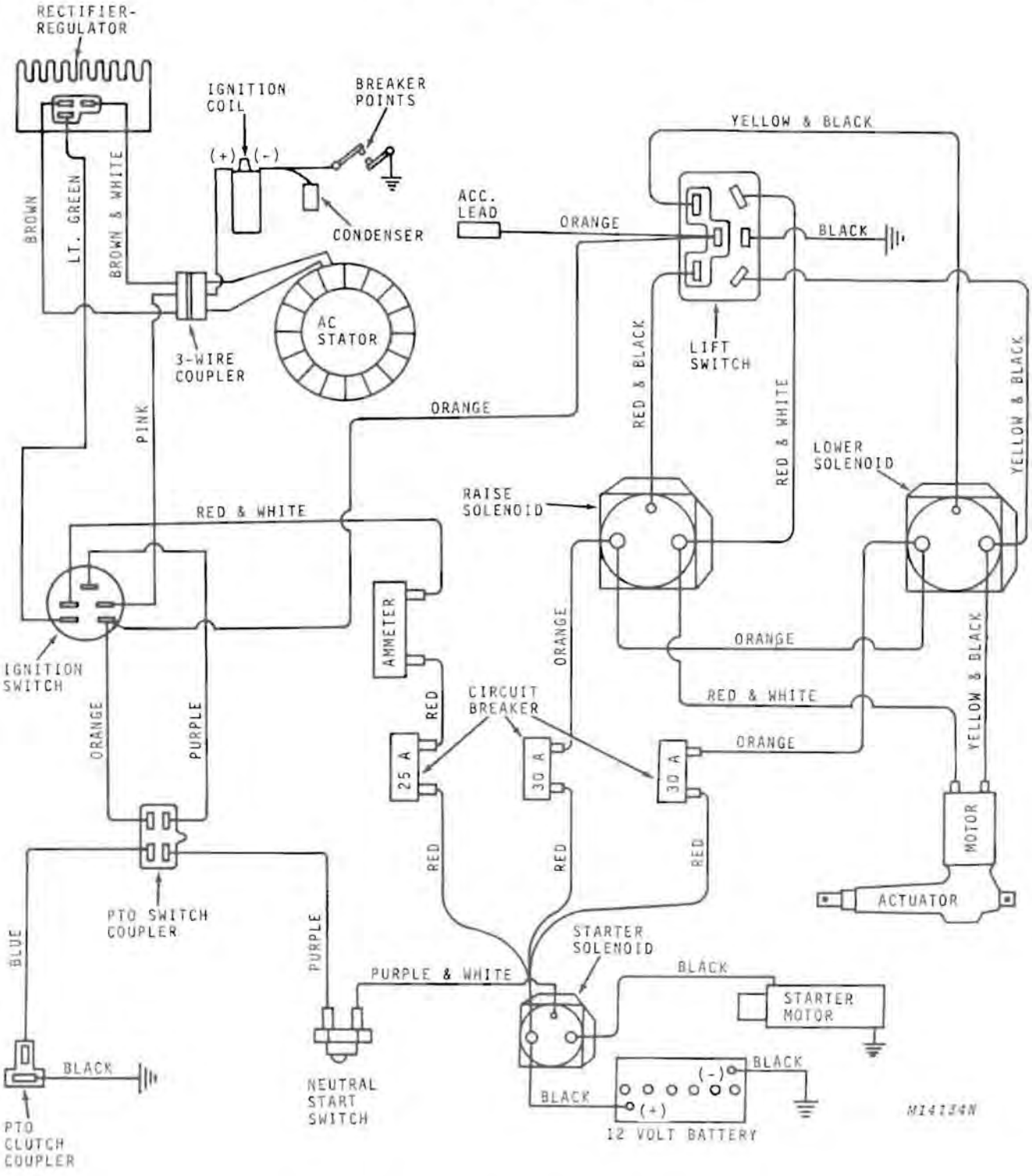

Fig. 3-Schematic of Electrical System Without Headlights

TESTING

Recommended test procedures for dealers having their own test equipment are outlined in each group for testing electrical components on and off the tractor. The purpose of the tests is to isolate the cause of trouble in the cranking, ignition, or charging system as well as the electric PTO clutch and electric lift.

Test equipment of high quality is a must for accurate diagnosis of electrical malfunctions. Always follow the procedures outlined by the manufacturer of the test equipment to supplement instructions contained herein.

NOTE: Because there are many manufacturers of test equipment, each with their own specific operating instructions, it is important to follow the manufacturer's recommendations if the procedures in this manual should contradict those of the manufacturer.

DIAGNOSING MALFUNCTIONS

Ignition System

Engine is Hard to Start

Breaker points worn or out of adjustment.

Spark plug faulty.

Loose or corroded electrical connections.

Condenser or coil faulty.

Engine Misfires

Incorrect spark plug gap.

Defective or loose spark plug cable.

Incorrect spark plug.

Breaker points pitted or corroded.

Incorrect breaker point gap.

Loose wire in primary circuit.

Leaking or broken high tension wire.

Defective coil or condenser.

Engine Backfires or Knocks

Cracked spark plug porcelain.

Ignition out of time.

Engine Pre-Ignition

Ignition out of time.

Spark plug electrodes burned.

Engine Loses Power

Breaker points worn or out of adjustment.

Spark plug faulty.

Condenser or coil faulty.

Engine Overheating

Ignition out of time.

Cranking System

Starter Turns Slowly

Weak or defective battery.

Worn brushes or dirty commutator.

Armature binding.
Adjust end play. Lubricate bushings lightly with SAE 10 oil. Replace end caps if bushings are badly worn.

Starter Spins Without Engaging

Drive pinion spline badly knicked or scored.
Replace Bendix drive assembly.

Drive pinion gear damaged.
Replace Bendix drive assembly.

Broken teeth on flywheel ring gear.

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Starter Fails to Energize

Transmission control lever not in neutral or PTO clutch is engaged.

Corroded or loose connections.

Broken or frayed insulation.

Defective solenoid.

Defective starter.

Weak or defective battery.

Corroded battery terminals.

Poor battery ground.

Defective safety switches.

Improperly seating brushes.
Install new brushes and spring kit.

High insulation between commutator segments.
Undercut to depth of 1/32-inch.

Shorted armature.
Repair or replace armature.

Starter Drawing Excessive Current

Dirty or gummed armature.

Shorted or grounded armature.
Install new armature.

Worn armature shaft bushings.

Misaligned starting motor.
Use proper mounting bolts and torque to specification.

Misaligned armature shaft.
Check end cap bushing.

Engine resistance.
Check engine for seized piston, or binding rod, crankshaft, bearings, or bushings. Disengage clutch for cold weather starting.

Battery Uses Too Much Water

Rectifier-regulator charge rate too high.

Cracked or damaged battery case.

Spewing electrolyte through filler caps.

Battery Discharges Rapidly

Loose or corroded battery terminals and cable ends.

Low electrolyte level.

Low or no alternator output.

Loose connections or damaged wires.

Shorted ammeter terminals.

Battery Remains Low or Discharged

Electrolyte, moisture, and dirt on case.

Loose or corrdoed battery terminals and cable ends.

Tractor not operated long enough to charge battery.

Loose or damaged wires.

Defective battery.

Low or no alternator output.

Defective rectifier-regulator.

Battery Spewing

Battery overfilled.

Loose battery hold-down bolts.

Charge rate too high.

DIAGNOSING MALFUNCTIONS—Continued

Charging System

No AC Output From Alternator

Loose connections or damaged wires.

Ground, open or short in stator.

Unsteady or Low Alternator Output

Loose connections or damaged wires.

Shorting of AC leads to regulator.
Separate AC leads and replace alternator, if tests show it to be defective.

No DC Output From Rectifier-Regulator

Defective alternator.

Defective rectifier-regulator.

Loose connections at rectifier-regulator, ammeter, ignition switch, or circuit breaker.

Defective 25 ampere circuit breaker

Electric Lift Actuator

Lift Fails to Operate

Discharged battery.

Motor thermo-overload switch open due to overheated motor.

Loose connections or damaged wires.

Lift switch or solenoid(s) defective.

Defective 30 ampere circuit breaker(s).

Defective motor.

Motor Thermo-Overload Switch Trips

Holding switch too long at end of stroke.

Lift linkage binding.

Binding motor or actuator drive mechanism.

Lift Will Not Hold Load in Raised Position

Worn or broken brake spring.

Worn brake in casting.

Group 10
CRANKING SYSTEM

PRINCIPLE OF OPERATION

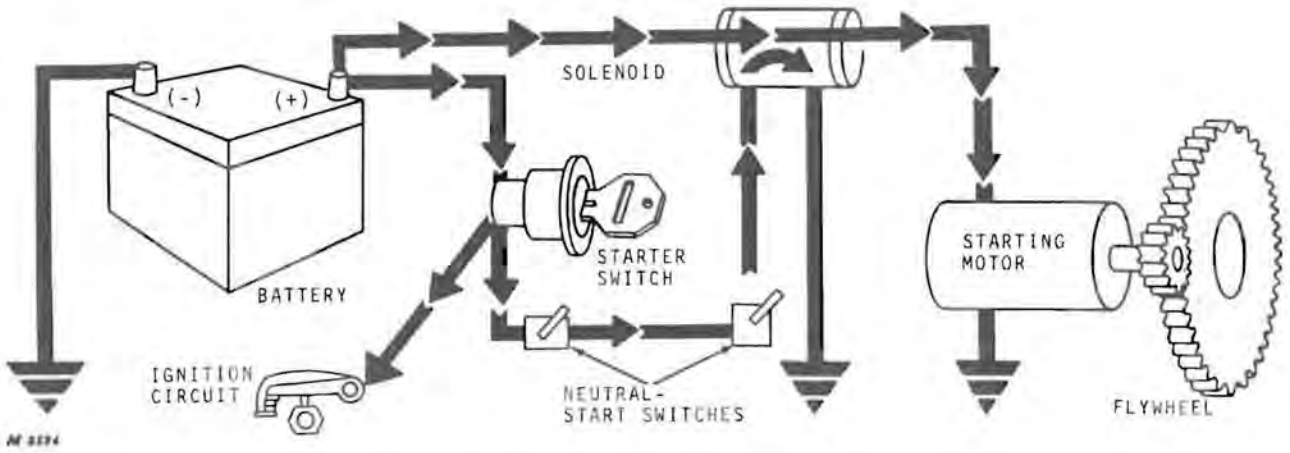


Fig. 1-Cranking Circuit of Tractor

The cranking system consists of a 12-volt storage battery, a key switch, two neutral-start safety switches, a solenoid, and a compact starting motor, which engages and disengages with the engine ring gear through a Bendix-type drive.

Battery

The storage battery is of the lead-acid variety. Lead is used in the construction of the cell plates and a sulfuric acid solution serves as the electrolyte.

Tractors are shipped from the factory with dry-charged batteries. This means, the plates are charged, but electrolyte must be added just before using.

The 12-volt battery has a hard rubber case with six individual cells. Each cell contains a specific number of sets of negative and positive plates.

All plates of like charge are interconnected so that the accumulative charges are present at the positive and negative battery terminals.

As a battery discharges and the energy is not replenished, the sulfuric acid is withdrawn from the electrolyte and the lead sulfate deposits build up on the plates. This causes the specific gravity of the electrolyte to diminish. Charging the battery reverses the chemical reaction, restoring the electrolyte to original potential.

IMPORTANT: Avoid battery damage by charging at the manufacturer's recommended ampere-hour charging rate.

Ignition Switch

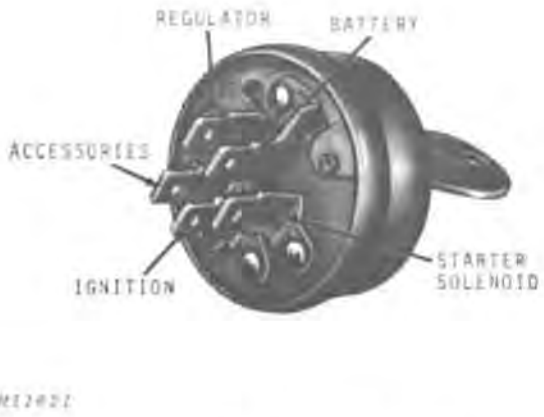


Fig. 2-Ignition Switch

The ignition switch, Fig. 2, directs the flow of electricity from the battery to the proper circuit.

In the case of the cranking circuit, when the switch is in the "START" position current is directed from the battery to the starter solenoid and to the ignition system.

When the switch is returned to "RUN" position following engine start, current is diverted from the solenoid and routed to the accessories, charging, and ignition circuits.

Solenoid

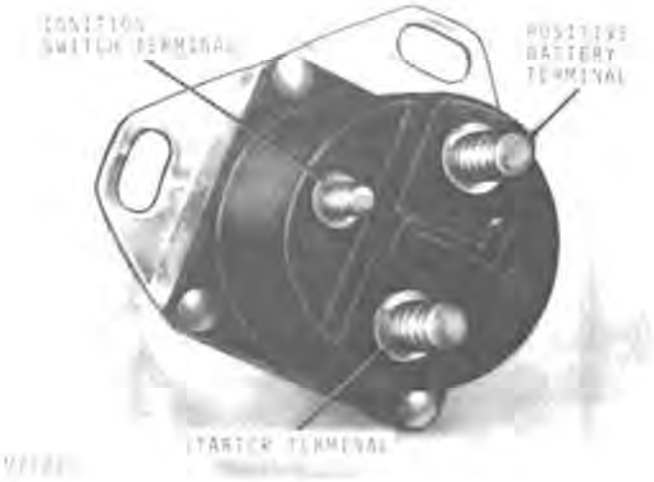


Fig. 3-Starter Solenoid

The solenoid, Fig. 3, is an electric switch, composed of an electromagnet and spring-loaded plunger.

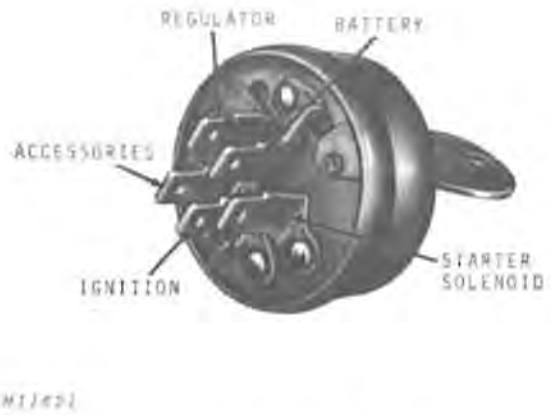
One large contact point of the solenoid is connected to the positive terminal of the battery and the other is connected to the starter terminal. The solenoid case is grounded to the frame, as is the negative post of the battery.

When the ignition switch is turned to the "START" position, current from the switch flows through the solenoid windings forming a complete circuit with the grounded case and setting up an electromagnetic field.

This draws the cylindrical plunger into the center of the field, overcoming a spring around the plunger. A copper contact on the end of the plunger closes the circuit across the battery and starter contact points, permitting current flow from the battery to the starter.

Once the engine starts, the key switch is permitted to return to the "RUN" position, cutting off the energy to the solenoid and collapsing the electromagnetic field. The spring-loaded plunger moves out of the magnetic field, breaking contact between the battery and starter contacts.

Ignition Switch



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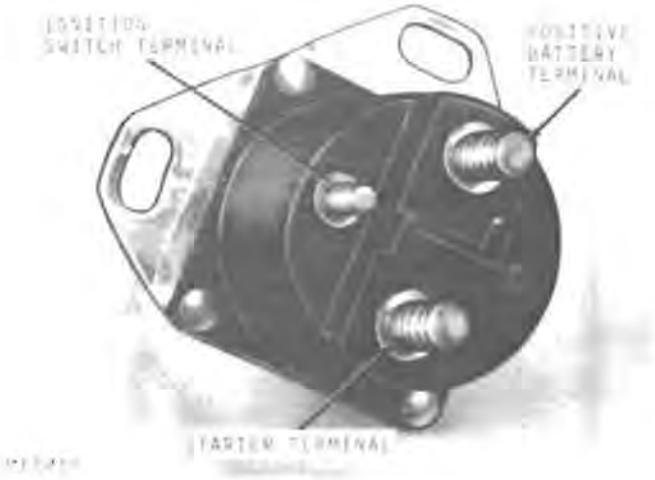

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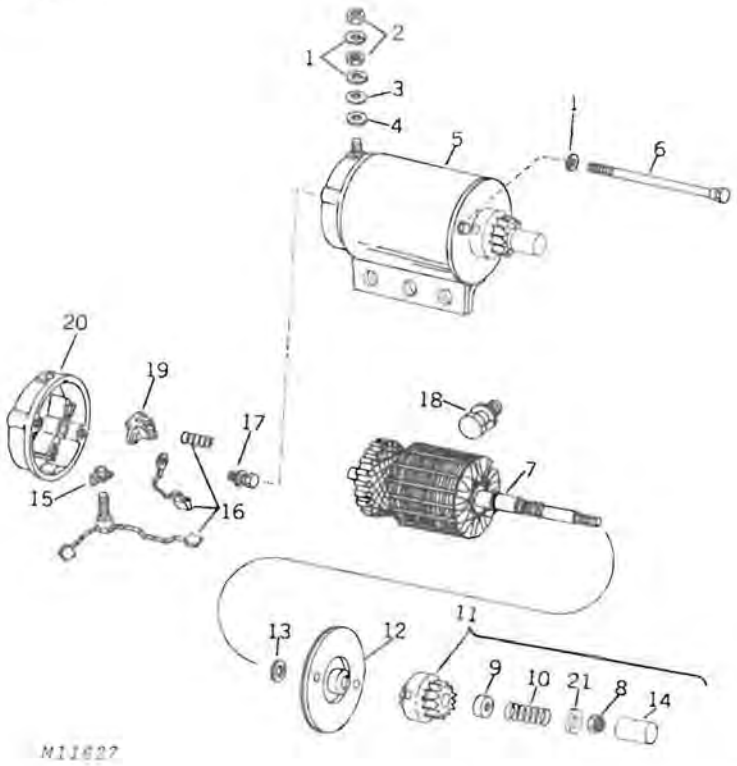
Starter



1—Lock Washer
2—Nut
3—Washer
4—Insulating Washer
5—Housing
6—Thru Bolt
7—Armature
8—Stop Nut
9—Gear Stop Spacer
10—Anti-Drift Spring
11—Drive Assembly
12—Drive End Cap
13—Thrust Washer
14—Dust Cover
15—Insulating Bushing
16—Brush and Spring Kit
17—Machine Screw
18—Bolt
19—Brush Holder
20—Commutator End Cap
21—Dust Cover Spacer

NOTE: Starters may vary as to design of Drive End Cap and Mounting Bracket for Housing. Refer to Parts Catalog for differences in SMH12A2 and SMH12A4 Starters. SMH12A4 shown.

Fig. 4-Exploded View of Starter

The permanent magnet starter, Fig. 4, differs from the conventional wire-wound starter in construction and torque characteristics.

This type starting motor requires considerable less current to operate. The lower current demand means lower operating temperatures, longer brush life, and "starts" even with poorly charged batteries.

On conventional starters, a relatively heavy current is directed thru the field coils and armature to build up a strong magnetic field necessary to start the armature turning.

The permanent magnet starter needs current only for the armature in order to set up opposing magnetic fields to start it turning. This current is induced into the starter in the usual manner with the ignition switch, battery, solenoid, and four brushes.

The drive consists of only three parts; a drive gear, anti-drift spring, and spring cup. When the armature turns, the drive gear moves laterally into mesh with the flywheel. As the engine starts and speeds up, the armature is overrun causing the drive gear to disengage.

TESTING

Testing Battery

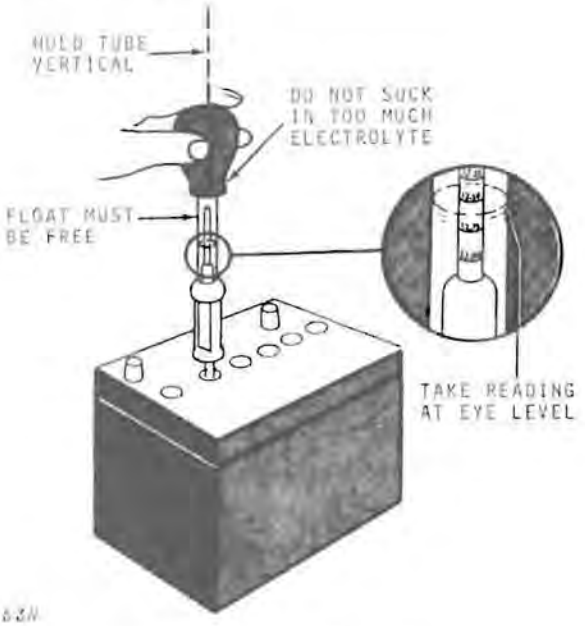


Fig. 5-Testing Specific Gravity

Checking Specific Gravity

To determine whether the battery is capable of meeting the requirements of the starting motor, it is necessary to duplicate operating conditions by subjecting the battery to a load test. To obtain a true test, the battery should be at least 75 percent charged. This can be determined by taking a hydrometer reading, Fig. 5.

The following table illustrates typical ranges of specific gravity (amount of unused sulfuric acid remaining in the solution) for a cell in various states of charge, with respect to its ability to crank the engine at 80°F. with initial full-charge specific gravity at either 1.260 or 1.280.

Specific Gravity	Capacity
1.260 to 1.280	100%
1.230 to 1.250	75%
1.200 to 1.220	50%
1.170 to 1.190	25%
1.140 to 1.160	Very little useful capacity
1.110 to 1.130	Discharged

Checking Battery Voltage

With a battery in good condition, each cell contributes approximately 1.95 to 2.08 volts. If battery charge is low and less than 0.05 volt difference is noted between the highest and lowest cells, the battery may be recharged.

If this difference is more than 0.05 volts, this could indicate a cracked plate or other damage which could call for replacement of the battery.

There are two methods of testing battery capacity. Battery electrolyte temperature should be at or near 80 degrees Fahrenheit for these tests.

Before making either of the two following tests, first check electrolyte level in battery. Add water if necessary. If water is added, be sure it is thoroughly mixed with the underlying electrolyte by charging. Battery voltage should be 11.5 to 12.6 volts before testing. Refer to instructions supplied by test equipment manufacturer, when using high-rate equipment.

Using the first method, crank the engine for 15 seconds with the starting motor and measure the battery voltage. If voltage is less than 9.6 volts at the end of 15 seconds replace battery.

As a second method, use high-rate discharge test equipment, Fig. 6.

Discharge the battery by means of a heavy-duty carbon pile at a rate 3 times the ampere-hour capacity. Follow equipment manufacturer's recommendations for testing.

If after 15 seconds the battery voltage is less than 9.0 volts, the battery fails to meet the load test, indicating loss of capacity or internal short circuits. Any battery that passes the load test is a good battery and can be relied upon to fulfill the requirements of the starting motor under normal conditions.

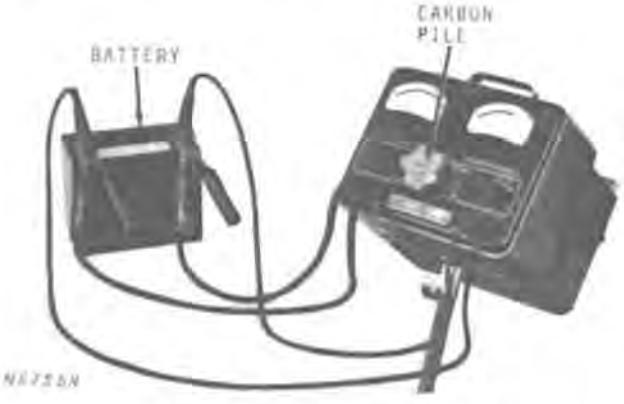


Fig. 6-Testing Battery Capacity

Testing Cranking System

If the starter fails to crank the engine, inspect the cranking circuit for loose or badly corroded connections and damaged wiring.

Refer to page 10-4 to determine battery condition. Be sure transmission shift lever is in neutral and PTO clutch switch is disengaged. If the unit still fails to crank, jump across the large solenoid terminals with a heavy jumper lead. If starter operates, either the solenoid, neutral-start switches, or ignition switch is defective. Further testing will be required to isolate the defect.

NOTE: Prior to removing any of the starting circuit switches be sure current is reaching the switch in question.

If the starter still fails to operate, either the starter is at fault or the engine is siezed.

Testing Ignition Switch

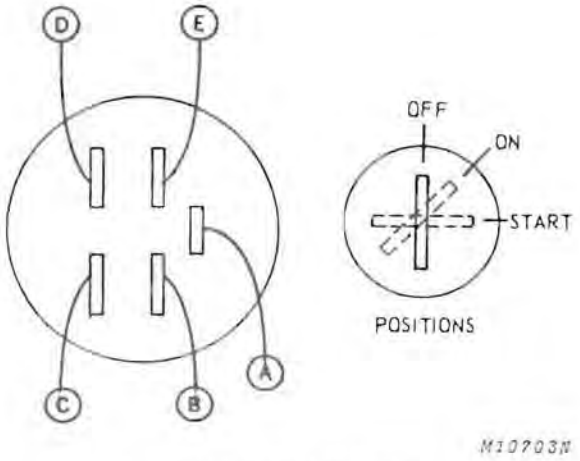


Fig. 7-Testing Ignition Switch

Remove coupler from ignition switch to expose terminals. Remove battery to provide access.

The ignition switch can be tested with a test light. Check for continuity between terminals with switch placed in each of three positions.

See Fig. 7 and chart below for correct current flow diagram. If switch is defective it must be replaced.

Position	Closed	Open
OFF	-	A, B, C, D, E
ON	B, C, D, E	A
START	A, B, D, E	C

Testing Safety-Start Switches

The 110 Tractor has two safety-start switches. A neutral-start switch is located in the gear shift quadrant, Fig. 8, and requires that the gear shift lever be in neutral position before starting.

A safety-start switch is also incorporated with the PTO clutch lever. The PTO lever must be in the disengaged position (down) before attempting to start the engine.

Fig. 8-Adjusting Quadrant Neutral-Start Switch

Quadrant neutral-start switch failure usually requires only adjustment to correct. If solenoid will not activate with the shift lever in neutral, loosen the two quadrant screws, Fig. 8, and slide the quadrant rearward as far as possible; then, tighten screws. Also check shift lever return spring for adequate tension and replace if necessary.

Testing Safety-Start Switches —Continued

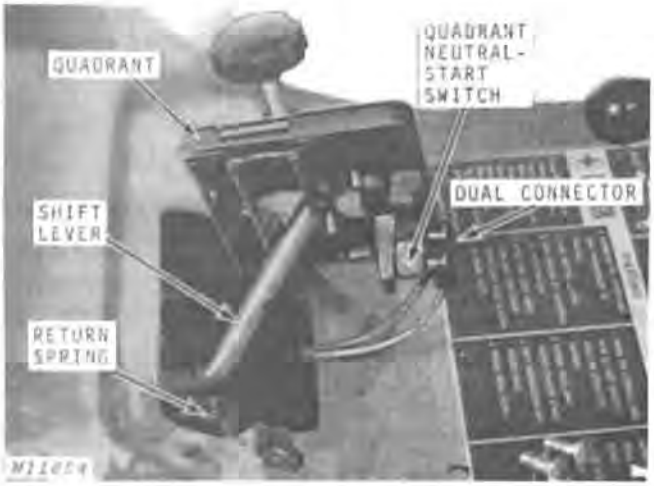


Fig. 9-Quadrant Neutral-Start Switch

If solenoid still does not activate, remove quadrant screws and lift quadrant from fender deck to expose switch, Fig. 9. Place an ohmmeter or a test light across the two switch terminals and depress the switch plunger. Continuity should be indicated. If not, replace the switch.

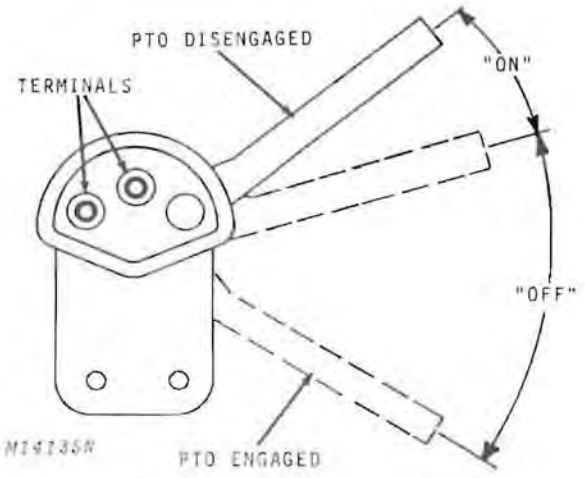


Fig. 10-Testing PTO Clutch Switch

Remove the coupler from the PTO clutch switch to expose the switch terminals, Fig. 10. Connect an ohmmeter or test light to the terminals of the switch. Move the PTO clutch lever to the disengaged position (down). Test light should light. Move the PTO clutch lever to the engaged position (up). Test light should not light.

Testing Starter Solenoid

Fig. 11-Testing Starter Solenoid

Remove gas tank to provide access to solenoid. Remove the purple wire from the solenoid.

Jump from the positive (+) battery terminal directly to the purple wire terminal on solenoid, Fig. 11. The solenoid should "click", closing the main contacts and causing the starter motor to crank. If solenoid does not activate, it should be replaced.

Testing Starter

If the starter fails to crank properly when the engine is known to be in good operating condition and the rest of the cranking circuit is found to be satisfactory, remove the starter and check it further. Remove gas tank to provide access for starter removal.

With the starter removed from the engine, check the armature for freedom of operation by turning the shaft. Tight, dirty or worn bushings, a bent armature shaft, or loose field rivets may cause the armature to drag and turn hard.

Disassemble the starter for further testing and inspection. See page 40-10-11 for starter disassembly procedures.

See testing procedures below. The armature is the only item that can be tested because the fields are the permanent magnet type.

Testing Armature

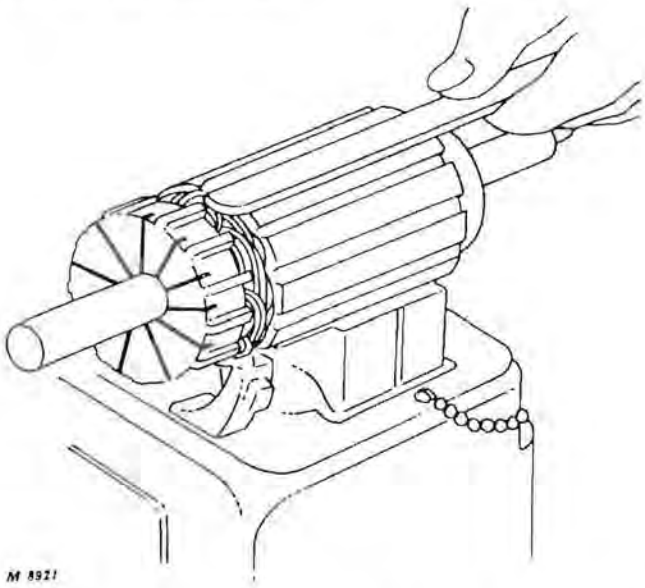


Fig. 12-Checking Armature for Short Circuits

If inspection does not reveal the cause of failure, test the armature for opens, shorts and grounds as follows:

1. SHORTS - A burned commutator bar indicates a shorted armature. Short circuits are located by rotating the armature on a growler with a steel strip (hacksaw blade) held on the armature, Fig. 12. The steel strip will vibrate on the area of the short circuit.

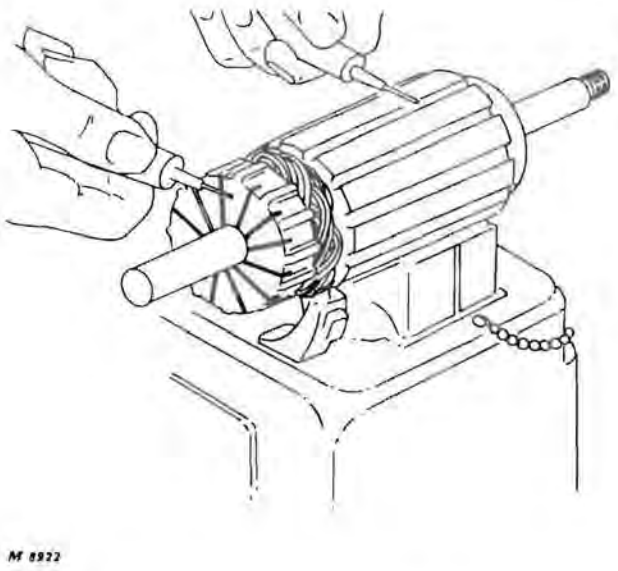


Fig. 13-Checking Armature for Grounds

2. GROUNDS - Grounds in the armature can be detected with a test lamp and probes, Fig. 13. If the lamp lights when one test probe is placed on the commutator and the other probe on the armature core or shaft, the armature is grounded.

3. OPENS - Inspect for loose connections at the point where the armature windings are attached to the commutator bars. Poor connections cause arcing and burning of the commutator. Resolder any poor connections and turn armature commutator in a lathe to provide a good surface for brushes.

If tests reveal any of the above listed conditions, replace the armature.

ANALYSIS

Battery

Cracked Case

If a cracked battery case is found, install new battery and advise customer to keep battery electrolyte at specified level and to keep battery fully-charged in freezing weather.

Other causes could be rough handling of battery or pounding cables onto terminals.

Pitted Battery Terminals

If battery terminals are severely pitted, the probable cause is tractor operation with loose cable connections. This results in arcing across terminal-to-cable gap.

Low Battery Condition

Several causes of low battery condition could exist, including:

1. Improper electrolyte level.
2. Excessive use of accessories without engine operating.
3. Ignition switch left in "run" position.
4. Faulty regulator or alternator.
5. Loose battery connections.
6. Dirty battery case.
7. Short in electrical system.

Starter

Overheating

Overheating of starter can result from armature binding or long duration cranking of a hard starting engine.

Poor Starter Performance

This could be caused by a number of conditions, including:

1. Excessive lubrication of end cap bushing, resulting in gum formation, and high resistance at the commutator.
2. Armature binding.
3. Dirty or damaged Bendix drive assembly.
4. Badly worn brushes or weakened brush springs.
5. Excessive voltage drop in cranking circuit.
6. Battery or wiring defects.
7. Shorts, opens, or grounds in armature.

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REPAIR

Battery

Removing Battery

Loosen bolts through terminal clamps. Use a terminal puller to remove clamps. If terminal puller is not available, spread clamps before prying them off battery posts.

To avoid injury from a spark or short circuit, disconnect cable from the negative battery terminal first. Then remove boot from positive terminal and disconnect cable from positive terminal.

Servicing Battery

Good battery servicing in the tractor should include the following items:

1. Clean battery.
2. Inspect cables including ground connections.
3. Clean terminals.
4. Inspect hold-downs.
5. Inspect case for leaks.
6. Make hydrometer test.
7. Add water if necessary. Use caution to protect tractor from electrolyte damage.
8. Recharge battery if less than 75% charged.

Activating New Battery

When activating a new battery, remove from tractor before filling with electrolyte. This will prevent damage to tractor in case electrolyte spills.

Add electrolyte until plates are just covered. Then charge at 30 to 40 amps for 10 minutes or 15 amps for 30 minutes.

Charging the battery will increase battery temperature and raise the electrolyte level. If electrolyte is still below the ring in the battery neck, add enough electrolyte to fill to the bottom of the ring. See Figure 15 on the next page.

Advise customers to add water as recommended in the operator's manual. A healthy battery will consume about one teaspoon of water per cell each month.

CAUTION: After the battery is activated, hydrogen and oxygen gases in the battery are very explosive. Therefore, it is necessary to keep open flames and sparks away from battery.

Cleaning Battery

Corrosion around the battery terminals is normal. However, an accumulation of corrosion over a long period can shorten the life of the battery. It is therefore important to keep battery terminals as clean as possible.

To clean terminals, remove battery from tractor. Remove all corrosion using a wire brush. Wash terminals using a solution of one part ordinary baking soda to four parts water. Do not permit cleaning solution to enter battery cells.

Wash entire battery case, battery base, and hold-down straps with clear water. Do not get water on switches and wiring connections.

Battery—Continued

Installing Battery

Fig. 14-Installing Battery

Clean and dry battery exterior. Position battery and install battery hold-down, Fig. 14.

Attach positive cable to positive (+) battery terminal.

Damage to the alternator-stator or rectifier-regulator can occur if battery polarity is reversed, if the battery is fast charged, or if welding is done on the tractor. Disconnect the connector from the regulator before charging, jumping, or welding.

Never hammer terminal clamps onto battery posts when connecting battery cables. To do so could result in damage to the battery.

Attach ground cable to negative (−) battery terminal. Coat both terminals with petroleum jelly.

IMPORTANT: Slide rubber boot over positive battery terminal until terminal and clamp are completely covered.

Be sure top and bottom vent holes in each cell cap are open.

Checking Battery Electrolyte Level

Advise customer to periodically check the level of the electrolyte in the battery cells. This should be done at least once a week during peak operating periods.

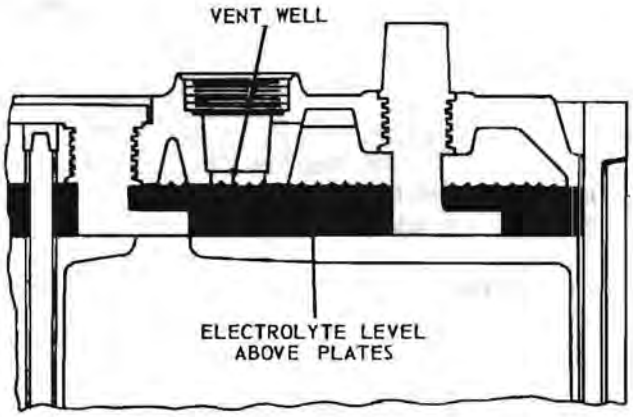

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Fig. 15-Proper Level of Electrolyte in Battery Cells

Proper level is normally to the bottom of the ring (filler neck) so that the tops of the battery plates are covered, Fig. 15. **Do not overfill.**

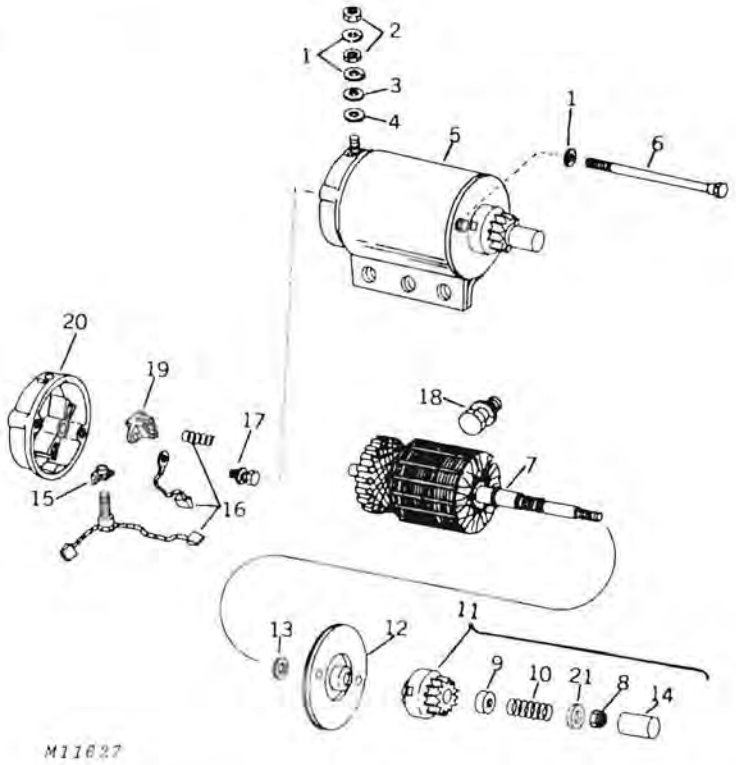
Add only distilled water to the battery. If not available, be sure to use clean, soft water. Avoid water with a high mineral content.

Never add acid to the battery unless electrolyte is lost by spilling. To add acid to the battery will unbalance the 10 to 1 sulfuric acid-to-water ratio.

Always wait until after checking specific gravity before adding water to the battery. This will assure a true reading. If level is too low to check specific gravity, add water and operate system for a few minutes to mix water and electrolyte, then check.

In freezing weather, never add water to the battery unless tractor will be operated for a period of time to allow mixing of the water and electrolyte.

Starter



1—Lock Washer
2—Nut
3—Washer
4—Insulating Washer
5—Housing
6—Thru Bolt
7—Armature
8—Stop Nut
9—Gear Stop Spacer
10—Anti-Drift Spring
11—Drive Assembly
12—Drive End Cap
13—Thrust Washer
14—Dust Cover
15—Insulating Bushing
16—Brush and Spring Kit
17—Machine Screw
18—Bolt
19—Brush Holder
20—Commutator End Cap
21—Dust Cover Spacer

NOTE: Starters may vary as to design of Drive End Cap and Mounting Bracket for Housing. Refer to Parts Catalog for differences in SMH12A2 and SMH12A4 Starters. SMH12A4 shown.

Fig. 16-Exploded View of Bosch Model No. SMH12-A4 Starter

Removing Starter

It is necessary to remove battery, battery base, and gas tank to provide access to starter.

Remove starter cable and two cap screws securing starter to engine block. Remove starter.

Disassembling Starter

Remove dust cover from end of starter drive, Fig. 17. Hold drive grear and remove 3/8-inch stop nut. Remove drive parts from armature shaft.

Fig. 17-Disassembling Starter Drive

Disassembling Starter—Continued

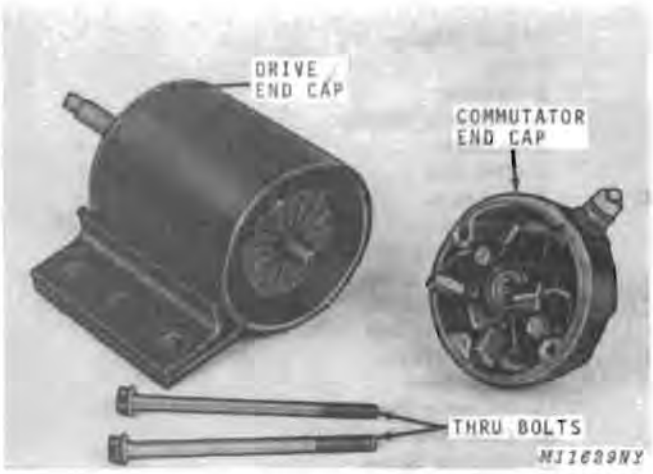


Fig. 18-Disassembling Starter

Remove the two thru bolts which hold the end caps to starter housing.

Remove commutator end cap carefully, Fig. 18, to avoid losing brush springs which may pop out when end cap is removed.

Inspection

Clean and inspect starter drive components for excessive wear. Replace parts as necessary.

See "Testing Starter" on pages 40-10-6 and 40-10-7.

Inspect bearing in mounting bracket and end cap. Also inspect armature shaft. If armature shaft has excessive play in bearings, replace end caps. It may be necessary to replace armature if bearing surfaces are worn badly. Excessive bearing play will allow armature to rub against fields.

Clean and inspect commutator. If surfaces are badly grooved, true up on a lathe and undercut mica. Brushes must make good contact with commutator.

Replacing Brushes

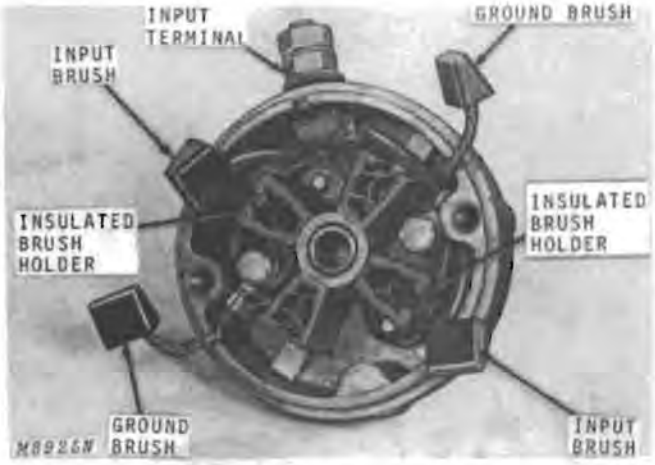


Fig. 19-Replacing Brushes

Replace brushes whenever they show any amount of wear. To replace input brush assembly, remove nuts and washers from terminal and pull the brushes out through the inside of cap. When assembling, place the input brushes into the insulated brush holders.

The leads from the ground brushes are attached to the metal screws which secure the insulated brush holders to the end cap, Fig. 19. Place these brushes in the non-insulated brush holders.

Assembling Starter

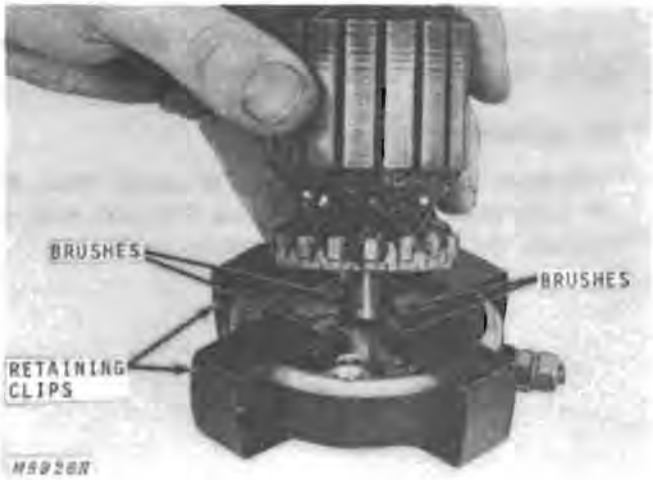


Fig. 20-Installing Brushes

Preparing the starter end cap is the first step of starter assembly.

Place brush springs into brush holders. Then, in succession, place each brush in its respective holder with the beveled side up.

Compress brush spring and place a U-shaped retaining clip made of banding steel onto each brush, Fig. 20.

Wipe commutator clean with a dry cloth and lubricate armature shaft with a small amount of light grease.

Place armature into end cap, Fig. 20, and remove U-shaped brush retaining clips.

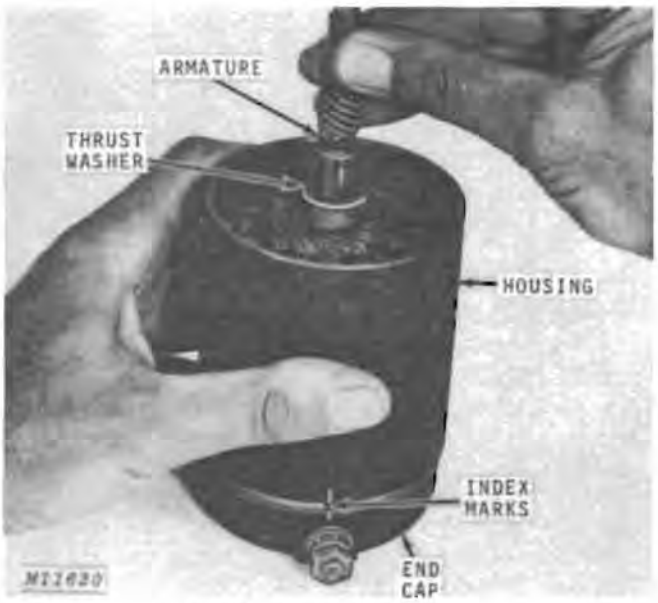


Fig. 21-Aligning Index Marks

Place starter housing over armature while exerting down pressure on the armature. This prevents brush springs from pushing armature up and away from end cap. If this occurs, reload brushes into end cap and reassemble.

Align housing with end cap using the index marks on cap and housing as a guide, Fig. 21.

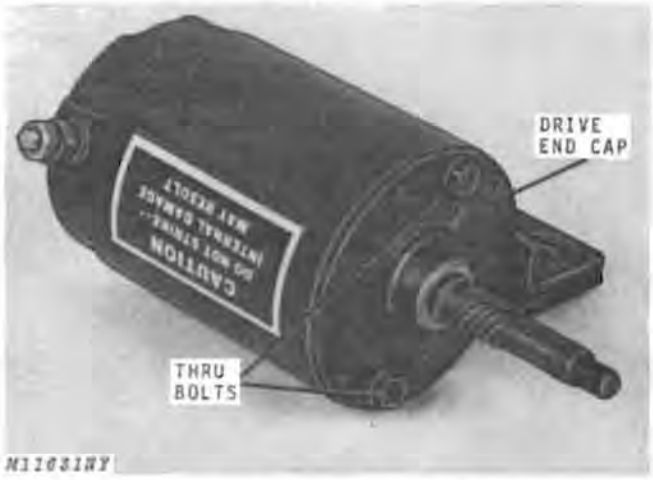


Fig. 22-Assembling Drive End Cap

Place thrust washer onto armature shaft, Fig. 21. Lubricate drive end cap bearing with light grease and install drive end cap onto armature.

NOTE: The starter housing has a mark and an indentation on the inside which must fit into the two indentures on the drive end cap.

Insert thru bolts, Fig. 22, and torque to 20 to 25 inch-pounds.

Fig. 23-Assembling Starter Drive

Lubricate armature shaft splines with a light coat of oil. Install drive assembly components as shown, Fig. 23. Torque stop nut to 45 to 50 inch-pounds.

Install starter on engine.

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Group 15
MAGNETO IGNITION SYSTEM
8 hp-Tractor (Serial No. -252,832)

PRINCIPLE OF OPERATION

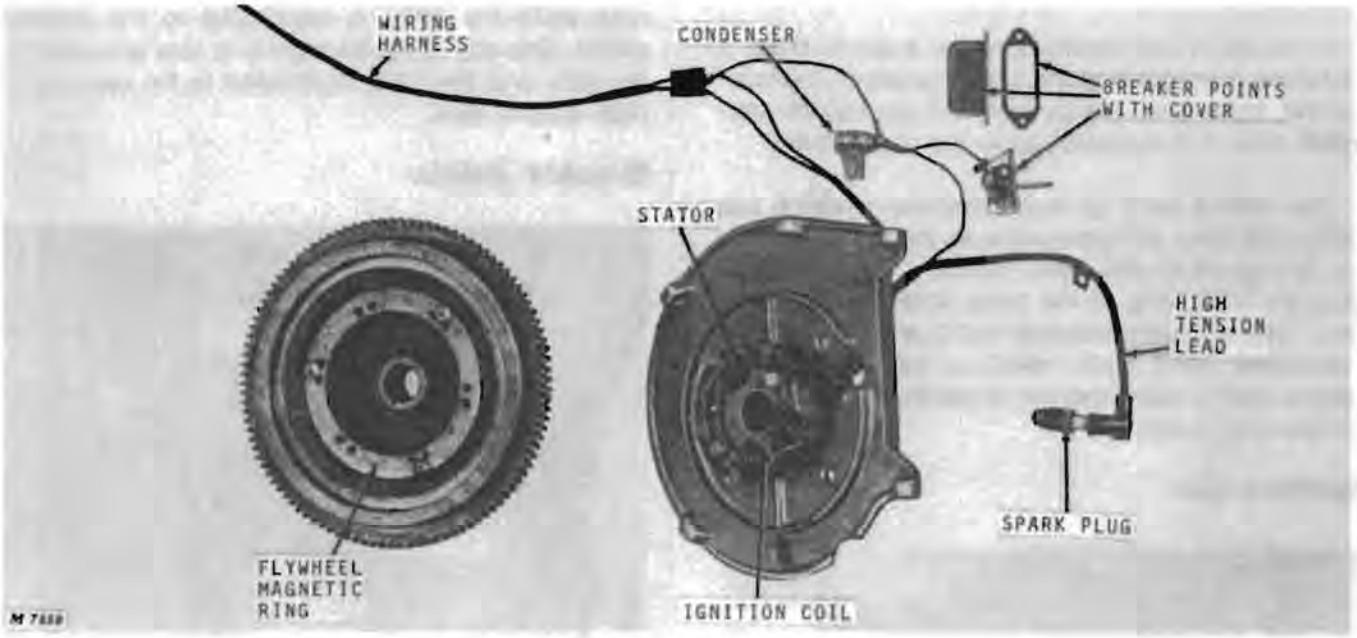

Fig. 1-Ignition System Components

The 8 hp Tractor (Serial No. -252,832) features a flywheel magneto-alternator-type ignition system, Fig. 1. This system includes 12 flywheel-mounted magnets, the stator, ignition coil, breaker points, condenser, high tension lead and spark plug.

As the cranking system turns the flywheel, the 12 permanent magnets rotate around the coil-core (stator) assembly. The stator is mounted in a fixed position on the engine bearing plate.

The magnetic flux flows in one direction through the center leg of the core as the north pole of the magnet rotates adjacent to it, then reverses its direction as the south pole moves past.

When the flux flows through the core, electricity is induced in the primary windings of the coil. At the instant of reversal of the magnetic field through the core, the induced current reaches its maximum.

At this same instant, the engine should be on its compression stroke with the piston nearing the top of the cylinder. Proper spark timing is essential here. Since a brief lag is experienced between the time fuel ignites and the time it reaches full power, the ignition spark must occur slightly in advance of the piston reaching the top of the compression stroke.

When ignition is required, the breaker points are opened by the action of the breaker rod. This causes a halt in current flow in the primary winding of the coil and a sudden collapse of the magnetic field surrounding the coil windings.

The rapid change in the concentration of magnetism causes voltage to be induced in every turn of both the primary and secondary windings.

The voltage induced in the primary windings is quickly absorbed by the condenser, which acts as a reservoir for the surge of power in the primary coil windings.

If this surge had nowhere to go, it would effect a complete breakdown of the entire function. The condenser holds this energy only for an instant after which time it is released back into the primary.

The voltage build up in the secondary, which has up to 100 times as many turns as the primary, could go as high as 25,000 volts. Normally, however, voltage increases only to the point to bridge the spark gap. This is usually between 6,000 and 20,000 volts depending upon such variables as compression, speed, shape and condition of electrodes and width of spark plug gap.

Ignition Coil

Fig. 2-Ignition Coil

The ignition coil, Fig. 2, mounted on the alternator stator, is a pulse transformer that transforms or steps up low alternator voltage to the high-voltage necessary to ignite the fuel-air mixture at the gap of the spark plug.

The ignition coil contains three basic parts: (1) a primary winding consisting of a few hundred turns of relatively heavy wire, (2) a secondary winding consisting of several thousand turns of very fine wire, and (3) a laminated soft iron stator core which serves to concentrate the magnetic field. The assembly is carefully insulated against heat and moisture.

One end of the primary winding is grounded to the core while the other is connected to the breaker points. One end of the secondary is also grounded to the core and the other connected to the spark plug high tension lead.

Breaker Points

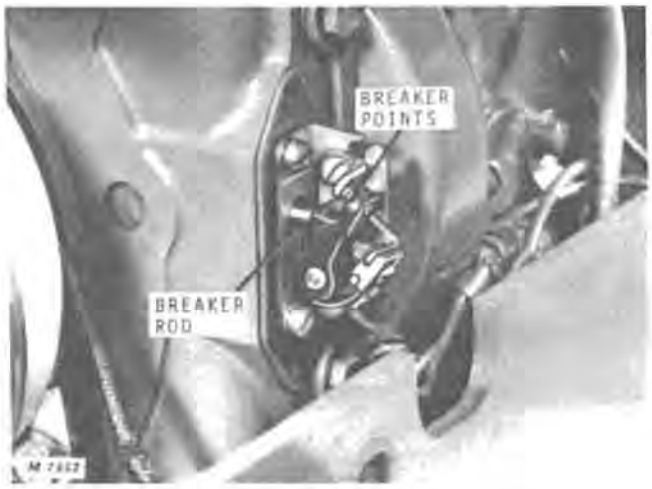

Fig. 3-Breaker Points

Engine operation is greatly affected by the condition and adjustment of the breaker points. Fig. 3, which time the firing of the spark plug.

The points are tripped by the breaker rod, operated by a lug on the camshaft. A specific time is required for the magnetic field within the ignition coil to build up to sufficient value. Unless the points are adjusted to specification, weak, early or late sparking occurs.

Condenser

When the magnetic field in the coil collapses, voltage much higher than the original voltage is induced into the primary winding. As the breaker points open, the current tends to continue flowing across the points. The resulting arc would damage the points in a short time.

The condenser, Fig. 4, by absorbing the surge of high voltage, dampens the tendency of current to arc across the points. The condenser also allows the magnetic field to collapse rapidly which contributes to high voltage being induced into the secondary windings.

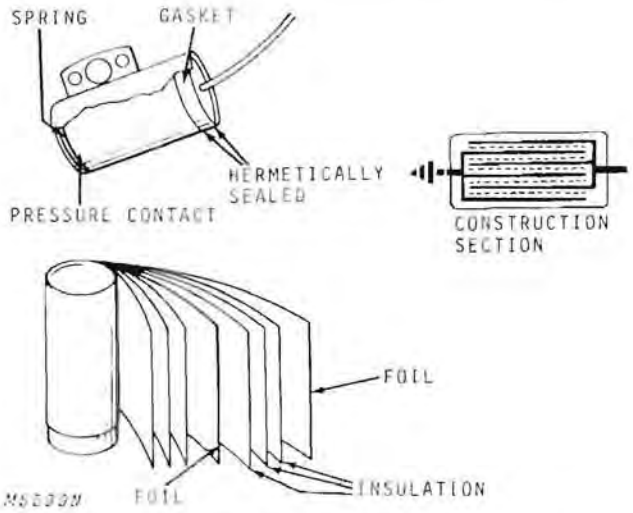

Fig 4-Cutaway View of Condenser

A condenser with too low capacity will cause arcing and burning of ignition points.

TESTING

Several factors contribute to the overall performance of an ignition system - all components must be in good condition and the spark must be properly timed.

Hard starting, low power and erratic operation can often be attributed to faulty ignition. If poor ignition is suspected, the first thing to do is to determine if the ignition system is actually at fault.

A simple operational test will determine this.

Preliminary Engine Test

Remove the high tension lead at the spark plug, Fig. 5. Bend a paper clip and insert it into boot. Hold the end of the clip about 1/8 inch away from the cylinder head, while cranking the engine. (Make sure engine is cranked fast enough to produce a spark.)

If a sharp snappy spark occurs, the trouble is apparently not in the ignition coil, condenser or breaker points, although it could still be attributed to a poor spark plug. If no spark or a very weak spark occurs, ignition trouble is indicated.

When checking an ignition system, the components most commonly requiring servicing or adjustment should be checked first.

Fig. 5-Testing Ignition System

Ignition Coil

The ignition coil does not require service—only replacement. Located on the stator, the coil should stay relatively clean. Whenever the engine is removed or coil problems are indicated, check coil wiring connections for good electrical contact.

Coil windings are subject to open and short circuits. On magneto type coils, this can be detected with an ohmmeter. Resistance in the primary should not be more than 2 or 3 ohms, while in the secondary, resistance will be in the range of 8,000 - 10,000 ohms.

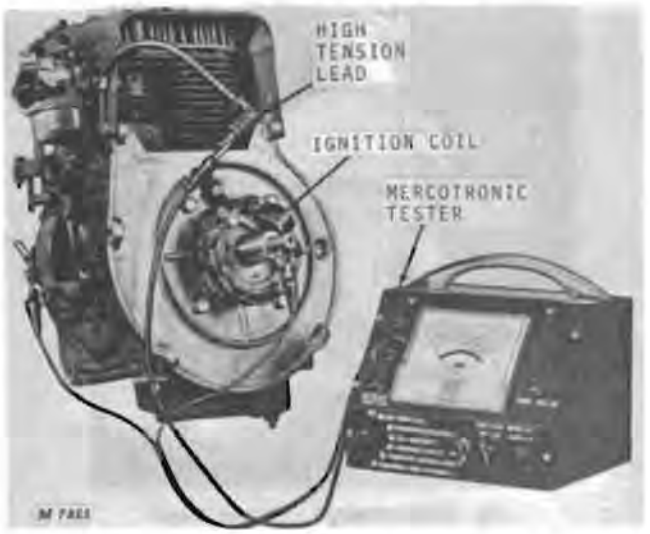

Fig. 6-Testing Coil Power

TESTING—Continued

Make the following checks according to test equipment manufacturer's recommendations:

1. Coil power test, Fig. 6
2. Coil high speed test
3. Coil surface insulation test
4. Coil continuity test
5. Coil ground test

Testing Condenser

The test unit, Fig. 6 can also be used to test the condenser. Follow manufacturer's recommendations to make the following condenser tests:

1. Capacity test
2. Leakage
3. Short
4. Series resistance test

INSPECTION

Spark Plug

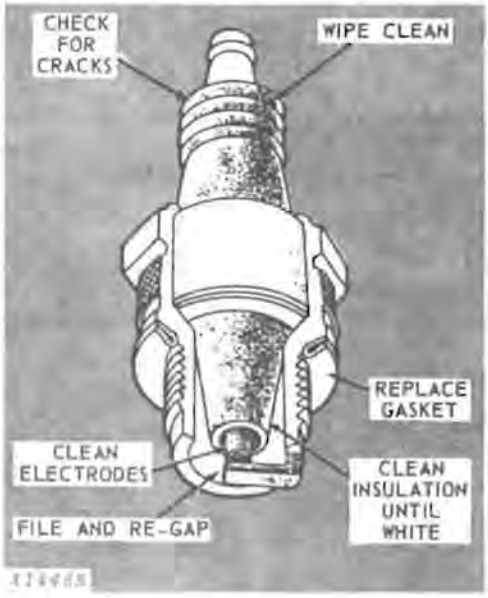

Fig. 7-Maintenance of Spark Plugs

Engine misfire or generally poor operation is often caused by a spark plug in poor condition or by one with improper gap setting. Clean, regap or replace plugs as necessary, Fig. 7.

Breaker Points

Fig. 8-Burned Breaker Points

Breaker points burned in a manner such as those in Fig. 8 could be the result of excessively high voltage, oily or dirty points, a faulty condenser or improper point adjustment.

Pitted points and some transfer of material between points is considered normal. Points should be replaced if transfer is more than 0.020 inch.

Ignition Coil

Inspect coil assembly for damage that may affect its operation. Look especially for cracks or gouges in insulation, evidence of overheating or other damage. Make sure electrical leads are intact, especially where they enter the coil.

Condenser

Inspect condenser for visible damage. Look especially for damaged terminal lead, dents or gouges in can, or broken mounting clip.

REPAIR

Remove, inspect and regap spark plug to 0.020-inch each 100 hours. Bend only the outer electrode when setting gap. A wire gauge should be used as a plain, flat feeler gauge cannot accurately measure the true width of a spark gap. See example in Fig. 9.

Use a spark plug wrench to remove old plug. Always use a new spark plug gasket when replacing plug. Tighten plug to 15 to 20 ft-lbs torque.

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Spark Plug

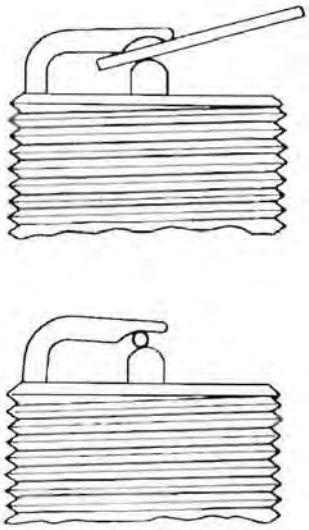

Fig. 9-Checking Spark Plug Gap

Ignition Coil

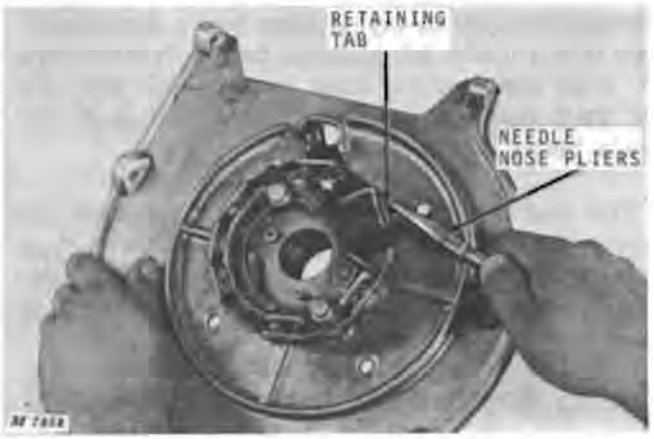

Fig. 10-Removing Ignition Coil

To test or replace coil, remove engine from tractor and flywheel from engine. See page 20-15-3.

The ignition coil is secured to a stator post by a tab, Fig. 10, wedged between the post and the inside of the coil. Bend the retaining tab until vertical and remove faulty coil from the stator post.

No service is possible on the coil. Replace if inspection or testing proves a coil to be defective.

When installing new coil, position tab with clip in hole in stator post. Slip coil over tab and stator post. Bend protruding end of tab over to prevent interference with flywheel magnets.

Use epoxy bonding material to secure high tension lead in coil whenever lead is removed for service.

Install flywheel on engine and test engine on stand. Install engine in tractor, according to instructions on page 20-15-20.

Breaker Points

Engine operation is affected by breaker point condition and adjustment. If points are burned or oxidized, little or no current will pass. As a result, the engine may not operate at all or may miss, particularly at full throttle.

Adjusting breaker point gap affects the time that contacts are opened and closed. A definite time is required for the magnetic field within the ignition coil to build up to sufficient value.

If the contact points are closed for too short a time, a weak spark will be produced by the coil. If the points are set too wide, they will open before the primary current reaches maximum value. On the other hand, if set too close, they will open after the primary current has passed its maximum value.

Fig. 11-Replacing Breaker Points

Replace burned or pitted breaker points, Fig. 11. If slightly pitted points have been dressed down with a point file as a temporary field fix, replace points at first opportunity. If points are oxidized, rub a piece of coarse cloth across surfaces. Clean dirty or oily points with cloth, but make sure no particles of lint are left between surfaces.

To replace points, remove screws "A." Be sure lock washers are in place when installing new points.

Condenser

If the condenser shorts out, the coil will be unable to produce output voltage. On the other hand, if it opens or decreases in capacity, the output voltage will be greatly reduced and the ignition points will burn excessively.

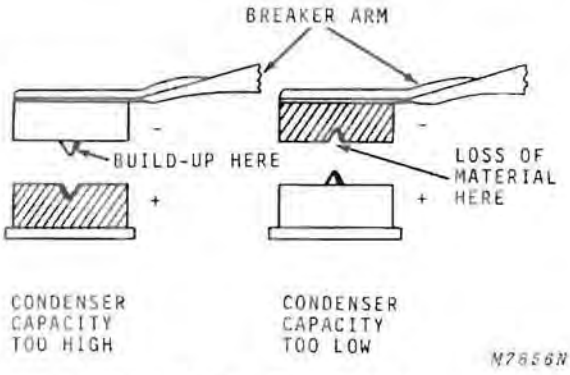

Fig. 12-Breaker Point Build-Up

If burned breaker points occur frequently, the condition of the condenser should be suspected. If condenser has too small capacity, metal will transfer from the stationary contact to the movable contact. If capacity is too large, the metal will build up on stationary contact, Fig. 12.

Condensers can be tested off the tractor on test units such as Fig. 13. Follow manufacturer's recommendations to make the following condenser tests:

1. Capacity
2. Leakage
3. Short
4. Series resistance

Fig. 13-Testing Condenser Capacity

ADJUSTMENTS

Adjusting Breaker Points

Fig. 14-Adjusting Breaker Points

The engine is equipped with a timing sight hole in the blower housing. Fig. 15. Remove the snap button covering the hole by prying loose with a screwdriver. Two timing marks are stamped on the flywheel—the "T" mark indicates top dead center (TDC) while the "S" mark indicates the spark point, which is 20 degrees before top dead center.

Two methods are used for timing—the static and timing light methods. The timing light method is more accurate; however, a storage battery must be used according to the timing light manufacturer's instructions.

Timing Engine (Static Timing Method)

Remove breaker point cover. Remove spark plug lead to prevent unintentional starting. Rotate engine by hand in direction of normal rotation (clockwise when viewed from flywheel end). Points should just begin to break as the "S" 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 0.020-inch when fully open, Fig. 14.

If necessary, loosen point gap adjusting screw and adjust gap to 0.020 inch. Maximum gap setting can vary from 0.018 to 0.022 inch, to achieve smoothest running. Securely tighten adjusting screw after timing.

Timing Engine (With Timing Light)

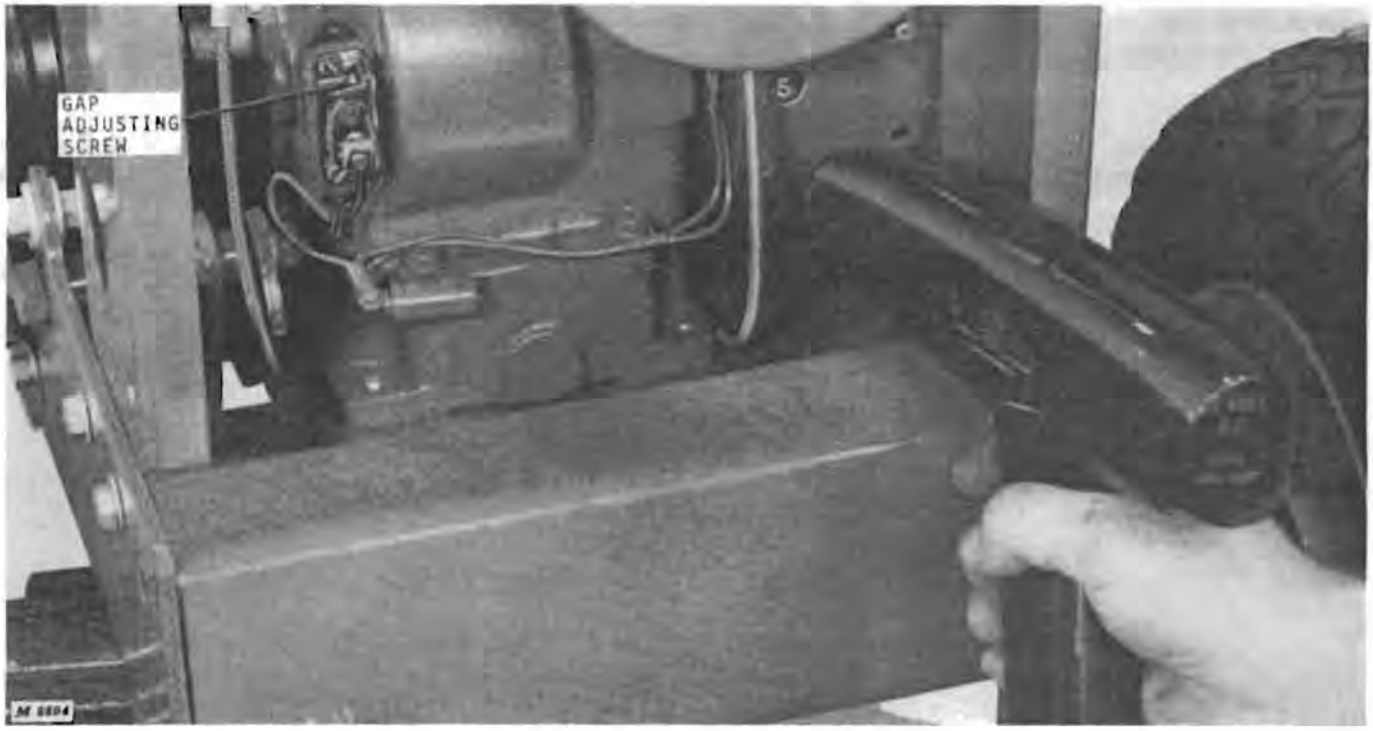

Fig. 15-Timing Ignition with Timing Light

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, Fig. 15.

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: Some lights have sharp prongs on spark lead. With these, simply push prong thru boot until it contacts metal connector.

Connect one timing light lead to the wire wrapped around spark plug terminal.

Connect second timing light lead to positive side of battery—see timing light instructions for battery size, wiring, etc.

Connect third timing light lead to ground.

Remove snap button from blower housing. Rotate engine by hand until "S" mark is visible. Chalk "S" line for easy reading.

Start engine. Run at 1200 to 1800 rpm. Aim timing light into sight hole. The light should flash just as "S" mark is centered in sight hole of blower housing.

If timing is off, remove breaker point cover, loosen gap adjusting screw and shift breaker plate until "S" mark is exactly centered. Retighten adjusting screw before replacing breaker point cover.

SPECIFICATIONS

Spark Plug Gap ..... 0.020 in.
Breaker Point Gap ..... 0.018 to 0.022 in.

Coil Resistance
- Primary Windings ..... 2 to 3 ohms
- Secondary Windings ..... 8,000 to 10,000 ohms

Condenser
- Capacity-Microfarads ..... .18 to .23 mfds

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Group 20
BATTERY IGNITION SYSTEM
8 hp Tractors (Serial No. 252,833-)
and 10 hp Tractors

PRINCIPLE OF OPERATION

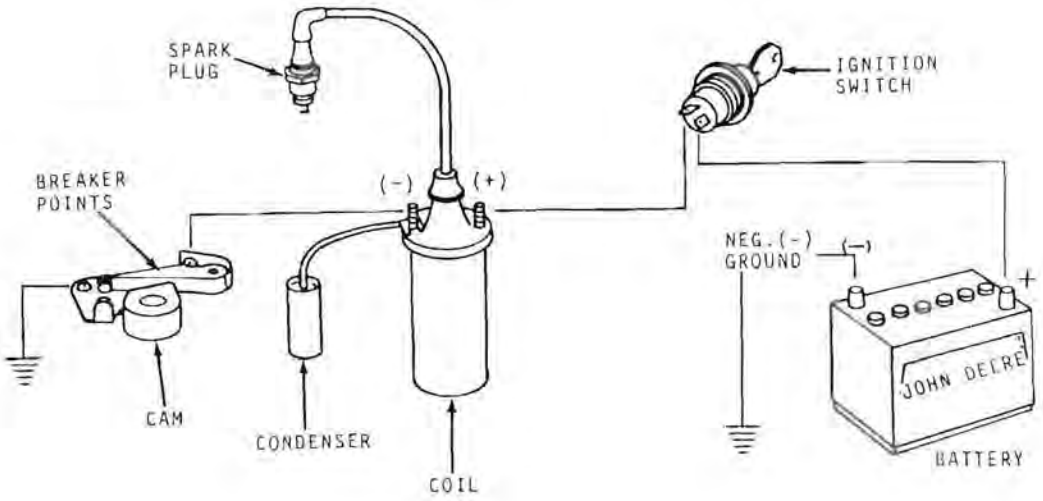

Fig. 1-Ignition System Components

The battery ignition system differs from the magneto ignition in two ways.

1. Current is supplied to the ignition coil from the battery rather than from a permanent magnet self-powered magneto.

2. The ignition switch must be closed in the battery system for the current to flow through the coil. Magneto systems require an open-circuit type switch.

The function of any ignition system is the same, and that is to produce a hot spark at the plug at the right time to ignite the fuel mixture.

Here is how the battery ignition works:

With the ignition switch closed, current flows from the battery through the primary windings of the coil, and through the closed breaker points to ground.

At the point when the piston is near top dead center on the compression stroke, the breaker points are opened by the cam and push rod.

When the points are opened, the primary circuit is broken and the magnetic field collapses.

With the collapse of the primary field, the magnetic lines of force cut across the secondary coil windings and a high-voltage is induced. The high-voltage developed in the secondary coil causes the current to jump across the spark plug electrode gap, making a spark.

The residual current in the primary winding is absorbed by the condenser. This eliminates arcing at the points and aids in producing a stronger spark at the spark plug.

Litho in U.S.A.

Ignition Coil

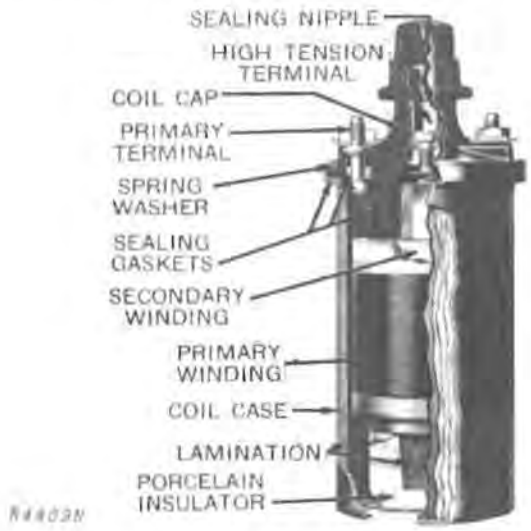

Fig. 2-Ignition Coil

The ignition coil is a pulse transformer that transforms the low battery voltage to the high-voltage necessary to ignite the fuel-air mixture at the gap of the spark plug.

The ignition coil contains three basic parts: a primary winding consisting of a few hundred turns of relatively heavy wire, a secondary winding consisting of many thousand turns of very fine wire, and laminated soft iron which serves to concentrate the magnetic field. The primary winding is assembled around the outside of the secondary winding and the laminated iron provides both a core and outside shell about both the windings. These three units are placed in the coil case and immersed in oil. The coil cap with its necessary attachments to the windings completes the entire coil.

When the primary circuit is energized (breaker points closed), a magnetic field is built up around both the primary and secondary coils. When the primary circuit is de-energized (breaker points open), the magnetic field collapses about the coils inducing a voltage within both of the coils. The voltage developed within the primary coil is absorbed and dissipated by the condenser. The voltage developed within the secondary coil (possibly 25,000 volts or more) is distributed to the spark plug for igniting the fuel-air mixture within the cylinder.

Breaker Points

Fig 3-Breaker Points

Engine operation is greatly affected by the condition and adjustment of the breaker points, Fig. 3, which time the firing of the spark plug.

The points are tripped by the breaker rod, operated by a lobe on the camshaft. A specific time is required for the magnetic field within the ignition coil to build up to sufficient value. Unless the points are adjusted to specification, weak, early, or late sparking occurs.

Condenser

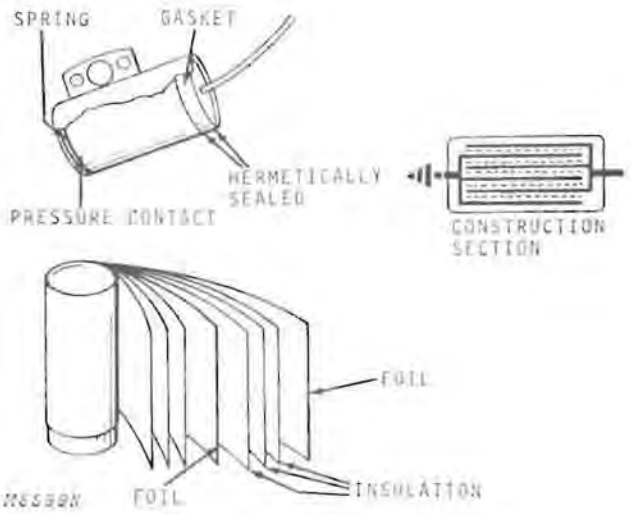

Fig. 4-Cutaway View of Condenser

When the magnetic field in the coil collapses, voltage much higher than the original voltage is induced into the primary winding. As the breaker points open, the current tends to continue flowing across the points. The resulting arc would damage the points in a short time. The condenser, by absorbing the surge of high-voltage, dampens the tendency of current to arc across the points. The condenser also allows the magnetic field to collapse rapidly which contributes to high-voltage induced into the secondary windings.

Spark Plug

A spark plug, Fig. 5, consists mainly of two electrodes separated from each other by a specific gap. The side electrode is connected to the shell of the spark plug. The center electrode is completely insulated from the shell. The high-voltage produced in the secondary winding of the coil is applied to the center electrode and causes a spark to jump the gap to the side electrode. The spark, inside the cylinder, ignites the fuel-air mixture and starts the combustion process in the combustion chamber of the cylinder.

The gap spacing between electrodes is critical for efficient engine operation. Correct spark plug gap affects the entire range of performance of the engine; starting, idling, accelerating, power, and top speed.

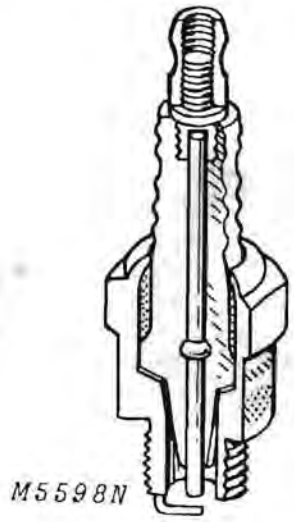

Fig. 5-Spark Plug

Spark plugs must operate within a certain temperature range to give good performance. The ability of the spark plug to conduct heat away from the center electrode and its insulating material is controlled by the design of the shell and insulator. The path for heat escape is through the insulating material, the plug shell, the gasket, and threads to the cylinder head. By varying the construction of the insulator, the spark plug manufacturer is able to produce spark plugs of different heat dissipating characteristics.

Ignition Switch

The ignition switch in the battery ignition system routes the electrical current from the battery to the coil in both "START" and "RUN" positions. Since electrical current is needed to operate the ignition coil, a switch with a closed ignition circuit is required. This means that opening the circuit will stop the ignition function. Magneto systems are just the opposite, as they operate when the ignition switch is open, and stop when the switch is closed.

Litho in U.S.A.

TESTING

Preliminary Engine Test

Several factors contribute to the overall performance of an ignition system. All components must be in good condition and the spark must be properly timed.

Hard starting, low power, and erratic operation can often be attributed to faulty ignition. If poor ignition is suspected, the first thing to do is to determine if the ignition system is actually at fault. A simple operational test will determine this.

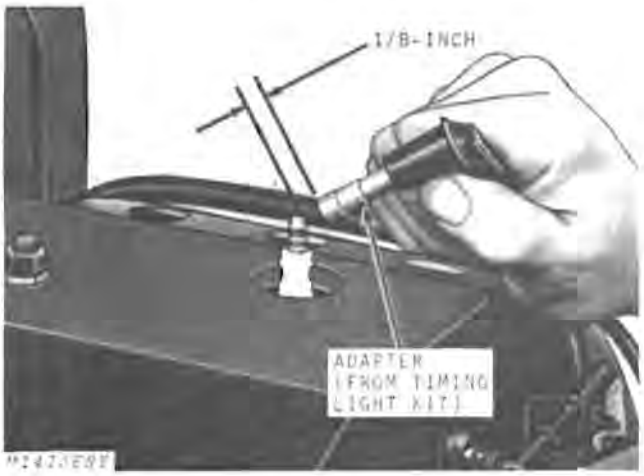

Fig. 6-Checking Spark at Plug

Install an adapter in spark plug connector and hold 1/8-inch from spark plug terminal, Fig. 6, while cranking engine.

A weak spark or no spark indicates ignition system difficulties. Test further to isolate problem.

A sharp, snappy spark indicates coil, breaker points, and condenser are in good condition.

Test Equipment

Adequate approved electrical test equipment is required to accurately test electrical circuits and intelligently diagnose unsatisfactory performance.

The following tests are made using the Merc-O-Tronic analyzer, Fig. 7. If different equipment is used, the same tests should be made, but follow the test equipment manufacturer's recommendations for procedures.

Testing Battery

Refer to page 40-10-4 to test the battery.

Testing Coil

Fig. 7-Testing Coil Power

The ignition coil is either satisfactory or not. Coil failure occurs all at once, much as an electric light bulb. It does not degenerate gradually.

When coil failure is suspected, use an analyzer, Fig. 7, to test coil.

Follow manufacturer's recommendations to test the following:

1. Coil power test.
2. Coil high-speed test.
3. Coil surface insulation test.
4. Coil continuity test.
5. Coil ground test.

Litho in U.S.A.

Testing Condenser

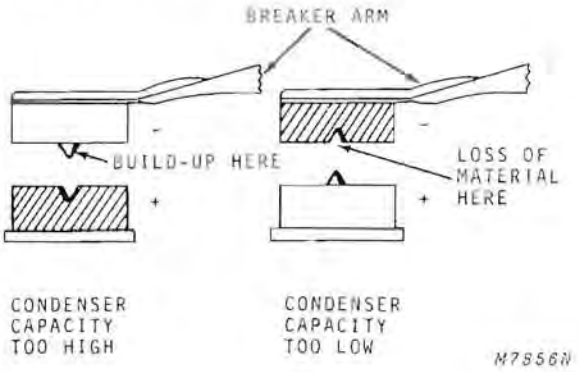

Fig. 8-Breaker Point Build-Up

If badly burned breaker points occur frequently, the condenser should be suspected. If condenser has too small capacity, metal will transfer from the stationary contact to the movable contact. If capacity is too large, the metal will build up on stationary contact, Fig. 8.

Condensers can be tested off the tractor on test units such as in Fig. 9. Follow manufacturer's recommendations to make the following condenser tests:

1. Capacity
2. Leakage
3. Short
4. Series resistance

Fig. 9-Testing Condenser Capacity

REPAIR

Spark Plug

Fig. 10-Checking Spark Plug Gap

Remove, inspect, and regap spark plugs to 0.020-inch every 100 hours, Fig. 10. Bend only the outer electrode when setting gap.

Do not sandblast, wire brush, scrape, or otherwise service plug in poor condition - best results are obtained with a new plug.

Use a spark plug wrench to remove and replace plug. Tighten plug to 27 foot-pounds torque.

Good operating conditions are indicated if plug has a light coating of gray or tan deposit. A dead white, blistered coating could indicate overheating.

A black (carbon) coating may indicate an over-rich fuel mixture caused by a clogged air cleaner or improper carburetor adjustment.

Ignition Coil

Coil Polarity

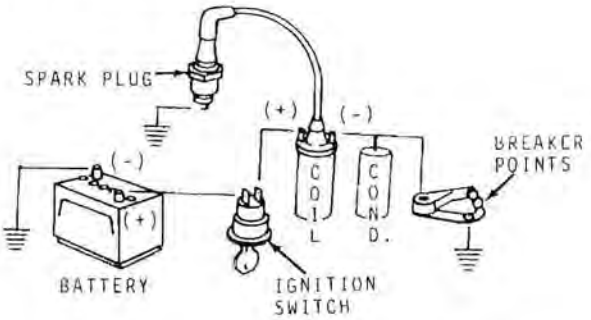

Fig. 11-Correct Polarity Diagram

Wrong polarity of the coil is not a serious problem, but can cause damage over a long period of time. A coil that is connected incorrectly will require an extra 4000 to 8000 volts to create a spark.

A properly connected coil has the positive (+) terminal connected to the battery lead and the negative (−) terminal connected to the breaker point and condenser leads, Fig. 11.

Servicing Coil

The only service required on the coil is to keep the terminals and connections clean and tight. The coil itself should be kept reasonably clean.

Rubber nipples used on the high-voltage terminal must be in good condition to prevent leakage at this point.

There is no repair for the coil. If it is defective it must be replaced.

Breaker Points

Engine operation is greatly affected by breaker point condition and adjustment. If points are burned or badly oxidized, little or no current will pass. As a result, the engine may not operate at all or may miss, particularly at full throttle.

Fig. 12-Replacing Breaker Points and Condenser

To replace points, remove point cover; then remove screws "A", Fig. 12.

Check condition of breaker point push rod. An excessively tight push rod can hang up and cause ignition failure, particularly with a hot engine.

Install new points and adjust gap as instructed on page 40-20-7.

Replace cover, being certain rubber grommet and cover gasket are in position and in good condition.

Condenser

If inspection or tests disclose a defective condenser, replace condenser. Install a new condenser, Fig. 12, whenever condition of points indicate need.

ADJUSTMENTS

Adjusting Breaker Points

⚠ CAUTION: Disconnect spark plug cable to prevent accidental starting of the engine.

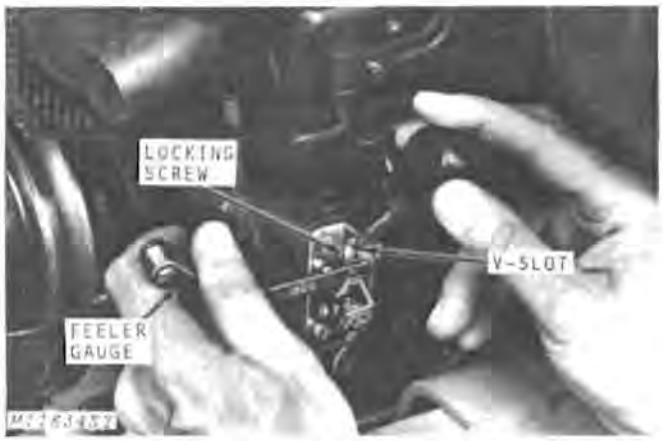

Fig. 13-Adjusting Breaker Points

Remove ignition point cover and rotate engine flywheel until points are fully open.

Check point gap with a 0.020-inch feeler gauge. If adjustment is required, loosen locking screw and move screwdriver in V-slot until points are properly set. After tightening locking screw, recheck point gap.

Ignition timing is affected by breaker point gap. Increasing gap advances timing; decreasing gap retards timing.

Breaker point gap can vary from .018 to .022 inch to achieve correct timing. See "Timing Engine", this page.

Replace badly burned or pitted breaker points. If points are oxidized, rub a piece of coarse cloth across surfaces. Clean dirty or oily points with cloth, but make sure no particles of lint are left between surfaces.

Timing Engine

The engine is equipped with a timing sight hole in the blower housing. Two timing marks are stamped on the flywheel - the "T" mark indicates top dead center (TDC) while the "S" mark indicates the spark point, which is 20 degrees before top dead center.

Two methods are used for timing - the static and timing light methods.

Static Timing Method

Fig. 14-Static Timing

Connect an ohmmeter or flashlight tester to breaker point lead screw and to ground, Fig. 14. Breaker point lead must be disconnected from points.

Rotate engine in normal rotation until test light goes out, indicating points are just starting to open.

At this time, "S" mark on flywheel should appear in center of timing sight hole. Adjust gap slightly, if necessary, to obtain this condition.

Timing Light Method

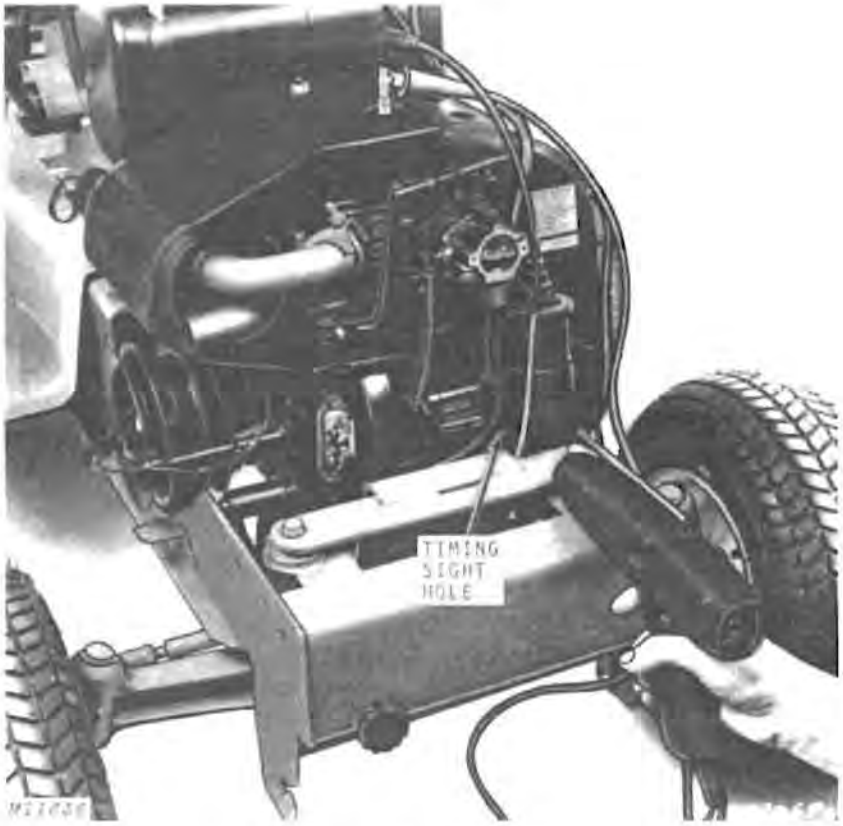

Fig. 15-Timing With Timing Light

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.

Remove high-tension lead at spark plug. Install adapter, Fig. 15, and reconnect spark plug lead.

Connect one timing light lead to this adapter. Connect second timing light lead to positive side of battery, see timing light instructions for battery size, wiring, etc. Connect third timing light lead to ground.

Rotate engine by hand until "S" mark is visible through sight hole. Chalk "S" line for easy reading.

Run engine at 1200 to 1800 rpm. Aim timing light into sight hole. The light should flash just as "S" mark is centered in sight hole of blower housing.

If timing is off, adjust breaker point gap slightly to correct.

Litho in U.S.A.

Group 25
CHARGING SYSTEM

PRINCIPLE OF OPERATION

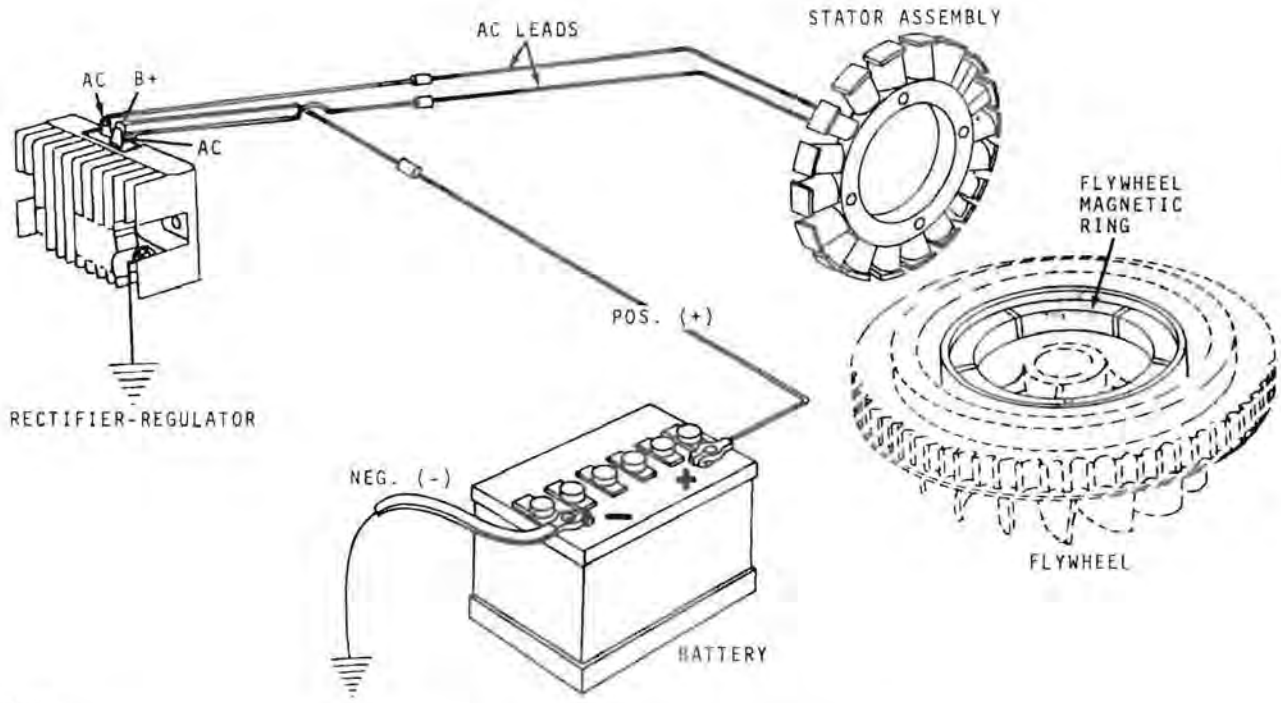

Fig. 1-Principle of Charging System Operation

Alternator

The alternator, Fig. 1, supplies electrical energy to charge the 12-volt battery. The battery, in turn, furnishes energy for cranking, ignition, and other accessories.

The alternator features (1) a ceramic magnet ring, permanently affixed to the inside rim of the flywheel, (2) an alternator-stator assembly bolted to the engine bearing plate, and (3) a rectifier-regulator unit mounted externally on the tractor.

The ceramic magnet ring is permanently assembled with spring pins to the flywheel. The ceramic magnets are very strong, but the material is brittle. Always handle the flywheel with care to prevent damage.

The magnetic ring on the inside rim of the flywheel, rotates around the stator, generating an alternating current in the stator windings. This alternating current is routed to a rectifier-regulator where it is converted to direct current. Direct current conversion is required because the polarity of the battery will not accept alternating current.

The rectifier-regulator also controls the rate of charge to the battery, dpending on battery requirements.

With this system, the battery and alternator work hand-in-hand to supply the needs of the engine and accessories - each one being dependent upon the other.

Rectifier-Regulator

Fig. 2-Rectifier-Regulator

The alternating current produced in the alternator is changed to direct current in the rectifier-regulator, Fig. 2. Direct current is necessary for charging the battery.

This change is accomplished through the use of solid state electronic devices which are arranged to form a half-wave bridge rectifier.

Regulation is also provided by electronic devices (Zener diodes) which "sense" the counter-voltage created by the battery to control or limit the charging rate. Since these devices generate heat in operation, the regulator is equipped with finned surfaces to provide a greater cooling surface.

When the battery is in a low state of charge, the regulator permits a higher charge rate to the battery. When battery is fully charged, the devices limit the charging rate.

TESTING

The following tests are designed to isolate the cause of trouble in the charging system. A complete diagnosis guide appears in Group 5 of this section.

Adequate, approved electrical test equipment is required to accurately test electrical circuits and intelligently diagnose unsatisfactory performance.

NOTE: Because there are many manufacturers of test equipment, each with its own specific operating instructions, it is important to follow the manufacturer's recommendations if the procedures in this test section contradict those of the manufacturer.

Testing Circuit Wiring

Fig. 3-Faulty Wiring

The wiring, Fig. 3, in the circuit is just as important a part of the charging system as the electrical units themselves. Poor connections between the regulator and battery or poor ground connections between the battery-to-engine and engine-to-frame will cause a lowering of the charging rate. Inspect for a good ground contact between rectifier and pedestal.

A visual inspection will often reveal much useful information relative to the condition of the charging system. All wiring should be inspected periodically for damaged insulation. Faulty wiring should be replaced. All terminals should be checked for loose or corroded connections, and cleaned and tightened, as necessary.

Unwanted resistance in the circuit results in unwanted voltage losses or drops. An excessive voltage drop in the charging circuit tends to keep the battery in an undercharged condition.

Testing Alternator and Regulator

When testing the alternator be sure the battery is capable of holding a charge. See page 40-10-4 for battery testing information.

IMPORTANT: When testing the charging system, be sure battery polarity is correct. Prevent alternator (AC) leads from touching or shorting, because this could permanently damage the stator.

Litho in U.S.A.

Quick Check of Charging System

Remove spark plug wire and crank engine 15 seconds to partially discharge battery. Reinstall spark plug wire and start engine.

With engine idling, place load on charging system by engaging PTO clutch and operating electric lift. Tractor ammeter will show a discharge condition.

Increase engine rpm by lifting up on throttle lever. As engine speed increases, discharge condition will disappear; ammeter will show a charging condition at full rpm.

If this does not occur, make the following tests to determine which component has failed. Use the following sequence:

AC Voltage Test

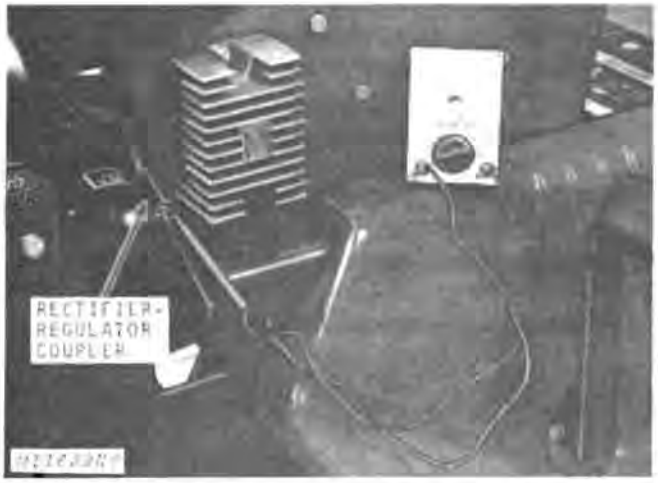

Fig. 4-Checking AC Voltage Output

Remove 3-prong coupler from rectifier-regulator unit. Insert leads from AC voltmeter into the brown and brown/white wire coupler terminals, Fig. 4. Start engine and run at full speed (no load).

Alternator should supply 28 to 32 volts to the regulator.

If voltage is substantially below 28 volts, the alternator is defective and should be replaced. If 28 volts or higher, the alternator is producing properly.

See "Repair" on page 40-25-4 for alternator stator replacement.

DC Voltage Test

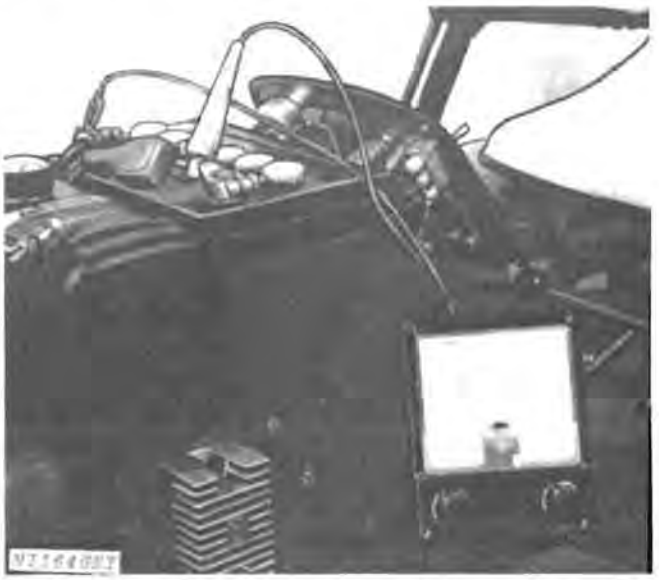

Fig. 5-Checking DC Voltage

If AC voltage test proved alternator to be producing current, but ammeter still will not show a charge, reconnect coupler to rectifier-regulator and make the following test.

Connect a DC voltmeter across the battery terminals, Fig. 5. Run engine at slow idle. Note voltmeter reading.

Increase engine rpm to full speed and note voltmeter reading again. A voltage differential of 1/2 to 4 volts should be indicated between idle speed and full speed.

If no differential is indicated, rectifier-regular appears to be faulty. However, make DC amperes test as explained on page 40-25-4 before replacing rectifier-regulator.

DC Amperes Test

To check amperage, battery must be partially discharged. If battery is not partially discharged, remove spark plug wire and crank engine 15 seconds to partially discharge battery. Install spark plug wire.

Fig. 6-Checking DC Amperes at Battery

Install ammeter in series between battery cable and positive battery post, Fig. 6, with engine running.

CAUTION: Do not permit positive battery cable or meter cables to touch gas tank or tractor. Shorting could occur.

IMPORTANT: Never start an engine through a test meter.

Adjust polarity on meter. Ampere reading should be from 10 to 15 amps with engine at full throttle, depending on battery condition. If battery is partially discharged and no amps are available, and previous test proved the alternator to be functioning properly, the rectifier-regulator is defective.

If DC voltage and amperage prove satisfactory, there is no reason to service the charging system if battery will not stay charged. The problem would be in the battery.

REPAIR

Replacing Alternator Stator

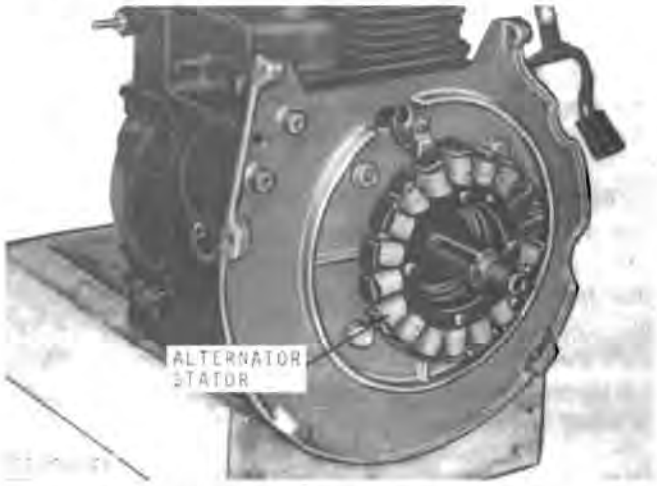

Fig. 7-Alternator Stator (Flywheel Removed)

If AC voltage test proved alternator stator defective, replace as follows:

Remove blower housing and flywheel.

Remove stator wires from clip and 3-terminal coupler, Fig. 7. Remove 4 screws securing stator to bearing plate and remove stator.

Reverse above procedure for installation.

Group 30
ELECTRIC LIFT

PRINCIPLE OF OPERATION

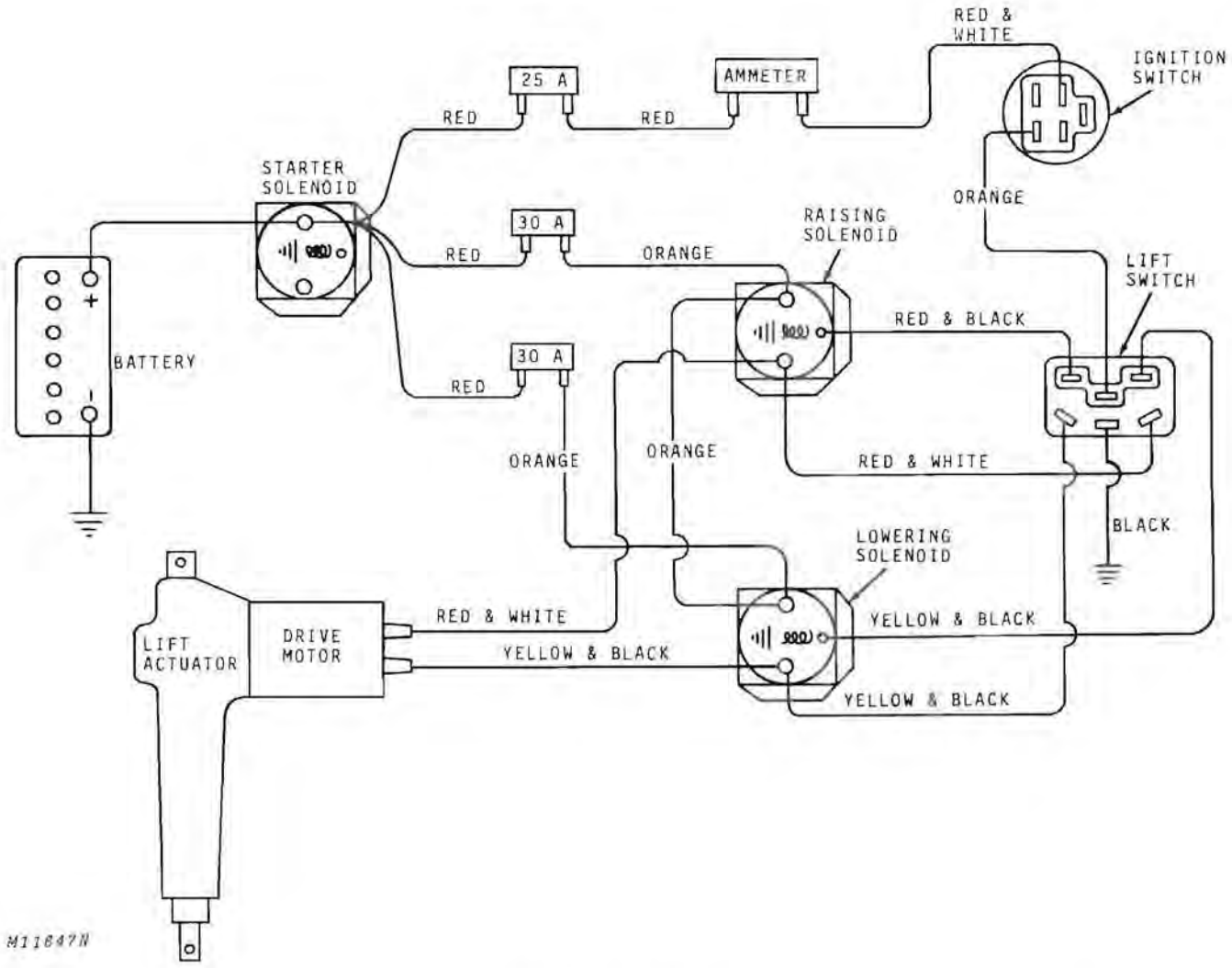

Fig. 1-Electric Lift Circuitry

The electric lift has five main parts; driver motor, lift actuator, lift rod, primary lift shaft, and lift switch.

The lift switch, Fig. 1, is grounded on one side from the switch to the driver motor. The other side of the switch actuates two solenoids; one for raising the lift, and the other for lowering the lift.

Moving the switch "UP" closes one solenoid, Fig. 2, allowing current to flow to motor, to switch, to ground, lifting the implement.

Moving the switch "DOWN", closes the other solenoid, Fig. 3, allowing current to flow in the opposite direction, to motor, to switch, to ground, lowering the implement.

TESTING ELECTRIC LIFT

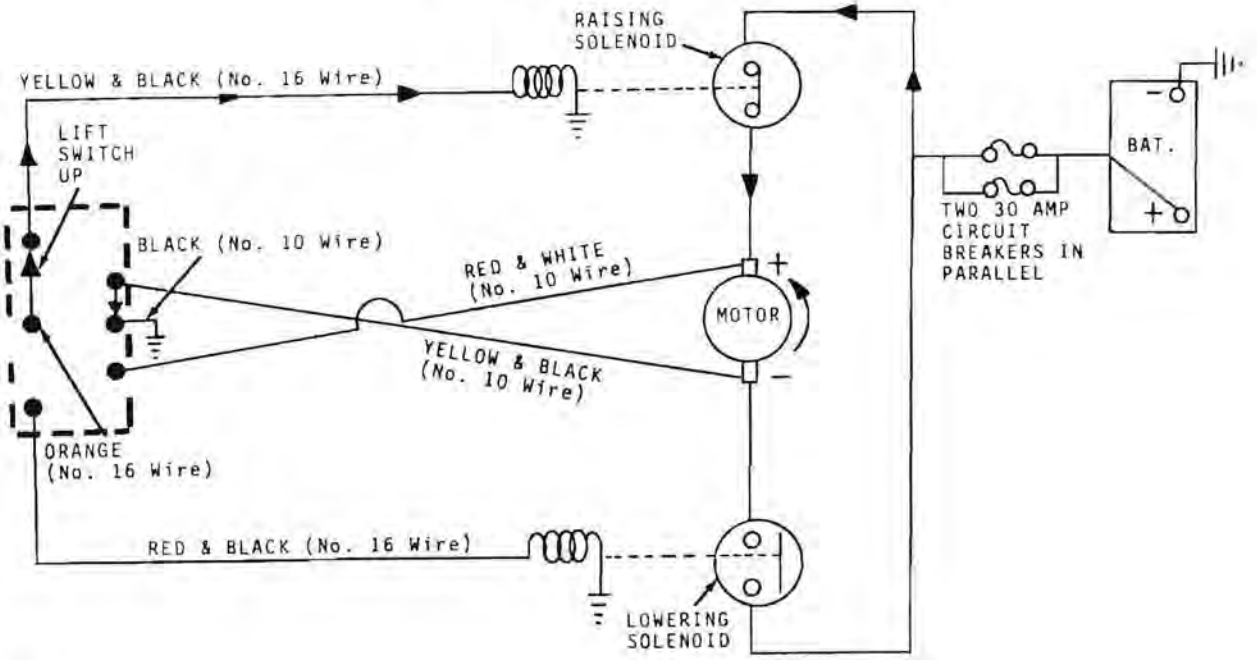

Fig. 2-Lift Switch Up—Implement Raises

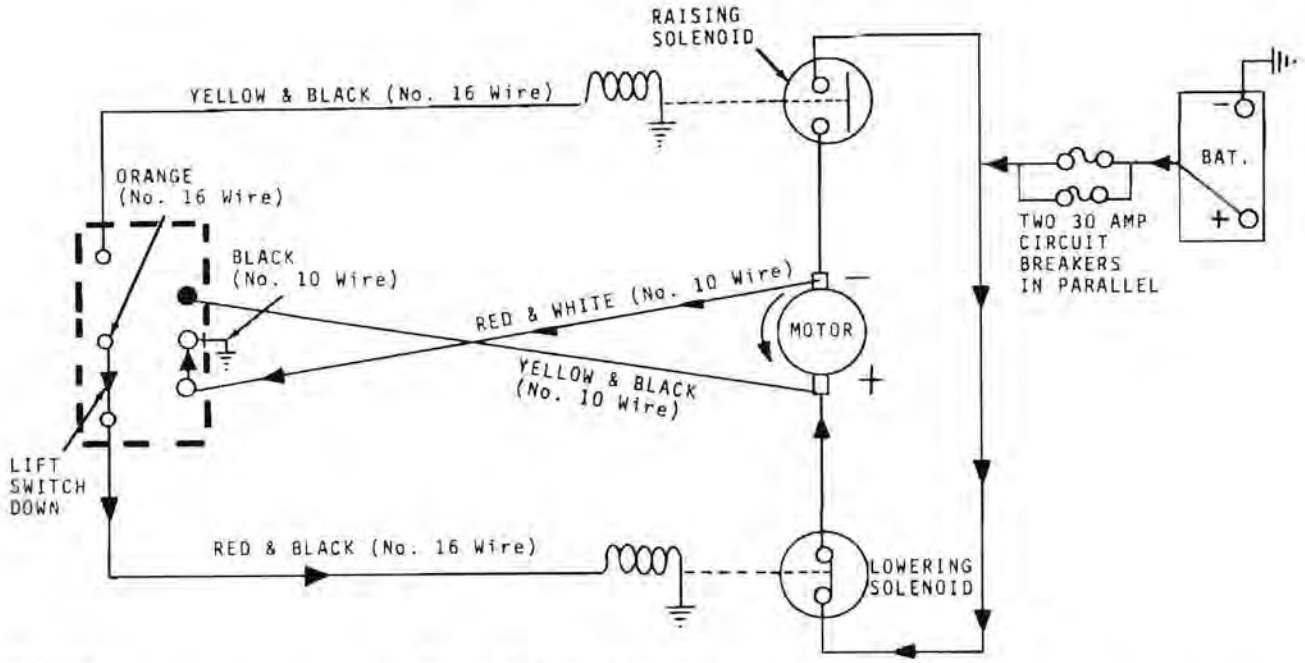

Fig. 3-Lift Switch Down—Implement Lowers

Disconnect coupler from drive motor. Using a 12-volt test light, check to see if inoperative condition of the lift is due to a faulty lift or to problems in the electrical system itself.

Connect prongs from test light into each coupler opening (from electrical system). Turn key switch on and move lift switch up. Test light should glow. Then move lift switch to down position. Test light should glow.

If light operates in both positions, problem lies with the lift mechanism. If light fails to operate, problem is in the electrical system itself. Check the solenoids, circuit breakers, and switches.

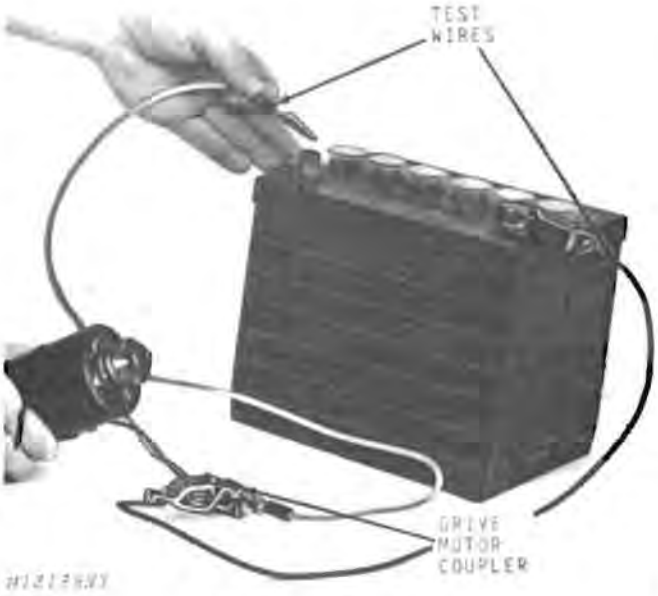

Fig. 4-Testing Lift Motor

To test drive motor, remove motor from tractor and attach wires to each of the terminals on the drive motor coupler Fig. 4. Attach one wire to the positive battery post and the other wire to the negative battery post. The motor shaft should rotate. Reverse the wires on the battery and the motor should rotate in the opposite direction. If the motor fails to rotate in either direction, it should be replaced.

REMOVAL

Disconnect electrical wire from drive motor. Remove cotter pins and drilled pins securing electric lift actuator to actuator support and primary lift shaft. Remove electric lift actuator.

DISASSEMBLY AND REPAIR

Electric Motor

Fig. 5-Removing Drive Motor From Actuator

Remove two thru bolts securing motor to motor adapter and remove motor, Fig. 5.

NOTE: There are no service procedures for the motor. If it does not function as explained under "Testing", Fig. 4, replace the motor.

Gear Box

Fig. 6-Worm Gear Screw

DO NOT attempt to replace the worm gear in the gear box. This gear is preloaded during factory assembly and the large screw, Fig. 6, is staked in place to maintain the proper end play. If the worm gear is damaged, replace the gear box.

To replace brake spring in gear box, use AM34885 Brake Spring and Spacer Kit. See assembly, page 40-30-5.

Remove two socket head screws securing motor adapter to gear box. Remove adapter and gasket.

Fig. 7-Removing Spacer

Use a screwdriver to remove spacer, Fig. 7, and then remove brake spring.

Cover Tube and Actuator

Fig. 8-Removing Cover Tube and Bearing Support

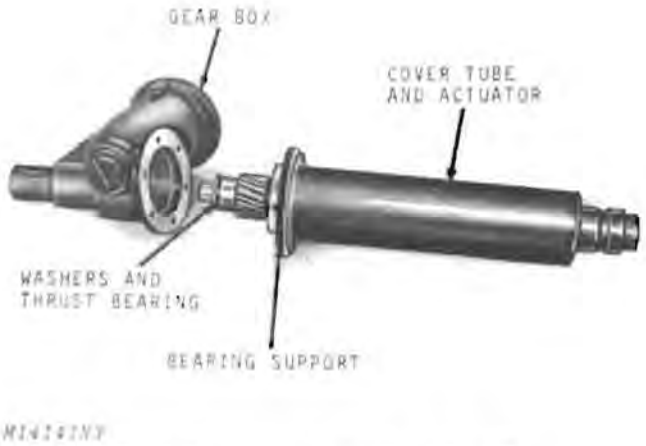

Fig. 9-Removing Actuator From Gear Box

Remove six self-tapping screws, Fig. 8, securing cover tube and bearing support to gear box. Remove cover tube with actuator and bearing support from the gear box, Fig. 9.

Pull the cover tube with O-ring and gasket off the actuator. Bearing support stays with actuator and gear.

NOTE: The O-ring located in the nylon bushing is replaceable. If the nylon bushing is damaged, replace cover tube. The gear, two thrust washers, four plain washers and bearing support are replaceable.

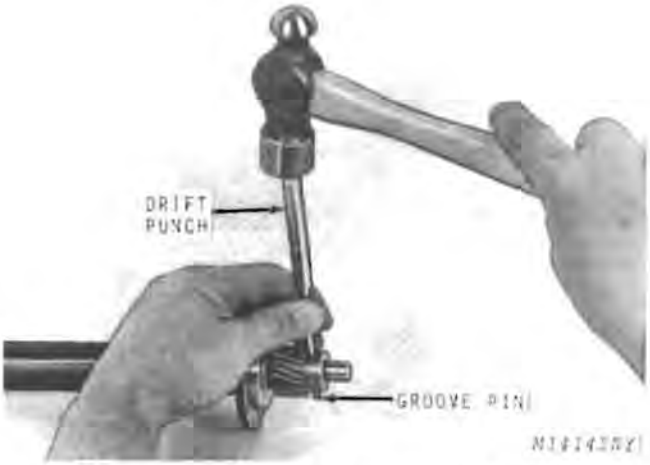

Fig. 10-Removing Gear From Actuator Shaft

Remove two washers and thrust bearing from end of actuator shaft. Use a drift punch and drive out the groove pin, Fig. 10, securing gear to shaft. Remove gear, two washers, thrust bearing and bearing support from shaft.

Fig. 11-Actuator Shaft

The actuator shaft, Fig. 11, is not serviceable. Any damage to this part requires complete replacement.

ASSEMBLY

Cover Tube and Actuator

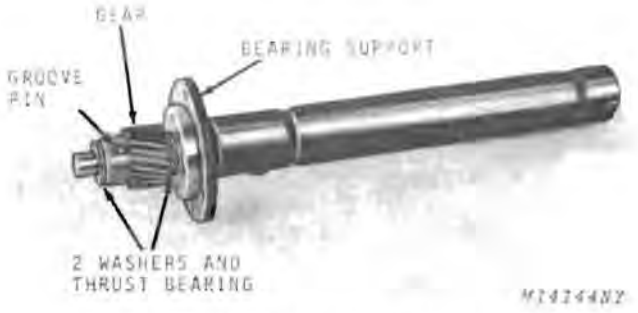

Fig. 12-Actuator Assembly

Install bearing support, washer, thrust bearing, washer and gear. Secure gear to shaft with groove pin. Install washer, thrust bearing and washer on the end of shaft, Fig. 12. Install new gasket and cover tube over actuator.

Apply John Deere Multipurpose-Type Lubricant on O-ring and nylon bushing of cover tube to allow cover tube to slide on actuator.

Apply John Deere Multipurpose-Type Lubricant on to end of actuator shaft and gear and on worm gear in gear box.

Fig. 13-Installing Actuator Assembly to Gear Box

Install actuator assembly into gear box and secure with six self-tapping screws, Fig. 13.

Motor to Gear Box

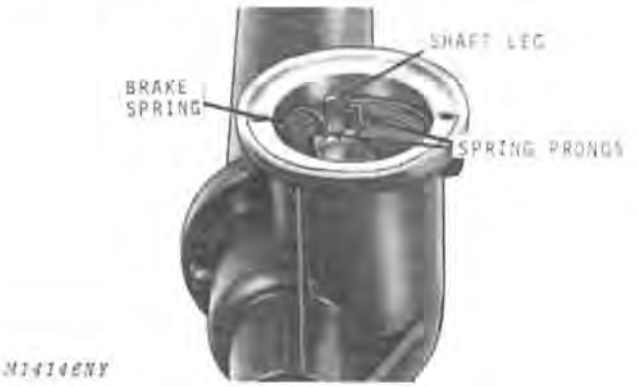

Fig. 14-Brake Spring Installed in Gear Box

Lubricate outside of brake spring lightly with John Deere Multipurpose-Type Lubricant. Install brake spring into gear box with leg of shaft arm between prongs of spring, Fig. 14.

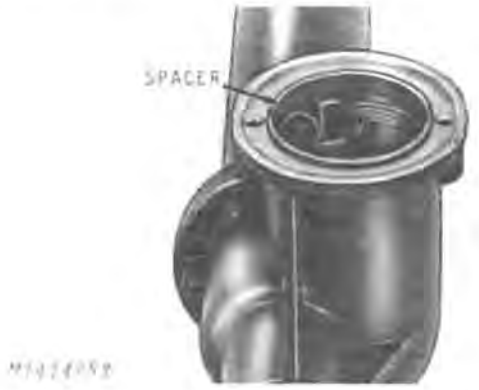

Fig. 15-Installing Spacer

Install spacer into gear box leaving spacer protruding slightly out of gear box, Fig. 15. Install motor adapter with new fiber gasket and secure with socket head screws.

Fig. 16-Positioning Spacer

Using a screwdriver positioned across holes as shown in Fig. 16, pry up on both sides of spacer until it strikes screw hole boss in motor adapter. Be sure coils of spring are in spring recess and that the spring rotates easily.

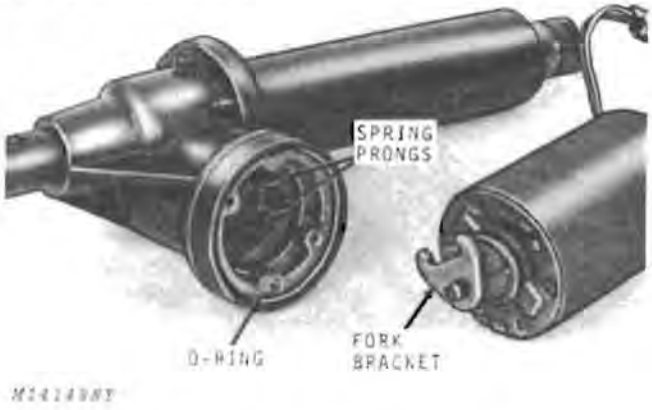

Fig. 17-Installing Motor to Motor Adapter

Install new O-ring in motor adapter. Install motor on adapter with prongs of spring positioned between forks of fork bracket on motor shaft, Fig. 17. Tighten thru bolts securely.

INSTALLATION

Connect electric lift actuator to actuator support and primary lift shaft with drilled pins and cotter pins. Connect electrical wire to drive motor.

ADJUSTMENT

If the mower deck strikes the tractor drag link, adjust the electric lift actuator as follows:

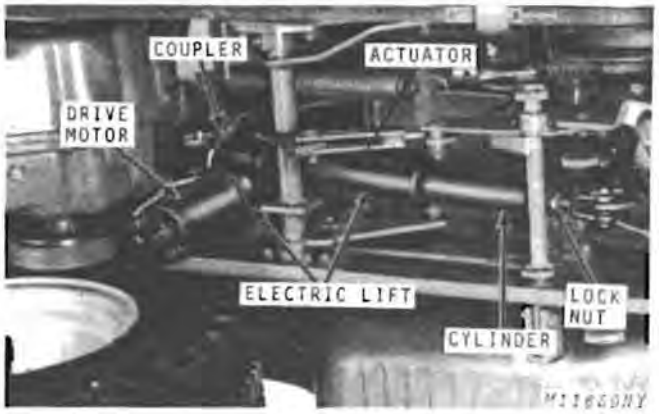

Fig. 18-Adjusting Electric Lift

Loosen lock nut, Fig. 18, located at forward end of actuator.

Using an appropriate wrench, turn actuator to shorten the amount of exposed thread on actuator yoke. Tighten lock nut and test for interference.

Adjust for a 1/4 to 3/8-inch clearance between the mower deck and the drag link.

When using electric lift to raise heavy loads, it is recommended that the electric lift helper spring kit be installed. See page 40-30-7.

INSTALLING ELECTRIC LIFT HELPER SPRING KIT

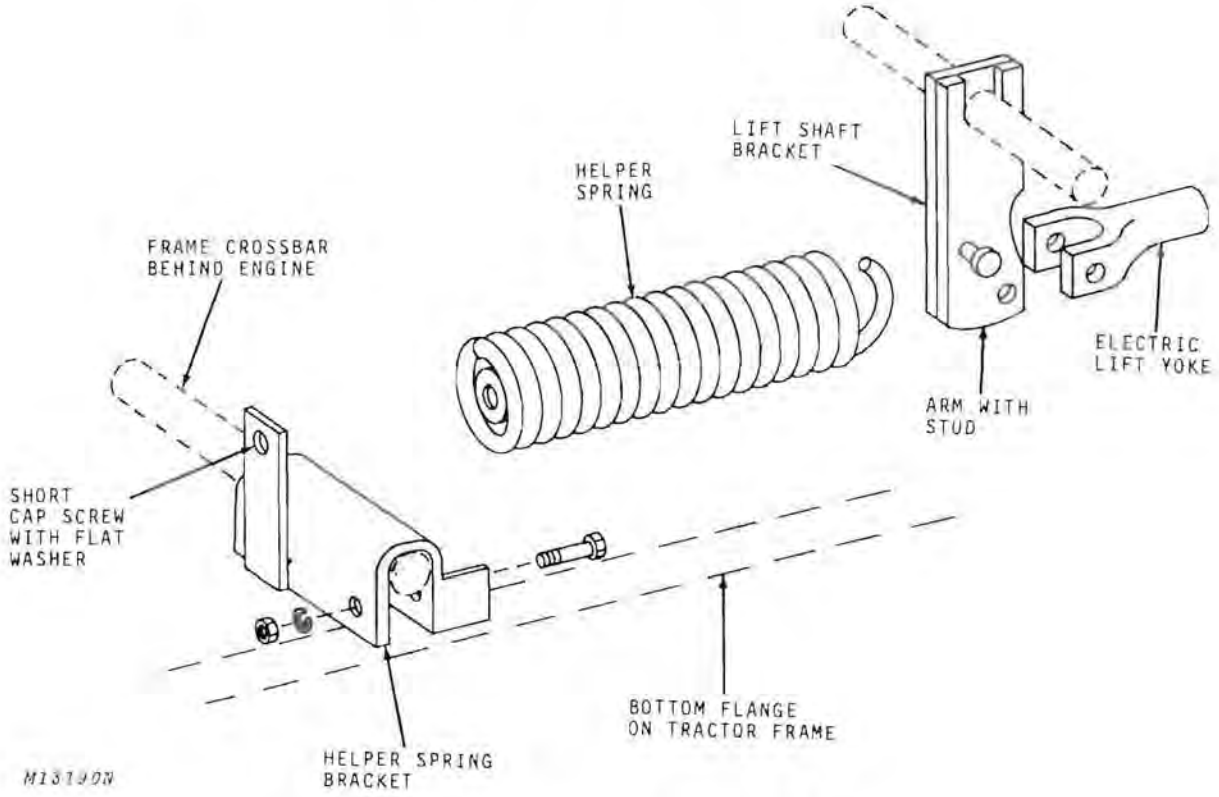

Fig. 19-Installing Electric Lift Helper Spring Kit

Install electric lift helper spring kit as follows:

Remove cotter pin and drilled pin in electric lift yoke, Fig. 19. Remove and discard spacer (not shown).

Install arm with stud on outside of lift shaft bracket (toward frame) with curved notch toward yoke. Reinstall yoke with drilled pin and cotter pin.

Install flat washer on short cap screw and insert cap screw into helper spring bracket. Turn cap screw into spring nut all the way. Then back cap screw out 1/2 turn to allow spring to pivot slightly.

Hook helper spring over stud. Position helper spring bracket over frame crossbar tight against frame. Install cap screw, lock washer and nut.

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Section 50
POWER TRAIN
Group 5
GENERAL INFORMATION

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DESCRIPTION

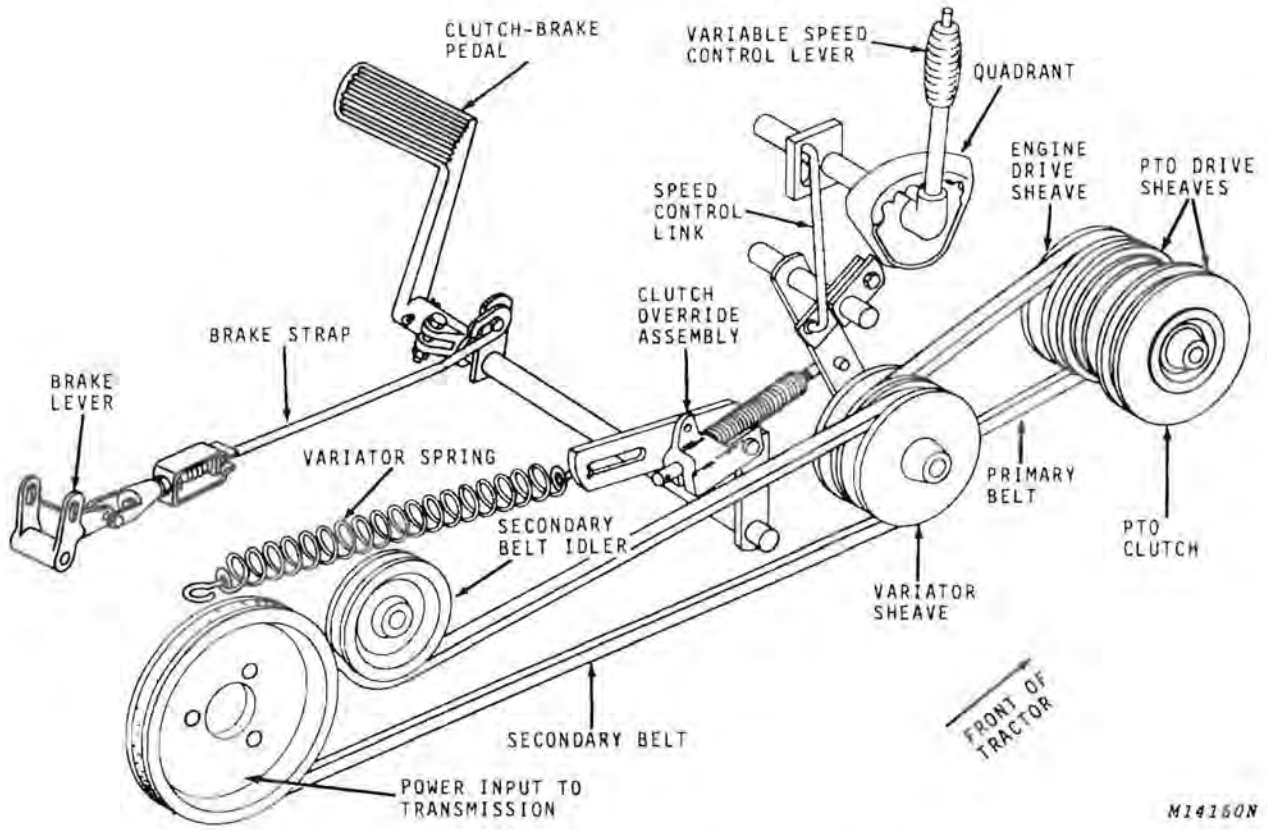

Fig. 1-Power Train Components (Ser. No. 250,001-272,000)

The power train of the 110 Tractor consists of the following components: engine drive sheave, variator sheave, transaxle power input sheave and primary and secondary drive belts.

Forward speed of the tractor can be increased or decreased by moving the variable speed control lever forward or rearward. Speeds can be varied from 0.4 to 7.4 mph by using the variator in conjunction with the 4-speed transaxle.

With the variable speed drive, changes in travel speed can be made without shifting gears.

When the clutch is used in conjunction with the gear shift lever, the pedal need only be depressed until power is disconnected. Further depressing of the clutch pedal applies braking force to the rear wheels on tractors (Serial No. 250,001 to 272,000). On tractors with Serial No. 272,001 and above there is a clutch and brake assembly which operate independently of each other.

Refer to pages 50-10-1 and 50-10-2 for a more detailed explanation of the clutch brake and variable speed operation.

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Group 10
CLUTCH, BRAKE, AND VARIABLE SPEED DRIVE

PRINCIPLE OF OPERATION

Variable Speed Control Lever

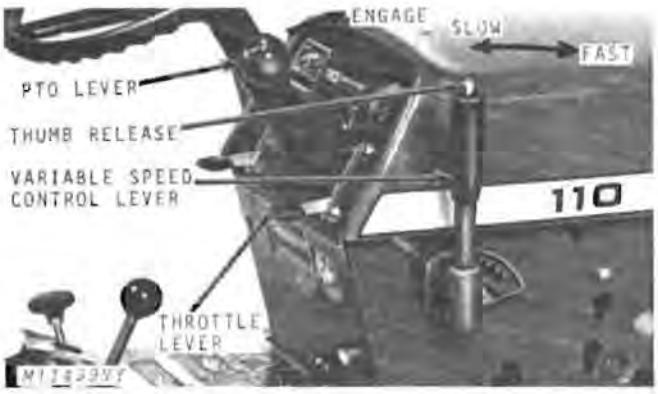

Fig. 1-Variable Speed Control Lever

The variable speed is regulated manually with the variable speed control lever, Fig. 1. By depressing the thumb release and moving the variable speed control lever toward the front of the tractor, the variator is moved rearward and the tractor speed is increased. Releasing thumb pressure on the variable speed control lever locks the lever in any of seven speed positions on the quadrant.

NOTE: Only five positions are operative at any one time when the drive is properly adjusted. The other two positions allow for belt "tolerances" and normal wear before adjustment becomes necessary.

Clutch or Clutch-Brake Pedal

Fig. 2-Clutch Pedal or Clutch-Brake Pedal

The variator and variable speed can also be controlled with the clutch pedal or clutch-brake pedal to vary tractor speed within the limits determined by the position of the variable speed control lever. When the variable speed control lever is positioned fully forward, the full speed range of the variator and tractor can be controlled with the clutch pedal or clutch-brake pedal as it is depressed through the variable speed range, Fig. 2.

Depressing the clutch-brake pedal (tractors under Ser. No. 272,001) through the neutral range moves the variator forward to disengage the drive. Further depression applies braking force to the rear wheels; this is the braking range. In this manner, the drive is always disengaged before the brake is applied. Clutch and brake pedals operate independently on tractors above Serial No. 272,000.

The variator is load and torque sensitive when heavy draft loads are applied. For example, while using a plow or front-mounted blade and with the variable speed control lever forward (fast speed), the tractor may slow down as the variator shifts itself into a lower range.

This also causes the clutch pedal or clutch-brake pedal to creep downward. The pedal comes up again as the load is relieved.

Fig. 3-Setting Parking Brake—Serial No. (250,001-272,000)

When the clutch-brake pedal is fully depressed on tractors below Serial No. 272,001, the parking brake can be set by moving parking brake lever downward in its slot, Fig. 3. On tractors above Serial No. 272,000 depress brake pedal and move parking brake lever downward in its slot.

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Variator

The variator, Fig. 4, has two outside half sheaves fixed to a common hub. The center sheave is free to slide on the shaft.

In operation, the variator is moved like a pendulum, between the engine drive sheave and transmission-driven sheave, Fig. 5.

Drive Disconnect

When the clutch pedal or clutch-brake pedal is depressed, the variator moves forward, Fig. 5, releasing the primary belt from the engine sheave.

Release of clutch pedal or clutch-brake pedal allows variator to swing rearward tightening primary belt, engaging engine drive sheave.

Slow Speed Position

With the variable speed control lever in the rearward or slow speed position, the variator sheave will be in a pre-set position, Fig. 6, which will provide for a large primary and a small secondary sheave circumference. This change in circumference will effectively reduce secondary belt speed, resulting in a slow rate of travel.

High Speed Position

When the variable speed control lever is moved to the forward or high speed position, the variator center sheave will shift due to increased primary belt tension, Fig. 7. The result of the center variator sheave shift will be a smaller circumference for the primary belt and a larger circumference for the secondary belt speed, resulting in a higher rate of travel for the tractor.

With this system, faster or slower travel speeds are available while the engine speed remains constant. All transmission gear positions can be used in conjunction with the variable speed control.

NOTE: The engine MUST be running to allow variator to change belt positions. The clutch over-ride assembly on tractors, Serial No. (250,001-272,000) allows the clutch-brake pedal to be depressed and locked with the engine shut "off".

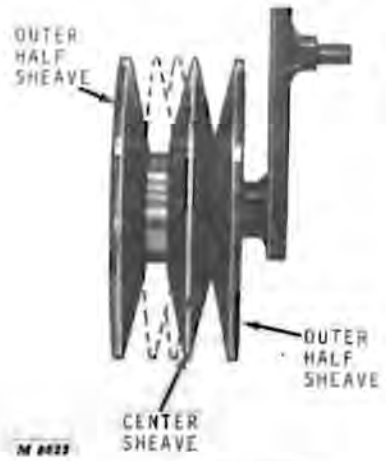

Fig. 4-Variator

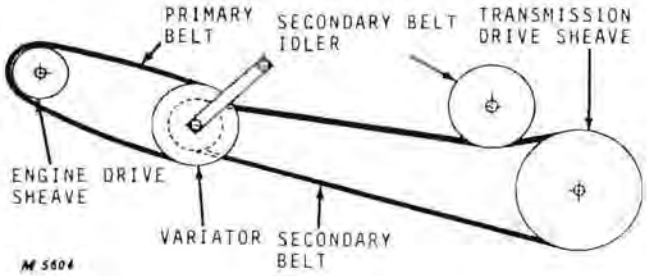

Fig. 5-Clutch Position

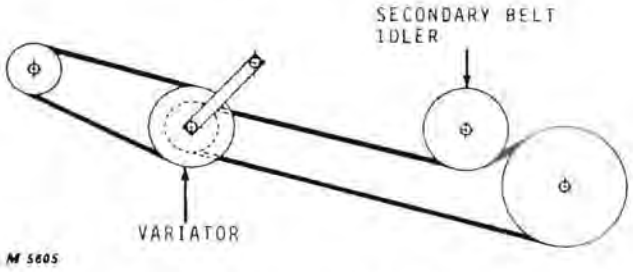

Fig. 6-Slow Speed Position

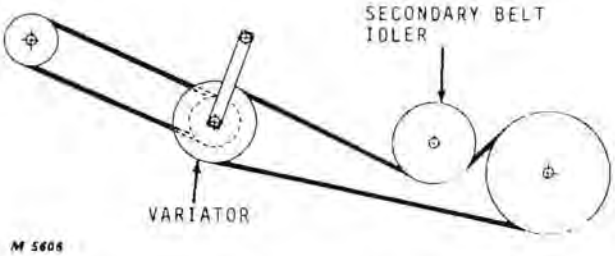

Fig. 7-High Speed Position

PRELIMINARY DIAGNOSIS OF MALFUNCTIONS

A diagnosis for the clutch, brake, and variable speed drive malfunctions appears on page 50-10-4. Below are some of the more common complaints to consider before referring to "Diagnosing Malfunctions."

Variable Speed Drive

Probably the most frequent complaint with the variable speed drive is that the tractor will not respond to movements of the variable speed control lever.

First, the engine must be running before the variator can shift belt positions to vary the speed.

Second, even when the variable drive is correctly adjusted, the variable speed control lever will not affect tractor speed when the lever is in forward notches 6 or 7 on the quadrant, Fig. 8.

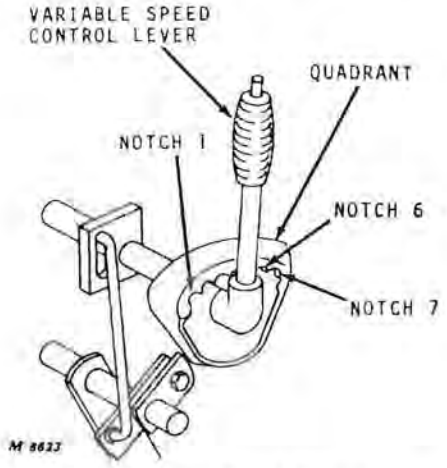

Fig. 8-Variable Speed Control Lever

Positions 6 and 7 are provided to allow for belt tolerances and normal linkage wear before adjustment becomes necessary.

However, when the tractor does not respond to movements of the variable speed control lever in other positions on the quadrant, the control linkage needs adjusting. Follow adjustment procedure, page 50-10-8, carefully.

Primary belt wear can throw the variable speed linkage out of adjustment. When this happens, there will be no forward travel when the variable speed control lever is in notch 1 on the quadrant (slow speed position). Adjust the linkage as described on page 50-10-18.

If the tractor is stopped (without depressing the clutch pedal or clutch-brake pedal) with the variable speed control lever in the forward position, the belts will jam in the variator if the variable speed control lever is moved back (slow speed position) before starting engine. This will lock the tractor in a declutched position. Move the control lever forward to correct this condition.

To prevent this situation, advise customers against moving the variable speed control lever unless the engine is running.

If variator is free-wheeling and the variator pivot is free, check for adequate tension on variator spring to be sure there is tension enough to return the variator when accelerating. If not, replace the spring.

Check and correct all items listed under "Diagnosing Malfunctions" when variator action and tractor acceleration are sluggish.

Brakes

A clutch over-ride is incorporated into the brake system of tractors below Serial No. 272,001 to assure positive braking action regardless of the position of the variable speed control lever.

If difficult or poor braking action occurs it is important that the brake be inspected for proper adjustment and the possibility of sticking from dirt accumulation.

DIAGNOSING MALFUNCTIONS

Belts

Belts Seem to Slip Under Load.

Weak secondary idler spring.

Variator linkage not properly adjusted.

Dirt in variator sheave grooves.

Variator arm binding at pivot (in pedestal).

Glazed or greasy belts.

Dirty or gummy variator sheave hub.

V-belts worn or lumpy.

Worn sheaves.

Broken variator spring.

Primary Belt Jumps Off Variator Sheave.

Primary belt guide improperly located.

Primary belt too long.

Oil or grease on belt.

Worn or nicked variator sheaves.

Dirt in variator groove.

Secondary Belt Jumps Off Variator Sheave.

Worn, bent, or nicked input sheave.

Worn or nicked variator sheaves.

Dirt in variator and/or input sheave.

Worn (center) variator sheave bearing.

Slack Primary Belt.

Variator linkage not properly adjusted.

Worn or nicked variator sheaves.

Primary belt too long.

Weak variator spring.

Slack Secondary Belt.

Weak secondary idler spring.

Secondary belt idler arm pivot binding.

Broken variator spring.

Excessive Primary Belt Wear.

Clutch over-ride not adjusted properly. (Tractors below Serial No. 272,001)

Dirty or greasy variator sheave hub.

Dirt in variator sheave grooves.

Excessive Secondary Belt Wear.

Weak secondary idler spring.

Worn, bent, or nicked input sheave.

Belt worn or lumpy.

Dirt in sheave grooves.

Secondary belt idler arm pivot binding.

Oil or grease on belt.

Variator

Noisy Variator.

Worn center variator sheave bearing.

Worn variator bearing.

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Clutch

Clutch Hard to Operate.

Engine not running.

Brake linkage not properly adjusted.

Clutch override on Tractors below Serial No. 272,001 not properly adjusted.

Variator arm binding in pivot (in pedestal).

Secondary belt idler arm pivot binding.

Clutch Pedal Strikes Top of Footrest.

Brake rod not properly adjusted (Tractors below Serial No. 272,001).

Clutch Pedal Creeps Down Under Load.

Load and torque sensing feature operating.
This is a characteristic of drive when encountering loads with variable speed control lever fully forward.

Weak variator spring.

Variator linkage not properly adjusted.

Clutch Will Not Disengage.

Clutch over-ride and/or brake rod not properly adjusted. (Tractors below Serial No. 272,001).

Short secondary belt.

Variator not properly adjusted.

Primary belt too short.

Clutch Pedal Jumps

Primary V-belt and/or secondary V-belt worn or lumpy.

Dirt in sheave grooves.

Loose input sheave on transaxle hub.

Worn variator bearings.

Worn, bent or nicked sheaves.

Brake

No Brakes.

Brake linkage not properly adjusted.

Variator not properly adjusted. (Tractors below Serial No. 272,001).

Dirt in sheave grooves. (Tractors below Serial No. 272,001).

Brakes Not Effective.

Worn lining.

Oil on lining.

Broken band.

Miscellaneous

Tractor Does Not Move (Engine Running).

Variator binding belts.
Move variable speed control lever forward.

Parking brake set.

Variator not properly adjusted.

Primary belt too long.

Variator arm binding in pivot (in pedestal).

Excessive Tractor Vibration.

Primary V-belt and/or secondary V-belt worn or lumpy.

Loose input sheave cap screws (transaxle).

Bent or damaged input sheave (transaxle).

Dirt in sheave grooves.

Tractor Will Not Move With Variable Speed Control Lever Pulled Back

Variator not properly adjusted.

Primary belt too long.

Dirty or greasy variator sheave hub.

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DIAGNOSING MALFUNCTIONS—Continued

Tractor Will Not Accelerate When Variable Speed Control Lever is Moved Forward.

Variator center sheave too tight on variator hub.

Dirty or gummy variator sheave hub.

Variator arm binding in pivot (in pedestal).

Variator not properly adjusted.

Short secondary belt.

Weak variator spring.

Primary belt too short.

Tractor Will Not Attain Specified Travel Speed.

Variator not properly adjusted.

Clutch shaft tight in support brackets.

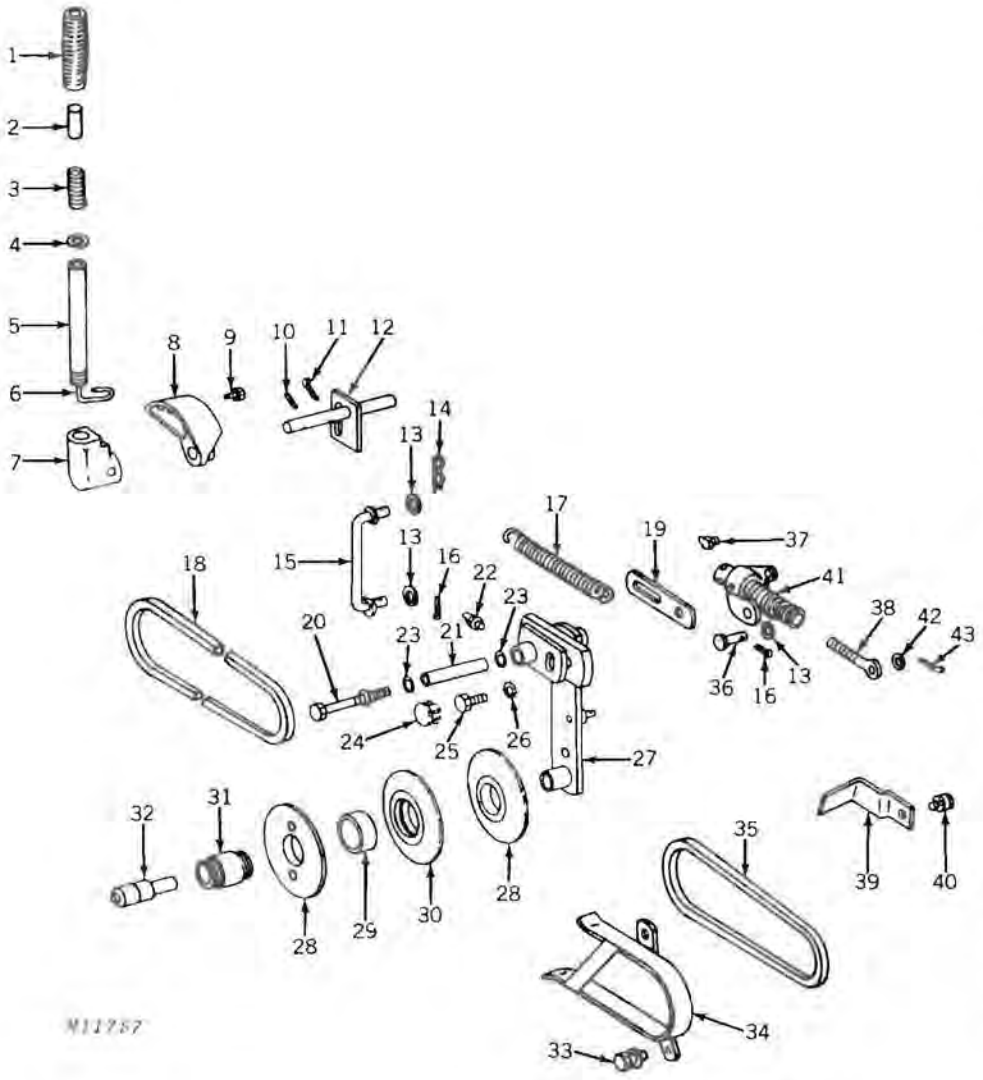
Dirty or gummy variator sheave hub.

Weak variator spring.

Primary belt too short.

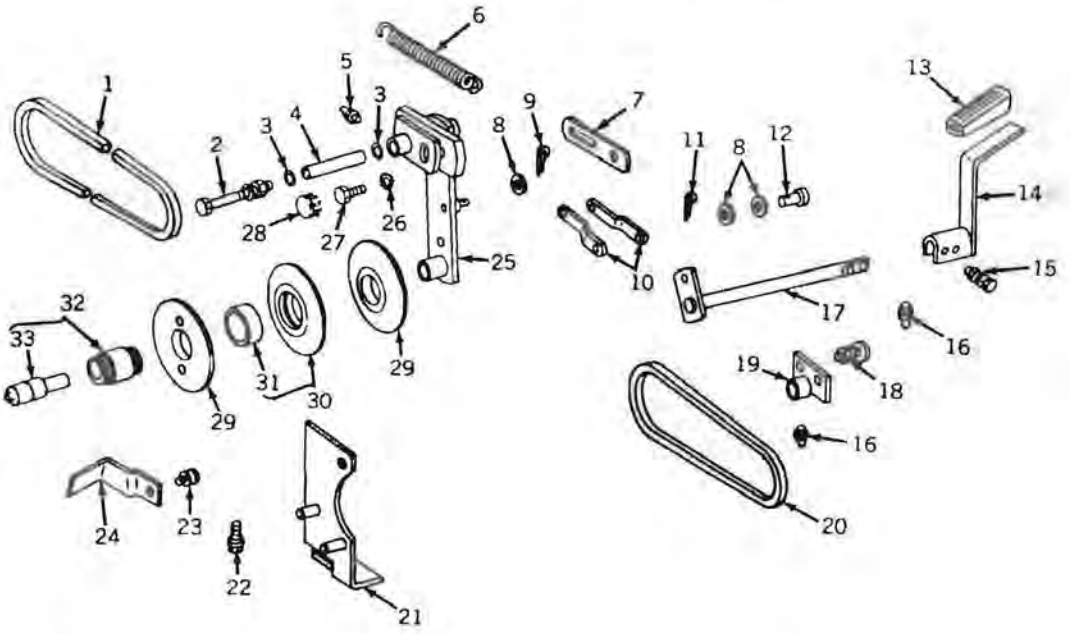
Variator arm binding in pivot (in pedestal).

Weak secondary idler spring.



1—Handle Grip
2—Thumb Release
3—Spring
4—Washer
5—Speed Control Lever
6—Speed Control Rod
7—Lever Hub
8—Lever Quadrant
9—Screw
10—Spring Pin
11—Cotter Pin
12—Speed Control Shaft
13—Washer
14—Spring Locking Pin
15—Speed Control Shaft Link
16—Cotter Pin
17—Variator and Clutch Spring
18—Secondary Belt
19—Spring Link
20—Cap Screw w/Lock Washer
21—Pivot Ferrule
22—Grease Fitting
23—O-Ring
24—Button Plug
25—Cap Screw
26—Lock Washer
27—Variator Arm
28—Outer Variator Half Sheave
29—Center Sheave Bearing
30—Center Sheave
31—Hub
32—Bearing and Shaft Assembly
33—Cap Screw w/Lock Washer
34—Belt Guide
35—Primary Belt
36—Drilled Pin
37—Grease Fitting
38—Clutch Over-Ride Link
39—Belt Guide
40—Cap Screw w/Lock Washer
41—Clutch Over-Ride
42—Washer
43—Cotter Pin

Fig. 9-Variator Assembly - Tractors, Serial No. (250,001-272,000)



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1—Secondary Belt
2—Cap Screw with Lock Washer and Nut
3—O-Ring
4—Pivot Ferrule
5—Grease Fitting
6—Variator Spring
7—Spring Link
8—Washer
9—Cotter Pin
10—Clutch Link
11—Cotter Pin
12—Drilled Pin
13—Pedal Pad
14—Clutch Pedal
15—Cap Screw with Lock Washer and Nut
16—Grease Fitting
17—Clutch Shaft
18—Carriage Bolt with Lock Washer and Nut
19—Clutch Shaft Bearing
20—Primary Belt
21—Belt Guide
22—Cap Screw with Lock Washer
23—Cap Screw with Lock Washer
24—Belt Guide
25—Variator Arm
26—Lock Washer
27—Cap Screw
28—Button Plug
29—Outer Half Variator Sheave
30—Center Variator Sheave with Bearing
31—Center Sheave Bearing
32—Variator Bearing and Hub Assembly
33—Bearing and Shaft Assembly

Fig. 10-Variator Assembly - Tractors, Serial No. (272,001-)

Replacing Primary V-Belt

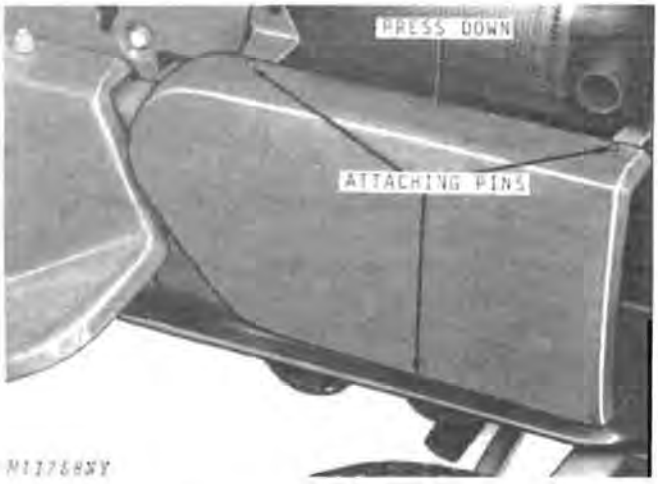

Fig. 11-Removing PTO Shield

Remove PTO shield by pushing down, Fig. 11, and unhook bottom of shield from lower attaching pin. Then lift outward and upward on bottom of shield to unhook top of shield from two attaching pins.

8 hp Tractors (Serial No. 250,001 - 272,000) and 10 hp Tractors (Serial No. 250,001 - 285,000)

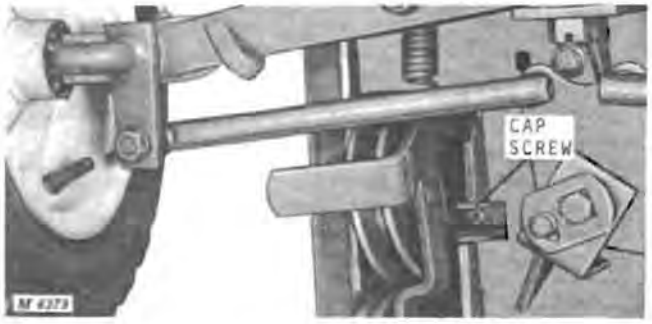

Fig. 12-PTO Brake Retaining Screw

Remove PTO brake cap screw, Fig. 12.

Lift and pivot clip to release clutch arm, Fig. 13. Lower clutch arm and remove PTO drive sheave. Be careful not to get dirt or foreign material into sheave bearings.

NOTE: Secondary belt and hydraulic pump drive belt 10 hp tractors, Serial No. 260,001 - 272,000) must be removed to replace primary belt.

Depress clutch-brake pedal and lock parking brake. Remove belt guides and shield mounting bracket. Loosen 5/16-inch cap screw on variator

Fig. 13-PTO Clutch Arm

belt guide and slip guide up far enough to remove belt from variator sheave and engine sheave.

Replace belt and reassemble parts removed.

IMPORTANT: After replacing primary belt, readjust variator. Refer to "Adjustment," page 50-10-18.

8 hp Tractors (Serial No. 272,001 - 285,000 and 310,001 - 320,000)
10 hp Tractors (Serial No. 285,001 - 310,000)

Fig. 14-PTO Clutch Arm and Pivot Pin

Remove spring locking pin, Fig. 14, from pivot pin and remove pivot pin from clutch arm pivot. Remove clutch arm and proceed as outlined previously.

10 hp Tractors (Serial No. 320,001 -)

Fig. 15-PTO Clutch Arm

Lift and pivot clip to release clutch arm, Fig. 15, and proceed as outlined previously.

Replacing Secondary V-Belt

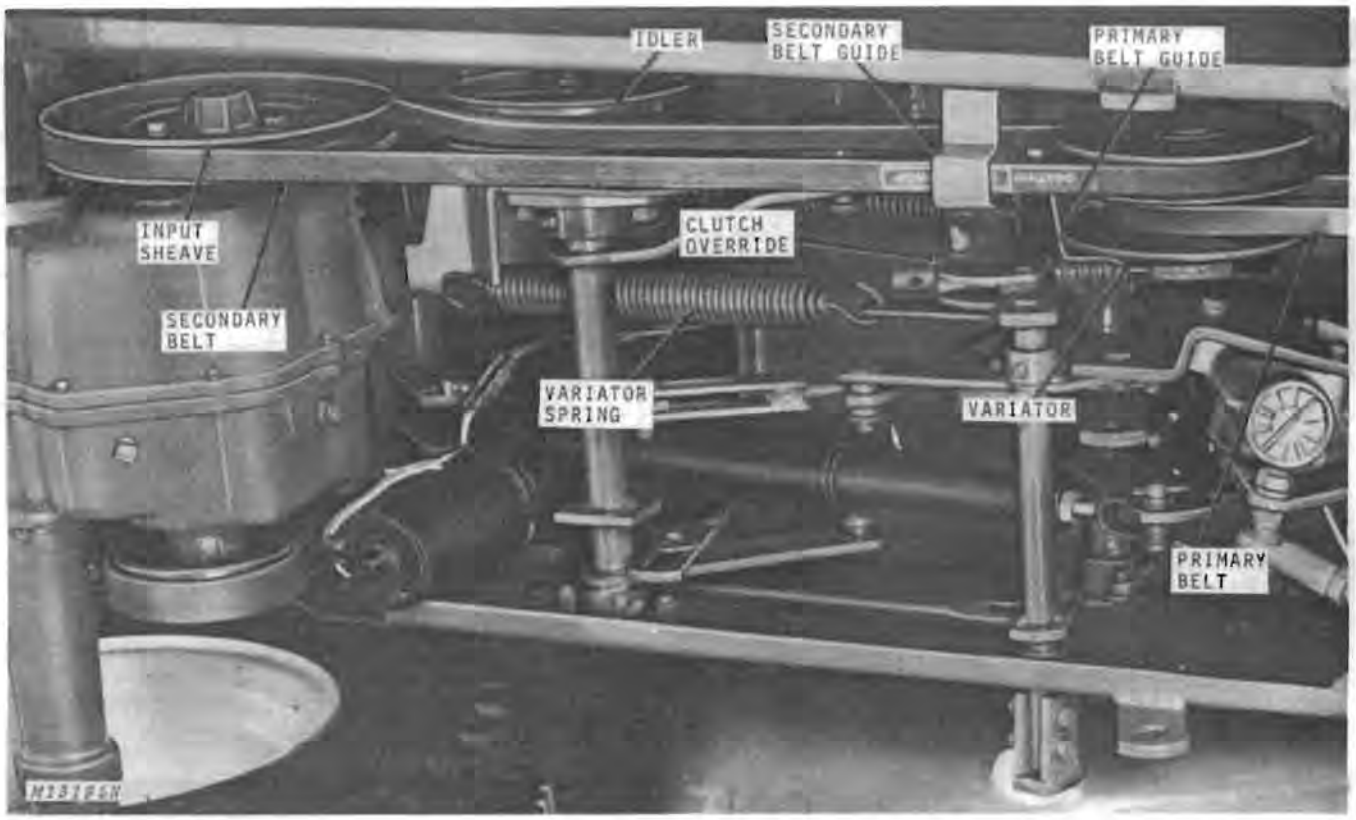

Fig. 16-Secondary Belt

To replace worn or broken secondary belt, move variable speed control lever forward (fast speed position). Turn engine over momentarily (do not start engine) to allow variator to move to fast speed position. Then raise secondary idler and slip secondary belt off variator. Remove three screws from input sheave, Fig. 16, and slide sheave off hub far enough to remove belt.

Install new belt around variator sheave. Block up secondary idler to release belt tension and install belt and input sheave.

After belt replacement, check variator and brake adjustments.

Inspecting V-Belts

The V-belts in the tractor transmit power by friction and a wedging action against the sheaves. All belts and sheaves wear with use. Normal wear can be recognized as even wear, both on the belt and sides of sheave.

A slight raveling of the belt does not indicate premature belt failure. Cut off the raveling when the covering begins to peel.

When evidence of extreme or abnormal belt wear is noted, check first for faulty sheaves. A bent, nicked, or chipped sheave will cause rapid belt wear. Replace sheaves found in this condition.

Belt wear, tractor vibration, and erratic operation will result when dirt becomes packed and lodged in V-grooves of the sheaves. Check especially the variator sheave. Loosen and clean dirt from all sheaves.

See page 50-10-4 of "Diagnosing Malfunctions" for other possible causes of belt wear.

Cleaning V-Belts

Clean belts by wiping them with a clean cloth. Avoid use of solvents since this will soften the materials and cause the clutch to grab. Replace belts found to be oily or greasy.

Do not use belt dressings. Dressings often give only temporary gripping action while softening the belt and causing eventual deterioration, and shortening of the belt life. Dressings also will cause a "grabby" clutch.

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Servicing Variator

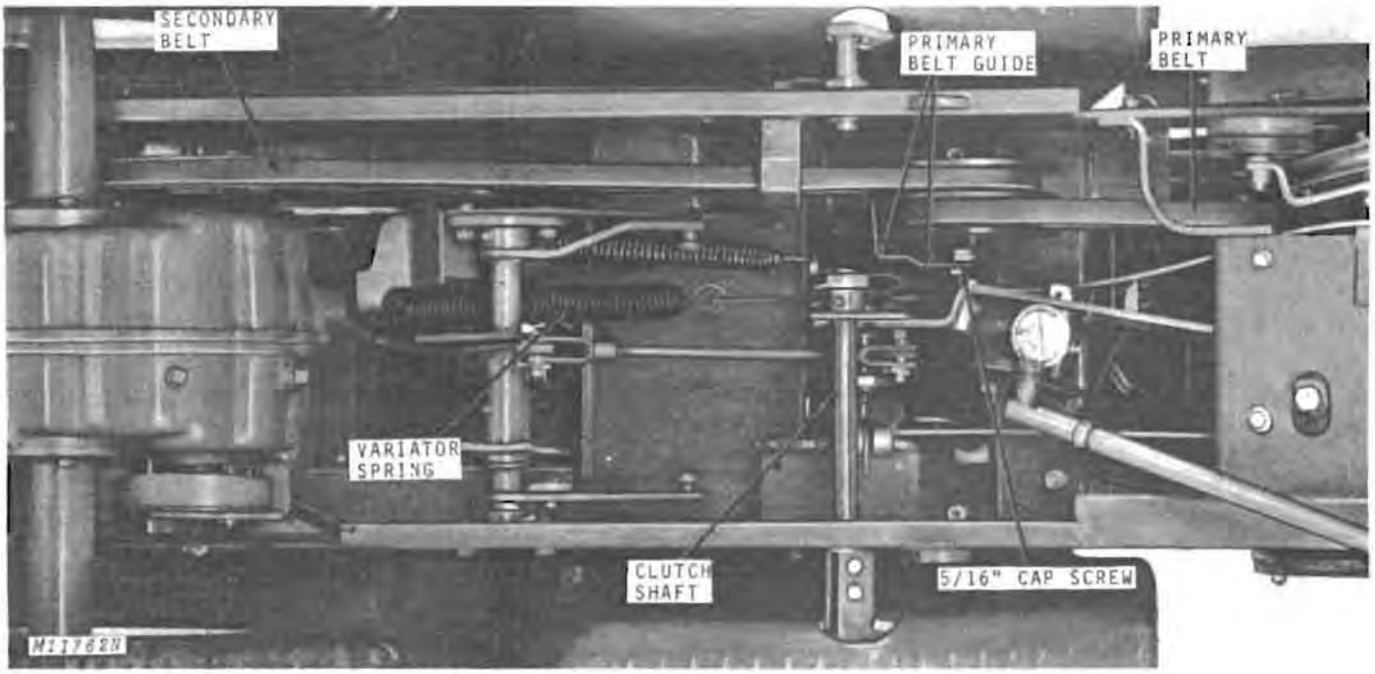

Fig. 17-Removing Variator from Tractor

Removing Variator

Remove secondary belt from secondary sheave. Pivot variator forward by depressing clutch pedal or clutch-brake pedal. Loosen 5/16" cap screw securing primary belt guide to variator arm and pivot guide away to allow room for primary belt to be removed. Remove primary belt from variator sheave.

Disconnect variator spring. Disconnect clutch override (Tractors below Serial No. 272,001) from variator and clutch shaft arm, Fig. 16. Remove clutch override.

Remove battery and battery base to provide access. (Tractors below Serial No. 272,001) Disconnect speed control shaft link (Key 15, Fig. 9) from speed control shaft (Key 12, Fig. 9).

Remove variator pivot cap screw (Key 20, Fig 9 or Key 2, Fig. 10).

Guide variator assembly out through bottom of tractor. Pivot end of variator must pass through notch in tractor frame, Fig. 18.

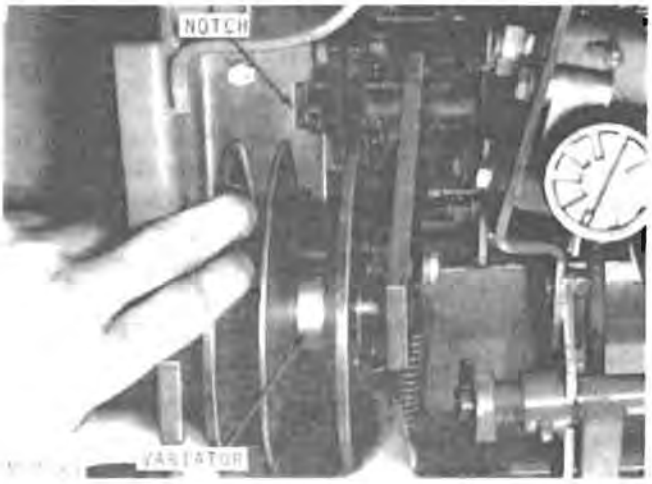

Fig. 18-Removing Variator

Disassembling Variator Sheave

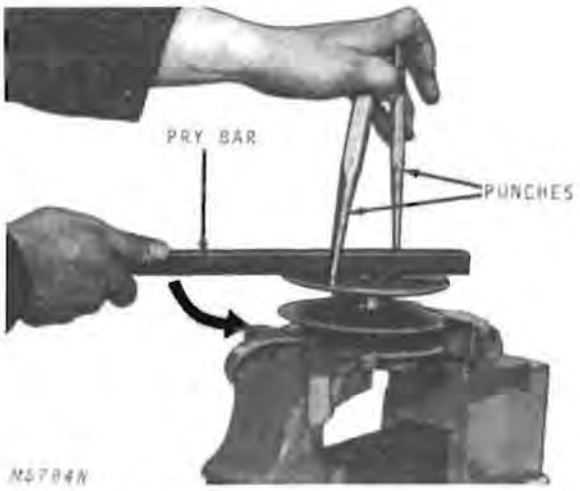

Fig. 19-Disassembling Variator Sheave

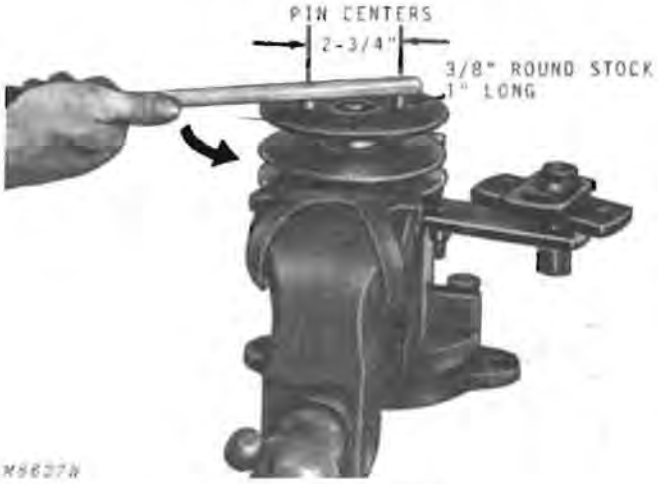

Fig. 20-Disassembling Variator Sheave (with special tool)

Place variator half sheave (next to bearing support) in a vise with soft jaws as shown in Fig. 19. Insert ends of two large punches in holes of sheave and a bar between punches. Then turn counterclockwise to remove sheave. Lift center sheave from variator hub.

Using the same procedure as described above, a special tool can be used as shown in Fig. 20. This tool is not available from a supplier, but can be made by drilling a bar of steel and inserting 3/8-inch round stock as shown. Weld round stock into place after tool has been tried and checked.

Removing Variator Bearing and Arm

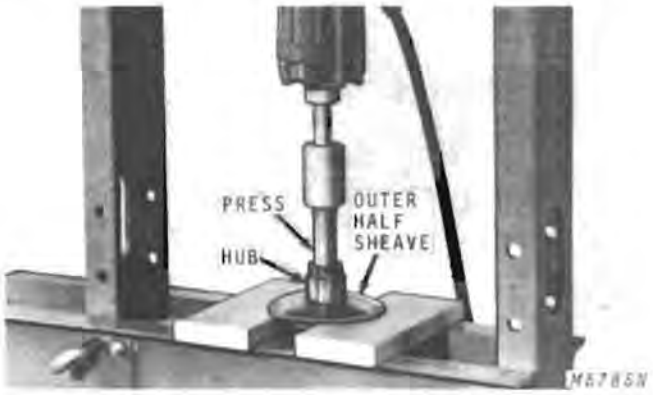

Fig. 21-Pressing Variator Bearing From Hub

Place variator bearing and hub assembly under press, Fig. 21, and press bearing from hub. Be sure to press against outer race only.

Place hub in a vise and remove half sheave as described in Fig. 19 or Fig. 20. Press bearing out of variator arm.

Inspecting Variator

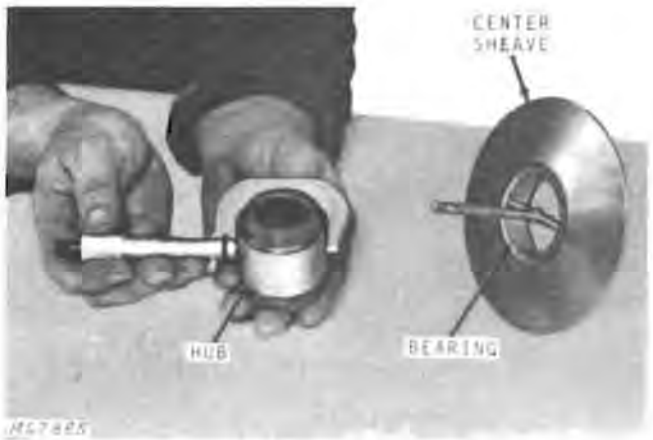

Fig. 22-Checking Center Sheave Bearing and Hub

Measure I.D. of center sheave bearing and O.D. of variator hub, Fig. 22, after cleaning parts thoroughly. Refer to Fig. 25 for wear tolerances. Replace center sheave or hub if wear limits are exceeded. Do not attempt to service center sheave bearing. Bearing and center sheave are available only as factory assembly.

Check center sheave and sheave halves for wear on the sheave faces or for evidence of damage or nicks. Replace parts which may cause excessive belt wear or which would upset the delicate balance of the variator assembly.

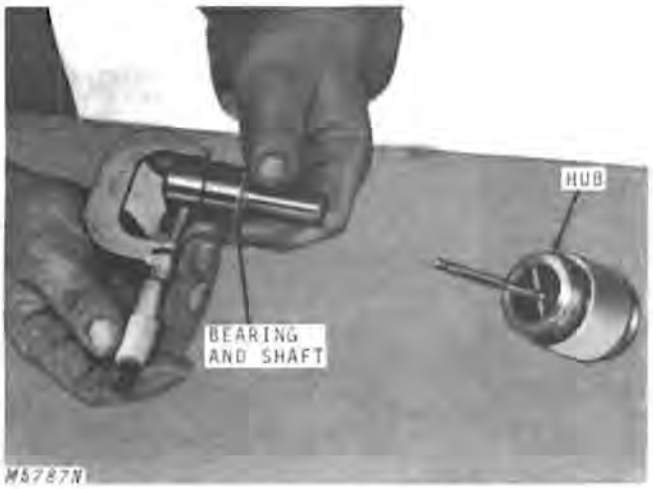

Fig. 23-Checking Variator Bearing and Hub

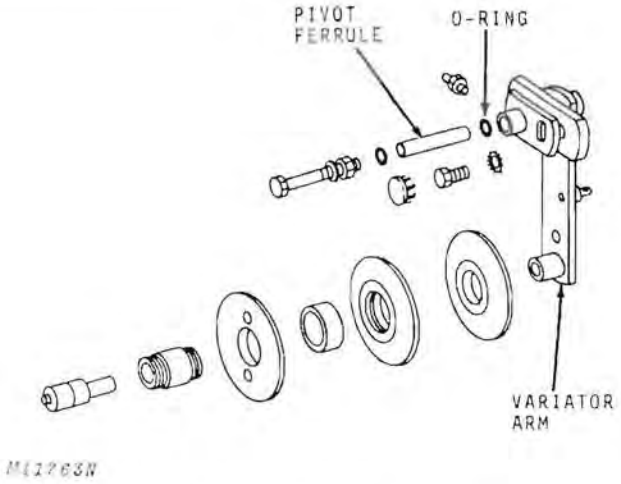

Fig. 24-Inspecting Variator Pivot

Measure press fit between bearing and hub, Fig. 23. See Fig. 25 for wear limits. Check bearing condition, and also check press fit of bearing shaft in variator arm. Replace parts necessary to obtain proper fit.

IMPORTANT: The center sheave bearing is lubricated with a special grease at the factory and will last for the lifetime of the sheave. Do not attempt to lubricate.

Inspect the pivot ferrule and O-rings for wear or damage, Fig. 24. Variator arm must be free to pivot on ferrule. Replace parts as necessary.

Grease ferrule and O-rings and reassemble.

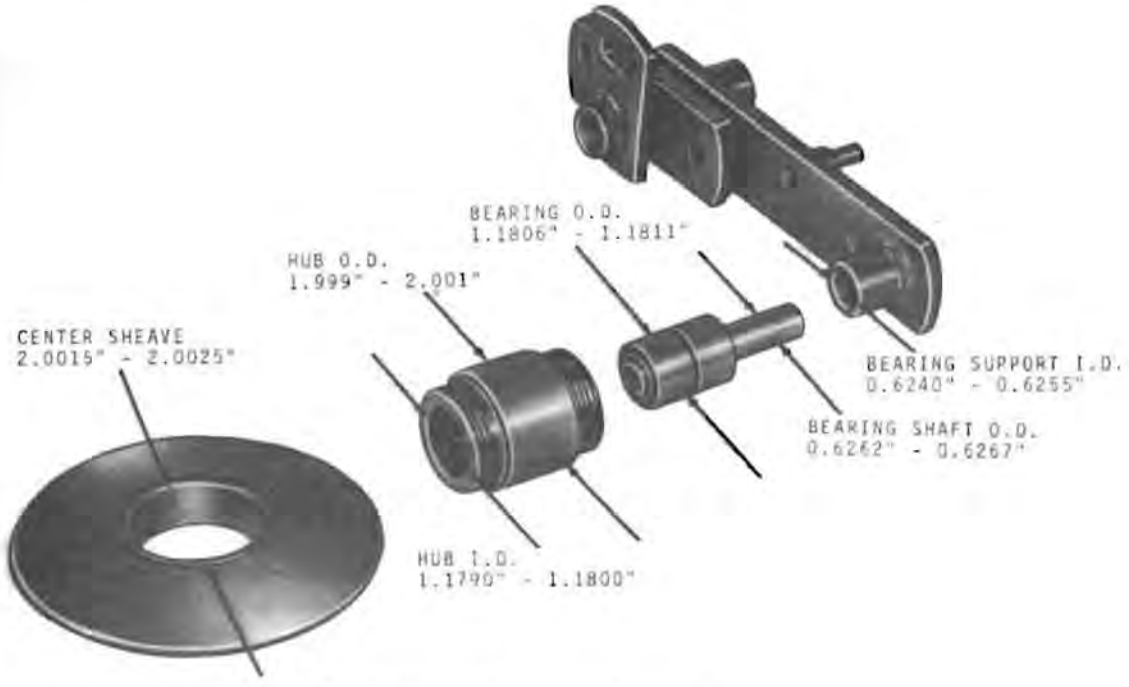

Fig. 25-Variator Component Dimensions

Assembling Variator

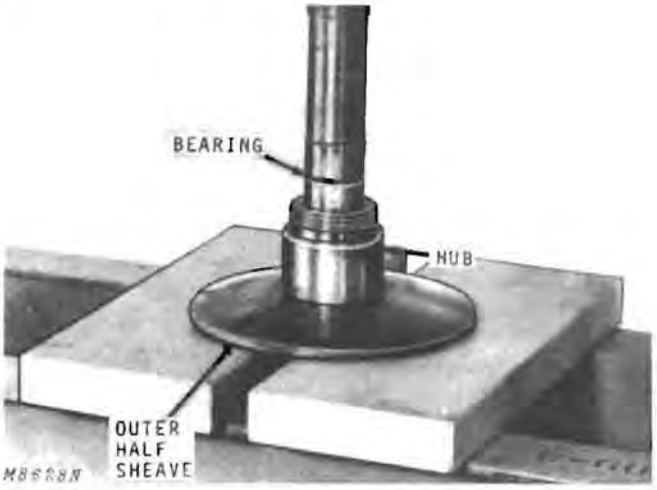

Fig. 26-Pressing Bearing in Hub

Thread outer sheave half onto hub.

Coat bearing case with a light film of oil. Place hub with sheave on press bed, Fig. 26. Pressing on outer race only, press bearing into hub until bearing end is 0.12-inch below hub face, Fig. 27.

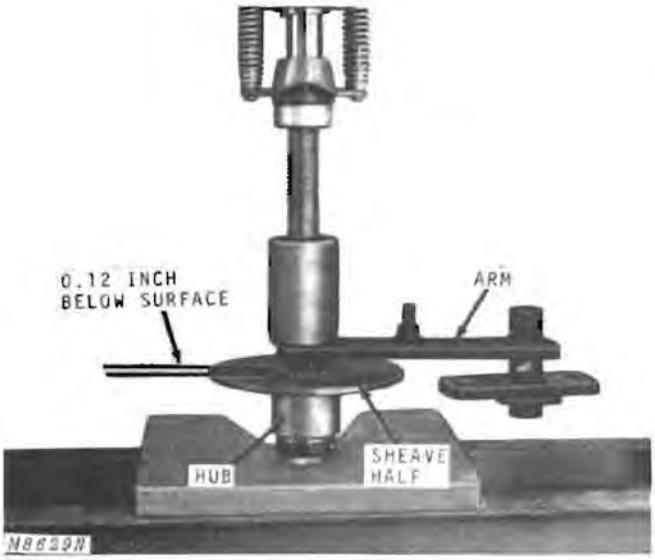

Fig. 27-Pressing Variator Arm on Bearing Shaft

Wipe a light film of oil on bearing shaft. Place variator arm on bearing shaft with weld down, Fig. 27. Press variator arm on bearing shaft until end of bearing shaft is flush with outside of variator arm.

Clamp assembly in a vise having soft jaws as shown in Fig. 19. Place center sheave assembly on hub and thread half sheave on hub. Using two large punches and a bar, or special tool, tighten sheaves firmly by turning sheave in opposite direction as shown in Fig. 19.

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Fig. 28-Staking Variator Hub

Spike threads three or four places on both sides of variator as shown in Fig. 28.

Installing Variator

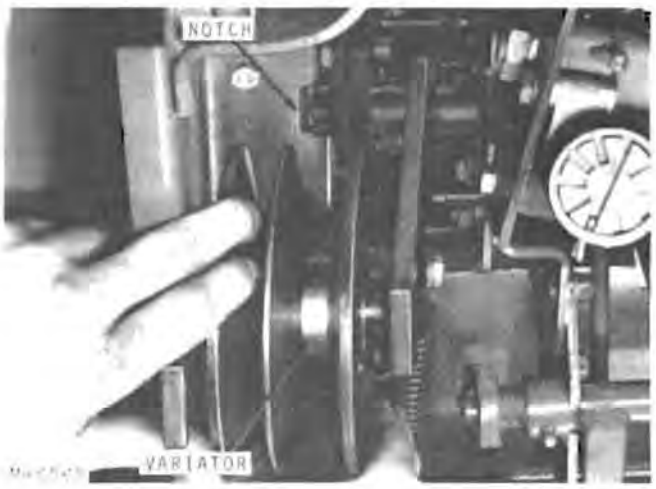


Fig. 29-Installing Variator

Install variator assembly from underneath tractor, guiding pivot end through notch in tractor frame, Fig. 29. Be certain O-rings do not slip out of position. Install pivot cap screw "A", Fig. 30, and tighten securely. Connect speed control link, Fig. 30.

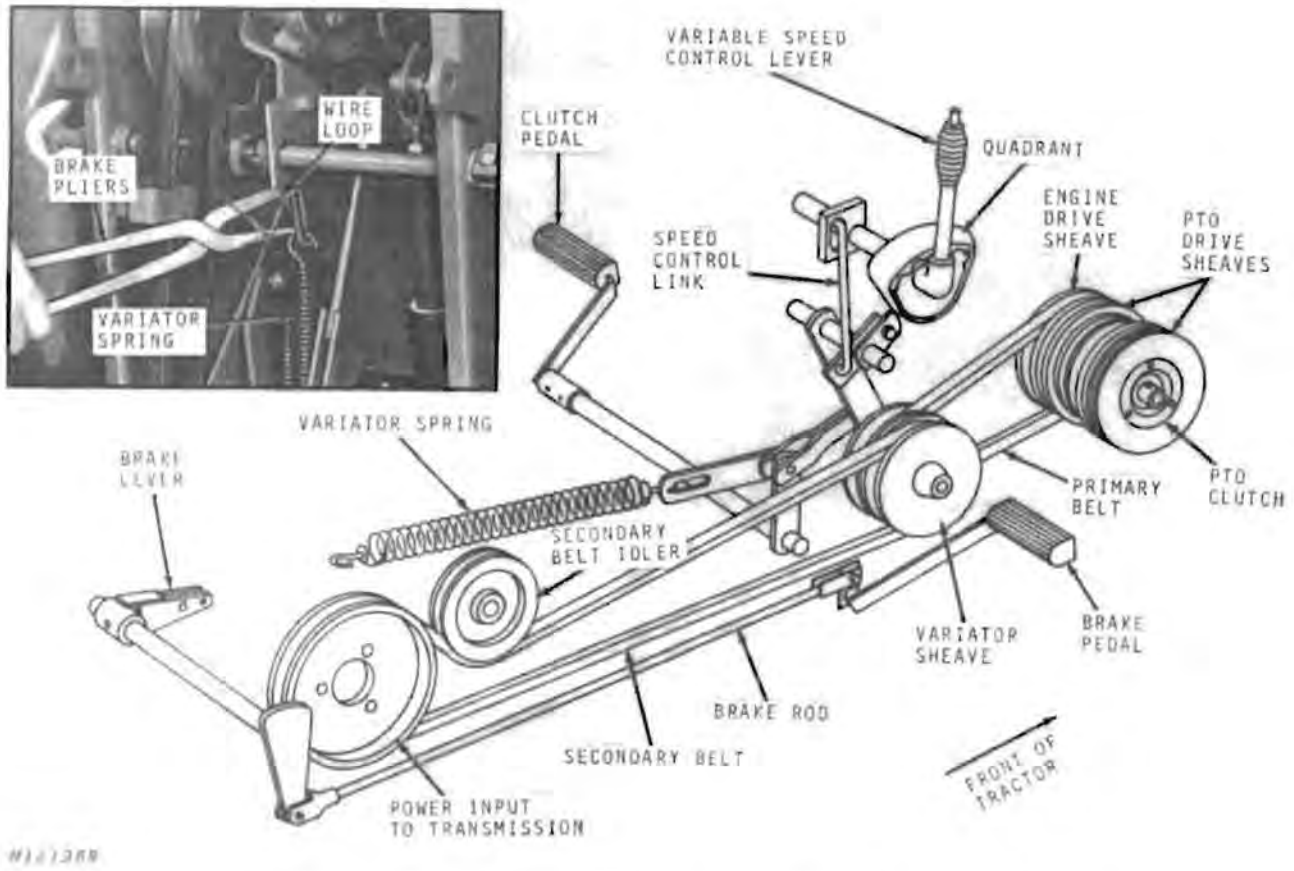


Fig. 30-Installing Variator Assembly - Tractors (Serial No. 272,001-) Illustrated

Connecting Variator Spring

Connect variator spring to spring link with an automotive brake spring pliers and wire loop or "S" hook as shown in insert of Fig. 30.

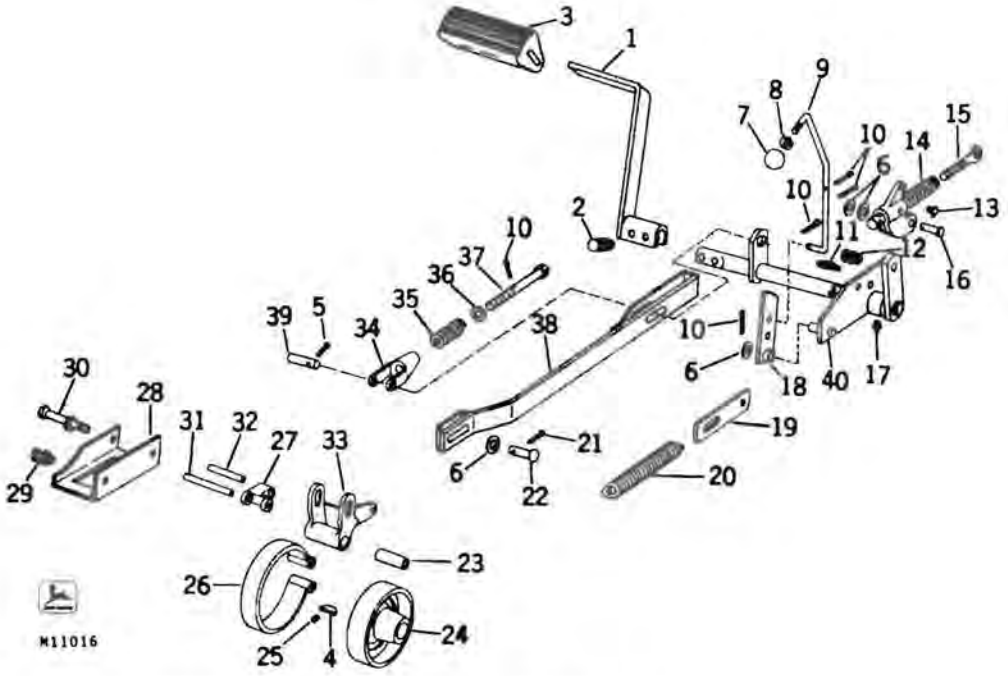
Install primary belt. To ease primary belt installation, move variator lever rearward and depress and lock parking brake. This will hold variator sheave in a forward position.

Next, install secondary belt. To facilitate this belt installation, release parking brake and move the variator lever to the forward position before placing belt over sheave. In most cases, it will be helpful to move secondary belt idler upward to gain the additional belt length required for installation.

Position primary belt guide approximately 1/16-inch from sheave and tighten retaining cap screw firmly.

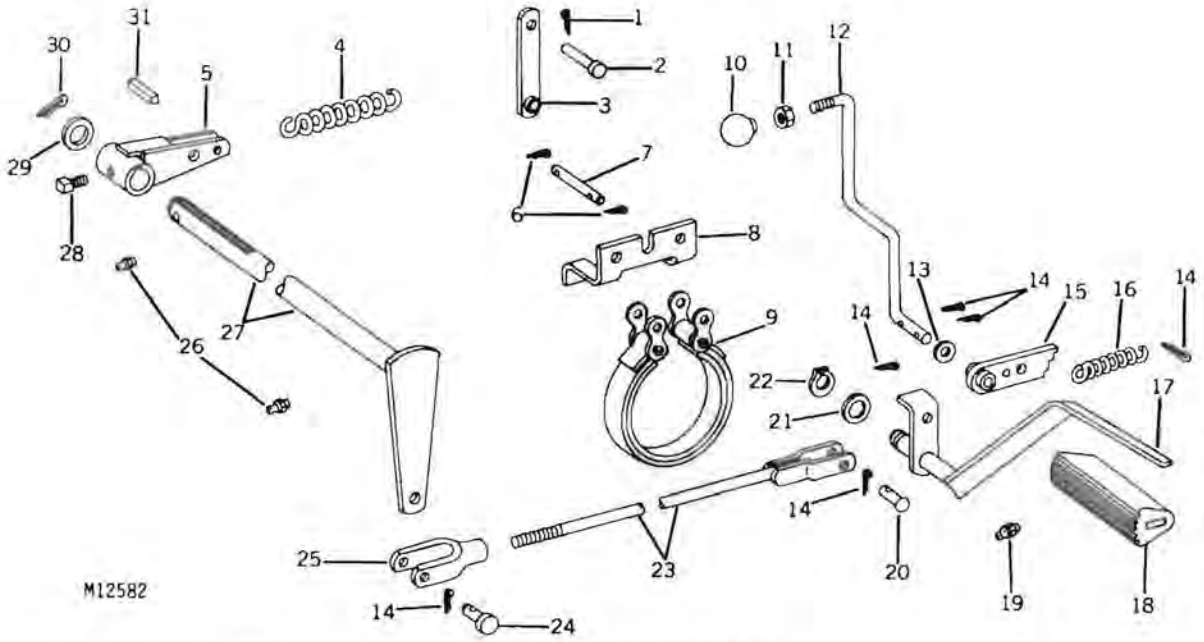
After installation is completed, make final adjustments to variator following the procedure listed on page 50-10-18.

Brakes



1—Clutch-Brake Pedal
2—Cap Screw
3—Pedal Pad
4—Woodruff Key
5—Cotter Pin
6—Washer
7—Parking Brake Knob
8—Nut
9—Parking Brake Rod
10—Cotter Pin
11—Parking Brake Spring
12—Bolt
13—Grease Fitting
14—Clutch Override Assembly
15—Clutch Override Link
16—Drilled Pin
17—Grease Fitting
18—Parking Brake Stop Arm
19—Spring Link
20—Clutch and Brake Spring
21—Cotter Pin
22—Drilled Pin
23—Brake Arm Pivot
24—Brake Pulley
25—Set Screw
26—Brake Band
27—Brake Arm
28—Brake Lever Bracket
29—Cap Screw
30—Cap Screw
31—Spring Pin
32—Brake Pin
33—Brake Lever
34—Brake Yoke
35—Spring
36—Washer
37—Brake-Adjusting Bolt
38—Brake Rod
39—Pivot Pin
40—Clutch and Brake Shaft

Fig. 31-Exploded View of Clutch-Brake Components Tractors (Serial No. 250,001-272,000)



1—Cotter Pin
2—Drilled Pin
3—Brake Link
4—Return Spring
5—Brake Arm
6—Cotter Pin
7—Drilled Pin
8—Bracket
9—Brake Band
10—Parking Brake Knob
11—Nut
12—Parking Brake Lever
13—Washer
14—Cotter Pin
15—Parking Brake Ratchet
16—Parking Brake Spring
17—Brake Pedal
18—Pedal Pad
19—Grease Fitting
20—Drilled Pin
21—Washer
22—Snap Ring
23—Brake Rod
24—Drilled Pin
25—Brake Rod Yoke
26—Grease Fitting
27—Brake Shaft
28—Screw
29—Washer
30—Cotter Pin
31—Key

Fig. 32-Exploded View of Brake Components Tractors (Serial No. 272,001-)

Replacing Brake Band

A brake band with bonded linging is used on all 110 Tractors. Whenever brake band servicing is required, due to worn or damaged lining, the following procedure should be used.

Fig. 33-Removing Brake Assembly (Deck removed for clarity)

Remove spring locking pin and drilled pin from brake arm, Fig. 33.

On tractors (Serial No. 272,001-), remove cotter pin (14) and drilled pin (24) from brake arm, Fig. 32, page 50-10-16.

There are two access holes on the left frame through which a socket and extension can be inserted for removal of the brake band retaining cap screws. Remove these two cap screws and slip band off bottom of the brake pulley. Lift band assembly upward and to the right to remove.

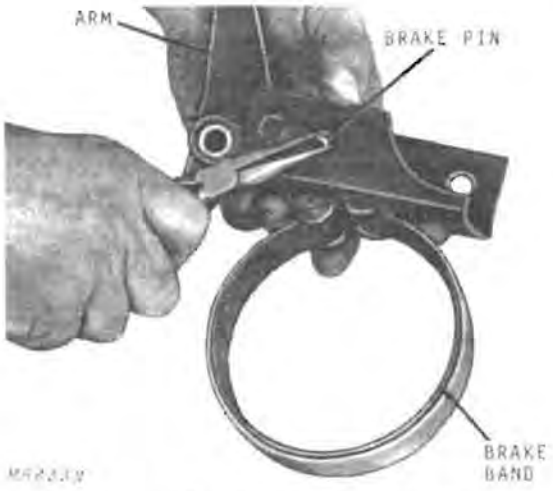


Fig. 34-Removing Brake Pin

Remove brake pin, Fig. 34, and separate brake band assembly from bracket.

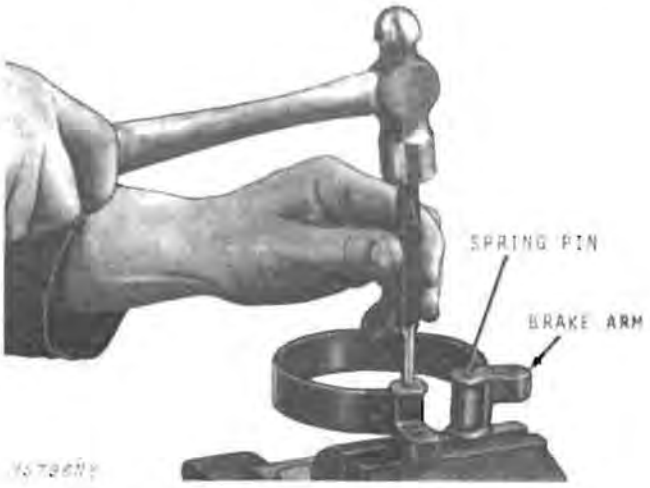


Fig. 35-Removing Spring Pins From Arms and Band

Drive spring pins from arm band as shown on Fig. 35. Tractors (Serial No. 272,001-) do not require removal of pins or brake arms.

Lubricate lever pivot before reassembly.

Reverse disassembly procedure to assure correct installation.

After installing brake band assembly on tractor, refer to "Adjustment" page 50-10-18 and adjust brake linkage accordingly.

Replacing Brake Pulley

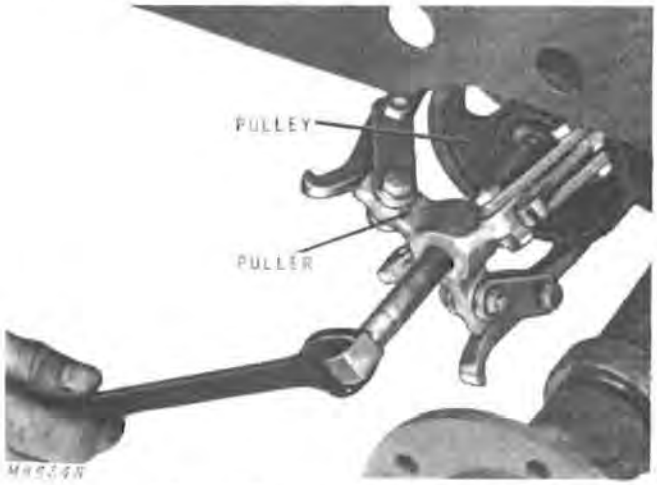


Fig. 36-Removing Brake Pulley

Loosen pulley retaining set screw and remove brake pulley using a puller similar to the one shown in Figure 36.

When replacing pulley, tap pulley onto shaft with a soft mallet and install set screw. Use Loctite to secure set screw.

ADJUSTMENTS

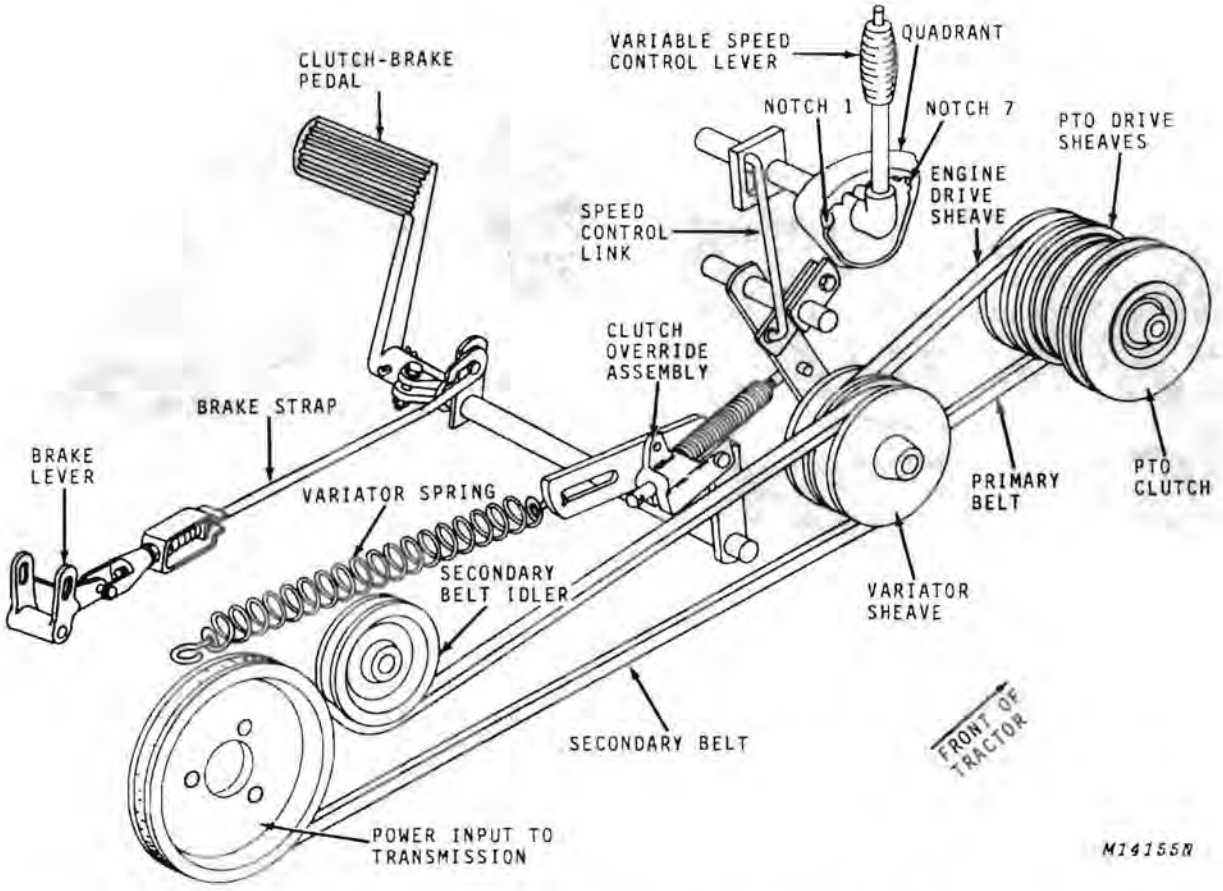


Fig. 37-Schematic of Clutch, Brake, and Variator (Serial No. 250,001-272,000)

Linkage Adjustment Tractors (Serial No. 250,001-272,000)

Brake clutch, and variator adjustments should not be made individually because each adjustment affects the other. Always adjust the entire linkage as explained on these pages when adjustment is required.

When tractor linkage is properly adjusted, the variable speed control lever will increase tractor speed when moved forward from quadrant notch 1 through notch 5.

Linkage adjustment is necessary when either of the following occurs:

A. Tractor is inoperative when variable speed lever is in notch 1 on the quadrant (slow speed position).

B. Clutch-Brake pedal strikes foot-rest when pedal is fully depressed.

Adjust tractor linkage as shown on page 50-10-19 and 50-10-20.

Variator Linkage Adjustment Tractors (Serial No. 250,001-)

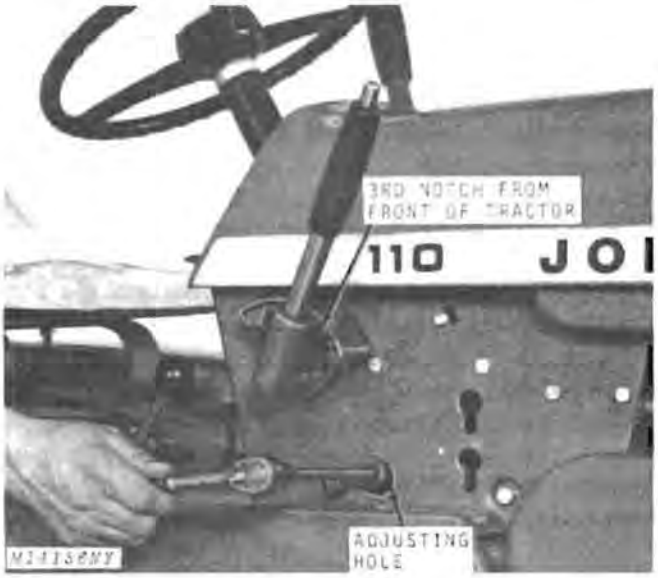


Fig. 38-Adjusting Variator

Place variable speed lever in notch 5 on the quadrant, which is the third notch from the front of the tractor, Fig. 38.

Pry plug button from adjusting hole in tractor pedestal and loosen cap screw (one or two turns) with a 3/4-inch socket wrench.

Disconnect spark plug cable and turn engine several revolutions with key starter until the clutch or clutch brake pedal raises as high as it will go.

Center cap screw in adjusting hole. Tighten cap screw firmly and replace plug button in adjusting hole.

NOTE: If, after adjusting variator linkage, tractor still will not move when variable speed control lever is in first notch on the quadrant (slow speed position) and the clutch pedal or clutch-brake pedal is released, a new primary belt must be installed.

Clutch-Brake Pedal Adjustment Tractors (Serial No. 250,001-272,000)

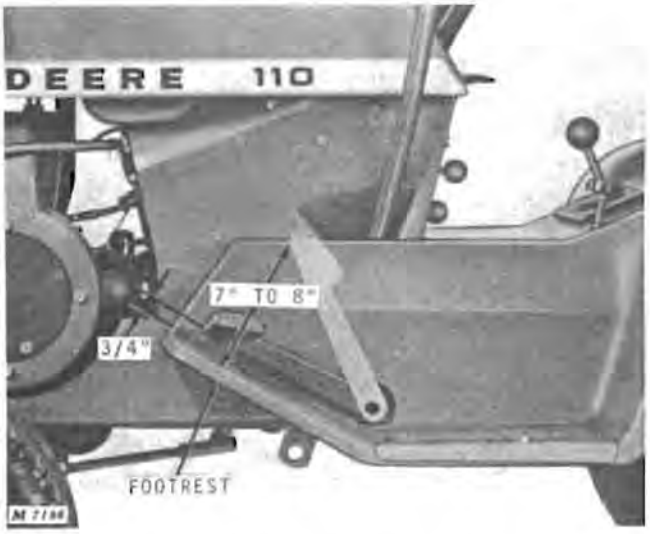


Fig. 39-Clutch-Brake Pedal Heights

The clutch-brake pedal is properly adjusted when the lowest point on the pedal is not less than 3/4 inch from the top of the footrest when fully depressed, Fig. 39. If less than 3/4 inch above the footrest when fully depressed, adjust the brake as follows:

Fig. 40-Adjusting Brake Linkage Tractor (Serial No. 250,001-272,000)

Remove spring locking pin and drilled pin from clevis, Fig. 40.

Turn clevis onto brake rod until a 3/4 inch dimension can be obtained as shown in Fig. 39. Replace drilled pin and insert spring locking pin.

There is no separate clutch adjustment on tractors beginning with Serial No. 272,001 and above, because clutch-variator functions have been separated from the braking process.

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Brake Pedal Adjustment Tractors (Serial No. 272,001-)

Fig. 41-Brake Pedal Adjustment

When brake pedal pushes down to fender deck or no longer gives braking pressure it is necessary to adjust brake. Lack of parking brake pressure also indicates need for adjustment.

Remove pin and turn clevis, Fig. 41, on brake rod as far as necessary to put brake in first notch of park lock.

Adjusting Clutch Override Tractors (Serial No. 250,001-272,000)

Fig. 42-Adjusting Clutch Override Screw (Tractors, Serial No. 250,001-272,000)

The clutch-brake pedal height should not exceed 7 to 8 inches from the foot-rest when clutch is released. Place the variable speed control lever in notch 7 (fast drive position) when this measurement is taken.

If the clutch-brake pedal rises higher than 7 to 8 inches when released it will be necessary to adjust the clutch override.

To adjust the clutch override insert a punch or narrow screwdriver into the hole in the adjusting screw, Figure 42. Turn screw counterclockwise until the 7 to 8-inch dimension is obtained.

Belt Guide Adjustment Tractors (Serial No. 250,001-)

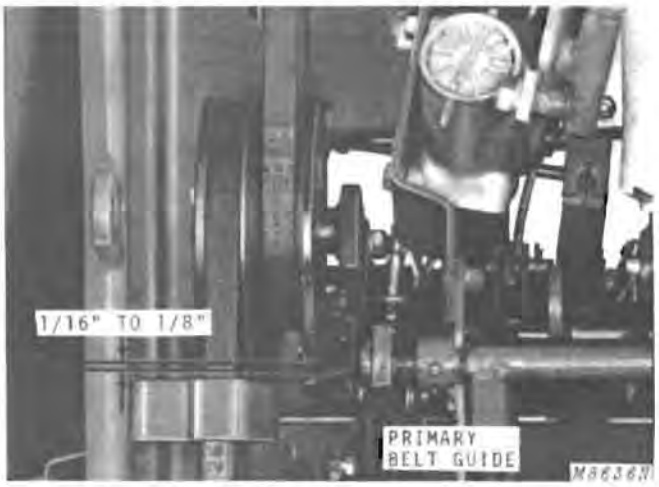

Fig. 43-Adjusting Primary Belt Guide

If the primary belt jumps the variator sheave when the clutch pedal or clutch-brake pedal is depressed, the distance between the variator and primary belt guide should be checked. Distance between guide and sheave should not exceed 1/8-inch as shown in Figure 43.

SPECIFICATIONS

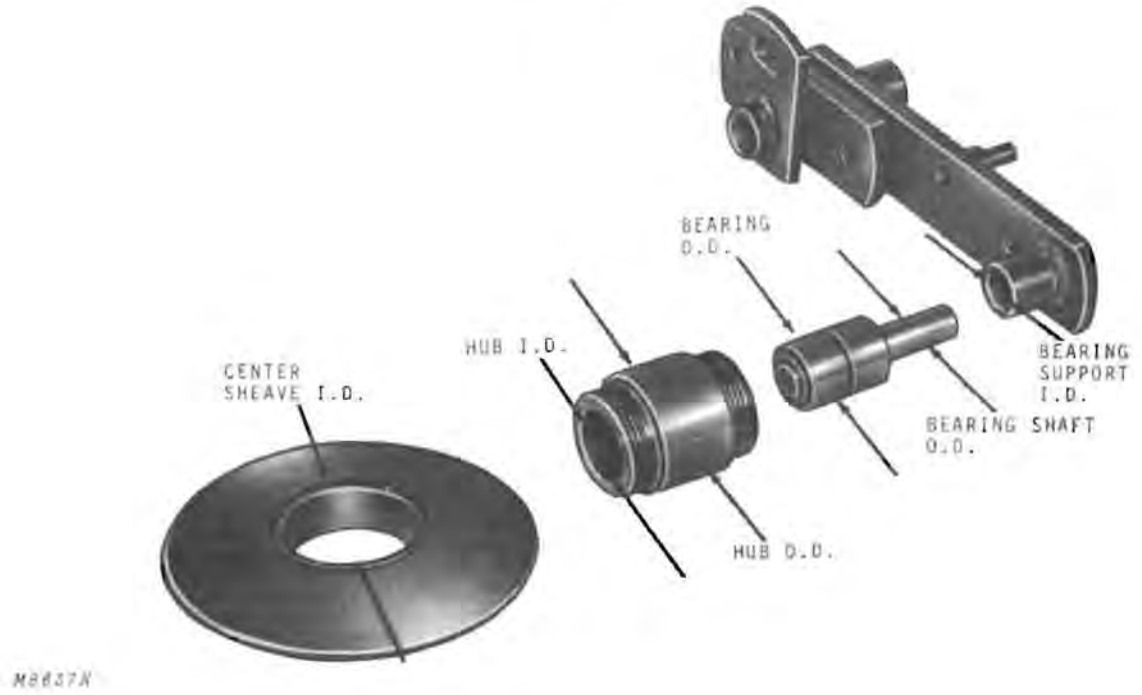

Fig. 44-Variator Press Fit Components

Component	Dimension
Center Sheave I.D. w/bearing	2.0015 to 2.0025 in.
Hub O.D.	1.999 to 2.001 in.
Hub I.D.	1.1790 to 1.1800 in.
Bearing O.D.	1.1806 to 1.1811 in.
Bearing shaft O.D.	0.6262 to 0.6267 in.
Bearing support I.D.	0.6240 to 0.6255 in.
Primary belt guide (Distance between variator and guide)	1/16 to 1/8 in.

SPECIAL TOOLS

Name	Part No.	Use
Brake Spring Pliers	12-inch	To install variator spring

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Group 15
4-SPEED TRANSAXLE

PRINCIPLE OF OPERATION

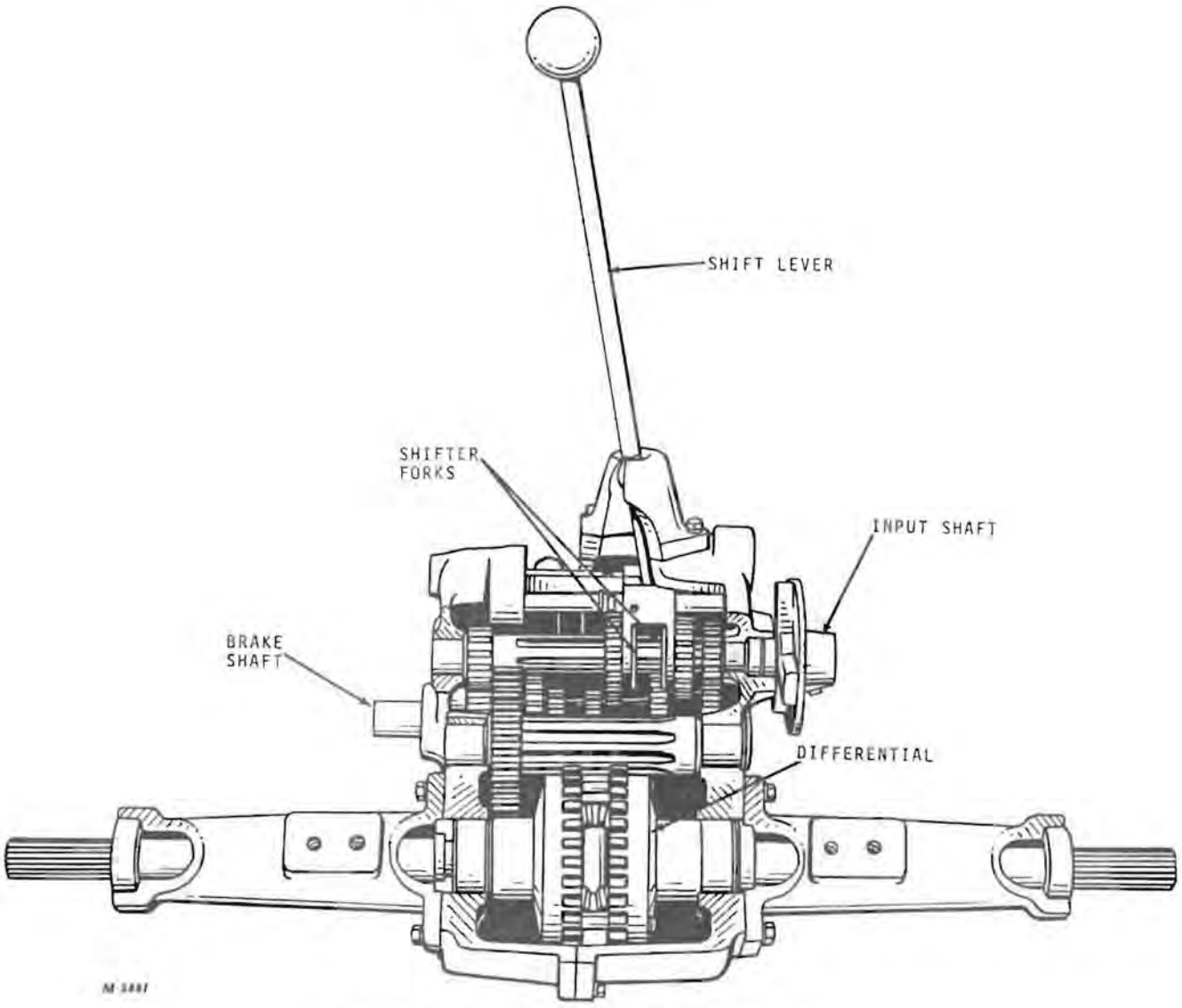

Fig. 1-Tractor Transaxle - 4 Forward Speeds - 1 Reverse

The transaxle, Fig. 1, is a complete unit consisting of a transmission and differential axle. Gear shifting is accomplished by a direct-mounted shift lever connected to the four forward gears and one reverse.

There are two distinct shifter fork and gear assemblies: one for reverse, first and second; the other for third and fourth.

The transaxle has automotive-type alloy gears turning on anti-friction bearings and is oil-bath lubricated. Needle bearings are used throughout except for the input shaft bearing and axle housing bearings which are ball bearings.

A bevel gear type differential is regular equipment on 110 Tractors.

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GEAR SHIFT PATTERN

Fig. 2-Gear Shift Pattern

Gear shifting for all four forward gears and reverse is accomplished with a shift lever, Fig. 2, mounted on the transaxle and two separate shifter forks and gear assemblies. One fork controls the first, second and reverse gear positions. The other fork controls the third and fourth gear positions.

Study illustrations below and at right to determine power transmission from the input shaft to the axles in each gear position.

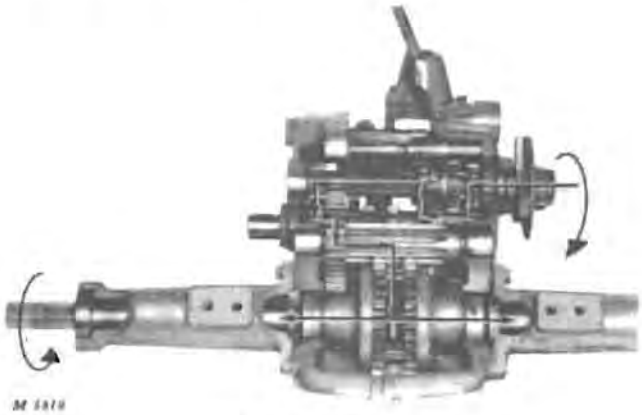


Fig. 3-Reverse Gear

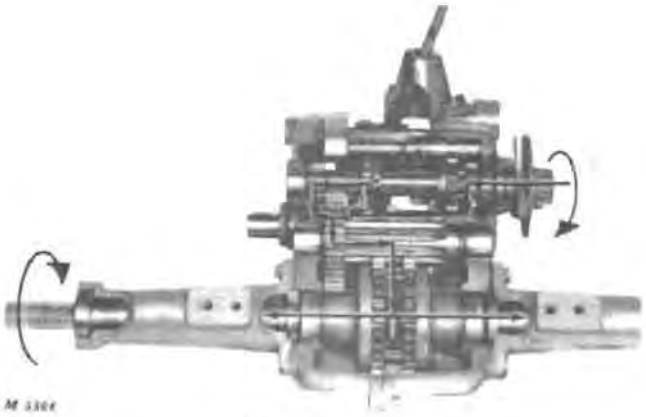


Fig. 4-1st Gear

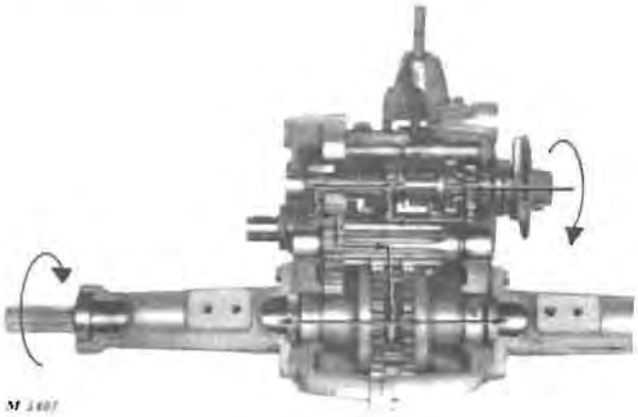


Fig. 5-2nd Gear

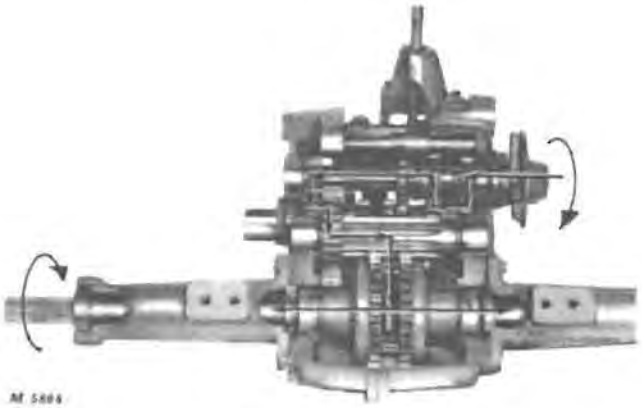


Fig. 6-3rd Gear

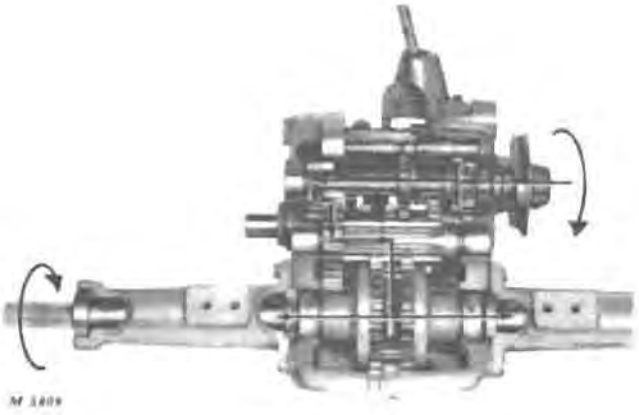


Fig. 7-4th Gear

DIAGNOSING MALFUNCTIONS

Gears Clash When Shifting.

Clutch-brake (Serial No. 250,001-272,000) and variable speed control not properly adjusted.

Shifting gears while tractor is in motion.

Clutch pedal or clutch-brake pedal not fully depressed.

Linkage not properly assembled.

Hard Shifting.

Clutch-brake (Serial No. 250,001-272,000) and variable speed control not properly adjusted.

Shifting gears while tractor is in motion.

Clutch pedal or clutch-brake pedal not fully depressed.

Loose shifter housing bolts.

Shift quadrant not properly adjusted.

Shifter forks, rod(s), or other transmission gear selection components damaged.

Worn shifter lever assembly.

Jumps Out of Gear.

Quadrant not properly adjusted.

Gear(s) damaged from shifting while tractor is in motion.

Worn spline on input shaft.

Worn shifter gear spline.

Shifter forks, rod(s), or other transmission gear selection components damaged.

Locked In Gear.

Clutch-brake (Serial No. 250,001-272,000) and variable speed control not properly adjusted.

Clutch pedal or clutch-brake pedal not fully depressed.

Noisy Forward Speeds.

Low lubricant level.

Differential bevel gears worn or damaged.

Gears worn or damaged in transmission section of transaxle.

Worn or damaged bearing.

Noisy In Reverse.

Low lubricant level.

Reverse idle gear and/or shaft worn or damaged.

Differential bevel pinion gear(s) worn or damaged.

Lubricant Leaks.

Excessive lubricant.

Loose case screws.

Loose shifter housing bolts.

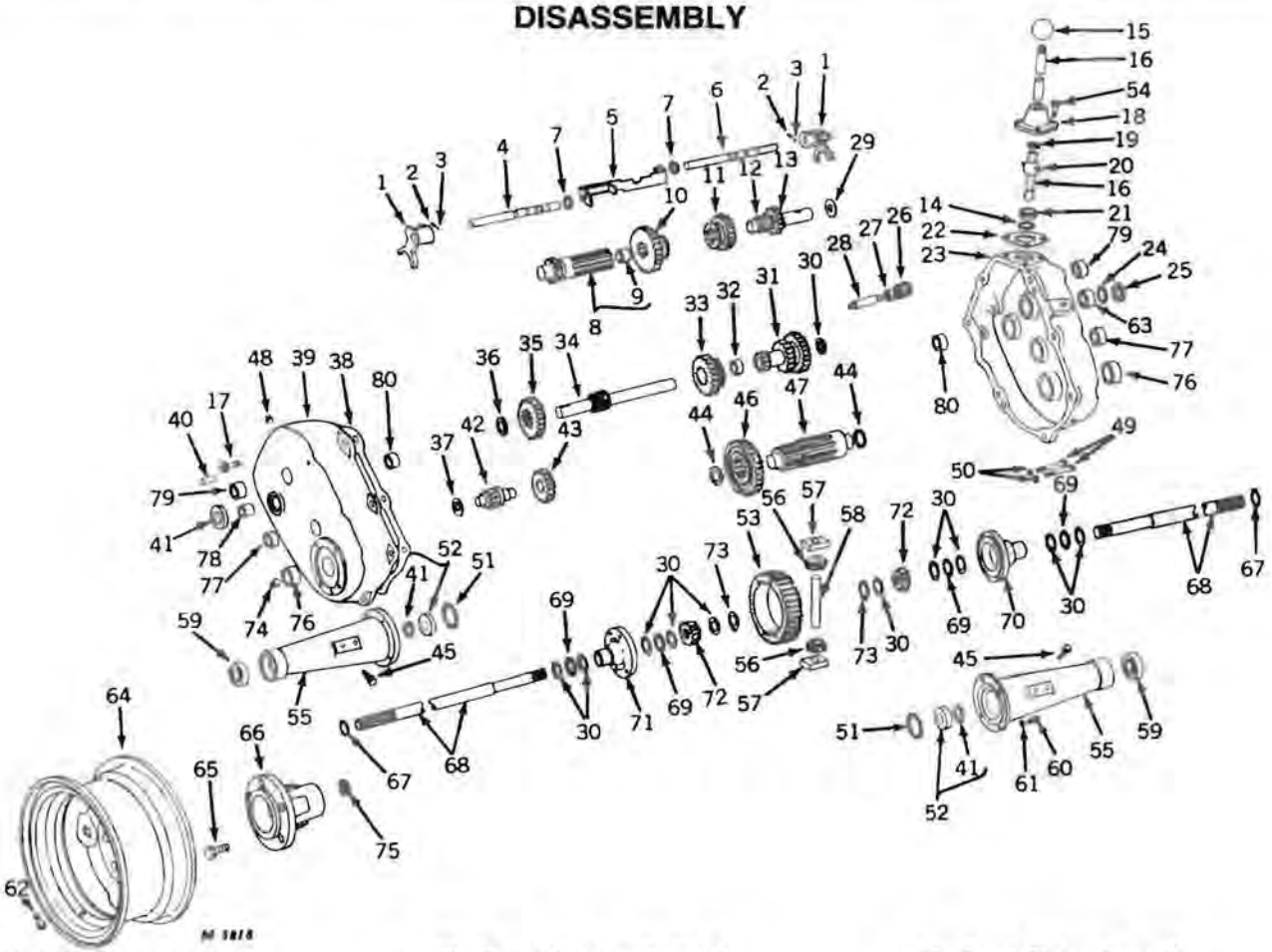
Worn or damaged shifter housing seal.

Worn or damaged shaft seal.

Defective O-ring between case and axle housing.

Defective case gasket.

DISASSEMBLY



1—Shifter Fork (2 used)
2—Spring (2 used)
3—Ball (2 used)
4—Shifter Rod (1st, 2nd and reverse speeds)
5—Shifter Guide
6—Shifter Rod
7—Snap Ring (2 used)
8—Shifter Shaft and Gear
9—Needle Bearing
10—26-Tooth Shifter Gear (1st, 2nd and reverse speeds)
11—20-Tooth Shifter Gear (3rd and 4th speeds)
12—Input Shaft and Pinion
13—16-Tooth Input Shaft Gear
14—Snap Ring
15—Knob
16—Shifter Lever
17—Cap Screw (8 used)
18—Shifter Lever Housing
19—Rubber Seal
20—Spring Pin
21—Keeper
22—Gasket
23—Case
24—Input Shaft Bearing
25—Oil Seal (1-5/8" O.D.)
26—Reverse Idler Gear
27—Spacer (1-1/16" long)
28—Reverse Idler Shaft
29—Thrust Washer (3/4" I.D. x 1-1/4" O.D.)
30—Thrust Washer (7/8" I.D. x 1-7/16" O.D.) (13 used)
31—3-Cluster Gear
32—Spacer (15/32" long)
33—2-Cluster Gear
34—Brake Shaft and Pinion
35—30-Tooth Idler Gear
36—Thrust Washer (1" I.D. x 1-1/2" O.D.)
37—Idler Shaft Washer
38—Gasket
39—Cover
40—Dowel Pin (2 used)
41—Oil Seal (1-3/8" O.D.)
42—Idler Shaft and Pinion
43—22-Tooth Idler Gear
44—Thrust Washer (1-5/16" I.D. x 1-1/2" O.D.) (2 used)
45—Cap Screw (5 used)
46—36-Tooth Output Gear
47—Output Shaft
48—Pipe Plug (2 used)
49—Cap Screw (4 used)
50—Lock Washer (4 used)
51—O-Ring (2 used)
52—Axle Retainer (2 used)
53—Ring Gear
54—Cap Screw (3 used)
55—R.H. or L.H. Axle Housing (2 used)
56—Bevel Pinion (2 used)
57—Drive Block (2 used)
58—Drive Pin
59—Axle Housing Bearing (2 used)
60—Cap Screw (8 used)
61—Lock Washer (8 used)
62—Rear Tire Valve (2 used)
63—Needle Bearing (1" O.D.) (3 used)
64—Rear Wheel (2 used)
65—Wheel Bolt (10 used)
66—Rear Wheel Hub (2 used)
67—Snap Ring (2 used)
68—R.H. or L.H. Axle (2 used)
69—Thrust Bearing (7/8" I.D. x 1-7/16" O.D.) (4 used)
70—R.H. Carriage
71—L.H. Carriage (tapped)
72—Bevel Gear (2 used)
73—Snap Ring
74—Drain Plug
75—Take-up Washer (4 used)
76—Needle Bearing for Axle Shaft (2 used)
77—Needle Bearing for Output Shaft (2 used)
78—Needle Bearing for Brake Shaft
79—Needle Bearing for Shifter Shaft
80—Needle Bearing for Idler Shaft and Idler Pinion

Fig. 8-4-Speed Transaxle (with bevel gear differential)

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Removing Transaxle

To facilitate transaxle removal, remove fenderdeck.

Fig. 9-Preparing Transaxle for Removal (Right Rear Wheel Removed for Clarity)

Place variable speed control lever in its fast position (forward-most notch).

Raise up on secondary belt idler to release belt tension. Slip belt off variator sheave and transaxle drive sheave. Do not pry belt from sheaves. If necessary remove transaxle drive sheave to ease removal.

Block up tractor and remove rear wheels. Remove spring pin and disconnect brake rod from brake arm, Fig. 9.

Remove six cap screws that retain the hitch plate to tractor frame, Fig. 9, and roll hitch plate and transaxle assembly rearward as shown in Fig. 10.

Fig. 10-Hitch Plate and Transaxle Assembly Removed from Tractor

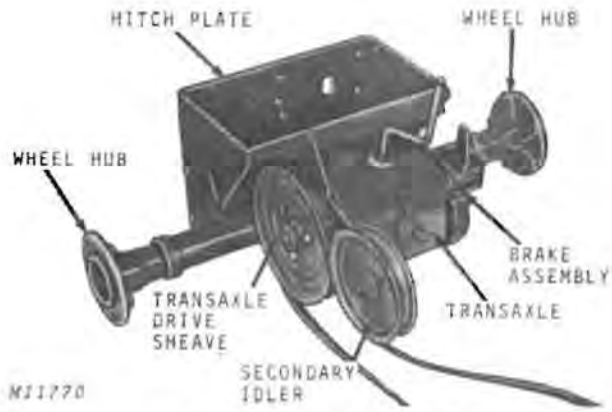

Fig. 11-Preparing Transaxle for Disassembly

To facilitate transaxle disassembly, Fig. 11, remove the following components:

Wheel hubs	Secondary idler
Hitch plate	Brake band assembly
Drive sheave	Shift lever
Input hub	Neutral start switch and bracket

When removing the shift lever assembly, place lever in neutral before removing retaining screws.

When removing wheel hubs it is advisable to use a wheel or gear puller to prevent damage.

Opening Transaxle

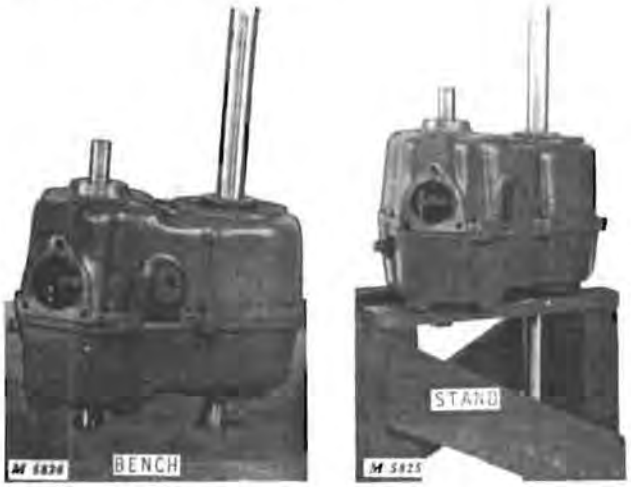

Fig. 12-Transaxle Repair Stands

Drill two 2-inch holes in line with each other 8 inches apart in a sturdy work bench or stand, Fig. 12.

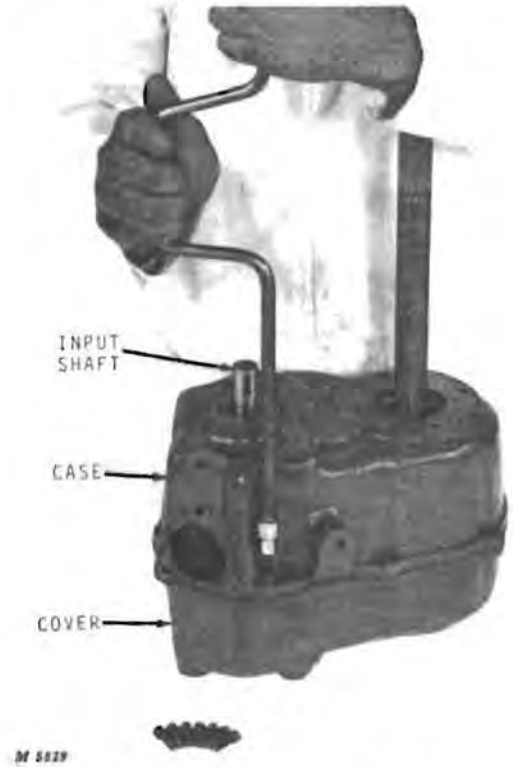

Fig. 13-Removing Case Screws

Place transaxle in bench or stand vertically with socket head cap screws and input shaft upward. Remove eight screws, Fig. 13.

Grasp the input shaft with the right hand and the transaxle case with the left hand. Lift case slowly and shake lightly so all loose parts remain in cover, Fig. 14.

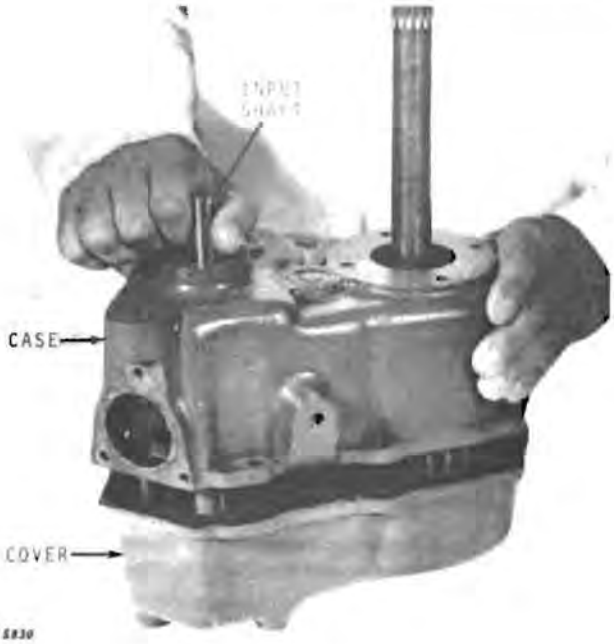

Fig. 14-Removing Cover

Removing Internal Components

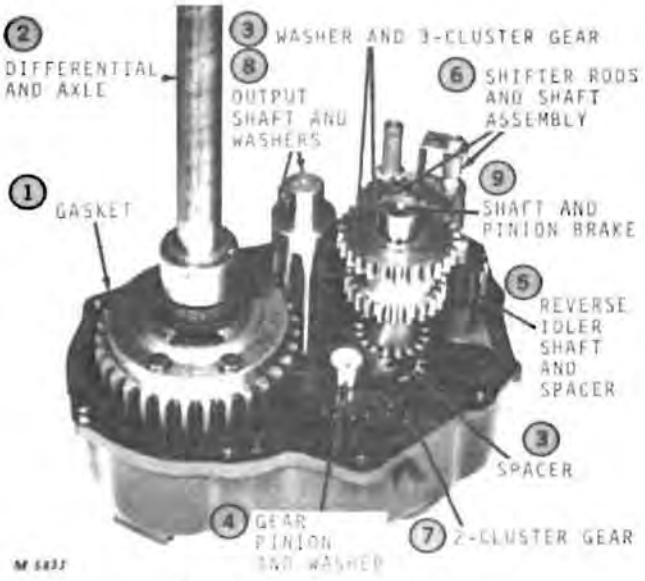

Fig. 15-Gear Removal Sequence

Figs. 15 and 16 will identify the group assemblies for the 4-speed transaxle. Lift them from the case in the following order.

1. Gasket.

2. Differential and axle assembly.

3. Washer, 3-cluster gear, and spacer from shaft and pinion brake.

4. Gear pinion and washer.

5. Reverse idler assembly.

6. Shifter rod and shaft assembly.

7. 2-cluster gear.

8. Output shaft and washers (one at each end of shaft).

9. Shaft and pinion, idler gear and washer.

10. Input shaft.

NOTE: Input shaft, Fig. 16, is installed with a press fit. If close inspection reveals that gears and bearing are satisfactory, do not remove input shaft.

If it is necessary to remove the input shaft, do not use the case itself to support any of the pressure required to separate the input assembly or brake shaft assembly from the case halves. Use a large pipe to support the pinion and press the shaft from the opposite side.

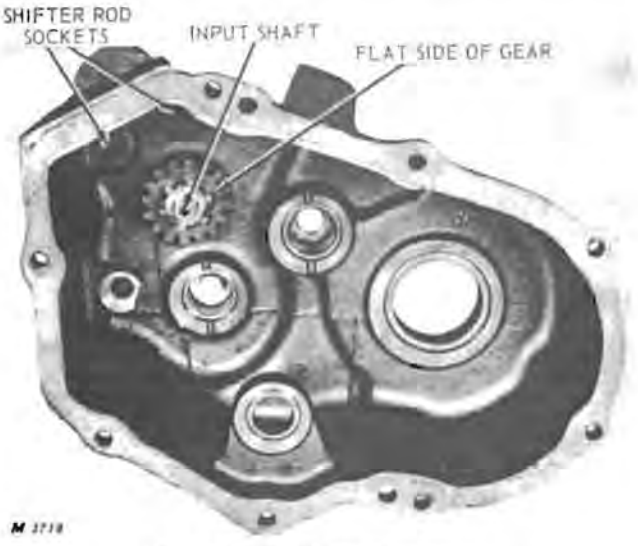

Fig. 16-Gear Removal Sequence

Disassembling Shifter Lever

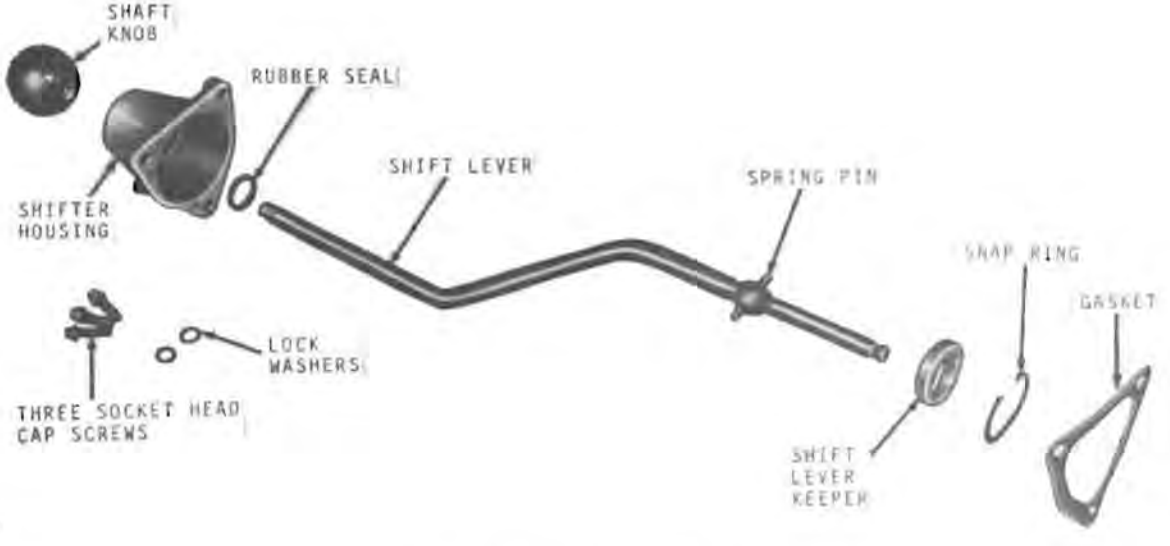

Fig. 17-Shift Lever Components

To disassemble shift lever, Fig. 17, remove snap ring in shifter housing and slide assembly apart.

INSPECTION AND REPAIR

Wash all internal parts in a safe cleaning solvent. Brush and scrape foreign matter from all parts and dry thoroughly.

NOTE: Oil the bearings immediately after cleaning to prevent rusting.

Inspecting Gears and Shafts

Replace all gears having chipped, broken, or worn teeth. Badly scored gears must be replaced.

Replace any shaft that is bent, scored, or worn. Replace any shaft showing side wear or if any of the splines are damaged.

M 5811

Fig. 18-Transaxle Gear Tooth Wear

Chipped, broken, or excessive wear on gear teeth ends, Fig. 18, is usually caused by shifting transaxle while tractor is still moving or by gears not being properly meshed when tractor is under load. Gear wear as illustrated can cause gears to jump out of position.

M 5812

Fig. 19-Broken Detent Springs

Broken detent springs, Fig. 19, can cause gear damage. When the springs are broken, the shifter fork is free to move, thus allowing gear pressure to slide the gears out of mesh.

When the gears slide out of gear, especially under load, gear chipping or cracking will result.

M 5813

Fig. 20-Damaged Bevel Pinion Gears

Prolonged heavy drawbar loads and wheel slippage are the most common cause of bevel pinion gear failure, Fig. 20, in the differential section of the transaxle.

M 5814

Fig. 21-Damaged Input Shaft Spline

Damage to the input shaft spline, Fig. 21, is caused by improper coupling of the shifter shaft and input shaft when transaxle is shifted into high range. A broken detent spring or an improperly adjusted quadrant are normally the cause of improper coupling.

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Fig. 22-Worn Spline in Shifter Gear

A damaged shifter gear spline as shown in Fig. 22 is caused by improper coupling of the shifter and input shaft. A worn or damaged shifter gear will cause gear jump-out when the tractor is operated in high range or under heavy drawbar loads.

Inspecting Oil Seals and O-Rings

Always replace oil seals in axle housings whenever transaxle is disassembled. Always use new O-rings on axle housings.

Refer to "Bearing Analysis," page 20-15-12 for bearing and seal examination.

Inspecting Transmission Case

Inspect the transmission case halves for cracks, worn or damaged bearing bores, damaged threads, and case mating surfaces.

Inspecting Shifter Assembly

Check condition of the shifter forks, shift rods, and detent springs. Slide forks along the shaft to inspect grooves. If a good snap is felt in each detent position, disassembly is not necessary.

Inspecting Drive Blocks

Check condition of differential drive blocks. Replace if cracked or broken.

ASSEMBLY

Bevel Gear Differential

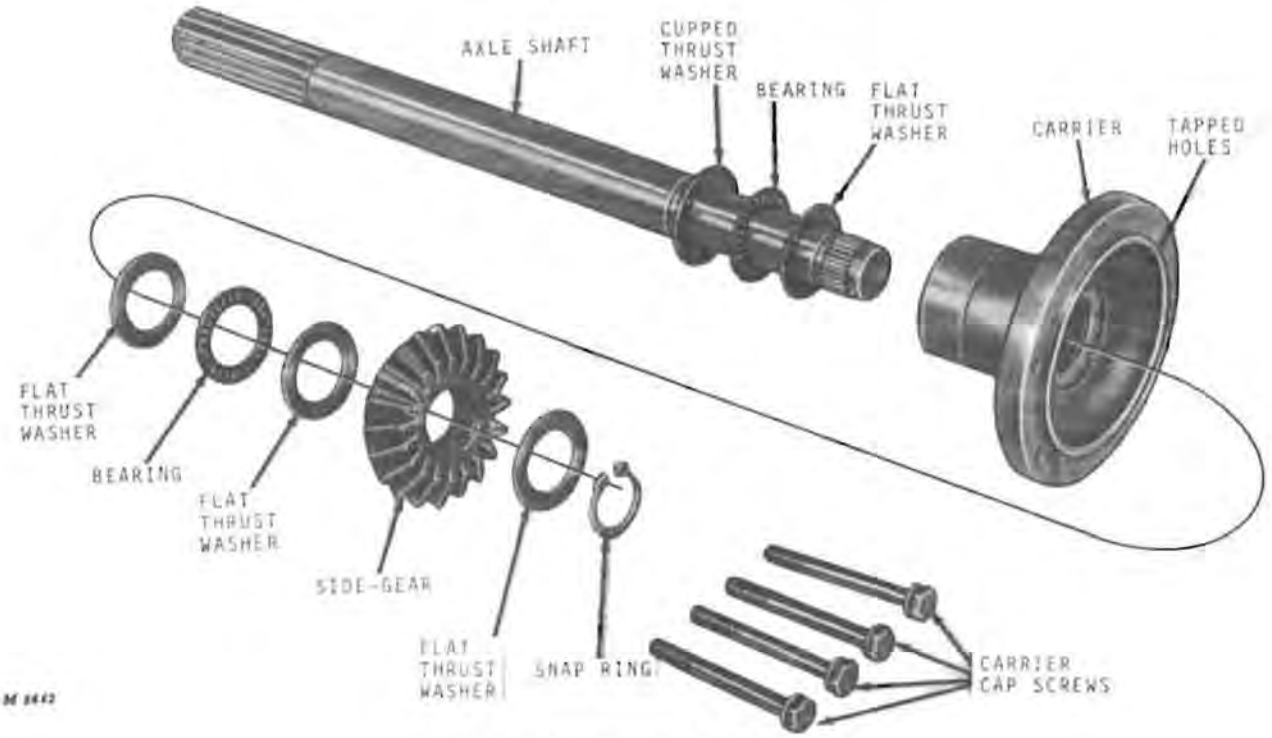


Fig. 23-Exploded View of Differential Assembly

To assemble the bevel gear differential, install the thrust washers, bearings, carriers, and side gears on the axle shafts. Secure with snap rings.

Position the thrust washers exactly as shown in Fig. 23. It is important that the cupped thrust washer be placed onto axle first.

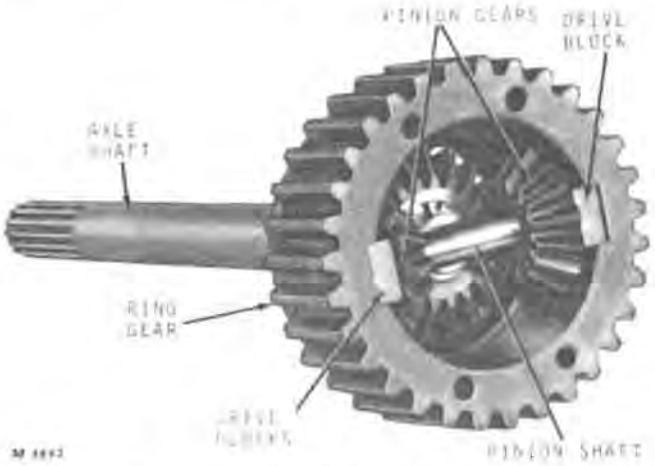


Fig. 24-Assembling Ring and Pinion Gears

Second, place ring gear, Fig. 24, onto one of the carriers and install the pinion gears, pinion shaft, and drive blocks.

Position the other carrier and install the four cap screws and lock washers. Tighten cap screws to 25 to 30 ft-lbs torque.

The axles should rotate freely in opposite directions when assembled. Place the differential aside for later installation.

Bearings

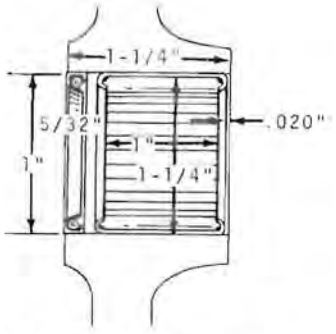


Figure 25-Installing Bearings

All bearings are pressed into the bearing bores from the inside of the axle housing interior, Fig. 25.

Bearing drivers to install bearings properly are listed under special tools, page 50-15-19. As a general rule, all bearings should be pressed into the housing to a depth of 0.020 inch beyond flush with housing interior.

Input Shaft And Gear

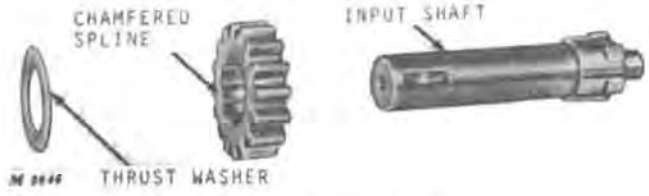


Fig. 26-Input Shaft and Gear

Assemble input shaft, gear, and thrust washer. Chamfered gear spline must be toward outer end of shaft as shown in Fig. 26. Gear is a light press fit onto shaft.

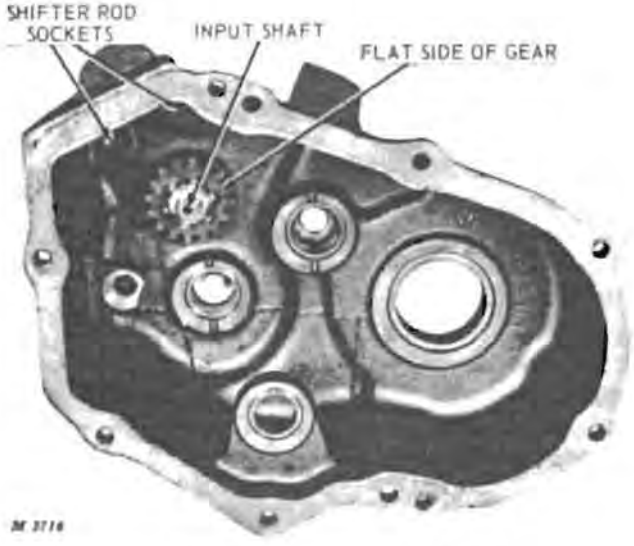


Fig. 27-Assembled Input Shaft

Install washer, input shaft and gear assembly into case as shown. Use special tool to protect seal when slipping shaft through seal. Refer to "Special Tools," for proper seal sleeve. Flat side of gear should now face upward, Fig. 27.

Idler Gear and Pinion Shaft

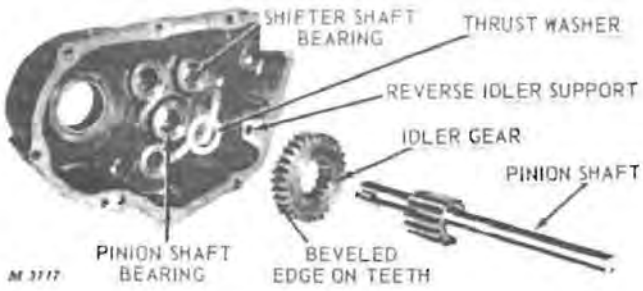


Fig. 28-Idler Gear and Shaft

Use seal sleeve tool listed under "Special Tools," and assemble thrust washer, idler gear, and pinion shaft as shown in Fig. 28. Beveled edge of teeth must face away from pinion shaft as shown. Pinion shaft is a light press fit through idler gear.

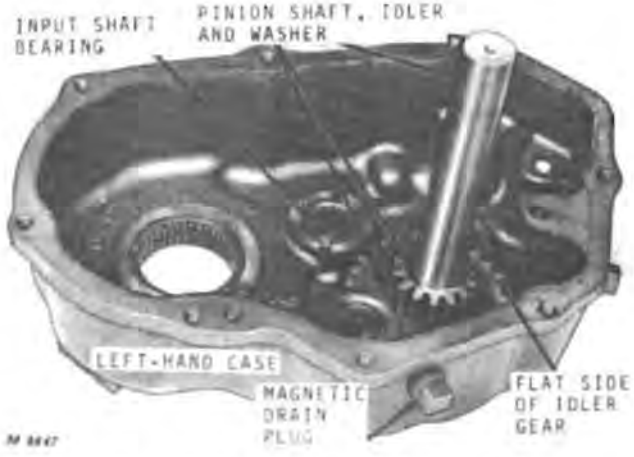


Fig. 29-Idler Gear and Shaft Assembly

When thrust washer, idler gear, and pinion shaft are properly assembled and installed, they will appear as shown in Fig. 29. The flat edge of the idler gear should now face upward.

Output Shaft and Gear

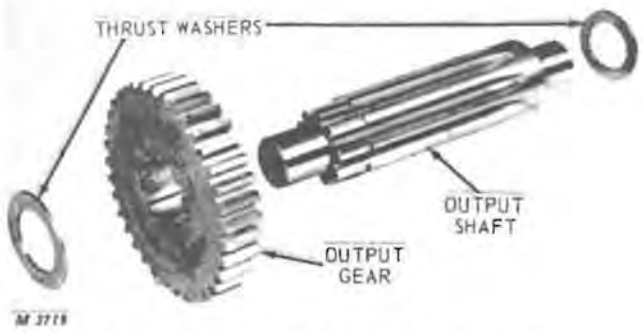


Fig. 30-Output Shaft and Gear Assembly

The output gear is assembled on the output pinion shaft with a press fit. A thrust washer is used on both ends of output shaft, Fig. 30.

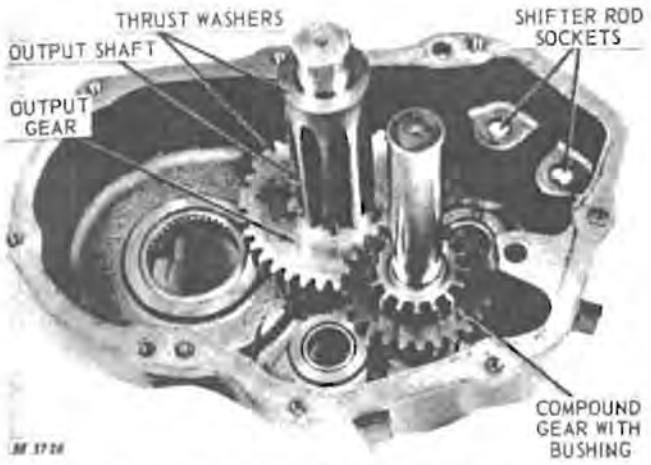


Fig. 31-Output Shaft and Gear Installed

Install output gear, pinion shaft and thrust washers into left-hand case, Fig. 31.

Install compound gear with bushing into left-hand case, Fig. 31.

Shifter Shaft

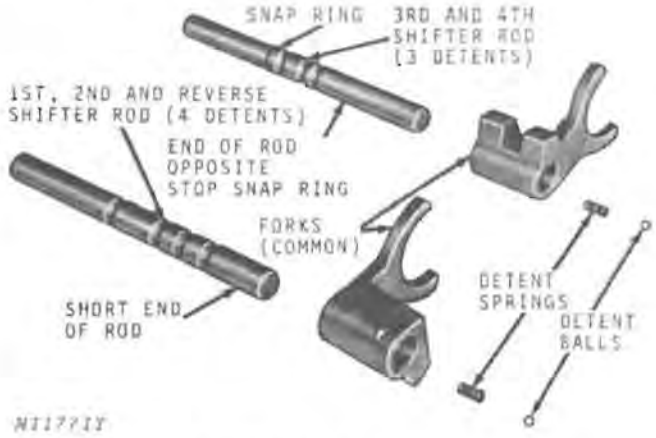


Fig. 32-Shifter Components

Because of heavy detent pressure, the assembly of these rods can be difficult. Assemble forks as shown in Fig. 32. 1st, 2nd, and reverse fork will face to the left and the 3rd and 4th fork will face to the right or away from the rod. The 1st, 2nd, and reverse rod must have the short end of shifter rod toward fork. The 3rd and 4th shifter fork must have end opposite stop snap ring toward fork as shown in Fig. 32. Start the rod into the fork. Depress detents and complete the assembly. Slide forks along rod. A good snap should be felt in each detent. Place forks in neutral positions at this time, Fig. 33.

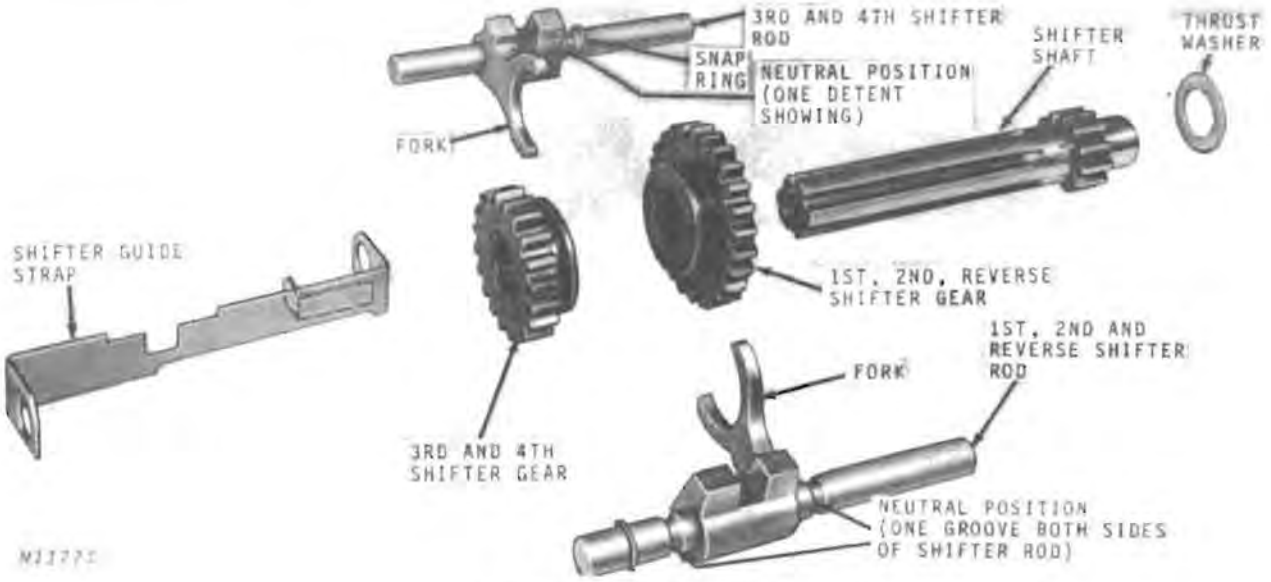


Fig. 33-Shifter Shaft and Gear Components

To assemble shifter, lay out parts as shown in Fig. 33. Be sure forks are in neutral detent. 1st, 2nd, and reverse will have one detent showing on each side of fork, Fig. 34. 3rd and 4th will have one detent showing on side of shifter fork or one detent showing between fork and snap ring. Be sure shifter rod with one detent showing on each side of fork is used with 1st, 2nd, and reverse shifter gear and that shifter rod with one detent between fork and snap ring is used with 3rd and 4th shifter gear.

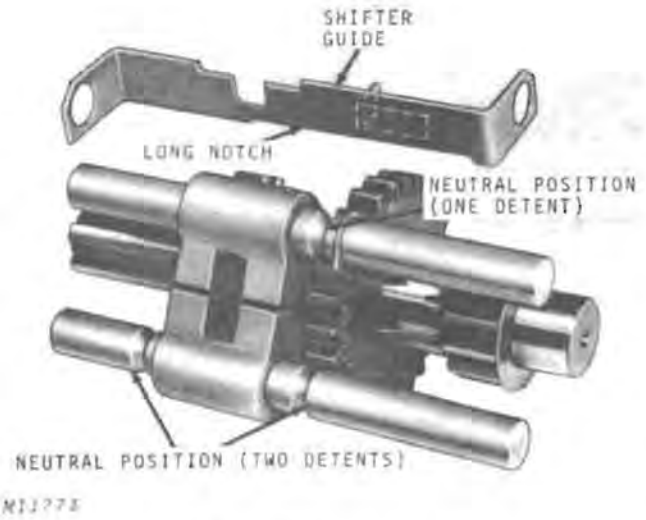


Fig. 34-Shifter Assembly

The shifter shaft assembly should appear as shown in Fig. 34. The slot in the forks should line up when the large gear is slipped as far as possible on the spline. Note the position of exposed grooves on shifter rods.

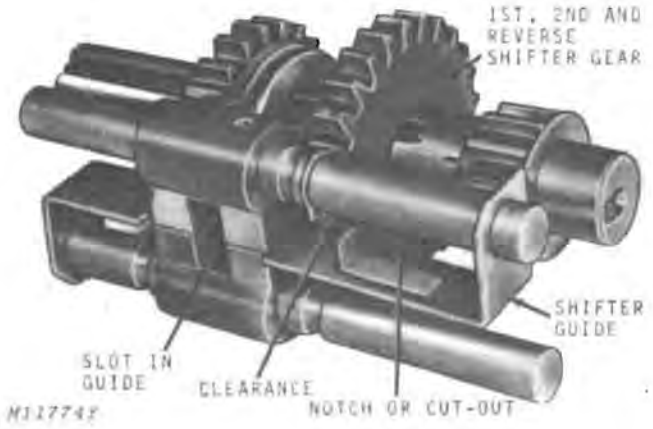


Fig 35-Shifter Assembly

Assemble shifter guide over shifter rods. Slot in guide should match rectangular opening between the forks. The long notch in underside of guide should clear the large 1st, 2nd, and reverse shifter gear, Figs. 34 and 35.

Shifter Shaft—Continued

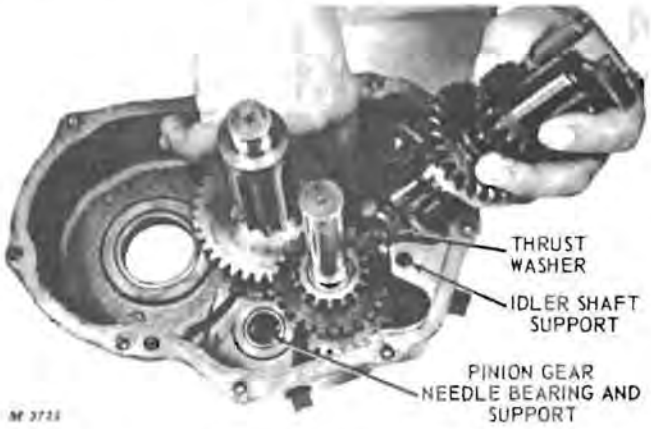


Fig. 36-Shifter Installation

Place thrust washer over needle bearing. Grasp shifter assembly firmly in left hand and lower it into case. When lowered and positioned, shifter shaft should be through thrust washer and in shifter shaft bearing case. Fig. 36. The shifter rods should now enter the two machined sockets in left-hand case.

Idler Gear, Pinion, and Thrust Washer

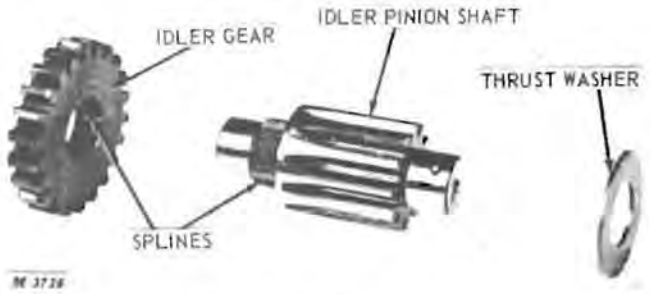


Fig. 37-Idler Components

The inside of the idler gear is splined to slip freely onto splined end of idler pinion, Fig. 37.

Reverse Idler Shaft and Gear

Fig. 38-Reverse Idler Components

Assemble reverse idler shaft assembly as illustrated. Round edge of teeth faces spacer, Fig. 38.

NOTE: Shaft is the same on both ends.

Installing Reverse Idler, Idler Gear Assembly, and Spacer

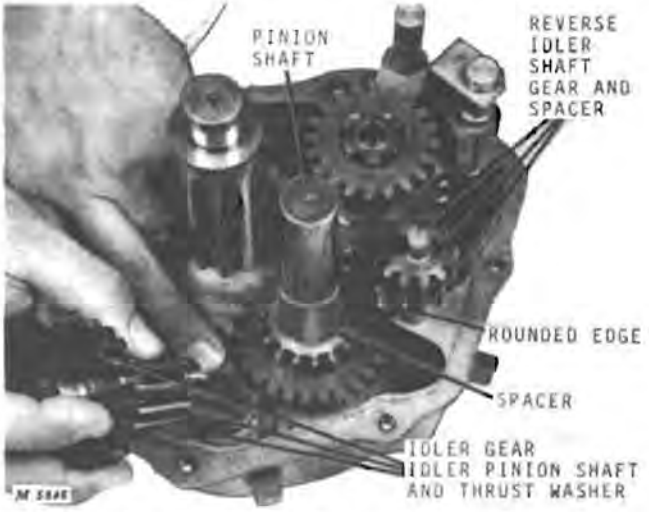


Fig. 39-Installing Idler and Reverse Idler

Install reverse idler assembly, Fig. 39.

Install thrust washer, idler pinion shaft, and idler gear. Fig. 37 shows proper assembly before lowering into left-hand case. Fig. 39.

Place spacer on pinion shaft, Fig. 39.

Installing Cluster Gear and Thrust Washer

Fig. 40-Transmission Assembled

Install gear cluster and thrust washer on pinion shaft as shown in Fig. 40.

All parts assembled thus far should appear as shown in Fig. 40.

Installing Differential

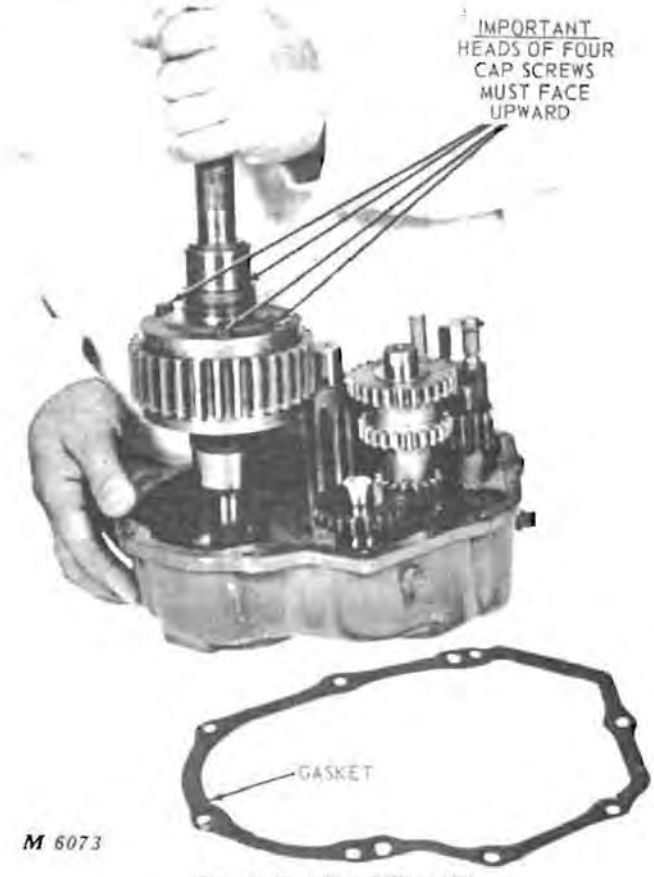


Fig. 41-Installing Differential

Install differential assembly into left-hand case with cap screw facing upward as shown in Fig. 41.

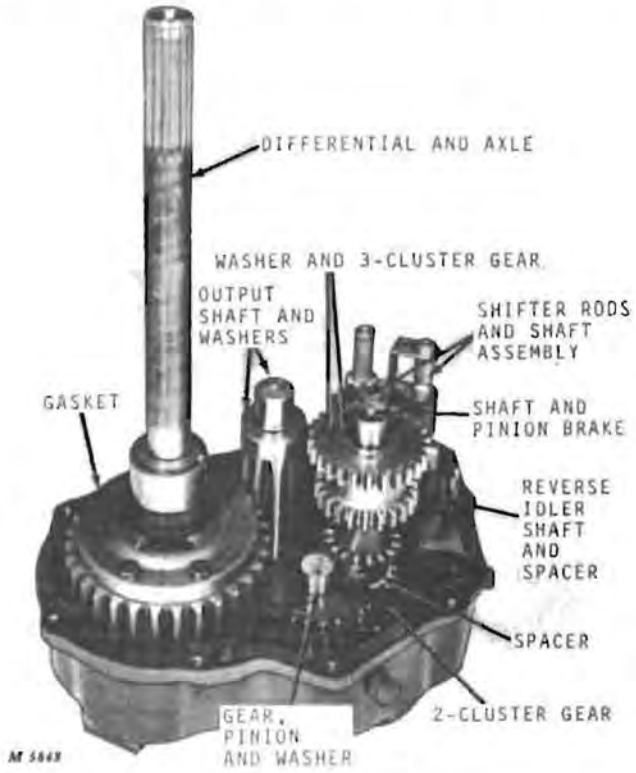


Fig. 42-Completed Internal Assembly

The internal components should now appear as shown in Fig. 42.

Position a new gasket on the lower (left-hand) case at this time.

Placing Cover on Case

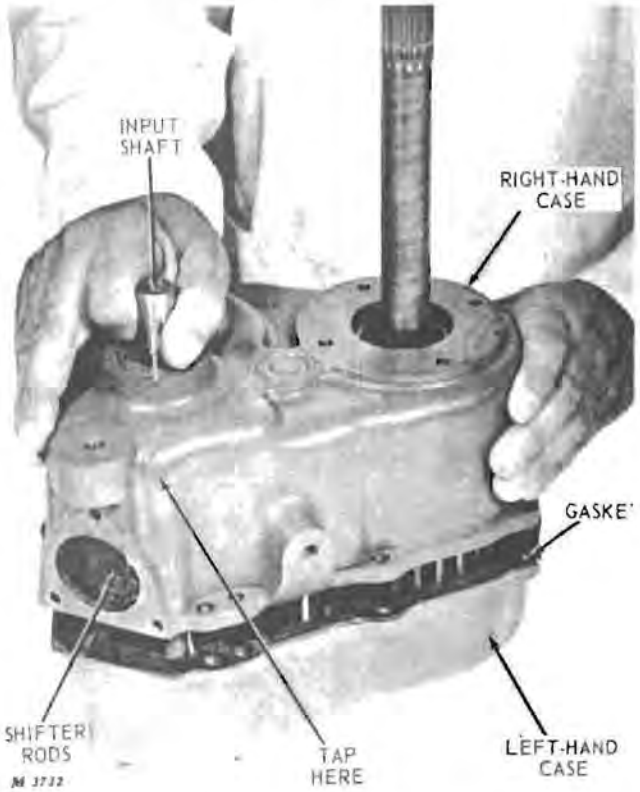


Fig. 43-Closing Case

Install right hand case half over axle and input shaft as illustrated in Fig. 43. Shake case slightly to align shafts and shifter assembly. Also, a short turn of the input shaft will help align shafts and gears.

To close the last one-half inch, tap the right-hand case horizontally as shown in Fig. 43. If case will not close, reach through round hole in right-hand case with a screwdriver and move shifter rods. This will help align shifter rods so they will fall into shifter rod sockets in right-hand case.

Installing Seals

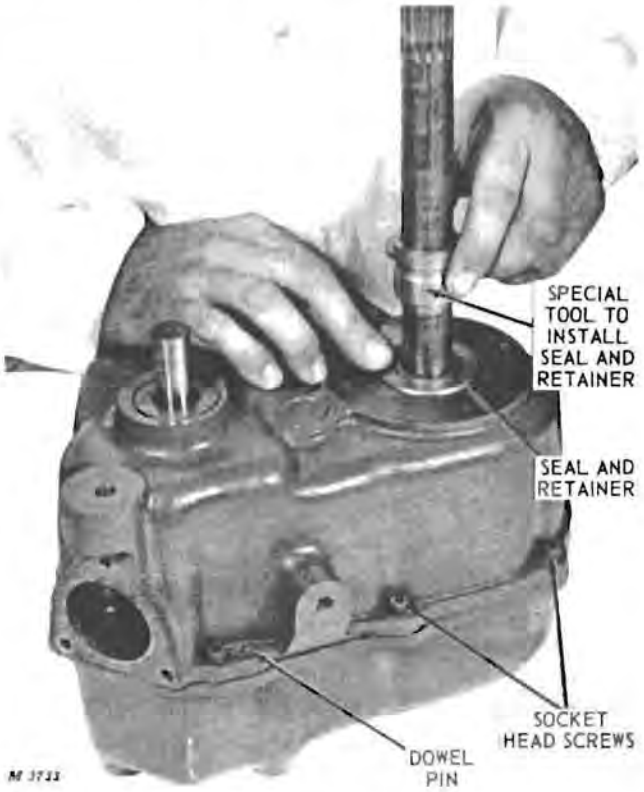


Fig. 44-Installing Retainers and Seals

Insert eight socket head screws, Fig. 44, and tighten to 120 in-lbs torque.

Install retainer and new seal with special oil seal cone tool, page 15-19. Shim stock may be substituted for the tool to prevent cutting seal during installation. The seal is properly installed when the open face of seal is facing inward toward the gears. Fig. 44.

Installing Axle Supports

Fig. 45-Installing Axle Supports

Install O-rings and axle supports with bearings as shown in Fig. 45. Always use new O-rings. Refer to "Bolt Torque Chart," page 10-10-4 and tighten support bolts accordingly.

Positioning Shifter Forks

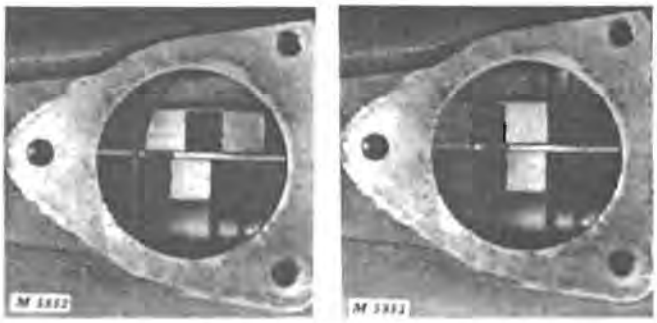


Fig. 46-Shifter Forks

Inspect the shifter forks, Fig. 46, to be sure they are aligned and in neutral position. Failure to do this will cause damage to the transmission when engaged under power. (Compare illustrations above.)

Assembling Shifter Lever

The shifter is assembled in the order shown in Fig. 17, page 50-15-7. When assembling shifter, be sure rubber seal is positioned properly in shifter housing. A little shellac or gasket cement will be helpful to prevent incorrect positioning of the rubber seal in the housing. Align housing, keeper, and spring pin in shift lever and place snap ring in groove in shifter housing. Tighten screws to 120 in-lbs torque.

Installing Transaxle

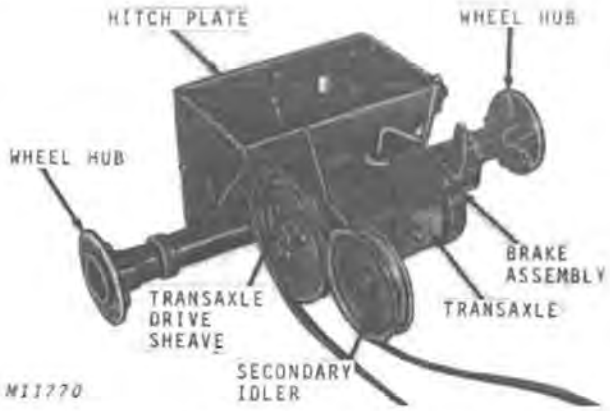


Fig. 47-Transaxle Installation

Install brake assembly, input hub, secondary idler, driven sheave with belt, and hitch assembly to transaxle, Fig. 47.

Before installing transaxle in tractor base, check transaxle by turning driven sheave and shifting transaxle in each gear.

Apply Loctite to threads on all set screws used in assembling components to transaxle. Refer to "Bolt Torque Chart," page 10-10-4 and tighten bolts and set screws accordingly.

Installing Transaxle—Continued

Fig. 48-Transaxle Installed

Install wheel hubs with washers and snap rings. Bolt wheels to hubs and roll transaxle into tractor base, Fig. 48. Install cap screws in hitch plate and frame and tighten securely.

Connect brake clevis and secondary idler spring, Fig. 48. Then slip secondary belt onto variator.

Install fender-deck assembly.

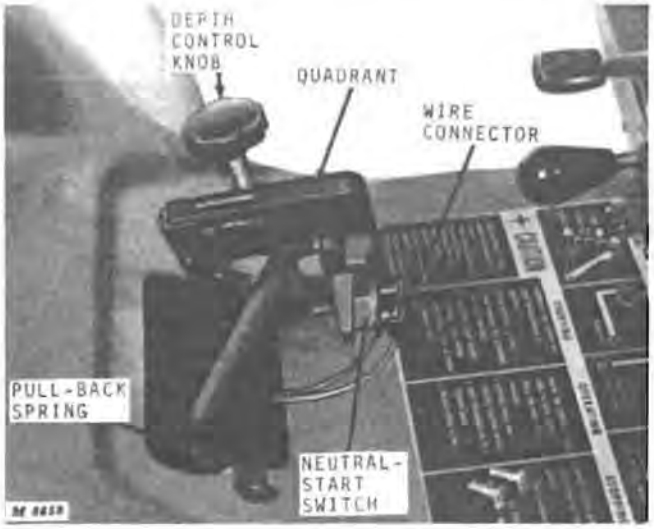


Fig. 49-Connecting Plunger-Type Neutral-Start Switch

Loosen and lift quadrant as shown in Fig. 49. Attach wire connectors to switch and re-install quadrant.

After attaching quadrant assembly, install shift lever knob and depth control knob. Tighten lock nut firmly on depth control knob.

Refer to "Adjustment," page 50-10-18, and adjust brake and variator linkage.

Refer to Lubrication Chart, page 10-20-1 and add lubricant.

TORQUE FOR HARDWARE

Item	Torque
Differential Carrier Capscrews	25-30 ft-lbs.
Shifter Lever Housing	120 in-lbs.
Transaxle Case Socket Head Screws	120 in-lbs.

SPECIAL TOOLS

Name	No.	Use
Bearing Support	670162	To support and drive inner race of ball bearings.
Tool, 1-1/8—1-3/8-inch	670170	Needle bearing removal and installation.
Tool, 15/16—1-3/16-inch	670171	Needle bearing removal and installation.
Tool, 7/8—1-1/8-inch	670172	Needle bearing removal and installation.
Tool, 1—1-1/4-inch	670173	Needle bearing removal and installation.
Tool, 1-3/4—2-1/8-inch	670174	Needle bearing removal and installation.
Tool, 3/4—1-inch	670175	Needle bearing removal and installation.
Tool, 3/4—1-1/4-inch	670176	Needle bearing removal and installation.
Burnishing Rod and 7/8-inch Ball	670177	Sizing brake shaft bushing.
Oil Seal Cone 1-inch	670179	Install brake shaft axle seals.
Oil Seal Tool 1-inch	670180	Install seal.
Oil Seal Cone 3/4-inch	670182	Install input shaft seal.
Bushing Tool 7/8-inch	670183	Bushing removal and installation.
Oil Seal and Ball Bearing Tool	670184	Seal and bearing driver 3/4-inch shafts.
7/8-inch Seal Sleeve	670185	Install brake shaft and axle seals.
7/8-inch Shaft Seal Driver	670186	Install brake and axle seals.
Shifter Shaft Bearing Driver Tool	670194	Needle bearing installation.
1-inch Ball Bearing Tool	28679	To remove ball bearings.
Retaining Ring Pliers	OTC1340	Remove retaining rings from axle ends.
Motor-Rotor Repair Stand	OTC1730-A	To invert tractor for servicing transaxle and components beneath tractor.

Litho in U.S.A.

Group 20
PTO CLUTCH
8 hp Tractor (Serial No. 250,001-260,000)
10 hp Tractor (Serial No. 260,001-272,000)

PRINCIPLE OF OPERATION

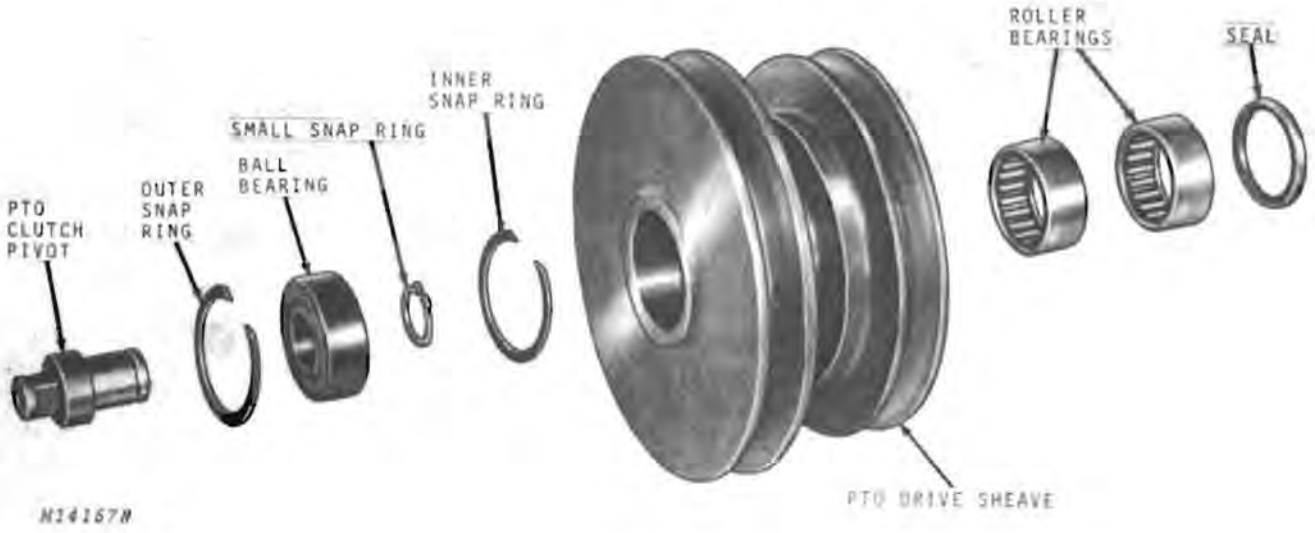


Fig. 1-PTO Clutch Drive Sheave Assembly

The PTO clutch drive sheave assembly, Fig. 1, is of the cup and cone-type. The cone, which has the clutch lining bonded to it, is attached directly to the engine crankshaft. The cup slides on the engine crankshaft and is controlled by the PTO clutch linkage.

Engaging the PTO clutch slides the cup into contact with the cone, starting rotation. Disengaging the PTO clutch slides the cup out of engagement with the cone and into engagement with a brake shoe, stopping rotation.

DIAGNOSING MALFUNCTIONS

Clutch Will Not Engage

Clutch linkage bent or broken.
Fulcrum bolt out of adjustment.
Clutch lining on cone worn excessively.

Clutch Will Not Disengage

Clutch linkage bent or broken.
Fulcrum bolt out of adjustment.

Clutch Will Not Stop Rapidly When Disengaged

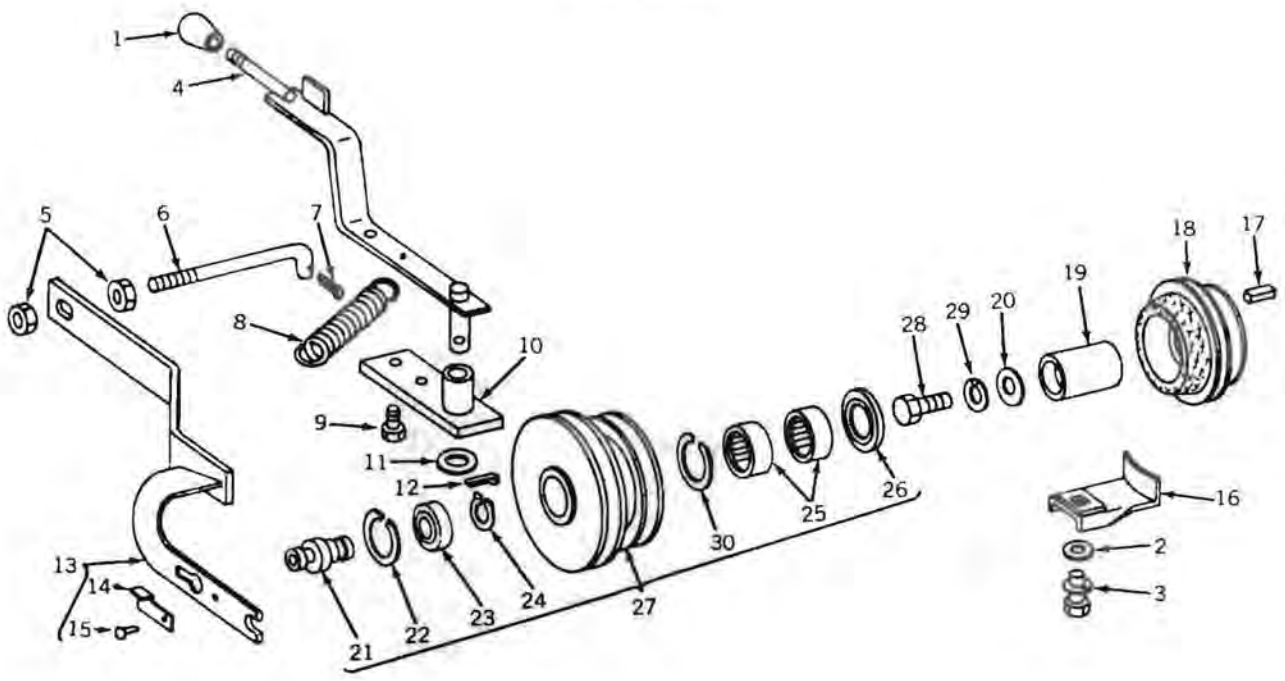
Clutch brake shoe out of adjustment.
Clutch brake shoe lining worn excessively.

PTO Drive Sheave Noisy

Drive sheave bearings dry.
Bearings worn excessively.
PTO clutch pivot bearing worn excessively.

Litho in U.S.A.

REPAIR



M 9843

1—Throw-Out Knob
2—Washer
3—Cap Screw and Lock Washer
4—PTO Clutch Arm
5—Elastic Stop Nut (2 used)
6—PTO Clutch Link
7—Cotter Pin
8—Spring
9—Self-Tapping Screw (2 used)
10—PTO Clutch Arm Support
11—Washer
12—Cotter Pin
13—Throw-Out Arm Assembly
14—Lock-Out Clip
15—Rivet
16—Clutch Brake Shoe
17—1/4-Inch Key
18—Clutch Cone with Lining
19—Bearing Inner Race
20—Retaining Washer
21—PTO Clutch Pivot
22—Outer Snap Ring
23—Ball Bearing
24—Small Snap Ring
25—Needle Bearing (2 used)
26—Oil Seal
27—PTO Clutch Cup with Bearings
28—Cap Screw
29—Lock Washer (2 used)
30—Inner Snap Ring

Fig. 2-Exploded View of PTO Clutch Assembly

Disassembly

Remove clutch throw-out arm assembly (13, Figure 2) from PTO clutch pivot (21) and fulcrum bolt. Loosen clutch brake shoe (16) sufficiently to allow PTO clutch cup (27) to be removed. Remove PTO clutch cup. Remove cap screw (28) and washers (29 and 20) from end of crankshaft and remove bearing inner race (19). Remove clutch cone (18) and key (17). If tractor has hydraulic lift, hydraulic pump drive belt must be removed prior to removing cone.

Remove outer snap ring (22) and press PTO clutch pivot (21) out of PTO drive sheave. Remove inner snap ring (30). Press two needle bearings (25) and oil seal (26) out of PTO drive sheave. Remove small snap ring (24) from PTO clutch pivot and press ball bearing (23) off PTO clutch pivot.

Inspection

Inspect clutch linings and mating surfaces for excessive wear. Inspect bearings, bearing inner race and seal. Inspect PTO brake shoe for excessive wear. Replace parts as necessary.

Inspect clutch linkage and linkage return spring to be certain nothing is bent, broken, or stretched.

Litho in U.S.A.

ASSEMBLY

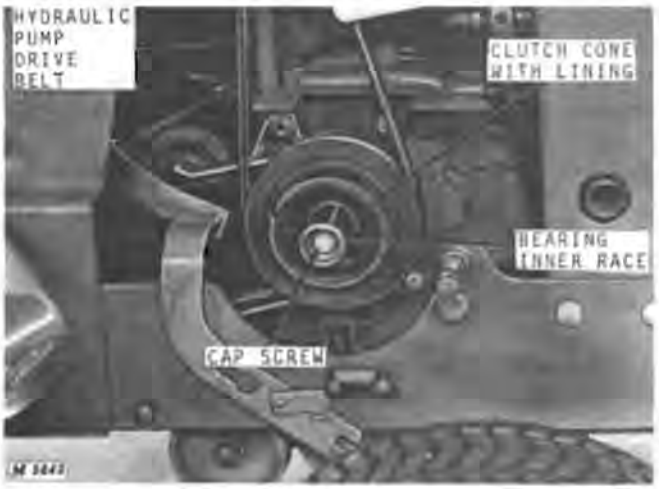


Fig. 3-Clutch Cone and Bearing Inner Race Assembly

Install key in crankshaft and slide clutch cone onto crankshaft. Install belt for hydraulic pump if tractor is so equipped.

Install bearing inner race and secure with retaining washer, lock washer and cap screw, Fig. 3. Tighten securely.

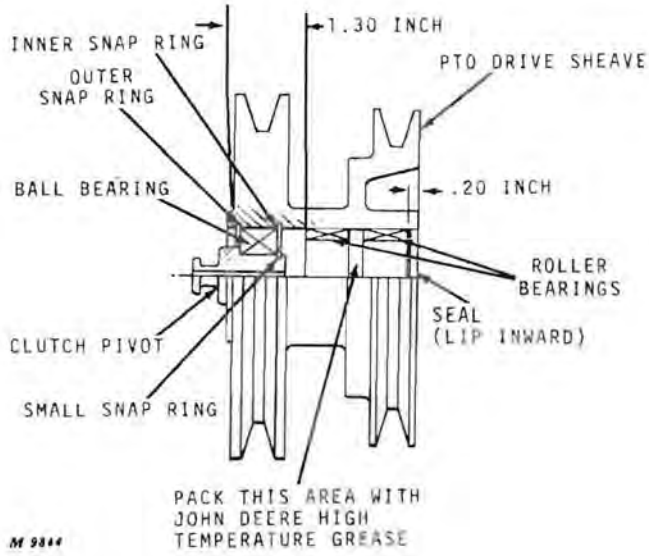


Fig. 4-PTO Drive Sheave Assembly Detail

Press bearings and seal into PTO drive sheave following dimensions given in Fig. 4. Pack bearings with John Deere High Temperature Grease.

Press clutch pivot into ball bearing and secure with small snap ring. Install inner snap ring into PTO drive sheave, press clutch pivot assembly into PTO drive sheave, and secure with outer snap ring, Fig. 4.

Slide complete PTO clutch sheave assembly onto bearing inner race.

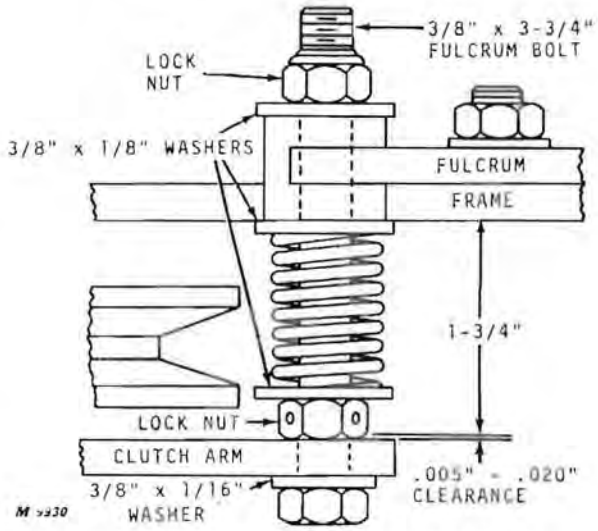


Fig. 5-Spring-Loaded Fulcrum Bolt Detail (Serial No. 250,001-272,000)

Fig. 5 shows the proper assembly and adjustments for the clutch fulcrum bolt.

Connect clutch throw-out arm to PTO clutch pivot and fulcrum.

Check adjustment of clutch components as described on page 50-20-4.

ADJUSTMENT

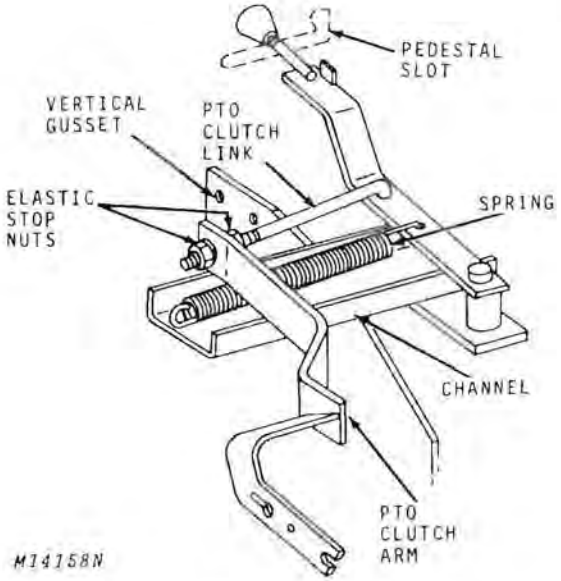


Fig.6-Clutch Linkage

The inner elastic stop nut on the PTO clutch link, Fig. 6, should be screwed on the rod so that 1-5/16 inches of thread remain between the nut and the right-hand end of link. The outer elastic stop nut should be screwed on the link until 5/8 inch of thread remains.

NOTE: Do not thread the nuts on the rod beyond these dimensions because there must be 7/16-inch clearance between nuts.

Make final adjustment to PTO clutch as follows:

The PTO clutch must start to engage when the PTO clutch lever (located on the instrument panel pedestal) is halfway between the engaged and the disengaged position, thus giving 1/2 slot of free travel.

If less than 1/2 slot of free travel is present, lengthen fulcrum bolt, Fig. 5, slightly.

If more than 1/2 slot of free travel is present, shorten fulcrum bolt, Fig. 5, slightly.

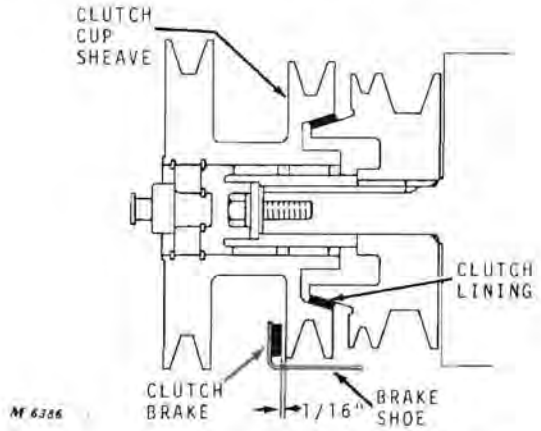


Fig. 5-PTO Clutch Brake Adjustment

With PTO clutch engaged, adjust the brake shoe so there is approximately 1/16-inch clearance between the brake shoe and clutch cup sheave, Fig. 7.

Group 25
PTO CLUTCH
8 hp Tractor (Serial No. 272,001-285,000) and (Serial No. 310,001-320,000)
10 hp Tractor (Serial No. 285,001-310,000)

PRINCIPLE OF OPERATION

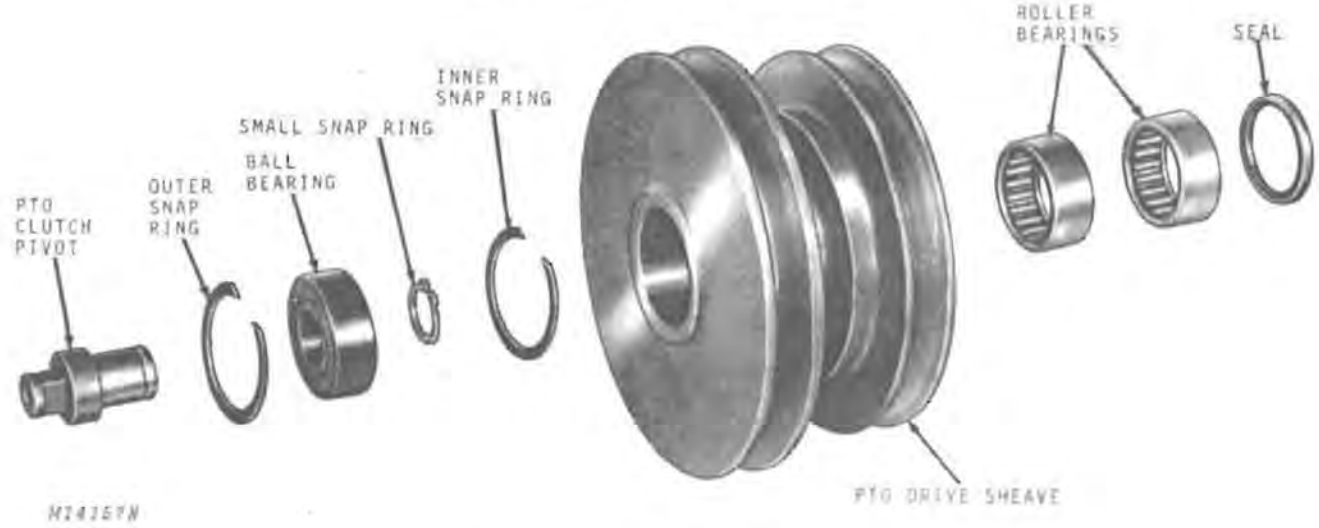


Fig. 1-PTO Clutch Drive Sheave Assembly

The PTO clutch drive sheave assembly, Fig. 1, is of the cup and cone-type. The cone, which has the clutch lining bonded to it, is attached directly to the engine crankshaft. The cup slides on the engine crankshaft and is controlled by the PTO clutch linkage.

Engaging the PTO clutch slides the cup into contact with the cone, starting rotation. Disengaging the PTO clutch slides the cup out of engagement with the cone and into engagement with a brake shoe, stopping rotation.

DIAGNOSING MALFUNCTIONS

Clutch Will Not Engage

Clutch linkage bent or broken.
Fulcrum bolt out of adjustment.
Clutch lining on cone worn excessively.

Clutch Will Not Disengage

Clutch linkage bent or broken.
Fulcrum bolt out of adjustment.

Clutch Will Not Stop Rapidly When Disengaged

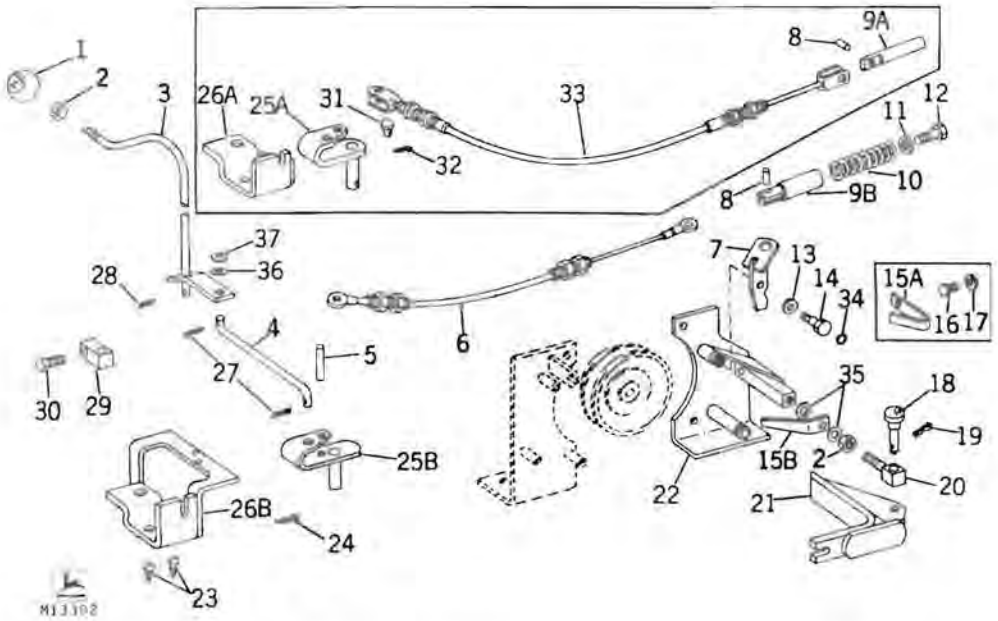
Clutch brake shoe out of adjustment.
Clutch brake shoe lining worn excessively.

PTO Drive Sheave Noisy

Drive sheave bearings dry.
Bearings worn excessively.
PTO clutch pivot bearing worn excessively.

Litho in U.S.A.

REPAIR



1 —Knob
2 —Jam Nut
3 —Handle
4 —Link
5 —Spring Pin
6 —Cable Assembly
7 —Cam Lever
8 —Spring Pin
9A—Spring Rod
9B—Spring Rod
10 —Spring
11 —Flat Washer
12 —Cap Screw
13 —Spring Washer
14 —Shoulder Bolt
15A—V-Spring
15B—Spring
16 —Cap Screw
17 —Lock Washer
18 —Drilled Pin
19 —Spring Locking Pin
20 —Pivot Bolt
21 —Clutch Lever
22 —Bracket
23 —Self-Tapping Screw
24 —Cotter Pin
25A—Pivot
25B—Pivot
26A—Pivot Bracket
26B—Pivot Bracket
27 —Cotter Pin
28 —Cotter Pin
29 —Pivot Block
30 —Cap Screw
31 —Drilled Pin
32 —Cotter Pin
33 —Cable Assembly
34 —Retaining Ring
35 —Flat Washer
36 —Spring Washer
37 —Flat Washer

Fig. 2-Exploded View of PTO Controls

Disassembly

Remove clutch lever (21, Fig. 2) from pivot bolt (20) and drilled pin (18).

Loosen clutch brake shoe (15, Fig. 3) sufficiently to allow PTO clutch cup (8, Fig. 3) to be removed. Remove PTO clutch cup. Remove cap screw (9) and washers (10 and 11, Fig. 3) from end of crankshaft and remove bearing inner race (12). Remove clutch cone (13) and key (14).

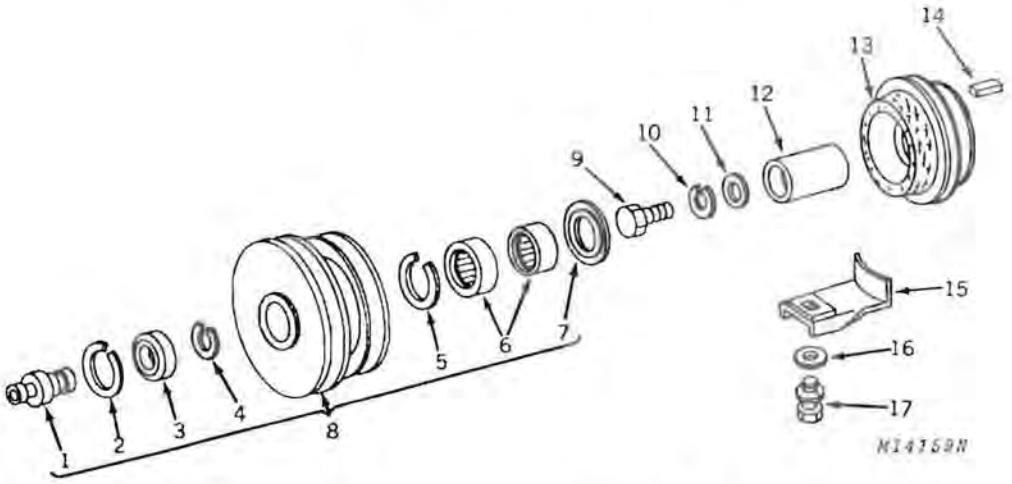
Remove outer snap ring (2, Fig. 3) and press PTO clutch pivot (1) out of PTO clutch cup. Remove inner snap ring (5). Press two needle bearings (6) and oil seal (7) out of PTO clutch cup. Remove small snap ring (4) from PTO clutch pivot and press ball bearing (3) off PTO clutch pivot.

Inspection

Inspect clutch linings and mating surfaces for excessive wear. Inspect bearings, bearing inner race and seal. Inspect PTO brake shoe for excessive wear. Replace parts as necessary.

Inspect clutch linkage and linkage return spring to be certain nothing is bent, broken, or stretched.

REPAIR—Continued



1—PTO Clutch Pivot
2—Outer Snap Ring
3—Ball Bearing
4—Small Snap Ring
5—Inner Snap Ring
6—Needle Bearing (2 used)
7—Oil Seal
8—PTO Clutch Cup with Bearings
9—Cap Screw
10—Lock Washer (2 used)
11—Retaining Washer
12—Bearing Inner Race
13—Clutch Cone with Lining
14—1/4-Inch Key
15—Clutch Brake Shoe
16—Washer
17—Cap Screw and Lock Washer

Fig. 3-Exploded View of PTO Clutch

ASSEMBLY

Install key in engine crankshaft and slide clutch cone onto crankshaft.

Install bearing inner race and secure with retaining washer, lock washer and cap screw.

Press bearings and seal into PTO clutch cup following dimensions given in Fig. 4. Pack bearings with John Deere High-Temperature Grease (AT30408).

Press clutch pivot into ball bearing and secure with small snap ring. Install inner snap ring into PTO clutch cup. Press clutch pivot assembly into PTO clutch cup and secure with outer snap ring, Fig. 4.

Slide complete PTO clutch cup assembly onto bearing inner race.

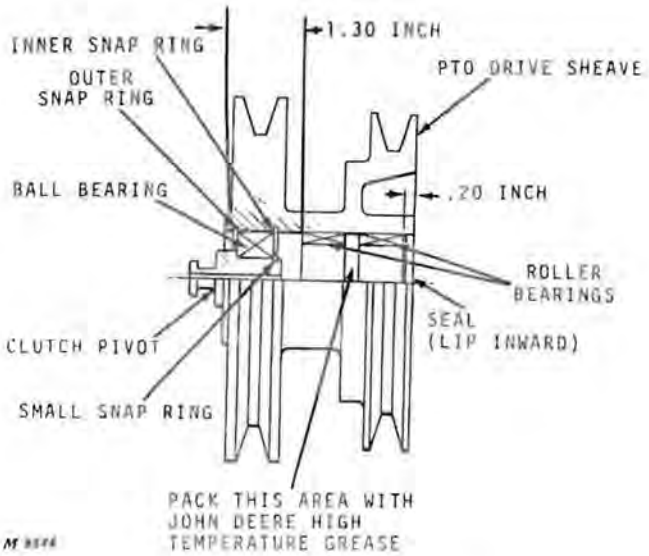


Fig. 4-PTO Drive Cup Assembly

ASSEMBLY—Continued

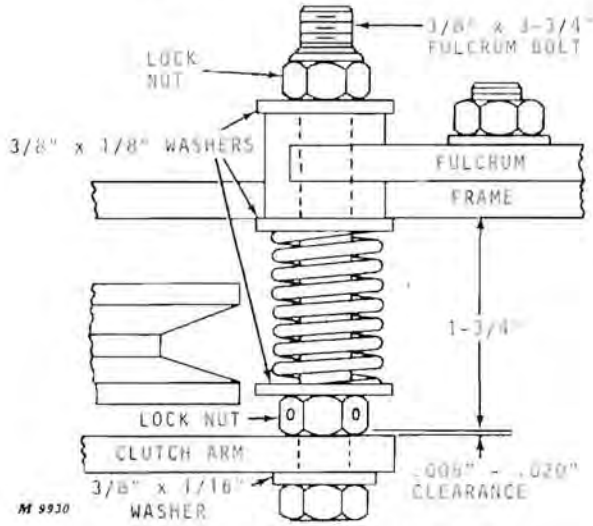


Fig. 5-Spring-Loaded Fulcrum Bolt

Replace clutch fulcrum with new spring-loaded type, Fig. 5, if tractor is not already equipped with this fulcrum. Adjust dimensions as shown in Fig. 5.

ADJUSTMENT

Adjusting PTO Clutch

Fig. 6-Adjusting PTO Clutch

1. Move PTO clutch lever on the control panel to the disengaged position (down).

2. Loosen front jam nut and tighten rear jam nut on cable conduit, Fig. 6, until 1/8-inch clearance exists between the spring pin and the cam lever when the PTO clutch lever is moved to the engaged position (up).

3. Check clutch engagement and disengagement by engaging and disengaging PTO clutch lever on the control panel.

Adjusting PTO Brake

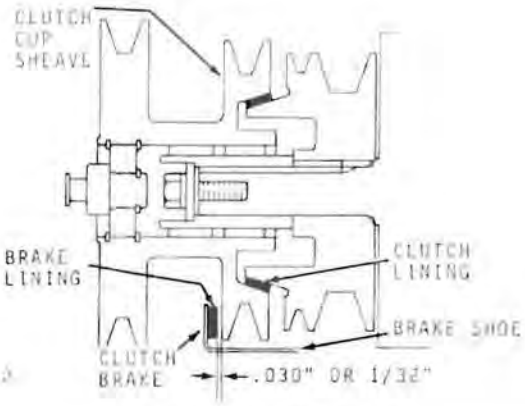


Fig. 7-Adjusting PTO Brake

The PTO clutch brake stops the mower blades, snow thrower rotor, rotary tiller tines and any of the PTO-operated equipment soon after disengaging the drive with the PTO clutch lever.

With the engine shut off, engage the PTO clutch lever (up position) and check the distance between the brake and clutch cup sheave using a blade-type feeler gauge. When properly adjusted, the distance should be .030-inch or 1/32-inch, Fig. 7, when the clutch is engaged.

Fig. 8-PTO Brake Adjusting Cap Screw

If adjustment is required, use a 1/2-inch socket with extension to loosen cap screw, Fig. 8. Slide brake shoe in slotted hole until proper adjustment is obtained. Tighten cap screw firmly.

Group 30
PTO CLUTCH
10 hp Tractor (Serial No. 320,001-)

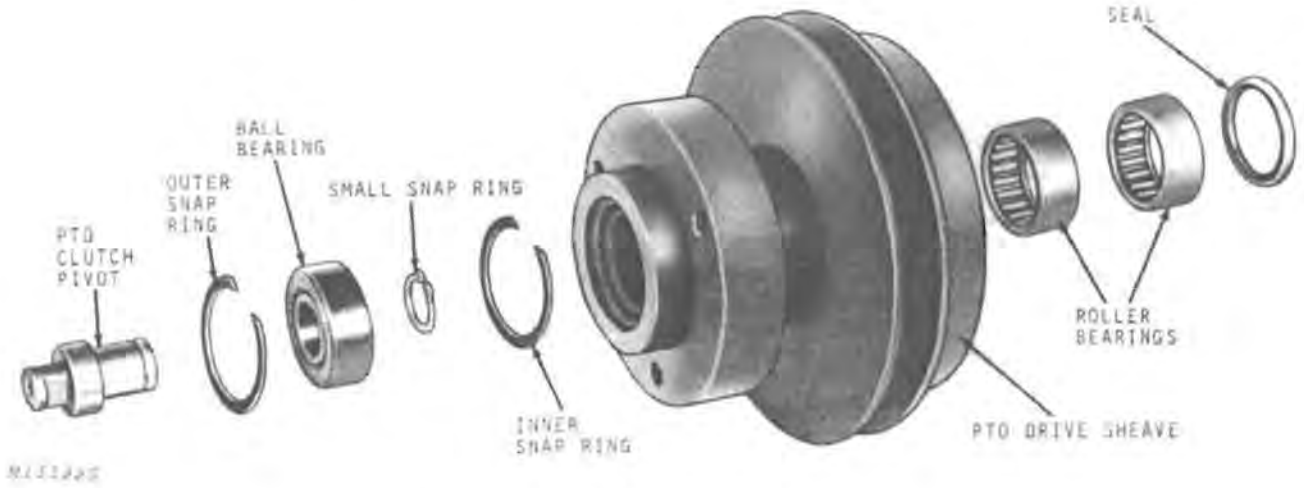


Fig. 1-PTO Clutch Drive Sheave Assembly

PRINCIPLE OF OPERATION

The manual PTO clutch used on the 110 Tractor, (Serial No. 320,001-) is of the cup and cone-type. The cone, which has the clutch lining bonded to it, is attached directly to the engine crankshaft. The cup, (PTO drive sheave), Fig. 1, slides on the crankshaft, and is controlled by the PTO clutch linkage.

Engaging the PTO clutch, slides the cup into contact with the cone, starting rotation. Disengaging the PTO clutch slides the cup out of engagement with the cone and into engagement with the brake shoe, stopping rotation.

DIAGNOSING MALFUNCTIONS

Clutch Will Not Engage

Clutch linkage bent or broken.

Clutch linkage out of adjustment.

Clutch lining on fulcrum bolt worn excessively.

Clutch Will Not Disengage

Clutch linkage bent or broken.

Clutch linkage out of adjustment.

Clutch Will Not Stop Rapidly When Disengaged

Clutch brake shoe out of adjustment.

Clutch brake shoe lining worn excessively.

PTO Drive Sheave Noisy

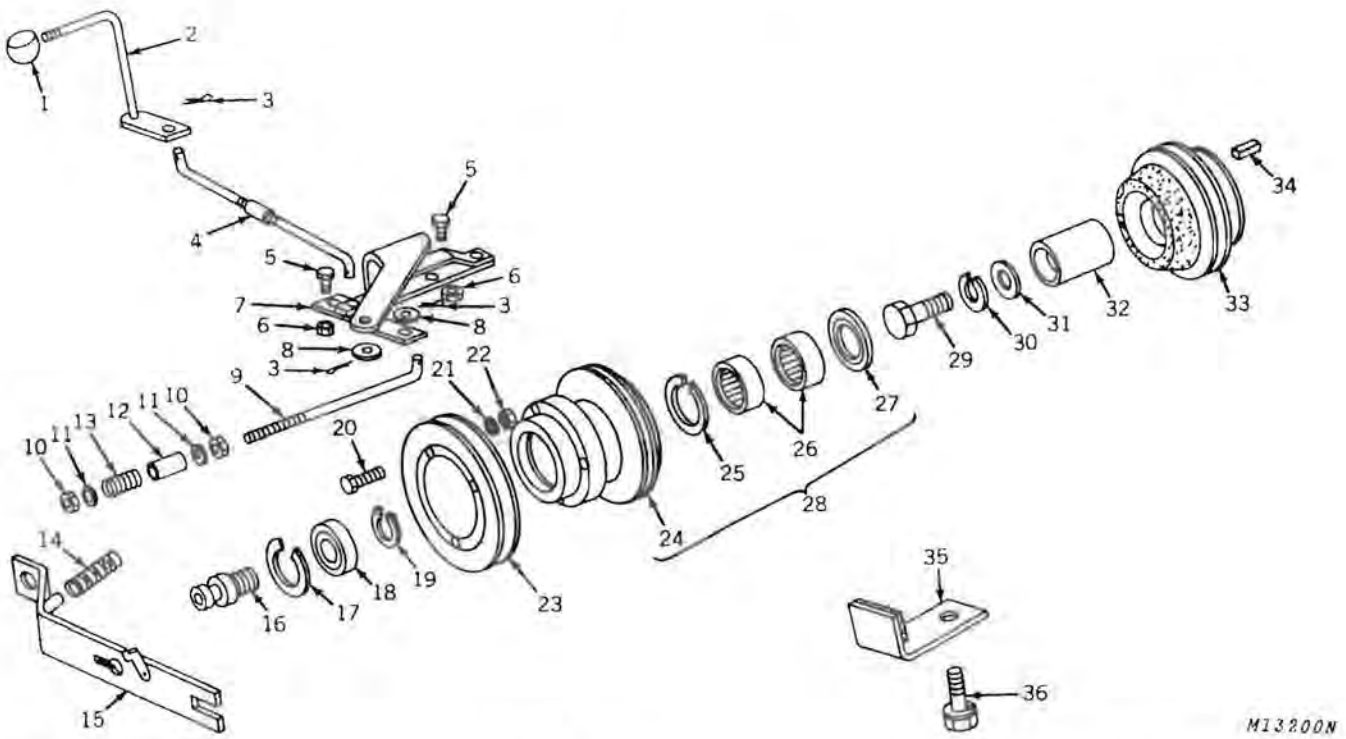
Drive sheave bearing dry.

Bearing worn excessively.

PTO clutch pivot bearing worn excessively.

Litho in U.S.A.

REPAIR



1—Knob
2—Handle
3—Cotter Pin
4—Rod
5—Bolt
6—Nut
7—Pivot
8—Washer
9—Adjusting Link
10—Adjusting Lock Nut
11—Washer
12—Spacer
13—Spring
14—Brake Spring
15—Clutch Arm
16—PTO Clutch Pivot
17—Outer Snap Ring
18—Ball Bearing
19—Small Snap Ring
20—Sheave Bolt
21—Lock Washer
22—Nut
23—Sheave
24—PTO Clutch Cup
25—Inner Snap Ring
26—Needle Bearing (2 used)
27—Oil Seal
28—PTO Clutch Cup with Bearings
29—Cap Screw
30—Lock Washer
31—Retaining Washer
32—Bearing Inner Race
33—Clutch Cone With Lining
34—Key
35—Clutch Brake Shoe
36—Cap Screw and Lock Washer

Fig. 2-Exploded View of PTO Clutch Assembly

Disassembly

Remove clutch arm assembly (15, Fig. 2) from PTO clutch pivot (16) and fulcrum bolt. Loosen clutch brake shoe (35) sufficiently to allow PTO clutch cup (28) to be removed. Remove PTO clutch cup. Remove cap screw (29) and washers (30 and 31) from end of crankshaft and remove bearing inner race (32). Remove clutch cone (33) and key (34).

Remove outer snap ring (17) and press PTO clutch pivot (16) out of PTO clutch cup. Remove inner snap ring (25). Press two needle bearings (25) and oil seal (27) out of PTO drive sheave. Remove small snap ring (19) from PTO clutch pivot and press ball bearing (18) off PTO clutch pivot.

Inspection

Inspect clutch linings and mating surfaces for excessive wear. Inspect bearings, bearing inner race and seal. Inspect PTO brake shoe for excessive wear. Replace parts as necessary.

Inspect clutch linkage and linkage return spring to be certain nothing is bent, broken or stretched.

ASSEMBLY

Fig. 3-Clutch Cone and Bearing Inner Race Assembly

Install key in crankshaft and slide clutch cone onto crankshaft.

Install bearing inner race and secure with retaining washer, lock washer and cap screw, Fig. 3, and tighten securely.

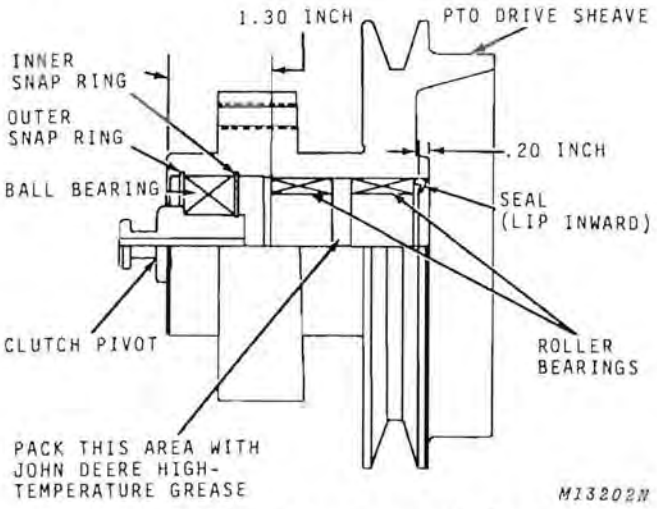


Fig. 4-PTO Drive Sheave Assembly Detail

Press bearings and seal into PTO drive sheave following dimensions given in Fig. 4. Pack bearing with John Deere High-Temperature Grease or equivalent. See page 10-20-3. Press clutch pivot into ball bearing and secure with small snap ring. Install inner snap ring into PTO drive sheave, and secure clutch pivot and ball bearing with outer snap ring. Fig. 4.

Slide complete PTO clutch sheave assembly onto bearing inner race.

ADJUSTMENT

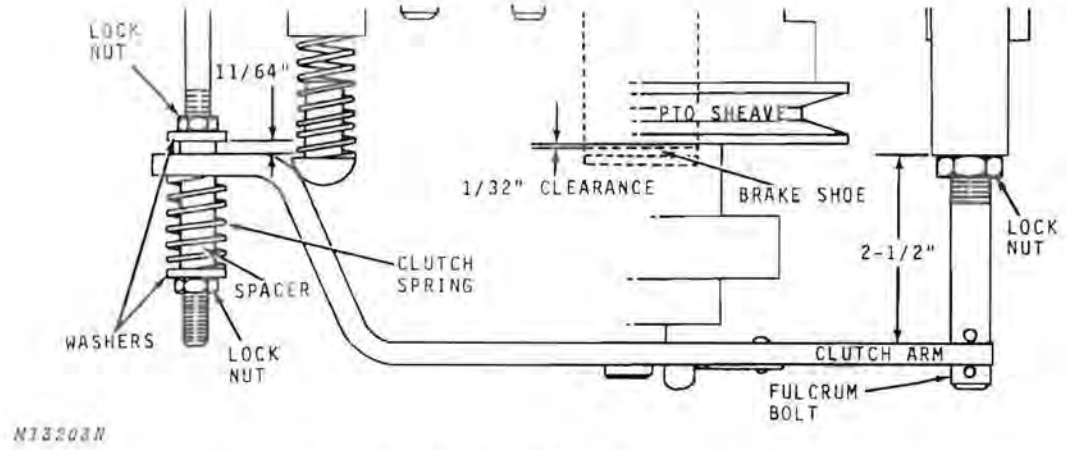


Fig. 5-PTO Clutch and Brake Adjustments

Loosen lock nut on fulcrum bolt, and adjust fulcrum bolt to preliminary setting of 2-1/2 inches shown in Fig. 5.

Adjust clutch spring position by drawing up lock nuts and washers tight against spacer.

With PTO in the engaged position, adjust for 11/64-inch gap between clutch arm and washer. The clutch arm must be kept approximately parallel with the clutch sheave.

If necessary, readjust fulcrum bolt to keep clutch arm parallel with the clutch sheave, and still retain correct gap between clutch arm and washer. Tighten lock nut on fulcrum bolt.

With clutch engaged, loosen cap screw on PTO brake. Adjust to 1/32-inch gap between PTO sheave and the brake shoe, then tighten cap screw.

NOTE: The brake must be readjusted every time the PTO clutch is adjusted.

Section 60
HYDRAULIC SYSTEM
Group 5
GENERAL INFORMATION

TABLE OF CONTENTS

Litho in U.S.A.

PRINCIPLE OF OPERATION

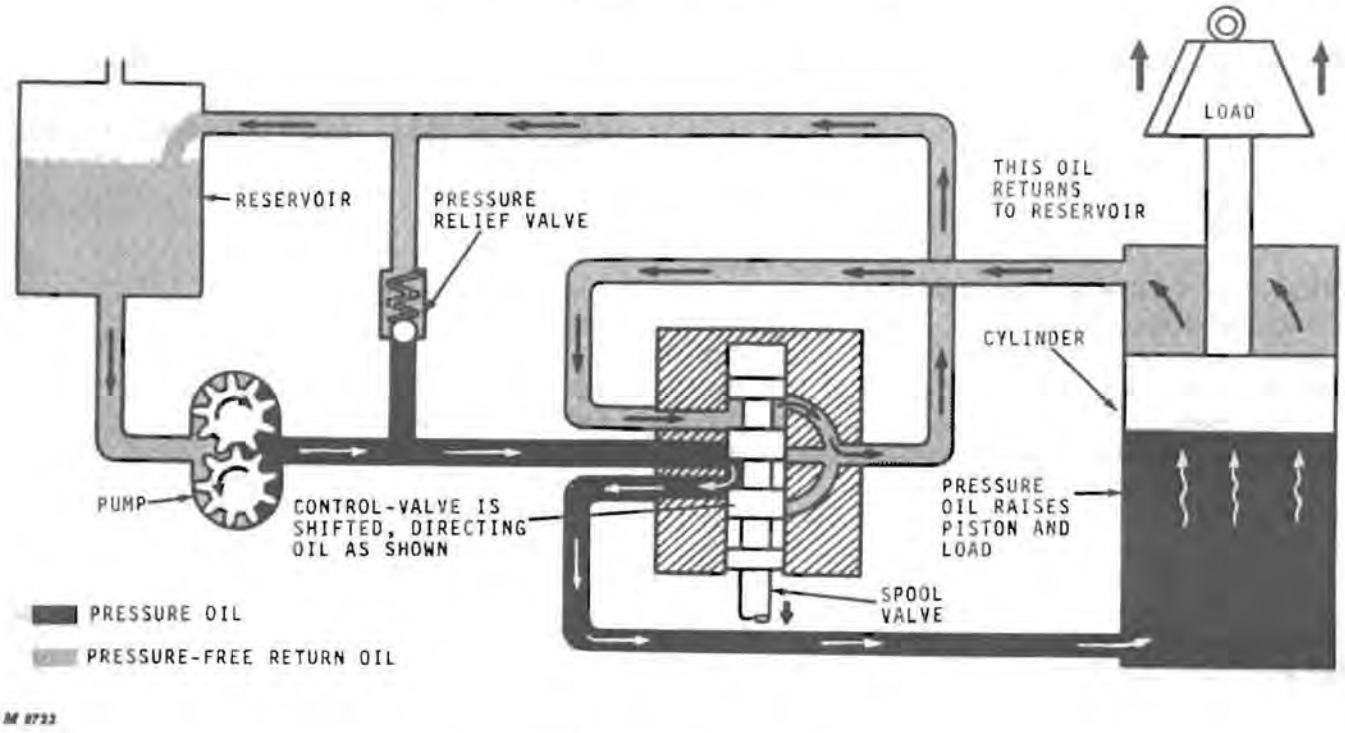


Fig. 1-Open Center System in Operation-Raising a Load

110 Tractors (Serial No. 260,001-272,000) may be equipped with a hydraulic lift system consisting of a pump, control valve, reservoir, cylinder and the lines connecting these parts, Fig. 1.

The hydraulic system is of the open-center design. This means that there is a continuous flow of oil from the reservoir to the pump, to the control valve and back to the reservoir. (In a closed-center hydraulic system there is no flow of oil when the control valve is in a neutral position).

When the lift lever is raised, the valve spool moves outward. The positive displacement gear pump forces oil into the center input passage of the control valve. Pressurized oil is then distributed through the valve ports into work port "B" and the double-acting cylinder, Fig. 2.

As the pressurized oil moves the piston through its stroke, oil from the opposite end of the cylinder leaves the cylinder and enters the control valve at port "A," Fig. 2, and continues through the return passage of the control valve and back to the reservoir.

The direction of oil flow is reversed through the valve and cylinder when the lift lever is lowered. This action moves the spool inward, thus reversing oil flow by opening and closing the proper passages.

When the lift lever is released, the spool is returned to the center (neutral) position by the spool springs. In the neutral position the oil is circulated through the valve and back to the reservoir.

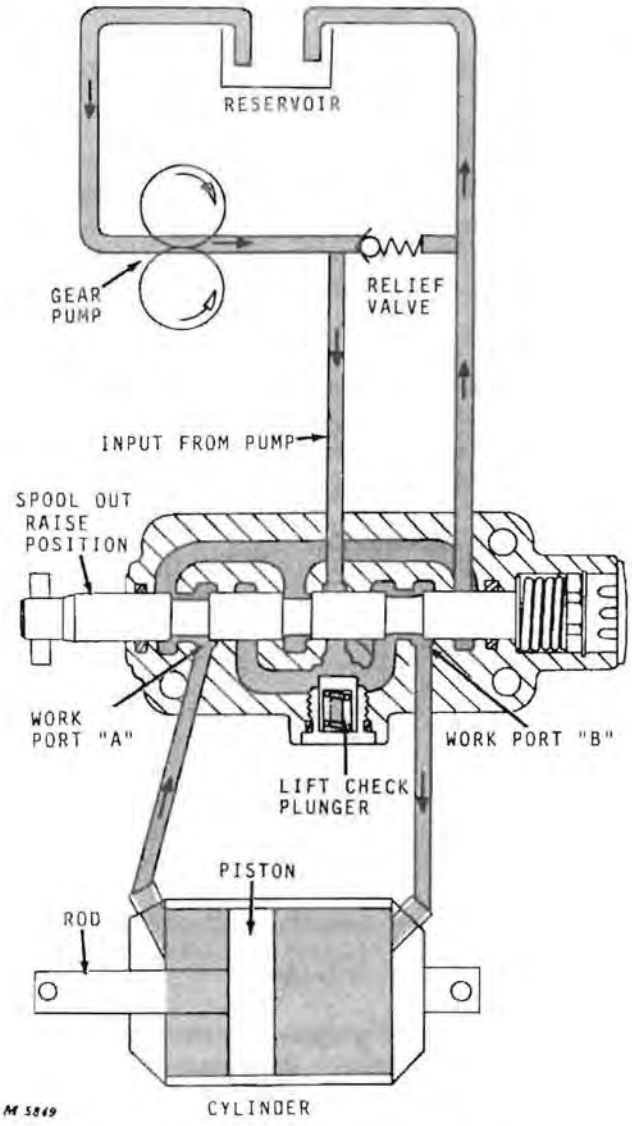


Fig. 2-Oil Flow Schematic - Raised Position

Although the hydraulic cylinder is double-acting, slotted links prevent the retracting cylinder from exerting down pressure when front or rear mounted equipment and the mower is lowered. All mounted equipment is lowered by its own weight and allowed to "float" in the lowered position.

The relief valve opens when operating pressure reaches the calibrated setting. See "Specifications," page 60-15-7.

The filler plug also serves as a breather for the system. A small screen mesh located in the center of the filler plug filters air entering the system. Be sure breather is cleaned when servicing hydraulic unit.

ADDING LUBRICANT

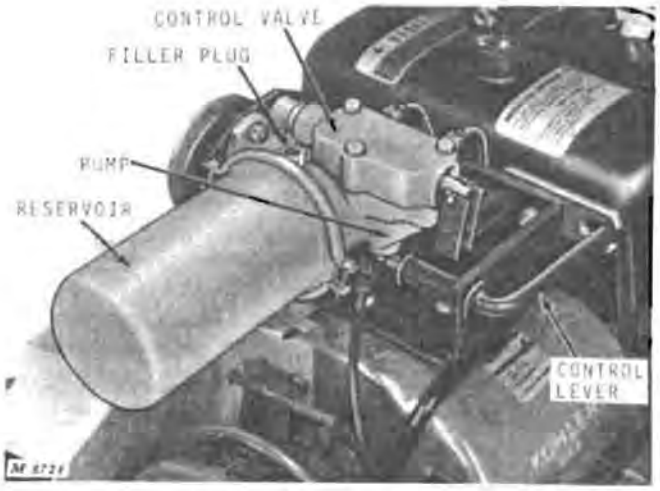


Fig. 3-Control Valve, Pump and Reservoir

When servicing the hydraulic system, remove filler plug, Fig. 3, and check fluid level. It should be 1 to 1-1/2-inches from top of reservoir. When required, add John Deere All-Weather Hydrostatic Fluid or an equivalent Automatic Transmission Fluid - Type "A" or "F". Use only fluids of this type to prevent cavitation and foaming of oil.

The hydraulic system does not require periodic changing of the lubricant. However, if the unit is disassembled for servicing, new oil should be used. Refer to Section 10, Specifications, for system capacity.

IMPORTANT: Never allow dirt to enter the hydraulic system.

Owners should be instructed to check the hydraulic fluid level every 25 hours. The breather in the filler plug should be cleaned every 25 hours.

SYSTEM ANALYSIS

Here are three of the most common complaints connected with the hydraulic system. However, before servicing the system, be sure to check page 60-5-6 for diagnosing other hydraulic system malfunctions.

Oil Leakage

A slight amount of oil leakage below the control valve and pump is considered normal. Advise customer to ignore this condition except to wipe these areas occasionally to prevent accumulation of dust and dirt above the engine.

Fig. 4-Faulty O-ring Causing Oil Leakage

Leakage can be caused by O-rings which are worn, damaged or have paint on them, Fig. 4.

Loss of Hydraulic Pressure

Fig. 5-Defective Pump Diaphragm and Pump Body

Loss of hydraulic pressure and failure to lift can be caused by a scored diaphragm or pump body, Fig. 5. Body wear and loss of pressure also can be caused by prolonged periods of operation with excessive drive belt tension. Excessive belt tension causes rapid bearing wear which allows the pump gears to contact and wear the body. Cavitation, foaming oil or slow hydraulic lift operation may indicate a scored body.

Loss of hydraulic pressure also can be caused by normal wear of the pump gear teeth. This condition can be detected by slow operation of the hydraulic lift, cavitation or foaming oil.

Erratic Lift Operation

Fig. 6-Marred or Scratched Lift Check Plunger Causes Load to Lower When Lift Lever is Raised

Scratched or pitted surfaces on lift check plunger, Fig. 6, and seat will allow work load to lower when spool is in slow raise position.

Weak or broken centering spool springs can also cause the spool to move out of position. This causes self-actuation of the control valve. Check the spool springs when lift lever action seems to be slow. Also check lift lever stop adjustment, page 60-15-6.

When the workload drops for no apparent reason, check for oil around the cylinder connections. If connections are not losing oil, the piston O-ring may be leaking. The hydraulic cylinder is not serviceable and must be replaced when found defective.

TESTING

Pressure Gauge

Fig. 7-Pressure Gauge Installed on Valve

A pressure gauge, Fig. 7, or a hydraulic test unit incorporating a pressure gauge and flow meter, Fig. 8, can be used to test hydraulic pressure.

Before making tests, check the reservoir for proper oil level. Inspect hoses and connections for leaks or damage.

NOTE: Run the tractor for about five minutes at 1/2 throttle to bring the hydraulic oil to operating temperature. Operate hydraulic control lever several times during the warm-up period.

Before stopping engine, lower hydraulic lift lever until cylinder is fully retracted.

Wipe dirt and dust from unit and hoses with a clean cloth.

Hydraulic Test Unit

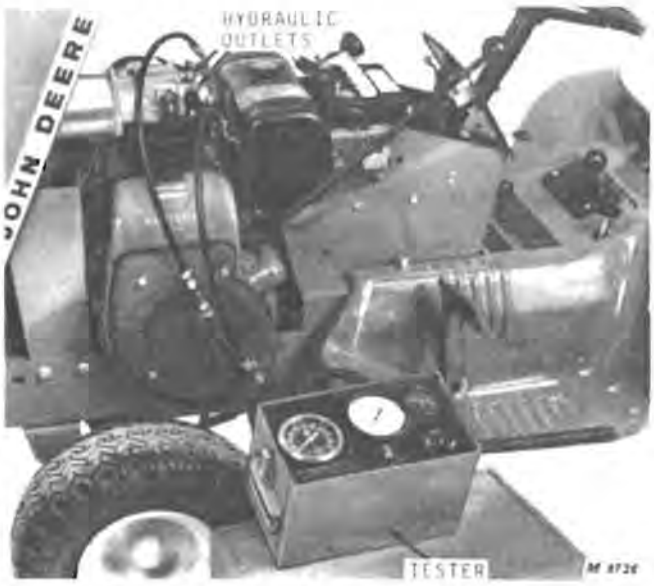


Fig. 8-OTC Model No. Y-90 Hydraulic Tester Installed for Flow and Pressure Test

The following illustrations are reference guides for connecting a pressure gauge or hydraulic tester to check system pressure. The Owatonna Tool Co. Model No. Y-90 Hydraulic Tester, Fig. 8, can also be used to measure flow. Refer to instructions supplied by test equipment manufacturer.

After gauge or hydraulic tester is connected, start engine and raise throttle lever until engine is running at 3600 rpm. Raise hydraulic lift lever and observe reading. Refer to "Specifications," page 60-15-7, for pump output. Refer to "Diagnosing Malfunctions," page 60-5-6, to correct low system pressure.

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DIAGNOSING MALFUNCTIONS

Pump, Valve and Reservoir

Noisy Pump Caused by Cavitation

Fluid low in reservoir.

Improper viscosity oil.

Oil Screen in reservoir plugged.

Oil in System Gets Hot

Fluid low in reservoir.

Contaminated oil.

Relief valve setting too high or too low.

Improper viscosity oil.

Hoses restricted (crimped or pinched).

Leaks.

Pump Shaft Seal Leaking

Worn shaft seal.

Broken diaphragm seal or backup gasket.

Bearing out of position.

Excessive internal wear.

Foaming Oil

Improper viscosity oil.

Low System Pressure

Fluid low in reservoir.

Loose, worn or damaged drive belt.

Weak relief valve spring or worn adapter.

Loose drive sheave (key missing).

Loose relief valve seat.

External Leakage

Loose screws.

Damaged O-rings.

Valve spool worn or damaged.

Work Load Lowers with Spool in "Slow-Raise" Position

Damaged lift check plunger.

Damaged lift check seat.

Damaged O-ring on lift check plug.

Load Drops with Spool in Center Position

Valve spool worn or damaged.

Sticky Valve Spool

Paint on exposed end of spool.

Bent spool.

Hydraulic System Inoperative

Loose or worn drive belt.

Loose drive sheave (key missing).

Loose relief valve seat.

Cracked Pump Body

Excessive relief valve pressure.

Cylinder

Load Drops

Cylinder O-ring worn or damaged.

Loose hose fittings.

Worn or damaged piston O-ring.

Oil Spews Out of Breather

Reservoir over-filled.

Oil foaming.

Breather-filler plug partially plugged.

Group 10
CONTROL VALVE

GENERAL INFORMATION

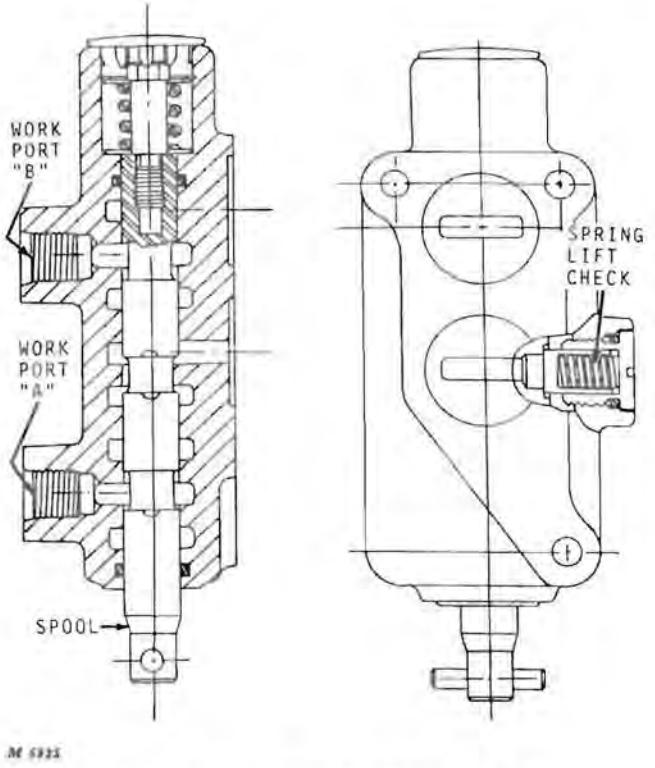
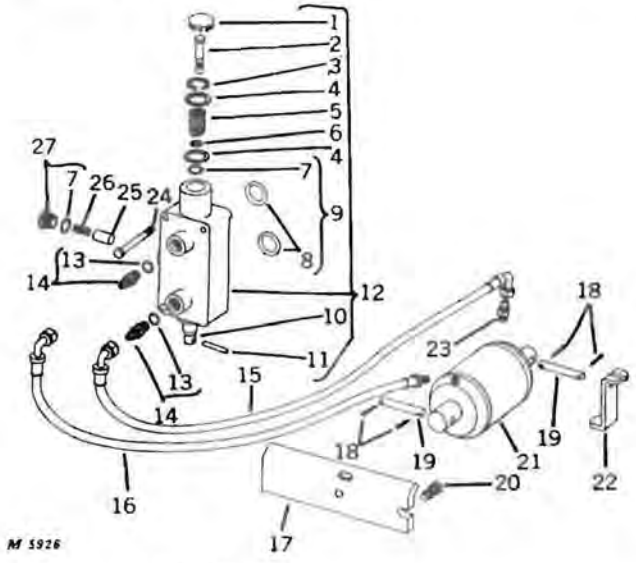


Fig. 1-Cutaway View of Control Valve

The open center valve, Fig. 1, provides a continuous flow of oil from the reservoir, to the pump, to the control valve and back to the reservoir when the lift lever is in neutral position and the tractor engine is running.

REPAIR

Before removing and disassembling the control valve, Fig. 2, be sure to check "Diagnosing Malfunctions," page 60-5-6 for all possible external causes of difficulty.



1—Button Plug
2—Spool Screw
3—Snap Ring
4—Washer (4 used)
5—Inner and Outer Springs
6—Spool Spacer
7—O-Ring (3 used)
8—Control Valve O-Ring (2 used)
9—Control Valve O-Ring Kit
10—Spool
11—Pin
12—Control Valve Assembly
13—O-Ring for Connector (2 used)
14—Control Valve Connectors (2 used)
15—Lower Hose
16—Upper Hose
17—Cylinder Bracket
18—Cotter Pin (4 used)
19—Cylinder Pin (2 used)
20—Self-Tapping Screw (2 used)
21—Hydraulic Cylinder
22—Locking Clip
23—Cylinder Connector
24—Cap Screw (3 used)
25—Lift Check Plunger
26—Lift Check Spring
27—Lift Check Plug

Fig. 2-Exploded View of Control Valve and Related Parts

Removing Valve from Tractor

Lower equipment to ground and with engine stopped, move control lever up and down to release all pressure in system.

Wipe all dirt from connections on valve body. Disconnect hoses at valve body. Cap connections on valve body and plug hoses.

Loosen idler, remove drive belt, drive sheave and key. Remove two mounting bolts.

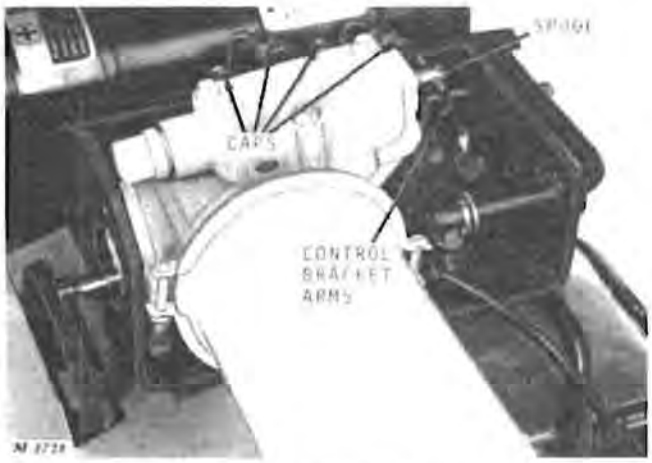


Fig. 3-Removing Pump

Twist unit to disconnect end of spool from control bracket arms, Fig. 3 and remove hydraulic unit.

Thoroughly wash outside of assembly with clean, safe cleaning solvent.

Drain reservoir before removing valve assembly from pump body.

Removing Valve Assembly from Pump

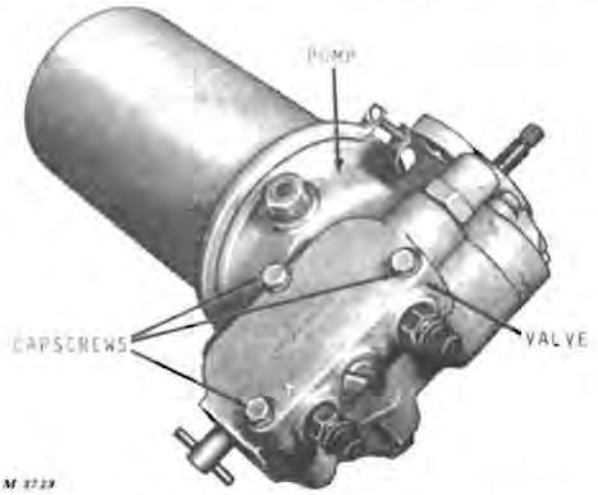


Fig. 4-Separating Valve Assembly from Pump

Remove valve assembly from pump by removing three cap screws, Fig. 4, which hold valve assembly to pump back plate.

Discard O-rings between the valve body and pump back plate.

Disassembling Valve

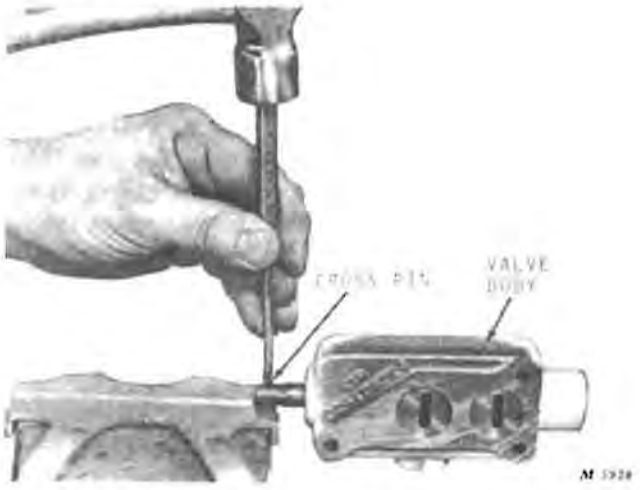


Fig. 5-Removing Cross Pin From Spool

Rest small diameter of spool end on a partially closed vise and very carefully remove cross pin, Fig. 5.

IMPORTANT: Use special care to prevent marring or bending spool.

Removing Valve Spool

Fig. 6-Removing Valve Spool from Valve Body

Remove vent cap from valve body. Pull valve spool assembly, Fig. 6.

Removing Centering Spring

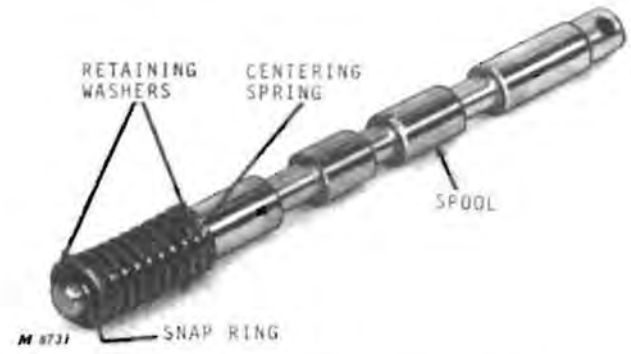


Fig. 7-Removing Spool Centering Spring

Do not disassemble spool unless the spool centering spring is broken. Whenever disassembly is necessary, remove snap ring. Remove spring and retaining washers from spool, Fig. 7.

Removing O-Rings and Lift Check

Fig. 8-Removing O-Rings and Lift Check Assembly

Remove and discard O-rings from inside diameter of each end of spool bore, Fig. 8.

With a large screwdriver or impact tool, loosen and remove plug, lift check spring and plunger. Discard O-ring from slotted plug.

INSPECTION

Valve Housing

Fig. 9-Checking Valve Housing for Wear and Damage

Check valve housing for cracks or damaged threads. Inspect inside diameter of valve for scratches or excessive wear, Fig. 9.

The lift check seat is machined into the valve body. Inspect lift check seat in body for damage, Fig. 9. It is important that the lift check seat be smooth.

Spool Plunger and Springs

Remove burrs from spool with fine emery cloth. Inspect spool for wear, scratches or other damage. The housing and spool must always be replaced as a matched assembly.

Inspect lift check plunger for scratches or unevenness of seating surface.

Whenever lift check seat is scratched or pitted, dress seat surface until plunger seating area is smooth and even.

Inspect inner and outer spool centering springs for breakage. Replace weak or broken springs.

ASSEMBLY

NOTE: Replace all control valve O-rings with new O-rings whenever the valve is disassembled for service.

Installing O-Rings in Valve Body

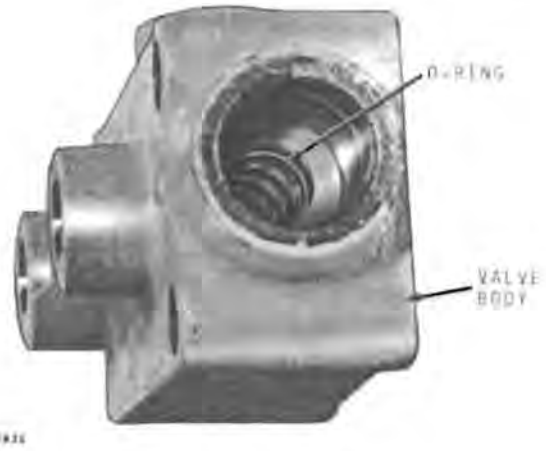


Fig. 10-Valve Body O-Rings

Apply oil to new O-rings and install in valve body, Fig. 10. Always use new O-rings.

Installing Lift Check Plug

Install new O-ring on lift check plug, Fig. 11. Replace lift check plunger or spring if they appear to be damaged or worn. Install lift check plunger and spring and insert plug, Fig. 11. Tighten plug firmly.

Fig. 11-Lift Check Assembly

Assembling Spool

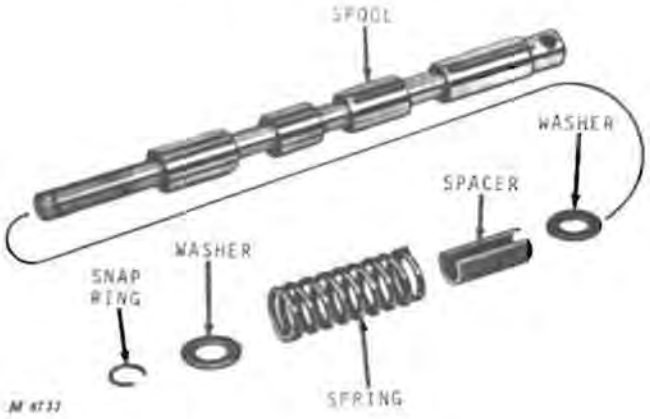


Fig. 12-Spool Assembly

Assemble spool in the order shown above, Fig. 12. Handle the spool carefully. Marred surfaces of the spool will cause binding within the body. Any damage to the spool or body will require replacement of the valve body and spool assembly because they are not supplied separately.

Installing Spool

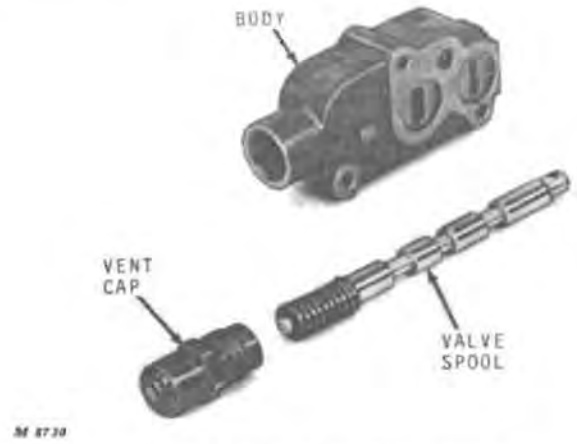


Fig. 13-Installing Spool-90-Degree Unit

Apply oil to O-rings in spool bore and insert spool assembly from spring end of valve body, Fig. 13. Insert spool slowly while rotating spool so as not to cut O-ring as spool lands pass through O-ring. With spool in place, install vent cap and tighten firmly.

Installing Cross Pin

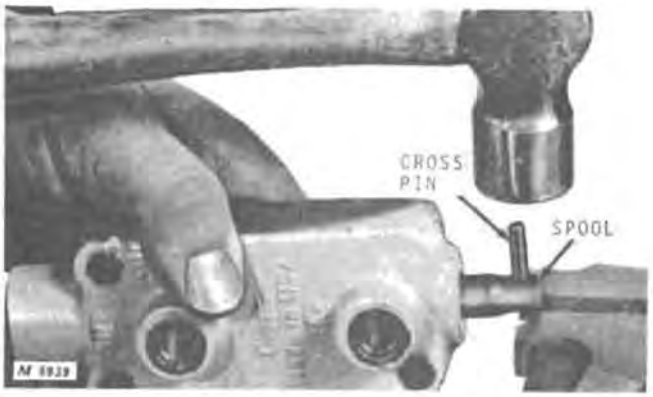


Fig. 14-Installing Cross Pin in Spool

Rest small end of spool on partially closed vise, Fig. 14, and install cross pin.

Installing Valve Assembly on Pump

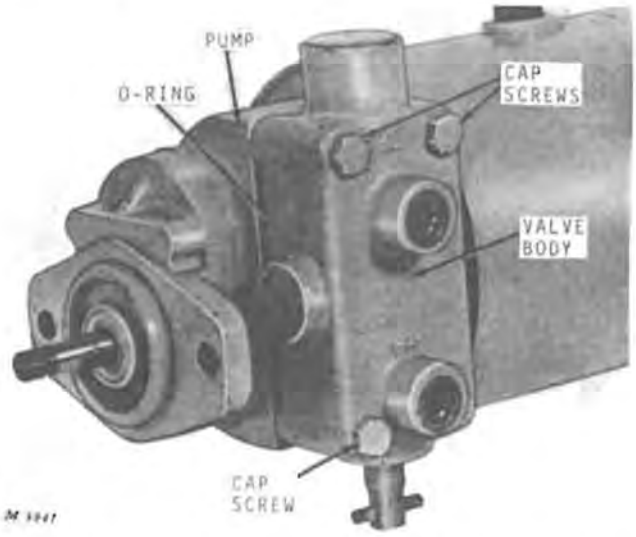


Fig. 15-Installing Valve Assembly to Pump Back Plate

With new O-rings between valve body and back plate, secure valve assembly to pump back plate with three cap screws, Fig. 15.

Refer to "Bolt Torque Chart," page 10-10-4, and tighten three cap screws accordingly.

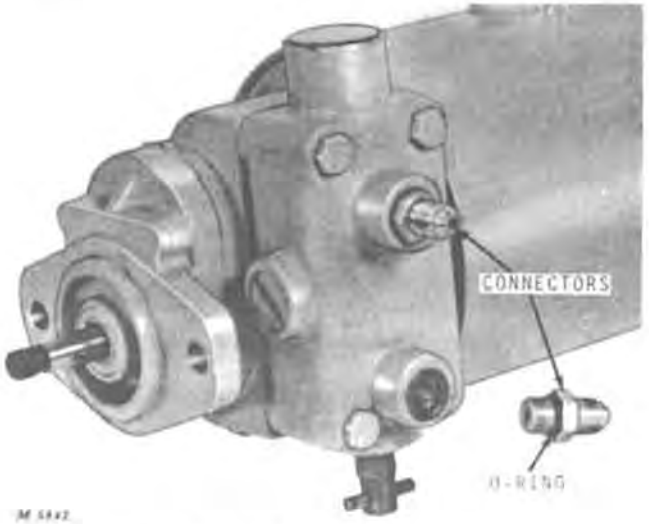


Fig. 16-Hose Connectors

Place new O-rings on connectors and screw connectors into valve body, Fig. 16. Tighten connectors firmly.

Installing Pump Base

Fig. 17-Attaching Pump Base

Place pump base over studs. Install lock washers and nuts on studs, Fig. 17, and torque to 360 in-lbs.

Installing Pump

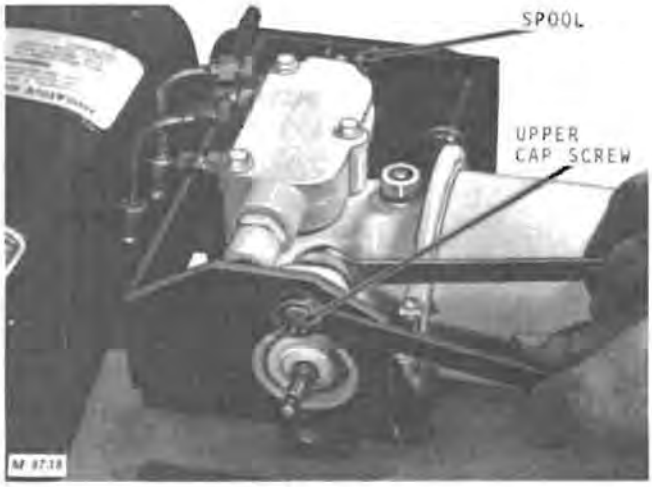


Fig. 18-Attaching Pump to Base

Insert end of spool in lever arms and install upper flange cap screw, Fig. 18. Do not tighten until bottom cap screw has been installed. See Fig. 19.

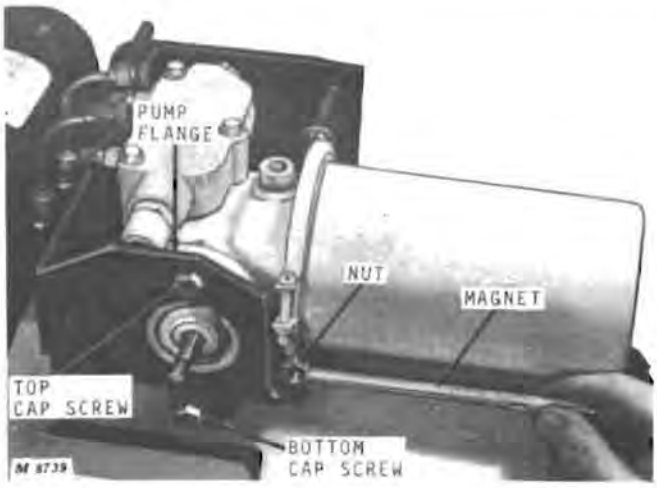


Fig. 19-Installing Lower Pump Flange Cap Screw

Use either a small magnet, Fig. 19, or your fingers to insert the retaining nut between the pump flange and body. Tighten both upper and lower cap screws firmly.

Installing Drive Components

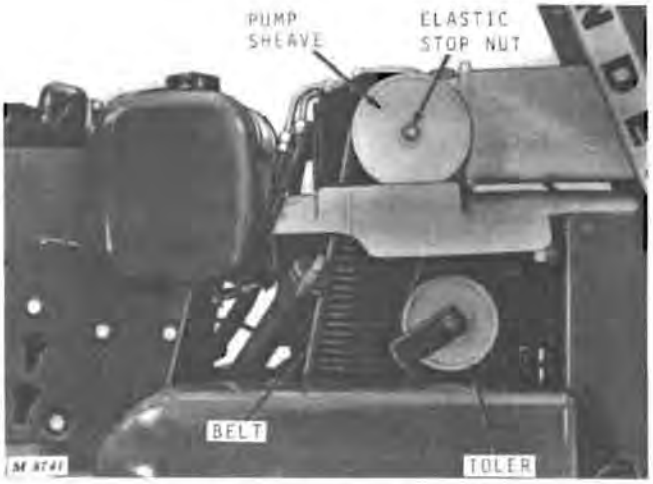


Fig. 20-Installing Drive Components

Install key in shaft. Install sheave on shaft and secure with elastic stop nut, Fig. 19. Install drive belt.

Adjust drive belt tension.

Refer to Fig. 2, and connect hoses to valve assembly. Fill reservoir with 2 U.S. pints of John Deere All-Weather Hydrostatic Fluid or an equivalent Type A or F Automotive Automatic Transmission Fluid.

TORQUE FOR HARDWARE

Location	Torque
Spool shoulder bolt	60 to 65 in-lbs
Valve body cap screws	7 to 10 ft-lbs
Pump Base Stud Nuts	360 in-lbs

SPECIAL TOOLS

Name	No.	Use
Retaining Ring Pliers	OTC 1120	Removing snap ring from valve body.

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Group 15
PUMP

GENERAL INFORMATION

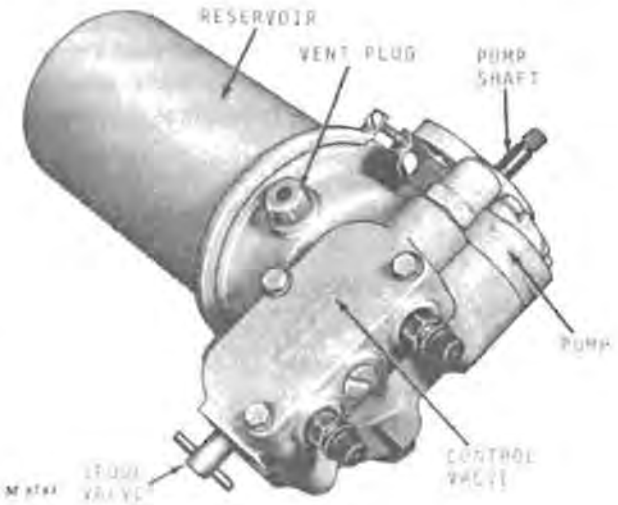


Fig. 1-Hydraulic Pump and Control Valve

When the pump, Fig. 1, is in operation, the pump drive turns the drive gear which in turn rotates the idler gear. Oil enters the suction port from the reservoir and is trapped between the gear teeth and the closely fitted housing. As the teeth come together at the opposite side of the pump, the oil is displaced and forced out through the pressure port. The volume of oil the pump delivers is dependent upon the speed at which the gears turn.

With a control valve in the oil line, oil is directed to the cylinder for raising and lowering equipment.

The pressure in the system is determined by the relief valve setting. If pressure is too great, the relief valve will channel the excess oil directly back to the reservoir.

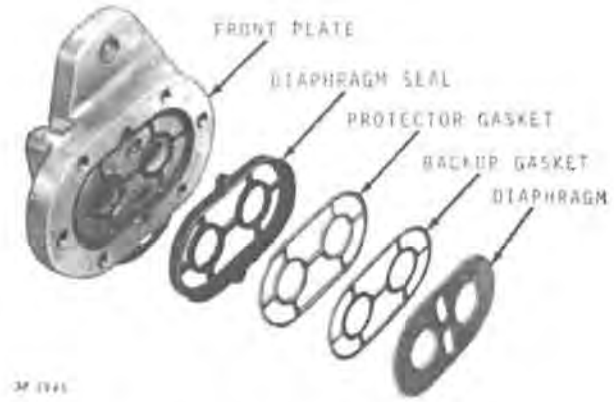


Fig. 2-Diaphragm, Gaskets and Diaphragm Seal

Gear end clearance is kept at a minimum by means of a thin, flexible bronze faced steel plate. This plate is called a diaphragm, Fig. 2, since it actually flexes to reduce gear end clearance, rather than the entire plate moving as is common with ordinary wear plates.

The diaphragm is kept in contact with the gear ends by hydraulic pressure which is carefully controlled. The area behind the wear plate is divided into pie shaped compartments by a special moulded rubber diaphragm seal, protector gasket and backup gasket.

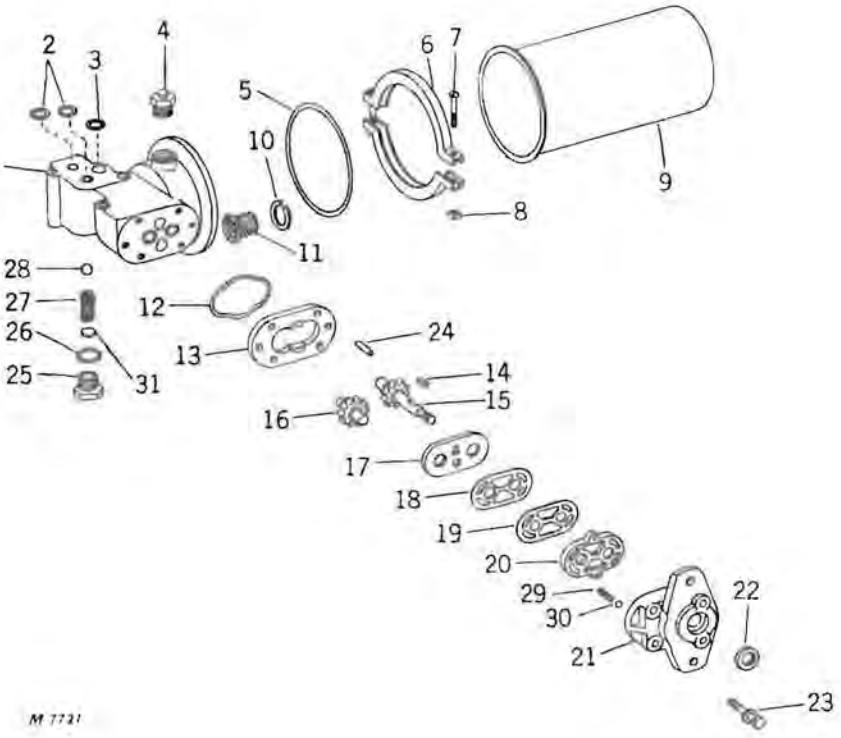
The diaphragm seal has a spoke-like pattern running around the gear shafts with interconnected "V"-grooves. This seal fits into a corresponding pattern of grooves in the front plate with the "V" down. The protector gasket and backup gasket fit on the top of the diaphragm seal being the same general pattern as the seal. The purpose of these gaskets is to prevent extrusion of the seal into the space between the diaphragm and the front plate.

GENERAL INFORMATION—Continued

When the pump is in operation, oil from the pressure port is forced under the diaphragm seal and is distributed by the interconnecting "V"-groove in the seal. This oil pressure forces the gaskets against the wear plate, thus dividing the area under the wear plate into pie shaped seal compartments.

A small hole is drilled through the diaphragm into each compartment. These connect the small chambers formed by the gear teeth to the compartments under the wear plate. Because of the location of these holes, the pressure under the diaphragm is slightly higher than the corresponding section in the gear chamber. Consequently, the diaphragm is always kept in close contact with the gear ends, compensating for deflection from pressure, thermal expansion or wear. This greatly increases pump efficiency.

REPAIR



1—Pump Body Assembly
2—O-Ring
3—O-Ring
4—Plug Assembly
5—O-Ring
6—Clamp Assembly
7—Screw
8—Nut
9—Reservoir
10—Snap Ring
11—Filter
12—O-Ring
13—Pump Rear Plate
14—Key
15—Pump Drive Gear
16—Pump Driven Gear
17—Diaphragm
18—Backup Gasket
19—Protector Gasket
20—Diaphragm Seal
21—Front Plate Assembly
22—Shaft Seal
23—Cap Screw
24—Dowel Pin
25—Plug Assembly
26—O-Ring
27—Spring
28—Check Ball
29—Spring
30—Check Ball
31—Spring Seat

Fig. 3-Exploded View of Hydraulic Pump and Reservoir

Removing Pump from Tractor

Refer to page 60-10-2 to remove pump, valve and reservoir assembly from tractor.

Separating Pump

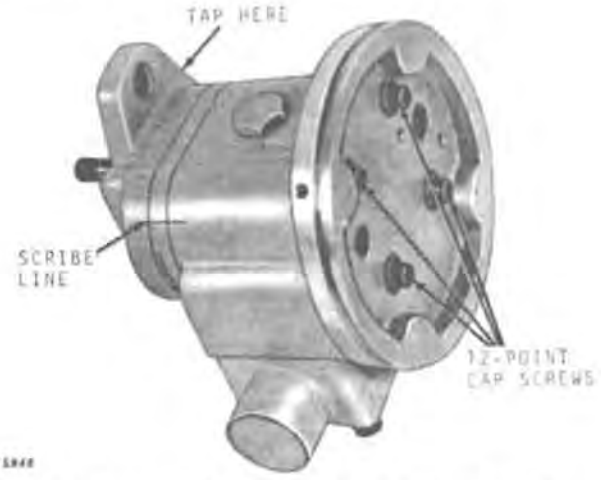


Fig. 4-Separating Front Plate, Body and Back Plate

Before separating pump assembly, scribe a clear line across outside of pump assembly, Fig. 4. This will assure proper reassembly.

Remove reservoir and four 12-point cap screws.

Tap against front plate, Fig. 4, to separate front plate, body and back plate. Do not use sharp tools or screwdriver to separate parts.

Removing Diaphragm Seal

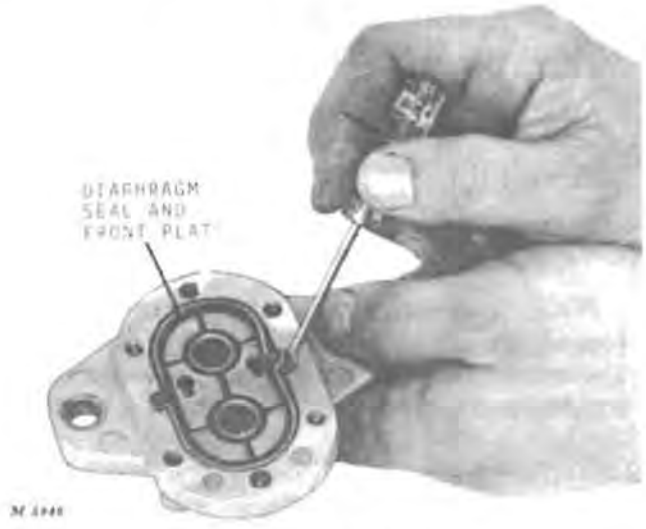


Fig. 5-Removing Seal

Place a screwdriver under the diaphragm seal, Fig. 5, being careful not to damage front plate. Lift diaphragm seal and gaskets from plate. Discard diaphragm seal and gaskets.

Fig. 6-Removing Relief Valve Seat

The relief valve seat, Fig. 6, is locked in place. Do not attempt to remove seat unless repair is necessary. Apply heat to back plate and use screwdriver to remove seat.

When replacing seat, apply Loctite or equivalent and turn in to specified depth. See "Specifications," page 60-15-7.

INSPECTION

Wash all parts in a clean safe cleaning solvent and dry them with compressed air.

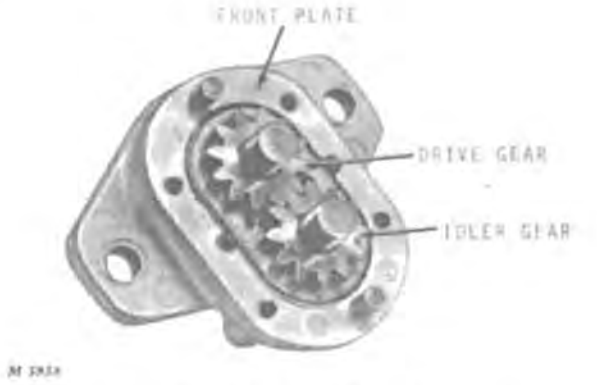


Fig. 7-Checking Pump Gears

Inspect the drive gear and idler gear shafts, Fig. 7, at bearing points and seal areas for rough surfaces and excessive wear. Inspect drive shaft for broken keyway.

When gear and shaft replacement is required, replace both the drive and idler gear shaft assemblies at the same time. This procedure eliminates a worn gear being mated with a new gear, thus increasing gear life.

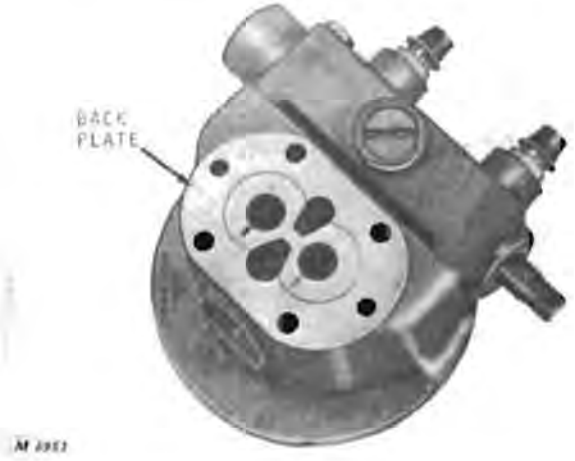


Fig. 8-Checking Back Plate Wear

Small scratches and some wear pattern should be considered normal and will not affect pump operation. Check plate wear, Fig. 8. Refer to "Specifications," page 60-15-7, for back plate wear tolerance. Replace back plate if worn beyond specification.

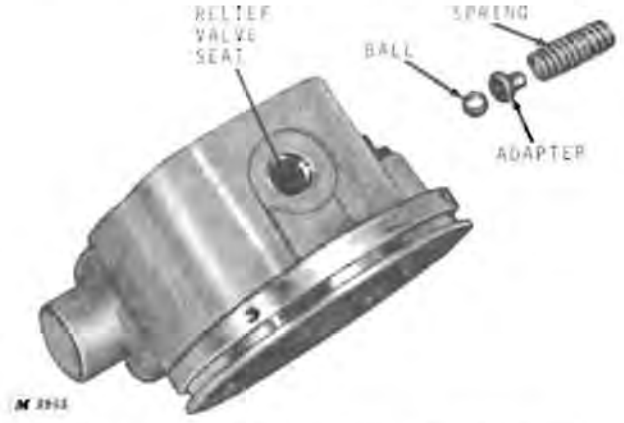


Fig. 9-Relief Valve Adapter, Ball, Spring and Seat

Inspect condition of relief valve seat, ball, adapter and spring, Fig. 9. Replace parts showing abnormal wear.

If relief valve seat removal is necessary, refer to Fig. 6.

ASSEMBLY

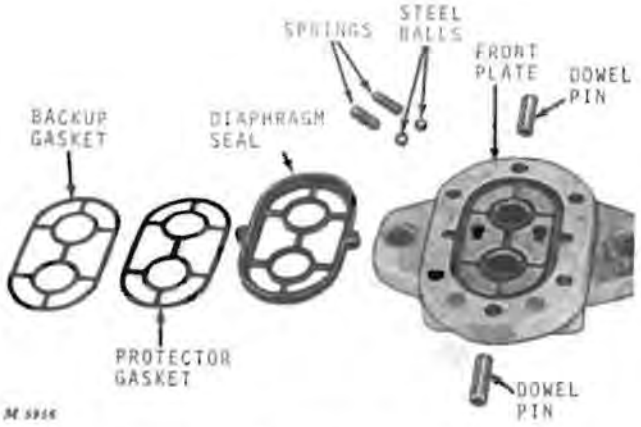


Fig. 10-Installing Front Plate Components

Install new diaphragm seal, protector gasket, backup gasket and diaphragm when reassembling pump, Fig. 10. Install diaphragm seal in grooves of front plate with seal "V" groove down. Use small blunt screwdriver to position seal in grooves. Press protector gasket and backup gasket into diaphragm seal. Drop steel balls into respective seats and place springs over balls.

Fig. 11-Installing Diaphragm

Place diaphragm on top of gaskets with bronze face up and coined indents on suction side, Fig. 11. The entire diaphragm must fit inside the raised rim of the diaphragm seal. Insert dowel pins in front plate.

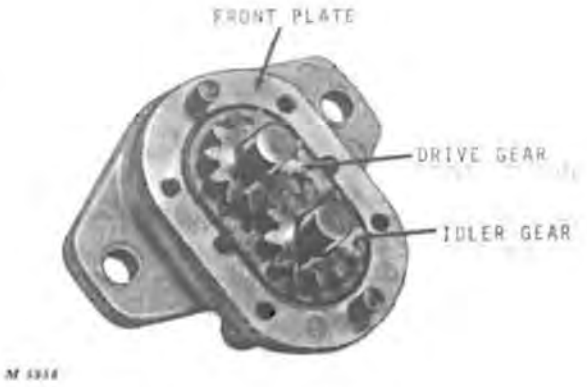


Fig. 12-Installing Gears in Front Plate

Dip gear assemblies in light, clean oil and slip into front plate bearings, Fig. 12.

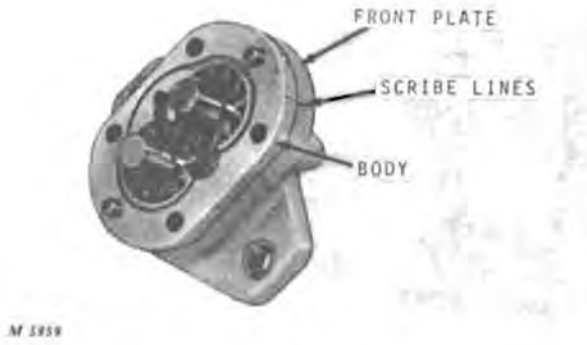


Fig. 13-Placing Body on Front Plate

Apply a thin layer of gasket sealer to both milled outer flange surfaces of body. Slip body over gears onto front plate. Half moon port cavities in body must face away from front plate and scribe lines should be aligned, Fig. 13. The cavity with the small hole drilled in it must be on the pressure side of pump.

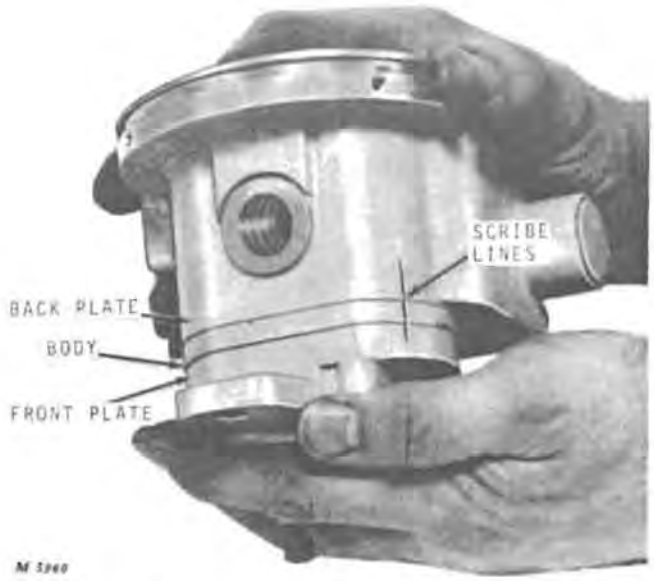


Fig. 14-Positioning Front Plate and Gear Assembly on Back Plate

Place front plate and gear assembly onto back plate and press in place with hands, Fig. 14. Check to be sure scribe lines are aligned.

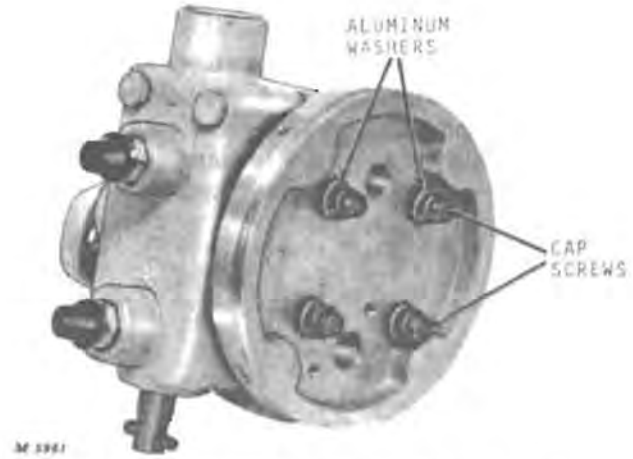


Fig. 15-Tightening Four 12-Point Cap Screws-In-Line Unit Illustrated

Place new aluminum washers over the four 12-point cap screws. Install cap screws through back plate and secure front plate to back plate, Fig. 15. Refer to "Specifications," page 60-15-7, and torque bolts.

Fig. 16-Installing Shaft Seal

Place tape over keyway in shaft. Oil seal liberally and slip shaft seal over drive shaft.

Tap seal in place with a deep socket and hammer, Fig. 16.

The outer face of the seal should be flush with outer edge of front plate when seal is in place.

Rotate the drive shaft to make sure there is no interference with rotating parts. A smooth, heavy drag indicates a good pump. An irregular drag or seized shaft indicates an improperly assembled pump. (Pump rotation is counterclockwise from end of shaft.)

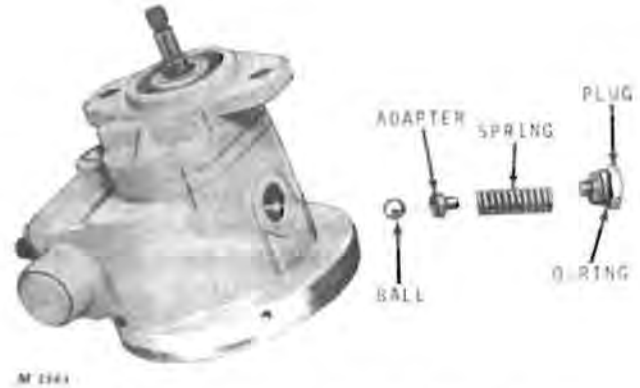


Fig. 17-Installing Relief Valve Assembly

Whenever relief valve seat has been removed, refer to "Specifications," page 60-15-7, for proper seat depth. Install seat in back plate as shown in Fig. 17.

NOTE: Seat must be held in place with Loctite or equivalent. Clean threads and seat thoroughly before applying Loctite. Wipe off excess Loctite after positioning seat.

Installing Reservoir

Refer to Fig. 3 and install new O-ring (5) in groove of pump housing and position reservoir. Secure reservoir to housing with two-piece circular clamp (6).

Install the assembly on the tractor and connect the hydraulic hoses to the valve assembly.

Fill the reservoir with fluid, page 60-5-3.

Adjust drive belt tension, Fig. 18.

ADJUSTMENTS

Adjusting Drive Belt Tension

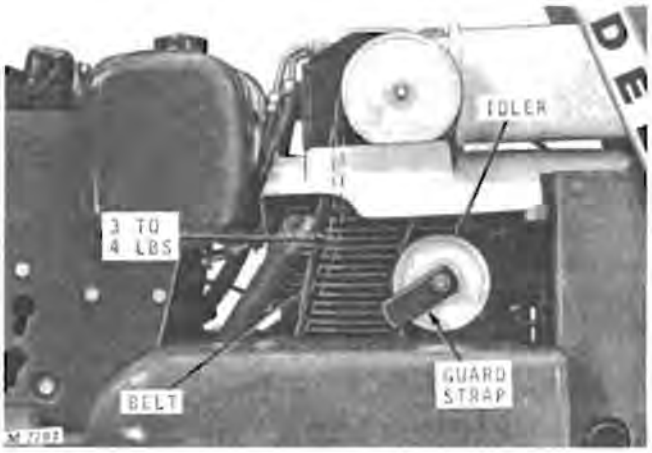


Fig. 18-Adjusting Belt Tension

Loosen the idler bolt and move idler against belt until a 3 to 4-pound pressure midway between the sheaves deflects the belt 1/2 inch, Fig. 18.

Tighten the idler nut firmly to maintain proper belt tension.

Adjusting Lift Lever Stops

1. Loosen jam nuts on outer stop and move lift lever to full raised position.
2. Position head end of bolt in bottom slot in inner stop.

NOTE: Be sure to keep 1/32 to 1/16-inch clearance between the bolt head and inner stop.

3. Tighten nuts. Allow lift lever to return to neutral position. Check for equal travel of lift lever in both raised and lowered position.

NOTE: Equipment should raise when lever is raised and lower when lever is lowered.

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SPECIFICATIONS

Component	New	Wear Tolerance
Relief Valve Pressure	800 (−0 + 100) psi	.....
Relief Valve Seat (Top of seat to top of body)	1.776 - 1.786-in.	.....
Pump Output	1.5 gpm at 3600 rpm engine speed	.....
Displacement	0.149 cu. in. per rev.	.....
Back Plate Wear	Flat	0.0015-in.

TORQUE FOR HARDWARE

Location	Torque
12-Point Cap Screws	7-10 ft-lbs
Relief Valve Plug	20-25 ft-lbs.

SPECIAL TOOLS

Name	No.	Use
Hydraulic Tester	OTC Model No. Y-81-2-1	Check system pressure.
In Line Hydraulic Tester	OTC Model No. Y-90	Measure flow, temperature and pressure.

Litho in U.S.A.

Group 20
CYLINDER

GENERAL INFORMATION

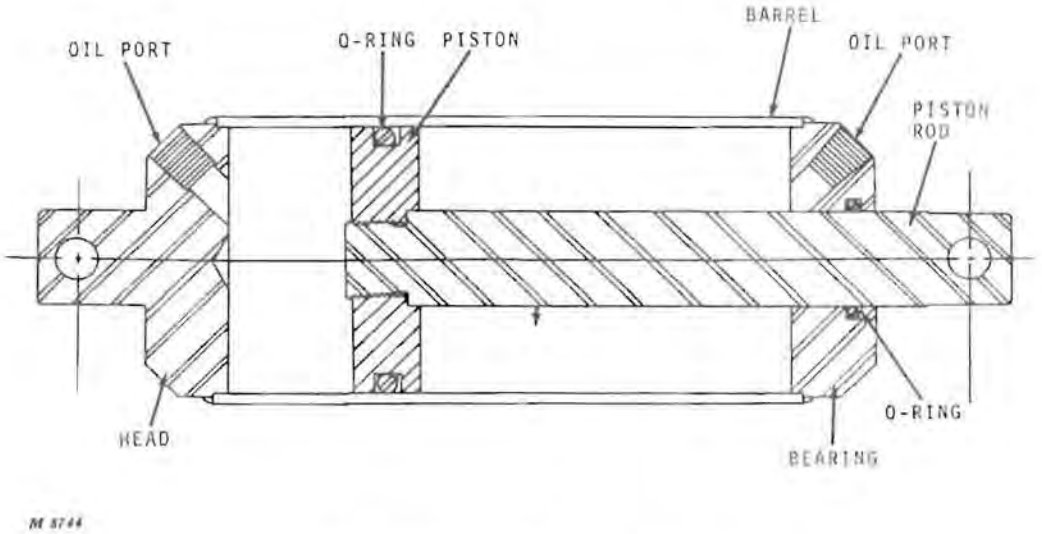


Fig. 1-Cutaway of Remote Cylinder

The Cessna remote cylinder is connected to the engine base and lower lift shaft. When the hydraulic lift lever on the tractor is raised or lowered, the remote cylinder is extended or retracted, thus actuating the lift linkage and raising or lowering mounted equipment.

The cylinder is double-acting and connected to the valve body by two high-pressure flexible hoses. Although the hydraulic cylinder is double acting, slots in the hydraulic linkage prevent the retracting cylinder from exerting downward force on front- or rear-mounted equipment.

This prevents damage to the equipment and allows it to "float" with ground contours.

The hydraulic cylinder is a welded assembly and is not serviceable. A new cylinder must be installed if the old cylinder is defective. Check "Diagnosing Malfunctions," for possible causes of cylinder failure.

Remove old cylinder and install new cylinder as instructed on page 60-20-2.

REMOVAL

Wipe all dirt from connections on valve body. Move hydraulic lift lever up and down to release all pressure in system.

Disconnect hoses at valve body. Cap connections on valve body and plug hoses.

Remove the pins attaching the cylinder to the tractor. Slip the pin head end of the cylinder through the tractor frame. Remove the hoses and cylinder as an assembly.

INSTALLATION

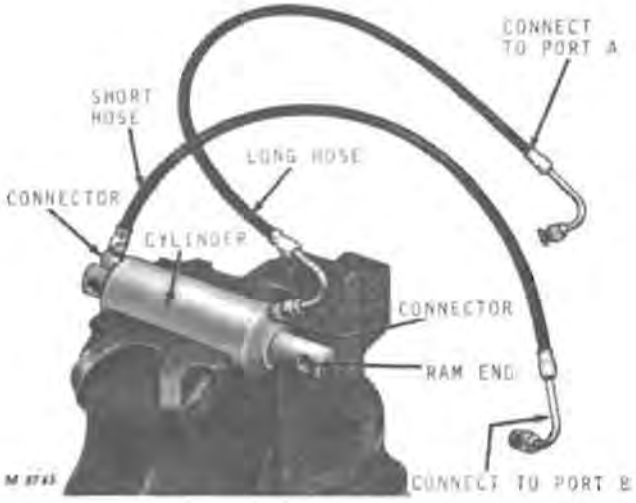


Fig. 2-Connecting Hoses to Cylinder

Lightly clamp cylinder in a vise with soft jaws, Fig. 2.

Screw connector in bearing end of cylinder and tighten firmly.

Connect hose with two steel extensions to connector on bearing end of cylinder. Position hose as shown in Fig. 2 before tightening connection. The end of the hose with most bend in steel line connects to cylinder. End with least bend connects to port "B" on valve body after cylinder is assembled to tractor.

Connect hose with one steel extension to head end of cylinder as shown in Fig. 2. Screw end without steel extension in cylinder head. End with steel extension connects to port "A," on valve body after cylinder is installed on tractor.

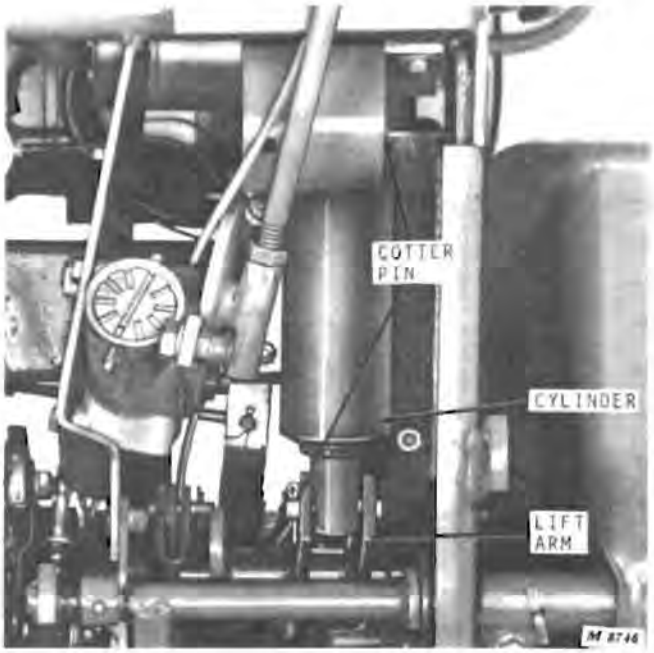


Fig. 3-Connecting Cylinder to Tractor

Insert pin through tractor frame, frame brackets and cylinder. Insert cotter pins and spread ends, Fig. 3.

Insert pin through lower lift shaft arms, piston rod and clip. Insert cotter pins and spread ends, Fig. 3.

Section 70
MISCELLANEOUS
Group 5
STEERING LINKAGE

TABLE OF CONTENTS

Litho in U.S.A.

GENERAL INFORMATION

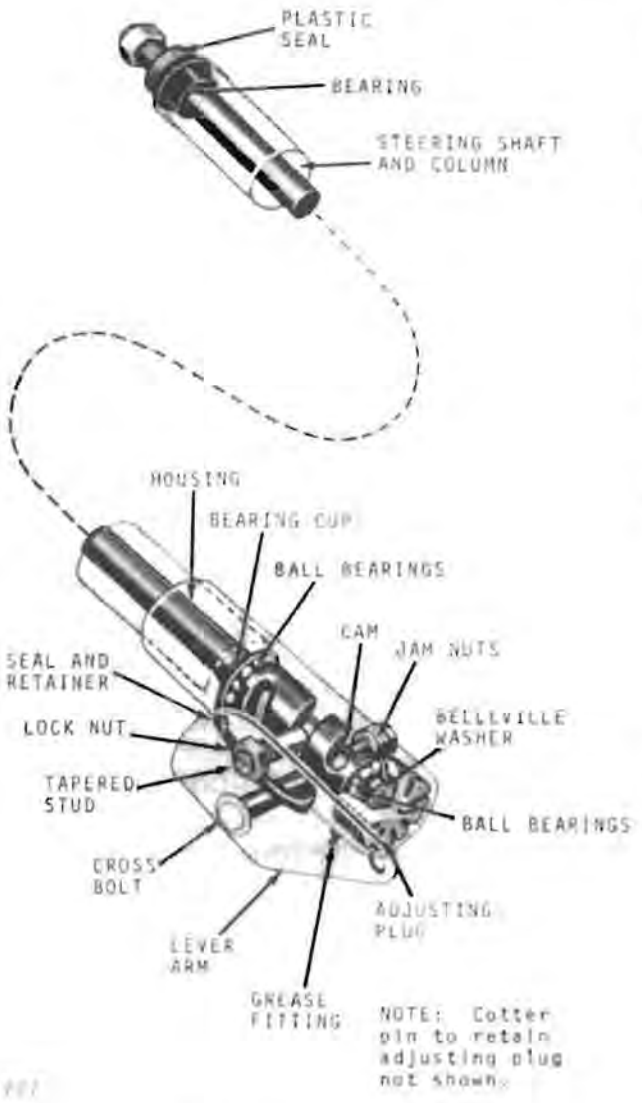


Fig. 1-Steering Gear

The steering linkage consists of the steering gear assembly, drag link, spindles, and tie rod.

The steering gear has a 14:1 steering ratio. It is a cam and lever style steering gear, utilizing the cam lever arm, cross bolt, and tapered stud as shown in Fig. 1.

With this style steering system the lever arm is actuated whenever the cam is rotated. This in turn, pulls or pushes the drag link connected to the left steering spindle. Movement of the drag link rotates the spindle to turn the wheels left or right.

The left and right-hand steering spindles are connected by a tie rod, Fig. 2, to give equal movement on both spindles.

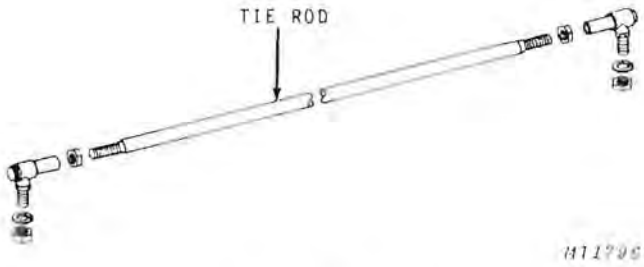
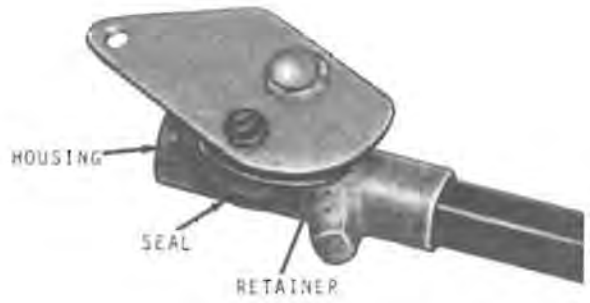


Fig. 2-Tie Rod

STEERING ANALYSIS

Listed below is a preliminary analysis of difficulties that can occur with the steering system. Familiarize yourself with information on this page before proceeding to "Diagnosing Malfunctions" on page 70-5-5.

Seal and Retainer



MI1770

Fig. 3-Damaged Seal

A damaged seal, Fig. 3, is caused by overgreasing the housing or an improperly adjusted cross belt in the lever arm.

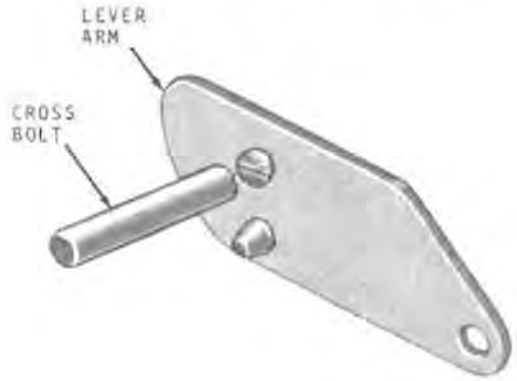
Housing

A broken steering gear housing, Fig. 4, is most commonly caused by the wheel striking a solid object when the tractor is traveling at fast speed. It can also be caused by applying excessive pressure on steering wheel with heavy load on front of tractor. EXAMPLE: Tractor equipped with GT-3 tires and front end loader.

To reduce steering effort, the tractor should be in motion when turning front wheels, especially with heavy ballast on front of tractor.

MI1790

Fig. 4-Broken Steering Gear Housing

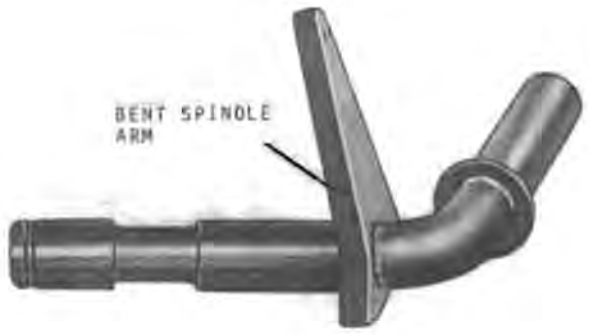


MI1791

Fig. 5-Broken Lever Arm Cross Bolt

A broken lever arm cross bolt, Fig. 5, is caused by excessive force being applied either by the steering wheel or excessive weight on front end.

Spindle



M11788

Fig. 6-Bent Spindle Arm

A bent spindle arm, as shown in Fig. 6, is usually the result of the front wheel striking a solid object.

Ball Joints

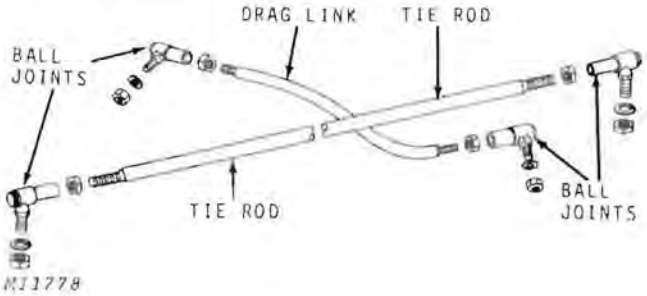


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Fig. 7-Ball Joints

Replace ball joint assembly, Fig. 7, whenever excessive looseness or other damage is noticed.

DIAGNOSING MALFUNCTIONS

Loose Steering

Steering gear out of adjustment.

Cracked steering gear housing.

Loose ball joint nuts.

Worn ball joints.

Hard Steering

Tires not properly inflated.

Steering gear not properly adjusted (too tight).

Tight spindles.

Drag link installed incorrectly.

Bent spindle arm.

Tight ball joints.

Incorrect toe-in.

Tractor Turns Shorter in One Direction

Spindle arm striking axle stop.

Drag link installed incorrectly and/or adjusted.

Bent spindle and/or spindle arm.

Leaky Steering Gear Housing

Damaged seal.

Damaged retainer.

Steering gear over-lubricated.

Tire Strikes Tractor on Turns

Drag link not properly adjusted.

Bent spindle and/or spindle arm.

Bent axle.

Tires not properly inflated.

Drag link not properly adjusted.

Steering Column Squeaks When Steering Wheel is Turned

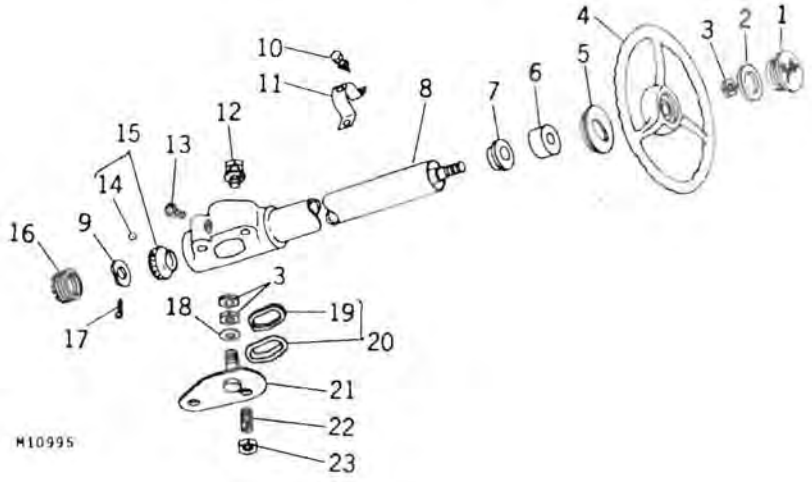
No tape around jacket tubing (clamp and bracket area in pedestal).

Lack of lubrication.

Excessive End Play

Loose adjusting plug.

REPAIR



1—Steering Wheel Emblem
2—O-Ring
3—Jam Nut
4—Steering Wheel
5—Grommet
6—Bearing Seal
7—Bearing
8—Steering Gear Assembly
9—Spring Washer
10—Screw
11—Steering Column Clamp
12—Cap Screw
13—Grease Fitting
14—Steel Ball
15—Bearing Kit
16—Adjusting Plug
17—Cotter Pin
18—Washer
19—Lever Arm Seal
20—Seal and Retainer Kit
21—Lever Arm
22—Stud
23—Jam Nut

Fig. 8-Exploded View - Steering Linkage

Removing Steering Wheel and Steering Gear

Remove steering wheel with a puller, Fig. 9. The wrong puller will damage the steering wheel.

Remove battery from battery base.

Remove clamp around steering jacket in pedestal. Disconnect drag link, remove cap screws holding housing to frame and slip steering gear out from below tractor.

Fig. 9 Removing Steering Wheel

Disassembling Steering Gear

Loosen jam nut on tapered stud in lever arm. Turn stud counterclockwise until resistance is felt. Remove nuts from lever arm cross bolt and remove from housing. Remove plug in steering gear housing and slide shaft with cam and bearings from column.

Inspecting Steering Gear Parts

Wash parts in a clean, safe solvent and dry with compressed air and clean cloth.

Refer to page 20-15-12 to check bearing condition. Inspect cam, housing, and plug for cracks, scoring, and other damage especially in the bearing area, Fig. 10. Replace parts showing excessive wear or damage.

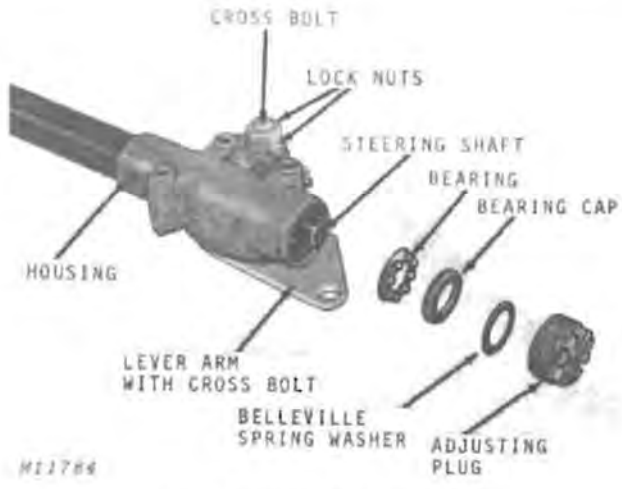


Fig. 10-Steering Gear Disassembly

ASSEMBLY

Assembling Steering Gear

Fig. 11-Installing Bearing

Apply grease and place bearing balls, ball cups, and retaining rings on both ends of cam, Fig. 11.

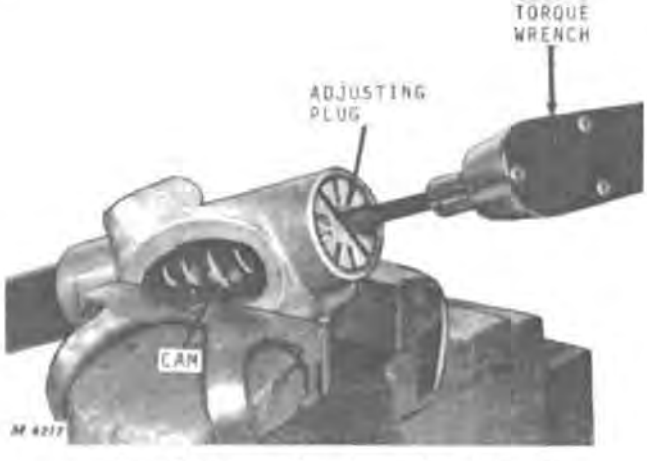


Fig. 12-Installing Cam Assembly in Housing

Grease cam lightly with John Deere Multi-Purpos Lubricant or an equivalent SAE multi purpose-typ grease.

Slide cam and tube assembly into housing a jacket tube. Install plug and torque, Fig. 12, acco ing to "Specifications," page 70-5-11.

ASSEMBLY—Continued

Assembling Steering Gear—Continued

Fig. 13-Cotter Pin Through Housing

After torquing, lock adjusting plug with a cotter pin, Fig. 13. Be sure steering shaft turns freely after torqueing.

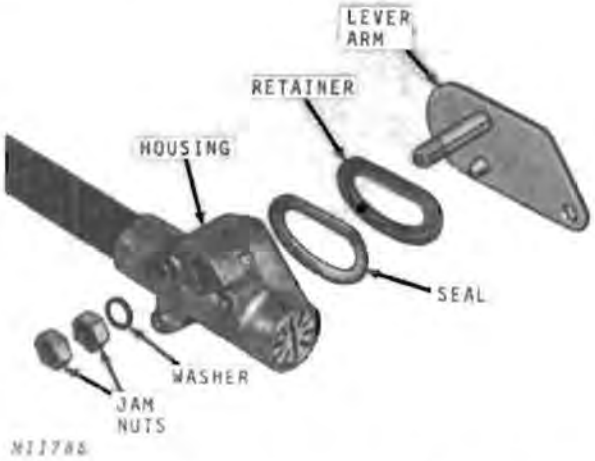


Fig. 14-Attaching Lever Arm to Steering Gear

Install new seal and retainer from repair kit. Attach lever arm to steering gear housing with washer and two jam nuts, Fig. 14.

Installing Steering Gear

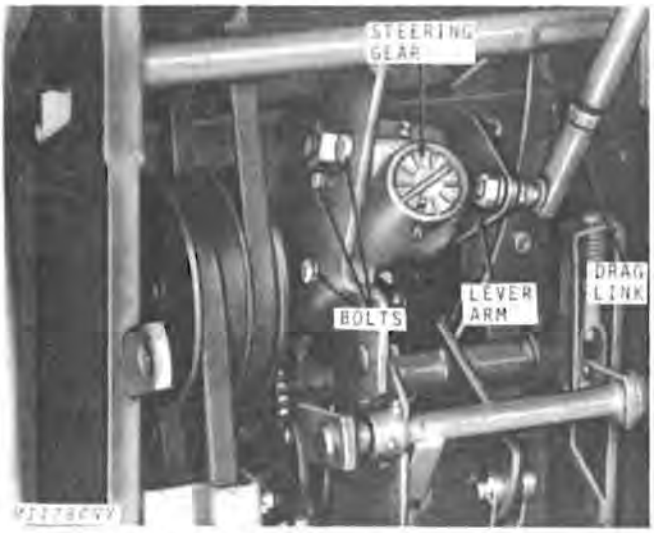


Fig. 15-Installing Steering Gear

Position steering gear assembly in tractor and install with bolts as shown in Fig. 15. Apply Loctite or equivalent to threads of bolts at steering gear housing. Place clamp over upper part of steering column in pedestal and secure clamp with two bolts.

Connect drag link to lever arm, Fig. 15, and tighten nuts firmly.

Refer to Fig. 8, page 70-5-6 and install steering wheel. Tighten steering wheel retaining nut to 10-12 ft-lbs of torque.

Insert O-ring into slot in steering wheel cap and press cap into steering wheel.

Adjust the steering gear mechanism according to the sequence explained on page 70-5-9.

ADJUSTMENTS

Steering Gear

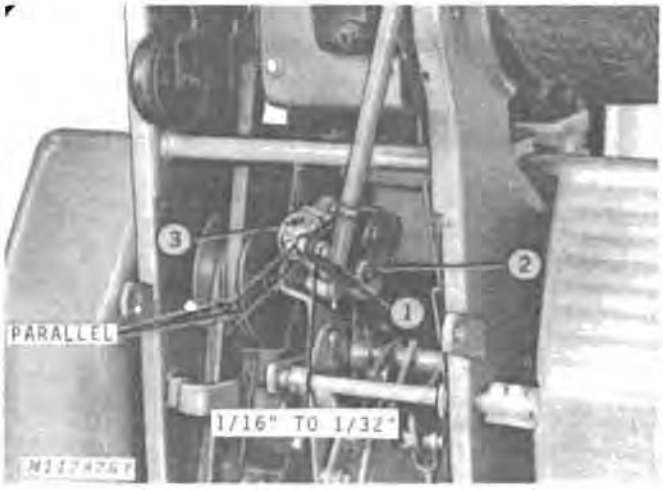


Fig. 16-Steering Gear Adjustment

To remove excessive backlash, Fig. 16, (loose steering) and to properly adjust steering gear, follow this procedure:

1. Disconnect drag link from lever arm.

2. Loosen jam nut and stud two or three turns.

3. Loosen jam nut on cross bolt and tighten only the inside nut using a thin open end wrench until all end play (see arrow) is removed or until the distance between the lever arm and steering gear body is between 1/16 and 3/32 inch, Fig. 16. Tighten jam nut to 22 to 25 ft-lbs torque.

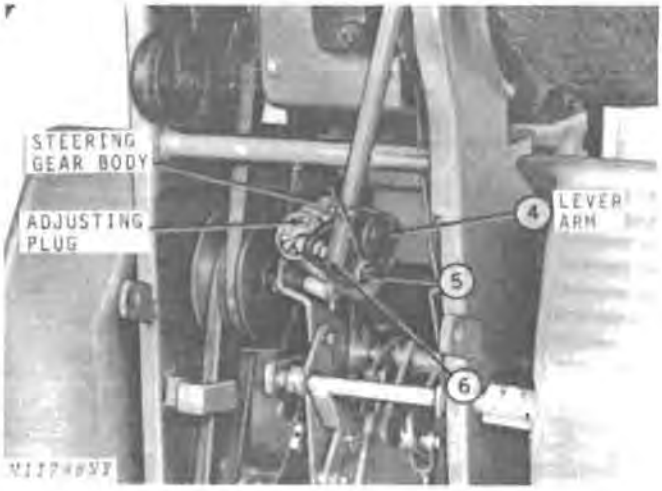


Fig. 17-Steering Gear Adjustment

4. Turn lever arm until the arm is parallel with steering gear body, Fig. 17.

5. Turn stud in (clockwise) until snug to remove all backlash. Then move lever arm through its full steering range in both directions (front to rear). Steering wheel will turn as this check is made. When properly adjusted, a slight drag can be detected in the midpoint of the range (when line between the pivot bolt and ball joint is vertical). Tighten jam nut to 40 ft-lbs torque.

Make final test by turning lever arm through full range.

6. Connect ball joint to lever arm.

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Adjusting Tow-In

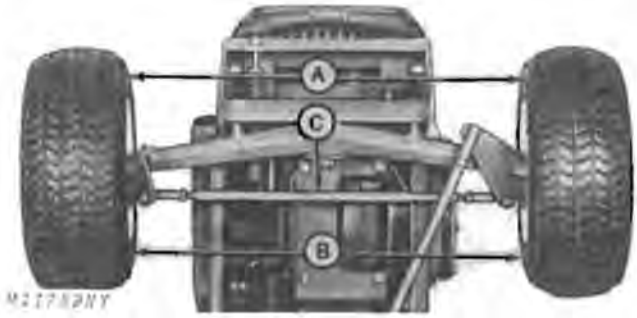

Fig. 18-Adjustable Tie Rod

Measure distances "A" and "B," Fig. 18. The tractor has proper toe-in or alignment when dimension "A" is 3/16 inch less than dimension "B." When required, loosen jam nuts and turn tie rod "C" until proper toe-in is obtained. Tighten jam nuts firmly.

Adjusting Steering Linkage

The adjustment of steering linkage, Fig. 19 is important for three reasons:

1. To attain adequate clearance between the drag link and tire.

2. To provide equal left and right turning radius.

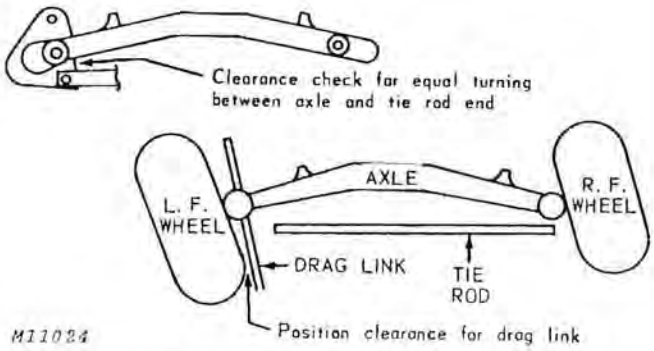

Fig. 19-Steering Linkage Adjustment

3. To provide maximum clearance when mower deck is raised.

The over-all length of the drag link determines left and right turning radius. To equalize turning radius, lengthen or shorten drag link until left and right spindle stops are equal distance from the axle.

If drag link interferes with left front tire and mower deck, loosen front drag link ball joint lock nut. Swing drag link outward. Lock ball joint lock nut and retest for clearance. Light contact with frame or tire is acceptable.

TORQUE FOR HARDWARE

Location	Torque
Steering gear plug	10-14 ft-lbs
Lever arm cross bolt	22-25 ft-lbs
Jam nut on lever arm stud	40 ft-lbs
Steering wheel retaining nut	10-12 ft-lbs

SPECIAL TOOLS

Name	Part No.	Use
15/16" Open-End Wrench		Locking lever arm cross bolt.
Puller	SNAP-ON CJ-950	To remove steering wheel.
Puller	OTC 853A	To remove steering wheel.

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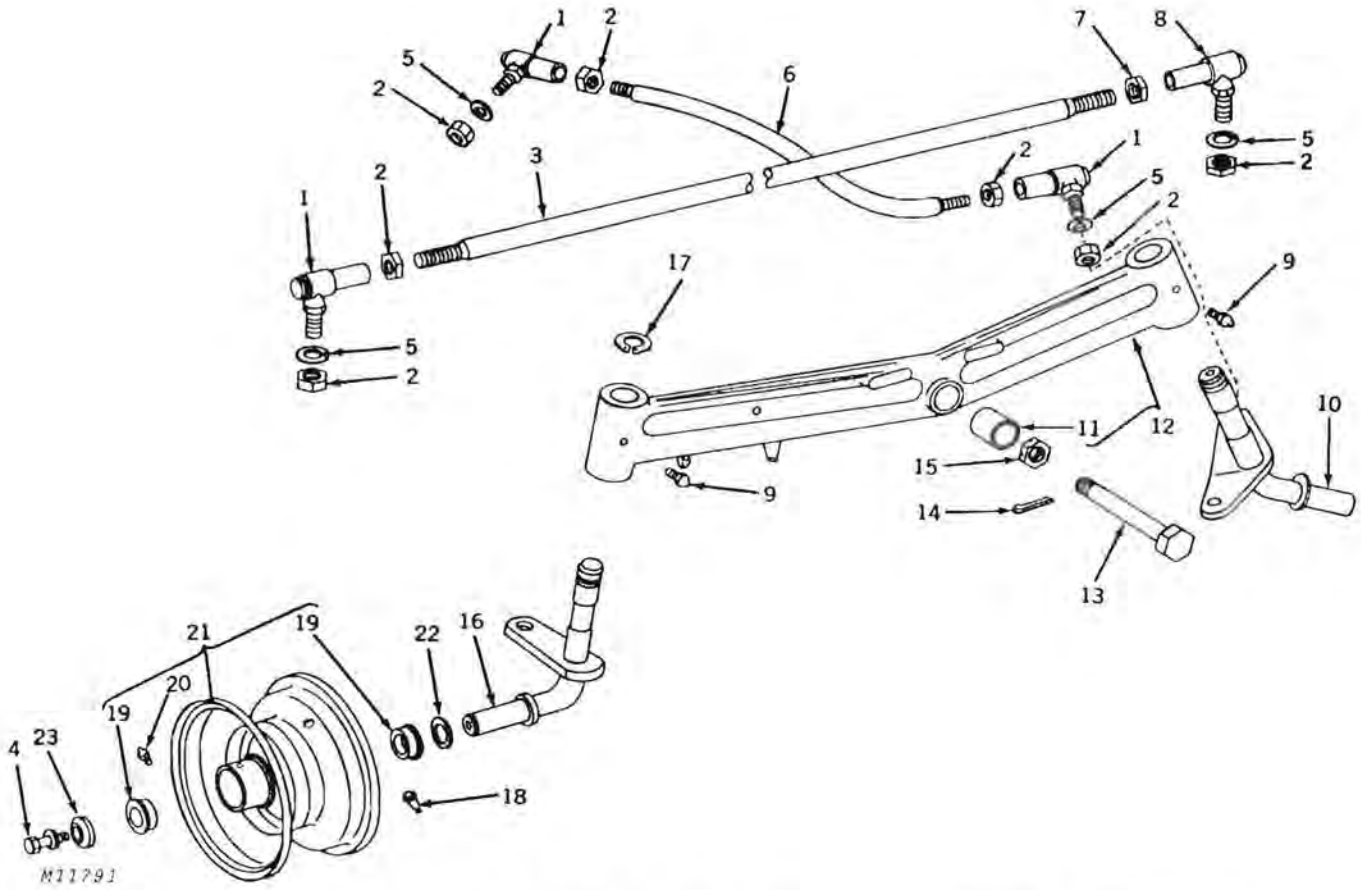
Group 10
FRONT WHEELS AND AXLES

INTRODUCTION

Refer to Group 5, "Steering Linkage," for service and adjustment of all linkage related to the front wheels. Group 5 includes service of ball joints, tie rod, toe-in adjustment, etc. This group covers only front wheel spindles, bearings, and axle.

REPAIR



1—Ball Joint Assembly
2—Jam Nut
3—Tie Rod
4—Cap Screw
5—Lock Washer
6—Drag Link
7—Jam Nut
8—Ball Joint Assembly
9—Grease Fitting
10—L.H. Front Wheel Spindle
11—King Pin Bushing
12—Axle with Bushing
13—King Pin Bolt
14—Cotter Pin
15—Slotted Nut
16—R.H. Front Wheel Spindle
17—Snap Ring
18—Valve Stem
19—Bearing
20—Grease Fitting
21—Front Wheel Disk
22—Spring Washer
23—Spindle Cap

Fig. 1-Exploded View of Front Wheels and Axles

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Removing Front Wheels

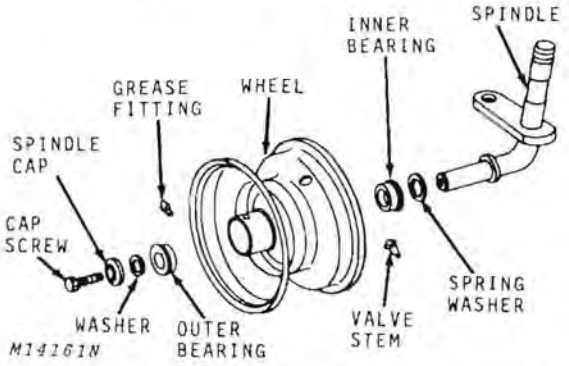

Fig. 2-Removing Front Wheel Components from Spindle

Jack up tractor until wheel clears the ground. Remove cap screw, Fig. 2. Remove spindle cap, outer bearing, wheel, inner bearing, and spring washer.

Removing Spindle From Axle

Fig. 3-Removing Snap Ring

To remove spindle, disconnect tie rod end, and using a snap ring pliers, remove snap ring, Fig. 3. Slip spindle out of axle.

Inspecting Bearings

Refer to "Bearing Analysis," page 20-15-12, to determine wheel bearing condition. Service as necessary.

INSTALLATION

Installing Axle

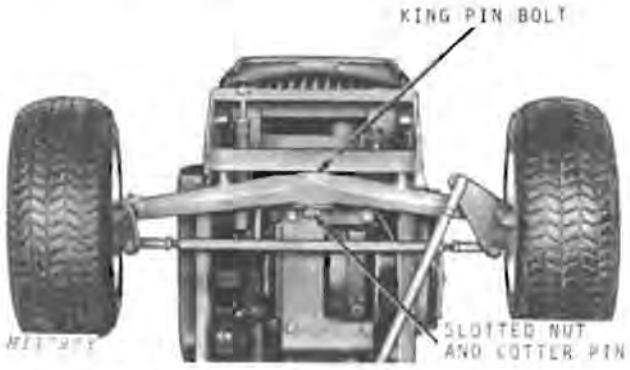

Fig. 4-Installing Axle on Tractor

Check king pin bushing and other king pin components for wear or any other damage. Replace parts as necessary.

Grease king pin assembly and install axle on tractor base. Axle stop must be to right-hand side of tractor and facing away from tractor, Fig. 4. Secure king pin bolt with slotted nut and cotter pin.

Installing Spindles

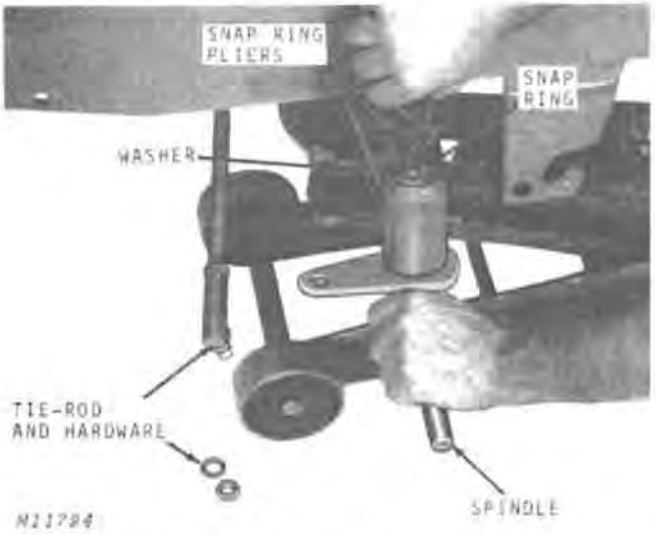

Fig. 5-Installing Front Axle, Spindles, and Front Wheels

Apply light coat of grease on upper spindle shaft. Install spindles into axle, Fig. 5.

Installing Bearings and Wheels

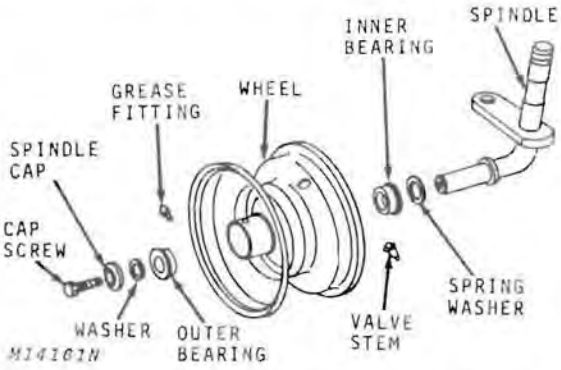

Fig. 6-Installing Bearings and Wheels

Pack wheel bearings with John Deere Multi-Purpose Lubricant or an equivalent SAE multipurpose-type grease. Install spring washer, inner bearing, wheel, outer bearing, spindle cap and cap screw, Fig. 6.

NOTE: There is no adjustment necessary on the front wheel bearings.

SPECIAL TOOLS

Name	Part No.	Use
Retaining Ring Pliers	OTC No. 1340	To remove retaining ring from spindle.
Retaining Ring Pliers	OTC No. 614	To remove retaining ring from spindle.

Litho in U.S.A.

Group 15
LIFT LINKAGE

GENERAL INFORMATION

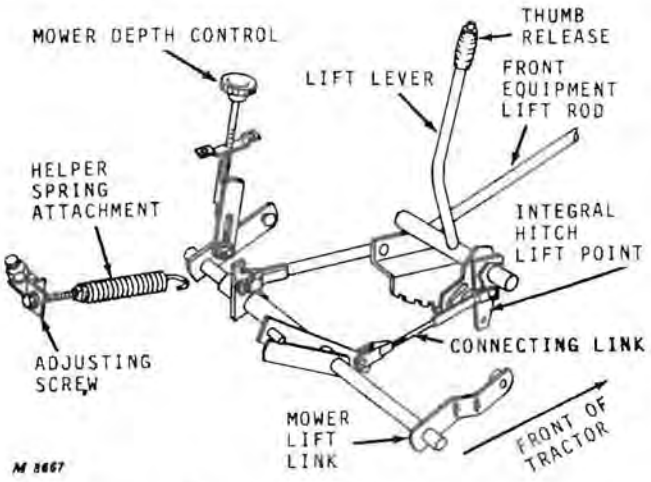

Fig. 1-Manual Lift Linkage

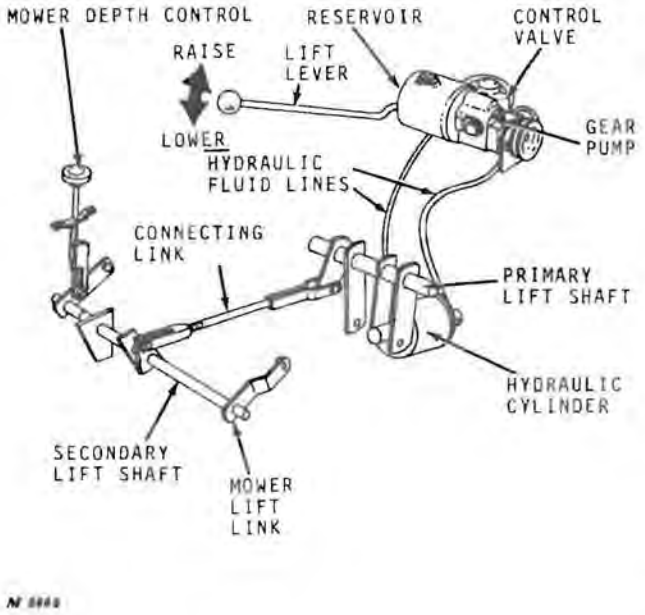

Fig. 2-Hydraulic Lift Linkage

Manual Lift

110 Tractors with manual lift have linkage as shown in Fig. 1.

The manual lift linkage requires no adjustment or service other than lubrication. If parts become worn or damaged, they must be replaced.

The helper spring is not a regular part of the tractor, but is available for mounted equipment such as the snow thrower, front blade, rotary tiller and integral hitch. When installed as shown, Fig. 1, the helper spring decreases the effort required to raise heavy equipment with the manual lift lever. Although not needed for mower operation, the helper spring may be left in place if any of the above equipment has been used previously on the tractor.

NOTE: Be sure to loosen helper spring (relieve tension) when not in use but left on tractor.

Hitch and Mower Depth Control

The hitch and mower depth control permits rear mounted equipment and the rotary mower to return to the adjusted operating level each time the lift lever is lowered. This control also enables the operator to keep the mower or rear mounted equipment in the raised position while using the lift lever to operate front mounted equipment.

Hydraulic Lift

110 Tractors with hydraulic lift have linkage as shown in Fig. 2.

A double-acting hydraulic cylinder working through a primary and secondary lift shaft performs the same function as the manual lift lever.

The lift cylinder is a sealed unit and requires no adjustment or care other than normal inspection and cleaning.

DIAGNOSING MALFUNCTIONS

Hard Lifting

No helper spring or improper spring tension.
Install spring or increase tension to reduce lift effort.

Lower lift shaft and/or lift shaft hub lacks lubrication.

Lift lever not properly seated in lift lever hub.

Linkage pin not properly installed (in pedestal).

Lever quadrant not properly adjusted.

Lift Lever Breakage

No helper spring or improper spring tension.
Install spring or increase tension to reduce lift effort.

Lift lever not properly seated in lever hub.

Linkage pin not properly installed (in pedestal).

Lever quadrant not properly adjusted.

Very Little Lift

Lift rod not properly adjusted (lower lift shaft arm to front mounted equipment).
Turn yoke in on lift rod.
Connecting rod not properly adjusted (rod between lower lift shaft and rear lift shaft for mower, integral hitch and tiller.
Turn yoke in to increase transport.

Linkage pin not properly installed (in pedestal).

No Lift When Lift Lever is in Full Raised Position

Connecting rod not properly adjusted (rod between lower lift shaft and rear lift shaft) for mower, integral hitch and tiller.

Lift rod not properly adjusted (front mounted equipment).

Broken weld on primary lift shaft (in pedestal).

Lift Lever Will Not Stay in Raised Position

Weak or broken release rod spring.

Thumb release not properly seated on release rod.

Quadrant not properly positioned.

Very Little Down Travel

Depth control screw turned all the way down.
Turn depth control screw counterclockwise.

Lift rod not properly adjusted (front mounted equipment).

Connecting rod not properly adjusted (rod between lower lift shaft and rear lift shaft).

Lift Lever Hard to Move Forward

Helper spring too tight.
Loosen spring tension (release all tension when using mower).

Lower Lift shaft and/or lift shaft hub lacks lubrication.

Lift lever not properly seated in lift lever hub.