110 and 112 Lawn and Garden Tractors Serial No. (100,001 - 250,000)

JOHN DEERE

SERVICE MANUAL

110 and 112 Lawn and Garden Tractors
Serial No. (100,001 - 250,000)

SM2088 (01NOV69) English

John Deere
Lawn & Grounds Care Division
SM2088 (01NOV69)

LITHO IN U.S.A.
ENGLISH

Service Manual
110 AND 112 LAWN AND GARDEN TRACTORS
(Serial No. 100,001-)

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INTRODUCTION

Service Manual

This service manual contains service and maintenance information for John Deere 110 and 112 Lawn and Garden Tractors (Serial No. 100,001-).

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 at the end of the Groups for easy reference.

This manual can be kept in its own cover, or it can be removed and filed in your service manual rack or placed behind the service manual tab in your Lawn and Garden Parts and Service 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.

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Section 10
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SERIAL NUMBERS

Each lawn and garden tractor is assigned an individual serial number. Serial numbers are written in parentheses throughout this manual for the reasons shown below. All serial number references are tractor serial numbers and not engine specification numbers.

(0000-) When a serial number appears before the dash, the design change was introduced beginning with that serial number and is still current.

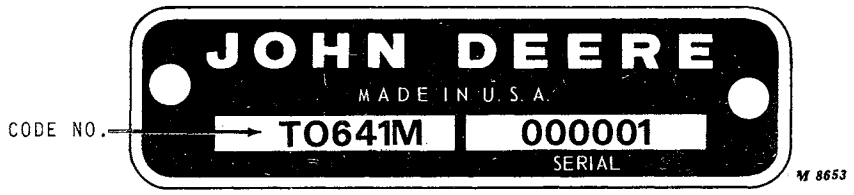
(-0000) When a serial number appears after the dash, the design change was effective up to and including that serial number and is no longer effective.

(0000-0000) When a serial number appears both before and after the dash, the design change was effective with the first serial number, but is no longer effective after the second serial number.

VINTAGE INFORMATION

Year Manufactured	110 Tractor Tractor Serial No.	112 Tractor Tecumseh Tractor Serial No.	112 Tractor Kohler Tractor Serial No.
1968	(100,001-130,000)	(100,001-130,000)	
1969	(130,001-150,000)	(130,001-150,000)	(150,001-160,000)
1970	(160,001-185,000)	(160,001-180,000)	(160,001-225,000)
1971	(185,001-)	(185,001-)	(225,001-)

SERIAL NUMBER PLATE



IDENTIFICATION CODES

The tractor identification code is indicated on tractor serial number plates. See the chart below for tractor identification codes.

Tractor	Manual Lift	Hydraulic Lift	Code No.
110	X		0641M
110		X	0647M
112 (Tecumseh)	X		0651M
112 (Tecumseh)		X	0657M
112 (Kohler)	X		0652M
112 (Kohler)		X	0653M

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Group 10
SPECIFICATIONS

ENGINE SPECIFICATIONS

	110 Tractors	112 Tractors (Tecumseh)	112 Tractors (Kohler)
MODELS			
Manual Lift	110	112	112
Hydraulic Lift	110H	112H	112H
ENGINE			
Manufacturer	Kohler	Tecumseh	Kohler
Model	K 181 S	HH 100	K 241 AS
Cylinders	One	One	One
Cycle	4	4	4
Bore and Stroke	2.94 x 2.75 in.	3.31 x 2.75 in.	3.25 x 2.875 in.
Displacement	18.63 cu. in.	23.75 cu. in.	23.9 cu. in.
Speeds (Fast)	1800-3800 rpm	1800-3800 rpm	1800-3800 rpm
Speeds (Idle)	1200-1700 rpm	1200-1700 rpm	1200-1700 rpm
Horsepower (Engine Manufacturers' Rating)*	8 @ 3600 rpm (*)	10 @ 3600 rpm (*)	10 @ 3600 rpm (*)
Normal Compression	110-120 psi	110-120 psi	110-120 psi
Valve Clearance (intake) cold	0.007 in.	0.010 in.	0.010 in.
Valve Clearance (exhaust) cold	0.016 in.	0.020 in.	0.020 in.
FILTERS			
Air	Dry Filter	Dry Filter	Dry Filter
Gasoline	In-Line Strainer	In-Line Strainer	In-Line Strainer

ELECTRICAL SYSTEM

Battery	12 Volt	12 Volt	12 Volt
Ignition	Magneto	Solid State (* *)	Battery-Coil
Spark Plug Gap	0.025 in.	0.030 in.	0.020 in.
Breaker Point Gap	0.020 in.	Not required (* *)	0.020 in.
Trigger Air Gap	Not required	0.006-0.010 in.	Not required
Charging System	Alternator w/Rectifier	Alternator w/Rectifier	Alternator w/Rectifier
Starter	12 Volt Motor w/Gear Drive	12 Volt Motor w/Gear Drive	12 Volt Motor w/Gear Drive

* *The horsepower ratings shown are established by the engine manufacturer in accordance with standard internal combustion engine institute procedure. They are corrected to 60°F. and 29.9 in. on a mercury barometer and are developed from laboratory test engines equipped with standard air cleaner and muffler.*

* * *Battery-coil ignition beginning with Serial No. 161,772. Breaker point gap 0.020 inch.*

CAPACITIES

Cavities	110 Tractors	112 Tractors (Tecumseh)	112 Tractors (Kohler)
Fuel Tank - U.S. Gallons	1.75	1.75	1.75
Crankcase - U.S. Pints	2.5	2.5 (* * *)	3.0
Transaxle - U.S. Pints	3.5	3.5	3.5
Hydraulic Lift System - U.S. Pints	2.5	2.5	2.0

* * * *3 U.S. pints beginning with Serial No. 161,772.*

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FUEL AND LUBRICANTS

Fuel	Regular Gasoline
Crankcase Lubricant	AM30730 Summer (SAE 30) AM30710 Winter (SAE 5W-20)
Transmission Lubricant	AM30200M Lubricant
Hydraulic System	Automatic Transmission Fluid—Type A

TRANSMISSION AND AXLE

TRANSMISSION	
Type	Transaxle
Gear Selections	4 Forward—1 Reverse
TRAVEL SPEEDS (@ 3600 RPM Engine Speed)	
1st Gear	Variable, .4 to 1.0 mph
2nd Gear	Variable, 1.3 to 2.9 mph
3rd Gear	Variable, 2.4 to 5.0 mph
4th Gear	Variable, 3.4 to 7.4 mph
Reverse	Variable, 1.8 to 3.3 mph

BRAKES, CLUTCH AND STEERING

BRAKES	
Type	Drum and shoe, Pedal Operated
Parking	Hand Lock to Foot Brake
CLUTCH	V-Belt System
STEERING	Enclosed Gear
WHEEL BEARINGS	
Front	Tapered Roller
Rear	Sealed Ball

CURB WEIGHTS

	110 Tractor	112 Tractor (Tecumseh)	112 Tractor (Kohler)
Manual Lift—High Flotation Tires (GT-3)	613 lbs.	624 lbs.	640 lbs.
Hydraulic Lift—High Flotation Tires (GT-3)	625 lbs.	636 lbs.	660 lbs.

NOTE: See specific sections for detailed specifications

TIRE SPECIFICATIONS AND TRACTOR DIMENSIONS

	110 Tractor Only	110 and 112 Tractors		
	All Purpose Tires (GT-1)	**High-Flotation Tires (GT-3)**	**Traction Tires (GT-4)**	**High-Flotation Tires (GT-5)**
WHEEL TREAD				
Front	29 in.	30 in.	29 in.	30 in.
Rear	27 or 33 in.	27 or 33 in.	27 or 33 in.	28-1/2 or 31 in.
TIRE SIZES				
Front	4.80/4.00-8, 2-ply	16x6.50-8, 2-ply	4.80/4.00-8, 4-ply	16x6.50-8, 2-ply
Rear	6-12, 2-ply	23x8.50-12, 2-ply	23x8.50-12, 2-ply	23x10.50-12, 2-ply
TIRE INFLATION*				
Front	12 to 30 psi	6 to 16 psi	12 to 40 psi	6 to 16 psi
Rear	6 to 12 psi	5 to 10 psi	5 to 10 psi	5 to 10 psi
DIMENSIONS				
Wheel Base	46 in.	46 in.	46 in.	46 in.
Over-all Length	66-3/4 in.	66-3/4 in.	66-3/4 in.	66-3/4 in.
Over-all Height	41 in.	41 in.	41 in.	41 in.
Over-all Width				
(min)	34-1/2 in.	37 in.	35 in.	39 in.
(max)	39 in.	41-1/2 in.	41-1/2 in.	41-1/2 in.
Turns Outside	36 in. radius	34 in. radius	34 in. radius	33 in. radius

* *Inflation will vary with attachment used.*

NOTE: GT-6 Tire Specifications are the same as GT-3 Front and GT-4 Rear Specifications.

GT-7 Tire Specifications are the same as GT-4 Front and GT-5 Rear Specifications

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.

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Group 15
TUNE-UP AND ADJUSTMENT

PRELIMINARY ENGINE TESTING

Operation	Specification	Reference
Cylinder compression	110-120 psi (1000 rpm)	Section 20, Group 5 or 25
Crankcase vacuum	5-10 inches of water column	Section 20, Group 5 or 25

MINOR TUNE-UP GUIDE

Operation	Specification	Reference
Change oil	Summer above 32° F.— SAE 30 (AM 30730) Winter below 32° F— SAE 5W-20 (AM 30710)	Section 10, Group 20
Clean and regap spark plug	Clean electrodes and insulator. Replace gasket Set spark gap at 0.025 in. 110 tractor; 0.030 in. 112 tractor w/Tecumseh engine; 0.020 in. 112 tractor w/Kohler engine	Section 40, Group 15 or 20
Remove air cleaner, inspect and replace if dirty or clogged.	Air cleaner must be clean. (No air flow specifications available.)	Section 30, Group 15
Adjust carburetor	High speed mixture needle Idle mixture needle	Section 30, Group 10
Adjust governor speed	Speed (fast)— 3800 rpm no load; Speed (idle)— 1200-1700 rpm	Section 20, Group 20 or 40
Check and clean fuel tank and fuel shut off strainer.	Regular gasoline only	Section 30, Group 20
Battery hydrometer test	1.260-1.280 sp. gr. 100% charged at 80° F.	Section 40, Group 10

MAJOR TUNE-UP GUIDE

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

Operation	Specification	Reference
Recondition carburetor	Install carburetor 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 0r 30
Remove shrouding, clean engine and cylinder head fins	.....	Section 20, Group 10 or 30
Test condenser	Capacity .18-.23 Microfarads Delco No. 1965489 Capacity .13-.16 Microfarads Phelon No. FG-7533	Section 40, Group 15 or 20
Test coil	K181 Kohler Engine Operating 3 amp Max. Ohms 3800 to 6000 K241AS Kohler Engine Operating .55 amp Max. Ohms 5500 to 9500	Section 40, Group 15 or 20
Replace breaker points	Point gap 0.020 in.	Section 40, Group 15 or 20
Retime ignition	"SP" or "S" mark on flywheel at 1200-1800 rpm	Section 40, Group 15 or 20
	112 Tractor with Solid State Ignition	
Test charger coil	400 to 450 Ohms	Section 40, Group 25
Adjusting Ignition Air Gap	.006 to .010 in.	Section 40, Group 25

Group 20
FUEL AND LUBRICANTS

FUEL

Use regular grade gasoline of a recognized brand. Avoid using stale or long-storage gasoline. Stale gasoline does not vaporize properly, thus causing hard starts.

Use of premium grade gasoline (ethyl) is not recommended in small tractor engines. The engine compression ratio is not high enough to require premium grade, which can cause a buildup of lead deposits. These deposits cause a loss of power and shorten engine life.

Do not mix oil with gasoline. Do not use white gas.

LUBRICANTS

Illustrated lubrication instructions have been included in the operator's manual furnished with your customer's machine. Remind your customer to follow these recommendations.

Oil used in the engine crankcase should have an American Petroleum Institute (API)/SAE classification of Service MS. Never fill engine crankcase above full (F) mark on dipstick.

The charts below and on next page indicate the type of lubricant, capacities and service intervals recommended for 110 and 112 tractors.

CAPACITIES

Cavities	110 Tractors	112 Tractors (Tecumseh)	112 Tractors (Kohler)
Fuel Tank - U.S. Gallons	1.75	1.75	1.75
Crankcase - U.S. Pints	* 2.5	* 2.5 (†)	* 3.0
Transaxle - U.S. Pints	3.5	3.5	3.5
Hydraulic Lift System - U.S. Pints	2.5	2.5	2.0

* *Initial fill for new engine or after engine has been disassembled for service. Thereafter 2 pints only (such as periodic oil changes).*

†*3 U.S. pints beginning with Serial No. 161,772.*

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TYPE OF LUBRICANT
(110 and 112 Tractors)

Crankcase - (API)/SAE Service MS Detergent type	
Summer - Above 32° F	SAE 30 - John Deere AM30730
Winter - Below 32°F	SAE 5W-20 John Deere AM30710
Transaxle	John Deere AM30200M (SAE 90)
Hydraulic Lift	Automatic Transmission Fluid Type A
Tractor Grease Fittings and Front Wheel Bearings	SAE (Seasonal grade) Multipurpose-Type Grease

SERVICE INTERVALS
(110 and 112 Tractors)

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
Hydraulic Lift System	200 hours or 2 years
Tractor Grease Fittings (See page 20-4 for locations)	Spring and fall season
Front Wheel Bearings (repack)	Each time wheel is removed

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CHANGING CRANKCASE OIL

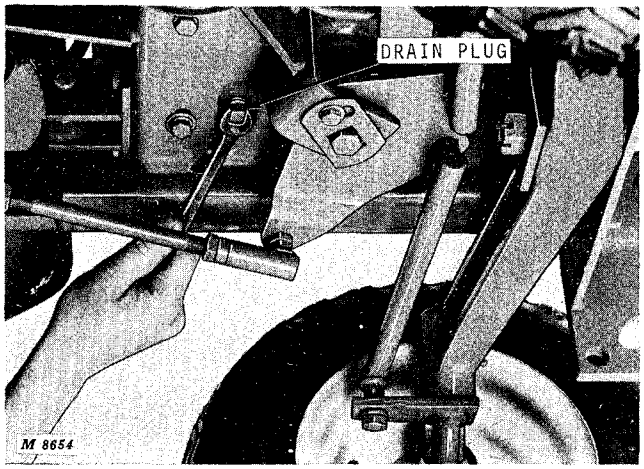

Fig. 1-Draining Oil (K181-HH100)

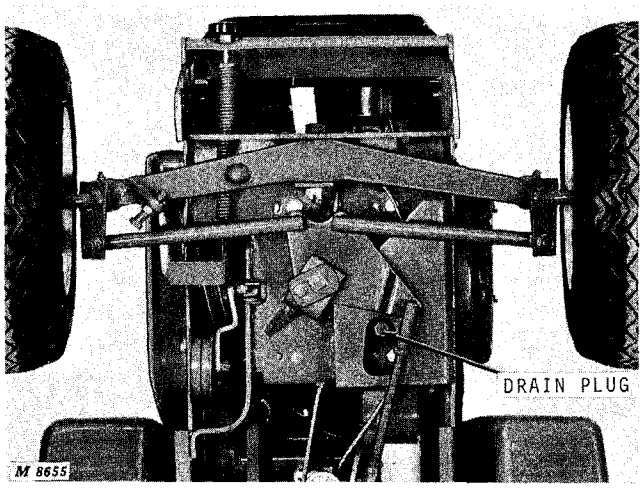

Fig. 2-Draining Oil (K241)

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

Remove drain plug and allow oil to drain into a container.

Install plug and fill crankcase with oil of the proper viscosity (page 20-2) to "F" mark on dipstick. Crankcase capacity is approximately 2-1/2 pints for 110 Tractors and 112 Tractors with Tecumseh engines. 112 Tractors with Kohler engines and 112 Tractors with Tecumseh engines, beginning with Serial No. 161,772, have a capacity of approximately 3 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

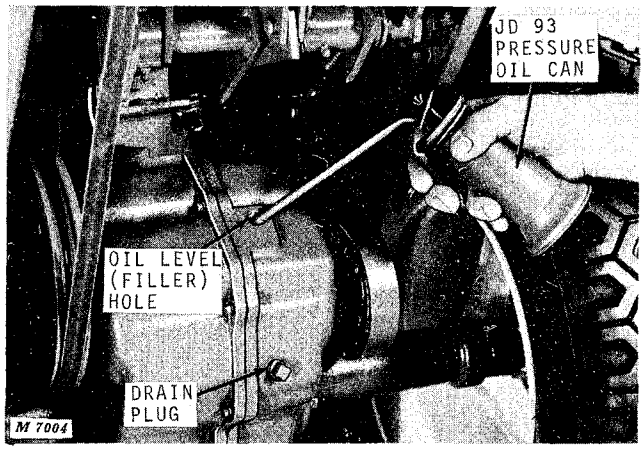

Fig. 3-Adding Oil to Transaxle

Remove oil level (filler) plug from front of transaxle.

When required, use a pressure oil can to add AM30200M Transmission Lubricant through filler hole until oil spills out. Be sure tractor is on a level surface when checking.

Use JD93 pressure oil can or equivalent to fill transaxle as shown above.

Change transmission oil every 200 hours.

NOTE: Refill or add transmission lubricant through fill tube at rear of deck if tractor is so equipped. Oil level (filler) hole must be open to assure correct lubricant level when filling.

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GREASE FITTING LOCATION

Lubricate the grease fittings indicated below using a John Deere Pisto-Luber or hand grease gun containing SAE multipurpose-type grease. Wipe fittings clean before and after lubrication.

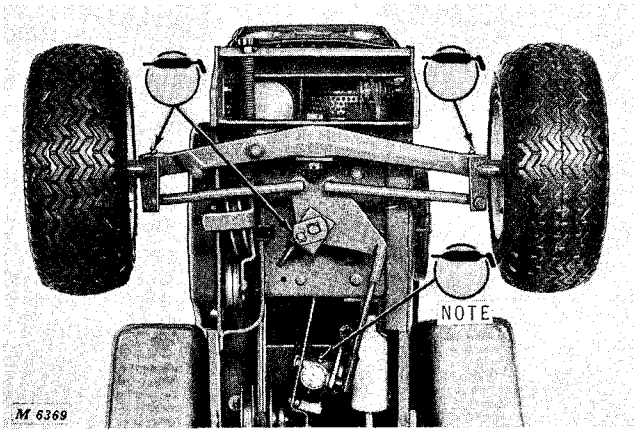

Fig. 4-Fittings on Front Axle, Steering Column and Bearing Cone

NOTE: Do not overlubricate steering column fitting. Only 3 or 4 strokes with hand grease gun or AM31300 Pisto-Luber are necessary. Do not use a high-pressure grease gun on this fitting. The Pisto-Luber is available from your John Deere dealer.

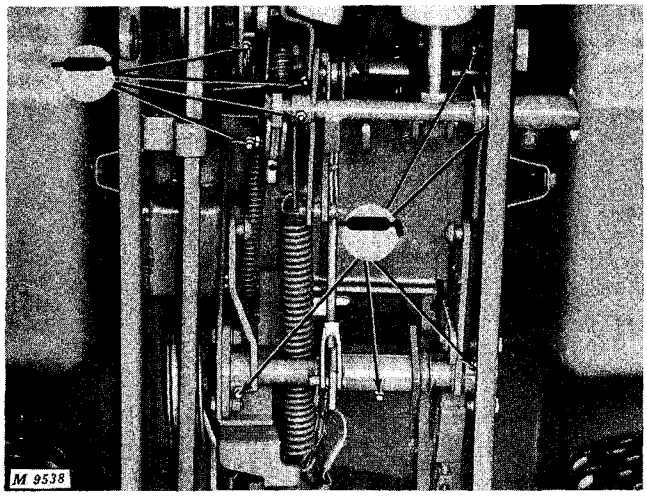

Fig. 5-Fittings on Variator Linkage, Lift Linkage and Rear Lift Shaft

REPACK POWER TAKE-OFF CLUTCH BEARING

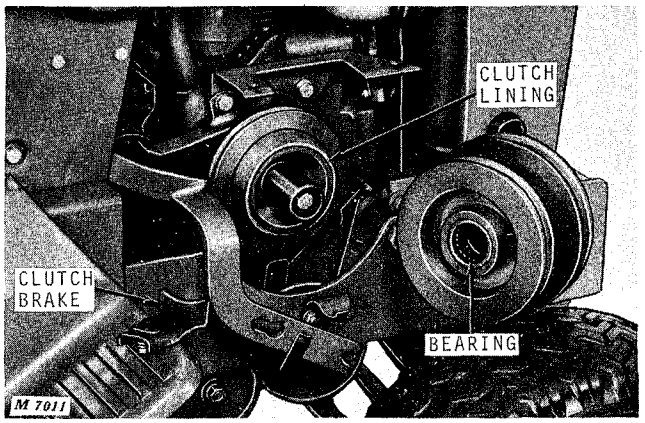

Fig. 6-Checking PTO Clutch

Disconnect the clutch arm and remove the clutch brake. Check PTO clutch to be certain that no dust or dirt has entered the bearing. Also check condition of clutch lining and clutch brake.

Remove old grease from bearing with solvent at the beginning of each spring and fall season or sooner if dirt is found in the bearing. Dry thoroughly and repack bearing with John Deere High Temperature Grease, AT17659T, available in one-pound cans. Connect the clutch arm and reinstall the clutch brake. Adjust the clutch brake so there is 1/16-inch clearance between the brake and clutch cup sheave when the clutch is engaged.

See Section 50, Group 20, for PTO clutch service information.

Section 20
ENGINE

Group 5
GENERAL INFORMATION
KOHLER ENGINES FOR 110 AND 112 TRACTORS

TABLE OF CONTENTS—KOHLER ENGINES

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TABLE OF CONTENTS—TECUMSEH ENGINE (Serial No. 100,001-161,771)

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DESCRIPTION

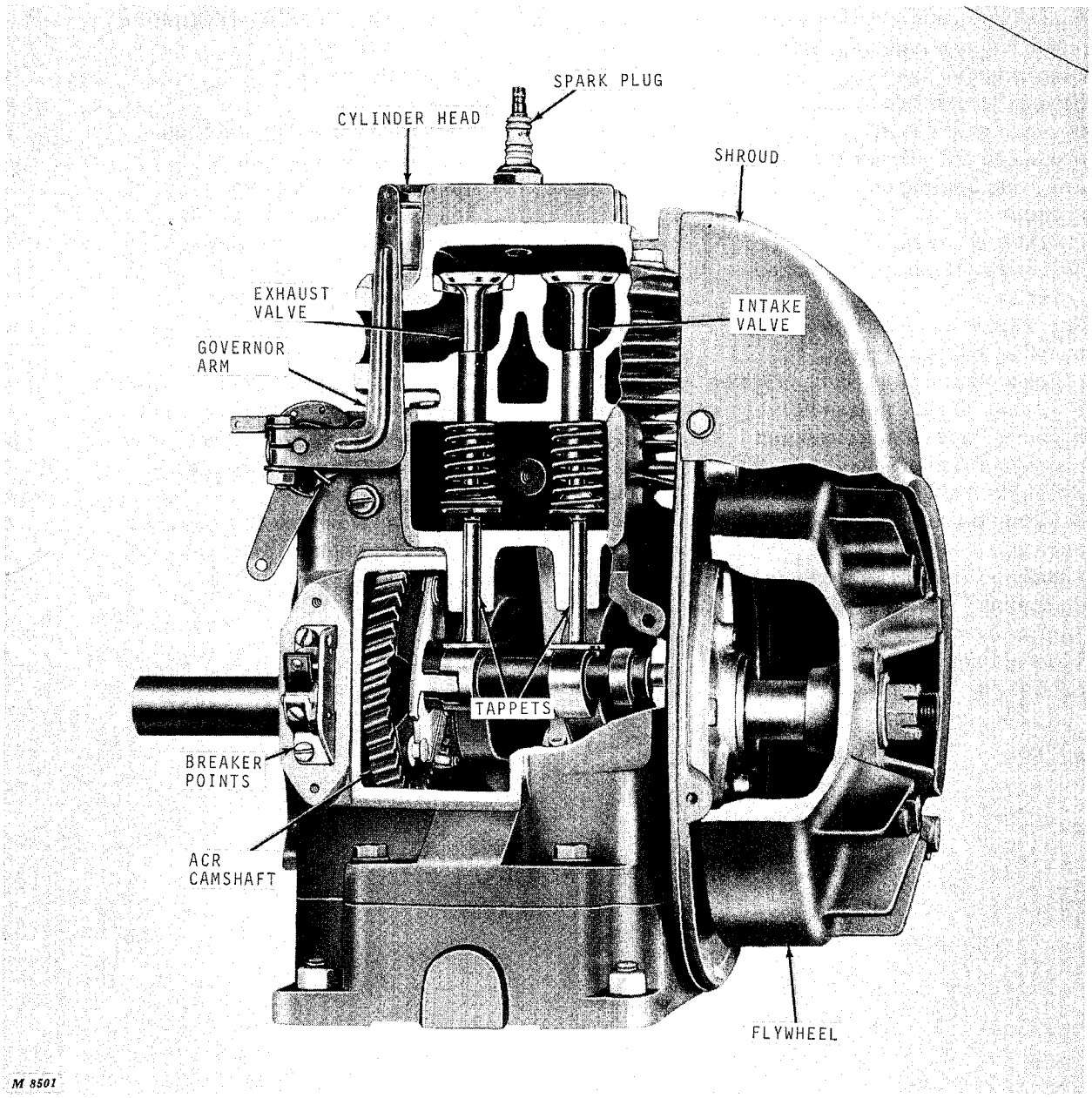

Fig. 1-Cutaway View of Kohler K181S Engine Showing Valves and Tappets

The Kohler K181S Engine powers the 110 Tractor; the Kohler K241AS Engine is optional power for the 112 Tractor. These engines are of a single-cylinder, four-cycle, air-cooled design.

Both engines have cast iron blocks, anti-friction ball bearings, oil bath lubrication, and internal fly-weight governors.

In addition, the Kohler K241AS Engine features a dynamic balance system which consists of two balance gears rotated by the crankshaft in the opposite direction of crankshaft rotation.

Detailed specifications for each engine are covered in Section 10, "General," and at the end of each group in this section.

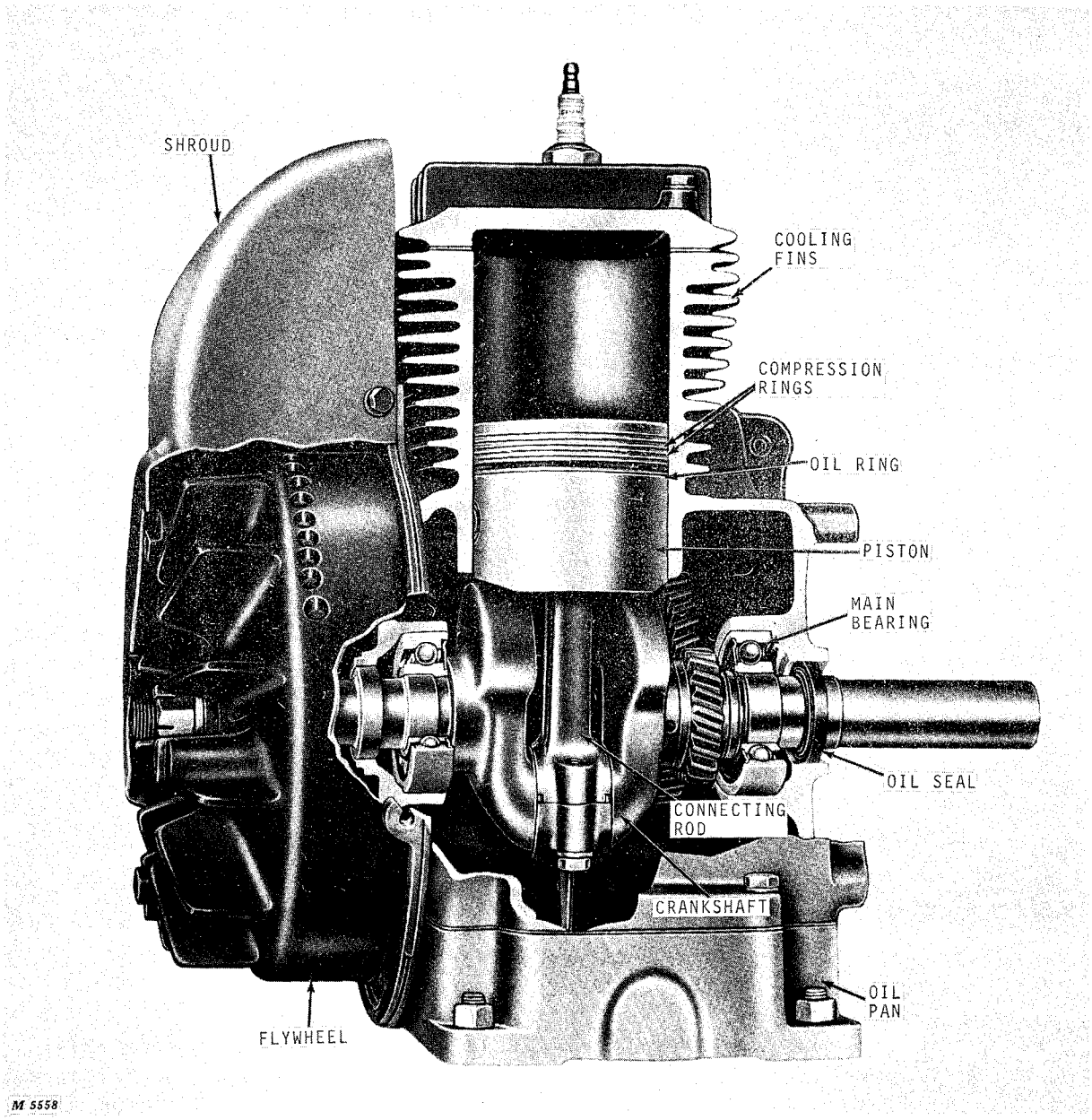

Fig. 2-Cutaway View of Kohler K181S Engine Showing Piston, Crankshaft and Bearings

The maximum brake horsepower curve shows the performance of laboratory engines equipped with standard air cleaner, muffler and flywheel corrected to sea level barometer and with free air temperature of 60° F. Horsepower decreases 3-1/2% for each 1000 feet above sea level, and 1% for each 10° F. above 60° F.

Horsepower ratings are established in accordance with Society of Automotive Engineers - Small Engine Test Code - J 607.

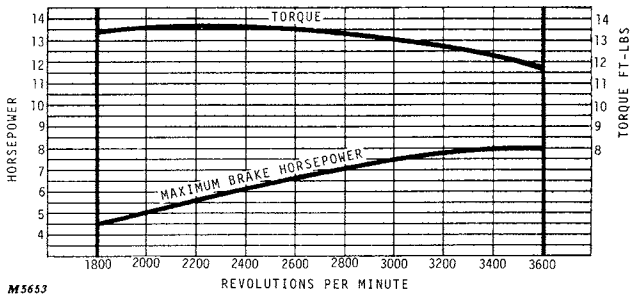

Fig. 3-Torque-Horsepower Chart

DESCRIPTION—Continued

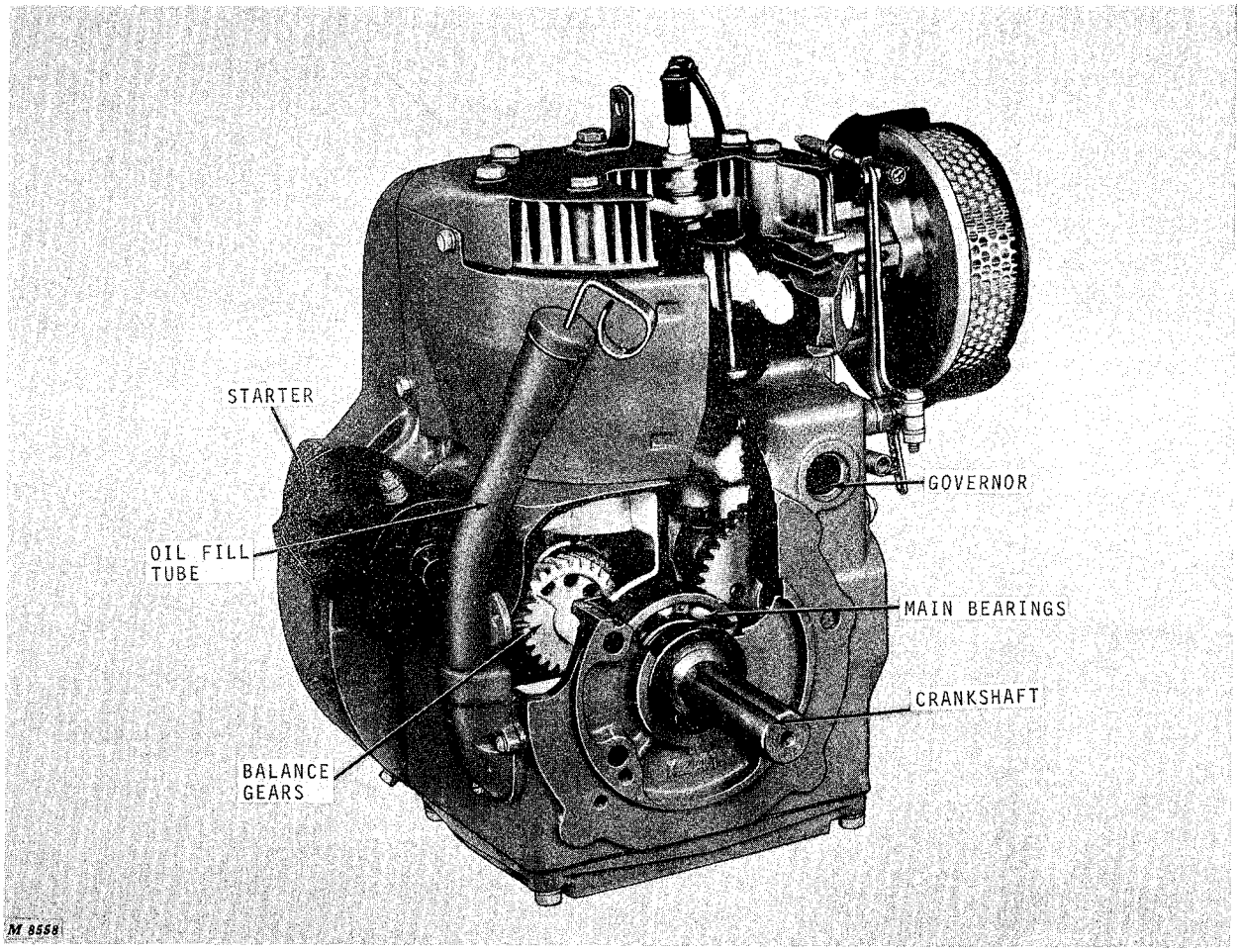

Fig. 4-Cutaway View of Kohler K241AS Engine

The Kohler K241AS Engine is a four-cycle, air-cooled, internal combustion engine. It has a cast iron cylinder block, anti-friction crankshaft bearings, and a dynamic balance system.

In addition, the engine features a battery-ignition system, gear-driven flyweight governor, oil bath lubrication, and a fuel pump for positive fuel delivery at all speeds.

The engine is rated at 10 horsepower at 3600 rpm.

ENGINE ANALYSIS

PRELIMINARY ENGINE CHECKS

A complete diagnosis guide of engine malfunctions begins on page 5-9. 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.

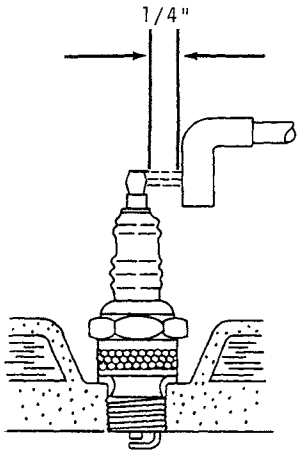

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Fig. 5-Checking Spark At Plug

Check spark, Figure 5, whenever engine will not start. If engine will not crank, follow diagnosis procedure on page 5-9.

Remove ignition cable from spark plug and install adaptor or ordinary paper clip. Hold approximately 1/4 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" guide 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 5-8.

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 on tractors (Serial No. 100,001-) 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.

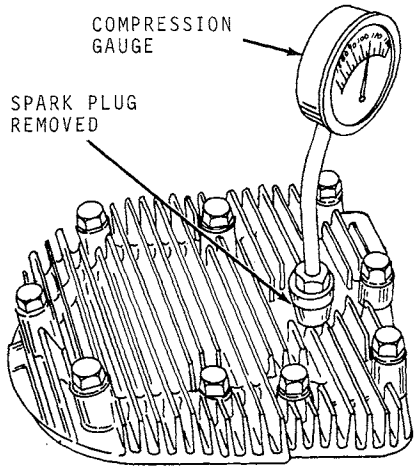

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Fig. 6-Testing Engine Compression

Depress clutch-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.

Compression Test—Continued

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, Figure 6. 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.

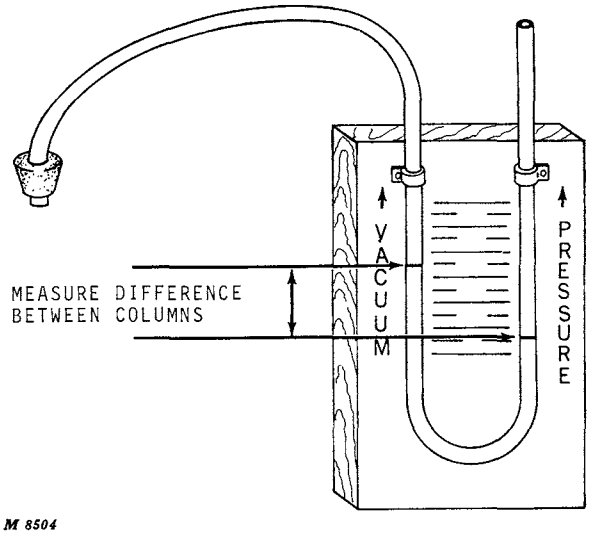


Fig. 7-Checking Crankcase Vacuum

Connect a water U-tube manometer, Figure 7, 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 10-9 of this Section 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

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.

Defective ignition module (Tecumseh HH100 engine).

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 properly adjusted.

Faulty condenser.

Defective ignition coil.

Dirt in fuel system.

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

DIAGNOSING MALFUNCTIONS—Continued

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.

Litho in U.S.A.

Engine Knocks

Engine out of time.

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 or 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.

Litho in U.S.A.

Group 10
CYLINDER HEAD, VALVES AND BREATHER KOHLER ENGINES FOR 110 AND 112 TRACTORS

GENERAL INFORMATION

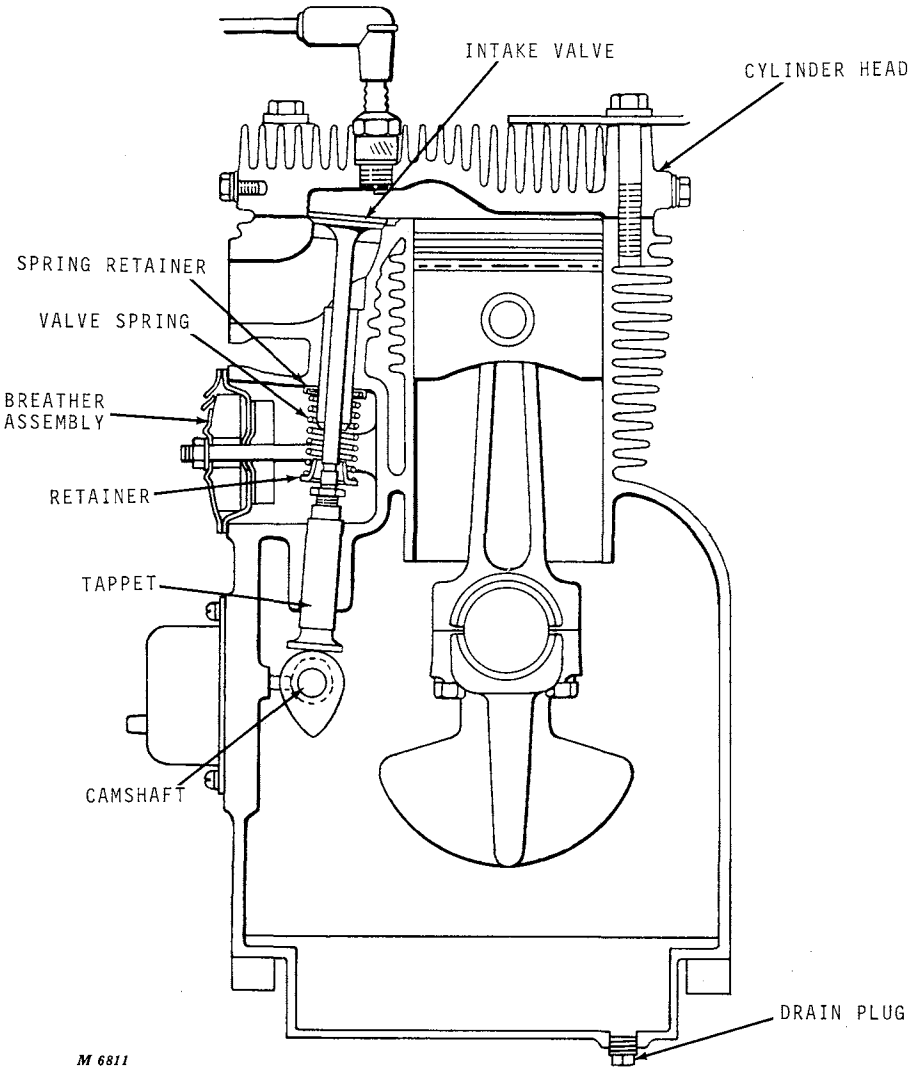


Fig. 1-Schematic View of Valves and Tappets

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 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 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 10-8.*

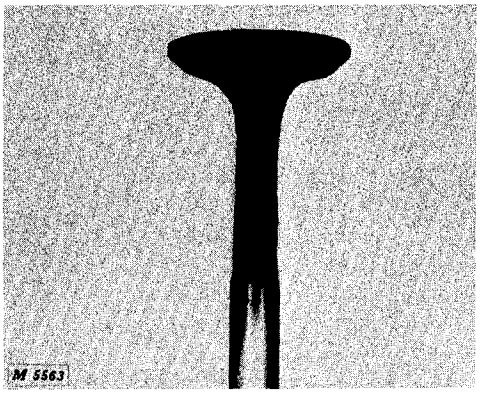


Fig. 3-Valve Stem Corrosion

Valve stem corrosion 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.**

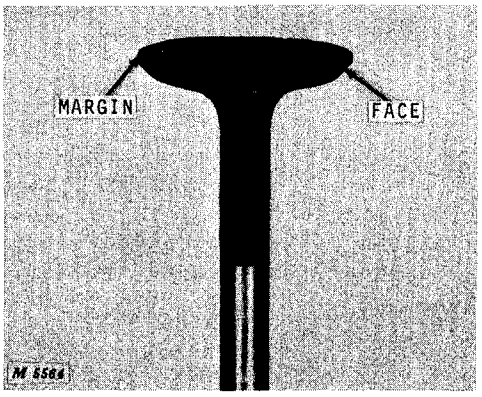


Fig. 4-Exhaust Valve Running Too Hot

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, Figure 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 or overheated spark plug, which causes pre-ignition, or a lean fuel mixture.

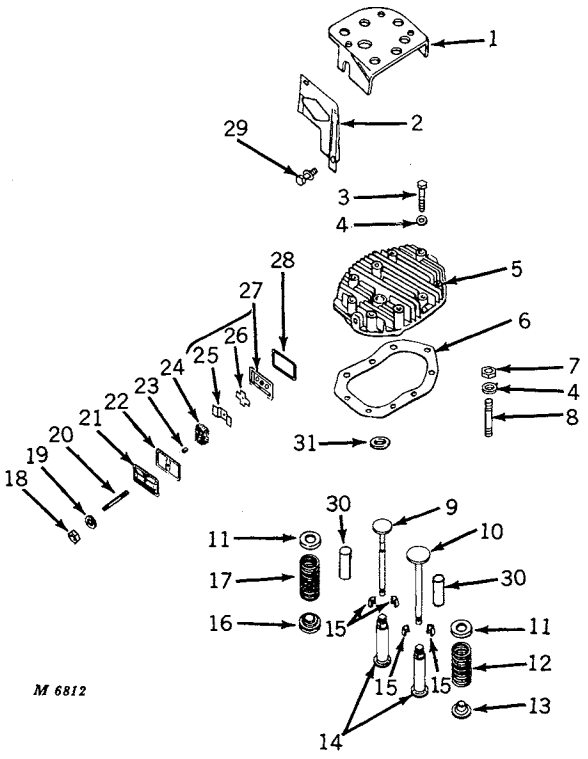
Fig. 5-Gummy Valve Causing Valve to Stick

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

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

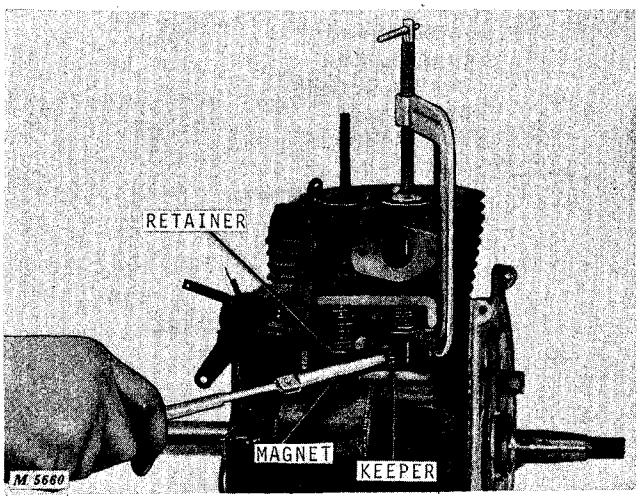


Fig. 7-Removing Valves

Use a valve spring compressor to compress valve springs, Figure 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

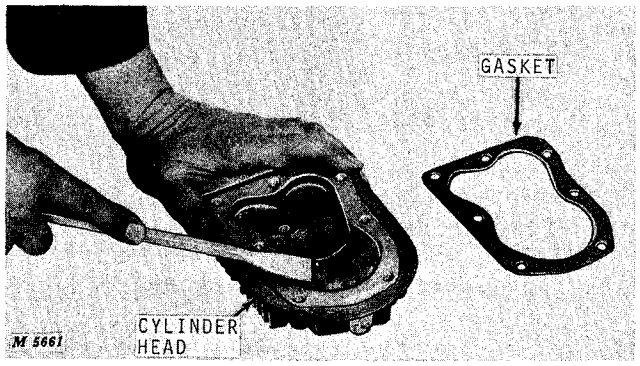


Fig. 8-Cleaning Cylinder Head

Remove all deposits from combustion chamber and gasket surface of head with a scraper 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.

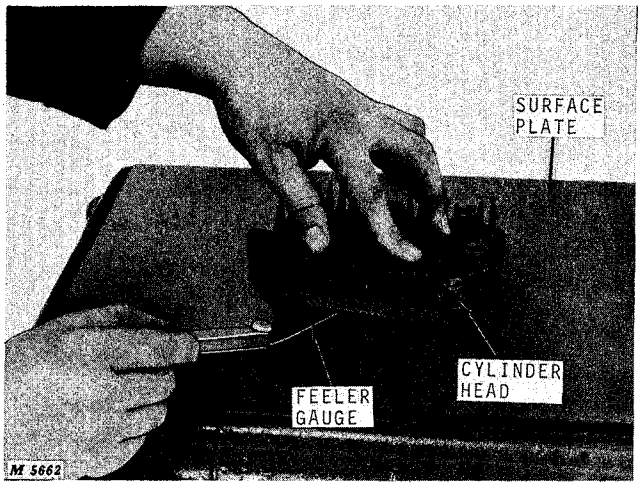


Fig. 9-Checking Surface of Cylinder Head

Check the cylinder head for cracks, 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 Figure 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

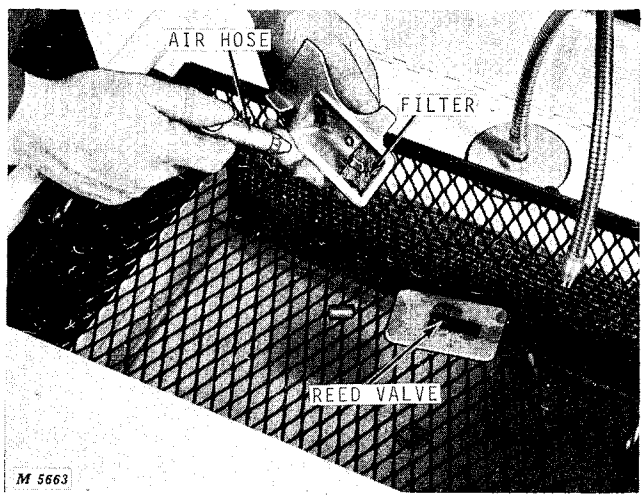


Fig. 10-Cleaning Breather Filter

Clean all breather parts in solvent. 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

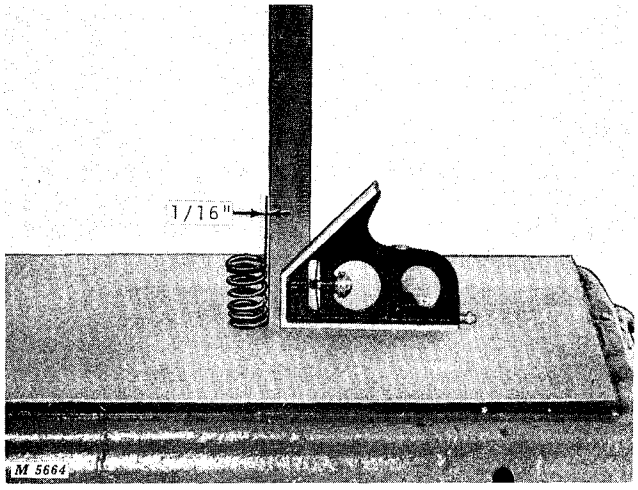


Fig. 11-Valve Spring Squareness

Check valve spring for squareness, using a steel square and a surface plate, Figure 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 10-11, for out-of-square limits.

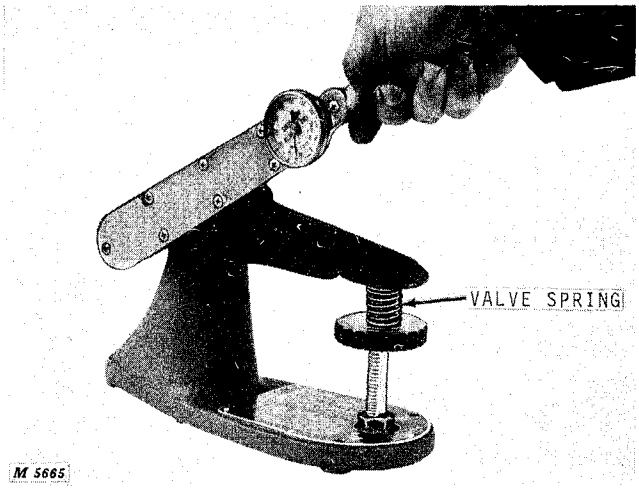


Fig. 12-Valve Spring Tension

Check valve spring for proper pressure, Figure 12. Refer to Specifications, page 10-11, 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.

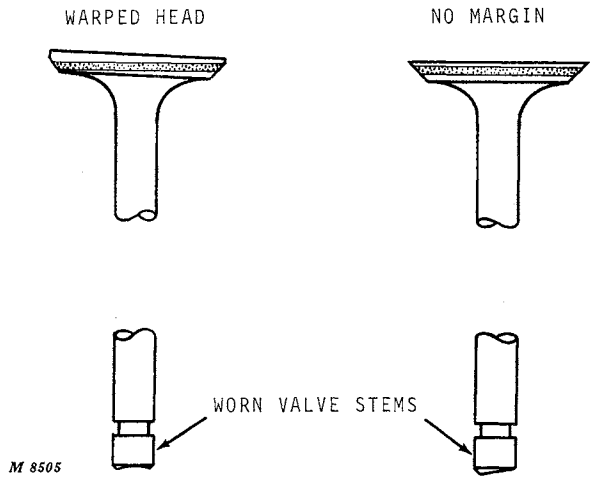


Fig. 13-Faulty Valves

Inspect valve faces, heads and stems for distortion,. pitting, and burning. 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.

Reconditioning or Replacing Valves

Valve Guides

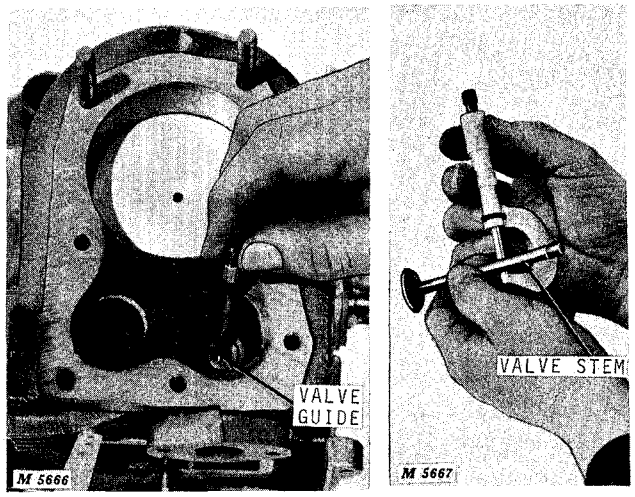


Fig. 14-Measuring Valve Guides and Stems

Clean the valve guides first to assure valve alignment when cutting valve seats.

Use valve guide cleaner to clean inside of valve guide. Then measure I.D. of valve guide, and O.D. of valve stem, Figure 14. Valve to guide clearance is 0.0015 and 0.0020 inch. Replace and ream guides, as necessary. Refer to page 10-11 for additional specifications.

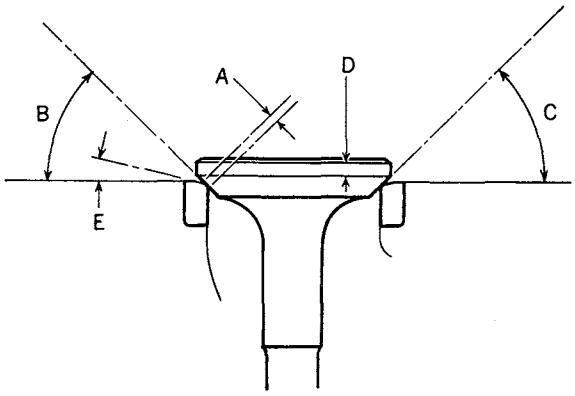
Valve Seats

Replace broken and excessively worn valve seats. Use either stellite or molychrome nickel steel seats. Follow procedure on page 10-8.

The intake valve seat is machined into the cylinder block. When required, an intake valve seat insert may be installed. See page 10-8.

Hold the valve seating surface "A," Figure 15, as close to 1/32 inch as possible. Seats with more than 1/16-inch seating surface should be narrowed (cut back) with 30° cutter, "E," Figure 15.

The valve seat angle "B" depends upon valve face angle "C." New valves have a 45° face. Recondition valve seats with 45° cutters and lap valves. See page 10-7.



A-Valve Seating Surface (1/32 inch)
B-Valve Seat Angle (45°)
C-Valve Face Angle (45°)
D-Valve Margin (1/16 inch)
E-Seat Narrowing Angle (30°)

Fig. 15-Valve Seat and Surface Dimensions

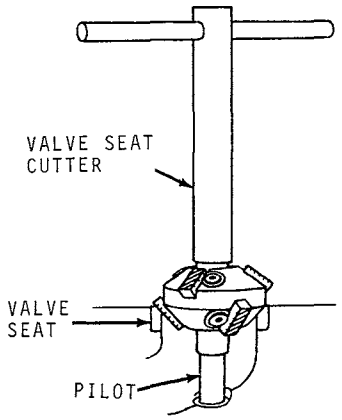


Fig. 16-Valve Seat Cutter

This valve seat cutter will cut a 45° valve seat and narrow the seat to 30°. See Special Tools, page 10-12, for tool number and manufacturer.

When reconditioning valves, be sure there is no more than 1/16-inch and no less than 1/32-inch margin "D" on the valve.

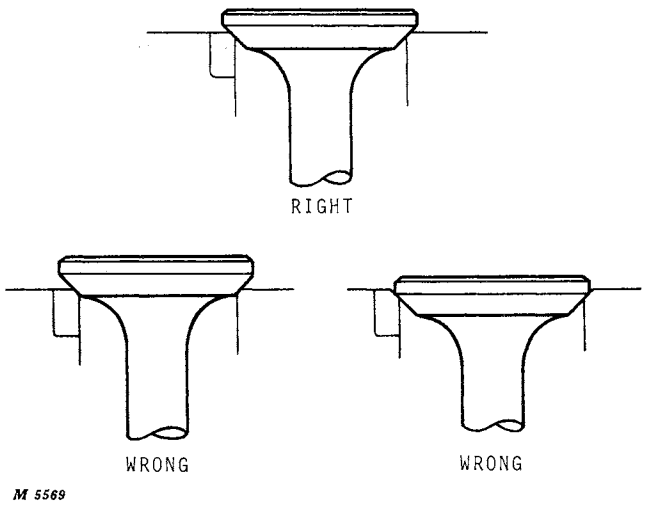


Fig. 17-Valve and Seat Relationship

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

Valve Lapping

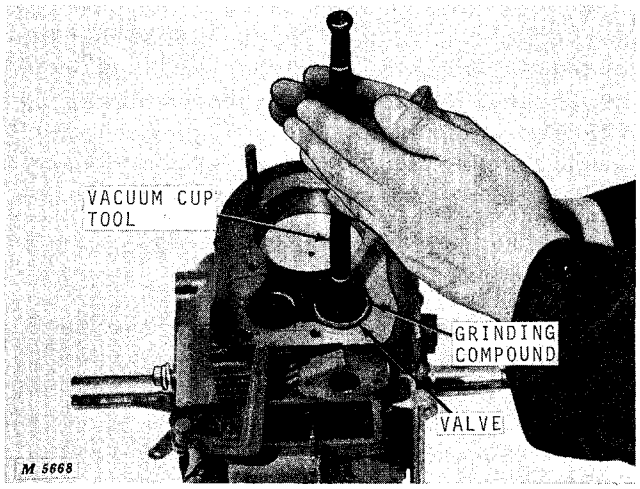


Fig. 18-Lapping Valves

Coat face of valve sparingly with a fine grade of valve grinding compound. Use a vacuum cup tool, Figure 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. See page 10-11.

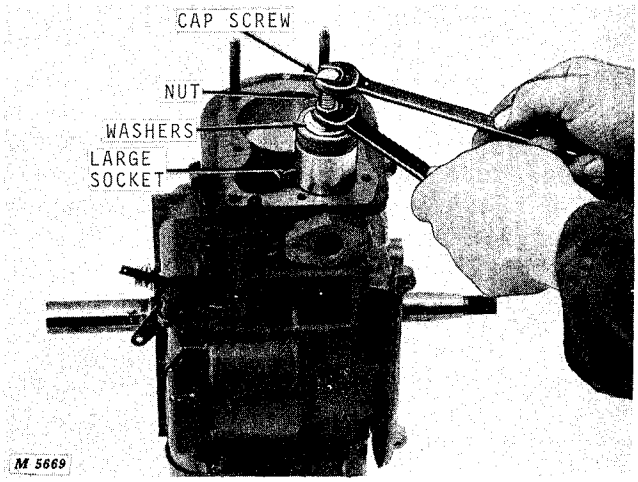


Fig. 19-Removing Valve Guides

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, Figure 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.

Replacing Valve Guides—Continued

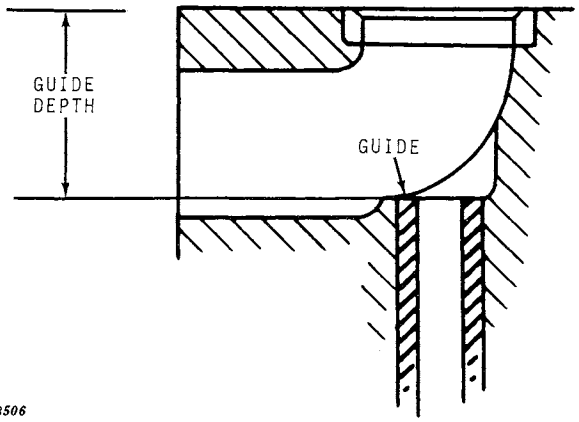


Fig. 20-Installing Valve Guides

Thoroughly clean guide hole in block. Press new guide into place. Guide depth is measured from top of block. Ream guide to correct size. See "Specifications," page 10-11.

Replacing Exhaust Valve Insert

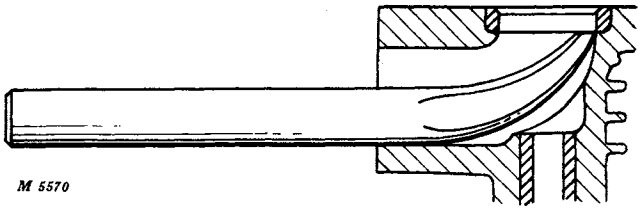


Fig. 21-Removing Exhaust Valve Insert

To remove exhaust seat insert, use extractor, Figure 21 or a valve seat puller. Clean seat area thoroughly before installing new insert. If extractor is not available, break seat with cold chisel and carefully extract broken pieces.

The exhaust valve insert is retained by a press fit only. Chill both the insert and driving tool in dry ice before pressing insert into block.

Installing Intake Valve Insert

If an intake valve seat is burned or worn beyond refacing, an insert can be machined and installed by a competent small engine rebuilder.

Checking Valve Clearance

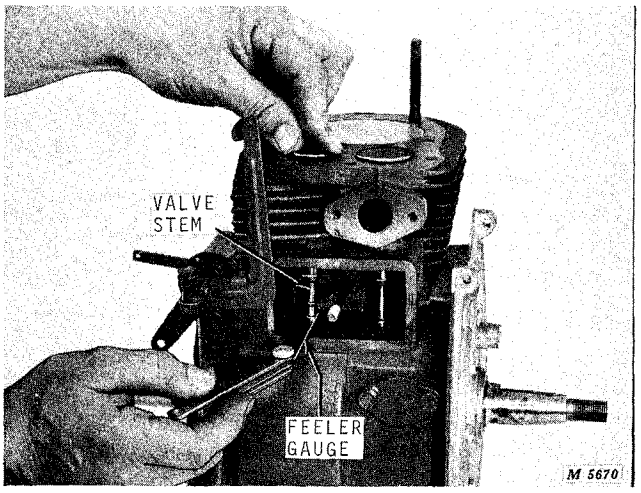


Fig. 22-Checking Valve-to-Tappet Clearance

Valve grinding changes the tappet and valve clearance. After grinding or installing new valves, check clearance as follows:

1. Rotate crankshaft until piston is top dead center (end of compression stroke) and crankshaft keyway is at exactly 12 o'clock (top) position. If breaker points are properly adjusted, they will be opening at this time. It is important that this procedure be followed to insure that the exhaust tappet is NOT riding on the automatic compression release mechanism.

2. Insert valves in their guides and hold valves firmly on seats.

3. Check clearance between bottom of each valve stem and its tappet with a feeler gauge, Figure 22. Refer to "Specifications," page 10-11, for proper valve clearance. On K181S Engines, grind valve stems for correct clearance. The K241AS Engines have adjustable tappets which will take up the additional clearance created by grinding the valve stems.

INSTALLATION

Installing Valve Springs, Retainers and Keepers

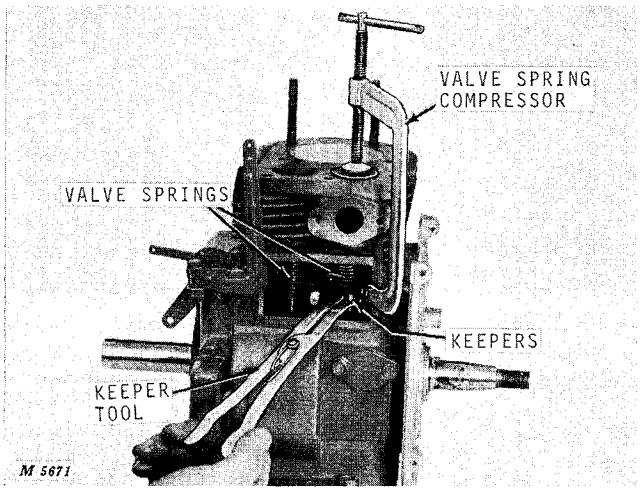


Fig. 23-Installing Valve Springs, Retainers and Keepers

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, Figure 23. If tool is not available, apply grease to keepers to hold them on the valve stem and insert them by hand.

Assembling Breather

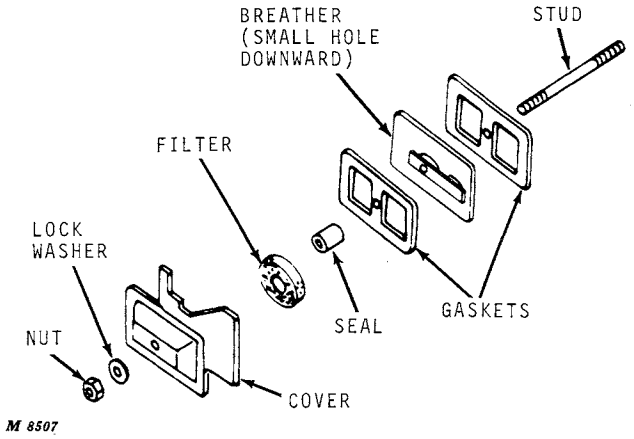


Fig. 24-Breather Parts (K181S Engine)

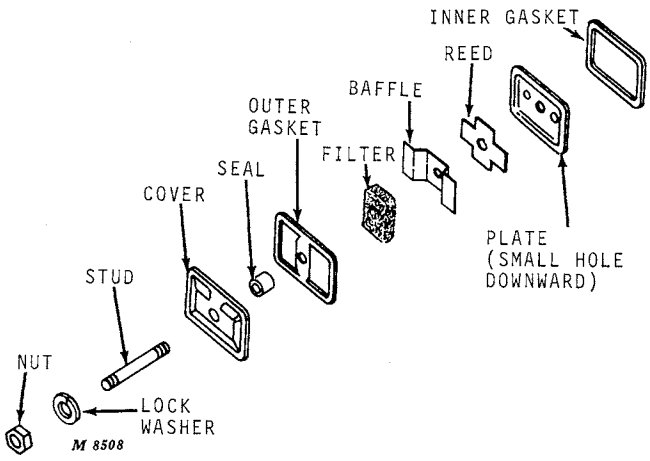


Fig. 25-Breather Parts (K241AS Engine)

The correct order of breather assembly is very important. For correct assembly, refer to Figures 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.

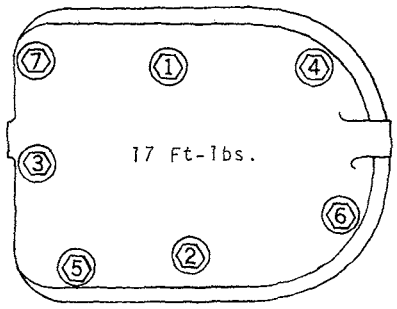


Fig. 26-Cylinder Head Bolt Tightening Sequence (K181S Engine)

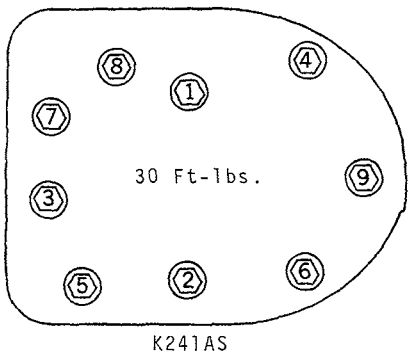


Fig. 27-Cylinder Head Bolt Tightening Sequence (K241AS Engine)

It is important to tighten all cylinder head bolts with an even pressure and in their correct sequence, Figure 26 or 27, so that uneven stresses will not set up in cylinder wall. Refer to "Specifications," page 10-11, for proper cylinder head bolt torque.

Installing Carburetor

K181S Engine

Connect throttle linkage in proper holes on governor arm and throttle shaft arm, Figure 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, Figure 29, to engine block using a new gasket, tighten bolts firmly. Connect fuel line to

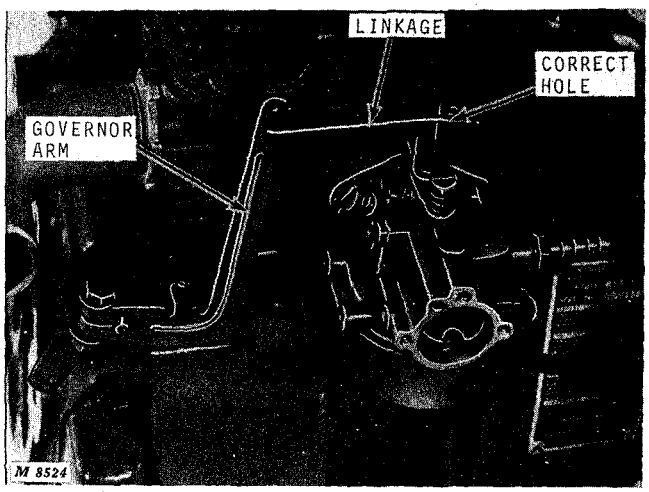


Fig. 28-Carburetor Assembly (K181S Engine)

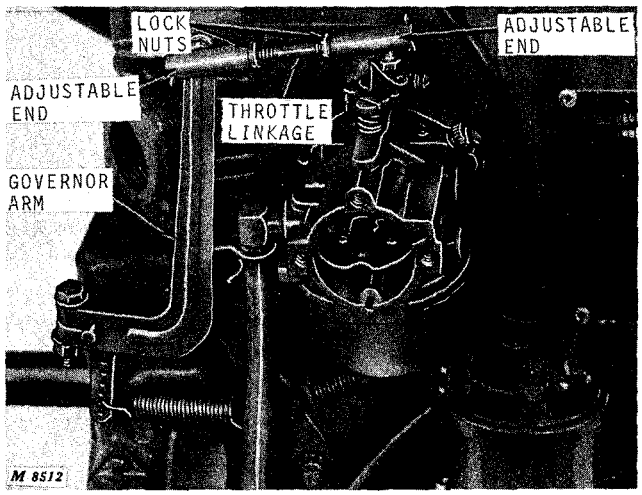


Fig. 29-Carburetor (K241AS Engine)

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.

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 10-11, 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.

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SPECIFICATIONS

Kohler K181S and K241AS Engines

Component	New Part Dimension	Wear Tolerance
Valve guide, inside diameter	0.312 to 0.313 inch	.....
Valve guide depth (K181S)	1-5/16 inch	.....
Valve guide depth (K241AS)	1-15/32 inch	.....
Valve stem diameter—Intake	0.3105 to 0.3110 inch	.....
Exhaust	0.3090 to 0.3095 inch	.....
Valve seat width	1/32 inch	5/64 inch
Valve face width	3/32 inch	.....
Valve margin	1/16 inch	1/32 inch
Valve spring squareness	1/32-1/16 inch	3/32 inch
Valve spring compressed tension (intake or exhaust) (K181S)	18 to 22 lbs. at 1-15/16-inch length	.....
Valve spring compressed tension (intake) (K241AS)	43 to 49 lbs. at 1-5/16-inch length	.....
Valve spring compressed tension (exhaust) with rotator (K241AS)	43 to 49 lbs. at 1-5/16-inch length	.....
Valve spring free length (intake or exhaust) (K181S)	1-3/4 inch	1/32 inch
Valve spring free length (intake) (K241AS)	1-13/16 inch	1/32 inch
Valve spring free length (exhaust) with rotator (K241AS)	1-7/8 inch	1/32 inch
Cylinder head flatness	Contact at all points	Replace if warped

Table of Clearances

Item	Clearances
Intake valve stem in guide	0.0010 to 0.0025 inch
Exhaust valve stem in guide	0.0025 to 0.0040 inch
Valve clearance—intake (cold) (K181S)	0.006 to 0.008 inch
Valve clearance—intake (cold) (K241AS)	0.008 to 0.010 inch
Valve clearance—exhaust (cold) (K181S)	0.015 to 0.017 inch
Valve clearance—exhaust (cold) (K241AS)	0.017 to 0.020 inch

Torques For Hardware

Location	Torque
Cylinder head bolts (K181S)	17 ft-lbs
Cylinder head bolts (K241AS)	30 ft-lbs
Spark plug (cold)	27 ft-lbs

Tune-Up Data

Item	Specifications
Engine compression	110 to 120 psi
Spark plug gap (K181S)	0.025 inch
Spark plug gap (K241AS)	0.020 inch
Valve face angle	45°, see page 10-6
Valve seat angle	45°, see page 10-6
Crankcase vacuum	
(A) U-tube manometer	5-10 inches water column

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SPECIAL TOOLS

Name	Part No.	Use
Extractor	K.O. LEE R95	To remove exhaust valve seat insert.
Valve Spring Tester	STURTEDANT Model SPT	To check valve spring pressure.
Adjustable Reamers	QUICK SET 43	Ream valve guides after installation.
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
U-Tube Manometer	DWYER Model 1211-24	Check crankcase vacuum.
Valve Seat Cutter Kit for Kohler Engines	NEWAY No. 102S Kit, NEWAY Sales Inc., Corunna, Michigan	Recondition valve seat.

Group 15

PISTON, CRANKSHAFT, MAIN BEARINGS AND FLYWHEEL KOHLER ENGINES FOR 110 AND 112 TRACTORS

GENERAL INFORMATION

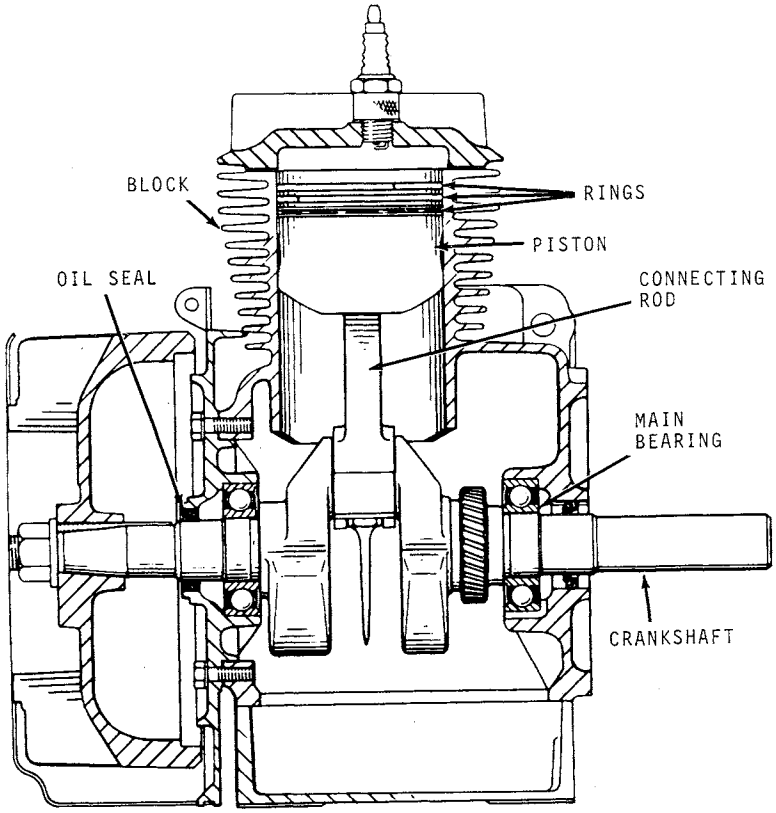

Fig. 1-Cutaway View of Kohler K181S Engine

Oversize pistons and rings are available for K181S 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.

The short block for the Kohler K241AS Engine includes the dynamic balance gears in addition to the above parts.

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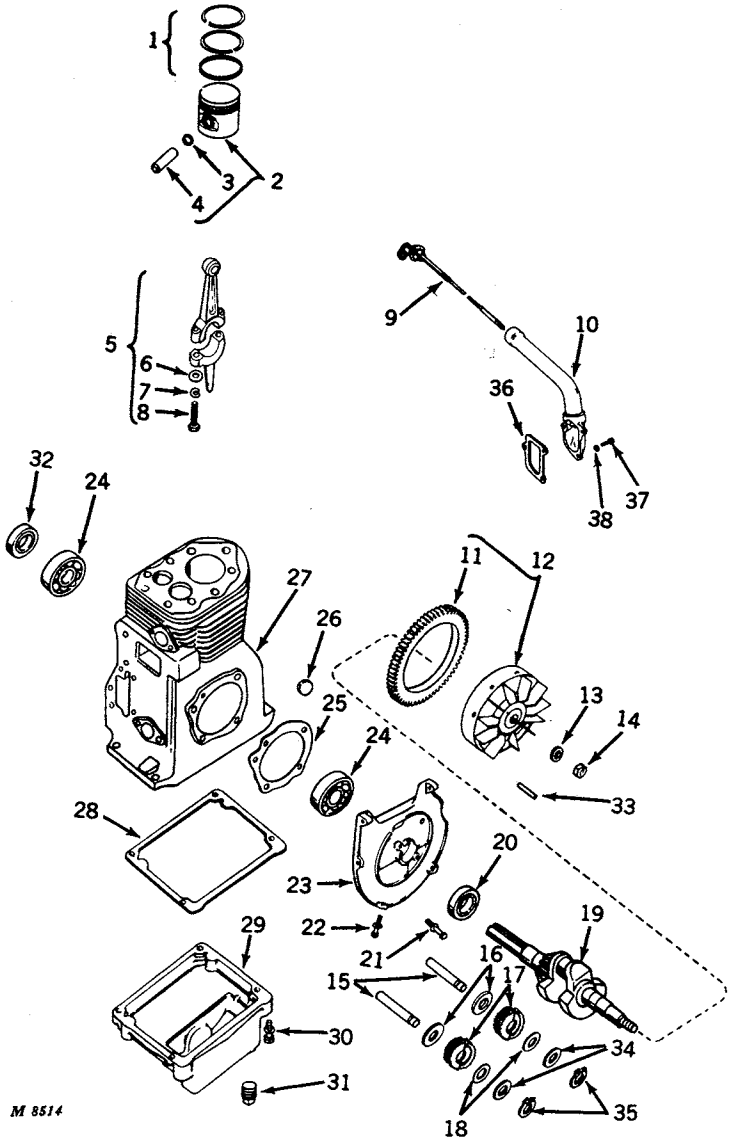
REPAIR



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

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, Figure 3.

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

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

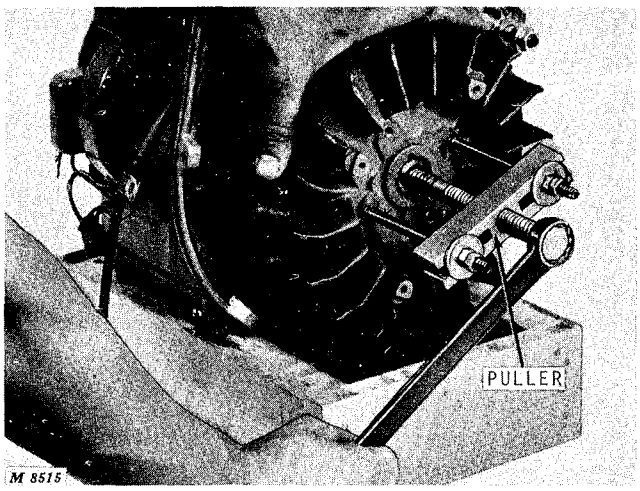


Fig. 3-Removing Flywheel

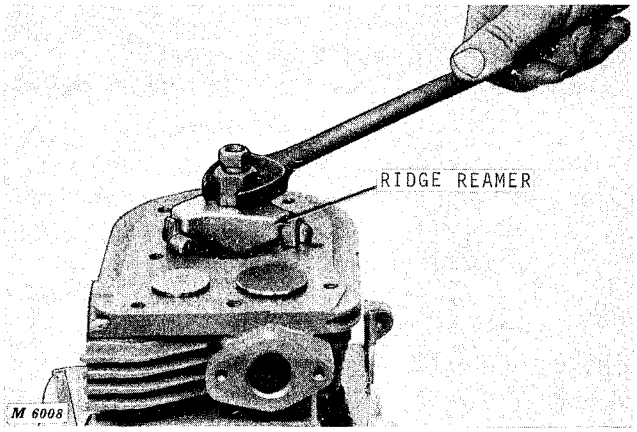


Fig. 4-Removing Ridge with Ridge Reamer

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

Remove bearing plate (23, Figure 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 engine from tractor. Drain oil. Remove blower housing, flywheel, bearing plate, and oil pan.

Disassembling Kohler K241AS Engine—Continued

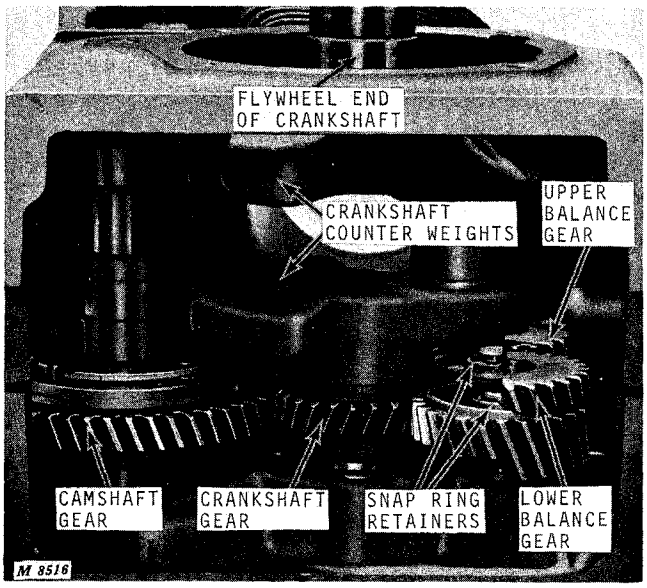


Fig. 5-Removing Balance Gears

Remove connecting rod cap and piston. Using a small snap ring pliers, remove snap ring from lower balance gear. Be careful not to lose spacer washers. Remove lower balance gear.

Remove crankshaft. Remove snap ring, spacer washers and upper balance gear (Figure 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 Stub Shaft

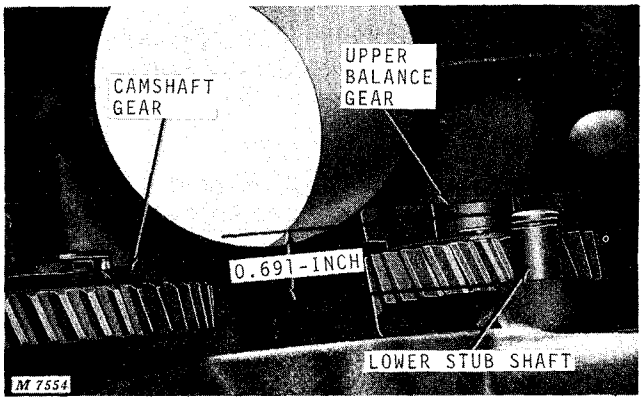


Fig. 6-Installing Stub Shafts

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, Figure 6.

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

Inspecting Balance Gear and Bearing

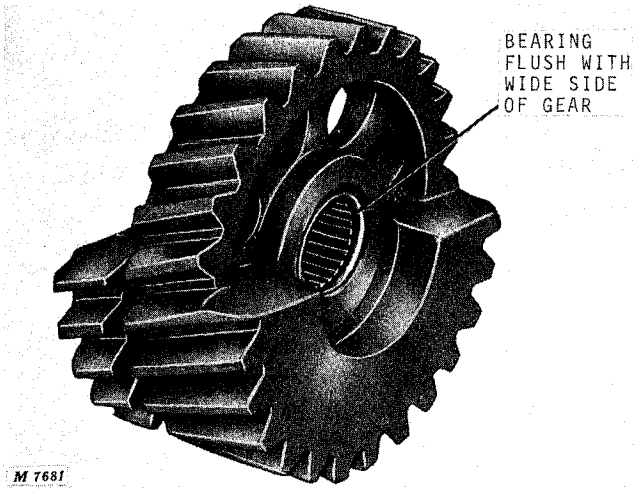


Fig. 7-Installing Needle Bearing in Gear

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 Figure 7.

Removing Piston Rings

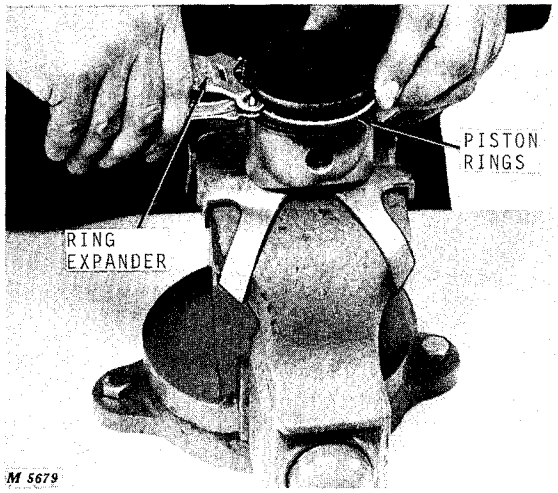


Fig. 8-Removing Piston Rings

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, Figure 8. Discard old rings.

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

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, Figure 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.

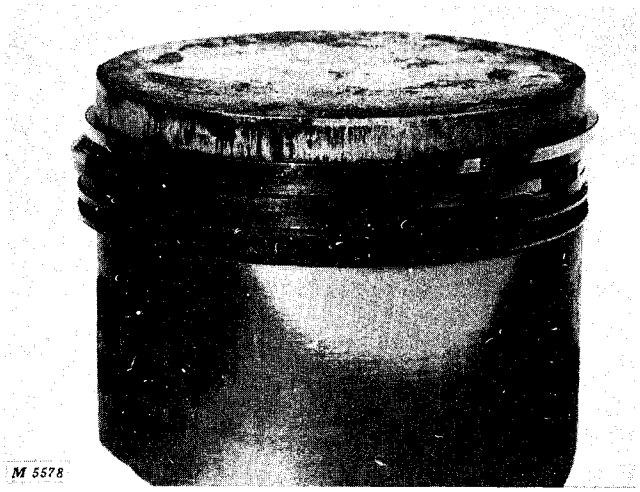


Fig. 9-Scored Piston and Rings

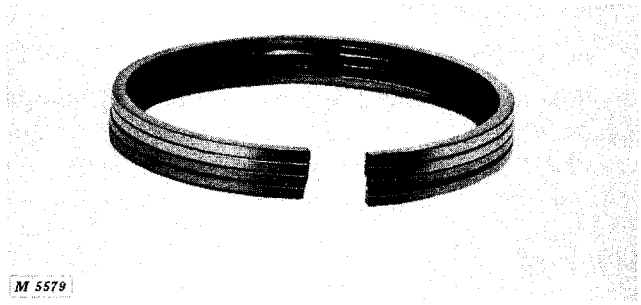


Fig. 10-Piston Rings with Improper End Gap

Rings of the wrong size or rings having improper end gap, Figure 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.

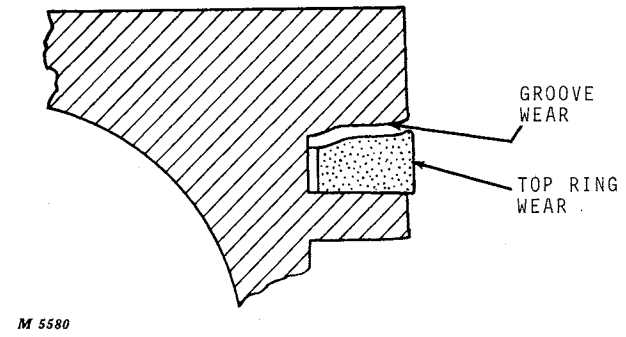


Fig. 11-Top Ring and Groove Side Wear

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

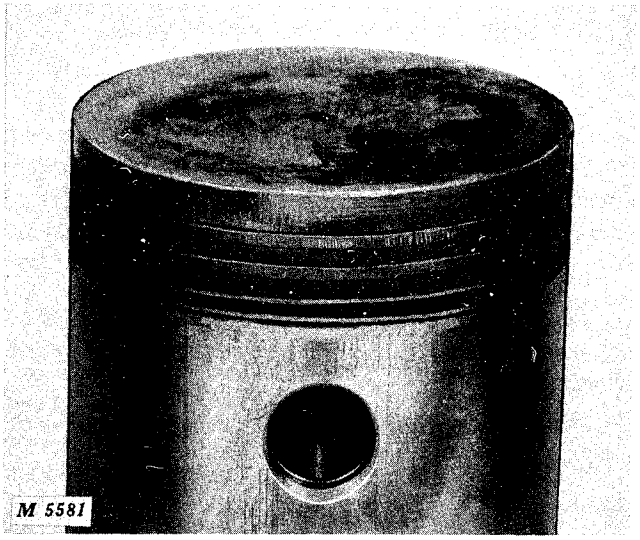


Fig. 12-Piston Rings Stuck and Broken Because of Lacquer, Varnish and Carbon Build-Up

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. 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 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.

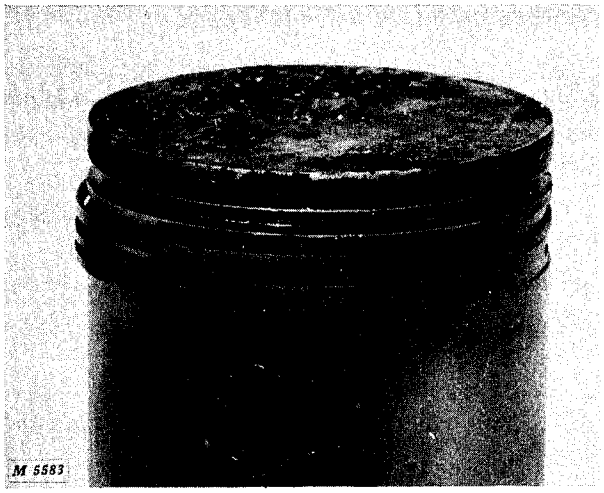


Fig. 14-Worn Oil Rings Which Cannot Provide Oil Control

Rails of the oil ring are worn down to the oil drain holes. 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, Figure 15.

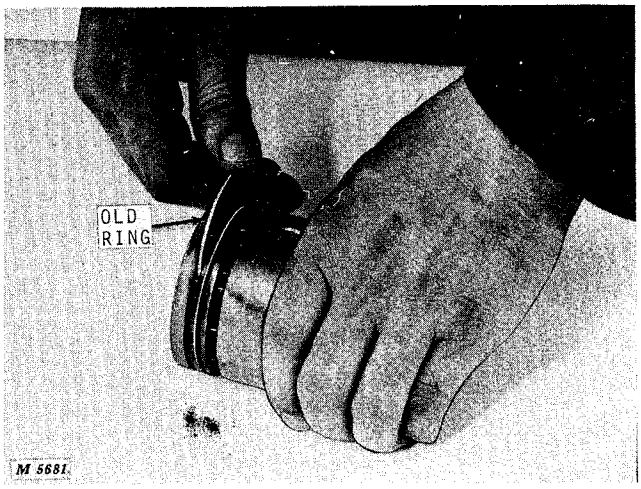


Fig. 15-Cleaning Ring Grooves

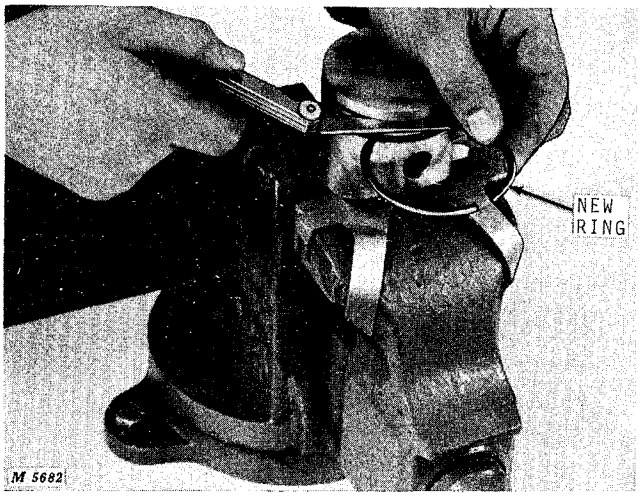


Fig. 16-Measuring Ring Clearance

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, Figure 16. Refer to "Specifications," page 15-21, 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 15-8. Replace faulty pistons.

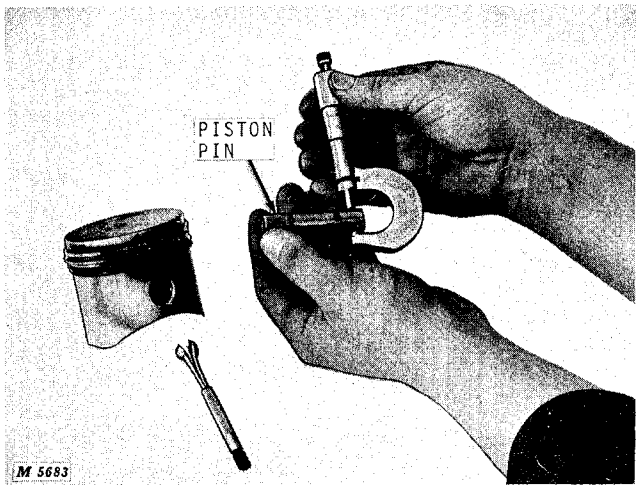


Fig. 17-Measuring Piston Pin and Piston

Measure piston pin-to-piston clearance with a micrometer. Ream out piston and rod and install oversize piston pins when necessary. See "Specifications," page 15-21. 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, Figures 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 heavy-duty 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 15-10 for deglazing and boring information.

Analyzing Piston Wear

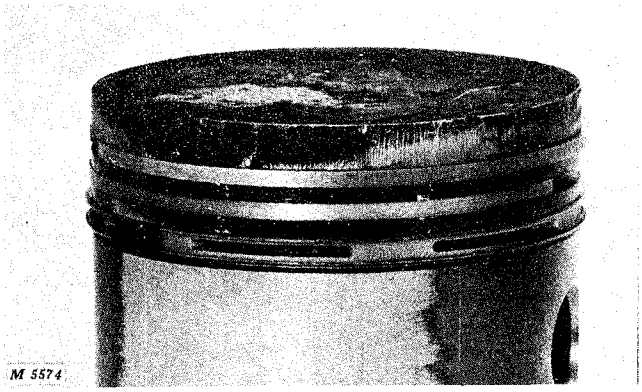


Fig. 19-Piston Top Land Burning Caused by Detonation

Detonation 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.

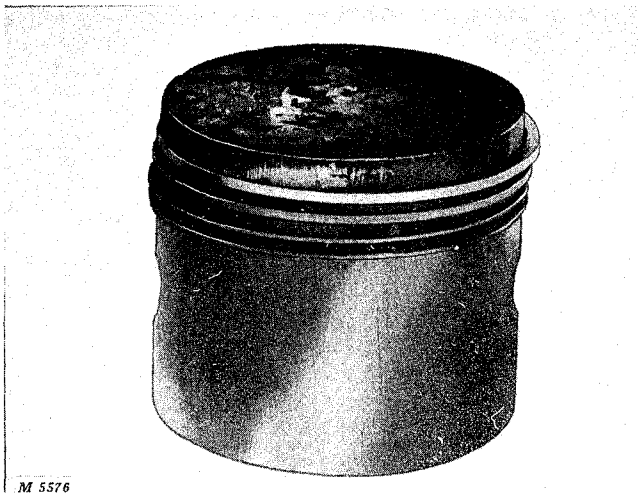


Fig. 20-Diagonal Piston Wear Pattern Caused by Bent or Twisted Connecting Rod

Check rod and piston alignment when a piston shows a diagonal wear pattern extending across the skirt of the piston. 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.

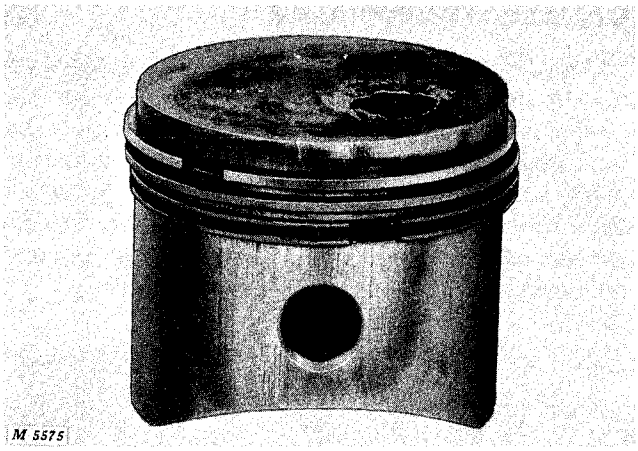


Fig. 21-Hole Burned in Piston Caused by Pre-Ignition

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, 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.

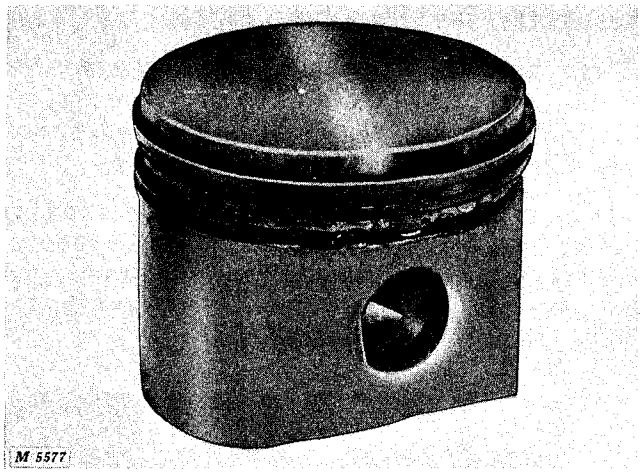


Fig. 22-Piston Damage Caused by Piston Pin Retainer Coming Loose

In the above illustration 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.*

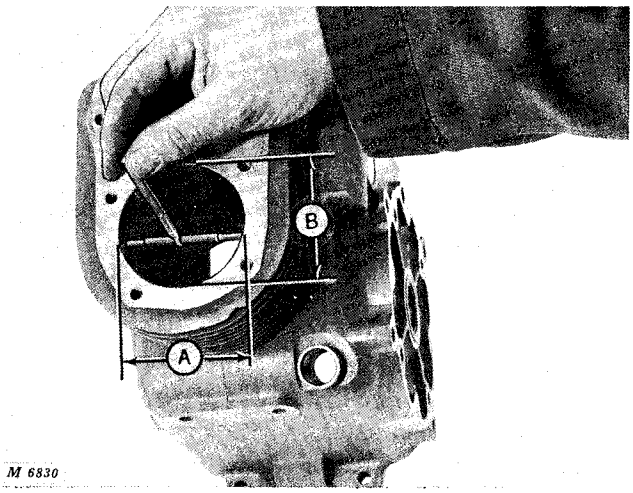


Fig. 23-Measuring Cylinder Bore

Use a telescoping gauge and micrometer to measure bore in two places at top and bottom of ring travel area, Figure 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 15-21, 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.

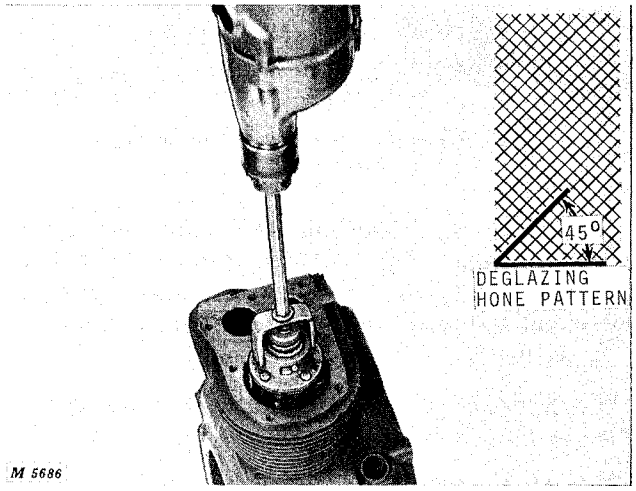


Fig. 24-Deglazing Cylinder Bore

Use a deglazing tool to break glaze, Figure 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 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 15-22.

Honing to 0.010-inch oversize to accommodate oversize piston and rings can also be done with a coarse stone in the deglazing tool, Figure 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

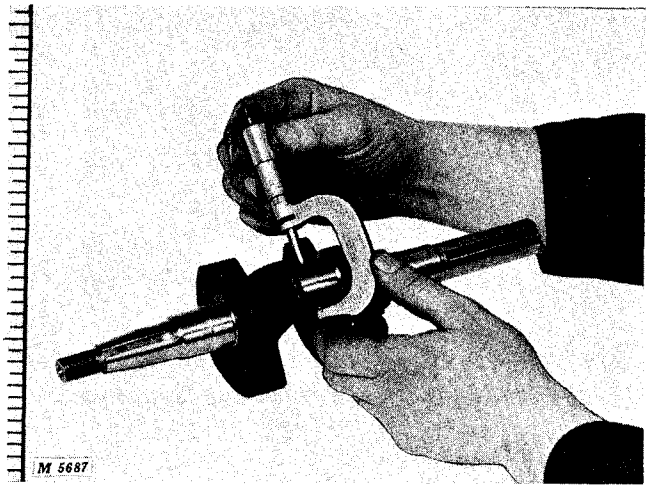


Fig. 25-Measuring Crankshaft Journal

Wipe crankshaft dry and check journal condition. Clean up threads on end of shaft if necessary. If crankshaft journal indicates wear, Figure 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

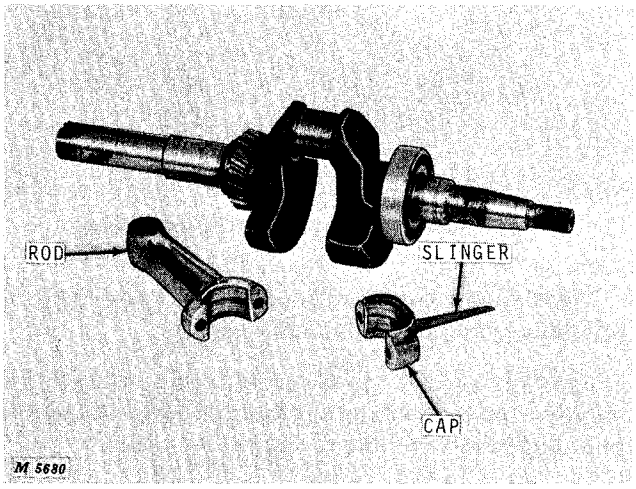


Fig. 26-Crankshaft Connecting Rod and Cap

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

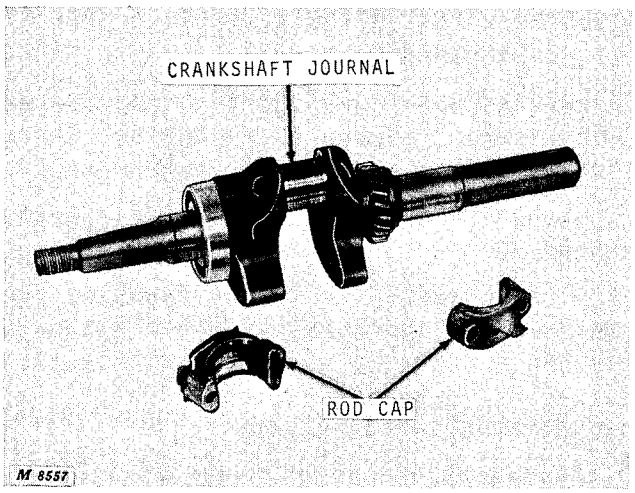


Fig. 27-Scored and Galled Crankshaft Journal and Rod Cap Caused by Lack of Lubrication

Lack of lubrication or improper lubrication, Figure 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 15-21, for wear tolerances.

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.

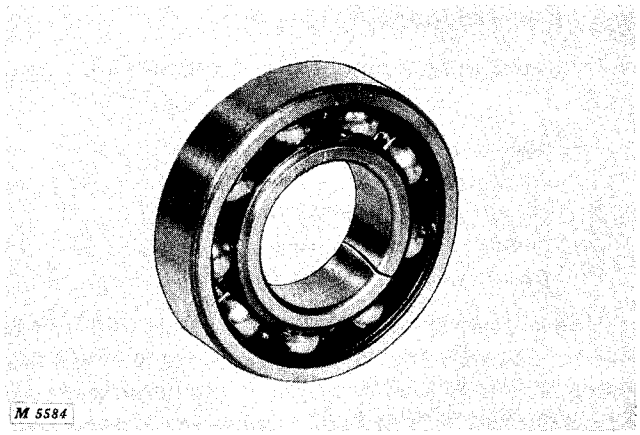


Fig. 28-Broken Races Caused by Misaligned Bearing During Installation

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

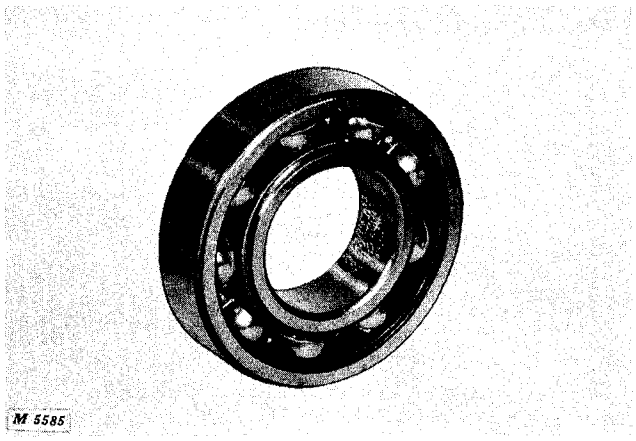


Fig. 29-Bearing Wear Caused by Crack or Looseness on Shaft

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, Figure 29.

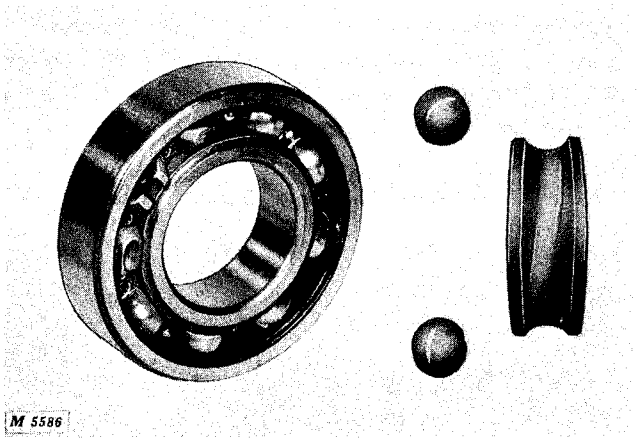


Fig. 30-Bearing Wear Caused by Misalignment

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

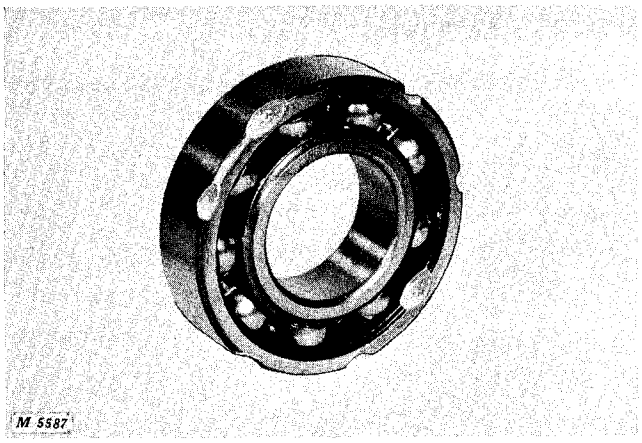


Fig. 31-Nicks in Outer Race Caused by Using Chisel or Driftpin to Remove or Install Bearing

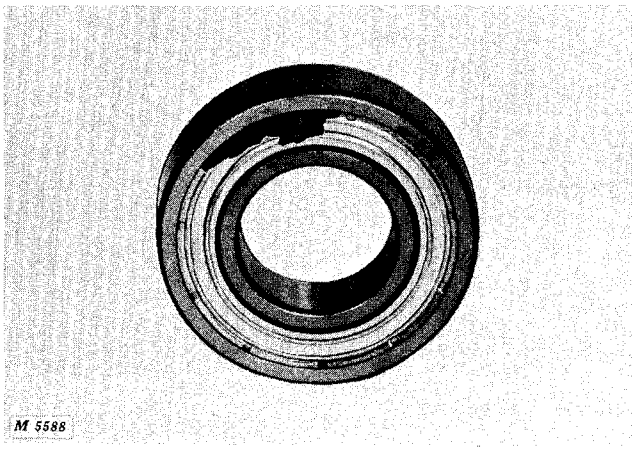


Fig. 32-Oil Seal Damage Caused by Careless Installation with Sharp Tool

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.

INSTALLATION

Installing Balance Gears

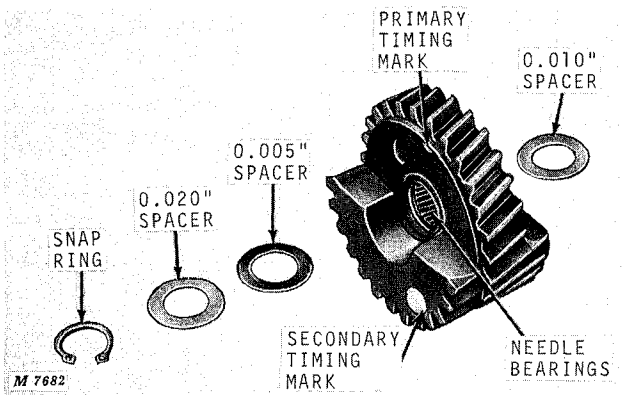


Fig. 33-Balance Gear Assembly

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, Figure 33.

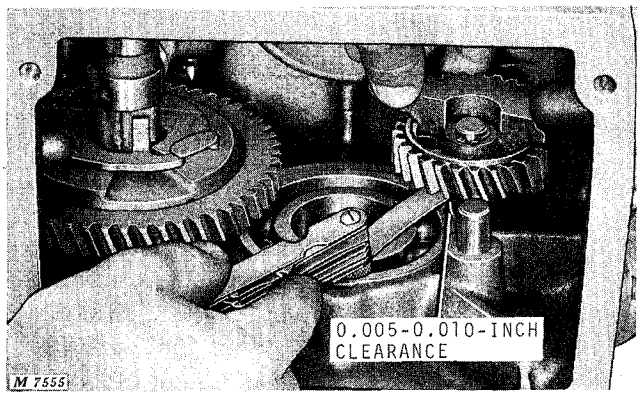


Fig. 34-Checking Balance Gear End Play

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

NOTE: If you are going to use a timing tool when installing the crankshaft, page 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 15-15, install only the upper balance gear at this time.

Installing Crankshaft with Timing Tool (Kohler K241AS Engine)

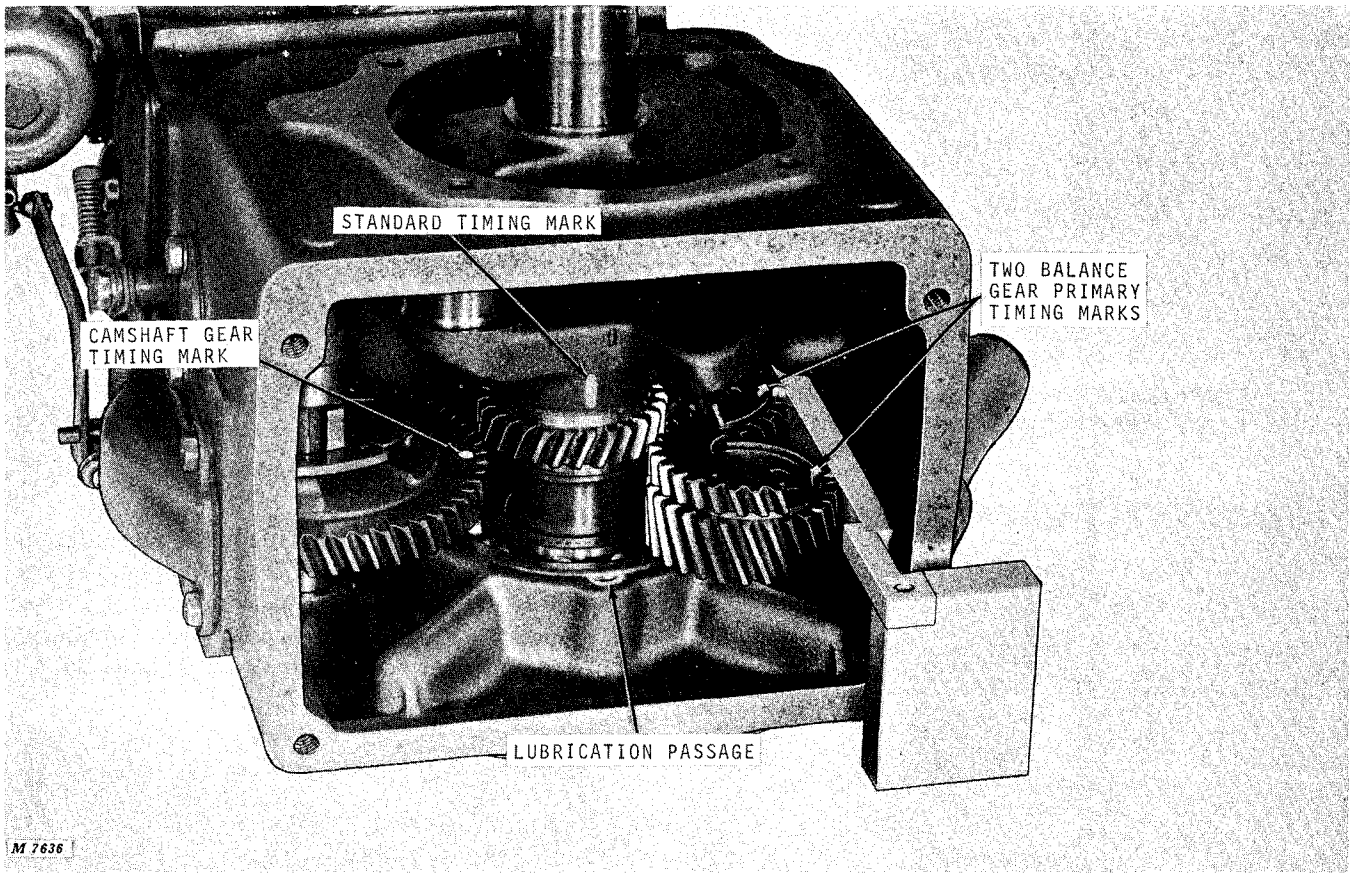


Fig. 35-Timing Balance Gears with Special Tool

NOTE: The special balance gear timing tool, Figure 35, makes precision installation of the crankshaft more accurate. See "Special Tools," page 15-22.

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, Figure 35. Turn crankshaft so that standard timing mark on crankshaft is in line with lubrication passage in engine block, Figure 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 Figure 5, page 15-4.

Installing Crankshaft without Timing Tool (Kohler K241AS Engine)

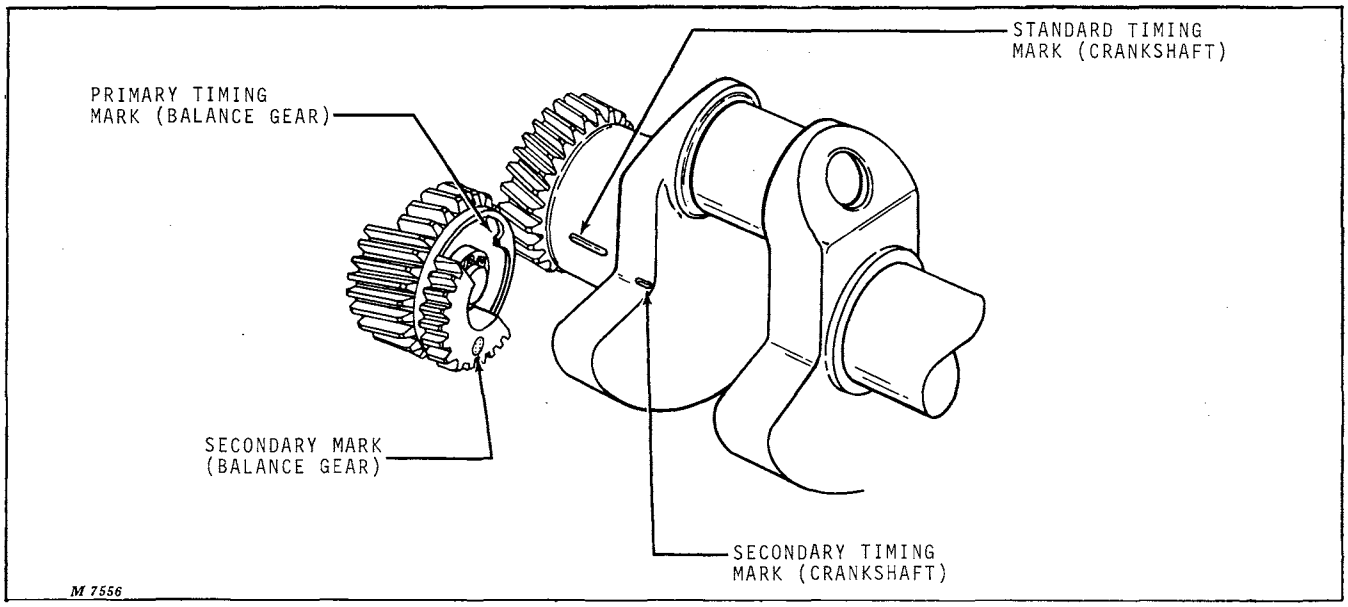


Fig. 36-Timing Marks for Installing Dynamic Balance Gears

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

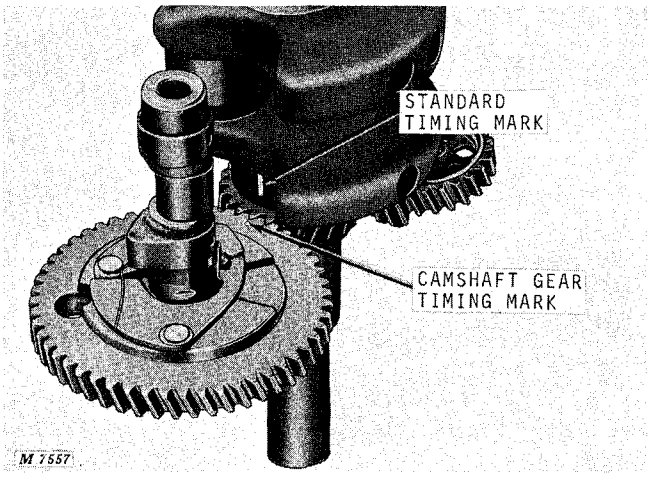


Fig. 37-Aligning Crankshaft and Camshaft Gears

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, Figure 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, Figure 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 Figure 5, page 15-4. A straight line should be formed by the half-moon sections of the balance gears, Figure 5, page 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 15-13.

Installing Crankshaft (Kohler K181S Engine)

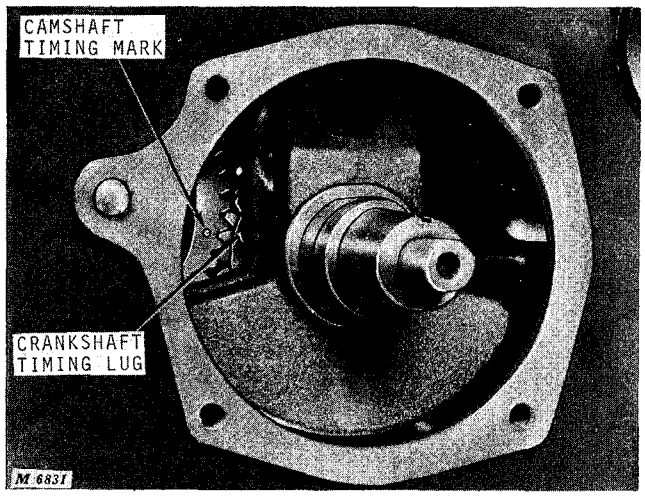


Fig. 38-Timing Marks on Crankshaft and Camshaft

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, Figure 38. Chalk timing mark positions for ease of viewing during assembly.

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

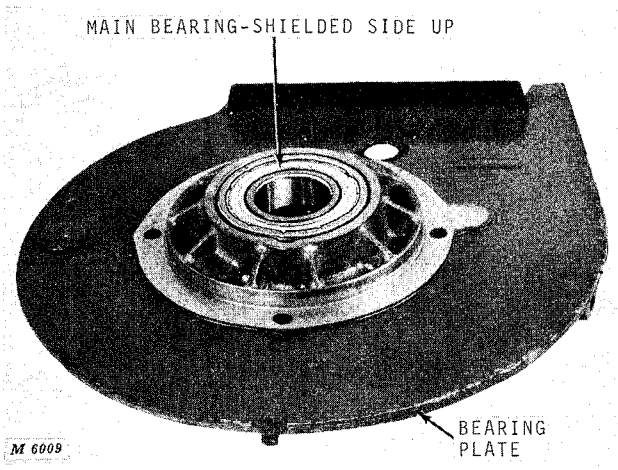


Fig. 39-Installing Main Bearing in Bearing Plate

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

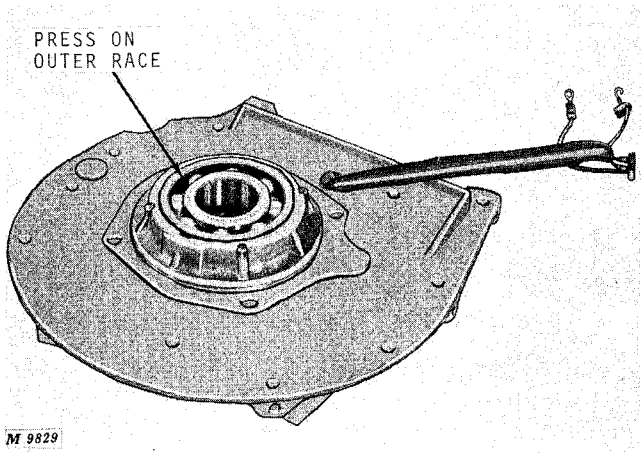


Fig. 40-Installing Main Bearing in Bearing Plate

With bearing plate properly supported and ball bearings facing direction shown, press main bearing, Figure 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

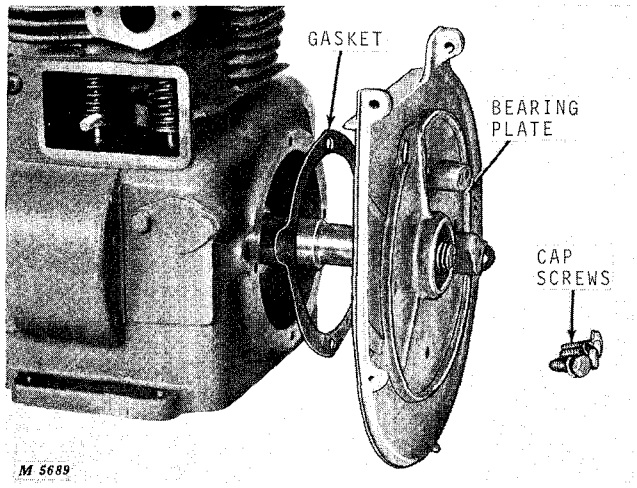


Fig. 41-Installing Bearing Plate with Bearing on Cylinder Block

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, Figure 41. Draw cap screws up evenly until correct torque is obtained. See "Torque Chart," Section 10.

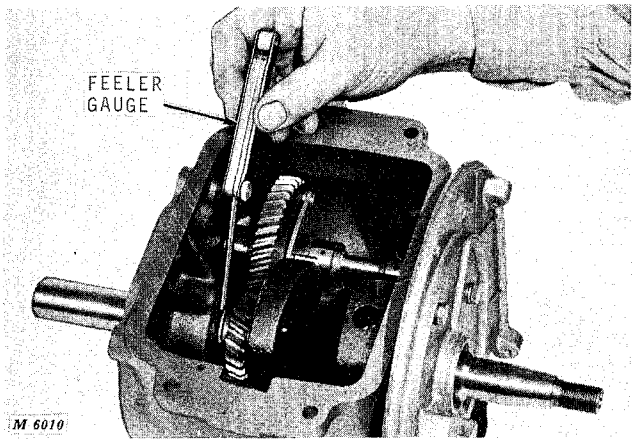


Fig. 42-Checking Crankshaft End Play

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, Figure 42. Refer to "Specifications," page 15-21, for crankshaft end play. Use gaskets as required to obtain correct crankshaft end play.

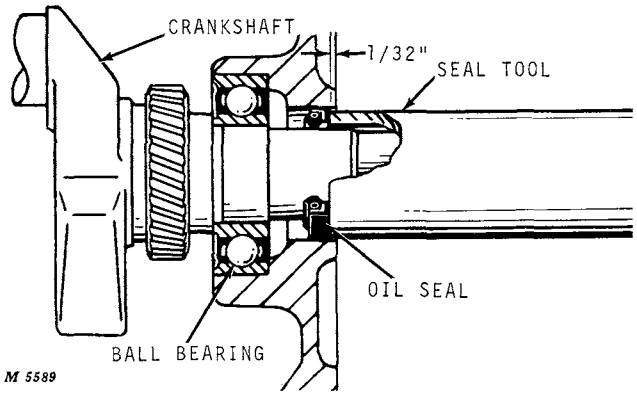


Fig. 43-Oil Seal Installation

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, Figure 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

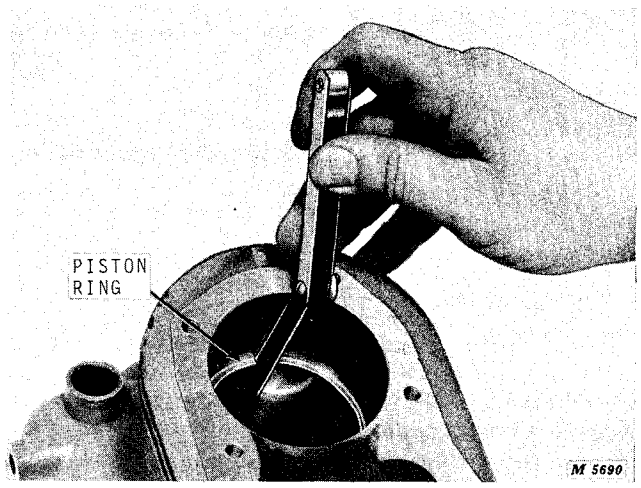


Fig. 44-Checking Ring End Gap

Before installing rings on piston, insert each ring into the cylinder bore to check ring end gap, Figure 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, Figure 44. See "Specifications," page 15-21, 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, Figures 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.**

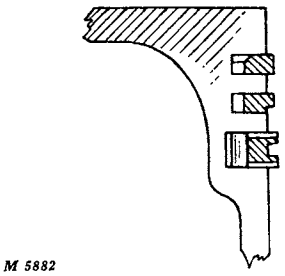


Fig. 45-Piston Ring Assembly

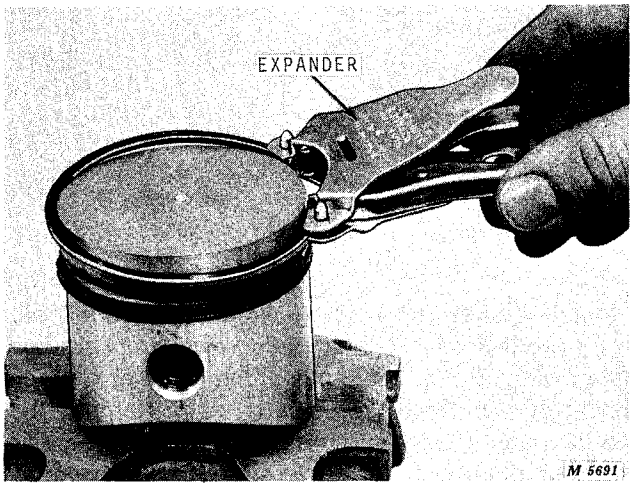


Fig. 46-Installing Rings

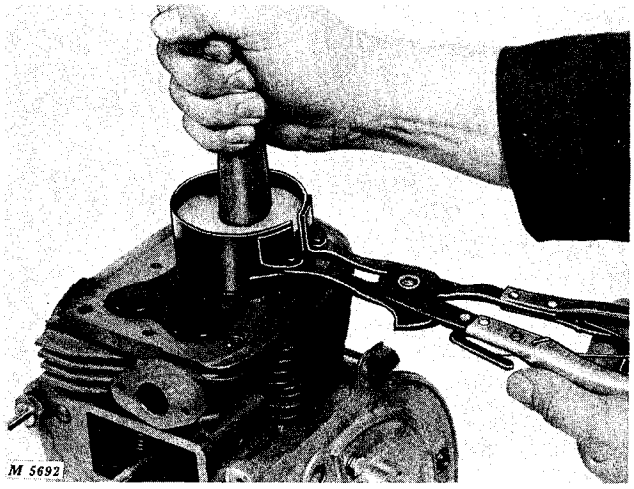


Fig. 47-Installing Piston in Cylinder

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

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

Attaching Rod to Crankshaft

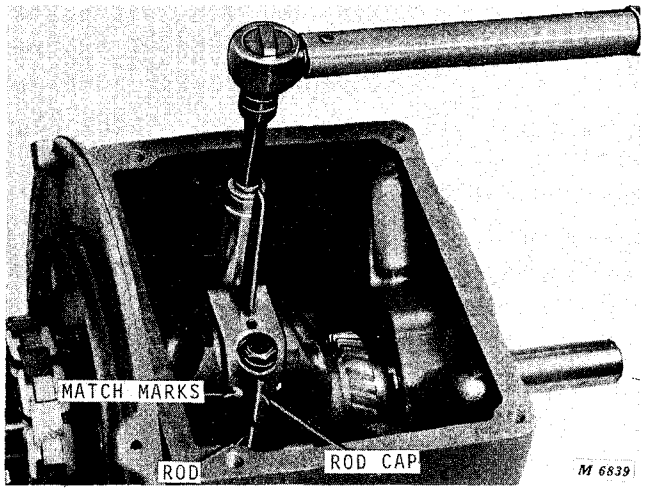


Fig. 48-Rod and Crankshaft Assembly

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, Figure 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 15-22.

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, Figure 49. Install cap screws and torque to specification listed in "Torque Chart" in Section 10.

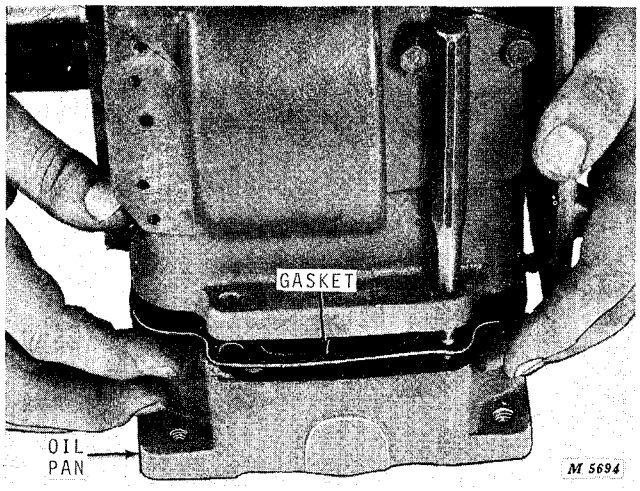


Fig. 49-Oil Pan and Gasket Assembly

Installing Flywheel

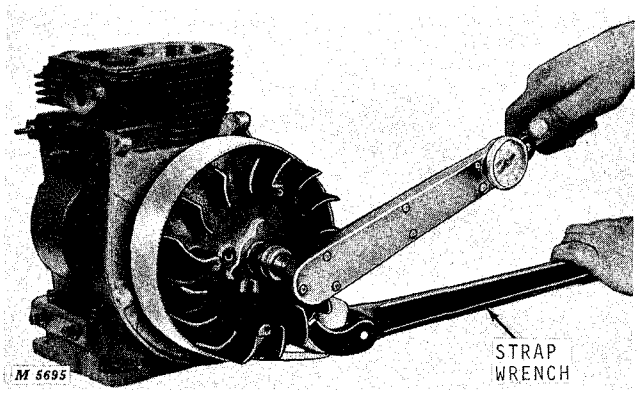


Fig. 50-Flywheel Assembly

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, Figure 50, while torquing nut. See "Torques for Hardware," page 15-22, for proper flywheel nut torque.

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

Installing Shrouding

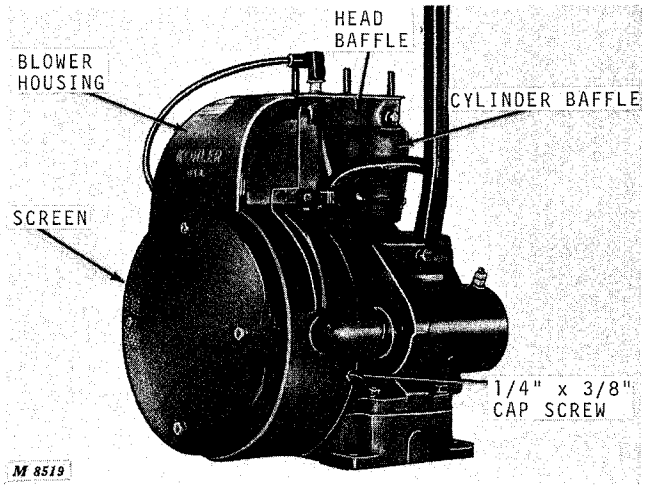


Fig.51-Installing Engine Shrouding (K181S Engine)

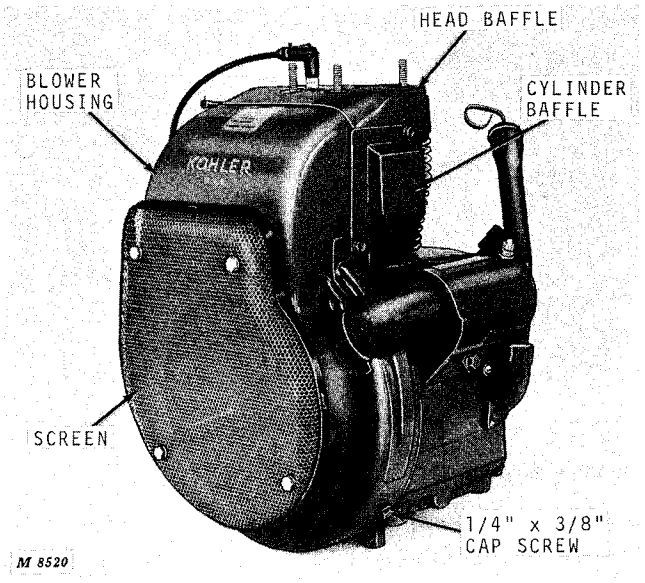


Fig. 52-Installing Engine Shrouding (K241AS Engine)

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 Figures 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 20-6 of this Section for proper carburetor and governor arm assembly. See adjustments and adjust accordingly.

SPECIFICATIONS

K181S and K241AS Kohler Engines

Component	K181S	K241AS
Bore and stroke	2-15/16 x 2-3/4 inches	3-1/4 x 2-7/8 inches
Bore diameter, new	2.9375 inches	3.250 inches
Crankshaft end play	0.002 to 0.023 inches	0.003 to 0.020 inches
Crankshaft journal-to-connecting rod side clearance	0.005 to 0.016 inches	0.007 to 0.016 inches
Crankshaft journal length	1.1860 to 1.1855 inches	1.5000 to 1.4995 inches
Crankshaft journal diameter, new	1.125 inch	1.187 inch
Connecting rod journal size	1.181 inch	1.575 inch
Connecting rod-to-crankshaft journal running clearance	0.001 to 0.002 inch	0.001 to 0.002 inch
Connecting rod-to-piston pin clearance	0.0006 to 0.0011 inch	0.0003 to 0.0008 inch
Piston pin-to-piston boss	0.0001 inch interference to 0.0003 inch Loose	0.0000 to 0.0003 inch Select Fit
Piston-to-cylinder bore (thrust face)	0.0045 to 0.0070 inch	0.003 to 0.004 inch
Piston-to-cylinder bore (top of skirt)	0.006 to 0.008 inch	0.0075 to 0.0085 inch
Piston pin bore size	0.62565 inch	0.85975 inch
Piston pin diameter	0.625 inch	0.86 inch
Ring side clearance, top ring	0.0025 to 0.0040 inch	0.002 to 0.004 inch
Ring side clearance, middle ring	0.0025 to 0.0040 inch	0.002 to 0.004 inch
Ring side clearance, oil ring	0.001 to 0.0025 inch	0.001 to 0.003 inch
Ring end gap	0.007 to 0.017 inch	0.010 to 0.020 inch
Ring width, inches, top ring	0.093 inch	0.093 inch
Ring width, inches, middle ring	0.093 inch	0.093 inch
Ring width, inches, oil ring	0.187 inch	0.187 inch
Camshaft pin-to-camshaft clearance	0.0010 to 0.0035 inch	0.001 to 0.0035 inch
Camshaft pin-to-block (Bearing plate end)	0.0005 to 0.0020 inch	0.0005 to 0.002 inch
Camshaft pin-to-block (power take-off end) (interference)	0.0015 to 0.003 inch	0.0015 to 0.0030 inch
Camshaft pin-to-breaker cam	0.0010 to 0.0035 inch	0.0010 to 0.0025 inch
Camshaft end play	0.005 to 0.010 inch	0.005 to 0.010 inch
Valve stem clearance in guide, intake	0.0010 to 0.0025 inch	0.0010 to 0.0025 inch
Valve stem clearance in guide, exhaust	0.0025 to 0.0040 inch	0.0025 to 0.0040 inch
Valve guide in block (interference)	0.0005 to 0.0020 inch	0.0005 to 0.0020
Valve seat in block (exhaust) (interference)	0.002 to 0.004 inch	0.003 to 0.005 inch
Valve clearance, intake (cold)	0.006 to 0.008 inch	0.008 to 0.010 inch
Valve clearance, exhaust (cold)	0.015 to 0.017 inch	0.017 to 0.020 inch
Valve seat angle	44.5 degrees	44.5 degrees
Valve face angle	45 degrees	45 degrees
Valve seat width	0.037 to 0.045 inch	0.037 to 0.045 inch
Valve tappet clearance in block	0.0005 to 0.002 inch	0.0008 to 0.0023 inch
Governor bushing-to-governor cross shaft clearance	0.0005 to 0.002 inch	0.001 to 0.0025 inch
Governor gear-to-governor shaft	0.0025 to 0.0055 inch	0.0005 to 0.0020 inch
Ball bearing-to-cylinder block (interference)	0.0014 to 0.0029 inch	0.0006 to 0.0022 inch
Ball bearing-to-bearing plate (interference)	0.0014 to 0.0029 inch	0.0012 to 0.0028 inch
Ball bearing-to-crankshaft (interference to loose)	0.0005 to 0.0002 inch	0.0004 to 0.0005 inch

Torques for Hardware

Location	Torque
Connecting rod cap screws	(K181S) 200 in-lbs. (K241AS) 300 in-lbs.
Flywheel nut	(K181S) 50-60 ft-lbs. (K241AS) 60-70 ft-lbs.
Misc. hardware	Refer to Torque Chart, Section 10

Tune-Up Data

Item	Specifications
Crankcase lubricant	Refer to Section 10 for proper crankcase lubricant
Oil change	Every 25 hours of operation or every 8 hours under extremely dusty conditions
Engine block	0.005 inch wear or 0.004 inch out of round. Install heavy-duty rings

SPECIAL TOOLS

Name	Part No.	Use
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
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

Group 20

CAMSHAFT, TAPPETS AND GOVERNOR KOHLER ENGINES FOR 110 AND 112 TRACTORS

GENERAL INFORMATION

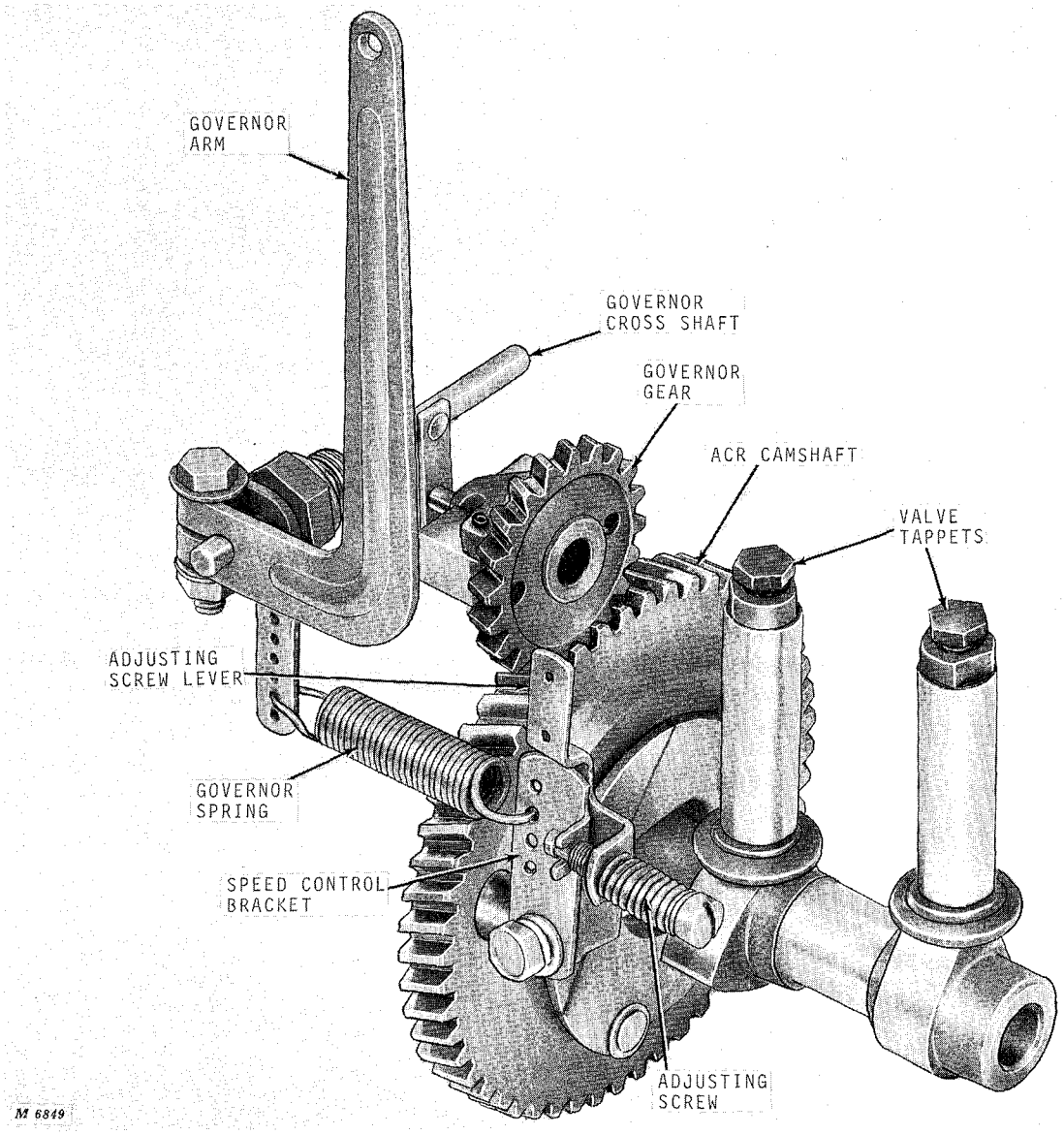


Fig. 1-Assembled View of Camshaft, Tappets and Governor

The camshaft-driven governor 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

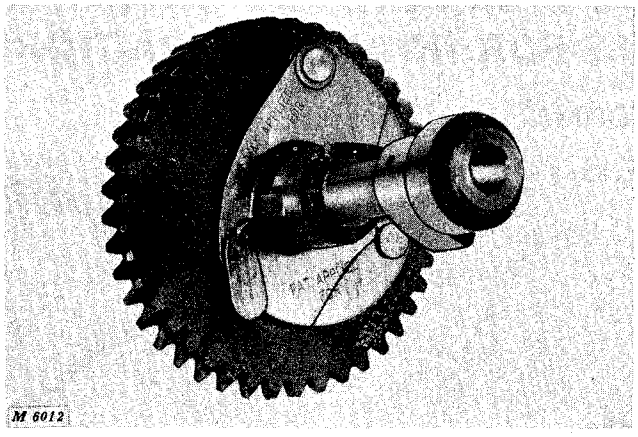


Fig. 2-Automatic Compression Release Camshaft (ACR)

Automatic compression release 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, Figure 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.

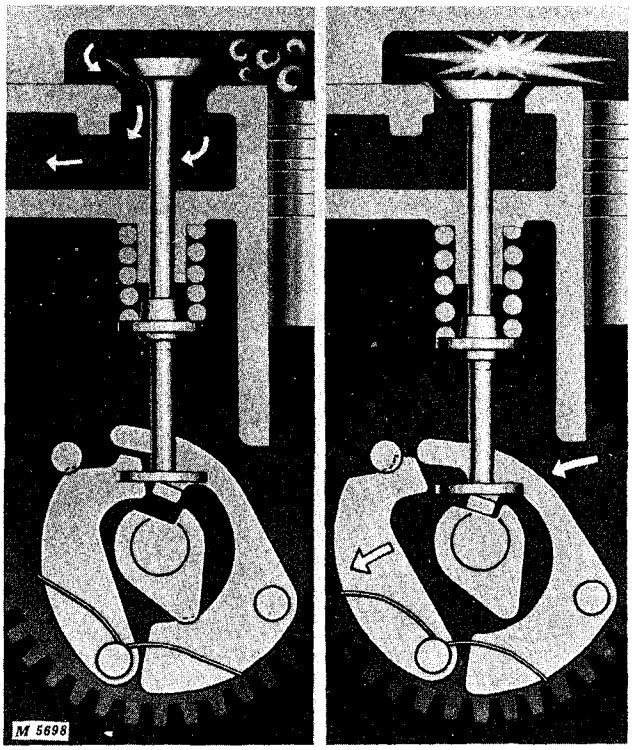
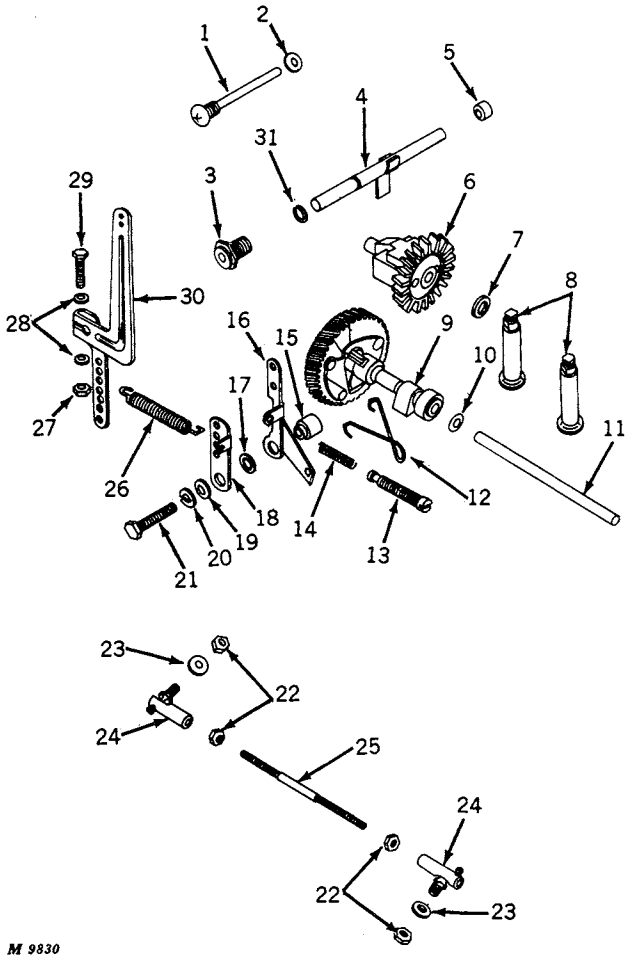


Fig. 3-ACR Operation

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

Remove engine and all component parts covered in Group 15.

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

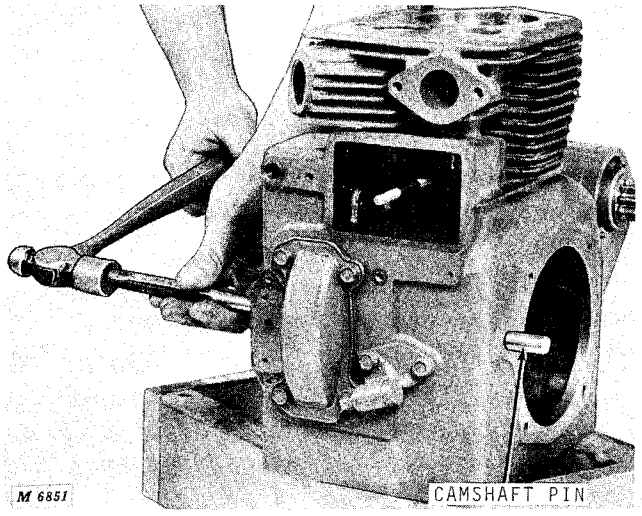


Fig. 5-Removing Camshaft Pin

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

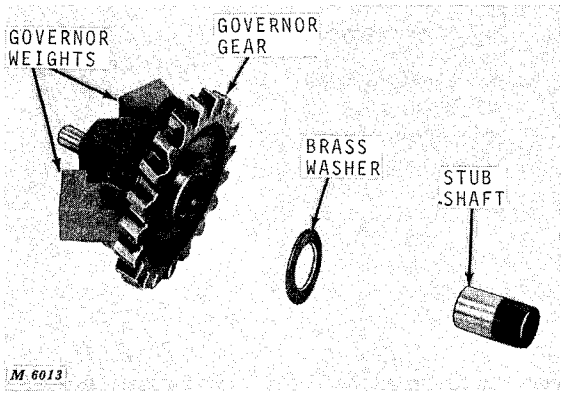


Fig. 6-Governor Gear Assembly

The governor gear assembly, Figure 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, Figure 7. This is important. If arm is loose, install new cross shaft.

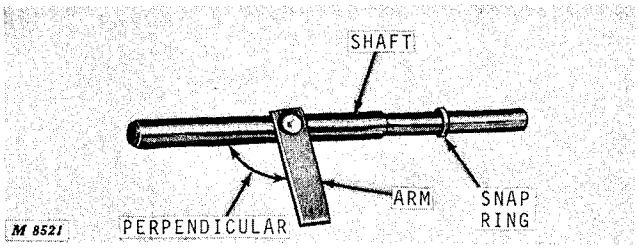


Fig. 7-Governor Cross Shaft

INSTALLATION

Installing Governor

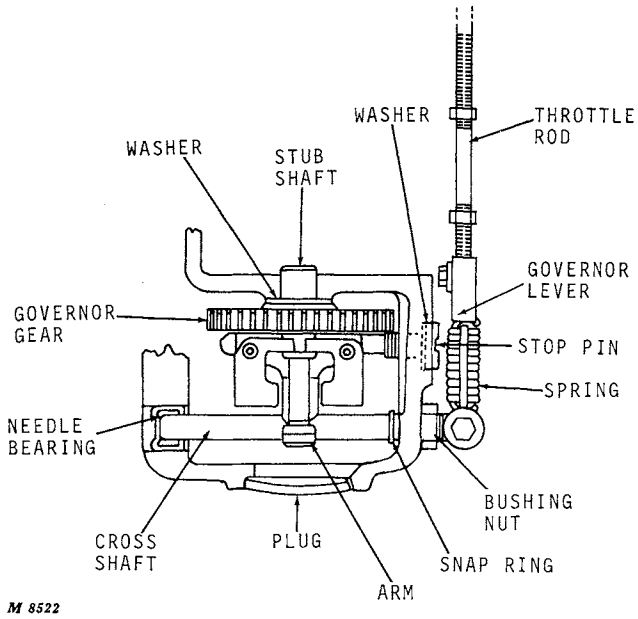


Fig. 8-Cross-Section of Governor Assembly (K241AS Engine)

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, Figure 7, 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

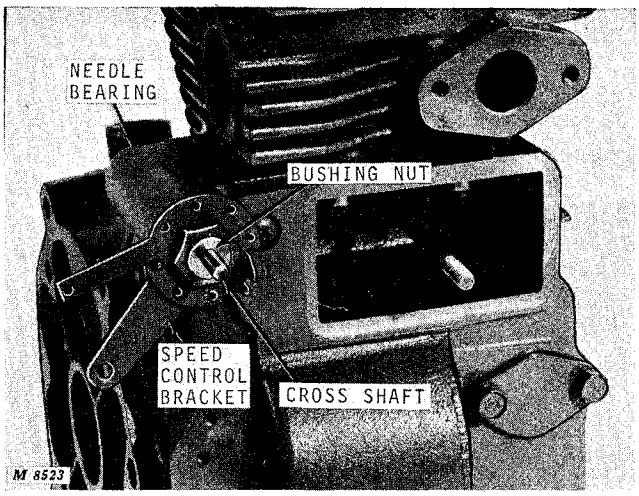


Fig. 9-External Governor Parts (K181S Engine)

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, Figure 9.

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

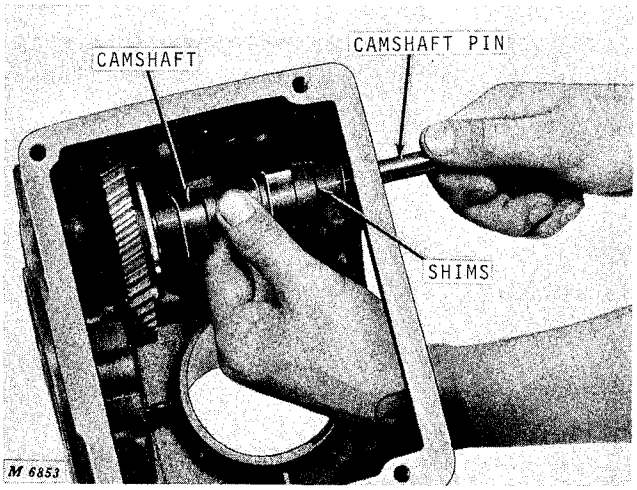


Fig. 10-Installing Camshaft

Install tappets in holes from which removed.

While holding camshaft assembly, Figure 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 20-7. 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

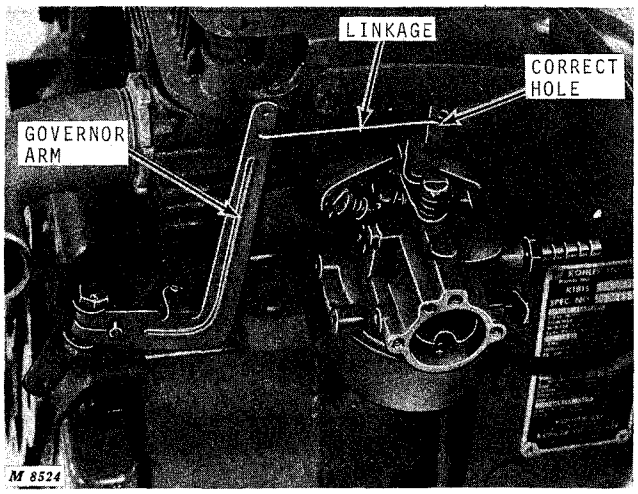


Fig. 11-Governor-to-Carburetor Linkage (K181S Engine)

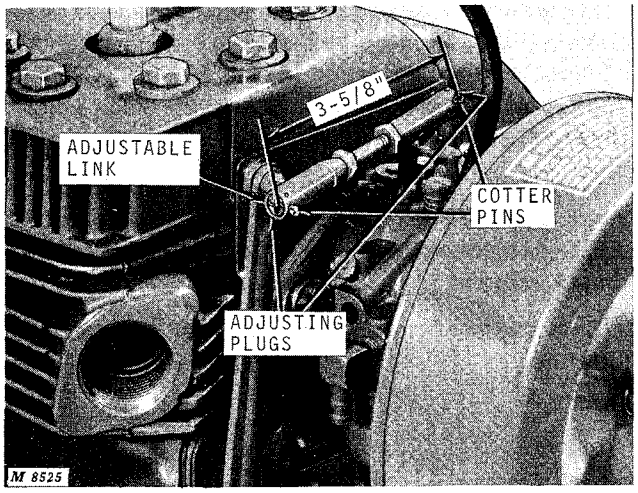


Fig. 12-Governor-to-Carburetor Linkage (K241AS)

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

On K241AS Engines, install the adjustable link as shown in Figure 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, Figure 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

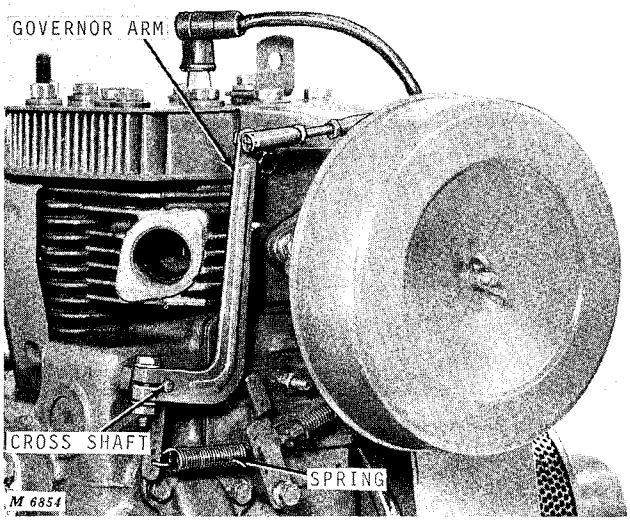


Fig. 13-Positioning Governor Arm

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

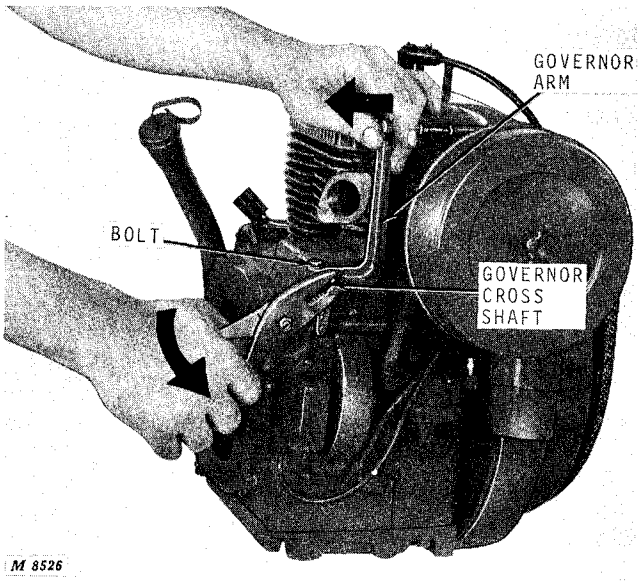


Fig. 14-Adjusting Governor Arm

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, Figure 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, Figure 14.

ADJUSTMENT

Governor Speed Adjustment (Kohler K181S Engine)

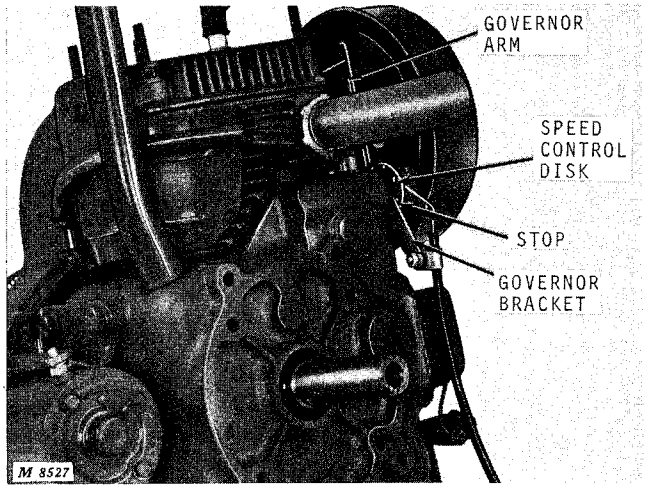


Fig. 15-Adjusting Governor Speed

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, Figure 15, as required until maximum engine speed is 3800 rpm on a tachometer with all drives disengaged. See "Special Tools," page 15-22. Tighten bushing nut but AVOID EXCESSIVE PRESSURE. Governor arm must operate loosely..

Governor Speed Adjustment (Kohler K241AS Engine)

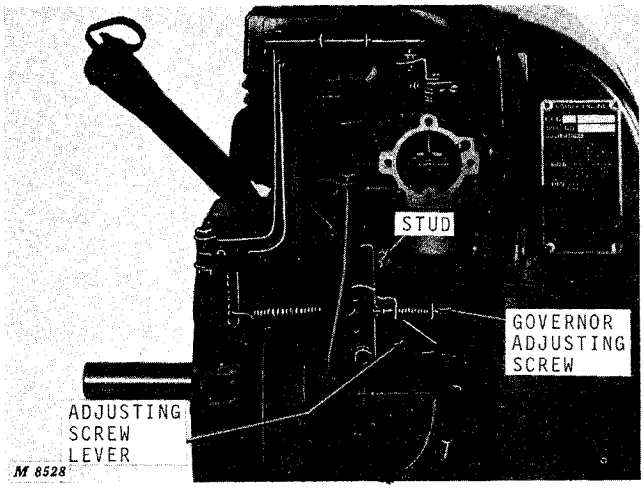


Fig. 16-Adjusting Governor Speed

To adjust governor, Figure 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 15-22.

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

SPECIFICATIONS

'K181S and K241AS Kohler Engines

Table of Clearances

Item	Clearances
Camshaft pin-to-camshaft clearance	0.001 to 0.0035 inch
Camshaft end clearance	0.005 to 0.010 inch
Tappet in block	0.0005 to 0.0020 inch

SPECIAL TOOLS

Name	Part No.	Use
15/16-inch tappet wrench		To loosen or tighten governor bushing nut.

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Group 25

GENERAL INFORMATION
TECUMSEH ENGINE FOR 112 TRACTOR

DESCRIPTION

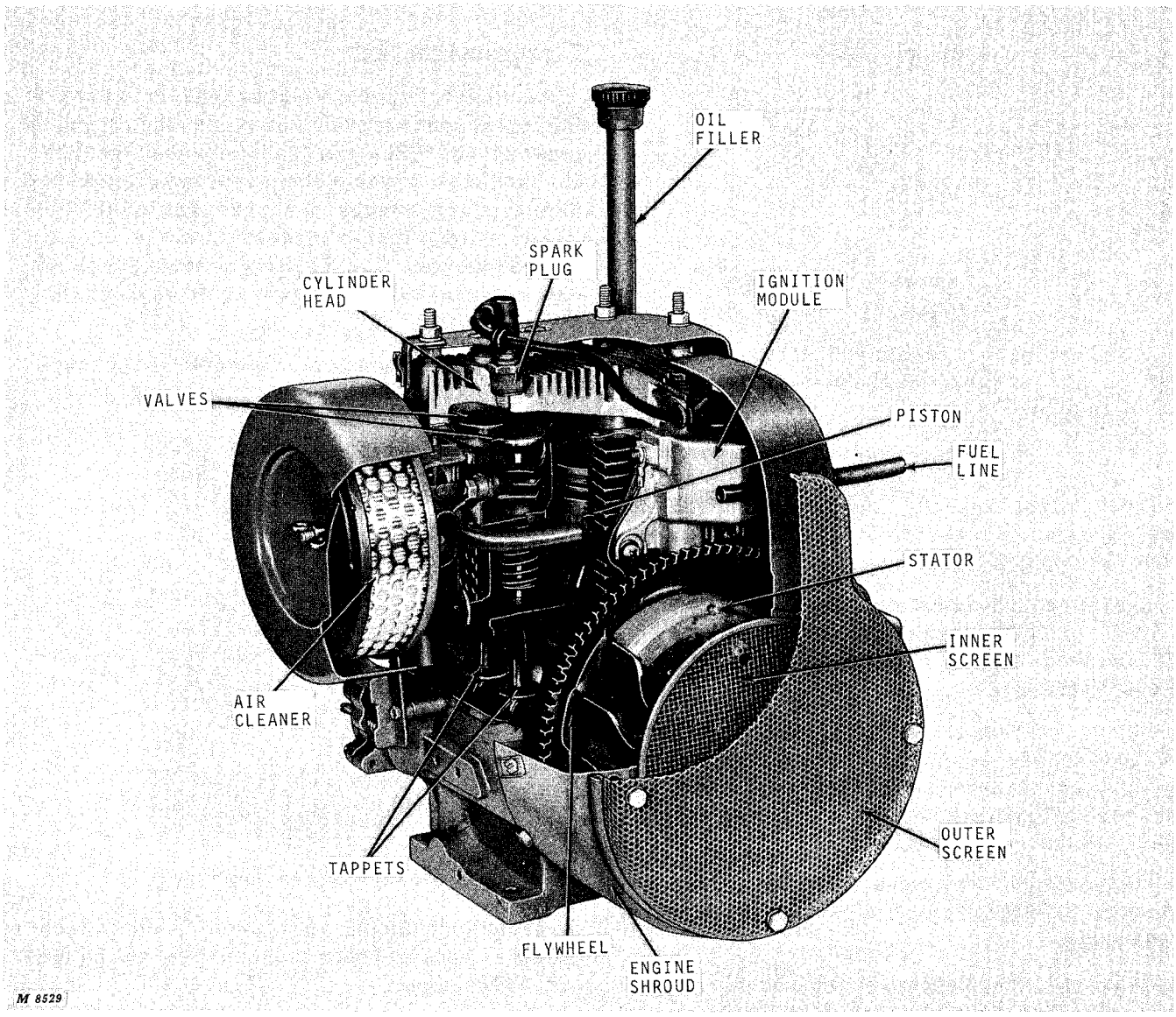

Fig. 1-Cutaway View of Tecúmseh HH100 Engine Showing Piston, Valves and Tappets

The Tecumseh HH100 Engine used in 112 Tractors is a four-cycle, internal combustion engine. It has a cast iron block, and is an L-head, single cylinder engine with large bore, short-stroke design.

The engine is air cooled with tapered roller crankshaft bearings, is oil bath lubricated and has an internal weight governor.

Detailed specifications for the HH100 engine are covered in Section 10 "General," and at the end of each group in this section.

Tecumseh HH100 engines in 112 Tractors beginning with Serial No. 161,772 vary from earlier models. Changes include battery-coil ignition, a new cylinder head, and a crankcase capacity of 3 U.S. pints.

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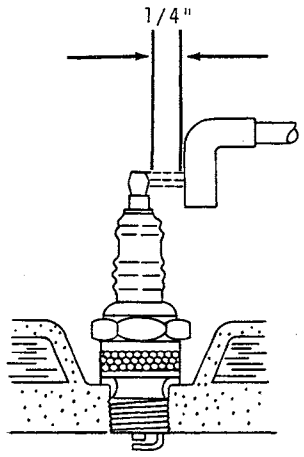
ENGINE ANALYSIS

PRELIMINARY ENGINE CHECKS

A complete guide for diagnosing engine malfunctions appears on page 5-9 of this Section. 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.



M 8502

Fig. 2-Checking Spark at Plug

Check spark, Figure 2, whenever engine will not start. If engine will not crank, follow diagnosing procedure on page 5-9.

Remove ignition cable from spark plug and install adaptor or ordinary paper clip. Hold approximately 1/4 inch away from grounded engine shrouding while cranking the engine.

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 is either in the ignition charger coil or ignition trigger module.

If there is good spark between the adaptor and the grounded surface, the problem is in the fuel system or spark plug.

If gas tank is full, check fuel shut-off valve on 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" on page 5-9 to check for internal difficulties.

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 engine is burning oil, losing power or running erratically and when carburetion and ignition adjustments do not correct the condition.

Compression Test

The HH100 Engine is equipped with an instamatic EZEE-start compression release camshaft. It will be referred to as "EZEE-start" in this manual. The EZEE-start feature releases compression pressure during lower cranking speeds. It is important to crank the engine at 1000 rpm, or more to obtain an accurate compression test. The EZEE-start mechanism is disengaged when the tachometer reads approximately 650 rpm.

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

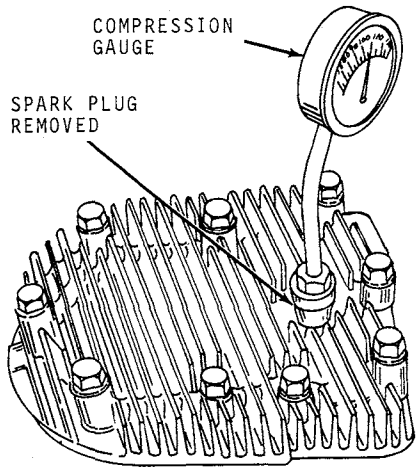


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Fig. 3-Testing Engine Compression

Depress clutch-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 valves in wide open position by raising throttle lever all the way and lowering choke lever.

Install compression gauge in cylinder, Figure 3. Follow manufacturer's recommendations for installing and reading compression tester.

Test Conclusions

An engine in top operating condition will read 80 to 110 psi when engine is cranked approximately 1000 rpm.

A compression test above 110 psi, indicates excessive deposits in the combustion chamber or on the piston.

A reading lower than 80 psi indicates leakage at the cylinder head gasket, piston rings or valves. *Engine should be reconditioned if compression falls below 80 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 crankshaft breather maintains a partial vacuum in the crankcase when the engine is operating properly.

Connect a water U-tube manometer to oil filler hole in cylinder block, Figure 4. Tester must hang vertically as shown. 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.

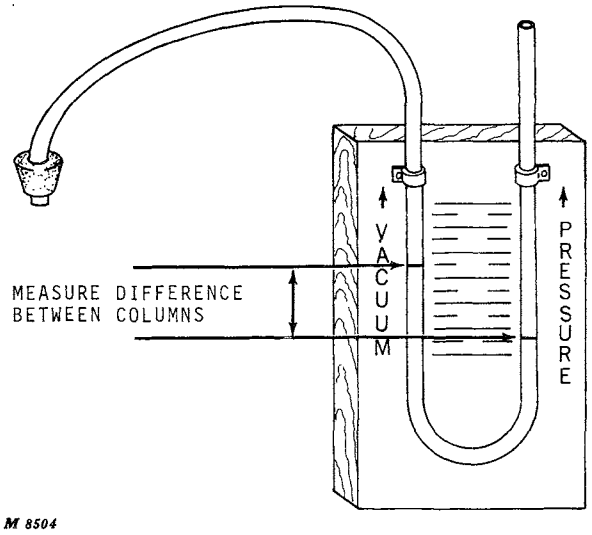

Fig. 4-Checking Crankcase Vacuum

Test Conclusions

Proper crankcase vacuum for the HH100 Engine is a 7 to 12 inch water column on the manometer gauge.

A crankcase vacuum reading lower than indicated above is most likely due to a leaking breather valve or improperly assembled breather. See Group 30 and carefully reassemble breather parts as shown. A low vacuum reading may also be caused by leaky valves, engine blow-by or worn oil seals.

If the crankcase is found to be pressurized rather than having a vacuum, the breather filter may be plugged.

Engines with zero vacuum or 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

Refer to Group 5 of this Section, pages 5-9 through 5-11 for details.

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Group 30

CYLINDER HEAD, VALVES AND BREATHER TECUMSEH ENGINE FOR 112 TRACTOR

GENERAL INFORMATION

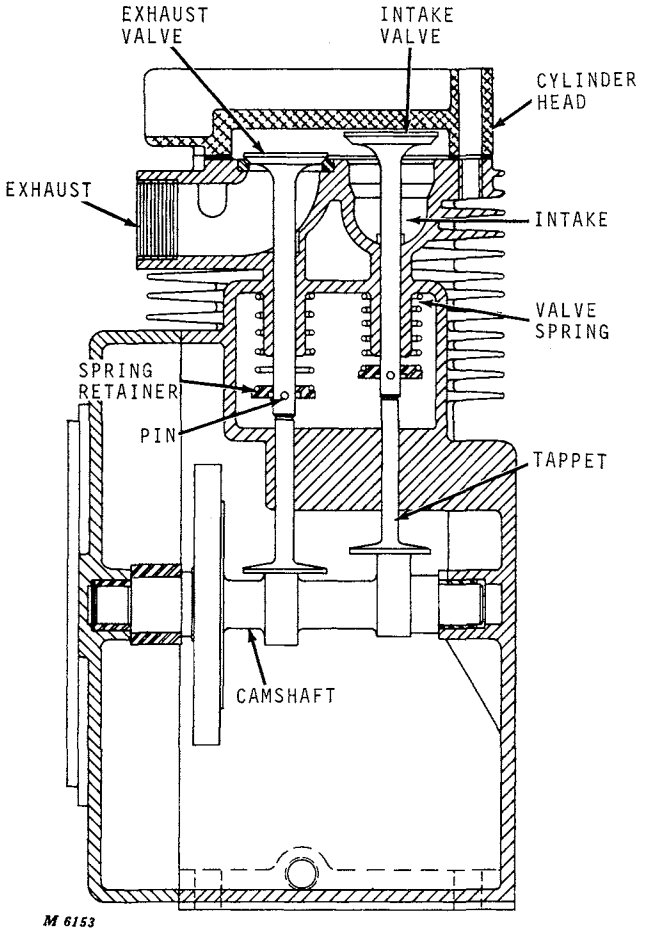


Fig. 1-Schematic View of Valves and Tappets

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 seat insert is press fitted into the block and can be replaced. The intake valve seat is machined into the block. The breather assembly is mounted in front of the valve spring chamber below the carburetor.

Valve guides can be reamed and new valves with oversize stems installed when guide wear tolerances are exceeded.

VALVE ANALYSIS

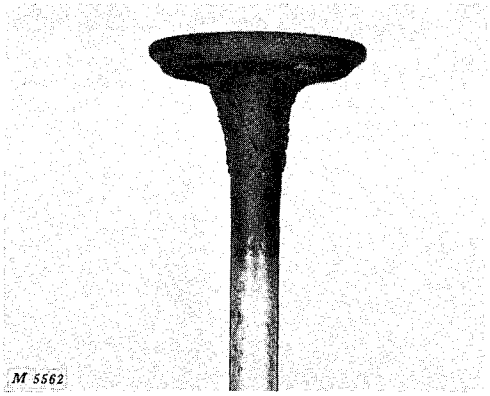


Fig. 2-Lead Deposits on Leaky Intake Valve

Lead deposits on the intake valve, Figure 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 seating 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 30-8.*

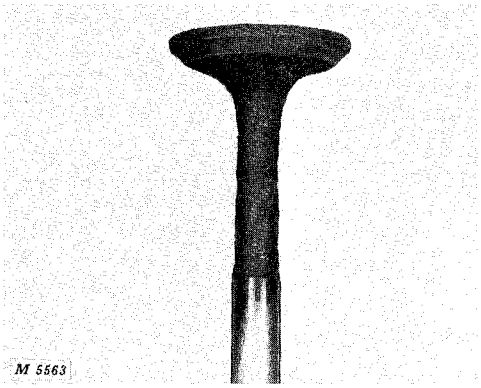


Fig. 3-Valve Stem Corrosion

Valve stem corrosion, Figure 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.

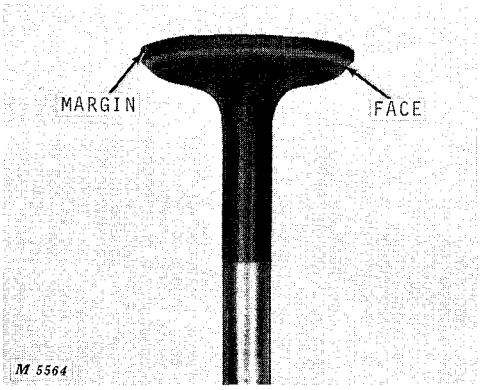


Fig. 4-Exhaust Valve Running Too Hot

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, Figure 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 or overheated spark plug, which causes pre-ignition, or a lean fuel mixture.

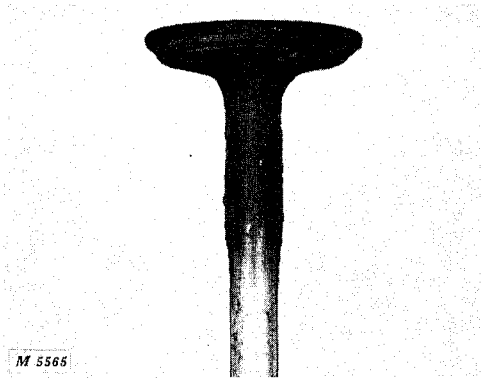


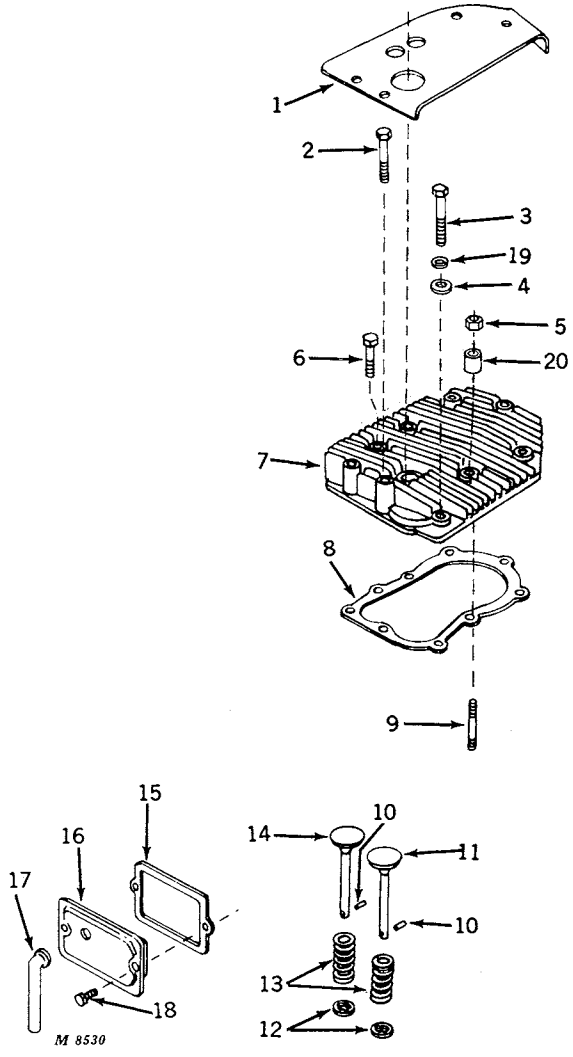
Fig. 5-Gummy Valve Causing Valve to Stick

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

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 to use fresh gasoline and to drain gasoline from all fuel lines and carburetor before storing tractor.

REPAIR



1-Cylinder Head Cover
2-5/16″ Cap Screw
3-5/16″ Cap Screw
4-Washer, Hardened (9 used)
5-Hex. Nut (6 used)
6-5/16″ Cap Screw
7-Cylinder Head
8-Gasket
9-Stud (4 used)
10-Pin (2 used)
11-Intake Valve
12-Spring Cap (2 used)
13-Valve Spring (2 used)
14-Exhaust Valve
15-Breather Gasket
16-Breather Assembly
17-Breather Tube
18-Machine Screw (2 used)
19-Spring Washer (9 used)
20-Spacer, 5/8″

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.

For accessibility, remove the grille. Also remove the cowl and hood assembly.

Remove heat shield. Disconnect throttle and choke conduits at carburetor and control arm. Remove carburetor, control arm, breather assembly, blower housing, cylinder head, and head gasket.

Removing Valves

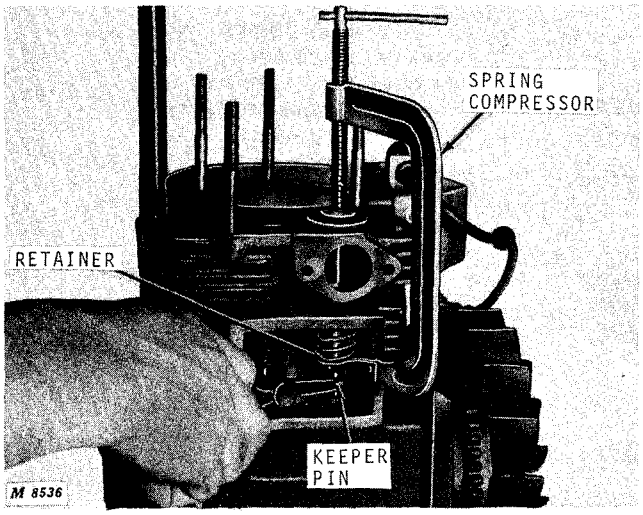


Fig. 7-Removing Valves

Use a spring compressor to compress valve springs, Figure 7. Remove keeper pins from valve stem and lift valves from engine block.

Remove valve spring retainers and valve springs from valve chamber.

Inspecting Cylinder Head

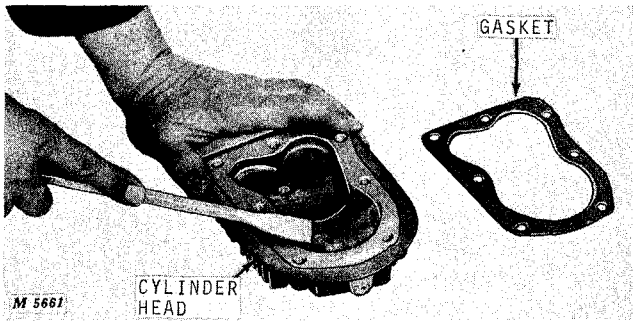


Fig. 8-Cleaning Cylinder Head

Remove all deposits from combustion chamber and gasket surface of head with a scraper 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.

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.

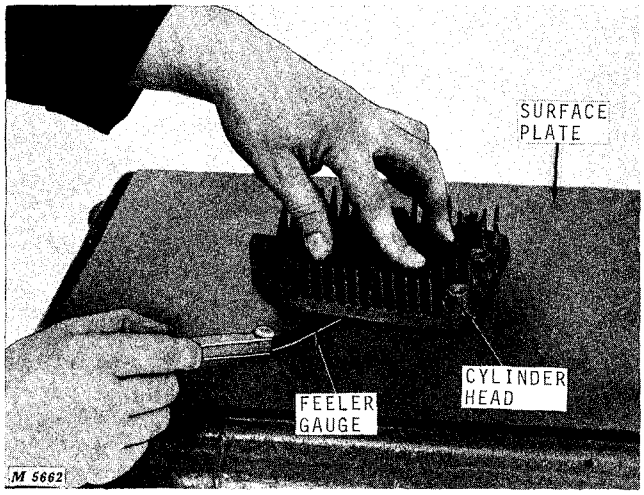


Fig. 9-Checking Cylinder Head Surface

When a cylinder head is removed because of gasket leaks, check the flatness of the cylinder head by placing it on a surface plate, Figure 9. Check to see that gasket surfaces make contact at all points. Replace the cylinder head if it is warped.

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

Inspecting Breather

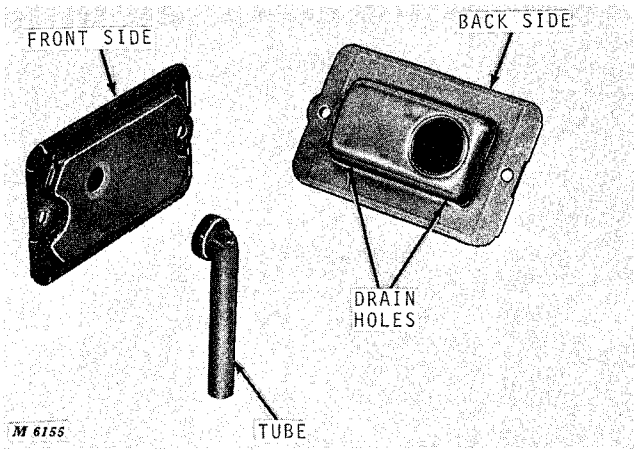


Fig. 10-Cleaning Breather Filter

The breather is a sealed assembly. Do not immerse assembly in cleaning solvent. Carefully wipe outside of assembly with a clean cloth. After wiping, remove breather tube, Figure 10, and clean tube thoroughly in cleaning solvent. Discard assembly if inside of breather assembly is full of sludge or if assembly is distorted. Replace complete assembly when vacuum test indicates faulty breather.

Be sure drain holes in breather assembly are open and down.

Testing Valve Springs

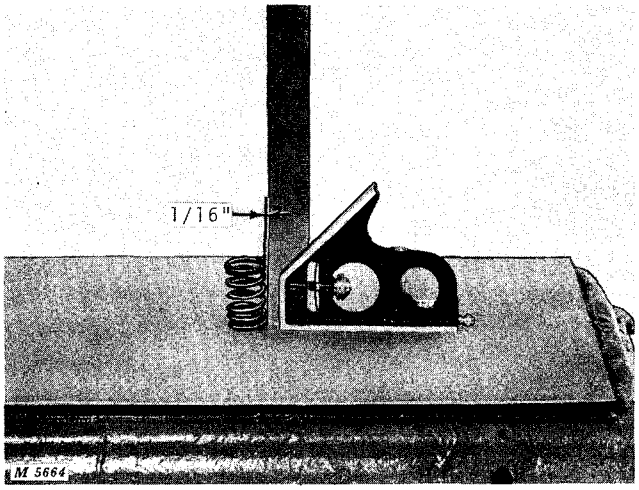


Fig. 11-Valve Spring Squareness

Check valve spring for squareness, using a steel square and a surface plate, Figure 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 30-11, for out of square limits.

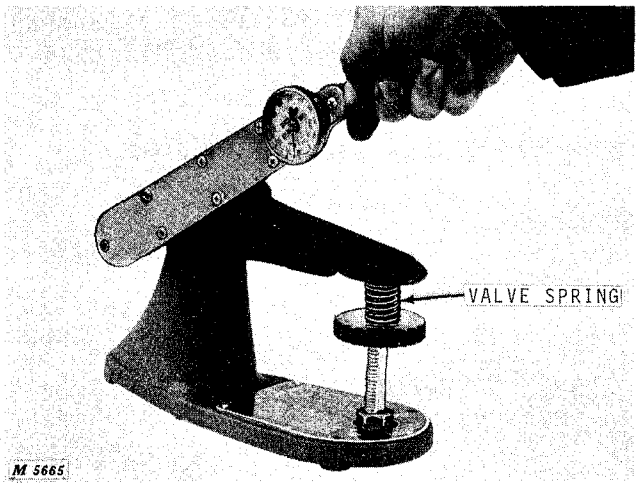


Fig. 12-Valve Spring Tension

Check valve spring for proper pressure, Figure 12. Refer to "Specifications," page 30-11, 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.

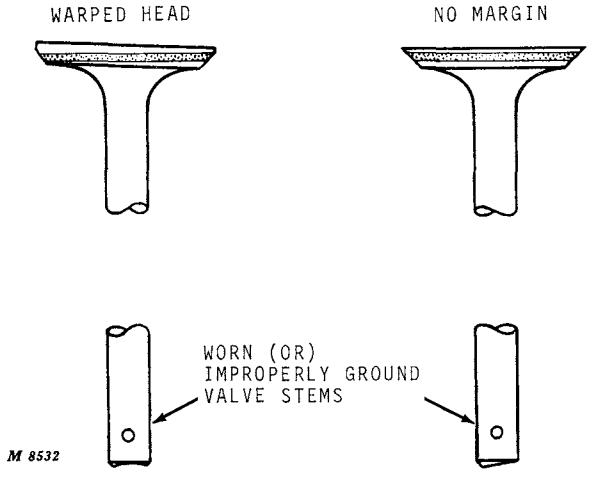


Fig. 13-Faulty Valves

Check valve faces, heads and stems, Figure 13, for defects. Also look for bent valve stems and excessive corrosion causing pits on valve face or stem. Replace

Inspecting Valves—Continued

valves with a warped head. Recondition or replace valves with less than 1/64-inch margin. Valve stem ends should be ground square before checking valve tappet clearance.

Reconditioning or Replacing Valves

Valve Guides

Clean the valve guides first to assure valve alignment when cutting valve seats.

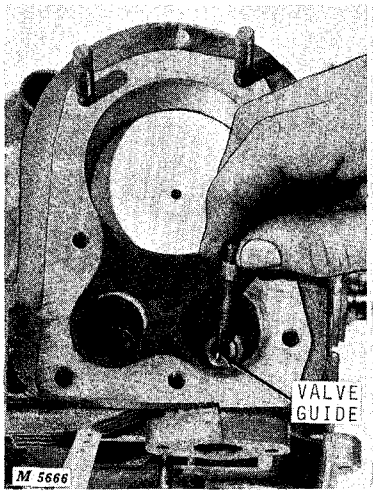


Fig. 14-Measuring Valve Guide

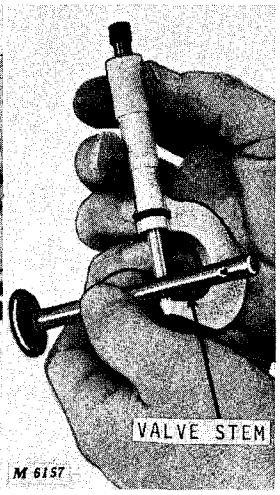


Fig. 15-Measuring Valve Stem

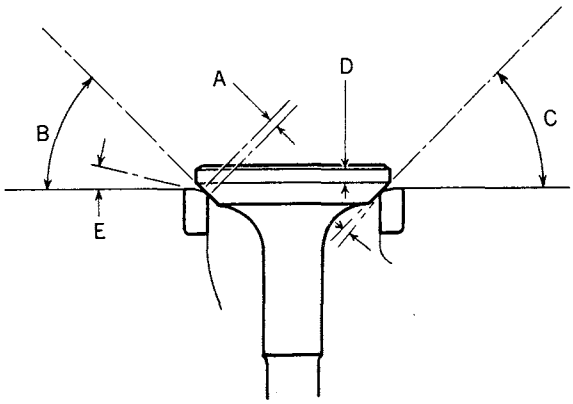
Use valve guide cleaner to clean inside of valve guide. Then measure I.D. of valve guide, Figure 14, and O.D. of valve stem, Figure 15. Refer to "Specifications," page 30-11, for tolerances. Ream guides as necessary.

Valve Seats

A broken or worn exhaust valve seat (insert) may be replaced. See page 30-8. They are either stellite or molychrome nickel. The intake valve seat is machined into the cylinder block.

Hold the valve seating, surface "A," Figure 16, as close to 3/64 inch as possible. Seats with more than 1/16-inch seating surface should be narrowed (cut back) with a 30° cutter, "E," Figure 16.

The valve seat angle "B" depends upon valve face angle "C." New valves have a 45° face. Recondition valve seats with 46° cutters and lap valves. See page 30-7.



A. Valve Seating Surface (3/64-inch)
B. Valve Seat Angle (46°)
C. Valve Face Angle (45°)
D. Valve Margin (1/16-inch)
E. Valve Narrowing Angle (30°)

Fig. 16-Valve Seat and Surface Dimensions

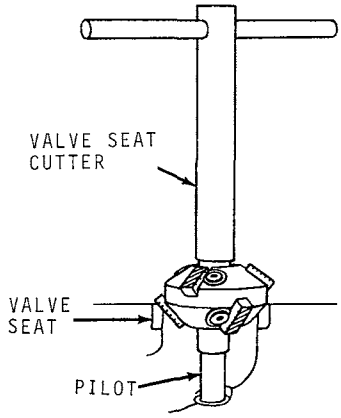


Fig. 17-Valve Seat Cutter

This valve seat cutter will cut a 46° valve seat and narrow the seat to 30°. See "Special Tools," page 30-12, for tool number and manufacturer.

When reconditioning valves, be sure there is no more than 1/16-inch and no less than 1/64-inch margin "D" on the valve.

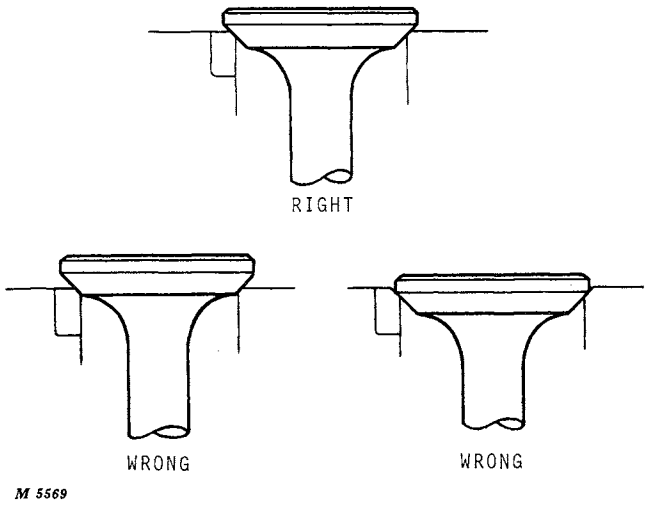


Fig. 18-Valve and Seat Relationship

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

Valve Lapping

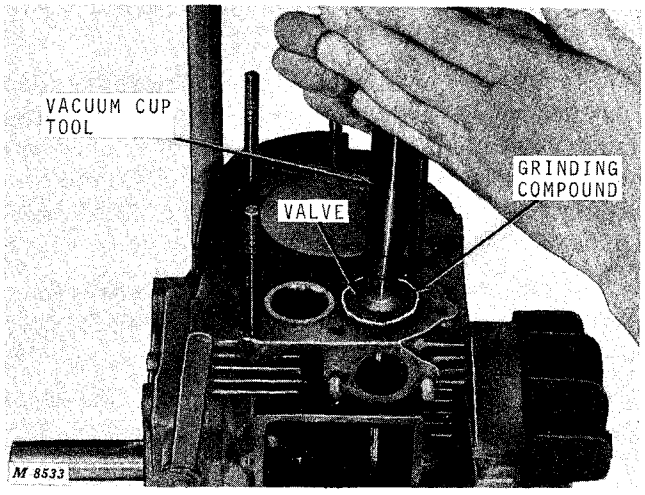


Fig. 19-Lapping Valves

Coat face of valve sparingly with a fine grade of valve grinding compound. Use a vacuum cup tool, Figure 19, to grip top of valve. 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 seal 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.

Reaming Valve Guides

If valve guide clearance exceeds maximum tolerance, ream the guide.

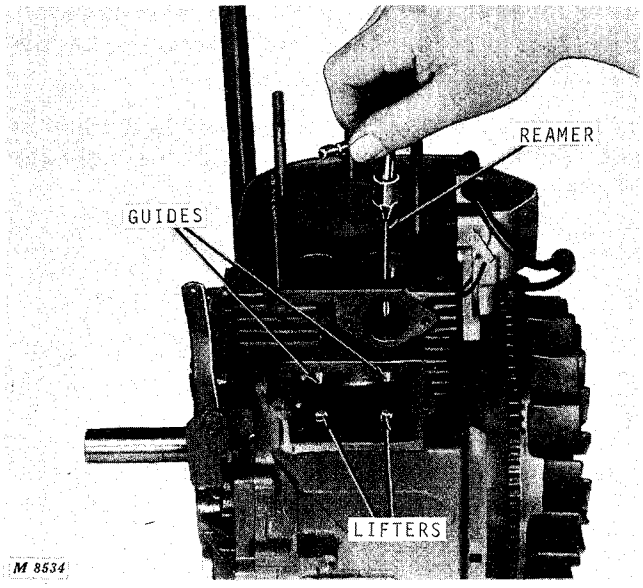


Fig. 20-Reaming Valve Guides

Use an adjustable reamer, Figure 20, when enlarging valve guides for an oversize valve stem diameter. See "Specifications," page 30-11 for valve guide oversize dimensions. See "Special Tools" page 30-12, for an adjustable reamer to enlarge valve guides.

IMPORTANT: Do not enlarge lifter guides, because lifters with oversize stems are not available.

Removing and Installing Exhaust Valve Seat Insert

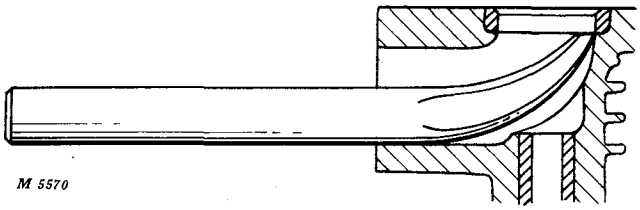


Fig. 21-Removing Exhaust Valve Seat Insert

To remove exhaust valve seat insert, use extractor, Figure 21, or a valve seat puller. Clean seat area thoroughly before installing new insert. If extractor is not available, break insert and drive out.

The exhaust valve insert is retained by a press fit only. Chill both the insert and driving tool in dry ice before pressing insert into block.

Checking Valve Clearance

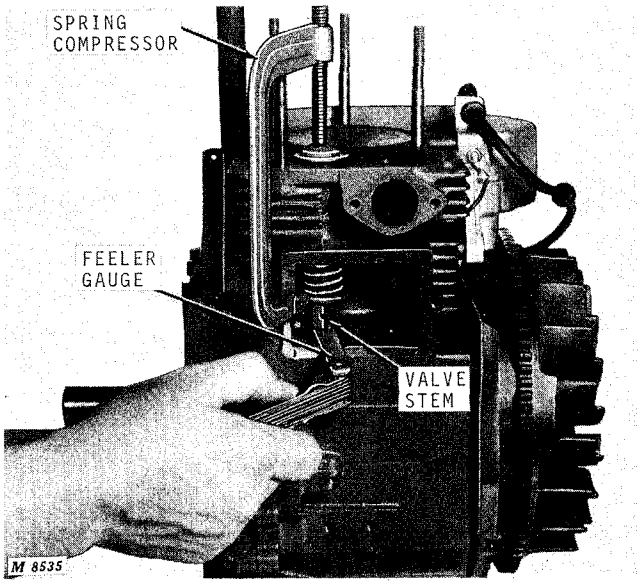


Fig. 22-Checking Valve-to-Lifter Clearance

Valve grinding changes the lifter and valve clearance. After grinding or installing new valves, check clearance as follows:

1. Rotate crankshaft until piston is top dead center (end of compression stroke) and crankshaft keyway is at exactly 12 o'clock (top) position. It is important that this procedure be followed to insure that the exhaust valve lifter is NOT riding on the EZEE-Start mechanism.

2. Insert valves in their guides and hold valves firmly on seats with either your fingers or a compressor as shown in Figure 22.

3. Check clearance between bottom of each valve stem and its lifter with a feeler gauge, Figure 22. Refer to "Specifications," page 30-11, for proper valve clearance. Grind off tip of valve stem in a valve resurfacing machine set to grind a perfectly square face. Grind tip of stem until proper clearance is obtained.

INSTALLATION

Installing Valve Springs, Retainers and Keeper Pins

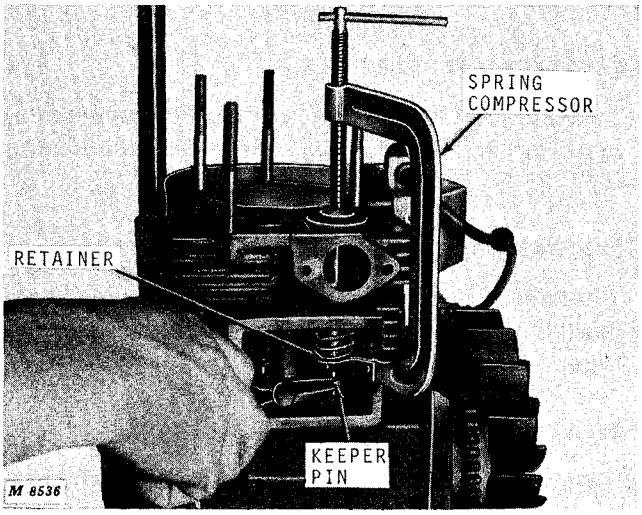


Fig. 23-Installing Valve Springs, Retainers and Keeper Pins

Place valve spring and retainer in valve spring chamber, Figure 23. Install valves in guides working them back and forth to make sure they slip through the guides easily. Using a valve spring compressor, compress the springs and install keeper pins in hole of stem, Figure 23.

Installing Breather

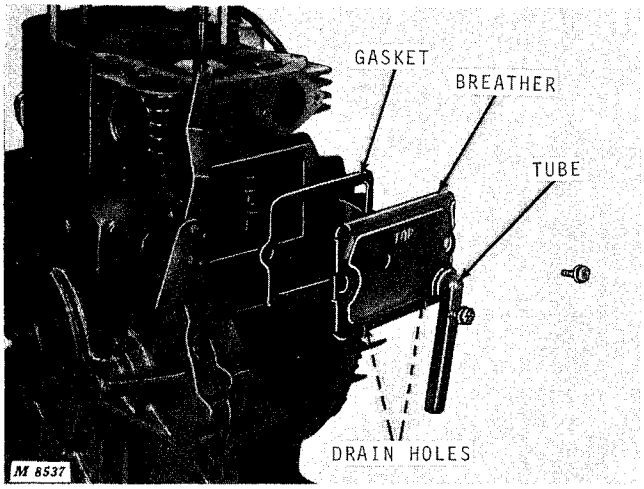


Fig. 24-Breather Parts

Install rubber breather tube on breather assembly, Figure 24. Install breather assembly on cylinder block with drain holes toward the base of the engine. Always use a new gasket. Tighten retaining screws firmly.

Installing Cylinder Head

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

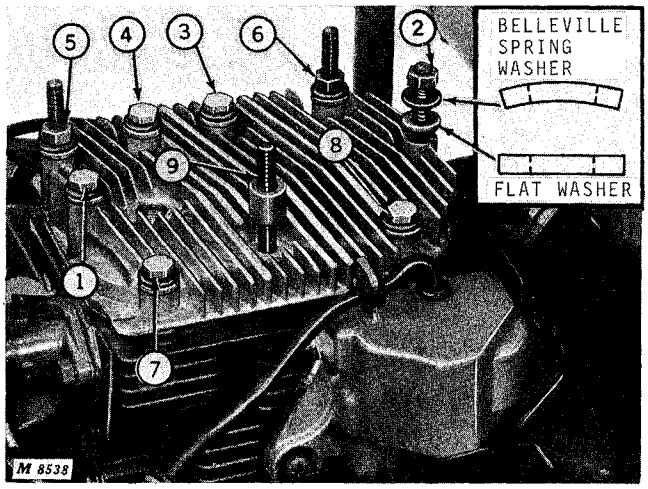


Fig. 25-Cylinder Head Bolt Tightening Sequence

Position head gasket on block.

IMPORTANT: Install head gasket dry. Do not use Permatex, or other sealant on gasket.

Place milled head over gasket and install the 5/8-inch spacer over stud (9, Figure 25).

NOTE: Lubricate the threads of all studs and head bolts with paraffin or engine oil prior to installation.

Place hardened special flat washer (next to head) and special Belleville spring washer (crown up) on each head bolt and stud with the exception of the stud with spacer. See inset, Figure 25.

IMPORTANT: Head bolts 7 and 8 are 1-3/4 inches long, bolts 1 and 4 are 2 inches long and bolt 3 is 2-1/4 inches long.

Follow the sequence shown in Figure 25 and tighten the head bolts and stud nuts to 100 in-lbs of torque. Tighten bolts and nuts evenly in 50 in-lb steps until 200 in-lbs of torque is reached.

NOTE: Stud 9 with spacer cannot be torqued until blower housing is installed.

Install blower housing and grass screens.

Litho in U.S.A.

Installing Carburetor

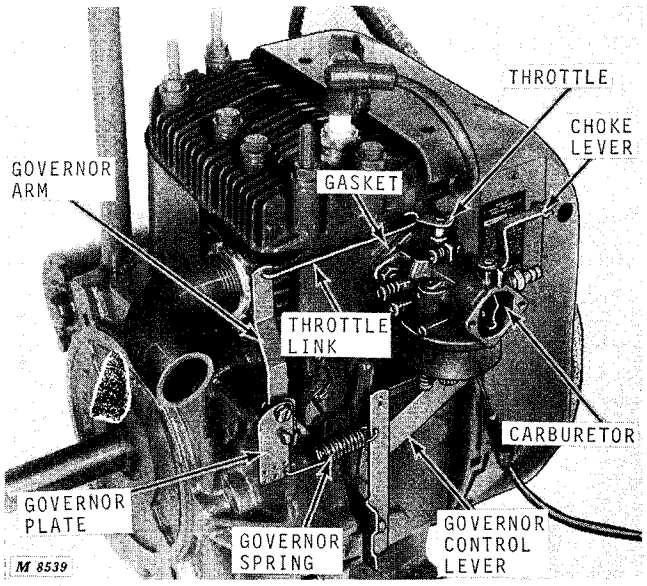


Fig. 26-Carburetor Assembly (Air Filter Base Removed for Clarity)

Connect throttle link in holes on governor arm and throttle shaft arm. Using a new gasket, mount carburetor on engine block and tighten nuts firmly. Install governor spring and control lever. Tighten control lever pivot screw firmly. Place governor spring in proper hole on governor plate, Figure 26. Install cables and secure conduits in clamps. Check controls for correct travel. Readjust if necessary. Connect fuel line.

Installing Muffler

Coat threads on muffler with an anti-seize compound to prevent carbon fusion.

Screw muffler in block hand tight. Exhaust outlet should be at bottom of muffler.

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 30-11, for proper spark plug gap. See Section 40, "Electrical System," for spark plug testing.

Setting Ignition Module Air Gap

Refer to Section 40, "Electrical System," for air gap setting procedure.

Installing Hydraulic System

Refer to Section 60, "Hydraulic System," for detailed service information.

SPECIFICATIONS

HH100 Tecumseh Engine

Item	Dimension	Wear Tolerance
Valve guides, STD dia.	0.312 to 0.313 inch	0.0015 to 0.0020
Valve guides, 0.030 inch oversize	0.343 to 0.344 inch	0.0015 to 0.0020
Valve seat width	0.042 to 0.052 inch	. . . .
Valve face width	0.089 to 0.099 inch	
Valve margin	1/16 inch	1/32 inch
Valve spring squareness	1/32 to 1/16 inch	3/32 inch
Valve spring compressed tension	19-21 lbs. at 1-21/32-inch length	. . . .
Valve spring free length	2-1/8 inch	. . . .
Valve stem diameter		
Intake, standard	0.309 to 0.310 inch	. . . .
Exhaust, standard	0.308 to 0.309 inch	. . . .
Intake, oversize	0.340 to 0.341 inch	. . . .
Exhaust, oversize	0.340 to 0.341 inch	. . . .
Cylinder head flatness	Contact at all points	Replace warped head

Table of Engine Clearances

Item	Clearance
Intake valve clearance cold	0.010 inch
Exhaust valve clearance cold	0.020 inch

Torque For Hardware

Location	Torque
Cylinder head bolts	200 in-lbs
Spark plug (cold)	15 to 20 ft-lbs

Tune-Up Data

Item	Specifications
Engine compression	80 to 110 psi
Spark plug gap	0.030 inch
Valve face angle	45 degrees
Valve seat angle	46 degrees
Crankcase vacuum U-tube manometer	7 to 12 inches water column

SPECIAL TOOLS

Name	Part No.	Use
Extractor	K.O. LEE R95	To remove exhaust valve seat insert.
Valve Spring Tester	STURTEDANT Model SPT	To check valve spring pressure.
Adjustable Reamers	QUICK SET 43	Ream valve guides after installation.
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.
U-Tube Manometer	DWYER Model 1211-24	Check crankcase vacuum.
Valve Seat Cutter Kit	NEWAY No. 102S Kit, NEWAY Sales Inc., Corunna, Michigan	Recondition valve seat.

Group 35

PISTON, CRANKSHAFT, MAIN BEARINGS AND FLYWHEEL TECUMSEH ENGINE FOR 112 TRACTOR

GENERAL INFORMATION

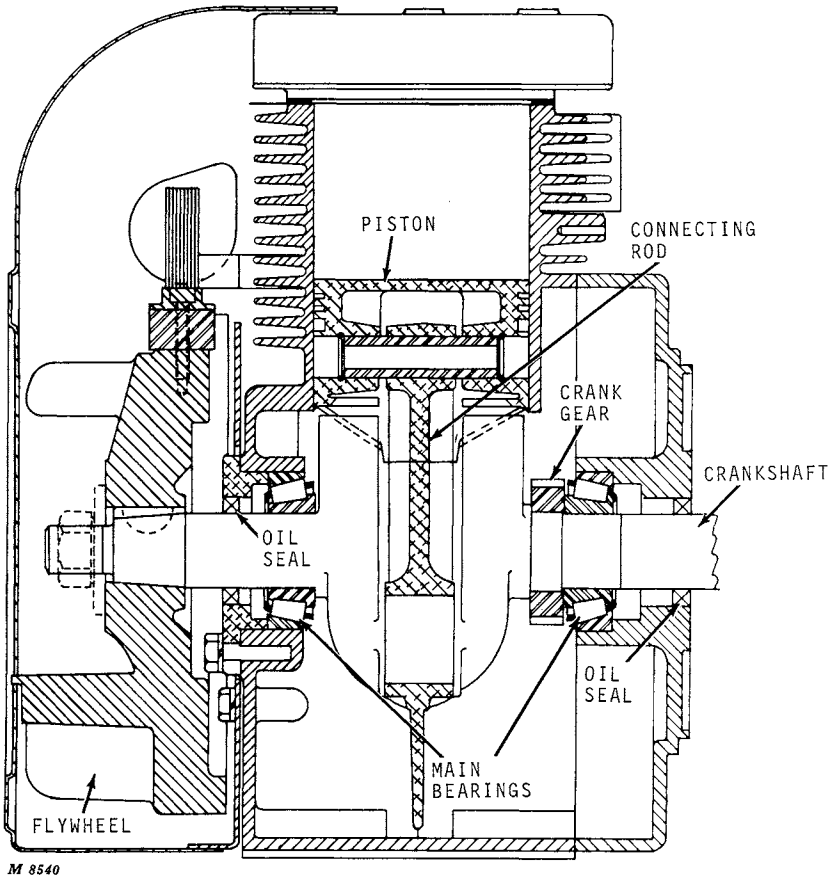
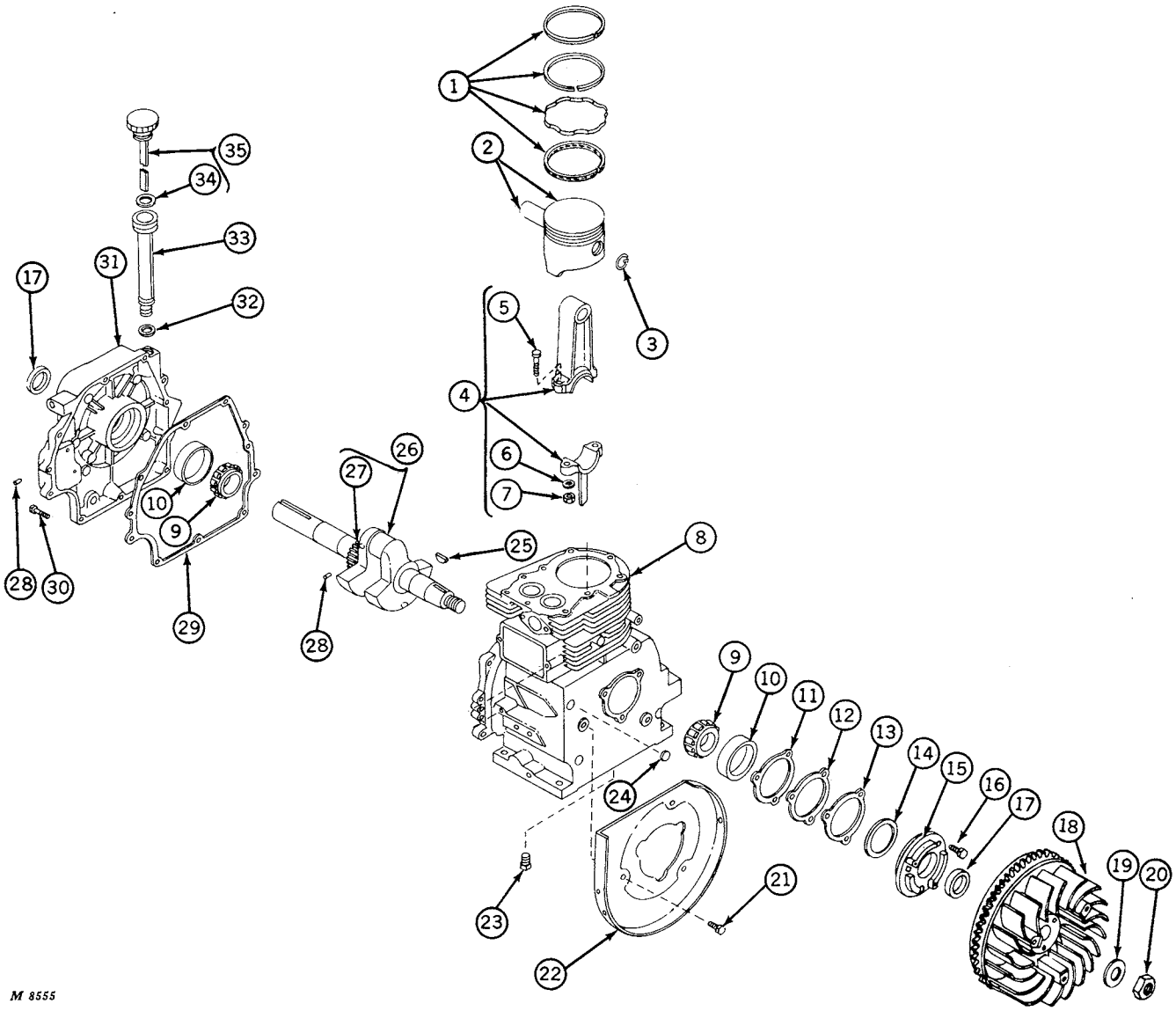


Fig. 1-Cutaway View of Tecumseh HH100 Engine

Oversize pistons and rings are available for the HH100 Tecumseh Engine.

A short block assembly is also available. It is complete with cylinder block, crankshaft, bearings and seals, connecting rod with piston, internal governor parts, valves and springs, camshaft and cylinder cover and cylinder head.

REPAIR



1-Ring Set
2-Piston Assembly
3-Retaining Ring (2 used)
4-Rod Assembly
5-Bolt (2 used)
6-Washer (2 used)
7-Lock Nut (2 used)
8-Cylinder Block
9-Roller Bearing (2 used)
10-Bearing Cup (2 used)
11-Shim Gasket (0.003″/0.004″ thick) (Use as req'd)
12-Shim Gasket (0.004″/0.005″ thick) (Use as req'd)
13-Shim Gasket (0.005″/0.007″ thick) (Use as req'd)
14-Steel Spacer (0.010″ thick) (Use as req'd)
15-Bearing Retainer
16-Cap Screw (3 used)
17-Oil Seal (2 used)
18-Flywheel
19-Washer
20-Nut
21-Cap Screw (3 used)
22-Baffle
23-Drain Plug
24-Expansion Plug
25-Woodruff Key
26-Crankshaft Assembly
27-Crankshaft Gear
28-Pin (2 used)
29-Gasket
30-Cap Screw (8 used)
31-Cylinder Cover
32-Gasket
33-Oil Tube
34-O-ring
35-Dipstick

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 front grille.

3. Remove four cowl support bolts from tractor frame. Remove hood and cowl panels as an assembly.

4. Close fuel shut-off valve and remove gas tank.

5. Disconnect ignition wire harness at harness connector.

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

7. Remove muffler shield and hydraulic system if tractor is so equipped. *NOTE: Do not disconnect hydraulic lines unless hydraulic system is to be repaired also.*

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

Disassembling Engine

Remove engine shrouding, ignition module, carburetor, starter, and oil filler tube.

Remove cylinder head, breather assembly and valves. See Group 30 of this section.

Removing Cylinder Ridge

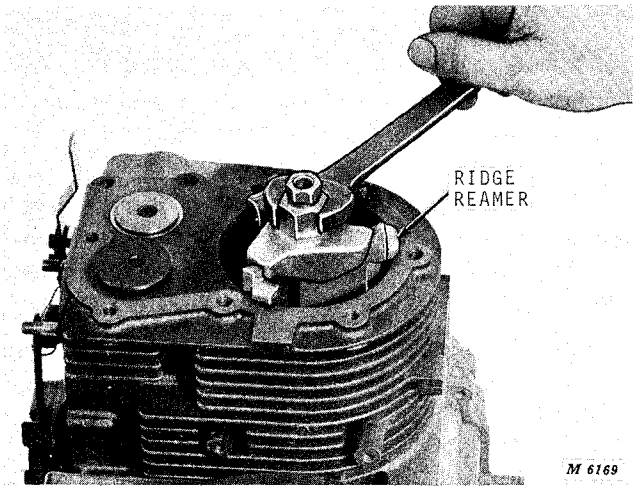


Fig. 3-Removing Ridge at Top of Cylinder Bore

Turn flywheel until piston is at lowest position, (B.D.C). Remove carbon and ridge from top of cylinder bore with ridge reamer, Figure 3. *NOTE: Piston damage will occur if ridge is not removed before pushing piston out of cylinder bore.*

Pulling Flywheel

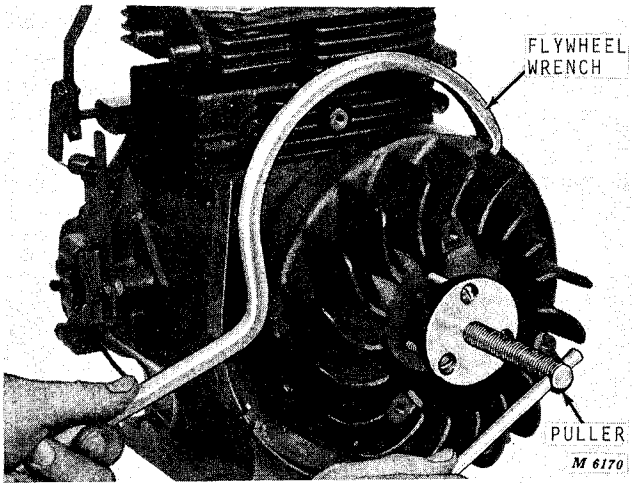


Fig. 4-Flywheel Puller

Break flywheel nut loose with a long handle nut spinner and a flywheel wrench. Flywheel wrench is shown in Figure 4. The flywheel is mounted on a tapered shaft and should be removed with a puller, Figure 4. Remove key from crankshaft.

Removing Cylinder Cover

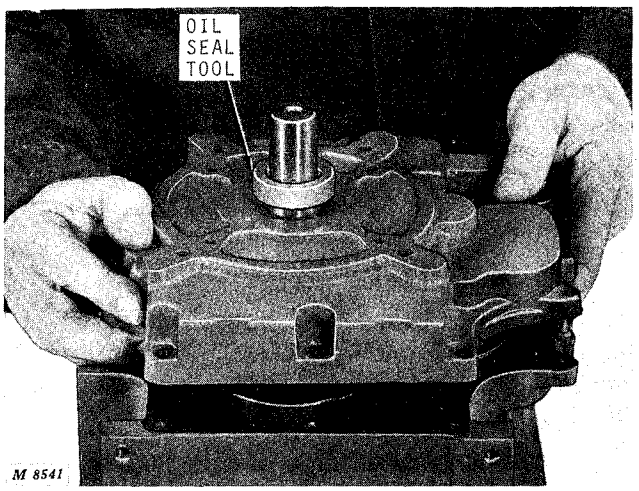


Fig. 5-Cylinder Cover Removal

Place engine on two blocks high enough to allow the tapered end of crankshaft to extend freely. Using oil seal sleeve tool, remove cylinder cover, Figure 5.

Removing Cylinder Cover—Continued

See "Special Tools," page 35-19, for oil seal sleeve tool. Remove governor spool, camshaft and lifters. Identify exhaust lifter with an "x" marking to assure correct installation during assembly.

Remove and discard lock nuts from connecting rod bolts. *NOTE: Use thin wall socket to remove lock nuts. Using the wrong socket will force pressure against rod cap and cause misalignment.* Remove connecting rod cap and push piston and rod out top of block.

Removing Crankshaft

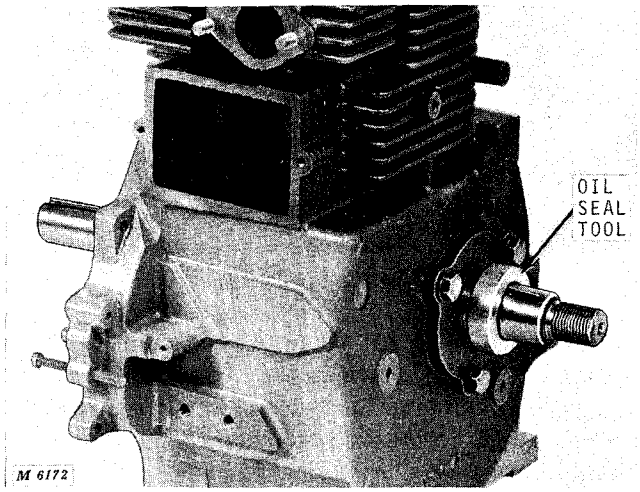


Fig. 6-Crankshaft Removal

Insert seal sleeve tool in bearing retainer seal and remove crankshaft from cylinder block.

Remove bearing retainer, bearing cup and shims. Discard paper shims.

Remove retaining ring and governor gear assembly.

Removing Piston Rings

Clamp the connecting rod in a vise with soft jaws to prevent damaging rod. **IMPORTANT: Tighten vise only tight enough to hold the assembly. Too much pressure will damage rod.**

Use ring expander to remove rings, Figure 7. Discard old rings.

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

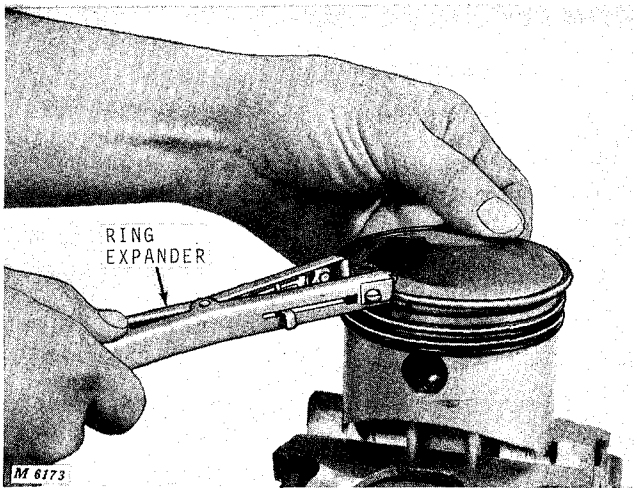


Fig. 7-Removing Piston Rings

Analyzing Piston Ring Wear

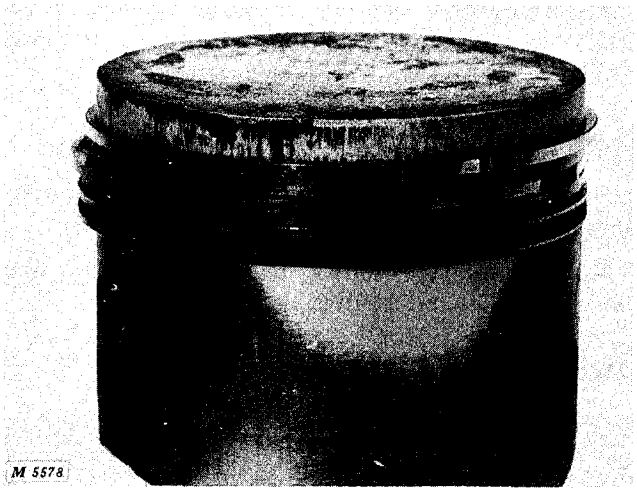


Fig. 8-Scored Piston and Rings caused by Overheating as Temperatures Reach Melting Point of the Materials

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, Figure 8.

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.

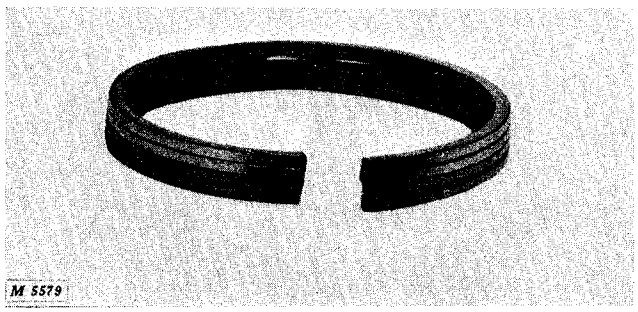


Fig. 9-Piston Rings with Improper End Gap

Rings of the wrong size or rings having improper end gap, Figure 9, cannot conform to the shape of the cylinder. This results in high oil consumption and excessive blow-by. This could also be caused by end gaps in alignment.

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

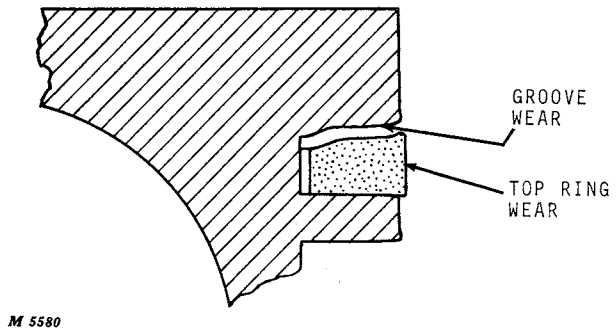


Fig. 10-Top Ring and Groove Side Wear

Check wear of ring grooves carefully, Figure 10, especially the top groove. The top ring and groove are exposed to most combustion temperature and pressure as well as airborne abrasives which enter the combustion chamber.

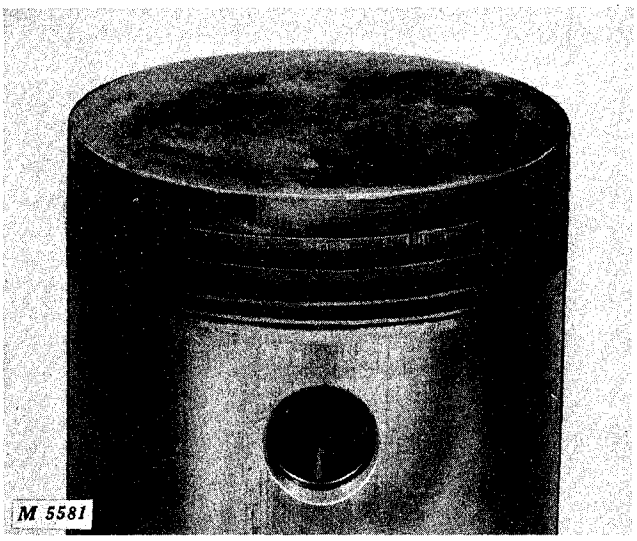


Fig. 11-Piston Rings Stuck and Broken Because of Lacquer, Varnish and Carbon Build-Up

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 making the rings stick, Figure 11. When this happens, excessive oil consumption and blow-by will occur.

Engine heating and ring sticking are most often caused by:

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

Analyzing Piston Ring Wear—Continued

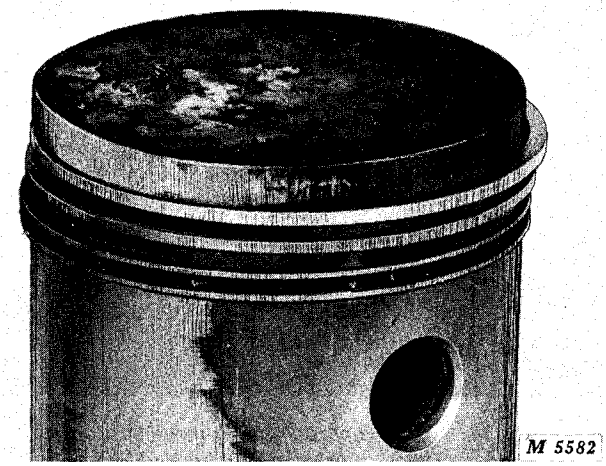


Fig. 12-Scratched Ring Faces Caused by Abrasives in the Engine

Vertical scratches across the faces of piston rings, Figure 12, 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.

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.

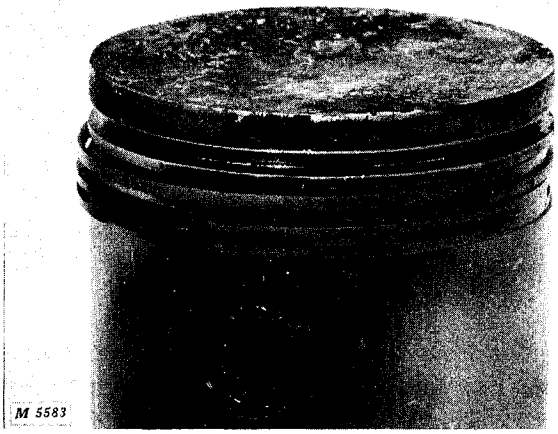


Fig. 13-Worn Oil Rings Which Cannot Provide Oil Control

Rails of the oil ring are worn down to the oil drain holes and the oil ring surface is worn flat, Figure 13. 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

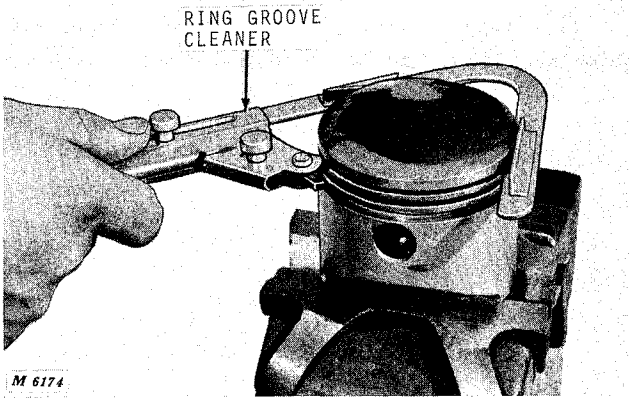


Fig. 14-Cleaning Ring Grooves

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 holes are clean.

Clean carbon from piston ring grooves with a ring groove cleaner, Figure 14. If cleaning tool is not available, break an old ring and use it to clean grooves.

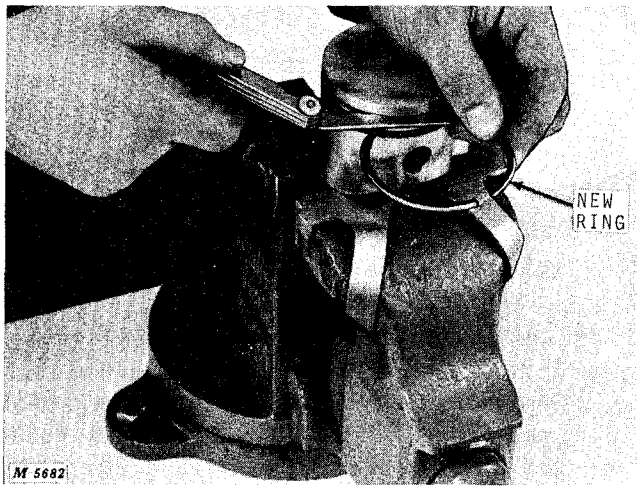


Fig. 15-Measuring Ring Clearance

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, Figure 15. Refer to "Specifications," page 35-18, 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 35-8. Replace faulty pistons.

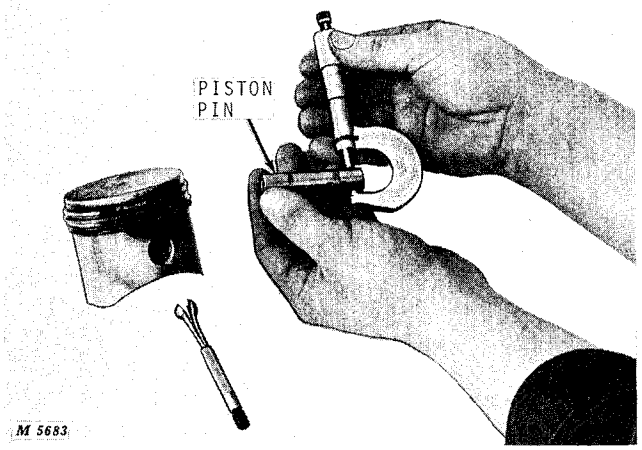


Fig. 16-Measuring Piston Pin and Piston

Measure piston pin-to-piston clearance with a micrometer, Figure 16. Ream out piston and rod and install oversize piston pins when necessary. See "Specifications," page 35-18. Oversize piston pins are available for service.

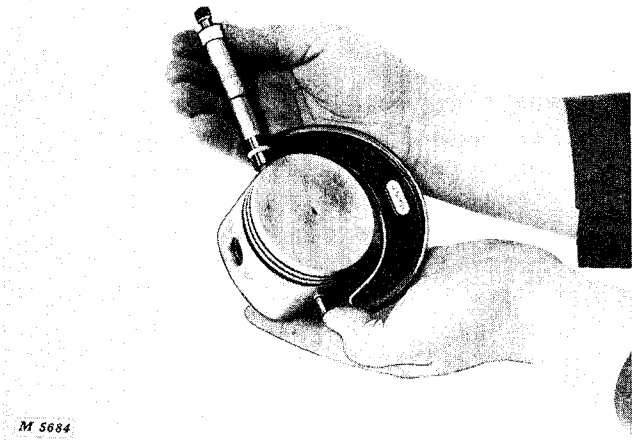


Fig. 17-Measuring Piston

Check the piston-to-cylinder bore clearance by measuring the piston and bore diameters, Figures 17 and 24.

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 more than 0.013 inch, rebore cylinder if piston is within tolerance. Install oversize piston and rings. See "Specifications," page 35-18.

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

See page 35-11 for deglazing and reboring information.

Analyzing Piston Wear

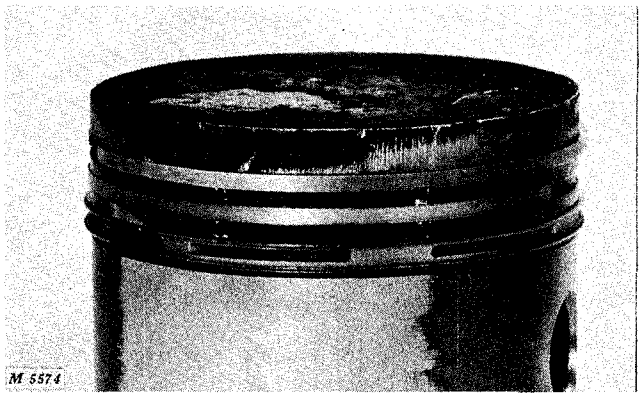


Fig. 18-Piston Top Land Burning Caused by Detonation

Detonation is a form of abnormal combustion causing excessive temperature and pressure in the combustion chamber, Figure 18. 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. 19-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 resulitng in pings, vibration, detonation and power loss. Severe damage to piston, rings and valves results from pre-ignition, Figure 19.

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. 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, Figure 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.

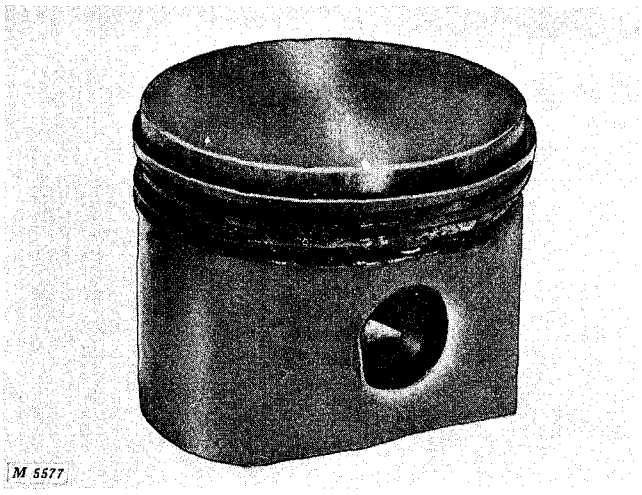


Fig. 21-Piston Damage Caused by Piston Pin Retaining Ring Coming Loose

In Figure 21 a piece of the retaining ring found its way into the oil ring.

Pin retaining rings loosen or break due to:

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

Inertia can cause a retaining ring or loose object inside the piston pin to beat out the piston and cylinder in the pin boss area. Damage to both the piston and cylinder occurs.

Inspecting Crankshaft

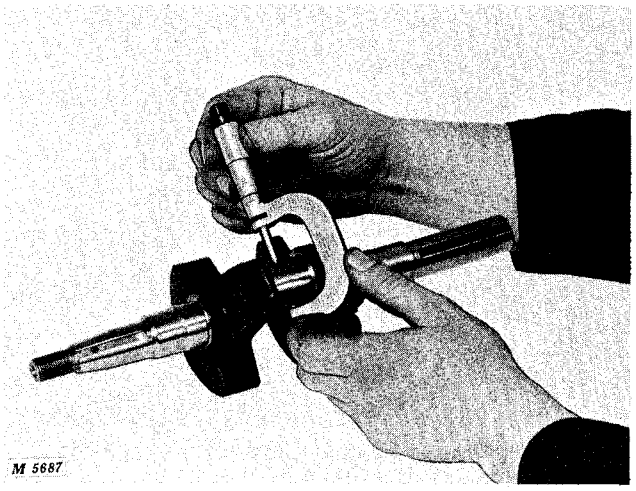


Fig. 22-Measuring Crankshaft Journal

Wipe crankshaft dry and check general condition. Clean up threads on end of shaft if necessary. If crankshaft journal indicates wear beyond specified limits or if journal is scored, replace crankshaft, Figure 22. Replacement crankshafts have crankshaft gear, journal, and bearings assembled to crankshaft. New bearing cups are also provided and should be used when installing a new crankshaft assembly.

Analyzing Connecting Rod And Cap Wear

Check rod and cap for signs of bending, cracking or unusual wear patterns.

Lack of lubrication or improper lubrication can cause the connecting rod and cap to seize to the crankshaft and may even cause rod particles to become embedded 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.

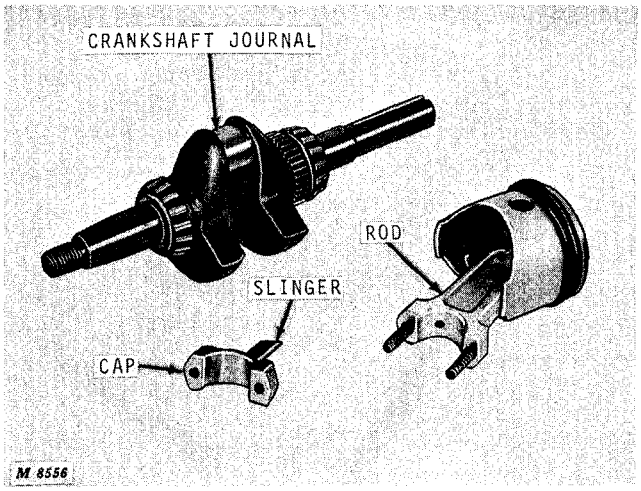


Fig. 23-Crankshaft, Rod and Cap

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 with sludge.
4. Oil not changed regularly.
5. Bearing cap installed incorrectly.

Note especially the condition of the rod and cap bearing area, Figure 23. 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.*

Measure fit of rod and cap to crankshaft journal. Also measure fit of piston pin in piston and rod. See "Specifications," page 35-18.

Inspecting and Repairing Block

After throughly 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 per cent kerosene and 75 per cent 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.*

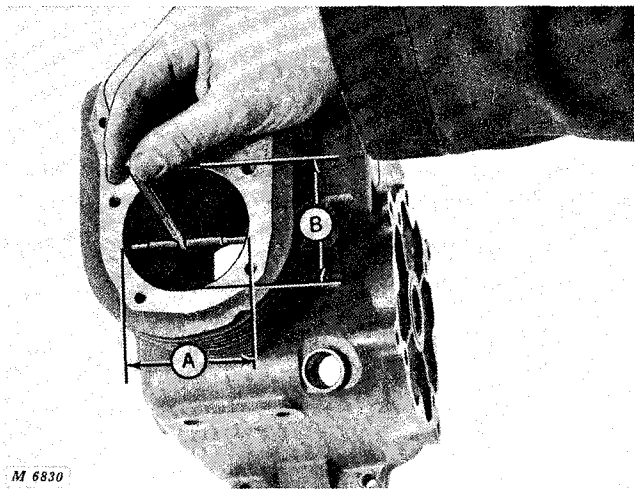


Fig. 24-Measuring Cylinder Bore

Use a telescoping gauge and micrometer to measure bore in two places at top and bottom of ring travel area, Figure 24. 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 35-18, 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 conform to the cylinder bore. This finish also retains a small film of oil to provide ring lubrication for the ring surface and prevents scoring.

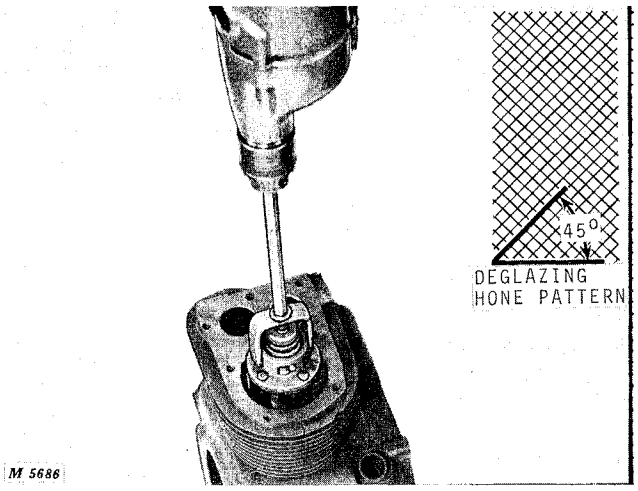


Fig. 25-Deglazing Cylinder Bore

Use a deglazing tool to break glaze, Figure 25. Follow manufacturer's 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 35-7, 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 35-19.

Honing to 0.010-inch oversize to accommodate oversize piston and rings can also be done with a coarse stone in the deglazing tool, Figure 25, and refinishing with finer grit stones. *IMPORTANT: If block is jigged in a drill press for honing, be sure honing tool and block are in true alignment.*

Inspecting Camshaft

Check camshaft for broken or cracked gear teeth. Check operation of EZEE-start assembly making sure all parts are intact and operate freely. Check condition of flywheel spring. If camshaft needs attention, see Group 40 for camshaft and governor service.

Inspecting Main Bearings

Main bearings turn in an oil mist and are normally durable. 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.

Analizing Bearing Wear

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

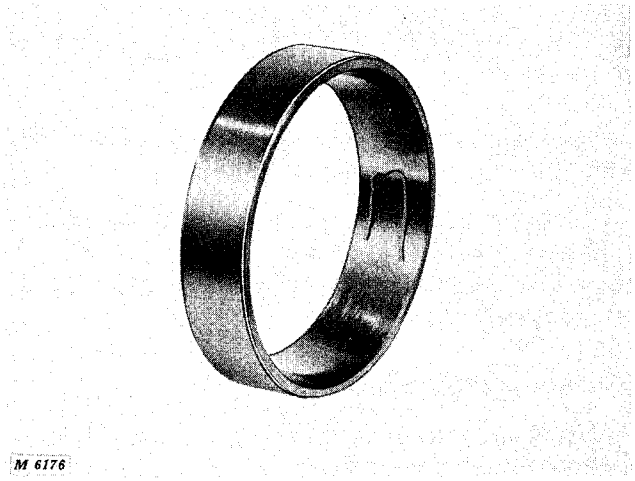


Fig. 26-Pitting and Longitudinal Crack

The longitudinal crack and pitting in the bearing cup in Figure 26 was caused by improper fit of the cup in its housing. The cup did not turn, but there was a hollow, worn spot in the housing underneath the damaged areas, which caused the cup to flex and become damaged as shown.

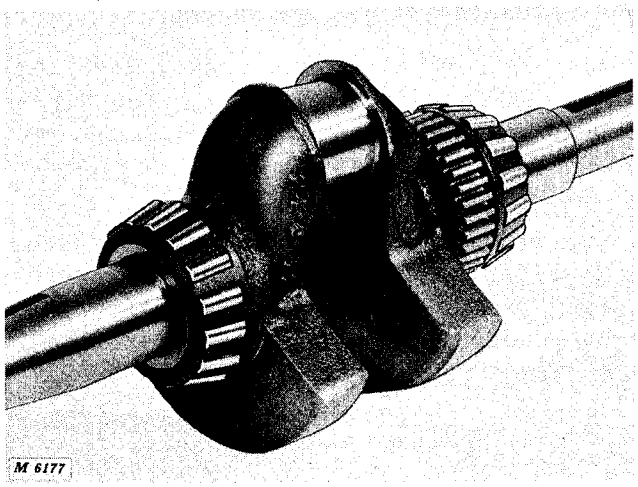


Fig. 27-Chipped Rollers

Chipping of roller bearings, Figure 27, is caused by improper crankshaft end play adjustment.

Refer to pages 15-12 and 15-13 of this section for an analysis of other bearing failures.

INSTALLATION

Installing Crankshaft

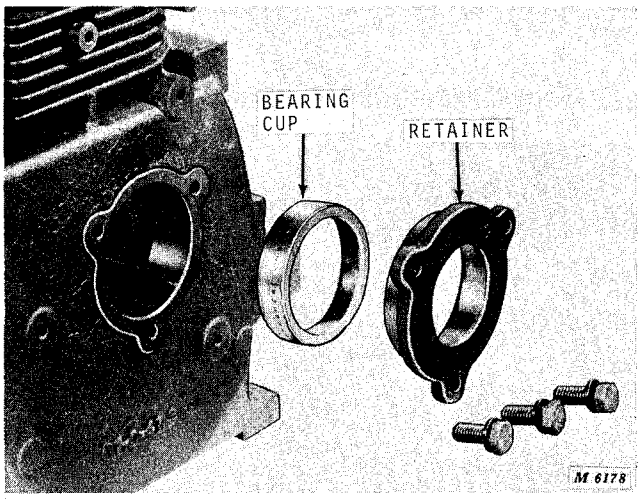


Fig. 28-Bearing Retainer Assembly

Bolt bearing retainer and cup (thin edge inward) to engine block, Figure 28. Tighten cap screws only finger tight because this is only a temporary installation. Place engine on its side on blocks high enough to allow tapered end of crankshaft to extend freely when crankshaft is installed in block.

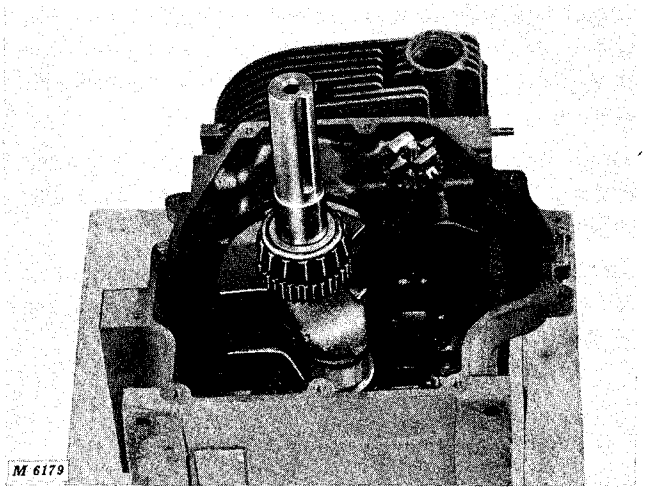


Fig. 29-Installing Crankshaft

Install crankshaft with tapered end down in cylinder block, Figure 29.

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 pin bore. A properly fitted piston pin can be pressed into position with hand pressure. Install retaining ring in each end of piston pin bore, making sure that rings are securely seated in retainer grooves in piston.

Use a rod aligner to check rod and piston alignment. Follow manufacturer's recommendations for checking and correcting alignment.

Checking Piston Ring End Gap

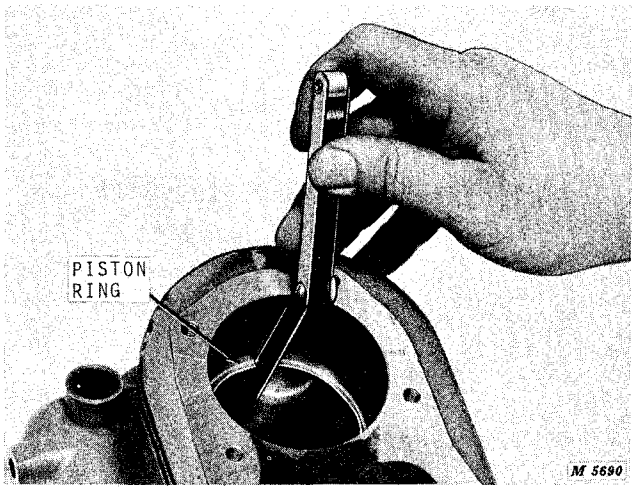


Fig. 30-Checking Ring End Gap

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

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. Ring gap should be in the .010 to .020 inch range.

Measure the ring end gap by inserting a feeler gauge between the ends of the ring, Figure 30. See "Specifications," page 35-18, for correct ring end 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 on Piston

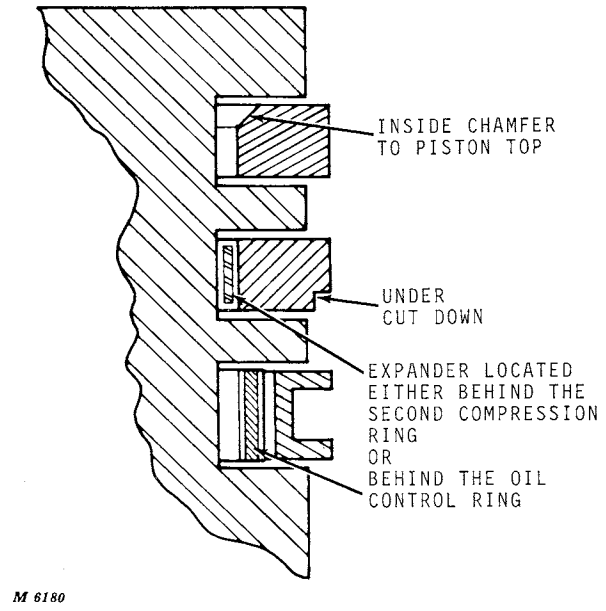


Fig. 31-Piston Ring Assembly

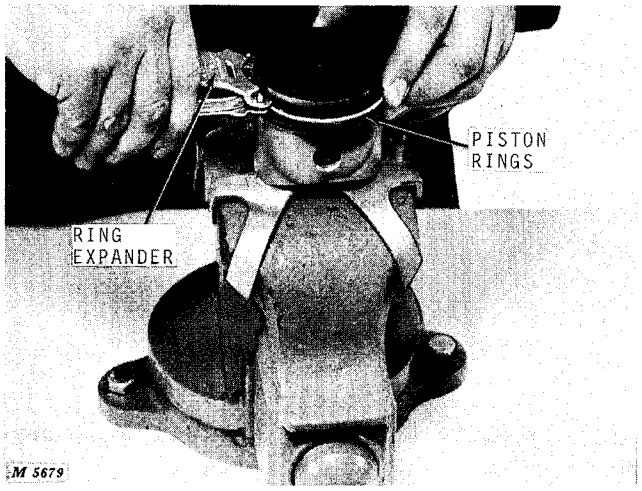


Fig. 32-Installing Rings on Piston

After checking ring side clearance and end gap, use ring expander, Figure 32, to position rings exactly as shown in Figure 31. *Notice the ring expander: The narrow expander is used behind the second compression ring and the wide expander is used behind the oil ring. The standard ring set has the narrow expander behind the second compression ring as shown, Fig*ure 31. The 0.010 and 0.020-inch oversize ring sets have the wide expander behind the oil ring as shown, Figure 31. When installing the rings, note the marks on the first and second ring indicating the top of the ring. If ring set differs from original, follow instructions packed with rings.

Stagger the piston ring gaps by moving each ring until the gaps are out of alignment as much as possible to prevent compression loss.

Remember correct ring installation will assure full power.

Installing Connecting Rod and Piston

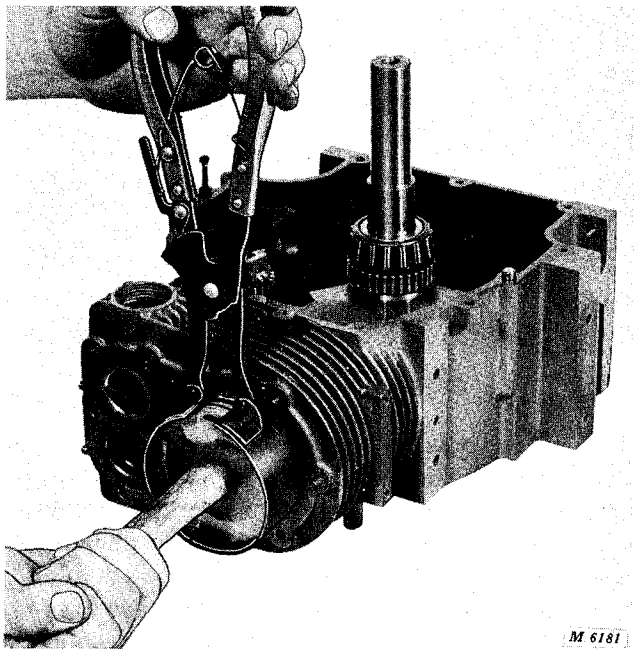


Fig. 33-Installing Piston Assembly in Cylinder Block

Clean new connecting rod bearing surfaces with a clean cloth. New rods are coated with lead which will slightly oxidize in storage. It is important that this oxidation be removed before installation.

Coat piston, rod bearing surface and ring generously with light oil and insert complete assembly into cylinder bore using ring compressor, Figure 33.

NOTE: Be sure match marks on connecting rod and rod cap are aligned and face out of the cylinder toward the PTO end of crankshaft.

Attaching Rod To Crankshaft

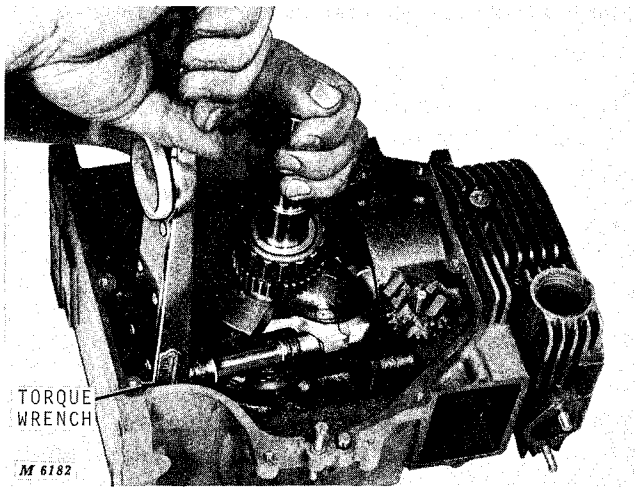


Fig. 34-Torquing Connecting Rod Lock Nuts

IMPORTANT: Install new lock nuts on connecting rod bolts.

Refer to "Specifications," page 35-18, for connecting rod lock nut torque and torque nuts accordingly, Figure 34.

IMPORTANT: Use a thin wall socket to tighten connecting rod lock nuts. Using the wrong tools to tighten cap will cause misalignment of bearing cap and bearing damage.

After initial torque, use a drift and a hammer and strike the rod bearing cap above each lock nut. This will seat the cap releasing some torque on the lock nuts. Retorque lock nuts to specifications.

Installing Tappets and Camshaft

Install lifters in guides. It is good practice to place lifter in same guide from which it was removed.

Install camshaft. Match chamfered gear tooth on crankshaft gear with mark on camshaft gear, Figure 35. Install governor spool on governor gear shaft.

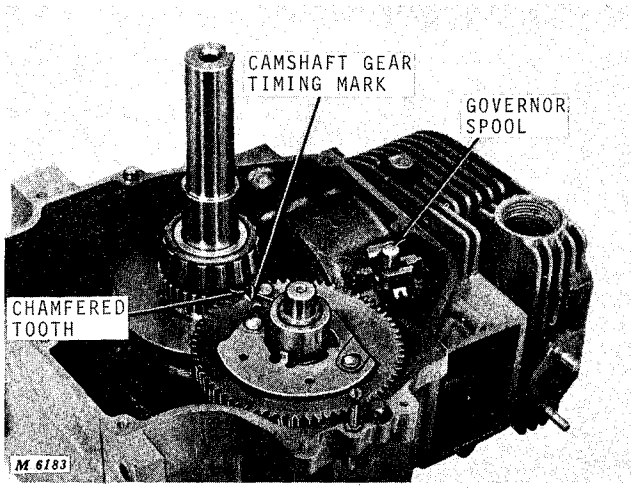


Fig. 35-Timing Marks on Crankshaft and Camshaft

Installing Cylinder Cover

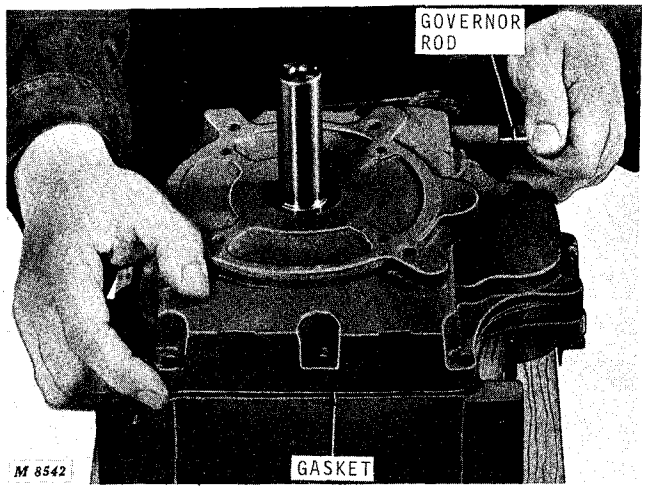


Fig. 36-Installing Cylinder Cover

Apply oil to crankshaft and camshaft bearings. Install new cylinder cover gasket on cylinder block. Use dowels in cylinder block to keep gasket positioned. Turn governor rod clockwise (facing end of shaft) and install cylinder cover, Figure 36. Refer to "Torque Chart," in Section 10 for cylinder cover bolt torque and tighten bolts accordingly.

Checking Crankshaft End Clearance

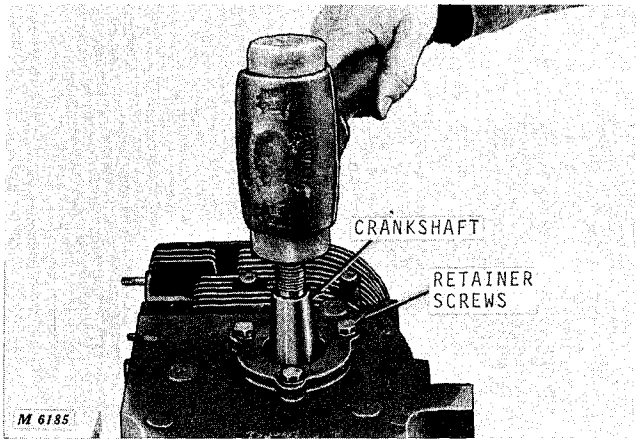


Fig. 37-Seating PTO Bearing

Invert engine, Figure 37.

Turn the crankshaft until the piston is at T.D.C. Tighten bearing retainer screws lightly and tap the flywheel end of the crankshaft lightly with a mallet to seat bearing.

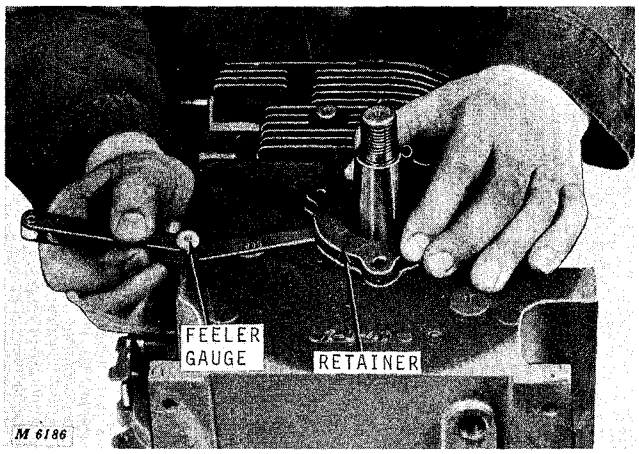


Fig. 38-Checking Gap Between Cylinder Block and Retainer

Remove three screws from bearing retainer. Insert a feeler gauge between the bearing retainer and machined surface of cylinder block, Figure 38, and record the reading. If space does not exist between the retainer and the machined gasket surface to allow insertion of the feeler gauge, use a 0.010-inch steel spacer. Place steel spacer between bearing cup and inside surface of the retainer. More than one may be used if required.

After determining the gap between the retainer and the machined surface on the cylinder block, determine the shim thickness as follows to obtain the required 0.002-0.003-inch crankshaft end play.

Example only

0.003-inch	clearance between retainer and cylinder
+0.003-inch	required end play, equals
0.006-inch	shim thickness required.
+0.003-inch	add half of shim thickness required to compensate for gasket compression, equals
0.009-inch	use shim gaskets that total this amount. In this case, using two 0.004 to 0.005-inch thick gaskets would allow correct crankshaft end play.

The shim gasket part numbers and thicknesses are:

John Deere Part No.	Tecumseh Part No.	Thickness
M 42193	31970	0.003-in./0.004-in.
M 42194	31971	0.004-in./0.005-in.
M 42195	31972	0.005-in./0.007-in.

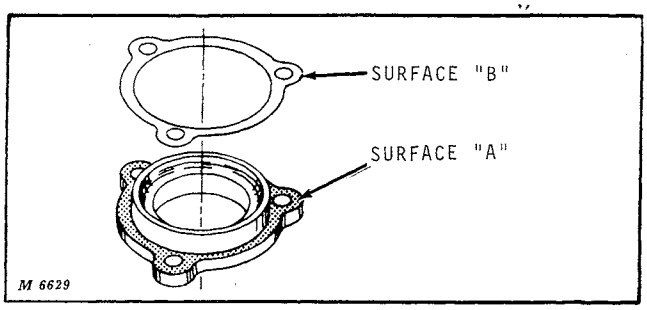


Fig. 39-Surfaces To Be Sealed

With retainer and gaskets(s) positioned as shown in Figure 39, apply a thin coating of non-hardening Permatex No. 3 or John Deere PT502 Sealant to bearing retainer at surface "A." Place shim gasket or gaskets onto bearing retainer and apply thin coating of the same sealant to surface "B" of top shim gasket.

IMPORTANT: Sealant must be placed on gasket, not on cylinder block.

Secure bearing retainer with three cap screws with lock washers. Refer to "Specifications," page 35-18, for correct torque and torque screws accordingly.

Installing Seals

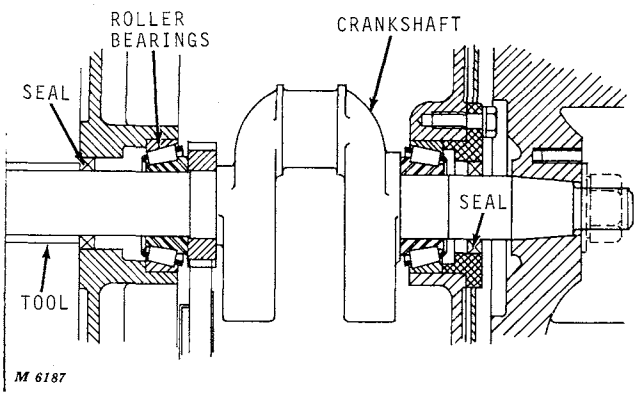


Fig. 40-Installing Seals

Install oil seal with lip facing inward. Use oil seal sleeve tool to prevent seal damage. Tap seal in place with a piece of tubing. Seal must be square in seal bore and pressed in to a distance of flush or 0.025 inch beyond flush of cylinder cover and bearing retainer exterior, Figure 40. Install blower housing baffle. See "Torque Chart" in Section 10 and tighten baffle bolts accordingly.

Installing Flywheel

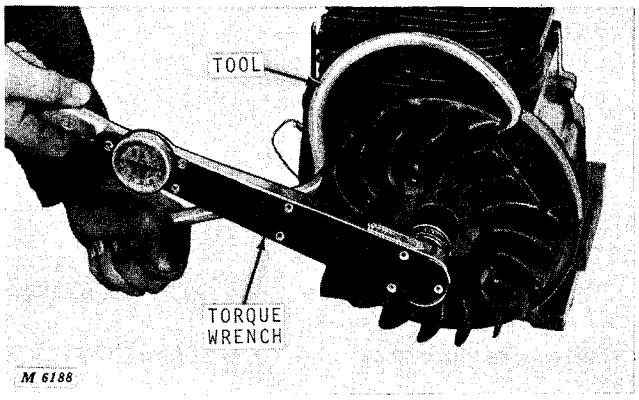


Fig. 41-Torquing Flywheel Nut

Place key in crankshaft keyway. Install flywheel washer and nut. Use flywheel tool to hold flywheel from rotating while torquing nut, Figure 41. Torque nut to 53 ft. lbs.

Installing External Components

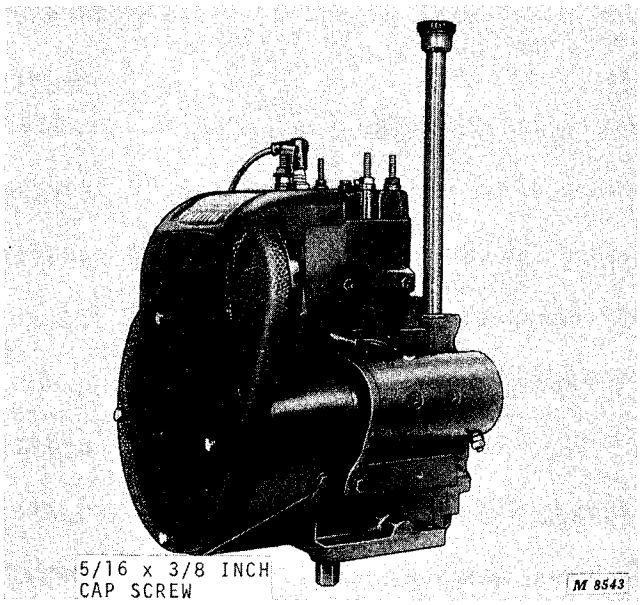


Fig. 42-Engine Assembled

Install ignition trigger module and set air gap to 0.006 to 0.010 inch. Refer to Section 40 for specifications. Connect module feed wire and install blower housing, cylinder baffle, and starter.

Install inner and outer grass screens, carburetor and remaining external components, Figure 42.

Refer to Group 40 of this section for carburetor and governor assembly and adjustment.

Note position of 5/16 x 3/8-inch cap screw.

SPECIFICATIONS

HH100 Tecumseh Engine

Item	New Part Dimension	Wear Tolerance
Crankshaft journal size	1.3750 to 1.3755 inches	0.001 to 0.003 inch
Piston pin diameter	0.6873 to 0.6875 inch	....
Piston diameter	3.304 to 3.305 inches	....
Cylinder bore	3.3120 to 3.3130 inches	0.003 to 0.008 inch taper
Connecting rod large end	.... to 1.3760 inches	0.001 to 0.003 inch
Width compression ring groove	0.0950 to 0.0960 inch	....
Width oil ring groove	0.1880 to 0.1900 inch	....
Side clearance ring groove	0.0020 to 0.0035 inch	....
Top piston land clearance	0.0305 to 0.0335 inch	....
Piston skirt clearance	0.006 to 0.008 inch	....
Top piston land clearnace	0.0305 to 0.0335 inch	....
Ring end gap	0.010 to 0.020 inch	....

Torque For Hardware

Location	Torque
Connecting rod lock nuts	86 to 110 in-lbs
Bearing retainer	65 to 110 in-lbs
Flywheel nut	53 ft-lbs
Miscellaneous hardware	Refer to "Torque Chart," Section 10

Table of Engine Clearances

Item	Clearance
Crankshaft end clearance	0.002 to 0.003 inch
Piston skirt clearance	0.006 to 0.008 inch
Piston ring end gap	0.010 to 0.020 inch

SPECIAL TOOLS

Name	Part No.	Use
Flywheel Puller	Tecumseh No. 25183	To remove flywheel
Flywheel Tool	Tecumseh No. 21637	To hold flywheel stationary
Piston Ring Expander	Tecumseh No. 670117	To remove and install new rings on piston
Oil Seal Sleeve	Tecumseh No. 670196	To protect seal during installation
Micrometer, 1-inch	Starrett 230RL	Check piston pin diameter
Micrometer, 2-inch	Starrett 2RL	Check crankshaft journal diameter
Micrometer, 4-inch	Starrett 436XRL	Check piston diameter
Inside Telescoping Gauge, 5/16-6-inch	Starrett S579H	Check Cylinder bore
Feeler Gauge	OTC 860A	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 cut
Medium Stone for AMMCO 500 Cylinder Hone	AMMCO 620	Semi-finish cut
Coarse Stone for AMMCO 500 Cylinder Hone	AMMCO 619	For roughing cylinder (primary cut)
Piston Ring Band Handle	KD850	Tighten piston ring compressor
Piston Ring Compressor	KD 850-B-1	To compress piston rings
Ridge Reamer	AMMCO Model 2100	To remove ridge at top of cylinder bore

Litho in U.S.A.

Group 40
CAMSHAFT, TAPPETS AND GOVERNOR TECUMSEH ENGINE FOR 112 TRACTOR

GENERAL INFORMATION

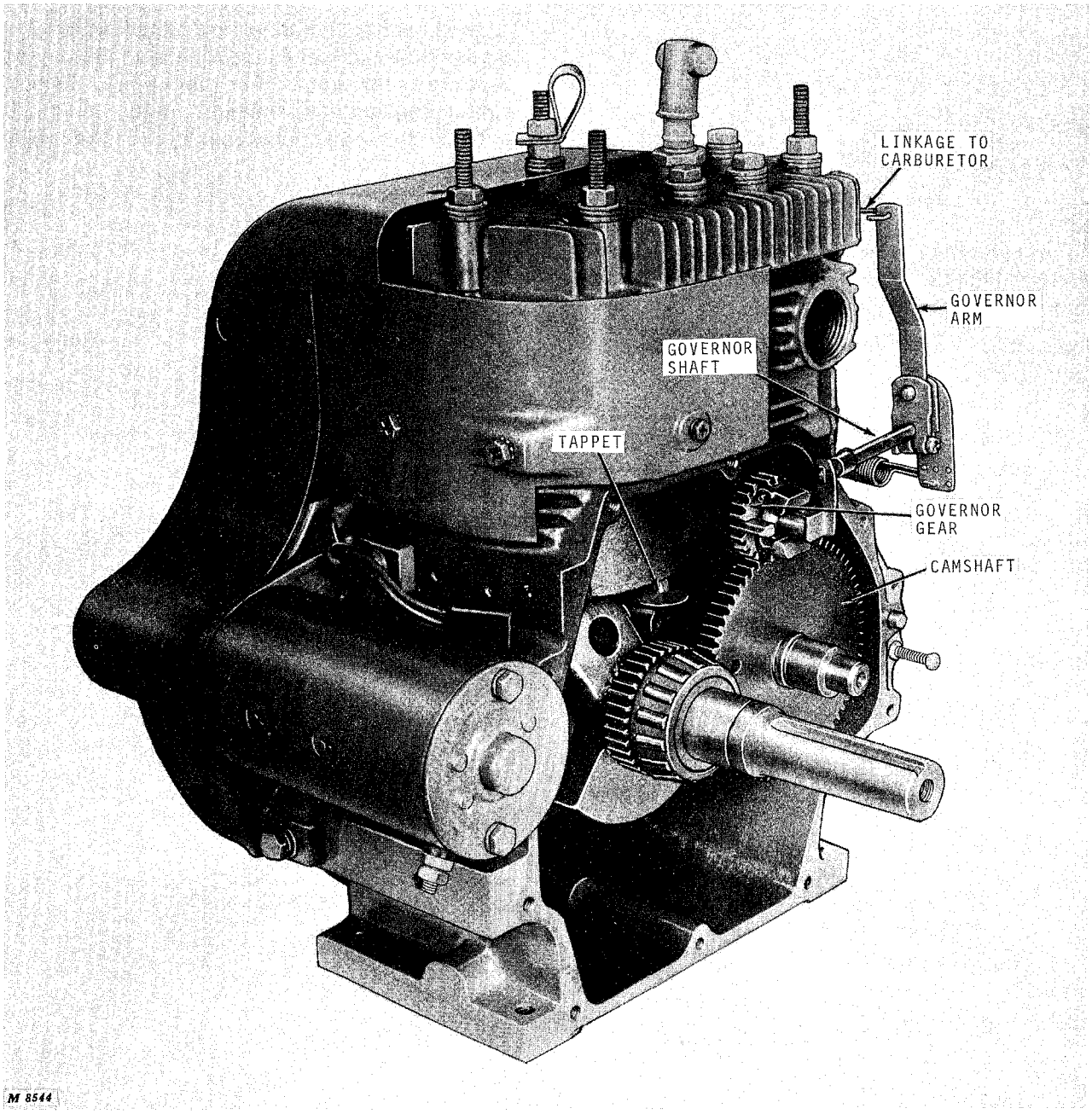


Fig. 1-Assembled View of Camshaft, Tappets and Governor

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

The Insta-Matic EZEE-Start Compression Release Camshaft is explained in detail on the next page.

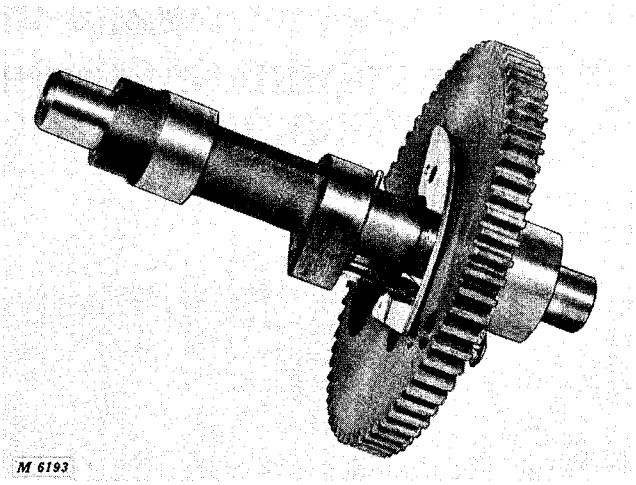


Fig. 2-Insta-Matic EZEE-Start Camshaft

The Tecumseh HH100 Engine used in the 112 Tractor features the Insta-Matic EZEE-Start Camshaft, Figures 2 and 3.

All short blocks are equipped with EZEE-Start Camshafts.

The EZEE-Start mechanism consists of a sliding pin located in a hole drilled through the camshaft near the exhaust cam lobe. When the engine is not operating, this pin protrudes above the cam lobe against the exhaust valve lifter to hold the valve slightly open. After the engine starts, a centrifugally-activated yoke retracts the pin so that it no longer raises the exhaust valve lifter. Thus, full compression and full power are instantly re-established through all rpm ranges.

The mechanical device holds the exhaust valve open momentarily while the piston is on the compression stroke. Therefore, much less effort is needed to spin the engine at the required rpm for starting. This feature is especially valuable to ease cold weather starting.

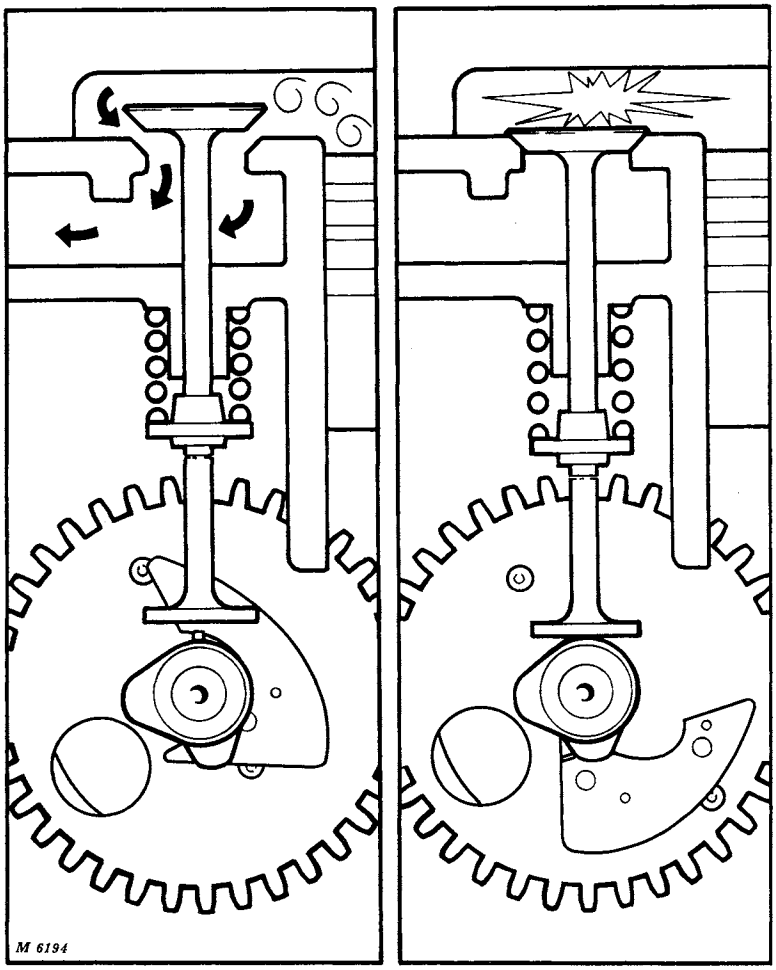
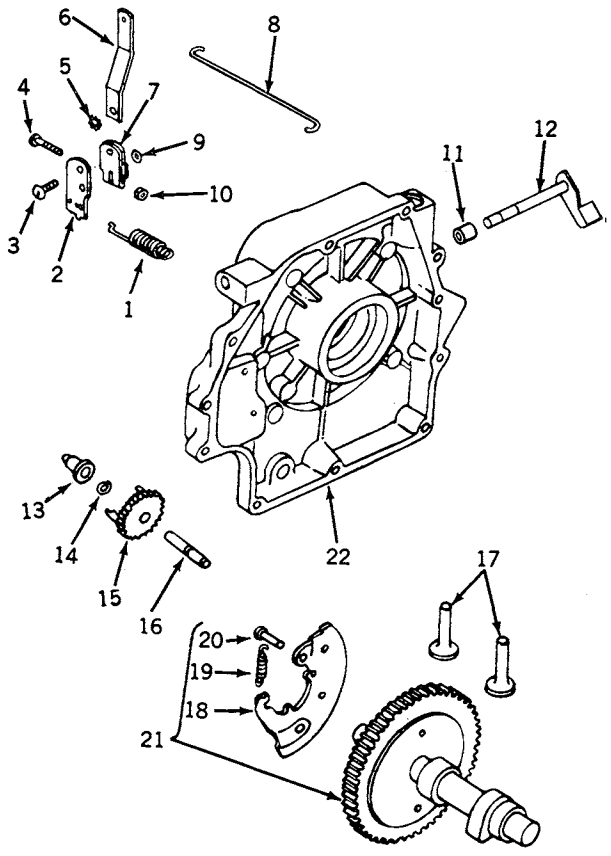


Fig. 3-EZEE-Start Operation

REPAIR



M 9831

1-Governor Spring
2-Spring Plate
3-3/16" x 1/2" Machine Screw
4-3/16" x 7/8" Machine Screw
5-Internal Tooth Washer
6-Governor Arm
7-Clamp
8-Link
9-Retaining Ring
10-Hex. Nut
11-Rod Spacer
12-Governor Rod
13-Governor Spool
14-Retaining Ring
15-Governor Gear
16-Governor Shaft
17-Valve Lifter (2 used)
18-Cam Yoke
19-Spring
20-Yoke Rivet (3 used)
21-Compression Release Camshaft Assembly
22-Cylinder Cover

Fig. 4-Exploded View of Camshaft and Governor

Removing Camshaft and Tappets

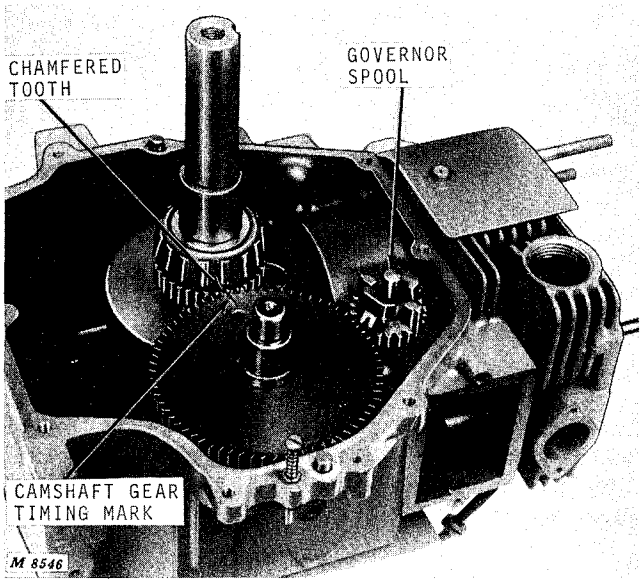


Fig. 5-Engine with Components Removed for Camshaft Servicing

Remove engine and all component parts (excluding connecting rod and piston assembly and crankshaft), Figure 5. Refer to Groups 30 and 35 for detailed disassembly.

Turn the crankshaft until the piston is at T.D.C. Remove governor spool, camshaft and tappets. Mark tappets "EX" and "IN" so they will be installed in same guide during reassembly.

Removing Governor Gear

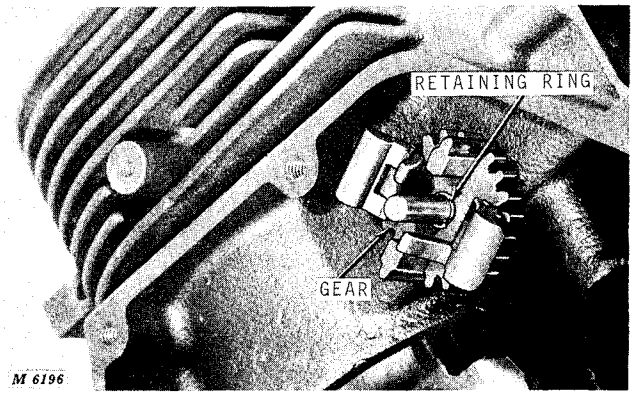


Fig. 6-Removing Retaining Ring and Governor Gear Assembly

Remove the retaining ring and the governor gear assembly, Figure 6.

Removing Governor Rod

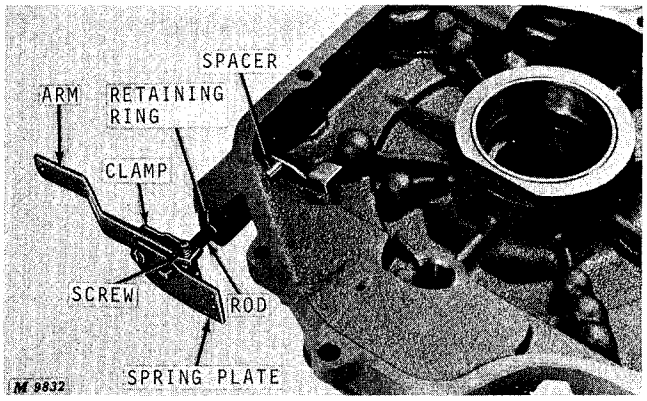


Fig. 7-Governor Rod

Loosen governor arm clamp screw and remove governor arm assembly. Remove paint from governor rod. Remove retaining ring and governor rod with lever, Figure 7.

Inspecting Camshaft

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

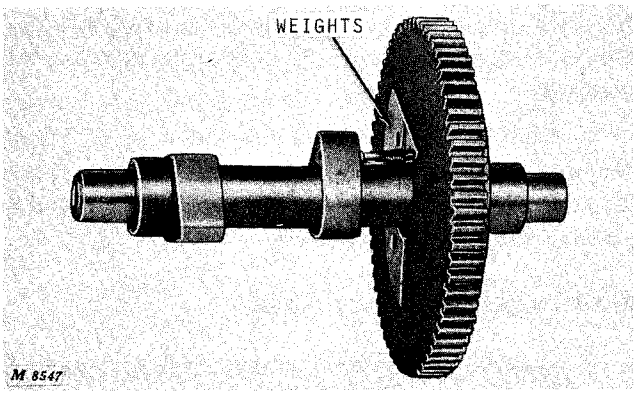


Fig. 8-Camshaft Assembly

Check camshaft for cracked, worn or broken gear teeth.

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

Check camshaft bearings and lobes with a micrometer. Refer to "Specifications," page 40-7, for tolerances.

Inspecting Governor Gear

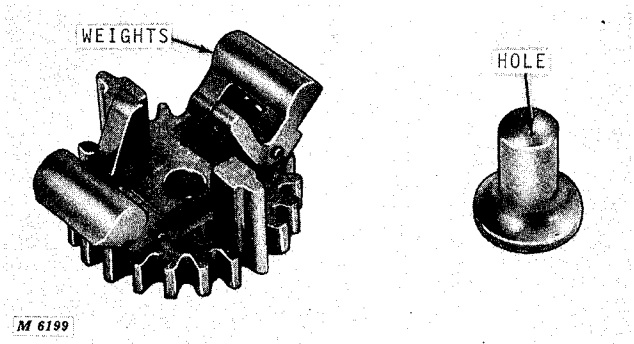


Fig. 9-Governor Gear Assembly

The governor gear assembly will not normally show much wear. Be sure weights operate freely and that gears and teeth are in good condition. Replace governor gear assembly if necessary.

Check hole in closed end of spool, Figure 9. The hole is for lubrication and must be kept open and clean.

Inspecting Governor Rod

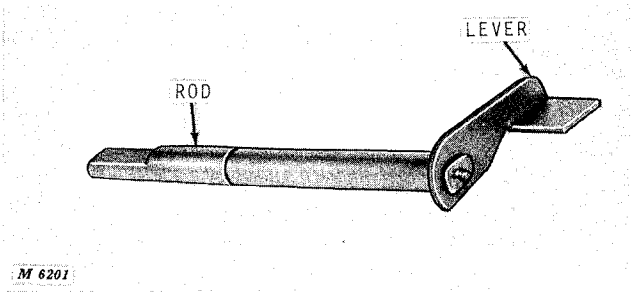


Fig. 10-Governor Rod Assembly

The governor rod assembly is replaceable. If rod shows wear or damage, replace rod.

Check lever on governor rod. Lever must be tight on governor rod for accurate governor control of engine. Replace assembly if wear is noticeable.

Inspecting Governor Shaft

The governor shaft is replaceable. If shaft shows excessive wear or damage, replace shaft.

Remove the governor shaft by threading the shaft with a 1/4-28 die. Place a spacer or number of washers on the shaft and turn on a nut. By tightening the nut against the washers, the shaft will be pulled from the cylinder block.

INSTALLATION

Installing Governor Shaft

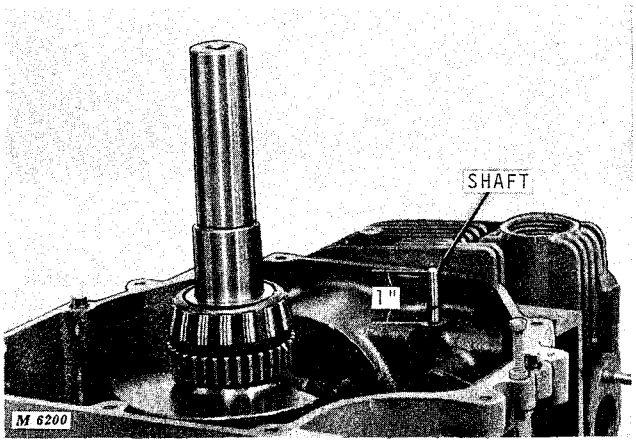


Fig. 11-Installing Governor Shaft

Position the governor gear shaft over the opening in the cylinder block and tap lightly with a hammer to start shaft. Place block on press bed and press shaft into the cylinder block until 1 inch of the shaft protrudes from the machined surface to the top of the governor shaft, Figure 11.

Installing Governor Gear and Spool

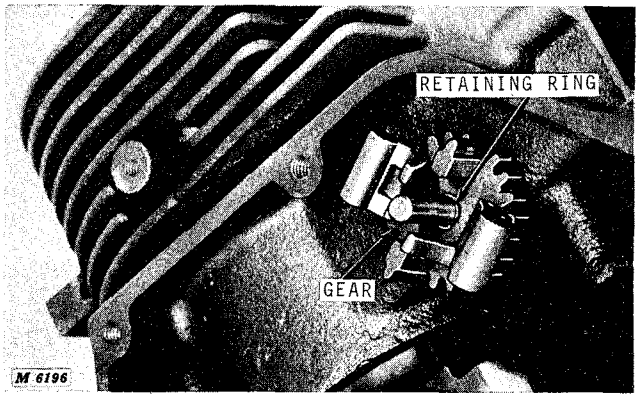


Fig. 12-Installing Governor Gear Assembly

Install governor gear assembly on governor shaft and install retaining ring, Figure 12.

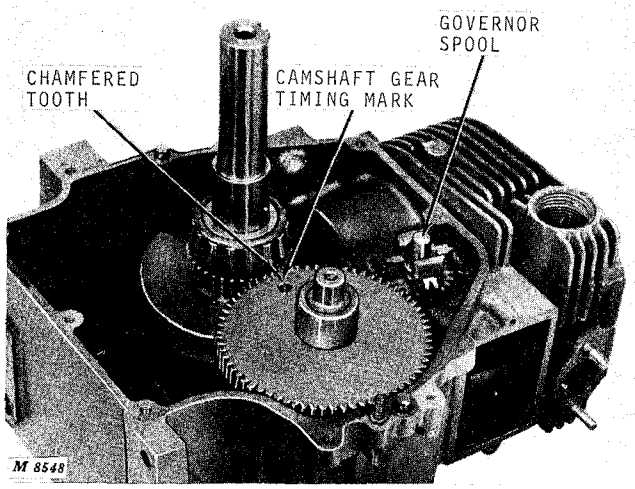


Fig. 13-Governor Spool

Oil governor gear shaft and place governor spool on shaft, Figure 13. *NOTE: Hole in end of spool must be opened and spool must operate freely on governor shaft.*

Installing Tappets and Camshaft

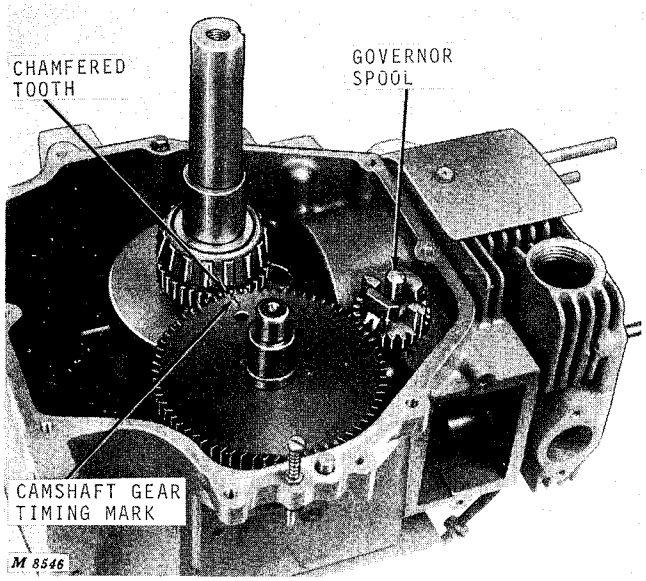


Fig. 14-Valve Timing

Install tappets in the same guides from which they were removed during disassembly. Install camshaft, matching chamfered tooth on crankshaft gear with mark and hobbing hole on camshaft gear, Figure 14.

Installing Governor Rod and Arm

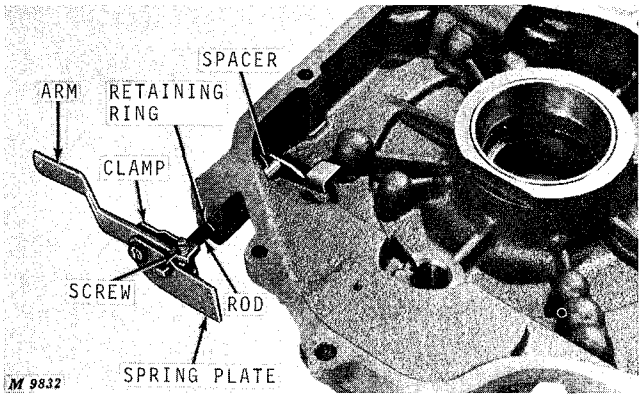


Fig. 15-Installing Governor Rod

Install spacer on governor rod. Oil governor rod and install rod in cylinder cover. Secure rod with retaining ring, Figure 15.

Assemble arm, clamp and spring plate, Figure 16. Slide assembly on governor rod as far as undercut permits. Tighten clamp screw firmly.

Refer to Group 35 and reassemble the engine.

Installing Governor Linkage

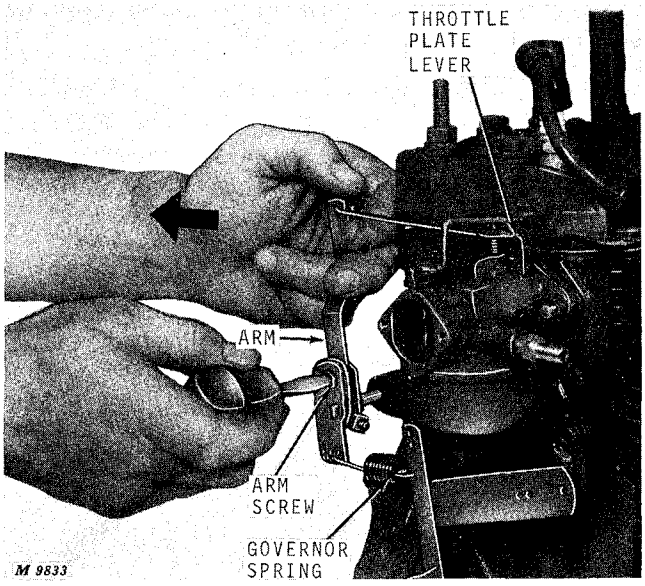


Fig. 16-Connecting Governor Lever

Connect governor spring to spring plate as shown in Figure 16.

Loosen arm screw slightly and apply pressure to arm as shown to fully open carburetor throttle plate. Hold arm in this position and tighten screw.

ADJUSTMENT

Adjusting Governor Stop Screw

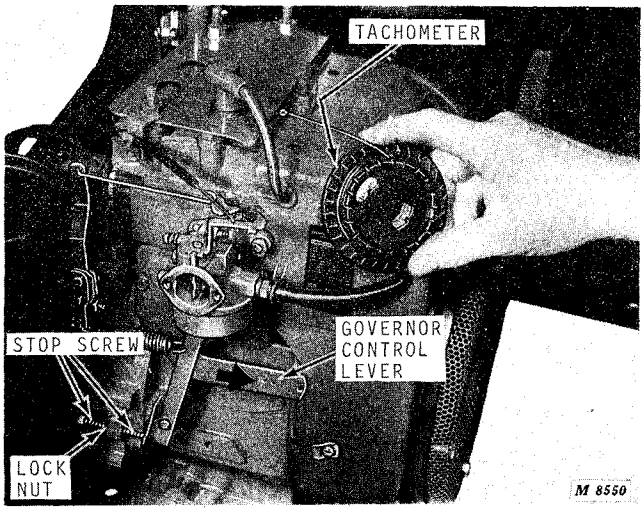


Fig. 17-Governor Stop Screw and Lock Nut

Before attaching the throttle cable and conduit set the engine for maximum rpm. Set the high speed (3700-3800 rpm) with the engine running as follows:

Loosen lock nut on governor stop screw. Move top of control lever forward to the right (facing front of engine), until lower end strikes the stop screw, Figure 17. Turn stop screw in (clockwise) to decrease maximum rpm. Turn stop screw out (counterclockwise) to increase maximum rpm. **IMPORTANT: Tachometer should not exceed 3600 rpm. Be sure all drives are disengaged when setting engine speed. When adjustment is obtained, tighten lock nut on governor stop screw.**

Adjusting Cable and Conduit

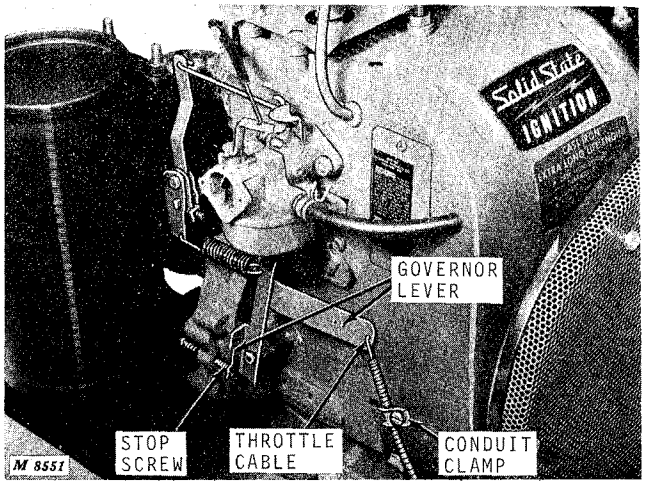


Fig. 18-Positioning Conduit

Insert throttle cable end in governor lever and place under conduit clamp as shown in Figure 18. Move throttle lever on dash to fully raised position, then move governor lever until lower end of lever strikes stop screw. Tighten conduit clamp firmly.

IMPORTANT: After the engine is assembled and installed in the tractor, follow the engine tune-up procedure given in Section 10.

SPECIFICATIONS

HH100 Tecumseh Engine

Item	New Part Dimension	Wear Tolerance
Cam lobe diameter (nose to heel)	0.803 to 0.806-inch	0.002 inch
Camshaft bearing diameter	0.6235 to 0.6240-inch	0.002 inch

Litho in U.S.A.

Section 30
FUEL SYSTEM
Group 5
GENERAL INFORMATION

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Litho in U.S.A.

PRINCIPLE OF OPERATION

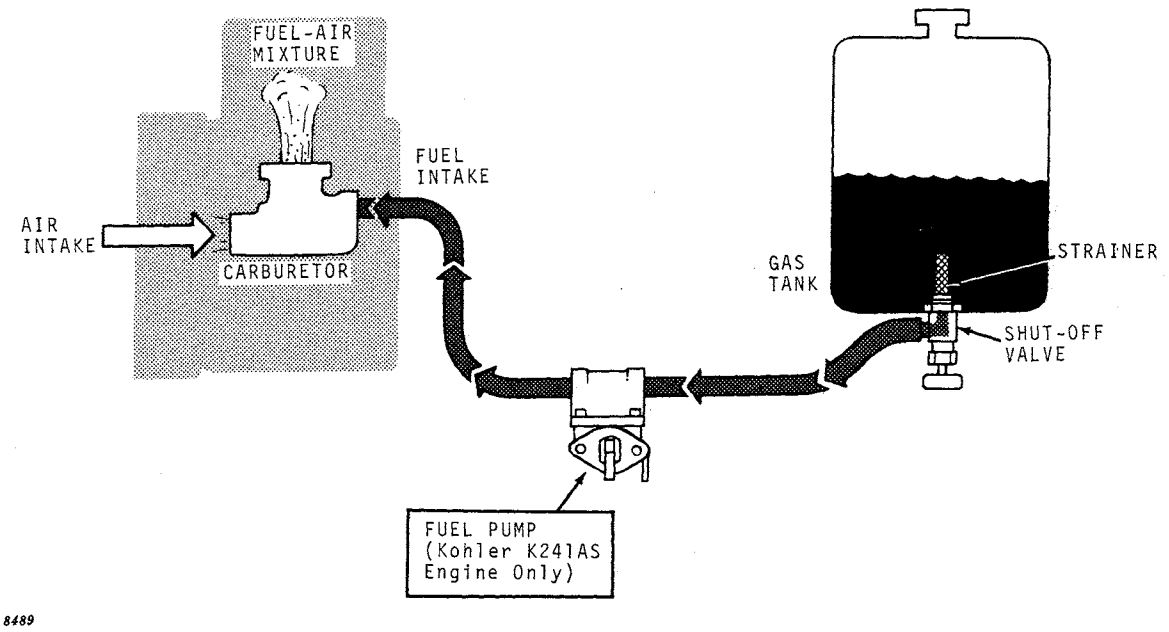


Fig. 1-Fuel System for 110 and 112 Tractors (Serial No. 100,000-)

Gasoline flows from the gas tank through a shut-off valve to either a fuel strainer or sediment bowl where it is filtered. Fuel flow is by gravity except on a 112 Tractor equipped with a Kohler K241AS engine which has a fuel pump.

Both Kohler and Tecumseh engines us a constant-speed, constant-load, float-type carburetor to provide the fuel-air mixture necessary to operate the engine.

All tractors use a replaceable paper-type element to filter dirt and dust particles from the air.

DIAGNOSING MALFUNCTIONS

Carburetor

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 cable loose in control swivel.

Fuel shut-off valve closed.

Water, rust or stale fuel in gas tank.

Carburetor gummed.

Air lock in fuel line.

Air filter element restricted.

Also see "Diagnosing Malfunctions," page 5-9 of Section 20, "Engines" for other solutions to hard engine starting.

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.

Also see "Diagnosing Malfunctions," page 5-10 of Section 20, "Engines" for other solutions to engine stalling.

Rough idle

High speed and idle mixture needles not properly adjusted.

Float setting incorrect.

Air filter element restricted.

Dirt, water or ice in fuel system.

Also see "Diagnosing Malfunctions," pages 5-10 of Section 20, "Engines," for other solutions to rough engine idle.

Poor acceleration

High speed and idle mixture needles not properly adjusted.

Air filter element restricted.

Throttle cable slipping in control swivel.

Sticky fuel inlet needle.

Dirty or damaged high speed mixture needle.

Dirt or paint on throttle return spring.

110 Tractors: Arm loose on governor cross shaft.

112 Tractors: Check condition of governor spool.

Also see "Diagnosing Malfunctions," page 5-10 of Section 20, "Engines," for other solutions to poor engine acceleration.

Engine surging

High speed and idle mixture needles not properly adjusted.

Dirt or paint on throttle return spring.

Fuel strainer plugged.

Too low on fuel.

Flooding or leaking carburetor

Sticky fuel inlet needle.

Float setting incorrect.

Float leaking.

Litho in U.S.A.

Carburetor—Continued

Gas Drips From Carburetor

Loose fuel fitting.

Fuel line loose on fuel fitting.

112 Tractors: Bowl drain leaking.

Sediment Bowl

Gas Drips at Sediment Bowl

Loose shut-off valve.

Loose bowl nut.

Worn or damaged gasket.

No Fuel in Sediment Bowl

Shut-off valve closed.

Gas tank empty.

Filter screen clogged.

Fuel Strainer

No Fuel Reaches Carburetor

Shut-off valve closed.

Gas tank empty.

In-line strainer clogged.

Gas Tank vent restricted.

Fuel Pump

112 Tractors with Kohler K241AS Engine

Fuel Pump Leaking

Tighten assembly screws.

Repair pump.

Fuel Pump Not Pumping

Repair or replace pump.

Group 10
CARBURETOR

KOHLER ENGINES

GENERAL INFORMATION

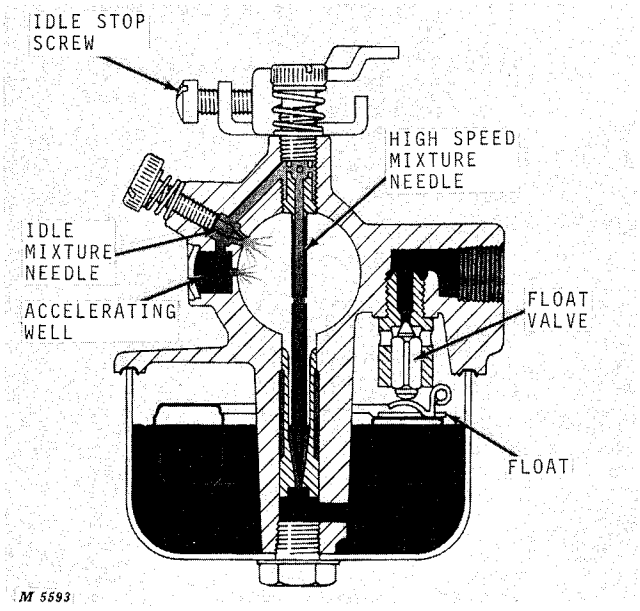


Fig. 1-Cutaway View of Carburetor

Fuel enters the bowl through a valve controlled by the float,Figure 1. Air entering the carburetor is controlled by the choke valve whenstarting. The air-fuel mixture entering the engine is regulated by the throttle valve which maintains uniform engine speed under varying loads, as controlled by the governor.

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

The carburetor has two adjusting needles (one for high speed and the other for low or idle speeds, Figure 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 venturi when engine is idling or when throttle valve is in the full closed position.

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

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 rod from carburetor throttle lever.

Remove carburetor from engine and remove air cleaner base.

Remove fuel bowl, float needle, and needle 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 a 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.

Litho in U.S.A.

Allow parts to remain in the solution from one to two hours. Then remove and rinse with fresh cleaning solvent. Dry 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 valve to be sure valve seat material or other debris is not adhering to tapered surface of valve. If any material appears on tapered surface, replace float and valve seat assembly.

Inspect seat assembly for wear or other damage. If valve seat is damaged in any way, replace valve seat assembly and float valve.

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.

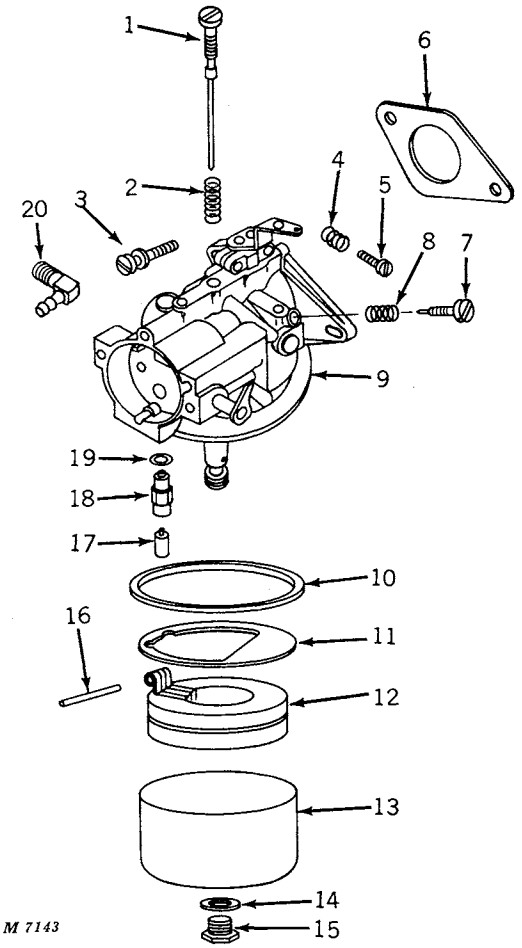
Check float pin and replace if worn.

Inspect tapered ends of needles. If a ring has been cut in the tapered surface of either 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 seating surface. Examine threaded holes for damaged threads.

Inspect jets for damaged or plugged holes. Replace if damaged.



1-High Speed Mixture Needle
2-Spring
3-Cap Screw
4-Spring
5-Idle Speed Screw
6-Gasket
7-Idle Mixture Needle
8-Spring
9-Carburetor with Choke and Throttle Valves
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

Fig. 2-Exploded View of Carter Carburetor Components

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.

ASSEMBLY

Install the carburetor repair kit whenever the carburetor is disassembled for service and parts show wear.

Installing Float Valve

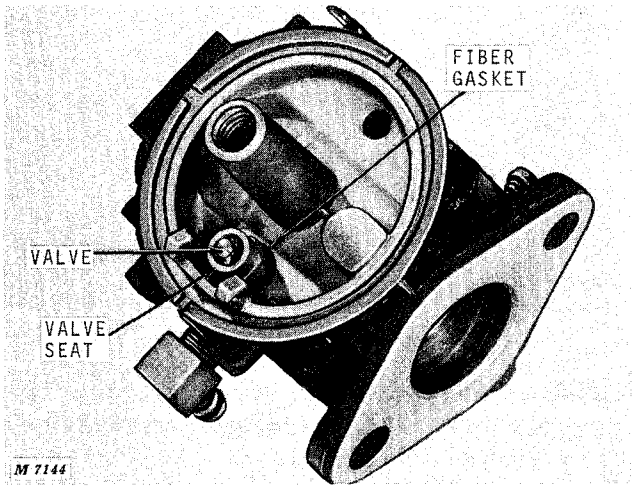


Fig. 3-Installing Float Valve Seat and Valve

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 (18, Fig. 2) into carburetor housing.

Insert valve (17, Fig. 2) with tapered end against valve seat, Figure 3.

Installing Float and Float Shaft

Assemble float (12, Fig. 2), to carburetor housing with float pin (16). Invert carburetor, Figure 4. With float resting lightly on float valve, the distance between float and machined surface of carburetor body should be 13/64 inch. To increase or decrease the distance, bend lip on float. Dimension should be made on free end of float (opposite valve seat), Figure 4.

NOTE: Be sure carburetor-to-bowl gasket (10) has a perfect seat and forms a gas-tight seal.

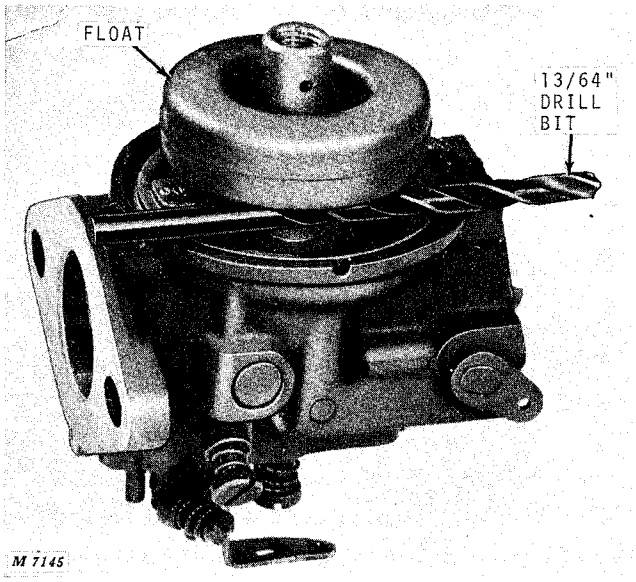


Fig. 4-Adjusting Float

Position bowl gasket (11), fuel bowl (13), bowl screw gasket (14) and bowl screw (15). Tighten screw firmly, Figure 2.

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

IMPORTANT: Do not force needles too firmly against seat because it will groove needle point and cause carburetor malfunction.

INSTALLATION

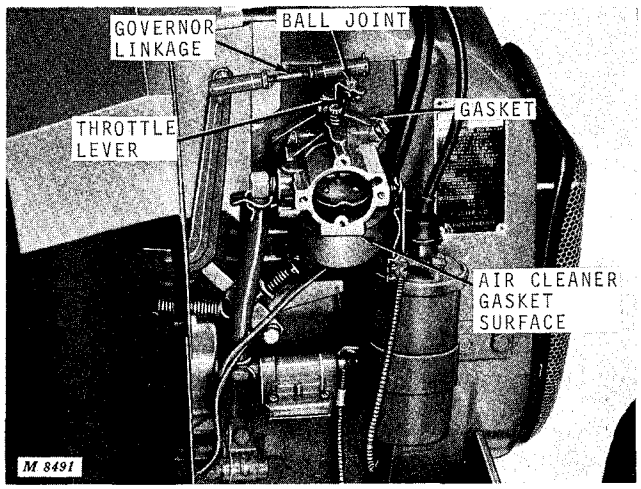


Fig. 5-Installing Carburetor Assembly on Cylinder Block (K241AS Engine)

Place new gasket between carburetor flange and cylinder block and bolt carburetor to cylinder block, Figure 5.

Install throttle rod ball joint to throttle lever on K241AS Engine, Figure 5.

INSTALLATION—Continued

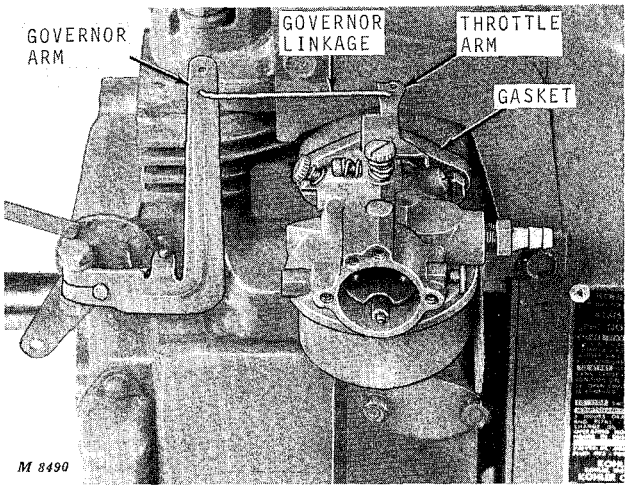


Fig. 6-Installing Carburetor Assembly (K181S Engine)

On K181S engines, connect governor linkage in bottom hole of governor arm and in hole closest to throttle shaft in throttle arm, Figure 6.

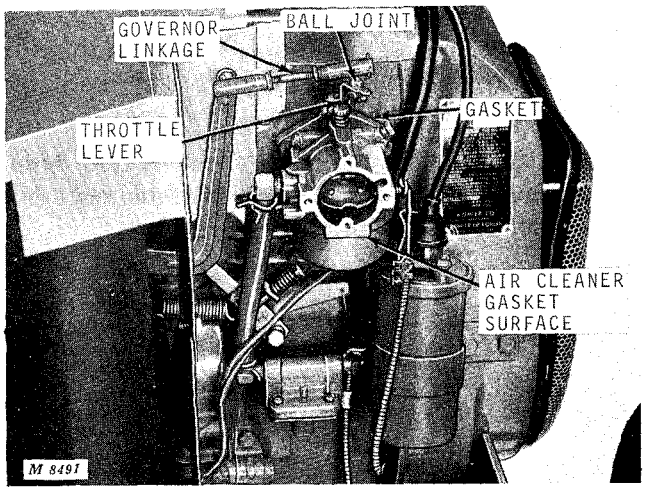


Fig. 7-Completing Carburetor Installation

Attach fuel line and control cables to carburetor and secure conduit clamps.

Place new gasket on carburetor body, Figure 7, 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

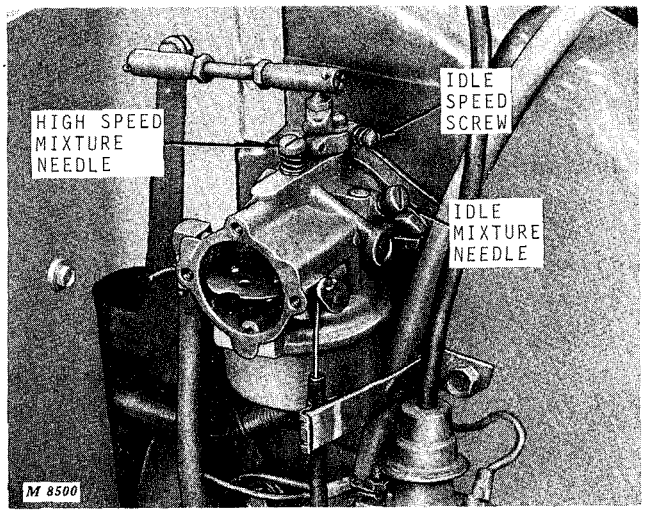


Fig. 8-Carburetor Adjustments

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

1. Run engine until warm, then shut off. Turn high speed mixture needle clockwise until closed. Close finger tight only. Then open one and one-half turns.

2. Turn idle mixture needle clockwise until closed. Close finger tight only. Then open two complete turns. Start engine and raise throttle lever on dash panel to "fast" position.

3. 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.

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

5. Advance throttle lever quickly to check for uniform acceleration. If engine misses, gas-air mixture is too lean. Turn high speed mixture needle counterclockwise until positive acceleration can be obtained. If excess exhaust smoke is noticed, mixture is too rich. Readjust idle mixture needle if necessary until good balance is achieved and engine idles smoothly between 1200-1700 rpm. The idle speed screw adjusts the speed at which the engine idles. This is factory adjusted and will not normally require adjustment.

SPECIFICATIONS

(Carter Carburetor for Kohler K181S and K241AS Engines)

Speeds		
High speed (No load)	3800 rpm	Refer to carburetor adjustment, page 10-4.
Idle speed (No load)	1200-1700 rpm	Refer to carburetor adjustment, page 10-4.
Float Setting		
Distance between float and machined surface of carburetor body (Carburetor inverted)	13/64-inch	Check and/or adjust whenever carburetor is disassembled for service, page 10-3.

Litho in U.S.A.

TECUMSEH ENGINE

GENERAL INFORMATION

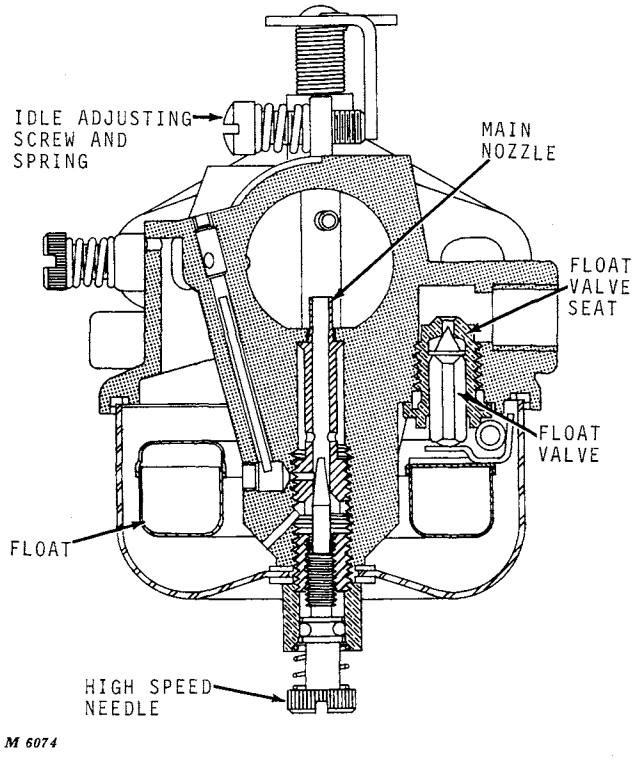


Fig. 9-Cutaway View of Walbro Carburetor

Fuel enters the bowl through a valve controlled by the float, Figure 9. 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, as controlled by the governor.

Whenever the throttle is opened quickly to give extra power for a sudden load, an extra amount of fuel is required for a momentarily richer air-fuel mixture. The secondary idle discharge provides the extra fuel.

The carburetor has two adjusting needles; one for high speeds and one for low speeds, and an idle adjusting 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 venturi when engine is idling or when throttle valve is in the full closed position.

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 even though no other new parts are installed.

Disassembling Carburetor

Remove carburetor from engine and remove air cleaner base and elbow.

Remove high speed and idle mixture needles. Remove idle adjusting screw.

Remove fuel bowl retaining nut, fuel bowl, fuel bowl gasket, float assembly, needle valve, spring and needle seat.

Remove screws holding throttle valve and remove valve and throttle shaft with return spring from carburetor housing.

Remove choke valve and choke shaft.

Removing Main Nozzle

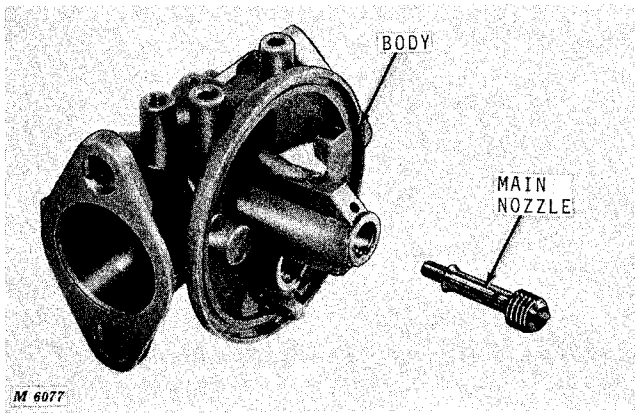


Fig. 10-Main Nozzle

Normally the main nozzle, Figure 10, should not be removed. Remove the main nozzle only if the high speed needle seat is damaged or because of excessive dirt.

Cleaning Carburetor

Clean all parts in a 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.

Good carburetor cleaning solutions can be obtained from most automotive 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.

Allow parts to remain in solution from one to two hours. Then remove and rinse with fresh cleaning solvent. Dry 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 of 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 tapered end of float valve for wear. If tapered end of valve appears worn or damaged, replace float valve and valve seat assembly.

Inspect seat assembly for wear or other damage. If valve seat is damaged in any way, replace valve seat assembly and float valve.

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 shaft and replace if worn.

Inspect tapered ends of idle and high speed adjusting needles. If a ring has been cut in the tapered surface of either needle because it was turned too tightly against the seat, replace the needle. Check condition of O-ring on high speed mixture needle. Replace if damaged.

The seat for the idle mixture needle is an integral part of the carubretor body casting. Replace carburetor body if seat is damaged.

The seat for the high speed mixture needle is part of the main nozzle. When replacing the high speed mixture needle, the main nozzle should also be replaced.

Inspect carburetor body casting and fuel bowl for cracks or damaged seating surface. Examine threaded holes for damaged threads. Check throttle and choke shaft bearing areas in carburetor body for wear. Replace if worn or damaged.

Inspect jets for damaged or plugged holes. Replace carburetor body if damage is present.

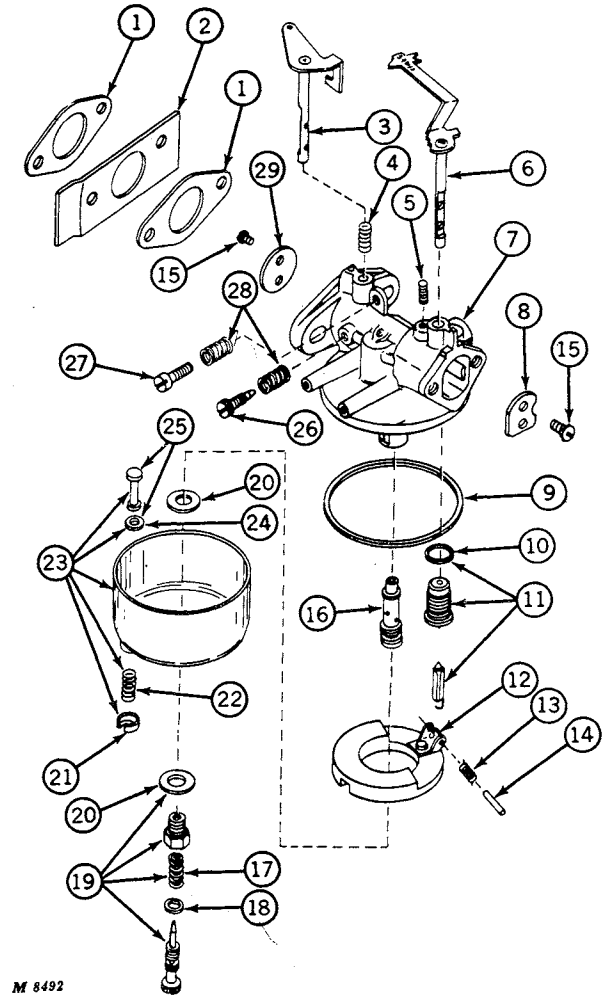
Check the condition of all springs. Replace worn or damaged springs.

Check fuel bowl drain assembly. Replace internal rubber seat if fuel bowl has been leaking.

Check fuel pickup passage. It must be clean to assure adequate fuel flow from the fuel bowl to the metering systems.

Inspect throttle and choke shaft for excessive wear or damage in the bearing area.

ASSEMBLY



1-Gasket (2 used)
2-Air Baffle
3-Throttle Shaft and Lever
4-Throttle Return Spring
5-Choke Stop Spring
6-Choke Shaft and Lever
7-Carburetor Body
8-Choke Shutter
9-Gasket
10-Seat Gasket
11-Float Valve and Seat Assembly
12-Float
13-Float Spring
14-Float Pin
15-Machine Screw (4 used)
16-Main Nozzle
17-Adjusting Needle Spring
18-Gasket
19-High Speed Adjusting Needle Assembly
20-Gasket
21-Retainer
22-Bowl Drain Spring
23-Bowl and Drain Assembly
24-Drain Stem Gasket
25-Drain Stem
26-Idle Adjusting Needle
27-Idle Adjusting Machine screw
28-Adjusting Needle Spring (2 used)
29-Throttle Shutter

Fig. 11-Exploded View of Walbro Carburetor Components

Installing Main Nozzle

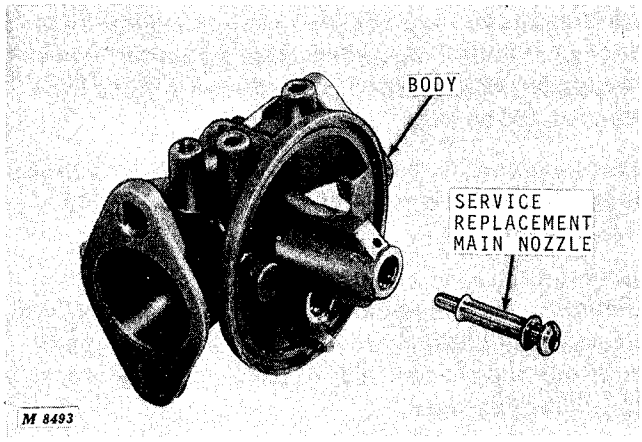


Fig. 12-Main Nozzle

Install service replacement main nozzle with undercut in threaded area in carburetor body, Figure 12. Never reuse the original main nozzle, should it have been removed to clean carburetor or for any other reason. This procedure must be followed to assure delivery of fuel to the idle system.

Tighten nozzle firmly.

Installing Throttle Assembly

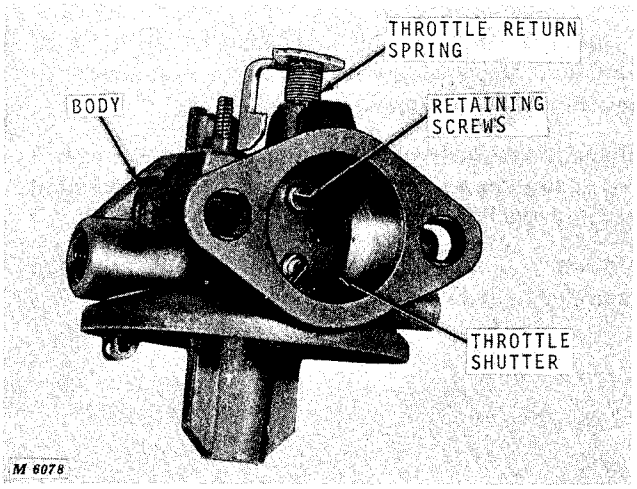


Fig. 13-Installing Throttle Shaft and Shutter

Slip throttle return spring on shaft, Figure 13. Position U-shaped end of spring on throttle shaft arm. Wind opposite end of spring approximately 180 degrees and install throttle shaft (3, Fig. 11) in carburetor body. Install throttle shutter with the lettering facing out when closed, Figure 13. Install and tighten retaining screws firmly. The throttle shaft should move freely. If throttle shaft turns hard, loosen screws and reposition throttle shutter.

Litho in U.S.A.

Install idle adjusting screw and spring, Figure 14.

Installing Choke Assembly

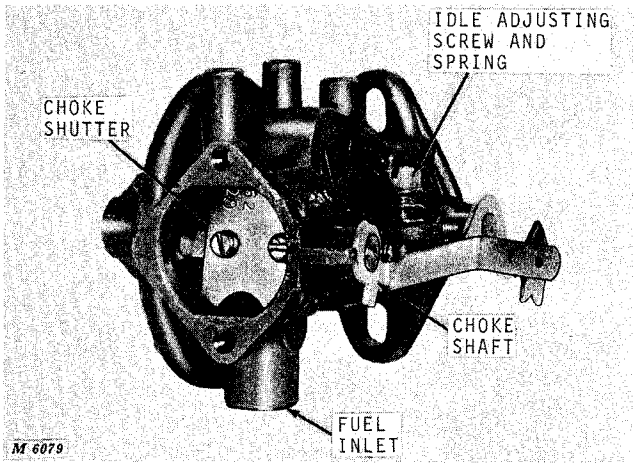


Fig. 14-Installing Choke Shaft and Shutter

Install choke shaft, Figure 14. Turn choke shaft lever to closed position. Install choke shutter with lettering facing out and notch in shutter facing toward fuel inlet in closed position, Figure 14.

Installing Float Valve Seat and Valve Assembly

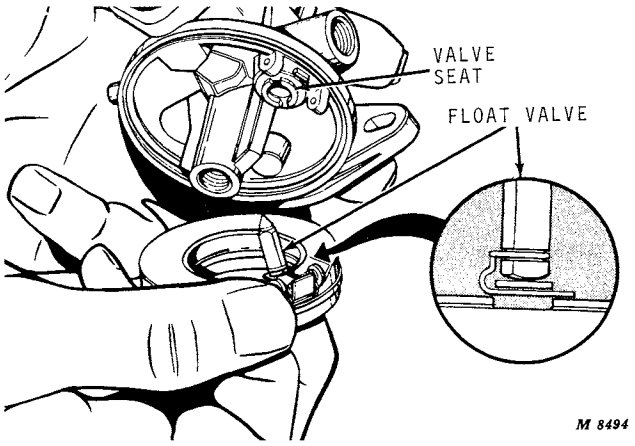


Fig. 15-Installing Float Valve Seat and Float Valve

Use a new gasket and install float valve seat in carburetor body, Figure 15. Refer to "Specifications," page 10-12 and torque valve seat accordingly.

Assemble float valve clip to float as shown in Figure 15.

Installing Float Spring and Float Pin

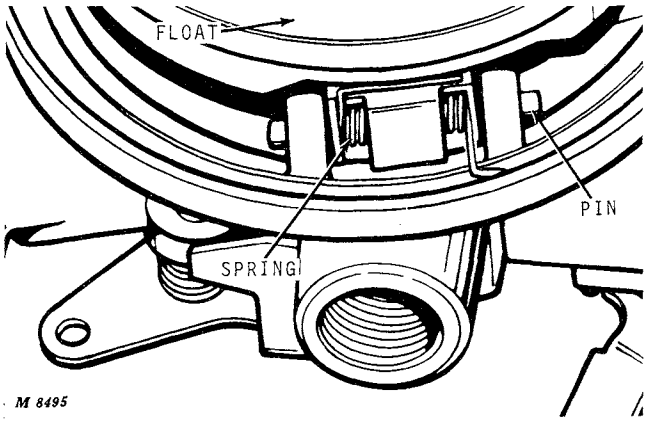


Fig. 16-Installing Float, Float Spring and Pin

Install the float, float spring and pin as shown in Figure 16.

Adjusting Float

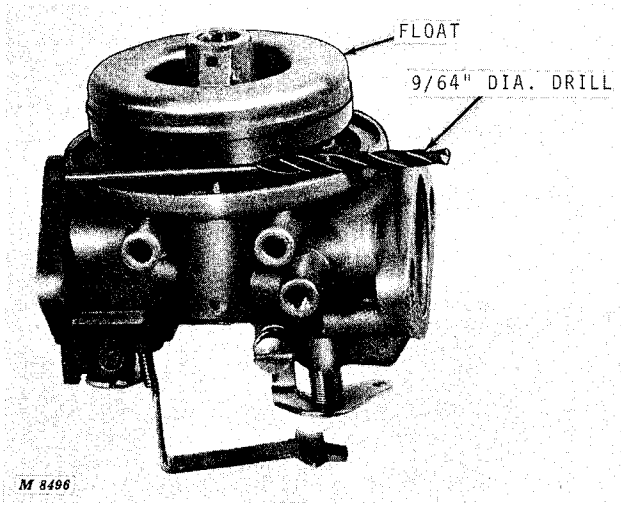


Fig. 17-Float Setting

Invert carburetor, Figure 17. With float resting on float valve, the distance between the float and carburetor body should be 0.140 inch. Bend lip on float to increase or decrease this dimension. Dimension should be made on free end of float (opposite valve seat). Figure 17 illustrates a 9/64-inch diameter drill (0.140 inch) across the point of measurement.

Installing Gaskets, Fuel Bowl and Retaining Nut

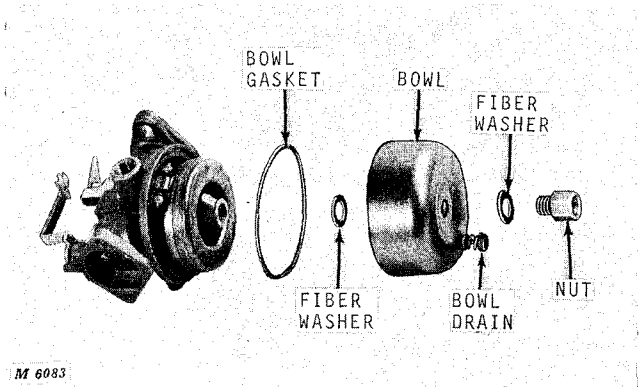


Fig. 18-Installing Fuel Bowl Gaskets, Fuel Bowl and Retaining Nut

Install a new fuel bowl gasket, Figure 18. Stretch gasket if necessary to fit seat. Install new fiber washer between center of fuel bowl and carburetor body.

Place fuel bowl on carburetor body. Position fuel bowl and drain to the right as shown in Figure 18. Install fiber washer and fuel bowl retaining nut (part of high speed adjusting needle assembly).

Installing Mixture Needles

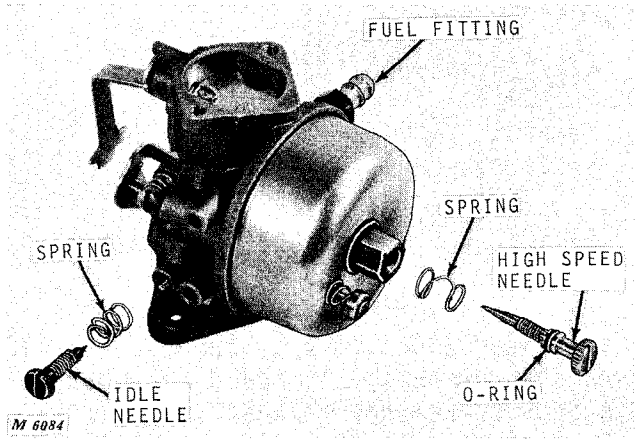


Fig. 19-Installing Idle and High Speed Mixture Needles

Place O-ring in undercut on high speed mixture needle, Figure 19. Place spring on needle and install needle in fuel bowl retaining nut.

Place spring on idle mixture needle and install needle in carburetor body, Figure 19.

Install and tighten fuel fitting, Figure 19.

IMPORTANT: Overtightening may crack the carburetor body.

INSTALLATION

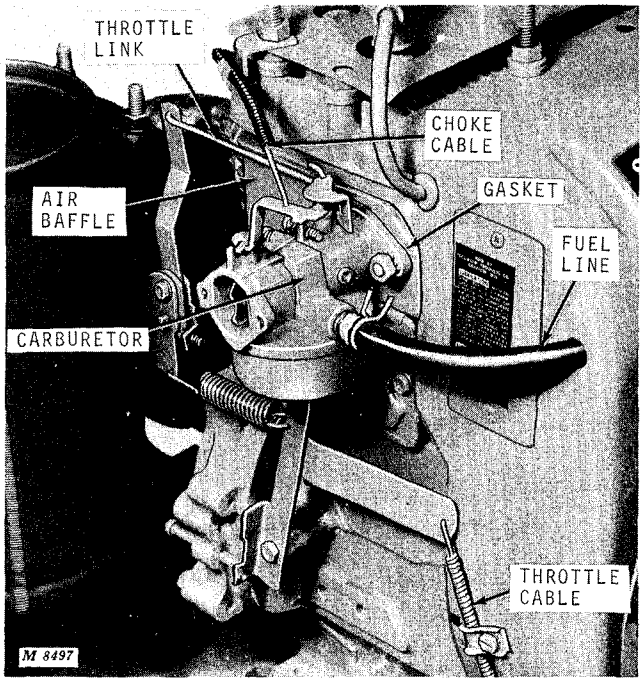


Fig. 20-Installing Carburetor Assembly on Cylinder Block

Connect throttle link to governor lever and throttle shaft lever. Position link ends as shown in Figure 20.

Install new gasket (1, Fig. 12) between air baffle (2) and cylinder block whenever air baffle has been removed. Install new gasket (1) between carburetor and air baffle. Install carburetor and nuts. Tighten nuts firmly.

Attach fuel line and choke cable to choke lever, Figure 20.

Adjust choke and secure conduit clamp, note position of wire. Figure 20. Raise and lower control lever. Readjust choke if necessary.

Use new gasket between carburetor body and air cleaner base and install air cleaner assembly.

ADJUSTMENT

NOTE: Make the following initial carburetor settings to assure engine starting after assembly.

1. Turn idle mixture needle one and one-quarter turn off seat.

2. Turn high speed mixture needle one and one-half turn off seat.

3. Back off idle adjusting screw one turn after end of screw contacts throttle lever.

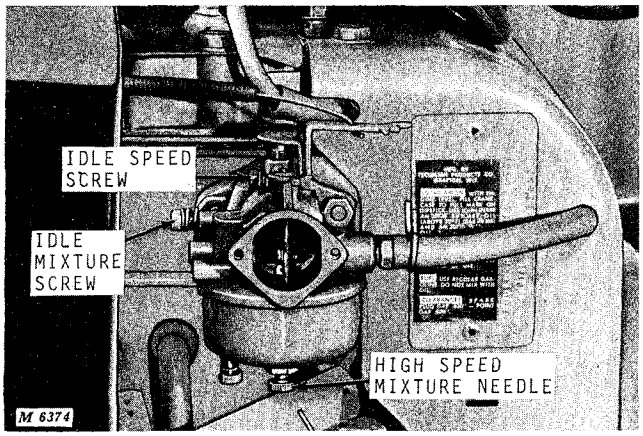


Fig. 21-Carburetor Adjustments

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

1. Run engine until warm, then shut engine off. Turn high speed mixture needle clockwise until closed. Close finger tight only. Then open 1-1/2 turns.

2. Turn idle mixture needle clockwise until closed. Close finger tight only. Then open 1-1/4 turns.

3. Start engine and raise throttle lever on dash panel to "FAST" position. Allow engine to warm up.

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

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

6. Advance throttle lever quickly to check for uniform acceleration. If engine misses, gas-air mixture is too lean. Turn high speed mixture needle counterclockwise until positive acceleration can be obtained. If excess exhaust smoke is noticed, mixture is too rich. Readjust idle mixture needle if necessary until good balance is achieved and engine idles smoothly between 1200 and 1700 rpm. The idle adjusting screw adjust the speed at which the engine idles.

SPECIFICATIONS

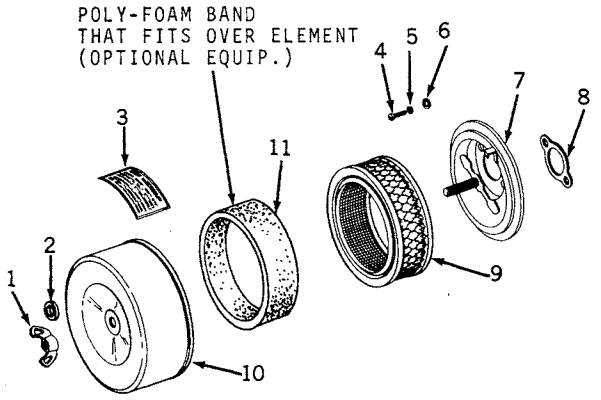
(Walbro Carburetor for Tecumseh HH100 Engine)

Speeds		
High speed (No load)	3800 rpm	Refer to carburetor adjustment, page 10-11. Refer to governor adjustment, page 40-7, Section 20.
Idle speed (No load)	1200-1700 rpm	Refer to carburetor adjustment, page 10-11. Refer to governor adjustment, page 40-7, Section 20.
Float Setting Distance between float and carburetor body (Carburetor inverted)	9/64-inch	Check and/or adjust whenever carburetor is disassembled for service, page 10-9.
Float Valve Seat Torque	40-50 in-lbs	Refer to carburetor assembly, page 10-9.

Litho in U.S.A.

Group 15
AIR CLEANER

GENERAL INFORMATION



M 9326

1—Wing Nut	7—Base
2—Copper Washer	8—Air Cleaner Gasket
3—Decal	9—Air Filter Element
4—Machine Screw	10—Air Filter Cover
5—Lock Washer	11—Polyurethane Pre-Cleaner (Extra Equipment)
6—Plain Washer	

Fig. 1-Exploded View of Air Cleaner Components

The air cleaner 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.

SERVICE

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

Cleaning

Air Filter

The air filter element should be cleaned every 5 hours of operation.

Tap the filter lightly against a flat surface and brush out dust.

Do not dip the filter into a liquid cleaner of any type. Replace filter if bent, crushed or damaged. Replace if extremely dirty. Under extremely dusty conditions, replace every 100 hours of operation. When in doubt, replace filter. This is inexpensive insurance to protect the engine.

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. Assemble cover and tighten wing nut on cover finger tight, Figure 1.

IMPORTANT: On air cleaners having metal wing nuts, be sure copper washer is in place next to wing nut. (The washer is not necessary with nylon wing nuts.)

Pre-Cleaner

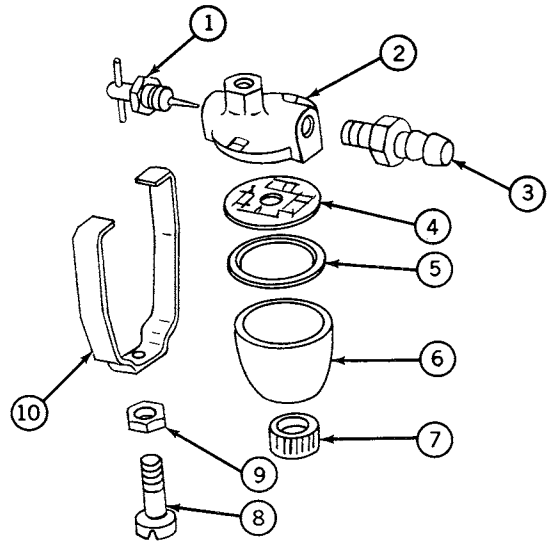
A long-life, polyurethane-band pre-cleaner (11, Fig. 1) is available as extra equipment for customers operating in extremely dry and dirty conditions.

The pre-cleaner, which fits over the air filter element inside the cover, should be washed occasionally in water and squeezed dry. Never soak pre-cleaner in oil.

Litho in U.S.A.

Group 20
SEDIMENT BOWL, FUEL STRAINER, AND GAS TANK

SEDIMENT BOWL



1-Needle Shut-Off Valve	6-Bowl
2-Base	7-Thumb Nut
3-Connector	8-Machine Screw
4-Screen	9-Nut
5-Gasket	10-Bail

Fig. 1-Exploded View of Sediment Bowl

The sediment bowl is easily cleaned by closing the needle shut-off valve and loosening the thumb nut, Figure 1, until the bowl can be removed.

IMPORTANT: Be sure engine has cooled before cleaning sediment bowl.

Wash out sediment bowl and dry thoroughly whenever dirt particles are noted in the bowl. Advise customer to use a clean gasoline container.

Replace the gasket whenever the sediment bowl is removed for cleaning.

With fuel shut-off valve still closed, remove gasket. Remove screen by carefully prying it over the center retainer. Clean screen thoroughly, making sure that all screen holes are open.

IMPORTANT: After assembling sediment bowl and screen, remove gas line at carburetor. Open shut-off valve and fill sediment bowl. When gas begins to run out, connect gas line.

This will allow air to escape and avoid possible air lock in the fuel hose or carburetor.

FUEL STRAINER

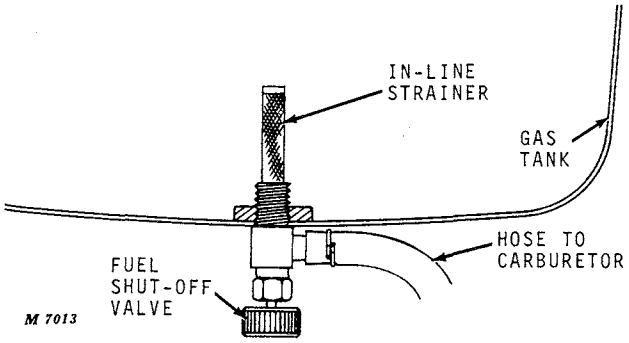


Fig. 2-In-Line Fuel Strainer

On Tractors, Serial Number 130,001 and above, the sediment bowl is replaced by an in-line fuel strainer which extends into the gas tank, Figure 2.

Shut off fuel by turning thumb screw on fuel shut-off valve. Remove fuel line from carburetor, 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 fuel line. Attach fuel line to carburetor.

GAS TANK

Clean gas tank, sediment bowl and fuel strainer whenever gum deposits have been detected in the gas tank or when dirty fuel has obviously been used.

CAUTION: 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

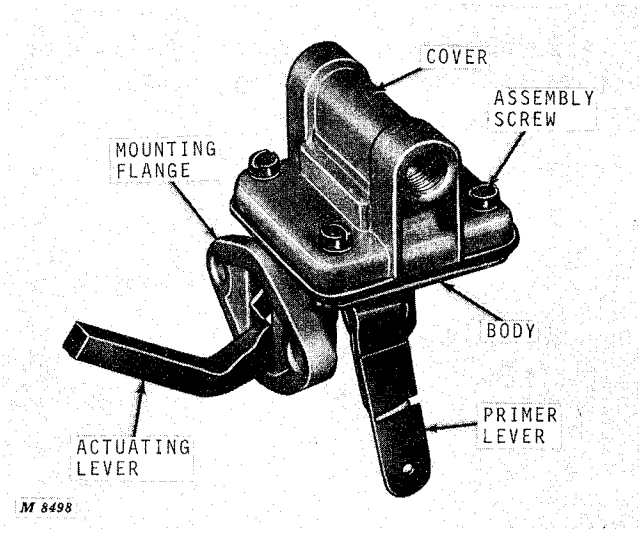


Fig. 1-Fuel Pump

The mechanical fuel pump 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. The pump is equipped with a primer lever on the lower body of pump.

Repair kits are available for reconditioning the pump. These kits include the necessary gaskets, seals, and check valve components.

REPAIR

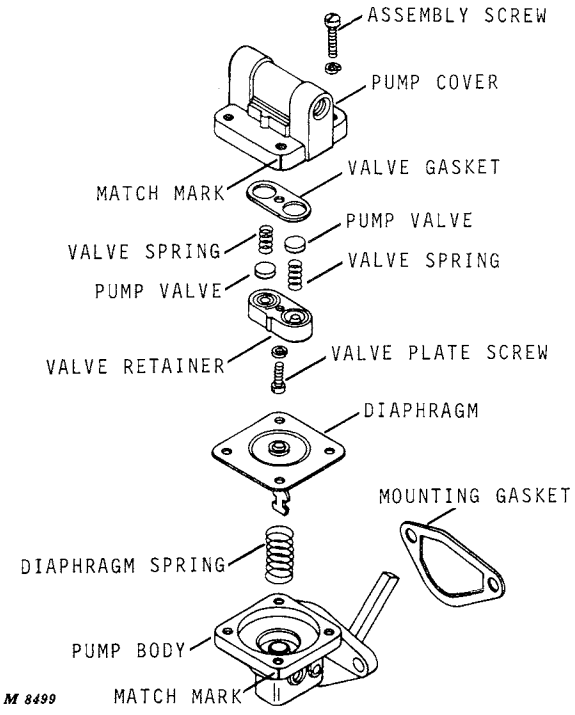


Fig. 2-Exploded View of Fuel Pump

Remove fuel lines and mounting screws holding pump to engine. 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 Figure 2.

Clean pump cover thoroughly with a safe solvent and a fine wire brush.

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 Figure 2.

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

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.

Replace diaphragm by positioning, pressing, and turning to allow diaphragm to be hooked into actuating lever.

Hold pump body. Attach cover to body 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 gas leaks.

SPECIAL TOOLS

No.	Name	Use
OTC KC18	Hose Clamp Pliers	To remove fuel line hose clamps.

Section 40
ELECTRICAL SYSTEM
Group 5
GENERAL INFORMATION

TABLE OF CONTENTS

Litho in U.S.A.

PRINCIPLE OF OPERATION

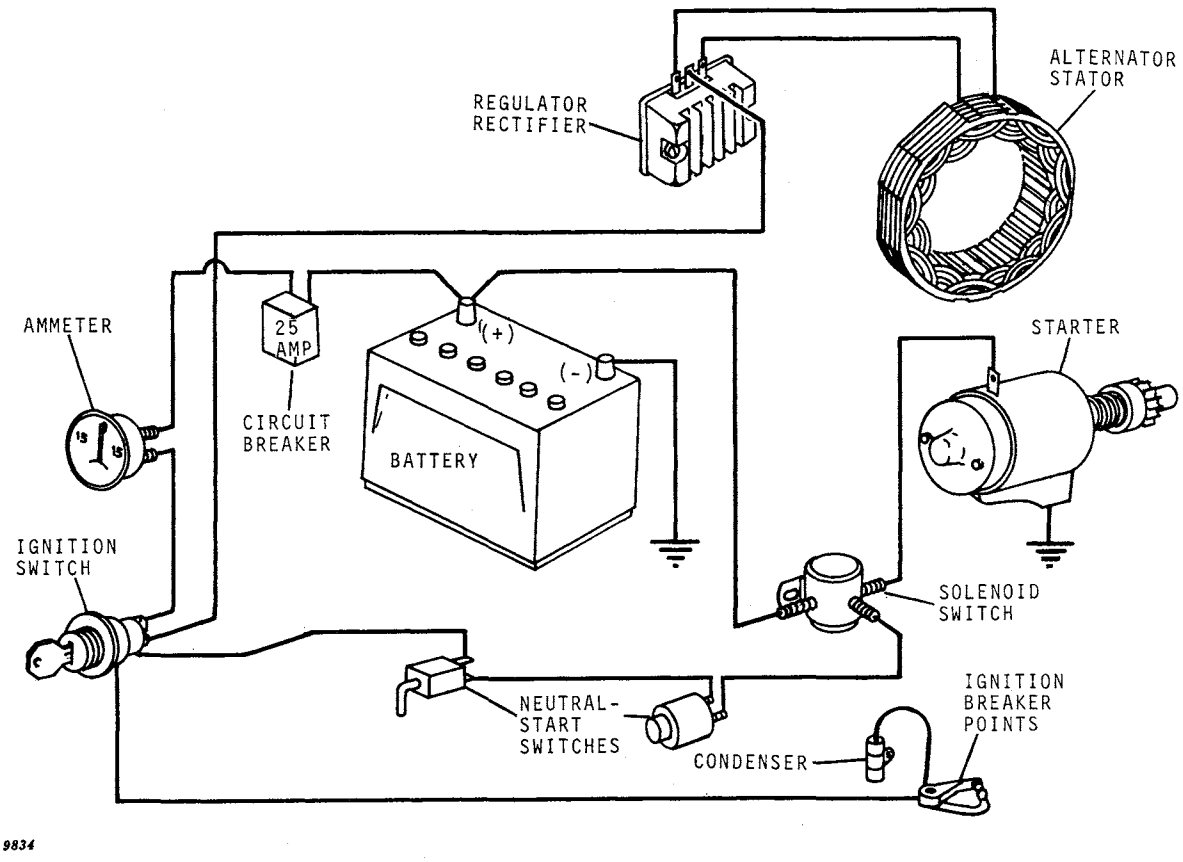


Fig. 1-Electrical System, 110 and 112 Tractors (Serial No. 185,001-)

The 110 and 112 Tractor electrical systems are basically alike, Figure 1. Only minor differences exist between the ignition systems of these tractors.

The chart below identifies the type of ignition system used with the different engine models.

Tractor	Engine Model	Ignition
110	Kohler K181S	Magneto Ignition
112	Kohler K241AS	Battery-Coil Ignition
112	Tecumseh HH100 Serial No. (100,001-161,771)	Solid-State Ignition (Breakerless)
112	Tecumseh HH100 Serial No. (161,772-)	Battery-Coil Ignition

Each of the three engines uses an electric starter motor and solenoid starting system. Neutral-start safety switches are wired in series between the ignition switch and solenoid to prevent accidental starting.

A 12-volt battery with a rectified AC charging system powers each of the electrical systems. A voltage regulator-rectifier is used to control the charging system.

110 and 112 Tractors (Serial No. 185,001-) feature a master 25 amp. circuit breaker, which protects the electrical system in case of a short circuit or overload.

Wiring diagrams (Figures 2 through 7) are included in the following pages to aid in understanding and diagnosing electrical system malfunctions.

WIRING DIAGRAM
110 and 112 Tractors Without Headlights
(Serial No. 100,001-130,000)

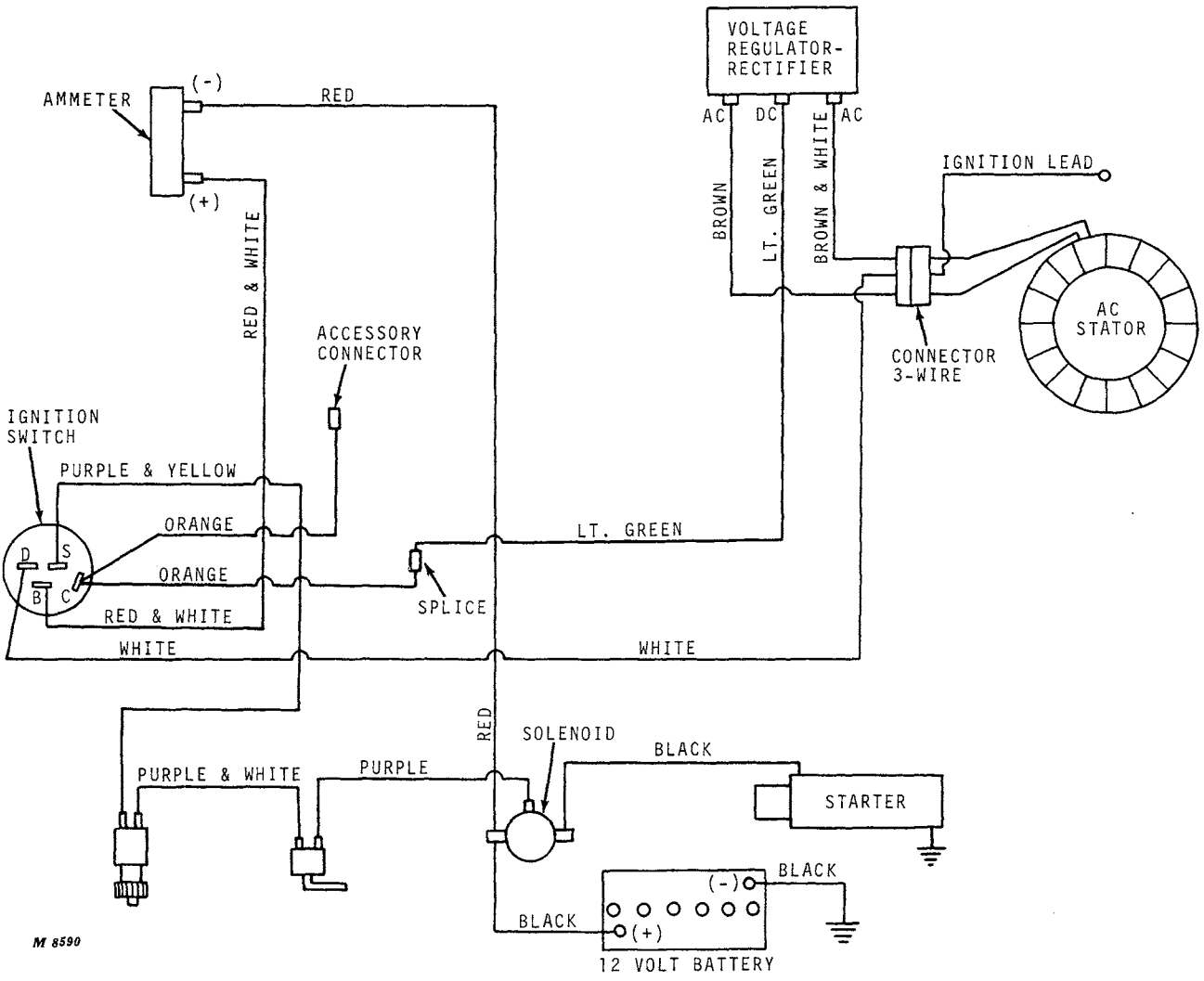


Fig. 2-AM32174 Wiring Harness with AM30771 Ignition Switch but Without Headlights and Lighter, Tractors (Serial No. 100,001-130,000)

WIRING DIAGRAM
110 and 112 Tractors With Headlights
(Serial No. 100,001-130,000)

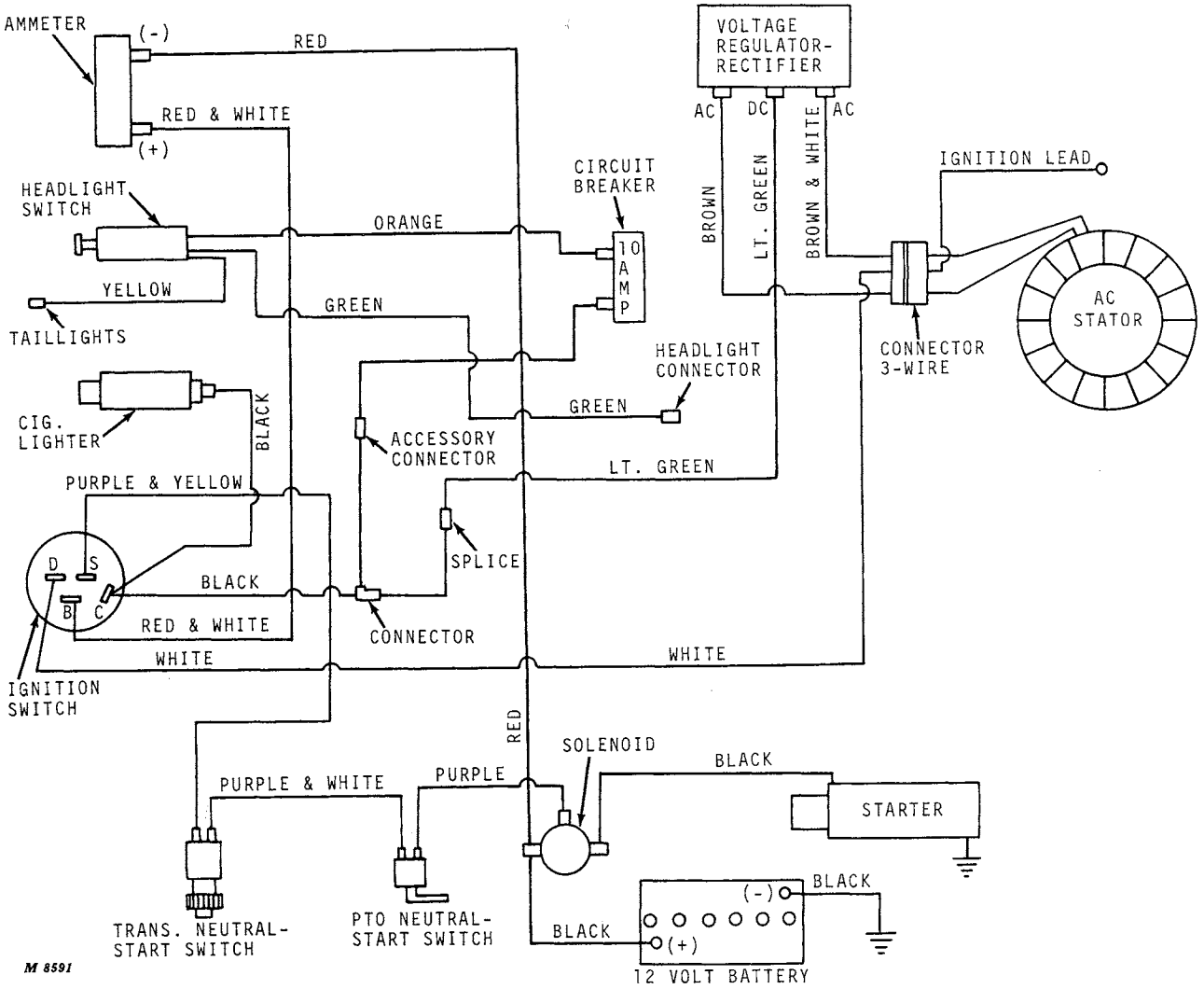


Fig. 3-AM32174 Wiring Harness with AM30771 Ignition Switch with Headlights and Lighter, Tractors (Serial No. 100,001-130,000)

WIRING DIAGRAM
110 Tractors - (Serial No. 130,001-185,000)
112 Tractors - Solid State Ignition (Serial No. 130,001-161,771)

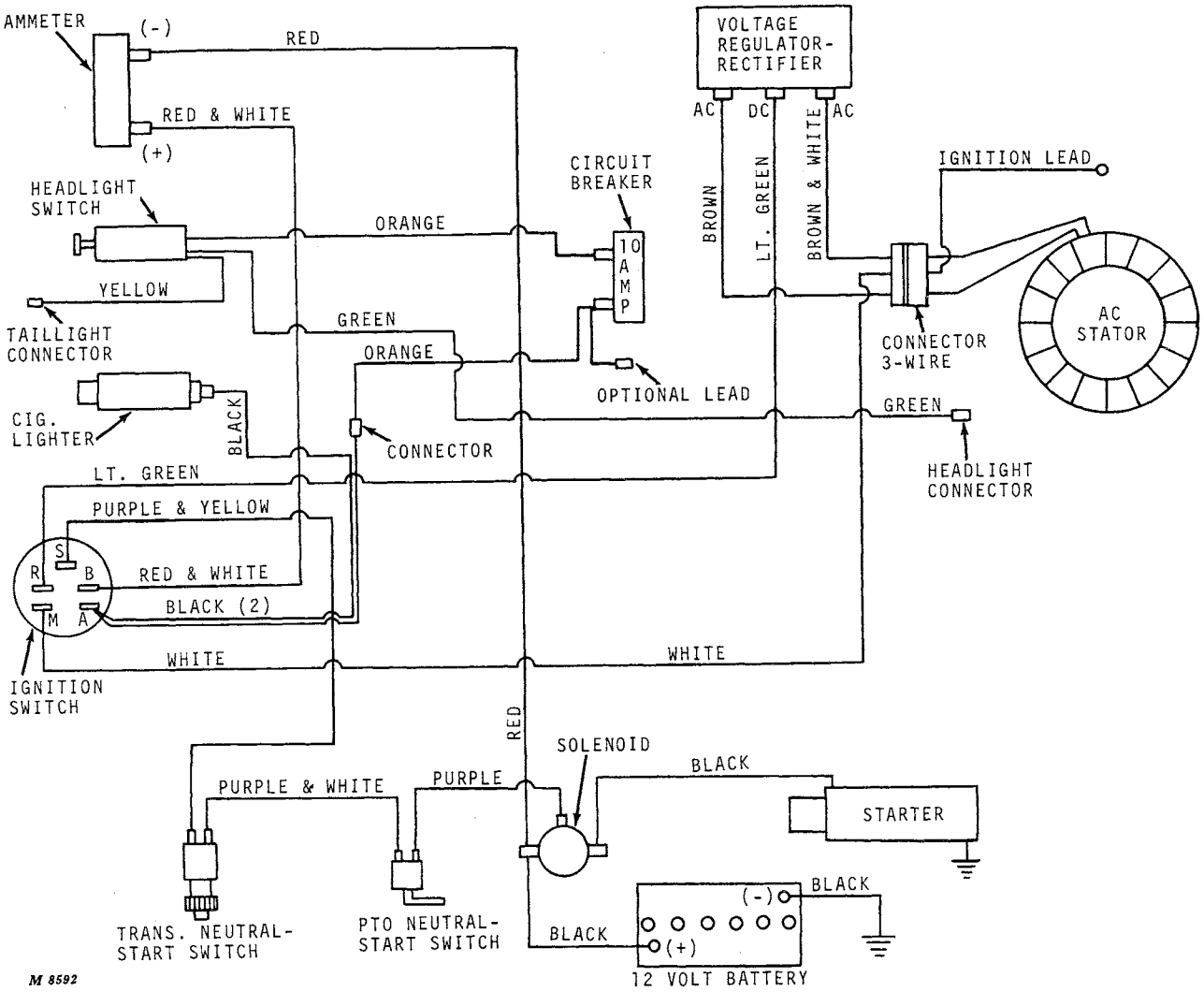


Fig. 4-Wiring Harness with Headlights, and Lighter

WIRING DIAGRAM
112 Tractors With Battery-Coil Ignition
(Serial No. 150,001-185,000)

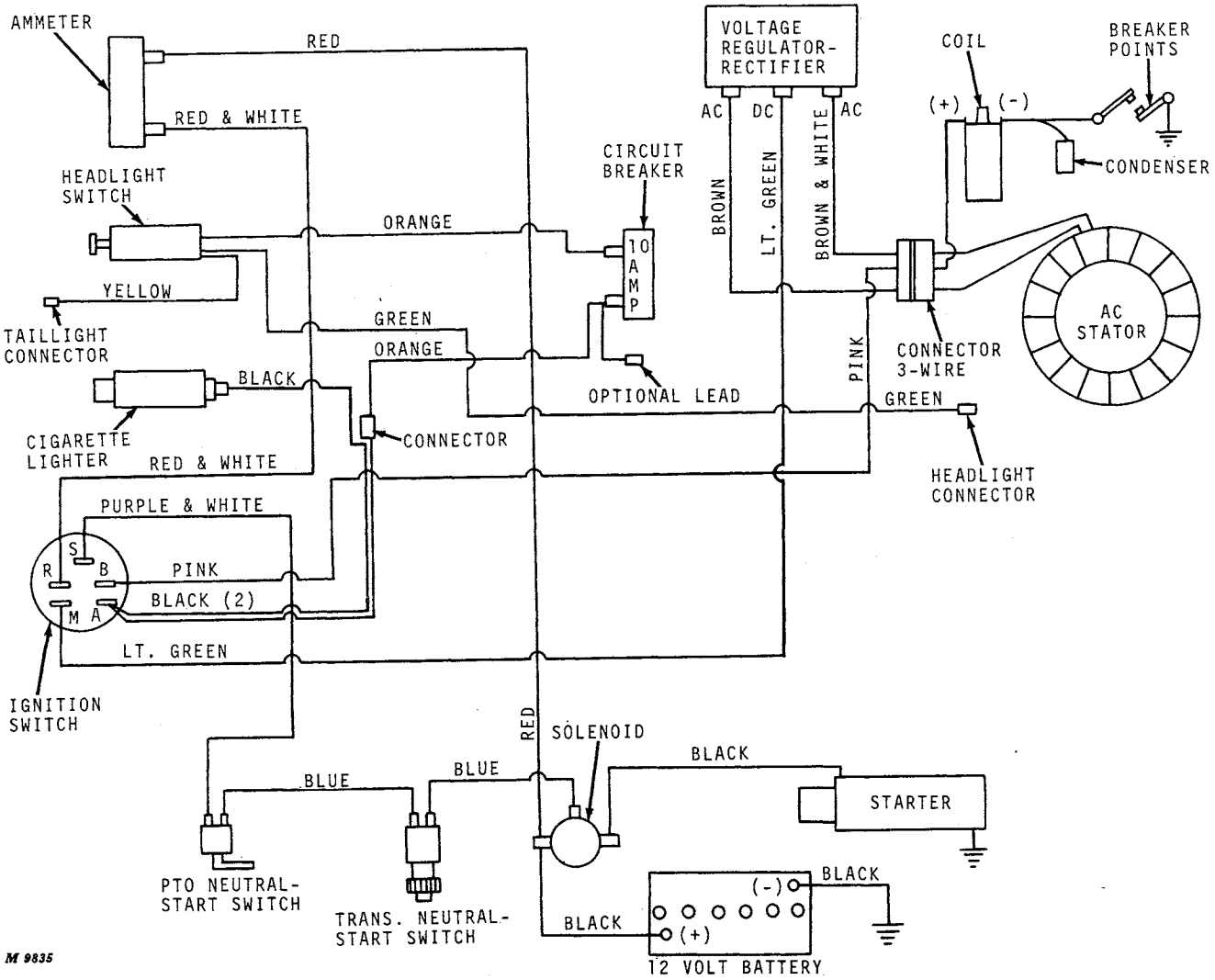


Fig. 5-Wiring Harness with Headlights, and Lighter

WIRING DIAGRAM
110 Tractors (Serial No. 185,001-)
Magneto Ignition

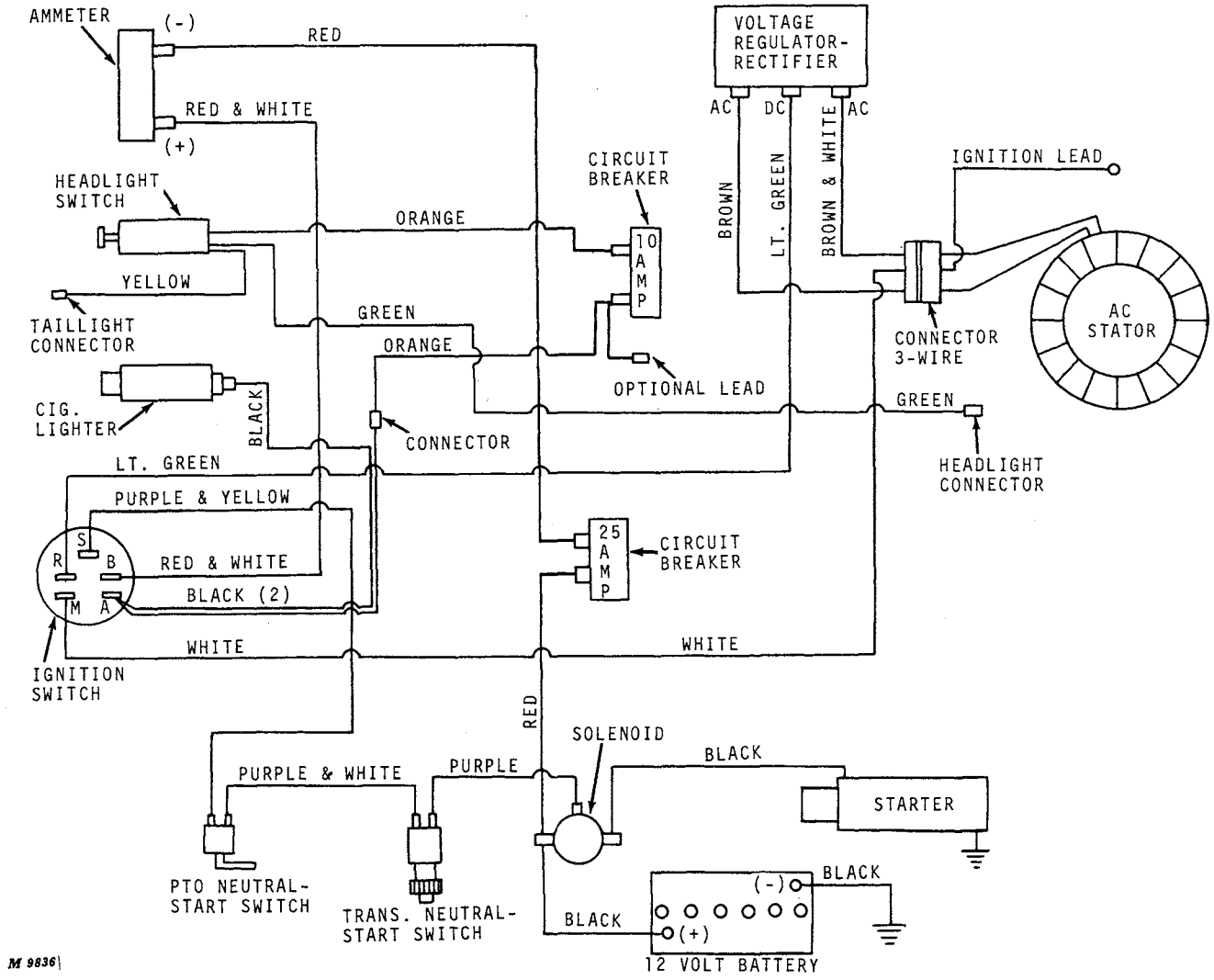


Fig. 6-Wiring Harness with Headlights and Lighter

WIRING DIAGRAM
112 Tractors (Serial No. 185,001-)
Battery-Coil Ignition

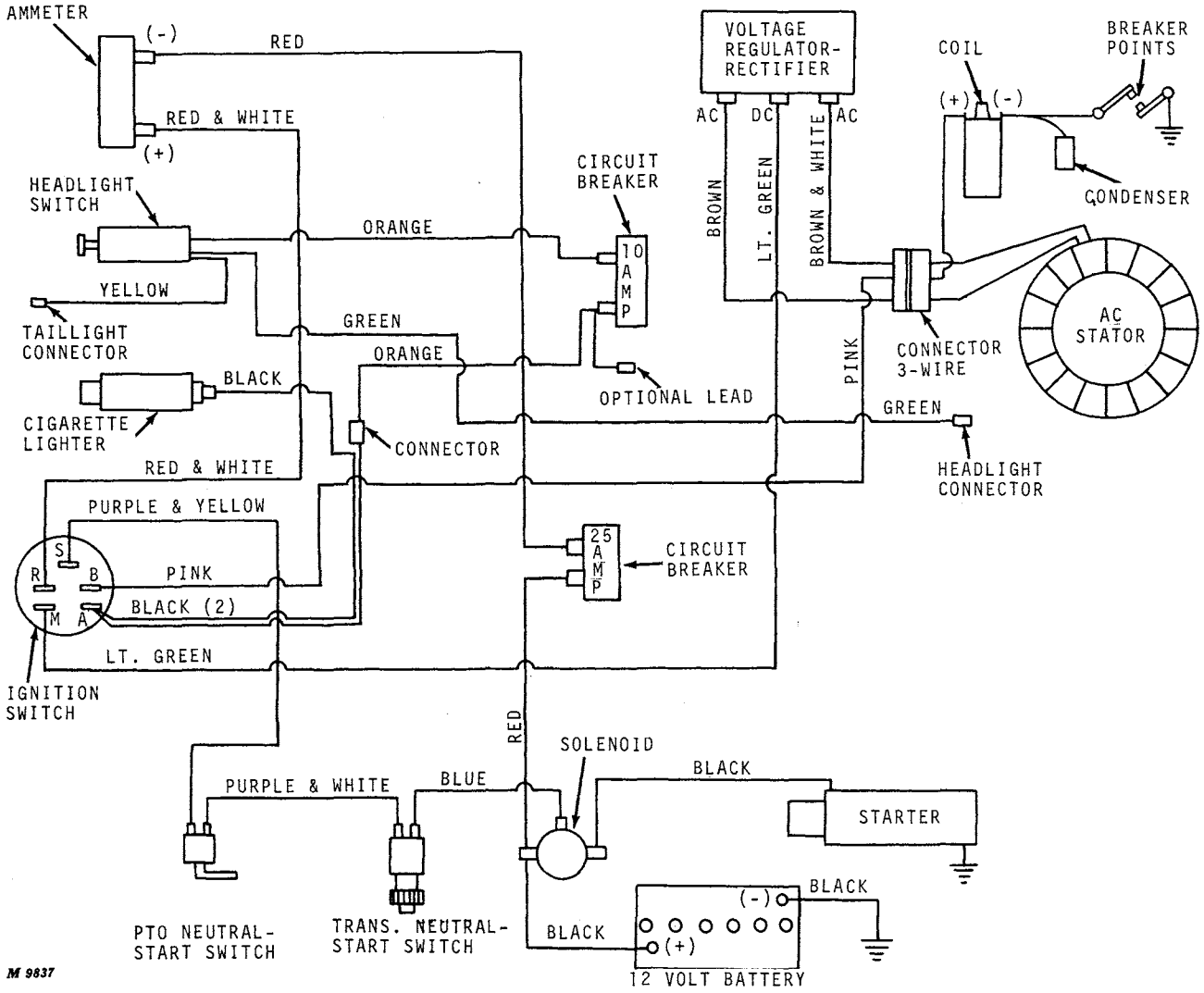


Fig. 7-Wiring Harness With Headlights and Lighter

TESTING

Instructions are provided 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.

Recommended test procedures for dealers having their own test equipment are outlined in Groups 10, 15, 20, 25, and 30.

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

NOTE: Three different types of ignition systems are used on the 110 and 112 Tractors. Use ONLY the diagnostic procedures that apply to the particular system being tested. See page 5-2.

Engine

Engine is Hard to Start

Breaker points worn or out of adjustment.

Spark plug faulty.

Loose or corroded electrical connections.

Condenser or coil faulty.

Ignition module too far from flywheel projection pins.

Set air gap at 0.006 to 0.010 inch.

Engine Misfires

Incorrect spark plug gap.

Defective or loose spark plug.

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.

Defective ignition switch.

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.

Starter

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.

Defective safety switches.

Poor battery ground.

Inoperative ignition switch.

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.

Shorted field. (Wire-Wound Fields)
Replace starter.

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.

Ring gear on flywheel has broken teeth.

Starter Drawing Excessive Current

Broken or jammed starter drive.

Dirty or gummed armature.

Shorted or grounded armature.
Install new armature

Grounded field. (Wire-Wound Fields)
Replace starter if field is defective.

Worn armature shaft bushings.

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

Misaligned armature shaft.
Check end cap bushing.

Loose field assemblies. (Wire-Wound Fields)
Tighten fields.

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

Battery

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.

Check charging rate.

Low electrolyte level.

Blown rectifier-regulator fuse.

Too many accessories functioning at once.

Low or no alternator output.

Loose connections or damaged wires.

Battery Remains Low or Discharged
Electrolyte, moisture and dirt on case.

Moisture-logged battery decal.

Loose or corroded battery terminals and cable ends.

Tractor not operated long enough to charge battery.

Loose or damaged wires.

Defective ignition switch.

Defective battery.

Continuous loads in excess of alternator capacity.

Low or no alternator output.

Defective rectifier-regulator.

Blown rectifier-regulator fuse.

Battery Spewing
Battery overfilled.

Loose battery hold down bolts.

Battery Leaking
Cracked or damaged battery case.

Loose or damaged cell cover.

Ammeter

Ammeter Shows Discharging When Engine Idles
At low (idle) engine rpm battery voltage is higher than alternator voltage. This condition is normal.

Ammeter Shows Discharge Continually
Loose connections or damaged wires.

Lights

Lights Will Not Light
Circuit breaker defective.

Loose or damaged wires.

Poor ground.

Sealed beams burn out.
Install new sealed beam units. Instruct operator to throttle down to idle speed before shutting off engine. Shut off lights before shutting off engine.

Alternator

No Alternator Output
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.

Excessive Alternator Output
Check rectifier-regulator. Replace if necessary.

Regulator

Regulator Heating Up
No battery in circuit for period of over 45 minutes.
If tractor must be operated without a battery, disconnect plug from regulator.

Regulator or Fuse Burned Out
Polarity reversed through battery by battery charger or jumper cables.
When using battery charger or jumper cables be sure polarity is correct. As a precaution, disconnect plug above regulator.

Cigarette Lighter

Cigarette Lighter Will Not Function
Loose or damaged lead.

Unit not properly grounded.

Circuit breaker tripped.

Headlight Circuit Breaker Trips When Cigarette Lighter Element is Pushed in to Heat
Lighter fused through circuit breaker for lights.
Disconnect lead and connect lead to unfused hot lead.

Litho in U.S.A.

Group 10
CRANKING SYSTEM

PRINCIPLE OF OPERATION

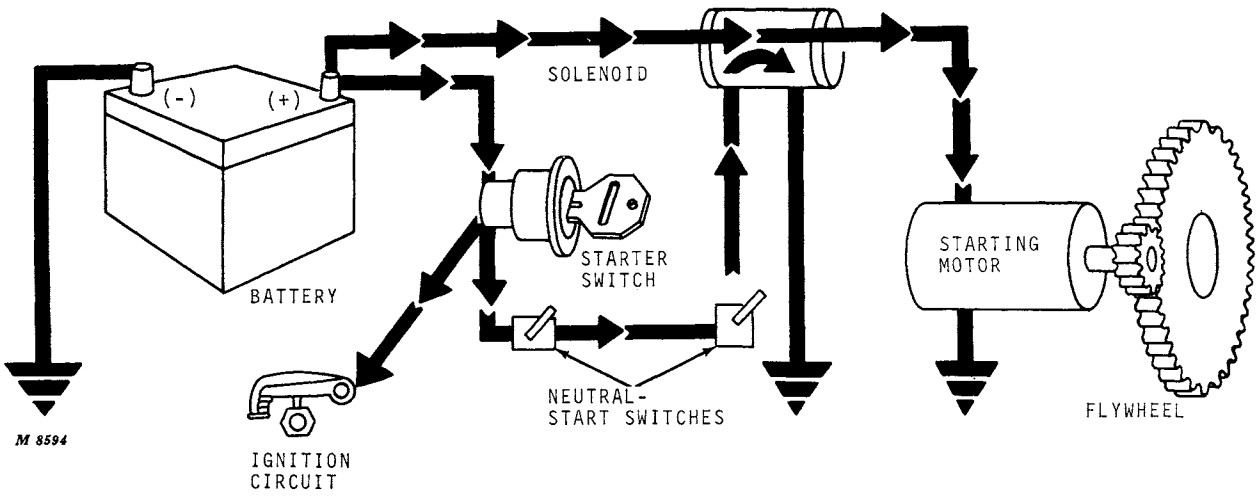


Fig. 1-Cranking Circuit of Tractor

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.

Key Switch

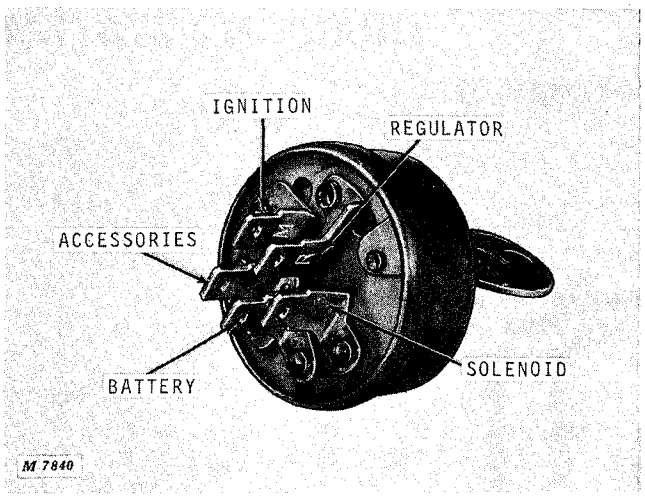


Fig.2-Key Switch

The key switch, Figure 2, is nothing more than a flow divider which 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 to flow from the battery to the solenoid.

When the switch is returned to "run" position following engine start, current is diverted from the solenoid and routed instead to the accessories and charging circuit.

IMPORTANT: Be sure that correct 5-prong key switch is installed in tractors above Serial No. 130,000. Use of a battery-coil-type key switch in a Solid State ignition system will damage ignition module. AM31995 Key Switch (bronze colored case) should be used in Solid State and magneto tractors. AM32318 Key Switch (silver colored case) should be used in all battery-coil ignition tractors.

Solenoid

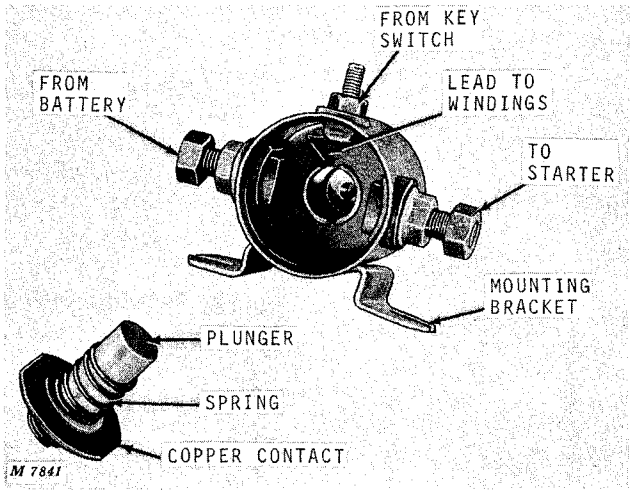


Fig. 3-Solenoid Components

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

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

When the ignition switch is turned to the "start" position, current from the switch flows to 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, energizing 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.

Starting Motor

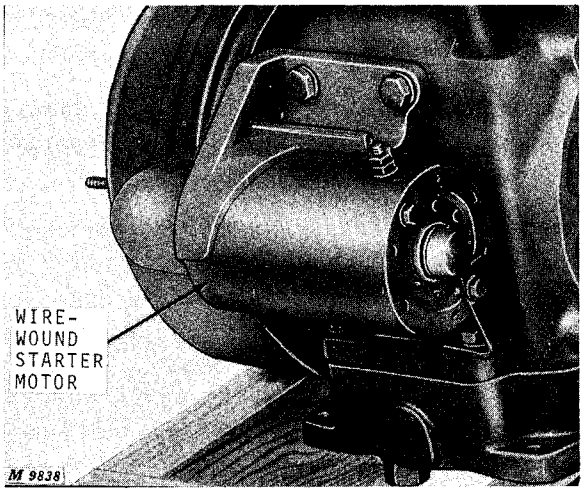


Fig. 4-Wire-Wound Starter Motor

Two types of starter motors are used on 110 and 112 Tractors. Early Kohler and all Tecumseh engines use the wire-wound field starters, Figure 4. Later Kohler engines feature permanent magnet field starters, Figure 5.

The permanent magnet field starter draws less current than the wire-wound field starter because no current is necessary in the field. The armature, brushes, and commutator are basically the same.

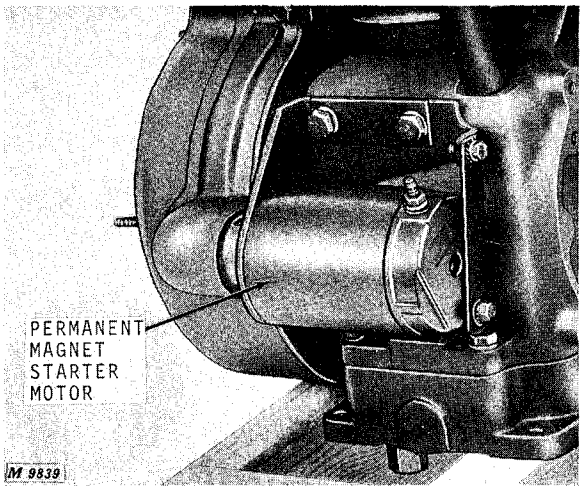


Fig. 5-Permanent Magnet Starter Motor

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 fires and speeds up, the armature is overrun causing the drive gear to disengage. The anti-drift spring holds the drive gear in the disengaged position when the starter is not operating. The spring cap acts as a shock absorber.

IMPORTANT: If the flywheel is still rotating when the starter is engaged, the pinion and ring gear will clash, damaging the gears.

Cranking time must be limited to prevent overheating of the starter. Maximum cranking time is 60 seconds, followed by a 30 second cooling period. If an engine fails to start after 60 seconds, ignition or carburetion problems are indicated. These should be corrected before the engine is placed in operation.

TESTING

Testing Battery

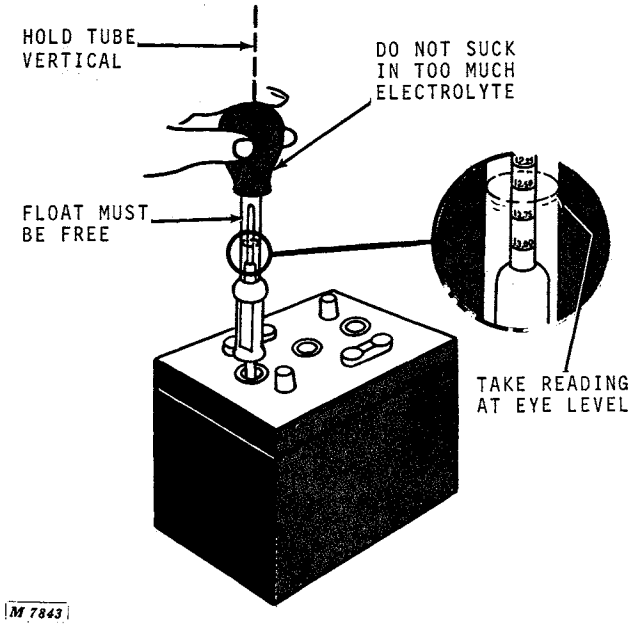


Fig. 6-Testing Specific Gravity

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, Figure 6.

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, Figure 7.

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.

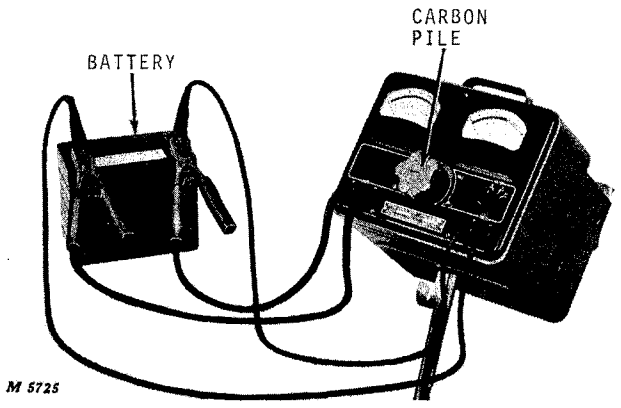


Fig. 7-Testing Battery Capacity

Testing Starter

If the starter fails to crank properly, inspect the engine 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 is disengaged. If the unit still fails to crank, wire around the switch and solenoid with a heavy jumper lead. If starter operates, the solenoid, neutral-start, 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 fails to operate, either the starter or engine is at fault.

Excessive friction in the engine may be caused by tight bushings or bearings, a seized piston or rod or by clutches that have not properly disengaged.

If the starter still 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.

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. If the armature does not turn freely, disassemble the starter.

Testing Starter for Grounds (Wire-Wound Fields)

With starter removed from tractor, remove commutator end frame and armature.

Check for grounds with test prods from the starter field terminal to the starter frame, Figure 8.

If the lamp lights, it indicates that the unit is internally grounded. Repair or replace parts as required.

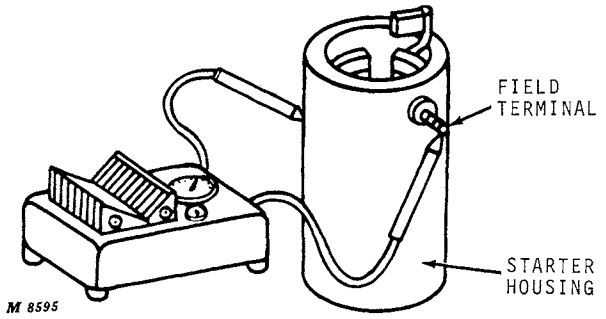


Fig. 8-Checking for Grounded Starter

Testing Starter for Open Fields (Wire-Wound Fields)

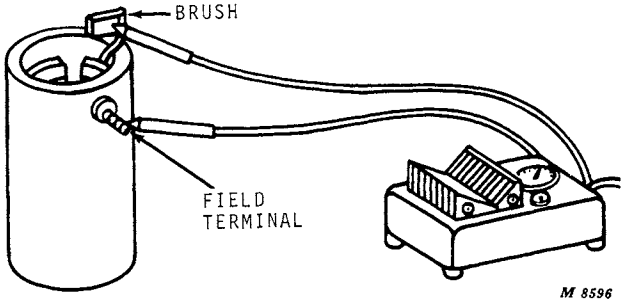


Fig. 9-Checking for Open Field Coils

If the unit is not grounded, check the field for an open circuit, Figure 9. A test lamp should light when one test point is placed on the field terminal and the other is placed on the field brush.

If it does not light, the circuit is open. If the open is due to a broken lead or bad connection, it can be repaired, but if the open is inside one of the field coils, the starter must be replaced.

Testing Starter for Shorted Fields (Wire-Wound Fields)

Because of the low resistance in the field windings, there is no satisfactory test for short-circuited field windings. If the starting motor does not perform after all other tests have been made and no defects found, a short circuit can be suspected.

Testing Armature

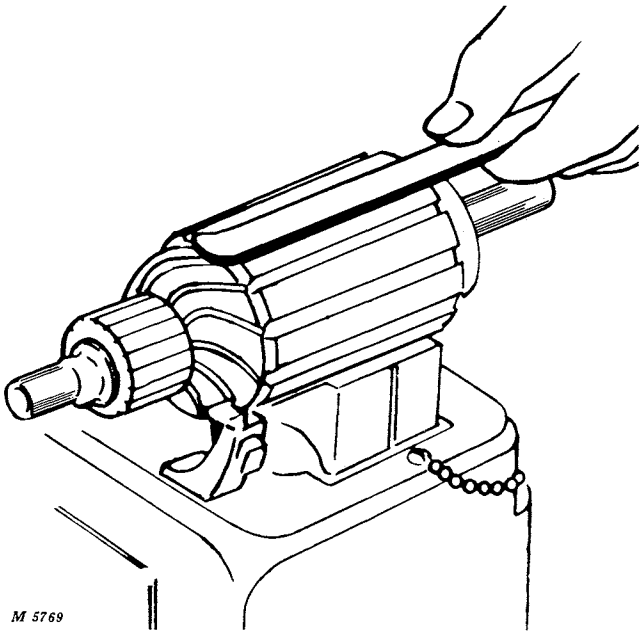


Fig. 10-Checking Armature for Short Circuits

If the trouble has not yet been located, 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 in a growler with a steel strip (hacksaw blade) held on the armature, Figure 10. The steel strip will vibrate on the area of the short circuit.

Shorts between bars are sometimes caused by brush dirt or copper between bars. Inspect for this condition. Undercut commutator insulation 1/32 inch to eliminate these shorts. If cause of short cannot be found, replace armature.

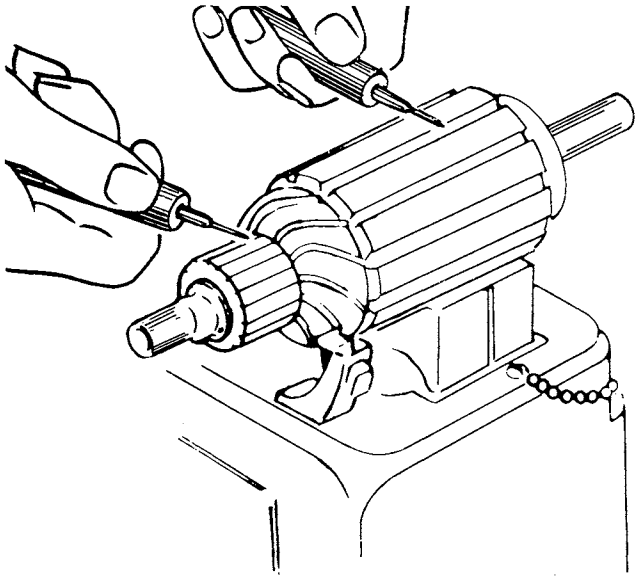


Fig. 11-Checking Armature for Grounds

2. GROUNDS—Place armature on bench. Grounds in the armature can be detected by use of a test lamp and prods. If the lamp lights when one test prod is placed on the commutator and the other test prod on the armature core or shaft, the armature is grounded, Figure 11.

3. OPENS—Inspect for loose connections at the points where the conductors are joined to the commutator. Poor connections cause arcing and burning of the commutator. If bars are not badly burned, resolder leads in riser bars. Turn down commutator in a lathe. Undercut insulation between commutator bars 1/32 inch. Check regulator.

4. If armature checks good on the above test, but the commutator is worn, dirty, out of round, or has high insulation, turn down the commutator and undercut insulation 1/32 inch.

Testing Solenoid

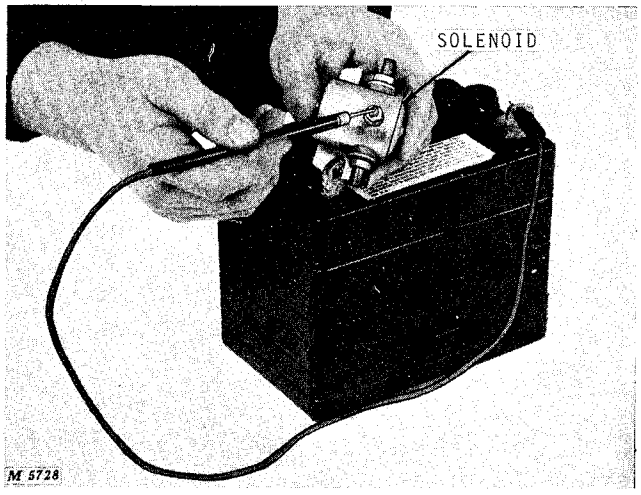


Fig. 12-Solenoid Test

The solenoid (magnetic switch) is a sealed unit and cannot be repaired.

With a continuity tester and a battery of correct voltage, connected as shown in Figure 12, momentarily touch jumper lead to solenoid terminal. If solenoid is in good condition, the plunger will snap in and close the main contacts.

The solenoid can be tested in the tractor. Removal as shown in Figure 12, is optional.

Failure of the above test indicates a defective solenoid. Replacement will be necessary.

Testing Neutral-Start Switches

Neutral-start switch failure is sometimes the wrong diagnosis for a switch which needs only a simple adjustment or cleaning.

⚠ CAUTION: Be sure spark plug cable is disconnected from the plug to prevent accidental starting of the engine while making the following test.

Test first by holding the ignition switch in the start position, while moving the transmission shift lever from the neutral position into forward or reverse drive position.

If contact is made and the engine begins to crank, the neutral-start switch needs adjusting or replacing.

If no contact is made with the shift lever in neutral position, the neutral switch is out of adjustment or defective.

Adjusting Neutral-Start Switches, Tractors (Serial No. -160,000)

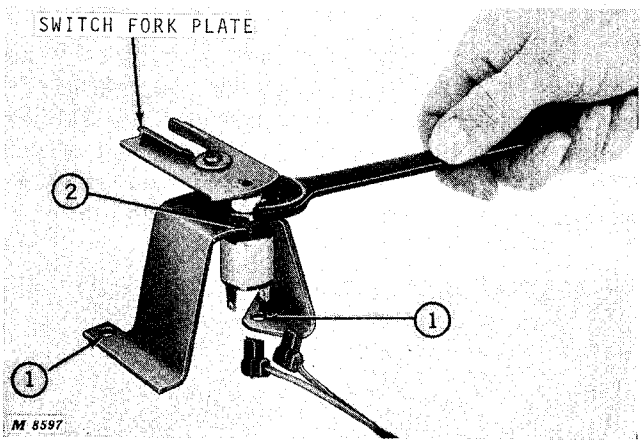


Fig. 13-Adjusting Neutral-Start Switch

1. When the shift lever is in the neutral position, it must move forward and rearward without striking either side of the switch fork plate. If the lever strikes and moves the fork, loosen the two bolts holding the switch bracket to the transaxle and shift the bracket until the shift lever does not strike the switch fork. Tighten bolts firmly, Figure 13.

2. Loosen jam nut and turn switch inward until the plunger barely makes contact with underside of fork plate on either side of dimple. Tighten jam nut firmly. **IMPORTANT: Be sure plunger barely touches underside of fork plate. If plunger contacts fork plate too hard, the switch will be active at all times.**

Adjusting Neutral-Start Switch, Tractors (Serial No. 160,001-)

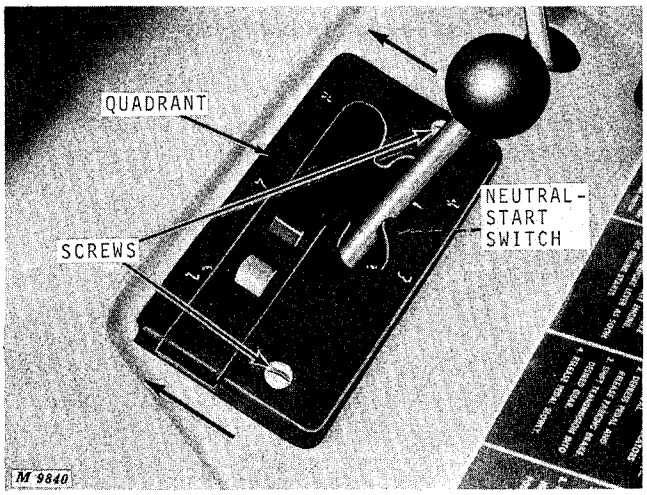


Fig. 14-Adjusting Neutral-Start Switch

Testing Neutral-Start Switches —Continued

The neutral-start switch cannot be adjusted in the quadrant. If no contact is made with the shift lever in neutral, loosen the two quadrant screws and slide the quadrant rearward, Figure 14. Tighten the screws firmly. Also check the shift lever pull-back spring for adequate tension. Replace spring if it is stretched.

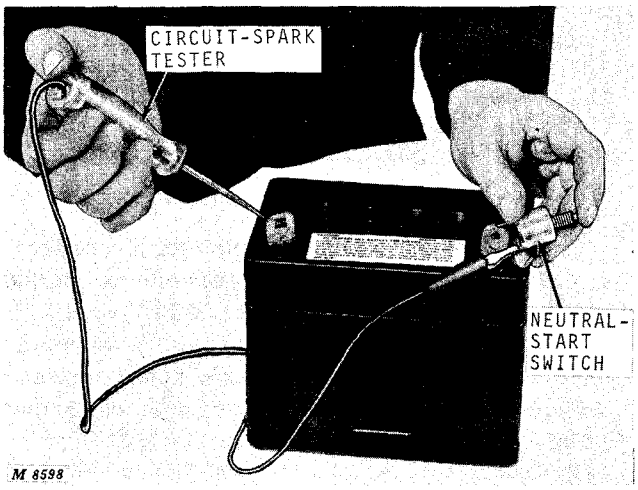


Fig. 15-Testing Neutral-Start Switches

If engine still does not crank, remove switches from tractor and test electrically as follows.

The following test can be used on the neutral-start and PTO clutch switches on all tractor models.

1. Connect circuit test light lead to switch terminal. Place switch and tester on battery terminals, Figure 15.

2. Push switch plunger down. If circuit tester light does not go on, switch is defective.

Testing Ignition Switch

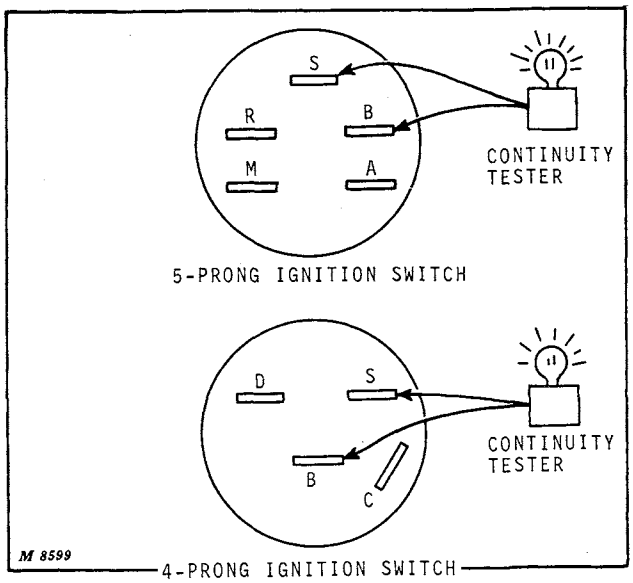


Fig. 16-Testing Key Ignition Switch

1. Connect a continuity tester (with it's own power supply) between battery and solenoid terminals as shown in Figure 16.

2. Turn key to "Start" position. Continuity tester should light. If tester does not light, replace switch.

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 severe arcing across loose field connections.

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 or field.

Litho in U.S.A.

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 16 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.

Installing Battery

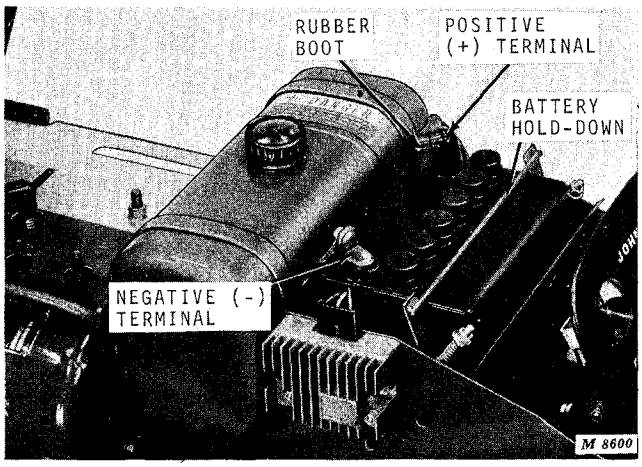


Fig. 17-Installing Battery

Clean and dry battery exterior. Position battery and install battery hold-down, Figure 17.

Attach positive cable to positive (+) battery terminal.

Damage to the alternator 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 above 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

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

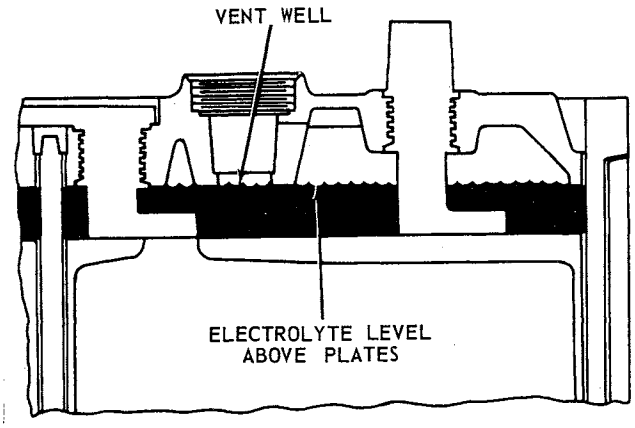


Fig. 18-Proper Level of Electrolyte in Battery Cells

Proper level is normally to the bottom of the ring (filler neck) so that the tops of the battery plates are covered, Figure 18. **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.

Battery Precautions

Disconnect terminal at rectifier-regulator unit when using a charger on the battery, or when "jumping" from another battery. This will eliminate damage to rectifier-regulator if polarity is accidently reversed.

Battery connections should be tight at all times, especially when charging batteries. Loose cables will cause arcing and pitting of the connections and eventual failure.

⚠ CAUTION: Gas from battery electrolyte is flammable. Keep all sparks and fires away from the battery. When charging the battery, gas is created more rapidly. Be sure the room where battery is charged is well-ventilated. To avoid injury from a spark or short circuit, disconnect the battery ground strap when working on any part of the electrical system or engine. This will also prevent accidental starting.

Protect against fire and explosion. During refueling, never touch battery with gas can, hose nozzle or other metal objects. Keep positive battery post covered with rubber boot on end of cable.

Solenoid

The solenoid is a sealed unit; replace when tests prove it defective.

Fasten solenoid to pedestal with bolts, washers and nuts and tighten firmly.

Leads should always be connected correctly. Refer to Wiring Diagrams, Group 5 for correct lead connections.

Neutral-Start Switch (-160,000)

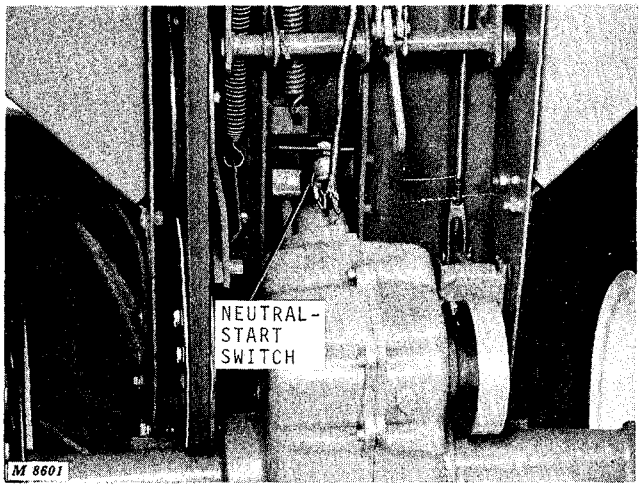


Fig. 19-Neutral-Start Switch Components

Before replacing or repairing the neutral-start switch, be sure to test switch as detailed on page 10-7 and 10-8. A simple adjustment or cleaning may correct the problem.

The late style neutral-start switch with quadrant and return spring may be used as a replacement part on all tractors (Serial No. 100,001-). See Figure 20.

Neutral-Start Switch (160,001-)

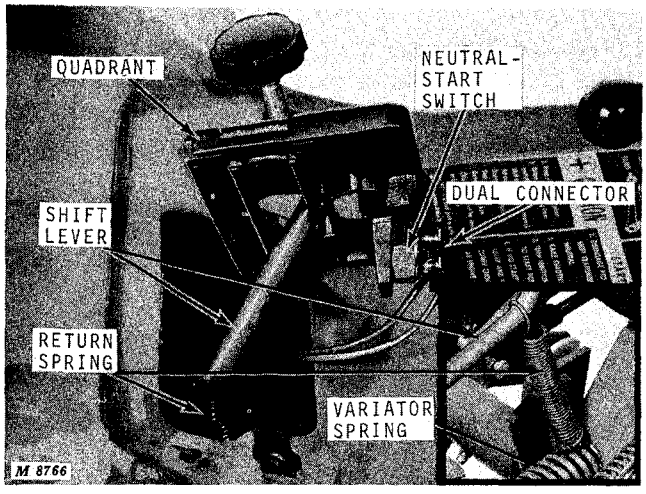


Fig. 20-Neutral-Start Switch and Quadrant

Test switch in the manner shown on page 10-8. Switch must have continuity to be acceptable for use. When replacing switch, turn into quadrant until firmly seated. Adjust quadrant as shown on page 10-7.

Attach wires and lever return spring as shown in Figure 20.

Starter (Wire-Wound Field)

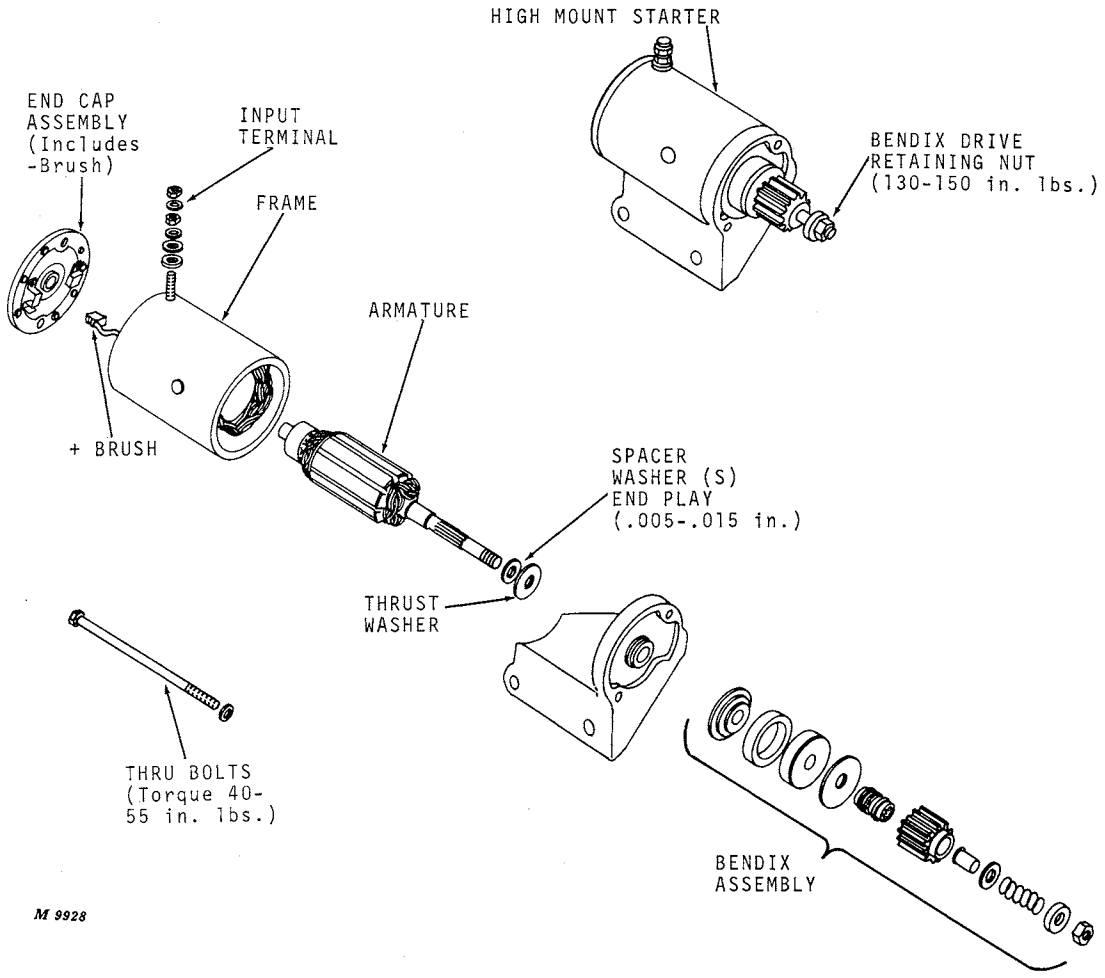


Fig. 21-Components of Starter Motor—Wire-Wound Starter

Removing Starter

Disconnect negative cable from battery.

Disconnect solenoid-to-starter wire from field terminal.

Remove two mounting bolts holding starter to engine block.

Disassembling Starter

Remove two through bolts holding commutator end cap to starter housing. Remove nut from Bendix-type drive assembly and pull armature from starter housing.

NOTE: Be sure to observe the order in which Bendix-type drive assembly parts are removed. Do not lose spacers in drive end cap.

Servicing Starter

Service on the starter should be limited to the brushes, end cap, armature, and Bendix drive assembly. If field coils are found defective, replace starter housing assembly or entire starter.

Brushes

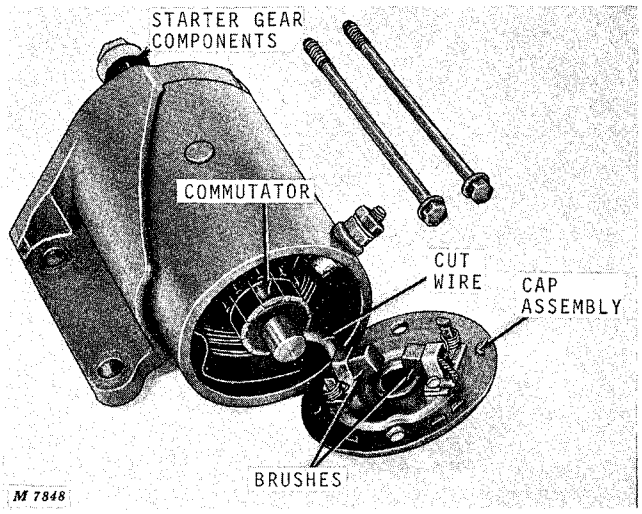


Fig. 22-Brushes and Commutator

If starting motor energizes, but cranks too slowly to induce engine operation, check brushes, Figure 22, for wear or excess dirt. Remove two thru bolts and loosen end cap.

Replace brushes, Figure 22, if unevenly worn or worn to less than 5/16-inch length. Always replace springs and brushes whenever a starter is reconditioned. This can be done by replacing entire end cap assembly with brush kit or by replacing brush kit alone.

If brush kit only is installed, drill out old rivet from end cap and rivet new negative brush in its place. Peel back insulating material and remove old positive brush from field winding. Solder or clip new brush to same field wire. Rewrap insulating material around new joint.

If a new end cap is to be installed, attach positive brush to field coil wire as described above. End cap contains a pre-installed negative brush.

To complete installation of brushes, see assembly instructions.

Armature

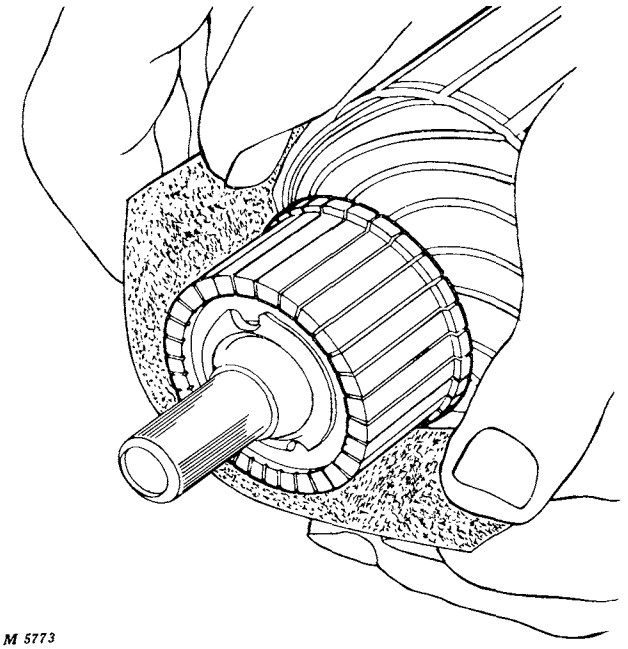
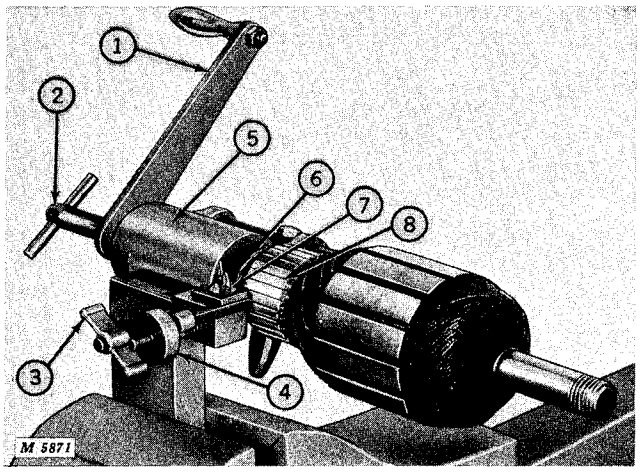


Fig. 23-Cleaning Commutator

When inspecting the starter armature, also note the condition of the commutator. If the commutator is glazed or dirty, it can be cleaned by placing the armature in a lathe. While the armature is rotating, hold a strip of number 00 sandpaper lightly against the commutator, moving the sandpaper back and forth, Figure 23.

Turning Down Commutator



1-Operating Handle
2-Removal Screw
3-Clamp Wing Nut
4-Tool-Adjusting Nut
5-Frame
6-Mandrel
7-Lock Wing Nut
8-Commutator

Fig. 24-Armature and Lathe

Blow out all dust after sanding the commutator. If the commutator is rough, out of round, has high mica, or is extremely dirty, it will require "Turning down" in a lathe and the mica undercut between the bars, Figure 24.

Never clean armatures in a degreasing-tank or with degreasing compounds because damage to the insulation might occur.

Check armature on growler for opens, shorts or grounds. See page 10-6 for test procedure and repair recommendations.

Field Coils

Do not attempt to service field coils, unless cause is a broken lead or brush wire or bad connection. Replace complete starter if field is defective.

Bendix Drive Assembly

If Bendix drive assembly drive pinion or splined sleeve are damaged, replace entire assembly.

Assembling Starter

Install armature into starter body (field coils). Place spacing washers over armature shaft and slide drive end assembly cap into place.

NOTE: Use 0.005, 0.010 and 0.020-inch spacing washers, as required, to obtain an armature end play of 0.005 to 0.015 inch.

Apply a light coat of SAE 10 oil to end cap bushing.

To install end cap, insert a snap ring pliers or needle nose pliers between end cap and starter housing. Spread brushes and carefully guide brushes over commutator.

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

Install thru bolts and tighten to specifications (40 to 55 in-lbs).

Install Bendix drive assembly on armature shaft in order shown in Figure 21, page 10-13.

Tighten nut to specification (130 to 150 in-lbs). Apply a light coating of SAE 10 oil to armature shaft splines.

Turn starter shaft after assembly to insure that armature turns freely. If binding occurs, it may be necessary to remove a spacing washer. If shaft moves back and forth in starter, additional spacing washers may be required.

Installing Starter

Use only the special mounting bolts (and lock washers) when installing starter.

In addition to securing the starter to the machined surface on the crankcase, these special bolts provide proper alignment of the Bendix drive pinion gear to the ring gear on the engine.

Use of ordinary bolts will allow starter to shift, which could result in clashing and damage to the gears or possible damage to the drive cap which also serves as the mounting bracket.

Starter (Permanent Magnet Field)

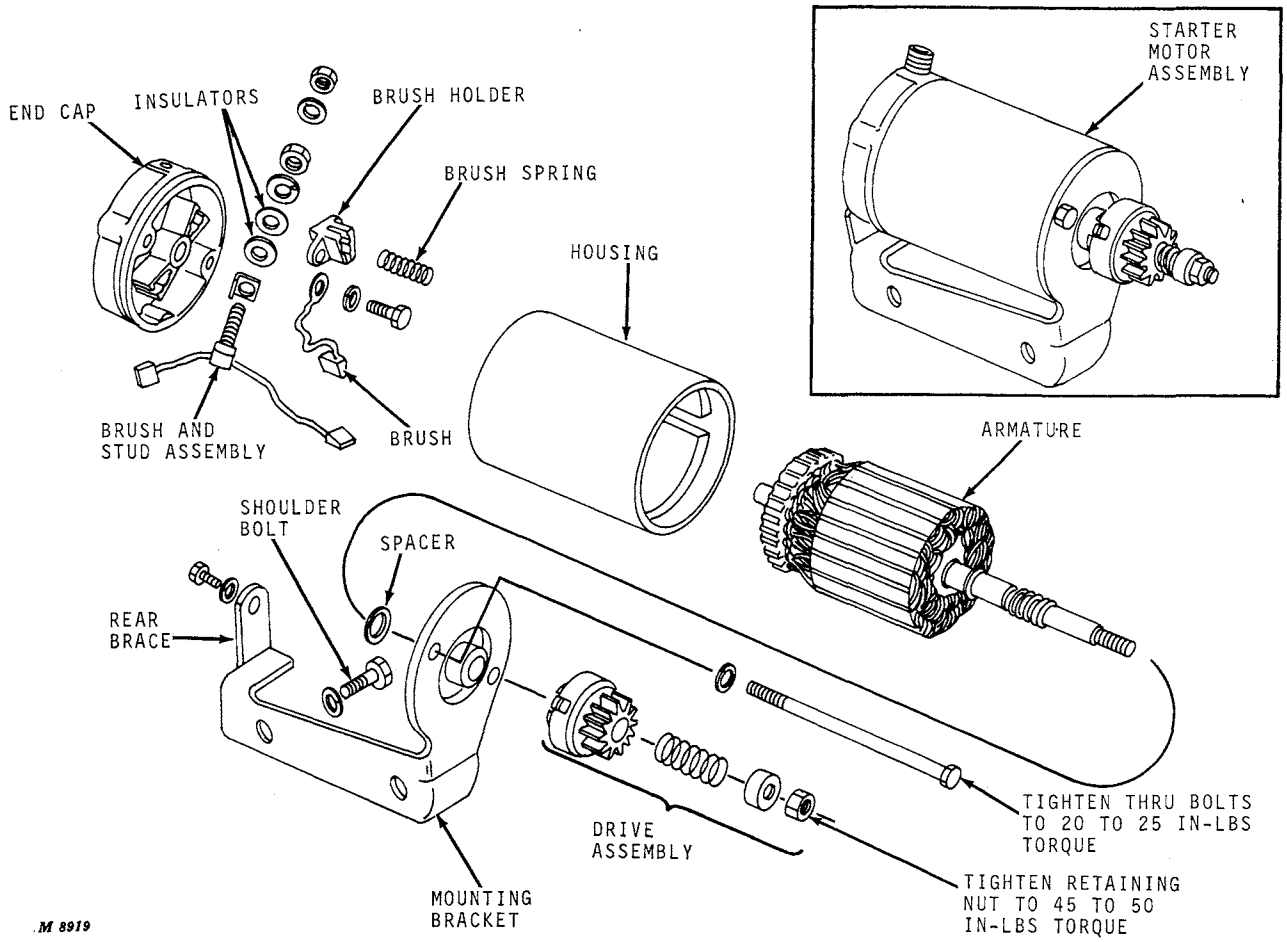


Fig. 25-Starting Motor Components—Permanent Magnet Starter

Repair to the starter is limited to the brushes, end cap, mounting bracket, armature and starter drive assembly. Any of these parts can be replaced if found to be defective. Fields in this starter are permanent magnets and no service is required or possible. Any serious defect in the magnets will require a complete starter replacement.

Removing Starter

Disconnect negative cable from battery.

Disconnect solenoid-to-starter cable from starter terminal.

Remove two mounting bolts holding starter to engine block.

Disassembling Starter Drive

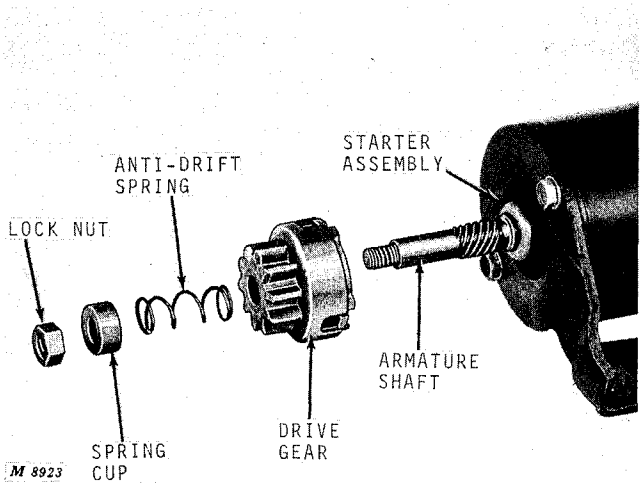


Fig. 26-Starter Drive

Hold drive gear and unscrew 3/8-inch lock nut. Remove drive parts from armature shaft.

Disassembling Starter

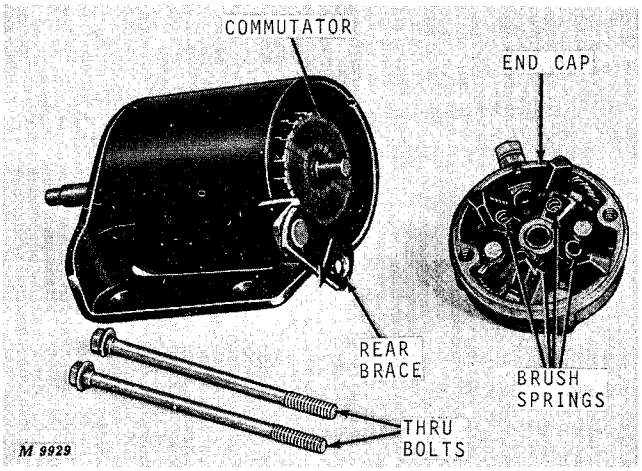


Fig. 27-Disassembling Starter

Remove the two thru bolts which hold the end caps to starter housing. Remove 1/4 x 5/8-inch cap screw from rear brace. Tap rear brace downward (see arrow) to provide room for removal of end cap.

Remove end cap carefully, Figure 27, to avoid losing brush springs which will pop out when end cap is removed.

Inspection

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

Inspect bearing in mounting bracket and end cap. Also inspect armature shaft. If armature shaft has excessive play in bearings replace mounting bracket and end cap. 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

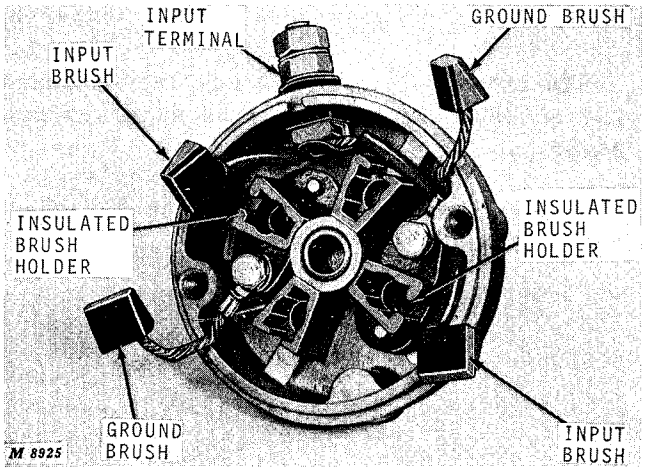


Fig. 28-Replacing Brushes

Replace brushes whenever they show any appreciable 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, Figure 28, place these brushes in the non-insulated brush holders.

Assembling Starter

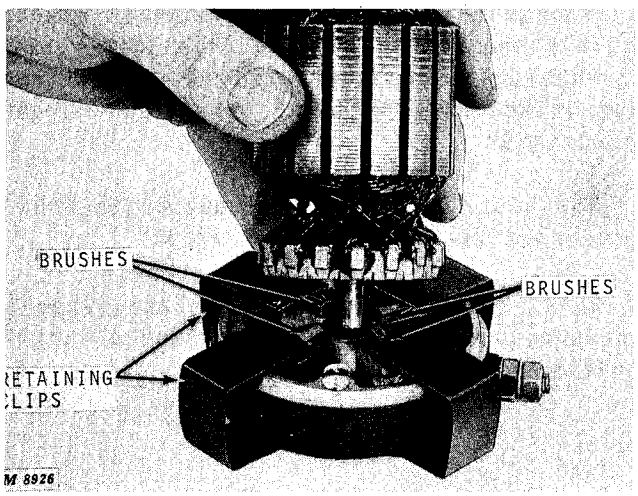


Fig. 29-Installing Brushes

The preparation of the starter end cap is the first step in the assembly of the starter.

First, 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, Figure 29.

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

Place armature into end cap, Figure 29, and remove U-shaped brush retaining clips.

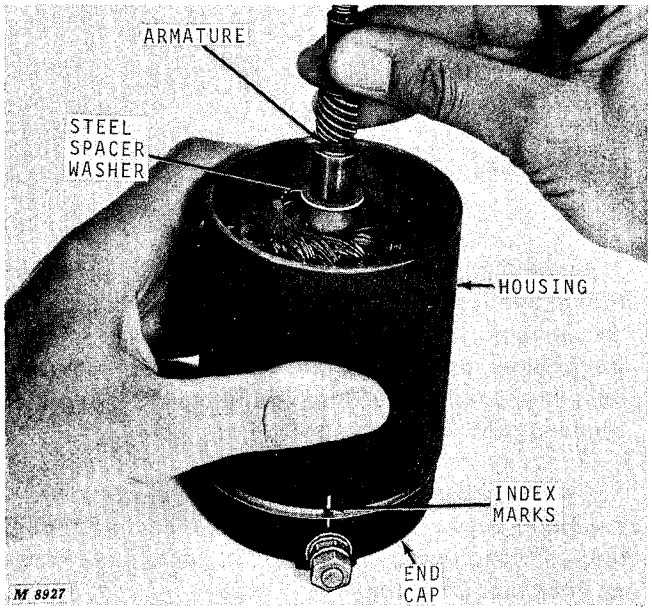


Fig. 30-Aligning Index Marks

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, Figure 30.

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.

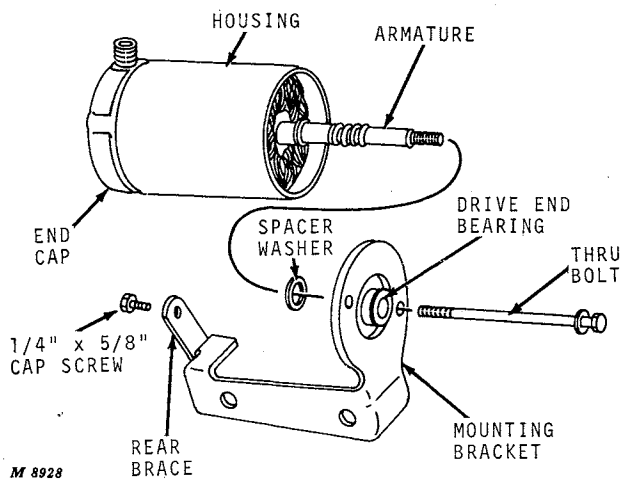


Fig. 31-Assembling Starter to Bracket

Place steel spacer washer onto armature shaft and insert armature shaft through drive end bearing of mounting bracket, Figure 31.

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

Position rear brace and install 1/4 x 5/8-inch cap screw and tighten firmly.

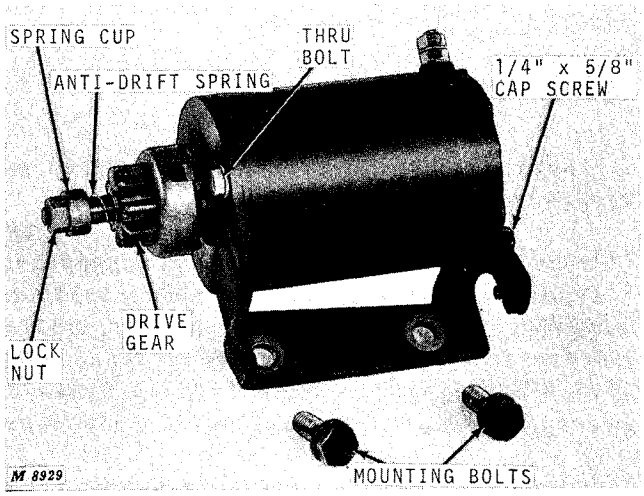


Fig. 32-Installing Drive Assembly

Install starter drive gear, anti-drift spring, spring cup, and lock nut on armature shaft. Torque lock nut to 45 to 50 inch-pounds, Figure 32.

Install starter on engine, using the two shoulder bolts previously removed. Attach solenoid to starter wire and tighten all bolts firmly.

Group 15
MAGNETO IGNITION SYSTEM
110 TRACTOR–KOHLER K181S ENGINE

PRINCIPLE OF OPERATION

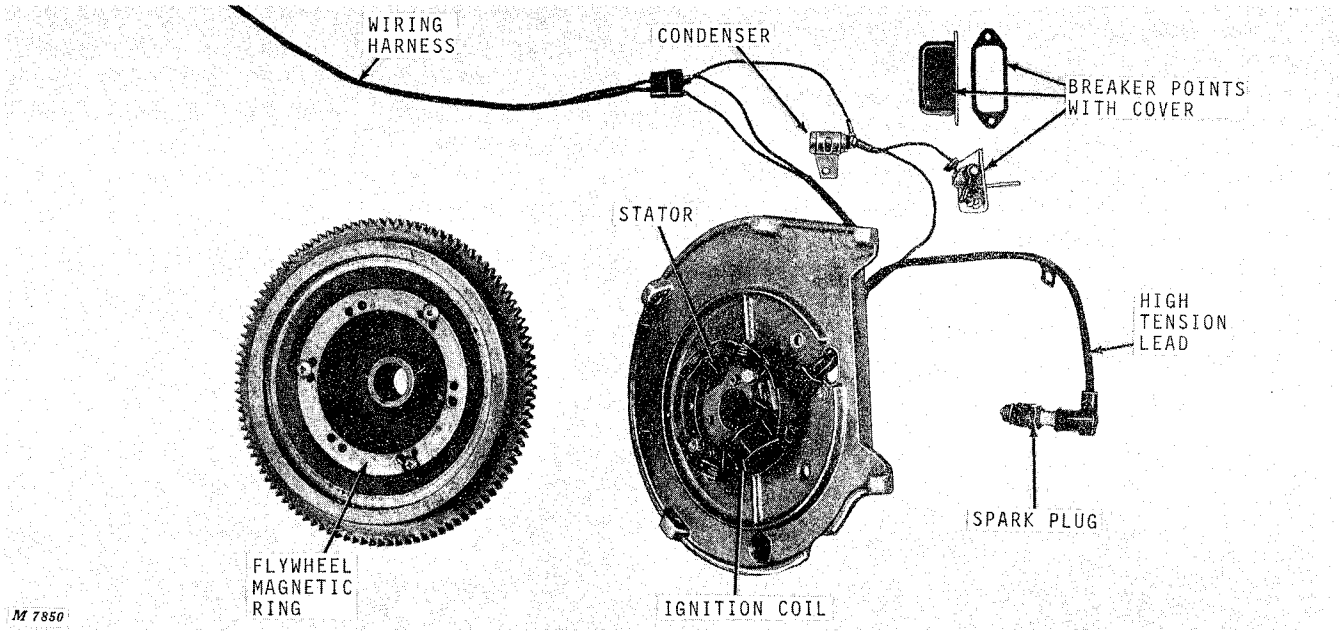


Fig. 1-Ignition System Components

The 110 Tractor features a flywheel magneto-alternator type ignition system. The system, Figure 1, includes 12 flywheel-mounted magnets, the stator, ignition coil, breaker points, condenser, high tension wire, 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

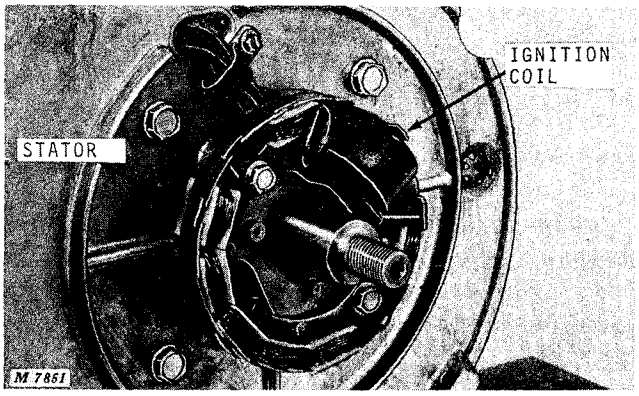


Fig. 2-Ignition Coil

The ignition coil, Figure 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

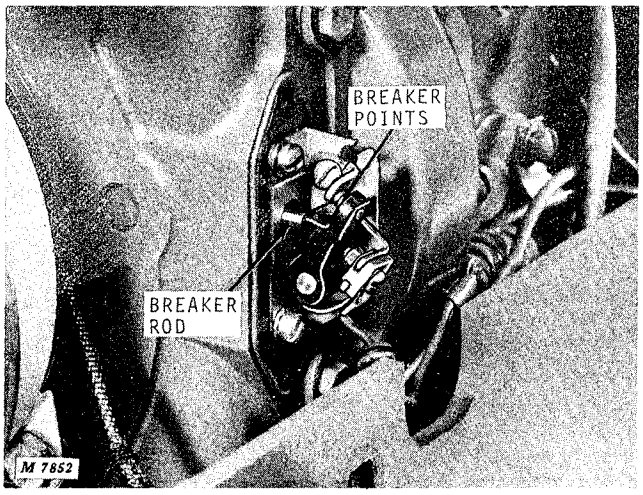


Fig. 3-Breaker Points

Engine operation is greatly affected by the condition and adjustment of the breaker points, Figure 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.

Spark Plug

A spark plug consists mainly of two electrodes separated from each other by an air 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. This spark ignites the fuel-air mixture and starts the combustion process in the cylinder.

The air gap between electrodes is critical as it affects the entire range of engine performance—starting, idling, accelerating, power and top speed.

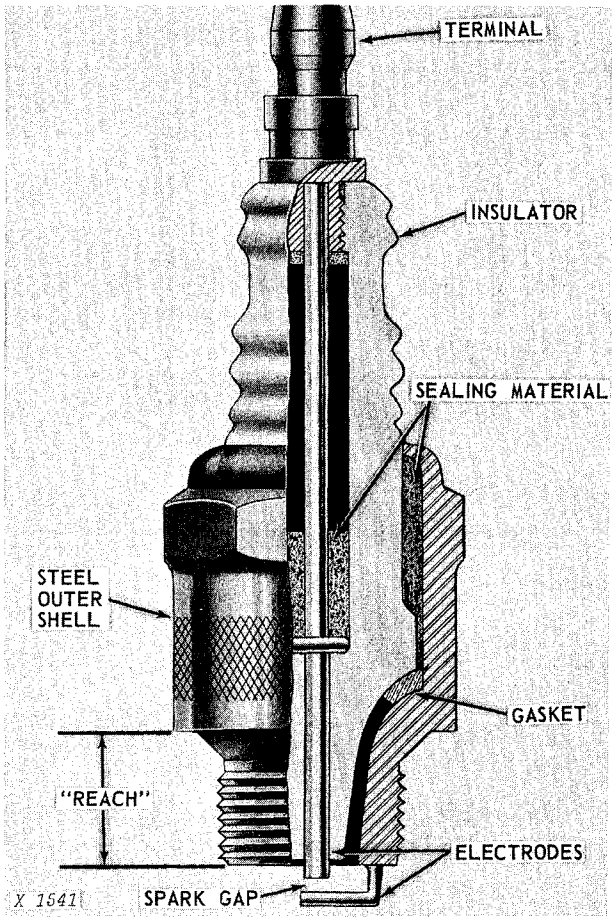


Fig. 4-Cutaway View of Spark Plug

Spark plugs, Figure 4, must operate within a specific 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.

Condenser

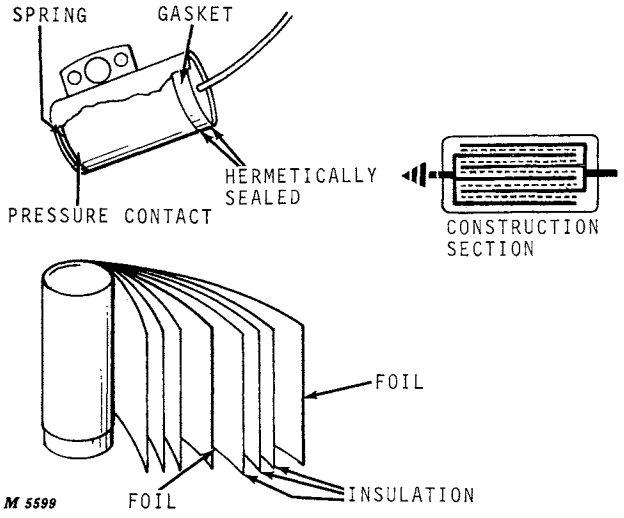


Fig. 5-Cutaway View of Condenser

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, Figure 5, 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.

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

ANALYSIS

Spark Plug

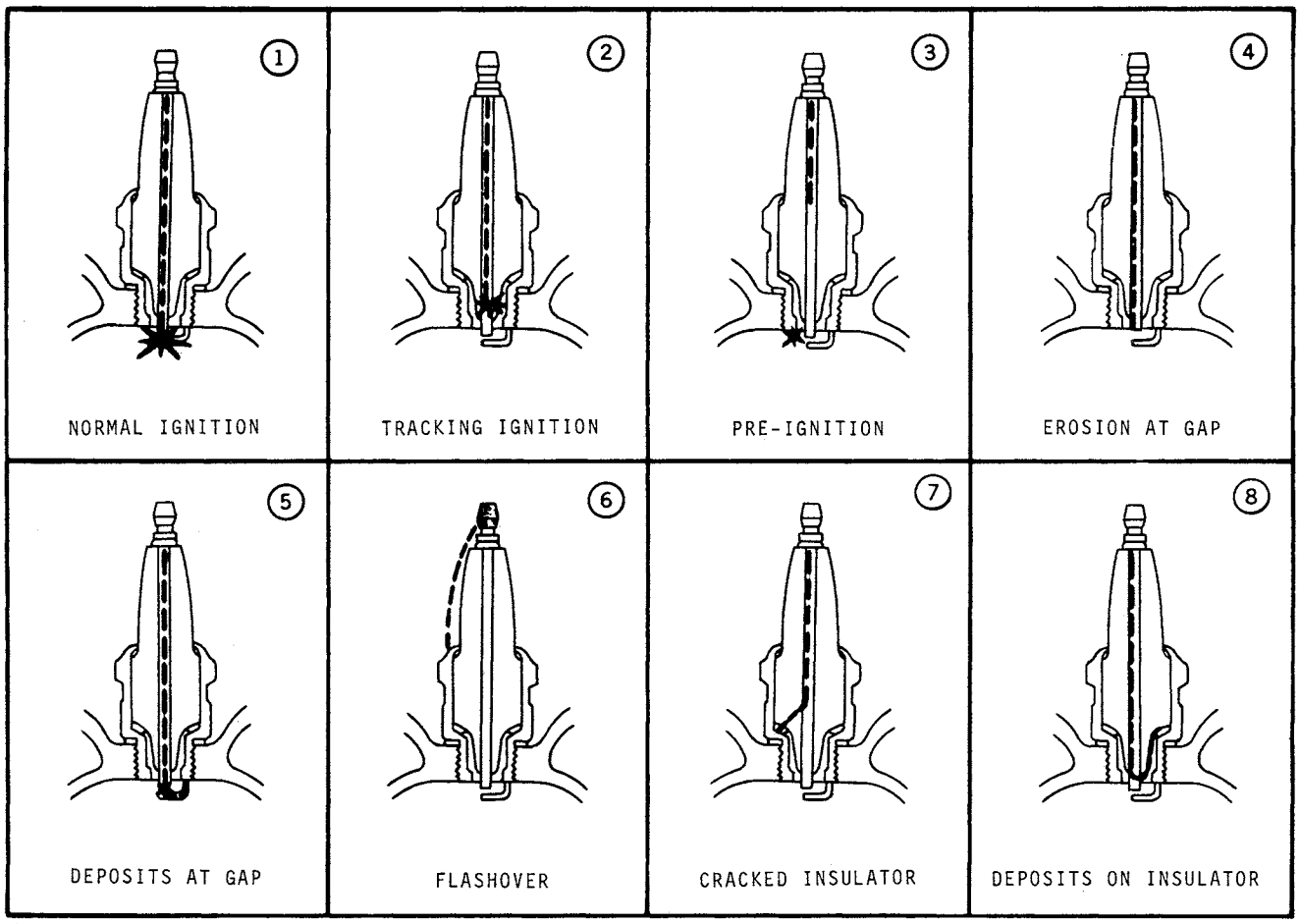


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Fig. 6-Spark Plug Misfires

In nearly every case of spark plug failure, the cause must be corrected before new or reconditioned spark plugs are installed. Otherwise, servicing will again be needed in a short time.

Figure 6 illustrates what takes place in a faulty spark plug during ignition. The numbered statements below tell what causes the misfirings.

1. *Normal ignition* occurs when a spark of adequate energy is delivered at the correct instant across the electrode gap as shown.

2. *Tracking ignition* occurs when the spark, jumping from one deposit "island" to another, ignites the fuel charge at some point along the insulator nose. The effect is to retard ignition timing.

3. *Pre-ignition* occurs when some surface in the combustion chamber becomes hot enough to fire the fuel-air mixture before the spark occurs.

4. *Erosion* of the plug electrodes may prevent voltage from jumping the gap.

5. *Deposits* may have bridged the gap so that the coil voltage is drained away without a spark occurring.

6. *Flashover* is caused by moisture or dirt or by a worn out terminal boot. This allows voltage to short across the outside of the insulator.

7. *Cracks* in the plug insulator may allow high voltage to short circuit to the ground.

8. *Deposits* formed on the *insulator* surface may drain away voltage.

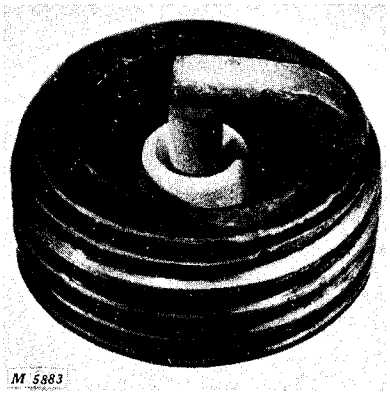


Fig. 7-Normal Operation

A spark plug with brown to grayish-tan deposits and slight electrode wear is normal, and indicates good engine adjustments, Figure 7.

A spark plug having this appearance may be cleaned, regapped and reinstalled.

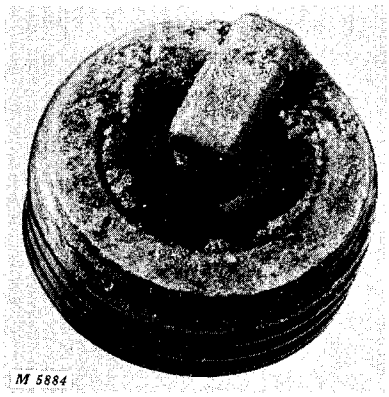


Fig. 8-Oil Fouling

Wet oily deposits, Figure 8, with a minor degree of electrode wear may be caused by oil pumping past worn rings or excessive valve stem guide clearance.

"Break-in" of a new or recently overhauled engine before rings are fully seated may also result in this condition. Usually, the spark plug can be degreased, cleaned and reinstalled. Install a new spark plug if carbon deposit is more than that shown.

Fig. 9-Carbon Fouling

Dry, fluffy, black carbon deposits, Figure 9, may result from over-rich carburetor adjustments. A clogged air cleaner can restrict air flow to the carburetor causing rich mixtures.

Poor ignition output (faulty breaker points, weak coil or condenser) can reduce voltage and cause misfiring. A fouled spark plug is the result, not the cause of this problem. After the cause has been eliminated, the spark plug can be cleaned, regapped and reinstalled.

Fig. 10-Deposit Fouling

Red, brown, yellow and white colored coatings, Figure 10, which accumulate on the insulator are by-products of combustion and come from the fuel and lubricating oil, both of which today, generally contain additives.

Most powdery deposits have no adverse affect on spark plug operation, however, they can cause intermittent missing under severe operating conditions, especially at high rpm and under heavy loads.

If insulator is heavily coated, install a new spark plug.

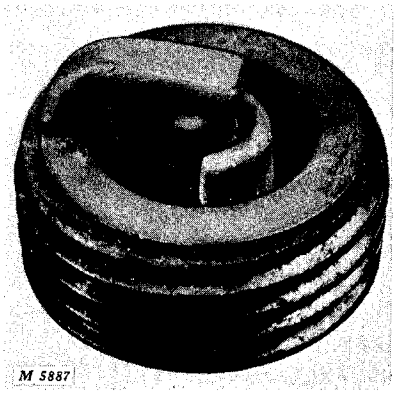


Fig. 11-Heat Shock Failure

Heat shock, Figure 11, is a common cause of broken and cracked insulator tips. Incorrect ignition timing and a poor grade fuel are usually responsible for heat shock failures. Rapid increase in tip temperature under severe operating conditions causes the heat shock and fracture results.

Another common cause of chipped or broken insulator tips is carelessness in regapping by either bending the center wire to adjust the gap, or allowing the gapping tool to exert pressure against the tip of the center electrode or insulator when bending the side electrode to adjust the gap. See specifications and install a new spark plug.

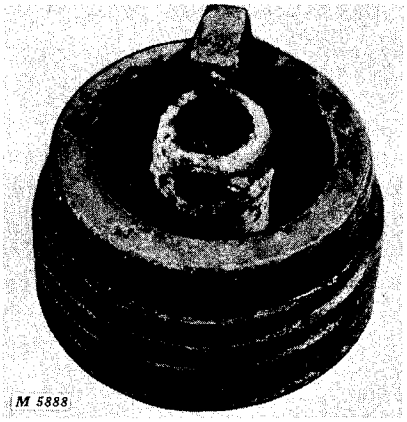


Fig. 12-Pre-Ignition

Pre-ignition, Figure 12, causing burned or blistered insulator tip and badly eroded electrodes indicates excessive overheating. Clogged shrouding, dirty engine fins and sticky valves can also result in pre-ignition. Lean fuel-air mixtures are an additional cause. See specifications and install a new spark plug.

Breaker Points

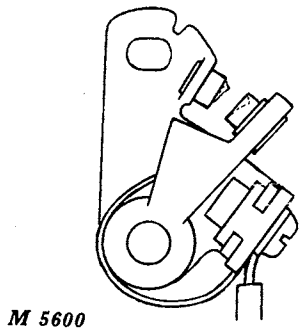


Fig. 13-Burned Breaker Points

Breaker points burned in a manner such as those in Figure 13, 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.

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.

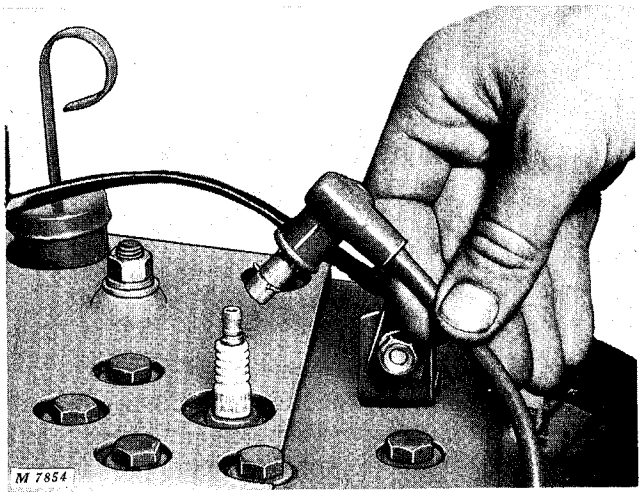


Fig. 14-Testing Ignition System

Remove the high tension lead at the spark plug, Figure 14. Bend a paper clip and insert it into boot. Hold the end of the clip about 1/16 to 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.

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.

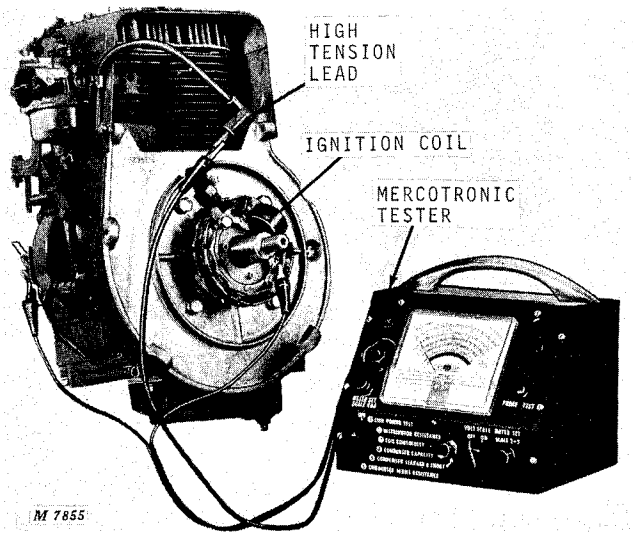


Fig. 15-Testing Coil Power

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

1. Coil power test, Figure 15
2. Coil high speed test
3. Coil surface insulation test
4. Coil continuity test
5. Coil ground test

Testing Condenser

The test unit, Figure 15 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

Litho in U.S.A.

INSPECTION

Spark Plug

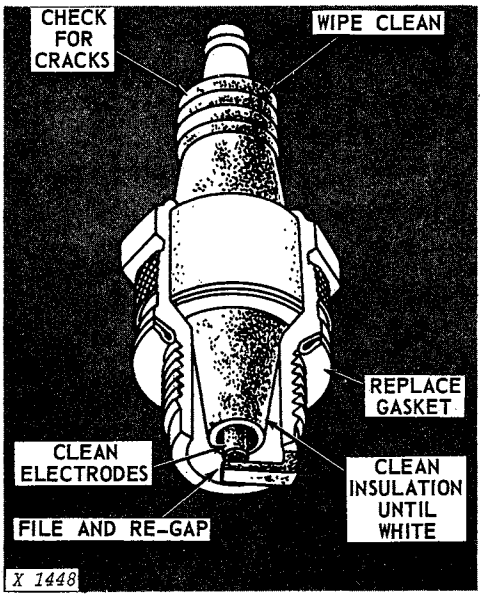


Fig. 16-Maintenance of Spark Plugs

Engine misfire or generally poor operation is often caused by a spark plug in poor condition or by one with improper gap setting. Plugs fail for various reasons. Refer to spark plug analysis on pages 15-4 thru 15-6 to determine if plug should be cleaned and regapped or replaced, Figure 16.

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

Spark Plug

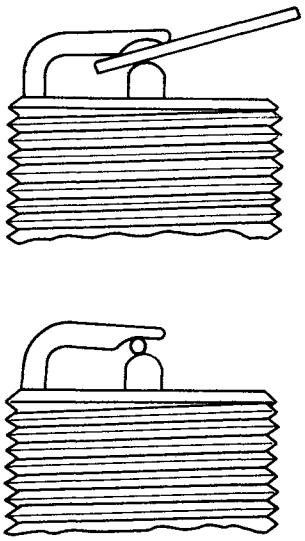


Fig. 17-Checking Spark Plug Gap

Remove, inspect and regap spark plug to 0.025-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 Figure 17.

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.

Good operating conditions are indicated if plug has 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 clogged air cleaner or improper carburetor adjustment. See Figure 9, page 15-5.

Ignition Coil

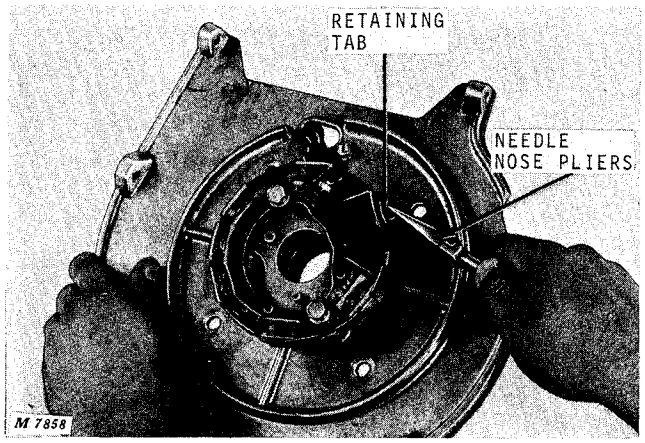


Fig. 18-Removing Ignition Coil

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

The ignition coil is secured to a stator post by a tab, Figure 18, 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 15-20 of Section 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.

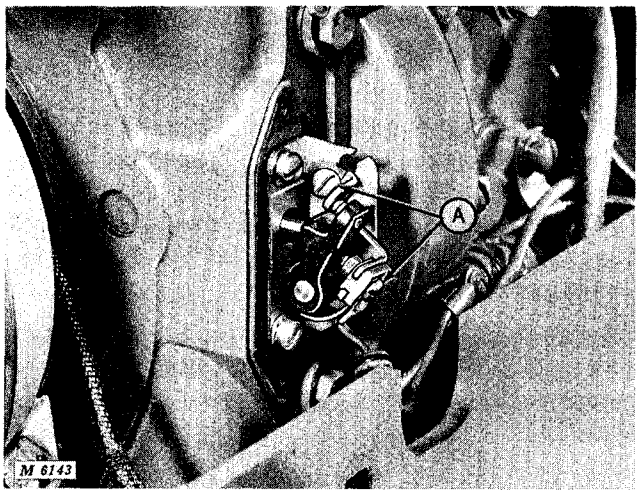


Fig. 19-Replacing Breaker Points

Replace burned or pitted breaker points, Figure 19. 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.

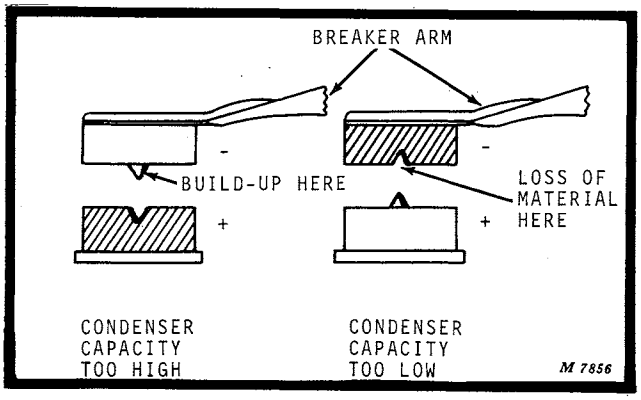


Fig. 20-Breaker Point Build-Up

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, Figure 20.

Condensers can be tested off the tractor on test units such as Figure 21. Follow manufacturer's recommendations to make the following condenser tests:

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

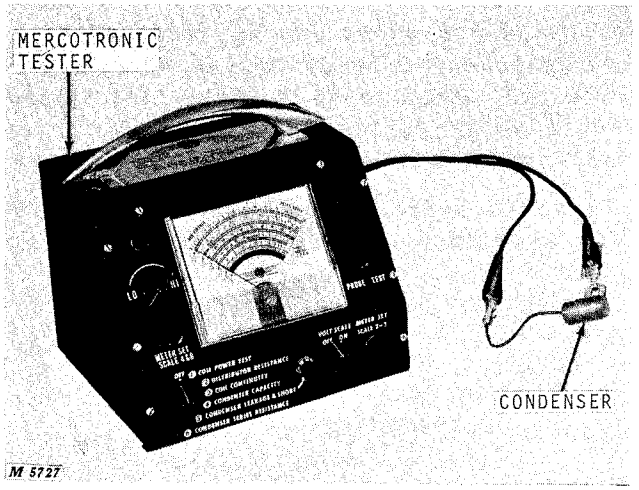


Fig. 21-Testing Condenser Capacity

ADJUSTMENTS

Adjusting Breaker Points

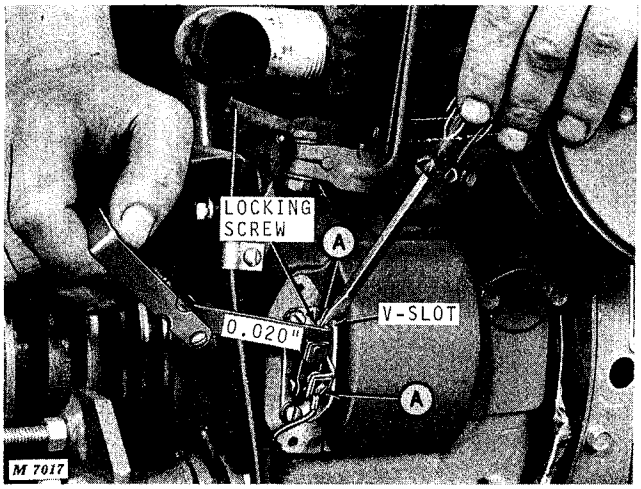


Fig. 22-Adjusting Breaker Points

The engine is equipped with a timing sight hole in the blower housing, Figure 23. 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, Figure 22.

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)

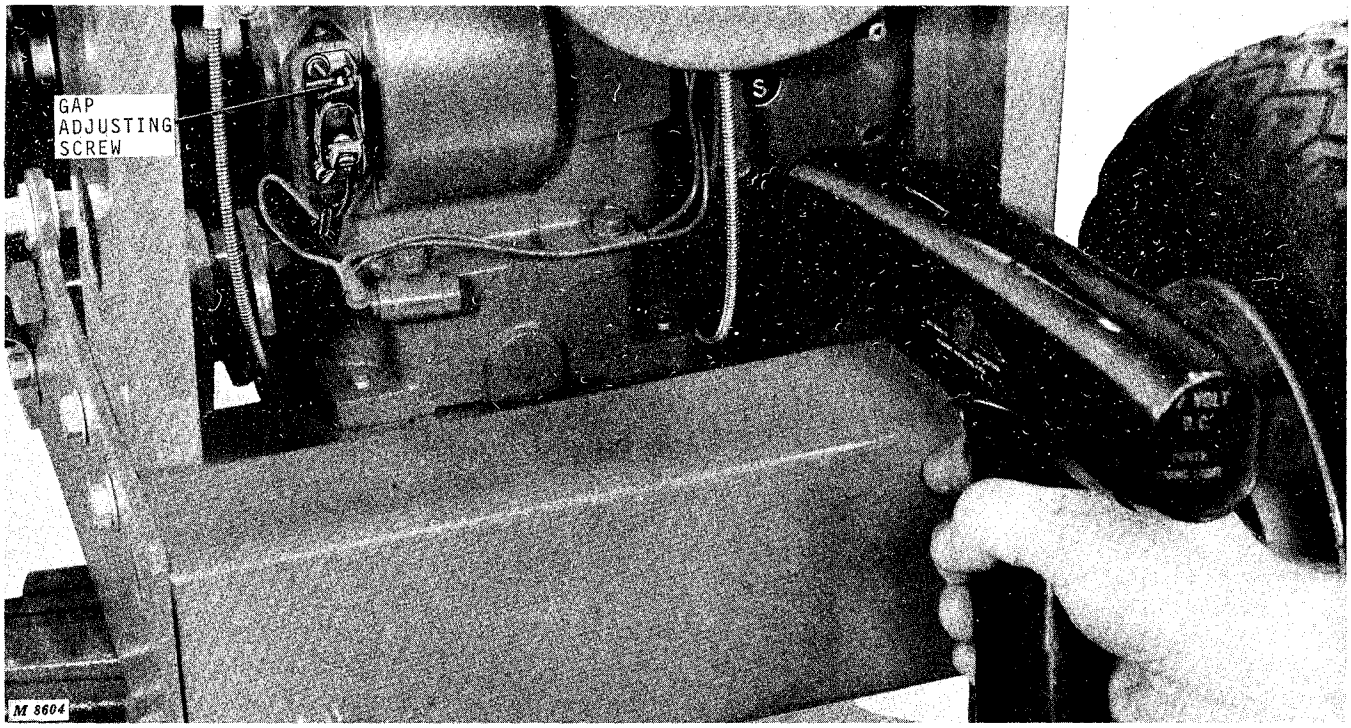


Fig. 23-Timing Ignition with Timing Light

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, Figure 23.

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	0.025 inch
Breaker Point Gap	0.018 to 0.022 inch
Coil Resistance	
Primary Windings	2 to 3 ohms
Secondary Windings	8,000 to 10,000 ohms
Condenser	
Capacity-Microfarads	.18 to .23 mfds

Litho in U.S.A.

Group 20
BATTERY IGNITION SYSTEM
112 TRACTOR–KOHLER K241AS ENGINE
112 TRACTOR—TECUMSEH HH100 ENGINE
(Serial No. 161,772-)

PRINCIPLE OF OPERATION

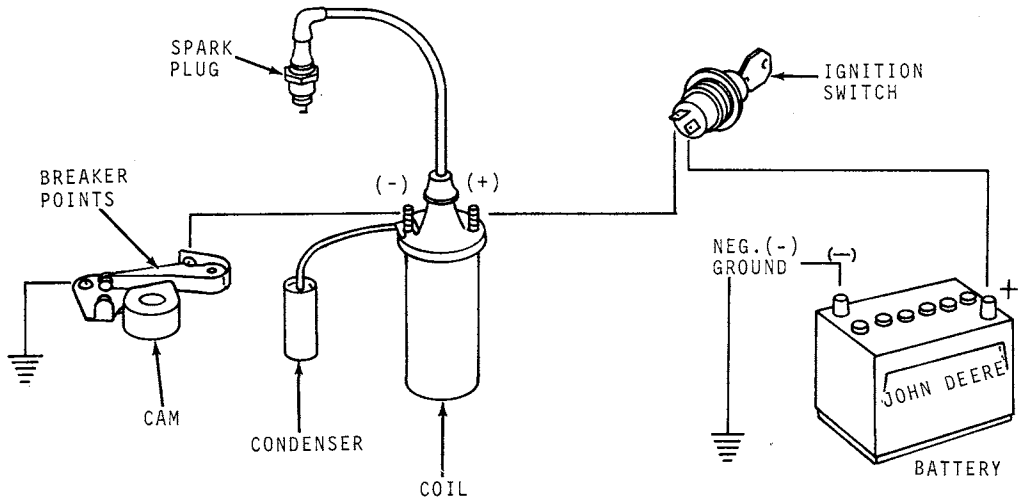


Fig. 1- Ignition System Components

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 for ignition of the fuel mixture.

Here is how the battery ignition works:

With the ignition switch closed, current flows from the battery to 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 electric circuit is broken and the magnetic field breaks down.

With the collapse of the primary field, the magnetic lines of force cut across the conductor coil windings and a high voltage is induced in the secondary windings.

A spark occurs at the spark plug, which is in the secondary circuit. The high voltage developed in the secondary coil causes the current to jump across the spark plug electrode gap, thus 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.

Ignition Coil

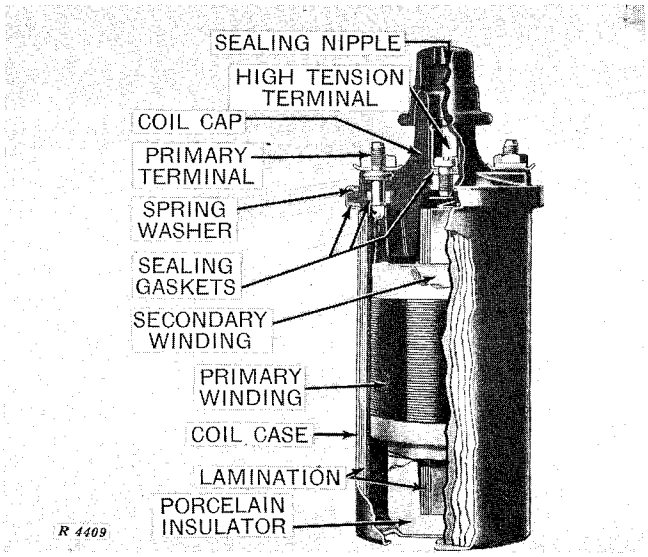


Fig. 2-Ignition Coil

The ignition coil is a pulse transformer that transforms or steps up the low battery or generator 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 (the breaker points are closed), a magnetic field is built up around both the primary and secondary coils. When the primary circuit is de-energized (the breaker points are opened), 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

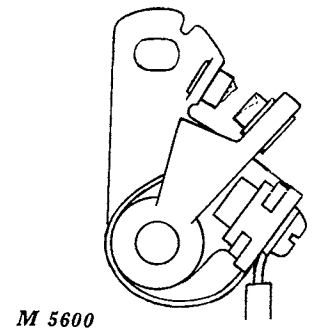


Fig. 3-Breaker Points

Engine operation is greatly affected by the condition and adjustment of the breaker points, Figure 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

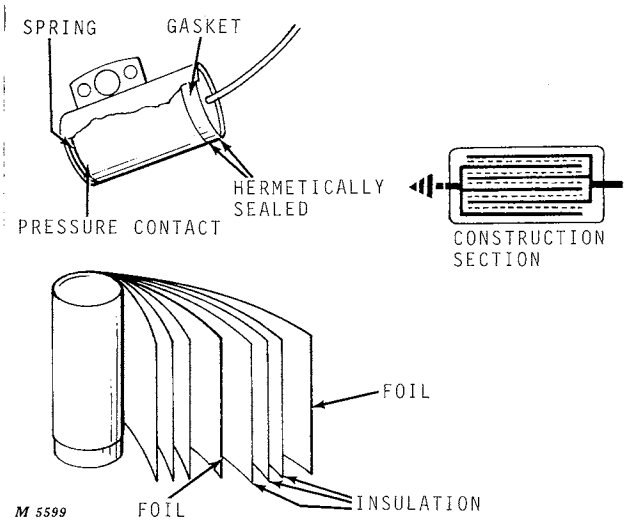


Fig. 4-Cutaway View of Condenser

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.

Litho in U.S.A.

Spark Plug

A spark plug 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. This 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.

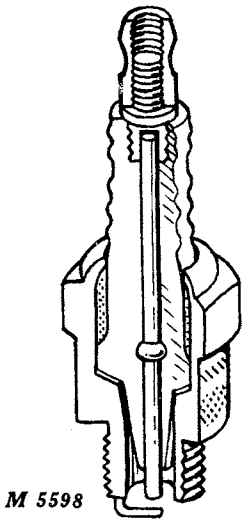


Fig. 5-Spark Plug

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.

Battery and Spark Plug

Refer to Groups 10 and 15 for information on the battery and spark plug.

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 and solid state 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

Instructions are provided for testing electrical components on and off the tractor. The purpose of the tests is to isolate the cause of trouble in the ignition system. A complete diagnosis guide is in Group 5 of this Section.

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

Many servicemen prefer to have their electrical components tested by professionals using highly complex test equipment. Good automotive repair centers provide this service. The coil, voltage regulator, solenoid and alternator stator used on the 110 and 112 Lawn and Garden Tractors can be tested on automotive test equipment.

The following test procedures are recommended for dealers having their own test equipment. Equipment needed is listed on page 20-10.

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 test section should contradict those of the manufacturer.

Testing Battery

Refer to page 10-4 of this section to test the battery.

Testing Coil

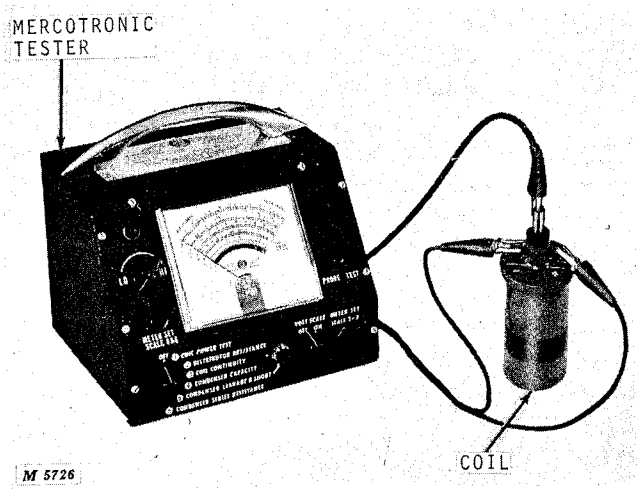


Fig. 6-Testing Coil Power

The ignition coil is either in a satisfactory condition or it is 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, Figure 6, to test coil. The analyzer will also test the condenser and solenoid as well as checking voltage and amperage. See equipment manufacturers operators hand book for specifications for particular unit being tested.

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.

Testing 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.

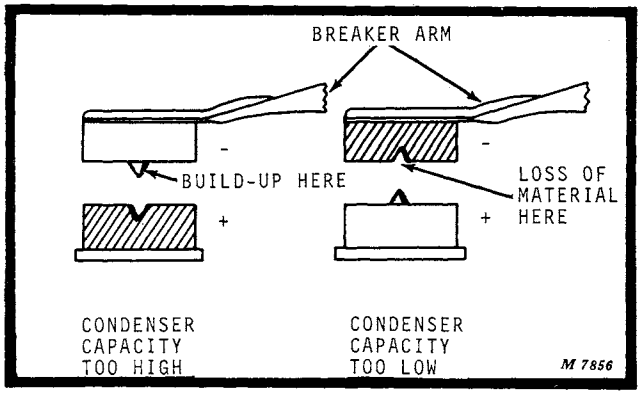


Fig. 7-Breaker Point Build-Up

If badly 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, Figure 7.

Condensers can be tested off the tractor on test units such as in Figure 8. Follow manufacturer's recommendations to make the following condenser tests:

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

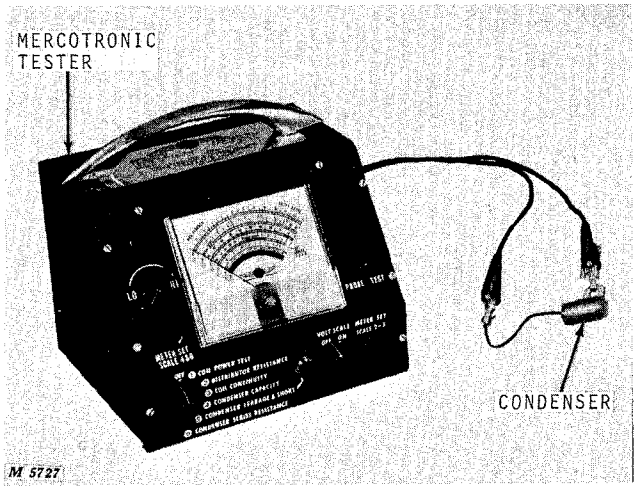


Fig. 8-Testing Condenser Capacity

Testing Spark Plug

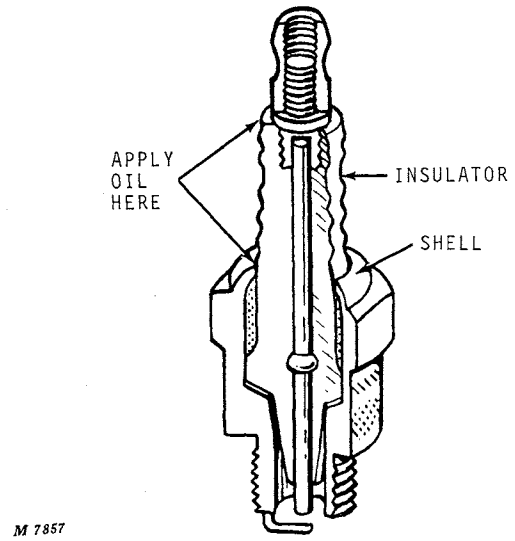


Fig. 9-Spark Plug

Test the plug, Figure 9, for compression leakage at the insulator seal. Apply a coating of oil to the shoulder of the plug where the insulator projects through the shell, and to the top of the plug, where the center electrode and terminal project from the insulator.

Place the spark plug under pressure, either by turning the engine over the compression stroke or in a commercial tester. Disconnect the high tension wire during the test.

Leakage is indicated by air bubbling through the oil. If the test indicates compression leakage, replace plug.

INSPECTION

Spark Plug

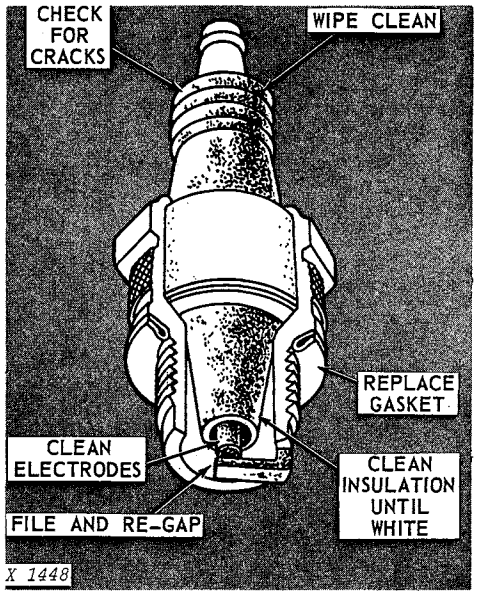


Fig. 10-Maintenance of Spark Plugs

Engine misfire or generally poor operation is often caused by a spark plug in poor condition or by one with improper gap setting. Plugs fail for various reasons. Check to see if the porcelain insulator is cracked or is coated with oil, carbon or other deposits, Figure 10.

This can cause the high voltage ignition impulse to pass from the center electrode to ground without jumping the plug gap. As an engine operates, the electrodes are gradually burned or worn away. Check the gap to see if it has become so wide that the available ignition voltage cannot jump the gap, causing the engine to miss.

Ignition Coil

Inspect coil assembly for damage that may affect its operation. Look especially for cracks, evidence of overheating or other damage.

Condenser

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

REPAIR

Spark Plug

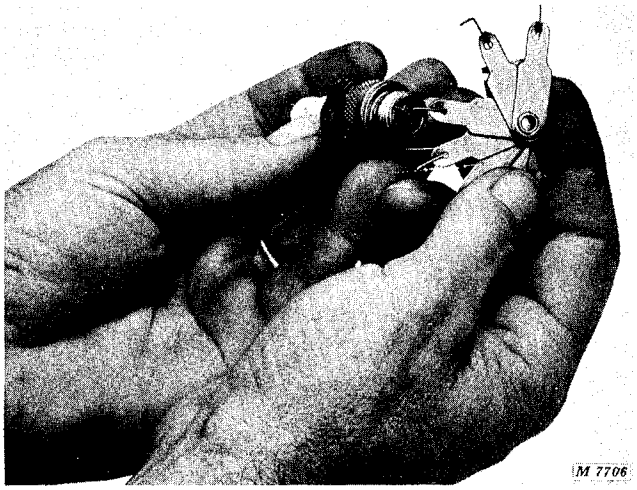


Fig. 11-Checking Spark Plug Gap

Remove, inspect and regap spark plug to 0.020-inch every 100 hours, Figure 11. 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.

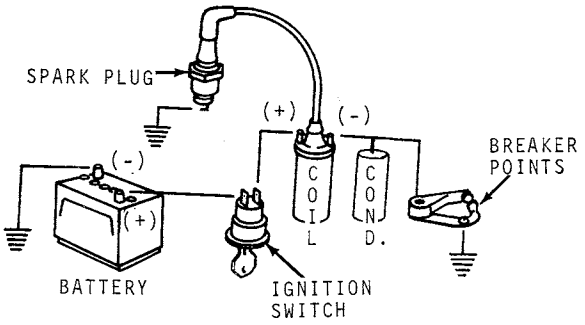
Use a spark plug wrench to remove old plug. Always use a new spark plug gasket when replacing plug. Tighten plug to 15 to 20 ft-lbs torque.

Good operating conditions are indicated if plug has 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 clogged air cleaner or improper carburetor adjustment. See Figure 9, page 15-5 of this section.

Ignition Coil

Coil Polarity



M 8606

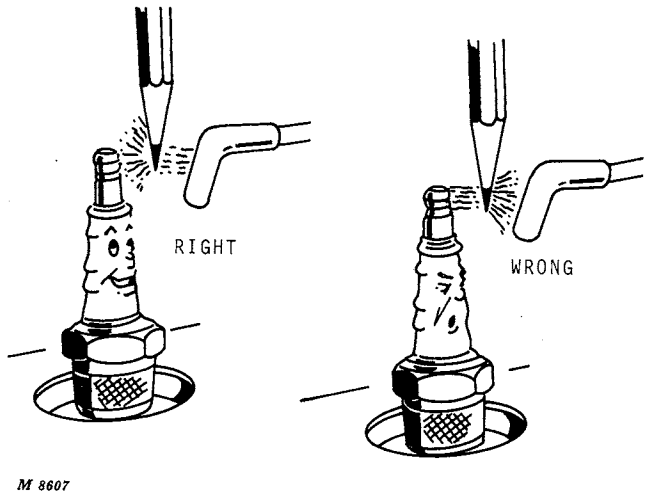
Fig. 12-Correct Polarity Diagram

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 coil that is wired correctly will have the same polarity as the battery, Figure 12. If the battery has a negative ground, the coil negative terminal should be connected to the breaker point lead. If the battery has a positive ground, the coils positive terminal should be connected to the breaker point lead.

The wrong coil polarity makes the center electrode of the spark plug have the wrong polarity. This can cause misfiring as voltage requirements increase.

Checking Coil Polarity



M 8607

Fig. 13-Testing Polarity at the Spark Plug

One method of checking polarity is to connect the negative lead of a volt meter to the spark plug terminal. With the engine running, momentarily touch positive voltmeter lead to a ground. The coil polarity is correct if the meter reads up scale.

Another method is to hold the spark plug wire terminal about 1/4 inch from the spark plug. Insert the lead point of a wooden pencil between lead and spark plug, Figure 13. Spark should flare and turn orange on the plug side of pencil lead if polarity is correct.

A loss of engine power is also evidenced if coil polarity is reversed. Refer to illustrations in Group 5 for detailed electrical wiring diagrams.

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 on the coil. If it is cracked or has bad wiring, it must be replaced.

ADJUSTMENT

Adjusting Breaker Points

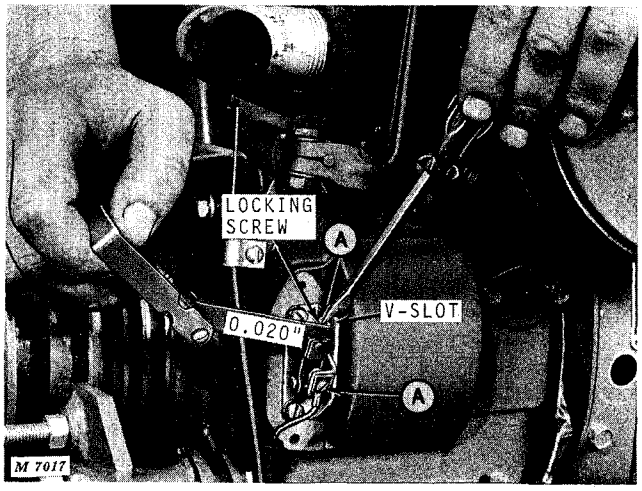


Fig. 14-Adjusting Breaker Points

The engine is equipped with a timing sight hole in the blower housing, Figure 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, Figure 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)

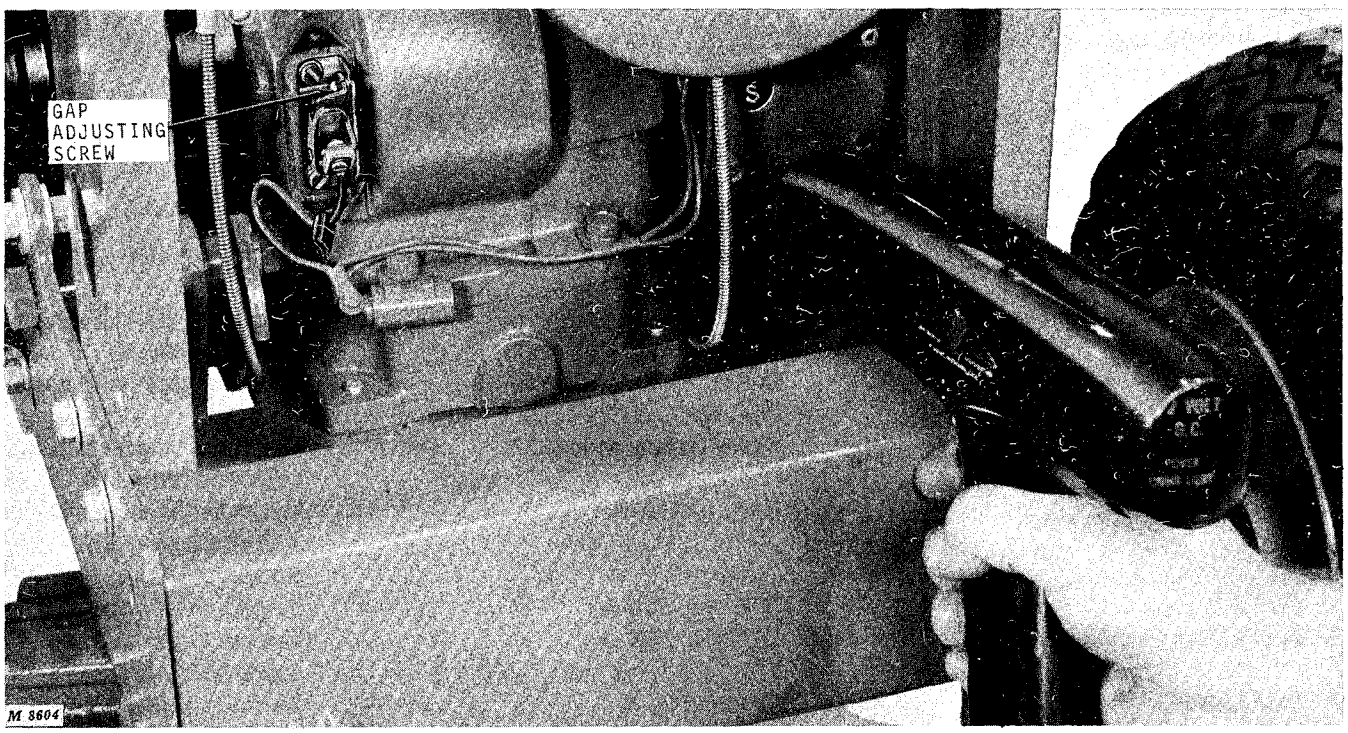


Fig. 15-Timing Sight Hole

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, Figure 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 inch
Breaker Point Gap ..... 0.018 to 0.022 inch

SPECIAL TOOLS

Name	Manufacturer and No.	Use
Hydrometer-Thermometer	Snap on BB-4A	To check battery condition.
Generator-Regulator Tester	Snap on MT-401B	To check generator output and voltage.
Timing Light	Mercotronic Model 65-12DC	To set engine timing.
Battery Charger	Silver beauty model 220	For initial charge and to recharge batteries.
Ignition Point File	Snap on HB-5	To file breaker points and spark plug electrodes.
Feeler Gauge	OTC No. 860-A	To gap breaker points.
Spark Plug Wire Gauge	OTC No. 866	To check gap and regap spark plug.
Test Lamp	Snap on CT-6	Test circuits.
Magneto Analyzer	Mercotronic Model 98 Mercotronic Instruments Corporation 215 Branch St. Almont, Michigan	Test coil condenser, solenoid, battery voltage and check continuity.

Group 25
SOLID STATE IGNITION SYSTEM
112 TRACTOR—TECUMSEH HH100 ENGINE
(Serial No. 100,001-161,771)

PRINCIPLE OF OPERATION

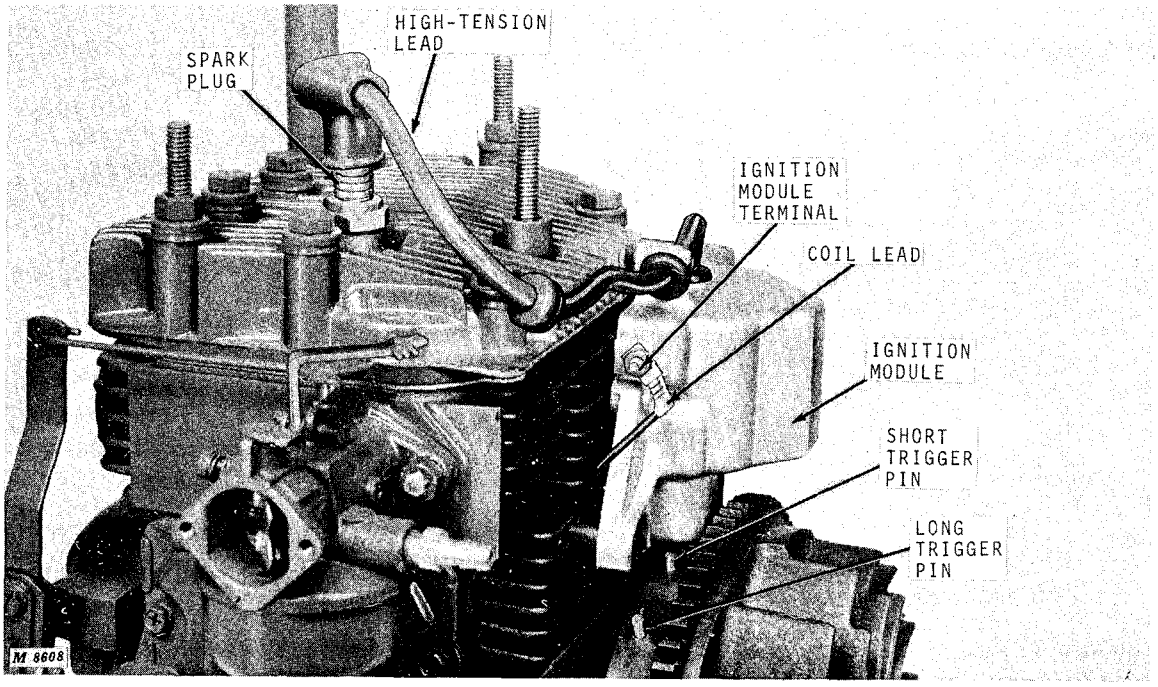


Fig. 1-Ignition System Components

The Solid State Ignition System, Figure 1, consists of the following features:

1. Solid state transistor circuitry.
2. No moving parts.
3. Faster and hotter spark.
4. Longer spark plug life.
5. No breaker points or condenser to service.
6. Fixed timing—no adjustment required.

A solid state ignition system functions somewhat like the magneto in one respect; that is, the power sources are alike. Both systems receive ignition current from the flywheel magnets and ignition input coils.

Current from the input coil is directed to a diode rectifier, located in the ignition module. This current is stored momentarily in a capacitor until required. A trigger coil induces a small current into the system which in turn closes a rectifier switch.

Two steel pins positioned in the outer rim of the flywheel perform the triggering and timing functions.

The current which is released from the capacitor by the silicon controlled rectifier (SCR) is routed to the ignition output coil where it is stepped up enough to jump the spark plug gap.

This particular solid state ignition system places all components into a cast aluminum housing and seals the entire unit with plastic. This unit will be referred to as the Ignition Module in this manual.

Service on this type ignition system is limited to setting of trigger air gap and replacement of the ignition module and the stator and coil assembly.

Litho in U.S.A.

TESTING

Perform the following tests and check the components listed below. If this fails to correct the problem, replace the ignition module.

1. Ignition coil and stator.
2. Flywheel.
3. Ignition module.
4. High tension lead (spark plug).
5. Spark plug.

Testing Ignition Module

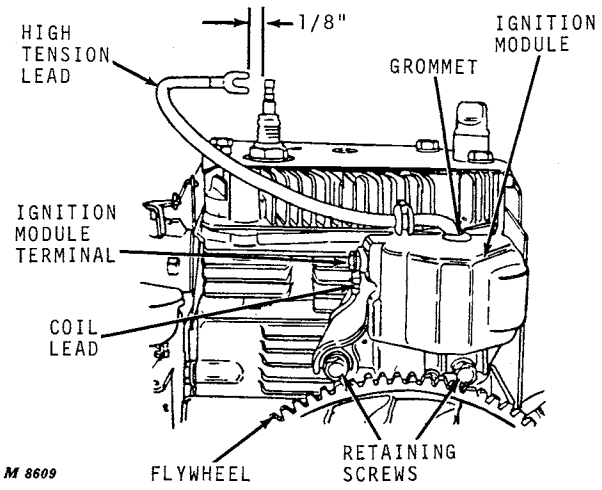


Fig. 2-Testing Ignition Module

Test ignition by using a test plug or hold the high tension lead terminal 1/8 inch from the spark plug, Figure 2. Crank the engine over rapidly. If a good blue spark jumps the gap, the ignition system is functional.

If no spark is present make the following checks.

Check high tension lead for a ground out or a disconnect at the ignition module.

Check the ignition coil lead and the connection to ignition module terminal.

Checking Air Gap

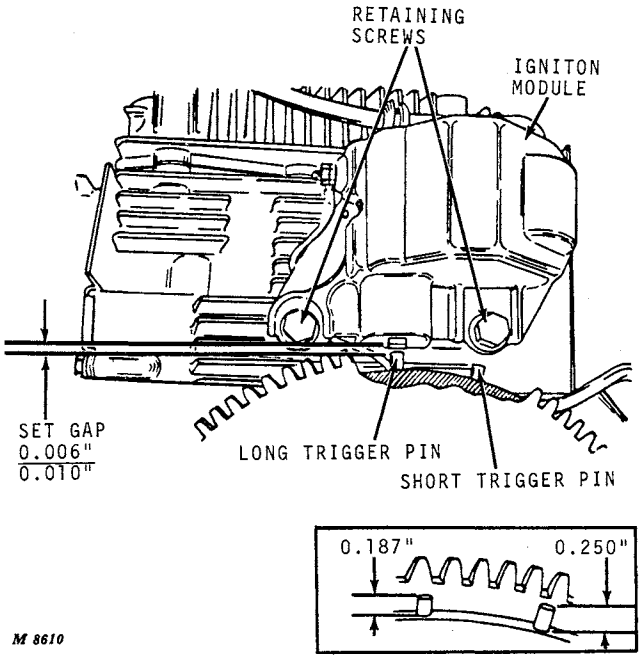


Fig. 3-Adjusting Air Gap

Adjust the system so that 0.006 to 0.010 inch clearance exists between the ignition unit and the long trigger pin in the flywheel.

To adjust, loosen the retaining screw and move the unit to find the proper gap.

If the gap cannot be adjusted, check trigger pin length. The short trigger pin should extend 0.187 inch from the mounting surface.

The long trigger pin should extend 0.250 inch from the mounting surface.

Remove the flywheel and drive the pin(s) in or out the required amount.

Testing Ignition Coil

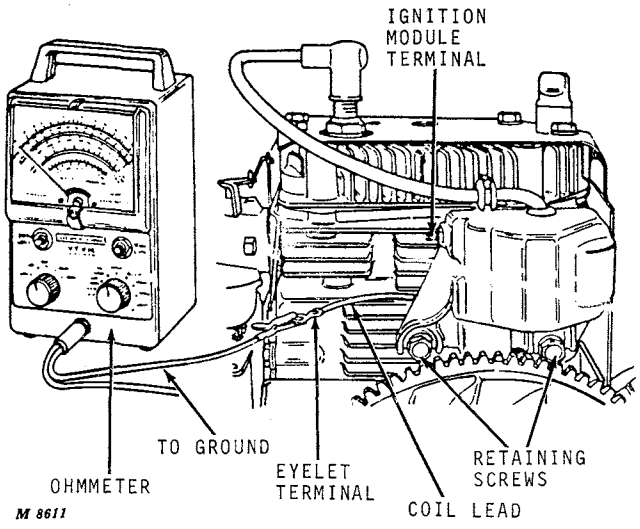


Fig. 4-Ignition Coil Test

Remove the coil lead from the ignition module terminal. To check series resistance of the ignition coil, attach leads from a standard ohmmeter to the lead eyelet terminal and to ground, Figure 4.

If resistance is below 400 ohms, replace the stator assembly which includes the ignition coil.

If coil resistance is above 450 ohms, replace the ignition module.

NOTE: The ignition coil cannot be replaced separately.

REPAIR

Replacing Stator Assembly

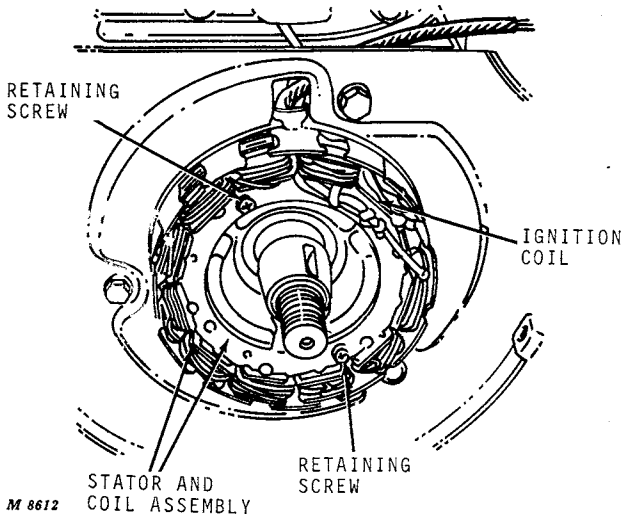


Fig. 5-Replacing Stator Assembly

To replace stator assembly remove two retaining screws and disconnect wire leads, Figure 5. Reverse procedure to install new stator assembly.

NOTE: Refer to Magneto Ignition system for diagnosing malfunctions. Section 40, Group 15.

Replacing Ignition Module

To replace the ignition module, remove blower housing and two retaining screws, Figure 4. Install a new module with the two retaining screws and connect wire leads. Adjust air gap as shown in Figure 3.

SPECIFICATIONS

Component	Dimension
Trigger Pin Air Gap	0.006 to 0.010 inch
Trigger Pin Height	
Long Pin	0.250 inch
Short Pin	0.187
Spark Plug Gap	0.030 inch
Ignition Coil Resistance	400 ohms
Ignition Module Resistance	400 to 450 ohms

Litho in U.S.A.

Group 30
CHARGING SYSTEM

PRINCIPLE OF OPERATION

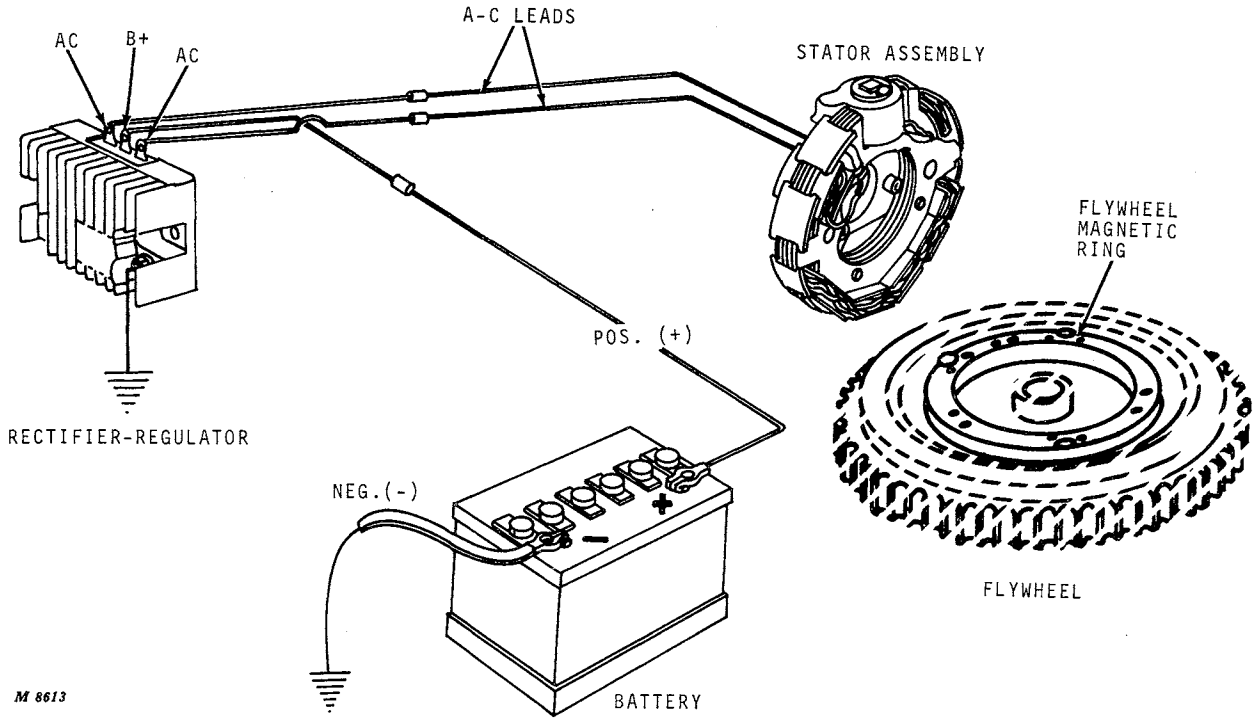


Fig. 1-Principle of Alternator Operation

Alternator

An alternator system, Figure 1, supplies electrical energy to charge the 12-volt battery. The battery, in turn, furnishes energy for cranking, lights, and other accessories.

The 10-ampere alternator features (1) a permanent magnetic ring bolted 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 magnetic ring is composed of 12 permanent magnets imbedded in a cast ring. These high strength magnets are arranged between pole pieces providing an equal number of north and south magnetic poles.

The magnetic ring, bolted to the inside rim of the flywheel rotates around the stator.

As the magnetic ring rotates about the stator, an alternating current is generated in the stator winding. This alternating current is routed to a rectifier-regulator where it is converted to direct current. Direct current conversion is required as the battery will not accept alternating current because of its electrical polarity.

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.

Litho in U.S.A.

Rectifier-Regulator

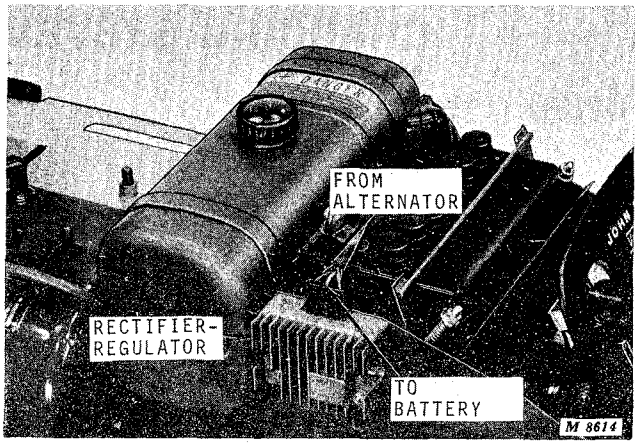


Fig. 2-Rectifier-Regulator

The alternating current produced in the alternator is changed to direct current in the rectifier-regulator unit, Figure 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 full-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.

REGULATOR WIRING CHANGE

110 Tractor (Serial No. 100,001-105,757)
112 Tractor (Serial No. 100,001-107,385)

The following wiring changes are recommended for the above tractors (1) if not previously accomplished and (2) if battery discharging is encountered when tractors are not operated for a prolonged period.

This procedure places the regulator into the accessory circuit, which switches off with the key. This eliminates any chance of back drain through the regulator.

Remove negative cable from battery to prevent shorting. Remove positive cable and battery hold-down clamp. Lift battery from tractor.

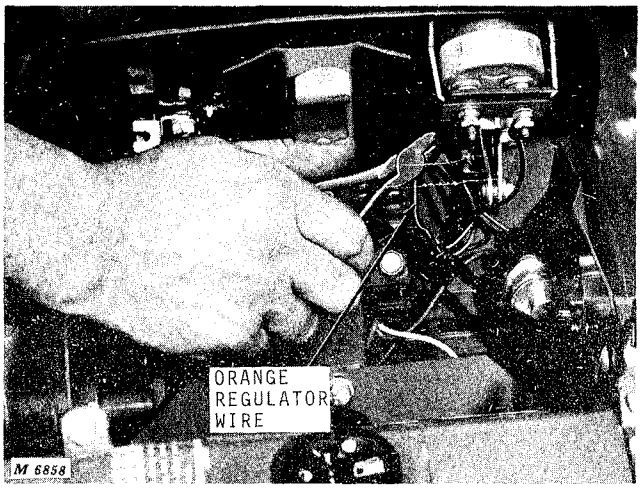


Fig. 3-Cutting Regulator Wire

Cut orange wire from regulator as close to the molded rubber eyelet as possible, Figure 3.

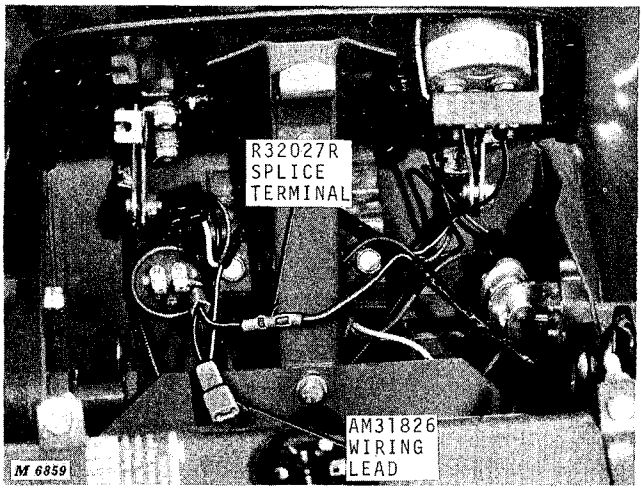


Fig. 4-Attaching Wires to Ignition Switch, Using AM31826 Wiring Lead

Install an AM31826 Wiring Lead, Figure 4, on end of orange wire. Use a standard connector such as an R32027R Splice Terminal found in the AR30963R Spark Plug Cable and Lead Kit.

Install male blade on accessory post of ignition switch.

If you have the AR30963R Spark Plug Cable and Lead Kit and wish to service a tractor without using the AM31826 Wiring Leads, proceed as follows:

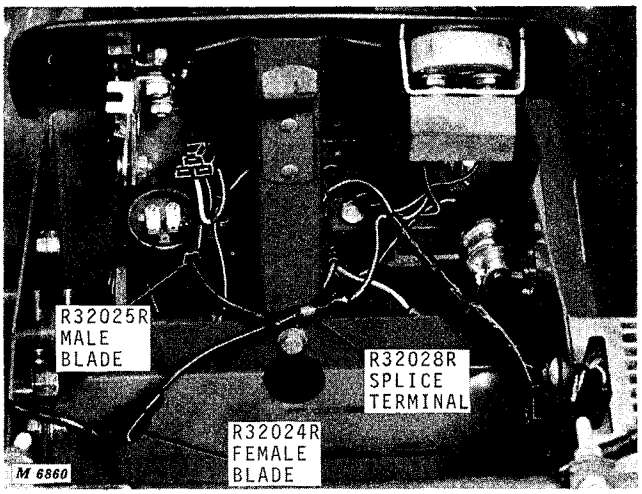


Fig. 5-Attaching Wires to Ignition Switch, without AM31826 Wiring Lead

Remove insulation from the ends of an R32024R Female Blade with Lead and an R32025R Male Blade with Lead, Figure 5. Splice bare wires together and thread into an R32028R Splice Terminal.

Thread bare end of orange regulator wire into other end of splice terminal. Crimp the splice terminal over the wire and tape. Attach male blade to the accessory post on the ignition switch.

NOTE: 3-Blade Connector is removed from switch in Figures 4 and 5 for illustration purposes only.

Accessories normally attached to the ignition post may be connected in the female blade outlet. If no accessories are to be used, place tape over the outlet to prevent accidental shorting.

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.

Many servicemen prefer to have their electrical components tested by professionals using highly complex test equipment. Good automotive repair centers provide this service.

The following test procedures are recommended for dealers having their own test equipment. Equipment needed is listed at the end of this section.

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 test section contradict those of the manufacturer.

Testing Circuit Wiring

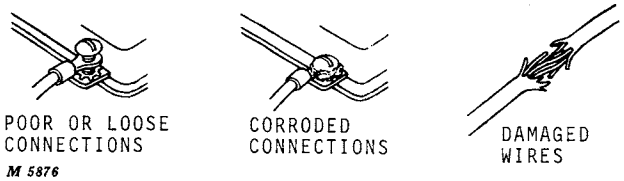


Fig. 6-Faulty Wiring

The wiring, Figure 6, in the circuit is just as important a part of the charging system as the electrical units themselves. Undersize wire or loose connections between the regulator and battery or poor ground connections between the battery and alternator will cause a lowering of the charging rate to the battery.

TESTING—Continued

High resistance resulting from loose or corroded connections in the charging circuit between the alternator and regulator will result in a high voltage at the alternator and may cause premature failure of the regulator.

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. 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 in a full state of charge. See page 10-4 of this section.

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

Quick Check of Charging System

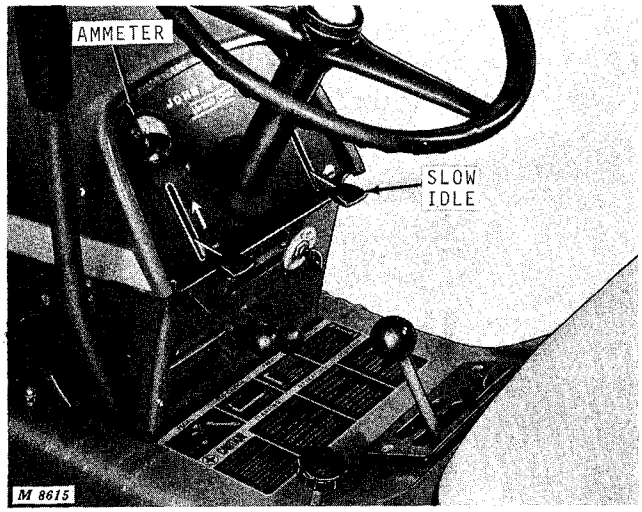


Fig. 7-Quick-Testing Charging System

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

Run at slow idle, Figure 7. Place load on charging system by turning on lights, if tractor is so equipped. 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, proceed to make the following tests to determine electronic component which has failed.

When testing the charging system of the tractor, use the following sequence:

Checking Rectifier-Regulator Fuse

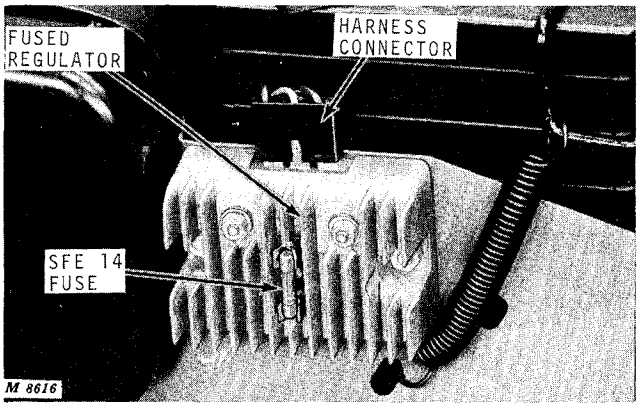


Fig. 8-Checking for Blown Fuse

It is important to inspect for a blown SFE-14 fuse in the rectifier-regulator, Figure 8, before proceeding to test the charging system.

Replace fuse and inspect for original cause of system short or overload.

AC Voltage Test

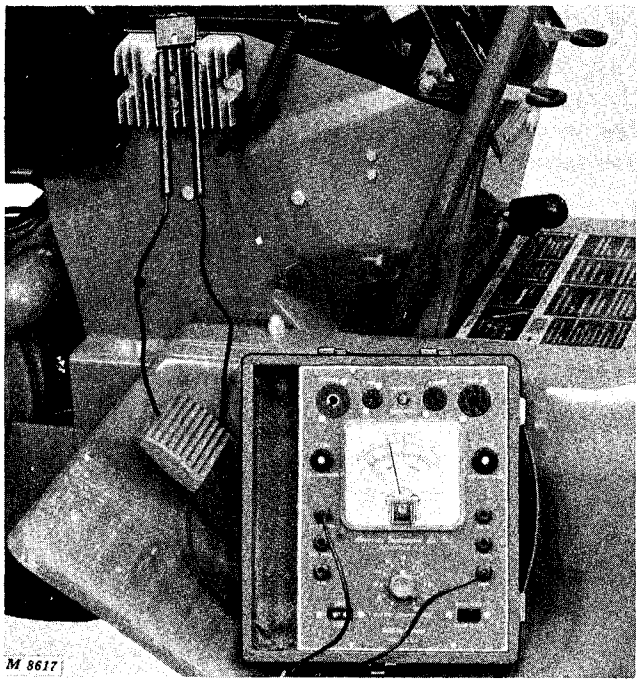


Fig. 9-Checking AC Voltage

Start engine. Remove 3-prong connector from rectifier-regulator unit. Insert leads from AC voltmeter into the two outer plug connections. Check voltage recorded with engine running at full speed (no load), Figure 9.

Alternator should supply 28 to 32 volts to the regulator.

If no charge is being received by the battery (0 ammeter reading) and voltage is substantially below 28 volts, the stator is defective and should be replaced.

If no charge is being received by the battery (0 ammeter reading) and voltage is more than 25 to 28 volts, the stator is producing properly. Therefore, by process of elimination, the rectifier-regulator must be at fault.

DC Voltage Test

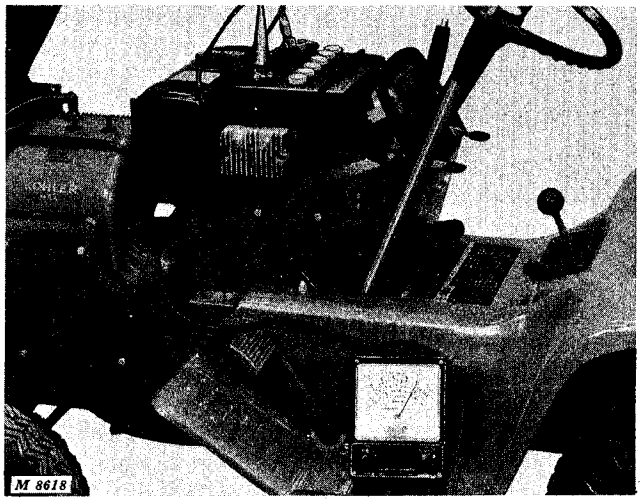


Fig. 10-Checking Battery and Regulator Condition

To check regulator output, run engine at full speed (no load). Check the positive terminal to ground with a direct current voltmeter, Figure 10. If reading is more than 14.7 volts, rectifier-regulator is not functioning properly. Replace regulator.

DC Amperes Test

To check amperage, battery must be in need of some charge value. If battery is partially discharged, proceed. If not, remove spark plug wire and crank engine 15 seconds to partially discharge battery. Install spark plug wire.

CAUTION: Never start an engine through a test meter.

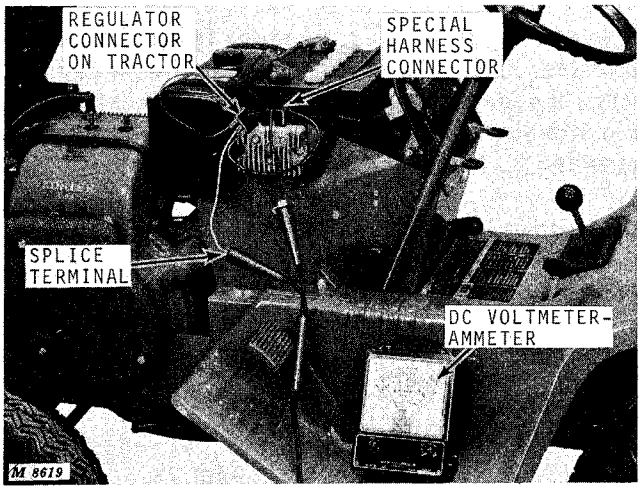


Fig. 11-Checking DC Amperes at Battery

Install ammeter in a series between battery cable and positive battery post, or use a special harness as shown in Figures 11 and 12.

To make this harness, install blades on each outer wire of a regulator connector. Place a metal splice terminal on the center wire. Complete the tool by installing a blade on one end of a short piece of wire; a splice terminal on the other.

To check amperage, remove connector from regulator and install special harness connector as in Figure 11. Insert outer two blades in regulator connector. Insert short strip of wire into center slot of regulator connector. Start engine and test for available amperes.

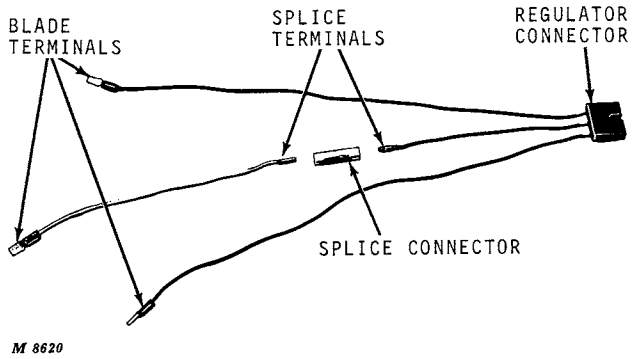


Fig. 12-Special Wiring Harness for Attaching Ammeter in Series

Remove splice connector, and attach ammeter to splice terminals.

Adjust polarity on meter. Ampere reading should be from 1 to 10 amps 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.

AC Leads and Windings

The stator can also be tested out of the engine by connecting ohmmeter leads to AC wire from stator and ground, Figure 13.

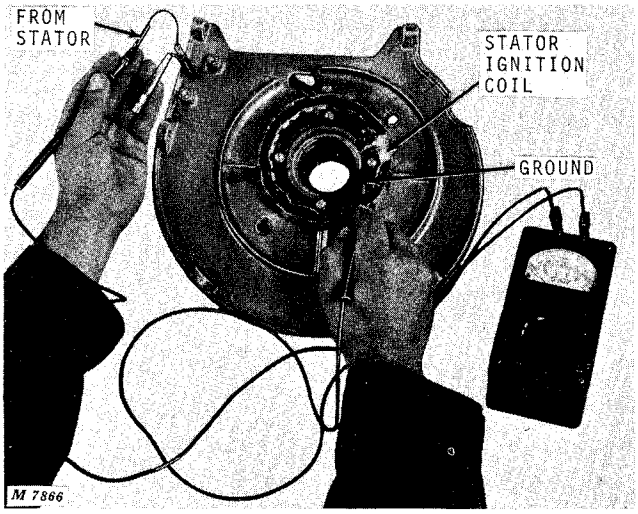


Fig. 13-Testing Stator and AC Lead with Ohmmeter

NOTE: A test light can be used to check stator continuity for battery charging coils, but an ohmmeter must be used when checking the stator ignition coil.

To check the stator windings, connect ohmmeter leads to both AC stator leads. The reading on the low scale should be between 0.2 and 0.3 ohms. Any reading below 0.2 ohms indicates an open winding and a higher reading indicates a shorted winding.

For test procedures regarding the ignition system, refer to the preceding sections.

REPAIR

No adjustments are possible on the alternator system and field service on this system is not recommended.

A faulty regulator or alternator should be replaced with a new unit if testing proves either part defective.

To remove alternator, see Section 20 for instructions on engine removal and disassembly. Remove flywheel, which houses rotating magnetic field. Remove screws holding stator to bearing plate.

When replacing an alternator stator on the magneto equipped 110 Tractor, remove ignition coil from old stator core. Install coil on new stator core if testing shows coil to be in good condition.

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Section 50
POWER TRAIN
Group 5
GENERAL INFORMATION

TABLE OF CONTENTS

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DESCRIPTION

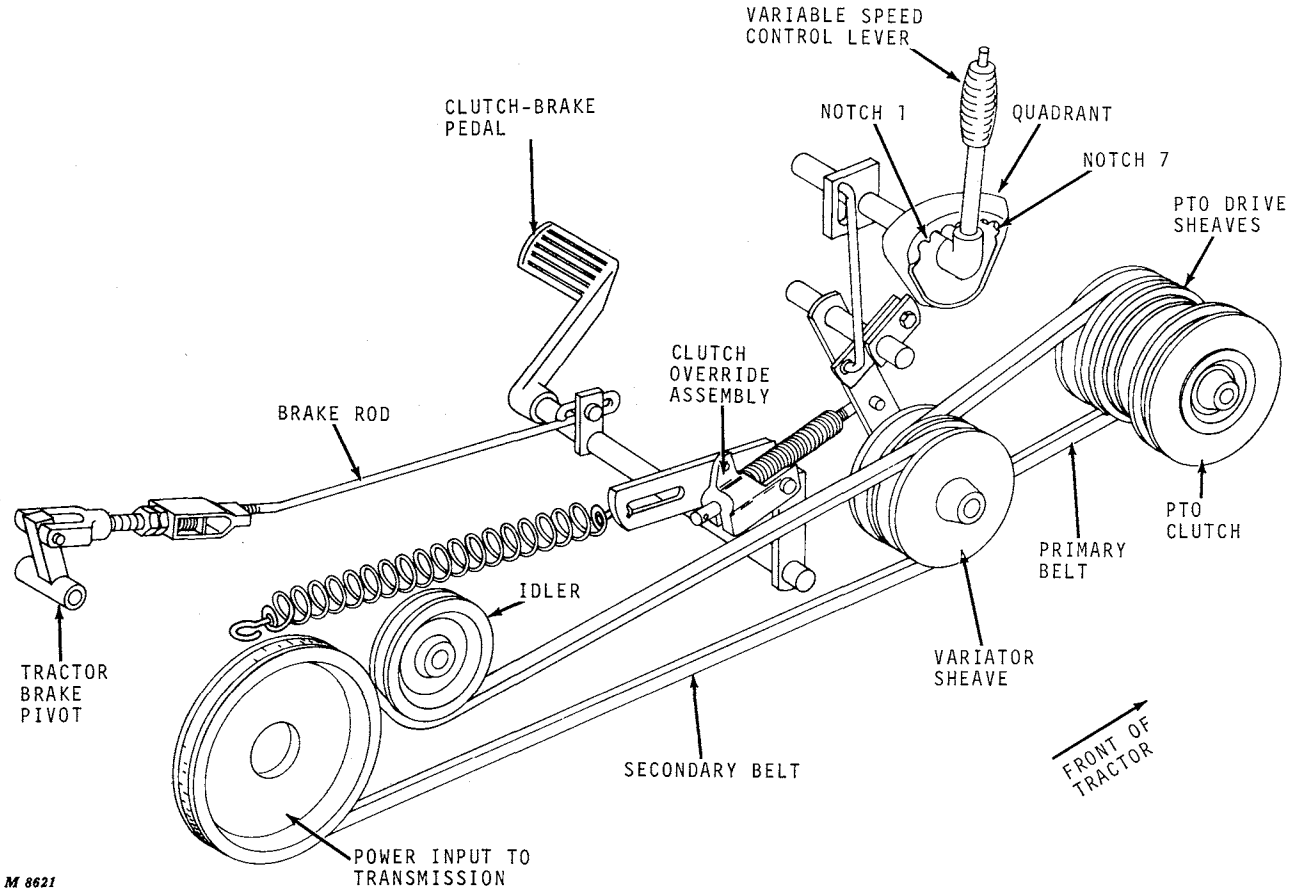

Fig. 1-Power Train Components

The power train of the 110 and 112 Tractors consists of the following components: engine drive sheave, variator sheave, transaxle power input sheave, primary and secondary drive belts and the idler-variator spring.

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 with this system.

With the variable speed drive, changes in travel speed can be made without using the clutch.

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.

Refer to pages 10-1 and 10-2 for a more detailed explanation of the clutch-brake and variable speed operation.

Group 10
CLUTCH, BRAKE AND VARIABLE SPEED DRIVE

PRINCIPLE OF OPERATION

VARIABLE SPEED CONTROL LEVER

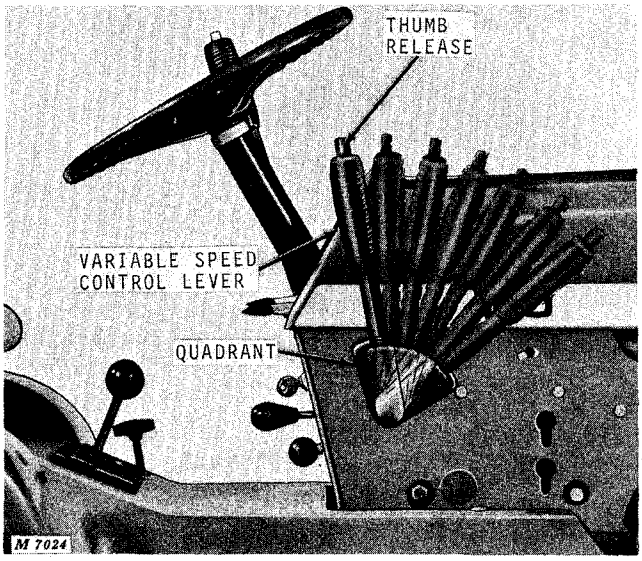

Fig. 1-Variator Linkage

The variable speed is regulated manually with the variable speed control lever, Figure 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-BRAKE PEDAL

The variator and variable speed can also be controlled with the 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-brake pedal as it is depressed through the variable speed range, Figure 2.

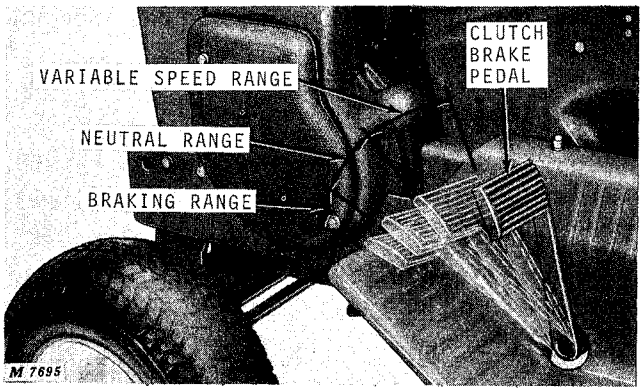

Fig. 2-Clutch-Brake Pedal

Depressing the clutch-brake pedal 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.

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-brake pedal to creep downward. The pedal comes up again as the load is relieved.

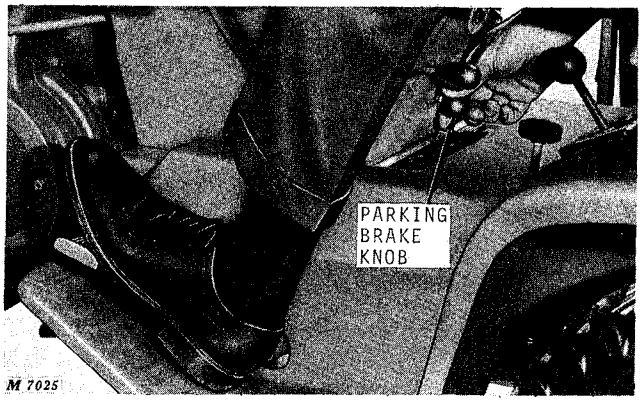

Fig. 3-Setting Parking Brake

When the clutch-brake pedal is fully depressed the parking brake can be set by moving parking brake lever downward in its slot.

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VARIATOR

The variator (Figure 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 (Figure 5).

Engine Drive Clutch

When the clutch-brake pedal is depressed, the variator moves forward, Figure 5, releasing the primary belt from the engine sheave.

Release of 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 preset position, Figure 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. 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, Figure 7. This change will increase 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.

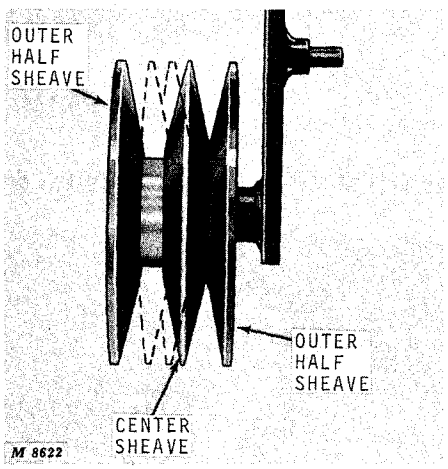

Fig. 4-Variator

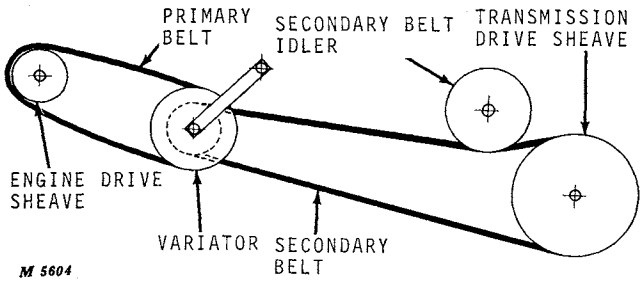

Fig. 5-Clutch Position

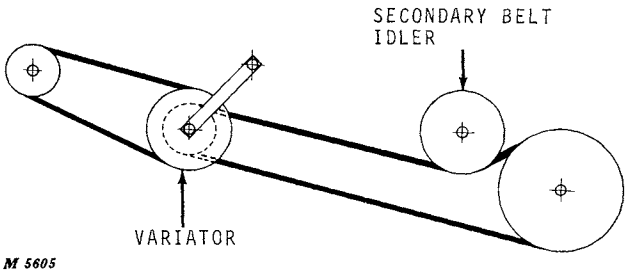

Fig. 6-Slow Speed Position

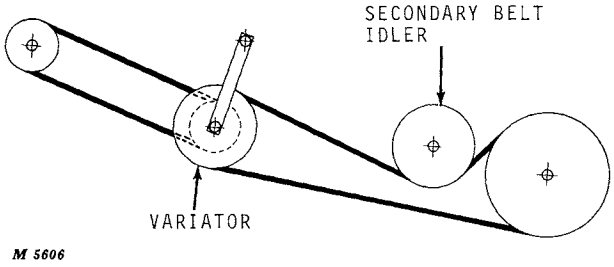

Fig. 7-High Speed Position

PRELIMINARY DIAGNOSIS OF MALFUNCTIONS

A diagnosis for the clutch, brake and variable speed drive malfunctions appears on page 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, Figure 7.

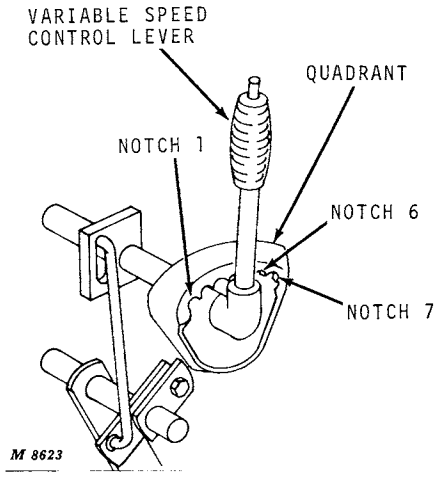

Fig. 8-Variable Speed Control Lever

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 position 1, on the quadrant, the control linkage needs adjusting. Follow adjustment procedure, page 10-16, carefully.

Primary belt wear can throw the variable speed linkage out of adjustment. When this happens, there will be no forward travel even when the variable speed control lever is in notch 1 on the quadrant (slow speed position). Adjust the linkage as described on page 10-15.

If the tractor is stopped without depressing the clutch-brake pedal with the variable speed control lever in the forward position, free-wheeling action will occur the next time the tractor is started should the control lever be moved back (slow speed position) before starting the engine.

To prevent this free-wheeling action, pull the variable speed control lever to the rear (slow speed position) before setting the parking brake and stopping the engine.

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.

A misaligned engine drive sheave could also be at fault. Align engine sheave.

Readjust variable speed control linkage. See "Adjustments," page 10-15.

Check and correct all items listed under "Diagnosing Malfunctions" when variator action and tractor acceleration are sluggish.

BRAKES

A clutch override is incorporated into the brake system 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 variator be inspected for proper adjustment and the possibility of being sticky from the accumulation of dirt.

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DIAGNOSING MALFUNCTIONS

BELTS

Belts Seem to Slip Under Load.
Weak secondary idler spring.

Variator linkage not properly adjusted.

Variator in clutch position.

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.
Secondary belt idler arm pivot binding.

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.

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.

Worn or nicked variator sheaves.

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.

CLUTCH

Clutch Hard to Operate.
Engine not running.

Brake rod not properly adjusted.

Clutch override not properly adjusted.

Variator arm binding in pivot (in pedestal).

Secondary belt idler arm pivot binding.

Dirty or greasy variator hub.

Clutch Pedal Strikes Top of Footrest.
Brake rod not properly adjusted.

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 override and/or brake rod not properly adjusted.

Short secondary belt.
Move transaxle to forward position.

Variator not properly adjusted.

Primary belt too short.
Install correct belt.

Clutch Pedal Jumps.
Primary V-belt and/or secondary V-belt worn or lumpy.

Dirt in sheave grooves.

Loose input sheave on transaxle hub.

BRAKE

No Brakes.
Engine not running.
Operate engine for more effective braking.

Brake rod not properly adjusted.
Adjust linkage.

Variator not properly adjusted.

Dirt in sheave grooves.

Brakes Not Effective.
Worn lining.

Oil on lining.

Broken band.

MISCELLANEOUS

Tractor Does Not Move (Engine Running).
Variator clutched.
Move variable speed control lever forward.

Parking brake set.

Variator not properly adjusted.

Primary belt too long.
Install correct length belt.

Variator arm binding in pivot (in pedestal).

Excessive Tractor Vibration.
Primary V-belt and/or secondary V-belt worn or lumpy.

Loose transaxle drive sheave cap screws.

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.
Install proper belt.

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.
Install proper belt.

Variator arm binding in pivot (in pedestal).

Weak secondary idler spring.

REPAIR

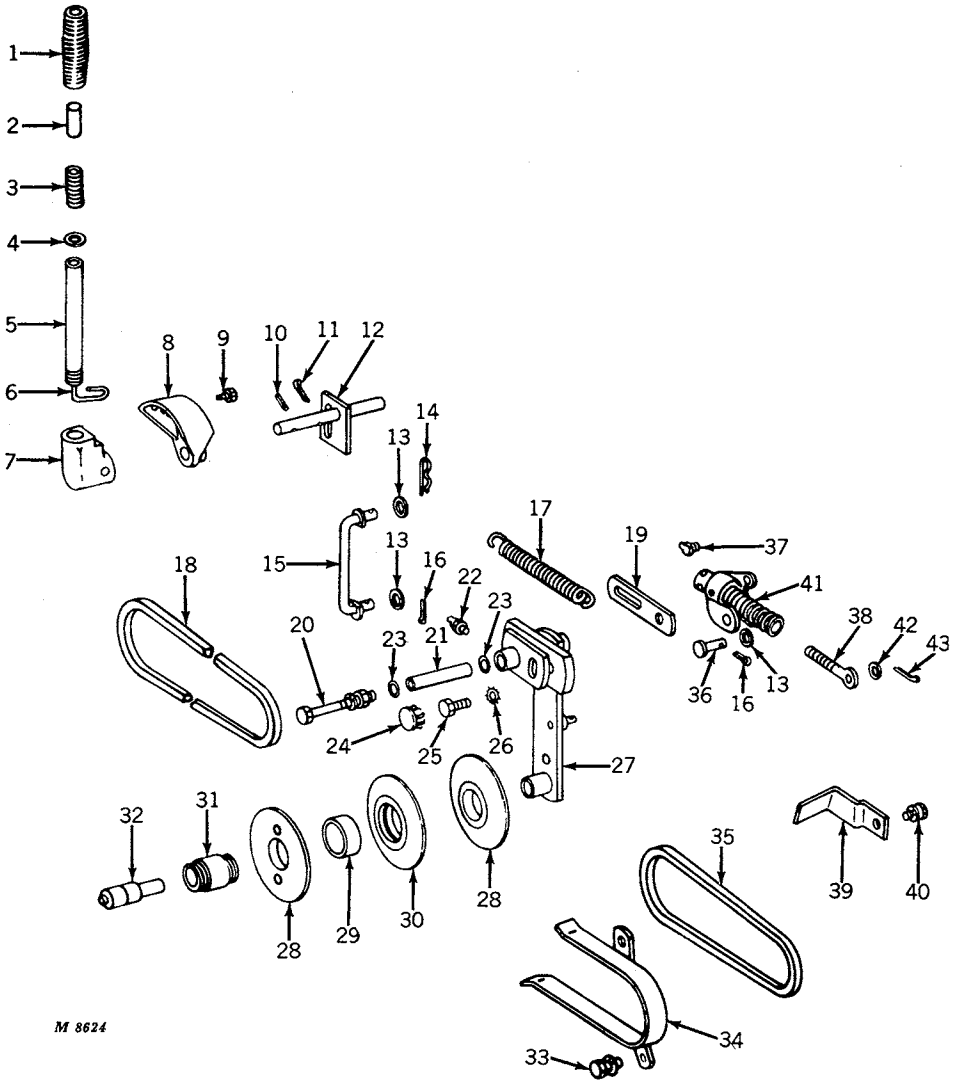

Fig. 9-Variator Assembly

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
Nut
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
Lock Washer
34-Belt Guide
35-Primary Belt
36-Drilled Pin
37-Grease Fitting
38-Clutch Override Link
39-Belt Guide
40-Cap Screw
Lock Washer
41-Clutch Override
42-Washer
43-Cotter Pin

REPLACING PRIMARY V-BELT

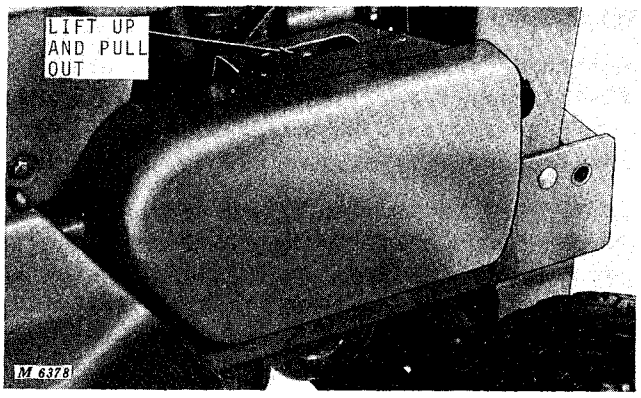

Fig. 10-PTO Shield

Remove PTO shield by lifitng up with fingers and pulling out, Figure 10.

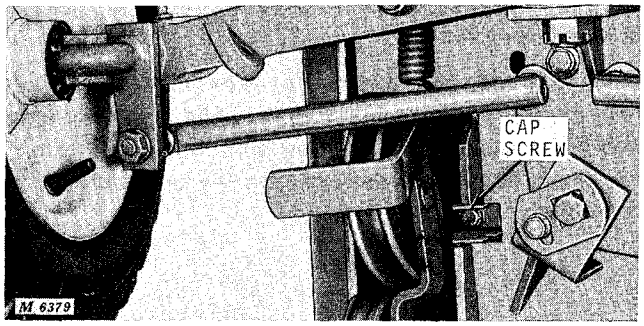

Fig. 11-PTO Brake Retaining Screw

Remove PTO brake cap screw, Figure 11.

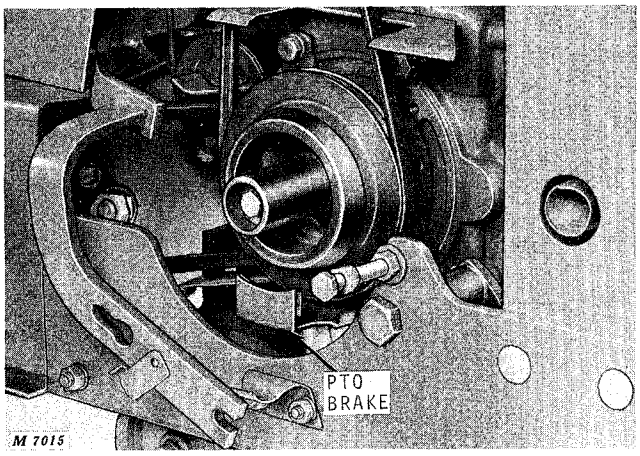

Fig. 12-PTO Brake
(PTO Drive Sheave Removed to Illustrate Position of PTO Brake)

Remove PTO brake, Figure 12.

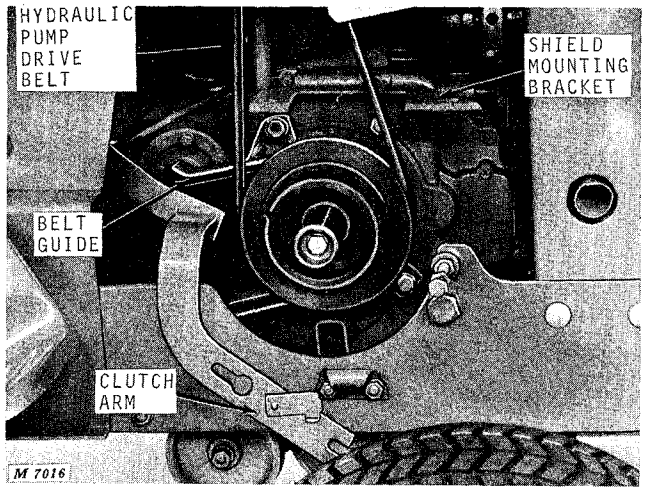

Fig. 13-Removing PTO Sheave

Unsnap clutch arm clip and slide clutch arm and PTO sheave off shaft. Be careful not to get any dirt or foreign material into sheave bearings, Figure 13.

NOTE: Secondary belt and hydraulic pump drive belt 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 belt guide and slide 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 10-15.

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REPLACING SECONDARY BELT

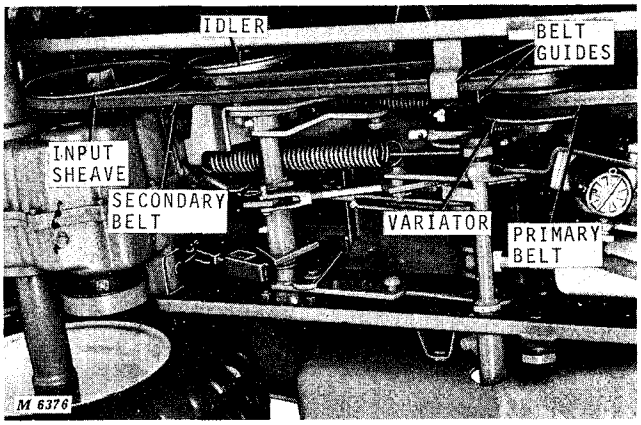


Fig. 14-Secondary Belt

To replace worn or broken secondary belt, move variable speed control lever forward (fast speed position). Turn engine over momentarily to allow variator to move to fast speed position. Then raise secondary idler and slip secondary belt off variator. Remove three screws, Figure 14 from input sheave 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 adjustents.

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 covering 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 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.

SERVICING VARIATOR

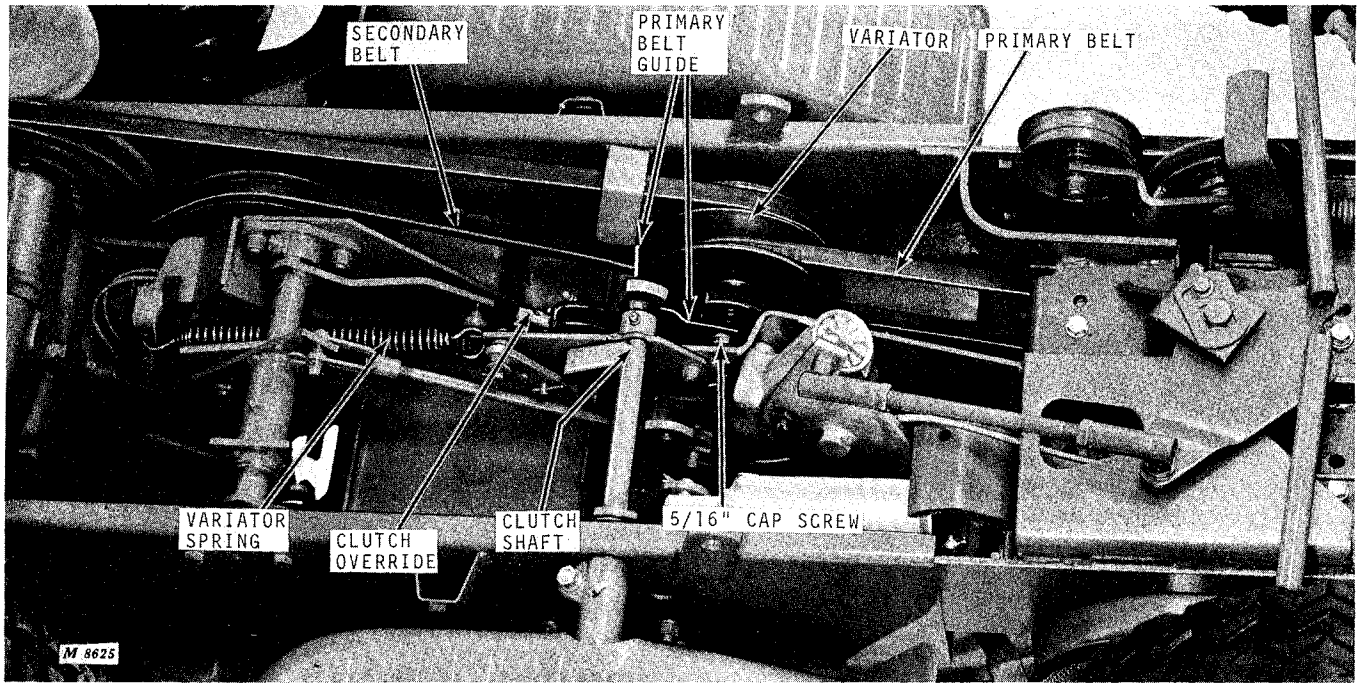


Fig. 15-Removing Variator from Tractor

Removing Variator

Remove primary and secondary belt from variator. **IMPORTANT: Do not pry belts over sides of variator, Figure 15.**

Loosen 5/16-inch cap screw on primary belt guide and slide guide up far enough to remove belt from variator sheave and engine sheave.

Disconnect variator spring. Remove battery and battery base. Disconnect clutch override at variator arm and clutch shaft arm. Disconnect speed control shaft link and remove variator pivot cap screw (both illustrated in Figure 9). Guide pivot end of variator arm through notch in tractor frame, Figure 16. Variator must be removed from underside of tractor.

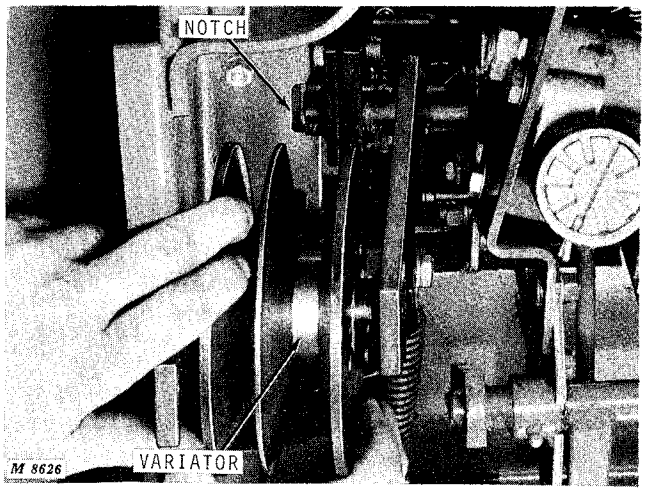


Fig. 16-Removing Variator

Disassembling Variator Sheave

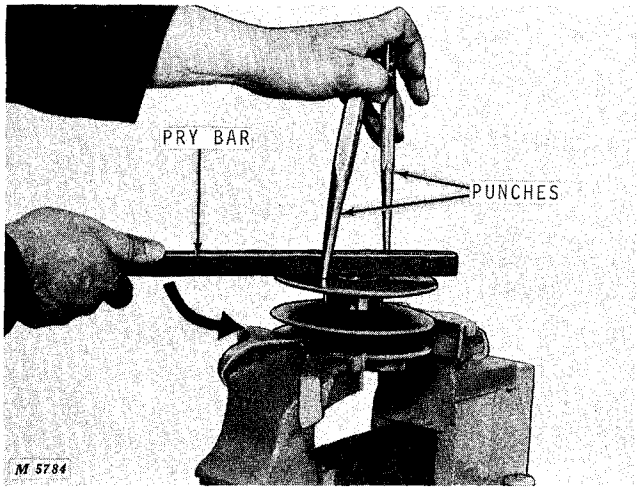


Fig. 17-Disassembling Center Variator Sheave

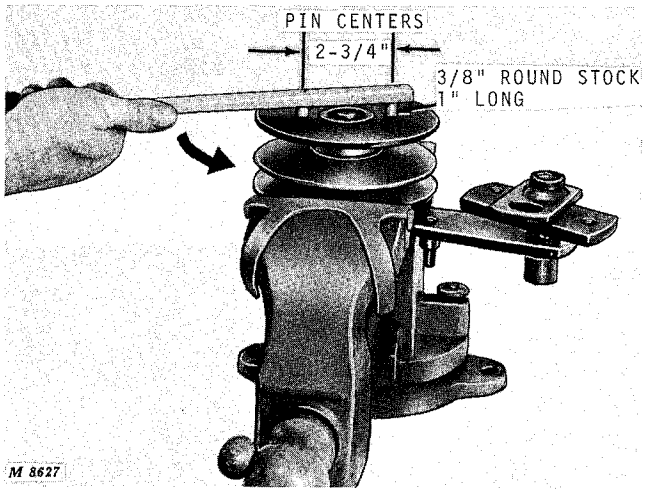


Fig. 18-Disassembling Center Variator Sheave (with special tool)

Place variator half sheave (next to bearing support) in a vise with soft jaws as shown in Figure 17. 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 Figure 18. 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

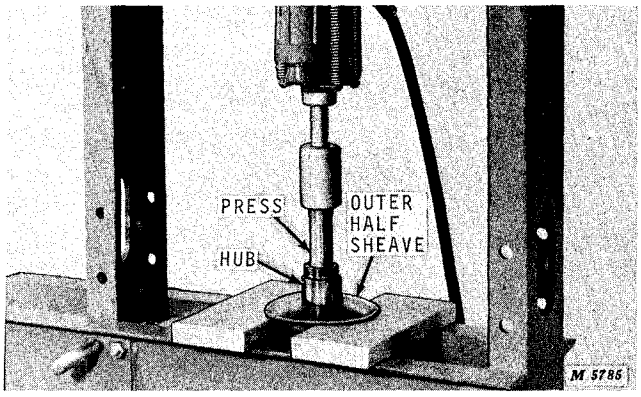


Fig. 19-Pressing Variator Bearing From Hub

Place variator bearing and hub assembly under press, Figure 19, and press bearing from hub. Be sure to press against outer race only.

Place hub in a vise and remove half sheave.

Inspecting Variator

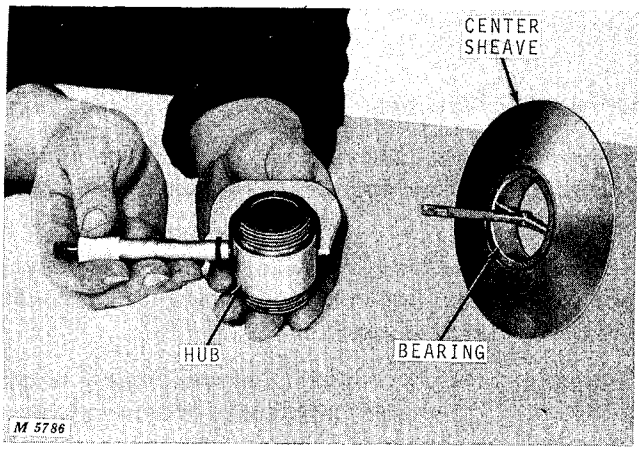


Fig. 20-Checking Variator Bearing and Hub

Measure I.D. of center sheave bearing and O.D. of variator hub, Figure 20, after cleaning parts thoroughly. Refer to "Specifications," page 10-18 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 a 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.

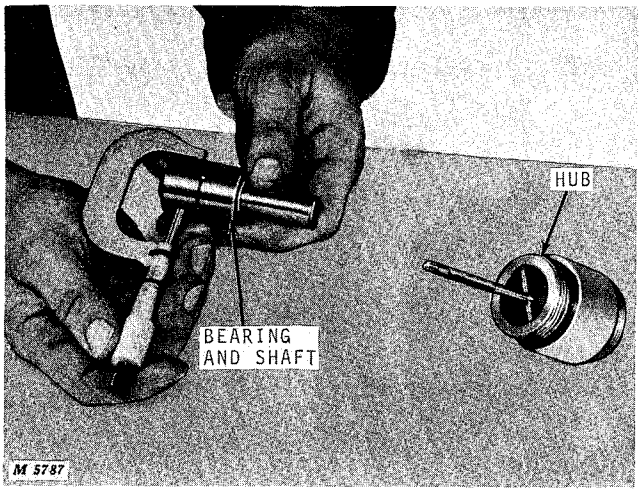


Fig. 21-Checking Variator Bearing and Shaft

Measure press fit between bearing and hub, Figure 21. See "Specifications," page 10-18, 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.

Assembling Variator

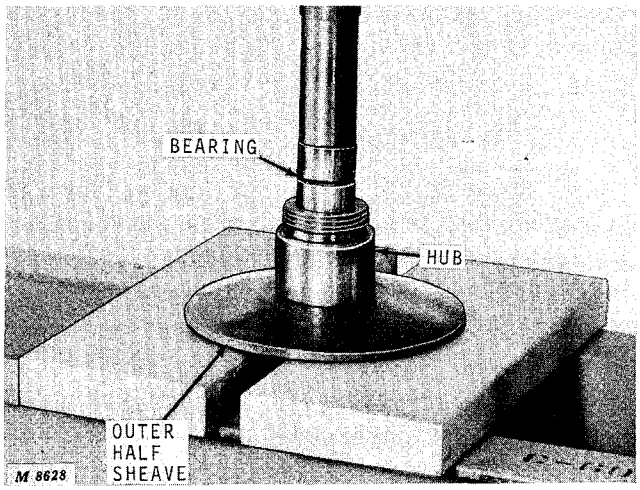


Fig. 22-Pressing Bearing in Hub

Coat bearing case with a light film of oil. Place hub with sheave on press bed, Figure 22. Pressing on outer ring only, press bearing into hub until distance between bearing end and hub face is 0.12-inch below hub face, Figure 23.

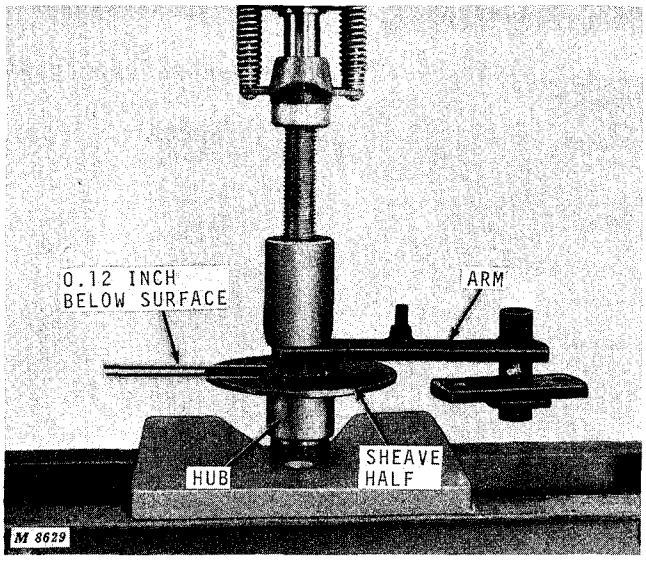


Fig. 23-Pressing Variator Arm on Bearing Shaft

Wipe a light film of oil on bearing shaft. Place variator arm on bearing shaft with weld down. 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 Figure 17. Place center sheave assembly on hub and thread half sheave on hub. Using two large punches and a bar, tighten sheaves firmly by turning sheave in opposite direction as shown in Figure 17.

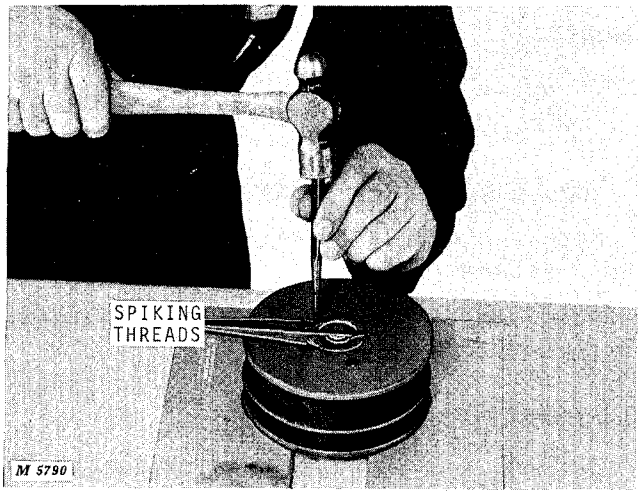


Fig. 24-Staking Variator Hub

Spike threads three or four places on both sides of variator as shown in Figure 24.

Installing Variator

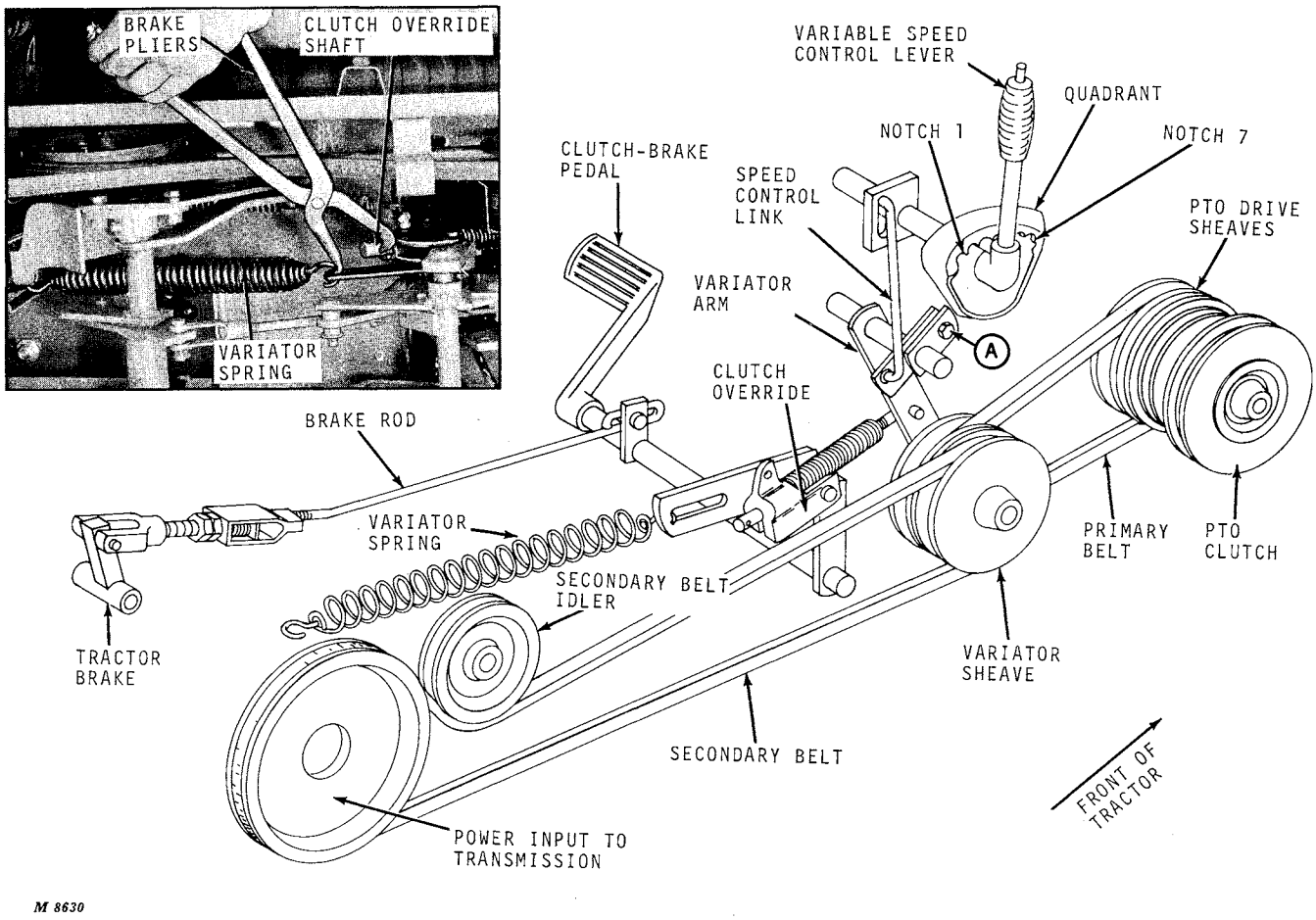


Fig. 25-Installing Variator Assembly

Install variator assembly in the following manner:

Guide pivot end of variator arm through notch in tractor frame from the underneath side, Figure 16.

Install pivot cap screw "A," Figure 25, and tighten firmly. Connect speed control link.

Connecting Variator Spring

Connect variator spring to spring link with an automotive brake spring pliers as shown in inset of Figure 25.

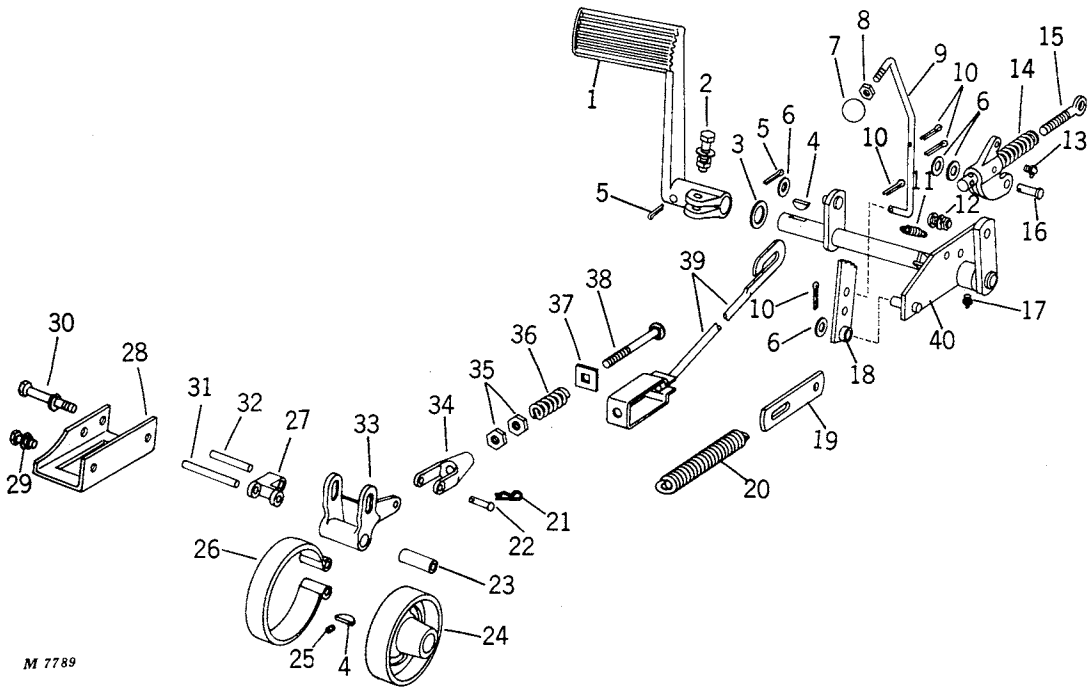
Install primary belt. To ease primary belt installation, move variator lever rearward and depress and lock parking brake. This will hold variator sheave in a forward position.

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 tightener 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 10-15.

BRAKES



1-Clutch-Brake Pedal
2-Cap Screw
Nut
Lock Washer
3-Washer
4-Woodruff Key
5-Cotter Pin
6-Washer
7-Parking Brake Knob
8-Nut
9-Parking Brake Rod
10-Cotter Pin
11-Spring
12-Bolt
Nut
Lock Washer
13-Grease Fitting
14-Clutch Override Assembly
15-Clutch Override Link
16-Drilled Pin
17-Grease Fitting
18-Parking Brake
19-Spring Link
20-Clutch and Brake Spring
21-Spring Locking 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
Lock Washer
30-Cap Screw
Lock Washer
31-Spring Pin
32-Brake Pin
33-Brake Lever
34-Brake Yoke
35-Nut
36-Spring
37-Spring Stop
38-Bolt
39-Brake Rod
40-Clutch and Brake Shaft

Fig. 26-Exploded View of Clutch-Brake Components

Replacing Brake Band

A brake band with bonded lining is used on all 110 and 112 Tractors. Whenever brake band servicing is required due to worn or oily lining or other damage, the following procedure should be used.

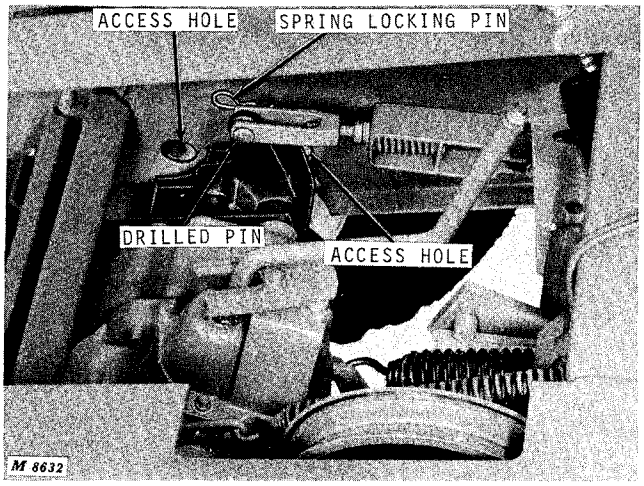


Fig. 27-Removing Brake Assembly (Deck removed for clarity)

Remove spring locking pin and drilled pin from brake arm, Figure 27.

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 brake pulley. Lift band assembly upward and to the right to remove.

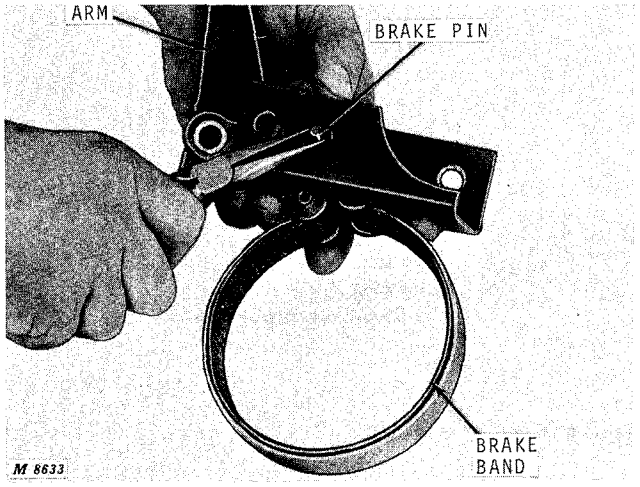


Fig. 28-Removing Brake Pin

Remove brake pin, Figure 28, and separate brake band assembly from arm and bracket.

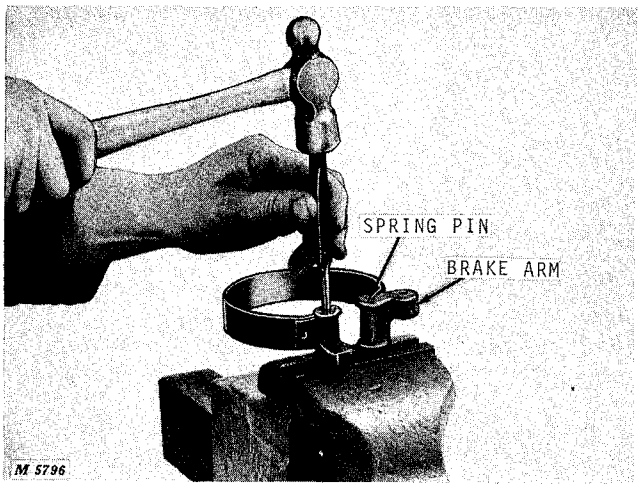


Fig. 29-Removing Spring Pins From Arms and Band

Drive spring pins from arm and band as shown on Figure 29.

Lubricate lever pivot before reassembly.

Reverse disassembly procedure to assure correct installation.

After installing brake band assembly on tractor, refer to "Adjustment" page 10-15, and adjust brake linkage accordingly.

Replacing Brake Pulley

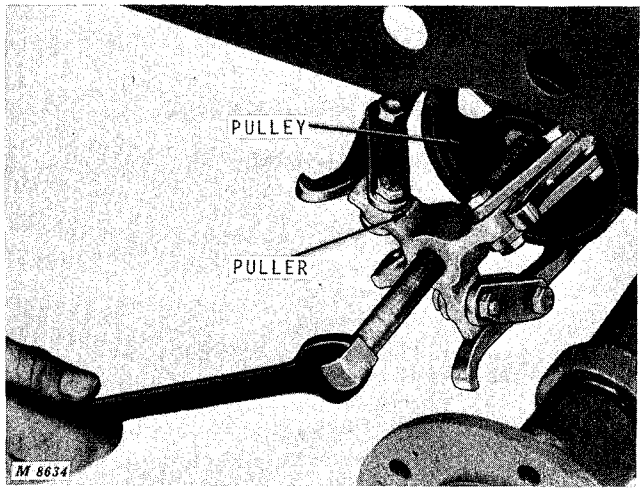


Fig. 30-Removing Brake Pulley

Loosen pulley retaining set screw and remove brake pulley using a puller similar to the one shown in Figure 30.

When replacing pulley, tap pulley onto shaft with a soft mallet and install set screw. Use a thread lock compound to secure set screw.

ADJUSTMENTS

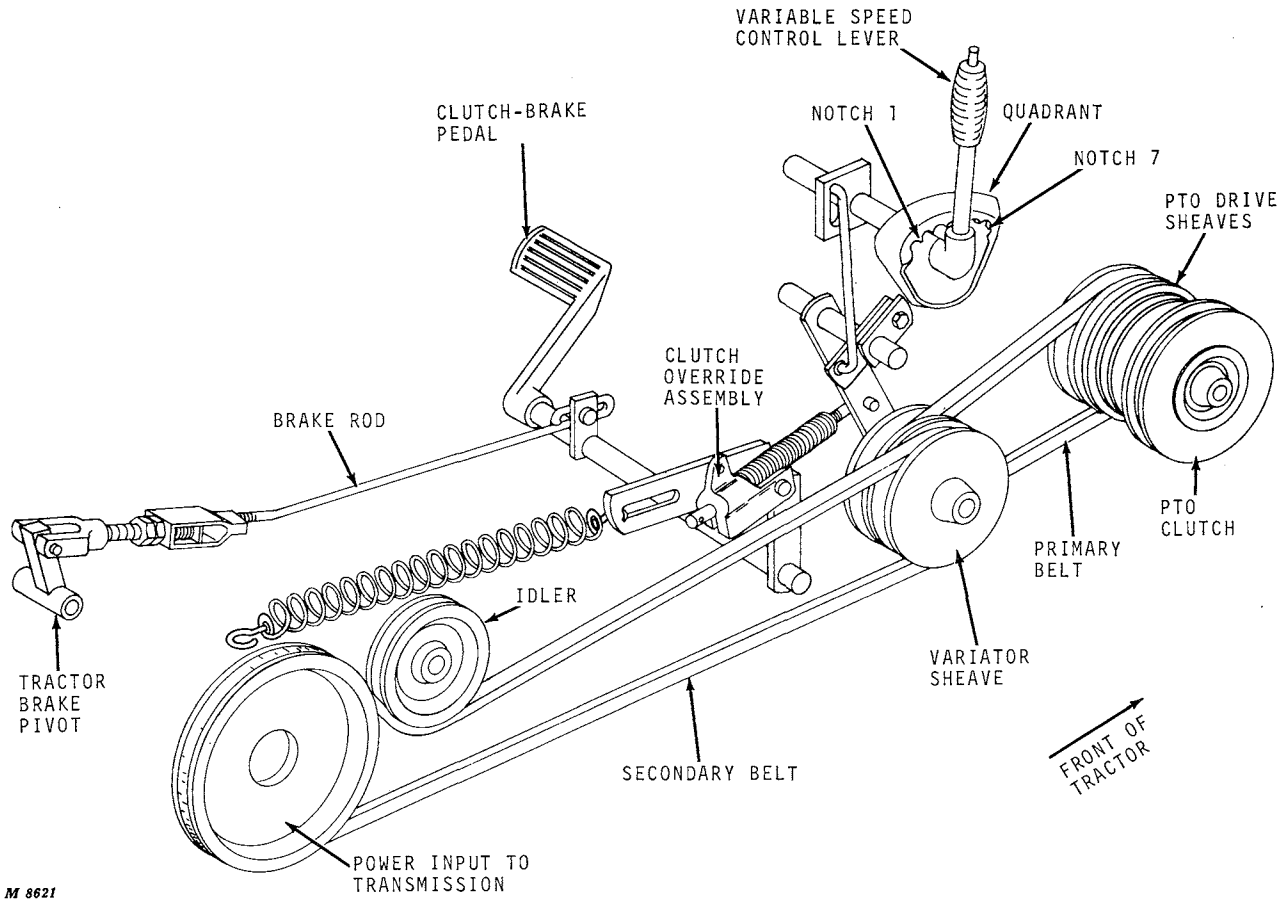


Fig. 31-Schematic of Clutch, Brake, and Variator

LINKAGE ADJUSTMENT

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 follows.

Place variable speed lever in notch 5 on the quadrant, which is the third notch from the front of the tractor, Figure 32.

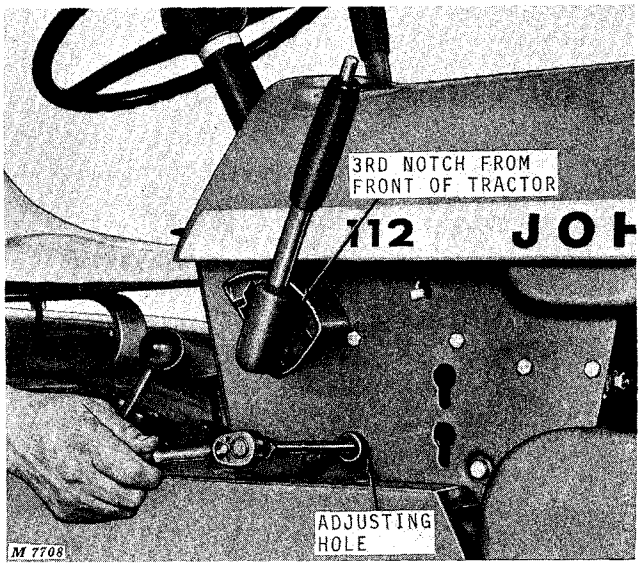


Fig. 32-Variator Adjusting Hole

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-brake pedal rises 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-brake pedal is released, a new primary belt must be installed.

CLUTCH-BRAKE PEDAL ADJUSTMENT

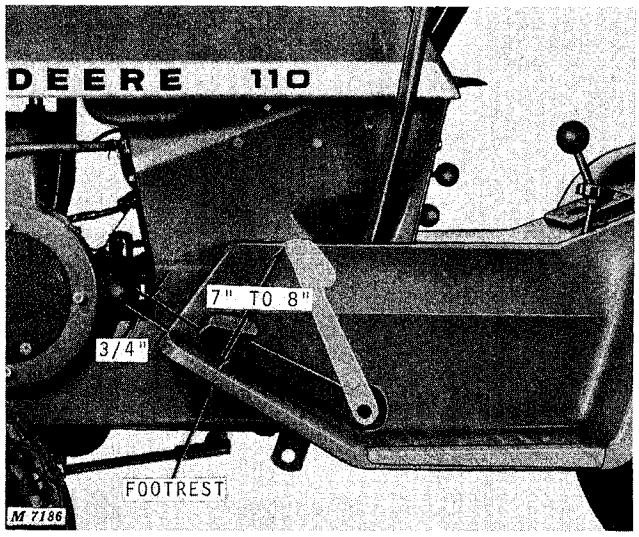


Fig. 33-Clutch-Brake Pedal Heights

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, Figure 33. If less than 3/4 inch above the footrest when fully depressed, adjust the brake as follows:

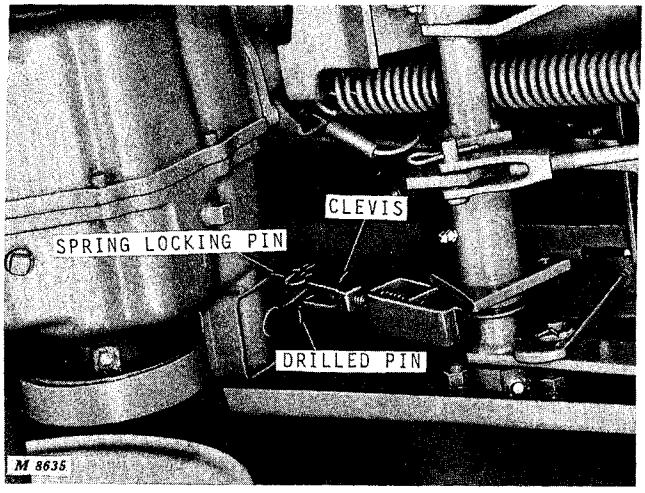


Fig. 34-Adjusting Brake Linkage

Remove spring locking pin and drilled pin from clevis, Figure 34.

Turn clevis onto brake rod until a 3/4 inch dimension can be obtained as shown in Figure 33. Replace drilled pin and insert spring locking pin.

ADJUSTING CLUTCH OVERRIDE

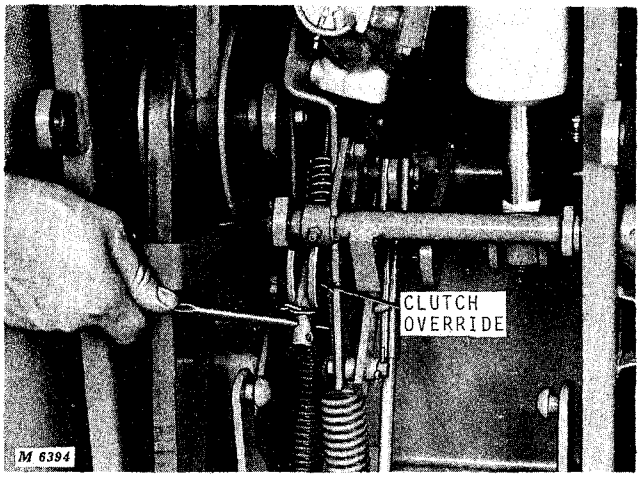


Fig. 35-Adjusting Clutch Override Screw

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 35. Turn screw counterclockwise until the 7 to 8-inch dimension is obtained.

BELT GUIDE ADJUSTMENT

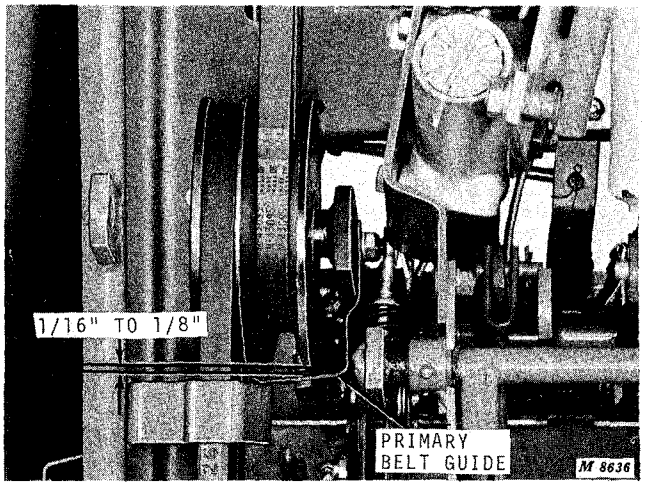


Fig. 36-Adjusting Primary Belt Guide

If the primary belt jumps the variator sheave when the 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 36.

SPECIFICATIONS

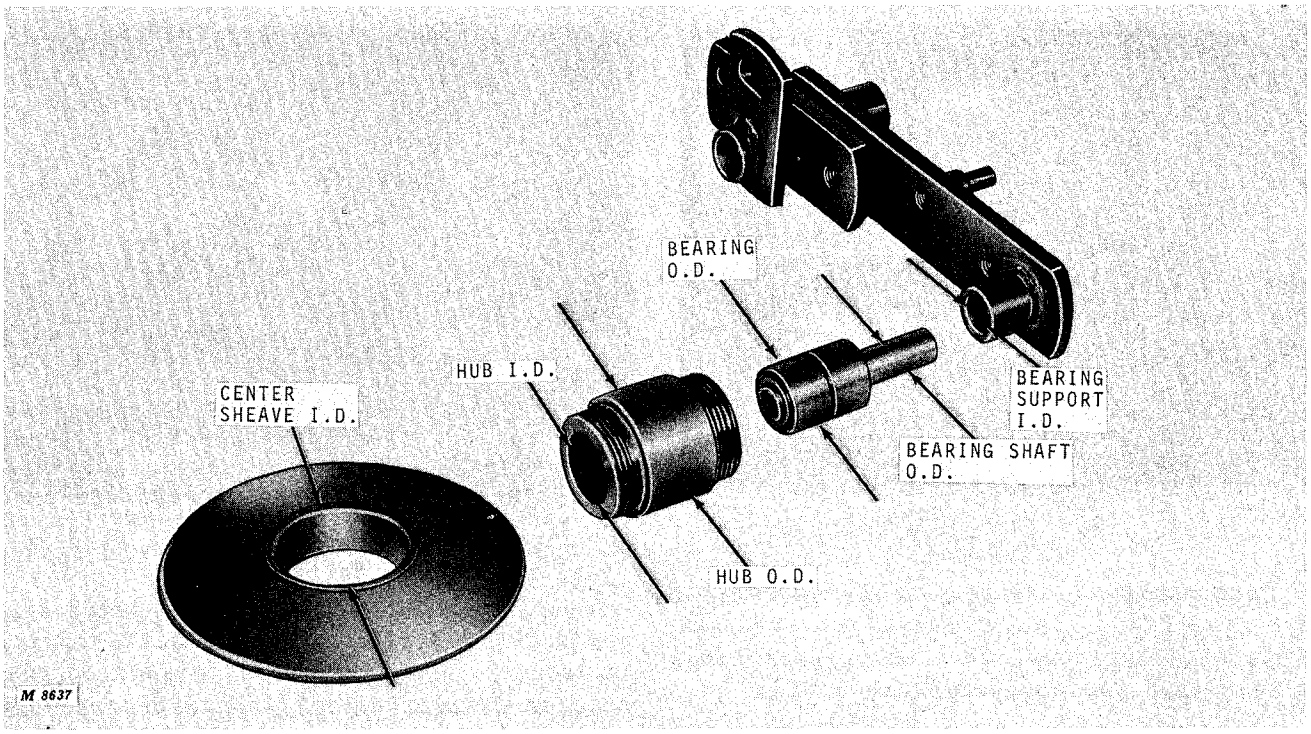


Fig. 37-Variator Press Fit Components

Component	Dimension
Center Sheave I.D. w/bearing	2.0015 - 2.0025 inches
Hub O.D.	1.999 - 2.001 inches
Hub I.D.	I.1790 - 1.1800 inches
Bearing O.D.	1.1806 -1.1811 inches
Bearing shaft O.D.	0.6262 - 0.6267 inch
Bearing support I.D.	0.6240 - 0.6255 inch
Primary belt guide (Distance between variator and guide)	1/16 - 1/8 inch

SPECIAL TOOLS

Name	Part No.	Use
Brake Spring Pliers	12-inch	To install variator spring

Group 15
4-SPEED TRANSAXLE

PRINCIPLE OF OPERATION

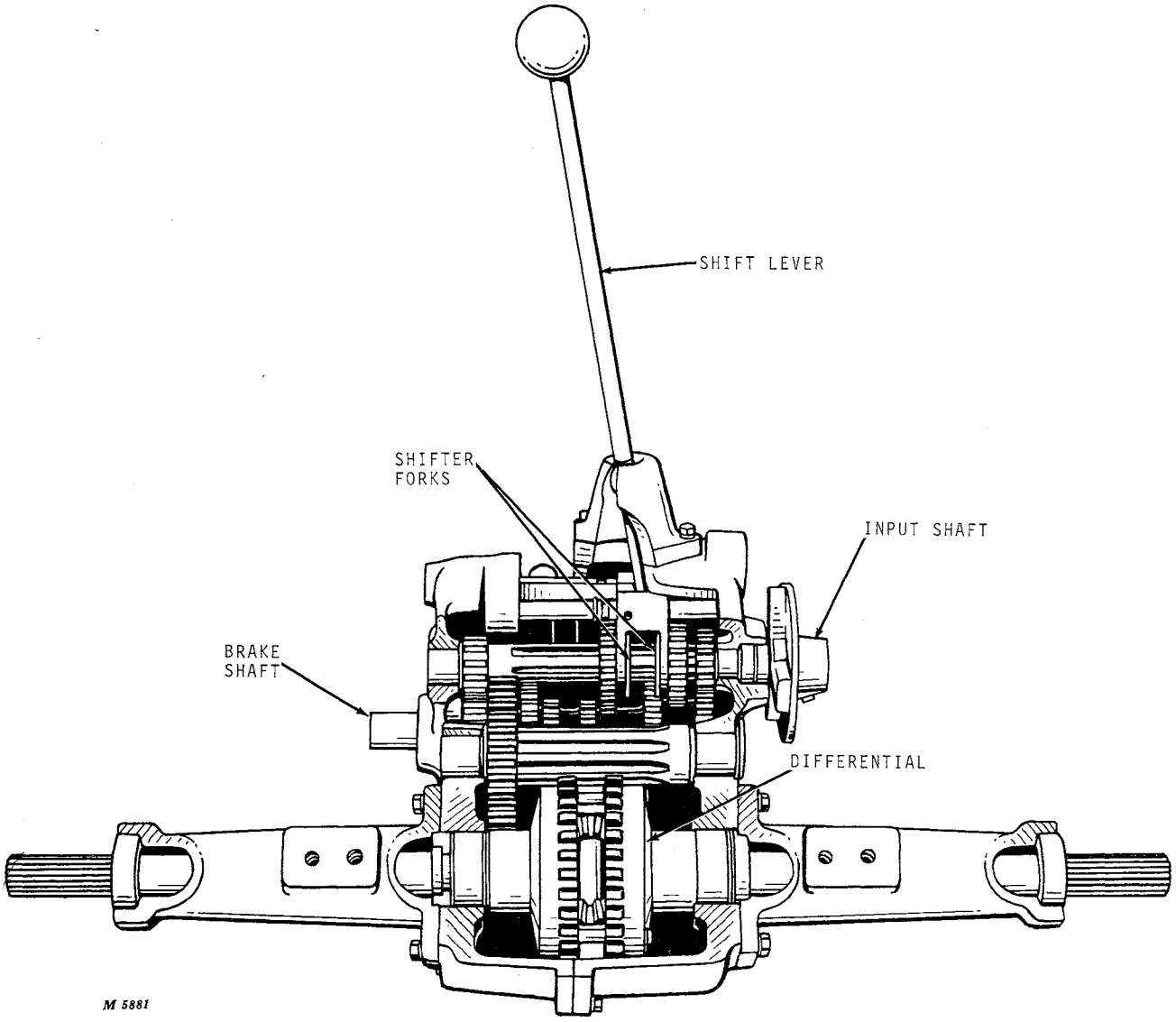


Fig. 1-Tractor Transaxle - 4 Forward Speeds - 1 Reverse

The transaxle 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 all 110 and 112 Tractors with the exception of the 112 hydraulic lift tractors. All 112 hydraulic lift tractors above serial number 130,000 are equipped with a limited slip differential, which can be identified by the number #2317 stamped on the differential serial number plate. For additional information refer to page 15-11.

GEAR SHIFT PATTERN

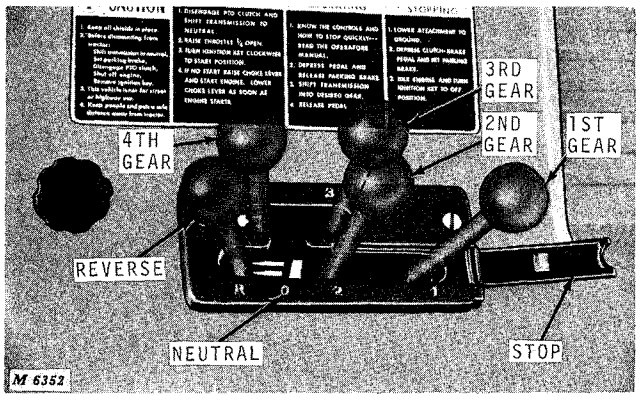


Fig. 2-Gear Shift Pattern

Gear shifting for all four forward gears and reverse is accomplished with a shift lever, Figure 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 left to determine power transmission from the input shaft to the axles in each gear position.

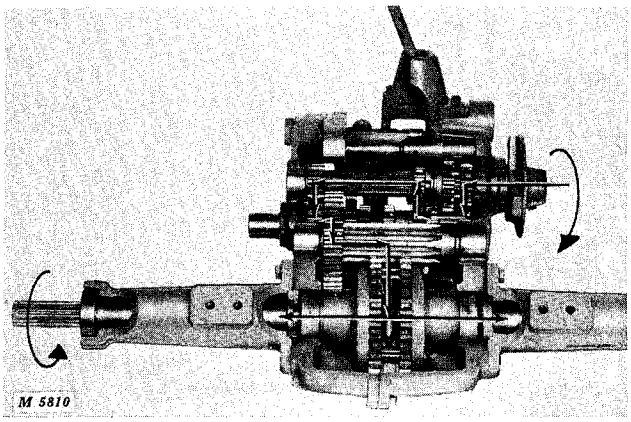


Fig. 3-Reverse Gear

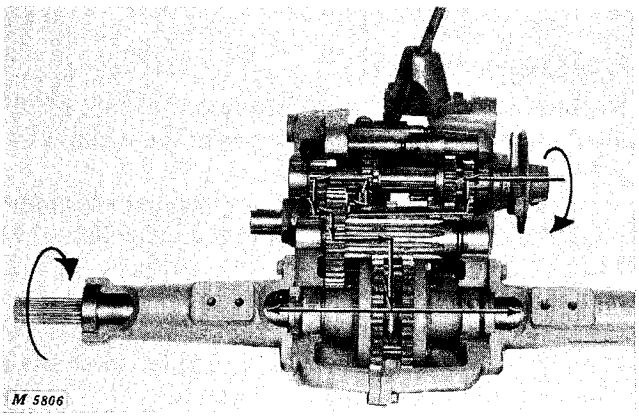


Fig. 4-1st Gear

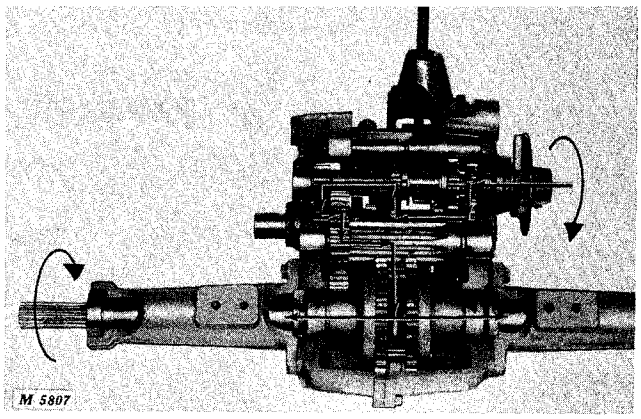


Fig. 5-2nd Gear

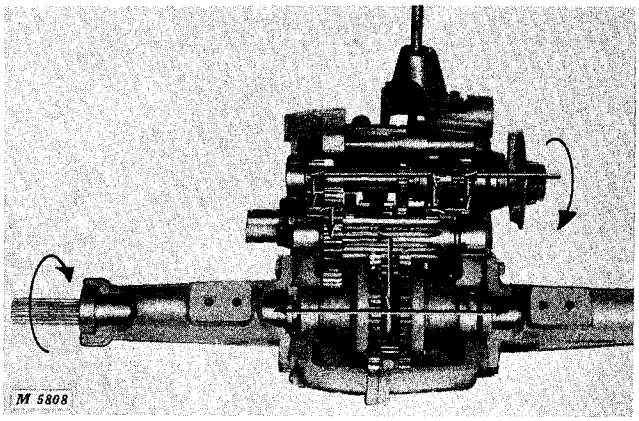


Fig. 6-3rd Gear

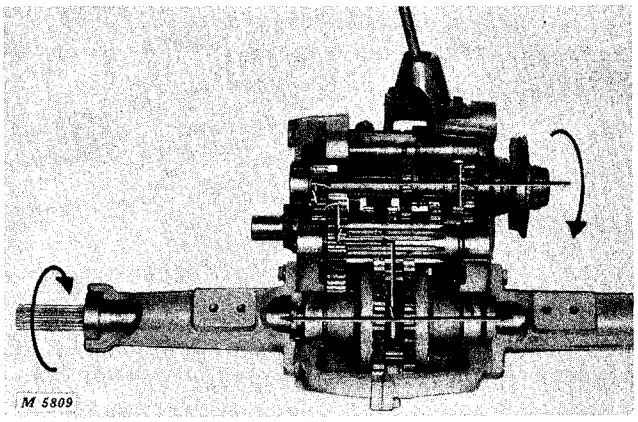


Fig. 7-4th Gear

DIAGNOSING MALFUNCTIONS

TRANSAXLE

Gears Clash When Shifting.

Clutch-brake and variable speed control not properly adjusted.

Shifting gears while tractor is in motion.

Clutch-brake pedal not fully depressed.

Linkage not properly assembled.

Hard Shifting.

Clutch-brake and variable speed control not properly adjusted.

Shifting gears while tractor is in motion.

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 and variable speed control not properly adjusted.

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.

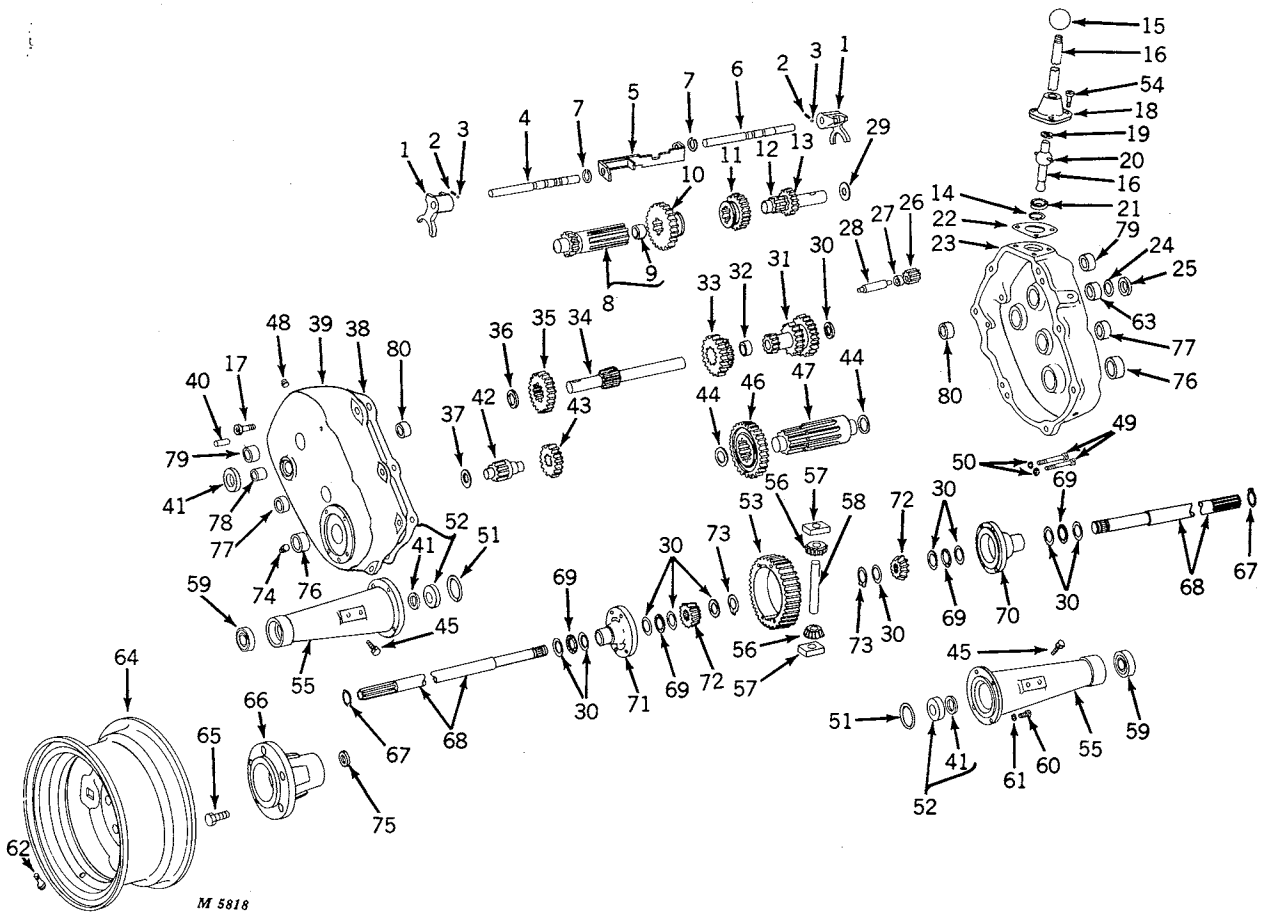
Worn or damaged shifter housing seal.

Worn or damaged shaft seal.

Defective O-ring between case and axle housing.

Defective case gasket.

REPAIR



1-Shifter Fork (2 used)
2-Spring (2 used)
3-Ball (2 used)
4-Shifter Rod (1st, 2nd and reverse speeds)
5-Shifter Stop
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 Pinon
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 fender-deck.

On the 110 and 112 Tractors serial number (160,001-) it will be necessary to disconnect the neutral-start switch harness at the wire connector before removing fender-deck.

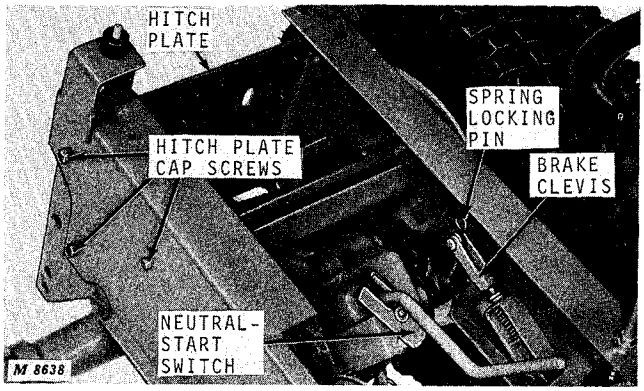

Fig. 9-Preparing Transaxle for Removal (Right Rear Wheel Removed for Clarity)

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 clevis from brake arm.

Disconnect neutral start switch at wire connector.

Remove six cap screws that retain the hitch plate to tractor frame, and roll hitch plate and transaxle assembly rearward as shown in Figure 10.

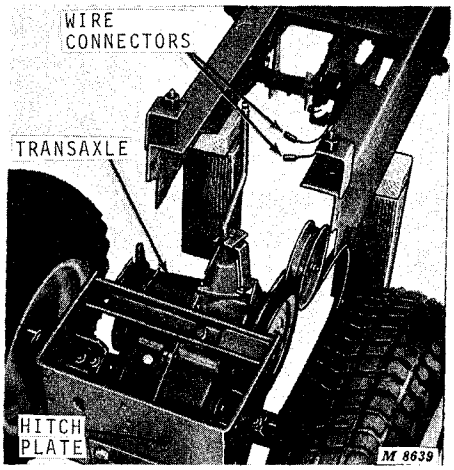

Fig. 10-Hitch Plate and Transaxle Assembly Removed from Tractor

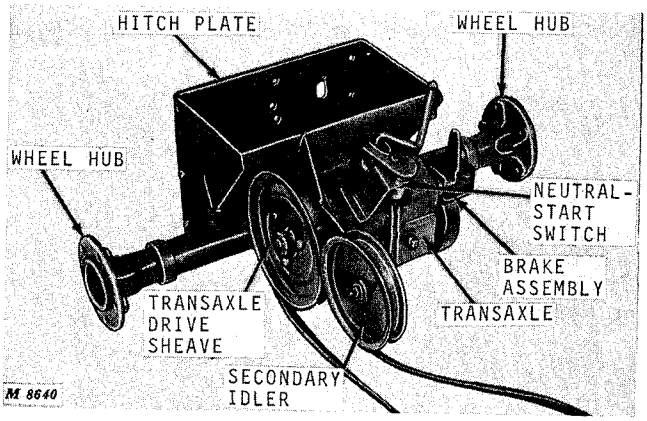

Fig. 11-Preparing Transaxle for Disassembly

To facilitate transaxle disassembly, 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

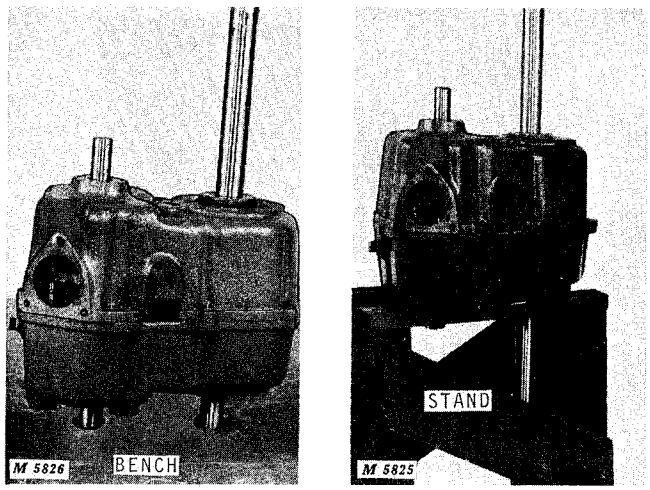

Fig. 12-Transaxle Repair Stands

Drill two 2-inch holes in line with each other 8-inches apart in a sturdy work bench or stand, Figure 12.

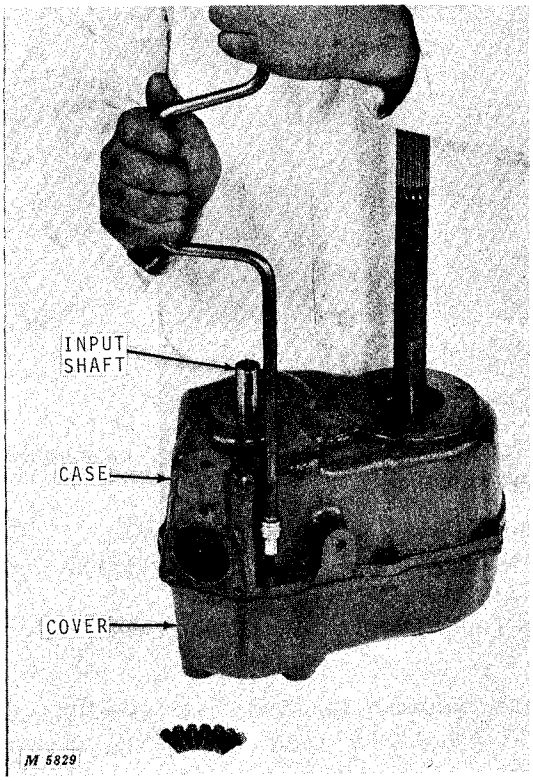

Fig. 13-Removing Case Screws

Place transaxle in bench or stand vertically with socket head cap screws and input shaft upward. Remove eight screws, Figure 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, Figure 14.

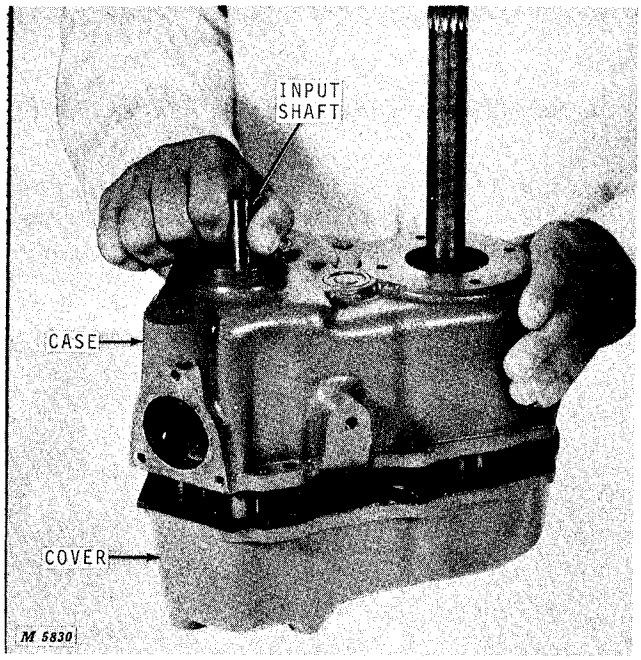

Fig. 14-Removing Cover

REMOVING INTERNAL COMPONENTS

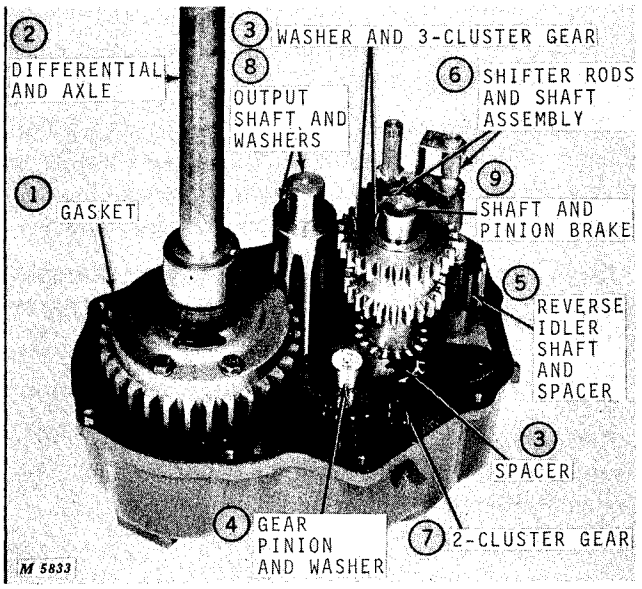

Fig. 15-Gear Removal Sequence

Figures 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.

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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, Figure 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.

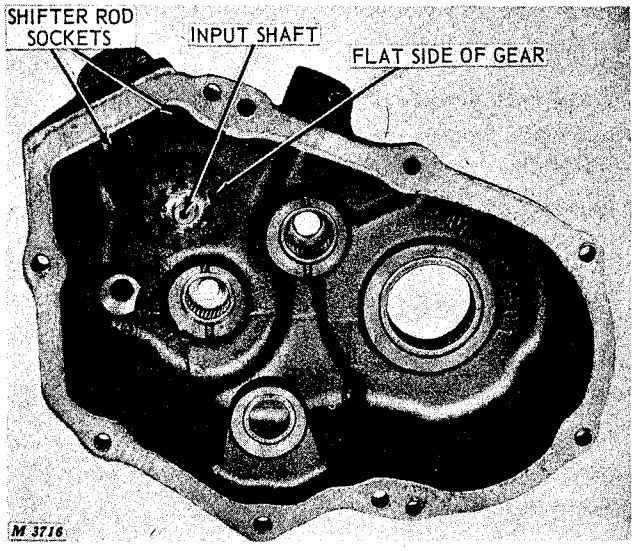

Fig. 16-Gear Removal Sequence

DISASSEMBLING SHIFTER LEVER

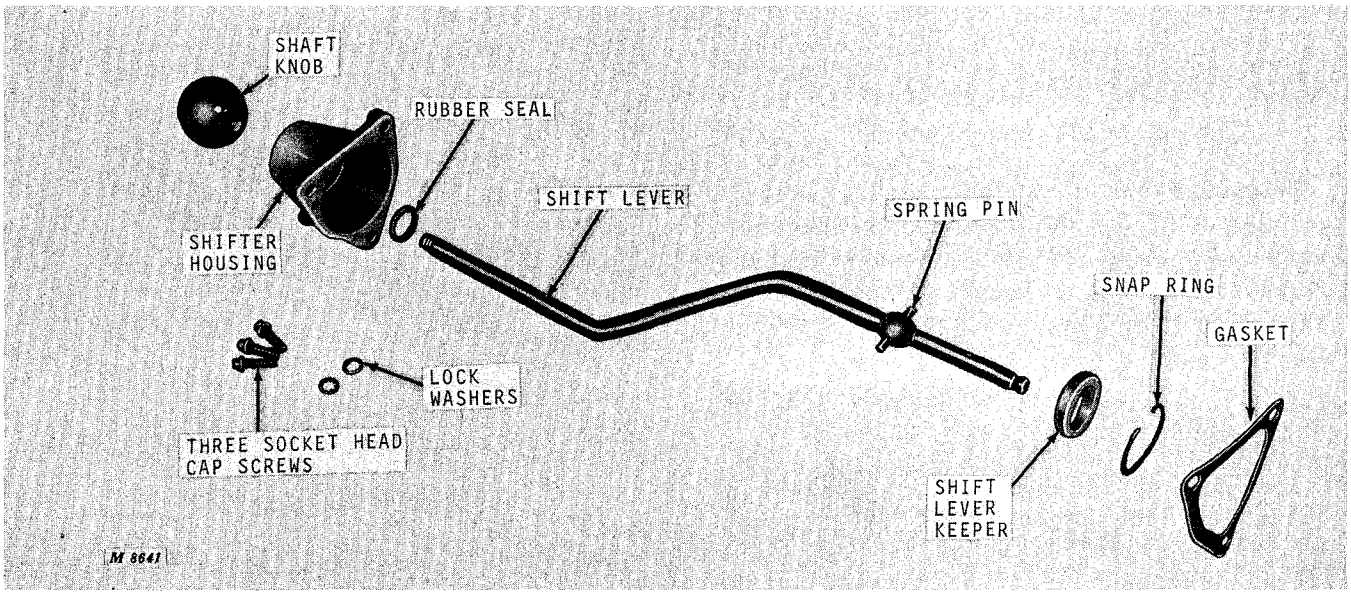

Fig. 17-Shift Lever Components

To disassemble shift lever, remove snap ring in shifter housing and slide assembly apart.

INSPECTION

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.

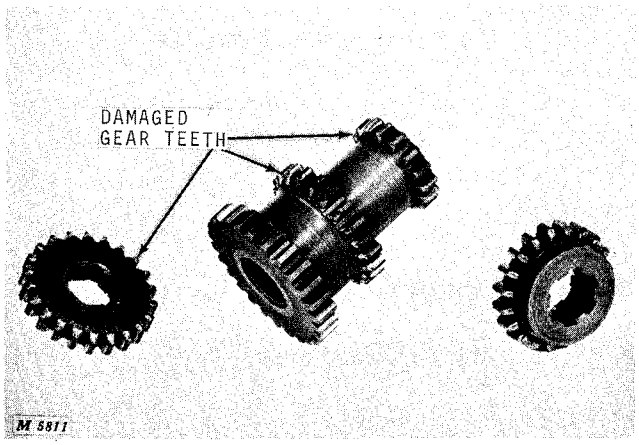

Fig. 18-Transaxle Gear Tooth Wear

Chipped, broken or excessive wear on gear teeth ends, Figure 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.

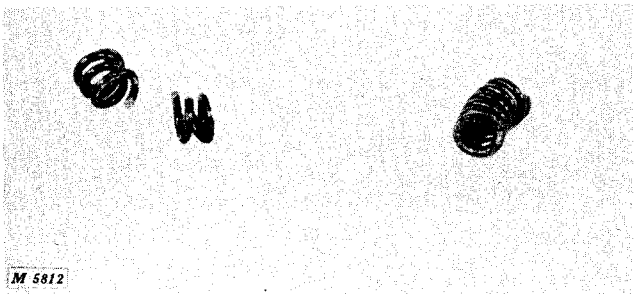

Fig. 19-Broken Detent Springs

Broken detent springs, Figure 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.

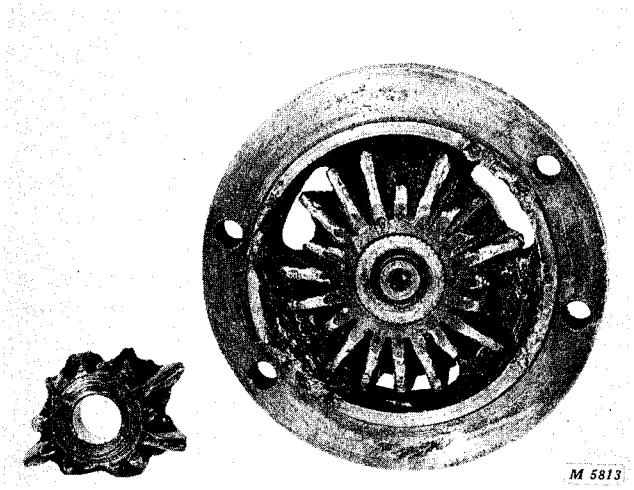

Fig. 20-Damaged Bevel Pinion Gears

Prolonged heavy drawbar loads and wheel slippage are the most common cause of bevel pinion gear failure, Figure 20, in the differential section of the transaxle.

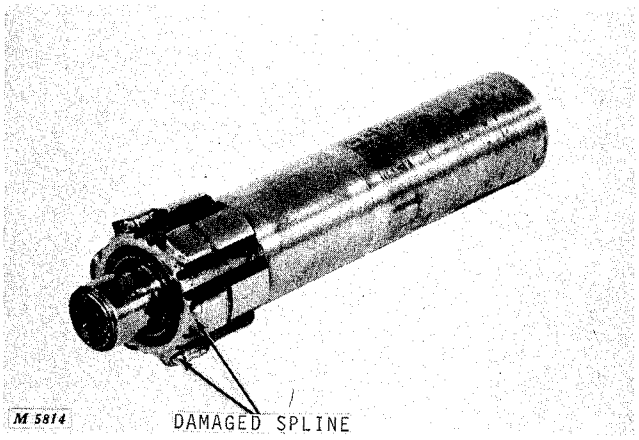

Fig. 21-Damaged Input Shaft Spline

Damage to the input shaft spline 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.

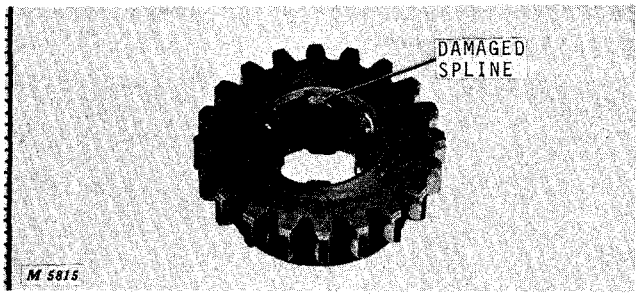

Fig. 22-Worn Spline in Shifter Gear

A damaged shifter gear spline as shown in Figure 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 15-12 of Section 20 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 ASSEMBLY

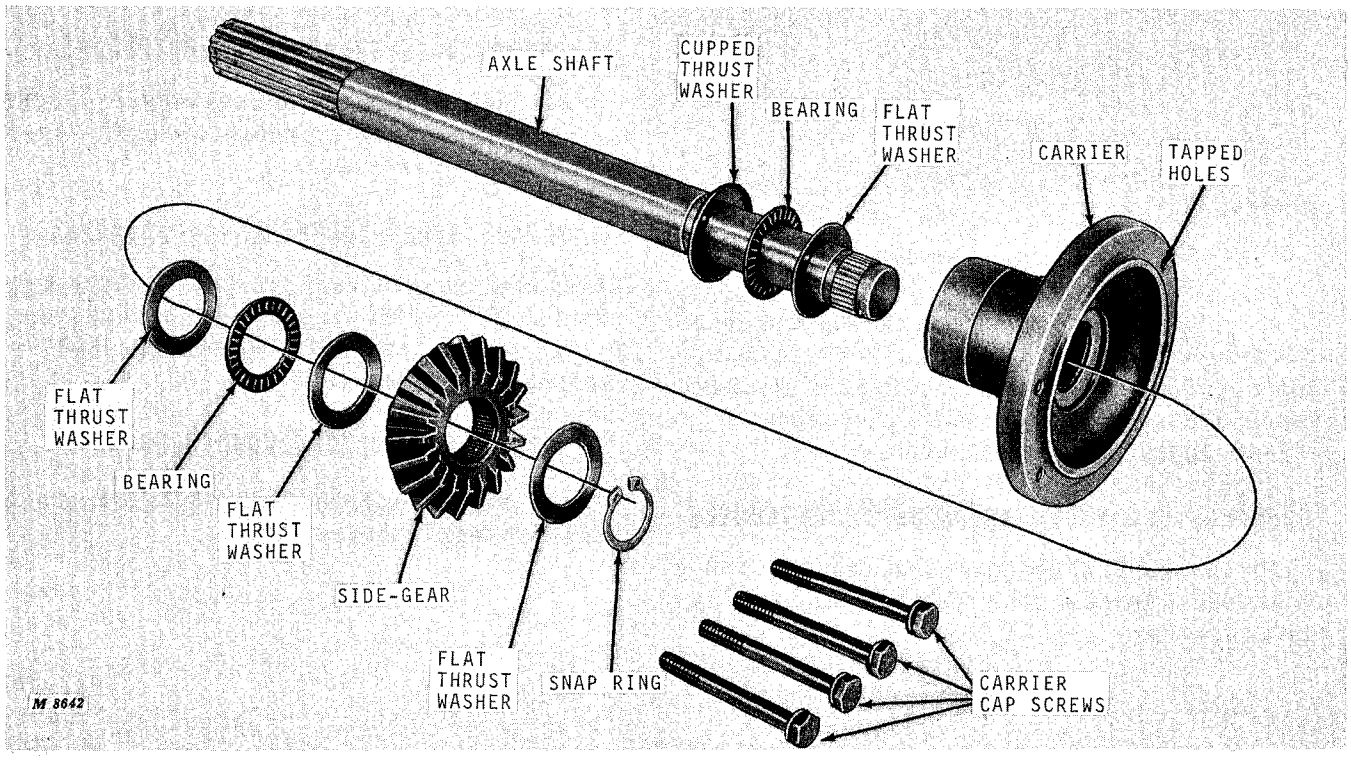

Fig. 23-Exploded View of Differential Assembly

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 Figure 23. It is important that the cupped thrust washer be placed onto axle first.

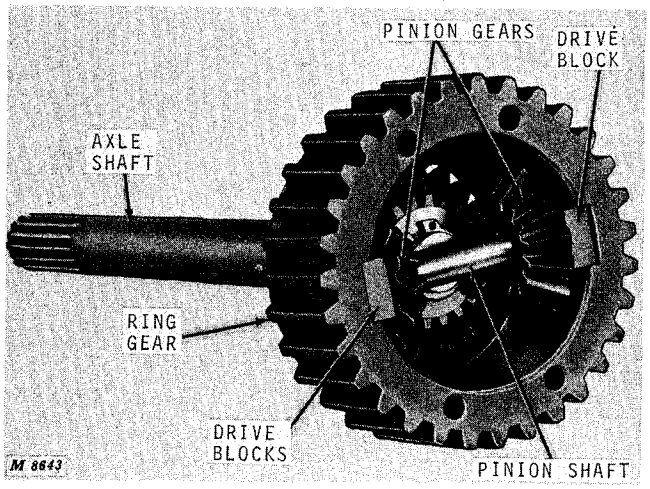

Fig. 24-Assembling Ring and Pinion Gears

Second, place ring gear, Figure 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

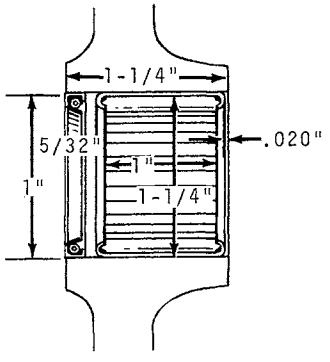

Fig. 25-Installing Bearings

All bearings are pressed into the bearing bores from the inside of the axle housing interior, Figure 25.

Bearing drivers to install bearings properly are listed under special tools, page 15-20. As a general rule, all bearings should be pressed into the housing to a depth of 0.020 inch beyond flush with housing interior.

LIMITED SLIP DIFFERENTIAL ASSEMBLY

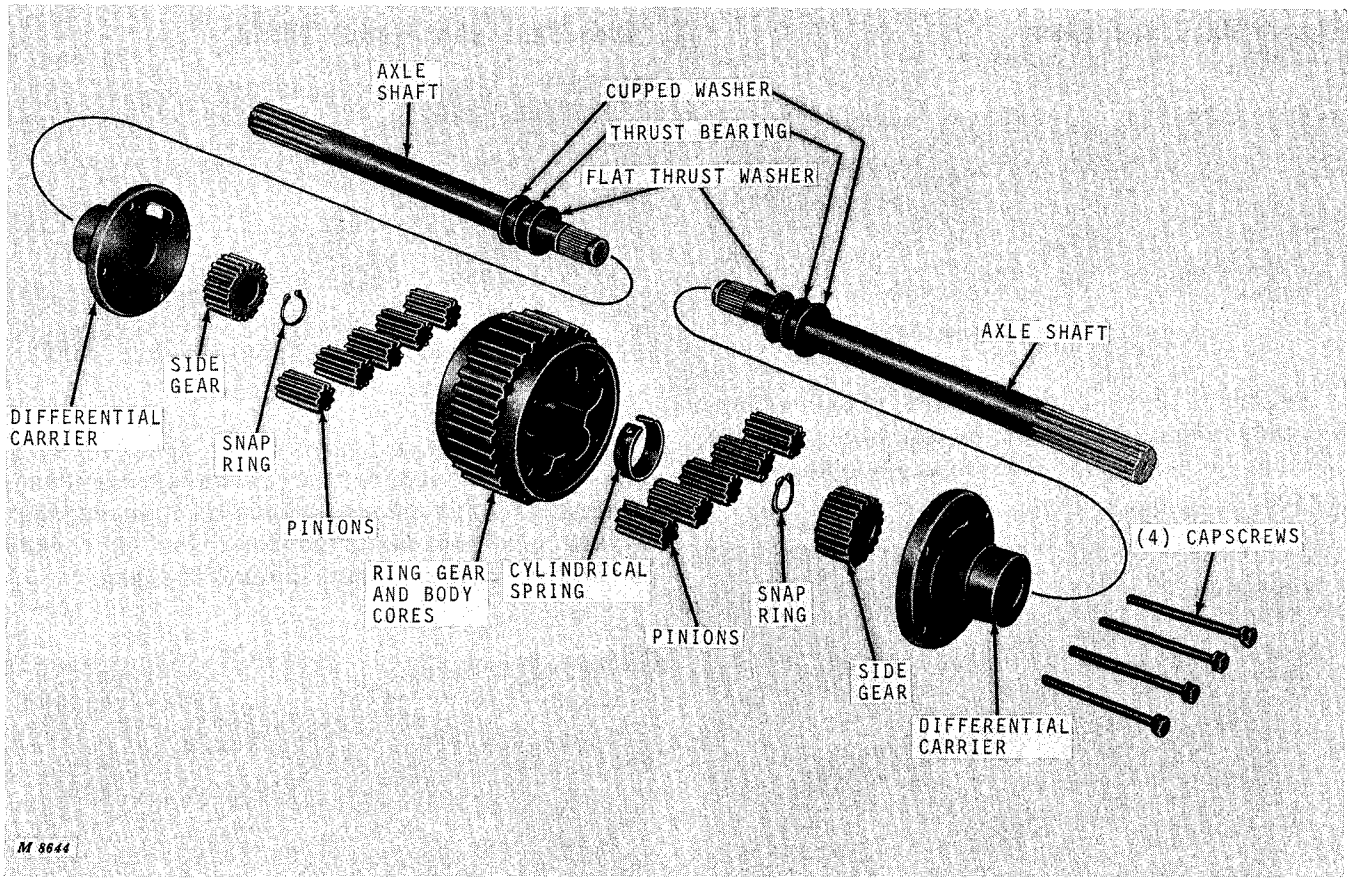

Fig. 26-Exploded View of Limited Slip Differential

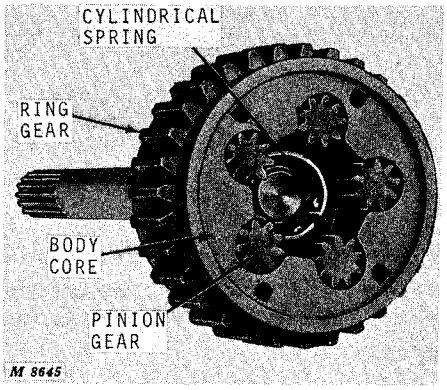

Fig. 27-Assembly of Pinion Gears

Install body cores to ring gear so that pockets in one core are out of alignment with pockets in the other core, Figure 27.

Assemble thrust washers, differential carriers and side gears to axles and secure with the snap rings, Figure 26.

Install pinion gears on one side, then use the differential carrier and axle to hold them from falling out when unit is turned over. The side gear must mesh with the five pinions.

Insert the remaining five pinions to mesh with those previously installed.

Insert the cylindrical spring, Figures 26 and 27, with a pair of large 90° tip snap ring pliers. It should bottom on the side gear and contact most of the ten pinions when properly positioned, Figure 27.

Install other axle, insert four cap screws and tighten securely.

ASSEMBLY OF TRANSAXLE

Input Shaft And Gear

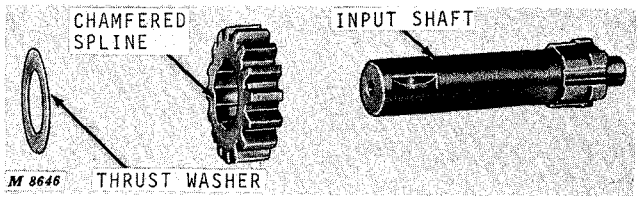

Fig. 28-Input Shaft and Gear

Assemble input shaft, gear and thrust washer. Chamfered gear spline must be toward outer end of shaft as shown in Figure 28. Gear is a light press fit onto shaft.

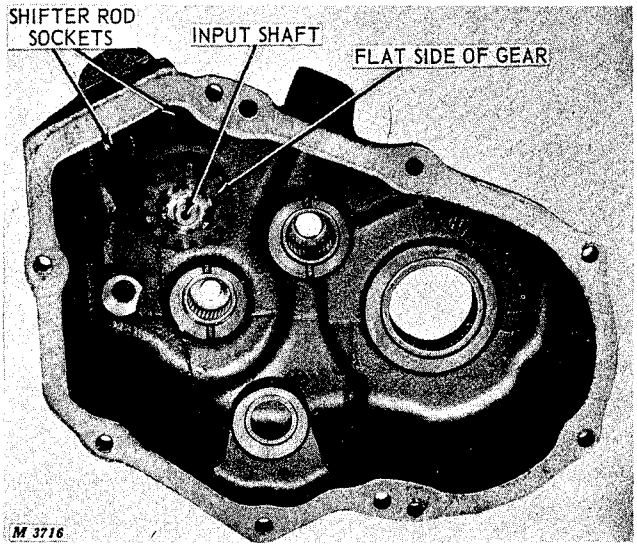

Fig. 29-Assembled Input Shaft

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," page 15-20, for proper seal sleeve. Flat side of gear should now face upward, Figure 29.

Idler Gear and Pinion Shaft

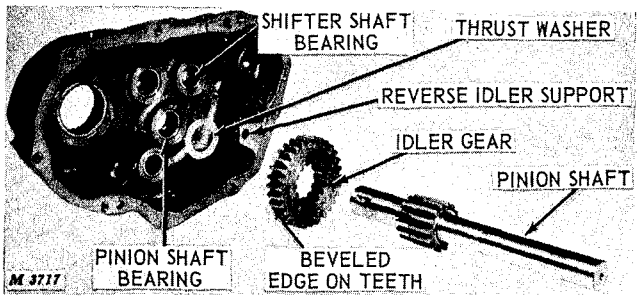

Fig. 30-Idler Gear and Shaft

Use seal sleeve tool listed under "Special Tools," page 15-20, and assemble thrust washer, idler gear and pinion shaft as shown in Figure 30. Beveled edge of teeth must face away from pinion shaft as shown. Pinion shaft is a light press fit through idler gear.

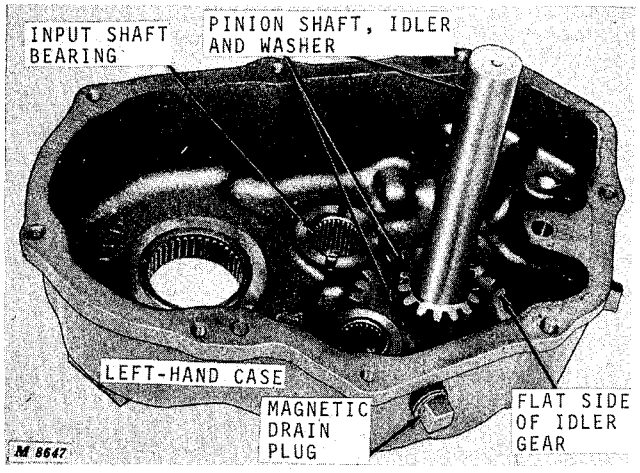

Fig. 31-Idler Gear and Shaft Assembly

When thrust washer, idler gear and pinion shaft are properly assembled and installed, they will appear as shown in Figure 31. The flat edge of the idler gear should now face upward.

Output Shaft and Gear

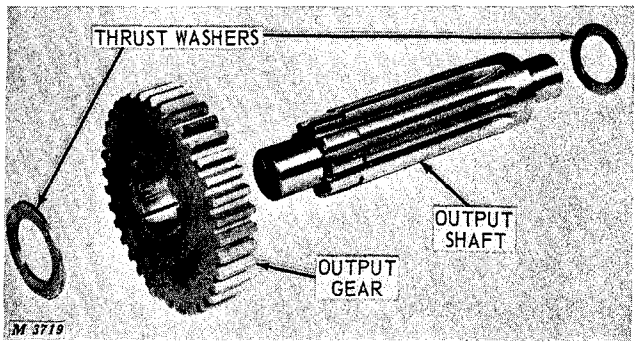

Fig. 32-Output Shaft and Gear Assembly

The output gear is assembled to the output pinion shaft with a press fit. A thrust washer is used on both ends of output shaft, Figure 32.

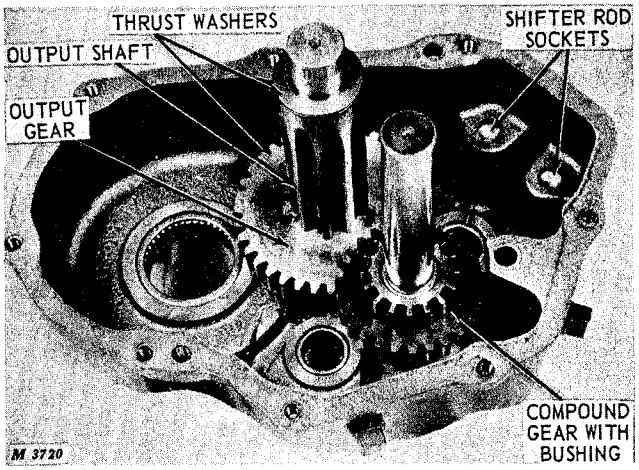

Fig. 33-Output Shaft and Gear Installed

Install output gear, pinion shaft and thrust washers into left-hand case, Figure 33.

Install compound gear with bushing into left-hand case, Figure 33.

Shifter Shaft

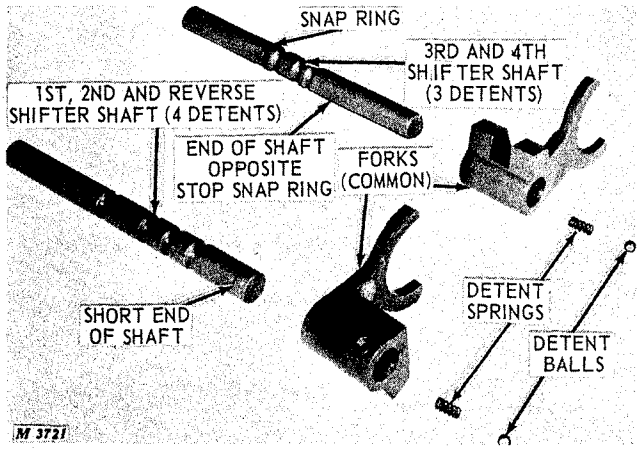

Fig. 34-Shifter Components

Because of heavy detent pressure, the assembly of these shafts can be difficult. Assemble forks as shown in Figure 34. 1st, 2nd and reverse fork will face to the left and 3rd and 4th fork will face to the right or away from shaft. The 1st, 2nd and reverse shaft must have the short end of shifter shaft toward fork. The 3rd and 4th shifter fork must have end opposite stop snap ring toward fork as shown in Figure 34. Start the shaft into the fork. Depress detents and complete the assembly. Slide forks along shaft. A good snap should be felt in each detent. Place forks in neutral positions at this time, Figure 35.

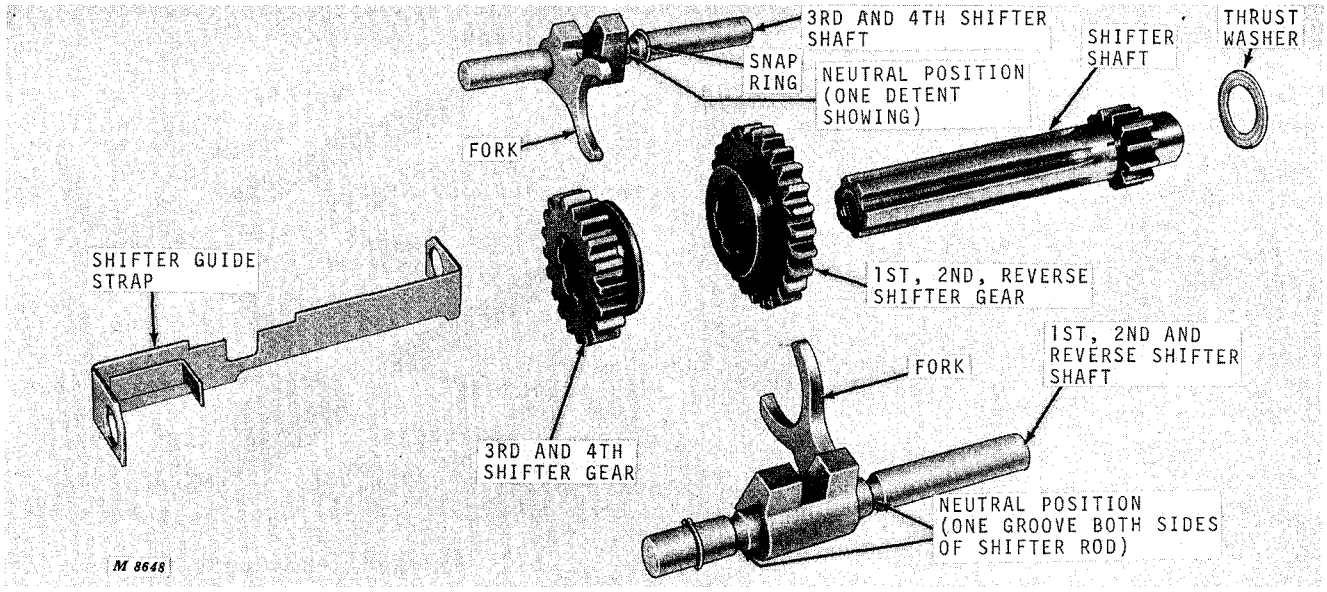

Fig. 35-Shifter Shaft and Gear Components

To assemble shifter, lay out parts as shown in Figure 35. Be sure forks are in neutral detent. 1st, 2nd and reverse will have one detent showing on each side of fork, Figure 36. 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.

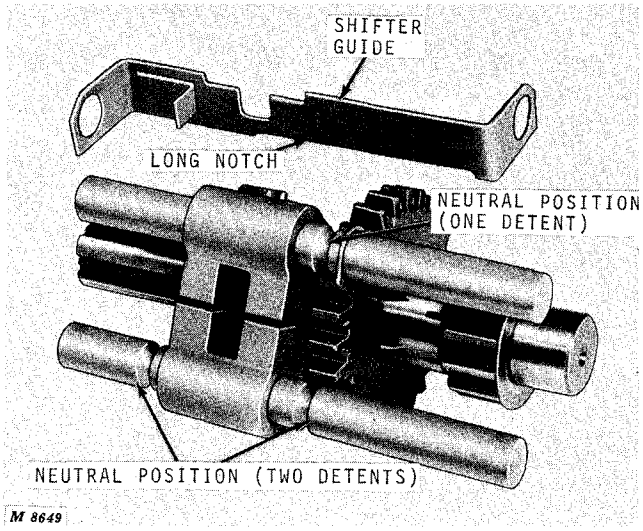

Fig. 36-Shifter Assembly

The shifter shaft assembly should appear as shown in Figure 36. 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.

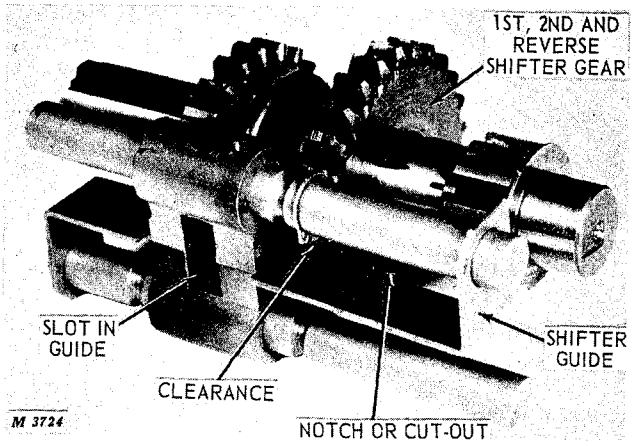

Fig. 37-Shifter Assembly

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, Figures 36 and 37.

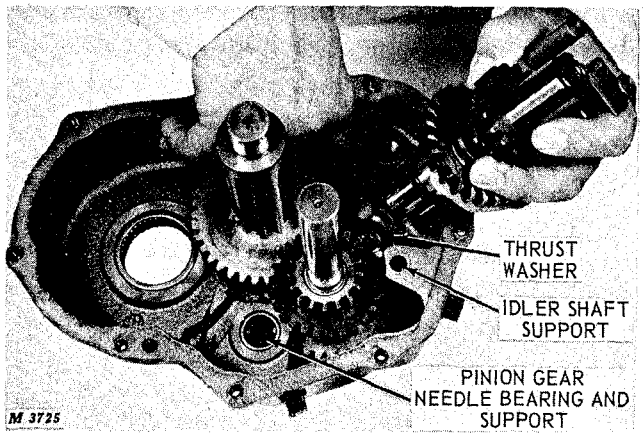

Fig. 38-Shifter Installation

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. Figure 38. The shifter rods should now enter the two machined sockets in left-hand case. Figure 33.

Idler Gear, Pinion and Thrust Washer

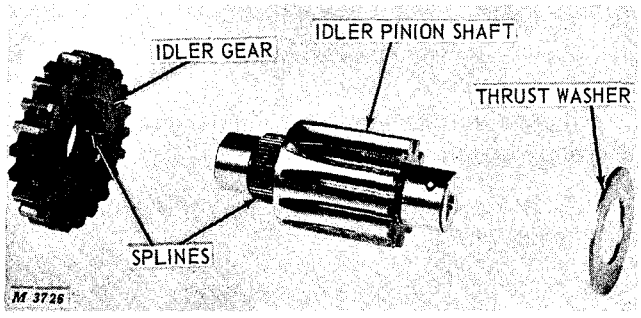

Fig. 39-Idler Components

The inside of the idler gear is splined to slip freely onto splined end of idler pinion, Figure 39.

Reverse Idler Shaft and Gear

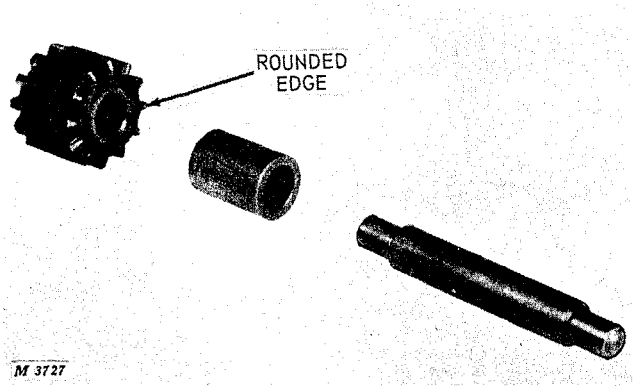

Fig. 40-Reverse Idler Components

Assemble reverse idler shaft assembly as illustrated. Round edge of teeth faces spacer, Figure 40.

NOTE: Shaft is the same on both ends.

Installing Reverse Idler, Idler Gear Assembly and Spacer

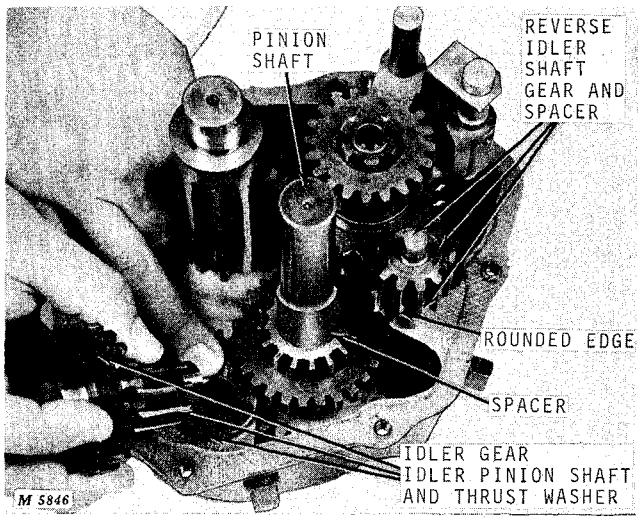

Fig. 41-Installing Idler and Reverse Idler

Install reverse idler assembly, Figure 41.

Install thrust washer, idler pinion shaft and idler gear. Figure 39 shows proper assembly before lowering into left-hand case, Figure 41.

Place spacer on pinion shaft, Figure 41.

Installing Cluster Gear and Thrust Washer

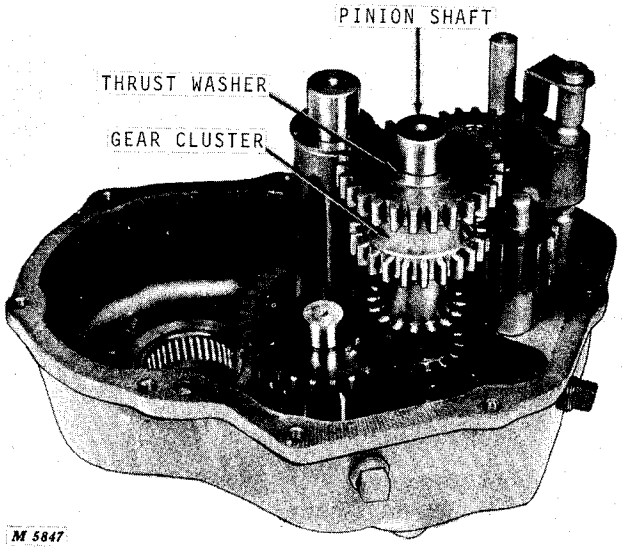

Fig. 42-Transmission Assembled

Install gear cluster and thrust washer on pinion shaft as shown in Figure 42.

All parts assembled thus far should appear as shown in Figure 42.

Installing Differential

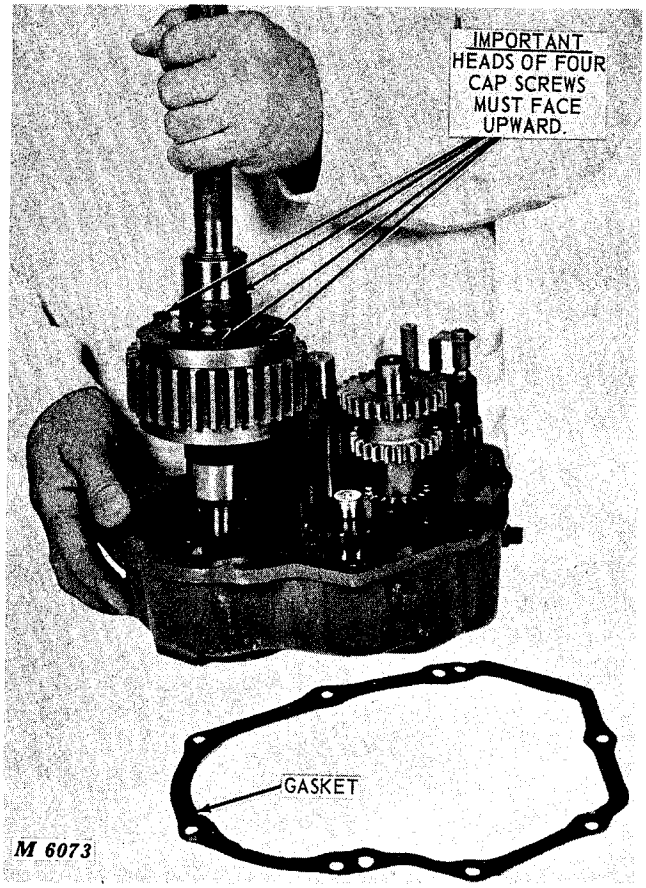

Fig. 43-Installing Differential

Install differential assembly into left-hand case with bolt heads facing upward as shown in Figure 43.

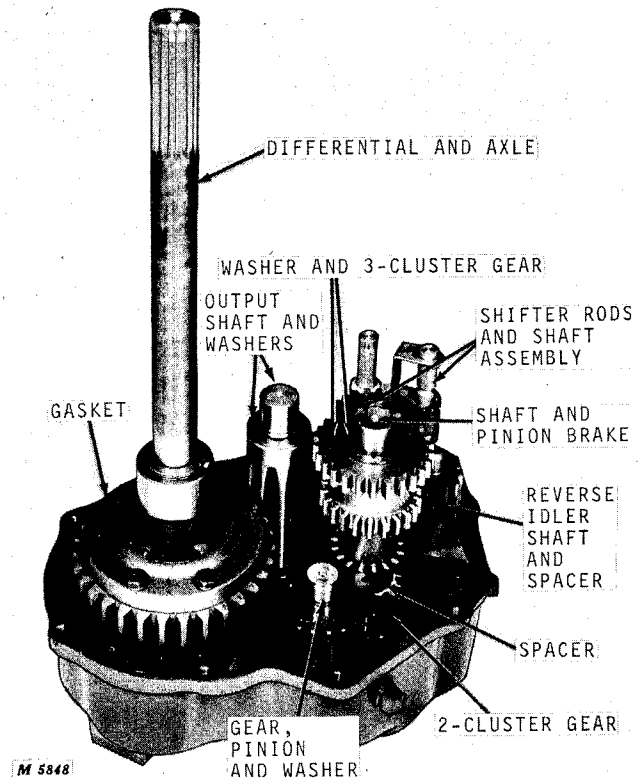

Fig. 44-Completed Internal Assembly

The internal components should now appear as shown in Figure 44.

Position a new gasket on the lower (left-hand) case at this time.

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Placing Cover on Case

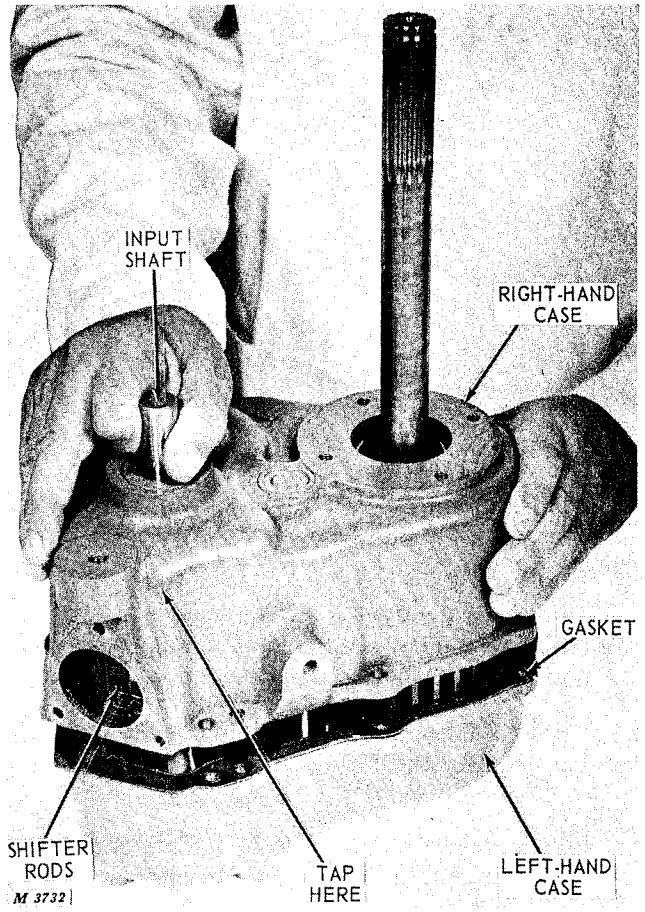


Fig. 45-Closing Case

Install right hand case half over axle and input shaft as illustrated in Figure 45. 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 Figure 45. 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

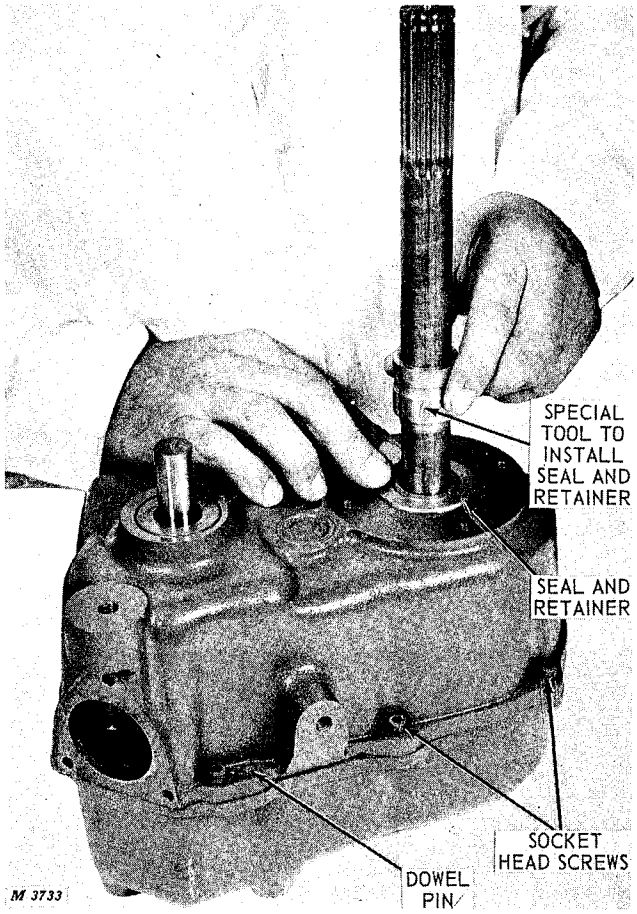


Fig. 46-Installing Retainers and Seals

Insert eight socket head screws, Figure 46, and tighten to 120 in-lbs torque.

Install retainer and new seal with special oil seal cone tool, page 15-20. 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. Figure 46.

Installing Axle Supports

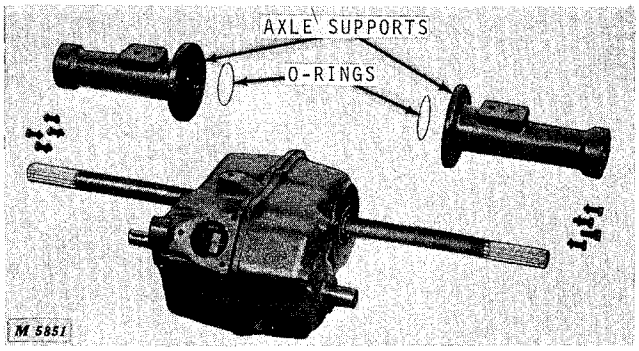
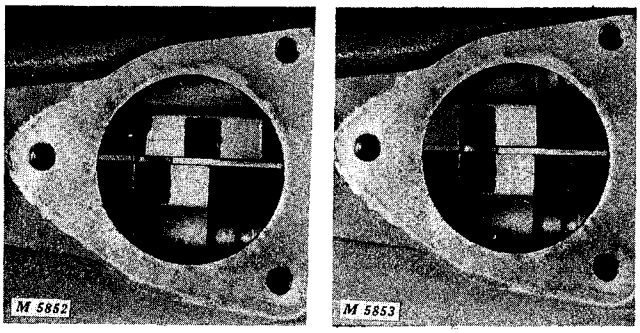


Fig. 47-Installing Axle Supports

Install O-rings and axle supports with bearings as shown in Figure 47. Always use new O-rings. Refer to "Bolt Torque Chart," section 10, page 10-4 and tighten support bolts accordingly.

Positioning Shifter Forks



Incorrect *Correct*

Fig. 48-Shifter Forks

Inspect the shifter forks 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 Figure 17, page 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

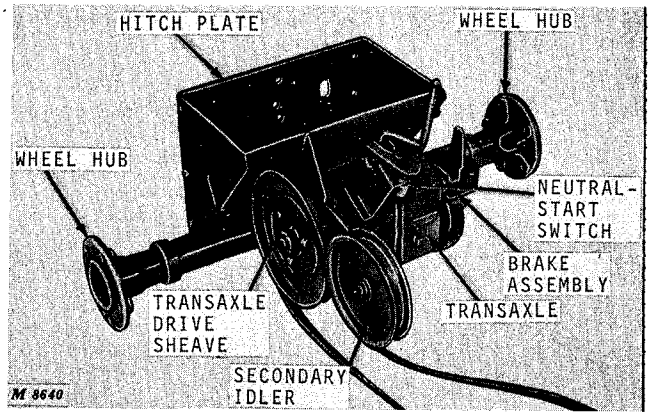


Fig. 49-Transaxle Installation

Position neutral start bracket with switch, shift lever and gasket on transaxle, Figure 49. Secure with three screws.

The above mentioned neutral start switch installation may be omitted when tractor is equipped with the plunger type switch. See section 40, page 10-12.

Install brake assembly, input hub, secondary idler, driven sheave with belt, and hitch assembly to transaxle, Figure 49.

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," section 10, page 10-4 and tighten bolts and set screws accordingly.

Refer to Section 40 and adjust neutral-start switch and bracket.

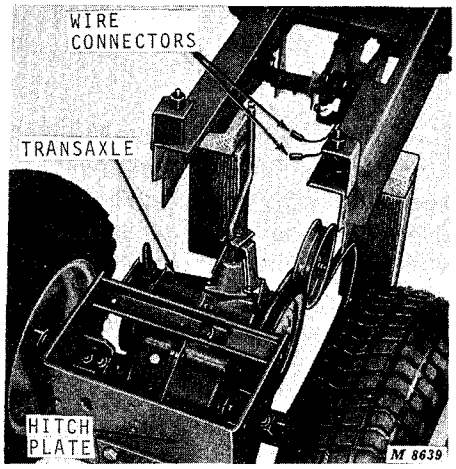


Fig. 50-Transaxle Installed

Install wheel hubs with washers and snap rings. Bolt wheels to hubs and roll transaxle into tractor base, Figure 50. Install cap screws in hitch plate and frame and tighten securely.

Connect brake clevis and secondary idler spring, Figure 50. Then slip secondary belt onto variator.

Connect neutral-start switch leads. On tractors above serial number 160,000 refer to Figure 51.

Install fender-deck assembly.

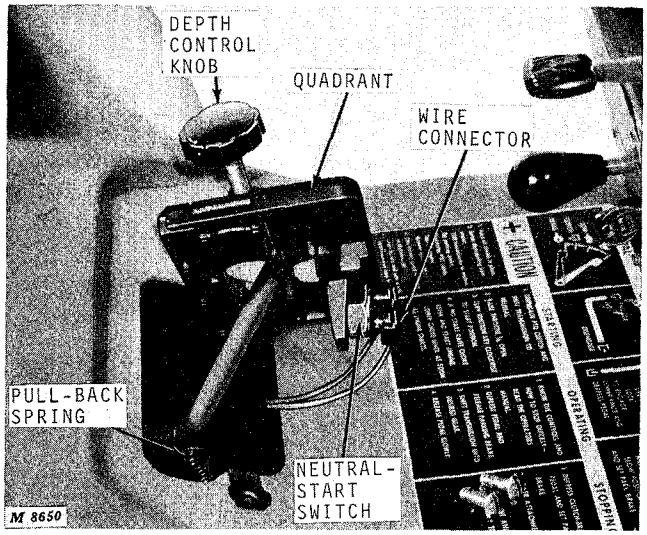


Fig. 51-Connecting Plunger-Type Neutral-Start Switch

On tractors above serial number 160,000, loosen and lift quadrant as shown in Figure 51. 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 10-15, and adjust brake and variator linkage.

Refer to Lubrication Chart, section 10, page 20-1 and add lubricant.

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	OCT1340	Remove retaining rings from axle ends
Motor-Rotor Repair Stand	OCT1730-A	To invert tractor for servicing transaxle and components beneath tractor.

SPECIFICATIONS

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.

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Group 20
PTO CLUTCH

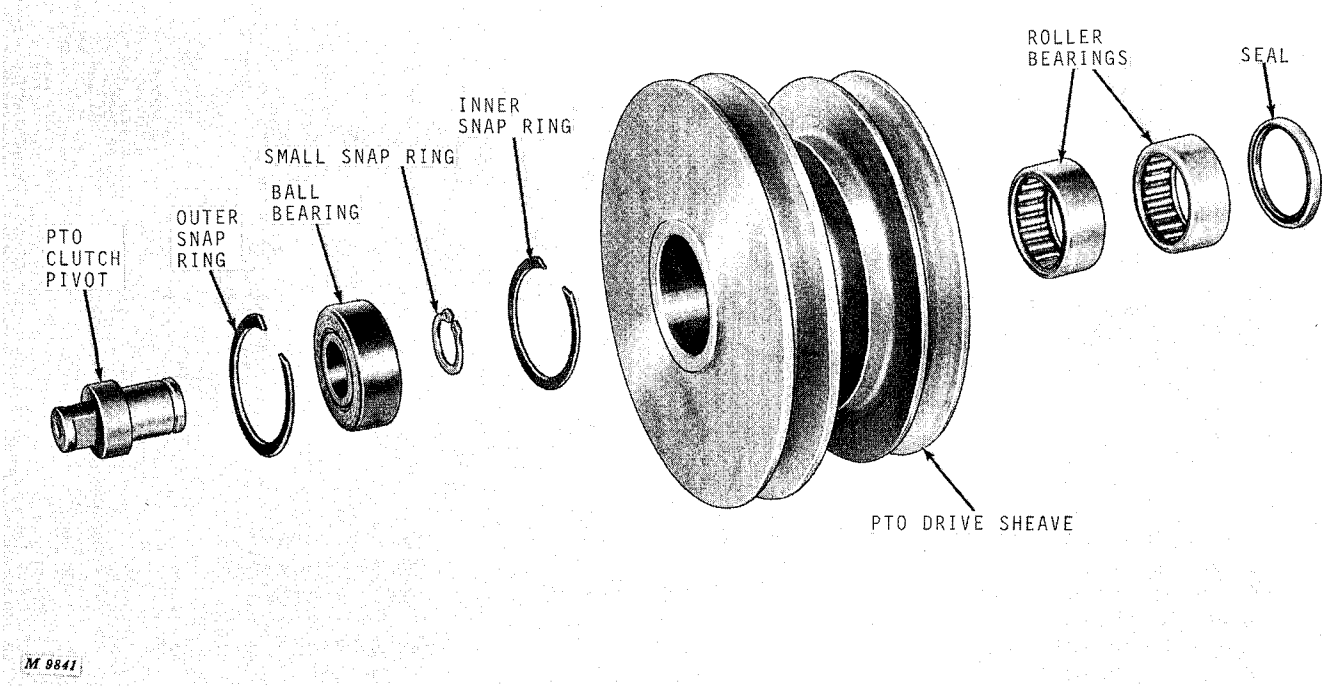

Fig. 1-PTO Clutch Drive Sheave Assembly

PRINCIPLE OF OPERATION

The PTO clutch used on 110 and 112 Tractors 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, Figure 1) slides on the crankshaft, 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.

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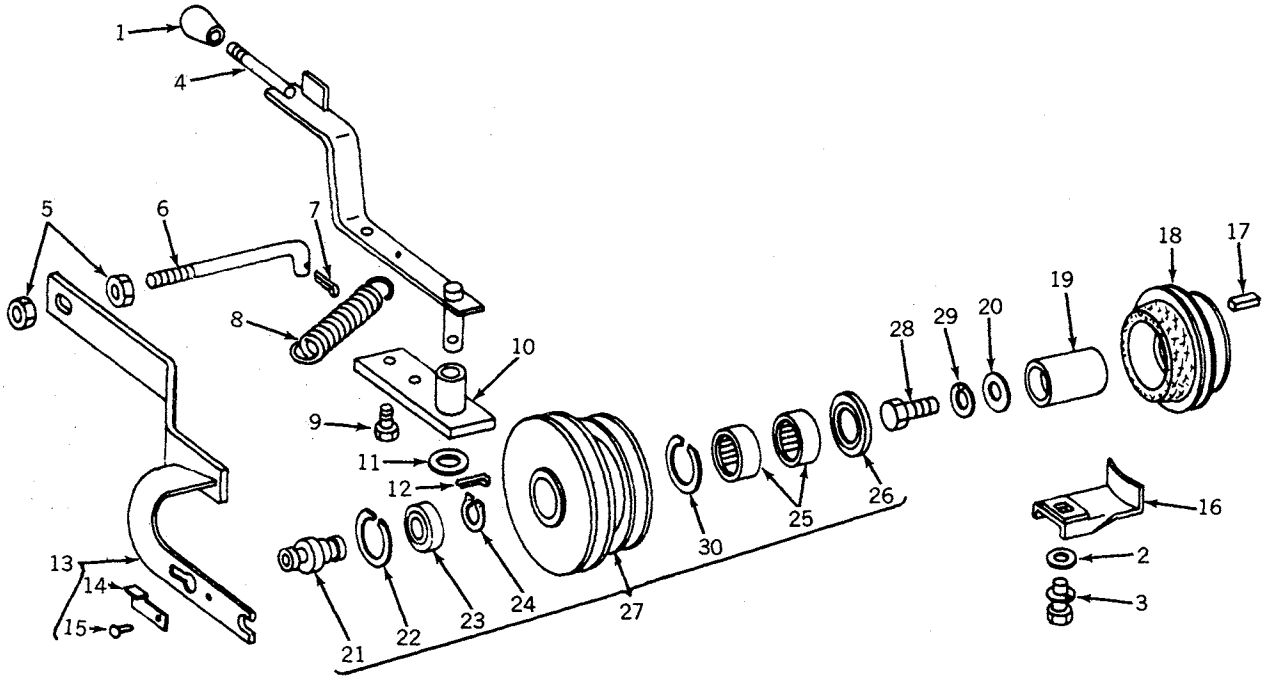
REPAIR



M 9842

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.

Assembly

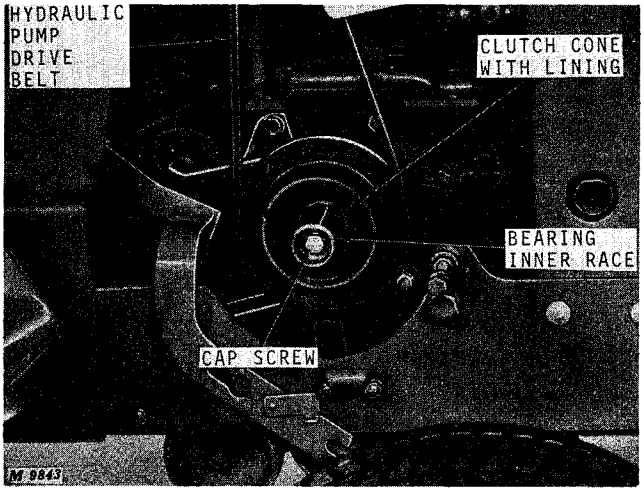


Fig. 3-Clutch Cone and Bearing Inner Race Assembly

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, Figure 3. Tighten securely.

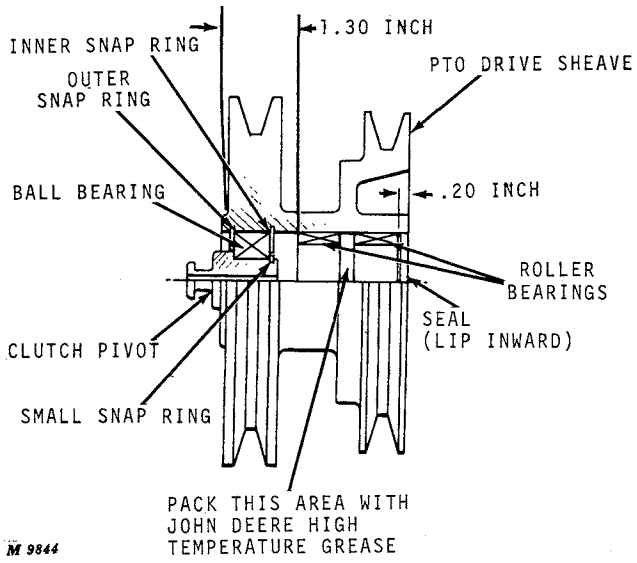


Fig. 4-PTO Drive Sheave Assembly Detail

Press bearings and seal into PTO drive sheave following dimensions given in Figure 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, Figure 4.

Slide complete PTO clutch sheave assembly onto bearing inner race.

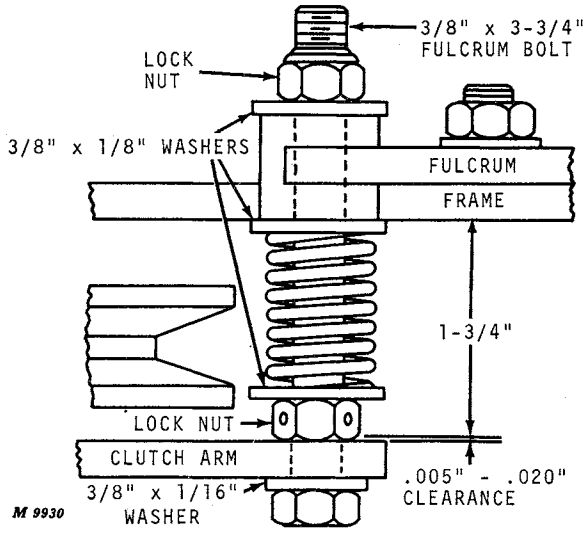


Fig. 5-Spring-Loaded Fulcrum Bolt Detail

Replace clutch fulcrum with new spring-loaded type, Figure 5, if tractor is not already equipped with this fulcrum. This is available as a complete kit. Adjust to dimensions shown in Figure 5.

Connect clutch throw-out arm to PTO clutch pivot and fulcrum.

Check adjustment of clutch components as described on the next page.

ADJUSTMENT

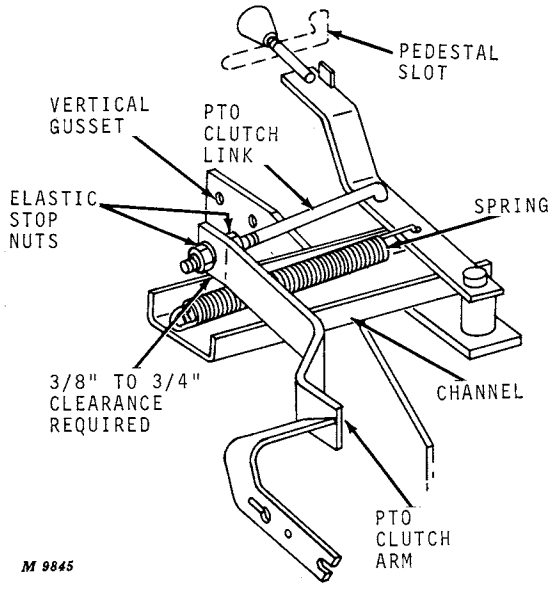


Fig. 6-Clutch Linkage

The inner elastic stop nut on the PTO clutch link, Figure 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.

NOTE: On tractors below Serial No. 130,000, it may be necessary to lower the fulcrum until there is 3/8 to 3/4-inch clearance between the rear end of the clutch arm and the edge of the channel reinforcement, Figure 6. If fulcrum strikes tractor frame before clearance is achieved, notch the frame and slot the attaching holes so the fulcrum can be lowered further. Lower fulcrum until the 3/8 to 3/4-inch measurement is obtained.

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, Figure 5, slightly.

If more than 1/2 slot of free travel is present, shorten fulcrum bolt, Figure 5, slightly.

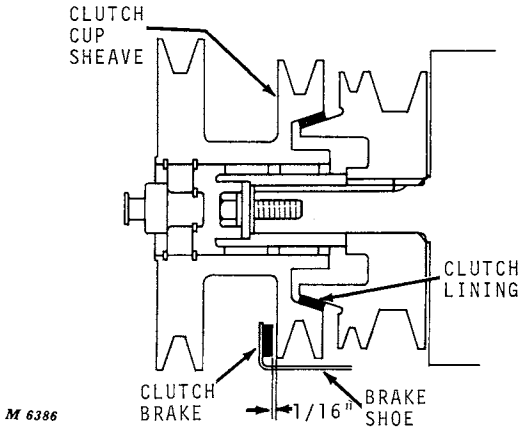


Fig. 7-PTO Clutch Brake Adjustment

With PTO clutch engaged, adjust the brake shoe so there is approximately 1/16-inch clearance between the brake shoe and clutch cup sheave, Figure 7.

Section 60
HYDRAULIC SYSTEM

Group 5
GENERAL INFORMATION

TABLE OF CONTENTS

Litho in U.S.A.

PRINCIPLE OF OPERATION

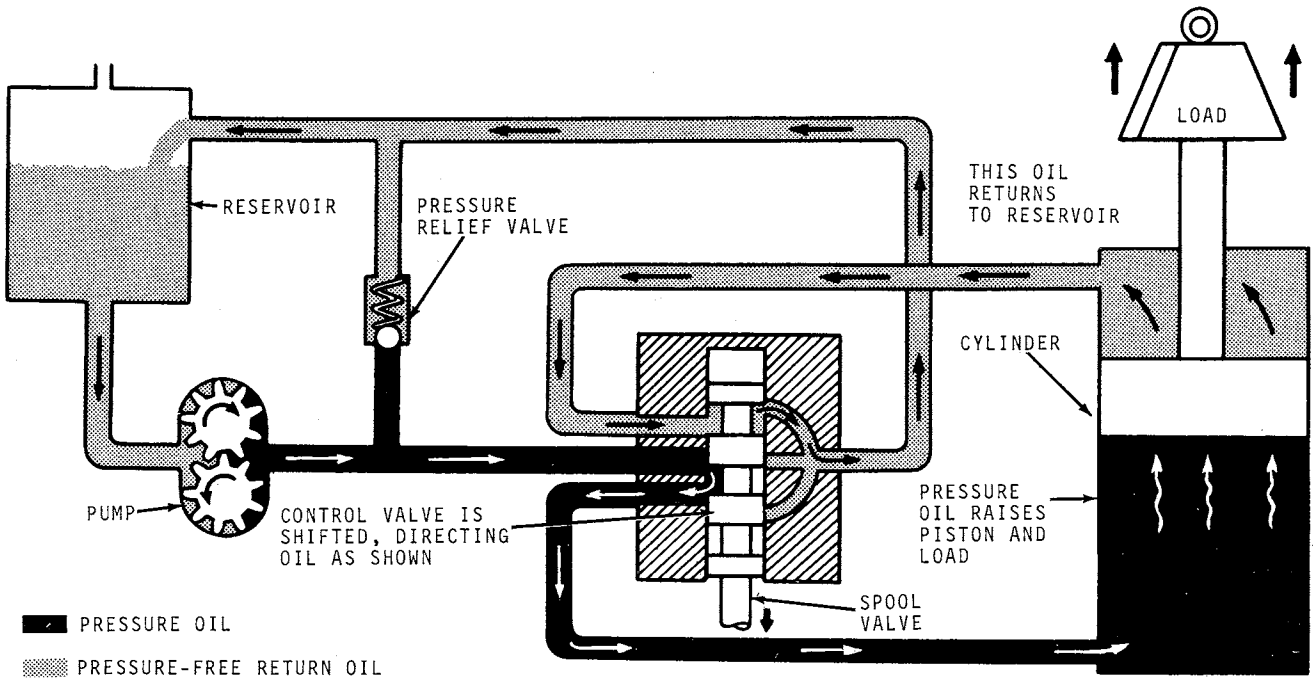


Fig. 1--Open-Center System in Operation-Raising a Load

110H and 112H Tractors are equipped with hydraulic lift systems consisting of a pump, valve, reservoir, cylinder and the lines connecting these parts, Figure 1.

Two different style hydraulic units are used. The in-line unit has the reservoir in line with the pump drive shaft; whereas, the 90-degree unit has the reservoir at a 90-degree angle to the pump drive shaft. Internal components are similar.

Both the in-line and 90-degree units are 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 continuous 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, Figure 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,"Figure 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.

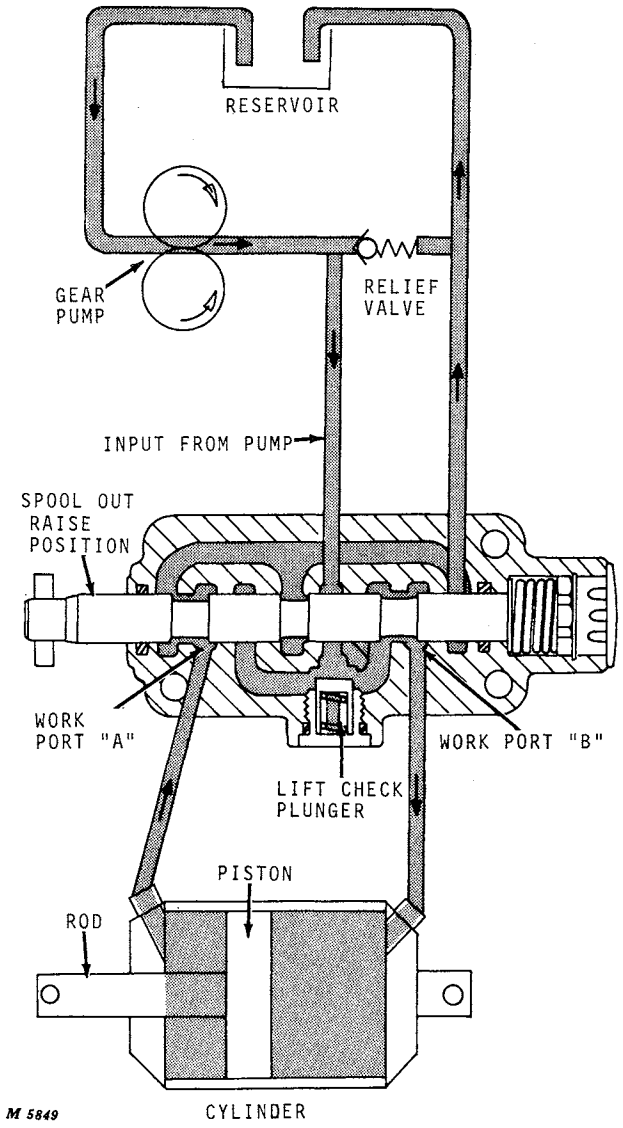


Fig. 2-Oil Flow Schematic - Raised Position

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.

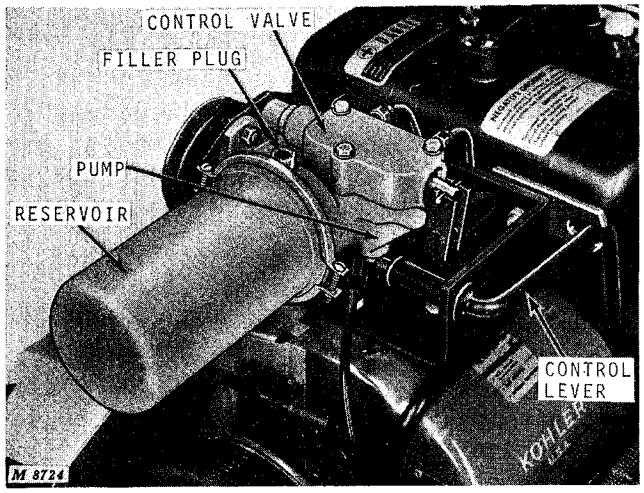


Fig. 3-Control Valve, Pump and Reservoir Mounted on Engine (90° Unit)

The relief valve opens when operating pressure reaches the calibrated setting. See specifications, page 15-9.

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

When servicing the hydraulic system, remove filler plug, Figure 3, and check fluid level. It should be 1 to 1-1/2-inches from top of reservoir. When required, add Automatic Transmission Fluid - Type "A". Use only this Type Fluid 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 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.

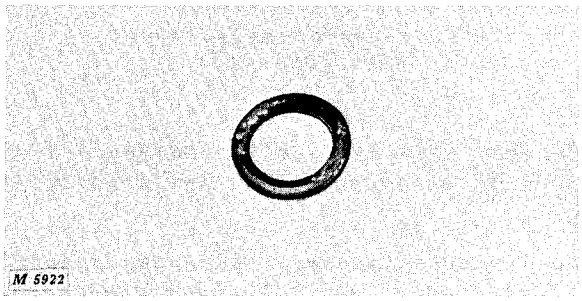


Fig. 4-Faulty O-ring Causing Oil Leakage

Leakage can be caused by O-rings which are worn, damaged or have paint on them, Figure 4.

Loss of Hydraulic Pressure

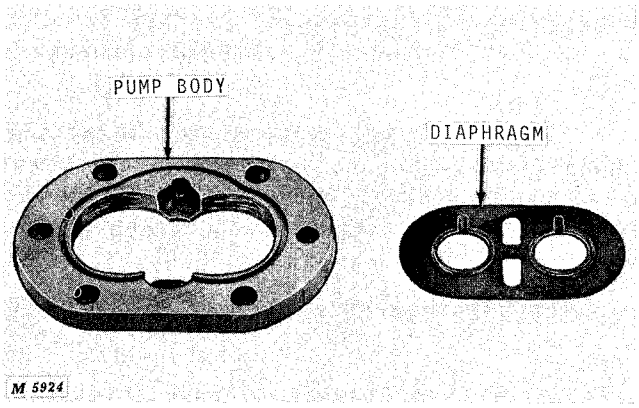


Fig. 5-Defective Pump Diaphragm and Pump Body

Loss of hydraulic pressure and failure to lift can be caused by a scored diaphragm or pump body. 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

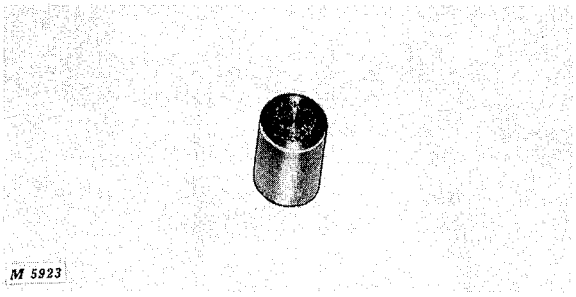


Fig. 6-Marred or Scratched Lift Check Plunger Causes Load to Lower When Lift Lever is Raised

Scratched or pitted surfaces on lift check plunger 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 15-8.

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

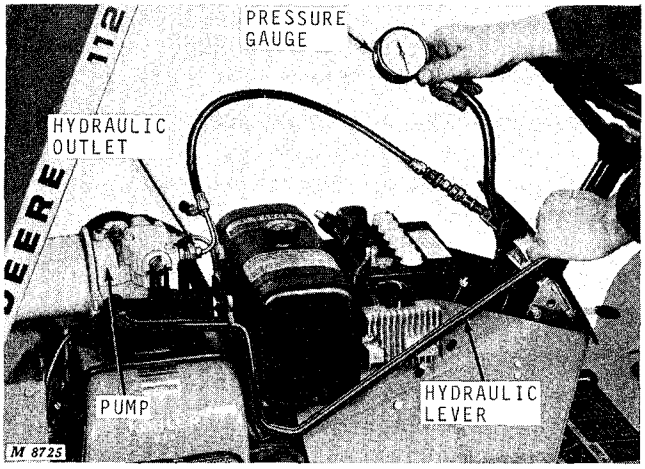


Fig. 7-Pressure Gauge Installed on Valve

A pressure gauge, Figure 7, or a hydraulic test unit incorporating a pressure gauge and flow meter, Figure 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

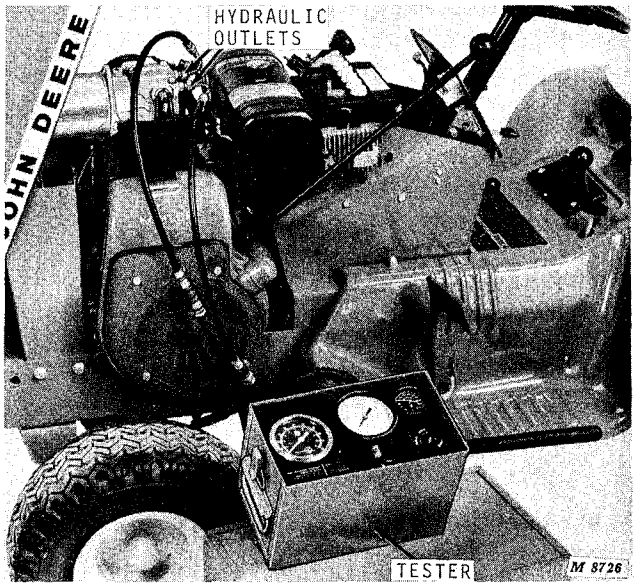


Fig.8-OTC Model No. Y-90 Hydraulic Tester Installed for Flow and Pressure Test

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, Figure 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 15-9, for system pressure. Refer to "Diagnosing Malfunctions," page 5-6, to correct low system pressure.

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

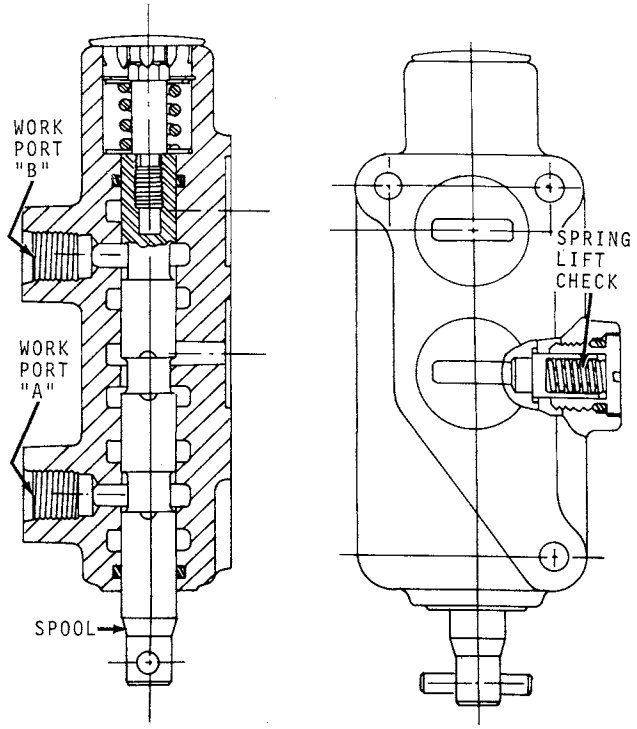
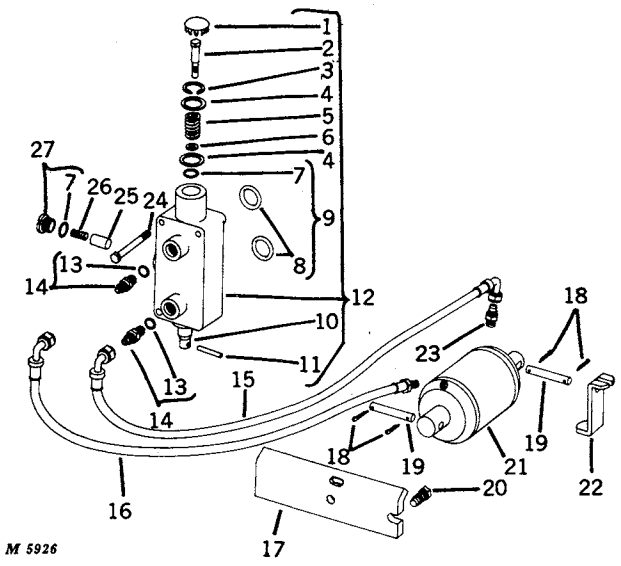


Fig. 1-Cutaway View of Control Valve

The open center valve 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, be sure to check "Diagnosing Malfunctions," page 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.

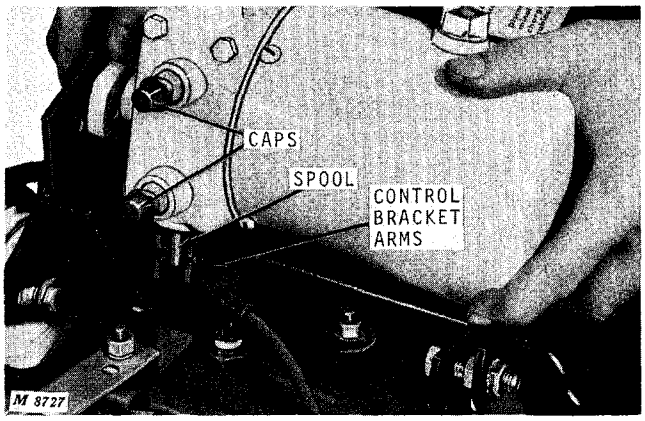


Fig. 3-Removing Pump-In-line Unit

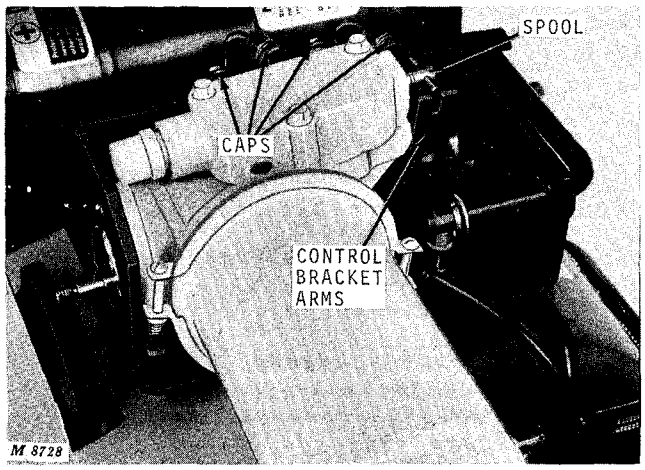


Fig. 4-Removing Pump-90-Degree Unit

Twist unit to disconnect end of spool from control bracket arms, Figures 3 and 4, 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

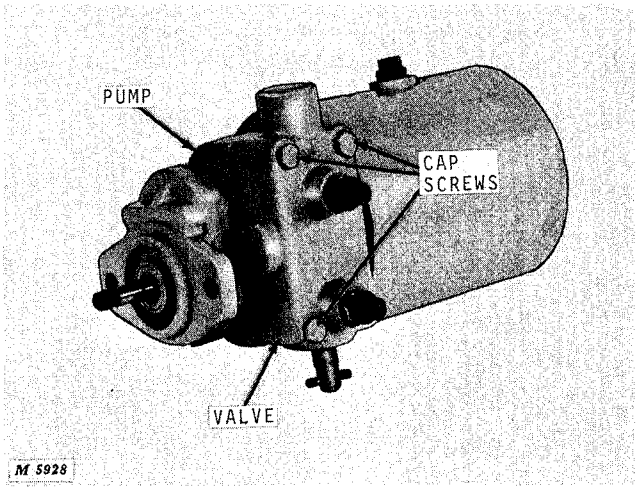


Fig. 5-Separating Valve Assembly from Pump-In-line Unit

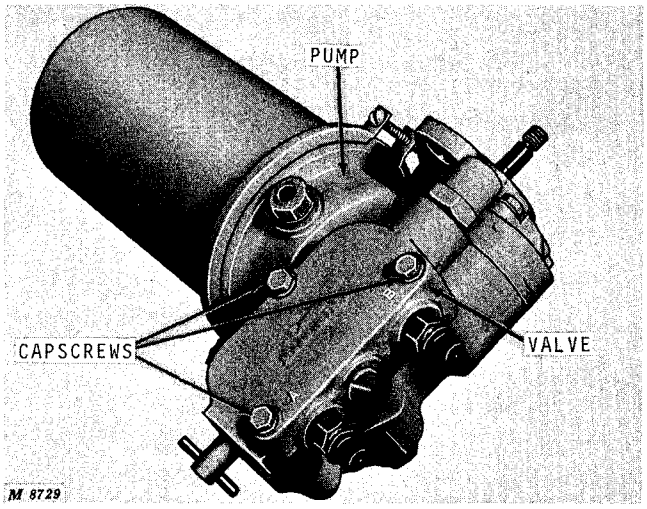


Fig. 6-Separating Valve Assembly from Pump-90-Degree Unit

Remove valve assembly from pump by removing three cap screws, Figures 5 and 6, which hold valve assembly to pump back plate.

Discard O-rings between the valve body and pump back plate.

Disassembling Valve

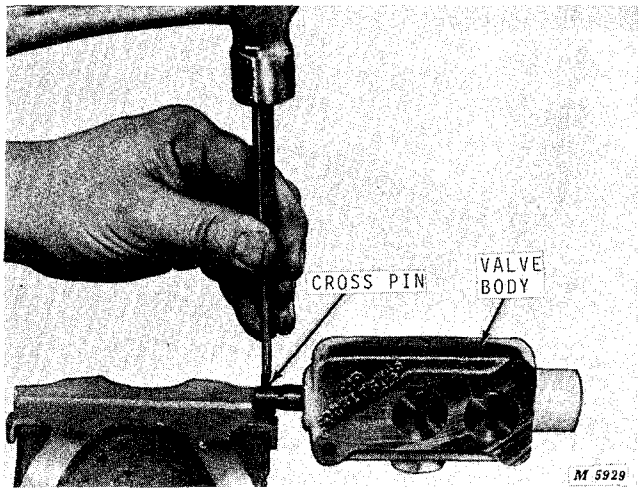


Fig. 7-Removing Cross Pin From Spool

Rest small diameter of spool end on a partially closed vise and very carefully remove cross pin, Figure 7.

IMPORTANT: Use special care to prevent marring or bending spool.

Removing Valve Spool

In-line Unit

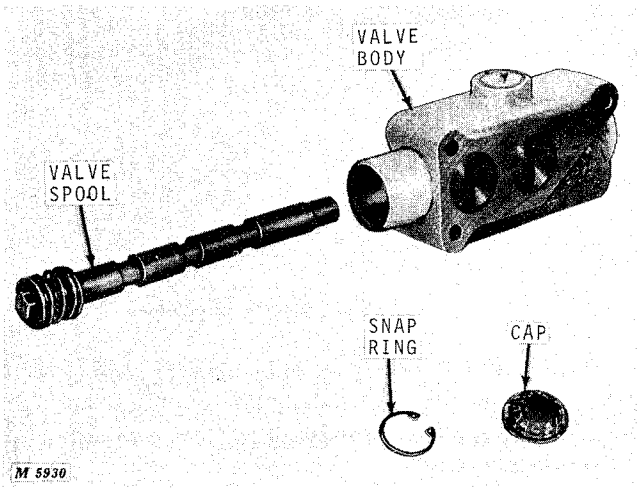


Fig. 8-Removing Valve Spool From Valve Body - In-line Unit

Remove cap and snap ring from valve body. Pull valve spool out spring end of valve body, Figure 8.

90-Degree Unit

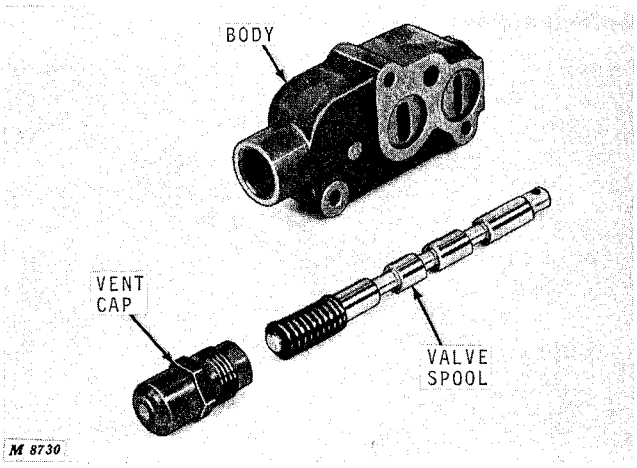


Fig. 9-Removing Valve Spool from Valve Body-90-Degree Unit

Remove vent cap from valve body. Pull valve spool assembly, Figure 9.

Removing Centering Spring

In-line Unit

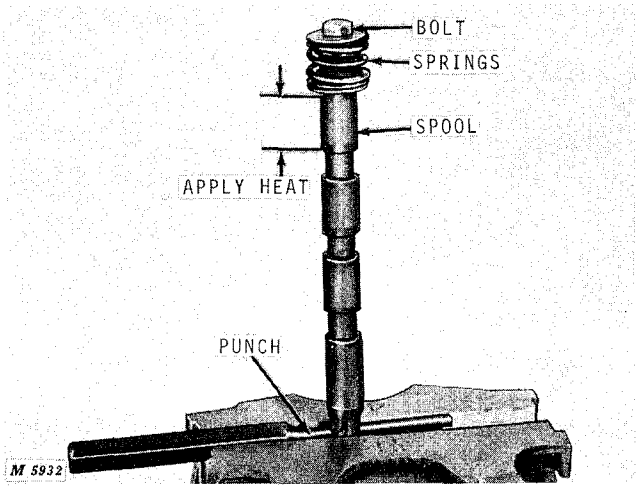


Fig. 10-Removing Spool Centering Springs-In-line Unit

Do not remove bolt from spool unless springs are broken.

Insert punch through hole in spool and clamp spool in a vise with soft jaws, Figure 10.

IMPORTANT: Apply heat to threaded end of spool, Figure 10, before attempting to remove shoulder bolt from spool.

Removing Centering Spring-Continued

90-Degree Unit

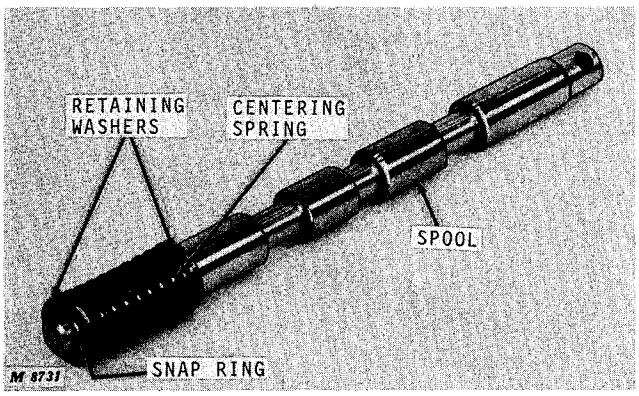


Figure 11-Removing Spool Centering Spring 90-Degree Unit

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, Figure 11.

Removing O-rings and Lift Check

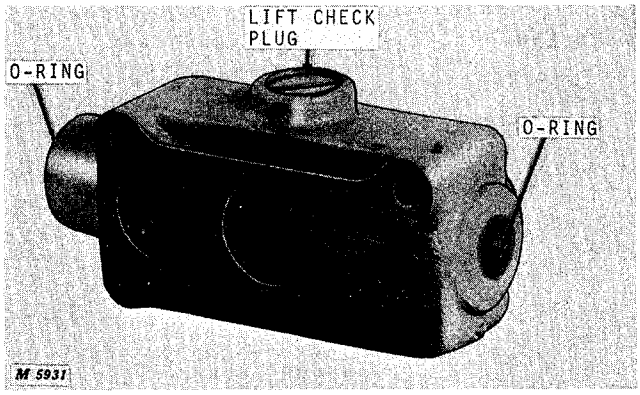


Fig. 12-Removing O-Rings and Lift Check Assembly

Remove and discard O-rings from inside diameter of each end of spool bore, Figure 12.

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

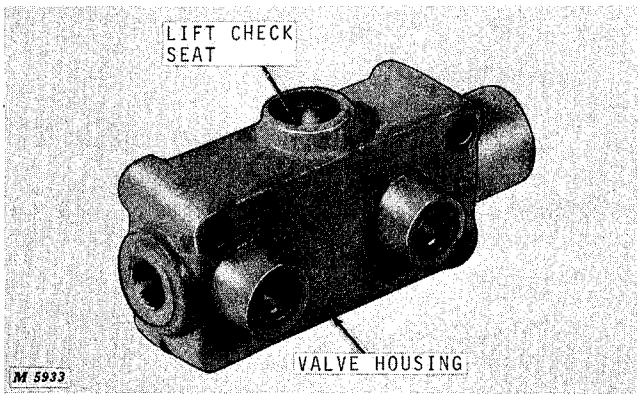


Fig. 13-Checking Valve Housing for Wear and Damage

Check valve housing for cracks or damaged threads. Inspect inside diameter of valve for scratches or excessive wear, Figure 13.

The lift check seat is machined into the valve body. Inspect lift check seat in body for damage, Figure 13. It is important that the lift check seat be smooth.

Spool Plunger and Springs

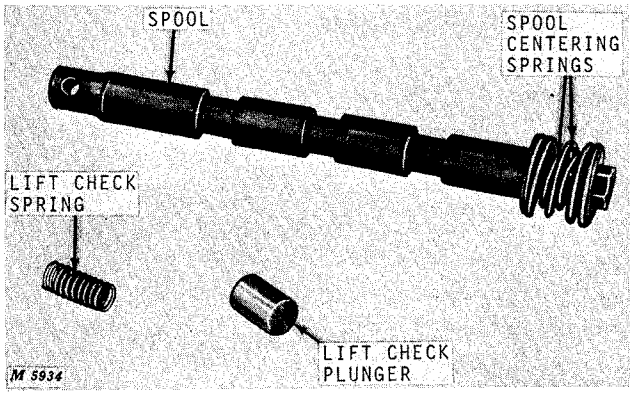


Fig. 14-Inspecting Valve Components

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, Figure 14, 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

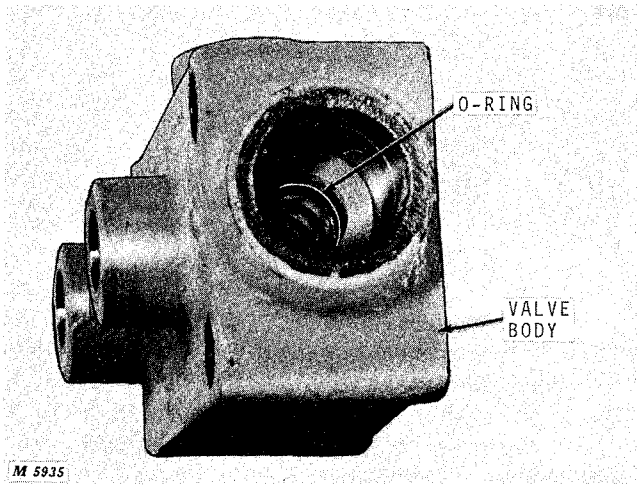


Fig. 15-Valve Body O-Rings

Apply oil to new O-rings and install in valve body, Figure 15. Always use new O-rings.

Installing Lift Check Plug

In-Line Unit

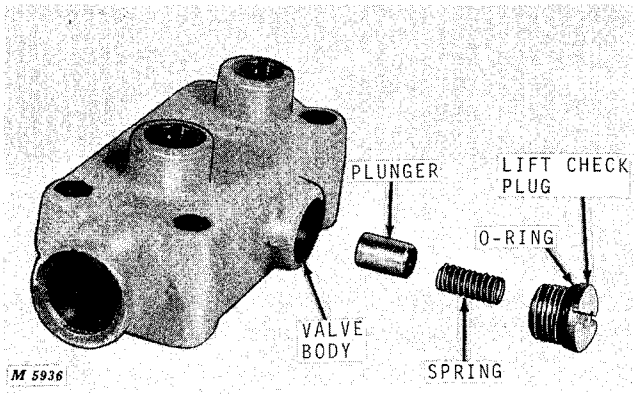


Fig. 16-Lift Check Plug Assembly

Install new O-ring on lift check plug, Figure 16. If lift check plunger or spring is damaged, replace them. Install lift check plunger and lift check spring in valve body and secure with lift check plug, Figure 16. Tighten plug firmly.

90-Degree Unit

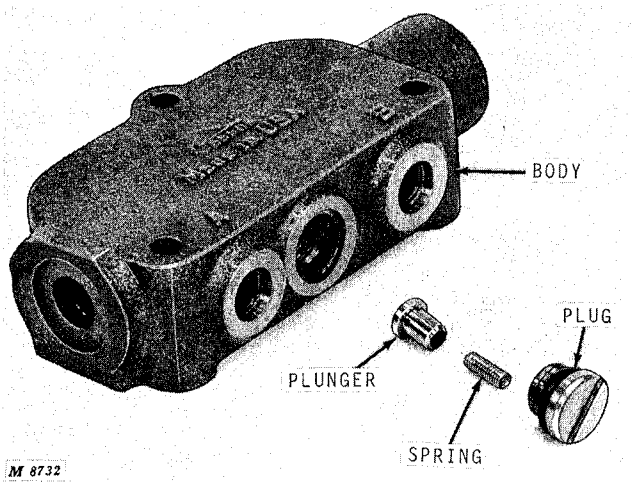


Fig. 17-Lift Check Plug Assembly

Install new O-ring on lift check plug, Figure 17. Replace lift check plunger or spring if they appear to be damaged or worn. Install lift check plunger and spring and insert plug, Figure 17. Tighten plug firmly.

Assembling Spool

In-Line Unit

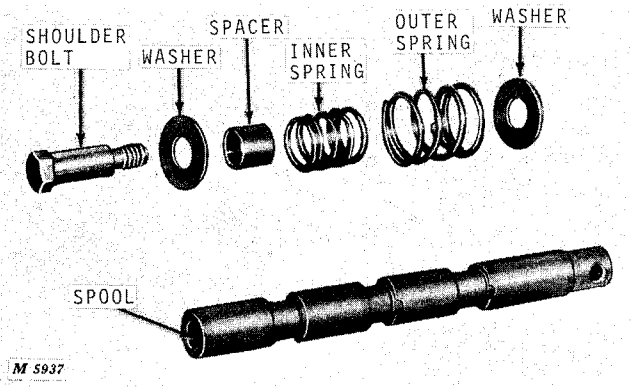


Fig. 18-Spool Assembly In-line Unit

Assemble spool in the order shown above, Figure 18. Apply Loctite or equivalent to threads of shoulder bolt and install.

Refer to torque specification on page 10-9 and torque spool centering spring bolt accordingly.

Assembling Spool-Continued

90-Degree Unit

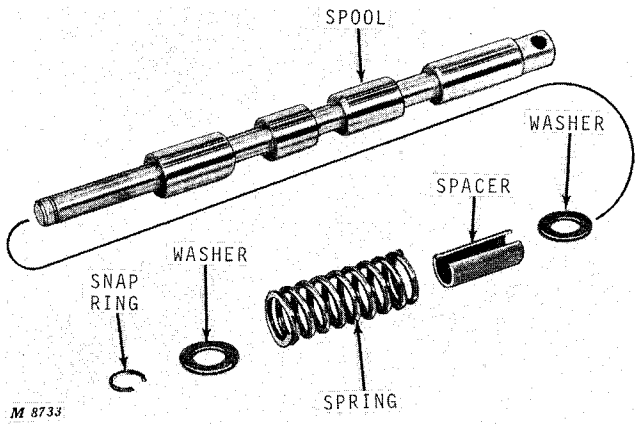


Fig. 19- Spool Assembly 90-Degree Unit

Assemble spool in the order shown above, Figure 19. 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

In-line Unit

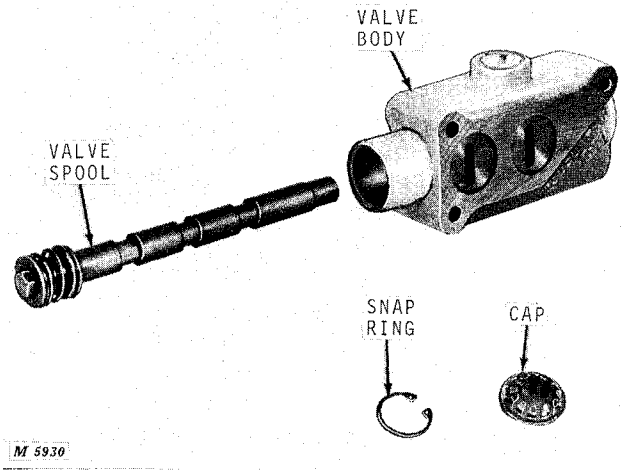


Fig. 20-Installing Spool-In-line Unit

Apply oil to O-rings in spool bore and insert spool assembly from spring end of valve body, Figure 20. Insert spool slowly while rotating spool so as not to cut O-ring as spool lands pass through O-ring. With spool in place, insert snap ring and snap cap into place.

90-Degree Unit

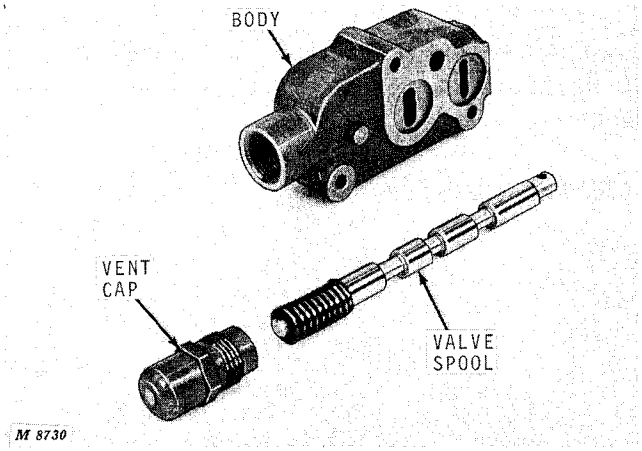


Fig. 21-Installing Spool-90-Degree Unit

Apply oil to O-rings in spool bore and insert spool assembly from spring end of valve body, Figure 21. 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

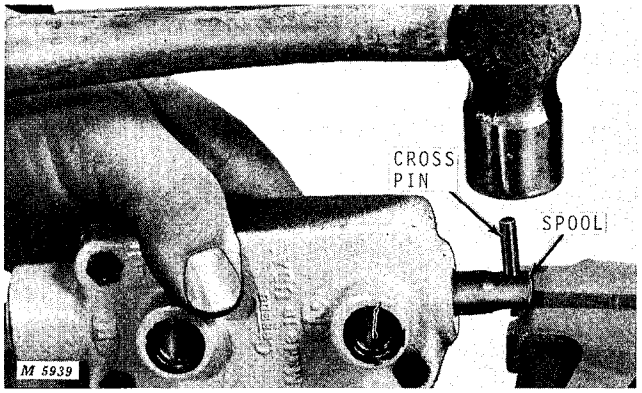


Fig. 22- Installing Cross Pin in Spool

Rest small end of spool on partially closed vise, Figure 22, and install cross pin.

Installing Valve Assembly on Pump

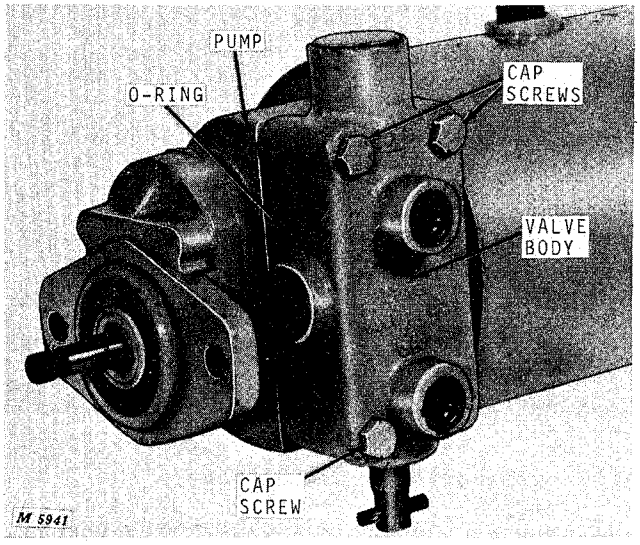


Fig.23-Installing Valve Assembly to Pump Back Plate

With new O-rings between valve body and back plate, secure valve assembly to pump back plate with three cap screws, Figure 23.

Refer to torque chart Section 10, "Specifications," and tighten three cap screws accordingly.

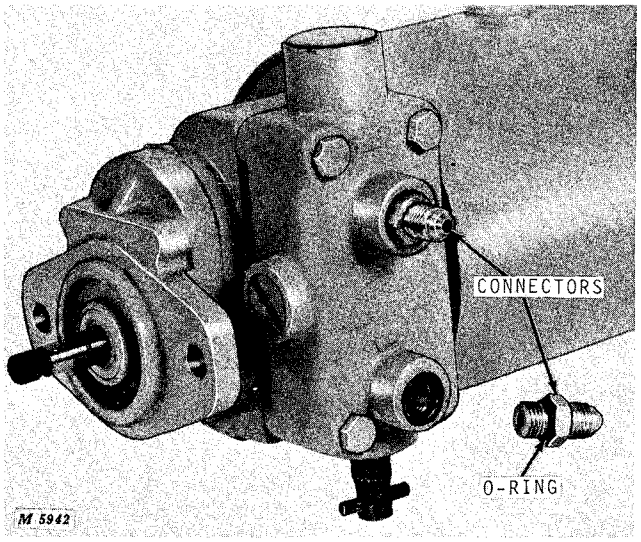


Fig. 24-Hose Connectors

Place new O-rings on connectors and screw connectors into valve body, Figure 24. Tighten connectors firmly.

Installing Pump Base

In-line Unit

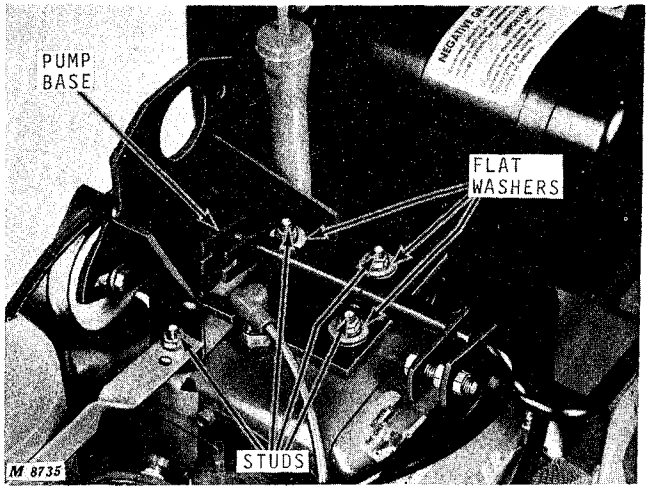


Fig. 25-Attaching Pump Base - In-line Unit

When installing pump bases with 5/8-inch stud holes, use 1-inch O.D. flat washers over the studs as shown in Figure 25. The washers are not required on bases with 3/8-inch holes.

Torque stud nuts to 200 in-lbs.

90-Degree Unit

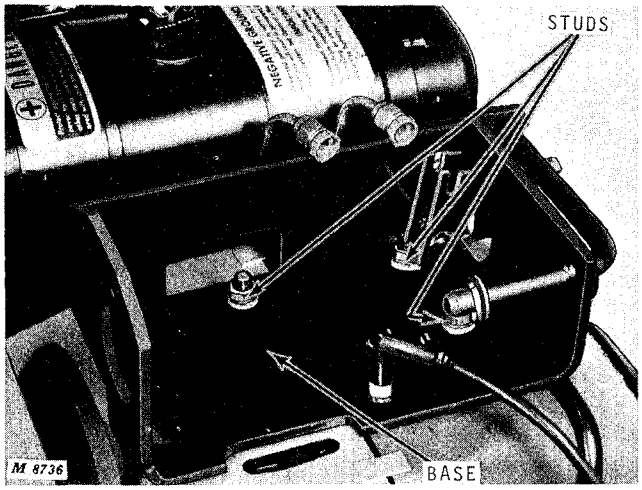


Fig. 26-Attaching Pump Base -90 Degree Unit

Place pump base over studs. Install lock washers and nuts on studs and torque to 360 in-lbs.

Installing Pump

In-line Unit

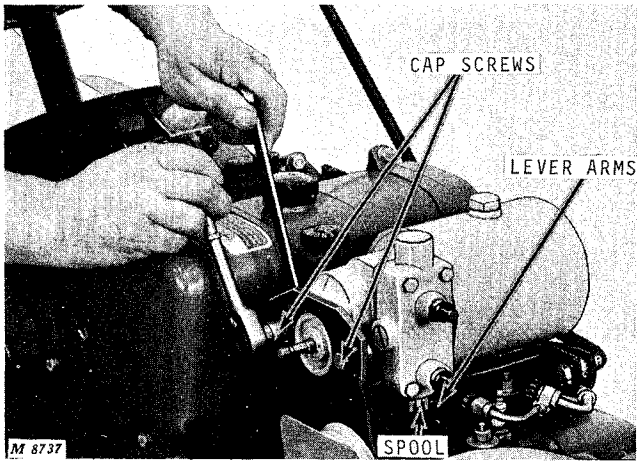


Fig. 27-Attaching Pump to Base- In-line Unit

Position end of spool in lever arms and attach pump flange to base with two cap screws, nuts, and lock-washers, Figure 27.

90-Degree Unit

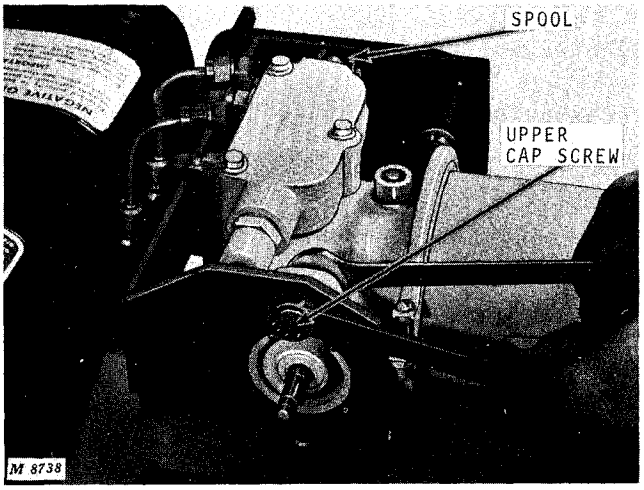


Fig. 28-Attaching Pump to Base- 90-Degree Unit

Insert end of spool in lever arms and install upper flange cap screw, Figure 28. Do not tighten until lower cap screw has been installed. See Figure 29.

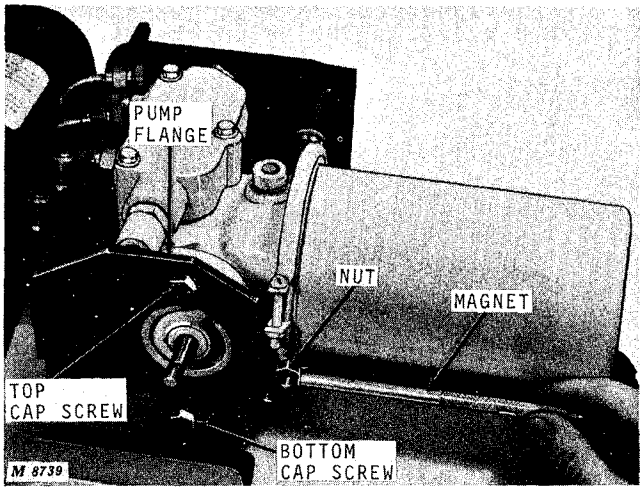


Fig. 29-Installing Lower Pump Flange Cap Screw-90-Degree Unit

Use either a small magnet, Figure 29, 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

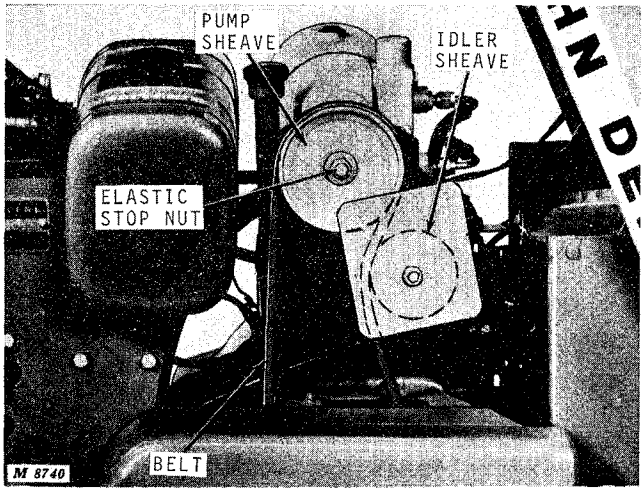


Fig. 30 Installing Drive Components -In-line Unit 110 and 112 Tractor with Tecumseh Engine

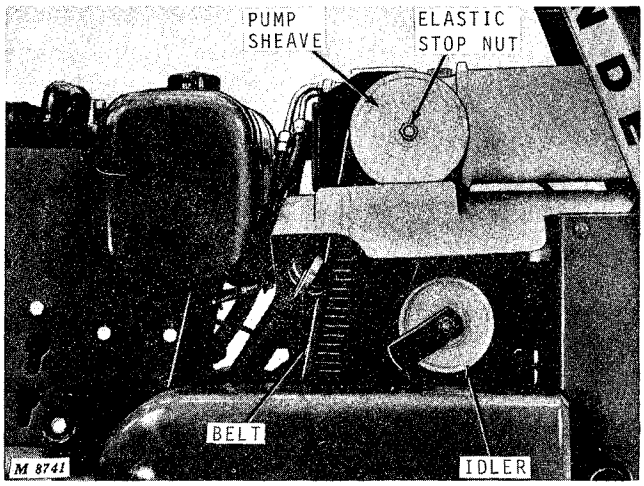


Fig. 31-Installing Drive Components-90-Degree Unit 112 Tractor with Kohler Engine

Install key in shaft, install sheave on shaft and secure with elastic stop nut, Figure 30 or 31. Install drive belt.

Adjust drive belt tension, page 15-8.

Refer to Figure 2 and connect hoses to valve assembly. Fill reservoir with fluid, page 5-3. Refer to Section 10 for Hydraulic System capacity.

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 (90-Degree unit)	360 in-lbs
Pump Base Stud Nuts (In-line unit)	200 in-lbs

SPECIAL TOOLS

Name	No.	Use
Retaining Ring Pliers	OTC 1120	Removing snap ring from valve body.

Litho in U.S.A.

Group 15
PUMP

GENERAL INFORMATION

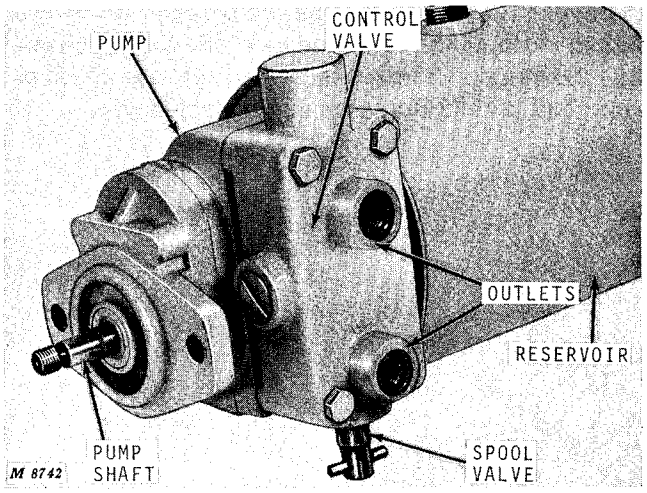


Fig. 1-In-line Unit

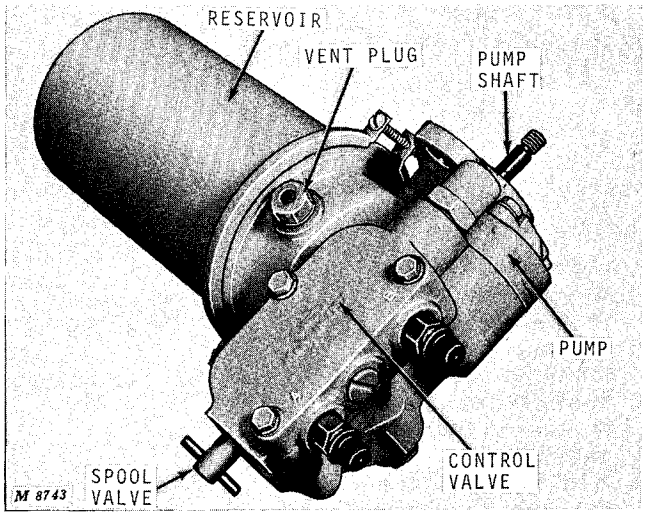


Fig. 2-90-degree Unit

Pumps of the in-line unit, Figure 1, and the 90-degree unit, Figure 2, are alike with the exception of their respective gear housings. Unless otherwise specified, the service procedures listed will be the same for both pumps.

When the pump 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 though 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.

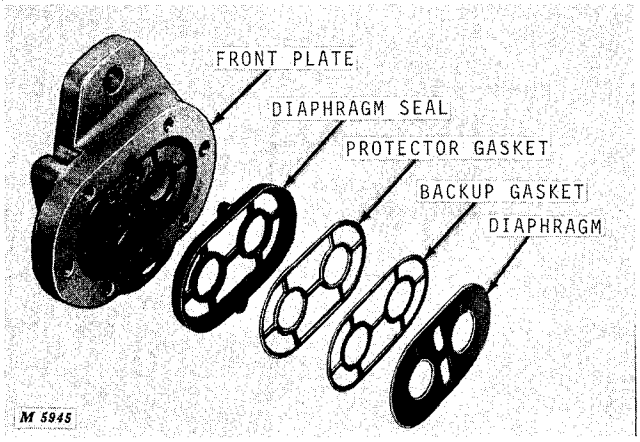


Fig. 3-Diaphragm, Gaskets and Diaphragm Seal

Gear end clearance is kept at a minimum by means of a thin, flexible bronze faced steel plate. This plate is called a diaphragm 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.

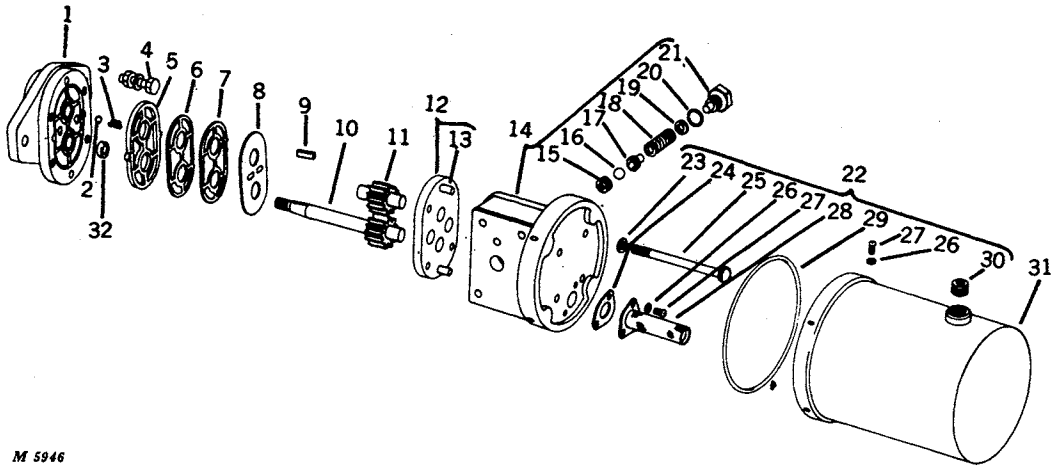
Litho in U.S.A.

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.

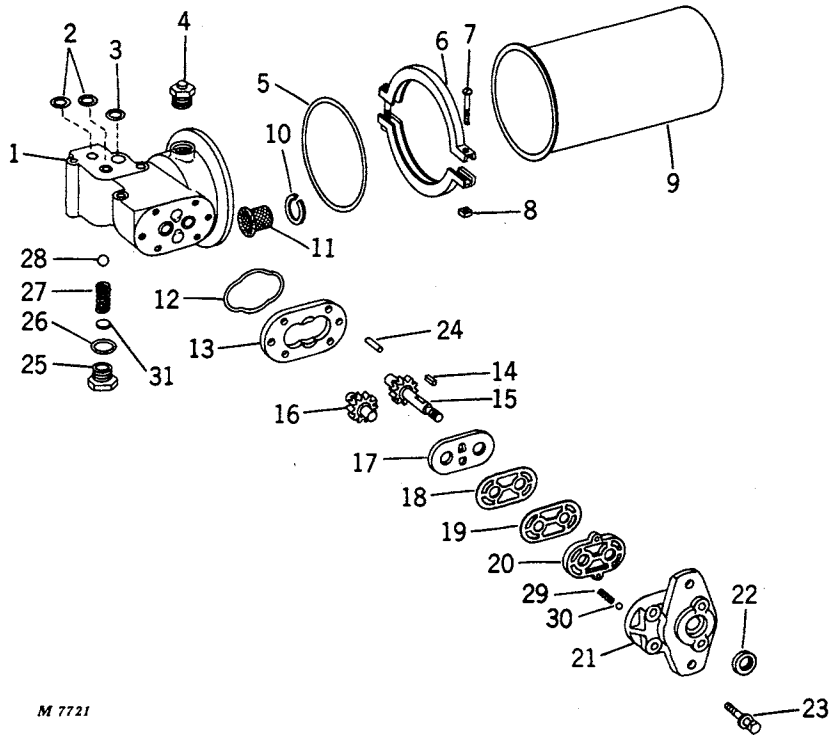
A small hole is drilled though diaphragm into each compartment. These connect the small chambers formed by the gear teeth to the compartments under the wear plate. Because of the location of these holes, the pressure under the diaphragm is slightly higher than the corresponding section in the gear chamber. 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-Front Plate
2-Steel Ball (2 used)
3-Check Spring (2 used)
4-Cap Screw (2 used)
5-Diaphragm Seal
6-Protector Gasket
7-Backup Gasket
8-Diaphragm
9-Key
10-Drive Shaft and Gear
11-Idler Shaft and Gear
12-Body and Dowel
13-Dowel (2 used)
14-Back Plate Assembly
15-Relief Valve Seat
16-Steel Ball
17-Relief Valve Adapter
18-Relief Valve Spring
19-Relief Valve Shim
20-O-Ring
21-Hex. Hd. Plug
22-Filter Replacement Kit
23-Aluminum Washers (4 used)
24-Filter Gasket
25-12-Point Cap Screws (4 used)
26-Internal Tooth Washer (6 used)
27-Machine Screw (6 used)
28-Filter
29-O-Ring
30-Filler Plug
31-Reservoir
32-Drive Shaft Seal

Fig. 4- Exploded View of Hydraulic Pump and Reservoir— In-line Unit



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. 5-Exploded View of Hydraulic Pump and Reservoir— 90-Degree Unit

Removing Pump from Tractor

Refer to page 10-2 to remove pump, valve and reservoir assembly from tractor.

Separating Pump

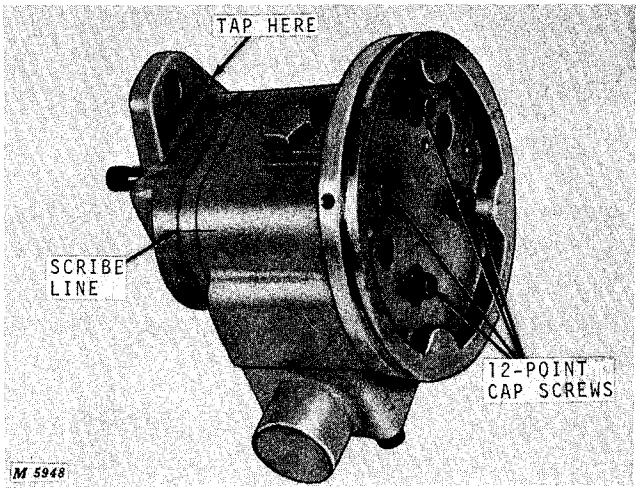


Fig. 6-Separating Front Plate, Body and Back Plate-In-line Unit Illustrated

Before separating pump assembly, scribe a clear line across outside of pump assembly, Figure 6. This will assure proper reassembly.

Remove reservoir and four 12-point cap screws.

Tap against front plate, Figure 6, to separate front plate, body and back plate. Do not use sharp tools or screwdriver to separate parts.

Removing Diaphragm Seal

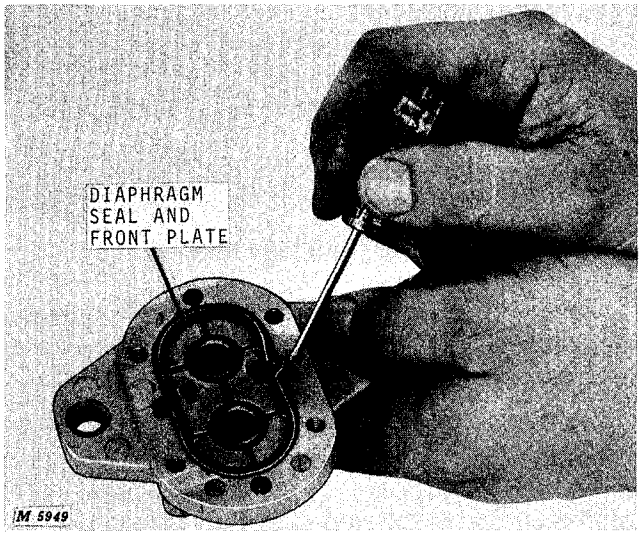


Fig. 7-Removing Seal

Place a screwdriver under the diaphragm seal, Figure 7, being careful not to damage front plate. Lift diaphragm seal and gaskets from plate. Discard diaphragm seal and gaskets.

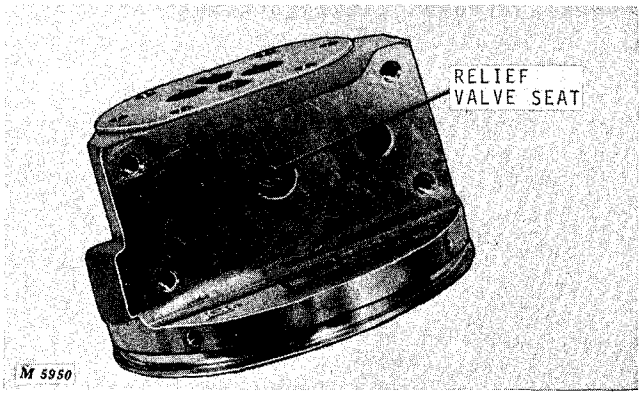


Fig. 8-Removing Relief Valve Seat

The relief valve seat 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 15-9.

INSPECTION

Wash all parts in a clean safe cleaning solvent and dry them with compressed air.

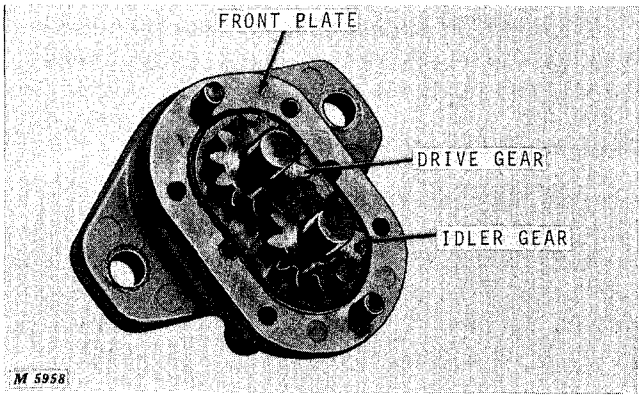


Fig. 9-Checking Pump Gears

Inspect the drive gear and idler gear shafts 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.

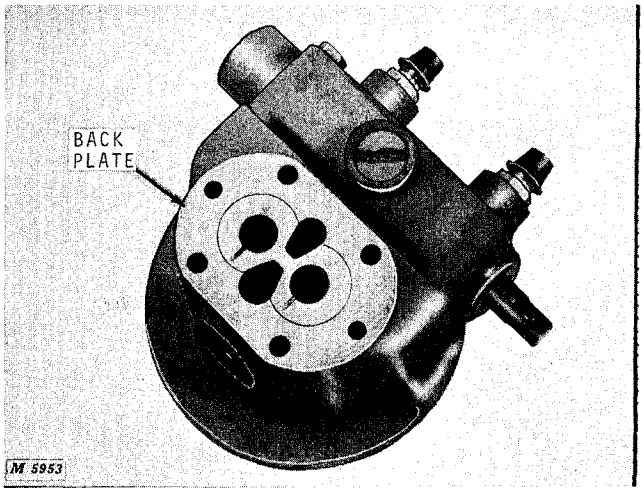


Fig. 10-Checking Back Plate Wear

Small scratches and some wear pattern should be considered normal and will not affect pump operation. Check plate wear, Figure 10. Refer to "Specifications," page 15-9,for back plate wear tolerance. Replace back plate if worn beyond specification.

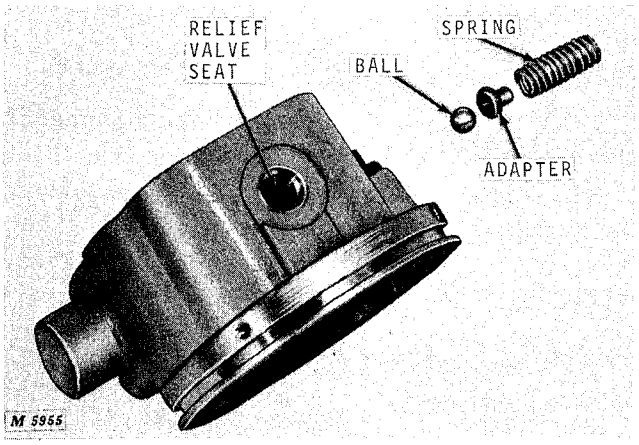


Fig. 11-Relief Valve Adapter, Ball, Spring and Seat

Inspect condition of relief valve seat, ball, adapter and spring, Figure 11. Replace parts showing abnormal wear.

If relief valve seat removal is necessary, refer to Figure 8.

ASSEMBLY

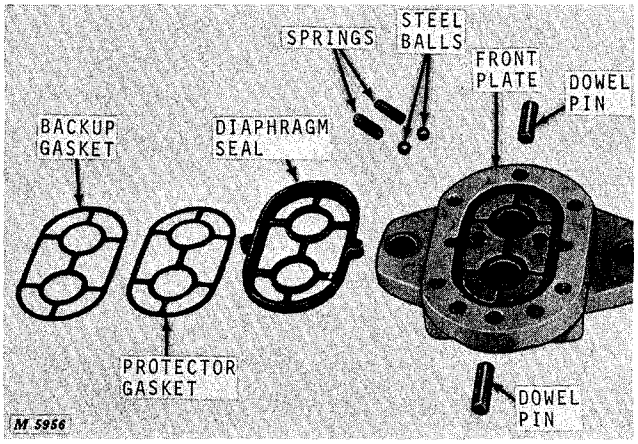


Fig. 12-Installing Front Plate Components

Install new diaphragm seal, protector gasket, backup gasket and diaphragm when reassembling pump, Figure 12. 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.

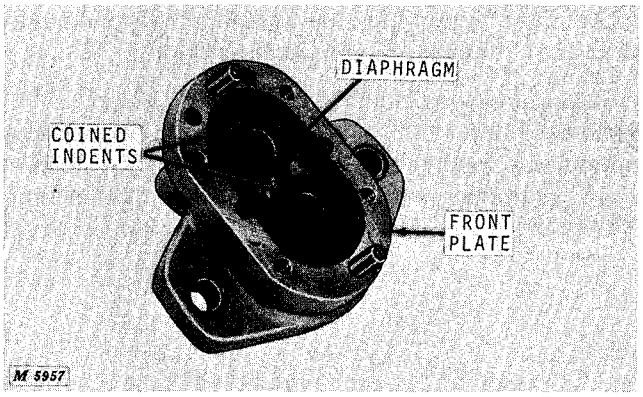


Fig. 13-Installing Diaphragm

Place diaphragm on top of gaskets with bronze face up and coined indents on suction side, Figure 13. The entire diaphragm must fit inside the raised rim of the diaphragm seal. Insert dowel pins in front plate.

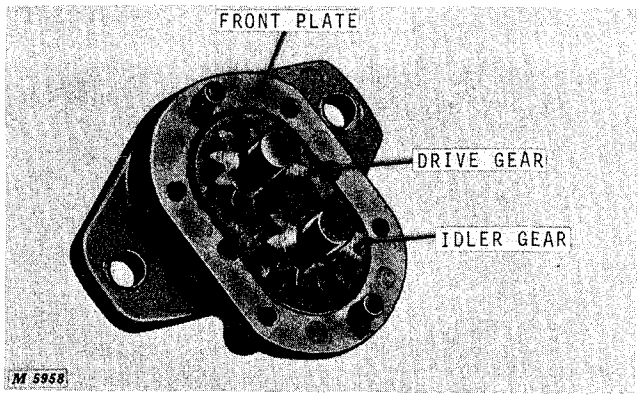


Fig. 14-Installing Gears in Front Plate

Dip gear assemblies in light, clean oil and slip into front plate bearings, Figure 14.

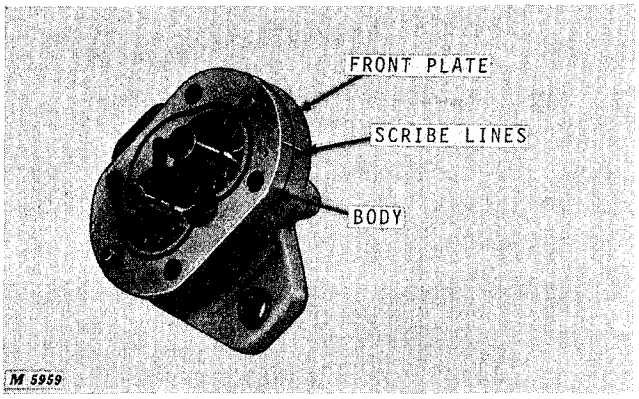


Fig. 15-Placing Body on Front Plate

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, Figure 15. The cavity with the small hole drilled in it must be on the pressure side of pump.

ASSEMBLY-Contiued

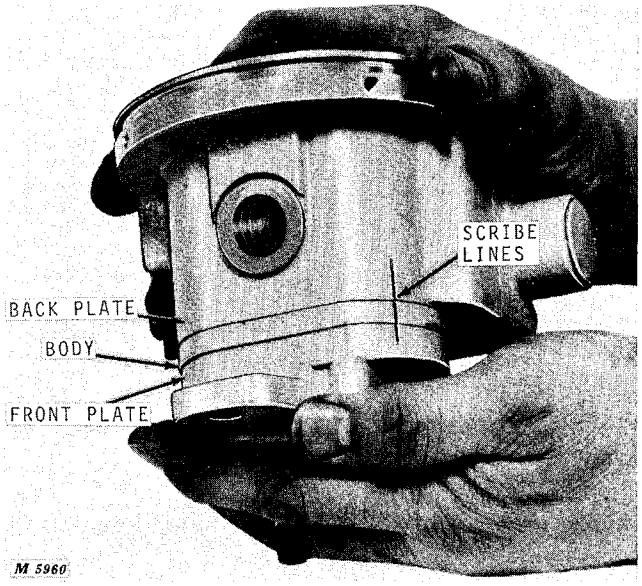


Fig. 16-Positioning Front Plate and Gear Assembly on Back Plate

Place front plate and gear assembly onto back plate and press in place with hands, Figure 16. Check to be sure scribe lines are aligned.

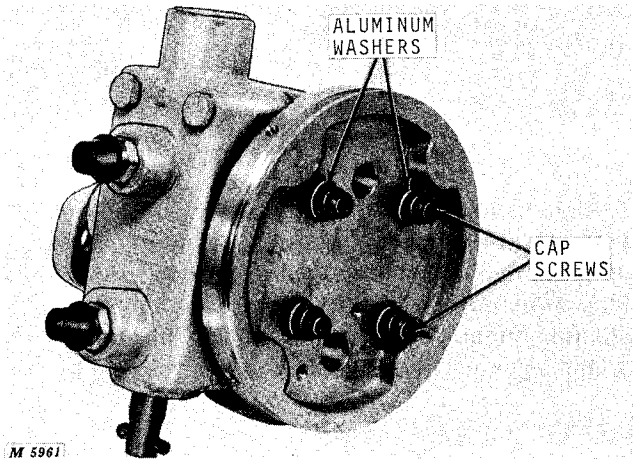


Fig. 17-Tightening Four 12-Point Cap Screws-In-line Unit Illustrated

Place new aliminum washers over the four 12-point cap screws. Install cap screws through back plate and secure front plate to back plate, Figure 17. Refer to "Specifications," page 15-9, and torque bolts.

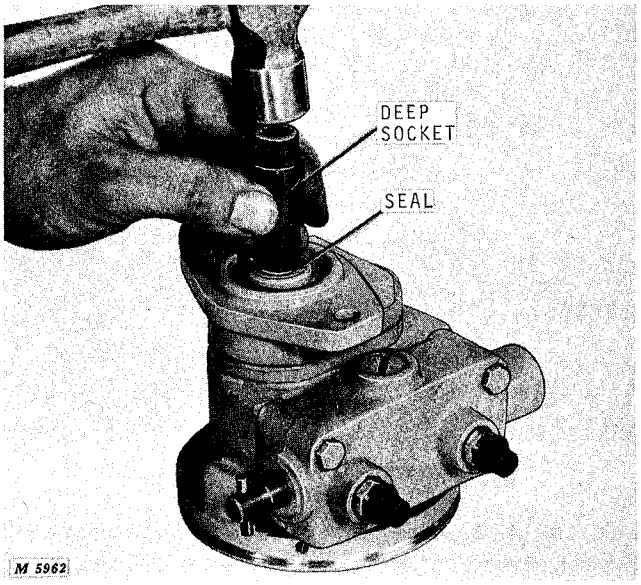


Fig. 18-Installing Shaft Seal

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, Figure 18.

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).

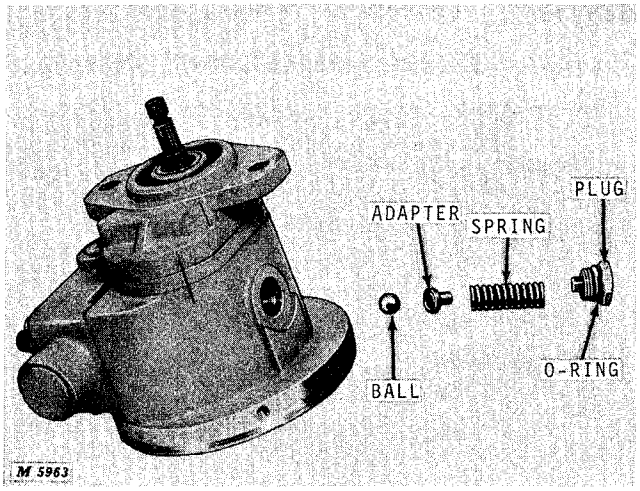


Fig. 19-Installing Relief Valve Assembly

Whenever relief valve seat has been removed, refer to "Specifications," page 15-9, for proper seat depth. Install seat in back plate as shown in Figure 8.

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.

Converting 1500 psi Pump to 800 psi—In-line Unit

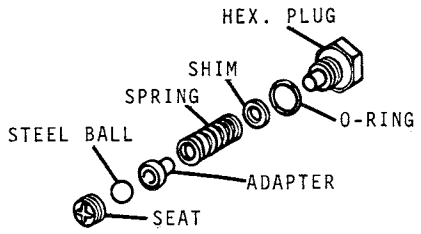


Fig. 20-Exploded View of Relief Valve

110H and 112H Tractors (Serial Number 100,001 through 130,000) are equipped with 1500 psi pressure relief valves, Figure 19. In most cases this high pressure is not required. Reduce pressure to 800 psi by replacing the 1500 psi pressure relief spring with and H31256H 800 psi pressure relief spring.

Before installing the new spring, check depth of relief valve seat in pump housing. Depth should be 1.776 to 1.786 inches. If depth falls short of this range, or if seat is loose, remove seat. Apply Loctite and reinstall to proper depth.

After pump has been installed, pressure test system for proper psi at the outlets. If pressure is below 800 to 900 psi, add one or more H31257H shims and retest.

Installing Reservoir and Filter In-line Unit

Refer to exploded view of in-line unit, Figure 4, and install new filter gasket (24) and filter (28) to back plate with two washers and two machine screws.

Install new O-ring over reservoir mounting shoulder and carefully slide reservoir onto pump. Secure reservoir to back plate with four washers and machine screws. Turn filler plug loosely into reservoir port.

Install the assembly on the tractor and connect the hydraulic hoses to the valve assembly.

Fill the reservoir with fluid, page 5-3.

Adjust drive belt tension, Figure 21.

Installing Reservoir-90-Degree Unit

Refer to Figure 5 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 5-3.

Adjust drive belt tension, Figure 22.

ADJUSTMENTS

Adjusting Drive Belt Tension

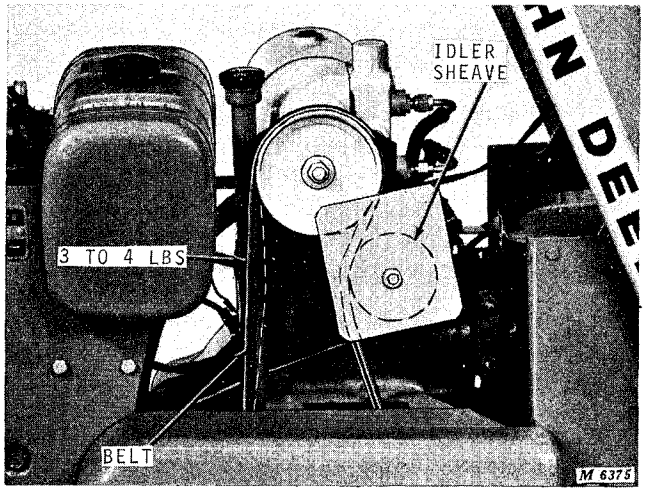


Fig. 21-Adjusting Belt Tension
110 and 112 Tractor with Tecumseh Engine-In-Line Unit

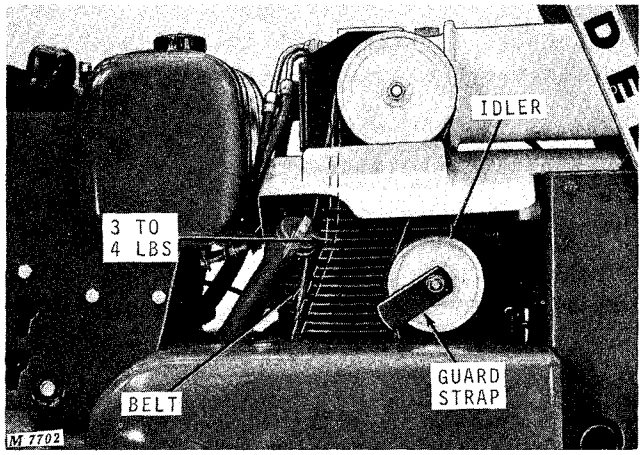


Fig. 22-Adjusting Belt Tension
112 Tractor with Kohler Engine-90-Degree Unit

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.

Tighten the idler nut firmly to maintain proper belt tension.

Changing Direction of Lift Lever Operation

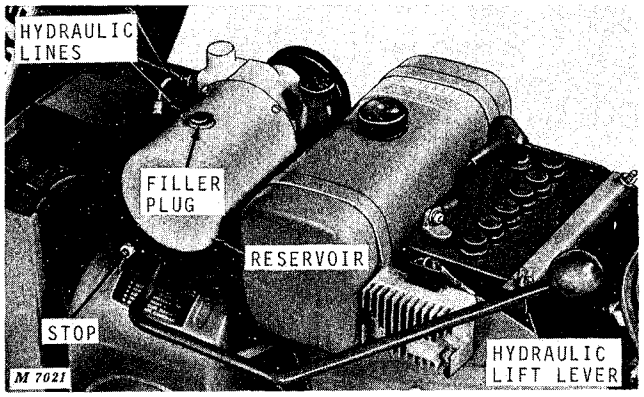


Fig. 23-Adjusting Lift Lever

Hydraulic lines are connected at the factory to permit the equipment to raise when the lift lever is raised and lower when the lift lever is lowered. If, for any reason, you wish to reverse the lifting direction, disconnect hydraulic lines at the pump (shown) and reverse the lines.

IMPORTANT: Be sure that hydraulic lines are thoroughly cleaned with solvent and dried before disassembly. Do not allow even the smallest particle of dirt or foreign material to enter the pump during reassembly. This is important.

Check hydraulic fluid level in reservoir after assembly.

Adjusting Lift Lever Stops

1. Loosen jam nuts on outer stop, Figure 23, 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.

SPECIFICATIONS

Component	New	Wear Tolerance
Relief Valve Pressure, Tractors (Serial No. -130,000)	1500 (−0 + 100) psi	.....
Relief Valve Pressure, Tractors (Serial No. 130,000-)	800 (−0 + 100) psi	.....
Relief Valve Seat (Top of seat to top of body)	1.776-1.786-inch	.....
Pump Output	1.5 gpm at 3600 rpm engine speed	.....
Displacement	0.149 cu. in. per rev.	.....
Back Plate Wear	Flat	0.0015-inch

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.

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Group 20
CYLINDER

GENERAL INFORMATION

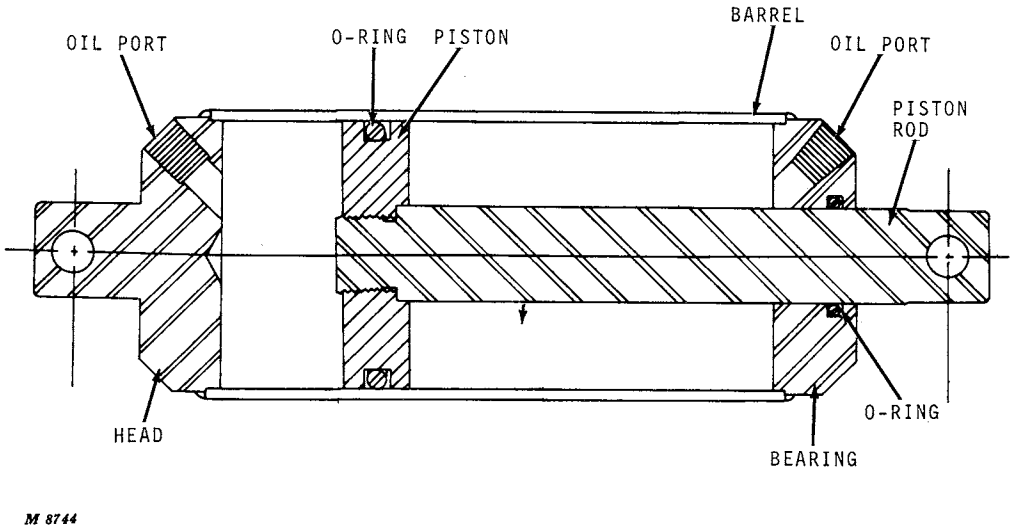

Fig. 1-Cutaway of Remote Cylinder

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," Group 5 for possible causes of cylinder failure.

Remove old cylinder and install new cylinder as instructed on the next page.

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

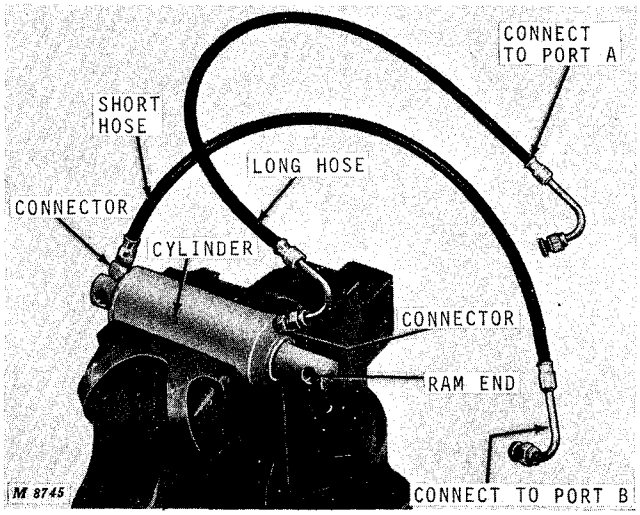

Fig. 2-Connecting Hoses to Cylinder

Lightly clamp cylinder in a vise with soft jaws, Figure 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 Figure 2 before tightening connection. The end of the hose with the 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.

NOTE: Hydraulic lines may be reversed on control valve to reverse direction of lift lever control when desired. See page 15-8.

Connect hose with one steel extension to head end of cylinder as shown in Figure 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.

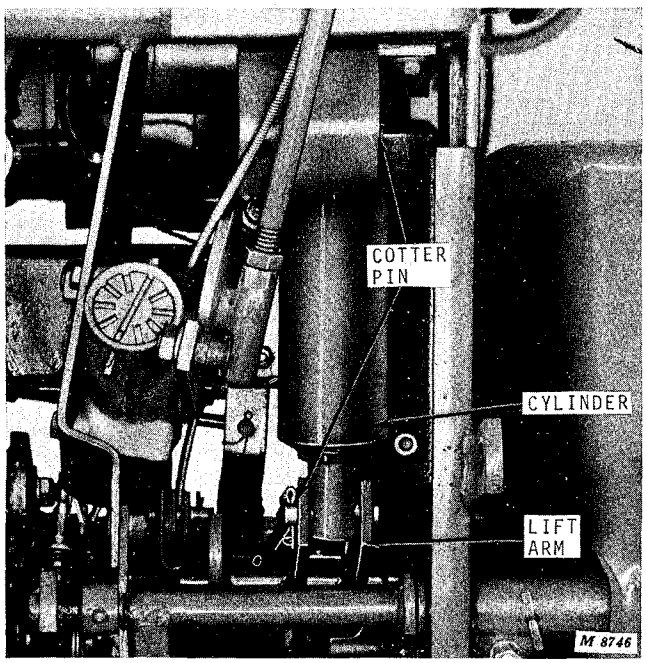

Fig. 3-Connecting Cylinder to Tractor

Insert pin through tractor frame, frame brackets and cylinder. Insert cotter pins and spread ends, Figure 3.

Insert pin through lower lift shaft arms, piston rod and clip. Insert cotter pins and spread ends, Figure 3.

Section 70
MISCELLANEOUS
Group 5
STEERING LINKAGE

TABLE OF CONTENTS

Litho in U.S.A.

GENERAL INFORMATION

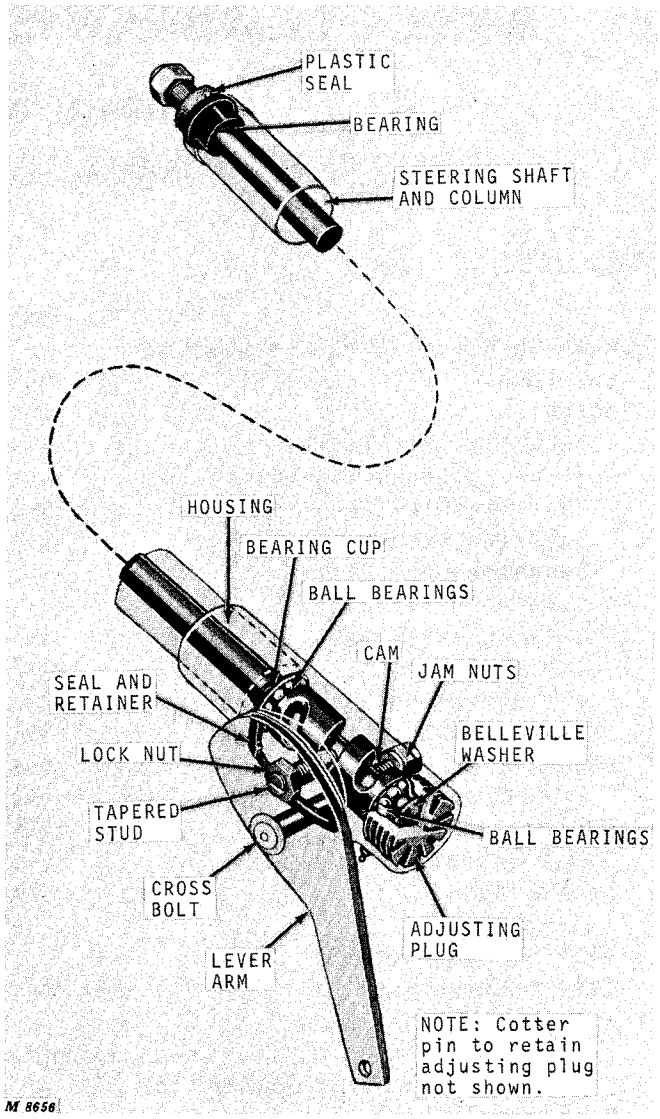

Fig. 1-Ross Steering Gear

The steering linkage consists of the steering gear assembly, drag link, steering arm, spindles and tie rods.

The Ross 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 Figure 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, causing rotation of the steering arm on the bolt and cone assembly.

Movement of the steering arm causes the tie rods to move the spindles in the front axle, thereby changing wheel position.

The tie rods originally supplied on the tractor may be either one piece or adjustable.

Adjustable tie rods can be used as a service replacement for the one piece tie rods, if the need arises for additional toe-in adjustment of the front wheels.

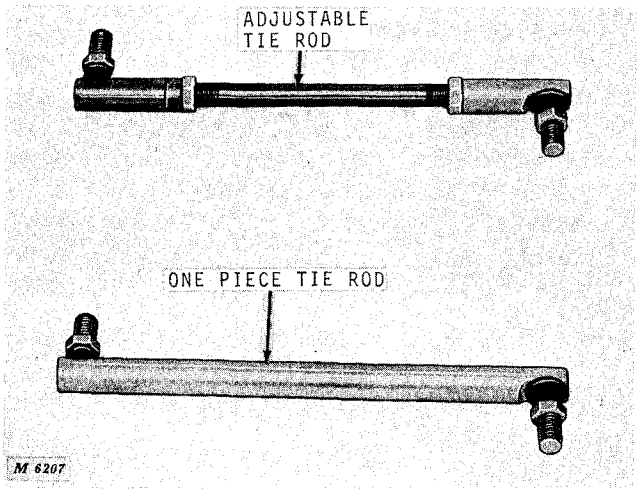

Fig. 2-Tie Rods

STEERING ANALYSIS

Listed below is a preliminary analysis of difficulties that can occur with the steering system. Familiarize yourself with the information on this page before proceeding to "Diagnosing Malfunctions" on the following page.

Seal and Retainer

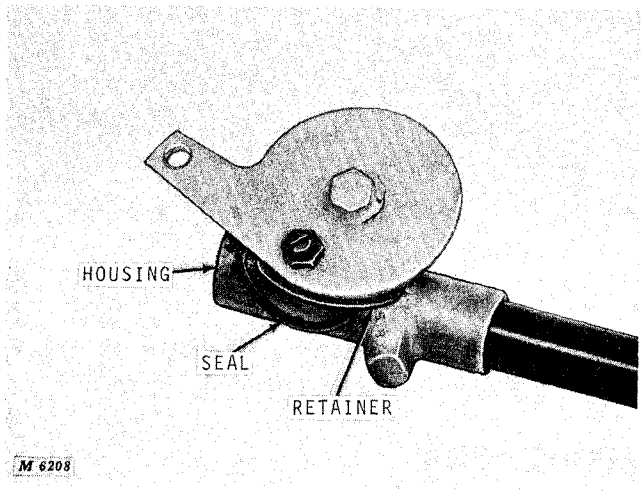

Fig. 3-Damaged Seal

A damaged seal, Figure 3, is caused by overgreasing the housing or an improperly adjusted cross bolt in the lever arm.

Housing

A broken steering gear housing 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.

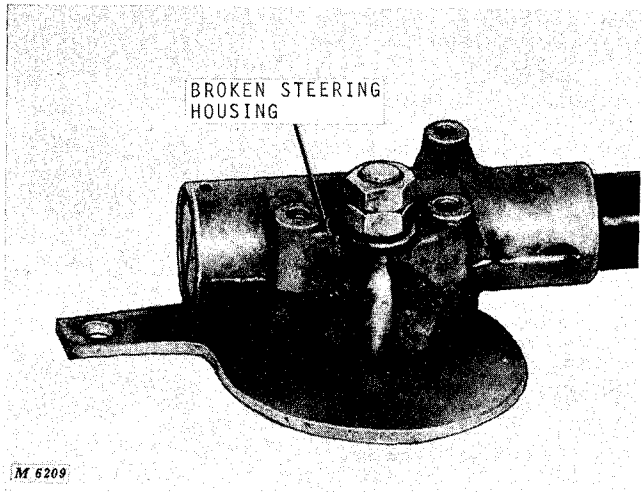

Fig. 4-Broken Steering Gear Housing

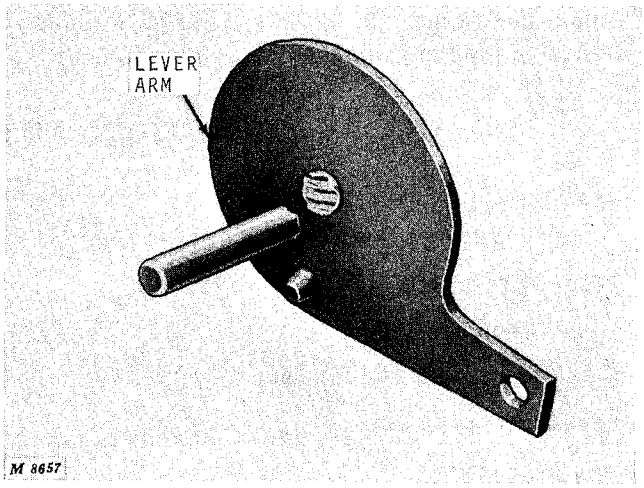

Fig. 5-Broken Lever Arm Cross Bolt

A broken lever arm cross bolt is caused by excessive force being applied either by the steering wheel or excessive weight on front end.

Spindle

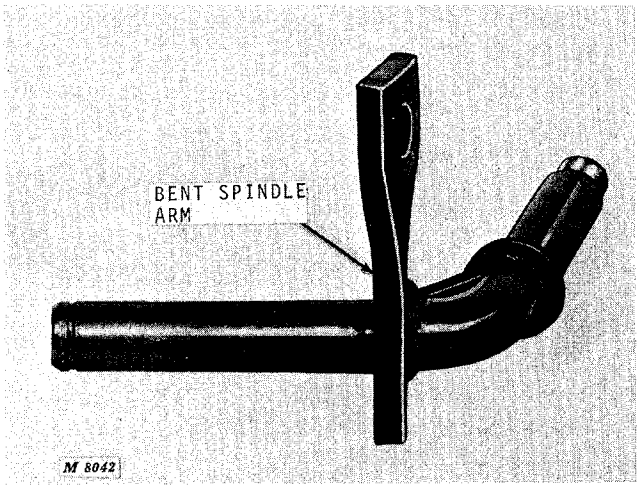

Fig. 6-Bent Spindle Arm

A bent spindle arm, as shown in Figure 6, is usually the result of the front wheel striking a solid object.

Ball Joints

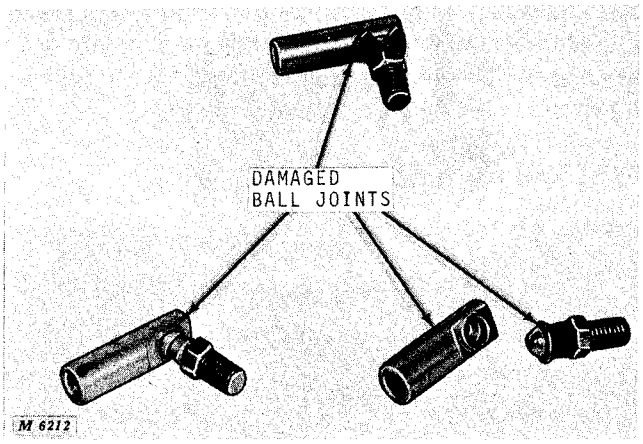

Fig. 7-Ball Joints

Replace ball joint assembly whenever excessive looseness or other damage is noticed, Figure 7.

DIAGNOSING MALFUNCTIONS

Loose Steering

Steering gear out of adjustment.

Worn steering arm.

Loose steering arm.

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.

Tight steering arm, not properly adjusted and/or lubricated.

Drag link installed incorrectly.

Hard Steering—Continued

Bent spindle arm.

Tight ball joints (s).

Incorrect toe-in.
Adjust tie rods on tractors so equipped.

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.

Tire Strikes Tractor on Turns—Continued

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.

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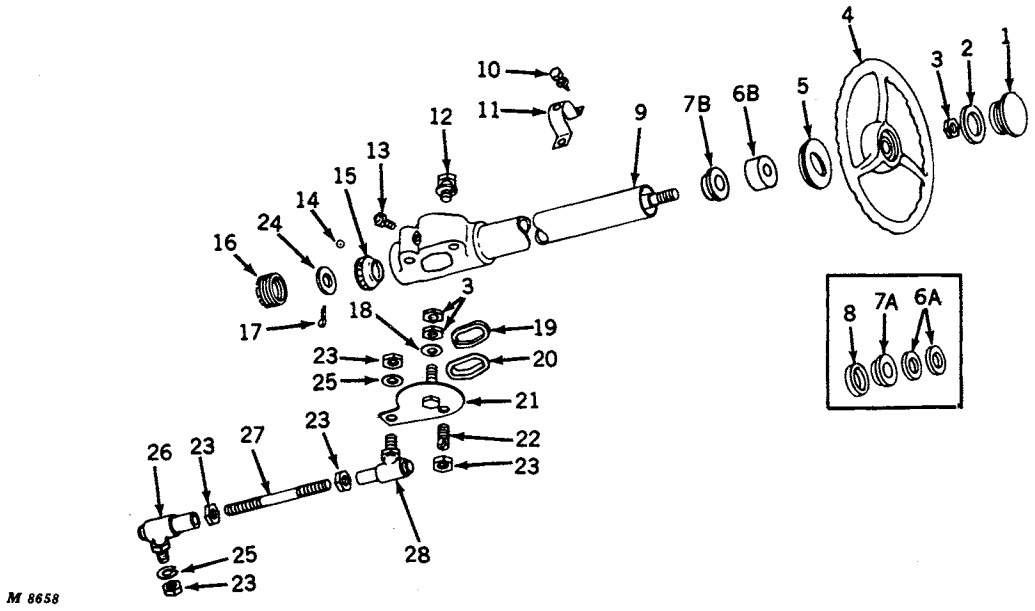
REPAIR



1-Steering Wheel Emblem
2-O-Ring
3-5/8″ Hex. Nut
4-Steering Wheel
5-Grommet
6A-Felt Washer (2 used) (-130,000)
6B-Bearing Seal
7A-Bearing Spacer (-130,000)
7B-Bearing
8-Bearing Retainer
9-Steering Shaft and Column
10-Thread Cutting Screw (2 used)
11-Clamp
12-Cap Screw (3 used)
13-Grease Fitting
14-Steel Balls (16 used)
15-Bearing Cups and Retainers (2 used)
16-Adjusting Plug
17-Cotter Pin
18-Washer
19-Lever Arm Seal
20-Retainer
21-Lever Arm and Cross Bolt
22-Tapered Stud
23-1/2″ Hex. Jam Nut (Fine Thread) (3 used)
24-Spring washer (130,001-)
25-1/2″ Lock Washer (6 used)
26-Ball Joint (R.H. Threads) (2 used)
27-Drag Link
28-Ball Joint (L.H. Threads)

Fig. 8-Exploded View - Steering Linkage

Removing Steering Wheel and Steering Gear

Remove steering wheel with a puller, Figure 9, or shock device. Using the wrong type 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.

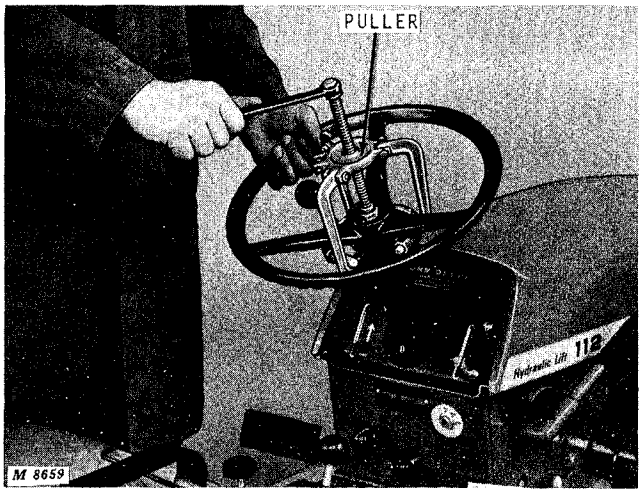


Fig. 9-Removing Steering Wheel

Disassembling Steering Gear

Loosen jam nut (23, Figure 8) on tapered stud (22) in lever arm. Turn stud counterclockwise until resistance is felt. Remove nuts (3) 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 Section 20, Group 15, to check bearing condition. Inspect cam, housing and plug for cracks, scoring and other damage especially in the bearing area. Replace parts showing excessive wear or damage.

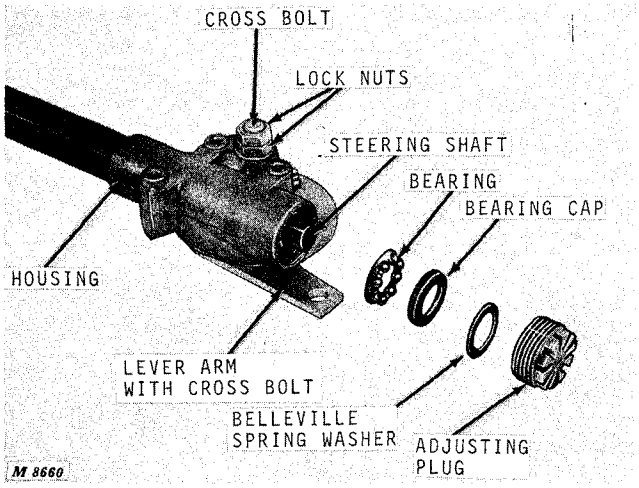


Fig. 10-Steering Gear Disassembly

ASSEMBLY

Assembling Steering Gear

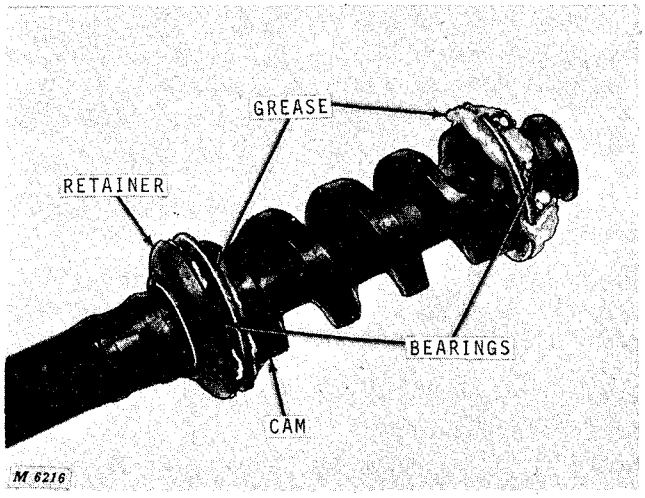


Fig. 11-Installing Bearing

Apply grease and place bearing balls, ball cups and retaining rings on both ends of cam, Figure 11.

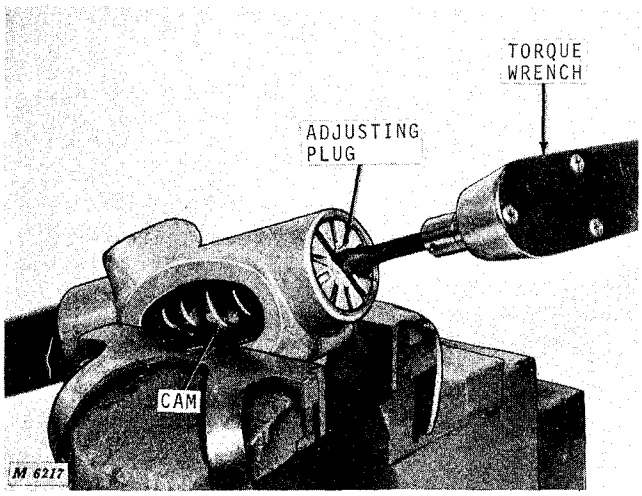


Fig. 12-Installing Cam Assembly in Housing

Grease cam lightly with multi-purpose type grease.

Slide cam and tube assembly into housing and jacket tube. Install plug and torque according to "Specifications," page 5-11.

ASSEMBLY - Continued

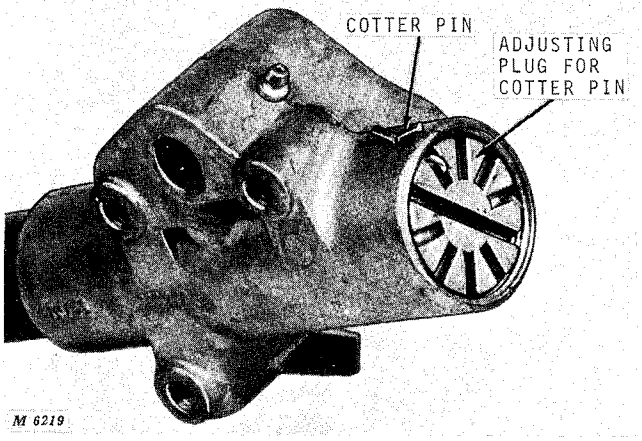


Fig. 13-Cotter Pin Through Housing

After torquing, lock adjusting plug with a cotter pin, Figure 13. Be sure steering shaft turns freely after torquing.

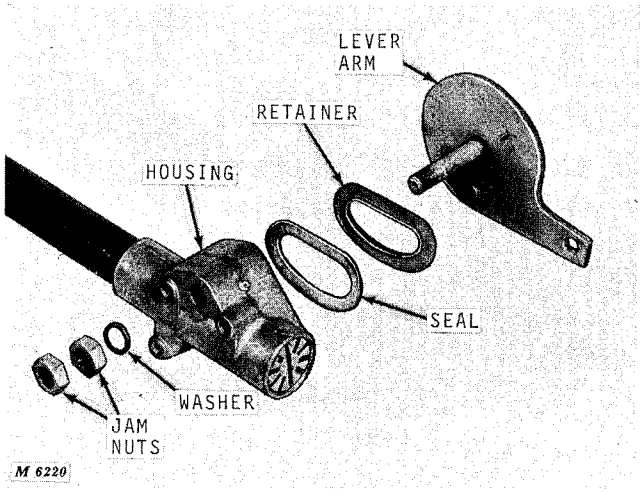


Fig. 14-Attaching Lever Arm to Steering Gear

Install new seal and retainer from repair kit. Attach lever arm to steering gear housing with washer and two jam nuts, Figure 14.

Installing Steering Gear

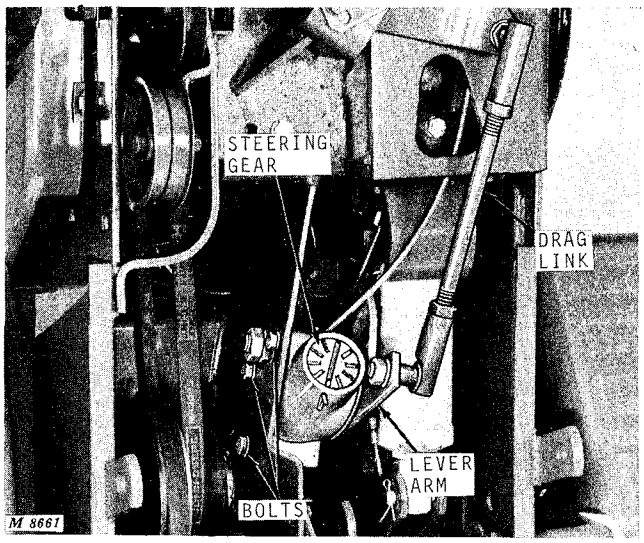


Fig. 15-Installing Steering Gear

Position steering gear assembly in tractor and install with bolts as shown in Figure 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, Figure 15, and tighten nuts firmly.

Refer to Figure 8, page 5-6 and install steering wheel. Refer to "Specifications," page 5-11 for steering wheel retaining nut 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 5-9.

ADJUSTMENTS

Steering Gear

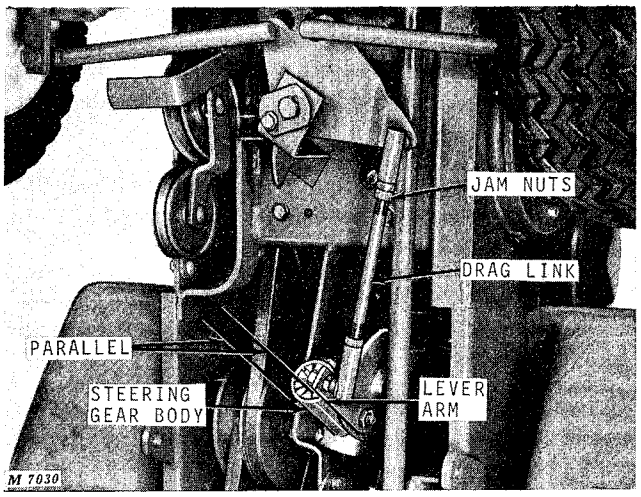


Fig. 16-Steering Gear Adjustment

When properly aligned, the lever arm will be parallel with the steering gear body when the front wheels are pointed straight forward.

If adjustment is required, loosen jam nuts on drag link and turn the drag link either in or out until properly adjusted. Tighten jam nuts firmly.

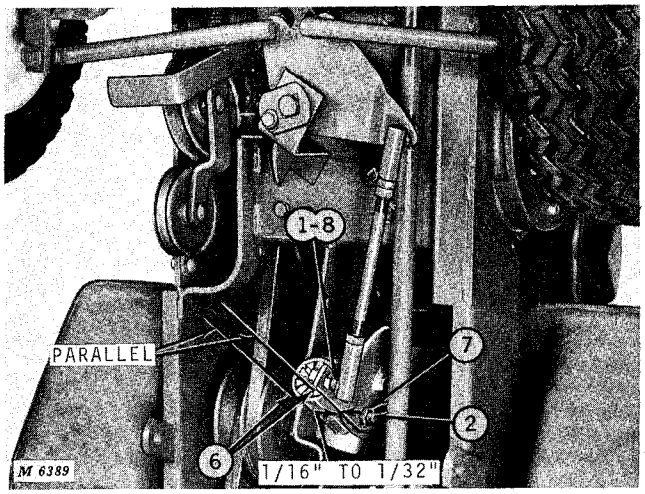


Fig. 17-Steering Gear Adjustment

To remove excessive backlash (loose steering) and to properly adjust steering gear, follow this procedure:

1. Disconnect ball joint from lever arm.

2. Loosen jam nut and stud two or three turns.

NOTE: Disregard steps 3 and 4 on 110 Tractors above serial number 130,086, and on 112 Tractors above serial no. 130,113.

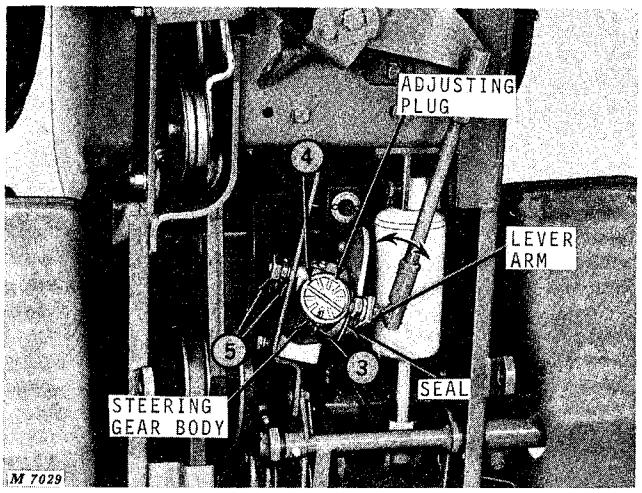


Fig. 18-Steering Gear Adjustment

3. Remove cotter pin holding adjusting plug in steering gear body. Use screwdriver to turn adjusting plug into steering gear body until 7 to 12 ft-lbs torque has been obtained. Back plug out until steering wheel turns freely with no drag. Lift up on steering wheel to check end play.

4. Turn plug only far enough after adjustment to insert cotter pin through steering gear body and closest slot in plug. Spread cotter pin.

5. 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. Tighten jam nut to 22 to 25 ft-lbs torque.

6. Turn lever arm until the arm is parallel with steering gear body.

7. 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.

8. Connect ball joint to lever arm.

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Adjusting Steering Arm Cone

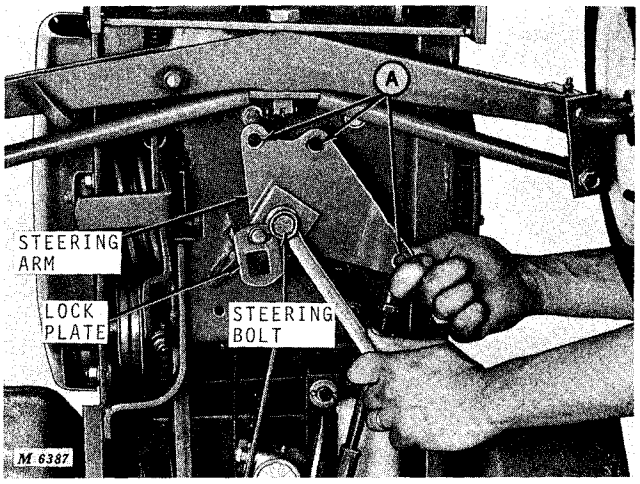

Fig. 19-Steering Cone Adjustment

Block up front end of tractor so that front tires are off the ground.

Disconnect ball joints at points "A."

Turn steering arm by hand and notice freedom of movement. When properly adjusted, the steering arm will pivot freely through the entire steering range with only a slight amount of drag.

If steering arm turns hard or has worn and loosened so that you can feel end play in the steering arm bearing, remove lock plate.

Remove steering bolt with lower cone and steering arm. Apply grease to lower cone and upper cone (in tractor frame) and reassemble.

Tighten bolt only until a slight amount of drag can be felt when turning the steering arm and all end play has been removed.

Position lock plate over bolt head and tighten lock plate cap screw. Be sure plain washer is used with lock plate cap screw.

Reassemble ball joints in position "A."

Adjusting Tow-In On Tractors With Adjustable Tie Rods

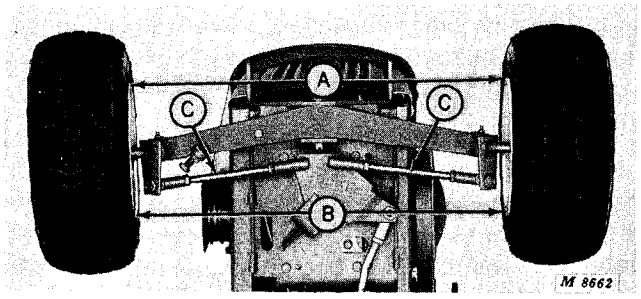

Fig. 20-Adjustable Tie Rods

Measure distances "A" and "B." 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 both right-hand and left-hand tie rods "C" equally until proper toe-in is obtained. Tighten jam nuts firmly.

TORQUE FOR HARDWARE

Location	Torque
Steering gear plug (without spring washer)	7-12 ft-lbs
Steering gear plug (with spring washer)	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 Tappet 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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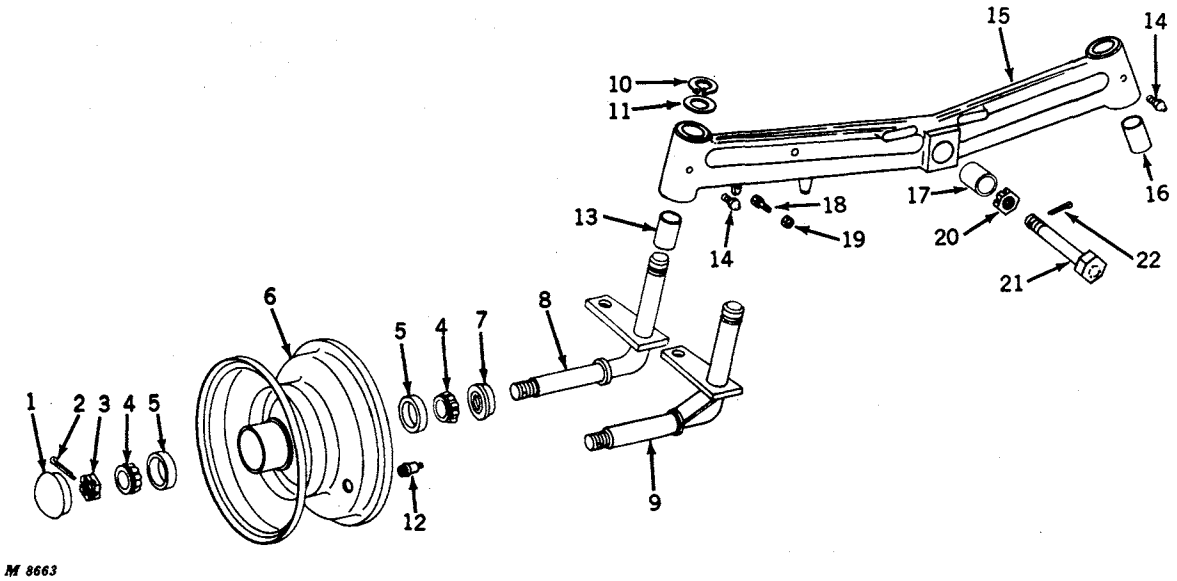
Group 10

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 rods, toe-in adjustment, etc. This group covers only front wheel spindles, bearings and axles.

REPAIR



1-Spindle Cap
2-Cotter Pin
3-5/8" Slotted Hex. Nut
4-Outer Cone
5-Cup
6-Front Wheel
7-Inner Cone with Seal
8-Front Wheel Spindle
9-Front Wheel Spindle (heavy duty)
10-Snap Ring
11-Spindle Washer
12-Front Tire Valve
13-Bronze Bushing (2 used)
14-Grease Fitting
15-Front Axle
16-Bronze Bushing (2 used)
17-King Pin Bushing
18-Steering Stop Bolt
19-1/2" Hex. Jam Nut
20-3/4" UNF Hex. Slotted Nut
21-3/4" UNF x 3-5/8" King Pin Bolt
22-Cotter Pin

Fig. 1-Exploded View of Front Wheels and Axles

Removing Front Wheels

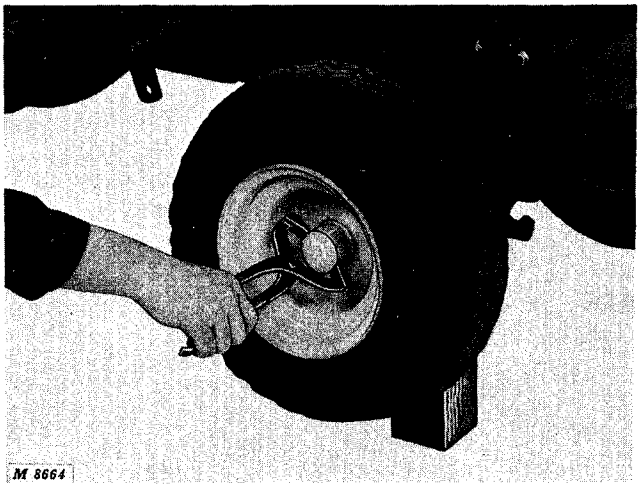


Fig. 2-Removing Front Wheel Components from Axle

Block up or hoist front of tractor until wheel clears the ground. Remove cap from wheel, Figure 2. Remove cotter key, slotted nut, wheel and bearings from spindle inside cap.

Removing Spindle From Axle

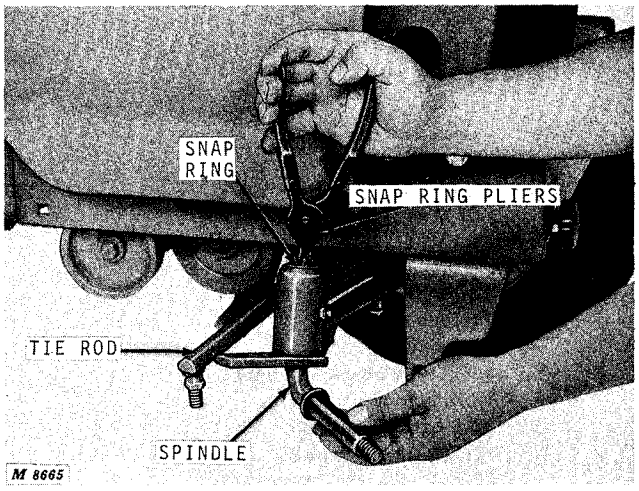


Fig. 3-Removing Snap Ring

To remove spindle, disconnect tie rod end, and using a snap ring pliers, remove snap ring and washer, Figure 3. Slip spindle out of axle.

Inspecting Bearings

Refer to Section 20, Group 15, "Bearing Analysis," to determine wheel bearing condition. Service as necessary.

Inspecting Axle Bushings

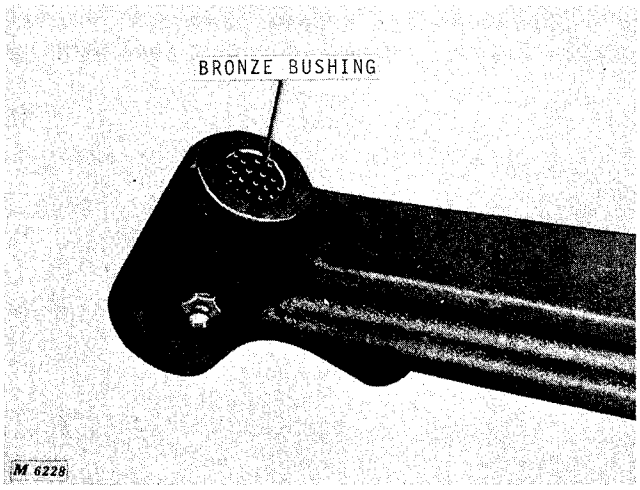


Fig. 4-Axle Spindle Bushing

Excessive bushing wear, Figure 4, is caused by lack of lubrication. Replace bushing indicating excessive wear or out of round.

Removing Axle Bushings

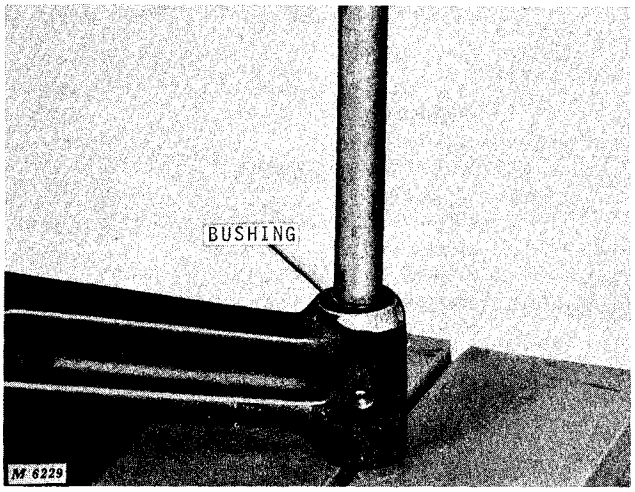


Fig. 5-Pressing Bushings Out of Axle

Remove king pin to separate axle from tractor. Place axle end on press bed and press bushings out of axle, Figure 5.

INSTALLATION

Installing Axle Bushings

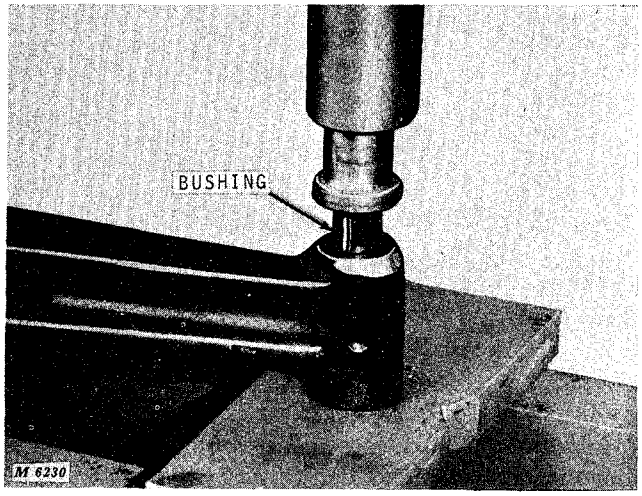


Fig. 6-Installing Axle Bushings

Wipe axle bushing bore clean. Coat bushings with oil. Place ***axle*** on press and press bushings in axle until bushing is flush with axle face.

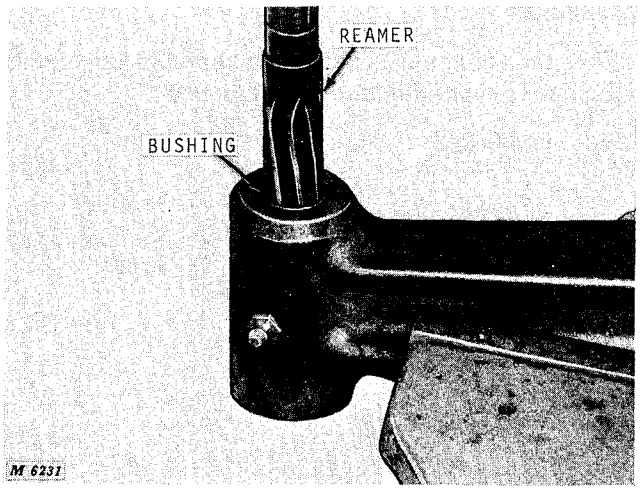


Fig. 7-Reaming Bushings

Place axle in a vise and turn reamer through axle bushings, Figure 7. Refer to "Specifications," page 10-5, for correct axle bushing dimension.

Installing Axle

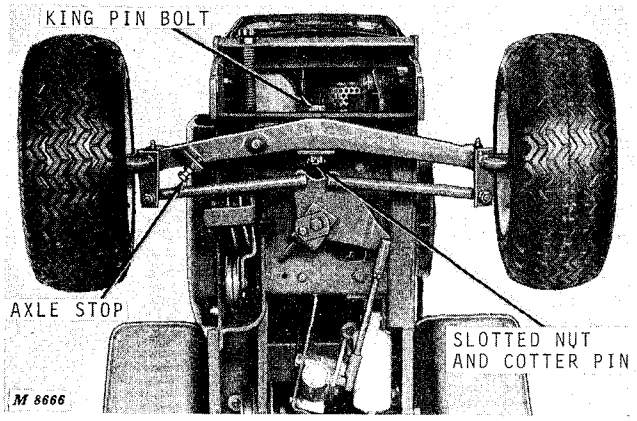


Fig. 8-Installing Axle on Tractor

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, Figure 8. Secure king bolt with slotted nut and cotter pin.

Installing Spindles

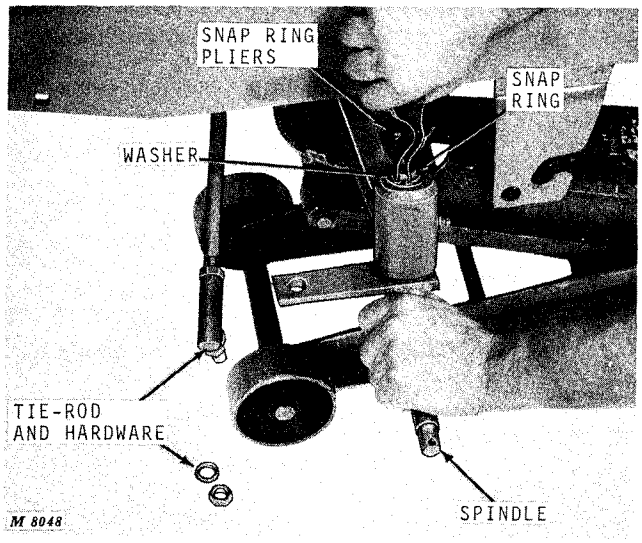


Fig. 9-Installing Front Axle, Spindles and Front Wheels

Apply light coat of grease on upper spindle shaft. Install spindles into axle bushing, Figure 9.

Installing Bearings and Wheels

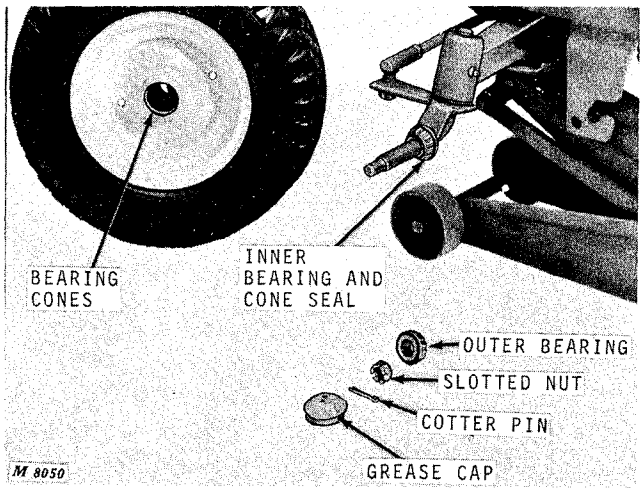


Fig. 10-Installing Bearings and Wheels

Pack wheels with SAE multipurpose-type grease. Install bearing with seal, wheel, outer bearing and slotted nut on axle, Figure 10. Adjust wheel bearings according to the following instructions. Place grease cap on wheel.

ADJUSTMENT

Front Wheel Bearing

Adjust the front wheel bearings if the wheel is loose on the spindle or if the wheel does not rotate freely.

1. Raise the tractor until the front tires clear the floor.

2. Remove the grease cap from the wheel.

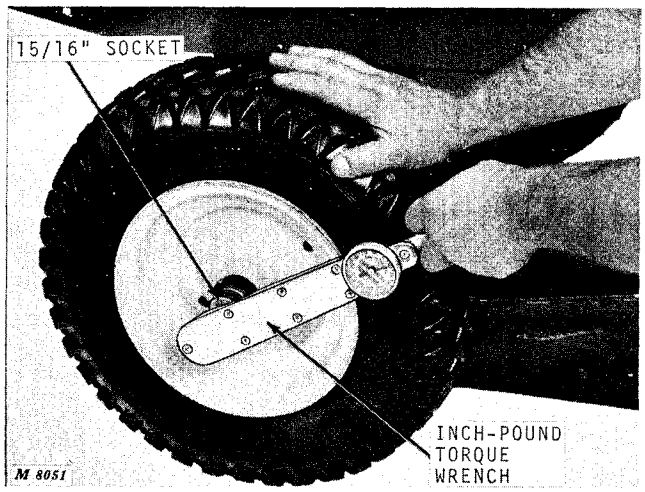


Fig. 11-Adjusting Wheel Bearing

3. Wipe the excess grease from the end of the spindle and remove cotter pin and slotted nut.

4. While rotating the wheel and tire, tighten the slotted nut to 60 to 120 in-lbs torque to seat the bearings, Figure 11. Back off slotted nut until wheel turns freely.

5. Using a 15/16-inch open end wrench, back off the nut until the slot in nut aligns with cotter pin hole in spindle.

6. Install a new cotter pin and bend the long end of the cotter pin around the end of the axle.

7. Install cap.

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SPECIFICATIONS

Item	New Part	Wear Tolerance
Front Axle Spindle Bushings	0.751-0.755 in.	0.002 to 0.003 in.

TORQUE FOR HARDWARE

Item	Torque
Spindle Slotted Nut	60-120 in-lbs. Back off nut. See adjustments.

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.
Grease Cap Tool	SNAP-ON GCP-10	To remove grease cap from wheel.

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Group 15
LIFT LINKAGE

GENERAL INFORMATION

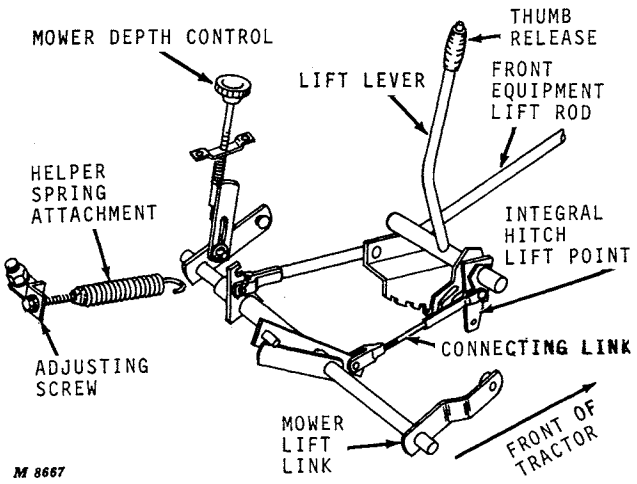

Fig. 1-Manual Lift Linkage

Manual Lift

110 and 112 Tractors with manual lift have linkage as shown in Figure 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, Figure 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 in 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.

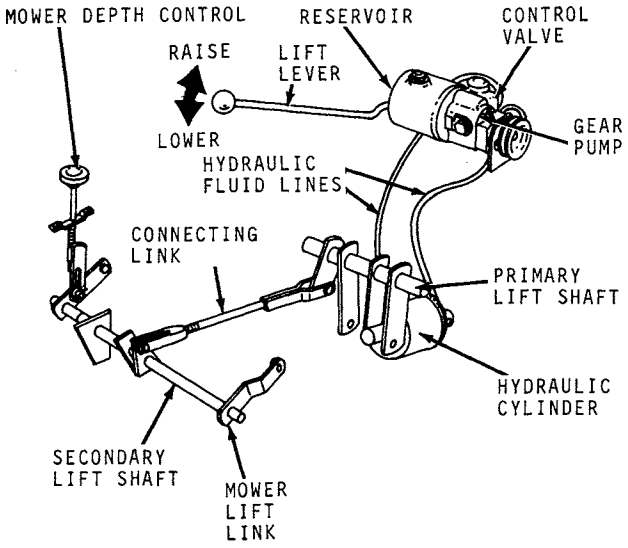

Fig. 2-Hydraulic Lift Linkage

Hydraulic Lift

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.

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