John Deere

Service Manual

110 and 112 Lawn and Garden Tractors

(Serial No. -100,000)

SM-2059-(Apr-67)

John Deere Horicon Works
SM2059 (Apr-67)
LITHO IN U.S.A.
ENGLISH

Service Manual

110 AND 112 LAWN AND GARDEN TRACTORS

(Serial No. -100,000)

CONTENTS

Litho in U.S.A.

INTRODUCTION

This service manual contains service and maintenance information for John Deere 110 and 112 Lawn and Garden Tractors (Serial No. -100,000).

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.

All sections of this service manual should be carefully studied by the serviceman. Much basic information such as the principles of 4-cycle engine operation, carburetion and ignition have been omitted. Such information can be found in any good library and is recommended reading for the new serviceman before consulting this manual for service procedures.

Emphasis is placed on diagnosing malfunctions, analysis and testing. Diagnosing malfunctions lists possible troubles, their causes and how to correct them. Under specific components these troubles are analyzed to help the serviceman understand what is causing the problem so he can correct it 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 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 always will be up-to-date and be a valuable asset in your service department.

Litho in U.S.A.

Section 10
GENERAL

Group 5
TRACTOR IDENTIFICATION

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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. Only the last four digits of the serial number are shown for earlier tractors and the last six digits for later tractors. All serial number references are tractor serial numbers and not engine specification numbers.

(3551-) When a serial number appears before the dash, the design change was introduced beginning with that serial number and is still current.

(-40000) 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.

(40001-65000) 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

	110 Tractor					112 Tractor
	(-3550)	(3551-15000)	(15001-40000)	(40001-65000)	(65001-100,000)	(-100,000)
Year Manufactured	1963	1964	1965	1966	1967	1966-1967
Model - Manual Lift	110	110	110	110	110	112
Model - Hydraulic Lift	---	---	---	110H	110H	112H
Engine Model Number	Kohler K161S	Kohler K181S	Kohler K181S	Kohler K181S	Kohler K181S	Tecumseh HH100
Engine Horsepower	7	8	8	8	8	10
Transaxle Speeds (Forward)	3	3	4	4	4	4
Transaxle Speeds (Reverse)	1	1	1	1	1	1

SERIAL NUMBER PLATES

SERIAL NO. (-15000)

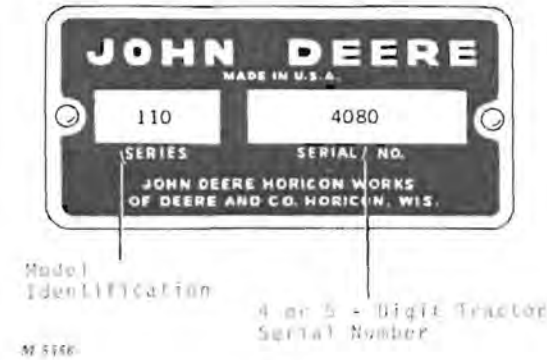


Fig. 1

SERIAL NO. (15001-40000)

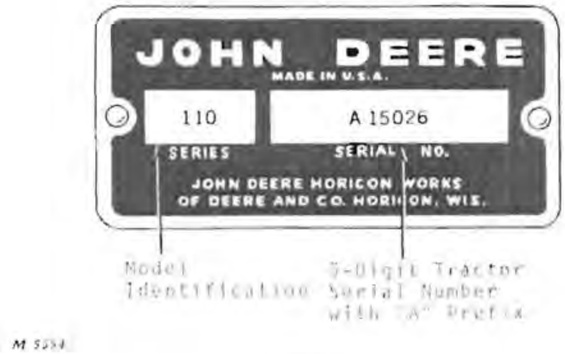


Fig. 3

SERIAL NO. (40001-65000)

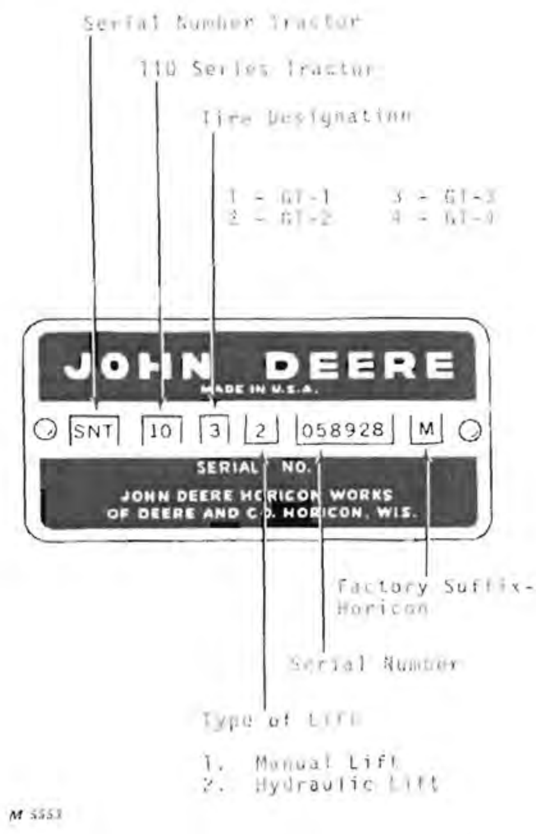


Fig. 2

SERIAL NO. (65001-100,000)

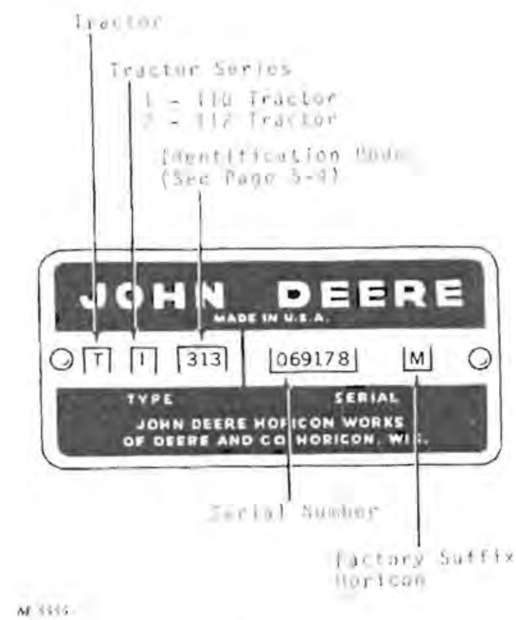


Fig. 4

IDENTIFICATION CODES

TRACTOR CODES

The tractor identification code is indicated on tractor serial number plates beginning with tractor Serial No. 65001. See the chart below for tractor identification codes.

Tire	110 Manual Lift		110 Hydraulic Lift		112 Manual Lift	112 Hydraulic Lift
	Without Mower Drive	With Mower Drive	Without Mower Drive	With Mower Drive	Without Mower Drive	Without Mower Drive
GT-1	300	304	307	311	---	---
GT-2	301	305	308	312	---	---
GT-3	302	306	309	313*	314	316
GT-4	303	---	310	---	315	317

**Example: Code 313 is a 110 Tractor with hydraulic lift, factory installed mower drive and GT-3 high-flotation tires.*

TIRE CODES

Tires for Lawn and Garden Tractors are referred to in abbreviated form as GT-1, GT-2, GT-3 or GT-4. The description of each is as follows:

Tire	Size, Front	Size, Rear	Tubeless	Ply	Tread
GT-1	4.80/4.00-8	6-12	No	2	All Purpose
GT-2	4.80/4.00-8	6-12	No	2	Traction
GT-3	16x6.50-8	23x8.50-12	Yes	2	High-Flotation
GT-4	4.80/4.00-8	---	No	4	Studded
GT-4	---	23x8.50-12	Yes	2	Traction

TIRE INTERCHANGEABILITY

Tractor tires may be interchanged depending on Serial Numbers as follows:

Tractor Serial No.	GT-1	GT-2	GT-3	GT-4
	110 Tractors			
(- 4048)	X	X	--	--
(4049-15000)	X	X	X	--
(15001-40000)	X	X	X	--
(40001-65000)	X	X	X	X
(65001-100,000)	X	X	X	X
	112 Tractors			
(- 3550)	--	--	X	X
(3551-)	--	--	X	X

Note that GT-3 and GT-4 front tires should not be used on 110 Tractors Serial No. (- 4048). Steering gear ratios below this serial number are not adequate for these tires.

Group 10
SPECIFICATIONS

ENGINE SPECIFICATIONS

Engines	110 Tractors		112 Tractors
	(-3550)	(3551-)	(-100 000)
Engine Model No.	K161S	K181S	HH100
Manufacturer	Kohler	Kohler	Tecumseh
Cylinders	One	One	One
Cycle	Four	Four	Four
Bore & Stroke	2.875 x 2.50 in.	2.94 x 2.75 in.	3.31 x 2.75 in.
Displacement	16.22 cu. in.	18.63 cu. in.	23.70 cu. in.
Speeds (fast) No Load	1800-3800 rpm	1800-3800 rpm	1800-3800 rpm
Speeds (idle)	1200-1700 rpm	1200-1700 rpm	1200-1700 rpm
Horsepower (Engine Manufacturers Rating)*	7 @ 3600 rpm*	8 @ 3600 rpm*	10 @ 3600 rpm*
Normal Compression	110-120 psi	110-120 psi	110-120 psi
Valve Clearance	---	---	---
(Intake) Cold	0.007 in.	0.007 in.	0.010 in.
Valve Clearance	---	---	---
(Exhaust) Cold	0.016 in.	0.016 in.	0.010 in.

******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 29.92 in. Hg. Barometer and are developed from laboratory test engines equipped with standard air cleaner and muffler less motor-generator equipment.*

CAPACITIES

Cavities	110 Tractors			112 Tractors
	(-15000)	(15001-40000)	(40001-100,000)	(-100,000)
Fuel Tank - U.S. Gallons	1.9	1.9	1.9	1.9
Crankcase - U.S. Pints	2.5	2.5	2.5	2.5
Transaxle - U.S. Pints	2.0	3.0	3.0	3.0
Hydraulic Lift System - U.S. Pints	--	--	2.5	2.5

VARIABLE GROUND SPEEDS - MILES PER HOUR
(at 3600 rpm engine speed)

	110 Tractor				112 Tractor
	(-3550)	(3551-15000)	(15001-65000)	(65001-100,000)	(-100,000)
1st Gear	.9 to 2.5	1.1 to 2.5	.37 to .84	.4 to .8	.4 to 1.0
2nd Gear	1.6 to 4.5	2.1 to 4.4	1.1 to 2.5	1.1 to 2.5	1.3 to 2.9
3rd Gear	2.4 to 6.5	3.0 to 6.5	2.1 to 4.4	2.1 to 4.4	2.4 to 5.0
4th Gear	---	---	3.0 to 6.5	3.0 to 6.5	3.4 to 7.4
Reverse	1.2 to 3.4	1.5 to 3.4	1.6 to 2.9	1.6 to 2.9	1.8 to 3.3

CURB WEIGHTS

	110 Tractor				112 Tractor
Tire Groups	(-3550)	(3551-15000)	(15001-40000)	(40001-100,000)	(-100,000)
GT-1 Manual Lift	500 lbs.	513 lbs.	531 lbs.	545 lbs.	---
GT-2 Manual Lift	500 lbs.	513 lbs.	531 lbs.	545 lbs.	---
GT-3 Manual Lift	---	*535 lbs.	550 lbs.	568 lbs.	579 lbs.
GT-4 Manual Lift	---	---	---	570 lbs.	581 lbs.
GT-1 Hydraulic Lift	---	---	---	566 lbs.	---
GT-2 Hydraulic Lift	---	---	---	566 lbs.	---
GT-3 Hydraulic Lift	---	---	---	583 lbs.	591 lbs.
GT-4 Hydraulic Lift	---	---	---	586 lbs.	594 lbs.

**Weight becomes effective with Serial No. 4049.*

TRACTOR SPECIFICATIONS

	110 Tractor Only	110 and 112 Tractors	
	All Purpose and Traction Tires (GT-1 & 2)	High-Flotation Tires (GT-3)	High-Flotation Traction Tires (GT-4)
WHEEL TREAD			
Front	29 in.	30 in.	30 in.
Rear.	27 or 33 in.	27 or 33 in.	27 or 33 in.
TIRE SIZES (Also see Group 5)			
Front	4.80/4.00-8 2 ply	16 x 6.50-8 2 ply	4.80/4.00-8 4 ply
Rear.	6-12 2 ply	23 x 8.50-12 2 ply	23 x 8.50-12 2 ply
TIRE INFLATION			
Front	12 psi	8 psi	40 psi
Rear.	6 psi	5 psi	5 psi
DIMENSIONS			
Wheel Base	44 in.	44 in.	44 in.
Over-all Length	63 in.	63 in.	63 in.
Over-all Height	38-3/4 in.	38-3/4 in.	38-3/4 in.
Over-all Width:			
(min.)	34-1/2 in.	37 in.	37 in.
(max.)	39 in.	41-1/2 in.	41-1/2 in.
Turns Outside	30-1/2 in. radius	28-1/2 in. radius	28-1/2 in.

TRANSAXLE - See Section 50 for detailed specifications.

ELECTRICAL SYSTEM - See Section 40 for detailed specifications.

FUEL SYSTEM - See Section 30 for detailed specifications.

CLUTCH, BRAKE AND VARIATOR - See Section 50 for detailed specifications.

STEERING AND WHEEL BEARINGS - See Section 70 for detailed specifications.

BOLT TORQUE CHART

Grade of Bolt		SAE-2	SAE-5	SAE-8	Socket or Wrench Size	
Min. Tensile Strength		64,000 PSI	105,000 PSI	150,000 PSI		
Grade Marking on Bolt						
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.

TRACTOR SPECIFICATIONS

	110 Tractor Only	110 and 112 Tractors	
	All Purpose and Traction Tires (GT-1 & 2)	High-Flotation Tires (GT-3)	High-Flotation Traction Tires (GT-4)
WHEEL TREAD			
Front	29 in.	30 in.	30 in.
Rear.	27 or 33 in.	27 or 33 in.	27 or 33 in.
TIRE SIZES (Also see Group 5)			
Front	4.80/4.00-8 2 ply	16 x 6.50-8 2 ply	4.80/4.00-8 4 ply
Rear.	6-12 2 ply	23 x 8.50-12 2 ply	23 x 8.50-12 2 ply
TIRE INFLATION			
Front	12 psi	8 psi	40 psi
Rear.	6 psi	5 psi	5 psi
DIMENSIONS			
Wheel Base	44 in.	44 in.	44 in.
Over-all Length	63 in.	63 in.	63 in.
Over-all Height	38-3/4 in.	38-3/4 in.	38-3/4 in.
Over-all Width:			
(min.)	34-1/2 in.	37 in.	37 in.
(max.)	39 in.	41-1/2 in.	41-1/2 in.
Turns Outside	30-1/2 in. radius	28-1/2 in. radius	28-1/2 in.

TRANSAXLE - See Section 50 for detailed specifications.

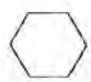
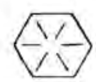
ELECTRICAL SYSTEM - See Section 40 for detailed specifications.

FUEL SYSTEM - See Section 30 for detailed specifications.

CLUTCH, BRAKE AND VARIATOR - See Section 50 for detailed specifications.

STEERING AND WHEEL BEARINGS - See Section 70 for detailed 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					U.S. Regular	
Bolt Dia.	U.S. Dec. Equiv.		TORQUE IN FOOT POUNDS		Bolt Head	Nut
1/4	.250	6	10	14	7/16	7/16
5/16	.3125	13	20	30	1/2	1/2
3/8	.375	23	35	50	9/16	9/16
7/16	.4375	35	55	80	5/8	11/16
1/2	.500	55	85	120	3/4	3/4
9/16	.5625	75	130	175	13/16	7/8
5/8	.625	105	170	240	15/16	15/16
3/4	.750	185	300	425	1-1/8	1-1/8
7/8	.875	*160	445	685	1-5/16	1-5/16
1	1.000	250	670	1030	1-1/2	1-1/2

Multiply Readings by 12 for inch pound values.

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

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

SET SCREW SEATING TORQUE CHART

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

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

Group 15
TUNE-UP AND ADJUSTMENT

IMPORTANT: Before attempting to tune-up the 110 or 112 Tractor engine, first determine if performance can be restored by tune-up. Do this by making the preliminary engine tests below.

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
Battery hydrometer test	1.260-1.280 sp. gr. 100% charged at 80°F.	Section 40, Group 10

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 Clean insulation Replace gasket Set gap at 0.025 in.	Section 40, Group 10
Remove air cleaner and clean by tapping lightly against flat surface	Check air cleaner condition Replace if necessary	Section 30, Group 15
Adjust carburetor	High speed mixture needle Idle mixture needle	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, sediment bowl and strainer	Regular gasoline only	Section 30, Group 20

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 or 30
Remove shrouding, clean engine and cylinder head fins	. . . .	Section 20, Group 10 or 30
Test condenser	Capacity .18-.23 Microfarads Delco No. 1965489	Section 40, Group 10
Test coil	Operating amp. 2.25 max. Secondary continuity Min. 3.9 OHMS, Max. 4.08 OHMS, Delco No. 1115043	Section 40, Group 10
Replace breaker points	Point gap 0.020 in.	Section 40, Group 10
Retime ignition	"SP" or "S" mark on flywheel at 1200-1800 rpm	Section 40, Group 10

COMMON ADJUSTMENTS

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

Adjustment	Specification	Reference
Clutch, brake and variable speed	. . . .	Section 50, Group 10
Steering linkage	. . . .	Section 70, Group 5
Belt tension:		
Motor-Generator	. . . .	Section 40, Group 15
Hydraulic Pump	. . . .	Section 60, Group 15
Primary	. . . .	Section 50, Group 10
Secondary	. . . .	Section 50, Group 10

Group 20
FUEL AND LUBRICANTS

FUEL

Use regular grade gasoline only of recognized brand. It should be fresh and from a supply blended for the area in which it is to be used. Summer blends held over for winter use will not vaporize properly at lower temperatures and may be the real reason for slow starts. White gas may be used only if octane rating is at least 75.

Do not mix oil with gasoline.

Never use premium grade gasoline (ethyl) in small tractor engines. The compression ratio (6.5 to 1) is not high enough to require the premium grade and it can cause a severe buildup of lead deposits in the engine. The deposits will rob power and may shorten the life of the engine.

LUBRICANTS

Carefully written and illustrated instructions have been included in the operator's manual furnished with your customer's machine. Remind your customer to follow the recommendations in those instructions.

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 chart below and on page 20-2 indicates type of lubricant, capacities and service intervals recommended for both 110 and 112 tractors.

CAPACITIES

Cavities	110 Tractor	112 Tractor
Fuel Tank - U.S. Gallons	1.9	1.9
Crankcase - U.S. Pints	*2.5	*2.5
Transaxle - U.S. Pints	2.0 (-15000)	3.0
Transaxle - U.S. Pints	3.0 (15001-)	3.0
Hydraulic Lift System - U.S. Pints	2.5 (1 to 1-1/2 inches below top of reservoir)	2.5 (1 to 1-1/2 inches below top of reservoir)

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

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
Hydraulic Lift	Automatic Transmission Fluid Type A
Tractor Grease Fittings and Front Wheel Bearings	SAE (Seasonal grade) Multi-Purpose 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

CHANGING CRANKCASE OIL

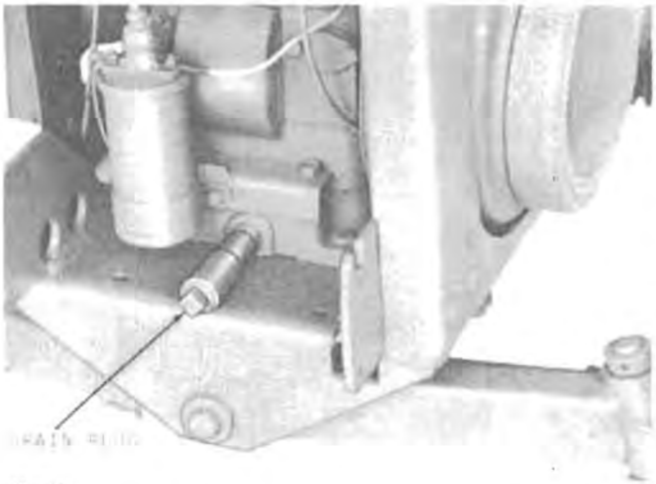


Fig. 1 - Oil Drain on 110 Tractors (-15000)

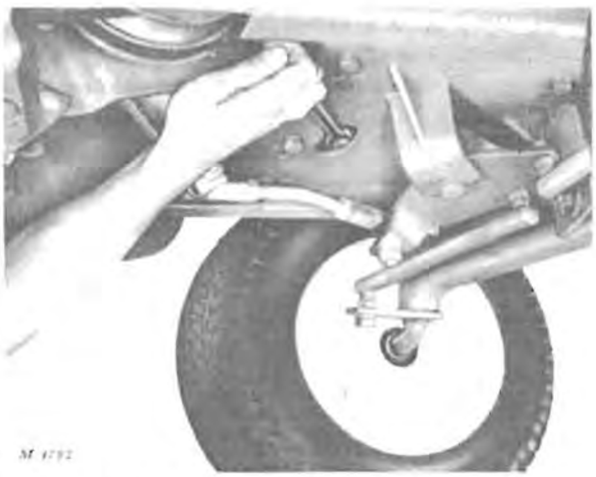


Fig. 2 - Oil Drain on 110 Tractors (15001-100,000) and 112 Tractors (-100,000)

Before draining oil, allow engine to warm up. Dirt and foreign material is in suspension when oil is hot.

CHANGING TRANSAXLE OIL

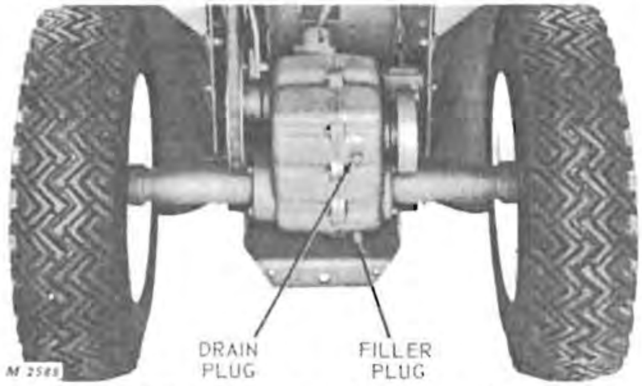


Fig. 3 - Filling Transaxle on 110 Tractors (-3550)

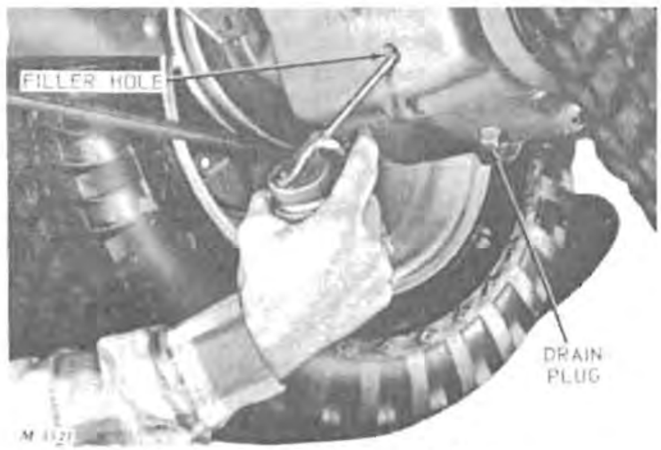


Fig. 4 - Filling Transaxle on 110 Tractors (3551-100,000) and 112 Tractors (-100,000)

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

GREASE FITTING LOCATION

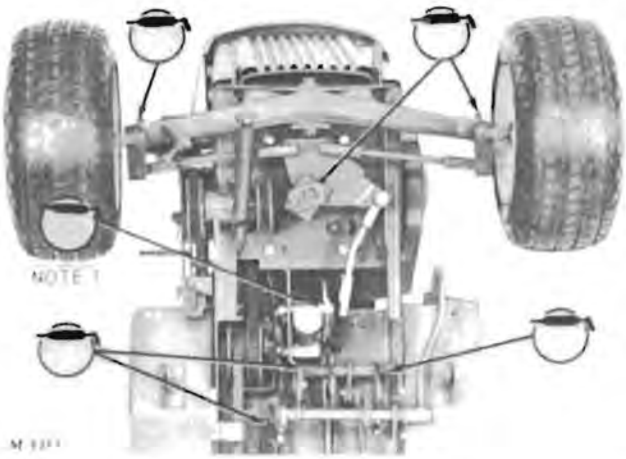


Fig. 5 – Tractor Grease Fittings

110 Tractors Serial No. 40001 and higher and 112 Tractors have grease fittings as indicated above. 110 Tractors Serial No. 40000 and below do not have all grease fittings indicated above.

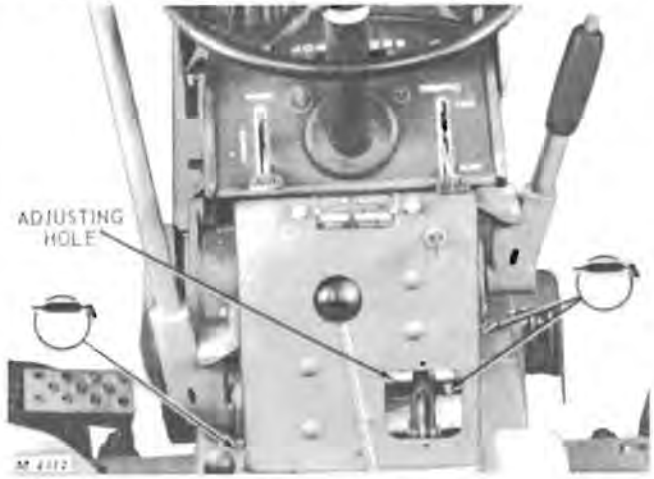


Fig. 6 – Inspection Plate Removed to Expose Grease Fitting

NOTE: Do not overlubricate steering column fitting. Only 3 or 4 strokes with hand grease gun or 15 to 20 strokes with JD5804 Lubrigun are necessary. Do not use high pressure grease guns on this fitting.

Section 20
ENGINE

Group 5
GENERAL INFORMATION

KOHLER ENGINE FOR 110 TRACTOR

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110 TRACTOR

Litho in U.S.A.

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DESCRIPTION

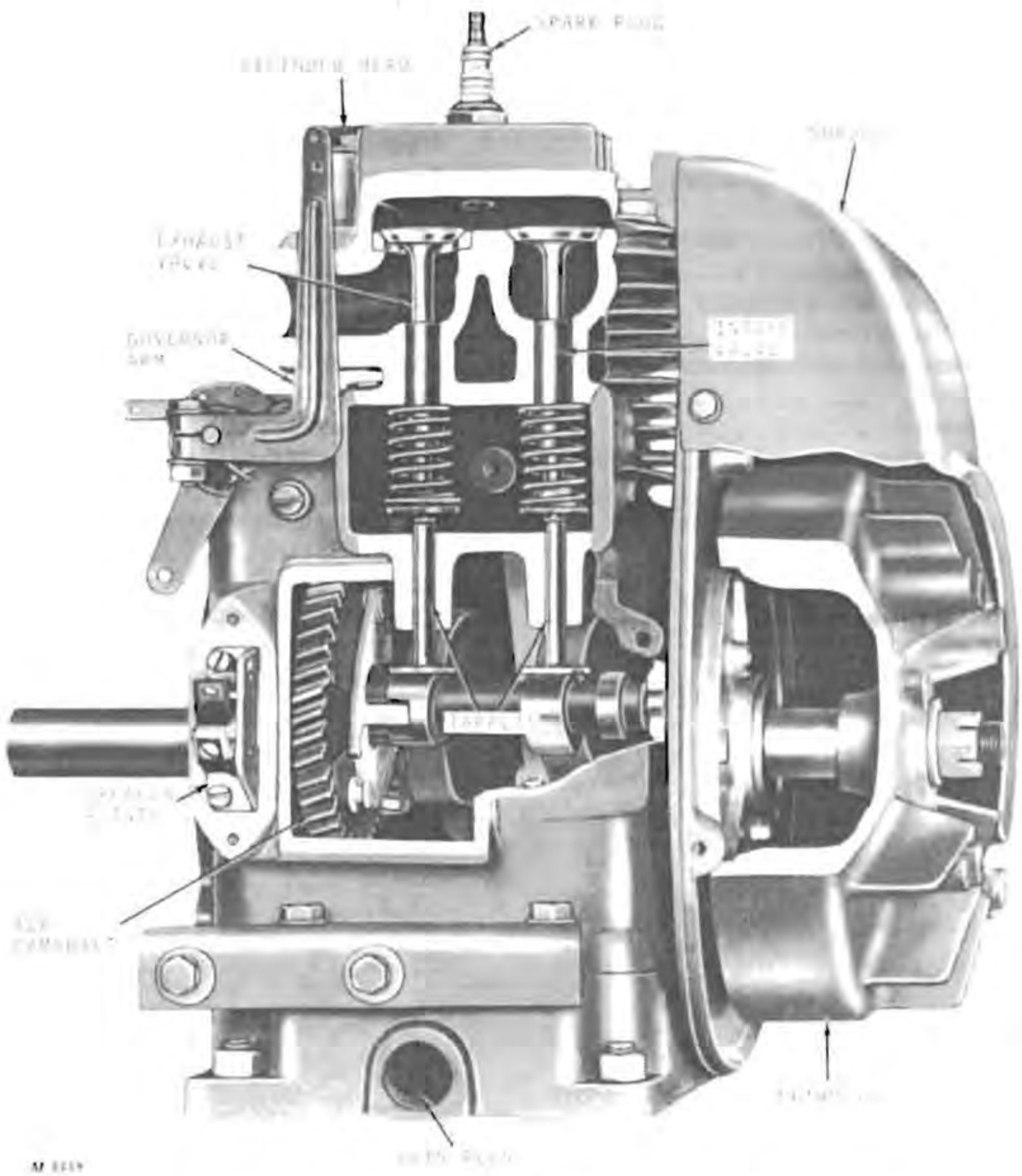

Fig. 1—Cutaway View of Kohler K181S Engine Showing Valves and Tappets

Both K161S and K181S engines used in 110 Tractors are Kohler four cycle, internal combustion engines. They have cast iron blocks, and are L-head, single cylinder with large bore - short stroke design.

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

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

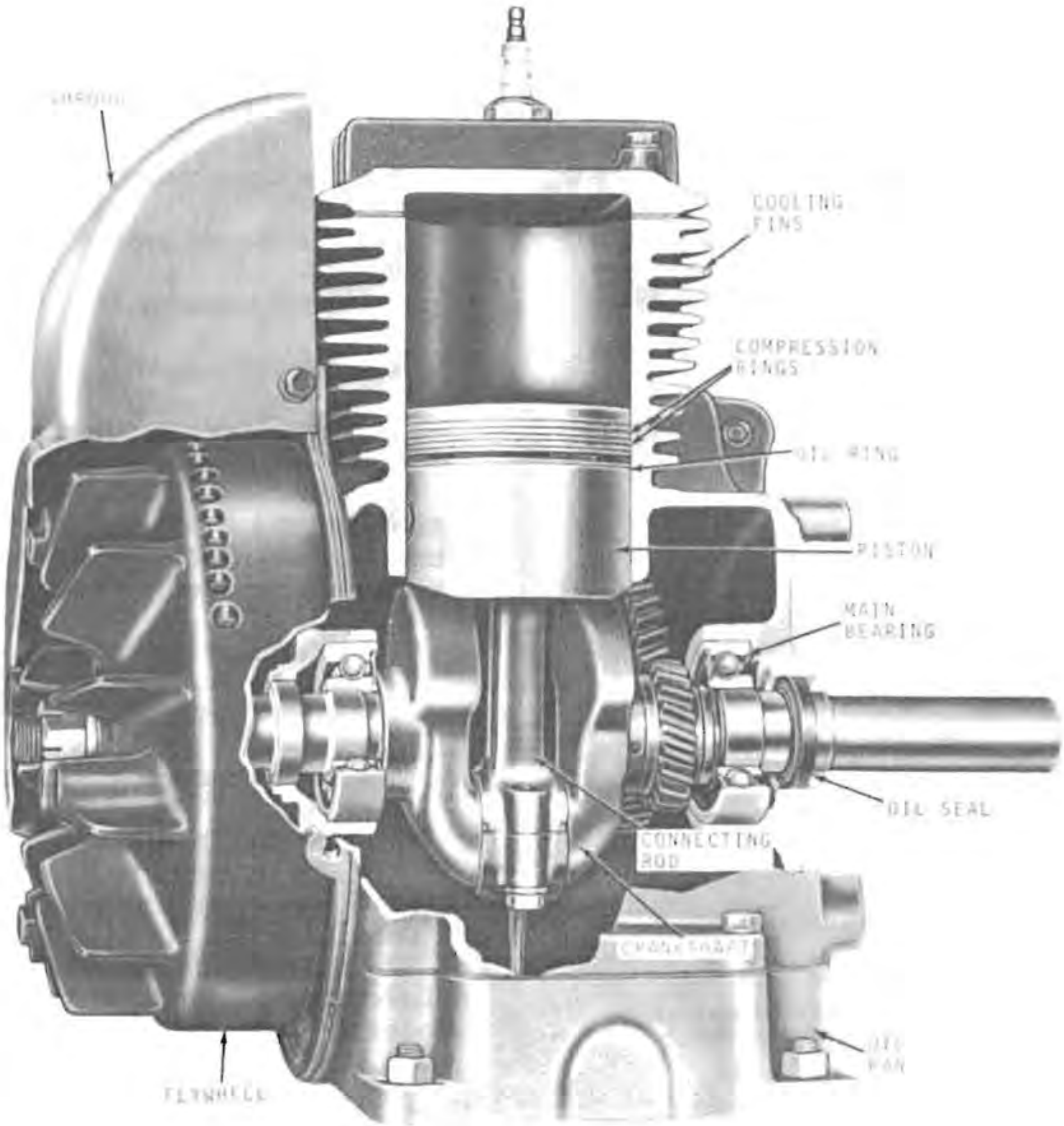

Fig. 2–Cutaway View of Kohler K181S Engine Showing Piston, Crankshaft and Bearings

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.

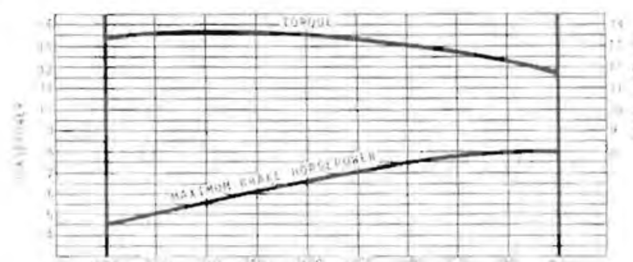

Fig. 3–Torque-Horsepower Chart

DESCRIPTION—Continued

Fig. 4–Kohler K161S 7 Horsepower Engine Serial No (-3550)

Fig. 5–Kohler K181S 8 Horsepower Engine Serial No. (3551-15000)

Fig. 6–Kohler K181S 8 Horsepower Engine Serial No. (15001-100000)

110 Tractors, Serial No. (- 3550), are equipped with Kohler K161S 7 Horsepower engines. Visible differences between this and later engines are:

1 - Air cleaner location.

2 - Screw-type dipstick.

3 - Blower housing.

4 - Muffler design.

5 - Engine identification markings.

Tractors, Serial No. (3551-15000), used Kohler K181S 8 Horsepower engines. In addition to mechanical changes necessary to obtain the extra horsepower, visible changes are:

1 - Air cleaner position.

2 - Push-type dipstick.

3 - Extra screen in blower housing.

4 - Improved muffler.

5 - Engine identification markings.

Tractors, Serial No. (15001-100000) use the Kohler K181S 8 Horsepower engine which has the following visible external changes:

1 - Crankcase drain on bottom of pan.

2 - Coil relocated for easier point access.

Internal changes on engines for tractors, Serial No. (40001-100000), include:

1 - Automatic compression release camshaft (ACR).

2 - Exhaust valve rotators for tractors equipped with hydraulic lift.

3 - Studs are provided in the engine head to carry the hydraulic pump and valve on 110H Tractors.

ENGINE ANALYSIS

PRELIMINARY ENGINE CHECKS

A complete diagnosis guide of engine malfunctions appears 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.

Fig. 7–Checking Spark At Plug

Check spark, Figure 7, 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 on sediment bowl 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 not 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 and 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

110 Tractors (-40001) have engines with a regular camshaft. Tractors (40001-100,000) have engines with ACR (Automatic Compression Release Camshaft). Because ACR relieves compression pressure during lower cranking speeds, it is important to crank the engine at 1000 rpm or more to obtain an accurate test. ACR mechanism is disengaged when engine speed reaches approximately 650 rpm.

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

Fig. 8–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.

COMPRESSTION TEST - Continued

Set throttle and choke valve in wide open position by raising throttle lever all the way and lowering choke lever.

Install compression gauge in cylinder, Figure 8. Follow manufacturer's recommendations for installing and reading compression tester.

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 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 100 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 engine is operating properly.

Connect water U-tube manometer to oil filter hole in cylinder block, Figure 9. Tester must hang vertical as shown. Start and run engine at 1200-1700 rpm. Allow engine to warm up and observe reading on scale. Follow manufacturers recommendations for installation, testing and compensation for the effect of altitude on the gauge reading.

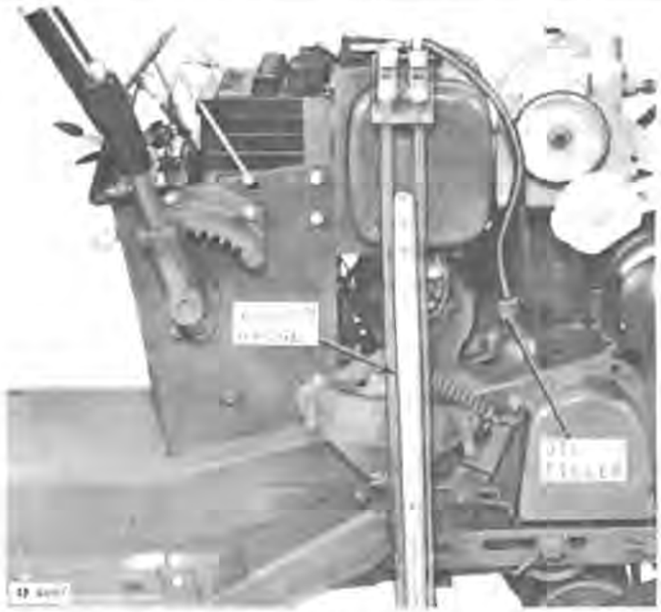

Fig. 9—Checking Crankcase Vacuum

Test Conclusions

Proper crankcase vacuum for both the K161 and K181 engines is 5-inches to 10-inches water column.

A crankcase vacuum reading lower than indicated above is most likely due to a leaking breather valve or improperly assembled breather. See Group 10 and carefully reassemble all breather parts. 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 have a vacuum, chances are that the breather plate has been assembled backwards or the breather filter is 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

ENGINE

Engine Will Not Crank

Transaxle not in neutral.
Place shift lever in neutral position.

Battery discharged or defective.
Check battery condition.
Replace battery if necessary.

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

PTO drive engaged.
Disengage clutch.

Defective safety switch(es).
Replace switch(es).

Loose motor-generator belt.
Adjust belt tension.

Broken motor-generator sheave.
Replace motor-generator sheave.

Defective solenoid.
Replace solenoid.

Loose electrical connections.
Tighten connections firmly.

Motor-generator malfunction.
Check condition of motor-generator.
Repair or replace if necessary.

Engine seized.
Check engine condition.

Engine Cranks But Will Not Start

Empty fuel tank.
Fill fuel tank.

Restricted fuel tank vent.
Replace cap or cap gauge assembly.

Fuel shut-off valve closed (valve below fuel tank).
Open shut-off.

Clogged, restricted or air lock in fuel line.
Clean and bleed line.
Replace line if necessary.

Breaker points worn or pitted.
Check condition.
Replace if necessary.

Spark plug fouled or pitted.
Check condition of plug.
Clean and regap.
Replace if necessary.

Incorrect spark plug.
Install proper spark plug.

Battery not fully charged.
Charge battery and check condition.
Replace battery if necessary.

Loose electrical connections.
Tighten connections firmly.

Wire leads not properly connected.
Connect wire leads to their respective terminal.

High speed and idle mixture needles not properly adjusted.
Adjust carburetor.

Faulty condenser.
Replace condenser.

Defective ignition coil.
Replace coil.

Dirt in fuel system.
Remove fuel system and clean dirt and water from system.
Install new gaskets.
Install carburetor kit if necessary.

Frayed wire(s) causing ground(s).
Repair wire(s), replace if necessary.

Engine Starts Hard

Spark plug pitted or fouled.
Check condition of plug.
Clean and regap.
Replace if necessary.

Breaker points worn, pitted or out of adjustment.
Check breaker point condition.
Clean and regap.
Replace breaker points if necessary.

DIAGNOSING MALFUNCTIONS—Continued

Engine Starts Hard—Continued

High tension wire shorted.
Replace wire.

High tension wire loose at spark plug or coil.
Check spark plug connection and install wire properly in coil.

Loose electrical connections.
Check connections and tighten leads firmly.

Restricted fuel tank vent.
Replace filler cap or cap gauge assembly.

Clogged fuel line or air lock.
Clean and bleed line.
Replace line if necessary.

Broken choke cable.
Replace and adjust cable properly.

Throttle cable not properly adjusted.
Check cable at control and governor assembly and adjust properly.

Dirt or water in fuel system.
Remove fuel system and clean dirt and water from system.
Install new gaskets.
Install carburetor kit if necessary.

High speed and idle mixture needles not properly adjusted.
Adjust needles properly.

Wrong valve clearance.
Check and adjust valve clearance.

Bad head gasket.
Replace gasket and torque cylinder head properly.

Restricted exhaust system.
Check exhaust system condition.
Replace muffler if necessary.

Low compression.
Check compression and service engine accordingly.

Engine Starts But Fails to Keep Running

Restricted fuel tank vent.
Replace fuel cap or cap gauge assembly.

High speed and idle mixture needles not properly adjusted.
Adjust needles properly.

Broken choke cable.
Replace and adjust cable properly.

Dirt or water in fuel system.
Remove fuel system and clean dirt and water from system.
Install new gaskets.
Install carubretor kit if necessary.

Carburetor float not properly adjusted or leaky float.
Check float condition, adjust float.
Install new float and adjust if necessary.

High tension wire loose at spark plug or coil.
Check spark plug connection and install wire properly in coil.

High tension wire shorted.
Replace wire.

Breaker points not properly adjusted.
Clean and regap.
Replace breaker points if necessary.

Loose connections.
Check and tighten wires properly.

Defective head gasket.
Replace head gasket and torque cylinder head properly.

Faulty condenser.
Check condenser.
Replace if necessary.

Excessive engine load (lugging engine).
Reduce engine load.

Engine Runs But Misses

High tension wire loose from spark plug or coil.
Check spark plug connection and install wire properly in coil.

Breaker points out of adjustment or worn and pitted.
Clean and adjust.
Replace points if necessary.

Spark plug fouled or pitted, incorrect gap.
Clean and regap plug.
Replace plug if necessary.

Incorrect spark plug.
Install proper plug.

Loose electrical connections.
Tighten connections.

Carburetor float not properly adjusted or hole in float.
Check condition of float.
Adjust float to proper position.
Replace leaky float.

Dirt or water in fuel system.
Remove fuel system and clean dirt and water from system.
Install new gaskets.
Install carburetor kit if necessary.

Wrong valve clearance.
Check valve clearance and valve condition.
Repair valve as necessary.

Faulty coil.
Check coil condition.
Replace coil if necessary.

Engine Misses Under Load

Spark plug fouled or pitted, incorrect gap
Clean and regap plug.
Replace spark plug if necessary.

High speed and idle mixture needles not properly adjusted.
Adjust needles.

Spark plug fouled or pitted, incorrect gap.
Check spark plug condition.
Clean and regap.
Replace spark plug if necessary.

Incorrect spark plug.
Install proper spark plug.

Breaker points out of adjustment or worn and pitted.
Clean and adjust.
Replace points if necessary.

Ignition out of time.
Set engine timing.

Dirt or water in fuel system.
Remove fuel system and clean dirt and water from system.
Install new gaskets.
Install carburetor kit if necessary.

Old fuel.
Drain system and fill fuel tank with fresh fuel.

Linkage misaligned (throttle arm to governor arm).
Straighten linkage to prevent binding.

Engine Will Not Idle

Idle speed too low.
Adjust idle screw.

High speed and idle mixture needles not properly adjusted.
Adjust needles properly.

Dirt or water in fuel system.
Remove fuel system and clean dirt and water from system.
Install new gaskets.
Install carburetor kit if necessary.

Restricted fuel tank.
Replace filler cap or cap gauge assembly.

Spark plug fouled or pitted, incorrect gap.
Check spark plug condition.
Clean and regap.
Replace spark plug if necessary.

Wrong valve clearance.
Check valve clearance and valve condition.
Service valve(s) as necessary.

Low engine compression.
Check compression.

Engine Misses When Advancing Throttle

Cold engine.
Choke engine before advancing throttle.

High speed and idle mixture needles not properly adjusted.
Adjust needles.

Spark plug fouled or pitted, incorrect gap.
Check spark plug condition.
Clean and regap.
Replace spark plug if necessary.

Linkage misaligned (throttle arm to governor).
Straighten linkage to prevent binding.

DIAGNOSING MALFUNCTIONS—Continued

Engine Loses Power

Crankcase low on oil.
Fill crankcase to proper level.
Change oil if tractor has been operated 8 hours since last oil change.

Engine shrouding plugged.
Remove shrouding and clean engine fins and inside of shrouding.

Excessive engine load.
Reduce engine load by shifting transmission in lower gear and/or by moving variable-speed control lever back.

Restricted air filter.
Clean and check air filter element condition.
Replace filter if necessary.

Dirt or water in fuel system.
Remove fuel system and clean dirt and water from system.
Install new gaskets.
Install caruburetor kit if necessary.

High speed and idle mixture needle not properly adjusted.
Adjust needles properly.

Spark plug fouled or pitted, incorrect gap.
Check spark plug condition.
Clean and regap.
Replace spark plug if necessary.

Too much oil in crankcase.
Drain oil and refill crankcase with proper amount of crankcase lubricant.

Low engine compression.
Check compression.
Repair and replace parts as necessary.
Torque head bolts.

Worn cylinder bore.
Check cylinder condition.
Repair as necessary.

Engine Overheats

Dirty or plugged shrouding and engine fins.
Remove shrouding and clean engine fins and shrouding.

High speed and idle mixture needles not properly adjusted.
Adjust needles properly.

Too much oil in crankcase.
Drain oil and fill crankcase with proper amount of crankcase lubricant.

Worn valve stem and/or guides.
Check condition of valve stems and guides.
Replace valves and/or guides if necessary.

Crankcase low on oil.
Fill crankcase to proper level.
Change oil if tractor has been operated 8 hours since last oil change.

Excessive engine load.
Reduce work load by shifting transmission in lower gear and/or by moving variable-speed control lever back.

Faulty breather causing low crankcase vacuum.
Clean breather assembly.
Replace parts as necessary.

Engine Knocks

Engine out of time.
Time ignition.

Old fuel.
Drain fuel tank and refill with good grade of regular gasoline.

Excessive engine load.
Reduce engine load by shifting transmission in lower gear and/or by moving variable-speed control lever back.

Crankcase low on oil.
Fill crankcase to proper level.
Change oil if tractor has been operated 8 hours since last oil change.

Engine Backfires

High speed and idle mixture needles not properly adjusted.
Adjust needles properly.

Loose cylinder head or blown head gasket.
Torque head bolts.
Replace head gasket if necessary.

Intake valve sticking in guide.
Free valve stem in guide.

Ignition out of time.
Set engine timing.

Engine Low on Power at High Speed

Restricted air filter.
Clean and check air filter element condition.
Replace filter if necessary.

Spark plug fouled or pitted, incorrect gap.
Check spark plug condition.
Clean and regap.
Replace spark plug if necessary.

Incorrect spark plug.
Install correct plug.

Restricted exhaust.
Repair and clean muffler.
Replace muffler if necessary.

Breaker points out of adjustment, worn and pitted.
Clean and adjust.
Replace points if necessary.

Clogged fuel line or air lock.
Clean and bleed air from fuel line.
Replace fuel line if necessary.

Broken choke cable.
Replace cable and adjust choke valve to correspond with control on panel.

Clogged breather assembly.
Clean breather assembly.
Install new parts as necessary.

Defective ignition coil.
Check coil.
Replace coil if necessary.

Engine Does Not Maintain Constant Speed (surges)

High speed and idle mixture needles not properly adjusted.
Adjust needles properly.

Spark plug gap incorrect.
Check spark plug condition.
Clean and regap spark plug.
Install new spark plug if necessary.

Throttle to governor linkage not properly assembled.
Assemble linkage correctly.

Breaker points out of adjustment, worn or pitted.
Clean and adjust.
Replace points if necessary.

Dirt or water in fuel system.
Remove fuel system and clean dirt and water from system.
Install new gaskets.
Install carburetor kit if necessary.

Sensitive governor.
Install anti-surge spring.

Engine Uses Excessive Amount of Oil

Clogged breather assembly.
Clean breather assembly.
Replace parts as necessary.

Breather not assembled properly.
Assemble breather properly.

Worn or broken piston rings.
Install new rings.

Worn cylinder bore.
Recondition cylinder.
Replace parts as necessary.

Clogged oil holes in piston.
Clean piston and check piston condition.
Install new parts as necessary.

Wrong size piston rings.
Install proper rings.

Worn valve stems and/or valve guides.
Check condition of valve stems and guides.
Replace valves and/or guides if necessary.

Incorrect oil viscosity.
Drain crankcase and fill with oil of proper viscosity.

Faulty breather causing low crankcase vacuum.
Check crankcase vacuum.
Replace parts as necessary.

DIAGNOSING MALFUNCTIONS—Continued

Engine Runs Erratically

Dirt or water in fuel system.
- Remove fuel system and clean dirt and water from system.
- Install new gaskets.
- Install new carburetor kit if necessary.

High speed and idle mixture needles not properly adjusted.
- Adjust needles properly.

Idle speed too low.
- Turn idle screw until proper idle rpm is obtained.

Spark plug fouled or pitted, incorrect gap.
- Check spark plug condition.
- Clean and regap.
- Replace spark plug if necessary.

Poor compression.
- Check compression.
- Repair and replace parts as necessary.

Faulty breather causing low crankcase vacuum.
- Check crankcase vacuum.
- Replace parts as necessary.

Carburetor leaking at gaskets or at connection.
- Install new gasket(s) and/or tighten connection.

Restricted fuel tank vent.
- Replace filler cap or cap gauge assembly.

Throttle to governor linkage misassembled.
- Assemble and adjust linkage properly.

Sensitive governor.
- Install anti-surge spring.

Gasoline in Crankcase

Carburetor float not properly adjusted or leaking.
- Check condition of float.
- Adjust or replace float if necessary.

Float valve and/or seat.
- Check condition of needle and seat.
- Install carburetor kit if necessary.

Group 10

CYLINDER HEAD, VALVES AND BREATHER KOHLER ENGINE FOR 110 TRACTOR

GENERAL INFORMATION

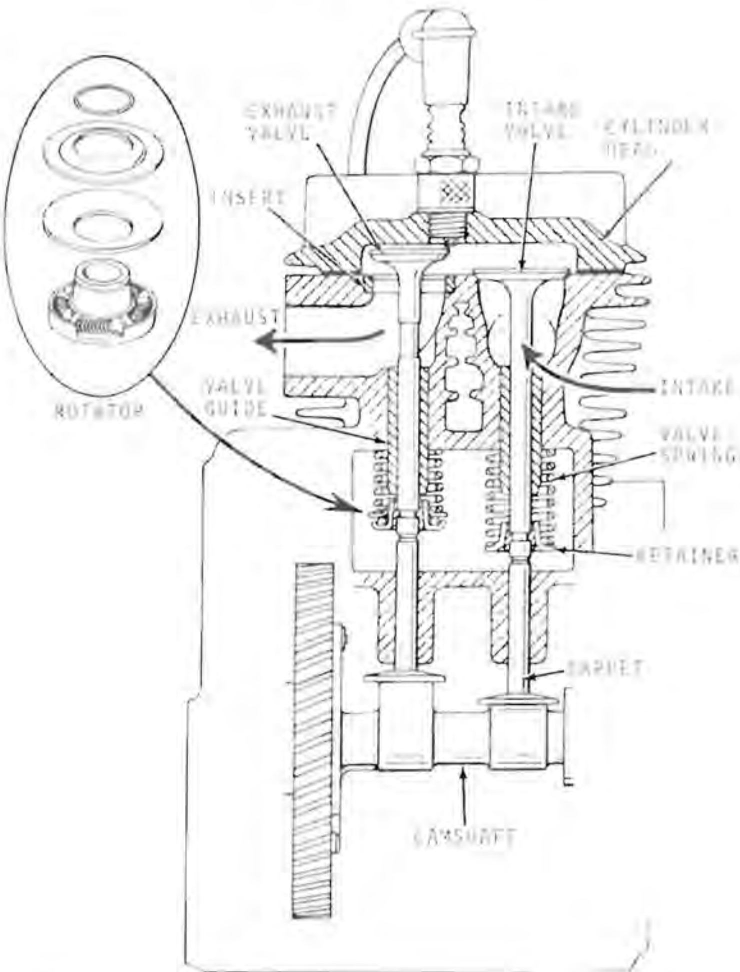

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Fig. 1—Schematic View of Valves and Tappets

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

Tractors, Serial No. (40001-100,000) equipped with hydraulic lift, have a valve rotator on the exhaust valve. Any time the valves are removed, special caution should be taken to insure that the correct valve spring and tappet are used with the rotator on the exhaust valve assembly.

The exhaust valve 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 replaced when wear tolerances are exceeded.

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 leakage of exhaust gases back 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 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 engine is stopped before it has had a chance to warm up.

Valve corrosion can also occur during storage when the engine has not been run 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 causes 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. 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 disfiguration 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 can also be caused by improper spark plug or overheated spark plugs which cause pre-ignition or a lean fuel mixture.

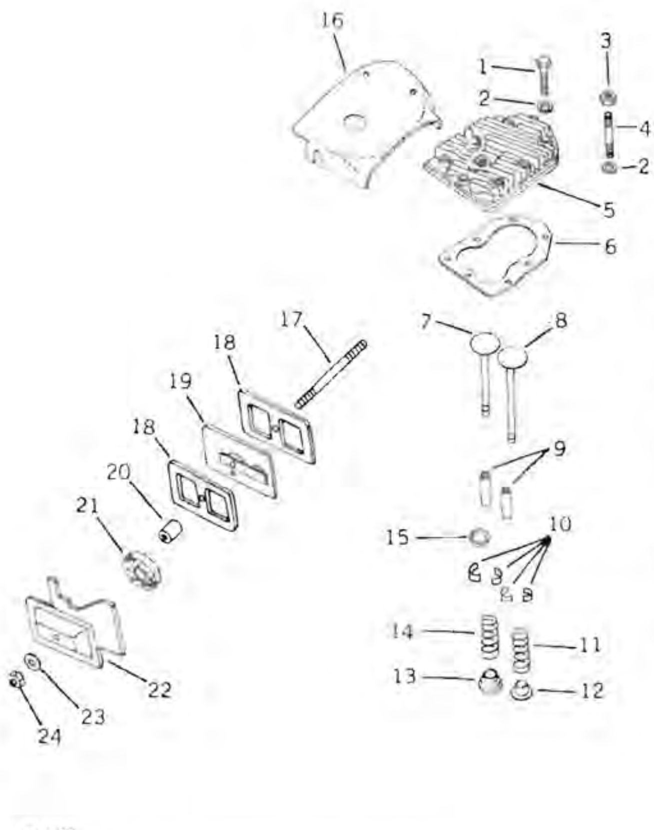
Fig. 5—Gummy Valve Causing Valve to Stick

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 – Cap Screw (5 used)
2 – Washer (9 used 30198D–10 used 30270D)
3 – Hex. Nut (9 used 30198D–10 used 30270D)
4 – Stud (2 used 30198D–3 used 30270D)
5 – Cylinder Head
6 – Head Gasket
7 – Exhaust Valve
8 – Intake Valve
9 – Valve Guides (2 used)
10 – Spring Keeper (4 used)
11 – Intake Valve Spring
12 – Spring Retainer (Intake and Exhaust, 30198D–Intake, 30270D)
13 – Exhaust Valve Rotator (30270D)
14 – Exhaust Valve Spring
15 – Exhaust Valve Insert
16 – Head Baffle
17 – Stud
18 – Gasket (2 used)
19 – Breather
20 – Seal
21 – Filter
22 – Cover
23 – Lock Washer
24 – Hex. Nut

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, hydraulic lift system on engine, motor-generator bracket, head baffle, cylinder head and head gasket.

REMOVING VALVES

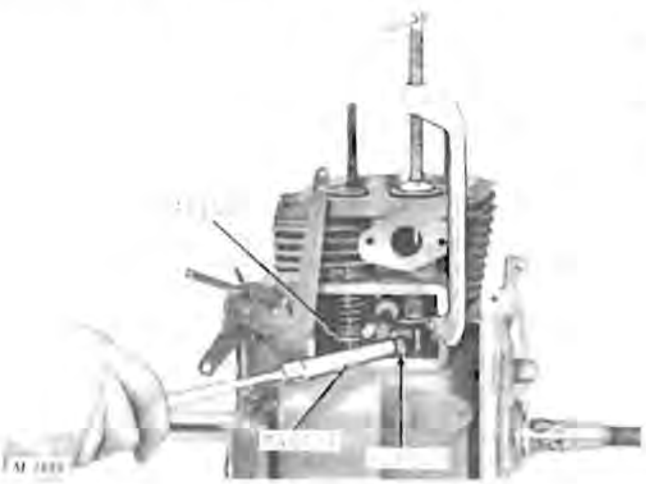


Fig. 7—Removing Valves

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. Note that 110H Tractors have a rotator type retainer and the exhaust valve spring is shorter than the intake valve spring.

INSPECTING CYLINDER HEAD

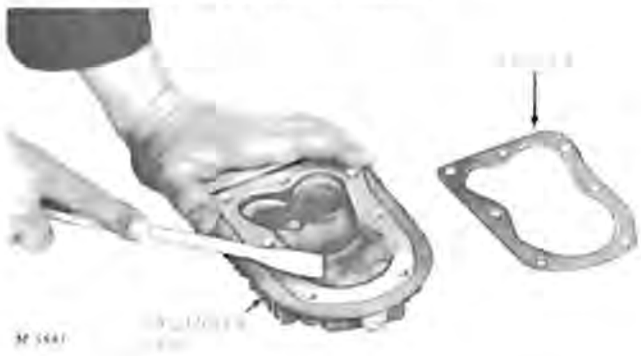


Fig. 8—Cleaning Cylinder Head

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

NOTE: Always use new head gasket after removing 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

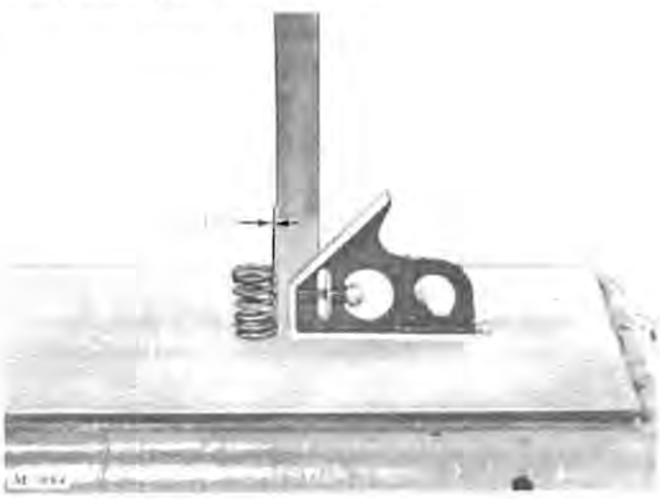


Fig. 11–Valve Spring Squareness

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.

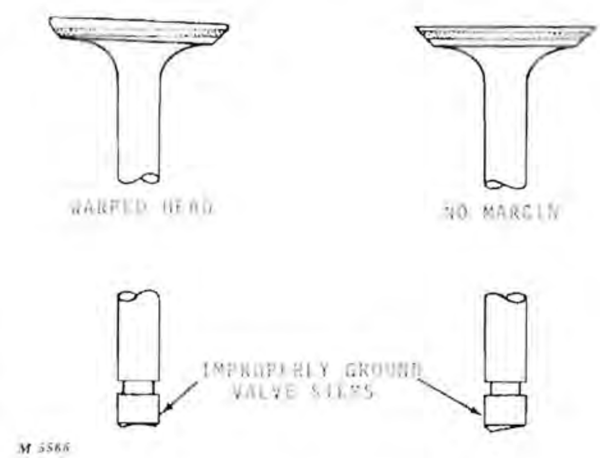


Fig. 13–Faulty Valves

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 valves with 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

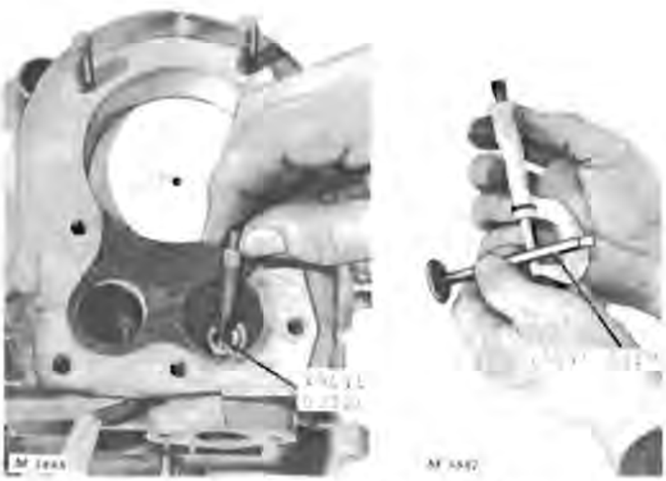


Fig. 14–Measuring Valve Guides and Stems

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. Refer to Specifications, page 10-11, for clearance. Replace and ream guides as necessary.

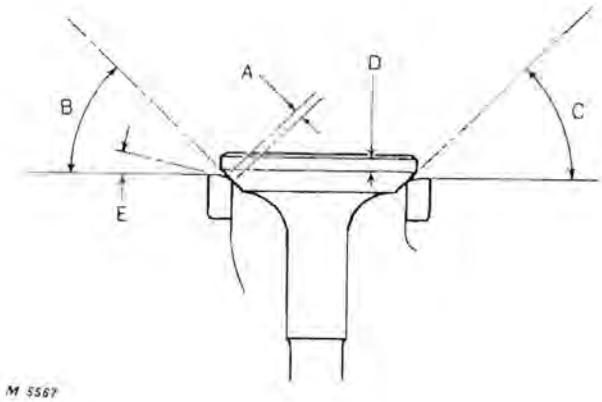
Valve Seats

Broken or worn exhaust valve seats (insert) may be replaced. See page 10-8. They are either stellite or molychrome nickel.

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

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

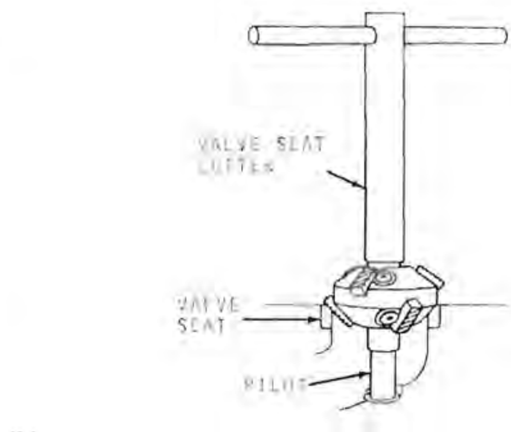


Fig. 16–Valve Seat Cutter

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 1/64-inch margin "D" on the valve.

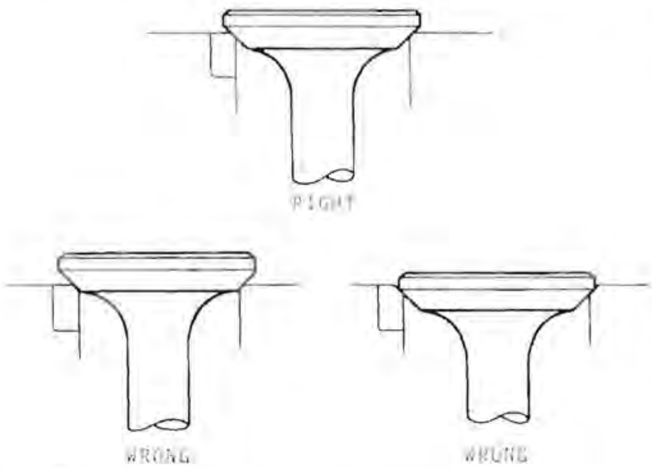


Fig 17—Valve and Seat Relationship

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

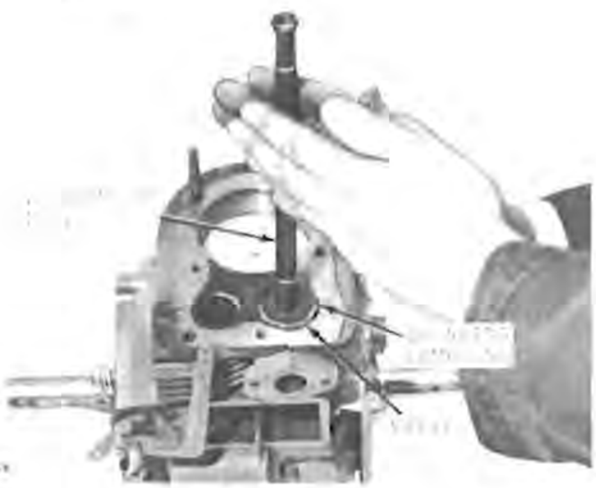


Fig. 18—Lapping Valves

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 an oscillating 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, replace the guide.

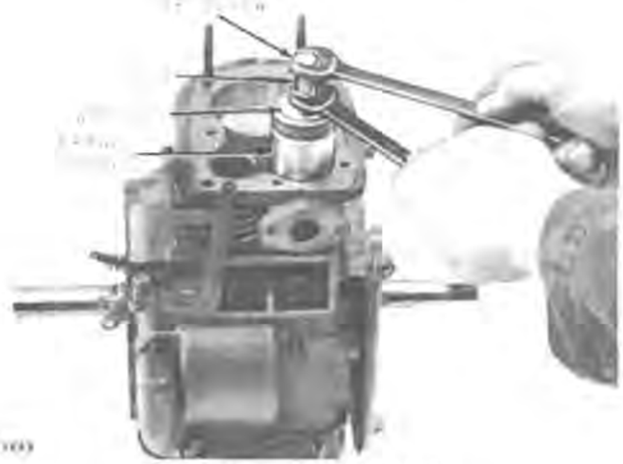


Fig. 19—Removing Valve Guides

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

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

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

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

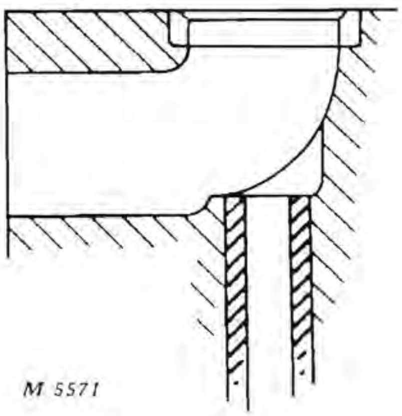


Fig. 20—Installing Valve Guides

Thoroughly clean hole and press valve guide into hole 1-5/16 inches from top of block. After installing new guide, ream hole as required for necessary valve clearance in guide. Refer to Specifications, page 10-11, for valve guide clearances.

REPLACING EXHAUST VALVE INSERT

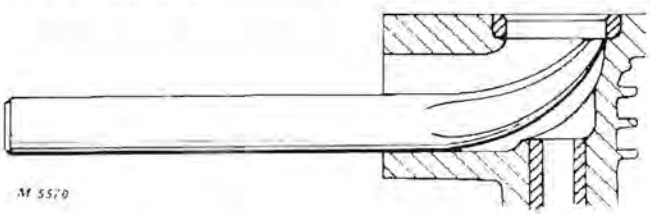


Fig 21—Removing Exhaust Valve Insert

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 insert and drive out.

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

INSTALLING INTAKE VALVE INSERT

If the intake valve seat is beyond repair in the cast iron block, an insert is available for service. Bore block to depth shown, Figure 22, and install insert as explained above for exhaust valve inserts.

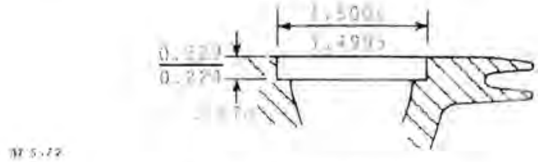


Fig. 22—Intake Valve Seat

CHECKING VALVE CLEARANCE

Fig 23—Checking Valve 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 on engines so equipped.

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 feeler gauge, Figure 23. Refer to Specifications, page 10-11, 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 KEEPERS

Fig. 24–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 24. If tool is not available, apply grease to keepers to hold them on the valve stem and insert them by hand.

NOTE: Engines in 110H Tractors have an exhaust valve rotator and a shorter exhaust valve spring, Figure 6.

ASSEMBLING BREATHER

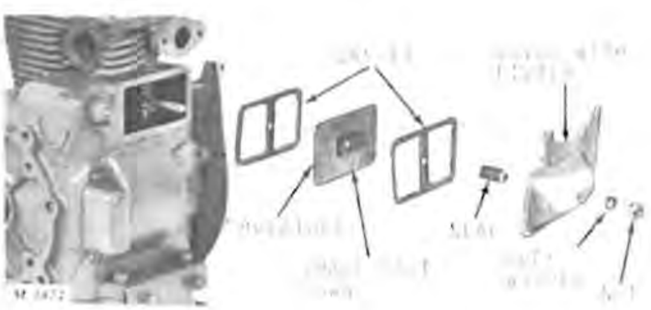


Fig. 25–Breather Parts

The correct order of breather assembly is very important. For correct assembly, refer to Figure 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 head has been removed for service. This will assure a gas tight fit.

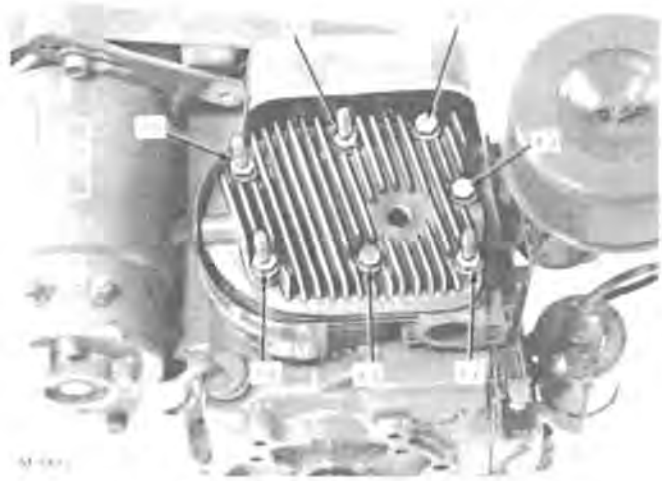


Fig. 26–Cylinder Head Bolt Tightening Sequence

It is important to tighten all cylinder head bolts with an even pressure and in their correct order, Figure 26, 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

Fig. 27–Carburetor Assembly

Connect throttle link in proper holes on governor arm and throttle shaft arm, Figure 27. Using new gasket, mount carburetor to engine block and tighten bolts firmly. Connect fuel line to carburetor, install head baffle and generator bracket.

INSTALLING HYDRAULIC LIFT ASSEMBLY

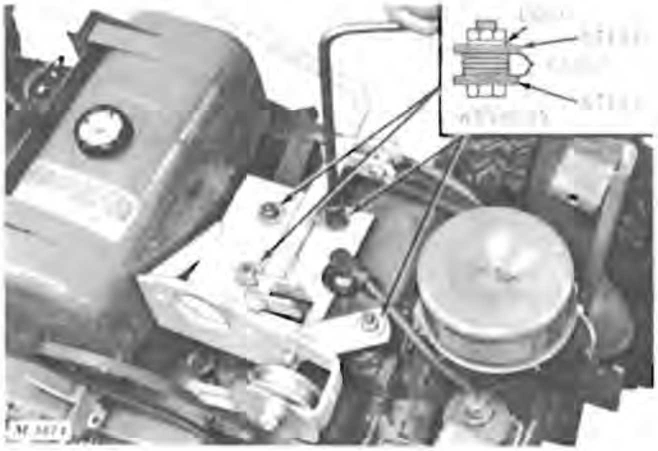


Fig. 28–Hydraulic Lift Assembly

For tractors equipped with hydraulic lift system, install mounting bracket assembly, pump assembly, drive sheave and drive belt. Be sure all washers are positioned as shown, Figure 28. Refer to Section 60 if necessary to complete the hydraulic assembly.

INSTALLING MUFFLER

Fig. 29–Muffler Installation

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, Figure 29.

CHECKING AIR FILTER

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

ADJUSTMENTS

HYDRAULIC BELT TENSION

Refer to Section 60, Group 15, for proper belt tension.

HYDRAULIC LIFT LEVER

Refer to Section 60, Group 10, to adjust lever for uniform travel in both directions.

SPARK PLUG GAP

Refer to Specifications, page 10-11, for proper spark plug gap. See Section 40, Electrical System, for spark plug testing.

BREAKER POINT GAP

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

SPECIFICATIONS

K161S AND K181S KOHLER ENGINES

Component	New Part Dimension	Wear Tolerance
Valve guide, inside diameter	0.312/0.313 inch	. . . .
Valve stem diameter—Intake	0.3105/0.3110 inch	. . . .
Exhaust	0.3090/0.3095 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	18-22 lbs. at 1-5/16-inch length	. . . .
Valve spring compressed tension (exhaust) with rotator	15-17 lbs. at 1-5/16-inch length	. . . .
Valve spring free length	1-3/4 inch	. . . .
Valve spring free length (exhaust) with rotator	1-1/2 inch	. . . .
Cylinder head flatness	Contact at all points	Replace if warped

TABLE OF CLEARANCES

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

TORQUE FOR HARDWARE

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

TUNE-UP DATA

Item	Specifications
Engine compression	110-120 psi
Spark plug gap	0.025 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
(B) Mercury gauge	1/2-1 inch mercury

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 ENGINE FOR 110 TRACTOR

GENERAL INFORMATION

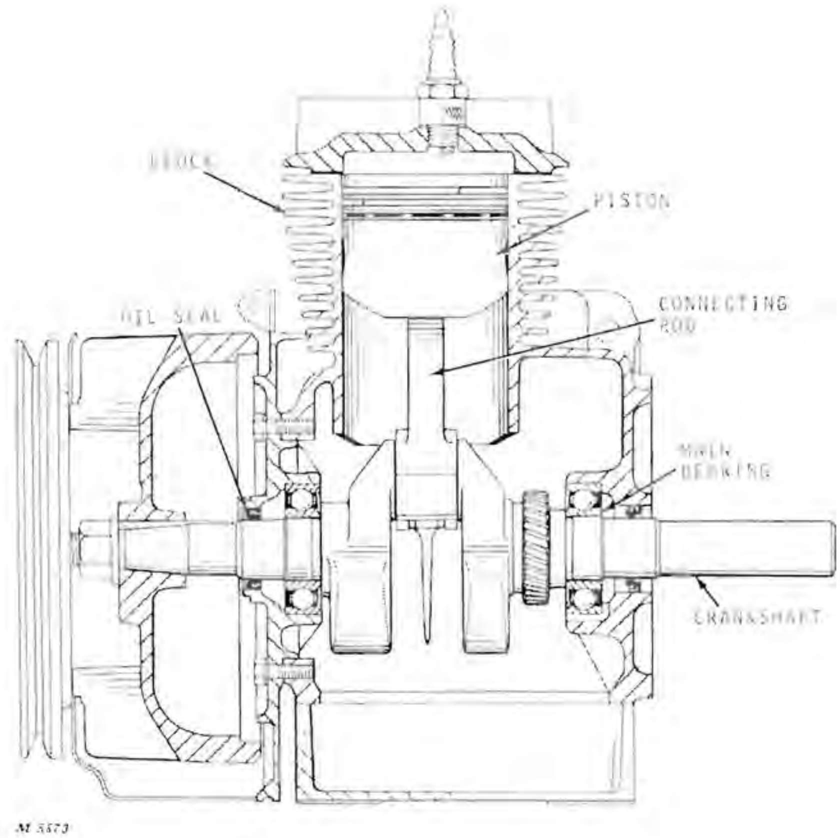
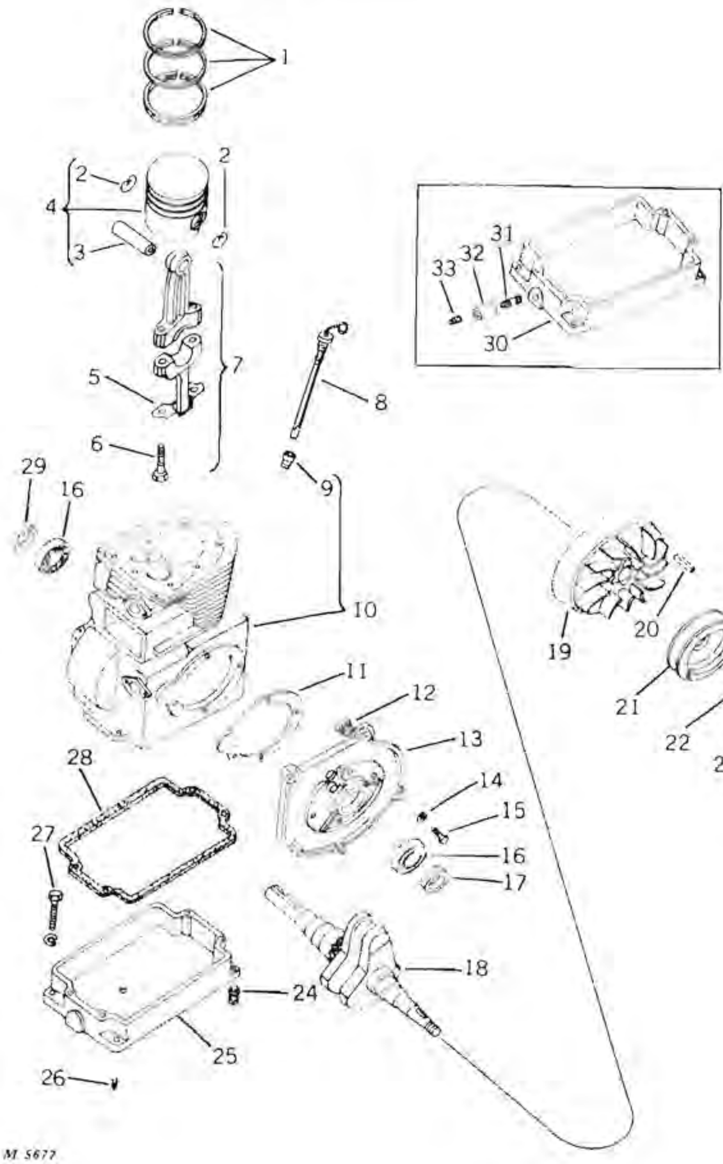


Fig. 1–Cutaway View of Kohler K181S Engine

Oversize pistons and rings are available for K161 and K181 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 and rotator, compression release camshaft and head studs.

REPAIR



1 – Ring Set
2 – Retainer (2 used)
3 – Piston Pin
4 – Piston Assembly
5 – Lock
6 – Screw (2 used)
7 – Rod Assembly
8 – Dipstick
9 – Dipstick Tube
10 – Cylinder Block
11 – Bearing Plate Gasket
12 – Plug Button
13 – Bearing Plate
14 – Copper Washer (4 used)
15 – Cap Screw (4 used)
16 – Ball Bearing (2 used)
17 – Front Oil Seal
18 – Crankshaft
19 – Flywheel
20 – Key
21 – Pulley
22 – Lock Washer
23 – Lock Nut
24 – Cap Screw (4 used)
25 – Oil Pan – SN (15001-)
26 – 3/8" Pipe Plug – SN (15001-)
27 – Cap Screw (4 used)
28 – Oil Pan Gasket
29 – Rear Oil Seal
30 – Oil Pan – SN (-15000)
31 – Pipe Nipple – SN (-15000)
32 – Pipe Coupling – SN (-15000)
33 – 1/2" Pipe Plug – SN (-15000)

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 by spreading hood only far enough to remove one pin at a time. *NOTE: Too much deflection could cause the hood to crack.*

3. Remove front grille.

4. Shut off gas at sediment bowl and remove gas tank.

5. Disconnect ground wire on engine and coil wire. *NOTE: Coil and condenser come off with the engine.*

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

7. Remove hydraulic system above cylinder head 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, motor-generator, 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 spiner 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.

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

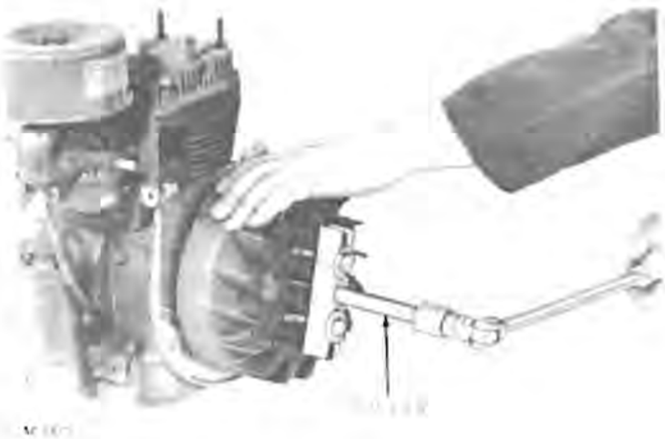


Fig. 3–Removing Flywheel

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 (13, Figure 2). Be sure key is removed from end of crankshaft before removing plate. **Be careful not to cut oil seal.**

Leave bearing and seal in the bearing plate unless bearing or seal service is required.

Lift out crankshaft.

NOTE: It may be necessary to press crankshaft out.

REMOVING PISTON RINGS

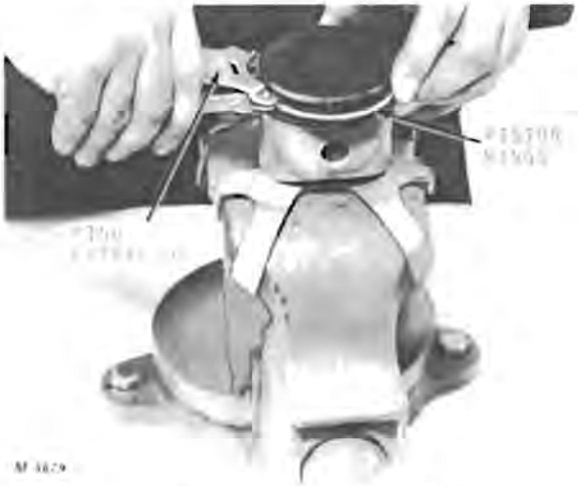


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Fig 5–Removing Piston Rings

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

Use ring extractor to remove rings, Figure 5. Discard old rings.

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

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

PISTON RING ANALYSIS

Light scuffing or scoring of both rings and piston occurs when unusually high friction and combustion temperatures approach the melting point of ring and piston material, Figure 6.

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.

M 3371

Fig. 6–Scored Piston and Rings Caused by Overheating as Temperatures Reach Melting Point of the Materials

M 3378

Fig. 7–Piston Rings with Incorrect End Gap

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

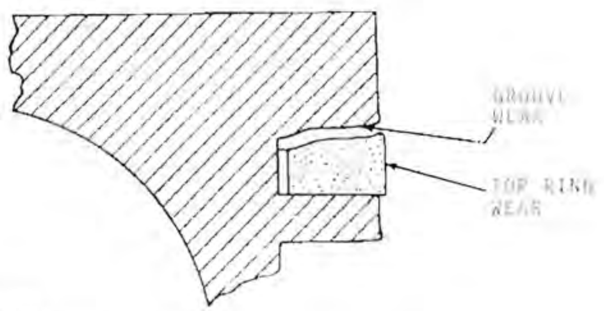

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Fig. 8–Top Ring and Groove Side Wear

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

Fig. 9–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. When this happens excessive oil consumption and blowby will occur.

Engine heating and ring sticking are most often caused by:

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

Fig. 10–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 because the life of a new set of rings will be short otherwise.

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.

PISTON RING ANALYSIS—Continued

Fig. 11—Worn Oil Rings Which Cannot Provide Oil Control

Rails of the oil ring are worn down to the steel expander spacer and the oil ring surface is worn flat. 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 holes 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 12.

Fig. 12—Cleaning Ring Grooves

Fig. 13—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 13. Refer to Specifications, page 15-18, 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 15-7. Replace faulty pistons.

Fig. 14–Measuring Piston Pin and Piston

Measure piston pin to piston clearance with micrometer. Ream out piston and rod and install oversize piston pins when necessary. See Specifications, page 15-18. Oversize piston pins are available for service.

Fig. 15–Measuring Piston

Check the piston-to-cylinder bore clearance by measuring the piston and bore diameters, Figures 15 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.

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 15-11 for deglazing and boring information.

PISTON ANALYSIS

Fig. 16–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.

PISTON ANALYSIS—Continued

Fig. 17—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. 18—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 19—Piston Damage Caused by Wrist Pin Lock Coming Loose

In the above illustration a piece of the lock found its way into the oil ring.

Pin locks loosen or break due to:

1. Rod misalignment.
2. Excessive crankshaft end play.
3. Crank pin taper.
4. Weak pin locks.
5. Pin locks incorrectly installed.

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

INSPECTING CRANKSHAFT

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, take the crankshaft to a competent automotive shop to turn the crankpin 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.

Fig. 20—Measuring Crankshaft Journal

CONNECTING ROD AND CAP ANALYSIS

Fig 21—Crankshaft Connecting Rod and Cap

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

Fig. 22-Scored and Galled Crank Pin and Rod Cap Caused by Lack of Lubrication

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 imbedded in the hardened steel crankshaft. When the rod and cap seize to the crankshaft, the connecting rod and piston may both brake 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 with dirty oil.
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.*

Measure fit of rod and cap to crankshaft bearing. Also measure fit of piston pin in piston and rod. See specifications for wear tolerances.

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

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.*

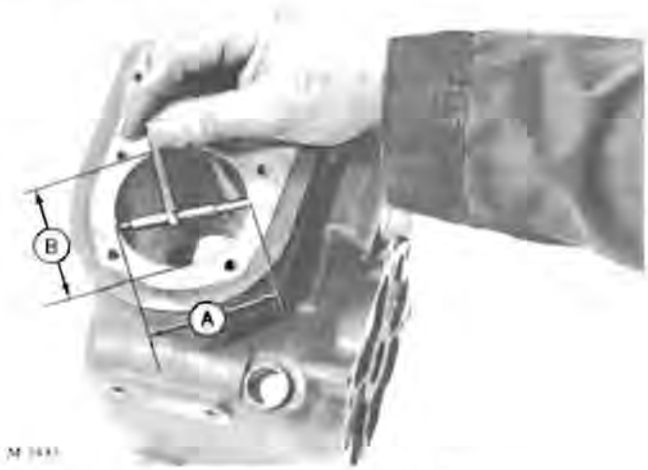


Fig. 23-Measuring Cylinder Bore

Use a telescoping gauge and micrometer to measure bore in two places at top and bottom of ring travel area. 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 15-18, 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 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° should be obtained while operating the tool vertically during deglazing.

BORING CYLINDER BLOCK

If block is to be bored as determined on page 15-7, clean and dry block thoroughly. Reboring can be done by machining at a reliable automotive repair shop or by electric drill and boring tool. See Special Tools, page 15-19.

Reboring to 0.010-inch oversize to accomodate oversize piston and rings can also be done with a course stone in the deglazing tool, Figure 24, and finishing with finer grit stone(s). *IMPORTANT: If block is jigged in a drill press for reboring, be sure boring tool and block are in true alignment.*

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.

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.

BEARING ANALYSIS

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

Fig. 25–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. Always use bearing driver tool and remove burrs before installing bearings.

Fig. 26—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 26.

Fig. 27—Bearing Wear Caused by Misalignment

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

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. 28—Nicks in Outer Race Caused by Using Chisel or Driftpin to Remove or Install Bearing

Fig. 29—Oil Seal Damage Caused by Careless Installation with Sharp Tool

INSTALLATION

INSTALLING CRANKSHAFT

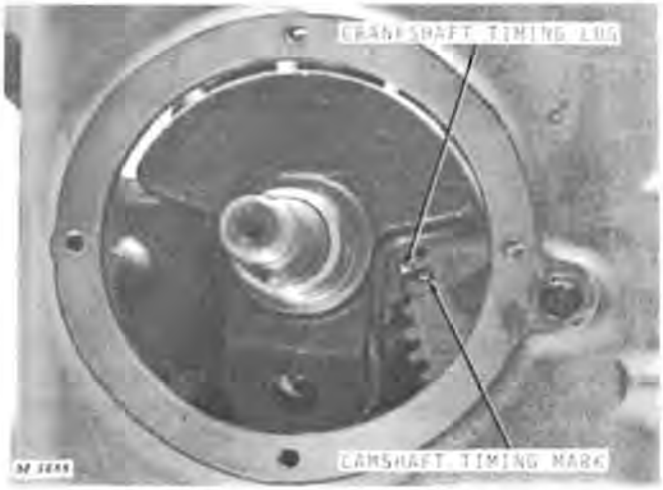


Fig. 30–Timing Marks on Crankshaft and Camshaft

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 30. Chalk timing mark positions for ease of viewing during assembly.

ASSEMBLING BEARING, BEARING PLATE AND OIL SEALS

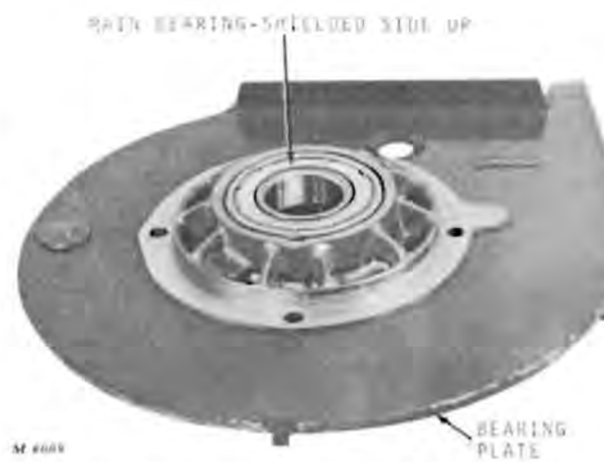


Fig. 31–Installing Main Bearing in Bearing Plate

With bearing plate properly supported, press main bearing, shielded side up, Figure 31, 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—Continued

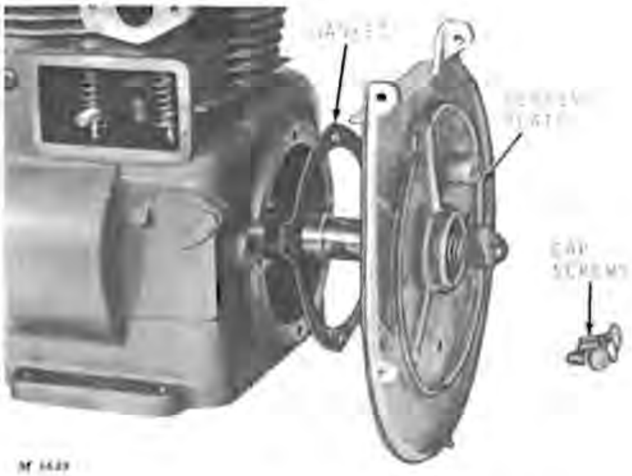


Fig. 32—Installing Bearing Plate with Bearing on Cylinder Block

Install gasket and bearing plate over crankshaft, attach with four one-inch cap screws and copper washers, Figure 32. Draw cap screws up evenly until correct torque is obtained. See torque chart, Section 10.

Fig. 33—Checking Crankshaft End Clearance

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 33. Refer to Specifications, page 15-18, for crankshaft end clearance. Use gaskets as required to obtain correct crankshaft end clearance.

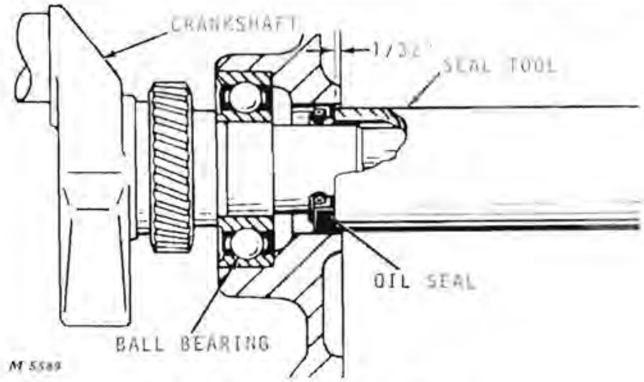


Fig. 34—Oil Seal Installation

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 34.

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 snap rings are securely seated in retainer grooves in piston bore.

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. 35–Checking Ring End Gap

Before installing rings on piston, insert each ring into the cylinder bore to check ring end gap, Figure 35.

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 35. See Specifications, page 15-18, 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 ring expander to position all rings exactly as shown, Figure 36. 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.

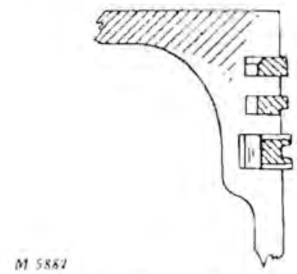


Fig. 36–Piston Ring Assembly

Fig. 37–Installing Rings

Fig. 38–Installing Piston in Cylinder

Coat piston and ring generously with light oil and insert complete assembly into cylinder bore using ring compressor, Figure 38.

NOTE: Be sure match marks on connecting rod and rod cap are aligned and face flywheel side of engine, Figure 39.

ATTACHING ROD TO CRANKSHAFT

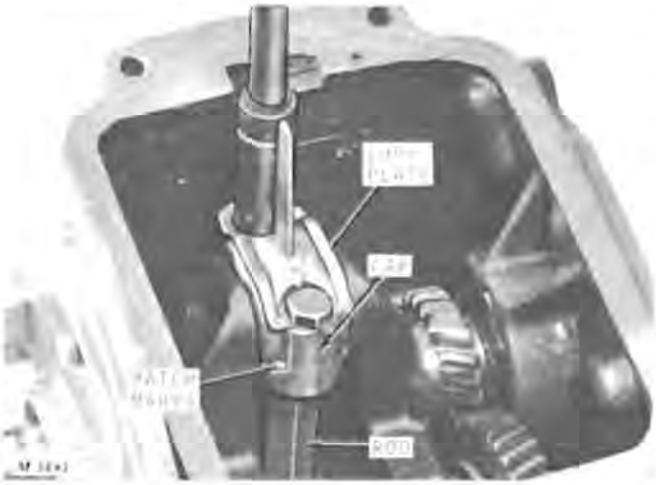


Fig 39–Rod and Crankshaft Assembly

After piston assembly is installed, place block on end and oil connecting rod and crank pin. Be sure that match marks on connecting rod and cap, Figure 39, are aligned and face flywheel side of engine.

Attach connecting rod cap, lock plate and cap screws to the connecting rod.

Use a torque wrench to tighten connecting rod cap screws to 220-inch pounds. Back off screws and tighten to 200-inch pounds. This two step procedure will assure a tight fit of rod to crankshaft and avoids possibility of screws tightening in threads while rod remains loose on crankshaft.

IMPORTANT: Bend lips of lockplate 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 40. Place coil bracket on front of cylinder block. Install two 3/8 x 1-1/4-inch cap screws through coil bracket and engine block. Install two 3/8 x 1-inch cap screws through rear of engine block. Refer to Torque Chart, Section 10 and torque cap screws accordingly.

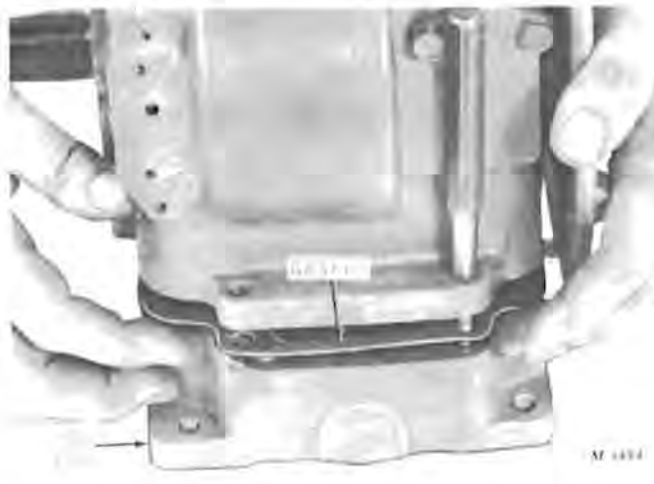


Fig. 40–Oil Pan and Gasket Assembly

INSTALLING FLYWHEEL

Fig 41–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 41, while torquing nut. See Specifications, page 15-18, for proper flywheel nut torque.

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

INSTALLING SHROUDING

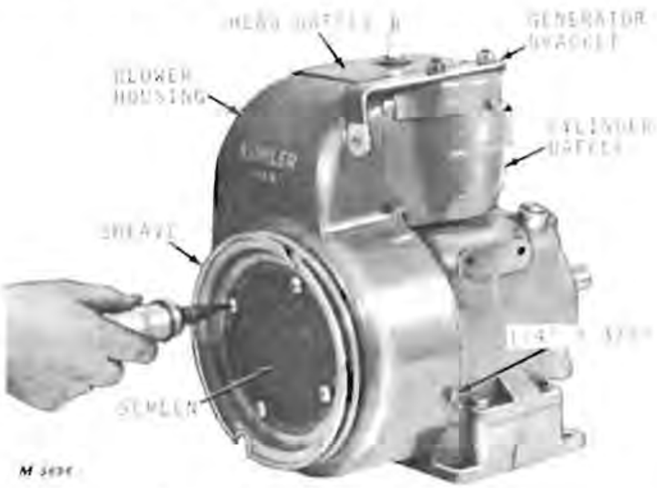


Fig. 42–Installing Engine Shrouding

Install blower housing, cylinder baffle, head baffle and motor generator bracket. Install sheave and screen to engine block. Tighten screw firmly.

Note position of 1/4 x 3/8-inch cap screw.

INSTALLING EXTERIOR COMPONENTS

Fig 43–Assembling Carburetor, Coil and Condenser

Install coil and condensor, Figure 43. 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 for proper carburetor and governor arm assembly. See adjustments and adjust accordingly.

SPECIFICATIONS

K161S K181S Kohler Engines

Component	New Part Dimension	Wear Tolerance
Crankshaft pin size	1.186 inch	0.0025 inch out of round Replace or grind crank pin
Piston pin diameter K161S-K181S	0.6247/0.6249 inch Standard	. . . .
Piston diameter top of skirt (just below oil ring groove) at 90° to piston pin bore		
K161S	2.8675/2.8685 inch	2.8625 inch
K181S	2.929 /2.930 inch	2.925 inch
Piston pin bore	0.625 /0.627 inch	0.632 inch
Cylinder bore K161S	2.875 inch	2.880 or 0.004 inch out of round
K181S	2.9375 inch	2.9425 or 0.004 inch out of round
Ring groove side clearance	0.002 /0.0035 inch	. . . .

TABLE OF CLEARANCES

Item	Clearances
Crankshaft end clearance	0.002/0.023 inch
Connecting rod-large end	0.001/0.002 inch
Connecting rod-large end side clearance	0.005/0.016 inch
Piston skirt clearance at thrust face	
Top of skirt	0.006/0.008 inch
Bottom of skirt	0.003/0.006 inch
Piston ring end gap	0.007/0.017 inch

TORQUES FOR HARDWARE

Location	Torque
Connecting rod cap screws	220-200 in-lbs See page 15-16
Flywheel nut	75 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 crank pin 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

Group 20

CAMSHAFT, TAPPETS AND GOVERNOR KOHLER ENGINE FOR 110 TRACTOR

GENERAL INFORMATION

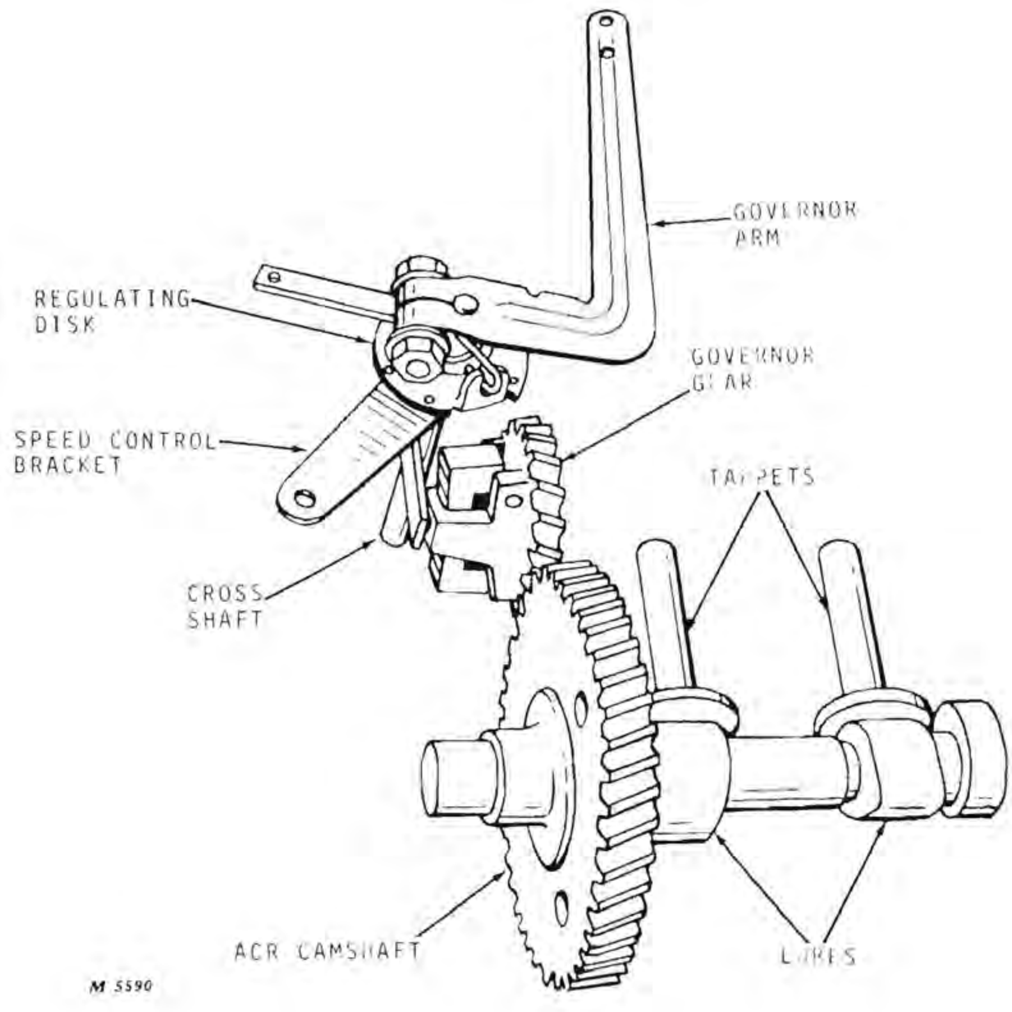


Fig. 1—Assembled View of Camshaft, Tappets and Governor

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

Spark advance and automatic compression release camshafts are covered in detail on the next page.

SPARK ADVANCE CAMSHAFT

Fig. 2–Spark Advance Camshaft

The K161 Engine used in 110 Tractors (-3550) and K181 Engine used in Tractors (3551-40000) have spark advance camshaft, Figure 2.

Weights on the camshaft gear actuate the breaker point cam, which in turn retards the ignition timing during the cranking cycle. As engine reaches 500-600 rpm, timing is advanced and engine operates in the standard manner at all higher speeds.

AUTOMATIC COMPRESSION RELEASE CAMSHAFT

Fig. 3–Automatic Compression Release Camshaft (ACR)

K181 Engines in 110 Tractors (40001-100,000) have the automatic compression release camshaft, Figure 3.

The ACR camshaft can be installed in engines on 110 Tractors (-40000). The necessary parts are provided in kit form. After installation, check valve clearance, page 10-11.

All short blocks are equipped with ACR camshafts.

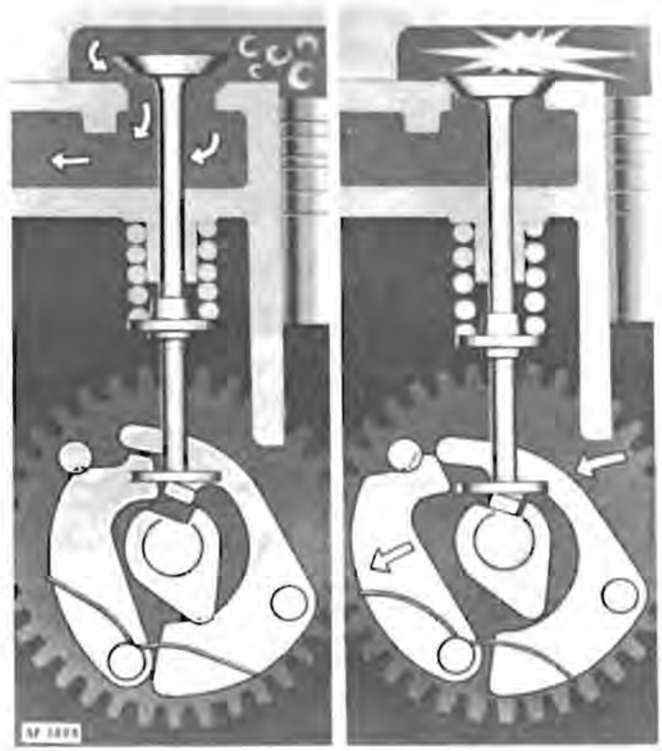


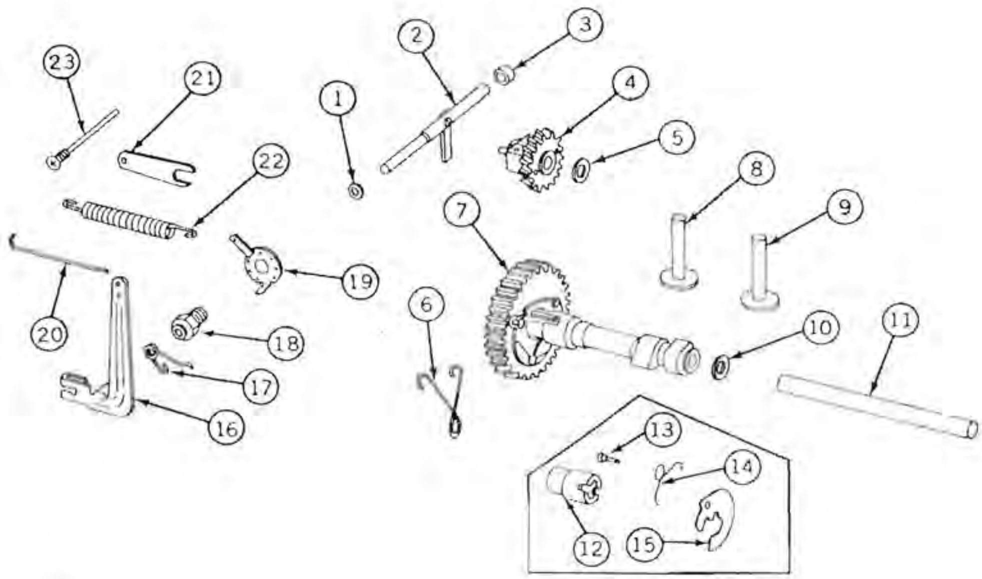
Fig. 4–ACR Operation

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 4. 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.

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

REPAIR



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1 – Governor Shaft Washer
2 – Governor Cross Shaft
3 – Needle Bearing
4 – Governor Gear
5 – Brass Washer
6 – Spring (ACR Camshaft)
7 – Camshaft (ACR)
8 – Exhaust Valve Tappet (2-1-32 Inch Overall Length)
    Spark Advance Camshaft (-40000)
    Exhaust Valve Tappet (2 Inch Length)
    ACR Camshafts (40001-100,000)
9 – Intake Valve Tappet (2-1/32 Inch Overall Length - Top of Stem Flat)
10 – Spacer (0.005 or 0.010 Inch As Required)
11 – Camshaft Pin
12 – Ignition Cam (Other Than ACR) (-40000)
13 – Flywheel Pin (Other Than ACR) (-40000)
14 – Spark Advance Spring (Other Than ACR) (-40000)
15 – Flyweight (Other Than ACR) (-40000)
16 – Governor Lever
17 – Governor Spring
18 – Governor Bushing
19 – Regulating Disc
20 – Governor Linkage
21 – Speed Control Bracket
22 – Linkage Spring
23 – Governor Stop Pin

Fig. 5–Exploded View of Camshaft and Governor

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.

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 6. Removing or installing pin incorrectly will damage engine block.

Lift out camshaft.

CAUTION: Watch for and save thin camshaft shim(s) when removing camshaft.

Fig. 6–Removing Camshaft Pin

Mark tappets before removing to be sure they are returned to same tappet hole. Lift tappets out.

REMOVING GOVERNOR

Loosen nut on governor arm 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 (23, Fig. 5) and copper washer. Governor assembly and cross shaft (2, Fig. 5) may now be removed.

INSPECTING CAMSHAFT

Wash governor and camshaft in 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.

NOTE: ACR camshafts are available for service only as a complete assembly except for the flyweight spring. Individual parts are available for spark advance camshafts.

INSPECTING GOVERNOR GEAR

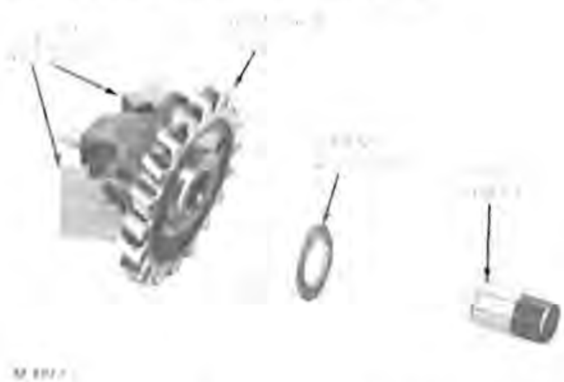


Fig 7–Governor Gear Assembly

The governor gear assembly 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 8. This is important. If arm is loose, install new cross shaft.

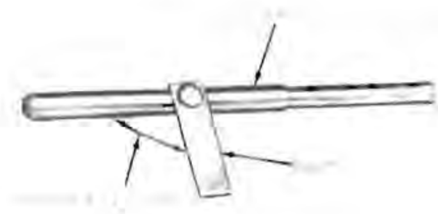


Fig. 8–Governor Cross Shaft

INSTALLATION

INSTALLING GOVERNOR

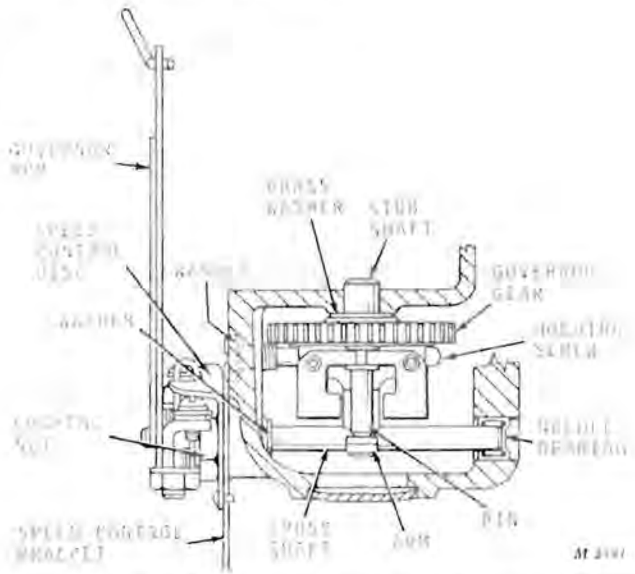


Fig. 9–Cross-Section of Governor Assembly

Place cylinder block on its side. Install cross shaft from inside of block. Place brass washer and governor gear assembly on stub shaft, Figure 9. Place washer on holding screw and turn in from outside of engine block.

Place washer and speed control disk on end of cross shaft. Thread bushing nut into block, clamping speed control bracket into place. Tighten nut lightly.

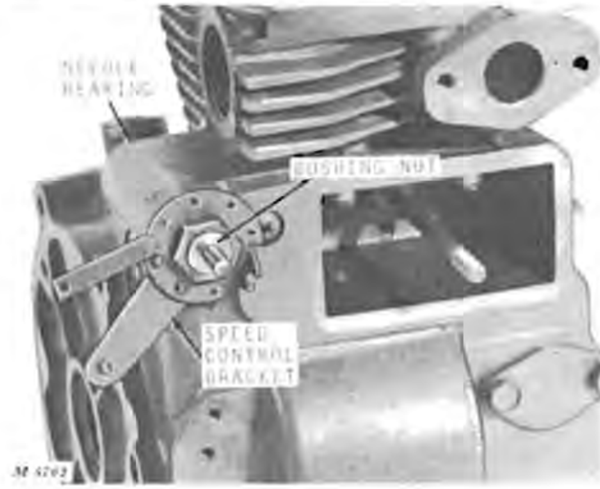


Fig. 10–External Governor Parts

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.

ASSEMBLING SPARK ADVANCE CAMSHAFT

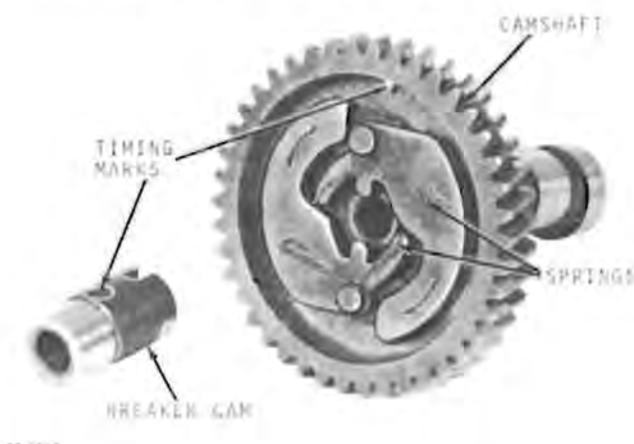


Fig. 11–Assembling Spark Advance Camshaft

Place tappets back in same holes from which they were removed.

Assemble spark advance camshaft by first loosening springs on flyweights and positioning cam as shown, Figure 11.

Fig. 12–Assembling Camshaft

Position breaker cam between flyweight lugs. *IMPORTANT: Breaker cam can be assembled 180° out of time. Be sure timing mark on cam is directly opposite protrusion on camshaft casting, Figure 12.*

Load camshaft springs after installing cam by sliding them into position behind flyweights, Figure 11.

The ACR camshaft requires no assembly.

INSTALLING CAMSHAFT

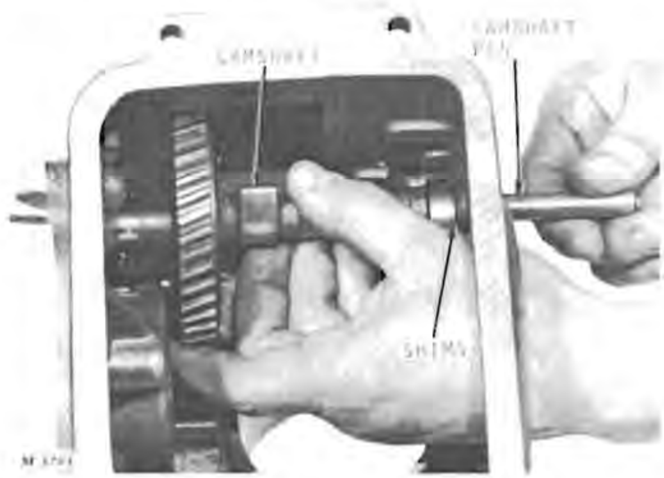


Fig. 13–Installing Camshaft

While holding camshaft assembly, 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).

ASSEMBLING CAMSHAFT—Continued

Use feeler gauge to check camshaft end clearance. See Specifications, page 20-8. 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.

INSTALLING GOVERNOR ARM

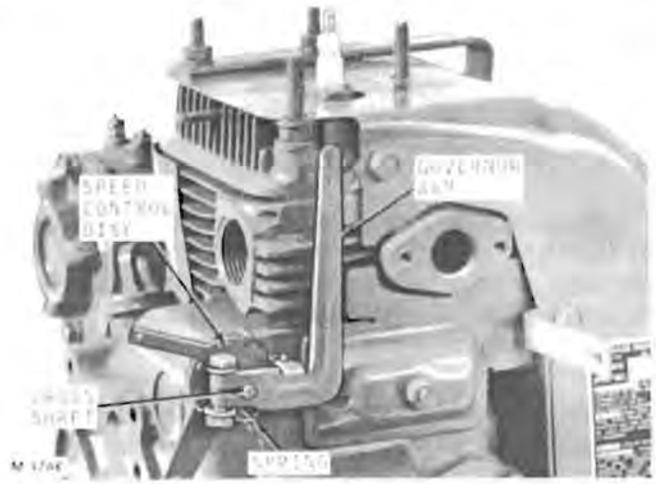


Fig. 11—Positioning Governor Arm

Turn block upright and slide governor arm, spring and bolt assembly on end of cross shaft. *Be sure spring is positioned into slot in speed control disk.*

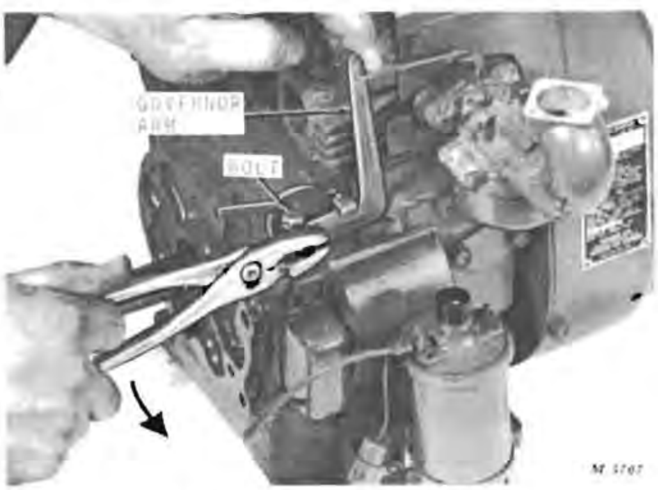


Fig 15—Adjusting Governor Arm

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 15. Move governor through its full arc of travel to be sure it operates loosely. Relieve pressure on bushing nut if too tight.

Refer to "Installation" on pages 10-9 and 15-13 to complete engine assembly.

CONNECTING GOVERNOR ARM TO CARBURETOR

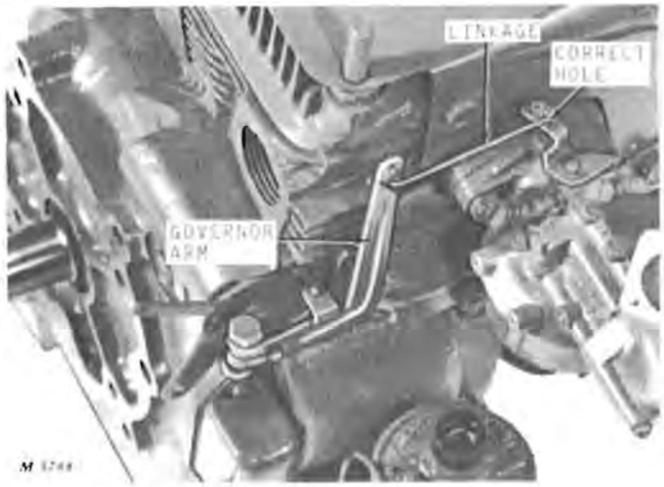


Fig. 16—Governor-to-Carburetor Linkage

Connect linkage between governor arm and carburetor in correct holes as indicated, Figure 16.

INSTALLING ENGINE IN TRACTOR

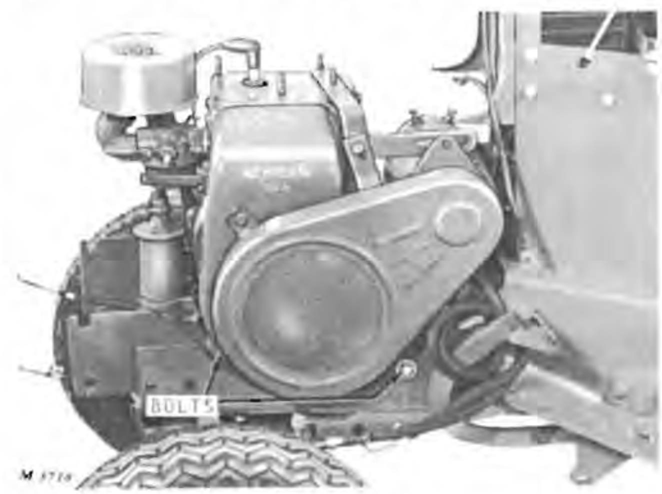


Fig. 17—Installing Engine

Position engine in tractor and attach engine base to same holes in tractor frame.

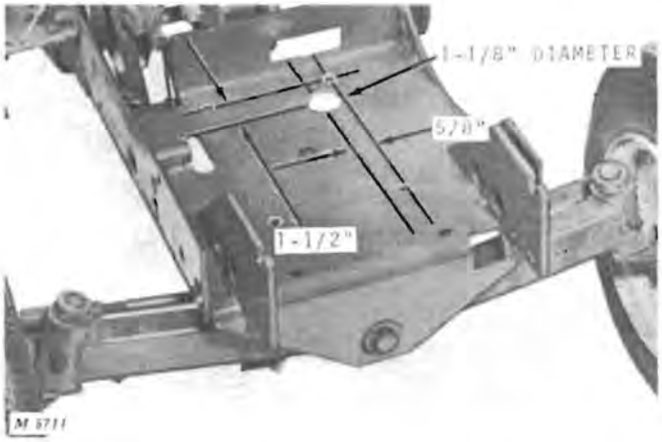


Fig. 18–Drilling Holes in Engine Base When Installing Service Engine on 110 Tractors (3551-15000)

When installing service engines with a bottom oil drain on older tractors, an extra hole must be drilled and enlarged. Locate hole from dimensions given in Figure 18.

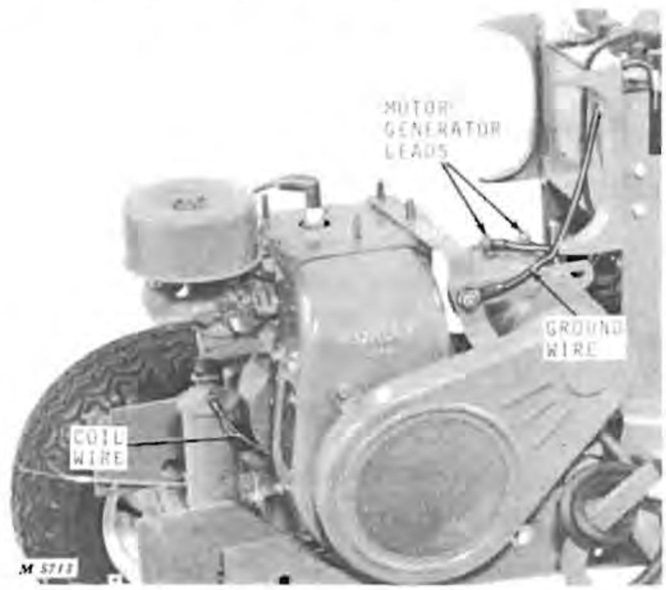


Fig. 19–Electrical Connections

Attach ground wire to bracket shown in Figure 19. Connect wires to coil and motor-generator. Refer to Section 40, Electrical System, for wiring diagram if necessary.

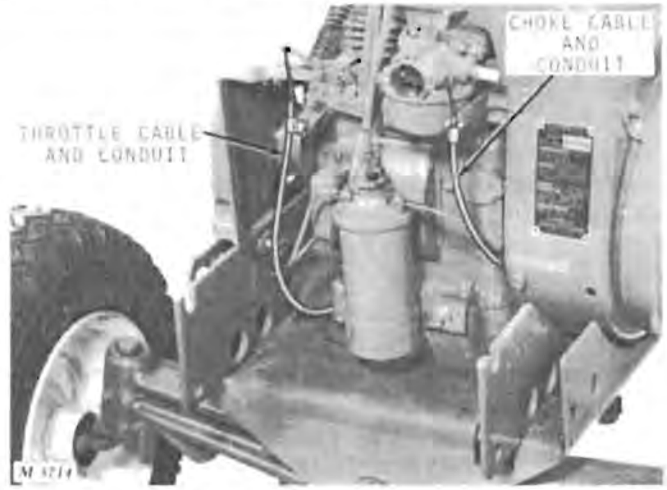


Fig 20–Installing Choke and Throttle Cables

Attach choke and throttle cables, Figure 20. Be sure choke is fully open when control lever on dash panel is down. Also make certain throttle cable synchronizes throttle control with carburetor control.

Adjust as necessary by loosening clamp on cable and positioning as required. Tighten clamp firmly.

Fig. 21–Installing Gas Tank

Install and tighten gas tank and bands, Figure 21.

ADJUSTMENT

GOVERNOR SPEED ADJUSTMENT

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 22, as required until maximum engine speed is 3800 rpm with all drives disengaged. Tighten bushing nut but AVOID EXCESSIVE PRESSURE. Governor arm must operate loosely.

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

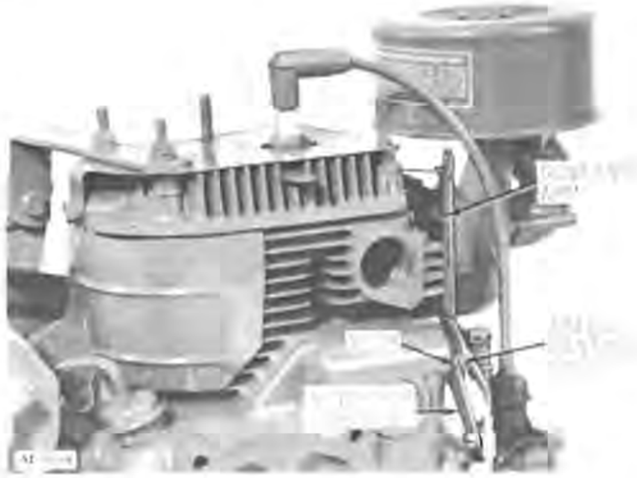


Fig. 22–Governor Speed Control

SPECIFICATIONS

K161S AND K181S KOHLER ENGINES

TABLE OF CLEARANCES

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

TORQUE FOR HARDWARE

Location	Torque
Miscellaneous hardware	Refer to torque chart, Section 10

TUNE-UP DATA

Item	Specifications
Camshaft end clearance	Shim as required

SPECIAL TOOLS

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

Group 25

GENERAL INFORMATION
TECUMSEH ENGINE FOR 112 TRACTOR

DESCRIPTION

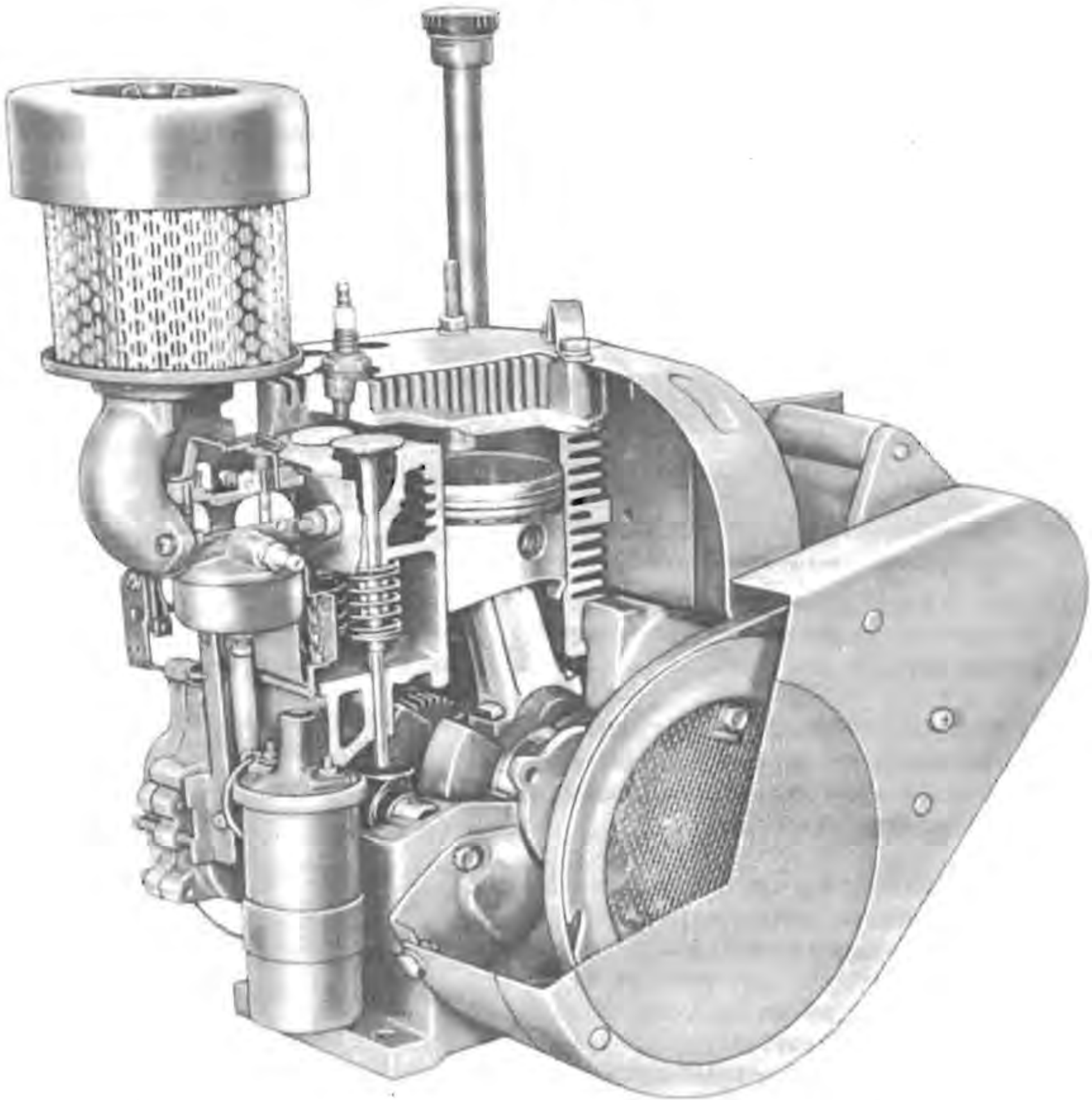


Fig. 1—Cutaway View of Tecumseh HH100 Engine Showing Piston, Valves and Tappets

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 flyweight governor.

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

ENGINE ANALYSIS

PRELIMINARY ENGINE CHECKS

A complete guide for diagnosing engine malfunctions appears on page 25-4. However, the majority of engine trouble reports are of a minor non-chronic nature and are usually due to electrical or fuel system difficulties. First make the checks listed below to isolate the majority of engine problems.

Fig. 2–Checking Spark at Plug

Check spark, Figure 2, whenever engine will not start. If engine will not crank, follow diagnosing procedure on page 25-4.

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 most likely is in the breaker points and condenser. Clean or replace points and adjust gap. If breaker points are burned, replace the condenser also.

If there is good spark between the adaptor and the grounded surface, the problem is in the fuel-air system. If gas tank is full, check shut-off valve on sediment bowl and gas lines to carburetor to be certain gas is getting to carburetor. Open carburetor valves as instructed in Section 30, Group 10. 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 25-4 to check for internal difficulties.

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 25-3.

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, loosing power or running erratically and when carburetion and ignition adjustments do not correct the condition.

COMPRESSION TEST

The HH100 Engines are equipped with an instamatic EZEE-start compression release camshaft. They will be referred to as "EZEE-start" in Section 20 of this service 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 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.

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 60 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 60 psi indicates leakage at the cylinder head gasket, piston rings or valves. *Engine should be reconditioned if compression falls below 60 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 engine is operating properly.

Connect water U-tube manometer to oil filler hole in cylinder block, Figure 4. Tester must hang vertical as shown. Start and run engine at 1200-1700 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.

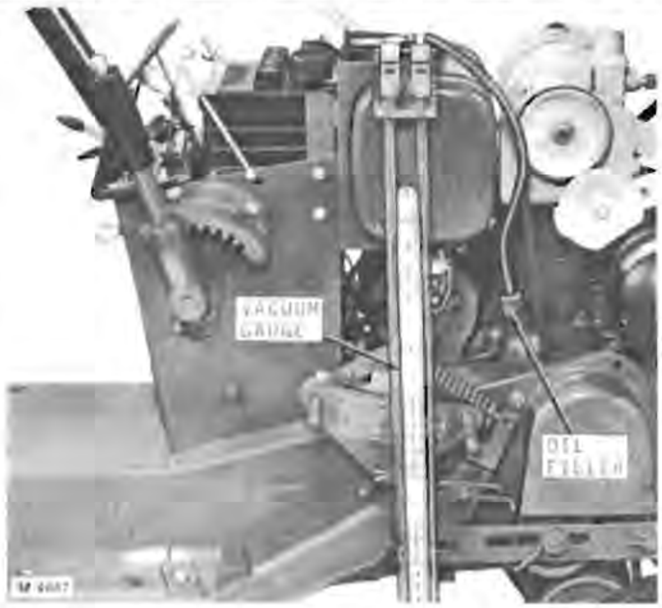


Fig. 4–Checking Crankcase Vacuum

Test Conclusions

Proper crankcase vacuum for the HH100 Engine is 7 inches to 12 inches water column.

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

ENGINE

Engine Will Not Crank

Transaxle not in neutral.
Place shift lever in neutral position.

Battery discharged or defective.
Check battery condition.
Replace battery if necessary.

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

PTO drive engaged.
Disengage clutch.

Defective safety switch(es).
Replace switch(es).

Loose motor-generator belt.
Adjust belt tension.

Broken motor-generator sheave.
Replace motor-generator sheave.

Defective solenoid.
Replace solenoid.

Loose electrical connections.
Tighten connections firmly.

Motor-generator malfunction.
Check condition of motor-generator.
Repair or replace if necessary.

Engine seized.
Check engine condition.

Engine Cranks But Will Not Start

Empty fuel tank.
Fill fuel tank.

Restricted fuel tank vent.
Replace cap or cap gauge assembly.

Fuel shut-off valve closed (valve below fuel tank).
Open shut-off.

Clogged, restricted or air lock in fuel line.
Clean and bleed line.
Replace line if necessary.

Breaker points worn or pitted.
Check condition.
Replace if necessary.

Spark plug fouled or pitted.
Check condition of plug.
Clean and regap.
Replace if necessary.

Incorrect spark plug.
Install proper spark plug.

Battery not fully charged.
Charge battery and check condition.
Replace battery if necessary.

Loose electrical connections.
Tighten connections firmly.

Wire leads not properly connected.
Connect wire leads to their respective terminal.

High speed and idle mixture needles not properly adjusted.
Adjust carburetor.

Faulty condenser.
Replace condenser.

Defective ignition coil.
Replace coil.

Dirt in fuel system.
Remove fuel system and clean dirt and water from system.
Install new gaskets.
Install carburetor kit if necessary.

Frayed wire(s) causing ground(s).
Repair wire(s), replace if necessary.

Valve(s) open (stem sticking in guide).
Free valve.
Clean guide and valve stem if necessary.

Engine Starts Hard

Spark plug pitted or fouled.
Check condition of plug.
Clean and regap.
Replace if necessary.

Breaker points worn, pitted or out of adjustment.
Check breaker points condition.
Clean and regap.
Replace breaker points if necessary.

High tension wire shorted.
Replace wire.

High tension wire loose at spark plug or coil.
Check spark plug connection and install wire properly in coil.

Loose electrical connections.
Check connections and tighten leads firmly.

Restricted fuel tank vent.
Replace filler cap or cap gauge assembly.

Clogged fuel line or air lock.
Clean and bleed line.
Replace line if necessary.

Broken choke cable.
Replace and adjust cable properly.

Throttle cable not properly adjusted.
Check cable at control and governor assembly and adjust properly.

Dirt or water in fuel system.
Remove fuel system and clean dirt and water from system.
Install new gaskets.
Install carburetor kit if necessary.

High speed and idle mixture needles not properly adjusted.
Adjust needles properly.

Wrong valve clearance.
Check and adjust valve clearance.

Bad head gasket.
Replace gasket and torque cylinder head properly.

Restricted exhaust system.
Check exhaust system condition.
Replace muffler if necessary.

Low compression.
Check compression and service engine accordingly.

Valve(s) open (stem sticking in guide).
Free valve.
Clean valve stem and guide if necessary.

Engine Starts But Fails to Keep Running

Restricted fuel tank vent.
Replace fuel cap or cap gauge assembly.

High speed and idle mixture needles not properly adjusted.
Adjust needles properly.

Broken choke cable.
Replace and adjust cable properly.

Dirt or water in fuel system.
Remove fuel system and clean dirt and water from system.
Install new gaskets.
Install carburetor kit if necessary.

Carburetor float not properly adjusted or leaky float.
Check float condition, adjust float.
Install new float and adjust if necessary.

High tension wire loose at spark plug or coil.
Check spark plug connection and install wire properly in coil.

High tension wire shorted.
Replace wire.

Breaker points not properly adjusted.
Clean and regap.
Replace breaker points if necessary.

Loose connections.
Check and tighten wires properly.

Defective head gasket.
Replace head gasket and torque cylinder head properly.

Faulty condenser.
Check condenser.
Replace if necessary.

Excessive engine load (lugging engine).
Reduce engine load.

Engine Runs But Misses

High tension wire loose from spark plug or coil.
Check spark plug connection and install wire properly in coil.

Engine Runs But Misses—Continued

Breaker points out of adjustment or worn and pitted.
Clean and adjust.
Replace points if necessary.

Spark plug fouled or pitted, incorrect gap.
Clean and regap plug.
Replace plug if necessary.

Incorrect spark plug.
Install proper plug.

Loose electrical connections.
Tighten connections.

Carburetor float not properly adjusted or hole in float.
Check condition of float.
Adjust float to proper position.
Replace leaky float.

Dirt or water in fuel system.
Remove fuel system and clean dirt and water from system.
Install new gaskets.
Install carburetor kit if necessary.

Wrong valve clearance.
Check valve clearance and valve condition.
Repair valve as necessary.

Faulty coil.
Check coil condition.
Replace coil if necessary.

Engine Misses Under Load

High speed and idle mixture needles not properly adjusted.
Adjust needles.

Spark plug fouled or pitted, incorrect gap.
Check spark plug condition.
Clean and regap.
Replace spark plug if necessary.

Incorrect spark plug.
Install proper spark plug.

Breaker points out of adjustment or worn and pitted.
Clean and adjust.
Replace points if necessary.

Ignition out of time.
Set engine timing.

Dirt or water in fuel system.
Remove fuel system and clean dirt and water from system.
Install new gaskets.
Install carburetor kit if necessary.

Old fuel.
Drain system and fill fuel tank with fresh fuel.

Linkage misaligned (throttle arm to governor arm).
Straighten linkage to prevent binding.

Engine Will Not Idle

Idle speed too low.
Adjust idle screw.

High speed and idle mixture needles not properly adjusted.
Adjust needles properly.

Dirt or water in fuel system.
Remove fuel system and clean dirt and water from system.
Install new gaskets.
Install carburetor kit if necessary.

Restricted fuel tank.
Replace filler cap or cap gauge assembly.

Spark plug fouled or pitted, incorrect gap.
Check spark plug condition.
Clean and regap.
Replace spark plug if necessary.

Wrong valve clearance.
Check valve clearance and valve condition.
Service valve(s) as necessary.

Low engine compression.
Check compression.

Engine Misses When Advancing Throttle

Cold engine.
Choke engine before advancing throttle.

High speed and idle mixture needles not properly adjusted.
Adjust needles.

Spark plug fouled or pitted, incorrect gap.
Check spark plug condition.
Clean and regap.
Replace spark plug if necessary.

Linkage misaligned (throttle arm to governor).
Straighten linkage to prevent binding.

Engine Looses Power

Crankcase low on oil.
Fill crankcase to proper level.
Change oil if tractor has been operated 8 hours since last oil change.

Engine shrouding plugged.
Remove shrouding and clean engine fins and inside of shrouding.

Excessive engine load.
Reduce engine load by shifting transmission in lower gear and/or by moving variable speed control lever back.

Restricted air filter.
Clean and check air filter element condition.
Replace filter if necessary.

Dirt or water in fuel system.
Remove fuel system and clean dirt and water from system.
Install new gaskets.
Install carburetor kit if necessary.

High speed and idle mixture needles not properly adjusted.
Adjust needles properly.

Spark plug fouled or pitted, incorrect gap.
Check spark plug condition.
Clean and regap.
Replace spark plug if necessary.

Too much oil in crankcase.
Drain oil and refill crankcase with proper amount of crankcase lubricant.

Low engine compression.
Check compression.
Repair and replace parts as necessary.
Torque head bolts.

Worn cylinder bore.
Check cylinder condition.
Repair as necessary.

Engine Overheats

Dirty or plugged shrouding and engine fins.
Remove shrouding and clean engine fins and shrouding.

High speed and idle mixture needles not properly adjusted.
Adjust needles properly.

Too much oil in crankcase.
Drain oil and fill crankcase with proper amount of crankcase lubricant.

Worn valve stem and/or guides.
Check condition of valve stems and guides.
Replace valves and guides if necessary.

Crankcase low on oil.
Fill crankcase to proper level.
Change oil if tractor has been operated 8 hours since last oil change.

Excessive engine load.
Reduce work load by shifting transmission in lower gear and/or by moving variable-speed control lever back.

Faulty breather causing low crankcase vacuum.
Clean breather assembly.
Replace parts as necessary.

Engine Knocks

Engine out of time.
Time ignition.

Old fuel.
Drain fuel tank and refill with good grade of regular gasoline.

Excessive engine load.
Reduce engine load by shifting transmission in lower gear and/or by moving variable-speed control lever back.

Engine Knocks—Continued

Crankcase low on oil.
Fill crankcase to proper level.
Change oil if tractor has been operated 8 hours since last oil change.

Engine Backfires

High speed and idle mixture needles not properly adjusted.
Adjust needles properly.

Loose cylinder head or blown head gasket.
Torque head bolts.
Replace head gasket if necessary.

Intake valve sticking in guide.
Free valve stem in guide.

Ignition out of time.
Set engine timing.

Engine Low on Power at High Speed

Restricted air filter.
Clean and check air filter element condition.
Replace filter if necessary.

Spark plug fouled or pitted, incorrect gap.
Check spark plug condition.
Clean and regap.
Replace spark plug if necessary.

Incorrect spark plug.
Install correct plug.

Restricted exhaust.
Repair and clean muffler.
Replace muffler if necessary.

Breaker points out of adjustment, worn and pitted.
Clean and adjust.
Replace points if necessary.

Clogged fuel line or air lock.
Clean and bleed air from fuel line.
Replace fuel line if necessary.

Broken choke cable.
Replace cable and adjust choke valve to correspond with control on panel.

Clogged breather assembly.
Clean breather assembly.
Install new parts as necessary.

Defective ignition coil.
Check coil.
Replace coil if necessary.

Engine Does Not Maintain Constant Speed (surges)

High speed and idle mixture needles not properly adjusted.
Adjust needles properly.

Spark plug gap incorrect.
Check spark plug condition.
Clean and regap spark plug.
Install new spark plug if necessary.

Throttle to governor linkage not properly assembled.
Assemble linkage correctly.

Breaker points out of adjustment, worn or pitted.
Clean and adjust.
Replace points if necessary.

Dirt or water in fuel system.
Remove fuel system and clean dirt and water from system.
Install new gaskets.
Install carburetor kit if necessary.

Engine Uses Excessive Amount of Oil

Clogged breather assembly.
Clean breather assembly.
Replace parts as necessary.

Breather not assembled properly.
Assemble breather properly.

Worn or broken piston rings.
Install new rings.

Worn cylinder bore.
Recondition cylinder.
Replace parts as necessary.

Clogged oil holes in piston.
Clean piston and check piston condition.
Install new parts as necessary.

Wrong size piston rings.
Install proper rings.

Worn valve stems and/or valve guides.
Check condition of valve stems and guides.
Replace valves and guides if necessary.

Incorrect oil viscosity.
Drain crankcase and fill with crankcase oil of proper viscosity.

Faulty breather causing low crankcase vacuum.
Check crankcase vacuum.
Replace parts as necessary.

Engine Runs Erratic

Dirt or water in fuel system.
Remove fuel system and clean dirt and water from system.
Install new gaskets.
Install new carburetor kit if necessary.

High speed and idle mixture needles not properly adjusted.
Adjust needles properly.

Idle speed too low.
Turn idle screw until proper idle rpm is obtained.

Spark plug fouled or pitted, incorrect gap.
Check spark plug condition.
Clean and regap.
Replace spark plug if necessary.

Poor compression.
Check compression.
Repair and replace parts as necessary.

Faulty breather causing low crankcase vacuum.
Check crankcase vacuum.
Replace parts as necessary.

Carburetor leaking at gaskets or at connection.
Install new gasket(s) and/or tighten connection.

Restricted fuel tank vent.
Replace filler cap or cap gauge assembly.

Throttle to governor linkage misassembled.
Assemble and adjust linkage properly.

Gasoline in Crankcase

Carburetor float not properly adjusted or leaking.
Check condition of float.
Adjust or replace float if necessary.

Faulty float valve or seat.
Check condition of needle and seat.
Install carburetor kit if necessary. See John Deere Lawn and Garden Service Bulletin No. 67-3.

Group 30

CYLINDER HEAD, VALVES AND BREATHER TECUMSEH ENGINE FOR 112 TRACTOR

GENERAL INFORMATION

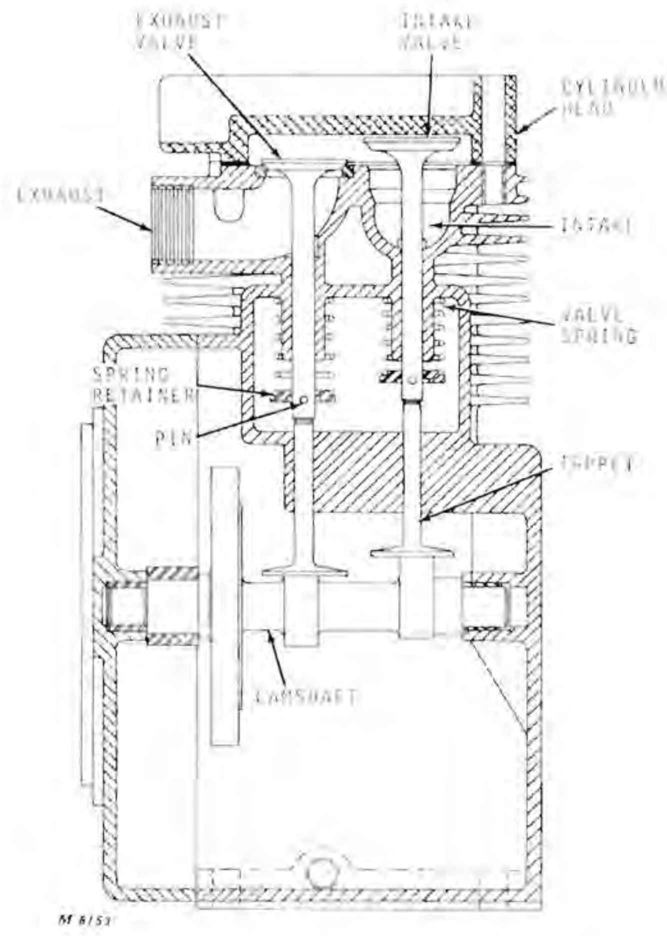


Fig. 1—Schematic View of Valves and Tappets

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 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 consist mostly of lead and some metal which comes from the lubricating oil. It is caused by a small amount of leakage of exhaust gases back 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 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 before it has had a chance to warm up.

Valve corrosion can also occur during storage when the engine has not been run 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 causes 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. 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 disfiguration 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 can also be caused by improper spark plug or overheated spark plugs which cause pre-ignition or a lean fuel mixture.

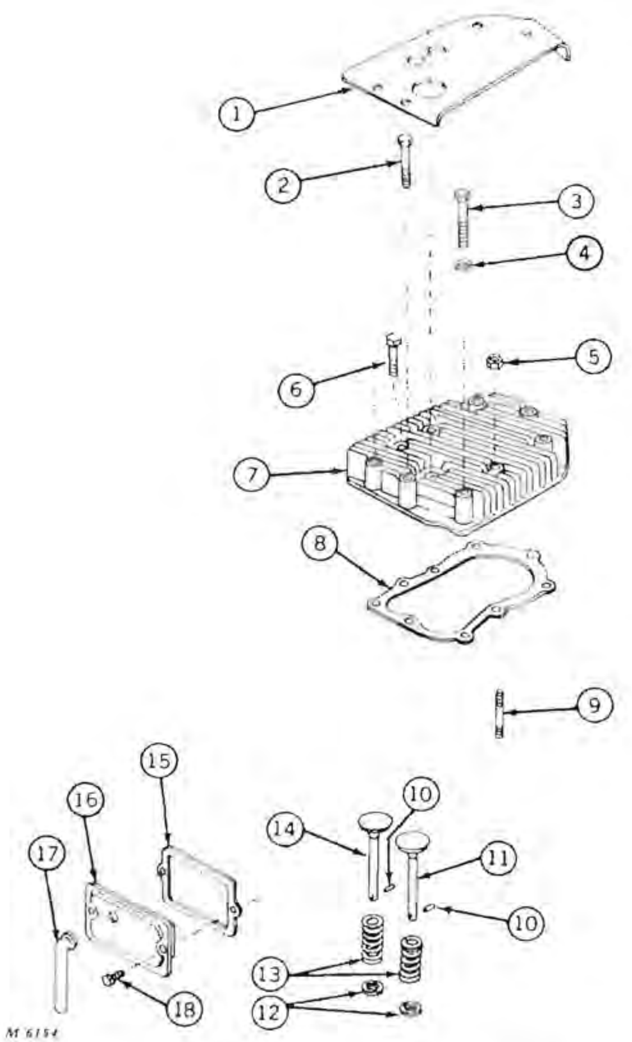
Fig. 5—Gummy Valve Causing Valve to Stick

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 gasoline from all fuel lines and carburetor before storing tractor.

REPAIR



1 – Cylinder Head Cover
2 – 5/16" x 2" Cap Screw
3 – 5/16" x 2-1/4" Cap Screw
4 – Washer (7 used)
5 – Hex. Nut (6 used)
6 – 5/16" x 1-3/8" 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)

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 throttle and choke conduit and cable end at carburetor and control arm. Remove carburetor, control arm and breather assembly, head baffle, cylinder head and head gasket.

REMOVING VALVES

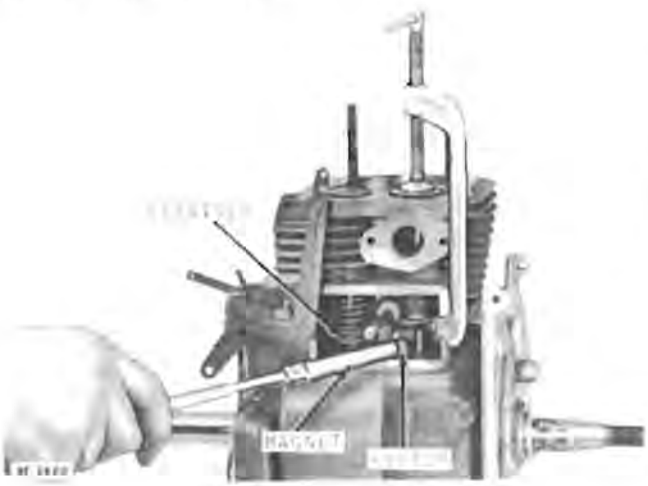


Fig. 7–Removing Valves

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

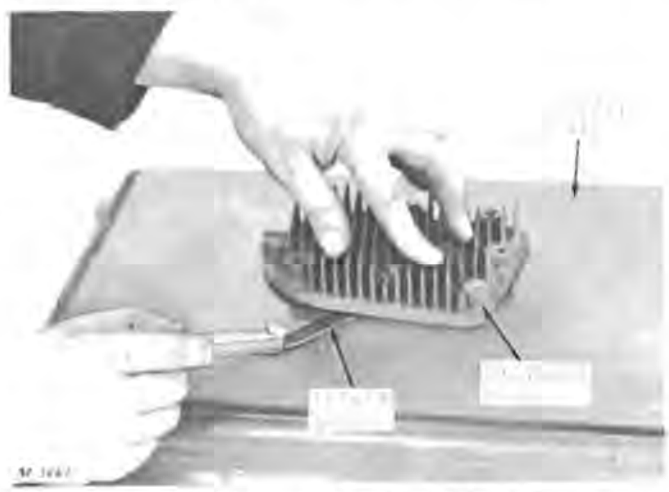


Fig. 9–Checking Cylinder Head Surface

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: Always use new head gasket after removing cylinder head.

INSPECTING BREATHER

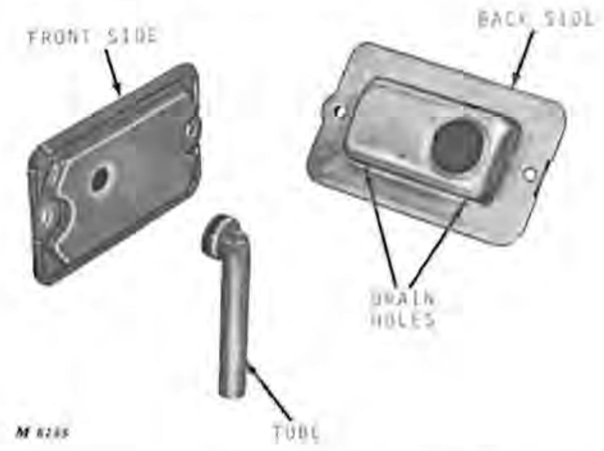


Fig. 10–Cleaning Breather Filter

The breather is a sealed assembly. Do not immerse assembly in cleaning solvent. Carefully wipe outsides of assembly with a clean cloth. After wiping, remove breather tube 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 not clogged.

TESTING VALVE SPRINGS

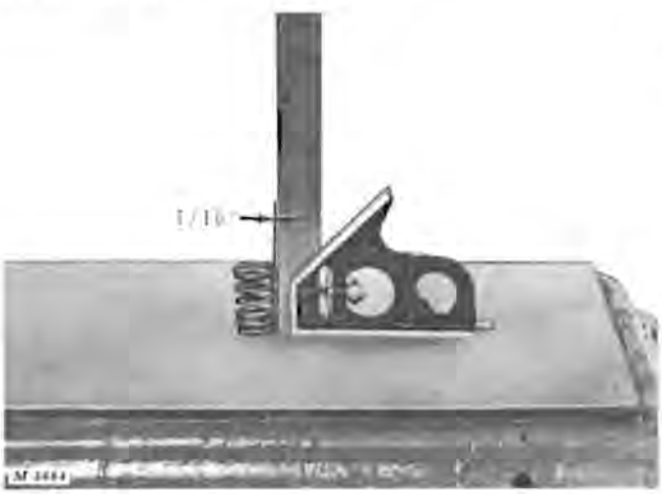


Fig. 11–Valve Spring Squareness

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 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.

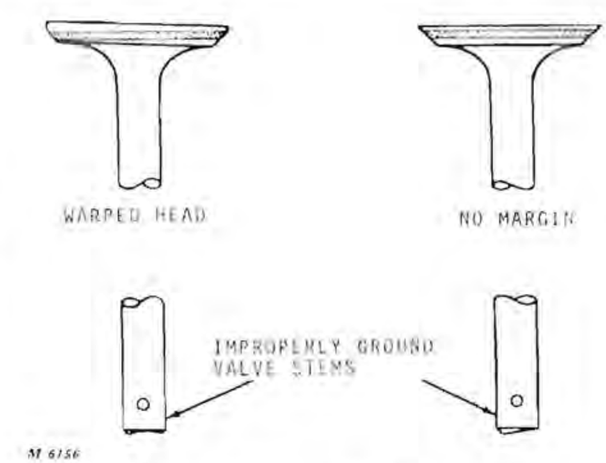


Fig. 13–Faulty Valves

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

INSPECTING VALVES—Continued

face or stem. Replace valves with 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.

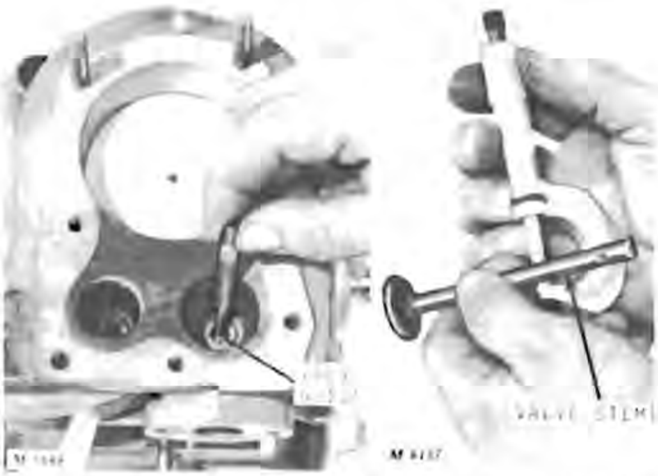


Fig. 14–Measuring Valve Guide *Fig. 15–Measuring Valve Stem*

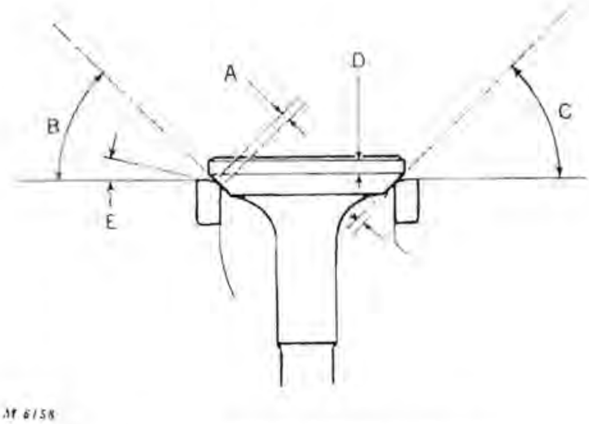
Use valve guide cleaner to clean inside of valve guide. Then measure I.D. of valve guide, Figure 14, and O.D. of valve stem, Figure 15. Refer to "Specifications," page 30-11, for tolerances. Ream guides as necessary.

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.

The valve seating surface "A," Figure 16, should be held as close to 3/64 inch as possible. Seats with more than 1/16-inch seating surface should be narrowed (cut back) with a 31° 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 (31°)

Fig. 16–Valve Seat and Surface Dimensions

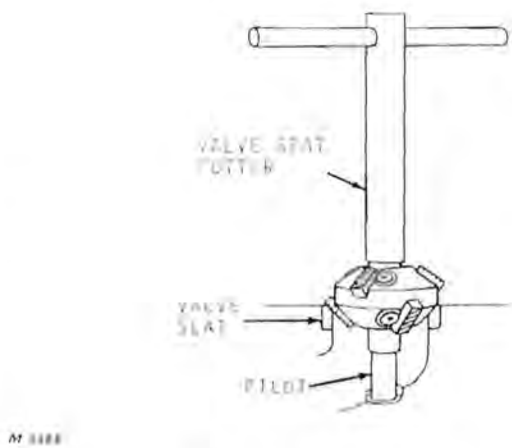


Fig. 17–Valve Seat Cutter

This valve seat cutter will cut a 46° valve seat and narrow the seat to 31°. 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.

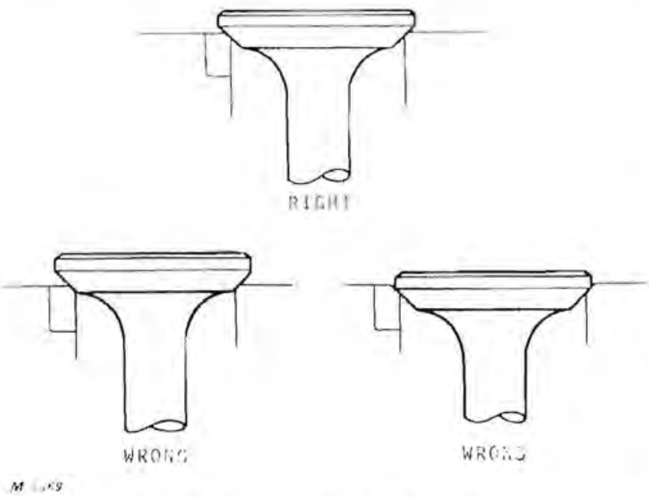


Fig. 18–Valve and Seat Relationship

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

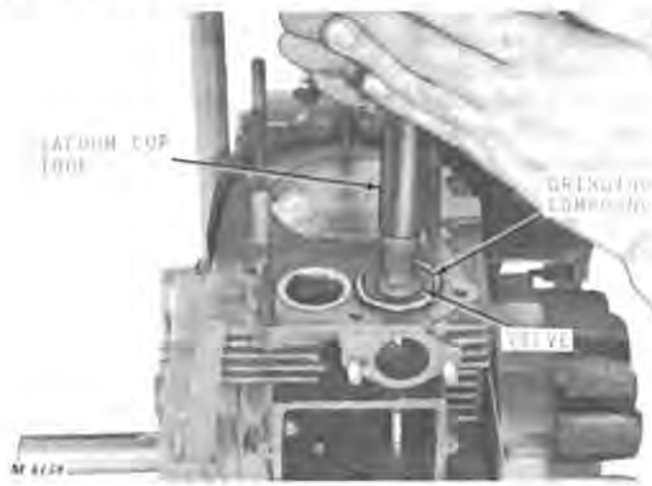


Fig. 19–Lapping Valves

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 an oscillating 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.

REAMING VALVE GUIDES

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

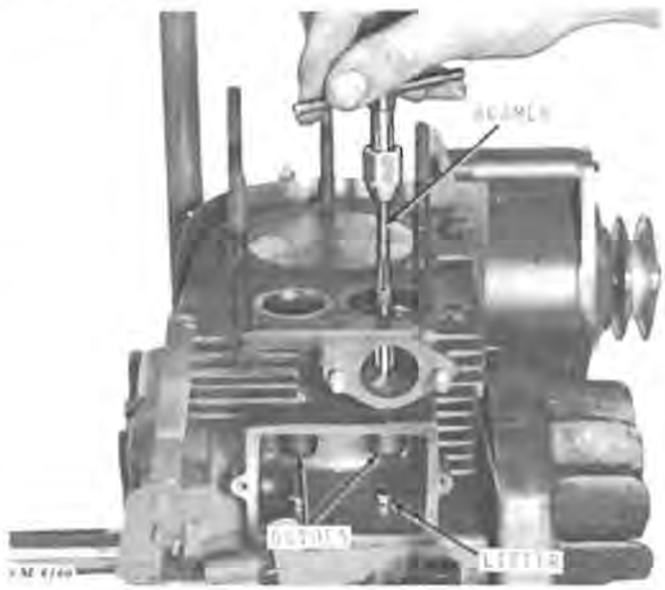
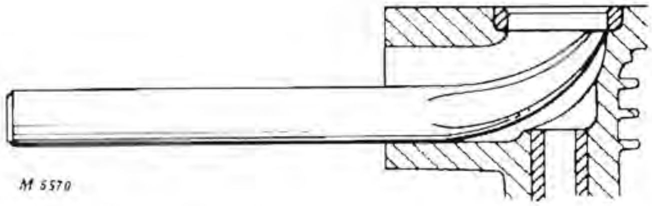


Fig. 20–Reaming Valve Guides

Use an adjustable reamer, Figure 20, when enlarging valve guides to oversize 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.

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

REMOVING AND INSTALLING EXHAUST VALVE SEAT INSERT



M 5570

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

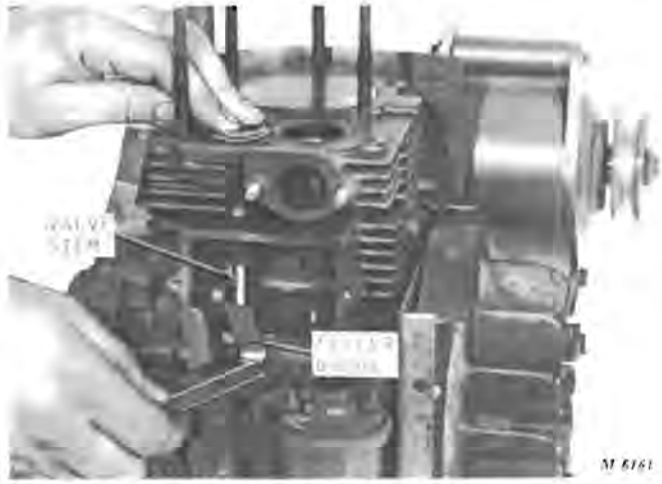


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Fig. 22–Checking Valve Clearance

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. If breaker points are properly adjusted, they will be open at this time. It is important that this procedure be followed to insure that the exhaust lifter is NOT riding on the EZEE-start mechanism.

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

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

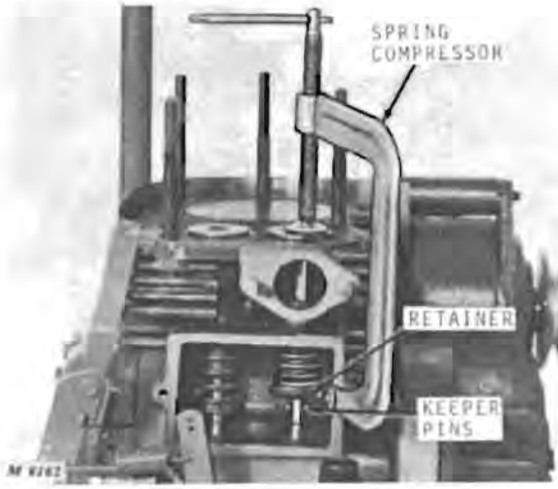


Fig. 23–Installing Valve Springs, Retainers and Keeper Pins

Place valve spring and retainer in valve spring chamber. 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 keeper pins in hole of stem, Figure 23.

INSTALLING BREATHER

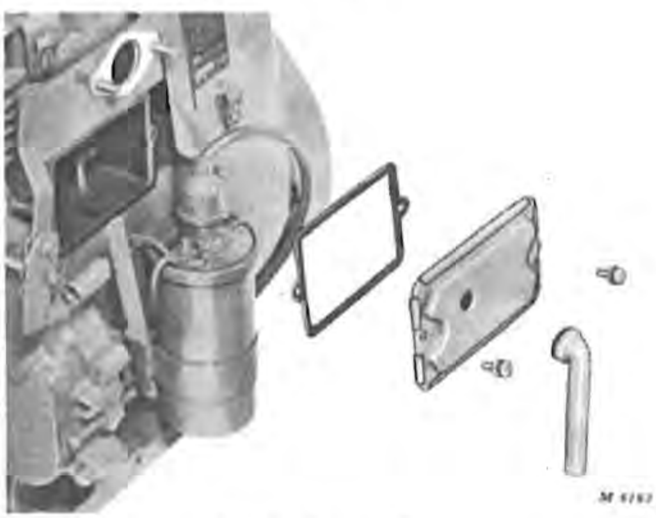


Fig. 24–Breather Parts

Install rubber breather tube on breather assembly. 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 head has been removed for service. This will assure a gas tight fit.

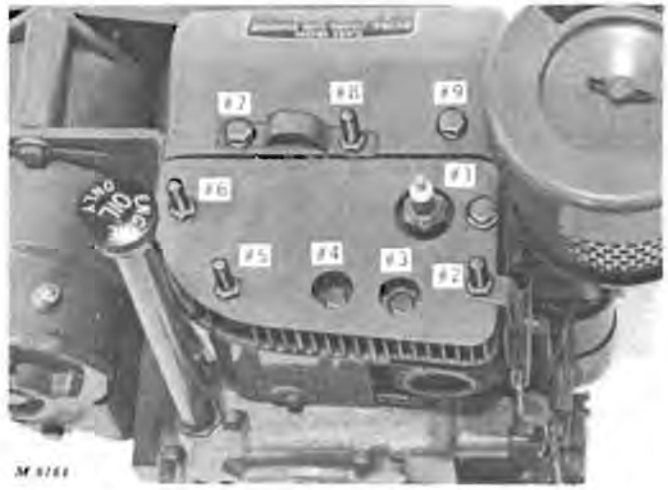


Fig. 25–Cylinder Head Bolt Tightening Sequence

It is important to tighten all cylinder head bolts with an even pressure and in their correct order, Figure 25, so that uneven stresses will not set up in cylinder wall. Refer to "Specifications," page 30-11, for proper cylinder head bolt torque.

INSTALLING CARBURETOR

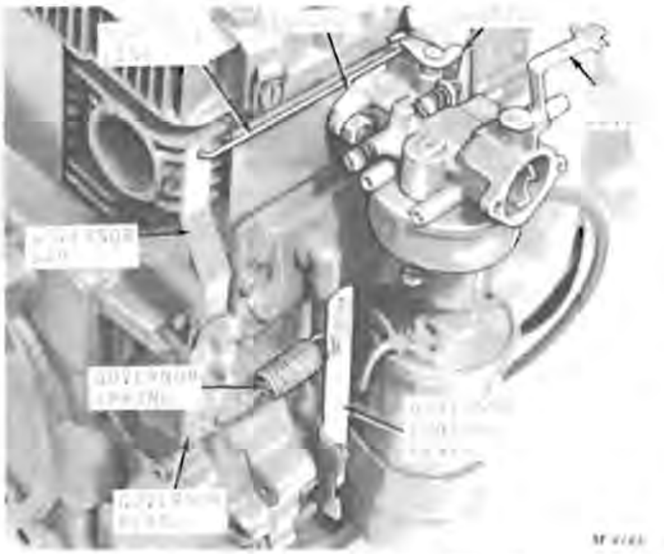


Fig. 26—Carburetor Assembly (Air Filter Base Removed for Clarity)

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 HYDRAULIC LIFT ASSEMBLY

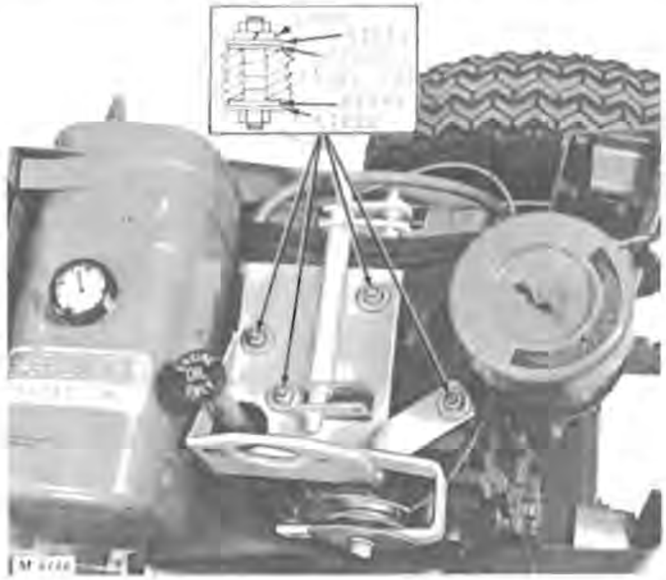


Fig. 27—Hydraulic Lift Assembly

For tractors equipped with hydraulic lift system, install mounting bracket assembly, pump assembly, drive sheave and drive belt. Be sure all washers are positioned as shown, Figure 27. Refer to Section 60, if necessary, to complete the hydraulic assembly.

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.

ADJUSTMENTS

HYDRAULIC BELT TENSION

Refer to Section 60, Group 15, for proper belt tension.

HYDRAULIC LIFT LEVER

Refer to Section 60, Group 10, to adjust lever for uniform travel in both directions.

SPARK PLUG GAP

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

BREAKER POINT GAP

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

SPECIFICATIONS

HH100 TECUMSEH ENGINE

Item	New Part Dimension	Wear Tolerance
Valve guides, STD dia.	0.312 to 0.313 inch	. . .
Valve guides, oversize dimension	0.343 to 0.344 inch	. . .
Valve seat width	0.042 to 0.052 inch	. . .
Valve face width	0.089 to 0.099 inch	0.083 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	0.309-0.310 inch	. . .
Exhaust, standard	0.308-0.309 inch	. . .
Intake, oversize	0.340-0.341 inch	. . .
Exhaust, oversize	0.340-0.341 inch	. . .
Cylinder head flatness	Contact at all points	Replace warped head

TABLE OF ENGINE CLEARANCES

Item	Clearance
Valve clearance (both) cold	0.010 inch

TORQUE FOR HARDWARE

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

TUNE-UP DATA

Item	Specifications
Engine compression	60-100 psi
Spark plug gap	0.030 inch
Valve face angle	45°
Valve seat angle	46°
Crankcase vacuum U-tube manometer	7-12 inches water column

SPECIAL TOOLS

Name	Part No.	Use
K.O. Lee R95	Extractor	To remove exhaust valve seat insert.
STURTEVANT Model SPT	Valve Spring Tester	To check valve spring compressed tension.
QUICK SET 43	Adjustable Reamers	To ream valve guides.
B-K 1896	Valve Grinding Compound	To lap valve seat and valve face.
SNAP-ON CF19	Valve Lifter	To compress valve springs.
DWYER Model 1211-24	U-Tube Manometer	Check crankcase vacuum.
NEWAY NO. 102 W Kit Neway Sales, Inc. Corunna, Michigan	Valve Seat Cutter Kit for Tecumseh Engines	Recondition valve seat.

Group 35

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

GENERAL INFORMATION

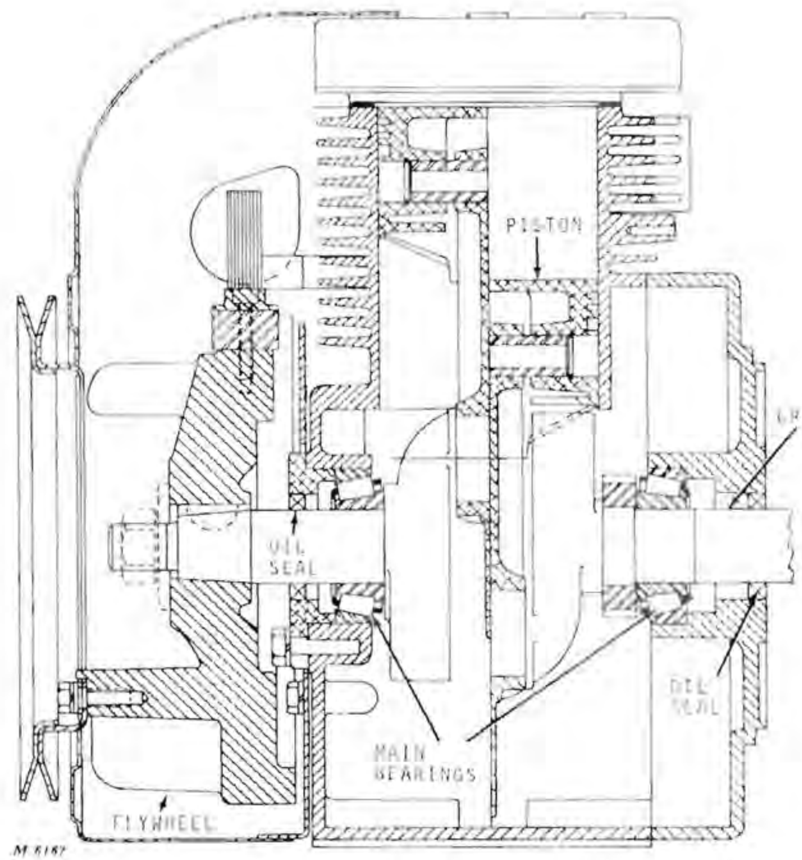
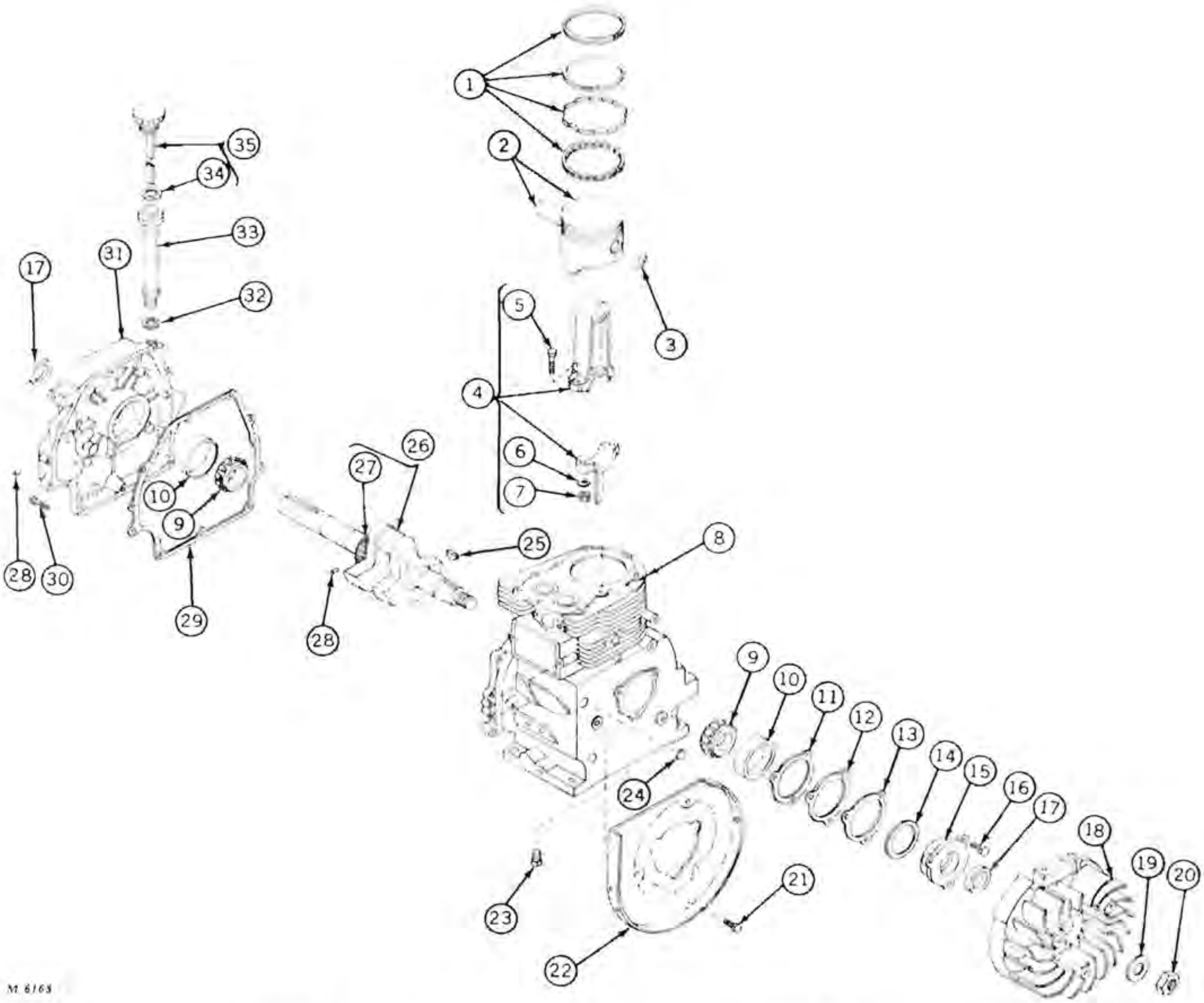


Fig. 1—Cutaway View of Tecumseh HH100 Engine

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 – Cylinder Cover
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 tractor hood by spreading hood only far enough to remove one pin at a time. *NOTE: Too much deflection could cause the hood to crack.*

3. Remove front grille.

4. Shut off gas at sediment bowl and remove gas tank.

5. Disconnect ground wire on engine and coil wire. *NOTE: Coil and condenser comes off with the engine.*

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

7. Remove hydraulic system above cylinder head 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, motor-generator, coil, condenser, carburetor, dipstick 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

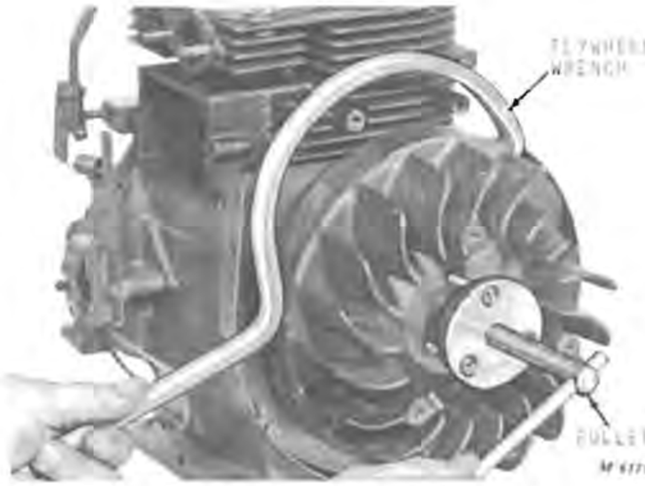


Fig. 4–Flywheel Puller

Break flywheel nut loose with a shock tool or use 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

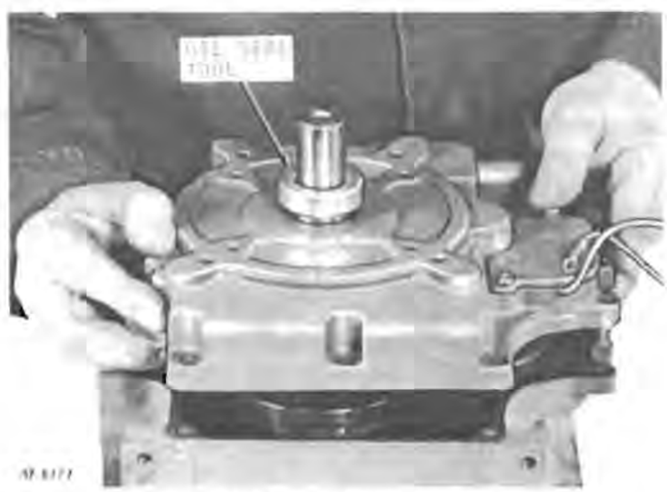


Fig. 5–Cylinder Cover Removal

Remove cylinder housing baffle. 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, 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. **CAUTION: Tighten vise only tight enough to hold the assembly. Too much pressure will bend 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

PISTON RING ANALYSIS

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 ring and 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.

M 5579

Fig. 9–Piston Rings with Incorrect End Gap

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

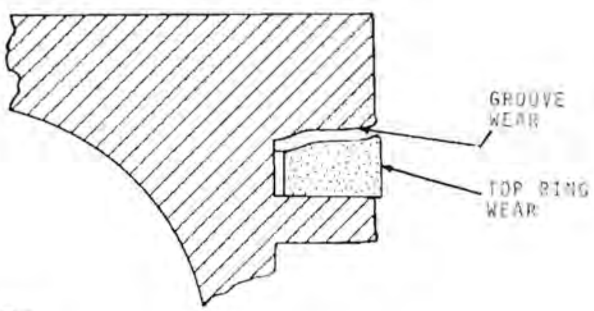


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Fig. 10–Top Ring and Groove Side Wear

Check wear of ring grooves carefully, 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.

M 5581

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. When this happens, excessive oil consumption and blow-by will occur.

Engine heating and ring sticking are most often caused by:

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

Fig. 12–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 because the life of a new set of rings will be short otherwise.

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.

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

Rails of the oil ring are worn down to the steel expander spacer and the oil ring surface is worn flat. 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.

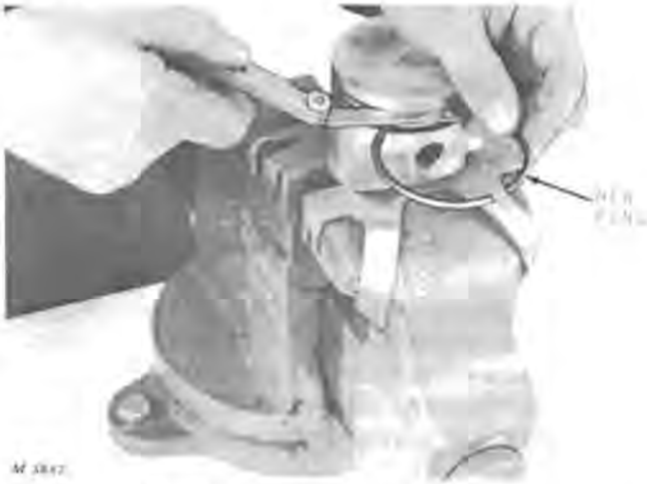


Fig. 15–Measuring Ring Clearance

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 micrometer. 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.

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 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 and 0.020 inch sizes for service.

See page 35-11 for deglazing and reboring information.

PISTON ANALYSIS

Fig. 18–Piston Top Land Burning Caused by Detonation

Fig. 19–Hole Burned in Piston Caused by Pre-Ignition

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.

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. 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—Piston Damage Caused by Pin Lock Coming Loose

In the above illustration a piece of the lock found its way into the oil ring.

Pin locks loosen or break due to:

1. Rod misalignment.
2. Excessive crankshaft end play.
3. Crank pin taper.
4. Weak pin locks.
5. Pin locks incorrectly installed.

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

INSPECTING CRANKSHAFT

Fig. 22–Measuring Crank Pin

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. Replacement crankshafts have crankshaft gear, pin and bearings assembled to crankshaft. New bearing cups are also provided and should be used when installing new crankshaft assembly.

CONNECTING ROD AND CAP ANALYSIS

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.

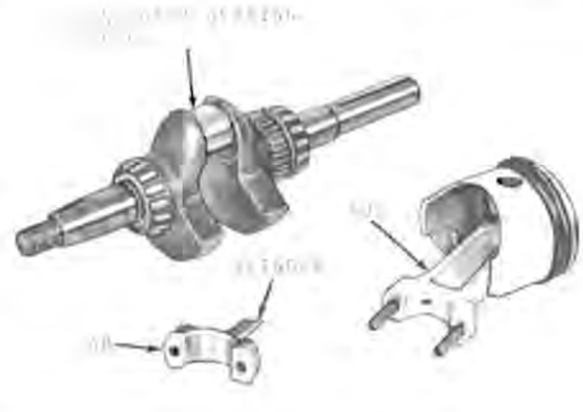


Fig. 23–Crankshaft, Rod and Cap

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. Evidence of score marks on these areas indicates impurities in the oil or engine run without oil. Replace rod showing scratch mark 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 bearing. Also measure fit of piston pin in piston and rod. See "Specifications," page 35-18.

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 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.*

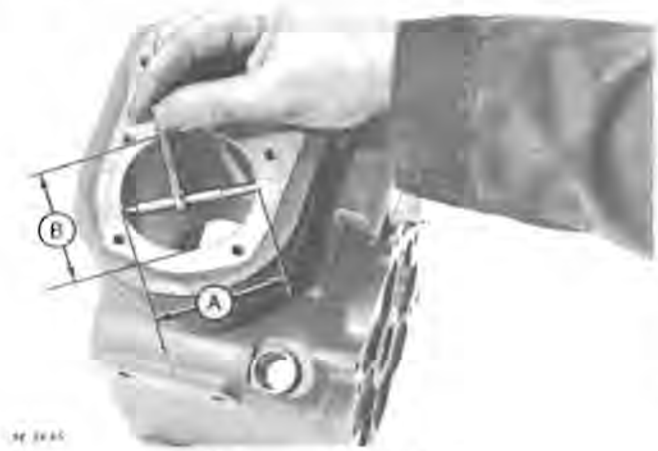


Fig. 24–Measuring Cylinder Bore

Use a telescoping gauge and micrometer to measure bore in two places, at top and bottom of ring travel area. 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° 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 electric drill and boring tool. See "Special Tools," page 35-19.

Reboring to 0.010-inch oversize to accommodate oversize piston and rings can also be done with a course stone in the deglazing tool, Figure 25, and refinishing with finer grit stones. *IMPORTANT: If block is jigged in a drill press for reboring, be sure boring 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 flyweight spring. If camshaft needs attention, see Group 40 for camshaft and governor service.

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.

BEARING ANALYSIS

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 this bearing cup 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 is caused by improper crankshaft end play adjustment.

Refer to pages 15-11 and 15-12 of this section for an analysis of other bearing failures.

INSTALLATION

INSTALLING CRANKSHAFT

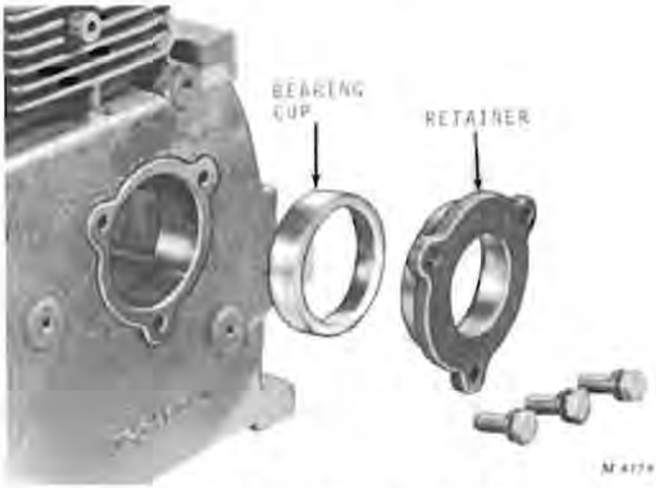


Fig. 28–Bearing Retainer Assembly

Bolt bearing cup (thin edge inward) and bearing retainer 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 retainer in both ends of piston pin bore, making sure that snap rings are securely seated in retainer grooves in piston bore.

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.

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 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

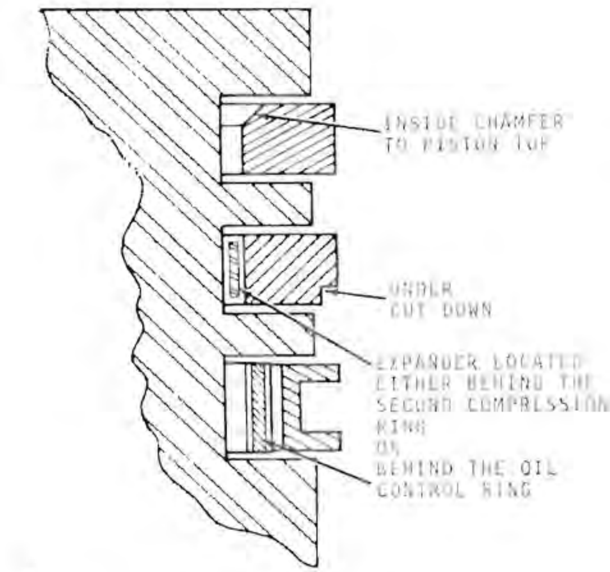


Fig. 31–Piston Ring Assembly

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, Figure 31. 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.*

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, only 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.

CAUTION: 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 (13 oz.) 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 reinstall lifter in same guide from which it was removed.

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

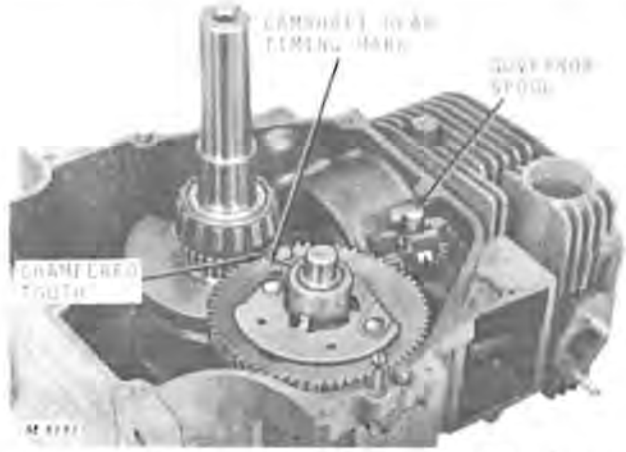


Fig. 35–Timing Marks on Crankshaft and Camshaft

INSTALLING CYLINDER COVER

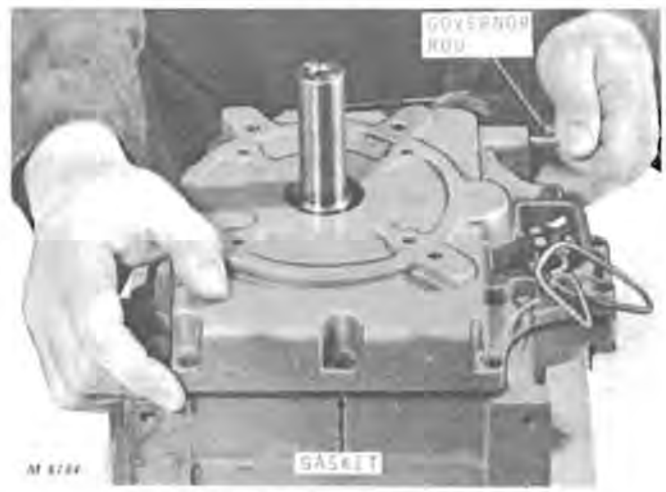


Fig. 36–Installing Cylinder Cover

Apply oil to crankshaft and camshaft bearings. Install new cylinder cover gasket on cylinder block. Use dowels in cylinder block to keep gasket positioned. Remove breaker points and push rod or remove box cover and hold breaker points open. Move breaker point push rod toward points to prevent damage to push rod when cylinder cover is installed. 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. PTO end of crankshaft must extend freely.

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

0.003-inch—clearance between cover and cylinder.

+0.003-inch—required end play.

0.006-inch—shim thickness required.

+ 0.003-inch—add half of shim thickness required to compensate for gasket compression

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.

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

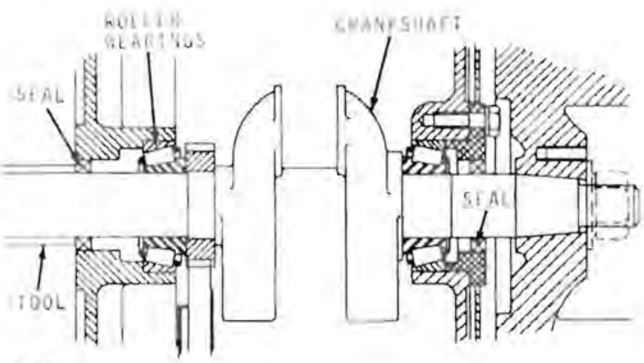


Fig. 39–Installing Seals

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 39. Install blower housing baffle. See "Torque Chart" in Section 10 and tighten baffle bolts accordingly.

INSTALLING FLYWHEEL

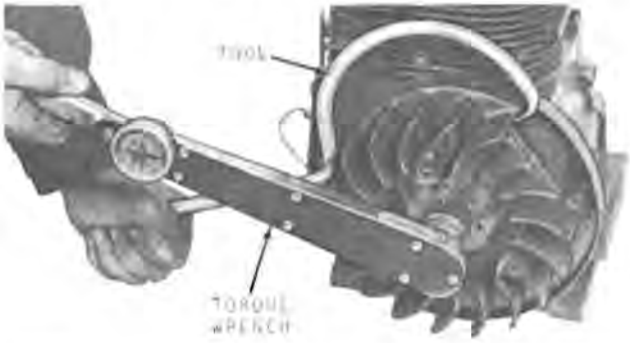


Fig. 40–Torquing Flywheel Nut

Place key in crankshaft keyway. Install flywheel washer and nut. Use flywheel tool to hold flywheel from rotating while torquing nut, Figure 40. Refer to "Specifications," page 35-18, for flywheel nut torque and torque nut accordingly.

INSTALLING SHROUDING

Fig. 41–Installing Engine Shrouding

Install blower housing, cylinder baffle, head baffle and motor-generator brackets. Bolt sheave and screen to flywheel. Tighten screws firmly. Install motor-generator drive belt and belt guard. Refer to Section 40 for proper belt tension.

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

INSTALLING EXTERNAL COMPONENTS

Fig. 42–Assembling Carburetor, Coil and Condenser

Install coil, condenser, and all external components, Figure 42. Attach wires to their respective terminals.

Be sure breaker point push rod is in place and was not damaged during cylinder cover installation. Also inspect, clean and adjust breaker points if necessary. See Section 40.

Refer to Group 40 for proper carburetor and governor assembly and adjustment.

SPECIFICATIONS

HH100 TECUMSEH ENGINE

Item	New Part Dimension	Wear Tolerance
Crankshaft pin size	1.3750 to 1.3755 inches	1.3720 inches or 0.003-inch out of round
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	3.3080 inches
Connecting rod large end	. . . .	1.3760 inches
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	. . . .

TORQUE FOR HARDWARE

Location	Torque
Connecting rod lock nuts	86-110 in-lbs
Bearing retainer	65-110 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 crankpin 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	KD 850	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

Group 40

CAMSHAFT, TAPPETS AND GOVERNOR TECUMSEH ENGINE FOR 112 TRACTOR

GENERAL INFORMATION

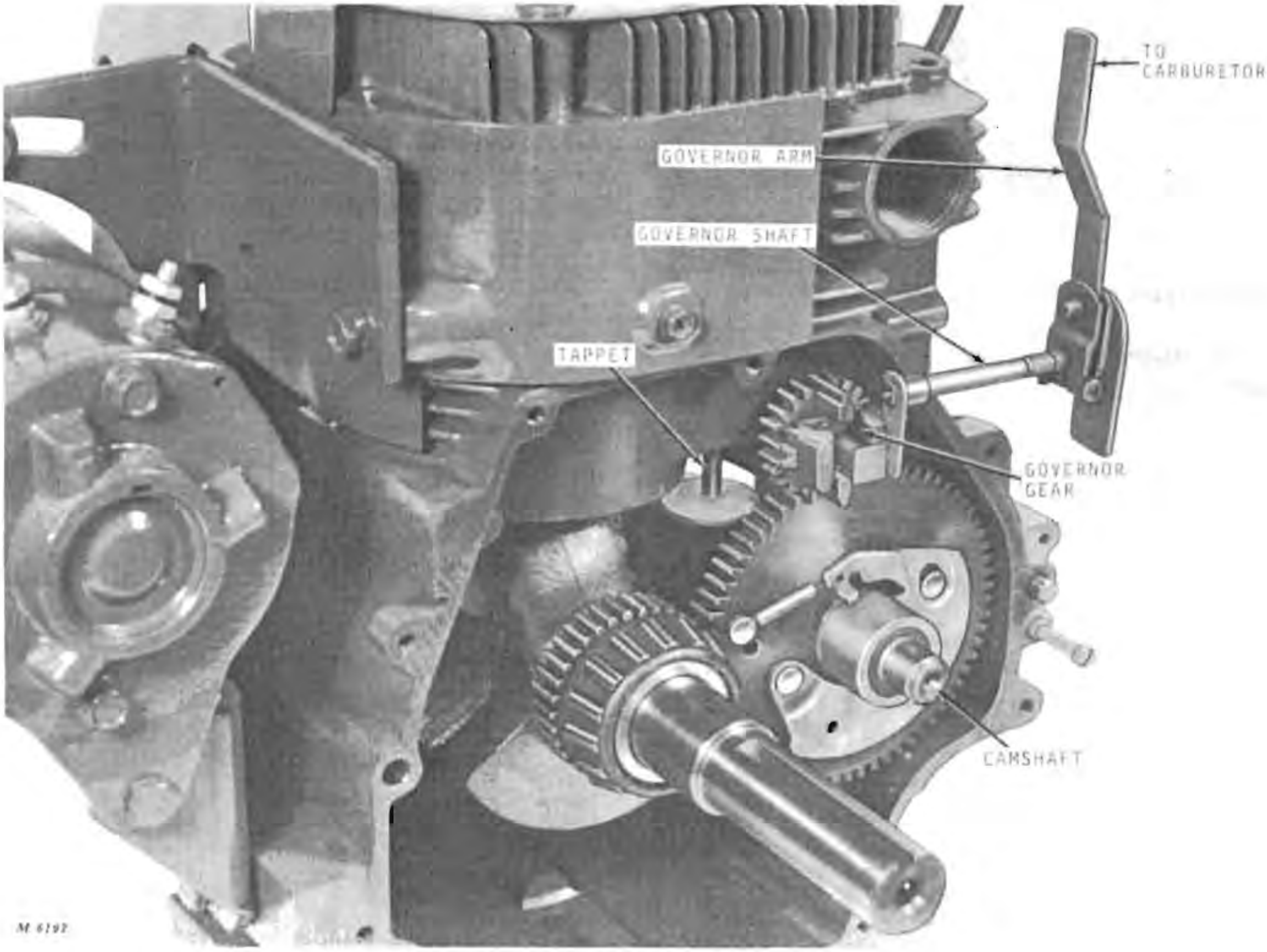


Fig. 1–Assembled View of Camshaft, Tappets and Governor

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

Tecumseh HH100 Engines used in 112 Tractors (-100,000) have the Insta-Matic EZEE-Start Camshaft, Figure 2.

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. When the engine is not operating, this pin protrudes above the cam 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 bears against the valve lifter when the valve is fully closed. 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 during cold weather starting.

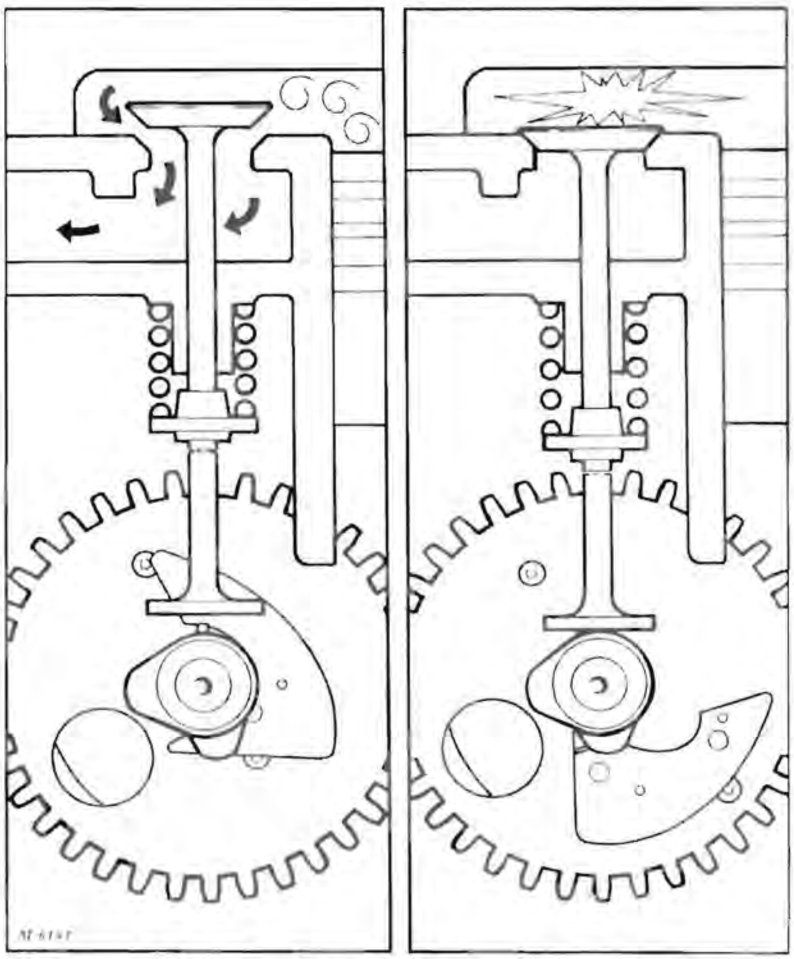
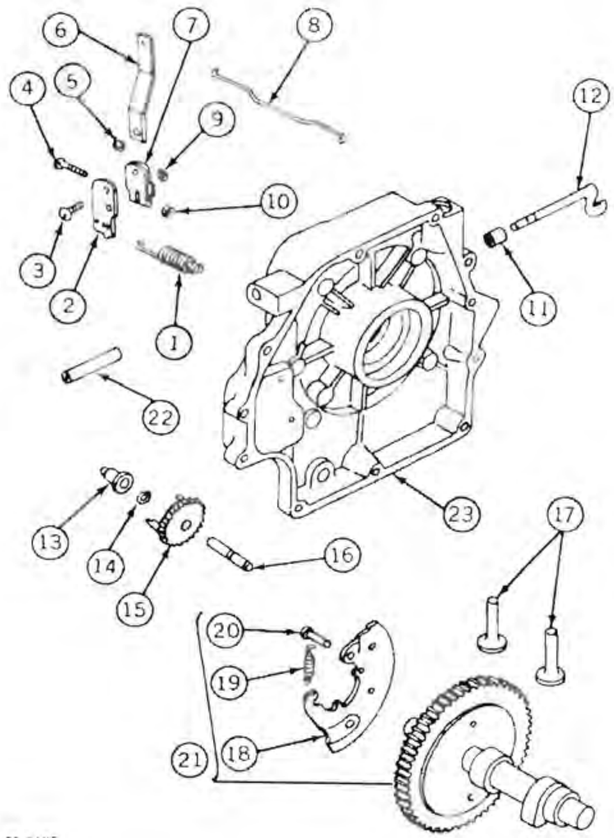


Fig. 3–EZEE-Start Operation

REPAIR



M 6195

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 Lever
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 – Replaceable Bearing (-5644)
23 – Cylinder Cover

Fig. 4–Exploded View of Camshaft and Governor

REMOVING CAMSHAFT AND TAPPETS

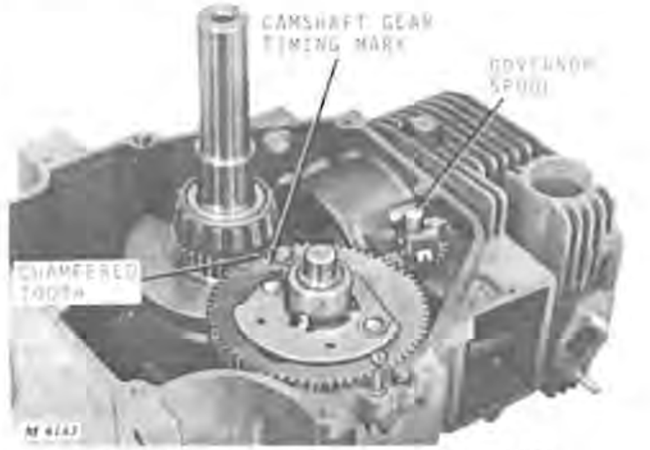


Fig. 5–Engine with Components Removed for Camshaft Servicing

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

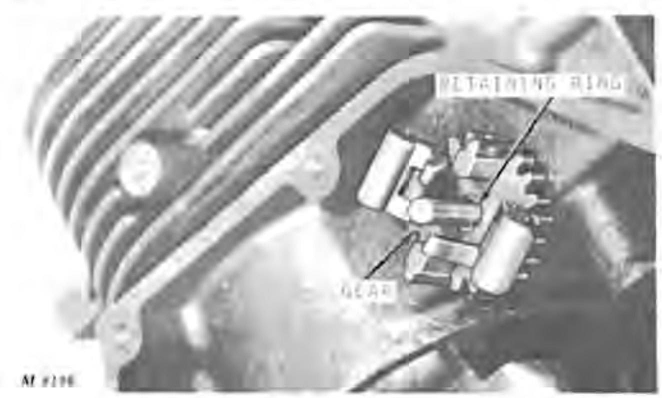


Fig. 6–Removing Retaining Ring and Governor Gear Assembly

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

REMOVING GOVERNOR ROD

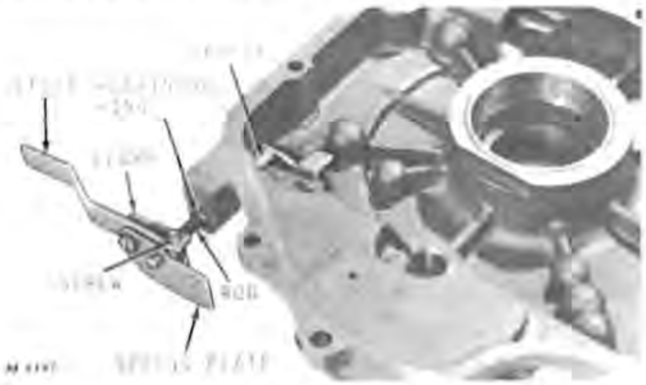


Fig. 7—Governor Rod

Loosen governor arm clamp screw and remove governor lever 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.

The breaker cam normally does not show any wear; therefore, the cam should never require replacing.

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 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.

GOVERNOR ROD

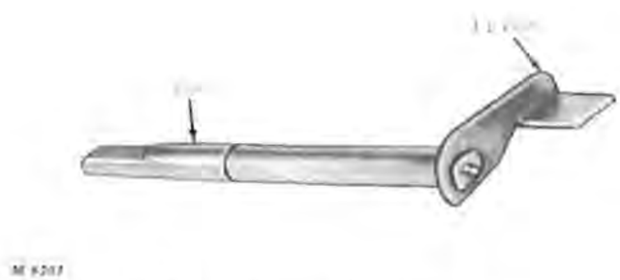


Fig. 10—Governor Rod Assembly

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

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.

REPLACING GOVERNOR ROD BEARING

The cylinder cover used in the engine for 112 Tractors (-5644) has a bearing for the governor rod (22, Figure 4). This bearing can be replaced when excessive wear is noticed.

The cylinder cover used in the engine for 112 Tractors (5645-) does not have a replaceable bearing in the governor rod hole. However, the surface will normally not show much wear.

INSTALLING GOVERNOR GEAR AND SPOOL

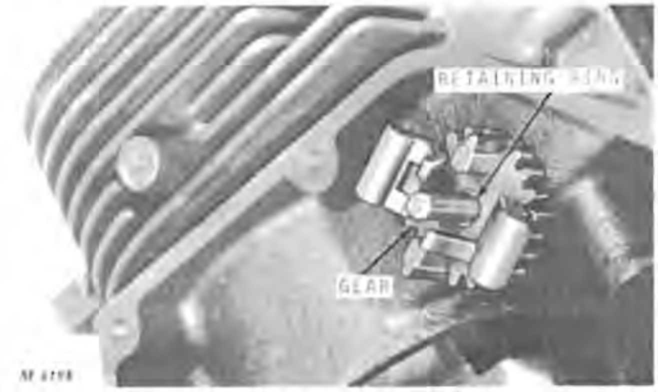


Fig. 12–Installing Governor Gear Assembly

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

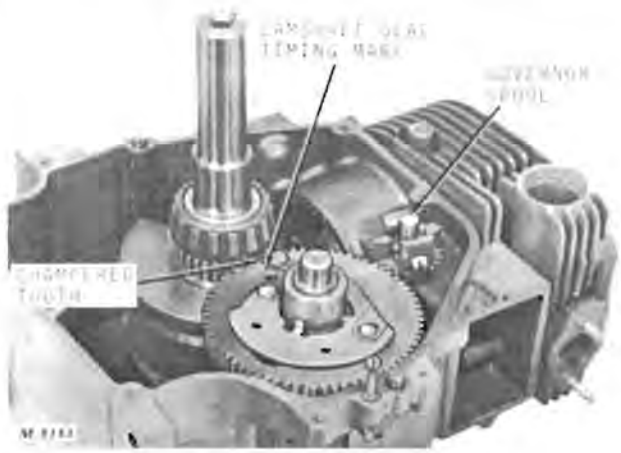


Fig. 13–Governor Spool

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 BREAKER CAM ON CAMSHAFT

Fig. 14–Breaker Cam Position

Install breaker cam with notch toward camshaft gear. Align notch with tab on camshaft, Figure 14.

INSTALLING TAPPETS AND CAMSHAFT

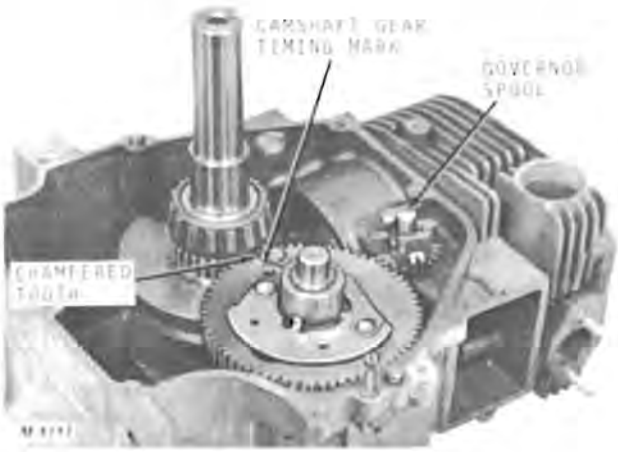


Fig. 15–Valve Timing

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 15.

INSTALLING GOVERNOR ROD AND LEVER

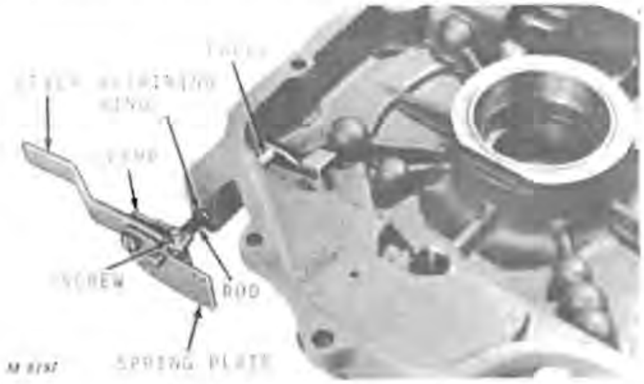


Fig. 16–Installing Governor Rod

Install spacer on governor rod. Oil governor rod and install rod in cylinder cover. Secure rod with retaining ring, Figure 16.

Assemble lever, 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.

CONNECTING GOVERNOR LEVER

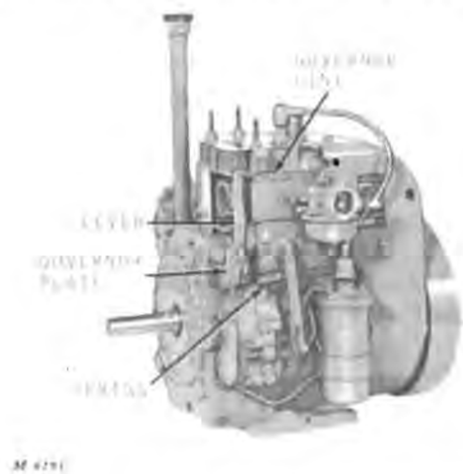


Fig. 17–Connecting Governor Lever

Connect governor spring to bottom hole of governor plate, Figure 17.

Refer to Group 35 and install all external components. Connect governor link and adjust as instructed on the next page.

ADJUSTMENT

ADJUSTING GOVERNOR SPEED

Fig. 18–Governor Linkage Adjustment

Hold control lever to right with socket or wedge device, Figure 18.

Loosen lever screw.

Apply pressure on right side of governor arm facing front of tractor. Tighten lever screw firmly. Remove wedge.

ADJUSTING GOVERNOR STOP SCREW

Before attaching the remote speed control (cable and conduit) set the engine for maximum rpm. Set the high speed (3700-3800 rpm) with the engine running. 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 19. Turn in (clockwise) to decrease maximum rpm. Turn out (counterclockwise) to increase maximum rpm. *CAUTION: Tachometer should not exceed 3800 rpm. Be sure all drives are disengaged when setting engine speed. When adjustment is obtained, tighten lock nut on governor stop screw.*

Fig. 19–Governor Stop Screw and Lock Nut

ADJUSTING CABLE AND CONDUIT

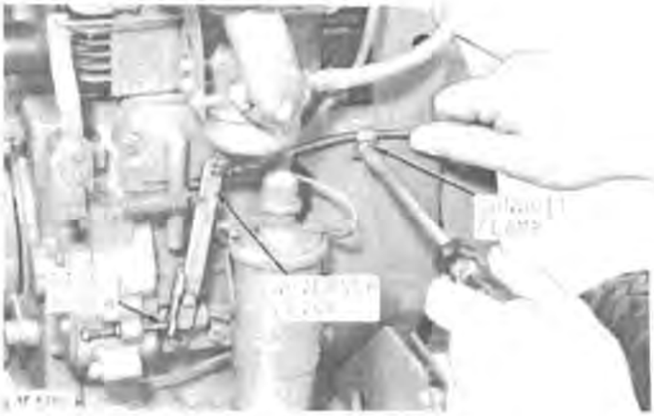


Fig. 20–Positioning Conduit

Insert cable end in lower hole (large hole) of control lever. Move throttle lever on dash until distance between top of lever and top of slot is 1/4 inch. Move governor lever until lower end of lever strikes governor stop screw, Figure 20. 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	0.788-inch
Camshaft bearing diameter	0.6235 to 0.6240-inch	0.6195-inch

Section 30
FUEL SYSTEM

Group 5
GENERAL INFORMATION

TABLE OF CONTENTS

Litho in U.S.A.

PRINCIPLE OF OPERATION

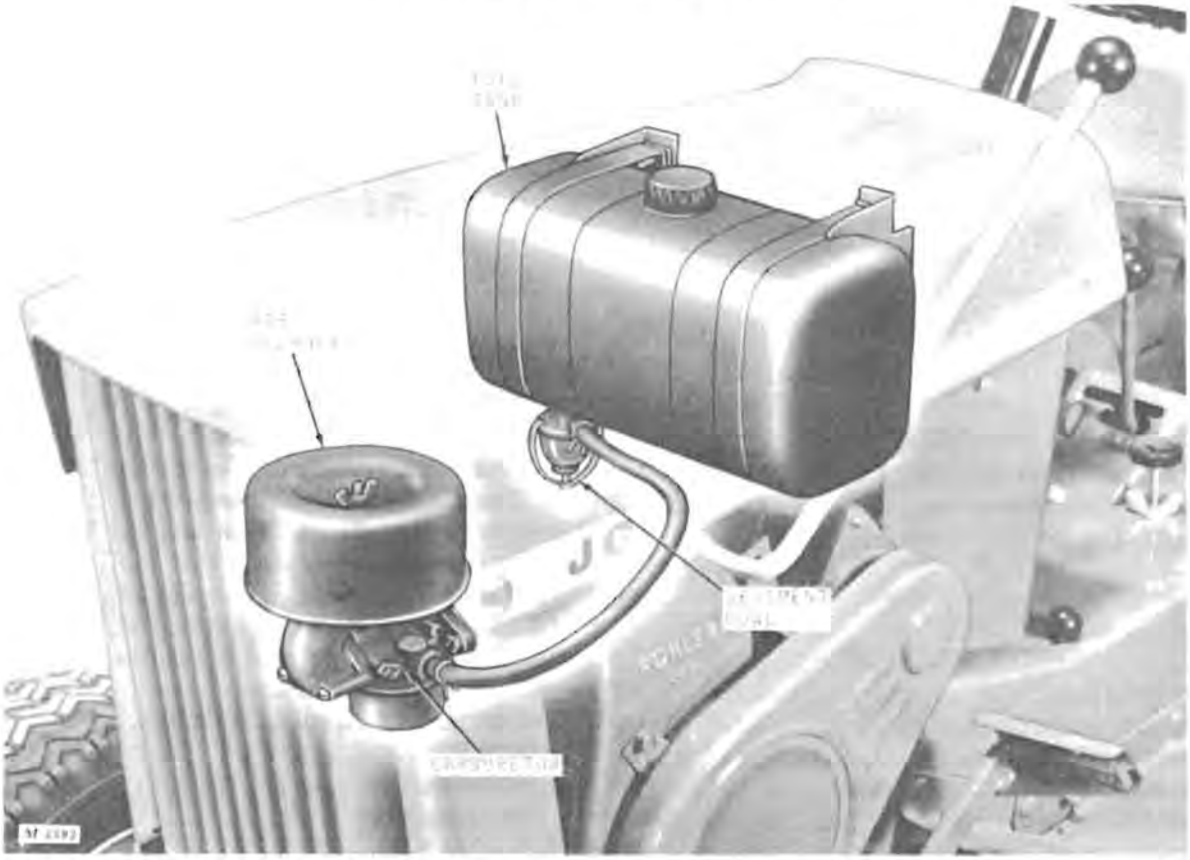


Fig. 1—Gravity Flow Fuel System for 110 and 112 Tractors

The fuel tank is mounted above the engine and carburetor to allow gravity feed of the fuel, eliminating the need for a fuel pump. Gasoline flows from the tank through a strainer screen, into the sediment bowl and carburetor.

Kohler engines on 110 Tractors use a side draft Carter carburetor having three adjustments: high speed and idle mixture needles and an idle adjusting screw.

Tecumseh engines on 112 Tractors use a side draft Walbro carburetor having three adjustments: high speed and idle mixture needles and an idle adjusting screw.

DIAGNOSING MALFUNCTIONS

CARBURETOR

Hard Engine Starting

Engine flooded.
Lower choke control.

Restricted gas tank vent.
Replace cap or cap gauge assembly.

High speed and idle mixture needles not properly adjusted.
Adjust needles properly, page 10-5 or 10-11.

Fuel inlet needle sticking to seat.
Install new needle and seat assembly.

Choke cable loose in control swivel.
Position lever and choke valve and tighten cable in swivel.

Fuel shut-off valve closed.
Open valve.

Water, rust or stale fuel in gas tank.
Remove tank and flush.
Refill tank with fresh fuel.

Gummed carburetor.
Clean carburetor, page 10-2 or 10-7.
Install new carburetor kit.

Air lock in fuel line.
Remove fuel line at carburetor and bleed fuel line.

Restricted air filter element.
Clean element.
Check condition.
Replace element if necessary.

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.
Adjust needles properly, page 10-5 or 10-11.

Dirt, water or ice in fuel system.
Remove components and clean.
Replace parts as necessary.

Restricted gas tank vent.
Replace cap or cap gauge assembly.

Restricted fuel line.
Install new fuel line.

Air lock in fuel line.
Remove fuel line at carburetor and bleed fuel line.

Restricted air filter element.
Clean element.
Check condition.
Replace element if necessary.

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.
Adjust needles properly, page 10-5 or 10-11.

Incorrect float setting.
Adjust float, page 10-4 or 10-9.

Restricted air filter element.
Clean element.
Check condition.
Replace element if necessary.

Dirt, water or ice in fuel system.
Remove components and clean.
Replace parts as necessary.

Also see "Diagnosing Malfunctions," page 5-11 of Section 20, "Engines," for other solutions to rough engine idle.

CARBURETOR—Continued

Poor Acceleration

High speed and idle mixture needles not properly adjusted.
Adjust needles properly, page 10-5 or 10-11.

Restricted air filter element.
Clean element.
Check condition.
Replace element if necessary.

110 Tractors: Arm loose on governor cross shaft.
Replace cross shaft assembly.

112 Tractors: Check condition of governor spool.
Clean hole in each end of spool.
Replace spool if necessary.

Throttle cable slipping in control swivel.
Adjust linkage and tighten cable in swivel.

Sticky fuel inlet needle.
Replace needle and seat assembly.

Dirty or damaged high speed mixture needle.
Replace damaged needle.

112 Tractors: Dirt or paint on throttle return spring.
Clean spring.

Also see "Diagnosing Malfunctions," page 5-11 of Section 20, "Engines," for other solutions to poor engine acceleration.

Engine Surging

High speed and idle mixture needles not properly adjusted.
Adjust needles properly, page 10-5 or 10-11.

112 Tractors: Dirt or paint on throttle return spring.
Clean spring.

Too low on fuel.
Refill fuel tank.

Flooding or Leaking Carburetor

Sticky fuel inlet needle.
Replace needle and seat assembly.

Incorrect float setting.
Adjust float to proper level, page 10-4 or 10-9.

Leaking float.
Replace float and adjust to proper level, page 10-4 or 10-9.

Gas Drips from Carburetor

Loose fuel fitting.
Tighten fitting. Install a new fitting if necessary.
Replace fuel line if necessary.

Fuel line loose on fuel fitting.
Relocate hose clamp on fuel line.
Install new fuel line if necessary.

112 Tractors: Bowl drain leaking.
Push up and release bowl drain several times.
Replace bowl drain assembly if necessary.

SEDIMENT BOWL

Gas Drips at Sediment Bowl

Loose shut-off valve.
Tighten needle valve retaining nut.

Loose bowl nut.
Replace gasket and secure bowl nut.

No Fuel in Sediment Bowl

Shut-off valve closed.
Open valve.

Empty fuel tank.
Fill tank.

Filter screen clogged.
Clean screen.
Replace screen if necessary.

Group 10
CARBURETOR

110 TRACTOR

GENERAL INFORMATION

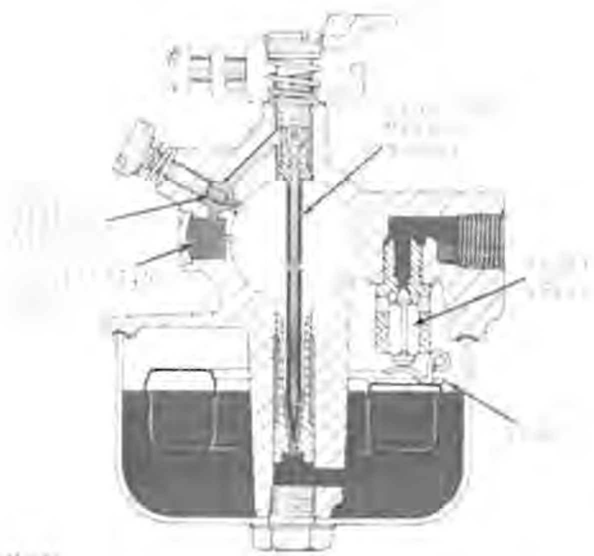


Fig. 1—Cutaway View of Carburetor

Fuel enters the bowl through a valve controlled by the float, Figure 1. Air entering the carburetor is controlled by the choke valve 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 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.

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.

Remove fuel bowl, float needle and needle seat.

Remove high speed and idle mixture needles.

Remove screws holding throttle valve. Remove valve and shaft from carburetor housing.

Remove choke valve, choke shaft retaining ball and spring.

CAUTION: Place a rag over end of choke shaft opposite choke shaft lever to prevent retaining ball from flying out when shaft is removed.

CLEANING CARBURETOR

Clean all parts in a carburetor cleaning solvent.

CAUTION: Never clean holes or passages with small drill bits or wire, as 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.

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.

CAUTION: 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 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.

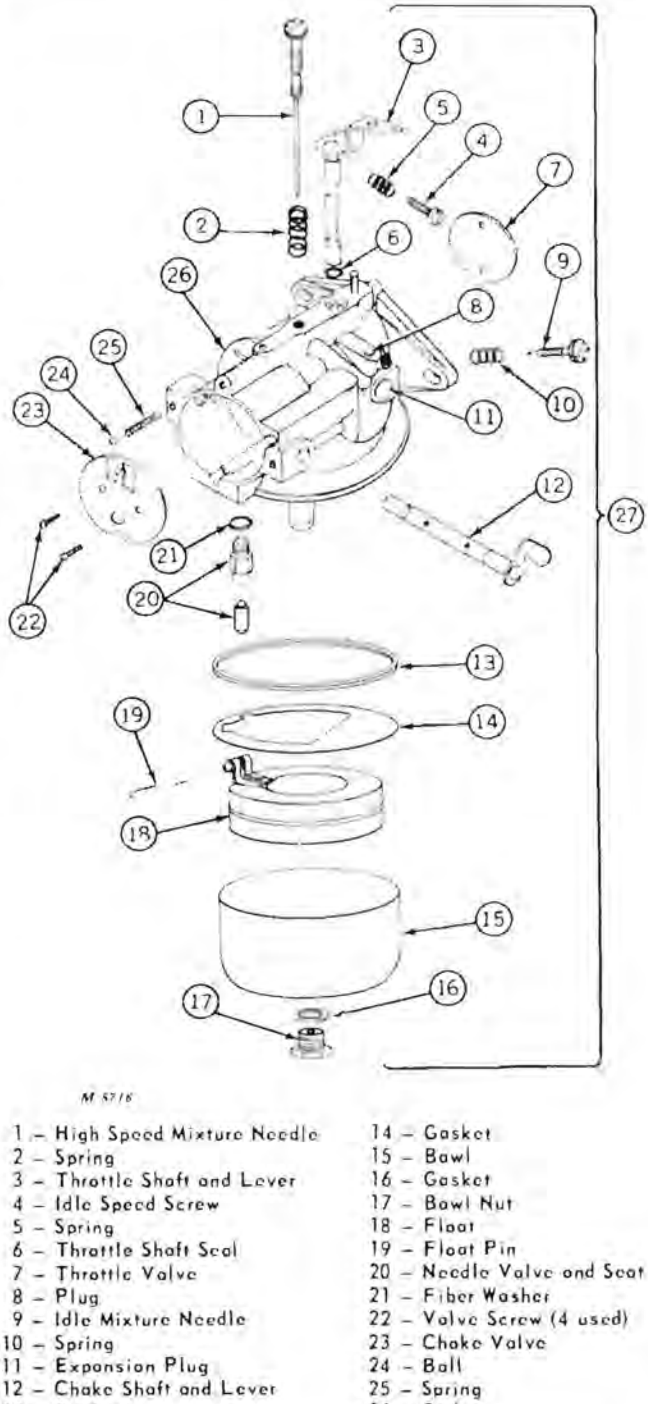
Check float shaft and replace if worn.

Inspect tapered ends of 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. 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 if damaged.



1 - High Speed Mixture Needle
2 - Spring
3 - Throttle Shaft and Lever
4 - Idle Speed Screw
5 - Spring
6 - Throttle Shaft Seal
7 - Throttle Valve
8 - Plug
9 - Idle Mixture Needle
10 - Spring
11 - Expansion Plug
12 - Choke Shaft and Lever
13 - Gasket
14 - Gasket
15 - Bowl
16 - Gasket
17 - Bowl Nut
18 - Float
19 - Float Pin
20 - Needle Valve and Seat
21 - Fiber Washer
22 - Valve Screw (4 used)
23 - Choke Valve
24 - Ball
25 - Spring
26 - Body

Fig 2-Exploded View of Carter Carburetor Components

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

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

ASSEMBLY

Replace all gaskets when carburetor is disassembled for service. Use new gasket between carburetor flange and cylinder block when installing carburetor on cylinder block.

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

INSTALLING THROTTLE ASSEMBLY

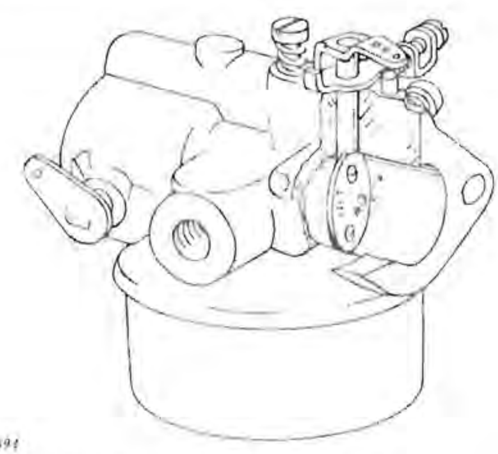


Fig. 3–Installing Throttle Shaft and Valve

Slip felt seal (6), Figure 2, on throttle shaft and install throttle shaft (3) and valve (7) in carburetor body (26). Valve must be installed with trademark "C" on side towards idle port, (R.H. side) when viewed from flange end, Figure 3. With screws loose, seat valve by tapping lightly with a small screwdriver. Hold in place while tightening screws.

INSTALLING CHOKE ASSEMBLY

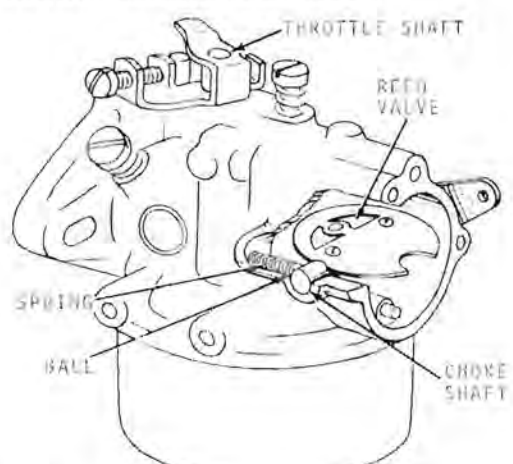


Fig. 4–Installing Choke Shaft and Valve

Install spring (25), ball (24) and choke shaft (12) in carburetor body. Use a small blunt punch to push ball back when slipping end of choke shaft through carburetor body, Figure 4.

Assemble choke valve as shown in Figure 4.

IMPORTANT: The choke valve can be installed backwards and also at the wrong angle. Be sure moveable reed valve is towards inside of carburetor body, Figure 4, and that top of valve is angled towards inside of body.

Tighten screws firmly.

Fig. 5–Installing Valve Seat and Valve

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

Screw valve seat assembly (20) into carburetor housing.

Insert valve with tapered end against valve seat, Figure 5.

INSTALLING FLOAT AND FLOAT SHAFT

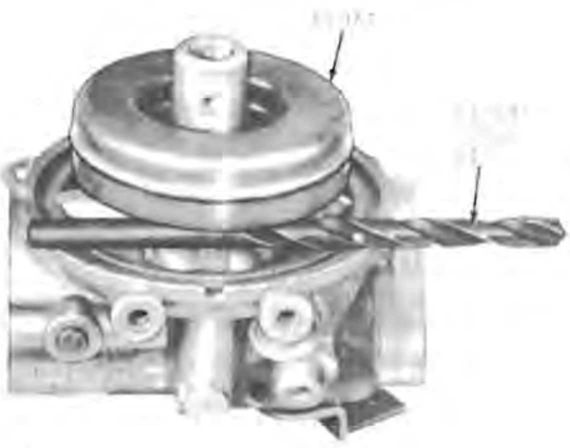


Fig. 6–Adjusting Float

Assemble float (18), Figure 2, to carburetor housing with float pin (19). Invert carburetor, Figure 6. 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 6.

NOTE: Be sure carburetor-to-bowl gasket has a perfect seat and forms an air tight joint.

Position bowl gasket (14), fuel bowl (15), bowl nut gasket (16) and bowl nut (17). Tighten screw firmly.

Install idle mixture needle (9), through spring (10) and high speed mixture needle (1) through spring (2) and into carburetor body.

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

INSTALLATION

Fig. 7–Installing Carburetor Assembly to Cylinder Block

Connect governor link in bottom hole of governor arm and in hole closest to throttle shaft in throttle arm, Figure 7.

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

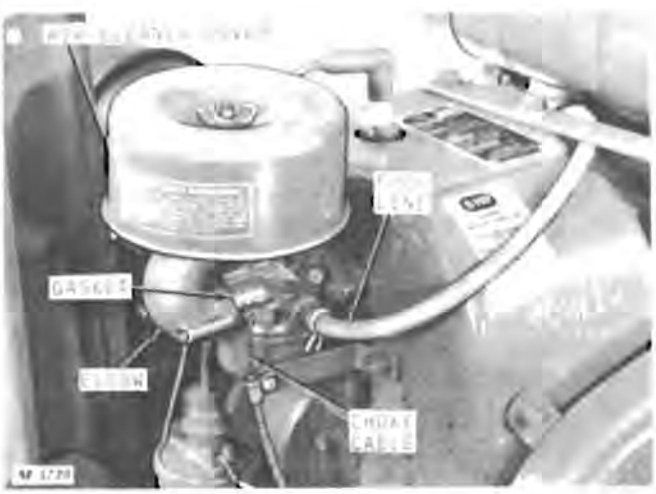


Fig. 8–Installing Carburetor Components

Attach fuel line and control cables to carburetor, Figure 8.

Secure conduit clamps to supporting brackets, Figure 8. Throttle linkage is not illustrated.

Place new gasket on carburetor body and bolt elbow to carburetor, Figure 8.

Place filter element on base making sure it seats tightly around base. Install cover and tighten wing nut finger tight, Figure 8.

ADJUSTMENT

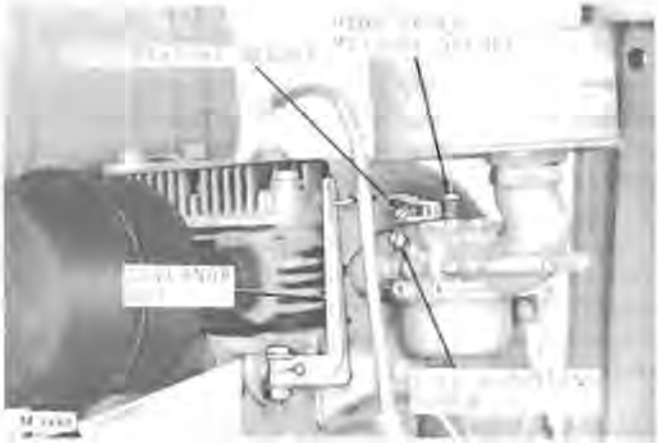


Fig. 9–Carburetor Adjustments

Under normal operating conditions the carburetor will not require adjusting. If, after a period of time, the engine misses, backfires, or excessive exhaust smoke is noticed, adjustment may be required.

Idle adjustment and high speed adjustment must be made at the same time as 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.

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 needle 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 1200-1700 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 K161S AND K181S ENGINES)

Speeds		
High speed (No load)	3800 rpm	Refer to carburetor adjustment, page 10-5.
Idle speed (No load)	1200-1700 rpm	Refer to carburetor adjustment, page 10-5.
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 10-4.

112 TRACTOR

GENERAL INFORMATION

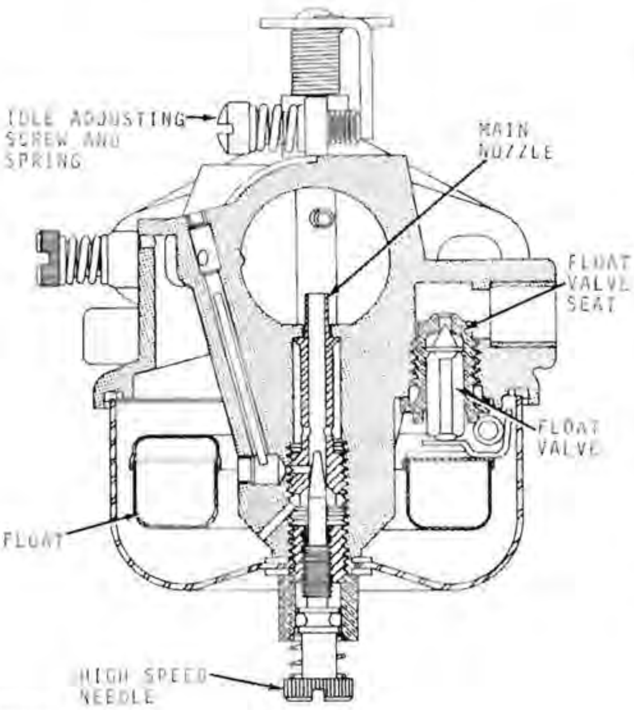


Fig. 10–Cutaway View of Walbro Carburetor

Fuel enters the bowl through a valve controlled by the float, Figure 10. 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 soltuion 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. 11–Main Nozzle

Normally the main nozzle, Figure 11, 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.

CAUTION: 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.

CAUTION: 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 needles. If a ring has been cut in the tapered surface of either needle because the needle has been 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 carburetor 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.

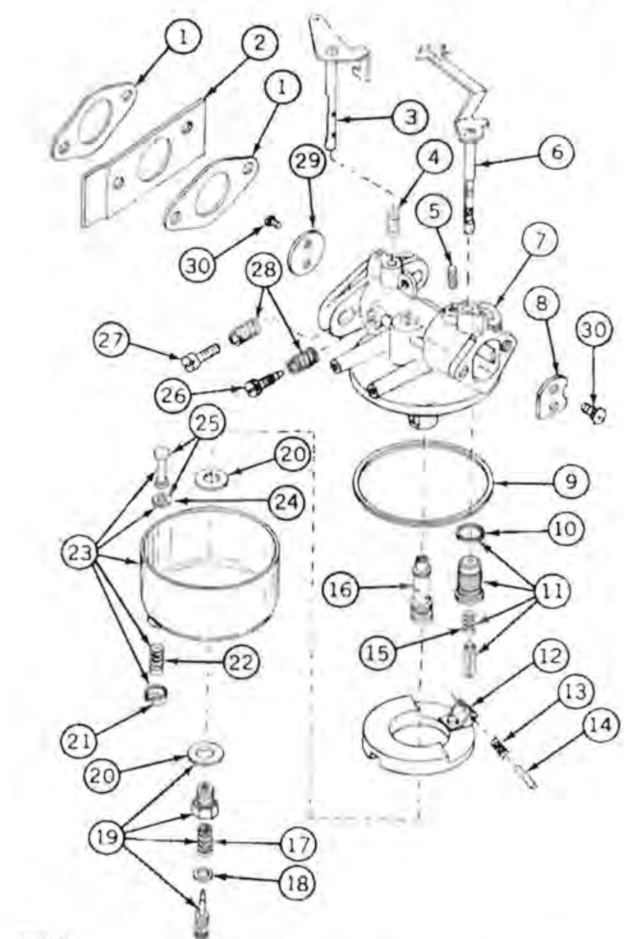
Check the condition of all springs. Replace worn or damaged springs.

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 – Valve Spring
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
30 – Machine Screw (4 used)

Fig. 12–Exploded View of Walbro Carburetor Components

INSTALLING MAIN NOZZLE

Fig. 13–Main Nozzle

Install service replacement main nozzle with undercut in threaded area in carburetor body, Figure 13. 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

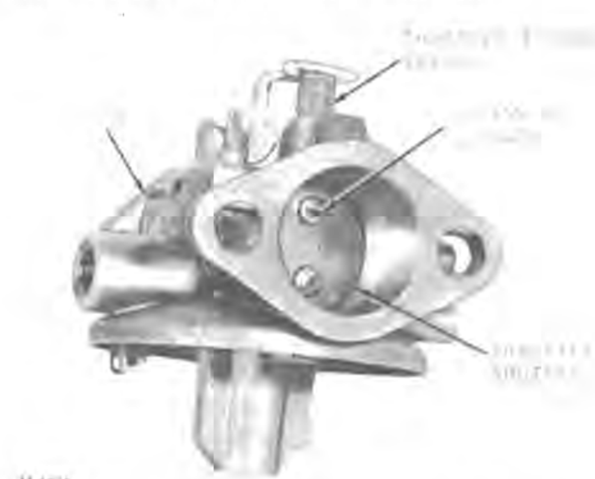


Fig. 14–Installing Throttle Shaft and Shutter

Slip throttle return spring on shaft, Figure 14. Position U-shaped end of spring on throttle shaft arm. Wind opposite end of spring approximately 180 degrees and install throttle shaft (3, Fig. 12) in carburetor body. Install throttle shutter with the lettering facing out when closed, Figure 14. Install and tighten retaining screws firmly. The throttle shaft should move freely.

If throttle shaft turns hard, loosen screws and reposition throttle shutter.

Install idle adjusting screw and spring, Figure 15.

INSTALLING CHOKE ASSEMBLY

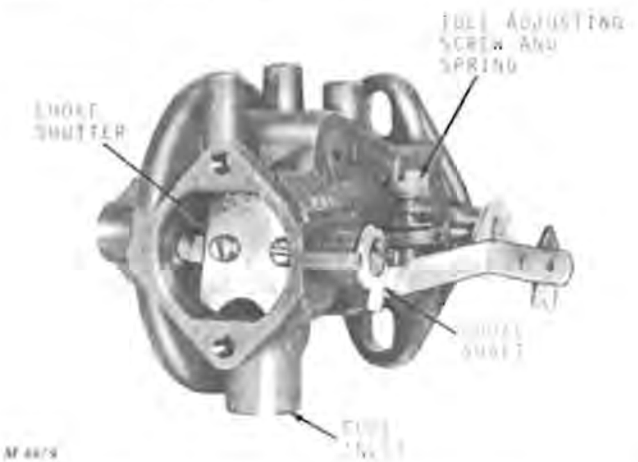


Fig. 15–Installing Choke Shaft and Shutter

Install choke shaft, Figure 15. 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 15.

INSTALLING FLOAT VALVE SEAT AND VALVE ASSEMBLY

Fig. 16–Installing Float Valve Seat, Valve Spring and Valve

Use a new gasket and install float valve seat in carburetor body, Figure 16. Refer to "Specifications," page 10-12 and torque valve seat accordingly.

Install float valve spring and valve in valve seat, Figure 16.

INSTALLING FLOAT SPRING AND FLOAT PIN

Fig. 17–Installing Float, Float Spring and Pin

Install the float, float spring and pin as shown in Figure 17.

ADJUSTING FLOAT

Fig. 18–Float Setting

Invert carburetor, Figure 18. With float resting on float valve, the distance between the float and carburetor body should be 0.110 to 0.130 inch. Bend lip on float to increase or decrease this dimension. Dimension should be made on free end of float (opposite valve seat). Figure 18 illustrates a 1/8-inch diameter drill (0.125 inch) across the point of measurement.

INSTALLING GASKETS, FUEL BOWL AND RETAINING NUT

Fig. 19–Installing Fuel Bowl Gaskets, Fuel Bowl and Retaining Nut

Install a new fuel bowl gasket, Figure 19. 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 drain to the right as shown in Figure 19. Install fiber washer and fuel bowl retaining nut (part of high speed adjusting needle assembly).

INSTALLING MIXTURE NEEDLES

Fig. 20–Installing Idle and High Speed Mixture Needles

Place O-ring in undercut on high speed mixture needle, Figure 20. 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 20.

Install and tighten fuel fitting, Figure 20.
CAUTION: Overtightening may crack the carburetor body.

INSTALLATION

Fig. 21–Installing Carburetor Assembly on Cylinder Block (Air Cleaner Base Removed for Clarity)

Connect throttle link to governor lever and throttle shaft lever. Position link ends as shown in Figure 21.

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 21.

Adjust choke and secure conduit clamp, note position of wire, Figure 21. Raise and lower control lever. Readjust choke if necessary.

Use new gasket between carburetor body and air cleaner elbow 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.

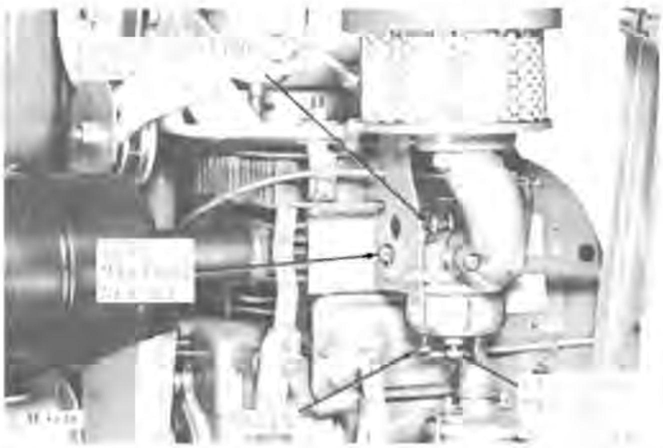


Fig. 22–Carburetor Adjustments

NOTE: Idle adjustment and high speed adjustment must be made at the same time as 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 one and one-half turns.

2. Turn idle mixture needle clockwise until closed. Close finger tight only. Then open two complete 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 adjusts the speed at which the engine idles.

SPECIFICATIONS

(WALBRO CARBURETOR FOR TECUMSEH HH100 ENGINE)

Item	New Part	Wear Tolerance
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)	0.110 to 0.130 inch	Check and/or adjust whenever carburetor is disassembled for service, page 10-9.
Valve Seat Torque	40-50 in-lbs	Refer to carburetor assembly, page 10-9.

Group 15
AIR CLEANER

110 TRACTOR

GENERAL INFORMATION

Fig. 1–Air Filter

The air cleaner consists of the base mounted on the carburetor, an air filter element and a cover that fits over the filter element which is held down by a wing nut. The filter element is made of treated paper with a soft sealing edge.

A narrower air cleaner, AM21034 is used on 110 Tractors (-3550) with K161 engines. 110 Tractors (3551-) with K181 engines use AM30800 air cleaner.

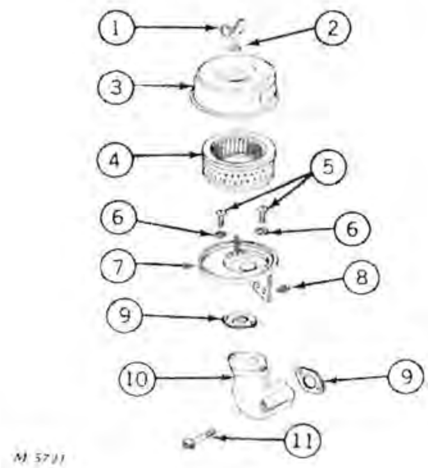
Care of the air cleaner is important since all the air that enters the engine goes through the air filter element. A clogged air filter element restricts air flow and reduces engine efficiency. A damaged air filter element allows dirt to enter the engine and causes immediate damage to internal working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

SERVICE

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

CLEANING

The air filter element should be cleaned every 5 hours of operation. This is done by tapping the air cleaner lightly against a flat surface.



1 – Wing Nut
2 – Copper Washer
3 – Cover
4 – Air Filter
5 – Screw (2 used)
6 – Lock Washer (4 used)
7 – Base
8 – Tapping Screw (2 used)
9 – Gasket (2 used)
10 – Elbow
11 – Machine Screw (2 used)

Fig. 2–Exploded View of Air Cleaner Components

Do not dip the air filter element into a liquid cleaner of any type. Replace filter if bent, crushed or damaged. Replace element if extremely dirty. When in doubt, replace element. 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 2.

112 TRACTOR

GENERAL INFORMATION

Fig. 3–Air Filter

The air cleaner consists of the base mounted on the carburetor, an air filter element and a cover that fits over the filter element which is held down by a wing nut. The AM31000 Filter Element is made of treated paper with a soft sealing edge, Figure 3.

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.

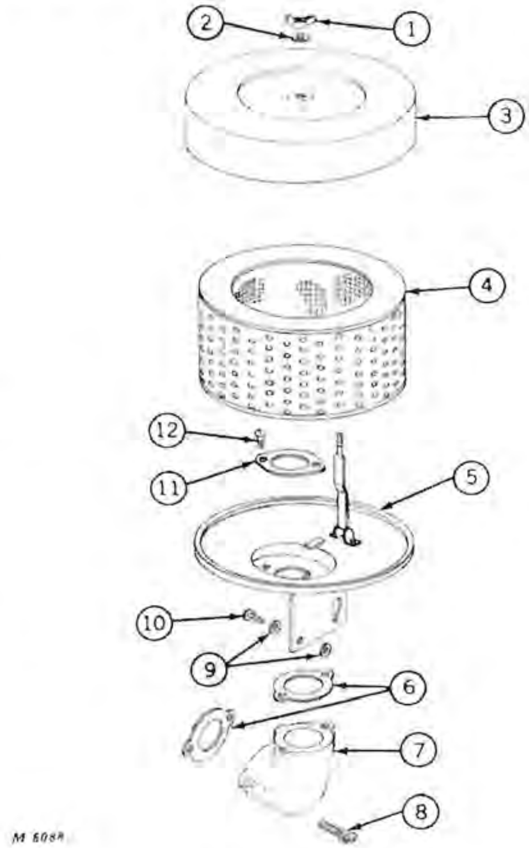
SERVICE

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

CLEANING

The air filter element should be cleaned every 5 hours of operation. This is done by tapping the air cleaner lightly against a flat surface.

Do not dip the air filter element into a liquid cleaner of any type. Replace filter if bent, crushed or damaged. Replace element if extremely dirty. When in doubt, replace element. This is inexpensive insurance to protect the engine.



1 – Wing Nut
2 – Fiber Washer
3 – Cover
4 – Air Filter
5 – Bracket
6 – Gasket (2 used)
7 – Elbow
8 – Machine Screw (2 used)
9 – Washer (4 used)
10 – Tapping Screw (2 used)
11 – Spacer
12 – Machine Screw (2 used)

Fig. 4–Exploded View of Air Cleaner Components

IMPORTANT: Never run the 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.

Group 20

SEDIMENT BOWL, FUEL STRAINER AND GAS TANK

SEDIMENT BOWL

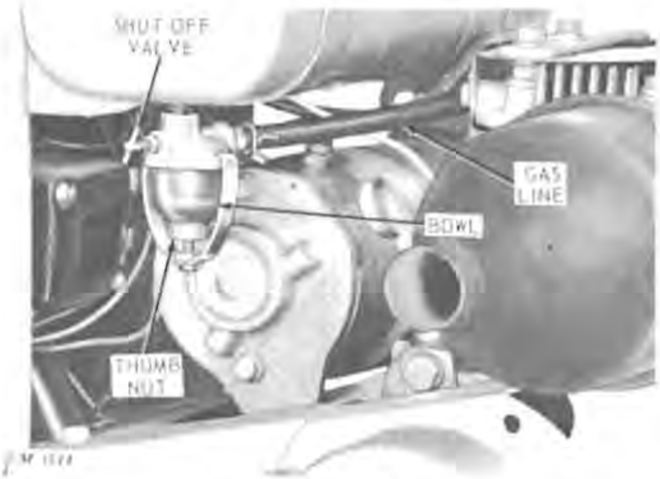


Fig. 1–Sediment Bowl

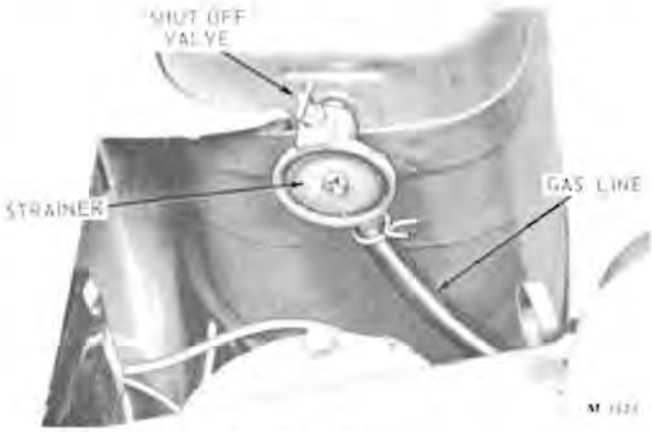


Fig. 2–Fuel Strainer

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

> **CAUTION: 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 clean gasoline containers.

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

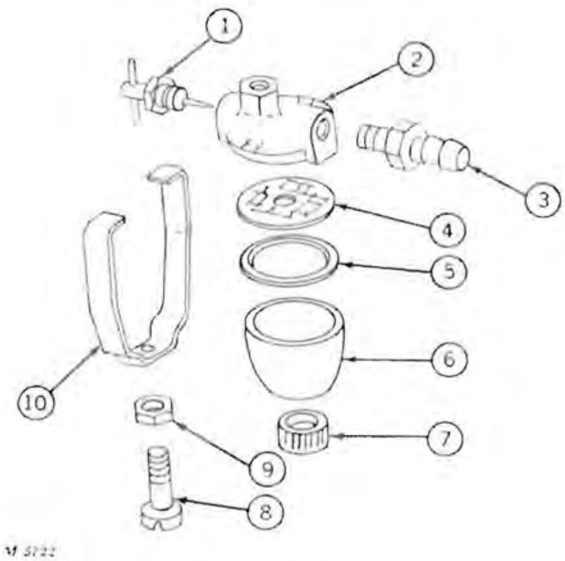
FUEL STRAINER

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

Refer to Figure 3 to reassemble sediment bowl and fuel strainer.

IMPORTANT: After assembling sediment bowl and strainer, remove gas line at carburetor while opening shut-off valve and filling sediment bowl. When gas begins to run out, connect gas line.

This will allow air to escape and avoid possible air lock in the gas line.



1 – Needle Valve
2 – Base
3 – Connector
4 – Screen
5 – Gasket
6 – Bowl
7 – Cup
8 – Machine Screw
9 – Nut
10 – Bail

Fig. 3–Exploded View of Sediment Bowl

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.

Do not attempt to solder the gas tank unless proper precautions are taken. Because of the size of the tank (1.9 U.S. gal.) it may be more desirable to replace the tank rather than attempt to repair it.

SPECIAL TOOLS

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

Section 40
ELECTRICAL SYSTEM

Group 5
GENERAL INFORMATION

TABLE OF CONTENTS

Litho in U.S.A.

PRINCIPLE OF OPERATION

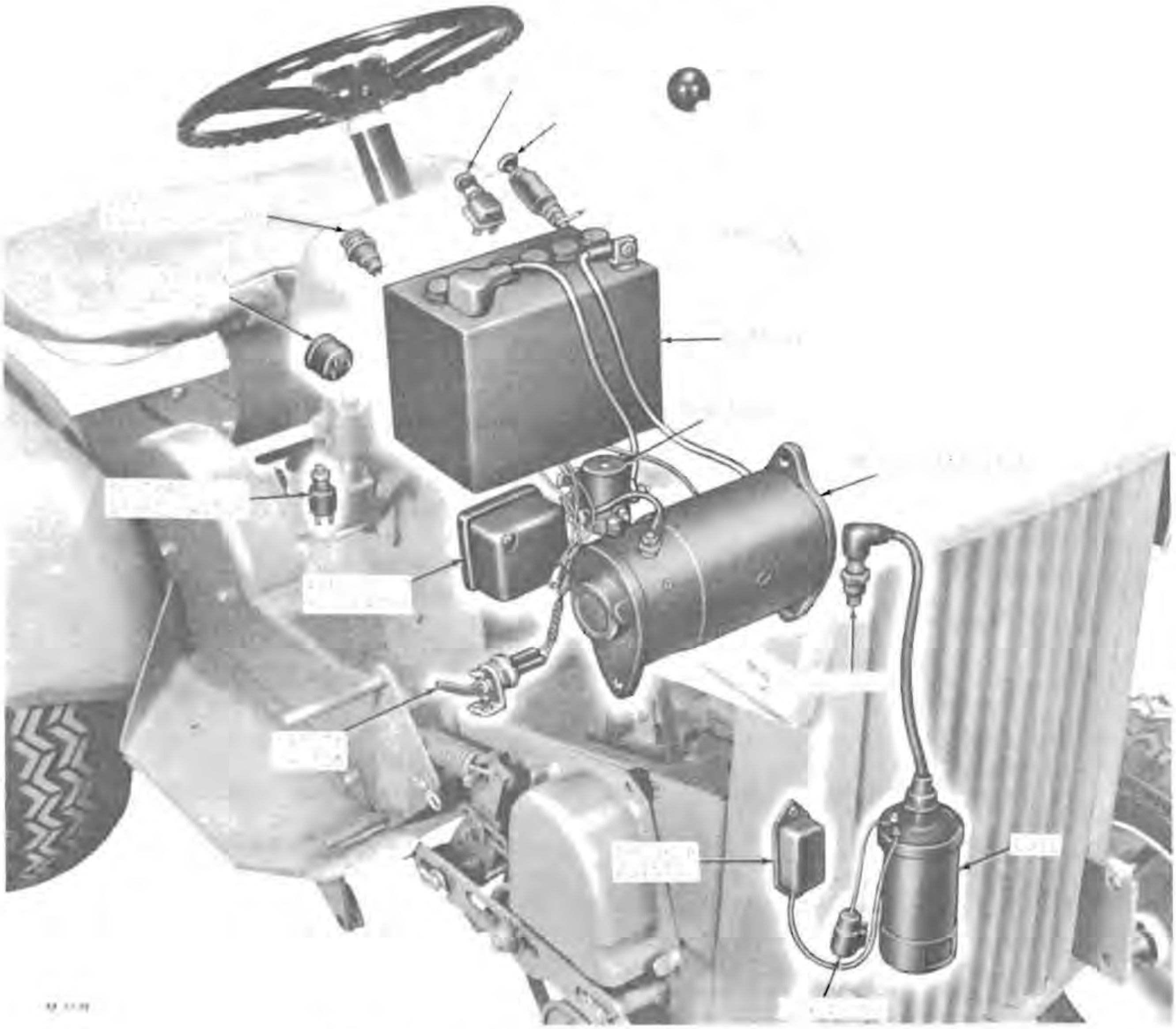


Fig. 1—Electrical Components and Relative Location of Each

The 110 and 112 Tractor ignition and generating system circuits are identical. Both are 12-volt, negative-ground systems.

The Kohler K161S, K181S and Tecumseh HH100 engines are equipped with Delco-Remy voltage-regulator, coil, condenser and motor-generator.

When the key switch is turned to the right (start position), the solenoid is energized through a pair of safety switches. Continuity through these switches is made only when the tractor shift lever is in neutral position and the equipment clutch is disengaged.

Once the solenoid is energized, a charge from the battery is relayed to the cranking unit called a motor-generator. This unit performs a dual function. It provides cranking power until the engine starts; then functions as a generator to charge the battery.

The start position of the switch also energizes the ignition coil which in turn builds up voltage necessary to fire the spark plug and ignite the fuel-air mixture. The voltage build-up and collapse is accomplished with the use of breaker points and a condenser.

Once the engine is operating, the ignition switch returns to the "on" position. In this position, the generating circuit is completed. Current moves from the generator to the electrical system or battery via the voltage regulator and indicator light.

When the switch is turned to the "off" position, the "hot" line to the coil is broken at the ignition switch thus stopping the engine.

Headlights, cigarette lighter and radio are connected to the accessory lead. When installing headlights on tractors (Serial No. -3550), some rewiring is necessary. See page 20-1 of Section 40.

Tractors (Serial No. -15000) do not have an indicator light.

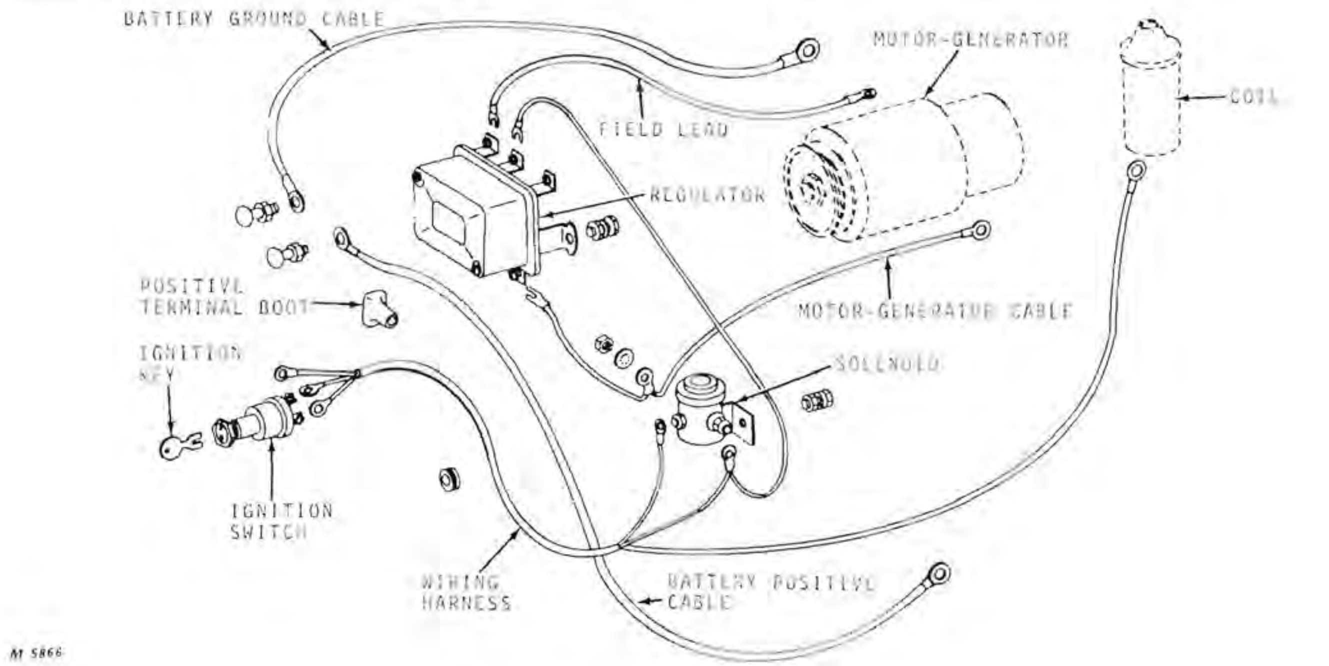


Fig. 2—Wiring Schematic (-3550)

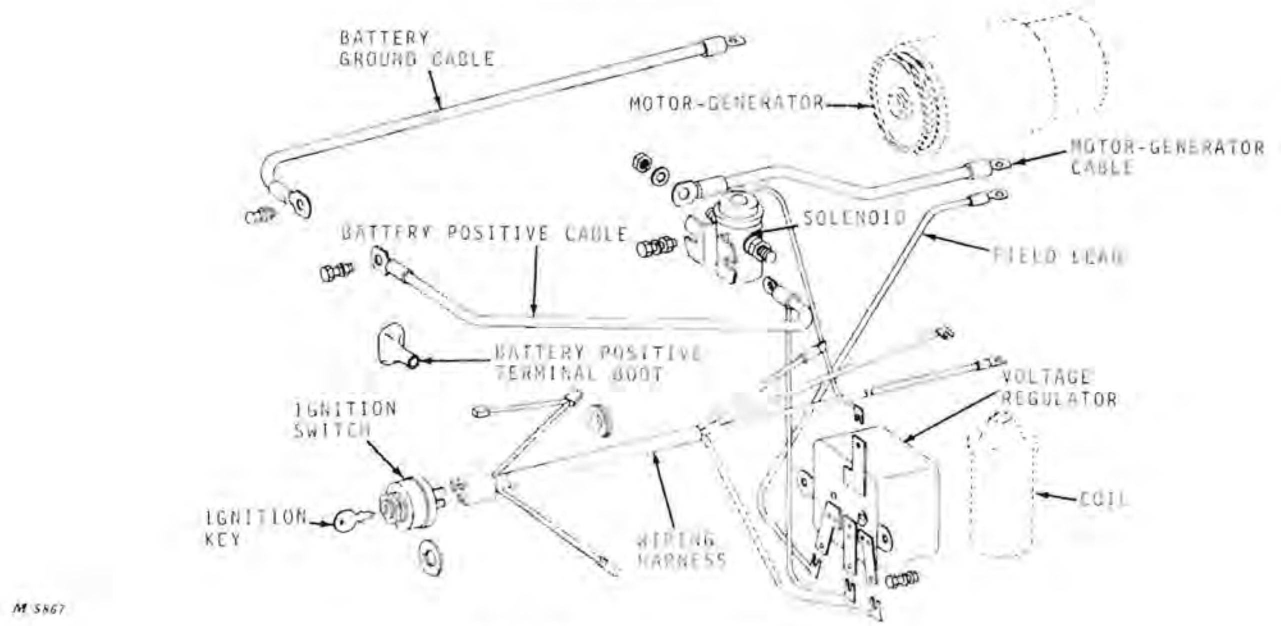


Fig. 3—Wiring Schematic (3551-15000)

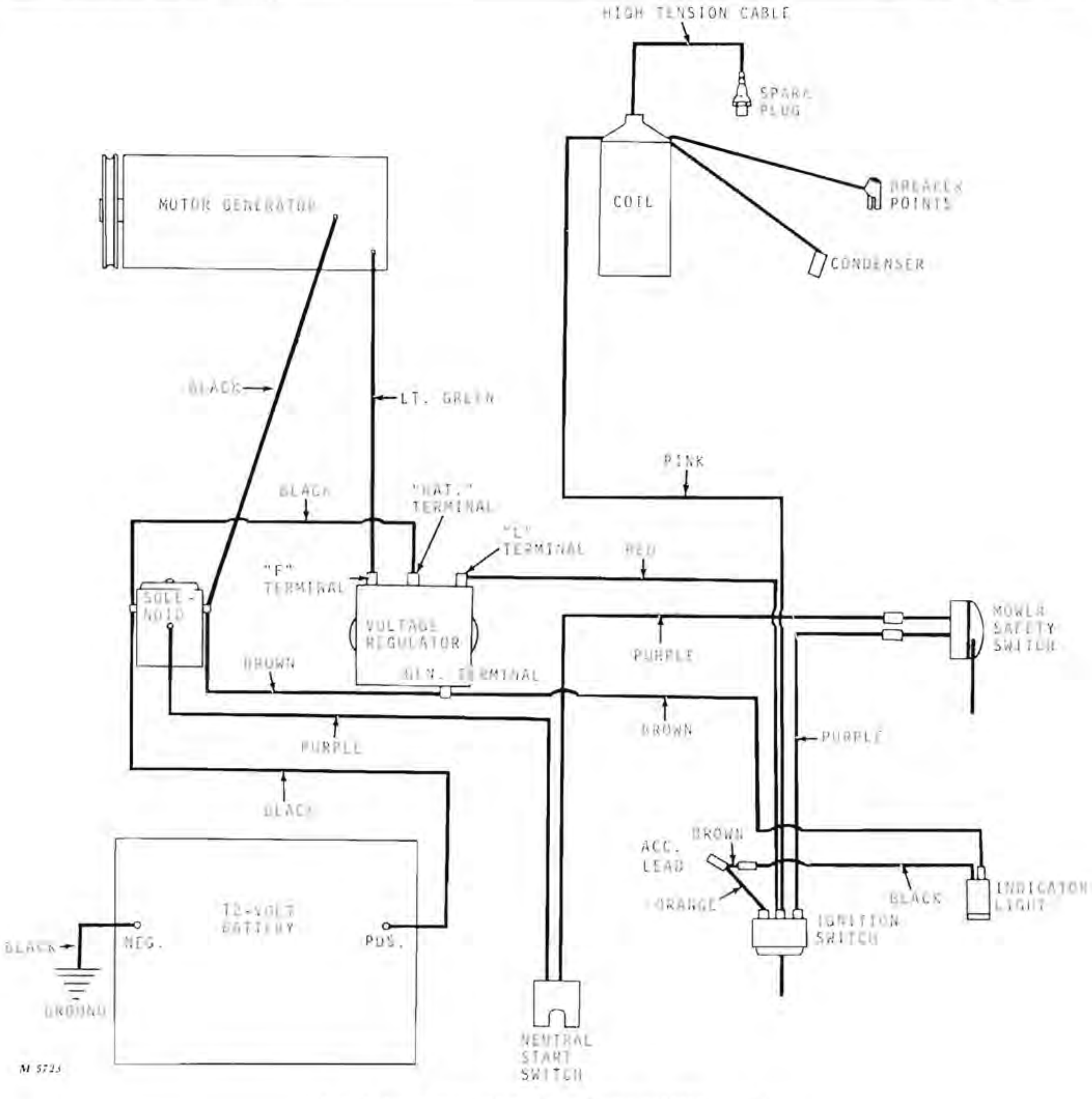


Fig. 4—Electrical System Wiring Diagram (15001-   )

Fig. 5—Schematic View of Generator Indicator Lamp

DIAGNOSING MALFUNCTIONS

BATTERY

Battery Uses Too Much Water

Voltage regulator charge rate too high.
Check current-voltage setting.
Adjust, repair or replace regulator if necessary, page 15-15.

Cracked or damaged battery case.
Replace battery if necessary.

Spewing through filler caps.
Tighten hold down bolts.

Battery Discharges Rapidly

Loose or corroded battery terminals and cable ends.
Clean terminals and cable ends.

Check current-voltage setting.
Adjust, repair or replace voltage-regulator if necessary, page 15-15.

Low water level.
Add water, page 10-8.

Too many accessories functioning at once.
Reduce load.

Low or no motor-generator output.
Check motor-generator condition, page 15-6.

Loose connections or damaged wires.
Tighten connections. Repair or replace damaged wires, page 15-2.

Battery Remains Low or Discharged

Moisture and dirt on case. Moisture logged battery decal.
Remove battery.
Remove decal and clean battery well with soda or ammonia.
Clean terminals and cable ends before installing battery back in tractor.

Loose or corroded battery terminals and cable ends.
Clean terminals and cable ends.

Tractor not operated long enough to charge battery.
Boost battery with battery charger periodically.

Loose or damaged wires.
Tighten connections. Repair or replace damaged wires, page 15-2.

Defective battery.
Charge battery. Check or replace if necessary, page 10-8.

Continuous loads in excess of generator capacity.
Reduce load.

Low or no motor-generator output.
Check motor-generator condition, page 15-6.

Check current-voltage setting.
Adjust, repair or replace voltage regulator if necessary, page 15-15.

Battery Spewing

Battery overfilled.
Lower electrolyte to proper level to prevent electrolyte from spewing out of cell covers.

Loose battery hold down bolts.
Tighten hold down bolts firmly.

Voltage regulator charge rate too high.
Check current-voltage setting.
Adjust, repair or replace regulator if necessary.

Battery Leaking

Cracked or damaged battery case.
Replace battery.

Loose or damaged cell cover.
Check condition of cell cover.
Replace cell cover if necessary.

MOTOR-GENERATOR INDICATOR LAMP

Motor-Generator Lamp Lights When Engine Idles

At low (idle) engine rpm battery voltage is higher than generator voltage. This should be considered normal.

Motor-Generator Indicator Lamp Lights Continually

Loose connections or damaged wires.
Tighten connections. Repair or replace damaged wires, page 15-2.

Motor-Generator Indicator Lamp Lights Continually—Continued

No motor-generator output.
Check motor-generator condition, page 15-6.

Socket leads not properly connected.
Connect leads properly, page 5-3 or 5-4.

MOTOR-GENERATOR

Motor-Generator Fails to Crank

Motor-generator V-belt loose.
Tighten belt.

Motor-generator sheave split.
Replace sheave.
Check condition of belt.
Replace belt if necessary.

Battery discharged.
Charge battery. Check battery condition and replace if necessary, page 10-8.

Corroded battery terminals and/or cable ends.
Clean terminals and cable ends.

Tight bearing in motor-generator end frame.
Clean and check bearing condition.
Replace with special lubricant.
Replace bearing if necessary, page 15-12.

Loose connections or damaged wires.
Tighten connections. Repair or replace damaged wires, page 15-2.

Improper brush spring tension.
Replace spring, page 15-10.

Worn brushes.
Replace brushes, page 15-10.

Ground, open or short in either or both field coils.
Replace coils if necessary, page 15-12.

Ground, open or shorts in armature.
Check commutator condition.
Repair commutator, turn and undercut mica.
Replace armature if necessary, page 15-6.

Defective solenoid.
Replace solenoid, page 10-6.

No Generator Output

Loose connections or damaged wires.
Tighten connections. Repair or replace damaged wires, page 15-2.

Ground, open or short in either or both field coils.
Replace coils if necessary, page 15-12.

Ground, open or short in armature.
Check commutator condition.
Repair commutator, turn and undercut mica.
Replace armature if necessary, page 15-6.

Worn brushes.
Replace brushes, page 15-10.

Improper brush spring tension.
Replace springs, page 15-10.

Unsteady or Low Generator Output

Loose drive belt.
Tighten belt, page 15-17.

Loose connections or damaged wires.
Tighten connections. Repair or replace damaged wires, page 15-2.

Brushes worn or sticky.
Replace brushes, page 15-10.

Low brush spring tension.
Replace springs, page 15-10.

Commutator dirty, out of round or high mica.
Turn commutator down and undercut mica, page 15-12.

Excessive Output

Check current-voltage regulator setting.
Adjust, repair or replace regulator if necessary, page 15-15.

Motor-generator field circuit grounded.
Install new insulating washers, bushings or field coil insulation.
Replace field coil if necessary, page 15-12.

Excessive Noise

Defective drive sheave (halves separated).
Replace sheave.

Worn or dirty bearings.
Clean and check bearing condition.
Repack with special lubricant.
Replace bearings if necessary, page 15-12.

Bent brush holder.
Replace brush holder, page 15-11.

Loose mounting.
Tighten mounting bolts.

REGULATOR

Battery Rundown (Winter Operation)
Infrequent engine operation.
Temporarily increase operating voltage of regulator by disconnecting the lead to the regulator "Bat" terminal and reconnecting this lead to the regulator "L" terminal. An external adjustment unit can be installed for winter and summer use, page 15-18.

CIGARETTE LIGHTER

Cigarette Lighter Will Not Function
Loose or damaged lead.
Tighten lead.
Repair or replace damaged wiring.

Unit not properly grounded.
Secure unit firmly in panel.

Circuit breaker tripped.
Reset circuit breaker, page 20-3.

Headlight Fuse Burns Out When Cigarette Lighter Element is Pushed in to Heat
Lighter fused through light fuse.
Disconnect lead and connect lead to unfused hot lead.

LIGHTS

Lights Will Not Light
Fuse burned out.
Replace fuse.

Loose or damaged wires.
Tighten connections. Repair or replace damaged wires, page 15-2.

Poor ground.
Check ground circuit.
Make sure all connections are clean for good ground.

Group 10
IGNITION SYSTEM

GENERAL INFORMATION

The ignition system has two circuits; primary and secondary. The primary is a low-voltage circuit and the secondary is a high-voltage circuit. The primary circuit consists of the battery, a solenoid, a switch, breaker points, a condenser and necessary wiring to connect these units. The secondary circuit consists of the secondary winding in the coil, spark plug and high tension wire to connect coil secondary circuit to the spark plug.

When the breaker points are closed, the primary or low-voltage current flows from the battery through the ignition switch to the primary windings in the coil, then to ground through the closed breaker points. When the breaker points open, the magnetic field build-up in the primary windings of the coil moves through the secondary windings of the coil inducing high-voltage current. This high-voltage current is distributed to the spark plug to ignite the fuel-air mixture in the combustion chamber.

IGNITION COIL

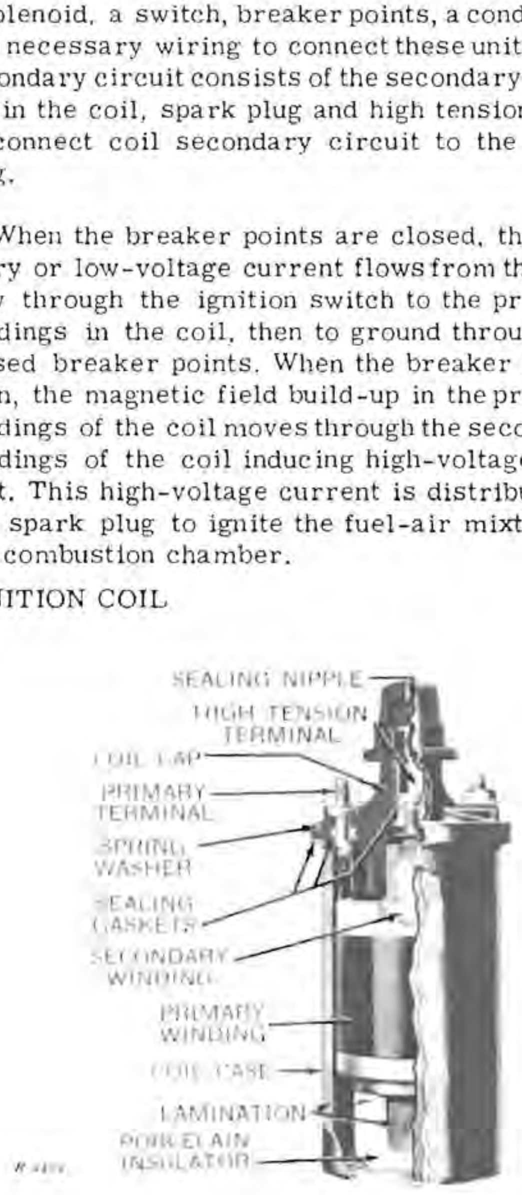


Fig. 1 -Ignition Coil

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 (possibly 250 volts) 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.

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.

Litho in U.S.A.

SPARK PLUG—Continued

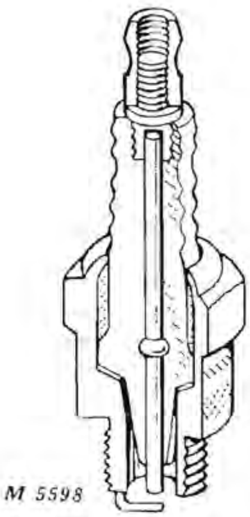


Fig. 2—Spark Plug

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 characteristcs.

CONDENSER

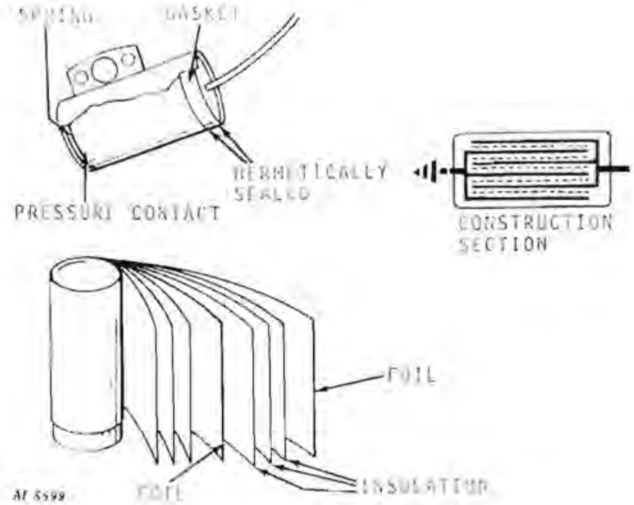


Fig. 3—Cutaway View of Condenser

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.

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

SPARK PLUG ANALYSIS

Fig. 4–Normal Operation

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

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

Fig. 5–Oil Fouling

Wet oily deposits 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. 6–Carbon Fouling

Dry, fluffy, black carbon deposits 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. 7–Deposit Fouling

Red, brown, yellow and white colored coatings 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.

SPARK PLUG ANALYSIS—Continued

Fig. 8—Heat Shock Failure

Heat shock 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. 9—Pre-Ignition

Pre-ignition, causing burned or blistered insulator tip and badly erroded 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.

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 motor-generator 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 10-17.

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

TESTING BATTERY

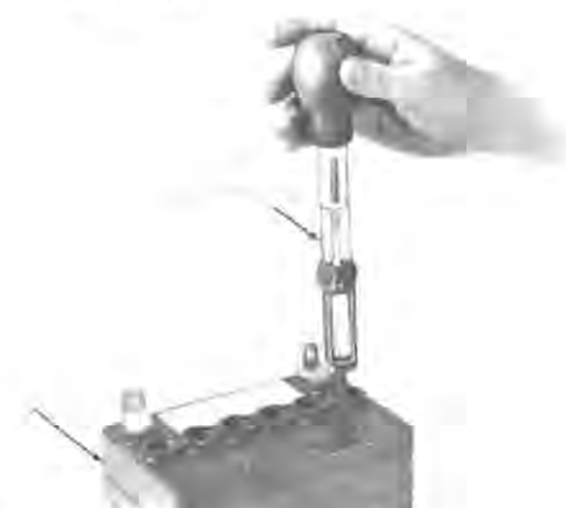


Fig. 10—Testing Specific Gravity

To determine whether the battery is capable of meeting 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 75% charged or higher. This is determined by taking hydrometer readings, Figure 10.

The following table illustrates typical ranges of specific gravity (amount of unused sulfuric acid remaining in the solution) for a cell in various stages 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.

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

There are two methods of testing the battery capacity. Battery electrolyte temperature should be at or near 80°F. for these tests. Before making either of the two following tests, 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 cranking engine to determine battery condition. Refer to instructions supplied by test equipment manufacturer when using high rate test equipment.

The first method is by cranking the engine for 15 seconds with the starting motor and measuring the battery voltage. The voltage should not be less than 9.6 volts at the end of 15 seconds. If less than 9.6, replace battery.

The second method is by using high rate discharge test equipment, Figure 11.

The test consists of discharging the battery, by means of a heavy-duty carbon pile at a rate of 3 times the ampere-hour capacity (24 ampere-hour battery used in both 110 and 112 Tractors). After 15 seconds the battery voltage should not be less than 9.0 volts. If battery fails to meet the load test, it indicates loss of capacity or internal short circuits. Any battery that passes the load test, is a good battery and can be relied upon to full-fill the requirements of the starting motor under normal conditions.

Fig. 11–Testing Battery Capacity

TESTING COIL

Fig. 12–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 12, to test coil. The analyzer will also test the condenser and solenoid as well as checking voltage and amperage. See specifications for manufacturer and model of this test unit.

TESTING COIL—Continued

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

Fig. 13–Testing Condenser Capacity

The test unit, Figure 13 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

TESTING SOLENOID

The solenoid (magnetic switch) used on 110 and 112 Tractors is a sealed unit and cannot be repaired. A simple test for proper operation can be made by using a battery as shown in Figure 14.

With a continuity tester and a battery of correct voltage, connected as shown in Figure 14, momentarily touch jumper lead to solenoid terminal. If switch is in good condition, the plunger will snap in and close the main contacts. Continuity tester light should also light if tester is so equipped.

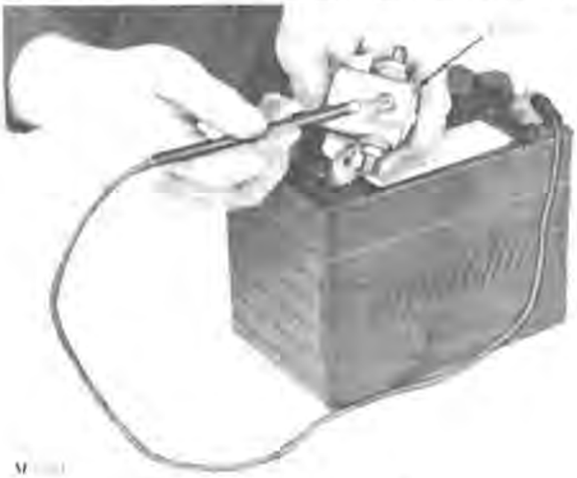


Fig. 14–Solenoid Test

Test unit, Figure 14 can also be used for testing solenoid continuity.

TESTING SAFETY SWITCHES

Neutral-start switch failure is sometimes the wrong diagnosis for a switch which needs only a simple adjustment to fix it.

When the engine fails to crank when the shift lever is in neutral and the tractor clutch throw-out is disengaged, it is likely that the neutral-start switch needs adjusting, especially on tractors (Serial No. -15000).

CAUTION: Be Sure Spark Plug Cable Is Disconnected from Plug to Prevent Accidental Starting of the Engine While Making the Following Test.

Test first by holding the ignition switch in the start position with one hand while moving the shift lever from side to side in the neutral position or into one of the gear positions with the other hand.

If contact is made and the engine begins to crank, the neutral-start switch needs adjusting. Refer to page 10-15 for repair and adjustment.

If engine still does not crank, test electrically as follows:

Fig. 15–Testing Safety Switches

Neutral-Start Switch Test

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.

Safety Switch Test

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

2. With switch lever up against stop, circuit test light should light. If light does not burn, switch is defective.

Test the plug 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.

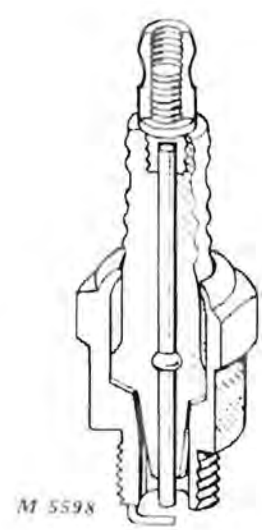


Fig. 16–Spark Plug

TESTING MOTOR-GENERATOR ON TRACTOR

If the motor-generator fails to crank properly, inspect the entire cranking circuit for loose or badly corroded connections and damaged wiring. Refer to page 10-5 to determine battery condition. If the unit fails to crank, wire around the solenoid with a heavy jumper lead. If motor-generator operates, the solenoid or ignition switch is defective and should be replaced. If the unit fails to operate, trouble can be attributed to the engine or the motor-generator. Excessive friction in the engine may be caused from tight bearings, seized piston or rod or from clutches that are not properly disengaged.

If the unit 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, the motor-generator should be removed for further checking.

With the motor-generator removed from the engine, the armature should be checked for freedom of operation by turning the shaft. Tight, dirty or worn bearings, a bent armature shaft, or loose pole shoe screws may cause the armature to drag and turn hard. If the armature does not turn freely, the motor must be disassembled. However, if the armature does operate freely, the motor should be given a No-Load test as shown in Figure 4, page 15-2. During this test the motor is operated without the drive being connected to a load and the current draw and the armature speed noted. Refer to Group 15 for all motor-generator tests and specifications.

TIMING ENGINE

Fig. 17–Timing K181S Engine

Kohler K181S engines have a timing sight hole, Figure 17. The K161S 7 h.p. engine has a timing hole, but is not accessible when in the tractor.

Time K161S engines used on early Model 110 Tractors and HH100 engines, used on 112 Tractors, by setting point gap with a feeler gauge. See engine Section 20. A timing light cannot be used on these engines.

To use a battery powered timing light, the PTO belt guard and right hand side panel must be removed, Figure 17.

Set breaker point gap approximately 0.020 inch with a feeler gauge, Section 20. Then with engine running between 1200 and 1800 rpm, adjust the points until "S" or "SP" or first mark on flywheel is centered in sight hole.

NOTE: The first "S" or "SP" mark will appear 20° before top dead center. The second mark is top dead center and is stamped with "DC" or "T" below the mark.

IMPORTANT: Be sure the engine is operating at 1000 rpm or faster when making this adjustment or the automatic advance and retard mechanism may shift timing and confuse the results.

REPAIR

BATTERY

Charging Battery

The Prestolite 7 LU is a small battery with little space for expansion of the acid. Therefore, the battery is likely to overflow from (1) the heat of operating temperature or (2) to trapped air when filling. When first adding electrolyte, pour in only enough to cover the plates. Then, charge the battery at 7 amperes for 30 minutes or run the tractor for an hour. Check the acid level. Raising the battery temperature from room condition to over 100° F. when charging will many times bring the acid level to the ring in the neck. If it is still below the ring, add enough acid—not water, to bring the level to the bottom of the ring.

CAUTION: Do not bring the acid level up on or above the ring, only to the bottom of the ring.

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.

During charging, the temperature of the electrolyte rises, causing it to expand. Hydrogen natural gas by-products, carry tiny bubbles of electrolyte through the vents. These bubbles burst and the acid is deposited on top of the battery case, as well as elsewhere on the tractor. A minor accumulation immediately starts a weak drain of power.

This is not the time to charge the battery and turn up the regulator. Instead remove the battery, clean it well (the tractor, too) with soda or ammonia and polish the battery terminals and cable ends.

Charge the battery at a 4-ampere rate until a hydrometer reading of 1.250 is attained.

NOTE: The hydrometer reading must be taken at an electrolyte temperature of 80°F. or corrected to 80°F. with a correcting type hydrometer. If you cannot get a "corrected" reading of at least 1.230 after a few hours of slow charge, chances are the battery is permanently damaged.

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 spark away from battery.

The regulator output must never exceed 14.2 to 14.5 volts. Regulators should be adjusted only by trained servicemen with proper equipment to check and set them.

Servicing Battery

Good battery servicing in the tractor should include the following 9 items.

1. Clean battery.
2. Inspect cables including ground connections.
3. Clean terminals.
4. Inspect hold-downs. Tighten finger tight only.
5. Inspect case for leaks.
6. Make hydrometer test.
7. Add water if necessary. Use caution to protect tractor from acid damage.
8. Recharge battery if less than 75% charged.
9. Make load test, page 10-4.

Cleaning Battery

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

Follow the reverse procedure when connecting cables to battery terminals.

Wipe battery with a damp cloth. If terminals are corroded, use a stiff brush and wash with a solution of baking soda consisting of one part baking soda to four parts water. Keep vent plugs tight while washing. After washing, flush battery with clear water. Then coat terminals with petroleum jelly or light film of oil to protect against corrosion. Be sure vent holes are open.

SOLENOID

The solenoid is a sealed unit; replace switch when test shows defective.

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

It is important that leads are connected correctly. Refer to Group 5 for correct lead connections.

COIL

Ignition coils do not normally require any service. However, at time of breaker point replacement, it is wise to visually inspect the coil for the following.

Check the top of coil for cracks or carbon tracks, either of which can cause current leakage resulting in poor performance. It may be necessary to clean the top of the coil with a clean rag and solvent for better visual analysis. Coil replacement may be indicated.

Check coil tower to see if it has been eroded by poor connection. See page 10-12 for proper coil installation and assembly.

CONDENSER

Replace condensers found defective or whenever installing new points.

SPARK PLUG

Fig. 18- Cleaning Spark Plug

SPARK PLUG—Continued

Use a spark plug wrench to remove plug. Always use a new spark plug gasket when replacing plug.

Examine the firing end of the spark plug, noting the type of deposits and the degree of electrode erosion. Refer to pages 10-3 and 10-4 for various types of spark plug fouling and their causes.

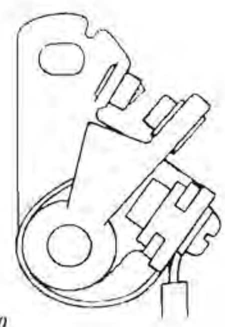
Clean the plug on a sand blast cleaner, following manufacturers instructions. Do not prolong the use of the abrasive blast as it will erode the insulator and electrodes. Clean ALL abrasive from plug before turning into engine.

Brush threads with a wire brush.

Clean the electrode surfaces with a small file, Figure 18. Dress the electrodes to obtain flat parallel surfaces on both the center and side electrode.

After cleaning, examine the plug carefully for cracked or broken insulator, badly pitted electrodes, and other signs of failure. Replace if damaged. Adjust spark plug gap, Figure 30. Torque plug to recommended specifications.

BREAKER POINTS



M 5600

Fig. 19—Burned Breaker Points

Breaker points can be burned from excessively high voltage, oily or dirty points, a faulty condenser or improper point adjustment.

Pitted points and some transfer of material between the points is considered normal. If point transfer is 0.020 inch or more, replace the points.

Rough contacts which are greyish in color often have a greater area of contact than new contacts, and will provide satisfactory service until most of the tungsten is worn off.

Clean the points with a few strokes of a clean oil free fine-cut contact (riffle) file. Do not attempt to remove all roughness nor dress the point surfaces smooth; merely remove the scale or dirt. Never use emery cloth or sand paper to clean the points since abrasive particles will embed in the point surface and cause arcing and rapid burning of the points.

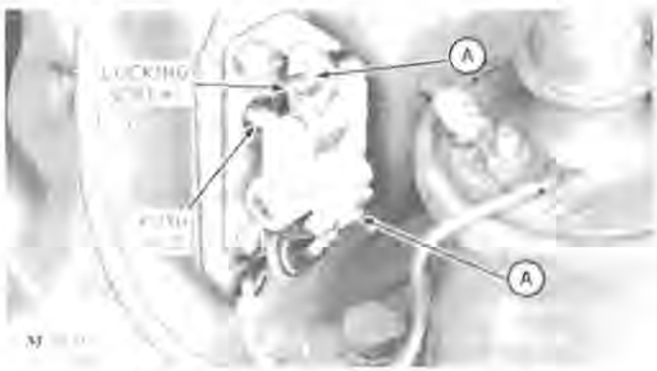


Fig. 20—110 Tractor Point Replacement

When replacing points, remove screws "A". Be sure lock washers are in place on 110 Tractor before reassembly.

Replacement points for 112 Tractor are packaged with a new fiber push rod. Be sure to install new push rod whenever replacing points.

Refer to Figures 28 or 29 and adjust breaker point gap.

SPARK PLUG—Continued

Use a spark plug wrench to remove plug. Always use a new spark plug gasket when replacing plug.

Examine the firing end of the spark plug, noting the type of deposits and the degree of electrode erosion. Refer to pages 10-3 and 10-4 for various types of spark plug fouling and their causes.

Clean the plug on a sand blast cleaner, following manufacturers instructions. Do not prolong the use of the abrasive blast as it will erode the insulator and electrodes. Clean ALL abrasive from plug before turning into engine.

Brush threads with a wire brush.

Clean the electrode surfaces with a small file, Figure 18. Dress the electrodes to obtain flat parallel surfaces on both the center and side electrode.

After cleaning, examine the plug carefully for cracked or broken insulator, badly pitted electrodes, and other signs of failure. Replace if damaged. Adjust spark plug gap, Figure 30. Torque plug to recommended specifications.

BREAKER POINTS

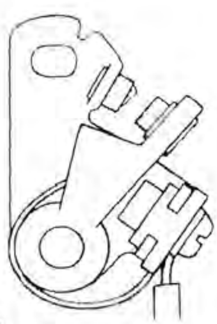


Fig. 19–Burned Breaker Points

Breaker points can be burned from excessively high voltage, oily or dirty points, a faulty condenser or improper point adjustment.

Pitted points and some transfer of material between the points is considered normal. If point transfer is 0.020 inch or more, replace the points.

Rough contacts which are greyish in color often have a greater area of contact than new contacts, and will provide satisfactory service until most of the tungsten is worn off.

Clean the points with a few strokes of a clean oil free fine-cut contact (riffle) file. Do not attempt to remove all roughness nor dress the point surfaces smooth; merely remove the scale or dirt. Never use emery cloth or sandpaper to clean the points since abrasive particles will embed in the point surface and cause arcing and rapid burning of the points.

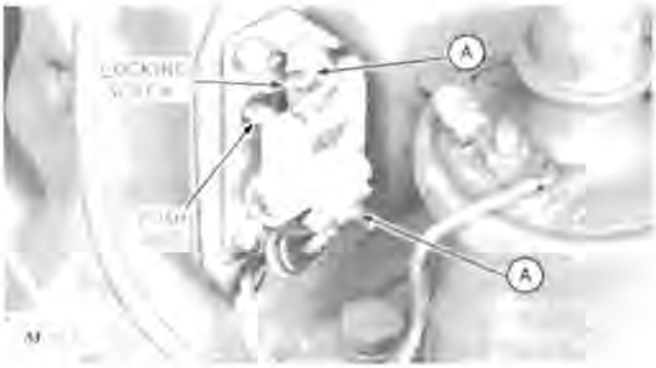


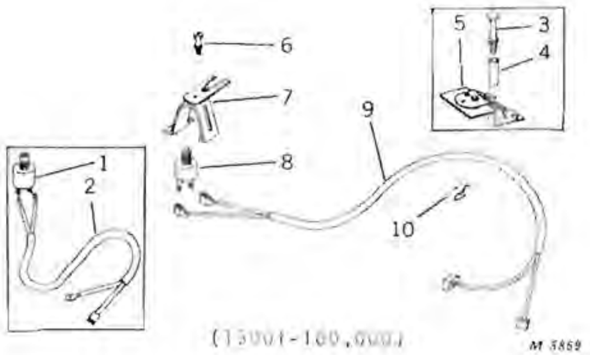
Fig. 20–110 Tractor Point Replacement

When replacing points, remove screws "A". Be sure lock washers are in place on 110 Tractor before reassembly.

Replacement points for 112 Tractor are packaged with a new fiber push rod. Be sure to install new push rod whenever replacing points.

Refer to Figures 28 or 29 and adjust breaker point gap.

NEUTRAL-START SWITCH



1 – Switch (-3550)
2 – Harness (-3550)
3 – Cap Screw (-15000)
4 – Spacer (-15000)
5 – Bracket (-15000)
6 – Cap Screw and Washer (15001)
7 – Bracket (15001-)
8 – Switch (3551-)
9 – Harness (3551-)
10 – Clamp (-)

Fig. 21–Neutral-Start Switch Components

Before replacing or repairing neutral-start switch, be sure to test switch as detailed on page 10-6. A simple adjustment may correct the problem.

NEUTRAL-START SWITCH BRACKETS

Fig. 22–Old and New Neutral-Start Switch Brackets for Tractors Serial No. 15000 and Below

Install the new neutral-start switch bracket, Figure 22, whenever replacement of the old bracket is required on 110 Lawn and Garden Tractors (Serial No. -15000).

The sturdier bracket, which has been substituted for the older bracket, is made of heavier gauge steel and has two mounting legs rather than one.

The new bracket is assembled and adjusted in the same manner and uses the same hardware and switch as the old bracket.

INSTALLATION

BATTERY

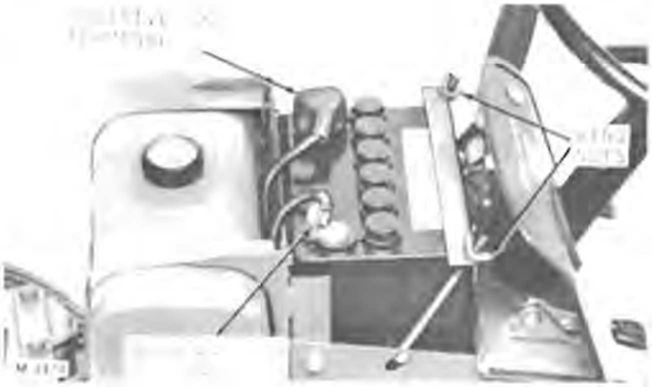


Fig. 23–Installing Battery

If tractor has a battery pad, tuck small portion of pad between battery base and fuel tank.

Battery pad is not furnished on 110 Tractors Serial No. 67001 and above or on 112 Tractors Serial No. 5201 and above.

Battery pad may be removed and discarded from all earlier tractors when servicing battery provided hold-down bolts are tight.

Position battery in tractor with terminals closest to front of tractor, Figure 23. Tighten hold-down wing nuts only finger tight.

Attach wire from solenoid to positive (+) battery terminal.

IMPORTANT: Be sure rubber boot is installed on positive wire and that it completely covers the positive terminal.

Attach ground wire to negative (-) battery terminal.

COIL AND CONDENSER

Fig. 24–110 Tractor Ignition Components

Fig. 25–112 Tractor Ignition Components

Insert coil in coil mounting clamp and tighten mounting clamp bolt firmly.

Fasten coil clamp and condenser to mounting bracket with two screws, lock washers and wrought washers. Tighten screws firmly, Figures 24 and 25.

Connect long red wire (from ignitions switch) to positive (+) terminal on coil. Connect condenser and point lead to coil negative (-) terminal. Do not reverse these connections.

BREAKER POINTS

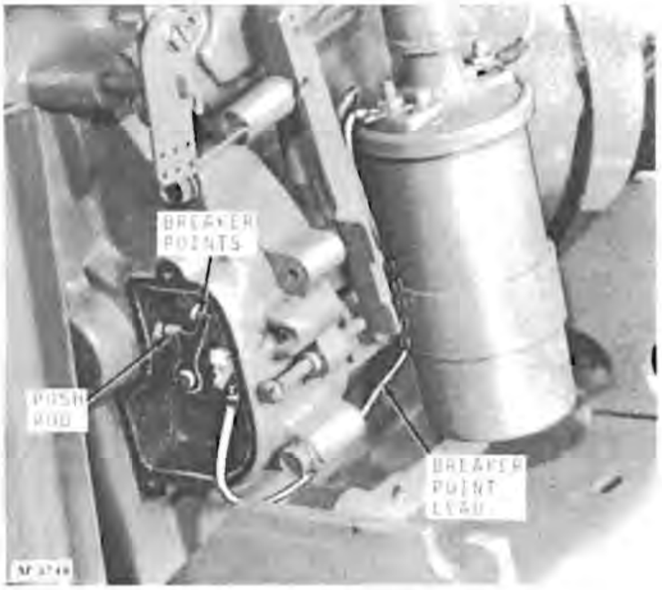


Fig. 26–Installing Breaker Points (112 Tractor Illustrated)

Be sure rubber grommet is installed over wire to points before connecting wire to points on 110 Tractors.

NOTE: When installing new points on 112 Tractors, be sure to include new push rod, Figure 26, included with the points.

Install breaker point cover.

SOLENOID

Fig. 27–Installing Solenoid

Install solenoid as shown in Figure 27. Tighten cap screws firmly. Connect black cable with brown lead to right hand terminal of solenoid. Connect black cable with black lead to left hand terminal of solenoid. Connect purple lead to small terminal on solenoid. Refer to illustrations in Group 5 when making electrical connections.

ADJUSTMENT

ADJUSTING BREAKER POINTS WITH GAUGE

Fig. 28–Adjusting Points - 110 Tractor

Fig. 29–Adjusting Points - 112 Tractor

Disconnect spark plug cable to prevent accidental starting of the engine. Remove ignition point cover and rotate engine flywheel until points are fully open.

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

After tightening locking screw, recheck point gap.

Check engine timing on 110 Tractors with timing light for positive timing. See Figure 17.

ADJUSTING SPARK PLUG GAP

Fig. 30–Adjusting Spark Plug Gap

Determine spark plug condition, pages 10-3 and 10-4.

Reusable plugs, after being cleaned, must be regapped. Distance between electrodes should be 0.025 inch on 110 Tractors and 0.030 inch on 112 Tractors. Bend the outer electrode only for proper gap.

Always remove old spark plug gasket and install new gasket when installing cleaned plug back in engine. Gaskets are available at any automotive jobber. A new gasket is supplied with new plugs. Tighten plug to 15 to 20 ft-lbs torque.

CHECKING COIL POLARITY

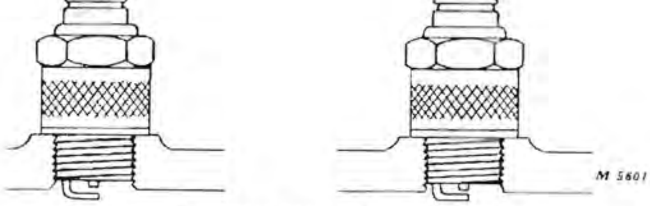


Fig. 31–Checking Coil Polarity

Coil polarity is important because incorrect polarity will require 4000-8000 volts more to fire the spark plug. One method to check polarity is to connect the negative lead of a volt meter to the spark plug terminal. With engine running, momentarily touch positive volt-meter lead to a good ground. The coil polarity is correct if the meter reads up scale.

Another method is to hold the spark plug high tension wire about 1/8 inch from the spark plug. Insert lead point of a wooden pencil in spark, Figure 31. Spark should flare and turn orange on plug side of pencil lead if polarity is correct. A loss of engine power is also noticed when the coil polarity is incorrect.

Refer to illustrations in Group 5 for proper electrical connections.

ADJUSTING NEUTRAL-START SWITCH AND BRACKET

Before attempting to make any switch or bracket adjustments, check the neutral-start bracket for excessive looseness at fork pivot. Also check condition of dimple on underside of fork. Replace bracket if necessary.

Continued usage of the tractor shifter lever will cause the neutral-start switch to wear and loosen, making switch adjustment necessary. Occasionally, a neutral-start switch is replaced or is bypass-wired even though a few simple adjustments would fix it. Before replacing a switch, follow the adjustment procedure described here for 110 and 112 Tractors.

Fig. 32–Tester Connected to Switch Terminals 110 Tractors (-15000)

There are two adjustments which are important so that the neutral start switch will operate as designed, whenever the shift lever is placed into neutral to complete the engine cranking circuit.

To adjust neutral start switch and bracket, connect a continuity tester to switch terminals, Figure 32.

1. Position shift lever so that dimple in under side of fork plate is above or touching switch plunger. Loosen jam nut and turn switch inward until continuity is observed on meter. Then turn switch barrel 1/4 turn clockwise and tighten jam nut.

2. Move shift lever up and down in neutral position. If dimple in underside of fork does not contact plunger, loosen both switch bracket screws and move bracket until dimple in fork contacts plunger. Tighten cap screws firmly.

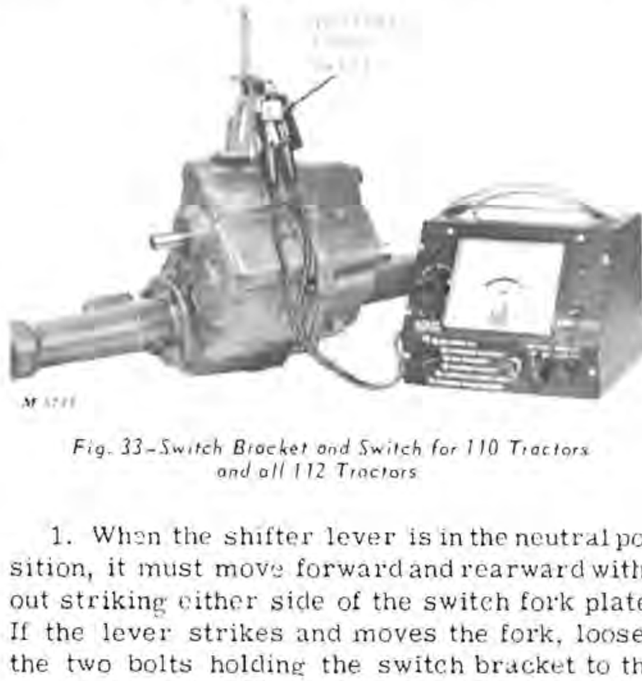


Fig. 33–Switch Bracket and Switch for 110 Tractors and all 112 Tractors

1. When the shifter 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 shifter lever does not strike the switch fork. Tighten bolts firmly.

2. Connect a continuity tester to switch terminals, Figure 33. Loosen jam nut and turn switch inward until continuity is observed on meter. Then turn switch barrel 1/4 turn clockwise and tighten jam nut.

CAUTION: Be sure dimple is not pushing plunger down too far. If plunger contacts fork too hard, the switch will be active at all times and will bend bracket.

When proper adjustment is obtained, the engine should start only when the shift lever is in neutral position.

SPECIFICATIONS

ELECTRICAL COMPONENTS

Component	New Part	Wear Tolerance
Spark Plug Gap 110 Tractors - K161S-7HP K181S-8HP Kohler Engines	0.025 inch	. . . . .
112 Tractors - HH100-10HP Tecumseh Engine	0.030 inch	. . . . .
Breaker Point Gap (all engines)	0.020 inch	. . . . .
Battery	12 volts	Refer to specifications chart supplied by test equipment manufacturer and use appropriate control settings for battery being tested
Coil Power Test Operating amperage	2.25 Max. @ 21,000 volts	Refer to specifications chart supplied by test equipment manufacturer and use appropriate control settings for coil being tested
Continuity Test OHM Resistance	3.9 Min/4.8 Max. @ 8,000 volts ±1,000 volts	
Condenser Capacity-Microfarads Minimum resistance Flash	.18-.23 1,000 meg. OHMs 500 volts D.C.	Refer to specifications chart supplied by test equipment manufacturer and use appropriate control settings for condensser being tested

TORQUE FOR HARDWARE

Location	Torque
Spark plug (cold) K161S-7HP and K181S-8HP Kohler	15-20 ft-lbs
HH100-10HP Tecumseh	15-20 ft-lbs

TUNE UP DATA

Item	Specifications
Battery level	Water should cover plates at all times. Use clean distilled water when possible.
Spark plug	Periodically clean and regap, see Figure 30.
Breaker points	Replace badly pitted or burned breaker points.

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.

Litho in U.S.A.

Group 15
CHARGING SYSTEM

GENERAL INFORMATION

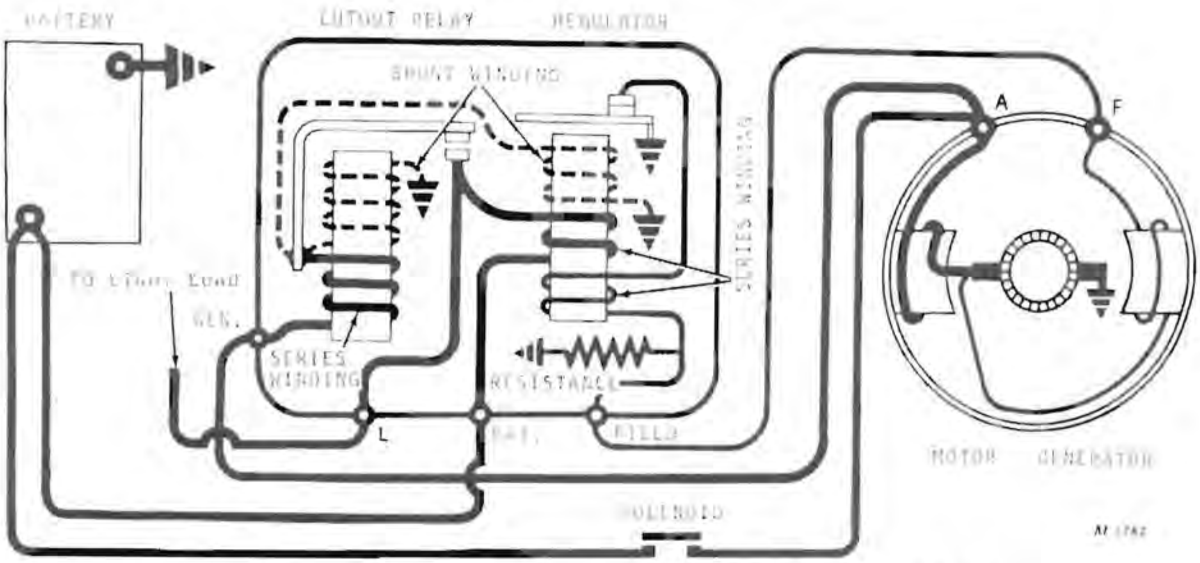


Fig. 1–Wiring Diagram Showing Motor-Generator, Regulator, Battery and Switch

The Delco-Remy Motor-Generator functions as a cranking motor when the solenoid is closed. After the engine is operating and the motor switch opens the circuit, the unit functions as a generator.

The motor-generator contains a series and a shunt field. Both fields are effective for developing torque when the unit performs as a cranking motor. Figure 1 illustrates the circuitry of the two terminal motor-generator with the two unit regulator used on 110 and 112 Tractors. When this unit operates as a generator, the shunt field is the main field and the series field acts as a bucking field, which tends to limit generator output at high speed.

The combination current-voltage regulator is a device which provides control of the generator output and circuit voltage so as to meet various battery and operating requirements.

The cutout relay is a device which closes the circuit between the generator and battery when the generator is operating at sufficient speed to charge the battery and which opens this circuit when the generator slows down or stops to prevent the battery from discharging back through the generator.

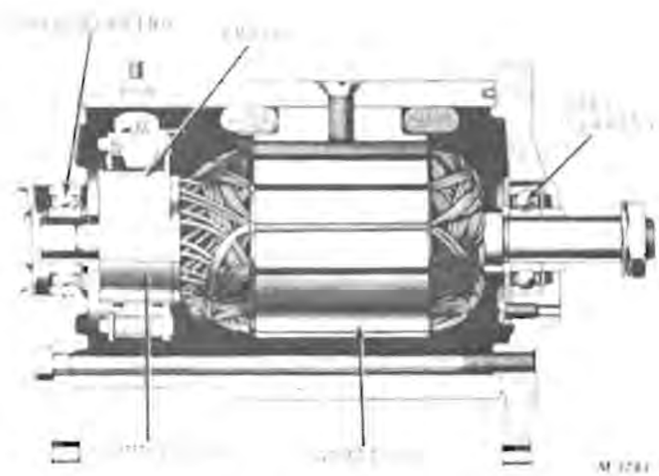


Fig. 2–Cross Sectional View of Motor-Generator

TESTING

Provided here are instructions for testing electrical components on and off the tractor. The purpose of the tests is to isolate the cause of the trouble in the generating 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 motor-generator and voltage regulator can be tested on automotive test equipment.

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

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

TESTING CIRCUIT WIRING

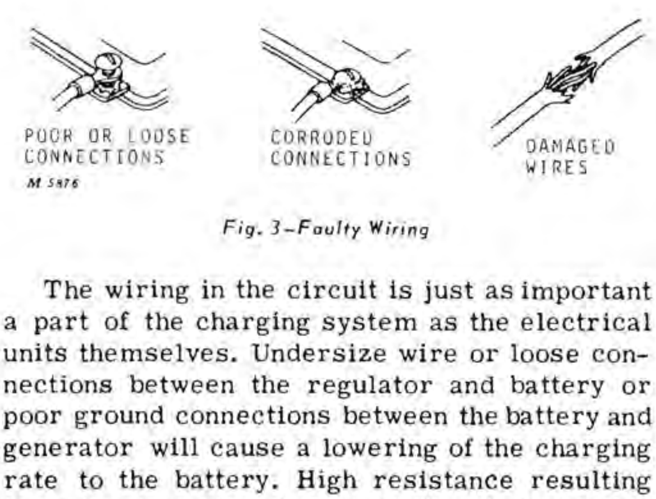


Fig. 3–Faulty Wiring

The wiring 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 generator will cause a lowering of the charging rate to the battery. High resistance resulting from loose or corroded connections in the charging circuit between the generator and regulator will result in a high voltage at the generator and may cause premature failure of the regulator points.

A visual inspection will often reveal much useful information relative to the condition of the charging system. All wiring should be visually inspected periodically for damaged insulation. Faulty wiring should be replaced. All terminals should be checked for loose or corroded connections. Terminals should be cleaned and tightened if 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 MOTOR-GENERATOR OFF TRACTOR

First check motor-generator on tractor as explained on page 10-7 of Section 40. Then, perform the no-load test as instructed below with the motor-generator removed from the tractor.

MOTOR-GENERATOR NO LOAD TEST

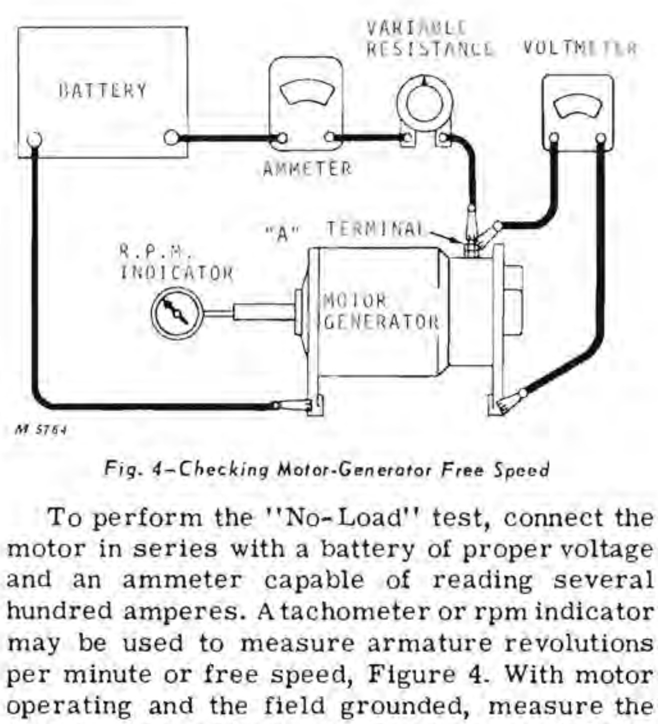


Fig. 4–Checking Motor-Generator Free Speed

To perform the "No-Load" test, connect the motor in series with a battery of proper voltage and an ammeter capable of reading several hundred amperes. A tachometer or rpm indicator may be used to measure armature revolutions per minute or free speed, Figure 4. With motor operating and the field grounded, measure the current draw and note the armature speed. Compare these readings with specifications on page 15-19 to determine if the motor is operating properly.

Test Conclusions

1. Rated current draw at rated speed, as found in specifications, indicates normal condition of the motor-generator.

2. Low free speed and high current draw indicates:

(a) Too much friction-tight, dirty or worn bearings, bent armature shaft or loose pole shoes allowing armature to drag.

(b) Shorted armature. Check on a growler after disassembly.

(c) Grounded armature or fields. Check further after disassembly.

3. Failure to operate with high current draw indicates:

(a) Direct ground in the terminal or fields.

4. No current draw indicates:

(a) Open field circuit. Check after disassembly by inspecting internal connections and tracing circuit with a test lamp.

(b) Open armature coils. Inspect the commutator for badly burned bars after disassembly.

(c) Broken brush springs, worn brushes, high insulation between the commutator bars or other causes which would prevent good contact between the brushes and commutator.

5. Low no-load speed and low current draw indicates:

(a) High internal resistance due to poor connections, defective leads, dirty commutator and causes listed under No. 4.

6. High free speed and high current draw indicates a shorted shunt or series field coil. A shorted shunt coil can be determined by following paragraph 3, page 15-5 under "No Output" on page 15-4. If the shunt coil performs properly, replace the series coil.

7. High free speed and near normal current draw indicates an open shunt coil. Replace the coil and check for improved performance.

8. Noise emanating from a generator may be caused by a loose mounting or drive pulley. It can also be caused by worn or dirty bearings, or improperly seated brushes. Dirty bearings may sometimes be saved by cleaning and lubricating, but worn bearings should be replaced. Excessive noise may result if the brush holder is bent, resulting in improper seating of the brush. Such a brush holder must be replaced.

TESTING GENERATOR OUTPUT

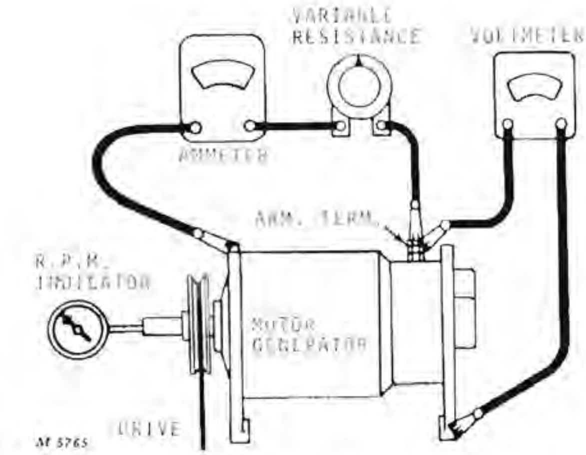


Fig. 5—Checking Motor-Generator Output

To check the motor-generator output, some means of driving the unit is necessary. Also an ammeter, variable resistance and voltmeter, connected as shown in Figure 5 is needed. The field connection must be grounded with a jumper lead. Refer to specifications, page 15-19, for specified rpm and rotation, and drive unit accordingly. Adjust the voltage by varying the resistance and read ammeter. The unit should function according to specifications. If not, repair or replace parts as indicated in the following test conclusions.

Test Conclusions (No Output)

If the generator will not produce any output, check the commutator, brushes and internal connections. Sticking brushes, a dirty or gummy commutator or poor connections may prevent the generator from producing any output. Solder thrown from the commutator riser bars indicates that the generator has been overheated from excessive output. Often this leads to an open circuit and burned commutator bars and consequently no output. (See paragraph 4, page 15-5.) If the brushes are satisfactorily seated and are making good contact with the commutator, and the cause of trouble is not apparent, use a test lamp as follows to locate the trouble (leads must be disconnected from motor-generator terminals).

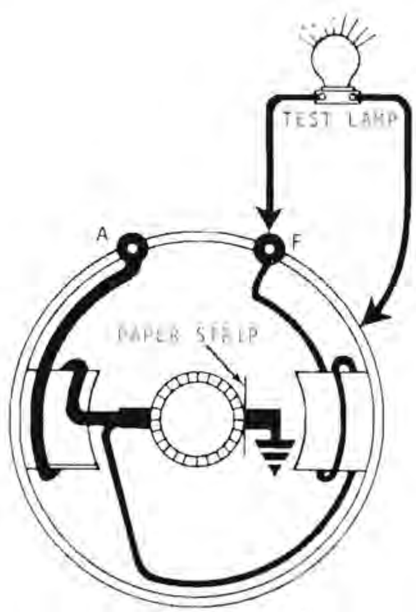


Fig. 6–Checking for Grounded Motor-Generator

1. Remove motor-generator from tractor. Remove end frame (commutator end). Raise the grounded brush from the commutator and insulate with a piece of paper. Place end frame in place using care not to move paper strip. Install and snug through bolts. Check for grounds with test prods from the generator "F" terminal to the generator frame, Figure 6. If the lamp lights, it indicates that the unit is internally grounded. Location of the ground can be found by disconnecting the field and brush leads from the insulated brush holder and checking the brush holders, armature and field separately. Repair or replace parts as required.

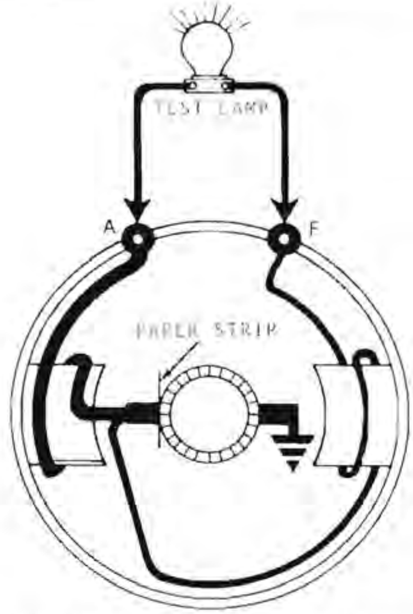


Fig. 7–Checking for Open Field Coils

2. If the unit is not grounded, check the field for an open circuit, Figure 7 with a test lamp. The lamp should light when one test point is placed on the field terminal and the other is placed on the armature terminal.

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 coil must be replaced.

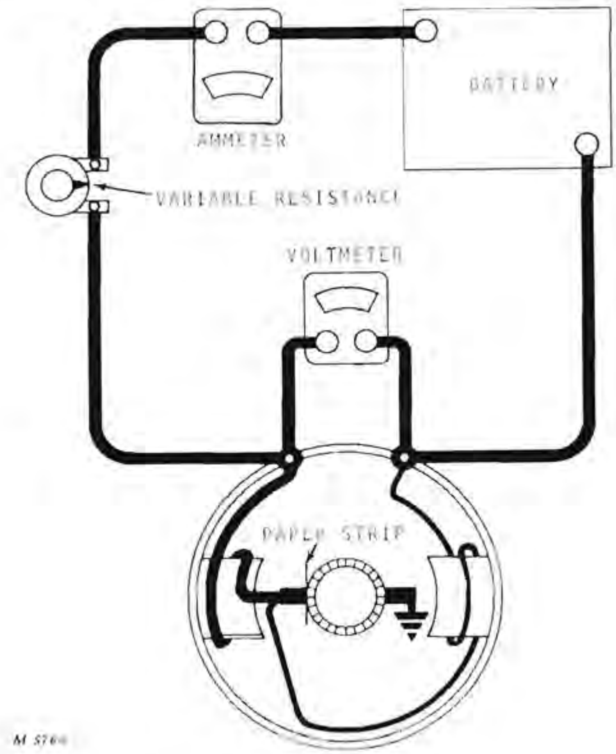


Fig. 8–Checking Shorted Field Coils

3. If the field is not open, check for a short circuit in the field, Figure 8, by connecting a battery and an ammeter in series with the field circuit. Proceed with care, since a shorted field may draw excessive current which might damage the ammeter. If the field coil current draw is not within specification for the specified voltage, new field coils will be required.

NOTE: If a shorted shunt field is found, check the regulator contact points, since a shorted field may have permitted excessive field current which would have caused the regulator contact points to burn. Clean or replace points as required.

4. If the trouble has not yet been located, check the armature for open and short circuits. Open circuits in the armature are usually obvious since an arc will occur at the commutator bars connected to the open winding every time they pass under the generator brushes and consequently become burned. If the bars are not too badly burned and the open circuit can be found and repaired, the armature can usually be saved. When this condition is found, the regulator should be checked and readjusted if necessary so the setting is within specifications.

Test Conclusions (Unsteady or Low Output)

If the generator produces a low or unsteady output, the following factors should be considered:

1. A loose drive belt that slips and consequently causes a low or unsteady output.

2. Brushes that stick in their holders, or low brush spring tension which will prevent good contact between the brushes and commutator resulting in low and unsteady output. This will also cause arcing and burning of the brushes and commutator.

3. A commutator that is dirty, out of round, or has high mica causing generator output to be low and unsteady. To correct these conditions, turn the commutator down in a lathe and undercut the mica. Burned commutator bars may indicate an open circuit condition in the armature as already stated in paragraph 4 under "No Output" (below left).

Test Conclusions (Excessive Output)

When a generator produces excessive voltage or current, disconnect the lead from the "F" terminal. If the generator output remains high, with the "F" terminal lead disconnected, then the trouble is in the generator itself which must be further analyzed to locate the source of trouble.

Since the motor-generator field circuit is grounded through the regulator, accidental internal grounding of the field circuit will prevent normal regulation so that excessive output will be produced by the generator. On this type of unit, an internally grounded field circuit which would cause excessive output may be located by connecting a test lamp between the "F" terminal and the generator frame, Figure 6. All leads should be disconnected from the "F" terminal and the brush to which the field lead is connected inside the generator should be raised off the commutator before this test is made. If the test lamp lights, the field is internally grounded. If the field has become grounded because of defective insulation on a field lead, repair can be made by reinsulating the lead. It is also possible to make repair where a ground has occurred at the pole shoes by removing the field coils and reinsulating them. A ground at the "F" terminal stud can be repaired by installing new insulating washers or bushings.

TESTING ARMATURE

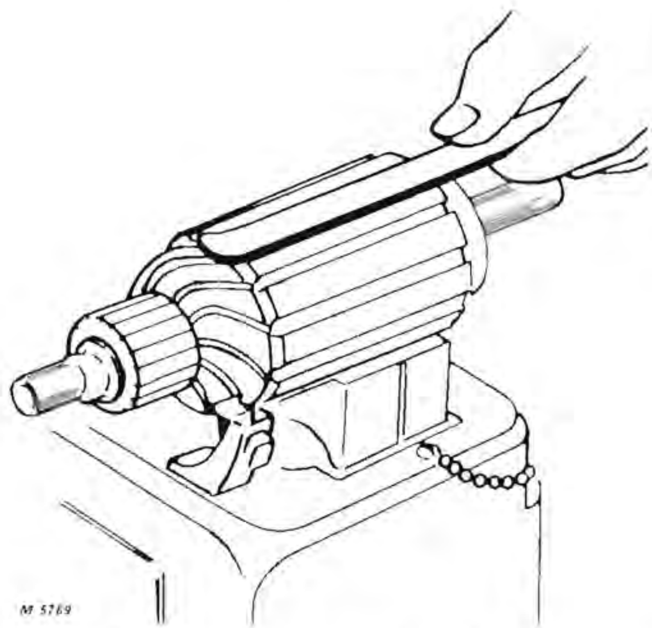


Fig. 9—Checking Armature for Short Circuits

Test the armature for opens, shorts and grounds as follows:

1. SHORTS - Short circuits are located by rotating the armature in a growler with a steel strip (hacksaw blade) held on the armature. The steel strip will vibrate on the area of the short circuit.

2. GROUNDS - 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.

3. OPENS - Inspect the points where the conductors are joined to the commutator for loose connections. Poor connections cause arcing and burning of the commutator. Refer to repairs, page 15-10, if armature has loose connections.

If the commutator is worn, dirty, out of round, or has high insulation, the commutator should be turned down and undercut.

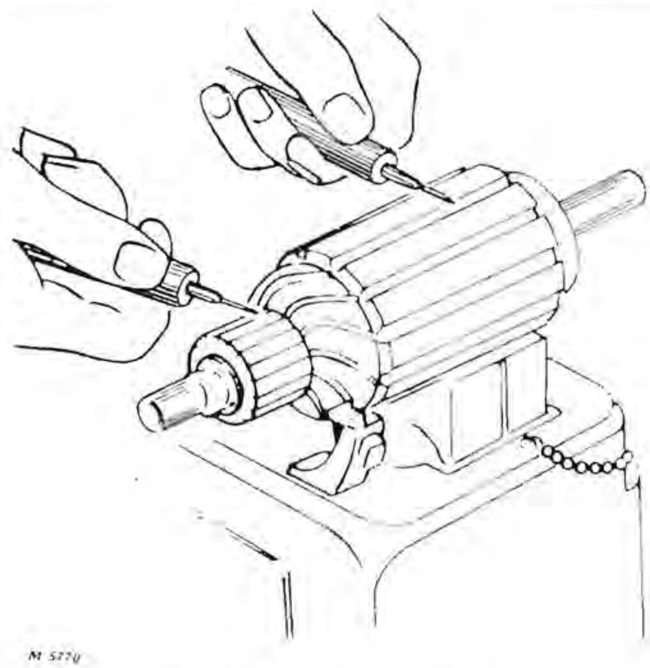


Fig. 10—Checking Armature for Grounds

TESTING VOLTAGE REGULATOR

The proper testing equipment in the hands of a qualified mechanic is necessary to assure proper and accurate regulator settings. Any attempt on the part of untrained personnel to adjust regulators is likely to lead to serious damage to the electrical equipment.

After making any generator or regulator tests or adjustments, the generator should be polarized to avoid damage to equipment. See page 15-18.

In analyzing complaints of voltage-regulator operation, any of several basic conditions may be found.

1. Battery Remains Charged with Low Water Usage - This indicates normal generator-regulator operation. Regulator settings may be checked as outlined in the following sections.

2. Battery Remains Charged with High Water Usage - If the electrolyte level in the battery drops rapidly to the top of the separators, it indicates that the current-voltage regulator is not reducing the current flowing to the battery as it should. Excessive current flowing to a fully charged battery will cause serious damage in the battery. This operating condition may result from:

   a. Improper setting of the current-voltage regulator unit.

   b. Defective current-voltage regulator unit.

   c. Grounded generator field circuit (in either generator, regulator or wiring).

   d. The load and battery leads may be interchanged at the regulator terminals.

To determine the cause of trouble, first disconnect the lead from the regulator "F" terminal with the generator operating at medium speed. If the output remains high, the generator field is grounded either in the generator or in the wiring. If the generator output stops, the regulator is probably at fault, and it should be checked for high current-voltage setting. Refer to Figure 4, page 5-4, for possibility of interchanged leads at the "L" and "B" terminals.

3. Battery Remains Low or Discharged - This condition could be due to:

   a. Loose connections or damaged wires.

   b. Defective battery (Battery should take charge and should crank engine).

   c. High circuit resistance. (Check voltage drop between "BAT" terminal of regulator and battery. Drop should not exceed 0.15 volts with 3-4 amperes flowing.)

   d. Low regulator setting.

   e. Damage or defects within the regulator.

   f. Defects within the motor-generator.

   g. Continuous loads in excess of generator capacity.

If Generator Shows Some Output - With generator operating at medium speed, a charge rate of 1 to 3 amperes is normal with fully charged battery at normal operating temperatures. If battery is in a discharged condition or is extremely hot, charge rate will be considerably higher. If condition of battery indicates that charge rate is too low, momentarily ground "FIELD" terminal of regulator. If output shows a strong increase, trouble is probably due to low setting of current-voltage regulator unit or to dirty contact points in regulator. If output does not increase, generator is probably at fault and should be checked. Refer to Figures 6, 7, and 8.

If Generator Shows No Output - With generator operating at medium speed, momentarily connect a jumper between "GENERATOR" and "BATTERY" terminals of regulator. If generator shows output, the relay is at fault. If generator does not show output, momentarily ground "FIELD" terminal or generator. If generator now shows output, regulator is at fault. If generator still does not show output, the generator is at fault and should be checked.

4. Damaged Resistor - If the resistor attached beneath the regulator is broken or otherwise damaged, the contact points of the current-voltage regulator unit soon become burned. This condition results in a low generator output. Whenever a resistor is replaced it will usually be found necessary to clean the contact points in order to restore satisfactory operation.

5. Damage Within the Regulator - This may be due to reversed generator polarity. Generator polarity must be corrected, as explained under "Polarizing Generator," page 15-18, after any checks of the regulator or generator, or after disconnecting and reconnecting leads.

TESTING REGULATOR

The electrical settings of the cutout relay and the current-voltage regulator unit may be checked either on or off the tractor without removing the regulator cover. When bench checks are made, the regulator must be connected only to a generator of the type for which it is designed. Results obtained with any other type of generator will be meaningless. When the regulator is checked on a tractor, all loads (including ignition) connected to the "L" terminal must be switched off. To furnish ignition current during tests for electrical settings, use a jumper lead to connect free end of battery lead direct to primary terminal of ignition coil (switch side).

TESTING CURRENT-VOLTAGE REGULATOR UNIT SETTING

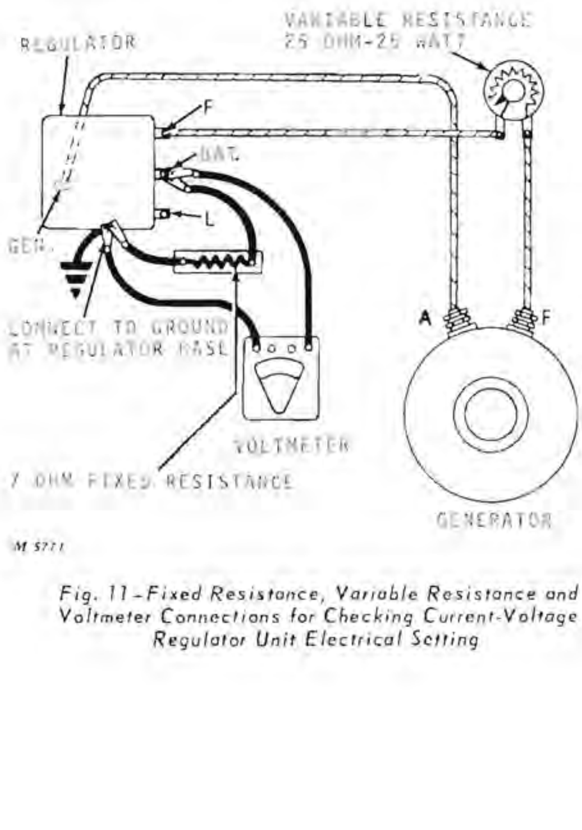


Fig. 11-Fixed Resistance, Variable Resistance and Voltmeter Connections for Checking Current-Voltage Regulator Unit Electrical Setting

To check the electrical setting of the current-voltage regulator unit, disconnect the lead from the "BATTERY" terminal of the regulator and connect a fixed resistor from the "BATTERY" terminal of regulator to "GROUND" on the regulator base, Figure 11. The system also requires a 7-Ohm fixed resistor as shown in Figures 11 and 12.

Disconnect the lead from the "FIELD" terminal of the regulator, and connect a variable resistance (25-Ohm-25 watt) in series between the lead and the "FIELD" terminal. The variable resistance must have an "open" position at the extreme left end of its travel, Figure 11.

Connect a low reading test voltmeter between the "BATTERY" terminal of the regulator and "GROUND" at the base of the regulator. For this check, the regulator must be stabilized at operating temperature, otherwise the results are of no value. To stabilize the regulator, operate the generator at a speed of 2500 rpm for at least 15 minutes with the fixed resistor connected and the knob of the variable resistance turned to the right so that the resistance is entirely cutout.

With the generator operating at 2500 rpm and all electrical load (including ignition) disconnected from the "L" terminal of the regulator, slowly turn the operating knob of the variable resistance to the left until the circuit is broken at the "open" position. Then turn the knob back to the right slowly until the resistance is entirely cutout. Note the voltage setting. If the check is repeated, the knob on the variable resistance must be turned to the "open" position each time before the voltage is again raised.

TESTING CUTOUT RELAY CLOSING VOLTAGE

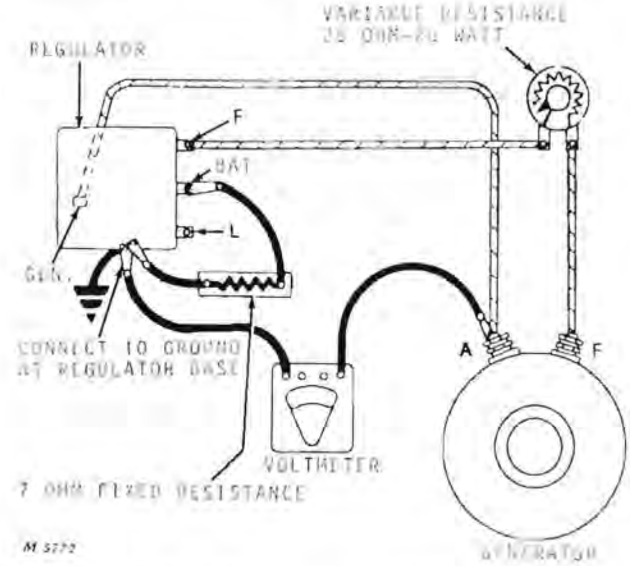


Fig. 12–Fixed Resistance, Variable Resistance and Voltmeter Connections for Checking Cutout Relay Closing Voltage

The cutout relay closing voltage check should be made immediately after the current-voltage regulator unit check while the regulator is stabilized at operating temperature.

Electrical connections for this test are exactly like those for the current-voltage unit check except that the voltmeter is connected from the "A" terminal of the generator to "GROUND" as shown in Figure 12.

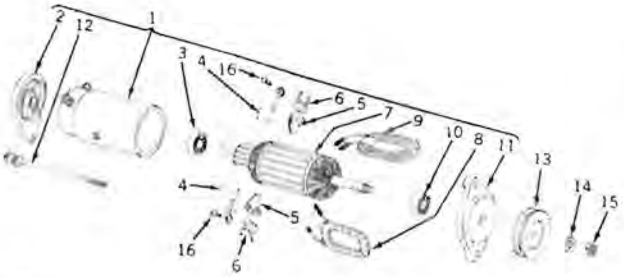
To check the cutout relay closing voltage, turn the knob of the variable resistance to the right until the resistance is entirely cutout, and start the generator.

Adjust the generator speed to approximately 2500 rpm. Slowly turn the knob of the variable resistance to the left until the "open" position is reached and the field circuit is broken. Then turn the knob slowly to the right so that the generator voltage rises slowly until the relay closes. (Closing of the relay is indicated by a sharp drop in voltage.) Note the closing voltage.

If the check is repeated, the knob on the variable resistance must be turned to the "open" position each time (so that the field circuit is broken) before raising the voltage to the closing point of the relay. This is necessary to eliminate the effects of residual magnetism.

REPAIR

MOTOR-GENERATOR



1 – Motor-Generator Complete
2 – Commutator End Frame
3 – Commutator End Bearing
4 – Brush (2 used)
5 – Brush Arm (2 used)
6 – Brush Spring (2 used)
7 – Armature
8 – L.H. Field Coil (3/16'' OD Wire)
9 – R.H. Field Coil (3/32'' OD Wire)
10 – Drive End Bearing
11 – Drive End Frame
12 – Thru Bolt (2 used)
13 – Pulley
14 – Shaft Washer
15 – Shaft Nut
16 – Machine Screw (2 used)

Fig. 13–Exploded View of Motor-Generator

Cleaning Parts

Disassemble motor-generator and clean parts with compressed air and a dry cloth. Never clean parts in a degreasing tank or by use of degreasing compounds since this might damage insulation so that a short or ground would subsequently develop.

Brushes

Fig. 14–Brushes

Fig. 15–Testing Brush Spring Tension

Check brushes to make sure they are not binding in the brush holder and that they are resting at the proper angle and are making a good firm contact on the commutator.

Brushes worn down to one-half their original length when compared with new ones, should be replaced.

The brush spring tension should be as stated in specifications, page 15-19. Excessive tension will cause rapid brush and commutator wear, while insufficient tension will result in arcing and burning of the brushes and commutator. Brush spring tension can be checked with a spring gauge hooked on the brush arm as shown in Figure 15.

Correction in tension can be made by bending the brush spring as required. If the brush spring shows evidence of overheating by appearing blued or burned, a new spring should be installed. Overheating will cause a spring to lose its temper. If the brushes are worn down to one-half their original length, when compared with new brushes, they should be replaced.

Brush Holders

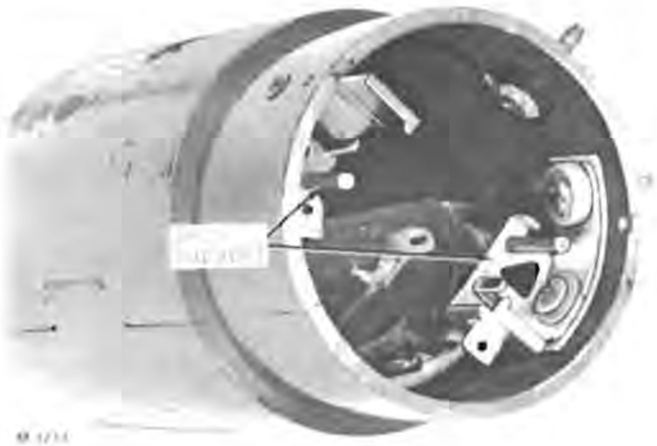


Fig. 16--Installing Brush Holders

The brush holder assemblies are mounted on the inside of the generator frame, Figure 16. Replace damaged brush holders. To remove brush holder(s), drill out rivets holding them to frame. Secure new holders to frame with screws, nuts and washers provided in the replacement package.

Armature

When inspecting the motor-generator, 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 17.

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.

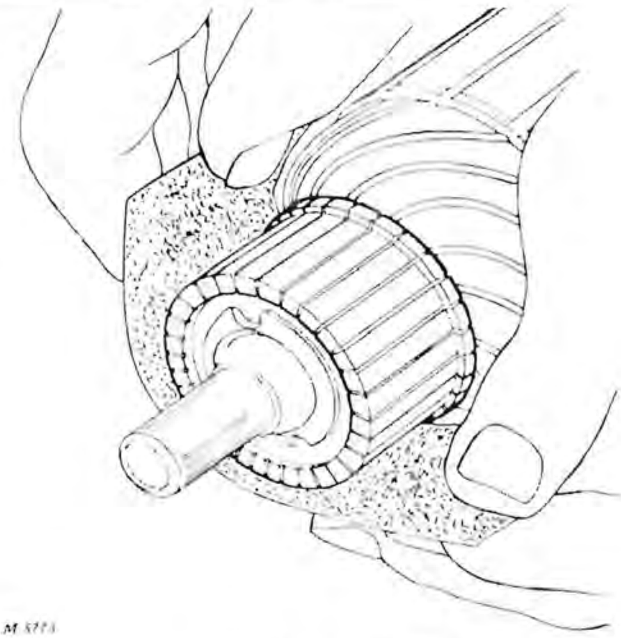
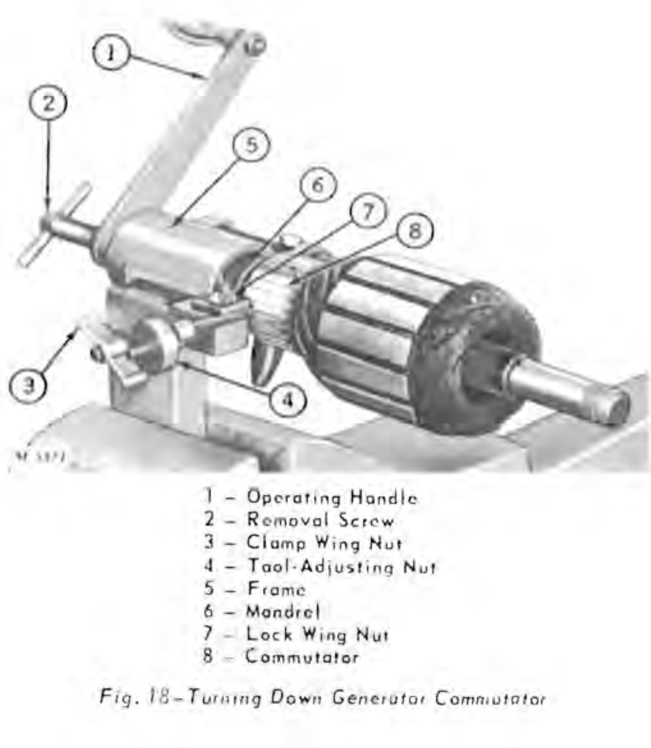


Fig. 17–Cleaning Commutator



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. 18–Turning Down Generator Commutator

Fig. 19–Undercutting Mica

If tests indicate that the armature is suitable for service, turn down commutator and undercut mica with a lathe or by using a tool as shown in Figures 18 and 19.

Use a strip of 00 sandpaper to polish the commutator. Do not use emery cloth.

If the commutator is worn, dirty, out of round, has high insulation or if leads are re-soldered in the riser bars, the commutator should be turned down. Follow tool manufacturer's instructions.

End Frame Bearings

Fig. 20–Installing Bearing in End Frame

Press bearing in end frame as shown in Figure 20. Bearing must be flush with interior of end frame.

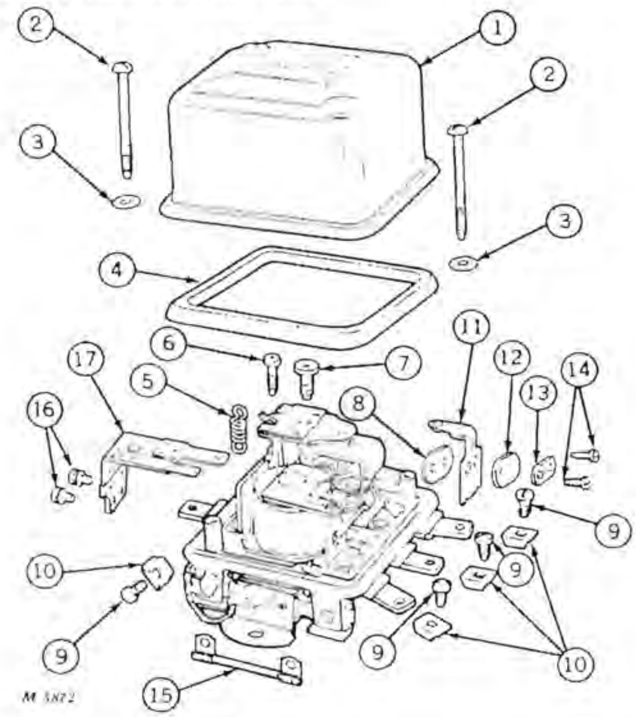
Field Coils

Fig. 21–Field Coils

Fig. 22–Installing Field Coils

The field coils should be checked for grounds, opens or shorts as previously explained. Grounded field coils may sometimes be repaired by removing them so they can be reinsulated. Care must be used to avoid excessive bulkiness when applying new insulation since this might cause the pole shoe to cut through and cause another ground when the coils are reinstalled.

VOLTAGE REGULATOR



1 – Cover
2 – Cover Screw (2 used
3 – Insulating Washer (2 used)
4 – Gasket
5 – Spring
6 – Relay Screw
7 – Regulating Screw
8 – Insulating Washer
9 – Terminal Screw (4 used)
10 – Terminal Clamp (4 used)
11 – Regulator Contact
12 – Bushing
13 – Lock Washer
14 – Contact Screw (2 used)
15 – Resistor
16 – Armature Screw (2 used)
17 – Armature

Fig. 23–Exploded View of Voltage Regulator

Usually, if a field coil is open or shorted internally, it must be replaced since it is difficult to repair such a defect.

Field coils can be removed from the field frame most easily by the use of a pole shoe screwdriver. This tool permits easy loosening and removal of the pole shoe screws so that the pole shoes and field coils can be taken out of the field frame. When loosening the pole shoe screws, it is also advisable to use a pole shoe spreader, since this prevents distortion of the field frame. The pole shoe screwdriver and spreader should also be used when reassembling the field coils and pole shoes into the field frame, Figure 24.

Careful assembly is necessary to prevent shorting or grounding of the field coils when pole shoes are tightened into place.

NOTE: Be sure to polarize generator as explained on page 15-18.

In many cases, regulator trouble can be eliminated by a simple cleaning of the contact points, plus some possible readjustment. The points should be cleaned with a spoon or riffle file. Never use emery cloth or sandpaper to clean the contact points.

The current-voltage unit by its action protects the electrical system from high voltage and prevents excessive charge rates to a fully charged battery.

Before removing regulator, disconnect battery ground cable at battery to prevent injury or damage to system from sparks. Always identify leads with a piece of tape. This will assure connecting proper lead(s) to their respective terminal on the voltage regulator.

Never set the regulator outside specified limits. Always refer to specifications.

Always make sure that the rubber gasket is in place and compressed when replacing cover. The gasket prevents entrance of moisture, dust, and oil vapors which might damage the regulator.

CAUTION: NEVER use a regulator designed to be used with a positive grounded battery.

After any generator or regulator tests or adjustments, the generator should be polarized to avoid damage to equipment, page 15-18.

The cutout relay requires three checks and adjustments: air gap, point opening and closing voltage. The air gap and point opening adjustments are made with the battery disconnected.

The current-voltage unit requires two checks and adjustments: air gap and voltage setting.

Cutout Relay-Air Gap

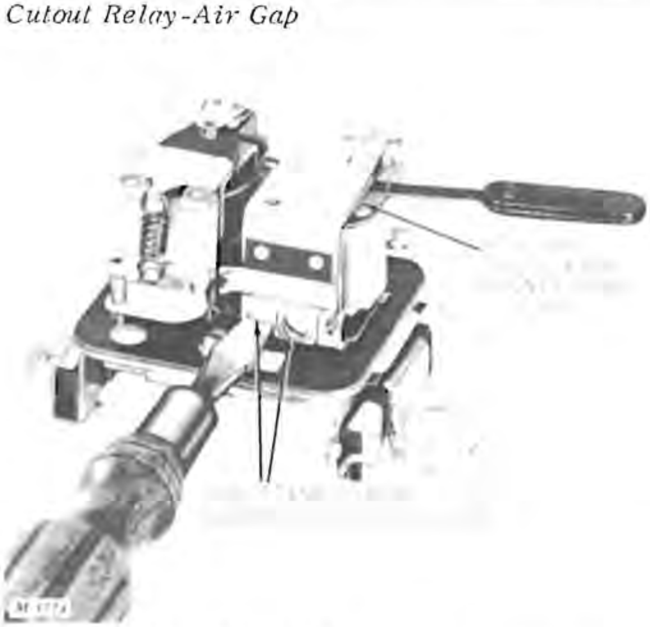


Fig. 24–Cutout Relay Air Gap Check and Adjustments

Battery must be disconnected when the air gap setting is made.

Place fingers on armature directly above core and move armature down until points just close, and then measure air gap between armature and center of core, Figure 24. To adjust air gap, loosen two screws at back of relay and raise or lower armature as required. Tighten screws after adjustment. Refer to specifications, page 15-19, for proper air gap.

Point Opening

Battery must be disconnected when the point setting is made.

Check point opening and adjust by bending the upper armature stop, Figure 25. Refer to specifications, page 15-19, for proper relay point opening.

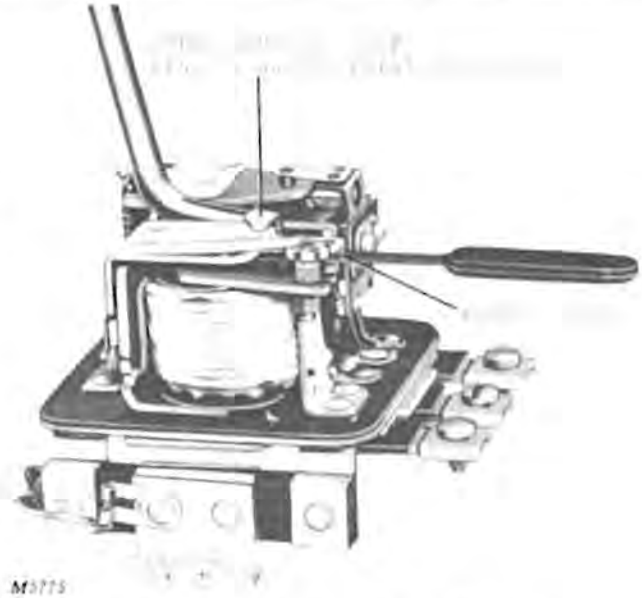


Fig. 25–Cutout Relay Point Opening Check and Adjustment

Closing Voltage

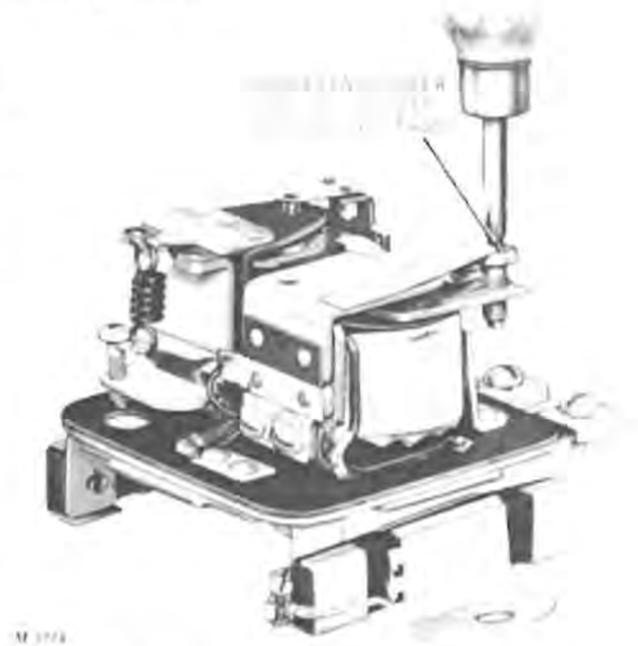


Fig. 26–Adjusting Cutout Relay Closing Voltage

Adjust closing voltage by turning adjusting screw, Figure 26. Turn screw clockwise to increase spring tension and closing voltage, and turn counterclockwise to decrease closing voltage.

Current-Voltage - Air Gap

The current-voltage unit requires two checks and adjustments: air gap and voltage setting.

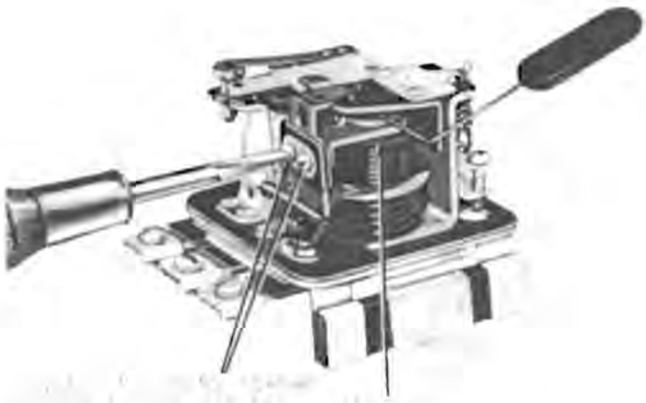


Fig. 27 — Current-Voltage Unit Air Gap Check and Adjustment

To check air gap, push armature down until the contact points are just touching, and then measure air gap, Figure 27. Adjust by loosening contact mounting screws and raising or lowering contact bracket as required. Be sure points are lined up, and tighten screws after adjustment.

Voltage Setting

Adjust voltage setting by turning adjusting screw, Figure 28. Turn screw clockwise to increase voltage setting and counterclockwise to decrease voltage setting. After each adjustment, set cover in place before checking setting.

CAUTION: If adjusting screw is turned down (clockwise) beyond normal range required for adjustment, spring support may fail to return when pressure is relieved. In this case, turn screw counterclockwise until sufficient clearance develops between screw head and spring support, then bend spring support upward carefully with small pliers until contact is made with screw head. Final setting of unit should always be approached by increasing spring tension, by reducing it. In other words, if setting is found to be too high, unit should be adjusted below required value and then raised to exact setting by increasing spring tension. Be sure screw is exerting force on hanger.

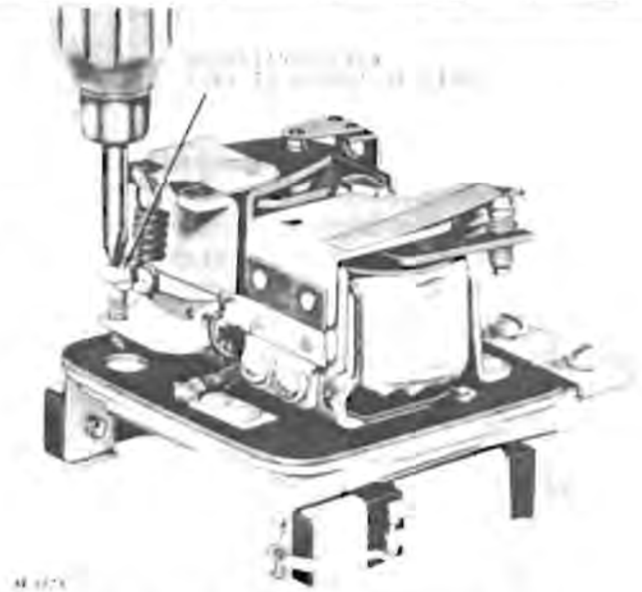


Fig. 28 — Adjusting Voltage Setting of Current-Voltage Regulator Unit

Regulator Spring Replacement

When installing a new spring on units of this type, care must be taken to avoid bending or distorting spring supports or armature hinge. Spring should preferably be hooked at the lower end first and then stretched upward by means of a screwdriver blade inserted between the turns, or by the use of any other suitable tool, until upper end of spring can be hooked. Do not try to pry upper end of spring over spring support. Make connections as in Figure 28, and adjust as described under "Voltage Setting" at left.

Regulator Polarity

The 110 and 112 Tractor use a voltage regulator designed for use with negative grounded batteries while other regulators are designed for use with positive grounded batteries. Using the wrong polarity regulator will cause the regulator contact points to deteriorate and give short life. Care must be used to avoid interchanging the two types in service.

Fig. 29 – Letter "N" Indicates Negative Grounded Battery

ASSEMBLY

MOTOR-GENERATOR

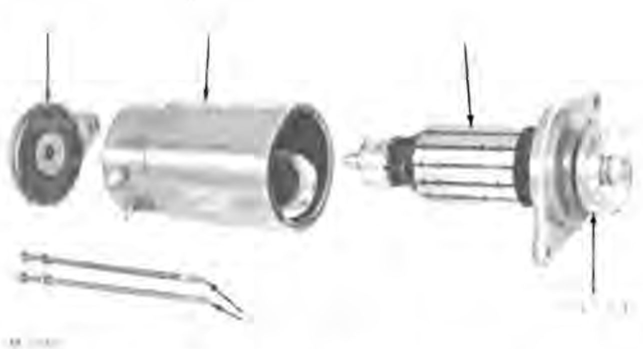


Fig. 30 – Assembling Motor-Generator

Assemble motor-generator as follows:

1. Place armature in a vise with soft jaws. Pack drive end frame bearing with high temperature wheel bearing grease. Refer to specifications for proper type grease. Assemble drive end frame with bearing, pulley, lock washer and nut to armature shaft. Refer to specifications, page 15-19, for armature nut torque, tighten accordingly. Remove armature from vise.

2. Slip armature into main frame. Dowel in drive end frame must correspond with hole in main frame.

3. Pack commutator end frame bearing with high temperature wheel bearing grease. Refer to specifications for proper type grease. Assemble commutator end frame to armature and main frame. Dowel in commutator end frame must correspond with notch in main frame.

4. Insert thru bolts and torque according to specifications, page 15-19.

Motor-Generator Bracket

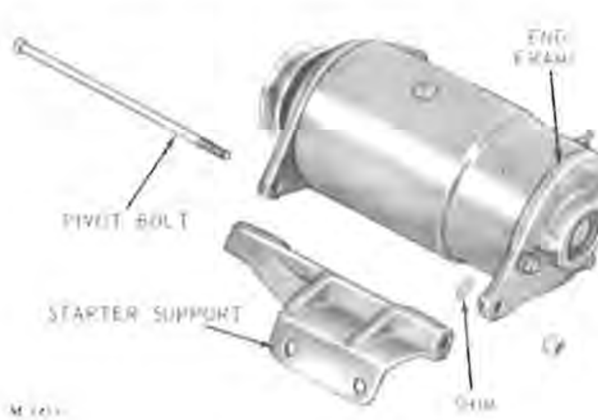


Fig. 31 – Add Shim Between End Frame and Support

When assembling support to motor-generator having one long pivot bolt, be sure to place a 0.005- or 0.010-inch shim washer in the space between the starter support and commutator end frame, Figure 31.

Excessive clearance between the parts will cause pivot bolt failure due to engine vibration.

ELECTRICAL CONNECTIONS

Refer to Figure 32 to make electrical connections. Also refer to the illustrations in Group 5.

NOTE: When removing and replacing regulator wires on 110 Tractors (Serial No. -3550), rewire regulator as explained on page 20-1 of Section 40.

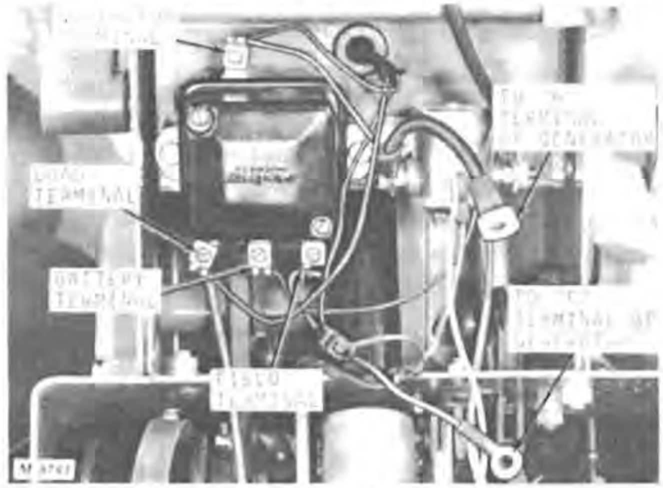


Fig. 32 – Connecting Motor-Generator and Voltage Regulator

ADJUSTMENTS

MOTOR-GENERATOR BELT TENSION

The motor-generator belt will require tightening whenever the engine fails to turn over when the ignition is turned on and starter is running.

When belt slippage is first noticed, tighten belt immediately to prevent excessive belt wear.

(110 Tractor)

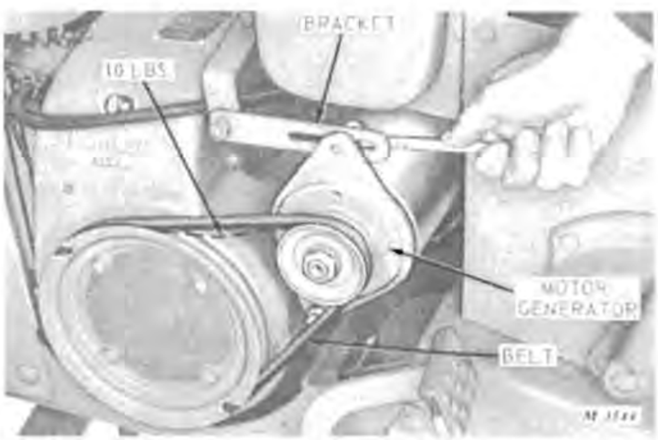


Fig. 33 – Adjusting Belt Tension on 110 Tractor

Loosen cap screw on bracket, Figure 33. Place pry bar between engine block and motor-generator housing. Do not allow end of bar to contact shrouding. Doing so will bend shrouding. Move motor-generator back until a 15 pound pressure midway between the sheaves deflects the belt 1/4-inch.

Tighten cap screw to hold motor-generator in this position to maintain proper tension.

(112 Tractor)

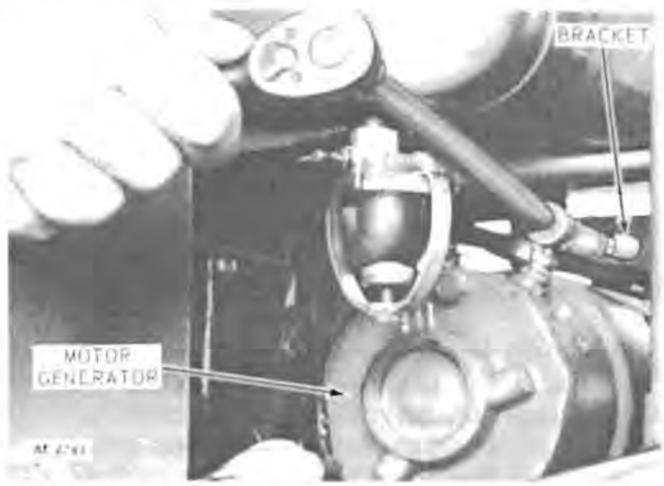


Fig. 34 – Adjusting Belt Tension on 112 Tractor

Use universal socket extension to loosen and tighten cap screw on 112 Tractor.

Adjust belt tension as explained at left for 110 Tractor.

POLARIZING GENERATOR

After reconnecting leads, momentarily connect a jumper lead between the "BATTERY" terminal of regulator and "ARMATURE" terminal of generator. This allows a momentary surge of current to flow through the generator which correctly polarizes it. Reversed polarity may result in vibration, arcing and burning of the relay contact points.

EMERGENCY WINTER OPERATION

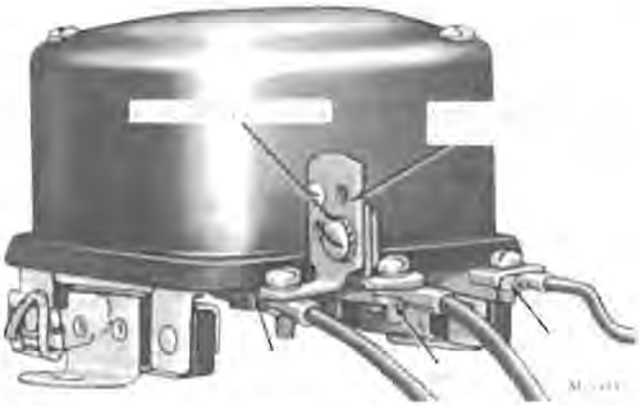


Fig. 35 – Increasing Regulator Voltage

During winter operation, if rundown batteries are repeatedly experienced and the condition is found to be due to short or infrequent engine operation, it is advisable to increase temporarily the operating voltage of the regulator.

A simple method of increasing voltage is to disconnect the lead to regulator "BAT" terminal and reconnect this lead to the regulator "L" terminal. The reconnection bypasses the current-voltage feature of the regulator, automatically allowing an increase in the operating voltage and increasing the amount of charge to the battery.

CAUTION: Operate the regulator with these connections only during cold weather and when operating periods are short or infrequent. Re-establish the original lead connections as soon as mild weather returns, or operation time becomes normal, otherwise the battery will be damaged by overcharge.

For ease in bypassing the current-voltage feature of the regulator, an external adjustment can be installed as shown in Figure 35.

The external adjustment unit shown in Figure 35 can be purchased from any United Delco-Remy service station under package No. 1951938.

SPECIFICATIONS

MOTOR-GENERATOR

Delco Motor-Generator Model	Rotation Viewing D.E.	Circuit	Spec. No.	Brush Spring Tension (OZ)	Field Current 80° F.		Cold Output 80° F.			NO-LOAD TEST				
					AMPS	VOLTS	AMPS	VOLTS	AV.RPM.	Volts	Av. AMPS	Max. AMPS	Min. RPM	Max. RPM
1101974	C	A	3102	24-32	1.45 1.57	12	10	14	5450	11	13	18	2500	2900
1101970	C	A	3101	24-32	1.52 1.62	12	12	14	4950	11	12	18	2500	2900

The following specifications are for Model 1101974 and Model 1101970 Motor-Generators.

ITEM	*WEAR TOLERANCE*
Brushes	Replace when worn to 1/2 of original length.
Brush, Spring(s)	Replace if blued or burned. Refer to chart above for spring brush tension.
Commutator	Refer to specification chart supplied by test equipment manufacturer and use appropriate control settings for armature being tested.
Field Coils	Refer to specifications chart supplied by test equipment manufacturer.

VOLTAGE REGULATOR

Regulator Model	Circuit	Polarity	CUTOUT RELAY				VOLTAGE REGULATOR		
			Air Gap (in)	Point Opening (in)	Closing Voltage Range	Adjust To	Air Gap (in)	Setting Range	Adjust To
1118979	"A"	N	0.020	0.020	11.8 to 14 Volts	12.8 Volts	0.075	13.6 to 14.5 Volts	14 Volts

TORQUE FOR HARDWARE

Location	*Torque*
Motor-Generator Thru Bolts	170-200 in-lbs
Armature-Pulley Nut	40 ft-lbs

TUNE UP DATA

Item	*Specifications*
Frame bearings	Clean and repack when brushes are replaced, or every 1000 hrs., whichever occurs first. Use John Deere AT17659T High Temperature Grease.

SPECIAL TOOLS

Name	No.	Use
Tachometer	Stewart-Warner 757-W	Measures armature rpm or free speed. Check amperes.
Volt-Amp Tester	Snap-On MT-316A	Check voltage and amperes.
Rheostat	Snap-On MT-316A	To vary resistance when making regulator test and adjustments.
Circuit-Spark Tester	Snap-On CT-6	Circuit checks.
7 OHM Fixed Resistance	Delco-Remy	To check electrical settings of the current-voltage regulator.
Feeler Gauge	Delco-Remy	To check point opening.
Armature Stop Tool	Delco-Remy	To adjust upper armature stop.
Wire Feeler Gauge	Delco-Remy	To check air gap.
Regulator Point File	Snap-On HB-2470	Clean contact points.
Voltage Regulator Riffle File	Snap-On HB-1997	Clean contact points.

Group 20
ELECTRICAL ACCESSORIES

HEADLIGHTS

Fig. 1–Adjusting Headlights

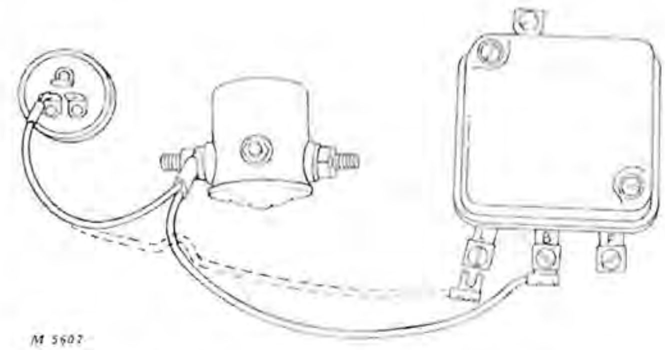


Fig. 2–Rewiring Regulator for Increased Electrical Load - 110 Tractors (-3550)

Turn adjusting nut, Figure 1 to regulate direction of light beam. Tighten nuts firmly.

Rewiring Voltage Regulator (-3550)

When headlights are installed on 110 Tractors (Serial No.   -3550), or other electrical equipment is connected to the accessory lead, it is very important to rewire the voltage regulator as indicated in Figure 2. The rewiring will allow the regulator to compensate for the increased electrical load.

Rewire the regulator as follows:

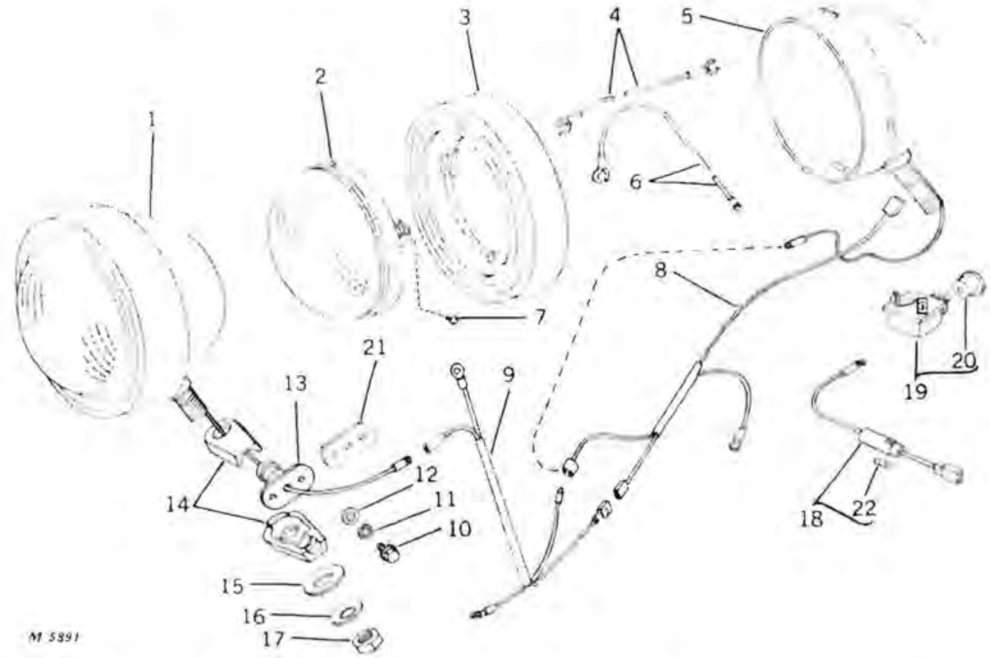
1. Remove battery and gas tank.

2. Remove nut and green wire from solenoid.

3. Push back rubber grommet and cut off the one green wire at large connector from ignition switch. Be sure stub end of wire is pushed back under rubber grommet. Reassemble green wire with eyelet to solenoid.

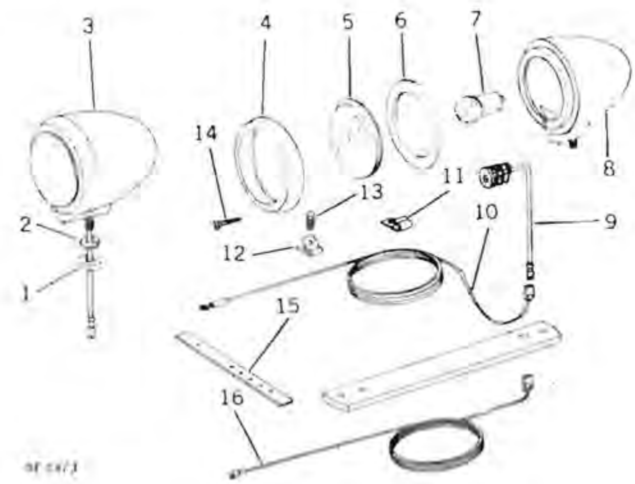
4. Install flag connector on end of green wire which was cut off at (3).

5. Connect green wire with new flag connector (4) to the "L" terminal of the voltage regulator.



1 – Front Lamp (2 used)
2 – Sealed Beam (2 used)
3 – Rubber Molding (2 used)
4 – Ground Wire (2 used)
5 – Lamp Body (2 used)
6 – Lead Wire (2 used)
7 – Screw (2 used)
8 – Secondary Harness
9 – Primary Harness
10 – Tapping Screw (4 used)
11 – Lock Washer (4 used)
12 – Plain Washer (4 used)
13 – Mounting Bracket
14 – Clamp (4 used)
15 – Plain Washer (2 used)
16 – Internal Tooth Washer (2 used)
17 – Hex. Nut (2 used)
18 – Lead Wire with Fuse
19 – Light Switch
20 – Knob
21 – Mounting Plate (2 used)
22 – 9 Amp. Fuse

Fig. 3–Exploded View of Headlights



1 – Hex. Nut
2 – Lock Washer
3 – Taillight
4 – Molding
5 – Lens
6 – Gasket
7 – 12-16 Volt Bulb
8 – Body
9 – Bulb Wire
10 – Lead Wire
11 – "J" Clamp (2 used)
12 – Lead Clip (2 used)
13 – Machine Screw (2 used)
14 – Molding Screw
15 – Rubber Strap (3 used)
16 – Ground Wire (-3550)

Fig. 4–Exploded View of Taillight

1 – Indicator Lens
2 – Spring
3 – Red Bulb
4 – Indicator Lamp Assembly

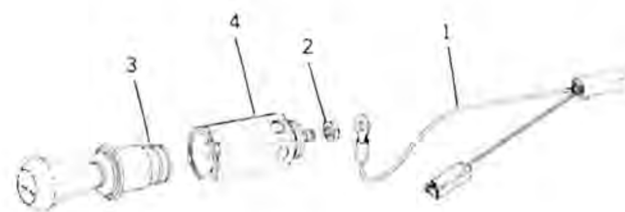
Fig. 5–Exploded View of Generator Indicator Lamp

CIGARETTE LIGHTER

Fig. 6–Resetting Circuit Breaker in Cigarette Lighter

The cigarette lighter has no fuse, but is protected by a circuit breaker inside the lighter housing.

If lighter fails to operate, reset circuit breaker by raising tractor hood and pushing a small wire into the hole at the rear of the lighter housing, as shown in Figure 6. Remove wire after resetting circuit breaker, as shown in Figure 6.



M 5875

1 – Lead Wire Connection
2 – Hex. Nut
3 – Element
4 – Socket

Fig. 7–Exploded View of Lighter Components

Section 50
POWER TRAIN

Group 5
GENERAL INFORMATION

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(Continued on next page.)

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DESCRIPTION

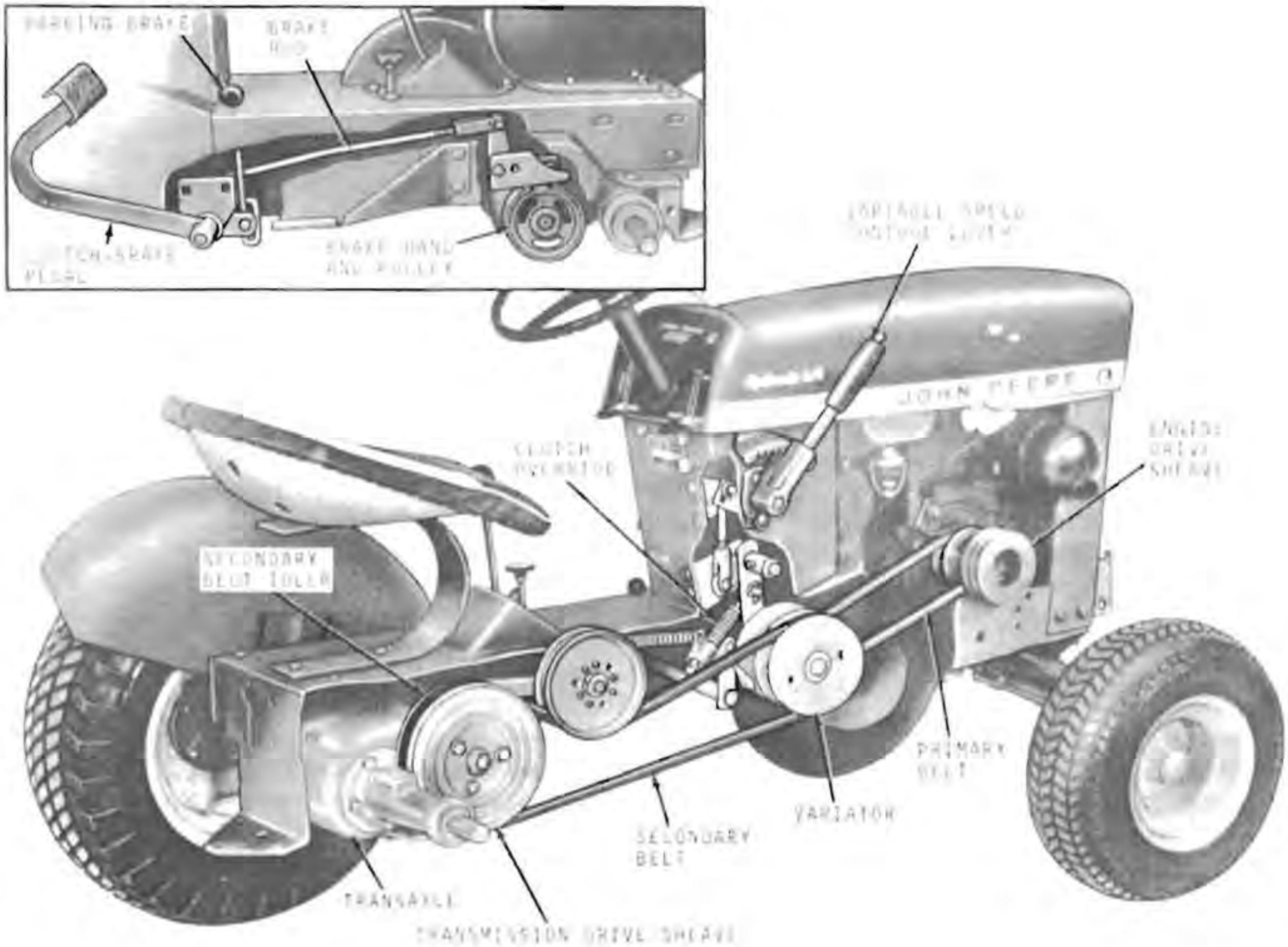


Fig. 1—Cutaway Showing Power Train Components 110 Tractors (40001-) and 112 Tractors

The same basic power train components—variator, transaxle, brake, primary and secondary belts—are used on all 110 and 112 Tractors (Fig. 1). The main difference between these tractors is that 110 Tractors, Serial No. (- 15000) are equipped with a transaxle having three forward speeds. 110 Tractors, Serial No. (15001-) and all 112 Tractors are equipped with a transaxle having four forward speeds. These transaxles are not interchangeable.

Tractor ground speed for each transaxle gear is covered in "Specifications," Section 10.

Group 10

CLUTCH, BRAKE AND VARIABLE SPEED DRIVE

PRINCIPLE OF OPERATION

VARIABLE SPEED CONTROL LEVER

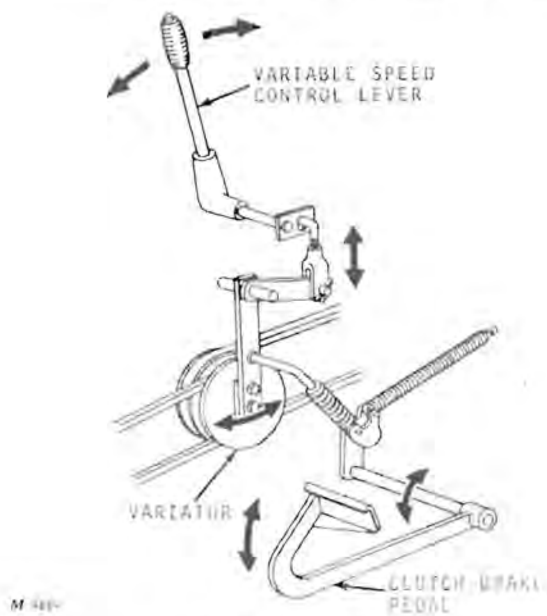


Fig. 1–Variator Linkage

The variable speed is regulated manually with the variable speed control lever (Fig. 1), on all 110 and 112 Tractors. By depressing the thumb release and moving the variable speed control lever towards 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 possible 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 range (A, Fig. 2).

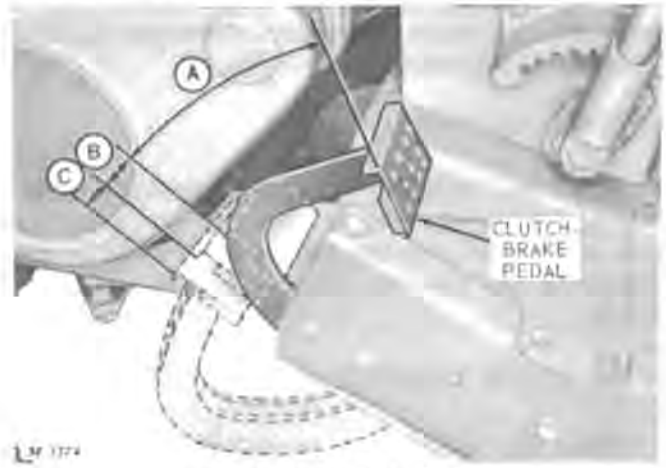


Fig. 2–Clutch-Brake Pedal

Depressing the clutch-brake pedal through range "B" moves the variator forward to disengage the drive. Range "C" is the brake position. In this manner, the drive is always disengaged before the brake is applied. The parking brake can then be raised to the park position to hold the variator and brake linkage in the brake position (Fig. 3).

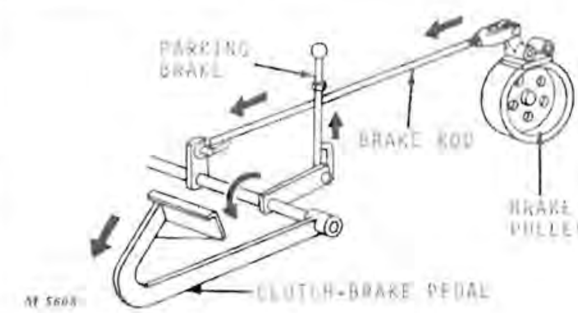


Fig. 3–Clutch-Brake Linkage

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.

VARIATOR

The variator (Fig. 4), has two outside half sheaves fixed to a common hub. The center sheave is free to slide on the shaft.

In operation, the variator is moved like a pendulum, between the engine drive sheave and transmission driven sheave (Fig. 5).

CLUTCH POSITION

When the variator is moved forward to the "clutch" position (Fig. 5), the primary belt tension is relieved and the belt is forced out of the engine drive sheave groove, disengaging the drive.

SLOW SPEED POSITION

When the variator is moved rearward (Fig. 6), the primary belt tension is increased, forcing the belt into the engine drive sheave and engaging the drive. The primary belt now revolves around a larger radius on the variator while the secondary belt revolves around a smaller radius. This reduces the secondary belt speed causing the driven sheave on the transaxle to turn slower. This results in a slow tractor travel speed while the engine speed remains constant.

HIGH SPEED POSITION

When the variator is moved still farther to the rear (Fig. 7), the primary belt is forced deeper into variator, exerting side pressure on the center variator sheave. Because the center sheave is free to slide on the shaft, the pressure exerted by the side of the primary V-belt forces the center sheave towards the secondary belt. This causes the secondary belt to ride up the sides of the variator and revolve around a larger radius. The primary belt now revolves around a smaller radius, thereby increasing the secondary belt speed and increasing the speed of the transaxle driven sheave.

This results in a faster tractor travel speed while the engine speed remains constant. In this manner, the tractor ground speed is variable in all transmission gear positions and at any engine speed. *NOTE: The belts change position in the variator only when the engine is running.*

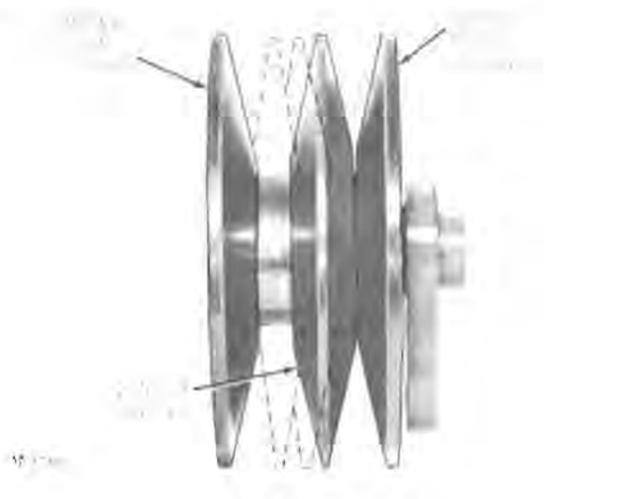


Fig. 4–Variator

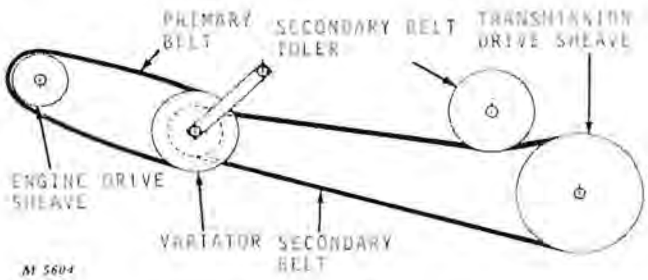


Fig. 5–Clutch Position

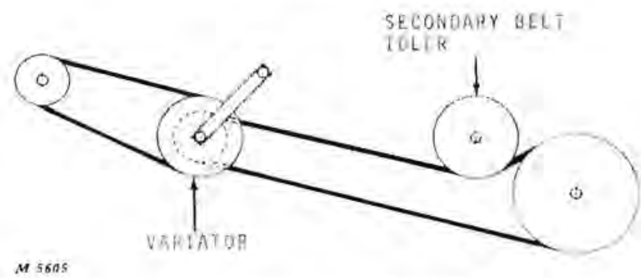


Fig. 6–Slow Speed Position

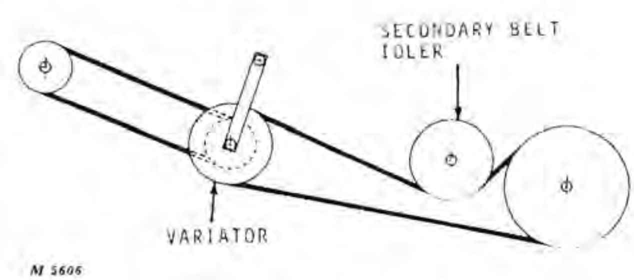


Fig. 7–High Speed Position

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 perfectly adjusted, the variable speed control lever will not affect tractor speed when the lever is in forward positions 1 or 2 on the quadrant, Figure 8.

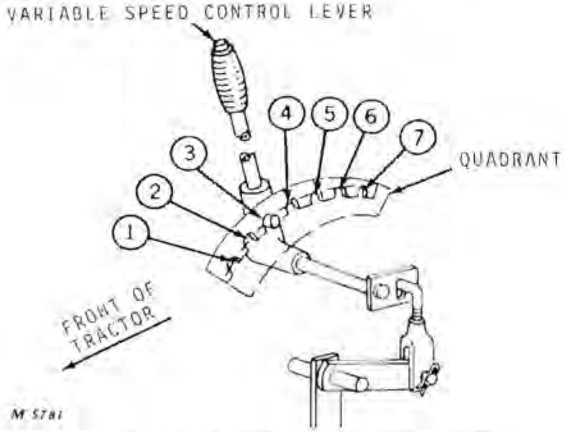


Fig. 8–Variable Speed Control Lever

Positions 1 and 2 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 7, on the quadrant, or if the clutch-brake pedal strikes the bottom of the footrest when released, 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 7 on the quadrant (fast speed position). Adjust the linkage as described on page 10-16.

If the tractor is stopped without depressing the clutch-brake pedal with the variable speed control lever in the forward position, clutching 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 clutching 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.

The brake rod may also be binding on the brake rod arm on the clutch shaft. When this condition is found, enlarge the pin hole to permit the linkage to operate freely.

Readjust variable speed control linkage. See "Adjustments," page 10-16.

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

BRAKES

Difficult braking or no brake at all may also be caused by a sticky, dirty or improperly adjusted variator.

Difficult braking on 110 Tractors (- 40001) can be experienced if the engine stalls when the variable speed control lever is in the forward (high speed position). Caution customers to operate tractor with the variable speed control lever in the rear (slow speed) position when working on steep slopes or similar hazardous conditions under which the engine could stall.

110 Tractors (40001-) and all 112 Tractors have a clutch-override to assure positive braking regardless of the position of the variable speed control lever.

DIAGNOSING MALFUNCTIONS

BELTS

Belts Seem to Slip Under Load.
Weak secondary idler spring.
Increase spring tension.
Install new spring if necessary.

Variator linkage not properly adjusted.
Adjust linkage.

Variator in clutch position.
Move variable speed control lever forward.

Dirt in variator sheave grooves.
Clean dirt from sheave grooves.

Variator arm binding at pivot (in pedestal).
Lubricate pivot.
Replace parts if necessary.

Dirty or gummy variator sheave hub.
Clean hub and variator center sheave bearing.

V-belts worn or lumpy.
Replace belt.

Secondary belt too long.
Move transaxle to rear position.
Replace V-belt if necessary.

Primary Belt Jumps Off Variator Sheave.
Primary belt guide improperly located.
Adjust guide.

Primary belt too long.
Replace belt.

Oil or grease on belt.
Wipe oil and grease from belt.
Replace belt if necessary.

Worn or nicked variator sheaves.
Check condition of sheaves.
Replace parts as necessary.

Dirt in variator groove.
Clean dirt from sheave groove.

Secondary Belt Jumps Off Variator Sheave.
Secondary belt idler arm pivot binding.
Clean and lubricate pivot.
Replace parts as necessary.

No secondary belt guide, 110 Tractors (3551-10076).
Install belt guide.

Worn, bent, or nicked input sheave.
Replace sheave if necessary.

Worn or nicked variator sheaves.
Replace parts as necessary.

Dirt in variator and/or input sheave.
Clean dirt from sheave grooves.

Worn (center) variator sheave bearing.

Slack Primary Belt.
Variator linkage not properly adjusted.
Adjust linkage.

Worn or nicked variator sheaves.
Check condition of sheaves.
Replace parts as necessary.

Primary belt too long.
Replace belt.

Weak variator spring.
Replace spring.

Slack Secondary Belt.
Weak secondary idler spring.
Increase spring tension.
Install new spring if necessary.

Secondary belt idler arm pivot binding.
Clean and lubricate pivot.
Replace parts as necessary.

Transaxle in forward position.
Move transaxle to rear position.

Excessive Primary Belt Wear.
Clutch rod not adjusted properly.
Adjust linkage.

Dirty or gummy variator sheave hub.
Clean hub and variator center sheave bearing.

Dirt in variator sheave grooves.
Clean dirt from grooves.

Excessive Secondary Belt Wear.
Weak secondary idler spring.
Increase spring tension.
Install new spring if necessary.

Worn, bent or nicked input sheave.
Replace sheave.

Belt worn or lumpy.
Replace belt, move transaxle to rear position.

Worn or nicked variator sheaves.
Check condition of sheaves.
Replace parts as necessary.

Dirt in sheave grooves.
Clean dirt from grooves.

Secondary belt idler arm pivot binding.
Clean and lubricate pivot.
Replace parts as necessary.

Oil or grease on belt.
Clean belt.
Replace belt if necessary.

VARIATOR

Noisy Variator.
Worn center variator sheave bearing.
Replace center sheave assembly.

Worn variator bearing.
Replace bearing.

Variator Squeals - 110 Tractors (-9082).
Variator brake.
Remove variator brake assembly.
Install new input sheave.

CLUTCH

Clutch Hard to Operate.
Engine not running.
Run engine when operating clutch.

Brake rod not properly adjusted.
Adjust brake rod.

Clutch rod not properly adjusted.
Adjust clutch rod.

Variator arm binding in pivot (in pedestal).
Lubricate pivot.
Replace parts if necessary.

Secondary belt idler arm pivot binding.
Clean and lubricate pivot.
Replace parts as necessary.

Dirty or gummy variator hub.
Clean hub and variator center sheave bearing.

Clutch Pedal Goes Down Beyond Top of Footrest.
Brake rod not properly adjusted.
Adjust brake rod.

Clutch Pedal Creeps Down Under Load.
Load and torque sensitive feature operating.
This is a characteristic of drive when encountering loads with variable speed control lever fully forward.

Weak variator spring.
Replace spring.

Variator linkage not properly adjusted.
Adjust variator.

Clutch-Brake Pedal Strikes Bottom of Footrest.
Clutch rod not properly adjusted.
Adjust linkage.

Primary belt too long.
Replace belt.

Variator linkage not properly adjusted.
Adjust linkage.

DIAGNOSING MALFUNCTIONS—Continued

Clutch Will Not Disengage.

Clutch rod and/or brake rod not properly adjusted.
Adjust linkage.

Short secondary belt.
Move transaxle to forward position.

Variator linkage not properly adjusted.
Adjust linkage.

Primary belt too short.
Install correct belt.

Secondary belt idler striking idler cover screw.
Install lock washer between screw head and idler cover.

Clutch Pedal Jumps.

Primary V-belt and/or secondary V-belt worn or lumpy.
Replace belt.

Excessive clutch shaft end clearance.
Add washer between bearing and clutch-brake pedal arm.

Dirt in sheave grooves.
Clean dirt out of grooves.

Loose input sheave on transaxle hub.
Tighten cap screws.

BRAKE

No Brakes.

Engine not running.
Operate engine for more effective braking.

Brake rod not properly adjusted.
Adjust linkage.

Wrong length fender bolt by brake bracket.
Install proper length bolt through fender and tractor base.

Secondary belt idler striking idler cover screw.
Install lock washer between screw head and idler cover.

Variator linkage not properly adjusted.
Adjust linkage.

Secondary belt too short.
Move transaxle to forward position.

Dirt in sheave grooves.
Clean dirt from grooves.

Brakes Not Effective.

Worn lining.
Replace band assembly.

Oily lining.
Clean oil from lining.
Replace band assembly if necessary.

Wrong length fender bolt by brake bracket.
Install proper length bolt through fender and tractor base.

Broken band.
Replace band assembly.

MISCELLANEOUS

Tractor Does Not Move (Engine Running).

Variator clutched.
Move variable speed control lever forward.

Parking brake set.
Release brake.

Variator linkage not properly adjusted.
Adjust linkage.

Primary belt too long.
Install correct length belt.

Variator arm binding in pivot (in pedestal).
Lubricate arm.
Replace parts as necessary.

Excessive Tractor Vibration.

Primary V-belt and/or secondary V-belt worn or lumpy.
Replace V-belt.

Loose transaxle drive sheave cap screws.
Tighten cap screws firmly.

Bent or damaged input sheave (transaxle).
Replace sheave.

Dirt in sheave grooves.
Clean dirt from grooves.

Tractor Will Not Move With Variable Speed Control Lever Pulled Back.

Weak secondary idler spring.
Increase spring tension.
Install new spring if necessary.

Variator linkage not properly adjusted.
Adjust linkage.

Primary belt too long.
Install proper belt.

Dirty or gummy variator sheave hub.
Clean hub and inside of center sheave bearing.
Check center sheave condition.
Replace if necessary.

Tractor Will Not Accelerate When Variable Speed Control Lever is Moved Forward.

Clutch shaft tight in clutch brackets.
Lubricate clutch shaft brackets.
Align brackets if necessary to ease clutch shaft movement.

Variator center sheave too tight on variator hub.
Check variator center sheave bearing and hub tolerance.
Replace parts as necessary.

Dirty or gummy variator sheave hub.
Clean hub and center sheave bearing.

Variator arm binding in pivot (in pedestal).
Lubricate pivot.
Replace parts if necessary.

Variator-brake linkage not properly adjusted.
Adjust linkage.

Short secondary belt.
Move transaxle to forward position.
Install new belt if necessary.

Weak variator spring.
Install new spring.

Primary belt too short.
Install proper belt.

Tractor Will Not Attain Specified Travel Speed.

Variator linkage not properly adjusted.
Adjust linkage.

Clutch shaft tight in clutch brackets.
Lubricate clutch shaft brackets.
Align brackets if necessary to ease clutch shaft movement.

Dirty or gummy variator sheave hub.
Clean hub and center sheave bearing.

Weak variator spring.
Replace spring.

Primary belt too short.
Install proper belt.

Variator arm binding in pivot (in pedestal).
Lubricate pivot.
Replace parts if necessary.

Short secondary belt.
Move transaxle to forward position.

Weak secondary idler spring.
Increase spring tension.
Replace spring if necessary.

REPAIR

INVERTING TRACTOR

The Owatonna Motor-Rotor Repair Stand, Figure 9, is available to make easy work of in-tractor adjustments and repair of power train components. See "Special Tools," page 20-21.

Be sure to shut off gas connection and drain tank to prevent gas leakage when tractor is turned upside down. Remove battery, drain engine crankcase and plug hydraulic reservoir before inverting tractor.

Fig. 9–Repair Stand

REPLACING PRIMARY V-BELT

CAUTION: To prevent possibility of injury, always remove spark plug cable before removing belts.

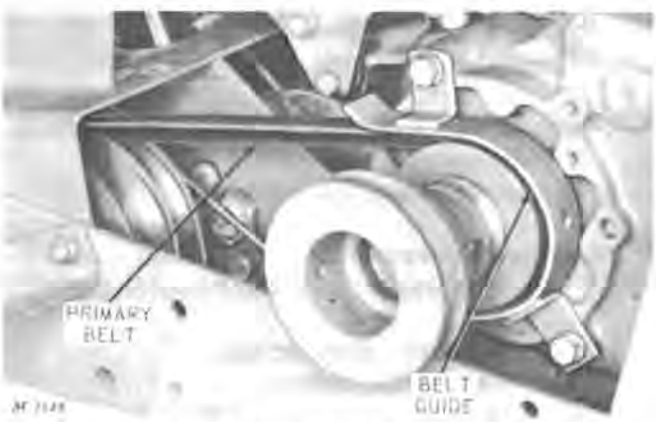


Fig. 10–Primary Belt and Belt Guide

Remove muffler and disconnect safety switch leads. Remove belt guards, belt guide, hydraulic drive belt and mower drive if tractor is so equipped. Move variable speed control lever forward (fast speed position). Turn engine over slightly until variator is fully back. Then raise secondary idler and slip secondary belt off variator sheave.

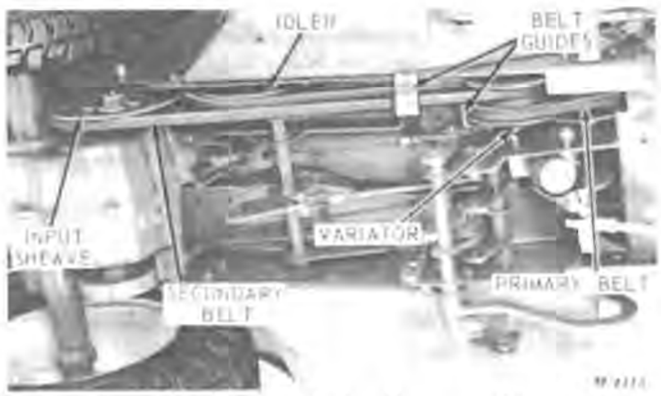


Fig. 11–Belts, Belt Guides, Variator and Input Sheave

After secondary belt is removed from variator, depress clutch-brake pedal and lock parking brake to hold variator forward. Remove primary belt guide, Figure 10, and loosen bolt holding belt guide, Figure 11. Remove belt from variator and engine sheave.

Reverse above procedure to install new primary belt. Adjust primary belt guide, Figure 11.

IMPORTANT: After replacing primary belt, readjust linkage. Refer to "Adjustment," page 10-16.

REPLACING 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 11, 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.

NOTE: If transmission has been moved rearward, to take up secondary belt slack prior to belt replacement, loosen bolts and move transmission forward before installing new secondary belt. Tighten bolts holding transmission.

Readjust variator and brake linkage after moving transmission.

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 10-5 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

REMOVING VARIATOR

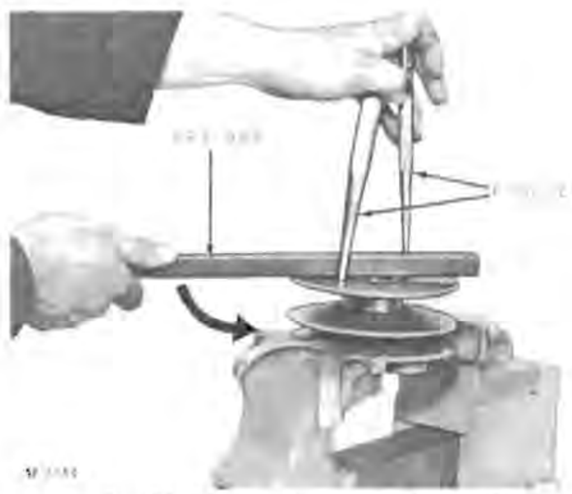


Fig. 12–Disassembling Center Variator Sheave

Remove primary and secondary belt from variator. *IMPORTANT: Do not pry belts over sides of variator.*

Remove two cap screws from variator arm to remove variator.

Place variator half sheave (next to bearing support) in a vise with soft jaws as shown in Figure 12. 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.

REMOVING VARIATOR BEARING AND ARM

Fig. 13–Pressing Variator Bearing From Hub

Place variator bearing and hub assembly under press, Figure 13, and press bearing from hub. Be sure to press against outer race only.

Place hub in a vise and remove half sheave with two punches and a bar.

INSPECTING VARIATOR

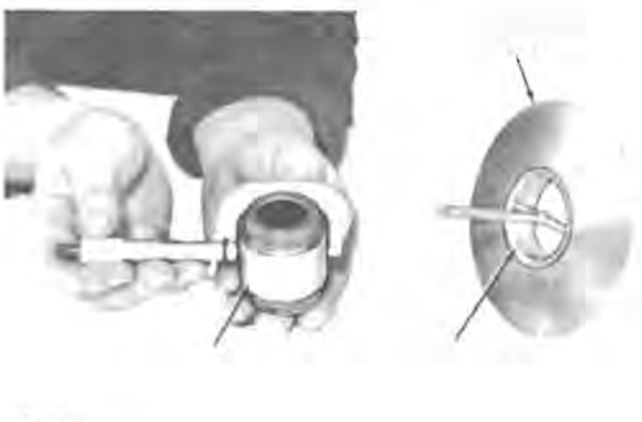


Fig. 14–Checking Variator Bearing and Hub

Measure I.D. of center sheave bearing and O.D. of variator hub, Figure 14, after cleaning parts thoroughly. Refer to "Specifications," page 10-20 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. 15–Checking Variator Bearing and Shaft

Measure press fit between bearing and hub, Figure 15. See "Specifications," page 10-20, for wear limits. Check bearing condition, Section 20. Also check press fit of bearing shaft in bearing support. Replace parts necessary to obtain proper fit.

IMPORTANT: The center sheave is lubricated with a special grease at the factory and will last for the lifetime of the sheave. Do not attempt to lubricate center sheave.

ASSEMBLING VARIATOR

Fig. 16–Pressing Bearing in Hub

Coat bearing case with light film of oil. Place hub with sheave on press bed and press bearing into hub until distance between end of bearing shaft and hub face is 0.031-0.047 inch beyond hub face, Figure 16.

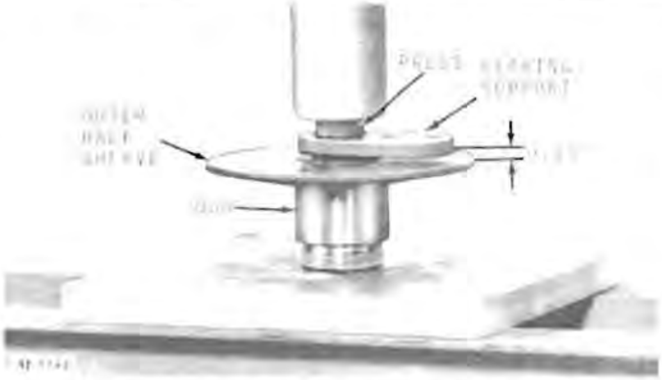


Fig. 17–Pressing Bearing Support on Bearing Shaft

Wipe light film of oil on bearing shaft. Place bearing support on bearing shaft with weld down or under cut-up, depending on type of support. Press bearing support on shaft until distance between bearing support and sheave is 0.13 inch, Figure 17.

Clamp assembly in vise having soft jaws as shown in Figure 12. 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 12.

Fig. 18–Staking Variator Hub

Spike threads three or four places on both sides of variator as shown in Figure 18. After spiking threads, recheck distance between bearing support and sheave, Figure 17. If distance is greater than 0.13 inch, press bearing support further on shaft until proper distance is obtained.

INSTALLING VARIATOR

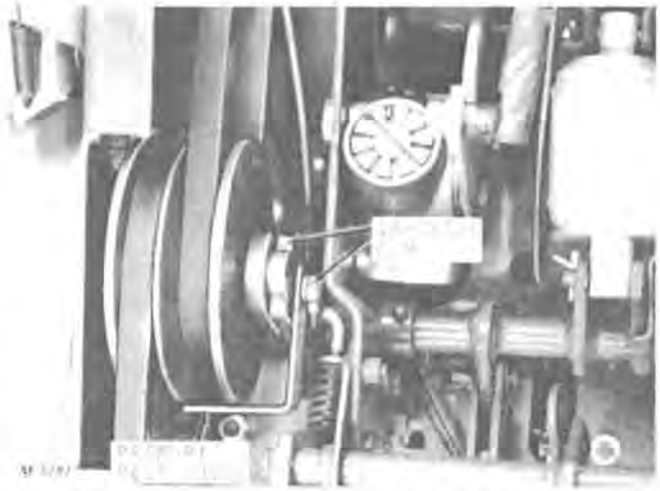
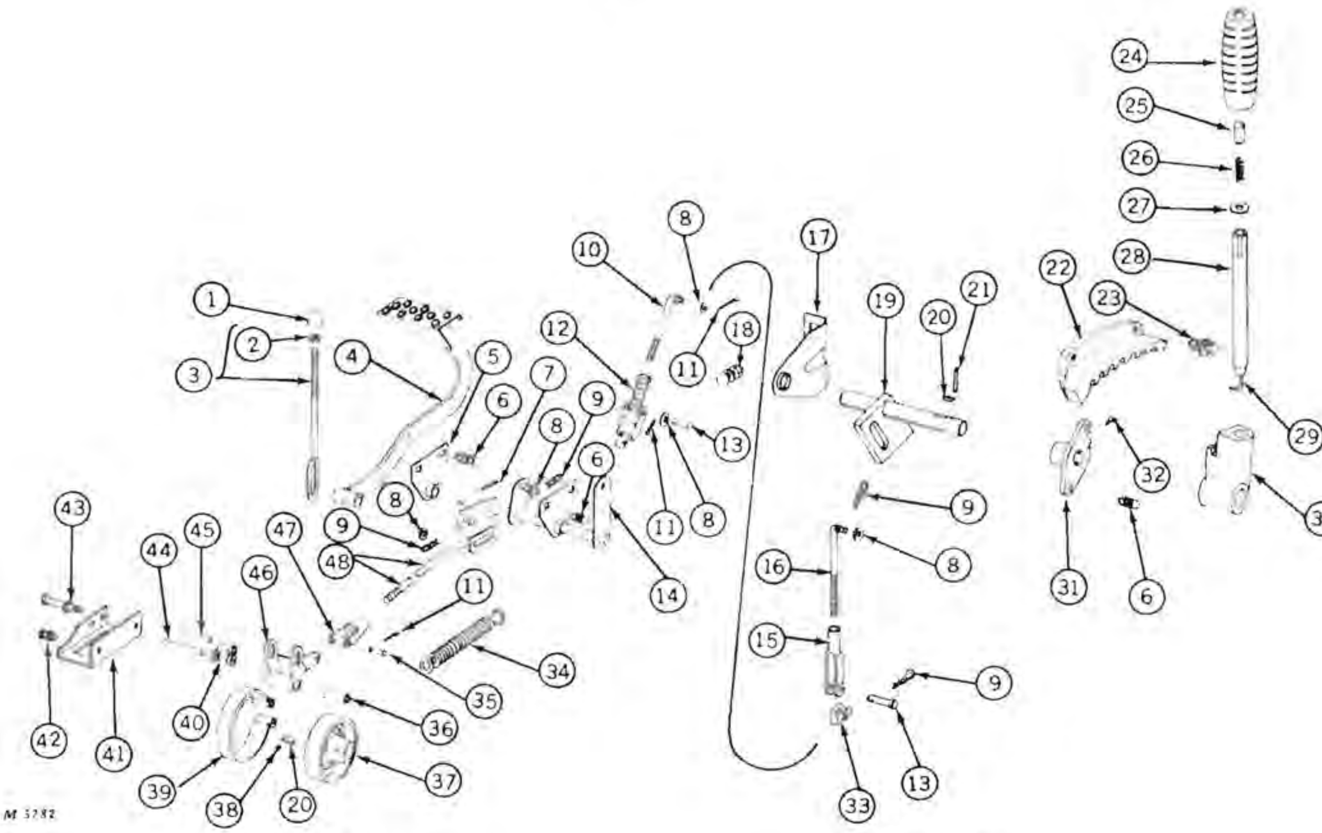


Fig. 19–Installing Variator Assembly on Variator Arm

Attach variator and primary belt guide on variator arm with two cap screws. Install belts and adjust primary belt guide as shown in Figure 19. Tighten cap screws firmly.

After installation, refer to "Adjustment," page 10-16, and readjust variator linkage.

BRAKES



1 – Brake Release Knob
2 – Stop Nut
3 – Brake Release Rod
4 – Clutch and Brake Lever
5 – L.H. Bracket
6 – Carriage Bolt (4 used)
7 – Spring Pin
8 – Washer (4 used)
9 – Spring Locking Pin (4 used)
10 – Clutch Rod
11 – Cotter Pin (3 used)
12 – Clutch Over-ride
13 – Drilled Pin (2 used)
14 – Clutch and Brake Shaft
15 – Yoke
16 – Linkage Rod
17 – Shaft Bracket
18 – Carriage Bolt
19 – Speed Control Shaft
20 – Woodruff Key (2 used)
21 – Spring Pin
22 – Lever Quadrant
23 – Cap Screw (2 used)
24 – Handle Grip
25 – Thumb Release
26 – Spring
27 – Washer
28 – Speed Control Lever
29 – Speed Control Rod
30 – Lever Hub
31 – Bearing Housing
32 – Grease Fitting
33 – Clip for Yoke
34 – Spring
35 – Drilled Pin
36 – Pivot
37 – Brake Pulley
38 – Set Screw
39 – Brake Band
40 – Brake Arm
41 – Bracket
42 – Cap Screw
43 – Cap Screw
44 – Spring Pin
45 – Solid Pin
46 – Brake Lever
47 – Yoke
48 – Brake Rod

Fig. 20–Exploded View of Clutch-Brake and Variator Linkage Components

REPLACING BRAKE BANDS

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 depending on the tractor serial number.

110 Tractors (-3550)

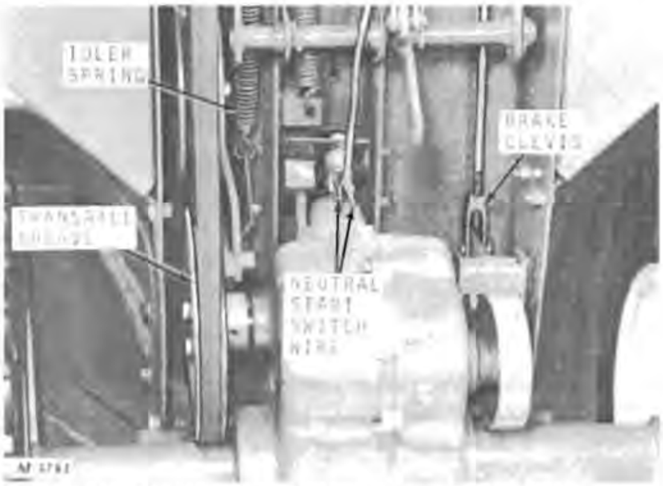


Fig. 21–Separating Transaxle From Tractor Base (-3550)

On tractors (-3550), the frame must be separated from the transaxle to replace the brake band or brake pulley.

To separate, remove three cap screws from transaxle sheave on input shaft, disconnect brake clevis, idler spring and neutral start wires as shown in Figure 21.

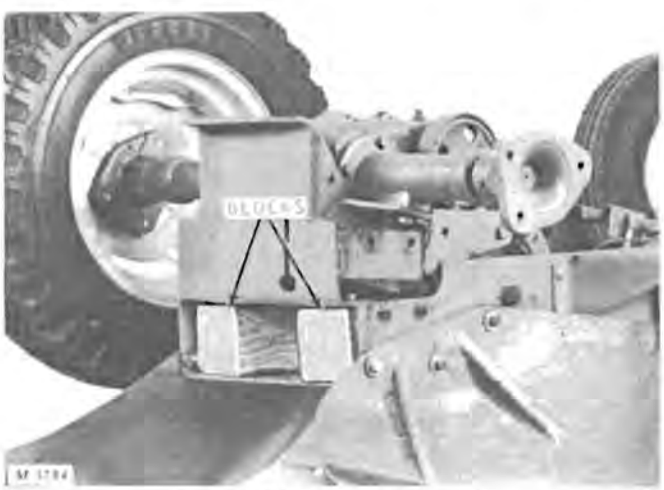


Fig. 22–Blocking Up Transaxle

Remove eight cap screws securing tractor base to hitch assembly. Raise transaxle assembly and place blocks between transaxle and tractor base as shown in Figure 22.

Fig. 23–Removing Brake Pin

Remove brake pulley with puller.

Remove brake band pivot bolt and raise assembly. Slip brake pin out of brake arms and lever as shown in Figure 23.

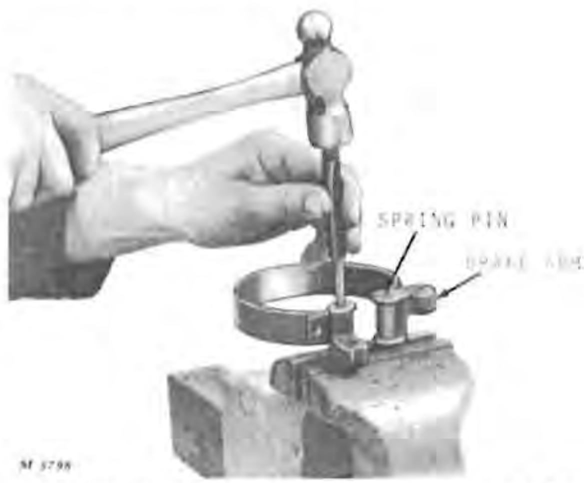


Fig. 24–Removing Spring Pins From Arms and Band

Drive spring pins from arms and band as shown in Figure 24.

Lubricate lever pivot before reassembly.

Reverse disassembly procedure to assure correct installation.

After installing transaxle on tractor, refer to "Adjustment," page 10-16, and adjust linkage accordingly.

REPLACING BRAKE BANDS

110 Tractors (3551-15000)

Fig. 25—Removing Brake Pulley

Loosen pulley set screw and remove brake pulley with a puller as shown in Figure 25.

Fig. 26—Brake Lever Stop

Disconnect brake rod from brake arm on clutch shaft. Bend end of lever stop far enough to clear brake lever, Figure 27. Remove brake pivot bolt and lower assembly from brake bracket. Remove brake pin, Figure 26.

Use light grease to lubricate lever pivot before reassembling pivot in lever.

Apply loctite to threads before tightening set screw in brake pulley.

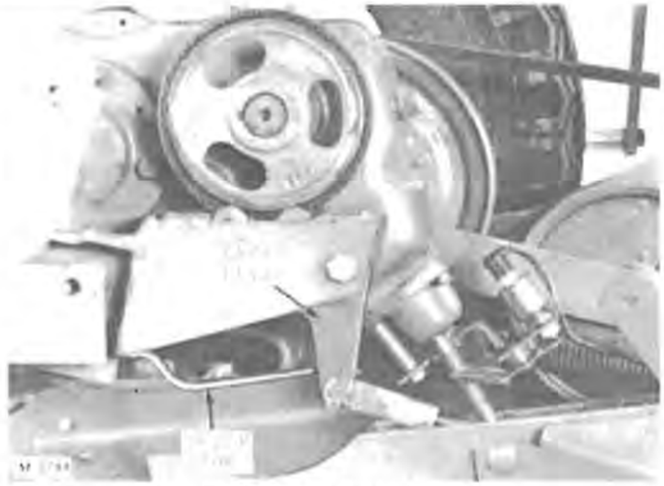


Fig. 27—Adjusting Brake Lever Stop

Adjust lever stop against lever to prevent brake arms from dragging on brake pulley as shown in Figure 27.

To check lever stop adjustment, place shifter lever in neutral position. If brake adjustment is correct, the brake pulley should be free enough to rotate by hand.

After assembling brake, refer to "Adjustment," page 10-16, and adjust linkage accordingly.

REPLACING VARIATOR BRAKE SHOE

110 Tractors (-9082)

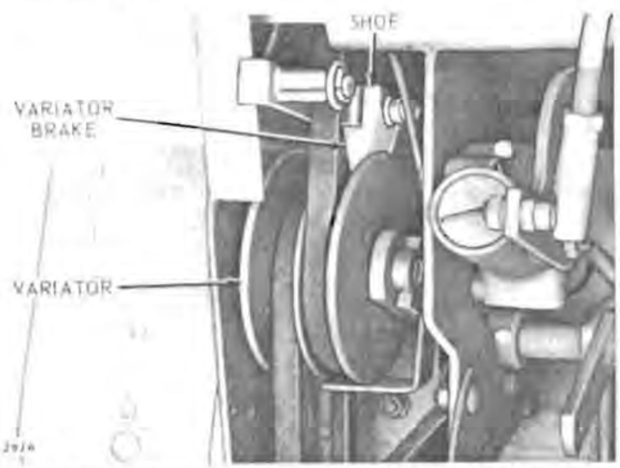


Fig. 28—Brake Shoe - 110 Tractors (-9082)

A brake shoe was provided on 110 Tractors (-9082) to stop the flywheel action of the heavy cast iron input sheave on the transaxle when clutching drive train.

The brake shoe is not required on 110 Tractors having the lighter sheet metal input sheave. The shoe may be removed on these tractors.

If the brake shoe causes undesirable squealing on tractors having the brake shoe and cast iron sheave, remove the brake shoe and replace the cast iron input sheave with the lighter sheet metal sheave. Remove the variator brake assembly only on tractors equipped with sheet metal sheave.

REPLACING BRAKE BANDS

110 and 112 Tractors (15001-100,000)

Fig. 29–Brake Band Replacement on 110 Tractors (15001-100,000) and 112 Tractors (-100,000)

Remove left-hand fender by removing three cap screws. Refer to brake band replacement for 110 Tractors (-3550) to remove brake band having brake bracket with one hole as shown in Figure 29.

To remove brake band on 110 Tractors with two holes in brake bracket, Figure 30, and all 112 Tractors, remove left-hand fender by removing three cap screws. Loosen brake pulley set screw and pull brake pulley from shaft with a puller.

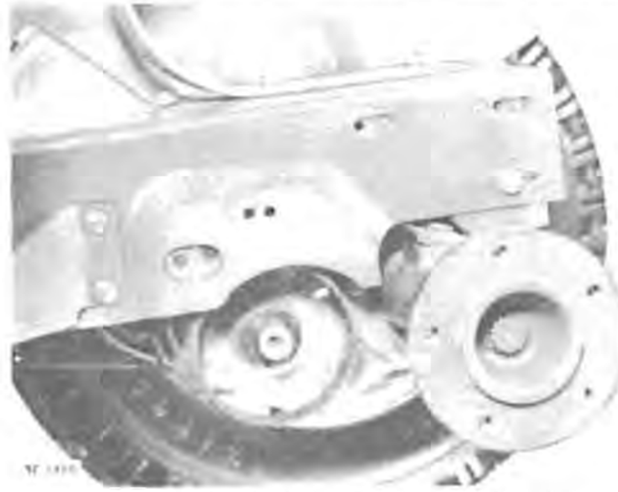


Fig. 30–Brake Bracket Used on Later 110 and All 112 Tractors

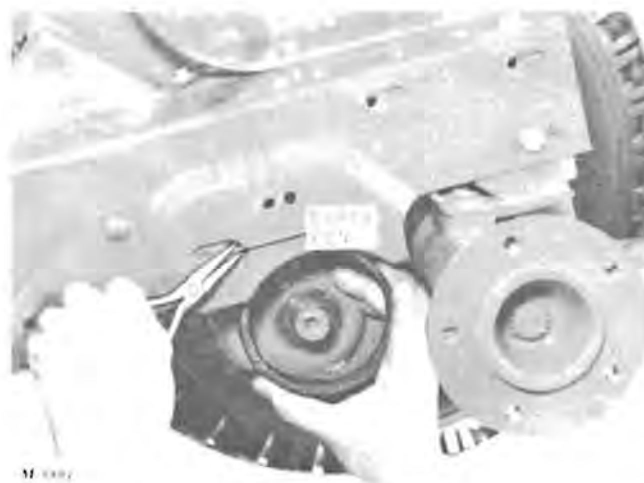


Fig. 31–Removing Brake Pin

Remove brake band pivot bolt through slotted hole in tractor frame.

Then lift brake band until brake pin is aligned with hole in brake bracket. Using a needle nose pliers, pull brake pin through hole as shown in Figure 31.

Lubricate lever pivot before reassembly.

Apply Loctite to threads before tightening set screw in brake pulley.

After assembling brake, refer to "Adjustment," page 10-16 and adjust linkage accordingly.

ADJUSTMENT

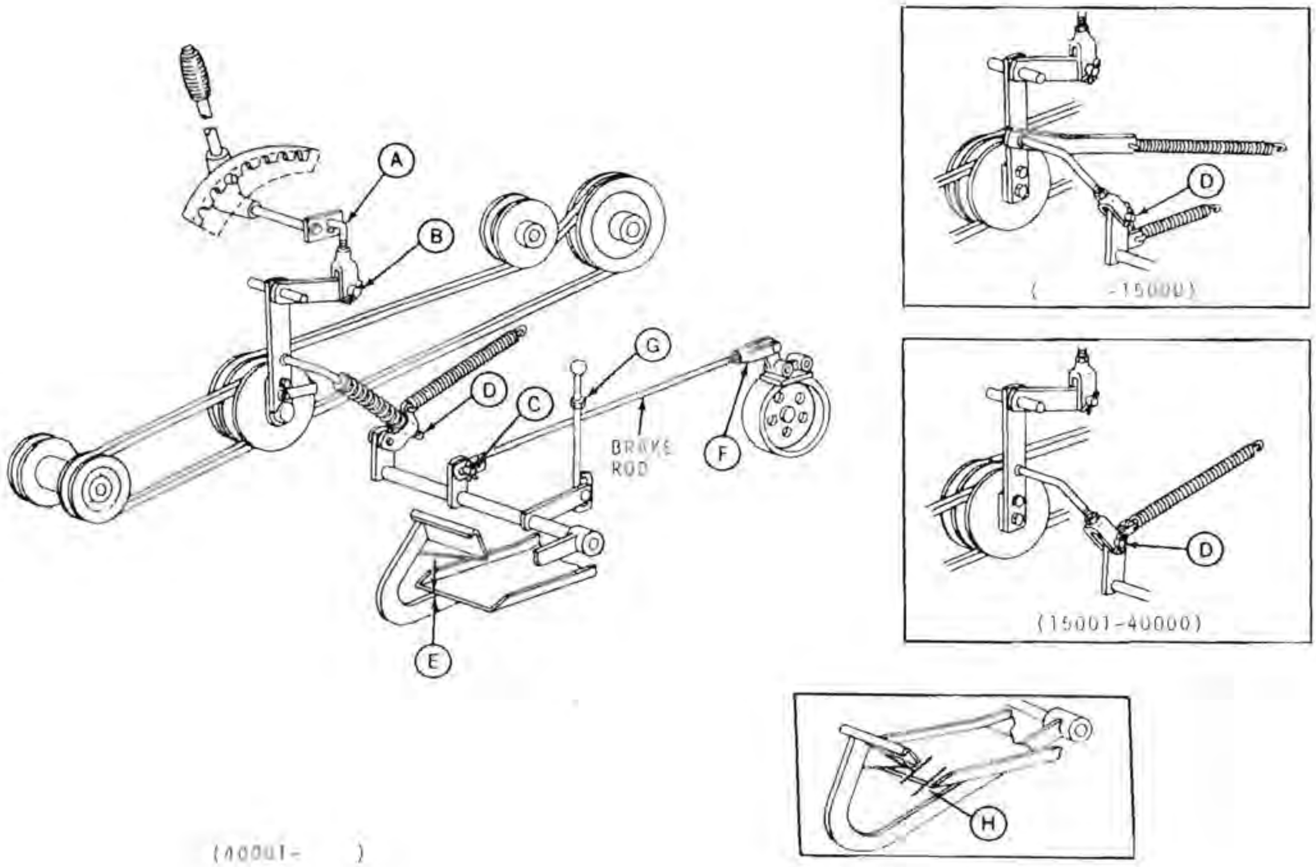


Fig. 32—Schematic Showing Relationship of Clutch, Brake and Variable Speed Drive

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 7 through notch 3.

Linkage adjustment is necessary when either of the following occurs:

A. Tractor is inoperative when variable speed lever is in notch 7 on the quadrant (slow speed position).

B. Clutch-brake pedal strikes bottom of footrest during normal operation.

Adjust tractor linkage as follows:

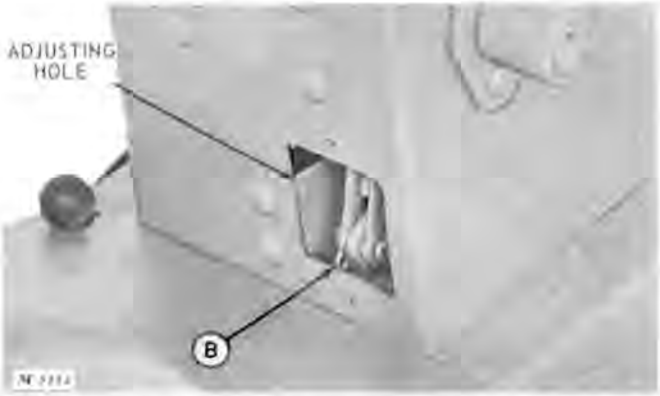


Fig. 33–Variator Adjustment in Pedestal

1. Remove inspection plate from pedestal to open adjusting hole and disconnect linkage "B," Figure 33.

2. Disconnect brake linkage at "C."

3. Place variable speed lever in notch 3 on the quadrant which is the third notch from the front of the tractor.

4. Disconnect spark plug cable and turn engine with key starter several revolutions.

5. Measure distance at "E" which is the distance between the bottom of the footrest and the top of the clutch-brake arm. This distance should be 1/2 inch. If dimension "E" is not 1/2 inch, adjust according to tractor Serial No. as follows:

110 Tractors (-40000)
Disconnect "D," Figure 32, and turn threaded clevis either up or down until dimension "E" is 1/2 inch.

110 Tractors (40001-) and All 112 Tractors
Insert tapered punch or screwdriver at "D," Figure 32, and turn rod either up or down until dimension "E" is 1/2 inch.

6. Hold link "A" to top of slot and turn threaded clevis up or down as required until pin can easily be inserted at "B." Insert spring locking pin.

7. Connect pin "C" temporarily.

8. Turn engine several times with key starter while moving ground speed control lever to notch 7 (slow position).

9. Depress clutch-brake pedal as far as possible. The top of the clutch-brake pedal should now be 3/4 inch above the top of the footrest (dimension "H"). If not, turn brake rod into clevis "F" until the 3/4 inch dimension can be obtained. Insert spring locking pin into pin "C."

10. Turn nut "G" on parking brake rod either up or down until the clutch-brake pedal can be held in the lowered position.

    If, after adjusting linkage, tractor still will not move when ground speed control lever is in first notch on the quadrant (slow speed position), remove inspection plate and turn threaded clevis up one or two turns on link "A." If necessary, install a new primary belt.

V-BELT TENSION ADJUSTMENT

V-belt tension should be adjusted if -

A. Clutch-brake pedal strikes the bottom of footrest when variable speed control lever is in the forward position.

B. Tractor does not move when variable speed control lever is in the rearmost notch in quadrant.

C. Secondary belt strands operate less than 3/4-inch apart.

Adjust V-belts as follows for each condition A through C.

A-B PRIMARY BELT TENSION

If at any time the clutch-brake pedal strikes the bottom of the footrest or if the tractor does not move with the variable speed control lever in the rearmost notch in the quadrant, the tractor linkage will require adjusting as explained beginning on page 10-16.

If, after making the adjustment, the tractor is still inoperative with the variable speed control lever in the rearmost notch in the quadrant, Figure 32, install a new primary belt.

C SECONDARY BELT TENSION

If excessive belt stretching allows the idler to rub on the lower belt strand or operates less than 3/4 inch at the closest point, additional belt tension can be obtained by moving transmission rearward as follows:

110 Tractors (-15000)

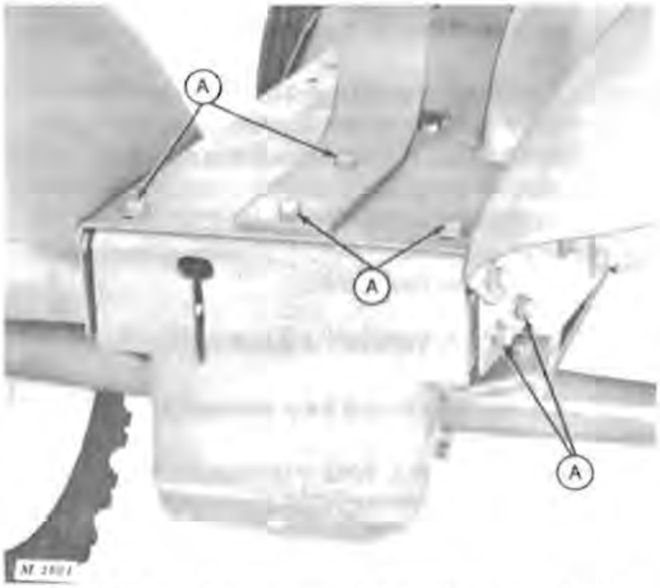


Fig. 34–Moving Transmission - 110 Tractors (-15000)

Loosen cap screws "A," Figure 34, and move transmission in slotted holes toward rear of tractor until desired tension is obtained. Tighten nuts firmly.

CAUTION: Do not allow transmission and wheels to angle to one side in slotted holes. This causes "dog tracking" of the rear wheels and secondary belt wear.

After moving transmission, be sure to readjust variator and brake rod linkage, page 10-16.

110 and 112 Tractors (15001-100,000)

Remove cap screws "A," Figure 35, and move transmission rearward into second set of holes. Insert cap screws through rear holes and tighten firmly.

After moving transmission, be sure to readjust varaitor and brake rod linkage, page 10-16.

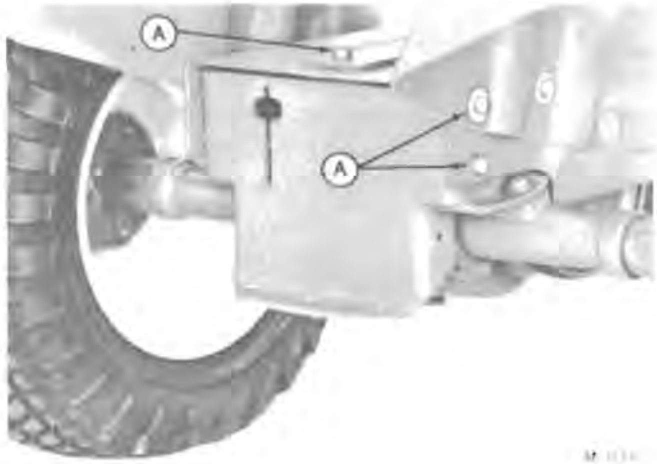


Fig. 35–Moving Transaxle - 110 and 112 Tractors (15001-100,000)

BELT GUIDE ADJUSTMENT

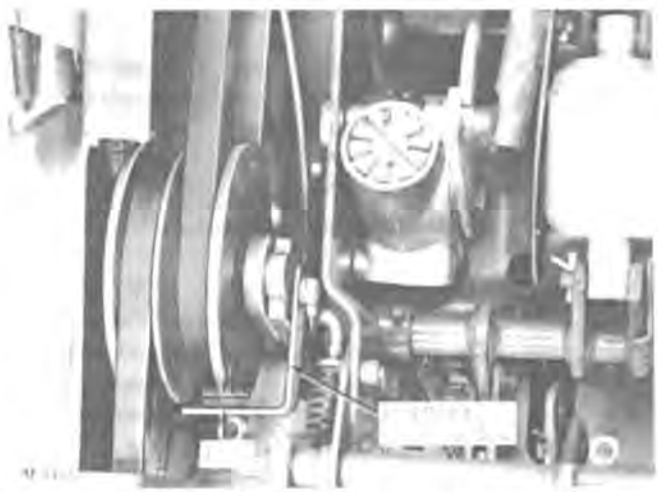


Fig. 36–Primary Belt Guide

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.

Under certain conditions, the secondary belt of the 110 Tractor may jump out of the variator groove. This usually happens when the tractor is driven down a steep incline in second or third gear, with the variator in the forward (fast speed) position, while at the same time the engine acts as a brake.

A secondary belt guide was not installed at the factory on 110 Tractors (3551-10076). Install belt guide, Figure 37, to prevent belt jumping out of variator groove.

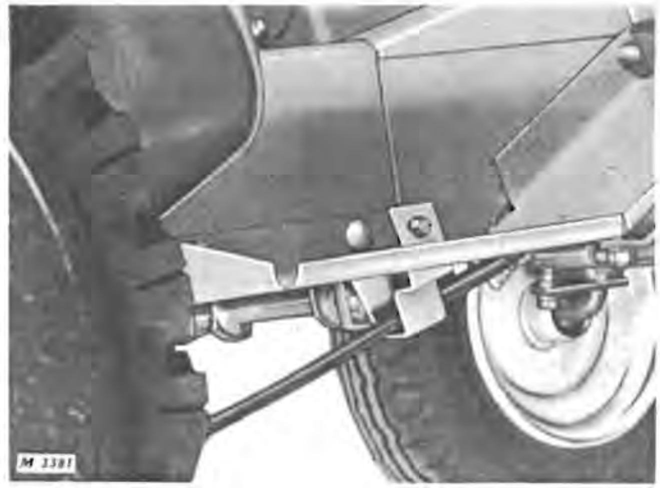


Fig. 37—Secondary Belt Guide

SPECIFICATIONS

Fig. 38—Variator Press Fit Components

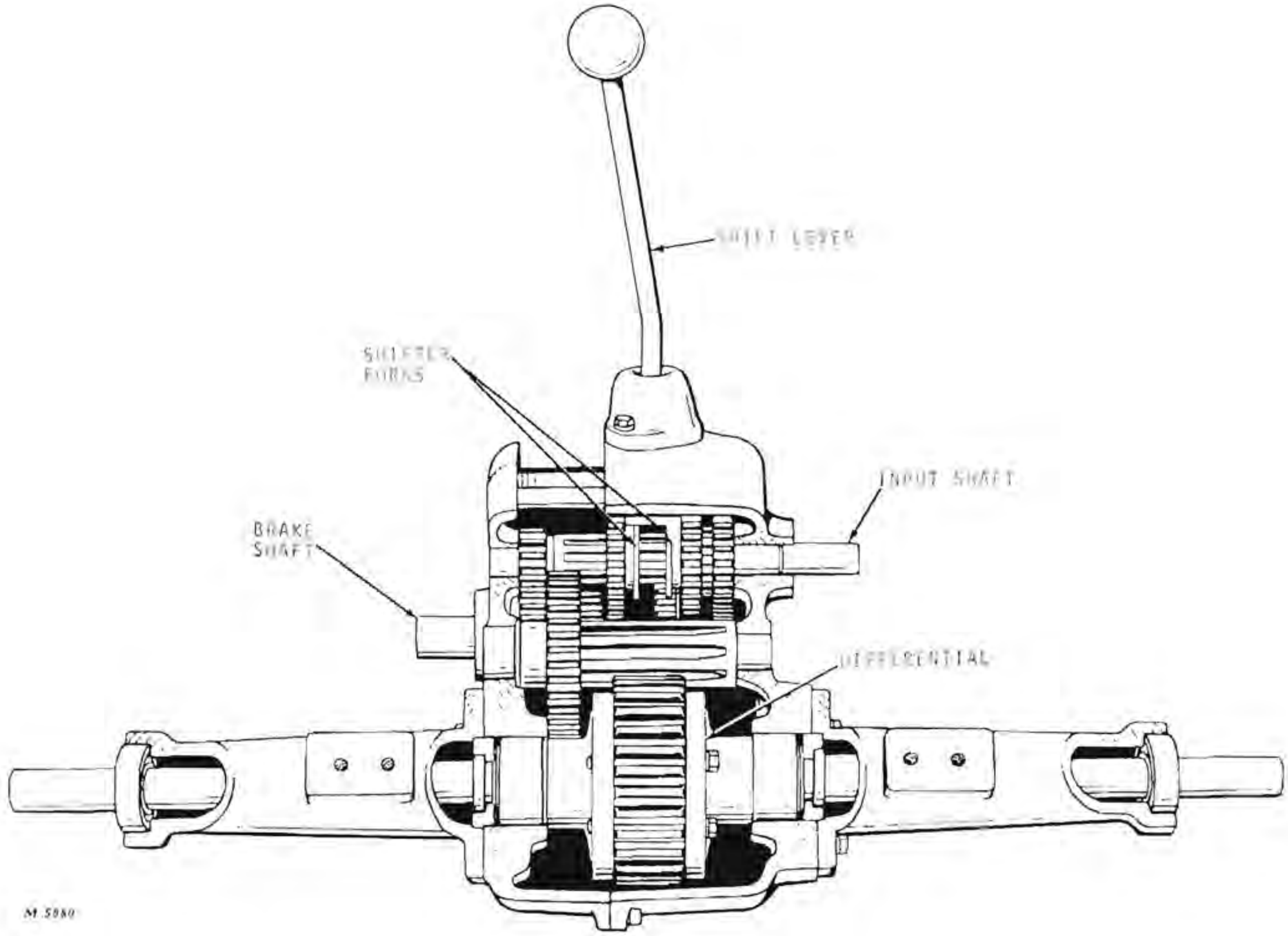
Component	Dimension
Center sheave I.D. w/bearing	2.0015 - 2.0025 inches
Hub O.D.	1.999 - 2.001 inches
Hub I.D.	1.17945 - 1.1800 inches
Bearing O.D.	1.1806 - 1.1811 inches
Bearing shaft O.D.	0.6262 - 0.6267 inch
Bearing support I.D.	0.6240 - 0.6255 inch
Primary belt guide (Distance between variator and guide)	1/16 - 1/8 inch
Clutch-brake pedal (Distance between bottom of footrest and pedal arm)	1/2 - 5/8 inch
Clutch brake pedal (Distance between top of footrest and top of clutch-brake pedal with pedal depressed)	3/4 inch

SPECIAL TOOLS

Name	Part No.	Use
Combination 2-Jaw, 3-Jaw Puller	OTC 1011-A	To remove brake pulley from input shaft
Motor-Rotor Repair Stand	OTC 1730-A	To invert tractor for tractor bottom service
Riser for Motor-Rotor Repair Stand	See page 20-22	Required to invert tractor on OTC Motor-Rotor Repair Stand
Tractor Bracket	See page 20-22	To mount tractor to OTC Motor-Rotor Repair Stand

Group 15
3-SPEED TRANSAXLE

PRINCIPLE OF OPERATION



M 5980

Fig. 1–110 Tractor Transaxle (-15000) 3 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 three forward speeds and one reverse.

There are two distinct shifter fork and gear assemblies: one for reverse and first, the other for second and third.

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.

Three speed and four speed transaxles are not interchangeable. However, design changes in the axle, carriage and differential on tractors (3572-15000) may be incorporated in transaxles of older tractors (-3571) as explained on page 15-8.

Refer to "Specifications," Section 10, for tractor speeds in each transaxle gear.

GEAR SHIFT PATTERN

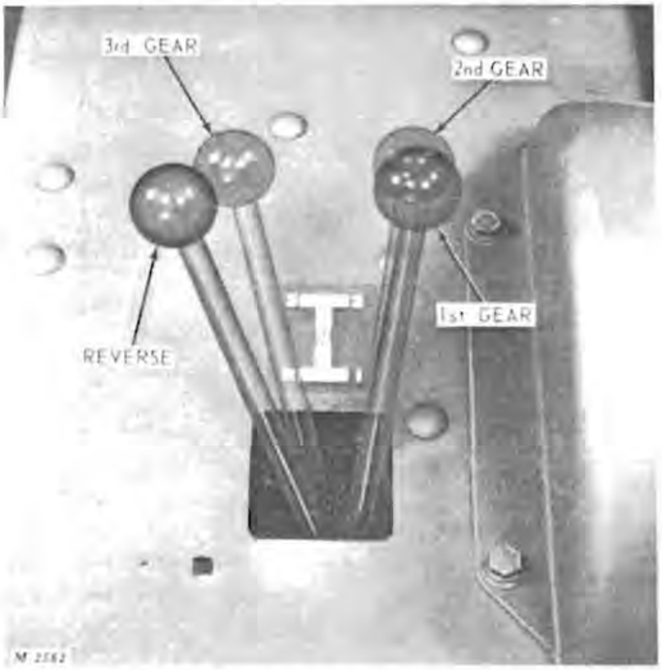


Fig. 2–Gear Shift Pattern - 110 Tractors (-15000)

Gear shifting for all speeds of the 3 forward speeds and 1 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 reverse and first gear positions and the other fork controls the second and third positions.

Study the illustrations below and at left to determine power transmission from the input shaft to the axles in each gear position. Note the slight gear movement between 1st and 2nd gear positions.

Fig. 3–Reverse Gear

Fig. 4–1st Gear

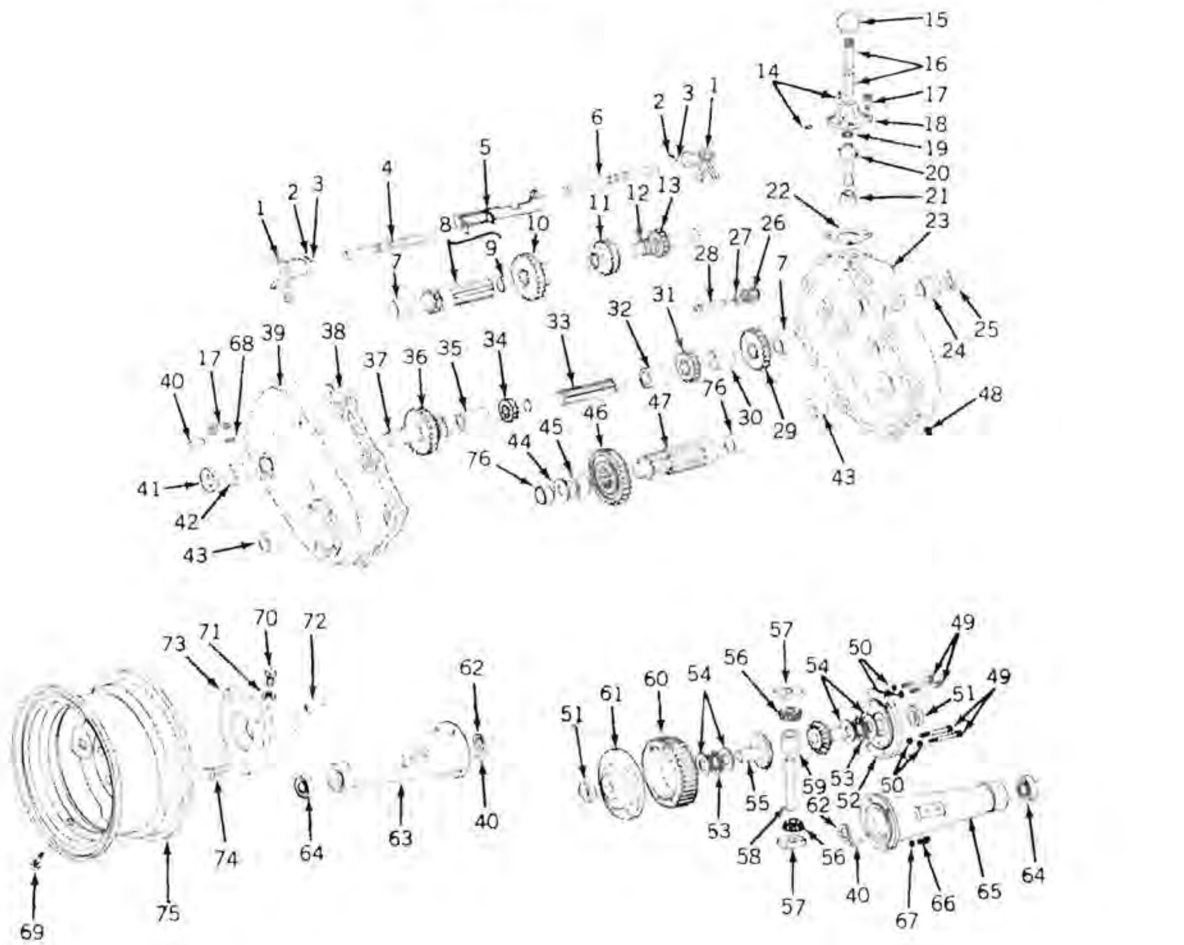
Fig. 5–2nd Gear

Fig. 6–3rd Gear

DIAGNOSING MALFUNCTIONS

Refer to pages 20-3 and 20-4 of this section for diagnosing transaxle malfunctions.

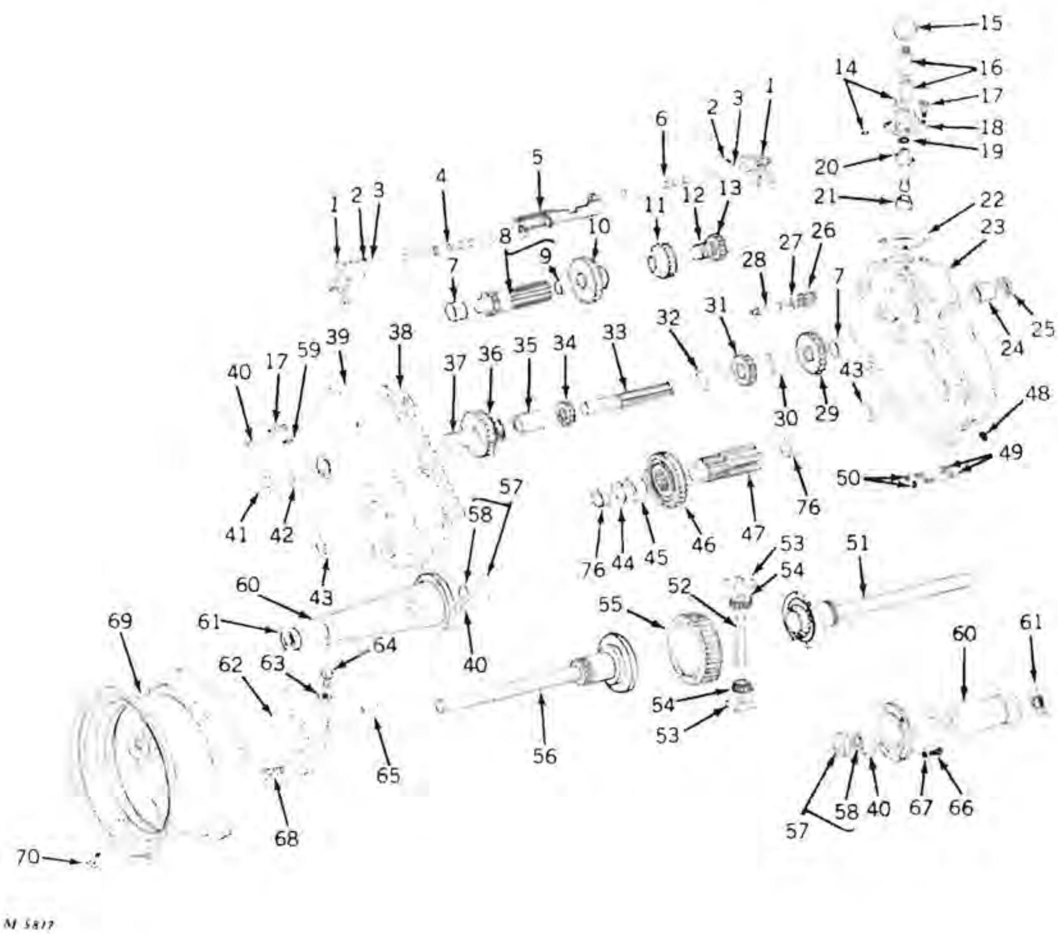
REPAIR



M 5816

1 – Shifter Fork (2 used)
2 – Spring (2 used)
3 – Ball (2 used)
4 – Shifter Rod (1st & reverse speeds)
5 – Shifter Stop
6 – Shifter Rod (2nd & 3rd speeds)
7 – Needle Bearing for Shifter Shaft
8 – Shifter Shaft and Gear
9 – Needle Bearing for Input Shaft
10 – 26-Tooth Shifter Gear (1st & reverse speeds)
11 – 20-Tooth Shifter Gear (2nd & 3rd speeds)
12 – Input Shaft and Pinion
13 – 16-Tooth Input Shaft Gear
14 – Pin (2 used)
15 – Shifter Lever Knob
16 – Shifter Lever
17 – Socket Head Cap Screw (11 used)
18 – Lever Housing
19 – Rubber Seal
20 – Spring Pin
21 – Keeper
22 – Gasket
23 – Case
24 – Needle Bearing
25 – Oil Seal (1-1/4" O.D.)
26 – Reverse Idler Gear
27 – Spacer (7/16" long)
28 – Reverse Idler Shaft
29 – 26-Tooth Idler Shaft Gear
30 – Spacer (3/4" long)
31 – 22-Tooth Idler Shaft Gear
32 – Spacer (1-3/16" long)
33 – Idler Shaft
34 – 16-Tooth Idler Shaft Gear
35 – Bronze Bushing (1-1/4" long)
36 – 30-Tooth Idler Gear
37 – Idler Pinion and Brake Shaft
38 – Case and Cover Gasket
39 – Cover
40 – Dowel Pin (4 used)
41 – Oil Seal (1-1/2" O.D.)
42 – Needle Bearing for Brake Shaft
43 – Needle Bearing for Axle (2 used)
44 – Washer
45 – Spacer (5/8" long)
46 – 36-Tooth Output Gear
47 – Output Shaft
48 – Pipe Plug (2 used)
49 – Cap Screw (4 used)
50 – Lock Washer (4 used)
51 – Spacer (3/16" thick)
52 – R.H. Carriage
53 – Thrust Bearing (2 used)
54 – Thrust Washer (4 used)
55 – Axle (2 used)
56 – Bevel Pinion (2 used
57 – Drive Block (2 used)
58 – Drive Pin
59 – Spacer (1-5/8" long)
60 – Ring Gear
61 – L.H. Carriage
62 – Oil Seal for Axle Housing (2 used
63 – L.H. Axle Housing
64 – Bearing for Axle Housing (2 used)
65 – R.H. Axle Housing
66 – Cap Screw (8 used)
67 – Lock Washer (8 used)
68 – Set Screw
69 – Rear Tire Valve (2 used)
70 – Set Screw (2 used)
71 – Hex. Jam Nut (2 used)
72 – Woodruff Key (2 used)
73 – Rear Wheel Hub (2 used)
74 – Wheel Bolt (6 used)
75 – Rear Wheel (2 used)
76 – Needle Bearing

Fig. 7–3-Speed Transaxle - 110 Tractor (-3571)



1 – Shifter Fork (2 used)
2 – Spring (2 used)
3 – Ball (2 used)
4 – Shifter Rod (1st & reverse speeds)
5 – Shifter Stop
6 – Shifter Rod (2nd & 3rd speeds)
7 – Needle Bearing for Shifter Shaft
8 – Shifter Shaft and Gear
9 – Needle Bearing for Input Shaft
10 – 26-Tooth Shifter Gear (1st & reverse speeds)
11 – 20-Tooth Shifter Gear (2nd & 3rd speeds)
12 – Input Shaft and Pinion
13 – 16-Tooth Input Shaft Gear
14 – Pin (2 used)
15 – Shifter Lever Knob
16 – Shifter Lever
17 – Socket Head Cap Screw (11 used)
18 – Lever Housing
19 – Rubber Seal
20 – Spring Pin
21 – Keeper
22 – Gasket
23 – Case
24 – Needle Bearing
25 – Oil Seal (1-1/4" O.D.)
26 – Reverse Idler Gear
27 – Spacer (7/16" long)
28 – Reverse Idler Shaft
29 – 26-Tooth Idler Shaft Gear
30 – Spacer (3/4" long)
31 – 22-Tooth Idler Shaft Gear
32 – Spacer (1-3/16" long)
33 – Idler Shaft
34 – 16-Tooth Idler Shaft Gear
35 – Bronze Bushing (1-3/4" long)
36 – 30-Tooth Idler Gear
37 – Idler Pinion and Brake Shaft
38 – Case and Cover Gasket
39 – Cover
40 – Dowel Pin (4 used)
41 – Oil Seal (1-3/8" O.D.)
42 – Needle Bearing for Brake Shaft
43 – Needle Bearing for Axle (2 used)
44 – Washer
45 – Spacer (5/8" long)
46 – 36-Tooth Output Gear
47 – Output Shaft
48 – Pipe Plug (2 used)
49 – Cap Screw (4 used)
50 – Lock Washer (4 used)
51 – R.H. Axle and Carriage Assembly
52 – Drive Pin
53 – Drive Block (2 used)
54 – Bevel Pinion (2 used)
55 – Ring Gear
56 – L.H. Axle and Carriage (tapped carrier)
57 – Axle Retainer with Seal
58 – Oil Seal
59 – Set Screw
60 – R.H. or L.H. Axle Housing (2 used)
61 – Axle Housing Bearing (2 used)
62 – Rear Wheel Hub (2 used)
63 – Hex. Jam Nut (2 used)
64 – Set Screw (2 used)
65 – Woodruff Key (2 used)
66 – Cap Screw (8 used)
67 – Lock Washer (8 used)
68 – Cap Screw (6 used)
69 – Rear Wheel (2 used)
70 – Rear Tire Valve (2 used)

Fig. 8–3-Speed Transaxle - 110 Tractor (3572-15000)

REMOVING TRANSAXLE

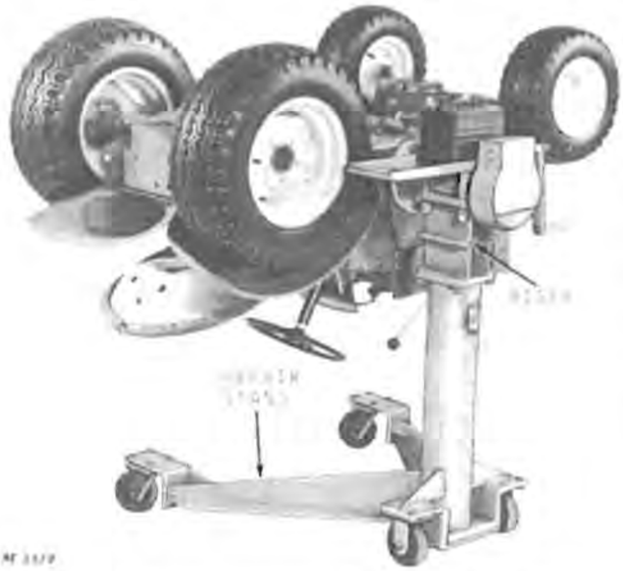


Fig. 9—Tractor Inverted on Repair Stand for Easy Transaxle Removal

For ease of transaxle removal, mount tractor on repair stand as shown in Figure 9. See "Special Tools," pages 20-21 and 20-22 in this section for repair stand information and how to make the adapters for 110 and 112 Tractors.

Run engine and move variable speed control lever forward (fast speed position) before placing tractor on repair stand. This will aid in secondary belt removal.

The following procedure must be taken before mounting tractor on repair stand.

1. Shut off fuel at sediment bowl.

2. Remove gas tank.

3. Remove battery.

4. Drain engine crankcase.

5. Replace vented filler cap on hydraulic reservoir with pipe plug to prevent leakage.

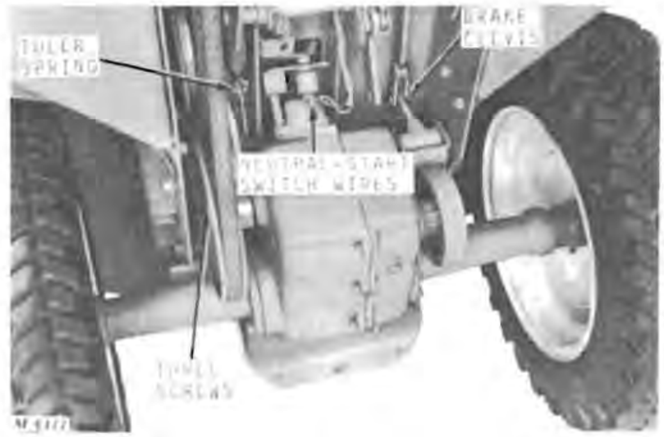


Fig. 10—3-Speed Transaxle Removal

With tractor inverted, disconnect brake clevis pin, idler spring and neutral-start wires from switch.

Remove three cap screws from driven pulley on input shaft, Figure 10.

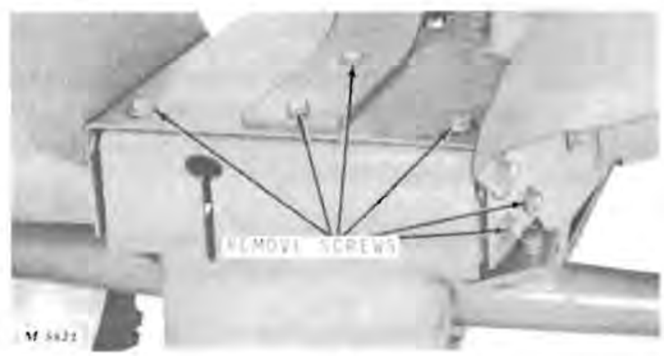


Fig. 11—Removing 3-Speed Transaxle from Tractor Base

Remove wheels, then remove the remaining screws that hold the transaxle support and hitch plate to tractor base. Lift transaxle away from tractor.

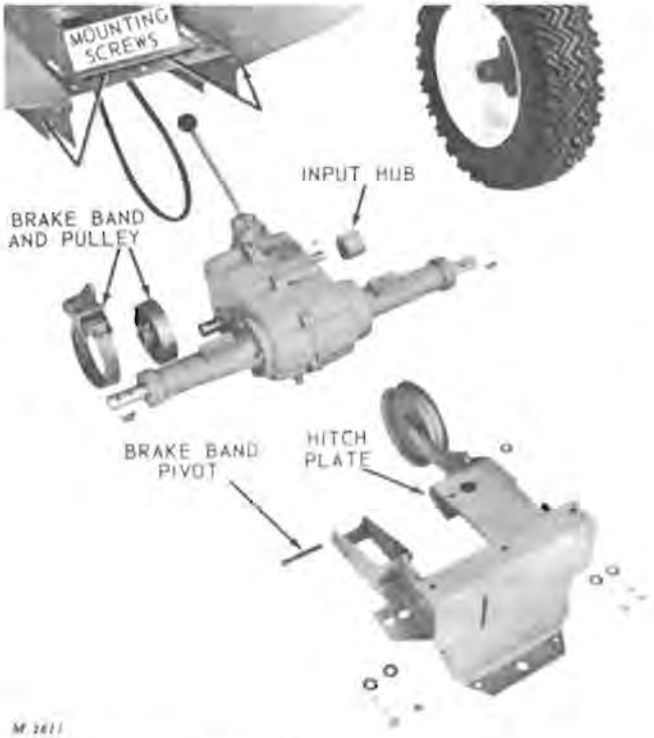


Fig. 12–Removing External Parts from 3-Speed Transaxles

Remove brake, idler arm, hitch, input hub and wheel hub assemblies from transaxle, Figure 12 and 13. Use a puller to prevent hub breakage or internal differential damage.

CAUTION: Never use hammer on end of axles or drive shafts toward transmission.

Position shift lever in neutral. Remove neutral start bracket with switch, shifter assembly, axle supports and retainers with seal, Figure 13. Use extreme care when removing axle supports since they are machined to a light press fit.

NOTE: Mark locations of right and left-hand axle housings on transaxles of 110 Tractors (-3571).

Clean and polish axles as necessary to permit easy removal of axle support.

Fig. 13–Removing External Parts

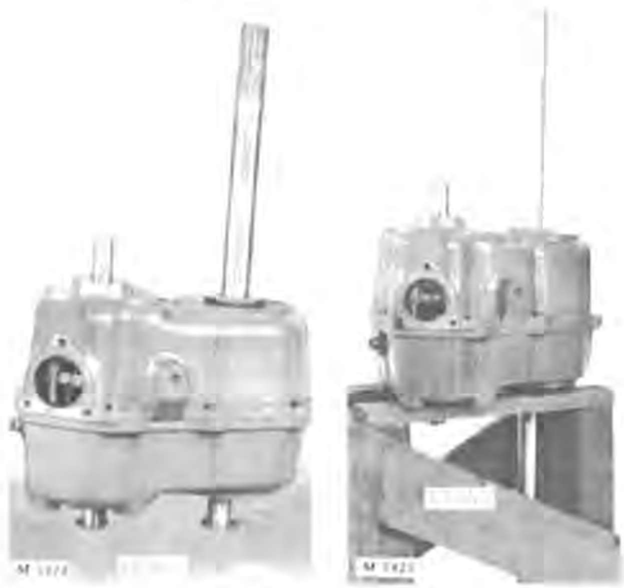
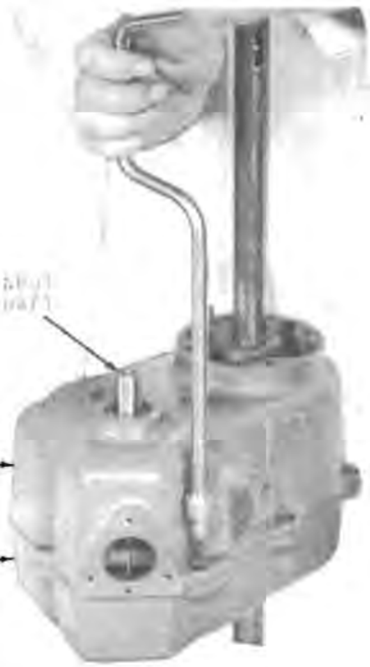


Fig. 14–Transaxle Repair Stands

Drill two holes in a sturdy work bench about 8 inches from the front of the bench. A wooden stand may be used instead.

OPENING TRANSAXLE

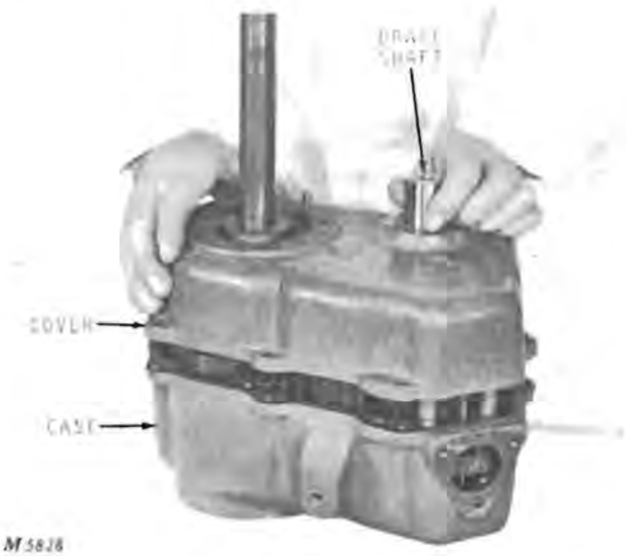


M 5827

Fig. 15–Removing Case Screws

Place transaxle in bench or stand vertically with socket head cap screws up. Remove eight screws, Figure 15. Leave dowel pins in place.

While holding case halves together, invert entire transaxle and reposition in bench. THIS IS IMPORTANT. Transaxle cover must be removed first.



M 5828

Fig. 16–Removing Case

Drive out dowel pins. Grasp the brake shaft with the left hand and transaxle cover with the right hand. Lift case slowly and shake lightly so all loose parts remain in lower case, Figure 16.

REMOVING INTERNAL COMPONENTS

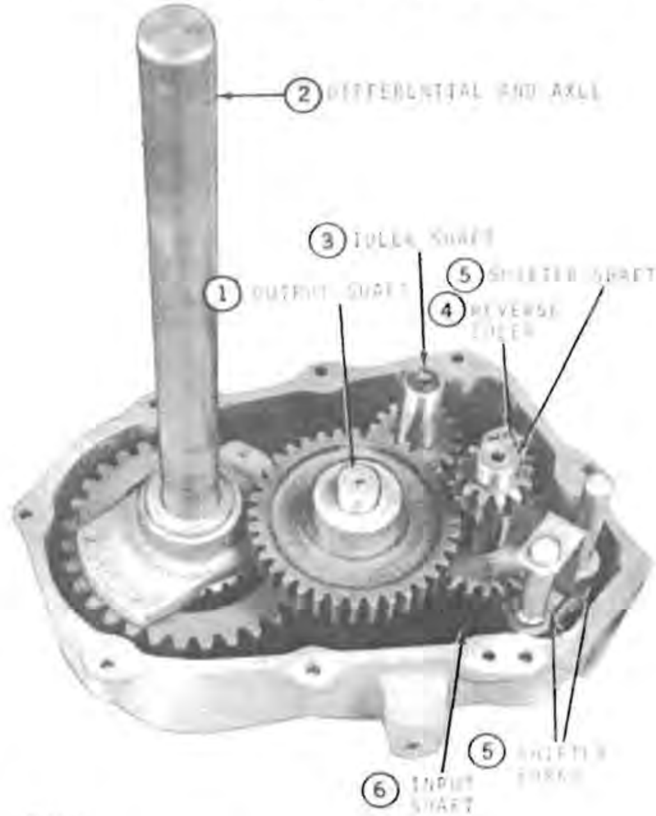


Fig. 17–Gear Removal Sequence

Figures 17 and 18 will identify the group assemblies for the 3-speed transaxle. Lift them from the case in the following order:

1. Output shaft.
2. Differential and axle assembly.
3. Idler shaft.
4. Reverse idler.
5. Shifter shaft and forks assembly.
6. Input shaft, Figure 18.

NOTE: Input shaft, Figure 18, is installed with a press fit. If close inspection reveals that gears and bearing are satisfactory, do not remove input shaft.

Fig. 18-Gear Removal Sequence

DISASSEMBLING SHIFTER LEVER

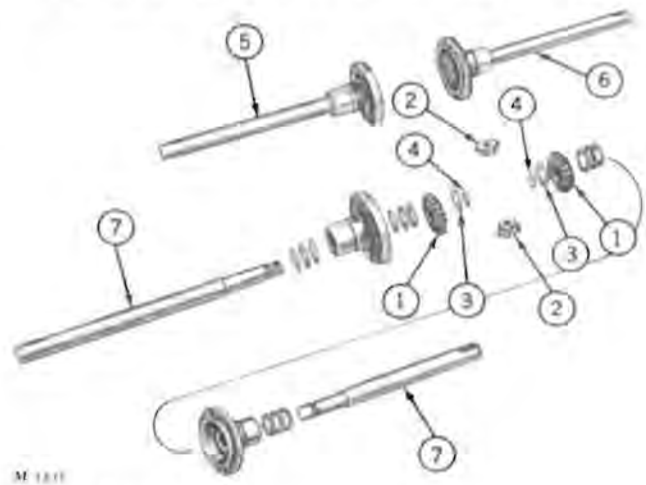
Fig. 19-Shearing Cross Pin

To disassemble the shifter, it will be necessary to self shear the cross pin between the housing and keeper. Use a vise and blunt shaft or punch as shown in Figure 19.

INSPECTION

Refer to page 20-10 of this Section for instructions on inspecting parts for wear and breakage.

REPLACING AXLE SHAFTS AND PINION GEAR



1 - Axle Bevel Gear
2 - Bevel Pinion Gear
3 - Thrust Washer
4 - Inner Axle Snap Ring
5 - Left-Hand Axle and Carriage (-15000)
6 - Right-Hand Axle and Carriage (-15000)
7 - Left-Hand Axle Shaft (3572-15000) (Replacement Axle)

Fig. 20-Old and New Style Differential Parts

110 TRACTORS (-3571)

The axle shafts and bevel gears for transaxles in this serial number range are factory assembled and can only be serviced by replacing the shaft and gear assembly.

110 TRACTORS (3572-15000)

The axle shaft and bevel gear (1 and 7) for transaxles in this serial number range are factory assembled with the bevel gear rolled or peened on the splined shaft. A loose bevel gear indicates trouble and should be serviced. A bent axle or broken bevel gear requires new parts.

When either the axle shaft or bevel gear must be serviced, the AM30744 gear kit consisting of two axle bevel gears (1) and two pinion gears (2) must be used.

IMPORTANT: Gears in this kit are a matched set. Do not mix old and new gears.

New axles (7), thrust washers (3) and snap rings (4) must also be used.

ASSEMBLY

DIFFERENTIAL ASSEMBLY

Fig. 21–Differential Assembly - 110 Tractors (-3571)

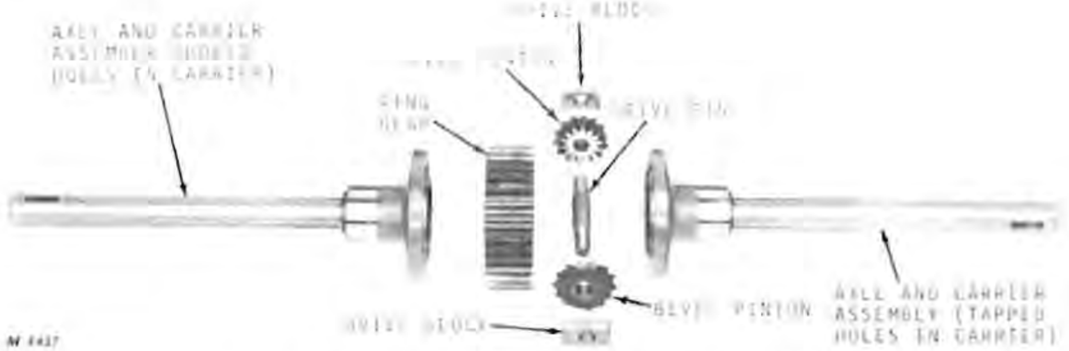


Fig. 22–Differential Assembly - 110 Tractors (3572-15000)

Refer to page 20-10 and inspect bevel pinion gears before assembling differential.

Assemble all parts shown above depending upon the tractor serial number.

Apply Loctite or equivalent to ends of threads and assemble cap screws through carrier into tapped carrier. Be sure lock washer is under head of screw.

Refer to "Bolt Torque Chart," page 10-4 of Section 10, for proper cap screw torque.

The axles should rotate freely in opposite directions when assembled. Lay the differential assembly aside for later installation.

BEARINGS

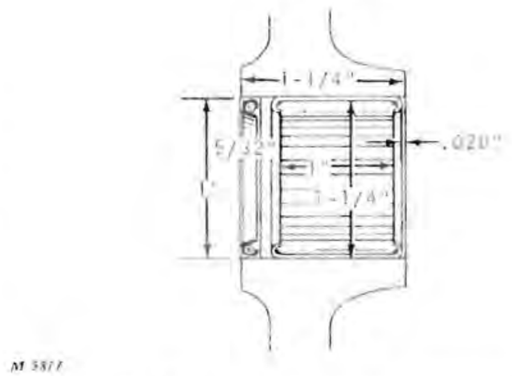


Fig. 23–Installing Bearings (3572-1500(

All bearings are pressed into tl bores from the inside of the case intc ure 23. Be sure seal is installed with

Bearing drivers to install bearin are listed under "Special Tools," As a general rule, all bearings shoul into the bearing bore to a depth c beyond flush with case interior.

INPUT SHAFT AND GEAR

Fig. 24–Input Shaft and Gear Assembly

Assemble input shaft and gear. Counterbored gear spline must face to right as shown in Figure 24. Gear is a press fit onto shaft.

Fig. 25–Assembled Input Shaft

Install input shaft and gear into case as shown. Flat side of gear should now face upward.

IDLER SHAFT AND GEARS

Fig. 26–Idler Shaft and Gear Assembly

Assemble idler shaft, Figure 26. These gears are a slip fit on the spline. Notice that raised hub of large gear faces short spacer. The teeth on the medium and small gear have round engagement edges that must face the large gear. Spacers are of different length. Assemble as shown in Figure 26.

The long round end of the idler shaft turns in the bushing on the brake shaft. Be sure end of shaft is not battered.

Fig. 27—Idler Shaft Installation

Install idler shaft and gears in case, Figure 27. Long end of shaft faces upward. Large gear engages the input gear.

REVERSE IDLER SHAFT AND GEAR

Fig. 28—Reverse Idler Shaft and Gear Assembly

Assemble reverse idler shaft assembly as illustrated. Round edge of teeth faces spacer.

Fig. 29—Reverse Idler Installed

Install reverse idler and shaft in case with round edge of teeth and spacer upwards, Figure 29.

SHIFTERS

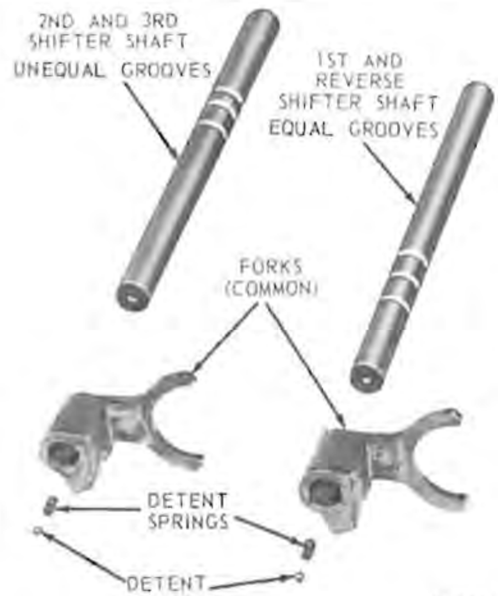


Fig. 30—Shifter Fork Assembly

Because of heavy detent pressure, the assembly of these shafts can be difficult.

Assemble forks as shown in Figure 30. Both forks should face to the right for assembly. The 2nd and 3rd shaft must have the unequally spaced grooves at the top and away from the fork as shown. The 1st and reverse shaft must have the shortest ungrooved end face the fork as shown. 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 center or neutral detent positions at this time.

SHIFTER SHAFT

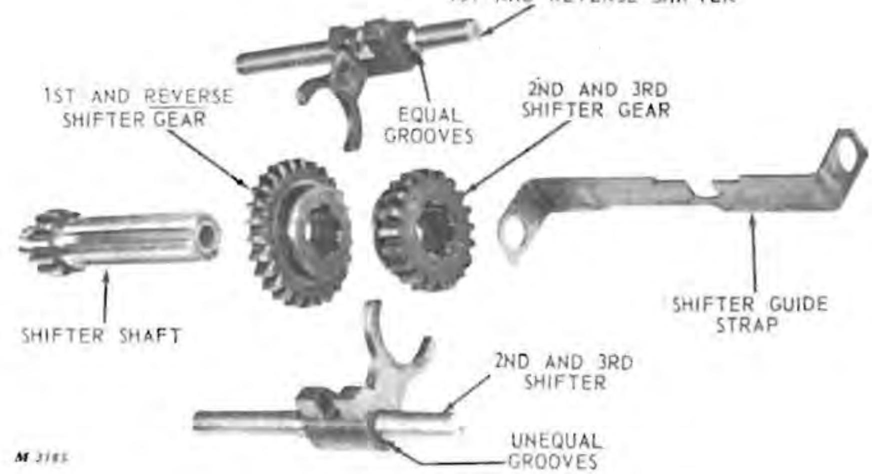


Fig. 31–Shifter Components

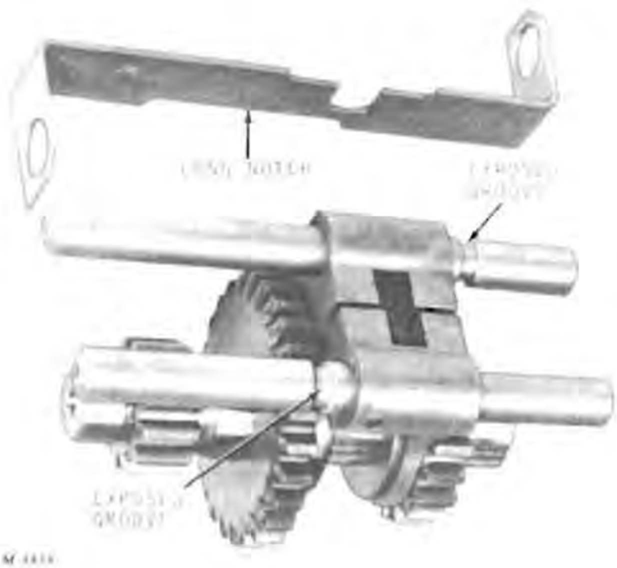


Fig. 32–Shifter Assembly

To assemble shifter, lay out parts as shown in Figure 31. Be sure forks are in center grooves. Note that the exposed groove on the unequally spaced 2nd and 3rd shifter faces the gear on the shifter shaft. The exposed groove of the 1st and reverse equally spaced shifter faces away from the gear on the shifter shaft.

The shifter shaft assembly should appear as shown in Figure 32. 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 shafts.

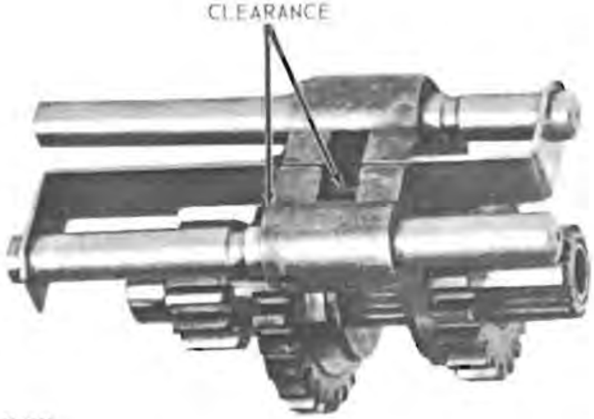


Fig. 33–Shifter Assembly

Fig. 34–Shifter Installation

Assemble shifter guide over shifter shafts. Slot in guide should match rectangular opening between the forks. The long notch in underside of guide should clear the large 1st and reverse shifter gear, Figures 32 and 33.

Grasp shifter assembly firmly in left hand and lower it into case. The input shaft stud should enter needle bearing in end of shifter shaft. The shifters should now enter the two machined sockets in bottom of the case.

Fig. 35–Partial Assembly

All parts assembled thus far should appear as shown in Figure 35.

INSERTING DIFFERENTIAL ASSEMBLY IN CASE

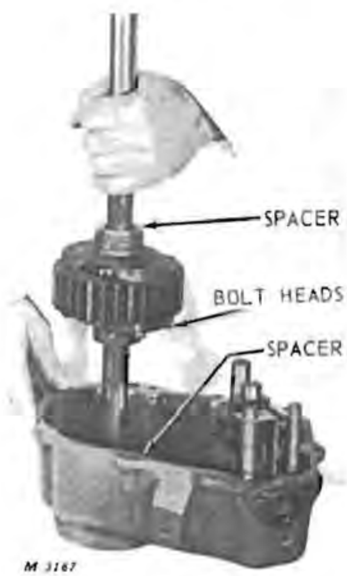


Fig. 36–Differential Assembly

Install differential and axle assembly into the case with the bolt heads on the right-hand carrier downward, Figure 36. A thick, hardened spacer or thrust bearing assembly must be on each side of the differential as shown for 110 Tractors (-3571). For 110 Tractors (3572-15000), be sure needle bearing is flush with inside of case and cover and no lower than 0.020 inches below flush.

Fig. 37–Differential Installed

The assembly should now appear as shown in Figure 37.

OUTPUT SHAFT

Fig. 38–Output Shaft Components

The output gear shaft is assembled to the pinion with a press fit. A slight looseness can be tolerated because the spacer and washer will hold the gear in place.

Fig. 39–Output Shaft Installation

Install the output shaft assembly in the case as shown in Figure 39. It may be necessary to lift the differential about 1/2 inch to mesh gears during assembly.

Position the gasket on the lower case at this time.

BRAKE SHAFT AND COVER

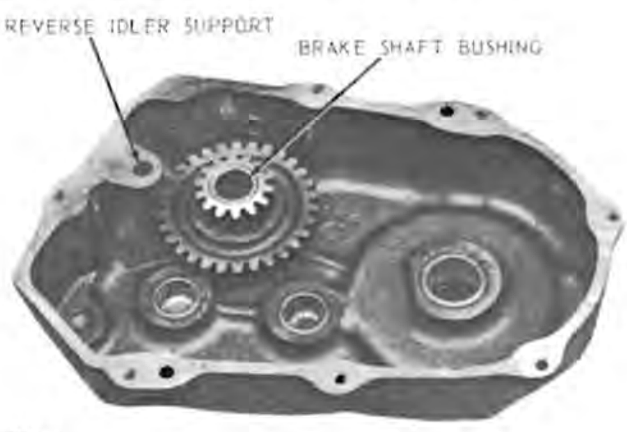


Fig. 40–Brake Shaft Installed

The brake shaft and large pinion are a press fit to each other within the case. This is necessary because of the overhang of the reverse idler support bearing. Do not use the case itself to support any part of the pressure required to install the pinion and shaft. To assemble, support the case on a sleeve slightly larger than the needle bearing. Start the shaft through the gear with flat side of teeth up and press from the side shown in Figure 41.

Fig. 41–Brake Shaft Components

New brake bushing tolerances are 0.749 to 0.751 inch. Replace if worn beyond wear tolerance limit of 0.756 inch.

If bushing is replaced, check I.D. It may require reaming. Bushing I.D. dimension is 0.749/0.751 inch.

PLACING COVER ON CASE

Fig. 42–Assembling Cover and Case

Loosen or remove set screw on transaxles so equipped, Figure 42.

Install the left-hand case half as illustrated in Figure 42. Shake the case lightly, and all shafts and bearings will align themselves. To close the last 1/2 inch, tap the case horizontally at the corner indicated.

Fig. 43–Inserting Dowel Pins

Align and insert dowel pins, Figure 43. Start socket head cap screws from bottom.

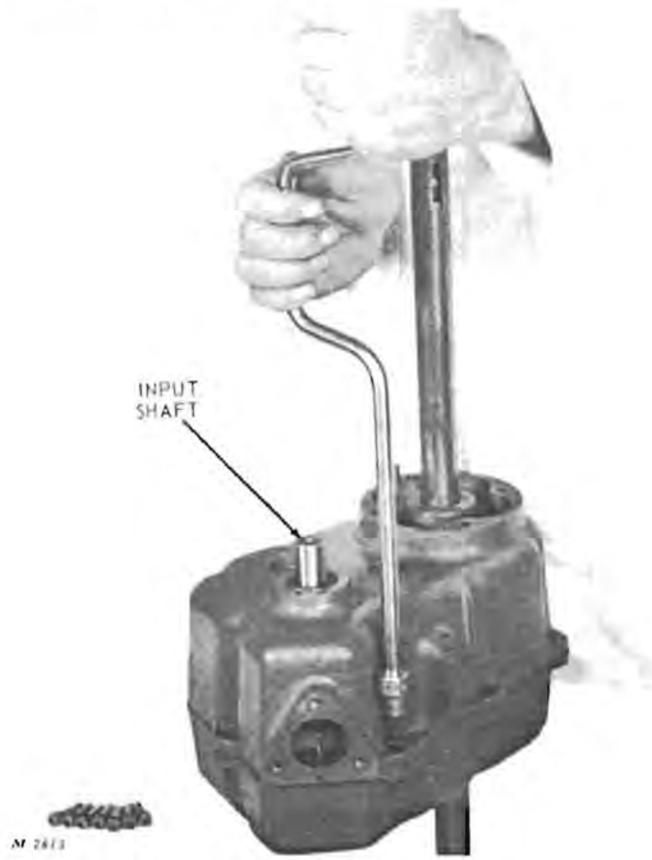


Fig. 44–Transaxle Inverted

Invert transaxle and tighten case screws securely to 120 in-lbs. Put Loctite on threads, then tighten set screw against the shifter shaft, Figure 43, on transaxles so equipped.

INSTALLING SEALS

Fig. 45–Installing Seals

Use seal driver to install seals or seal with retainer. Refer to "Special Tools," page 20-21, for proper seal driver. Install seal after shaft has been installed.

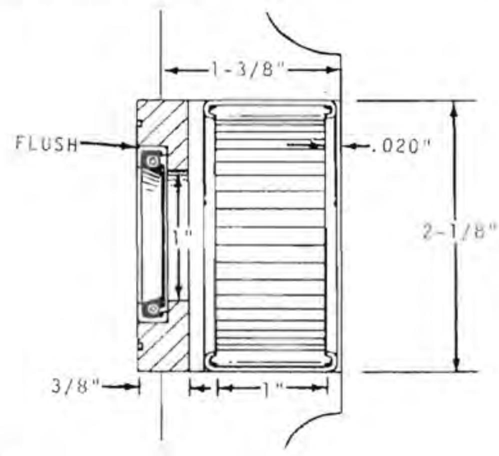


Fig. 46–Seal Retainer and Bearing Installation

Be sure seal is installed with lip inward, Figure 46.

Fig. 47–Axle Support Installation

Install axle supports, Figure 47. Refer to "Bolt Torque Chart," page 10-4 of Section 10 and torque axle bolts accordingly.

POSITIONING SHIFTER FORKS

Fig. 48–Incorrect

Fig. 49–Correct

Inspect the shifter forks to be sure they are aligned and in neutral. Failure to do this will cause damage to the transmission when engaged under power. (Compare illustrations above.)

ASSEMBLING SHIFTER LEVER

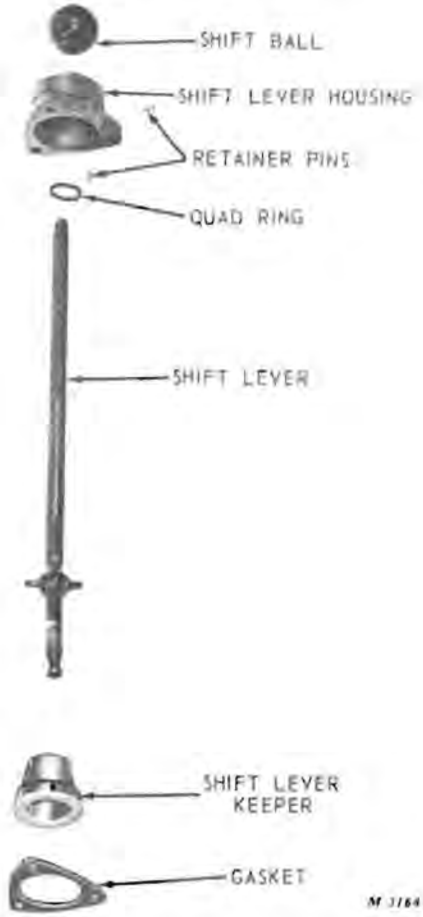


Fig. 50–Shifter Lever Components

The shifter is assembled in the order shown in Figure 50. To prevent incorrect positioning of the quad ring in the housing, a little shellac or gasket cement will be helpful. Align the small cross pin holes between housing and keeper and drive in new pin. Then install the second pin as a retainer and locater in the housing. Position neutral start bracket lever and gasket on the transaxle. When the locating pin is positioned on the housing, the slight bend in the lever should point to the left. If it does not, reassemble the shift lever and shift lever housing. Tighten three screws to 120 in-lbs.

INSTALLING TRANSAXLE

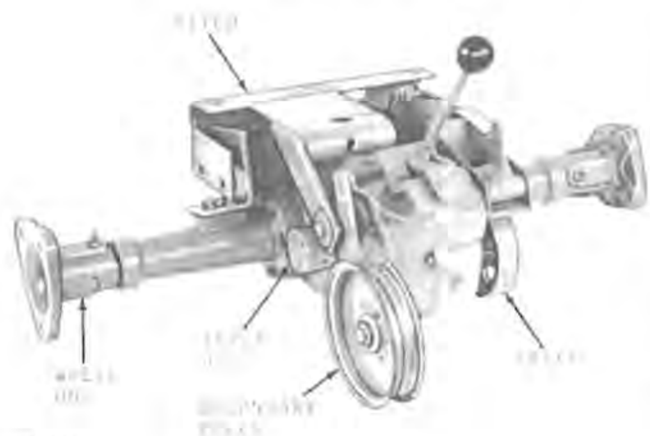


Fig. 51–Transaxle Installation

Install brake, input hub, secondary idler, hitch, neutral-start bracket with switch, and wheel hub assemblies on transaxle, Figure 51. Apply Loctite or equivalent to threads on all bolts and set screws used in assembling components to transaxle. Refer to "Bolt Torque Chart," page 10-4 of Section 10, and tighten bolts accordingly.

Refer to page 10-15 of Section 40, and adjust neutral-start switch and bracket.

Before installing transaxle in tractor base, check transaxle by turning input hub and shifting transaxle in each gear.

Place transaxle in tractor base, Figure 52. Install cap screws holding transaxle support and hitch plate to tractor base.

Place secondary belt on transaxle sheave and install sheave on hub with three cap screws. Connect brake clevis and secondary idler spring, Figure 52.

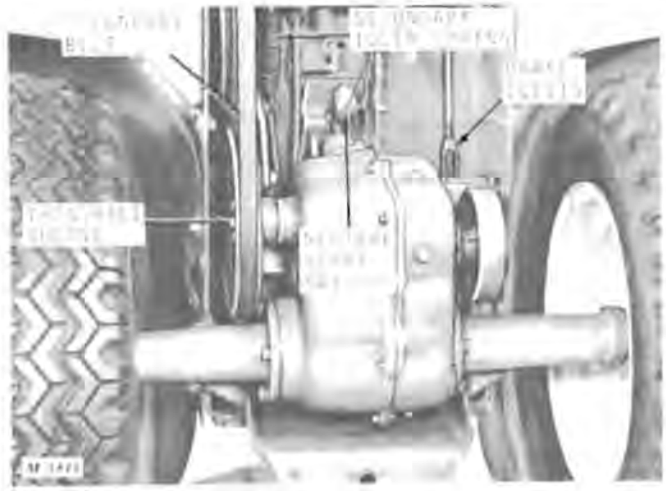


Fig. 52–Transaxle Installed

Bolt wheels to hubs with wheel bolts. Refer to "Bolt Torque Chart," page 10-4 of Section 10, and tighten hardware accordingly.

Connect neutral-start switch leads.

Refer to "Adjustment," page 10-16, and re-adjust brake and variator linkage.

Add lubricant after turning tractor upright. See "Lubrication Chart," page 20-1 of Section 10.

SPECIAL TOOLS

See page 20-21 for a listing of the special tools required to service the transaxle. Repair stand adapters are on page 20-22.

Group 20
4-SPEED TRANSAXLE

PRINCIPLE OF OPERATION

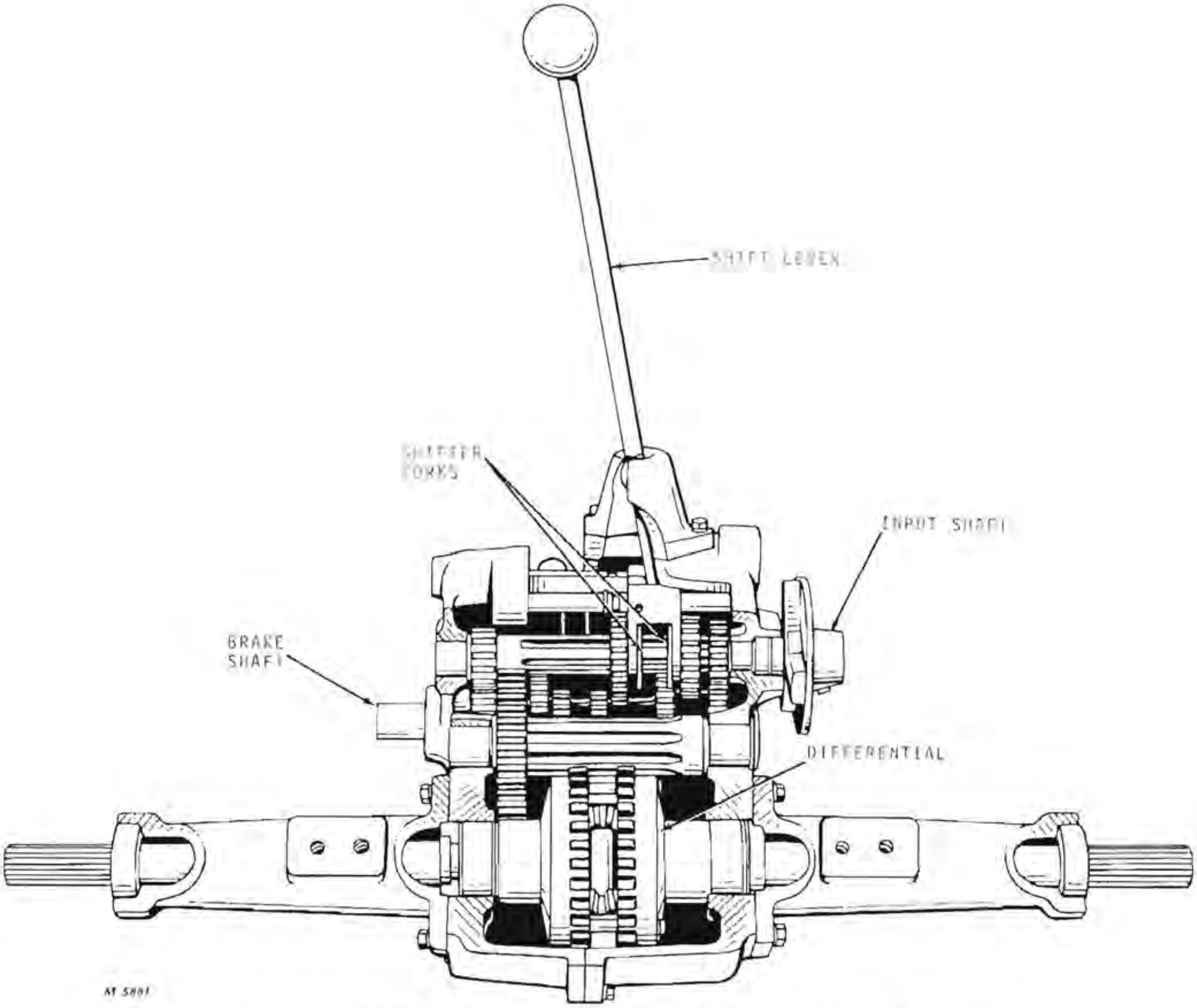


Fig. 1–110 and 112 Tractor Transaxle (15001-100,000) - 4 Forward Speeds - 1 Reverse

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 speeds 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.

The 3-speed and 4-speed transaxle are not interchangeable. That is, a 4-speed transaxle cannot be installed in tractors having a 3-speed transaxle, nor can a 3-speed transaxle be installed in a tractor with a 4-speed transaxle. This is because extensive changes to the tractor frame and components are required.

GEAR SHIFT PATTERN

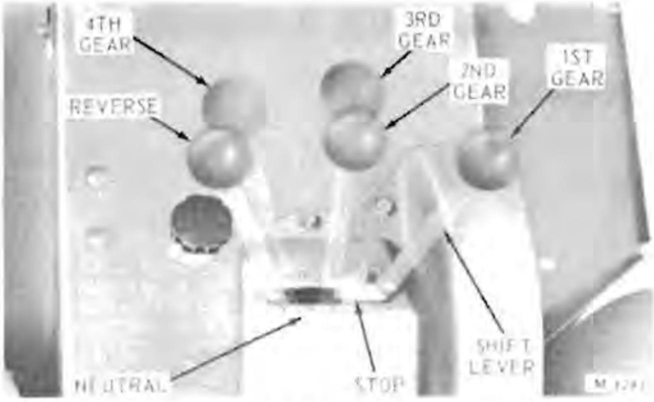


Fig. 2–Gear Shift Pattern - 110 and 112 Tractors (15001-100,000)

Gear shifting for all four forward speeds 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.

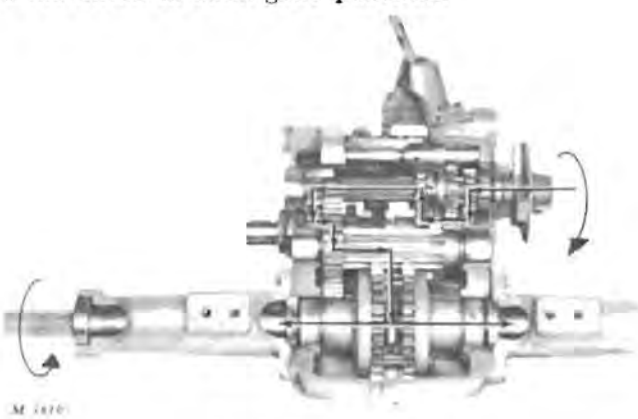


Fig. 3–Reverse Gear

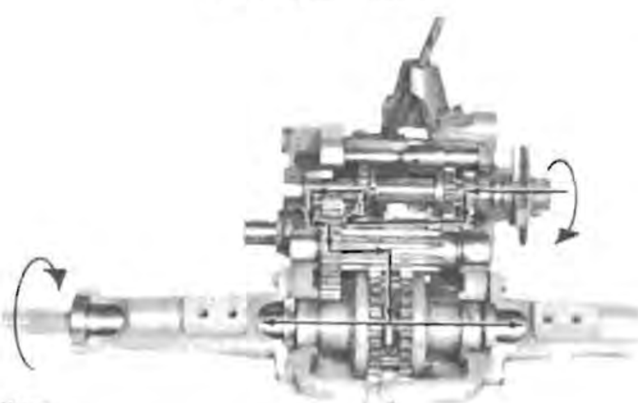


Fig. 4–1st Gear

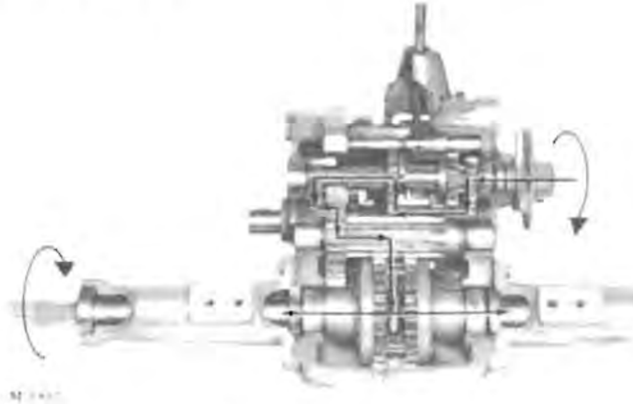


Fig. 5–2nd Gear

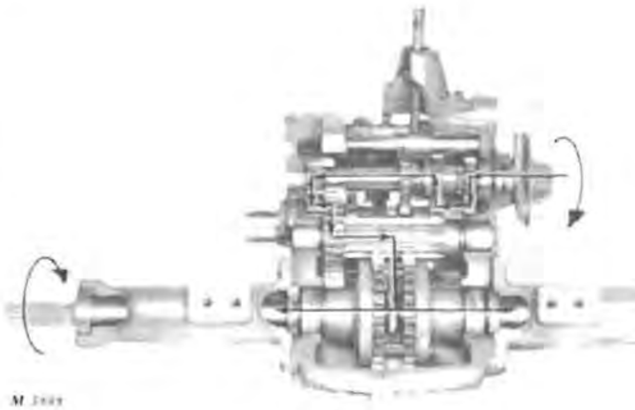


Fig. 6–3rd Gear

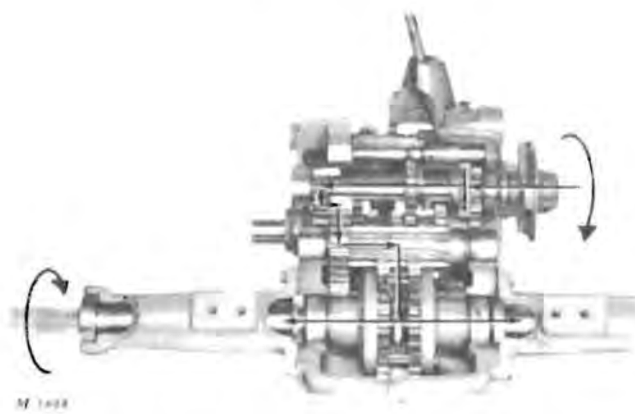


Fig. 7–4th Gear

DIAGNOSING MALFUNCTIONS

TRANSAXLE

Gears Clash When Shifting.

Variator linkage not properly adjusted (mainly clutch rod).
Adjust variator linkage and/or adjust clutch rod.

Shifting gears while tractor is in motion.
Stop tractor before shifting gears.

Clutch-brake pedal not fully depressed.
Press clutch-brake pedal all the way down before shifting.

Linkage not properly assembled.
Assemble linkage properly.

Short secondary belt.
Move transaxle to forward position.
Replace secondary belt if necessary.

Hard Shifting.

Variator linkage not properly adjusted (mainly clutch rod).
Adjust variator link and/or adjust clutch rod.

Shifting gears while tractor is in motion.
Stop tractor before shifting gears.

Clutch-brake pedal not fully depressed.
Press clutch-brake pedal all the way down before shifting.

Loose shifter housing bolts.
Tighten bolts firmly.

Shift quadrant not properly adjusted.
Position quadrant correctly.

Shifter forks, rod(s) or other transmission gear selection components damaged.
Check condition of parts.
Replace parts as necessary.

Worn shifter lever assembly.
Check condition of parts.
Replace parts as necessary.

Jumps Out of Gear.

Quadrant not properly adjusted.
Position quadrant correctly.

Gear(s) damaged from shifting while tractor is in motion.
Check condition of gears.
Install new gears if necessary.

Worn spline on input shaft.
Replace input shaft.

Worn shifter gear spline.
Replace gear.

Shifter forks, rod(s) or other transmission gear selection components damaged.
Check condition of parts.
Replace parts as necessary.

Second and third shifter rod set screw loose.
Tighten screw firmly on three speed transaxles so equipped.

Locked in Gear.

Variator and brake linkage not properly adjusted.
Adjust linkage.

Clutch-brake rod not fully depressed.
Press clutch-brake pedal all the way down.

Heavy draft load.
Reduce work load.

Noisy Forward Speeds.

Refer to page 20-4 for noise characteristics of transaxle.

Low lubricant level.
Fill transaxle to proper level.

Differential bevel gears worn or damaged.
Check condition of gears.
Install bevel gear kit if necessary.

Gears worn or damaged in transmission section of transaxle.

Check condition of parts.
Replace parts as necessary.

Worn or damaged bearings.
Check bearing condition.
Replace bearings if necessary.

Noisy in Reverse.

Low lubricant level.
Fill transaxle to proper level.

Reverse idle gear and/or shaft worn or damaged.
Check condition of parts.
Replace parts as necessary.

Differential bevel pinion gear(s) worn or damaged.
Check condition of gears.
Install bevel gear kit if necessary.

Lubricant Leaks.

Excessive lubricant.
Lower lubricant to proper level.

Loose case screws.
Tighten screws firmly.

Loose shifter housing bolts.
Tighten housing bolts firmly.

Worn or damaged shifter housing seal.
Replace seal.

Worn or damaged seal.
Replace seal.

Bad O-ring between case and axle housing.
Install new O-ring.

Defective case gasket.
Install new gasket.

TRANSAXLE NOISE

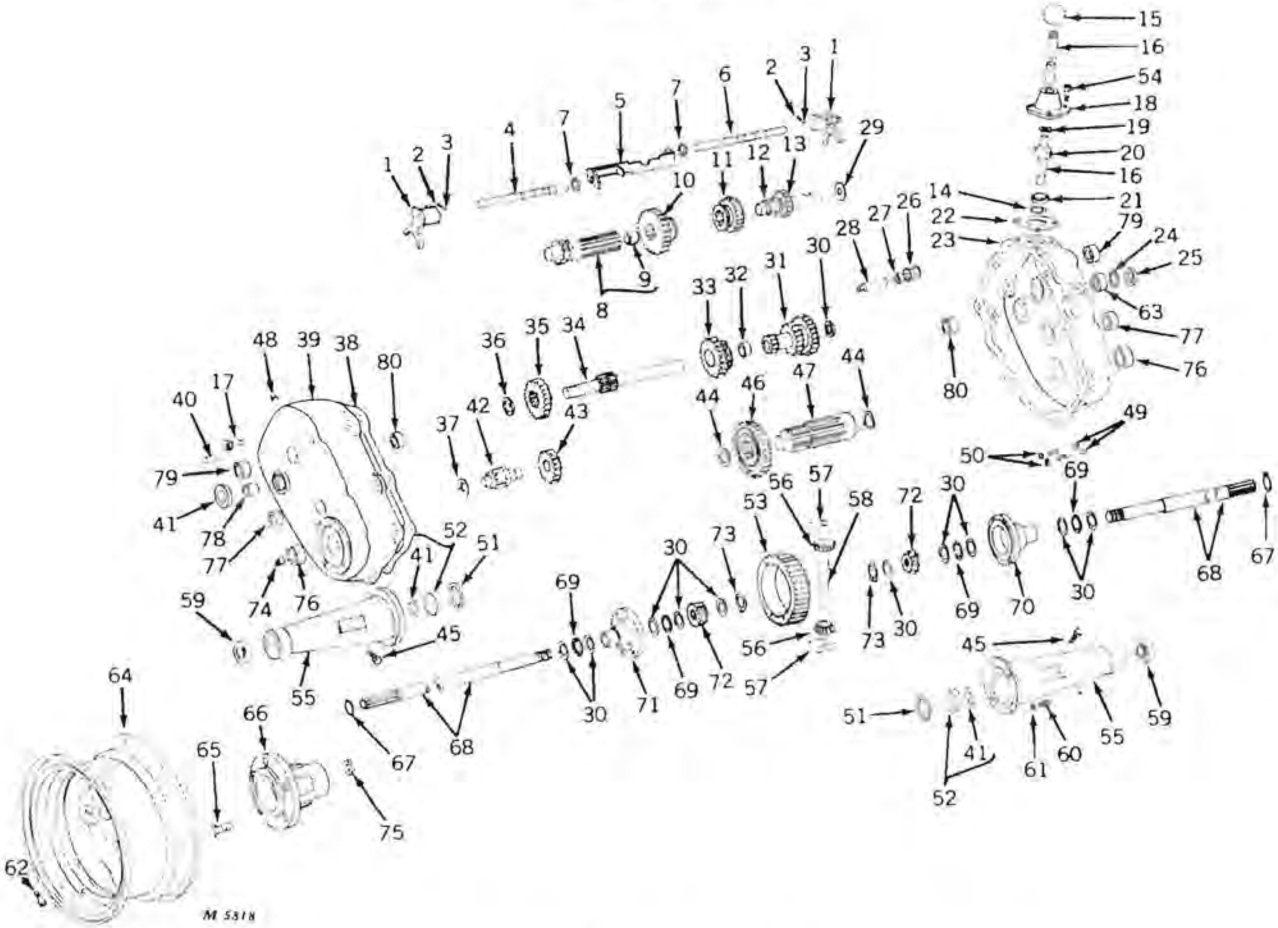
Noise characteristics in the transaxle are more difficult to diagnose and repair than mechanical failures. Some transaxle noise heard only at certain speeds or under remote conditions must be considered normal. Transaxle noise tends to be more pronounced in certain gears when the variable speed control lever is forward (fast speed position). This noise is NOT a sign of trouble in the transaxle.

Abnormal gear noise can be recognized since it produces a "clicking" sound and will be very pronounced in the gear range in which the noise occurs. If damaged gears are in the differential components of the transaxle, the gear noise will be pronounced in all gear speeds.

Gear chatter and noise has been found to be a two cluster gear (33), Figure 8, assembled in reverse position. This occurs on certain original 4-speed transaxles when the transaxle has been disassembled and transaxle noise persists. Check for improper assembly of the cluster gear.

Chronic complaints of transaxle noise when there is no conceiveable cause, can be minimized by adding a commercial gear supplement, such as "Slip G" to reduce normal gear noise level.

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 Pinion
35 – 30-Tooth Idler Gear
36 – Thrust Washer (1" I.D. x 1-1/2" O.D.)
37 – Idler Shaft Washer
38 – Gasket
39 – Cover
40 – Dowel Pin (2 used)
41 – Oil Seal (1-3/8" O.D.)
42 – Idler Shaft and Pinion
43 – 22-Tooth Idler Gear
44 – Thrust Washer (1-5/16" I.D. x 1-1/2" O.D.) (2 used)
45 – Cap Screw (5 used)
46 – 36-Tooth Output Gear
47 – Output Shaft
48 – Pipe Plug (2 used)
49 – Cap Screw (4 used)
50 – Lock Washer (4 used)
51 – O-Ring (2 used)
52 – Axle Retainer (2 used)
53 – Ring Gear
54 – Cap Screw (3 used)
55 – R.H. or L.H. Axle Housing (2 used)
56 – Bevel Pinion (2 used)
57 – Drive Block (2 used)
58 – Drive Pin
59 – Axle Housing Bearing (2 used)
60 – Cap Screw (8 used)
61 – Lock Washer (8 used)
62 – Rear Tire Valve (2 used)
63 – Needle Bearing (1" O.D.) (3 used)
64 – Rear Wheel (2 used)
65 – Wheel Bolt (10 used)
66 – Rear Wheel Hub (2 used)
67 – Snap Ring (2 used)
68 – R.H. or L.H. Axle (2 used)
69 – Thrust Bearing (7/8" I.D. x 1-7/16" O.D.) (4 used)
70 – R.H. Carriage
71 – L.H. Carriage (tapped)
72 – Bevel Gear (2 used)
73 – Snap Ring
74 – Drain Plug
75 – Take-up Washer (4 used)
76 – Needle Bearing for Axle Shaft (2 used)
77 – Needle Bearing for Output Shaft (2 used)
78 – Needle Bearing for Brake Shaft
79 – Needle Bearing for Shifter Shaft

Fig. 8–4-Speed Transaxle - 110 and 112 Tractors (15001-100,000)

REMOVING TRANSAXLE

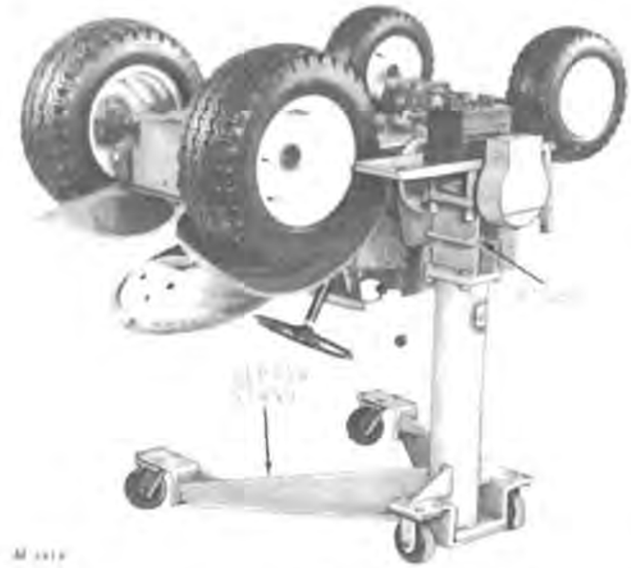


Fig. 9—Tractor Inverted on Repair Stand for Easy Transaxle Removal

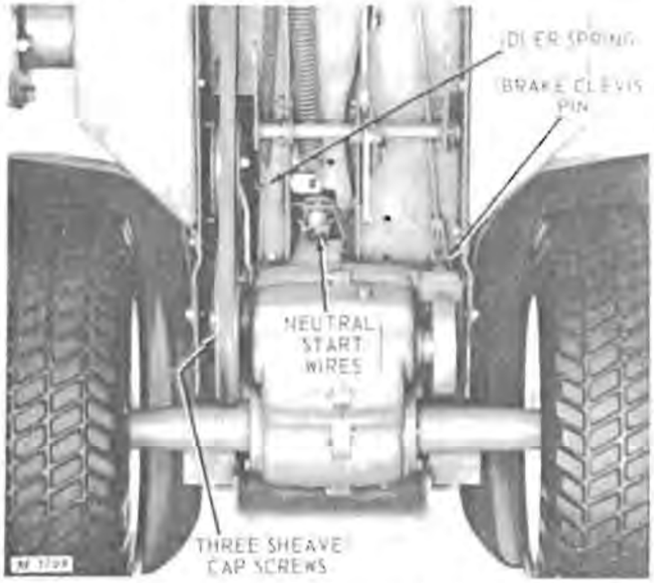


Fig. 10—4-Speed Transaxle Removal

For ease of transaxle removal, mount tractor on repair stand as shown in Figure 9. See "Special Tools," pages 20-21 and 20-22 for repair stand information and how to make the adapter for 110 and 112 Tractors.

Run engine and move variable speed control lever forward (fast speed position) before placing tractor on repair stand. This will aid in secondary belt removal.

The following procedure must be taken before mounting tractor on repair stand.

1. Shut off fuel at sediment bowl

2. Remove gas tank

3. Remove battery

4. Drain engine crankcase

5. Replace vented filler cap on hydraulic reservoir with pipe plug to prevent leakage.

With tractor inverted, disconnect brake clevis pin, idler spring and neutral-start wires from switch, Figure 10.

Slip secondary belt off variator and remove shift quadrant from deck.

Fig. 11—Removing 4-Speed Transaxle from Tractor Base

Remove wheels. Then remove the remaining screws that hold the transaxle support and hitch plate to tractor base. Lift transaxle away from tractor.

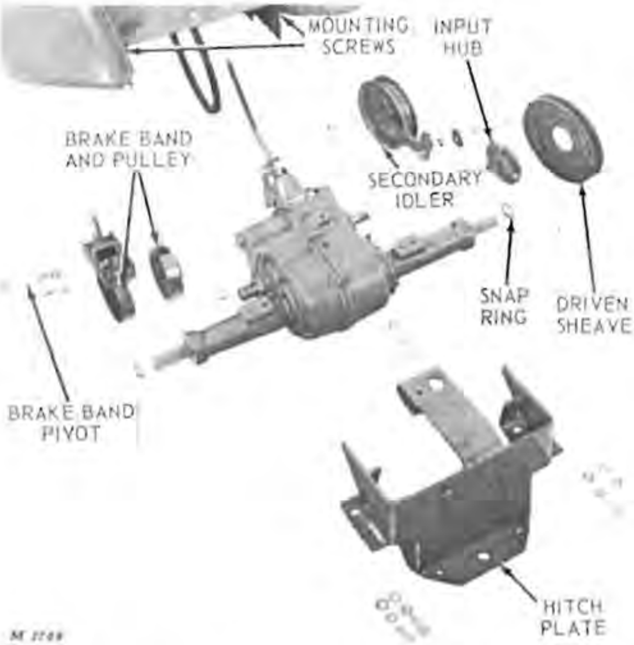


Fig. 12–Removing External Parts

Remove brake, idler arm, hitch plate, input hub and wheel hub assemblies from transaxle, Figure 12. Use a puller to prevent hub breakage or internal differential damage.

CAUTION: Never use hammer on end of axles. Never drive shafts toward transmission.

Position shift lever in neutral. Remove neutral start bracket with switch, shifter assembly, axle housings, O-rings and retainers with seal, Figure 13. Use extreme care when removing axle supports since they are machined to a light press fit.

Clean and polish axles as necessary to permit easy removal of axle housing.

Fig. 13–Removing External Parts

Fig. 14–Transaxle Repair Stands

Drill two holes in a sturdy work bench about 8 inches from the front of the bench. A wooden stand may be used instead.

OPENING TRANSAXLE

Fig. 15–Removing Case Screws

Place transaxle in bench or stand vertically with socket head cap screws and input shaft upward. Remove eight screws, Figure 15.

Drive out dowel pins. 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 16.

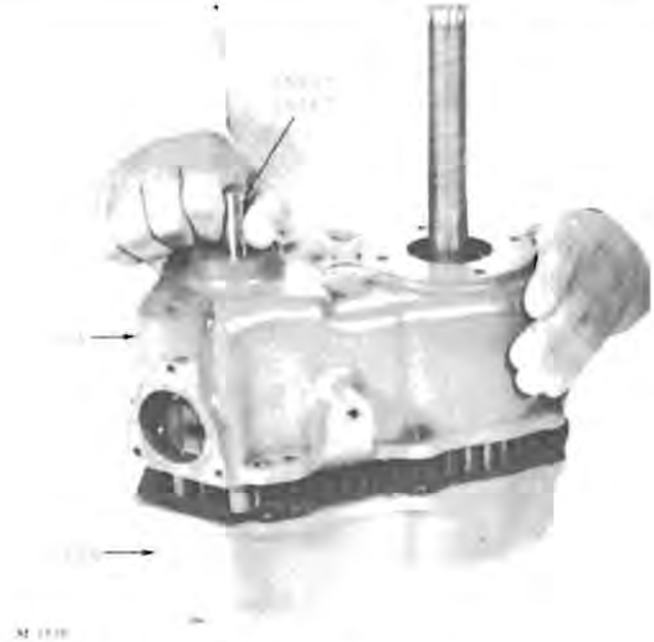


Fig 16–Removing Cover

REMOVING INTERNAL COMPONENTS

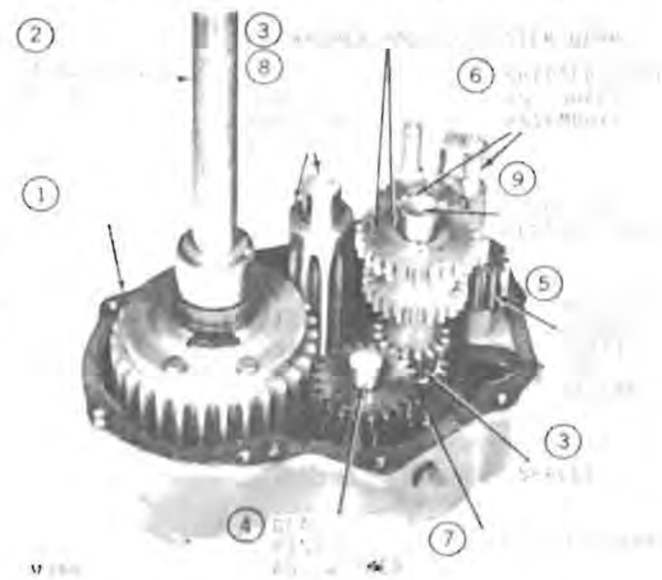


Fig. 17–Gear Removal Sequence

Figures 17 and 18 will identify the group assemblies for the 4-speed transaxle. Lift them from the case in the following order.

1. Gasket.

2. Differential and axle assembly.

3. Washer, 3-cluster gear and spacer from shaft and pinion brake.

4. Gear pinion and washer.

5. Reverse idler assembly.

6. Shifter rod and shaft assembly.

7. 2-cluster gear.

8. Output shaft and washers (one at each end of shaft).

9. Shaft and pinion, idler gear and washer.

10. Input shaft.

NOTE: Input shaft, Figure 18, 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.

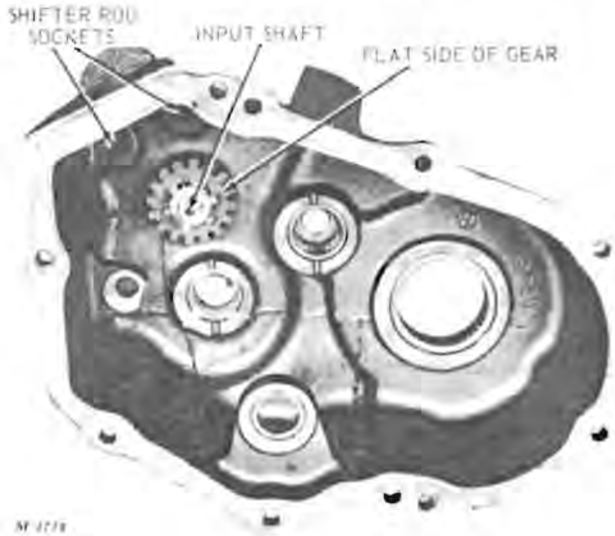


Fig. 18–Gear Removal Sequence

DISASSEMBLING SHIFTER LEVER

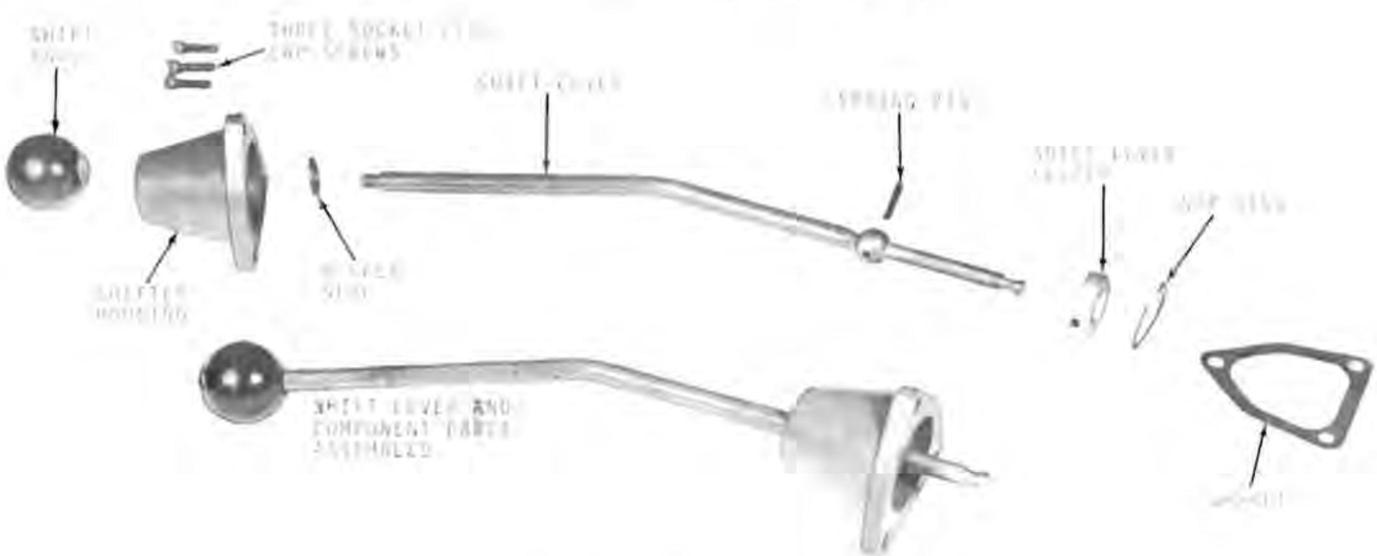


Fig. 19–Shift Lever Components

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. 20–Transaxle Gear Tooth Wear

Chipped, broken or excessive wear on gear teeth ends, Figure 20, 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. 21–Broken Detent Springs

Broken detent springs, Figure 21, 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. 22–Damaged Bevel Pinion Gears

Prolonged heavy drawbar loads and wheel slippage are the most common cause of bevel pinion gear failure, Figure 22, in the differential section of the transaxle.

Fig. 23–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. 24—Worn Spline in Shifter Gear

A damaged shifter gear spline as shown in Figure 24 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 15-11 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.

REPLACING AXLE SHAFTS AND PINION GEAR

110 TRACTORS (15001-42035)

When either of the axle bevel gears or pinions are to be replaced on transaxles in this tractor serial number range, the AM30744 gear kit consisting of two axle bevel gears and two pinion gears must be used.

IMPORTANT: Gears in this kit are a matched set. Do not mix old and new gears.

The axles and thrust washers do not have to be replaced unless servicing is required.

110 AND 112 TRACTORS (42036-100,000)

All differential parts can be replaced as individual parts items for all transaxles in this tractor serial number range.

ASSEMBLY

DIFFERENTIAL ASSEMBLY

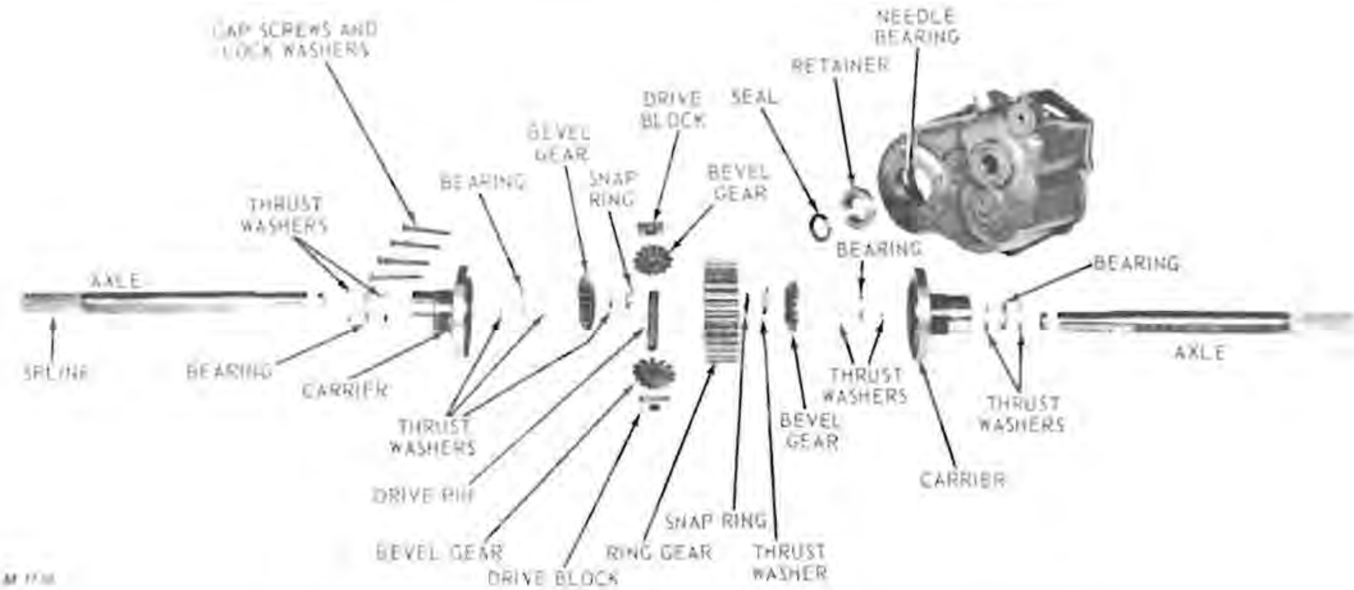


Fig. 25–Exploded View of Differential Assembly - 110 and 112 Tractors (15001-100,000)

Assemble all parts shown above.

Apply Loctite or equivalent to ends of threads and assemble cap screws through carriers. Be sure lock washer is under head of screw.

Refer to "Bolt Torque Chart," page 10-4 of Section 10, for proper cap screw torque.

The axles should rotate freely in opposite directions when assembled. Lay the differential assembly aside for later installation.

BEARINGS

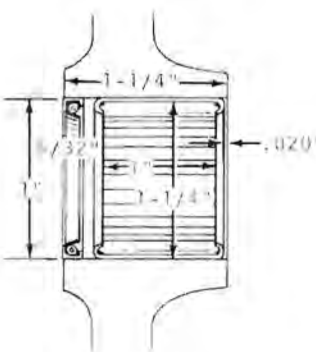


Fig. 26–Installing Bearings

All bearings are pressed into the bearing bores from the inside of the case interior, Figure 26.

Bearing drivers to install bearings properly are listed under special tools, page 20-21. As a general rule, all bearings should be pressed into the case to a depth of 0.020 inch beyond flush with case interior.

INPUT SHAFT AND GEAR

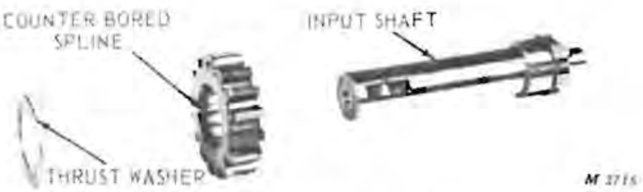


Fig. 27–Input Shaft and Gear

Assemble input shaft, gear and thrust washer. Counterbored gear spline must face to left as shown in Figure 27. Gear is a light press fit onto shaft.

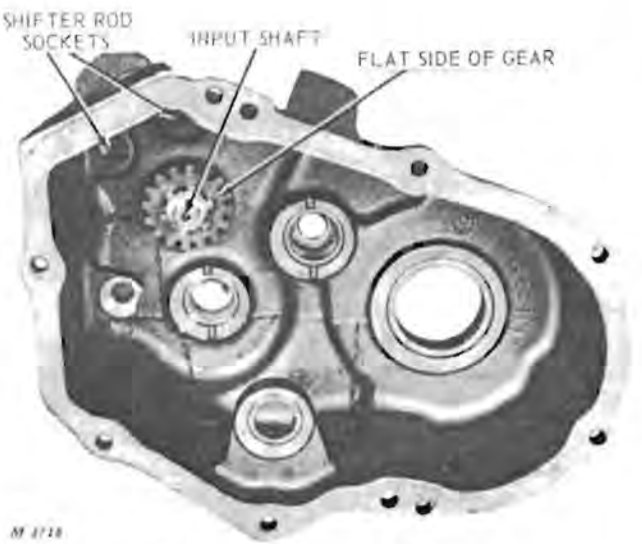


Fig. 28–Assembled Input Shaft

Install washer, input shaft and gear into case as shown. Use special tool to protect seal when slipping shaft through seal. Refer to "Special Tools," page 20-21, for proper seal sleeve. Flat side of gear should now face upward, Figure 28.

IDLER GEAR AND PINION SHAFT

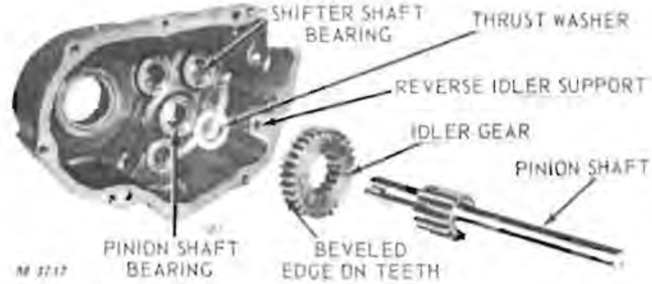


Fig. 29–Idler Gear and Shaft

Use seal sleeve tool listed under "Special Tools," page 20-21, and assemble thrust washer, idler gear and pinion shaft as shown in Figure 29. Beveled edge of teeth must face away from pinion shaft as shown. Pinion shaft is a light press fit through idler gear.

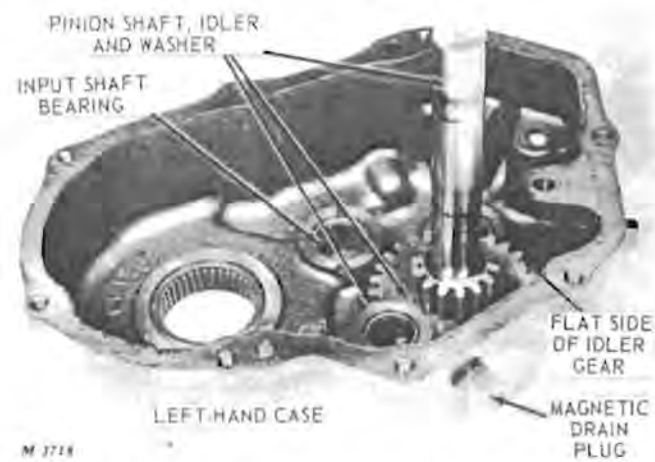


Fig. 30–Idler Gear and Shaft Assembly

When thrust washer, idler gear and pinion shaft are properly assembled and installed, they will appear as shown in Figure 30. The flat edge of the idler gear should now face upward.

OUTPUT SHAFT AND GEAR

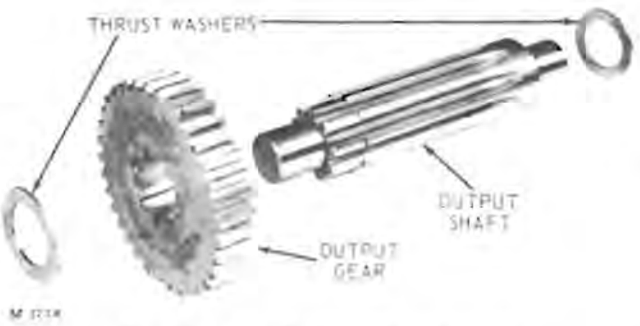


Fig. 31–Output Shaft and Gear Assembly

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 31.

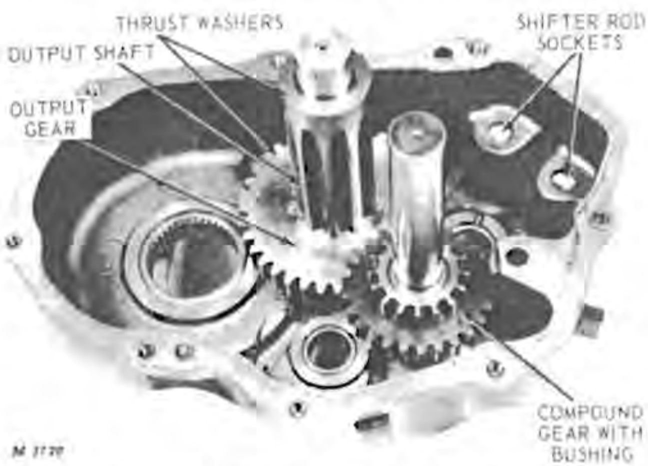


Fig. 32–Output Shaft and Gear Installed

Install output gear, pinion shaft and thrust washers into left-hand case, Figure 32.

Install compound gear with bushing into left-hand case, Figure 32.

SHIFTER SHAFT

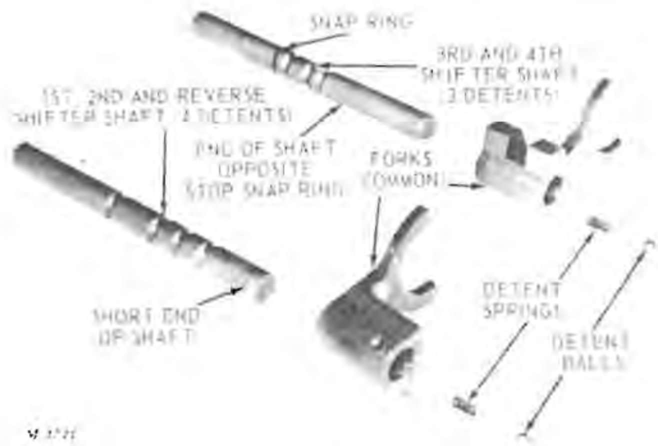


Fig. 33–Shifter Components

Because of heavy detent pressure, the assembly of these shafts can be difficult. Assemble forks as shown in Figure 33. 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 33. 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.

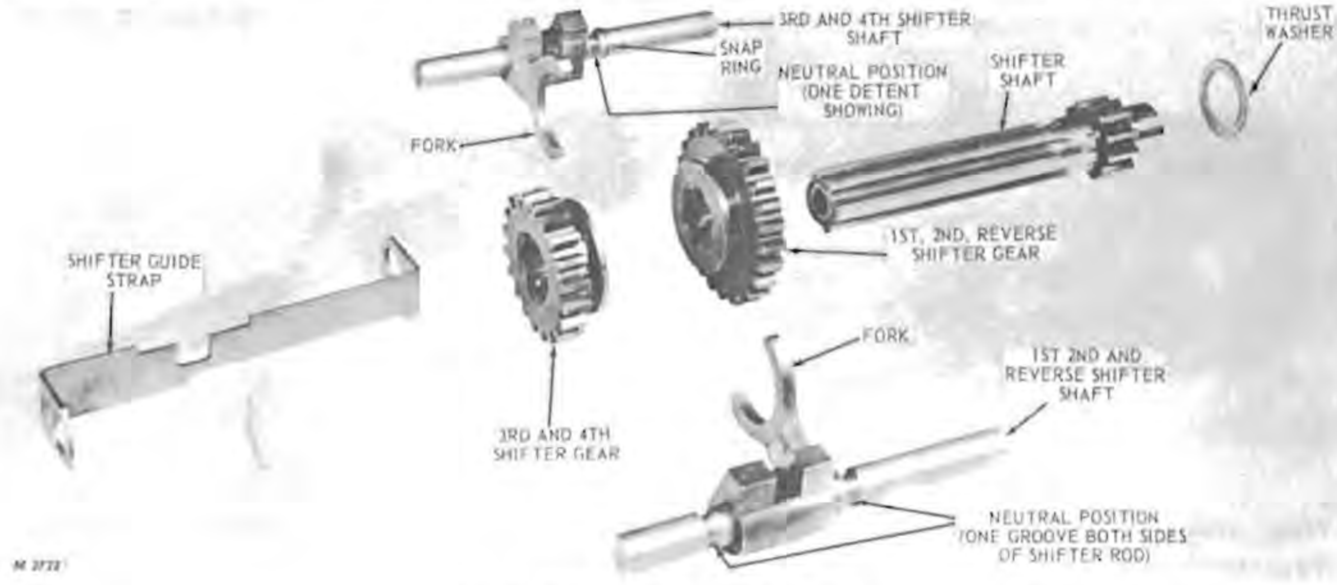


Fig. 34–Shifter Shaft and Gear Components

To assemble shifter, lay out parts as shown in Figure 34. Be sure forks are in neutral detent. 1st, 2nd and reverse will have one detent showing on either side of fork, Figure 35. 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 either 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.

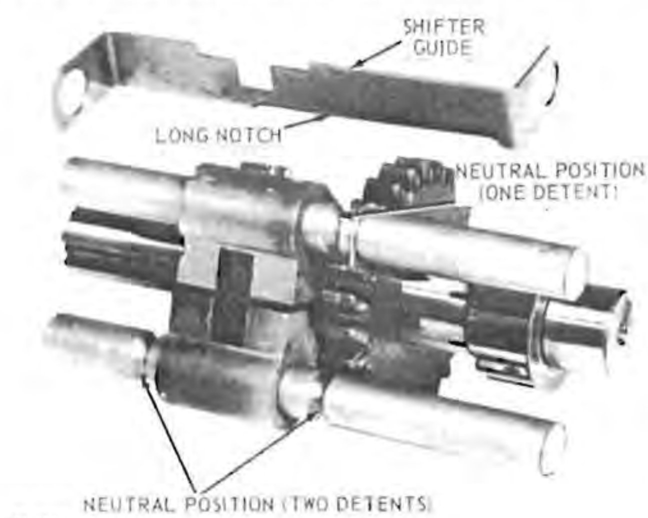


Fig. 35–Shifter Assembly

The shifter shaft assembly should appear as shown in Figure 35. 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.

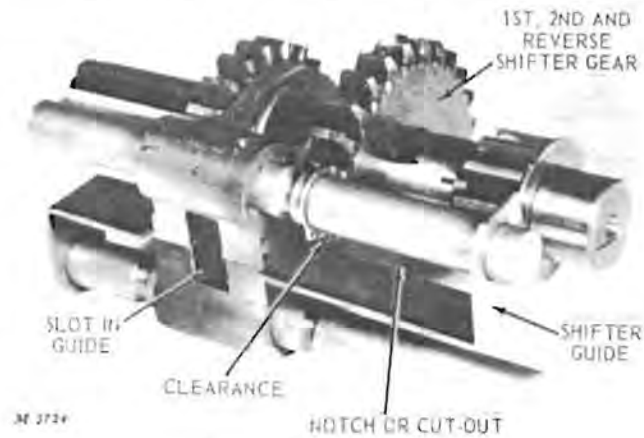


Fig. 36–Shifter Assembly

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 35 and 36.

Fig. 37–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. (See Fig. 29.) The shifter rods should now enter the two machined sockets in left-hand case. (See Fig. 32.)

IDLER GEAR, PINION AND THRUST WASHER

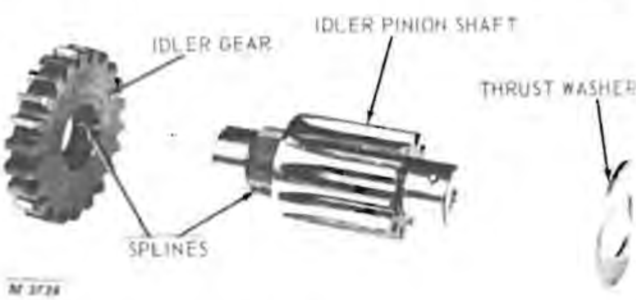


Fig. 38–Idler Components

The inside of the idler gear is splined to slip freely onto splined end of idler pinion, Figure 38.

REVERSE IDLER SHAFT AND GEAR

Fig. 39–Reverse Idler Components

Assemble reverse idler shaft assembly as illustrated. Round edge of teeth faces spacer, Figure 39.

NOTE: Shaft is the same on both ends.

INSTALLING REVERSE IDLER, IDLER GEAR ASSEMBLY AND SPACER

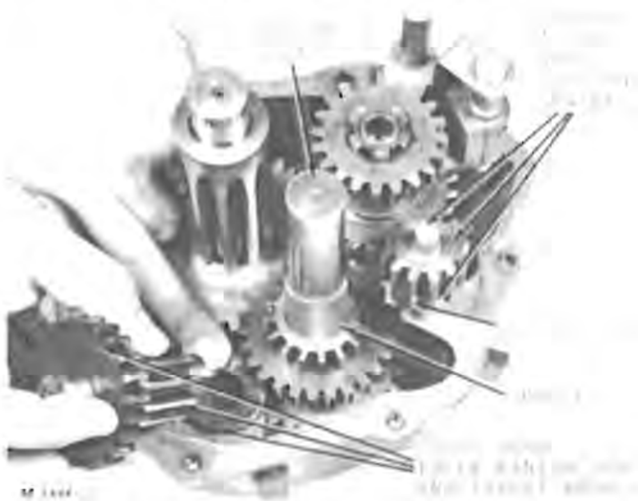


Fig. 40–Installing Idler and Reverse Idler

Install reverse idler assembly, Figure 40.

Install thrust washer, idler pinion shaft and idler gear. Figure 38 shows proper assembly before lowering into left-hand case, Figure 40.

Place spacer on pinion shaft, Figure 40.

INSTALLING CLUSTER GEAR AND THRUST WASHER

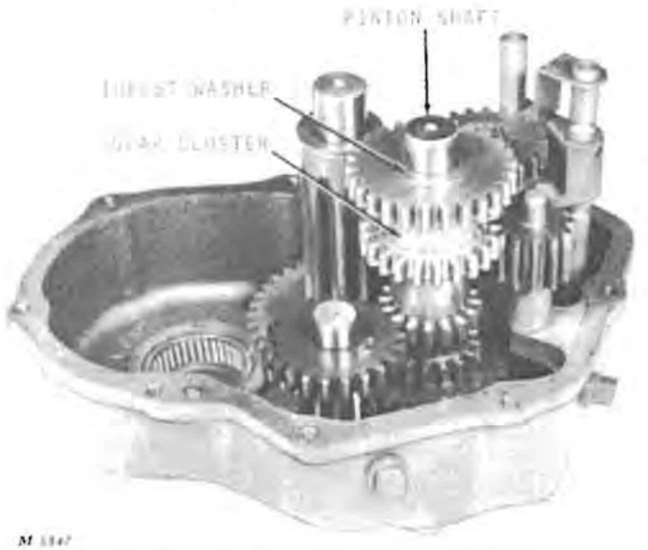


Fig. 41–Transmission Assembled

Install gear cluster and thrust washer on pinion shaft as shown in Figure 41.

All parts assembled thus far should appear as shown in Figure 41.

INSTALLING DIFFERENTIAL

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Fig. 42–Installing Differential

Install differential assembly into left-hand case with bolt heads facing upward as shown in Figure 42.

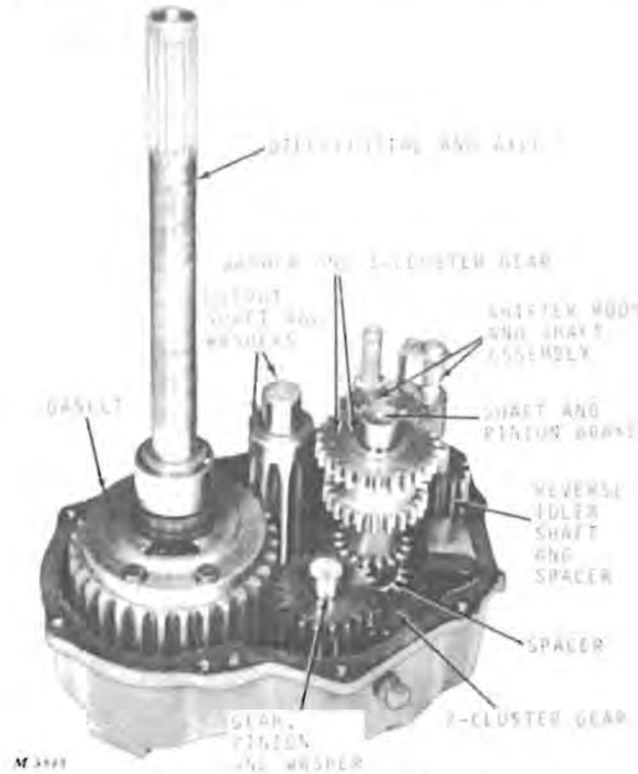


Fig. 43–Completed Internal Assembly

The internal components should now appear as shown in Figure 43.

Position the gasket on the lower (left-hand) case at this time. Use new gasket.

PLACING COVER ON CASE

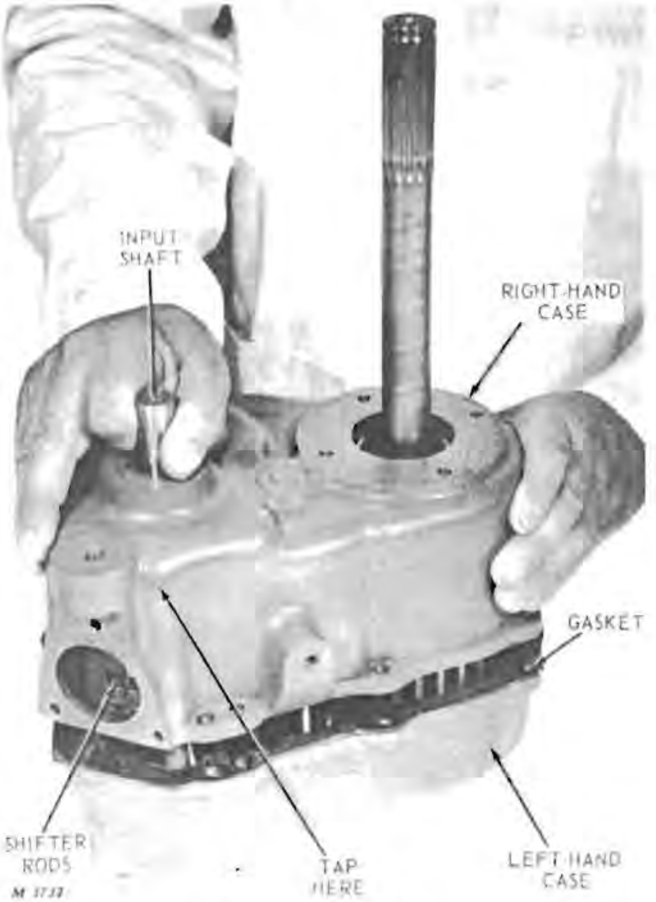


Fig. 44–Closing Case

Assemble the right-hand case half as illustrated in Figure 44. Shake the case lightly and all shafts and bearings will align themselves. Also, a short turn in both directions on the input shaft will help align gears.

To close the last one-half inch, tap the right-hand case horizontally as shown in Figure 44. 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

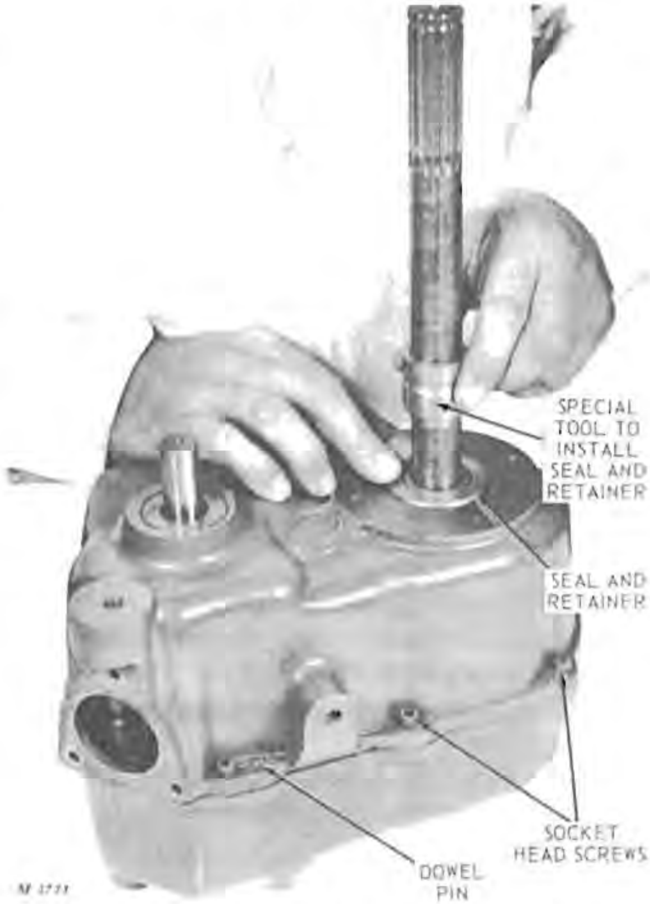


Fig. 45–Installing Retainers and Seals

Insert dowel pins and bolt case halves together with eight socket head cap screws, Figure 45. Torque cap screws to 120 in-lbs.

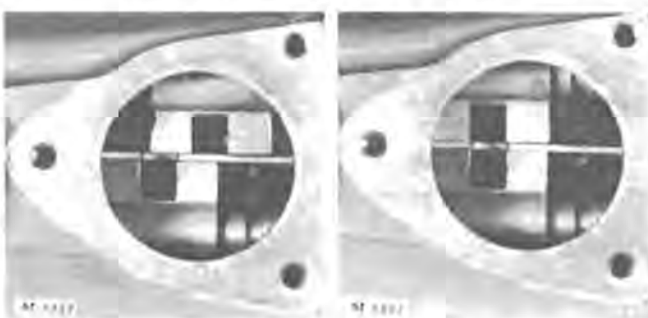
Install retainer and new seal with special tool, page 20-21, or shim stock to prevent cutting seal when sliding it over splined end of axle. Oil seal lip must face inward, Figure 45.

INSTALLING AXLE SUPPORTS

Fig. 46–Installing Axle Supports

Install O-rings and axle supports with bearings as shown in Figure 46. Always use new O-rings. Refer to "Bolt Torque Chart," page 10-4 of Section 10 and torque support bolts accordingly.

POSITIONING SHIFTER FORKS



Incorrect Correct

Fig. 47–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 19, page 20-9. 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. Torque cap screws to 120 in-lbs.

INSTALLING TRANSAXLE

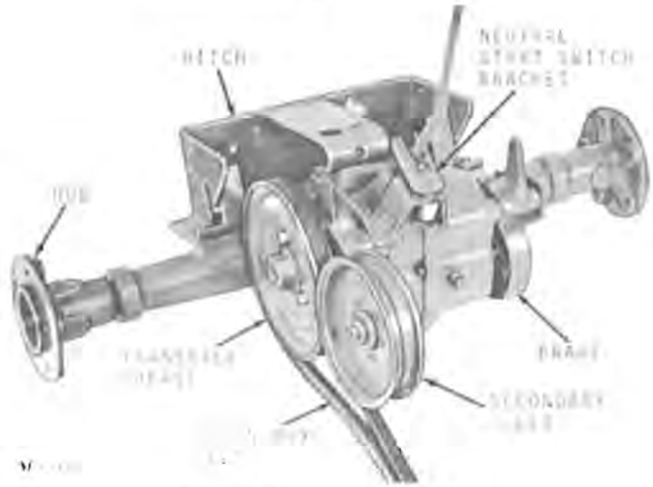


Fig. 48–Transaxle Installation

Position neutral start bracket with switch, shift lever and gasket on transaxle, Figure 48. Secure with three screws.

Install brake, input hub, driven sheave with belt, secondary idler and hitch assembly to transaxle, Figure 48.

Before installing transaxle in tractor base, check transaxle by turning driven sheave and shifting transaxle in each gear.

Apply Loctite to threads on all bolts and set screws used in assembling components to transaxle. Refer to "Bolt Torque Chart," page 10-4 of Section 10 and tighten bolts and set screws accordingly.

Refer to page 10-15 of Section 40 and adjust neutral-start switch and bracket.

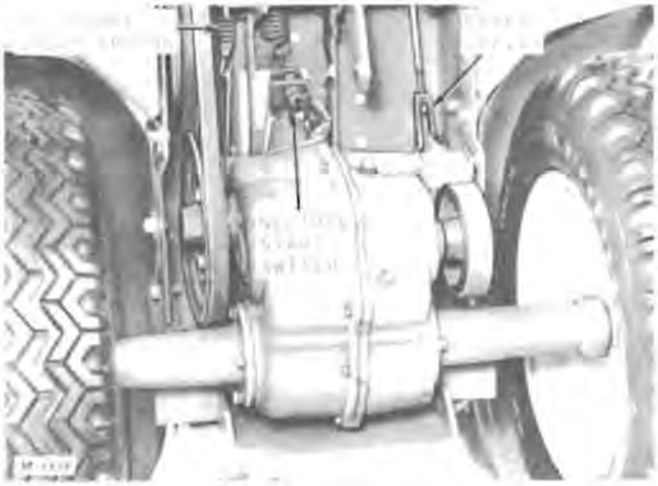


Fig. 49—Transaxle Installed

Place transaxle in tractor base, Figure 49. Install cap screws holding transaxle support and hitch plate to tractor base.

Connect brake clevis and secondary idler spring, Figure 49. Then slip secondary belt on variator.

Install wheel hubs with washers and snap rings. Bolt wheels to hubs with wheel bolts. Refer to "Bolt Torque Chart," page 10-4 of Section 10 and tighten hardware accordingly.

Connect neutral-start switch leads.

ADJUSTING QUADRANT

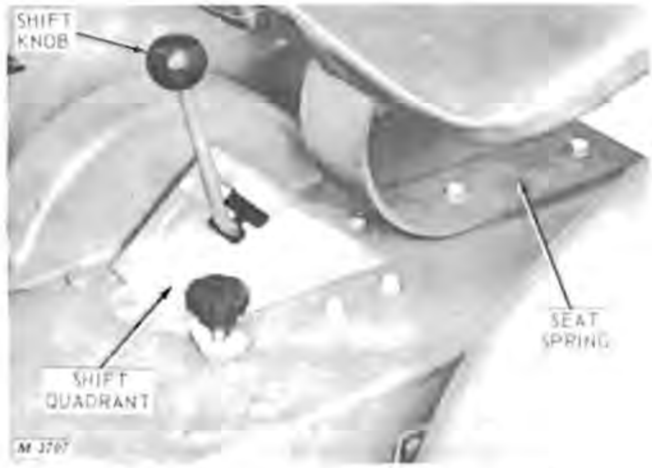


Fig. 50—Quadrant Installation and Adjustment

Turn tractor upright and install shift quadrant. Apply Loctite to shift lever threads and tighten knob on lever. Position quadrant before tightening screws. Secure seat spring to tractor base.

Refer to "Adjustment," page 10-16, and adjust brake and variator linkage.

Refer to Lubrication Chart, page 20-1 of Section 10 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	OTC1340	Remove retaining rings from axle ends
Motor-Rotor Repair Stand	OTC1730-A	To invert tractor for servicing transaxle and components beneath tractor.

REPAIR STAND ADAPTERS

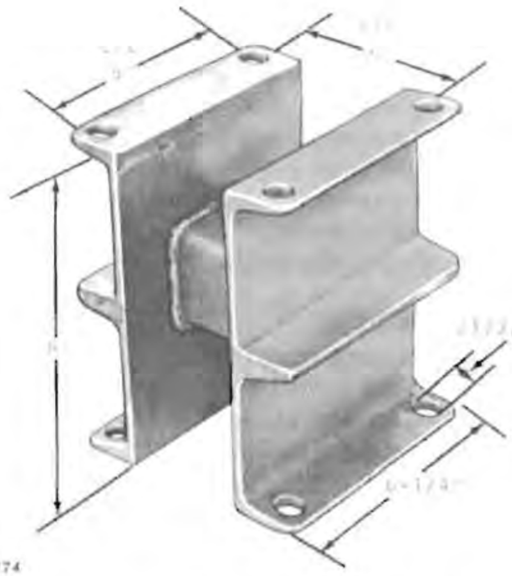


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Fig. 51–Riser for Motor-Rotor Repair Stand - Required to Invert Tractor on Motor-Rotor Repair Stand

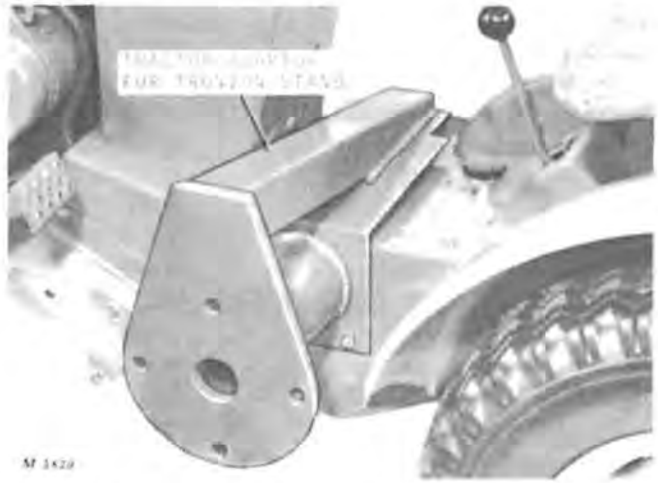

Fig. 52–Tractor Bracket Installed on Tractor

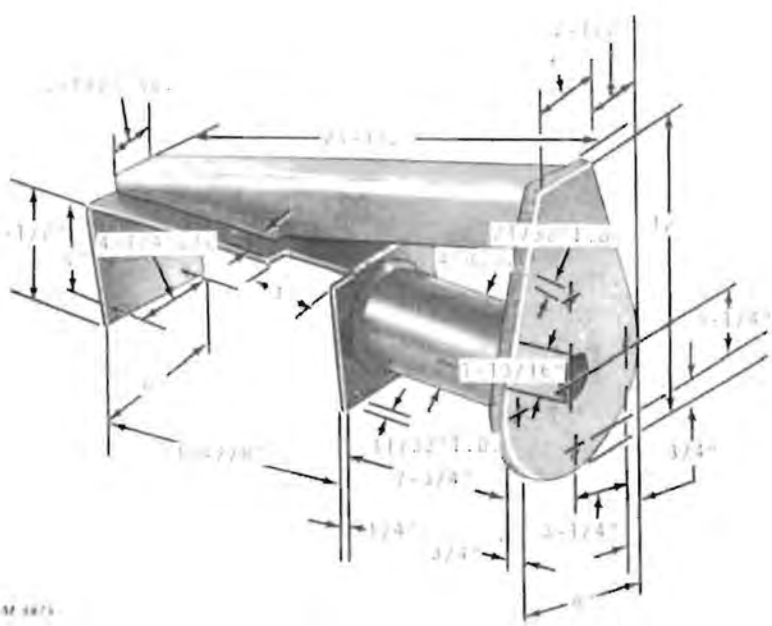

Fig. 53–Tractor Bracket - Required to Mount Tractor on OTC Motor-Rotor Repair Stand

Section 60

HYDRAULIC SYSTEM

Group 5

GENERAL INFORMATION

TABLE OF CONTENTS

Litho in U.S.A.

PRINCIPLE OF OPERATION

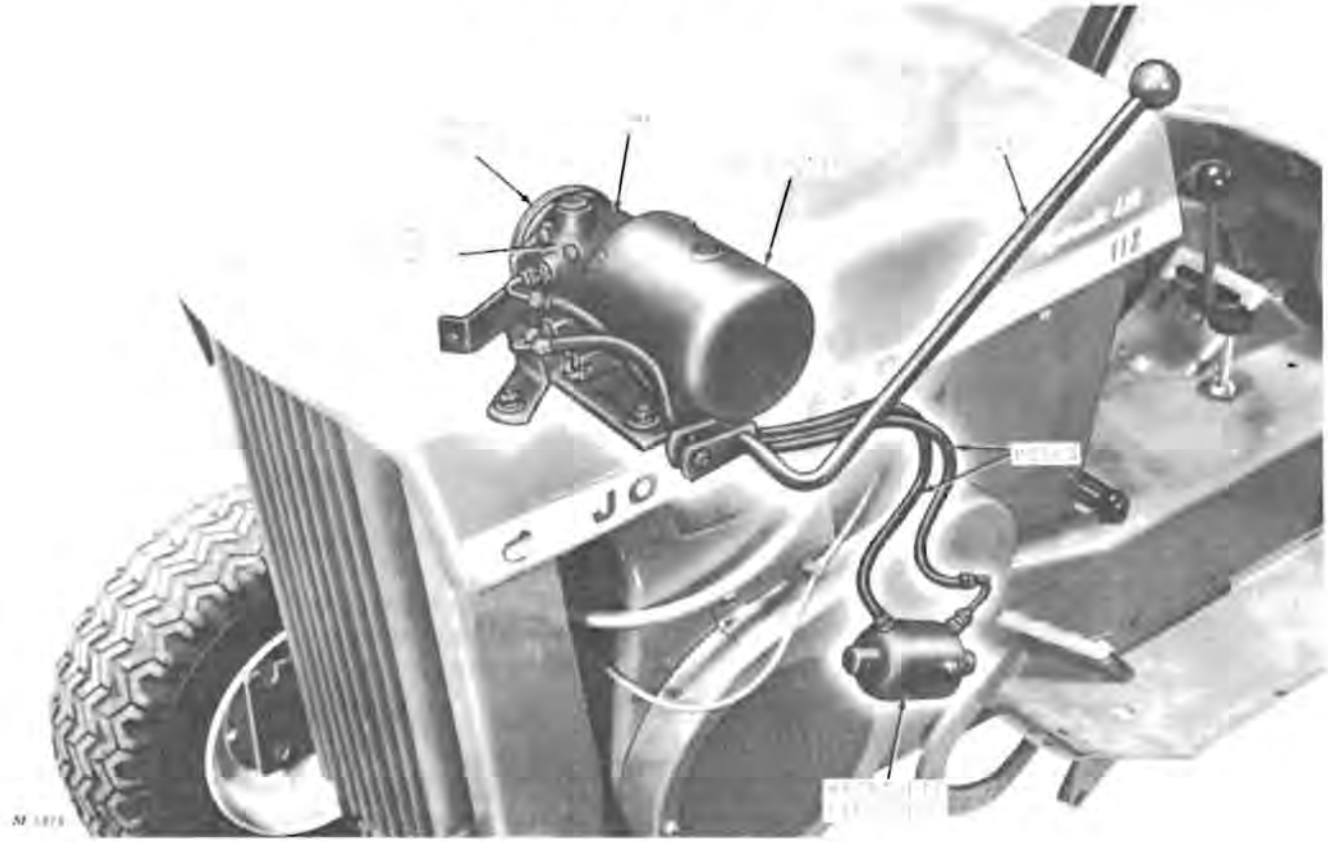

Fig. 1—Schematic View of Hydraulic System

110H and 112H Tractors are equipped with a hydraulic lift system consisting of a pump, valve, reservoir, cylinder and the lines connecting these parts, Figure 1.

There is a continuous flow of oil from the reservoir to the pump, to the control valve, and back to the reservoir making it an open-center hydraulic system. (In a closed-center system there is no continuous flow of oil when the control valve is in neutral.)

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.

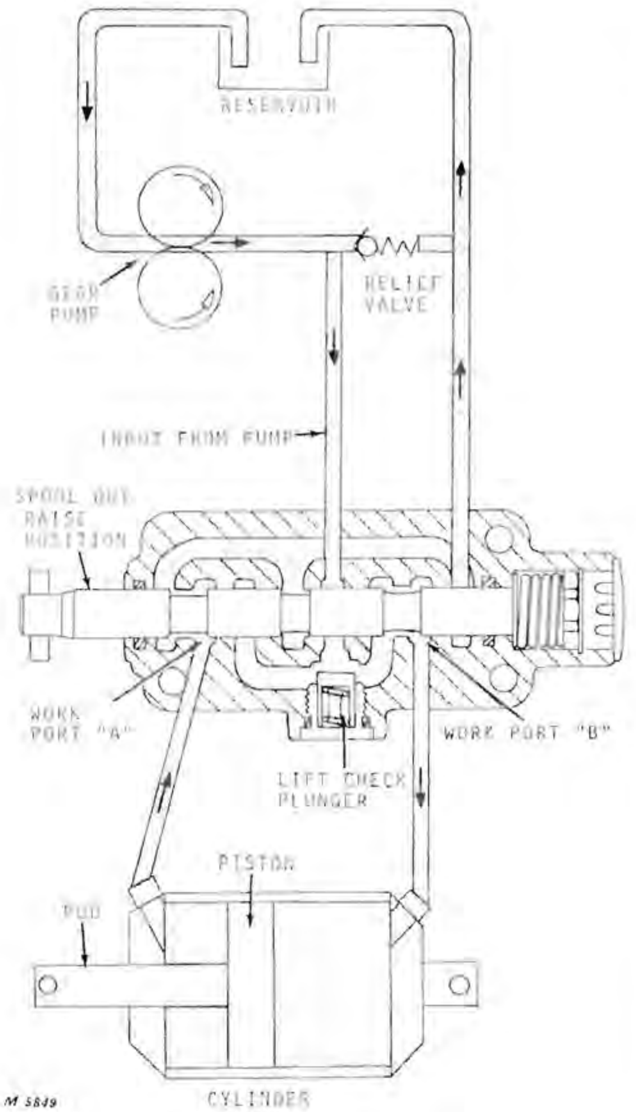

Fig. 2–Oil Flow Schematic - Raised Position

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. Refer to Section 70 for servicing and adjusting the lift linkage.

Fig. 3–Control Valve, Pump and Reservoir Mounted on Engine

The relief valve opens when operating pressure reaches 800 (-0+100) psi.

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.

CAUTION: Never allow even the smallest particle of 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 pages 5-6 and 5-7 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.

If excessive leakage seems to be caused by oil spewing out the filler-vent plug on the reservoir, especially on 112H Tractors (-6727), a baffle plate can be installed on the pump back plate. See page 15-3.

Fig. 4–Faulty O-Rings Causing Oil Leakage

Leakage can also 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 probably caused by contaminated oil. 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 sluggish. Also check lift lever stop adjustment, page 15-9.

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

A pressure gauge or a hydraulic test unit incorporating a pressure gauge and flow meter 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.

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 9, 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 15-10, for system pressure. Refer to "Diagnosing Malfunctions," page 5-6, to correct low system pressure.

PRESSURE GAUGE

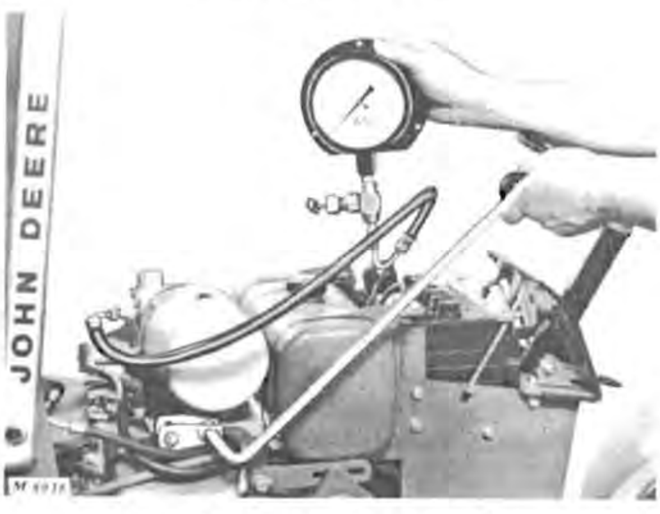

Fig. 7–Pressure Gauge Installed on Valve

HYDRAULIC TEST UNIT

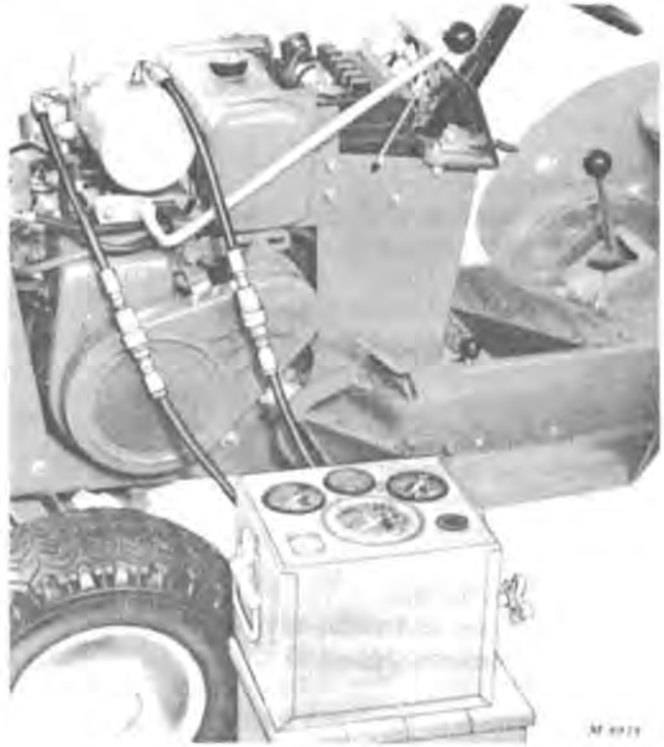

Fig. 8–OTC Model No. Y-81-2-1 Hydraulic Tester Installed for Pressure Test

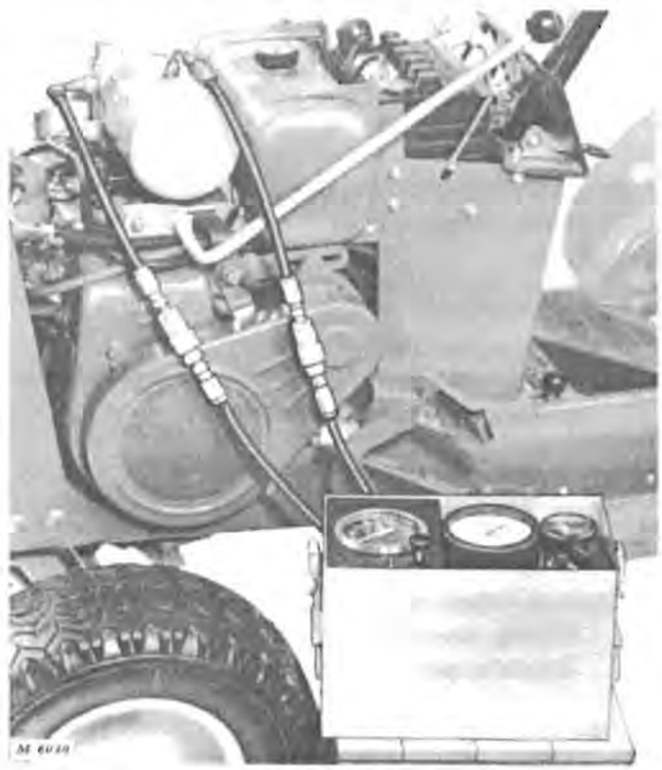

Fig. 9–OTC Model No. Y-90 Hydraulic Tester Installed for Flow and Pressure Test

DIAGNOSING MALFUNCTIONS

PUMP, VALVE AND RESERVOIR

Noisy Pump Caused by Cavitation

Fluid low in reservoir.
Check level and fill reservoir to proper level, page 5-3.

Oil too heavy.
Drain system and fill with oil of proper viscosity, page 5-3.

Oil filter in reservoir plugged.
Drain system, clean filter and fill with new fluid, page 5-3.

Oil in System Gets Hot

Fluid low in reservoir.
Check level and fill reservoir to proper level, page 5-3.

Contaminated oil.
Drain oil and refill with new fluid of proper viscosity, page 5-3.

Relief valve setting too high or too low.
Check pressure, page 15-8.
Add or remove shims as required to obtain correct pressure.

Oil viscosity too high or too low.
Drain system and fill with proper viscosity fluid, page 5-3.

Hoses restricted (crimped or pinched).
Route lines properly to prevent restriction.

Leaks
Torque screws.
Apply "Copper Coat" or equivalent to milled surfaces if necessary.

Pump Shaft Seal Leaking

Worn shaft seal.
Replace seal.

Broken diaphragm seal or backup gasket.
Check condition of diaphragm and gasket.
Replace parts as necessary.

Bearing out of position.
Check bearing position and condition, page 15-4.
Replace front plate if necessary.

Excessive internal wear.
Disassemble unit and check for internal wear.
Replace parts as necessary.

Foaming Oil

Fluid low in reservoir.
Check level and fill reservoir to proper level, page 5-3.

Oil viscosity too light or too heavy - wrong oil.
Drain system and fill with non-foaming oil of proper viscosity, page 5-3.

Low System Pressure

Fluid low in reservoir.
Check level and fill reservoir to proper level, page 5-3.

Loose, worn or damaged drive belt.
Check condition of belt.
Tighten belt to proper tension, page 15-8.
Replace belt if necessary.

Weak relief valve spring or worn adaptor.
Check condition of parts.
Replace parts as necessary.
Add shims if necessary.

Loose drive sheave (key missing).
Install key and tighten sheave nut firmly.

Loose relief valve seat.
Install seat to proper depth.
See specifications, page 15-10.

External Leakage

Loose screws.
Tighten screws.
Disassemble pump and apply "Copper Coat" or equivalent to milled surfaces if necessary.

Damaged O-rings.
Replace O-rings between valve and back plate.

Valve spool worn or damaged.
Check valve assembly.
Replace valve assembly if necessary.

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Oil Spewing Out Breather
No return baffle 110H Tractors (40001-68793) and 112H Tractors (-6727)
Install baffle, page 15-3.

Work Load Lowers with Spool in "Slow-Raise" Position
Damaged lift check plunger.
Replace plunger, page 10-4.

Damaged lift check seat.
Replace valve assembly.

Damaged O-ring on lift check plug.
Replace O-ring.

Load Drops with Spool in Center Position
Valve spool worn or damaged.
Replace valve assembly.

Sticky Valve Spool
Paint on exposed end of spool.
Remove paint with paint remover.
Wipe end of spool with clean cloth and apply light film of oil on spool end.

Bent spool.
Replace valve assembly.

Hydraulic System Inoperative
Loose or worn drive belt.
Check condition of belt.
Tighten belt, page 15-8.
Install new belt if necessary.

Loose drive sheave (key missing).
Install key and tighten sheave.

Loose relief valve seat.
Install seat to proper depth.
See specifications, page 15-10.

Cracked Pump Body
Excessive relief valve pressure.
Check pressure, page 15-8.
Remove shims as necessary.

CYLINDER

Load Drops
Cylinder O-ring worn or damaged.
Replace cylinder.

Loose hose fittings.
Tighten fitting.

Worn or damaged piston O-ring.
Replace cylinder

Defective weld.
Weld hole shut.
Replace cylinder if necessary.

CONTROL ASSEMBLY

Lift Lever Operates Hard
Stop bolt not properly assembled and/or adjusted.
Assemble and adjust bolt properly, page 15-9.

Bent or broken linkage.
Repair linkage.
Replace assembly if necessary.

Lift Lever Inoperative
Broken control arms to spool.
Replace lever and mounting bracket assembly.

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Group 10
CONTROL VALVE

GENERAL INFORMATION

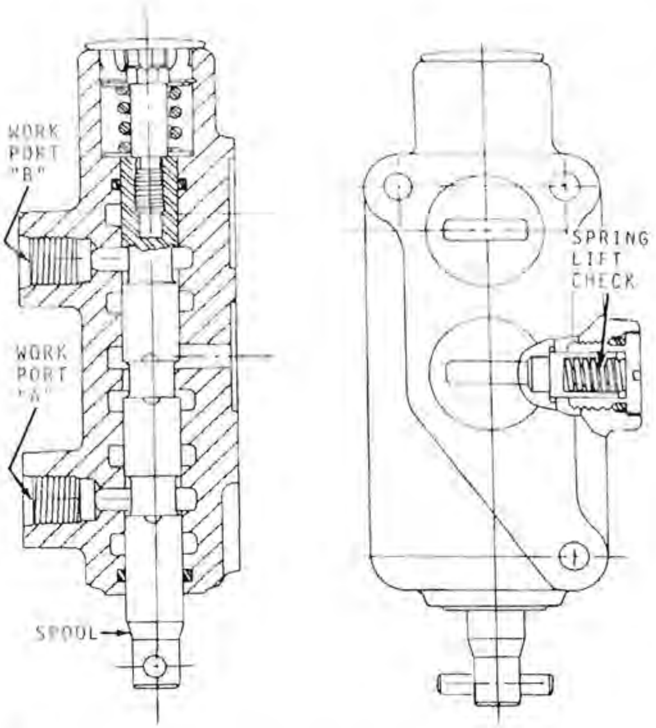


Fig. 1—Cutaway View of Control Valve

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," pages 5-6 and 5-7 for all possible external causes of difficulty.

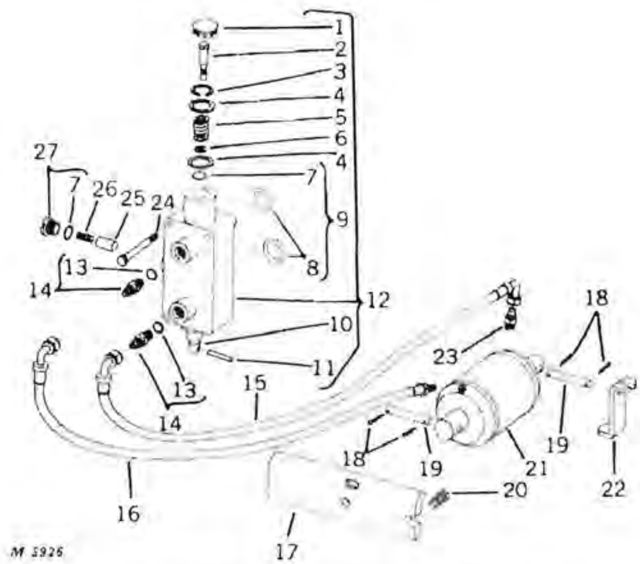


Fig. 2—Exploded View of Control Valve and Related Parts

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 Connecter (2 used)
14 – Control Valve Connectors (2 used)
15 – Lower Hose, 30" Long
16 – Upper Hose, 27¼" Long
17 – Cylinder Bracket
18 – Cotter Pin (4 used)
19 – Cylinder Pin (2 used)
20 – 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

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–Spool Hooked to Control Linkage Arms

Twist unit to disconnect end of spool from control bracket arms, Figure 3, and remove hydraulic unit.

Thoroughly wash outside of assembly with clean, safe cleaning solvent.

Drain reservoir before removing valve assembly from pump body.

REMOVING VALVE ASSEMBLY FROM PUMP

Fig. 4–Separating Valve Assembly From Pump

Remove valve assembly from pump by removing three cap screws, Figure 4, which hold valve assembly to pump back plate.

Discard O-rings between the valve body and pump back plate.

DISASSEMBLING VALVE

Fig. 5–Removing Cross Pin From Spool

Rest small diameter of spool end on a partially closed vise and very carefully remove crosspin, Figure 5.

CAUTION: Use special care to prevent marring or bending spool.

Fig. 6–Removing Valve Spool From Valve Body

Remove cap and snap ring from valve body. Pull valve spool out spring end of valve body, Figure 6.

Fig. 7–Removing O-Rings and Lift Check Assembly

Remove and discard O-rings from inside diameter of each end of spool bore, Figure 7.

With a large screwdriver or impact tool, loosen and remove plug, lift check spring and plunger. Discard O-ring from slotted plug.

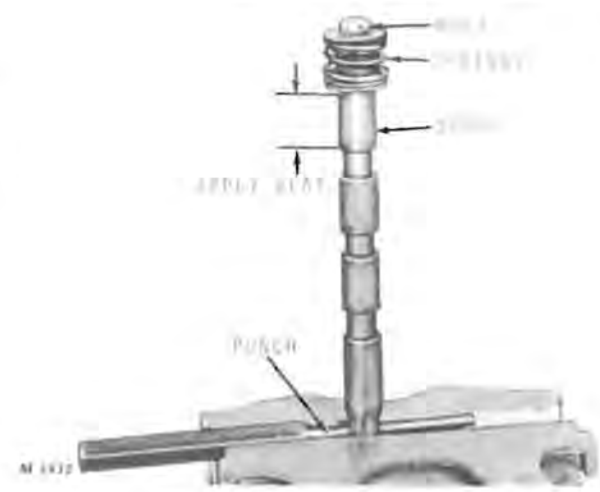


Fig. 8–Removing Spool Centering Springs

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 8.

IMPORTANT: Apply heat to threaded end of spool, Figure 8, before attempting to remove shoulder bolt from spool.

Clean and dry all parts thoroughly and inspect parts for wear and damage. Clean O-ring grooves in valve body of all foreign matter, Figure 7.

INSPECTION

VALVE HOUSING

Fig. 9–Checking Valve Housing for Wear and Damage

Check valve housing for cracks or damaged threads. Inspect inside diameter of valve for scratches or excessive wear, Figure 9.

The lift check seat is machined into the valve body. Inspect lift check seat in body for damage, Figure 9. It is important that the lift check seat be smooth.

SPOOL PLUNGER AND SPRINGS

Fig. 10–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 10, 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 or excessive weakness. 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. 11–Valve Body O-Rings

Apply oil to new O-rings and install in valve body, Figure 11. Always use new O-rings.

INSTALLING LIFT CHECK PLUG

Fig. 12–Lift Check Plug Assembly

Install new O-ring on lift check plug, Figure 12. 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 12. Tighten plug firmly.

INSTALLING SPOOL

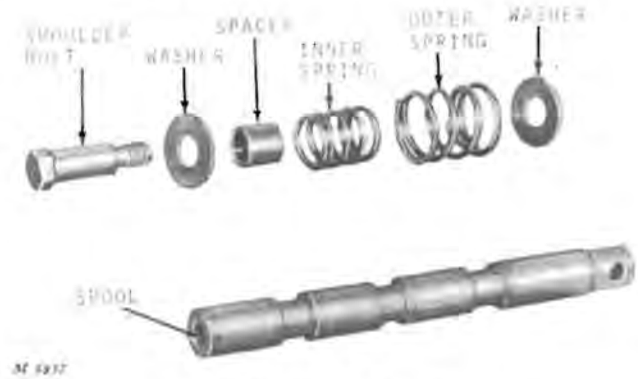


Fig. 13–Spool Assembly

If valve housing is to be replaced, a new spool must be used because the valve body and spool are a matched assembly. If spool centering springs are broken or show signs of cracking, use new springs.

If spool has been disassembled, place spool in vise with soft jaws and secure inner and outer springs to spool with washer and shoulder bolt, Figure 13. Apply loctite or equivalent to threads of shoulder bolt.

Refer to torque specifications on page 10-7 and torque spool centering spring bolt accordingly.

Fig. 14–Installing Spool

Apply grease to O-rings in spool bore and insert spool assembly from spring end of valve body, Figure 14. Insert spool slowly while rotating spool so as not to cut O-ring as spool lands pass through O-ring.

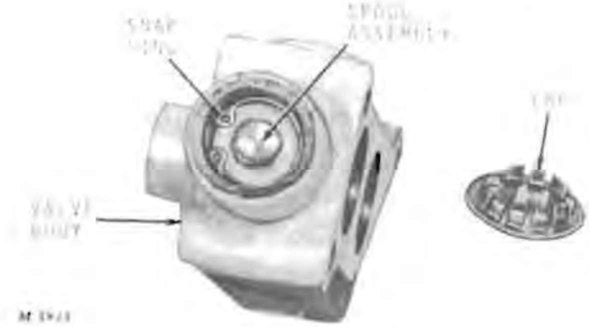


Fig. 15–Installing Snap Ring

Secure spool assembly in valve body with snap ring, Figure 15.

Place cap on spring end of valve body.

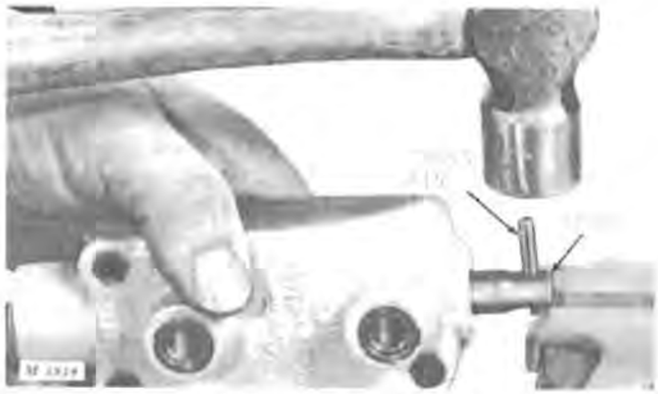


Fig. 16–Installing Cross Pin in Spool

Rest small end of spool on partially closed vise, Figure 16, and install cross pin.

Fig. 17–Valve Body O-Rings

Wipe a light film of clean grease on O-rings and place O-rings on valve body, Figure 17.

INSTALLING VALVE ASSEMBLY ON PUMP

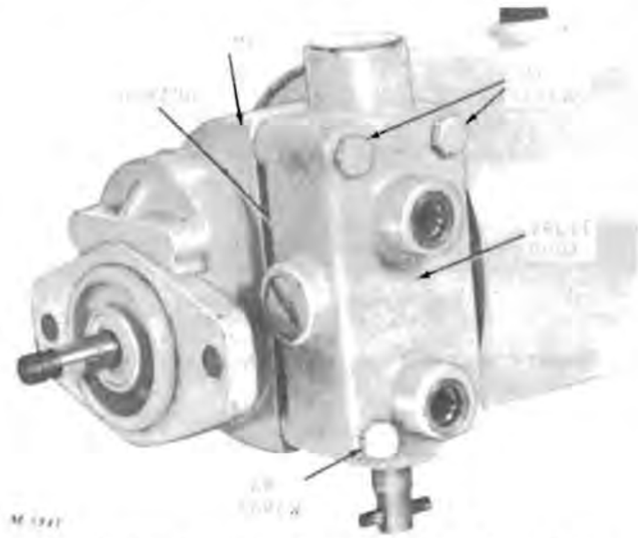


Fig. 18–Installing Valve Assembly to Pump Back Plate

With new O-rings between valve body and back plate, secure valve assembly to pump back plate with three cap screws, Figure 18.

Refer to torque chart Section 10, "Specifications," and tighten three cap screws accordingly.

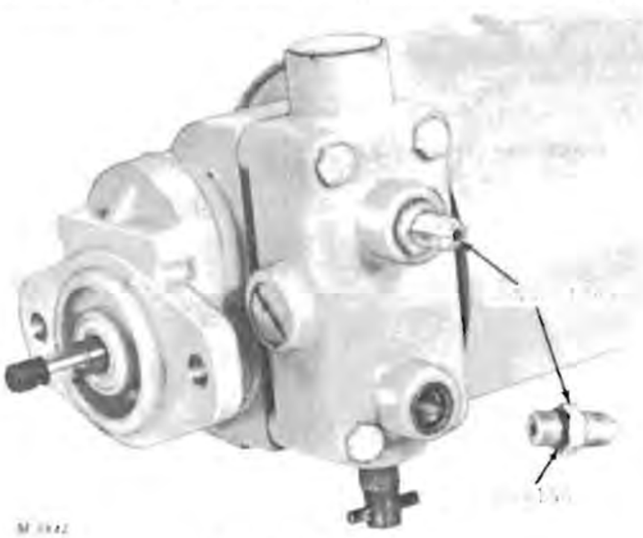


Fig. 19–Hose Connectors

Place new O-rings on connectors and screw connectors into valve body, Figure 19. Tighten connectors firmly.

INSTALLING ON TRACTOR

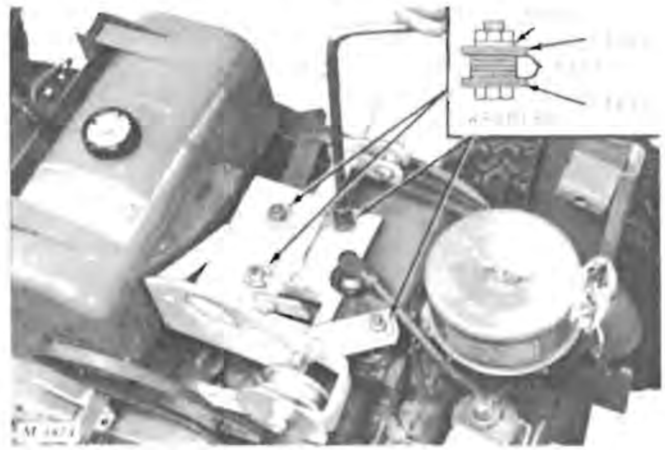


Fig. 20–Attaching Hydraulic Base

Position hydraulic base on engine making sure washers and fiber washers are positioned as shown in inset, Figure 20.

Fig. 21–Installing Pump, Valve and Reservoir to Lever and Mounting Bracket

Position end of spool in lever arms and secure front plate to bracket with two bolts, lockwashers and nuts, Figure 21.

Install key in shaft, install sheave on shaft and secure with elastic stop nut. 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.

Fig. 22–Installing Drive Components

TORQUE FOR HARDWARE

Location	Torque
Spool shoulder bolt	60-65 in. lbs.
Valve body cap screws	7-10 ft. lbs.

SPECIAL TOOLS

Name	No.	Use
Retaining Ring Pliers	OTC 1120	Removing snap ring from valve body.

Group 15
PUMP

GENERAL INFORMATION

Fig. 1—Cross Section of Gear Pump

The gear pump with pressure loaded wear plate consists of a drive gear and an idler gear in a closely fitted housing, Figure 1.

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 beeween the gear teeth and the closely fitted housing. As the teeth come together at the opposite side of the pump, the oil is displaced and forced out through the pressure port. The volume of oil the pump delivers is dependent upon the speed at which the gears turn.

With a control valve in the oil line, oil is directed to the cylinder for raising and lowering equipment.

The pressure in the system is determined by the relief valve setting. If pressure is too great, the relief valve will channel the excess oil directly back to the reservoir.

Fig. 2—Diaphragm, Gaskets and Diaphragm Seal

Gear end clearance is kept at a minimum by means of a thin, flexible bronze faced steel plate. This plate is called a diaphragm 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

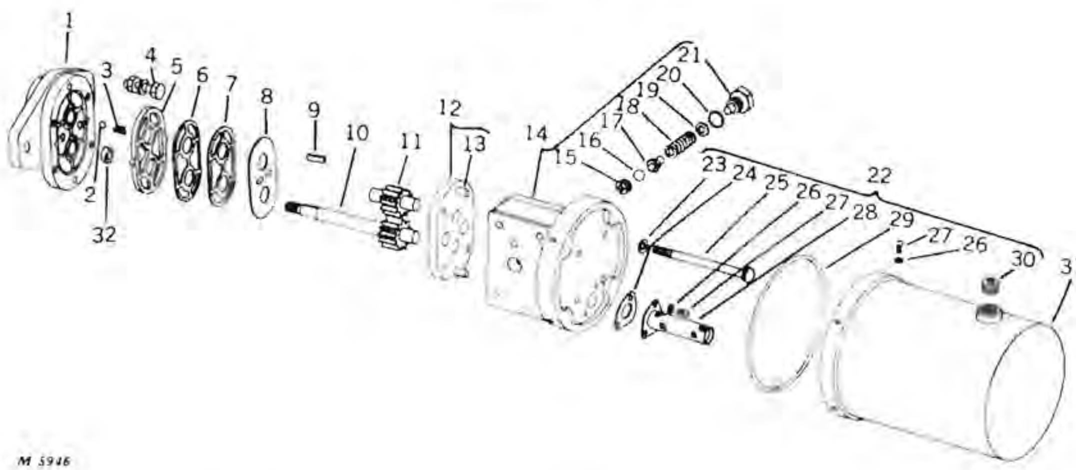
GENERAL INFORMATION—Continued

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.

When the pump is in operation, oil from the pressure port is forced under the diaphragm seal and is distributed by the interconnecting "V"-groove in the seal. This oil pressure forces the gaskets against the wear plate, thus dividing the area under the wear plate into pie shaped seal compartments.

A small hole is drilled through the diaphragm into each compartment. These connect the small chambers formed by the gear teeth to the compartments under the wear plate. Because of the location of these holes, the pressure under the diaphragm is slightly higher than the corresponding section in the gear chamber. Consequently, the diaphragm is always kept in close contact with the gear ends, compensating for deflection from pressure, thermal expansion or wear. This greatly increases pump efficiency.

REPAIR



1 – 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. 3—Exploded View of Hydraulic Pump and Reservoir

REMOVING PUMP FROM TRACTOR

Refer to page 10-2 to remove pump, valve and reservoir assembly from tractor. The control valve requires removal only when back plate is being replaced.

INSTALLING BAFFLE PLATE

Fig. 4–Baffle Installed in Back Plate

If oil spewing from the filler-breather plug has been detected, it is not necessary to separate the pump to correct this condition.

This condition is sometimes found on 110H Tractors (40001-68793) and 112H Tractors (-6727) when return oil enters the reservoir above the normal level.

Later models have a baffle covering the return port or the return port may be relocated and the old port plugged with a ball.

Correct oil spewing on earlier models by installing a baffle, Figure 4, over the return port. The baffle, including assembly instructions, is available as a parts item.

SEPARATING PUMP

Fig. 5–Separating Front Plate, Body and Back Plate

Before separating pump assembly, scribe a clear line across outside of pump assembly, Figure 5. This will assure proper reassembly.

Remove reservoir and four 12-point cap screws.

Tap against front plate, Figure 5, to separate front plate, body and back plate. Do not use sharp tools or screwdriver to separate parts.

Fig. 6–Removing Seal

Place a screwdriver under the diaphragm seal, Figure 6, being careful not to damage front plate. Lift diaphragm seal and gaskets from plate. Discard diaphragm seal and gaskets.

Fig. 7–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 15-10.

INSPECTION

Wash all parts in a clean safe cleaning solvent and dry them with compressed air.

Inspect all parts for wear, and remove all scratches, nicks, burrs and rough spots with emery cloth. Check condition of springs.

Fig. 8–Measuring Gear Shafts

Inspect the drive gear and idler gear shafts at bearing points and seal areas for rough surfaces and excessive wear. Use a micrometer to measure the shafts, Figure 8. Refer to "Specifications," page 15-10, for shaft tolerance. Inspect drive shaft for broken keyway. Shafts and gears are available as assemblies only.

Inspect the face of the gear for scoring and excessive wear. Use a micrometer to measure gear width. Snap rings should be in groove in drive and idler shaft gears. If gears require replacing, replace gear and shaft as an assembly. If edges of teeth are sharp, break edges with emery cloth.

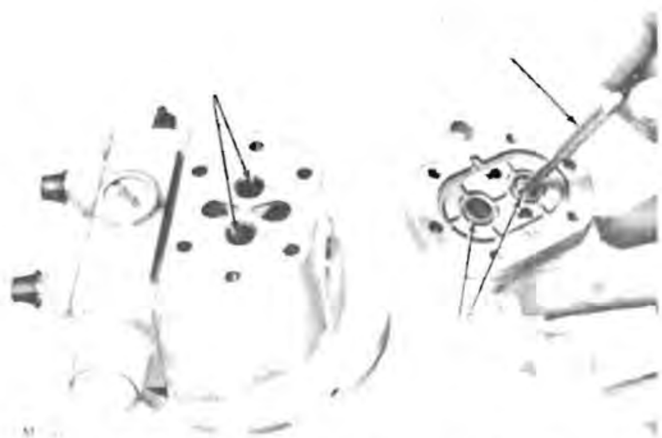


Fig. 9–Measuring Inside Diameter of Bearings

Use a telescope gauge to measure bearing wear in the front and back plate, Figure 9. Refer to "Specifications," page 15-10, for bearing tolerance. Bearings in front plate should be flush with islands in groove pattern. Bearings are available for service only as a plate and bearing assembly. Replace front or back plate if scored or if bearings are worn beyond specifications.

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 15-10, for back plate wear tolerance. Replace back plate if worn beyond specification.

Fig. 11–Measuring Gear Pocket

Inspect the gear pockets for scoring or wear, Figure 11. Refer to "Specifications," page 15-10, for gear pocket diameter. If gear pockets are scored or worn, beyond specifications, replace body.

Fig. 12–Relief Valve Adapter, Ball, Spring and Seat

Inspect condition of relief valve seat, ball, adapter and spring, Figure 12. Replace parts showing abnormal wear.

If relief valve seat removal is necessary, refer to Figure 7.

ASSEMBLY

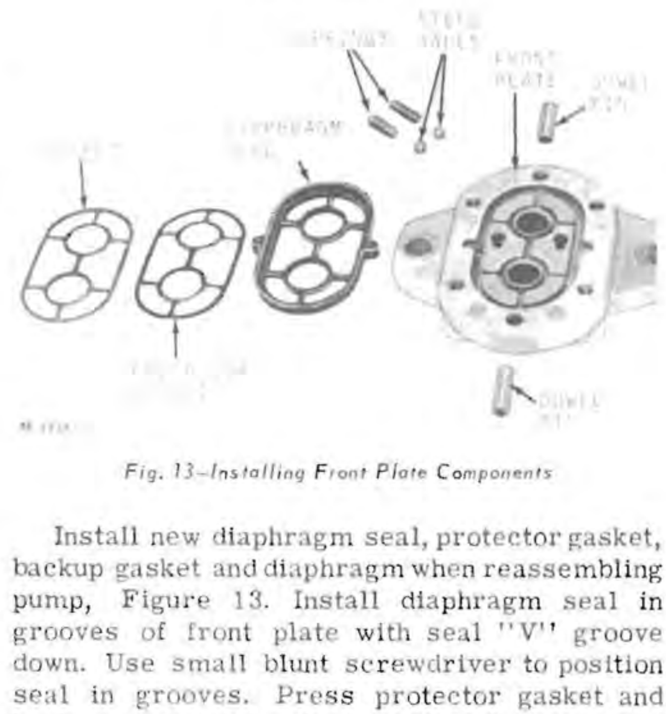


Fig. 13–Installing Front Plate Components

Install new diaphragm seal, protector gasket, backup gasket and diaphragm when reassembling pump, Figure 13. 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.

ASSEMBLY—Continued

Fig. 14—Installing Diaphragm

Place diaphragm on top of gaskets with bronze face up and coined indents on suction side, Figure 14. The entire diaphragm must fit inside the raised rim of the diaphragm seal. Insert dowel pins in front plate.

Fig. 15—Installing Gears in Front Plate

Dip gear assemblies in light, clean oil and slip into front plate bearings, Figure 15.

Fig. 16—Placing Body on Front Plate

Apply a thin layer of "Copper Coat" or equivalent to both milled 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 16. The cavity with the small hole drilled in it must be on the pressure side of pump.

Fig. 17—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 17. Check to be sure scribe lines are aligned.

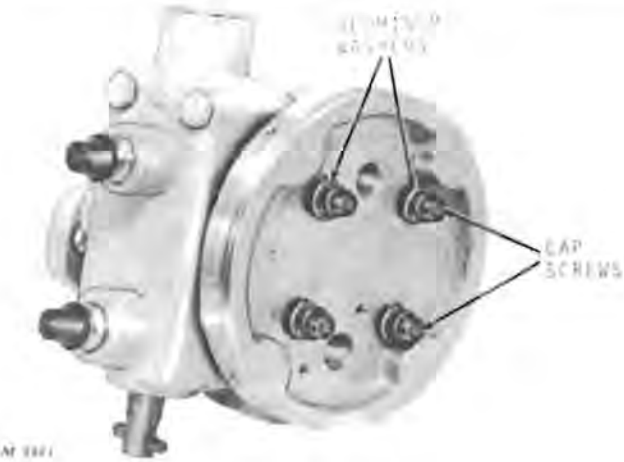


Fig. 18–Tightening Four 12-Point Cap Screws

Place new aluminum washers over the four 12-point cap screws. Install cap screws through back plate and secure front plate to back plate, Figure 18. Refer to "Specifications," page 15-10, and torque bolts.

Fig. 19–Installing Shaft Seal

Place scotch tape over keyway in shaft. Oil seal liberally and work shaft seal over drive shaft.

Tap seal in place with a deep well socket and hammer, Figure 19.

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. A jerky drag or frozen shaft indicates an improperly assembled pump. (Pump rotation is counterclockwise from end of shaft).

Fig. 20–Installing Relief Valve Assembly

Whenever relief valve seat has been removed, refer to "Specifications," page 15-10, for proper seat depth. Install seat in back plate as shown in Figure 7.

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.

After relief valve seat is properly located, install ball adapter and spring in back plate. Place new O-ring on plug and secure parts with plug, Figure 20. See page 15-8 for pressure adjustment.

Fig. 21–Installing Filter and Reservoir

Refer to exploded view, Figure 3, and install new filter gasket and filter to back plate with two washers and two machine screws.

Install new O-ring over reservoir mounting shoulder and carefully slide reservoir onto pump. Be sure port in reservoir is in correct location, Figure 21. Secure reservoir to back plate with four washers and machine screws. Turn filler plug loosely into reservoir port.

If valve assembly was removed, see page 10-6 for correct assembly.

Install the assembly on the tractor. Refer to Figure 2, page 10-1 and connect the hydraulic hoses to the valve assembly.

Fill the reservoir with fluid, page 5-3.

Adjust drive belt tension and relief valve pressure as explained on this page.

ADJUSTMENTS

DRIVE BELT TENSION

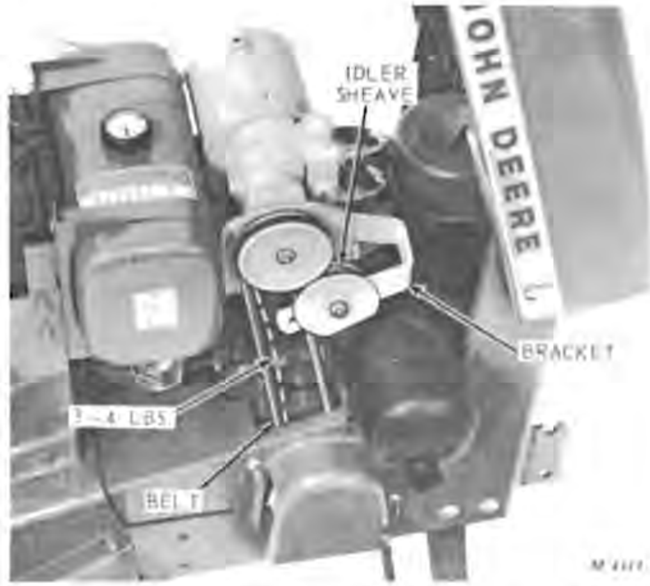


Fig. 22–Adjusting Drive Belt Tension

Loosen the idler bolt and move idler against belt until a 3 to 4 pound pressure midway between the sheaves deflects the belt 1/2 inch.

Tighten the idler nut firmly to maintain proper belt tension.

RELIEF VALVE PRESSURE

A pressure gauge having sufficient capacity must be used to obtain proper relief valve pressure. Excessive pressure can do severe damage to various components, thus voiding warranty. Add or remove shims as necessary until 800 (-0 + 100) psi is obtained.

Always follow instructions supplied by test equipment manufacturer. See page 5-5 for hydraulic test equipment.

LIFT LEVER STOP

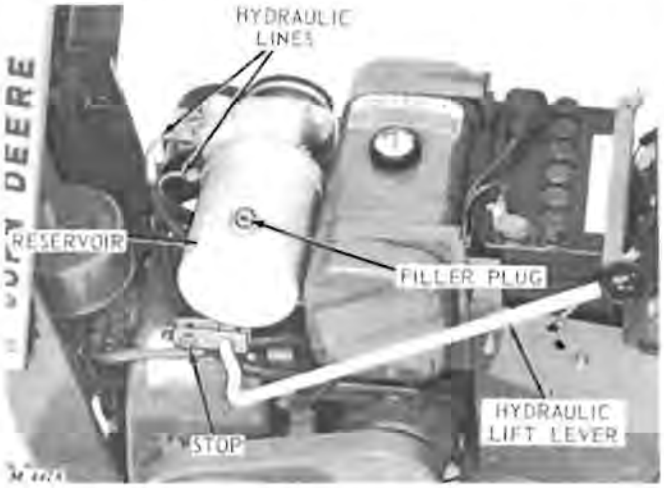


Fig. 23–Adjusting Lever Stop

Loosen jam nuts on outer stop and move lift lever to full raised position.

Position head end of bolt in bottom of slot in inner stop. *NOTE: Be sure to keep 1/32 to 1/16-inch clearance between the bolt head and inner stop.*

Tighten nuts. Allow lift lever to return to neutral position. Check for equal travel of lift lever in both raised and lowered position.

DIRECTION OF LIFT

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, Figure 23, and reverse the lines.

SPECIFICATIONS

COMPONENT	NEW	WEAR TOLERANCE
Relief Valve Pressure	800 (-0 + 100) psi	. . . .
Relief Valve Seat (Top of seat to top of body)	1.776-1.786-inch	. . . .
Pump Output	1.5 gpm at 3600 rpm engine speed	. . . .
Displacement	0.149 cu. in. per rev.	. . . .
Gear Shafts	0.4371-0.4373-inch	0.4359-inch
Gear Width	0.2788-0.2794-inch	0.2779-inch
Bearings (front and back plate)	0.4386-0.4389-inch	0.4376-inch
Back Plate Wear	Flat	0.0015-inch
Body (gear pockets)	1.1675-1.1681-inch	1.1696-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
0-1 Micrometer	Starrett 230 RL	Check gear shafts and gear widths.
Telescope Gauge	Starrett 829 D	Check inside diameter of bearing in front and back plates.
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.

Group 20
CYLINDER

GENERAL INFORMATION

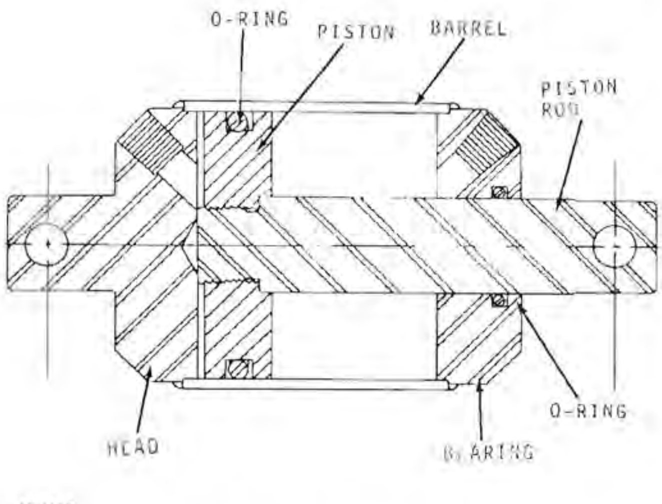
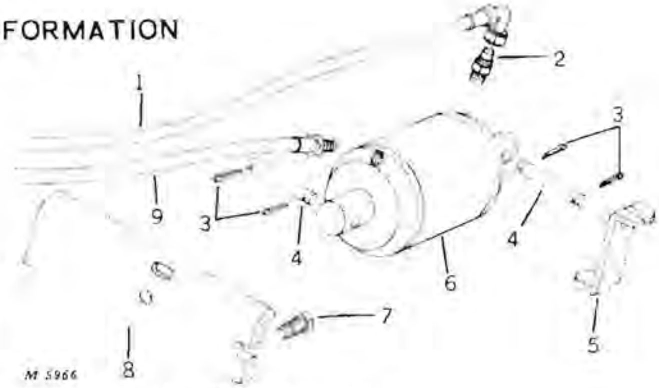


Fig. 1—Cutaway of Remote Cylinder



1 – 30" Hydraulic Hose
2 – Connector
3 – 1/8" x 3/4" Cotter Pin (4 used)
4 – Drilled Pin (2 used)
5 – Locking Clip
6 – Cylinder
7 – Thread Cutting Screws (2 used)
8 – Cylinder Bracket
9 – 27" Hydraulic Hose

Fig. 2—Exploded View of 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.

Fig. 3—Hydraulic Cylinder

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 from the head end of the cylinder through the tractor frame. Remove the hoses and cylinder as an assembly.

INSTALLATION

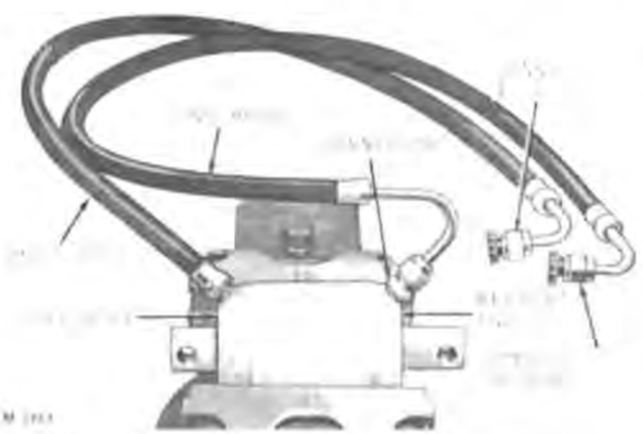


Fig. 4—Connecting Hoses to Cylinder

Lightly clamp cylinder in a vise with soft jaws, Figure 4.

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 4 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 15-9.

Connect hose with one steel extension to head end of cylinder as shown in Figure 4. 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.

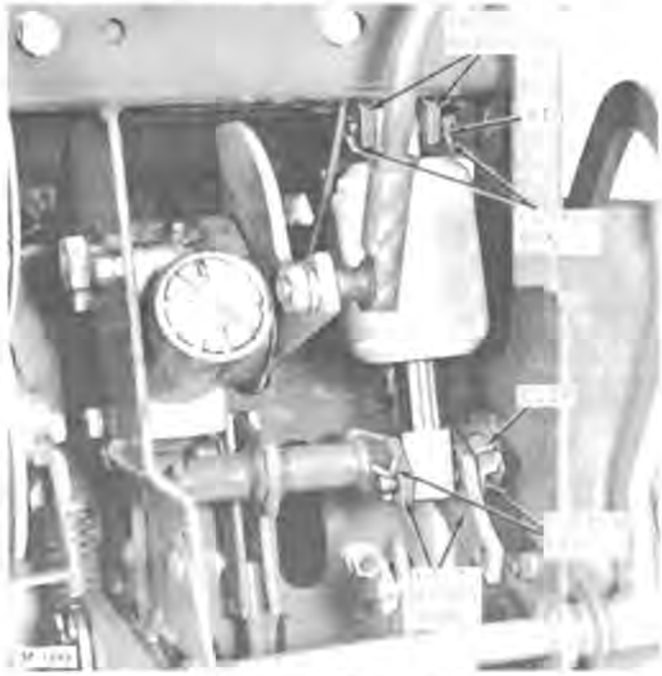


Fig. 5—Connecting Cylinder to Tractor

Insert pin through tractor frame, frame brackets and cylinder. Insert cotter pins and spread ends, Figure 5.

Insert pin through lower lift shaft arms, piston rod and clip. Insert cotter pins and spread ends, Figure 5.

SPECIFICATIONS

Item	*New Part*
Bore	2-1/2-inch diameter
Stroke	1-1/2-inch
Rod Size	0.875-inch diameter

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 cam and lever arm with cross bolt and taper stud, Figure 1. The lever arm is actuated whenever the cam is rotated.

The steering gear used on 110 Tractors (-4048) has a 12:1 steering ratio. To prevent premature steering gear failure, GT-3 tires should not be used on 110 Tractors (-4048).

The steering gear used on 110 Tractors (4049-100,000) and 112 Tractors (-100,000) has a 14:1 steering ratio. The 14:1 steering ratio reduces steering effort for tractors equipped with GT-3 and GT-4 tires.

110 Tractors (-67939) and 112 Tractors (- 3550) have adjustable tie rods, Figure 2.

110 Tractors (67940-100,000) and 112 Tractors (3551-100,000) have one piece tie rods, Figure 2.

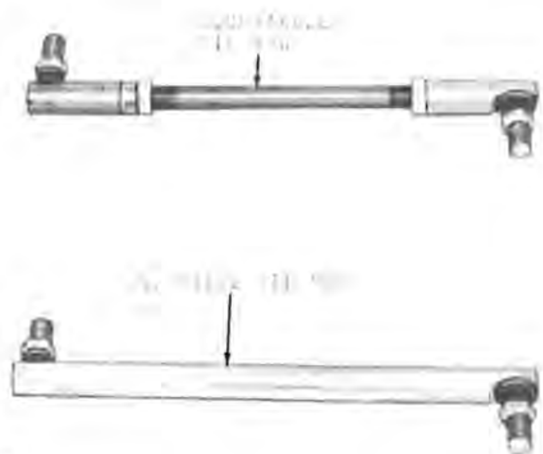


Fig. 2–Tie Rods

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 over-greasing of 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

DRAG LINK

Fig. 5–Ball Joint Disconnected from Drag Link

Ball joint damage as shown in Figure 5, is caused by an improperly positioned drag link. Refer to page 5-9 for proper position of drag link rod.

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.

DIAGNOSING MALFUNCTIONS

Loose Steering

Steering gear out of adjustment.
Adjust steering gear assembly.

Worn steering arm (non-adjustable).
Check condition of parts.
Replace parts as necessary.

Loose steering arm (adjustable type).
Adjust cone.

Cracked steering gear housing.
Replace steering gear.

Loose ball joint nuts.
Tighten nuts firmly.

Worn ball joints.
Replace ball joints.

Hard Steering

Tires not properly inflated.
Inflate tires to recommended psi.

Steering gear not properly adjusted (too tight).
Adjust steering assembly.

Hard Steering—Continued

Tight spindles.
Lubricate spindles.
Repair or replace spindle(s) if necessary.

Tight steering arm, not properly adjusted and/or lubricated.
Check condition of steering arm.
Repair and/or replace parts as necessary.

Drag link installed incorrectly.
Position drag link properly.

Bent spindle arm.
Replace spindle.
Adjust tie rods if so equipped.

Tight ball joint(s).
Replace tie rod or tie rod end.

Incorrect toe-in.
Adjust tie rods on tractors so equipped.
Replace spindle if necessary.
On others replace spindles.

Tractor Turns Shorter in One Direction

Spindle arm striking axle stop.

Adjust axle stop screw.

Do not allow inside of right-hand tire to strike intermediate assembly when tractor is so equipped.

Drag link installed incorrectly and/or adjusted.

Install drag link correctly and/or adjust.

Bent spindle and/or spindle arm.

Adjust tie rods on tractors having adjustable tie rods.

Replace spindle if necessary.

On tractors without adjustable tie rods, replace parts as necessary.

Leaky Steering Gear Housing

Damaged seal.

Install seal and retainer kit.

Damaged retainer.

Install seal and retainer kit.

Steering gear overgreased.

Use less grease when lubricating steering gear.

Tire Strikes Tractor on Turns

Drag link not properly adjusted.

Adjust drag link.

Bent spindle and/or spindle arm.

Replace spindle.

Tire Wear

Wheels toed-out.

Adjust to proper toe-in.

Bent spindle and/or spindle arm.

Adjust tie rods on tractors having adjustable tie rods.

Replace spindle if necessary.

On tractors without adjustable tie rods, replace parts as necessary.

Bent axle.

Check axle condition.

Replace axle if necessary.

Tires not properly inflated.

Inflate tires to recommended psi.

Drag link not properly adjusted.

Adjust drag link.

Steering Column Squeaks When Steering Wheel is Turned

Loose clamp around jacket tubing in pedestal.

Tighten clamp screws.

No tape around jacket tubing (clamp and bracket area in pedestal).

Wrap jacket with adhesive or electrical tape and tighten clamp screws.

Lack of lubrication.

Lubricate steering gear housing.

Excessive End Play

Loose adjusting plug.

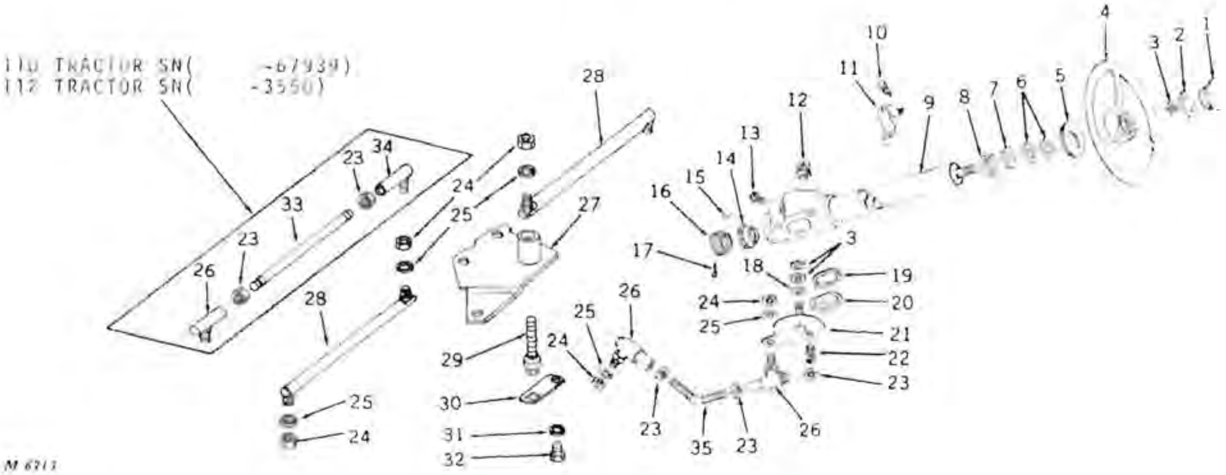
Tighten plug properly and spike threads.

On later tractors install cotter pin.

Bearings out of retainer.

Install bearings in retainer.

REPAIR



1 – Steering Wheel Emblem
2 – O-Ring
3 – 5/8" Hex. Nut (3 used)
4 – Steering Wheel
5 – Grommet
6 – Felt Washer (2 used)
7 – Bearing Spacer
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 – Bearing Cups and Retainers (2 used)
15 – Steel Balls (16 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 – 1/2" Hex. Nut (6 used)
25 – 1/2" Lock Washer (6 used)
26 – Ball Joint (R.H. Threads) (2 used)
27 – Steering Arm
28 – One-Piece Tie Rod Assembly (2 used)
29 – Bolt and Cone Assembly
30 – Locking Strap
31 – Washer
32 – Self-Tapping Screw
33 – Adjustable Tie Rod
34 – Ball Joint (L.H. Threads)
35 – Drag Link

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 on tapered stud (22, Figure 8) in lever arm. Turn stud counterclockwise until resistance is felt. Remove nuts from lever arm cross bolt (21, Figure 8) 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. 11–Steering Gear Disassembled

ASSEMBLY

ASSEMBLING STEERING GEAR

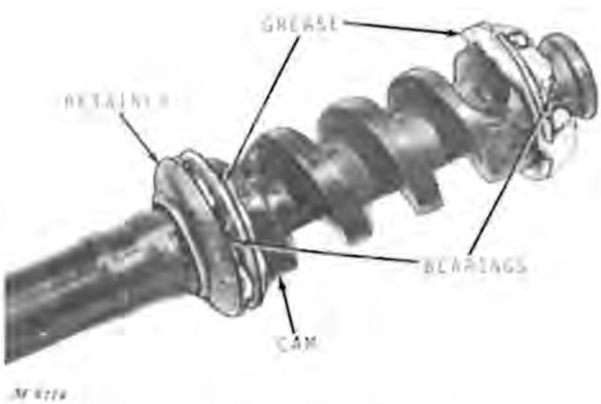


Fig. 10–Installing Bearing

Apply grease and place bearing balls, ball cups and retaining rings on both ends of cam, Figure 10.

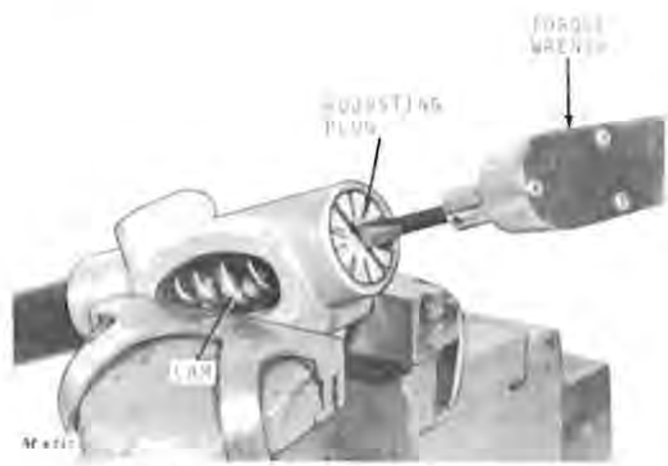


Fig. 12–Installing Cam Assembly in Housing

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.

Fig. 13–Locking Plug in Housing - Tractors (-51052)

After torquing, lock plug by upsetting the threads on plug with a punch, Figure 13.

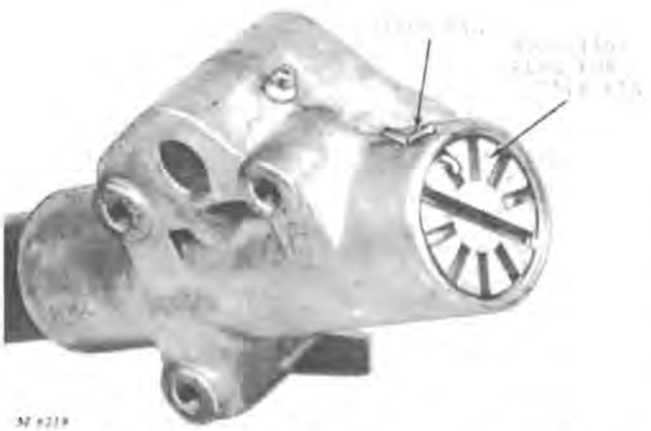


Fig. 14–Cotter Pin Through Housing - Tractors (51053-)

After torquing, lock plug with a cotter pin, Figure 14. Be sure steering column turns freely after torquing.

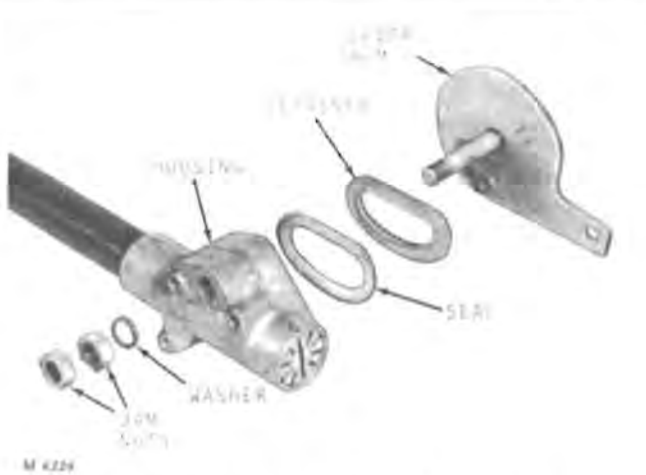


Fig. 15–Attaching Lever Arm to Steering Gear

Install new seal and retainer from AM30980 kit. Attach lever arm to steering gear housing with washer and two jam nuts, Figure 15.

INSTALLING STEERING GEAR

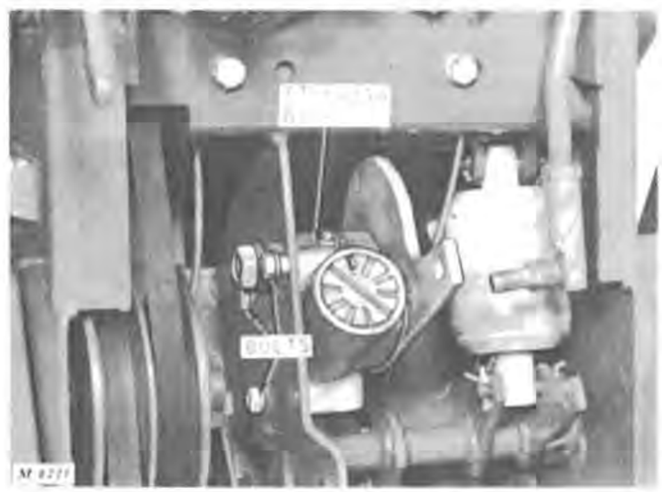


Fig. 16–Installing Steering Gear

Position steering gear assembly in tractor and install with bolts as shown in Figure 16. 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.

Fig. 17–Connecting Drag Link to Lever Arm

Connect drag link to lever arm, Figure 17 and tighten nut firmly.

NOTE: It is important that drag link is positioned with bend facing the center of the tractor before tightening nuts.

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 below.

ADJUSTMENTS

STEERING GEAR

Adjust steering mechanism in the sequence described below: Make these adjustments when excessive play (loose steering) is noticed or if steering becomes difficult.

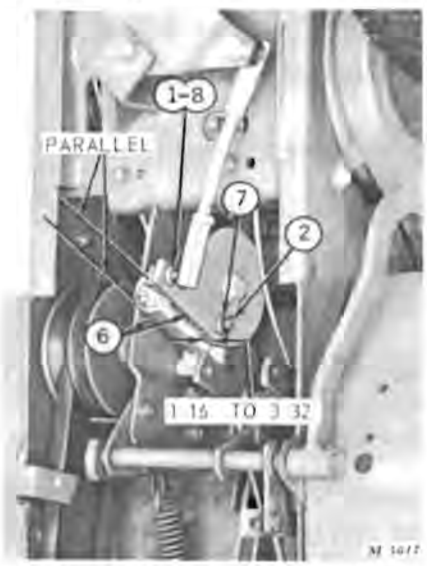


Fig. 18–Steering Gear Adjustment

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 turn stud counterclockwise two or three turns.

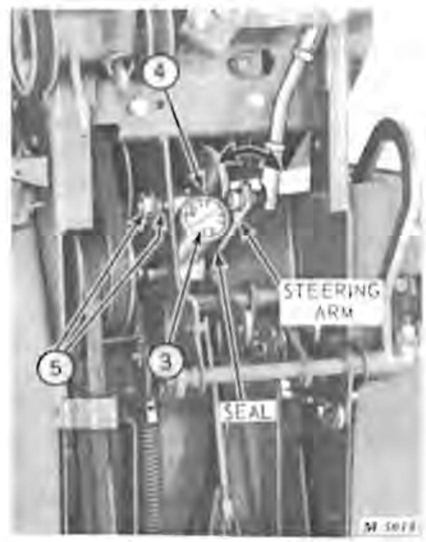


Fig. 19–Steering Gear Adjustment

3. Remove cotter pin holding adjusting plug in gear housing. Steering columns on Tractors (-51052) do not have a cotter pin. Refer to "Specifications," page 5-11, for plug torque and turn adjusting plug into housing until proper torque is obtained. Back plug out until steering wheel turns freely with no drag.
4. Lock plug after adjustment is obtained. On Tractors (-51052), lock plug by upsetting plug threads with a punch and hammer as shown in Figure 13. On Tractors (51053-   ), lock plug by turning plug only far enough to insert cotter pin through housing and closest slot in plug. Spread cotter pin as shown in Figure 14.

Fig. 20–Adjusting Lever Arm

5. Loosen jam nut on cross bolt and tighten only the inside nut using a thin open-end wrench, Figure 20, until all end play is removed or until the distance between the steering arm and gear housing is between 1/16 and 3/32 inch. After adjustment is completed, refer to "Specifications," page 5-11, for lever arm cross bolt torque.

6. Turn steering arm until the arm is parallel with steering gear body.

7. Turn stud in (clockwise) until snug to remove all backlash. Then move steering 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 cross bolt and ball joint is vertical). After adjustment is completed, refer to "Specifications," page 5-11, and torque jam nut. Make final test by turning steering arm through full range.

8. Set front wheels straight forward and turn steering wheel so that lever arm is parallel with steering gear housing (center of lever arm travel). Connect drag link as shown in Figure 18.

It may be necessary to lengthen or shorten drag link by turning drag link end.

It is important that drag link is positioned with bend facing the center of the tractor before tightening nuts, Figure 17.

Check steering for equal turn in both directions.

Readjust ball joint if necessary.

ADJUSTING STEERING ARM ON 110 TRACTORS (40001-100,000) AND 112 TRACTORS (- 100,000)

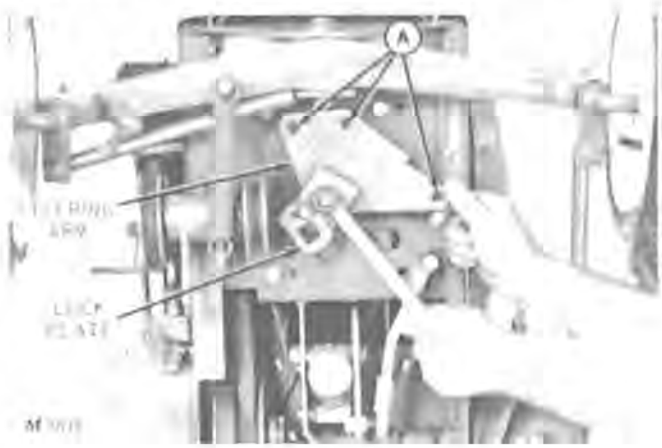


Fig. 21–Adjusting Steering Arm

Adjust steering arm as follows:

1. Disconnect drag link and tie rods at "A."

2. Loosen lock retaining screw and remove lock from bolt head.

3. Remove steering bolt, cone and arm assembly. Apply grease to both inner and outer cones and reassemble.

4. Tighten bolt only until a slight amount of drag can be felt when turning the steering arm through its range and all end play has been removed.

5. Position lock plate over bolt head and tighten lock plate cap screw. Be sure plain washer is used with lock plate cap screw. Reassemble tie rods and drag link to steering arm and tighten nuts firmly.

ADJUSTING TOW-IN ON TRACTORS WITH ADJUSTABLE TIE RODS

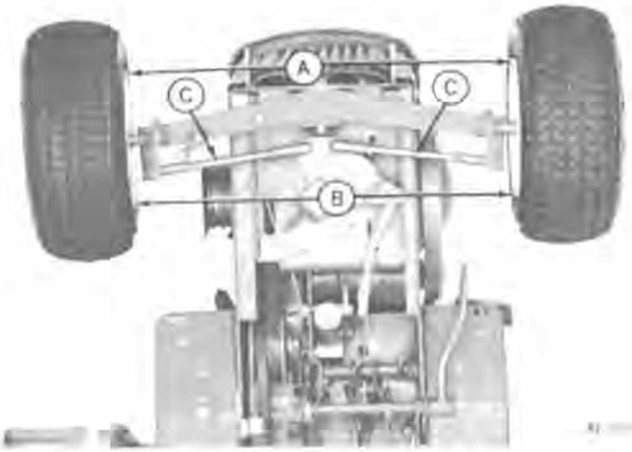


Fig. 22–Adjustable Tie Rods - 110 Tractors (-67940) and 112 Tractors (-3550)

Measure distances "A" and "B" above. 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	7-12 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

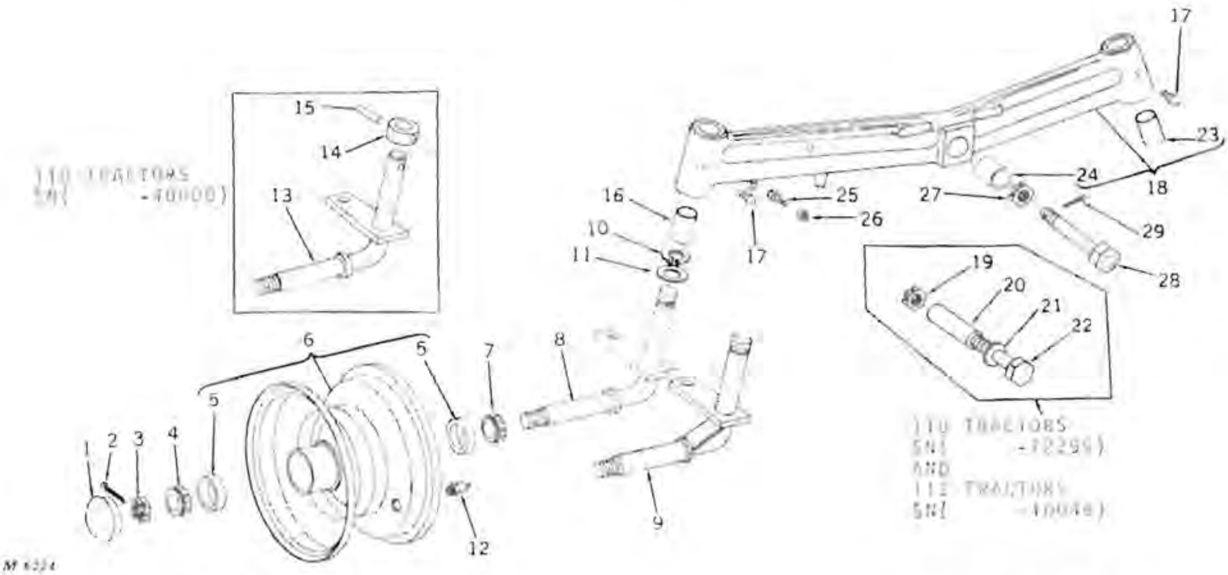
Name	Part No.	Use
15/16" Open-End Tappet Wrench	See Figure 20	Locking lever arm cross bolt.
Puller	SNAP-ON CJ-950	To remove steering wheel.
Puller	OTC 515	To remove steering wheel.

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 used)
2 – Cotter Pin (2 used)
3 – 5/8'' Slotted Hex. Nut
4 – Outer Cone (2 used)
5 – Cup (4 used)
6 – Front Wheel (2 used)
7 – Inner Cone with Seal (2 used)
8 – Front Wheel Spindle (110 Tractors) (2 used)
9 – Front Wheel Spindle (112 Tractors and 110 Tractors with Loaders) (2 used)
10 – Snap Ring
11 – Spindle Washer
12 – Front Tire Valve (High Flotation Tires Only)
13 – Front Wheel Spindle (110 Tractors)
14 – Spindle Keeper (110 Tractors)
15 – Spring Pin (110 Tractors)
16 – Bronze Bushing (4 used)
17 – Grease Fitting (2 used)
18 – Front Axle with Bushings
19 – 1/2'' Hex. Slotted Nut
20 – King Pin Bearing
21 – Washer
22 – 1/2'' UNF x 3-1/2'' King Pin Bolt
23 – Bronze Bushing (4 used)
24 – King Pin Bushing
25 – Steering Stop Bolt
26 – 1/2'' Hex. Jam Nut
27 – 3/4'' UNF Hex. Slotted Nut
28 – 3/4'' UNF x 3-5/8'' King Pin Bolt
29 – Cotter Pin

Fig. 1–Exploded View of Front Wheels and Axles for 110 and 112 Tractors

REPAIR—Continued

Differences in tractor front end parts depending on tractor serial number are shown in the exploded view on the preceding page.

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

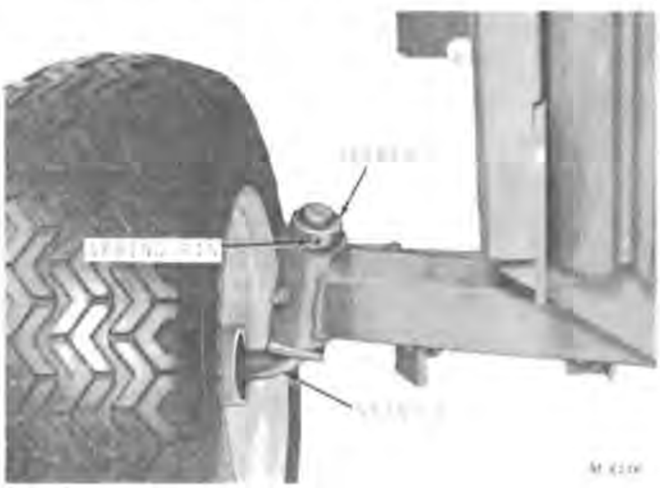


Fig. 3–Axle Keeper

110 Tractors (-15000) have an axle keeper as shown in Figure 3. Disconnect tie rod. Remove spring pin with a blunt punch and slip spindle out of axle.

Fig. 4–Washer and Retaining Ring

To remove axle on 110 Tractors (15000-100,000) and 112 Tractors (-100,000) disconnect tie rod. Use retaining ring pliers and remove retaining ring and washer, Figure 4. 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. 5–Axle Spindle Bushing

Excessive bushing wear, Figure 5, is caused by lack of lubrication. Replace bushing indicating excessive wear or out of round.

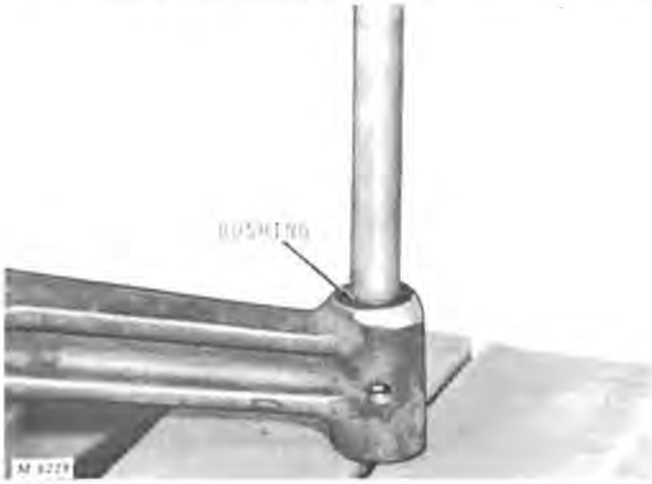


Fig. 6–Pressing Bushings Out of Axle

Remove king pin to separate axle from tractor. Place axle end on press bed and press bushings out of axle, Figure 6.

INSTALLATION

INSTALLING AXLE BUSHINGS

Fig. 7–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.

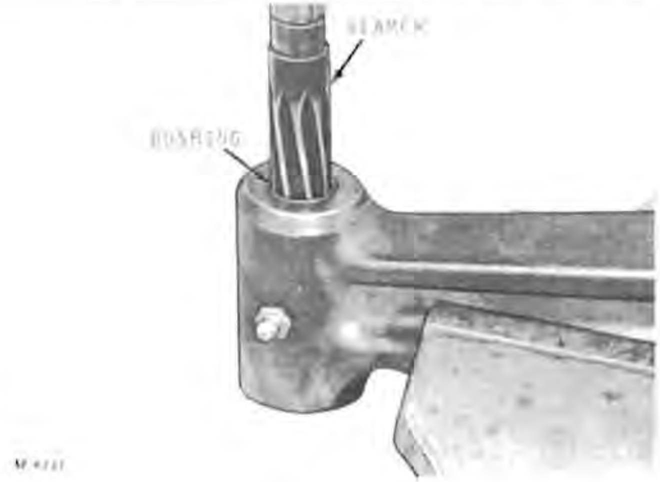


Fig. 8–Reaming Bushings

Place axle in a vise and turn reamer through axle bushings, Figure 8. Refer to "Specifications," page 10-5, for correct axle bushing dimension.

INSTALLING AXLE

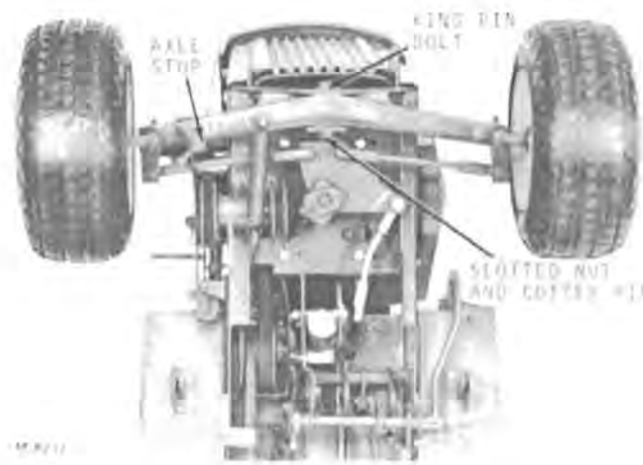


Fig. 9–Installing Axle on Tractor

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 9. Secure king bolt with slotted nut and cotter pin.

Use the illustrations on page 10-4 as reference guides during reassembly depending on tractor serial number.

INSTALLING AXLE—Continued

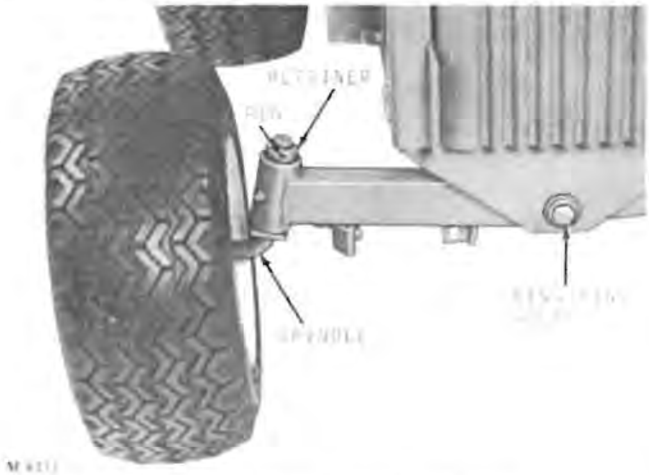


Fig. 10–Front Axle, Spindles and Front Wheels with Bearings 110 Tractors (-15000)

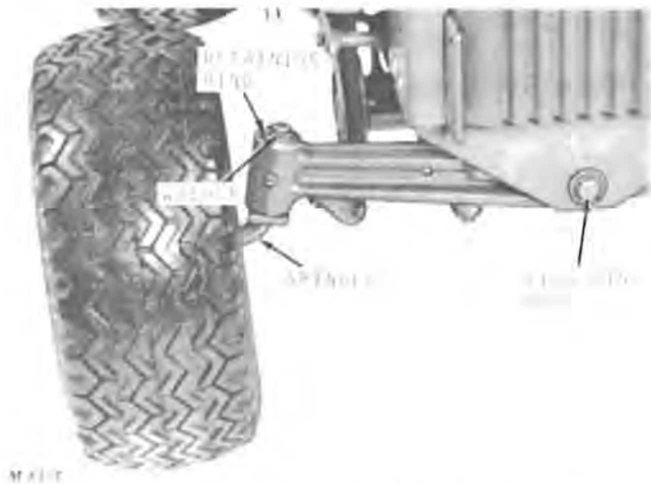


Fig. 11–Front Axle, Spindles and Front Wheels with Bearings on 110 Tractors (15001-100,000) and 112 Tractors (-100,000)

INSTALLING SPINDLES

Apply light coat of grease on spindle shaft. Install spindles into axle bushing, Figure 10 or 11, depending on tractor serial number.

INSTALLING BEARINGS AND WHEELS

Fig. 12–Installing Bearings and Wheels

Pack wheels with SAE multipurpose-type grease. Install bearing with seal, wheel, outer bearing and slotted nut on axle, Figure 12. Refer to "Adjustments," page 10-5, and adjust wheel bearings accordingly. Place grease cap on wheel.

ADJUSTMENT

FRONT WHEEL BEARING

Fig. 13–Adjusting 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 wheel.
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, torque the slotted nut to within 60 to 120 in-lbs to seat the bearings, Figure 13. 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.

SPECIFICATIONS

Item	New Part	Wear Tolerance
Front Axle Spindle Bushings	0.751-0.755 in.	0.770 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.

Group 15
LIFT LINKAGE

GENERAL INFORMATION

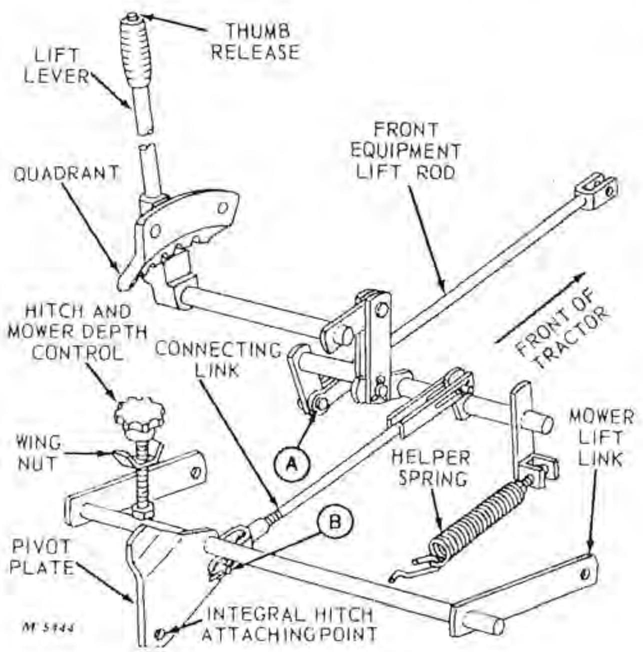


Fig. 1–Manual Lift Linkage

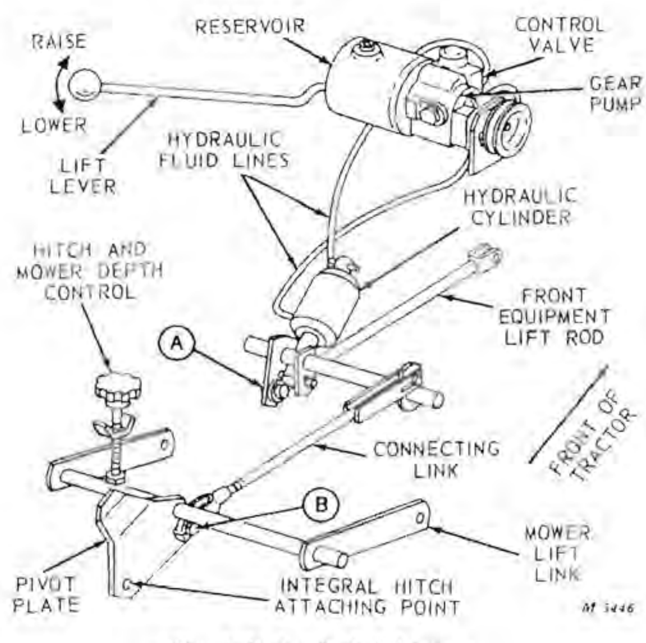


Fig. 2–Hydraulic Lift Linkage

MANUAL LIFT

110 and 112 Tractors with manual lift have linkage as shown in Figure 1. Variations in lift shaft, lift levers, lever hubs, depending on tractor serial number, are explained under "Repair" in this group.

Lift adjustments can be made with the threaded clevis at "A" and "B," Figure 1. The helper spring is not a regular part of the tractor, but is furnished with front mounted equipment such as the snow thrower and front blade. It is also furnished with the 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.*

HYDRAULIC LIFT

Lift adjustments can be made on the hydraulic lift linkage by turning threaded clevis at points "A" and "B," Figure 2. The slot in the connecting link allows hydraulic pressure only on the lift stroke. On the retracting stroke, the slotted linkage prevents down pressure on mounted equipment to prevent damage and allows the equipment to "float" with ground contour.

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.

Refer to "Adjustments," page 15-7, for the method of adjusting the hitch and mower depth control.

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.
Lubricate fittings.

Lift lever not properly seated in lift lever hub.
Position lever correctly in hub.

Linkage pin not properly installed (in pedestal).
Install pin correctly.

Lever quadrant not properly adjusted.
Position quadrant correctly.
Apply film of grease on quadrant notches.

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.
Position lever correctly in hub.

Linkage pin not properly installed (in pedestal).
Install pin correctly.

Lever quadrant not properly adjusted.
Position quadrant correctly.

Lift link pinned in wrong hole of lower lift shaft arm, 110 Tractors (-15000).
Refer to operator's manual supplied with equipment for correct position of link.

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.

Lift link pinned in wrong hole of lower lift shaft arm, 110 Tractors (-15000).
Refer to operator's manual supplied with equipment for correct position of link.

Linkage pin not properly installed (in pedestal).
Install pin correctly.

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.
Turn yoke in until lift is obtained.

Lift rod not properly adjusted (front mounted equipment).
Turn yoke in until lift is obtained.

Broken weld on primary lift shaft (in pedestal).
Replace lift shaft.

Lift link pinned in wrong hole of lower lift shaft arm, 110 Tractors (-15000).
Refer to operator's manual supplied with equipment for correct position of link.

Lift Lever Will Not Stay in Raised Position

Weak or broken release rod spring.
Replace spring.

Thumb release not properly seated on release rod.
Put Loctite on threads and tighten thumb release on release rod.

Quadrant not properly positioned.
Adjust quadrant.

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).
Turn yoke out.

Connecting rod not properly adjusted (rod between lower lift shaft and rear lift shaft).
Turn yoke out.

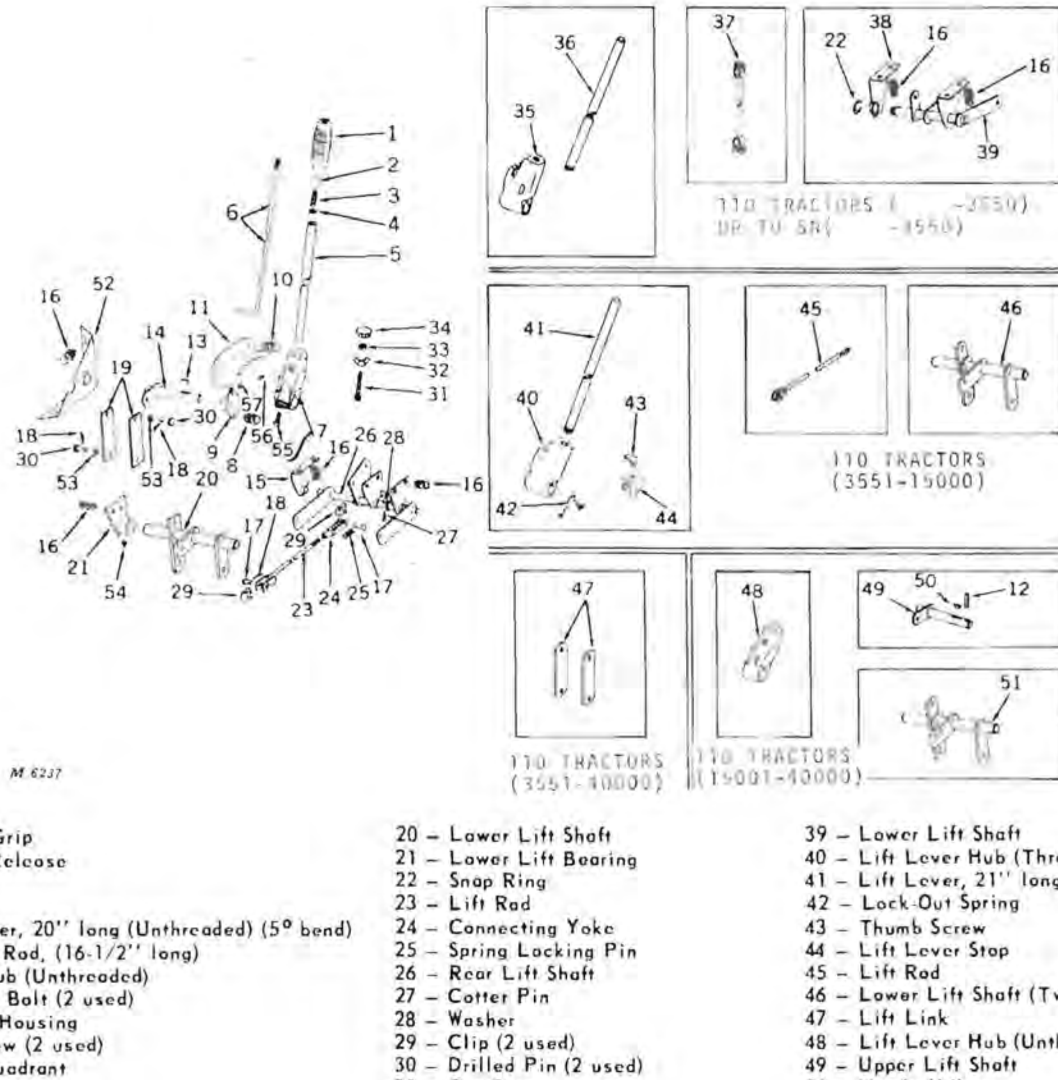
Lift Lever Hard to Move Forward

Helper spring too tight.
Loosen spring tension (release all tension when using mower).

Lower lift shaft and/or lift shaft hub lacks lubrication.
Lubricate fittings.

Lift lever not properly seated in lift lever hub.
Position lever in hub.

REPAIR



1 – Handle Grip
2 – Thumb Release
3 – Spring
4 – Washer
5 – Lift Lever, 20'' long (Unthreaded) (5° bend)
6 – Release Rod, (16-1/2'' long)
7 – Lever Hub (Unthreaded)
8 – Carriage Bolt (2 used)
9 – Bearing Housing
10 – Cap Screw (2 used)
11 – Lever Quadrant
12 – Spring Pin
13 – Woodruff Key
14 – Upper Lift Shaft
15 – Rear Lift Bearing
16 – Carriage Bolt (10 used)
17 – Drilled Pin (2 used)
18 – Cotter Pin (2 used)
19 – Lift Link
20 – Lower Lift Shaft
21 – Lower Lift Bearing
22 – Snap Ring
23 – Lift Rod
24 – Connecting Yoke
25 – Spring Locking Pin
26 – Rear Lift Shaft
27 – Cotter Pin
28 – Washer
29 – Clip (2 used)
30 – Drilled Pin (2 used)
31 – Cap Screw
32 – Wing Nut
33 – 3/8'' Hex. Nut
34 – Lift Stop Knob
35 – Lever Hub (Threaded)
36 – Lift Lever, 16'' long (Threaded)
37 – Lift Link
38 – Lower Lift Bearing
39 – Lower Lift Shaft
40 – Lift Lever Hub (Threaded)
41 – Lift Lever, 21'' long (Threaded)
42 – Lock-Out Spring
43 – Thumb Screw
44 – Lift Lever Stop
45 – Lift Rod
46 – Lower Lift Shaft (Two adjusting holes)
47 – Lift Link
48 – Lift Lever Hub (Unthreaded)
49 – Upper Lift Shaft
50 – Woodruff Key
51 – Lower Lift Shaft
52 – Upper Lift Shaft Bearing
53 – Spring Washer (2 used)
54 – 1/4'' Straight Grease Fitting
55 – 5/16'' x 1-1/4'' Cap Screw
56 – 5/16'' x 1-1/2'' Cup Point Set Screw
57 – 1/4'', 90° Grease Fitting

Fig. 3—Exploded View of Lift Linkage

REPAIR—Continued

REMOVING LIFT LINKAGE IN PEDESTAL

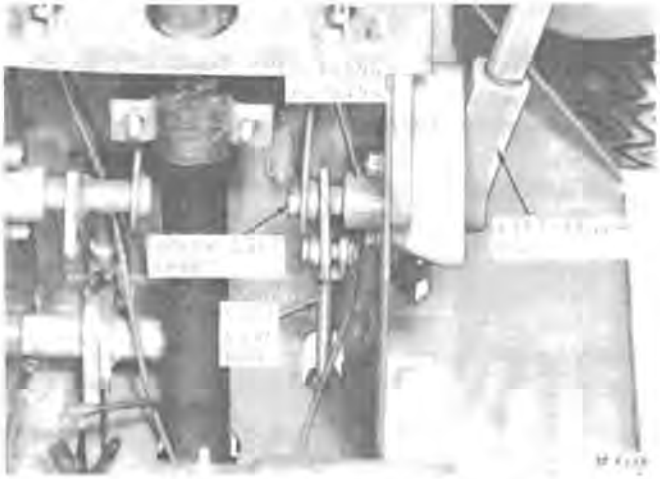


Fig. 4—Lift Linkage Components in Pedestal - 110 Tractors (-3550)

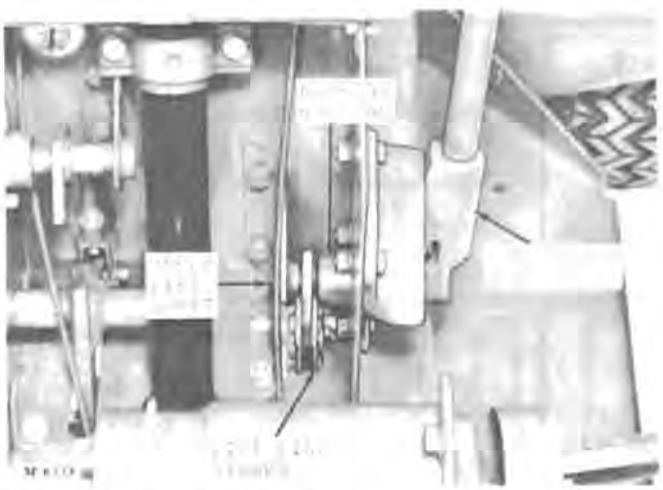


Fig. 5—Lift Linkage Components in Pedestal - 110 Tractors (3551-100,000) and 112 Tractors (-100,000)

Remove battery, gas tank and battery base to service lift linkage components in the pedestal.

To prevent breakage of shaft bearing, a puller should be used to remove lift lever hub from upper lift shaft, Figures 4 and 5.

The lift lever hub on early 110 Tractors is secured to the lift shaft with a spring pin. Later Model 110 Tractors and all 112 Tractors have a clamp type hub, (7, Fig. 3).

REMOVING THUMB RELEASE AND LIFT LEVER

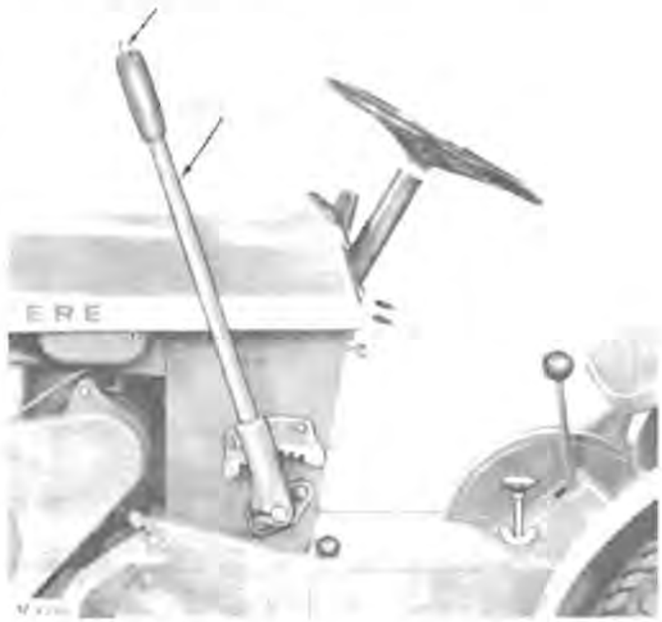


Fig. 6—Removing Thumb Release

Whenever it is necessary to remove the thumb release button, remove the rubber hand grip and heat the button to about 300° F. Turn thumb release button counterclockwise. The release button is threaded in to the internal control rod and is secured with Loctite. Forcing the button counterclockwise to remove it can cause the rod to break at the threads. Heating the button reduces the holding power of the Loctite and releases the rod.

CAUTION: Do not overheat the button, because this will destroy the plated finish and draw the temper from the latch spring.

Lift levers in 110 Tractors (-15000) are threaded and must be unscrewed from the hub.

Lift levers in 110 and 112 Tractors (15001-100,000) are slip fitted into the hub and held in place with a set screw.

ASSEMBLY

INSTALLING LIFT LINKAGE

Detailed instructions are not provided for installing the lift linkage. Install the lift linkage as illustrated on this page depending on the serial number of the tractor involved. Also refer to the exploded view on page 15-3.

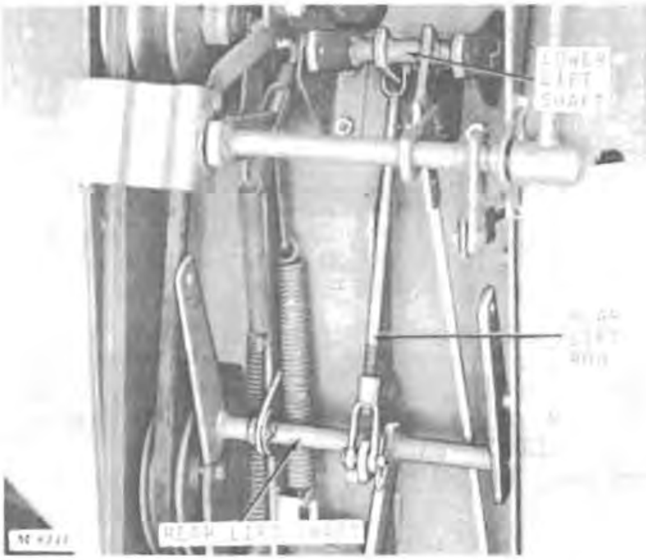


Fig. 7–Bottom View - 110 Tractors (-3550)

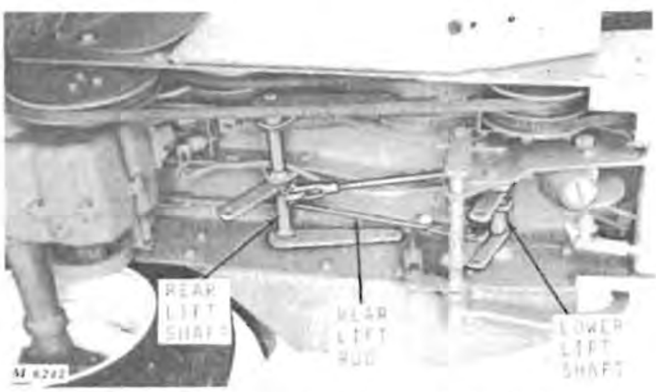


Fig. 8–Bottom View - 110 Tractors (3551-15000)

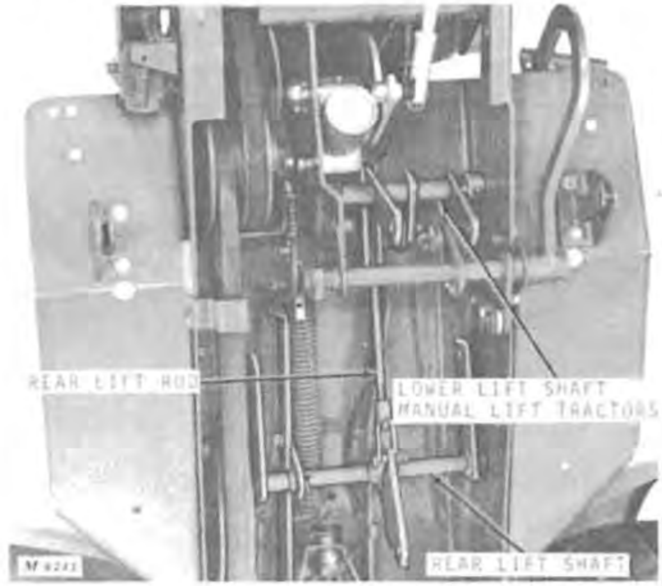


Fig. 9–Bottom View - 110 Tractors (15001-100,000) and 112 Manual Lift Tractors (-100,000)

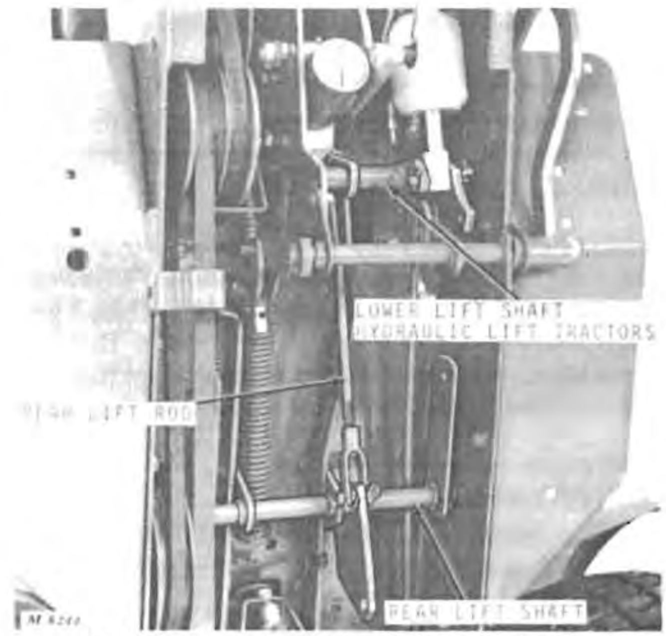


Fig. 10–Bottom View - 110 and 112 Hydraulic Lift Tractors

INSTALLING LIFT LEVER

Fig. 11–Lift Lever with Threaded End

110 Tractors (3551-15000)

Depress thumb latch and insert control rod into lever hub. Be sure to insert rod under the spring.

When tightening the lever, be sure to screw it into the hub until no threads show. However, before tightening, raise the rubber hand grip high enough so that the marks from the pipe wrench or vise grip will not show when the rubber grip is pushed down into place again.

110 Tractors (15001-100,000) and All 112 Tractors

Slide lever into hub and secure it in place with the set screw. See the exploded view, Figure 3.

INSTALLING ANTI-VIBRATION CLIP

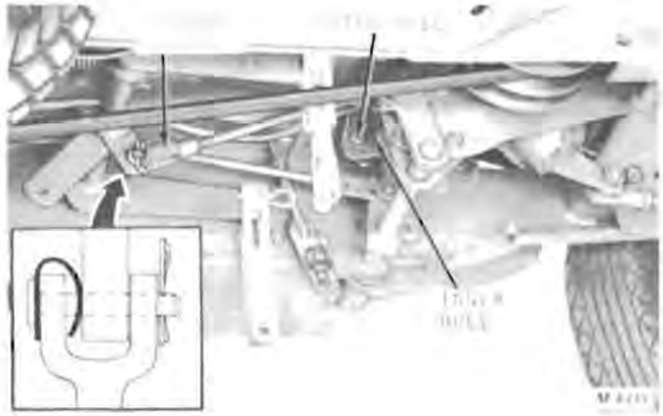


Fig. 12–Anti-Vibration Clip (Inset)

Install anti-vibration clips as shown, Figure 12, at threaded clevis joints.

Notice reference to "inner hole" and "outer hole" in lift links. Before installing rotary mowers or other equipment on 110 Tractors (-15000) position lift pin in outer hole of lift arm, Figure 12.

ADJUSTMENTS

DEPTH CONTROL - 110 TRACTORS (-15000)

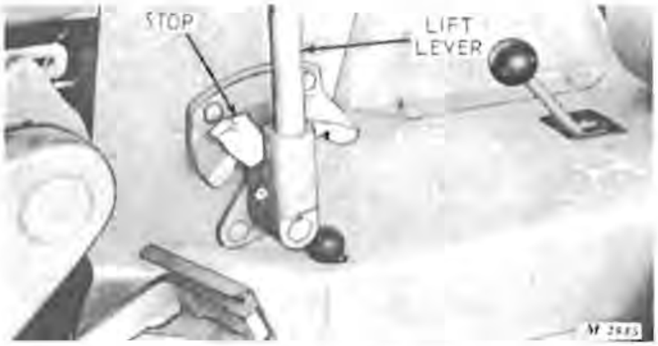


Fig. 13–Lift Lever Stop

Earlier Model 110 Tractors have a lever stop, Figure 13, to regulate depth control.

HELPER SPRING

Increase helper spring tension until coils separate 1/64 inch with lift lever in raised position.

Instruct owners to loosen spring to remove all tension when not using front or rear mounted equipment.

HITCH AND MOWER DEPTH CONTROL 110 TRACTORS (15001-100,000) AND 112 TRACTORS (-100,000)

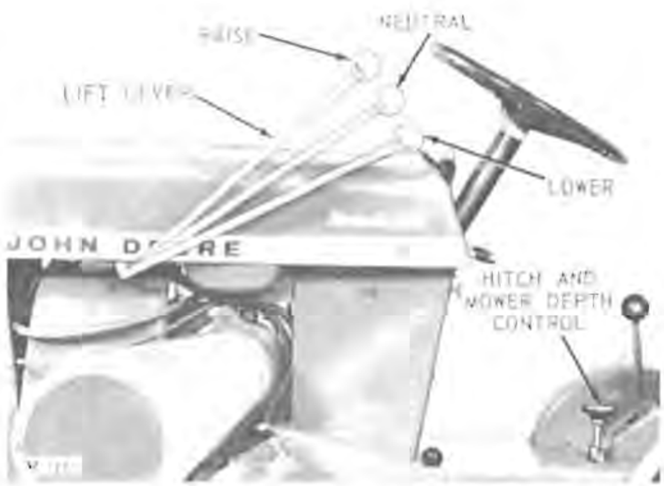


Fig. 14–Lift Lever and Depth Control

To keep hitch, mower or rear mounted equipment in raised position, turn depth control knob down as far as it will go.

Front mounted equipment is not affected by the depth control setting.

Make fine lift adjustments for the rotary mower and rear mounted equipment by turning threaded clevis on connecting link in or out, Figure 12.

Litho in U.S.A.