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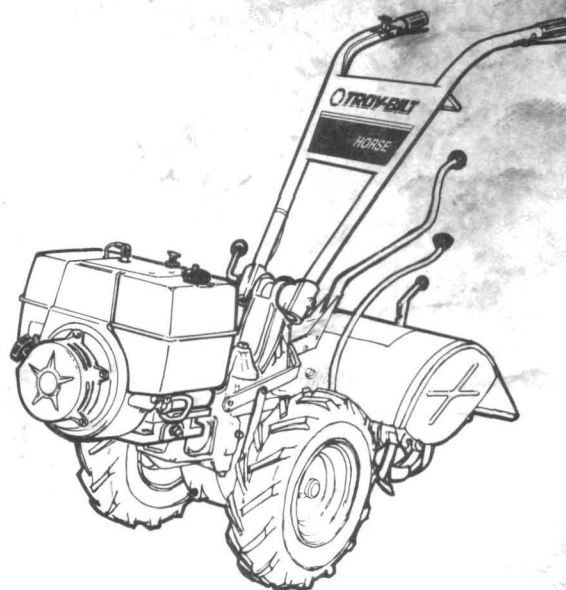
TROY-BILT

Technical Manual

PTO HORSE Tiller

Models

7 HP
8 HP



GARDEN WAY INC.

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- This manual provides transmission service information for the PTO HORSE Model TROY-BILT® Roto Tiller-Power Composter built by TROY-BILT Manufacturing Company, Troy, New York. Use this manual for tillers with serial numbers 640000 and up.

- This manual was written for and intended to be used by professional service technicians who have been trained in the proper servicing of outdoor power equipment.

- All information, illustrations, and specifications contained in this manual are based on the latest information available at the time of publication. The right is reserved to make changes at any time without notice. If you have any questions concerning the information contained in this manual please contact:

Technical Service Department
TROY-BILT® Manufacturing Company
102nd Street and 9th Avenue
Troy, New York 12180
Call Toll-Free: 1-800-833-6990.



This symbol is used to alert you to important safety messages in this manual and on decals affixed to the tiller. When you see this symbol, carefully read and follow its safety message. Failure to do so could result in personal injury or property damage.

- This manual is divided into seven sections as shown in the Table of Contents. For best results, read each section in its entirety before attempting any repair work.

- This manual is designed to be used in combination with the PTO Horse Model Owner/Operator Manual. *The Owner/Operator Manual contains additional service and maintenance information that is not covered in this manual.*

Refer to "Quick Reference Repair Index" in this section for a listing of the service and maintenance topics that are covered in the Owner/Operator Manual.

- Service and maintenance information regarding engines is not covered in this manual. Such information can be obtained by consulting the Service Repair Manuals available from the engine manufacturer. You should, however, call our Technical Service Department with questions concerning engine replacement or interchangeability.

- Throughout this manual, you will see references to the left and right sides of the tiller. This refers to the left and right sides of the tiller as you would see them standing in the operator's position.

Safety First

When working on the tiller or its engine, closely follow operating instructions and recommended safety practices at all times. Failure to do so could result in personal injury or property damage. Here are some basic safety precautions you should keep in mind at all times when doing repair work:

KNOW THE TILLER AND ENGINE!

Read the Owner/Operator Manual carefully. Be sure you know what each tiller and engine control does before you attempt to operate it. Read and follow all safety rules. Never allow inexperienced persons or children to operate the tiller or its engine.

WEAR PROPER APPAREL!

Don't wear loose clothing or jewelry that could get caught in moving parts of the tiller or its engine.

AVOID MOVING PARTS!

Keep hands, feet, hair, clothing, and tools safely away from moving parts when the engine is running.

AVOID ACCIDENTAL STARTING!

When servicing the machine, prevent unintentional starting of the engine by disconnecting the spark plug wire and keeping the wire away from the spark plug. Place engine controls in the OFF position and shift the Wheels/Tines/PTO Drive Lever into NEUTRAL.

WEAR EYE PROTECTION!

Safety goggles or a face shield should be worn whenever there is the possibility of danger to the eyes from flying parts or particles.

PREVENT FIRES AND EXPLOSIONS!

Gasoline is highly flammable and explosive and should be used and stored with extreme caution. Keep gasoline away from open flame, sparks, and do not smoke in the vicinity of gasoline cans or fuel tanks. Do not add gasoline to a fuel tank when the engine is running or still hot. Fill the fuel tank outdoors, in a well-ventilated area. Store gasoline in a cool, well-ventilated place, safely away from any spark or flame producing equipment. Store only in a U.L. approved container and safely out of reach of children. Wipe off any spilled gasoline and move the engine away from gasoline fumes before starting engine.

Use flammable cleaning solvents only according to recognized safety practices (never use gasoline as a cleaning solvent). Oily rags and waste should be packed

SECTION 1: General Information

in a U.L. approved covered metal safety container to prevent fire from spontaneous combustion.

HANDLE BATTERIES WITH CARE! Batteries contain sulfuric acid that can cause blindness, burn skin, and eat through clothing. Wear safety goggles when working near the battery or when handling battery acid. Remove all rings and metal jewelry when working on the battery or electrical system.

Batteries also produce explosive gases. Keep sparks, flames, and cigarettes away. Ventilate when charging or using in an enclosed space.

Do not cause a short circuit by touching both battery terminals at the same time with tools or other metallic objects. Also, do not allow a tool or other metallic object to touch a terminal that is not grounded and an adjacent metallic part that is grounded. A spark from a short circuit could cause an explosion of battery gases or gasoline.

AVOID ENGINE EXHAUST FUMES! Do not run the engine in an enclosed area. Exhaust gases contain carbon monoxide, an odorless and deadly poison. Provide adequate ventilation at all times. After running the engine, don't touch the muffler or other hot engine parts until they have cooled down.

HANDLE PARTS CAREFULLY! With continued use, the teeth on gears and worms may wear to sharp, knife-like edges. Therefore, when handling these parts, use care to avoid cutting yourself.

REPLACEMENT PARTS! Use only genuine Troy-Bilt replacement parts. Replacement parts manufactured by others could present safety hazards even though they may fit on this tiller.

Quick Reference Repair Index

To obtain service information for the following topics, please refer to either this Technical Manual or the Owner/Operator Manual, as indicated in the table below.

	TECHNICAL MANUAL	OWNER/OPERATOR MANUAL
Air Cleaner		X
Battery		X
Bearing Cap, PTO Power Unit	X	
Bearing Cap, Tiller Attachment	X	
Bearings, Drive Shaft	X	
Bearings, Tiller Drive Shaft	X	
Bearings, Tiller Tine Shaft	X	
Bearings, Wheel Shaft	X	
Belts		X
Bolo Tines		X
Bronze Bushings	X	
Carburetor		X
Choke		X
Clutch	X	
Clutch Roller		X
Cover, Transmission	X	
Depth Regulator		X
Dog Clutch, Tiller Attachment	X	
Dog Clutch, PTO Power Unit	X	
Drive Shaft, PTO Power Unit	X	
Drive Shaft, Tiller Attachment	X	
Eccentric Lever	X	
Electric Start System		X
Engine		X
Fuel		X
Handlebar Height Adjustment		X
Ignition System		X
Lubrication Points		X
Neutral Plunger	X	
Oil Drain Plug	X	
Oil (Engine and Transmission)		X
Oil Level Check Plug	X	
Pinion Shaft	X	
Pinion Shaft Gears	X	
PTO Power Unit	X	
Reverse Disc		X
Solenoid		X
Throttle Cable		X
Tiller Attachment	X	
Tiller Drive Shaft	X	
Tiller Housing Cover	X	
Tiller Tine Shaft	X	
Tines/PTO Clutch Lever	X	
Tires/Wheels		X
Transmission Pulley		X
Wheel Shaft	X	
Wheel Speed Gears	X	
Wheel Speed Lever		X
Worm, PTO Power Unit Drive Shaft	X	
Worm, Tiller Drive Shaft	X	
Worm Gear, Wheel Shaft	X	
Worm Gear, Tiller Tine Shaft	X	

The following charts list the most common problems experienced with the tiller drive train. Symptoms of problems are listed along with possible remedies. If following the repair procedures does not fix the problem, call the TROY-BILT® Tiller Technical Service Department at TOLL-FREE: 1-800-833-6990.



WARNING: When servicing the machine, prevent unintentional starting of the engine by disconnecting the spark plug wire and keeping the wire away from the spark plug. Place the engine throttle control in the OFF position and shift the Wheels/Tines/PTO Drive Lever into NEUTRAL.

Forward and Reverse Shifting Problems

Symptom	Remedy
Wheels/Tines/PTO Lever is hard to shift into reverse.	<ul style="list-style-type: none"> • Check the reverse disc for wear. See the Owner/Operator Manual for instructions. • Check the adjustment of the reverse disc and/or reverse spring and plunger assembly. See the Owner/Operator Manual for instructions. • Clean and re-lubricate the motor mount bars, belt adjustment block, and linkages on lever. See the Owner/Operator Manual for instructions.
Wheels/Tines/PTO Lever sticks in forward.	<ul style="list-style-type: none"> • Lubricate the motor mount bars, belt adjustment block, and linkages on the lever. See the Owner/Operator Manual for instructions. • Check the tension on the drive belt. See the Owner/Operator Manual for instructions.
Tiller stays in reverse when the Wheels/Tines/PTO Lever is released.	<ul style="list-style-type: none"> • Lubricate the motor mount bars, belt adjustment block, and linkages on the lever. See the Owner/Operator Manual for instructions. • Check the adjustment of the reverse disc and/or reverse spring and plunger assembly. See the Owner/Operator Manual for instructions.
Wheels/Tines/PTO Lever jumps out of forward.	<ul style="list-style-type: none"> • Raise the belt adjustment block as the drive belt may be too tight. See the Owner/Operator Manual for instructions. • Install a new clutch pawl spring at the end of the lever. The old spring may be overstretched.
Wheels/Tines/PTO Lever is hard to shift into forward.	<ul style="list-style-type: none"> • Lubricate the motor mount bars, belt adjustment block, and linkages on lever. See the Owner/Operator Manual for instructions.

SECTION 2: Transmission Troubleshooting

Wheel Speed Shifting Problems

Symptom	Remedy
Wheel Speed Lever drops out of fast speed.	<ul style="list-style-type: none">• Check the tension on the Wheel Speed Lever's castle nut. See "Tightening the Castle Nut On the Wheel Speed Lever" in Section 7 of this manual.
Wheel Speed Lever hard to shift.	<ul style="list-style-type: none">• Inspect the Wheel Speed Lever:<ul style="list-style-type: none">■ Lubricate the Wheel Speed Lever linkage where the connecting rod joins the shift lever and the connecting rod swivel.■ The connecting rod at the bottom of the lever may be backwards or bent in towards the transmission and hitting it.■ Lubricate the washers and castle nut on the pivot point of the lever.■ Check the tension on the Wheel Speed Lever's castle nut. See "Tightening the Castle Nut On the Wheel Speed Lever" in Section 7 of this manual.• Check if the clutch is binding on the wheel shaft. See "Testing for a Bubbled Wheel Shaft" in Section 7 of this manual.
Wheel Speed Lever moves into slow speed but not into fast.	<ul style="list-style-type: none">• Check if the clutch is binding on the wheel shaft. See "Testing for a Bubbled Wheel Shaft" in Section 7 of this manual.
Wheel Speed Lever moves freely but the transmission does not shift out of or into fast or slow speed.	<ul style="list-style-type: none">• Disconnect the shift linkage from the eccentric lever and try moving the eccentric lever by hand. If the lever rotates 360 degrees around the eccentric shaft, the spirol pin that connects the lever and the shaft is broken or missing. Replace the spirol pin. If the lever and the shaft together rotate 360 degrees, the shaft is broken and must be replaced. (Although rare, the eccentric shifting pin could be broken or missing, which would also result in the lever and shaft being able to rotate a full 360 degrees.)

SECTION 2: Transmission Troubleshooting

Wheels and/or Tines Do Not Turn

Symptom	Remedy
Wheels and tines won't turn even though Wheels/Tines/PTO Lever seems to work properly.	<ul style="list-style-type: none">• Inspect the drive belt for wear or mis-adjustment. See the Owner/Operator Manual for instructions.• Check condition and adjustment of reverse disc. See the Owner/Operator Manual for instructions.• Inspect the mounting bolt on the transmission drive pulley. It may be loose or missing, which would allow the key in the pulley to fall out. If so, the drive belt or reverse disc will turn the pulley but the pulley will not turn the power unit drive shaft. Tighten the bolt (with the concave washer in place) securely.• Check for play in the power unit drive shaft. If there is play in the drive shaft, find out why. It could be a loose bearing cap, improper shimming, damaged bearings or worn worms.• If the transmission is new or rebuilt, the key on the transmission engine pulley may not have been installed. If so, the pulley cannot transfer power to the drive shaft.• If the transmission is new or rebuilt, the internal keys in the pinion assembly may not have been installed. If so, the pinion gears will not drive the wheel speed gears.
Tines turn but the wheels do not turn or turn only in one speed. The Wheel Speed Lever moves the clutch into either gear.	<ul style="list-style-type: none">• Inspect the hi-pro key that lets the clutch turn the wheel shaft. It may be missing or broken.• Inspect the lugs on each side of the clutch; they may be worn.• Inspect the fast and slow speed wheel gears. One or both may be worn.• Inspect the fast and slow speed pinion gears. One or both may be worn.• Inspect the power unit drive shaft worm. It may be worn and not meshing with the bronze worm gear on the pinion shaft assembly.• Inspect the bronze worm gear on the pinion shaft assembly. It may be worn and not meshing with the power unit drive shaft worm.• If the transmission is new or rebuilt, the key that holds the bronze worm gear to the fast speed pinion gear may not have been installed. This means the bronze worm gear will turn but it will not turn the pinion gear.• If the wheels only turn in the fast wheel speed and if the transmission is new or rebuilt, the key may be missing from the stem pinion gear, preventing the transmission from operating in slow gear. The key locks the stem pinion to the fast speed pinion gear.

SECTION 2: Transmission Troubleshooting

Wheels and/or Tines Do Not Turn

Symptom	Remedy
Wheels turn but the tines do not.	<ul style="list-style-type: none"> • Make sure the Tines/PTO Clutch Lever is engaged. • Adjust the Tines/PTO Clutch Lever. • Make sure the power unit or tiller attachment's dog clutch key is in place and that each key is fully seated. Both dog clutches must be able to slide lengthwise on their shafts. • Inspect the eccentric lever on the Tines/PTO Clutch; it may be broken. • Inspect the tiller attachment drive shaft worm. It may be worn and unable to mesh with the bronze tiller shaft worm gear. • Inspect the bronze tiller drive shaft worm gear. It may be worn and unable to mesh with the tiller drive shaft worm. • Inspect the keys that hold the tine holders to the tine shaft; they may be sheared or missing. Or, the holders may be worn. See the Owner/Operator Manual for instructions. • If the transmission has been in service for a long time, the key that holds the bronze worm gear to the tiller shaft may be broken. If the transmission is new or rebuilt; the key may be missing.
Wheels and tines turn on top of the ground but stop or hesitate in the soil.	<ul style="list-style-type: none"> • Check the drive belt for proper adjustment. See the Owner/Operator Manual for instructions. • Check if the mounting bolt for the transmission drive pulley is missing. This would allow the key inside the pulley to fall out. • Follow the remedies for "Wheel and tines won't turn though Wheels/Tines/PTO Lever seems to work properly." See Page 2-3. • Follow the remedies for "Tines turn but the wheels do not turn or turn only in one speed." See Page 2-3.

Wheel Shaft Moves To One Side

Symptom	Remedy
The wheels and wheel shaft move to one side.	<ul style="list-style-type: none"> • Check for play in the wheel shaft. If there is more than .015" play, one or both snap rings are out of the groove(s).

Noise from Rear Tiller Bearing

Symptom	Remedy
A growling or whining noise from the tiller attachment rear bearing.	<ul style="list-style-type: none"> • Inspect the bearing and bearing cup for wear or damage. • Inspect the tiller shaft bronze worm gear for wear or damage.

Oil Leaks

Symptom	Remedy
<p>Oil leaks from the wheel shaft oil seals.</p>	<ul style="list-style-type: none"> • An oil seal is worn or damaged. Check for side-to-side and vertical play in the wheel shaft and replace seal. • Give new seals time to lap in. • Inspect the wheel shaft for minor damage at the oil seal location: <ul style="list-style-type: none"> ■ Inspect for corrosion, pitting, or scoring. ■ Use emery cloth to remove any minor defects. ■ Attempt to seat the seal so that it is on an undamaged part of the shaft. ■ Replace the wheel shaft if necessary. • Determine if the seal fits loosely in the transmission bore. Contact the TROY-BILT Technical Service Department for a special seal. • Be sure the transmission is filled with SAE 90 or SAE 140 gear oil. A lighter viscosity oil will cause leakage. • Make sure that a non-hardening gasket sealer was applied to the outside diameter of the oil seal prior to its installation. • Make sure the housing bore has no nicks or scratches that would permit oil to seep out between the seal and the housing.
<p>Oil leaks from the rear of the tiller attachment housing.</p>	<p>If the leak is from the oil seals on the tiller tine shaft:</p> <ul style="list-style-type: none"> • Make sure the seals have non-hardening gasket sealer around the outside edges. • An oil seal is worn or damaged; replace the seal. • Inspect the tiller tine shaft for minor damage at the oil seal location: <ul style="list-style-type: none"> ■ Inspect for corrosion, pitting, or scoring. ■ Use emery cloth to remove any minor defects. ■ Replace the tiller tine shaft if necessary. • Check for sand holes (imperfections in the cast iron) or cracks in the housing cover. <p>If the leak is on the left side of the tiller housing:</p> <ul style="list-style-type: none"> • Apply non-hardening gasket sealer to each of the tiller housing cover screws and tighten the screws. • Replace any worn or damaged gaskets. • Make sure the housing cover bore has no nicks or scratches that would permit oil to seep out. • Make sure the housing bore has no nicks or scratches that would permit oil to seep out between the seal and the housing. <p>If the leak is from the rear bearing cap:</p> <ul style="list-style-type: none"> • Inspect the rear bearing cap: <ul style="list-style-type: none"> ■ Make sure the screws are the correct length. ■ Apply non-hardening gasket sealer to each of the rear bearing cap bolts and tighten the bolts. • Replace a worn or damaged gasket. • Check for excessive play in the tiller tine shaft.

SECTION 2: Transmission Trouleshooting

Oil Leaks

Symptom	Remedy
Oil leaks from the front oil seal on the power unit drive shaft. Oil could appear in the base of the motor mount under the pulley. (Make sure this is not an oil leak from the neutral plunger assembly, which is an oil relief point.)	<ul style="list-style-type: none"> • Replace a worn or damaged oil seal and check for play in the shaft. • Apply a layer of non-hardening gasket sealer to each of the front bearing cap bolts and tighten the bolts. • Replace a worn or damaged gasket. • Make sure the leak is at the front oil seal. You could be seeing oil that leaked from the engine air cleaner, power unit housing cover, or engine seal. • Check the transmission gear oil level when the unit is cold. If overfilled, drain it to the proper level.
Oil leaks from the handlebar base or the bottom of the reverse spring and plunger assembly.	<ul style="list-style-type: none"> • Loosen and remove the oil level check plug to make sure the oil level is correct. If the transmission is overfilled, let the excess oil drain out. • See if oil is leaking from the neutral plunger. If oil is leaking from here, take no action; the neutral plunger is an oil relief point.
Oil is leaking from the eccentric shaft and lever.	<ul style="list-style-type: none"> • Replace the oil seal.
Oil is leaking from any pipe plug in the transmission housing.	<ul style="list-style-type: none"> • Remove the pipe plug and apply a layer of non-hardening gasket sealer. Then re-install the plug. • Check to see if the plug is cross-threaded.
Oil is leaking between the power unit housing cover and the housing.	<ul style="list-style-type: none"> • Tighten the housing cover bolts. • Replace the gasket. • A special transmission cover gasket (Part No. 9260) may be required if the leak continues.

Before you begin your repair or maintenance procedure take a moment to perform a pre-service inspection of the following transmission parts. In doing so, you may discover additional problems that can be corrected while the tiller is in your shop.

Wheel Shaft — Inspect the wheel shaft for movement and oil leaks:

- Grasp the tiller's handlebars and tilt the tiller forward so its weight is resting entirely on the wheels and move the tiller side-to-side. See Figure 3-1.

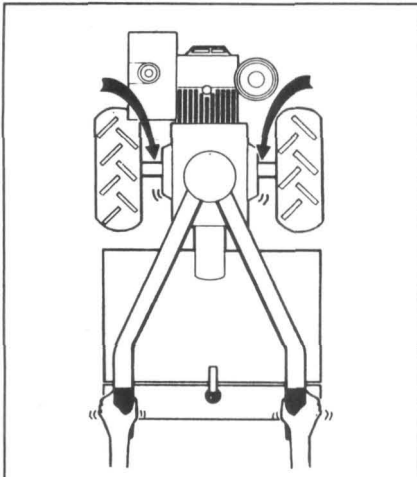


Figure 3-1: Pre-Disassembly Inspection of the Wheel Shaft.

If the tiller moves more than .015" from side-to-side on the wheel shaft, it indicates that the wheel shaft needs either to be shimmed or that one or both of the snap rings has become dislodged from the snap ring groove(s).

- If oil is leaking from around one or both of the wheel shaft oil seals, replace the oil seal(s) and determine why the oil seal(s) failed.



WARNING: When servicing the machine, prevent unintentional starting of the engine by disconnecting the spark plug wire and keeping the wire away from the spark plug. Place the engine throttle control in the OFF position and shift the Wheels/Tines/PTO Drive Lever into NEUTRAL.

PTO Power Unit Drive Shaft

Pulley — Check the PTO drive shaft pulley (see Figure 3-2) for end play and oil leaks:

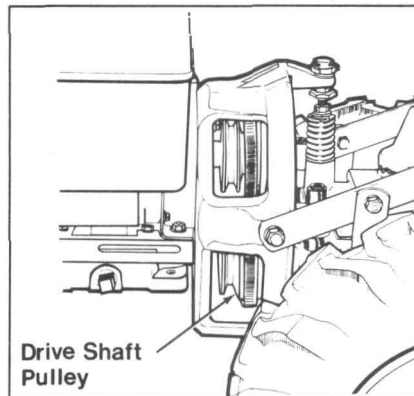


Figure 3-2: Pre-Disassembly Inspection of the Drive Shaft Pulley.

- Using two hands, grasp the drive shaft pulley and pull it in and out to check for end play.

There should be .005" to .010" play. If the drive shaft pulley has more play, the bolt that holds the pulley may need to be tightened. This bolt should be tightened to 170 inch/lbs.

If tightening does not reduce the play, the PTO power unit drive shaft needs to be shimmed.

- Look for oil leaks around the pulley. If you see oil, make sure that it did not come from the neutral plunger on the housing cover; this is an oil relief point.

If you suspect an oil leak from around the pulley, inspect the following:

- The bolts holding the front bearing cap may not be sufficiently tightened.
- The washers on the bolts that hold the front bearing cap may be worn or the bolts may not have been coated with non-hardening gasket sealer.
- The front bearing cap gasket may have failed.
- The front drive shaft oil seal may have failed; find out why.

Tiller Attachment — Tip the tiller so that you have a full view of the tiller attachment (see Figure 3-3). Then check the following:

- Inspect the area around the rear bearing cap for oil leaks. If you see an oil leak, inspect the following:

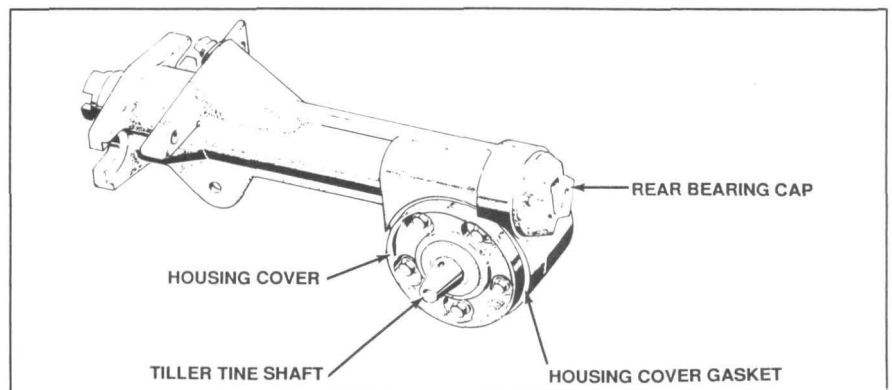


Figure 3-3: Pre-Disassembly Inspection of the Tiller Attachment.

SECTION 3: Pre-Service Inspection

a. The bolts holding the rear bearing cap may not be sufficiently tightened.

b. The washers on the bolts that hold the rear bearing cap may be worn or the bolts may not have been coated with non-hardening gasket sealer.

c. The rear bearing cap gasket may have failed.

- Inspect the left side of the tiller tine shaft for oil leaks. If you see an oil leak, inspect the following:

a. The tiller housing cover may not be sufficiently tightened; check all five bolts.

b. The washers on the bolts that hold the tiller housing cover may be worn or the bolts may not have been coated with non-hardening gasket sealer.

c. The tiller housing cover gasket(s) may have failed.

d. The tiller housing cover oil seal may have failed; find out why.

- Inspect the right side of the tiller tine shaft for oil leaks. If you see an oil leak, the oil seal needs to be replaced. Then, discover why the oil seal failed.

- Check the tiller tine shaft for play:

Using two hands, grasp the tiller tine shaft and rotate the shaft back and forth.

You should be able to rotate the shaft slightly and to hear a small click. This means the tiller tine shaft is shimmed correctly.

If you cannot rotate the shaft and do not hear a click, it means that the side cover needs to be shimmed outward using various thicknesses of gaskets. This procedure is explained in Section 6 of this manual (see "Tiller Tine Shaft Assembly").

Being able to rotate the shaft more than a small amount and hearing a louder click means the tiller tine shaft is either shimmed incorrectly

(too many gaskets) or that the bronze worm gear is wearing out.

- There should be no end play, vertical play or diagonal play in the tiller tine shaft. If you find such play, tighten the tiller housing cover bolts.

If this does not eliminate the play, a shim may need to be installed on the tiller tine shaft, as explained in Section 6 of this manual.

PTO Power Unit and Tiller Attachment Drive Shaft

Connection — Engage the Tines/PTO Clutch Lever and turn the pulley at the front of the PTO power unit. The dog clutches between the tiller attachment and the PTO power unit should engage and the tiller tine shaft should move as you turn the pulley. If the dog clutches do not engage, the Tines/PTO Clutch Lever may need to be adjusted.

The PTO Horse Model transmission consists of two separate transmission assemblies: the PTO Power Unit transmission and the Tiller Attachment transmission (see Figure 4-1). The transmission housings are held together by a locking collar, a dowel pin and two swing-bolts.

The PTO Power Unit transmission and the Tiller Attachment transmission can be removed from the tiller as a complete assembly by following the instructions in this section. Use Figure 4-2 as a reference for part locations in these instructions.

If only the Tiller Attachment transmission needs to be removed from the tiller, refer to the Owner/Operator Manual for instructions on how to remove the transmission when the tiller is fully assembled.



WARNING: When servicing the machine, prevent unintentional starting of the engine by disconnecting the spark plug wire and keeping the wire away from the spark plug. Place the engine throttle control in the OFF position and shift the Wheels/Tines/PTO Drive Lever into NEUTRAL.



DANGER

The battery produces inflammable and explosive hydrogen gas and the electrolyte solution contains poisonous and corrosive sulfuric acid. To avoid injury, carefully follow the safety precautions in the Owner/Operator Manual when removing and installing the battery.

Transmission Removal

1. On tillers equipped with the Operator Presence Control Forward Interlock System (S/N 857307 and up), disconnect the Forward Interlock Wire Harness assembly (1) located on the right side of the handlebar base.
2. For electric start tillers only:
 - a. Remove the battery as described in the Owner/Operator Manual.
 - b. Disconnect the red starter cable from the starter motor on the engine.
 - c. Disconnect the recharging wire that leads from the keyswitch wire harness to the engine.
 - d. For Briggs & Stratton engines only: Disconnect the green shutoff wire on the right side of the engine.

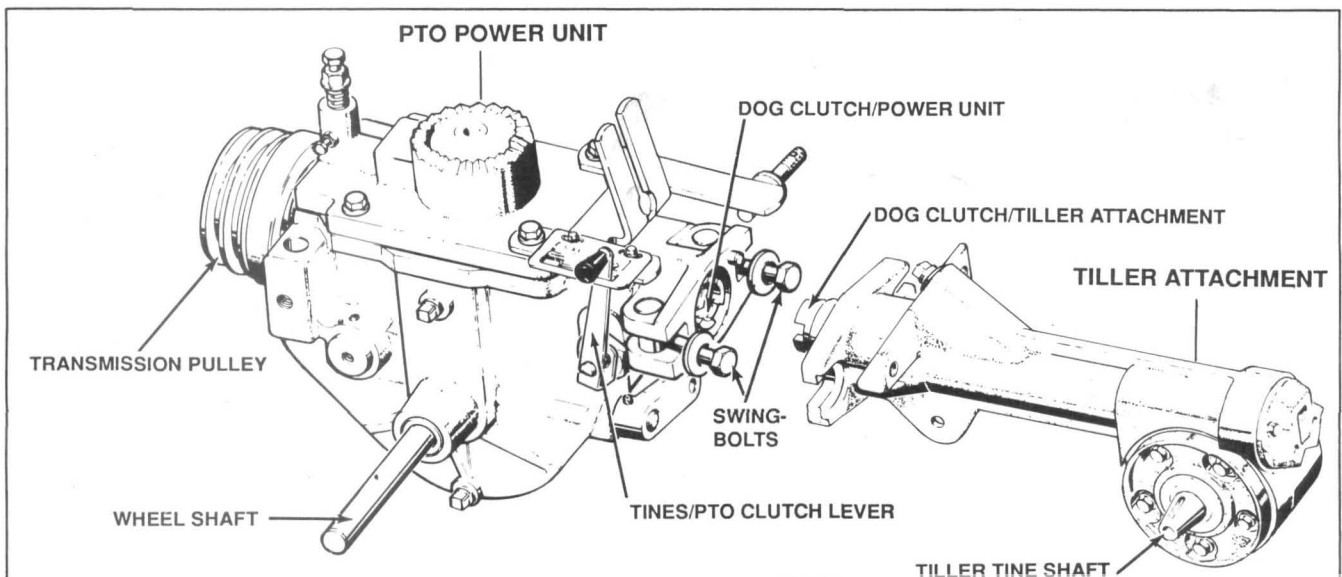


Figure 4-1: PTO Power Unit Transmission and Tiller Attachment Transmission

SECTION 4: Transmission Removal and Installation

e. Remove the two mounting bolts and lockwashers that secure the legs of the battery bracket to the transmission cover and remove the bracket.

3. Remove the forward bolt on the right side of the shift lever bracket. Remove the Forward Interlock Wire Harness plug connector with bracket (2) on tillers so equipped.

4. Wrap the engine half of the Forward Interlock Wire Harness assembly (on tillers so equipped) around the engine.

5. Remove the throttle control and cable (3) from the handlebar.

6. Remove the bolt (4) at the forward end of each side of the yoke. These are the bolts that attach the yoke to the engine mount. After you remove these bolts, pull the yoke back.

Note: Take care to recover the bushing in each side of the yoke.

7. Remove the bumper/guard attachment. Or, remove the red plugs in the top of the engine mounting bars (5) if a bumper is not attached.

8. Loosen the jam nut on the bolt (6) that retains the engine mounting bar on each side of the PTO power unit. Then remove the bolt from each side.

9. Support the weight of the engine by placing a block under the engine. This is necessary to prevent the engine from falling off when you remove the final engine mounting bar.

10. Lubricate both engine mounting bars. Then, using a punch and taking care to not damage the threads in the top of the engine mounting bars, knock one of the engine mounting bars down and out of the transmission housing and motor mount.

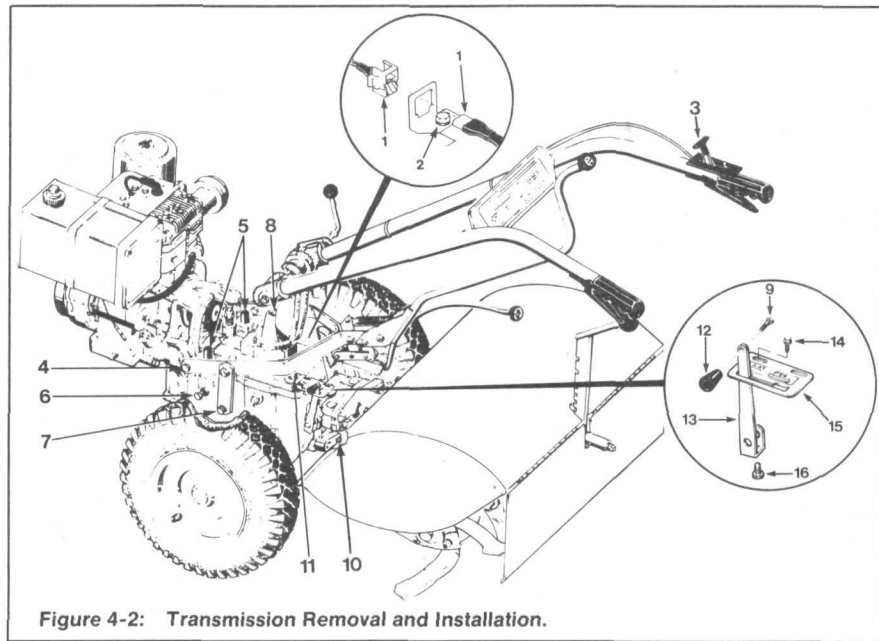


Figure 4-2: Transmission Removal and Installation.

11. Remove the other engine mounting bar.

12. Remove the engine from the tiller.

13. Remove the two final bolts (7) that hold the yoke pivot links to the PTO power unit and remove the yoke.

Note: Take care to recover the bushing in each side of the yoke.

14. Remove the bolt (8) or T-handle that holds the handlebar mounting base to the transmission housing cover and remove the base and the attached handlebars.

15. Remove the bolt (9) that holds the Tines/PTO Clutch Lever knob (12) to the lever. Then remove the knob.

16. Remove the locknut that retains the wheel speed lever connecting rod swivel to the eccentric lever (10).

17. Remove the two final bolts from the shift lever bracket (11), one from the top left side and one from the right side. Then remove the bracket along with the attached Wheel Speed Lever and

Tines/PTO Clutch Lever detent shifting plate (15).

18. Remove the wheels from the wheel shaft. See the Owner/Operator Manual for instructions. Or, if the wheel is rusted on the shaft, see "Removing a Rusted Wheel" in Section 7 of this manual.

Separating the Transmissions

1. Put the transmission (PTO power unit and tiller attachment assembly) on the floor, a workbench, or other surface that is comfortable for you.

2. Loosen the swing bolts (shown in Figure 4-1) that join the PTO power unit and tiller attachment.

3. Swing the bolts off the tiller attachment.

4. Separate the PTO power unit from the tiller attachment.

Attaching the Transmissions

1. Clean the surfaces of the transmissions where they join together.
 2. Make sure the dog clutches have been greased. Fill the dog clutch cavity on the PTO power unit with grease up to where the rear of the PTO power unit widens to accept the tiller attachment. Then grease the dog clutch on the tiller attachment so that the dog clutch is covered with grease.
 3. Align the locating pin on the PTO Power Unit housing with the locating hole on the tiller attachment housing and join the PTO power unit and tiller attachment. If necessary, turn the pulley on the front of the PTO power unit to adjust the dog clutch until it fits the tiller attachment dog clutch.
- Note:** If you put the Tines/PTO Clutch in neutral you will not have to line up the dog clutches.
4. Swing the bolts so that they connect to the tiller attachment.
 5. Tighten the bolts. Use a torque wrench and tighten the bolts to 70-80 ft/lbs.

Transmission Installation

1. Install the wheels.
2. Install the shift lever bracket (11) with the left-side bolt and right-side bolt (the one that goes in horizontally). Be sure that the Tines/PTO Clutch Lever (13) is installed through the slot in the detent plate (15). Make sure to tighten the bolts securely.
3. Install the Wheel Speed Lever connecting rod swivel on the eccentric lever (10).
4. Install the locknut that retains the swivel to the lever. Tighten the nut securely and then loosen it 1/8 turn.

5. Install the knob (12) on the Tines/PTO Clutch Lever (13) with the bolt (9).
6. Install the handlebar mounting base and the attached handlebars to the transmission housing cover with the long bolt (8) or T-handle.
7. Install the bolt, bushing, and washer (7) that holds the yoke pivot links to each side of the PTO power unit.
8. Apply a liberal coating of grease to the engine mounting bars (5).
9. Position the engine on the PTO power unit and support the engine with a block.
10. Install one of the engine mounting bars halfway. Use a rubber hammer to tap the bar down. Take care to not damage the threads in the top of the bar.
11. Back off the jam nut and install the locking bolt (6) for the bar. Turn the bolt until it is finger tight and you feel it strike the bar. Then maintain very light pressure on the bolt with a wrench.
12. Slowly tap the engine mounting bar the rest of the way in. When the groove in the bar reaches the bolt, the pressure on the bolt will be relieved.
13. Tighten the bolt until it is snug and then back off 1/4 turn. Next, hold the bolt with one wrench while tightening the jam nut with a second wrench.
14. Repeat the previous four steps for the other engine mounting bar.
15. Install the bumper on the tiller. If the tiller did not have a bumper, install the red plugs in the top of the engine mounting bars to protect the threads in the bumper mounting holes.
16. Set the yoke in the necessary

position and install the bolt, bushings, and washers (4) that hold each side of the yoke to the motor mount. If necessary, temporarily detach the clutch pawl spring before attaching the yoke. Be sure to reattach the spring after the yoke is installed.

17. Attach the throttle control cable (3) to the handlebar. Use plastic wire ties to secure the cable to the handlebar.
18. On tillers so equipped, attach the Forward Interlock System plug connector with bracket (2) to the top of the shift lever bracket and install the forward bolt on the right side of the shift lever bracket.
19. On tillers so equipped, connect the Forward Interlock System engine wire harness assembly to the handlebar wire harness assembly (1).



WARNING:

To help avoid personal injury, the Forward Interlock Safety System should be tested for proper functioning every time the tiller or PTO Power Unit is used. After completing all of the assembly steps, refer to "Test Operation of Forward Interlock Safety System" in the PTO Horse Model Owner/Operator Manual.

20. For electric start tillers only:
 - a. Attach the battery bracket to the transmission cover and attach the two mounting bolts and lock-washers that secure the legs of the bracket.
 - b. For Briggs & Stratton engines only: Connect the green shutoff wire on the right side of the engine.

SECTION 4: Transmission Removal and Installation

c. Connect the recharging wire that leads from the keyswitch wire harness to the engine.

d. Connect the red starter cable to the starter motor on the engine.

e. Install the battery as described in the Owner/Operator Manual.

21. Loosen the two bolts (14) that secure the Tines/PTO Clutch Lever detent plate (15) to the shift lever bracket.

22. Loosen the bolt (16) that secures the Tines/PTO Clutch Lever (13) to the eccentric shaft.

23. Move the lever until it is inside one of the two detent slots in the detent plate. Then tighten

the bolt (16) that holds the lever to the shaft. A correctly installed lever will have to be pulled out before you are able to slide the lever to the other detent slot.

24. With the lever in the ENGAGE position (both dog clutches must be fully engaged), slide the detent plate to the rear of the housing against the lever until it can go no further. Move the plate forward $1/16$ of an inch and tighten the two detent plate mounting bolts (14). You should feel some lever play in either the ENGAGE or DISENGAGE position.

25. Install the drive belt on the engine and transmission pulleys

and adjust the belt tension according to the directions found in the Owner/Operator Manual.

26. Check the operation of the Wheels/Tines/PTO Lever by shifting it into Forward, then Neutral and Reverse. The lever should hold properly in Forward and should release quickly from Reverse when you release the lever. Refer to the Owner/Operator Manual for information on making final adjustments to this important control lever.

27. Make sure that the transmissions for the power unit and the tiller attachment are correctly filled with gear oil.

The following subsections explain how to service various items on the PTO Horse Model Power Unit Transmission.



WARNING: When servicing the machine, prevent unintentional starting of the engine by disconnecting the spark plug wire and keeping the wire away from the spark plug. Place the engine throttle control in the OFF position and shift the Wheels/Tines/PTO Drive Lever into NEUTRAL.

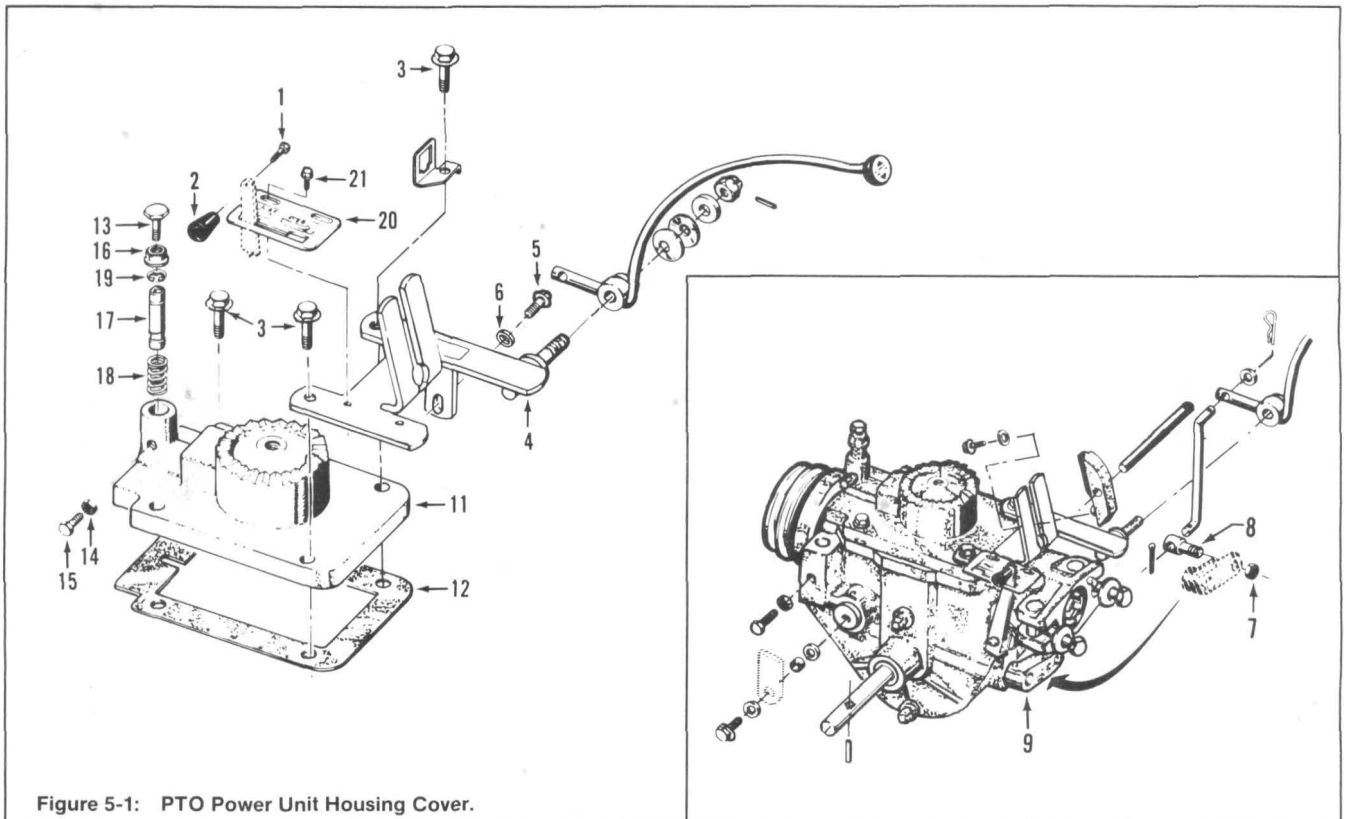


Figure 5-1: PTO Power Unit Housing Cover.

PTO Power Unit Housing Cover

These instructions describe how to service the PTO power unit housing cover. Use Figure 5-1 as a reference for part locations in these instructions.

Removal

1. Remove the bolt (1) that holds the Tines/PTO Clutch Lever knob (2) to the Tines/PTO Clutch Lever. Then remove the knob.
2. Remove the two bolts (3) and washers (if present) from the top of the shift lever bracket (4).
3. Remove the bolt (5), lock-

washer (if present), and the washer (6) from the side of the shift lever bracket.

4. Remove the shift lever bracket.
5. Remove the locknut (7) that holds the speed shift lever connecting rod swivel (see inset) (8) to the eccentric lever (9).
6. Separate the tiller attachment from the PTO power unit. See "Separating the PTO Power Unit and Tiller Attachment Transmission Assembly" in Section 4 for instructions.
7. Set the PTO power unit on a bench or other comfortable work area.

8. If necessary, drain the transmission gear oil from the PTO power unit by loosening and removing the oil drain plug, which is located below the wheel shaft on the left side of the transmission housing. After the oil is drained, apply a coating of non-hardening gasket sealer on the threads and reinstall the oil plug. If the plug is damaged, use a new plug.

9. Remove the remaining two bolts (3) and lockwashers (if present) that secure the PTO power unit housing cover (11), and remove the cover.
10. Discard the gasket (12).

PTO Power Unit Drive Shaft

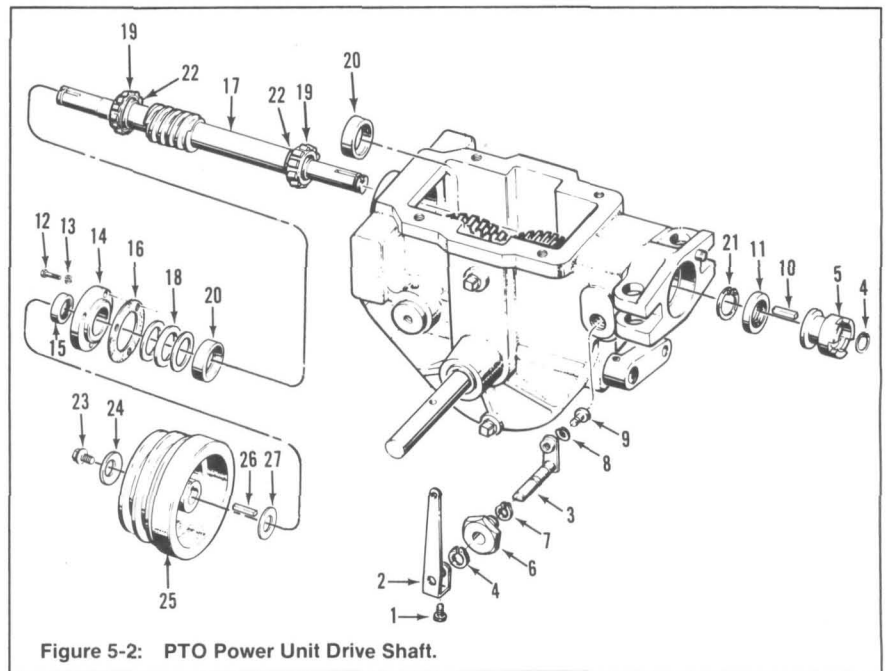
These instructions describe how to service the PTO power unit drive shaft. Before you can perform these instructions you must first remove the PTO power unit housing cover. See "PTO Power Unit Housing Cover" in this section for removal instructions.

Use Figure 5-2 as a reference for part locations in these instructions.

Note: Either of two basic types of drive shafts may have been installed at the factory: an integral worm design (worm is machined directly from the shaft material), or a welded worm design (the worm is welded to the shaft and can be identified by blue welds at either end of the worm). Each design has its own part number and requires specific related parts. Before installing a new drive shaft or related drive shaft parts, first determine which type of shaft you are working with. See the tiller parts catalog for parts ordering information.

Removal

1. Remove the bolt (1) that holds the Tines/PTO Clutch Lever (2) to the clutch lever eccentric shaft (3). Then remove the lever from the shaft.
2. Loosen the hex nut/bushing (6) on the Tines/PTO Clutch Lever shaft and remove the remainder of the Tines/PTO Clutch Lever assembly (6-9). Observe the part of the lever (9) that engages the dog clutch (5). If it is excessively worn or damaged, or if the customer has had difficulty engaging the tiller attachment, replace the part with a newer-style socket head screw that is included with a complete conversion kit (Part No.



- 10353). Refer to "Installing a New Tines/PTO Clutch Lever Assembly" in Section 7 of this manual.
3. Use snap ring pliers to remove the (external) snap ring (4) that retains the dog clutch (5) to the drive shaft (17). You will have to push in the dog clutch (5) to gain access to the snap ring.
4. Remove the dog clutch using a pair of needle nose pliers. Also make sure you retrieve the drive shaft key (10).
5. Remove the bolt (23) and concave washer (24) that hold the transmission pulley (25) to the drive shaft.
6. Remove the pulley and the drive shaft key (26). On welded drive shafts, remove the shoulder washer (27).
7. Remove the bolts (12) and lockwashers (13) that hold the front bearing cap (14).
8. Remove the front bearing cap.
9. Use an arbor press to remove the oil seal (15) from the front

bearing cap.

10. Remove and discard the gasket (16) from the front bearing cap.
 11. Pull the drive shaft (17) forward slightly just enough to dislodge the shims (18). Remove the shims.
 12. Remove the front bearing cup (20) from the housing.
- Note:** Keep each bearing cup paired with its bearing if you intend to reuse them. Each bearing cup wears differently according to its bearing.
13. Remove the drive shaft through the front of the transmission housing.
 14. Insert a long bar in through the front of the transmission housing to knock out the rear oil seal (11). Be careful not to damage the inside of the housing, the bearing cup (20), or the retaining ring (21).
 15. Put your hand down through the top of the housing and remove the rear bearing cup (20) if you

SECTION 5: PTO Power Unit Transmission

cannot do this with your fingers, insert a long bar in through the rear of the housing to tap the bearing cup out. Be careful to not damage the inside of the housing or the (internal) snap ring (21).

16. The (internal) snap ring (21) can be removed (if necessary) by reaching through the rear of the transmission with snap ring pliers.

17. The front and rear drive shaft bearings (19) are pressed-on and can be removed (if necessary) with an arbor press and a bearing puller attachment. After removing the bearings, remove the shoulder washers (22), if so equipped.

Inspection

These instructions describe how to inspect vital parts on the PTO power unit drive shaft. In addition to inspecting the parts you have removed, you should also inspect any replacement parts you will use.

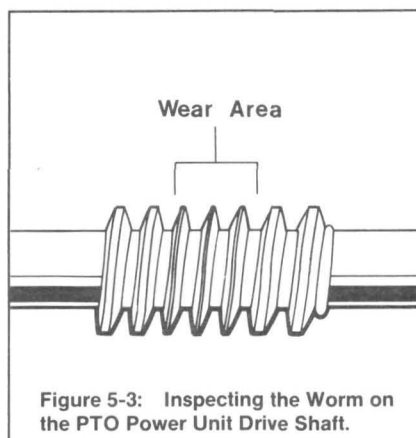
Note: Thoroughly degrease and clean all parts before inspection.

Drive Shaft —

1. The drive shaft should not be scored, pitted, or corroded where the oil seals are located.

- If the shaft is scored around the oil seal areas, discard the drive shaft.
- If the shaft is pitted around the oil seal areas you may be able to relocate the oil seals to a smooth area.
- If the shaft is corroded around the oil seal areas, try using fine (400 grit) emery cloth to clean the area.

2. Before installing the drive shaft you should use 400 grit emery cloth to polish the shaft up to and including the keyways. This will prevent cutting of the oil seals when they are installed.



3. The snap ring groove should be just wide enough to fit the snap ring. If the groove has expanded, discard the drive shaft.

Also, examine the edges of the snap ring groove. If the rear-facing edge on the groove is rounded off, you should not reuse the drive shaft as this edge bears the force of the snap ring. You can reuse the drive shaft if only the front-facing edge is rounded off.

Worm — The threads on the worm should not be excessively worn. Since only the middle of the worm is in contact with the bronze worm gear on the pinion shaft assembly, you can compare the outside threads of the worm with the middle threads. If the width of the threads in the middle is half or less than the width of the threads at the ends of the worm, discard the drive shaft. See Figure 5-3.

Also, inspect the worm for heat damage. If the worm has a bluish color then proper lubrication has not been maintained; discard the drive shaft.

Bearings — If the bearing has a bluish color then proper lubrication has not been maintained; discard the bearing and bearing cup.

Also, if the bearing or its cup is scored or excessively worn, dirt

may have gotten inside to the shaft. If the cup is scored or excessively worn, discard the bearing and bearing cup.

Inspect for chipped or broken roller bearings, and inspect the bearing cage for damage.

Note: Bearings and bearing cups must be replaced in pairs. Do not mix old and new bearings and bearing cups.

Installation

Use Figure 5-2 as a reference for part locations in these instructions.

1. Make sure the pinion shaft assembly is in place and correctly installed. See the pinion shaft installation instructions in this section.

2. Install the (internal) snap ring (21) that retains the rear bearing cup in the rear of the housing.

3. Install the rear bearing cup (20) with the tapered end facing forward to receive the bearing, by inserting it in through the top of the housing and setting it toward the rear. If necessary, use an old drive shaft inserted into the front of the housing to seat the bearing cup.

4. Using #30 weight oil, lightly lubricate both bearings on the drive shaft.

Note: Follow this procedure to install a new bearing on the drive shaft:

a. Place a shoulder washer (22) on the front and rear of the drive shaft. If reinstalling a shaft that did not have shoulder washers, do not install them.

b. Using an arbor press, install the bearings until they stop on the shaft. Use a bearing cup as a base to hold the bearing as you are pressing it on.

c. Lightly lubricate the new bearings with #30 weight oil.

5. Insert the drive shaft (17) into the front of the housing.

6. Install the bearing cup (20) on the front bearing.

7. Place the front bearing cap (14) over the bore opening and seat it by tapping it with a mallet. A gasket (16) should not be on the bearing cap at this time. Hold the bearing cap firmly in place with one hand while you check the drive shaft for end play by pulling and pushing the drive shaft. Correct end play is between .005 and .010 of an inch.

a. If there is less than .005 of an inch play or if the end play is between .005 and .010 of an inch, then remove the bearing cap and place a gasket (16) on the cap. Check for end play again. If the end play is correct, go to step 8.

b. If there is more than .010 of an inch play, then remove the bearing cap and shim (18) accordingly. Test for end play again. If the end play is correct, remove the bearing cap and place a gasket (16) on the cap. Then go to step 8.

8. Install the front bearing cap and secure it with bolts (12) and lockwashers (13). If lockwashers are not available, apply a coating of non-hardening gasket sealer to the tip of the bolts.

9. Apply a layer of non-hardening gasket sealer to the outer sealing edge of the front bearing cap oil seal (15). Install the seal flush with the bearing cap.

10. Apply a layer of non-hardening gasket sealer to the outer sealing edge of the rear drive shaft oil seal (11). Install the seal and stop when you feel the seal hit the snap ring.

11. Apply a heavy coating of

grease to the dog clutch (5), including the groove in the outer surface. Slide the dog clutch on the drive shaft, making sure the three "ears" point to the rear of the transmission.

12. Align the keyway in the shaft and the keyway in the dog clutch and insert the key (10) all the way forward.

13. Using snap ring pliers, install the (external) snap ring (4) that retains the dog clutch to the drive shaft. The flat side of the snap ring should face the rear of the transmission. Although not easy to observe, the snap ring has a flat side and a rounded side.

14. Stick your finger in the eccentric shaft assembly hole and position the groove on the dog clutch in the center of the hole.

15. Apply a thin coating of grease to the socket head screw (or ball bearing assembly on earlier models) on the eccentric shaft assembly and the shifting arm (6-9). Then insert the assembly into the hole. Hold the assembly so that the socket head screw is at 12 o'clock.

16. Using your fingers, gently turn the hex nut/bushing (6) until the hex nut is snug against the power unit housing.

Note: The hex nut/bushing should turn freely at all times until the nut is against the housing.

Do not use force; you can damage the eccentric shaft or socket head screw. If necessary, back the nut off a few turns and rotate the eccentric shaft a fraction of a turn. Then try to thread the nut inward again.

17. Make sure that you have properly seated the screw head in the clutch groove. Rotate the eccentric shaft back and forth while looking through the rear of

housing. The screw is properly seated if the clutch moves back and forth with each turn of the eccentric shaft.

18. Tighten the hex nut/bushing securely with a wrench.

19. Fill the dog clutch cavity with grease. Stop where the housing bore widens to accept the tiller attachment sleeve.

20. Attach the Tines/PTO Clutch Lever (2) and finger tighten the bolt (1) that holds the lever.

21. Install the PTO power unit housing cover. See the instructions in this section.

22. Install the drive shaft pulley by reversing steps 5 and 6 of the drive shaft removal instructions.

Pinion Shaft Assembly

These instructions describe how to service the pinion shaft assembly. Before you can service the pinion shaft assembly you must first drain the transmission gear oil and remove the PTO power unit drive shaft assembly. See the drive shaft removal instructions in this section.

Use Figure 5-4 as a reference for part locations in these instructions.

Removal

1. Using a 3/16-inch punch and a hammer, knock out the spiro roll pins (1) from the pinion bearing retaining plugs (2) on each side of the housing.

2. Using pump pliers or screw-in pullers, remove the pinion bearing retaining plugs.

3. Cut and discard the O-ring (3) from each retaining plug.

4. Remove the shims (4) from either side of the housing.

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5. Insert a 1/4-inch punch through the right side of the housing and use a hammer to drive the stem pinion shaft (5) and the key (6) to the left and out. Avoid damaging the bearing (7) in the right side of the housing. The bearing (7) and washer (8) in the left side of the housing will be attached to the pinion shaft. See Figure 5-5.

Note: Be careful not to damage the shaft or the inside of the housing.

As you drive the stem pinion shaft out, try to catch the washer (8) and shim (4A) in the right side of the housing on the end of the

punch. If the washer and shim fall into the housing, be sure to remove them so they will not damage the transmission.

With the stem pinion shaft removed, the pinion gear cluster (9-12) can be removed from the housing.

6. Remove the bearing (7) from the right side of the housing. If the bearing does not come out easily, use a large punch to gently knock it out.

Note: Be careful not to damage the inside of the housing.

7. The following parts should not be disassembled unless inspection shows them to be worn or damaged.

8. Use an arbor press to remove the bearing (7) and washer (8) from the stem pinion (5). See Figure 5-5.

9. Use a snap ring pliers to remove the (external) snap ring (9) that retains the fast speed pinion gear (11) to the bronze worm gear (10).

10. Place the worm gear (10) on an open vise so that the fast speed gear (11) is hanging down between the vise jaws. Then use a 1-inch diameter bar to tap the fast speed gear down and off the worm gear. Check to make sure the key (12) also came off with the fast speed gear.

Note: Be careful to not damage the inside bore of the fast speed gear.

Inspection

These instructions describe how to inspect vital parts on the pinion shaft assembly. In addition to inspecting the parts you have removed, you should also inspect any replacement parts you will use.

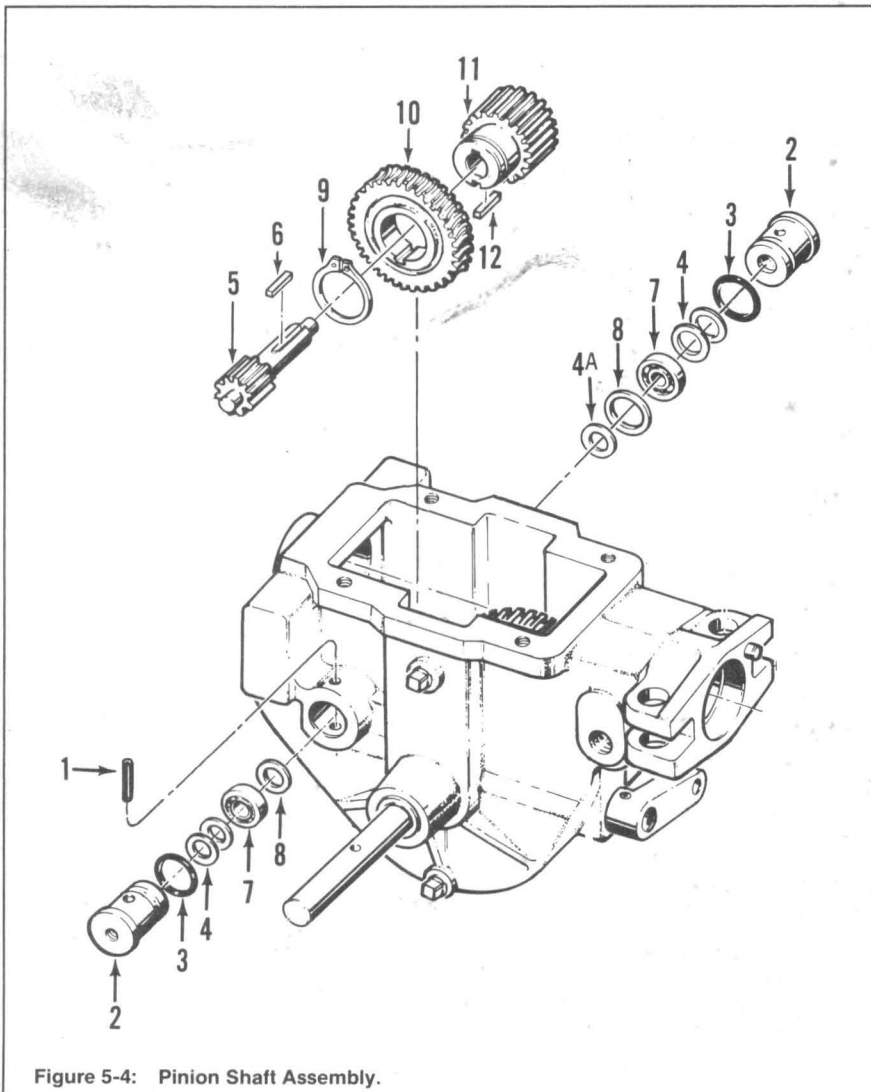


Figure 5-4: Pinion Shaft Assembly.

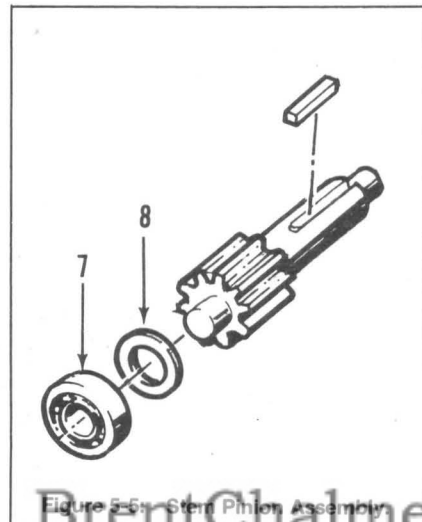


Figure 5-5: Stem Pinion Assembly.

Note: Thoroughly degrease and clean all parts before inspection.

Bearings — Hold the end of the stem pinion and spin the stem pinion bearing. If the bearing wobbles, or makes a growling noise, or cannot spin at all, replace the bearing with a new one. To test the other bearing, pinch it by the hole and spin it. If it wobbles, or makes a growling noise, do not reuse it.

Stem Pinion — If the gear teeth are broken or excessively worn, discard the stem pinion.

Fast Speed Pinion Gear — If the gear teeth are broken or excessively worn, discard the gear. Also, make sure the key is in good condition and is secure in the gear keyway.

Bronze Worm Gear — If the gear teeth are damaged or excessively worn, discard the gear.

Side Plugs — Check the groove where the O-ring seats; there should be no burrs or sharp edges to cut the O-ring. Use a fine file or 400 grit emery paper to smooth any rough spots.

Make sure the O-ring grooves are clean. Dirt or debris will prevent the O-rings from seating properly.

Transmission Housing — Make sure the transmission housing has no burrs or sharp edges that could cut the O-ring as you install the side plugs. Use a fine file or 400 grit emery paper to smooth any rough spots.

Installation

Before you install the pinion shaft assembly the wheel shaft assembly must first be in place. See the wheel shaft installation instructions in this section.

Use Figure 5-4 as a reference for part locations in these instructions.

1. Attach the key (12) to the outside keyway in the fast speed pinion gear (11). Make sure the key does not obstruct the snap ring groove.

2. Attach the bronze worm gear (10) to the fast speed pinion gear making sure the worm gear hub is placed towards the fast speed pinion gear. To attach, set the bronze worm gear on an open vise and seat the fast speed gear with a rubber mallet.

3. Attach the (external) snap ring (9) to the fast speed pinion gear. Make sure the rounded side of the snap ring is facing towards the fast speed gear. Though not easy to observe, the snap ring has a flat side and a rounded side.

4. Using an open vise and a rubber mallet, attach the washer (8) and bearing (7) to the left side of the stem pinion (5). If you are using a sealed bearing, make sure the seal faces out.

5. Use #30 weight oil to lubricate the two bearings (7).

6. Attach the key (6) to the stem pinion. Make sure the key is flush with the edge facing the worm gear. Then use a hammer and chisel to notch the back of the keyway in the stem pinion shaft. This will prevent the key from sliding back. See Figure 5-6.

7. Place the assembled worm gear (10) and fast speed pinion gear (11) into the housing. Position the empty keyway in the fast speed gear at 12 o'clock.

8. Support the assembly by inserting your finger through the right side of the transmission housing. Insert the stem pinion assembly in from the left side of the housing, carefully aligning the key in the stem pinion with the keyway in the fast speed gear.

Using a soft mallet, drive the stem

pinion in until the bearing is flush with the housing bore.

Note: Make sure the key does not become dislodged from the shaft.

Finish installing the stem pinion by using the pinion bearing retaining plug (2) as a driver. As you drive in the stem pinion, carefully align the gear teeth on the slow speed cast iron wheel gear with the teeth on the stem pinion. Drive the plug in until the spirol pin hole in the plug is aligned with the spirol pin hole in the transmission housing.

9. Line up the spirol pin hole in the housing with the hole in the plug and insert a punch in the hole. This will keep the stem pinion from moving when you install the bearing in the other side.

10. Install a washer (8) and shim (4A) on the right side of the stem pinion shaft.

Note: Use a .062" thick shim (4A) on the right side of the stem pinion shaft. This shim is the same

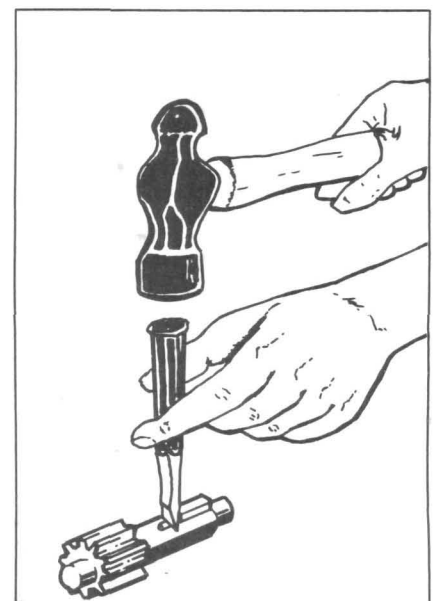


Figure 5-6: Notching the back of the stem pinion.

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thickness as the washer (8). Using a shim that is the same thickness as the washer will prevent any warping of the washer.

11. Using a mallet, install a bearing (7) flush with the right side housing bore. Then use the pinion bearing retaining plug (2) as a driver and seat the bearing, washer, and shim flush against the fast speed pinion gear.

12. Make sure the fast and slow speed pinion gears are flush against the worm gear.

13. Make sure the bearings are flush against their respective gears.

14. Line up the spirol pin hole on the right side retaining plug with the hole in the housing.

15. Center the worm gear. Use the drive shaft opening at the front of the PTO power unit to sight and center the gear. If the gear is not centered, tap the appropriate retaining plug inward until the gear is centered (hold the opposite plug firmly in place when driving a plug inward).

16. Repeat the previous two steps until the worm gear is centered as you view it through the opening in the front of the PTO power unit.

17. With the worm gear centered, push inward on the two retaining plugs and check to see if the spirol holes in the plugs and the housing are aligned. If a plug is not seated deeply enough, tap it in until the holes are aligned. If a plug is seated too deeply, remove it and insert one or more shims (4) until the holes are aligned.

18. Install O-rings (3) on each plug (2).

19. Use #30 weight oil to lubricate the O-rings and insert the plugs on each side.

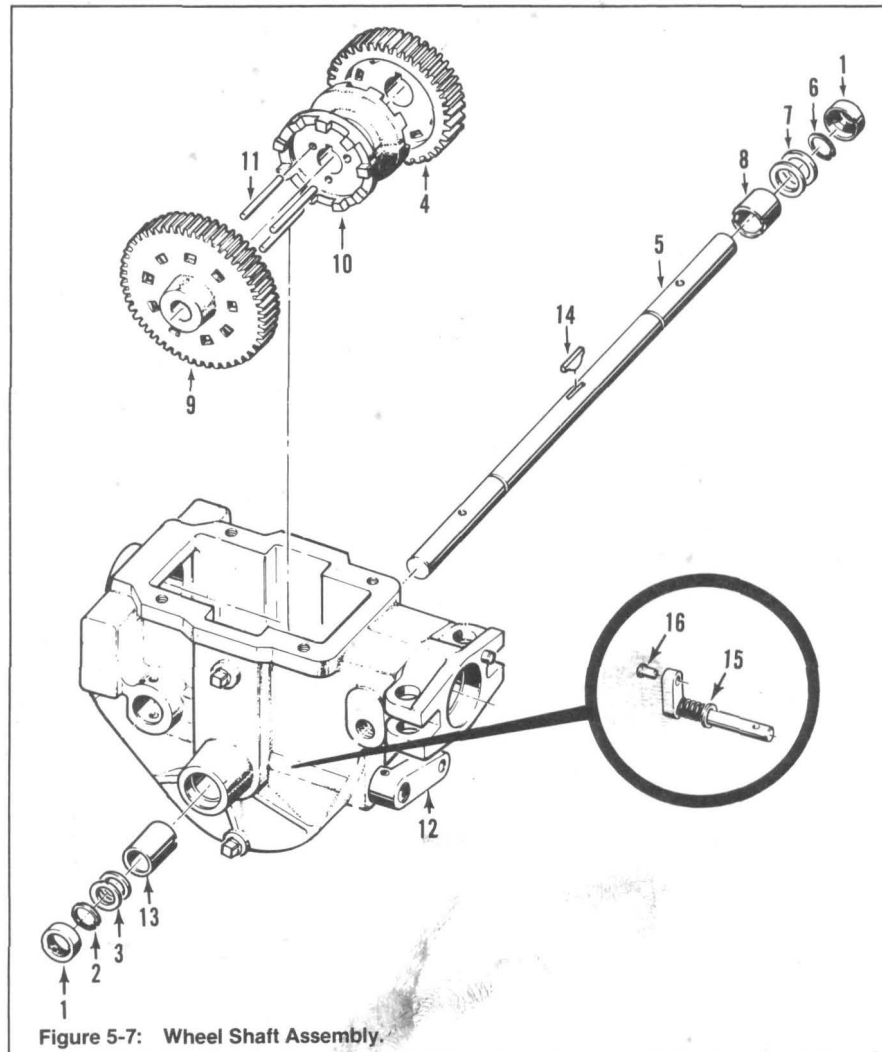


Figure 5-7: Wheel Shaft Assembly.

20. Install the spirol pins (1) on each side.

21. With the wheel drive clutch in neutral, try to spin the bronze worm gear. It should turn easily, driving the two cast iron wheel gears as it turns. If the gear does not spin freely, strike the plugs (2) inward with a rubber hammer. This should free-up the pinion shaft assembly. If the gear still does not spin freely, it is shimmed too tightly.

Wheel Shaft Assembly

These instructions describe how to service the wheel shaft assembly. For instructions on how to remove the wheel shaft without disassembling the entire PTO power unit, see "Removing the Wheel Shaft Without Disassembling the Transmission" in Section 7.

Use Figure 5-7 as a reference for part locations in these instructions.

Removal

Before you can service the wheel shaft assembly, you must first remove the pinion shaft assembly. See the pinion shaft removal instructions in this section.

1. Remove the left side oil seal (1). You can remove the seal with a screwdriver and hammer by tapping in at an angle and prying against the the transmission case (if necessary, use two screwdrivers positioned at opposite sides of the seal).

Note: Be careful not to damage the wheel shaft with the screwdriver(s) while prying.

2. Remove and discard the left side (external) snap ring (2) that retains the wheel shaft (5) inside the housing.

3. Use a magnet to remove the shim(s) (3). Discard the shim(s).

4. Shift the eccentric lever (12) into neutral. The clutch and gears must be disengaged.

5. Using a rubber mallet, tap the wheel shaft to the right while you slowly turn the fast speed (smaller) gear (4). The object is to line up the key (14) in the shaft with the keyway in the fast speed gear. This is a trial and error procedure. Keep trying until you feel the key in the shaft begin to advance through the fast speed gear. After the key begins to pass through the gear, continue until you remove the wheel shaft (5) along with the right side bronze bushing (8), oil seal (1), snap ring (6), and shims (7). Discard the bushing, oil seal, snap ring, and shims(s).

6. Check that the hi-pro key (14) is still attached to the wheel shaft. If it is not, retrieve it from inside the housing.

7. Lift the slow speed (larger) gear (9), fast speed gear, clutch

(10), and three clutch guide pins (11) out of the housing.

8. Remove and discard the bronze bushing (13) from the left side of the housing. Use an old wheel shaft inserted from the right-hand side to drive the bushing out.

Inspection

These instructions describe how to inspect vital parts on the wheel shaft assembly. In addition to inspecting the parts you have removed, you should also inspect any replacement parts you will use.

Note: Thoroughly degrease and clean all parts before inspection.

Wheel Shaft —

- If the wheel shaft is scored or pitted around the oil seal areas, you may be able to relocate the oil seals further out, or in, in order to avoid the damaged area.

- If there is corrosion around the oil seal areas, try using an emery cloth to clean the area. If the wheel shaft is badly scored or pitted around the oil seal areas, discard the wheel shaft.

- If the seal area is excessively worn, discard the wheel shaft.

- Examine both ends of the wheel shaft for burrs or rough edges that could prevent the shaft from passing through the gears or clutch. Use a file or emery cloth to remove any rough spots.

- If the outside edges of the snap ring grooves are rounded, you will have to discard the wheel shaft as these edges bear the force of the snap rings.

If the grooves have expanded you may be able to use shims to take up the slack. If not, discard the wheel shaft.

- If the area around the keyway

has bubbled due to key movement, discard the wheel shaft. See "Testing for a Bubbled Wheel Shaft" in Section 7.

Fast and Slow Speed Gears —

- If there are any broken or excessively worn teeth, discard the gear.

- If the clutch dogs have worn a groove more than 1/4 through the wall of the gear (usually due to speed shifting), discard the gear.

Clutch —

- If the clutch dogs are excessively rounded, discard the clutch.

- If any clutch dogs are missing, discard the clutch.

- If the keyway is damaged, you may be able to straighten it with a file. Otherwise, discard the clutch.

Note: If the keyway is too wide, the wheel shaft is more likely to bubble and you may need to replace the wheel shaft soon afterwards.

Gear Shifting Guide Pins — Make sure the guide pins are absolutely straight. If a pin is even slightly bent, discard it.

Installation

Before you install the wheel shaft assembly, the eccentric shaft assembly must first be installed. See the eccentric shaft installation instructions in this section.

Use Figure 5-7 as a reference for part locations in these instructions.

1. Before installing the wheel shaft:

- Make sure the hi-pro key (14) is firmly seated in the keyway.

- Make sure the clutch (10) and fast speed gear (4) pass freely over the hi-pro key in the wheel

shaft. If there is any binding,

SECTION 5: PTO Power Unit Transmission

check for burrs or rough edges either on the key or in the keyway.

- Make sure there are no burrs or rough edges in the bore opening of the slow speed gear (9).

- Using a spray lubricant, lubricate the clutch where the shaft and pins will fit.

2. Insert the three clutch guide pins (11) into the clutch. If a guide pin binds, discard it and use a new one.

3. Assemble the fast gear, clutch, and slow gear; the gear hubs face out.

4. Insert a piece of wood between the eccentric lever (12) and the housing to relieve the pressure of the eccentric shaft (15) on the clutch as you are installing it.

5. Gently place the gear and clutch assembly into the housing so that the eccentric pin (16) fits into the groove on the clutch. Make sure the smaller (fast speed) gear is on the right side.

6. Look through the wheel shaft opening and line up the keyways on the fast speed gear and clutch.

7. Insert the wheel shaft through the right side and slip it through the gears and clutch.

8. Remove the piece of wood from the eccentric lever and check to make sure the eccentric shaft can move freely from side to side.

9. Using #30 weight oil, lubricate the bronze bushings (8, 13).

10. Making sure the oil pick-up grooves are facing in, use a hammer to insert a bronze bushing (8 or 13) about 1/8 of the way in the housing.

11. Using a rubber hammer and driver, and making sure the oil pick-up grooves are facing in,

install the other bronze bushing (8 or 13) so that the edge of the bushing is flush with the edge of the counterbore in the transmission housing. Then finish installing the other bushing in a similar manner.

12. Use a rubber hammer to strike down on the wheel shaft on both sides of the housing. This will loosen the shaft and make it easy to turn.

13. On the left or right side (it doesn't matter which side), insert a .062" wheel shaft shim (3, 7) and then install a snap ring (2, 6). Gently tap this end of the shaft inward so that the snap ring is flush against the bushing.

Note: The snap ring has two sides: a flat side and a rounded side. Make sure the flat side is against the outside edge of the groove.

14. Go to the other side of the housing and shim (3, 7) the gap between the bushing and the snap ring groove.

15. Install the snap ring (6) after you shim the wheel shaft.

16. Using a rubber hammer, tap down on both ends of the wheel shaft. Then check for end play. There should be between .005" and .015" play in the shaft. Add or remove shims as needed.

17. Turn the wheel shaft with your hand; it should spin freely. Also, there should be no vertical or diagonal play. Vertical or diagonal play indicates a worn bronze bushing.

18. Apply a layer of non-hardening gasket sealer to the outside edges of the two oil seals (1) and install them at each end of the wheel shaft. Each seal should be flush with the edge of the transmission housing.

Eccentric Shaft Assembly

These instructions describe how to service the eccentric shaft assembly. Before you can remove the eccentric shaft you must first remove the wheel shaft. See the wheel shaft removal instructions in this section.

Use Figure 5-8 as a reference for part locations in these instructions.

Removal

1. Remove the wheel speed shifting pin (1) from the eccentric shaft.

2. Turn the housing upside down. Use a 5/32-inch drift to remove the spirol roll pin (2) that retains the eccentric lever (4) to the eccentric shaft (3).

3. From the outside of the housing, tap the eccentric shaft (3) inward until you remove the eccentric lever (4).

4. Continue tapping the eccentric shaft inward until the shaft drops into the housing.

5. Remove the spring (6) and washer (7) from the shaft.

6. Remove and discard the eccentric shaft oil seal (5). You can use a small screwdriver to pry it out.

Inspection

If the seal area on the eccentric shaft is excessively worn or scored, discard the eccentric shaft. Minor scoring can be removed with an emery cloth.

Installation

Use Figure 5-8 as a reference for part locations in these instructions.

1. Put the eccentric shaft spring (6) and washer (7) on the eccentric shaft (3).

2. Insert the eccentric shaft assembly into the PTO power unit.

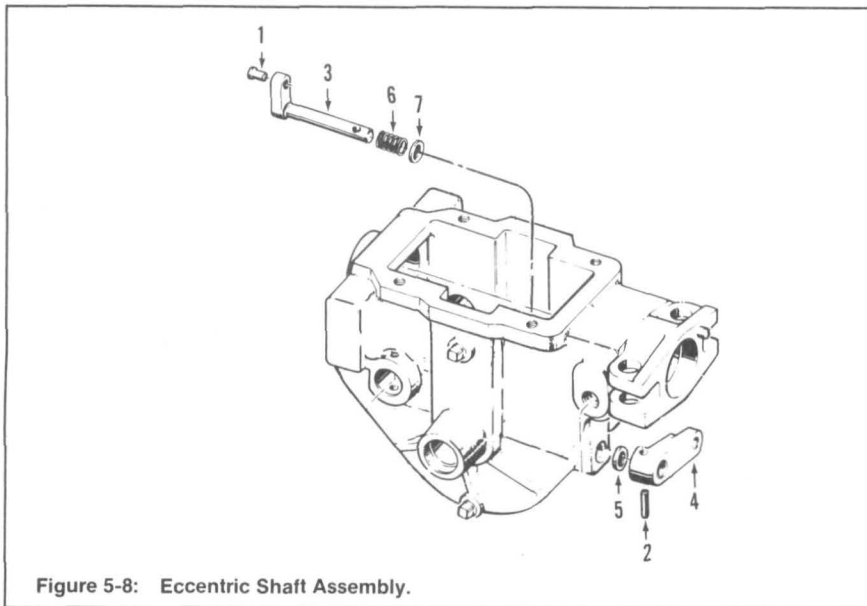


Figure 5-8: Eccentric Shaft Assembly.

housing. Make sure the shifting arm on the eccentric shaft is facing up, or at 12 o'clock, inside the housing.

3. Apply a layer of non-hardening gasket sealer to the eccentric shaft oil seal (5) and use a seal driver to install it flush with the transmission housing.

4. Start the spiral roll pin (2) in the eccentric lever (4) while the lever is still on the workbench. Then install the lever on the eccentric shaft. Make sure the lever is extended to the right side of the housing.

5. Install the wheel speed shifting pin (1) in the eccentric shaft.

SECTION 6: Tiller Attachment Transmission

This section describes the procedures for servicing the tiller attachment transmission.



WARNING: When servicing the machine, prevent unintentional starting of the engine by disconnecting the spark plug wire and keeping the wire away from the spark plug. Place the engine throttle control in the OFF position and shift the Wheels/Tines/PTO Drive Lever into NEUTRAL.

Tiller Drive Shaft Assembly

These instructions describe how to remove, inspect, and install the tiller attachment's drive shaft.

Use Figure 6-1 as a reference for part locations in these instructions.

Note: Either of two basic types of drive shafts may have been installed at the factory: an integral

worm design (the worm is machined directly from the shaft material), or a welded worm design (the worm is welded to the shaft and can be identified by blue welds at either end of the worm). Each design has its own part number and requires specific related parts. Before installing a new drive shaft or related drive shaft parts, first determine which type of shaft you are working with. See the tiller parts catalog for parts ordering information.

Removal

1. Set the tiller housing in a vise and tighten the vise jaws around the metal plate that contains the bolt hole for the depth regulator drag bar (see Figure 6-1).
2. Push the dog clutch (1) into the housing (the clutch is under spring tension) until you see the forward (external) snap ring (2) that retains the dog clutch. Then remove the snap ring with a pair of snap ring pliers.

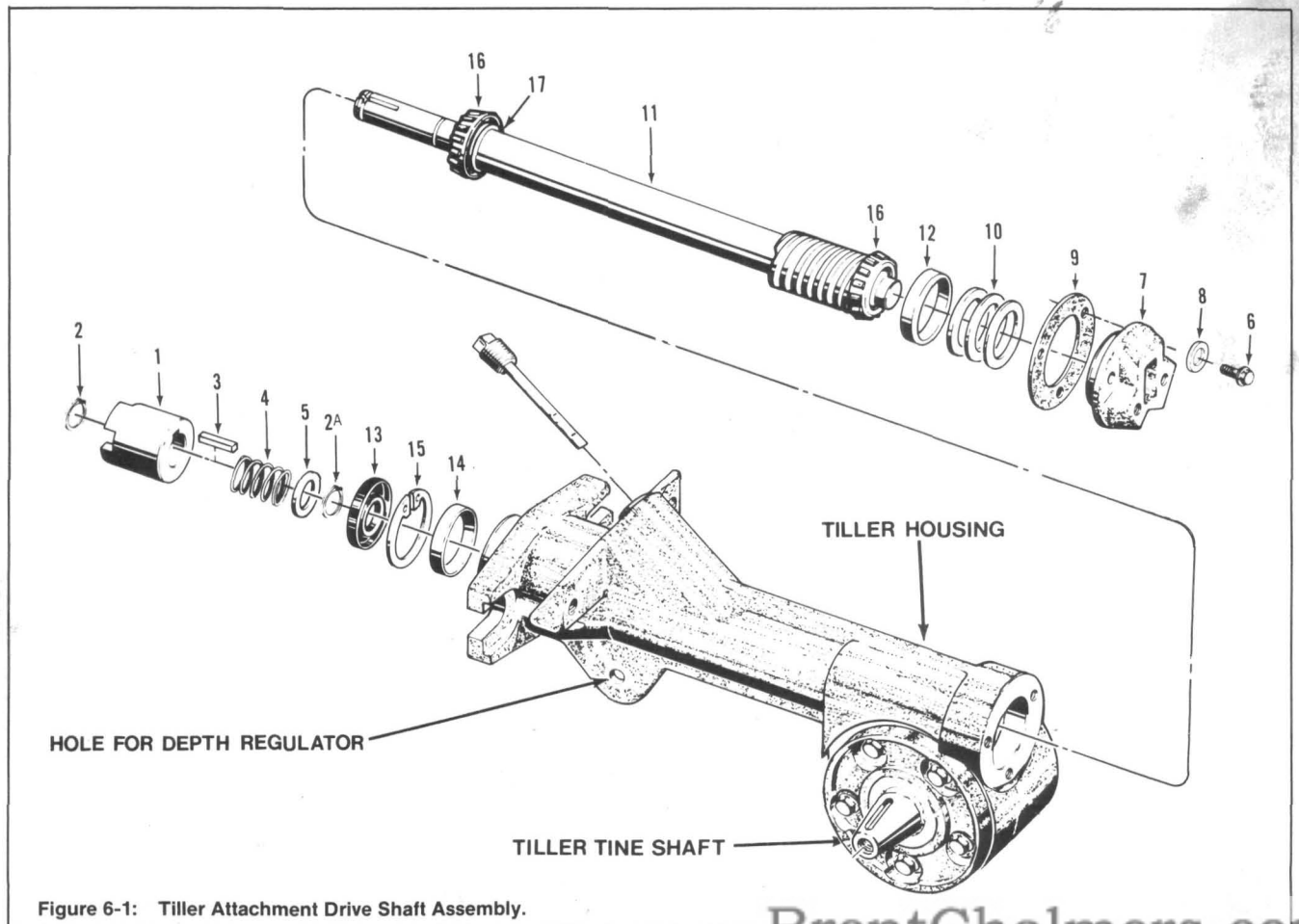


Figure 6-1: Tiller Attachment Drive Shaft Assembly.

3. Remove the dog clutch and the key (3).
 4. Remove the dog clutch spring (4).
 5. Remove the dog clutch shim (5).
 6. Remove the second (external) snap ring (2a).
 7. Remove the three bolts (6) that secure the rear bearing cap (7), also removing and discarding the nylon washers (8), if any. Have a pan ready to catch the gear oil that will pour out when you remove the rear bearing cap in the next step.
 8. Remove the rear bearing cap and the gasket (9). Discard the gasket.
 9. Use a rubber hammer to tap the forward end of the drive shaft (11) toward the rear of the housing. As you are tapping the shaft, catch the bearing cap shims (10) and bearing cup (12) at the rear of the shaft. Discard the shims. Drive the shaft out until the drive shaft worm clears the housing. Leave the drive shaft in this position until you complete step 10.
- Note:** Keep each bearing cup paired with its bearing if you intend to reuse them. Each bearing cup wears differently according to its bearing.
10. Remove the tiller tine shaft assembly. See the tiller tine shaft removal instructions in this section. You must remove the tiller tine shaft before you can completely remove the tiller drive shaft.
 11. Remove the tiller drive shaft.
 12. Remove the oil seal (13) by placing a long bar through the rear of the housing and tapping the seal out.
- Take care not to damage the bear-

ing cup (14), snap ring (15), or tiller housing.

13. Remove the (internal) snap ring (15) that retains the front bearing cup (14) using a pair of snap ring pliers.
14. Remove the bearing cup. If the bearing cup resists, insert an old tiller drive shaft into the back of the transmission housing and use its bearing to nudge the bearing cup forward. It is not recommended that you use a good drive shaft for this.

Note: Remember to keep track of which bearing cups go with which bearings. You will need to assemble them in the same pairs.

15. After the drive shaft is removed and you have an empty tiller housing, thoroughly degrease and clean the inside and outside of the housing.

16. The drive shaft bearings (16) are pressed-on and can be removed (if necessary) with an arbor press and a bearing puller attachment. On the welded worm style drive shaft only, remove the shoulder washer (17) after removing the front bearing.

Inspection

These instructions describe how to inspect parts on the tiller drive shaft. In addition to inspecting the parts you have removed from the tiller housing, you should also inspect any replacement parts you will use.

Note: Thoroughly degrease and clean all parts before inspection.

Drive Shaft —

- The drive shaft should not be scored, pitted, or corroded where the oil seal is located. If the shaft is lightly corroded, you might be able to clean it using an emery cloth. If the shaft is slightly scored or pitted you might be able to

adjust the position of the front seal so that it is seated on a smooth part of the shaft. If the drive shaft is excessively pitted or corroded, especially in the area where the oil seal seats, discard the drive shaft.

- Inspect the drive shaft for burrs or rough spots at the ends of the shaft and where the bearings fit on the shaft. Use a file or emery cloth to remove rough spots or burrs, being careful not to remove too much metal where the bearings will be seated. (Doing so will prevent the proper fit of the bearings on the shaft.)
- The keyway should be just wide enough for the key to fit. If the keyway expands and becomes too wide; discard the tiller drive shaft.
- The two snap ring grooves should be just wide enough to fit the snap ring. If the groove becomes too wide, you will have to discard the tiller drive shaft.

Also, the forward-facing edges of the grooves should not be rounded off; these are the edges that bear the force of the snap ring. If this edge is rounded you must discard the tiller drive shaft.

Worm — The worm should not be excessively worn. Since only the middle of the worm is in contact with the bronze worm gear on the tiller tine shaft, you can compare the end of the worm (on the tiller drive shaft) with the middle. If the width of the teeth in the middle is half or less than the width of the teeth at the ends, discard the tiller drive shaft.

Also, inspect the worm for heat damage. If the worm has a bluish color then proper lubrication has not been maintained; discard the tiller drive shaft.

Bearings — If the bearing has a bluish color then proper lubrication

SECTION 6: Tiller Attachment Transmission

tion has not been maintained; discard the bearing and bearing cup.

Also, if the bearing or its cup is scored or excessively worn, dirt may have gotten inside the transmission. If the cup is scored or excessively worn, discard the bearing and bearing cup.

Inspect for chipped or broken roller bearings, and inspect the bearing cage for damage.

Installation

Use Figure 6-1 as a reference for part locations in these instructions.

1. Spread a layer of #30 weight oil on the inside of the front bearing cup (14). Make sure the beveled cup is facing the correct way to receive the bearing and insert the bearing cup into the front of the tiller housing.

Note: Remember to match the bearings to the bearing cups as you found them before disassembly.

2. Install the (internal) snap ring (15) used to retain the front bearing cup. Make sure the flat side of the snap ring is towards the front of the tiller attachment (towards the PTO power unit). Although not easy to observe, the snap ring has a flat side and a rounded side.

If you have some difficulty inserting the snap ring in the groove, insert the ring past the groove. Then use the drive shaft to slide the ring forward and into the groove.

3. Using #30 weight oil, lubricate both bearings on the drive shaft.

Note: Follow this procedure to install new bearings on the drive shaft:

a. On the welded worm style drive shaft only, place the shoulder washer (17) on the front of the

drive shaft.

b. Lubricate the new bearings with #30 weight oil.

c. Using an arbor press, install the front bearing until it stops at the drive shaft shoulder. Install the rear bearing until it stops against the worm.

4. Insert the tiller drive shaft (11) through the rear of the tiller housing.

5. Spread a layer of #30 weight oil on the inside of the rear bearing cup (12). Make sure the beveled cup is facing the correct way to receive the bearing. Insert the bearing cup into the back of the tiller housing.

6. Place a gasket (9) on the rear bearing cap (7) and gently tap the cap into place. Securely attach the cap with all three screws but do not use a gasket sealer on the screws or install nylon washers at this point. You will next check for play in the drive shaft.

7. Using a mallet, tap the drive shaft to the rear to seat the bearing cup. Push and pull the forward end of the tiller drive shaft. You should feel between .005" and .010" play in the shaft.

Remove the rear bearing cap and shim accordingly (start with the thinnest shims). Repeat this procedure until the forward and backward play in the drive shaft is between .005" and .010".

8. Remove the three screws from the rear bearing cap.

9. Install the rear bearing cap and secure it with screws (6) and nylon washers (8). If washers are not available, you can coat the tip of the screws with a layer of non-hardening gasket sealer.

10. Apply a layer of non-hardening gasket sealer to the outside edge of the tiller drive

shaft oil seal (13). Then install the oil seal.

11. Install the (external) rear snap ring (2a) that retains the dog clutch to the shaft. Make sure the flat side of the snap ring is towards the rear of the tiller attachment.

12. Install the dog clutch shim (5).

13. Install the dog clutch spring (4).

14. Install the key (3) in the keyway.

15. Slide the dog clutch (1) over the key, with the "ears" on the clutch facing forward.

16. Push the dog clutch in and install the (external) snap ring (2) that retains the dog clutch to the shaft. Make sure the flat side of the snap ring is towards the front of the tiller attachment.

If you have some difficulty inserting the snap ring in the groove, insert the ring past the groove. Then let the dog clutch slide forward and it will push the ring forward into the groove.

17. Install the tiller tine shaft. See the instructions in this section.

Tiller Tine Shaft Assembly

These instructions describe how to remove, inspect, and install the tiller attachment's tine shaft assembly.

Use Figure 6-2 as a reference for part locations in these instructions.

Removal

You will have to disassemble the tiller tine shaft assembly to replace a damaged worm gear, bearing, or shaft. Also, you will have to remove the tiller tine shaft to remove the tiller drive shaft. See

the Owner/Operator Manual for instructions on how to remove the bolo tine holders.

1. Remove the five bolts (1) and nylon washers (2), if any, that secure the tiller housing cover (3). Discard the washers. Have a pan ready to catch the gear oil that will pour out when you remove the housing cover in the next step.
2. Remove the housing cover by gently tapping the right side of the tine shaft inward with a soft mallet.
3. Discard the tiller housing cover gasket(s) (4).
4. Use a soft mallet to strike inward on the right side of the tiller tine shaft (5). If necessary, strike downward on the right side of the shaft. This will collapse the right side oil seal (6) and help the tiller cluster to come out.
5. Remove the tiller tine shaft (5) and the attached gear and bear-

ings from the tiller housing.

6. It is possible that you are removing the tiller tine shaft as part of the tiller drive shaft removal procedure. Regardless of why you are removing the tiller tine shaft, you must replace the oil seals. When you have the opportunity, perform the following two steps.

a. Put the tiller housing cover on an open vise so that the ends of the cover are supported. Tap out the oil seal (6) and discard it.

Note: Do not pry or tap directly on the side of the cover. Doing so could damage or score the bearing cup or the inside of the cover.

b. Turn the transmission housing on one side and tap out the oil seal (6) from the right side of the housing.

Note: Be careful not to damage or score the bearing cup or the inside of the housing.

7. Remove the bearing cup (8) from the right side of the tiller housing, using a punch to drive the cup inward. Be careful not to damage the inside of the tiller housing.

Note: You only need to remove this bearing cup if you will be using a new right side roller bearing. If you replace a bearing you must also replace the bearing cup.

Keep each bearing cup paired with its bearing if you intend to reuse them. Each bearing cup wears differently according to its bearing.

8. Use a punch to remove the bearing cup from the housing cover (only if you are installing a new left side roller bearing).

9. To disassemble the gear and bearing assembly:

a. Place the tiller tine shaft assembly on an arbor press.

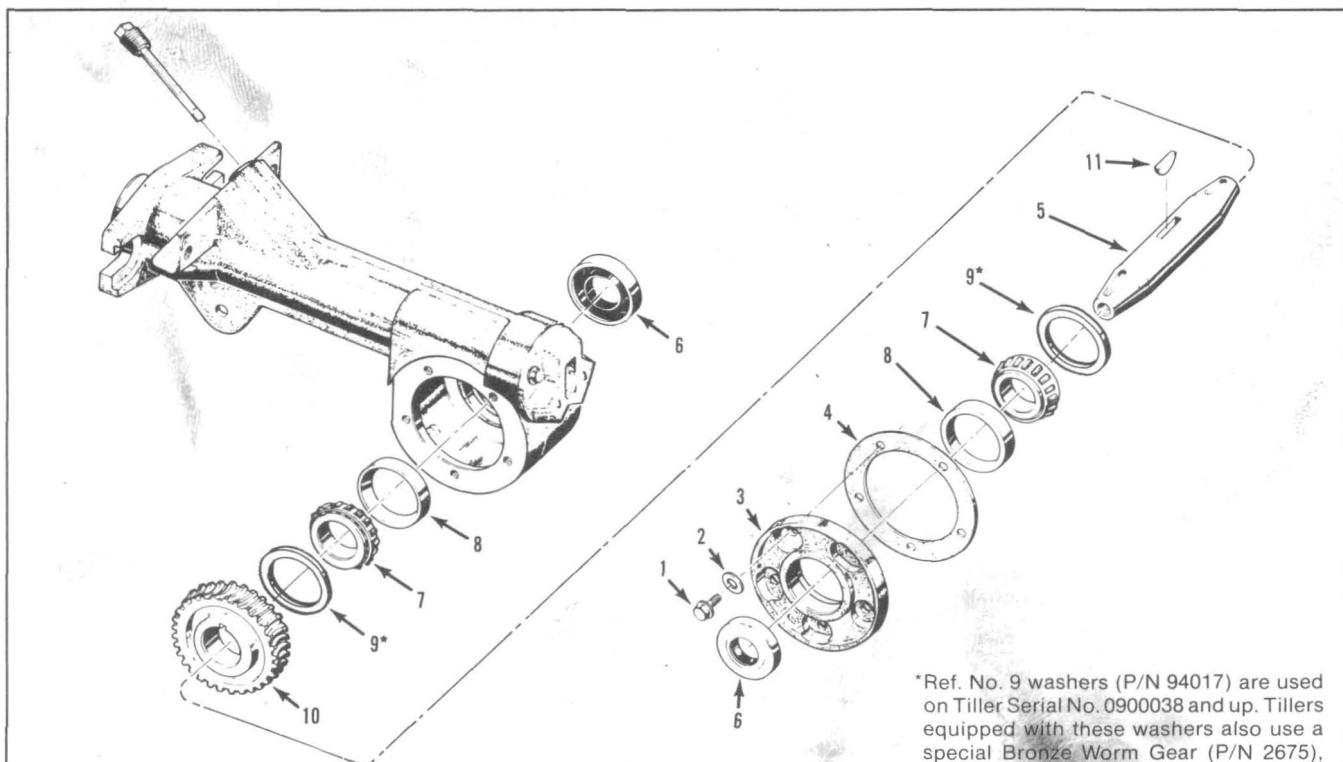


Figure 6-2: Tiller Attachment Tine Shaft Assembly.

*Ref. No. 9 washers (P/N 94017) are used on Tiller Serial No. 0900038 and up. Tillers equipped with these washers also use a special Bronze Worm Gear (P/N 2675), Woodruff Key (P/N 97067) and Bearing/Cup Assembly (P/N 11522).

SECTION 6: Tiller Attachment Transmission

b. Force the shaft down. This will dislodge one bearing (7). Also remove the washer (9), if so equipped.

10. Turn the shaft assembly 180 degrees and use the arbor press to dislodge the other bearing (and washer, if so equipped).

11. Slide the worm gear (10) off the shaft.

12. Remove the Woodruff key (11), if necessary.

Inspection

These instructions describe how to inspect parts on the tiller tine shaft. In addition to inspecting the parts you have removed, you should also inspect any replacement parts you will use.

Note: Thoroughly degrease and clean all parts before inspection.

Tiller Tine Shaft — The shaft should not be scored, pitted, or corroded in the areas where the oil seals are located. If the shaft is scored, pitted, or corroded, try using an emery cloth to clean the area. If the scoring, pitting, or corrosion is too extensive, discard the shaft.

Also, remove any burrs or rough spots on the ends of the shaft.

Bronze Worm Gear — If the gear teeth are damaged or excessively worn, discard the gear.

Bearings — If the bearing has a bluish color then proper lubrication has not been maintained; discard the bearing and bearing cup.

Also, if the bearing or its cup is scored or excessively worn, dirt may have gotten inside the housing. If so discard the bearing and bearing cup.

Test each roller in the bearing by spinning it with your fingers. If a roller makes a growling noise or

does not move at all, discard the bearing.

Washers (on tillers so equipped)

You will only be able to inspect the washers if you should need to disassemble the shaft. If a washer is warped, discard it.

Installation

1. Install the Woodruff key (11) in the shaft.

2. Slide the bronze worm gear (10) on the shaft. The worm gear should be centered over the key.

3. Use an arbor press to replace a bearing (and washer, if so equipped). Make sure the washer is between the bearing and the bronze worm gear.

Note: If an arbor press is not available, use the housing cover (without the oil seal installed) as a centering device. Simply support the cover on open vise jaws and place the bearing in the bearing cup (cup must be installed in cover). Add the washer (if so equipped) and tap the shaft down with a soft mallet. Repeat this procedure for the other end, making sure the bronze worm gear is centered over the key.

4. Turn the shaft 180 degrees and use an arbor press to replace the other bearing (and washer, if so equipped). Check to make sure the bronze worm gear is centered over the key.

5. Use an emery cloth to clean the tine shaft, especially around the oil seal locations.

6. Replace the bearing cup (8) in the housing cover (3) by using a piece of wood as a driver to seat the cup. Make sure the tapered bearing cup is oriented correctly to receive the bearing. Also make sure the bearing cup goes fully inside the cover; no metal should and the inside edge of the cover

7. Use the same technique to replace the bearing cup (8) in the right side of the tiller housing.

8. If not already installed, install the tiller drive shaft assembly. See the installation instructions in this section.

9. Insert the tiller tine shaft assembly (5) in the tiller housing. Make sure the side on the bronze worm gear whose gear edges are the sharpest is facing towards the rear of the machine.

Note: Since the front of each gear tooth gets little wear and the rear of each tooth gets most of the wear, rotate the gear so that the best side is facing the rear.

10. Install a new gasket (4) on the tiller housing cover (3). As you begin the shimming procedure, start with the thinnest gasket, which is .010". Do not install the oil seals (6) at this time.

11. Bolt the cover on using two bolts (1) about 180 degrees apart.

Note: Even without the bolts installed, you should not be able to wiggle the cover from side to side or rotate it. Do not use the cover if you can.

12. Check the tine shaft for play:

a. Using two hands, grasp the tiller tine shaft and rotate the shaft back and forth.

b. You should be able to rotate the shaft slightly and to hear a small click. This means the tiller tine shaft is shimmed correctly.

c. If you cannot rotate the shaft and do not hear a click, remove the .010" gasket and install a .030" gasket. If necessary, begin using gaskets in pairs to gradually increment the thickness of the gasket. For example, if a .030" gasket is insufficient, use a .030" and .010" gasket together. If these

are not sufficient, use two .030" gaskets, etc. until the shaft is shimmed correctly.

Note: No more than .060" in total gasket thickness should be needed to correctly shim the tine shaft. Call the Troy-Bilt Technical Service Department if more than .060" shimming is required.

d. There should be no end play, vertical play or diagonal play in the tiller tine shaft. If you find such play, tighten the tiller housing cover bolts.

If this does not eliminate the play, insert a shim (Part No. 1447-1,

1447-2 or 1447-3) between the gear and bearing on the tiller tine shaft.

13. Repeat the previous two steps until you feel the correct amount of play in the tiller tine shaft.

14. Using new washers (2), fully bolt the cover in place. These are nylon washers that function as an oil sealer. If the washers are not available, coat the tips of the bolts with a non-hardening gasket sealer.

15. Apply a layer of non-hardening gasket sealer to the

outside edge of an oil seal. Then install the oil seal on the right side of the tiller housing so that the seal is flush with the housing.

16. Apply a layer of non-hardening gasket sealer to the outside edge of another oil seal. Then install the oil seal on the left side of the tiller housing so that the outside edge of the seal is flush with the housing.

17. Refill the housing with gear oil according to the instructions found in the Owner/Operator Manual.

Installing a New Tines/PTO /Clutch Lever Assembly

In early model PTO Horse models, a ball bearing assembly on the Tines/PTO Clutch Shaft functioned as the contact piece that moved the PTO power unit dog clutch to engage the tiller attachment dog clutch. However, time has demonstrated that the ball bearing wears prematurely in this situation. Therefore, a common maintenance/service procedure is to replace the old ball bearing assembly with a new style screw-head assembly and a new style dog clutch.

The Part Number 10353 service kit contains all the parts necessary to perform this procedure.

Removing the Existing Assembly

1. Separate the tiller tine attachment from the PTO power unit. See "Separating the Transmissions" in Section 4.
2. Make the PTO power unit level (horizontal).
3. Remove the bolt (1) that holds the clutch lever knob (2) to the clutch lever (3). Then remove the clutch lever knob and bolt (see inset, Figure 7-1).
4. Remove the bolts (4) that hold the detent plate (5). Then remove the detent plate. (See inset, Figure 7-1).
5. Remove the bolt (6) that holds the clutch lever to the eccentric shaft (11) and remove the clutch lever.
6. Unscrew the eccentric shaft hex nut/bushing (7). Then lift the shaft up (tilting the assembly in the housing down) and withdraw the assembly from the housing.



WARNING: When servicing the machine, prevent unintentional starting of the engine by disconnecting the spark plug wire and keeping the wire away from the spark plug. Place the engine throttle control in the OFF position and shift the Wheels/Tines/PTO Drive Lever into NEUTRAL.

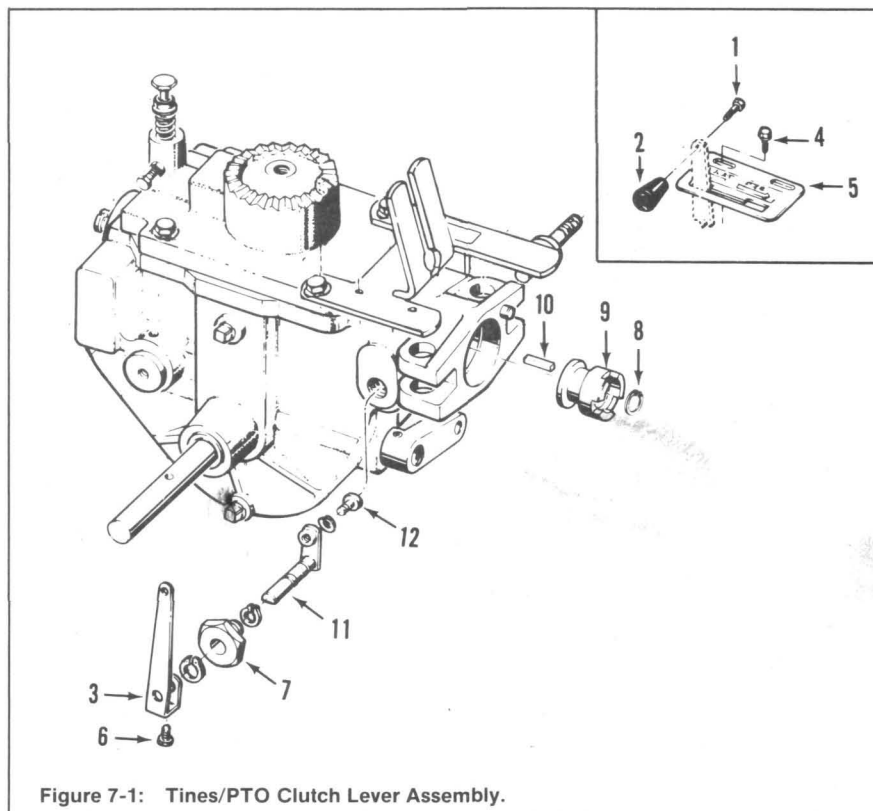


Figure 7-1: Tines/PTO Clutch Lever Assembly.

Discard the eccentric shaft assembly.

7. Remove and discard the (external) snap ring (8) that retains the dog clutch (9) to the drive shaft.
8. Remove and discard the dog clutch.
9. Remove and discard the key (10) that holds the dog clutch on the drive shaft.

Installing a New Assembly

1. Apply a coating of grease to the new dog clutch (9) (Part No. 2120-3) and slide it on the drive shaft. Make sure the three ears

point toward the rear of the transmission.

2. Align the keyway in the shaft and the keyway in the dog clutch and insert the new key (10) (Part No. 9301) all the way forward.
3. Install a new (external) snap ring (8) (Part No. 9500) to retain the dog clutch to the drive shaft. Install the flat side of the snap ring facing the rear of the transmission. Although not easy to observe, the snap ring has a flat side and a rounded side.
4. Stick your finger in the eccentric shaft assembly hole; you want to position the groove on the

dog clutch in the center of the hole.

5. Apply a thin coating of grease to the socket head screw (12) on the eccentric shaft assembly. Then insert the assembly into the hole. Hold the assembly so that the socket head screw is at 12 o'clock.

6. Using your fingers only, gently thread the eccentric shaft hex nut/bushing (7) until the hex nut is snug against the power unit housing.

The hex nut/bushing should turn freely at all times until the nut is against the housing. Do not use force; you can damage the eccentric shaft or socket head screw. If necessary, back the nut off a few turns and rotate the eccentric shaft a fraction of a turn. Then try to thread the nut inward again.

7. Make sure that you have properly seated the screw head in the clutch groove. Rotate the eccentric shaft back and forth while looking through the rear of housing. The screw is properly seated if the clutch moves back and forth with each turn of the eccentric shaft.

8. Tighten the hex nut/bushing securely with a wrench.

9. Fill the dog clutch cavity with grease. Stop where the housing bore widens to accept the tiller attachment sleeve.

10. Attach the clutch lever (3) and finger tighten the bolt (6) that holds the clutch lever.

11. Install the detent plate (5) and loosely install the two bolts (4) that hold the detent plate; do not tighten the bolts yet.

12. Install the clutch lever knob (2) and the bolt (1) on the clutch lever.

13. Move the lever until it is

inside one of the two detent slots cut into the detent plate. Then tighten the bolt that holds the lever. A correctly installed lever will have to be pulled out before being able to slide it over to the other detent stop.

14. With the lever in the ENGAGE position, slide the detent plate to the rear of the housing against the lever until it can go no further. Move the plate forward 1/16 of an inch and tighten the two detent-plate mounting screws. You should feel some lever play in either the ENGAGE or DISENGAGE position.

Removing a Rusted Wheel

If you need to remove the wheel shaft and the left wheel or both wheels are rusted to the shaft, follow these instructions. If only the right wheel is rusted to the wheel shaft, you can still remove the wheel shaft by following the instructions in Section 5 of this manual. Once the wheel shaft is off you can soak the rusted wheel(s) in a penetrating lubricant until you can remove it.

1. Remove the roll pin that holds the wheel to the wheel shaft. If the pin does not come out smoothly, tap it out using another pin as a driver. It is important to use a pin that is the same size.

2. Remove the hubcap.

3. Spray a penetrating lubricant into the wheel hub and let it soak.

4. Raise the wheels off the ground and leave them suspended in the air.

5. Insert an old wheel shaft into the hub until it butts against the tiller's wheel shaft. Then, using the old shaft as a driver, strike the end of the old shaft with a hammer.

Note: Only strike a few times and not very hard. You do not want to run the risk of popping the snap ring out of its groove. Doing so will make it very difficult to remove the wheel.

6. If you are successful, the wheel will begin to vibrate off the wheel shaft.

7. If you are not successful, you will have to saw the rusted wheel off. Then, the wheel shaft can be removed by following the instructions in Section 5 of this manual.

Note: Soak the rim of the sawed-off wheel in lubricant overnight. Then use an arbor press to remove the shaft from the wheel.

Removing the Wheel Shaft Without Disassembling the Transmission

This wheel shaft removal and replacement method may take some practice before you are truly proficient, but it can save you time in removing, inspecting and replacing a wheel shaft because you do not have to separate the transmission from the tiller or disassemble the transmission.

See Figure 7-2 as a reference for the part numbers in this section.

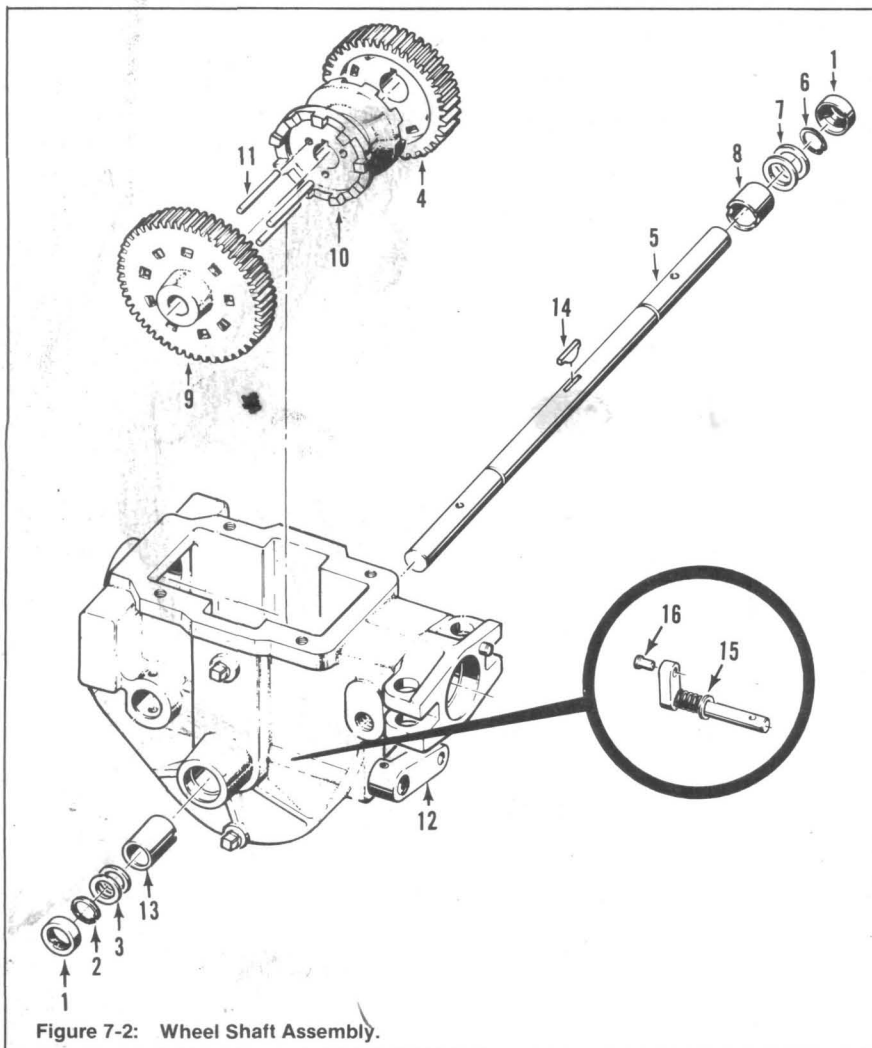
Removal

1. Remove the oil drain plug and drain the transmission gear oil. Inspect the plug and if it is not damaged, replace it after the oil is drained.

2. Remove both wheels. See the Owner/Operator Manual for Instructions.

Note: If a wheel is rusted to the shaft, see "Removing a Rusted Wheel" in this section.

SECTION 7: Special Repairs and Procedures



3. From the left side of the wheel shaft, remove the oil seal (1), the (external) snap ring (2), and the shim(s) (3). See Section 5 in this manual for more details.
4. From the right side of the wheel shaft, remove the oil seal (1).
5. Insert a screwdriver in the hole on the right side of the wheel shaft. This is the hole for the spiral pin that holds the wheel hub to the shaft.
6. Shift the Wheel Speed Lever so that the clutch is in NEUTRAL.
7. Strike the left side of the shaft with a rubber hammer. The shaft will move inward until the hi-pro

key (14) on the shaft hits the side of the fast speed wheel gear (4). Slowly rotate the shaft with the screwdriver and continue to strike the left side of the shaft with the hammer. You are trying to align the key (14) in the shaft with the keyway in the fast speed wheel gear to permit the removal of the shaft.

Continue hitting the shaft until you feel it passing through the fast speed gear. Then finish driving the shaft out.

Note: If you had to saw the left wheel off, you will have to use an old wheel shaft as a driver. This will require you to find someone

to assist you in turning the screwdriver while you hold the old shaft and hammer.

As you tap the drive shaft out, the key in the shaft will also remove the right-side bushing, snap ring, shim(s), and oil seal.

8. Using a long punch inserted from the right side of the housing, remove the bronze bushing (13) from the left side of the housing. You will have to pass the punch through the clutch and wheel speed gears.

9. Disassemble and inspect the wheel shaft. See Section 5 in this manual for more details.

Installing the Wheel Shaft

1. Install a hi-pro key (14) in the wheel shaft.
2. Inspect the new wheel shaft for burrs or other rough spots that could make inserting the shaft through the gears and clutch difficult. If necessary, use emery cloth to remove any rough spots.
3. Pull the eccentric lever (12) back and wedge it. This releases the eccentric shaft (15) pressure on the clutch (10).
4. Line up the keyways on the fast speed wheel gear (4) and clutch (10). Use a screwdriver inserted through the right side of the housing to position them at 12 o'clock.
5. Lubricate the wheel shaft (5).
6. With the key in the wheel shaft positioned at 12 o'clock, insert the shaft through the right side. Do not use force; do not use a hammer.
7. Pass the wheel shaft and its key through the fast speed gear, clutch, and slow speed gear. This may take a few attempts until you

Note: If necessary, you can remove the power unit housing cover to move the gear and clutch by hand.

8. Complete the installation of the wheel shaft. See Section 5 of this manual for more information.

Identifying a Bubbled Wheel Shaft

A wheel shaft is bubbled when the metal around the keyway raises or swells slightly. This weakening of the metal is due to excessive pressure being exerted by the clutch on the hi-pro key to turn the wheels. This is often caused by improper shifting or by the wheels striking an object that abruptly cause them to stop turning.

A bubbled wheel shaft should be discarded and replaced with a new one.

Testing for a Bubbled Wheel Shaft

Disconnect the linkage from the eccentric lever and work the eccentric lever by hand. If the lever is difficult to move the wheel shaft may be bubbled.

Tightening the Castle Nut On the Wheel Speed Lever

Follow these instructions to tighten the castle nut (see Figure 7-3). The castle nut holds the Wheel Speed Lever on the transmission.

1. Remove the spring pin from the castle nut.
2. Tighten the castle nut. When the castle nut is properly tightened, it should require a force of 13-17 lbs. to move the Wheel Speed Lever.
3. Align the nearest slot in the castle nut with the hole in the mounting stud. Make sure that the castle nut is still tight and that the Wheel Speed Lever moves freely.
4. Install a new spring pin until it is flush with the top of the slotted nut.

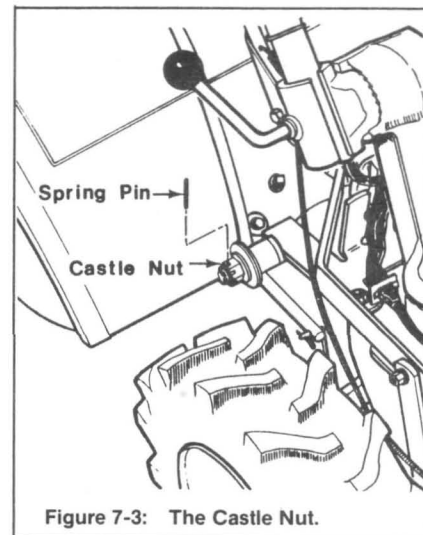


Figure 7-3: The Castle Nut.

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Call Toll-Free: 1-800-833-6990

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