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ROTOTILLER

ALL
MODELS



**SHOP
MANUAL**

FRAZER FARM EQUIPMENT CORPORATION

AUBURN, INDIANA

FAMILIARIZATION AND SERVICE

INSTRUCTION MANUAL

FOR ALL

ROTOTILLER

POWER TILLERS

FRAZER FARM EQUIPMENT CORPORATION

AUBURN, INDIANA

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FOREWORD

This Manual was written expressly for the use of the Frazer Farm Equipment Dealers, to serve as a complete guide and reference for the maintenance and repair of the Rototiller Power Tiller. Because of the unique design employed, standard service tools which are generally available to most repairmen, are not suitable for accurate, dependable repair to these units. This Manual therefore emphasizes the proper use of the special tools which were developed especially for this purpose and are discussed in Section XII.

All service methods contained herein, represent the combined efforts of the Factory Service Department together with the many suggestions forwarded to us by our Distributors and their Dealers.

Section and paragraph identification has been simplified for quick reference; the first number denotes the section, and the number following the dash identifies the paragraph. Paragraphs are consecutively numbered, starting with each section.

All services have been grouped according to major assemblies, and each subject insofar as possible, has been sub-classified into removal, disassembly adjustment, reassembly and installation headings. Service Standards for each major assembly have been tabulated and placed near the head of each section for quick reference. In addition, general specifications and a short description are given in the Introduction following.

Introduction

1. DESCRIPTION

The Rototiller is a two-wheeled tilling unit provided with an adjustable trailing runner to vary the tilling depth. The handle bars are adjustable both for horizontal and vertical position enabling the operator to walk on untilled ground, while all operating controls are operated from the handle bars.

Two tiller sizes are used, the 20" and the 26" widths.

2. GENERAL SPECIFICATIONS

Models B1-6, B1-6RS, B1-7, B1-7RS

Tread—(Center distance between wheels) 19"

Shipping Weight 450 lbs. (Approx.)

Wheels Disc 12 x 2.50" interchangeable with steel wheels equipped with cleats.

Turning Radius
(Overall Machine) 66" Approx.

Tires 2 ply, 4.00 x 12"

Overall width (Handle bars straight back)

Over wheels 24"

Over hood & flaps 26" tines 33"

Over hood & flaps 20" tines 28"

Overall width
(handle bars swung to side) 48"

Overall Length—
Max. (Handle bars down) 84¾"

Overall height—
Max. (Handle bars up) 59½"

Overall length—
Min. (Handle bars up) 70¾"

Height over fuel tank
(at 20 degree angle) 35"

3. PERFORMANCE DATA

Speed @ 2400 RPM—low gear 3/4 mph

Tiller shaft 245 rpm

Tilling range, tank full 4-5 hrs. approx.

Depth of cut 0 to 9" as adjusted

4. DIFFERENCES IN MODELS.

MODEL B1-6.—This model consists of the standard Rototiller Power Tiller as shown in figure 1. Cleated steel wheels are optional.

MODEL B1-6RS.—Consists of the standard model B1-6 plus a reverse gear unit. Engine numbers bearing the prefix "R", are delivered with reverse gear installed at the factory. The reverse gear unit may be installed on model B1-6 Rototiller Power Tiller.

Model B1-6 units will bear Serial Nos. 1014 through 37013; Model B1-6RS units Serial Nos. 50001 through 56000.

NOTE

Engine numbers bearing the suffix "T" are fitted with one-piece hubs instead of the two-piece free-wheeling type. Serial numbers are stamped on a plate located directly beneath the choke button. Engine numbers are stamped on the right side of the engine crankcase.

MODEL B1-7.—This model consists of the latest standard Rototiller Power Tiller equipped with "dual" purpose Wheel Hub Clutches as shown in figure 2.

MODEL B1-7RS.—Consists of the standard model B1-7 plus a reverse gear unit. Engine numbers bearing the prefix "R" are delivered with reverse gear installed at the factory. The reverse gear unit may be installed on Model B1-7 Rototiller Power Tiller.

Model B1-7 units will bear Serial Nos. 60,001 through 92,000; Model B1-7RS units, Serial Nos. 101,001 through 111,000.

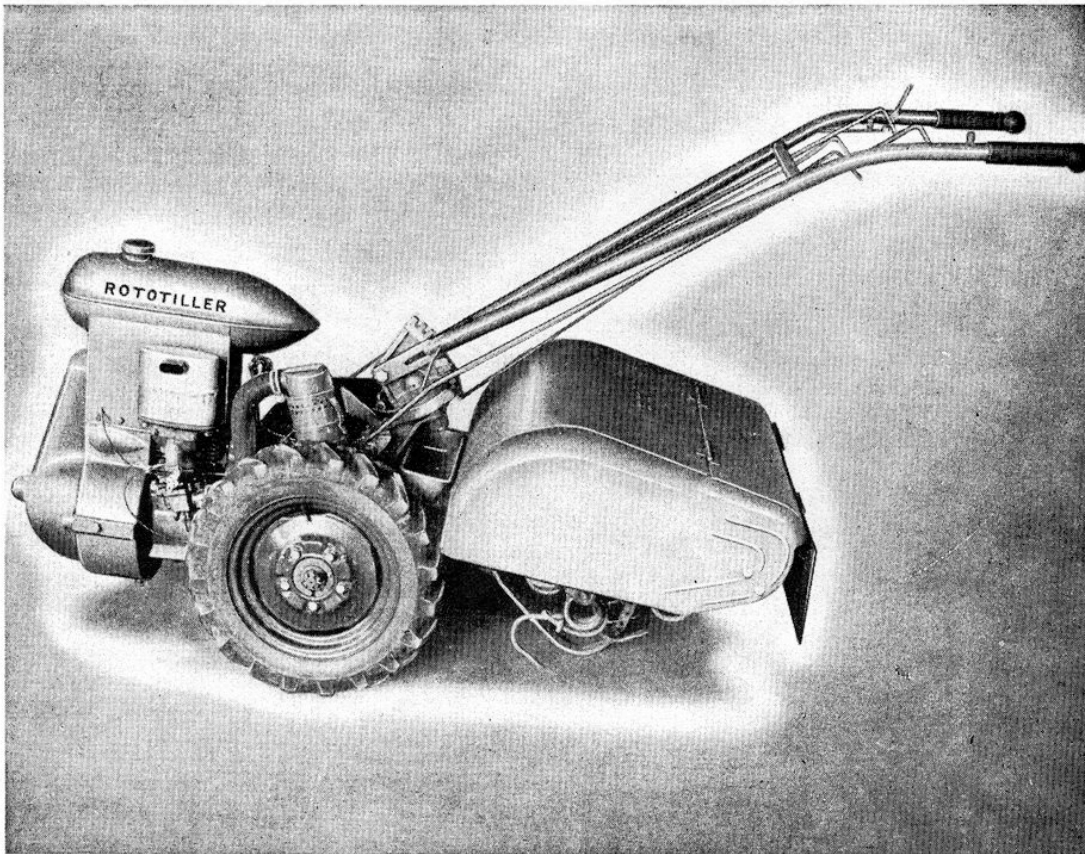


FIG. 1—STANDARD MODEL B1-6

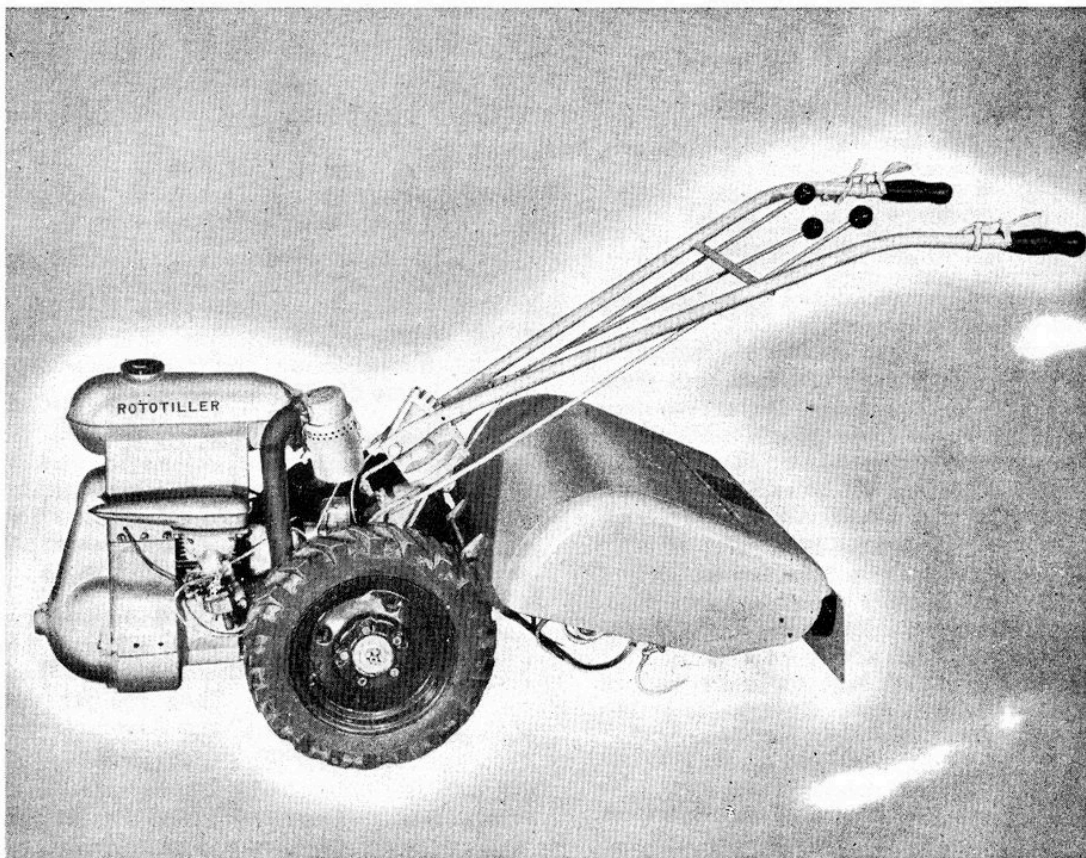


FIG. 2—STANDARD MODEL B1-7

SECTION 1

Complete Disassembly and Assembly For Major Overhaul

1-1. DISASSEMBLY INTO SUB-ASSEMBLIES

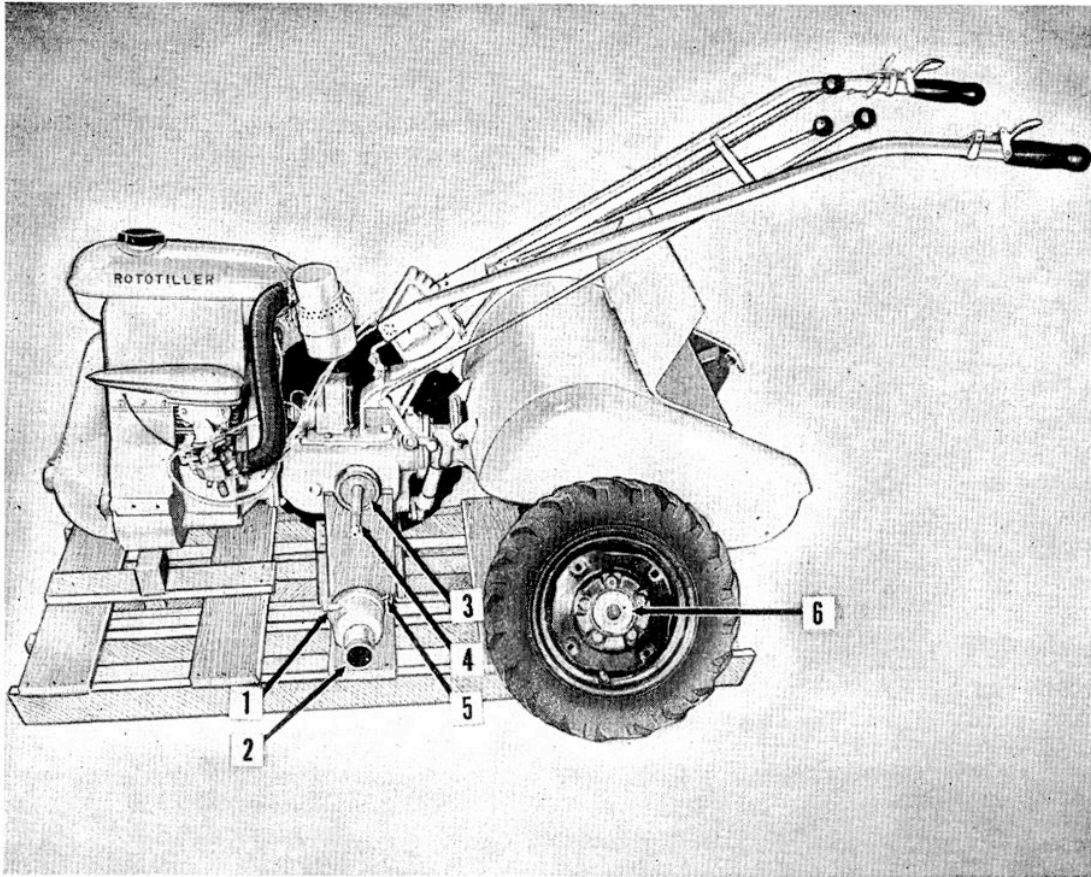


FIG. 3—READY FOR DISASSEMBLY

1. Control cable clip
2. Inner Hub
3. Thrust washer

4. Axle shaft
5. Inner hub set screw
6. Outer hub (attached to wheel)

1-2. REMOVE HANDLE-BAR ASSEMBLY

- a. Disconnect throttle control housing clamp and wire, at carburetor.
- b. Disconnect ground wire at magneto.
- c. Loosen clamp at engine, then pull throttle control housing free. On reverse gear units, also loosen intermediate cable clamp on transmission case flange. On B1-7 and B1-7RS MODELS disconnect Hub Clutch Control wire at Clutch Control lever assembly and clip on inner Hub.
- d. Remove cotter pin and disconnect each of the following: tiller clutch control, horizontal control, and transmission shift control rods.
- e. Remove nut and bolt at lower end of handle bar, then lift complete assembly from machine.

- b. Remove cotter pin, castellated axle nut and flat washer from left wheel, then pull off wheel and outer hub assembly. If machine is not equipped with the early type free-wheeling, the one-piece hub will come off with the wheel.
- c. Pull inner hub from shaft.
- d. Pull right wheel from transmission and remove the left wheel, outer hub, inner hub and axle shaft as an assembly. Remove hub and wheel from shaft.
- e. On B1-7 and B1-7RS Models, remove cotter pin and castellated axle nut, then pull off wheel with lockout bushing and outer hub assembly. Then remove complete Wheel Control Clutch Assembly attached to transmission flange by Stud-Hub Stop.

1-3. REMOVE WHEELS.

- a. Raise machine until wheels are clear then place blocks under transmission, or hoist machine onto shipping crate. (See figure 3.)

NOTE

If machine is to be hoisted, it will balance if hoist is attached to handle-bar bolt hole.

- 1-4. REMOVE HOOD ASSEMBLY.
 - a. Remove tiller hood adjusting-bar wing nut and bolt.
 - b. Remove tiller hood mounting bracket nuts and lift assembly from unit.
- 1-5. REMOVE STARTER ASSEMBLY.—Unscrew two cap screws at front of cooling fan housing to remove housing and starter assembly
- 1-6. REMOVE CARBURETOR, MUFFLER, AND MANIFOLD.
 - a. Loosen clamp screws at air-cleaner tube to carburetor.
 - b. Shut off gas at fuel filter valve, then disconnect fuel line at carburetor.
 - c. Remove choke control wire and housing from carburetor.
 - d. Remove two nuts and two cap screws. then lift off muffler.
- 1-7. REMOVE FUEL TANK.
 - a. Disconnect fuel line at strainer, and remove line.
 - b. Remove spark plug wire and spark plug.
 - c. Remove six round-head cap screws which fasten base of fuel tank to crankcase, and remove assembly.
- 1-8. REMOVE MAGNETO.—Remove cap screws at base of magneto and remove magneto assembly. Remove magneto adjustable floating coupling if machine is not the reverse gear type.
- 1-9. REMOVE HANDLE-BAR BASE. — Remove four cap screws holding handle-bar base to transmission and remove the handle bar base and air cleaner assembly. If machine is the reverse gear type, the speed shift lever bracket can be lifted off.
- 1-10. REMOVE TILLER DRIVE ASSEMBLY.
 - a. Place blocks under engine to support weight when tiller drive assembly is removed.
 - b. Remove four cap screws at flange between tiller drive housing and rear of transmission, then slide housing away from transmission.
- 1-11. REMOVE ENGINE
 - a. Remove six bolts from flange between rear of engine and transmission, using two 3/8" x 8" bars or bolts as guides to slide engine away from transmission.
 - b. Remove magneto drive-gear thrust washer or, if equipped with reverse gears, thrust washer and spacer from end of magneto drive shaft, in transmission.
- 1-12. REMOVE REVERSE GEAR UNIT— (IF EQUIPPED)
 - a. Disconnect reverse control link assembly from reverse control lever.
 - b. Loosen adjustable coupling nut, and slip coupling from magneto shaft, then remove shaft key.
 - c. Remove magneto drive gear and shaft from gear assembly.
 - d. Remove six cap screws and lock washers, and remove intermediate cable clamp, then separate reverse gear case from transmission case. Remove spacer and shims from transmission worm shaft. (Refer to Service Bulletin #12.)
- 1-13. REASSEMBLY OF SUB-ASSEMBLIES
- 1-14. INSTALL REVERSE GEAR (IF EQUIPPED) TO TRANSMISSION.
 - a. Using a new gasket, assemble reverse gear unit to transmission case with six cap screws and lock washers, after replacing spacer and shims on transmission worm shaft, match splines of transmission worm drive shaft. Install intermediate cable clamp under cap screw at upper left side.
 - b. Install magneto drive gear and shaft, so that shaft end emerges through the bearing in the transmission case.
 - c. Install shaft key on magneto drive shaft, then fit adjustable coupling onto shaft and tighten nut just enough to keep coupling from sliding off.
 - d. Connect reverse control link assembly to reverse control lever. Secure with cotter pin.
- 1-15. INSTALL ENGINE.
 - a. Make sure that gasket surfaces are clean and place a new transmission-to-crankcase gasket in position.
 - b. Inspect the magneto drive gear thrust washer; if worn or distorted install a new one on end of magneto drive shaft. If machine is the reverse gear type, install spacer, then thrust washer onto magneto drive shaft.
 - c. Set the engine and transmission on blocks, then aligning the two units with two long tapered drive-pins as guides, slide the two units carefully together taking care to mesh gears and guide magneto drive shaft into engine-case bearing.
 - d. Tighten flange bolts evenly.
- 1-16. INSTALL WHEEL AND AXLE ASSEMBLY.
 - a. Insert axle shaft from right side through the left side of transmission.
NOTE: The end of the shaft without the bushing enters the case first. Enter the shaft carefully to avoid burring the low gear bushing, or distorting the oil seals.
 - b. Install the inner hub, then follow with outer hubs, wheels, washers and castellated nuts. If equipped with one-piece hubs, renew the rubber-seals near the inner face of each hub. On B1-7 and B1-7RS models replace Wheel Control Clutch Assembly and attach to transmission flange with Stud-Hub Stops, then replace wheel and outer hub making certain that ears of clutch spring interlock slot on energizer and hub section.
 - c. Tighten axle nuts until snug, then back off left nut one castellation and install cotterpins in both nuts.

- d. Place transmission on blocks high enough for wheels to be installed. Unless steel wheels are used, replace wheels so that the "V" of the tire tread of the arrow side of the tire points toward the engine. For standard tread, the valve stems should face out. Tighten wheel bolts and inflate tires to 10-12 lbs. pressure.
- e. If lubricant leaks from outer ends of axle shaft, on machines equipped with the early type free wheeling, install water pump packing as follows:
 - (1) Remove axle nuts and washers from both ends of axle.
 - (2) Starting with right side, wrap packing into recess at inner end of threads on shaft to completely close space between shaft and wheel hub, and to cover key-way.
 - (3) Install flat washer and axle nut; tighten nut and install a new cotter pin.
 - (4) Wrap left shaft in a similar manner; install washer and axle nut; draw nut up tight and back off one castellation, then install a new cotter pin.

The following procedure is recommended not only for installation of Wheel Hub Clutches on B1-6 and B1-6RS Rototillers, but also for stopping prevailing oil leakage between transmission and inner hub on early models of B1-7 and B1-7RS Rototillers.

- (1) Apply Permatex to outer surface of oil dust seal in inner wheel hub. (Surface contacting metal.)
- (2) Place Part No. 5633 SEALER on outer edge of oil dust seal, approximately 9 5/8" to each oil dust seal. Do not leave ends gap.
- (3) Place Part No. 5634 SEALER on inner edge of inner hub, approximately 11 3/4" to each inner hub. Do not leave ends gap.

1-17. REPLACE TILLER DRIVE ASSEMBLY. — Check gasket surfaces of connecting flanges to make sure they are clean. Using a new gasket, slide tiller drive assembly into position, then install four cap screws and lock washers, and tighten evenly.

1-18. REPLACE HANDLE-BAR BASE AND AIR CLEANER ASSEMBLY.—With the cog section of handle-bar base to the rear, mount to top of transmission. The four cap screws and lock washers used, also fasten the transmission cover to case. On reverse gear units, assemble the speed shifter upper link to the bracket and spring assembly, then fasten assembly to transmission case with the two bolts on the right side.

1-19. REPLACE MAGNETO ASSEMBLY.

- a. Check the magneto adjustable coupling to see that it is flush with rear end of shaft, then tighten lock nut finger-tight to hold in position.
- b. Install magneto adjustable coupling (floating) drive member, indexing the prongs of the coupling as magneto is slid into position.
- c. Tighten magneto plate cap-screws which also serve as the transmission cover.
- d. Check for clearance of .010 inch between floating coupling and drive member. Move adjustable coupling on shaft to obtain proper clearance. (See figure 26.)

1-20. IGNITION TIMING. (FAIRBANKS-MORSE MAGNETO).

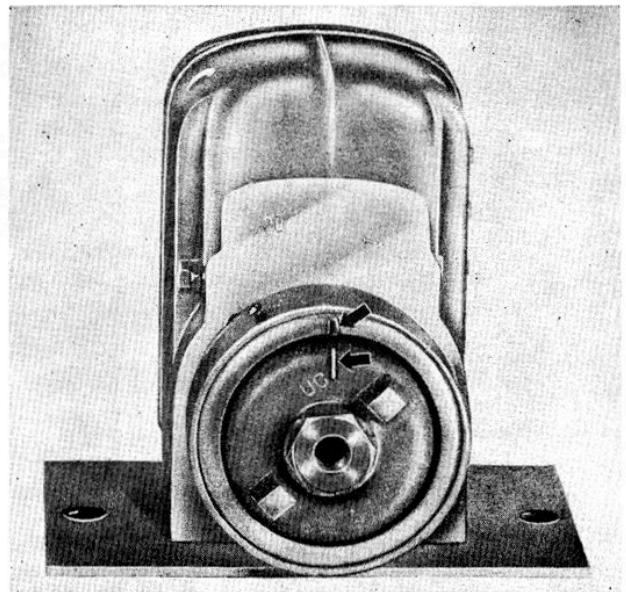


FIG. 4—FAIRBANKS-MORSE MAGNETO

- a. Using a screw driver, straighten lock washer lugs to free magneto lock nut at coupling. Hold cooling fan, loosen lock nut, and back off several turns. The special magneto and wheel bolt wrench supplied in tool kit should be used.
- b. Remove spark plug to permit easier cranking of engine.
- c. Rotate fan until timing mark on outer face of fan is in perfect alignment with timing mark on crankcase. (See figure 24.)
- d. Turn magneto coupling to the right (clockwise) by hand until the timing mark on drive member is in perfect alignment with timing mark on impulse starter housing. (See figure 4.)

- e. Hold drive coupling to prevent it from rotating, then tighten lock nut finger-tight.
- f. Hold fan to prevent it from rotating, then tighten magneto lock nut securely using special wrench provided in tool kit.
- g. Fasten lock nut in place by bending lugs of lock washer over flats of nut.
- h. Connect magneto ground lead.

1-21. IGNITION TIMING. (EDISON-SPLITDORF MAGNETO.)

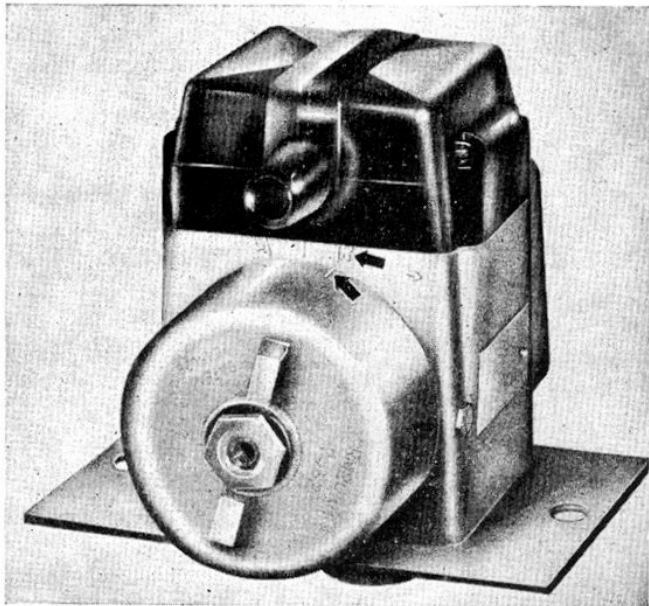


FIG. 5—EDISON-SPLITDORF MAGNETO

Directions for checking and setting timing of the Edison-Splitdorf Magneto are the same as for the Fairbanks-Morse Magneto, except that the timing marks are located just right of center on the outer surface of the impulse cover, and on the front surface of the magneto housing. (See figure 5.)

1-22. INSTALL FUEL TANK ASSEMBLY.

- a. Clean gasket surfaces, then using a new manifold-to-engine gasket, install manifold and muffler assembly with two cap screws and lock washers.
- b. Before installing carburetor, thread choke control wire and housing through clamp bracket at back of carburetor. Clamp housing into position so that it just extends through the bracket, then thread choke wire into swivel.
- c. Using a new gasket, install carburetor with two cap screws and lock washers.
- d. With choke control (on right side of engine) pushed in as far as it will go, back off $1/32$ ", then set choke lever in wide open position and tighten the choke wire swivel set screw. Work the choke control and inspect for full range operation.

- e. Install gas line and tighten connections at fuel tank and carburetor. Open fuel shut-off valve and inspect for fuel leaks if tank is filled, then close valve.
- f. Install oil cleaner-to-carburetor air tube and tighten tube clamps.

1-24. INSTALL STARTER AND COOLING FAN HOUSING.—Install housing to front of engine using two cap screws and lock washers.

IMPORTANT

Before installing the starter and fan housing, pull starter cable out to full length. Check to see that slot in starter pulley, which holds the knot on end of starter cable, is on opposite side of cable pull. This will prevent cable from pulling out. In addition, make sure that spring winds cable its full length.

1-25. INSTALL HOOD ASSEMBLY.

- a. Support handle-bar assembly in position, then secure in place with $5/8$ x 3" handle-bar fork bolt.
- b. Tighten slotted nut on fork bolt, then back off one slot to install cotter pin and to secure necessary clearance.
- c. Install control rods in the following order: wheel speed control, (or reverse control), horizontal control, vertical control and tiller shift control. On B1-7 and B1-7RS models the horizontal and vertical selection is controlled by one rod.

NOTE

Both speed shifter and tiller control rods should be installed so that bent portions, containing cotter pin hole, point down.

1-27. CONNECT THROTTLE CONTROL.

- a. Run throttle control housing through intermediate cable clamp (on reverse gear units only) and through clamp on engine, then insert housing in carburetor clamp, and tighten clamp securely.
- b. Insert throttle wire into carburetor throttle lever swivel, but do not tighten.
- c. Pull throttle control on right handle-bar to full closed position, toward operator, then move it forward to within $1/16$ " or $1/8$ " clearance between throttle and handle-bar.
- d. Move throttle lever on carburetor to full closed position (aft) and tighten swivel screw, securely locking control wire in place.
- e. Check installation by operating throttle lever while shifting handle-bars to extreme right and left, noting any restriction or binding.

f. Tighten cable clamp on engine.

1-28. ADJUST TRANSMISSION SHIFT LINKAGE.

—Refer to paragraphs 8-60 and 8-61.

2-1. DESCRIPTION AND THEORY OF OPERA-

TION. The two-cycle power plant used in the Rototiller Power Tiller is unique because it has only three moving parts, the piston, the connecting rod, and the crankshaft. There are no valves, valve springs, tappets, camshafts, camshaft gears or bearings, etc., to cause breakdown or require adjustment. The large accurately-balanced crankshaft is

mounted in high-radial-capacity ball bearings, and needle roller bearings are employed in both ends of the heat-treated, drop-forged connecting-rod. This type of construction offers simplicity, durability and long trouble-free service.

Unlike the conventional four-cycle engine which fires at alternate strokes, the Rototiller Power Tiller Engine fires at each successive downward thrust. (See figure 6.) When the fuel mixture explodes during the power portion of the downward stroke (a), fuel mixture which has been drawn into the crankcase, is compressed; in addition, the exhaust port is uncovered which allows the exhaust pres-

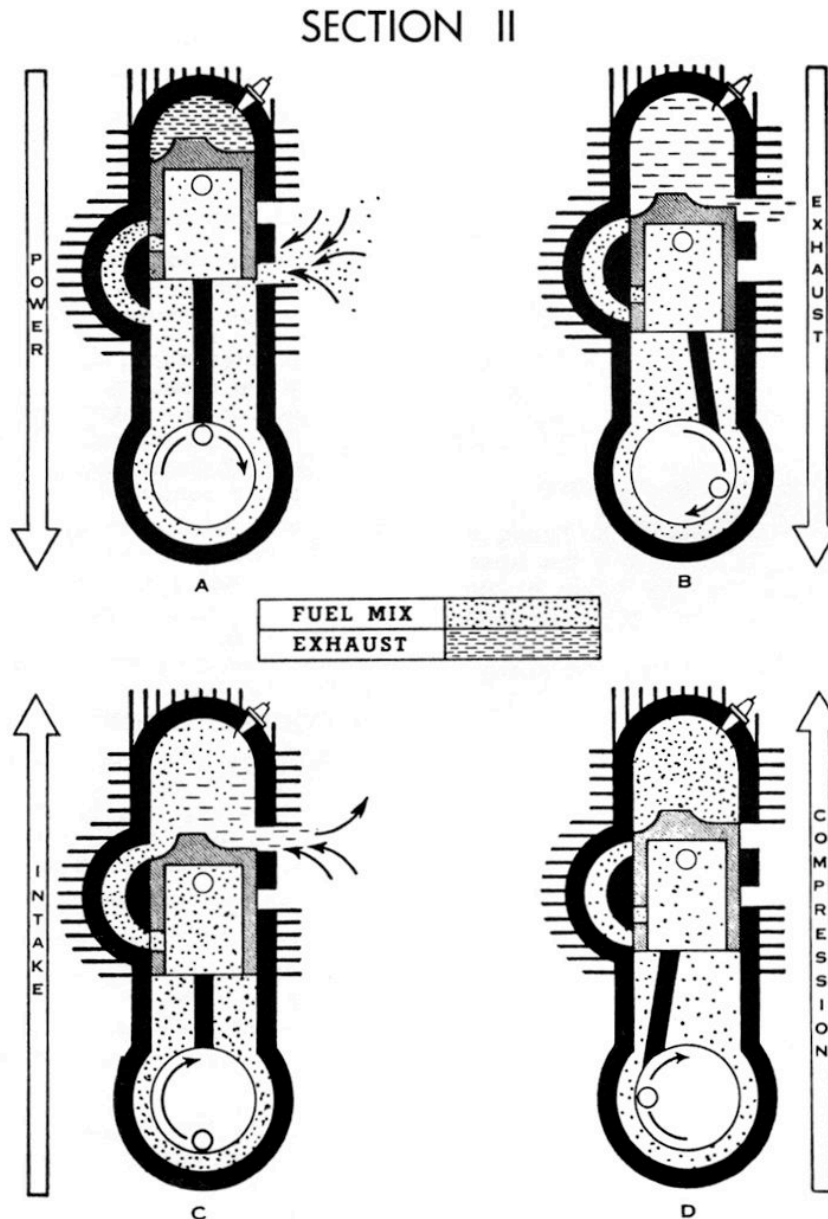
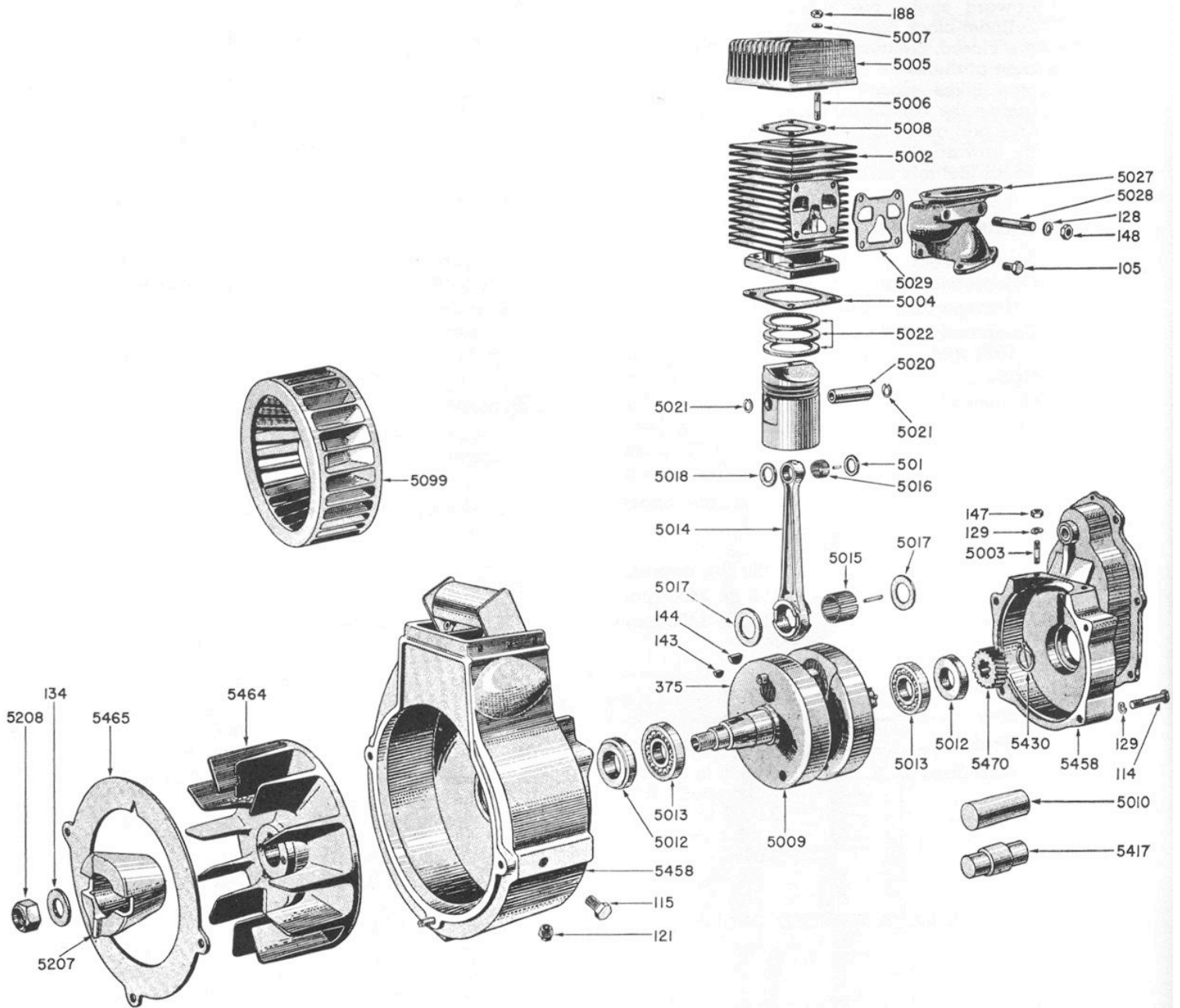


FIG. 6—ENGINE THEORY



EXPLODED ENGINE ASSEMBLY

2-3. ENGINE REMOVAL

- 2-4. DISCONNECT ENGINE CONTROLS. — Disconnect magneto ground lead at magneto and throttle wire at carburetor.
- 2-5. REMOVE FUEL TANK.—Refer to paragraph 1-8.
- 2-6. REMOVE CARBURETOR, MUFFLER, AND MANIFOLD.—Refer to paragraph 1-7.
- 2-7. REMOVE STARTER ASSEMBLY. — Refer to paragraph 1-6.
- 2-8. REMOVE ENGINE.—Refer to paragraph 1-12.
- 2-9. ENGINE DISASSEMBLY.
- 2-10. REMOVE STARTING DOG AND BLOWER FAN.

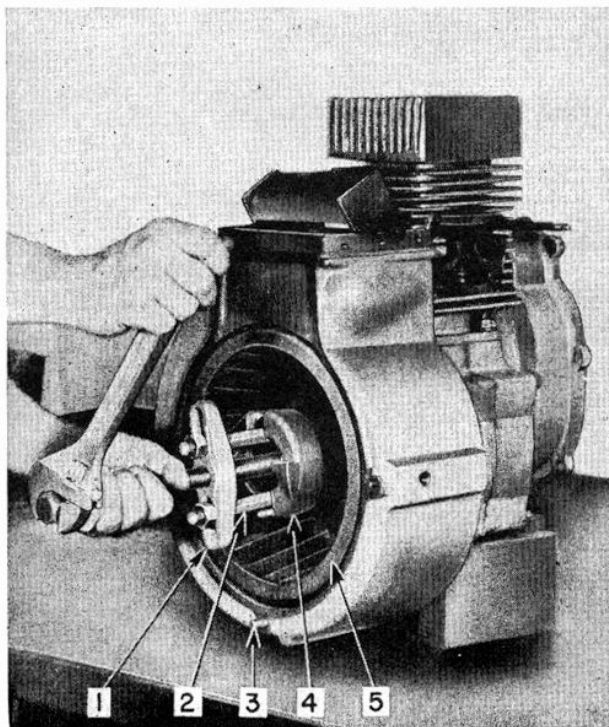


FIG. 7—REMOVING STARTING DOG

1. Puller
 2. Puller Dog
 3. Dowel
 4. Starting dog
 5. Cooling Fan
- a. Remove crankshaft nut. (Left hand thread.)
- b. Using puller GP-18 with puller dogs, remove starting dog. (See figure 7.)
- c. Using puller GP-18 fitted with two 5/16 x 4" cap screws furnished in special tool kit, remove blower fan. (See figure 8.) Remove both keys and inspect for burrs, etc.

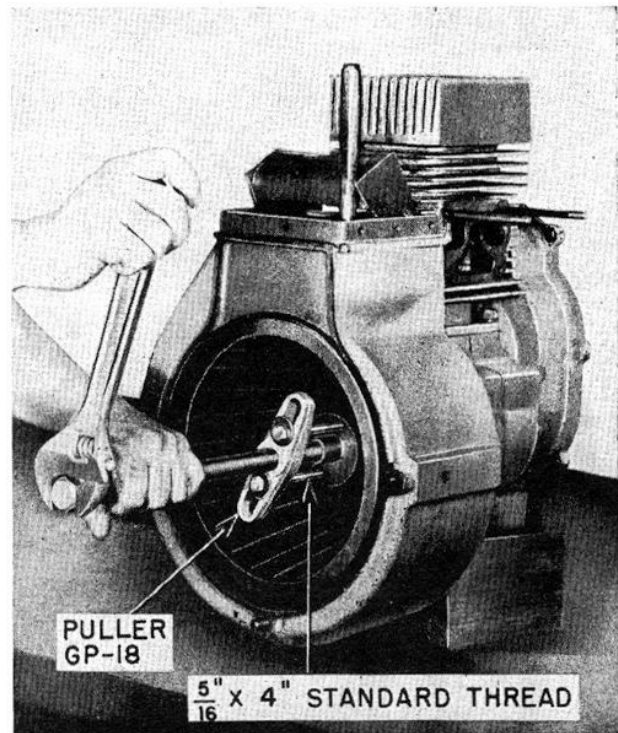


FIG. 8—REMOVING BLOWER FAN

- 2-11. REMOVE CRANKSHAFT GEAR. — Remove snap ring (Part No. 5024) with a screwdriver, or two snap rings (Part No. 5430) using ring plier GP-16; from end of crankshaft then remove small crankshaft gear.

2-12. REMOVE CYLINDER BLOCK

- a. Remove four nuts which secure cylinder block to crankcase.
- b. Loosen four cap screws which fasten the two crankcase halves together, then lift block and cylinder head from crankcase.
- c. Remove cylinder block gasket.

2-13. REMOVE CRANKSHAFT ASSEMBLY

- a. Remove four cap screws which fasten crankcase halves together, then tap gently with hammer to loosen; remove rear end of crankcase.
- b. Pull crankshaft and piston assembly from front end of crankcase.
- c. Using driver GP-7, force magento drive-shaft from inside of the case.

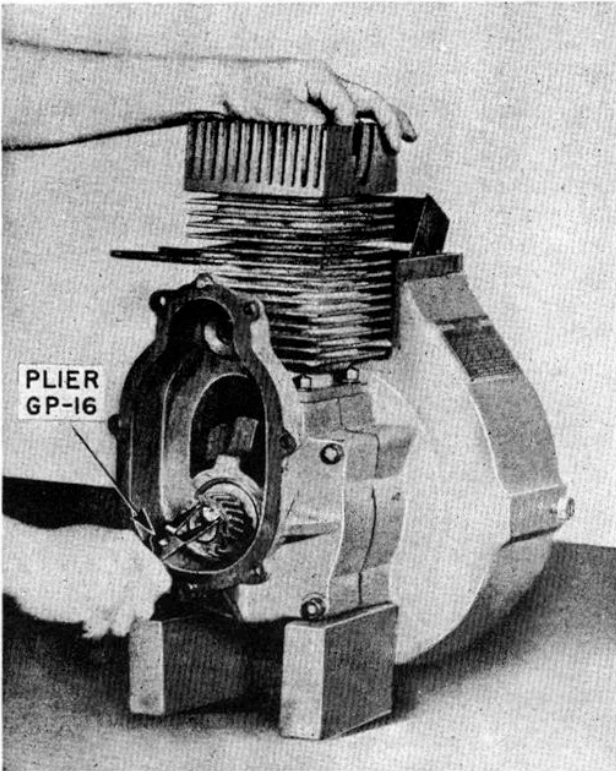


FIG. 9—REMOVING CRANKSHAFT GEAR SNAP RINGS

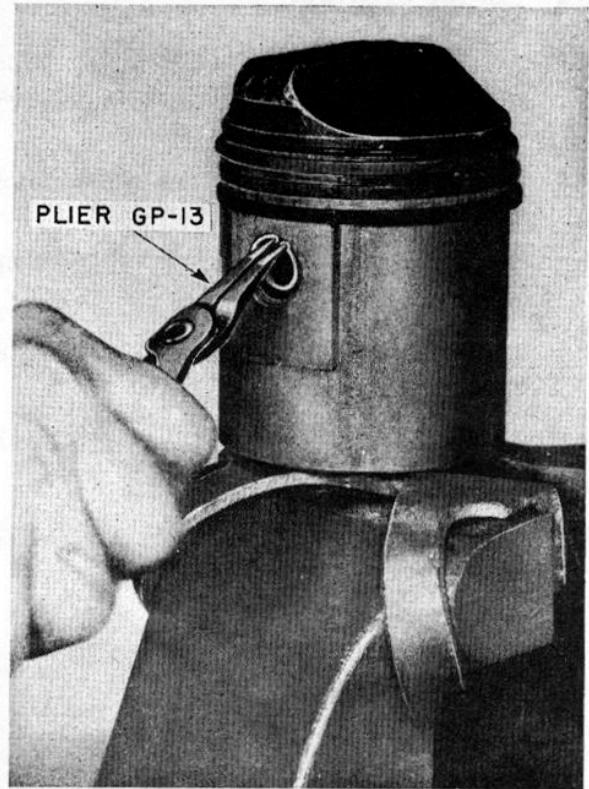


FIG. 10—REMOVING SNAP RING FROM PISTON

2-14. DISASSEMBLE CRANKSHAFT AND PISTON ASSEMBLY.

- a. Using wrench GP-2, loosen one set screw to remove front end of crankshaft from crank pin.
- b. Remove connecting rod and piston assembly, by sliding rod from crank pin while holding thrust washers against both sides to prevent losing any of the 25 roller bearings.

2-15. DISASSEMBLE PISTON AND ROD ASSEMBLY.

- a. Using ring plier GP-13, remove snap rings from sides of piston pin bosses. (See figure 10).
- b. Immerse piston in oil and heat to 150 degrees F. then remove piston pin, 22 needle bearings and 2 thrust washers.
- c. Remove piston rings using tool C-266. (See figure 11.)

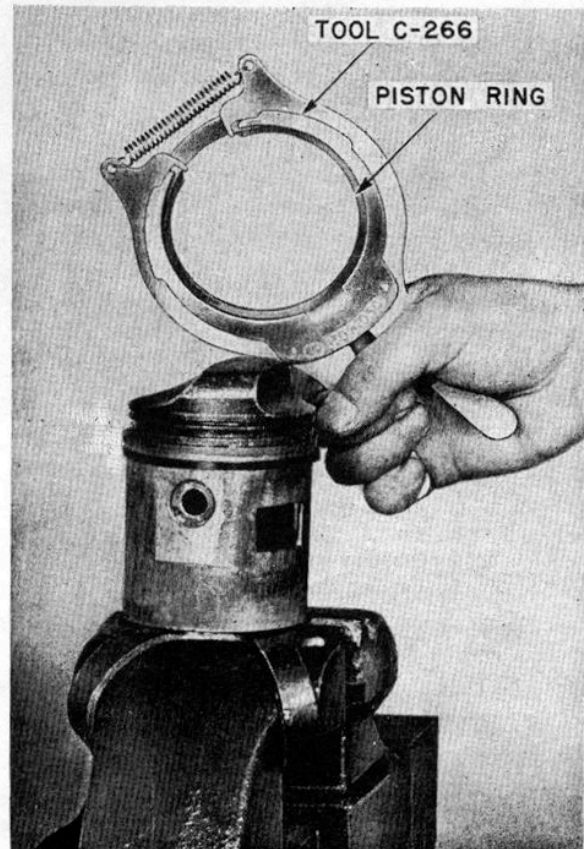


FIG. 11—REMOVING PISTON RINGS

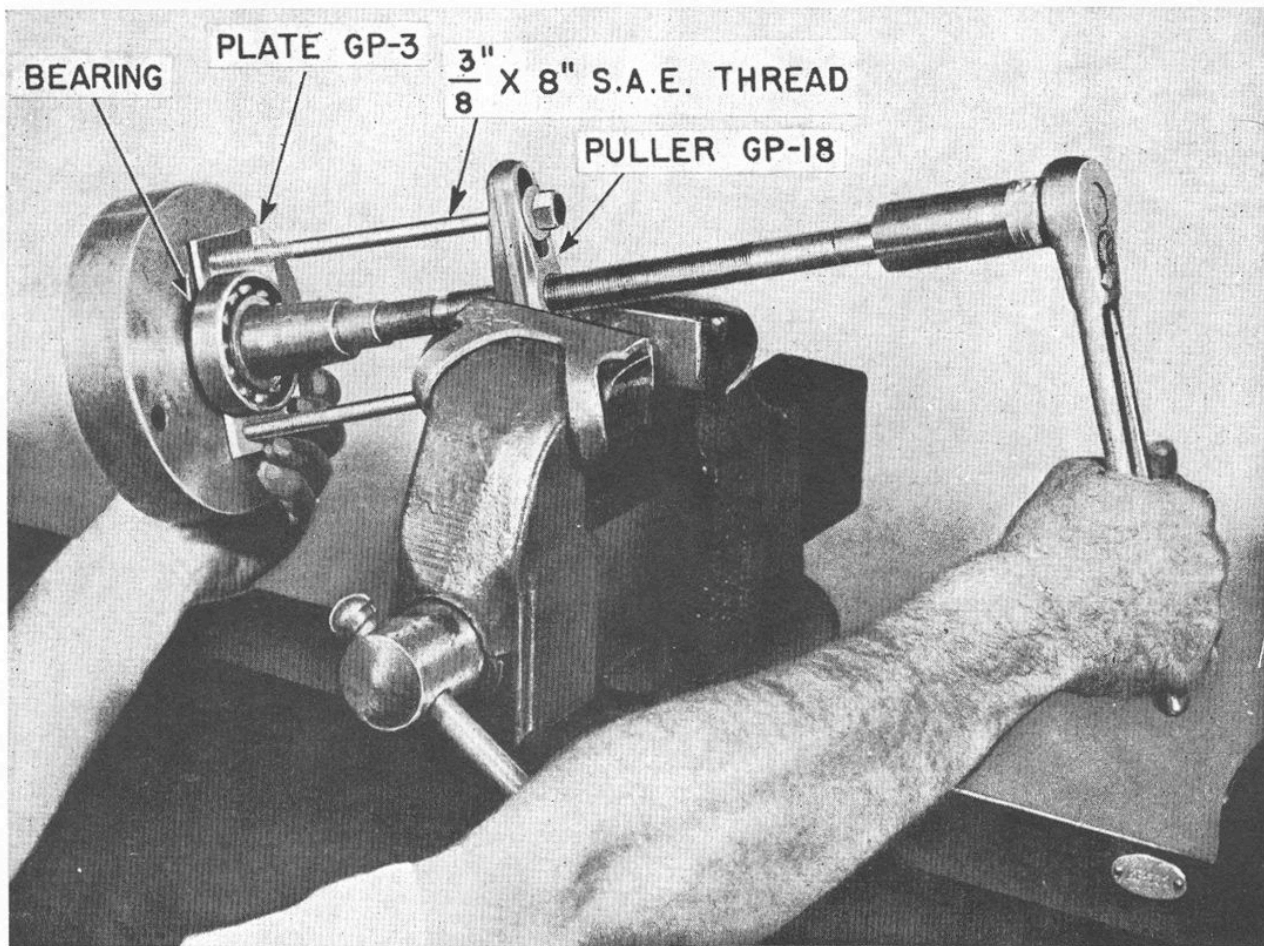


FIG. 12—REMOVING CRANKSHAFT BEARING

2-16. DISASSEMBLE CRANKSHAFT

- a. From each half of crankshaft, remove oil seals using plate GP-3 with puller GP-18. (See figure 12.)
- b. Remove ball bearings from each half of crankshaft using plate GP-3 with puller GP-18.
- c. Loosen remaining set screw and remove crank pin.

2-17. INSPECTION AND MAINTENANCE. — Immerse all parts in clean solvent, then scrub thoroughly and dry with compressed air.

CAUTION

Do not spin ball-bearings with air.

2-18. CYLINDER. — Inspect cylinder walls for scores and excessive wear. If wall is badly marked replacement is indicated, as this part cannot be rebored.

2-19. PISTON AND RINGS.

- a. Check piston for burn and scuff marks.
- b. Check pin fit in piston. Immerse piston in oil heated to 150 degrees F; pin should be a thumb pressure fit.
- c. Check ring fit in piston land. Ring must move freely with a minimum clearance as shown in figure 13.

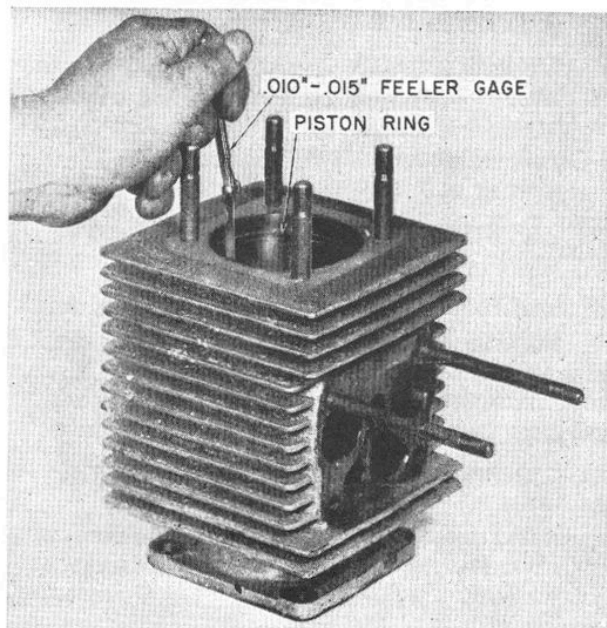


FIG. 13—CHECKING PISTON RING BUTT GAP

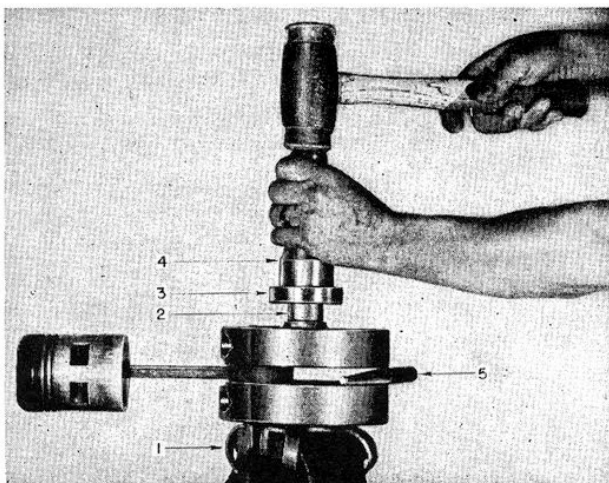


FIG. 14—INSTALLING CRANKSHAFT & BALL BEARING

1. Leaded vice jaws
2. Crankshaft
3. Ball bearing
4. Driver GP-4
5. Temporary spacer

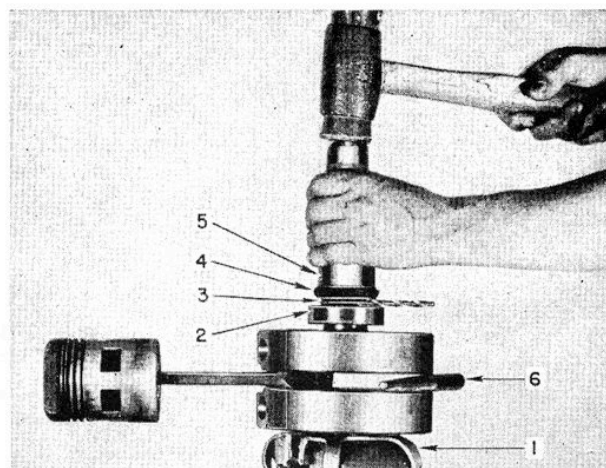


FIG. 15—REPLACING CRANKSHAFT OIL SEAL

1. Leaded vice jaws
2. Ball bearing
3. 1/4" drill
4. Oil seal
5. Driver GP-4
6. Temporary spacer

2-20. **CONNECTING ROD.**—Inspect wrist pin and crankshaft bearing surfaces for marks and roughness; replace if necessary.

2-21. **NEEDLE BEARINGS.**—Complete needle replacement is recommended; however, if not available inspect each needle for flat spots.

2-22. **CRANKSHAFT.**—Inspect crankpin for scores or flat spots; replace pin if necessary.

2-23. **OIL SEALS.**—Replace all oil seals with new ones, as they are generally distorted when pulled from the crankshaft.

2-24. **BALL BEARINGS.** — After bearings have been cleaned and thoroughly dried, spin by hand and check for smoothness. Before assembling crankshaft and crankcase, apply light oil to bearings liberally.

2-25. **GASKETS.**—Always use new gaskets when reassembling the engine.

2-26. **SNAP RINGS.**—New snap rings are recommended, as the old ones may have been overheated and lost their resilience.

2-27. ENGINE REASSEMBLY

2-28. ASSEMBLE CRANKSHAFT.

a. Install ball bearings on each end of crankshaft using driver GP-4; press or hammer tightly against shoulder. (See figure 14).

b. Using driver GP-4, press oil seals on to each end of crankshaft, maintaining a clearance of 1/4 inch drill as gage. (See figure 15).

c. Install crank pin in crankshaft until flush with outside face. Using wrench GP-2, tighten set screw exerting a 60 lbs. pull at end of wrench.

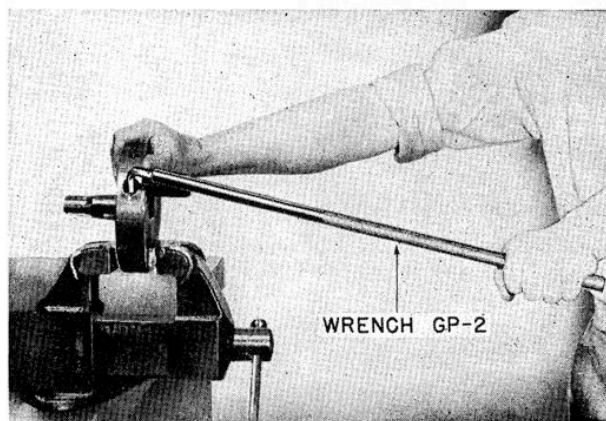


FIG. 16—REPLACING CRANKSHAFT CRANK PIN

d. Place thrust washer on crank pin, then follow with connecting rod.

e. Using light film of vaseline or equivalent, insert 25 needle bearings between connecting rod and crank pin, then put the remaining thrust washer onto the pin.

f. Install the other half of crankshaft loosely on the crank pin, then insert aligning tool GP-1 in drilled holes in crankshaft. (See figure 17.)

g. Place a .020 feeler gage between side of connecting rod and thrust washer.

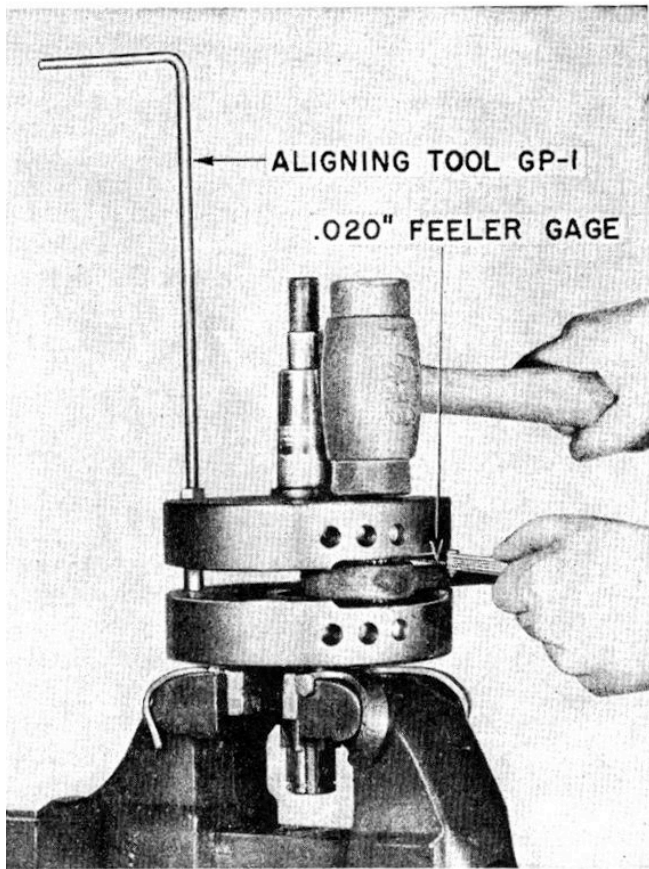


FIG. 17.—MEASURING CLEARANCE BETWEEN CONNECTING ROD AND THRUST-WASHER

- h. With .020 feeler gage in place, press both crankshaft halves together and tighten set screw using wrench GP-2, exerting a pull of 60 lbs. at end of wrench.

NOTE

1. FROM ENGINE SERIAL #B66-1220 TO P66-4200 Part #5010 (STRAIGHT TYPE) CRANKPIN WAS USED.
 2. FROM ENGINE SERIAL #B66-4201 and up, two "step type" crankpins were used, the first being of one-piece construction and the latter of a two piece construction both serviced under Part #5427. This type crankpin automatically sets the needle clearance.
- i. Remove feeler and aligning tool, then recheck for .020 clearance between connecting rod and thrust washer.
- j. When replacing crankpin Part #5427. Make certain that aligning tool GP-1 is inserted in drilled holes in crankshaft halves.

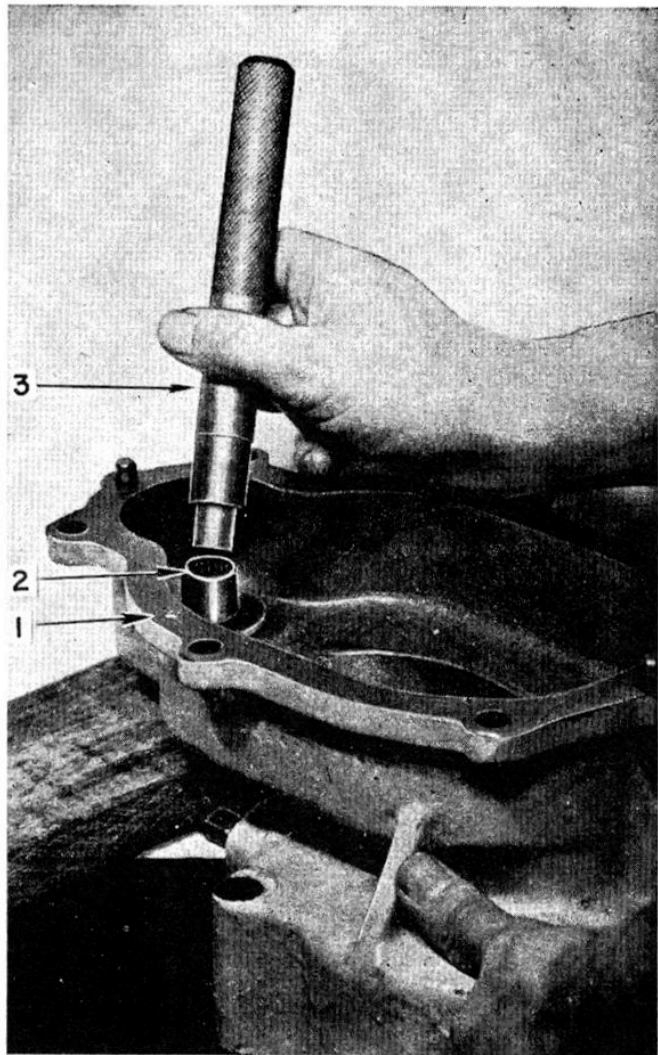


FIG. 18.—INSTALLING MAGNETO DRIVESHAFT BEARING IN CRANK CASE

1. Crankcase—rear half
2. Magneto—shaft bearing
3. Driver GP-7

- k. Use tap drill "Q" (332) 3/4 deep and tap 1/2" deep on both side of crankpin and crankshaft halves. Drilling in new location will not effect the balance of crankshaft assembly.

2-29. ASSEMBLE CRANKCASE AND CRANKSHAFT.

- a. Install magneto drive-shaft bearing in rear crankshaft housing, using driver GP-7. (See figure 18.)
- b. Place crankshaft in front crankshaft (blower) housing with tapered end of crankshaft forward.
- c. Coat matching crankcase surfaces with Aviation No. 3 Permatex, then fasten rear crankcase to front crankcase using four cap screws and lock washers to draw case together.

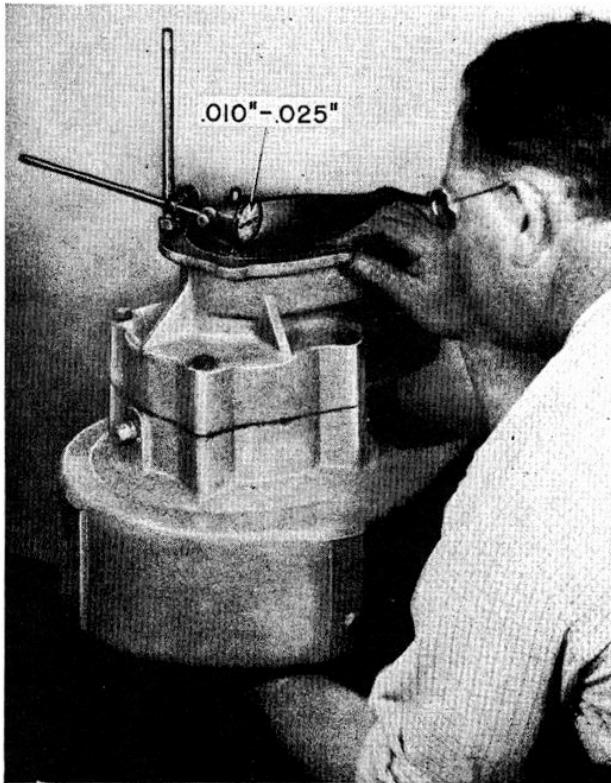


FIG. 19—MEASURING CRANKSHAFT END-PLAY

- d. With dial indicator mounted in position as shown in figure 19, touching end of crankshaft, check end play by moving shaft up and down.

NOTE

Rototiller Serial Nos. B66-4201 and up are equipped with a new

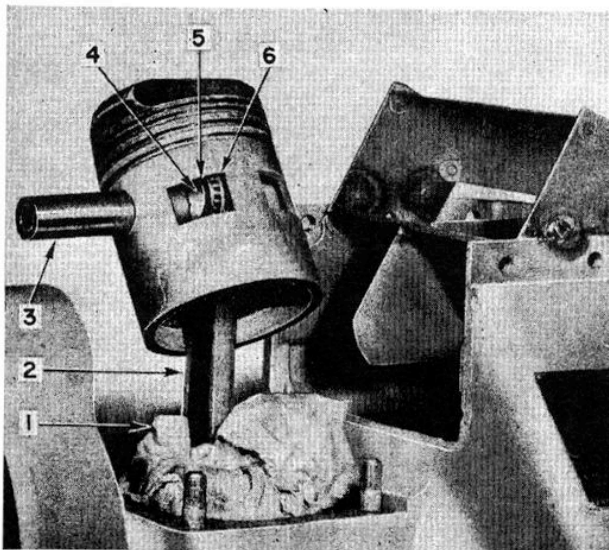


FIG. 20—INSTALLING PISTON PIN

1. Rag (to prevent needles from dropping into crankcase)
2. Connecting Rod
3. Piston Pin
4. Arbor GP-9
5. Thrust Washer
6. Needle Bearings (22 required)

type crankpin Part #5427, which automatically provides the correct end play and needle bearing clearance.

- e. If end play exceeds .025 inch, loosen set screw on one (either) half of crankshaft, and increase clearance between connecting rod and thrust washer by spreading the halves slightly. This will decrease the amount of end play in the crankshaft which should be from .010 to .025 inch.

NOTE

When making this adjustment use aligning tool GP-1 to keep crankshaft halves in alignment.

2-30. ASSEMBLE PISTON PIN AND RINGS.

- a. Wrap a rag around connecting rod and over opening in crankcase; then place pilot tool GP-9 in piston-pin end of connecting rod. Insert 22 needle bearings between rod and pilot tool, then place thrust washers on both sides of needle bearing.
- b. Heat piston in oil to 150 degrees F then place over needles and thrust washers, taking care that piston ports face the right hand side of engine looking forward. Insert piston pin, forcing pilot through opposite of piston boss.

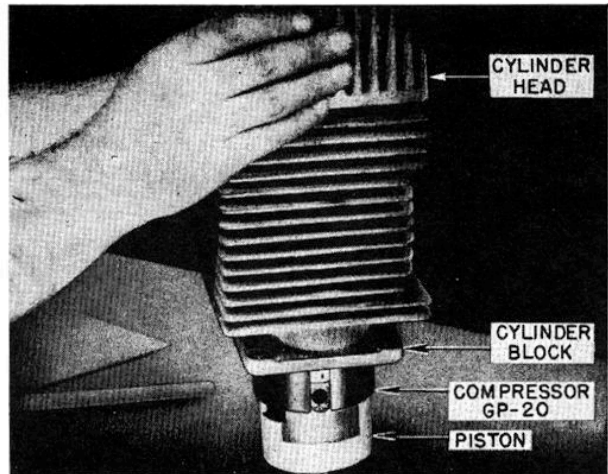


FIG. 21.—INSTALLING CYLINDER BLOCK ONTO PISTON

- c. Install a snap ring in each piston boss using plier GP-13. (See figure 20.)
- d. Install rings on piston with tool GP-C-266 so that each ring gap fits the staking pin in each ring groove.

NOTE

The piston assembly shown in figure 20, shows the gaps of the upper and lower rings in proper position entered on each staking pin. The center ring gap should be centered on the pin on the other side of the pistons.

2-31. INSTALL CYLINDER BLOCK.

- a. Loosen four crankcase cap screws which fasten crankcase halves together, so that cylinder block will slip freely over studs.
- b. Install cylinder block gasket.
- c. Remove plug from front crankcase half, then turn crankshaft until holes line up. Insert bolt or aligning tool through holes to keep shaft from turning.
- d. Slip cylinder block over piston, using ring compressor GP-20 to guide piston into cylinder.

NOTE

Cylinder block exhaust and intake ports must face left side of engine, looking forward.

- e. Tighten the four crankcase cap screws, and install cylinder block washers and nuts, then tighten evenly.
- f. Replace plug in front half of crankcase.

2-32. INSTALL STARTING DOG AND FLYWHEEL FAN.

- a. Install two keys on front end of crankshaft.

- b. Install blower fan and starting dog. Install washer and lock nut (left hand thread).

2-33. INSTALL DRIVE GEAR.—Place drive gear on end of crankshaft, and secure in place with two new type snap rings, Part No. 5430 in place of the single snap ring Part No. 5024. (Refer to Service Bulletin No. 4)

2-34. ENGINE INSTALLATION.

2-35. INSTALL ENGINE.—Refer to paragraph 1-14.

2-36. INSTALL FUEL TANK ASSEMBLY.—Refer to paragraph 1-21.

2-37. TIME MAGNETO TO ENGINE. — Refer to paragraph 1-19.

2-38. INSTALL CARBURETOR, MUFFLER, AND MANIFOLD.—Refer to paragraph 1-22.

2-39. REPLACE STARTER AND COOLING FAN HOUSING.—Refer to paragraph 1-23.

2-40. CONNECT THROTTLE CONTROL.—Refer to paragraph 1-26.

SECTION III

Engine Lubrication

3-1. FUEL AND LUBRICATING OIL MIXTURES.—

All moving parts of the engine are lubricated by oil mixed with gasoline. It is therefore of the utmost importance that only the finest quality of SAE engine oil be used to mix with the gasoline. Never pour oil or gasoline into the fuel tank without first thoroughly mixing them. Make certain that oil is clean and also the container used for mixing and the funnel for pouring.

- a. More than 1/2 pint of oil to each gallon of gasoline is not necessary except during the "breaking-in" period, a mixture exceeding the recommended portions may cause hard starting, excessive smoking of the engine, excessive carbon formation and possible fouling of the spark plug.
- b. For temperatures below 70 degrees F, mix one pint of finest grade SAE 40 engine oil with each gallon of gasoline used during the first 50 hours of operation. Reduce oil to 1/2 pint per gallon after the first 50

hours of operation. For temperatures above 70 degrees F, mix one pint of finest SAE 50 engine oil with each gallon of gasoline used during the first 50 hours of operation. Reduce oil to 1/2 pint per gallon after the first 50 hours of operation.

NOTE

Too much emphasis can not be given to the matter of oil selection. High grade oil of the body suited to the requirements of the Rototiller engine is the most important single item in the economical operation of the unit, yet it is the cheapest item of operating cost. Select your oil solely on quality and suitability, never on price. Unapproved lubrication is sure to bring unsatisfactory performance and unnecessary expense.

SECTION IV

Fuel System

4-1. **FUEL TANK.**—The fuel tank is constructed of two halves welded and soldered together at the central flanges. The threaded adapter which extends from the lower rear, is soldered to the inside of the tank. If fuel will not flow freely into the fuel strainer, the fuel tank cap vent should be cleared. If this does not remedy the trouble, the tank should be removed, flushed thoroughly with clean gasoline, and then blown clear with compressed air.

4-2. FUEL STRAINER

4-3. **DESCRIPTION.**—The fuel strainer provides an effective means for filtering the fuel mixture before it reaches the carburetor. Fuel flows through the shut-off valve directly into the glass sediment bulb and upward and through the strainer screen into the carburetor fuel line. The fuel strainer should be disassembled and cleaned when dirt or water is visible in the sediment bulb.

4-4. DISASSEMBLY AND CLEANING.

- a. Close gasoline cut-off needle valve by turning it to the right until tight.
- b. Loosen clamping thumb-screw beneath sediment bowl.
- c. Remove sediment bowl and fine wire-mesh strainer screen; clean thoroughly.

CAUTION

Care should be taken not to puncture the strainer screen.

4-5. INSTALLATION.

- a. If the cork gasket is dried out, cracked, or broken, replace with a new one.
- b. To replace strainer, reverse procedure in paragraph 4 preceding, taking care to seat bowl and gasket properly with screen on top of cork gasket next to main body of assembly. Tighten clamping thumb-screw securely.
- c. Open gasoline cut-off valve by turning approximately four full turns to the left.

NOTE

If any leakage of gasoline at needle valve is evident, tighten packing nut on valve body.

4-6. CARBURETOR AIR CLEANER.

4-7. **DESCRIPTION.**—The oil-bath type air cleaner on B1-6 and B1-6RS is bracket mounted to the left side of the handle-bar bracket. On the B1-7 and B1-7RS models the air cleaner is bracket mounted to the left side of the fuel tank. Air enters the cleaner through the holes in the upper body and is directed downward to the oil cup. As the incoming air is forced to reverse its direction of flow immediately above the surface of the oil, the heavier particles of dust are carried into the oil by the momentum. The air then is drawn upward through a copper gauze filter-element where the remaining dust is removed, then to the carburetor through the air hose. The air cleaner should be removed and thoroughly cleaned, every 250 hours of operation.

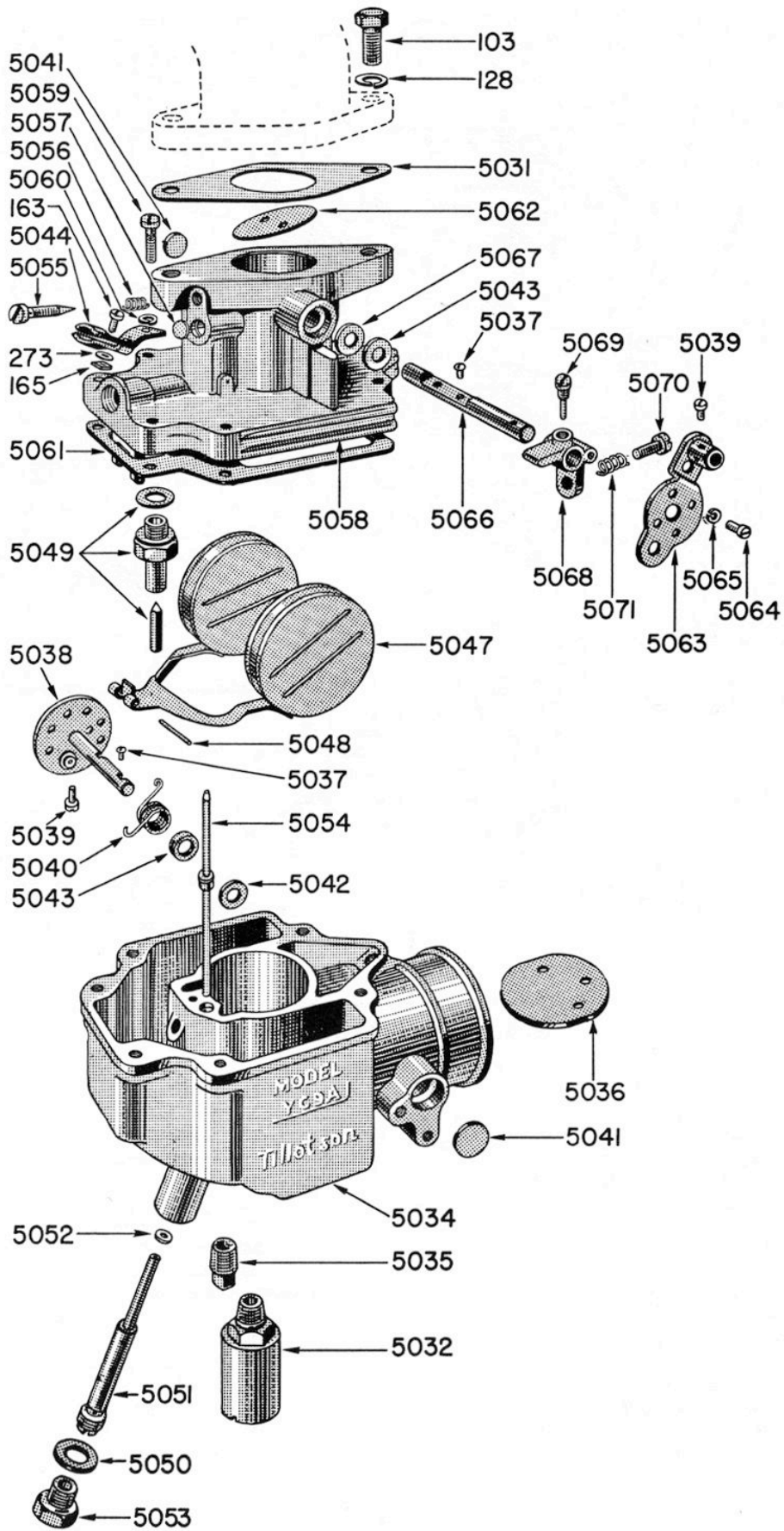
IMPORTANT

Empty and clean the oil cup daily or more often under severe dust conditions. Refill with clean engine oil SAE 10 or 20 for cold weather, SAE 30 for warm weather, and SAE 40 for extremely hot weather.

4-8. REMOVAL AND MAINTENANCE.

- a. Disconnect hose from air cleaner to carburetor, then remove 3 cap screws which secure air cleaner bracket to handle-bar base. On B1-7 and B1-7RS models disconnect air hose from air cleaner to carburetor, then loosen clamp which secures air cleaner to bracket.
- b. Remove lower cup from air cleaner then wash cup and interior of main body in kerosene.
- c. Examine screen-mesh side of body for freedom from dirt, dust, and foreign matter, then blow out with air pressure.

4-9. **INSTALLATION.**—Secure air cleaner bracket to handle-bar base with 3 cap screws and lock washers, on B1-7 and B1-7RS models clamp air cleaner to bracket, then connect air hose to pipe. Refill cup with proper grade of oil up to mark, and replace in lower end of air cleaner making certain that both clips are engaged.



EXPLODED CARBURETOR ASSEMBLY

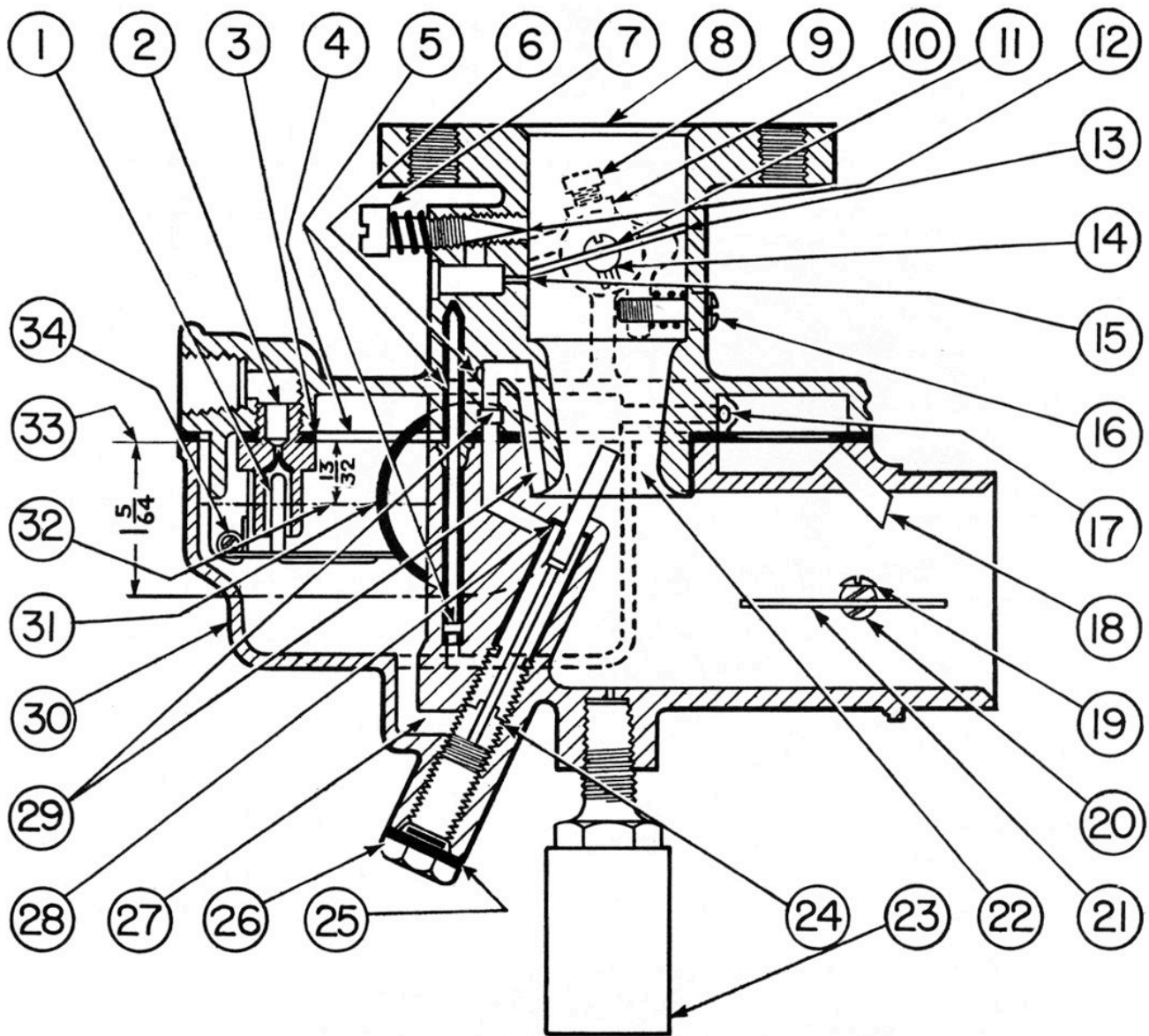


FIG. 22—CARBURETOR THEORY

- | | |
|-----------------------------------|---------------------------------------|
| 1. Inlet needle | 18. Bowl vent |
| 2. Inlet seat | 19. Split screw |
| 3. Inlet seat gasket | 20. Choke shaft |
| 4. Body gasket | 21. Choke shutter |
| 5. Idle tube and fuel restriction | 22. Venturi |
| 6. Idle air bleed | 23. Fuel vapor dispenser |
| 7. Idle mixture adjusting screw | 24. Main nozzle |
| 8. Throttle body | 25. Nozzle plug gasket |
| 9. Set-screw | 26. Nozzle plug |
| 10. Throttle lever stop | 27. Main supply channel |
| 11. Split screw | 28. Main nozzle gasket |
| 12. Idle discharge port (Upper) | 29. Air bleed channel and restriction |
| 13. Throttle shutter | 30. Carburetor body |
| 14. Throttle shaft | 31. Float |
| 15. Idle discharge port (Lower) | 32. Fuel level |
| 16. Idle speed regulating screw | 33. Float setting |
| 17. Internal bowl vent | 34. Float pin |

4-10. CARBURETOR

4-11. DESCRIPTION AND THEORY OF OPERATION. (See figure 22). The Tillotson Updraft Carburetor (YC Series) is sturdily built and carefully designed for industrial requirements. No external air bleed holes are required, as all air is taken through the air horn, which equalizes or balances internal air pressure thus preventing rich nozzle metering due to a clogged air cleaner. The idle mixture is controlled by an adjusting needle; all other speed mixtures are controlled by a fixed jet. A fuel vapor dispenser which prevents flooding also aids in dissipating water condensation, and promotes vaporization of the fuel and oil mixture.

A constant fuel level is maintained in the bowl and channels of the carburetor by the needle (1) and seat (2) assembly and floats (31). When the engine is idling, gasoline reaching its level, passes from channel (27) through the main nozzle (24) and into the idle tube (5). Suction at the throttle shutter (13) draws fuel up through this tube where it is mixed with air, at idle air bleed (6). The mixture continues upward where it enters the air stream at the upper idle discharge port (12) and mixes with the additional air passing the slightly opened throttle shutter (13).

At slow speeds, which necessitates

opening the throttle shutter further, the mixture is drawn from the lower idle discharge port (15).

When pulling a load or operating at high speed, with throttle shutter (13) opened, suction at the shutter is reduced, which minimizes fuel discharge at the upper discharge port (12). In addition, air velocity through the venturi (22) is increased to its maximum, which draws additional fuel from main nozzle outlet (24). As engine-speed or load increases, air is automatically bled into the main nozzle through the channel and restriction (29) causing a correct fuel mixture to be metered under all conditions of speed or load.

4-12. CARBURETOR SPECIFICATIONS.

Size 7/8"
 Type Updraft
 Choke Universal, Spring-Loaded
 Adjustments Idle Speed and Idle Mixture
 Floats Two attached to One Lever,
 Centered on Main Nozzle.
 Concentricity Will Operate when Tilted
 up to 50 degrees.
 Balance All Internal Pressures Equalized
 Bushings Steel, at Throttle Shaft
 Casting Metal Zinc Die-Casting Only;
 Cronak Treated to
 Resist Corrosion
 Weight 2 1/8 lbs.

4-13. TROUBLE SHOOTING

Trouble	Probable Cause	Remedy
ENGINE FAILS TO IDLE	Idle speed regulating screw loose Idle tube dirty. Worn throttle shaft or seal permits excessive air to enter the carburetor at the throttle.	Remove screw and stretch spring until tension is sufficient to hold screw in place when properly adjusted. Remove upper carburetor body from lower, then clean channel and tube with compressed air. Replace worn parts with new ones.
ENGINE STALLS	See "Engine Fails to Idle" above. Fuel level in bowl too high.	Adjust floats as directed in paragraph 4-21. If floats are set correctly and indications are that the fuel level is still higher than 13/32" below the upper rim of the bowl, remove the inlet needle and seat assembly and clean with a soft cloth. Place the needle on the inlet seat and tap gently while rotating the needle between thumb and forefinger to insure a new seating surface. Reassemble then if fuel level is still too high, replace with a new assembly.
POWER FAILURE	Choke shutter partially closed. Main nozzle loose in seat. Main nozzle dirty.	Shutter must be wide open except when starting or warm-up the engine. Adjust choke control linkage as directed in paragraph 4-32. Tighten, using a narrow-bladed screw driver. Remove nozzle after unscrewing plug, then remove dirt from base and blow compressed air through air-bleed channel.
	Fuel line obstructed.	Remove fuel line at carburetor and check for free flow of fuel. If no obstruction is found, clean fuel strainer as directed in paragraph 4-4.

4-14. CARBURETOR REMOVAL AND DISASSEMBLY.

4-15. REMOVAL OF CARBURETOR.

- a. Shut off gas supply at valve under fuel tank.
- b. Disconnect throttle control wire and housing, at carburetor.
- c. Disconnect fuel line at carburetor.
- d. Disconnect air cleaner-to-carburetor air tube, at carburetor.
- e. Disconnect carburetor from intake manifold and while removing it, disconnect the choke control wire and housing from the carburetor.
- f. Remove carburetor-to-intake-manifold gasket.

4-16. REMOVAL OF THROTTLE SHUTTER

AND SHAFT.—(Refer to Figure 22).

- a. Remove set screw (9) from throttle lever stop (10), then remove the throttle level and the stop together.
- b. Mark the shutter with a prick-punch so that the side facing out can be identified.
- c. Remove two split screws (11) which fasten throttle shutter to shaft. (The two screws may bind when removing due to being spread when installed.)
- d. Remove throttle shaft (14), seal, and retaining washer.

4-17. REMOVAL OF CHOKE SHUTTER AND SHAFT.

- a. Remove two cap screws which secure choke shutter (21) to shaft (20), and remove shutter through air intake.
- b. Allow choke shaft to unwind on spring, then remove shaft assembly. Remove spring from shaft.
- c. Remove shaft seal and retaining washer from carburetor body.

4-18. CARBURETOR DISASSEMBLY.

- a. Remove six cap screws which fasten throttle body (8) to carburetor body (30) and remove throttle body assembly.
- b. Remove the float-lever pin (34) and lift out the float (31) and needle (1) then remove the carburetor throttle-body gasket (4).
- c. Remove needle valve seat (2) and gasket (3).
- d. Remove idle adjusting screw and spring (7).
- e. Remove idle tube (5) from carburetor body.
- f. Remove main discharge nozzle plug (26) and gasket (25) from under side of carburetor.

4-19. CARBURETOR MAINTENANCE.

4-20. CLEANING.—To obtain maximum efficiency from this carburetor, it must be kept free of dirt, grit, and water. When cleaning, use compressed air; never use a wire or fine drill for small holes. Where compressed air is not available a wooden toothpick may be used. The carburetor bowl may be cleaned and then flushed and drained through the

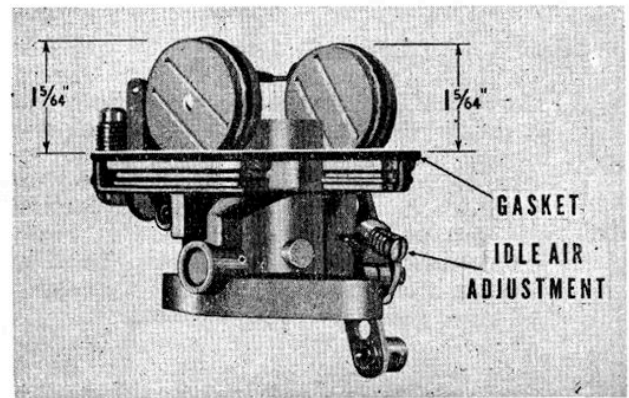


FIG. 22—FLOAT SETTING

- plug at the bottom of the bowl.
- 4-21. FLOAT LEVEL.—Turn upper body assembly upside down, and with float lever resting on the inlet needle, carefully bend each lever arm so that the distance between the face of the body gasket and the top of the raised seam encircling each float is 1-5/64". (See figure 23).

NOTE

This measurement is critical and must be maintained for both floats to obtain proper performance.

- 4-22. FUEL VAPOR DISPENSER (23).—Immerse in clean solvent, then blow dry with compressed air.
- 4-23. INLET NEEDLE (1). (Refer to Figure 22).—Inspect for ridges or any defect which could prevent proper seating.
- 4-24. THROTTLE SHAFT (14).—If shaft is badly worn so that excessive air enters the carburetor at the throttle, replace with new shaft.
- #### 4-25. CARBURETOR ASSEMBLY AND INSTALLATION.
- 4-26. ASSEMBLY OF THROTTLE SHUTTER AND SHAFT.
- a. Insert throttle shaft (14) with long end out, on the same side as idle adjusting screw, (7), flat side up. Replace shaft seal and retaining washer.
 - b. Install throttle lever and stop (10) on throttle shaft (14), lining up hole for set screw (9). Install set screw and tighten.
 - c. Place throttle shutter (13) in position with prick-punch mark showing, and tighten securely. Screw-ends (11) are split, and are to be spread after tightening. This may be done with a screw driver through the venturi (22), then operate the throttle making sure that it does not bind or stick in any position.
 - d. Close valve tightly and hold up to a light to check for full closure with the idle speed adjusting screw backed off. If shutter is not centered, loosen screws (11), then close the shutter tightly, then re-tighten the screws.

4-27. ASSEMBLY OF CHOKE SHUTTER AND SHAFT.

- a. Install choke valve lever return-spring onto choke shaft assembly, straight end of coil spring first, then insert straight end of spring into hole in choke lever that lines up with spring.
- b. Install choke shaft assembly into the carburetor body and rotate shaft until hook of spring contacts pin; continue turning shaft approximately 1/4-turn, putting tension on spring, or until flats on the shaft face up.
- c. Insert choke shutter (21) through slot in shaft (20) with hole side facing out.
- d. Line up holes in shaft and shutter by holding in closed position, then tighten screws (19) securely.
- e. Permit shutter to open under spring tension, then spread screw shanks (19).

4-28. REASSEMBLY OF CARBURETOR.

- a. Install a new fibre gasket (28) on main nozzle (24); install in carburetor body using a screw driver of correct width and tighten securely.

CAUTION

Be sure that old gasket was not left in body of carburetor when nozzle was removed. More than one gasket will cause excessive fuel consumption.

- b. Install discharge nozzle plug (26) and gasket (25); tighten securely.
- c. Inspect fuel vapor dispenser (23). If damaged, replace with a new one and install in bottom of carburetor.
- d. Install idle tube (5) into body of carburetor with tapered end up.
- e. Install needle valve seat (2) and gasket (3) into throttle body and tighten.
- f. Check needle valve (1) for ridges; install in seat.
- g. Install gasket (4) onto throttle body.
- h. Install float (31) and float pin (34).
- i. Install throttle body (8) to carburetor body (30) taking care not to damage idle tube (6) as it enters throttle body.
- j. Place throttle and choke control clamps in position and tighten screws evenly.
- k. Install idle adjusting screw and spring (7); tighten until screw bottoms, being careful not to damage needle. Back screw out from 1-1/2 to 2 turns.

4-29. INSTALLATION.

- a. Install choke control cable into choke control bracket so that housing just extends through bracket, then clamp in position. Thread choke-wire through choke lever swivel, and clamp with set screw.

- b. Using a new carburetor-to-intake-manifold gasket, bolt carburetor to intake manifold.
- c. Connect air cleaner-to-carburetor tube making sure that connections are tight. (Inspect tube; if cracked or damaged replace.)
- d. Connect fuel line at carburetor, then turn on shut-off valve under fuel tank. Inspect for leaks in fuel line, then close valve.

4-30. CARBURETOR.

4-31. THROTTLE CONTROL. — Connect throttle control cable to carburetor in the following manner:

- a. Clamp housing so that it extends through bracket.
- b. Insert wire, through swivel on carburetor throttle lever.
- c. Move throttle control lever on right handle bar, to full closed position (toward operator) and then move throttle forward until 1/16" to 1/8" clearance exists between throttle and handle bar.
- d. Move throttle lever on carburetor to full closed position (rearward) and tighten swivel set-screw to lock control wire in place securely.
- e. Operate throttle to check for restrictions, then start engine and set idle speed with adjusting set-screw (9) to 600 rpm.

4-32. CHOKE CONTROL.

- a. Loosen choke wire clamp screw at swivel then place choke lever in wide open position.
- b. Push choke control in, as far as it will go, then hold in this position and clamp wire at lever swivel.
- c. Check choke button operation.

4-33. IDLE MIXTURE.

- a. With engine idling at about 600 rpm, turn adjusting screw (7) until engine runs evenly.
- b. Open throttle and run engine fast for a few seconds to clear manifold, then reset idling speed to 600 rpm.
- c. Recheck idle mixture if necessary.

4-34. EXHAUST MANIFOLD. — The combination intake and exhaust manifold conducts the carburetor fuel mixture to the cylinder, and the engine exhaust to the muffler. Keep the mounting nuts and cap screws tight, and replace gaskets when leakage is evident.

4-35. MUFFLER.—The exhaust muffler is designed to minimize the exhaust pressure as well as deaden the engine detonations. Inspect the copper cap screws which fasten the muffler to manifold for tightness, frequently.

SECTION V

Cooling System

5-1. **DESCRIPTION.**—The cooling system is designed and engineered to provide ample engine cooling under full load condition, when in the stationary position as well as in field operation. The air is drawn through the grill in the starter housing by the blower type fan on the front end of the crankshaft, which also serves as the engine flywheel. The air is forced through an opening on the upper right side of the fan housing, and passes through the control fins or deflectors into the sheet metal fuel tank support, which also serves as a shroud. This arrangement conducts the air flow over, around, and through the cooling fins on the engine.

In order to prolong the life of the engine, it is necessary to keep the system free from dirt which will prevent the proper dissipation of heat, and defeat the purpose of the cooling system.

5-2. COOLING SYSTEM MAINTENANCE.

- a. Remove starter assembly after unscrewing two cap screws which secure it to front of engine.
- b. Wash blades of cooling fan with kerosene to remove all dirt and foreign matter, blow dry with air pressure and check for cracked or broken blades.
- c. Disconnect choke wire at carburetor.
- d. Shut off gas flow at needle valve and disconnect fuel line below tank, at sediment bowl.
- e. Remove six 1/4" machine screws which hold fuel tank support to fan housing.
- f. Remove fuel tank and support from engine, avoid spilling fuel.
- g. With a stiff bristle brush and kerosene, thoroughly clean all dirt and foreign matter from cooling fins on cylinder and cylinder head.
- h. Replace fuel tank and starter assembly by reversing procedure in steps f, e, d, c and a, preceding.

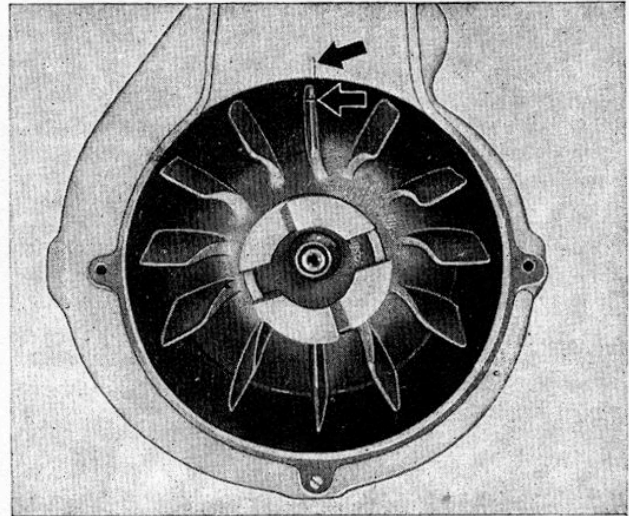


FIG. 24—COOLING SYSTEM

SECTION VI

Ignition System

6-1. GENERAL DESCRIPTION.

a. **MAGNETO.**—The magneto is an electrical generating device designed to produce controlled electric-spark discharges. These discharges, which must be of sufficient intensity to meet the ignition requirements of the Rototiller Power Tiller internal combustion engine, are produced independently of any external source of electric power. The magneto depends solely upon the mechanical energy supplied by hand cranking, which obviates the need for a heavy battery or the generating system to keep it charged.

To increase engine starting efficiency, an impulse-starter mechanism has been incorporated with the magneto, which rotates the magneto shaft much faster than the engine cranking speed, thereby producing a high-intensity spark for cranking purposes. This device functions only at cranking speeds and automatically retards the ignition spark while in operation.

b. **SPARK PLUG.**—The actual ignition spark which occurs in the engine cylinder, takes place between the electrodes of the spark plug; therefore, the importance of the type and the condition of the plug should never be over-estimated. The spark plug used in the Rototiller Power Tiller engine is commonly referred to as the "cool", type of plug, all spark plugs being classified into five groups; "hot", "warm", "normal", "cool", and "cold". "Cold" plugs are fitted with short insulators which quickly carry heat from the core, while "hot" plugs are fitted with long insulators which dissipate the heat slowly.

The center electrode is generally made of a nickel alloy wire, while the insulator in which it is set, is usually made of porcelain. The insulator possesses high electrical and heat resistance to mechanical pressure.

6-2. THEORY OF OPERATION.

Current generation begins in the primary (low tension) circuit when relative movement of the primary winding and the interlocking magnetic field occurs.

The current in the primary coil winding builds a magnetic field which permeates the turns of the secondary coil winding, this field reaching its peak simultaneously with the primary current. Breaker point action interrupts the current flow at the instant of maximum field, and causes the immediate and complete collapse of the magnetic field existing in the coil. The self-induced voltage occurring in the primary winding as a result of

the breaker interruption of the primary circuit, is received by the condenser which is connected across the breaker points. This action induces a more rapid collapse of the primary field, and reduces arcing with consequent contact point burning.

The high ratio of turns in the coil secondary winding to those of the primary, induces a very high voltage in the secondary, since each line of force in collapsed primary field cut the turns of the secondary winding. The secondary circuit or high tension is established when this induced voltage is high enough to jump the gap between the spark plug electrodes.

6-3. TROUBLE SHOOTING CHART.

TROUBLE	POSSIBLE CAUSE	SUGGESTED REMEDY
A. Flooding	Hot or cold engine, over rich fuel mixture.	Dry out cylinder, crank engine slowly, fuel shut-off; or let engine stand idle for short interval.
B. Insufficient fuel or air.	Empty fuel tank; clogged fuel supply line; clogged air intake.	Replenish fuel; clean fuel supply system and check carburetor; clean air intake system.
C. Ignition Connections.	Loose or corroded terminals; broken cable; short circuited switch.	Clean or replace cable terminals; inspect soldered or clamped joints; test and replace cable; check ignition switch.
D. Spark Plug	Corroded, worn or damaged points; cracked or carbonized insulation.	New plug; clean points and insulator, adjust points to recommended opening; never attempt to adjust center electrode.

6-4. REMOVAL AND DISASSEMBLY OF FAIRBANKS-MORSE MAGNETO.

NOTE

Before attempting any repairs, remove all external dirt and provide a clean pan into which the parts may be placed as they are removed.

- 6-5. REMOVE MAGNETO. — Remove two cap screws which secure magneto to transmission and lift off while disengaging the coupling floating member.
- 6-6. REMOVE MAGNETO END COVER (5).—Remove four screws, lock washers, and flat washers (4) which fasten end cover (5) to magneto. Remove gasket (6).
- 6-7. REMOVE CONTACT POINT ARM (48).—Remove screw (44) and lock washer (43) from terminal at moveable contact point arm spring (46); then lift out arm (48).
- 6-8. REMOVE WICK (54).—Remove screw, (52), lock washer, and flat washer (53), then lift out wick and spacer (54).

- 6-9. REMOVE CONDENSER (2).—Remove screw, lock washer, and flat washer (1), then lift out condenser (2).

- 6-10. REMOVE STATIONARY CONTACT BRACKET (49).—Remove screw, lock washer and flat washer (47) which fasten bracket and point (49) to bearing plate (50) and lift out. Remove adjusting screw (45).

- 6-11. REMOVE FRONT BEARING PLATE (50). — Remove four screws (51) then carefully pry and lift out bearing plate (50) and bushing (41).

- 6-12. REMOVE MAGNETO MOUNTING PLATE.—Remove four cap screws and lock washers from under side of magneto and remove mounting plate.

- 6-13. REMOVE IMPULSE COUPLING SHELL (23).

- a. Place contact point end of Rotor in vise equipped with leaded jaws, then bend lip of lock washer (25) away from nut (26) holding impulse coupling shell (23); remove nut and lock washer using pliers, lift out impulse coupling shell complete with drive spring (24).

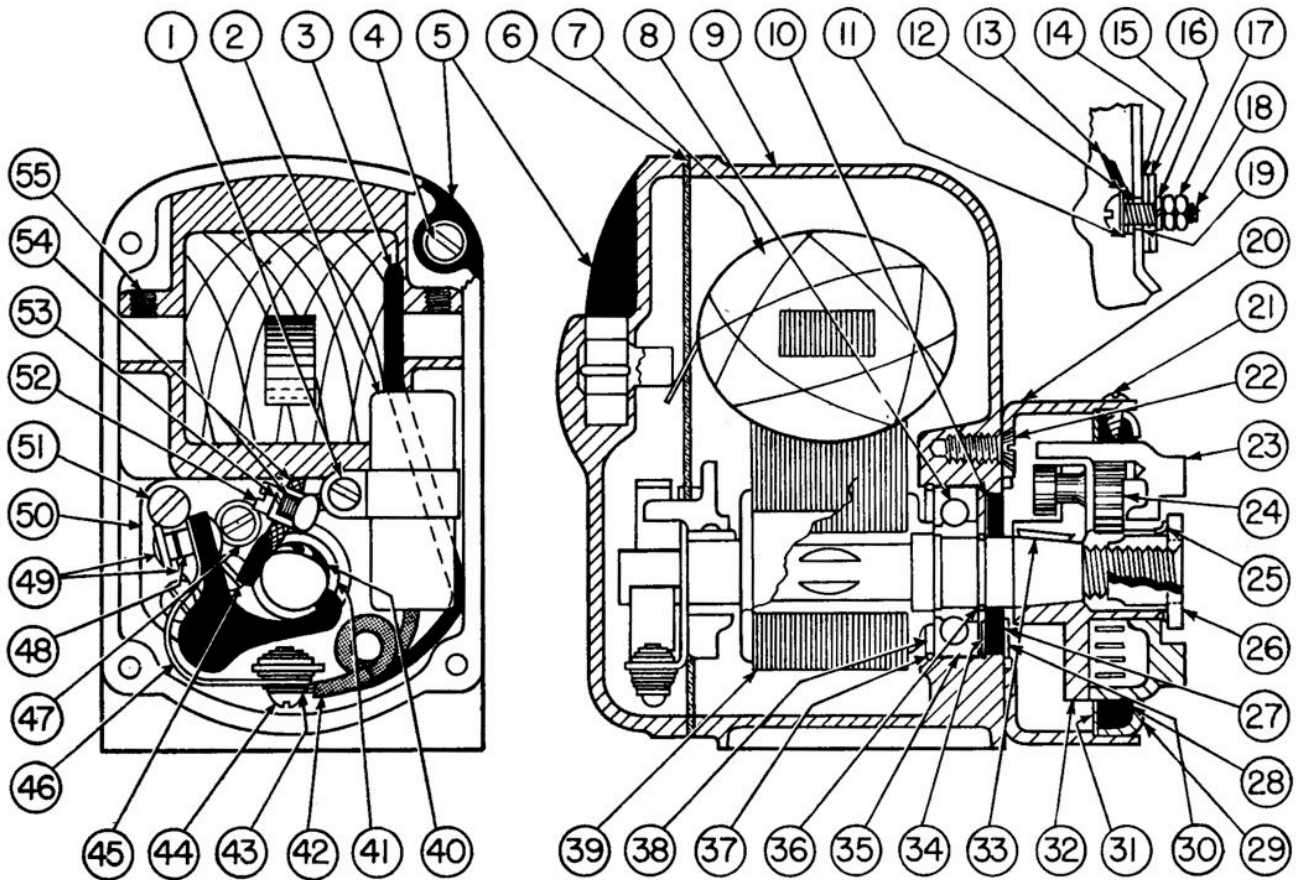


FIG. 25—NOMENCLATURE LIST FOR FAIRBANKS-MORSE MAGNETO

- | | |
|--------------------------------------|---------------------------------------|
| 1. Screw, Lock Washer, & Flat Washer | 28. Felt Washer |
| 2. Condenser | 29. Cupped Washer |
| 3. Primary Terminal | 30. Rubber Seal |
| 4. Screw, Lock Washer, & Flat Washer | 31. Flat Washer |
| 5. End Cover | 32. Coupling Hub |
| 6. Gasket | 33. Key |
| 7. Field Coil | 34. Insulating Washer |
| 8. Thrust Bearing | 35. Insulating Strip |
| 9. Magneto Housing | 36. Snap Ring, Rotor Shot |
| 10. Thrust Washer (Inner) | 37. Snap Ring, Bearing |
| 11. Flat Washer | 38. Insulating Washer |
| 12. Insulating Washer | 39. Rotor |
| 13. Ground Wire | 40. Cam |
| 14. Insulating Washer | 41. Sleeve Bearing |
| 15. Flat Washer | 42. Condenser Terminal |
| 16. Lock Washer | 43. Lock Washer |
| 17. Nut | 44. Screw |
| 18. Ground Terminal Screw | 45. Adjusting Screw |
| 19. Insulating Bushing | 46. Spring |
| 20. Impulse Starter Housing | 47. Screw, Lock Washer, & Flat Washer |
| 21. Self-Tapping Screw | 48. Contact Point Arm (Moveable) |
| 22. Screw | 49. Bracket & Stationary Point |
| 23. Impulse Coupling Shell | 50. Front Bearing Plate |
| 24. Drive Spring | 51. Screw |
| 25. Special Lock Washer | 52. Screw (Wick) |
| 26. Nut | 53. Lock Washer & Flat Washer |
| 27. Thrust Washer (Outer) | 54. Wick and Spacer |
| | 55. Screw (Field Coil) |

- 6-14. REMOVE COUPLING HUB (31). — Replace coupling nut (26) and turn down tight, then back off one turn. Using pliers, grip coupling hub (32) and pry up while tapping nut with soft hammer. Lift hub from Rotor taper then remove nut (26), hub (32), and key (33).
- 6-15. REMOVE IMPULSE STARTER HOUSING (20).
- Remove two self-topping screws (21), then using a screwdriver, pry out cupped washer (29) and lift out felt washer (28) and flat washer (31).
 - Remove two screws (22) which fasten impulse starter housing (20) to magneto, then lift off housing.
- 6-16. REMOVE ROTOR (39).
- Remove outer thrust washer (27) then pry out rubber seal (30), and inner thrust washer (10).
 - Using a screwdriver remove outer snap ring (36) from rotor shaft.
 - Using a fibre hammer, tap rotor from bearing (8), then remove it from housing.
- 6-17. REMOVE ROTOR THRUST BEARING (8).
- Remove inner snap ring (37) using long nosed pliers.
 - Lift out the insulating washer (34), then tap bearing (8) toward magneto body and remove.
 - Lift out bearing insulating strip (35) and the remaining insulating washer (38).
- 6-18. REMOVE FIELD COIL (7).—Using a narrow bladed screwdriver loosen the two screws (55) in top of magneto body then lift out coil.

NOTE

It will be necessary to tap screwdriver lightly to loosen the screws.

- 6-19. REMOVE GROUND WIRE AND TERMINAL.
- Remove nuts (17) from ground wire terminal screw (18), then remove lock washer (16) flat washer (15) and insulating washer (14).
 - From inside the magneto, remove terminal screw (18), ground wire (13), flat washer (11), insulating washer (12), and insulating bushing (19).
- 6-20. INSPECTION AND SERVICE FOR FAIRBANKS-MORSE MAGNETO.—Before inspecting and reassembling the parts, provide a pan of clean solvent, clean rags, and a stiff bristled brush. Do not soak felt parts or insulating material in solvent. Replace all gaskets and test all insulating parts electrically, before reinstalling them.
- 6-21. BREAKER POINT CONTACTS. — Examine contact surface carefully. If pitting or pyramiding is apparent, place contacts in a vise where a small tungsten file or fine stone may be used to recondition the surfaces.

NOTE

Contact points must be completely free from oil and grease of any kind. Clean with carbon-tetrachloride using a small brush.

In cases where contact surfaces cannot be renewed satisfactorily or where the breaker

arm rubbing block has worn excessively, replace with a new assembly. Improper functioning of the breaker arm spring, or loose fit or binding at the pivot bearing, are additional reasons for complete replacement.

- 6-22. CAM WICK.—Replace the cam wick whenever new breaker contact points are installed. Do not oil or grease a wick of this type since it is difficult to control the quantity of lubricant as well as match the original impregnation.
- 6-23. SLEEVE BEARING.—Long continued use of a magneto may eventually necessitate replacing the sleeve bearing (41) in the front bearing plate. Since bearing removal is not advisable without use of special tools and fixtures, a new bearing plate and bushing assembly should be installed. Because this bearing is of the porous factory-impregnated type, lubrication is not necessary.
- 6-24. BALL BEARING.—Using a clean solvent in a clean container, swish the bearings in the fluid, then revolve by hand while thus submerged. Compressed air, if completely dry may be used to finish the cleaning.

CAUTION

Never spin bearing with compressed air.

After removing bearings from the cleaning fluid, immerse in clean light oil and spin until all solvent has been removed.

Repack with medium-soft high melting-point grease; the quantity of grease used should not exceed 1/3 to 1/2 of the total capacity of the bearing. Too much grease is a common cause of bearing failure due to overheating.

- 6-25. IMPULSE COUPLING. — Clean the impulse coupling thoroughly, using solvent, dry with compressed air. Lubricate the drive spring with a small amount of high melting-point grease.
- 6-26. COIL.—Since urgent cases of magneto field service necessities coil checking without use of standard test equipment, the substitution type test must be used. If a new identical part is available, the questionable coil should be substituted by a new one and the magneto spark checked as directed in paragraph 7-42. If a test of the magneto spark then gives acceptable results, the original coil is probably at fault, although it should be checked when standard test equipment is available.
- 6-27. CONDENSER.—Test the condition of the condenser in a similar manner; replace the questionable condenser with a new unit of the same electrical value, then test the magneto spark. If magneto is then satisfactory, the original condenser is probably at fault although it should be checked when standard test equipment is available.

- 6-28. LEAKAGE PATHS.—The high voltage surge of the secondary (high tension) circuit occasionally jumps to ground by a different route than across the spark plug gap. Once such a path is established, the ignition spark is likely to continue on it. The following are the major causes of leakage paths:

1. Carbon or corrosion, moisture, dirt, within the magneto.
2. Broken cable or poor cable connections.
3. Too wide a spark plug point gap.
4. Too high engine compression.

A surface leakage path can usually be located because of the burning effect of the high voltage spark on plastic or other insulating materials.

Leakage paths may be cleaned from the surface of end caps and other similar parts, but their use thereafter should be limited to temporary service. Smoothing off sharp edges or corners will also help prevent sparking to ground across air gaps.

- 6-29. **CORROSION CAUSED BY OXIDATION.** — Continued high voltage arcing within the sealed magneto housing may result in oxidation, which can be a cause of complete failure. Interior corrosion is readily identified once the unit is opened, since it causes a green discoloration of copper and brass parts. A brown deposit is also usually found throughout the magneto, together with some evidence of moisture condensation. If corrosion is noticed in time, the cause should be located. Causes are as follows:

1. Spark gap across a loose connection in the secondary (high tension).
2. Excess jumping across the safety gap caused either by an incorrectly adjusted safety gap, or by a break in the wire to the spark plug.
3. Carbon paths within the magneto.

The magneto must be completely disassembled and each part thoroughly cleaned. Bearings are an especially difficult problem since the lubricant is usually also oxidized; in most cases it is preferable to replace the bearing. When cleaning metal parts, fine emery cloth may be used, while rotors may be buffed. Parts, so cleaned, should be blown completely free of dust particles, with compressed air. All gaskets, seals and washers must be replaced. Inspect bakelite parts for indications of carbon paths. Where there is evidence of flashover, the part must be discarded, since re-use may result in further oxidation.

- 6-30. **REASSEMBLY AND INSTALLATION OF FAIRBANKS-MORSE MAGNETO.** (See figure 25.)
- 6-31. **REPLACE GROUND WIRE AND TERMINAL.**
- a. Place insulating washer (12), flat washer (11), ground wire terminal (13), and insulating bushing (19) on terminal screw (18) in the order named; insert into hole in side of housing.
 - b. On threads of screw (18), install insulating washer (14), flat washer (15) and lock washer (16); secure in place with nut (17).
- 6-32. **INSTALL FIELD COIL (7).** — Place coil in housing so that the bronze spring terminal faces out and points down, then tighten screws (55) securely.
- 6-33. **INSTALL ROTOR THRUST BEARING (8).**
- a. Place insulating washer (38) and insulating strip (35) in position on rotor thrust

bearing (8) then pack bearing with lubricant and assemble in magneto housing so that numbered side of bearing enters the housing first.

- b. Install insulating washer (34) and inner snap ring (37) using long nosed pliers.
- 6-34. **INSTALL ROTOR (39).**
- a. Insert rotor in magneto housing with threaded end through thrust bearing (8); tap into position using a fibre hammer.
 - b. Place outer snap ring (36) on shaft and hand press into groove.
 - c. Place inner thrust washer (10) on shaft, then follow with a new rubber seal (30) and the outer thrust washer (27).
- 6-35. **INSTALL IMPULSE STARTER HOUSING (20).** — Place starter housing (20) in position on magneto housing; secure in place with screws (22).
- b. Lock screws in position by upsetting housing metal into screw grooves, using a small punch.
- 6-36. **INSTALL COUPLING HUB (32).** — Install key (33) on rotor shaft, then line up hub keyway and tap lightly in place.
- 6-37. **INSTALL IMPULSE COUPLING SHELL (23).**
- a. Place coupling shell (23) and spring (24) in position, so that spring flat enters groove in coupling hub (32).
 - b. Place end of rotor shaft in soft jawed vise, then turn shell clockwise approximately 3/4 turn so that it enters starter housing completely.

NOTE

If shell will not enter housing completely position the spring so that it enters the other hub groove.

- c. Place large flat washer (31) in starter housing (20) then insert large felt washer (28) in cupped washer (29) and place in starter housing so that timing mark is at top; lining up holes, secure with self-tapping screws (21).
 - d. Place lock washer (25) in position on coupling shell and install nut (26). Tighten securely, then lock in place by lifting lip of washer up against side of nut, and remove from vise.
- 6-38. **ATTACH MAGNETO MOUNTING PLATE.** — Fasten mounting plate to magneto housing with four cap screws and lock washers so that small holes face impulse starter.
- 6-39. **INSTALL FRONT BEARING PLATE (50).** — Place front bearing plate and bushing assembly in position and secure in place with four flush-head screws (51). Stake in position with a small punch.
- 6-40. **INSTALL STATIONARY CONTACT BRACKET (49).** — Install adjusting screw (45) into bearing plate (50); turn down until tight, then loosen 1/2 turn. Install contact bracket loosely with screw, lock washer and flat washer (42).
- 6-41. **REPLACE CONDENSER (2).** — Install condenser on to bearing plate with flat washer, lock washer, and round head screw (1).

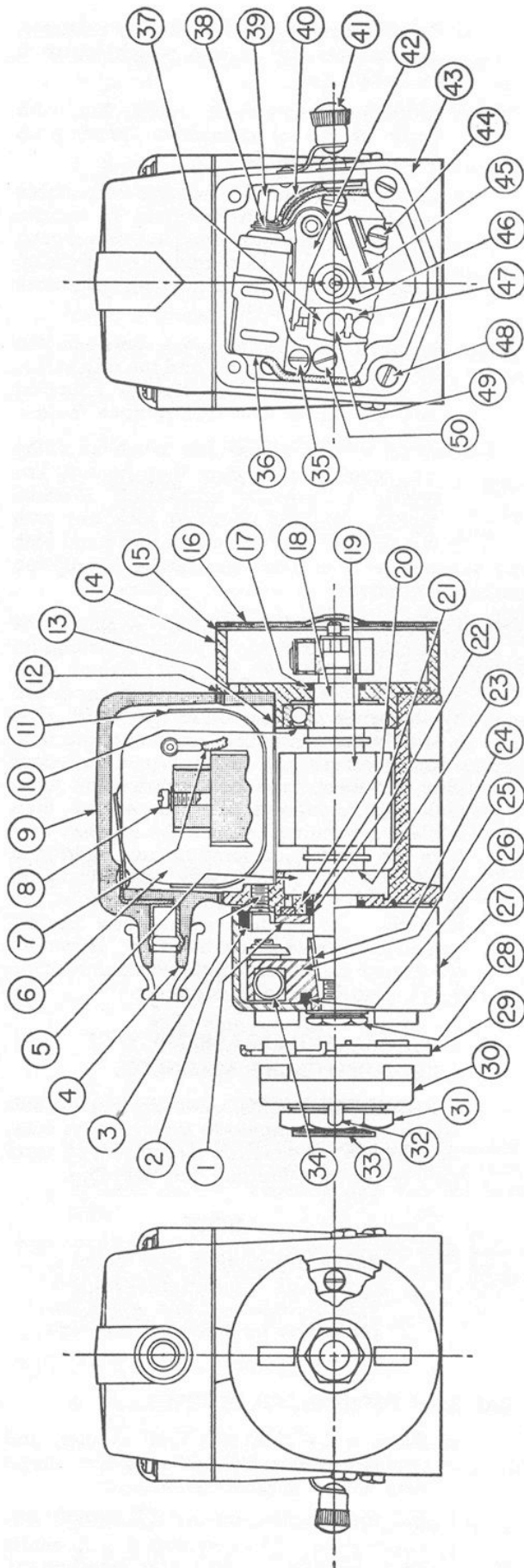


FIG. 27—NOMENCLATURE LIST FOR EDISON-SPLITDORF MAGNETO

1. Stop Pin Plate
2. Seal Holder Assembly
3. Screw—Stop Pin Plate
4. Wire Connector
5. Bearing—Rotor
6. Coil Assembly
7. Lead Assy.—Primary
8. Screw, Lock Washer, Flat Washer and Coil
9. Magneto Housing Cover
10. Ring—Grease Retaining
11. Insulator—Coil
12. Gasket—Housing Cover
13. Insulator
14. Bearing Plate
15. Gasket
16. Breaker Cover
17. Retainer—Felt Washer
18. Washer—Felt
19. Rotor
20. Plug
21. Washer—Felt
22. Retainer—Felt Washer
23. Shim
24. Drive Key
25. Magneto Member
26. Felt Seal
27. Impulse Coupling Housing
28. Nut, Lockwasher and Notched Washer
29. Float Member
30. Drive Member
31. Nut
32. Locking Washer
33. Cone
34. Spring Assembly
35. Screw and Lock Washer Condenser
36. Condenser
37. Screw, Sealing Washer and Washer Housing Cover
38. Lockwasher
39. Nut—Condenser Terminal
40. Ground Switch Lead
41. Ground Switch
42. Breaker Bar
43. Magneto Housing
44. Screw and Lock Washer—Cam Wiper
45. Cam Wiper Assembly
46. Cam
47. Contact Bracket
48. Screw and Lock Washer Breaker Cover
49. Screw-Contact Bracket
50. Screw and Lock Washer Bearing Plate

6-42. REPLACE WICK (54). — Insert bushing in wick, then insert screw (52) with flat washer, and lock washer (53) through bushing and install on bearing plate (50).

6-43. INSTALL CONTACT POINT ARM AND BRACKET (48). — Place contact point arm on bearing plate (50) so that brass rod enters hole in arm, then secure ground lead (13), spring (46), condenser terminal (42) and primary terminal (3) to threaded fitting on bearing with screw (44) and lock washer (43) in the order named.

6-44. ADJUST CONTACT POINT GAP.

- a. Turn Rotor until movable contact arm rests on high portion of cam (40).
- b. Adjust gap between points for a clearance of .020" by turning adjusting screw (45) in the proper direction.
- c. Tighten contact arm attaching screw (47) securely.

6-45. INSTALL END COVER. (5).—Apply a coat of sealing varnish to gasket surfaces, then place a new gasket (6) in position on end cover. Install and tighten using four flat washers, lock washers, and filister head screws (4).

6-46. TEST MAGNETO.

- a. CHECK ROTOR ROTATION.—Place magneto on a bench with mounting plate facing "up" so that the impulse coupling will not restrict movement of the rotor, then turn rotor by hand to check for noticeable binding or rubbing.

NOTE

The pull due to the magnetic break which occurs during rotation should not be confused with binding.

- b. Insert spark plug wire into end cover socket, and bend to within 1/8" of mounting plate, then turn impulse coupling over by hand, watching for a spark the instant the coupling releases.

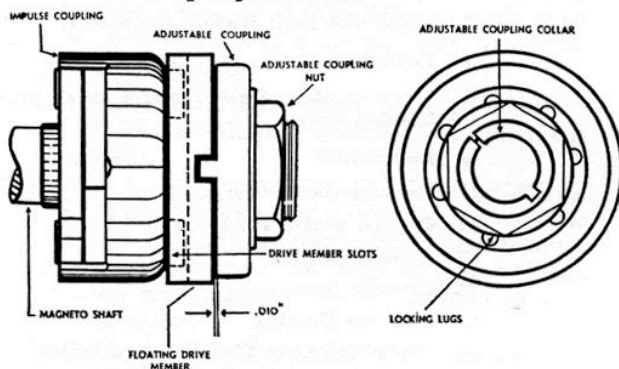


FIG. 26—MAGNETO TIMING

6-47. INSTALL AND TIME MAGNETO.

- a. Set magneto in place on top of transmission case while engaging the coupling floating member, then secure to transmission case with cap screws and lock washers.

- b. Remove cooling fan housing by unscrewing the two cap screws which fasten it to crankcase.

- c. Align mark on rim of cooling fan, with mark at top of crankcase housing as shown in figure 24.

- d. Loosen lock nut on magneto adjustable coupling, and turn magneto in normal direction of rotation until impulse starter clicks, then reverse rotation until mark on impulse drive member lines up with mark on impulse housing.

- e. Insert a .010 feeler gage between the floating drive member, and the adjustable coupling flange, then tighten coupling lock nut finger tight and remove feeler.

- f. Insert a bar across the notches of the crankshaft starting dog; then holding bar rigidly to prevent crankshaft rotation, tighten magneto coupling lock nut with wrench supplied in tool kit and bend lock washer flats over nut. Recheck coupling clearance.

6-48. TESTING IGNITION SPARK.—It should be remembered that a spark produced within an engine cylinder with the fuel mixture compressed, is not identical to a spark produced by the same equipment in open air. The best field test of ignition spark strength is to add a short air gap to the gap of the spark plug and then make the ignition spark jump both gaps as follows: Start the engine, then while it is running, remove the ignition wire from the spark plug terminal and hold it in position about 1/16" away from its spark plug terminal; if the engine continues to run normally, the ignition spark may be assumed to have sufficient strength. However, a test such as this is of little value unless the spark plug is in good condition.

6-49. REMOVAL AND DISASSEMBLY OF EDISON-SPLITDORF MAGNETO.

6-50. REMOVE MAGNETO.—Remove cap screws which secure magneto to transmission case, then loosen the coupling nut and lift off magneto while disengaging the coupling.

NOTE

Before attempting any repairs, remove all external dirt and provide a clean pan into which the parts may be placed as they are removed.

6-51. REMOVE IMPULSE STARTER.

- a. Remove the shaft nut, lock washer, and notched washer (28) while holding starter lugs with a monkey wrench.
- b. Pull the impulse housing (27) straight out.
- c. Using puller GP-18 equipped with puller dogs, remove the magneto member (25) and remove felt seal (26).

- d. Remove key (24) from tapered shaft.
 - e. Remove sealing felt and ring assembly (2) after unscrewing two screws and lock washers which secure it to stop in plate (1).
 - f. Remove the stop pin plate by unscrewing three flush head screws, (3) then pry plate up with a screw driver.
- 6-52. REMOVE BREAKER COMPARTMENT COVER.—Remove the four attaching screws and lock washer, (48) then lift off cover (16) and remove gasket (15).
- 6-53. REMOVE CAM WIPER (45).—Remove attaching screw and lock washer, (44) then lift off cam wiper (45).
- 6-54. REMOVE BREAKER POINT CONTACTS.
- a. Remove fixed contact bracket (47) after unscrewing two shouldered screws (49) which attach it to front bearing plate.
 - b. Remove condenser (36), and breaker bar and spring (42) as an assembly by taking out the condenser attaching screw and lock washer (35), and then sliding breaker bar from bearing stud. Disconnect spring and remaining terminals from condenser.
- 6-55. REMOVE BEARING PLATE (14). — Remove three bearing plate attaching screws and lock washers (50), then tap the whole assembly lightly at the shaft drive-end, which will loosen and permit removal of the breaker housing.
- 6-56. REMOVE ROTOR. (19.) — Grasping rotor shaft (19), pull gently from magneto housing.

CAUTION

Do not place rotor on a dirty bench top; as it will attract small steel chips readily. As the rotor is strongly magnetic, these will be very difficult to remove.

- 6-57. REMOVE MAGNETO HOUSING COVER. (9).—Remove housing cover (9) and gasket (12) after unscrewing and removing four screws, sealing washers and flat washers (37).
- 6-58. REMOVE COIL (6).—Remove two lock washers, flat washers and screws (8), then lift off coil. (8). Remove flexible insulator (11) from housing, then pry up rigid insulator (13).
- 6-59. REMOVE BALL BEARINGS. (5).
- a. Remove leather plugs (20) from front bearing knock out holes.
 - b. Pry up metal grease retaining rings (10) from each bearing.
 - c. Remove ball assemblies from outer races.
 - d. Remove outer races by tapping them gently out of the casings using a small punch through the three holes behind each race.
- e. Pull inner races from the rotor shaft using a suitable puller.
- f. Remove two retainers (22 and 17), two felt washers (2) from drive end, and one washer (18) from breaker end.
- 6-60. INSPECTION AND SERVICE OF EDISON-SPLITDORF MAGNETO.—All services listed under inspection and service of Fairbanks-Morse Magneto (Par. 7-20) are applicable to Edison-Splitdorf magneto excepting paragraphs 22, 23, and 25.
- 6-61. BEARING SHIMS. (23).—Assemble bearings rotor and breaker compartment with magneto housing omitting grease seals and bearing felts. The shaft should turn freely without perceptible play. Shims to be added should be installed between the inner ball race and the shoulder of the shaft at the drive end.

NOTE

The pull due to magnetic break which occurs during rotation, should not be confused with binding.

- 6-62. REASSEMBLY AND INSTALLATION OF EDISON-SPLITDORF MAGNETO. (See figure 27.)
- 6-63. INSTALL BALL BEARINGS (5).
- a. Install bearing outer races and front bearing plate (14) in magneto housing.
 - b. Lubricate ball assemblies with medium-soft high melting-point grease, then place in bearing outer races.
 - c. Moisten small felt seals (21 and 18) with oil, then insert one in front bearing plate (14) and two in end of magneto housing, then install retainers (22 and 17).
 - d. Install new metal grease retaining rings (10) so that they are exactly flush with the rim of the outer races.
 - e. Fill the front bearing knock-out holes with grease.
- 6-64. INSTALL ROTOR. (19).—Insert threaded end of rotor (19) through housing into thrust bearing (5).
- 6-65. INSTALL FRONT BEARING PLATE (14).—Align front bearing plate (14) with holes in housing, then tap plate gently in place and secure with filister head screws and lock washers, (50).
- 6-66. INSTALL COIL (6).
- a. Insert the rigid coil insulating sheet (13) in housing so that slotted corner will permit coil lead (7) to enter front bearing plate.
 - b. Place flexible insulator (11) around coil so

that it covers the under side, then thread the coil lead (7) into the breaker compartment so that the insulating sleeves protect the lead where it passes through the casting.

- c. Seat the coil on the housing shoes and fasten in place with two flat washers, lock washers, and screws (8).

6-67. INSTALL HOUSING COVER (9).—Using a new gasket (12) coated lightly on either side with a good sealing compound, fasten housing cover (9) in place with four sealing washers, flat washers, and screws (37), so that wire connector (4) faces away from the breaker housing.

6-68. INSTALL CONDENSER (36).—Install the condenser in the breaker compartment with hex terminal nut (39) left loose, but with the terminals of the main primary lead (7), ground switch lead (40) and a special lock washer (38), threaded on the condenser terminal below the nut. Secure condenser to breaker compartment with a lock washer and filister head screw (35).

6-69. INSTALL BREAKER POINT CONTACTS.

- a. Install fixed contact bracket (47) in breaker compartment with two shouldered screws (49).
- b. See that the breaker bar spring is twisted slightly so that it tends to keep the bar (42) from riding out on its bearing stud.
- c. Lubricate bearing stud lightly, then install breaker bar (42) while guiding spring slot onto its position on the condenser terminal. Tighten condenser terminal nut (39) with an ignition open end wrench.

6-70. ADJUST BREAKER CONTACT CLEARANCE.

—With cam (46) rotated so that bar (42) rides the high side, adjust stationary contact bracket (47) for an opening of .015".

6-71. INSTALL CAM WIPER. (45).—Moisten cam wiping felt (45) with 6 to 8 drops of oil, then

fasten to bearing plate (14) with screw and lock washer (44) so that it engages the cam lightly.

NOTE

Do not over-oil, otherwise oil may be thrown around the breaker contacts.

6-72. INSTALL BREAKER COVER. (16).—Cement a new gasket (15) to breaker cover (15), then secure in place with four cap screws and lock washer (48).

6-73. INSTALL IMPULSE COUPLING.

- a. Secure stop pin plate to front of magneto housing with three flush head screws (3) so that the stop pin is located directly above the rotor shaft.
- b. Install a new sealing felt and ring assembly (2) over the stop plate and secure in place with two screws and lock washers. Oil the felt liberally. Apply a very small amount of grease to the hook of the fly weights and to the nose at the short end of the lever.
- c. Replace the felt seal (26) in the magneto member (25) and apply sufficient oil to nearly saturate it, but not enough to leave the parts wet with oil.
- d. Replace key (24) in tapered shaft, then install magneto to member assembly (25) onto shaft, tapping it lightly into place.
- e. Install notched washer and lock washer on end of shaft, then secure with special sleeve nut (28).

6-74. TEST MAGNETO.—Refer to paragraph 6-46.

6-75. INSTALL AND TIME MAGNETO.—Refer to paragraph 6-47.

6-76. TEST IGNITION SPARK. — Refer to paragraph 6-48.

SECTION VII
Manual Starting System

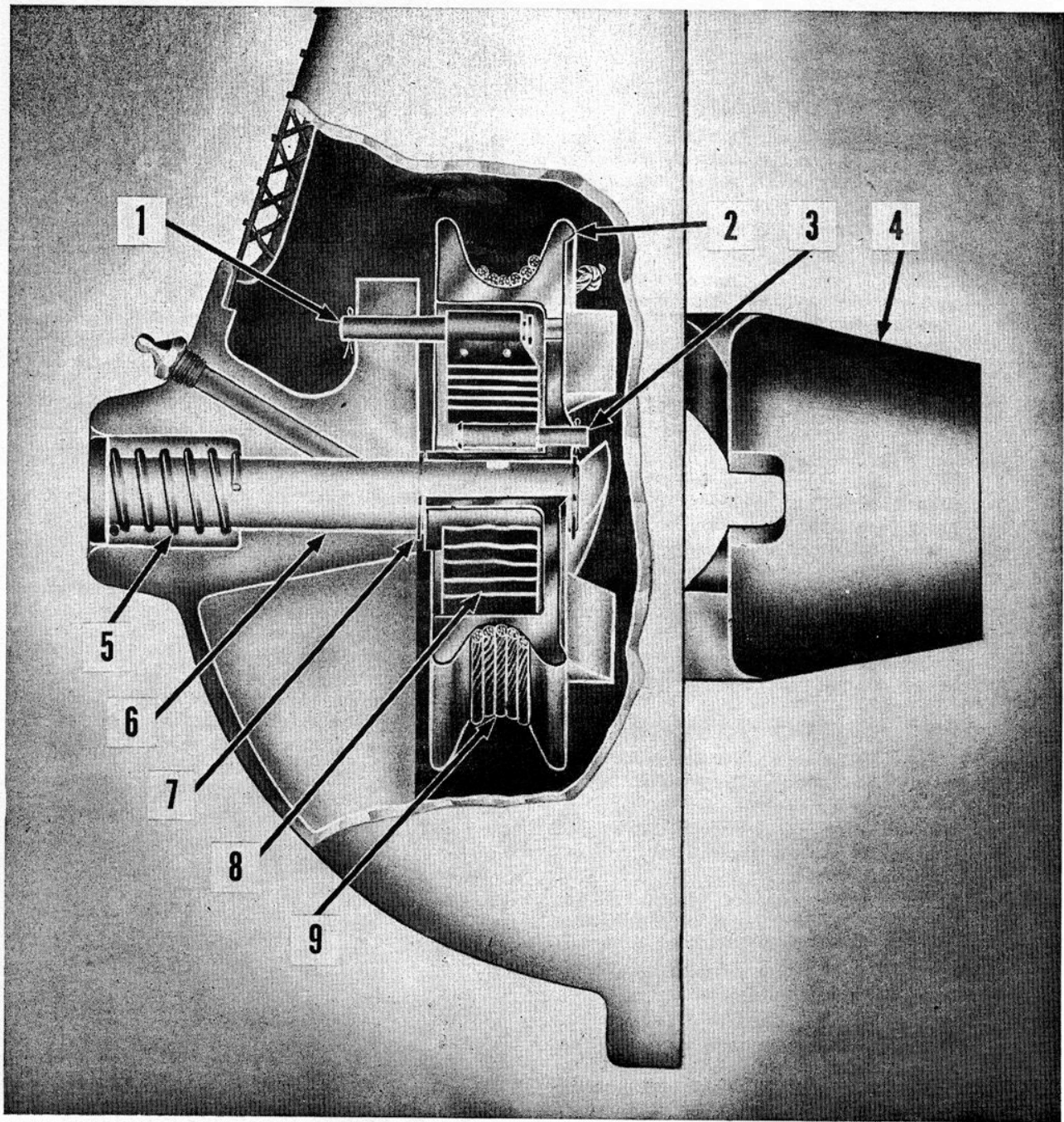


FIG. 28—SECTIONAL VIEW OF STARTING ASSEMBLY

- | | |
|-----------------------------------|---------------------|
| 1. Clevis Pin (spring to casting) | 5. Shaft Spring |
| 2. Pulley | 6. Starter Shaft |
| 3. Clevis Pin (spring to pulley) | 7. Shaft Snap Ring |
| 4. Starting Dog | 8. Rewinding Spring |
| | 9. Starter Cable |

7-1. **DESCRIPTION.**—The manual starting system consists essentially of a housing, movable shaft, pulley and flat-type wound spring, and a flexible steel cable. The spring-loaded pulley is fitted with dogs which engage the starting dog when the movable shaft is pushed "in". When the cable is pulled, it turns the pulley and cranks the engine. The cable is then automatically rewound by spring.

7-2. **REMOVAL AND DISASSEMBLY.**

7-3. **REMOVE STARTER HOUSING.** — Remove two cap screws and flat washers which secure starter housing to front of engine.

7-4. **REMOVE CABLE.**

- a. Pull on starter handle until end of travel is reached.
- b. Holding pulley in that position with one hand, release starter handle and unwind remaining loop from pulley.
- c. Remove knotted end of cable from pulley slot, then permit pulley to wind up slowly.

7-5. **REMOVE AND DISASSEMBLE PULLEY.**

- a. Using Plier GP-15, remove snap ring from end of shaft.
- b. Reach behind the pulley and remove cotter pin from clevis pin which anchors spring to housing. Withdraw pulley with spring from shaft, and remove clevis pin.
- c. Remove cotter pin from clevis pin which anchors spring to center of pulley, then remove spring from pulley.

7-6. **REMOVE PULLEY SHAFT.**—Push shaft "in" from outside the housing so that the second snap ring can be removed with Plier GP-15 then remove shaft and coil spring from front of housing.

7-7. **MAINTENANCE AND INSPECTION.**

7-8. **SPRINGS.**—Examine springs for cracks and distortion. Defective springs must be replaced.

7-9. **PULLEY.**—Examine carefully for cracks and flaws. Pulley should rotate freely but not loosely on shaft.

7-10. **CABLE.**—Check cable for broken strands and kinks. Remove cable from handle after loosening handle set-screw.

7-11. **SNAP RINGS.**—Always use new snap rings when reassembling the starter.

7-12. **REASSEMBLY AND INSTALLATION.**

- a. Assemble coil-spring onto shaft, then insert into shaft hole from front of housing.
- b. Install snap ring onto shaft just past the first groove.
- c. Push shaft "in" from the outside until the second shaft groove appears inside the housing, then slide the snap ring on until it rests evenly in shaft groove.

7-13. **ASSEMBLE AND INSTALL SPRING AND PULLEY.**

- a. Fasten end of spring to pulley (using the short clevis pin), so that pulley must rotate clockwise to wind spring; then secure clevis pin with cotter pin.
- b. Secure pulley in a vise so that the jaws grip the flanges, then wind spring care-

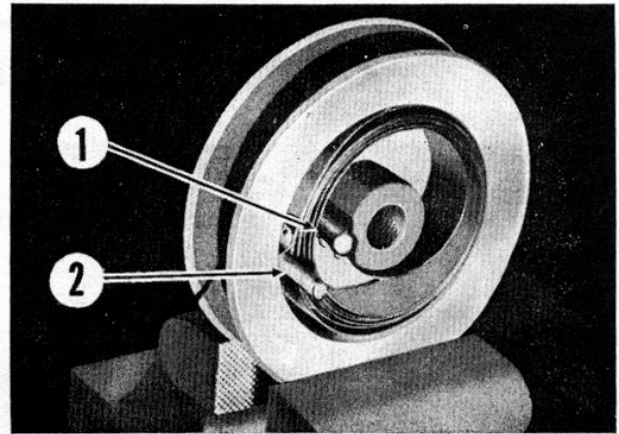


FIG. 29—STARTING SPRING & PULLEY

1. Short Clevis Pin
2. Long Clevis Pin

fully, alternately pulling then winding until the loop on end of spring is ready to be forced into the pulley.

- c. Place pulley on shaft then rotate until protruding clevis pin enters hole in housing, then push pulley on all the way, and install cotter pin in clevis pin.
- d. Install snap ring on end of shaft to secure pulley in place.

7-14. **INSTALL CABLE.**

- a. Support housing, then turn pulley by hand counterclockwise, until spring is completely wound.
- b. Engage knotted end of cable in pulley slot, if pulley slot is less than one-half turn from the cable fair-lead, wind cable one complete turn clockwise around the pulley, then engage knot in the slot and release starter handle slowly so that cable winds up completely.



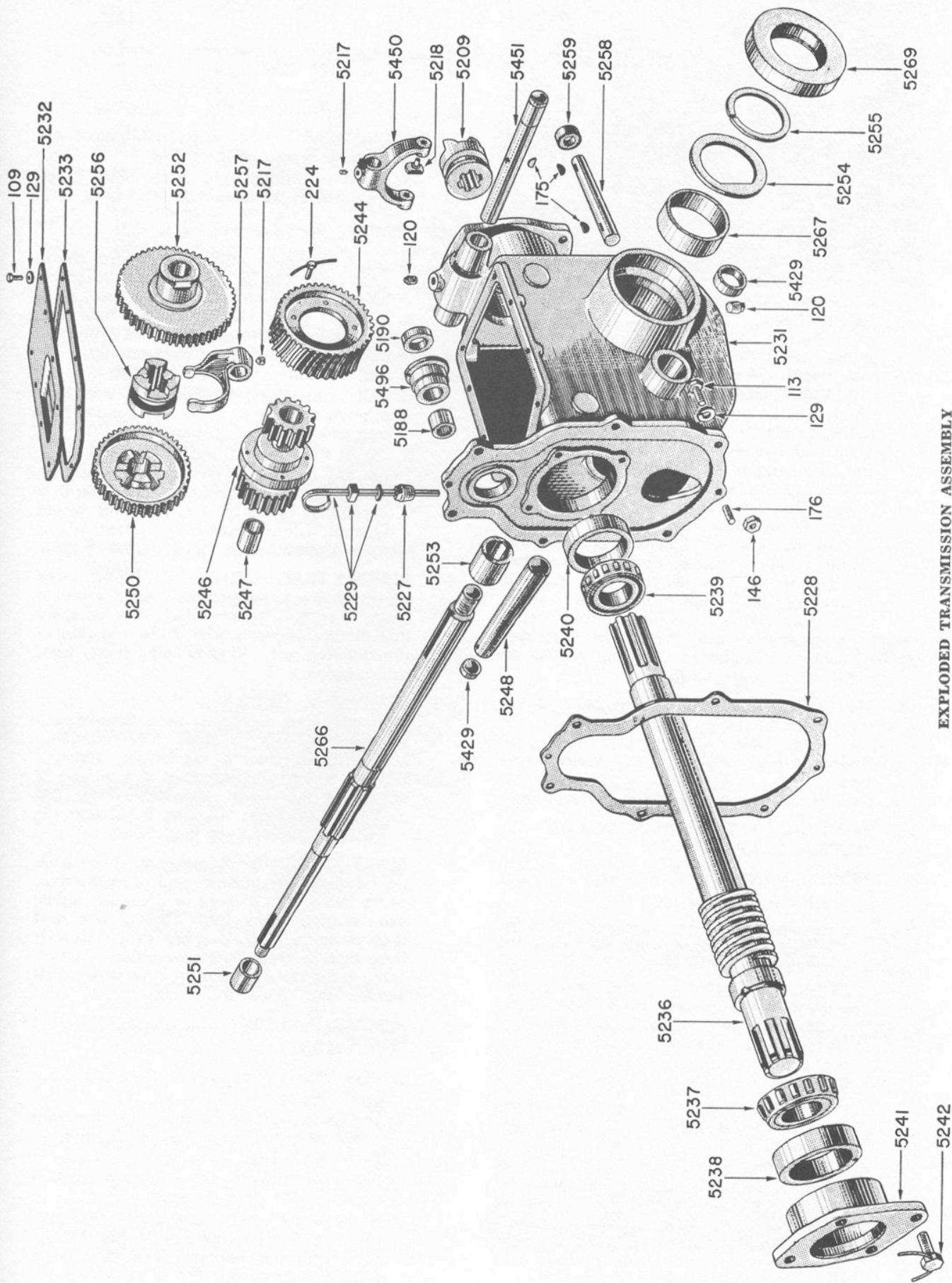
FIG. 30—DRIVING CLEVIS PIN INTO HOUSING

CAUTION

Never release the starter handle suddenly; unless permitted to wind up slowly and evenly, the cable may become fouled and jump off the pulley.

7-15. **INSTALL STARTER ASSEMBLY.**

- a. Secure starter assembly to front of housing with two flat washers and cap screws.
- b. Lubricate starter shaft fitting with non-fibrous chassis lubricant.



EXPLODED TRANSMISSION ASSEMBLY

SECTION VIII

Transmission And Reverse Gear

8-1. DESCRIPTION.

a. TRANSMISSION — The speed transmission, bolted directly to the rear of the engine transfers power to the wheels through a triple reduction drive. This drive consists of one set of helical gears with 20/49 reduction, one worm and gear with 1/19 reduction, and two sets of spur gears which drive the wheels. The spur gears are in constant mesh, "high", "neutral", and "low" selection being made by a sliding sleeve (dog) splined to the wheel shaft. The speed of the tiller shaft is unaffected by any change of gear ratio in the transmission and its speed depends solely upon the speed of the engine.

b. REVERSE GEAR — The reverse gear unit which may be purchased separately and installed on Model B1-6 and B1-7 Power Tillers, is located between the speed transmission and the engine. Forward and reverse speeds are controlled by the "Wheel Speed Control Rod", which is designated as the "Reverse Control Rod" of machines equipped with reverse gears. A sliding pin-type mechanical clutch splined to the main drive pinion shaft, engages the pinions to transmit engine torque to the transmission worm shaft. The clutch engages the front pinion to transmit "forward" torque to the transmission, and engages the rear pinion to transmit "reverse" torque.

8-2. SPECIFICATION. — Speed at 2400 engine rpm:
Low Gear—.725 mph
High Gear—1.345 mph
(Speeds based on 4.00 x 12 tractor tread tires.)

Backlash between worm and pinion—none

8-3. REMOVAL OF TRANSMISSION AND REVERSE GEAR.

8-4. REMOVE HANDLE BAR AND BASE ASSEMBLY, AND AIR CLEANER.

- a. Disconnect tiller shift and speed shift (or "reverse") control rods after removing cotter pins and flat washer.
- b. Disconnect throttle control cable at carburetor, then remove cable clamp from engine and pull control cable free. On reverse gear units, also loosen intermediate cable clamp on transmission case flange.
- c. Disconnect ground wire from magneto.
- d. Remove air hose from air cleaner, then remove oil cup.
- e. Remove four cap screws and lock washers which secure handle-bar base to transmission case, and lift off base complete with handle-bar assembly and air cleaner. If machine is equipped with reverse gear, the speed shift lever bracket and spring, can be removed.

8-5. REMOVE TILLER HOOD.

- a. Disconnect tiller hood adjusting-bar from bracket.
- b. Remove bracket pin from tiller hood mounting bracket and lift from unit.

8-6. REMOVE WHEELS.

- a. Raise machine until wheels are clear, then place blocks under transmission or hoist machine onto shipping crate.
- b. Remove cotter pin, castellated axle nut, and flat washer from left wheel, then pull off wheel and outer hub assembly.
- c. Pull inner hub from transmission.
- d. Pull right wheel from transmission and remove the wheel, outer hub, inner hub and axle shaft as an assembly.
- e. On B1-7 and B1-7RS models remove cotter pin and castellated axle nut, then pull off wheel with lockout bushing and outer hub assembly. Then remove complete wheel Control Clutch Assembly attached to transmission flange by Stud-Hub Stop.

8-7. REMOVE TILLER AND DRIVE.—Place blocks under engine to support its weight, then remove four cap screws and lock washers from flange between tiller drive and rear of transmission, then slide housing away from transmission.

8-8. REMOVE MAGNETO. — Disconnect spark plug wire from magneto, then remove cap screws and lock washers from magneto base, and lift from transmission. Remove floating drive member, then if machine is not the reverse gear type, loosen lock nut and slip adjustable coupling from magneto drive shaft, and remove key.

8-9. REMOVE ENGINE.—Remove six bolts from flange between engine and transmission; using two 3/8" x 8" bars or bolts as guides, slide engine away from transmission and remove magneto drive-gear thrust washer from end of shaft in transmission. If machine is the reverse gear type, remove thrust washer and spacer from shaft.

8-10. REMOVE REVERSE GEAR UNIT. (IF EQUIPPED)

- a. Disconnect reverse control link assembly from reverse control lever.
- b. Loosen adjustable coupling nut, and slip coupling from the magneto shaft, then remove shaft key.
- c. Remove magneto drive gear and shaft from reverse gear assembly.
- d. Remove six cap screws and lock washers, remove intermediate cable clamp, then separate reverse gear case from transmission case.

8-11. DISASSEMBLY OF TRANSMISSION.

8-12. REMOVE MAGNETO GEAR AND SHAFT BEARING.

- a. Remove the two remaining cap screws from the transmission cover and remove the cover and gasket.
- b. Remove adjustable coupling and key from the magneto drive shaft.
- c. Remove the gear and shaft from the gear end.
- d. To remove magneto drive shaft bearing and oil seal, use driver GP-7 (See figure 18.) If bearing retainer comes out with bearing, place retainer in a vise and remove bearing, then place retainer back in transmission housing after aligning dowel pin.

- 8-13. REMOVE DRIVE GEAR.—Using Plier GP-16, remove both snap rings from the forward end of the transmission main shaft, then remove the drive gear and spacer.

NOTE

Serial Nos. up to 5000 are equipped with one heavy type snap ring which should be replaced with two of the newer type, Part No. 5430.

- 8-14. REMOVE AND DISASSEMBLE WORM SHAFT.

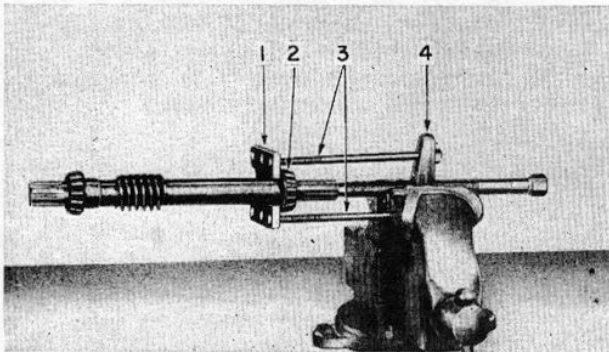


FIG. 31—REMOVING BEARING FROM TRANSMISSION SHAFT

1. Plate GP-6
2. Roller Bearing
3. 8" Bolts (S.A.E. Threads)
4. Puller GP-18

- a. Remove wire lacing and four cap screws from the bearing retainer.
- b. Remove the retainer. Care should be taken not to damage shims (Check number of shims and total thickness.).
- c. Remove worm shaft assembly from the front end of the case. (Note: Tiller clutch dog and the shifter clutch dog shoes will slide off at the rear end of the case.)
- d. To remove bearings from worm drive shaft, use Plate GP-6 and Puller GP-18 as shown in figure 31.

- 8-15. REMOVE SHIFT SLEEVE. — Remove the transmission speed shift sleeve through the top of the case.

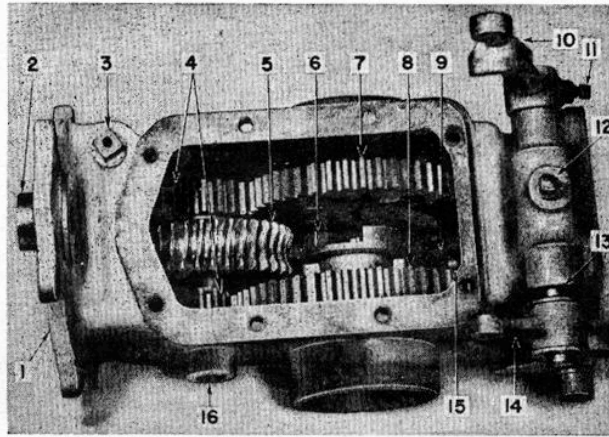


FIG. 32—SPEED TRANSMISSION GEARING

1. Transmission Case
2. Magneto Drive Shaft Bearing, Retainer, & Seal Assembly
3. Oil Filler Plug
4. Worm Gear Pinion
5. Worm Gear
6. Shift Sleeve
7. High Speed Gear
8. Low Speed Gear
9. Shift Fork
10. Tiller Clutch Shift-Lever
11. Set Screw
12. Pipe Plug
13. Tiller Clutch Shift-Lever Shaft
14. Transmission Shift Lever
15. Transmission Shift-Fork Shaft

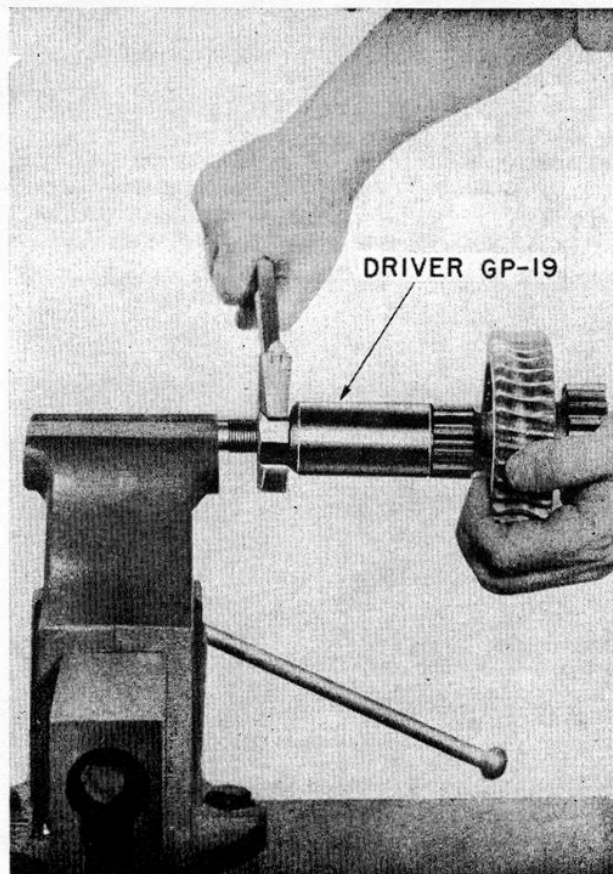


FIG. 33—BROACHING PINION BUSHING

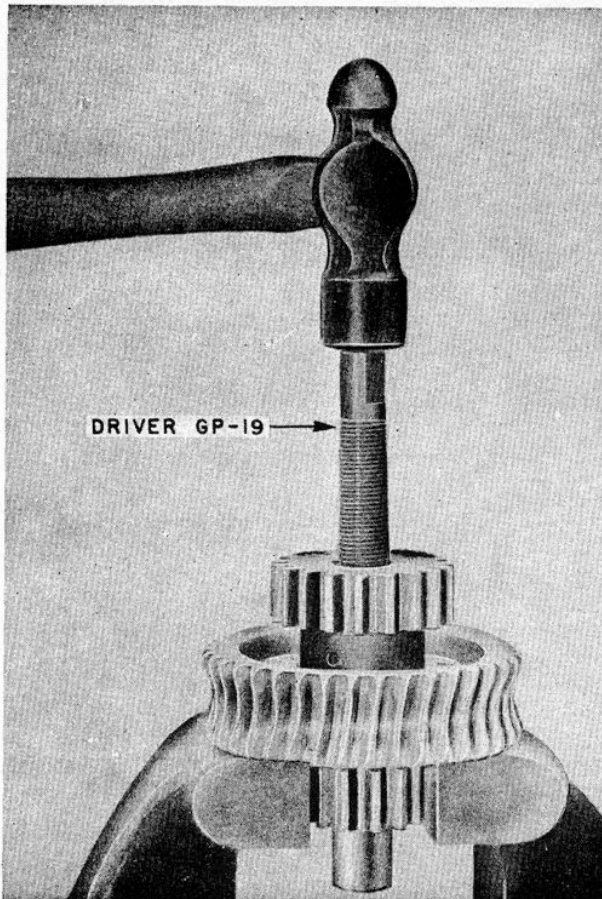


FIG. 34—DRIVING BUSHING FROM PINION GEAR

8-16. REMOVE AND DISASSEMBLE WORM AND PINION GEAR ASSEMBLY.

- a. Remove Welch plug, then unscrew set screw from the right side of the transmission case, and remove the pinion shaft

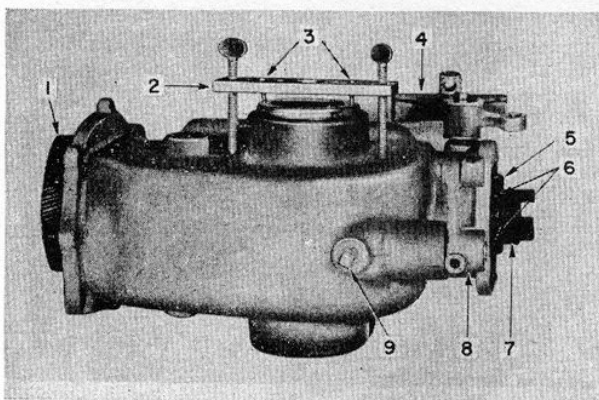


FIG. 35—REMOVING TRANS. OIL SEAL

1. Transmission Drive Gear
2. Puller GP-12
3. Self-Tapping Screw
4. Transmission Shift Lever
5. Tiller Clutch Dog Shift-Fork
6. Tiller Clutch Dog Shoe
7. Tiller Clutch Shift Dog
8. Transmission Shift Arm
9. Drain Plug

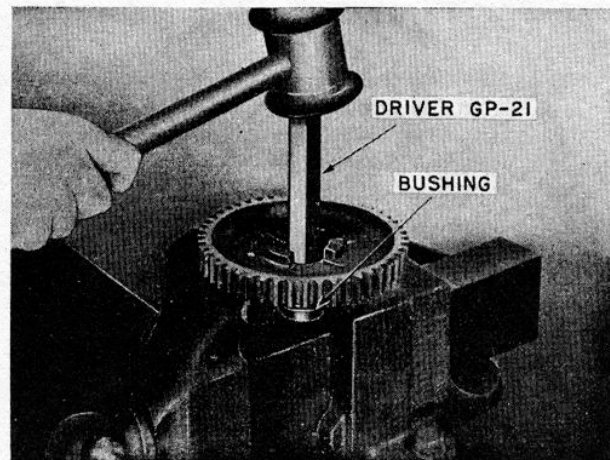


FIG. 36—REMOVING BUSHING FROM LOW-SPEED GEAR

and remaining Welch plug from the other side of case.

- b. Remove worm and pinion gear, and single thrust washer through the top of transmission case.

NOTE: On Serial Nos. B-66-2474 and up, the thrust washer has been omitted. When re-assembling, DO NOT OMIT THRUST WASHER ON SERIAL NOS. UP TO AND INCLUDING B-66-2473

- c. Remove lacing wire, then remove four cap screws and separate the worm gear from the transmission worm gear pinion.
- d. To remove bushings from transmission pin gear, use Driver GP-19.

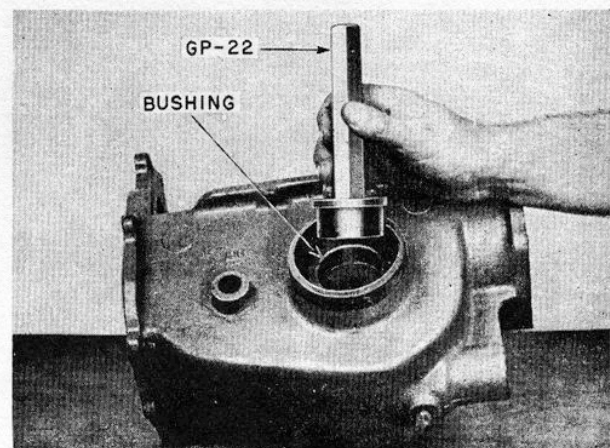


FIG. 37—REMOVING TRANSMISSION SPEED GEAR BUSHING

8-17. REMOVE SHIFT FORK AND SHAFT.

- a. Remove cotter pins from shift control link upper and lower connections, then remove the control link.
- b. Loosen set screw in transmission shift arm, located at the bottom and rear of transmission case. Then remove the arm and key from shifter shaft.
- c. Remove the transmission shift fork and shaft assembly from the inside of the case.

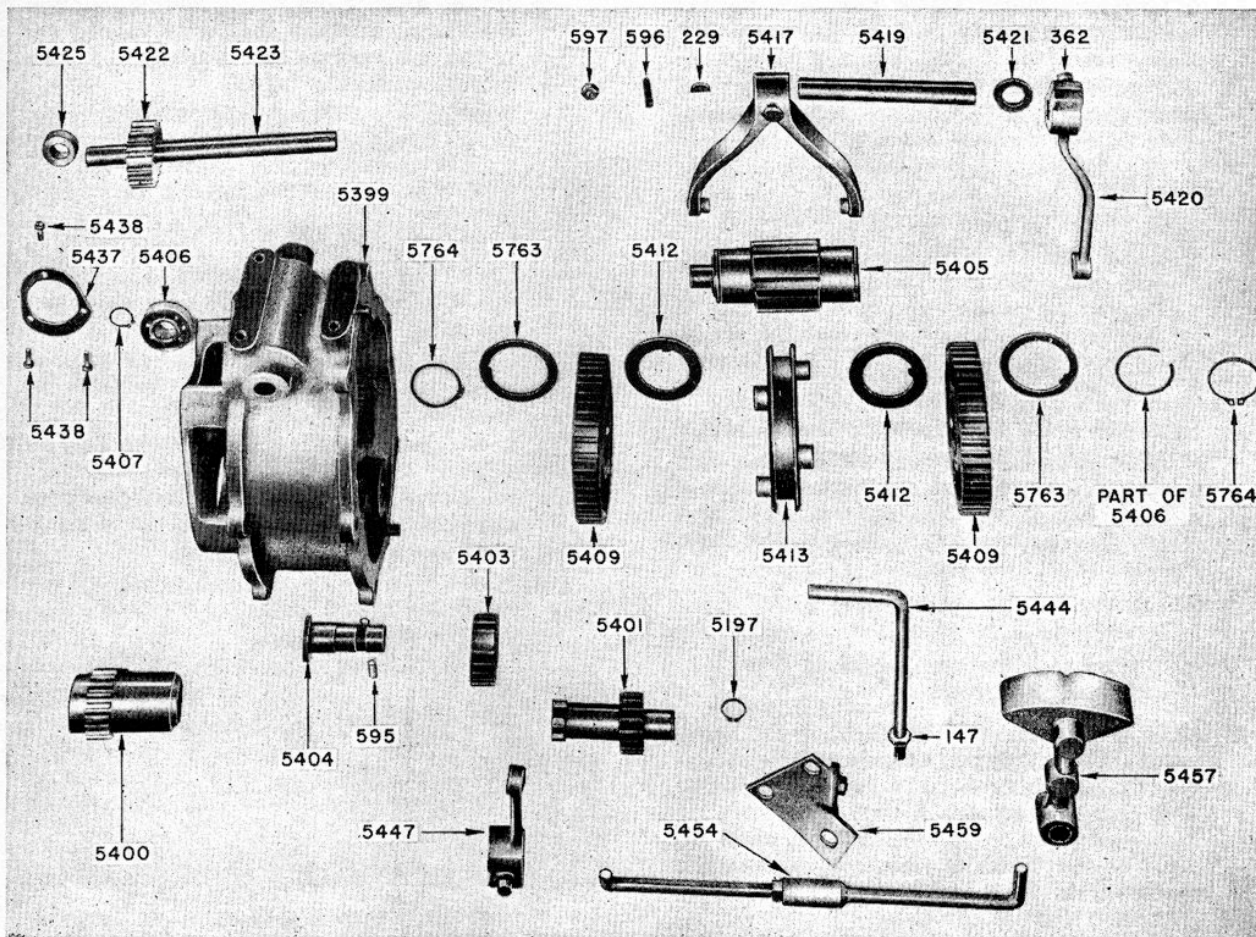


FIG. 38—EXPLODED VIEW OF REVERSE GEAR

d. To remove transmission speed shifter shaft oil seal, use a chisel and cut seal from the case.

8-18. REMOVE AND DISASSEMBLE HIGH AND LOW SPEED GEARS.

- a. Remove oil seals by drilling two 1/8" holes, and inserting self-tapping screws through Puller GP-12 as shown in figure 35.
- b. Using Plier GP-17, remove the snap ring and thrust washer from the hubs of both the low and high speed gears.
- c. Remove the gears from the inside of the transmission case.
- d. Bushing may be removed from low speed gear using Driver GP-21; the axle shaft bushing can be driven off with a hammer.
- e. High and low speed gear outer bushings may be removed using Driver GP-22.

8-19. REMOVE TILLER SHIFT LINKAGES.

- a. Remove the set screw in the tiller shift lever and remove the lever and key.
- b. Remove the 1/4" pipe plug in the top and rear of the transmission case, and through the plug hole loosen the set screw in the tiller shift shaft fork.
- c. Shift the shifter fork on the shaft to the right as far as possible and drive the shaft to the left until the key can be removed,

remove the shaft through the left side of the case and the shifter fork out through the top.

- d. Remove the snap ring on the end of the shifter shaft using snap ring Plier GP-16 and remove the speed shifter lever assembly.

8-20. DISASSEMBLY OF REVERSE GEAR.

8-21. REMOVE CLUTCH SHIFTER SHAFT

- a. Loosen lock nut, then remove screw from clutch shifter fork at open end of gear case.
- b. Pull shaft from fork until key can be removed, then withdraw lever and shaft from gear case and remove felt washer.

8-22. REMOVE IDLER GEAR SHAFT — Loosen Allen set screw at lower right side of gear case and pull shaft from idler gear.

8-23. REMOVE AND DISASSEMBLE GEAR AND CLUTCH ASSEMBLY.

- a. Using Plier GP-16 remove large snap ring from worm gear drive shaft, at open end (rear) of gear case.
- b. Remove tanged gear retaining washer, drive gear, and tanged thrust washer from shaft, then remove idler gear from case.

- c. Grasping clutch shifter fork near the set screw, pull fork and clutch assembly from shaft.
- d. Remove lock wire, then three (3) cap screws which fasten ball bearing retainer to front (closed) end of gear case.
- e. Remove large lock ring from ball bearing, then tap bearing end of worm gear drive shaft, gently from the case.
- f. Using Pliers GP-15, remove small snap ring and press ball bearing from shaft.
- g. Remove large snap ring using Plier GP-16, then remove tanged gear retaining washer, drive gear and tanged thrust washer from shaft.

8-24. REMOVE SHAFT AND PINION ASSEMBLY

—Using Plier GP-15 remove snap ring and retaining washer from shaft at rear (open) end of gear case, then remove shaft and pinion through opening in other end of case. Remove shaft from pinion.

NOTE

All needle bearings may be easily removed and replaced using an arbor press.

8-25. **CLEANING AND INSPECTION.** — Immerse transmission case and all parts in clean solvent and scrub thoroughly, then wipe (or dry with compressed air).

It is especially important that all parts be clean so that flaws or wear can be detected readily.

8-26. **GEARS.**—Inspect all gears for condition of teeth, chips, cracks and burrs. Replace with new parts if any defect is found.

8-27. **CLUTCH SLEEVE.**—Inspect drive pins for wear or cracks. Replace if necessary.

8-28. **BUSHINGS.**—Examine all bushings for wear indicated by score marks or flat spots. When replacing pinion gear bushings, they should be carefully pressed in then broached. The broaching (burnishing) takes place when the Driver GP-19 is withdrawn from the gear.

8-29. **BEARINGS.**—If scores, chips or flat spots are evident, ball and roller bearings must be replaced.

8-30. **SNAP RINGS.**—Always use new snap rings throughout when reassembling transmission as they may have acquired a "set".

8-31. **OIL SEALS.**—As oil seals are easily distorted during removal, always use new oil seals throughout.

8-32. **TRANSMISSION CASES.**—The transmission cases should be inspected minutely for cracks at flanges and other points of stress.

8-33. **TRANSMISSION SHIFT LINK.** — Check as follows:

- a. Push lower rod into barrel; if any free travel exists before spring pressure is encountered, unscrew the cap and replace springs with new ones.

NOTE

Springs should measure 1 1/2" in length uncompressed.

- b. If new springs are not available, enough additional washers should be placed between two springs to compensate for the amount of spring "set".
- c. When reassembling, lubricate with 1 oz. of No. 3 cup grease.

8-34. REASSEMBLY OF TRANSMISSION

8-35. REPLACE TILLER SHIFT LINKAGES.

- a. Partially insert the shift shaft in the transmission from the left side with set-screw end first.
- b. Holding the clutch dog shift fork in position, push shaft through until key can be inserted in shaft key-way.
- c. Install key in shaft key-way, then line up key slot in fork with key, and slide shaft through and adjust until shaft counterbore appears through plug hole in top of transmission case.
- d. Install set-screw so that shaft and fork are locked securely, then replace 1/4" pipe plug in top of transmission case.
- e. Install the speed shift lever on the shaft, with neutral notch toward transmission, and replace snap ring using snap ring Plier GP-14.
- f. Install the tiller shift lever on the shaft; line up set-screw holes, then install set-screw.

8-36. ASSEMBLE AND INSTALL TRANSMISSION SPEED GEARS.

- a. Install bushings into low speed gear, using Driver GP-21; place gear on a flat surface with dogs facing down, then drive bushing in until flush with gear sleeve.
- b. Using a soft hammer, install bushing on axle shaft.
- c. Install high and low speed gear bushings into transmission case using Driver GP-22.
- d. Insert the low speed gear (or large gear) through the top of the transmission case into the opening on the left side. Pressing the gear tight against the case, install the thrust washer onto the gear hub from the outside and install the snap ring, using Plier GP-16.
- e. Install the high speed gear (or small gear) on the right side of the transmission in the same manner as the low speed gear.

8-37. INSTALL SHIFT FORK AND SHAFT.

- a. Insert the speed shift-fork and shaft assembly into position from the inside of the transmission case.
- b. From outside of the transmission case, install the shift shaft oil seal (lip side in) onto the shaft. Roll the seal carefully onto shaft to prevent damaging leather lips.
- c. Drive seal into place with Driver GP-10 and install key on shaft.
- d. Install shift arm on end of fork shaft after lining up key slot and set-screw holes, then tighten set screw.

8-38. ASSEMBLE AND INSTALL WORM AND PINION GEAR ASSEMBLY.

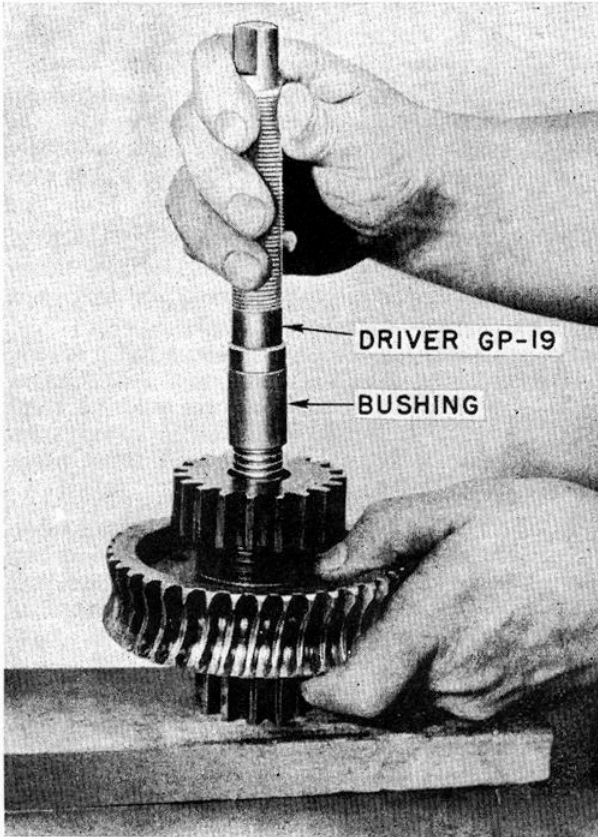


FIG. 39—INSTALLING TRANSMISSION PINION BUSHING

- a. Install bushings into pinion gear.
- b. Assemble worm to pinion gear with four cap screws, tighten securely, then install lock wire to prevent loosening.
- c. Place gear assembly in position in transmission case (small gear to the left) clear through case and pinion assembly.

NOTE

On Serial Nos. B66-2473 and up, the thrust washer must be installed between the transmission case and the pinion as shown in figure.

8-39. REPLACE SHIFT SLEEVE.—Install the transmission shift sleeve so that sleeve groove fits onto shift fork, then hold the shift lever to one side so that sleeve will engage the gear dogs and permit the axle shaft to be installed.

8-40. REPLACE WHEEL AND AXLE ASSEMBLY.

- a. Install hub oil seals into sides of transmission case using Driver GP-22.
- b. Insert axle shaft from right side of transmission case pushing through oil seal, small gear, shift sleeve, large gear, and through to the left side of the case.

NOTE

The end of the shaft without the bushing, enters the case, first. Insert the shaft carefully to avoid burring the low gear bushing, or distorting the oil seals.

- c. Install inner hub, then follow with outer hub, wheel, washer and castellated nut.
- d. Tighten axle nut until snug, then back off one castellation and install cotter pin.

NOTE

On machines not equipped with free wheeling, it is good practice to remove both wheels and one-piece hubs from axle shaft, and renew the rubber seals near the inner face of each hub.

8-41. ASSEMBLE AND INSTALL WORM SHAFT.

- a. Install bearings on worm shaft, using Plate GP-6 with puller GP-18 as shown in figure 31.
- b. Place tiller clutch dog and shoes in position at rear of transmission case.
- c. Install worm shaft through front of transmission, and guide clutch onto worm shaft splines.
- d. Place the same thicknesses of shims in position at front of transmission case, then install bearing retainer with four cap screws, tighten screws evenly.

IMPORTANT

When worm shaft is installed with the proper shim thickness, a slight drag should be evident when the shaft is rotated by hand. If drag is too great, or no drag whatever exists, correct this condition by adding or removing shims.

- e. Install lock wires to prevent cap screws from loosening.

8-42. INSTALL TRANSMISSION DRIVE GEAR.

- a. Place drive gear spacer on front end of worm shaft with tapered side in.
- b. Install transmission drive gear and secure in place with two snap rings (Part No. 5430) using Plier GP-16.

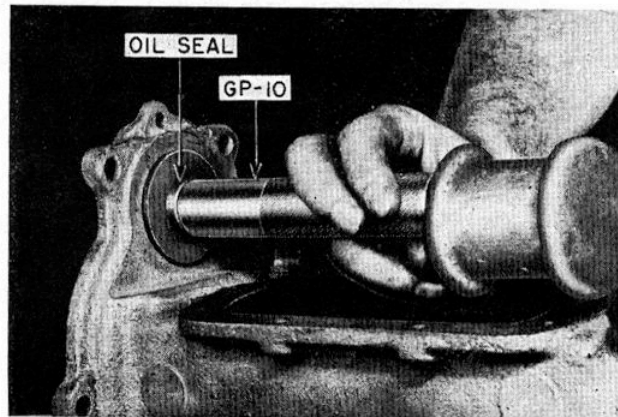


FIG. 40—INSTALLING MAGNETO SHAFT OIL SEAL

- 8-43. **INSTALL MAGNETO GEAR AND SHAFT BEARING.**
- Using Driver GP-7, install needle bearing in retainer at top of transmission case so that bearing is just flush with flange face.
 - Install magneto drive shaft and gear while meshing shaft gear with transmission drive gear.
 - Mount magneto shaft oil seal on shaft with lip toward bearing, and drive into place with Driver GP-10. (See figure 40).
 - Install magneto adjustable coupling and shaft key so that jam nut faces forward, end of coupling should be flush with end of the shaft.
 - Install transmission cover and gasket and secure with two front cap screws. Remaining cap screws are used for magneto and the handle bar holder.
- 8-44. **INSTALL SHIFT LINK.**
- Insert transmission speed shift link (jam nut end up) into the lower shift arm at the bottom of transmission so that elbow points toward transmission.
 - Insert upper control link into the shift arm so that elbow points toward transmission.
 - Insert upper control link into the shift arm so that elbow points to the rear.
 - Install cotter pins on each link, then place shift lever in "neutral" position.
- 8-45. **REASSEMBLY OF REVERSE GEAR. (SEE FIGURE 38.)**
- 8-46. **ASSEMBLE AND INSTALL GEAR AND CLUTCH ASSEMBLY.**
- On large end of worm gear drive shaft, install thrust washer so that tang fits into spline ends, then follow with drive gear and gear retaining washer with tang engaged in shaft notch. Secure parts to shaft with large snap ring, using Plier GP-16.
 - On small end of shaft, match clutch disc splines to shaft splines and install clutch. Follow with thrust washer so that tang fits into spline end, then install drive gear and gear retaining washer with tang engaged in shaft notch. Secure parts to shaft with large snap ring, using Plier GP-16.
 - Press ball-bearing onto shaft and secure in place with small snap ring, using Plier GP-16.
 - Place idler gear in position in gear case. Do not install idler gear shaft at this time.
 - Engage clutch shifter-fork shoes with clutch, then taking care to mesh drive gear with idler gear, insert assembly into gearcase so that ball-bearing lock ring can be installed.

NOTE

When assembled to clutch disc, set-screw hole in shifter fork must face away from ball-bearing.

- Fasten bearing retainer to front of case with three fillister-head screws, and lock securely with lock wire.

- 8-47. **INSTALL CLUTCH SHIFTER SHAFT.**
- Install felt washer on shifter shaft and lever assembly and insert shaft through side of case into shifter fork until key-way appears between gear case and fork.
 - Install key in shaft key-way, then line up with key-slot in fork; drive the shaft in until flat spot appears through set-screw hole in shifter fork. Install set screw and secure with lock nut.
- 8-48. **INSTALL SHAFT AND PINION ASSEMBLY.**
- Assemble shaft and pinion, then insert small end through hole in front of gear case.
 - Guide the bearing surface into needle bearing in rear of case, and mesh pinion with drive gear; then on end of shaft which protrudes from needle bearing, install retaining washer and snap ring, using Plier GP-15.
- 8-49. **INSTALL IDLER GEAR SHAFT.**—Insert idler-gear shaft through idler gear needle bearing, and through hole in casting as far as possible. Lock idler-gear shaft in place by tightening Allen set screw in lower right side of gear case.
- 8-50. **INSTALLATION OF TRANSMISSION AND REVERSE GEAR.**
- 8-51. **INSTALL REVERSE GEAR (IF EQUIPPED) TO TRANSMISSION.**
- Using a new gasket, assemble reverse gear unit to transmission case with six cap screws and lock washers, after matching splines of transmission worm shaft with splines of reverse gear worm drive shaft.
 - Install magneto drive gear and shaft so that shaft end emerges through the bearing in the transmission case.
 - Install shaft key on magneto drive shaft, then fit adjustable coupling onto shaft and tighten nut just enough to keep coupling from sliding off.
 - Connect reverse control link assembly to reverse control lever. Secure with cotter-pin.
- 8-52. **INSTALL HANDLE BAR AND BASE ASSEMBLY.**
- Secure handle bar base to top of transmission case with four cap screws and lock washers. On reverse gear units, install speed shift lever bracket and spring onto handle bar bracket with the two cap screws on the right side.
 - Connect Tiller shift and speed shift (or reverse) control rods to shift arms with flat washers and cotter pins so that control rod elbows face transmission.
 - Connect hose to air cleaner and install oil cup.
 - Connect ground wire to magneto terminal.
- 8-53. **INSTALL ENGINE.**—Refer to paragraph 1-14.

- 8-54. INSTALL TILLER AND DRIVE.—Refer to paragraph 1-17.
- 8-55. INSTALL AND TIME MAGNETO.—Refer to paragraph 6-47.
- 8-56. INSTALL TILLER HOOD.—Align Tiller and Tiller bracket holes, then insert bracket pin and secure with a flat washer and cotterpin at each end.
- 8-57. CONNECT THROTTLE CONTROL.—Refer to paragraph 1-28.
- 8-58. LUBRICATE TRANSMISSION. — Lubricate transmission as indicated in paragraph 11-6. If lubricant leaks from outer ends of axle shaft, install water packing as follows:
- a. Remove axle nuts and washers from both ends of axle.

8-59. TRANSMISSION SHIFT LINKAGE ADJUSTMENT.

8-60. ADJUSTMENT FOR UNITS WITHOUT REVERSE GEAR.

- a. Pull the wheel speed control rod all the way back.
- b. Push the Rototiller forward until the wheels lock. This indicates that the transmission clutch is engaged.
- c. Remove cotterpin and disconnect the upper control link from the shift lever.
- d. Press shift arm down while rocking the Rototiller back and forth to insure complete clutch engagement.
- e. With shift lever resting against the lock spring, loosen the jam nut on upper link, and turn link until it can slip easily into the shift lever trunion, then replace the cotterpin.

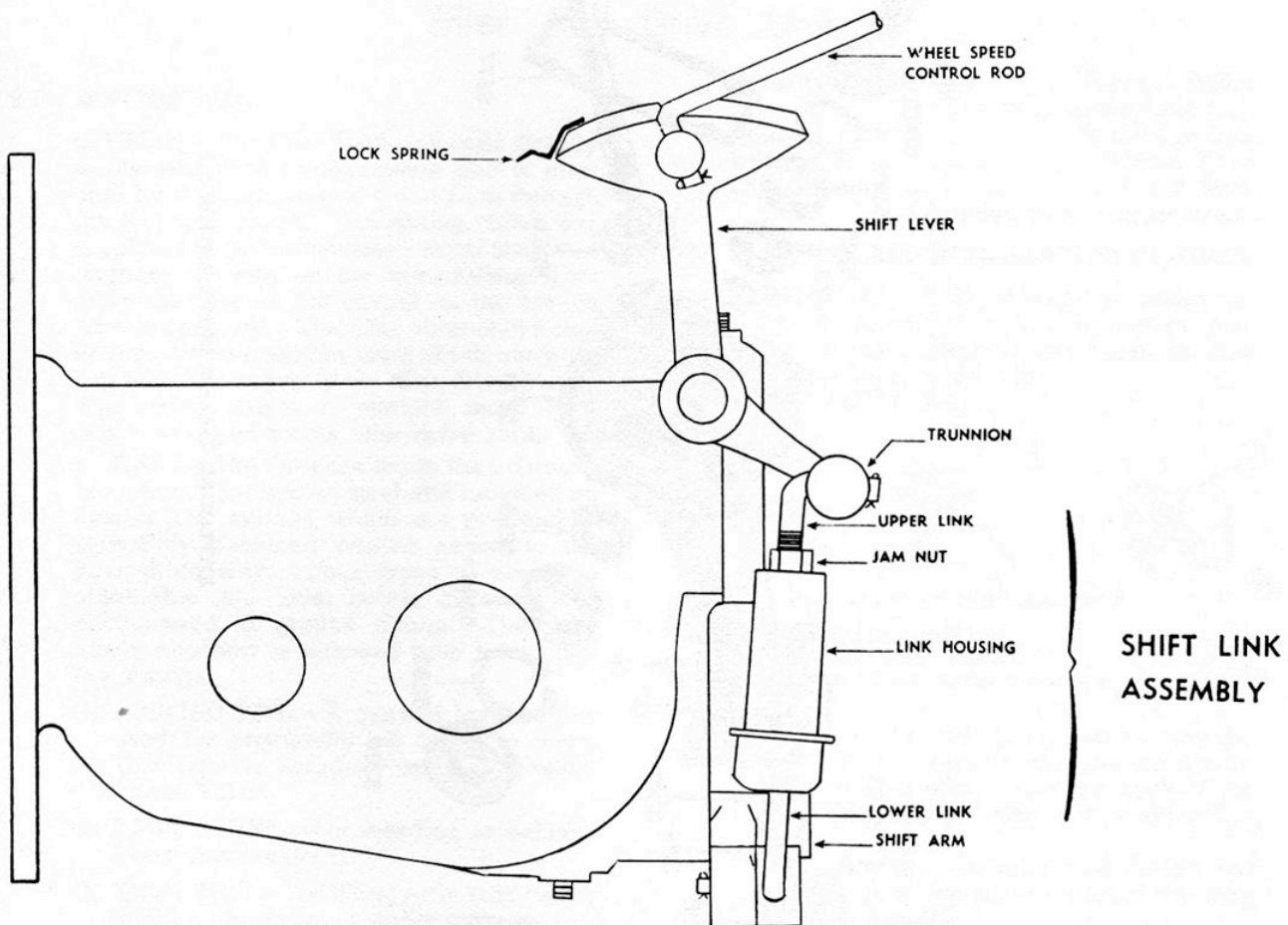


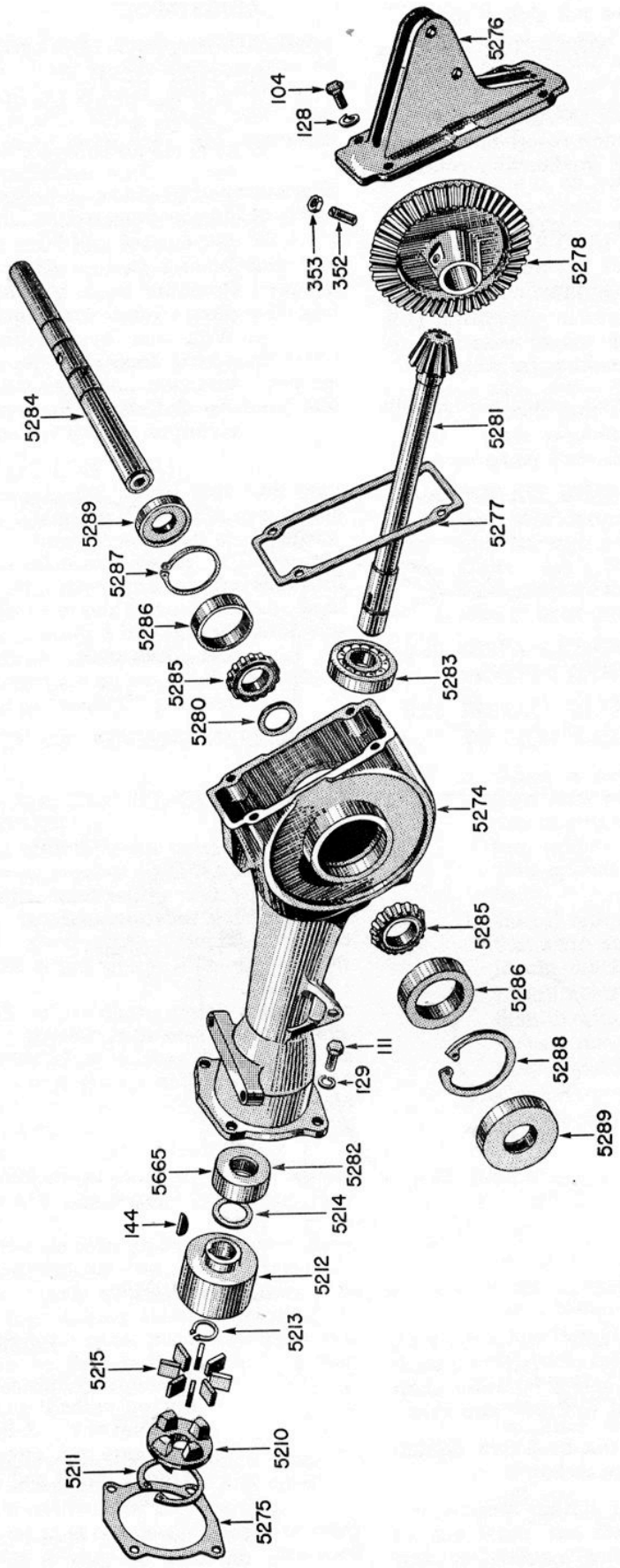
FIG. 41—TRANSMISSION SHIFT LINK ADJUSTMENT

- b. Starting with right side, wrap packing into recess at inner end of threads on shaft to completely close space between shaft and wheel hub, and to cover key-way.
- c. Install flat washer and axle nut; tighten nut and install a new cotterpin.
- d. Wrap left shaft in a similar manner; install washer and axle nut; draw nut up tight and back off one castellation, then install a new cotterpin.

NOTE

The upper link must enter the trunion without pushing or pulling the link. Adjustment must be made by screwing the link threads in or out of the spring housing.

- f. Push the wheel speed control rod lever all the way in, then push the Rototiller forward until the wheels lock. If the link is



EXPLODED TILLER DRIVE ASSEMBLY

properly adjusted, the shift lever will appear on the other side of the lock spring, or exactly opposite of the position shown in figure 41.

8-61. ADJUSTMENT FOR UNITS EQUIPPED WITH REVERSE GEAR.

To adjust the reverse and the transmission linkages, place the reverse control rod in reverse position and proceed as follows:

- a. Disconnect lower shift link from transmission shift arm.
- b. Press down on transmission shift arm and push the Power Tiller forward until wheels lock.
- c. Operate the speed shift lever (upper link)

- so that the upper notch is engaged with the bracket.
- d. Loosen jam nut on upper link, and turn control link housing until lower link slides easily into shift arm.
- e. Tighten jam nut and install cotter pin in lower link.
- f. Disconnect reverse control link from reverse control clutch lever.
- g. Operate reverse control rod so that shift lever quadrant is just to the rear of lock spring.
- h. Loosen jam nut on reverse control link and adjust link so it can be inserted easily into the reverse clutch lever.
- i. Tighten jam and install cotter pin at reverse clutch lever.

SECTION IX

Tiller And Drive Unit

9-1. DESCRIPTION.

a. **TILLER.**—The tiller drive unit bolts directly to the rear of the transmission and is powered by the transmission worm shaft through the dog type clutch. The sliding clutch dog is splined to the transmission worm shaft and engages the dog on the transmission tiller drive shaft, when the control on the handle bars is operated. The tiller shaft clutch dog in turn, drives a leather lined shock absorber cup which is keyed to the tiller drive pinion. The pinion drives a straight bevel gear which is keyed to the tiller drive shaft.

b. **TINES.**—The tines are made from chrome-vanadium heat-treated steel and mounted on flexible coil springs which are attached to especially designed casting keyed to the tiller drive shaft. Four types of tines are obtainable and cover nearly all conditions encountered in ground tillage. They are easily attached or removed from the mounting springs.

- (1) **POINTED TINE.**—A general purpose tine used for practically all types of work. This type is standard on the Rototiller Power Tillers.
- (2) **PARING TINE.**—For weeding or cultivating at shallow depth.
- (3) **KNIFE TINE.**—For tilling soils with heavy green undercrops, or stable manure.
- (4) **"S" TINE.**—For half or full depth tilling of soil encrusted with coarse obstacles such as stones and roots. This type of tine should always be used for woodland tilling.

9-2. SPECIFICATIONS.

Gear Ratio	1-4
Speed	245 rpm at Engine Speed of 2400 rpm
Pinion Bearings	Single Row Bearing Ball Type

Bevel Gear Bearings	Tapered Roller Bearing With Removable Cup
Housing	Malleable Iron
Lubrication	Splash Type
Oil Capacity	1 1/2 Pints (Obtained from Transmission)

9-3. REMOVAL AND INSTALLATION OF TINES.

- a. **REMOVAL.**—Using a hammer, loosen the tine by driving it back to the narrow portion of the coil-spring loop, then remove by turning it to the right.
- b. **INSTALLATION.**

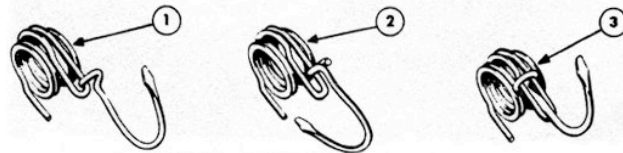


FIG. 42—TINE INSTALLATION

- 1. Starting position
- 2. Half Turn position
- 3. Full Turn (Locked) Position

- a. Facing the coil spring and holding the tine with the point up (the position it is in when on the tiller), enter the hook of the tine over the right side of the coil-spring loop.
- b. Turn the tine one-half turn to the left and push back to the narrow part of the loop of the coil-spring.
- c. Turn the tine another one-half turn to the left and pull forward into locked position.

9-4. REMOVAL AND DISASSEMBLY OF TILLER DRIVE.

9-5. REMOVE TILLER DRIVE UNIT. — Remove tiller hood then unscrew four cap screws and lock washer which fasten tiller and transmission flanges together.

9-6. REMOVE TINE SPRING HOLDERS.

- a. Remove self-locking nut and washer from end of each tine holder assembly; if studs

- unscrew at inner end, remove stud, nut, and washer, together.
- b. Remove tine spring holders after tapping them off gently with a soft hammer.
- c. Remove tine holder studs, using pliers.
- d. Remove drive shaft keys and clearance washers.

9-7. REMOVE TILLER DRIVE-SHAFT AND RING GEAR.

- a. Remove tiller drive housing cover and gasket; drain out lubricant.
- b. Place housing in vise as shown in figure 43.
- c. Remove both oil seals as follows: Using Puller GP-12 as a guide, center-punch the seal and drill two holes (with a #41 drill) for the self-tapping screws furnished with puller. Fasten puller to seal with metal screws as shown in figure 35. Then remove seal by tightening wing bolts.

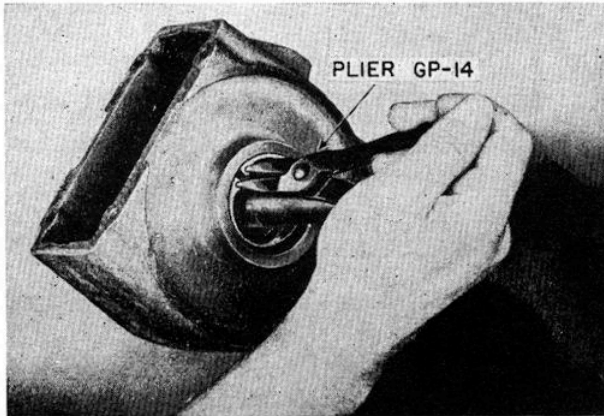


FIG. 43—REMOVING TILLER DRIVE SHAFT BEARING-RETAINER SNAP RING

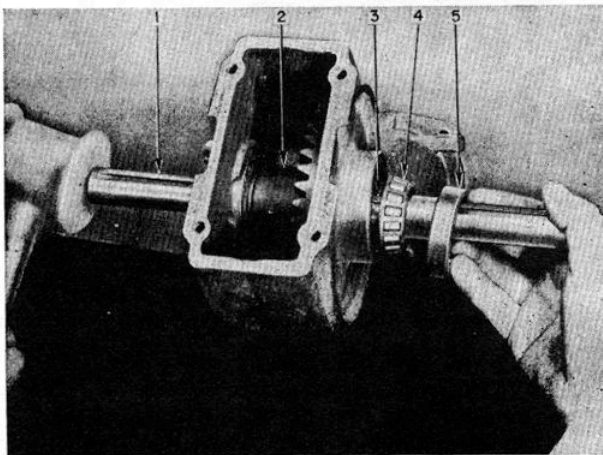


FIG. 44—REMOVING TILLER DRIVE SHAFT

1. Drive Shaft
2. Bevel Gear
3. Key
4. Bearing Cone
5. Bearing Cup

- d. Remove snap ring from right side of housing, using Plier GP-14.
- e. Using a soft hammer, tap drive shaft from left to right side; right bearing will come out with shaft. (See figure 44.)
- f. Remove bearing from shaft using Plate GP-6 with Puller GP-18. (See figure 31.)
- g. Remove tapered snap ring from left side of housing Plier GP-14.
- h. Remove bearing cone, then drive cup from left side of housing with Driver GP-11 as shown in figure 49, then remove ring gear and shims.

9-8. REMOVE SHOCK ABSORBER HOUSING.

- a. Change position of tiller drive housing in vise as shown in figure 45, then remove snap ring which secures clutch dog to drive shaft with Plier GP-17.

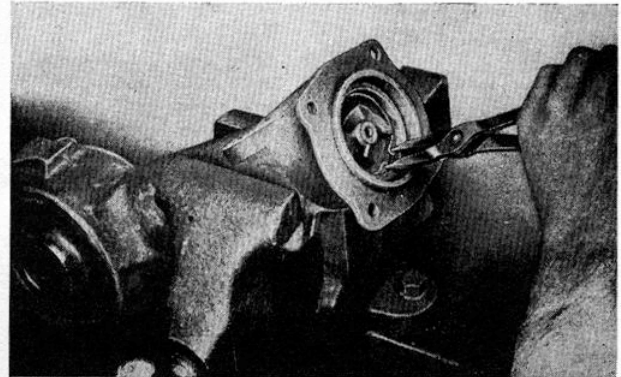


FIG. 45—REMOVING CLUTCH DOG RETAINING SNAP RING

- b. Remove clutch dog by grasping one of the protruding teeth with pliers then tap the end of the shaft gently with a brass drift while pulling the dog from the shaft.
- c. Remove the clutch shock absorber leathers (eight).
- d. Remove snap ring which secures shock absorber housing to pinion shaft, using Pliers GP-15, then draw shock absorber housing from shaft.

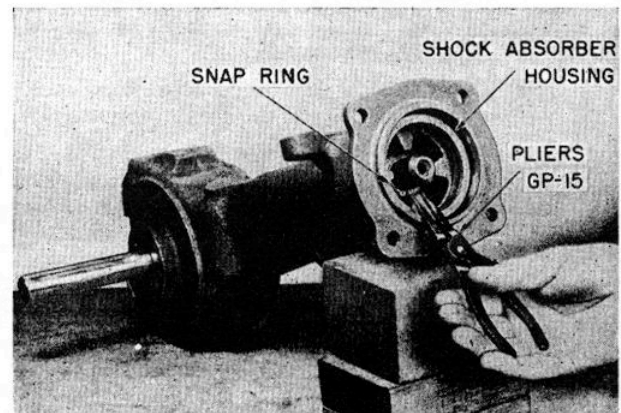


FIG. 46—REMOVING SHOCK ABSORBER HOUSING

9-9. REMOVE AND DISASSEMBLE PINION SHAFT.

- a. Remove shaft key and bronze thrust washer from pinion shaft.
- b. Remove pinion shaft by sliding it out from end of housing.
- c. Remove pinion shaft ball bearing using Plate GP-6 with Puller GP-18 as shown in figure 31.

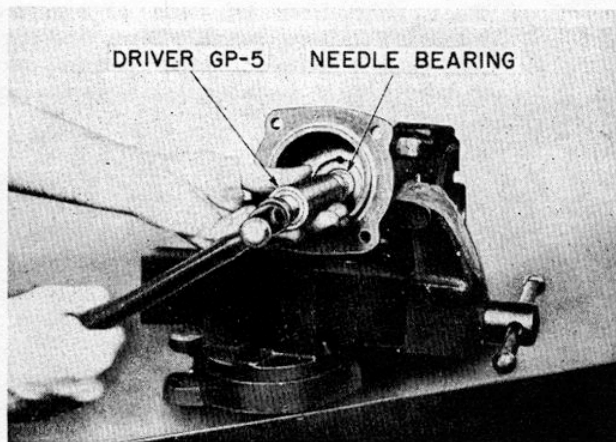
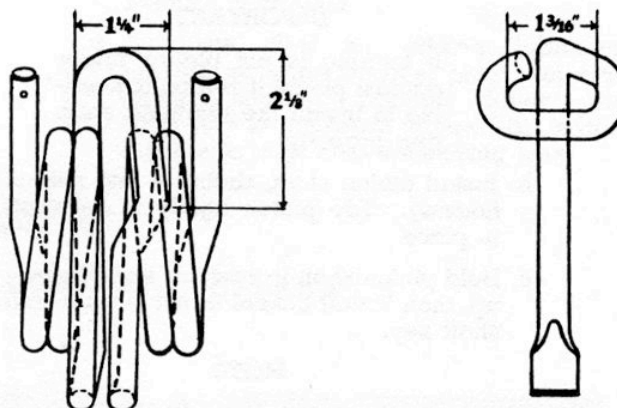


FIG. 47—REMOVING TILLER PINION SHAFT NEEDLE BEARING

- 9-10. REMOVE NEEDLE BEARING. — Remove pinion shaft front bearing (Torrington) from tiller housing, using Driver GP-5. Insert double-stepped end of driver into bearing, and force through until driver shoulder meets housing, then remove bearing from rear.
- 9-11. INSPECTION AND MAINTENANCE.
- 9-12. HOUSING AND TINE HOLDERS. — Inspect tiller housing and tine holder castings for flaws or cracks, especially at points of stress. See that the tine spring holes are not elongated or otherwise deformed. Cracks in castings which permit lubricant leakage may be welded, provided that they do not occur at points of stress.
- 9-13. TINES AND SPRINGS. — Minimum dimensions for undistorted tines and springs are shown in figure 48. It should be noted that the width of the spring must exceed the width of the tine by a minimum of $1/16$ ".

NOTE

On some springs the loop (or center portion) may be found to be off center. These springs are still usable and can be installed in any position except the two next to the tiller housing. For these two center positions (which are on an angle) the spring with loops most nearly centered should be installed to eliminate possibility of the tines damaging the housing. Tines or springs which do not meet the dimensions shown in figure or are otherwise distorted should be replaced with new ones.



Tine Holder Spring

Tine

FIG. 48—TINE AND SPRING DIMENSIONS

- 9-14. BEARINGS.—Bearings should be thoroughly cleaned in solvent and then dried with compressed air. Presence of cracks, flat spots, or binding indicates replacement.
- 9-15. OIL SEALS AND GASKETS. — Always replace oil seals and gaskets with new ones when reassembling the tiller drive unit.
- 9-16. SNAP RINGS. — Always replace snap rings with new ones; the old snap rings may have become over-heated at some time and lost the resilience necessary to perform its function.
- 9-17. SHOCK ABSORBER HOUSING AND LEATHERS. — Examine shock absorber housing for flaws or cracks, especially at the inner teeth. See that keyway is free from burrs and undistorted. Always replace leather pads with new ones throughout.
- 9-18. GEARS. — Immerse gears in solvent and wipe dry. Inspect for nicked, chipped, or broken teeth, check condition of all keyways; replace if damage is evident.

9-19. REASSEMBLY AND INSTALLATION OF TILLER DRIVE.

- 9-20. INSTALL NEEDLE BEARING. — Place tiller housing in vise as shown in figure 47, and drive bearing (Torrington) into place using Driver GP-5. Insert single-stepped end of driver into bearing, then place in until bearing is flush with case.
- 9-21. ASSEMBLE AND INSTALL PINION SHAFT.
- a. Install bearing on pinion shaft; place firmly into position against pinion using Plate GP-6 with Driver GP-18 as shown in figure 31. Use $3/8$ " x 8" SAE bolts with puller.

IMPORTANT

If bearing is not placed firmly against pinion it will be impossible to install the retaining snap ring properly.

- b. Install pinion shaft, sliding it into rear of housing. Tap pinion lightly to set shaft in place.
- c. Hold pinion shaft in position with keyway up, then install bronze thrust washer and shaft key.

NOTE

Blunt end of key should face thrust washer.

9-22. INSTALL SHOCK ABSORBER HOUSING AND CLUTCH DOG.

- a. Insert shock absorber housing onto shaft and secure in position with snap ring, using Plier GP-15.

IMPORTANT

Make sure that snap ring is seated properly.

- b. Install eight leather shock absorber pads into housing.
- c. Insert tiller clutch dog onto shaft so that pads grip the teeth, the lock dog in place with snap ring, using Plier GP-17.

9-23. INSTALL TINE HOLDER DRIVE SHAFT AND RING GEAR.

- a. Place tapered bearing onto drive shaft using Plate GP-6 with Puller GP-18, then press bearing firmly onto shaft against shoulder. Install shaft key.
- b. Change position of tiller housing in vise, as shown in figure 47, then install unbev-

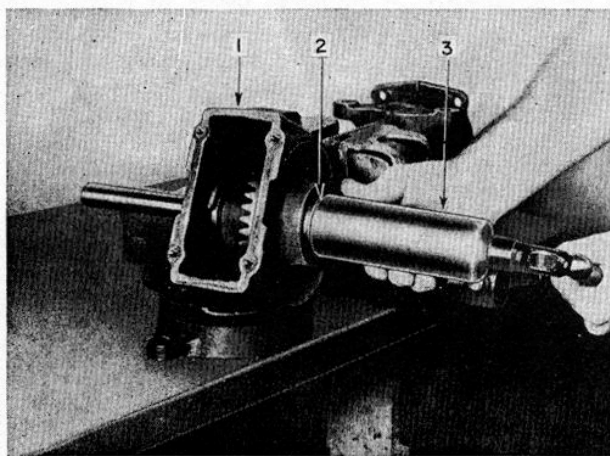


FIG. 49—INSTALLING TILLER DRIVE SHAFT OIL SEALS

1. Tiller Housing
2. Oil Seal
3. Driver GP-11

eled snap ring in right side of housing using Plier GP-14.

- c. Install bearing cup in right side of housing with thick edge facing out; using Driver GP-11 through the left side of the case press cup firmly against snap ring.
- d. Place bearing cones and shims (if used) in position, then insert ring gear in right side of housing.
- e. Insert shaft from left side of housing through ring gear, bearing cone, and cup until shaft is centered. Insert bearing cup with thick edge facing out until snap ring groove appears.

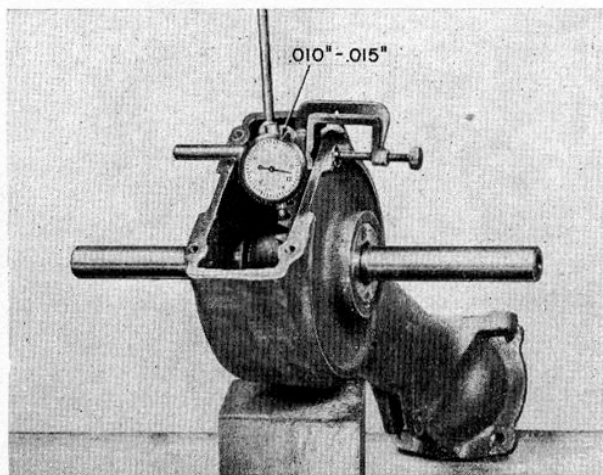


FIG. 50—MEASURING BACKLASH BETWEEN PINION AND RING GEAR

- f. Install beveled snap ring in housing with bevel facing out, MAKING SURE THAT SNAP RING IS LOCKED IN HOUSING GROOVE.

IMPORTANT

Backlash between pinion and ring gear should be between .101 and .015. If backlash does not conform to these measurements, remove or add to shims between ring gear and bearing.

- g. Insert Sleeve GP-11 onto shaft (thick end first), then using fingers, press oil seal over shaft and onto sleeve. Drive seal into housing with Driver GP-11 as shown in figure 49. This procedure applies to both seals.
- h. Install housing cover and gasket onto housing using four cap screws and lock washers.

- 9-24. INSTALL TINE SPRING HOLDERS. — Assemble clearance washers, tiller drive keys, and studs on shaft (each side) then slide spring holders onto shaft followed by steel washers. Lock assembly in place tightly with a new self-locking nut on each side.

9-25. INSTALL TILLER DRIVE UNIT.

- a. Align transmission and tiller housing flanges then install four cap screws and lock washers.
- b. Connect depth runner to tiller housing cover.

c. Replace tiller hood.

- d. Lubricate tiller by adding lubricant through transmission filler plug with machine in horizontal position. Allow sufficient time for lubricant to flow from transmission to tiller before checking level.

SECTION X

Wheel Hub Clutch - Wheels - Steering

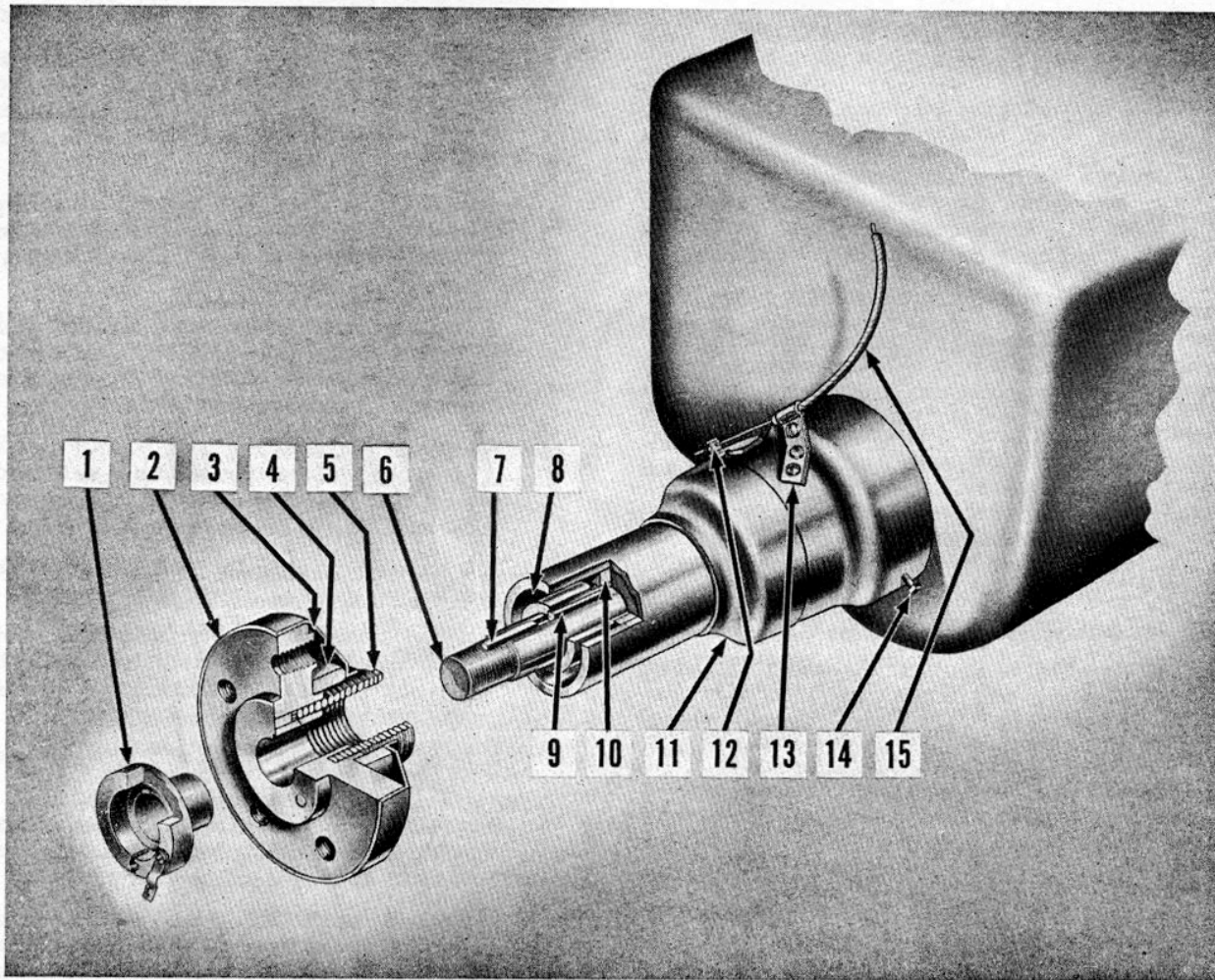


FIG. 51—SECTIONAL VIEW OF HUB CLUTCH AND LOCKOUT ASSEMBLY

- | | |
|-----------------------|------------------------|
| 1. Lockout Bushing | 9. Inner Race Key |
| 2. Outer Hub | 10. Energizing Ring |
| 3. Seal Retainer | 11. Inner Hub |
| 4. Oil and Dust Seal | 12. Clutch Lever |
| 5. Clutch Spring | 13. Control Cable Clip |
| 6. Axle Shaft | 14. Set Screw |
| 7. Bearing Key | 15. Control Cable |
| 8. Inner Control Race | |

10-1. WHEEL HUB CLUTCH AND LOCKOUT ASSEMBLY.

10-2. DESCRIPTION. — The mechanism in the Wheel Hub Clutch and Lockout Assembly when controlled from the handle-bar thumb control levers, contributes to greater ease and maneuverability of the Rototiller Power Tiller. When the lockout pin is inserted the "free-wheeling" feature is inactive and automatically the Rototiller is converted into a straight axle drive. This dual purpose control selection contributes to the Rototillers versatility under all soil conditions.

10-3. REMOVAL OF WHEEL HUB CLUTCH AND LOCKOUT ASSEMBLY.

- a. Disconnect control wires from clutch control lever, trunnions by loosening the set screws.
- b. Disconnect the control wire housing extending from each side of handle-bar fork to the clips on each inner axle hub.
- c. Raise machine until wheels clear, then place blocks under transmission, or hoist machine onto shipping crate.
- d. Remove cotterpin, castellated axle nut from left and right side and remove both wheels and outer hubs. The lockout bushing and key will come free with removal of wheels.
- e. Pull inner hub assembly from axle, same procedure to be followed on opposite side.

10-4. DISASSEMBLY OF WHEEL HUB CLUTCH.

- a. Remove clutch control spring (5), inner race (8), and inner race key. On machines not equipped with lockout bushing, remove wheel hub bearing.
- b. Remove energizer ring (10) then remove clutch control lever assembly by revolving counter-clockwise.
- c. Remove inner seal retainer (3), inner oil and dust seal (4), and pull outer race assembly.
- d. Remove outer thrust washer, pull out energizer assembly, friction arresting washer, actuating clutch spring, and oil seal.

10-5. CLEANING AND INSPECTION. — Immerse all metal parts in clean solvent and scrub thoroughly, then wipe (or dry with compressed air). It is especially important that all parts be clean so that flaws or wear can be detected readily.

10-6. CLUTCH SPRINGS. — Inspect all springs for condition of chips, cracks and burrs. Replace with new springs if any defect is found.

10-7. INNER RACE. — If cracked or flat spots evident, replace with new part.

10-8. ENERGIZER. — If pins are distorted or

burred, replace with new part.

10-9. ENERGIZER RING. — Inspect for cracks or burrs if found defective, replace with new part.

10-10. OIL SEAL. — As oil seals are easily distorted during removal, always use new seals for precautionary purpose.

10-11. REASSEMBLY OF WHEEL HUB CLUTCH AND LOCKOUT ASSEMBLY.

- a. Before starting reassembly use a light film of high temperature, low temperature grease. Do not use any other type.
- b. Position wheel control clutch case so that actuating clutch spring, friction arresting washer, energizer assembly, and outer thrust washer, can be replaced in that order.
- c. Insert outer race and spacer assembly so that the three prongs on energizer assembly enter through holes in spacer, then insert energizer ring (10).
- d. Position inner dust and oil seal (4), against raised portion of outer race and spacer assembly, then install inner seal retainer (3), and secure in place.
- e. On flanged end of wheel control clutch case apply Permatex on inner side and insert oil and dust seal (4), then insert oil seal on transmission shaft opening.
- f. Insert flat washer through transmission axle and against transmission flange.
- g. Slide clutch assembly on axle and against transmission assembly, align hub stop nut with notch on transmission flange and secure assembly in position.
- h. Insert inner clutch race and key to transmission axle.
- i. Insert clutch spring, make certain that right spring is inserted and in correct position.
- j. Replace outer hub and wheel, making certain that lockout is keyed to axle, then replace castellated nut until snug. Back off one castellation and insert cotterpin.

10-12. PRECAUTION POINTS.

- a. The right hand clutch spring is wound counter-clockwise and the left hand clutch spring is wound clockwise, under no condition should these springs be reversed in installation. The notched end of springs must be inserted into Wheel Control Clutch Assembly.
- b. Do not install axle nut tight against wheel, tighten axle nut until snug. Then back off one castellation and insert cotterpin. All abutting parts in the Hub and

Wheel Control Assembly should be in light but positive contact. Hard contact will render the assembly inoperative or wear it excessively.

c. The three holes located on clutch control lever assembly are to be used only when the Clutch Control Lever travel exceeds beyond the center line of axle shaft. Should this action prevail, remove screw and place lever in position so that lever, when pushed forward until light contact of the inner mechanism is felt, will not travel beyond center line of axle shaft with lever pointing away from transmission case. This precautionary measure is taken so that the control wire extending from cable clamp on inner hub to the trunnion on the Clutch Control Lever Assembly will be in a direct line and will delete the possibility of bending control wire.

d. The design of the clutch is such that the parts require a light film of special grease when first assembled. Use only high temperature, low temperature grease. Do not use any other type.

10-13. WHEEL HUB CLUTCH ADJUSTMENT.

a. Raise both thumb control steering levers on the handle bar as high as possible without forcing. The thumb control steering levers are now in the engaged position.

b. Fasten the control cable housing extending from each side of handle bar fork, to the clips on each inner axle hub. Cable housing should extend approximately 1/4" beyond the clips.

c. Position the clutch control lever assembly on each hub by pushing the clutch control lever forward until a light contact of the inner mechanism is felt. The clutch control lever assembly on each is now in the engaged position, corresponding with control steering levers as outlined in step (a.) above.

d. Connect the control wires to the clutch control lever trunnions, and tighten the set screws securely.

10-14. CLUTCH OPERATION CHECK.

a. Start machine and push control-rod forward to engage the transmission gears.

b. Depress the thumb controls on the handle-bars fully; this should stop the forward motion of the machine.

c. Raise the thumb controls; the wheels should now be engaged with transmission gears; this should start the machine in forward motion.

NOTE

If wheels fail to engage or disengage when thumb control is operated, disconnect the control

wires from clutch control levers on inner hub and operate by hand. If clutch does not operate correctly, check lockout bushing and clutch springs and then reconnect the control wires.

10-15. HANDLE BAR AND CONTROLS.

10-16. DESCRIPTION AND OPERATION. — The handle bar assembly is a welded steel tube structure which provides mounting for the following controls:

a. CARBURETOR THROTTLE CONTROL.— Push lever on left handle bar forward to accelerate the engine; to rear to decelerate.

b. MAGNETO GROUNDING SWITCH. — Press button, to ground low tension circuit of the magneto and stop the engine.

c. THROTTLE CONTROL. — Pull, to move handle bars to the right, center, or left; release, to lock in desired position.

d. VERTICAL CONTROL. — Pull, to raise or lower handle bars according to height of operator; release to lock at desired height.

e. WHEEL SPEED CONTROL. — Pull, to engage transmission clutch with low speed gear; push, to engage clutch with high speed gear. To disengage clutch from gears and halt forward travel, move control rod to center position.

f. REVERSE CONTROL ROD. — On units equipped with reverse gear, the wheel speed control rod is designated as the reverse control rod. Pull, to "back up" the machine; push, to go forward. To halt, place the control in center position.

g. TILLER CLUTCH CONTROL. — Push, to engage tiller clutch; pull to disengage.

10-17. DISASSEMBLY OF HANDLE BAR.

a. Disconnect and remove wheel speed and tiller shift control rods.

b. Disconnect throttle control cable at carburetor and at clamp.

c. Disconnect magneto ground wire.

d. Remove cotter pin, then castellated nut and flat washer; then lift handle bar and sector assembly from machine.

e. Disconnect and remove horizontal and vertical control rods.

f. Remove cotter pin, then castellated nut from handle bar fork bolt to separate handle bar from sector. The flat spring or coil spring and pins may now be removed, if desired.

g. To remove magneto grounding wire, remove screws which fasten grounding switch to handle, then disconnect wire from bottom of switch by removing the

terminal screw. Before removing, test as directed in paragraph 10-18.

- h. To remove throttle control cable, remove cable from clamp on handle bar, then disconnect wire from throttle swivel and pull cable out from fork end of handle.
- i. To remove throttle control, remove snap ring and flat washer, then drive the pin from handle bar, spread the throttle yoke until swivel drops and the control can be lifted from the handle.

10-18. MAINTENANCE

- a. **MAGNETO GROUNDING SWITCH AND WIRING.** — If engine stops for no apparent reason, disconnect ground wire at magneto and attach to one side of test battery, connect other side of battery in series with a lamp and the handle bar switch mounting screw. Lamp should light only when switch is depressed. If test indicates a short circuit, remove switch and test separately. If switch is satisfactory, replace the complete magneto ground wire.
- b. **THROTTLE CONTROL CABLE.** — If control wire movement in housing is rough or jerky, replace complete cable assembly, connecting cable to carburetor as directed in paragraph 4-29. Lubricate with a few drops of engine oil.

c. **POSITION CONTROLS.** — See that springs have desired tension and are free from rust or cracks. Inspect locking pins for defects. Replace, if necessary.

- 10-19. **REASSEMBLY AND INSTALLATION.** — Reassembly and installation of the handle bar assembly is the reverse of the procedure given in the preceding paragraph.

NOTE

When installed properly, the elbows of the two inner control rods, face each other and the elbows of the two outer rods point down; all control rod handles, unless equipped with ball grips, point down.

10-20. WHEELS AND TIRES.

- 10-21. **GENERAL.** — The driving wheels are the drop-center disc-type 12" x 3.00", equipped with two-ply 4.00" x 12" rubber tires. Cleated steel wheels are optional. Recommended tire pressure is from 10 to 12 lbs. at normal air temperatures. The inner-tube valve stems are offset and must be installed so that the stem points toward the stem hole in the wheel. In addition, the arrow on the tire side wall should point in the forward direction of rotation so that the "V" treads of both tires face forward. When installing cleated steel wheels, the cleats of both wheels should form a "V" with points facing forward, to attain maximum traction.

SECTION XI

Service Lubrication, And Storage

11-1. PREPARATION FOR DELIVERY.

- 11-2. **UNCRATING AND ASSEMBLY.** — To facilitate packing and to save shipping space, Rototiller Power Tillers are shipped from the factory with the handle bar assembly, and the control rods and hood, removed. Direction for assembling are as follows:

- a. **REMOVE FROM CRATE.** — After top, sides and ends of crate have been removed, cut hold-down straps securing the Power Tiller to bottom of crate, then cut the wires which hold the hood in place and remove hood after disconnecting adjusting bar from rear of tiller. Remove long bolts which secure front housing to bottom of crate.

CAUTION

Under no circumstances should these bolts be screwed back into the front housing. The two 1/2" x 1 3/8" cap screws in the sides of the front housing may be removed if desired, but should never be replaced by a longer bolt.

- b. **INFLATE TIRES.** — Inflate tires to 10-12 lbs. pressure.
- c. **INSTALL HANDLE BARS.** — Install handle bar assembly and secure in place with 5/8" x 3" handle bar fork bolt.

NOTE

To provide necessary clearance, tighten slotted nut on fork bolt and then back off one slot, and lock with cotter pin.

- d. **CONNECT CONTROL RODS.** — The handle bar assembly is shipped with the control rods in the proper locations. Inasmuch as the rods are not interchangeable, simply secure the rods to their attachment points with cotter pins. (Cotter pins are strung on a wire attached to the handle bar bracket.) The "vertical" control rod connects to the lever in the center of the handle bar base. When installed properly the elbows of the outer rods point down; all control rod handles should point down.

e. CONNECT THROTTLE CONTROL.

- (1). Insert end of cable housing in clamp on body of carburetor, and tighten the clamp screw securely.
- (2). Insert inner wire through swivel on carburetor throttle lever BUT DO NOT TIGHTEN LOCK SCREW.
- (3). Place throttle on the right handle bar in full closed position (toward operator) and then move throttle forward until there is from 1/16" to 1/8" clearance between the throttle and handle bar.
- (4). With throttle on handle bar in that position, move throttle lever on carburetor to full closed position (rearward) and tighten the screw in swivel securely, to lock inner control wire in place.

f. CONNECT MAGNETO GROUNDING WIRE. — Fasten the wire coming from the left handle bar, to the terminal on the right side of the magneto.

g. INSTALL HOOD ASSEMBLY OR TRANSMISSION PLATE. — If the machine is to be used as a Power Tiller, attach the hood assembly to the hood bracket by inserting the bracket pin and securing it in place with a flat washer and cotterpin on each end. Connect hood adjusting bar to rear of tiller, using clevis pin and cotter pin.

NOTE

To facilitate crating, the hood adjusting bar is installed inverted. Therefore, the bar should be removed and re-installed, before attaching the hood.

If the machine is not to be used as a tiller but as a tractor, a transmission plate obtainable from your Rototiller Dealer may be installed as follows:

- (1.) Place a clean pan under the rear of the transmission, then remove four cap screws and lock washers, which fasten tiller drive housing to transmission.
- (2). Slide tiller away from transmission taking care not to injure the gasket.
- (3). Set gasket in place, then secure transmission plate to case with the four cap screws and lockwashers taken from the tiller.
- (4). Check transmission lubricant lever with dip stick; add additional lubricant if necessary.

11-3. INITIAL SERVICING.

a. FUEL AND LUBRICATING OIL MIXTURES:

FOR ALL TEMPERATURES
BELOW 70° F.

Thoroughly mix one pint of finest grade SAE 40 engine oil with each gallon of gas-

oline for the first 50 hours of operation; thereafter, use 1/2 pint for each gallon of gasoline.

FOR TEMPERATURES

ABOVE 70° F.

Thoroughly mix one pint of finest SAE 50 engine oil with each gallon of gasoline used during the first 50 hours of operation; thereafter, use 1/2 pint for each gallon of gasoline.

Because of the extra oil added to the gasoline during the first 50 hour period, considerable smoke from the exhaust may be expected. Should difficulty be experienced in starting the engine, inspect the spark plug for fouling due to the additional oil added to the gasoline during the "breaking-in" period. THE USE OF DETERGENT OR INHIBITED OILS IS NOT RECOMMENDED. Close fuel shut-off valve then open three to five full turns to permit fuel to flow to carburetor.

IMPORTANT

BE SURE GASOLINE AND OIL ARE THOROUGHLY MIXED BEFORE POURING INTO FUEL TANK. Fuel tank capacity is from 8 1/2 to 9 quarts.

b. TRANSMISSION LUBRICANT. — With the Power Tiller in horizontal position, check oil level in transmission. If low, bring to "full" mark on dip stick, with SAE 90 automotive gear oil. If the weather is extremely cold, SAE 80 should be used. (Lubricant from the transmission flows to and lubricates the tiller axle gears and bearings.)

NOTE

The use of hypoid gear lubricant is not recommended.

c. CARBURETOR AIR-CLEANER.—Fill carburetor air-cleaner to proper level with SAE 40 engine oil; SAE 20 if weather is extremely cold. (See Section 4-6.)

d. STARTER.—Check lubrication of starter. See that the starter shaft moves "in" freely with thumb pressure and springs all the way back when released.

e. WHEEL CLUTCHES. — The handle bar operated wheel clutches are packed with sufficient lubricant to last for the life of the machine.

f. CONTROLS.—See that all controls are lubricated and that they operate freely.

g. Remove any dents and touch up any chipped or bare spots.

h. Check all bolts and nuts for tightness.

11-4. **SERVICE LUBRICATION AND GENERAL MAINTENANCE.**

- 11-5. **ENGINE.** — All moving parts of the engine are lubricated by the oil mixed with the gasoline; therefore, it is of the utmost importance that only the finest quality of SAE 40 engine oil be used. For temperatures below 70°F use SAE 40; above 70°F, use SAE 50. The proper ratio of engine oil to gasoline is one-half pint of oil to each gallon of gasoline.

Less than one-half pint of oil in the gasoline, or the use of an inferior grade of oil, or oil lighter in viscosity than SAE 40 may result in damage to the engine.

More than one-half pint of oil to each gallon of gasoline is not necessary except during the "breaking-in" period, because it may cause hard starting, excessive engine smoking, excessive carbon formation, and possible fouling of the spark plug.

THE USE OF DETERGENT OR INHIBITED TYPE OILS IS NOT RECOMMENDED.

- 11-6. **TRANSMISSION AND TILLER.** — In normal operation use SAE 90 Automotive Gear Oil. In extreme cold weather use SAE 80 Automotive Gear Oil. **Use of hypoid gear lubricant is not recommended.** To add or refill transmission with lubricant, remove dip stick and filler plug. Oil level should be maintained between the "low" and "full" marks on dip stick, with the Power Tiller in horizontal position. Drain transmission and tiller drive, then flush entire system and refill with new oil after every 250 hours of operation or oftener under severe dust conditions, and always at the beginning of the Spring season. See directions for draining and flushing under "Starting after Storage." Tiller bearings are lubricated by lubricant from the transmission; therefore it is important that the transmission be kept filled to the upper level with the correct gear lubricant.
- 11-7. **STARTER SHAFT AND DRIVING WHEELS (FREE WHEELING HUBS.)**—Lubricate every 250 hours of operation with non-fibrous chassis lubricant. **NOTE: Avoid overlubricating starter shaft to prevent lubricant from being thrown on starter cable and fan.**
- 11-8. **CARBURETOR AIR CLEANER.** — Keep cup filled to indicated level with SAE 30 engine oil for normal operation. In extreme cold weather, SAE 20 or 10 engine oil is recommended; for extreme hot weather SAE 40 engine oil is recommended.

IMPORTANT

The life of the engine is greatly dependent upon proper and regular servicing of the air cleaner. **CLEAN CUP DAILY — OR OFTENER UNDER SEVERE DUST CONDITIONS — AND REFILL WITH NEW ENGINE OIL.**

Remove body of cleaner and rinse thoroughly in kerosene every 250 hours of operation, or oftener if required.

- 11-9. **TIRE PRESSURE** — Inflate tires from 10-12 lbs. pressure at normal air temperature.
- 11-10. **TIGHTENING.** — To prevent vibration and excessive wear of connecting parts, keep all screws, nuts, and bolts, properly tightened at all times.
- 11-11. **FUEL STRAINER** — Clean sediment bowl and filter screen every 250 hours of operation, or oftener, if required.
- 11-12. **CLUTCHES, HANDLE BAR, THROTTLE AND CHOKE CONTROLS.** — Lubricate with engine oil every 250 hours of operation, or oftener, if required.
- 11-13. **STORAGE.**
- 11-14. **OFF SEASON OR WINTER STORAGE.** —

When Power Tiller is to be idle for several months proper storage will not only prolong its life, but will also greatly reduce maintenance and operating costs. The following procedure is recommended:

- a. Thoroughly clean off mud and dirt, then wipe dry.
 - b. To prevent settling of sediment and formation of varnish, the fuel system, including the carburetor, should be completely drained.
 - c. Store in a clean, dry, and preferably dark place. Light, especially sunlight, is injurious to the rubber parts.
 - d. To lengthen the life of the tires, place blocks under the driving wheel axles to take the weight off the tires, and reduce air pressure to approximately 50% of normal. Be sure the tires are free from oil and grease.
 - e. To keep rust from forming inside the cylinder, remove the spark plug and pour two tablespoonfuls of engine oil into the cylinder through the spark plug opening. Before reinstalling the spark plug, crank the engine three or four times to distribute the oil over the cylinder wall, piston, and piston rings.
- 11-15. **STARTING AFTER STORAGE.** — To prevent damage to the fine finish of the gears and bearings by dirt and abrasives in the lubricant, the transmission and tiller axle housing should be thoroughly flushed out with a good grade of flushing oil before the Power Tiller is put into service after a long period of storage. These units should be flushed out after every 250 hours of operation or at least once each year as follows:
- a. So that tiller housing will drain quickly and more completely, tilt the Power Tiller forward until it rests on front of engine crankcase.

- b. Remove transmission dip stick, tiller plug and drain plug to permit transmission and tiller housing to drain completely.
- c. Reinstall transmission drain plug, return the power tiller to horizontal position, and pour four or five pints of flushing oil into transmission.
- d. With the handle bars, tilt the Power Tiller back and forth slowly in a rocking motion to flush the old lubricant out of the tiller housing and into the transmission.
- e. Again tilt the Power Tiller forward on engine crankcase, and remove drain plug; after transmission has been completely drained, repeat flushing operation as given in paragraph 3. Generally, flushing twice as outlined is sufficient to remove all of the old lubricant; however, the operation should be repeated for a third time, if necessary.
- f. Depress the handle bars to lower the tiller housing, then remove the cover plate from the rear of the housing. With a clean rag, remove any remaining flush-

ing oil and sediment.

- g. Return the Power Tiller to horizontal position; replace tiller housing cover plate and transmission drain plug; then fill transmission with six pints of SAE 80 or 90 Automotive Gear Oil. Replace filler plug and dip stick, then recheck housing cover, drain plug, and filler plug, for leakage.

NOTE

Sufficient time should be allowed for the tiller axle housing to fill before checking the lubricant level in the transmission, because the lubricant flows from the transmission housing to the tiller axle housing.

CAPACITIES

Transmission and Tiller Axle Housing Combined:

Model B1-6 & B1-7	6 pints
Model B1-6RS & B1-7RS	7 pints
Fuel tank (Oil and Gasoline Mixed)	8 1/2 to 9 quarts
Carburetor Air Cleaner	5 oz.

SECTION XII Special Tools

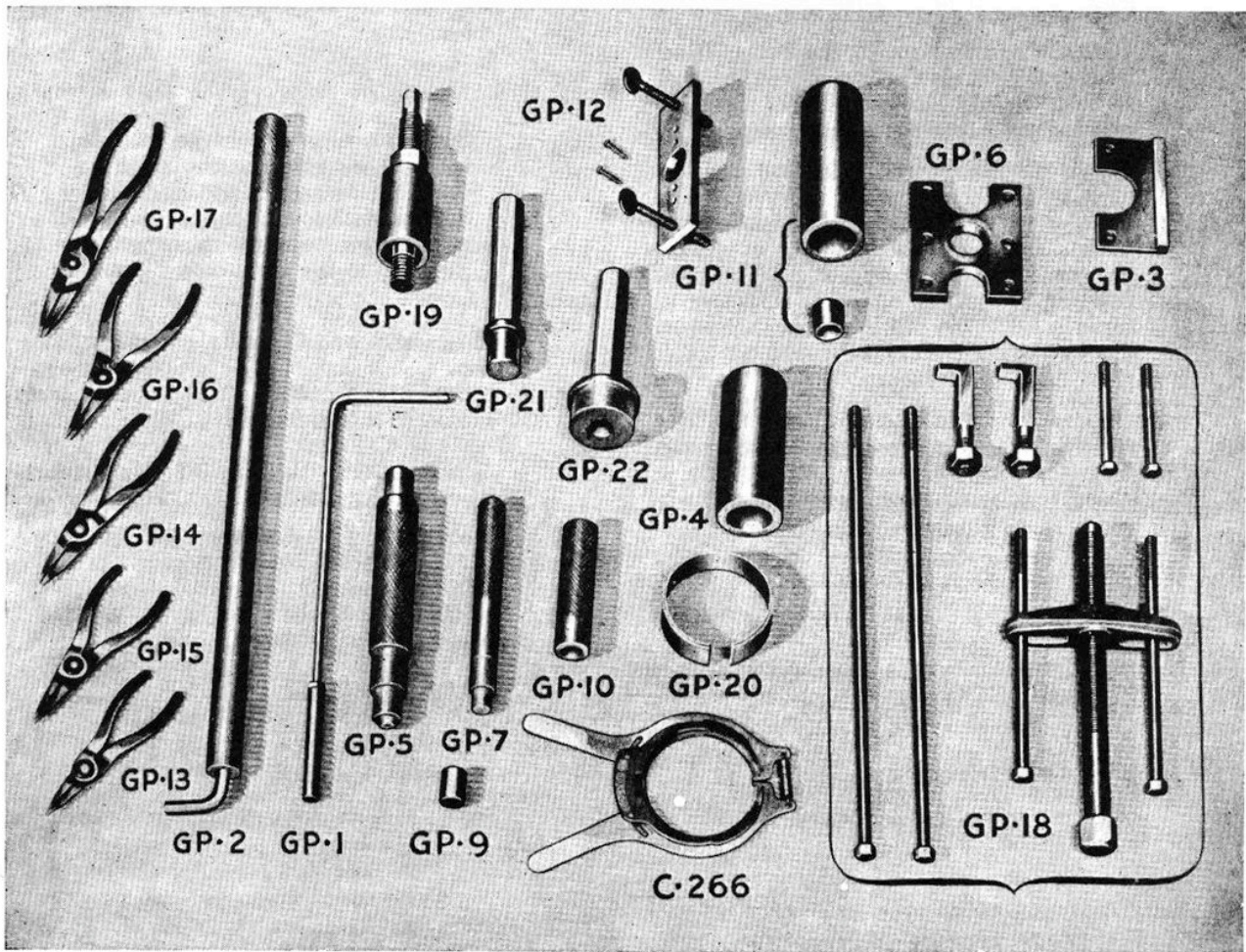


FIG. 52—SPECIAL TOOLS

12-1. To help you provide owners with dependable service the factory has developed this group of essential special service tools. These tools will assure fast, accurate, dependable service and allow time-saving, systematic shop operations.

When a service department is poorly equipped, service men will often attempt specialized or difficult service operations without having the necessary special service tools to do the work safely and efficiently. This results in haphazard or makeshift repairs which cause customer dissatisfaction, inconvenience and extra expense.

12-2. TINES

POINTED TINES — This tine is desirable for deep tillage, breaking up new sod after cover crops have been removed, in clay or where tilling is difficult. Tines of this type

should not be used in cover crops or in difficult stony conditions.

KNIFE TINE — This all-purpose tine can be used for preparing seed beds, for cultivating and mixing in cover crops or weeds. Good for general purposes with the exception of hard ground or extra deep tillage.

"S" TINE — This type of tine is more desirable than other tines in soil with coarse obstacles such as stone and medium sized roots and is useful under most conditions.

PARING TINE — This type is used for weeding, cultivating and shallow work.

12-3. INSTALLING TINES

When using the pointed tines the two center spring mounts are set at an angle by placing the outside prongs of the springs in the outer holes of holder. This angular position of the tines allows them to till evenly and helps to eliminate ridges below the center of the tiller drive housing.

When either the KNIFE, PARING or "S" tines are used the two center spring mounts are set at right angles to the holder by placing the outside prongs of the springs in the inside holes, in that position all tines are at the same angle.

CAUTION: If setting the Paring or "S" tine

at an angle be sure tines clear housing before putting in operation.

The KNIFE, PARING and "S" Tines come in pairs and can be installed as desired by the operator for varying conditions such as straddle row cultivating, full width cutting of cover crops, etc.