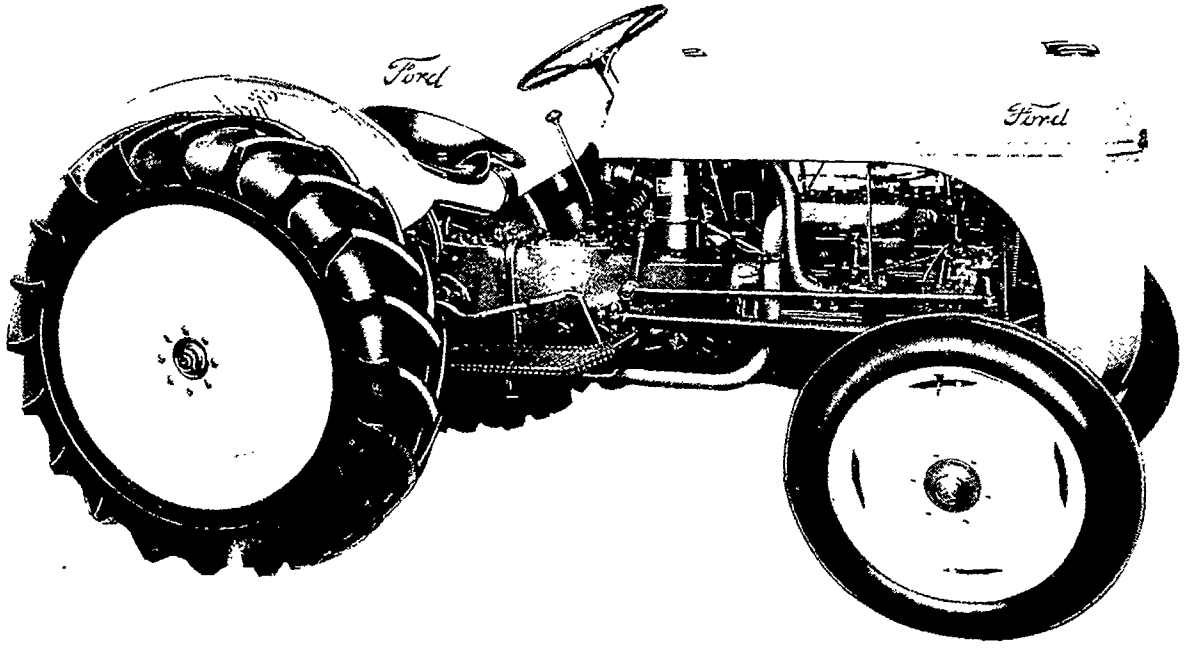
FORD

Service Manual

FORD
NEW HOLLAND

Tractors
9N, 2N and 8N



PLAINTIFF'S EXHIBIT

FD-2229b

NOTE: This service manual has been compiled from several out-of-print Ford Motor Company Publications. Although the primary subject of this manual is the 8N tractor, most of the information which follows is also useful for 9N and 2N tractors.

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DESCRIPTION AND SPECIFICATIONS

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111. DESCRIPTION.

The Model 8N Ford tractor is provided with a steering gear assembly of the automotive ball nut type. It is a highly efficient, easily serviced unit which is readily adjustable to compensate for wear. This steering gear has a low driver fatigue factor because of easy steering and a minimum of road shock.

The tractor is equipped with a four forward and one reverse gear transmission. The transmission contains constant-mesh helical gears, assuring quiet running and providing for long life.

The power take-off is driven from the transmission countershaft. A power take-off adapter is available to extend the shaft when such extension is necessary for fitting certain implements. The adapter meets the American Society of Agricultural Engineers' specifications for a standard tractor hitch. Any implement built to these standards may be hitched to the Ford tractor without the purchase of additional accessories.

The tractor hydraulic system consists of a piston pump driven directly by the power take-off shaft, and a self-contained hydraulic unit which includes the ram cylinder and control linkage. The hydraulic pump and unit are located in the center housing and employ the transmission oil as the hydraulic fluid. This design reduces the possibility of external oil leakage, and greatly reduces repair costs.

The belt pulley assembly is self-contained, and is driven by the power take-off shaft. The pulley assembly is easily mounted on the tractor and has a separate oil supply.

The differential assembly is of the heavy duty truck type, and is driven by the transmission main shaft. The differential furnishes the power directly to the semi-floating rear axles.

112. SPECIFICATIONS.

The following specifications are given as an aid to the mechanic in repairing the Model 8N Ford tractor.

a. General.

Type . . . . . 4-wheel, general purpose

Wheelbase . . . . . 70 in. at 48 in. tread width
Over-all length, front to drawbar . . . . . 115 in.
Over-all height . . . . . 54½ in.
Over-all width, normal tread . . . . . 64¾ in.
Tire size:
  Front . . . . . 4.00 x 19—4 ply
  Rear . . . . . 10.00 x 28—4 ply
Front tread . . . . . 48 to 76 inches in 4-inch steps
Rear tread . . . . . 48 to 76 inches in 4-inch steps
Ground clearance:
  Front axle . . . . . 21 in.
  Rear axle . . . . . 21 in.
  Center . . . . . 13 in.
Turning circle radius (with use of brakes):
  Made by outer front wheel . . . . . 8 ft.
  Made by centerline of tractor at rear axle . . . . . 3½ ft.
Shipping weight (including gasoline, oil, water, tires filled with air, operator not included) . . . . . 2,410 lbs.
Drawbar height . . . . . 8½ to 34¼ in., 18 in. standard setting

Gear Ratio	Final Gear Reduction	Speeds at 1500 R.P.M.	Speeds at 2000 R.P.M.
1 Low (first)	73.33 to 1	2.54 M.P.H.	3.40 M.P.H.
2 Plowing (second)	57.04 to 1	3.28 M.P.H.	4.37 M.P.H.
3 Cultivating (third)	41.45 to 1	4.51 M.P.H.	6.02 M.P.H.
4 High (Fourth)	19.86 to 1	9.40 M.P.H.	12.54 M.P.H.
5 Reverse	44.64 to 1	4.19 M.P.H.	5.58 M.P.H.

b. Capacities—U. S. Measure.

Fuel tank . . . . . 9 gals. standard
1 gal. reserve
10 gals. total
Engine oil pan (less filter absorption) . . . . . 6 qts.
Transmission, hydraulic lift, and differential . . . . . 5 gals.
Cooling system . . . . . 12 qts.
Oil bath air cleaner . . . . . Fill to indicated level
Belt pulley . . . . . 1 qt.

Tire pressure:
  10.00 x 28—4 ply . . . . . 12 lbs.
  4.00 x 19—4 ply . . . . . 26 lbs.

c. Engine.

Type	4-cylinder "L" head
Rated speeds	1500 and 2000 R.P.M.
Idle speed	400 R.P.M.
Cylinder bore	3.188 in.
Stroke	3.75 in.
Piston displacement	119.7 cu. in.
Torque	84 lbs. ft. at 1500 R.P.M.
Compression ratio	6.0 to 1
Sleeves	Dry type
Piston	Cast steel
Rings:	
Compression	2
Oil	1
Piston pin	Full floating
Rod bearings	Replaceable shell-type
Main bearings	Replaceable shell-type
Crankshaft	Cast steel, static and dynamic balanced
Compression pressure at cranking speed (sea level)	90 lbs. minimum

d. Ignition System.

Type	Battery
Distributor:	
Firing order	1-2-4-3
Drive	Directly by camshaft
Automatic spark advance	Centrifugal governor
Initial timing (degrees of crankshaft)	Top dead center
Maximum advance (degrees of crankshaft)	24°
Distributor breaker cam	4 lobe
Breaker contacts	1 set
Breaker contact spacing	0.015 in.
Spark plugs:	
Type	Marked H-10
Size	14 mm
Gap	0.025 to 0.028 in.

e. Carburetor.

Type	Single up-draft
Idle fuel adjustment	1 screw
Main fuel jet	1 screw
Idle speed	1 screw

f. Governor.

Type.....Variable speed, mechanically operated, centrifugal type
Governed speed range.....800 to 2200 R.P.M.
Maximum governed speed adjustment.....1 screw

g. Cooling System.

Radiator cap (pressure type):—
  Pressure valve opens at.....3¼ to 4¼ lbs. per sq. in.
  Vacuum valve opens at.....½ to 1 lb. per sq. in.
Water Pump:
  Type.....Centrifugal
  Drive.....V-belt
Fan:
  Type.....6-blade pull
  Drive.....V-belt
Thermostat:
  Location.....Cylinder head outlet hose
  Starts to open.....160-165° F.
  Fully open.....190-200° F.

h. Electrical System.

Generator:
  Type.....3-brush
  Drive.....V-belt
  Rating:
    1500 Engine R.P.M.....10 amps
    Maximum output.....11 amps
  Capacity.....119 watts
Generator regulator:
  Cutout closing voltage.....6.0 to 6.3 volts
  Voltage regulation.....7.0 to 7.3 volts
Battery:
  Type.....6-volt
  Drive.....Automatic engagement

i. Transmission.

Type.....Constant mesh
Release bearing (pre-lubricated).....Ball bearing
Pedal free travel.....¾ in.

j. Rear Axle.

Type.....Semi-floating
Ratio.....6.66 to 1

k. Brakes.

Type	Internal expanding
Control	Individual, mechanical
Adjustment at each wheel	1 screw
Brake pedal free play	¾ in.
Thickness of lining	0.187 in.
Width of lining	2.000 in.
Length of lining	12.910 in.
Total brake lining area (two wheels)	103.3 sq. in.

l. Steering Gear.

Type	Automotive ball nut
Ratio, turns of steering wheel for total travel of pitman arms, at 48 in. wheel tread	2.25
Steering wheel diameter	18 in.

m. Hydraulic System.

Type	Internal
Maximum pressure	1500-1700 lbs. per sq. in.
Pump:	
Type	Scotch yoke piston
Drive	Direct power take-off shaft
Capacity:	
2000 engine R.P.M.	2.85 gals. per min.
1500 engine R.P.M.	2.15 gals. per min.
Control	Manual and automatic
Oil supply	Transmission and differential

n. Power Take-off Adapter.

Spline	1⅜
Speed (1500 Engine R.P.M.)	545 R.P.M.

o. Belt Pulley.

Pulley speed (2000 engine R.P.M.)	1358 R.P.M.
Belt speed (2000 engine R.P.M.)	3199 ft. per min.
Pulley size (standard)	9 in.

Chapter

1

DESCRIPTION AND DISASSEMBLY

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The Ford 4-cylinder engine (figs. 1 and 2) is of the L-head type, having all cylinders and the upper half of the crankcase cast in one piece. Steel cylinder sleeves are used, which are easily replaced when rebuilding the engine. The distributor is driven directly from the front end of the camshaft.

111. DATA

Type	L-head
Taxable horsepower	16.2
Number of cylinders	4
Bore	3.187 in.
Piston displacement	119.5 cu. in.
Torque	85 lbs. ft. at 1200 RPM
Firing order	1-2-4-3

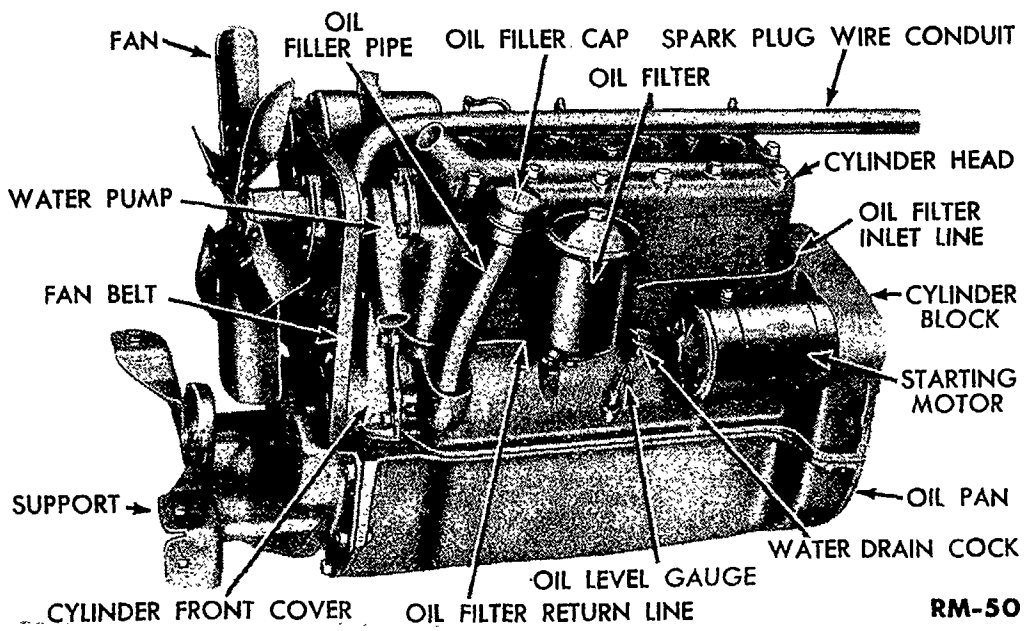


Fig. 1—Left ¾ Front View of Engine

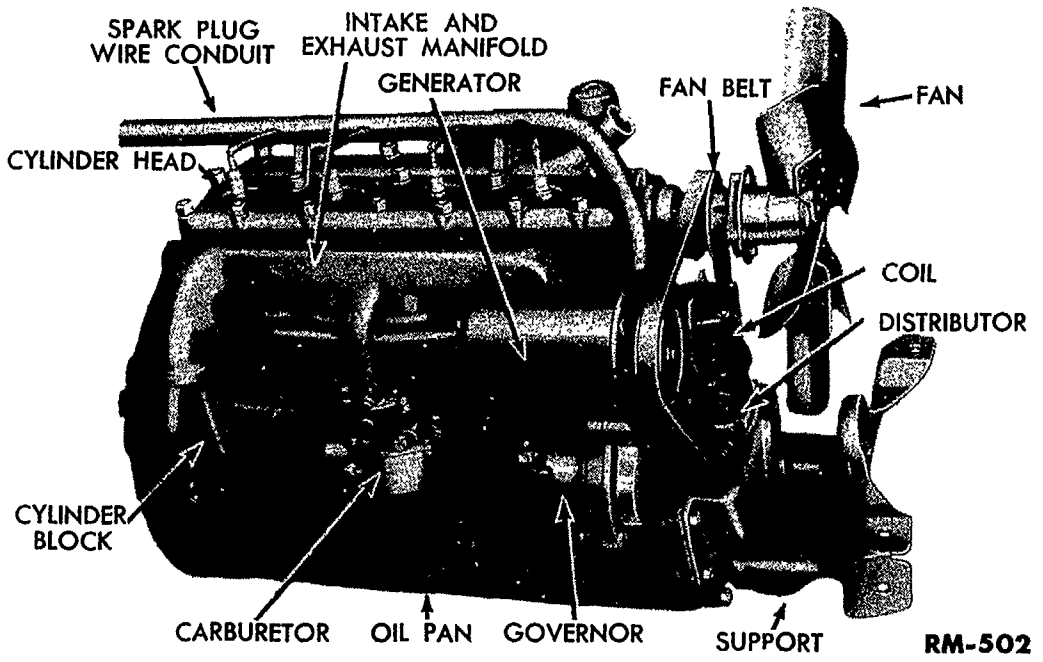


Fig. 2—Right ¾ Front View of Engine

Valve stem clearance to push rods:

Intake	0.010 to 0.012 in.
Exhaust	0.014 to 0.016 in.
Valve lifters	Non-adjustable

112. ACCESSORY REMOVAL.

In the disassembly procedures throughout this manual, disassembly is carried out only to the extent necessary for complete inspection of the parts subject to wear. The replacement or repair of the individual parts thus inspected is referred to as repair.

a. Remove Generator. Remove the nuts that secure the generator adjustment bracket to the timing gear side cover and generator. Disconnect the generator wiring. Remove the bolt and washer that secure the generator to the cylinder front cover, and remove the generator (fig. 2).

b. Remove Oil Filter. Disconnect the oil inlet line at the cylinder block. Disconnect the oil return line from the governor. Remove the two cap screws that secure the oil filter bracket to the cylinder head. Remove the oil filter and lines (fig. 1).

c. Remove Distributor and Spark Plug Wires. Remove the two nuts that secure the spark plug wire conduit to the cylinder head. Remove the two cap screws and lock washers that secure the

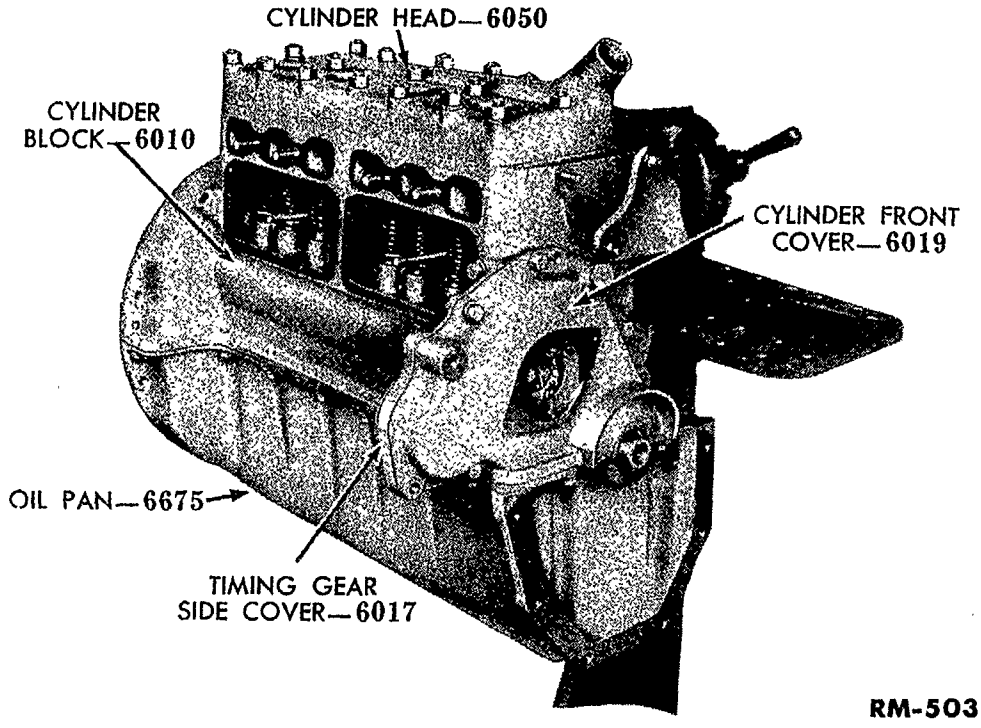


Fig. 3—Stripped Engine

distributor to the cylinder front cover. Remove the distributor and wires.

d. Remove Carburetor. Remove the two nuts and lock washers that secure the carburetor to the intake manifold. Remove the carburetor (fig. 2).

e. Remove Starting Motor. Loosen the two starting motor cap screws until the starting motor is free of the clutch housing. Lift the starting motor from the engine (fig. 1).

113. ENGINE DISASSEMBLY.

This section contains instructions for the complete disassembly of the stripped engine.

a. Remove Intake and Exhaust Manifolds. Remove the nuts and washers that secure the intake and exhaust manifolds to the cylinder block. Lift the manifolds off the cylinder block as an assembly (fig. 2).

b. Remove Water Pump. Remove the cap screw and nuts which secure the water pump to the cylinder block. Lift the water pump from the cylinder block.

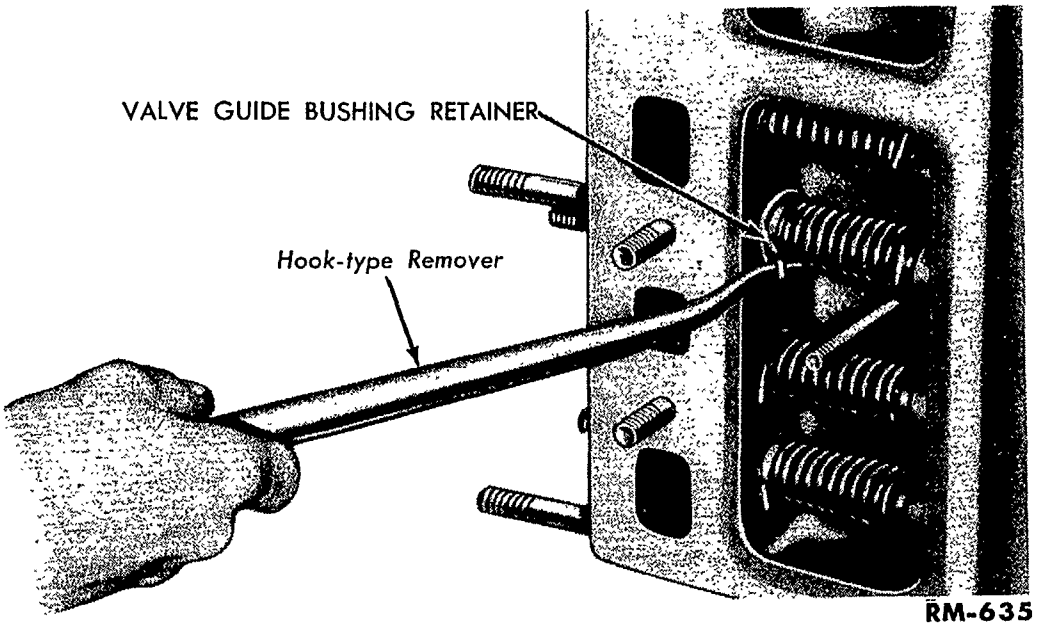


Fig. 4—Removing Valve Guide Bushing Retainer

c. Remove Clutch Disk. Press in on the clutch release levers, and install three wood wedges between the clutch release levers and pressure plate cover (fig. 48). Remove the six pressure plate cap screws, pressure plate, and clutch disk.

d. Remove Flywheel. Remove the lock wire from the four flywheel cap screws. Remove the four flywheel cap screws and dowel retainer. Tap the flywheel off the dowel pins with a rawhide hammer. Lift the flywheel out of the clutch housing.

e. Remove Cylinder Head. Remove all the nuts that hold the head to the cylinder block. Remove the cylinder head and gasket (fig. 3).

f. Remove Valve Assemblies and Camshaft. Remove the cylinder front cover (fig. 3) from the cylinder block. Remove the nut and flat washer from each valve chamber cover. Remove the valve guide bushing retainer with a hook-type remover (fig. 4) from all valves that are in the closed position. Turn the crankshaft until those valves which were in an open position are closed. Repeat the above procedure, and remove the remaining valve guide bushing retainers. Remove the valve assemblies from the cylinder block with

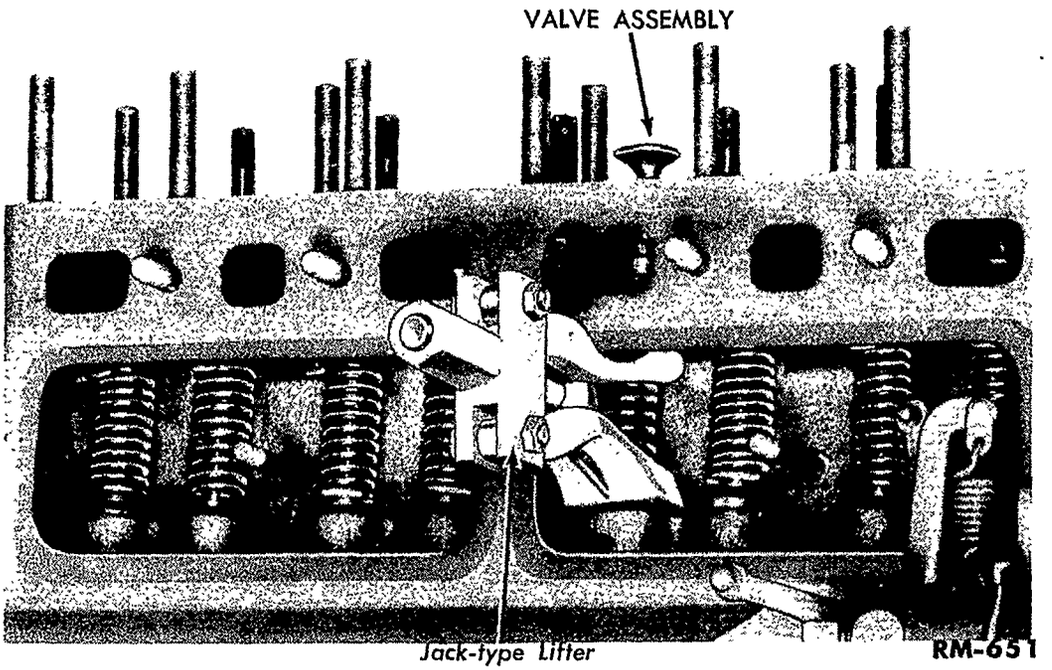


Fig. 5—Removing Valve Assembly

a jack-type lifter (fig. 5). As the valves are removed, tag or otherwise identify them as to the cylinders from which they were removed. Lift the push rods from the cylinder block. Slide the camshaft out of the cylinder block, being careful not to injure the camshaft bearing surface with the sharp corners of the cams.

g. Remove Oil Pump and Oil Pump Screen Cover Assembly. Remove the cap screws that secure the oil pan to the cylinder block, and remove the oil pan. Remove the lock wires and cap screws that secure the oil pump screen cover assembly to the oil pump (fig. 6). Remove the oil pump screen cover assembly from the engine.

h. Remove Connecting Rod and Piston Assemblies. Remove the two nuts from No. 1 connecting rod. Lift the connecting rod bearing cap from the connecting rod. Tap the connecting rod and piston out of the cylinder block with the handle end of a hammer (fig. 7). Install the connecting rod bearing cap on the connecting rod to prevent the bearing inserts from becoming mixed. Repeat the above procedure to remove the remaining connecting rod and piston assemblies.

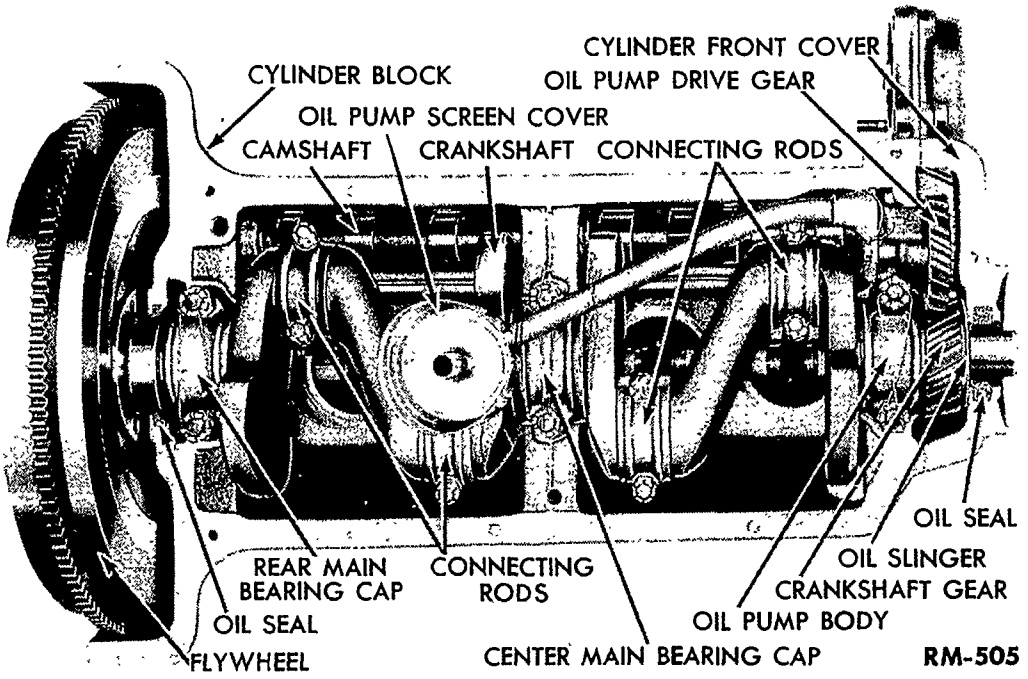


Fig. 6—Underside of Engine with Oil Pan Removed

i. **Remove Crankshaft.** Remove the lock wire and castellated nuts or self-locking nuts from the main bearing caps (fig. 7), and remove the bearing caps. Lift the crankshaft from the cylinder block.

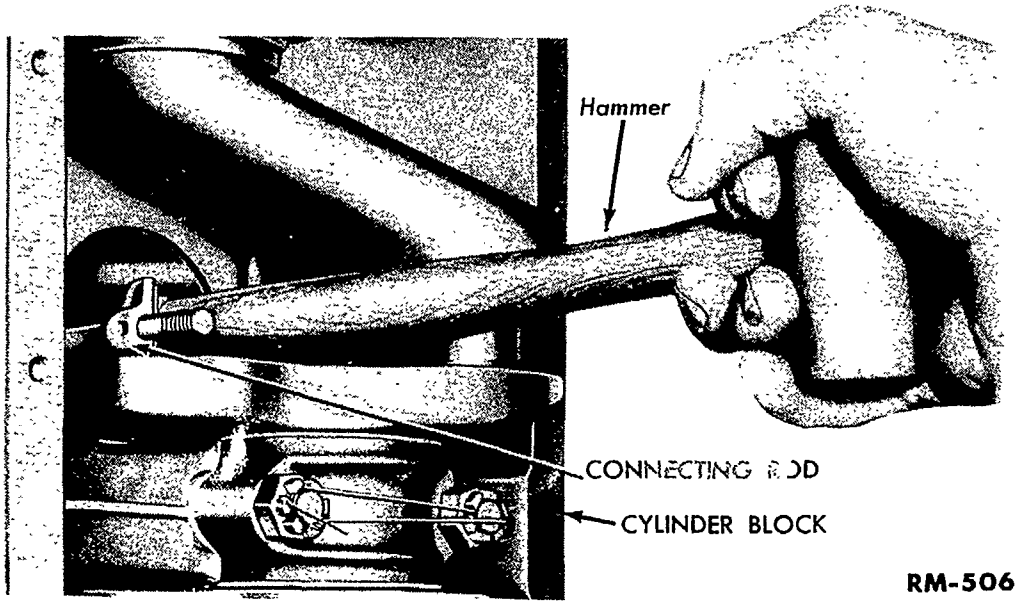


Fig. 7—Removing Connecting Rod and Piston Assembly

INSPECTION AND REPAIR

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121. CRANKSHAFT AND FLYWHEEL.

The disassembled crankshaft and flywheel assemblies are shown in figs. 10 and 11.

a. Crankshaft. Clean out the drilled oil passages in the crankshaft journals with a piece of wire. Clean the crankshaft thoroughly with cleaning solvent. Replace the crankshaft flange dowels if they are damaged. Replace a crankshaft gear that has chipped, broken, or worn teeth (subpar. (2) below). If the main journals or the crankpin journals are grooved or scored, the crankshaft must be remachined or replaced (subpar. (1) below). Light scores or scratches can be honed, then polished with No. 320 grit polishing paper. Measure

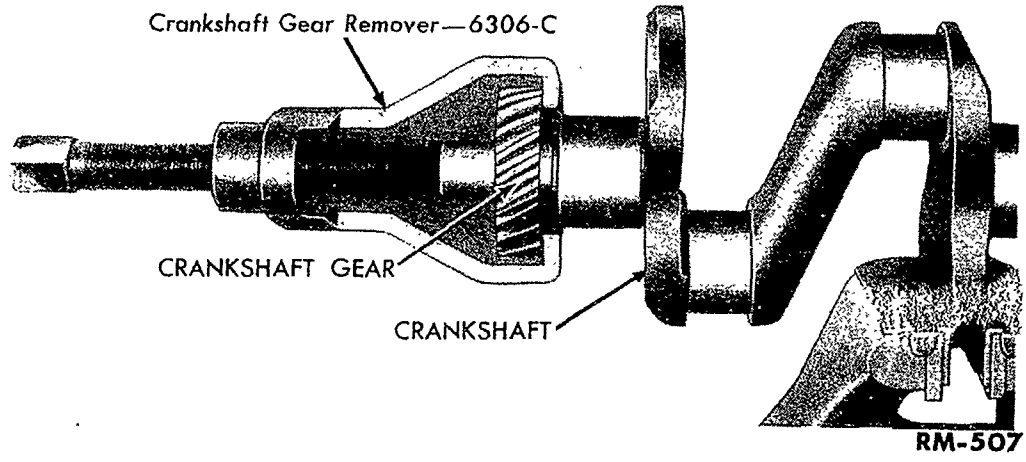
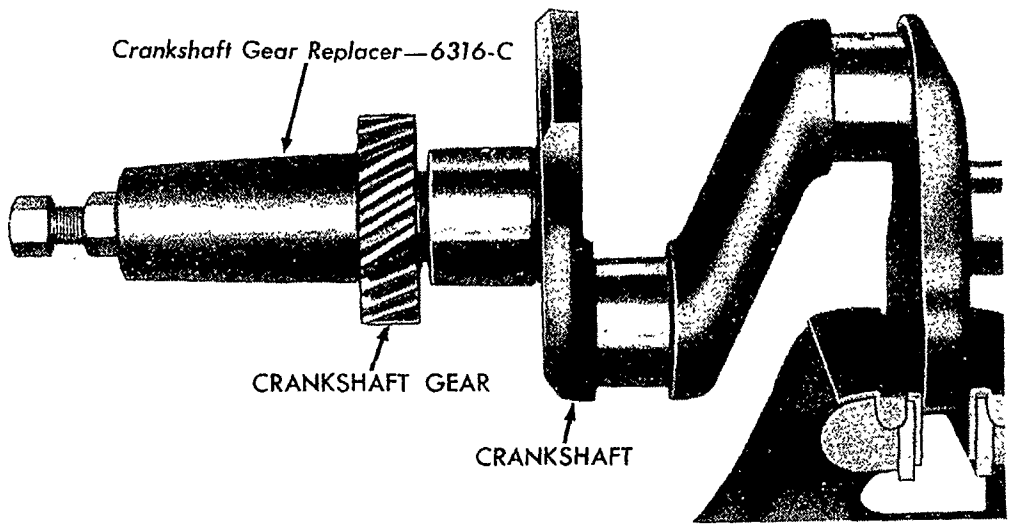


Fig. 8—Removing Crankshaft Gear



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Fig. 9—Installing Crankshaft Gear

each journal diameter at a minimum of four places to determine size, out-of-round, and taper. Remachine any journals that are out-of-round more than 0.0015 inch. Remachine journals that taper more than 0.001 inch (subpar. (1) below). Journals that are worn evenly with less than 0.001-inch taper, or less than 0.0015-inch out-of-round, need not be reground if the available bearings will provide not more than 0.003 inch clearance for the main bearings, or not more than 0.005 inch for the crankpin bearings.

(1) *REMACHINING CRANKSHAFTS.* Subtract the amount of undersize of the bearings to be used from the original size, and remachine the crankshaft by grinding it to this new size, then polish with No. 320 grit polishing paper, removing not more than 0.0009 inch from the diameter.

(2) *CRANKSHAFT GEAR REPLACEMENT.* Remove the crankshaft gear with a puller that pulls the gear evenly (fig. 8). Remove the woodruff key. To install the crankshaft gear, tap the woodruff key into the crankshaft, and install the gear on the crankshaft with a replacer as shown in fig. 9.

b. Flywheel. Clean the flywheel (fig. 11) thoroughly. Replace or reface a flywheel that has an excessively worn or scored friction face. Replace a flywheel ring gear (subpar. (1) below) that is cracked, chipped, or has excessively worn teeth.

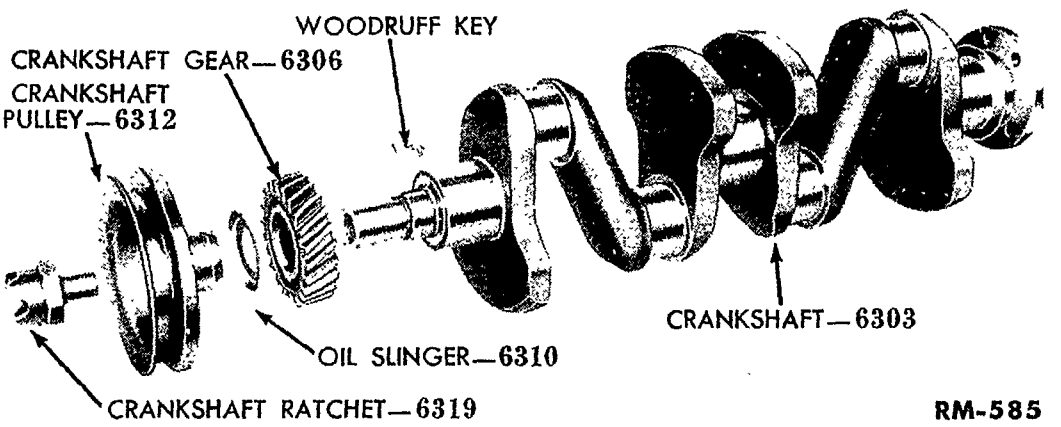


Fig. 10—Crankshaft Assembly, Disassembled

(1) *FLYWHEEL RING GEAR REPLACEMENT.* Drill a $^{17}/_{32}$-inch hole nearly through the flywheel ring gear on the engine side of the gear. Split the ring gear at the drilled hole with a chisel, and lift the ring gear off the flywheel. Clean the ring gear recess on the flywheel. Heat the ring gear evenly to 360° F., and place it on the cold flywheel, making sure it is seated in the recess of the flywheel.

(2) *REFACE FLYWHEEL.* Remove just enough material from the clutch friction surface to obtain a smooth, flat surface parallel with the flywheel mounting flange. The same amount of material must also be removed from that portion of the flywheel to which the clutch pressure plate is attached. If the thickness of the flywheel, measured between the friction surface and the flywheel mounting flange, is reduced to less than 0.855 inch in order to obtain a smooth, flat, surface, the flywheel must be discarded.

(3) *CLUTCH PILOT BEARING REPLACEMENT.* Drive the pilot bearing out of the flywheel. Install the pilot bearing into the flywheel with a fiber block or a rawhide hammer (fig. 11).

122. CYLINDER BLOCK.

Strip off the old gaskets from all the surfaces of the cylinder block. Remove the oil passage plugs from the front and rear of the cylinder block, and clean all oil passages in the cylinder block with steam or compressed air. Scrape all of the carbon from the cylinder block.

a. Inspection and Repair. If the valve springs in the cylinder block are corroded or rusted or if there is an excessive amount of sludge in the valve chamber, it is an indication that the cylinder

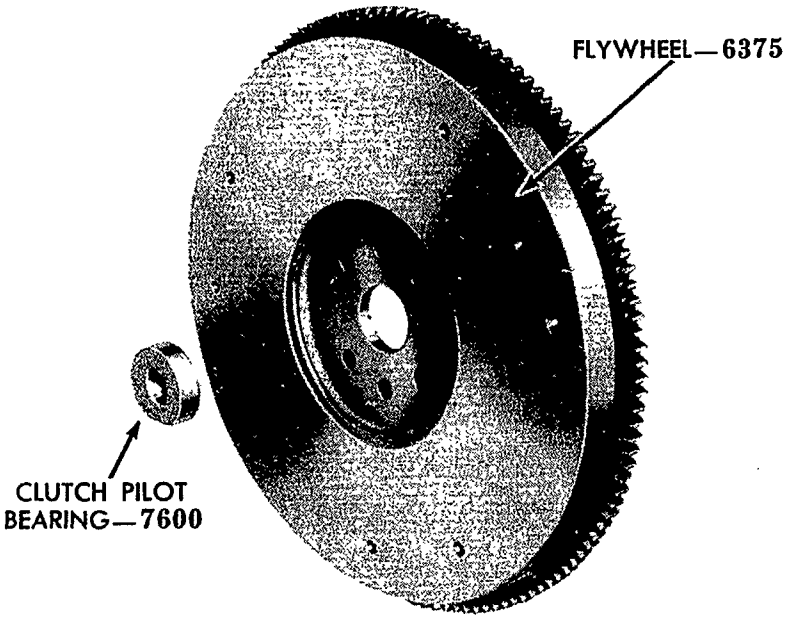


Fig. 11—Flywheel and Clutch Pilot Bearing

block might be cracked and should be checked thoroughly. Replace the cylinder block if it is cracked. Replace any expansion plugs (fig. 1) that are loose.

(1) *STUDS.* Replace damaged or broken studs (par. d below).

(2) *VALVE SEATS.* Replace any valve seat insert that is cracked or that is loose in the cylinder block (par. f below). Reface valve seats where there is any indication that the valve has not been seating, if new guides are to be installed, or if the width of the seat (fig. 16) measures more than 0.125 inch (par. e below).

NOTE: ***If the engine has been completely disassembled, reface all valve seats.***

(3) *CYLINDER SLEEVES.* Replace the cylinder sleeves (par. b. below) if a ridge is present at the top, or if the sleeves are collapsed or scored.

(4) *OIL RELIEF VALVE.* Replace the oil relief valve spring (fig. 12) located in the cylinder front cover if its tension is less than 44 ounces or more than 46 ounces when the length of the spring is compressed to 1.40 inches. Install the valve, spring, and valve nut in the cylinder front cover.

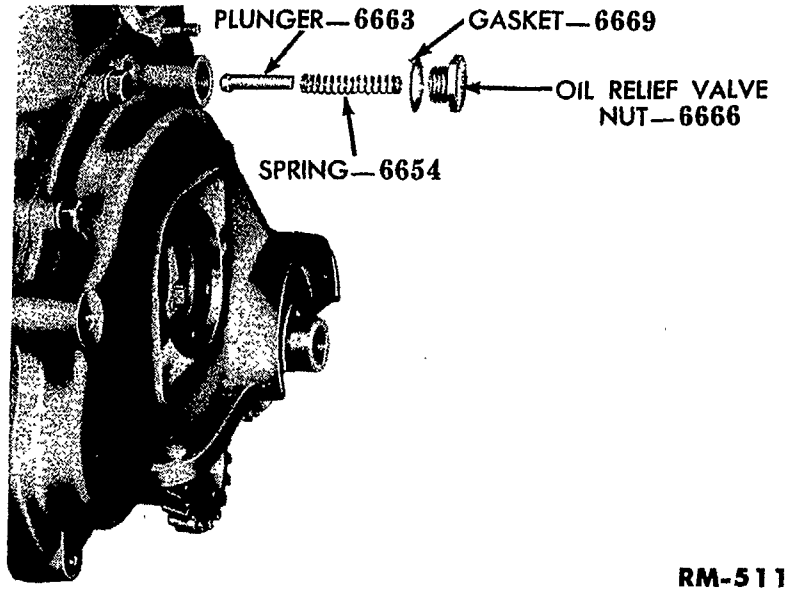


Fig. 12—Oil Relief Valve, Disassembled

b. Steel Sleeve Replacement. Remove the sleeves from the cylinder block, using a crushing tool (fig. 14). Drive the tool all the way to the bottom of the cylinder, then pull the crushed sleeve out of the cylinder. Install new sleeves, using the replacer as shown in fig. 15. After the sleeves are installed, use a piston (without rings) or a plug gauge in the cylinder to determine if the sleeve was properly installed. If the piston or plug gauge has a tendency to stick, the sleeve was buckled during installation. Remove the damaged sleeve, install a new sleeve, and recheck it (fig. 15).

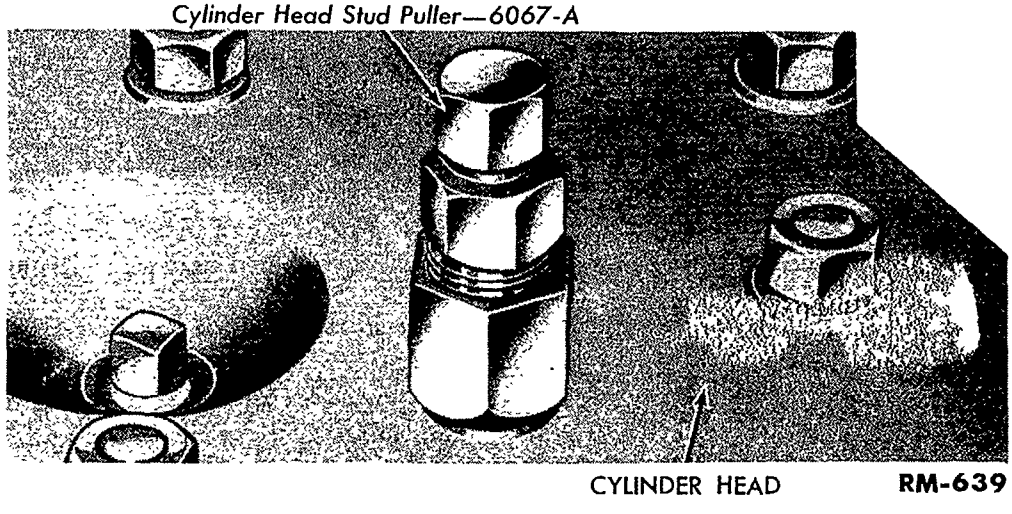


Fig. 13—Removing Cylinder Head Stud

§ 122. b.

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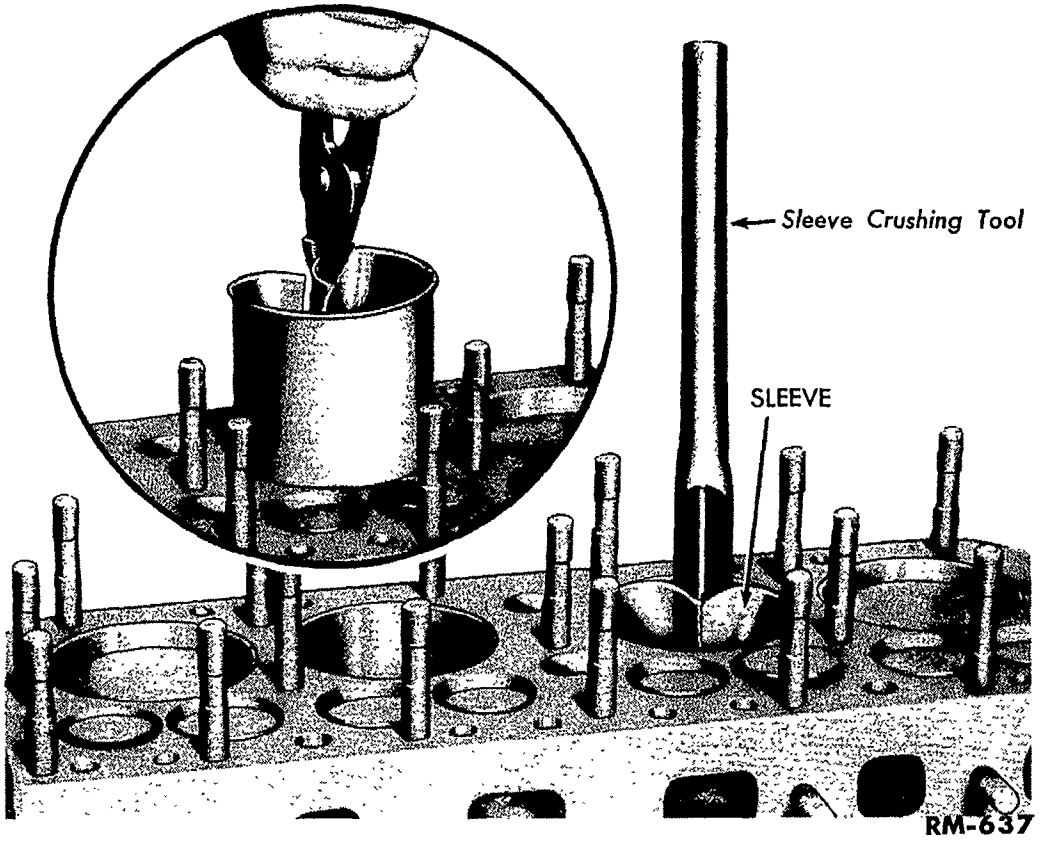


Fig. 14—Removing Cylinder Sleeve

c. Stud Replacement. Remove all damaged studs with a standard stud puller (fig. 13). To remove a broken stud, indent the end of the broken stud exactly in the center with a center punch. With a small drill, drill into the broken stud to a depth of approximately two-thirds of the length of the remaining portion of the stud, then follow up with a larger drill. The larger drill selected must leave a wall thicker than the depth of the threads. Select an extractor (EZ-out) of the proper size and insert it into the drilled hole, and screw out the remaining part of the broken stud. Install a new stud with a stud driver. Drive all studs until no threads show at the bottom of the stud.

d. Valve Seat Insert Replacement. Remove the valve seat inserts, being careful not to damage the cylinder block. If the counterbore is worn, remachine it to obtain a 0.0015 inch to 0.003 inch press fit on the replacement insert. Make sure that the counterbore is clean. Pack the new insert in dry ice for at least 15 minutes, and drive the insert in place in the counterbore, using a driver that assures the insert going into place evenly. Reface the valve seat insert (par. e below).

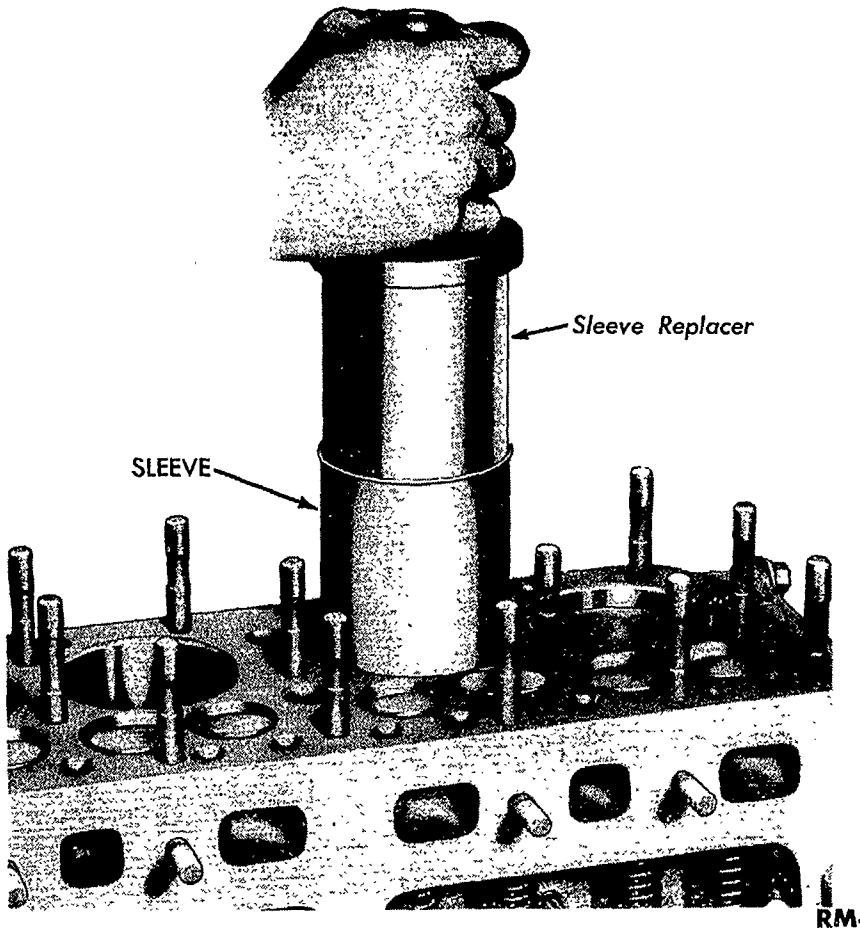


Fig. 15—Installing Cylinder Sleeve

e. Valve Seat Refacing. Reface each valve seat with a 90 degree (included angle) valve seat grinding wheel or valve seat cutter until the face of the seat is "cleaned up" and free from pits or nicks. If a valve seat cutter is used, it will be necessary to lap the valves into the seat. The time ordinarily required to lap the valves is saved by using an eccentric type valve seat grinder with which the grinding wheel contacts only one portion of the seat at any given time. If the grinder, including the pilot, is in good condition and the grinding wheel is kept sharp and properly dressed, it ordinarily is not necessary to lap the valves into the seats. After refacing, the width of the valve seat should not be more than 0.125 inch, measured across the face of the seat (fig. 16). If the seat is too wide, remove just enough stock from the top and/or bottom of the seat to reduce the width to 0.062 inch. Use a 120 degree (included angle) valve seat cutter for removing stock from the top of the seat and a 60 degree (included angle) cutter for removing stock from the bottom of the seat.

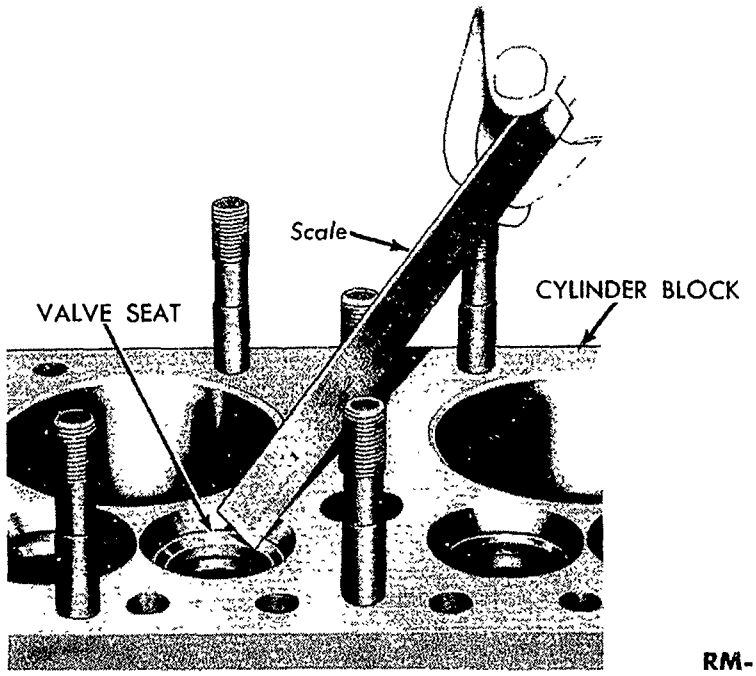


Fig. 16—Measuring Width of Valve Seat

123. PISTONS AND CONNECTING RODS.

To disassemble the piston and connecting rod, remove the piston rings with a piston ring expander. Remove the two piston pin retainers (fig. 17), and push the piston pin out of the piston. Scrape the carbon from the piston ring grooves and also from the top of the pistons. Clean all carbon and sludge from the oil holes in the oil ring groove. Make sure all of the oil holes in the connecting rod are open. Clean all parts thoroughly.

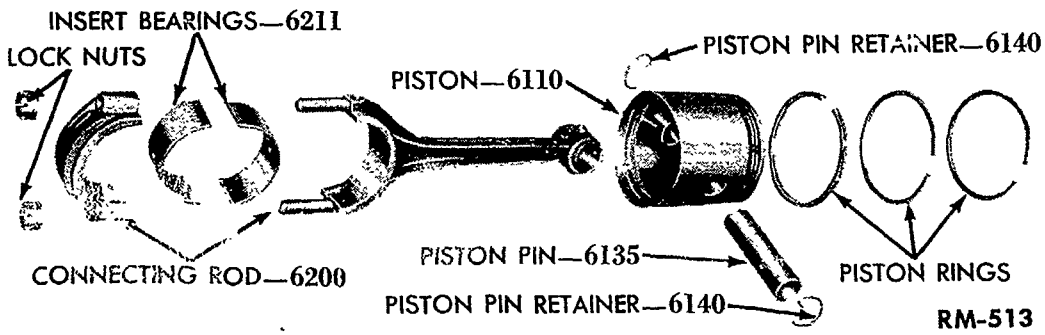


Fig. 17—Connecting Rod and Piston Assembly, Disassembled

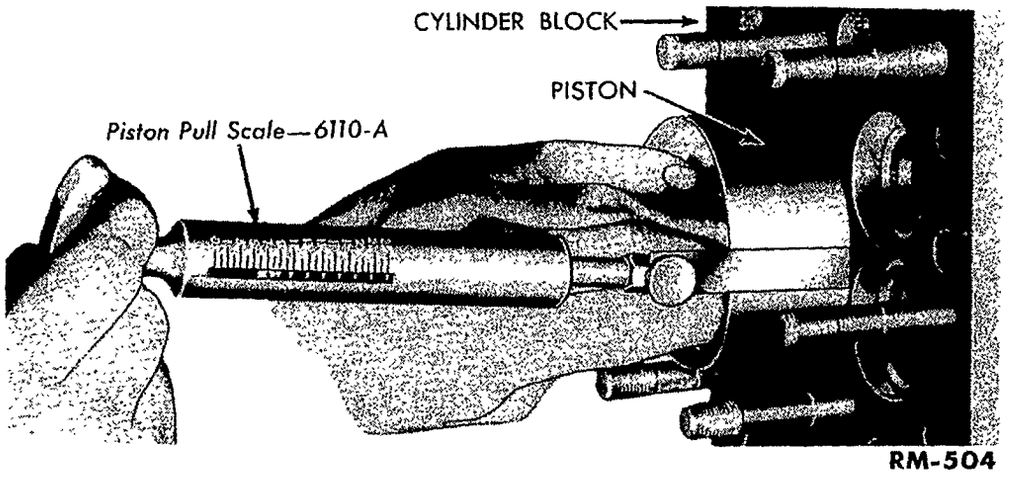


Fig. 18—Fitting Piston to Cylinder Bore

a. Inspection.

NOTE: ***Usually, the type of wear, or the condition of one of the reciprocating parts, can indicate a fault in other reciprocating parts, i.e. a bent connecting rod could result in unusual wear, on either, or both, the piston or the connecting rod bearing.***

(1) *PISTONS.* Discard pistons which are cracked, scored, damaged or have burned spots.

(*a*) FITTING PISTONS. To check the clearance of a piston in a cylinder bore, use a thickness gauge ½-inch wide and long enough to cover the entire length of a piston, and attach it to a tension scale. Place the gauge on the side of the piston bore, and push the piston in the cylinder so that the side of the piston, which is 90 degrees (right angle) from the piston pin hole, is against the thickness gauge. Withdraw the gauge and observe the reading on the tension scale (fig. 18). The thickness of the gauge to be used and the pounds pull for the various combinations of pistons and cylinder bores are as follows:

Cylinder Bore and Piston Combinations	Steel Piston	
	Gauge Thickness	Pull Pounds
New steel sleeve—new piston	0.003	5-8
Worn steel sleeve—new piston	0.004	5-8
Worn steel sleeve—worn piston	0.005	5-8

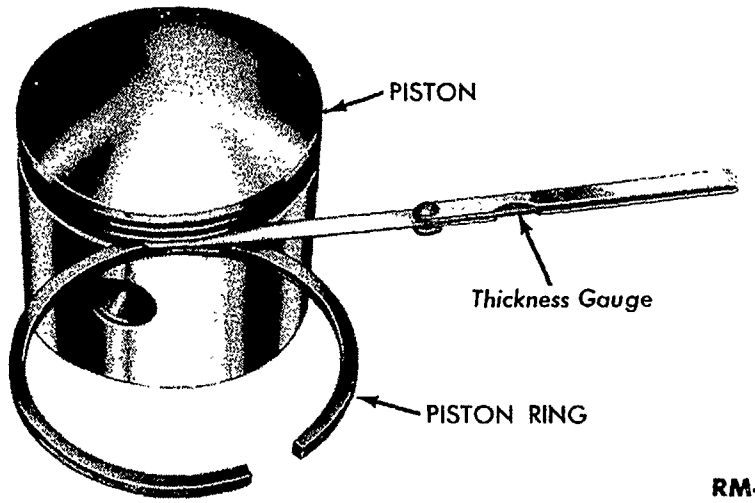


Fig. 19—Checking Ring Groove Width

(*b*) PISTON PIN BORES. Use a new piston pin as a gauge, and insert it in the piston pin bore. If the pin falls through by its own weight, the pin bore is excessively worn and must be reamed and burnished or honed to accommodate an oversize piston pin (par. b below).

(*c*) PISTON RING GROOVES. Check the width of the ring grooves with a new piston ring and a thickness gauge (fig. 19). Discard a piston if the clearance between the ring and the piston exceeds 0.004 inch.

(2) *PISTON PINS.* Replace piston pins that have become worn and measure to less than 0.749 inch.

(3) *CONNECTING RODS.* Replace connecting rods which have damaged studs. To check the piston pin bushing for wear, use a new piston pin as a gauge. If any looseness is felt, rebush the connecting rod (par. c below), or fit an oversize piston pin in both the connecting rod and the piston (par. b below). Check the connecting rods for being twisted. Bent or twisted connecting rods must be aligned (figs. 20 and 21) Where possible, use the original connecting rod for each cylinder. If any of the old rods are used in a different cylinder, file off the old number. Number each rod and cap as follows: Use $\frac{3}{32}$-inch steel stamps for numbering the connecting rods and caps, placing the new number in the same position as the old one.

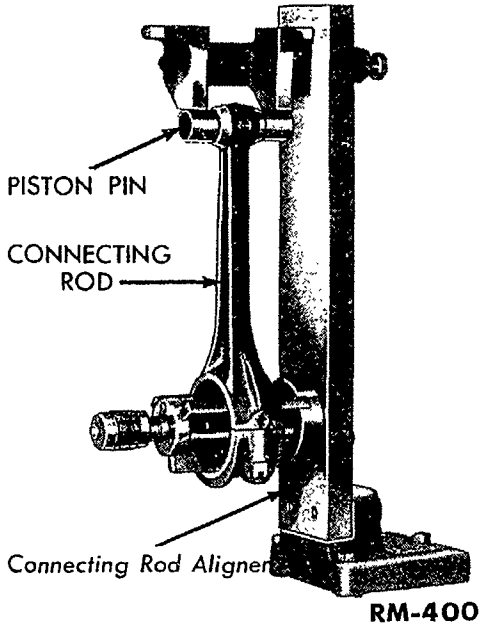


Fig. 20—Checking Connecting Rod for Bend

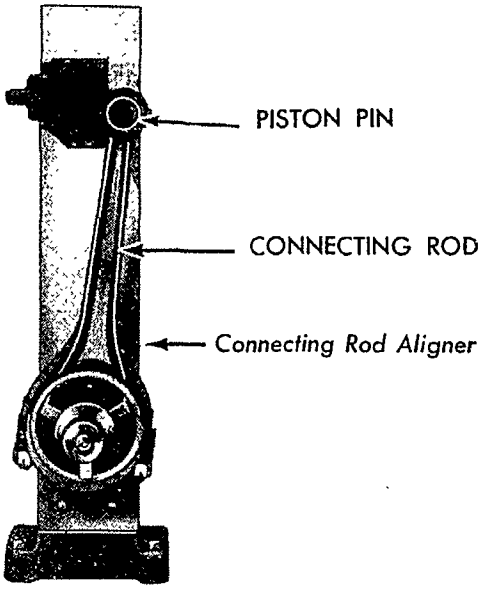


Fig. 21—Checking Connecting Rod for Twist

(4) *CONNECTING ROD BEARINGS.* Replace connecting rod bearings that are worn, pitted, scored, or discolored (due to overheating). Bearings otherwise satisfactory but with small pits need not be replaced. Bearings must be replaced where pits extend to the side of the bearing and permit oil to escape. Place a plug gauge (a round piece of accurately ground or rolled bar stock) on the inside surface of the bearing, and measure the thickness of the two pieces (fig. 22). Deduct the thickness of the bar stock from the reading obtained to determine the thickness of the connecting rod insert bearing. Replace each connecting rod bearing that measures 0.005 inch or more under its original size.

b. Fitting Oversize Piston Pins.

NOTE: ***This procedure applies only when piston pins are to be fitted to old pistons. When new pistons are used, the connecting rod bushings must be replaced if the old bushing does not provide the correct fit for a standard piston pin (par. d below).***

If a connecting rod bushing or a piston pin hole is worn and its inside diameter does not measure more than 0.7535 inch, it can be reamed and burnished or honed to fit a 0.001 inch or a 0.002 inch oversize piston pin. The correct fit for a piston pin in the connecting rod bushing exists when the pin to be used will pass slowly through the bushing by its own weight when the piston and pin are dry. The

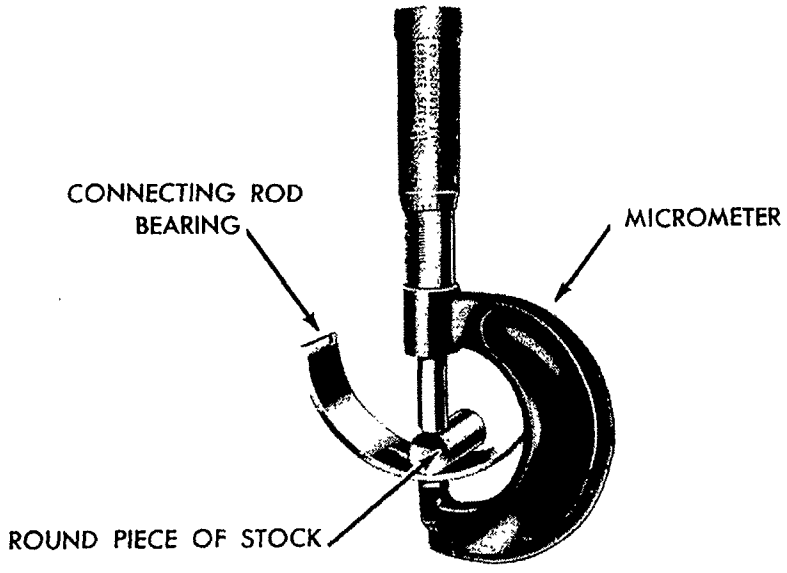


Fig. 22—Measuring Connecting Rod Bearing for Wear

correct fit for a piston pin in the piston exists when it can be inserted in the piston by a light push by hand with the piston and pin temperature at approximately 70 degrees.

c. Connecting Rod Bushing Replacement. Drive the bushing from the connecting rod with a suitable driver. Press a new bushing into the connecting rod. Drill the four oil holes in the bushing to the same size as the holes in the connecting rod. Ream and burnish or hone the bushing to 0.7505 inch. Check the alignment of the connecting rod, correcting any misalignment (figs. 20 and 21).

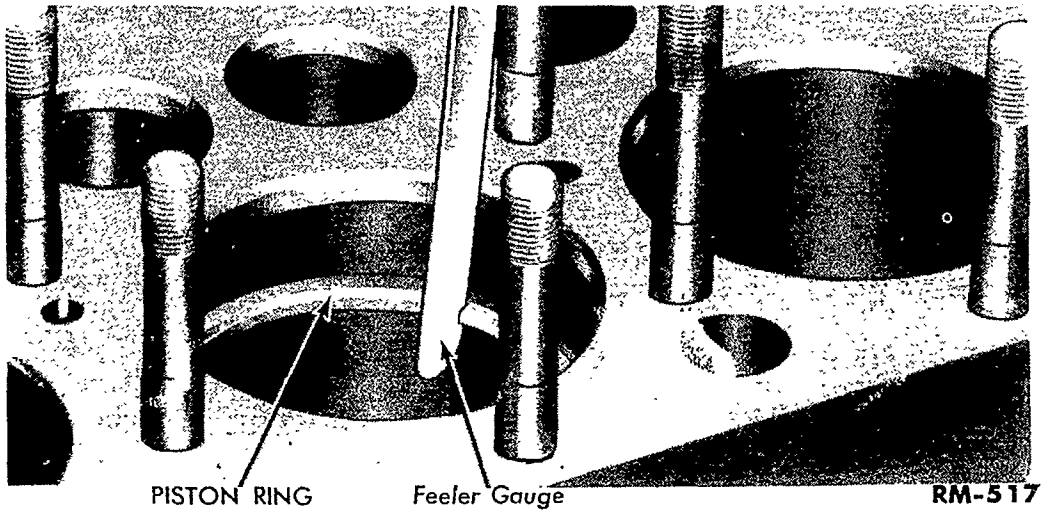


Fig. 23—Measuring Piston Ring End Gap

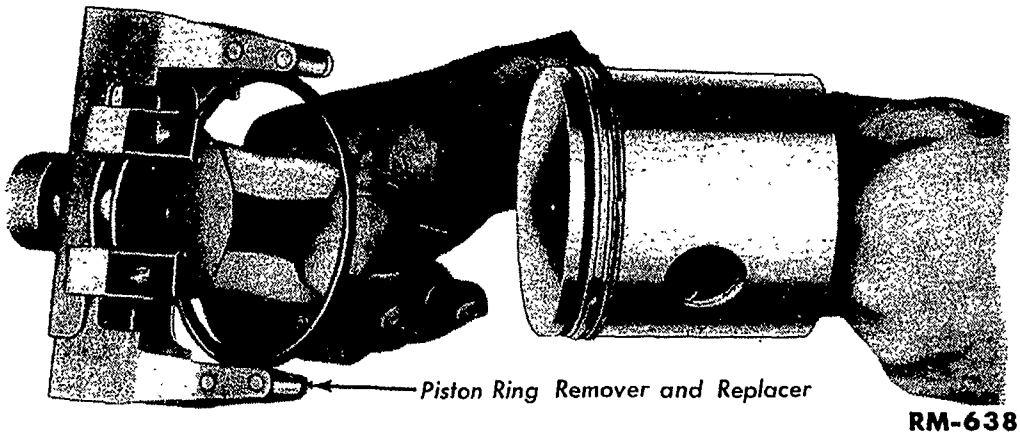


Fig. 24—Installing Piston Ring on Piston

d. Assemble Piston, Piston Pin, and Connecting Rod. Install the piston which was previously fitted (par. a (1) (a) above) for the particular cylinder to the connecting rod previously selected and having the number of that cylinder. Hold the piston in place on the connecting rod. Install a piston pin in the piston and connecting rod, and install a piston pin retainer in each piston pin bore groove.

e. Fitting and Installing Piston Rings. Place a new piston ring in the cylinder, and press it about half-way down into the cylinder bore with the bottom of a piston so the ring will be square with the cylinder wall. Measure the ring end gap with a thickness gauge (fig. 23). If the gap is less than 0.012 inch, remove the ring. Place the ring in a jig, and file it with a fine cut file until the correct gap (0.012 to 0.017 inch) is established. If the gap exceeds 0.035 inch, an oversize ring must be used. Roll the new piston ring around its groove in the piston. The top ring should roll freely and not have a clearance of less than 0.0015 inch or more than 0.0035 inch. The lower rings should roll freely and not have a clearance of less than 0.001 inch or more than 0.004 inch. Install the piston ring on the pistons with a piston ring expander (fig. 24). Repeat the entire above procedure for each piston ring

124. CAMSHAFT AND VALVE MECHANISM.

The disassembled camshaft and valve assemblies are shown in figs. 25 and 26.

a. Camshaft. Thoroughly clean the camshaft and camshaft gear. Replace a camshaft that has excessively scored or damaged

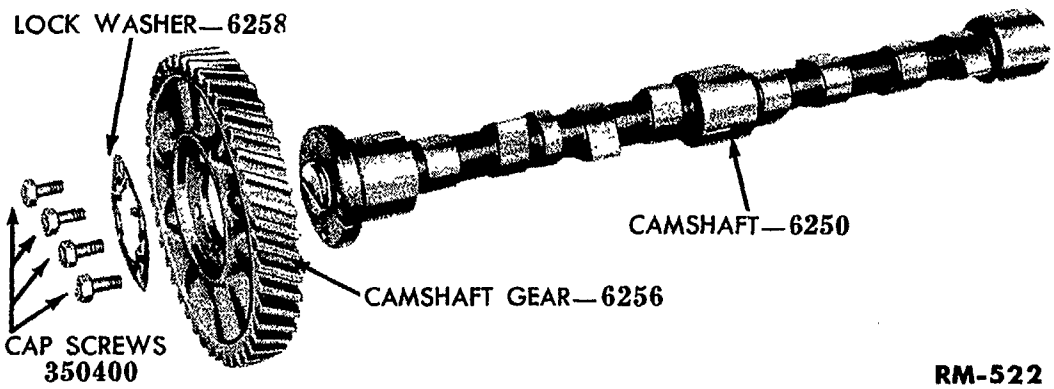


Fig. 25—Camshaft, Disassembled

cams, or worn, corroded, scored, or discolored journals. Replace a camshaft if any of the journals measure less than 1.795 inches. Replace a camshaft gear that is visibly worn, broken, or has chipped teeth.

To remove the camshaft gear, straighten the four tabs on the camshaft gear locking ring. Remove the four cap screws and locking ring. Lift the camshaft gear from the camshaft (fig. 25). To install the camshaft gear, place it on the camshaft, and install the locking ring and the four cap screws. Bend the tabs on the locking ring down onto the cap screws.

b. Valve Push Rods. Clean the push rods thoroughly. Replace push rods if the diameter is worn to less than 0.998 inch, or if they

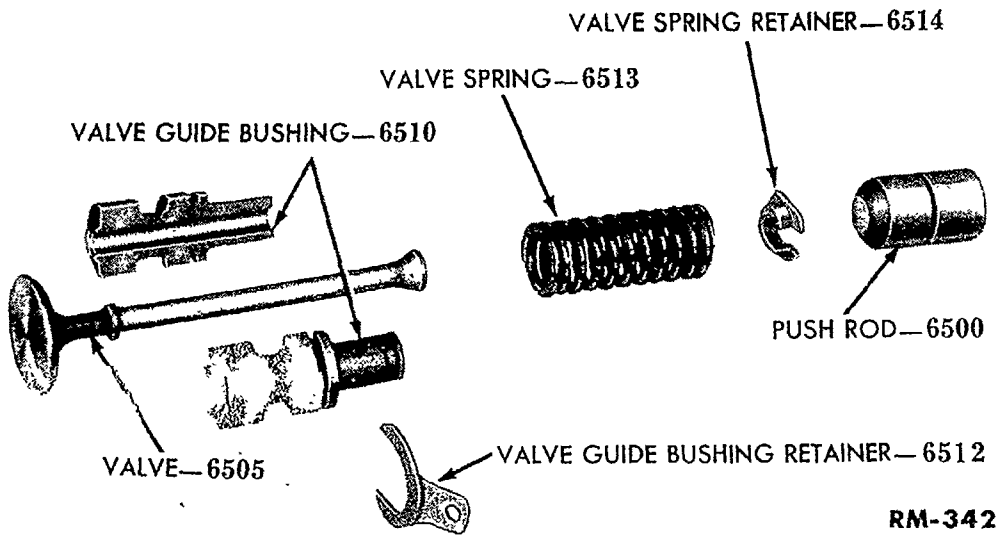
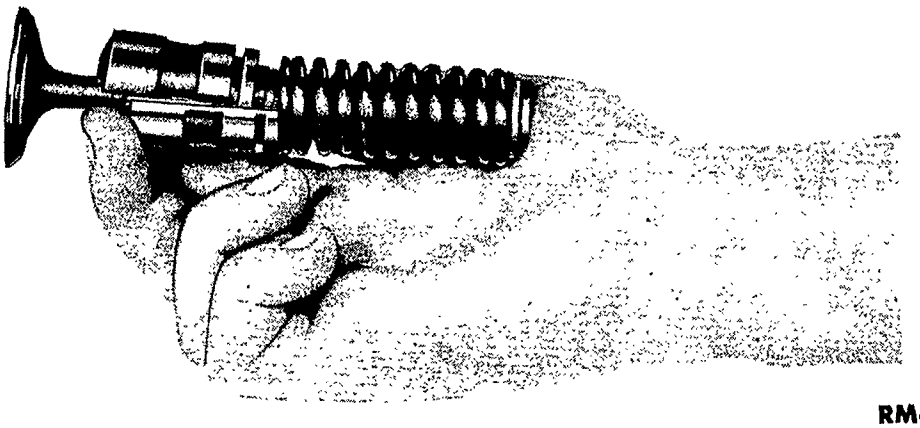


Fig. 26—Valve Assembly, Disassembled



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Fig. 27—Disassembling Valve Assembly

are scored or cracked. Pressed-steel type push rods may be resurfaced at the bottom end only. Replace any push rods that are less than 1.710 inches long after resurfacing.

c. Valves, Guides, and Springs. Hold the valve assembly in the hand, and compress the valve spring as shown in fig. 27. Lift one-half of the valve guide bushing from the assembly. Remove the other half of the valve guide bushing, spring, and spring retainer (fig. 26).

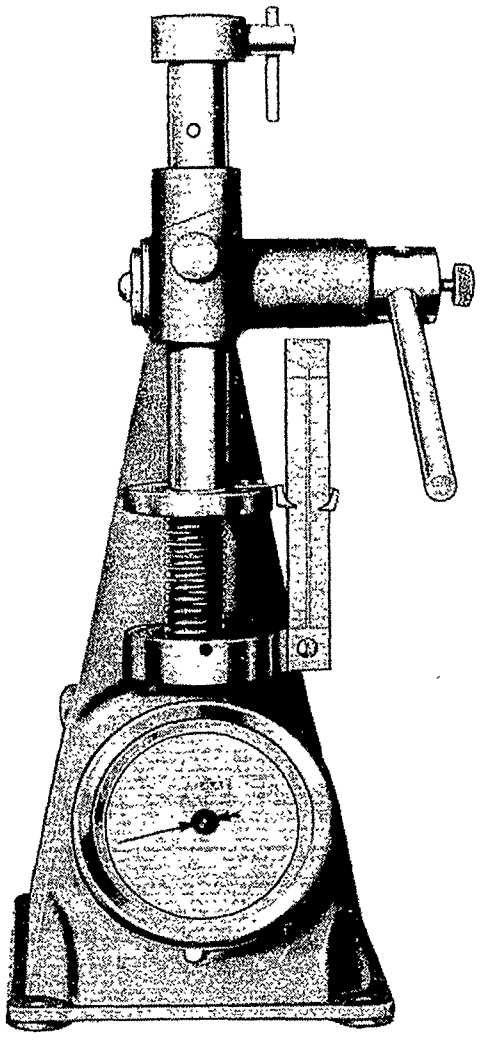
NOTE: ***Keep the two halves of each valve guide together in pairs.***

(1) *CLEANING, INSPECTION, AND REPAIR.* Scrape the carbon off the valve heads and stems. Clean the valves, springs, and valve guide bushings.

WARNING: ***Do not use caustic or any material that will injure the protective coating of paint on the valve springs. This paint is necessary to protect the spring from crankcase moisture.***

Replace valves that have bent or scored stems. Replace any valves the stems of which are worn to less than 0.3065 inch. Reface pitted, corroded, or burned valves. Replace valves that are pitted, burned, or warped that will not clean up with a light cut of the grinding wheel. If a cutter was used to reface the valve seats in the cylinder block, lap each valve into its seat.

(*a*) VALVE SPRINGS. Replace a valve spring if it has lost its protective coating of paint, or if the tension is less than 30 pounds or is more than 34 pounds when compressed to 2.13 inches (fig. 28).



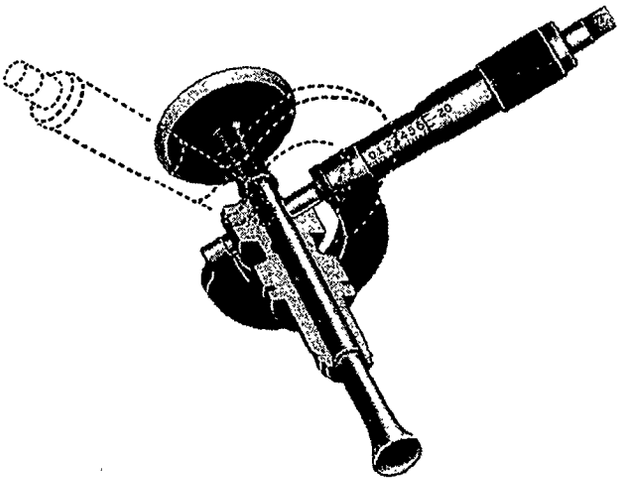
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Fig. 28—Checking Valve Spring Tension

(*b*) VALVE GUIDES.

NOTE: ***Any new valve guides that are to be used should be used as intake valve guides in order to keep the intake valve guide clearance to a minimum.***

Using a valve with a stem diameter of 0.311 inch as a gauge, place the valve in each half of the valve guide bushing, and measure each side with a micrometer, as shown in fig. 29. Replace both halves of any valve guide bushing if the measurement is less than 0.6565 inch. Select guides for each valve, measuring each half with the valve with which it is to be used. Any new guides being used and the old guides having the least wear should be used with the intake valves. Any guide and valve combination measuring more than 0.666 inch is satisfactory for exhaust valves.



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Fig. 29—Checking Valve Guide Bushing for Wear

(2) *ASSEMBLING VALVE ASSEMBLY.* Place the valve spring retainer and spring on the valve, and slide both halves of the valve guide bushing in place.

125. CYLINDER HEAD AND FRONT COVER.

Scrape all of the carbon from the cylinder head. Replace a cracked cylinder head or a head where the gasket surface is warped $\frac{1}{32}$ inch or more over the full length of the head. Replace the head if either the threads in the spark plug holes or the water temperature gauge hole is stripped. Repair any threads that are not stripped but are otherwise damaged. If the threads are damaged in either the spark plug holes or the water temperature gauge hole, clean up the threads with the correct size tap.

Replace the cylinder front cover and timing gear side cover if cracked or damaged in any way.

Check the gasket surface of the covers for nicks or damage, and make repairs as required.

126. OIL PUMP.

Clean all parts thoroughly, and blow out all oil passages with compressed air. Lift the driven gear from the pump (fig. 31). Press the drive gear from the driven gear and body (fig. 30).

a. Inspection and Repair. Replace an oil pump body if cracked or damaged. If the inside diameter of the drive gear bushing exceeds 0.566 inch, or the outside diameter of the driven gear shaft is less than 0.560 inch, replace the bushing or shaft (subpars. (1) and (2) below). Replace the fibre drive gear if it is worn, or if it has broken

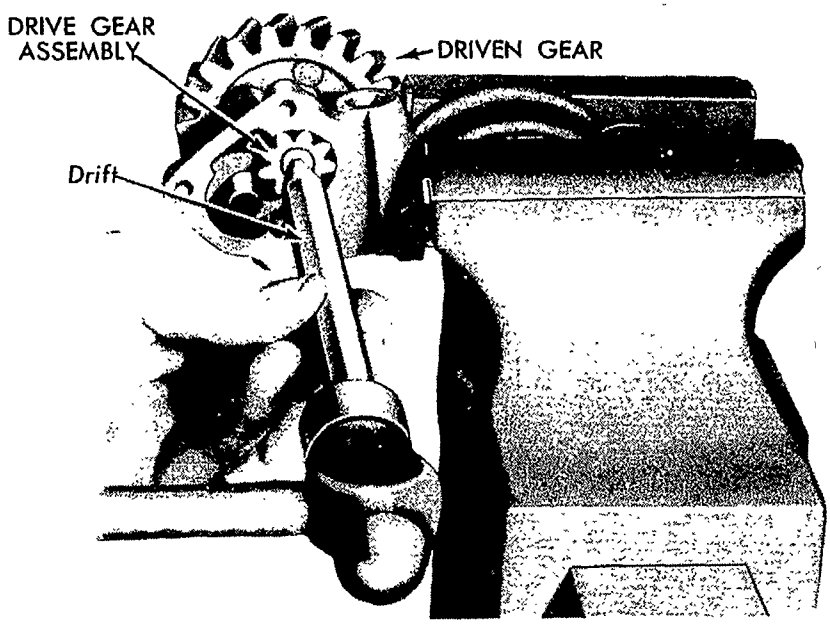


Fig. 30—Removing Oil Pump Drive Gear From Driven Gear and Body

or chipped teeth. Replace the driven gear if it is less than 0.560 inch long, or if the teeth are worn, chipped, or broken. Replace a broken or damaged oil pump screen cover assembly.

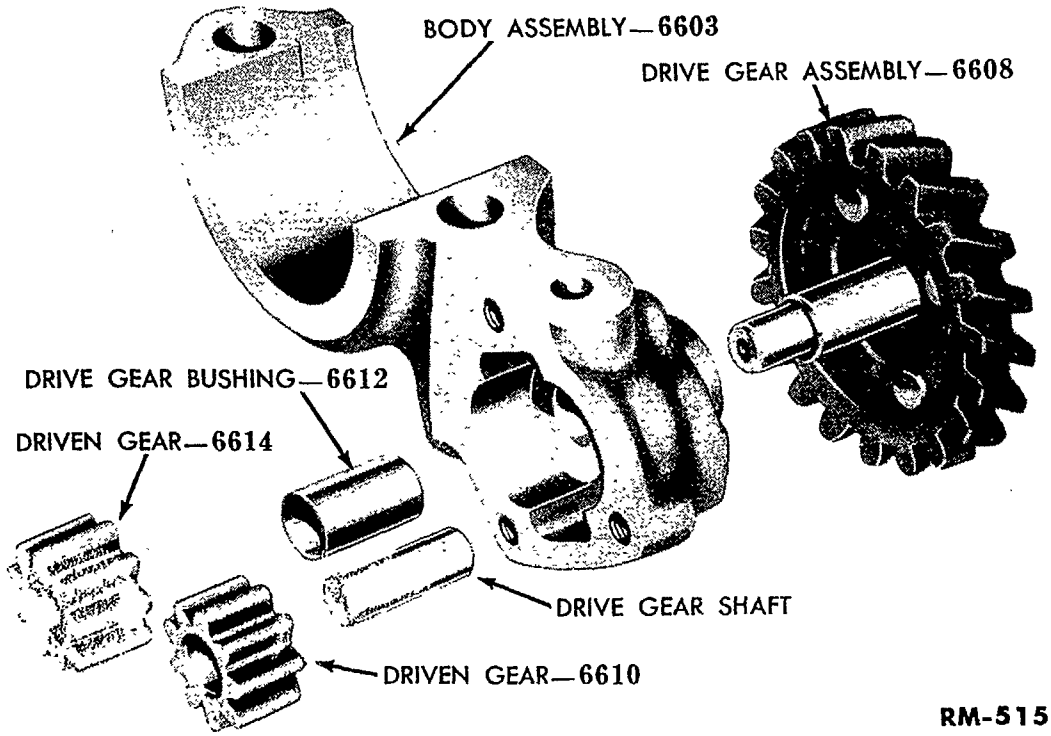


Fig. 31—Oil Pump, Disassembled

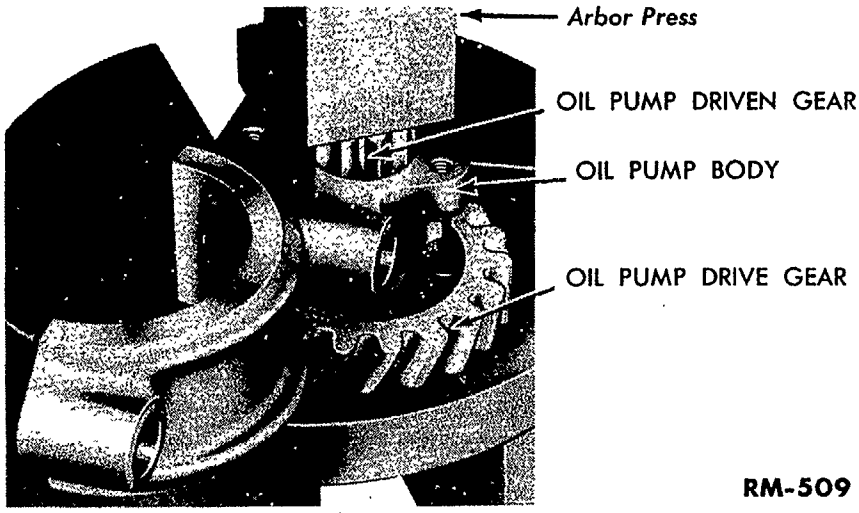


Fig. 32—Pressing Oil Pump Driven Gear Onto Oil Pump Drive Gear and Shaft

(1) *DRIVEN GEAR SHAFT REPLACEMENT.* Drive the driven gear shaft from the oil pump body (fig. 31). To install the driven gear shaft, press it into the oil pump body until the end of the shaft is flush with the outside of the oil pump body.

(2) *DRIVE GEAR BUSHING REPLACEMENT.* Drive the bushing from the oil pump body with a driver. To install the bushing, press it into the oil pump body until the inner edge of the bushing is flush with the oil pump body. Ream the bushing from 0.5625 to 0.5630 inch diameter.

b. Assembly. Place the drive gear in the oil pump body. Press the driven gear on the drive gear shaft, making sure the flat in the gear is in line with the flat side of the shaft. Install the driven gear in the oil pump body.

127. WATER PUMP.

The disassembled water pump is shown in fig. 34.

a. Disassembly. Place the water pump in a vise. Drive the shaft out of the pulley with a driver as shown in fig. 33. Remove the snap ring (fig. 34) from the water pump body. Press the shaft and bearing assembly out of the water pump body (fig. 34).

Remove the water pump seal snap ring, washer, seal and spring from the impeller (fig. 34).

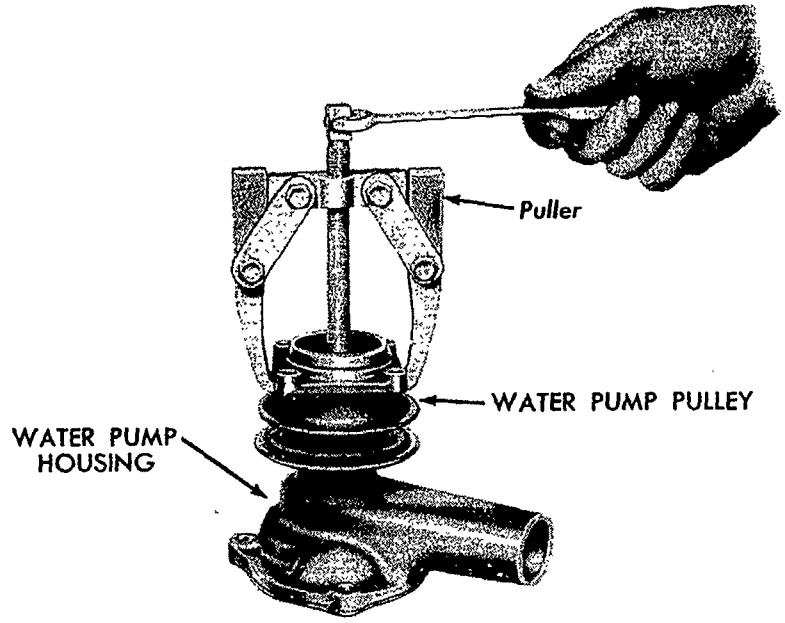


Fig. 33—Removing Water Pump Pulley

b. Cleaning. Clean all of the metal parts thoroughly with cleaning fluid.

c. Inspection. Replace a cracked or damaged water pump body (fig. 34). Replace the water pump seal if it is worn. Replace an impeller if it is cracked, excessively pitted, or if it has broken or damaged fins. Replace a pulley hub that is cracked or has stripped threads. Rotate the water pump bearing. If the bearing binds or has a tendency to stick, replace the bearing assembly. Replace the bearing assembly if there is end play or side play in the shaft.

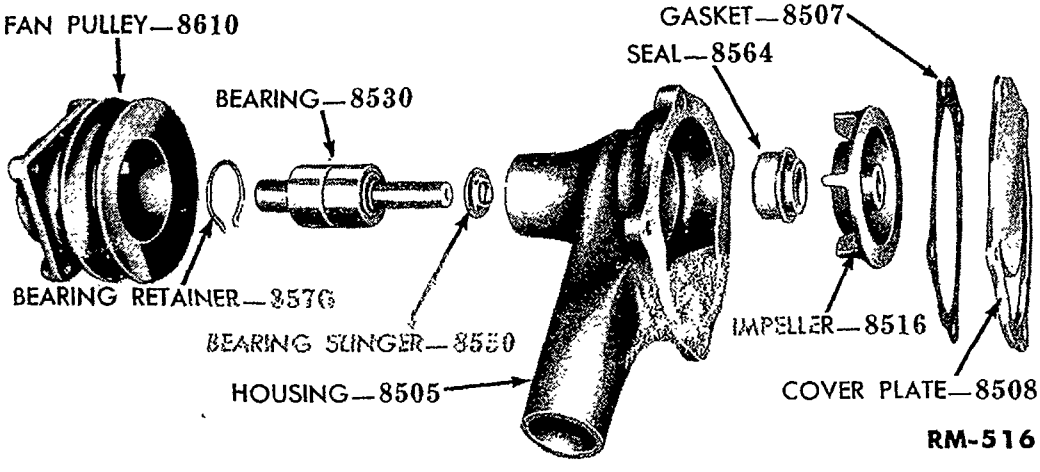


Fig. 34—Water Pump, Disassembled

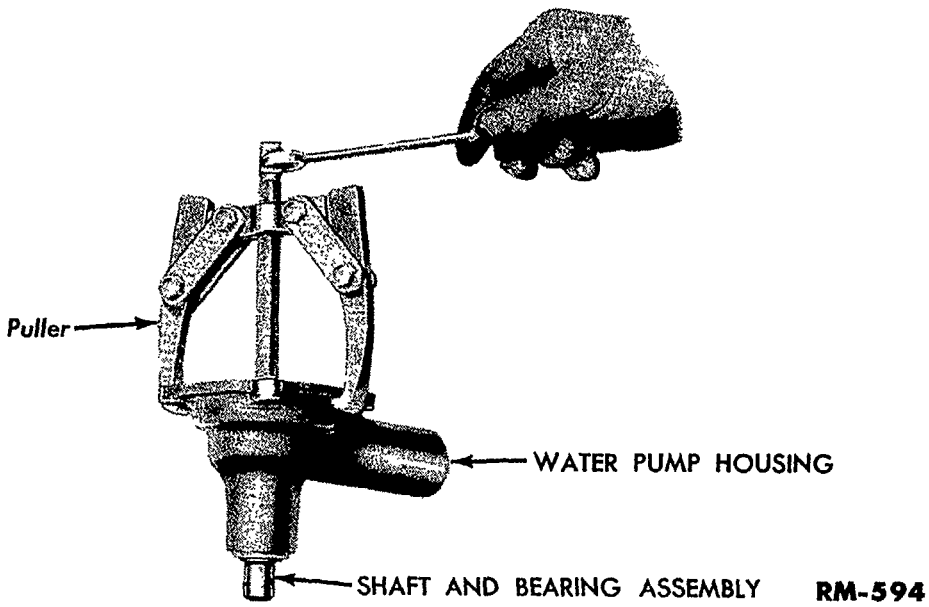


Fig. 35—Pressing Bearing and Shaft from Pulley Hub

d. Assembly. Press a new bushing in the body if the old one was removed. Dip a new seal and seal washer (fig. 31) in hydraulic brake fluid. Install the spring and seal assembly, seal washer, and snap ring in the impeller. Press the bearing and shaft assembly into the body (fig. 31). Press the impeller onto the shaft until it is flush with the end of the shaft. Install the water pump body snap ring in the body. Press the pulley onto the shaft until the pulley is flush with the shaft

128. GOVERNOR.

Remove the screw (fig. 36) that secures the driver unit to the body. Lift the driver unit from the body. Remove the hairpin clip, then remove the flat washer, shims, fork base, thrust bearing, upper race and balls (fig. 37) from the shaft. Remove the oil tube elbow connection from the body. Drive the grooved pin out of the fork and lever as shown in fig. 38. Pull the levers out of the body. Remove the dust seal and needle bearing from the body.

a. Inspection. Inspection of the governor should follow the nine procedures as given below

(1) *DRIVE GEAR.* Replace the drive gear (fig. 39) (par. **b** below) if it is chipped or worn.

(2) *BALL BEARING BASE.* Replace the ball bearing base (fig. 37) (par. **b** below) if it is cracked or damaged in any way.

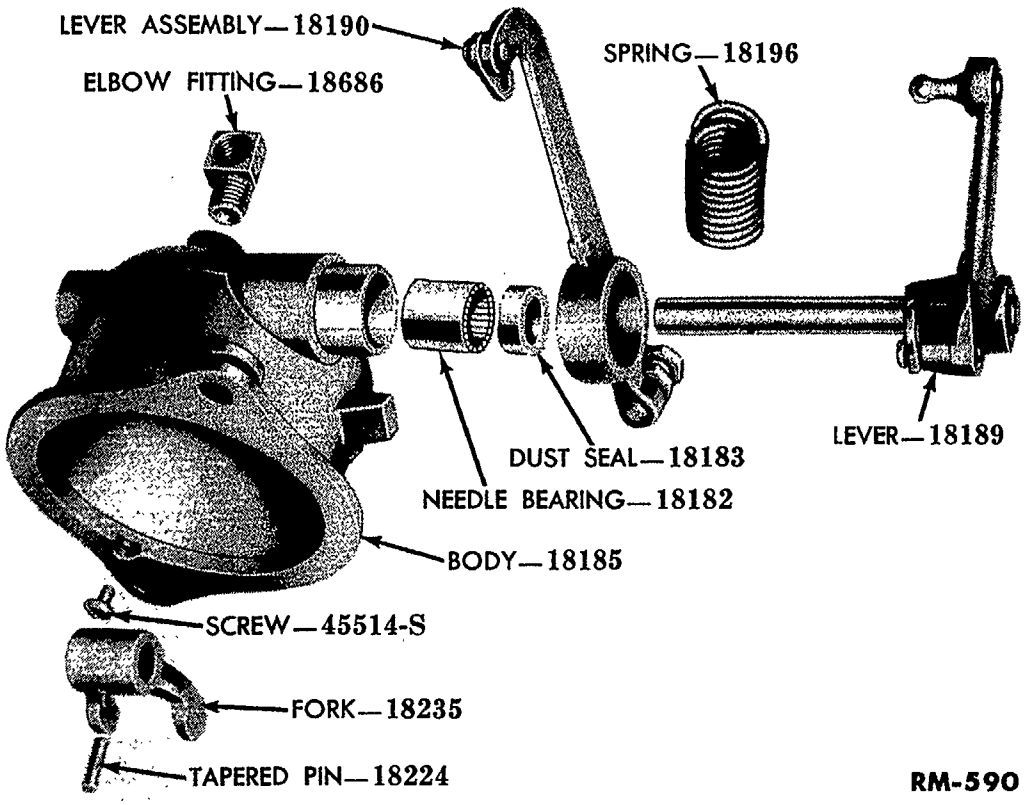


Fig. 36—Governor, Disassembled

(3) *LOWER RACE ASSEMBLY.* Replace the lower race assembly (fig. 37) if the plate is pitted, grooved or if the bearing is worn or damaged.

(4) *DRIVE SHAFT.* Replace the drive shaft (fig. 37) (par. c below) if the plate is loose on the shaft or if the slots in the plate are worn.

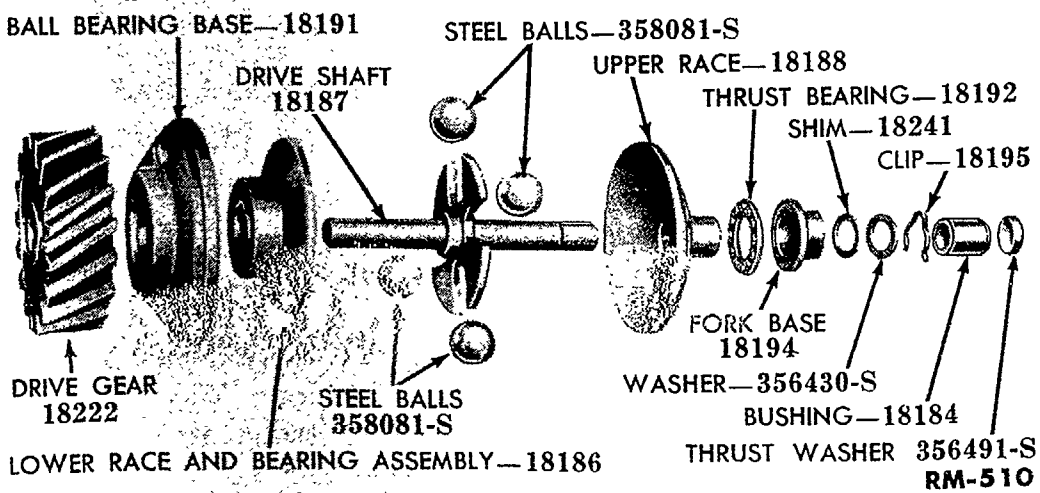
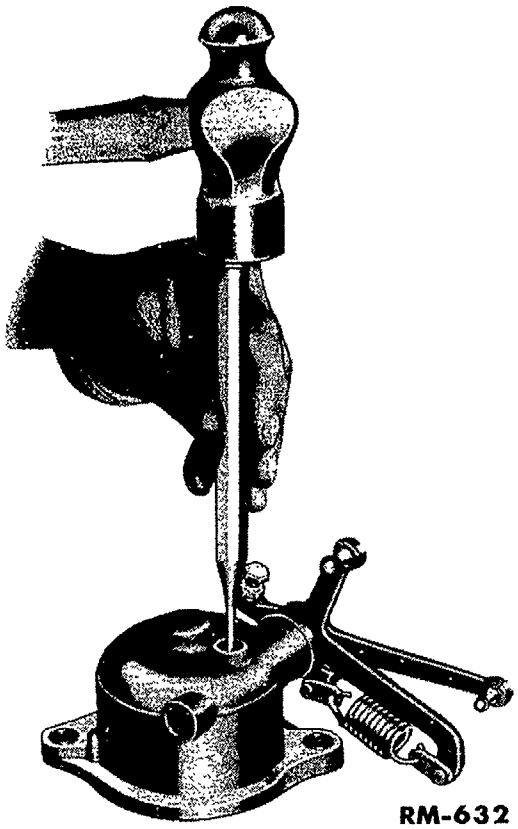
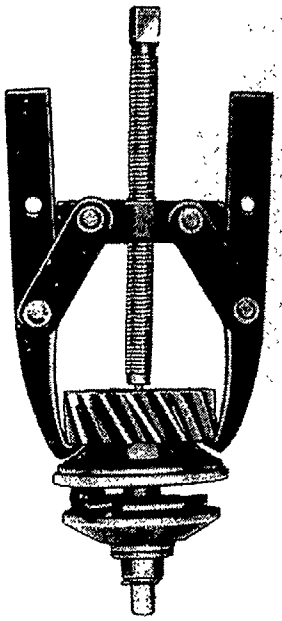


Fig. 37—Governor Drive Shaft, Disassembled



RM-632

Fig. 38—Driving Grooved Pin from Fork and Lever



RM-583

Fig. 39—Removing Governor Drive Gear

(5) *BALLS*. Replace a ball that has flat spots, pits, or that is damaged in any way. A discolored ball is due to a chemical reaction and does not effect the serviceability of a ball.

(6) *UPPER RACE*. Replace the upper race (fig. 37) if it is grooved or pitted.

(7) *THRUST WASHER*. Replace the thrust washer (fig. 37) if any of the balls are missing, or if any of the balls have flat spots.

(8) *FORK BASE*. Replace the fork base (fig. 36) if it is worn or damaged.

(9) *BODY*. Replace the body (fig. 36) if it is cracked or if the trunnion for the manual lever measures less than 0.9161 inch. Replace the bushing (par. c below) (fig. 37) if there is more than 0.005 inch clearance between the shaft and bushing. Replace the needle bearing if any of the needles are flat, or if any are missing. Always replace the grease seal if the shaft has been removed. Replace the fork if the bearing surface is worn flat.

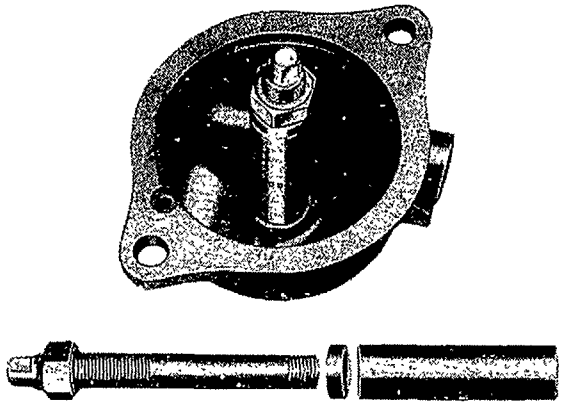


Fig. 40—Removing Governor Bushing

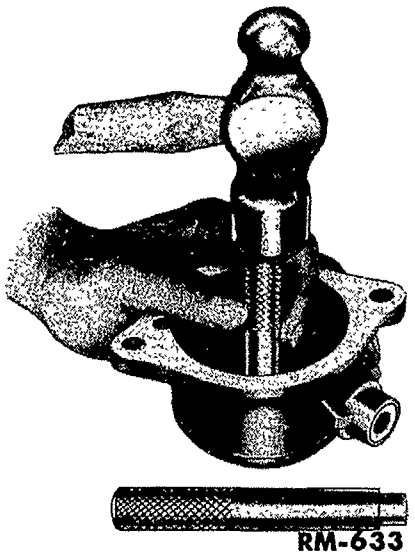


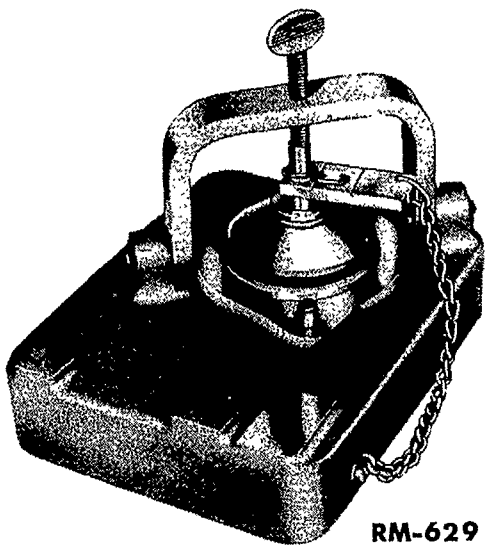
Fig. 41—Installing Governor Bushing

b. Repair. To replace the drive gear or ball bearing base, remove the drive gear from the shaft with a puller. Remove the ball bearing base and lower race from the shaft as an assembly. Press the lower race out of the ball bearing base. To assemble the shaft, press the lower race assembly in the ball bearing base. Install the ball bearing base assembly on the short end of the shaft (fig. 37). Press the gear on the shaft until the shaft is flush with the face of the gear.

To replace the bushing, remove the elbow connection from the body. Working through the elbow opening, drive the pin out of the fork and shaft with a small punch. Remove the levers from the body. Remove the bushing with an EZ-out type puller (fig. 40). To install the bushing, place the thrust washer in the body (fig. 37), and drive the bushing into the housing with a driver equipped with a pilot (fig. 41). Install the levers and fork in the body (fig. 36). Drive a new grooved pin in the fork and shaft. Install the elbow connection in the body.

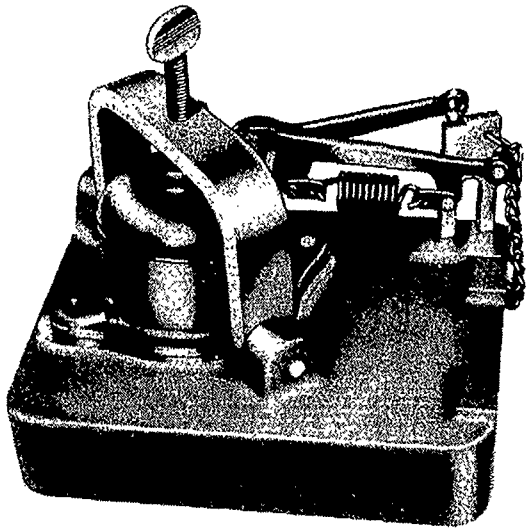
c. Assembly and Adjustments. To assemble the shaft assembly, place the four balls in position on the shaft, and install the upper race (fig. 37) over the balls. Install the thrust bearings and fork base on the shaft (fig. 37). Install the flat washer, shims, and hairpin clip (fig. 36) on the shaft.

To adjust the shaft, clamp it and the driver assembly in the governor setting gauge as shown in fig. 42. The clearance between the washer and fork base should be 0.220 inch to 0.230 inch. Add



RM-629

Fig. 42—Measuring Clearance Between Washer and Fork Base



RM-630

Fig. 43—"Go" and "No Go" Gauge Inserted Behind Governor Lever

or remove the 0.010 inch spacers as required until the correct clearance is established.

To install the drive shaft assembly in the body, install the lever and fork in the body, securing it with a grooved pin. Position the drive shaft assembly in the body, and install the governor body screw in the body.

To check the governor arm adjustment, install the governor on the governor setting gauge, and tighten the wing nut on the gauge finger tight. Hold the governor lever in the wide open position, and insert the "GO" and "NO GO" gauge as shown in fig. 43. If the gauge cannot be inserted, the clearance is insufficient and must be adjusted. If only the first step can be inserted, the clearance is satisfactory. If the second step can be inserted, the clearance is excessive and must be adjusted.

If the clearance is either insufficient or excessive, lay the governor arm across the bosses on the gauge (figs. 44 and 45). Strike the center of the governor arm with a light hammer. Recheck the arm adjustment.

129. OIL PAN, INTAKE AND EXHAUST MANIFOLDS.

Clean the oil pan thoroughly. Replace an oil pan that has stripped threads in the drain plug hole, or one that is badly dented, distorted, or cracked. Replace the oil pan drain plug and oil pump screen if damaged.

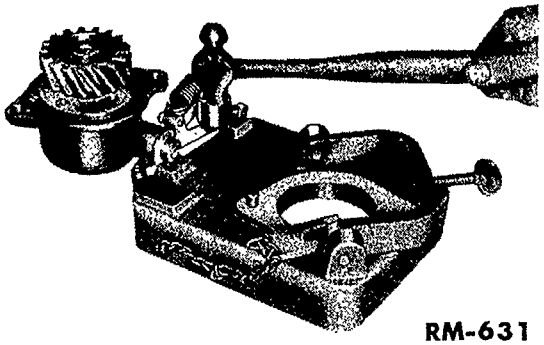


Fig. 44—Correcting Insufficient Clearance on Governor Arm

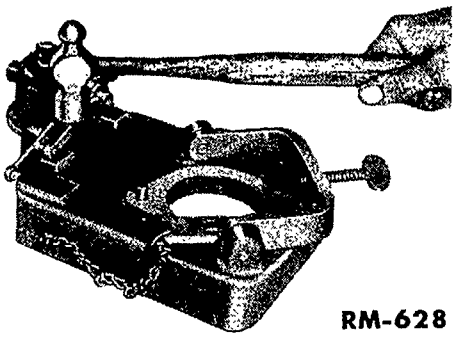


Fig. 45—Correcting Excessive Clearance on Governor Arm

To clean the intake and exhaust manifolds, scrape off all the carbon and all parts of the old gaskets. Clean the manifolds thoroughly.

Replace a manifold that is cracked or broken. Replace broken or damaged manifold studs (sec. 122).

ASSEMBLY OF ENGINE

Assembly 131
Installation of Accessories 132

131. ASSEMBLY.

Before assembling the component parts of the engine, make sure that each part is in a satisfactory condition for use (Chapter 11).

a. Install Crankshaft. Install the three upper halves of the main bearing inserts in the cylinder block. Install the three lower halves of the main bearing inserts in the two main bearing caps and oil pump body. Coat the main bearing inserts with a light film of oil. Install the crankshaft rear bearing oil seal retainer and seal in the rear of the cylinder block. Place the crankshaft in the cylinder block, and install the main bearing caps and oil pump body on the cylinder block. Install the main bearing cap nuts or self-locking nuts and tighten them from 80 to 90 pounds-feet if using self-locking nuts. Tighten from 75 to 80 pounds-feet if using castellated nuts. Pry the crankshaft forward and insert a feeler gauge as shown in Fig. 46.

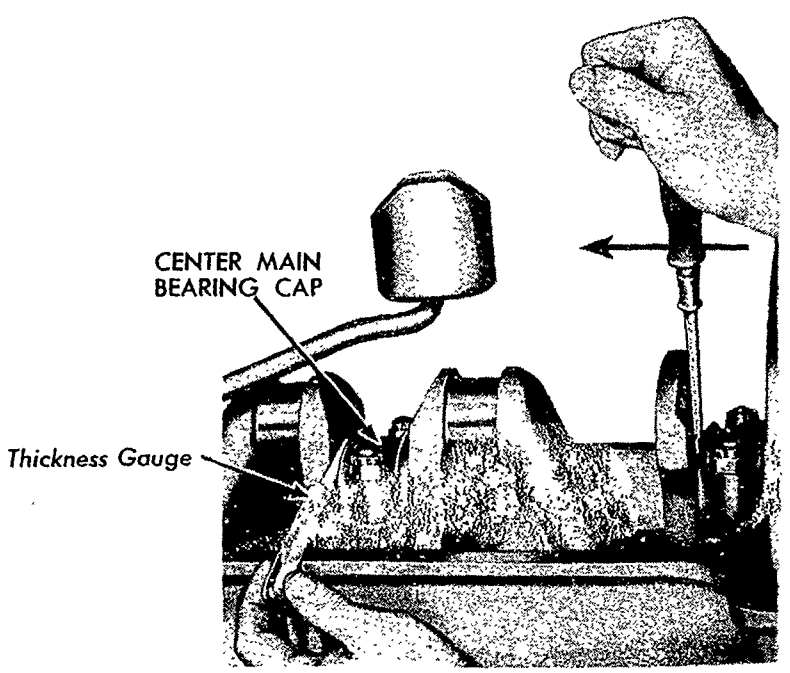


Fig. 46—Measuring Crankshaft End Play

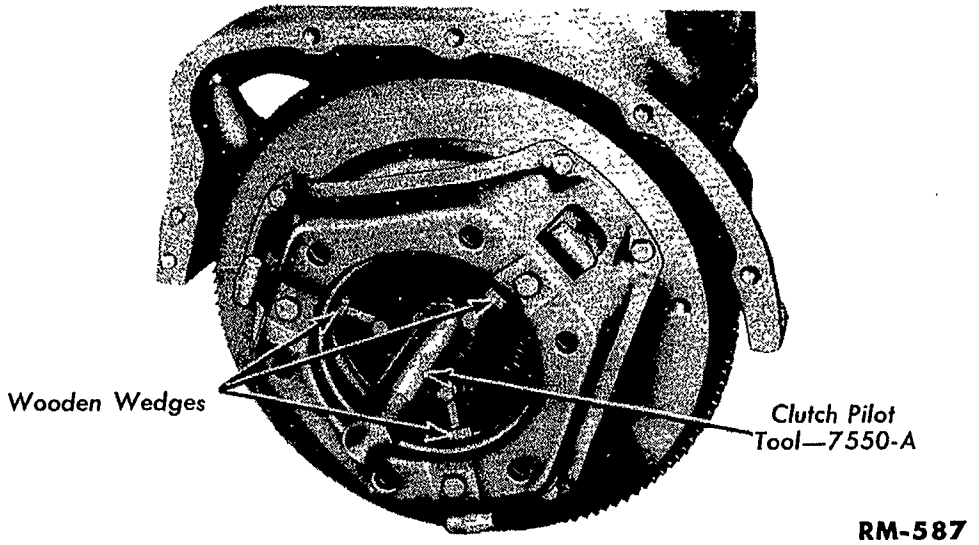


Fig. 47—Installing Clutch Disk and Pressure Plate

If the clearance exceeds 0.006 inch or is less than 0.002 inch, install a different center main bearing insert with a thicker flange to reduce the end play, or one with a thinner flange to increase the end play. Install lock wire in all of the main bearing caps.

b. Install Flywheel. Place the flywheel in place on the crankshaft. Make certain that there is no foreign matter or burrs between the flywheel and crankshaft. Install the dowel retainer and cap screws. Tighten the cap screws from 65 to 70 pounds-feet. If self locking cap screws are used, tighten from 75 to 80 pounds-feet. Check the flywheel runout with an indicator. If the flywheel has a runout of more than 0.005 inch, take the flywheel off and turn it one-half turn on the crankshaft, and install the dowel retainer and cap screws. If the runout is still more than 0.005 inch, replace or reface the flywheel. Install lock wire in the four cap screws.

c. Install Clutch Disk and Pressure Plate. Block the three clutch release levers down with wooden blocks (fig. 47). Position the clutch disk on the flywheel, and install a clutch pilot tool into the pilot bearing and disk. Position the pressure plate on the flywheel. Install and tighten the six lock washers and cap screws. Remove the clutch pilot tool and the wooden blocks from the pressure plate.

d. Install Camshaft Assembly. Install the camshaft in the cylinder block, being careful not to damage the camshaft bearing

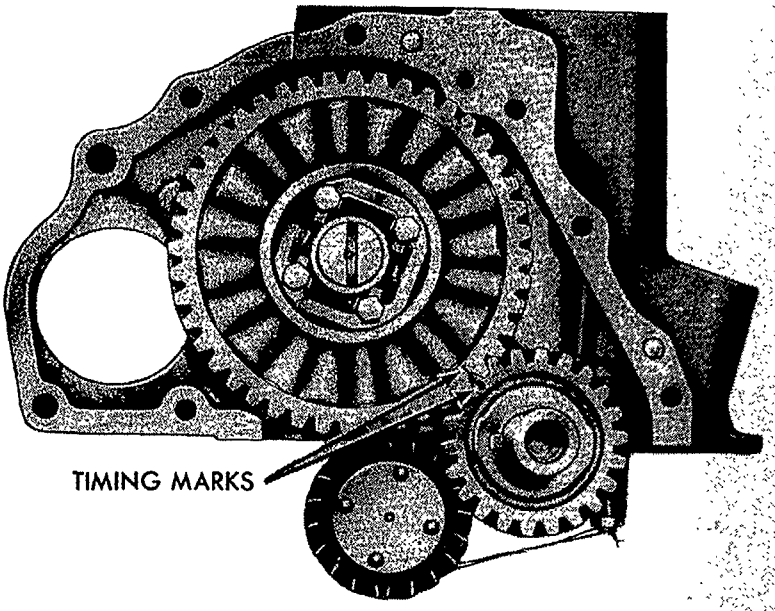


Fig. 48—Timing Marks

surface with the sharp corners of the cams. Make sure the timing mark on the camshaft gear is in line with the timing mark on the crankshaft gear (fig. 48).

e. Install Push Rod and Valve Assemblies. Place a push rod in each push rod bore. If any of the push rods stick in the bore, they are too tight and must be replaced. Place each valve assembly in its respective port, and install the valve guide bushing retainers (fig. 49). Turn the camshaft until No. 1 push rod is resting on the heel of the cam (fig. 50). With a thickness gauge, check the clearance between the push rod and the end of the valve stem (fig. 51). If the

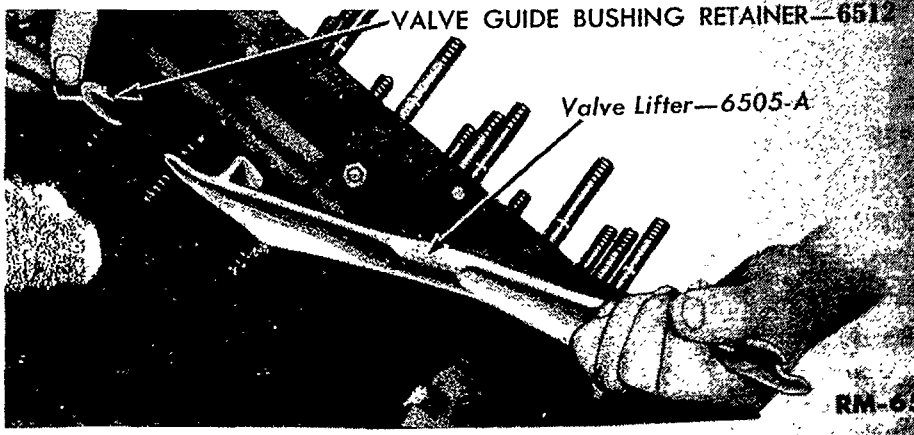


Fig. 49—Installing Valve Guide Bushing Retainer

§ 131. e.

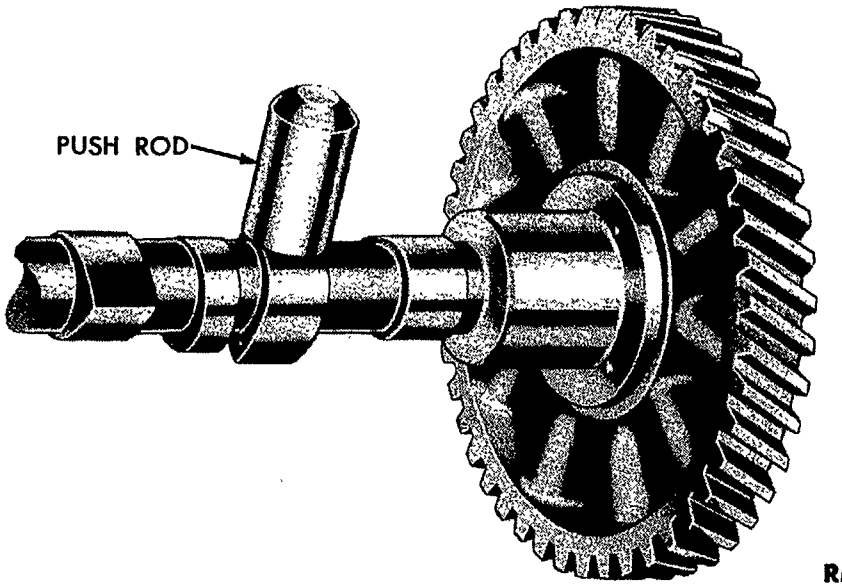


Fig. 50—Push Rod on Heel of Cam

clearance exceeds 0.012 inch intake and 0.016 inch exhaust, select a longer valve, or reface the valve or valve seat to decrease the clearance. If the clearance is less than 0.010 inch intake or 0.014 inch exhaust, select a shorter valve or remove the valve assembly, and grind the lower end of the valve stem until 0.010 to 0.012 inch (intake) and 0.014 to 0.016 inch (exhaust) is established.

f. Install Connecting Rod and Piston Assemblies. Select the piston assemblies for each cylinder as outlined in section 123. Oil

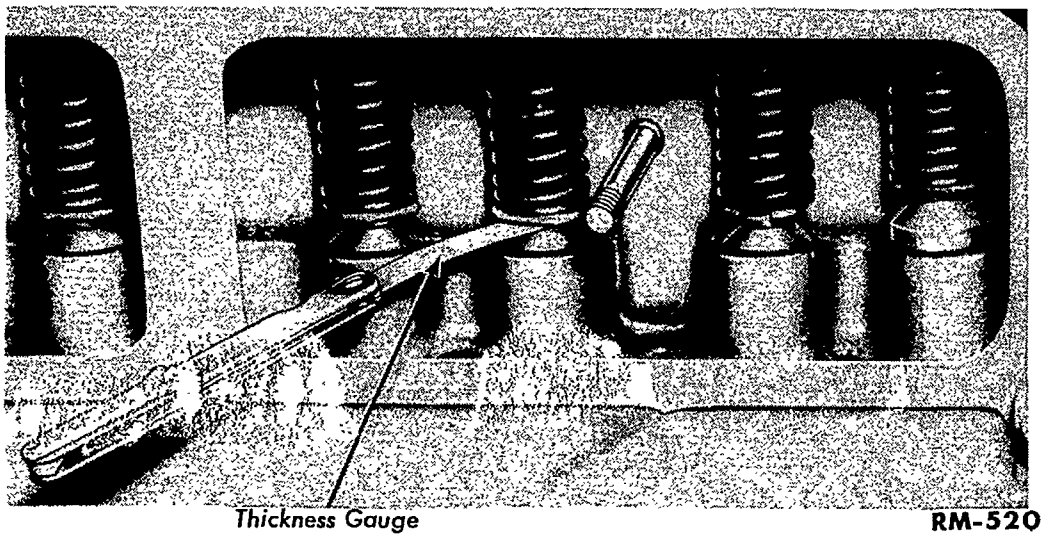


Fig. 51—Checking Clearance Between Valve Stem and Push Rod

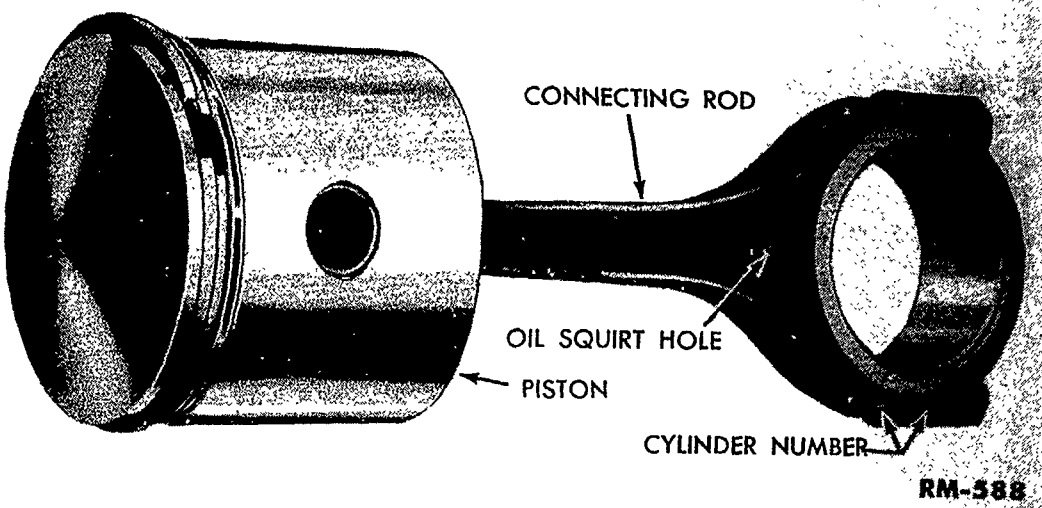


Fig. 52—Assembled Connecting Rod and Piston, Showing Oil Squirt Hole

the piston rings. Place No. 1 connecting rod and piston assembly in the No. 1 cylinder with the oil squirt hole in the connecting rod facing toward the front of the engine (fig. 52). Install a piston ring compressor on the piston rings, and tap the piston down into the cylinder with the handle end of a hammer (fig. 53). Place one-half of the connecting rod insert bearing in the connecting rod and the other half in the connecting rod bearing cap. Coat the connecting rod insert bearings with a light film of oil. Carefully position the connecting rod on the crankpin, and install the bearing cap on the connecting rod, making sure the number on the bearing cap is toward the camshaft side of the engine. Make sure that the insert bearings are not jarred out of place. Install, but do not tighten, the nuts. Repeat the above procedure when installing the other connecting rod and piston assemblies. Tighten all the connecting rod nuts from 35 to 40 pounds-feet, and install a cotter pin in each rod

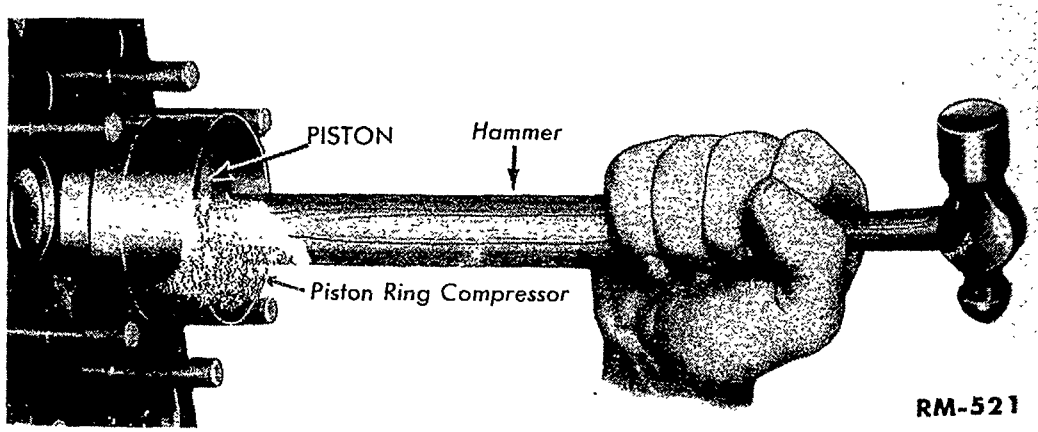


Fig. 53—Installing Connecting Rod and Piston Assembly

§ 131. f.

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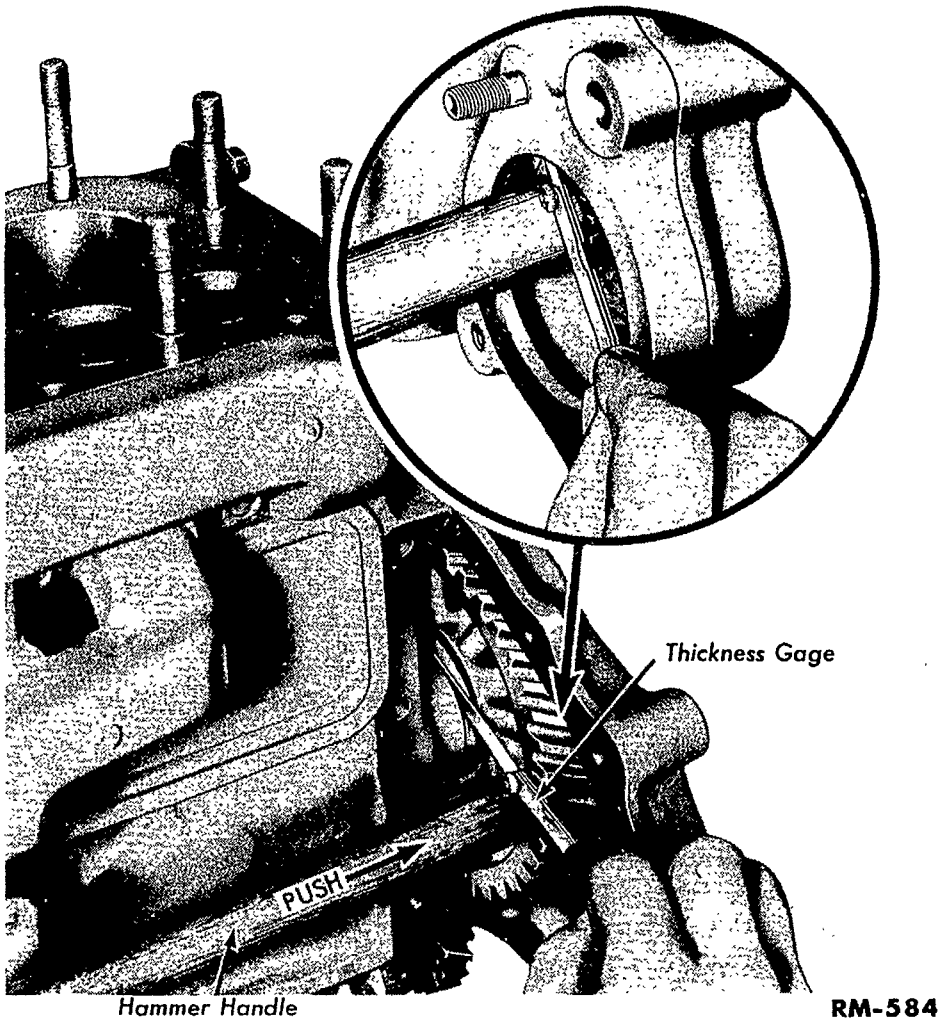


Fig. 54—Measuring Clearance Between Camshaft Gear and Cylinder Block

nut. If Marsden nuts (lock nuts) are used, tighten them from 40 to 45 pounds-feet.

g. **Install Oil Pump Cover Assembly.** Place the oil pump driven gear (fig. 31) on the shaft in the oil pump. Install the oil pump screen cover assembly and gasket onto the oil pump. Secure the screen cover assembly to the oil pump body with the three cap screws and lock wire.

h. **Install Cylinder Front Cover and Camshaft Gear Side Cover.** Hold the camshaft gear side cover and gasket in place on the cylinder block, and install the two lock washers and cap screws. Install the oil slinger on the crankshaft.

NOTE: *Soak the crankshaft packing in oil for two hours before installation.*

Install the crankshaft packing in the recess provided in the cylinder front cover. Insert a new gasket and cylinder front cover on the engine. Insert a thickness gauge between the camshaft gear and cylinder block while forcing the camshaft ahead with a hammer handle (fig. 54). If a clearance of more than 0.004 inch exists, replace the cylinder front cover.

i. Install Oil Pan.

NOTE: ***Soak the crankshaft packing in oil for two hours before installation.***

Install the packing in the recess at each end of the oil pan. Coat the bottom machined surface of the crankcase with grease to hold the oil pan gasket in place. Install the oil pan gasket on the cylinder block. Position the oil pan on the cylinder block, and install the cap screws.

j. Install Crankshaft Pulley. Place the crankshaft pulley on the crankshaft. Turn the pulley by hand until the slot in the pulley is lined up with the woodruff key in the crankshaft. Drive the pulley on the crankshaft with a fiber block. Install the crankshaft ratchet.

k. Install Cylinder Head. Place a new head gasket on the cylinder block. Make sure there is no foreign matter either in the cylinders or on the surface of the cylinder head or block. Place the cylinder head on the cylinder block. Install and tighten the cylinder head nuts from 50 to 60 pounds-feet. When tightening nuts, start from a centrally located nut, and tighten alternately each way.

l. Install Water Pump. Position the water pump and gasket on the cylinder block, and install the nuts and cap screw.

m. Install Intake and Exhaust Manifolds. Place the intake and exhaust manifold gaskets on the cylinder block studs. Secure the manifold to the cylinder block with the four nuts.

132. INSTALLATION OF ACCESSORIES.

The following instructions are based on the assumption that the various accessories are in good working order. Overhaul or repair accessories before installation if required.

a. Install Starting Motor. Position the starting motor (fig. 1) on the cylinder block, and tighten the two starting motor cap screws.

b. Install Carburetor. Place the carburetor in place on the intake manifold (fig. 2). Install and tighten the two carburetor nuts and lock washers.

c. Install Distributor and Spark Plug Wires. Place the gasket in position on the distributor. Place the distributor in position on the cylinder front cover, making sure that the tang on the distributor shaft is entered in the slot in the camshaft. Secure the distributor to the cylinder front cover with two cap screws and lock washers. Secure the spark plug wire conduit to the cylinder head with the two cap screws.

d. Install Oil Filter. Secure the oil filter to the cylinder head (fig. 1) with the two cap screws. Connect the oil filter return line to the governor and oil filter. Connect the oil filter inlet line to the connection located at the right-hand side of the cylinder block and to the oil filter.

e. Install Generator. Hold the generator in place on the cylinder front cover (fig. 2). Install the cap screw and washer, but do not tighten until the fan belt is adjusted after the engine is installed.

FITS AND TOLERANCES

	Section
Definition of Fits	141
Fits and Tolerances	142
Torque Wrench Readings	143

141. DEFINITION OF FITS.

The Table of Fits and Tolerances (Sec. 142) gives the original clearance established between various parts at the time of manufacture, as well as wear and limit clearances that indicate to what point the clearance may increase before the parts must be replaced. These clearances are based on the parts involved, all being at 70° F. The following definitions of the various types of fits are given to assist in arriving at the correct amount of clearance between parts not included in section 142, as well as to give a better appreciation of why the various tolerances must be adhered to. Generally speaking, all bores are made to a standard size (so that standard reamers, plug gauges, etc., may be used) with a plus tolerance. The maximum size of the male parts is usually a standard size less the minimum clearance required for the type of fit desired. The minimum size for male parts is the maximum size minus the tolerance.

a. Wring Fit. A wring fit is the type of fit required between a bore and a plug gauge, when using the plug gauge, to determine the inside diameter of the bore. With a wring fit, it is necessary to turn or wring the plug gauge or part to force it through the bore. This type of fit does not provide space for a film of oil.

b. Slip Fit. A slip fit exists when the male part is slightly smaller than the female part and involves less clearance than a running fit (par. c below). An example of the minimum allowable clearance for a slip fit would be a piston pin that, from its own weight, would pass slowly through the connecting rod bushing (bushing and pin both in a vertical position). In most cases (except where only a limited move-

ment of the parts is involved) slip fits are specified when, due to anticipated expansion (par. f below) of the female part, enough additional clearance will result to change this type of fit to a running fit (par. c below) and provide adequate clearance for a film of oil.

c. Running Fit. A running fit is a fit providing enough clearance for a continuous film of oil between the two parts. A running fit usually requires 0.001 inch for oil film plus a minimum of 0.001 inch for each 1 inch of diameter (par. f below).

d. Press Fit. A press fit is one that requires force to enter the male part into the bore. Accepted practice for press fits is to have the male part larger by 0.001 inch for each inch of diameter than the bore into which it is to be pressed.

e. Shrink Fit. Generally speaking, a shrink fit is tighter than a press fit. The amount of the shrink ranging from 0.001 inch to 0.002 inch for each 1 inch of diameter, and in some cases even more. The parts having a press fit may be assembled either by force or by the shrink method. There are two methods of shrinking two parts together, either one of which may be used (both may be used in some instances). One method involves expansion of the female member by heating. The other method involves contracting the male member by chilling with dry ice or liquid air.

f. Effect of Expansion on Fits. Allowances are made in establishing fits on parts that are exposed to higher temperatures in order to provide for the anticipated expansion of the part during operation and still provide adequate clearance for the type of fit required. Allowances must also be made for unequal expansion of dissimilar materials. Absolute minimum allowance for expansion of parts exposed to flame or exhaust gases (pistons, piston rings, and valves) is 0.001 inch for each 1 inch of diameter or length. In anticipating the expansion of a piston to make allowances for the additional clearance required in the cylinder, 0.001 inch for each 1 inch of diameter is added. In anticipating the expansion of a piston ring, to make allowances for the additional gap required between the ends of the piston ring, 0.001 inch for each linear inch of the part is added.

142. FITS AND TOLERANCES.

CYLINDER BLOCK

FIT LOCATION NAME	ORIGINAL FIT TOLERANCES	FIT WEAR LIMIT	TYPE OF FIT
Cylinder bore out-of-round	—	0.003 in.	—
Cylinder bore taper or maximum wear	—	0.006 in.	—
Clearance between camshaft and bearing	0.001 in. to 0.002 in.	0.004 in.	Running
Clearance between push rod and push rod bore	0.0005 in. to 0.0015 in.	0.003 in.	—

CONNECTING ROD AND PISTON ASSEMBLY

FIT LOCATION NAME	ORIGINAL FIT TOLERANCES	FIT WEAR LIMIT	TYPE OF FIT
Connecting rod side clearance	0.004 in. to 0.008 in.	0.011 in.	—
Piston pin clearance in connecting rod	0.0002 in. to 0.0005 in.	0.0015 in.	Slip
Piston pin clearance in piston	0.000 in. to 0.0005 in.	0.0015 in.	(Light Push)
Piston and cylinder	6 pounds to 10 pounds pull with a thickness gauge 0.003 in. and ½ in. wide	6 pounds to 10 pounds pull with a thickness gauge 0.005 in. and ½ in. wide	—
Top piston ring to groove side clearance	0.0015 in. to 0.0030 in.	0.004 in.	—
Balance of piston ring to groove side clearance	0.0010 in. to 0.0025 in.	0.004 in.	—
Piston ring end gap	0.012 in. to 0.017 in.	0.035 in.	—

VALVES

FIT LOCATION NAME	ORIGINAL FIT TOLERANCES	FIT WEAR LIMIT	TYPE OF FIT
Stem to guide clearance (exhaust)	0.0025 in. to 0.0045 in.	0.006 in.	Running
Stem to guide clearance (intake)	0.0015 in. to 0.0035 in.	0.005 in.	Running
Valve seat angle	45 degrees	—	—
Spring tension at 2.125 inches	31 to 34 lbs.	30 lbs.	—
Clearance between valve stem and push rod (exhaust)	0.14 to 0.16 in.	0.015 in.	—
Clearance between valve stem and push rod (intake)	0.010 to 0.012 in.	0.013 in.	—

OIL PUMP

Clearance between driven gear and shaft	0.002 in. to 0.0035 in.	0.005 in.	Running

CRANKSHAFT

FIT LOCATION NAME	ORIGINAL FIT TOLERANCES	FIT WEAR LIMIT	TYPE OF FIT
Crankshaft end play	0.002 in. to 0.006 in.	0.008 in.	
Main bearing clearance	0.000 in. to 0.003 in.	0.005 in.	Running
Crankpin to connecting rod clearance	0.0013 in. to 0.0035 in.	0.005 in.	Running and Floating

143. TORQUE WRENCH READINGS.

Main bearing nuts ..... 75 to 80 lbs.-ft.
Self-locking main bearing bolts ..... 100 lbs.-ft.
Connecting rod castellated nuts ..... 35 to 40 lbs.-ft.
Connecting rod self-locking nuts ..... 40 to 45 lbs.-ft.
Cylinder head nuts ..... 50 to 55 lbs.-ft.
Flywheel cap screws ..... 65 to 75 lbs.-ft.
Flywheel self-locking cap screws ..... 75 to 85 lbs.-ft.
Spark plugs ..... 24 to 30 lbs.-ft.

4-CYLINDER ENGINE CARBURETOR

	Section
Disassembly	221
Cleaning, Inspection, and Repair	222
Assembly	223

221. DISASSEMBLY.

This procedure consists of removing all parts from the carburetor, such as the choke, throttle valve, levers, jets, etc.

a. Remove Throttle Body From Carburetor Body. Remove the main adjustment ratchet screws, and remove the ratchet (fig. 18). Remove the main adjustment needle assembly from the throttle body. Remove the four screws which secure the throttle body to the carburetor body. Separate the two units.

b. Disassemble Throttle Body. Remove the float lever shaft, float, and float needle valve (fig. 18) from the throttle body. Remove the gasket and venturi. Remove the idler jet and economizer jet with a jet wrench or a small screw driver. Remove the idle adjusting needle. Remove the float needle seat (fig. 18) with a jet wrench.

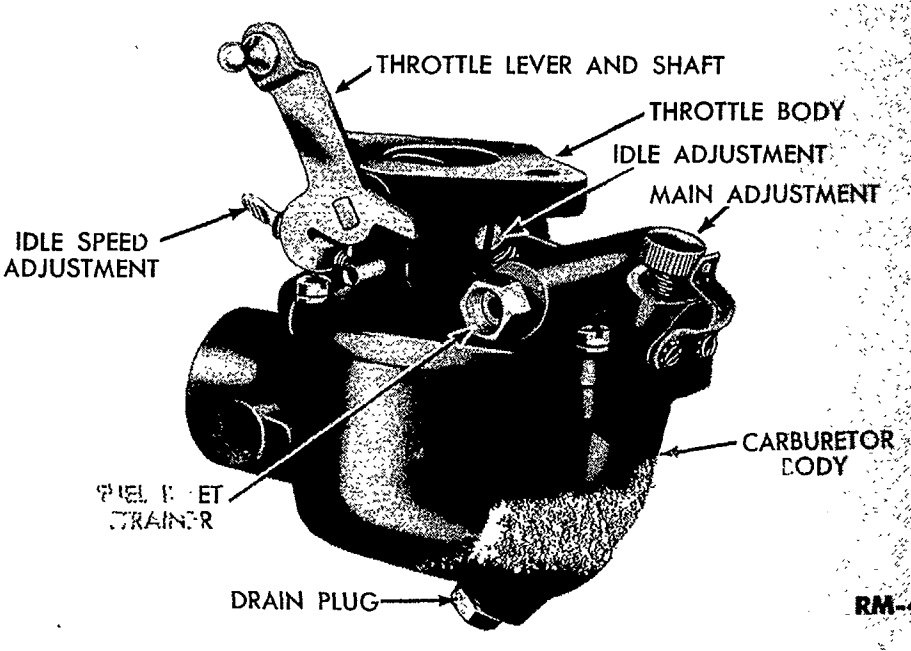


Figure 17—4-Cylinder Engine Carburetor

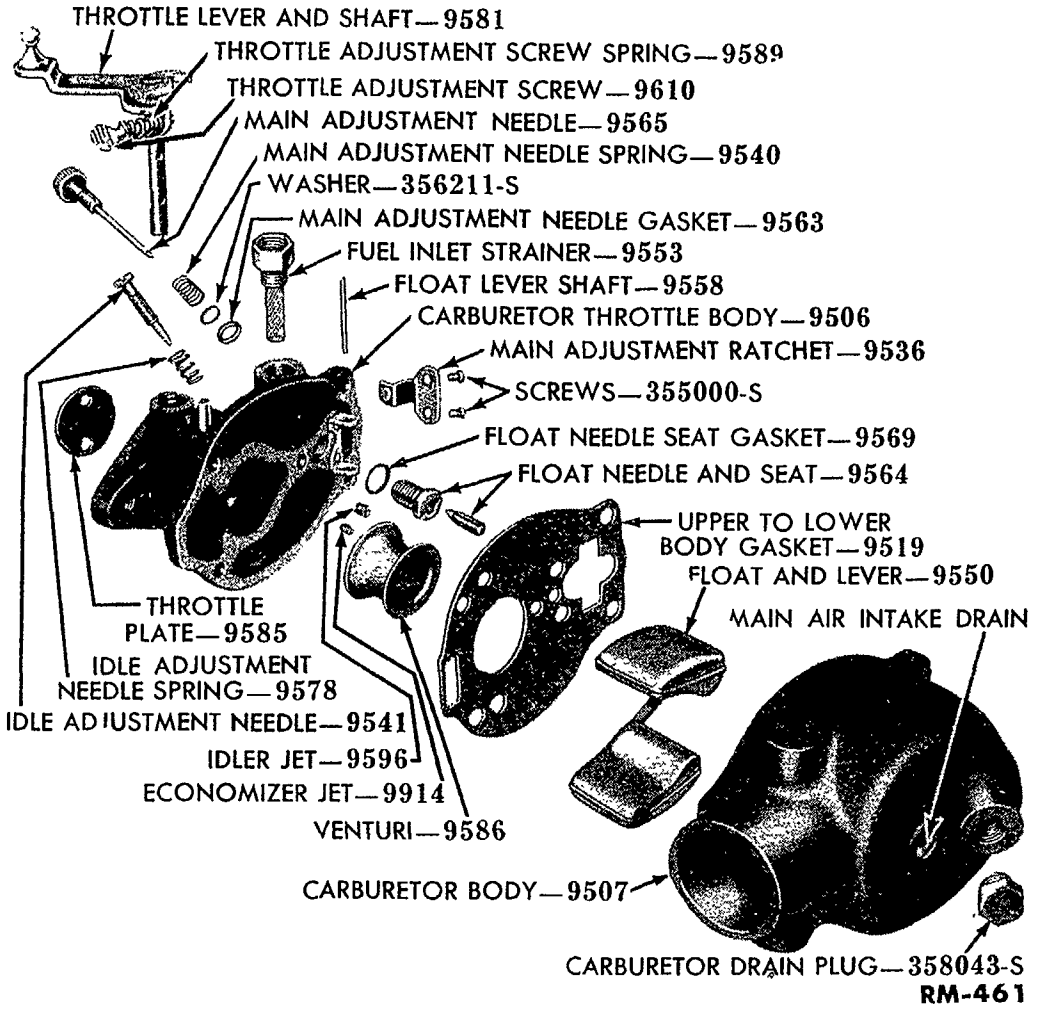


Figure 18—Carburetor, Disassembled

Remove the two screws which secure the throttle plate to the shaft. Remove the plate and throttle shaft from the throttle body.

c. Disassemble Carburetor Body. Remove the main metering jet (fig. 19) with a screw driver or jet wrench. Remove the two screws and lock washers that secure the choke plate in the choke lever and shaft. Pull the choke plate out of the shaft with a pair of pliers. Remove the choke shaft and lever and choke return spring from the carburetor body.

22. CLEANING, INSPECTION, AND REPAIR.

Clean all part thoroughly in a cleaning solution. Blow out all jets with compressed air.

a. Carburetor Body. Replace the carburetor body if it is cracked, if the threads are stripped, or if the jets are plugged and cannot be opened without damaging the jets.

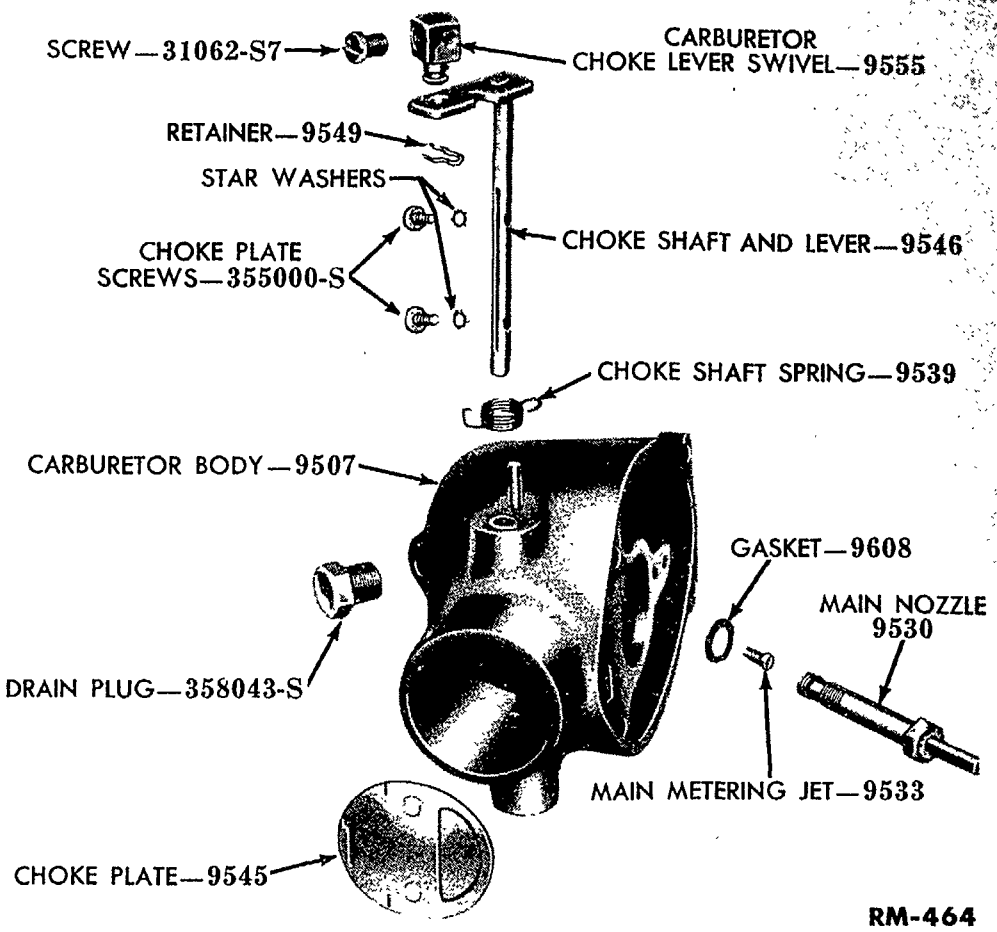


Figure 19—Carburetor Body, Disassembled

b. Carburetor Throttle Body. Replace the carburetor throttle body if it is cracked, if the threads are stripped, or if the throttle or choke shaft holes are worn. Replace the throttle body if the float hanger (fig. 18) is damaged.

c. Throttle Shaft and Lever. Replace the throttle shaft and lever (fig. 18) if the shaft is worn or bent, if the threads are stripped, or if the lever is damaged or loose on the shaft.

d. Choke Shaft and Lever. Replace the choke shaft and lever (fig. 19) if the shaft is worn or bent, if the threads are stripped, or if the lever is damaged or loose on the shaft.

e. Choke Plate. Replace the choke plate (fig. 19) if the poppet valve spring is weak and will not hold the poppet valve closed. Replace the choke plate if the plate or poppet valve is bent or damaged.

f. Float. Replace the float (fig. 18) if it is leaking or if it is bent or damaged in any way.

g. Venturi. Replace the venturi (fig. 18) if it is distorted or damaged in any way.

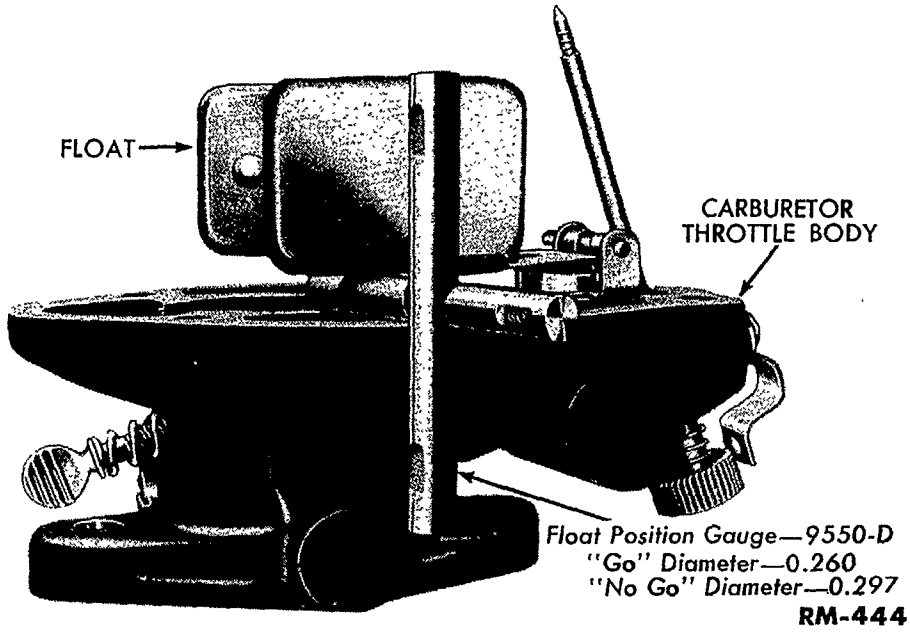


Figure 20—Measuring Float Level (4-Cylinder Engine Carburetor)

h. Main Nozzle. Replace the main nozzle (fig. 19) if it is bent, or if the threads are stripped.

i. Main Adjustment Needle. Replace the main adjustment needle (fig. 18) if the threads are stripped or if the valve is ridged.

j. Main Adjustment Needle Spring. Replace the main adjustment needle spring (fig. 18) if it is weak or broken.

k. Choke Shaft Spring. Replace the choke shaft spring (fig. 19) if it is broken or weak.

l. Float Needle and Valve Seat. The float needle and valve seat are matched in sets, therefore, when one is at fault, both must be replaced. Replace both the needle and the seat (fig. 18) if there is any indication of wear on either part.

m. Economizer Jet. Replace the economizer jet (fig. 18) if the threads are stripped or if the jet is damaged in any way.

n. Maximum Fuel Limiting Jet. Replace the maximum fuel limiting jet (fig. 18) if the threads are stripped, or if the jet is damaged in any way.

o. Idler Jet. Replace the idler jet (fig. 18) if the threads are stripped or if the jet is damaged in any way.

p. Idle Adjusting Needle. Replace the idle adjusting needle (fig. 18) if the threads are stripped or if the valve surface is ridged.

q. Idle Adjusting Needle Spring. Replace the idle adjusting needle spring (fig. 18) if it is broken.

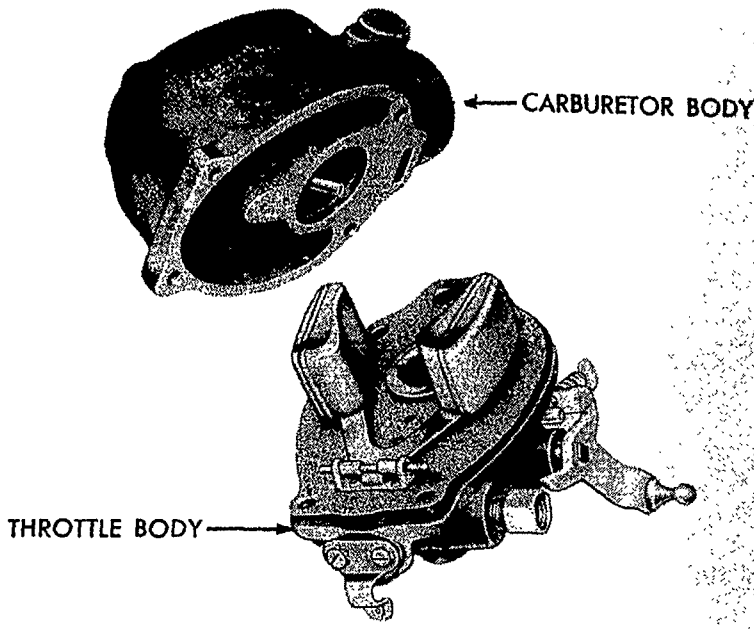


Figure 21—Assembling Carburetor Body to Carburetor Throttle Body

r. Main Adjustment Ratchet. Replace the main adjustment ratchet if it is broken (fig. 18).

223. ASSEMBLY.

This procedure consists of installing all parts, such as levers, springs, valves, etc., on the carburetor.

a. Assemble Carburetor Body. Place the choke return spring on the choke shaft and lever. Install new felt seals on the lever end of the choke shaft. Install the choke shaft and spring in the carburetor body. Hook the choke return spring on the peg on the body and on the lever so that the choke shaft lever will rest on the peg. Install the choke plate in the choke shaft. While holding the choke plate in the closed position, install and tighten the two choke plate screws and washers. Install the maximum fuel limiting jet in the carburetor body (fig. 19) with a small screw driver or jet wrench. Install the main nozzle and new gasket.

b. Assemble Carburetor Throttle Body. Install the idler jet and economizer jet (fig. 18) in the throttle body with a small screw driver or jet wrench. Install the float needle and a new gasket with a jet wrench. Install a new felt seal on the lever end of the throttle shaft. Install the throttle shaft and lever in the throttle body. Place the throttle plate on the throttle shaft, and install the two screws and lock washers. Hold the throttle lever in the closed position, and tighten

the two throttle plate screws. Install the idle fuel adjusting screw and spring. Turn the screw in until it seats lightly, then back it out ¾ of a turn. Place the venturi (fig. 18) in the gasket. Place the gasket on the throttle body so the large end of the venturi seats in the throttle body. Place the float needle valve in the float needle valve seat. Install the float in the throttle body. Secure the main adjustment ratchet to the throttle body with two screws and washers. Set the float to the correct level (fig. 20).

c. Assemble Carburetor Throttle Body to Carburetor Body. Place the carburetor throttle body on the carburetor body, as shown in fig. 21, being careful not to bend the float. Secure the carburetor throttle body to the carburetor body with four screws and lock washers. Install the main adjustment needle assembly, using a new gasket (fig. 18). Turn the adjustment needle in until it is seated lightly, then turn it out 1¼ to 1½ turns.

SERVICING THE STARTER

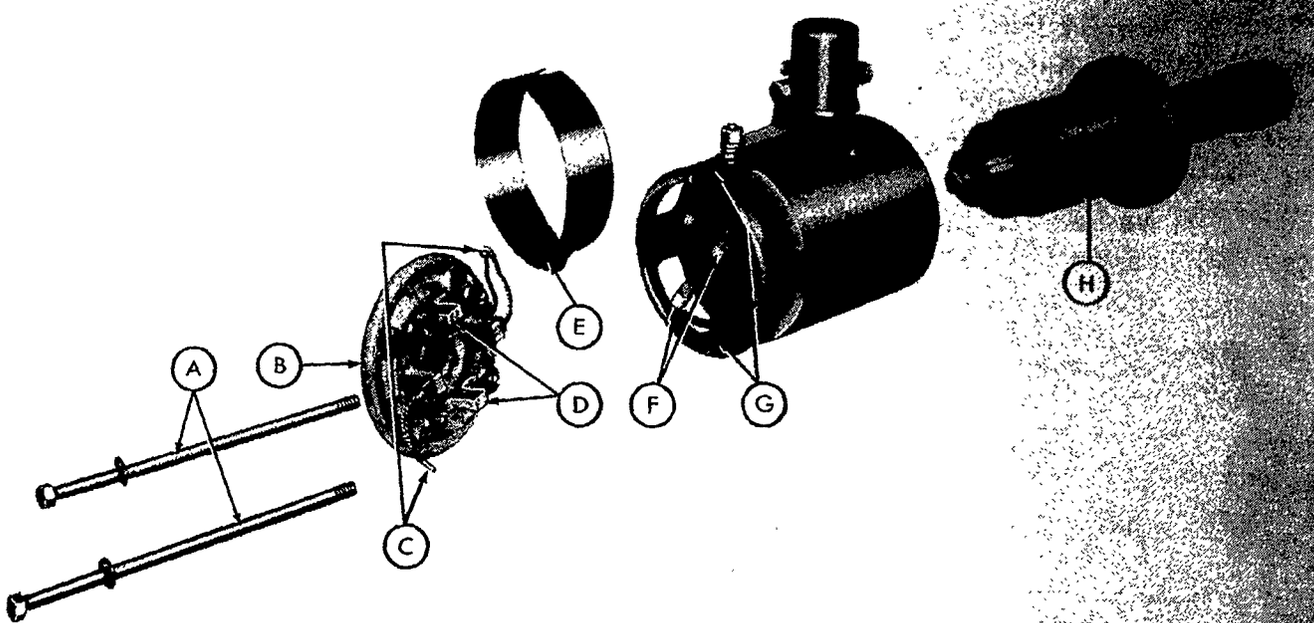


Fig. 1

I. REMOVING THE STARTER FROM THE TRACTOR

Step 1—Disconnect the electrical leads to the starter relay.

Step 2—Loosen the two long bolts until the starter assembly is free from the engine housing.

Step 3—Remove the starter assembly from the tractor.

II. DISASSEMBLING THE STARTER

Step 1—Remove the two long bolts (A-Figure 1).

Step 2—Remove the armature and the bendix assembly (H-Figure 1) as a unit.

Step 3—Remove the cover band (E-Figure 1) from the starter case.

Step 4—Remove the brush end plate assembly (B-Figure 1).

a. Remove the two insulated brushes (F-Figure 1) from the brackets (D-Figure 1) in the brush end plate.

b. Remove the two screws (G-Figure 1) that hold the ground brushes (C-Figure 1) to the starter housing.

III. CLEANING AND INSPECTING THE STARTER

Step 1—Thoroughly clean the armature and commutator with a cloth and mineral spirits.

NOTE: Avoid getting any mineral spirits on the armature windings.

Step 2—Check the armature windings for broken or damaged leads.

Step 3—Check the starter shaft bearings in the brush assembly and rear starter plate and replace if necessary.

Step 4—Check the brushes and replace them if they are broken or worn.

a. Remove the damaged brush from the leads.

b. Solder new brushes to the leads.

IV. ASSEMBLING THE STARTER

Step 1—Position the brush plate assembly to line

SERVICING THE STARTER

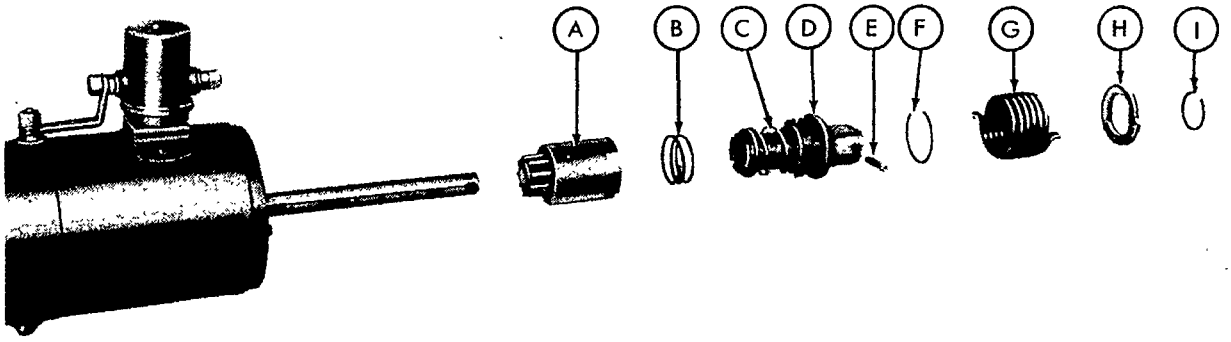


Fig. 2

up the dowel hole with the dowel hole in the starter case.

–Hold the brushes up in the brackets by positioning the spring clips on the side of the brush.

–Connect the two ground brush leads to the case.

–Install the armature and bendix assembly in the case.

Make sure the fibre washer is on the end armature shaft.

–Install the two long bolts.

–Push the brushes down on the commutator with a small screwdriver through the starter case band opening.

–Install the starter case band.

\SSEMBLING THE BENDIX

–Remove the lock spring (I-Figure 2).

–Remove the starter spring anchor plate (H-Figure 2).

–Remove the bendix spring (G-Figure 2).

–Remove the spring clip (F-Figure 2), and the starter spring anchor plate (D-Figure 2).

-Remove the pin (E-Figure 2) that secures the bendix assembly to the shaft.

-Remove the screw and shaft assembly (C-Figure 2).

Step 7—Remove the starter drive meshing spring (B-Figure 2).

Step 8—Remove the pinion and barrel assembly (A-Figure 2).

VI. ASSEMBLING THE BENDIX

Reverse the procedure in Steps 1 through 8, Part V, of this Job Plan.

VII. INSTALLING THE STARTER ON THE TRACTOR

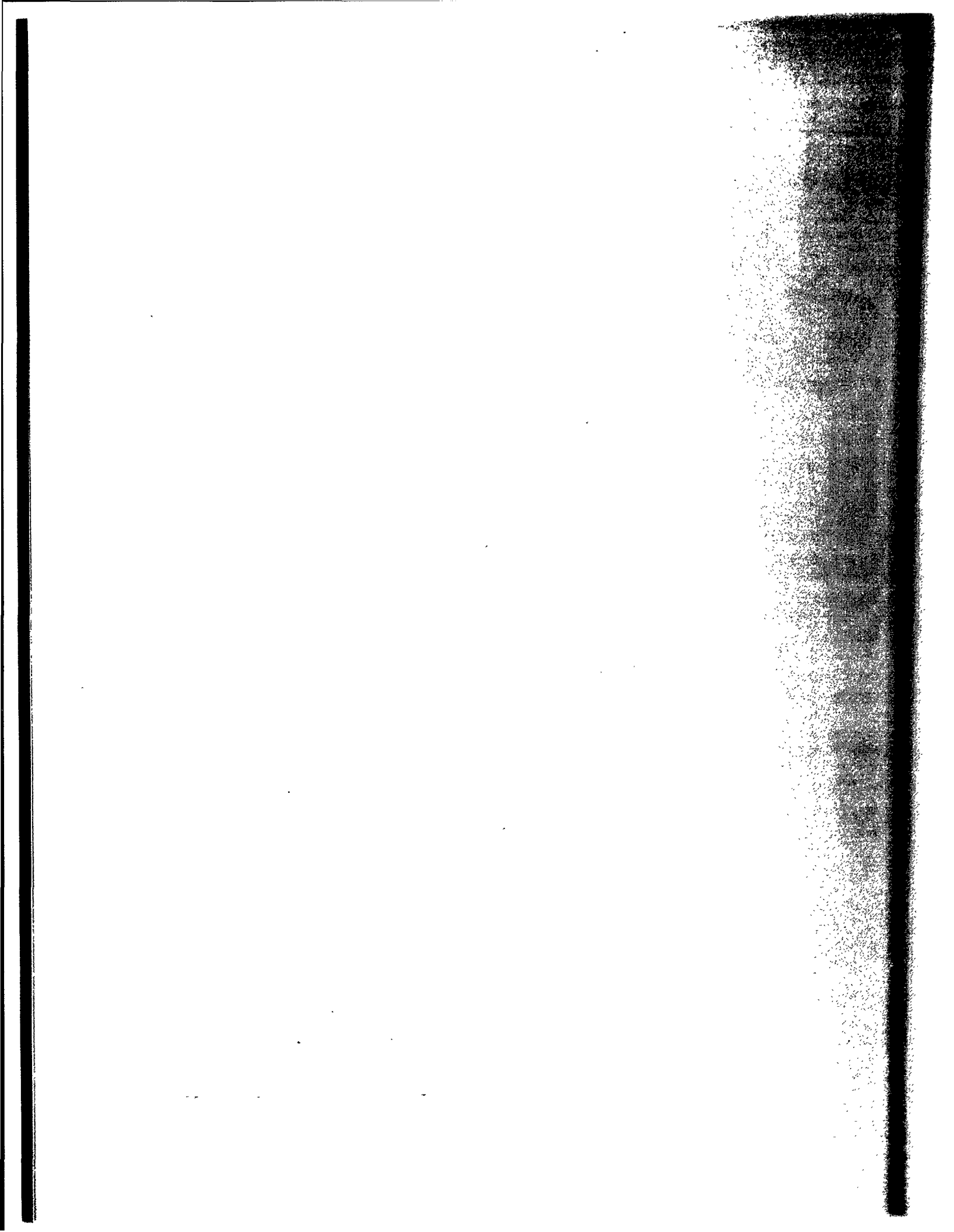
Step 1—Position the starter assembly on the tractor engine.

Step 2—Tighten the two bolts that secure the starter to the engine.

Step 3—Connect the electrical leads.

NOTE: At conclusion of Job 19:

a. Remove the engine lift plate.
b. Check the spark plug gaps and install spark plugs.
c. Install the wiring harness.
d. Install the battery box and air cleaner.
e. Install the tool box.
f. Install the battery and battery box cover.
g. Install the fan.
h. Install the radiator.
i. Install the hood.



Chapter 2
TRANSMISSION

Section

Disassembly 131
Inspection and Repair 132
Assembly 133

The Model 8N Ford tractor is equipped with a four-forward speed, constant-mesh transmission.

131. DISASSEMBLY.

The transmission comprises seven principle subassemblies. These should be removed as follows.

a. Remove Subassemblies. Remove the cover assembly. Remove the top shift rail and plates by loosening the nut on the shift fork and turning out the screw until the shaft is free to slide on the fork. Slide the shift rail out of the rear of the housing. The interlock spring and ball will fall from the top of the housing as the rail is removed. Remove the large shift pivot screws from each outside face of the housing, and remove the shift plates.

Disconnect the clutch release bearing retaining springs, and remove the bearing.

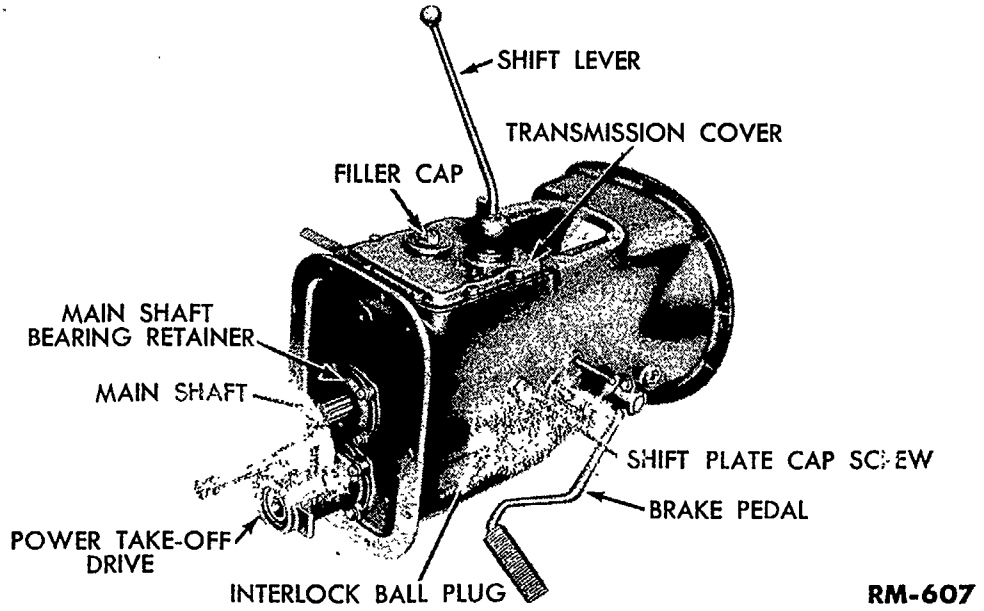


Fig. 9—Transmission

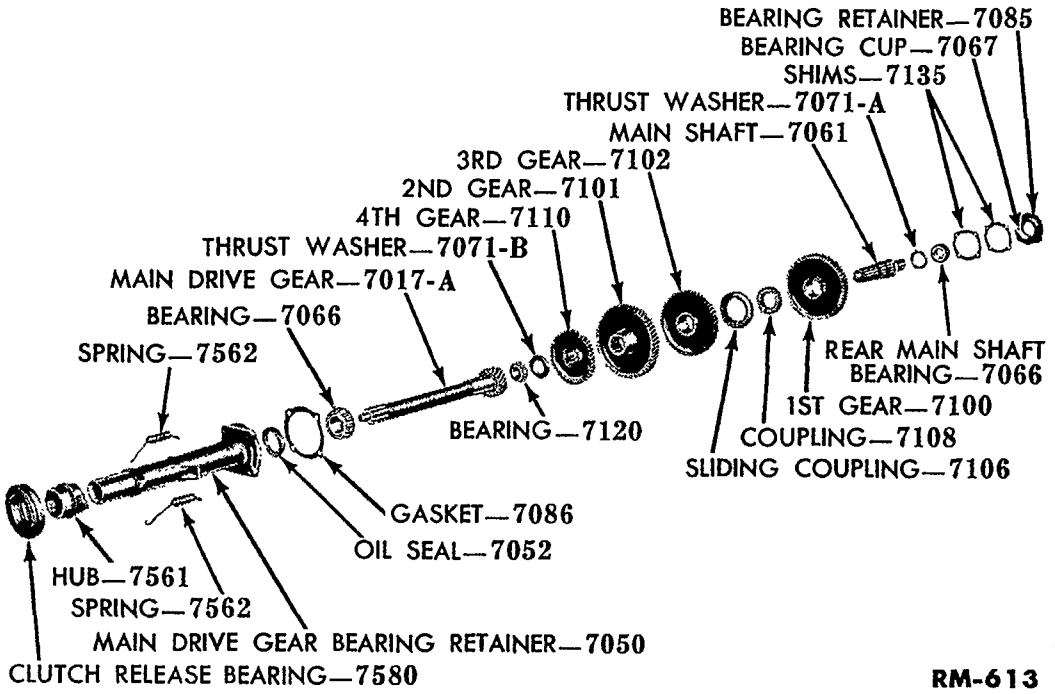


Fig. 11—Main Shaft Assembly, Disassembled

rear end of the transmission. Be sure that the gear teeth are not damaged.

b. Disassemble Subassemblies. The subassemblies of the transmission comprise the main shaft assembly, countershaft assembly, reverse idler assembly, power take-off shift assembly, clutch release bearing assembly, main drive gear bearing retainer assembly, and the transmission housing. Only the first four mentioned will be discussed here, as the disassembly of the remainder is obvious after their removal.

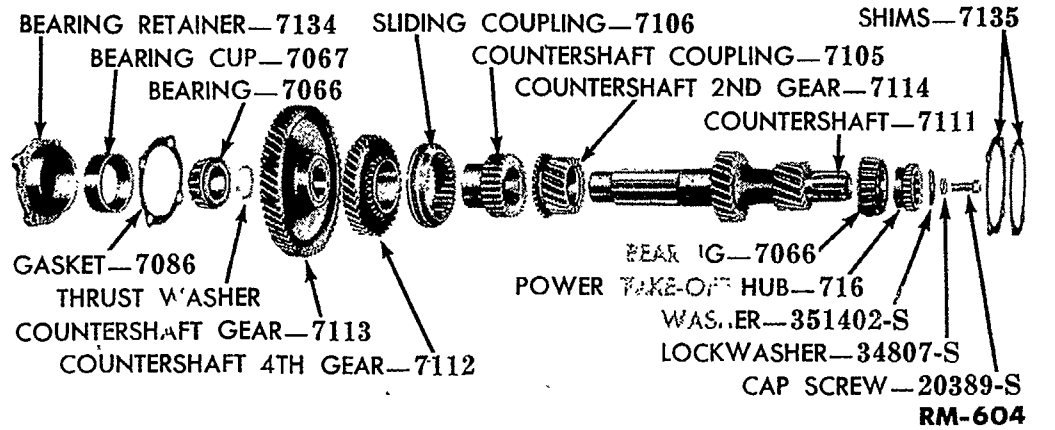


Fig. 12—Countershaft, Disassembled

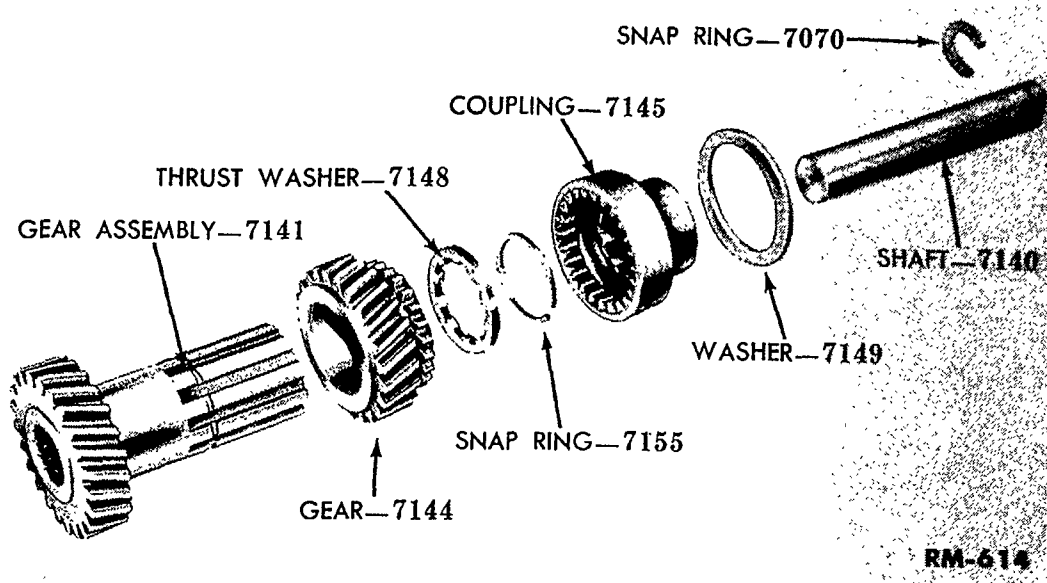


Fig. 13—Reverse Idler Gear, Disassembled

(1) *MAIN SHAFT ASSEMBLY.* Remove the bearing from the forward end of the main shaft (fig. 11). To remove the rear main shaft bearing, install a bearing puller on the 60T gear, and remove the gear, thrust washer, and bearing. Remove the rest of the gears from the shaft. Remove the forward roller bearing and the 20T main drive gear with a bearing puller.

(2) *COUNTERSHAFT ASSEMBLY.* Remove the rear roller bearing (fig. 12) with a bearing puller. Press the countershaft gear

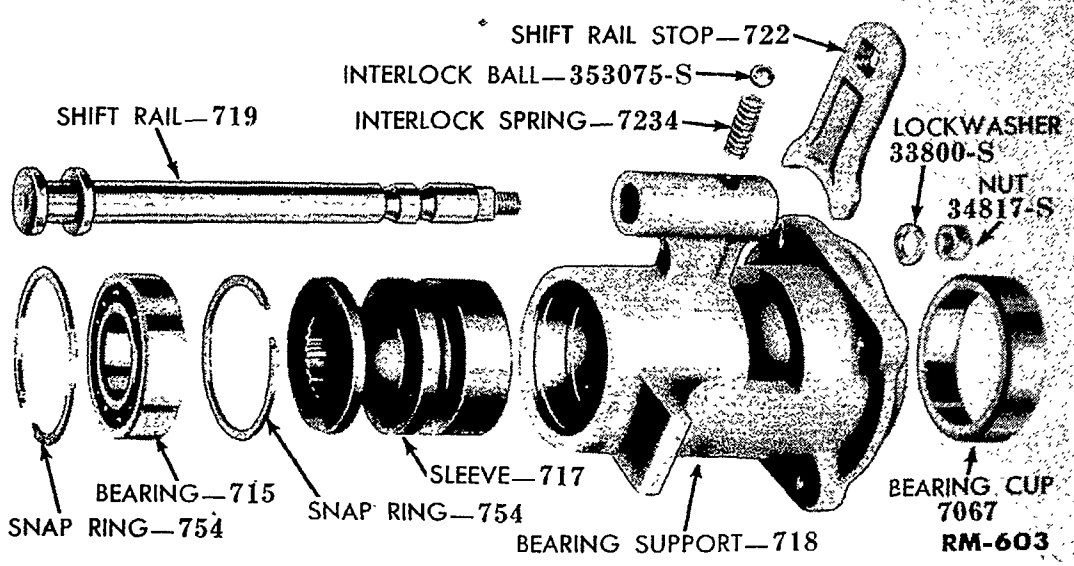


Fig. 14—Power Take-off Shift Assembly, Disassembled

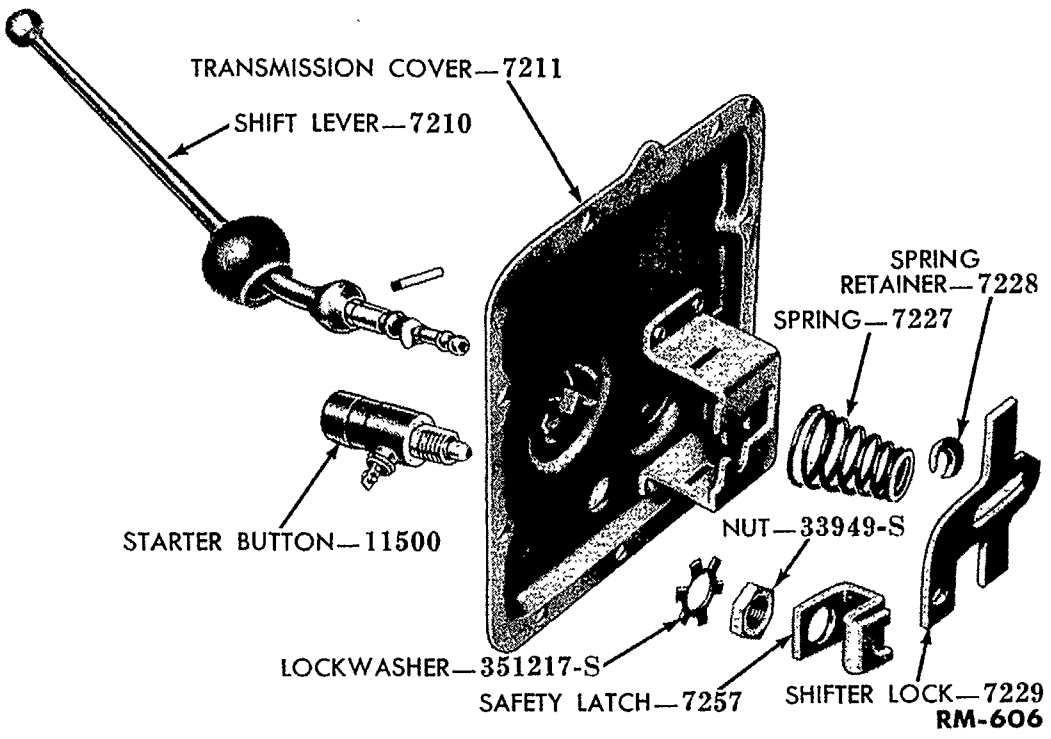


Fig. 15—Transmission Cover, Disassembled

(55T) and roller bearing off the countershaft. Lift the countershaft fourth gear (36T) and sliding coupling from the countershaft (fig. 12). Remove the countershaft coupling from the countershaft with a gear puller or press. Lift the countershaft second gear (18T) from the shaft.

(3) *REVERSE IDLER GEAR ASSEMBLY.* Remove the reverse gear coupling from the reverse idler gear and bushing assembly (fig. 13). Remove the snap ring, thrust washer, and reverse idler gear and bushing assembly.

(4) *POWER TAKE-OFF SHIFTER ASSEMBLY.* Remove the snap ring from the rear of the bearing support (fig. 14). Lift the bearing and clutch sleeve from the bearing support. Remove the nut and lock washer from the shift rail, and remove the shift rail toward the rear, being careful not to lose the interlock ball and spring. Lift out the shift fork.

(5) *TRANSMISSION COVER.* Slide the shift lever rubber boot up on the lever. Remove the starter switch. Compress the gearshift lever spring, and remove the horseshoe-type spring retainer. Pull up on the gearshift lever and, by turning it 90°, lift it out of the assembly. Tilt the safety latch plate and remove it from the guide support (fig. 15). Drive the pin from the gearshift lever, and lift off the lever.

132. INSPECTION AND REPAIR.

Inspection of the transmission must cover the following 9 items.

a. Gears. Replace all gears which have broken or chipped teeth or broken splines. Replace gears that rotate on a shaft and the inside diameter is excessively worn.

b. Shafts. Replace a shaft that has broken or damaged splines or teeth. Replace a shaft if the bearing surface is scored or excessively worn.

c. Bearings. Replace a bearing if it is scored or pitted or if any rollers are missing.

d. Bearing Cups. Replace any bearing cups that are scored or pitted.

e. Thrust Washers. Replace cracked or broken thrust washers.

f. Bearing Retainers. Replace cracked or damaged bearing retainers.

g. Shift Forks. Replace damaged or broken shift forks or one on which the threads are stripped.

h. Shift Lever. Replace a damaged shift lever.

i. Transmission Cover. Replace the transmission cover if it is damaged or if the bracket rivets are loose.

133. ASSEMBLY.

Assembly of the transmission includes the assembly of the sub-assemblies and of the transmission itself. Make sure that all parts are in a serviceable condition before assembly.

a. Main Shaft Assembly. To assemble the main shaft, press the rear thrust washer and bearing on the shaft (fig. 11). Install the first gear (60T) on the shaft with the coupling teeth facing toward the front of the shaft. Install the coupling and sliding coupling on the shaft. Install the third gear (52T) on the shaft with the coupling teeth facing toward the coupling. Install the second (56T) and fourth gears (39T) on the shaft with the long end of the hubs touching each other. Install the thrust washer and bearing on the shaft.

b. Countershaft Assembly. Press the bearing on the rear of the shaft (fig. 12). Install the power take-off hub, flat washer, lock washer, and cap screw. Install the countershaft second gear (18T) on the shaft, with the coupling teeth facing toward the front of the shaft. Press the countershaft coupling on the shaft with the sleeve end facing toward the front of the shaft. Install the sliding coupling. Install the fourth gear (36T) on the coupling sleeve with the coupling teeth on the gear facing towards the rear of the shaft. Press the countershaft gear (55T) on the shaft with the long end of the hub facing towards the rear of the shaft. Press the bearing on the shaft.

c. Reverse Idler Assembly. Install the reverse idler driven gear (23T) on the reverse idler gear (23T) and bushing assembly with the coupling teeth facing the end of the hub (fig. 13). Install the thrust washer and snap ring on the reverse idler gear and bushing assembly. Install the reverse gear coupling on the reverse idler driven gear sleeve with the coupling teeth facing the coupling teeth on the driven gear.

d. Power Take-off Shifter Assembly. Install the snap ring (fig. 14) in the bearing support. Install the clutch sleeve in the bearing support with the large end of the sleeve facing toward the bearing cup end of the bearing support. Install the bearing and snap ring in the bearing support. Install the interlock spring and ball. Depress the interlock ball, then push the shift rail into the bearing support until the threads on the rail are flush with the bearing support. Hold the shift rail stop in position in the bearing support and push the shift rail into the shift rail stop. Install the nut and lock washer on the shift rail.

e. Transmission Cover. If the shift lever has been removed, reinstall it, securing with a lever pin. This pin should be installed with an arbor press or bench vise. Install the safety latch plate. Place spring (7227) in position as shown in fig. 15. Slide the gearshift lever through the spring and safety latch plate and turn it 90 degrees until the pin is properly seated in the slot in the bottom of the cover. Compress the spring and install the spring retainer (7228). Position a new gasket on the starter switch and install the switch in the cover. Place the starter latch support over the threaded end of the switch and secure with a tabbed lockwasher and nut. Turn one of the tabs of the washer against the nut and secure the nut in place.

f. Single Transmission. Before assembling the transmission make sure that all assemblies are clean and dry. Oil is not to be added until after the bearing tension has been adjusted.

Install the reverse idler assembly in the housing with the gears facing toward the front. Hold a spacer washer between the coupling and the housing and install the reverse idler shaft and lock ring. Position the countershaft assembly in the transmission housing with the large gear at the front of the housing. Install the countershaft front bearing retainer and gasket. Hold the countershaft in position and install the power take-off shift assembly together with the shim pack which was previously removed and identified. Install the power take-off shaft in the shift assembly. Measure the torque necessary to turn the power take-off shaft. It should be from 15 to 30 pounds-inches. Add or remove shims as required to obtain this torque reading. Removing

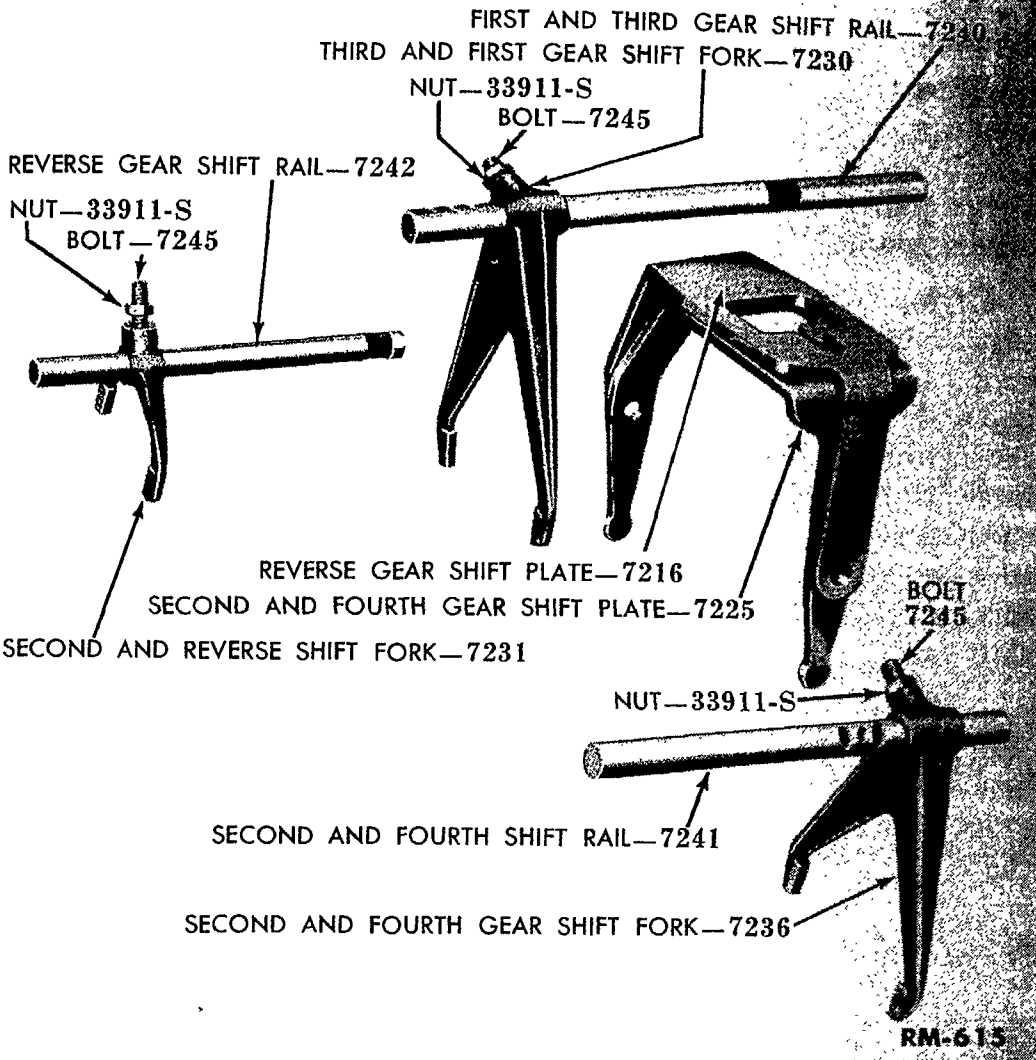


Fig. 16—Shift Rails and Shift Forks

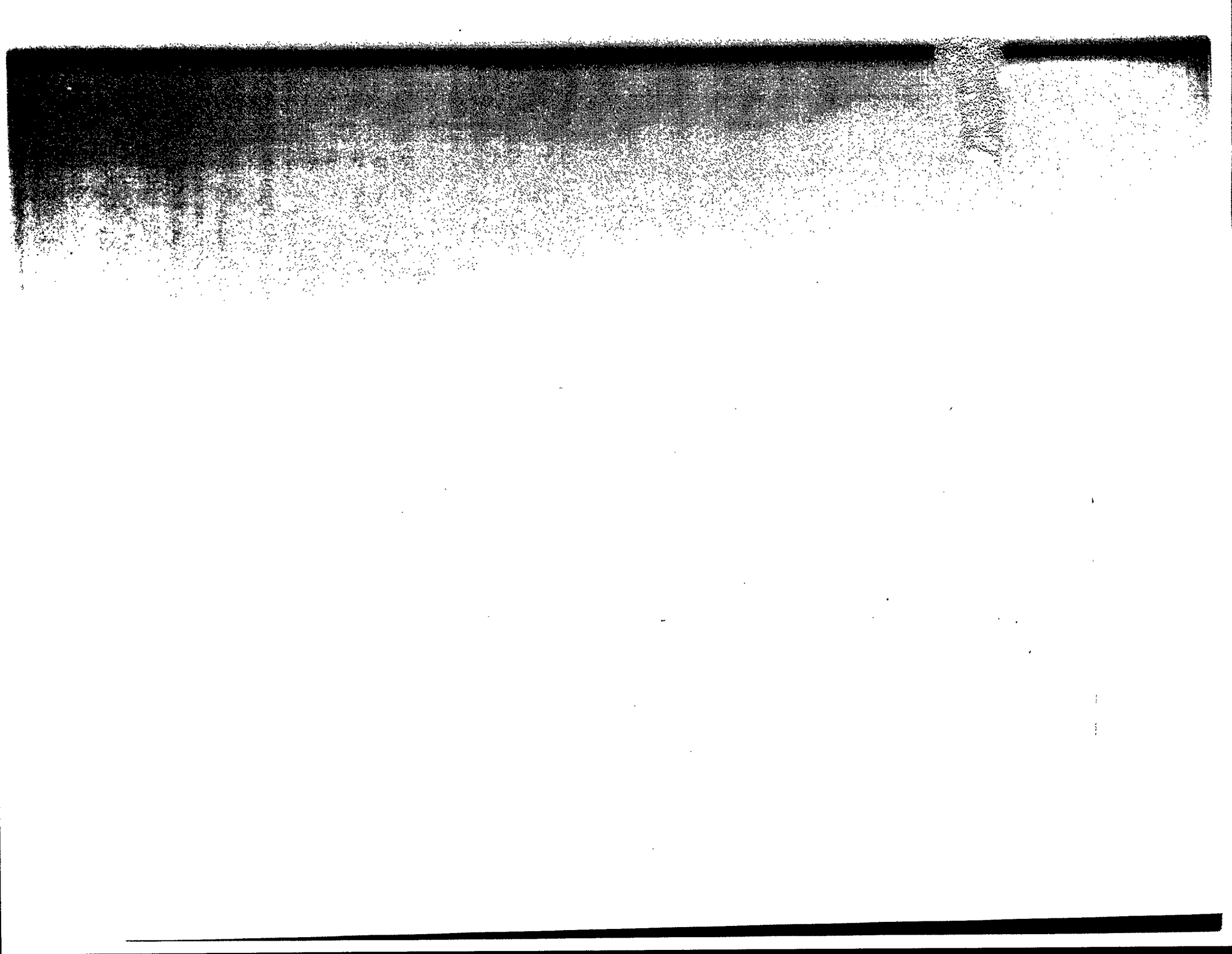
one 0.005 inch shim will increase the torque approximately 10 pounds-inches. Adding a 0.005 inch shim will decrease the torque a like amount.

Install the two lower shift rails and shift forks making sure that the deep square cornered slots face inward on both rails. Install the interlock ball spring and nut on each side of the housing. Install the main shaft assembly being careful not to damage the gear teeth. Install the rear main shaft bearing retainer assembly, using the metal shim pack previously removed and identified. Install the main drive gear bearing retainer assembly and gasket. Position all shift rails and forks in the neutral position and measure the torque required to turn the main shaft. Several turns should be completed so that the bearings will be properly seated. After the shift is turning uniformly, the torque should be from 20 to 35 pounds-inches. Add or remove shims as

required to obtain this torque reading. Removing one 0.005 inch shim will increase the torque approximately 10 pounds-inches. Adding a 0.005 inch shim will decrease the torque a like amount. Main shaft shims can be changed by supporting the rear main shaft bearing retainer over the power take-off shift shaft and sliding the shims in or out.

If it has been necessary to replace any of the transmission gears, a careful check should be made to make sure that all gears mesh properly. Install the power take-off shaft in the power take-off shift assembly. Engage the power take-off shaft with the transmission. Position the transmission in neutral and measure the torque required to turn the power take-off shaft. With the shaft turning uniformly, the torque should be from 30 to 60 pounds-inches. If more than 60 pounds-inches of torque are required to turn the shaft, one or more of the gears are binding at the teeth or on the hub shoulders. Determine which gear is binding and replace it.

Position the shift plates in the housing and install the shift plate cap screws. Install the upper shift fork and shift rail, positioning the deep square corner slot in the rail toward the opening in the shift plates. Install the interlock ball and spring in the hole at the top of the housing. Using a new gasket, install the transmission cover.



Chapter

3

POWER TAKE-OFF

Section

Disassembly 161

Inspection and Repair 162

Assembly 163

161. DISASSEMBLY.

The disassembled power take-off assembly is shown in fig. 48.

a. Power Take-off Adapter. To disassemble the power take-off adapter, remove the three cap screws which secure the shield and bearing cap (fig. 44) to the housing. Remove the shield and bearing cap from the housing. Drive the bearing and shaft assembly out of the housing. Grind the head off the rivet that secures the sleeve to the shaft. Remove the rivet from the shaft and sleeve. Pull the sleeve off the shaft. Remove the oil seal from the housing.

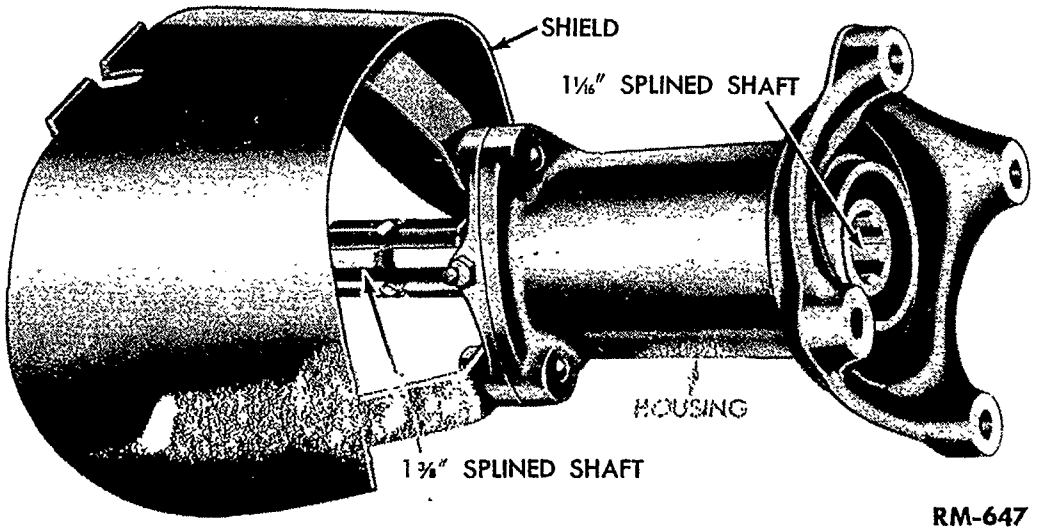


Fig. 44—Power Take-off Adapter

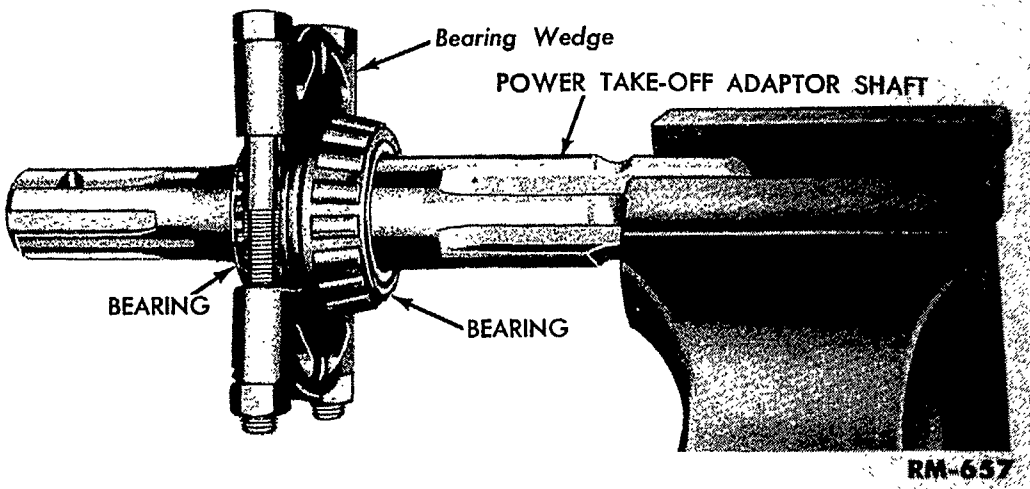


Fig. 45—Separating Power Take-off Adapter Shaft Bearings

b. Power Take-off Shaft. Remove the snap ring from the rear of the bearing. Press the shaft and bearing assembly from the power take-off cover. Press the dust and oil seal out of the power take-off cover (fig. 48).

162. INSPECTION AND REPAIR.

Clean all parts thoroughly in cleaning fluid. Discard all used gaskets and oil seals.

a. Power Take-off Adapter. The adapter assembly comprises the guard, shaft, sleeve, bearing, bearing race, and housing.

(1) *GUARD.* Replace the guard (fig. 47) if it is distorted or bent beyond repair.

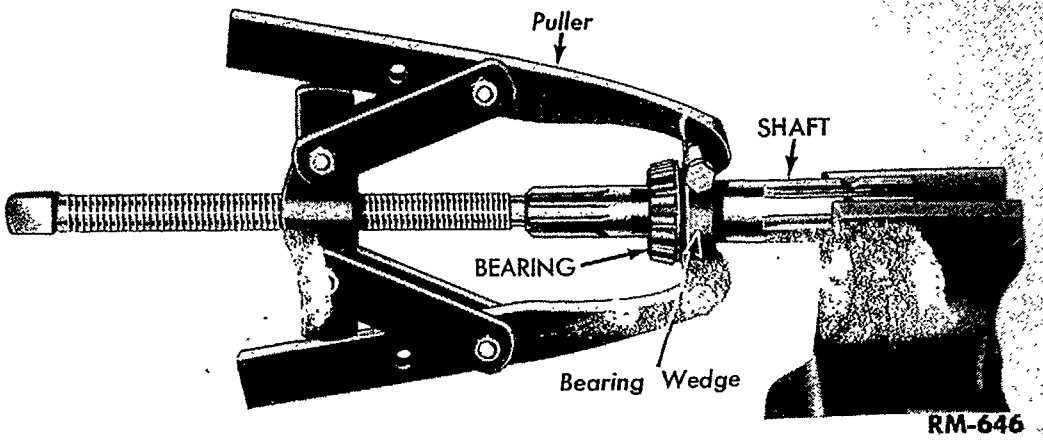


Fig. 46—Removing Power Take-off Adapter Shaft Bearings

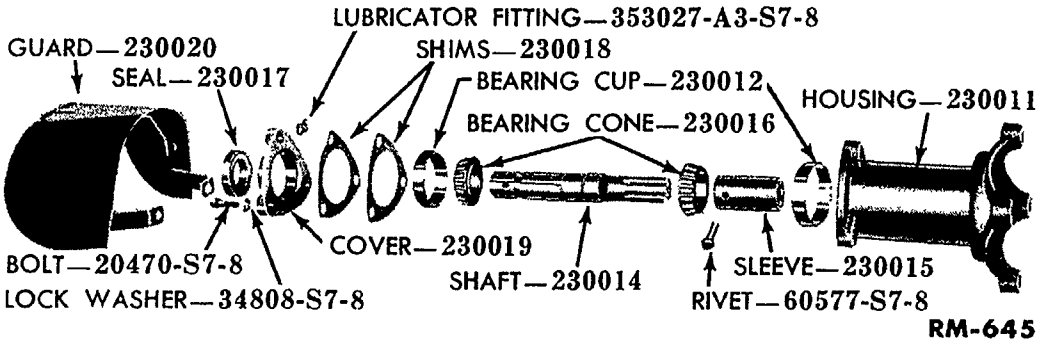


Fig. 47—Power Take-off Adapter, Disassembled

(2) *SHAFT.* Replace the shaft (fig. 47) if it is broken or if the splines are worn or damaged.

(3) *SLEEVE.* Replace the sleeve if the splines are worn or damaged.

(4) *BEARING.* Replace the bearing (fig. 47) if any of the rollers are missing, if they have flat spots, or if the surfaces are pitted or corroded. Separate the bearings with a bearing wedge and remove them with a puller as shown in figs. 45 and 46.

(5) *BEARING RACE.* Replace a bearing race that is scored, worn or pitted.

(6) *HOUSING.* Replace the housing if it is cracked or if the threads are stripped.

b. Power Take-off Shaft. Replace the shaft and bearing assembly (fig. 48) if the splines are damaged, if the bearing is scored, or corroded, if the bearing race is loose, or if the oil and dust seal surfaces are damaged. Always replace the oil seal if it has been removed.

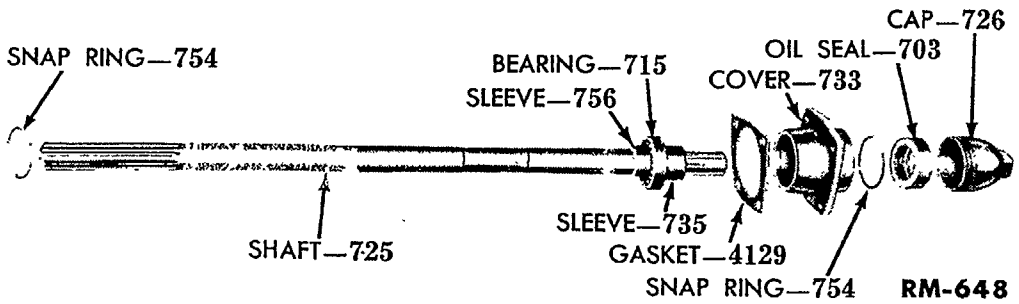


Fig. 48—Power Take-off Shaft, Disassembled

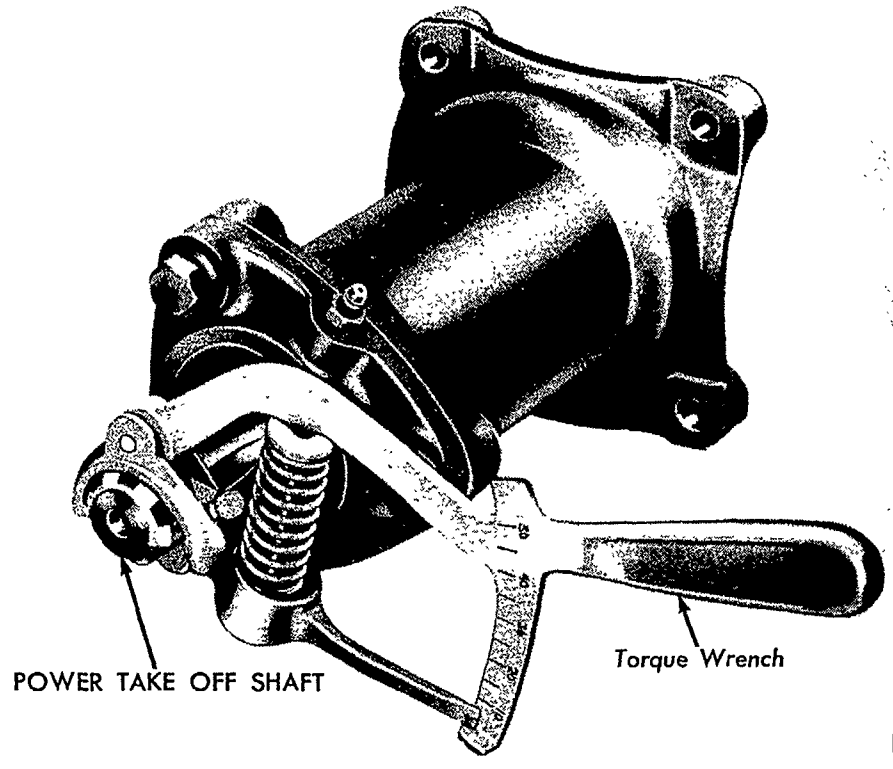


Fig. 49—Checking Bearing Preload

163. ASSEMBLY.

To assemble the power take-off adapter, position the sleeve on the shaft, and secure it to the shaft with a rivet (fig. 47). Install the bearing and shaft assembly in the housing with the sleeve end of the shaft towards the rear of the housing (fig. 47). Press the oil seal (fig. 47) in the bearing retainer. Install the bearing retainer, shims, and guard on the housing. Adjust the preload to 5 to 12 pounds-inches by increasing the shim pack to reduce the preload or by decreasing the shim pack to increase the preload.

To assemble the power take-off shaft assembly, press the oil seal (fig. 48) in the cover. Press the cover assembly onto the shaft and bearing. Install the rear snap ring in the cover. Install the cover cap.

Chapter

4

BELT PULLEY

Section

Disassembly 171

Inspection and Repair 172

Assembly 173

171. DISASSEMBLY.

Remove the filler plug (fig. 50) and allow the oil to drain. Remove the four cap screws that secure the cover to the housing. Remove the cover and gasket. Remove the cotter pin, castellated nut, washer, driven gear, and bearing from the pulley shaft. Tap on the side of the pulley to remove the shaft from the housing. Remove the four cap screws that hold the pulley to the shaft. Remove the pulley. Lift the drive gear and bearing assembly from the housing. Remove both oil seals from the housing.

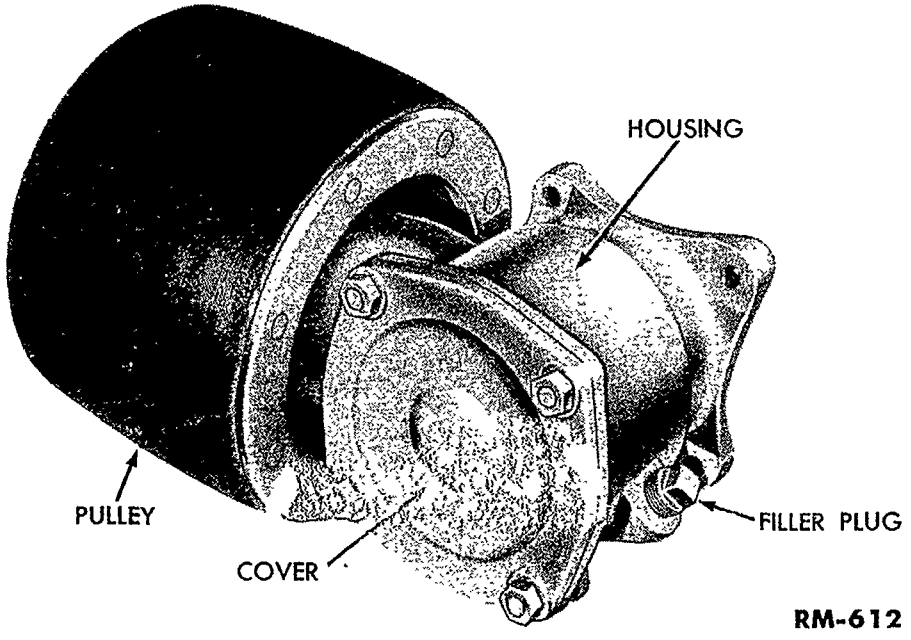


Fig. 50—Belt Pulley

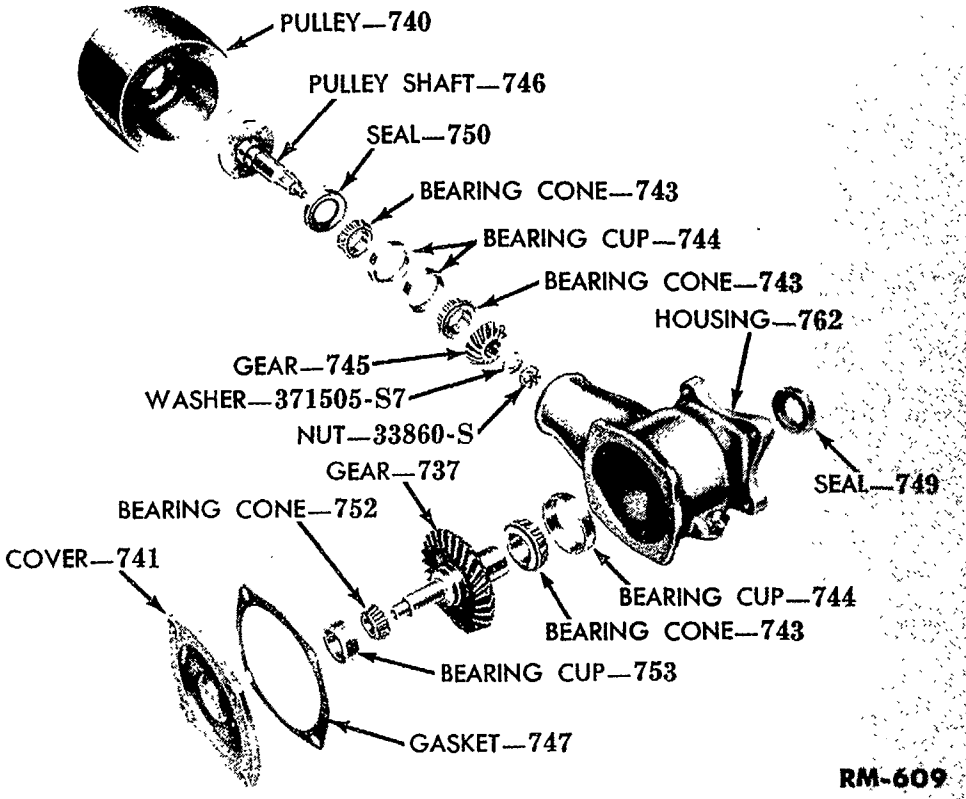


Fig. 51—Belt Pulley, Disassembled

172. INSPECTION AND REPAIR.

Clean all parts thoroughly in cleaning fluid. Discard all used gaskets and oil seals. Inspection must cover the housing, gears, shaft, bearings, and pulley.

a. Housing. Replace the housing (fig. 51) if it is cracked, if the gasket surface is damaged, or if the threads are stripped. Replace a bearing race if it is pitted, corroded, or cracked. To remove a bearing race, drive it out of the housing with a brass drift. To install the race, drive it into the housing with a driver that will apply pressure evenly on all sides of the race.

b. Drive and Driven Gears (Matched). Replace both gears if either gear has broken, chipped, or worn teeth, if the gears are excessively noisy when operating, or if the oil seal surface on the drive gear is damaged.

c. Pulley Shaft. Replace the pulley shaft (fig. 51) if the splines or oil seal surfaces are damaged or if the threads are stripped.

d. Bearings. Replace a bearing (fig. 51) that is pitted, corroded, or if any of the rollers are missing. Remove the bearings with a puller as shown in fig. 52.

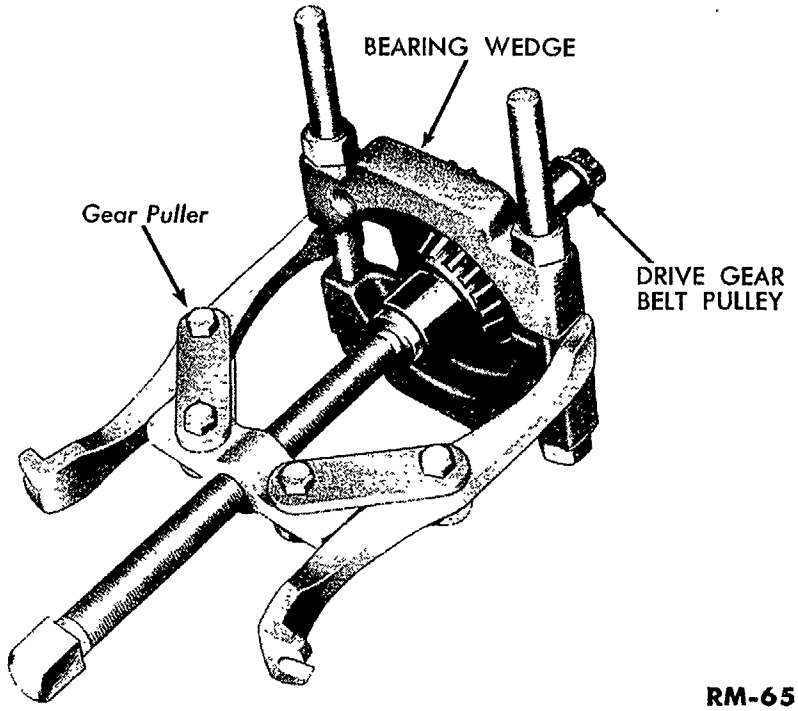


Fig. 52—Removing Bearing from Drive Gear

e. **Pulley.** Replace a pulley (fig. 51) if the belt surface is worn or if it is loose on the hub.

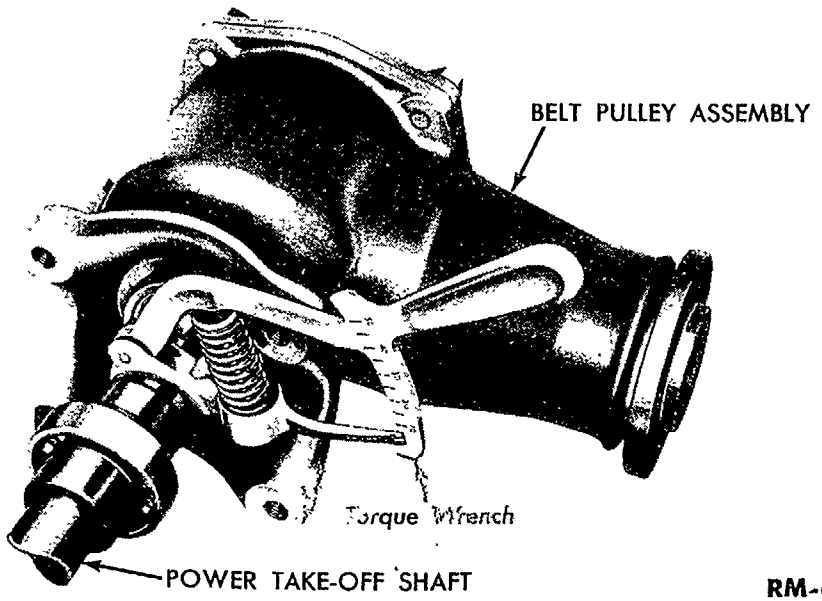


Fig. 53—Checking Driven and Drive Gear Torque

173. ASSEMBLY.

Install new oil seals in the drive shaft and pulley sides of the housing (fig. 51). Make sure the pulley shaft outer bearing inner race is in place before this seal is installed. Install the drive gear and bearing assembly in the housing.

Position the pulley shaft assembly part way in the housing, and install the inner bearing, driven gear, flat washer, and nut on the shaft. Tighten the nut, then tap the pulley shaft into the housing with a rawhide hammer. Repeat this procedure until the pulley shaft requires a torque of 5 to 12 pounds-inches to turn it freely. Install a cotter pin in the nut and shaft. Install a new gasket and position the cover on the housing. Install and tighten the four lock washers and cap screws. Secure the pulley to the pulley shaft with four cap screws and lock washers. Insert the power take-off shaft in the splines. Install a torque indicator on the shaft, and turn the shaft with the indicator. The reading should be 15 to 34 pounds-inches. Gaskets are supplied in thicknesses ranging from 0.012 to 0.023 inch. Install a thicker gasket to decrease the torque reading or a thinner gasket to increase the reading.

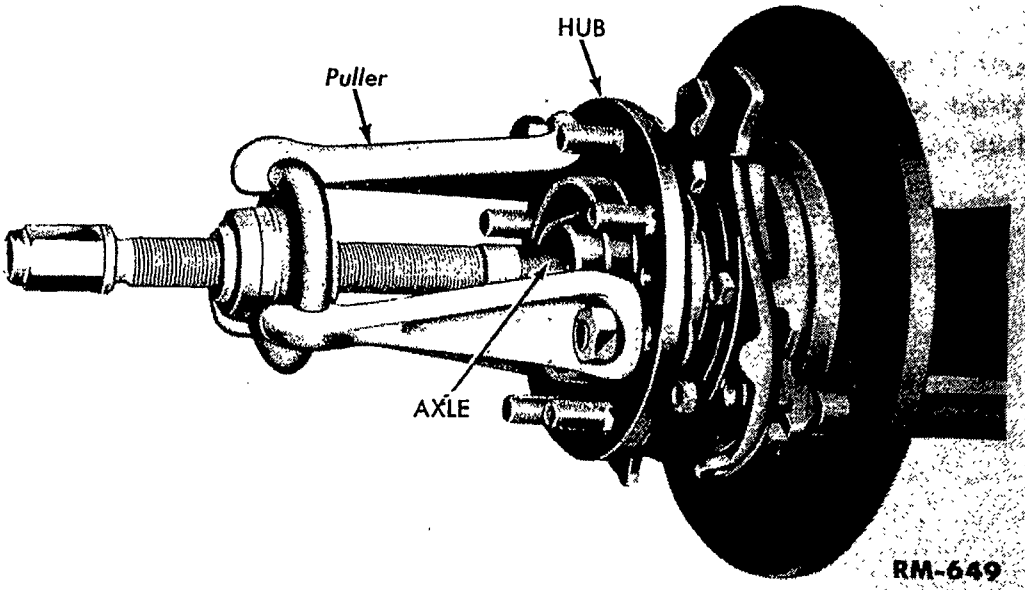


Fig. 33—Removing Hub From Axle

Place the differential assembly on a bench, and remove the lock wire and eight case bolts that secure the differential gear case to the drive gear assembly. Separate the two halves. If necessary, use a brass hammer to tap the two halves apart. Remove the differential spider, together with the differential pinions and thrust washers, from the differential gear case (fig. 35). Remove the differential side gears and thrust washers.

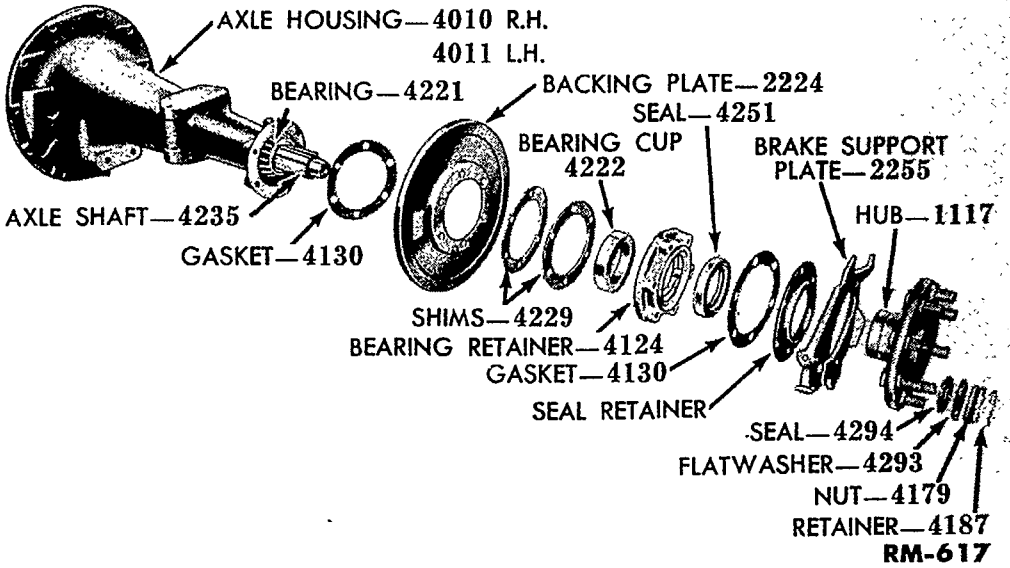


Fig. 34—Backing Plate and Hub, Disassembled

§ 151.

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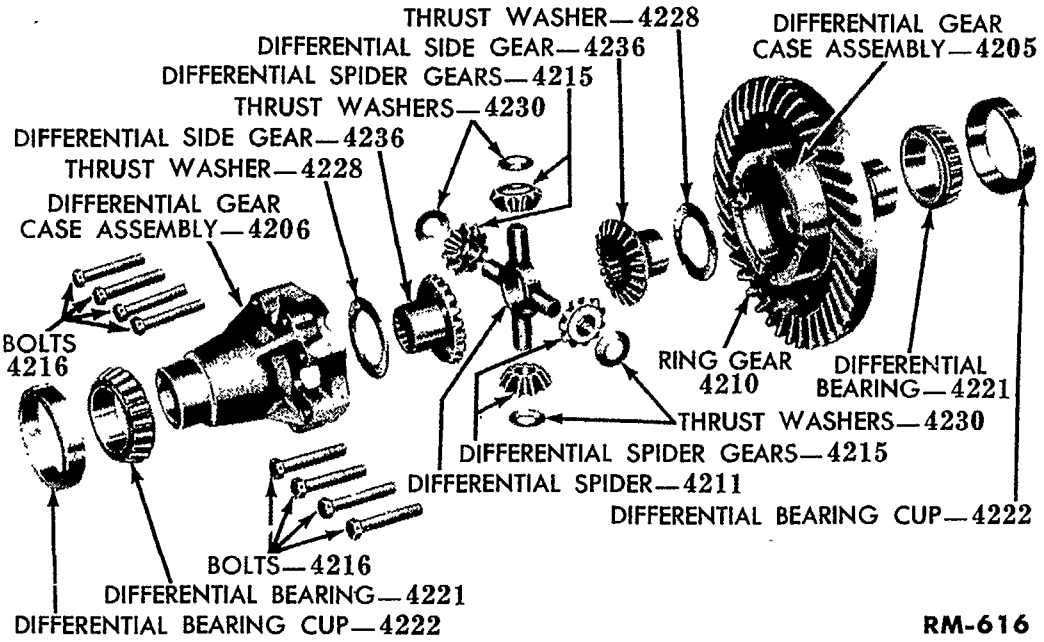


Fig. 35—Differential Assembly, Disassembled

Remove the six cap screws that secure the drive pinion sleeve to the center housing. Install the puller, as shown in fig. 36, and remove the pinion assembly.

Place the pinion assembly in a vise equipped with brass jaws. Bend the ears of the lock washer off the pinion bearing lock nut. Using two thin 2⅛ inch open-end wrenches, remove the pinion sleeve, thrust washer, and roller bearing from the pinion (fig. 42).

152. INSPECTION AND REPAIR.

Clean all parts thoroughly in cleaning fluid, and blow them dry. Discard all used gaskets and oil seals.

a. Axle Housing. Replace the axle housing and the center housing if they are cracked or bent. Replace the differential bearing cups at the inner end of the axle housings if they are pitted, corroded or discolored due to overheating (subpar. (1) below). Replace the thrust block on the left-hand axle housing if it shows wear. Replace the drive pinion pilot bearing in the center housing if the rollers have any flat spots, are discolored due to overheating, are pitted, or if they bind when rotated by hand (subpar. (3) below).

(1) *DIFFERENTIAL BEARING CUP REPLACEMENT.* To remove the differential bearing cups from either the right- or left-hand axle housing, use a puller that hooks behind the bearing cup. To install the bearing cup in either the right- or left-hand axle housing, use a replacer that pulls the bearing cup in place evenly, and draw the cup in flush with the shoulder in the axle housing.

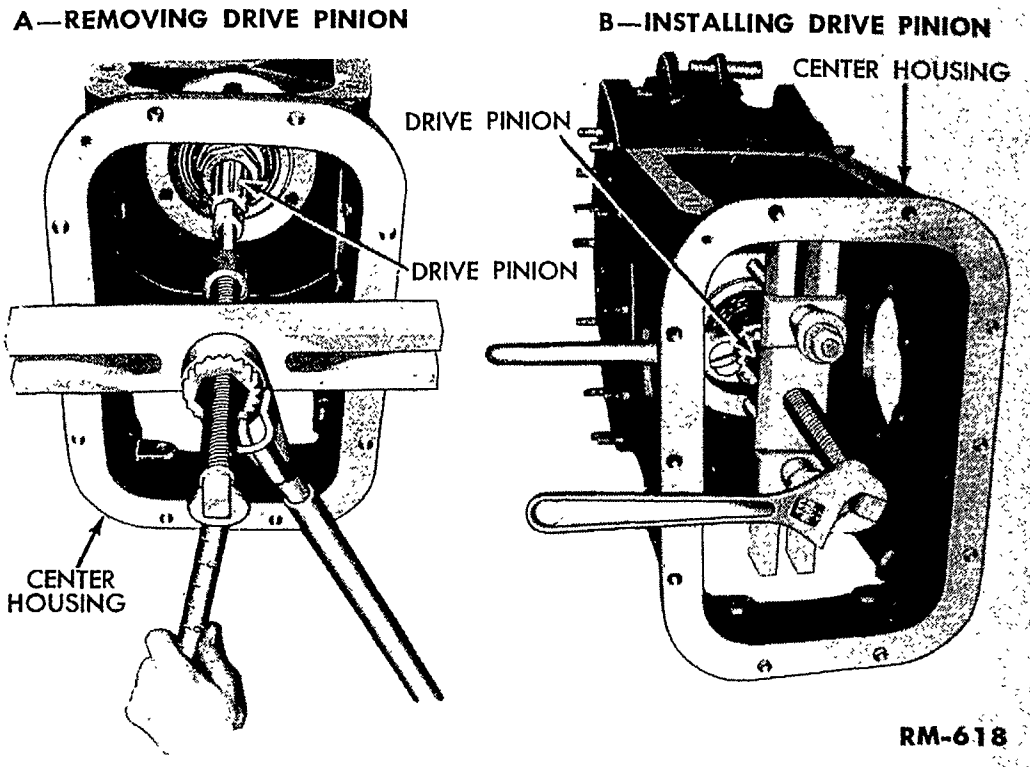


Fig. 36—Removing Drive Pinion Assembly

(2) *THRUST BLOCK REPLACEMENT.* To remove the thrust block, remove the two cap screws which secure the thrust block to the axle housing, and remove the block. To install, position the block in place on the housing, and install the two lock washers and cap screws.

(3) *DRIVE PINION PILOT BEARING REPLACEMENT.* Remove the pilot bearing, using a puller that applies pressure on the bearing outer race (fig. 37). To install a new pilot bearing, place the pilot bearing in position in the housing, and install the bearing, using a tool that applies pressure on the bearing outer race.

b. Differential Assembly. The drive gear assembly (including the differential gear case) and the drive pinion are furnished only in matched sets, and, if either is damaged, both must be replaced. Replace the drive gear assembly if it has chipped or missing teeth, or loose or missing drive gear rivets. Rotate the bearings on the drive gear assembly and the differential gear case by hand. If either bearing binds, has excessively loose races, is pitted, or is discolored due to overheating, replace the bearings (subpar. (1) below).

Replace the differential spider if the diameter is excessively worn at the differential spider gear bearing surfaces. Replace the differential

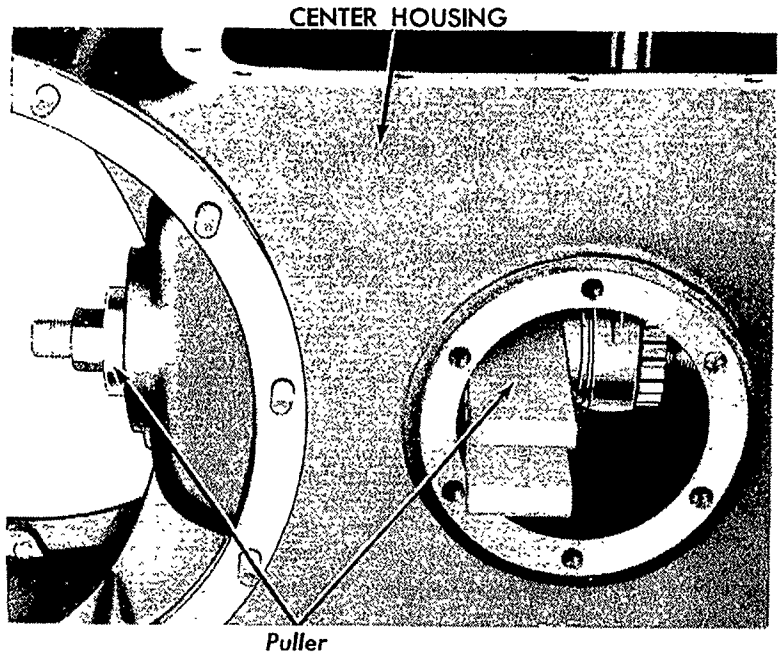


Fig. 37—Removing Drive Pinion Pilot Bearing

spider gears if they have chipped, pitted, or missing teeth, or if the inside diameter is excessively worn. Replace the differential side gears if they have broken, chipped, pitted, or excessively worn teeth or splines.

Insert a new axle shaft in the differential side gear. If the backlash is excessive, replace the differential side gear. Replace the differential spider gear thrust washer if excessively worn.

(1) *DIFFERENTIAL BEARING REPLACEMENT.* Remove the bearing from either the drive gear assembly or the differential case, using a puller that applies pressure to the inner race (fig. 39). To install a new bearing on the drive gear assembly or differential case, place either part in a press and, with a driver that applies pressure to the inner race evenly, press the bearing on the case until it is firmly seated on the shoulder of the case.

c. Drive Pinion Assembly. The drive gear assembly and the pinion gear are furnished only in matched sets, and if either is damaged, both must be replaced. Replace the drive pinion sleeve if it is cracked. Replace the drive pinion bearing cups in the sleeve if they are cracked, pitted, corroded, or discolored due to overheating (subpar. (1) below). Replace the drive pinion if the gear has chipped, pitted, or missing teeth, or if the shaft has damaged threads or splines. Replace the pilot bearing inner race at the end of the drive

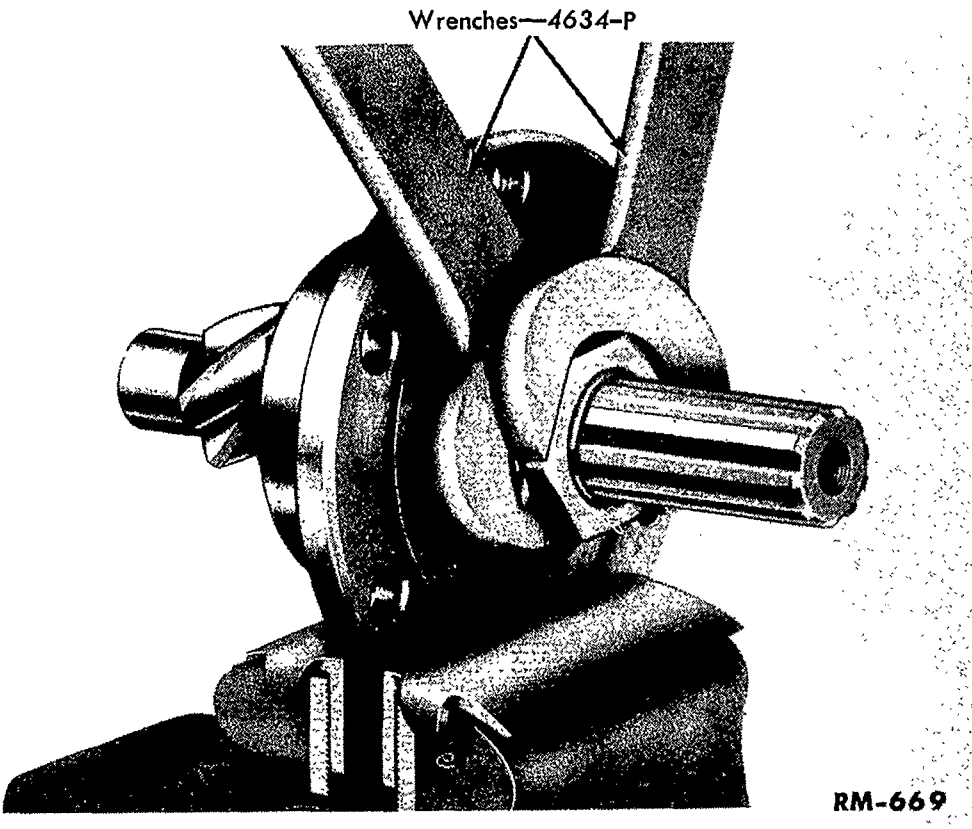


Fig. 38—Installing Drive Pinion Assembly

pinion if it is badly scored (subpar. (3) below). Rotate the bearing on the drive pinion by hand. If it binds, has excessively loose races or is discolored due to overheating, the bearing must be replaced (subpar. (2) below).

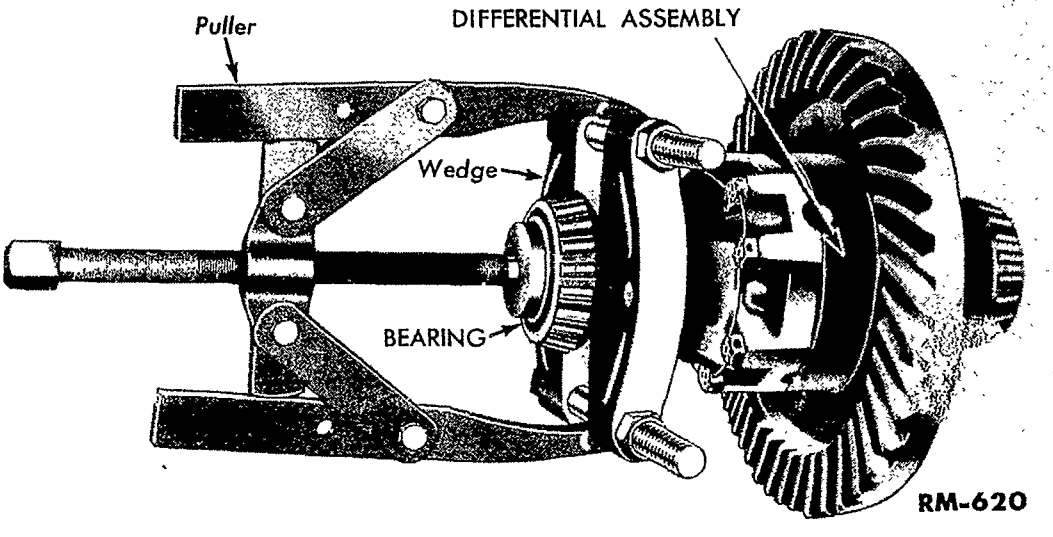


Fig. 39—Removing Differential Bearing

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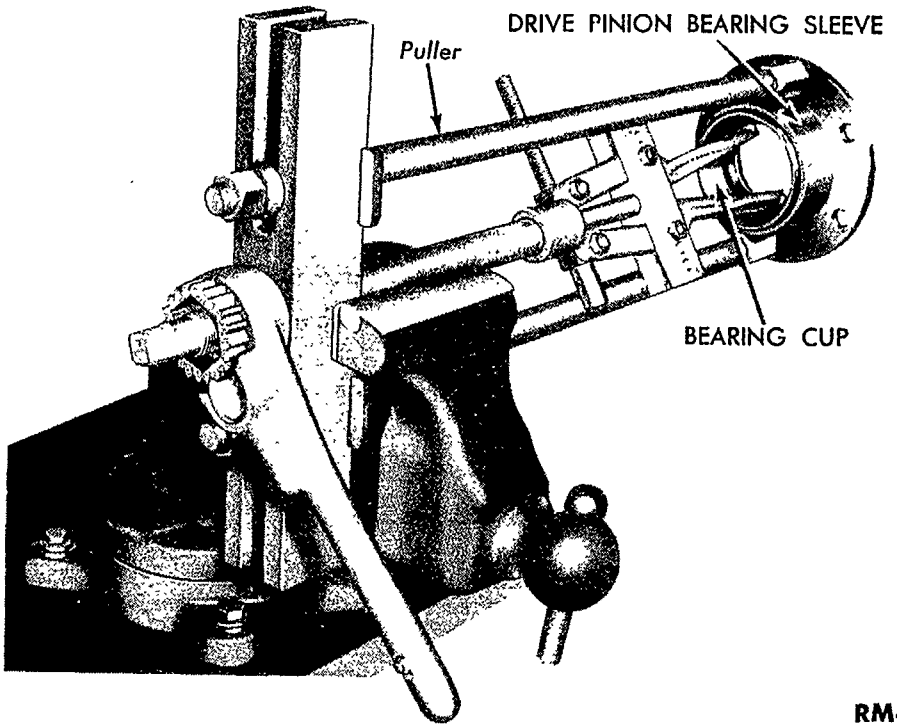


Fig. 40—Removing Drive Pinion Bearing Outer Race

(1) *DRIVE PINION BEARING CUP REPLACEMENT.* Place the drive pinion sleeve in a vise and, using a puller that hooks behind the bearing cup, pull the bearing cup (fig. 40). Repeat this operation to remove the other cup. To install new bearing cups, place the pinion sleeve in a vise. Place the cups in position on the pinion sleeve and, using a replacer that contacts the bearing cups evenly, draw the cups in the sleeve until they are seated flush with the shoulder in the sleeve.

(2) *DRIVE PINION BEARING REPLACEMENT.* Remove the bearing from the pinion, using a puller that applies pressure to the inner race. Install a new bearing, using a puller that applies pressure to the inner race of the bearing.

(3) *DRIVE PINION PILOT BEARING INNER RACE REPLACEMENT.* Remove the lock ring, using a sharp punch. Place the drive pinion so that the race rests on a solid base and, with a two-pound hammer, strike repeated blows along the race surface. This will cause the race to expand slightly. Drive a sharp chisel between the rear edge of the race and the pinion shoulder to start the race. Drive the race off the pinion, using a heavy punch. To install a new race, place it on the pinion with the chamfered side facing the pinion. Press the race on the pinion until it is against the shoulder of the pinion. Install the lock ring.

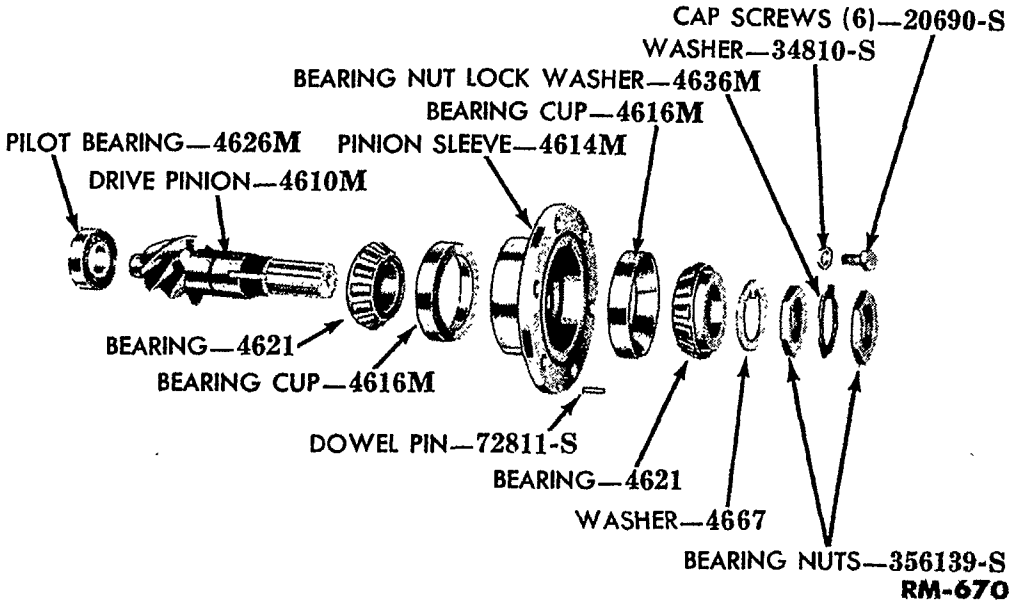


Fig. 41—Drive Pinion Assembly, Disassembled

d. Axle Shaft. Replace the axle shaft (fig. 36) if the splines or threads are damaged. Replace the axle shaft bearing (subpar. (1) below) if the rollers have flat spots or if any rollers are missing.

(1) *AXLE SHAFT BEARING REPLACEMENT.* Remove the axle shaft bearing with a puller that applies pressure on the inner race (fig. 42). To install the bearing, press it on the shaft, making sure all pressure is applied to the inner race (fig. 43).

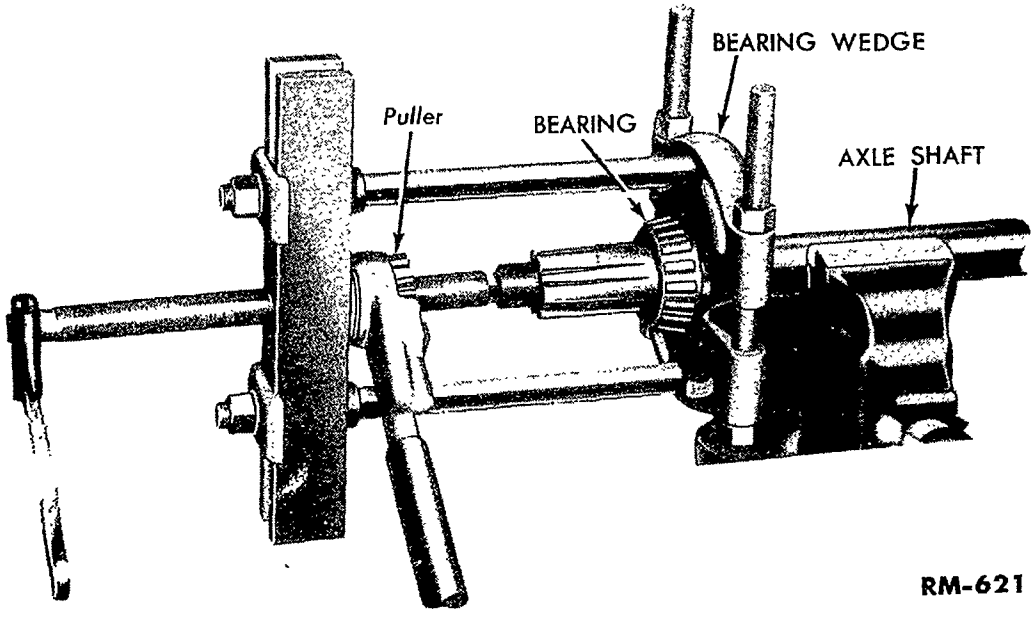


Fig. 42—Removing Axle Shaft Bearing

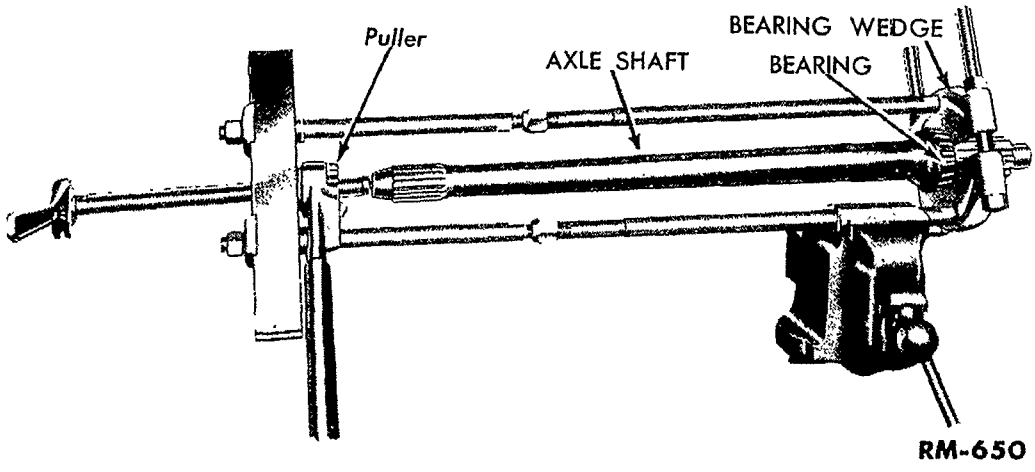


Fig. 43—Installing Axle Shaft Bearing

e. Axle Shaft Bearing Retainer. Replace the bearing race (subpar. (1) below) if it is scored or pitted. Discard all used gaskets and oil seals.

(1) *REAR AXLE OIL SEAL AND BEARING RACE REPLACEMENT.* To remove the rear axle oil seal or bearing race, drive it out of the retainer with a brass drift. To install, drive it into the retainer with a driver that applies pressure evenly on the race or oil seal.

153. ASSEMBLY.

Place the drive pinion sleeve in a vise equipped with brass jaws. Be sure that the bearings are thoroughly clean and that they have not been lubricated. The lubricant should not be applied to the bearings until after the bearing tension has been adjusted. Slide the drive pinion and bearing in the sleeve. Place the other bearing and the thrust washer on the pinion. Install the bearing adjusting nut and tighten the nut, using two 2⅛-inch thin, open end wrenches, until a torque of 12 to 16 pounds-inches is required to turn the pinion. After the correct adjustment is obtained, hold the adjusting nut with the wrench, and install the lock washer and lock nut. Tighten the lock nut while holding the adjusting nut stationary. Re-check the torque. Bend the tabs of the lock washer over both the lock nut and the adjusting nut.

Be sure that the drive pinion surface on the center housing has no nicks or high spots. Place the drive pinion assembly in position on the center housing. Line up the dowel pin in the sleeve of the pinion with the hole in the housing. Install the pinion assembly by applying pressure to the drive pinion shaft (fig. 38). Install the six cap screws

that secure the pinion to the housing. Place the thrust washer and differential side gear in the drive gear assembly.

Install the four differential spider pinion gears and thrust washers on the differential spider and place the spider, including the gears, in position on the drive gear assembly. Install the thrust washer and differential side gear in the differential gear case. Line up the matching numbers on the drive gear assembly and differential gear case so that the numbers are directly opposite each other. Place the two assemblies together. Install the eight bolts that secure the two assemblies together and tighten them evenly. Lock the eight bolts with locking wire.

Be sure that the differential side bearings are thoroughly clean, and apply a thin coating of grease on the bearings. Place a new gasket on the right-hand side of the center housing. Position the right-hand axle housing on the center housing. Install and tighten the nuts. Position the differential assembly in the center housing with the flat side of the drive gear facing the left-hand axle housing. Place a new gasket on the center housing. Position the axle housing on the center housing. Install and tighten the nuts.

Install the axle shafts in the housings. Install the gaskets and the oil seal retainers on the bearing retainers. Secure the brake shoe brackets to the bearing retainers with two cap screws in each bracket. Coat each axle housing flange with a light film of grease. Position the gaskets on the axle housings.

Remove several of the shims of the shim pack previously used on the bearing retainer, and place the remainder of the pack between the brake plate and the bearing retainer. Hold the brake cross shaft in position, and install the brake plate and bearing retainer assembly on the axle housing. Rotation of one axle shaft should now cause the other shaft to rotate in the same direction. If it does not, more shims must be removed.

Increase the shim pack thickness in steps of approximately 0.005 inch. It may be necessary to exchange thick shims for thin ones, or vice versa, to produce the required addition. The shim thickness must be increased until the rotation of one shaft causes the other to rotate in the opposite direction. By following this procedure, the amount of end play in the axles will be held to the desired limits (0.002 to 0.004 inch).

Install the hubs, seals, flat washers, nuts, and lock rings.

Chapter

6

HYDRAULIC SYSTEM

Section

Hydraulic Unit 141

Hydraulic Pump 142

Hydraulic System Adjustments 143

141. HYDRAULIC UNIT.

This section gives instructions for the disassembly, inspection and repair, and assembly of the hydraulic unit.

a. Disassembly. The hydraulic unit may be disassembled by subassemblies.

(1) *REMOVE RAM CYLINDER.* To remove the hydraulic ram cylinder, it is necessary to remove the four bolts that mount it on the hydraulic unit cover (fig. 17). Lift the ram cylinder off the assembly. If desired, the piston rod may be removed by disconnecting it from the ram arm.

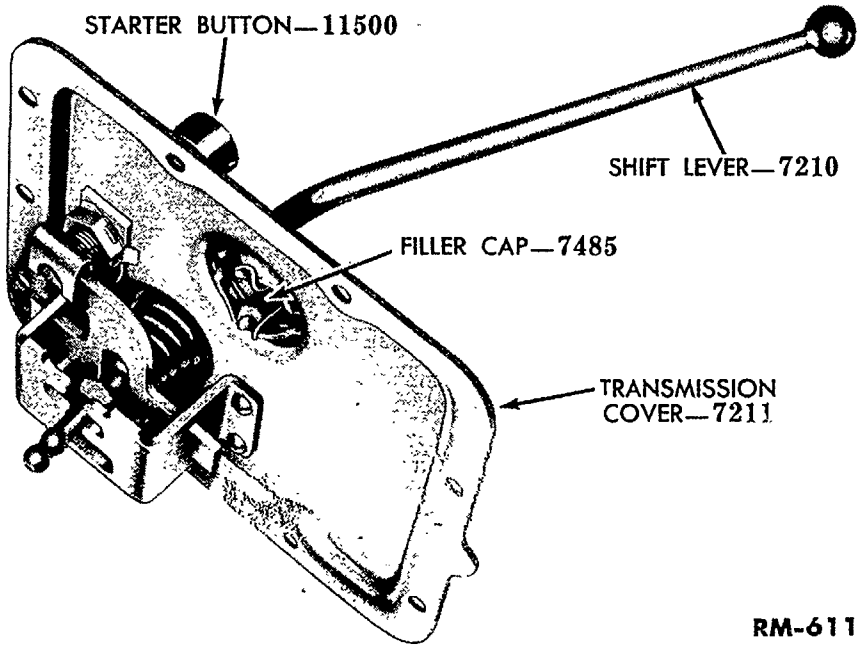


Fig. 17—Hydraulic Unit Assembly

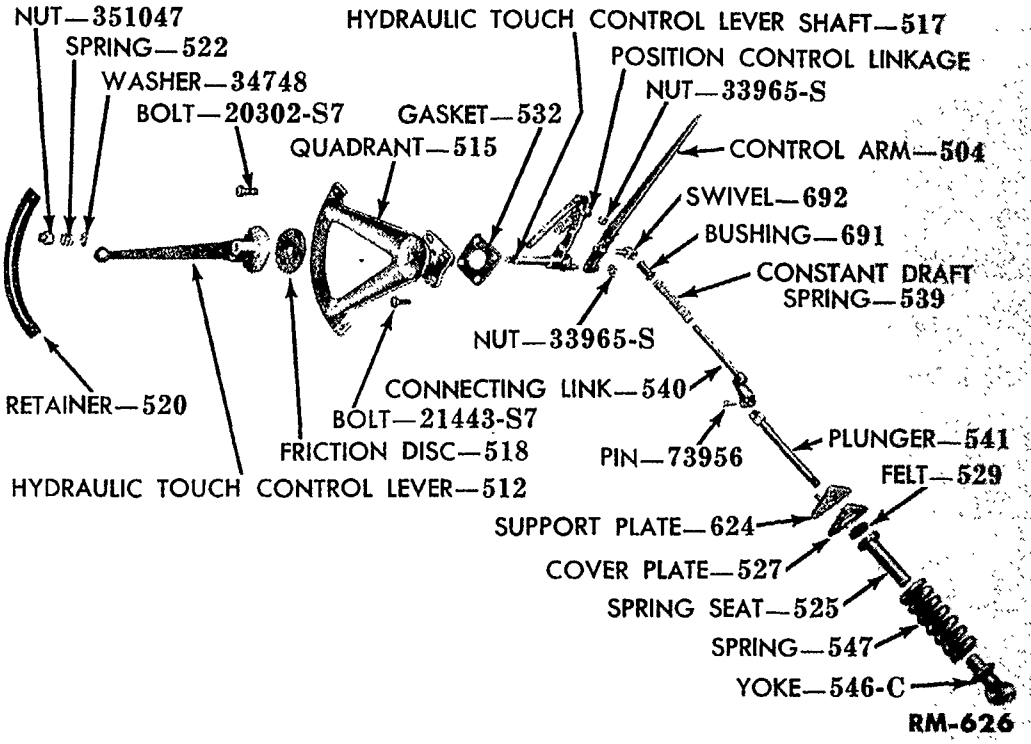


Fig. 18—Hydraulic Control Linkage

(2) *REMOVE CONTROL LINKAGE.* Remove the hydraulic touch control lever retainer (fig. 18) from the quadrant. Remove the nut, spring and flat washer that secure the hydraulic touch control lever shaft. Remove the hydraulic touch control lever, woodruff key, and the friction disk from the shaft.

Remove the cotter pin that attaches the linkage which secures the position control lever to the position control linkage (figs. 17 and 18). Remove the control arm, draft control linkage, and position control linkage.

(3) *REMOVE LIFT ARMS AND SHAFT.* Remove the two cap screws, lock washer, and the flat washer from each arm. Remove the lift arms from the shaft. Remove the shaft from the hydraulic unit cover. Remove the ram arm and the remaining bushing from the hydraulic unit cover (fig. 19).

b. Inspection and Repair. Clean all parts thoroughly in cleaning fluid. Scrape off any incrustated deposits on the cover or parts. It is very important that any foreign matter that might get into the oil be removed.

(1) *COVER.* Replace the cover if it is cracked or damaged in any way.

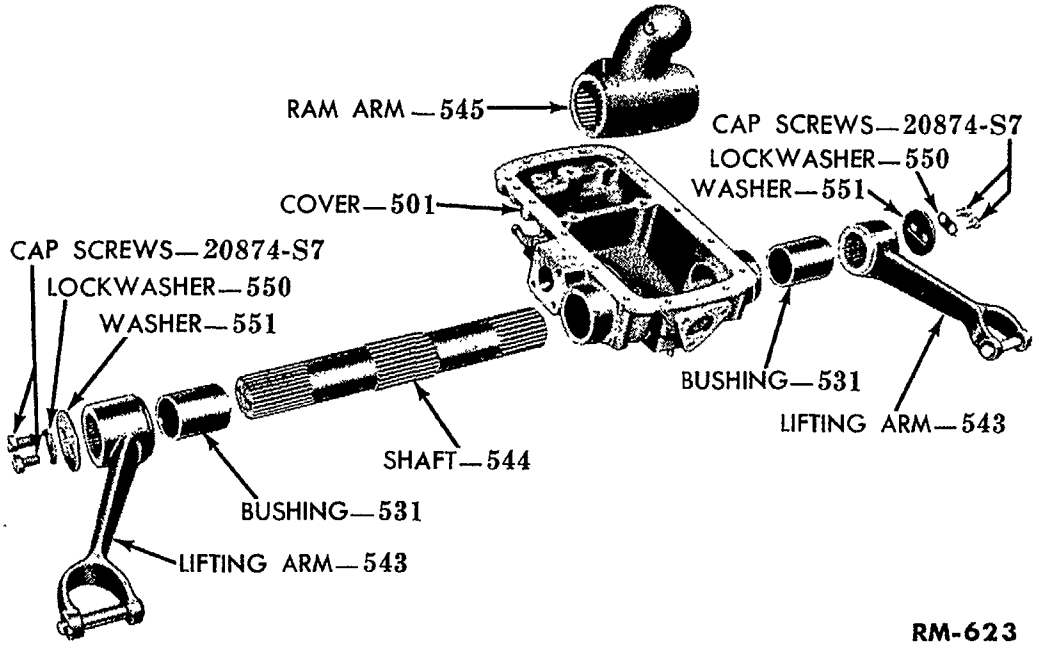


Fig. 19—Hydraulic Cover and Lift Arms, Disassembled

(2) *BUSHINGS.* Replace the lifting arm shaft bushings if they are scored, pitted, or if the inside diameter is excessively worn.

(3) *LIFTING ARM SHAFT.* Replace the lifting arm shaft if it is damaged or if the bearing surface is excessively worn.

(4) *LINKAGE.* Replace any linkage that is twisted, bent, or damaged in any way.

(5) *RAM CYLINDER AND PISTON.* Replace the ram cylinder (fig. 20) if it is scored or if the bore is excessively worn. Replace the piston rings when the cylinder is disassembled. Replace the piston if it is scored or cracked.

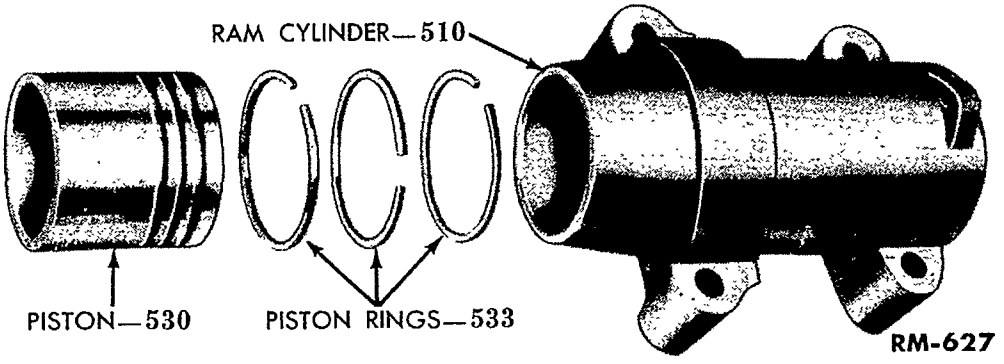


Fig. 20—Ram Cylinder, Disassembled

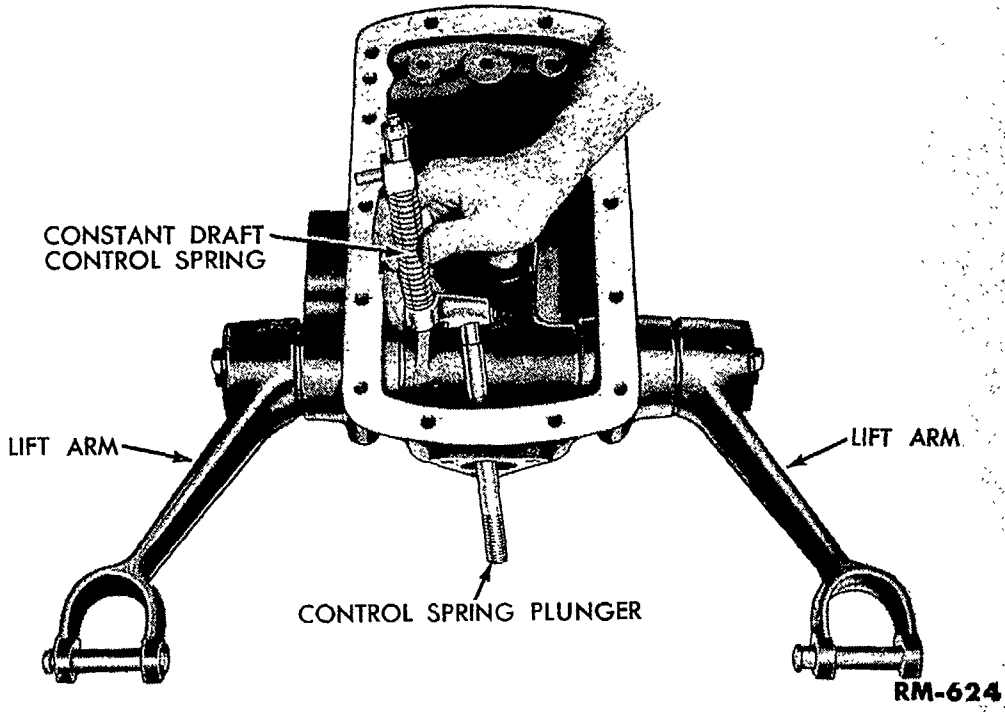


Fig. 21—Install Constant Draft Control Linkage

c. Assembly. The hydraulic unit may be assembled by subassemblies. The sequence of assembling subassemblies onto the hydraulic unit cover may be changed from that given below.

(1) *ASSEMBLE LIFT ARMS AND SHAFT.* Hold the ram arm in place in the hydraulic unit cover, and install the shaft. Install the two bushings (fig. 20) on the shaft. Install the two lift arms on the shaft, and secure each arm to the shaft with a flat washer, lock washer, and two cap screws. The lift arms should be tightened enough to prevent end play of the shaft. The lift arms should not bind to the extent that they will not settle under their own weight.

(2) *ASSEMBLE CONTROL LINKAGE.* Install the draft control linkage as shown in fig. 21. Place the position control linkage on the hydraulic touch control lever shaft, and insert this assembly in the hydraulic unit cover. Install the control arm on the draft control linkage and the hydraulic touch control lever shaft. Secure the control arm in place with a castellated nut and cotter pin.

Position the three-cornered plate with the pin at the top on the hydraulic unit cover and secure with three cap screws. Install a new felt washer in the control spring seat. Install the control spring seat, control spring, and yoke (fig. 18). Mount the quadrant, using a new gasket, on the hydraulic unit cover. Install a new friction disk and

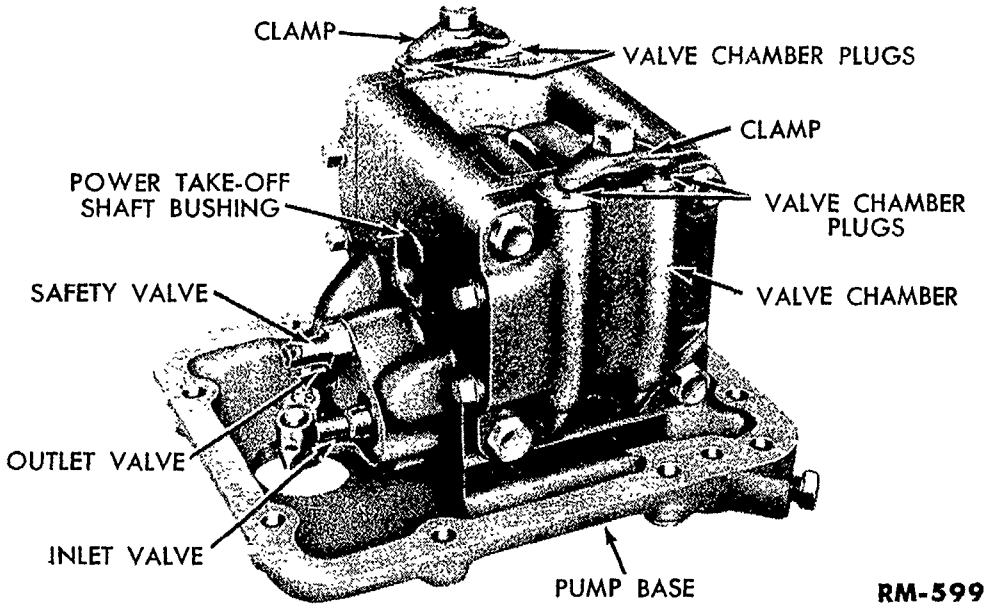


Fig. 22—Hydraulic Pump

woodruff key on the hydraulic touch control lever shaft. Install the hydraulic touch control lever on the shaft making sure that it slides freely on the woodruff key, and secure it in place with a flat washer, spring, and nut. If the woodruff key fits too tightly in the touch control lever and therefore cannot slide freely, the spring which maintains a constant pressure on the friction disk will be ineffective. Install the hydraulic touch control lever retainer. Connect the position control lever to the position control linkage.

(3) *ASSEMBLE RAM CYLINDER AND PISTON.* Assemble the rings onto the ram cylinder piston and equally space the ring gaps around the piston. Install the piston in the ram cylinder. Using new gaskets (three required) bolt the ram cylinder to the hydraulic unit cover. Install the piston rod.

142. HYDRAULIC PUMP.

The disassembled hydraulic pump is shown in fig. 22.

a. Disassembly. Remove the safety valve and check valve. Remove the cotter pin which secures the valve control lever to the base. Remove the cotter pin and clevis pin which secure the exhaust valve to the control lever. Remove the control lever. Remove the four cap screws which secure each valve chamber cover (fig. 22) to the base. With a soft hammer, tap the valve chambers off the base. Lift the cam and piston assembly out of the base. Remove the power take-off shaft bushing (figs. 22 and 26) from the base. Remove the

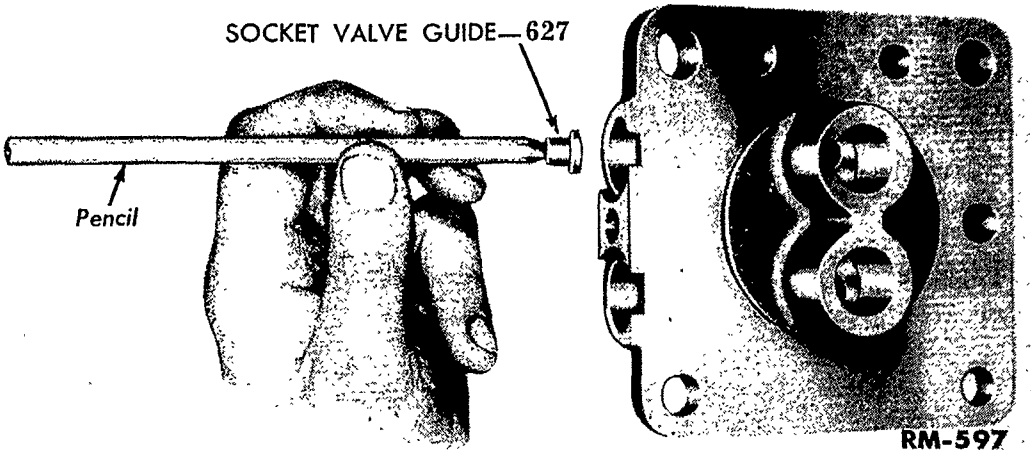


Fig. 23—Removing Valve Guide Seats

clamp from each valve chamber cover. Remove the two spring seats, outlet valve springs, outlet valves, inlet valve springs, inlet valves, valve guides, and valve guide seats from each valve chamber (fig. 27). Remove the two valve guide seats from each valve chamber cover with a pencil as shown in fig. 23.

b. Inspection and Repair. Clean all parts thoroughly in a cleaning solvent and blow dry with compressed air. Scrape gasket surfaces until all pieces of old gasket are removed.

(1) *SAFETY VALVE.* Replace the safety valve (fig. 24) if the check valve surface is ridged, if the ball is worn or damaged, or if the safety valve spring has taken a permanent set as shown by inability to hold the required pressure.

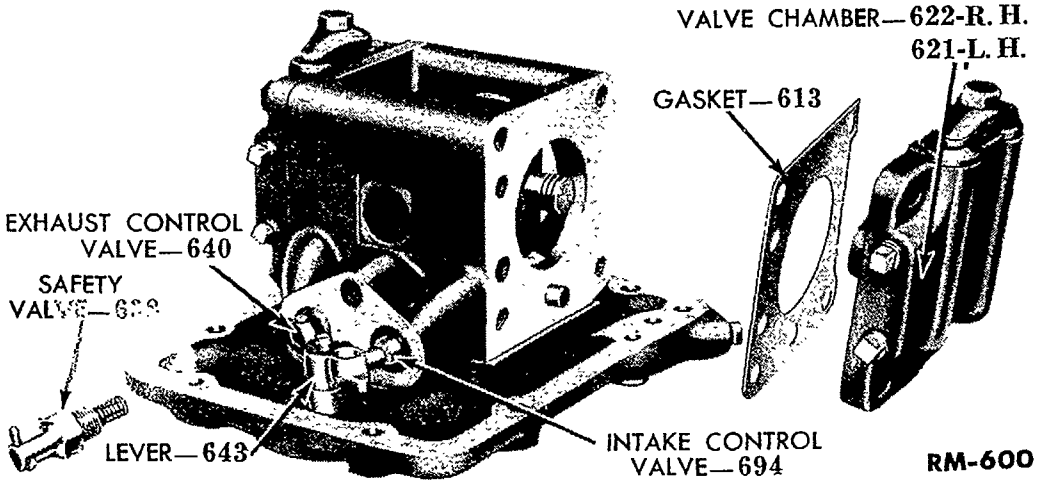


Fig. 24—Safety Valve and Valve Chamber

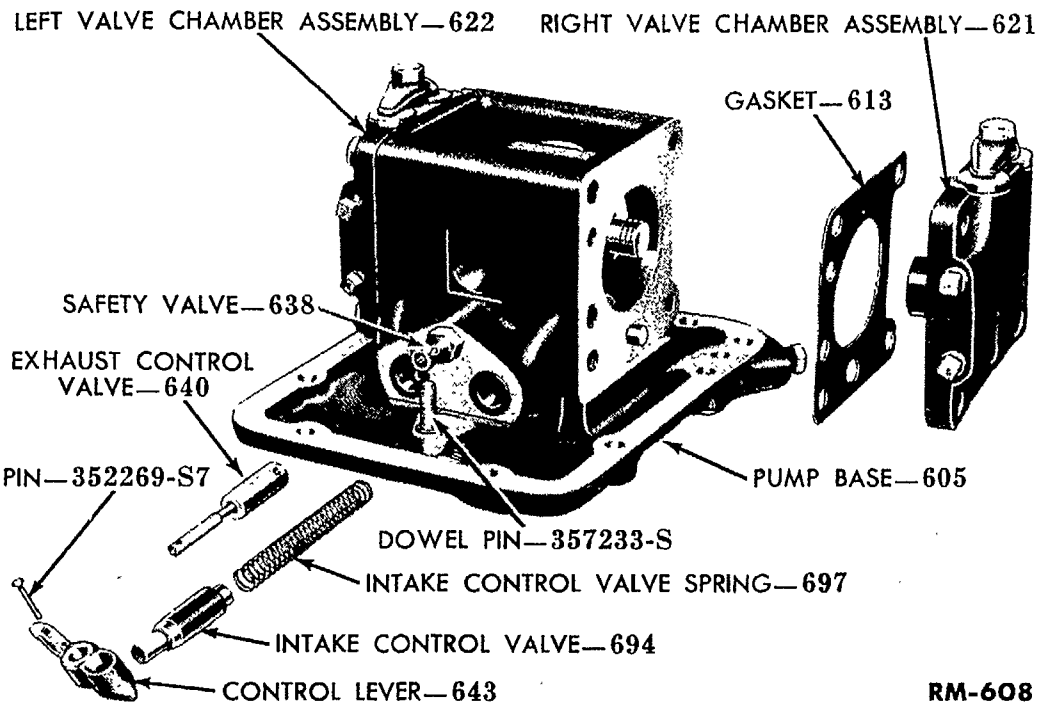


Fig. 25—Control Valves, Disassembled

(2) *INTAKE AND EXHAUST CONTROL VALVES.* Replace the intake or exhaust valve if they are scored, or if the spring in the outlet valve is broken. Replace the intake or exhaust control valve bushings (subpar. (a) below) if they are scored. It is important that the intake and exhaust control valves work freely in the bushings.

(*a*) CONTROL VALVE BUSHING REPLACEMENT. Drive the bushing out of the pump base. Press the new bushing into the pump base with a suitable pressure device equipped with a pilot, until it is perfectly flush with the machined surface on the base.

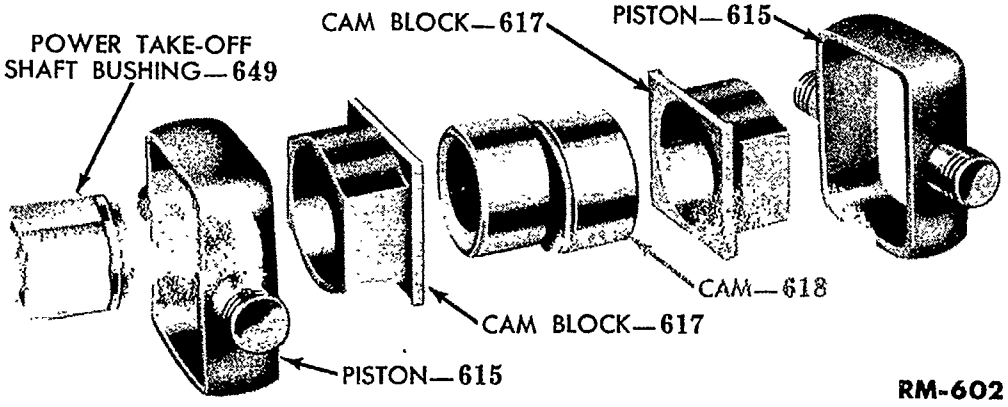


Fig. 26—Cam Blocks and Pistons, Disassembled

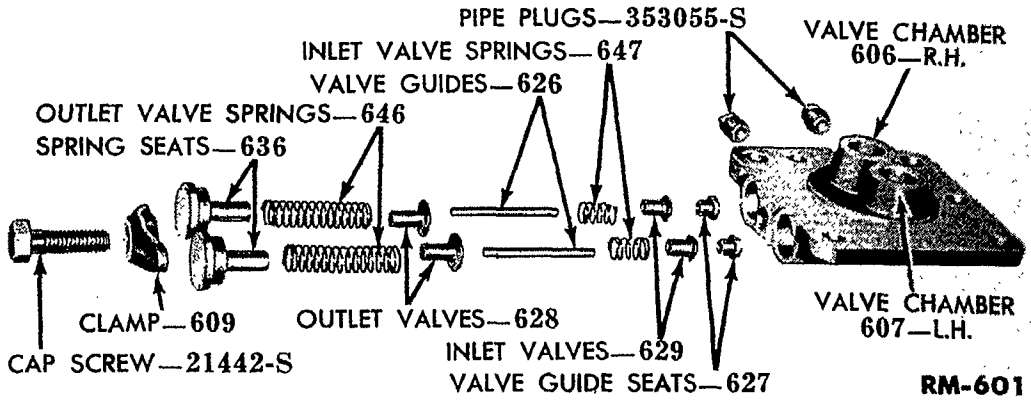


Fig. 27—Valve Chamber, Disassembled

(3) *PISTON*. Replace a piston (fig. 26) that is scored at any machined surface.

(4) *CAM, CAM BLOCK, AND POWER TAKE-OFF BUSHING*. Replace a cam, cam block, or power take-off bushing (fig. 26) if they are scored.

(5) *VALVE CHAMBER*. Replace a valve chamber (fig. 24) if it is cracked or if the inlet valve or outlet valve seats are rough or pitted.

(6) *PUMP BASE*. Replace the base (fig. 22) if it is cracked, if the gasket surface is nicked or damaged, or if any threads are stripped.

c. Assembly. Lubricate all parts before assembly. Install the exhaust control valve (fig. 27) in the exhaust control valve bushing. Install the intake control valve, spring, washer, and spring retainer in the bushing. Hold the intake control valve in the bushing, and install the valve control lever (fig. 27). Connect the exhaust control valve to the control lever with a clevis pin and cotter pin. Secure the control lever to the cover with a cotter pin. Install the safety valve assembly (fig. 24) on the pump base. Install the valve guide socket, valve guide, inlet valve, inlet valve spring, outlet valve, outlet valve spring, and valve chamber plug as shown in fig. 27. Secure the valve assembly in place with the top clamp and cap screw. This procedure applies to both the left and right valve chambers. Install the cam block on the cam as shown in fig. 26. Install a piston on each cam block, making sure that the narrow parts of the offset on each piston are together when the pistons are installed on the cam blocks. After the pistons are assembled on the cam blocks, the pistons may be fitted to the cylinders in a valve chamber to be sure that the pistons have been assembled correctly on the cam block. Install the power take-off bushing in the pump base. The shoulder on the power take-off bushing must be installed toward the pump piston assembly. Position the pistons, cam block, and cam assembly in the pump base,

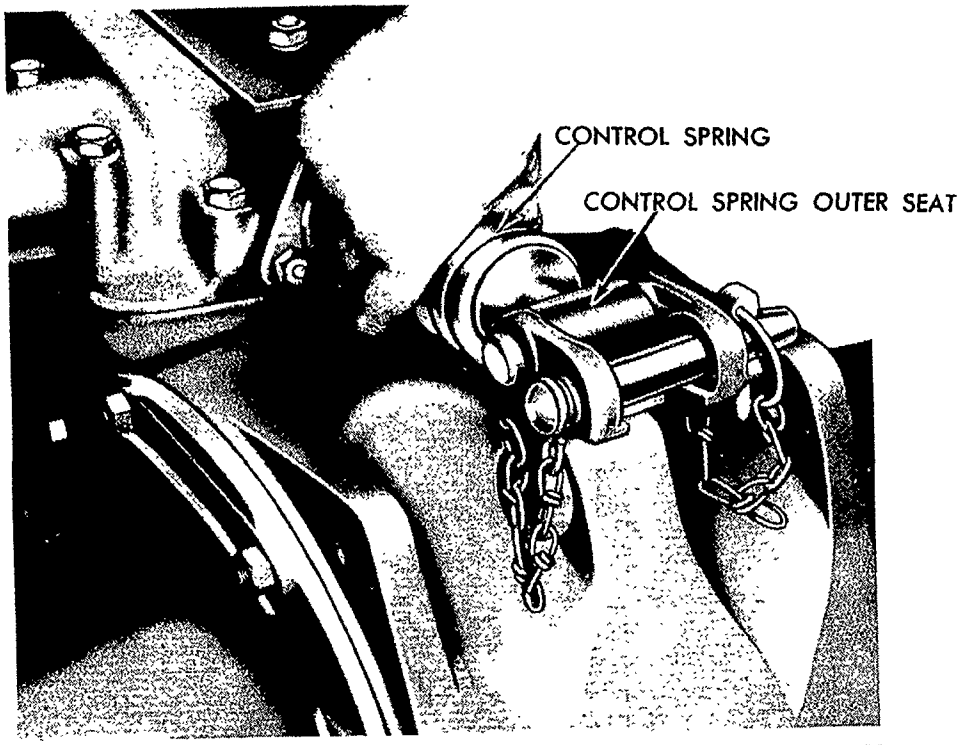


Fig. 28—Control Spring Adjustment

making sure that the shoulder on the power take-off bushing is seated in the recess in the forward end of the cam. Install the valve chambers and new gaskets on the pump base. When installing the valve chambers, be sure that the oil holes in the valve chamber are in line with the oil passages in the pump base. There are right and left hand valve chambers and it is possible to interchange them. The pipe plugs should be on the same end of the pump as the control valves (fig.22).

143. HYDRAULIC SYSTEM ADJUSTMENTS.

The hydraulic pump is of precision manufacture and does not require adjustment. The hydraulic unit, however, is composed of several subassemblies and must be carefully adjusted as outlined below.

a. External Adjustments. There are two external adjustments of the hydraulic unit. They may be made with the hydraulic unit either on or off the tractor.

(1) *ADJUSTMENT OF CONTROL SPRING.* Place the hydraulic touch control lever at the top of the quadrant, then turn the outer control spring seat until there is no end play in the spring. The preload on the control spring should be such that it is possible to turn the spring with a thumb and two finger grip as shown in fig. 28.

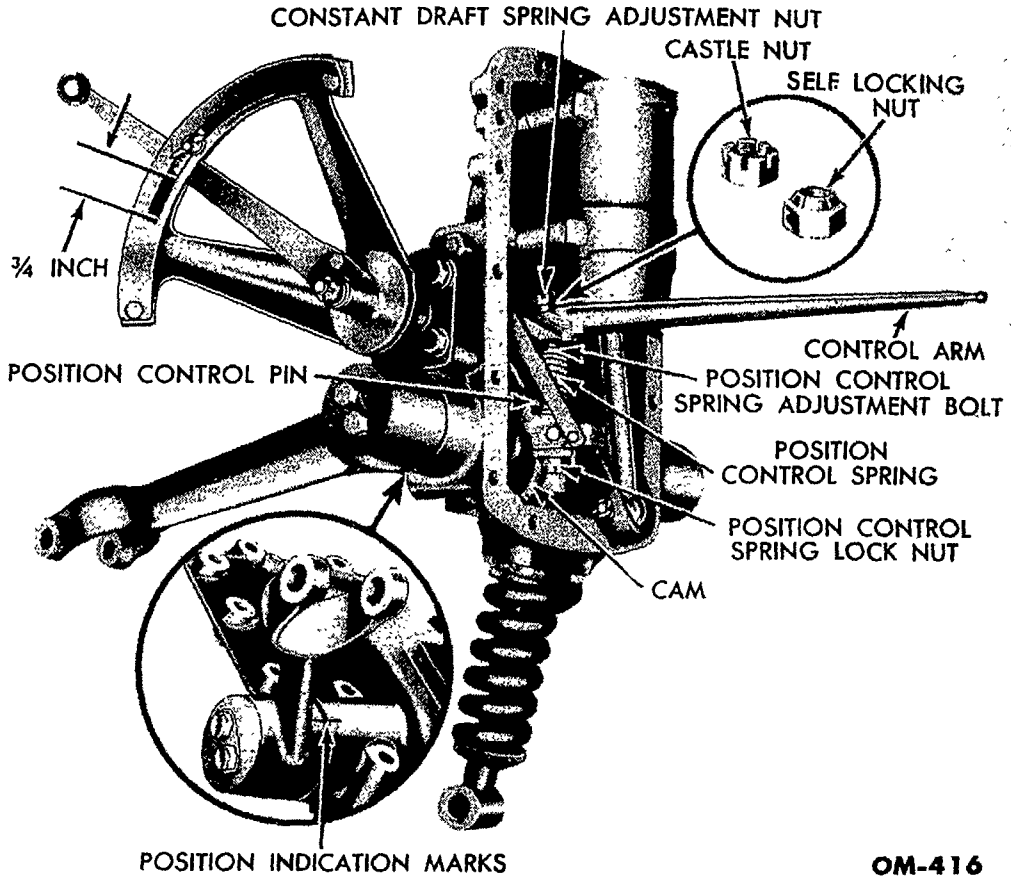


Fig. 29—Hydraulic Unit in Position for Adjustments

(2) *ADJUSTMENT OF FORCE REQUIRED TO MOVE HYDRAULIC TOUCH CONTROL LEVER.* This is accomplished by tightening or loosening the nut on the end of the hydraulic touch control lever shaft (fig. 17). Tightening the nut increases the force required to move the lever. It should be set so that it requires a pull of 4 to 5 pounds on the knob to move the lever.

b. Internal Adjustments. The internal adjustments have been carefully made at the factory. However, it may be necessary to readjust the hydraulic unit after an overhaul. These internal adjustments must be made before the unit is installed on the tractor.

The first step in making the internal adjustments is to check the two external adjustments as outlined above, and adjust if necessary.

(1) Support the unit in a vise in a vertical position with the control spring down as shown in fig. 29.

The lift arms must be supported in the fully raised position as indicated by the marks on the lift arms and housing (fig. 29).

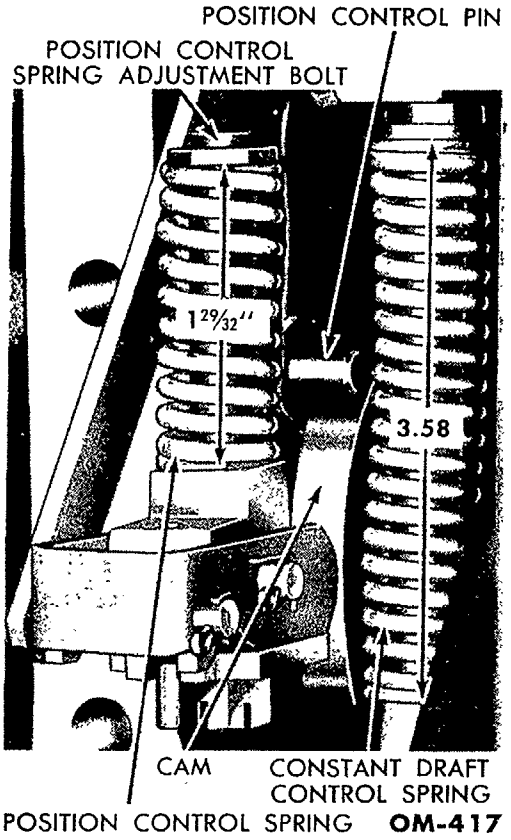


Fig. 30—Constant Draft Control and Piston Control Springs

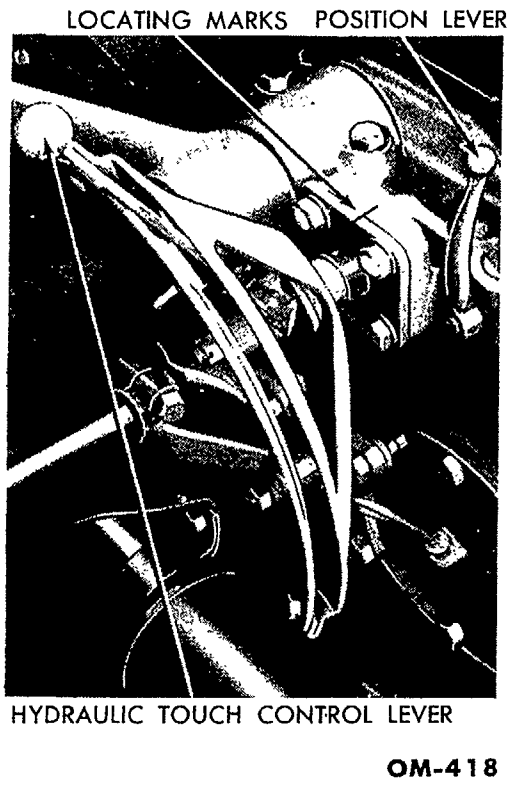


Fig. 31—Quadrant Locking Mark

(2) Examine the constant draft spring adjustment nut (fig. 29). If it is a lock nut, it should be tightened until the washer bears against the shoulder. If it is a standard castellated nut with a cotter pin, the nut should be adjusted to give the correct length of the constant draft spring, then the cotter pin can be installed. The constant draft spring should be 3.58 inches long (slightly over $3\frac{9}{16}$ inches is satisfactory) as shown in fig. 30.

(3) Examine the top of the quadrant support plate for locating marks as shown in fig. 31. The quadrant support cap screws should be loosened, locating marks aligned, and the cap screws tightened. If there are no locating marks, remove two cap screws from the quadrant support plate, loosen the two remaining cap screws, and center the slot in the quadrant support plate on the cap screws as accurately as possible. Replace and tighten the cap screws that support the quadrant.

(4) Place the position control lever in the position shown in fig. 29. Move the hydraulic touch control lever until there is an opening

of $\frac{3}{4}$ inch between the edge of the lever and the top end of the slot in the quadrant as shown in fig. 29.

(5) Make sure that the control arm moves freely and is held in a horizontal position by its own weight as shown in fig. 29. Loosen the position control lock nut, and adjust the length of the position control spring by turning the position control spring adjustment bolt (fig. 30). Adjust the position control spring length until the position control pin contacts the cam, and the position control spring adjustment bolt contacts the control arm, as shown in fig. 29. It will probably be necessary to hold the position control pin in contact with the cam. The position control spring length should be $1\frac{29}{32}$ inches plus or minus $\frac{1}{16}$ inch after the adjustment has been made (fig. 30). Tighten the position control spring lock nut after completing the adjustment.

After the above adjustments have been made, check the position of the hydraulic touch control lever and lift arms to be sure they were not moved while making the adjustments.

(6) Install the hydraulic unit on the tractor, making sure that the end of the control arm enters the opening in the valve control lever and that the control arm is not bent or damaged in any way during this operation. Do not install the inspection plate.

(7) Place the position control lever in the forward position, support the lower links near the raised position, and place the hydraulic touch control lever at the top of the quadrant. Check the position and operation of the intake control valve as follows:

(*a*) POSITION OF VALVE. The valve should be completely open when the hydraulic touch control lever is at the top of the quadrant. The valve is open when, by inserting the hand in the inspection opening, it is impossible to press the end of the control valve arm toward the pump face any farther.

(*b*) OPERATION OF VALVE. Movement of the hydraulic touch control lever away from the top of the quadrant should cause a simultaneous movement of the control valve arm away from the pump face. Movement of the control valve arm should begin at the start of movement of the hydraulic touch control lever.

There is only one position in which the quadrant support plate can be located where both of the above conditions will be met. To find this position, slightly loosen the four cap screws that support the quadrant. Hold the hydraulic touch control lever at the top of the quadrant and gently tap the quadrant support plate forward or backward until both of the above requirements are fulfilled.

(8) Tighten the four quadrant support cap screws securely and install the inspection plate on the center housing.

Chapter

7

STEERING GEAR

Section

Adjustments 121
Disassembly 122
Inspection and Repair 123
Assembly 124

The steering system includes the steering gear, steering wheel, and steering drag links between the pitman arms and the front axle spindle arms. The steering gear is of the recirculating ball bearing worm and nut type. Anti-friction steering is achieved by steel balls which serve as rolling contacts between the worm and nut.

Rotation of the steering tube shaft moves the ball nut along the worm. The left steering sector engages the rack on the ball nut, and is thereby rotated through an arc by the movement of the ball nut (fig. 2). The right sector engages the left sector and rotates the same number of degrees in the opposite direction. The pitman arms transfer the motion of the sector to the spindle arms through the drag links.

121. ADJUSTMENTS.

When the wheels are in the straight ahead position, all backlash should be removed, but if the wheels are turned to the extreme right or left, a slight backlash will be present due to the gear tooth design. This characteristic permits a backlash adjustment for wear between the worm nut teeth and the sector gears in the much used center position without causing binding or tightness in less used portions of the sector gears and worm nut.

Steering gear adjustments may be checked before removing the unit from the tractor or disassembling the unit. Adjusting the steering gear on the tractor in many cases will eliminate excessive backlash caused by improper adjustment between the sectors and the ball nut.

To determine the cause of excessive backlash, first check the adjustment of the steering tube bearings. Disconnect the drag links from the pitman arms. Turn the steering wheel to the right or left to the end of its travel, then back about ½ turn. Measure the force required to rotate it by use of a spring scale attached to the rim (fig. 7). If a force from ½ to 1½ pounds will maintain the wheel in

motion during the next ½ turn toward the center position, the tube shaft bearings do not require adjustment. Proceed as instructed in pars. **a** and **b** below. If no adjustment is required, proceed as instructed in par. **b** only.

a. Steering Tube Shaft Bearing Adjustment. The actual adjustment of the steering tube shaft bearings requires the removal of the steering gear from the tractor.

(1) *REMOVE STEERING GEAR.* Remove the steering wheel with a puller.

To remove the hood, shut off the fuel at the fuel shut-off valve, and disconnect the fuel line to the carburetor. Remove the four cap screws that secure the hood to the instrument panel. Remove the cap screws that secure the hood to the front axle support. Remove the intake air screen and connection. Lift off the hood.

Remove the air cleaner, tool box, battery, battery box, and choke rod.

Disconnect the throttle rod at its rear end, the governor compensating spring at the housing end, the starter wire at the switch end, and the oil line at the oil gauge.

Remove the two bolts that secure the steering gear to the instrument panel. Lift the instrument panel assembly off the steering shaft, but do not detach any of the wiring.

Remove the four bolts at the base of the steering gear, and lift out the assembly.

(2) *ADJUST STEERING TUBE SHAFT BEARINGS.* Remove the four cap screws that secure the steering tube to the steering gear housing. Pull the steering tube upward to remove or install shims as required. Shims vary in thickness and only those of the correct thickness must be removed or added to complete the adjustment. For example, if the spring scale reading was approximately ¼ pound, only one of the thinnest shims need be removed. It is better to have the bearings adjusted tightly rather than loosely, because loose bearings permit hammering and produce subsequent failure.

Reassemble the steering gear, and check the adjustment as outlined above.

b. Sector Adjustment. If the steering wheel has been removed, it must be installed temporarily to complete the sector adjustment.

Turn the steering wheel until the pitman arms are parallel and both point to the rear approximately 15°. Hold the steering wheel in this position, and feel for backlash by grasping the left pitman arm. If no backlash is apparent, no adjustment is required. If backlash is present, adjust the left sector.

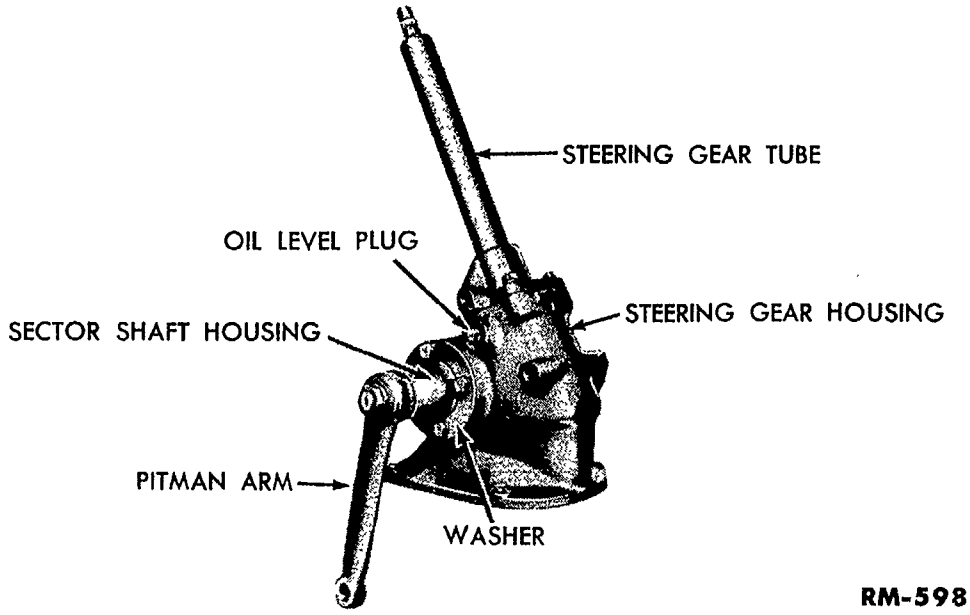


Fig. 1—Steering Gear Assembly

Remove the four cap screws that secure the sector shaft bearing housing to the steering gear housing, and turn the sector shaft bearing housing and its metal gasket counterclockwise (as viewed from the left side of the tractor) to the next set of notching holes. Replace and tighten the four cap screws.

Check the effect of the adjustment by measuring the force required to turn the steering wheel through the straight ahead position, with the pitman arms parallel. This measurement is taken with a spring scale as described above. Two to three pounds should be required to maintain the steering wheel in motion through the straight ahead position.

It is usually necessary to adjust the right sector if the left has been moved. Proceed as instructed for the left sector, except that the right sector shaft bearing housing must be turned in a clockwise direction, as viewed from the right side of the tractor, to remove excessive backlash. 2½ to 6 pounds should be required to maintain the steering gear in motion through the straight ahead position after both right and left sectors have been adjusted.

122. DISASSEMBLY.

To disassemble the steering gear, remove the nut that secures each pitman arm to the sector shafts. Remove each pitman arm with a puller. Remove the four cap screws that secure each sector shaft housing to the steering gear housing. Lift each sector shaft housing, thrust washer, gasket, and sector shaft from the steering gear hous-

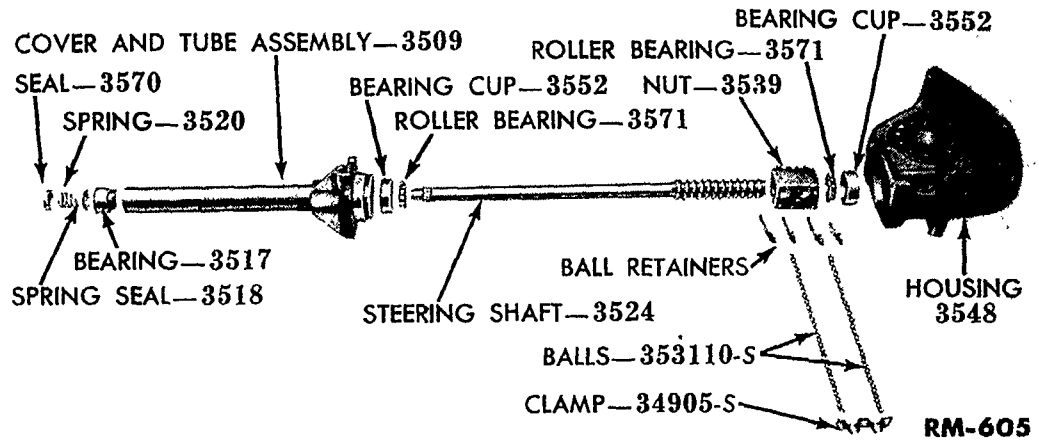


Fig. 2—Steering Tube Shaft, Disassembled

ing. Remove the four cap screws that secure the steering tube to the steering gear housing. Lift the tube and shaft assembly (fig. 1) from the housing.

CAUTION: ***When the steering gear is partially or completely disassembled, the ball nut assembly must not be permitted to turn so that it reaches the end of the worm on the steering shaft as this action may damage the ball retainer.***

Remove the three screws and clamp from the ball nut assembly (fig. 2). Lift the two ball retainers from the assembly and remove the ball bearings.

123. INSPECTION AND REPAIR.

Before inspection, clean all parts thoroughly in cleaning fluid and blow them dry with compressed air.

a. Inspection. Inspection of the steering gear must cover the following seven items:

(1) *STEERING TUBE.* Replace the steering tube (fig. 2) if it is bent or otherwise damaged. Replace the bearing race if it is scored or pitted. If the bearing at the top of the steering tube is damaged, it must be replaced.

(2) *ROLLER BEARINGS.* Replace a roller bearing if any of the rollers have flat spots, or if any of the rollers are missing.

(3) *STEERING TUBE SHAFT AND BALL NUT.* The individual parts of the steering shaft and ball nut must be inspected to determine the condition of the assembly.

(a) STEERING TUBE SHAFT. Replace the entire steering shaft and ball nut assembly if the worm on the shaft is pitted or otherwise damaged.

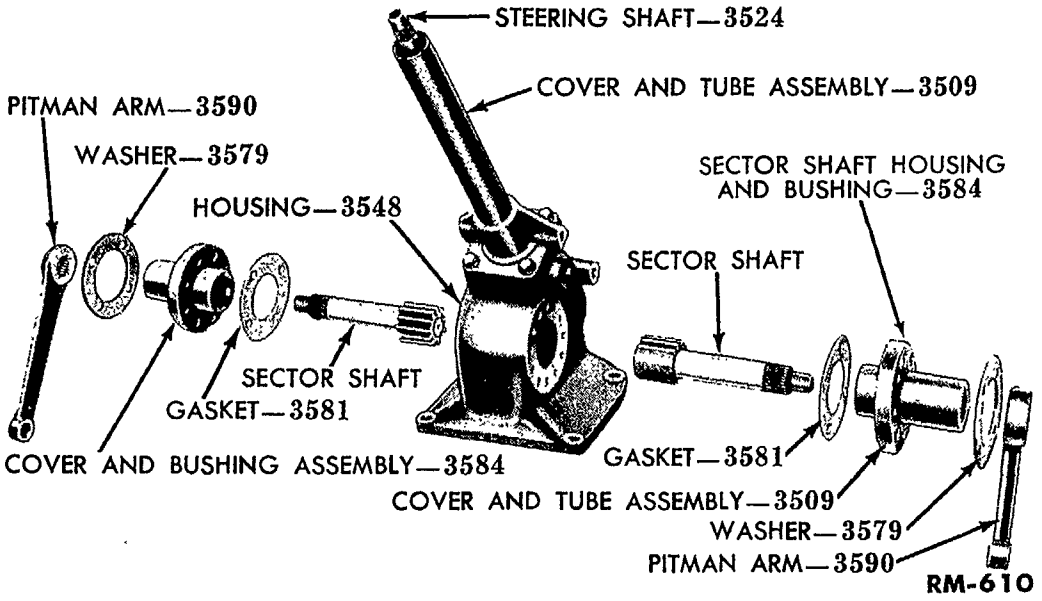


Fig. 3—Sector Shafts, Disassembled

(*b*) BALL NUT. Replace the entire steering shaft and ball nut assembly if the teeth are worn or if the ball race is pitted.

(*c*) BALL BEARINGS. Replace the entire steering shaft and ball nut assembly if any balls are worn, chipped, or pitted. Be sure that there are 60 balls within the assembly. Since these balls are held to a very close tolerance, it is not advisable to replace them individually.

(*d*) BALL RETAINERS. Replace the retainers if they are bent, damaged, or will not permit free passage of the balls.

(4) *STEERING GEAR HOUSING*. Replace the steering gear housing (fig. 3) if it is cracked or otherwise damaged. Replace the lower steering shaft bearing race if it is scored or pitted.

(5) *PITMAN ARM*. Replace a pitman arm (fig. 3) that has been damaged in any way.

(6) *SECTOR SHAFT HOUSING*. Replace the housing if it is damaged. Replace the sector shaft bushings if they are damaged or worn.

(7) *SECTOR SHAFT*. Replace a sector shaft (fig. 3) if the teeth or bearing surface are excessively worn.

b. Repair. To replace a bearing race, remove it from the housing or steering tube shaft with a puller. To install a bearing race, press it in place, making sure that it is seated firmly against the shoulder in the housing or steering tube.

To replace a sector shaft bushing, remove the seal and seal washer, then press the bushing from the housing, being careful not to damage the bore. Press the new inner bushing into the housing until

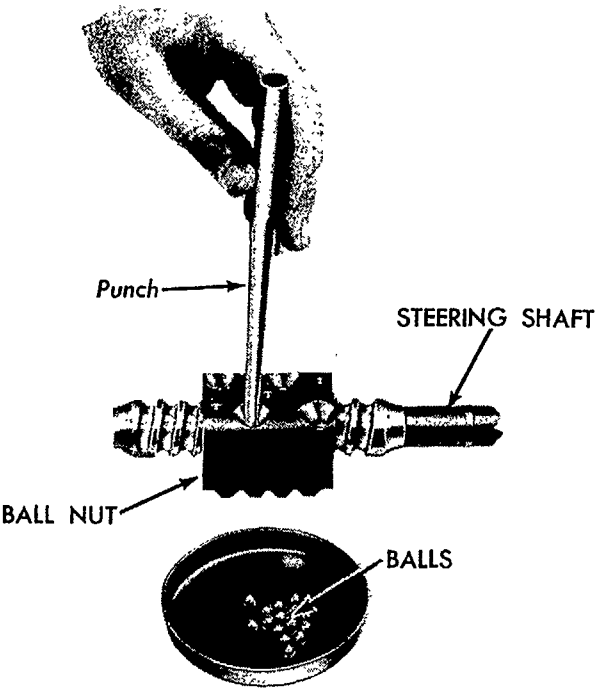


Fig. 4—Aligning Ball Nut on Steering Tube Shaft

it is $\frac{1}{8}$ inch below the face of the hub. Press the new outer bushing into the housing until it is level with, or slightly below, the bottom of the counterbore. Line ream both bushings in place to 1.125-1.126 inches in diameter.

124. ASSEMBLY.

Assembly should be accomplished only when inspection shows that every part is in a serviceable condition.

a. Steering Tube Shaft and Ball Nut. Place the steering shaft on a bench and position the nut over the middle section of the worm with the ball retainer holes on top. Align the ball retainer holes with the grooves in the worm on the steering shaft (fig. 4). Drop 20 balls into one of the retainer holes, then slowly rotate the steering shaft to carry the balls away from the hole. Continue dropping the balls into the hole until the ball circuit is full to the bottom of both holes or until the end of the steering shaft worm has been reached. Where the balls were stopped by the end of the worm, they should be held in position with a clean, blunt tool while the steering shaft is rotated in the opposite direction. This will make it possible to drop more balls into the retainer hole. Extreme care should be exercised to make certain that no balls are outside the regular ball circuits. If balls

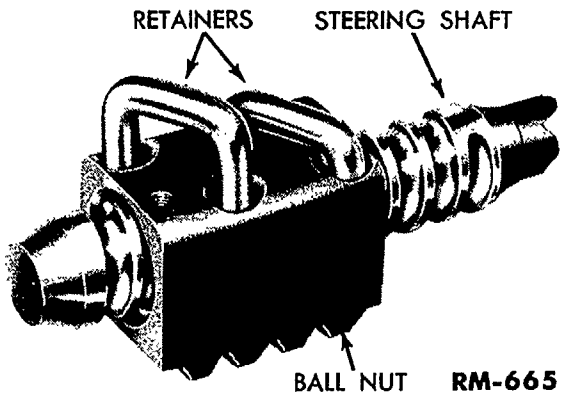


Fig. 5—Removing or Installing Ball Retainer

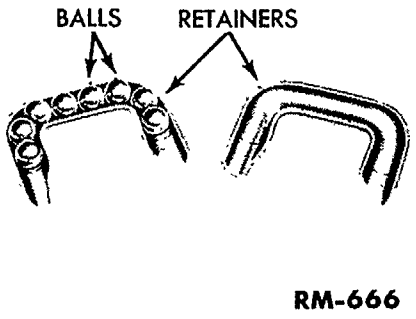


Fig. 6—Filling Ball Return Guide

remain in the groove between the two circuits, or at the ends, these balls cannot circulate and will cause ultimate failure of the steering gear.

It may be necessary to rotate the steering tube shaft alternately in both directions while, at the same time, holding the balls in place. This will make it possible to completely fill the ball circuit.

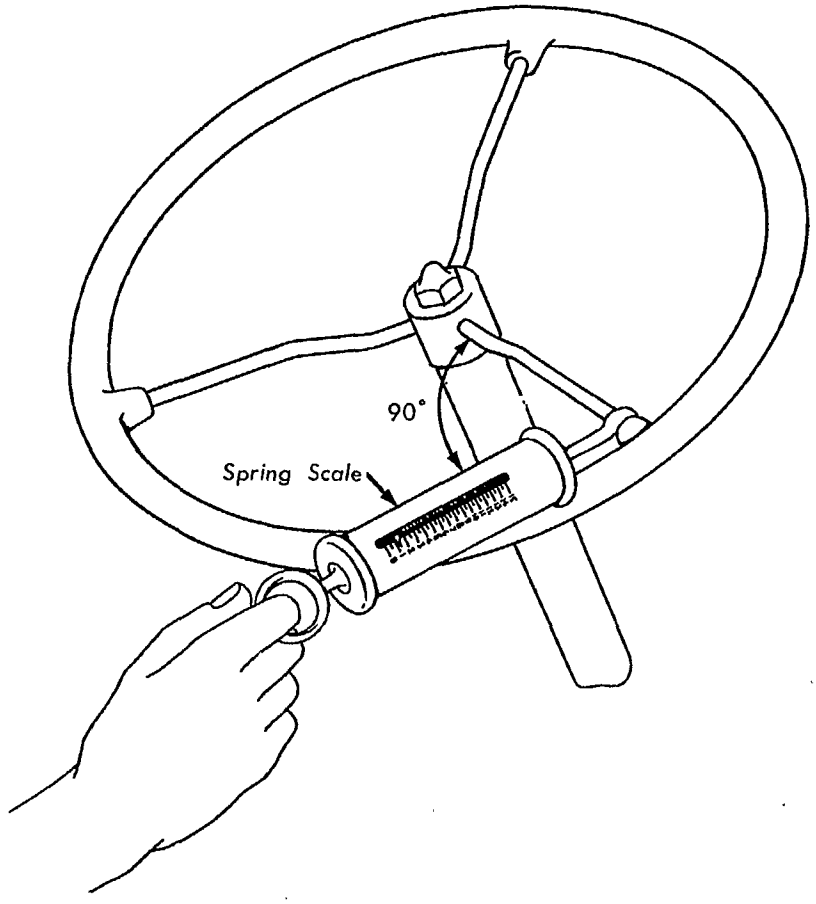
Lay one-half of the retainer on the bench, and fill it with 10 balls for the circuit being filled. Position the other half of the retainer over the balls, plug the ends with heavy grease, and insert the retainers into the retainer holes in the nut (fig. 6).

The second ball circuit is filled in the same manner.

Install the retainer clamp and three screws.

b. Installing and Adjusting Steering Tube Shaft and Sectors. Position a roller bearing in the bearing race in the housing on the upper bearing race of the shaft (fig. 2).

Place shims on the housing to an approximate thickness of 0.050 inch. Hold the steering tube shaft and ball nut assembly in place in the housing, with the rack teeth toward the sectors and the ball nut in the approximate center of the worm. Install the steering tube. Do not tighten the bolts so tight that damage to the bearings will result, especially when an insufficient thickness of shims have been used. Install the steering wheel and measure the force required to rotate it. This should be from 1 to 1½ pounds on a spring scale (fig. 7). Add or remove shims as required until the correct force is obtained. Be sure that the pulling force of the scale is at right angles to a steering wheel spoke when taking measurements.



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Fig. 7—Checking Steering Adjustment

Hold the ball nut in your hand and rotate the steering shaft until the center tooth (2 teeth each side) lines up with the center of the left sector shaft opening.

Place the left sector shaft (3 large and 4 small teeth) and thrust washer in the sector shaft bearing housing, and position the metal gasket on the housing. Install this assembly in the steering gear housing with the center tooth of the three large sector teeth meshed in the center space of the teeth on the ball nut. While engaging the left sector shaft and ball nut, it may be necessary to hold the ball nut in position by reaching through the hole in the right side of the steering gear housing. The bearing is eccentric in the sector shaft bearing housing and should be installed with the notch located at the bottom.

Rotate the left housing counterclockwise (as viewed from the left side of the tractor) to eliminate backlash. Secure the sector shaft bearing housing by installing the washer and four cap screws. The adjustment between the left sector and ball nut should be such that

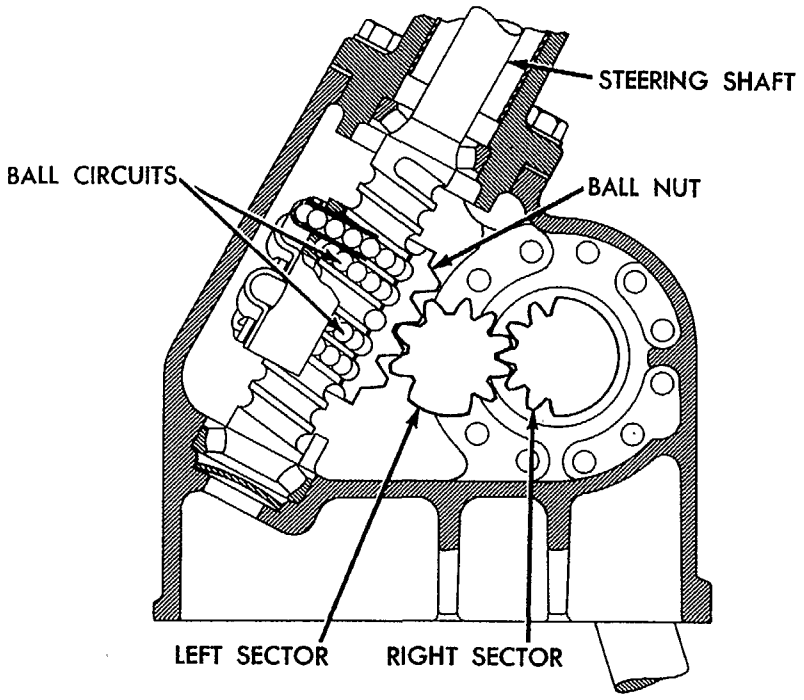


Fig. 8—Timing Sector Shaft and Ball Nut

a pull of 2 to 3 pounds is required to turn the steering wheel through the straight ahead position (fig. 7).

Place the right sector shaft and thrust washer in the sector shaft bearing housing, and position the metal gasket on the housing. The right sector must be engaged with its center tooth meshed in the third tooth space on the left sector gear, counting from the solid section of the gear, located on the bottom, as shown in fig. 8. The tooth on the right sector can be identified by a dot or mark on the end of the tooth.

The tooth space on the left sector also can be identified by a dot or mark. The bearing is eccentric in the sector shaft bearing housing and should be installed with the notch located at the bottom. Rotate the housing clockwise (as viewed from the right side of the tractor) to reduce backlash.

The adjustment between the right and left sector should be such that the force required to turn the steering wheel through the straight ahead position is 3 to 6 pounds.

The steering gear assembly should be filled with S.A.E. 90 oil. This oil may be pumped into the right side of the steering gear housing through the pipe plug hole.

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Chapter 8
Service Bulletins

The information contained in this chapter has been compiled from Model 8N Tractor Service Bulletins. Use this material as a guide when performing maintenance and repair operations on the tractor.

Attachments which were issued with the bulletins, have been reprinted, and numbered, and are now included at the back of this publication.

ENGINE

Bulletin Subject: New Valves and Adjustable Tappets for the Ford Tractor Kit, No. 8N-6546

Over the past year, in certain localities, a few owners have encountered some difficulty with tractor engine valves sticking or burning, particularly the exhaust valve. For the purpose of relieving this condition, new valves and adjustable tappets have been developed for service replacement on the Ford Tractor.

The new valve will relieve exhaust valve failure attributable to excessive deposits of the valve seat and/or valve stem. These experiences are local in character, and replacement of the standard valves with the new valves is not subject to warranty or policy adjustment. Please do not submit S.A.R.'s for replacements.

A kit, Part No. 8N-6546, is now being made available. It contains four new valve assemblies and eight adjustable tappets with wrenches. The wrenches are included to hold the tappets while adjustments are being made for length.

In Attachment No. 1 you will find a complete description of the valve as well as a drawing and instructions for proper installation and servicing. Complete instructions for the installation of the tappets are included in each kit. You will note that tappets are to be used for all eight valves; however, the new valves should be used only in the exhaust ports.

These kits are available for immediate shipment as announced in "Service Parts Release and Change Notice No. 50-2". Dealers should be advised of the availability of the subject parts, particularly in those areas where sticking or burning valves are now a problem.

Bulletin Subject: Engine Overhaul Gasket Kit, Part No. 8N-6008

Service Parts Release and Change Notice, 50-4, dated April 1, 1950, page 15, lists "Part No. 9N-6008 Motor Overhaul Gasket Kit REPLACED BY Part No. 8N-6008 Motor Overhaul Gasket Kit."

Part No. 9N-6008 kit, now in Distributor and Dealer inventory, should be used for the servicing of all tractors prior to the installation of the angle drive distributor only.

In addition to the gaskets, there are three 6020 series Front Cover Gaskets included in the new 8N-6008 Engine Overhaul Gasket Kit, so that the kit will be universally applicable to all 8N and 9N tractors. The three 6020 series gaskets all appear to be exactly alike, but actually there is a slight difference in each one.

Since there are no identifying markings on the parts, it is necessary to select the proper gasket to fit the engine being overhauled. If there is any doubt, the gasket should be matched with the mating parts on which it will be used.

Information on the application of these three particular gaskets is listed below.

9N-6020-B Gasket (Cylinder Front Cover)

This part is for use with all engine assemblies prior to tractor Serial No. 263844.

8N-6020-B Gasket (Cylinder Front Cover)

This part is for use on engine assemblies equipped with the angle drive distributor that may have the cast iron front and the cast iron timing gear side covers.

8N-6020C Gasket (Cylinder Front Cover)

This part is used on engine assemblies equipped with the angle drive distributor using the aluminum front and aluminum timing gear side covers.

Part No. 8N-6019A cover (cylinder front, cast iron) and Part No. 8N-6017A cover (cylinder timing gear side, cast iron) have not been used in production, but are listed as optional and may be used in the future. The Part No. 8N-6020-B, Gasket Cylinder Front Cover, is supplied in the Engine Overhaul Gasket Kit for use with the cast iron covers.

Bulletin Subject: Factors to Consider in Replacing Crankshaft Bearing Liners

It is well recognized that crankshaft bearing liners perform a vital function in the proper operation of the Ford tractor engine. Liners that are actually worn or damaged will cause excessive wear of related engine parts, a drop in engine oil pressure and increased engine noise. Therefore, the matter of whether crankshaft bearing liners SHOULD or SHOULD NOT be replaced merits careful consideration when the above engine conditions are noted or when an engine is torn down for general overhaul.

The following factors should be considered in checking the condition of liners and used as a guide in determining whether liners should be replaced.

1. Clearance between the liners and the crankshaft journals. This is the most important factor in checking bearings to determine whether the liners should be replaced. These clearances in the Ford Tractor engine should be as follows:

BEARING LINERS	NEW	WEAR LIMIT
Main	.001 - .003	.005
Crank Pin	.0004 - .0025	.005
End Play	.002 - .006	.008

These clearances should be carefully checked before liners are replaced. The use of Plastigage, as made available to the field by the Parts

Department in their Parts and Accessories Bulletin #81, will materially reduce the time and effort required to accurately check these clearances. Liners in which the clearance is not within the above wear limit should be replaced.

2. Presence of foreign material in the liner. Excessive amounts of foreign material embedded in the face of the liner may eventually cause unnecessary wear in the journals, and therefore, justifies replacing the liners. However, slight amounts of foreign material will do no harm and should not be considered as cause for liner replacement.

3. Liner Fatigue. This condition is indicated by areas in the face of the liner deteriorating or crumbling away leaving a ragged opening or pit in the face of the liner. Bearings otherwise satisfactory but with small pits need not be replaced. Bearings must be replaced where pits extend to the side of the liner and permit oil to escape.

4. Discoloration. Bearing liners may sometimes be discolored. This is not harmful and will not shorten the life of the bearing. Discoloration in itself, is not justification for replacing the bearing liners.

5. Unnecessary Replacement. It is important that the need for bearing liner replacement be fully established before such action is taken. Our records indicate a tendency toward replacing liners unnecessarily. In view of the fact that replaced liners are subject to recall for inspection pending approval of claims, you are urged to make certain that, in accordance with the above four factors, the liners are defective and actually need to be replaced.

Bulletin Subject: Tractor Changes-Use for Effective Point of Change Only

Effective with Tractor Serial No. 318023, the intake valve seat insert, Part No. 40-6057-B, has been removed from the Block Assembly, Part No. 8N-6010-B, and the Cylinder Assembly, Part No. 8N-6011-B. The seat is now integral with the block.

Extensive testing has proven that elimination of this intake valve seat insert will in no way affect the normal life of the engine block.

Occasionally you may find an intake valve seat insert used in a new tractor engine or service engine block, however, this will be an exception and should not be cause for concern in the field.

Valve seat insert, Part No. 40-6057-B, will continue to be sold as a service item and can be used to recondition engine blocks in the field where it is found to be necessary.

Manufacturers of the various types of seat grinding equipment provide detailed instructions for all steps in reconditioning valve seats, on both the cast and insert type, and these instructions should be followed.

Bulletin Subject: Wrenches for Adjustable Tappets

The recently announced tappet wrenches, Part No. 8N-17045-A Right Hand and Part No. 8N-17046-A Left Hand are designed to prevent tappets from turning while making the necessary tappet adjustments.

See Attachment #2 for instructions.

The price structure for the subject wrenches has been released in Service Parts Release and Change Notice 51-5 dated May 1, 1951 and is currently in your hands.

Bulletin Subject: Ford Tractor Head Bolt Torque Specifications

The use of the recommended head bolt torque is essential in the proper installation of the cylinder head. Improperly tightened head bolts could result in damage to the engine such as, warpage of the cylinder head, water leakage and cylinder head gasket failure. The torque specifications and correct procedure for tightening head bolts are covered in detail in Attachment #3.

Bulletin Subject: 8N Ford Tractor Engine

Overhauls on the 8N Ford Tractor engine must be done carefully and properly if maximum performance in engine life is to be expected and customers satisfied. In this connection the importance of properly fitting pistons, piston rings, piston pins, connecting rods and bearings cannot be over-emphasized.

Complete instructions have been furnished to you for the dealers' Service Departments in the Ford Tractor Repair Manual, Form No. 3695-47, and by various bulletins from the Dearborn Service Department. However, we find that these instructions are not being carried out in many service shops. It is possible that the mechanics do not have the complete specifications readily available to aid them in performing these important service operations more accurately and efficiently.

To make these complete specifications available to all dealer service shops immediately, we have gathered it together in Attachment #4, which covers in detail:

1. Proper piston fit to cylinder bore.
2. Specifications for piston ring side clearance.
3. Connecting rod alignment.
4. Checking crankshaft bearing clearances.

We are sure that you and your dealers will be happy to receive this information and know that if the procedures are carried out in detail, satisfactory results will be obtained in the correction of excessive oil consumption and loss of power.

Bulletin Subject: Servicing Cast Iron Sleeves, Part No. 8N-6055-B

As announced in Service Bulletin No. 190, dated December 5, 1951, cast iron sleeves were incorporated in production, effective with Tractor Serial No. 8N-433578.

Parts and Accessories Bulletin No. 202, dated January 2, 1952, announced the availability of the subject sleeve as a service item. In Attachment #5, instructions outline the correct procedure for servicing these sleeves in the field, and should be followed in detail to obtain satisfactory results.

Bulletin Subject: Engine Valve Clearance

Insufficient clearance between the tappet and the valve stem is one of the primary causes for valve burning. However, particles of carbon that lodge between the valve face and the valve seat are sometimes responsible for what appears to be insufficient valve clearance. The carbon does not allow the valves to completely close and in turn excessive heat is retained at the valve face which cannot be dissipated without contacting the valve seat.

When adjusting the valve tappets for proper clearances, as given in Service Bulletin No. 179, a uniform method of procedure is of extreme importance. The proper cold clearance for setting exhaust valves is .014 to .016 and for intake valves, .010 to .012.

In order to specify a uniform method of checking valve clearance on the tractor, the following chart is suggested:

VALVES OPEN	VALVES TO BE CHECKED
#1 Exhaust and 3 Intake	#2 Intake and 4 Exhaust
#1 Intake and 2 Exhaust	#3 Exhaust and 4 Intake
#2 Intake and 4 Exhaust	#1 Exhaust and 3 Intake
#3 Exhaust and 4 Intake	#1 Intake and 2 Exhaust

Correct adjustment of valve clearance may be obtained only if the valves indicated in the above chart are in full open position and with the engine at room temperature (approximately 70° F.).

When checking valve clearance, it cannot be overemphasized that the tappet should be against the flat of the cam and not on the cam ramp. In some cases it has been found that the tappet actually is not in contact with the cam when valve clearances are set, thus causing excessive clearance.

Bulletin Subject: Oversize Pistons and Ring Sets

Parts and Accessories Bulletin No. 267, dated December 1, 1952, announced the availability of oversized pistons and ring sets. These parts may only be used in 8N tractors which incorporate the cast iron sleeve, Part No. 8N-6055-B, as it is necessary to rebore and hone the sleeves to obtain the recommended piston fit to cylinder bore of 5 - 10 pounds pull, using a .002 x .50 ribbon pull scale.

In Attachment #6, instructions outline the correct procedure for installing the following oversize piston assemblies and ring sets.

PISTON ASSEMBLIES		RING SETS	
8N-6108-D	.020 O.S.	8N-6149-D	.020 O.S.
8N-6108-E	.030 O.S.	8N-6149-E	.030 O.S.
8N-6108-F	.040 O.S.	8N-6149-F	.040 O.S.

Instructions should be followed in detail to obtain satisfactory results.

IGNITION

Bulletin Subject: Installing and Timing the Angle Drive Distributor on the 8N Tractor

This bulletin and attachment #7 constitute the complete instructions for installing and timing the new angle drive distributor announced in Service Bulletin No. 114, dated March 30, 1950. Replacement parts for the new angle drive distributor are covered in Service Parts Release and Change Notice 50-4.

This distributor can be installed and timed without instrumentation, but we strongly advise the use of a stroboscopic timing light. In the interest of quality service and in order to assure maximum tractor performance, we recommend that every one of your dealers, not so equipped, purchase one of these timing lights. Such a light will improve the efficiency of the dealer's service department by assuring accurate timing -- the first time. This will reduce your dealer's service expense by speeding up the initial operation and eliminating the need for repeat service calls.

Bulletin Subject: Distributor Shaft 8N-12175 as Supplied in Parts Stock

The subject shafts are supplied as service parts without the holes drilled in them to pin the collar and gear to the shaft. In production, these holes are drilled after the shaft has been installed in the distributor assembly, so as to obtain the proper end play of the shaft.

In order to obtain this same clearance with the use of service parts, the following procedure is to be followed in the field.

1. Install the shaft in the distributor housing.
2. Put a .002 to .005 shim or feeler at the bottom end of the housing before slipping the collar on. This will provide for the proper amount of end play.

3. Drill the first hole to hold the collar in this position and rivet it in place.

4. Remove the shim or feeler.

5. Place the gear, Part No. 7RA 12390-C, on the shaft and remove the clamp and arm assembly, Part No. 7HA 12273, which is clamped against the shoulder on the distributor housing. Measure from this shoulder down 4.020 inches on the shaft and locate the bottom edge of the gear at this point.

6. This properly locates the gear and the hole may now be drilled in line with the holes in the gear and the gear riveted in place. Reattach the arm assembly, Part No. 7HA 12273.

Bulletin Subject: Correction of Errors in Tractor Operator's Manuals, Form No. 3729-50-F and 3729-50-M

Please make the following corrections on Page 10 under "Ignition System". These corrections apply only to tractors with the angle drive distributor installation.

Under Distributor: The specifications on lines 4 and 8 now read:

Initial timing (degrees of crankshaft)	Top dead center
Breaker contact spacing	0.015"

Under Distributor: The specifications on lines 4 and 8 <u>should</u> read:

Initial timing (degrees of crankshaft)	4° before top dead center
Breaker contact spacing	.024" -- .026"

Dealers should make the above corrections in the Operator's Manual during his pre-delivery inspection of the Ford Tractor.

The text for Ignition Timing on Pages 92, 93, 94 and 95 of the subject manuals is correct and need not be changed.

Bulletin Subject: Dust Shield Kit, Part No. 8N-12261-A for Angle Drive Distributor

The subject Dust Shield Kit, designed to prevent dust from entering the distributor assembly, is now available for service.

Investigation of premature point failures has revealed that abrasive dust and lack of cam lubrication are, in many cases, responsible for point failures. The presence of dust and the absence of lubrication causes rapid wear of the fiber block and if permitted to continue, the cam, of the cam and weights assembly, Part No. 8N-12176, will become scored. A scored distributor cam will cause rapid wear of the fiber block. This in turn will result in improper point spacing, arcing between the contacts, and rapid pitting of the points.

Corrective measures are as follows:

1. Replace the cam and weights assembly, Part No. 8N-12176, if found to be scored.
2. Install new points with contact spacing of .024 - .026.
3. Lubricate the cam in accordance with the instructions given in Section 364, Paragraph E, Page 93 of the Ford Tractor Operator's Manual.
4. Clean the contacts with chloroform after they have been properly spaced.
5. Install the Dust Shield Kit as outlined in the instructions contained in each kit.

TRANSMISSION

Bulletin Subject: Transmission Jumping Out of Reverse and/or Locking in Reverse and Another Gear at the Same Time.

A few cases have been reported to us from the field regarding transmissions jumping out of reverse or locking in two gears, (i.e. reverse and one of the forward gears) and excessive wear on the 8N-7100 Gear and Mating Shaft.

We have found in these instances that the snap ring groove in the 8N-7141, Gear and Bushing Assembly, is not sharp and square or the snap ring itself, Part No. 9N-7070 may have the edges on the inside diameter chamfered rather than square. To correct this condition, install a new 8N-7141 gear and bushing assembly or a 9N-7070 Snap Ring whichever is required.

NOTE: This applies to transmissions jumping out of reverse gear only, after serial number 245636.

Regular S.A.R. procedure is to be followed in all cases pertaining to the above.

HYDRAULIC

Bulletin Subject: 8N Tractor Hydraulic Pump Exhaust Valve Retaining Pins, 8N-641-A and 8N-641-B

1. PROBLEM:

   How to determine which pin to order for servicing tractors.

2. TRACTORS AFFECTED:

   Retaining Pin No. 641-A was used in 8N tractors from Serial No. 8N-1 thru 8N-56751.

Retaining Pin No. 8N 641-B replaced Retaining Pin 8N 641-A beginning with Tractor Serial No. 8N 56752 and continuing.

3. THEORY OF NEW PART:

Effective with Tractor Serial No. 8N 56752 the design of the Exhaust Valve No. 8N 630 was changed as follows: The holes in the end of the valve were eliminated because they were found to be a contributing factor to the problem of sticky valves. This change necessitated changing the Retaining Pin No. 8N 641-A.

4. FIELD CORRECTION:

When servicing the hydraulic pump on tractors below Serial No. 56752 that are equipped with the old style Exhaust Valve No. 8N 630, use Retaining Pin No. 8N 641-A. When servicing tractors over Serial No. 56752 with the new style Exhaust Valve No. 8N 640, use Retaining Pin No. 8N 641-B.

Bulletin Subject: Failure of the 74034-S Pin in the Hydraulic Lift Cover Assembly (8N Tractor)

1. PROBLEM:

To prevent breakage of the subject pin in new tractors.

2. PRODUCTION CORRECTION:

Effective with tractor serial number 179,000, new fixtures for the positive location of this pin hole were incorporated in production.

3. FIELD CORRECTION:

When the 74034-S pin breaks it is possible for pieces of the pin and the 9N-526 rod to drop into the differential or the hydraulic pump. The resulting damage is not only costly but the repair work involved is very time consuming and might leave the farmer without his tractor at a very critical time.

To prevent this damage in the field, we strongly recommend that all undelivered tractors below serial number 179,000, in distributors and dealers stocks, be check to determine whether or not the 74034-S pin will break. The procedure for this is to attach an implement to the tractor in the normal manner. Raise the implement just enough to barely clear the ground, so that the implement is fully supported by the tractor. Next, remove the cover assembly from the right hand side of the tractor and reach in with your hand and feel the pin to determine whether it is loose or tight. If tight, it will indicate that the pin is taking the thrust and that a new 9N-526 should be installed. Be sure to check the new 9N-526 and pin before replacing the lift cover on the tractor, to insure that there is no bind on the pin.

Bulletin Subject: Servicing Part No. 8N-640-A2 Hydraulic Pump Exhaust Valve

Up to the present time (October, 1949), the subject valve has only been available under one part number, 8N-640-A2. We are now making this valve in five sizes for service stock, each carrying its own part number and color code.

It is recommended that the exhaust valve always be fitted with a minimum of clearance. Now, for the first time, the Ford tractor service representative has a selection of valve sizes which enables him to make the best fit, under any circumstance. It is very important that the exhaust valve be properly fitted in the bushing for best operation of the hydraulic mechanism. To determine this fit, begin with the largest size valve and continue down the color code until the maximum valve size goes into the bushing. This should give a medium tight fit. This fit should be checked with the specified hydraulic oil on the valve and bushing. There is little danger of getting too tight a fit as long as the exhaust valve moves uniformly throughout its travel.

Should you find it necessary to replace the exhaust bushing (8N-625) because of score marks, be sure to install the new one with the holes in a vertical position in the pump housing.

The part number, size and corresponding color code of each valve is listed below:

Part No.	Size of Valve	Color Code
8N-640-A2	.5917 - .5918	White
8N-640-B	.5918 - .5920	Blue
8N-640-C	.5920 - .5921	Yellow
8N-640-D	.5923 - .5924	Green
8N-640-E	.5925 - .5926	Orange

All of the valves listed above are available for immediate shipment and should be ordered in the usual manner, by individual part numbers.

REAR AXLE AND DRIVE

Bulletin Subject: Rear Axle Spline and Hub

1. PROBLEM:

To insure tight fit of hub and rear axle.

In performing rear axle service operations that require the removal of a hub, we have found it advantageous to always replace the hub in the same position on the rear axle spline. This practice helps assure a good fit by utilizing the seat established in the original assembly of the tractor.

2. PRODUCTION CHANGE:

Effective with Tractor Serial Number 8N 147254, all rear axle splines and hubs

are now being stamped with a punch mark which will enable you to always realign them in the same position.

3. FIELD CORRECTION:

In performing rear axle service operations on tractors built prior to the above serial number, we advocate the following field procedure. Before disassembling the rear axle and hub, punch a similar mark on both the hub and rear axle, so that in the reassembly operation you will be able to match the hub to the rear axle as it was before disassembly.

STEERING

Bulletin Subject: Locating Marks for Adjustment of Front Wheel Toe-In on the 8N Tractor

1. PROBLEM:

Difficulty in centering the steering arm over the front axle locating mark.

2. PRODUCTION CORRECTION:

Beginning with tractor serial number 8N-181515, toe-in marks on the front axle were moved from the axle half to a point on the spindle housing directly below the slot in the steering arm, when the wheels are straight forward.

3. FIELD CORRECTION:

Until such time as there is a reprint for the Ford Tractor Operator's Manual (3729-49-C), it will be necessary for dealers to inform customers of the new location of these toe-in marks. The procedure for adjusting the turnbuckle on the drag links remains the same. However, be sure to align the slot in the steering arm with the toe-in mark on the spindle housing.

ELECTRICAL

Bulletin Subject: Installation of Generator 8N-10000-B on 2N and 9N Tractors

1. NEW PARTS REQUIRED:

A. 8N-10000-B Generator
B. 2N-10042 Kit (This kit contains all parts necessary to complete subject installation).

2. INSTALLATION PROCEDURE:

Complete installation instructions and a wiring diagram are in Attachment #8. Please note that the new 8N-10000-B generator can only be used in conjunction with the new 8N-10505-C regulator.

3. SECURING GENERATORS AND KITS:

When ordering a complete conversion assembly, order Generator 8N-10000-B and Kit No. 2N-10042 in the usual manner.

FUEL

Bulletin Subject: Carburetors on 8N Ford Tractors

Since the introduction of the 8N Ford Tractor, several changes have been made in the carburetor to obtain greater fuel economy and better tractor performance.

The information in Attachment #9 will aid in identifying the several variations of the carburetor that have been used, and outlines a procedure to use in the field service of this assembly.

MISCELLANEOUS OR GENERAL

Bulletin Subject: 8N Tractor Changes

Consistent with the efforts of the entire organization to continually improve our products, we are pleased to announce the following changes in the 8N Tractor.

Change No. 1 on All Tractors Starting with Serial No. 217307 on September 1, 1949

Old No. 8N-695-A2 Bushing (hydraulic pump intake valve) replaced by
New No. 8N-695-B Bushing (hydraulic pump intake valve)

The old bushing had four intake holes and a large chamfer, while the new bushing has but two intake holes; and instead of a chamfer there is just a small radius to break the sharp edge. The new bushing does not allow a surge of oil to reach the pistons and cause too rapid a rise in the implements.

Change No. 2 on All Tractors Starting with Serial No. 217307 on September 1, 1949

Old No. 8N-698-B Valve (intake control hydraulic pump) replaced by
New No. 8N-698-C Valve (intake control hydraulic pump)

The old valve had a short taper, while the new one has a much longer one. This longer tapered valve meters the oil to the intake holes in the bushing.

Change No. 3 on All Tractors Starting with Serial No. 215759 on August 29, 1949

Old No. 8N-539 Spring (draft control) replaced by
New No. 8N-539-B Spring (draft control)

This change has been made to provide a more positive fulcrum for the long control lever 8N-540, thus insuring a full intake position of the intake valve when cold oil would tend to resist this movement of the valve. The new springs are painted red to enable them to be quickly distinguished from the old springs which were not painted.

In addition, the free length of the new spring is $\frac{1}{2}$" shorter than the old one.

This new spring in no way changes previous instructions on adjusting the springs in the lift cover. A length of 3.58 inches or roughly 3-37/64 inches is still correct.

Change No. 4 on All Tractors Starting with Serial No. 215759 on August 29, 1949

Old No. 8N-541 Plunger (hydraulic lift draft control spring) replaced by
New No. 8N-541-B Plunger (hydraulic lift draft control spring)

Both of these plungers have the same over-all length, but the new one has a larger diameter head at the clevis end. This provides more bearing area on plate No. 8N-527.

Change No. 5 on All Tractors Starting with Serial No. 215759 On August 29, 1949

Old No. NCA-527-A Plate Assembly (hand lift cover)

Part number remains the same. The only revision made was in the steel and heat treatment thus increasing its strength.

Change No. 6 on All Tractors Starting with Serial No. 215759 on August 29, 1949

Old No. 8N-535 Rocker (hydraulic lift) replaced by
New No. NCA-535-A Rocker(hydraulic lift)

The old rocker has a single hole for attaching the top link. The new rocker has been built up with two additional holes for the top link attachment for occasions when the draft of the implement is so light that little or no reaction is registered through the main control spring. In such cases it will be possible to raise the top link into one of the additional positions provided to increase its leverage over the main control spring.

A general rule that may be followed regarding the position of the top link in the rocker is that the top hole is for light draft, middle hole for medium draft and bottom hole for heavy draft. If an implement with heavy draft is used with the top link in the top hole it upsets the balance of the hydraulic control, which can be corrected by putting the top link in the bottom hole.

Change No. 7 on All Tractors Starting with Serial No. 215043 on August 25, 1949

Old No. 350920-S Bolt (oil seal to retainer & cup assembly to center housing)

New number remains the same. The revisions were made in the type of steel and the bolt is now full bodied instead of being necked down between the threads and the knurled portion. The increase in body size will tend to prevent chucking of the hub. The change in the steel will prevent the bolts from stretching.

Change No. 8 on All Tractors Starting with Serial No. 216989 on September 2, 1949

Old No. 8N-3512 Panel Assembly (instrument) replaced by
New No. 8N-3512-C Panel Assembly (instrument)

The new panel has notches cut out at the bottom for the sector arms of the new steering assembly.

Change No. 9 on All Tractors Starting with Serial No. 216989 on September 2, 1949

Old No. 8N-3503 Gear Assembly (steering) replaced by
New No. 8N-3503-B Gear Assembly (steering)

In the old assembly the left hand sector was controlled from the ball nut and the right hand sector was controlled from the left sector, and both sectors were supported by a bearing on one end only. In the new assembly the sectors have bearings for support at both ends. Another advantage is that now the right hand sector is meshed directly with the ball nut and the left sector is meshed with the right sector. Backlash in the assembly can be eliminated by tightening up the adjusting screws extending through the right and left sides of the housing.

In the event that a new steering assembly is to be installed on an older model tractor, notches may be cut in the old panel assembly rather than replacing it with the new panel assembly.

Change No. 10 on All Tractors Starting with Serial No. 216989 on September 2, 1949

Old No. 8N-3304 Link Assembly (steering drag) R.H. replaced by
New No. 8N-3305-B Link Assembly (steering drag) L.H.

The above numbers are interchangeable.

Old No. 8N-3305 Link Assembly (steering drag) L.H. replaced by
New No. 8N-3304-B Link Assembly (steering drag) R.H.

The above numbers are interchangeable.

See the chart on Page 22 of the Ford Tractor Parts and Accessories Catalog, PA 5933-2, for further information on drag links.

On the old steering assembly the right hand drag link was the longest. In the new assembly the right sector is controlled directly by the ball nut and consequently the left hand drag link is the longest. There is no change in material or specifications only that the long drag link is now on the left side, and the short drag link is on the right side.

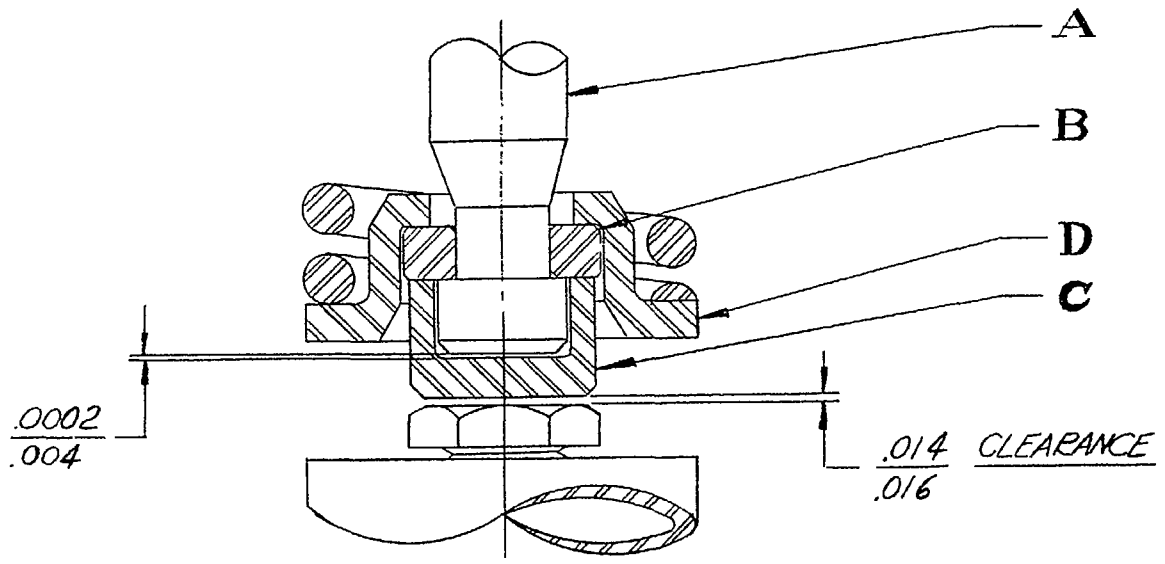
Change No. 11 on All Tractors Starting with Serial No. 215050 on August 25, 1949

Old No. 8N-7029 Washer (reverse idler gear thrust)

New part number remains the same. The change involves the addition of two tabs which are punched in the washer to anchor it to recesses in the transmission case. This prevents the washer from turning and wearing against the transmission case.

BULLETIN ATTACHMENTS

INSTALLATION INSTRUCTIONS FOR NEW VALVE IN THE FORD TRACTOR ENGINE



A new type exhaust valve assembly is illustrated and described above. The assembly consists of a valve "A", two keys "B", a cap "C", and a special spring retainer "D"; the standard spring being used with this assembly.

The parts, when correctly assembled, permit the valve to be entirely free of the spring force during the lift portion of the cycle. At the beginning of lift, the tappet lifts the keys through the medium of the cap which, in turn, lifts the spring retainer and spring, thus leaving the valve free of the influence of the spring with respect to cocking and undue side-loading. During the normal travel, the valve can turn, oscillate, or otherwise move in its guide. With this action, the deposits that tend to build up at the head end of the guide and on the stem are constantly scrubbed, thus preventing sufficient build-up to take up the normal clearance. Furthermore, the deposits that occur between the valve face and its mating seat cannot build up excessively or unevenly; the net result being that a much better contact is maintained between the two faces, which insures proper sealing.

INSTALLATION

The successful operation of the new valve assembly depends, to a large extent, on proper installation. The clearance required is controlled by the length between the face of the undercut in the valve and tip end, and the depth of the cap. If the cap depth is too shallow, it will not lift the keys and springs and, on the other hand, if the cap is too deep or the length between the groove face and tip is too great, the clearance will be excessive, resulting in a high wear rate and possible valve breakage.

This clearance can readily be checked after the parts are assembled in the engine, by turning the engine over until the valve is free in the lifted position. It should then be free and the actual clearance can be measured by locating an indicator on the valve head and noting the reading - then the valve is moved vertically. This clearance can be .0002", providing the valve turns freely, to not over .004" maximum vertical movement.

RECOMMENDED INSTALLATION

1. Check valve guides after cleaning out the deposits, and if bell-mouthed or worn so that the clearance is 50% over the original factory recommendation, install new guides.

2. Re-face cylinder seats and check with indicator.

3. Inspect valves and seats to be certain that parts have not been nicked in handling.

4. Turn the engine until the valve is lifted and check freedom by turning the valve head.

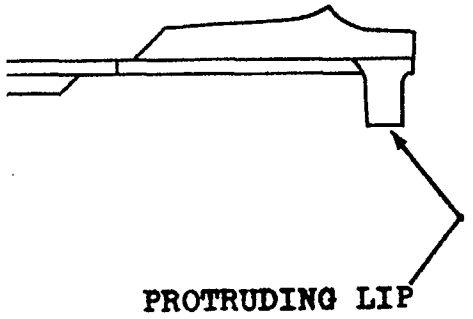
SERVICING

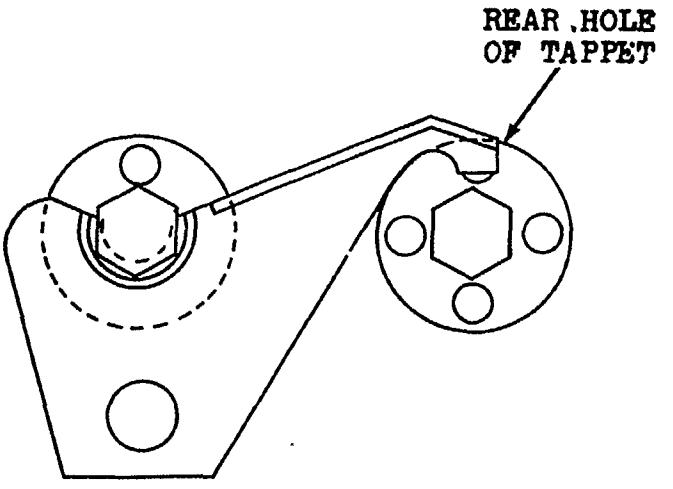
The valve assembly should improve valve life so that, under normal conditions,they do not need to be checked until the engine is ready for overhaul. Normally, the greatest wear will occur on the portion of the key that contacts the valve groove face. If this is excessive, the keys should be discarded.

Before reinstalling, check clearance by assembling retainer, keys, and cap to valve. Hold retainer and press on cap. Rotate valve while pressing parts together. The valve should turn freely. If binding occurs, it may be due to nicks, dirt, or cap too shallow. To correct for shallow cap, either use new cap or grind valve tip face.

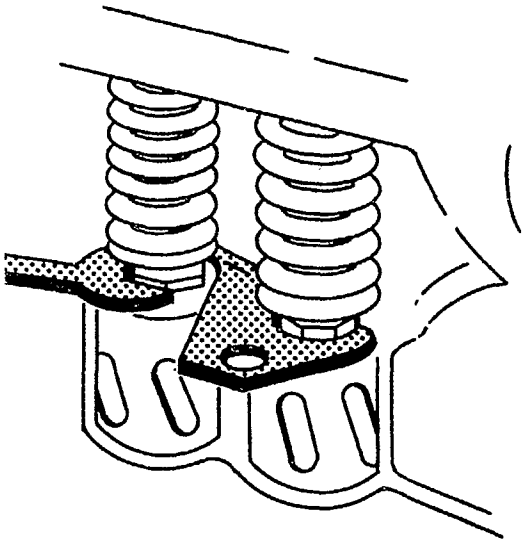
If valve is free, check clearance by inserting small piece of shim stock .004" thick between valve tip face and cap. Press parts together. If valve does not bind, clearance is too great and should be reduced by polishing the cap open end against a piece of fine emery cloth. Recheck clearance and rework cap until not more than .004" shim stock is required to bind valve.

INSTRUCTIONS

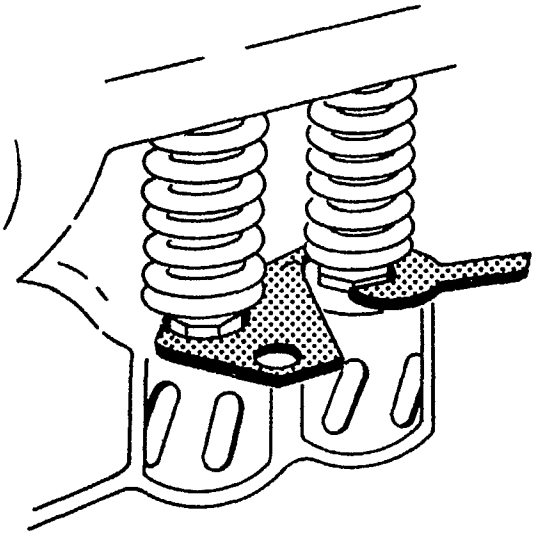




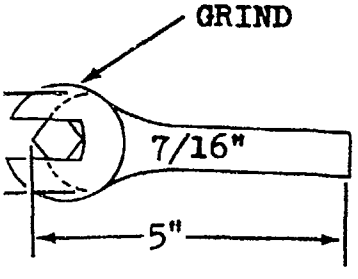
RIGHT HAND SHOWN



8N-17046-A
LEFT HAND



8N-17045-A
RIGHT HAND



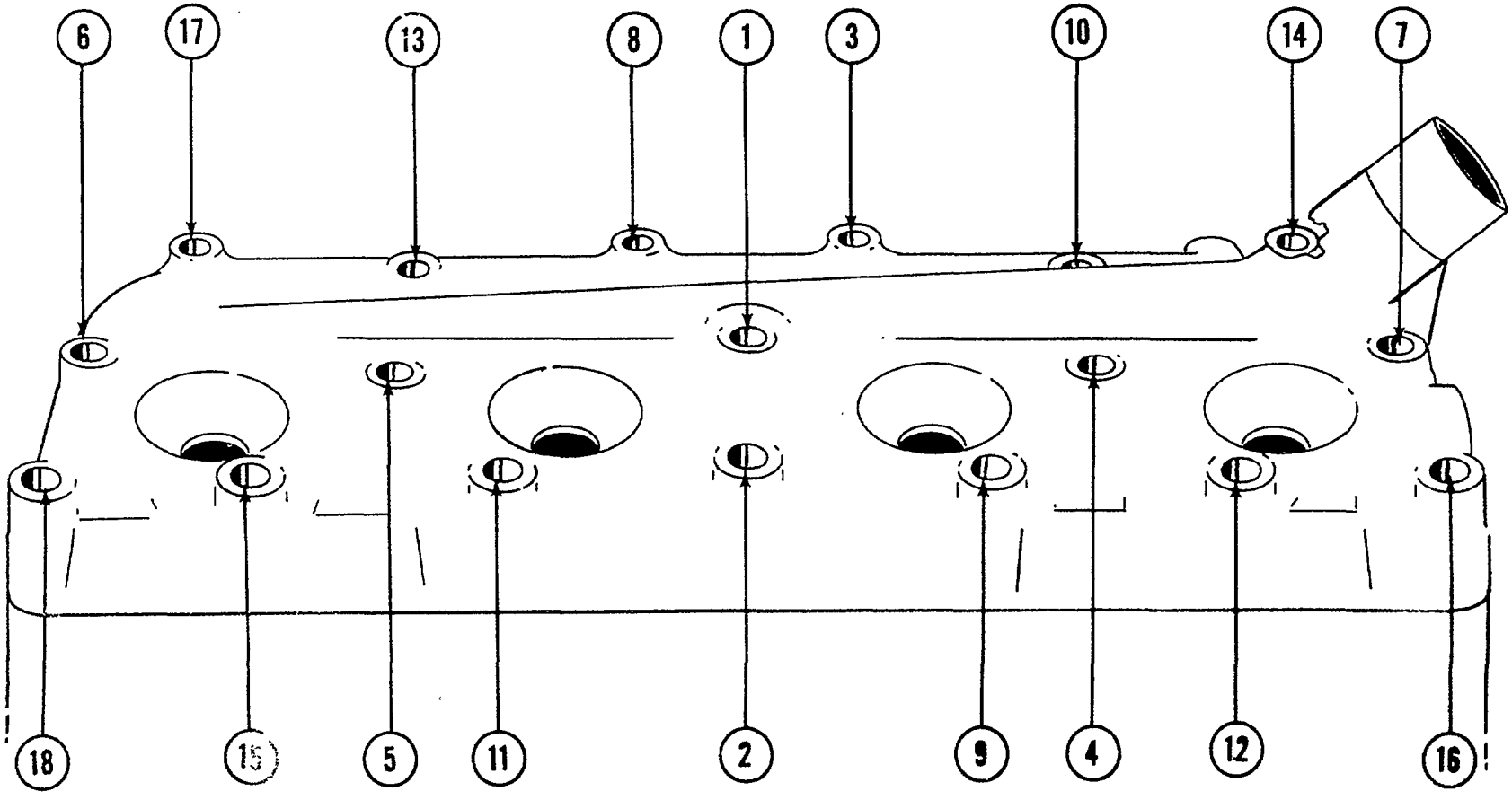
7/8" MAX

To adjust a tappet, proceed as follows:

1. Insert the protruding lip of the wrench into the rear hole of the tappet being adjusted.
2. Place the other end under the head of the adjacent tappet as shown.
3. To prevent interference with the tappet retaining wrench, grind the head of your tappet adjusting wrench to the dimension shown.

HEAD BOLT TORQUE SPECIFICATIONS

Cylinder Head Nuts.....50 to 55 Ft. Lbs.
Cylinder Head Cap Screws....65 to 70 Ft. Lbs.



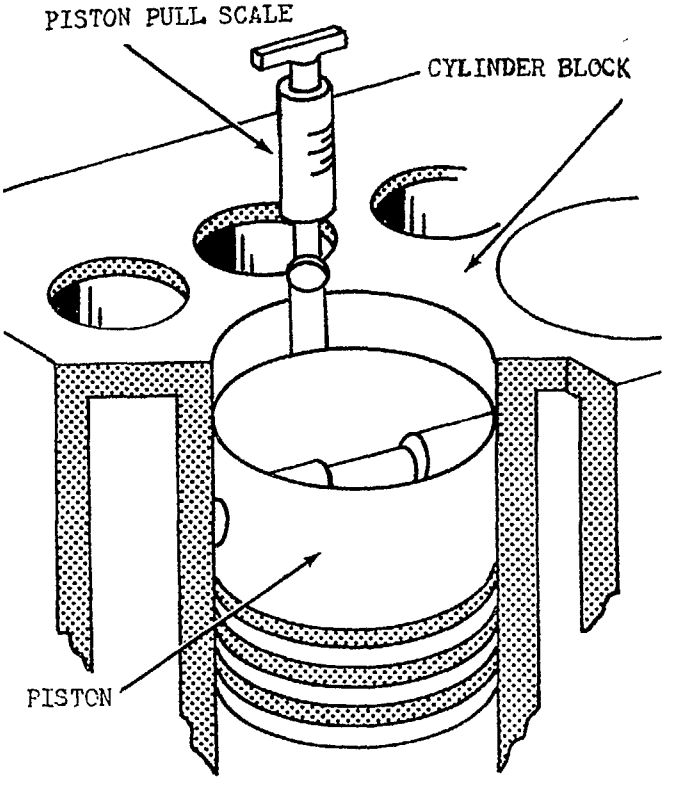
RECOMMENDED SEQUENCE FOR TIGHTENING
HEAD CAP SCREWS OR NUTS

FORD TRACTOR 8N ENGINE RING OVERHAUL
with
General Specifications

check the clearance of a piston in cyl-
er bore, use a thickness gauge 1/2" wide
l long enough to extend over the entire
gth of a piston. Attach the thickness gauge
i tension scale and place gauge on the side
the piston so that it is 90° (right angle)
m the piston pin hole. Invert the piston,
without rings push into bore far enough
as to have 1" to 1-1/2" clearance between
tom of piston and top of block. withdraw
gauge and observe the reading on the ten-
i scale.

The thickness gauge to use and the
inds pull for various piston and sleeve
nbinations are as follows:

inder and Aluminum ston Combination	Thickness Gauge	Pounds Pull
Sleeve-New Piston	.002 x 1/2 in.	5-10
Sleeve-Worn Piston	.003 x 1/2 in.	5-10
n Sleeve-New Piston	.003 x 1/2 in.	5-10
n Sleeve-Worn Piston	.004 x 1/2 in.	5-10

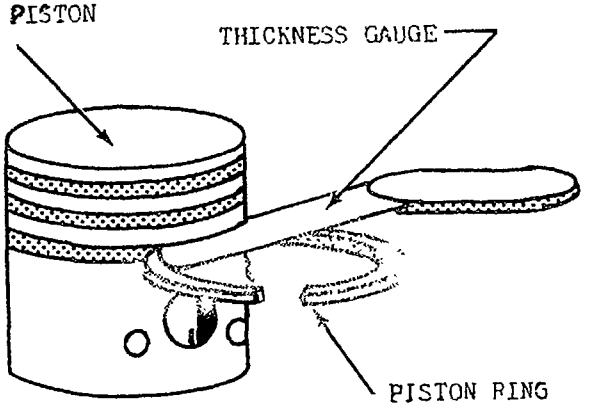


FITTING PISTON TO CYLINDER BORE

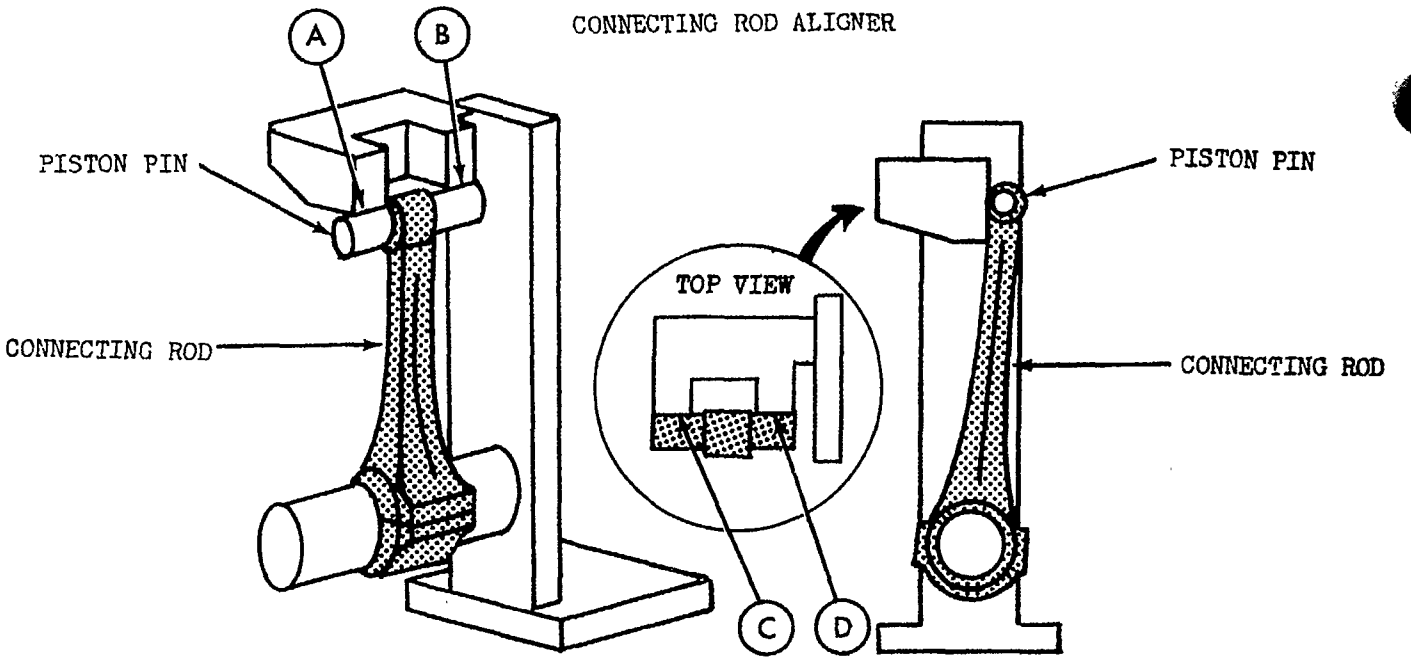
RING GROOVE WIDTH

Check the width of the ring grooves
h new piston rings and a thickness gauge
ery 120° around the circumference of
ston in accordance with the following
ecifications:

	Side Clearance	Wear Limit
Compression Rings	.0015-.003	.004
ond Compression Rings	.001-.0025	.0035
Control Ring	.0015-.003	.004



CHECKING RING GROOVE WIDTH



CHECKING CONNECTING ROD FOR BEND

CHECKING CONNECTING ROD FOR TWIST

ROD ALIGNMENT AND PISTON PIN FITS

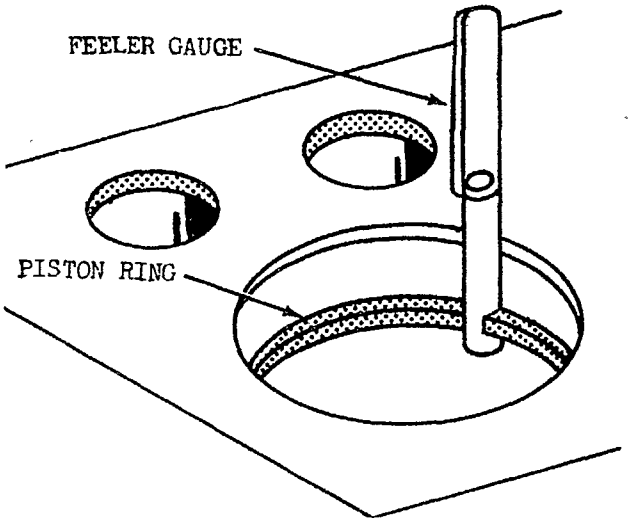
Check the connecting rod for alignment. Bent or twisted rods must be aligned within 0.0013 at each end of the piston pin when the pin is centered in the connecting rod. These measurements are taken on a standard connecting rod aligner at (A) and (B) for bend and at (C) and (D) for twist.

The correct fit for a piston pin in the connecting rod bushing exists when the pin to be used will pass slowly through the bushing by its own weight when pin and bushing are dry. If bushing is excessively worn, drive it from the connecting rod with a suitable driver. Press a new bushing into the rod. Drill the two oil holes in the bushing to the same size as the holes in the rod. Ream and burnish or hone the bushing to 0.7505 inch diameter.

Piston pin to piston fit is 0.000-0.0002. This may seem tight, but under operating temperature the expansion of the piston will permit sufficient clearance for efficient operation.

PISTON RING END GAP

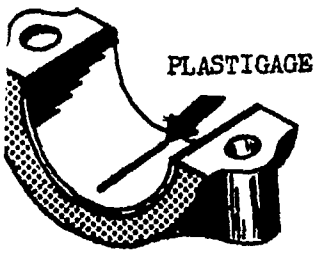
Place each new piston ring in the cylinder, and press it about halfway into the cylinder bore with AN INVERTED PISTON so the ring will be square with the cylinder wall. Measure the ring gap with a thickness gauge. If the gap is less than 0.007-0.017 in the top compression ring and less than 010-.017 in the second compression and oil ring, remove the ring and file it with a fine cut file until the correct ring gap is obtained. Ring end gap should be staggered on the piston at 120° when engine is being assembled.



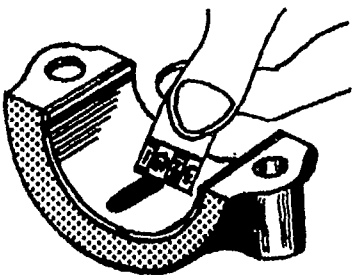
MEASURING PISTON RING END GAP

TORQUE WRENCH READINGS

	Torque Values
Main Bearing Nuts	75 - 85 Lbs. Ft.
Main Bearing Place Bolts	90 -100 Lbs. Ft.
Connecting Rod Nuts-Castellated	35 - 40 Lbs. Ft.
Connecting Rod Nuts-Self Locking	35 - 40 Lbs. Ft.
Connecting Rod Nuts-Marsden	35 - 40 Lbs. Ft.
Connecting Rod Lock Nuts-Pal	4 - 5 Lbs. Ft.
Cylinder Head Nuts	50 - 55 Lbs. Ft.
Cylinder Head Cap Screws	65 - 70 Lbs. Ft.
Fly Wheel Self Locking Cap Screws	75 - 85 Lbs. Ft.
Spark Plugs	25 - 30 Lbs. Ft.
Oil Pan to Cylinder Block	15 - 18 Lbs. Ft.



Plastigage inserted on bearing shell before it has been re-installed and tightened.



Plastigage after bearing cap has been removed. This bearing has .0015" clearance.

FITTING MAIN & CONNECTING ROD BEARINGS

Place a piece of Plastigage on the full width of the bearing insert. Install bearing cap and tighten nuts evenly with a torque wrench to 35 - 40 ft. pounds. Allow caps to remain tightened approximately one minute before removing caps to check Plastigage for oil clearance. Remove bearing. Flattened Plastigage will be found adhering to either bearing shell or crankshaft. Determine bearing clearance by comparing width of flattened plastic at widest point with graduation on container. If the clearance exceeds .003" on the main bearings, they should be replaced. Replace the connecting rod bearings if the clearance exceeds .003".

CONNECTING ROD AND PISTON ASSEMBLY

FIT LOCATION NAME	ORIGINAL FIT TOLERANCES	FIT WEAR LIMIT	TYPE OF FIT
Connecting rod side clearance	.004 in. to .011 in.	.013 in.	—
Piston pin clearance in connecting rod	.0001 in. to .0005 in. loose	.0012 in.	Slip
Piston pin clearance in piston	.000 in. to .0002 in. loose	.0012 in.	(Light Push)
Piston and cylinder	5-10 pounds pull on .002 x ½ in. shim	5-10 pounds on .003 x ½ in. shim	—
Top piston ring to groove side clearance	.0015 in. to .0030 in.	.004 in.	—
Second ring	.001-.0025	.0035 in.	—
Oil ring	.0015-.003	.004 in.	—
Top ring gap	.007-.017 in.	.030 in.	—
Second ring gap	.010-.017	—	—
Oil ring gap	.010-.017	—	—

CRANKSHAFT

FIT LOCATION NAME	ORIGINAL FIT TOLERANCES	FIT WEAR LIMIT	TYPE OF FIT
Crankshaft end play	.002 in. to .006 in.	.008 in.	
Main bearing clearance	.0005 in. to .0025	.005 in.	Running
Connecting rod bearing clearance	.0009 in. to .0025 in.	.005 in.	Running and Floating

INSTRUCTIONS
FOR
SERVICING CAST IRON SLEEVES
PART NO. 8N-6055-B

1. Remove the old sleeves from the cylinder block as follows:
   a. Remove the manifold and all valve assemblies.
   b. Remove cylinder ridge.
   c. Remove the connecting rod and piston assemblies.
   d. Remove the old sleeves with a constant pressure type sleeve remover.
   e. Cover the crankshaft with an oil soaked cloth.
   f. Clean all varnish and carbon from the cylinder block bore with a deglazing tool.
   g. Scrape the counter bore clean with a suitable tool.

NOTE: In all cases valve faces and seats should be reconditioned after installing sleeves. This is necessary to correct for any valve seat distortion that may be caused by the press fit of the sleeves into the cylinder block bores.

2. Install the new cast iron sleeves as follows:
   a. Wash each sleeve in gasoline or naptha to remove the protective coating of oil and dry the sleeve throughly.

CAUTION: Do not use an impact type sleeve installer.

   b. Press the sleeves into the cylinder block bores with a screw or constant pressure type sleeve installer.

NOTE: When reconditioning valve seats they should be checked with a dial indicator for runout. If this runout is found to be in excess of .0015, the valve seats should be ground and checked again.

3. Fit each piston to its respective sleeve bore using a pull scale with a .002 x ½" feeler gauge as specified in Service Bulletin No. 182, dated October 5, 1951. In the majority of cases, to obtain the required fit of 5-10 pounds pull, it will be necessary to hone the sleeve bore. If honing is necessary a suggested procedure is provided below.
   a. Use a rigid type hone and No. 220 grit stones. A drill with a capacity of 250-450 RPM should be used to drive the hone.

NOTE: The speed of the hone and rapidity of the stroke governs the cross hatch marks on the sleeve. The cross hatch marks should intersect at approximately 90° for proper ring seating.

   b. Operate the hone through the bor 10 or 12 complete strokes. Remo the hone, clean the sleeve with dry rags, and recheck the piston fit.
   c. Repeat the above procedure, until the necessary amount of material has been removed for the specified piston to bore fit.

CAUTION: Do not use gasoline or kerosene to clean the sleeve walls after the honing operation. Solvents of this type will not remove the abrasive but will further embed small abrasive particles into the pores of the cylinder block. Diagram "A" shows the surface of a sleeve wall before it has been properly cleaned and after it has been cleaned by following recommended procedure.

4. Clean the cylinder block of all foreign material as follows:
   a. Wipe or remove as much of the abrasive material as possible.
   b. Swab each sleeve wall, valve port and chamber with clean SAE 10 Motor Oil at least twice.
   c. Wipe the oil out of the sleeves with clean rags.
   d. Wash the sleeve bores and valve chambers with hot soapy water.
   e. Flush water jackets to remove foreign material which might cause excessive wear to the water pump.
   f. Remove the rags from the crankshaft and wash the crankshaft off with hot soapy water.
   g. Dry the cylinder block throughly. (Using compressed air)
5. Reassemble the engine.

Installation Instructions
for
Oversize Piston and Ring Sets

1. The following procedure is necessary prior to reboring and honing the cast iron sleeve, part no. 8N-6055-B, to fit oversize piston and ring assemblies.
   a. Determine which oversize piston assembly is required by measuring the diameter of the cylinder bore at its largest diameter (top of ring travel) by using an inside micrometer or telescope gauge and outside micrometer.
2. Install a cylinder boring machine on the cylinder block.
   a. Cover the crankshaft with an oil soaked cloth.
   b. Set the diameter of the cutting tool so that the cylinder bore will be .002" undersize to allow for honing the bore for the specified piston fit.
   c. The following are part numbers and mean diameters for service piston assemblies.

PISTON ASSEMBLIES

8N-6110-D	3.2080 Dia.	.020 O.S.
8N-6110-E	3.2180 Dia.	.030 O.S.
8N-6110-F	3.2280 Dia.	.040 O.S.

3. To obtain the required piston fit to cylinder bore of 5 - 10 pounds pull using a .002 x .50 ribbon and the specified sleeve finish for proper ring seating, the following procedure is recommended.
   a. Use a rigid type hone and No. 220 grit stones. A drill with a speed range of 250 - 450 R.P.M. should be used to drive the hone. The stones must be dry when used to obtain the desired cylinder sleeve finish.

NOTE: The speed of the hone and rapidity of the stroke governs the cross hatch marks on the sleeve. The cross hatch marks should intersect at approximately 90° for proper ring seating.

   b. Operate the hone through the bore 10 or 12 complete strokes. Remove the hone, clean the sleeve with dry rags, and recheck the piston fit.

c. Repeat the above procedure, until the necessary amount of material has been removed for the specified piston to bore fit.

CAUTION: Do not use gasoline or kerosene to clean the sleeve walls after the honing operation. Solvents of this type will not remove the abrasives but will further embed small abrasive particles into the pores of the cylinder block.

NOTE: If valve seats need refacing, this should be done previous to cleaning the cylinder block.

5. Clean the cylinder block of all foreign material as follows:

   a. Wipe or remove as much of the abrasive material as possible.

   b. Swab each sleeve wall, valve port and chamber with clean SAE 10 motor oil at least twice.

   c. Wipe the oil out of sleeves with clean rags.

   d. Wash the sleeve bores and valve chambers with hot soapy water.

   e. Flush water jackets to remove foreign material which might cause excessive wear to the water pump.

   f. Remove the rags from the crankshaft and wash the crankshaft with hot soapy water.

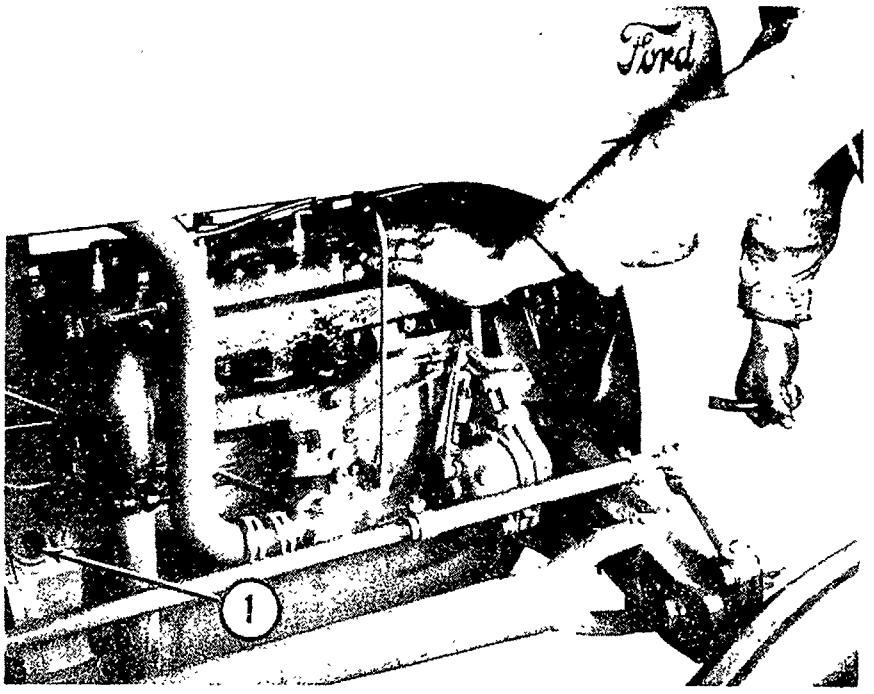
   g. Dry the cylinder block thoroughly, using compressed air.

6. Reassemble the engine with reference to Service Bulletin Number 182, dated October 5, 1951.

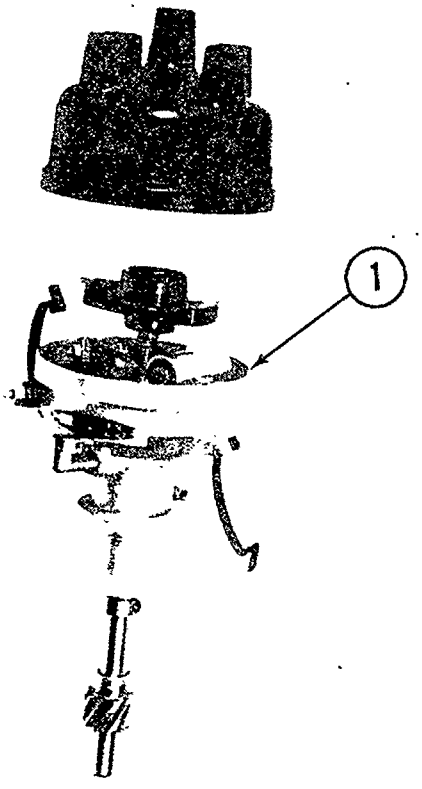
CORRECT INSTALLATION AND TIMING PROCEDURE FOR THE ANGLE DRIVE DISTRIBUTOR ON THE 8N FORD TRACTOR

Remove #1 spark plug.

With ignition off, place thumb or finger over the #1 spark plug hole and crank slowly until compression is felt (Fig. 1).



(Fig. 1)



(Fig. 2)

3. Continue to crank the engine until the timing mark, "0°" (dead center) on the flywheel, exactly aligns with the pointer in the timing window (1) Fig. 1 on the right side of flywheel housing.

NOTE: Flywheel is calibrated from "0°" to "20°" in two places, 180° apart.

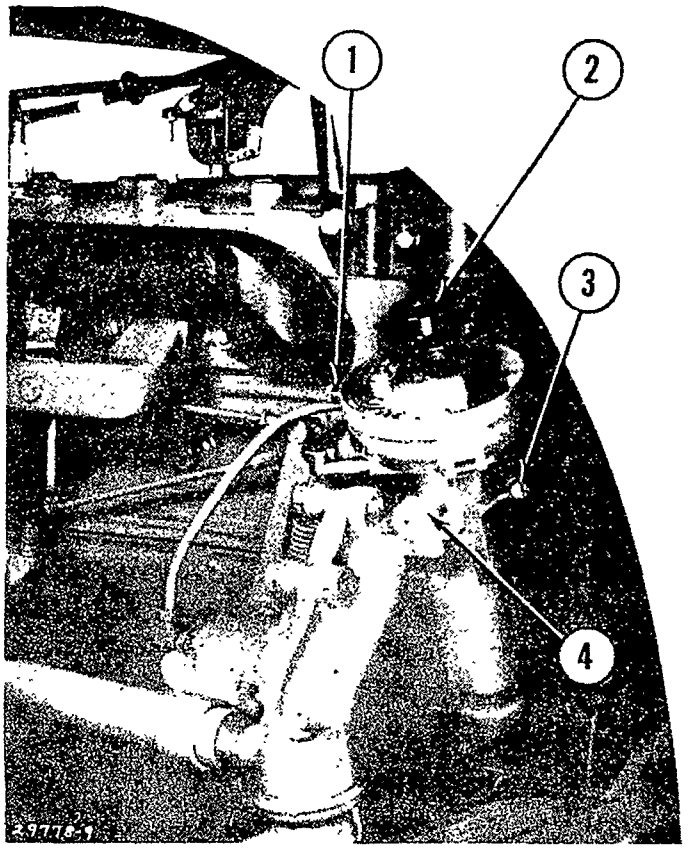
4. Insert the distributor assembly (1) Fig. 2. With the gears fully meshed, the rotor should point to the right front cylinder head bolt. If not, remove and re-engage until the proper rotor position is obtained (2) Fig. 3.

NOTE: The breaker point gap on this distributor should be .025".

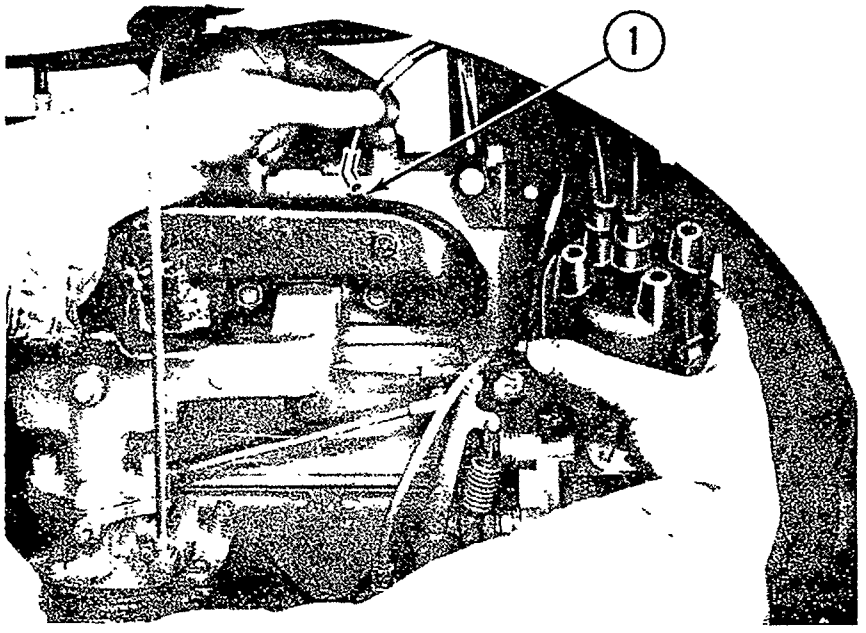
5. Loosen the clamp screw (3), Fig. 3 center the adjustment slot on the cap screw (4), Fig. 3 and tighten the cap screw.

6. Position the distributor housing so that the primary terminal is pointing to the rear (1), Fig. 3.

7. Rotate the distributor "counter clockwise" until the breaker Points are closed.



(Fig. 3)

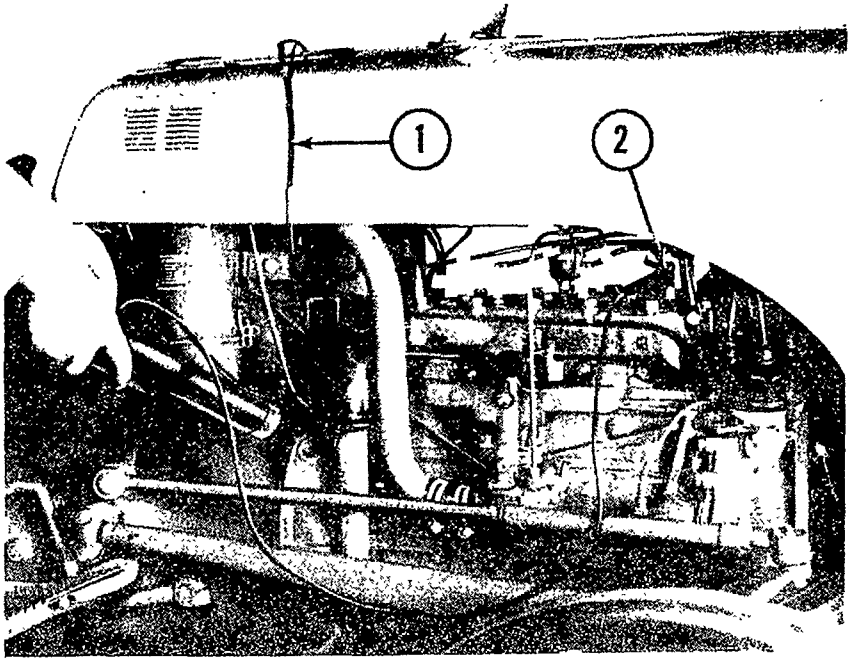


(Fig. 4)

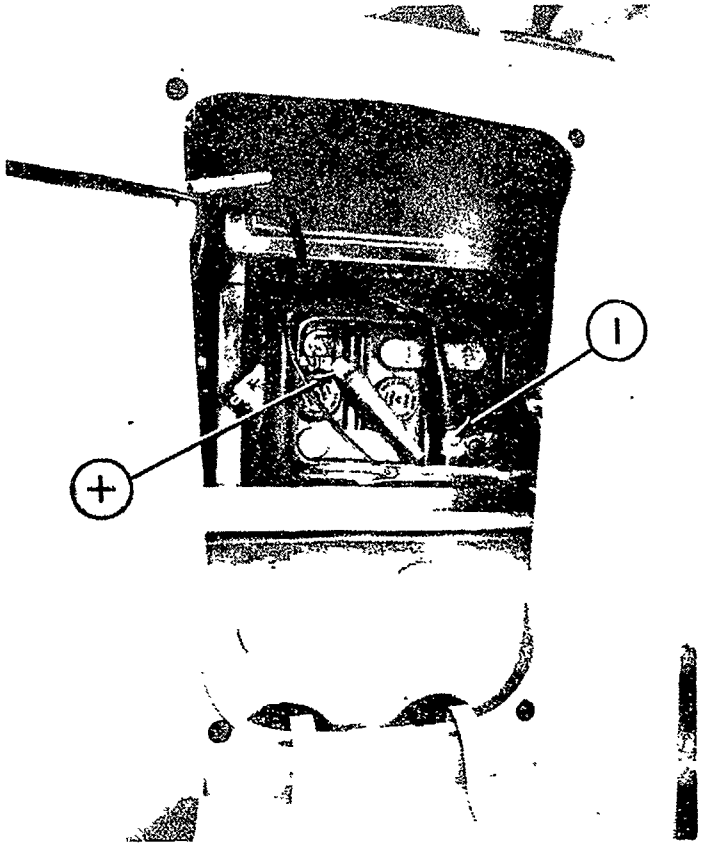
8. Install the distributor cap; connect the primary, secondary and #1 spark plug wires (See Fig. 4).

9. Hold the end of #1 spark plug wire approximately 1/8" from the cylinder head or manifold with the ignition "on", and then slowly rotate the distributor housing "clockwise" until a spark occurs at (1), Fig. 4. Tighten the clamp screw (3), Fig. 3 securely. The spark should occur in less than 1/8 turn of the distributor housing.

Install #1 spark plug and connect all spark plug wires to their respective numbers on the distributor cap (1 to 1, 2 to 2, 3 to 3, & 4 to 4).



(Fig. 5)



(Fig. 6)

11. Check the timing and automatic spark advance with timing light as shown in Fig. 5

a. Connect the single timing light wire to #1 spark plug terminal (2), Fig. 5 and the double wire to the battery (1), Fig. 5 and Fig. 6.

b. Start the engine and check the timing and automatic spark advance. The flywheel marks should line up with the timing window pointer, at various speeds, as follows:

400-500 rpm	4°
1000 rpm	8°- 9°
1500 rpm	12°- 13°
2000 rpm	17°- 18°

INSTALLATION INSTRUCTIONS 8N-10000-B Generator and 2N-10042 Kit on 2N and 9N Tractors.

Following is the procedure for installing the Generator 8N-10000-B and the Conversion Kit 2N-10042 on 2N and 9N Model tractors.

1. DISASSEMBLY:

   A. Remove the 8N-10000-A Generator assembly, the Generator belt adjusting clamp 2N-10181 (when used) and the Generator cutout 9N-10505-B.

   B. Tape or cut both ends of cutout to generator armature wire (yellow with black tracer) which was disconnected from cutout (bottom terminal) and generator.

2. INSTALLATION:

   A. Install the 8N-10000-B Generator and the 2N-10181-B Generator belt adjusting clamp (where used)

   B. Install (where 9N-10505-B cutout was removed) the 2N-10599 Mounting Bracket and 8N-10505-B Voltage Regulator Assembly.

   C. Attach the 2N-14305 wiring assembly to the 9N-12112 conduit with the four (4) 91A-10882 clips.

   D. Connect the yellow lead from the original wiring assembly 9N-14401-C (was connected to top terminal of cutout) to the battery terminal on voltage regulator.

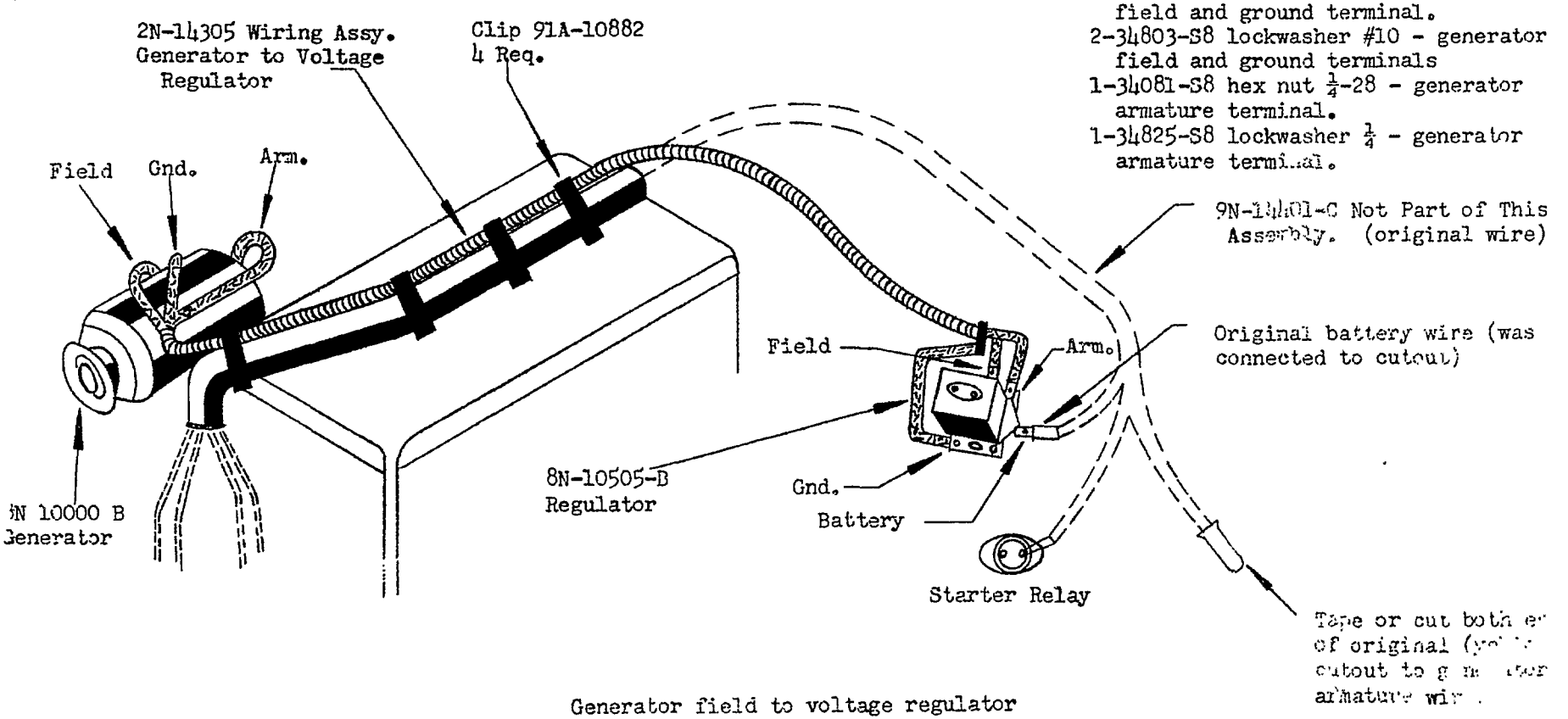
   E. Connect the leads as follows:

      1. Generator field to voltage regulator field (black with white tracer).
      2. Generator ground to voltage regulator ground (black with red tracer).
      3. Generator armature to voltage regulator armature (yellow with black tracer).

INSTALLATION DIAGRAM
FOR INSTALLING 8N-10000B GENERATOR ON 2N and 9N TRACTORS

Additional Parts Required (not shown on diagram)

1-2N-10181-B Generator belt adjusting clamp.
1-2N-10599 Bracket-mounting regulator.
3-33795-S7-8 hex nut $\frac{1}{4}$-20 mounting regulator to bracket.
3-34805-S7-8 L/washer $\frac{1}{4}$" - mounting regulator to bracket.
2-34079-S8 hex nut #10-32-Generator field and ground terminal.
2-34803-S8 lockwasher #10 - generator field and ground terminals
1-34081-S8 hex nut $\frac{1}{4}$-28 - generator armature terminal.
1-34825-S8 lockwasher $\frac{1}{4}$ - generator armature terminal.



Generator field to voltage regulator
Black with white tracer

Generator ground to voltage regulator
Black with red tracer

Generator armature to voltage regulator
Yellow with black tracer

IDENTIFICATION AND SERVICING OF CARBURETORS ON 8N FORD TRACTORS

A. Starting with Tractor Serial No. 8N-313112, a modified 8N carburetor became standard in production.

B. The following cross reference between the part numbers assigned and the part numbers used by the Marvel-Schebler Corporation will provide identification of all carburetors used on the 8N Ford Tractor.

Part No.	Marvel-Schebler Part No.	Type Carburetor
9N-9510	TSX 33	9N carburetor used on tractors prior to Serial No. 260596
8N-9510	TSX 241	8N carburetor used on tractors between Serial Nos. 260596 and 276115 (without economizer jet).
8N-9510	TSX 241A	8N carburetor used on tractors between Serial Nos. 276115 and 313112 (with economizer jet)
8N-9510	TSX 241B	8N carburetor used starting with Serial No. 313112 (modified)

NOTE: The Marvel-Schebler part number will be found on the boss located on the right hand side of the carburetor body.

C. The steps listed below are provided for guidance as an aid in the correction of complaints of unsatisfactory performance that may be encountered.

1. Check the timing of the distributor as outlined in Service Bulletin 115.

2. Disassemble the carburetor and clean it thoroughly.

3. The operation of tractors equipped with the TSX-241 carburetor in which the engine tends to "stumble" either while idling or when placed under load, can be improved by installing the economizer jet, Part No. 8N-9914. The installation of this jet along with proper carburetor adjustment, will in most cases correct this "stumbling" condition. (See Service Bulletin 118)

4. When reassembling the carburetor and fastening the halves together, care should be taken in tightening the screws. The rear screws (next to the air inlet) should be securely tightened first.

5. Both the 8N and the 9N carburetor are adjusted in much the same manner. In some cases, it may be necessary to open the idle adjustment needle of the 8N carburetor as much as one and one-quarter turns, and the main adjustment needle one and one-half turns to obtain proper engine performance.

In adjusting the 9N carburetor, turn the idle adjustment needle approximately three-quarters of a turn open and the main adjustment needle one full turn open.

NOTE: The fact that the 8N carburetor adjustment needles are opened more than those on the 9N carburetor does not necessarily mean increased fuel consumption. The increased openings in the 8N carburetor are due to the difference in construction and venting of the bowl. The gasoline consumption of the two carburetors should be approximately the same.

6. In cases where a tractor with an 8N carburetor does not operate satisfactorily, even after the carburetor jets have been installed and the carburetor properly adjusted, it is recommended that the entire carburetor assembly be replaced.

   In these cases submit an S.A.R. claim covering the cost of such replacement.

The percentage of defective carburetors will be very low and the recommendation given in item 6 above is not to be construed as a basis for making an all out carburetor replacement campaign.

Correction should be made on Page 82 of the Ford Tractor Operator's Manual (Ford form 3729-50-F). The paragraph in the middle of the page reads:

"The idle adjustment needle should be opened approximately two and one-half revolutions."

This sentence should be corrected to read:

"The idle adjustment needle should be opened approximately one (1) revolution."