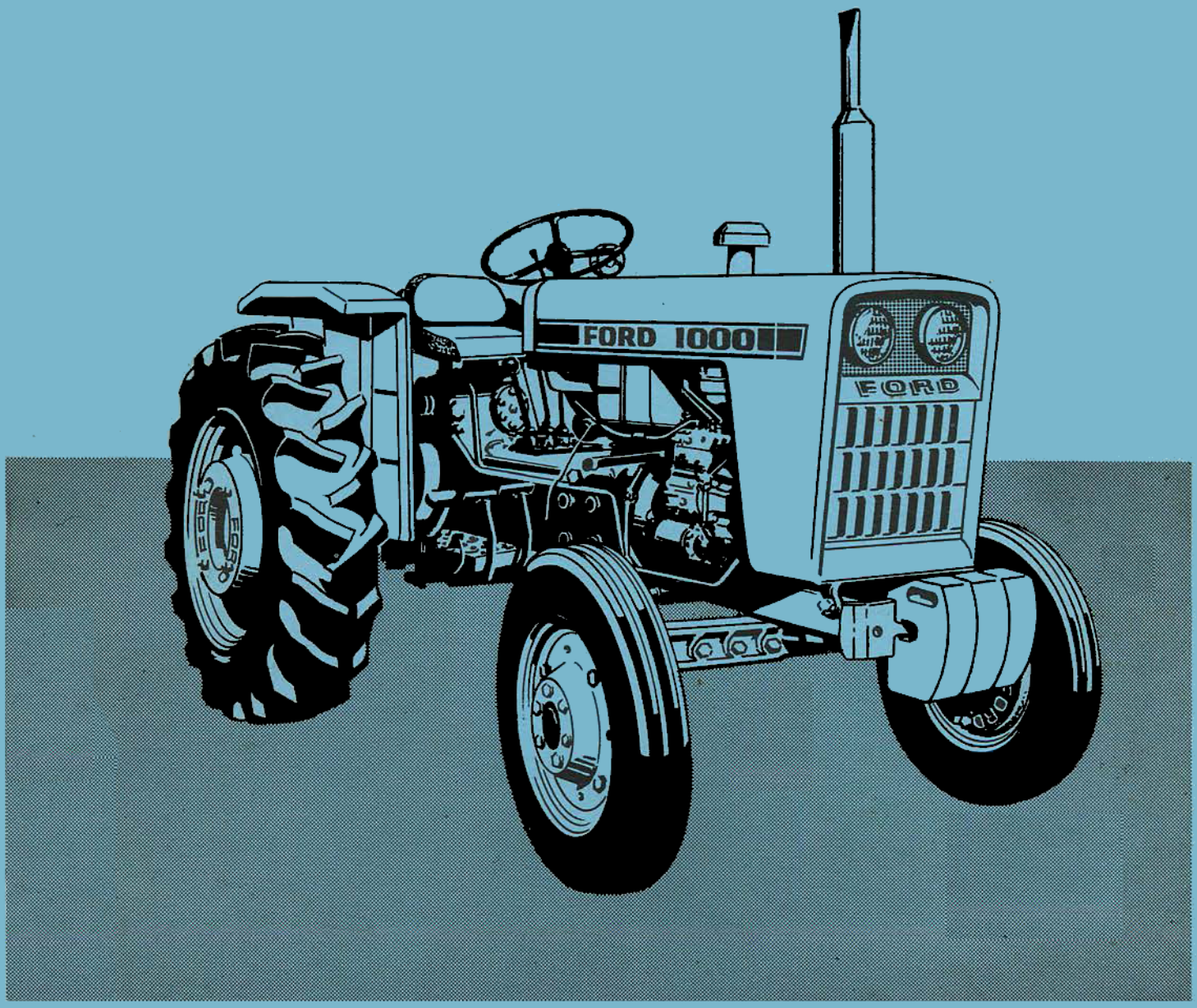
FORD 1000

Tractor Repair Manual



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Part 1

ENGINE

Chapter 1

ENGINE AND LUBRICATION SYSTEM

1. DESCRIPTION AND OPERATION

The Ford 1000 engine is a two cylinder four cycle diesel engine. This part of the manual deals with the removal, disassembly, inspection and repair, and assembly of the engine and the lubrication system, plus the cooling system.

CYLINDER HEAD AND ROCKER ARMS

The cylinder head assembly incorporates the valves, valve springs, and rocker arm assembly. The cylinder head is retained to the block by six studs. This provides a four bolt circle for each cylinder.

There is one complete rocker arm and support assembly for each cylinder. The rocker arms are retained to the rocker shaft by snap rings. The rocker arm support is located on a stud in the cylinder head and is aligned by means of a roll pin in the head which protrudes into a counter bore in the base of the rocker arm support.

The cylinder head incorporates a pre-combustion chamber. The injectors are located in the cylinder head and spray fuel into the pre-combustion chamber.

CYLINDER BLOCK ASSEMBLY

The crankshaft is supported by two main bearings. The main bearings are full circle bearings and are press fit bearings. The front bearing is located in a bore in the front of the block and the rear bearing is located in the flywheel cover. For proper alignment, the cover is dowelled to the block assembly.

There are also two thrust bearings controlling end movement of the crankshaft, one is on the flywheel cover and the other on the inside face of the front of the block. The thrust bearings are held in position by a roll pin.

The camshaft is mounted on the right side of the block assembly as viewed from the front of the engine. The camshaft is supported by ball bearings at each end. The rear of the camshaft is sealed with an O-ring which fits in a counterbore in the block and is held in position by the flywheel cover.

LUBRICATION SYSTEM

The oil pump assembly consists of a body, gear set, cover and drive gear. The oil pick up tube attaches to the rear of the body and extends into the sump. The body is located in a bore in the front of the block assembly below and to the left of the crankshaft location as viewed from the front. The gear set is positioned in the body and retained in position by the cover. The front cover is bolted to the oil pump body and to the block assembly. The oil pump drive gear is driven by the crankshaft gear.

Oil is picked up from the sump by the intake tube and drawn into the lower side of the oil pump body. Oil from the pump flows through passages in the block, past the relief valve, through the oil filter and returns to the area of the drilled bolt located directly above the oil pump. (The relief valve is mounted in the front of the block and intersects the main oil passage. When the oil pressure becomes higher than the rated value, page 30, oil is discharged through the relief valve and into the crankcase.) At this point, part of the oil is directed to the crankshaft front main bearing and passes through a drilling in the crankshaft to the No. 1 cylinder rod bearing. The remaining portion of the oil is directed through the external tube to the idler gear shaft. Inter connecting drilled passages in the idler gear shaft provide lubrication to the idler gear and connect with the external tube located between the idler gear shaft and the drilled bolt located above the camshaft. Oil flows from the tube and bolt to the main oil gallery. The main oil gallery flows the full length of the block assembly to the rear main bearing and to the No. 2 cylinder rod bearing by way of the crankshaft. The crankshaft and rod bearings are lubricated by means of oil passages through the block to the main bearings. The crankshaft is drilled from the main bearing journals to the rod bearing journals for lubrication of the rod bearings.

The tappet bores are also located within the main oil gallery. Oil flows around the tappets for lubrication and into a cross drilling in the tappet. From here it flows through the center of the tappet and up the hollow push rod to the rocker arm assembly.

The adjusting screw and the rocker arm have drilled passages which provide pressurized lubrication to the rocker arm shaft. Controlled oil leakage at this point lubricates the valve stems. Oil flows from the top of the head back to the sump in the same manner as other Ford Tractor engines. Cylinder walls, pistons, and piston pins are splash-lubricated by the crankshaft.

2. ENGINE REMOVAL AND DISASSEMBLY

A. REMOVAL

1. Disconnect and remove the battery cables, the starter relay terminals, the headlight terminals, the oil pressure sensor terminals, glow plug terminals and the water temperature gauge, then remove the battery.
2. Remove the nuts, the wiring harness, the air cleaner cap, and unlatch the back of the hood panel and remove the panel.
3. Remove the cotter pin, washer, and accelerator rod.
4. Close the fuel tank valve, loosen the clamps, and remove the fuel pipe and return pipe. Then remove the fuel tank and base.
5. Loosen the hose clamps, nuts and bolts, and remove the radiator and hose.
6. Remove the hydraulic pump suction and delivery tubes.
7. Remove the cotter pin, nut and steering drag link from the pitman arm.
8. Support the tractor by placing a suitable jack under the clutch housing.
9. Install a chain hoist to the engine and raise the hoist until the chain is taut.
10. Remove the six bolts on each side of the front axle support and remove the entire front axle assembly.
11. Loosen the bolts and clamps and remove the muffler and air cleaner.
12. Remove the bolts retaining the cylinder block to the clutch housing and remove the engine.
13. Loosen the bolts and remove the pressure plate and clutch disc from the flywheel.

B. DISASSEMBLY

1. To remove the flywheel nut, raise the lock washer and remove the nut.
2. Remove the oil pressure sensor, Figure 1.
3. Pull out the oil level dipstick.
4. Remove the three bolts and the air cleaner flange.
5. Remove the injection pipes from the injectors.
6. Loosen the four nuts and remove the fan.

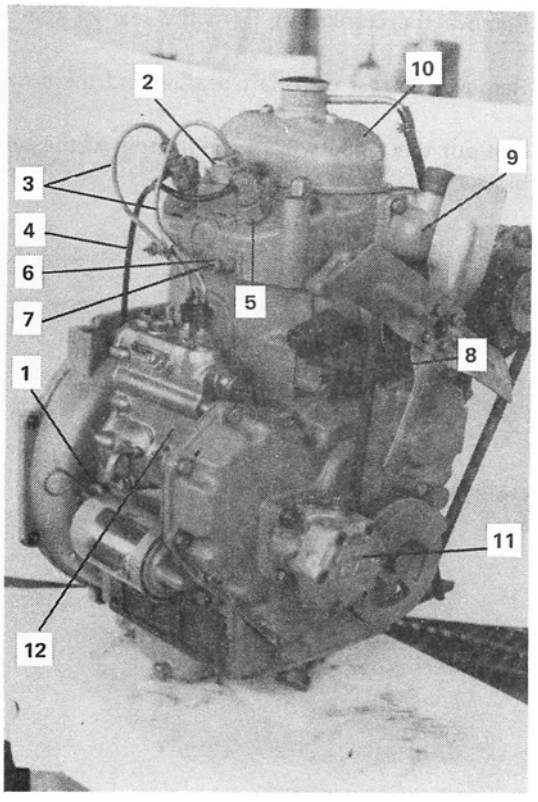


Figure 1
Engine External Components

1. Oil Pressure Sensor
2. Air Cleaner Flange
3. Injection Pipes
4. Return Pipe
5. Nozzle Holder
6. Glow Plug Connector
7. Glow Plug
8. Water Pump
9. Thermostat Cover
10. Rocker Arm Cover
11. Hydraulic Pump
12. Injection Pump

7. To remove the alternator assembly, remove the adjusting plate holder nuts and take out the alternator assembly and V-belt.

8. Remove the return pipe.

9. Remove the nozzle holder.

10. Disconnect and remove the glow plug assembly from the cylinder head.

11. Remove the starting motor.

12. Remove the six bolts and the water pump.

13. Remove the thermostat cover.

14. Remove the nuts and the rocker arm cover assembly.

15. Loosen the center nut and remove the rocker arm assembly and push rods, Figure 2.

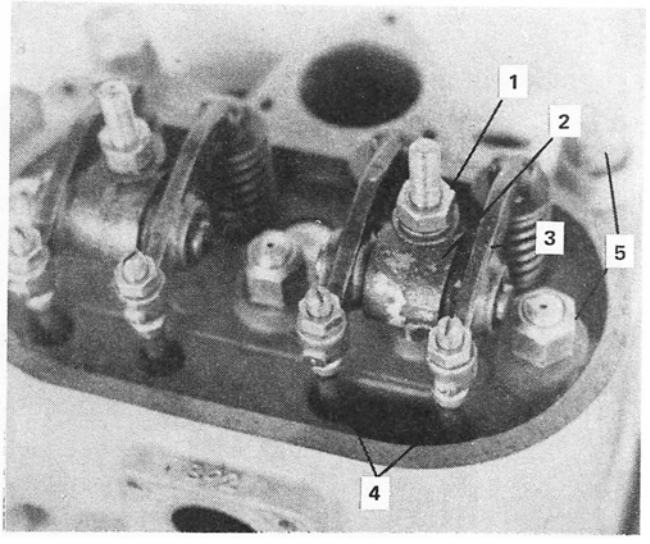


Figure2
Rocker Arm Assembly

1. Center Nut
2. Rocker Arm Shaft Support
3. Rocker Arm
4. Push Rods
5. Cylinder Head Nuts

16. Loosen the nuts evenly and remove the cylinder head and gasket from the cylinder block.

17. Remove the oil filter.

18. Remove the bolts and the crankshaft pulley and key.

19. Loosen the nuts and lockwashers and remove the hydraulic pump.

20. Remove the bolts and timing gear cover.

21. Remove the nut and the oil pump gear and key, Figure 3.

22. Loosen the nut and remove the injector coupling.

23. Remove the three bolts and the injection pump gear.

24. Remove the nuts and camshaft gear.

25. After removing the camshaft gear remove the bolt and tachometer assembly.

NOTE: The relief valve should be removed only when servicing of the valve is necessary.

26. Remove the bolts and idler gear, idler gear shaft and oil pipe.

27. Remove the bolts and injection pump from the front plate.

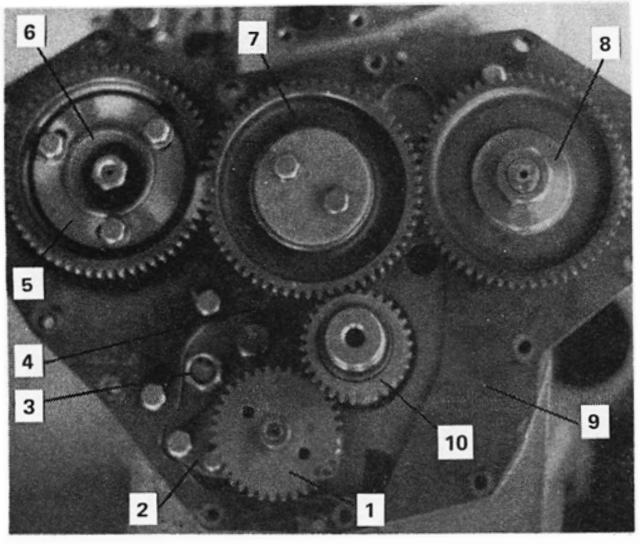


Figure 3
Timing Gears

1. Oil Pump Gear
2. Oil Pump Assembly
3. Relief Valve
4. Oil Pipe
5. Injection Pump Gear
6. Injection Pump Coupling
7. Idler Gear
8. Camshaft Gear
9. Front Plate
10. Crankshaft Gear

28. Loosen the bolts and remove the front plate.

29. To remove the flywheel, place a block of wood on the end of the crankshaft and tap with a hammer.

30. Turn the cylinder block upside down and remove the bolts and oil pan.

31. Remove the capscrews and oil suction filter, Figure 4.

32. Remove the two bolts and oil pump assembly.

33. Remove the bolts and bearing caps from the connecting rods. Then remove the piston and connecting rod assembly by tapping the assembly out towards the top of the cylinder block with a hammer handle, Figure 5.

    NOTE: Before removing the piston assembly, it may be necessary to use a cylinder ridge reamer to remove any ridge or carbon from the top of each cylinder.

34. Remove the bolts and flywheel cover. Take care not to damage the thrust bearing or oil seal.

35. Remove the crankshaft from the rear of the block.

36. Remove the rear camshaft bearing and the camshaft.

37. Pull out the tappets from the bottom of the cylinder block.

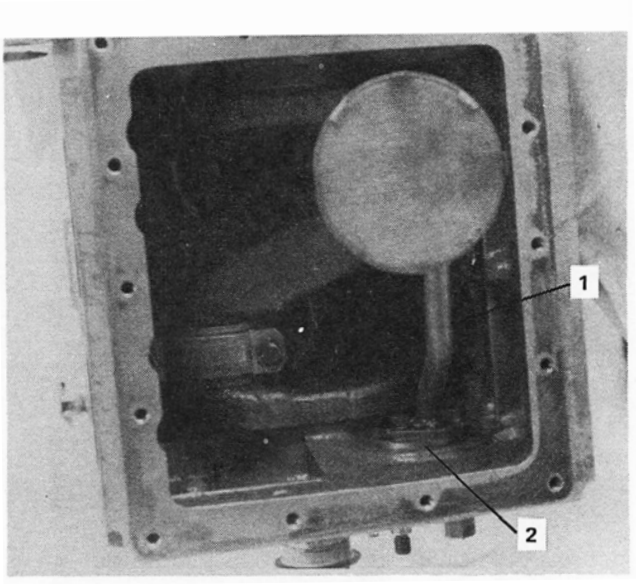


Figure 4
Oil Pump and Suction Filter

1. Oil Suction Filter
2. Oil Pump

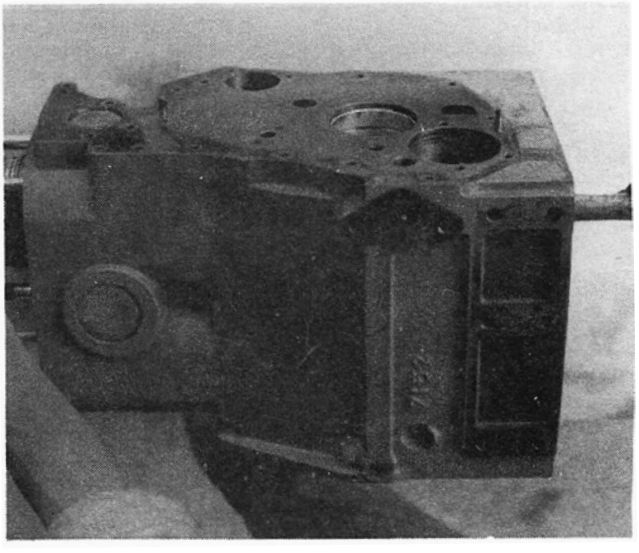


Figure 5
Piston and Connecting Rod Removal

3. CYLINDER HEAD, VALVES, AND RELATED PARTS

CYLINDER HEAD

A. Disassembly

1. Position the valve spring compressor over the valve and spring as shown in Figure 6, and compress the spring. Remove the valve keeper, the valve spring retainer, the valve spring and valve.

   NOTE: Mark the valves with their appropriate cylinder to aid in re-assembly.

2. Remove the valve guide oil seal.

B. Inspection and Repair

1. Inspect the cylinder head for cracks, nicks or burrs. Install a new head if necessary. Minor nicks or burrs can be removed with an oil stone. Make sure that the gasket contact area is clean.

2. Place the cylinder head on a surface plate. Measure for distortion of the cylinder head by inserting a feeler gauge at four points, A thru D, Figure 7. If distortion is more than the specified limit, page 27, it may be skimmed with a surface grinder to within specifications, page 27.

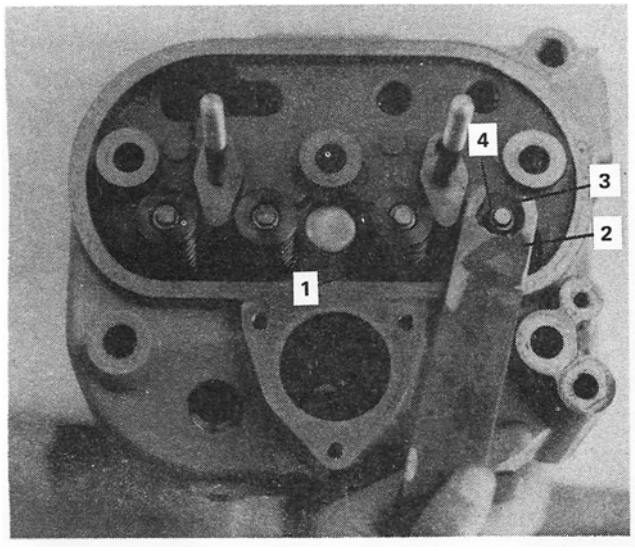


Figure 6
Valve Spring Removal

1. Valve Spring
2. Valve Spring Compressor
3. Valve Spring Retainer
4. Valve Keeper

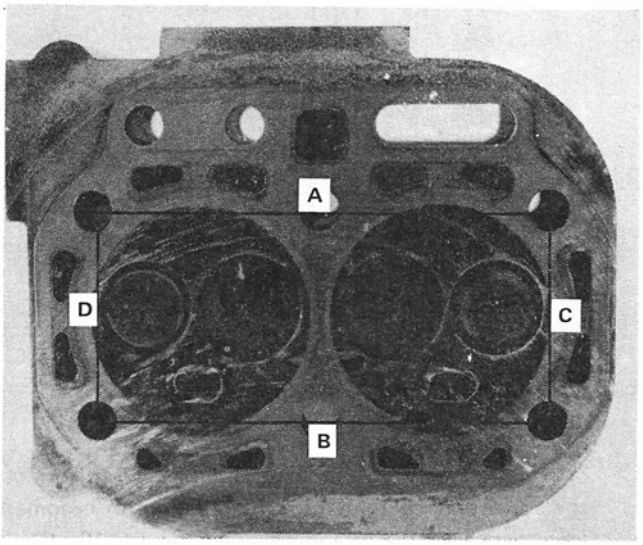


Figure 7
Checking Cylinder Head Distortion

VALVE GUIDE AND VALVE STEM

Inspection and Repair

1. Measure the valve stem diameter with a micrometer at three points I, II, and III, Figure 8. Valve stem size and allowable wear limits are listed in "Specifications" page 27. If wear exceeds these limits, replace the valve.

2. Measure the gap between the valve guide and valve stem, Figure 9. If the gap exceeds specified limits page 27, replace the cylinder head and valves.

VALVE SEAT

Inspection and Repair

1. Valve guide wear should be measured first to determine if valve seat repair is necessary. Refer to "Valve Guide and Valve Stem" inspection, above.

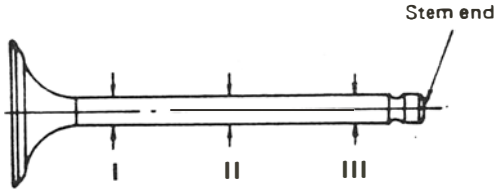


Figure 8
Measuring Valve Stem Diameter

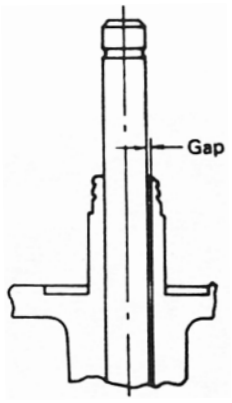


Figure 9
Valve Guide-to-Valve Stem Clearance

2. Seat cutters of 15°, 45°, and 75° are used to correct the valve seat so that the contacting width becomes equivalent to the standard, see Figure 10. Contacting width of both intake and exhaust valve seats are specified on page 28.

3. If the depth of the seat, Figure 11, exceeds the specified limit page 28, regrind the valve seats or replace the cylinder head.

4. Check the head and stem of the intake and exhaust valves for any seizure, wear or deformation. If any of these conditions exist, replace the valves.

5. Check the thickness of the valve head, Figure 12. If the thickness is less than specified limits page 28, replace the valve.

6. Check the valve seat contact by applying compound on the valve seat and then rotate the valve, Figure 13. Check that the valve contacting width is within the specified limit and that the contact is even.

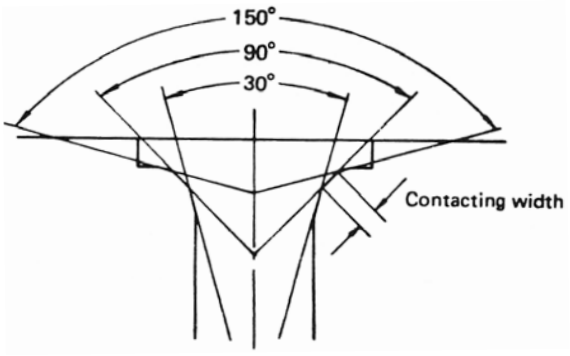


Figure 10
Valve Seat Contacting Width

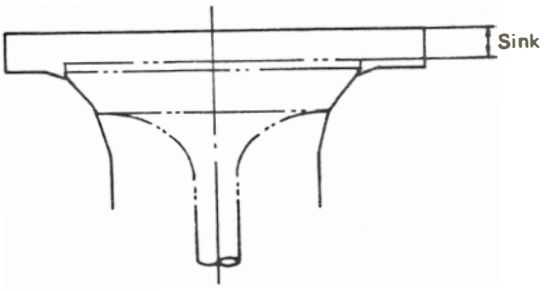


Figure 11
Valve Seat Depth

NOTE: If the contacting width is too wide, carbon will accumulate on the valve. If the contact is too narrow, rapid wear will result.

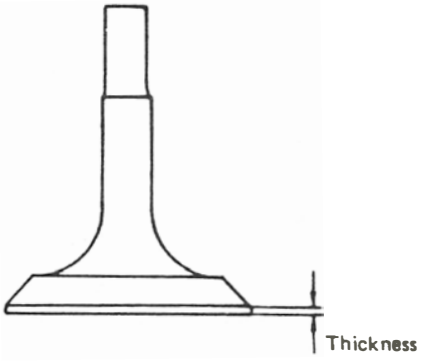


Figure 12
Valve Head Thickness

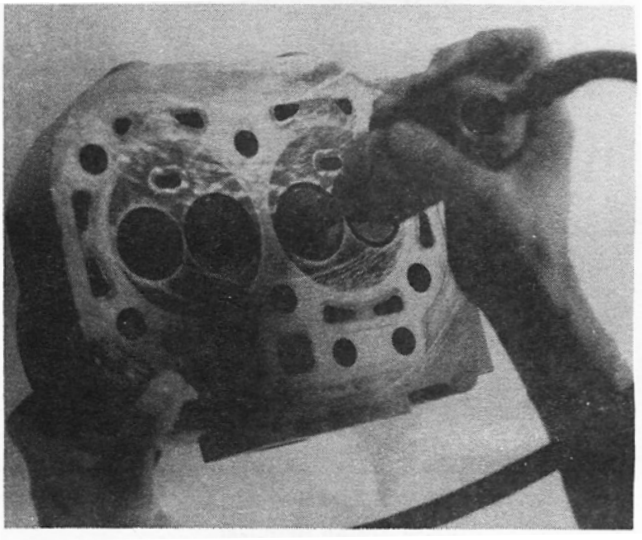


Figure 13
Checking Valve Seat Contact

VALVE SPRINGS

Inspection

1. Discard any valve springs that show signs of erosion or rust.

2. Check each valve spring for squareness, and free length. Measure the spring vertically with a square on a surface plate, Figure 14. Discard any valve springs that do not meet the specified limits page 27.

3. Measure each valve spring with a spring tester. Weak valve springs cause poor engine performance, therefore; if the springs do not meet specified limits page 27, replace the spring.

PUSH RODS AND TAPPETS

Inspection

1. Check the ends of the push rods for nicks, grooves, roughness or excessive wear. If the push rods are not straight, or if any of the above wear conditions exist, replace the rods. Do not attempt to straighten push rods.

2. Check the tappets for nicks, grooves, roughness, or excessive wear. If any of these conditions exist, replace the tappets.

ROCKER ARM ASSEMBLY

A. Disassembly

1. Identify the rocker arms with their appropriate cylinders to assure reassembly in the same location.

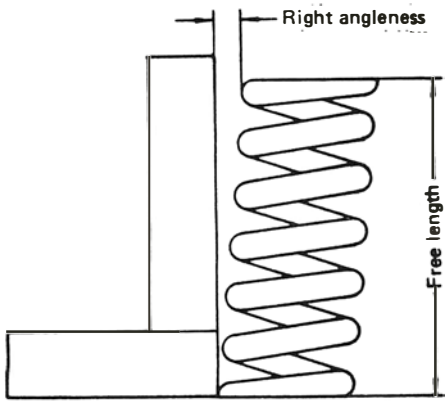


Figure 14
Checking Valve Spring Squareness

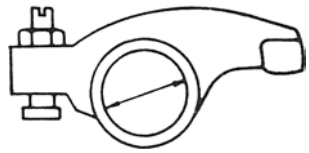


Figure 15
Measuring the Rocker Arm I.D.

2. Remove the snap rings at both ends of the rocker arm shaft and slide the rocker arms off the shaft.

B. Inspection and Repair

1. Measure the diameter of the rocker arm shaft with a micrometer. If the shaft diameter does not meet the specified limits page 28, replace the shaft.

2. Measure the inside diameter of the rocker arm, see Figure 15. Replace the rocker arm if wear exceeds the specified limits page 28.

3. Check for any uneven wear or damage on the valve end of the rocker arm. Remove imperfections with an oil stone or grinder, see Figure 16. If wear or damage is severe, replace the rocker arm.

4. If rocker arm assembly parts are within specifications, clean them thoroughly in solvent and make sure oil passages are clean of obstructions.

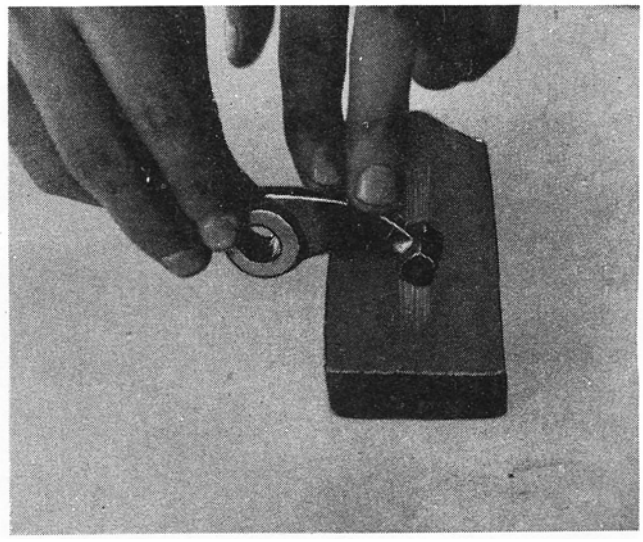


Figure 16
Removing Imperfections from Rocker Arm

C. Assembly

1. Coat the rocker arm shaft with engine oil prior to assembly. Lubricate the valve pads on all rocker arms.

2. Coat the inside bore of the rocker arms with engine oil prior to assembly.

3. Slide the rocker arm shaft through the rocker arm support.

4. Install the rocker arms in their original position on each end of the rocker arm shaft and retain in place by installing the snap rings on each end of the rocker arm shaft.

CYLINDER HEAD

Assembly

1. Insert each valve into the guide bore from which it was removed and lap it into position to give an even seat around the valve. On completion of this operation remove the valve and carefully clean the valve seat and seat insert of any lapping compound.

2. Lubricate all moving parts with engine oil prior to installation.

3. Insert each valve in the guide bore from which it was removed or to which a new valve was fitted. Position a new valve seal over each intake valve and guide.

4. Install the valve spring and retainer over the valve guide.

5. Compress the spring and spring retainer and install the valve keeper.

4. PISTON, RINGS, CONNECTING RODS, BEARINGS, AND CYLINDER BLOCK

PISTON, PISTON PIN AND RINGS

A. Disassembly

1. Using a ring expander, remove the piston rings.

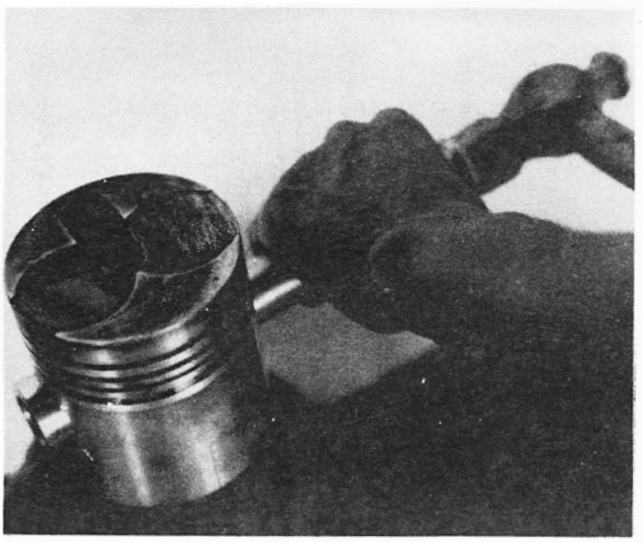


Figure 17
Removing Piston Pin

2. Remove the piston pin snap ring with snap ring pliers.

3. Heat the piston to 122-140°F (50-60°C) and remove the piston pin, Figure 17.

B. Inspection and Repair

1. Inspect pistons for cracks, streaks, seizure, damage at the ring lands, skirts, and pin bosses. Replace any piston that has these characteristics.

2. Measure the gap between the longer diameter of the piston skirt and the cylinder body, Figure 18. If the gap exceeds the specified limit page 29, a new piston should be installed.

3. Replace the piston rings if they are worn or damaged, or if the engine is being overhauled.

4. Place the ring at a right angle to the cylinder bore and measure the end gap with a thickness gauge, Figure 19. If the ring end gap exceeds the specified limit page 29, install new rings.

5. Measure the gap between the piston ring groove and

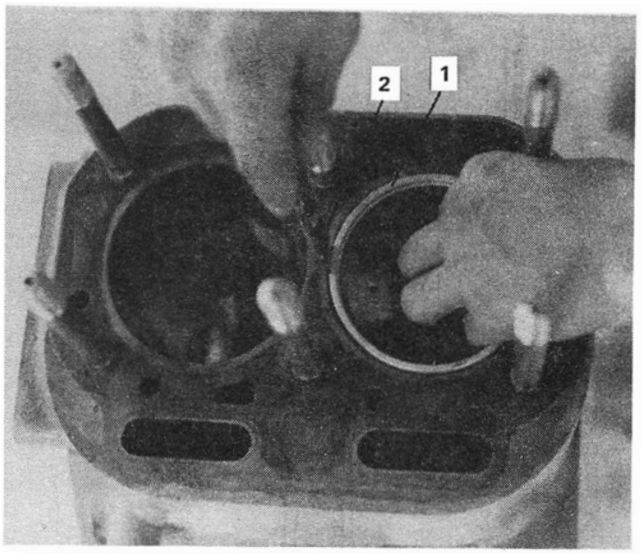


Figure 18
Measuring Piston Skirt-to-Cylinder Bore Clearance
1. Piston Skirt **2. Feeler Gauge**

the ring. If the gap exceeds specified limits page 29, install new rings.

NOTE: Piston rings should be installed with the R mark upward and with each ring gap being offset by 90°.

6. Measure the diameter of the piston pin. If the wear exceeds the specified limit page 29, install a new pin.

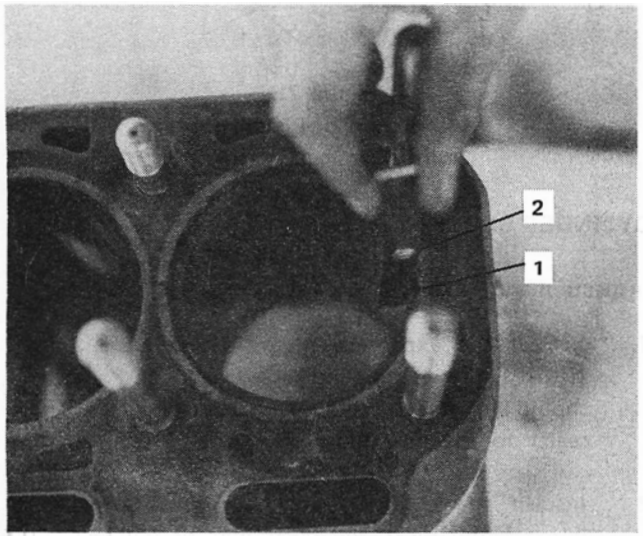


Figure 19
Measuring Piston Ring End Gap
1. Piston Ring **2. Feeler Gauge**

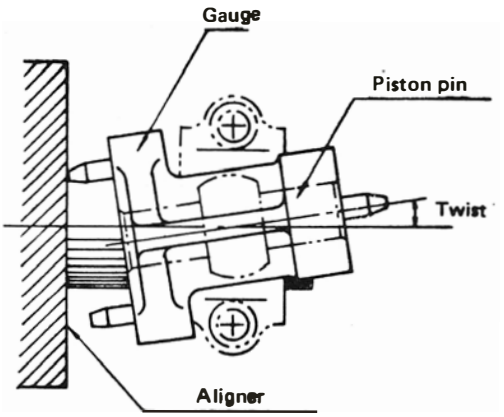


Figure 20
Measuring Rod Torsion

7. The piston pin fit with the connecting rod small end bushing is proper if the piston pin, with oil on its surface, can be pushed in under slight pressure when the piston is at normal room temperature.

CONNECTING RODS AND BEARINGS

Inspection and Repair

1. Measure the connecting rod for twist, warpage or other signs of damage, Figure 20.

2. Measure the large-end and small-end twist and straightness by using a connecting rod alignment fixture, Figure 21. If the measured value exceeds specified limits page 29, install a new connecting rod.

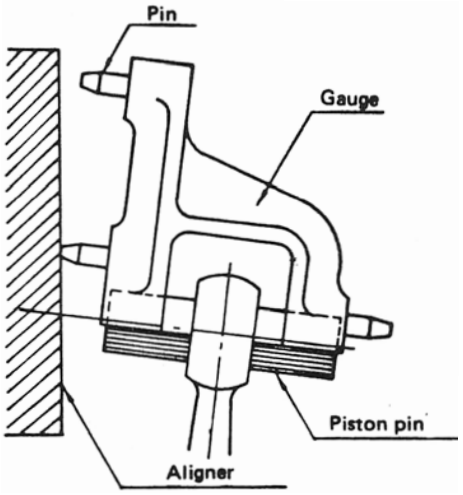


Figure 21
Measuring the Rod End Twist

3. Check the connecting rod bolts. Any part that shows signs of wear or damage should be replaced.

4. Inspect the connecting rod bearings for signs of wear, uneven contact, fatigue failure, scratches, seizure, or improper tension. Replace the bearings if any of these conditions exist.

5. Replace the bearing or crankshaft when oil clearance is excessive resulting from wear in the crankpin and bearing. Oil clearance limits are specified on page 28.

6. Insert the bearings into the connecting rod cap, Figure 22.

PISTON AND CONNECTING ROD

Assembly

1. Heat the piston up to 158°-212° F (70-100°C) and install the rod and pin. Make sure that the piston head mark and the connecting rod "F" mark are set as shown in Figure 23. Alignment marks of figures are inscribed on the connecting rod.

2. When replacing the connecting rod, piston or piston pin, choose one of the nearest in weight to the old part. Difference in weight between cylinders should be kept within 10 grams, (.35 oz.).

3. When fitting the connecting rod to the crankshaft, install the connecting rod so that the piston mark "*" faces toward the combustion chamber jet, and measure the play in axial direction, Figure 24. If the play exceeds the specified limits page 29, replace the connecting rod.

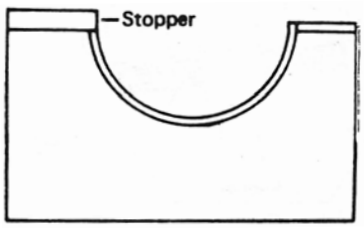


Figure 22
Rod Cap Bearing Installation

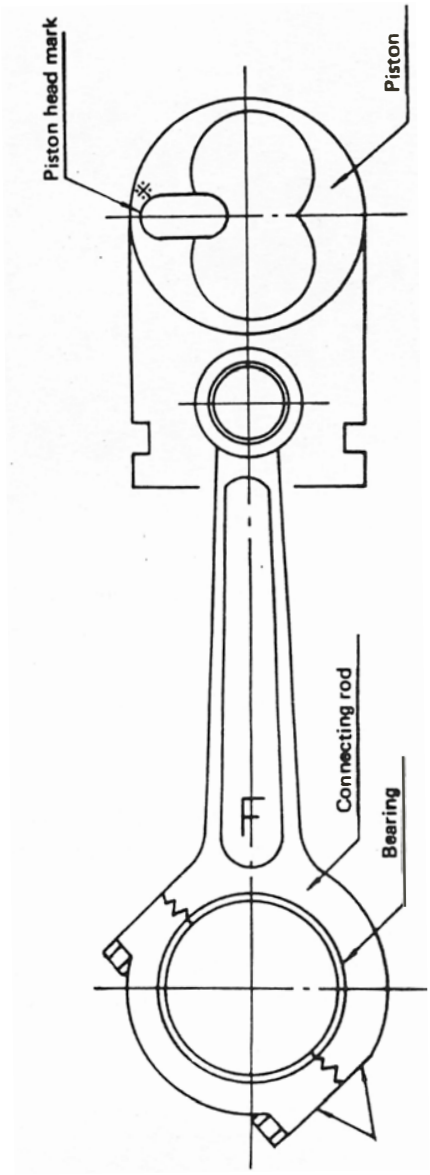


Figure 23
Installment of Piston Head with Connecting Rod

CYLINDER BLOCK

Inspection and Repair

1. Inspect the expansion plugs for evidence of rust. If rust is present this indicates leakage and new plugs should be installed. Remove the defective plugs. Apply sealer to the new plugs and install them securely.

2. Inspect the cylinder block for cracks, nicks, or burrs. Minor nicks and burrs may be removed from the top of the cylinder block with a surface grinder. Replace the cylinder block if severe damage has occured.

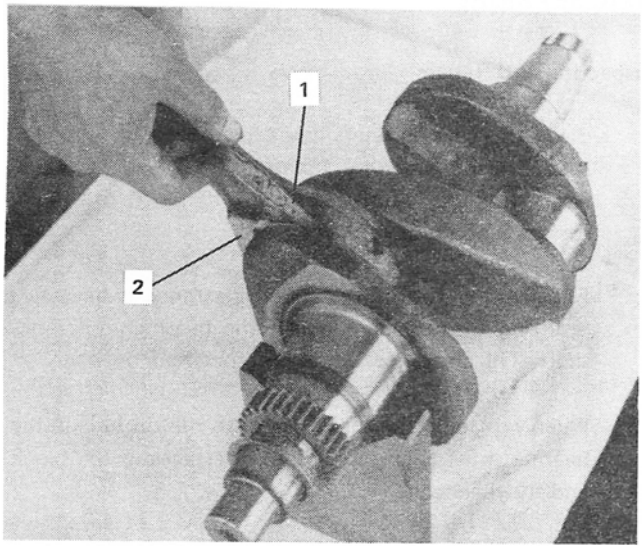


Figure 24
Measuring Connecting Rod Side Float
1. Feeler Gauge **2. Connecting Rod**

3. Check for distortion in the cylinder block in the same manner as for the cylinder head. Refer to page 5, "Cylinder Head." If distortion exceeds the specified limits page 27, resurfacing of the cylinder block must be performed.

4. Check the cylinder bores for waviness, scratches, scuffing, out of round, wear, and taper. These irregularities and scratches, although in most cases too small to be measured with the naked eye, usually can be felt by running a finger over the cylinder surface. Minor imperfections can be removed with a cylinder bore. If more severe damage is apparent the cylinder block should be rebored and new oversize pistons should be fitted.

5. Check the cylinder bore wear at the top, middle, and bottom of the bore with a cylinder bore gauge. Bore top is at the top piston ring position with the piston at TDC or about 11 mm (.433 in.) below the top of the cylinder block and bore bottom is at the piston skirt position at BDC. Wear is usually more severe at the top than at the bottom of the bore. Therefore, wear can be calculated by deducting the minimum diameter at the skirt from the maximum measured bore diameter. If the wear in the cylinder bore exceeds the specified limit page 27, rebore the cylinder and fit oversize pistons to the block.

5. CRANKSHAFT, MAIN BEARINGS, CAMSHAFT, FLYWHEEL AND TIMING GEARS

CRANKSHAFT

Inspection and Repair

1. Clean the crankshaft with a suitable solvent. Clean all drilled passages and blow out the passages with compressed air.

2. Place the crankshaft on V-blocks to check the crankshaft run-out. Measure the run-out by fitting a dial gauge to the crankshaft pulley and flywheel side oil seal surface area, Figure 25. Read the T.I.R. value after rotating the crankshaft one full turn. If the T.I.R. exceeds the specified limit page 28, replace the crankshaft.

3. Inspect the main and connecting rod journals and oil seal contact area of the crankshaft for cracks, scratches, grooves or scores. Minor imperfections may be dressed with an oil stone or crocus cloth. A severely damaged crankshaft should be replaced.

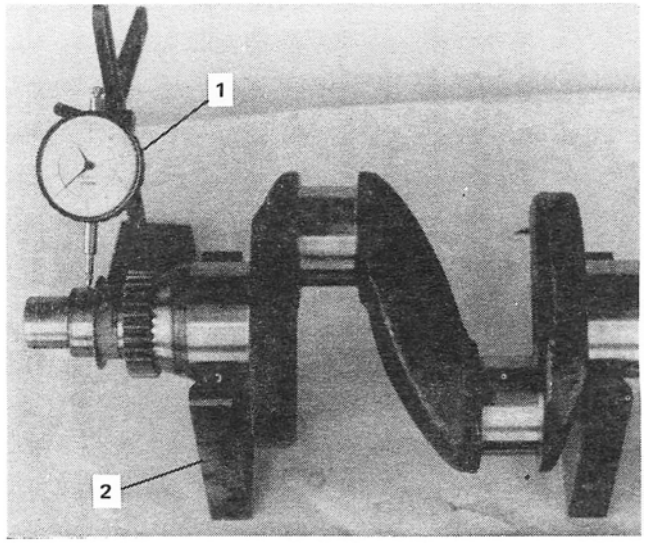


Figure 25
Measuring Crankshaft Run-Out
1. Dial Gauge **2. V-Blocks**

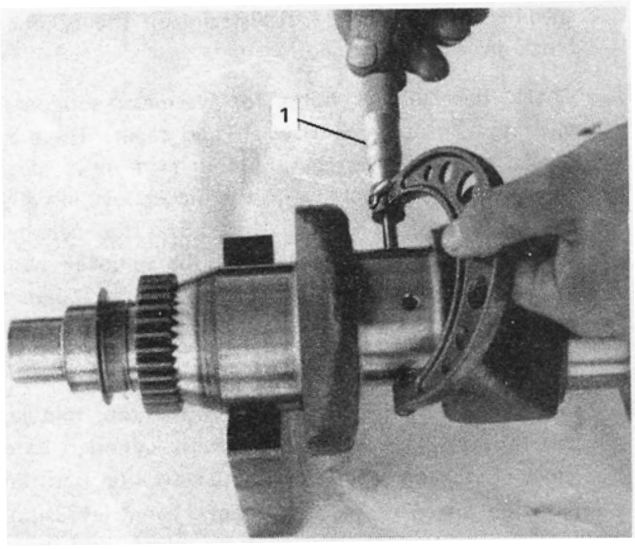


Figure 26
Measuring Crankshaft Journal
1. Micrometer

4. Measure the roundness and taper of the journals and pin with a micrometer, Figure 26. If the measured valve exceeds specified limits page 28, replace the crankshaft.

5. Measure the end float of the crankshaft with a feeler gauge at the crankshaft rear bearing position as shown in Figure 27. If the end float exceeds the specified limit page 28, replace the thrust bearing.

   NOTE: Install the thrust bearing with the oil groove facing the crankshaft thrust surface.

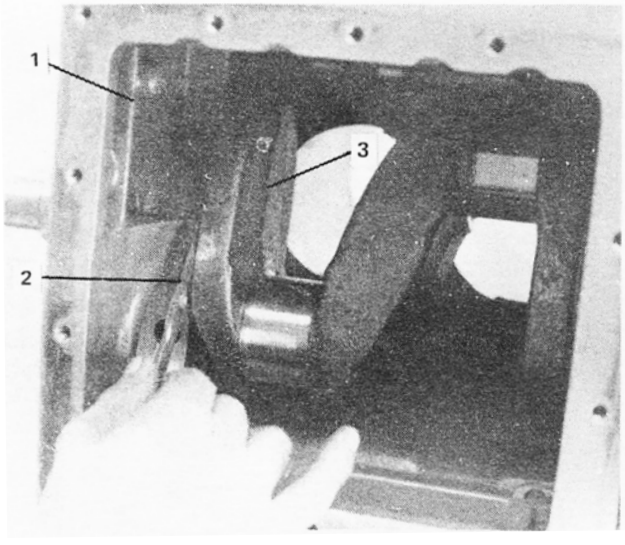


Figure 27
Measuring Crankshaft End Float
1. Rear of Cylinder Block
2. Feeler Gauge
3. Crankshaft

MAIN BEARINGS

Inspection and Repair

1. Clean the bearing liners and caps thoroughly. Inspect each bearing carefully. Bearings that have signs of wear, fatigue failure, scratches, chipped or scored surfaces should be replaced.

2. Replace the bearing when oil clearance is excessive resulting from wear between the bearing and crankshaft. Oil clearance limits are specified on page 28.

3. When replacing the main bearings, the oil hole in the bearing must align with the oil passages in the block and flywheel cover.

CAMSHAFT

Inspection and Repair

1. Inspect the camshaft journals and lobes for roughness, scores, nicks, pits, or discoloration from heat. Minor imperfections can be removed with an oil stone or crocus cloth.

2. Place the camshaft on V-blocks to check the camshaft run-out. Measure the camshaft run-out by placing a dial gauge at the center of the camshaft, see Figure 28. Read the maximum value after rotating the camshaft one full turn. If the T.I.R. exceeds the specified limit page 28, replace the camshaft.

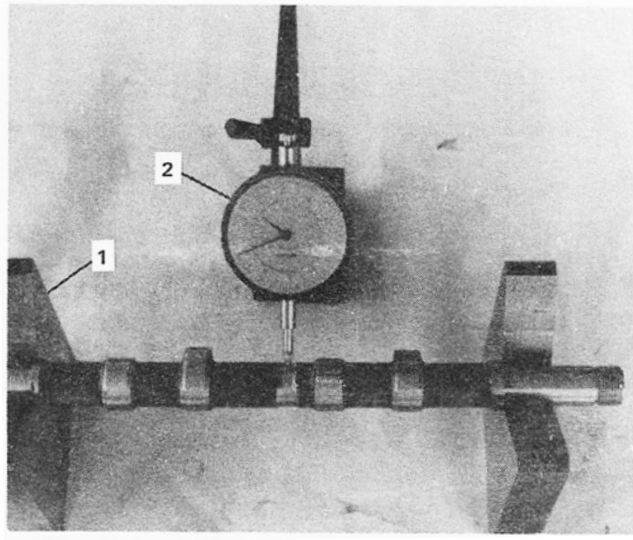


Figure 28
Measuring Camshaft Run-Out
1. V-Blocks
2. Dial Gauge

3. Measure the height of the camshaft lobes with a micrometer, see Figure 29. If the height of the camshaft lobes does not meet the specified limit page 28, replace the camshaft.

4. Check the camshaft roller bearings for wear. Ball bearings can be checked by rotating the outer race with one hand while holding the inner race with the other. Good bearings produce smooth movement while worn bearings produce vibration in the inner race. If any type of roughness, discoloration, or looseness of the balls is apparent, replace the bearing.

FLYWHEEL AND RING GEAR

Inspection and Repair

1. Inspect the flywheel for cracks, scores, or excessive roughness. Minor imperfections can be removed by re-surfacing the flywheel. If excessive warpage or damage is apparent, the flywheel should be replaced.

2. Measure the flywheel run-out with a dial indicator. Measure the run-out in the area where the clutch disc contacts the flywheel, see Figure 30. If the run-out exceeds the specified limit page 29, the flywheel should be machined to within specifications.

3. Check the ring gear for rough edges and for missing teeth which could scuff or gouge the teeth on the drive gear. If necessary, dress the teeth with a wire wheel to smooth up the edges. If the ring gear has signs of minor wear it can still be used by changing the position of the gear by 90°.

4. When installing a new ring gear, heat the gear to approximately 248-302°F (120-150°C). Quickly place the hot gear on the flywheel with the flat gear face against the shoulder of the flywheel. Be sure the ring gear face is flush with the flywheel then quench the gear with water to cool it rapidly.

TIMING GEAR

Inspection and Repair

1. Inspect the timing gears for missing teeth, scores, nicks, burrs, and the condition of the teeth wear pattern. Minor imperfections can be removed with a wire wheel. More severely damaged gears should be replaced.

2. To check timing gear backlash refer to page 17, "Engine Assembly."

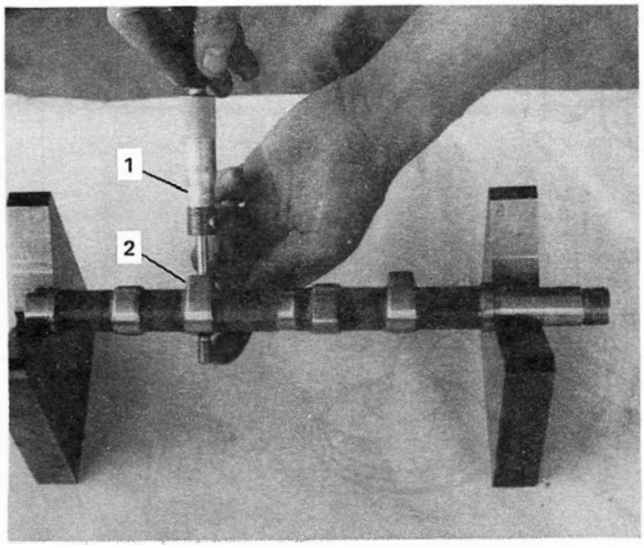


Figure 29
Measuring Height of Camshaft Lobes
1. Micrometer 2. Camshaft Lobe

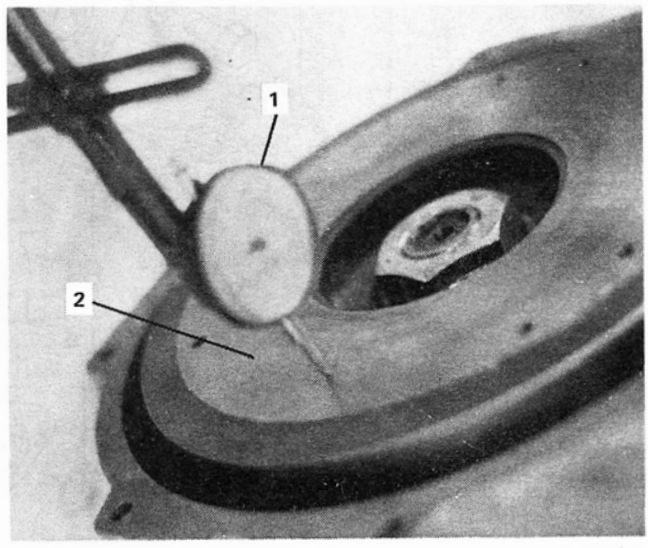


Figure 30
Measuring Flywheel Run-Out
1. Dial Gauge 2. Flywheel

6. OIL PUMP AND FILTER

OIL PUMP

A. **Disassembly and Inspection**
Refer to Figure 31.

1. Remove the cover from the oil pump.
2. Pull out the oil pump gears.
3. Inspect the oil pump housing cover, and gears for excessively worn or damaged parts. Replace any parts that are in poor condition.
4. Measure the clearance between the oil pump gear

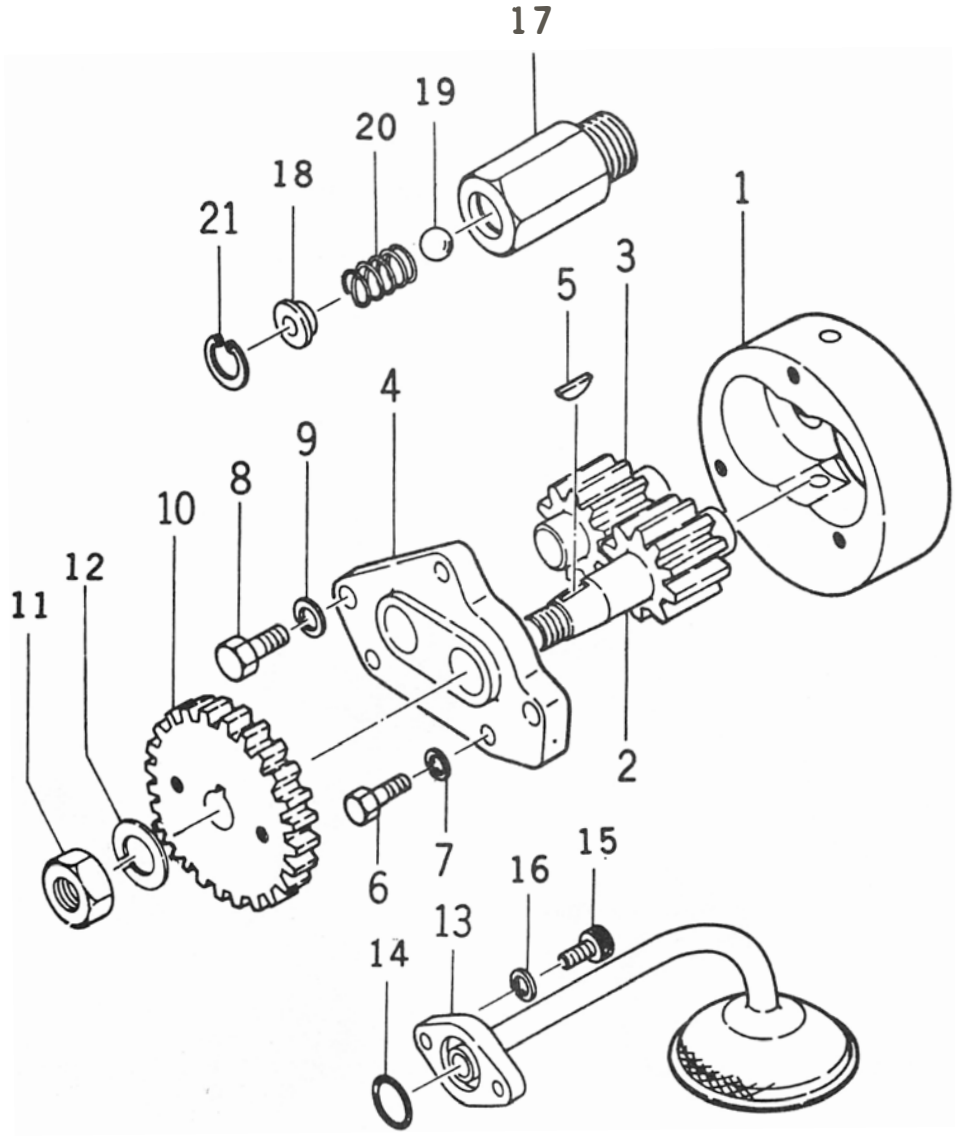


Figure 31
Exploded View of Oil Pump, Filter and Pressure Relief Valve

1. Pump Housing
2. Gear, Long Shaft
3. Gear, Short Shaft
4. Pump Cover
5. Key
6. Bolt
7. Washer
8. Bolt
9. Washer
10. Gear
11. Nut
12. Lock Washer
13. Filter
14. O-Ring
15. Capscrew
16. Lockwasher
17. Relief Valve Housing
18. Spring Holder
19. Ball
20. Spring
21. Snap Ring

and oil pump case, Figure 32. If the measured value exceeds the specified limit page 30, replace the gear.

5. Measure the clearance between the oil pump gear teeth and the oil pump case, Figure 33. If the clearance exceeds the specified limit page 30, replace the gear.

B. Assembly

1. Coat all moving parts with clean engine oil.

2. Insert the oil pump gears into the oil pump housing.

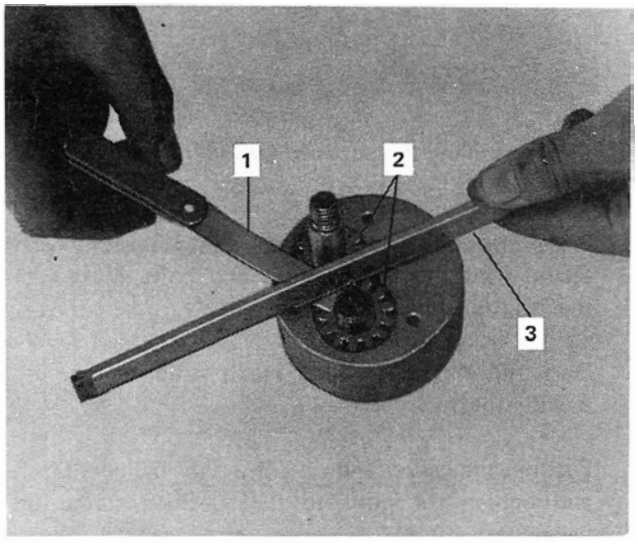


Figure 32
Checking Oil Pump Gear-to Case Clearance
1. Feeler Gauge **3. Straight Edge**
2. Oil Pump Gears

3. Place the oil pump cover onto the oil pump housing.

FILTER

Removal and Installation

1. To remove the oil filter, turn the cartridge body counter-clockwise and then discard the filter.

2. Place a thin coat of engine oil on the seal of the new filter. Install the filter and hand tighten only.

NOTE: The oil filter should be replaced after every 200 hours of operation.

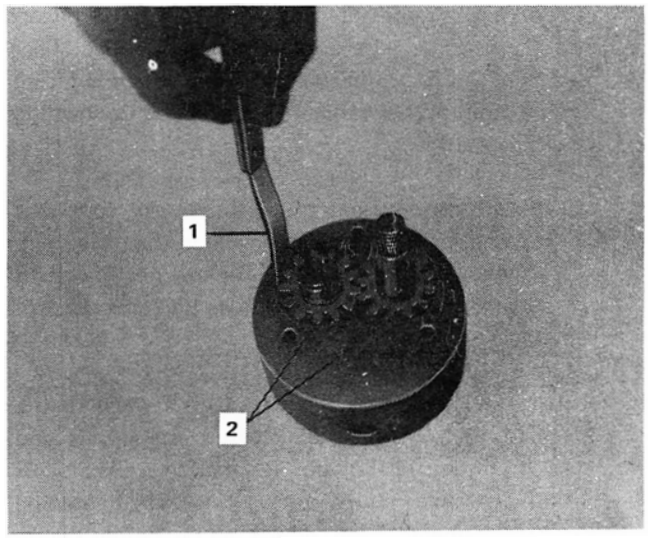


Figure 33
Checking Oil Pump Gear Tooth-to-Case Clearance
1. Feeler Gauge **2. Pump Gears**

7. ENGINE ASSEMBLY AND INSTALLATION

ENGINE

A. Assembly

1. Prior to assembly, apply clean engine oil to all moving and sliding components. Replace all old gaskets and packings with new ones. If necessary, use liquid packing to prevent oil leaks.

2. Insert the tappets into the cylinder block. Make sure that the tappets move up and down easily.

3. Insert the camshaft into the front camshaft bearing, and install the rear camshaft bearing. Make sure the camshaft rotates easily within the bearings.

4. Insert the front thrust bearing into the inside front wall of the cylinder block. Insert the crankshaft from the rear of the block into the front bearing. Take care not to damage the bearing.

5. If a new thrust bearing is being installed use a spring pin in the procedure. Make sure that the oil groove

is facing the crankshaft thrust area and that the spring pin sinks 0.5 mm (.020 in.) below the thrust bearing. See Figure 34.

6. To install the flywheel cover, fit the greased O-ring to the camshaft bearing, apply liquid packing to both sides of the packing, and secure the flywheel cover with bolts tightened diagonally to the torque specified on page 30. Take care not to damage the thrust bearing during the installation of the flywheel cover.

7. Before inserting the pistons make sure each piston ring end gap is offset by 90°.

8. Insert the piston into the cylinder bore using a piston ring compressor, Figure 35. Tap the piston into the cylinder bore using a hammer handle. Make sure that the piston head front mark notch is facing the injection pump. Refer to "Piston and Connecting Rod," page 10.

   NOTE: When installing the piston make sure that the top ring gap is not at a right angle to the piston pin. Also, make sure to install the connecting rod with the alignment mark of the smaller figure in the No. 1 cylinder.

9. Install the connecting rod caps and tighten to the specified torque page 30. Measure crankshaft end float in the axial direction to make sure that it is within specified limits page 28. After tightening the connecting rod caps check to see if the crankshaft can be rotated.

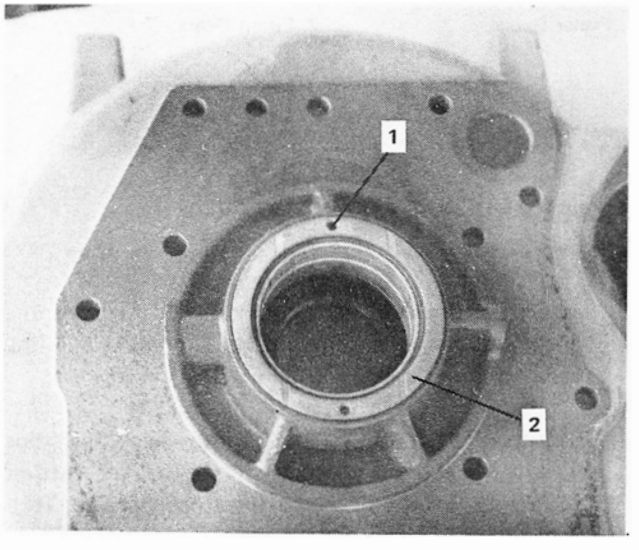


Figure 34
Installing Thrust Bearing
1. Spring Pin **2. Thrust Bearing**

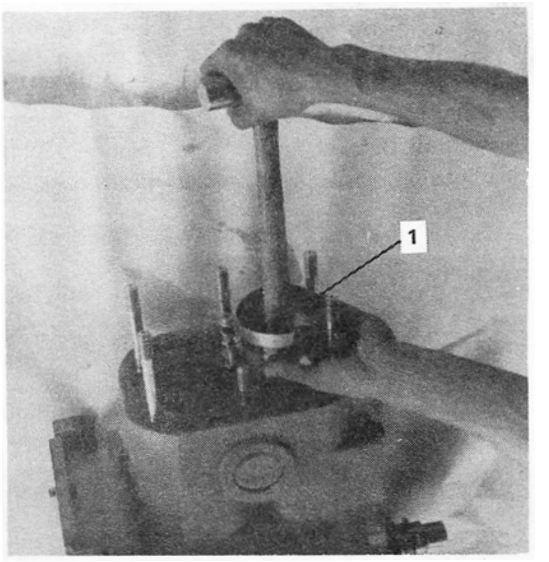


Figure 35
Installing Pistons Into Cylinder Block
1. Ring Compressor

10. Place the oil pump assembly into position and secure with the two washers and bolts. Make sure that the oil pump gear moves freely.

11. Place the oil suction filter into position and secure it with the two capscrews.

12. Position the gasket and oil pan on the cylinder block and tighten the bolts to the specified torque on page 30.

13. Position the flywheel key on the crankshaft.

14. When installing the flywheel, make sure that there is clearance between the key head and the groove in the flywheel. Install the lockwasher and nut and tighten the nut until it is snug. The nut is torqued later in the assembly procedure.

15. Place the front plate into position and secure with the bolts. Tighten bolts to specified torque page 30.

16. Position the injection pump on the front plate and secure into position with the bolts.

17. Install the idler gear shaft and oil pipe. Do not overtighten the bolt.

18. To install the idler gear, coat the bearing with oil and align the idler gear mark with the crankshaft gear mark, Figure 36. Tighten to the torque specified on page 30.

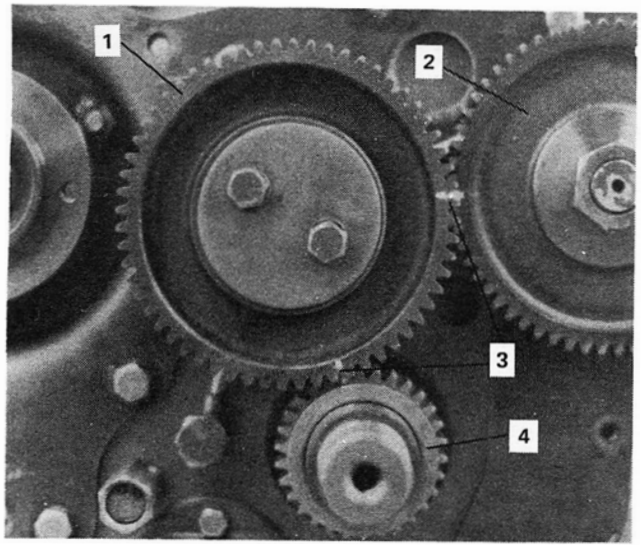


Figure 36
Installing Idler Gear

1. Idler Gear
2. Camshaft Gear
3. Matching Marks
4. Crankshaft Gear

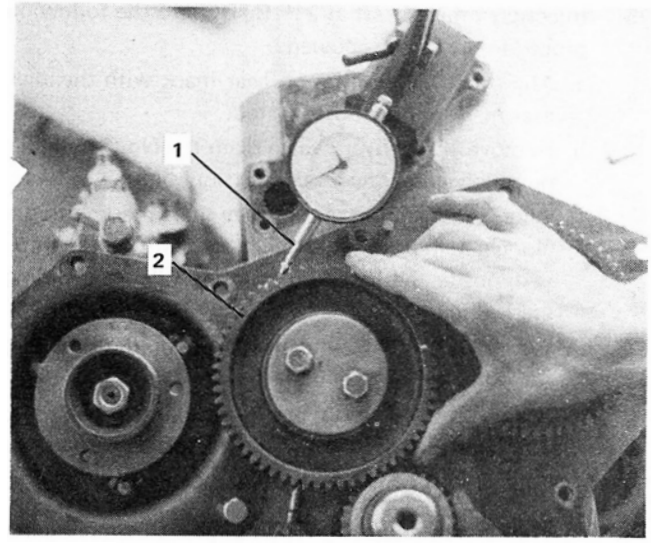


Figure 37
Checking Timing Gear Backlash

1. Dial Gauge
2. Idler Gear

19. If the relief valve has been serviced then install the relief valve and tighten to the specified torque page 30.

20. Install the tachometer assembly and secure it with the two bolts.

21. Engage the two tachometer gears together and then install the camshaft gear onto the end of the camshaft. Align the mark on the camshaft gear with the "O" mark on the idler gear, Figure 36, and tighten the camshaft gear nut to specified torque page 30.

22. At this time it is necessary to check the timing gear backlash.
    a. Measure the backlash of the timing gear with a dial gauge. See Figure 37.
    b. If the backlash exceeds the specified limit page 28, then the timing gear unit should be replaced.

23. Position the injector pump coupling over the injection pump shaft and key and secure with the washer and nut. Tighten the nut to the specified torque page 30.

24. Align the injection pump gear mark with the idler gear mark by turning the crankshaft counter-clockwise. Align the injection pump coupling with the slash (/) mark on the injection pump gear, see Figure 38, and tighten the bolts.

    NOTE: When the injection pump gear, or injection pump coupling is replaced, the injection timing must be set through the following procedure.

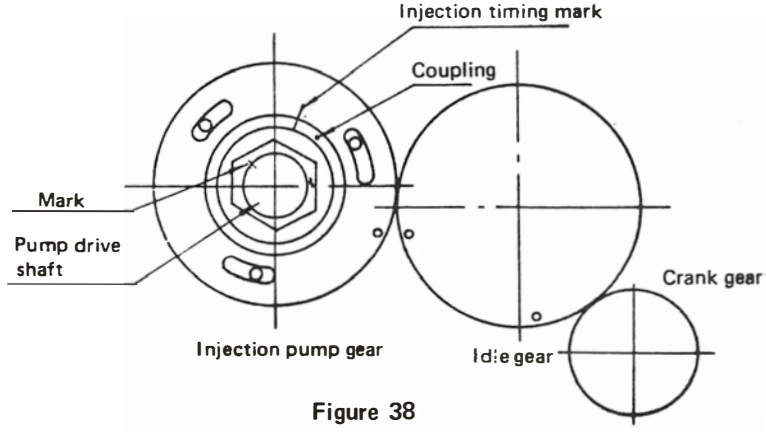


Figure 38
Injection Pump Timing

25. Injection timing is set at 21° BTDC and the following procedure must be followed:
    a. Align the injection pump gear mark with the idler gear mark as previously stated.
    b. Remove the delivery valve from the No. 1 cylinder pumping element on the injection pump.
    c. Align the injection pump drive shaft mark with the elongated hole in the injection pump gear which is opposite the injection pump-to-idler gear timing mark, Figure 38.
    d. Install the three pump gear to coupling retaining bolts but do not tighten.
    e. Rotate the injection pump coupling drive shaft until fuel ceases to flow out of the delivery valve holder. This is the spill-timing location.
    f. Tighten the injection pump gear-to-coupling retaining bolts to the specified torque, page 30.
    g. Using a chisel, inscribe a injection timing mark on the injection pump gear and coupling as shown in Figure 38.
    h. Replace the delivery valve in the No. 1 cylinder pumping element.

26. Install the oil pump gear and key over the oil pump shaft and secure with the washer and nut. Tighten the nut to the specified torque page 30.

27. Position the timing gear case and gasket on the cylinder block and secure with the bolts. Be careful not to damage the oil seal in the timing gear case.

28. Place the hydraulic pump into position and secure with the nuts and lockwashers.

29. Install the crankshaft pulley and key over the end of the crankshaft and secure it with the washer and nut. Tighten the nut to the specified torque, page 30.

30. Install the oil filter and hand tighten only.

31. Place a new head gasket on the cylinder block, then carefully position the cylinder head on the gasket. Coat the cylinder head bolts and nuts with engine oil and install the nuts finger tight.

32. Tighten the cylinder head nuts in the proper sequence, as shown in Figure 39. Tighten the head nuts in three steps progressively. Finally, tighten the head nuts to the specified torque on page 30.

33. Insert the push rods into the holes in the cylinder head from which they were removed. Make sure that the oil holes in the push rods are free from obstructions.

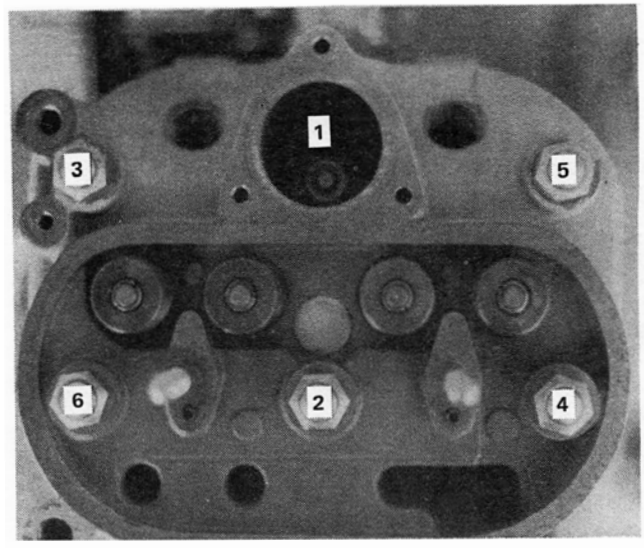


Figure 39
Cylinder Head Nuts Tightening Sequence

34. Position the rocker arm assembly on the cylinder head. Make sure that the holes in the rocker arm support are aligned with the roll pins in the cylinder head, and that the ends of the rocker arm adjusting screws are seated in the push rods.

35. Install the center nuts over the rocker arm assembly support bracket and tighten to the torque specified on page 30.

36. Rotate the engine and set the valve lash, Figure 40. The clearance for both the intake and exhaust valves should be as specified on page 28. The adjustment should be made while the engine is cool.

37. Position the gasket and rocker cover over the cylinder head and tighten the cap nuts to the specified torque, page 30. Take care not to damage the oil seal washer.

38. Place a light coat of liquid packing on the area of the flywheel cover where the starting motor and cover meet. Then position the starting motor in the flywheel cover and secure with the bolts.

39. Install the thermostat, cover, and gasket onto the cylinder head and secure with the bolts. Make sure that the thermostat spring is installed inside the cylinder head.

40. Position the gasket and water pump onto the cylinder block and secure with the bolts.

41. Fit the alternator to the holder and secure it to the gear case with the bolts. (Models up to No. 1375 have no holder.)

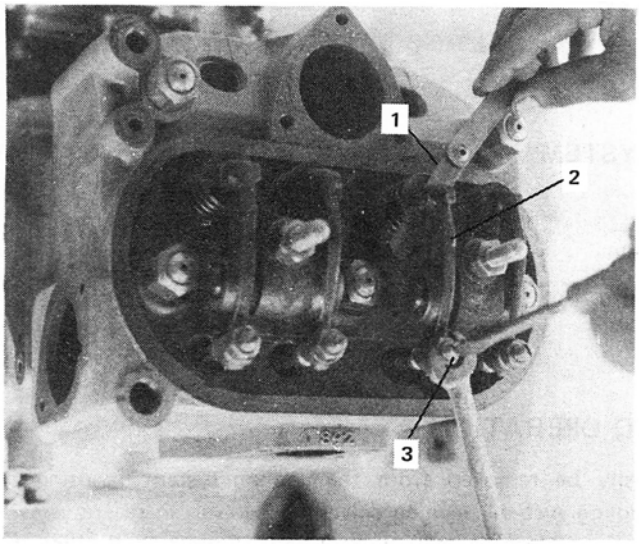


Figure 40
Adjusting Valve Lash

1. Feeler Gauge
2. Rocker Arm
3. Adjusting Screw

42. Fit the V-belt over the water pump pulley, the crankshaft pulley, and the alternator pulley and adjust the alternator so that the V-belt can be pressed down approximately 10-15 mm (7/16 to 9/16 in.) and then tighten the adjusting plate bolt.

43. Install the fan and secure with the four bolts.

44. Install the nozzle holder and tighten to the specified torque page 30.

45. Install the return pipe.

46. Install the glow plug assembly into the cylinder head.

47. Position the air cleaner flange and gasket onto the cylinder head and secure with the bolts.

48. Install the injection pipes onto the injectors and tighten. Do not over tighten the injection pipes, as damage may occur.

49. Insert the oil level dipstick.

50. Apply liquid packing to the threads of the oil pressure sensor and install the sensor into the cylinder block.

51. Tighten the flywheel nut to the torque specified on page 30. After tightening, bend the lockwasher tab over the flywheel nut.

B. Installation

1. Center the clutch disc assembly to the flywheel using a tool such as a pilot shaft or the transmission input shaft, and then position the pressure plate over the clutch disc and tighten the pressure plate bolts evenly to the flywheel to the specified torque page 30.

2. Using a chain hoist, position the engine in line with the clutch housing. Move the engine slowly towards the clutch housing making sure that the transmission input shaft is aligned with the clutch disc. Once the clutch disc and the transmission input shaft have been aligned secure the engine block to the clutch housing with the bolts. Tighten the bolts to the specified torque page 30.

3. Install the muffler and air cleaner and tighten the bolts and clamps.

4. Position the front axle assembly under the engine cylinder block and secure the front axle support to the cylinder block using the six bolts on each side of the front axle support. Tighten the bolts to the specified torque page 30.

5. At this time the floor jacks can be removed from under the clutch housing and the chain hoist can also be removed.

6. Position the steering drag link on the pitman arm, tighten the nut and install the cotter pin.

7. Install the hydraulic pump suction and delivery tubes.

8. Position the radiator, radiator support, and hoses, and tighten all nuts, bolts, and clamps. Tighten nuts and bolts to specified torque page 30.

9. Place the fuel tank base into position and tighten the bolts. Place the fuel tank on the base and tighten the fuel tank bands to secure the tank.

10. Place the fuel pipe and return pipe into position and install the clamps. Then open the fuel tank valve.

11. Install the accelerator rod, washer, and cotter pin.

12. Move the hood panel into position over the engine. Install the nuts under the hood support assembly, the wiring harness, the air cleaner cap, and latch the back of the hood panel.

13. Install the battery, the water temperature gauge, glow plug terminals, oil pressure sensor terminal, headlight terminals, starter relay terminals and connect the battery cables.

Part 1

ENGINE

Chapter 2

COOLING SYSTEM

1. DESCRIPTION AND OPERATION

The cooling system incorporates a radiator, water pump, thermostat, and cooling fan. The coolant is drawn from the bottom tank of the radiator by the water pump which delivers the coolant to the cylinder block. As the coolant enters the cylinder block it passes through cored passages to cool the cylinder walls. The coolant moves through the cylinder block and into the cylinder head assembly where it flows through cored passages in the cylinder head. The coolant continues to flow through the cylinder head to the thermostat.

If the thermostat is closed, a recirculating bypass is provided, allowing a portion of the coolant to recirculate from the head to the block for faster warm-up. When the thermostat is open, the coolant flows from the outlet connection of the head to the top of the radiator. Cooling is accomplished as the coolant flows down through the radiator tubes which are exposed to the cooler air temperatures created by the fan blast.

MAINTENANCE

Cleaning the Cooling System:

Normally, rust, sludge, and other foreign material can easily be removed from the cooling system by using a cooling system cleaning solvent. However, in severe cases, pressure flushing may be required. If pressure flushing is to be used, always remove the thermostat and make sure the cylinder head bolts are tightened properly before flushing. After the cooling system has been cleaned and filled, a good rust inhibitor should be added. However, the rust inhibitor is not necessary if the cooling system is to be conditioned with permanent antifreeze containing rust inhibitor.

Draining and Filling the Cooling System:

To drain the cooling system, open the drain cock in the cylinder block, and the radiator drain cock. Open the radiator pressure cap to speed draining. To fill the system, close the drain cocks, fill the system with coolant and add rust inhibitor or antifreeze, according to the season and locality. All permanent antifreeze sold by reputable manufacturers contains an anti-rust additive. Therefore, the addition of rust inhibitor, when permanent antifreeze is used, will not generally be necessary.

2. RADIATOR AND THERMOSTAT

RADIATOR

A. Removal

1. Drain the cooling system as previously outlined.
2. For easy accessibility, remove the hood panel as outlined under "Engine Removal", page 2.
3. Loosen the hose clamps and slide the clamps toward the middle of the hose.
4. Remove the nuts from the rubber bumpers located at the bottom of the radiator.
5. Disconnect the radiator support bracket and remove the radiator from the tractor.

B. Inspection and Repair

1. Check the upper tank for leaks.
2. Check the fins to be sure they are not bent or clogged.

3. Check the lower tank for leaks.

   NOTE: Any repairs done on the radiator should be performed by a qualified radiator repair shop.

C. Installation

1. To install the radiator, reverse the procedure outlined above, "Removal — Steps 1-5".

2. Fill the cooling system with coolant and add the proper amount of antifreeze, depending upon the season and locality.

3. Run the engine for several minutes and check for leaks in the radiator and at the hose connections.

THERMOSTAT

The thermostat is located in the coolant outlet connection on the front of the cylinder head. Thermostat opening and full open temperatures are listed in the "Specifications," page 30.

A. Removal

1. Drain the cooling system to below the level of the coolant outlet connection.

2. Remove the thermostat cover retaining bolts and slide the cover with the hose attached to one side.

3. Remove the thermostat and gasket.

B. Inspection

Place the thermostat in a container of water and heat the water, Figure 41. If the thermostat valve does not open at or near the opening temperature as specified on page 30, or if it fails to close when the water temperature decreases, install a new thermostat.

C. Installation

1. Clean the thermostat cover and the cylinder head surface of any foreign material.

2. Coat the new gasket with a sealer and position the gasket on the cylinder head.

3. Position the thermostat so that the heat element will be in the cylinder head.

4. Position the thermostat cover over the thermostat and install the retaining bolts.

5. Fill the radiator and operate the engine. Check for leaks around the thermostat cover.

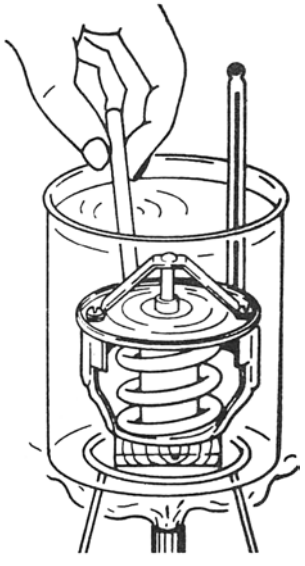


Figure 41
Checking Thermostat Operation

3. WATER PUMP

A. Removal

1. Drain the cooling system as previously outlined.

2. Remove the radiator as outlined on page 20, " Radiator Removal".

3. Loosen the alternator adjusting arm bolt and the two pivot bolts and relax the tension on the belt.

4. Remove the six water pump attaching bolts and loosen the hose clamp and remove the water pump and gasket.

B. Disassembly

1. Remove the four attaching bolts and remove the fan from the pump pulley.

2. Using a gear puller, remove the pump pulley from the shaft.

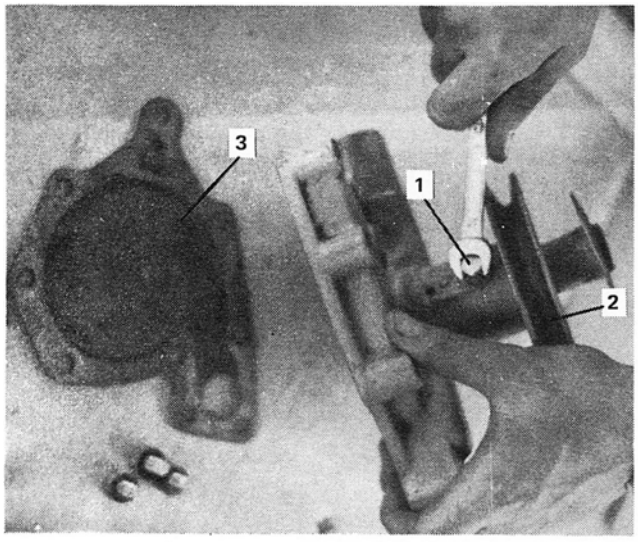


Figure 42
Water Pump Disassembly

1. Set Bolt **3. Set Plate**
2. Pulley

3. Remove the three attaching bolts and remove the set plate and gasket from the casing. Loosen the water pump bearing set bolt. See Figure 42.

4. Using a press, remove the impeller and shaft from the pump casing, see Figure 43.

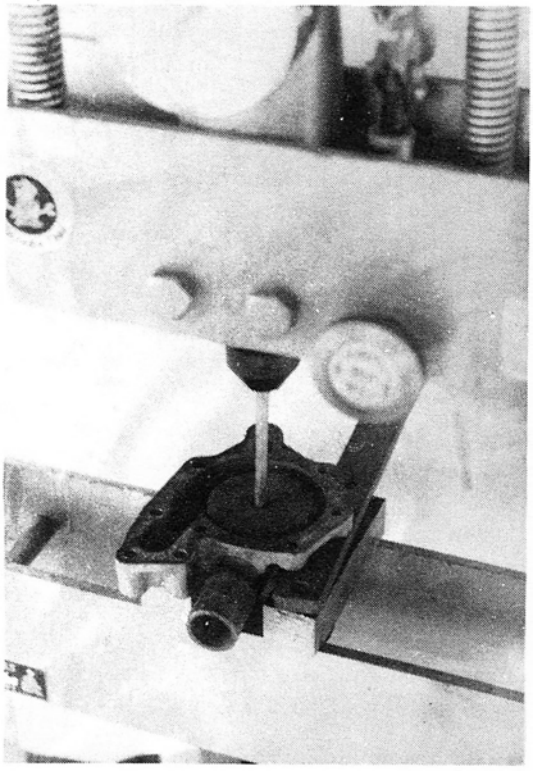


Figure 43
Impeller Removal

NOTE: Avoid using a hammer on the impeller. It is made of cast iron and can be easily broken if hit with a hammer.

C. **Inspection and Repair**

1. Check each component of the water pump for any cracks, wear or damage, Figure 44. Components which are damaged should be replaced.

2. Check the impeller for worn or damaged vanes and check the seal seat to be sure it is in good condition. Install a new impeller if the seat or vanes are damaged.

3. Check the bearing shaft for nicks, scores, or other damage. If the shaft is damaged a new shaft should be installed.

4. Check the water pump bearing for looseness in the radius direction and if it exceeds the specified limit on page 30, then replace the bearing.

5. Check the pump casing for cracks, fractures, or signs of leakage.

D. **Assembly**

1. Figure 45 is an exploded view of the water pump

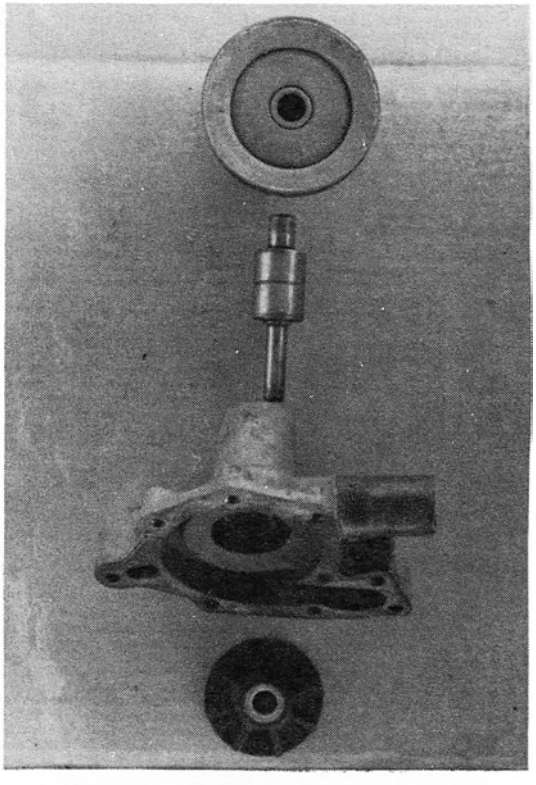


Figure 44
Water Pump Components

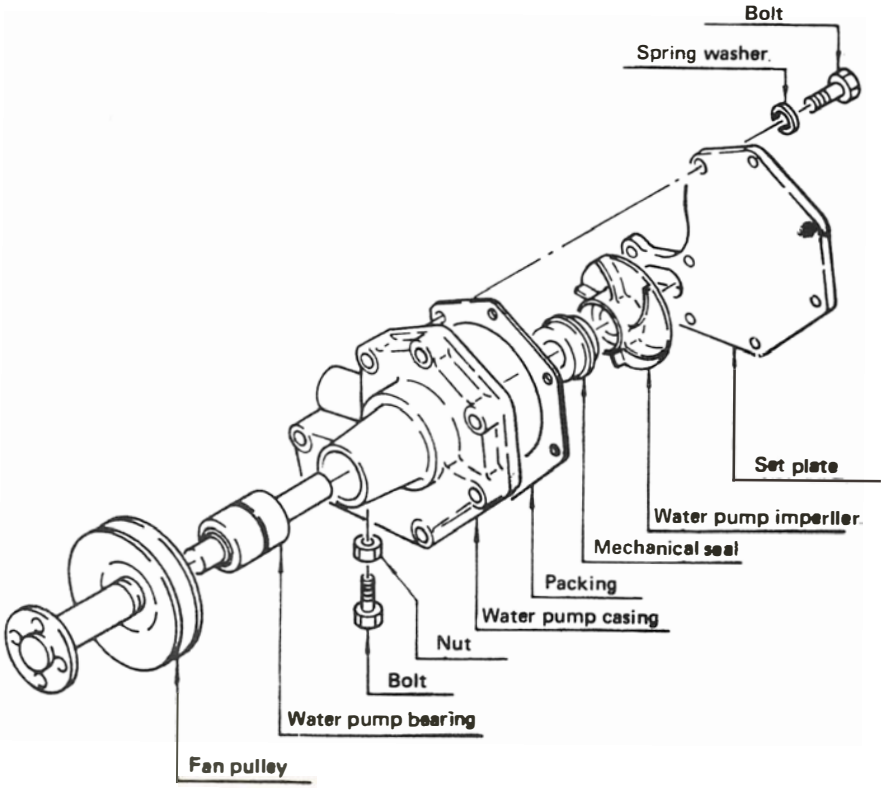


Figure 45
Exploded View of Water Pump

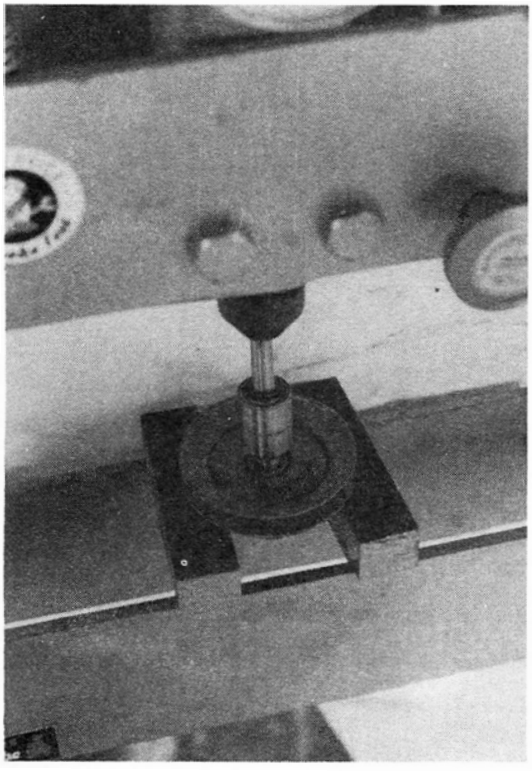


Figure 46
Bearing Installation

components. Use this figure for reference during reassembly. Using a press, install the bearing into the fan pulley, Figure 46.

2. Place the bearing into the pump casing using a press. Align the water pump casing bolt hole with the bearing outer race set hole.

3. Coat the casing side of the mechanical seal with a sealer and insert the seal into the casing.

4. Coat the mechanical seal impeller side with oil and install the impeller over the shaft using a press. Make sure that there is a standard clearance as shown in Figure 47.

5. Coat a new water pump gasket with a sealer and install the gasket and set plate onto the pump. Tighten the bolts to the specified torque, page 30.

6. Install the fan on the pulley. Tighten the bolts to the specified torque, page 30.

7. Rotate the pulley to make sure that the water pump operates smoothly.

E. Installation

1. Coat a new water pump gasket with a sealer and position the gasket and water pump onto the front of the cylinder block and install the six attaching bolts. Tighten the bolts to the specified torque, page 30. Position the hose onto the pump and tighten the clamp.
2. Position the V-belt and adjust the belt tension to within specification, page 30. Tighten the adjusting arm bolt and the two alternator pivot bolts.
3. Install the radiator as outlined on page 21. "Radiator-Installation".
4. Fill the cooling system. Run the engine for several minutes and check for leaks.

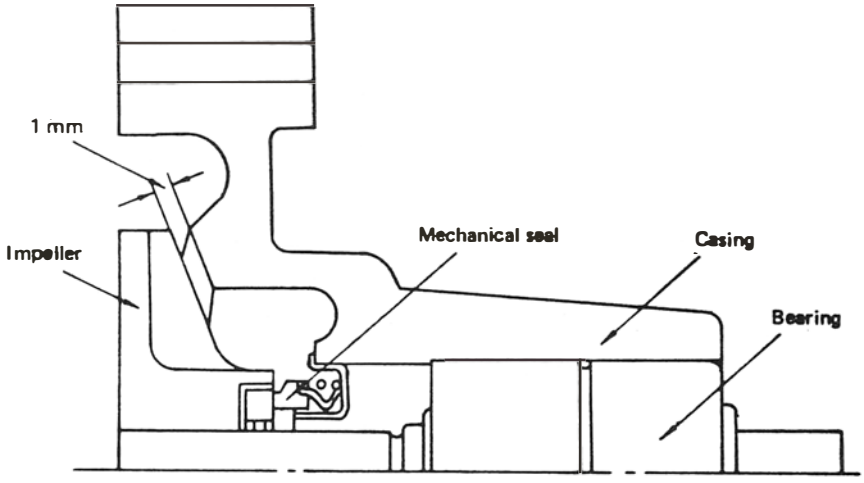


Figure 47
Impeller Installation

Part 1

ENGINE

Chapter 3

TROUBLE SHOOTING AND SPECIFICATIONS

1. TROUBLE SHOOTING

Trouble	Possible Causes
Engine Does Not Develop Full Power	1. Clogged air cleaner. 2. Fuel line obstructed. 3. Improper injection timing. 4. Improper nozzle injection pressure and angle. 5. Low cylinder compression. 6. Insufficient fuel injection. 7. Improper valve lash adjustment. 8. Burned, worn or sticking valves. 9. Blown head gasket. 10. Worn or sticking piston ring.
Low Cylinder Compression	1. Burned, worn, or sticking valves. 2. Bent valve stem. 3. Broken or weak valve spring. 4. Blown cylinder head gasket. 5. Worn or sticking piston ring. 6. Blown piston.
Poor Engine Idling	1. Improper injection timing. 2. Air in injection pump. 3. Improper governor adjustment.
Engine Knocks	1. Diluted or thin oil. 2. Insufficient oil supply. 3. Low oil pressure. 4. Worn crankshaft thrust bearing. 5. Excessive flywheel runout. 6. Excessive connecting rod or main bearing clearance. 7. Seized bearing. 8. Clogged oil passages. 9. Bent or twisted connecting rod. 10. Crankshaft journals out-of-round. 11. Excessive piston-to-cylinder bore clearance. 12. Excessive piston ring side clearance. 13. Broken or damaged rings. 14. Excessive piston pin clearance. 15. Seized piston. 16. Piston pin retainer loose or missing. 17. Improper valve lash adjustment. 18. Worn valve lifter. 19. Excessive timing gear backlash.

1. TROUBLE SHOOTING (CONT'D)

Trouble	Possible Causes
Low Oil Pressure	1. Engine oil level low. 2. Wrong grade of oil. 3. Clogged oil pump filter. 4. Faulty oil pressure relief valve. 5. Worn oil pump drive shaft or gears, or broken oil pipe. 6. Excessive main or connecting rod bearing clearances.
Oil Pressure Warning Light Fails to Operate	1. Bulb burned out. 2. Oil pressure sensor is faulty. 3. Warning light circuit faulty.
Excessive Oil Consumption	1. Engine oil level too high. 2. Leakage in the cylinder head gasket. 3. Oil loss past the pistons and rings. 4. Worn, broken, or sticking piston rings. 5. Clogged return hole of oil ring. 6. Worn valves and/or valve guides or worn seals. 7. Leakage past oil seals and gaskets. 8. External oil leaks from the engine.
Engine Overheats	1. Insufficient amount of coolant in the radiator. 2. Hose connection leaking or collapsed hose. 3. Radiator leakage. 4. Loose, worn, or broken V-belt. 5. Radiator fins bent or clogged. 6. Radiator cap not sealing. 7. Thermostat operating improperly. 8. Insufficient amount of engine oil. 9. Water pump operating improperly. 10. Improper valve clearance. 11. Resistance in the exhaust system. 12. Improperly installed cylinder head gasket. 13. Rust and/or scale clogged water ports. 14. Extended engine idling.
Temperature Gauge Fails to Reach Normal Operating Temperature	1. Faulty temperature sender. 2. Faulty thermostat. 3. Faulty temperature gauge.
Excessive Fuel Consumption	1. Improper injection timing. 2. Leakage at the injection pipe connectors. 3. Leakage at the fuel shut-off valve. 4. Improperly adjusted nozzle.

2. SPECIFICATIONS

ENGINE

Type	Diesel
Number of Cylinders	2
Displacement	1272cc (77.7 cu. in.)
Compression Ratio	21:1
Stroke	100mm (3.94 in.)
Bore	90mm (3.54 in.)
Firing Order	1–2
Rated Engine Speed	2500 rpm
Idle Speed	750–850 rpm
Maximum No-Load Speed	2650–2700 rpm

CYLINDER BLOCK

Cylinder Arrangement	In-line vertical
Cylinder Bore Diameter	90mm (3.543 in.)
Taper of Cylinder Bore	.2mm (.0079 in.)
Cylinder Bore Out-of-Round	.2mm (.0079 in.)
Rebore to Maximum Oversize	1.0mm (.0394 in.)
Cylinder Block Flatness	.05mm (.002 in.)
Allowable Limit for Cylinder Block Distortion	.12mm (.0047 in.)

CYLINDER HEAD

Valve Design	Overhead Valves
Bolt Pattern	4 Bolts per Cylinder
Cylinder Head Flatness	.05mm (.002 in.)
Allowable Limit for Cylinder Head Distortion	.12mm (.0047 in.)
Intake and Exhaust Valve Seat Angle	45°
Top Clearance	.98mm (.038 in.)

VALVE SPRINGS

Number per Valve	1
Type	Cylindrical Coil
Free Length	48mm (1.890 in.)
Tension at 36mm (1.4 in.)	14kg (30.8 lbs.) to 12kg (26.6 lbs.)
Valve Spring Squareness	1.0mm (.0394 in.)

VALVES

Valve Stem Diameter	8mm (.315 in.)
Valve Head Diameter:	
Intake	40mm (1.57 in.)
Exhaust	34mm (1.24 in.)
Valve Stem-to-Guide Clearance	
Intake	.03-.06mm (.0012-.0024 in.)
Exhaust	.04-.065mm (.0020-.0026 in.)

2. SPECIFICATIONS (CONT'D)

VALVES (CONT'D)

Allowable Valve Stem-to-Guide Wear Limit	
Intake	.2mm (.008 in.)
Exhaust	.25mm (.0098 in.)
Valve Seat Contacting Width	1.2-1.5mm (.0472-.0591 in.)
Allowable Valve Seat Wear Limit	2.0mm (.0787 in.)
Valve Seat Sink	.7-1.0mm (.027-.0394 in.)
Allowable Valve Seat Sink Wear Limit	2.0mm (.0787 in.)
Valve Head Thickness	1.3mm (.0512 in.)
Allowable Valve Head Wear Limit	1.0mm (.0394 in.)
Valve Lash (Intake and Exhaust)	.3mm (.012 in.)
Injection Timing	21° BTDC

CRANKSHAFT DRIVE GEAR

Number of Teeth	30
Timing Mark	Mark on Gear

CAMSHAFT DRIVE GEAR

Number of Teeth	60
Timing Mark	Mark on Gear
Timing Gear Backlash	.1mm (.004 in.)
Allowable Timing Gear Backlash	.3mm (.012 in.)

ROCKER ARM SHAFT

Shaft Diameter	13.7mm (.5394 in.)
Wear Limit	13.55mm (.5334 in.)

ROCKER ARM

Inside Diameter	.04mm (.0016 in.)
Wear Limit	.2mm (.008 in.)

CRANKSHAFT

Main Bearing Clearance	.04-.104mm (.0016-.0055 in.)
Crankshaft Bearing Oil Clearance	.056-.131mm (.002-.0051 in.)
Wear Limit for Bearing Clearance	.25mm (.010 in.)
Crankshaft Run-out	.06mm (.0024 in.)
Allowable Crankshaft Run-out	.12mm (.0048 in.)
Journal Out-of-Round, Taper	.05mm (.002 in.)
Crankshaft End Float	.1-.45mm (.0040-.017 in.)
Wear Limit for Crankshaft End Float	.7mm (.027 in.)

CAMSHAFT

Cam Lobe Height	32.05mm (1.26 in.)
Allowable Cam Lobe Wear Limit	31.65mm (1.25 in.)
Camshaft Run-out	.1mm (.004 in.)
Allowable Camshaft Run-out	.2mm (.008 in.)

2. SPECIFICATIONS (CONT'D)

CONNECTING RODS

Maximum Twist	.2mm (.008 in.)
Maximum Bend	.15mm (.006 in.)
Side Float	0.1-0.3mm (.004-.012 in.)
Allowable Side Float	.7mm (.027 in.)

PISTONS

Number of Compression Ring Grooves	3
Number of Oil Ring Grooves	1
Skirt-to-Cylinder Clearance	.115-.180mm (.0045-.0070 in.)
Piston Pin Diameter	32mm (1.260 in.)
Allowable Piston Pin Wear	31.95mm (1.258 in.)
Piston Pin to Rod Bushing Clearance	.01mm (.0004 in.)
Allowable Wear Limit	.05mm (.002 in.)
Oversize Pistons and Rings Available in	.5mm (.0197 in.)
	1.0mm (.0394 in.)

PISTON RINGS

Piston Ring End Gap	0.3-0.5mm (.0118-.0197 in.)
Allowable Wear Limit	1.5mm (.059 in.)
Piston to Compression Ring Groove Side Clearance	.03-.09mm (.0012-.0036 in.)
Allowable Wear Limit	.3mm (.012 in.)
Piston to Oil Control Ring Groove Side Clearance	.03-.07mm (.0012-.0028 in.)
Allowable Wear Limit	.15mm (.006 in.)
Oil Ring Width	4.5mm (.176 in.)
Compression Ring Width:	
Top	2.914mm (.1147 in.)
Intermediate	2.5mm (.098 in.)

FLYWHEEL

Flywheel Face Run-out	.2mm (.008 in.)

LUBRICATION SYSTEM

Main Bearings	Pressure
Connecting Rod Large Bearings	Pressure
Piston Pin Bushings	Splash
Cylinder Walls	Splash
Camshaft Bearings	Pressure
Timing Drive	Squirt
Tappets	Splash and Drain
Push Rods	Drip from Rocker Arms
Rocker Arms	Pressure
Capacity – Refill	4.7 Liters (5.0 U.S. Qts.)
Capacity – Dry Fill	5 Liters (5.3 U.S. Qts.)

ENGINE OIL GRADE

Consult the Operator's Manual for recommended oil types and viscosities.

2. SPECIFICATIONS (CONT'D)

OIL PUMP

Gear-to-Pump Housing Clearance . . . . . .07–.14 mm (.0028–.0056 in.)
Allowable Wear Limit . . . . . .25mm (.0098 in.)
Gear Teeth-to-Pump Housing Clearance . . . . . .01-.031mm (.0004-.0012 in.)
Pump Pressure . . . . . 2.5-4.0 kg/cm^2 (35.5-56.8 psi) at 2500 rpm.
Relief Valve Pressure . . . . . 2.5-4.0 kg/cm^2 (35.5-56.8 psi) at 2500 rpm.

COOLING SYSTEM

Capacity . . . . . 5.3 Liters (5.6 U.S. Qts.)
Radiator Cap Pressure . . . . . .914 kg/cm^2 (13 psi)
Fan Belt Deflection . . . . . 10-15mm (7/16 to 9/16 in.)
Water Pump:
- Type . . . . . Centrifugal
- Drive . . . . . V-Belt
- Bearing Wear Limit . . . . . .2mm (.008 in.)

Thermostat:
- Opening Temperature . . . . . 71°C (159.8°F)
- Full Open . . . . . 85°C (185°F)

TORQUE SPECIFICATIONS

Flywheel Cover Bolts . . . . . 4.5-5.0 kg-m (32.5-36 lbs. ft.)
Rod Cap Bolts . . . . . 7.0-7.5 kg-m (50-55 lbs. ft.)
Oil Pan Studs . . . . . 1.4-1.9 kg-m (10-14 lbs. ft.)
Front Plate Bolts . . . . . 1.4-1.9 kg-m (10-14 lbs. ft.)
Idler Gear Bolts . . . . . 1.8-2.0 kg-m (13-14.5 lbs. ft.)
Relief Valve . . . . . 9.0-10.0 kg-m (65-72 lbs. ft.)
Camshaft Gear Nut . . . . . 15.0-16.0 kg-m (108-116 lbs. ft.)
Injection Pump Coupling Nut . . . . . 4.0-5.0 kg-m (29-36 lbs. ft.)
Injection Pump Gear Bolts . . . . . 4.0-5.0 kg-m (29-36 lbs. ft.)
Oil Pump Gear Nut . . . . . 3.0-3.5 kg-m (21-25 lbs. ft.)
Crankshaft Pulley Nut . . . . . 4.0-5.0 kg-m (29-36 lbs. ft.)
Cylinder Head Nuts . . . . . 15.0-15.5 kg-m (108-112 lbs. ft.)
Rocker Arm Nuts . . . . . 4.9-6.5 kg-m (35-47 lbs. ft.)
Rocker Cover Nuts . . . . . 0.5-0.8 kg-m (3.6-5.8 lbs. ft.)
Nozzle Holders . . . . . 6.0-7.0 kg-m (43-50 lbs. ft.)
Flywheel Nut . . . . . 100-120 kg-m (723-868 lbs. ft.)

Torque specifications not listed above:

Bolt, Nut	TIGHTENING TORQUE	
	Standard Bolt	Special Bolt
M 6	.6-.8 kg-m (4.5-6.0 lbs. ft.)	1.0-1.3 kg-m (7.0-9.5 lbs. ft.)
M 8	1.3-1.8 kg-m (9.5-13.0 lbs. ft.)	2.5-3.5 kg-m (18.0-25 lbs. ft.)
M 10	2.0-3.0 kg-m (14.5-22 lbs. ft.)	5.5-7.0 kg-m (40-50 lbs. ft.)
M 12	5.0-6.0 kg-m (36-44 lbs. ft.)	9.0-11.0 kg-m (65-80 lbs. ft.)
M 16	10.0-12.0 kg-m (72-87 lbs. ft.)	16.0-18.0 kg-m (116-130 lbs. ft.)
M 18	12.0-14.0 kg-m (87-100 lbs. ft.)	20.0-24.0 kg-m (145-175 lbs. ft.)
M 20	15.0-17.0 kg-m (108-123 lbs. ft.)	24.0-26.0 kg-m (175-188 lbs. ft.)

NOTE: The special bolts can be identified by the number 7 or 8 on the head of the bolt.

PART 2

FUEL SYSTEM

CHAPTER 1

DIESEL FUEL SYSTEM

1. DESCRIPTION AND OPERATION

The fuel system of the Ford 1000 Tractor includes the fuel tank, fuel shut off and filter assembly, the fuel injection pump and the fuel injectors.

The fuel tank is mounted over the clutch housing behind the engine and is filled through the rear hood access door to the filler cap. The fuel tank is also equipped with a fuel gauge on the left side of the tank, see Figure 1.

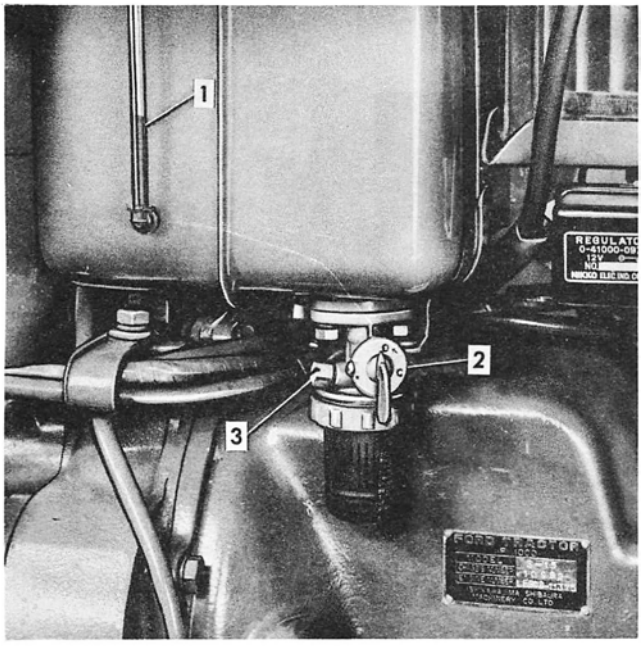


Figure 1
Fuel Gauge and Fuel Shut Off Valve

1. Fuel Gauge
2. Fuel Shut Off Valve
3. Air Bleed Screw

A fuel shut off and filter assembly, Figure 1, is on the lower left side of the fuel tank. The filter is of a 20 micron density and is located in a transparent sediment bowl for daily inspection. Fuel from the tank passes through the taper valve to the filter cup, Figure 2. While the fuel is passing through the element, any fine dirt or foreign material is trapped in the filter element and the fuel is then delivered to the injection pump. Two air bleed bolts are fitted to the cock body and air can be exhausted from the filter assembly by loosening these bolts.

The fuel injection pump is a two cylinder, barrel and plunger type, in-line pump similar to the Simms injection pump. The injection pump is located on the right side of the engine and is mounted to the engine front mounting plate. The injection pump is driven by the pump timing gear. An air bleed screw is located on the side of the pump, Figure 3, to remove all air from the system between the fuel tank and the pump oil gallery when the fuel system has been serviced.

Two pintle type injectors are used in the Ford 1000 engine which have a 1.01 mm (.040 in.) single orifice and are set to 120 kg/cm^2 (1700 psi) opening pressure. The pressure adjustment is made by adding or deleting shims from the top of the injector pressure adjusting spring. The pintle type injectors have an injection angle of 12^o. The injection pipes are 2 mm (.080 in.) I.D. and are the same length for each cylinder to help keep the injection intervals in time.

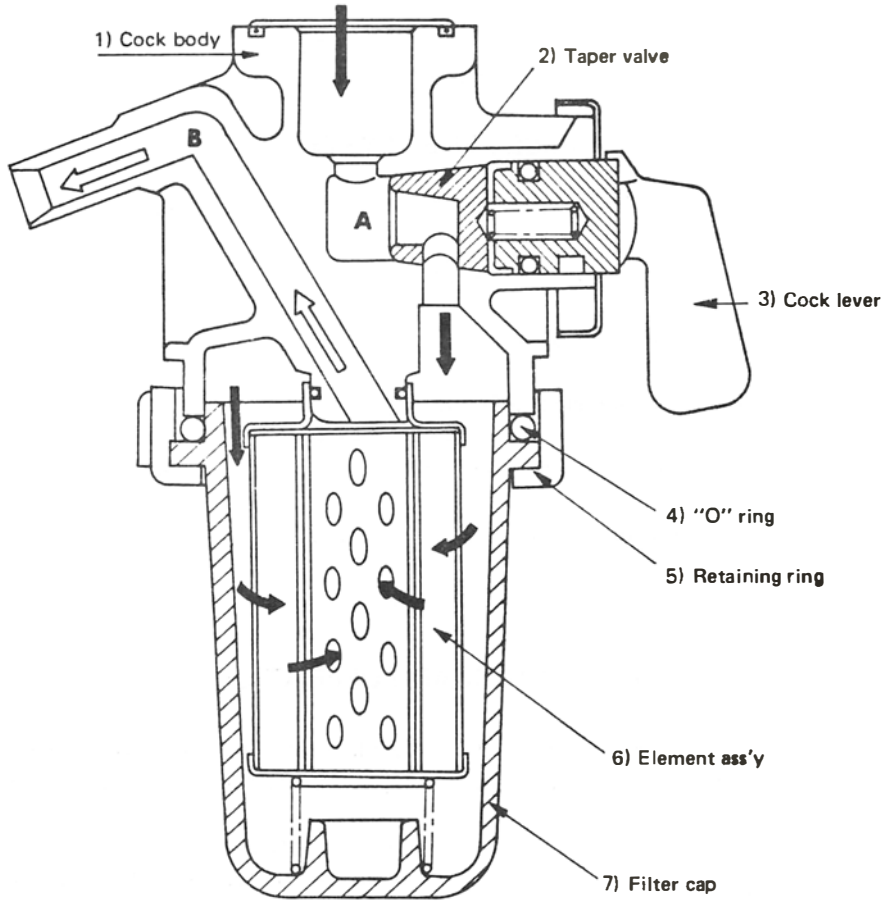


Figure 2
Fuel Filter Assembly

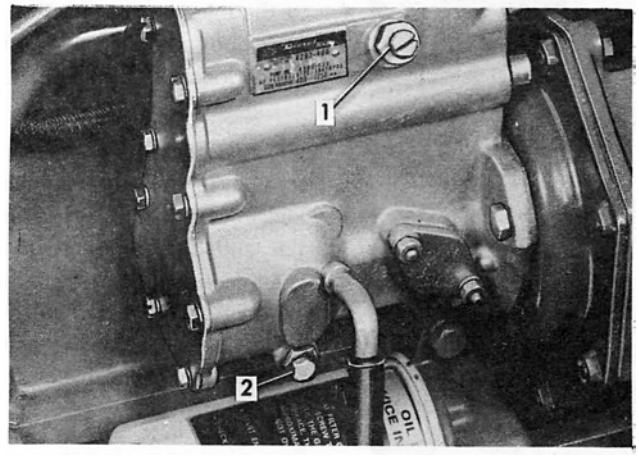


Figure 3
Injection Pump

1. Air Bleed Screw
2. Drain Plug

2. INJECTION NOZZLE

A. Removal

1. Clean all loose dirt from around the injectors and lines. Disconnect the leak-off lines from the injectors.
2. Disconnect the injection pump lines at the pump and injectors. Cover the ends of the lines and the injector inlet and leak-off ports to prevent the entry of foreign material or dirt.
3. Remove the injectors from the cylinder head and discard the dust sealing washers.
4. Remove and discard the copper injector sealing washers from the injector locating bores. Cover the bores to prevent entry of dirt.

B. Disassembly and Inspection
Refer to Figure 4

1. Loosen and remove the nozzle nut being careful not to drop the nozzle.
2. Remove the nozzle and needle valve.
3. Clean the nozzle body and needle valve and check the nozzle for any burn or score marks. Also check the seat for any fuel leakage. Fuel leakage from the seat can be corrected by lightly polishing the seat.
4. Inspect the upper and lower contact surfaces of the nozzle holder distance piece for clean contact.
5. Check the contacting area between the push rod and nozzle needle valve for wear. Check the spring seat for any cracks. Replace worn or damaged parts.
6. Clean all of the injector components in a good solvent.

C. Assembly

1. Reassembly should be done in the reverse procedure of "Disassembly ".
2. During reassembly be careful not to damage the needle valve. Tighten all connections securely to prevent leakage.

D. Installation

1. Place new dust sealing washers around the injector bodies.
2. Install a new copper sealing washer in each injector locating bore. Install the injectors and tighten to the torque specified on page 37.
3. Install the leak off lines, using new copper sealing washers above and below each connection.
4. Install the injector lines. Finger tighten the fittings at the injectors until after bleeding the fuel system. Tighten the fittings at the pump to the torque specified on page 37.
5. Bleed the fuel system of all air then tighten the injector lines at the injectors to the torque specified on page 37.

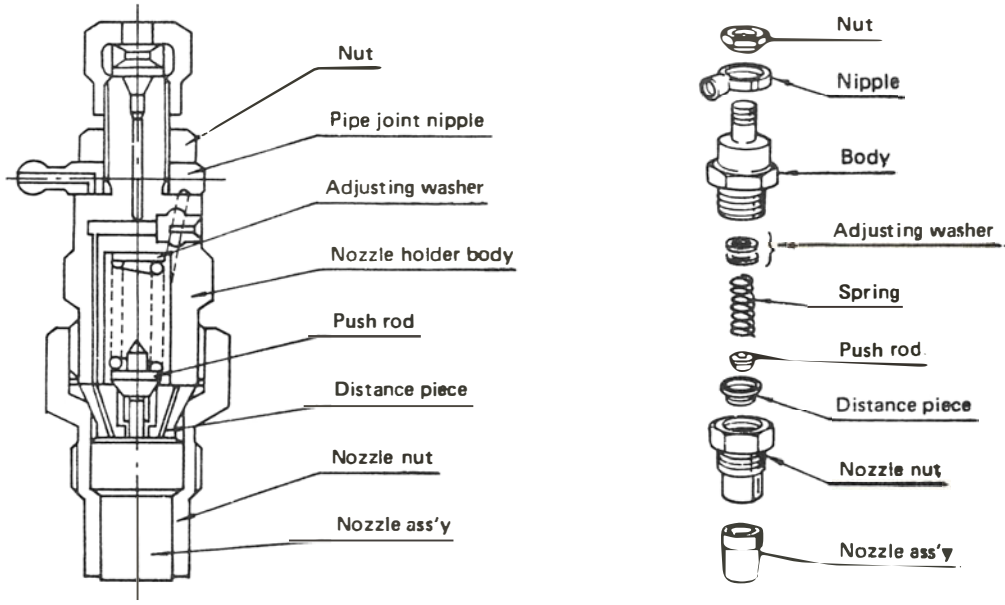


Figure 4
Exploded View of Injector

3. INJECTION NOZZLE TESTING

To remove the injection nozzle assembly from the cylinder head refer to Section 2, "Injection Nozzle – Removal," page 33.

Nozzle Injection Pressure

1. Attach a nozzle tester to the injection assembly, and operate the nozzle tester handle to clean the nozzle assembly.

2. Pump the tester to approximately 100 kg/cm^2 (1425 psi) of oil pressure and check the top of the needle valve and the threaded portion of the nozzle nut. If an oil leak is apparent, the seat and nozzle head can be repaired by polishing. Refer to Section 2, "Injection Nozzle – Disassembly and Inspection," page 33. If leakage still occurs after servicing the seat and nozzle head, replace the nozzle assembly.

3. Adjust the adjusting washers so that the injection will start at 120 kg/cm^2 (1700 psi) of pressure. A washer width of .1 mm (.004 in.) can increase the pressure by approximately 10 kg/cm^2 (140 psi).

4. During the testing there should be no drops in the mist pattern coming from the nozzle.

5. Check to make sure that the mist is being injected to an area of about 12^o from the nozzle center line.

6. Place a piece of white paper under the nozzle and repeat the test. A good spray pattern will leave a completely round circle on the paper.

4. FUEL FILTER AND FUEL TANK

FUEL FILTER

A. Removal

1. Turn the fuel shut off valve to the "OFF" position.

2. Loosen the retaining ring and remove the sediment bowl and element.

B. Repair

1. Clean the element in a suitable cleaner, keeping the element ends closed off with your fingers, see Figure 5.

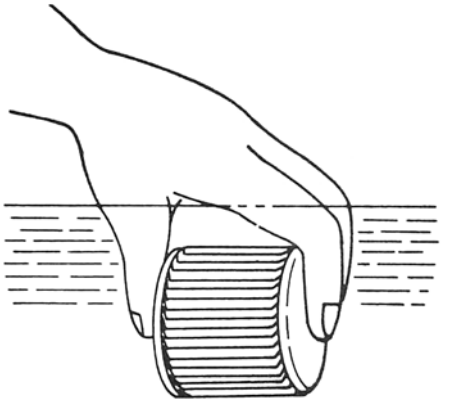


Figure 5
Fuel Filter Element

Note: The fuel filter element should be cleaned every 100 hours of operation and replaced at every 200 hours.

C. Installation

1. Position the element in the shut off valve body.

2. Install the O-ring and filter bowl over the element and tighten securely. Make sure the O-ring is seated properly.

3. Turn the fuel shut off valve to the "ON" position.

4. Bleed the air from the filter assembly by loosening the air bleed screw, Fig. 1, until the air bubbles are forced from the sediment bowl, then retighten the screw.

FUEL TANK

A. Removal

1. Remove the air cleaner inlet cap, unlatch the hood panel and tilt the panel forward.

2. Turn the fuel shut off valve to the "OFF" position.

3. Disconnect the fuel pipe.

4. Remove the tensioner screws from the fuel tank bands and remove the fuel tank.

B. **Installation**

1. Place the fuel tank in the bands and install and tighten the band tensioner screws.
2. Connect the fuel pipe.
3. Turn the fuel shut off valve to the "ON" position.
4. Position the hood panel over the fuel tank and secure the hood panel latches.
5. Install the air cleaner cap over the air cleaner assembly.

5. INJECTION PUMP

A. **Removal**

1. Clean all dirt from the injection pump and surrounding tractor parts.
2. Turn the fuel shut off valve to the "OFF" position.
3. Drain the coolant from the radiator and remove the radiator.
4. Disconnect the injection pump inlet line and the fuel injector lines.
5. Disconnect the throttle control rod.
6. Remove the engine front cover by following the procedure outlined in Part 1 Engine, Chapter 1, Section 2, "Engine Removal and Disassembly."
7. Remove the nut and the injector coupling from the injection pump drive shaft.
8. Remove the three retaining bolts and the injection pump from the engine front mounting plate.

B. **Installation**

1. Place a new pump-to-front mounting plate gasket on the injection pump and install the injection pump and retaining bolts. Tighten the bolts to the torque specified on page 37.
2. Install the injection pump coupling over the pump drive shaft and secure with the retaining nut. Refer to Part 1, Engine, Section 7, "Engine Assembly and Installation," for the proper procedure to follow in timing the injection pump.
3. Install the engine front cover and components by following the procedure outlined in Part 1, Engine, Section 7, "Engine Assembly and Installation."
4. Connect the throttle control rod.
5. Connect the injection pump inlet lines and the fuel injector lines.
6. Install the radiator and fill it with coolant.
7. Turn the fuel shut off valve to the "ON" position.
8. Loosen the fuel injection pump air vent screw, see Figure 3, and bleed the air out of the pump, then tighten the screw.

PART 2

FUEL SYSTEM

CHAPTER 2

TROUBLE SHOOTING AND SPECIFICATIONS

Section **Page**

1. TROUBLE SHOOTING

Trouble	Possible Cause
No fuel being injected from injection pump.	1. Check the fuel shut off valve to make sure it is in the "ON" position. 2. Clogged fuel filter or air in fuel pipe. 3. Air present in injection pump. 4. Faulty operation of injection pump.
Engine starts and stops.	1. Clogged fuel filter or fuel pipe. 2. Air in fuel system. 3. Insufficient fuel supply due to clogged fuel tank air breather cap. 4. Check for water in fuel.
Engine knocks.	1. Improper injection timing. 2. Nozzle injection pressure too high. 3. Improper nozzle injection.
Improper fuel injection timing.	1. Wrong mounting of injection pump gear and coupling. 2. Faulty injection pump operation.
Engine does not develop full power or speed.	1. Excessive oil leak from nozzle. 2. Improper injection pump timing. 3. Injection nozzle operating improperly. 4. Clogged fuel filter or fuel pipe. 5. Poor engine compression. 6. Faulty injection pump.
Engine emits black smoke	1. Improper injection timing. 2. Nozzle injection pressure too low. 3. Poor engine compression. 4. Damaged engine valves. 5. Restriction in air intake. 6. Faulty injection pump.

1. TROUBLE SHOOTING (Cont'd)

Trouble	Possible Cause
Engine power unstable.	1. Improper fuel supply. 2. Air or water in fuel. 3. Damaged injector nozzle. 4. Improper injection pump timing. 5. Faulty injection pump.
Engine idling unstable.	1. Air present in fuel system. 2. Faulty injection pump.
Improper nozzle operation.	1. Improperly adjusted injection pressure. 2. Leakage between nozzle and needle valve. 3. Seized nozzle needle valve. 4. Carbon or foreign matter present in nozzle hole.

2. SPECIFICATIONS

FUEL SYSTEM

Type ..... Diesel
Injection Pump:
- Type ..... In-line
- Timing ..... 21° BTDC

Injection Nozzle:
- Type ..... Pintle
- Injection Pressure ..... 120 kg/cm^2 (1700 psi)
- Injection Angle ..... 12°
- Injection Timing ..... 21° BTDC

Fuel Filter ..... Throw away type
Maximum No-Load Speed ..... 2650-2700 rpm
Low Idle Speed ..... 750-850 rpm

TORQUE SPECIFICATIONS

Injectors ..... 6-7 kg-m (43-50 lbs. ft.)
Injection Pump-to-Front Mounting Plate Bolts ..... 4.5-5.0 kg-m (32-36 lbs. ft.)
Injector Line Nuts ..... 2.4-3 kg-m (18-22 lbs. ft.)

PART 3

ELECTRICAL SYSTEM

CHAPTER 1

WIRING, LIGHTS, AND INSTRUMENTS

1. WIRING DIAGRAM

Figure 1 is the electrical wiring diagram for the Ford 1000 tractor.

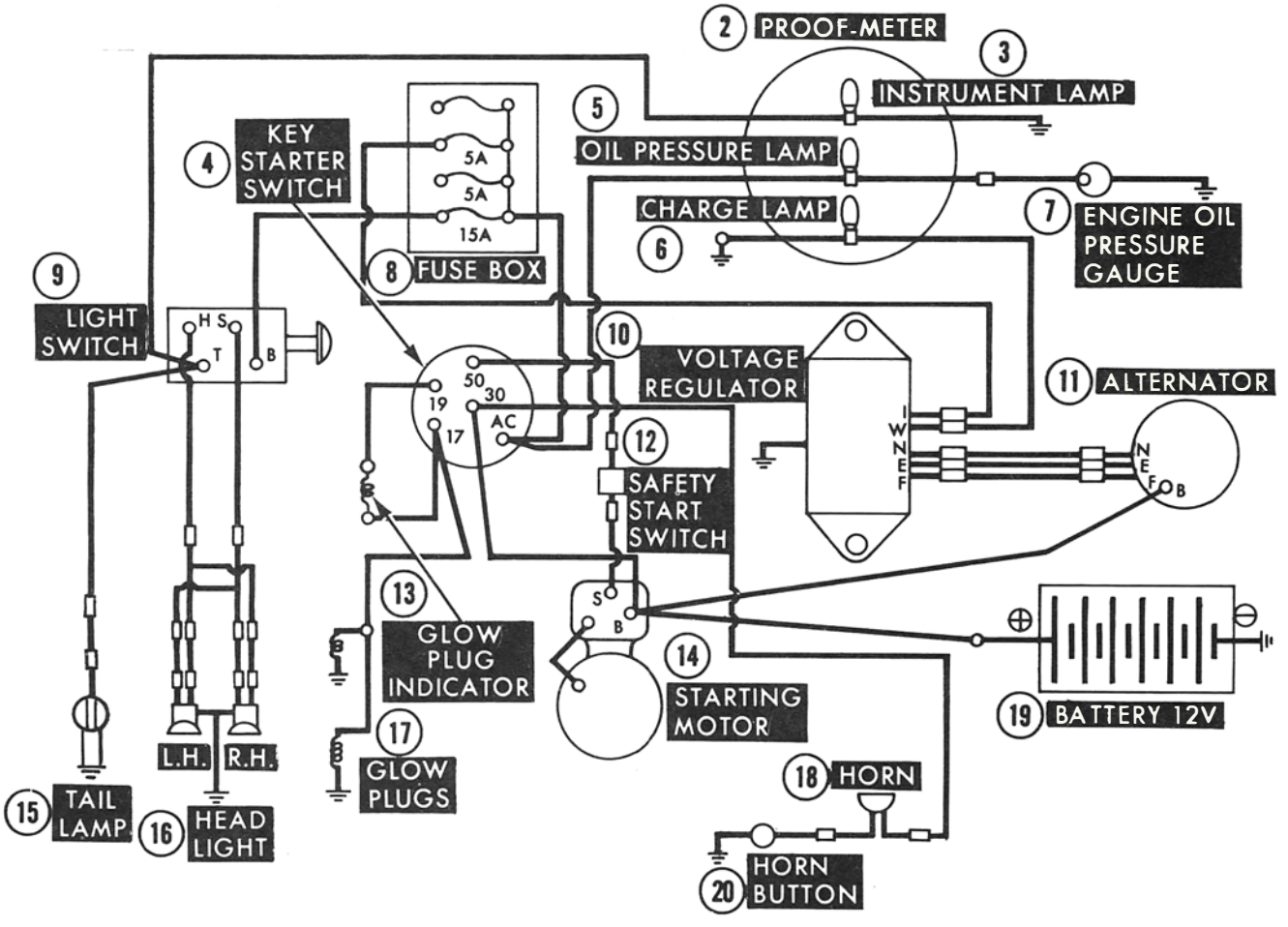


Figure 1
Ford 1000 Wiring Diagram

2. LIGHTS AND LIGHT SWITCH

The Ford 1000 is equipped with two headlights located in the front grille and a tail lamp which is located on the left rear fender as viewed from behind the tractor. The optional flasher warning lamp is also located on the left rear fender. The spring-loaded push-type switch on the flasher lamp housing is used to turn the flasher lamp on or off.

The light switch must be in its intermediate or full out position before the flasher will operate.

REMOVAL AND INSTALLATION

Headlamps

1. Remove the headlamp rim locking screw.
2. Remove the lamp unit from the lamp housing and separate the lens from the reflector. Remove the bulb.
3. Install the new bulb and assemble the lens and reflector making sure the wiring connections are tight; that the top of the unit is up; and that the locating tab is positioned in the slot. Refer to "Specifications" for correct bulb size.
4. Install the rim and tighten the rim locking screw.

Tail Lamp and Flasher Warning Lamp

1. Remove the lens and rim assembly and remove the bulb.
2. Install a new bulb and reinstall the lens and rim assembly. Refer to "Specifications" for correct bulb size.

Instrument Lights

1. Remove the screws that secure the instrument panel to the rear hood panel assembly and pull the instrument panel rearward.
2. If necessary, disconnect the Proof-Meter drive cable to obtain better access.
3. Remove the bulb socket from the rear of the instrument panel and install a new bulb. Refer to "Specifications" for correct bulb size.
4. Reassemble in the reverse procedure of steps 1 through 3.

LIGHT SWITCH

The light switch is located in the instrument panel on the left hand side of the steering column, Figure 2. The switch has three positions and is operated by pulling the knob out or pushing the knob in. The switch positions are:

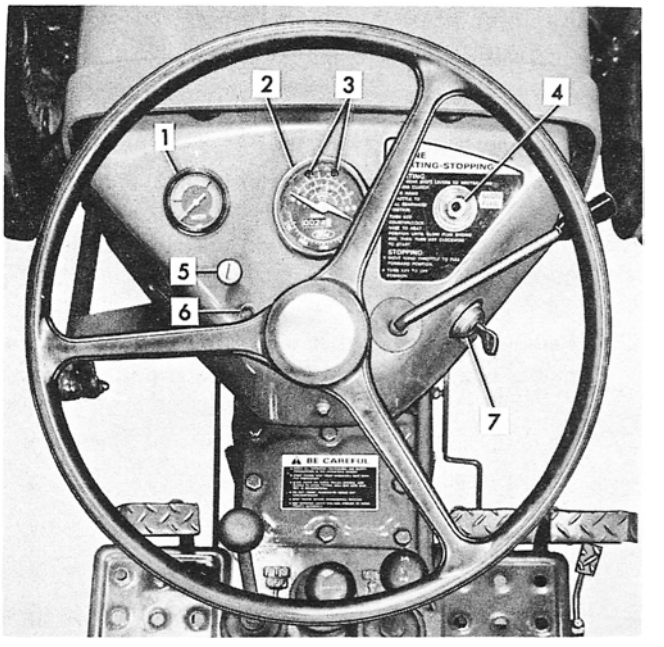


Figure 2
Instrument Panel

1. Temperature Gauge
2. Proof-Meter
3. Warning Lights
4. Glow Plug Indicator
5. Light Switch
6. Horn
7. Key-Starter Switch

Position	Lights
Full In	Off
Intermediate	Headlights (Low Beam) Instruments, and Tail Lamp
Full Out	Headlights (High Beam) Instruments, and Tail Lamp

Removal and Installation

1. Disconnect the battery ground (negative) cable from the battery.
2. Unscrew the light switch knob from the switch assembly.
3. Remove the jam nut.
4. Remove the switch from the instrument panel and disconnect the wires, and replace the switch.
5. After reconnecting the wires, install the switch in the instrument panel and secure in place with the jam nut. Replace the switch knob.
6. Connect the battery ground (negative) cable to the battery.

3. INSTRUMENT PANEL

The instrument panel houses the gauges and switches as shown in Figure 2.

REMOVAL AND INSTALLATION

To replace a gauge or switch in the instrument panel:

1. Disconnect the battery ground (negative) cable from the battery.
2. Remove the screws that secure the instrument panel to the rear hood panel assembly and pull the instrument panel rearward. If necessary, disconnect the Proof-Meter cable to obtain better access.
3. Remove the applicable switch or gauge from the panel.
4. Insert the new gauge or switch and connect the wires.
5. Replace the instrument panel.
6. Connect the battery ground (negative) cable to the battery.

PART 3

ELECTRICAL SYSTEM

CHAPTER 2

ALTERNATOR CHARGING SYSTEM

1. DESCRIPTION AND OPERATION

The alternator system consists of an alternator and voltage regulator. The alternator is cooled by a front mounted pulley and fan assembly that draws air into the housing. The air stream is directed across the rectifying diodes, stator, and rotor, and expelled out the openings in the front housing. The rotor assembly is mounted on ball bearings.

The alternator has six silicon diodes built into the rear cover, Figure 3. The alternator converts magnetic and mechanical energy to alternating current by rotating an electromagnet (the rotor) inside the stator assembly. The alternating current and voltage is changed to direct current (D.C.) by a three-phase, full wave rectifier system, employing the six silicon rectifying diodes.

The voltage regulator is designed to exercise automatic control over the charging system, and also to compensate for seasonal temperature change. The voltage regulator has two sets of points, one for high speed operation and one for low speed operation.

A field relay is located on the right side of the voltage regulator which switches off the charge lamp circuit and closes the point when the engine is started.

When the stator switch is closed, voltage from the battery is applied on the terminal I of the regulator, see Figure 4, thus the field relay is not operating, and the charge lamp is lighted through the W terminal. A field current is supplied through the terminal F of the alternator through the RC resistor of the regulator. When the revolution of the alternator increases by starting the engine, output voltage is generated in terminal B. As the revolution of the alternator increases, voltage equivalent to one-half of the voltage generated at terminal B is generated concurrently in the intermediate terminal N of the alternator. When this voltage reaches the level of approximately 4v, it actuates the field relay through the terminal N. When the field relay is actuated, the charge lamp goes off and the battery will be charged at higher engine rpm. The coil of the voltage regulator should maintain the voltage range between 13.5v through 14.2v, thus regulating the field current.

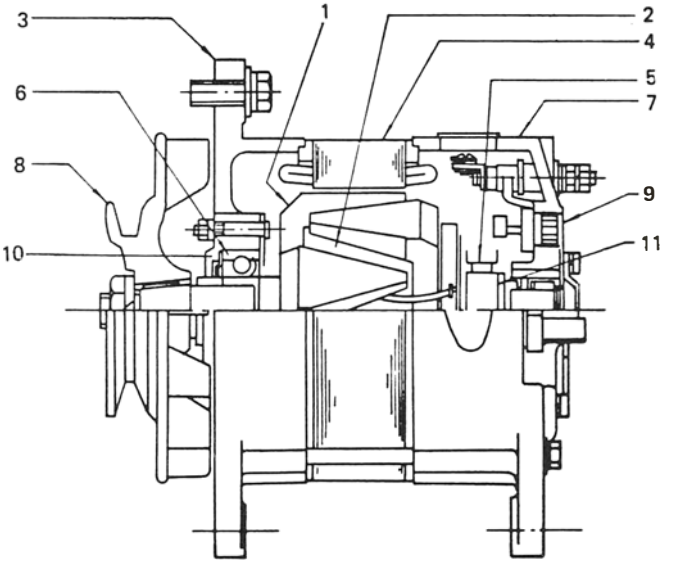


Figure 3
Sectional View of the Alternator

1. Rotor
2. Rotor Coil
3. Front Cover
4. Stator
5. Brush
6. Ball Bearing
7. Bracket
8. Pulley
9. Silicon Diodes
10. Bearing Retainer
11. Slip Ring

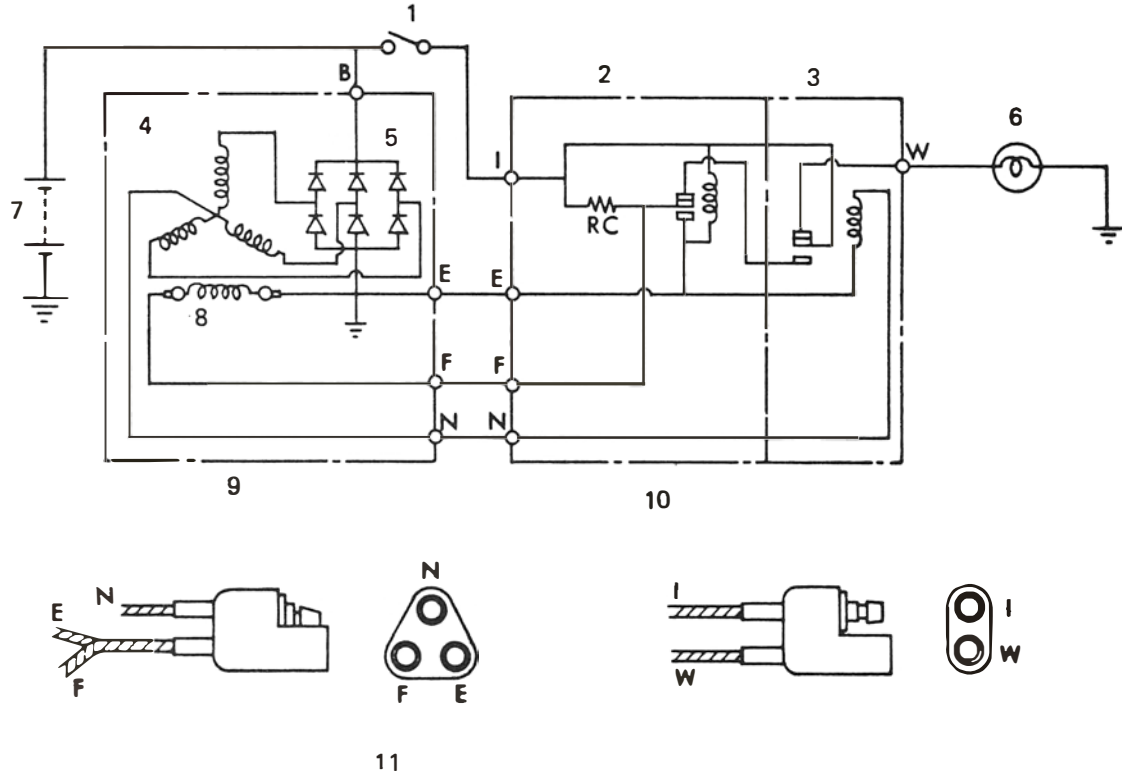


Figure 4
Electrical Diagram of the Alternator and Regulator

1. Stator Switch
2. Voltage Regulator
3. Field Relay
4. Stator Coil
5. Diodes
6. Charge Lamp
7. Battery
8. Rotor Coil
9. Alternator
10. Regulator
11. Regulator Terminal Socket

2. IN-VEHICLE TESTS

PRELIMINARY CHECKS

Prior to electrical testing, a thorough inspection of the charging and electrical system is required to eliminate associated conditions that may be interpreted as a defective alternator or regulator.

1. Check all electrical leads and connections, repair or replace necessary parts. Check the condition of the alternator drive belt and pulleys. Severe operating conditions will accelerate belt and pulley wear. Tighten the belt to within specification page 63, to avoid slippage during testing.

2. Disconnect the battery ground (negative) cable from the battery. Then remove the retaining screws and brush cover which is located at the rear of the alternator. Remove the brushes and check them for wear. If the brushes are worn beyond the specified limit page 63, install new brushes.

3. Re-install the brushes and cover assembly. Connect the battery ground (negative) cable to the battery.

4. Check the battery. The battery used in the electrical testing must be of correct voltage and must be in good condition and fully charged.

   DO NOT, under any circumstances, short the alternator field terminal to ground, as permanent damage to the regulator may result.

   DO NOT disconnect the voltage regulator connector plug from the tractor wiring harness while the alternator is operating. A large voltage transient could develop and may damage the alternator.

DO NOT disconnect the alternator output lead from the alternator while the alternator is operating. This same precaution applies to the battery cables. They must not be switched "off" or disconnected from the battery while the alternator is operating. The loss of battery resistance would cause system voltage to rise to an extreme value, damaging the alternator, regulator, and possibly other accessories.

ALWAYS disconnect the battery ground cable from the battery when removing or installing the alternator.

5. Check the key starter switch. One of its functions is to supply initial excitation current for the alternator rotor (field) windings. The switch must be in good condition to perform the following tests.

IN-VEHICLE TEST

Alternator

1. Connect the DC ammeter and the DC voltmeter to the alternator as shown in Figure 5. If the circuit is closed with the engine stopped, a current of approximately 1A runs if the field current is normal.

2. Start the engine and idle between 600-1000 rpm. The DC voltage of 15v or more is generated in the terminal B, Figure 5, if all equipment is operating normal.

   NOTE: Do not raise the engine speed over 1,200 rpm during the test. A diode may be damaged due to the rising voltage in the system.

Voltage Regulator

1. Check the battery to be sure the voltage is on the normal level of 12v or more. See Chapter 3, "Battery."

2. Turn the starter switch to the "ON" position and check the voltage between the terminals I and E, Figure 4, to be approximately 12v, and the voltage between the terminals F and E to be approximately 6v.

3. Start the engine. The voltage between the F and E terminals should rise to approximately 12v and the charge lamp should go off if the regulator is operating normally.

4. If the voltage between the I and E terminals remains in the range of 13.5v - 14.2v during charging, then the regulator is operating properly.

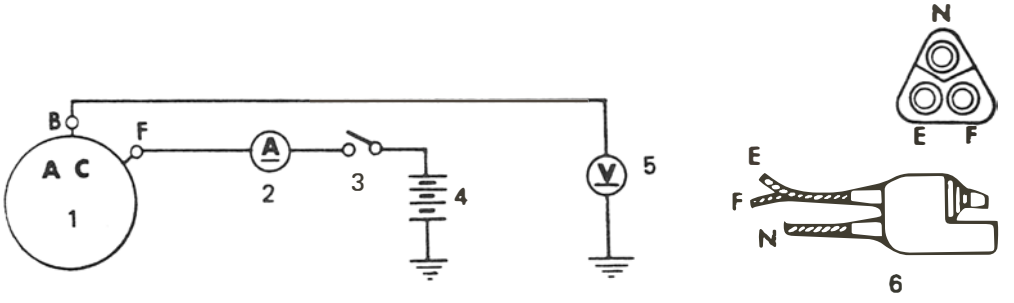


Figure 5
Alternator Inspection Circuit Diagram

1. Alternator
2. Ammeter
3. Switch
4. Battery
5. Voltmeter
6. Alternator Terminal Socket

3. ALTERNATOR OVERHAUL AND BENCH CHECK

A. Removal

1. Disconnect the battery ground (negative) cable from the battery.

2. Disconnect all wires from the alternator.

3. Remove the alternator from the tractor by removing the attaching bolts.

B. Disassembly

1. Remove the retaining screws and brush cover from the alternator and remove the brushes, Figure 6.

2. Remove the retaining nut and washer from the alternator shaft and remove the pulley and key, Figure 6.

3. Remove the thru bolts which secure the front and

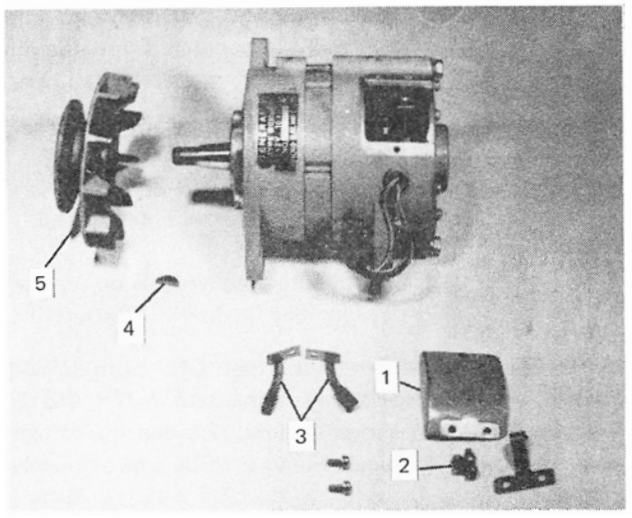


Figure 6
Alternator Brush and Pulley Removal

1. Brush Cover
2. Retaining Screws
3. Brushes
4. Key
5. Fan and Pulley Assembly

rear covers together, Figure 7. Separate the front and rear covers using a plastic hammer.

NOTE: Do not use excessive force in separating the covers because the wiring for the stator coil and diode bracket may be damaged.

4. Remove the screws securing the diode bracket to the stator coil terminal lead wire and then remove the rear cover, Figure 8.

5. Remove the screws securing the bearing retainer and remove the rotor assembly, Figure 8.

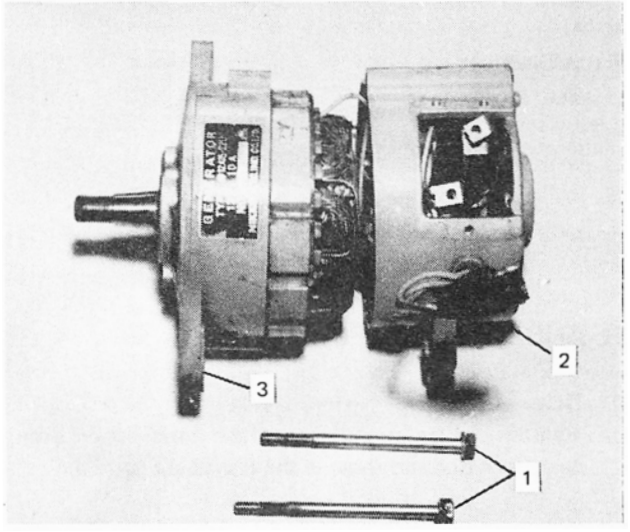


Figure 7
Alternator Cover Removal

1. Thru Bolts
2. Rear Cover
3. Front Cover

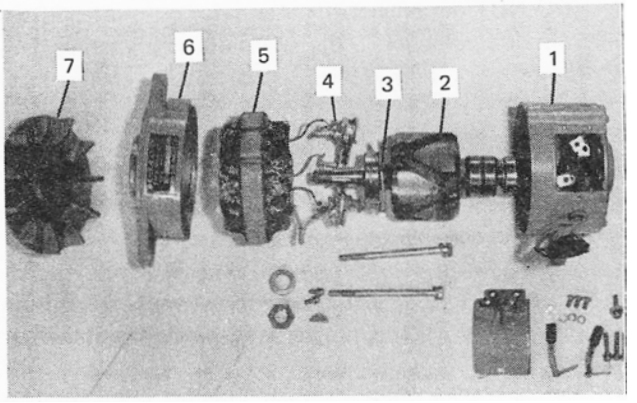


Figure 8
Rotor Removal

1. Rear Cover
2. Rotor Assembly
3. Bearing Retainer
4. Diodes
5. Stator
6. Front Cover
7. Fan and Pulley Assembly

6. Disconnect the diodes from the lead wire of the stator coil by using a soldering iron and remove the diode bracket.

NOTE: Disconnect the diode assembly from the stator coil terminals only when a diode bracket is being replaced. When disconnecting the diode assembly from the stator coil terminals, apply the soldering iron for no more than 2 seconds as prolonged excessive heat will damage the diode assembly.

7. Remove the stator coil from the front cover.

C. Inspection

Stator Coil

1. Using an ohmmeter check the insulation of the stator coil as shown in Figure 9. There should be no

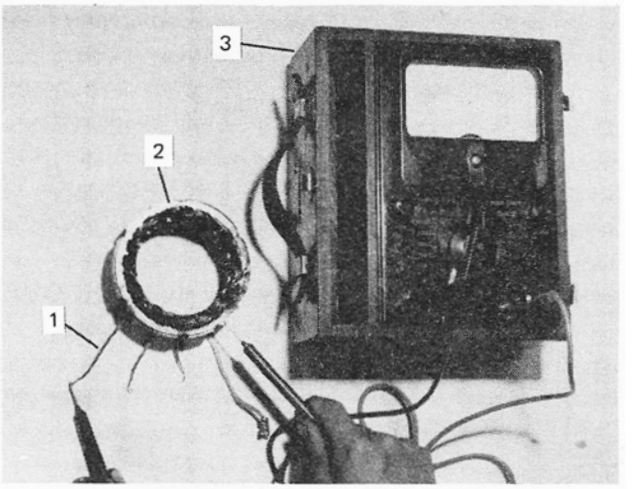


Figure 9
Insulation Test of Stator Coil

1. Stator Coil Terminal
2. Stator Coil Core
3. Tester

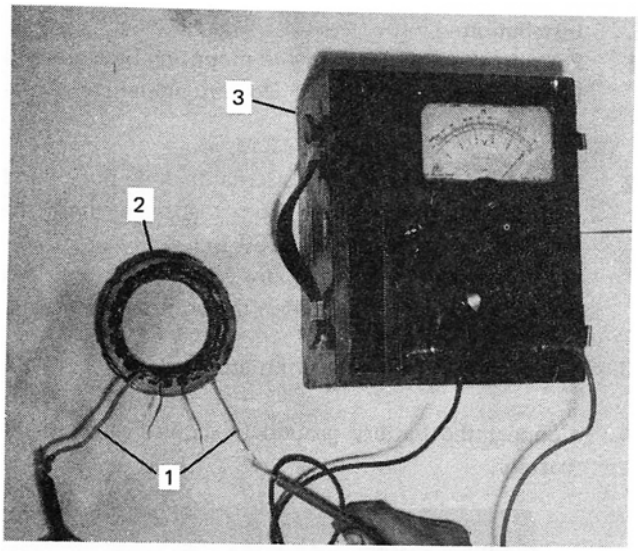


Figure 10
Conduction Test Between Stator Terminals

1. Stator Terminals
2. Stator Coil
3. Tester

conduction between the stator coil and the core. If conduction exists, the stator coil assembly must be replaced.

2. Check the conduction between the stator coil terminals as shown in Figure 10. If conduction does not exist between the terminals, replace the stator coil assembly.

Rotor Coil

1. Check the insulation of the rotor coil as shown in Figure 11. There should be no conduction between the slip ring and the core or the shaft of the rotor. If conduction exists, the rotor assembly must be replaced.

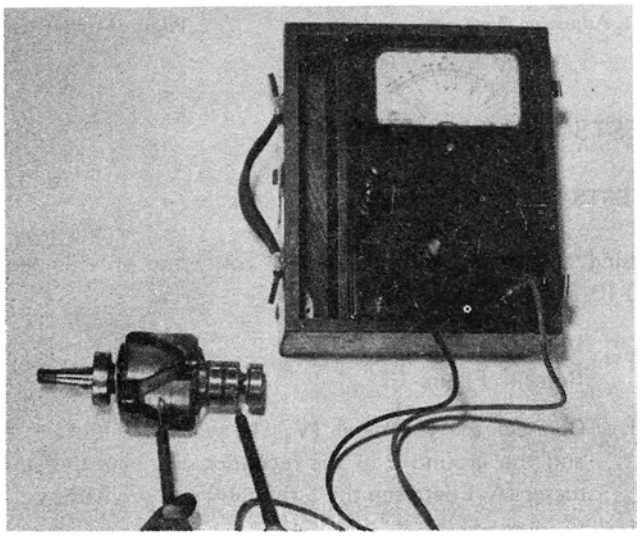


Figure 11
Insulation Test of Rotor Coil

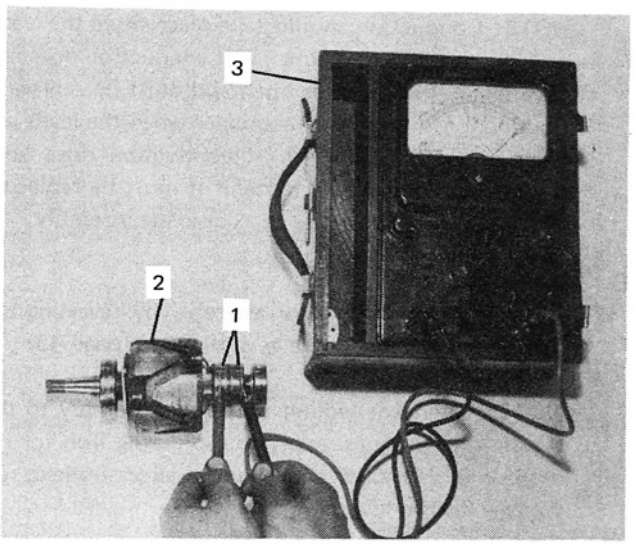


Figure 12
Conduction Test of Slip Rings

1. Slip Rings
2. Rotor Coil
3. Tester

2. Check the conduction between the two slip rings as shown in Figure 12. If no conduction exists between the slip rings, replace the rotor assembly.

Diode

1. Connect one test lead to the output terminal stud of the diode and the other to the exposed metal area on the auxiliary terminal of the heat sink, Figure 13.

2. Repeat the test with the leads reversed as shown in Figure 14.

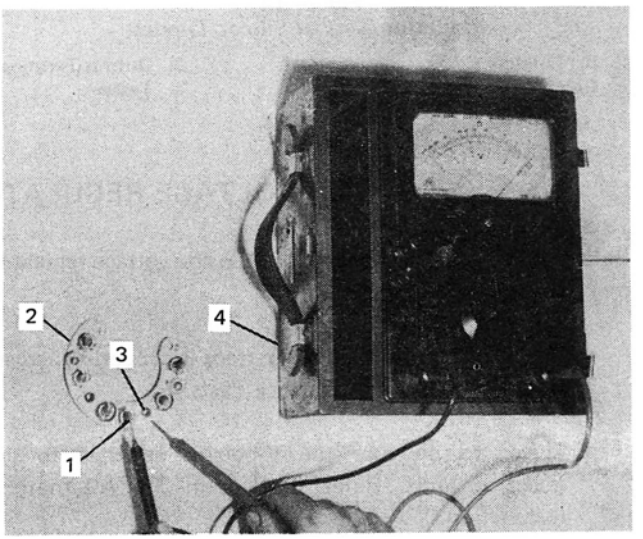


Figure 13
Conduction Test of Silicon Diodes

1. Output Terminal
2. Diode Assembly
3. Bare Metal
4. Tester

NOTE: Conduction should take place when the leads are connected as in Figure 13. If conduction does not take place, the diode is open and must be replaced. Conduction should not take place when the leads are reversed as in Figure 14. If conduction does take place, the diode is shorted and it must be replaced. Replace a defective diode as a complete assembly.

D. Assembly

1. Reassemble the alternator assembly by reversing the "Disassembly" procedure as outlined on page 43.

NOTE: When connecting the diode assembly to the stator coil terminals, apply the soldering iron for no more than 2 seconds as prolonged excessive heat will damage the diode assembly.

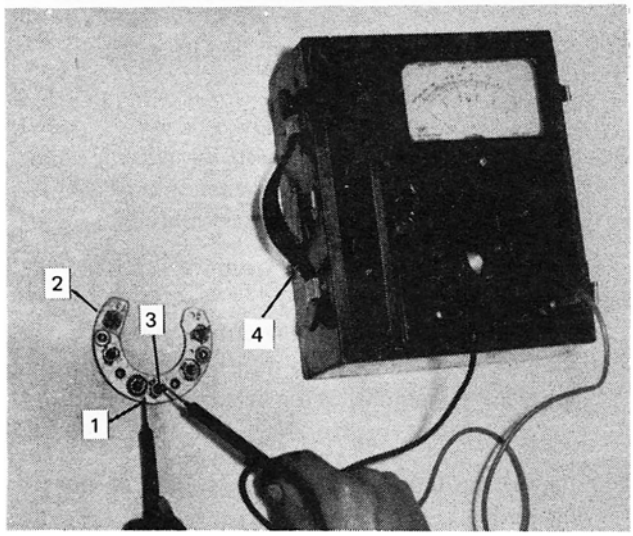


Figure 14
Insulation Test of Silicon Diodes

1. Bare Metal
2. Diode Assembly
3. Output Terminal
4. Tester

E. Installation

1. Position the alternator in the mounting brackets and install the retaining bolts. Do not tighten the bolts completely.
2. Place the V-belt over the alternator drive pulley and pull the alternator away from the engine until the belt has a 10-15 mm (.40-.60 in.) deflection measured between the alternator and the crankshaft pulley, see Figure 15. Tighten the bolts securely.
3. Connect all wires to the alternator.
4. Connect the battery ground (negative) cable to the battery.

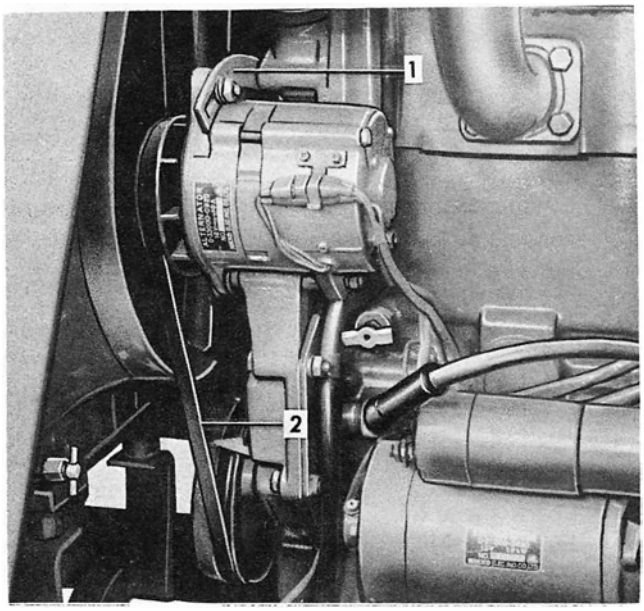


Figure 15
V-Belt Adjustment

1. Adjusting Quadrant
2. Point of Deflection

4. VOLTAGE REGULATOR TESTS AND ADJUSTMENTS

Before starting the test procedures on the voltage regulator, make the following checks:

- Check to be sure that the battery is properly charged. Refer to Chapter 3, "Battery Tests."
- Check to be sure the V-belt is adjusted to the specified limit. Refer to Section 3, "Alternator–Installation."
- Inspect the charging system wiring circuit for frayed or broken wires and for loose connections. Check all ground wires for good connections.

TESTS

Using a standard voltmeter (0-20 volts) and an ammeter (0-10 amps) proceed as follows:

A. Voltage Regulator
Refer to Figure 16.

1. Connect the voltmeter (V_1) between the terminal I and the ground E of the regulator. Connect the ammeter (A_1) between the terminal B and the battery.
2. Start the engine and turn on all electrical instruments, including the headlights. If a current of 3 amperes or

more is present when the engine speed is increased up to 1,000 rpm, the alternator output is sufficient. The voltage level should be in the range of 13.5-14.0v and should remain in this range even when the electrical instruments and headlights are turned off.

B. Field Relay

If the charge lamp stays on when the engine rpm is increased, current is not being generated through the system. The cause may be in a defective connection between the alternator and regulator, between the generator and the slip ring, or between the points in the regulator. If testing shows these components to be operating properly, then inspection of the field relay is necessary.

1. Connect the voltmeter (V_2), Figure 16, between the terminal N of the regulator and the ground E, and connect the ammeter (A_2) between the terminal I of the regulator and the key starter switch.

2. When the engine is started and idling, the current running to the rotor coil should be approximately 1 ampere on the ammeter. If this reading is obtained, the field relay is operating properly. The points of the field relay should be closed at a voltage reading of 3-4 volts.

3. The charge lamp should go off when the engine rpm is increased. If the charge lamp stays on even when the engine is idling, there may be a defective circuit in the terminal F, Figure 16, between the alternator and voltage regulator.

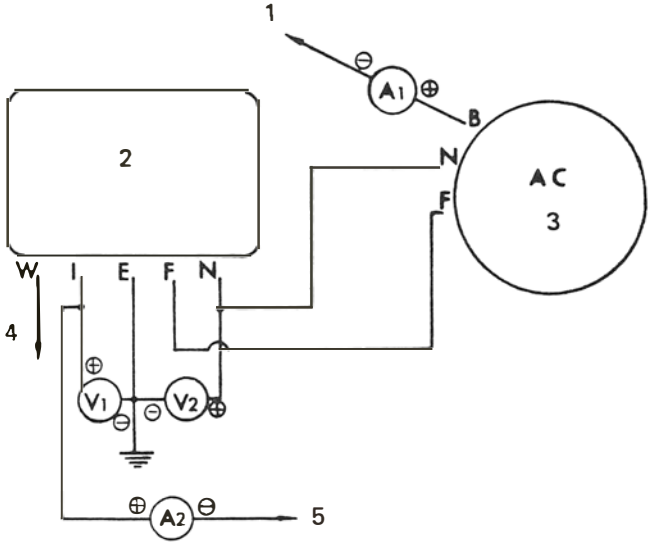


Figure 16
Voltage Regulator Inspection Circuit Diagram

1. Line to Battery
2. Regulator
3. Alternator
4. Line to Charge Lamp
5. Line to Key-Starter Switch

ADJUSTMENTS

A. Voltage Regulator

1. Disconnect the battery ground (negative) cable from the battery.

2. Disconnect the wiring harness from the voltage regulator and remove the retaining screws and regulator from the tractor.

3. Remove the retaining screws and cover from the voltage regulator.

4. Inspect each point and remove any corrosion or roughness with a fine file. If the points are severely damaged, replace the voltage regulator.

5. Inspect the yoke gap, the core gap, and the point gap, Figure 17, and adjust in that sequence to the specified value, page 63.

6. After making the point adjustment, reinstall the voltage regulator in the tractor and connect the wiring harness to the regulator and the battery ground cable (negative) to the battery.

7. Connect the voltmeter (V_1) between the terminal I and the ground E of the regulator as shown in Figure 16. Connect the ammeter (A_1) between the terminal B and the battery.

8. Start the engine and increase the engine speed to approximately 2,000 rpm. Adjust the voltage regulator

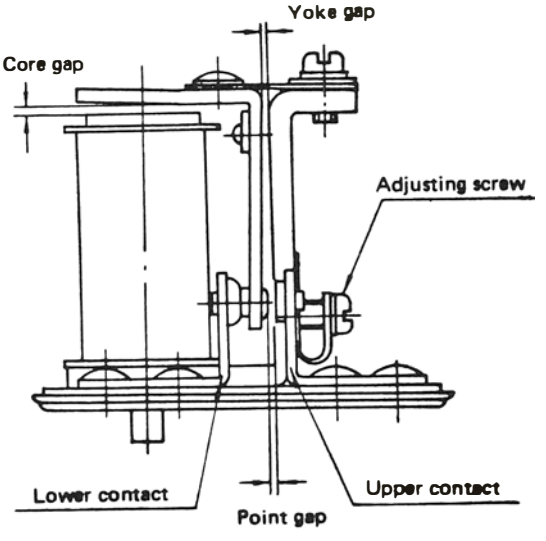


Figure 17
Voltage Regulator Adjustment

adjusting screw, Figure 17, until the voltmeter indicates 13.5-14.0 volts. The charging current to the battery should read 10 amperes or less when the voltage regulator has been adjusted.

B. Field Relay

1. Connect the voltmeter (V_2) between the terminal N of the regulator and the ground E as shown in Figure 16. Connect the ammeter (A_2) between the terminal I of the regulator and the key starter switch.

2. Start the engine and adjust the field relay adjusting screw, Figure 18, so that when the engine rpm is increased, there is a voltage level of 3-4 volts on the voltmeter and the field relay point is closed and a current of approximately 1 ampere is registered on the ammeter.

3. If an ammeter is not available, make the adjustment on the field relay until the charge lamp goes off.

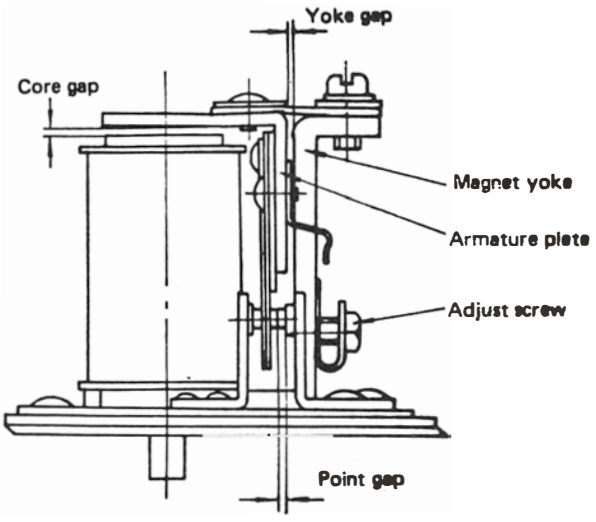


Figure 18
Field Relay Adjustment

PART 3

ELECTRICAL SYSTEM

CHAPTER 3

BATTERY

1. DESCRIPTION

The battery is rated at 70 ampere hours, delivers 12 volts with six cells, and is negatively grounded. The service replacement is a dry-charge 12 volt, 74 ampere hour negative ground assembly. The battery is located directly in front of the instrument panel under the hood panel.

The battery has three major functions:

- To provide a source of current for starting and lighting.
- To help control the voltage in the electrical system.
- To furnish current when the electrical demand exceeds the alternator output.

The battery is constructed so that each cell contains alternating positive and negative plates. Each positive plate is separated from a negative plate by a non-conducting porous separator which prevents the plates from contacting each other. If positive plates contact negative plates within a cell, the cell will short-circuit. All of the positive plates are welded to a post strap, forming a positive group, and all the negative plates are welded to a similar post strap, forming a negative group.

The liquid electrolyte in the battery is a sulphuric acid and water solution.

2. SPECIFIC GRAVITY

The specific gravity of battery electrolyte indicates the state of charge of the battery. The electrolyte in a fully charged battery is approximately 1.280 times as heavy as pure water when both liquids are at the same temperature. Therefore, the electrolyte of a fully charged battery would be described as having a specific gravity of 1.280 (approximately 32°). When the battery discharges, sulphuric acid in the electrolyte combines chemically with the plates, thus lightening the weight of the remaining electrolyte. The battery hydrometer will determine the specific gravity of the electrolyte in a cell. The amount of unused sulphuric acid in the solution is a measure of the degree of charge of a normal cell.

The following table illustrates a typical range of specific gravity for a cell in various stages of charge based on the ability of the battery to "turn over" the engine at 80° F (26.7° C.). The lower the temperature at which a battery is required to operate, the more necessary it is that the battery be maintained in a fully charged condition. A battery having a low specific gravity of 1.225 at 80° F. (26.7° C.) will operate the starting motor at warm temperatures but may fail at extremely low temperatures due to lower efficiency.

3. PERIODIC MAINTENANCE

Battery Efficiency At Various Temperatures	
Temperature	Efficiency of a Fully Charged Battery
80° F. (26.7° C.)	100%
50° F. (10.0° C.)	82%
30° F. (-1.1° C.)	64%
20° F. (-6.7° C.)	58%
10° F. (-12.2° C.)	50%
0° F. (-17.8° C.)	40%
-10° F. (-23.3° C.)	33%

Maximum battery life can be obtained only when proper care and periodic inspection is given to the battery. It is important that output capacity should not be exceeded by constant and excessive overloading, and that charging requirements be maintained.

Water is one of the essential chemicals of a storage battery and under normal conditions of operation is the only component of the battery which is lost as a result of charging. It is important that the recommended level of electrolyte be maintained for maximum battery life.

Servicing the Battery

The following steps must be observed when servicing the battery:

1. Never allow the electrolyte level to drop below the top of the plates, otherwise the acid will reach a high concentration that will damage the separators and impair the performance of the plates. The level of the electrolyte is correct when the liquid just covers the ring in the bottom of the filler well, or approximately 6.35 mm (.25 in.) above the plates.

2. Check the level of the electrolyte when at or near room temperature.

3. When refilling battery cells, use only distilled water. Do not use well water.

4. Always keep the battery at least ¾ charged, otherwise the battery plates will become sulfated and loss of efficiency will result with possible damage from freezing during cold temperatures.

5. Be careful to avoid overcharging the battery. Excessive charging will create high internal heat, expanding the positive plates and causing them to buckle and warp. Distortion of the battery case and displacement of the sealing compound will also result.

6. When fast charging the battery, be sure that the battery temperature does not exceed 125° F. (51.7° C.), otherwise the battery may be severely damaged.

   NOTE: Thermostatic control assures maximum charge in the shortest possible time. Maximum fast charge rate for a 12 volt battery should not exceed 30 amperes.

7. Never add sulphuric acid to a cell unless the electrolyte has been lost through spilling. Any electrolyte added must be at the proper specific gravity.

Dry Charged Batteries

If a new dry charged battery is to be installed, prepare the battery for service as follows:

1. Remove the battery cell vent plugs.

2. Fill each cell with electrolyte of the correct specific gravity as outlined in the chart below. The cells should be filled until the electrolyte is at the top of the ring in the bottom of the filler well, or approximately 6.35 mm (.25 in.) above the plates.

Specific Gravity of Electrolyte For Filling Dry and Dry Charged Batteries		
	Temperate Climates	Tropical Climates
Specific gravity of electrolyte for filling new batteries	1.260-1.270	1.230-1.240
Specific gravity of electrolyte at end of charge	1.270-1.285	1.240-1.255
Maximum permissible temperature of electrolyte during charge	125° F. (51.7° C.)	125° F. (51.7° C.)

IMPORTANT: The electrolyte should be diluted sulphuric acid, sufficiently pure for storage battery use and should preferably be at a temperature between 70° F. (21.1° C.) and 90° F. (32.2° C.). In cold climates it may be necessary to place the electrolyte and the battery to be serviced in a warm room until both have attained room temperature.

3. After filling, allow the battery to stand for at least 15 minutes. The electrolyte level in the cells may fall due to absorption. In this case it must be restored by adding more electrolyte of the correct specific gravity.

4. Install the battery cell vent plugs.

The battery is then ready for installation and can be used to start the tractor engine 15 minutes after filling. If an attempt to start is made and fails, let the battery stand one hour before a further attempt is made.

If facilities exist, it is a useful practice before installing the battery on the tractor, to give a freshening charge for about four hours at the normal charging rate of 8.0 amps and then check that all cells are gassing freely.

Removal and Installation

1. Disconnect the battery ground (negative) cable from the battery first. Then disconnect the positive cable.

2. Remove the wing nut and washer from the battery rod and remove the holder and lift the battery from the tray.

3. Install the battery in the tray with the positive terminal on the left side as viewed from the operator's seat. Secure the holder with the washers and wing nuts.

4. Connect the positive battery cable to the battery first and then connect the battery ground (negative) cable to the battery.

Charging the Battery

A slow charge is the only method to fully charge a battery. A high rate charger can be used to boost the capacity of a battery quickly, but must be followed by a slow charger to bring a battery to full charge.

1. Thoroughly clean the battery casing, cell covers, and terminals.

2. Check the level of the electrolyte in each cell. If necessary, add water as previously mentioned.

3. With a slow charger, use a rate of 3 to 4 amperes for a length of time necessary to bring the battery to a full charge. This may take 24 hours, or more, if the battery is heavily sulfated. A heavily sulfated battery may not accept a charge at all. When the battery is fully charged, the cells will gas freely and the specific gravity will remain constant. Remove the charger after three consecutive hydrometer readings taken at hourly intervals indicate that the specific gravity has stopped rising.

4. When using fast rate or high rate charges, carefully follow the manufacturer's instructions. A high rate charger cannot be used to charge a battery to full capacity. If a full charge is desired, use a slow charge after the high rate charge.

   IMPORTANT: High rate charging raises the temperature of the electrolyte, and, unless the charger is equipped with an automatic time or temperature device, the electrolyte will exceed 125° F. (51.7° C.) which may cause violent battery gassing.

CAUTION: When the battery is being charged, an explosive gas is being produced. Do not smoke or use an exposed flame when checking electrolyte level.

4. BATTERY TESTS

Before preparing the battery tests, check the battery for a dirty top, clogged vents, corrosion, raised cell covers, or a cracked case. Add water if the electrolyte is below the plates. Distilled water may be added to bring the electrolyte up to the proper level.

The state of battery charge can be determined by making the "SPECIFIC GRAVITY TEST" outlined below.

The condition of a discharged battery can be determined by its ability to deliver current as covered under "CAPACITY TEST," page 52.

The condition of a charged battery can be determined by its ability to accept charges as covered under "TEST CHARGING," page 52.

NOTE: The following tests are performed using a hydrometer, a battery starter tester (high-rate discharge tester), and battery charger.

Specific Gravity Test

To determine the state of charge, check the specific gravity of the battery with a hydrometer. If water has recently been added, accurate hydrometer readings will not be obtained.

1. With the float in a vertical position, away from the side of the barrel, take the reading with your eye at the level of the bottom of the curved portion of the liquid.

2. Adjust the hydrometer reading for electrolyte temperature variations by subtracting four points (0.004 specific gravity) for each 10° F. (-12° C.) below the temperature at which the hydrometer is calibrated and adding four points (0.004 specific gravity) for each 10° F. (-12° C.) above this temperature.

   The following are examples using a hydrometer calibrated at 80° F. (26.7° C.).

   Example 1:

   Temperature below 80° F. (26.7° C.):
   Electrolyte temperature ..... 20° F. (-6.7° C.)
   Hydrometer reading 1.270
   Subtract (6 x 0.004) 0.024
   Corrected Specific Gravity 1.246

   Example 2:

   Temperature above 80° F. (26.7° C.):
   Electrolyte temperature .....100° F. (37.8° C.)
   Hydrometer reading 1.255
   Add (2 x 0.004)..... 0.008
   Corrected Specific Gravity 1.263

3. Determine the state of charge using the following information:

State of Charge	Adjusted Specific Gravity
100%	1.280
75%	1.230
50%	1.180
25%	1.130
Discharged	1.080

   NOTE: Specific gravity should not vary more than 0.025 points between cells.

4. If the specific gravity is 1.280 or more, the battery is fully charged and in good operating condition.

5. If the specific gravity is below 1.280, charge the battery and inspect the charging system to determine the cause of the low battery charge.

Capacity Test

The battery capacity test is made to determine if the battery has sufficient discharge capacity for the load imposed upon it by the accessories while cranking the engine. The voltage reading obtained in this test is used to determine the battery condition. Before testing the battery, be sure that the electrolyte level is above the cell plates and that the specific gravity of each cell is 1.225 or more.

The battery may be tested on or off the tractor.

1. Set the current control switch of the battery starter tester (high-rate discharge tester) in the "OFF" position and the voltage selector switch at a voltage equal to, or slightly higher than the rated battery voltage. Connect the tester positive leads to the battery positive terminal and the tester negative leads to the battery negative terminal.

2. Turn the current control knob until the ammeter reading is three times the ampere-hour rating of the battery being tested. Note the voltage reading.

   - If the reading is 9.6 volts or more, the battery has a good output capacity and will readily accept a normal charge.

   - If the reading is below 9.6, test charge the battery as outlined under "TEST CHARGING," below.

CAUTION: Avoid leaving the high discharge load on the battery for periods longer than 15 seconds.

Test Charging

IMPORTANT: Use this test only on batteries that have failed the "BATTERY CAPACITY TEST."

1. Attach the battery starter tester (high rate discharge tester) positive leads to the battery positive terminal and the negative leads to the battery negative terminal.

2. Connect the battery charger positive lead to the battery positive terminal and the negative lead to the battery negative terminal.

3. Turn the charger timer past a "3 minutes" charge indication, and then back to the "3 minutes" indication.

4. Set the charging rate as close as possible to 40 amperes.

5. After three minutes of this fast charge, with the charger still operating on fast charge, observe the voltmeter reading as indicated below.

   - If the total voltage is over 15.5 volts, the battery is unsatisfactory in its present condition and probably is sulfated or worn out.

   - If the total voltage is under 15.5 volts, test the individual cell voltages (if battery has external cell connections) with the charger still operating on fast charge.

   - If the individual cell voltages are even, within 0.1 volt, test the specific gravity of each cell and recharge the battery according to the following:

Specific Gravity	Fast Charge Up to
1.150 or less	1 Hour
1.150 to 1.175	¾ Hour
1.175 to 1.200	½ Hour
1.200 to 1.225	¼ Hour
1.225 to 1.250	Slow Charge Only

   - If individual cell voltages are uneven by more than 0.1 volt, install a new battery.

NOTE: Always test the complete charging system whenever battery trouble is experienced. Refer to page 42.

PART 3

ELECTRICAL SYSTEM

CHAPTER 4

STARTING SYSTEM

1. DESCRIPTION

The function of the starting system is to crank the engine fast enough to enable it to start. The starting system consists of the starting motor, the safety start switch, and the key starter switch.

Before attempting to make repairs or adjustments to components of the starting system, make certain that the fan belt is properly adjusted, the battery is fully charged, and that all electrical terminal connections are secure.

2. STARTING MOTOR

Description and Operation

The starting motor, as with assemblies in other tractors, is a device that converts electrical energy into mechanical energy. The electrical energy is supplied to the starting motor by the battery. The mechanical energy is used to crank the engine during the starting operation. This energy is transmitted to the engine by the starter drive gear pinion to the ring gear on the flywheel. Figure 19 is a sectional view of the starting motor components.

As the current from the battery enters the starting motor, it passes into the solenoid. This current flowing through the solenoid winding creates a magnetic field strong enough to pull the plunger into the solenoid. This action rotates the shift lever which slides the drive gear pinion into engagement with the flywheel ring gear, Figure 20. When the plunger is pulled into the solenoid, it closes a switch which completes the starting motor circuit.

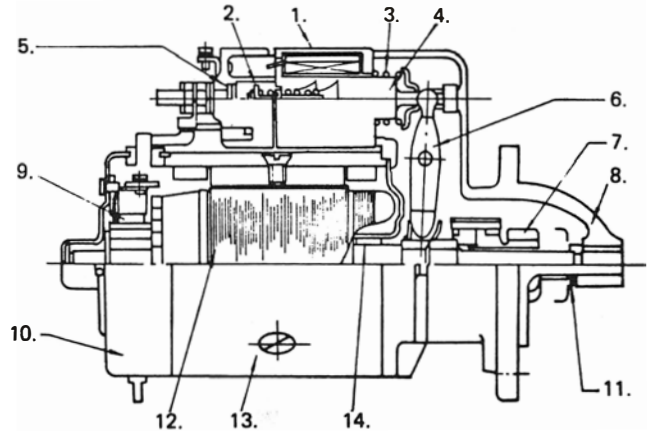


Figure 19
Sectional View of Starting Motor

1. Solenoid
2. Moving Contactor
3. Return Spring
4. Plunger
5. Stationary Contactor
6. Shift Lever
7. Pinion
8. Gear Case
9. Brush
10. Rear Cover
11. Pinion Stopper
12. Armature
13. Yoke
14. Center Bearing

SERVICING THE STARTING MOTOR

A. **Removal and Installation**

1. Disconnect the battery ground (negative) cable from the battery.

2. Disconnect the positive battery cable from the solenoid or starting motor terminal.

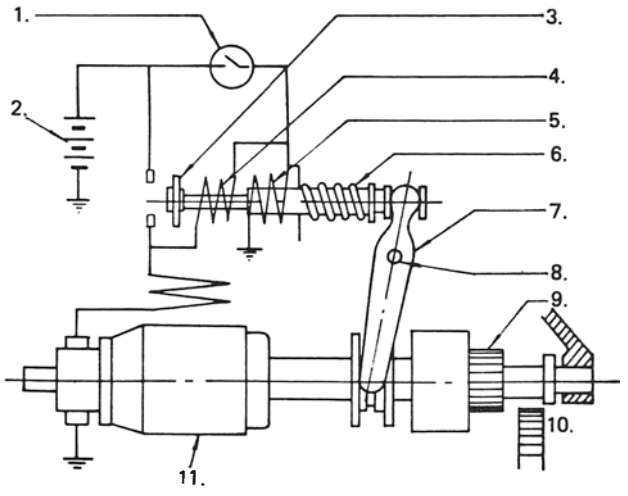


Figure 20
Sectional View of the Starter Pinion

1. Starter Switch
2. Battery
3. Contactor
4. Series Coil
5. Shunt Coil
6. Return Spring
7. Shift Lever
8. Shift Lever Pin
9. Pinion
10. Ring Gear
11. Armature

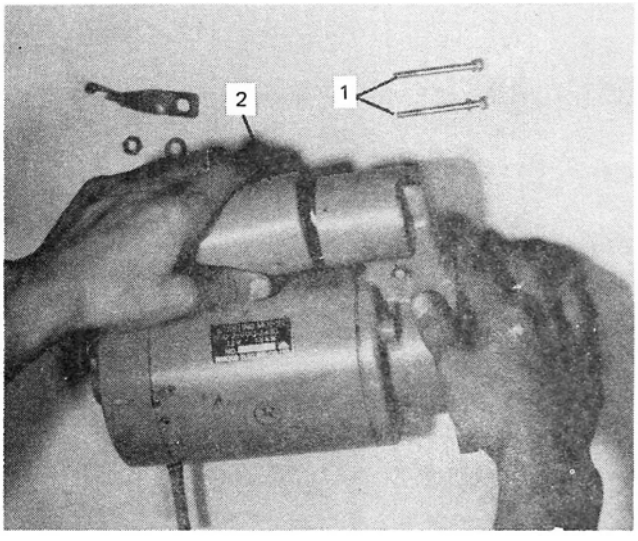


Figure 21
Solenoid Removal

1. Retaining Bolts
2. Solenoid Assembly

3. Remove the starting motor mounting bolts and remove the starting motor.

4. Reinstall the starting motor on the tractor in the reverse order of Steps 1 through 3.

B. Disassembly and Assembly

1. Disconnect the lead wire on the solenoid.

2. Remove the retainings bolts and the solenoid assembly from the starting motor Figure 21.

3. Remove the retaining bolts and rear cover from the starting motor.

4. Remove the brush holder and brushes from the starting motor, Figure 22.

5. Remove the pin from the shift lever.

6. Separate the armature and yoke from the case by tapping with a plastic hammer.

7. Remove the clips and the pinion stopper.

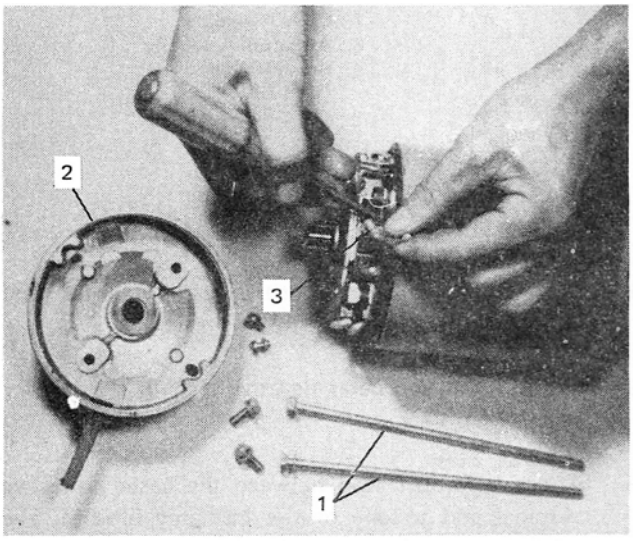


Figure 22
Brush Removal

1. Thru Bolts
2. Rear Cover
3. Brushes

8. Remove the pinion and center bearing. Refer to Figure 23 to identify the starting motor components.

9. Assemble the starting motor in the reverse order of Steps 1 thru 8.

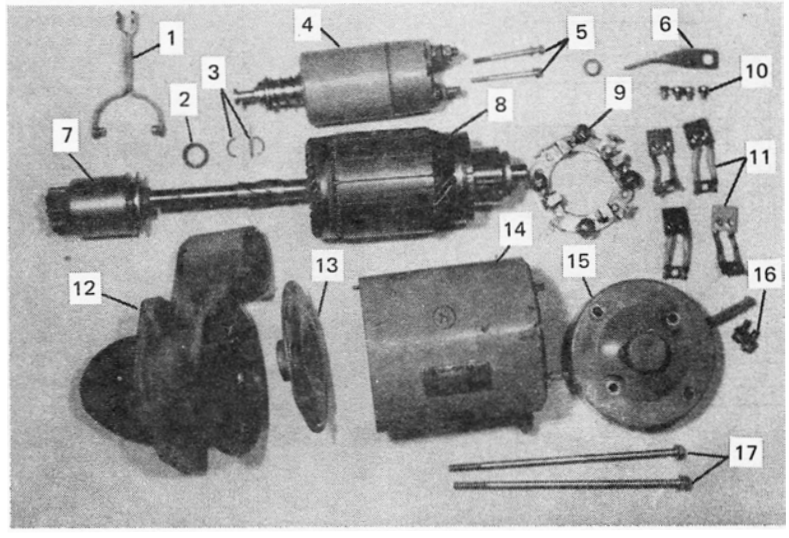


Figure 23
Starting Motor Disassembled

1. Shift Lever
2. Pinion Stop
3. Snap Ring
4. Solenoid Assembly
5. Retaining Bolts
6. Connect Bar
7. Drive Assembly
8. Armature Assembly
9. Brush Holder
10. Retaining Screws (Brush)
11. Brushes
12. Housing Assembly (Front)
13. Drive Housing
14. Housing (Center)
15. Housing (Rear)
16. Retaining Screws
17. Thru Bolts

C. Bench Tests

Field Coil Open Circuit Test:

1. Connect the voltmeter positive lead to the starting motor field terminal.
2. Connect the voltmeter negative lead to the battery negative terminal.
3. Attach a jumper lead between the battery positive terminal and to one of the insulated brushes. The voltmeter should indicate battery voltage.
4. Repeat the complete test with the jumper lead connected to the other insulated brush. The voltmeter should indicate battery voltage.

   NOTE: If no voltage is indicated in Steps 3 and 4, an open circuit exists in the field coils and new coils must be installed.

Field Coil Ground Circuit Test:

1. Complete steps 1 through 6 of the disassembly procedure, page 55.
2. Connect the voltmeter positive lead to the starting motor field terminal.
3. Connect the voltmeter negative lead to the battery negative terminal.
4. Insert a piece of insulation between the actuating coil contacts.

   NOTE: When performing this test, make sure the brush leads are not touching the starting motor frame and that the actuating coil ground wire is not touching the frame. An incorrect reading will result if the leads touch the frame.

5. Attach a jumper lead between the battery positive terminal and the starting motor frame.
6. The voltmeter reading should indicate zero voltage. If a reading is indicated, the field coils are grounded and new coils must be installed.

Inspecting Armature for Open Circuits:

Inspect the commutator surface for burned spots. These indicate the armature has an open circuit. The burned spots are caused by an arcing condition which results whenever the commutator segment connected to the open circuit winding passes under a brush. If burned spots are evident, install a new armature.

Armature Ground Circuit Test:

1. Complete steps 1 through 6 of the disassembly procedure, page 55.
2. Attach the voltmeter negative lead to the battery negative terminal.
3. Attach a jumper lead to the battery positive terminal.
4. Touch the armature core with the jumper lead while at the same time touching a commutator segment with the voltmeter positive lead. Test each segment of the commutator in this manner.
5. Observe the voltmeter and note if a voltage reading occurs. If voltage is evident, the armature windings are grounded and a new armature must be installed.

Armature Short Circuit Test:

In order to perform this test, armature test equipment or a "growler" is required. Refer to the manufacturer's instructions for locating short circuits.

D. Inspection and Repair

Brush Inspection:

1. Complete steps 1 through 4 of the disassembly procedure, page 55, to gain access to the brushes.
2. Check the movement of the brushes in their holders. If the brushes are sticking, clean them with a suitable solvent and if necessary, smooth the sides of the brushes with a fine abrasive or a smooth file.
3. Measure the length of the brushes. If they do not meet the specifications listed on page 63, install new brushes as outlined under "Brush Installation."
4. Check the brush spring tension using a spring scale. Install new springs if the existing brush springs are weak.

Brush Removal and Installation:

1. Remove the retaining screws and brushes from the starting motor.
2. Install the new brushes and retaining screws.
3. Make sure the new brushes move freely in their holders. If necessary, smooth the sides of the brushes with a fine abrasive or a smooth file.

Armature Assembly and Armature Bushing Inspection:

1. Complete steps 1 through 6 of the disassembly procedure, page 55, to remove the armature.
2. Inspect the armature for damage to the core and wire areas. If damaged, install a new armature; do not attempt to machine the core.
3. Inspect the armature shaft for distortion. Check the armature shaft runout by placing the shaft in V-blocks and positioning a dial indicator on the end of the shaft. Install a new armature if the runout is greater than that specified on page 63, or if the shaft is badly worn.
4. Examine the armature shaft bushing in the housing. Install a new bushing if it is found worn or scored.
5. Inspect the bushing in the drive end housing. If the bushing is worn or scored, install a new bushing.
6. Clean the commutator with a suitable solvent. The surface of the commutator should be burnished and free from pits and burned spots.
7. Measure the diameter of the commutator, Figure 24. If it does not meet the specified limit page 63, install a new armature.
8. Measure the depth of the single span mica of the commutator, Figure 25. If it does not meet the specified limit, page 63, install a new armature shaft.
9. Check the commutator runout by placing the shaft in V-blocks and positioning a dial indicator on the commutator. If the runout exceeds the specified limits, page 63, turn the surface using a lathe and sharp cutting tool. Rotate the armature at a high speed taking light cuts with the tool. After turning, polish the commutator using a fine abrasive.

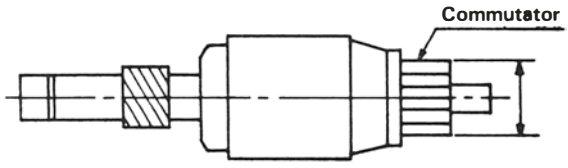


Figure 24
Commutator Inspection

NOTE: Do not reduce the diameter of the commutator to less than the dimensions specified on page 63. Do not undercut the insulation between the commutator segments.

10. Before installing the armature, check it for grounding as outlined on page 57.

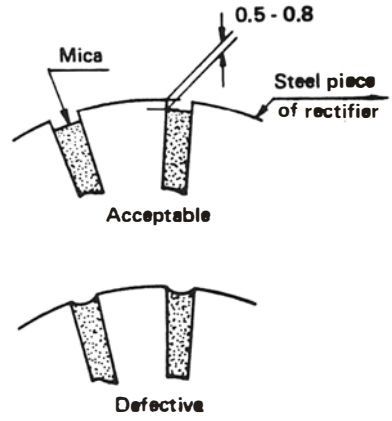


Figure 25
Commutator Mica Inspection

E. Final Tests and Adjustments

Starting Motor No Load Test:

A fully charged battery and a battery starter tester (high-rate discharge tester) with a carbon pile (current regulating device) should be used to perform this test.

1. Secure the starting motor in a soft-jawed vise.
2. Connect a heavy jumper cable between the battery negative terminal and the starting motor mounting flange.
3. Connect the ammeter and voltmeter leads as follows:
   - Voltmeter positive lead to battery positive terminal.
   - Voltmeter negative lead to battery negative terminal.
   - Ammeter positive lead to battery positive terminal.
   - Ammeter negative lead to the solenoid or starting motor terminal.
4. Adjust the carbon pile (current regulating device) until the voltmeter registers 12 volts. The starting motor should draw a maximum of 70 amps.

   NOTE: If the starting motor does not perform to specifications, check for grounded field coils, a rubbing armature, or a distorted armature shaft. Refer to the specifications on page 63, for armature shaft distortion.

3. SAFETY STARTER SWITCH

The safety-starter switch is mounted on the left side of the tractor underneath the tractor step. The tractor cannot be started until the clutch pedal is fully depressed. When the clutch pedal is depressed, the pedal shank is rotated to the point where it activates the safety starter switch, and current is allowed to flow to the starting motor.

A. Removal and Installation

1. Disconnect the electrical connections at the safety starter switch.

   NOTE: Make sure that the key-starter switch is in the "OFF" position before disconnecting the safety starter switch.
2. Remove the retaining bolts and the safety starter switch from the tractor.
3. Reinstall the safety starter switch in the reverse procedure of Steps 1 and 2.

B. Adjustment

Adjustment of the safety starter switch is accomplished by rotating the adjustable stop which contacts the plunger of the switch.

4. KEY-STARTER SWITCH

The key-starter switch is shown in Figure 26. Turning the key to the left will activate the glow plug. Turning the key to the right to the "ON" position will activate the warning lights and instruments. Turning the key further right to the "start" position will start the engine. Upon release, the key will spring return to the "ON" position.

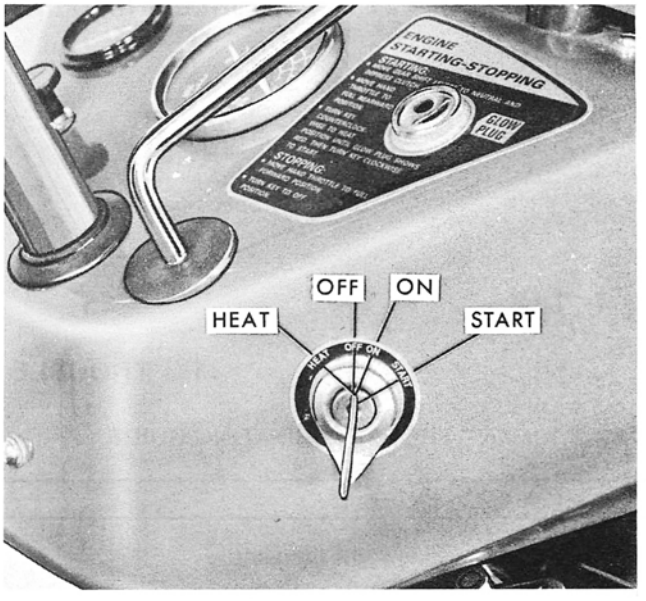


Figure 26
Key-Starter Switch

REMOVAL AND INSTALLATION

A. Removal

1. Disconnect the battery ground (negative) cable from the battery.
2. Remove the switch lock nut and remove the switch from the rear of the instrument panel.
3. Disconnect the wire harness connectors from the switch terminals.

B. Installation

1. Connect the wiring harness connectors to the switch terminals.
2. Place the switch in the instrument panel "D" slot. Fasten the switch securely to the panel with the switch lock nut.
3. Connect the battery ground (negative) cable to the negative terminal of the battery.

5. GLOW PLUGS

The glow plugs are located in the cylinder head on the right side of the engine. The wire from the glow plugs is connected to the key-starter switch. When the key-starter switch is held to the "heat" position, current is directed to the glow plugs. At this time, the glow plugs and glow plug indicator begin to heat. In approximately 30 seconds, the indicator will become red, which is a signal to release the starter key and start the tractor engine. The glow plugs are connected in parallel, therefore, if one of the plugs is defective, the remaining plug will be operative; however, the pre-heating time will be longer.

REMOVAL AND INSTALLATION

A. Removal

1. Disconnect the battery ground (negative) cable from the battery.
2. Remove the capscrews, wire, and glow plug connector strap from the glow plugs.
3. Remove the glow plugs from the cylinder head.

B. Installation

1. Install the glow plugs in the cylinder head.
2. Connect the wire and connector strap to the glow plugs and install the retaining capscrews.
3. Connect the battery ground (negative) cable to the battery.

PART 3

ELECTRICAL SYSTEM

CHAPTER 5

TROUBLE SHOOTING AND SPECIFICATIONS

1. TROUBLE SHOOTING

INSTRUMENT TROUBLE SHOOTING GUIDE

Trouble	Possible Causes
Oil Pressure Warning Light Inoperative	1. Loose or broken wiring. 2. Burned out bulb. 3. Defective oil pressure sensor unit.
Charge Lamp Inoperative	1. Loose or broken wire. 2. Burned out bulb. 3. Defective alternator or regulator.
Glow Plug Indicator Inoperative	1. Loose or broken wire. 2. Burned out indicator. 3. Key-starter switch faulty.
Temperature Gauge Erratic or Inoperative	1. Faulty gauge. 2. Broken or damaged bourdon tube.

LIGHTING SYSTEM TROUBLE SHOOTING GUIDE

Trouble	Possible Causes
All Lights Do Not Light	1. Dead battery. 2. Loose battery cable connections. 3. Fuse burned out. 4. Faulty wiring in the lighting circuit. 5. Defective light switch. 6. All light bulbs burned out. 7. Improperly adjusted voltage regulator.
Individual Lights Do Not Light	1. Burned out bulb. 2. Loose or broken light wires. 3. Poor ground.
Lights Burn Out Repeatedly	1. Loose or corroded wiring connections. 2. Improperly adjusted voltage regulator.

Trouble	Possible Causes
Flasher Warning Lamp Erratic or Inoperative	1. Loose or broken wire. 2. Faulty switch. 3. Burned out bulb. 4. Blown fuse. 5. Poor ground.

CHARGING SYSTEM TROUBLE SHOOTING GUIDE

Trouble	Possible Causes
Battery Low in Charge	1. Loose or worn alternator drive belt. 2. Poor battery. Condition will not accept or hold a charge. Electrolyte low. 3. Alternator not producing rated output. 4. Defective voltage regulator. 5. Excessive resistance in alternator-to-battery or battery-to-ground circuits. (Corroded terminals).
Alternator Charging at High Rate	1. Defective voltage regulator.
No Output from Alternator	1. Alternator V-belt broken. 2. Loose output connection. 3. All rectifying diodes defective. 4. Defective rotor or stator. 5. Defective isolation diodes, (open). 6. Defective voltage regulator.
Intermittent or Low Alternator Output	1. Alternator drive belt slipping. 2. Loose connections or broken cables in charging system. 3. One or two rectifying diodes defective. 4. Defective voltage regulator. 5. Wire broken in stator.

STARTING SYSTEM TROUBLE SHOOTING GUIDE

Trouble	Possible Causes
Engine Will Not Crank or Solenoid Does Not Click	1. Battery completely discharged. 2. Key-starter switch, safety starter switch inoperative. 3. Starting circuit open or has a high resistance.
Engine Will Not Crank But Solenoid Clicks	1. Burned solenoid terminal contacts. 2. Defective starting motor or loose or defective battery cables and connections. 3. Defective starting motor drive assembly. 4. Low charge in battery. 5. Engine seized.

Starting Motor Spins but Does Not Crank Engine	1. Defective starting motor drive assembly. 2. Defective flywheel ring gear.
Engine Cranks Slowly	1. Battery low in charge. 2. Excessive resistance in starting circuit. 3. Defective starting motor. 4. Tight engine.

2. SPECIFICATIONS

LIGHTS AND INSTRUMENTS

Headlamps:

Volts 12
Watts 35
Bulb No. . . . . No. 1074

Tail Lamp:

Volts 12
Watts 20
Bulb No. . . . . No. 89

Flasher Warning Lamp:

Volts 12
Watts 20
Bulb No. . . . . No. 89

Instrument Panel Lights:

Volts 12
Watts 3
Bulb No. . . . . No. 53

Instrument Panel Fuse . . . . . 5 amps.

Lighting Circuit Fuse . . . . . 15 amps.

Horn:

Voltage 12
Current Draw . . . . . 1 amp.

Oil Pressure Switch (Engine):

Volts 12

CHARGING SYSTEM

Battery:

Capacity (Ampere hour at 20 hour rate) 70
Voltage 12
Cells 6
Ground Terminal . . . . . Negative

Alternator:

Output (Warm Engine)	
Amperes at Approximately 5,000 Alternator rpm and 14v	10 amps.
Brush Length (Minimum)	10 mm (.40 in.)
Alternator V-belt Deflection	10-15 mm (.40-.60 in.)

Voltage Regulator:

Voltage	12
Yoke Gap	0.7 mm (.028 in.)
Core Gap	1.3 mm (.052 in.)
Point Gap	0.3 mm (.012 in.)

Field Regulator:

Yoke Gap	1.1 mm (.043 in.)
Core Gap	1.2 mm (.047 in.)
Point Gap	1.0-1.3 mm (.040-.052 in.)

STARTING SYSTEM

No Load Current Draw (Maximum):

At 12 Volts and 5,500 Starter rpm	50 amps.

Current Draw (Starter installed on engine):

At 9 Volts and 1,500 Starter rpm	250 amps.
Brush Length (Minimum)	12 mm (.472 in.)
Armature Shaft Runout (Maximum)	.08 mm (.003 in.)
Commutator Diameter (Minimum)	42 mm (1.65 in.)
Commutator Runout (Maximum)	.08 mm (.003 in.)
Depth of Commutator Mica (Minimum)	.2 mm (.0078 in.)

Torque Specifications: Torque specifications for the various bolts and nuts can be found in the chart on page 30.

PART 4

CLUTCH

CHAPTER 1

CLUTCH ASSEMBLY

1. DESCRIPTION AND OPERATION

The clutch used in the Ford 1000 is a dry, single plate, organic type assembly. The entire clutch assembly consists of the clutch pressure plate and cover assembly, the clutch disc, the flywheel, the release bearing, and the transmission input shaft. The clutch disc is installed between the flywheel and the pressure plate assembly which is itself attached to the flywheel with six bolts and lockwashers. Flywheel spacers are not used.

In the clutch "engaged" position the spring loaded pressure plate presses the clutch disc into contact with the engine flywheel and the drive from the engine is transmitted to the transmission by the friction between the linings of the clutch disc and the surfaces of the flywheel and pressure plate.

The clutch pedal is connected by a rod to a lever and cross shaft assembly on which a fork is mounted. The clutch cross shaft is secured to the fork by two roll pins. This fork engages a sliding release bearing and hub assembly. The release bearing contacts the ends of the release levers in the pressure plate assembly when the clutch is applied.

Depression of the clutch pedal causes the cross shaft and fork to move the release bearing forward and depress the pressure plate release levers thus drawing the pressure plate away from the clutch disc and releasing the disc from contact with the flywheel. The frictional drive to the transmission is thereby disconnected to enable gear changing to take place.

After a gear change is made and the clutch pedal is released, the release bearing and hub are returned to the free position by a spring secured to a spring hanger.

The main springs of the pressure plate assembly then reassert pressure on the plate moving it forward to press the clutch disc into contact with the flywheel and re-establish the drive to the transmission.

The release bearing is a pre-lubricated bearing type and never needs to be greased.

2. ADJUSTMENTS

Clutch Pedal Free Travel

To obtain maximum clutch life, it is essential that the clutch pedal free travel be checked every 50 hours to maintain a free travel of 19.0-30.1 mm (.75-1.20 in.) as measured along the path of travel of the pedal. Free travel is the distance the pedal can be moved before resistance is met, see Figure 1.

To adjust the clutch pedal free travel:

1. Remove the clutch rod cotter pin and clevis pin, and rotate the clevis as necessary, see Figure 1. Increasing the rod length will increase the pedal free travel and decreasing the rod length will decrease the clutch pedal free travel.
2. After the proper free travel is obtained, install the clevis pin and secure with a new cotter pin.

Safety Start Switch

The tractor cannot be started until the clutch pedal is fully depressed. The pedal shank, when depressed, is rotated to the point where the plunger of the safety start switch protrudes and activates the switch.

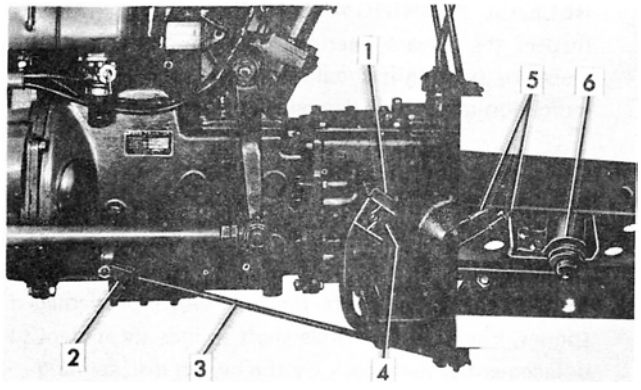


Figure 1
Clutch Pedal Adjustment and Safety Start Switch

1. Clutch Pedal
2. Clevis
3. Adjustment Rod
4. Clutch Pedal Free-Travel
5. Electrical Connections
6. Safety Start Switch

To adjust the safety start switch:
Rotate the adjustable stop which contacts the plunger of the switch until correct operation is obtained.

Clutch Release Lever Height

Uneven height of the release levers can cause improper clutch operation and premature clutch disc wear. Therefore, it is important that all three release levers are adjusted to the same height. It is also important that new pressure plate and cover assemblies be checked, and if necessary adjusted, prior to installation in the tractor.

To make this adjustment easier, remove the flywheel from the engine as outlined in Part 1, "Engine Removal and Disassembly."

1. Prior to adjusting the clutch, the clutch disc and pressure plate should be securely mounted to the flywheel.
2. Remove the retainer clips which are located over each of the adjuster screws, Figure 2.
3. Set the outer legs of the Special Tool SJ-101 so that they rest against the flywheel surface.
4. Loosen the locknut and turn the adjuster screw. Turning the adjuster screw clockwise will raise the release lever tip and turning the screw counter-clockwise will lower the lever tip.
5. The clutch is properly adjusted when the center leg of the special tool contacts each of the three release levers.
6. After the adjustment, the lock nuts must be securely tightened and the retainer clips installed.
7. Depress each release lever several times and re-check to be sure the levers are properly adjusted.

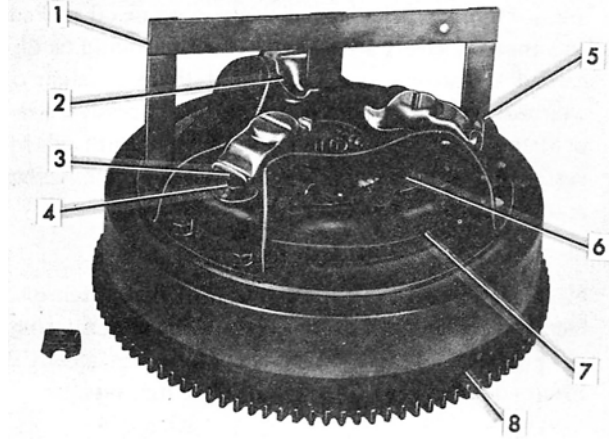


Figure 2
Clutch Adjustment

1. Adjustment Tool SJ-101
2. Release Lever
3. Adjuster Screw
4. Locknut
5. Retainer Clip
6. Clutch Disc
7. Pressure Plate
8. Flywheel

3. CLUTCH OVERHAUL

A. Removal

1. Separate the engine from the clutch housing as outlined in Part 1, Engine, Section 2, "Engine Removal and Disassembly."
2. Once the engine is separated from the clutch housing inspect the clutch assembly for any oil or water which may have leaked into the housing or for damaged release levers on the pressure plate and cover assembly.
3. Loosen the bolts retaining the pressure plate to the flywheel and remove the pressure plate and clutch disc.

B. Inspection and Repair

PRESSURE PLATE AND COVER ASSEMBLY

1. Check the face of the pressure plate for cracks, scoring, or distortion. Minor imperfections can be removed by resurfacing the pressure plate face.

2. Inspect the pressure plate release levers for wear or damage. Check the fixing pins and pin holes and the springs for damage. Replace the pressure plate if any damage is apparent.

3. Examine the pressure plate release levers to make sure the levers are free to operate smoothly, and that the pressure plate and springs are not discolored due to overheating.

4. If any part of the pressure plate and cover assembly is excessively worn, damaged, or distorted it will be necessary to replace the complete pressure plate and cover assembly.

CLUTCH DISC ASSEMBLY

1. Inspect the clutch disc to make sure that the linings are not loose, cracked, excessively worn or oil soaked, and that the rivets are secure. The disc should be discarded and a new one installed if there are signs of overheating due to clutch slippage or excessive wear, or if the friction faces are contaminated with oil. Investigate the source of any oil or grease on the facings and rectify before installing a new disc.

2. Inspect and measure the thickness of the clutch disc facing and the depth of the rivets in the clutch facing, see Figure 3. If these measurements do not meet the specified limit, page 69, replace the clutch disc.

3. Check the splines in the clutch disc for excessive wear or damage. Replace the clutch disc if damage is apparent.

4. Inspect the cushioning springs for damage. Replace the clutch disc if necessary.

Figure 3
Depth of Facing Rivets

RELEASE BEARING AND HUB

1. Inspect the release bearing for wear or damage. Replace the bearing if the inner race is scoured or if any indication of wear or damage is present.

2. Check the release hub and related components for abnormal wear or damage and replace if necessary.

DRIVE SHAFT

1. Inspect the drive shaft for any worn or damaged splines, Figure 4. The drive shaft splines are subject to defacement when struck by the clutch disc spline during the clutch engagement process. Minor damage can be corrected with a grinder. A more severely damaged shaft will have to be replaced.

NOTE: When replacing the drive shaft, the clutch disc should also be replaced to provide for longer life of each component.

C. **Installation**

It is important that all new pressure plates and clutch assemblies be checked and, if necessary, adjusted prior to installation in the tractor. To adjust the clutch release lever height, refer to "Adjustments," page 64.

When installing a new pressure plate and cover assembly make sure that the friction face of the pressure plate is free from dirt or oil film. Lightly lubricate the hub splines of the input shaft with silicon grease prior to installing the clutch disc.

1. If the flywheel has been removed, install the flywheel onto the crankshaft and tighten the nut to the torque specified on page 69.

2. Position the clutch disc on the flywheel using the input shaft splines as an alignment tool or a pilot shaft.

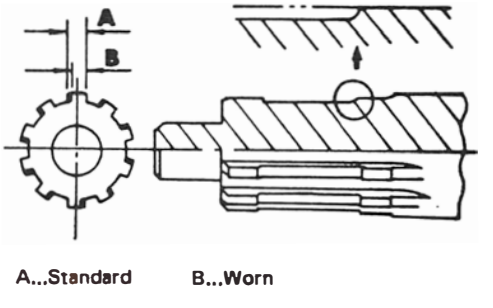


Figure 4
Drive Shaft Spline Wear

3. Locate the pressure plate assembly on the flywheel and install the locating bolts and lockwashers, Figure 5. Tighten the bolts evenly to the specified torque, page 69, then remove the pilot shaft.

4. Install the transmission input shaft if removed.

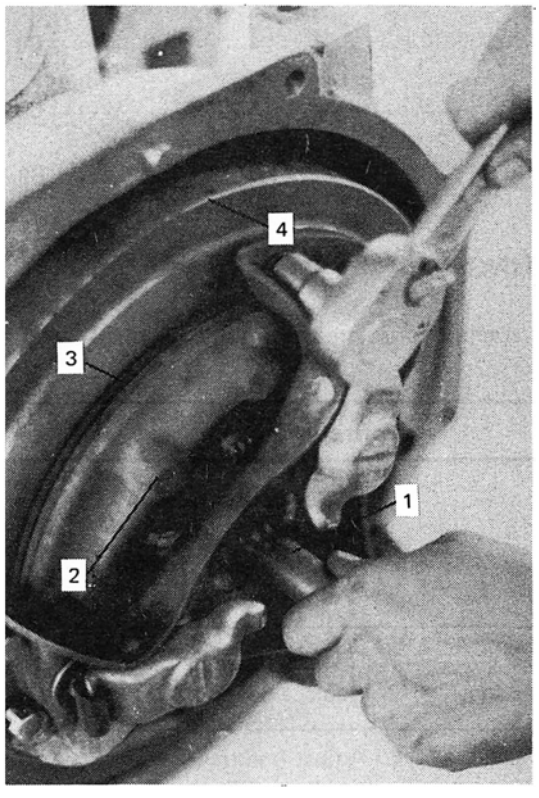


Figure 5
Installing the Clutch Disc and Pressure Plate

1. Pilot Shaft
2. Pressure Plate
3. Clutch Disc
4. Flywheel

5. Install the release bearing on the bearing release hub and move the hub to the rear of the clutch case. Connect the return spring to the hub and spring hanger, Figure 6.

6. Re-connect the engine and clutch housing as outlined in Part 1, "Engine – Installation."

7. Check and adjust the clutch free travel play as outlined in Section 2, "Adjustments."

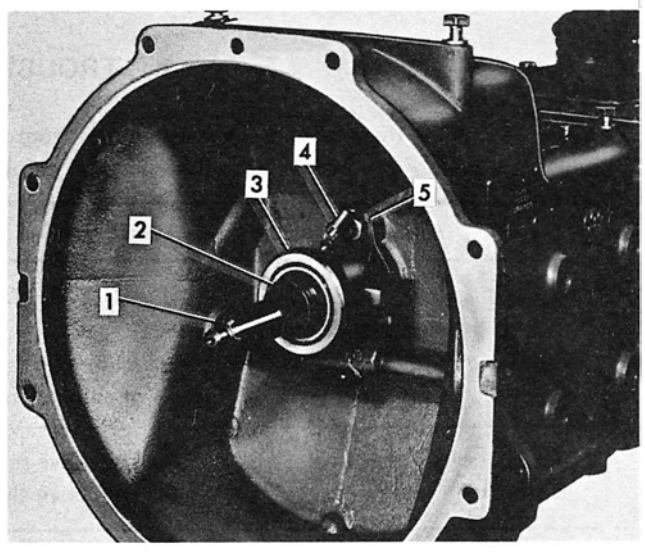


Figure 6
Release Bearing and Hub

1. Input Shaft
2. Hub
3. Release Bearing
4. Spring
5. Hanger

PART 4

CLUTCH

CHAPTER 2

TROUBLE SHOOTING, SPECIFICATIONS AND SPECIAL TOOLS

1. TROUBLE SHOOTING

Before removing the disc and cover assemblies from the tractor, attempt to isolate the trouble by referring to the corrective action for the specific problem listed below.

Problem	Possible Cause	Corrective Action
1. Excessive clutch pedal free play or loss of adjustment reserve.	1. Worn clutch disc 2. Clutch linkage out of adjustment.	1. Replace disc. Refer to "Clutch Overhaul." 2. Adjust linkage. Refer to "Adjustments."
2. Clutch noisy when free.	1. Defective release bearing 2. Defective clutch pilot bearing.	1. Replace bearing. 2. Replace bearing.
3. Clutch slipping.	1. Incorrect pedal free travel. 2. Worn disc facings. 3. Clutch pressure springs weak from over-heating.	1. Adjust free travel. Refer to "Adjustments." 2. Replace disc. Refer to "Clutch Overhaul." 3. Overhaul or install new clutch assembly. Refer to "Clutch Overhaul."
4. Clutch fails to engage smoothly.	1. Defective clutch disc. 2. Defective pressure plate assembly. 3. Worn clutch pilot bearing. 4. Defective flywheel.	1. Replace disc. Refer to "Clutch Overhaul." 2. Replace pressure plate assembly. Refer to "Clutch Overhaul." 3. Replace bearing. 4. Refer to Part 1, "Engine System" for removal and installation.
5. Difficulty in engaging gears.	1. Pedal free travel out of adjustment. 2. Damaged or out of adjustment release levers.	1. Refer to "Adjustments" to adjust the pedal free travel. 2. Adjust assembly. Refer to "Adjustments."
6. Pedal will not return completely to release position.	1. Broken clutch pedal return spring.	1. Install a new spring.

2. SPECIFICATIONS

Clutch Type	Dry
Clutch Disc	21.59 cm (8.5 in.) Organic
Clutch Pedal Free Travel	19.0-30.1 mm (.75-1.20 in.)
Riveting Degree	1.2 mm (.048 in.)
Allowable Wear Limit	2.5 mm (.098 in.)
Height of Release Levers	54 mm (2.13 in.)

TORQUE SPECIFICATIONS:

Pressure Plate-to-Flywheel Bolts	1.8-2.5 kg-m (13.0-18.0 lbs. ft.)
Flywheel Nut	100-120 kg-m (723-868 lbs. ft.)
Engine-to-Clutch Case Bolts	4.0-5.0 kg-m (29-36 lbs. ft.)

3. SPECIAL TOOLS

Release Lever Adjustment Tool	SJ-101

PART 5

TRANSMISSION, DIFFERENTIAL, REAR AXLE, AND RELATED PARTS

CHAPTER 1

SERVICING THE TRANSMISSION AND DIFFERENTIAL

1. DESCRIPTION AND OPERATION

The transmission for the Ford 1000 is a triple range, constant-mesh assembly, and is the forward portion of the transmission-center housing. It has a common oil reservoir with a capacity of 19.8 Liters (21 U.S. Qts.). Lubrication is provided by a high quality, extreme pressure, gear lubricant.

Three access compartments are provided thru the top of the housing for inspection of the transmission gears. The hydraulic lift cover encloses the rear compartment. The transmission shift cover and the front access plate fit over the forward two compartments.

The transmission has nine forward speeds and three reverse speeds. Three shift levers are used to engage the PTO, and to obtain all of the forward and reverse speeds. The lever on the left side is for PTO operation. The lever in the center is used to obtain 1st, 2nd, 3rd and reverse. The lever on the right is used to obtain the three gear ranges, see Figure 1.

Each of the shift levers is clearly identified by painted embossed markings on the cover Figure 1. The center and right hand levers also have the shift patterns embossed onto the respective shift lever knob.

Each of the three levers has a rubber boot securely fastened to a flange on the cover by means of a clamp. The PTO lever and the range lever are secured to the cover by a roll pin. It is necessary to pivot the gear shift lever, therefore it is secured to the cover by a pin that protrudes into a slotted portion of the lever shaft. Neutral position is obtained with the gear shift lever. There is no neutral position for the range lever. The PTO lever is either engaged or disengaged.

Secured to the front of the transmission is the main hydraulic reservoir. The forward portion of the reservoir casting serves as the clutch housing.

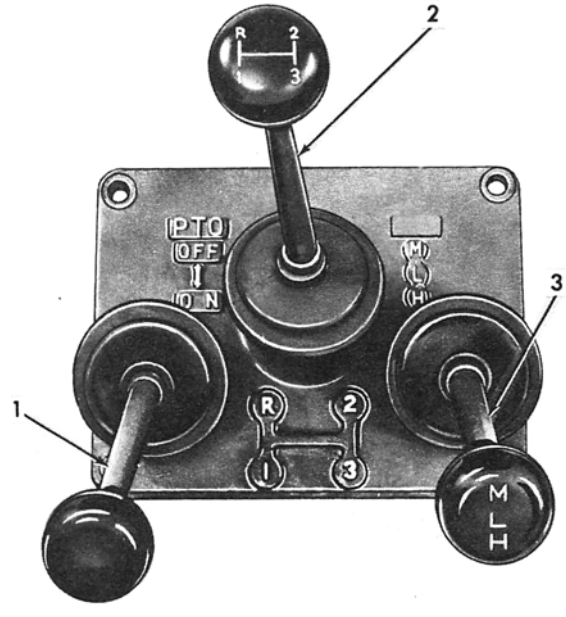


Figure 1
Shift Cover

1. PTO Lever
2. Gear Shift Lever
3. Range Lever

The differential consists of a conventional spiral bevel pinion and ring gear. It utilizes four straight bevel pinions and two straight bevel side gears. The drive pinion has 8 teeth and the ring gear has 49 teeth for a reduction ratio of 6.125:1. The ring gear and drive pinion are serviced as a set only.

The spider assembly consists of a long shaft and two short shafts that intersect at the center of the joint. The left-hand case fits over the right-hand case and against the flats on the ends of the shafts to prevent them from rotating.

The tractor ground speeds for each of the respective gears, when the tractor is equpped with 11.2 x 24 tires, are listed on page 88, under "Specifications".

2. TRANSMISSION OVERHAUL

A. Disassembly

1. Remove the rear wheels, fenders, and roll bar (if equipped) from the tractor.
2. Remove the pin at the brake rod joint and remove the bolts and brake cover.
3. Straighten the lockwasher, loosen the nuts, and remove the brake drums. Use push bolts to remove the brake drum if it cannot be removed by hand.
4. If oil is leaking into the brake chamber, remove the differential seal cover by using two push bolts, and replace the seals.
5. Remove the seat assembly and the hydraulic lift cover assembly, Figure 2.
6. Remove the bolts and the P.T.O. cover and remove the P.T.O. shaft and bearing holder from the rear of the housing.

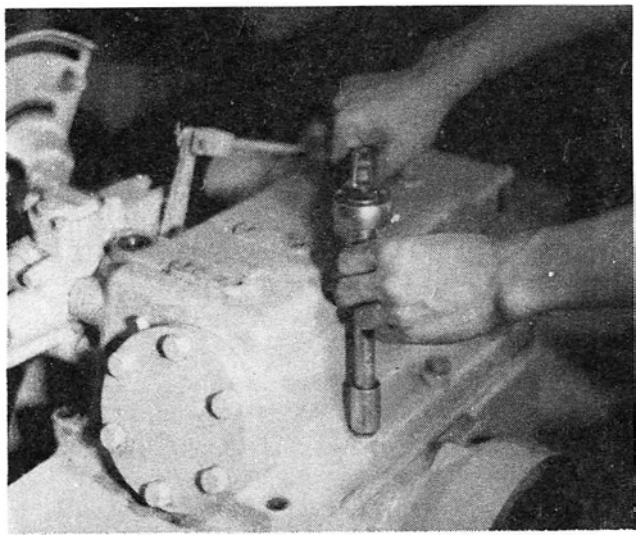


Figure 2
Hydraulic Lift Cover Removal

7. Remove the retaining bolts and the shift cover and case cover.
8. Pull out the spring pin on the left side of the differential lock pedal shaft.
9. Shift the differential lock clutch to the right and remove the snap ring securing the final gears.
10. Remove the bolts from the axle housing and remove the rear axle housings leaving the final gears in the transmission case.
11. Remove the final drive pinion cover and seal assemblies and final drive pinions.
12. Lay the right-hand final drive gear as far down in the center-housing as possible so as to clear the bottom of the right-hand carrier, see Figure 3. (The left-hand gear is shown in this position.)
13. Using two jackscrews, withdraw the right-hand carrier from the center housing, at the same time keeping the differential assembly in the left-hand carrier.
14. Lift the right-hand final drive gear between the differential and the center housing and withdraw it from the housing.
15. Pull the differential assembly to the right, out of the left-hand carrier, and lift it from the center housing.
16. Lay the left-hand final drive gear as far down in the center housing as possible to clear the bottom of the left-hand carrier.
17. Using two jackscrews, withdraw the left-hand carrier from the center housing and remove the left-hand final drive gear.

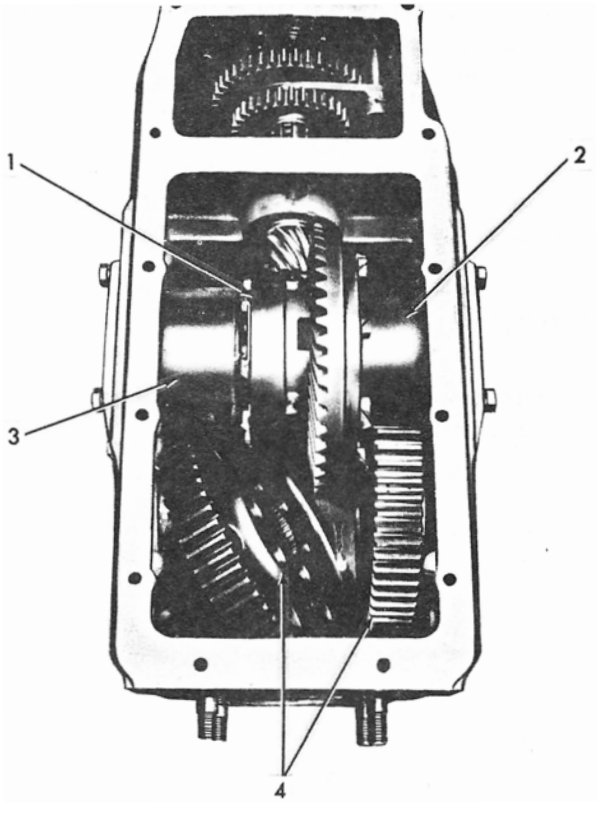


Figure 3
Differential Removal

1. **Differential Assembly**
2. **Right-Hand Carrier**
3. **Left-Hand Carrier**
4. **Final Drive Gears**

18. Remove the drive pinion assembly.

19. To disassemble the differential assembly refer to Section 3, "Differential Overhaul," page 75.

20. Remove the clutch rod and the retaining bolts which secure the clutch case to the transmission case and separate the transmission and clutch case, see Figure 4.

21. Pull out the spring pin from the shifter fork.

22. Remove the shifter rods one at a time, then remove the detent balls and springs. Be careful not to drop the balk pin into the transmission case, Figure 5.

23. Remove the shifter fork.

24. Pull the P.T.O. counter shaft forward leaving the P.T.O. sliding gear in the transmission case.

25. Drive the main shaft forward and out of the case using a brass hammer, Figure 6.

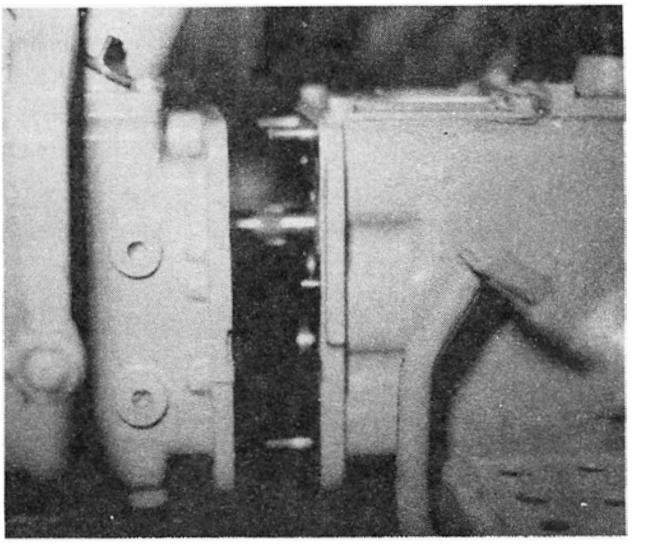


Figure 4
Separating the Clutch Case From the Transmission Case

26. Remove the snap ring from the counter shaft groove by pulling the shaft toward the front and then remove the snap ring from the rear bearing. Pull the countershaft out from the rear of the transmission case.

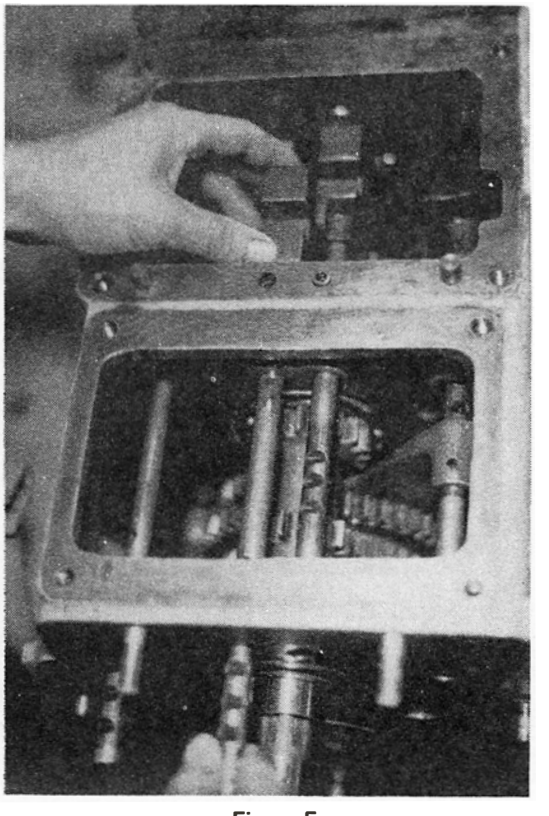


Figure 5
Shifter Rod Removal

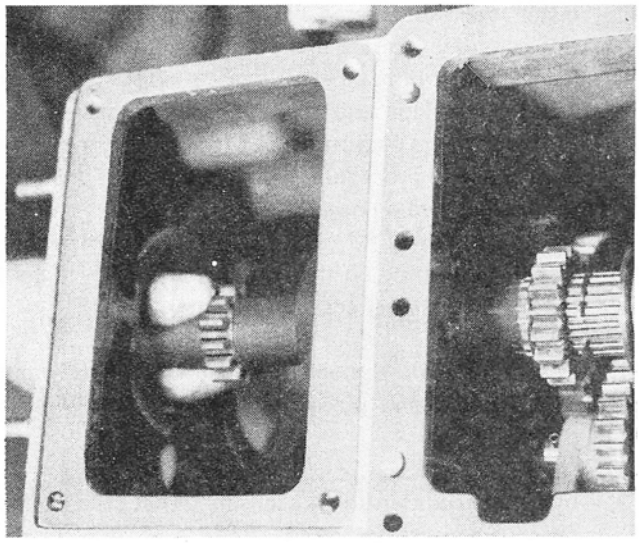


Figure 6
Main Shaft Removal

27. Remove the spring pin from the reverse idler gear shaft and remove the gear.

    NOTE: The gears, collars, and other parts remaining in the case should be kept in an orderly manner to aid in the assembly procedure.

B. Inspection

1. Clean all old lubricant and dirt from the parts with a suitable cleaning solvent.

2. To clean the bearings, rotate the bearings in cleaning solvent until all of the old lubricant has been removed. Dry the bearings with compressed air, being careful not to spin them.

3. Inspect all bearings for wear, scores, discoloration from overheating or for missing rollers. Check the bearing cups for wear, cracks, or scores. Check bearings for bent or worn retainers. Discard all defective bearings and cups.

4. After inspecting the bearings, lubricate them thoroughly and keep clean until ready for use.

5. Inspect the transmission case for cracks, worn bearing bores, damaged threads, or other damage. Install a new case if any of these conditions exist.

6. Discard all gears that are worn, chipped, broken or otherwise damaged. Small nicks or burrs should be removed with a fine grinding stone.

7. Inspect all shift lever forks and rails for wear or damage. Discard all defective parts as required and replace with new parts.

8. Install new oil seals and gaskets at time of assembly.

9. Lubricate all parts thoroughly with clean oil before the assembly procedure.

C. Installation

Refer to Figures 7 and 8

1. Install the mid range gear and the rear bearing on the countershaft, and install the countershaft from the rear of the transmission case. Insert the countershaft until the front of the shaft is in the rear compartment of the transmission case.

   NOTE: Prior to installing the countershaft, be certain that the upper bearing is installed in the web at the rear of the middle compartment.

2. Place the 39 tooth high range gear and bearing onto the countershaft and insert the front of the shaft into the middle compartment.

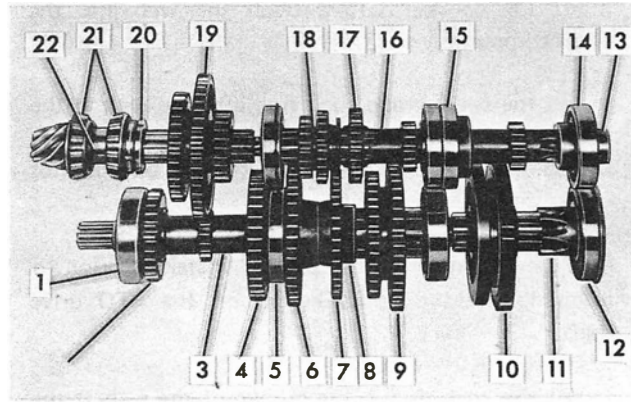


Figure 7
Transmission Gears

1. Bearing
2. Mid Range Gear
3. Countershaft
4. High Range Gear
5. Bearing
6. 2nd Gear
7. 3rd Gear
8. Spacer
9. 1st and Reverse Gear
10. PTO Gear
11. PTO Drive Shaft
12. Bearing
13. Input Shaft Coupler
14. Bearing
15. Double Bearing
16. Mainshaft
17. Reverse Gear
18. 2nd-3rd Gear
19. Sliding Range Gear
20. Locknuts & Washer
21. Tapered Bearings
22. Pinion Shaft

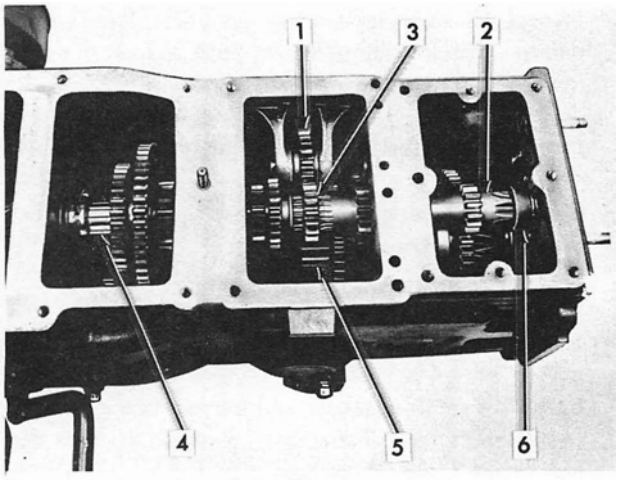


Figure 8
Transmission Gears Installed

1. Reverse Idler Gear
2. Mainshaft
3. Reverse Gear
4. Pinion Shaft
5. Countershaft
6. Input Shaft Coupler

3. Place the 43 tooth 2nd gear, the 39 tooth 3rd gear, the spacer and snap ring, and the 38 tooth and 46 tooth—1st and reverse gear on the countershaft and insert the countershaft through the web into the front compartment.

4. Install the bearing and snap ring into the web at the rear of the front compartment. Lay the 47 tooth sliding PTO gear in the compartment but do not install the PTO drive shaft.

   NOTE: The mainshaft must be installed prior to installing the sliding PTO gear on the PTO drive shaft.

5. Install the snap ring in the groove of the web at the rear of the middle compartment.

6. Install the double bearing on the mainshaft. Then install the snap ring, the reverse gear, and the other snap ring on the mainshaft.

7. Install the 2nd—3rd sliding gear on the shaft and carefully insert the mainshaft through the webs until the bearing seats against the snap ring in the second web.

8. Position the input shaft coupler so that the larger diameter is facing inward, and engage it with the splines of the mainshaft.

9. Install the rear tapered bearing on the pinion shaft and carefully insert the shaft through the rear web. Install the front tapered bearing, lock nut, lock washer, lock nut and the sliding range gear. Refer to Section 4, "Adjustments," page 77, for pinion shaft pre-load procedures. Tighten the locknut to the torque specified on page 88.

10. Install the bearing on the end of the PTO drive shaft and install the inner and outer snap rings.

11. Insert the shaft through the first web of the front compartment and place the sliding PTO gear onto the shaft.

12. Install the countersunk spacer, the thrust bearing, and the square cut spacer on the shaft.

    NOTE: The concave side of the first spacer is positioned towards the thrust bearing.

13. Install the PTO drive shaft through the countershaft until the bearing outer snap ring seats in the front web.

14. Install the reverse idler gear and shaft. Install the roll pins at each end of the shaft.

15. Insert the shifter forks in their respective grooves and insert the shifter rods. Make sure the balk pin is between the shifter rods 1-R and 2-3, see Figure 9.

16. Install the shifter boss on the shifter fork and install the spring pins into the shifter fork bosses. Secure the assembly with safety wire. Install the detent balls, springs, and pins.

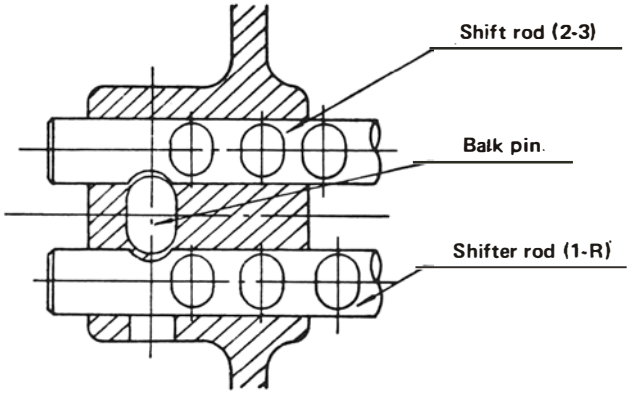


Figure 9
Balk Pin Installation

17. Install the shift cover and the case cover and tighten the bolts to the specified torque, page 88.

18. Position the left-hand final drive gear in the transmission case and install the left-hand carrier in the center housing.

19. Place the differential assembly into the center housing and position it into the left-hand carrier.

20. Lower the right-hand final drive gear between the differential assembly and the center housing and lay the gear as far down in the center housing as possible.

21. Install the right-hand carrier assembly into the center housing and position the final drive gear in the carrier. Refer to Section 4, "Adjustments," page 77, to adjust the backlash.

22. Install the final drive pinions and bearings and install the seal and cover assembly.

23. Align the transmission case with the clutch case and secure with the retaining bolts. Tighten the bolts to the torque specified on page 88. Install the clutch rod assembly.

24. Install the axle housings as outlined in Chapter 2, under "Rear Axle Overhaul—Installation," page 82.

25. Install the differential lock pedal, fork, and spring and secure in position with the spring pin.

26. Install the PTO connector and bearing on the PTO output shaft and insert through the bearing retainer and gasket assembly. Insert the shaft through the rear of the transmission case and position the PTO connector over the PTO drive shaft.

27. Install the bearing, oil seal, retainer gasket and outer PTO cover over the PTO output shaft and tighten the bolts to the specified torque, page 88.

28. Install the hydraulic lift cover assembly and gasket and tighten the bolts to the specified torque page 88.

29. Install the seat assembly.

30. Install the brake drum and secure with the spacer, lock nut washer, and lock nut.

31. Install the brake cover and retaining bolts. Connect the brake rod joint with the pin.

32. Install the fenders and rear wheels, (and roll bar if equipped) and tighten the wheel bolts to the specified torque, page 88.

3. DIFFERENTIAL OVERHAUL

A. Removal

1. Remove the differential assembly from the center housing by following the procedure outlined in Section 2, "Transmission Overhaul—Disassembly," page 71.

2. Clean the outer surface of the differential assembly with a suitable solvent and allow to dry.

B. Disassembly

Refer to Figure 10 during the disassembly procedure.

1. Straighten the ring gear retaining bolt lock straps and remove the bolts and ring gear from the differential assembly.

2. Straighten the differential case set bolt lock straps, and remove the bolts and the differential case.

3. Remove the spider assembly from the right hand case by pulling out the pinion shafts. Remove the pinions, joint and thrust washers from the case. Remove the side gear and thrust washer from the case.

4. Remove the side gear and thrust washer from the left-hand case.

C. Inspection

1. Clean all parts with a suitable solvent and blow dry with compressed air.

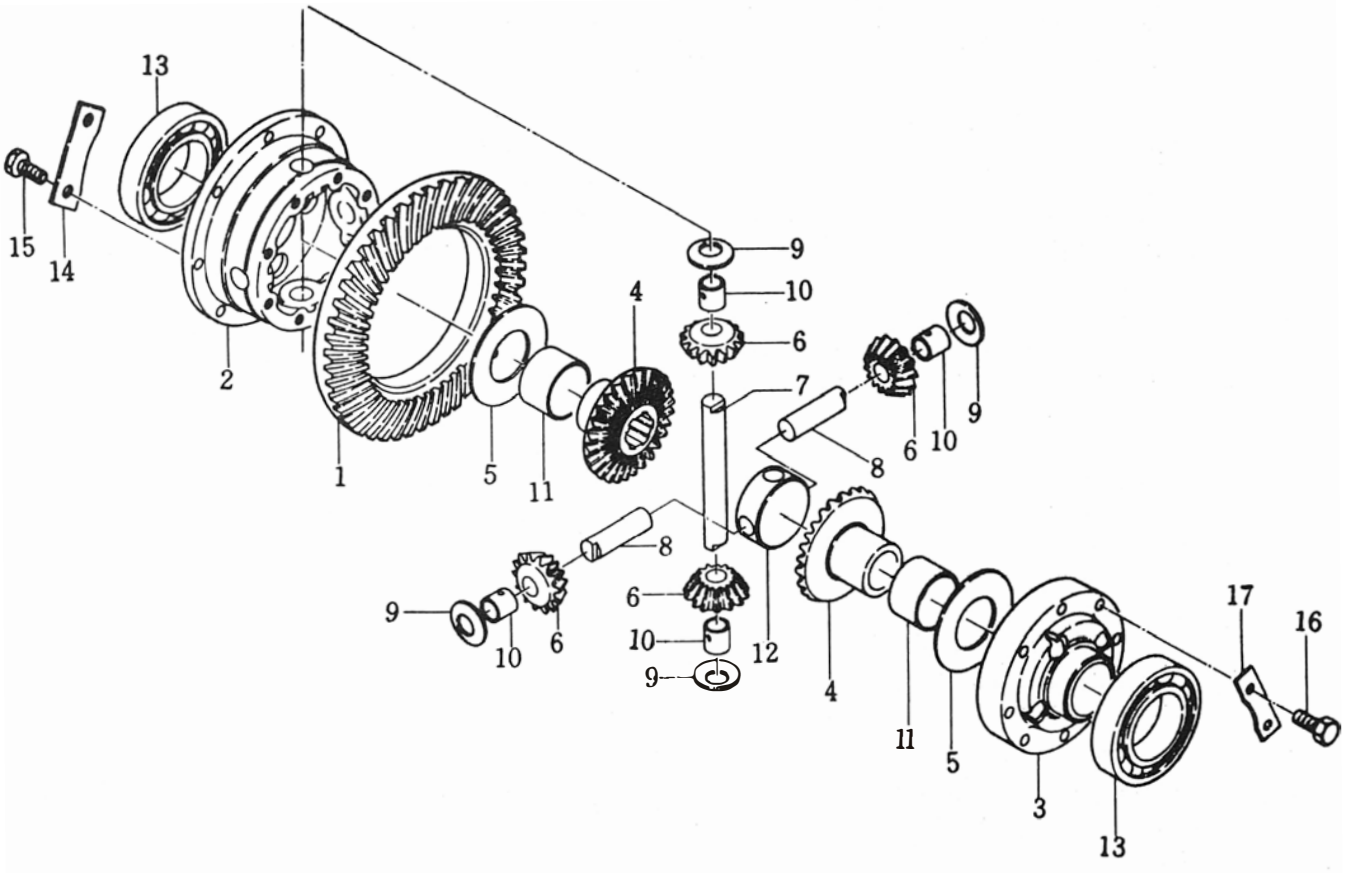


Figure 10
Exploded View of Differential Assembly

1. Ring Gear
2. Differential Housing R.H.
3. Differential Housing L.H.
4. Side Gears
5. Thrust Washers
6. Pinion Gears
7. Pinion Shaft
8. Pinion Shafts
9. Thrust Washers
10. Pinion Gear Bushings
11. Bushings
12. Differential Pinion Joint
13. Bearings
14. Lock Straps R.H.
15. Bolt
16. Bolt
17. Lock Straps L.H.

2. Inspect all gears for damage or excessive wear. Minor nicks can be removed with a grinding stone. Replace those parts which are severly damaged.

3. Check the differential thrust washer and differential pinion thrust washers for wear or damage. If wear is beyond the specified limit page 87, replace the thrust washers.

4. Inspect the pinion shafts for wear or damage. If the pinion shaft wear exceeds the specified limit page 87, replace the pinion.

D. Assembly

Refer to Figure 10.

1. Insert the thrust washer and side gear into the left-hand case, and install the thrust washer and side gear into the right hand case. Insert the longer pinion shaft through one of the four shaft holes in the right-hand case. A thrust washer and pinion are assembled on the shaft and the shaft is passed through the joint. Another pinion and thrust washer are added to the shaft and the shaft is then inserted through the opposite hole in the case.

2. Install the two shorter shafts, pinions, and thrust washers in the same manner as previously described. The shorter shafts will stop against the longer shaft at the center of the joint. Turn the flats on the outer ends of the shafts so that they are parallel with the inner face of the case.

3. Install the left-hand case over the right-hand case and against the flats preventing the shafts from rotating with the pinions. Install the lock straps and retaining bolts and tighten the bolts to the specified torque page 88. Bend the lock straps over the bolt heads.

4. Install the ring gear on the right-hand case and secure with the lock straps and retaining bolts. Tighten to the specified torque page 88, and bend the lock straps over the bolt heads.

E. Installation

1. Install the differential assembly as outlined in Section 2. "Transmission Overhaul - Installation", page 73.

2. Tighten all bolts to the specified torque page 88.

4. ADJUSTMENTS

DRIVE PINION BEARING PRELOAD

Drive pinion bearing preload is obtained by tightening the inner lock nut until resistance to turning is felt. The nut is then backed off slightly until there is no resistance and no end play. The outer nut is then tightened against the inner nut and the lock washer and a locking washer tab is bent into one notch on each nut.

TOOTH CONTACT AND GEAR LASH

Correct tooth contact, see Figure 11, and gear lash between the drive pinion and ring gear are obtained by the use of shims in two places. Shims are placed between a spacer and bearing on the gear end of the drive pinion. Shims are also placed between the flange of the right-hand differential carrier and the outside of the center housing. The shims are not changed unless it is necessary to replace a pinion and ring gear set.

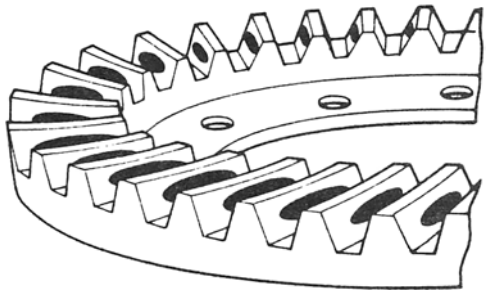


Figure 11
Correct Pinion Gear-To-Ring Gear Tooth Contact

The drive pinion and ring gear are identified by a set number which is stamped into the end of the drive pinion gear and on the circumference of the ring gear. In addition a "Value of Error" number is also stamped into the gear end of the pinion gear, Figure 12. This number is prefixed with a plus (+) or minus (-) to indicate the amount of error from a zero adjustment. If the value of error is greater on the new pinion than on the old pinion, additional shims will be required. If the value of error is less on the new pinion than on the old pinion, the number of shims is decreased.

The backlash between the ring and pinion gears is measured by placing a dial indicator at right angles to a tooth on the ring gear and measuring the movement of the gear. If the backlash exceeds the specified limit page 87, shims should be added or removed from between the carrier flange and the center housing.

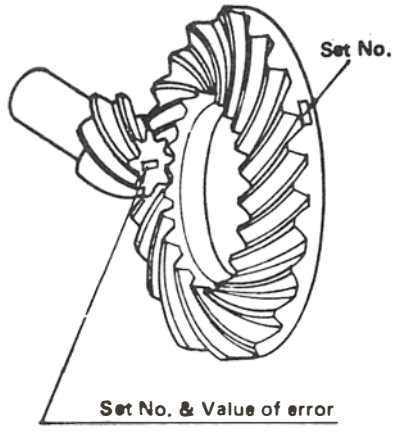


Figure 12
Differential Gear Set

FACE CONTACT

If the backlash between the drive pinion and ring gear is excessive, the teeth will contact each other at the upper edges of the faces, see Figure 13. Adding a shim on the back side of the drive pinion and removing a shim from the right-hand carrier flange will decrease the backlash.

FLANK CONTACT

If the teeth contact near the roots of the teeth, see Figure 14, decrease the number of shims on the back side of the drive pinion. The backlash must be adjusted properly by increasing the number of differential shims on the right-hand carrier flange.

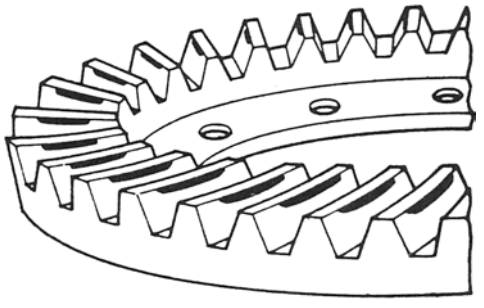


Figure 13
Face Contact

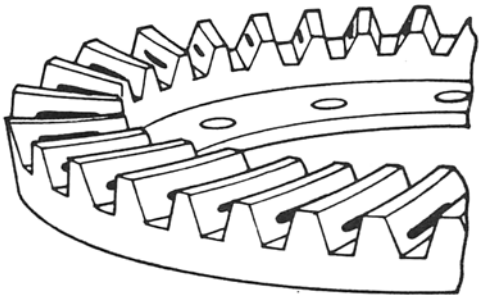


Figure 14
Flank Contact

TOE CONTACT

If the teeth contact on the toe side Figure 15, then increase the number of shims on the back side of the pinion gear and decrease the number of shims on the right-hand carrier flange.

HEEL CONTACT

If the teeth contact on the heel side, Figure 16, decrease the number of shims on the back side of the drive pinion.

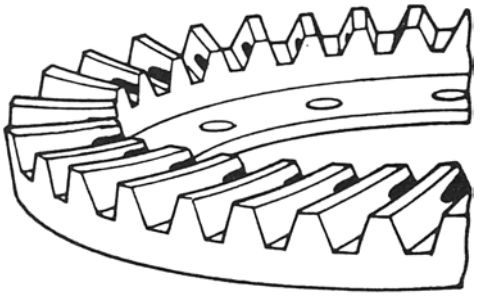


Figure 15
Toe Contact

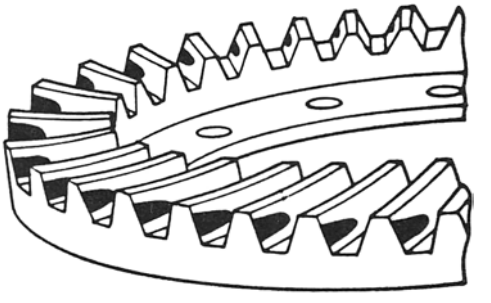


Figure 16
Heel Contact

PART 5

TRANSMISSION , DIFFERENTIAL, REAR AXLE, AND RELATED PARTS

CHAPTER 2

REAR AXLE, BRAKES, DIFFERENTIAL LOCK AND PTO SHAFT

1. DESCRIPTION AND OPERATION

The Ford 1000 rear axle is a double reduction type with primary reduction achieved by means of a conventional differential assembly and secondary reduction by means of a final drive pinion and final drive gear. The axle housings enclose the brake drums and brake shoe assemblies. The rear axle and transmission components are contained in the same housing and are lubricated from a common sump. The differential assembly, final drive gears, power take-off, and differential lock are housed in the rear compartment of the transmission center housing.

The major rear axle components, Figure 17, are shown in the same position as they are in the tractor. Power is taken from the transmission output shaft by the differential drive pinion and transmitted to the differential ring gear which in turn rotates a conventional four pinion differential assembly. The final drive pinion gear is splined to the differential side gear and is in mesh with the final drive gear which is splined to the axle. As the final drive pinion rotates with the differential assembly, power is transmitted to the final drive gear and the axle.

The axle housing supports the axle shaft and bearings, and the large round upper portion provides an enclosure for the tractor brakes, see Figure 18. The axles are splined to install the final drive gears. On the right-hand axle, and smaller diameter extension is splined for the differential lock sliding coupling which engages the blind holes on the inner face of the left-hand drive gear hub. The axle must be pressed out of the housing to service the bearings and the oil seal.

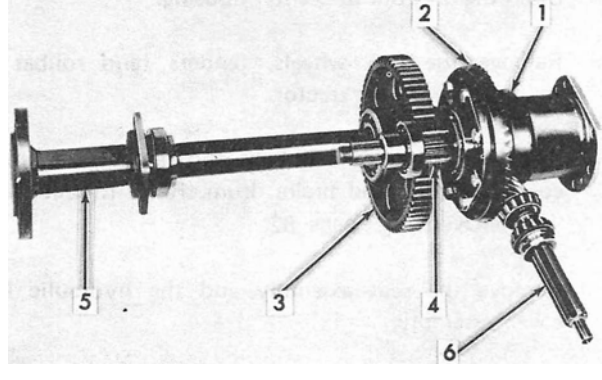


Figure 17
Major Rear Axle Components

1. Differential Assembly
2. Differential Ring Gear
3. Final Drive Gear
4. Final Drive Pinion Gear
5. Axle Assembly
6. Differential Drive Pinion Gear

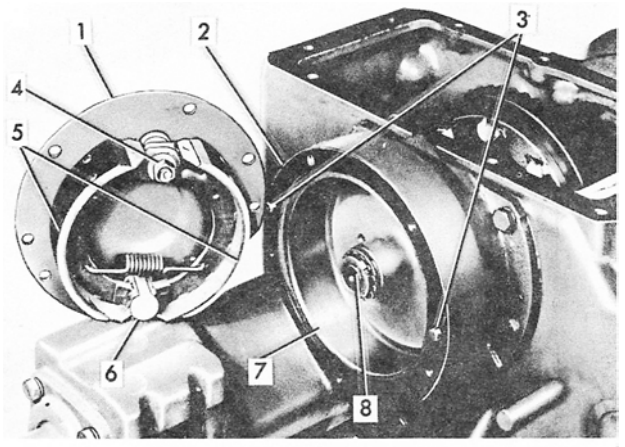


Figure 18
Brake Components

1. Cover
2. Axle Housing
3. Dowel Pins
4. Pivot Pin
5. Brake Shoes
6. Actuating Cam
7. Brake Drum
8. Final Drive Pinion Gear Shaft

The brakes on the Ford 1000 are of the internal expanding shoe type and are mechanically actuated. The brakes are located on the outside of the center housing and are enclosed in the upper portion of the axle housing. The brakes are sealed against dust and moisture entry by the cover. The brake drum is splined to the final drive pinion gear and turns at the same speed as the differential assembly.

The brake shoe pivot pin and actuating cam are assembled to the cover, see Figure 18. The cover is located on the dowel pins which keep it from turning when the brakes are applied.

The brake shoes are located on the pivot pin. The opposite ends of the shoes are held against the cam on the lever and cam assembly by the return spring. When the brakes are applied the brake lever rotates the cam which forces the brake shoes out against the brake drum. When the brakes are released, the pedal return spring pulls the lever and cam back to their original position and allows the shoe return spring to pull the shoes away from the drum.

The differential lock differs from that used on other tractors in that it must be held in engagement for as long as it is necessary to use it. It is not self-locking. A sliding coupling with three equally spaced lugs is mounted on splines on the right-hand axle and when the pedal is depressed, it engages similarly positioned blind holes in the final drive gear on the left-hand axle, locking the axles together.

A transmission type power take-off is used in the Ford 1000 tractor. The PTO operates only when the clutch is engaged. The PTO output shaft is connected to the transmission PTO shaft by a splined coupling. The PTO is engaged or disengaged by the left-hand shift lever.

2. REAR AXLE OVERHAUL

A. Removal

1. Drain the oil from the center housing.
2. Remove the rear wheels, fenders (and rollbar if equipped) from the tractor.
3. Disconnect the brake linkage and remove the brake cover assembly and brake drum. Refer to Section 3 "Brake-Overhaul", page 82.
4. Remove the seat assembly and the hydraulic lift cover assembly.
5. Remove the final drive gear retaining snap ring and the axle housing to center housing bolts.
6. Remove the complete housing and axle assembly from the tractor.

B. Disassembly

Refer to Figure 19 during the disassembly procedure.

1. Remove the axle housing cover retaining bolts.
2. Using a suitable press, apply pressure to the inner end of the axle to push the axle through the inner bearing which at the same time will push the outer bearing out of the housing bore.
3. Withdraw the axle assembly from the housing.
4. Remove the lock collar and lock washer from the axle shaft.
5. Using a suitable press, remove the outer bearing from the axle shaft and then remove the spacers, oil seal and axle housing cover.

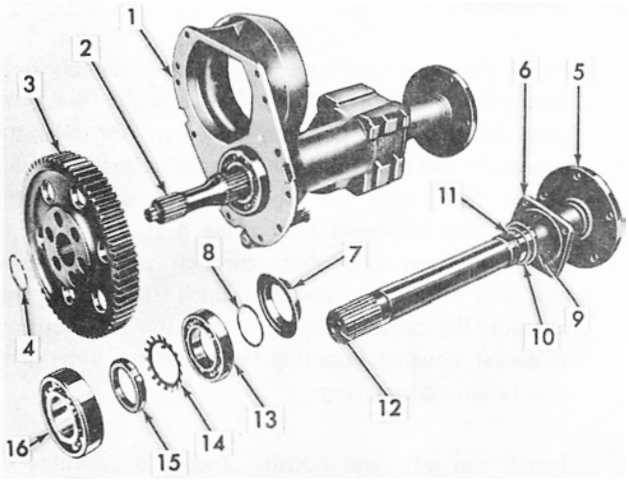


Figure 19
Exploded View of the Axle Assembly

1. Housing R.H.
2. Right-Hand Axle
3. Final Drive Gear
4. Snap Ring
5. Left-Hand Axle
6. Cover
7. Oil Seal
8. Plate
9. Flange
10. Hub
11. Oil Seal Retainer
12. Pilot Bushing
13. Outer Bearing Assembly
14. Lock Washer
15. Nut
16. Inner Bearing

C. Inspection

1. Clean all parts in a suitable solvent and allow them to dry.

2. Inspect the bearings for wear, discoloration, looseness, or any other damage. Replace if necessary.

3. Check the oil seal for wear, cracks, or other damage, and replace if necessary.

4. Check the axle to make sure it is not twisted or bent. Inspect the splines at the end of the axle shaft for wear or damage. Replace the axle shaft if necessary.

D. Assembly

1. Place the axle housing cover, gasket, spacer, oil seal, and spacer over the end of the axle shaft. Make sure the oil seal is positioned toward the axle housing cover.

2. Using a suitable press, see Figure 20, install the outer bearing onto the axle shaft and secure in place with the lock-washer and lock nut.

3. Insert the axle shaft into the housing, and press the outer bearing into the housing outer bore, Figure 21.

4. Install the axle cover to the axle housing with the retaining bolts.

5. Press the inner bearing onto the axle and into the housing counter bore.

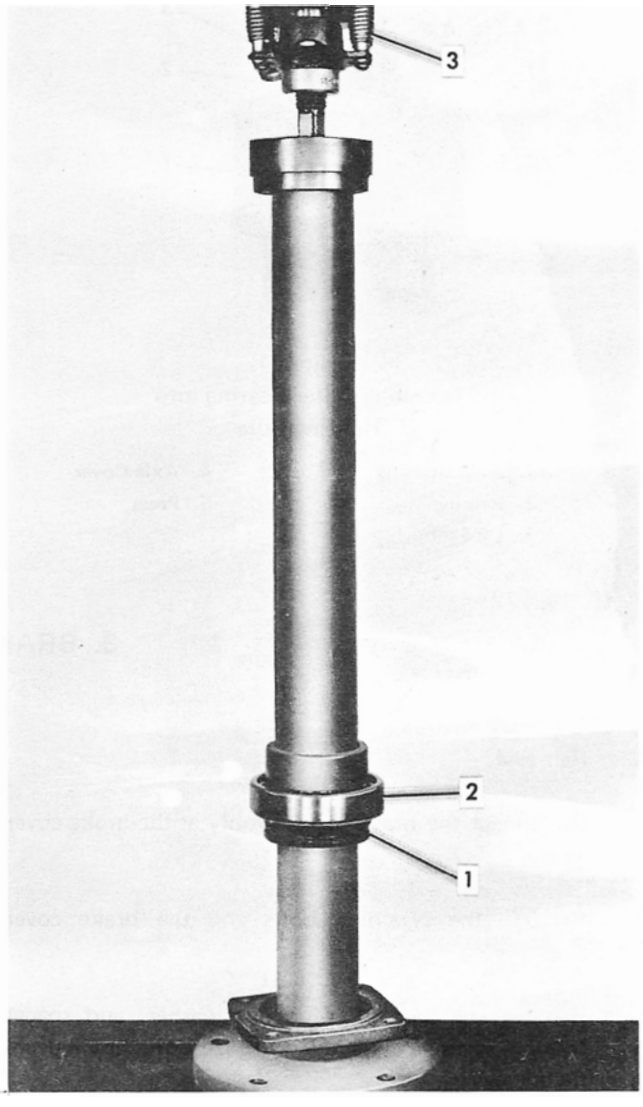


Figure 20
Outer Bearing Installation

1. Oil Seal
2. Outer Bearing
3. Press

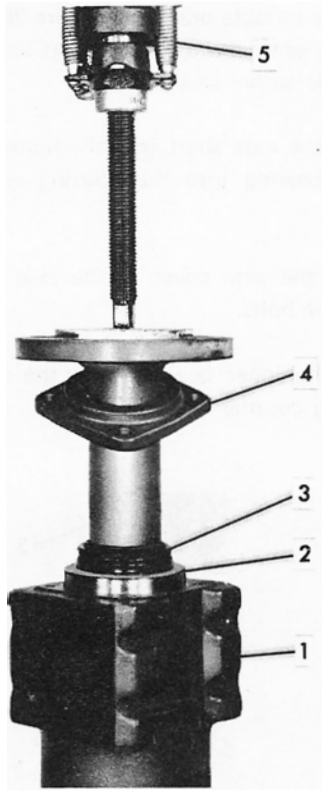


Figure 21
Installing Outer Bearing into Housing Bore

1. Axle Housing
2. Bearing
3. Oil Seal
4. Axle Cover
5. Press

E. Installation

1. Install the right-hand housing and axle assembly first. Insert the splines on the axle shaft into the final drive gear. At this time position the snap ring over the axle shaft and then hold the differential lock coupling in the fork, with the lugs on the coupling facing toward the left-hand final drive gear. Continue to push the right axle shaft through the final drive gear and differential coupling until the axle housing contacts the center housing. Install the axle housing-to-center housing retaining bolts and the final drive gear retaining snap ring.

2. Install the left-hand housing and axle assembly to the center housing. Make sure that the splines on the axle shaft line up with the final drive gear and that the bushed hole in the end of the left-hand axle pilots over the short, stub shaft, on the end of the right hand axle. Install the axle housing-to-center housing retaining bolts and the final drive gear retaining snap ring.

3. Install the hydraulic lift cover and the seat assembly.

4. Install the brake drum, cover, and connect the brake linkage. Refer to Section 3 "Brake Overhaul" below.

5. Install the fenders, wheels, and rollbar if equipped.

6. Fill the center housing with oil.

3. BRAKE OVERHAUL

A. Removal

1. Disconnect the brake rod assembly at the brake cover lever.

2. Remove the retaining bolts and the brake cover assembly.

3. Remove the lock nut, locknut washer, and spacer and then remove the brake drum from the brake drum shaft.

B. Disassembly

1. Using brake spring pliers, remove the return spring from the brake shoes.

2. Remove the nut, lockwasher, and flat washer from the pivot pin and remove the brake shoes.

C. Inspection and Repair

1. Clean and inspect all parts and install new parts where worn or damaged.

2. Inspect the brake shoe linings. If they are deeply scored or badly worn new shoes should be fitted.

3. Check the brake drum for streaks, discoloration or other damage. Minor imperfections can be removed with a lathe. If the inside diameter of the brake drum is less than the specified limit page 87, replace the drum.

D. Assembly

Refer to Figure 22.

1. Position the brake shoes over the pivot pin and retain with the flat washer, lock washer, and nut.

2. Place the brake shoes against the brake cam and install the return spring.

E. Installation

1. Position the brake drum onto the brake drum shaft and retain in place with the spacer, lockwasher and nut.

2. Position the brake cover assembly over the dowel pins and install the retaining bolts.

3. Connect the brake rod to the brake lever.

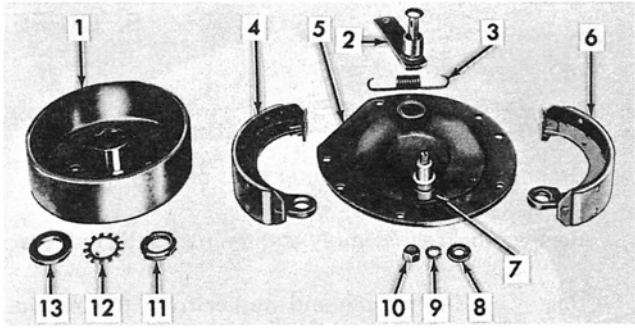


Figure 22
Brake Components

1. Drum
2. Lever and Cam Assembly
3. Return Spring
4. Shoe
5. Cover
6. Shoe
7. Pivot Pin
8. Flat Washer
9. Lock Washer
10. Nut
11. Nut
12. Lock Washer
13. Spacer

4. ADJUSTMENTS

BRAKES

Brake adjustment is made by changing the length of each brake rod to obtain the correct brake pedal free play.

To adjust the brakes:

1. Loosen the lock nut on the brake rod assembly, see Figure 23.

2. Rotate the brake rod until the correct free play is obtained on both brake pedals, see "Specifications" page 87.

3. Retighten the lock nut and check to see that the brake pedal free play is within the specified limit.

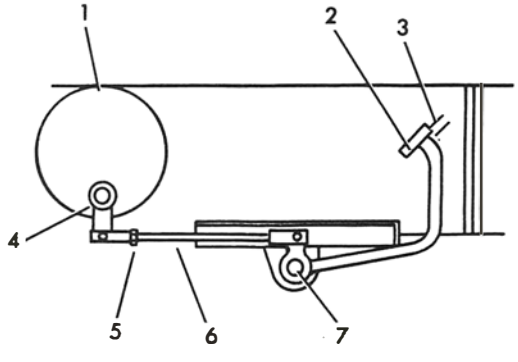


Figure 23
Brake Adjustment

1. Brake
2. Pedal
3. Free Play
4. Brake Lever
5. Lock Nut
6. Adjustable Rod Assembly
7. Cross Shaft

5. DIFFERENTIAL LOCK

A. **Removal**

1. Drain the oil from the center housing.
2. Remove the seat assembly and the hydraulic lift cover.
3. Remove the spring pin and washer from the left side of the differential lock shaft.
4. Remove the actuating pin from the middle of the differential shaft.
5. Grasp the return spring and fork and pull the shaft out of the center housing, then lift the spring and fork out of the housing.
6. If the differential sliding coupling is to be removed, the left-hand axle assembly must be removed. Refer to the procedure under Section 2 "Rear Axle Overhaul—Removal," page 80.

B. **Inspection and Repair**

1. Clean all parts with a suitable solvent and blow them dry with compressed air.
2. Check all O-rings for cracks or other damage, replace them if necessary.
3. Check all other parts for wear or damage and replace them if necessary.

C. **Installation**

1. If the differential sliding coupling was removed, install the coupling over the right-hand axle shaft making sure that the lugs on the coupling are facing the left-hand final drive gear. To install the left axle housing refer to the procedure under Section 2 "Rear Axle Overhaul—Installation," page 82.
2. Insert the differential lock shaft into the right side of the center housing and install the actuating pin in the middle of the shaft.
3. Insert the fork into the differential coupling and continue to push the differential shaft through the coupling.
4. Install the return spring over the shaft and push the shaft through the left side of the center housing. Install the washer and the spring pin on the end of the differential shaft.
5. Install the hydraulic lift cover and seat assembly.
6. Fill the center housing with oil.

6. PTO SHAFT

A. **Removal**

1. Remove the four bolts and the PTO cover from the rear of the center housing.
2. Pull the PTO shaft out from the rear of the housing.
3. Pry the bearing retainer from the center housing using a screw driver.

B. **Disassembly**

1. Using a suitable press, remove the two bearings from the PTO shaft.
2. Remove the oil seal from the rear cover.

C. **Inspection**

1. Inspect the PTO shaft splines for wear or damage. Minor burrs can be removed with an oil stone. If severe damage is apparent, replace the PTO shaft.
2. Inspect the bearings for wear or discoloration from heat. Replace the bearings if necessary.
3. Check the oil seal for wear, cracks, or other damage, replace if necessary.
4. Check the bearing retainer for severe wear or damage, replace if necessary.

D. Assembly

1. Using a suitable press, install the bearings on the PTO shaft.

2. If a new oil seal is installed, press it into the PTO cover.

E. Installation

1. Position the gasket on the bearing retainer and insert the retainer into the center housing.

2. Install the coupling on the end of the PTO shaft and insert the shaft assembly through the bearing retainer. Make sure the coupling lines up with the PTO drive shaft.

3. Install the PTO cover and the retaining bolts.

PART 5

TRANSMISSION, DIFFERENTIAL, REAR AXLE, AND RELATED PARTS

CHAPTER 3

TROUBLE SHOOTING AND SPECIFICATIONS

1. TROUBLE SHOOTING

TRANSMISSION

Trouble	Possible Causes
Gear Lubricant Leaks	1. Lubricant level too high 2. Loose drain plug 3. Faulty gaskets 4. Cracked transmission case
Noisy Transmission	1. Worn bearings 2. Excessive gear backlash 3. Broken gear or gear teeth 4. Incorrect gear mesh 5. Insufficient lubricant
Gears Will Not Shift	1. Broken change lever 2. Broken or bent shifter fork and/or shifter rod
Gears Will Not Stay Engaged	1. Weak stopper spring 2. Worn shift rod detent ball grooves 3. Unevenly worn gears 4. Worn or damaged detent balls
Gears Will Not Disengage	1. Bent shifter rod 2. Foreign matter present causing gears to jam 3. Rod slipping off due to dragging clutch

BRAKES

Trouble	Possible Causes
Braking is Poor	1. Improperly adjusted brake pedal 2. Worn or scored brake linings 3. Oil leaking into brake chamber
One Brake More Effective Than the Other	1. Improperly adjusted brake pedal free play 2. One brake is inoperative 3. Oil leaking into brake chamber
Noisy Brakes	1. Worn brake linings 2. Lining surfaces are slippery

2. SPECIFICATIONS

TRANSMISSION

Type	Selective Mesh
Speeds	9 Forward 3 Reverse
Oil Capacity	19.8 Liters (17.5 Imp. Qts.) (21 U.S. Qts.)
Lubricant	High quality, extreme pressure Gear lubricant as follows:

Temperature	Viscosity Grade
Under 0° C (32° F)	SAE 80
0° - 30° C (32°-86° F)	SAE 90
Over 30° C (86° F)	SAE 90 or 140

Gear Backlash	0.2 mm (.0078 in.)
Allowable Backlash	0.6 mm (.0236 in.)
Clearance Between Slide Gear and Main Shaft Spline	0.1 mm (.0039 in.)
Allowable Clearance Limit	.25 mm (.0098 in.)
Clearance Between Slide Gear and Shifter Fork	.1-.3 mm (.0039-.0118 in.)
Allowable Clearance Limit	1.0 mm (.0394 in.)
Clearance Between Slide Gear and Drive Pinion Spline	0.1 mm (.0039 in.)
Allowable Clearance Limit	.25 mm (.0098 in.)
Clearance Between Counter Shaft and Slide Gear Spline	0.1 mm (.0039 in.)
Allowable Clearance Limit	.25 mm (.0098 in.)

DIFFERENTIAL

Type	Bevel Gear
Ring Gear	Sprial Gear
Pinion Shaft Diameter	18 mm (.709 in.)
Allowable Wear Limit	.1 mm (.0039 in.)
Differential Thrust Washer Thickness	.2 mm (.0078 in.)
Allowable Wear Limit	0.1 mm (.0039 in.)
Pinion Thrust Washer Thickness	1.2 mm (.0472 in.)
Allowable Wear Limit	.1 mm (.0039 in.)
Drive Pinion-to-Ring Gear Backlash	.13–.18 mm (.0051 in.–.0070 in.)
Allowable Backlash	.5 mm (.0197 in.)
Final Drive Gear and Pinion Backlash	.2 mm (.0078 in.)
Allowable Backlash	.6 mm (.0236 in.)
Clearance Between Final Drive Gear and Axle Spline	.1 mm (.0039 in.)
Allowable Clearance Limit	.25 mm (.0098 in.)

BRAKES

Type	Mechanical Internal Expansion
System	Anchor Pin System
Brake Drum I.D.	170 mm (6.70 in.)
Brake Pedal Free Play	20-30 mm (.7874–1.180 in.)
Allowable Free Play	30 mm (1.180 in.)

2. SPECIFICATIONS (Cont.)

PTO

Type . . . . . Transmission
Shaft . . . . . 3.49 cm (1.35 in.) 6-spline SAE STD
Engine Speed for 540 rpm PTO Operation. . . . . 1955 rpm
Horsepower PTO Observed. 23.0
Gear Backlash . . . . . .2 mm (0078 in.)
Allowable Gear Backlash . . . . . .6 mm (.0236 in.)
Clearance Between PTO counter Shaft and Slide Gear Spline . . . . . .1 mm (.0039 in.)
Allowable Clearance Limit . . . . . .25 mm (.0098 in.)

TRACTOR GROUND SPEEDS (Equipped with 11.2 x 24 Tires)			
Gear	**Range**	**Ground Speed KPH**	**Ground Speed MPH**
1	1-Low	1.28	0.8
2	2-Low	1.76	1.1
3	3-Low	2.40	1.5
4	1-Med	3.20	2.0
5	2-Med	4.48	2.8
6	3-Med	6.08	3.8
7	1-High	7.36	4.6
8	2-High	10.24	6.4
9	3-High	13.92	8.7
R1	R-Low	1.92	1.2
R2	R-Med	5.12	3.2
R3	R-High	11.52	7.2

TORQUE SPECIFICATIONS:

Drive Pinion Gear Nut . . . . . 2.0 kg-m (14.5 lbs. ft.)
Rear Wheel Bolts . . . . . 17.0-19.0 kg-m (123-138 lbs. ft.)
Ring Gear Bolts . . . . . 5.0-6.0 kg-m (36-44 lbs. ft.)

Torque specifications not listed above:

BOLT, NUT	TIGHTENING TORQUE	
	STANDARD BOLT	**SPECIAL BOLT**
M6	.6-.8 kg-m (4.5-6.0 lbs. ft.)	1.0-1.3 kg-m (7.0-9.5 lbs. ft.)
M8	1.3-1.8 kg-m (9.5-13 lbs. ft.)	2.5-3.5 kg-m (18-25 lbs. ft.)
M10	2.0-3.0 kg-m (14.5-22 lbs. ft.)	5.5-7.0 kg-m (40.50 lbs. ft.)
M12	5.0-6.0 kg-m (36-44 lbs. ft.)	9.0-11.0 kg-m (65-80 lbs. ft.)
M16	10.0-12.0 kg-m (72-87 lbs. ft.)	16.0-18.0 kg-m (116-130 lbs. ft.)
M18	12.0-14.0 kg-m (87-100 lbs. ft.)	20.0-24.0 kg-m (145-175 lbs. ft.)
M20	15.0-17.0 kg-m (108-123 lbs. ft.)	24.0-26.0 kg-m (175-188 lbs. ft.)

NOTE: The special bolts can be identified by the number 7 or 8 on the head of the bolt.

PART 6

HYDRAULICS

CHAPTER 1

HYDRAULIC SYSTEM

1. DESCRIPTION AND OPERATION

The Ford 1000 hydraulic system is controlled by a single lever. An adjustable stop on the quadrant provides a reference for returning to a previous working depth (height) when intermittent changes in working depth are required, such as raising an implement for transport, see Figure 1.

This hydraulic system differs from other Ford hydraulic systems in that, the control valve is externally mounted, a separate reservoir is used, the lift cylinder is a replaceable sleeve rather than part of the control valve casting, and the system is almost entirely externally mounted, thus providing accessibility for service.

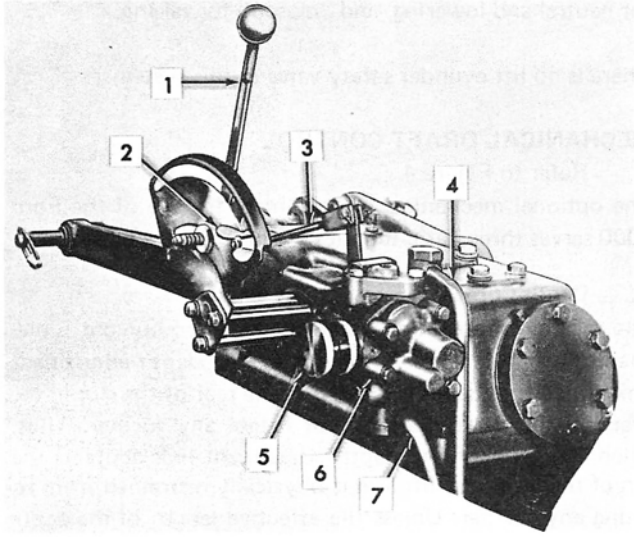


FIGURE 1
Hydraulic System Controls

1. Lift Control Lever
2. Adjustable Stop
3. Position Control Link
4. Oil Return Line
5. Flow Control (Drop Restrictor) Knob
6. Control Valve Assembly
7. Pressure Line

A flow control knob, Figure 1, provides for control of the rate of drop of the lift linkage. The device actually functions as a drop restrictor. An external position control link connects the lift arm to the control valve. This adjustable link transmits lift arm movement to the control valve spool linkage to return the spool to neutral once the desired amount of lift has been obtained. The pressure line connects to the bottom of the control valve, and the return line connects to the top of the lift cover.

POSITION CONTROL LINKAGE

Position control results from the ability to use lift shaft rotation to move the control valve spool from a raise or lowering position to neutral.

The lift control lever is connected by a shaft to a cam. The cam moves the upper end of the actuating lever forward or rearward as the lift control lever is lowered or raised. Refer to Figure 2. The actuating lever, in turn, pivots on the position control cam, and the lower end is in contact with the control valve spool. As the lift control lever is raised on the quadrant, the lower end of the actuating lever is thrust forward, pushing the control valve spool forward to initiate a raise action.

To stop the raise action without moving the lift control lever, the actuating lever pivot must move rearward to allow the spool to move to neutral. This is done by connecting the position control cam to the lift arm by the position

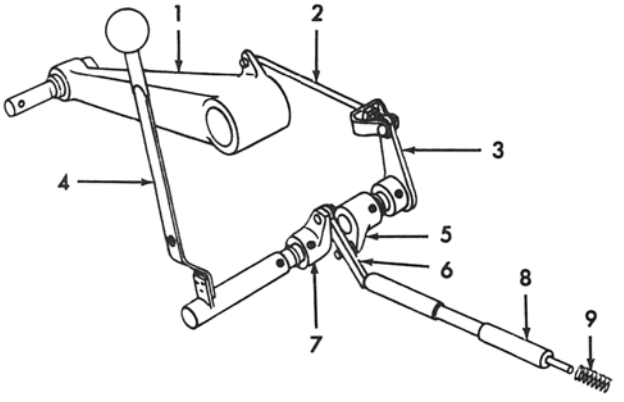


Figure 2
Position Control Linkage

1. Lift Arm
2. Position Control Link
3. Position Control Arm
4. Lift Control Lever
5. Position Control Cam
6. Actuating Lever
7. Lift Control Cam
8. Control Valve Spool
9. Return Spring

control link. Thus, as the lift arm rotates to raise an implement, the motion is translated to the position control arm to rotate the position control cam. The rotation moves the actuating lever pivot rearward. This allows the control valve spool spring to push the spool rearward to the neutral position, and lift action stops. In lowering, the process is reversed to provide incremental lowering.

HYDRAULIC LIFT CONTROL VALVE COMPONENTS

The five functional components of the hydraulic lift control valve assembly are illustrated in Figure 3.

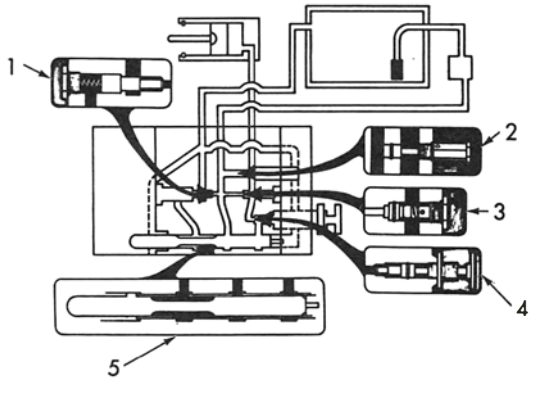


Figure 3
Control Valve Components

1. Unload Valve
2. System Relief Valve
3. Check Valve
4. Flow Control Valve
5. Control Valve Spool

A. System Relief Valve

The System Relief Valve protects the hydraulic system from excessive pressures. The relief pressure is set at 96.5 - 100 kg-cm^2 (1375-1425 psi). The relief pressure is adjusted by adding, or removing shims within the relief valve assembly.

B. Check Valve

The Check Valve is a one-way ball valve which allows oil to flow to the lift cylinder, but will not allow oil to return through reversed flow.

C. Flow Control Valve

The Flow Control Valve actually functions as a flow restrictor in that it is used to control the flow of oil being exhausted from the lift cylinder. Therefore, the setting of the flow control valve determines the rate of drop of the lift linkage.

D. Control Valve Spool

The Control Valve Spool is indirectly connected through the position control linkage to the lift control lever. The spool has three functional positions; "neutral" at mid travel, "lowering" when moved to the rear, and "raising" when moved forward. A return spring, located at the front of the spool, moves the spool to the neutral and lowering positions. The spool is mechanically moved to the raising position.

E. Unload Valve

The unload valve is operated by oil pressure directed by the control valve spool. It has two functional positions: "open" for neutral and lowering, and "closed" for raising.

There is no lift cylinder safety valve in this system.

MECHANICAL DRAFT CONTROL

Refer to Figure 4

The optional mechanical draft control feature of the Ford 1000 serves three basic functions. These functions are:

A. Depth Control

The maximum operating depth of tillage equipment is mechanically limited by the length of the depth adjustment link. When the rocker is located at the rear of the slot in the bracket, the draft shaft cannot rotate any further. Thus, when the loop of the depth adjustment link contacts the pin of the lever, the lift arm is physically restrained from rotating any further. Unless the effective length of the depth adjustment link is increased, the implement cannot attain a greater depth.

B. Increased Traction

The tractive effort of the rear wheels is increased when soil resistance increases. This results from the tendency of the

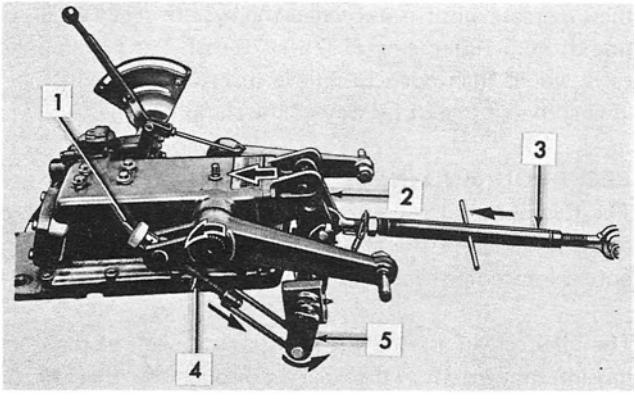


Figure 4
Mechanical Draft Control

1. Depth Adjustment Knob
2. Rocker Arm
3. Upper Link
4. Depth Adjustment Link
5. Draft Shaft and Lever Assembly

implement to rotate about the hitch pins. This rotational tendency produces a compressive force in the upper link, which pushes against the rocker, causing it to rotate in a counter-clockwise direction as shown in Figure 4. Because the rocker and the draft shaft and lever are a solid assembly, the same rotation occurs at the lever. The result is a tension load in the depth adjustment link which now pulls downward on the clevis of the lift arm, translating the counter-clockwise rotation to the lift arm, thus trying to raise the implement. Thus, the net result is a transfer of implement weight to the tractor rear wheels, thereby increasing the tractive effort.

C. Flexible Linkage

Because the rocker is free to move within the limits of the slot in the bracket, an attached implement can rise over obstructions and avoid damage. For transporting mounted equipment, install the bracket pin through the rocker and the hole in the bracket, located below the slot. Doing so will deactivate the draft control feature and minimize bouncing of the attachments.

HYDRAULIC LIFT SYSTEM OIL FLOW

A. Oil Flow – Neutral

Refer to Figure 5

When the hydraulic system control valve is in the neutral position, oil is pumped into the control valve under a pressure less than system relief pressure. This "charged pressure" oil enters the valve body, flows by the end of the system relief valve and dead ends at the control valve spool. The pressure then builds slightly to overcome the force of the light rate spring which is holding the unload valve on its seat, until the unload valve opens to allow the pumped oil to pass into the sump passage and return to the reservoir. All of the passages between the cylinder and the control valve spool will now contain oil of a uniform pressure. This includes both end covers, which also comprise part of the sump passage.

B. Oil Flow – Lowering

Refer to Figure 6

To exhaust oil from the ram cylinder which allows the lift linkage to lower, the lift control lever is moved downward on the quadrant, allowing the control valve spool spring to force the spool rearward to uncover the holes near the end of the bushing. Oil can now exhaust into the front cover of the valve at a rate determined by the flow control valve setting.

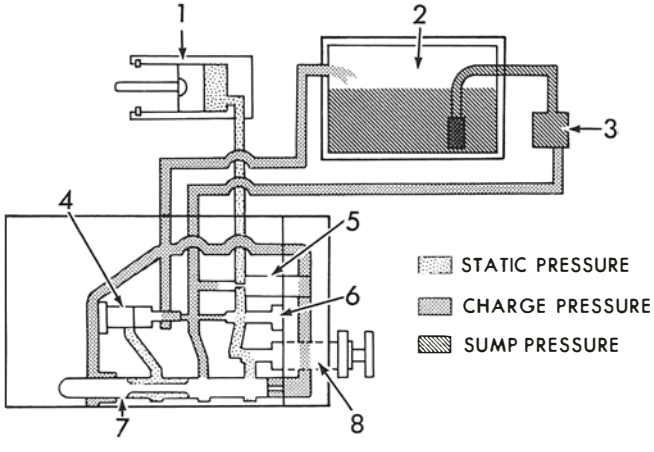


Figure 5
Hydraulic Oil Flow—Neutral

1. Cylinder
2. Reservoir
3. Pump
4. Unload Valve
5. System Relief Valve
6. Check Valve
7. Control Valve Spool
8. Flow Control Valve

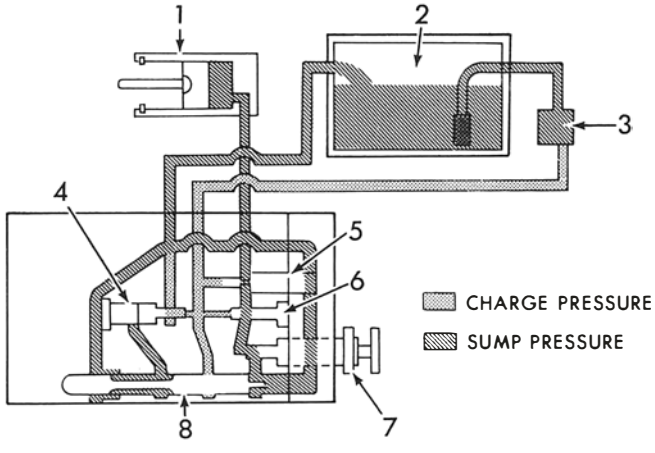


Figure 6
Hydraulic Oil Flow—Lowering

1. Cylinder
2. Reservoir
3. Pump
4. Unload Valve
5. System Relief Valve
6. Check Valve
7. Flow Control Valve
8. Control Valve Spool

When the control valve spool is in the lowering position, oil from the back side of the unload valve can exhaust around the spool into the rear cover of the control valve. Pumped oil can then fully open the unload valve and proceed back to the reservoir.

C. Oil Flow – Raising

Refer to Figure 7

To obtain a raising action, moving the control lever upward on the quadrant moves the control valve spool forward until pumped oil (charge pressure) is directed into the chamber behind the unload valve forcing it onto its seat and closing the passage to sump. Pump pressure now builds up (increases) until it exceeds the pressure inside the lift cylinder and forces the check valve off of its seat. This admits pumped oil into the lift cylinder passage and extends the cylinder.

If, at this point, the cylinder was for some reason prohibited from extending, the pumped oil pressure would then increase until it exceeded the system relief valve setting of 96.5-100kg/cm^2 (1375-1425 psi). The system relief valve would then open to relieve this excess pressure by allowing the oil to exit by way of the sump passage.

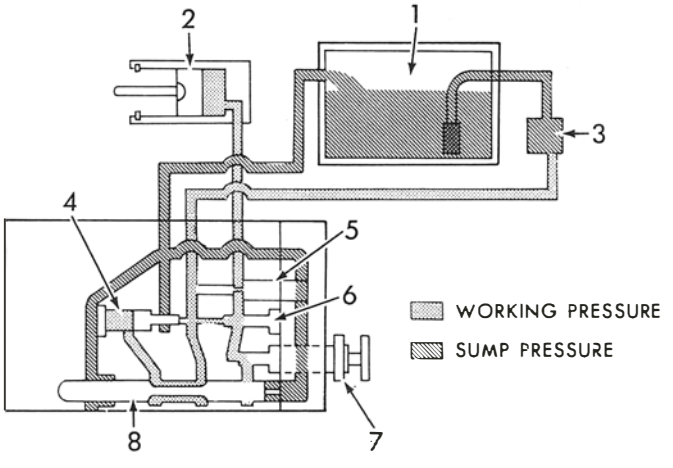


Figure 7
Hydraulic Oil Flow–Raising

1. Reservoir
2. Cylinder
3. Pump
4. Unload Valve
5. System Relief Valve
6. Check Valve
7. Flow Control Valve
8. Control Valve Spool

RESERVOIR AND INLET SCREEN

The hydraulic oil reservoir is a separate compartment located just behind the clutch bellhousing. The clutch shaft bore is located just forward of the reservoir bulkhead.

The inlet screen assembly is located to the left of the transmission input shaft, which passes through the reservoir, see Figure 8. The transmission input shaft is enclosed within a sleeve which is sealed to the bulkhead at each end by an O-ring. At the bottom of the reservoir is a drain plug and a clean out plate, Figure 8. The capacity of the hydraulic system is listed under "Specifications."

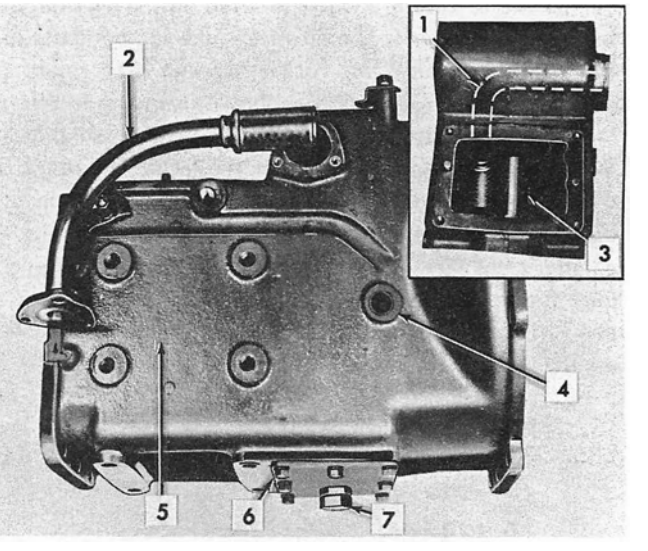


Figure 8
Inlet Screen and Reservoir

1. Inlet Screen Assembly
2. Inlet Screen Assembly
3. Transmission Input Shaft Sleeve
4. Clutch Shaft Bore
5. Hydraulic Oil Reservoir
6. Clean Out Plate
7. Drain Plug

2. ADJUSTMENTS AND PRESSURE TEST

POSITION CONTROL LINK ADJUSTMENT

The length of the position control link is critical. If it is too short, the control spool will be held forward in a raise position. In that case, the lift arms will fully raise without the spool returning to neutral. The system relief valve must then open to relieve the pressure build up. If the link is too long, full lift action cannot be attained. The pivot will be too far rearward to allow the actuating lever to push the spool forward when the lift arms are near maximum lift.

To properly adjust the length of the position control link:

1. Start the tractor engine.
2. Raise the lift control lever to the top of the quadrant.
3. When the lift arms raise to full lift, adjust the length of the position control link (illustrated in Figure 2), to the shortest length which will not cause the system relief valve to blow.

HYDRAULIC SYSTEM RELIEF VALVE— PRESSURE TEST

The hydraulic system of the Ford 1000 Tractor operates at a system pressure of 96.5-100 kg/cm^2 (1375-1425 psi). To check the system relief pressure, the lift arms must be chained down to obtain system relief pressure at the cylinder. To perform the pressure test:

1. Remove the test port plug from the cylinder head.
2. Install the adapter into the cylinder head, see Figure 9. Refer to Chapter 2, Section 3, "Special Tools," for correct fittings used in the pressure test.
3. Install the hose onto the adapter.
4. Install the pressure gauge onto the hose coupling.

   NOTE: The adapter NPD threads do not exactly match the British pipe threads of the test port. However, the amount of leakage that could result is very minimal and can be virtually eliminated by the application of a thread sealer. This installation will not damage the threads of the test port, and the plug will provide a leak free fit when reinstalled using a thread sealing compound.

5. With the test fittings installed, and the lift arms chained down, start the tractor engine and set the throttle to obtain an engine speed of 1,000 rpm. Raise the hydraulic lift control lever until the system relief valve blows. The gauge reading should stabilize at the specified system pressure. If the pressure does not meet that specified on page 98, add shims in the relief valve to increase pressure or remove shims from the relief valve to decrease pressure, to bring the reading to within specification.

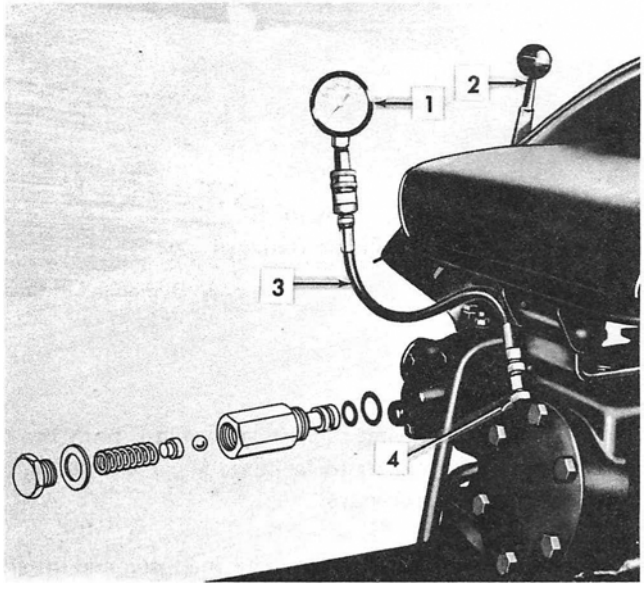


Figure 9
System Relief Pressure Test

1. Gauge
2. Lift Control Lever
3. Hose
4. Adapter

3. HYDRAULIC LIFT COVER OVERHAUL

A. Removal

1. Remove the seat assembly from the hydraulic lift cover.
2. Disconnect the hydraulic oil tubes from the hydraulic lift cover and control valve.
3. Remove the lift rods from the hydraulic lift arms.
4. Remove the retaining bolts and the hydraulic lift cover and gasket from the transmission case.

B. Disassembly

PISTON AND CYLINDER

1. Remove the retaining bolts and cylinder head cover from the hydraulic lift cover.
2. Push the piston out through the head end of the cylinder using a wooden handle, Figure 10.
3. If the sleeve must be replaced, it can be removed using a sleeve puller.

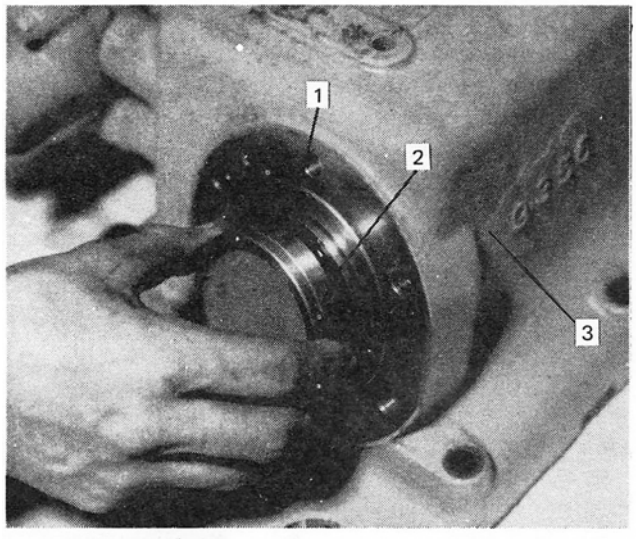


Figure 10
Piston Removal

1. Piston
2. O-ring
3. Hydraulic Lift Cover

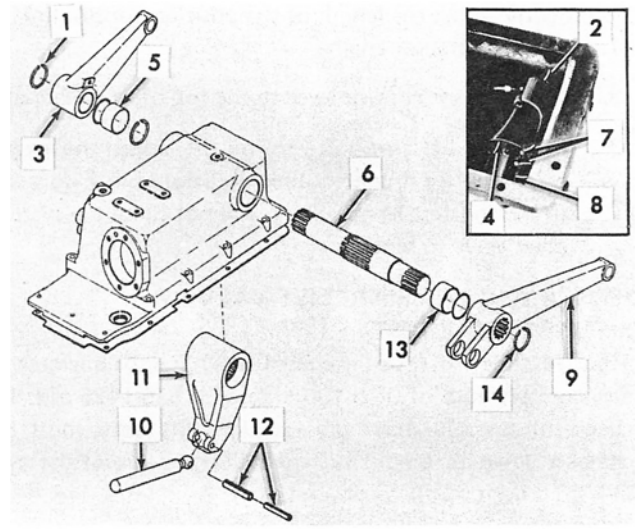


Figure 11
Lift Shaft Removal

1. Snap Ring
2. Ram Arm
3. Lift Arm
4. Snap Ring
5. Bushing
6. Lift Shaft
7. Alignment Marks
8. Lift Shaft
9. Lift Arm
10. Piston Rod
11. Ram Arm
12. Roll Pin
13. Bushing
14. Snap Ring

LIFT SHAFT

1. Prior to removing the lift arms, mark both the lift arms and lift shaft to facilitate alignment during the installation procedure.

2. Remove the lift arm retaining snap ring and lift arms from the lift shaft, refer to Figure 11.

3. Remove the ram arm snap ring.

   NOTE: The ram arm and lift shaft have alignment marks to assure proper alignment during installation.

4. Withdraw the lift shaft from the ram arm and hydraulic lift cover.

C. Inspection and Repair

PISTON AND CYLINDER

1. Check the piston and O-ring for wear or damage and replace if necessary, see Figure 12.

2. Check the lift cylinder sleeve for wear or damage and replace if necessary.

3. Check all O-rings for wear, cracks, or other damage and replace if necessary.

LIFT SHAFT

1. Check the lift shaft bushings and O-rings for wear or other damage and replace if necessary.

2. Check the splines on the lift shaft, lift arms, and ram arm for wear or damage. Minor nicks or burrs can be removed with an oil stone. If severe damage is evident, replace the damaged parts.

3. Check the piston rod and roll pins for wear or damage and replace if necessary.

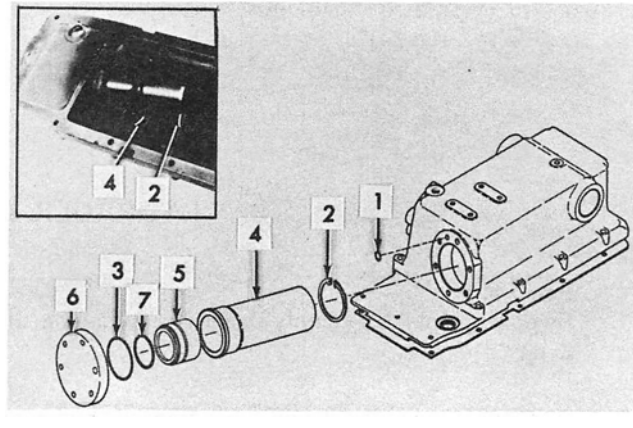


Figure 12
Exploded View of Piston and Cylinder Components

1. Cylinder Port O-ring
2. Piston Snap Ring
3. Sleeve O-ring
4. Cylinder Sleeve
5. Piston
6. Cylinder Head Cover
7. Piston O-ring

D. Assembly

PISTON AND CYLINDER

1. If the cylinder sleeve was removed, install the sleeve into the hydraulic lift cover and install the snap ring in the sleeve. Refer to Figure 12 during the assembly procedure.
2. Install the O-ring on the piston and insert the piston into the sleeve from the head end. Make sure that the concave side of the piston faces away from the head.
3. Install the O-ring on the head and install the head and retaining bolts. Tighten the bolts to the torque specified on page 98.

LIFT SHAFT

1. Insert the lift shaft through the hydraulic lift cover and through the ram arm, refer to Figure 11. Install the snap ring on the lift shaft to secure the ram arm in position.
2. Install the O-rings and lift arms onto the ends of the lift shaft and install the retaining snap rings.

NOTE: When reassembling these components, make sure that the ram arm aligns with the mark on the lift shaft, and the lift arms align with the marks on the lift shaft. Misalignment of these components may result in reduction of the range of lift, or the inability to fully lower the lift arms.

E. Installation

1. Position the gasket and hydraulic lift cover on the transmission case and install the retaining bolts. Tighten the bolts to the torque specified on page 98.
2. Install the lift rods onto the hydraulic lift arms.
3. Connect the hydraulic oil tubes to the hydraulic lift cover and control valve.
4. Install the seat assembly onto the hydraulic lift cover.
5. Start the engine, operate the hydraulic control valve and check for leaks.

4. HYDRAULIC PUMP

A. Removal

1. Disconnect the hydraulic oil tubes from the hydraulic pump.
2. Remove the retaining nuts and the hydraulic pump and drive gear from the engine front cover.

B. Disassembly and Inspection

The hydraulic pump is only serviced as an assembly. It is not practical to attempt to rebuild the pump because of the difficulty in obtaining proper gear and bearing clearances with the pump body. If the hydraulic pump is to be disassembled, the following procedure must be followed:

1. Remove the retaining nut and drive gear from the hydraulic pump shaft.
2. Remove the retaining bolts and cover from the pump body.
3. Remove the front seals, front bearings, drive shaft and gear, and the rear bearings and O-rings from the pump body, Figure 13.
4. Check the O-rings and seals for wear or damage and replace if necessary.
5. Check the bearings and pump drive shaft and gear for excessive wear or damage. Replace the complete pump if either conditions exist.

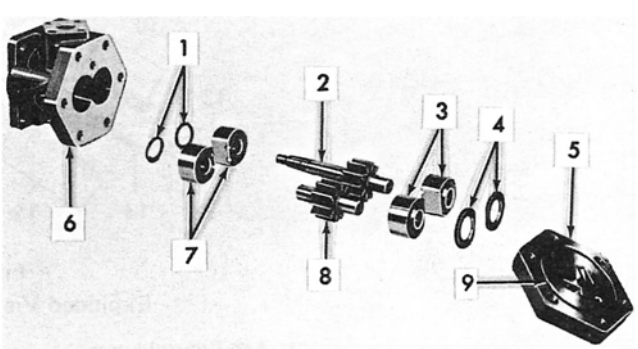


Figure 13
Exploded View of Hydraulic Pump

1. O-rings
2. Drive Shaft and Gear
3. Front Bearings
4. Front Seals
5. Pump Cover
6. Pump Body
7. Rear Bearings
8. Driven Gear
9. Cover O-ring

C. Assembly

Refer to Figure 13

1. Install a new O-ring in the hydraulic pump body.
2. Install the two O-rings, the rear bearings, the pump drive shaft and gear, the front bearings and front seals in the pump body.

   NOTE: Make sure that the bearings are reinstalled with the notches on the bearings facing the gears.
3. Insert a new O-ring in the hydraulic pump cover and install the cover and retaining bolts.
4. Install the pump drive gear and retaining nut.

D. Installation

1. Position the hydraulic oil pump and gasket on the engine front cover and install the retaining nuts.
2. Connect the hydraulic oil tubes to the pump.
3. Start the engine and check for leaks.

5. HYDRAULIC CONTROL VALVE

The component parts of the hydraulic system control valve are readily accessible. To gain access to a component, it is only necessary to remove the appropriate end cover. Refer to Figure 14 during any disassembly or assembly of the valve and its components. The control valve and bushing are serviced only as matched assemblies.

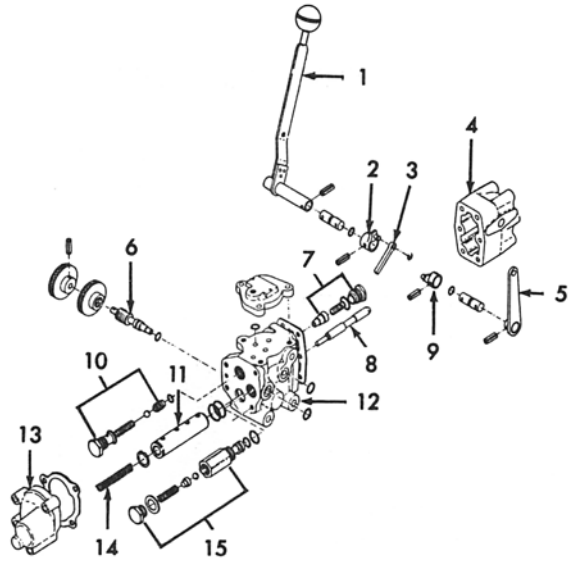


Figure 14
Exploded View of Control Valve

1. Lift Control Lever
2. Lift Control Cam
3. Actuating Lever
4. Rear Cover
5. Position Control Arm
6. Flow Control Valve
7. Unload Valve
8. Control Valve Spool
9. Position Control Cam
10. Check Valve
11. Control Valve Spool Bushing
12. Control Valve Body
13. Front Cover
14. Spool Return Spring
15. System Relief Valve

PART 6

HYDRAULICS

CHAPTER 2

TROUBLE SHOOTING, SPECIFICATIONS AND SPECIAL TOOLS

1. TROUBLE SHOOTING

Trouble	Possible Causes
Oil Pressure Drops	1. Damaged hydraulic piston O-ring. 2. Scratched or damaged cylinder sleeve. 3. Worn or damaged control valve spool.
Insufficient Oil Pressure	1. Faulty hydraulic pump. 2. Worn or damaged hydraulic piston O-ring. 3. Fatigued release spring. 4. Worn or damaged control valve spool. 5. Leaky hydraulic pipe fittings. 6. Scratched or damaged cylinder sleeve.
Oil Pressure Drops Erratically	1. Improperly adjusted flow rate valve. 2. Improperly adjusted draft control.

2. SPECIFICATIONS

Hydraulic Lift System

Type	Live Position Control Category I, 3-point linkage
Pump Type	Gear
Pump Capacity (per minute)	(15.9 Liters @ 100 kg/cm^2 at 2500 rpm) (3.5 Imp. Gal. @ 100 kg/cm^2 at 2500 rpm) (4.2 U.S. Gal. @ 1425 psi at 2500 rpm)
System Relief Valve Setting	100 kg/cm^2 (1425 psi)
Mechanical Draft Control	Optional
Hydraulic System Capacity	10 liters (8.75 Imp. Qts.) (10.5 U.S. Qts.)

Torque Specifications:

Cylinder Head Cover Bolts	5.5-7.0 kg-m (40-50 lbs. ft.)
Hydraulic Lift Cover Bolts	5.5-7.0 kg-m (40-50 lbs. ft.)

3. SPECIAL TOOLS

Hydraulic System Relief Pressure Test:

Adapter	3/8 - 24 MJIC Male x 7/16 - 20 MJIC Male
Hose	Female Coupler x 7/16 - 20 MJIC Female Swivel
Gauge	0-352 kg/cm^2 (0 - 5,000 psi)

PART 7

STEERING AND FRONT AXLE

CHAPTER 1

STEERING GEAR ASSEMBLY

1. DESCRIPTION AND OPERATION

The Ford 1000 is available with manual steering only. The steering gear assembly is mounted on the clutch case over the hydraulic reservoir. The steering gear is connected to the front wheels by a single steering arm and drag link which is connected to the spindle arm on the left-hand front spindle. The left-hand and right-hand spindle arms are linked by an adjustable connecting rod assembly.

Steering Gear Assembly

The steering gear assembly is of the re-circulating ball-nut type with the steering shaft, worm shaft and worm nut all in line. The gear teeth on the worm nut engage the gear sector teeth on the sector shaft which extends from the left-hand side of the steering gear housing. The steering shaft is enclosed in a tube clamped to the steering shaft housing which is bolted to the steering gear housing, see Figure 1. The steering housing cover supports the sector end of the sector shaft and contains the gear lash adjuster and adjuster locknut.

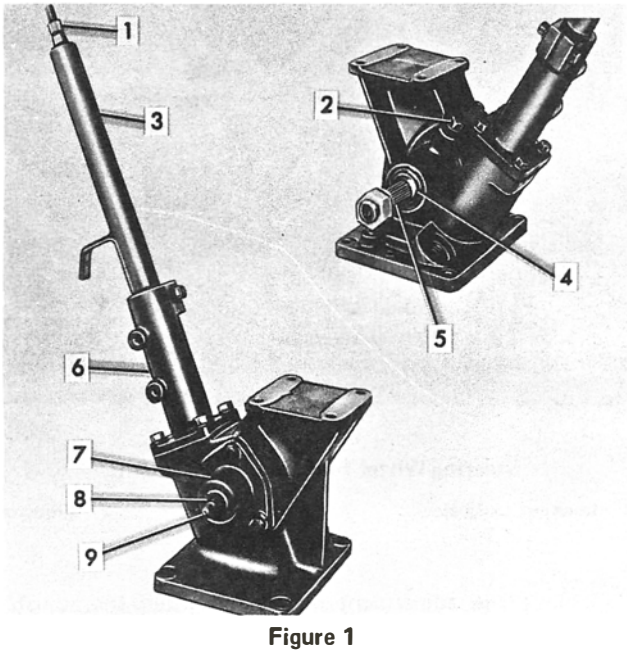


Figure 1
Steering Gear Assembly

1. Shaft
2. Filler Plug
3. Tube
4. Seal
5. Sector Shaft
6. Shaft Housing
7. Cover
8. Locknut (Adjuster)
9. Adjuster

Steering Gear Shaft and Housing

The steering shaft, worm nut, and the recirculating balls and guides, Figure 2, are serviced only as an assembly. The two lower ball bearing assemblies, one at each end of the shaft worm, absorb the lateral thrust loads imposed by the action

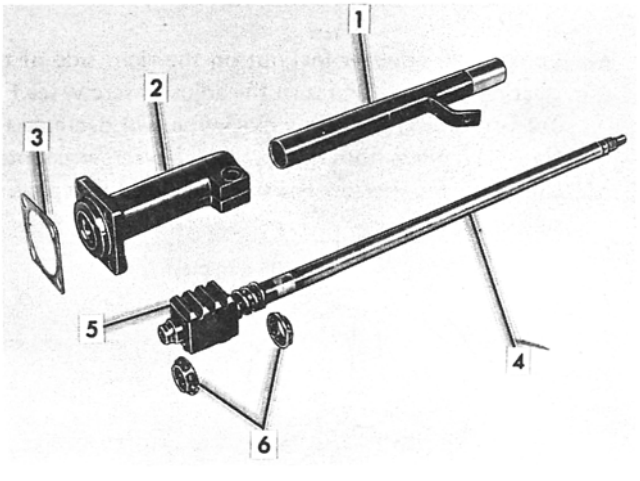


Figure 2
Steering Gear Shaft and Housing

1. Tube
2. Housing
3. Shim
4. Shaft
5. Nut Assembly
6. Bearings

of the sector gear and the worm nut and, together with a needle bearing in the upper end of the tube, also maintain alignment of the shaft and nut. The tube seats on a ridge in the upper portion of the shaft housing and is clamped in position. The shims are used between the shaft housing and steering gear housing to obtain the correct shaft thrust bearing pre-load.

Steering Gear Housing and Sector

The steering gear housing and the cover assembly support the sector shaft, see Figure 3. The shaft oil seal is located against the bushing in the housing. The plate fits under the head of the gear lash adjuster and together they fit into a slot on the end of the sector shaft.

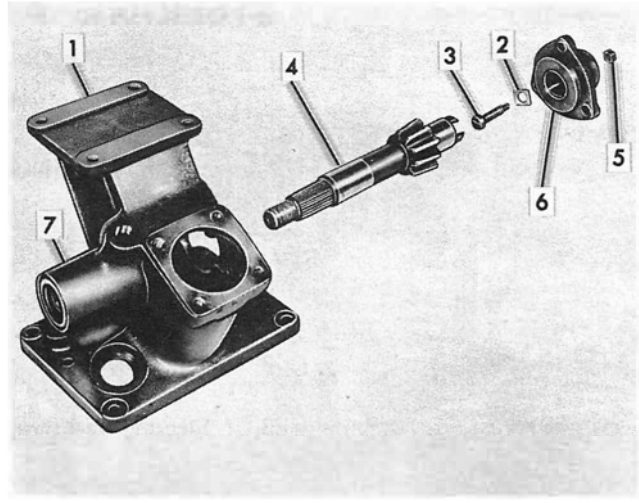


Figure 3
Steering Gear Housing and Sector

1. Housing
2. Plate
3. Adjuster
4. Sector
5. Locknut
6. Cover Assembly
7. Seal

2. ADJUSTMENTS

Steering Wheel Play

Steering wheel play in the direction of rotation should be between 20-35 mm (.78 - 1.38 in.) as shown in Figure 4. If the play exceeds the specified limit, page107, then adjustment is necessary.

1. Make sure that all link bolts are tightened properly. If severe wear is apparent, install new parts.

2. Loosen the adjuster locknut on the right side of the steering gear box and turn the adjuster screw, see Figure 5. Turning the screw clockwise will decrease the free play while turning the adjuster screw counterclockwise will increase the steering wheel free play.

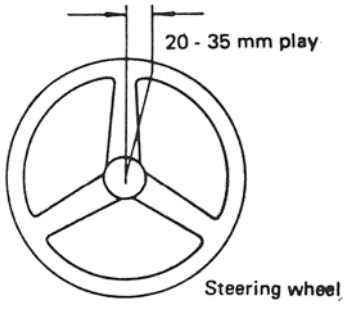


Figure 4
Steering Wheel Free Play

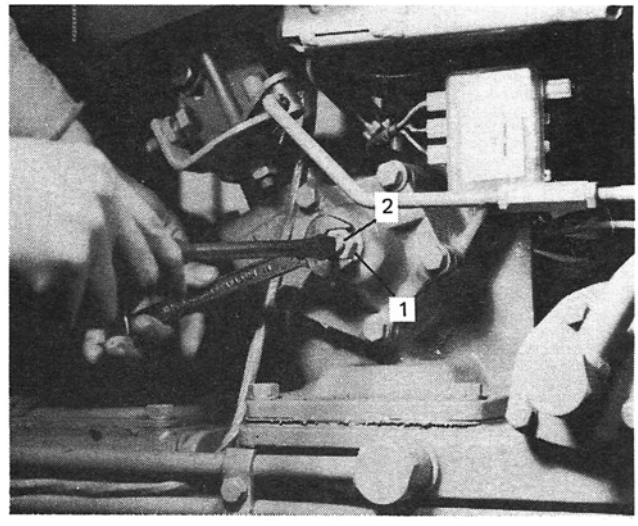


Figure 5
Steering Wheel Free Play Adjustment

1. Locknut (Adjuster)
2. Adjuster

3. Once the adjustment is made, tighten the adjuster locknut securely.

Thrust Play

1. Tighten the steering shaft housing bolts if loose.

2. If re-tightening the steering shaft housing bolts is not effective, then remove the four bolts and the steering shaft housing.

3. Add or remove shims from between the shaft housing and the steering gear housing until the thrust bearing preload meets the specified limit on page 107. The preload is measured with a pull scale and rope on the steering shaft with the sector shaft removed, see Figure 6.

Steering Wheel Rotation

If the steering wheel is difficult to turn, the trouble may be in the linkage, kingpins, or steering gear box.

To adjust:

1. Grease all linkage and kingpin bushings.
2. If steering is still difficult then increase the backlash of the steering gear box as outlined in this section under "Steering Wheel Play," page 100.

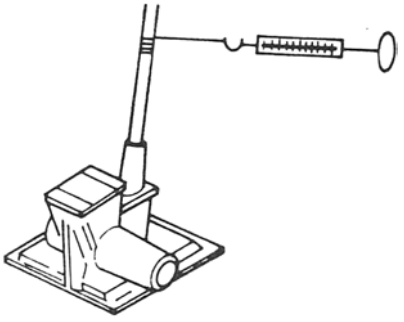


Figure 6
Measuring Steering Shaft Preload

3. STEERING GEAR OVERHAUL

A. Removal

1. Remove the nut, washer, and pitman arm from the steering gear sector shaft.
2. Remove the steering wheel cap, retainer, washer, and spacer from the steering shaft and remove the steering wheel.
3. Remove the instrument panel.
4. Remove the four retaining bolts and remove the steering gear assembly from the clutch case.

B. Disassembly and Inspection

1. Remove the sector shaft cover and adjuster screw assembly and pull out the sector shaft, refer to Figure 7.
2. Remove the four retaining bolts and remove the steering shaft housing and shims. Pull the steering shaft out of the housing.
3. Inspect the steering shaft and sector shaft for broken or severely worn teeth. Replace those parts which are severely damaged.
4. Replace any bushings or oil seals that are worn or damaged.

C. Assembly

1. When a new steering shaft or bearing is installed the number of shims must be changed to obtain the proper shaft thrust bearing pre-load. To adjust the preload, follow the procedure as outlined in Section 2 under "Thrust Play," page 100.
2. Install the sector shaft. Refer to Figure 7.
3. Install the adjuster screw assembly and the sector shaft cover and secure with the four retaining bolts.
4. Adjust the steering wheel play as outlined in Section 2 under "Steering Wheel Play," page 100.
5. Fill the steering gear box with the lubricant specified on page 107.

D. Installation

1. Position the steering gear assembly on the clutch case and secure with the retaining bolts.
2. Install the instrument panel.
3. Position the steering wheel on the shaft and secure it with the spacer, washer, retainer, and cap.
4. Install the pitman arm, washer, and nut onto the sector shaft.

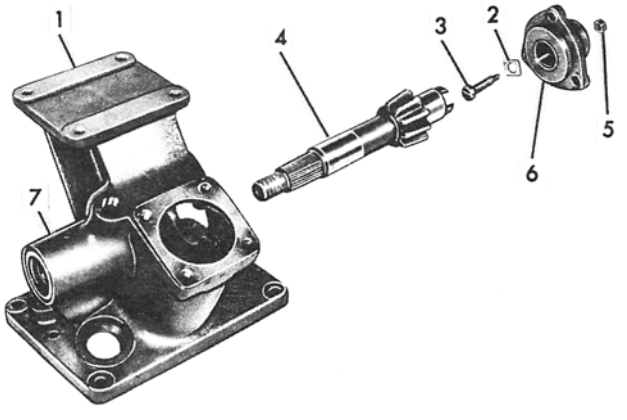


Figure 7
Steering Gear Housing and Sector

1. Housing
2. Plate
3. Adjuster
4. Sector
5. Locknut (Adjuster)
6. Cover Assembly
7. Seal

PART 7

STEERING AND FRONT AXLE

CHAPTER 2

FRONT AXLE AND RELATED PARTS

1. DESCRIPTION AND OPERATION

The front axle support bolts to the side of the engine block. There are two cross members in the middle of the axle support which support the axle pivot pin, and a front cross member that supports the front mounted weights.

The three piece adjustable axle pivots on a long pivot shaft which is supported between the two crossmembers of the front axle support. The large gussets between the center axle and the pivot shaft hub eliminate the need for radius rods. The front axle is adjustable from 109.3 - 153.4 cm (43.3 - 60.4 in.) in 15.2 cm (5.98 in.) increments.

O-rings at the top and bottom of the spindle housings on the outer axle seal out contaminants. Replaceable spindle bushings are installed in the housings. The spindle bearing is a ball thrust type.

The front wheel hub and bearings are of a conventional design. A double lip oil seal, which is located on the inside of the hub, and a bolted on hub cap and gasket provide the seal for the wheel bearings.

The drag link is adjustable for straight-ahead alignment of the steering gear and front wheels when changing tread width. The spindle arm connecting rod is adjustable for both toe-in and changing tread width.

The front wheel hub is supported on the wheel spindle by two opposed roller bearings. A castle nut is used on the end of the spindle to retain the hub and bearing assembly. This nut also provides an adjustment for bearing preload.

2. ADJUSTMENTS

Front Wheel Tread Settings

The front wheel tread setting is adjustable from 109.3-153.4 cm (43.3 - 60.4 in.) in approximately 15.2 cm (5.98 in.) increments by a combination of re-positioning the front axle and reversing the front wheels. See Figure 8. To re-position the front axle:

1. Raise the front of the tractor with a suitable jack sufficiently to enable the front wheels to move freely.
2. Remove the bolt from the connecting rod clamp.
3. Remove the positioning bolts, Figure 8, and move the axle sections in or out until the desired setting is obtained, then reinstall the positioning bolts.
4. Position the front wheels in the straight ahead position by adjusting the drag link, then reinstall the connecting rod clamp bolt.
5. Tighten all nuts securely.
6. Lower the tractor and remove the jack.
7. Check the toe-in as outlined in this section under, "Front Wheel Toe-In," below.

Front Wheel Toe-In

1. With the front wheels in the straight ahead position, mark the front of the wheels (not the tires) at wheel

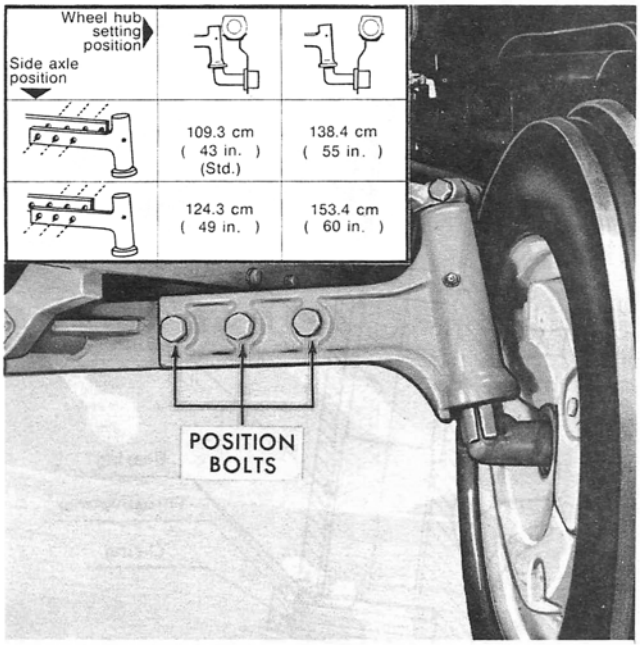


Figure 8
Front Wheel Tread Settings

hub height. Determine the straight ahead position by turning the wheel from lock to lock and then halfway back.

2. Measure and record the distance between the front of the wheels at the marks, then push the tractor forward or backward until the marks are at wheel hub height on the rear of the wheel.

3. Measure and record the distance between the rear of the wheels at the marks.

4. The difference between the dimensions recorded in the Steps 2 and 3 should give 0 - 12.7 mm (0 - .50 in.) toe-in. The distance between the wheels should be 0 - 12.7 mm (0 - .50 in.) greater when the marks are at the rear rather than at the front.

5. If the toe-in is not correct, adjust as outlined in the following procedure.

Adjusting the Toe-In

1. Loosen the connecting rod clamp bolt.

2. Adjust the connecting rod tube assembly as required to give 0 - 12.7 mm (zero - .50 in.) toe-in.

3. After the correct toe-in is obtained, install and tighten the connecting rod clamp bolt. Also tighten any loose connecting rod end assembly attaching bolts.

Pivot Shaft Radial and Thrust Play

Wear on the pivot shaft bushings or thrust washers will cause excessive radial and thrust play in the pivot shaft assembly.

To check radial play:

1. Measure the distance of radial play between the thrust washer and front axle support.

2. If the distance exceeds the specified limit on page 107, then replace the thrust washer and/or pivot shaft bearing.

To check thrust play:

1. Remove the pivot shaft cover and measure the play between the pivot shaft and bushing.

2. If the play exceeds the specified limit on page 107, then replace the pivot shaft and/or bushing.

3. FRONT WHEEL AND AXLE OVERHAUL

A. Disassembly

1. Remove the hood panel and wiring as outlined in Part 1 under "Engine – Removal."

2. Drain the cooling system and remove the radiator as outlined in Part 1, Chapter 2 under "Radiator – Removal."

3. Place a suitable jack under the clutch housing and raise the front of the tractor.

4. Remove the six retaining bolts from each wheel and remove the wheel and tire assembly.

5. Remove the retaining nut and drag link from the pitman arm.

6. Remove the six retaining bolts on each side of the cylinder block and remove the front axle support from the block.

7. Remove the set bolt and pivot shaft cover and pull out the pivot shaft.

8. Remove the retaining nuts and bolts from the spindle arms and remove the spindle arms from the spindles.

9. Remove the key and shims from the spindle.

10. Extract the spindle and thrust bearing and washer from the axle extension.

11. Remove the retaining bolts, cap, and gasket from the front hub.

12. Remove the cotter pin locating the castellated nut retaining the wheel hub.

13. Remove the nut and thrust washer, the outer bearing, and then the wheel hub.

14. Remove the snap ring, thrust washer, grease retainer, and the inner bearing from the rear of the wheel hub.

B. Inspection and Repair
Refer to Figures 9 and 10.

1. Clean components with a suitable solvent and air dry. Clean the machined surfaces and lightly lubricate.

2. Inspect the roller bearing cones, rollers, and cups for signs of excessive wear or damage. Renew if necessary.

3. Inspect the spindle bushings in the axle extension housings for wear or scoring. If necessary to renew, remove the axle extension from the center axle by removing the retaining bolts and their associated nuts and lockwashers. Remove the bushings making sure that the bores are not damaged, and install new bushings in the bores.

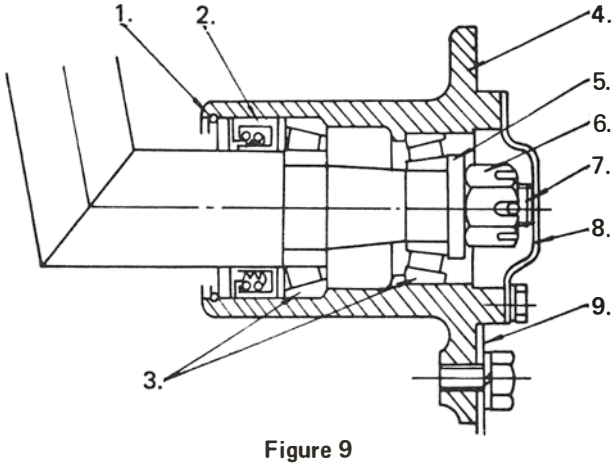


Figure 9
Front Wheel Hub Assembly

1. Snap Ring
2. Oil Seal
3. Bearing
4. Front Wheel Hub
5. Spacer
6. Castle Nut
7. Split Pin
4. Wheel Cap
9. Front Wheel

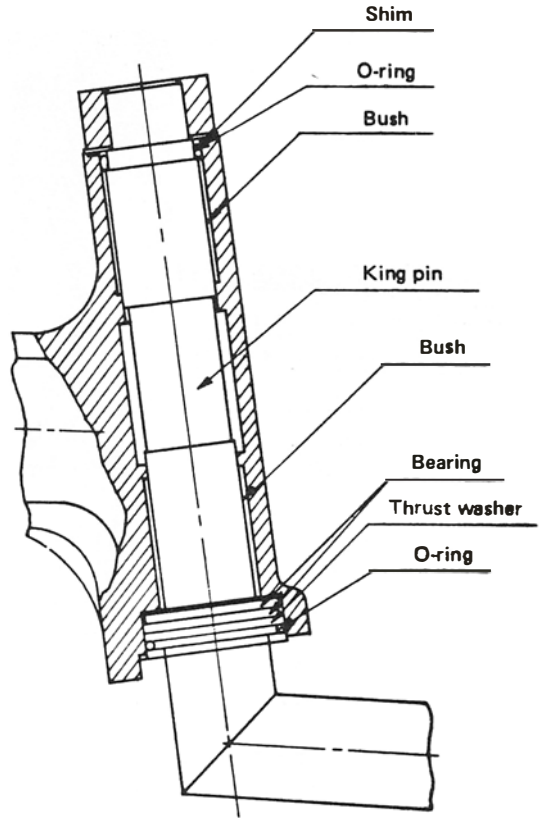


Figure 10
Spindle Arm Assembly

4. Inspect the spindle thrust bearing for correct operation and replace if necessary.

5. Inspect the wheel spindle bearing surfaces for scoring or excessive wear. If severe damage is apparent, then replace the spindle.

6. Inspect the pivot shaft bushings for wear or scoring. Replace if necessary.

7. Inspect the pivot shaft for extensive wear or damage. Replace the shaft if necessary. Refer to "Adjustments," Section 2 to determine correct "Radial Play" and "Thrust Play," page 103.

8. Inspect all O-rings, prior to assembly, to make sure that they are not cracked, cut, or excessively worn. Replace if necessary.

C. Assembly and Installation
Refer to Figures 9 and 10

1. Pack the cone and roller assembly with clean, short-fiber grease. Pack approximately 6.35 mm (.25 in.) of grease in the space between the bearing cups in the hub, but do not pack the hub completely. Apply a film of grease on the surface of the spindle.

2. Install the inner bearing, the grease retainer, thrust washer, and snap ring in the rear of the wheel hub.

3. Place the wheel hub on the spindle and install the outer bearing, the thrust washer, and castellated nut.

4. Tighten the nut, at the same time turning the wheel, until a slight drag is felt.

5. Back off the nut until the nearest slot in the nut lines up with the hole in the spindle. Install a new cotter pin.

6. Install the front hub gasket and cap and secure with the retaining bolts.

7. Pack the wheel spindle thrust bearing and install the thrust washer and bearing on the spindle.

8. Install the wheel spindle into the axle section housing making sure that it rotates freely.

9. Install a new spindle shaft O-ring and install the spacer and shims over the spindle.

10. Install the key and spindle arms over the spindles and secure in place with the bolts and nuts.

11. Install the pivot shaft through the front axle shaft and front axle support. Install the set bolt and pivot shaft cover and retaining bolts.

12. Position the front axle support over the cylinder block and secure in place with the six retaining bolts on each side.

13. Install the drag link and nut on the pitman arm.

14. Install the wheel and tire assembly using the six retaining bolts on each side.

15. Lower the tractor and remove the jack.

16. Install the radiator as outlined in Part 1, Chapter 2, under "Radiator – Installation."

17. Fill the cooling system.

18. Install the hood panel and wiring harness as outlined in Part 1, Chapter 1 under "Engine – Installation."

19. Check the toe-in as outlined in Section 2, "Adjustments" under "Front Wheel Toe-In," page 102.

PART 7

STEERING AND FRONT AXLE

CHAPTER 3

TROUBLE SHOOTING AND SPECIFICATIONS

1. TROUBLE SHOOTING

Trouble	Possible Cause
Loose Spindle	1. Worn or damaged bushings. 2. Improperly tightened spindle arm. 3. Worn or damaged thrust bearing. 4. Worn or damaged spindle shaft. 5. Improperly shimmed spindle shaft.
Hard Steering	1. Worn or damaged bushings in axle assembly end. 2. Seized spindle shaft. 3. Improperly lubricated steering linkages. 4. Worn or damaged thrust bearings. 5. Improper backlash in steering gear box. 6. Improperly tightened or worn tie rod end assembly.
Front Wheel Shimmy	1. Worn spindle shaft and/or bushings. 2. Worn pivot shaft and/or bushings. 3. Loose castle nut in the front wheel hub. 4. Loose connecting rod assembly. 5. Worn or damaged thrust bearings and/or washers. 6. Loose or worn tie rod assembly. 7. Loose spindle arm.

2. SPECIFICATIONS

STEERING

Type	Manual
Turns Lock-to-Lock	2.3
Turning Radius (Without Brakes)	272.5 cm (9.0 ft.)
Steering Wheel Play Limit	50 mm (1.97 in.)
Thrust Bearing Preload	1-3 kg/cm (.072-.21 lbs. ft.)
Lubricant	Gear oil SAE 90
Recommended Viscosity Grade	Under 0° C (32° F.) SAE 80
	0° C.-30° C. (32° F.-86° F.) SAE 90
	Over 30° C. (86° F.) SAE 90 or 140

FRONT AXLE

Pivot Shaft Radial Play	.1-.2 mm (.0040-.0080 in.)
Allowable Wear Limit	1 mm (.040 in.)
Pivot Shaft Thrust Play	.025-.084 mm (.0010-.0034 in.)
Allowable Wear Limit	.15 mm (.006 in.)
Front Wheel Toe-In	0-12.7 mm (0-.5 in.)

PART 8

WHEELS AND TIRES

CHAPTER 1

REAR WHEEL TRACK ADJUSTMENT AND WEIGHTING PROCEDURES

1. REAR WHEEL TREAD SETTINGS

The rear wheels on the Ford 1000 are adjustable from 1,216 mm to 1,490 mm (47.8 - 58.6 in.). Tread width settings are made by changing the position of the rim with respect to the wheel disc; by changing the position of the wheel disc with respect to the axle; and by inter-changing the rear rims. These various positions are shown in Figure 1.

After changing the rear wheel tread setting, the wheel rim-to-disc nuts, and the disc-to axle nuts should be tightened to the specified torque listed on page 112.

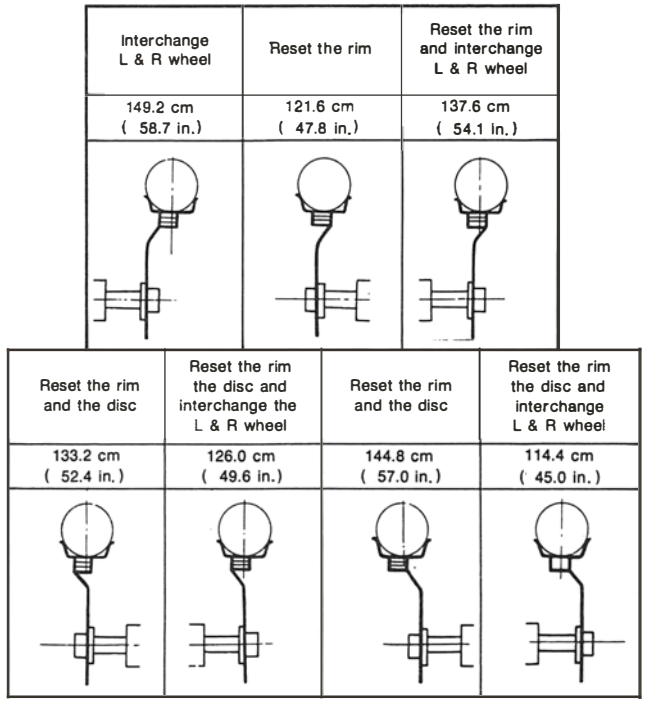


Figure 1

Rear Wheel Tread Settings

2. TRACTOR WEIGHTING

To obtain sufficient traction for maximum performance in heavy draft operations and to counter-balance rear mounted equipment, weight should be added to the tractor in the form of liquid ballast, cast iron weights as shown in Figures 2 through 4, or a combination of both.

FRONT END WEIGHTS

Cast iron weights may be attached to the front of the front axle support. The maximum number of weights that may be attached to the front axle support is three. Each weighs approximately 14 kg (30.8 lbs.), giving a maximum front end weight of 42 kg (92.5 lbs.).

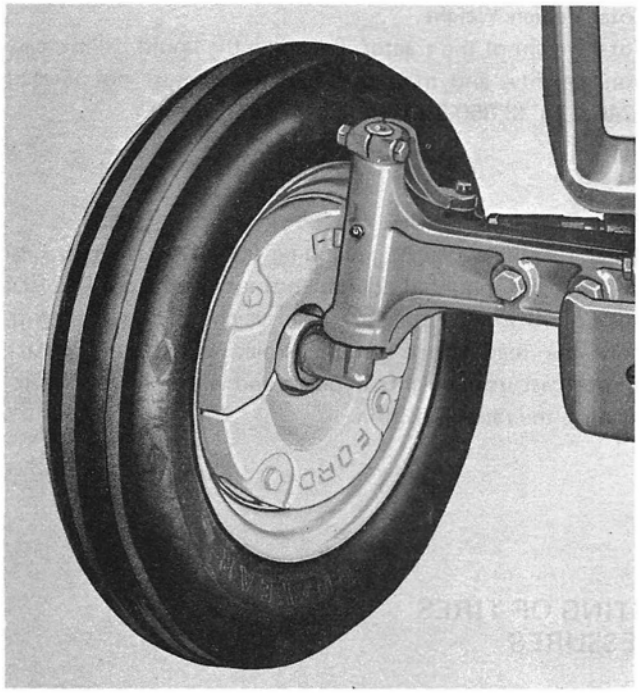


Figure 2

Front Wheel Weights

To install the weights:

1. Position the front ends weights over the front bracket on the front axle support.

2. Insert the spacer and secure the weight to the front bracket with the bolt, washer, lockwasher, and nut.

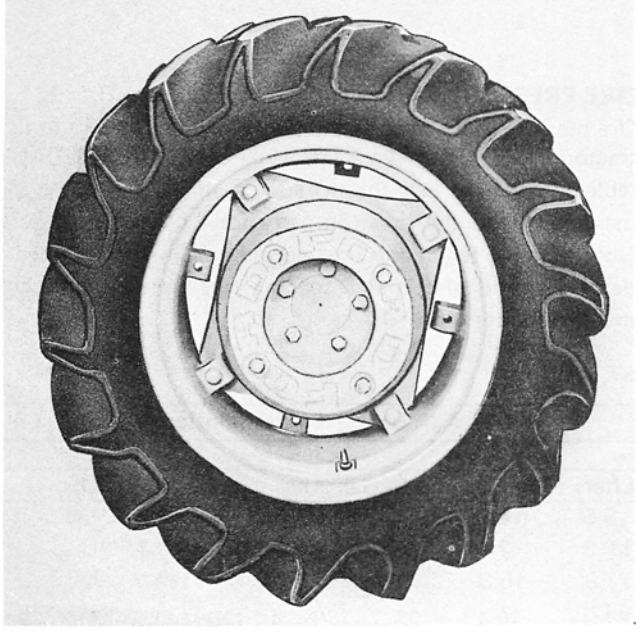


Figure 3

Rear Wheel Weights

FRONT AND REAR WHEEL WEIGHTS

Front Wheel Weights

Holes are provided in the front wheel disc to enable front wheel weights to be attached to the wheel. Each weight has an approximate weight of 15 kg (33 lbs.) and a quantity of two weights are fitted to each wheel.

To install the weights:

1. Position one of the weights on the inside (concave) surface of the wheel disc and secure in place with the retaining bolts.

2. Follow the same procedure as above for the other weights. Tighten the nuts to the specified torque, page 112.

Rear Wheel Weights

Holes are provided in the rear wheel discs to enable rear wheel weights to be attached to the wheels. Each weight has an approximate weight of 25 kg (55 lbs.) and a quantity of two weights for each wheel.

NOTE: Four weights can be installed on models after the Serial No. 201.

To install the weights:

1. Install the four studs in the wheel disc using a nut on the outside of the wheel disc and a lockwasher and nut on the inside of the wheel disc.

   NOTE: The distance from the outer edge of the stud to the outer surface of the wheel disc should be 128.5-131.5 mm (5.05-5.17 in.).

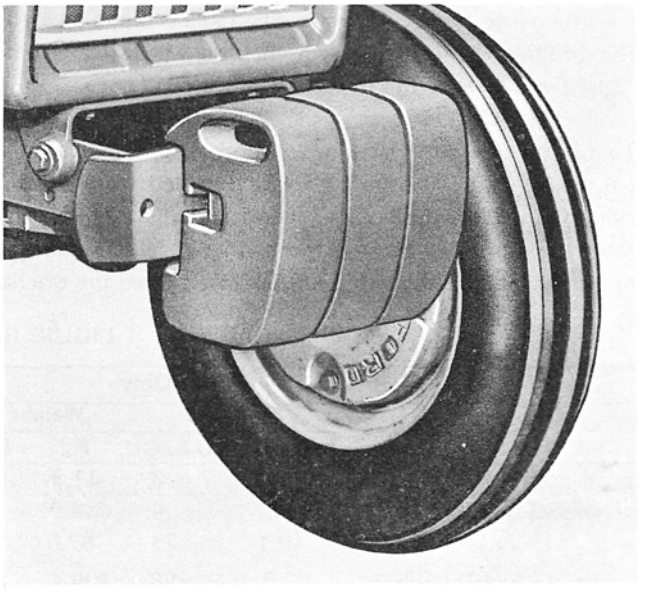


Figure 4

Front End Weights

2. Place the wheel weights over the studs and secure with the lockwasher and nut. When more than two weights are being mounted on each wheel, use the adapter studs to hold the 2nd and 3rd weight in position and the nut for the 4th weight. Tighten the nuts to the torque specified on page 112.

WEIGHTING LIMITATIONS

The weighting limitations that follow are limitations only. They do not imply that the tractor should be weighted to obtain the weights shown. Use only enough weight to obtain good performance, and do not exceed the tire load capacities. Do not add weight to the outer wheels of duals.

Total Vehicle Weight

Total weight of the tractor, including the liquid ballast, cast iron weights, and mounted equipment must not exceed 1746.4 kg. (3,850 lbs.).

Total Rear Axle Weight

Total rear axle weight, including liquid ballast, cast iron weights, and mounted equipment must not exceed 1246.4 kg. (2,748 lbs.). Total rear axle weight is measured with only the rear wheels on the scales, with liquid ballast, and/or cast iron weights in place, and with mounted equipment in the raised position.

3. LIQUID BALLASTING OF TIRES AND TIRE PRESSURES

LIQUID BALLAST

Water may be used as an inexpensive, but effective weight for the tractor front and rear wheels. In territories where the ambient temperature may fall to or below the freezing point of water, Calcium Chloride ($CaCl_2$) should be added to the water as a protection against freezing.

NOTE: NEVER add water to Calcium Chloride. Slowly add the Calcium Chloride flakes to the water and stir until dissolved. Allow the solution to cool before filling the tire.

The following table lists the tire sizes available, along with weighting information for each. The table is based on a 75% fill (tire filled to the valve stem when the valve stem is at its highest point at the top of the wheel.

To fill the tire with water or solution, a special adaptor is required that allows the air to be expelled from the tire while filling with the liquid. When filling the tire, the valve should be positioned at the top of the wheel, and the tractor weight supported with a suitable jack. When the tire has been filled with the maximum capacity of liquid, surplus is ejected through the air outlet in the adaptor.

After disconnecting the liquid supply, the adaptor is removed and the tire valve is installed. The tire pressure is then adjusted in the normal manner.

NOTE: Plain water freezes at 0° C (32° F). The 2.27 kg. (5 lb.) Calcium Chloride solution remains slush-free to -46.5° C. (-52° F.), and will freeze solid at -52° C. (-62° F).

TIRE PRESSURE

Tire pressure must be considered when adding weight to the tractor. The "TIRE INFLATION vs. PERMISSIBLE LOAD" table on page 111 lists the tire sizes available and shows the maximum load the tires can carry for a given air pressure. Note that the load capacities decrease as inflation pressure decreases, and also that a specific tire pressure is recommended for certain tire sizes.

LIQUID BALLAST TABLE

	Water Only					2.27 Kg. (5 lbs.) $CaCl_2$ Solution						
	Volume			Weight		Volume			$CaCl_2$		Weight	
Tire Size	Liters	Imp. Gal.	U.S. Gal.	Kg.	Lbs.	Liters	Imp. Gal.	U.S. Gal.	Kg.	Lbs.	Kg.	Lbs.
5.00x15	11.3	2.4	3	11.3	25	9.5	2.0	2.5	5.6	12.5	14.9	33
20x8.00-10	15.1	3.3	4	14.9	33	11.3	2.4	3	6.8	15	18.1	
11.2x24	87.0	19.1	23	87.0	192	71.9	15.8	19	43.0	95	114.7	253
13.6x16	105.9	23.3	28	106.1	234	87.0	19.1	23	54.4	120	141.5	312

NOTE: The above figures are for individual tires only. For combined front axle and/or rear axle weight, multiply the figures by 2.

TIRE INFLATION vs. PERMISSIBLE LOAD
METRIC MEASURES

Inflation Pressure (kg/cm^2)									
Front Tire Size	.55	.70	.85	1.40	1.70	1.95	2.25	2.50	2.80
	Maximum Permissible Load (Kg)								
5.00x15	–	–	–	245	272	300	322	345	367
20x8.00-10	205	230	258	–	–	–	–	–	–
Inflation Pressure (kg/cm^2)									
Rear Tire Size	.85	1.00	1.10	1.25	1.40	–	–	–	–
	Maximum Permissible Load (Kg)								
11.2x24	667	730	790	843	–	–	–	–	–
13.6x16	730	798	860	925	980	–	–	–	–

NOTE: Do not exceed the maximum load listed. Also, do not under-inflate or over-inflate the tires.

TIRE INFLATION vs. PERMISSIBLE LOAD
U.S. MEASURES

Inflation Pressures (psi)									
Front Tire Size	8	10	12	20	24	28	32	36	40
	Maximum Permissible Load (Lbs.)								
5.00x15	–	–	–	540	600	660	710	760	810
20x8.00-10	450	510	570	–	–	–	–	–	–
Inflation Pressures (psi)									
Rear Tire Size	12	14	16	18	20	–	–	–	–
	Maximum Permissible Load (Lbs.)								
11.2x24	1470	1610	1740	1860	–	–	–	–	––
13.6x16	1610	1760	1900	2040	2160	–	–	–	

NOTE: Do not exceed the maximum load listed. Also, do not under-inflate or over-inflate the tires.

4. SPECIFICATIONS

TIRES

Front:

Standard	5.00x15
Optional	20x8.00-10
Standard Tire Pressure	2.0 kg/cm^2 (28 psi)

Rear:

Standard	11.2x24
Optional	13.6 x16R3
Standard Tire Pressure	1.0 kg/cm^2 (14 psi)

Wheel Bolt Torques

Front Wheel Disc-to-Hub	5.5-6.2 kgm (40-45 lbs. ft.)
Rear Wheel Disc-to-Rim	25-30 kgm (180-217 lbs. ft.)
Rear Wheel Disc-to-Axle	17-19 kgm (123-137 lbs. ft.)

Cast Iron Weights

Front End Weights (3)	14 kg. (30.8 lbs.) each
Front Wheel Weights (4)	15 kg. (33 lbs.) each
Rear Wheel Weights (4)	25 kg. (55 lbs.) each

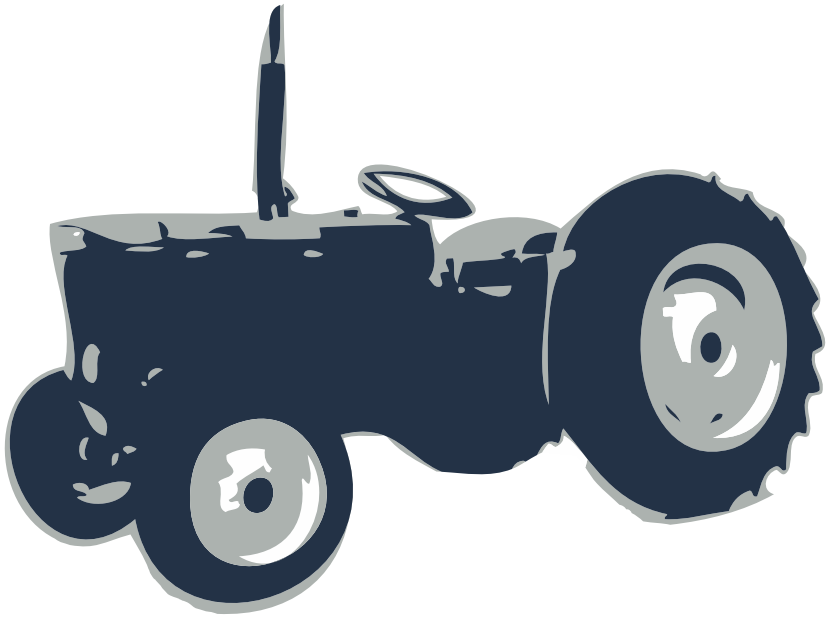
(Only 2 rear wheel weights can be installed on Models up to Serial Number 201.)

Weight Limitations

Total Vehicle Weight	1746.4 kg. (3850 lbs.)
Total Rear Axle Weight	1246.4 kg. (2748 lbs.)

Torque Specifications (Not listed above)

Front Wheel Weight-to-Disc Bolts	5-6 kgm (36-43 lbs. ft.)
Rear Wheel Weight-to-Disc Bolts	10-12 kgm (72-87 lbs. ft.)
Front Weight Bolts	5-6 kgm (36-43 lbs. ft.)



Ford Tractor Operations
Ford Motor Company

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