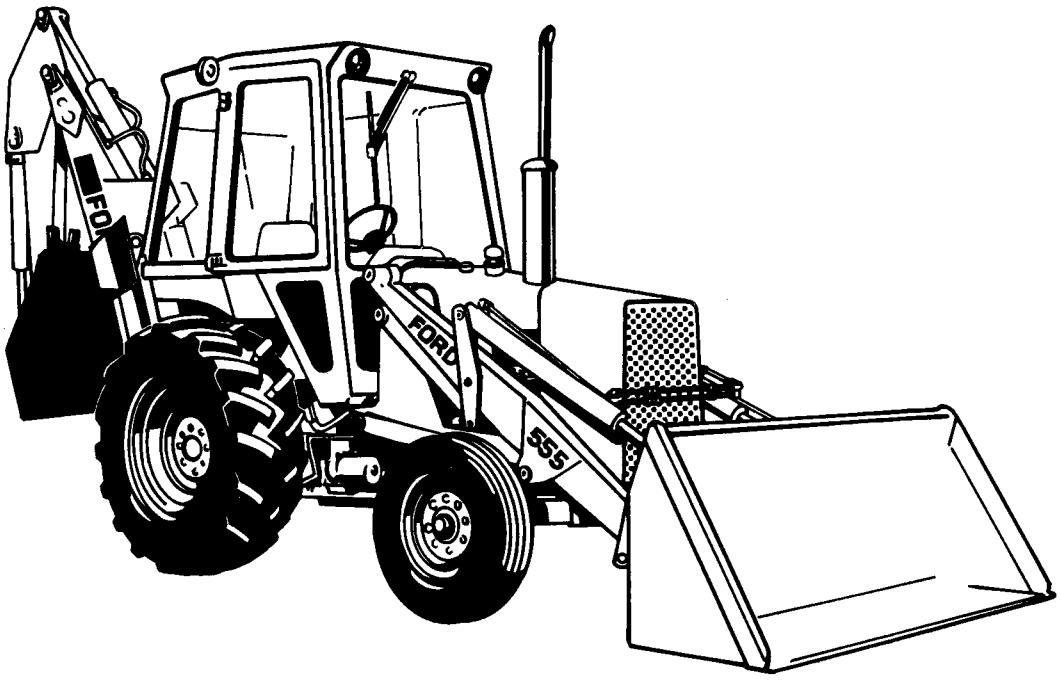
FORD

Service Manual

NEW HOLLAND

Tractor-Loader-Backhoe
550, 555

Vol. 1



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Reprinted

FOREWORD

This repair manual provides information for the proper servicing and overhaul of the Ford Models 550 and 555 Tractor-Loader-Backhoe and is an essential publication for all service personnel carrying out repairs and maintenance procedures.

The model 550 designates units produced in 1975 through 3/78. Model 555 designates units produced in 4/78 and later. Special service instructions are identified by tractor model number or applicable production dates throughout the text.

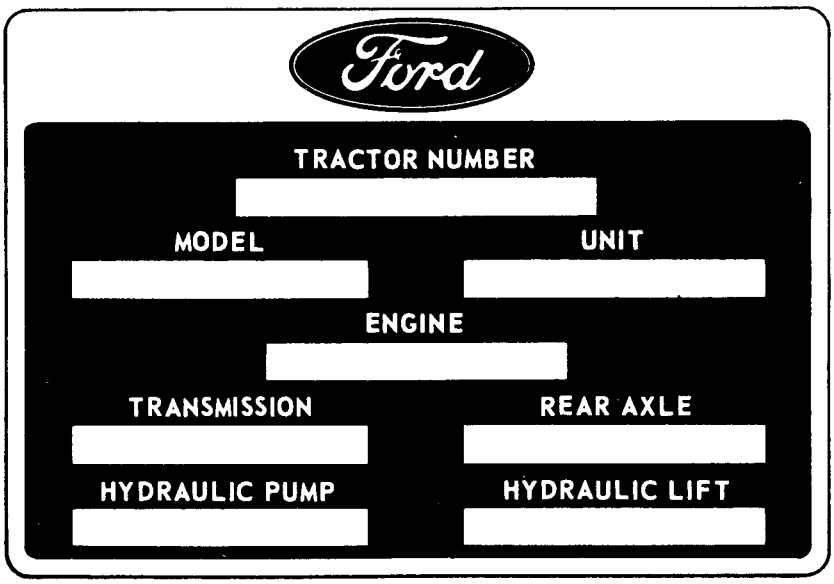
The Manual is divided into eleven PARTS each sub-divided into Chapters. Each Chapter contains information on general operating principles, detailed inspection and overhaul and, where applicable, trouble shooting, special tools and specifications.

The material contained in this Manual was correct at the time of going to print but Ford policy is one of continuous improvement and the right to change prices, specifications, equipment or design at anytime without notice is reserved. All data in this Manual is subject to production variations, so overall dimensions and weights should be considered as approximately only and the illustrations do not necessarily depict the unit to standard build specification.

TRACTOR OPERATIONS
FORD MOTOR COMPANY

PRODUCTION DATE CODES AND SERIAL NUMBERS

A vehicle identification plate is located on the steering console on the left hand side. Whenever effecting repair or overhaul of the Ford Tractor, the relevant information should be noted and used when referring to service bulletins or ordering parts.



This plate is stamped with the following information:

- TRACTOR NUMBER — Serial number prefixed by the letter 'A', 'B' or 'C'.
- MODEL — Production model code.
- UNIT — Production unit date code.
- ENGINE — Engine production date code.
- TRANSMISSION — Transmission production date code.
- REAR AXLE — Rear axle production date code.
- HYD. PUMP — Hydraulic pump production date code.
- HYD. LIFT — Hydraulic power lift production date code.

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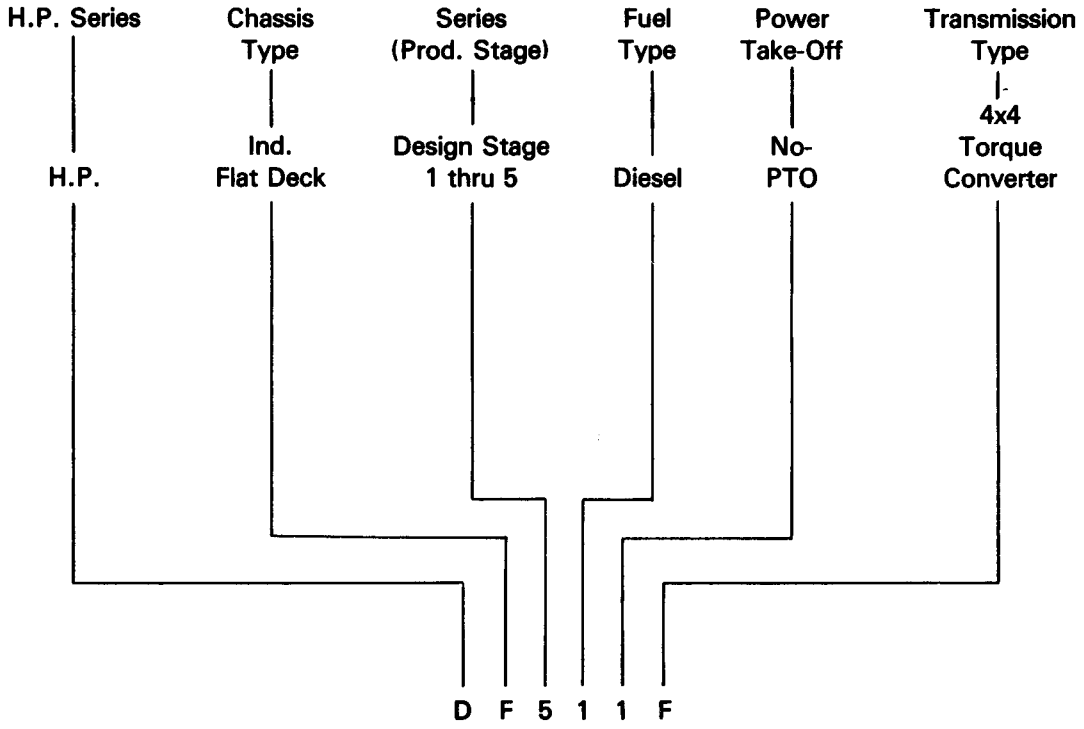
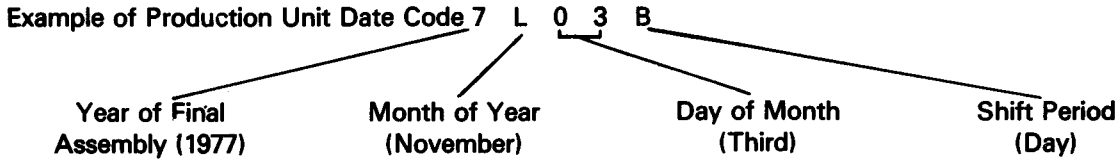
MODEL NUMBER — CODE



KEY TO PRODUCTION DATE CODES

First Number YEAR	First Letter MONTH		Second Number DAY OF MONTH	Second Letter PRODUCTION SHIFT
5—1975	A—Jan.	H—Aug.	01-32	A—Midnight
6—1976	B—Feb.	J—Sept.		B—Day
7—1977	C—March	K—Oct.		C—Afternoon
8—1978	D—April	L—Nov.		
9—1979	E—May	M—Dec.		
0—1980	F—June			
1—1981	G—July			



SAFETY PRECAUTIONS

Practically all Service work involves the need to drive the tractor. The Operator's Manual, supplied with each tractor, contains detailed safety precautions relating to Driving, Operating and Servicing that tractor. These precautions are as applicable to the service technician as they are to the operator, and should be read, understood and practiced by all personnel.

Prior to undertaking any maintenance, repair, overhaul, dismantling or re-assembly operations, whether within a workshop facility or out "in the field", consideration should be given to factors that may have an effect upon Safety, not only upon the mechanic carrying out the work, but also upon bystanders.

PERSONAL CONSIDERATIONS

- The wrong clothes or carelessness in dress can cause accidents. Check to see that you are suitably clothed.

  Some jobs require special protective equipment.

- **Eye Protection**
  The smallest eye injury may cause loss of vision. Injury can be avoided by wearing eye protection when engaged in chiselling, grinding, discing, welding, painting, etc.

- **Breathing Protection**
  Fumes, dust and paint spray are unpleasant and harmful. These can be avoided by wearing respiratory protection.

- **Hearing Protection**
  Loud noise may damage your hearing and the greater the exposure the worse the damage. If you feel the noise excessive, wear ear protection.

- **Hand Protection**
  It is advisable to use a protective cream before work to prevent irritation and skin contamination. After work clean your hands with soap and water. Solvents such as white spirit, paraffin, etc., may harm the skin.

- **Foot Protection**
  Substantial or protective footwear with reinforced toe-caps will protect your feet from falling objects. Additionally, oil-resistant soles will help to avoid slipping.

- **Special Clothing**
  For certain work it may be necessary to wear flame or acid- resistant clothing.

- Avoid injury through incorrect handling of components. Make sure you are capable of lifting the object. If in doubt get help.

EQUIPMENT CONSIDERATIONS

- **Machine Guards**
  Before using any machine, check to ensure that the machine guards are in position and serviceable. These guards not only prevent parts of the body or clothing coming in contact with the moving parts of the machine, but also ward off objects that might fly off the machine and cause injury.

- **Lifting Appliances**
  Always ensure that lifting equipment, such as chains, slings, lifting brackets, hooks and eyes are thoroughly checked before use. If in doubt, select stronger equipment than is necessary.

  Never stand under a suspended load or raised implement.

- **Compressed Air**
  The pressure from a compressed air line is often as high as 100 psi (6.9 bar) 7 (kgf/cm^2). It is perfectly safe if used correctly. Any misuse may cause injury.

  Never use compressed air to blow dust, filing, dirt, etc., away from your work area unless the correct type of nozzle is fitted.

  Compressed air is not a cleaning agent, it will only move dust, etc., from one place to another. Look around before using an air hose as bystanders may get grit into their eyes, ears or skin.

- **Hand Tools**
  Many cuts, abrasions and injuries are caused by defective tools. Never use the wrong tool for the job, as this generally leads either to some injury, or to a poor job.

  Never use

  — A hammer with a loose head or split handle.
  — Spanners or wrenches with splayed or worn jaws.
  — Spanners or files as hammers; or drills, clevis pins or bolts as punches.

  For removing or replacing hardened pins use a copper or brass drift rather than a hammer.

  For dismantling, overhaul and assembly of major and sub components, always use the Special Service Tools recommended.

  These will reduce the work effort, labor time and the repair cost.

  Always keep tools clean and in good working order.

- **Electricity**
  Electricity has become so familiar in day to day usage, that it's potentially dangerous properties are often overlooked. Misuse of electrical equipment can endanger life.

  Before using any electrical equipment — particularly portable appliances — make a visual check to make sure that the cable is not worn or frayed and that the plugs, sockets, etc., are intact. Make sure you know where the nearest isolating switch for your equipment is located.

GENERAL CONSIDERATIONS

- **Solvents**
  Use only cleaning fluids and solvents that are known to be safe. Certain types of fluids can cause damage to components such as seals, etc., and can cause skin irritation. Solvents should be checked that they are suitable not only for the cleaning of components and individual parts, but also that they do not affect the personal safety of the user.

- **Housekeeping**
  Many injuries result from tripping or slipping over, or on, objects or material left lying around by a careless worker. Prevent these accidents from occurring. If you notice a hazard, don't ignore it — remove it.

  A clean, hazard-free place of work improves the surroundings and daily environment for everybody.

- **Fire**
  Fire has no respect for persons or property. The destruction that a fire can cause is not always fully realized. Everyone must be constantly on guard.

  — Extinguish matches/cigars/cigarettes, etc., before throwing them away..
  — Work cleanly, disposing of waste material into proper containers.
  — Locate the fire extinguishers and find out how to operate them.
  — Do not panic — warn those near and raise the alarm.
  — Do not allow or use an open flame near the tractor fuel tank, battery or component parts.

- **First Aid**
  In the type of work that mechanics are engaged in, dirt, grease, fine dusts, etc., all settle upon the skin and clothing. If a cut, abrasion or burn is disregarded it may be found that a septic condition has formed within a short time. What appears at first to be trivial could become painful and injurious. It only takes a few minutes to have a fresh cut dressed, but it will take longer if you neglect it. Make sure you know where the First Aid box is located.

- **Cleanliness**
  Cleanliness of the tractor hydraulic system is essential for optimum performance. When carrying out service and repairs plug all hose ends and component connections to prevent dirt entry.

  Clean the exterior of all components before carrying out any form of repair. Dirt and abrasive dust can reduce the efficiency and working life of a component and lead to costly replacement. Use of a high pressure washer or steam cleaner is recommended.

OPERATIONAL CONSIDERATIONS

- Stop the engine, if at all possible, before performing any service.
- Place a warning sign on tractors which, due to service or overhaul, would be dangerous to start. Disconnect the battery leads if leaving such a unit unattended.
- Do not attempt to start the engine while standing beside the tractor or attempt to by-pass the safety start switch.
- Avoid prolonged running of the engine in a closed building or in an area with inadequate ventilation as exhaust fumes are highly toxic.
- Always turn the radiator cap to the first stop, to allow pressure in the system to dissipate when the coolant is hot.
- Never work beneath a tractor which is on soft ground. Always take the unit to an area which has a hard working surface — concrete for preference.
- If it is found necessary to raise the tractor for ease of servicing or repair, make sure that safe and stable supports are installed, beneath axle housings, casings, etc., before commencing work.
- Certain repair or overhaul procedures may necessitate "separating the tractor", either at the engine/front transmission or front transmission/rear transmission locations. These operations are simplified by the use of the Tractor Splitting Kit/Stands. Should this equipment not be available, then every consideration must be given to stability, balance and weight of the components, especially if a cab is installed.
- Use footsteps or working platforms when servicing those areas of a tractor that are not within easy reach.
- Before loosening any hoses or tubes connecting implements to remote control valves, etc., switch off the engine, remove all pressure in the lines by operating levers serveral times. This will remove the danger of personal injury by oil pressure.
- Prior to pressure testing, make sure all hoses and connectors not only of the tractor, but also those of the test equipment, are in good condition and tightly sealed. Pressure readings must be taken with the gauges specified. The correct procedure should be rigidly observed to prevent damage to the system or the equipment, and to eliminate the possibility of personal injury.
- When equipment or implements are required to be attached to the hydraulic linkage, either for testing purposes or for transportation, then "position control" should be used.
- Always lower equipment to the ground when leaving the tractor.
- If high lift attachments are installed on a tractor beware of overhead power, electric or telephone cables when traveling. Drop attachment near to ground level to increase stability and minimize risks.
- Do not park or attempt to service a tractor on an incline. If unavoidable, take extra care and block all wheels.
- Observe recommended precautions as indicated in this Repair Manual when dismantling the air conditioning system as escaping refrigerant can cause frostbite.
- Prior to removing wheels and tires from a tractor, check to determine whether additional ballast (liquid or weights) has been added. Seek assistance and use suitable equipment to support the weight of the wheel assembly.
- When inflating tires beware of over inflation — constantly check the pressure. Over inflation can cause tires to burst and result in personal injury.

Safety precautions are very seldom the figment of someone's imagination. They are the result of sad experience, where most likely someone has paid dearly through personal injury.

Heed these precautions and you will protect yourself accordingly. Disregard them and you may duplicate the sad experience of others.

SERVICE TECHNIQUES

A. SERVICE SAFETY

Appropriate service methods and proper repair procedures are essential for the safe, reliable operation of all motor vehicles as well as the personal safety of the individual doing the work. This Shop Manual provides general directions for accomplishing service and repair work with tested, effective techniques. Following them will help assure reliability.

There are numerous variations in procedures, techniques, tools, and parts for servicing vehicles, as well as in the skill of the individual doing the work. This Manual cannot possibly anticipate all such variations and provide advice or cautions as to each. Accordingly, anyone who departs from the instructions provided in this Manual must first establish that he compromises neither his personal safety nor the vehicle integrity by his choice of methods, tools or parts.

B. SERVICE TECHNIQUES

Clean the exterior of all components before carrying out any form of repair. Dirt and abrasive dust can reduce the efficient working life of a component and lead to costly replacement.

Time spent on the preparation and cleanliness of working surfaces will pay dividends in making the job easier and safer and will result in overhauled components being more reliable and efficient in operation.

Use cleaning fluids which are known to be safe. Certain types of fluid can cause damage to 'O' rings and cause skin irritation. Solvents should be checked that they are suitable for the cleaning of components and also that they do not risk the personal safety of the user.

Replace 'O' rings, seals or gaskets whenever they are disturbed. Never mix new and old seals or 'O' rings, regardless of condition. Always lubricate new seals and 'O' rings with hydraulic oil before installation.

When replacing component parts use the correct tool for the job.

HOSES AND TUBES

Always replace hoses and tubes if the cone end or the end connections are damaged.

When installing a new hose loosely connect each end and make sure the hose takes up the designed position before tightening the connection. Clamps should be tightened sufficiently to hold the hose without crushing and to prevent chafing.

The hoses are the arteries of the unit, be sure they are in good condition when carrying out repairs or maintenance otherwise the machine's output and productivity will be affected.

After hose replacement to a moving component check the hose does not foul by moving the component through the complete range of travel.

Be sure any hose which has been intalled is not kinked or twisted.

Hose connections which are damaged, dented, crushed or leaking, restrict oil flow and the productivity of the components being served. Connectors which show signs of movement from the original swaged position have failed, and will ultimately separate completely.

A hose with a chafed outer cover will allow water entry. Concealed corrosion of the wire reinforcement will subsequently occur along the hose length with resultant hose failure.

Ballooning of the hose indicates an internal leakage due to structural failure. This condition rapidly deteriorates and total hose failure soon occurs.

Kinked, crushed, stretched or deformed hoses generally suffer internal structural damage which can result in oil restriction, a reduction in the speed of operation and ultimate hose failure.

Free-moving, unsupported hoses must never be allowed to touch each other or related working surfaces. This causes chafing which reduces hose life.

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BEARINGS

Bearings which are considered suitable for further service should be cleaned in a suitable solvent and immersed in clean lubricating oil until required.

Installation of a bearing can be classified in two ways: press fit on rotating parts such as shafts, and gears, and push fit into static locations such as reduction gear housings. Where possible, always install the bearing onto the rotating component first.

Use the correct tools or a press, to install a bearing or bushing. In the absence of the correct tools or press, heat the bearings and/or the casing in hot oil to assist the installation of the bearing.

When bearings or bushings are removed always carefully check that the bearing is free from discoloration and signs of over-heating. Also check for mechanical damage such as excessive clearance, nicks and scuffing. If in doubt replace the bearings or bushings.

Bearings should never be removed unless absolutely necessary. Always use the recommended puller to reduce the risk of bearing or related component damage.

The reliability and durability of a unit depends on the effective operation of the many types of bearings and bushings which are incorporated in the complete assembly.

These bearings and bushings are subjected, in normal operation, to high working loads and adverse conditions.

Be sure during normal routine servicing, maintenance or repair that bearings are given the right attention and are installed with care.

PRESSURE TESTING

Prior to pressure testing be sure all hoses are in good condition and all connections tight. Pressure readings must be taken with gauges of specified pressure ratings.

The correct procedure should be rigidly observed to prevent damage to the system or the equipment and to eliminate the possibility of personal injury.

WARNING: *Service the engine compartment with the Loader bucket on the ground in the dumped position or in the raised position with the Loader lift cylinder "SAFETY BAR" installed (see Figure 1). Never work under or around a raised Loader without the "SAFETY BAR INSTALLED".*

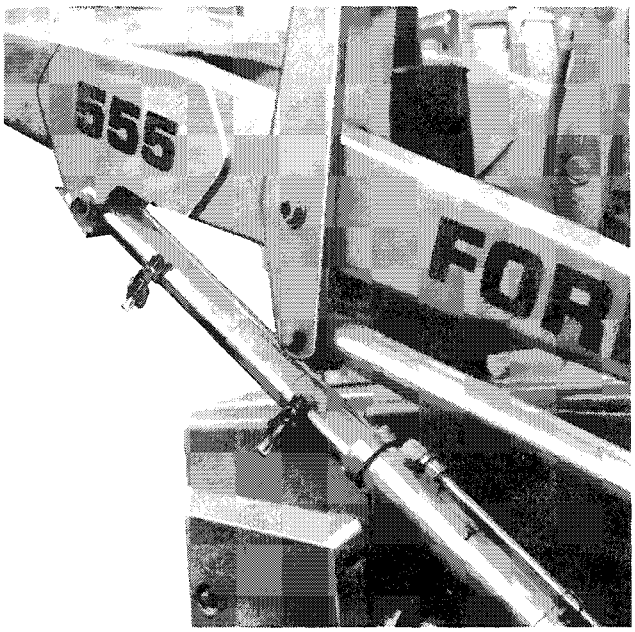

Figure 1
Loader Lift Cylinder "Safety Bar"
Installed in Raised Position

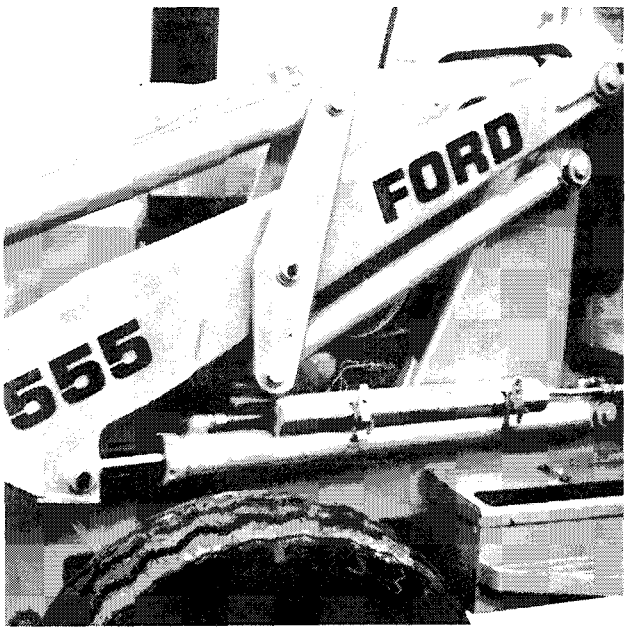

Figure 2
Loader Lift Cylinder "Safety Bar"
Installed in Storage Position

PART 1
ENGINE SYSTEM

Chapter 1
ENGINES

Chapter 2
COOLING SYSTEM

Chapter 3
TROUBLE SHOOTING, SPECIFICATIONS AND SPECIAL TOOLS

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PART 1
ENGINE SYSTEM

Chapter 1
ENGINES

A. ENGINE — DESCRIPTION AND OPERATION

This Chapter describes the overhaul and repair of the Ford Tractor diesel and gasoline engines. See Figures 1 and 2.

The diesel and gasoline engines are of the same basic design and overhaul procedures are essentially the same except as noted in the repair procedures.

Basic design differences are as follows:

The diesel engine piston has three compression rings and one oil control ring. The gasoline engine piston has two compression rings and one oil control ring. Both pistons have the combustion chamber in the top of the piston, however the diesel piston chamber is smaller to provide the higher compression ratio, Figure 3.

The fully floating piston pin is retained in the piston by two snap rings.

The gasoline engine intake manifold is designed with a water jacket around the main runner to provide a constant circulation of coolant to control the air intake temperature.

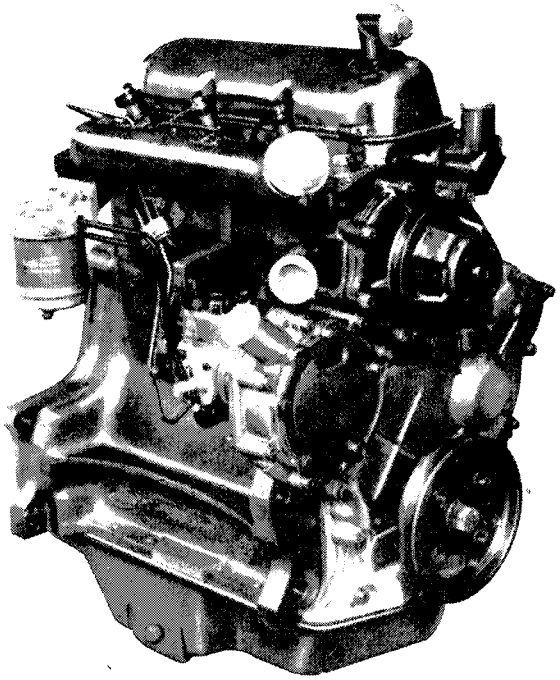

Figure 1
Diesel Engine with Distributor Type Fuel Injection Pump

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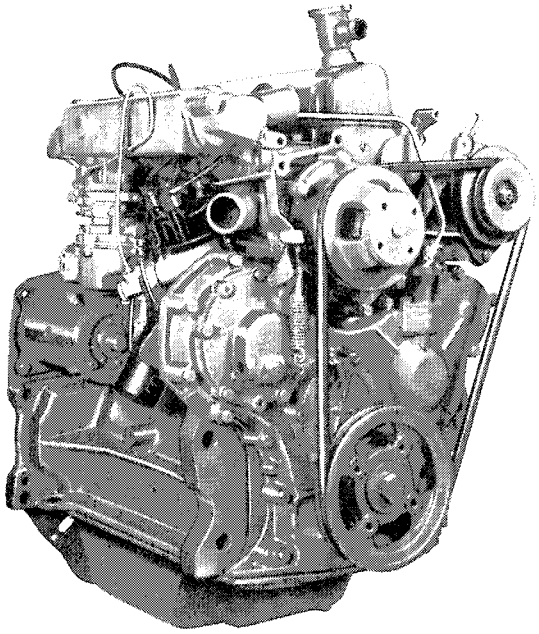

Figure 2
Gasoline Engine

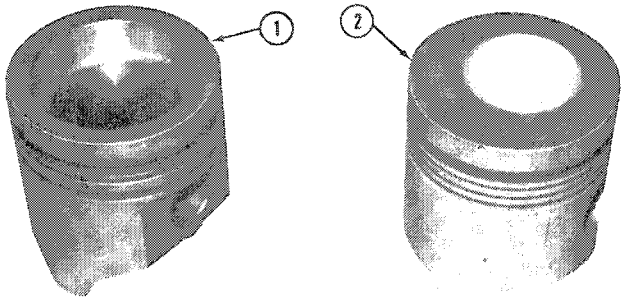

Figure 3
Pistons

1. Gasoline
2. Diesel

The thermostat is located in the intake manifold on gasoline engines and in the cylinder head on diesel engines.

The gasoline engine front cover is designed to accept the governor and fuel pump assemblies. The fuel pump, mounted on the front of the cover, is driven by a cam mounted on the engine camshaft.

Both engines feature cross flow cylinder heads with the inlet and exhaust manifolds on opposite sides of the head. The combustion chamber is formed in the crown of the piston.

The cylinder head assembly incorporates the valves, valve springs and spring retainers. Valve guides are an integral part of the cylinder head with replaceable valve seats pressed into the valve ports.

The crankshaft is supported in the cylinder block by four main bearings. Crankshaft end thrust is suppressed by a thrust bearing located on the second main bearing.

Front and rear crankshaft oil sealing is effected by one piece, single lip type seals.

The crankshaft rear main bearing carrier block is sealed by two composition type side seals and a gasket positioned between the block and the engine rear adapter plate.

LUBRICATION SYSTEM

Lubrication of the engine is maintained by a rotor type oil pump mounted at the base of the engine block. The oil pump is driven from the camshaft and draws oil from the engine sump through a wire mesh screen.

A spring loaded relief valve in the pump body limits the pressure in the system by directing excess oil back to the intake side of the pump.

Oil passes from the pump to an external, replaceable, canister type filter incorporating a relief valve which permits oil to be bypassed if filter blockage occurs, and be sure engine lubrication at all times.

Oil flows from the filter to the main oil gallery which runs the length of the cylinder block and intersects the camshaft follower chambers.

The main gallery also supplies oil to the crankshaft main bearings and to the connecting rod journals via drillings in the crankshaft. Drilled passages from each main bearing direct oil to the camshaft bearings.

The camshaft drive gear bushing is pressure lubricated through a drilled passage from the front main bearing. The gear has small oil passages machined on both sides which allow the oil to escape.

The timing gears are lubricated by oil from the cam follower chamber and the pressure lubricated camshaft drive gear bushing.

Cylinder walls, pistons and piston pins are splash lubricated by the connecting rods and rotating crankshaft.

An intermittent flow of oil is directed to the valve rocker arm shaft assembly via a drilled passage in the cylinder block located vertically above the No. 1 camshaft bearing. This drilling aligns with a corresponding hole in the cylinder head. As the camshaft turns, holes in the camshaft and camshaft bearing align and a regulated stream of oil is directed to the cylinder head and on up the rocker arm shaft support bolt to the rocker shaft. The oil flows from the shaft through drilled holes in each rocker arm bushing to lubricate both ends of the arms. Excess oil flows down the push rods and assists in lubricating the cam followers before draining back into the sump through cored openings in the block.

B. ENGINE — OVERHAUL

CYLINDER HEAD, VALVES AND RELATED PARTS

REMOVAL

NOTE: *The cylinder head can be removed with the engine installed in the tractor.*

1. Disconnect the battery.

   - Remove the vertical muffler.

2. Drain the radiator and cylinder block.

3. Shut off the heater hose taps then disconnect and plug the heater hoses.

4. Remove the radiator top hose.

5. Shut off the main fuel tank tap.

   - Remove the hood panel assembly.

   - Disconnect the air inlet hose at the clamp at the intake manifold.
   - Remove the vertical type exhaust pipe and bracket (where fitted).

6. Bend the lock tabs back and remove the attaching bolts, exhaust manifold and gasket.

7. Disconnect the cold start equipment (where fitted).

8. On diesel engines remove the injector lines from the fuel injection pump and the injectors. Cap the exposed openings in the pump, injectors and tube ends.

9. Disconnect the fuel lines and remove the fuel filter(s) from the inlet manifold.

   NOTE: *On gasoline engines, disconnect the fuel line and linkage from the carburetor. Remove the carburetor from the intake manifold. Disconnect the vacuum advance line from the intake manifold.*

10. Remove the retaining bolts and lockwashers and remove the intake manifold and gasket.

11. Remove the rocker cover bolts, rocker arm cover and gasket from the cylinder head.

12. Disconnect the fuel injector leak-off pipes. Clean the area surrounding the fuel injectors then remove the stud nuts and carefully withdraw the fuel injectors and washers, Figure 4.

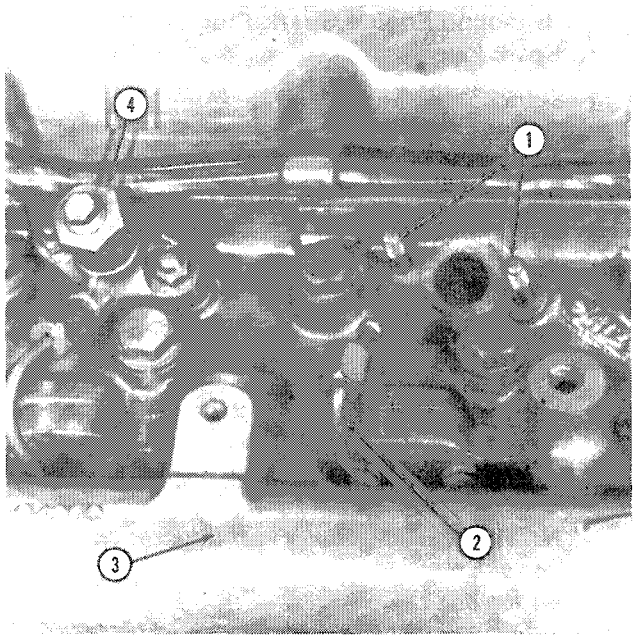

Figure 4
Fuel Injector Removed

1. Fuel Injector Mounting Studs
2. Fuel Injection Tube
3. Intake Manifold
4. Fuel Injector Assembly

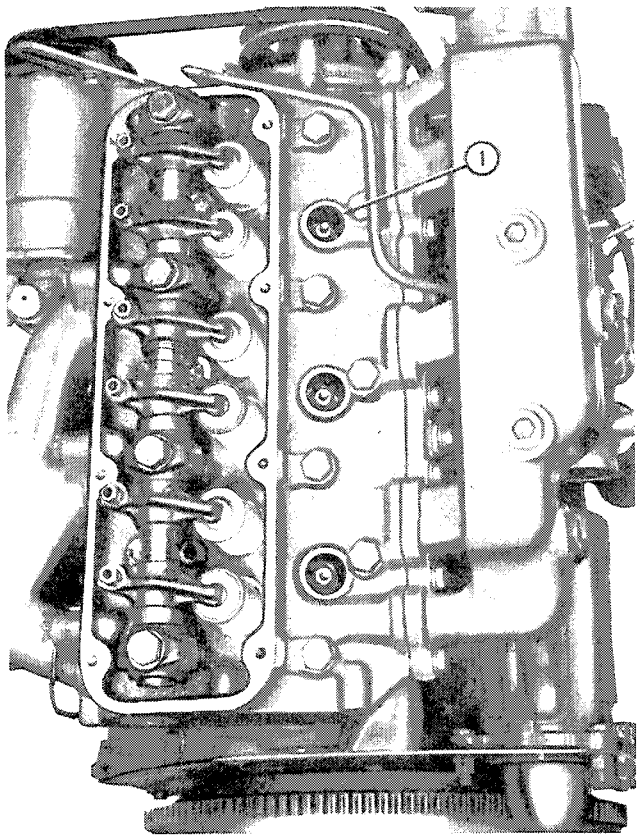

Figure 5
Gasoline Engine Spark Plug Location
1. Spark Plug

NOTE: *On gasoline engines remove the spark plugs, Figure 5.*

13. Check the push rods for straightness by rotating the rods with the valve closed and identify any bent rods.

14. Loosen the rocker shaft retaining bolts, which also serve as cylinder head bolts, evenly and alternately. Remove the rocker shaft assembly.

NOTE: *Leave the bolts in the rocker shaft supports during removal as they retain the supports on the shaft.*

15. Remove the push rods and place in a numbered rack.

16. Remove the remaining cylinder head bolts and washers working inwards from the ends to the center of the head.

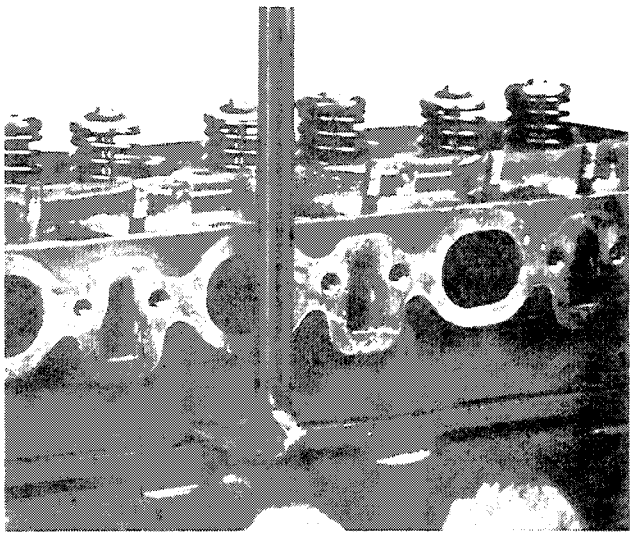

Figure 6
Cylinder Head Removal

17. Lift the cylinder head from the block. If necessary lever the head off on the pads provided, taking care not to damage the cylinder head or block faces, Figure 6.

DISASSEMBLY

Thermostat:

1. Remove the coolant outlet connection and the thermostat and gasket, Figure 7.

NOTE: *On gasoline engines, the water outlet connection and thermostat are incorporated in the intake manifold, water outlet cover and gasket are used to cover the hole in the front of the cylinder head. For inspection and repair see "Cooling System", Chapter 2.*

Cylinder Head:

1. Clean the head and remove carbon deposits from around the valve heads.

2. Using a valve spring compressor, Figure 8, remove the retainer locks, spring retainers/rotators, springs and seals from each valve, Figures 9 and 10.

3. Remove the valves and place in a numbered rack together with the valve rotators (where fitted).

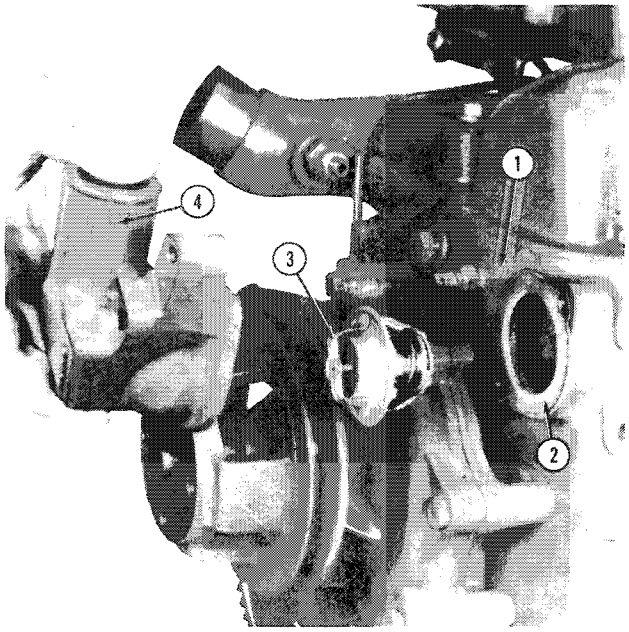

Figure 7
Thermostat Removal

1. Cylinder Head
2. Gasket
3. Thermostat
4. Coolant Outlet Connection

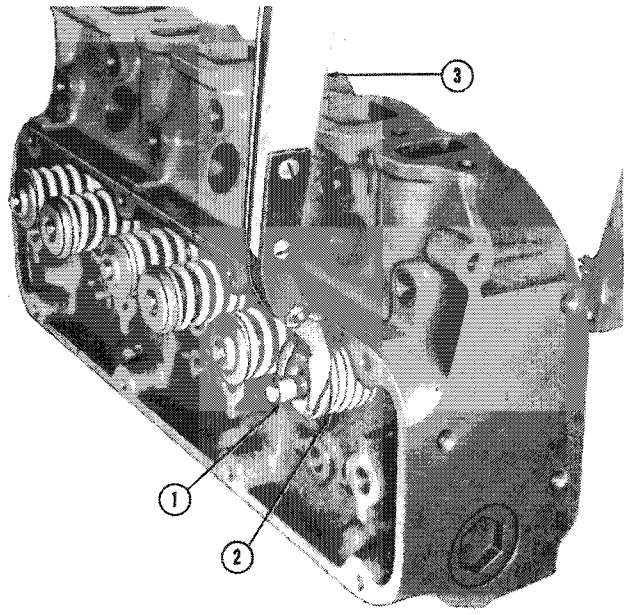

Figure 8
Valve Removal

1. Retainer Locks
2. Valve Spring
3. Valve Spring Compressor

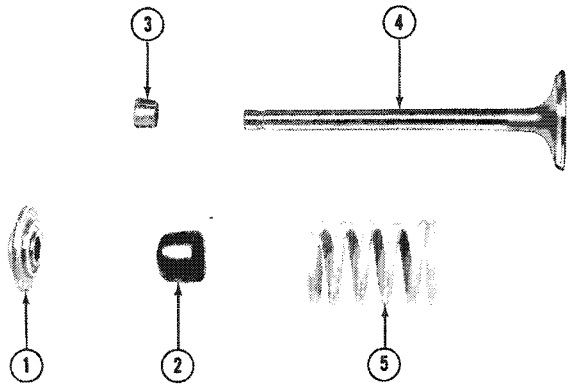

Figure 9
Intake Valve Assembly

1. Spring Retainer
2. Seal
3. Spring Retainer Lock
4. Intake Valve
5. Spring

Rocker Shaft Assembly:

1. Remove the cylinder head bolts which pass through the rocker shaft supports and slide the rocker shaft supports and slide the rocker shaft components from the shaft, Figure 11.

INSPECTION AND REPAIR

Cylinder Head:

1. Scrape all gasket surfaces clean then wash the cylinder head in a suitable solvent and thoroughly dry with a lint free cloth or compressed air.

2. Inspect the cylinder head for damage and, if necessary, remove nicks and burrs from the gasket faces using a suitable abrasive. Be sure all traces of abrasive material are removed after repair.

3. Use a straight edge to check the flatness of the cylinder head in all directions, Figure 12. For flatness requirement see "Specifications" — Chapter 3.

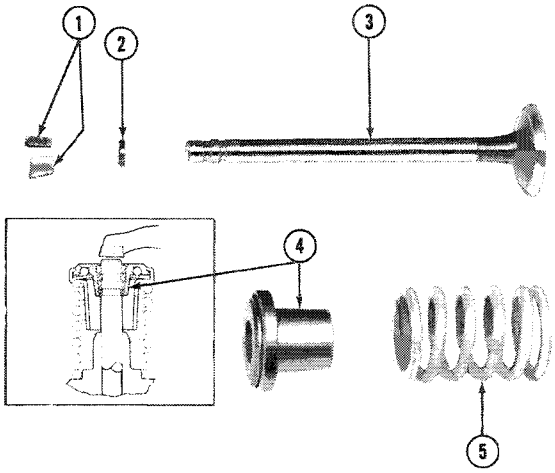

Figure 10
Exhaust Valve Assembly

1. Spring Retainer Locks
2. Seal
3. Exhaust Valve
4. Spring Retainer
5. Spring

NOTE: *If the cylinder head exceeds the flatness specification it may be skimmed providing the depth from the lower face of the valve insert to the cylinder head face is not less than 0.064 in. (1.63 mm).*

4. After skimming the head, check whether any cylinder head bolts are bottoming by mounting the cylinder head on the block without a gasket and without any of the pistons at T.D.C. Install all the bolts finger tight and ensure the rocker shaft supports and flat washers are fitted with the long bolts. If a 0.010 in. (0.25 mm) feeler gauge can be inserted under the bolt head then the bolts are bottoming and the cylinder block thread must be increased in depth. Use a 1/2 in. x 13 UNC — 2A thread tap.

Valve Seats:

1. Examine the valve seat inserts and reface if pitted but replace if damaged. If necessary, install an oversize insert by machining the seat counterbore in the cylinder head, see "Specifications" — Chapter 3. The insert must be chilled in dry-ice prior to installation.

   Dimension after Refacing:
   0.031 in. (0.79 mm) Minimum

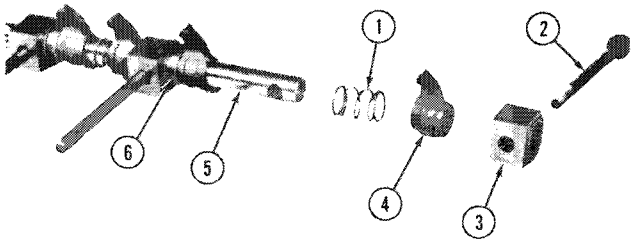

Figure 11
Rocker Shaft Disassembled

1. Spring
2. Retaining Bolt
3. Shaft Support
4. Rocker Arm
5. Shaft
6. Spacer

NOTE: *Valve seat inserts of 0.010 in. (0.25 mm) and 0.020 in. (0.5 mm) oversize on diameter are sometimes installed in cylinder heads in production. Heads fitted with oversize inserts are stamped S010/0S or S020/0S on the exhaust manifold side in line with the valve seat concerned.*

When replacing exhaust valve seat inserts be sure the replacement inserts are of the correct type as the size and material specification varies for the different engine types.

2. Check the width of the valve seat and, if necessary, reface by grinding to the dimensions shown in Figure 13.

3. Grind the seat width to (intake) 0.082" - 0.102", (2.082-2.590 mm)(exhaust) 0.084 - 0.106" (2.133-2.692 mm). Lower or raise the seat by removing material from the seat using the following stones:

   To lower the seat use a 30 degree stone. To raise the seat use a 60 degree stone.

   NOTE: *Refacing of the valve seat should always be co-ordinated with refacing of the valve to ensure a compression tight fit.*

Valves:

1. Inspect the valve face and, if pitted replace or reface by grinding to the dimensions shown in Figure 14.

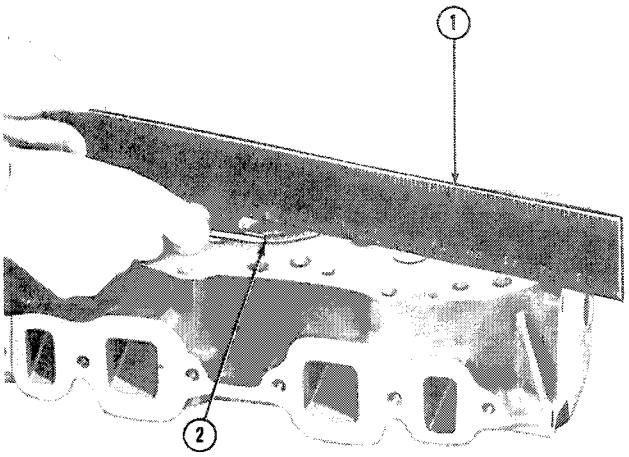

Figure 12
Measuring Cylinder Head Flatness
1. Straight Edge
2. Feeler Gauge

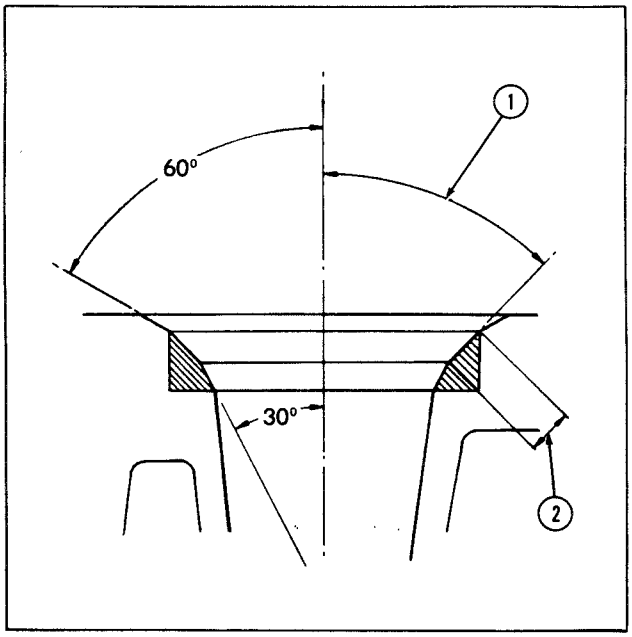

Figure 13
Valve Seat Dimensions
1. Valve Seat Angle - 44° 30' - 45° 00'
2. Valve Seat Width
   Intake 0.080 - 0.102 in. (2.032-2.590 mm)
   Exhaust 0.084 - 0.106 in. (2.133 - 2.692 mm)

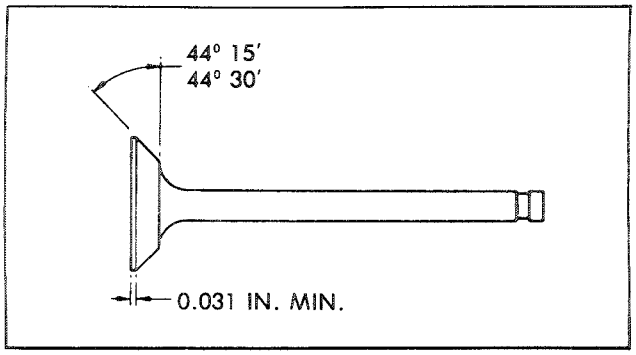

Figure 14
Intake and Exhaust Valves

2. Before refacing a valve, be sure the valve is free of defects and the stem is not bent. Check that the seat run-out, measured at right angles to the seat does not exceed a total of 0.0015 in. (0.038 mm).

IMPORTANT: *The finished valve seat should contact the center of the valve face. Using the refaced or new valve, check the seat using Prussian Blue. Rotate the valve with a light pressure and if the blue is transferred to the middle of the valve face, the contact is correct, Figure 15.*

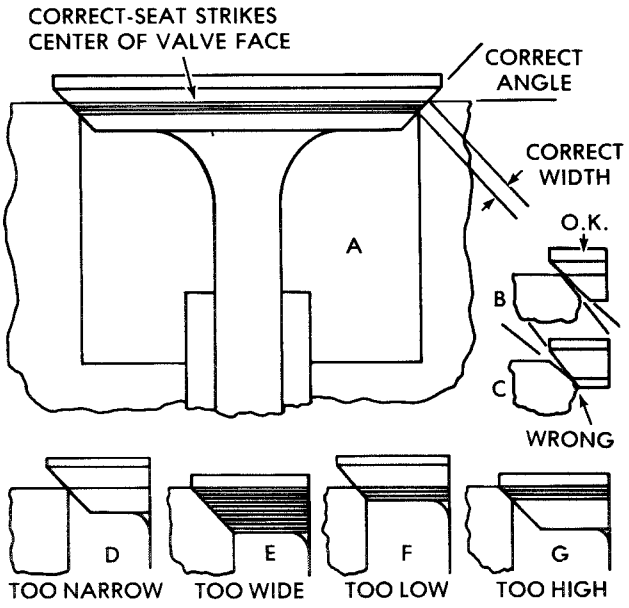

Figure 15
Valve Seating

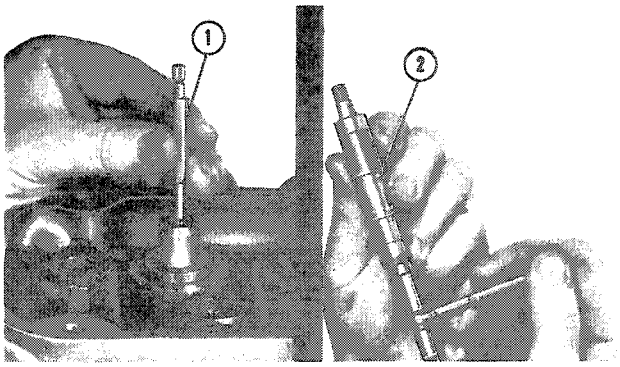

Figure 16
Measuring Valve Guide
1. Telescopic Gauge
2. Micrometer

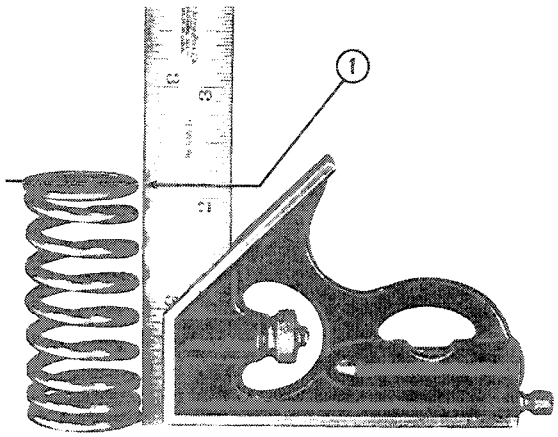

Figure 17
Checking Valve Spring Squareness
1. Maximum Out-Of-Square 0.06 in. (1.5 mm)

Valve Guides:

1. Using a telescopic gauge and micrometer, measure the valve to guide clearance, Figure 16. If the clearance exceeds the specified limits, see "Specifications" — Chapter 3, ream the valve guide to fit the next oversize valve.

   NOTE: *Production cylinder heads may have one or more 0.015 in. (0.38 mm) oversize valve guides and valves installed. Such cylinder heads have 15 or V015/OS stamped on the exhaust manifold side of the head opposite the valve(s) concerned.*

2. Use Tool Kit No. 2136 to ream out the valve guide to accept an oversize valve. The kit contains three reamer and pilot combinations as follows:

   - 0.003 in. (0.076 mm) Oversize Reamer and Standard Diameter Pilot.
   - 0.015 in. (0.38 mm) Oversize Reamer and 0.003 in. (0.076 mm) Oversize Pilot.
   - 0.030 in. (0.76 mm) Oversize Reamer and 0.015 in. (0.38 mm) Oversize Pilot.

   When going from a standard valve stem to an oversize always use the reamers in sequence. After reaming a valve guide, always check the valve seating and reface if necessary.

Valve Springs:

1. Replace worn or damaged valve springs. Check for squareness and reject if out-of-square exceeds 0.06 in. (1.5 mm), Figure 17. Check the free length and loaded length of each valve spring, see "Specifications" — Chapter 3. Be sure the valve spring retainer locks are in good condition and the exhaust valve rotators are not binding or worn.

Rocker Shaft Assembly:

1. Examine the rocker arm for wear or damage. Check the adjusting screw threads and replace if damaged. Inspect the rocker arm locating springs and spacers for damage. Check the rocker arm-to-shaft clearances and replace if beyond specified limits, see "Specifications" — Chapter 3.

2. Clean the shaft in a suitable solvent and thoroughly dry with compressed air to be sure the oil passages are free from obstruction.

ASSEMBLY

Cylinder Head:

1. Insert each valve in the guide bore from which it was removed and lap in position to be sure of even seat around the valve. Withdraw the valve and remove all traces of lapping compound.

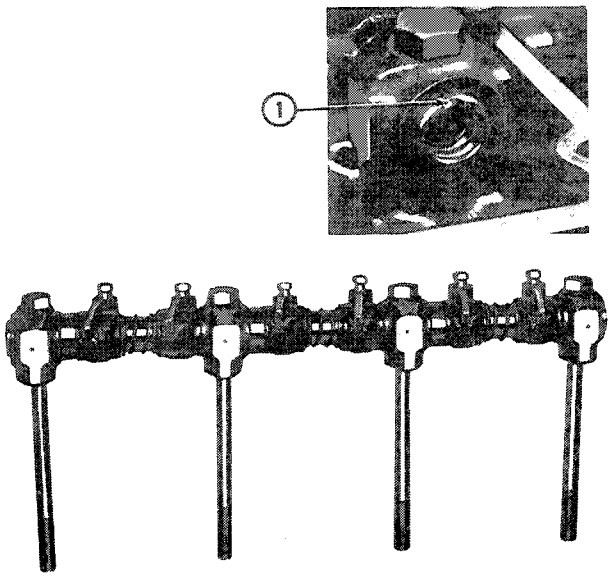

Figure 18
Rocker Shaft Assembly

1. Notch

2. Use a valve spring compressor to reassemble the valves, valve springs, retainers and retainer locks. For the exhaust valves install a new sealing ring in the second groove from the top of the valve stem.

Thermostat:

1. Install the thermostat (spring end towards the head), coolant outlet and a new gasket.

Rocker Shaft Assembly:

1. Coat all components with engine oil and position the notch on the front of the rocker shaft upwards to correctly locate the oil holes, Figure 18.

2. Start the assembly from the shaft rear end by securing a rocker arm support with a long bolt. Be sure the notch on the support is positioned to the right of the shaft when looking forward. Proceed to install a spacer, rocker arm, spring, rocker arm and support. Repeat the procedure until complete.

INSTALLATION

Installation of the cylinder head and ancillary equipment follows the removal procedure in reverse. On installation observe the following requirements:

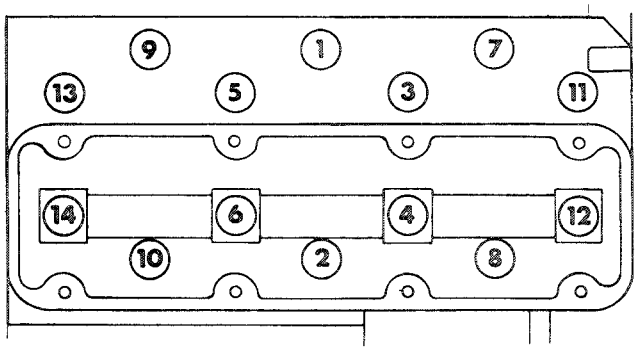

Figure 19
Cylinder Head Bolt Tightening Sequence

- Install new cylinder head, intake and exhaust manifold gaskets.

- Be sure washers are installed under the heads of the cylinder head retaining bolts. Tighten the cylinder head bolts in the sequence shown in Figure 19, and progressively in three steps as follows:

  (i) Torque to 90 lbf. ft. (122 Nm)

  (ii) Torque to 100 lbf. ft. (135 Nm)

  (iii) Torque to 110 lbf. ft. (140 Nm)

  NOTE: *The cylinder head bolts should be torqued only when the engine is cold.*

- Rotate the engine and set the valve lash. Figure 20 — see "Specifications" — Chapter 3.

- Install the injectors with new seat washers and cork seals.

- Install the injector lines and leak-off pipe with new washers.

- Use new lock tabs for the exhaust manifold retaining bolts and bend the tabs to effect retention.

- Tighten all nuts and bolts to the specified torques. See "Specifications" — Chapter 3.

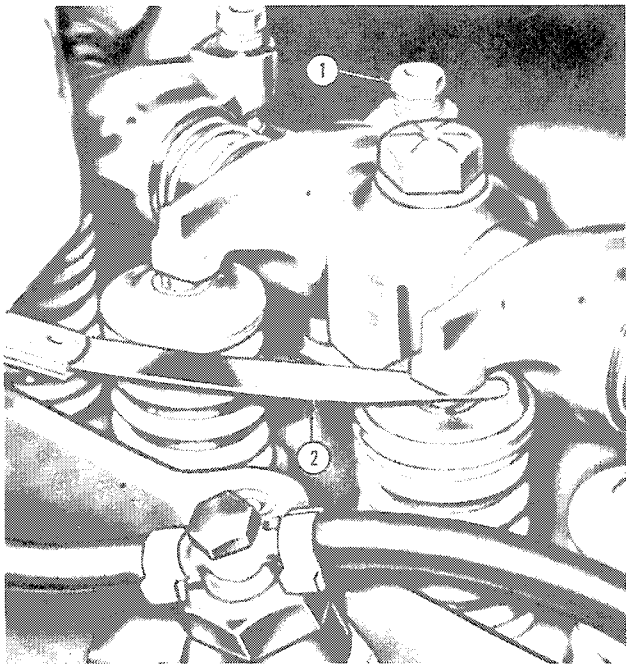

Figure 20
Setting Valve Lash

1. Adjuster Screw
2. Feeler Gauge

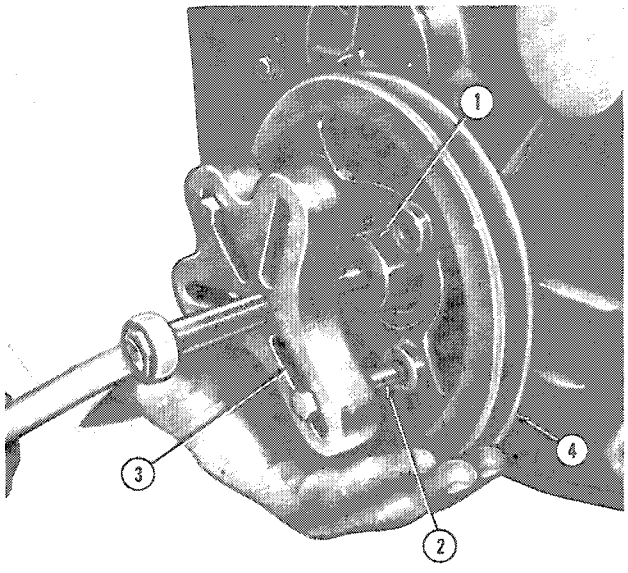

Figure 21
Crankshaft Pulley Removal

1. Shaft Protector No. 9212
2. 7/16-14 UNC Bolt
3. Puller No. 9539
4. Crankshaft Pulley

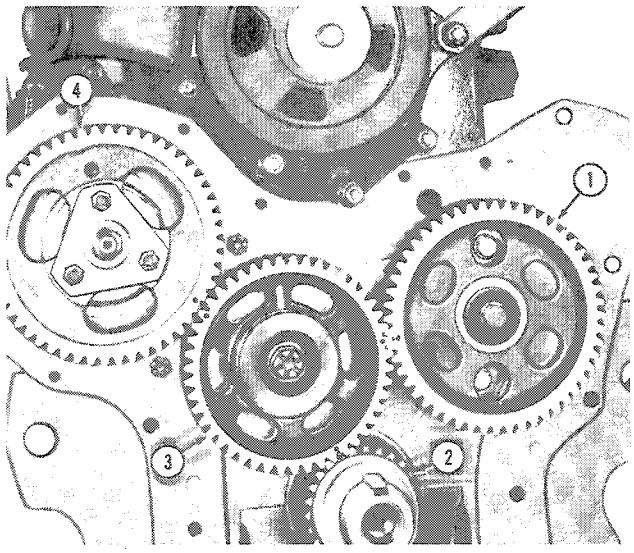

Figure 22
Timing Gears

1. Camshaft Gear
2. Crankshaft Gear
3. Camshaft Drive Gear
4. Injection Pump Drive Gear

ENGINE FRONT COVER AND TIMING GEARS

REMOVAL

NOTE: *The engine front cover and timing gears can only be serviced after removing the radiator and front axle. See "SEPARATING THE TRACTOR" — Part 10.*

1. Drain the engine oil and remove the oil pan.

2. Remove the fan drive belt and withdraw the bolt and washer from the center of the crankshaft pulley.

3. Using Puller No. 9539 and Shaft Protector No. 9212, remove the crankshaft pulley, Figure 21.

4. Remove the power steering pump, see "STEERING SYSTEMS" — Part 8.

5. Remove the front cover retaining bolts, front cover, and gasket. Remove the oil slinger from the crankshaft.

   NOTE: *On gasoline engines remove the fuel lift pump, push rod, and lines and the governor cover, outer race and drive assembly.*

Figure 23
Measuring Timing Gear Backlash
1. Camshaft Gear
2. Oil Slinger (Reference Only)
3. Feeler Gauge
4. Camshaft Drive Gear

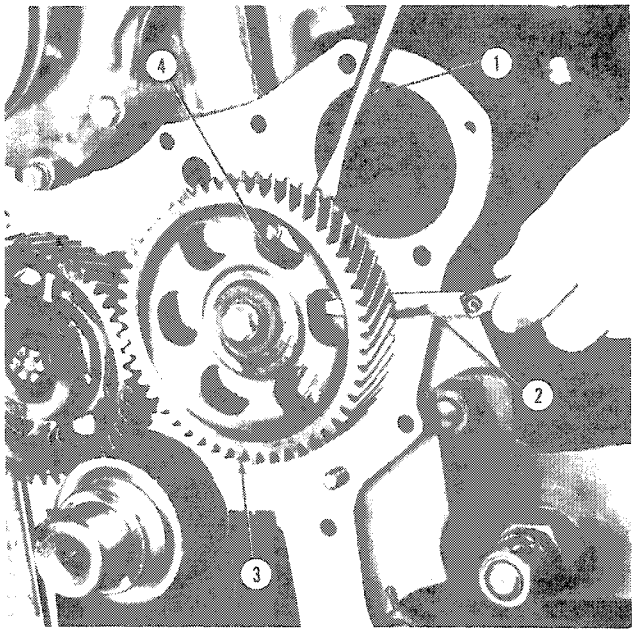

Figure 24
Measuring Camshaft End Play
1. Screw Driver
2. Feeler Gauge
3. Camshaft Gear
4. Thrust Plate

6. Before removing the timing gears, Figure 22, use a dial indicator or feeler gauges, to measure the backlash between each set of mating gears, Figure 23. Rotate the gears and check the backlash at four equidistant points on the gears. Install new gears if the backlash exceeds the specified limits see "Specifications" — Chapter 3.

7. Pry the camshaft gear away from the thrust plate and using a dial indicator or feeler gauges, measure the clearance, Figure 24. Install a new camshaft thrust plate if the camshaft end play exceeds the specified limits, see "Specifications" — Chapter 3.

8. Remove the fuel injection pump drive gear, camshaft drive gear and adapter and the camshaft gear. Use Tool No. 2134, 2137 to remove the crankshaft gear, Figure 25.

   NOTE: *On gasoline engines, an eccentric, Figure 26, is attached to the front of the camshaft gear.*

   NOTE: *The crankshaft gear should only be removed if it shows signs of wear.*

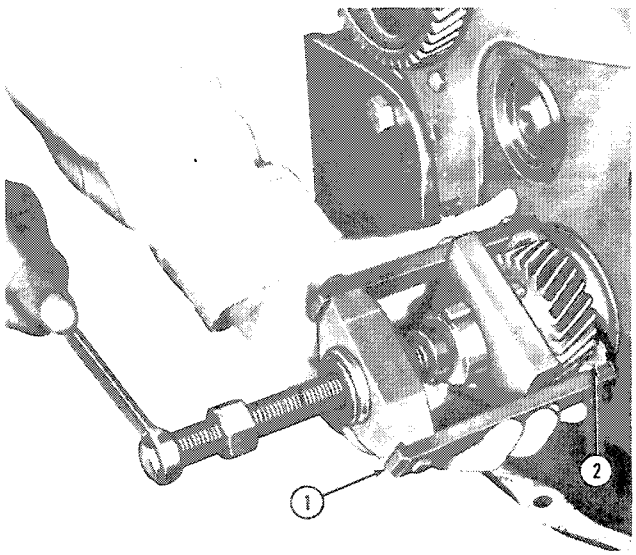

Figure 25
Crankshaft Gear Removal
1. Puller No. 2134
2. Insert No. 1237

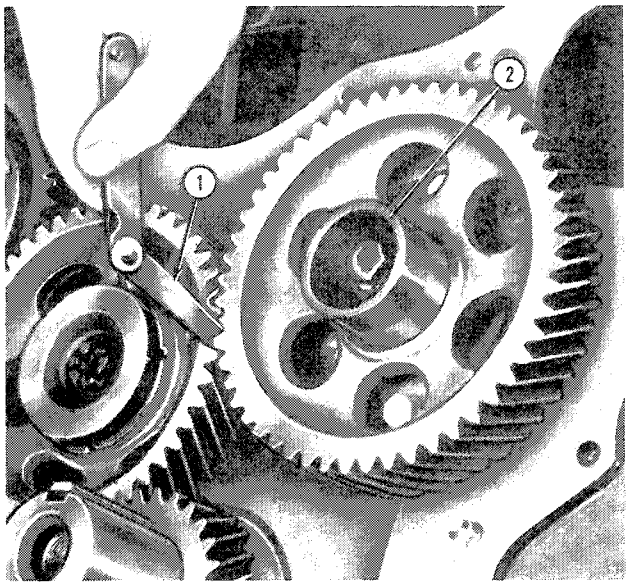

Figure 26
Checking Timing Gear Backlash
1. Feeler Gauge
2. Fuel Pump Drive Shaft

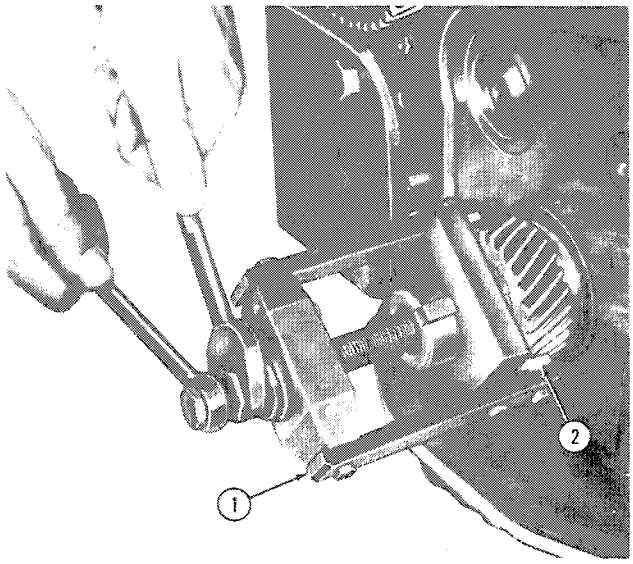

Figure 27
Installing Crankshaft Gear
1. Installer No. 2134
2. Insert No. 1237

INSPECTION AND REPAIR

1. Wash the gears and adapter in a suitable solvent and dry with a clean lint free cloth or compressed air.

2. Examine the gear teeth for wear, burrs or scratches. Any minor burrs or scratches may be removed with a fine abrasive; be sure all parts are thoroughly washed before re-assembly.

3. Be sure the camshaft drive gear adapter oil passage is free from obstruction and the drive gear bushing is not damaged.

4. Check the key and keyway in the end of both the camshaft and crankshaft for damage. Replace the keys if necessary.

INSTALLATION

1. Install the spacer, key and the camshaft gear then re-check the camshaft end play.

2. Locate the key then use Tool No. 2134 and 1237 to install the crankshaft gear, Figure 27.

3. Position No. 1 piston at Top Dead Center and install the camshaft drive gear and adapter with the timing marks aligned with those of the other gears.

   Tighten the bolt to the specified torque and recheck the backlash between the gears.

Diesel Engine:

4. Assemble the fuel injection pump to the engine front plate. Check No. 1 piston is at T.D.C. and install the injection pump drive gear with the timing mark aligned with that of the camshaft drive gear, Figure 28.

   NOTE: *All Ford engines with a distributor type fuel injection pump have a common fuel injection pump drive gear. This gear features two timing marks identified by numerals '3' and '4' for 3 and 4-cylinder engines respectively, Figure 29. When installing the pump drive gear, be sure the 3 cylinder timing mark aligns with the camshaft drive gear timing mark.*

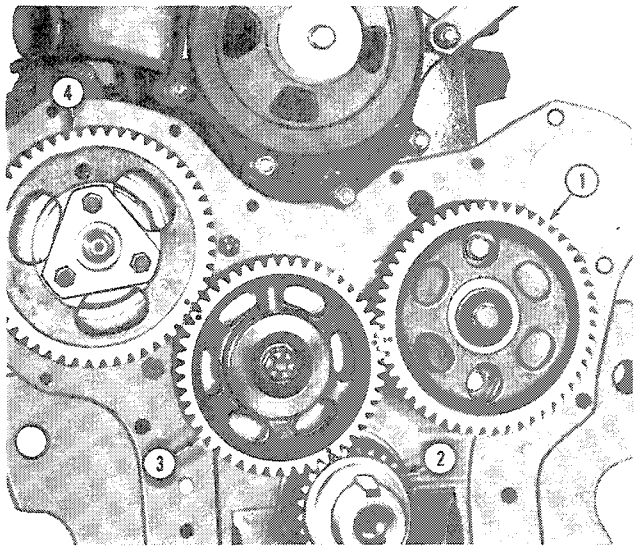

Figure 28
Aligning The Timing Gears
1. Camshaft Gear
2. Crankshaft Gear
3. Camshaft Drive Gear
4. Injection Pump Drive Gear

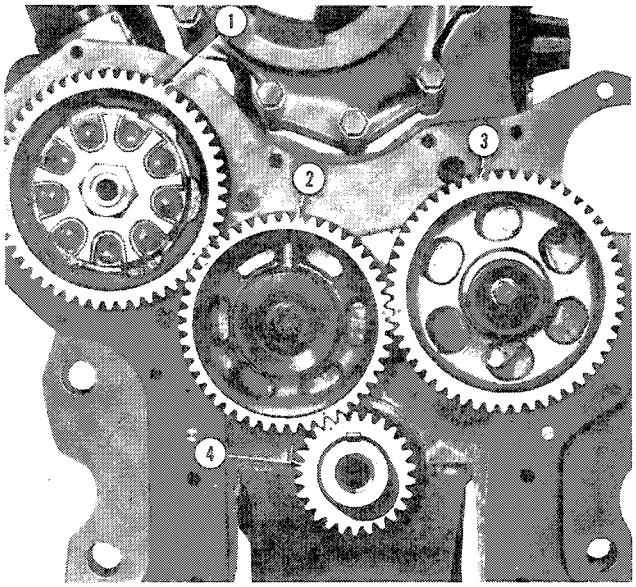

Figure 30
Timing Gears
1. Distributor Drive Gear
2. Camshaft Drive Gear
3. Camshaft Gear
4. Crankshaft Gear

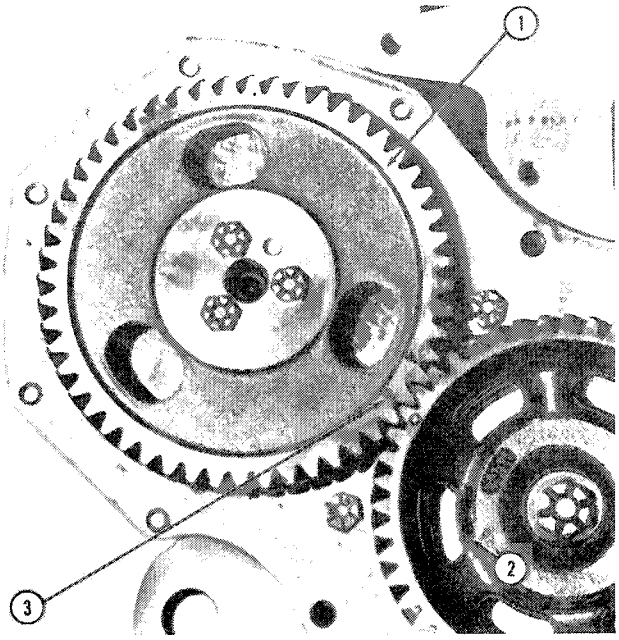

Figure 29
Injection Pump Drive Gear To Camshaft Drive Gear Timing
1. Pump Drive Gear
2. Camshaft Drive Gear
3. 3-Cylinder Timing Mark

Gasoline Engine:

Install the front timing gear with timing mark aligned with the governor drive gear, Figure 30 and tighten the self-locking retaining bolt to the specified torque. Install the governor outer race assembly.

5. Install a new dust seal in the front cover. Lubricate the oil seal with petroleum jelly and use Adapter No. 9210 to press the seal into the front cover.

6. Locate the oil slinger onto the crankshaft with the dished face outwards.

7. Position a new gasket on the engine front plate and install the front cover. Be sure the cover aligns with the dowel pins. Tighten the bolts to the specified torque.

8. Lubricate the crankshaft pulley spacer and slide over the key. Replace the pulley hub and tap onto the crankshaft. Tighten the securing bolt to the specified torque, see "Specifications" — Chapter 3.

9. Install the oil pan with a new gasket and tighten the bolts to the specified torque, see "Specifications" — Chapter 3.

10. Refill the engine with the correct grade and quantity of oil, see "Specifications" — Chapter 3.

GOVERNOR AND DRIVE GEAR

The gasoline engine governor is located inside the engine front cover. Linkage connects the throttle control, the governor and the carburetor together. All service work on the governor can be performed with the engine in the tractor, except removing the drive gear. The engine front cover must be removed to permit removal of the distributor/governor drive gear.

GOVERNOR REMOVAL

1. Disconnect the governor lever linkage, Figure 31.

2. Remove the governor housing from the engine front cover. Discard the old gasket, Figure 32.

3. Remove the governor outer race.

4. Remove the distributor drive gear retaining nut (left hand thread) and remove the driver assembly, Figure 33.

INSPECTION

1. Inspect the driver assembly and outer race for damage and wear.

2. Inspect the bushings and oil seal in the governor housing for burrs and excessive wear.

GOVERNOR INSTALLATION

1. Install the driver assembly. Tighten the retaining nut to the correct torque, see "Specifications" — Chapter 3.

2. Install the governor outer race.

3. Replace the housing using a new gasket.

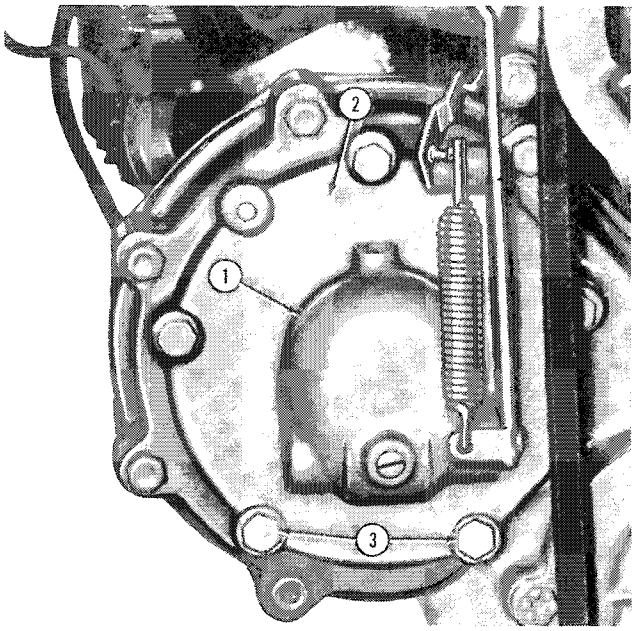

Figure 31
Gasoline Engine Governor Housing
1. Governor Housing
2. Front Cover
3. Attaching Bolts

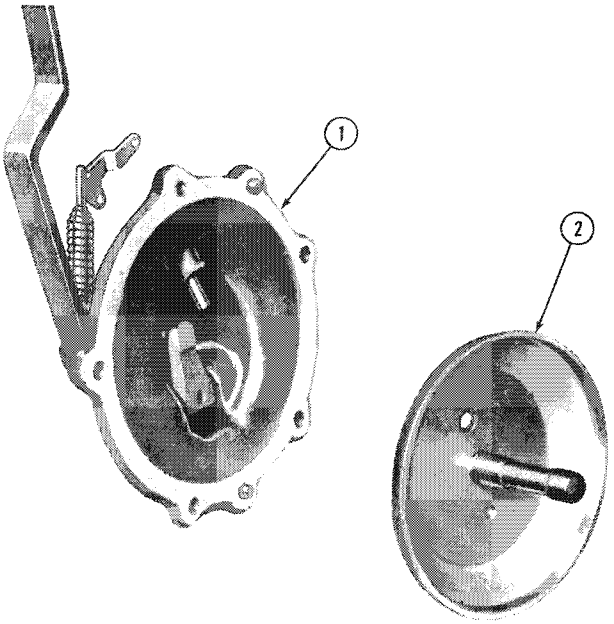

Figure 32
Governor Housing and Outer Race
1. Governor Housing
2. Outer Race

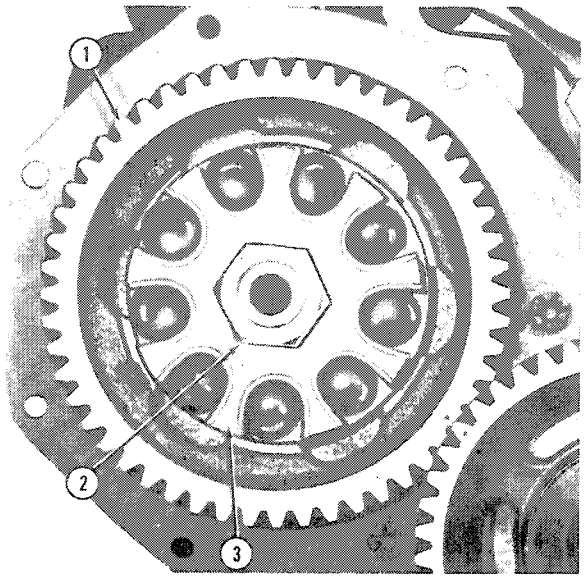

Figure 33
Engine Front Cover Removed Gasoline Engine
1. Drive Gear
2. Retaining Nut
3. Driver Assembly

OIL PAN REMOVAL

NOTE: *The oil pan can be removed with the engine installed in the tractor.*

1. Drain the engine oil and remove the oil level indicator.

2. Support the front transmission.

3. Remove the hood.

4. Disconnect the radiator shell support, slacken the engine to front support bolts leaving the nuts flush or partly disengaged from the end of the bolts.

5. Ease the front support and radiator assembly forward to allow the front oil pan bolts and the pan to be removed.

   NOTE: *Using this procedure it should not be necessary to disconnect the radiator hoses, power steering or hydraulic oil cooler tubes where fitted. However, care must be taken to be sure no components are unduly stressed.*

   WARNING: *Due to the weight of the cast iron oil pan, exercise great care on removal.*

INSPECTION AND REPAIR

1. Scrape all gasket material from the gasket surface then wash the oil pan in a suitable solvent and dry with a clean lint free cloth or compressed air.

2. Inspect the pan for cracks, damaged drain plug threads or distorted gasket surface.

INSTALLATION

Installation of the oil pan follows the removal procedure in reverse. On installation observe the following requirements.

- Be sure the gasket surfaces on the oil pan and block are clean.
- Install a new gasket and apply a thin film of sealer to the gasket, front cover and oil pan.
- Position the oil pan and install a bolt finger tight at each corner.
- Install the remaining bolts, tighten the rear bolts first, then tighten from the middle outward in each direction to the specified torque, see "Specifications" — Chapter 3.
- Fill the engine with the correct grade and quantity of oil, see "Specifications" — Chapter 3.
- Operate the engine and check for oil leaks.

OIL PUMP

REMOVAL

1. Remove the oil pan as previously described in this Chapter.

2. Remove the oil pump with the filter screen, Figure 34. Withdraw the intermediate shaft.

3. Disconnect the proofmeter drive cable from the driveshaft adapter and remove the engine oil filter.

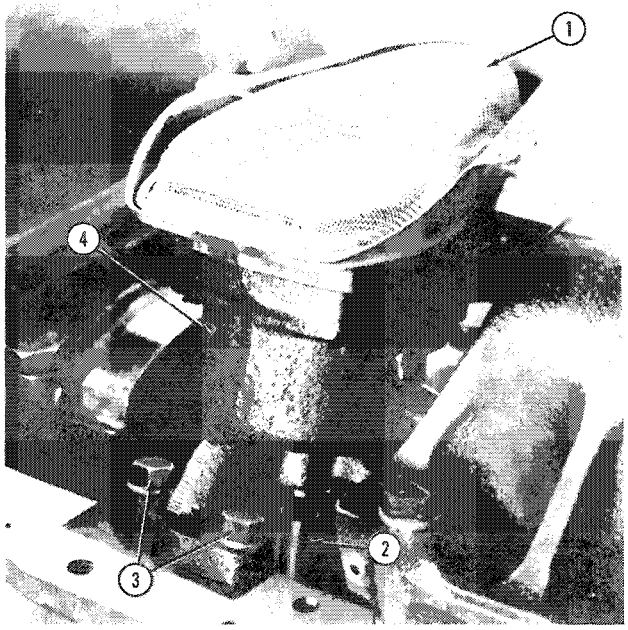

Figure 34
Oil Pump and Filter Screen
1. Filter Screen
2. Intermediate Shaft
3. Oil Pump Retaining Bolts
4. Oil Pump

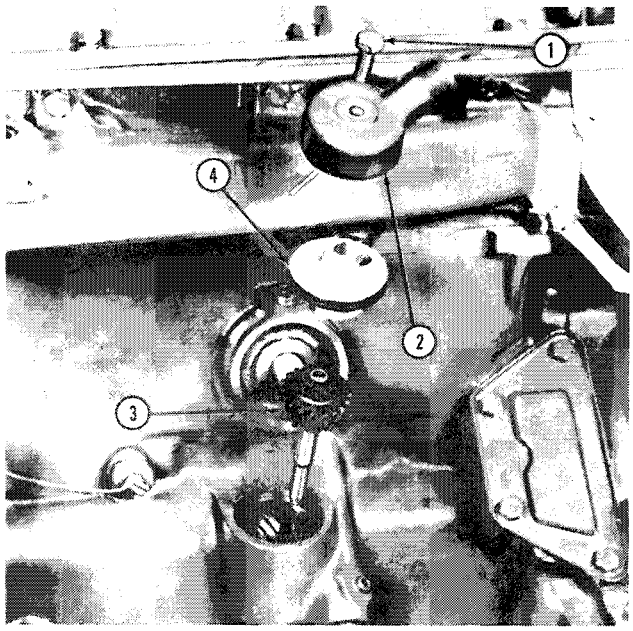

Figure 35
Oil Pump Drive Gear Removal
1. Retaining Bolt
2. Proofmeter Driveshaft Adapter
3. Oil Pump Drive Shaft and Gear Assembly
4. Drive Shaft Adapter Mounting Base

4. Slacken the retaining bolt then withdraw the driveshaft adapter assembly and the oil pump drive gear, Figure 35.

DISASSEMBLY

With reference to Figure 26.

1. Remove the pump screen.

2. Withdraw the retaining screw and washer assemblies then separate the inner and outer covers from the body and extract the rotor and shaft assembly.

3. Insert a self-tapping screw into the relief valve plug and pull the plug out of the body. Withdraw the relief valve and spring.

INSPECTION AND REPAIR

1. Wash all parts in a suitable solvent and dry with a clean lint free cloth or compressed air.

2. Inspect the inside of the pump cover and body for excessive wear.

3. Use a straight edge and feeler gauges to measure the endplay between the inner rotor and the pump body and measure the clearance between the outer rotor and the pump body, Figure 37.

4. Use feeler gauges to measure the clearance between the periphery of the outer rotor and the pump body, Figure 38.

   Replace the rotor assembly and/or pump body if beyond any of the specified limits, see "Specifications" — Chapter 3.

5. Check the relief valve spring tension, see "Specifications" — Chapter 3.

6. Inspect the relief valve for wear and check for freedom of movement within the bore. Inspect the valve bore for excess wear and scoring.

8. Examine the intermediate drive shaft socket ends for wear.

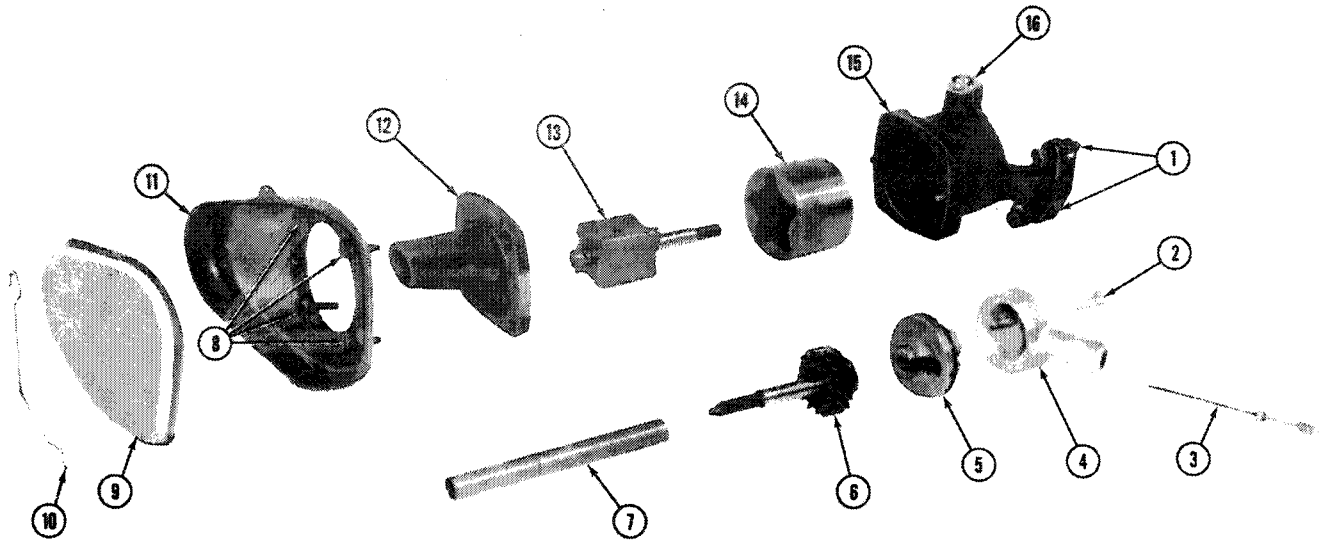

Figure 36
Oil Pump Assembly

1. Oil Pump Retaining Bolts
2. Adapter Retaining Bolt
3. Proofmeter Drive Shaft and Cable Assembly
4. Proofmeter Drive Shaft Adapter
5. Driveshaft Adapter Mounting Base
6. Oil Pump Drive Shaft and Gear Assembly
7. Intermediate Shaft
8. Screw and Washer Assemblies
9. Screen
10. Spring
11. Outer Cover
12. Inner Cover
13. Inner Rotor and Shaft Assembly
14. Outer Rotor
15. Body
16. Pressure Relief Valve Assembly

ASSEMBLY

Assembly of the oil pump components follows the disassembly procedure in reverse. On assembly observe the following requirements.

- Oil all the parts.
- The inner rotor and shaft assembly and the outer rotor are serviced as an assembly.
- Prior to installation, introduce clean engine oil into the inlet port and rotate the pump shaft by hand.

INSTALLATION

Installation of the oil pump follows the removal procedure in reverse. On installation observe the following requirements.

- Install a new gasket and tighten the bolts to the correct torque, see "Specifications" — Chapter 3.
- Install a new oil filter and oil filter cover gasket.

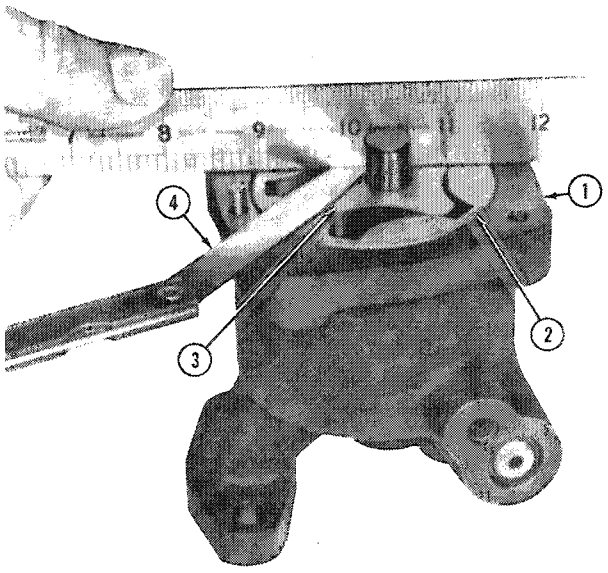

Figure 37
Measuring Oil Pump Clearance
1. Pump Body
2. Outer Rotor
3. Inner Rotor
4. Feeler Gauge

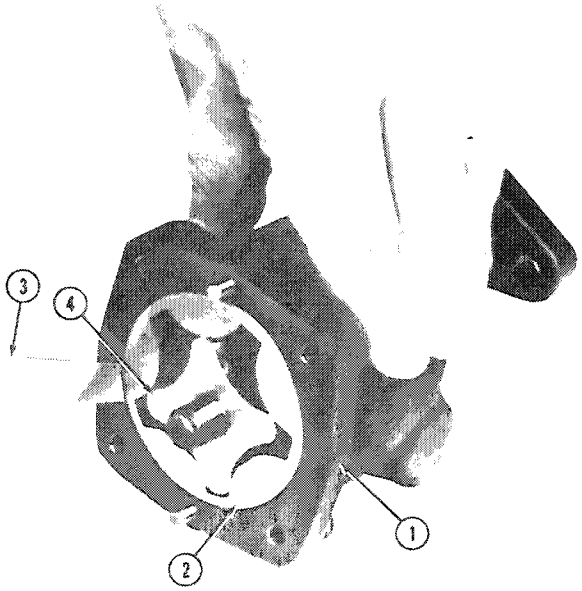

Figure 38
Measuring Outer Rotor to
Pump Body Clearance
1. Pump Body
2. Outer Rotor
3. Feeler Gauge
4. Inner Rotor

CONNECTING RODS, BEARINGS, PISTONS, RINGS AND CYLINDER BLOCK

REMOVAL

NOTE: *The connecting rods and pistons can be removed with the engine installed in the tractor after pior removal of the cylinder head, oil pan and oil pump assembly as described in this Chapter.*

1. If necessary, remove any ridge from the top of the cylinder bores with a cylinder ridge reamer or hand scraper, Figure 39. Do not cut down into the piston ring travel area.

2. With the piston at the bottom of its stroke, remove the nuts from the bearing cap bolts and remove the bearing cap and liner, Figure 40.

3. Use the handle end of a hammer to push the piston and rod assembly out of the top of the block. Remove the bearing liner from the connecting rod.

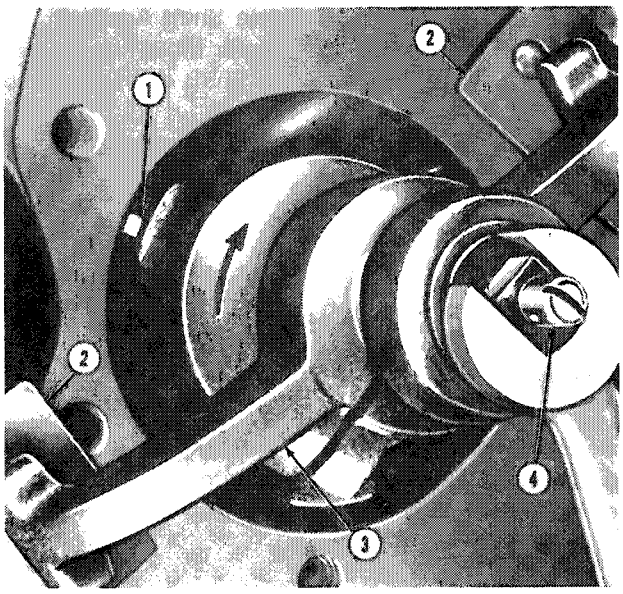

Figure 39
Removing Cylinder Ridge
1. Cutter Blade
2. Shoe
3. Reamer
4. Adjusting Screw

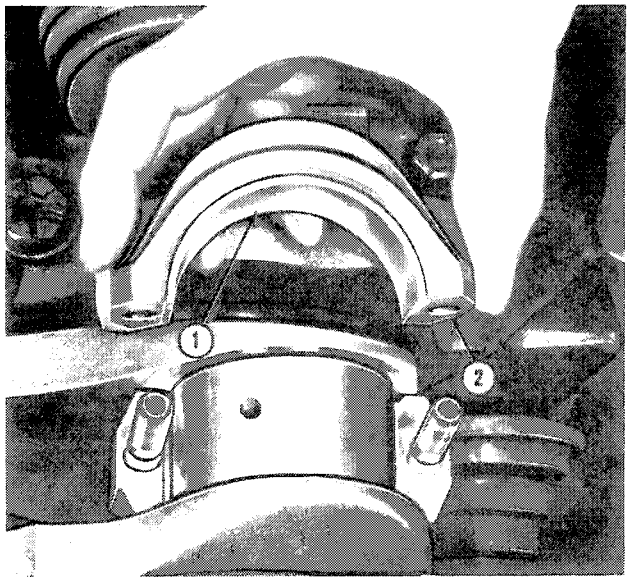

Figure 40
Connecting Rod Bearing Cap Removal
1. Bearing Liner
2. Bearing Cap

4. Turn the crankshaft to bring each piston to the bottom of its stroke and repeat this procedure. Keep the bearing caps and liners with their respective connecting rods.

Connecting Rod Bearings:

1. If the bearing liners are scored, have the flash overlay wiped out, show fatigue failure, or are badly scratched, as shown in Figure 41, install new bearing liners.

2. If the bearing liners appear to be serviceable, keep with their respective rods for reassembly in the engine. If the clearance exceeds the specified limits, new bearings must be installed. Undersize connecting rod bearings are available in 0.002 in. (0.0508 mm.), 0.010 in. (0.254 mm.), 0.020 in. (0.508 mm.), 0.030 in. (0.762 mm.) and 0.040 in. (1.016 mm.) for service. If new bearings are required follow the procedure covered in the crankshaft section of this chapter.

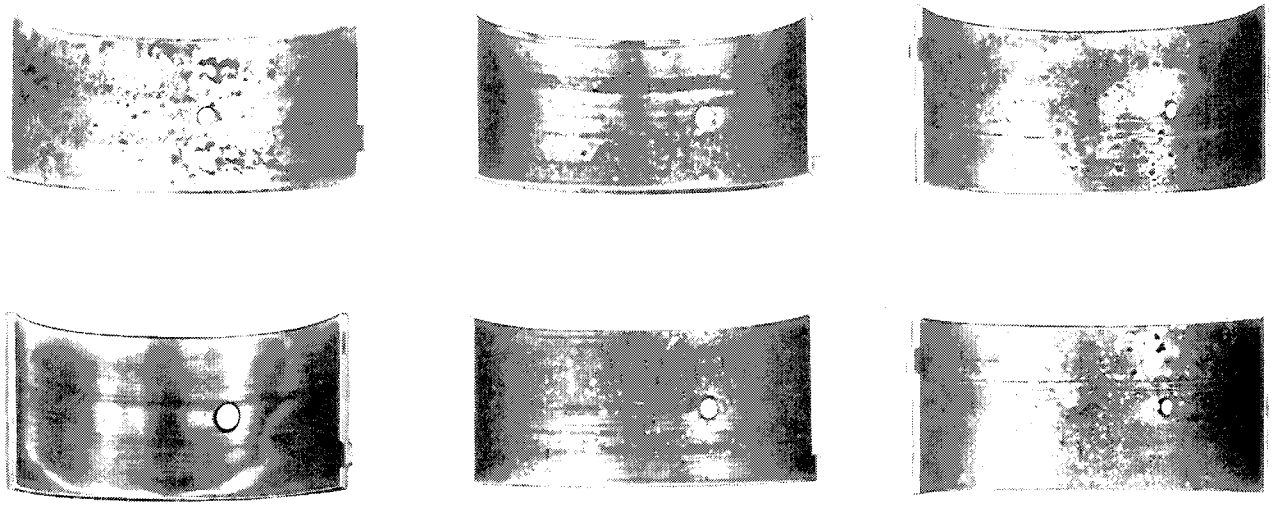

Figure 41
Typical Defective Bearing

DISASSEMBLY

1. Remove the piston pin retainer (snap ring) from each side of the piston and remove the pin.
2. Use an expander to remove the piston rings, Figure 42.
3. Identify each piston and rod for reassembly, Figure 43.

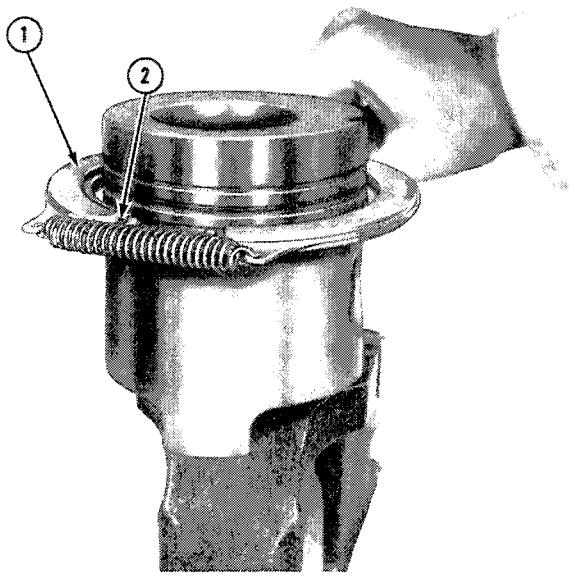

Figure 42
Piston Ring Removal

1. Piston Ring Expander
2. Piston Ring

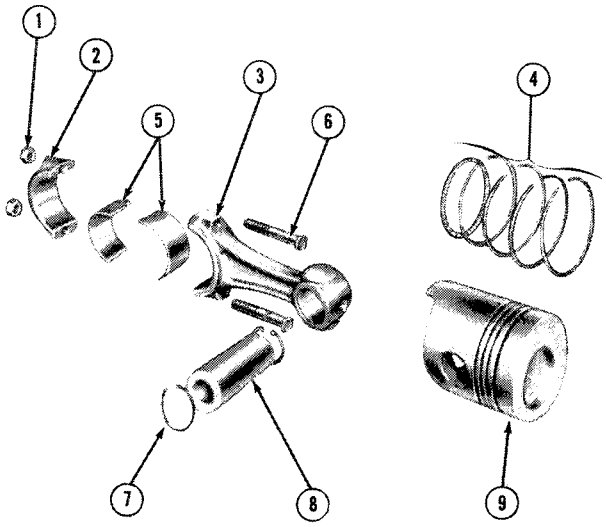

Figure 43
Piston and Connecting Rod Disassembled

1. Retaining Nuts
2. Bearing Cap
3. Connecting Rod
4. Piston Rings
5. Bearing Liners
6. Bolt
7. Pin Retainers
8. Piston Pin
9. Piston

INSPECTION AND REPAIR

1. Wash the piston and connecting rod assembly in a suitable solvent and dry with a clean lint free cloth or compressed air.

2. Inspect the piston ring lands, skirts and pin bosses for damage. Check for separation of the top ring insert from the piston.

3. Clean the ring grooves and using a new ring and feeler gauge check the piston ring lands for wear, Figure 44. For maximum ring clearance see "Specifications" — Chapter 3.

4. Check the connecting rod components for damage and place each connecting rod in an alignment fixture to check for distortion, see "Specifications" — Chapter 3.

5. Measure the outside diameter of the piston pin and the inside diameter of the connecting rod bushing. If the clearance is not within the specified limits, see "Specifications" — Chapter 4, press out the connecting rod bushing and install a new bushing using Tool No. 9514 with a suitable Adaptor, Figure 45.

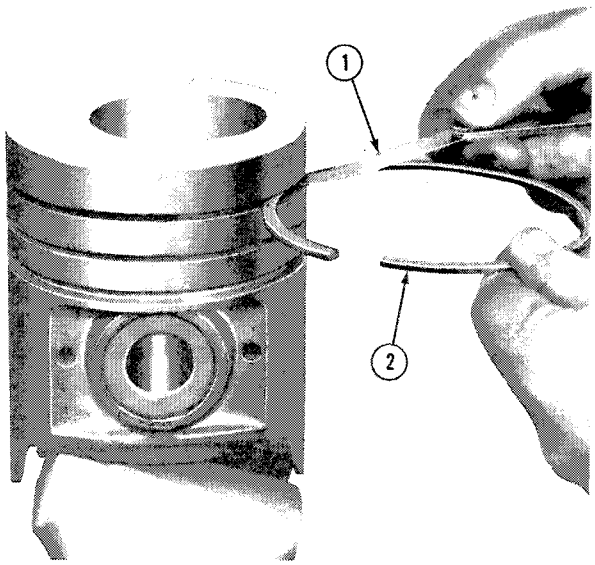

Figure 44
Checking Piston Ring Side Clearance

1. Feeler Gauge
2. New Piston Ring

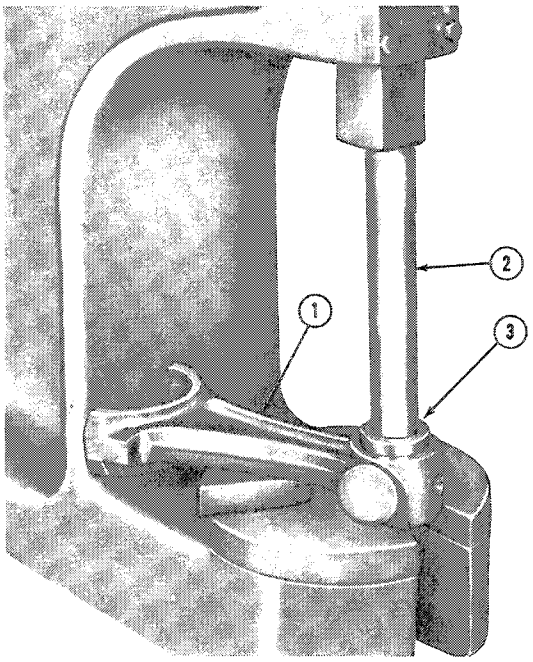

Figure 45
Connecting Rod Bushing Removal And Installation

1. Connecting Rod
2. Handle - Tool No. 9514
3. Adapter

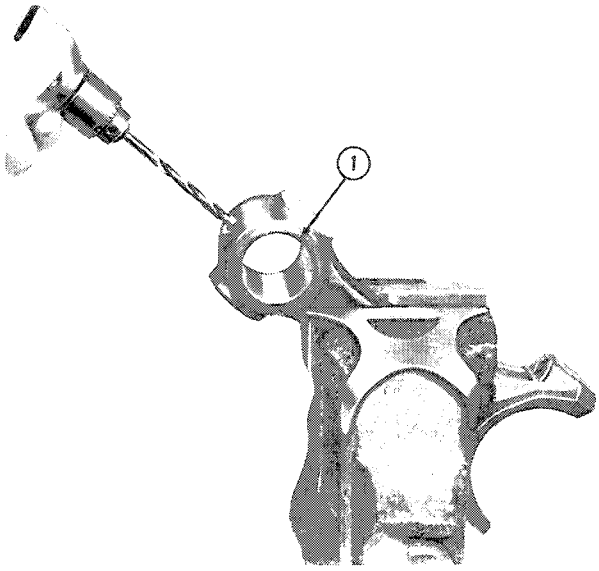

Figure 46
Connecting Rod Bushing Installed

1. Connecting Rod Bushing

6. After installation of a new connecting rod bushing, use the hole in the top of the rod as a guide, drill a 0.25 in. (6.4 mm) diameter hole through one wall of the bushing, Figure 46.

7. Use an expansion reamer to ream the bushing to obtain the specified bushing-to-piston pin clearance.

8. Check the connecting rod and main bearing clearances as described in this Chapter. If the bearing clearances exceed the specified limits, see "Specifications" — Chapter 3, then install new bearings as described in the CRANKSHAFT section of this Chapter.

9. Clean and inspect the cylinder block. Rust around the core plugs indicates leakage and new plugs should be installed with suitable sealant.

10. Inspect and measure the cylinder bores for waviness, scratches, scuffing, out-of-round, wear and taper. A wavy cylinder wall has a series of parallel lines or rings worn around the cylinder, within the ring travel area. These irregularities can be felt by running a finger over the surface. A scuffed cylinder can be identified by discolored areas. Out-of-roundness, wear and taper can only be detected with a cylinder bore gauge. Measure lengthwise and crosswise to obtain dimensions 'A', 'B', 'C' and 'D', Figure 47. Dimension 'A' compared with 'B', and dimension 'C', compared with 'D', indicates taper while the crosswise dimensions 'C' and 'D' compared to the lengthwise measurements 'A' and 'B' show if an out-of-round condition exists. See "Specifications" — Chapter 3.

11. If the cylinders are outside specification or the walls are damaged, the cylinders should be honed or bored to fit the next oversize pistons. The finished bore size can be determined by measuring the piston diameter at right angles to the piston pin and adding the appropriate piston-to-bore clearance, see "Specifications" — Chapter 3. Always bore the cylinder with the most wear first to determine the oversize pistons required.

    Oversize pistons are available as follows:

    - 0.004 in. (0.10 mm)
    - 0.020 in. (0.51 mm)
    - 0.030 in. (0.76 mm)
    - 0.040 in. (1.0 mm)

Bores to take 0.004 in. (0.10 mm) oversize pistons need only be honed. All honing should be done with a rigid hone having a grit size of 150-220. After reboring and honing, thoroughly wash and dry the cylinder block and coat the walls with engine oil.

12. For cylinders with severely damaged walls or to which maximum oversize pistons have already been installed, cylinder liners are available for sleeving the bore.

    - 4.4 in. (111.76 mm) Bore Thin Walled Lipped Sleeve:

      (i) Measure the outside diameter of the sleeve in four places and find the average diameter. Bore the block to 0.000-0.002 in. (0.00-0.05 mm) less than this average diameter.

      (ii) Machine the counterbore to the dimensions shown in Figure 48. The counterbore depth is critical as the sleeve must be flush with the block surface when installed.

      (iii) Install the liner and be sure the lip bottoms in the counterbore. If necessary the sleeve may be machined to bring it flush with the block face, or if necessary the block face may be skimmed by up to 0.005 in. (0.13 mm) to achieve a flush condition. If the block is skimmed be sure the piston to block height dimension is maintained within specification, Figure 49, see "Specifications" — Chapter 3.

      (iv) Bore and hone the sleeve to the diameter required. Only standard and 0.004 in. (0.10 mm) oversize pistons can be used with the thin walled 4.4 in. (111.76 mm) bore sleeve.

13. Check the flatness of the cylinder block-to-head surface, see "Specifications" — Chapter 3.

ASSEMBLY

NOTE: *Prior to assembly, check the cylinder bores for taper and out-of-round previously described in this Chapter.*

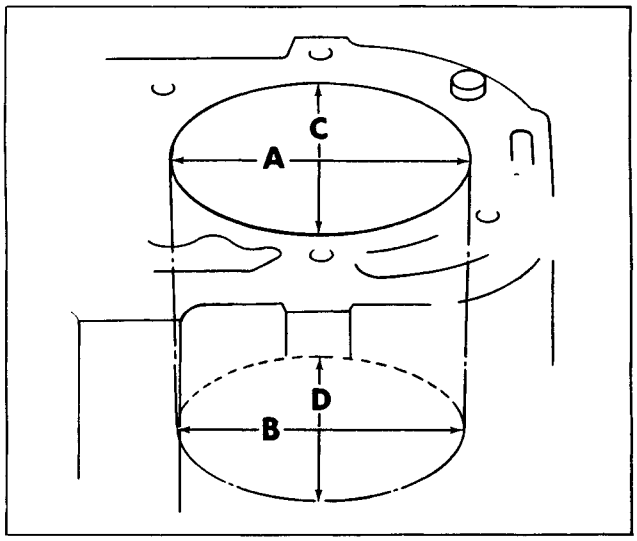

Figure 47
Cylinder Bore Measurements

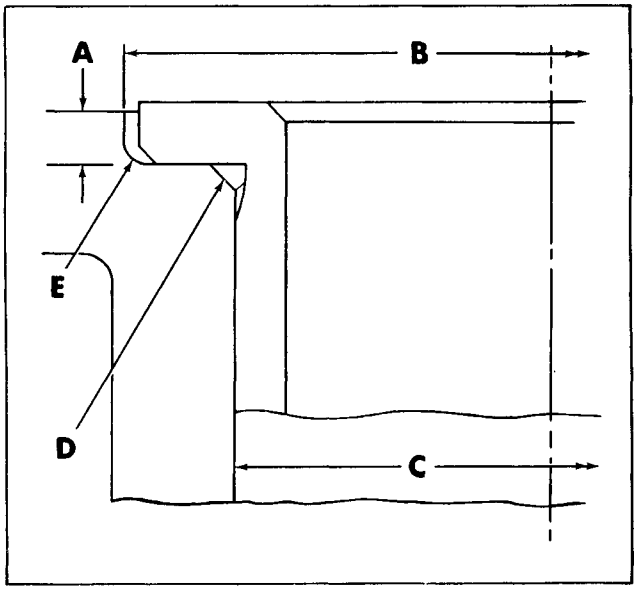

Figure 48
Dimensions for Machining Cylinder Bore For Thin Walled Sleeve

A. 0.095-0.099 in. (2.41-2.51 mm)
B. 4.746-4.753 in. (120.55-120.73 mm)
C. Bore Cylinder to Average Diameter of Sleeve less 0.000-0.002 in. (0.00-0.05 mm)
D. 0.020-0.030 in. (0.50-0.75 mm) x 45° Chamfer
E. 0.015 in. (0.381 mm) Radius Maximum

1. Prior to assembly, check the piston-to-bore clearance as follows:

   - Measure the cylinder bore diameter in a crosswise direction then measure the piston diameter at right angles to the piston pin.
   - Subtract the piston diameter from the bore diameter and the resultant figure should be within the specified clearance, see "Specifications" — Chapter 3.

     NOTE: *Pistons are available in both standard and oversizes. New pistons should be installed if the clearance exceeds the specified limits.*

   - If the clearance is **greater** than specified, try a similar new piston. If the clearance still exceeds the specified limit, measure the other cylinder bores and pistons and determine the cylinder with the greatest clearance. Based on the greatest clearance, rebore the cylinders to take the next oversize piston as previously described in this Chapter.
   - If the clearance is **less** than specified: Hone the bore to obtain the desired clearance as previously described in this Chapter.

2. Lubricate all components with engine oil then assemble the piston to the connecting rod with the notch on the piston crown aligned with the pip on the connecting rod and install the piston pin and retainer (snap rings), Figure 50.

3. Check the piston rings for minimum gap prior to installation in the relevant cylinder, Figure 51. Use a piston crown to squarely locate the ring in the bore. New rings should be checked for side clearance in the piston as previously described in this Chapter.

4. Use an expander to install the piston rings, starting with the oil control ring in the bottom groove and working upwards.

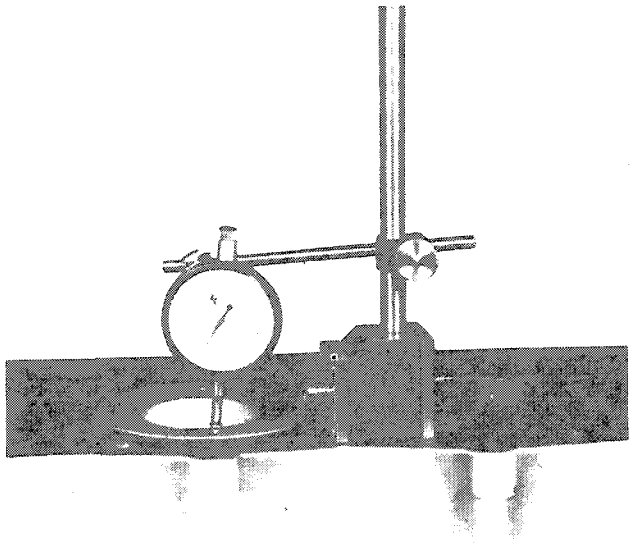

Figure 49
Measuring Piston To Block Height

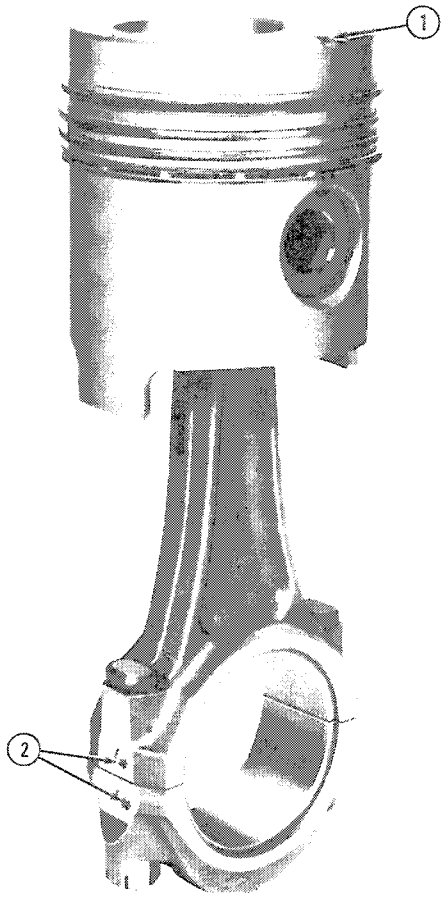

Figure 50
Piston To Connecting Rod Alignment
1. Notch To Front of Engine
2. Cap Numbers

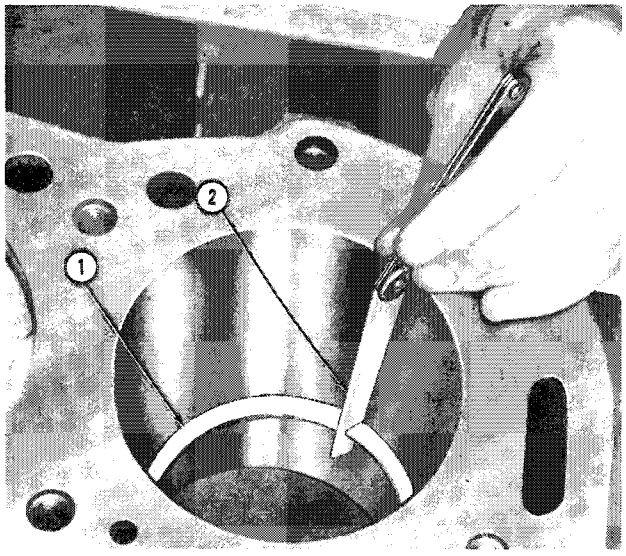

Figure 51
Checking Piston Ring Gap
1. Piston Ring
2. Feeler Gauge

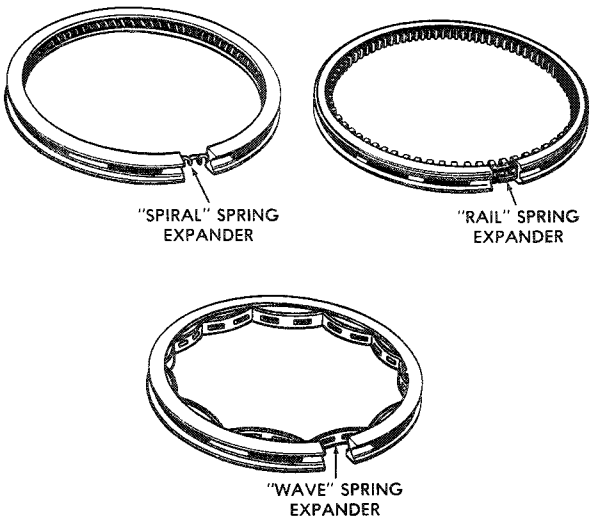

Figure 52
Piston Rings

Piston Rings:

The piston ring set comprises of:

- 3 Compression Rings.
- 1 Oil Control Ring.
- 1 Non-Slotted Ring Expander for No. 3 Compression Ring.
- 1 Spiral or rail type Ring Expander for Oil Control Ring.

Three different types of ring expanders are commonly used, Figure 52.

The "wave type" expander provides the least amount of wall pressure and is used behind the no. 3 compression ring.

The "spiral spring" expander provides greater wall pressure and is used behind the oil control ring.

The "rail type" spring expander provides slightly more wall pressure than the spiral spring and is an alternate design used interchangeably with the spiral spring expander.

Piston Ring Installation:

The design of the piston rings and the identification markings on the rings varies among engines. It is imperative that each of the respective piston rings is installed correctly in it respective ring groove. Use an expander to install the piston rings, starting with the oil control ring in the bottom groove and working upwards.

Oil Control Ring:

Install the oil control ring in the bottom groove as follows:

1. Open the coil spiral spring at the guide pin. Place the coiled spring in the oil groove of the ring, inserting the guide pin into the open end of the coil. Close until the spring ends butt.
2. Install the cast iron ring with either side up, with the inside groove of the ring over the coiled spring, placing the ring gap opposite the coil spring ends.

3rd Compression Ring:

The 3rd compression ring is dull grey or black and must be installed in the third groove. When installed the side marked "top" must be facing towards the top of the piston. The step on the inside of the ring will be facing upwards.

2nd Compresson Ring

The 2nd compression ring is dull chrome and must be installed in the second groove. When installed, the side marked "top" must be facing towards the top of the piston. The step on the inside of the ring will be facing upwards.

Top Compression Ring

The top compression ring is bright chrome and must be installed in the top groove. The top compression ring may be installed with either side up.

5. After installing the rings, stagger the ring gaps around the circumference of the piston.

NOTE: *Gasoline engine piston rings are assembled in the same manner as diesel engine piston rings, except the second compression ring must be assembled like the third compression ring on the diesel engine pistons. Always begin ring assembly from the oil ring groove.*

INSTALLATION

NOTE: *Before installing a piston and new rings into a used cylinder bore, remove the high polish on the cylinder wall by passing a hone lightly through the cylinder or by making a figure eight pattern with very fine emery cloth dipped in a mixture of fuel and lubricating oil. After honing, thoroughly wash and dry the bores and coat the walls with oil.*

1. Select the correct bearing liners, as described in the CRANKSHAFT section of this Chapter, and install in the connecting rod and cap. Be sure the bearing liner tang locates in the slots of the rod and cap.
2. Turn the crankshaft to position the No. 1 crankpin at the bottom of the stroke. Oil the piston, rings, cylinder bore and bearing liners. Use a ring compressor to install the piston into the cylinder, Figure 53. Be sure the notch on the top of the piston is towards the front of the engine.
3. Push the piston into the bore until the connecting rod bearing liner seats on the crankpin. Install the connecting rod bearing cap with the number on the cap on the same side as the number on the rod. Install new nuts and tighten to the correct torque, see "Specifications" — Chapter 3.
4. Use feeler gauges to check the side clearance of each connecting rod, Figure 54, see "Specifications" — Chapter 3.
5. Install the remaining piston and rod assemblies in the same manner.
6. Install the oil pump, the oil pan and the cylinder head as previously described in this Chapter.
7. Fill the engine with the correct grade and quantity of oil and the radiator with coolant, see "Specifications" — Chapter 3.
8. Start the engine and check for leaks.

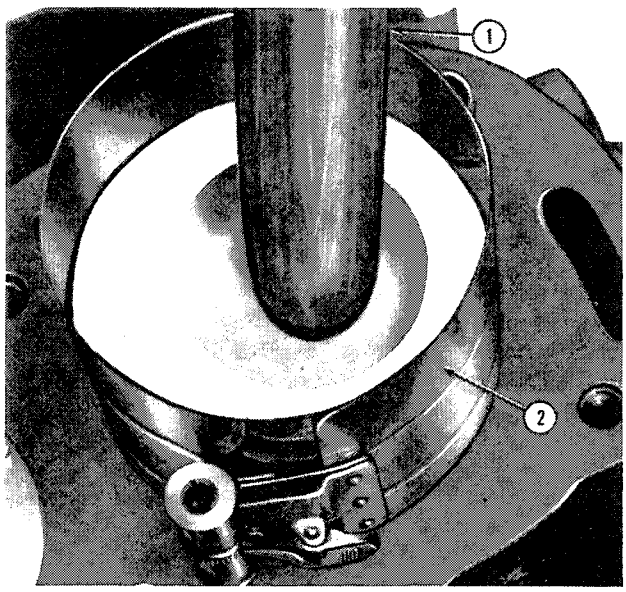

Figure 53
Piston and Connecting Rod Installation
1. Hammer Handle 2. Piston Ring Compressor

CRANKSHAFT – MAIN BEARINGS AND FLYWHEEL

The main bearings can be replaced with the engine in the tractor. To remove the flywheel, the engine must be separated between the engine and the transmission. To remove the crankshaft, the engine must be removed from the tractor.

MAIN BEARINGS

REMOVAL

1. Remove the oil pan, the oil pump and intermediate shaft as previously described in this Chapter.

2. Remove the main bearing cap from the journal to which the new bearing liners are to be installed. Always install one set of bearings at a time leaving the other main bearing caps securely in place.

3. Install a bearing liner removal tool in the crankshaft journal oil passage. Slowly turn the crankshaft counter-clockwise until the tool forces the bearing out of the cylinder block.

   NOTE: *If a bearing liner removal tool is not available, a suitable tool may be fabricated from a 1 in. (25 mm) 1/8 in. (3 mm) split pin as shown in Figure 55. The shorter pin is used to remove the thrust bearing insert.*

   Flatten and bend the head to 30° to conform to the angle of the oil passage in the crankshaft.

INSPECTION AND REPAIR

Clean the bearing liners, journals, and caps thoroughly. Inspect each bearing carefully. Bearing liners that have a scored, chipped, or worn surface, as shown in Figure 56, should be replaced. Reinstall the liners that appear serviceable. If new liners are installed, check the clearances, using Plastigage method. If the crankshaft is damaged, it should be reworked or replaced.

INSTALLATION

1. Apply a light coat of engine oil to the journal and bearing liner.

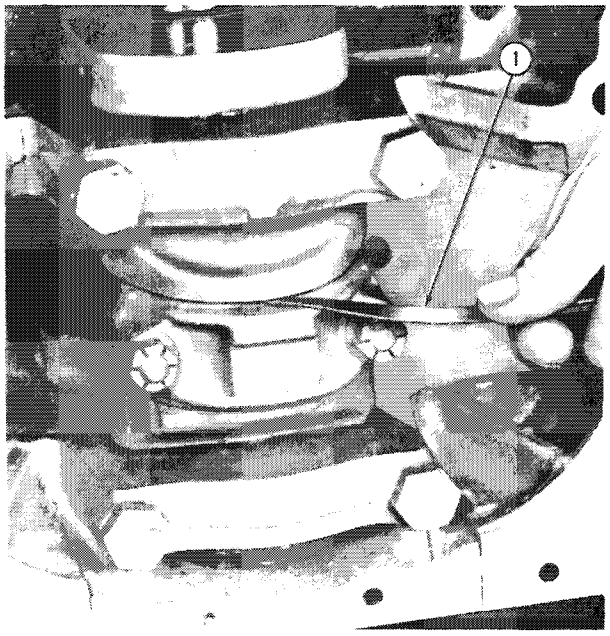

Figure 54
Checking Connecting Rod Bearing Side Clearance
1. Feeler Gauge

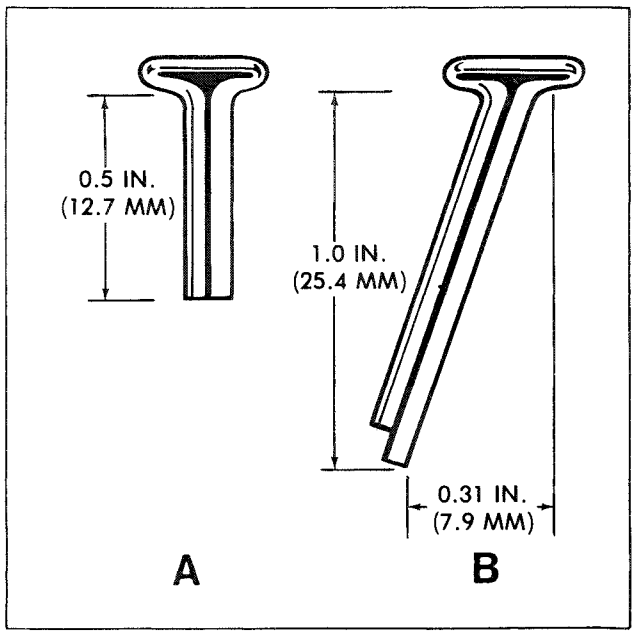

Figure 55
Bearing Liner Removal Tools
A. Thrust Bearing Insert Tool
B. Main Bearing Liner Tool

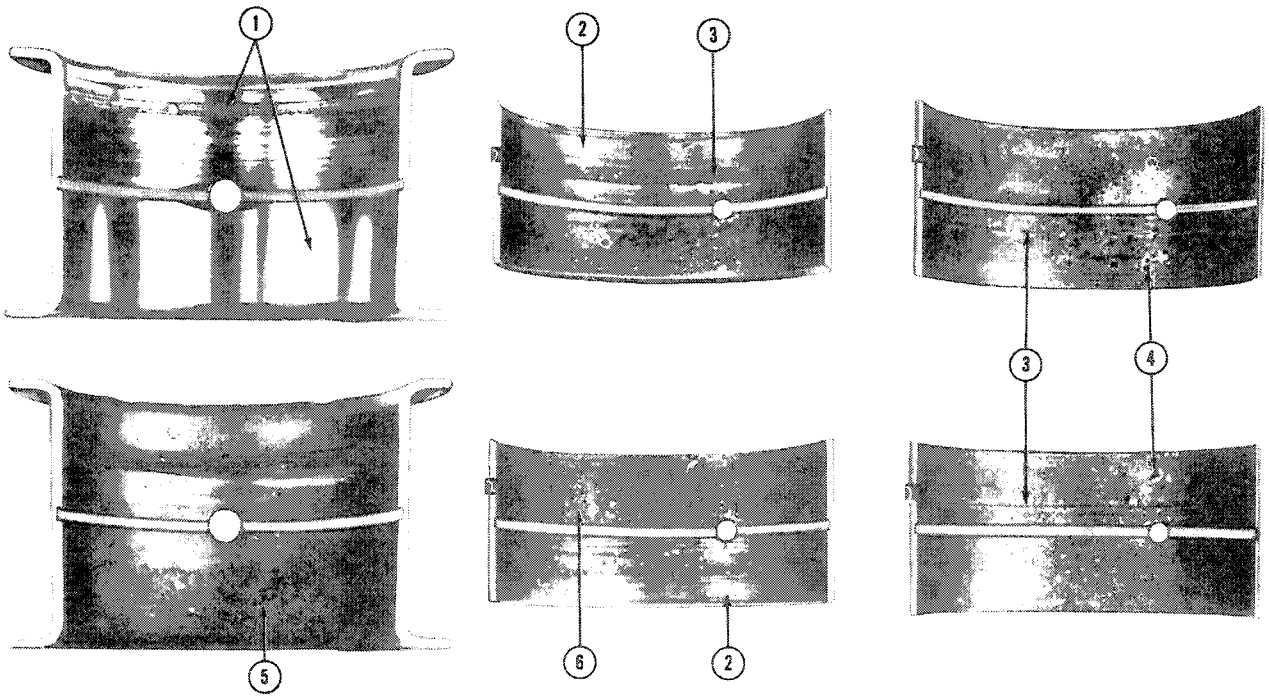

Figure 56
Typical Bearing Failures

1. Overlay Worn
2. Radii Ride
3. Scratches
4. Imbedded Dirt
5. Craters or Pockets
6. Fatique Failure

2. Locate the liner installation tool in the crankshaft journal oil passage and position the liner on the journal with the plain end of the liner at the tang side of the cylinder block. Slowly turn the crankshaft clockwise until the bearing is fully located. Remove the installation tool.

3. Lubricate the bearing cap and liner and install the liner into the cap. Position the bearing cap with the locking tang towards the camshaft side of the engine and install the retaining bolts. Tighten the bolts to the correct torque, see "Specifications" — Chapter 3.

4. If a new thrust bearing liner is installed, the bearing must be aligned as described in the CRANKSHAFT section of this Chapter.

5. Install the oil pump and intermediate shaft, and the oil pan.

FLYWHEEL

REMOVAL

1. Separate the tractor between the engine and the front transmission, see "SEPARATING THE TRACTOR" — Part 10.

2. Remove the pressure plate and clutch disc assembly from the flywheel, see "CLUTCHES" — Part 4.

3. Prior to removal, rotate the flywheel and use a dial, indicator to measure the run-out, Figure 57, see "Specifications" — Chapter 3. If the flywheel is outside the specification check the mating surfaces of the flywheel and the crankshaft for correct seating.

4. Remove the flywheel attaching bolts and carefully remove the flywheel.

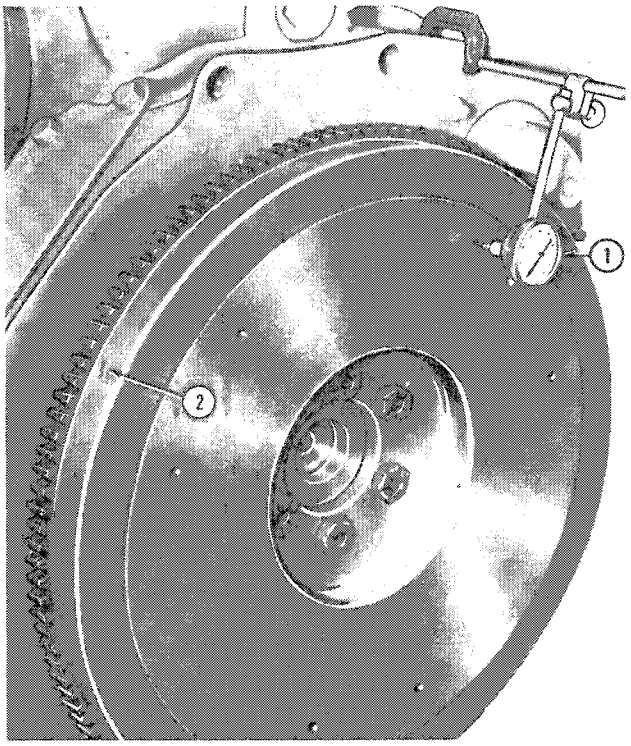

Figure 57
Checking Flywheel Run-Out
1. Dial Indicator Gauge
2. Flywheel

INSPECTION AND REPAIR

1. Inspect the flywheel ring gear and replace if the teeth are damaged. Check the flywheel for damage due to loosely or improperly fitted ring gear.

2. A damaged flywheel ring gear should be removed and replaced as follows:

   - Cut the old ring gear free from the flywheel.

   - Thoroughly clean the mating surfaces of the new ring gear and the flywheel.

   - Use temperature indicating crayons to mark the **side** face of the ring gear at six equally spaced locations. Mark with a 400°F (204°C) crayon at a point 0.5 in. (13 mm) below the root of the teeth and mark with a 450°F (212°C) crayon at a point just below the root of the teeth.

   - Use an oxy-acetylene torch with a tip size No. 2 maximum and direct the flame against the **internal** face of the gear.

   - Stop applying heat when the 400° F (204°C) crayon marks melt and before the 450° F (212 C) crayon marks melt.

   - Quickly place the hot gear on the flywheel with the flat face against the shoulder on the flywheel. Quench the gear with water.

INSTALLATION

1. Clean the crankshaft rear flange and the mating surface of the flywheel.

2. Establish the correct alignment of the flywheel to crankshaft mounting holes and install the flywheel. Tighten the attaching bolts to the correct torque and re-check the flywheel run-out, see "Specifications" — Chapter 3.

3. Install the pressure plate and clutch disc assembly, see "CLUTCHES" — Part 3.

4. Re-assemble the tractor, see "SEPARATING THE TRACTOR" — Part 10.

CRANKSHAFT

REMOVAL

1. Remove the engine from the tractor, see "SEPARATING THE TRACTOR" — Part 10, and place on an egine stand.

2. Remove the pressure plate and clutch disc assembly from the flywheel, see "CLUTCHES" — Part 4.

3. Remove the flywheel and engine rear cover plate.

4. Remove the crankshaft pulley and engine front cover.

   NOTE: *If the crankshaft is removed with the cylinder head in position, be sure all timing marks are realigned prior to reassembly. This action will prevent possible interference between the valves and pistons during re-assembly.*