
# Blue Ribbon Service

**Form GSS-1007**

# Engine

**File: Farmall Cub Tractor Service Manual**

INTERNATIONAL HARVESTER COMPANY
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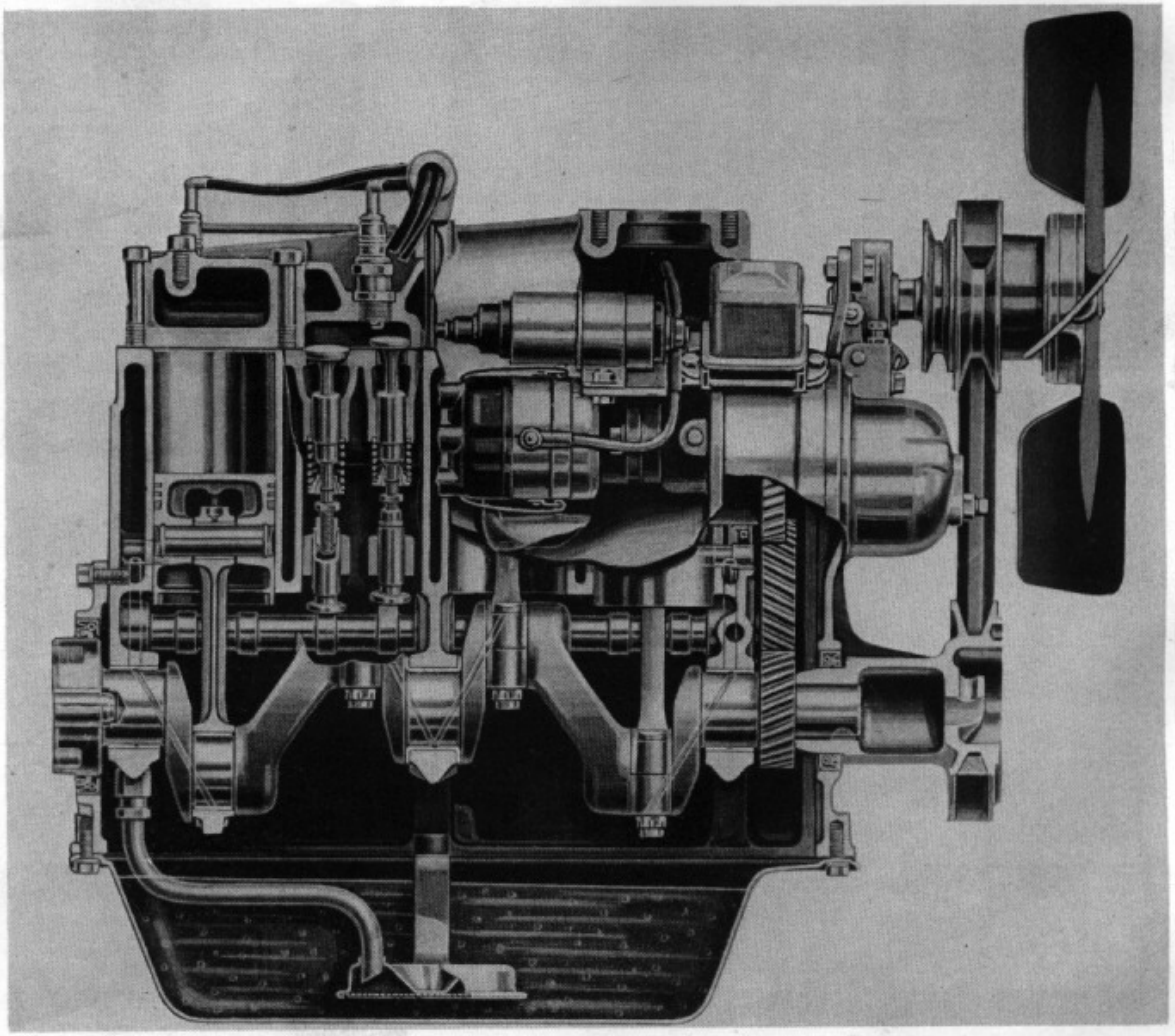


Illust. 1 -- Cross section of Farmall Cub engine, side view.

# GENERAL DESCRIPTION

For a list of engine specifications, see Form GSSS-1008 in the BRS Manual.

The Cub engine produces smooth operation and high thermal efficiency for low operating costs and long engine life.

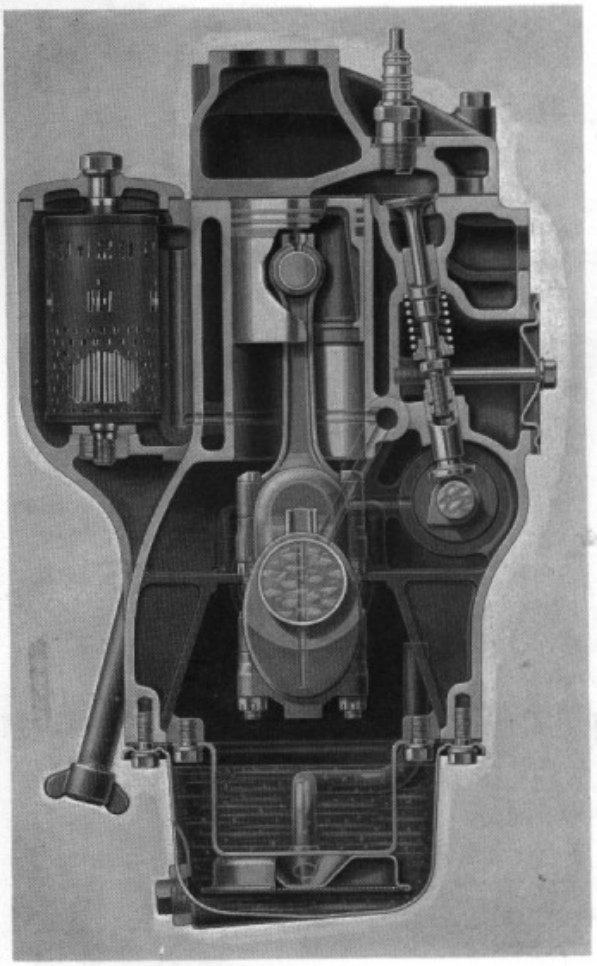
The engine is protected against entry of dust and abrasive material by (1) an oil bath cleaner, (2) a large-area, replaceable oil filtering element, and (3) a cleanable element incorporated in the crankcase breather. Efficient dust and oil seals at the crankshaft prevent the entry of dust at these points. The ignition drive is flange-mounted to the crankcase as another precaution in sealing the engine against the entry of dirt.

Ignition is provided by the International Harvester J-4 waterproof, fixed-spark, high-tension magneto. The automatic impulse coupling insures a hot spark for easy starting and retards the ignition timing at cranking speed for the protection of the operator or cranking motor. A battery-type ignition system incorporating automatic spark advance and waterproof construction is available as an attachment for Cub tractors already equipped with starting and lighting attachments. When the starting and lighting attachment is factory-installed as original equipment, battery ignition is included in place of the magneto.

A variable-speed, centrifugal-type engine governor makes it possible for the operator to select the most economical speed for the job being done. The governor is simple in construction. The rockshaft and connections are small and of light weight, which results in the snappy governor action so desirable for operation under variable loads.

The carburetor, manifold and compression ratio are designed for maximum power and economy when burning gasoline with an octane rating of 75 or higher.

Connecting rod and crankshaft bearings are of replaceable babbitt-lined, steel-backed micro-precision type. The engine lubrication system is the conventional force-feed type. A gear pump supplies oil under pressure to the various bearings and oil filter element through galleries and drilled passages in the crankcase and crankshaft. The crankcase is ventilated to reduce condensation of moisture to a minimum.



**Illust. 2 -- Cross section of Farmall Cub engine, front view.**

# REMOVING ENGINE FROM TRACTOR

To perform complete Blue Ribbon overhaul service on the Farmall Cub engine or to remove and service the crankshaft, camshaft and valve tappets, the engine must be removed from the tractor.

Utmost cleanliness is necessary when performing service operations because of the precision parts incorporated in the construction of modern tractors. Service work on the tractor engine should always be performed in the dealer's shop, where parts and surroundings can be kept clean and where service equipment is adequate. Before starting any major service work, the tractor should be steam cleaned and each individual part should be cleaned as soon as removed. Be sure you have all necessary tools and equipment. Proceed as follows to remove the engine:

1. Drain water, crankcase, oil and Touch-Control reservoir.

2. Disconnect battery cables (at battery) and headlight wires.

3. Remove air intake cap and radiator grill. (On old model Cub tractors the vertical muffler will also have to be removed at this time.)

4. Shut off fuel at fuel strainer and remove fuel pipe, hood and fuel tank.

5. Remove water outlet and inlet elbows.

6. Disconnect or remove all control rods and wires extending forward of the clutch housing.

7. Remove muffler and exhaust pipe, Touch-Control manifold and hydraulic pump. Cover openings in manifold, reservoir and hydraulic pump to prevent the entrance of dirt.

8. Remove governor connecting rod, air cleaner, exhaust and intake manifold with carburetor, and oil level gage with breather cap.

9. Remove generator, voltage regulator, fan assembly with belts, magneto or distributor assembly with spark plug wires, and cranking motor.

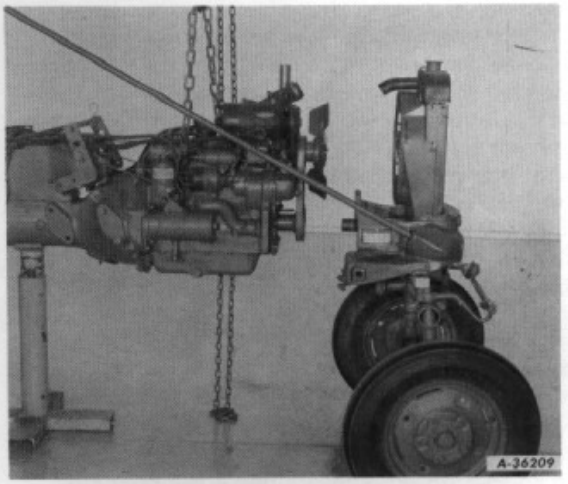
10. Disconnect steering shaft support arm bracket from steering shaft support arm.

11. Remove clutch housing cover immediately below the rear flange of the crankcase oil pan.

12. Attach chain hoist to the engine and adjust to eliminate slack.

13. Use wood blocks between the steering gear assembly housing and the front axle on both sides to eliminate movement on the front axle pivot shaft.

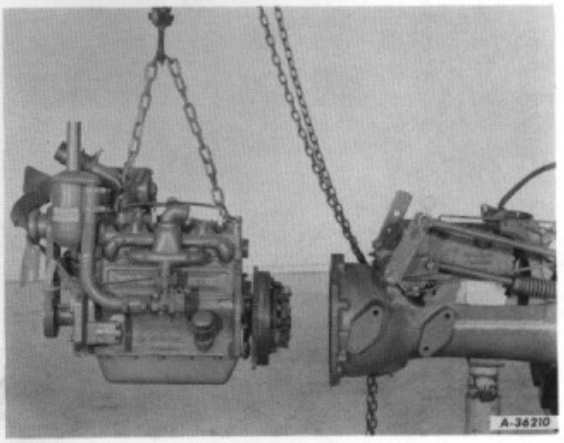
14. Remove the two bolts and two capscrews between the crankcase and steering gear housing. Roll front axle and radiator assembly away from the tractor. See Illust. 3




**Illust. 3 -- Front axle and radiator assemblies being removed from tractor.**

15. Adequately support the clutch housing and remove the four bolts and two capscrews between the clutch housing and the rear of the crankcase.

16. Separate the engine from the rear section of the tractor at the clutch housing.




**Illust. 4 -- Removing engine from rear section of tractor.**

# CYLINDER HEAD

SPECIFICATIONS

| | |
|---|---|
| Material | Gray iron |
| Cylinder head capscrews: | |
| Number | 15 |
| Diameter | 3/8-in. |
| Tension | 40-50 ft. lb. |

The cylinder head is a relatively simple casting into which the spark plugs and cooling water outlet are assembled. The 3/8-in. cylinder head capscrews should be turned down evenly a small amount at a time, starting in the center of the head and working toward each end. Use an accurate torque wrench and follow the sequence in Illust. 47 for final tightening of head to prevent distortion of the head or block. Use a new gasket each time the head is replaced. Reuse of an old gasket may result in compression or water leaks.

When this engine is used in high altitudes the compression ratio is raised by the use of a high-altitude cylinder head having smaller combustion chamber cavities. This ratio change is necessary to insure a normal compression pressure in the less dense air at high altitude. The use of this high altitude head at low or normal altitude will result in rough engine operation and compression knocks under load because compression pressure is increased above normal.

## Removing Cylinder Head

In order to service connection rods, piston assembly, camshaft, valve tappets or valves, the cylinder head must be removed. To remove the cylinder head only, cooling water must be drained.

1. Remove the hood, the fuel tank, generator, and the water outlet elbow.

2. Remove spark plugs.

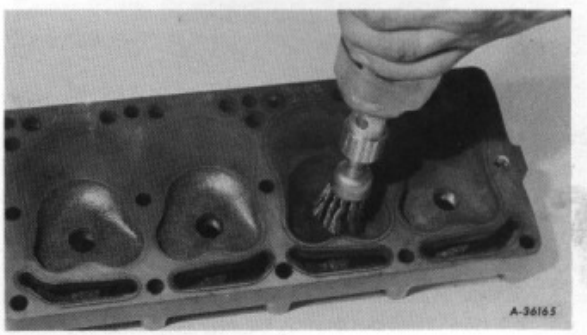
3. Remove the 15 cylinder head capscrews, and lift off cylinder head and gasket.

## Inspection and Service

After the cylinder head is removed it should be inspected as follows:

1. Check head and gasket for "blow-by" or compression leaks.

2. Remove carbon from combustion chamber cavities with wire brush. See Illust. 5.




**Illust. 5 -- Cleaning carbon from cylinder head.**

3. Clean cylinder head combustion cavities with cleaning solution.

4. Carefully inspect head for cracks.

5. Use a straight edge and inspect for warped head, particularly in any area which shows "blow-by."

6. Inspect water jacket in head for an accumulation of rust or lime deposit which would affect circulation of cooling water and cause hot spots. Clean if necessary.

7. Discard old gasket.

8. If cylinder head is satisfactory for further service, set aside and cover to keep clean.

# CONNECTING RODS AND BEARINGS

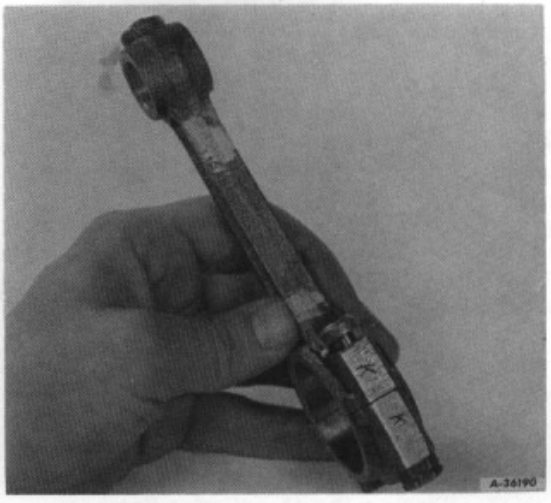
## SPECIFICATIONS

| | |
|---|---|
| Rod type | Forged, I-beam, heat treated |
| Distance between bearing and bushing centers | 5 in. |
| **Connecting rod bearings:** | |
| Type | Replaceable, micro-precision |
| Material | Steel-backed babbitt |
| Length | .756 in. |
| Journal diameter | 1.498 to 1.499 in. |
| Running clearance diameter | .001 to .003 in. |
| Side clearance | .005 to .012 in. |
| **Piston pin bushing (replaceable):** | |
| Material | Bronze |
| Length | 7/8-in. |
| Pin diameter | .6875 to .6878 in. |
| Running clearance diameter | .0003 to .0005 in. |
| **Bolts:** | |
| Number per rod | 2 |
| Size | 5/16-in. |
| Nut torque | 16-20 ft. lb. |

Each connecting rod for the Farmall Cub engine has two bolts with self-locking type nuts, which only require tightening to 16-20 ft. lb. torque to lock them securely.

Connecting rods in original production engines are stamped with the cylinder number on one side of the shank and one one side of the bearing cap, No. 1 starting at the front or timing gear end of the engine. Connecting rods furnished for service parts have letters instead of numbers. In either case, the numbered side of both the connecting rod and bearing cap or the lettered side of both are assembled on the camshaft side of the engine. See Illust. 6.

Connecting rod bearings are not adjustable and, when clearance is excessive the bearings must be replaced. Never attempt to file rods or caps to tighten bearings. Such procedures would make rods unfit for use with new bearings.

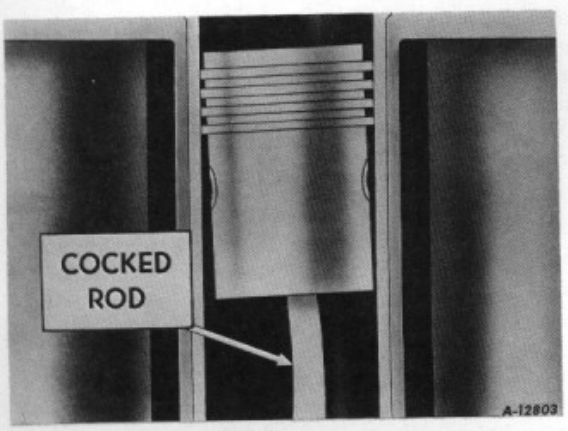



**Illust. 6 -- Connecting rod and bearing cap markings.**

New bearings furnished through service parts are available in standard size and .002-in. and .003-in. undersize for use with slightly worn standard crankshafts. Also, .030-in. and .032-in. undersize are available for reground crankshafts.

When installing connecting rod bearings be sure the bearing backs and rod surfaces are absolutely clean, smooth, and free from oil. Any foreign material lodged between the bearing back and the rod or cap not only interferes with the dissipation of heat from the bearing but also distorts the bearing and reduces the running clearance between the bearing and shaft. Bearings have a nib or projection which prevents the bearing from turning in the rod, and must be assembled with the nib engaging the milled notch in the rod.

Proper alignment of the connecting rod bearing in relation to the piston pin and piston skirt is most important. Cocked or twisted rods will prevent the piston and rings from contacting the cylinder wall squarely, which will result in oil being pumped up past the rings (see Illust. 7). When rods are badly misaligned a knock may develop, caused by the rod striking the piston boss. This indicates the rod is offset toward the front or rear. The use of a connecting rod aligner is strongly recommended for all engine overhauls to assure a Blue Ribbon quality service job. Always use genuine IH service parts to restore the tractor to "Like new" performance.




**Illust. 7 -- Bent connecting rods prevent rings from making proper contact with cylinder walls.**

Misalignment of connecting rods may be caused by engine overloads or premature firing. It may also occur during replacement of a piston pin if the bushing is reamed out of parallel with the rod bearing.

Use a good torque wrench when tightening connecting rod nuts. This will prevent distortion of the bearings and also prevent placing undue strain on the bolts. Tighten nuts down evenly from side to side to prevent pinching the bearing insert and to secure proper seating of the bearing cap. These nuts are of the self-locking type.

Piston pin bushings may be replaced in the rod and must be reamed or honed after assembly to obtain a running clearance of .0005-in. on the pin diameter. This is a light push fit with bushing and pin clean and dry (see Illust. 8). Notice that this is a slightly larger clearance than specified for the bore in the piston; thus, after assembling the piston on the rod, the movement will be between the rod bushing and pin only.

## Removing Connecting Rods and Bearings

In order to completely service the connecting rods, the crankcase oil and cooling system must be drained; the hood, fuel tank, cylinder head, and crankcase oil pan must be off; and the rods and pistons must be removed from the crankcase. Proceed as follows:

1. Remove crankcase oil pan, oil pump screen and oil screen tube.

2. Check cylinders for ridges at the top of piston ring travel. Ridges must be removed with a ridge reamer before piston and rod assemblies are removed. (See main heading Piston Assembly under Removing and Disassembling Piston Assembly).

3. Remove connecting rod bearing nuts and caps. Be sure to keep bearings and caps with the rods from which they were removed.

Note: It may be desirable to check bearing clearances at this time (see Inspection and Service below).

4. Remove the connecting rod and piston assemblies from the top of the cylinder.

Note: Before removing piston, mark top

camshaft side, so that when the piston is to be used for further service it can be installed in the same position and in the same cylinder.

5. Remove piston pin retainers and piston pin.

## Inspection and Service

In the interest of saving time, connecting rod bearing clearances should be checked prior to the removal of the rod and piston assembly. Proceed as follows:

1. Loosen all connecting rod bearing cap nuts.

2. Visually inspect both halves of the rod bearing for damage (pitted, scuffed, hot spots, etc.) as soon as removed. The bearing insert and the crankshaft journal must be wiped clean.

3. Remove bearing cap from one rod at a time to check clearance with Plastigage.

4. Place a piece of Plastigage with full width of the bearing insert about 1/4-in. off center. See Illust. 34.

Reinstall bearing cap and torque bearing cap nuts to 16 to 20 ft. lb. Remove the bearing cap. The flattened Plastigage will be found on either the bearing insert or the crankshaft. Compare the flattened Plastigage at several points with the graduations on the Plastigage envelope. The number in the matching graduations on the envelope indicates the clearance in thousandths of an inch. See Illust. 35.

5. Proceed in the same manner to check the remaining rod bearings. Running clearance should be .001 - .003 in. and side clearance (using feeler gage) should be .005 - .012 in. It is recommended that bearings be replaced when running clearances exceed .003 in.

Oil "throw-off" reaching cylinder walls from main and connecting rod bearings with excessive clearances will overload the oil control rings. This results in increased oil consumption and loss of oil pressure.

Note: When checking bearing clearance, be sure the bearing backs and the rod surfaces are absolutely clean and dry. Any foreign material between the bearing back and rod or cap will distort the bearing and the results will not be accurate.

6. When the connecting rods and piston assemblies are removed from the crankcase and the piston removed from the rod, check piston pin bushing for excessive wear. Running clearance should be .0003 - .0005 in., which is a light push fit with bushing and pin clean and dry. See Illust. 8.

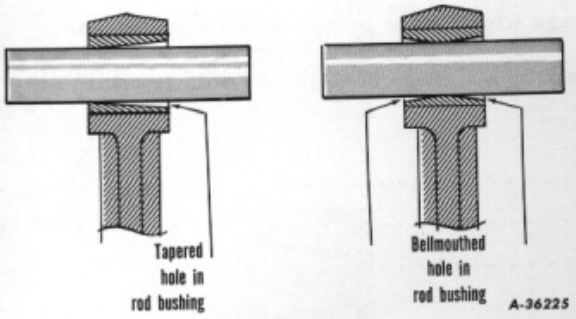

**Illust. 8 -- Checking piston pin fit in connecting rod**

If new bushings are required, it will be necessary to ream or bore them after installation to provide .0003 - .0005 in. running clearance.

Precision fitting of the piston pin in the connecting rod and the piston is important and should always be carefully checked during servicing. Without a precision pin hole gage, it is impossible to check a given pin fit accurately. However, you can make the following simple tests that will show whether pin fitting is acceptable.

a. Check for out-of-roundness. Press a new bushing into a connecting rod and ream or bore to size. With the pin securely held or clamped in a pin vise, rotate the rod back and forth several times on the pin, then remove the pin from the rod. Examine the shiny contact spots. A well fitted pin should show contact over the entire surface of the bushing.

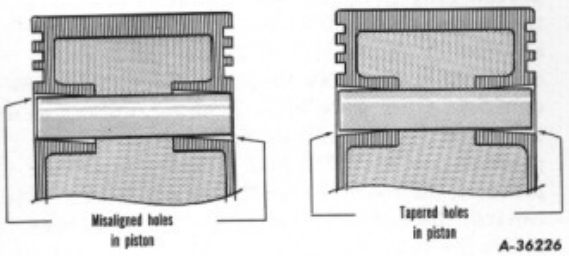
b. Test for taper or ballmouth. As explained above, fit a new rod bushing to a light drag fit and enter a pin from either end of the bushing. If it is free on one end and tight at the other end, the pin hole is tapered. If it enters easily from either end but becomes tight in the center of the bushing, the hole is bellmouthed. A good pin fit must have all surfaces parallel. See Illust. 9.




**Illust. 9 -- Improper correcting rod pin bushing bores.**

c. Check alignment between piston pin holes. Ream or bore piston to size for an oversize pin. The pin should enter the second boss without a "click," without forcing, and without binding. A good pin bearing has an even drag throughout both pin holes. A "click" when pin enters the second boss indicates pin holes are out of alignment.

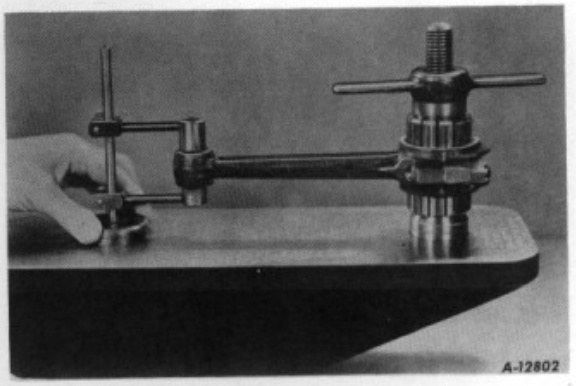
d. Test pin holes individually on each side of the piston. As explained for the connecting rod, check each hole for taper and for equal size. See Illust. 10




**Illust. 10 -- Improper pin hole bores in piston.**

The foregoing tests will indicate the general quality of work produced by the serviceman and his equipment. The serviceman must also know the exact clearance between the pin and the pin hole for each piston in order to produce the precision fit required for modern engines.

7. Check connecting rod for misalignment, using good rod aligning equipment. See Illust. 11.




**Illust. 11 -- Checking connecting rod alignment.**

After installing new piston pin bushing, or after reaming old bushings for oversized piston pins, connecting rod alignment must be checked and corrected. Hand reaming or honing the bushing does not insure a parallel condition of the crank journal and pin bushing bore in the rod.

Note: When installing oversize piston pins, check rod alignment with piston assembled on its rod.

8. Discard worn or damaged parts and replace with new standard or undersize or oversize parts as required.

9. Wrap or cover parts which are satisfactory for further service to keep clean until re-assembly.

# PISTON ASSEMBLY

## SPECIFICATIONS

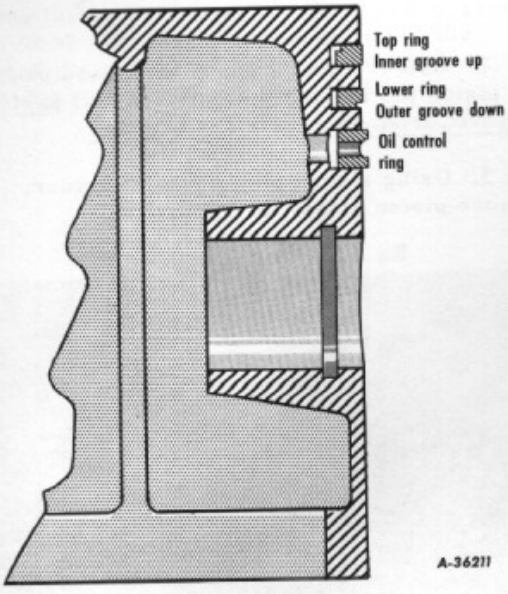
| | |
|---|---|
| Pistons: | |
| Material | Gray iron |
| Length | 2-7/8-in. |
| Clearance in cylinder bore | .0016 to .0024 in. |
| Use a .001-in. gage 1/2-in. wide as a "go" gage with a light pull of 4 to 6 lb. tension. | |
| Use a .002-in gage ribbon as a "no go" gauge with a tight pull of 11 to 14 lb. tension. | |
| Compression rings, 3/32-in. wide, per piston: | |
| Number | 2 |
| Clearance in groove | .0035 in. |
| Gap | .007 to .017 in. |
| Oil control rings, 3/16-in. wide, per piston: | |
| Number | 1 |
| Gap | .007 to .017 in. |
| Clearance in groove | .003 in. |
| Piston pin (full floating): | |
| Diameter | .6875 to .6878 in. |
| Clearance in piston | .0001 to .0003 in. |
| Clearance in rod bushing | .0003 to .0005 in. |
| Pin length | 2-3/16-in. |
| Retainers | Snap rings in piston |

Piston rings. The two compression rings are the same width but differ in the shape of their cross section. The top ring has a groove cut in the upper inner corner. Always be sure this ring is assembled with the groove up. The lower compression ring has a groove cut in the lower outer corner. This ring must be assembled with the groove down. The oil control ring is mounted in the bottom position on the piston. See Illust. 12.

In addition to the regular production rings, there are available replacement piston ring kits which will compensate for a certain amount of piston and cylinder wall wear. If the cylinder bores are not worn more than 0.0105-in. taper from top to bottom of ring travel area (see Illust. 41) or not more than 0.0026-in. out of round (egg-shaped), and the piston ring grooves in the piston are not worn to give more than 0.006-in. ring clearance, additional useful life of these pistons and cylinder bores may be had by installing the compensating ring kits. These replacement ring kits are furnished for both standard pistons and the .020 and .040-in. oversize pistons. If cylinder wall wear exceeds these limits, the cylinder must be bored to take oversize pistons for satisfactory operation and oil control. (See also main heading, Cylinder Block.)

Piston pins. Piston pins are of full floating type, retained in the piston by a snap ring at each end of the bore. The pins are a hand press-fit in the piston and a light pressure

should move the pin through the piston bore. An oversize pin (.005-in.) is available for service. Oversize pins are used when piston pin bore clearance exceeds .0003 in. and the piston is otherwise serviceable.

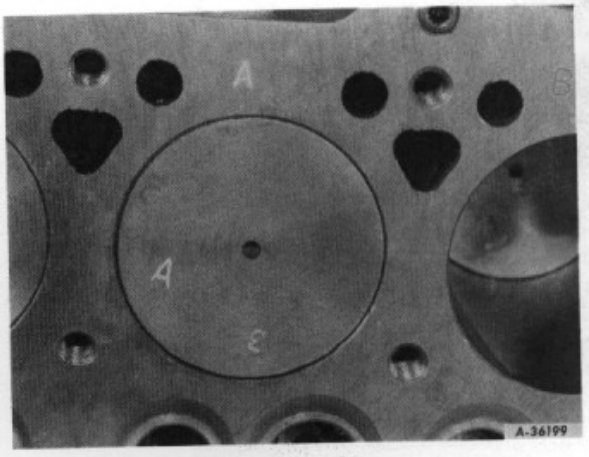



**Illust. 12 -- Sectional view of piston showing ring assembly.**

The piston bore and connecting rod bushing should be reamed or honed to give the clearance specified. After installing new piston pins the connecting rod alignment must be checked and corrected since hand reaming or honing the pin bushing does not insure a parallelled condition of the crank bearing and pin bushing bore in the rod.

Pistons. Gray iron pistons used in the Farmall Cub engine are the same design as used in carbureted engines of the previous production Farmalls of all models. They should be handled with the same care as any other precision fitted part; rough handling will result in distortion and damage. When cleaning the ring grooves for the mounting of new rings, the smooth sides of the piston grooves must not be scratched or gouged as these are the ring sealing surfaces.

Standard size pistons complete with rings, piston pin and retainers are available singly for service and are marked "C". These standard pistons will fit all crankcase bores marked "C", "D", or "E". Crankcase bores marked "A" or "B" must be honed slightly to give the specified piston clearance. The original bore size is indicated by stamping a letter "A", "B", "C", "D" or "E" on the top of the block, opposite each cylinder bore. See Illust. 13.




**Illust. 13 -- Markings on top of pistons and crankcase.**

The .020 and .040-in. oversize pistons are available singly as service parts or in sets of four, complete with corresponding rings, piston pins and retainers. They are for service on engines which, due to cylinder wall wear, must be rebored to .020 or .040-in. oversize.

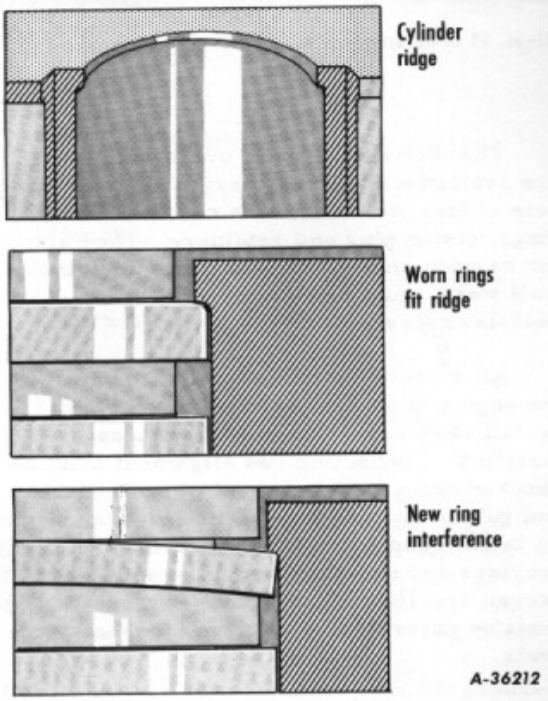
All factors contributing to oil control of the engine must also be checked and corrected when new rings and/or pistons are installed. Connecting rod alignment must be checked and corrected if out of line. Valve and guides must have specified clearance and be in good condition. The crankshaft and bearings and camshaft bearings must not exceed specified clearances. External leaks must be corrected by using new gaskets and seals.

## Removing and Disassembling Piston Assembly

In order to completely service the piston assemblies, the crankcase oil and cooling system must be drained and the hood, fuel tank, cylinder head, crankcase oil pan, and connecting rod and piston assemblies must be removed.

Since the pistons in the Farmall Cub engine are removed from the top of the crankcase, it is important that any ridges found at the top of the ring travel on the cylinder wall are removed with a ridge reamer before the pistons are removed. Failure to remove such ridges, left by normal wear, may result in broken lands on the pistons during removal. Also it will result in the top ring striking the ridge at the top of each piston stroke after new rings are installed, causing damage. See Illust. 14.

Note: Remove only enough material to eliminate the ridge. After reaming, raise each piston to the top of its stroke and clean out reamer cuttings. Be careful not to allow cuttings to drop into the water jacket openings, valve ports, or the manifold. For best results follow the reamer manufacturer's operating instructions.



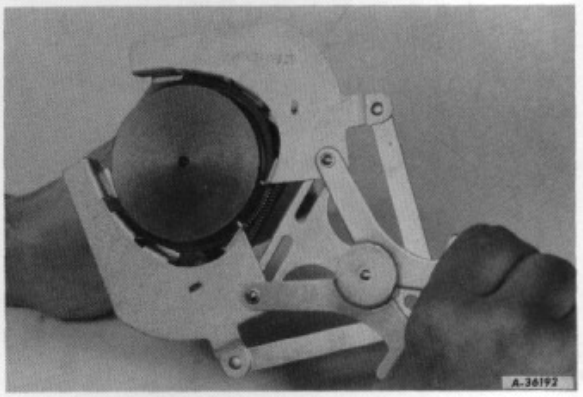

**Illust. 14 -- Interference between cylinder ridge and piston piston ring.**

1. After cylinder ridges are removed, take out all connecting rod and piston assemblies.

Note: Mark the top of each piston on the camshaft side prior to removal so that it can be reinstalled in the same position and in the same cylinder from which it was removed, if it is to be reused. Connecting rod crankshaft bearing clearances may be checked before removing the piston and rod assembly from the crankcase.

2. Remove piston pin retainer and push out piston pin in each piston. Keep all parts removed from each cylinder together.

3. Using a good piston ring expander, remove piston rings. See Illust. 15.

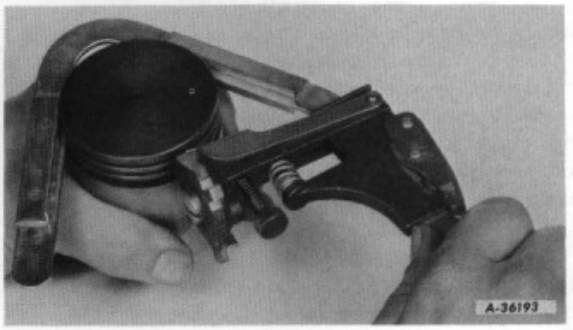



**Illust. 15 -- Removing piston rings.**

## Inspection and Service

1. Wash all parts of the piston assembly in cleaning solution.

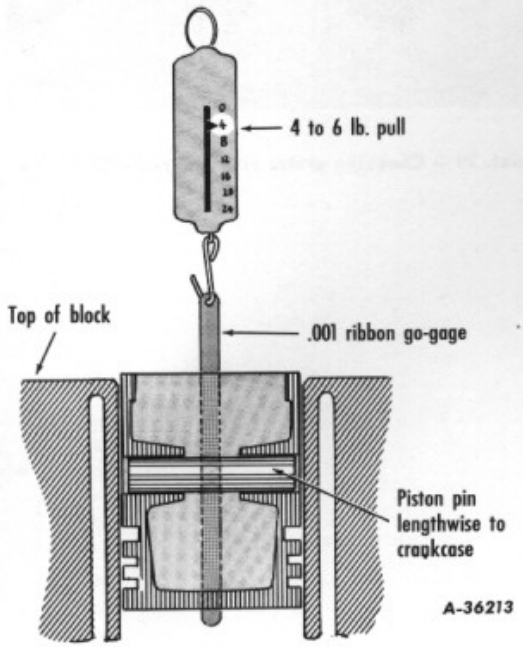
2. Clean ring grooves and oil drain holes in pistons thoroughly. See Illust. 16.




**Illust. 16 -- Cleaning piston ring groove.**

3. Visually inspect pistons for damage, such as cracks, bent or broken ring lands, etc.

4. Check piston clearance in cylinder bore with feeler gage. Insert feeler gage along the entire length of ring travel area on the thrust side of the piston and have the piston pin positioned lengthwise with the crankcase. See Illust. 17.




**Illust. 17 -- Checking piston fit in cylinder.**

If clearances exceed those given in Step 7, below, the cylinders must be rebored and oversized pistons installed. For the procedure for reboring see main heading Cylinder Block.

5. Check piston pin retainers to be sure they fit properly in the grooves.

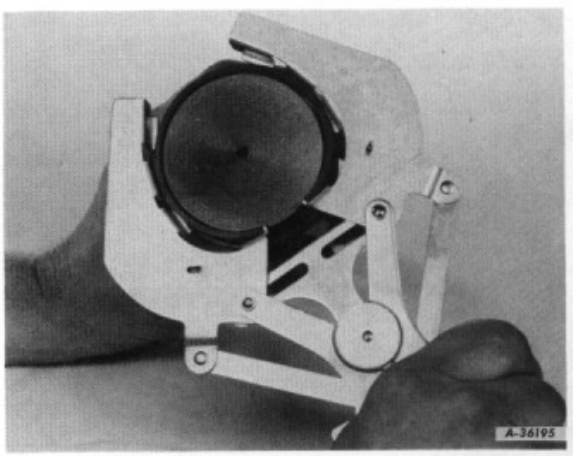
6. Check piston pins for excessive clearance in bosses in pistons. When clearance is excessive but piston is otherwise serviceable, oversized pins are available. Piston pin bore in the piston must be reamed or honed to give .0001 - .0003-in. running clearance when oversized pins are used. See Illust. 18.

7. Discard old piston rings. If cylinder bores are not worn more than .015-in. taper from top to bottom of ring travel area or are not more than .0026-in. out of round (egg-shaped) and ring grooves in piston are not worn to give more than .006-in. ring clearance, reboring is not necessary. Compensating ring kits are available and should be used.


**Illust. 18 -- Checking piston pin.**

8. Check all rings for gap opening by placing rings squarely in lower position of cylinder bore and measure gap with feeder gage. Gap should be from .007 - .017-in.

9. Install new rings on pistons. Be sure rings are installed groove inside and up on the top compression ring groove, and outside and down on the second compression ring, with ring gaps 180° apart. (See Illust. 12). Do not spread beyond the amount necessary to




**Illust. 19 -- Installing piston rings.**

slip over piston. Distorted rings will not seat and contact the cylinder wall at all points. See Illust. 19.

10. Check ring clearance in ring grooves on piston. If clearance exceeds .006 .006-in., new pistons should be used. See Illust. 20.

11. Check alignment of connecting rod and piston assembly. Correct as necessary.

12. Cover or wrap piston assemblies to keep clean for installation.


**Illust. 20 -- Checking piston ring clearance in groove.**

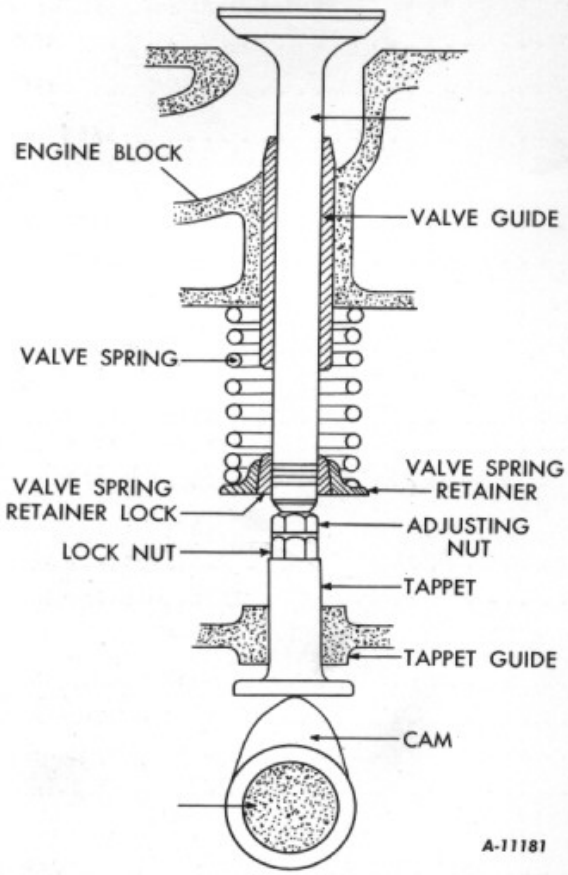
# ENGINE VALVES

## SPECIFICATIONS

| | |
|---|---|
| Material: | |
| Intake | SAE 3140 |
| Exhaust | Silchrome XCR |
| Length over-all | 3-25/64-in. |
| Lift | .222 in. |
| Head diameter: | |
| Intake | 1-3/32-in. |
| Exhaust | 29/32 in. |
| Face angle | 45° |
| Seat angle | 45° |
| Seat width | 3/64-in. |
| Stem: | |
| Diameter | .3095 - .3105-in. |
| Clearance in guide | .0015 - .0025-in. |
| Guides: | |
| Type | Replaceable |
| Size (ream size after assembly): | |
| Intake | .3115 - .3125-in. |
| Exhaust | .3125 - .3135-in. |
| Length | 1-1/2-in. |
| Springs: | |
| Free length | 1-31/32-in. |
| Test | 23 lb. at 1-1/4-in. |
| Tappets: | |
| Clearance in crankcase | .007 - .0032-in. |
| Clearance (cold) | .013-in. |
| Screw wrench size | 7/16-in. |
| Wrench size | 1/2-in. |
| Timing: | |
| Allowable variation | 5° |
| Intake: | |
| Opens | 5° after top center |
| Closes | 45° after lower center |
| Exhaust: | |
| Opens | 42° before lower center |
| Closes | 10° after top center |

The valve assembly in the Farmall Cub engine represents the highest skill in metallurgy and precision manufacturing. Therefore, a Blue Ribbon quality service job requires precision workmanship with good valve servicing equipment. Closely following manufacturer's operating instructions for valve equipment is of paramount importance to a Blue Ribbon Service job.

Valve tappets have self-locking tappet screws. Adjustments require two wrenches, one to hold the tappet and one to turn the tappet screw. Tappets may be removed from the crankcase after the camshaft is removed. See Illust. 21.




**Illust. 21 -- Valve assembly for valve-in-block engine.**

Valve springs for intake and exhaust are the same and these springs may be assembled either end up.

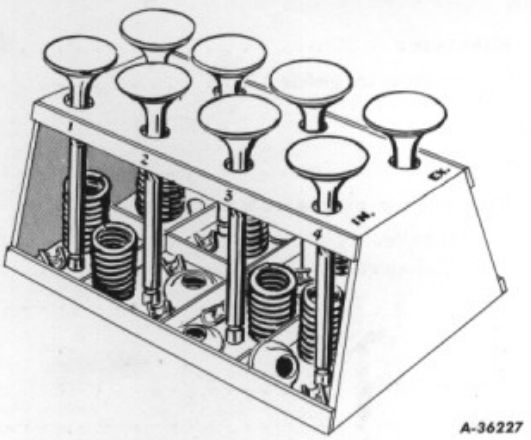
Replaceable valve guides furnished for service must be reamed to proper size after installation.

An exhaust valve rotator attachment is available as a special attachment. It consists of tulip-shaped exhaust valves, valve springs and roto-caps.

## Removing Valves

When only valve service is to be performed, the cooling system must be drained and the cylinder head, hydraulic pump and its manifold, the valve cover, and the engine manifold assembly must be removed.

Note: When valve assemblies are removed, all parts should be kept in order. They may then be reinstalled in the same ports, from which removed, if they are to be used for further service. See Illust. 22.



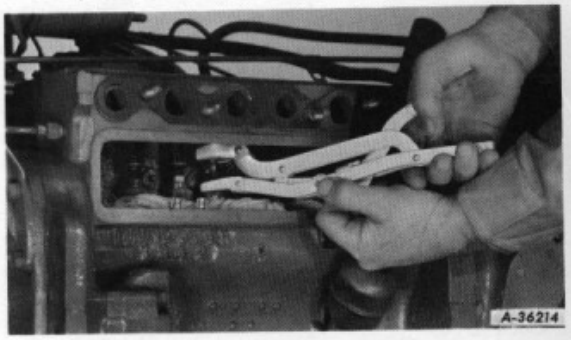

**Illust. 22 -- Rack for holding valves and accessories.**

1. Remove valve tappet cover and turn down tappet screws several turns so that springs may be removed easily and to prevent interference with valve stems after seats and faces are reground.

2. Compress valve springs with suitable tool and remove valve spring seat retaining keys. See Illust. 23. Be careful not to compress springs more than necessary, as they can be distorted.

Note: When only grinding valves, plug the holes in the valve compartment with

clean rags to prevent dropping valve spring seat retainer into the crankcase.




**Illust. 23 -- Removing valve spring seat retaining keys.**

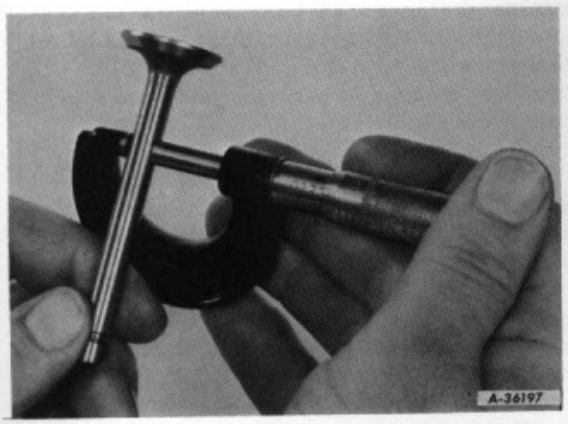
3. Remove valve spring seats, valve springs and valves. Keep valves in order so they may be reinstalled in the same port. See Illust. 22.

## Inspection and Service

After all valve assemblies are removed, clean all parts of each assembly with cleaning solvent and a brass wire brush.

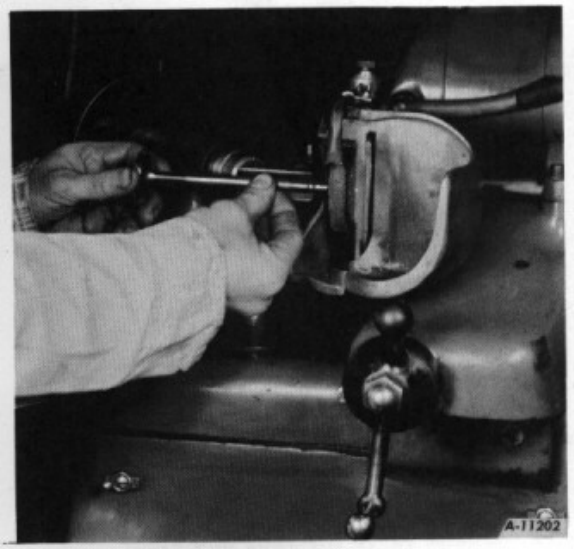
1. Visually inspect valves for excessive stem wear, bent stems, burned or warped heads, scuffed stems, worn spring retainer key grooves and valve heads. Discard all excessively worn or damaged valves.

2. "Mike" the diameter of the valve stem at several places to determine amount of wear. See Illust. 24.



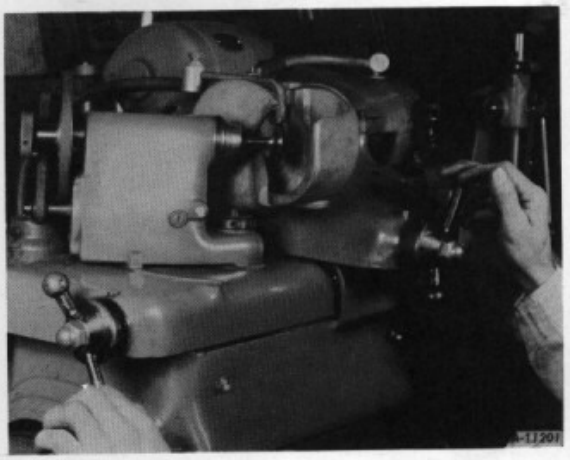

**Illust. 24 -- Checking valve stem diameter with micrometer.**

3. Check ends of valve stems for square tips. See Illust. 25.




**Illust. 25 -- Squaring tips of valve stems.**

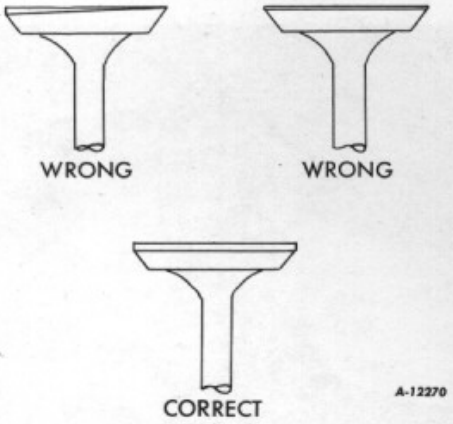
4. With a good valve refacing machine and following closely the manufacturer's instructions, reface all valves to be used for further service. See Illust. 26.



**Illust. 26 -- Grinding valve face.**

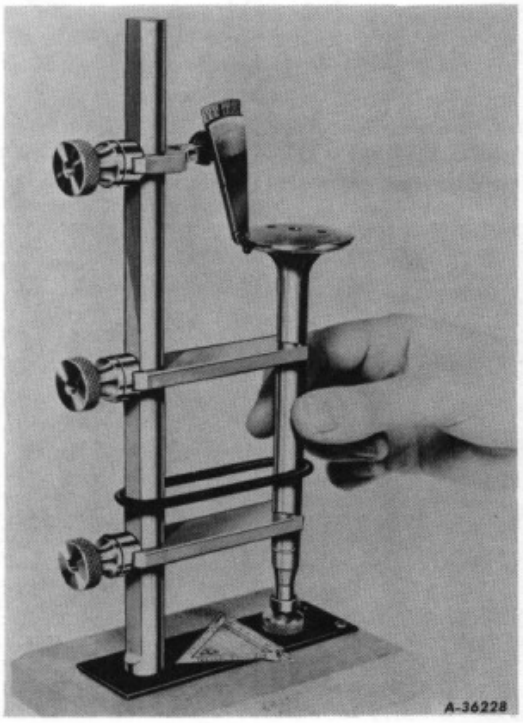
Be sure angles of refacing machine and seat grinding stones are correct. Keep seat stones and refacing wheels well dressed to insure smooth, accurate work.

Carefully check each valve margin after refacing. See Illust. 27.




**Illust. 27 -- Valve margins.**

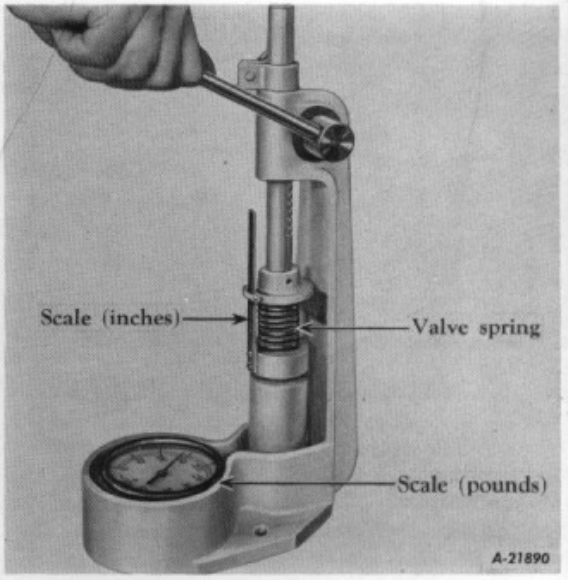
5. Check valve for face and stem "run-out". See Illust. 28.




**Illust. 28 -- Checking valve for runout.**

6. Check for worn or damaged spring seats and spring seat retainer keys.

7. Check valve springs for proper tension, rust pits and distortion. See Illust. 29.




**Illust. 29 -- Checking valve spring tension.**

8. Check valve tappet screws for wear and square up as required. Accurate tappet clearance adjustment cannot be accomplished if tappet screws and ends of valve stems are worn or grooved.

9. Clean and visually inspect for broken, cracked or worn valve guides.

10. Press out excessively worn or damaged guides, using care not to damage guide bore in crankcase.

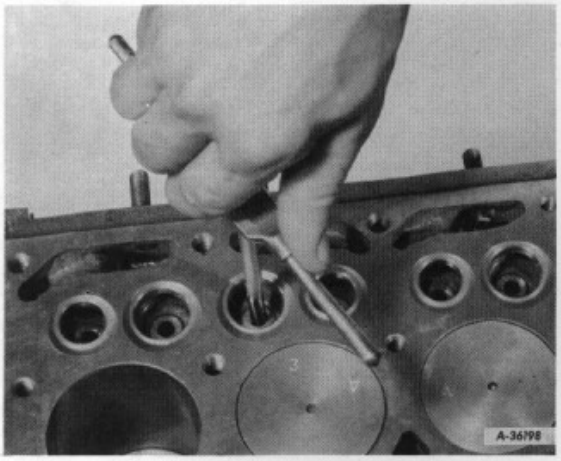
11. Press new guides into crankcase to a measured distance of 1 in. from the top surface of the crankcase to the top center of the guide (see Illust. 42) and ream to .0015 - .0025-in. clearance between valve stem and guide (see Illust. 30).

12. Having cleaned and checked valve seats, use a good valve seat grinder and closely follow manufacturer's instructions for grinding valve seats.

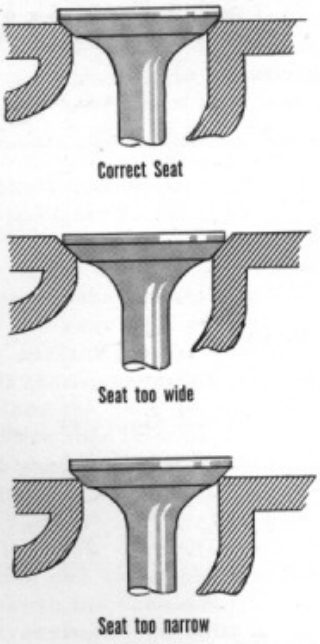
The valve seat angle is 45° and the normal seat width 3/16-in. for both intake and exhaust ports.

Note: Always service valve guides before grinding valve seats. A true valve seat

cannot be obtained when excessive clearance exists between the worn guide and the seat grinding pilot.




Illust. 30 -- Reaming valve guide to proper size.




Illust. 31 -- Valve seat location.

The seat should contact the approximate center of the valve face (see Illust. 31). Do not remove more material than is necessary when grinding or narrowing valve seats.

Lapping valves to their seats with compound is unnecessary if precision equipment is used correctly and the valve seat and face are true.

# CRANKSHAFT AND BEARINGS

## SPECIFICATIONS

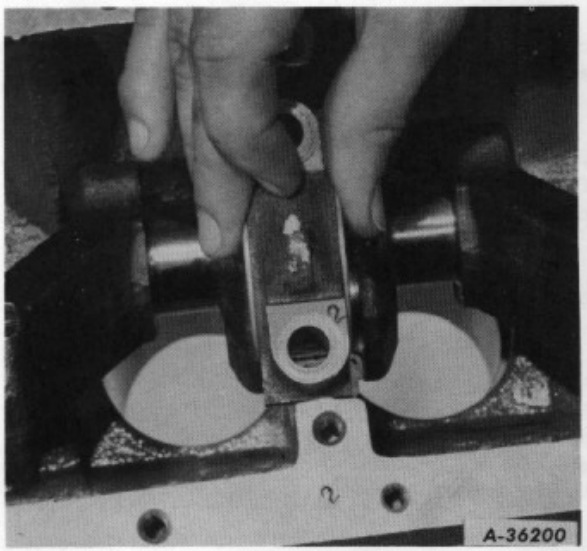
| | |
|---|---|
| **Crankshaft:** | |
| Material | SAE 1045 forging steel |
| Length over-all | 18-3/8-in. |
| Weight | 15-1/2-lb. |
| Bearing surfaces | Induction hardened |
| Crankshaft journal diameter | 1.623 to 1.624 in. |
| Connecting rod journal diameter | 1.498 to 1.499 in. |
| **Bearings (main):** | |
| Type | Replaceable, micro-precision |
| Number | 3 |
| Length: | |
| Front bearing | 1-1/16-in. |
| Center bearing | 1-3/16-in. |
| Rear bearing | 1-1/16-in. |
| Running clearance | .002 to .0035 in. |
| End clearance, end thrust taken on center bearing | .004 to .008 in. |
| Bearing cap bolt: | |
| Diameter | 7/16-in. |
| Torque | 55-60 ft. lb. |
| Crankshaft seals, each end | Spring-loaded, lip type |
| **Flywheel retaining bolts (4):** | |
| Diameter | 3/8-in. |
| Torque | 45-50 ft. lb. |

The crankshaft used in the Farmall Cub engine has induction hardened bearing journals and is drilled for pressure lubrication of connecting rod bearings. Each main bearing cap is numbered to correspond with a number stamped on the camshaft side of the crankcase (see Illust. 32). The precision-type bearings are not adjustable. When running clearances become excessive, replacement is necessary. Oil "throw-off" reaching cylinder walls from main and connecting rod bearings having excessive clearance will overload the oil control rings. This results in increased consumption of oil and loss of oil pressure.

Main bearings are available in standard production size for new shafts or for used shafts having little or no wear and .002 and .003-in. undersize for shafts slightly worn. Also available are .030 and .032-in. undersize for use with the reground "exchange" crankshaft. When servicing main bearings, one defective bearing will require the replacement of all three bearings; otherwise crankshaft "lay" or alignment cannot be maintained.

The replacement of crankshaft main bearings without removing the crankshaft should be done only in an emergency. When these bearings are worn sufficiently to require replacement or have failed through lack of lubrication, the entire crankcase and

its oil distribution bores should be thoroughly cleaned. This cannot be accomplished without the removal of the crankshaft.




**Illust. 32 -- Corresponding numbers on main bearing cap and crankcase.**

The crankshaft front and rear oil seals will also be worn and should be replaced. This cleaning of the crankcase and replacing of oil seals is the best insurance against early bearing failures through dirt or foreign material left in the crankcase oil distribution bores or from dirt entering worn oil seals.

The importance of cleanliness in connection with bearing installation cannot be overstressed. The bearing backs and their bores in the crankcase and caps must be clean and dry. Small particles of dirt or foreign matter left between the bearings and the case will distort the bearing. This not only reduces the bearing's running clearance but results in a poor transfer of bearing heat to the case. Such a condition will cause early bearing failure.

Bearing cap bolts should be tightened with a torque wrench to prevent overstressing the bolts and distortion of crankcase or bearing caps. Tighten bolts down evenly from side to side to prevent pinching the bearing insert and to secure proper seating of the bearing cap. These bearing bolts are the self-locking type and require only to be tightened to proper tension to lock securely.

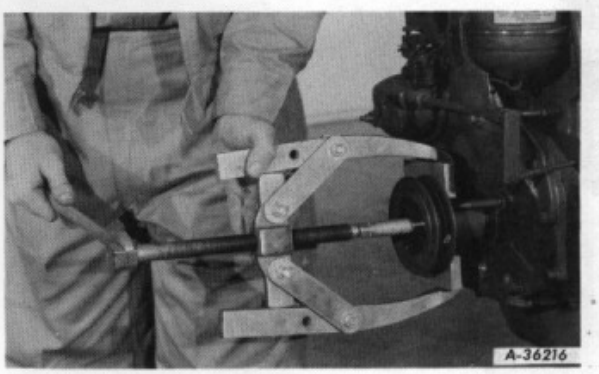
Oil seals. Spring-loaded, lip-type seals are provided at each end of the crankshaft. The front seal is pressed into the timing gear cover; the lip of this seal faces in toward the center of the engine and contacts the hub of the fan drive pulley. The rear crankshaft seal is pressed into a retainer which is bolted to the rear of the crankcase. The lip of this seal is assembled toward the center of the engine and contacts the outer diameter of the crankshaft flange. The bottom of the rear seal retainer also forms the gasket surface for the rear flange of the oil pan. It is necessary to remove the flywheel to replace the rear seal or its retainer gasket. When this is done, it is well to inspect the oil pump body gasket for possible oil leakage.

Flywheel. Four 3/8-in. self-locking bolts and one dowel pin are used to attach the flywheel to the crankshaft flange. To avoid overstressing these bolts a torque wrench is to be used.

The fan drive pulley. This pulley is a press fit on the crankshaft; a No. 6 Woodruff key, 5/32 x 5/8-in., positions the pulley on the shaft. Two notches have been provided on the outside diameter of the rear flange of the pulley. When the first notch is lined up with the pointer on the front cover, the battery ignition is at full advance. Lining up the second notch places the No. 1 and No. 4 cylinders at the top dead center.

## Removing Camshaft and Bearings

To completely service only the crankshaft and bearings, the crankcase oil, cooling and hydraulic systems must be drained and




**Illust. 33 -- Removing fan drive pulley.**

the engine removed from the tractor. The crankcase oil pan, fan pulley, front cover, connecting rod bearing caps, flywheel, and rear crankshaft oil seal must be removed from the engine.

1. Remove fan drive pulley using No. 1 020 316 R92 removing and installing tool with OTC 1002-L puller. See Illust. 33.

2. Remove governor assembly.

3. Remove crankcase front cover.

4. Remove engine clutch, flywheel and rear oil seal retainer with oil seal.

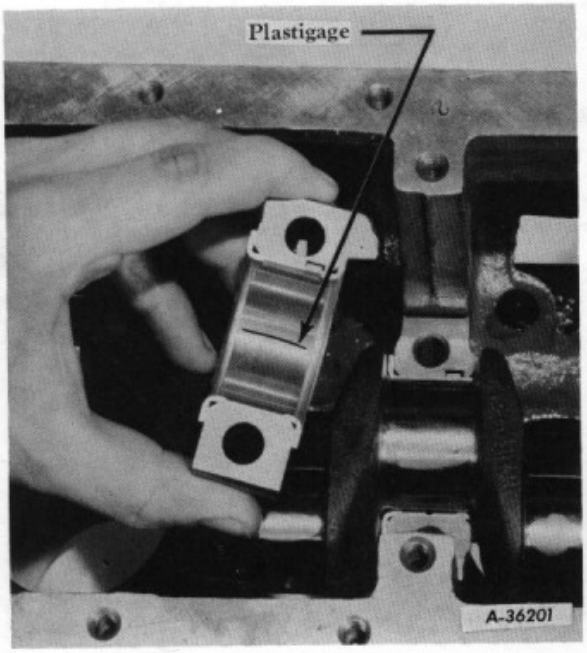
5. Remove crankshaft bearing bolts and caps.

6. Remove crankshaft and bearing inserts.

## Inspection and Service

In the interest of saving time, crankshaft bearing clearances should be checked prior to the removal of the crankshaft.

1. Position the crankcase so that the crankshaft is at the top, then loosen all crankshaft bearing cap bolts and remove one bearing at a time to check running clearance with Plastigage.



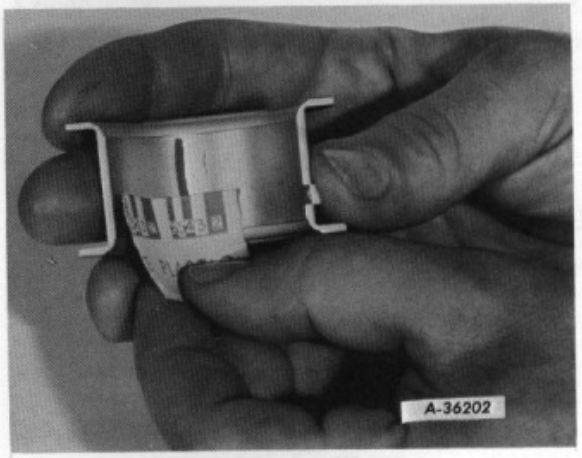

**Illust. 34 -- Location of Plastigage on bearing insert.**

2. Visually inspect the bearing for damage (pitted, scuffed, hot spots, etc.) as soon as removed.

3. Wipe bearing inserts and the crank journal clean and place a piece of Plastigage the full width of the bearing insert about 1/4" off center. See Illust. 34.

4. Install bearing and cap, and tighten bolts with a torque wrench to 55-60 ft. lb.

5. Remove bearing cap. Match the flattened Plastigage at several points (on either the bearing insert or the crankshaft), with the corresponding graduation on the Plastigage envelope, which indicates the clearance in thousandths of an inch. See Illust. 35.

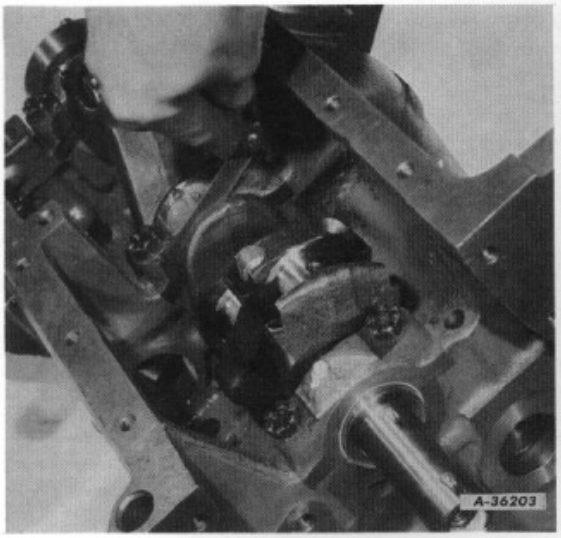



**Illust. 35 -- Checking flattened Plastigage to determine bearing clearance.**

6. Proceed in the same manner to check the remaining bearings. Running clearance should be .002 - .003-in. If you do not have Plastigage, an alternate method for checking crankshaft bearing running clearance is to place a .002-in. brass shim (1/4 x 1-in. long) lengthwise between the lower bearing half and crankshaft surface and tighten bearing bolts to 55-60 ft. lb. torque. If the clearance is not excessive, there should be a slight drag when turning the crankshaft.

7. Check crankshaft end clearance with a feeler gage at the front side of the center

bearing on both upper and lower thrust faces. See Illust. 36.



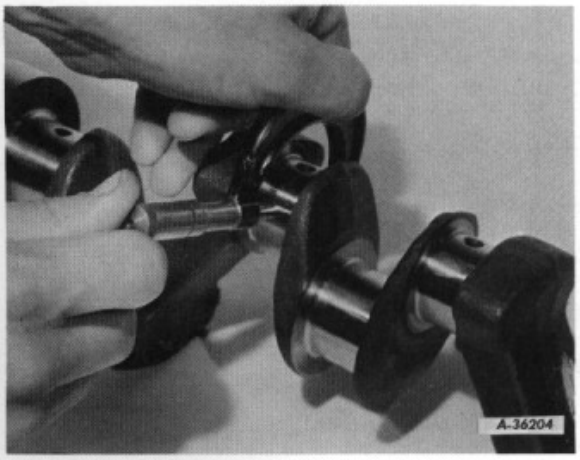

**Illust. 36 -- Checking crankshaft end clearance.**

While making this check be sure the crankshaft is held against the rear thrust face of the bearing to show total clearance at front side.

When installing center main bearing cap, hold crankshaft against the rear thrust face of the upper half of the bearing. Tighten center cap bolts lightly and tap cap toward the rear before final tightening of cap bolts. This lines up the upper and lower thrust surfaces of the bearing halves and prevents binding the shaft on the thrust surfaces.

8. Remove the crankshaft and check both crankshaft and connecting rod journals for out-of-round condition. Use a micrometer and take measurements at least three places around the journals. See Illust. 37.

9. If crankshaft is to be used for further service, clean oil passages by using a rifle barrel brush, solvent and air blow gun.




**Illust. 37 -- Checking connecting rod journal with micrometer.**

10. Inspect flywheel ring gear for damaged teeth.

11. Discard front and rear crankshaft oil seals.

12. Check clutch pilot bushing for damage or excessive wear. If necessary, a new bushing can be pressed into the rear of the crankshaft and burnished to size by using a polished driver .6266-in. diameter. This should leave a bushing inside diameter of .626 - .627-in. All burrs must be removed from the edge of the crankshaft bore to prevent shaving the bushing upon installation.

13. Check oil seal surfaces for roughness.

14. Discard all excessively worn or damaged parts.

15. Thoroughly clean all parts to be used for further service and wrap or cover to keep keep clean until reassembly.

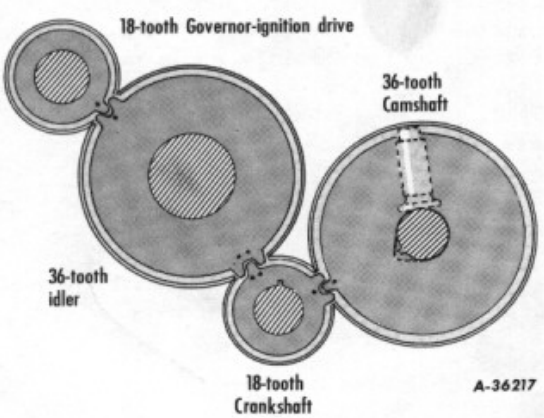
# TIMING GEARS

SPECIFICATIONS

| | |
|---|---|
| Crankshaft pinion | 18 teeth |
| Camshaft gear | 36 teeth |
| Idler gear | 36 teeth |
| Governor-ignition gear | 18 teeth |
| Type of teeth | Helical |
| Backlash | .003 - .006-in. |
| Idler shaft retainer bolt tension | 90-100 ft. lb. |

When the crankcase front cover is removed, the timing gear train is accessible. The camshaft is driven directly by the crankshaft pinion. The governor-ignition drive gear is driven from the crankshaft through an idler gear. All timing marks appear on the front side of gear rims with the exception of the governor-ignition gear, which is marked on the back side.

Refer to Illust. 38 for proper relation of timing marks; gears are viewed from front of engine. The position is upper dead center of the power stroke of No. 1 cylinder.




**Illust. 38 -- Timing gear diagram showing timing marks.**

The idler gear stud is supplied with oil through the pressure system. Timing gears receive their lubrication from the oil thrown from the idler, the front camshaft bearing and the front crankshaft bearing.

The ignition drive seal is pressed into the ignition drive opening of the crankcase from the rear. It must be square in the bore and positioned 23/32-in. from the ignition mounting flange face. The lip of this spring-loaded seal must face the governor-ignition drive gear. See Illust. 48.

## Removing Timing Gears

To service timing gears only, the front axle and radiator assembly, fan drive pulley, distributor or magneto, governor assembly and front cover must be removed from the tractor.

1. Remove idler gear shaft bolt and take out idler gear and shaft.

2. After camshaft is removed, press off camshaft gear.

3. After crankshaft is removed, press off crankshaft pinion.

4. The ignition drive gear with governor shaft and carrier is removed by removing governor assembly from crankcase front cover and disassembling the governor assembly.

## Inspection and Service

1. Before removing timing gears, check for backlash.

2. Clean and visually inspect all gears for damaged gear teeth.

3. Check idler gear bushing for excessive wear.

4. Discard excessively worn or broken parts.

5. Wrap or cover parts to be used for further service to keep clean for reassembly.

# CAMSHAFT AND BEARINGS

## SPECIFICATIONS

| | |
|---|---|
| **Camshaft:** | |
| Material | Cast iron alloy |
| Cam surfaces | Flame hardened |
| Length over-all | 15-25/32-in. |
| Minimum diameter | 13/16-in. |
| Type of drive | Helical gear |
| Gear tooth face width | 3/4-in. |
| **Bearings (bored in crankcase):** | |
| Material | Gray iron |
| Diameter and length: | |
| Front | 1.8755 x 13/16-in. |
| Center | 1.7505 x 3/4-in. |
| Rear | 0.8755 x 1-in. |
| Running clearance: | |
| Front and center | .002 to .0045 in. |
| Rear | .001 to .0035 in. |
| End clearance | .003 to .012 in. |

The camshaft is mounted in the crankcase without bushings; the bore in the gray iron case forms the three bearing surfaces. End clearance is limited by a retaining thrust plate between the crankcase and the drive gear.

The camshaft extends through the rear bearing bore into the oil pump body. This extended portion of the shaft is smaller in diameter than the rear bearing journal and carries a Woodruff key to drive the oil pump drive gear.

Removal of the camshaft only requires the removal of the engine from the tractor and removal of head, valves, oil pan, flywheel, oil pump, and crankcase front cover from the engine.

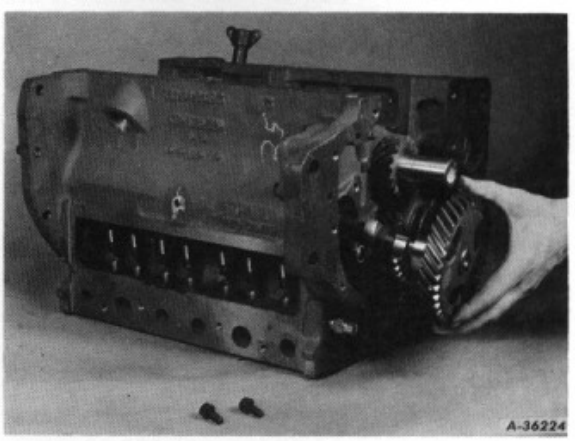
### Removing Camshaft

1. Remove oil pump body and gears at rear of camshaft.

2. Remove two 5/16-in. capscrews in the camshaft retainer plate through openings in the cam drive gear.

3. Turn crankcase upside down so tappets will fall away from camshaft to provide clearance for removal.

4. Withdraw camshaft from the front




**Illust. 39 -- Removing camshaft from crankcase.**

carefully so that the crankcase bores are not damaged by nicks from the edges of the cams. See Illust. 39.

5. Lift valve tappets out of crankcase.

## Inspection and Service

1. Check cam surfaces for damage.

2. Check oil pump keyway in camshaft for damage.

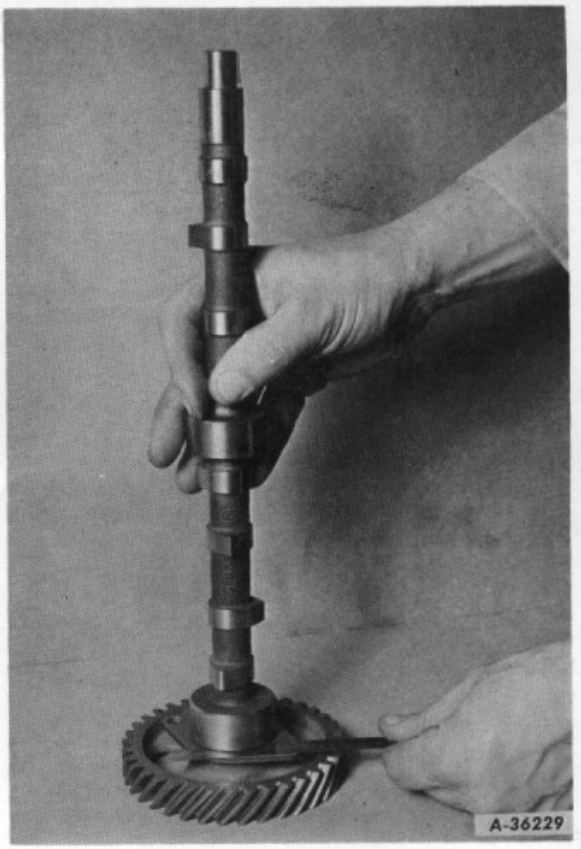
3. "Mike" bearing journals and bearing bores to determine amount of wear.

4. Check both ends of tappets for excessive wear or scoring.

5. Check camshaft gear for excessive wear or damage.

6. Check end clearance with feeler gage between front surface of camshaft front journal and thrust plate, with drive gear in place against shoulder on camshaft. See Illust. 40.

7. Replace excessively worn or damaged parts with new and wrap or cover to keep clean for reassembly.




**Illust. 40 -- Checking camshaft end clearance.**

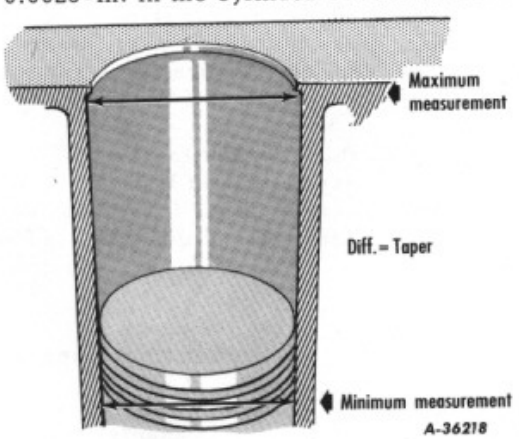
# CYLINDER BLOCK

## SPECIFICATIONS

| | |
|---|---|
| Valve guides: | |
| Type | Replaceable |
| Intake, ream size (after assembly) | .3115 - .3125-in. |
| Exhaust, ream size (after assembly) | .3125 - .3135-in. |
| Guide length | 1-1/2 in. |
| Valve seat: | |
| Angle | 45° |
| Width | 3/64-in. |
| Valve port diameter: | |
| Intake | .979-in. |
| Exhaust | .792-in. |
| Cylinder: | |
| Type | Cast-in-block |
| Bore | 2.625 to 2.627-in. |

### When to Rebore

As was noted under the main heading, Piston Assembly, replacement piston ring kits may be used to extend the life of the piston if cylinder wear has not been excessive. To be within safe limits, the taper from top to bottom of the ring travel area must not exceed 0.0105-in. and the out-of-round (egg-shape) condition must not exceed 0.0026-in. in the cylinder bores. If the bore is worn beyond these limits, a reboring job is required. See Illust. 41.




Illust. 41 -- Cross section showing cylinder taper.

### Preparing the Block

To rebore the cylinder block, the crankshaft and camshaft must be removed and the crankcase assembly stripped of all moving parts. Clean the water jackets with materials that will remove rust and scale and then flush thoroughly (see GSS-1016, Cooling System). Degrease the crankcase so that the abrasive material from the boring operation may be completely removed before reassembly.

Before setting up a boring machine on the block, the top must be carefully cleaned to remove all foreign materials, such as carbon, rust, or gasket cement. Use a 14-in. fine-cut, mill file to draw-file the block for removal of all burrs and high spots around the top edge and bolt holes. This will provide a smooth, true working surface for the boring operation. This is very important because the alignment of the cylinder bores depends entirely on the trueness of this working surface.

## Reboring

To save time, bore the cylinder having the greatest amount of wear and taper first. If this cylinder cleans up to the desired oversize, you can be sure that the remaining, smaller cylinder bores will clean up to the same size. Oversize pistons normally furnished for service are .020-in. and .040-in. oversize.

To center the boring machine on each cylinder, follow closely the instructions of the boring machine manufacturer. The centering fingers on the boring bar head should contact the cylinder wall below the area of ring travel, where the least wear has occurred. Slowly expand the centering fingers until they snugly contact the cylinder wall and, at the same time, shake the boring machine slightly to permit it to assume this alignment.

After making certain that the bar is accurately aligned with the center of the bore, tighten the anchoring device to secure the base of the machine to the top of the block. Retract the centering fingers and raise the boring bar head to the top. The machine is now centered and ready to perform the operation.

Use a good single point boring bar and bore all cylinders the same size, to within .0005 to .001-in. of the desired finished oversize. If honing equipment is not available for final finishing of the cylinders, they should be bored to the finished size. In the case of cylinders which are to be put into service in the "as bored" condition, the utmost care must be taken to assure that the boring tool has been perfectly ground and honed so that it will cut clean and produce a smooth finish. The finest possible tool feed should be used. If these precautions are not taken, rapid wear of the new pistons and rings may be expected.

## Honing

For best results, hone the cylinders to the finished size. This operation need not remove all boring tool marks, but should take off the tops of all tool marks. Final finish should be in the range of 15 to 30 micro-inches. If you have no means for measuring the finish, the use of about 220 grit stones will produce approximately the correct finish.

Cylinders that are too smooth will retard run-in and may result in ring scuffing. When cylinders are too rough, rapid ring wear will result. A rigid type wet hone is preferred for the final sizing operation, but a spring hone of the glaze-breaking type may be used if the other is not available. Spring hones should be equipped with 500 grit stones and stock removal should not exceed .0005-in. This type of hone should be dipped into SAE 10 or 20 lubricating oil before beginning the operation.

## Checking Clearance

To check the cylinder bores for correct clearance of the piston diameter, use a 0.001-in ribbon gage (1/2-in. wide) between the bare piston thrust surface and the cylinder wall. The gage ribbon should, with a light pull of 4 - 6 lb., pull out of the assembly with the piston in the ring wear area. This indicates a normal clearance of 0.0015 to 0.0025-in. if both the block and pistons are at normal room temperature at the time and if the pistons are not worn or out of round. See Illust. 17.

## Cleaning and Final Check-up

The success of any reboring job depends on the accuracy and smoothness of the finished bores, the amount of piston clearance and the thoroughness with which you clean the block and crankcase of all cuttings and abrasive materials resulting from boring and honing. The best reboring job will be a total loss unless the crankcase is scrupulously cleaned. Foreign material which remains causes rapid wear of pistons, rings, and cylinder walls, and will seriously damage engine bearings.

For thorough cleaning of the crankcase, washing in a tank of hot, agitated cleaning solution is the recommended procedure. If this cannot be done, use a good cleaning solution and air pressure blast followed by careful wiping with clean cloths and light lubricating oil. Surfaces should be wiped until a clean cloth shows no discoloration.

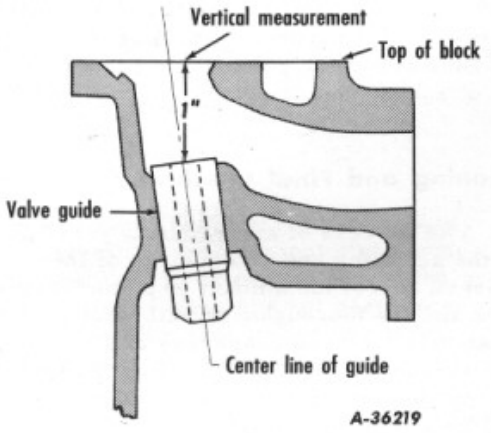
Check valve guides, when working on the block. Press out and replace any guides which are burned, cracked, broken, or excessively worn.

# ENGINE REASSEMBLY, INSTALLATION, INSPECTION AND SERVICING

## Engine Reassembly

During engine reassembly, special attention must be given to cleanliness, care and handling of parts, and final adjustments. For inspections, specifications, and service procedures on various parts and assemblies, see the previous headings in this manual section. Proceed as follows to reassemble engine:

1. Install new valve guides as required. Press them into the block to a measured distance of 1-in. from the top surface of the block to the top center of the guide. See Illust. 42.




**Illust. 42 -- Proper location of valve guide in the block.**

2. Ream valve guides to proper size as follows (see Illust. 30):

| | |
|---|---|
| Intake. . . . . | .3115 - .3125-in. |
| Exhaust . . . . . | .3125 - .3135-in. |

3. Press pinion on crankshaft.

4. Turn crankcase upside down, install crankshaft bearings, and tighten crankshaft bearing cap bolts evenly to 55-60 ft. lb. torque. See Illust. 32.

5. Install crankshaft rear oil seal retainer with new oil seal and new gasket.

6. Insert valve tappets in the crankcase.

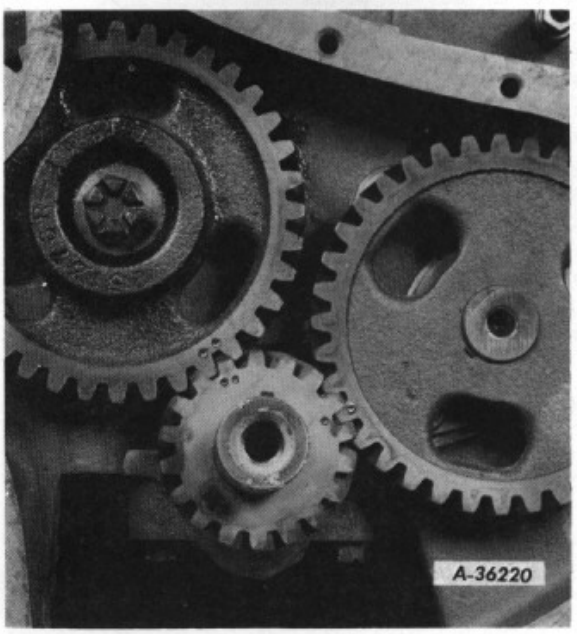
7. Place thrust washer over front end of camshaft and press camshaft gear into place. Check camshaft end clearance (see Illust. 40).

8. Insert the camshaft into the crankcase carefully to avoid damaging the bearing bores with the cams. Secure in place by bolting the thrust washer to the crankcase.

Note: To time the camshaft, align the camshaft gear tooth that has a single punch mark with the single punch mark on the crankshaft pinion as shown in Illust. 43.

9. Install the timing idler gear and tighten the retaining bolt 90 to 100 ft. lb. torque.

Note: Timing of the idler gear is accomplished by lining up the double punch mark on the idler gear with the double punch marked tooth on the crankshaft pinion. See Illust. 43.




**Illust. 43 -- Timing marks on camshaft, crankshaft and idler gears.**

10. Install the oil pump gears and the oil pump body. Use a new oil pump body gasket.

11. Assemble connecting rods, pistons, and piston pins and install the piston pin retainers.

12. Use ring expander tool and install piston rings. Be careful not to distort or break the rings (see Illust. 19).

Note: The top compression ring has a groove in the upper, inner corner and must be installed with this groove up. The lower compression ring has a groove in the lower, outer corner and must be assembled with the groove down (see Illust. 12). Gaps should be 180° apart.

13. Carefully install the pistons in the cylinders using the piston ring compression tool. See Illust. 44.


**Illust. 44 -- Using piston ring compressor to install pistons.**

14. Install connecting rod bearings and bearing caps. Tighten the cap bolts evenly to between 16 and 20 ft. lb. torque.

Note: Markings on the bearing cap and the shank of the connecting rod should be assembled to the camshaft side of the engine.

15. Install the valves, valve springs, and valve spring seats. Secure with the valve spring seat keys, using the valve lifter tool and valve seat key inserter.

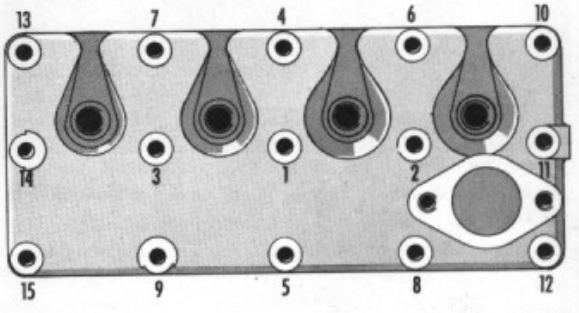
Note: In the exhaust valve rotator attachment, the rotator replaces the valve spring seat, and different valves and springs are used.

16. Adjust both intake and exhaust valve tappet clearances to .013-in. See Illust. 45.

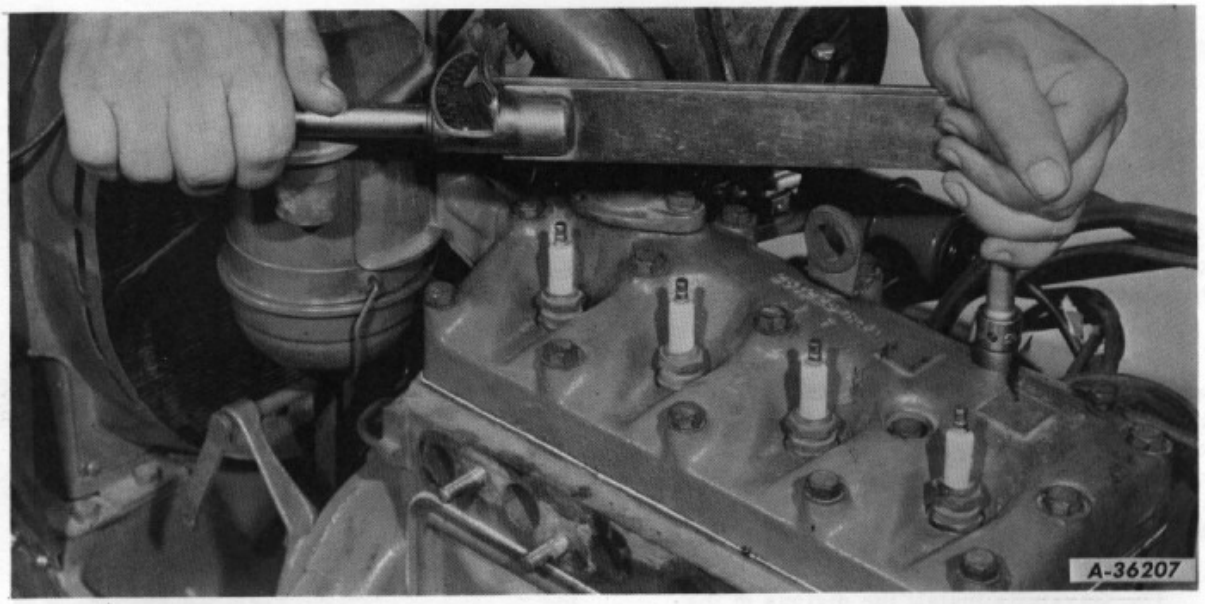

**Illust. 45 -- Adjusting valve tappets.**

17. Install the valve tappet cover using a new gasket.

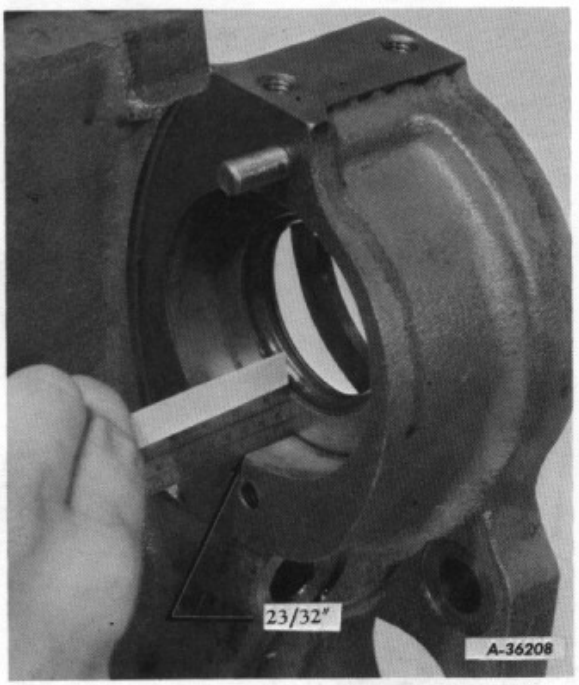
18. Install the cylinder head using a new gasket and tighten the head bolts properly to 45-50 ft. lb. torque. See Illust. 46.




**Illust. 46 -- Sequence for tightening cylinder head bolts.**




Illust. 47 -- Using a torque wrench to tighten the cylinder head bolts.

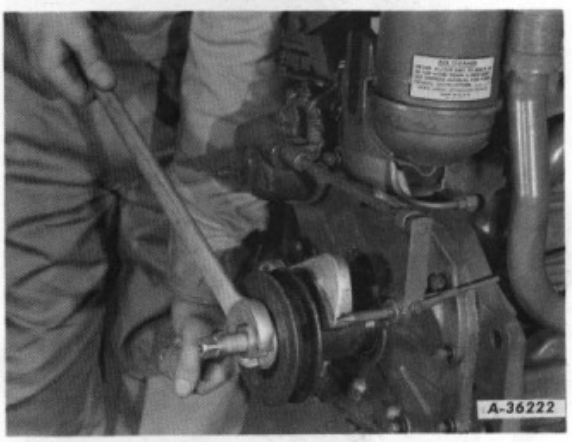



Illust. 48 -- Checking correct position of ignition drive oil seal.

19. Put on the crankcase front cover with a new oil seal and gasket. Do not tighten the capscrews at this time.

20. Install a new ignition drive oil seal in the crankcase. This seal must be square in its bore and positioned 23/32-in. from the ignition mounting flange face. See Illust. 48.

21. Carefully install the fan drive pulley using removing and installing tool No. 1 020 316 R92. See Illust. 49. Tighten the crankcase front cover capscrews. This permits the seal and the front cover to be centered by the fan drive pulley hub and insures an even contact of the seal around the pulley hub.




Illust. 49 -- Using two wrenches and special tool for installing the fan drive.

22. Install the oil pump screen and oil screen tube.

23. Put on the crankcase oil pan with a new gasket.

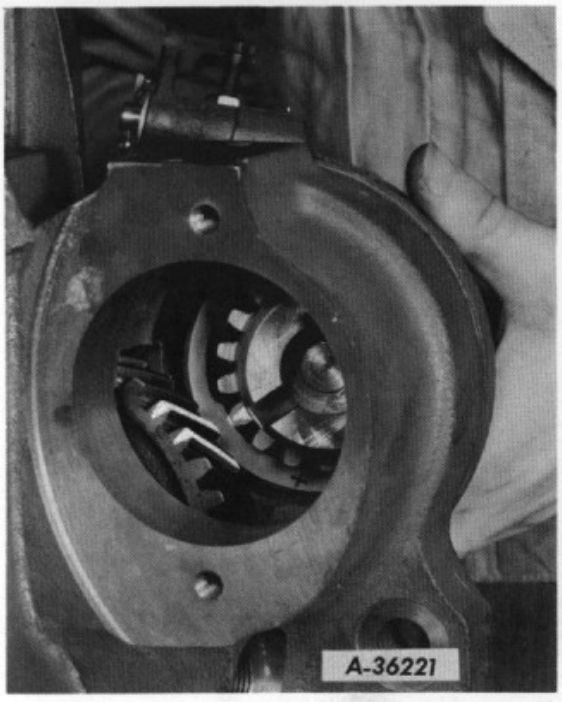
24. Install engine flywheel and tighten the retaining bolts to 45-50 ft. lb. torque.

25. Install the governor assembly with a new housing gasket. Time ignition drive gears as follows:

a. With a piece of chalk, mark the top surfaces of the two teeth on each side of of the single punch mark on the idler gear.

b. On the ignition drive gear, mark the top surface of the tooth having a single punch mark.

c. With the engine on top dead center of No. 1 firing stroke, mesh the marked tooth of the ignition drive gear with the two teeth that you marked on the idler gear. See Illust. 50.




**Illust. 50 -- Installing governor and ignition drive gear. Note chalk marked gear teeth in proper position.**

26. Set spark plug gap at .023-in. and install new spark plugs.

## Installation of Engine in Tractor

1. Attach chain hoist to engine and couple engine to clutch housing. Secure with four bolts and two capscrews.

2. Attach the fan assembly and generator and adjust the drive belts.

3. Attach the front axle and radiator assembly, then remove the chain hoist and wood blocks between steering gear housing and front axle.

4. Install clutch housing front cover.

5. Connect steering shaft support arm bracket to support arm.

6. Install water outlet and inlet elbows. Use new gaskets and new radiator hoses.

7. Install the cranking motor and voltage regulator.

8. Install the distributor assembly (or magneto) and the spark plug wires.

9. Put on the exhaust and intake manifold with carburetor, using new gaskets.

10. Attach the air cleaner and air cleaner pipe and governor connecting rod.

11. Install the hydraulic pump and manifold.

12. Put on the fuel tank and the hood.

13. Connect the fuel line and turn on the fuel valve at the strainer.

14. Attach the radiator grill, the exhaust pipe, muffler and air intake cap.

15. Connect or install all control rods, lines, and wires extending forward of the clutch housing.

16. Connect the battery cables to the battery.

## Tractor Final Inspection and Service

To insure maximum performance and efficient life from a Blue Ribbon overhauled tractor, the following inspections and servicing must be performed. Properly carried out, this procedure will greatly reduce the possibility of costly come-back service and dissatisfaction on the part of the customer.

1. Fill the cooling system according to requirements of the season.

2. Install new oil filter element and then fill crankcase to correct level.

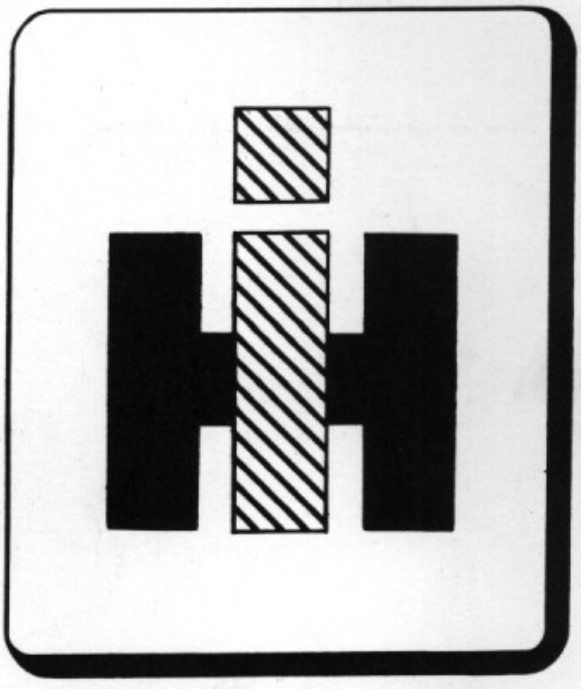
3. Clean and install oil level gage and breather cap.

4. Fill Touch-Control system with Touch-Control fluid.

5. Clean air cleaner oil cup and refill to correct level.

6. Lubricate fan hub, generator, magneto or distributor, and fill steering gear

7. Tune engine completely.



# 1st in service

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