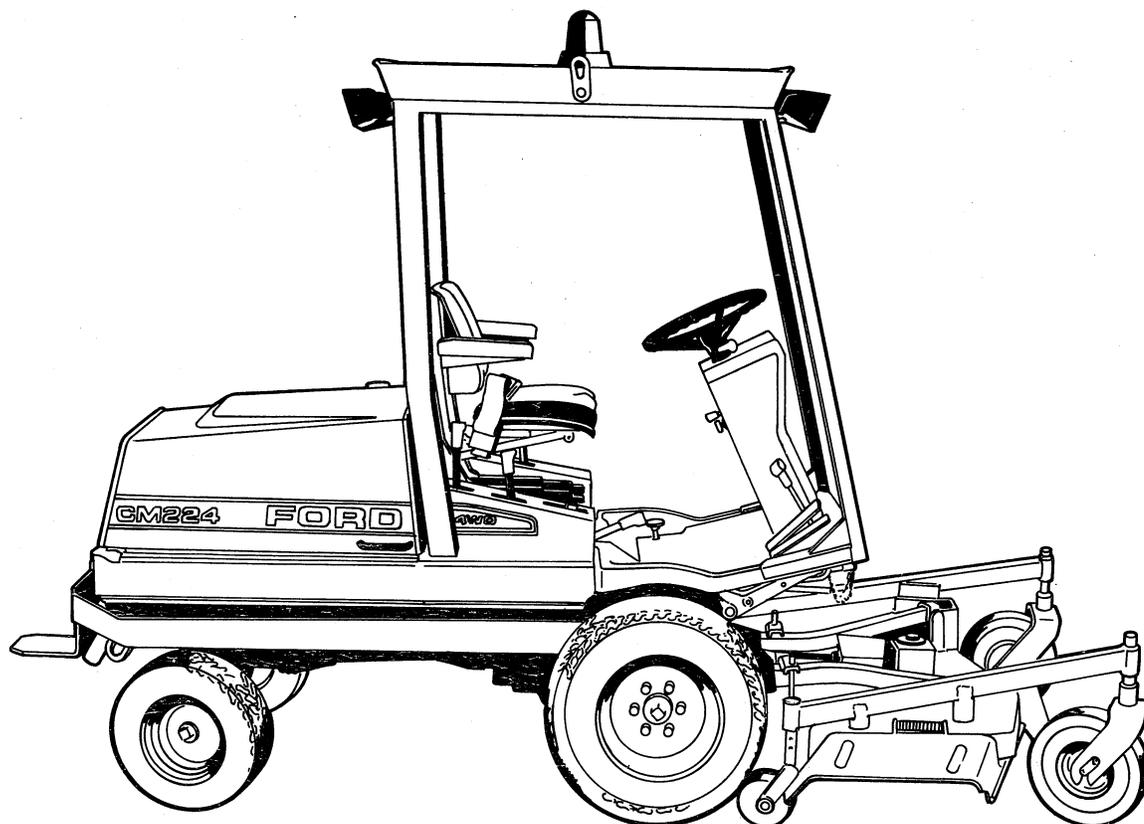


FORD



Service Manual

CM224 and CM274 Commercial Mowers



Reprinted

FOREWORD

This manual provides information for the proper servicing and overhaul of Ford CM224 and CM274 Commercial Mower Models and is an essential publication for all service personnel carrying out repairs and maintenance procedures.

The Manual is divided into ten 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.

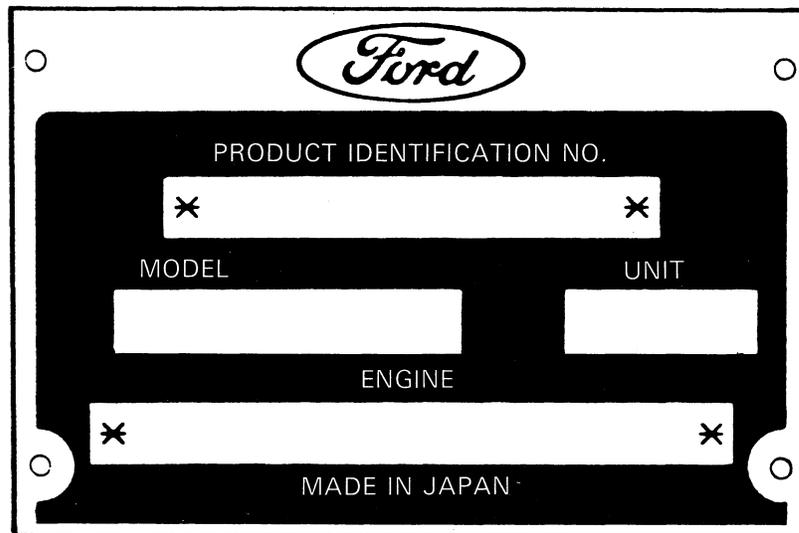
The material contained in this Manual was correct at the time of going to print, but Ford New Holland, Inc. policy is one of continuous improvement and the right to change prices, specifications, equipment or design at anytime without notice is reserved. All data in this Manual is subject to production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

FORD NEW HOLLAND, INC.

PRODUCTION DATE CODES AND SERIAL NUMBERS

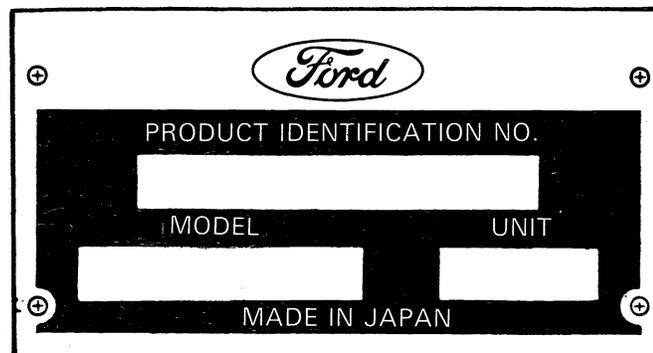
COMMERCIAL MOWER:

A VEHICLE IDENTIFICATION PLATE is located on the right-hand side of the Commercial Mowers on the main frame. The numbers on the plate are important should the Commercial Mowers require future service.



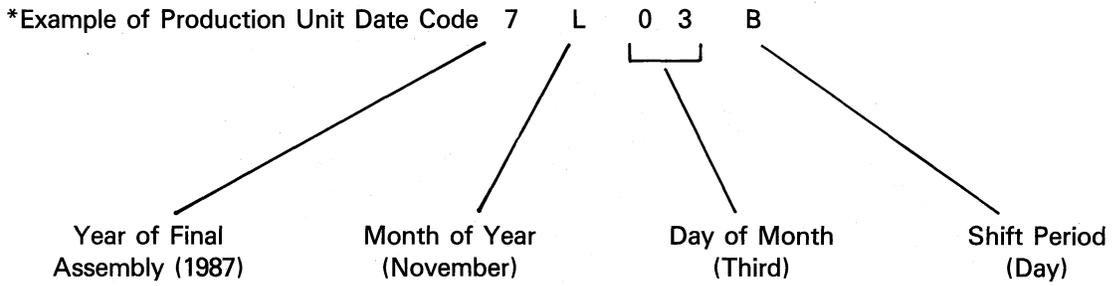
MOWER:

A PRODUCT IDENTIFICATION PLATE is located on the left-hand side of the mower deck. The numbers on the plate are important should the mower require service in the future.



UNIT PRODUCTION CODE:

| First Number YEAR | First Letter MONTH | Second Number DAY OF MONTH | Second Letter PRODUCTION SHIFT |
|----------------------|-----------------------|-------------------------------|------------------------------------|
| 1 — 1991 | A—Jan. G—July | 01/28/29/30/31 | A—Midnight B—Day C—Afternoon |
| 2 — 1992 | B—Feb. H—Aug. | | |
| 3 — 1993 | C—March J—Sept. | | |
| 4 — 1994 | D—April K—Oct. | | |
| 5 — 1995 | E—May L—Nov. | | |
| 0 — 1990 | F—June M—Dec. | | |





SAFETY PRECAUTIONS



Practically all service work involves the need to drive the commercial mower. The Operator's Manual, supplied with each commercial mower, contains detailed safety precautions relating to driving, operating and servicing that commercial mower. 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.
- **Skin Protection**
Used motor oil may cause skin cancer. Follow work practices that minimize the amount of skin exposed and the length of time used oil stays on skin.
- **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 the noise is excessive, wear ear protection.
- Avoid injury by correctly handling components. Make sure you are capable of lifting the object. If in doubt get help.
- **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 a raised implement.

- **Compressed Air**

The pressure from a compressed air line is often as high as 100 psi (6.9 bar). 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. They 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 its 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 commercial mower 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 commercial mower 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 commercial mowers 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 commercial mower or attempt to by-pass the neutral 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 commercial mower which is on soft ground. Always take the unit to an area which has a hard working surface, preferably concrete.
- If it is found necessary to raise the commercial mower for ease of servicing or repair, make sure that safe and stable supports are installed beneath axle housings, casings, etc., before commencing work.
- Before loosening any hydraulic hose, lower the attachment to the ground, switch off the engine and relieve all hydraulic pressure by operating the control lever several times. This will remove the danger of personal injury from oil pressure or accidentally dropping the attachment.
- Prior to pressure testing, make sure all hoses and connectors, not only of the commercial mower, 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.

WARNING: *Escaping hydraulic / diesel fluid under pressure can penetrate the skin causing serious injury.*



- *DO NOT use your hand to check for leaks. Use a piece of cardboard or paper to search for leaks.*
- *Stop engine and relieve pressure before connecting or disconnecting lines.*
- *Tighten all connections before starting engine or pressurizing lines.*

IF ANY FLUID IS INJECTED INTO THE SKIN, OBTAIN MEDICAL ATTENTION IMMEDIATELY OR GANGRENE MAY RESULT.

- When inflating tires beware of over inflation — constantly check the pressure. Overinflation 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.

MOWER – SAFETY PRECAUTIONS

- Read the commercial mower Operator's Manual carefully before using the equipment. Lack of operating knowledge can lead to accidents.
- Keep all safety devices and shields in place.
- Do not modify or alter or permit anyone else to modify or alter this mower or any of its components or any commercial mower function.
- Always keep people and pets a safe distance from the machine.
- Clear the work area of loose objects which might be picked up and thrown when the mower is operated.
- Disengage the power to the mower when transporting or not in use.
- Disengage the mower before backing up. Do not mow in reverse unless absolutely necessary and then only after careful observation of the entire work area behind the mower.
- Always shut the engine off when unclogging the chute.
- Always disengage the power to the attachments and stop the engine before leaving the operator's seat.

SERVICE TECHNIQUES

A. SERVICE SAFETY

Appropriate service methods and proper repair procedures are essential for the safe, reliable operation of all machinery 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 machines, 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 machines 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 that the hose does not foul by moving the component through the complete range of travel.

Be sure any hose which has been installed 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.

PART 1

ENGINE SYSTEMS

MODELS CM224 & 274

Chapter 1

ENGINE AND LUBRICATION SYSTEM

| Section | | Page |
|----------------|---------------------------------|-------------|
| A. | DESCRIPTION AND OPERATION | 1 |
| B. | ENGINE OVERHAUL | 3 |

Chapter 2

COOLING SYSTEM

| Section | | Page |
|----------------|---------------------------------|-------------|
| A. | DESCRIPTION AND OPERATION | 35 |
| B. | OVERHAUL | 36 |

Chapter 3

TROUBLE SHOOTING, SPECIFICATIONS

AND SPECIAL TOOLS

| Section | | Page |
|----------------|------------------------|-------------|
| A. | TROUBLE SHOOTING | 41 |
| B. | SPECIFICATIONS | 45 |
| C. | SPECIAL TOOLS | 54 |
| D. | COMPRESSION TEST | 55 |

PART 1 ENGINE SYSTEMS MODELS CM224 & CM274

Chapter 1 ENGINE AND LUBRICATION SYSTEM

| Section | Page |
|------------------------------------|------|
| A. DESCRIPTION AND OPERATION | 1 |
| B. ENGINE OVERHAUL | 3 |

A. DESCRIPTION AND OPERATION

This chapter describes the engine overhaul and repair procedures of the Models CM224 and CM274 Commercial Mowers. Repair procedures are essentially the same for all models except as noted in the repair procedures.

The commercial mowers are equipped with three-cyl-

inder in-line engines, Figure 1. They are all four cycle, overhead valve, liquid cooled engines. The engines are identified by a code number cast into the side of the cylinder block.

| Engine Identification | Commercial Mower Model |
|-----------------------|------------------------|
| S753 | CM224 |
| J823 | CM274 |

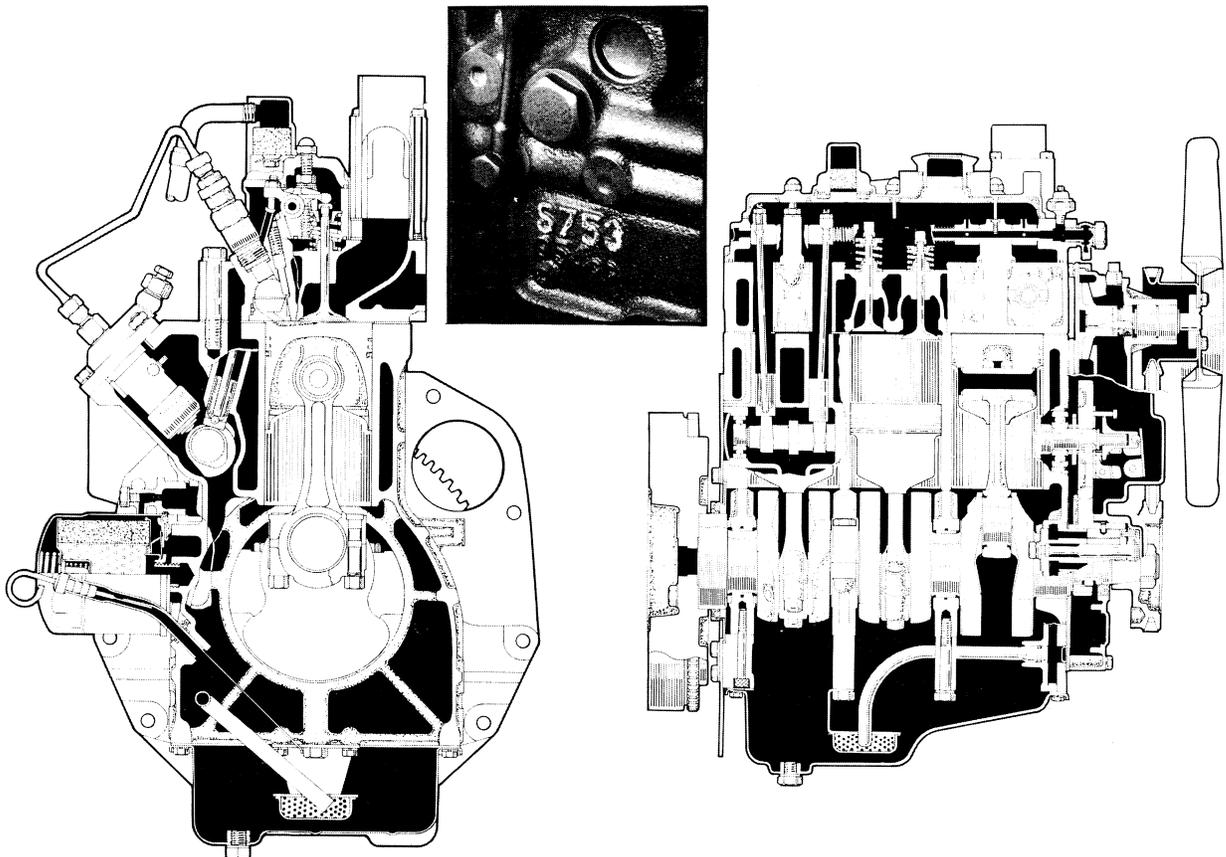


Figure 1
Engine Assembly (CM274 Shown)

S-25389

CYLINDER HEAD AND VALVE TRAIN COMPONENTS

The cylinder head incorporates the valve assemblies, rocker arms, rocker shaft, push rods, and lifters.

A swirl chamber located between the injector assembly and the main combustion chamber of the cylinders provides improved starting and greater fuel efficiency. Initial combustion starts in the pre-combustion chamber and as the air-fuel expansion occurs a strong swirl pattern is created in the main combustion chamber for more complete combustion of the air-fuel mixture.

The intake manifold is incorporated into the left-hand side of the valve cover assembly on the Model CM224. On the Model CM274 the air intake manifold is separated from the cast aluminum valve cover. The exhaust manifold is bolted to the right-hand side of the cylinder head on each of the models.

Standard size only valves are utilized with valve guides. Only standard size valves are available for service. The Model CM224 has a one-piece rocker shaft assembly. The Model CM274 rocker arm assembly is mounted in a housing.

CYLINDER BLOCK ASSEMBLY

The cylinder block assembly contains the pistons, connecting rods, crankshaft, timing gears and engine oil pump.

The crankshaft is supported on four main bearings. The front bearing is positioned in a bore in the front of the block.

The 2nd, 3rd and 4th bearings are split liners located in holders bolted to the block.

The camshaft is supported on two bearings located on each end of the block.

PISTON AND CONNECTING RODS

Both models utilize a straight connecting rod and a three ring piston.

LUBRICATION SYSTEM

Reference — Figure 2

The oil pump assembly is located within the idler drive gear at the front of the block and below and to the left

of the crankshaft as viewed from the front. The oil pump is driven by the crankshaft gear.

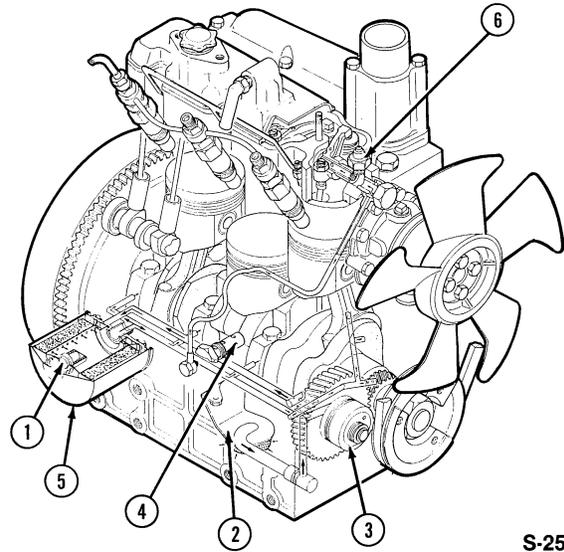


Figure 2
Lubrication (CM274 Shown)

- | | |
|-------------------|------------------------|
| 1. By-Pass Valve | 4. Relief Valve |
| 2. Suction Screen | 5. Filter |
| 3. Oil Pump | 6. Oil Pressure Sender |

Oil is picked up from the sump by the intake tube and drawn into the lower side drilling in the block to the oil pump. Oil from the pump flows through passages in the block, past the relief valve, through the oil filter and returns to the main oil gallery in the area of the drilled bolt located on the side of the block. Oil flow in the main oil gallery extends to the four main bearings. Oil flow to the main bearings passes through drilled passages in the crankshaft to the three connecting rod bearings. The remaining portion of the oil flow is directed through the external tube to the rocker arm assembly. Oil flows from the external tube into a passage in the rocker arm bracket to the rocker shaft.

Oil leakage from clearance between the rocker arms and the shaft overflows in the valve cover and lubricates the valve stems, push rods and tappets.

The relief valve is mounted in the side of the block and intersects the main oil passage. When the oil pressure exceeds the rated pressure, oil is by-passed through the relief valve directly to sump.

The cylinder walls, pistons, and piston pins are splash lubricated by the crankshaft.

ENGINE OIL FILTER

Because engine oil becomes contaminated with dust, carbon particles, metal dust and sludge, it is directed through a filter before entering the engine lubrication passages. The filter is a full-flow type whereby all of the oil from the pump is routed through the filter. To protect the engine from a loss of lubrication, the filter contains a by-pass valve which opens if the element becomes plugged, Figure 2.

B. OVERHAUL

CYLINDER HEAD REMOVAL

The cylinder head can be removed and replaced for service without removing the engine.

1. Drain the radiator coolant into a clean container.
2. Remove the air cleaner (2) and hose (1), Figure 3.

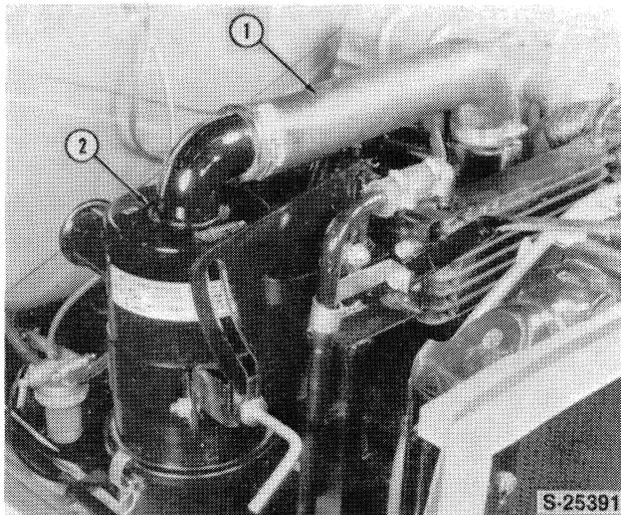


Figure 3
Air Cleaner Removal

1. Hose
2. Air Cleaner
3. Remove the transmission oil cooler (3) and cap all openings, Figure 4.
4. Remove the injector lines (1) leak-off tubes (3) and injectors (2), Figure 5.
5. Disconnect the vent tubes from the rocker cover, Figure 5.
6. Remove the exhaust manifold brace.

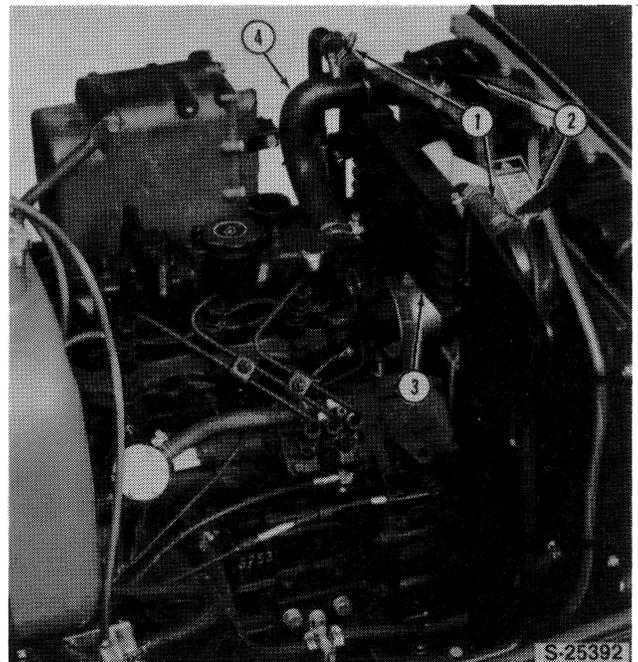


Figure 4
Oil Cooler Removal

1. Cooler Hoses
2. Braces — Radiator
3. Oil Cooler
4. Upper Radiator Hose

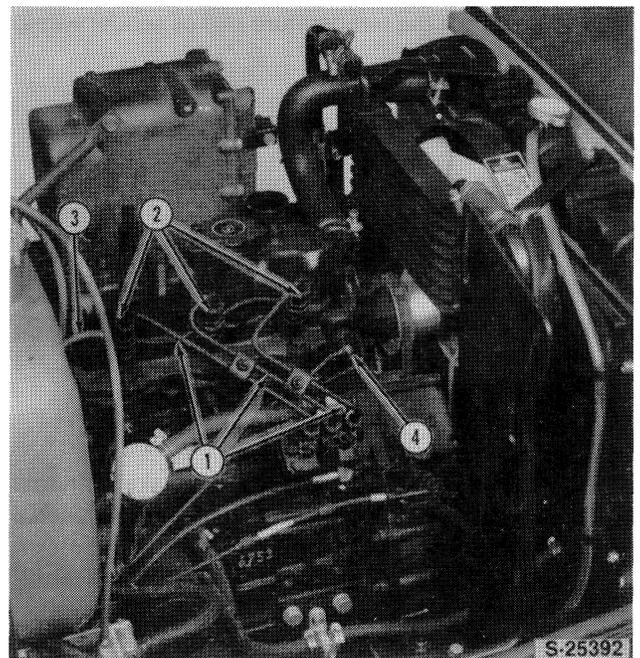


Figure 5
Injector Removal

1. Injector Lines
2. Injectors
3. Leak-Off Tube
4. Oil Pressure Switch

7. Loosen the clamp (1) at the muffler and allow it to slide downward, Figure 6.
8. Remove the exhaust manifold and muffler assembly (2) from the cylinder head, Figure 6.

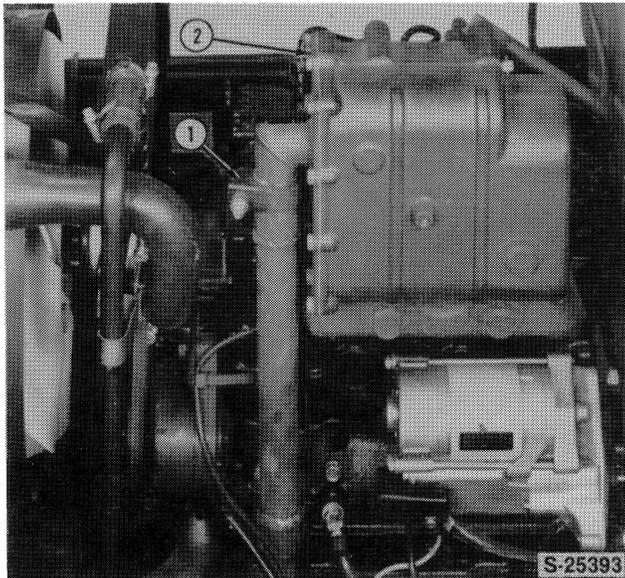


Figure 6
Muffler Removal

1. Clamp
2. Exhaust Manifold and Muffler

9. Disconnect the temperature and oil sender wires, Figure 5.
10. Remove the upper radiator hose (4), Figure 4.
11. Remove the banjo bolt from the oil pressure tube (1) at the front of the cylinder head, Figure 7.
12. Remove the glow plugs.
13. Remove the water pump (1) and thermostat (Model CM224), Figure 8. On the Model CM274 remove the thermostat housing, thermostat and water pump.
14. Remove the rocker cover and intake manifold assembly (1) from the cylinder head on the Model CM224, Figure 9. On the Model CM274 the rocker cover (1) and intake manifold (3) with spacer (2) must be removed, Figure 10.
15. Remove the rocker arm assembly and push rods, Figure 11.

NOTE: The rocker arms on the Model CM274 are contained in a housing, Figure 12.

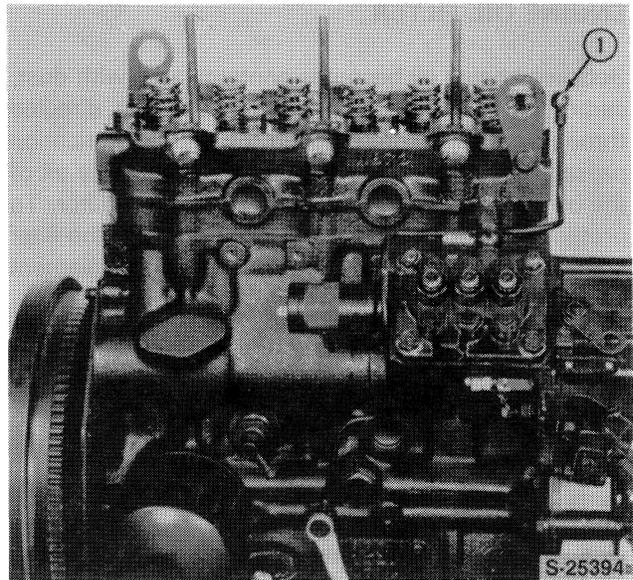


Figure 7
Cylinder Head Removal

1. Oil Pressure Tube

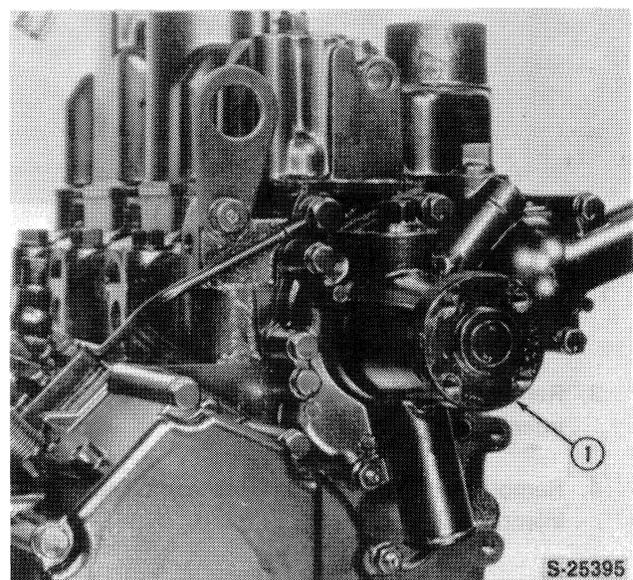


Figure 8
Water Pump Removal (CM224 Shown)

1. Water Pump

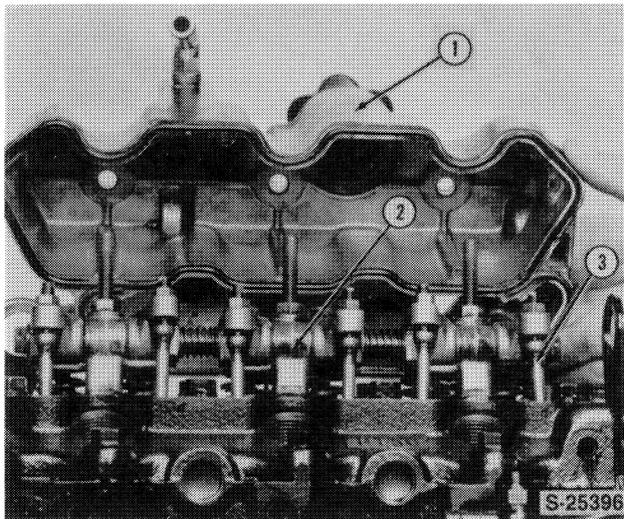


Figure 9

Rocker Arm Cover — CM224

- | | |
|----------------------------------|------------------------|
| 1. Rocker Arm Cover and Manifold | 2. Rocker Arm Assembly |
| | 3. Push Rods |

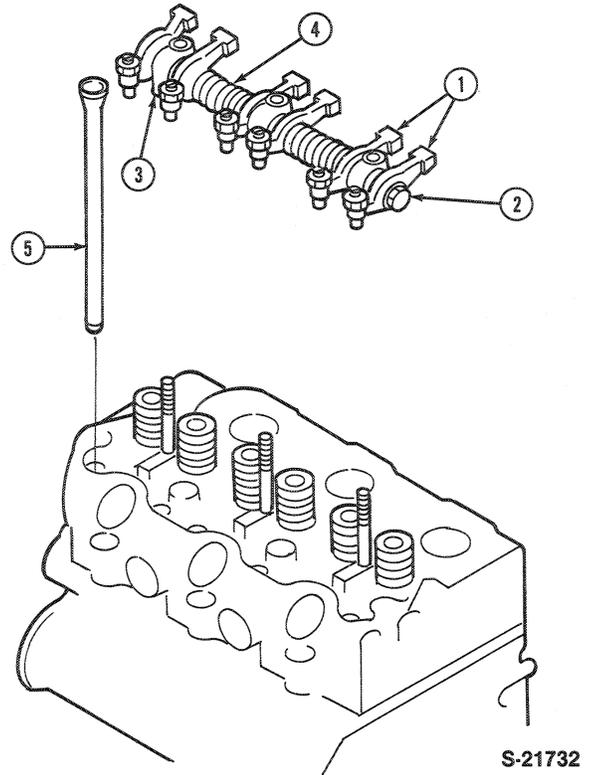


Figure 11

Rocker Shaft Removal — CM224

- | | |
|-----------------------|-------------|
| 1. Rocker Arms | 4. Springs |
| 2. Shaft | 5. Push Rod |
| 3. Rocker Arm Support | |

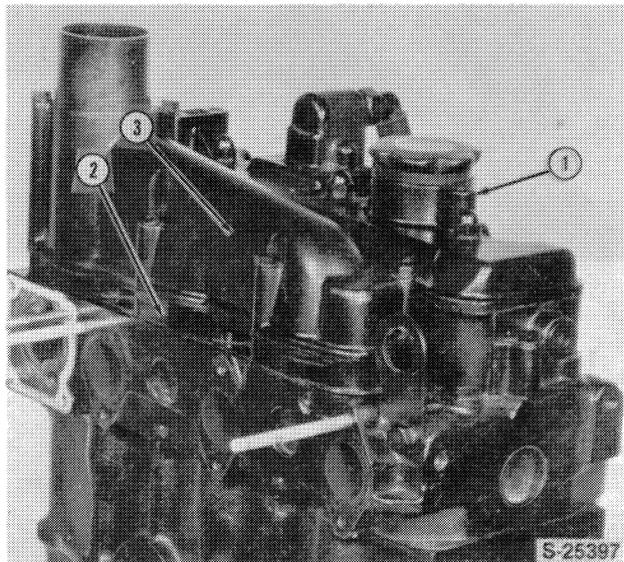


Figure 10

Rocker Arm Cover and Intake Manifold — CM274

- | | |
|---------------------|--------------------|
| 1. Rocker Arm Cover | 3. Intake Manifold |
| 2. Spacer | |

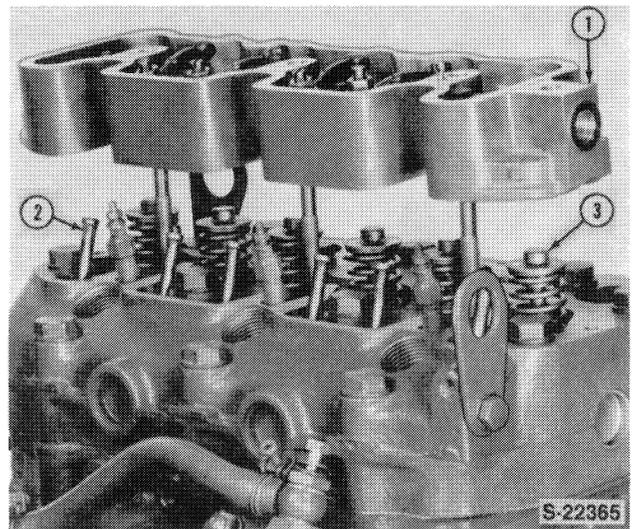


Figure 12

Rocker Arm Assembly

- | | |
|------------------------------------|-------------|
| 1. Rocker Arm and Housing Assembly | 2. Push Rod |
| | 3. Cap |

16. Remove the oil pressure switch (1), Figure 15.
17. Loosen the head bolts (1) alternately a half turn at a time to prevent warping the head, Figure 13.

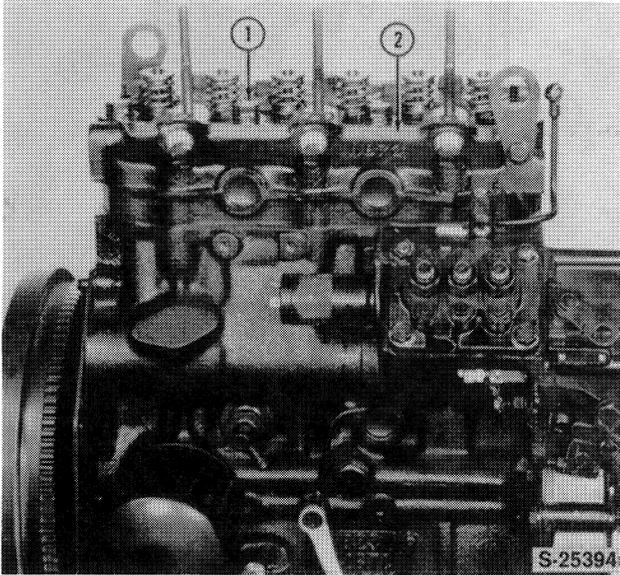


Figure 13
Cylinder Head Removal

1. Head Bolts
2. Cylinder Head

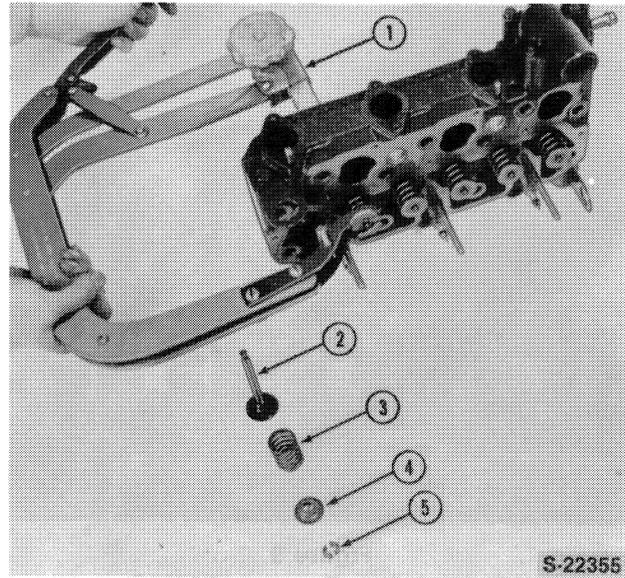


Figure 14
Cylinder Head Valve Removal

1. Valve Spring Compressor
2. Valve
3. Spring
4. Retainer
5. Keepers

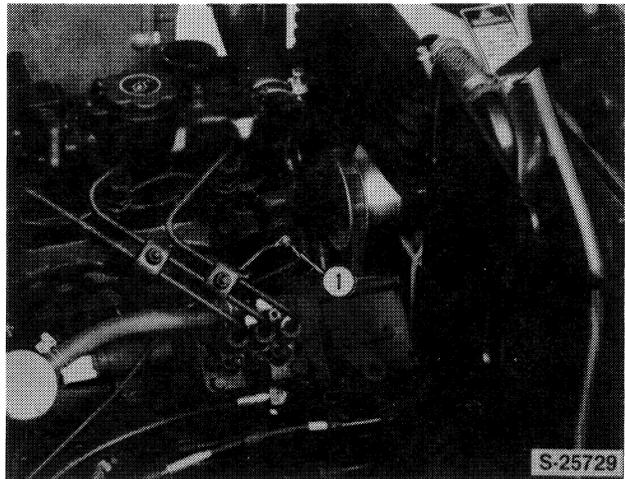


Figure 15
Oil Pressure Switch Location

1. Oil Pressure Switch

DISASSEMBLY

1. Clean the cylinder head and remove any carbon deposits from around the valve heads.
2. Use a valve spring compressor and remove the valve spring retainer locks, spring and spring retainer from the valves, Figure 14.
3. Remove the valves and place the valve components together in separately marked containers for reassembly in their original location.

INSPECTION AND REPAIR

CYLINDER HEAD

1. Clean all carbon deposits from the combustion chamber and valve ports using a wire brush and scraper.

2. Clean all dirt and residue from the gasket surface using care not to scratch or nick the machined surface.
3. Clean the cylinder head in solvent and air dry.
4. Check the head for cracks or damage, Figure 16, in the following areas:
 - Valve ports
 - Valve seats
 - Combustion chamber
 - External cracks in the water jackets

5. Inspect the gasket surfaces for scratches or nicks which could cause leakage.
6. Examine the core hole plugs for rust or signs of leakage. If a plug show signs of damaging rust or leakage, replace all the plugs in the head.
7. Use a straight edge and feeler gauge and check the cylinder head for warp lengthwise, crosswise and diagonally, Figure 17.

Resurface or replace the head if warpage is greater than 0.005 in. (0.12 mm).

Maximum resurfacing allowance is .020 in. (0.5 mm).

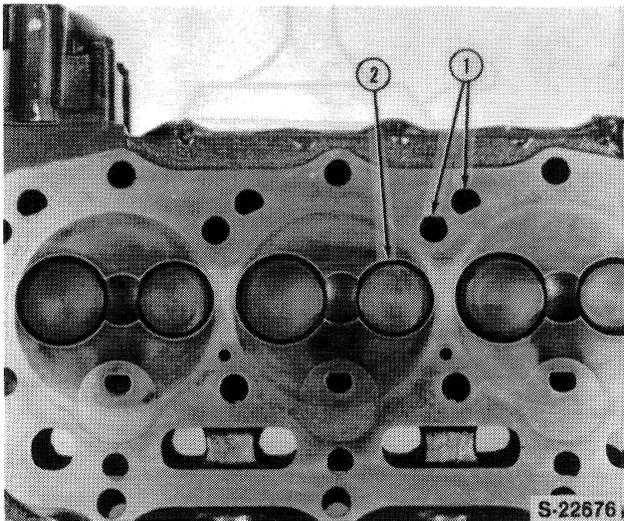


Figure 16

Cylinder Head Inspection

1. Cylinder Head Ports 2. Valve Seat

VALVE SEATS

Examine the valve seats and reface the seat if damaged.

Valve seat grinding requires that the seat be ground to the correct width and properly positioned as shown in Figure 18.

A valve that extends too deep into the combustion area will result in valve burning. If the valve is recessed too deep into the head it will cause a rapid build-up of carbon deposits.

1. Check the valve seat for surface defects. Use a 45° stone if necessary to reface. Grind away only enough material to provide a smooth even seat.

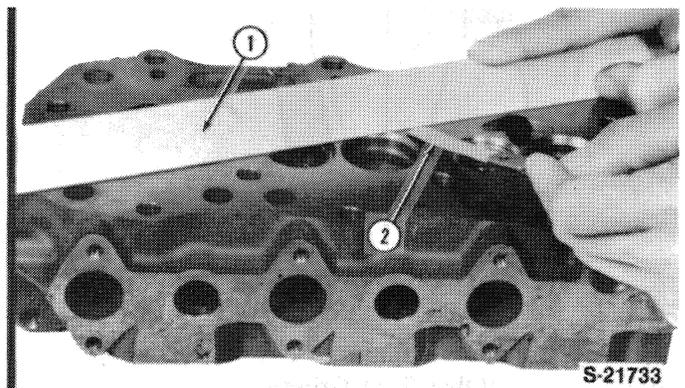
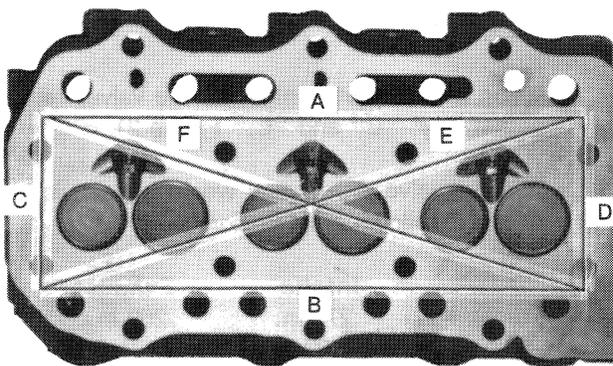


Figure 17

Measuring Cylinder Head Flatness

1. Straight Edge 2. Feeler Gauge

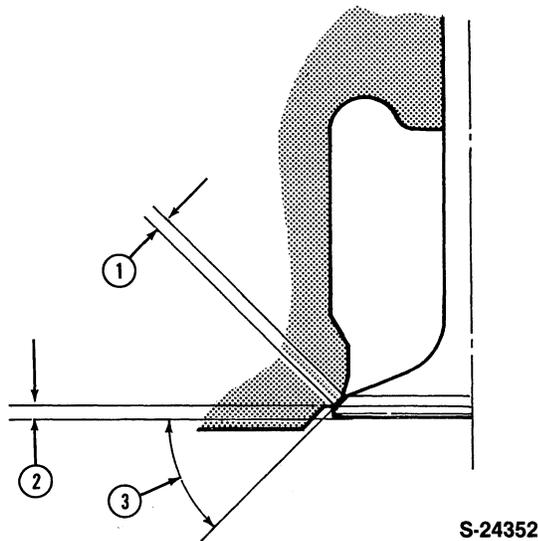


Figure 18
Valve Seat Dimensions

1. Valve Seat Width — .067-.082 in. (1.7-2.1 mm)
2. Valve Head Margin — .033-.043 in. (.85-1.15 mm)
3. Angle Of Valve Seat — 45°

2. Check the seat width, Figure 19, and if necessary, use a 15° stone to lower the seat contact point. Use a 75° stone to raise the seat contact point.

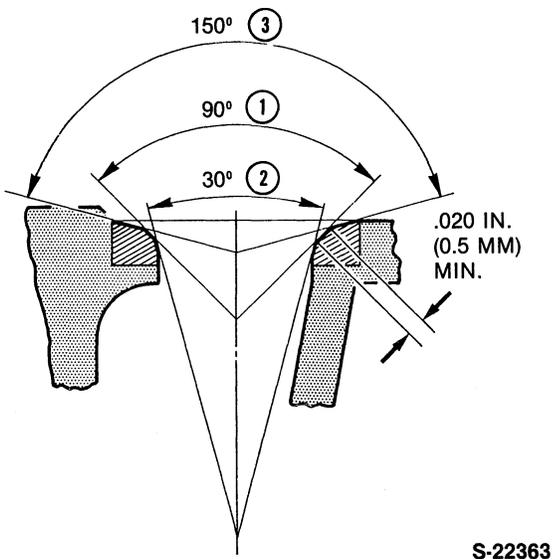


Figure 19
Valve Seat Grinding

1. Seat Angle — 45°
2. Lower Seat Location — 15° Stone
3. Raise Seat Location — 75°

NOTE: Refacing the seat should always be coordinated with refacing of the valve to assure a compression tight fit.

VALVES

1. Clean all deposits from the valves using a soft wire brush. Inspect the condition of the valve and discard any that are badly burned, cracked or bent, Figure 20.

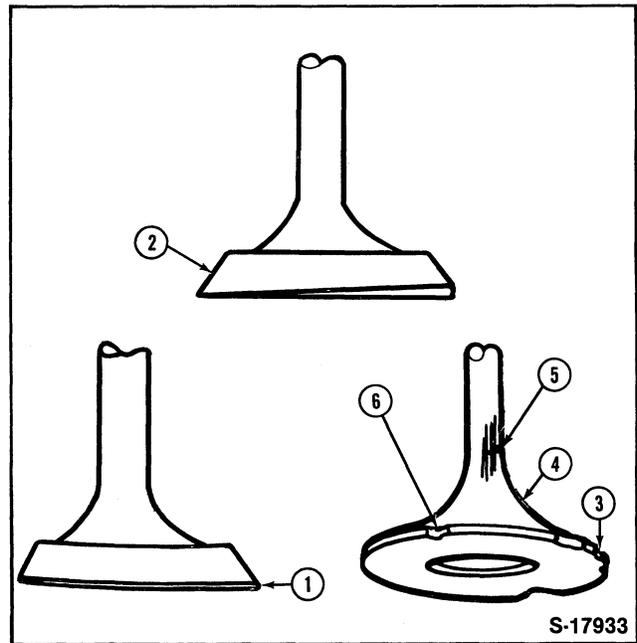


Figure 20
Valve Defect Inspection

1. Margin Too Thin — .020 in. (.5 mm)
2. Bent Valve
3. Pitting
4. Indented
5. Wear or Necking
6. Burned

2. Using a micrometer, measure the valve stem at points "A," "B" and "C," Figure 21.

Replace valve if the stem wear diameter is less than the following dimensions:

| | Intake | Exhaust |
|------------|-----------------------|-----------------------|
| Model: All | .271 in. (6.89 mm) | .269 in. (6.84 mm) |

3. If inspection indicates that the valve may be re-used, the valve should be ground as shown, Figure 22.

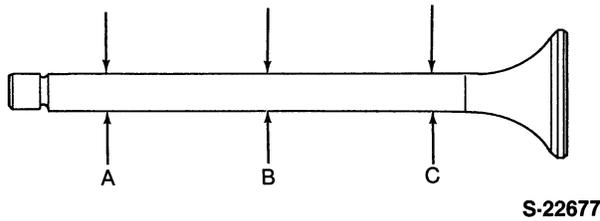


Figure 21
Valve Stem Wear Points

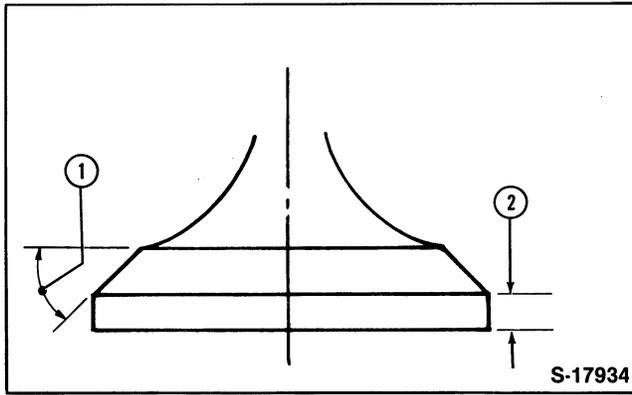


Figure 22
Valve Correctly Ground

- | | |
|-------------------|-----------------------|
| 1. 45° Angle Seat | 2. .036 in. (.925 mm) |
| | Std. — Minimum |
| | .020 in. (0.5 mm) |

IMPORTANT: After grinding the valve and seat, check to assure that the seat contacts the center of the valve face. Using Prussian Blue, lightly coat the valve in position and rotate the valve slightly while holding a light pressure against the valve. If the blue is transferred to the center of the valve face, the contact is correct.

If Prussian Blue is not available, mark the valve face or seat with a soft lead pencil as shown, Figure 23. Rotate the valve slightly in the seat. The penciled lines will be broken at the seat contact area.

VALVE GUIDES

Thoroughly clean the valve guides before attempting to check internal wear.

- Using a small hole gauge, measure the valve guide bore at the top and bottom wear points, Figure 24.

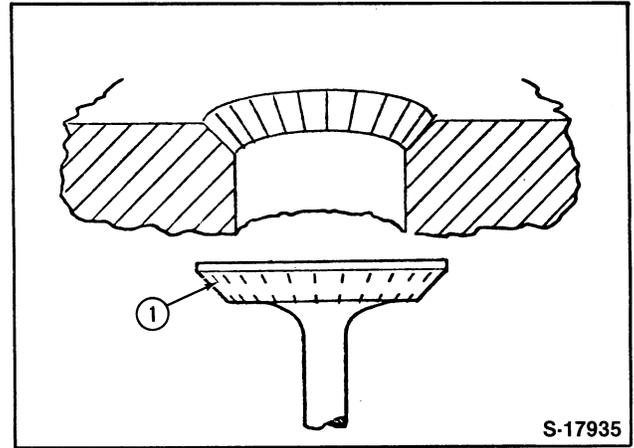


Figure 23
Valve Seat Contact Location

- Seat

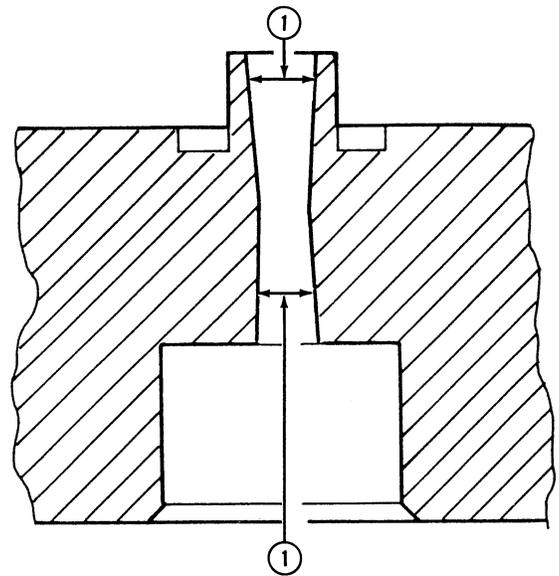
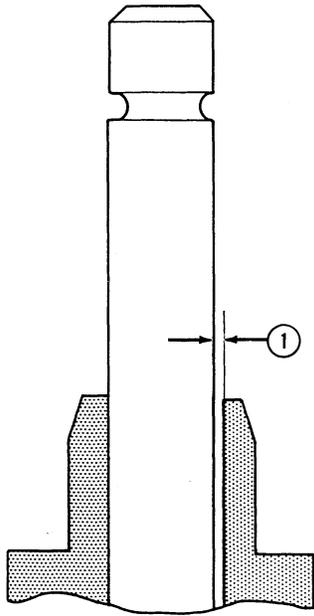


Figure 24
Valve Guide Wear Check

- Wear Point
- Determine the stem to guide clearance by subtracting the stem diameter from the valve guide diameter, Figure 25.

Replace valves if the clearance is more than .008 in. (0.2 mm).
- Replace the cylinder head if excessive clearance is determined. See "Specifications," Chapter 3, for wear limits.



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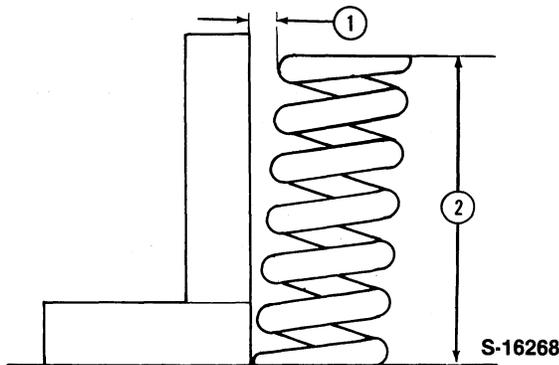
Figure 25

Valve Stem-to-Guide Clearance Check

1. Clearance

VALVE SPRINGS

1. Place the valve springs on a flat surface. Measure the free-length of the spring and squareness, Figure 26.



S-16268

Figure 26

Valve Spring Length and Squareness Check

1. Squareness
2. Free Length

Replace springs that do not meet the following specifications:

| | Max. Out of Square | Min Free-Length |
|------------|----------------------|------------------------|
| Model: All | .079 in. (2.0 mm) | 1.319 in. (33.5 mm) |

2. Place the springs in a suitable spring load tester and measure the spring load rating. Replace the springs that do not meet the following load specifications:

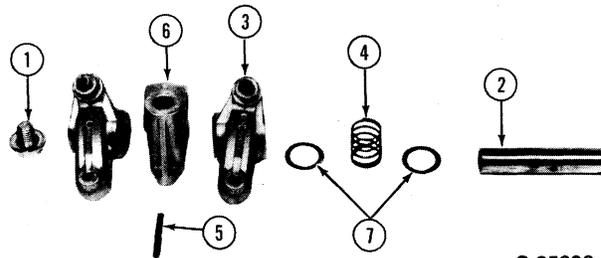
Model: All ... 17.8 lbs. (Min.) at 1.2 in. Height
(8.1 kg at 30 mm)

ROCKER ARMS

Model CM224

Reference — Figure 27

1. Remove the bolts (1) at each end of the rocker arm assembly.
2. Remove the roll pin (5) from the No. 1 cylinder rocker support (6) and remove the rocker shaft (2).



S-25398

Figure 27

Rocker Arm Assembly — CM224

- | | |
|---------------|-------------|
| 1. Bolt | 5. Roll Pin |
| 2. Shaft | 6. Support |
| 3. Rocker Arm | 7. Shim |
| 4. Spring | |

Model CM274

Reference — Figure 28

1. Remove the setscrew (1).
2. Remove the plug from the rear of the rocker shaft support.
3. Thread a 8 mm bolt into the rear end of the rocker shaft and slowly withdraw the rocker shaft while at the same time removing the rocker arms and springs.

NOTE: A setscrew (1), Figure 28 locks the rocker shaft in place in the support. Remove the setscrew before attempting to remove the rocker shaft.

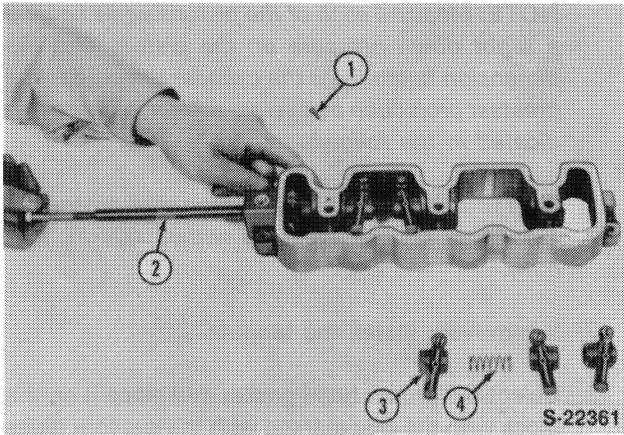


Figure 28
Rocker Arm

- | | |
|---------------------|---------------|
| 1. Screw | 3. Rocker Arm |
| 2. Rocker Arm Shaft | 4. Spring |

4. Inspect the rocker arms and shaft for wear or damage. Check the adjusting screws for damaged threads or excessive wear.
5. Check the valve stem contact area for pitting or excessive wear. Slight wear patterns may be removed using a fine grit oil stone.
6. Using a micrometer, measure the wear points on the rocker shaft as indicated, Figure 29.

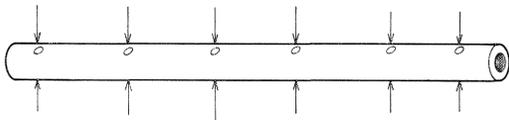


Figure 29
Rocker Arm Wear Points

Replace the rocker shaft if the wear at any point exceeds the following diameter:

| | |
|-------------|-----------------------------------|
| | Minimum Shaft Diameter |
| Model CM274 | .456 in. (11.57 mm) |

7. Using a hole gauge, measure the inside bore diameter of the rocker arm, Figure 30.

Replace the rocker shaft and/or rocker arm if the rocker arm to shaft clearance exceeds .008 in. (0.2 mm).

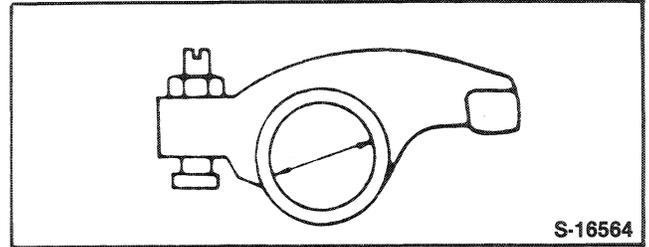


Figure 30
Measurement — Inside Bore

PUSH RODS

1. Check all push rods for straightness by rolling on a flat surface. Replace rods which are bent.
2. Inspect the ends of the push rods for excessive wear. If any push rod is worn, the corresponding lifter and rocker arm should also be inspected for excessive wear.

ASSEMBLY

Cylinder Head

1. Insert each valve in the guide from which it was removed and lightly tap the valve to be sure of an even seat around the valve face. Remove the valve and remove all traces of lapping compound.

NOTE: Use Tool 1587 and install new seals on the intake valve guides.

2. Using a valve spring compressor, assemble the valves, springs, retainers and keepers in the cylinder head.
3. Install the oil pressure switch (1), Figure 31.

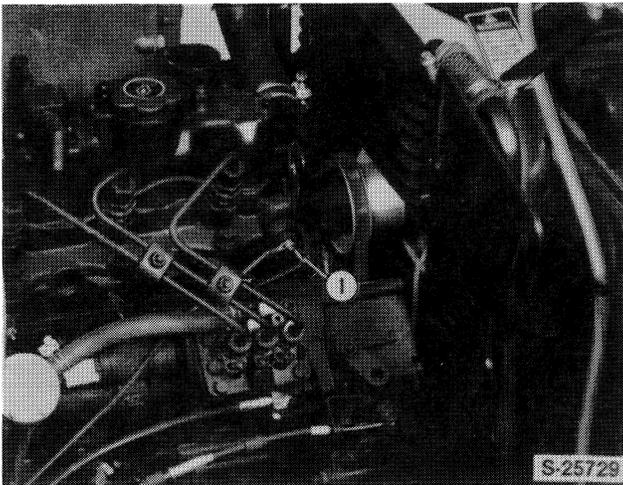


Figure 31

Oil Pressure Switch Location

1. Oil Pressure Switch

INSTALLATION

During assembly, the ultimate engine compression ratio is established by the thickness of the head gasket used. For service replacement, head gaskets of different thicknesses are available. The correct head gasket must be selected based upon the amount the pistons protrude above the face of the block when at top-dead-center.

The correct head gasket usage is determined as follows:

1. Position each of the pistons at top-dead-center and using a dial indicator, determine the distance each piston projects above the face of the block, Figure 32.

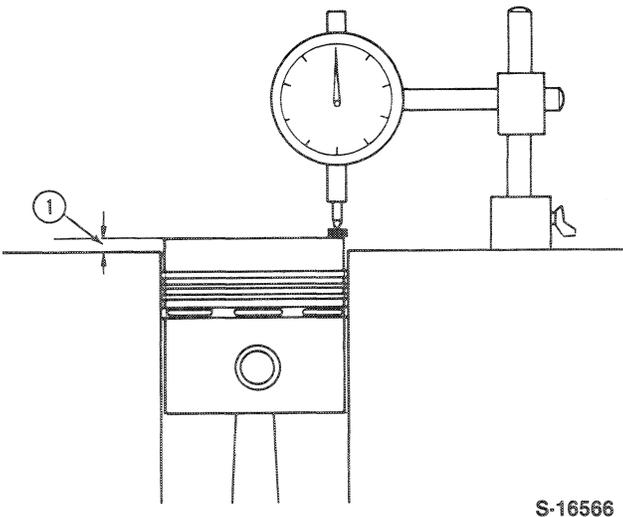


Figure 32

Measuring Piston Height Above Block Face

1. Piston Height Dimension

NOTE: Measure each of the pistons while holding a slight down pressure on the piston. Use the dimension taken from the cylinder which has the greatest projection and select a head gasket as indicated in the following chart.

NOTE: The variation in the amount of protrusion among all pistons must be within .004 in. (0.1 mm).

2. If removed, install the tappets.
3. Select the proper head gasket and place it on the block with the side marked with the last four digits of the part number up.
4. Tighten the cylinder head bolts in steps in the sequence as shown, Figure 33. Tighten to the final torque specification:

Torque Specification

Model CM224 36-38 lbs. ft.
(48.8-51.5 Nm)

Model CM274 65-68 lbs. ft.
(88-92 Nm)

5. Replace the push rods and valve stem caps in their original locations.
6. On the Model CM224 assemble and install the rocker arm assembly.

On the Model CM274 install and assemble the rocker shaft components in the support. Install the setscrew and end plugs.

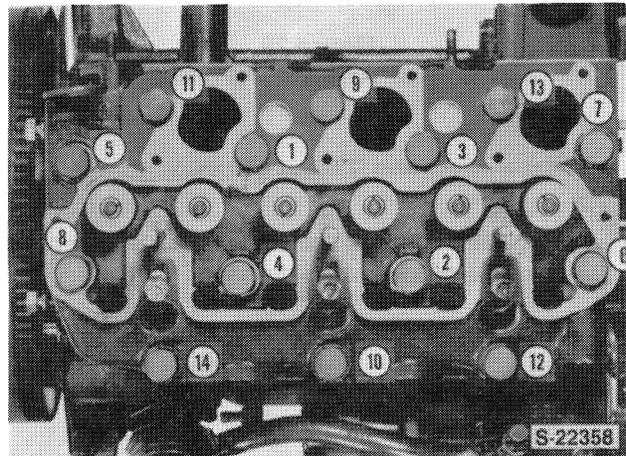


Figure 33

Head Bolt Torquing Sequence

| TRACTOR MODEL | MEASUREMENT | TIGHTENED THICKNESS | HEAD GASKET |
|---------------|------------------------------|---------------------|-------------|
| | | | PART NO. |
| CM224 | .018-.022 in. (0.45-0.55 mm) | .043 in. (1.1 mm) | 111146882 |
| | .022-.026 in. (0.55-0.65 mm) | .047 in. (1.2 mm) | 111146892 |
| | .022-.030 in. (0.65-0.75mm) | .051 in. (1.3 mm) | 111146901 |
| CM274 | .019-.023 in. (0.5-0.6 mm) | .047 in. (1.2 mm) | 111147150 |
| | .0236-.0276 in. (0.6-0.7 mm) | .051 in. (1.3 mm) | 111147160 |
| | .0276-.0315 in. (0.7-0.8 mm) | .054 in. (1.4 mm) | 111147170 |

NOTE: Last four digits of part numbers are stamped on the head gasket. Install head gasket with code numbers at top.

7. Install the assembled rocker shaft support onto the head and tighten the bolts to the specified torque:

Tightening Torque
14-18 lbs. ft. (20-25 Nm)

8. Adjust the rocker arm-to-valve clearance, Figure 34. Be sure the tappet is in its lowest position before making the adjustment. To be sure the tappet is in its lowest position, bring the piston to top-dead-center on the compression stroke (both valves closed).

With the adjusting screw locknut loosened, turn the adjusting screw to obtain .008 in. (0.2 mm) clearance and tighten the locknut.

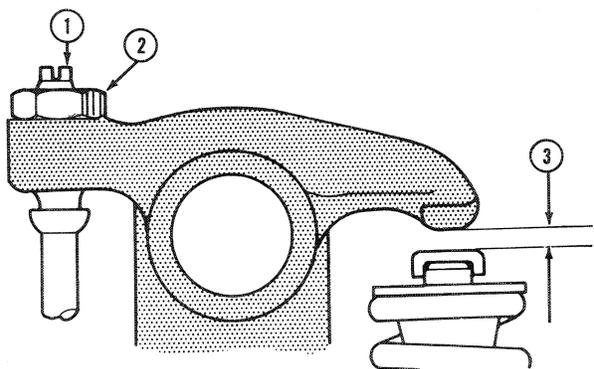


Figure 34
Valve Clearance Adjustment – Cold

1. Adjusting Screw
2. Locknut
3. Valve Clearance – 0.008 in. (0.2 mm)

TIMING COVER REMOVAL

1. Remove the radiator assembly. See "Radiator Removal," Chapter 2.
2. Remove the engine stop solenoid, Figure 35.

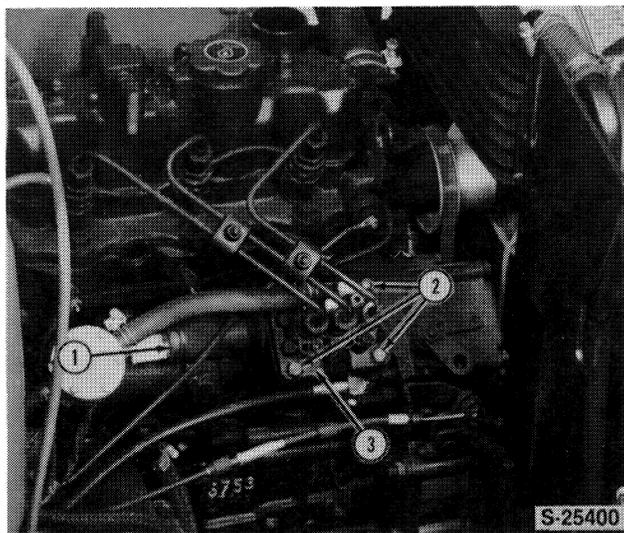


Figure 35
Stop Solenoid Removal

1. Stop Solenoid
2. Bolt and Nuts
3. Injection Pump

3. Remove the bolts and nuts (2) from the injection pump (3), Figure 35 and raise it up high enough to remove the snap pin (1), Figure 36. Disconnect the governor link (2) and remove the pump, Figure 36.

NOTE: Shims are used between the injection pump and the engine block to adjust engine timing. Note the number of shims and their thickness.

4. Unscrew the nut (3) and remove the crankshaft pulley (1) and key, Figure 37.
5. Remove the timing gear cover bolts (4), Figure 37 and remove the cover.

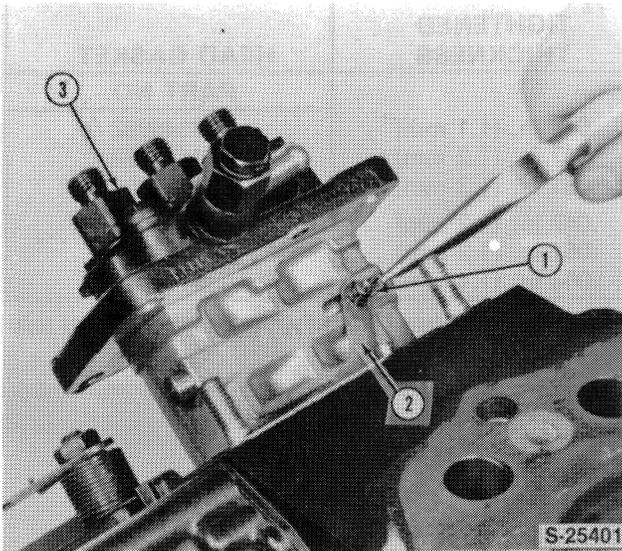


Figure 36
Injection Pump Removal

- | | |
|-------------|-------------------|
| 1. Snap Pin | 3. Injection Pump |
| 2. Link | |

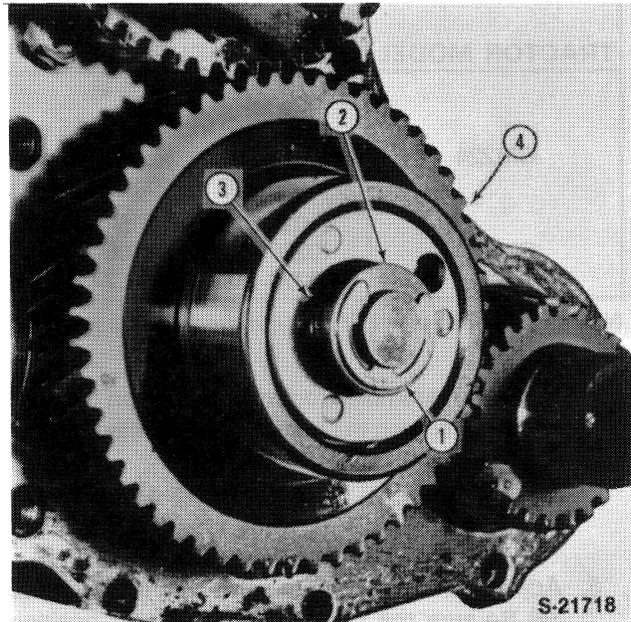


Figure 38
Engine Oil Pump Removal

- | | |
|------------------|---------------|
| 1. "E" Snap Ring | 3. Spring |
| 2. Collar | 4. Idler Gear |

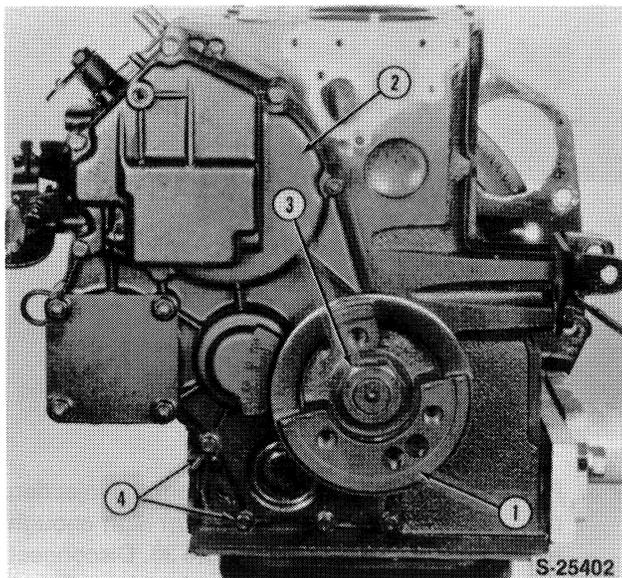


Figure 37
Timing Cover Removal

- | | |
|-----------------|---------------------|
| 1. Pulley | 3. Nut |
| 2. Timing Cover | 4. Cover Bolts (10) |

OIL PUMP

The oil pump is located inside of the idler gear (4), Figure 38 at the front of the engine.

REMOVAL

Reference — Figure 39

1. Remove the E-ring (1) and withdraw the collar (2), spring (3), shim (4) and cover (5), Figure 39.
2. Remove the gear (8) with rotor (6) as an assembly, Figure 39.
3. Remove the thrust washer (9), Figure 39.

NOTE: The port block and shaft assembly, Figure 40 is a press fit in the block. If the port block is damaged, remove and replace as an assembly as described under "Port Block Removal and Installation."

The oil pump relief valve (1) is located on the right side of the engine, Figure 41.

INSPECTION AND REPAIR

The pump consists of the idler gear and vane assembly, inner rotor, port block and shaft assembly and cover, as shown, Figure 39.

1. Check the pump cover and port block faces for excess wear or score marks.

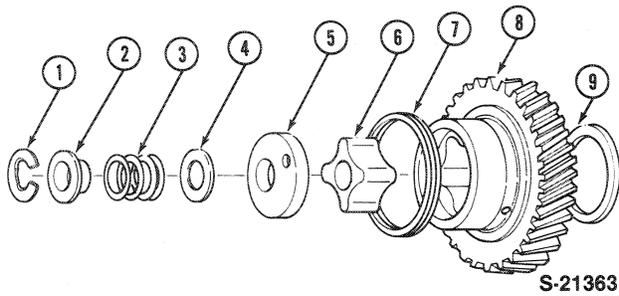


Figure 39
Idler Gear and Oil Pump Components

- | | |
|-------------|------------------|
| 1. "E" Ring | 6. Rotor |
| 2. Collar | 7. Spring |
| 3. Spring | 8. Idler Gear |
| 4. Shim | 9. Thrust Washer |
| 5. Cover | |

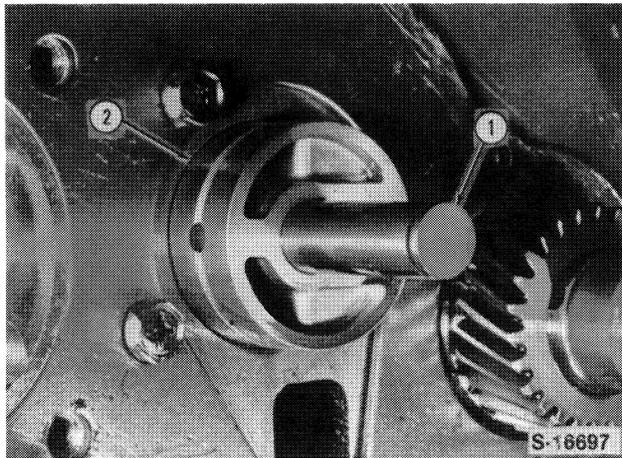


Figure 40
Port Block and Shaft Removal

1. Shaft
2. Port Block

2. Inspect the pump shaft, inner rotor and vane for excess wear or scratches.
3. Measure the rotor-to-vane clearance as shown, Figure 42, and replace defective components as required. See "Specifications," Chapter 3.

NOTE: The oil pump outer rotor (vane) is not serviced separately. If defective, replace the idler gear and vane as an assembly.

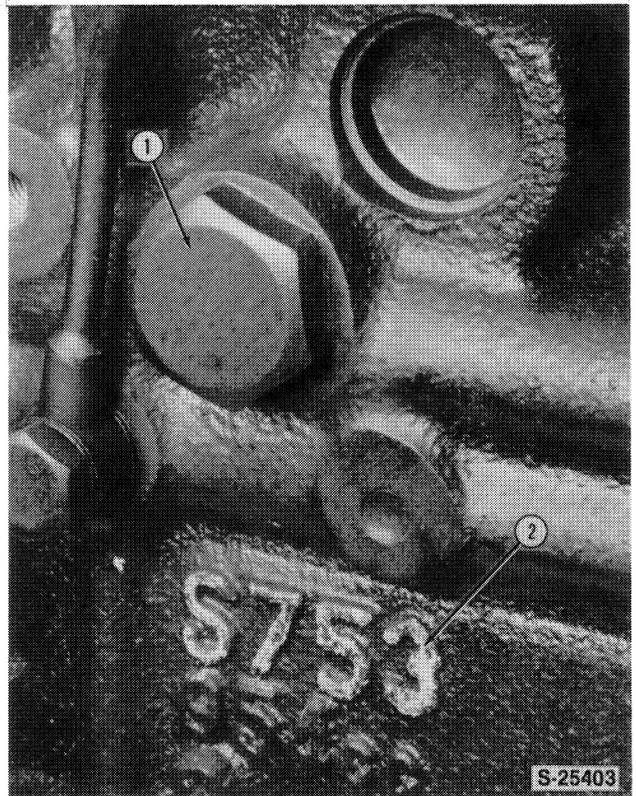


Figure 41
Oil Pump Relief Valve (CM224 Shown)

1. Relief Valve
2. Engine Identification Number

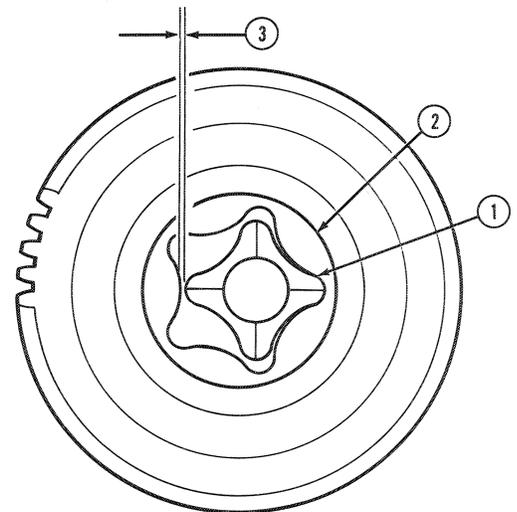


Figure 42
Rotor Clearance Check

1. Rotor
2. Vane
3. Clearance

S-21364

ASSEMBLY AND INSTALLATION

Reference — Figure 39

1. Position the thrust washer (9) on the port block.
2. Install the idler gear and vane assembly (8), inner rotor (6) and cover (5).

NOTE: Be sure to align the timing marks as shown, Figure 43.

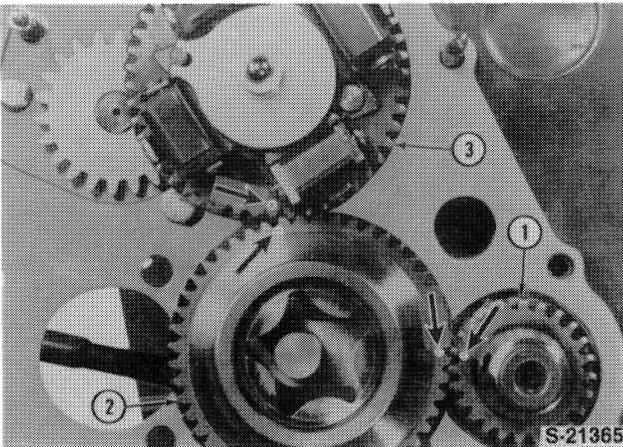


Figure 43

Timing Gear Mark Alignment

1. Crankshaft Gear
 2. Idler Gear
 3. Camshaft Gear
3. Install the shim (4), spring (3), collar (2) and E-ring on the pump shaft, Figure 39.
 4. Using a dial indicator against the pump cover as shown, Figure 44, measure the inner rotor end clearance against spring pressure. The rotor cover movement against the spring should not be less than 0.004 in. (.10 mm) or more than 0.008 in. (.20 mm).

Insufficient rotor end float clearance may cause binding and damage to the inner rotor, cover or port block. Excess clearance may allow the oil to by-pass around the sides of the rotor resulting in loss of oil pressure and volume in the engine lubrication circuit.

Adjust the rotor clearance by selecting shims (4), Figure 39, of the proper thickness.

Shims are available in .004 in. (.10 mm), .006 in. (.15 mm), .008 in. (.20 mm) and .020 in. (.50 mm) thickness.

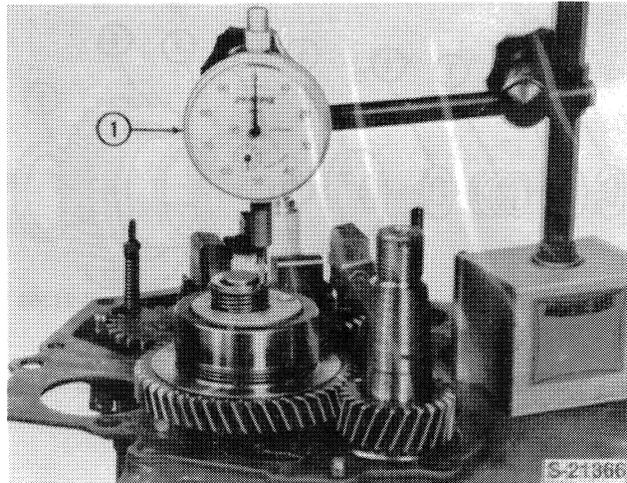


Figure 44

Inner Rotor Clearance Check

1. Dial Indicator

PORT BLOCK REMOVAL AND INSTALLATION

NOTE: The front timing gears and front adaptor plate must be removed to replace the oil pump port block and shaft assembly.

Remove the timing gears as previously described.

Remove the adaptor plate and gasket.

REMOVAL

1. Using Tool No. 11097, place the collars Tool No. 11099, in the grooves of the port block.
2. Align the setscrews of the puller with the counterbores in the collars and tighten the setscrews.
3. Using a slide hammer as shown, Figure 45, remove the port block and shaft assembly.

ASSEMBLY AND INSTALLATION

1. Using Tool No. 11063A screw the threaded pins (1) 11044, into the engine block as shown, Figure 46.
2. Assemble a new oil pump shaft into the new port block using the nut and washer previously removed.
3. Insert the port block assembly into the installer tool and place on the guide pins as shown, Figure 47.

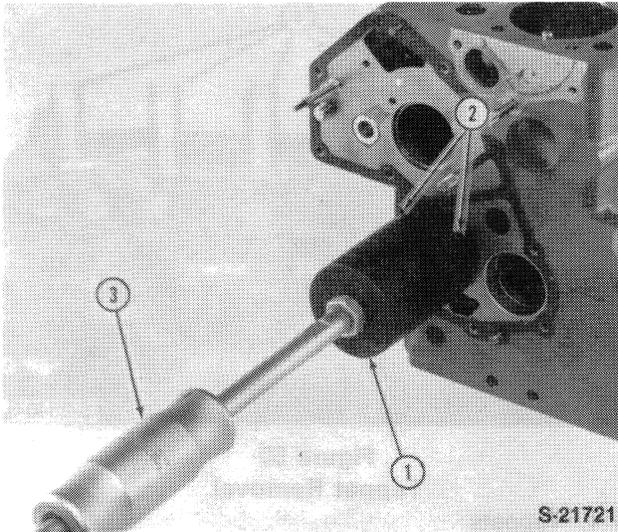


Figure 45

Oil Pump Port Block Removal

- 1. Puller — Tool No. 11097 and Sleeve 11099
- 2. Setscrews (2)
- 3. Slide Hammer 11099

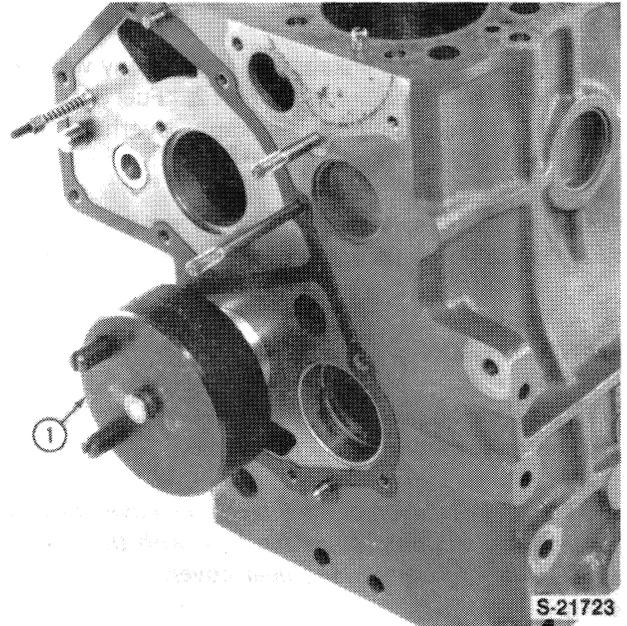


Figure 47

Port Block and Shaft Installation

- 1. Port Block Installer, 11063A

- 4. Use a suitable driver and install the port block assembly as shown, Figure 48.

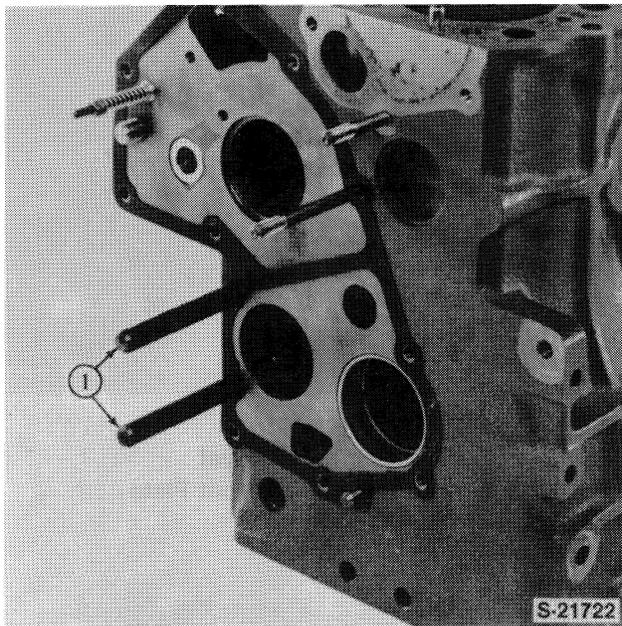


Figure 46

Port Block and Shaft Installation

- 1. Guide Pins, 11044

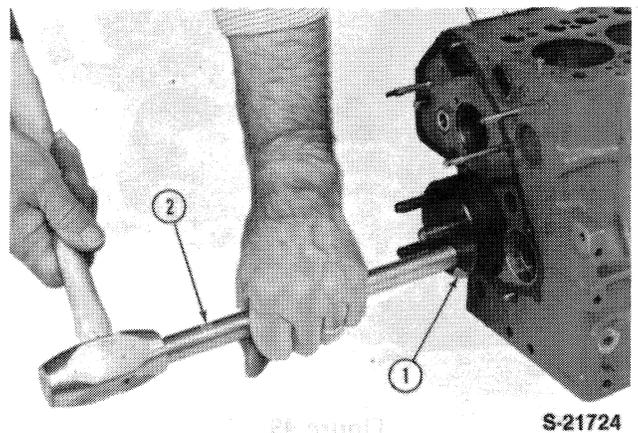


Figure 48

Port Block and Shaft Removal

- 1. Installer, Tool No. 11063A
- 2. Driver

NOTE: The installer tool must bottom against the engine block when fully positioned.

- 5. Using a new gasket, install the engine adaptor plate and complete the assembly of the front end components.

TIMING GEAR COVER

Inspect the governor linkage and replace any worn or damaged parts as required. See Part 2, "Fuel System," Chapter 1 for governor linkage overhaul and adjustments.

If required, use a suitable size remover and installer tool and replace the timing gear cover crankshaft oil seal.

INSTALLATION

Install the timing gear cover using a new gasket following the removal procedure in reverse.

NOTE: On installation of the timing gear cover, be sure to align the oil pump cover pin hole with the roll pin (1), Figure 49 in the timing gear cover.

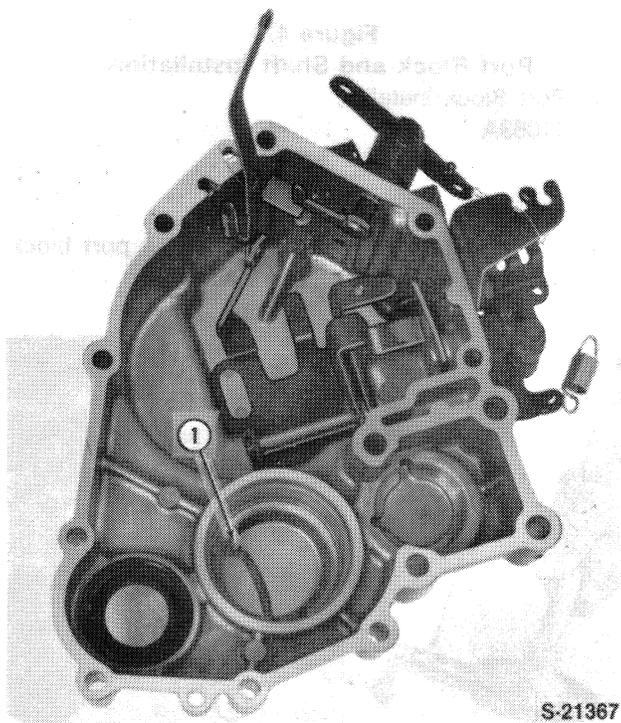


Figure 49

Timing Gear Cover Installation

1. Roll Pin

CAMSHAFT

REMOVAL

1. Remove the tappets (1) from the top of the block, Figure 50

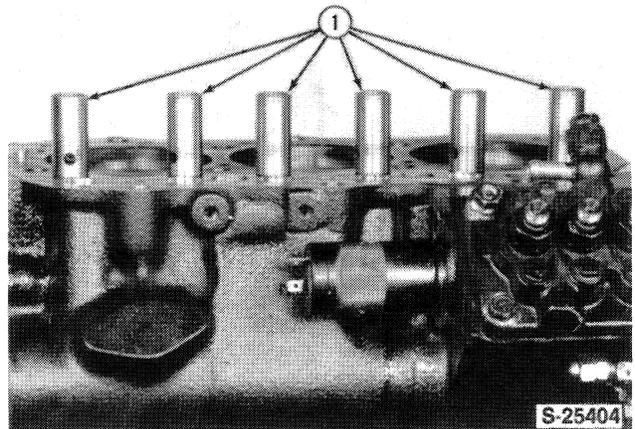


Figure 50
Tappet Removal

1. Tappets
2. Remove the bolts (1) from the plate and pull the camshaft (2) and governor out as an assembly, Figure 51.
3. Remove the engine front plate (3), Figure 51.

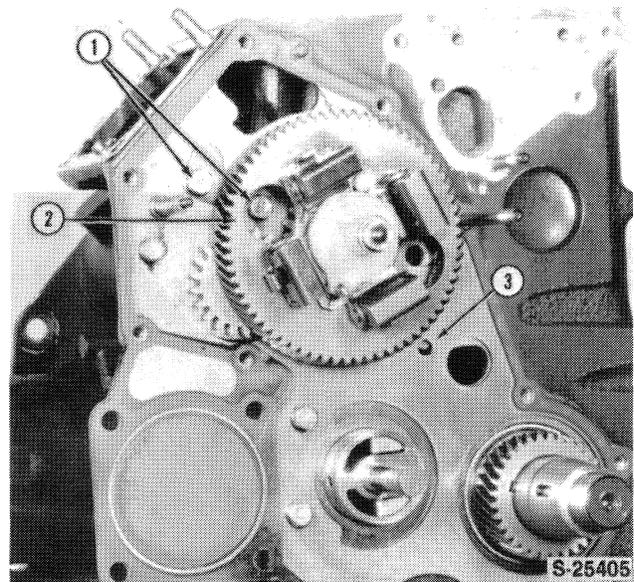


Figure 51
Camshaft Removal

1. Bolts
2. Camshaft and Governor
3. Front Plate

DISASSEMBLY

1. Using a suitable puller remove the camshaft gear and flyweight off of the camshaft