FORD

Service Manual

Tractors
TW5, TW15, TW25, TW35
8530, 8630, 8730, 8830

Part 1 – Engine Systems
Part 2 – Fuel Systems

Vol. 1

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CONTENTS

PART 1
ENGINE SYSTEMS

Chapter 1
ENGINE AND LUBRICATION SYSTEM

Chapter 2
TURBOCHARGER

Chapter 3
INTERCOOLER

Chapter 4
COOLING SYSTEM

Chapter 5
TROUBLE SHOOTING

Chapter 6
SPECIFICATIONS AND SPECIAL TOOLS

FOREWORD

This Service Manual provides information for the correct servicing and overhaul of the Ford TW Series and 30 Series 6-cylinder agricultural tractors and is an essential publication for all service personnel carrying out repairs or maintenance on these tractors. We recommend that this manual be available for reference at all times.

The Service Manual consists of thirteen Parts contained in six volumes. A Table of Contents is included in each volume which lists all thirteen Parts and the volume where each can be found.

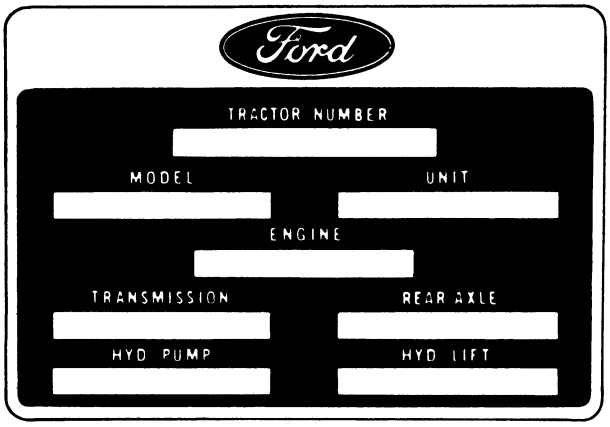
All Parts are subdivided into Chapters which convey information on general operating principles, detailed inspection and overhaul procedures and, where applicable, specifics on troubleshooting, special tools and specifications. Any reference in this manual to right, left, rear, front, top or bottom is as viewed from the operator's seat.

The information contained herein 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 any time without notice is reserved. All data in this manual is subject to production variations, and the illustrations do not necessarily depict tractors to standard build specifications.

PRODUCTION DATE CODES AND SERIAL NUMBERS

New Ford Series TW Tractors have a series identification plate located under the radiator filler access cover. Whenever effecting repair or overhaul the relevant series information should be noted and used when referring to Service Bulletins and/or the Parts Catalogue.

TRACTOR SERIES IDENTIFICATION PLATE



This plate is stamped with the following information:

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

KEY TO PRODUCTION DATE CODES

First Number YEAR	First Letter MONTH		Second Number DAY OF MONTH	Second Letter PRODUCTION SHIFT
1—1981 2—1982 3—1983 4—1984 5—1985	A—Jan. B—Feb. C—March D—April E—May F—June	G—July H—Aug. J—Sept. K—Oct. L—Nov. M—Dec.	01/28/29/30/31	A—Midnight B—Day C—Afternoon

Example of Production Unit Date Code 3 L 0 3 B

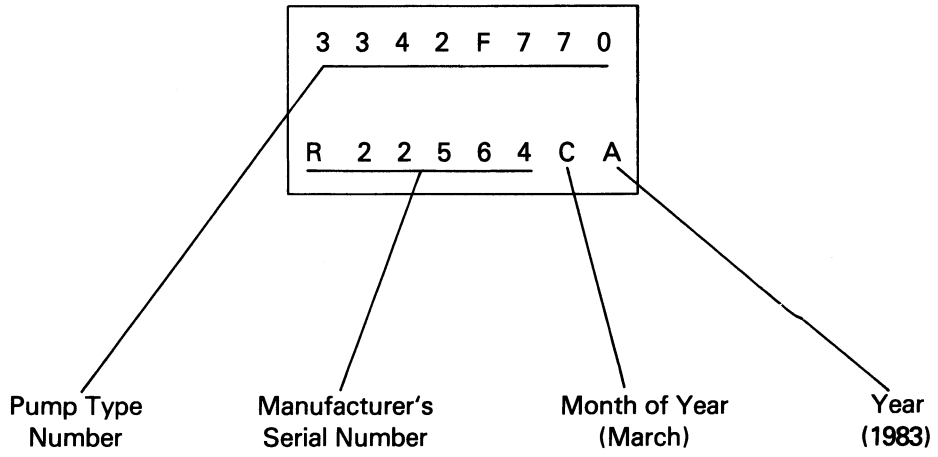
Year of Final Assembly (1983)	Month of Year (November)	Day of Month (Third)	Shift Period (Day)

FUEL INJECTION PUMP DATE CODES

The fuel injection pumps carry an identification plate with the pump type number, serial number and manufacturer's production date code. The date code can be identified by reference to the following chart.

MONTH	CODE		YEAR	CODE
	1981–82	1983–86		
January	N	A	1981	Y
February	O	B		
March	P	C	1982	Z
April	R	D		
May	S	E	1983	A
June	T	F		
July	U	G	1984	B
August	V	H		
September	W	J	1985	C
October	X	K		
November	Y	L	1986	D
December	Z	M		

Example of Fuel Injection Pump Identification Plate



⚠ SAFETY PRECAUTIONS

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

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

PERSONAL CONSIDERATIONS

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

  Some jobs require special protective equipment.

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

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

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

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

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

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

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

EQUIPMENT CONSIDERATIONS

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

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

  Never stand under a suspended load or raised implement.

- **Compressed Air**
  The pressure from a compressed air line is often as high as 100 lbf/in² (6.9 bar) (7 kgf/cm²). It is perfectly safe if used correctly. Any misuse may cause injury.

  Never use compressed air to blow dust, swarf, 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 or improvised 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 re-assembly of major and sub components, always use the Special Service Tools recommended.

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

  Always keep tools clean and in good working order.

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

  Before using any electrical equipment — particularly portable appliances — make a visual check to ensure 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 realised. Everyone must be constantly on guard.

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

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

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

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

OPERATIONAL CONSIDERATIONS

- Stop the engine, if at all possible, before performing any service.
- Place a warning sign on tractors which, due to service or overhaul, would be dangerous to start. Disconnect the battery leads if leaving such a unit unattended.
- Do not attempt to start the engine while standing beside the tractor or attempt to by-pass the safety start switch.
- Avoid prolonged running of the engine in a closed building or in an area with inadequate ventilation as exhaust fumes are highly toxic.
- Always turn the radiator cap to the first stop, to allow pressure in the system to dissipate when the coolant is hot.
- Never work beneath a tractor which is on soft ground. Always take the unit to an area which has a hard working surface — concrete for preference.
- If it is found necessary to raise the tractor for ease of servicing or repair, ensure that safe and stable supports are installed, beneath axle housings, casings, etc., before commencing work.
- Certain repair or overhaul procedures may necessitate "separating the tractor", either at the engine/front transmission or front transmission/rear transmission connections. These operations are simplified by the use of the Tractor Splitting Kit/Stands. Should this equipment not be available, then every consideration must be given to stability, balance and weight of the components, especially if a cab is installed.
- Use footsteps or working platforms when servicing those areas of a tractor that are not within easy reach.
- Before loosening any hoses or tubes connecting implements to remote control valves, etc., switch off the engine, remove all residual pressure in the lines by moving operating levers several times. This will remove the danger of personal injury by oil spurt.
- Prior to pressure testing, ensure all hoses and connectors, not only of the tractor, but also those of the test equipment, are in good condition and tightly secured. Pressure readings must be taken with the gauges specified. The correct procedure should be rigidly observed to prevent damage to the system or the equipment, and to eliminate the possibility of personal injury.
- When equipment or implements are required to be attached to the hydraulic linkage, either for testing purposes or for transportation, then "position control" should be engaged.
- Always lower equipment to the ground when leaving the tractor.
- If high lift attachments are fitted to a tractor beware of overhead power, electric or telephone cables when travelling. Drop attachment near to ground level to increase stability and minimise risks.
- Do not park or attempt to service a tractor on an incline. If unavoidable, take extra care and block all wheels.
- Observe recommended precautions as indicated in this Repair Manual Part 13 when dismantling the air conditioning system as escaping refrigerant can cause frostbite.
- Prior to removing wheels and tyres from a tractor, check to determine whether additional ballast (liquid or weights) has been added. Seek assistance and use suitable equipment to support the weight of the wheel assembly.
- When inflating tyres beware of over inflation — constantly check the pressure. Over inflation can cause tyre 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.

Safety is everybody's responsibility.

PART 1
ENGINE SYSTEMS

Chapter 1
ENGINE AND LUBRICATION SYSTEM

A. DESCRIPTION AND OPERATION

This chapter describes the overhaul and repair of the six cylinder, direct injection diesel engines of the Ford TW-5, TW-15, TW-25 and TW-35 series tractors.

All the engines are of similar design and many service procedures are common throughout the range. Each engine has a bore and stroke of 4.4 in (111.8 mm) which generates a displacement of 401 cu in (6580 cc). Increased power levels of the various models from the base engine are achieved by tailored fuel systems and the addition of a turbocharger or a turbocharger and intercooler combination.

CYLINDER HEAD ASSEMBLY—INCLUDING VALVE TRAIN COMPONENTS

The cylinder head assembly incorporates the valves, valve springs and rotators. The valve rocker arm shaft assembly is bolted to the cylinder block, through the head. The intake and exhaust manifolds are bolted to the head, the intake manifold being on the right side of the engine, and the exhaust manifold on the left.

The valve guides are an integral part of the cylinder head, and valves with oversize stems are available for service. Replaceable cast alloy valve seats are pressed into each valve port of the cylinder head. The alloyed steel exhaust valves are fitted with positive valve rotators. Intake valves use umbrella-type seals while the exhaust valves use a square section O-ring. The push rods are high tensile strength steel with oil-cushioned sockets, and locate inside the tappet. The tappets are cast cylindrical, chill-hardened iron. Valve lash is maintained by self-locking adjusting screws.

The camshaft is supported by five replaceable bearings, and is driven by the camshaft drive gear. Camshaft thrust is controlled by a plate secured to the block and located between the camshaft gear and the front journal of the camshaft.

The face of the cylinder head is flat and uses six evenly spaced headbolts per cylinder. The fuel injectors are mounted outside the rocker cover and the combustion chamber is in the head of the piston.

MANIFOLDS

The aluminium alloy intake and two part cast iron exhaust manifolds are on opposing sides of the cylinder head providing better heat distribution in the head with less heat being transferred to the intake manifold. Tractors are equipped with an exhaust expansion manifold and a vertical exhaust system. The intake manifold has a tapped hole for installation of a thermostart cold starting device. Another tapped hole is provided for the air cleaner restriction gauge.

CYLINDER BLOCK ASSEMBLY

The cylinder block is alloy cast iron with heavy webbing and deep cylinder skirts. The block features full length water jackets for cooling the cylinders. Cylinder arrangement is vertical in-line with the cylinders numbered from 1 to 6, starting at the front of the block, and the firing order is 1-5-3-6-2-4.

The oil pan sump is heavy cast iron, the oil filler tube and the dipstick are both located on the right side of the engine.

The oil pan is attached to the bottom of the cylinder block and is the sump for the lubrication system. The engine front cover is attached to the front engine adaptor plate forming a cover for the timing gears.

The crankshaft gear is keyed and press fitted on the front of the crankshaft. The crankshaft gear drives the camshaft drive gear which is attached to the front of the cylinder block. The camshaft drive gear drives the camshaft gear and the injection pump drive gear.

The camshaft gear is attached to the front of the camshaft by a bolt, lock washer, a flat washer and a spacer. The gear is keyed to the camshaft to maintain the position of the gear and drive the shaft.

All the timing gears can be checked by observing the timing punch marks on the gears. The crankshaft is supported in the cylinder block by seven main bearings. The fifth bearing from the rear is a flanged thrust bearing which controls crankshaft end play.

A slinger is machined on the rear of the crankshaft to direct oil away from the rear seal. The rear seal is of the circular lip-type and fits into a pocket machined into the cylinder block and rear main bearing cap. The cap also has two composition side seals. There is a rear plate gasket to assist in sealing the rear bearing.

The engine pistons have a continuous skirt around the entire piston. Each piston has three compression rings and one oil control ring, the top compression ring is a keystone ring.

The piston is connected to the crankshaft by a heavy I-beam connecting rod. The crankshaft end of the connecting rod has an insert-type bearing. The piston end of the connecting rod has a replaceable bronze bushing. The piston pin is a free-floating steel pin held in place in the piston by two snap-rings (circlips).

LUBRICATION SYSTEM

A gear rotor-type oil pump, driven from the crankshaft through an idler gear, is mounted on the front cover plate. It takes oil from the deepest part of the oil pan through a filter screen and pumps the oil into the lubrication system. A spring-loaded relief valve in the pump body limits the maximum pressure in the system by directing excess oil back to the intake side of the pump.

Oil flows from the pump to a replaceable cartridge external filter. A relief valve in the filter permits oil to bypass a clogged filter, thereby maintaining oil flow to the engine at all times.

Oil flows from the filter to the main oil gallery, which runs the length of the cylinder block and intersects the tappet chambers. The main oil gallery also supplies oil to all the crankshaft main bearings and to the connecting rod journals by way of the crankshaft. Camshaft bearings receive oil by means of drilled passages from the main bearings.

The camshaft drive gear bushing is pressure-lubricated through a drilled passage from the front main bearing and has spiral grooves to direct oil towards the outside of the gear. The gear has small oil passages machined on both sides which allows the oil to exhaust. The timing gears are splash-lubricated from the pressure-lubricated camshaft drive gear and the fuel injection pump overflow.

Cylinder walls and pistons are splash-lubricated by the crankshaft on the TW-5. Pistons are splash-lubricated on the TW-5; pressure-lubricated on the TW-15, TW-25 and TW-35 tractors. An intermittent flow of oil is fed to the valve rocker arm shaft assembly through a drilled passage in the cylinder block at the No. 1 camshaft bearing which indexes with a hole in the cylinder head. From the head, the oil flows up around the No. 1 rocker arm support bolt to the rocker shaft. The oil from the shaft flows through drilled holes in each rocker arm to lubricate the valve end and the adjusting screw end of the rocker arm. Oil from the ball ends of the rocker arms flows down the push rods and assists in lubricating the tappets and push rods. Excess oil drains into the push rod chamber through the push rod holes in the cylinder head and then back to the oil pan sump through cored openings in the block.

The fuel injection pump is also lubricated by pressurised oil supplied through the idler bearing.

The TW-35 tractor has a heat exchange manifold mounted on the left hand side of the engine block. Engine oil is water cooled as it is pumped through the heat exchange manifold. TW-5, TW-15 and TW-25 tractors have conventional bypass oil coolers incorporated in the radiator assembly. All models have two spin-on oil filters attached to the manifold which maintain the cleanliness of the engine oil.

B. CYLINDER HEAD, VALVES AND RELATED PARTS

The cylinder head can be removed from the engine for service with the engine installed in the tractor.

REMOVAL TW-5

1. Remove the pre-cleaner and fuel tank cap.

2. Unbolt the muffler pipe from the exhaust manifold and remove the muffler, muffler support bracket and muffler pipe from the tractor.

3. Remove the two side panels, three radiator grille panels and hood panel, Figure 1.

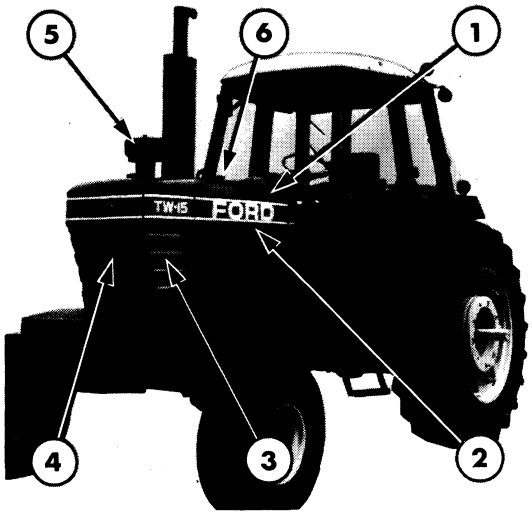


Figure 1
Sheet Metal: TW-5 and TW-15

1. Hood Panel
2. Side Panel
3. Side Panel
4. Front Grille
5. Pre-cleaner
6. Fuel Cap

4. Remove the air intake pipe at the intake manifold to the radiator bracket flange and remove from the tractor.

TW-15

With reference to Figures 5 and 6.

1. Remove the pre-cleaner and the fuel tank cap. Remove the muffler.

2. Remove the two side panels, three radiator grille panels and hood panel, Figure 1.

3. Unbolt and remove the muffler-to-turbocharger tube and remove the heatshield.

4. Remove the air intake pipe from the turbocharger to the radiator support. Remove the intake manifold hose, Figure 3.

5. Remove the turbocharger oil lines and the four bolts attaching the turbocharger to the exhaust manifold. Remove two turbocharger oil cooler bracket bolts. Withdraw the turbocharger and plug all openings to prevent the entry of dirt.

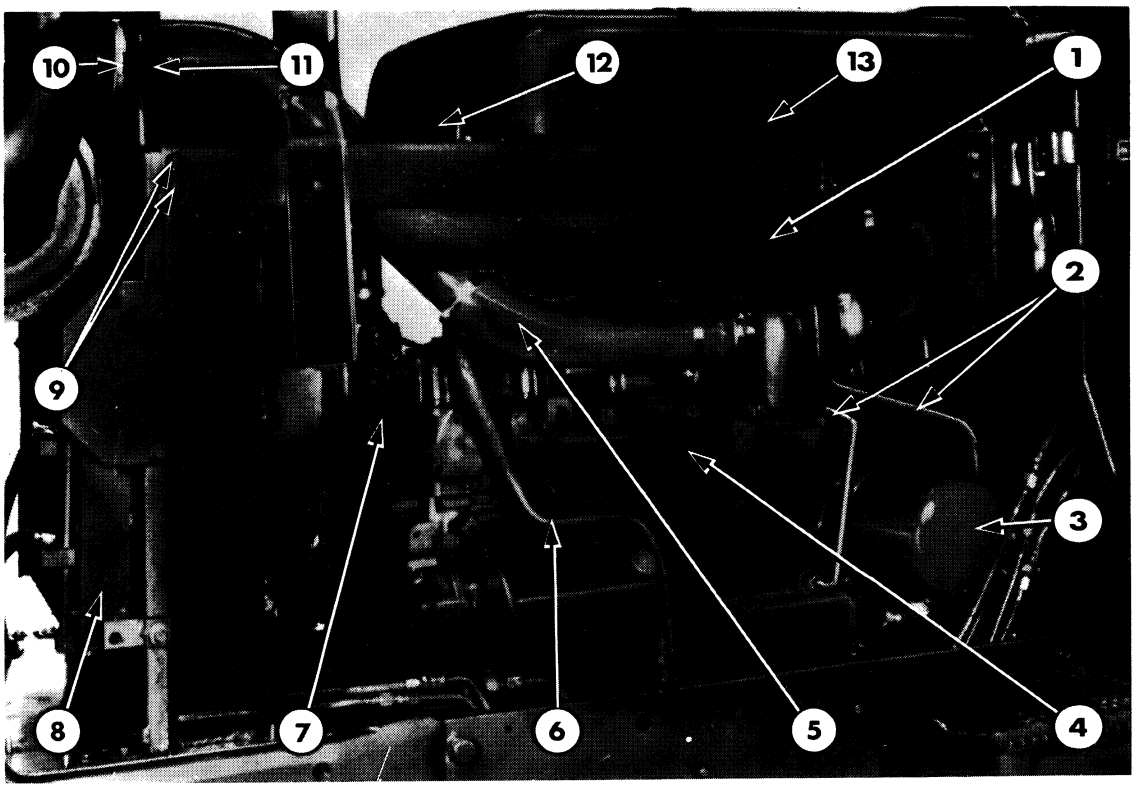


Figure 2
Access to Engine (TW-15)

1. Air Intake Tube
2. Turbocharger Lubrication Tubes
3. Engine Oil Filter
4. Exaust Manifold
5. Turbocharger to Muffler Tube
6. Breather Tube
7. Thermostat Housing
8. Hydraulic Oil Cooler
9. Fuel Tank Bracket Bolts
10. Air Cleaner Clamp
11. Flange Bolts
12. Muffler Support Bracket
13. Main Fuel Tank

6. Shut off the fuel at the main fuel tank.

7. Disconnect the wiring harness at the alternator and air intake sensor. Remove the harness from the fuel tank bracket.

8. Remove the eight bolts that attach the main fuel tank support brackets to the tractor.

9. Using a sling, remove the fuel tank and brackets from the tractor, Figure 4.

10. Remove the fan brace.

TW-25

With reference to Figures 5 and 6.

1. Remove the pre-cleaner and fuel tank cap.

2. Remove the muffler clamp and withdraw the muffler.

3. Remove the two side panels, grille and hood panel.

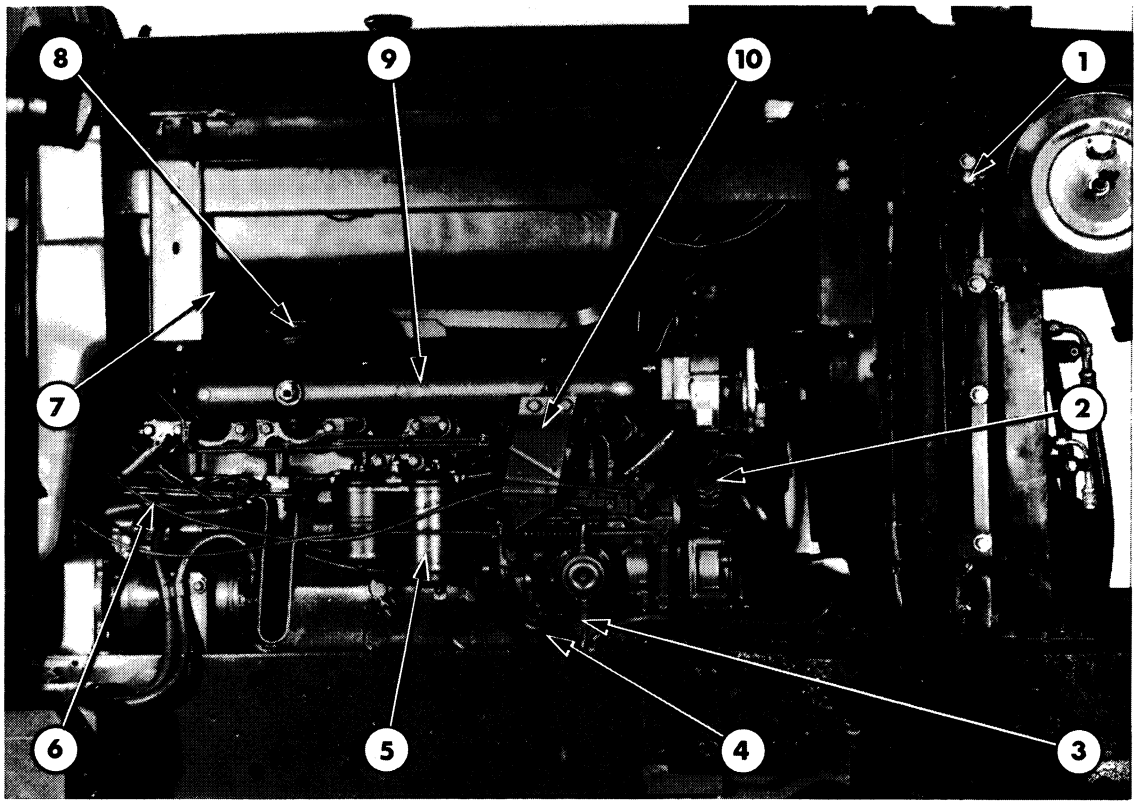


Figure 3
Access to Engine (TW-15)

1. Fuel Tank Support Bolts
2. Oil Filler Cap
3. Fuel Line
4. Engine Oil Dipstick
5. Throttle Cable
6. Fuel Shut-Off Cable
7. Fuel Shut-Off Valve
8. Intake Manifold Hose
9. Intake Manifold
10. Support Bracket

4. Unscrew the four air-cleaner mounting bolts and disconnect the aspirator hose and air cleaner to turbocharger tube. Withdraw the air-cleaner.

5. Remove the turbocharger exhaust hose clamp and air intake clamp. Disconnect the two turbocharger oil tubes and remove the turbocharger assembly.

TW-35

With reference to Figures 5 and 6.

1. Remove the pre-cleaner and fuel tank cap.

2. Remove the muffler clamp and withdraw the muffler.

3. Remove the two side panels, grille and hood panel.

4. Unscrew the four air-cleaner mounting bolts and disconnect the aspirator hose and air cleaner to turbocharger tube. Withdraw the air-cleaner.

5. Remove the turbocharger grille support and the air-cleaner to turbocharger tube and hose, Figure 7.

6. Disconnect and remove the intercooler to turbocharger tube and the aspirator hose.

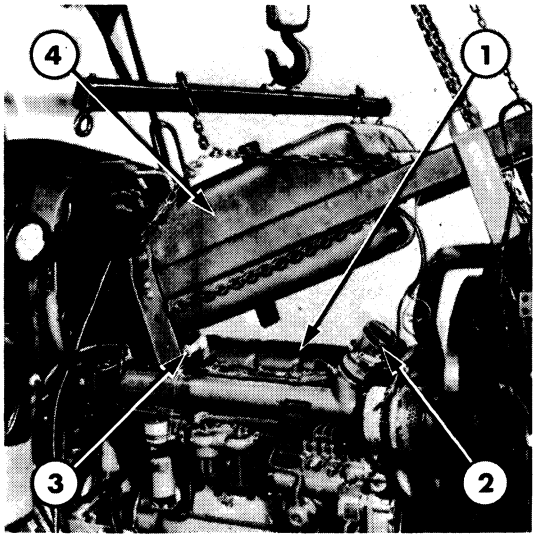


Figure 4
Access to Cylinder Head

1. Valve Cover
2. Intake Manifold Air Inlet
3. Fuel Shut-Off Valve
4. Main Fuel Tank

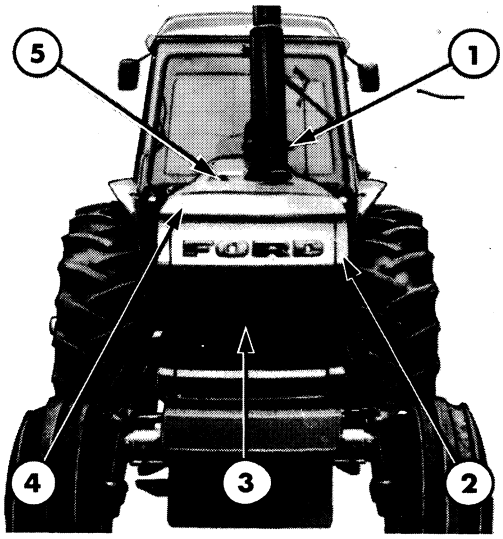


Figure 5
Sheet Metal: TW-25 and TW-35

1. Pre-Cleaner
2. Side Panels
3. Grille
4. Hood Panel
5. Fuel Tank Cap

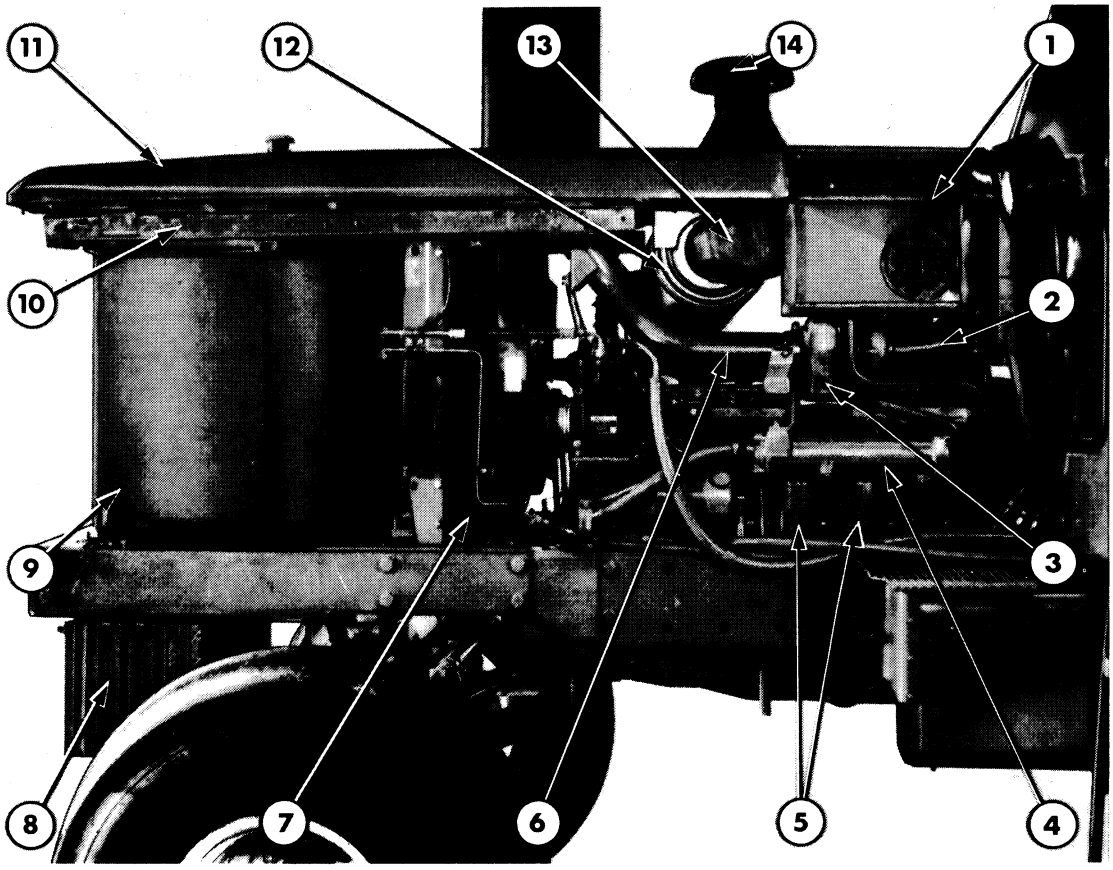


Figure 6
Access to Engine (TW-35)

1. Grille Support (Intercooler)
2. Intercooler-to-Turbocharger Tube
3. Turbocharger
4. Oil Cooler
5. Engine Oil Filter
6. Turbocharger Exhaust Tube
7. Radiator
8. Front Weights
9. Fuel Tank
10. Side Panel Rail
11. Hood Panel
12. Air Cleaner
13. Air Cleaner-to-Intercooler Tube
14. Pre-Cleaner

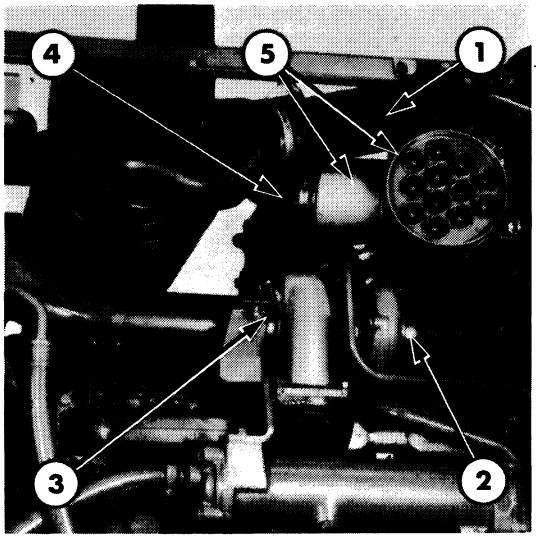


Figure 7
Turbocharger and Intercooler
1. Air Cleaner-to-Turbocharger Tube
2. Air Cleaner-to-Turbocharger Tubes and Clamps
3. Exhaust Clamp and Tube
4. Aspirator Tube
5. Intercooler

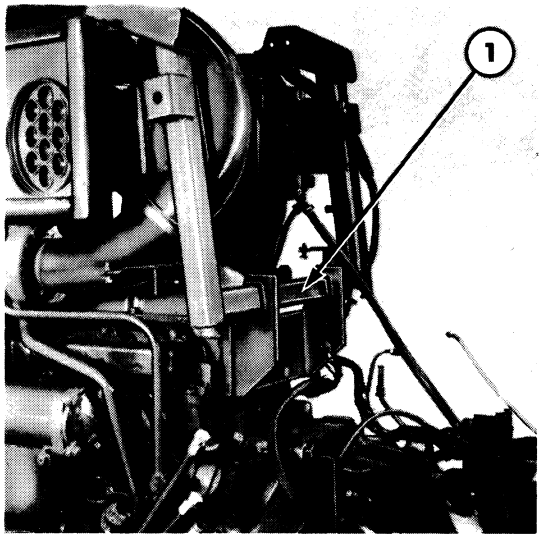


Figure 8
Engine Access
1. Intercooler Support Bracket

7. Unscrew the eight retaining bolts and withdraw the intercooler assembly.

8. Remove the clamps from the air intake and exhaust hose. Disconnect and remove the two turbocharger oil tubes.

9. Unscrew the six retaining bolts and withdraw the turbocharger assembly.

10. Remove the intercooler support bracket at the rear of the engine, Figure 8.

11. Remove the support bracket, fan and alternator bracket, and water pump as required, Figure 9.

ALL TRACTORS

1. Unscrew the twelve exhaust manifold bolts, and remove the exhaust manifold and gasket.

2. Remove the thermostart unit and the fuel delivery lines. Plug the fuel line, injector and fuel pump openings to prevent the entry of dirt.

3. Unscrew the fourteen intake manifold bolts, and remove the intake manifold and gasket.

4. Remove the breather tube from the rocker cover.

5. Drain the engine coolant.

6. Remove the fuel filters and lines from the engine. Plug all openings to prevent the entry of dirt.

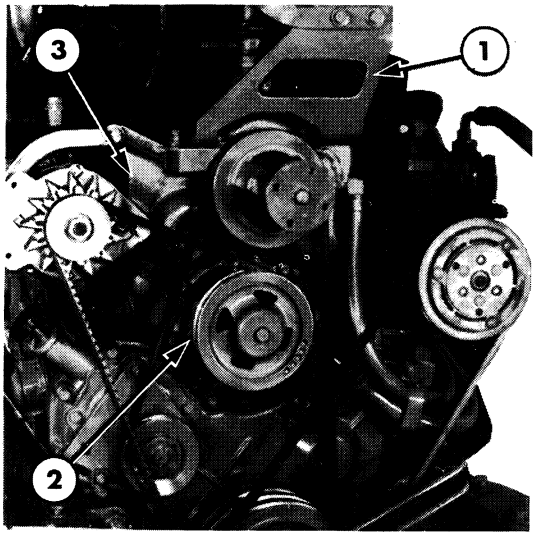


Figure 9
Engine Access
1. Bracket
2. Water Pump
3. Fan and Alternator Bracket

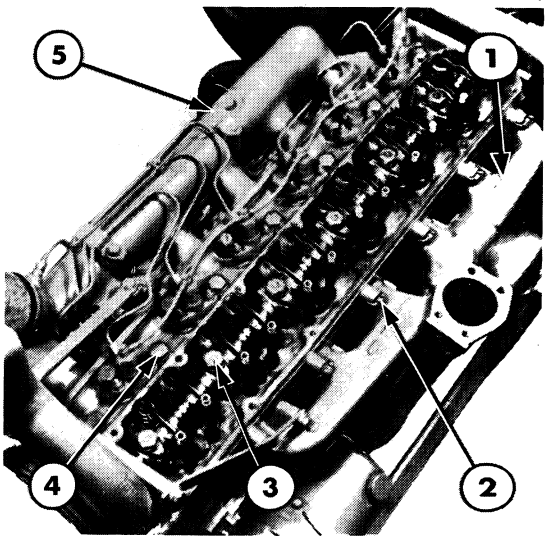


Figure 10
Top View of Engine
1. Exhaust Manifold
2. Lock Tab
3. Head/Rocker Arm Bolt
4. Head Bolt
5. Intake Manifold

7. Remove the rocker arm cover and gasket.

8. Remove the injector leak-off line at No. 6 cylinder.

9. Unscrew the two nuts from each injector, and remove the injectors. If the injectors cannot be withdrawn by hand it may be necessary to pry them out. Keep the area clean to avoid fouling the injectors with dirt.

10. Visually check the push rods for straightness by rotating them with the valve closed. Loosen the rocker arm shaft bolts evenly and remove the assembly from the tractor, Figure 10.

NOTE: *Do not remove the rocker arm shaft retaining bolts unless it is necessary to disassemble the rocker arm shaft.*

11. Remove the valve push rods from their holes in the cylinder head and arrange them in a rack in the order in which they were removed. It is important that the rods are installed in the same bores during reassembly.

12. Loosen and remove the cylinder head retaining bolts evenly, working from the ends to the centre of the head, and carefully lift the cylinder head from the block.

DISASSEMBLY

1. Before removing the valves from the cylinder head, clean all carbon deposits from the valve heads.

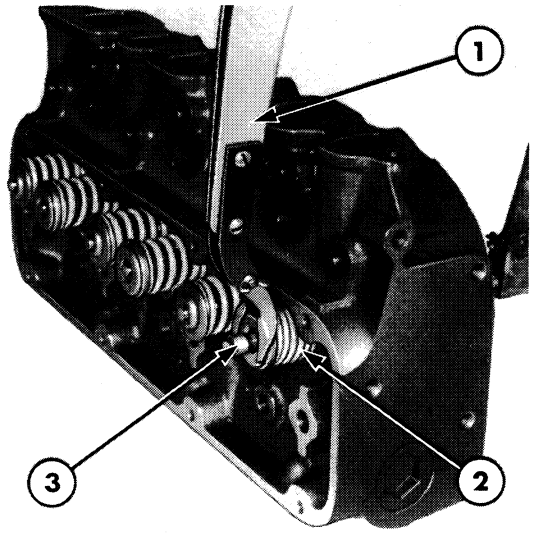


Figure 11
Removing Valves
1. Valve Spring Compressor
2. Valve Spring
3. Retainer Locks

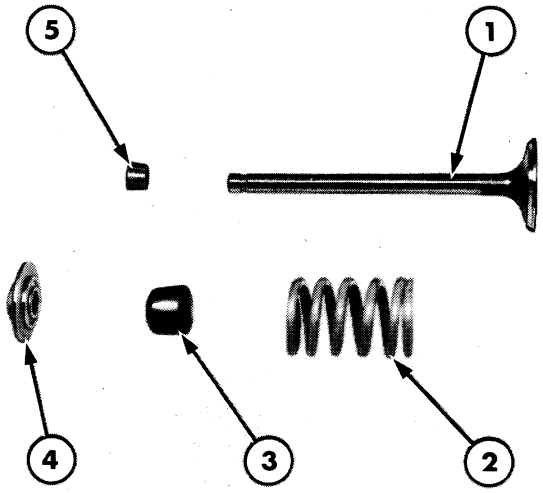


Figure 12
Intake Valve Assembly
1. Intake Valve
2. Spring
3. Seal (TW-5 only)
4. Retainer
5. Retainer Locks

2. Position the valve spring compressor over the valve and spring, and compress the spring, Figure 11.

   Intake Valves: Remove the retainer locks, spring retainer, spring, and valve stem seal, Figure 12.

   Exhaust Valves: Remove the retainer locks, the seal from its groove, and the valve rotator and spring, Figure 13.

3. Lift the valves from the cylinder head and place them in a numbered rack so they can be reinstalled in their respective guides. Keep the exhaust valve rotators with the valves from which they were removed.

CLEANING

1. With the valves removed clean the valve guide bores.

2. Remove all dirt, grit and grease from the cylinder head with a cleaning solvent.

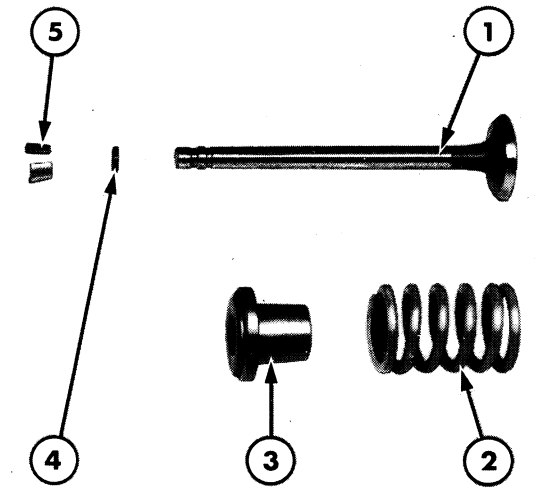


Figure 13
Exhaust Valve Assembly
1. Exhaust Valve
2. Valve Spring
3. Rotator
4. Seal
5. Retainer Locks

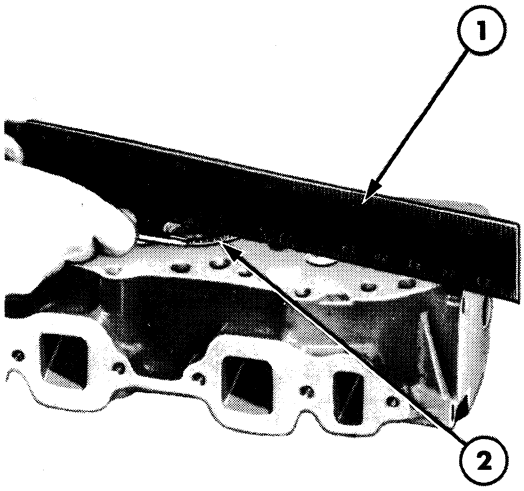


Figure 14
Measuring Cylinder Head Flatness
1. Straight Edge
2. Feeler Gauge

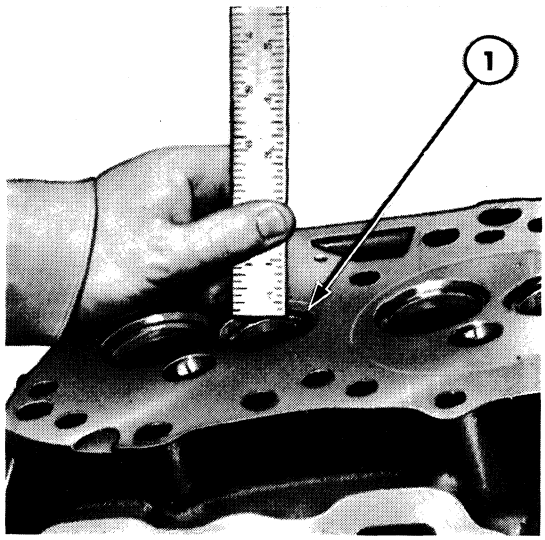


Figure 15
Measuring Valve Seat Width
1. Valve Seat

INSPECTION AND REPAIR

1. Inspect the cylinder head for cracks, nicks or burrs. Install a new head if necessary. Remove all burrs or nicks from the gasket surface.

2. With a straight edge and feeler gauge, check the flatness of the cylinder head, Figure 14. Specifications for flatness are 0.006 in (0.15 mm) maximum overall, or 0.003 in (0.76 mm) in any six inches (152.40 mm).

NOTE: *If the face of the cylinder head does not meet the flatness specification it may be skimmed, provided that the depth from the lower face of the valve seat insert to the cylinder head face is not reduced to less than 0.117 in (2.97 mm).*

3. If the head has been skimmed, determine that all the head bolts will bottom. Place the cylinder head, less gasket, on the block and install and finger tighten all the head bolts (rocker arm shaft supports and washers should be used under the long bolts). Using a feeler gauge, check the clearance between the underside of the head bolts and the cylinder head rocker arm support. If the clearance is 0.010 in (0.25 mm) or greater for any bolt, use a ½ in x 13 UNC-2A thread tap and increase the tap depth. The head bolts should be marked so they are reinstalled in the hole in which they were checked.

4. The intake and exhaust valve ports in the cylinder head are equipped with removable valve seat inserts. Remove and replace inserts that are cracked or loose, or that show excessive wear.

5. To install a larger insert than originally fitted, machine the counter bore for the seat in the cylinder head to the dimensions in Table 1, Page 14. The insert must be thoroughly chilled in dry ice before installation.

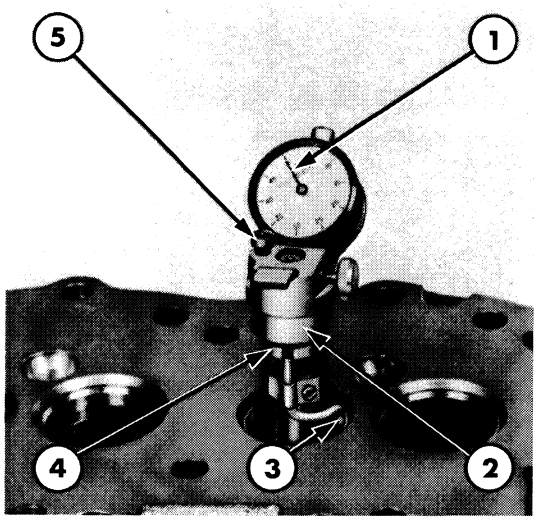


Figure 16
Checking Valve Seat Concentricity
1. Set Dial at "O"
2. Valve Seat Concentricity Gauge
3. Set Point to Ride on Valve Seat Face
4. Rotate Sleeve Clockwise and Read Dial
5. Tighten Pilot

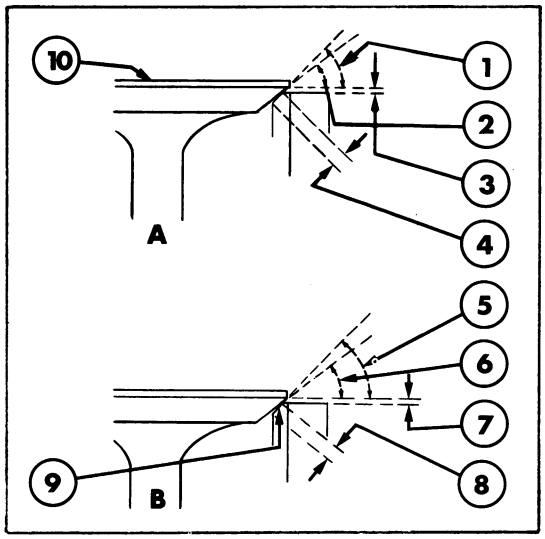


Figure 17
Valve Face and Seat Angles
A. Ford TW-5 intake and Exhaust Valves
Ford TW-15, TW-25 and TW-35 Exhaust Valves
B. Ford TW-15, TW-25 and TW-35 Intake Valves
1. Valve Seat Angle — 45°
2. Valve Face Angle — 44½°
3. 1/32 in (0. 79 mm)
4. Seat Width 3/32 in (2.38 mm)
5. Valve Seat Angle — 30°
6. Valve Face Angle — 29½°
7. 1/16 in (1.59 mm)
8. Seat Width — 3/32 in ± 1/64 in (2.38 ± 0.40 mm)
9. Valve Seat
10. Valve Face

6. Measure the width of the valve seats, Figure 15, and reface the seats if they do not meet the specifications shown in Figure 17.

7. Measure the concentricity of the valve seat with a suitable gauge, Figure 16, or check with Prussian Blue. If the valve seat runout exceeds 0.0015 in (0.0381 mm) reface the seat.

NOTE: *Reface the valve seat and face at the same time so the finished measurements correspond to Figure 17.*

Remove only enough metal from the seat to clean up the pits and grooves, or to correct the seat runout. After refacing, the seat should measure 0.094 in (2.38 mm) ± 0.015 in (0.40 mm). If the refaced seat exceeds this width, narrow the seat by removing stock from the top or bottom of the seat. See Step 8. If the seat measures less than this width, widen the seat.

8. Rotate a new or refaced valve lightly in the seat, using Prussian Blue. If the blue is transferred to the valve face 0.625 in (1.59 mm) below the upper edge of the valve face, the contact is satisfactory. If the blue is transferred to the valve face above or below this point, raise or lower the seat as follows:

FORD TW-15 INTAKE AND EXHAUST VALVES, TW-15, TW-25 AND TW-35 EXHAUST VALVES

Lower the valve seat by removing metal from the top of the seat with a 30° grinding wheel. Raise the valve seat by removing metal from the bottom of the seat with a 60° grinding wheel, Figure 18.

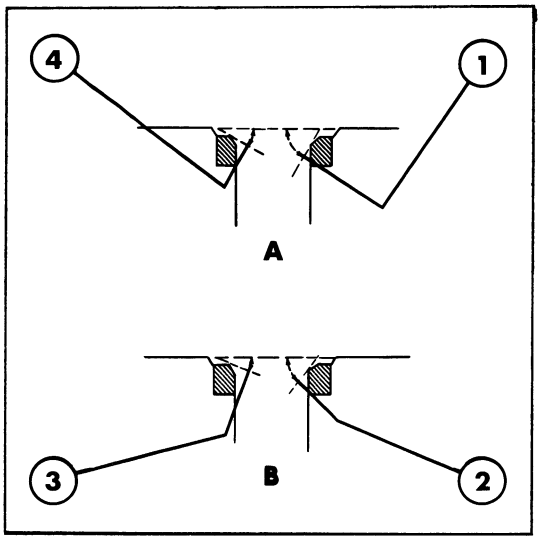


Figure 18
Dressing Valve Seats
A. Ford TW-5 Intake and Exhaust Valves
Ford TW-15, TW-25 and TW-35 Exhaust Valves
B. Ford TW-15, TW-25 and TW-35 Intake Valves
1. 60°
2. 45°
3. 15°
4. 30°

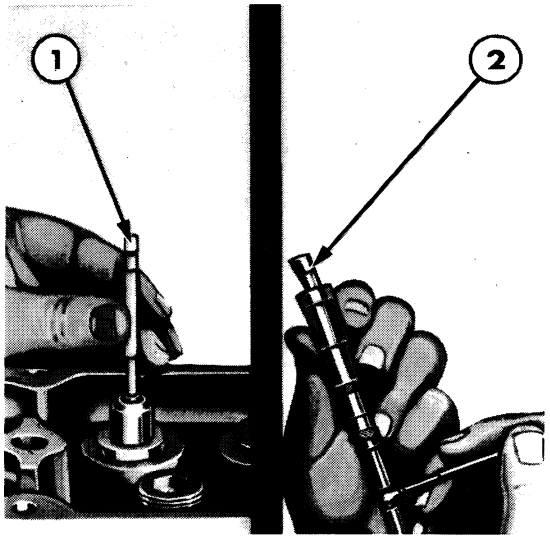


Figure 19
Measuring Valve Guide
1. Telescope Gauge
2. Micrometer

TW-15, TW-25 AND TW-35 INTAKE VALVES

Lower the valve seat by removing stock from the top of the seat with a 15° grinding wheel. Raise the seat by removing stock from the bottom of the seat with a 45° grinding wheel, Figure 18.

IMPORTANT: *Some cylinder heads may have one or more 0.003 in (0.0762 mm) or 0.015 in (0.381 mm) oversize valve guides and valves installed. The exhaust manifold side of the cylinder head opposite these valves will be stamped '03' or Y003 OS as appropriate.*

Valve stem-to-guide clearance tolerances are as follows. Intake valves, 0.0010—0.0045 in (0.0245—0.114 mm) — exhaust valves, 0.0020—0.0055 in (0.0508—0.0139 mm).

Measure stem-to-guide clearance with a telescoping gauge and micrometer, Figure 19. If the clearance is not within tolerances, or if excessive oil consumption is indicated, replace the guides concerned.

Valves with oversize stems are available for service. If it is necessary to ream the valve guides to install valves with oversize stems use the Oversize Valve Guide Reamers, Tool No. FT.6202 or 2136, and ream the guides in steps, using the small reamer and standard diameter pilot first.

The Oversize valve Guide Reamer Kit contains:

Reamer Diameter
0.003 in (0.0762 mm) oversize
0.015 in (0.3810 mm) oversize
0.030 in (0.7620 mm) oversize

Pilot Diameter
Standard Diameter
0.003 in (0.0762 mm) oversize
0.015 in (0.3810 mm) oversize

NOTE: *Always reface the valve seat after reaming the valve guide.*

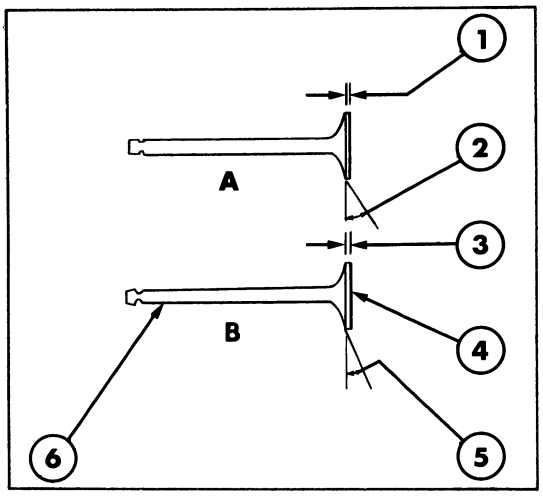


Figure 20
Critical Valve Measurements and Inspection Checks

A. Ford TW-5 Intake and Exhaust Valves
Ford TW-15, TW-25 and TW-35 Intake Valves
B. Ford TW-15, TW-25 and TW-35 Intake Valves
1. 1/32 in (0.79 mm) Minimum
2. 44½°
3. 1/16 in (1.58 mm)
4. Check Maximum Valve Face Run-Out
5. 29½°
6. Check for Bent Stems and Correct Diameter

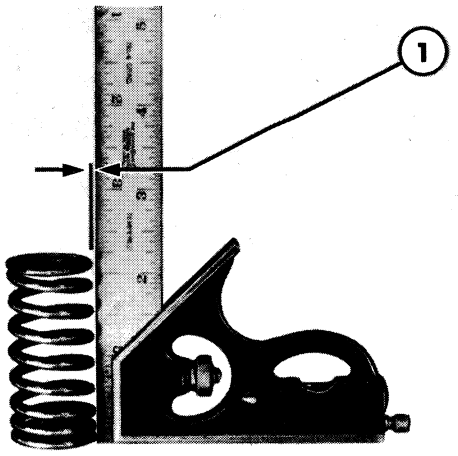


Figure 21
Checking Valve Spring Squareness

1. Not more than 1/16 in (1.59 mm)

VALVES AND PUSH RODS

INSPECTION

The critical inspection points of the valves are shown in Figure 20. Inspect the valve face and the edge of the valve head for pits, grooves, scores or other defects. Inspect the stem for a bent condition and the end of the stem for grooves or scores. Check the valve head for cracks, erosion, warpage or burn. Minor defects such as small pits or groves, can be removed.

Check the valve tip for pits or grooves and replace the valve if such a condition exists. Discard valves that are severely damaged.

Discard any valve springs that show signs of erosion or rust. Check each valve spring for squareness, Figure 21. Discard valve springs that are out of square in excess of 1/16 in (1.59 mm).

TABLE 1

Insert Oversize	Exhaust Valve Inlet	Intake Valve Seat Insert
	Counter Diameter in Cylinder Head	
0.010 in (0.254 mm)	1.607—1.608 in (40.82—40.84 mm)	1.907—1.908 in (43.44—43.46 mm)
0.020 in (0.508 mm)	1.617—1.618 in (41.07—41.10 mm)	1.917—1.918 in (43.69—43.72 mm)
0.030 in (0.762 mm)	1.627—1.628 in (41.33—41.36 mm)	1.927—1.928 in (43.95—43.97 mm)

Check specified free length and loaded height of the valve springs. Weak valve springs cause poor engine performance. If the free length is less than 2.16 in (54.8 mm), add one 0.030 in (0.76 mm) spacer between the cylinder head spring pad and the valve spring to bring the assembled height to the recommended dimensions of 2.13—2.19 in (53.9—55.6 mm).

Check the valve spring retainer locks to be sure they are in good condition. Rotate the exhaust valve positive rotator to be sure it is not binding or excessively worn. Install new rotators if necessary.

Check the ends of the push rods for nicks, grooves, roughness or excessive wear. If the push rods were not straight when checked or if any of the above wear conditions exist, install new rods. Do not attempt to straighten push rods.

REFACING VALVES

The valve refacing operation should be closely co-ordinated with the valve seat refacing operating so the finished angle of the valve is ½° less than the valve seat to provide an interference angle for better seating, Figure 17. Adjust the refacing tool to obtain a face angle of 44½° or 29½°, Figure 20.

Remove only enough stock to clean up the pits and grooves. Check the edge of the valve head, if less than 0.031 in (0.79 mm) margin, install a new valve.

Remove all grooves or score marks from the valve tip, then chamfer as necessary. Do not remove more than 0.010 in (0.25 mm) from the tip.

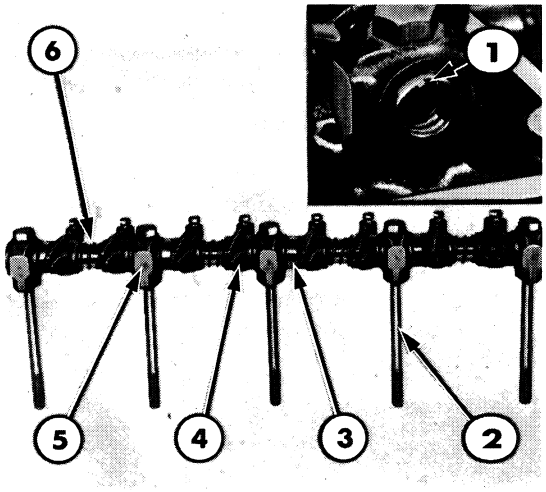


Figure 22
Rocker Arm Shaft

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

ROCKER ARMS AND SHAFT

DISASSEMBLY

To disassemble the rocker shaft assembly, remove the bolts that attach the rocker shaft to the cylinder head from the rocker shaft support, Figure 22.

INSPECTION

1. Inspect the rocker arm adjusting screws and the push rod ends of the rocker arms for stripped or worn threads.

2. Check the ball end of the screws for nicks, scratches or excessive wear.

3. Check the rocker arm locating springs and spacers for breaks or other damage.

4. Inspect the pad and insert end of the rocker arm for roughness or grooves, or excessive wear. If any of the above conditions exist, install new parts.

5. Check the rocker arm and rocker shaft diameters. If the diameter exceeds the specifications, Chapter 6, install a new part. If the shaft meets specifications, clean it thoroughly in solvent. Make sure the oil passages are clear of obstructions.

INSTALLATION

1. Reassemble the rocker arm and shaft assembly, Figure 22.

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

3. The rocker shaft has an identification groove at one end of the shaft. Position the mark upwards and use this end as the front of the shaft. This puts the oil holes and grooves in the shaft facing down.

4. Start reassembly from the rear of the shaft by first positioning a rocker arm support with the notch on the support to the right of the shaft facing forward.

5. Be sure the springs and spacers are in their correct position, Figure 22, then proceed with the assembly.

CYLINDER HEAD

ASSEMBLY

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

2. Lubricate all moving parts with engine oil prior to installation. Refer to Figures 12 and 13 for reference to parts of the intake and exhaust valves.

3. Insert each valve in the guide bore from which it was removed. Position a new valve seal over each intake valve (on the TW-5 only) and guide.

4. Install the valve springs over the valve guides.

5. On intake valves, compress the springs and spring retainer, Figure 12, and install the retainer locks. On exhaust valves, compress the spring and the valve rotator. Be sure to install the rotator onto the valve from which it was removed.

6. On exhaust valves install the new sealing ring into the second groove from the top of the valve stem and install the retainer locks.

CHECKING VALVE SPRING ASSEMBLED HEIGHT

Measure the assembled height of the valve spring from the surface of the cylinder head spring pad to the underside of the spring retainer. Use dividers, Figure 23.

If the assembled height is greater than the specified limit, install 0.030 in (0.76 mm) spacers between the cylinder head spring pad and the valve spring to bring the assembled height to the recommended dimension.

NOTE: *Do not install spacers unless necessary. Use of spacers in excess of recommendations will result in overstressing the valve springs and overloading camshaft lobes.*

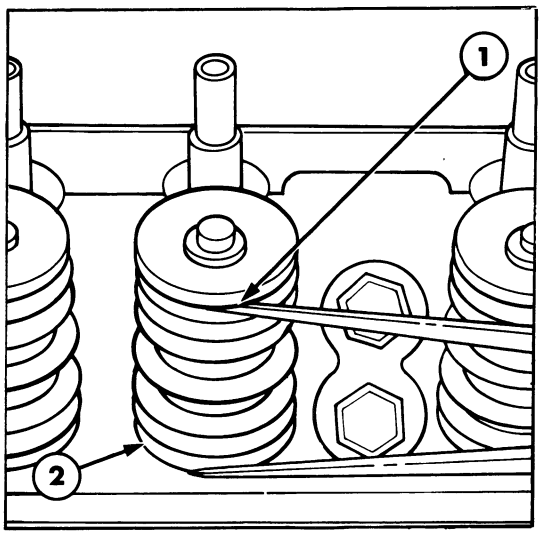


Figure 23
Checking Valve Spring Assembled Height
1. Underside of Spring Retainer
2. Surface of Spring Pad

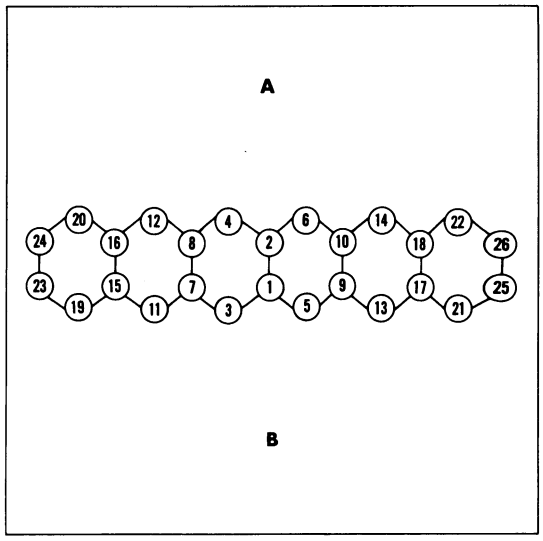


Figure 24
Cylinder Head Tightening Sequence
A. Intake Side
B. Exhaust Side

VALVE SPRING ASSEMBLED HEIGHT

1.72—1.78 in (43.6—45.2 mm)

INSTALLATION

1. Place a new head gasket on the cylinder block, then carefully position the cylinder head on the gasket. Two dowels are on the top of the cylinder block at opposite corners to aid in positioning the cylinder head and gasket.

2. Lubricate the cylinder head bolts and install them finger tight.

3. Install the valve push rod with the cupped end up, in the holes in the cylinder head from which they were removed. Be sure the ball ends of the push rods are seated in the tappet sockets.

4. Position the rocker shaft assembly on the cylinder head, the long cylinder head bolts and washers in the respective holes. Refer to Figure 10. Make sure that the ball ends of the rocker arm adjusting screws are seated in the cupped end of the push rods.

5. Tighten the cylinder head bolts in the sequence shown in Figure 24. Tighten the two steps:
   (a) 140 lbs.ft. (190 Nm)
   (b) 160 lbs.ft. (217 Nm)

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

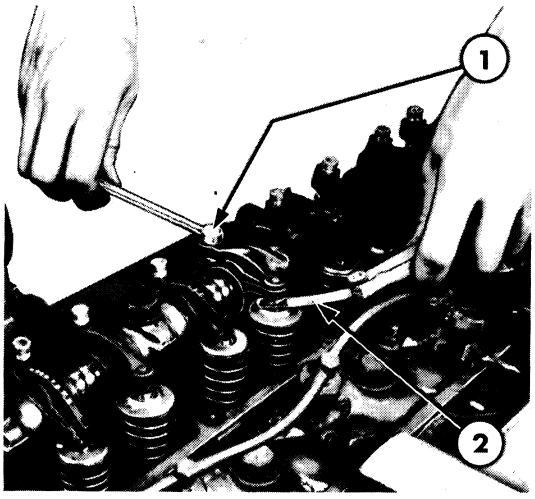


Figure 25
Adjusting Valve Lash
1. Adjusting Screw
2. Feeler Gauge

6. Rotate the engine and set the valve lash, Figure 25, to the specified limits, see 'Specifications', Chapter 6.

7. Install a new seat washer in each injector bore in the cylinder head. Position new cork seals over the injectors.

8. Install each injector into the cylinder head and over the two studs, Figure 11. Install the nut on each stud and tighten progressively to the specified torque, see 'Specifications', Chapter 6.

9. Using new copper washers, install the injector leak-off line.

10. Install a new gasket and the intake manifold onto the cylinder head. Secure the manifold with the bolts and lock washers and tighten the bolts to the specified torque, see 'Specifications', Chapter 6.

11. Attach the fuel filters to the manifold with two bolts and flat washers, and connect the fuel lines.

12. Connect the injector lines to the injection pump and to the injectors. Position the clamps on the injector lines in the same position from which they were removed.

13. Connect the cold start equipment.

14. Position a new exhaust manifold gasket on the cylinder head and install the exhaust manifold, Figure 6. Use new lock tabs and tighten the bolts to the specified torque, see 'Specifications', Chapter 6, and bend the lock tabs to retain the bolts.

15. Ford TW-5: Bolt the muffler with a new gasket installed to the exhaust manifold

    Ford TW-15 and TW-25: Bolt the turbocharger, with a new gasket installed, to the exhaust manifold. Install the oil pressure and return lines from the turbocharger to the engine.

IMPORTANT: *Whenever a turbocharger is installed in a tractor, the following procedure should be followed:*

(i) Connect the oil supply tube to the turbocharger and tighten the connection securely.

(ii) Do not connect the oil return tube to the turbocharger at this time.

(iii) Connect the air inlet-to-turbocharger tubes and the turbocharger-to-exhaust tubes, as detailed previously. Tighten all locations securely.

(iv) Place a container under the oil return passage of the turbocharger bearing housing.

(v) Crank the engine with the diesel engine stop control pulled out. Oil under pressure from the engine lubrication system will flow out of the turbocharger bearing housing into the container. This procedure will provide initial lubrication to the turbocharger.

(vi) Connect the oil return tube to the turbocharger and tighten the connection securely.

16. Connect the upper radiator hose to the cylinder head.

17. Fill the radiator with coolant.

18. Refit the rocker cover, installing a new gasket, and tighten the bolts to the specified torque, see 'Specifications', Chapter 6. Connect the ventilating tube.

19. Lift the air cleaner and support assembly into place and attach with the hardware previously removed.

20. TW-5: Attach the muffler to the air cleaner support assembly and connect the air intake tube to the intake manifold.

    Ford TW-15 and TW-25: Connect the exhaust extension to the turbocharger exhaust outlet and attach it to the air cleaner support assembly. Connect the air intake tube to the inlet side of the turbocharger and the air cleaner.

21. Install the fuel tank assembly.

22. Turn on the fuel.

23. Position the wiring harness in the clips on the support brace and connect the harness at the alternator and air intake restrictor valve.

24. Install the top hood panel and the precleaner.

25. Install both hood side panels and the radiator grille panel(s).

26. Bleed the system as described in Part 2, "FUEL SYSTEM".

TW-35

27. Bolt the turbocharger and new gasket to the exhaust manifold. Install the oil lines between the turbocharger and the engine. Install the water pump if removed, using a new gasket.

28. Install the thermostat — fan hub housing. Attach the radiator hose and heater hose, Figure 9.

29. Install the intercooler support bracket at the rear of the engine, Figure 8.

30. Install the intercooler, Figure 7.

31. Connect the intercooler-to-turbocharger tube, and install the aspirator hoses.

32. Install the air cleaner, and the air cleaner-to-turbocharger tube.

33. Attach the grille support, Figure 6.

34. Install the hood panel, grille and side panels, Figure 5.

C. ENGINE FRONT COVER AND TIMING GEARS

Engine front cover and timing gear service operations can be performed after separating the front axle assembly from the engine, transmission, and rear axle assembly, as outlined in Part 12, "SEPARATING THE TRACTOR".

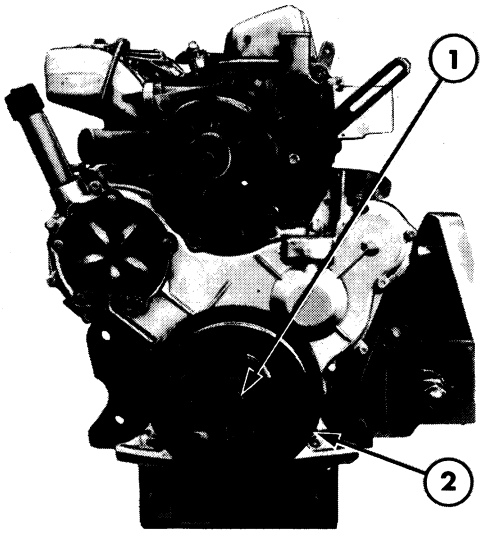


Figure 26
Crankshaft Pulley
1. Pulley Bolt
2. Crankshaft Pulley

CAMSHAFT PULLEY REMOVAL

1. Remove the fan and water pump belts. Remove the bolt and washer from the crankshaft pulley, Figure 26, Using Adjustable Bridge Puller, Tool No. 518 or 9539 and Shaft Protector No. 625-1 or 9212, Figure 27. To use the puller for this purpose, $\frac{7}{16}$" x 14 UNC bolts have to be used and the slots in the puller enlarged.

2. Check the pulley belt grooves to be sure the surfaces are smooth and the flanges are not cracked or broken.

3. Check the shaft spacer in the area that contacts the front oil seal to be sure it is free of scratches or grooves that may cause oil leakage past the seal. Clean the seal contact surface with solvent prior to installation.