FIATALLIS®

3500
3500 MKII
670 T

ENGINES

SERVICE MANUAL

Form 70650824 English
1/89

SAFETY RULES

GENERAL

Study the Operation and Maintenance Instruction Manual before starting, operating, maintaining, fueling, or servicing machine.

Read and heed all machine-mounted safety signs before starting, operating, maintaining, fueling or servicing machine.

Machine-mounted safety signs have been color coded yellow with black border and lettering for ***WARNING*** and red with white border and lettering for ***DANGER*** points.

Never attempt to operate the machine or its tools from any position other than seated in the operator's seat. Keep head, body, limbs, hands and feet inside operator's compartment at all times to reduce exposure to hazards outside the operator's compartment.

Do not allow unauthorized personnel to operate service or maintain this machine.

Always check work area for dangerous features. The following are examples of dangerous work areas: slopes, over hangs, timber, demolitions, fire, high walls, drop off, back fills, rough terrain, ditches, ridges, excavations, heavy traffic, crowded parking, crowded maintenance and closed areas. Use extreme care when in areas such as these.

An operator must know the machine's capabilities. When working on slopes or near drop offs be alert to avoid loose or soft conditions that could cause sudden tipping or loss of control.

Do not jump on or off machine. Keep two hands and one foot, or two feet and one hand, in contact with steps grab rails and handles at all times.

Do not use controls or hoses as hand holds when climbing on or off machine. Hoses and controls are movable and do not provide a solid support. Controls also may be inadvertently moved causing accidental machine or equipment movement.

Keep operator's compartment, stepping points, grab-rails and handles clear of foreign objects, oil, grease, mud or snow accumulation to minimize the danger of slipping or stumbling. Clean mud or grease from shoes before attempting to mount or operate the machine.

Be careful of slippery conditions on stepping points, hand rails, and on the ground. Wear safety boots or shoes that have a high slip resistant sole material.

For your personal protection. Do not attempt to climb on or off machine while machine is in motion.

Never leave the machine unattended with the engine running.

Always lock up machine when leaving it unattended. Return keys to authorized security. Heed all shut down procedures of the Operation and Maintenance Instruction Manual. Always set the parking brake when leaving the machine for any reason.

Do not wear rings, wrist watches, jewelry, loose or hanging apparel, such as ties, torn clothing, scarves, unbuttoned or unzipped jackets that can catch on moving parts. Wear proper safety equipment as authorized for the job. Examples: hard hats, safety shoes, heavy gloves, ear protectors, safety glasses or goggles, reflector vests, or respirators. Consult your employer for specific safety equipment requirements.

Do not carry loose objects in pockets that might fall unnoticed into open compartments. Do not use machine to carry loose objects by means other than attachments for carrying such objects.

DO NOT CARRY RIDERS unless the machine is equipped for carrying people to reduce personal exposure to being thrown off.

Do not operate machinery in a condition of extreme fatigue or illness. Be especially careful towards the end of the shift.

Roll Over Protective Structures are required on wheel loaders, dozer tractors, track type loaders, graders and scrapers by local or national requirements. *DO NOT* operate this machine without a Roll Over Protective Structure.

Do not operate a machine without a falling object protective structure (FOPS).

Do not operate this machine without a rear canopy screen when machine is equipped with rear mounted towing winch.

Seat belts are required to be provided with roll over protective structures or roll protection cabs by local or national regulations. Keep the safety belt fastened around you during operation.

Where noise exposure exceeds 90 dBA for 8 hours, wear authorized ear protective equipment per local or national requirements that apply.

Keep clutches and brakes on machine and attachments such as power control units, winches and master clutches adjusted according to Operation and Maintenance Instruction Manuals of the manufacturers at all times. *DO NOT* adjust machine with engine running except as specified.

Do not operate a machine with brakes out of adjustment. See the Operation and Maintenance Instruction Manual.

Move carefully when under, in or near machine or implements. Wear required protective equipment, such as hard hat, safety glasses, safety shoes, ear protectors.

To move a disabled machine, use a trailer or low boy truck if available. If towing is necessary, provide warning signals as required by local rules and regulations and follow Operation and Maintenance Instruction Manual recommendations. Load and unload on a level area that gives full support to the trailer wheels. Use ramps of adequate strength, low angle and proper height. Keep trailer bed clean of clay, oil and all materials that become slippery. Tie machine down securely to truck or trailer bed and block tracks (or wheels) as required by the carrier.

SAFETY RULES

To prevent entrapment in cabs or mounted enclosures, observe and know the mechanics of alternate exit routes.

On machines equipped with suction radiator fans, be sure to periodically check all engine exhaust parts for leaks as exhaust gases are dangerous to the operator. Keep a vent open to outside air at all times when operating within a closed cab.

STARTING FLUID IS FLAMMABLE. Follow the recommendations as outlined in the Operation and Maintenance Instruction Manual and as marked on the containers. Store containers in cool, well-ventilated place secure from unauthorized personnel. *DO NOT PUNCTURE OR BURN CONTAINERS.*

Follow the recommendations of the manufacturer for storage and disposal.

Wire rope develops steel slivers. Use authorized protective equipment such as heavy gloves, safety glasses when handling.

OPERATION

Before starting machine, check, adjust and lock the operator's seat for maximum comfort and control of the machine.

DO NOT START OR OPERATE AN UNSAFE MACHINE. Before working the machine, be sure that any unsafe condition has been satisfactorily remedied. Check brakes, steering and attachment controls before moving. Advise the proper maintenance authority of any malfunctioning part or system. Be sure all protective guards or panels are in place, and all safety devices provided are in place and in good operating condition.

Check instruments at start-up and frequently during operation.

Do not run the engine of this machine in closed areas without proper ventilation to remove deadly exhaust gases.

Be sure exposed personnel in the area of operation are clear of the machine before moving the machine or its attachments. *WALK COMPLETELY AROUND* the machine before mounting. Sound horn. Obey flag man, safety signals and signs.

Know the principles of cross steering of crawler tractors. Read section in Operation and Maintenance Instruction Manual on cross steering.

Keep engine exhaust system and exhaust manifolds clear of combustible material. Equip machine with screens and guards when working under conditions of flying combustible material.

If engine has a tendency to stall for any reason under load or idle, report this for adjustment to a proper maintenance authority immediately. Do not continue to operate machine until condition has been corrected.

Never use bucket as a man-lift.

Use recommended bucket for machine and material load ability and heaping characteristics of material, terrain, and other pertinent job conditions.

Avoid abrupt starts and stops when transporting a loaded bucket.

Inspect your seat belt webbing and hardware at least twice a year for signs of fraying, wear or other weakness that could lead to failure.

Use only designated towing or pulling attachment points. Use care in making attachment. Be sure pins and locks as provided are secure before pulling. Stay clear of draw bars, cables or chains under load.

When pulling or towing through a cable or chain, do not start suddenly at full throttle. Take up slack carefully. Guard against kinking chains or cables. Inspect carefully for flaws before using. Do not pull through a kinked chain or cable due to the high stresses and possibility of failure of the kinked area. Always wear heavy gloves when handling chain or cable.

Be sure cables are anchored and the anchor point is strong enough to handle the expected load. Keep exposed personnel clear of anchor point and cable or chain. *DO NOT PULL OR TOW UNLESS OPERATOR'S COMPARTMENT OF MACHINES INVOLVED ARE PROPERLY GUARDED AGAINST POTENTIAL CABLE OR CHAIN BACKLASH.*

During operation always carry ripper in full raised position when not in use and lowered to ground when parked.

When counterweights have been provided, do not work machine if they have been removed unless their equivalent weight has been replaced. See the Operation and Maintenance Instruction Manual.

When operating a machine know what clearances will be encountered, overhead doors, wires, pipes, aisles, roadways; also the weight limitations of ground, floor, and ramps.

Know bridge and culvert load limits and do not exceed them. Know machine's height, width, and weight. Use a signal person when clearance is close.

Be sure that the exact location of gas lines, utility lines, sewers, overhead and buried power lines, and other obstructions or hazards are known. Such locations should be precisely marked by the proper authorities to reduce the risk of accidents. Obtain shut-down or relocation of any such facilities before starting work, if necessary.

Be certain to comply with all local, state, and federal regulations regarding working in the vicinity of power lines.

When roading find out what conditions are likely to be met - clearances, congestion, type of surface, etc. Be aware of fog, smoke or dust element that obscure visibility.

When backing, always look to where the machine is to be moved. Be alert to the position of exposed personnel. *DO NOT OPERATE* if exposed personnel enter the immediate work area.

SUBJECT INDEX

SECTION 1—DESCRIPTION AND SPECIFICATIONS

TOPIC 1—DESCRIPTION

A. GENERAL

The 3500 engine is a four cycle, water cooled, overhead valve, turbocharged, compression ignition type diesel engine with six vertical in-line cylinders.

The fuel system consists of a combination primary and secondary fuel filter, differential needle type fuel injection nozzle holder assemblies, and a fuel injection pump with an integral fuel transfer pump and governor. The system cleans, prepares, and delivers accurately metered quantities of fuel under high pressure to the engine cylinders where it is ignited by heat of air compressed in the cylinders.

Proper lubrication is assured by a gear type lubricating oil pressure pump driven by a camshaft gear. Dual, full flow type oil filters keep the main oil gallery supplied with clean lubricating oil. Oil is pumped under 45 to 50 psi pressure from the main oil gallery to the crankshaft, connecting rods, idler gear, and rocker arm assembly. All other internal moving parts are lubricated by splash, spray, and oil in suspension.

A turbocharger is used to obtain greater power output of Model 3500 diesel engines over that of Model 3400 engines by increasing the supply of air of the cylinders.

The turbocharger responds to engine load demands by reacting to the flow of expanding exhaust gases and supplying a correlated volume of air to engine cylinders. During a heavy load/lugging operation, the increased flow of exhaust gases turns the turbine wheel faster, causing the compressor impeller to turn faster to supply more air to the intake manifold. Conversely, when engine load is light and the radial flow of gases within the turbine decreases, the turbocharger compressor reduces air supply to the intake manifold.

B. ENGINE STROKE SEQUENCE

In a 4 cycle diesel engine, a power stroke is made by each piston every two complete revolutions of the crankshaft. Sequence of strokes is intake, compression, power, and exhaust.

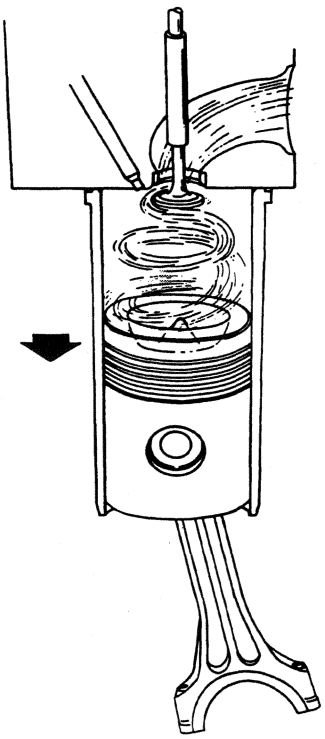

Fig. 1 -- Intake Stroke
(T-52046)

1. INTAKE STROKE

As the piston moves downward on the first, or intake stroke, air enters the cylinder through the air intake manifold and intake valve, which start to open a few degrees before the piston reaches top dead center. The intake charge, consisting of air only, rushes into the cylinder and is given a swirling motion by directional ports in the cylinder head.

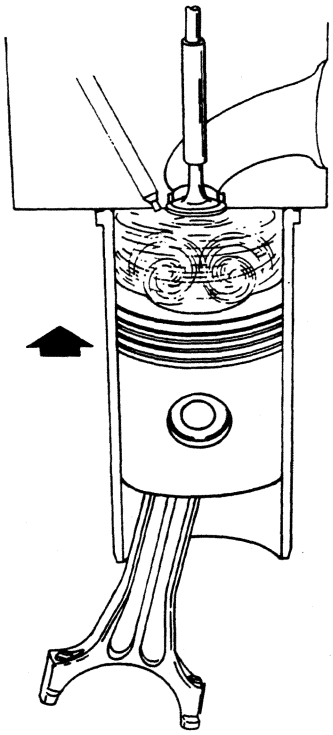

Fig. 2 -- Compression Stroke
(T-52045)

2. COMPRESSION STROKE

Shortly after the piston starts to move upward on the second, or compression stroke, the intake valve closes. The swirling motion of air admitted on the intake stroke is intensified during the compression stroke and its temperature is raised to approximately 1000°F. The contoured piston top compresses and simultaneously forces the air toward its center, giving it an additional rolling motion and greater velocity. At the proper instant during the compression stroke, a metered quantity of fuel is injected into the combustion chamber in a four-jet pattern under extremely high pressure. When the finely atomized fuel has mixed thoroughly with the turbulent air it is ignited by heat of the compressed air and immediately starts to burn.

3. POWER STROKE

Because the fuel and air is thoroughly mixed in the cylinder, it burns smoothly and evenly. As the burning gases expand they force the piston downward on its third, or power stroke. Near bottom of the power stroke the exhaust valve starts to open.

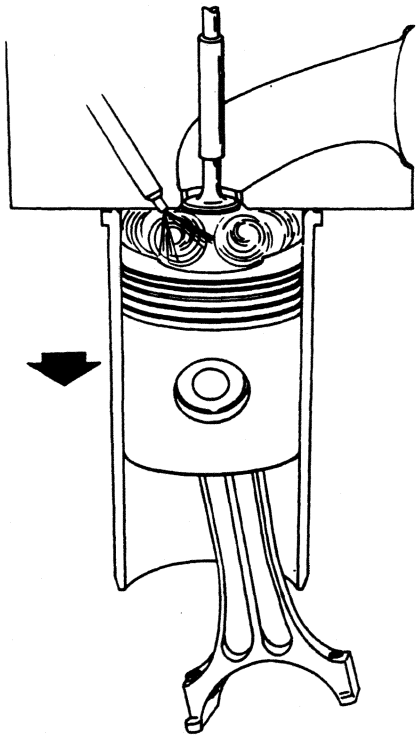

Fig. 3 -- Power Stroke
(T-52044)

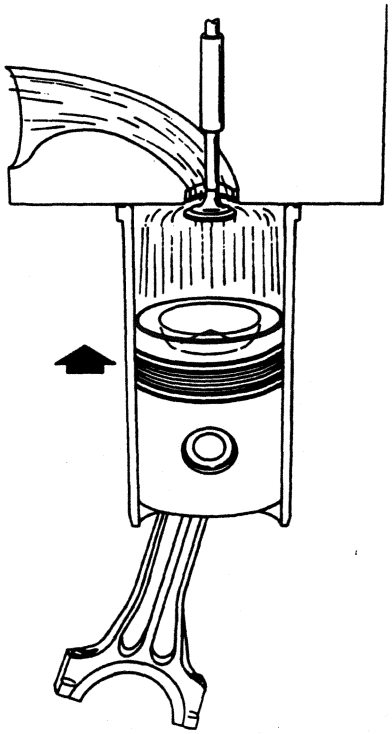

Fig. 4 -- Exhaust Stroke
(T-52043)

4. EXHAUST STROKE

As the piston moves upward on the fourth or exhaust stroke, the exhaust valve opens and burned gases are forced out of the cylinder by the upward travel of the piston. Shortly before the piston reaches top dead center, the intake valve starts to open to admit a fresh charge of air to the cylinder. A few degrees after the piston reaches top dead center, the exhaust valve closes completely, denoting the end of one cycle and begining of the next.

TOPIC 2—SPECIFICATIONS

A. BASIC ENGINE

Model 3500,670T
Type . . . . . .4 cycle
Number of Cylinders 6
Firing Order 1-5-3-6-2-4
Bore . . . . . 4-1/4"
Stroke . . . . . 5"
Cubic Inch Displacement 426
Crankshaft Rotation (viewed from fan end) . . . . . Clockwise
Number of Main Bearings 7
Compression Ratio (nominal) 16:1
Compression Pressure at Sea Level, 600 rpm, hot . . . . . 500 psi + or - 15 psi
Maximum Permissible Exhaust Restriction . . . . . 1" Hg

B. COOLING SYSTEM

Stabilized Coolant Temperature (minimum) . . . . . 180°F
Water Pump Type. Centrifugal, Belt Driven
Radiator, Pressurized . . . . . 7 psi

C. LUBRICATING SYSTEM

Type System . . . Full Flow, Circulating Pressure
Oil Pump Type . . . . . Gear, Positive Displacement
Oil Pressure Range, hot at full throttle . . . . . 30 - 55 psi
Pressure regulation governed by . . . . . Regulation Valve
Lubricating Oil Filters . . Dual Full Flow

D. FUEL INJECTION SYSTEM

1. ROOSA MASTER DC F.I.PUMP

Nozzle opening pressure. 3100 -- 3150 psi
Fuel pump timing to engine (engine stopped);

Models with automatic advance
7GB Prior to engine S/N 3D-09890 . . . . . 22° BTDC
Effective with engine S/N 3D-09890 . . . . . 24° BTDC
645 Prior to engine S/N 3D-10184 . . . . . 22° BTDC
Effective with engine S/N 3D-10184 . . . . . 24° BTDC

Models without automatic advance . . . . . 34° BTDC

Fuel injection pump speed to crankshaft ratio . . . . . 5 to 1

2. SIMMS FUEL INJECTION PUMP

Nozzle opening pressure. 3800 to 3850 psi
Fuel pump timing to engine (engine stopped) . . . . . 32° BTDC
Fuel injection pump speed to crankshaft ratio . . . . . .5 to 1

3. ROOSA MASTER DM4 F.I.PUMP
645-B Effective engine:
S/N 3D-56914 (static) .. 16°BTDC
S/N 70-1634 (static) .. 16°BTDC

E. VALVE DATA

1. Valve lash adjustment
Intake valve clearance (hot) . . . . 0.015"
Exhaust valve clearance (hot) . . 0.015"
2. Valve Timing
Exhaust valve (with 0.0195" tappet clearance)
Opens BBDC . . . . . 56°
Closes ATDC . . . . . 16°
Duration . . . . . 252°
Intake valve (with 0.0195" tappet clearance):
Opens BTDC . . . . . 20°
Closes ABDC . . . . . 48°
Duration . . . . . 248°

CAUTION

Tappets must be set with 0.0195" clearance to obtain proper valve opening and closing in degrees tabulated for the camshaft. Do not confuse this setting with valve lash adjustment data.

F. ENGINE SPEEDS

For specified high and low idle engine speeds, which vary depending upon the unit in which the engine is used, refer to the Operator's Manual furnished with the unit.

SECTION 2—COOLING SYSTEM

TOPIC 1—GENERAL

The engine cooling system includes the water pump, radiator, water inlet piping, thermostat, thermostat housing, oil cooler, hoses, engine coolant temperature gauge, cooling fan, and water passages in the cylinder block and cylinder head.

A double acting valve is provided in the radiator filler cap for relieving air pressure due to heat expansion and allowing atmospheric pressure to enter when cooling contraction occurs.

The water pump draws coolant from the bottom of the radiator and circulates it thru the water passages in the cylinder block and cylinder head. The coolant is discharged from the cylinder head thru the thermostat housing and radiator inlet hose into the upper part of the radiator. As the coolant passes from the top to the bottom of the radiator, the coolant dissipates its heat to the atmosphere by air drawn or pushed thru the radiator core by the cooling fan.

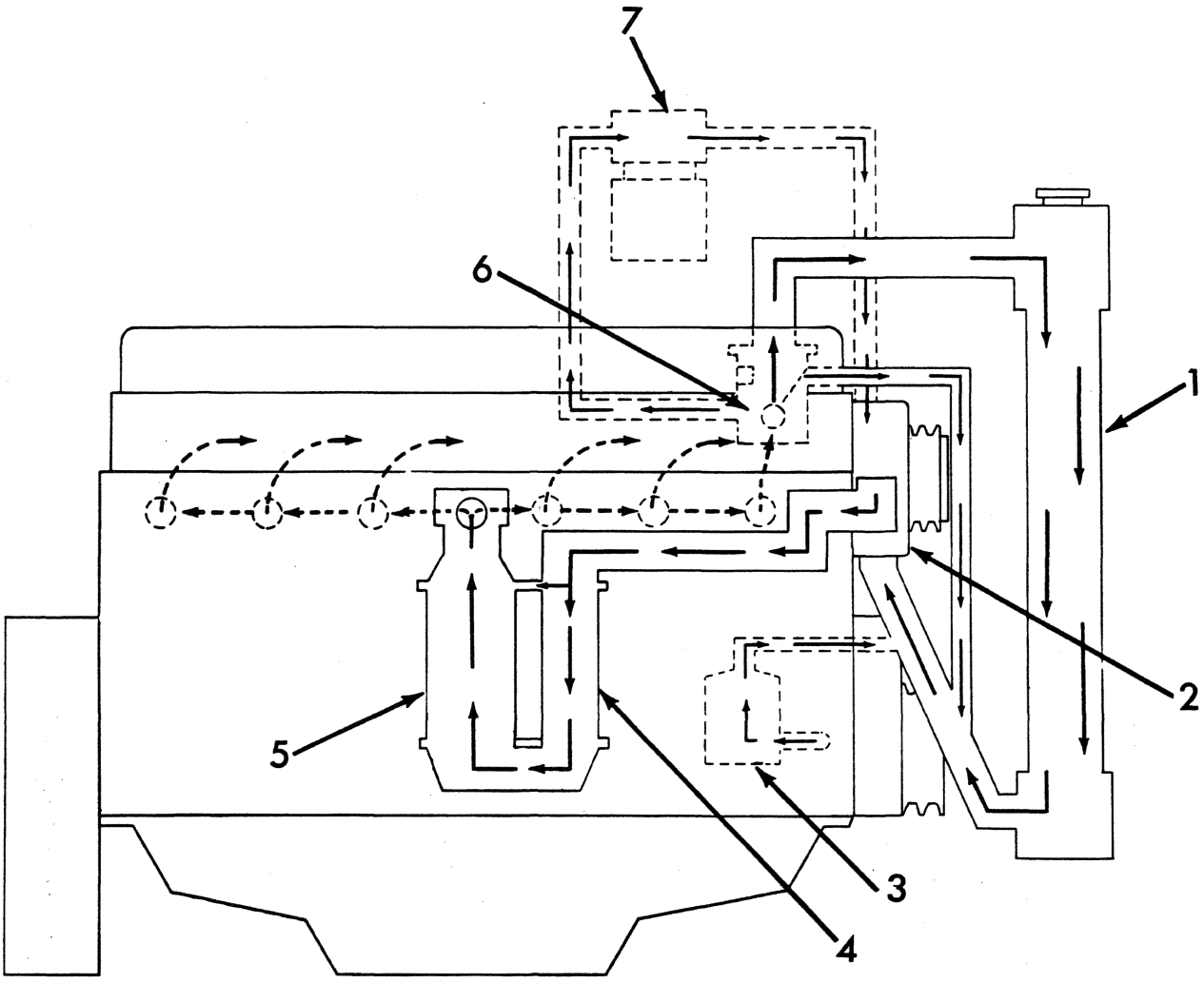

Fig. 1 -- Flow of Coolant -- Schematic Diagram
(T-51303)

1. Radiator
2. Water Pump
3. Coolant Filter (Special Equipment)
4. Engine Oil Cooler
5. Transmission Oil Cooler
6. Thermostat Housing
7. Air Compressor

TOPIC 2—RADIATOR

A. GENERAL

The radiator is of the fin and tube type and is properly positioned on the radiator support in relation to the cooling fan.

The radiator is bolted to the radiator support and rubber washers are used with each mounting bolt to reduce vibration and shock.

B. RADIATOR REMOVAL

1. Drain cooling system.
2. Remove the fan guard.
3. Loosen the clamps on the upper and lower radiator hoses and disconnect both hoses from the radiator.
4. Remove the radiator grill (also remove radiator guard from crawler loaders).
5. Remove the nuts, plain washers, rubber washers, and capscrews attaching the radiator support and remove the radiator.

C. RADIATOR INSPECTION AND REPAIR

1. Thoroughly clean exterior of radiator removing all foreign material from between cooling cores and fins. Be careful not to bend the fins, straightening any that may be bent.

2. Inspect radiator for clogging or leakage. Test radiator under water with 4 to 5 lbs. of air pressure. Note the source of the air bubbles and solder the leaks. Be sure to wash off the acid after soldering as the acid will eat into the tubes if not washed off. The radiator should be repaired only by qualified personnel.

3. Inspect the hoses for deterioration or damage. Replace as necessary.

D. RADIATOR INSTALLATION

1. Install the radiator by a direct reversal of the removal procedure.

2. Close the cooling system drain cocks. Fill system with coolant and check for leaks.

TOPIC 3—FAN, FAN BELTS, FAN SPACER, AND FAN PULLEY

A. GENERAL

The engine may be equipped with either a pusher type or suction type fan depending upon the application. The fan pushes or pulls (according to the type used) air thru the radiator and the engine coolant is cooled as it circulates from the top to the bottom of the radiator core. The fan, fan spacer, and water pump fan pulley are bolted to the hub which is pressed on the water pump shaft. The fan is driven from the crankshaft pulley by a pair of matched "V" type bolts.

B. FAN BELT ADJUSTMENT

Inspect drive belts frequently. Replace belts if they are damaged, badly worn, or soaked with oil and grease. Even though only one belt may need replacement because of damage or excessive wear, it is imperative that both belts be replaced to obtain satisfactory belt life. After replacement, approximately 24 hours operating time is required to properly seat a new pair of belts.

1. WHEEL LOADERS (WITH GENERATOR)

   Drive belts are properly adjusted when they can be depressed .19" to .50" (4,82 to 12,70 mm) halfway between the generator pulley and the crankshaft pulley. Refer to Fig. 2, and adjust belts as follows:

   a. Loosen the generator adjusting brace capscrew (1) and mounting capscrews (2); move generator in or out as required.

   b. Retighten the adjusting brace capscrew and mounting capscrews.

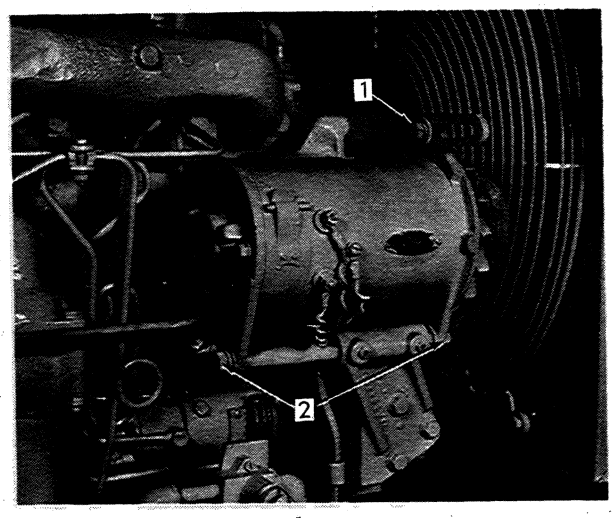

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FIG. 2 BELT ADJUSTMENT (WHEEL LOADERS WITH GENERATOR)

1. Adjusting brace capscrew
2. Mounting capscrews

2. WHEEL LOADERS (WITH ALTERNATOR)

   The belts, Fig. 2a, are properly adjusted when they can be depressed .18" to .50" (4,57 -- 12,70 mm) at a point halfway between the alternator pulley and the crankshaft pulley. A belt tension gauge provides another method by which the belt tension can be most consistently set. Correct tension is 80 -- 100 lbs. (36,29 -- 45,36 kg) as shown on gauge. Refer to Fig. 2a and adjust belts as follows:

a. Loosen adjusting brace capscrew (1) and alternator mounting capscrew (2).

b. Move the alternator in or out until correct tension has been obtained; then tighten capscrews (1) (2).

3. CRAWLER LOADERS (PRIOR TO ENGINE S/N 15109)

Belts are properly adjusted when they can be depressed .25" to .38" (6,35 -- 9,65 mm) halfway between fan belt tightener pulley and fan pulley. Refer to Fig. 2b, and adjust fan drive belts as follows:

a. Loosen nut on belt tightening capscrew.

b. Pry belt tightening brace up or down as necessary to obtain proper tension.

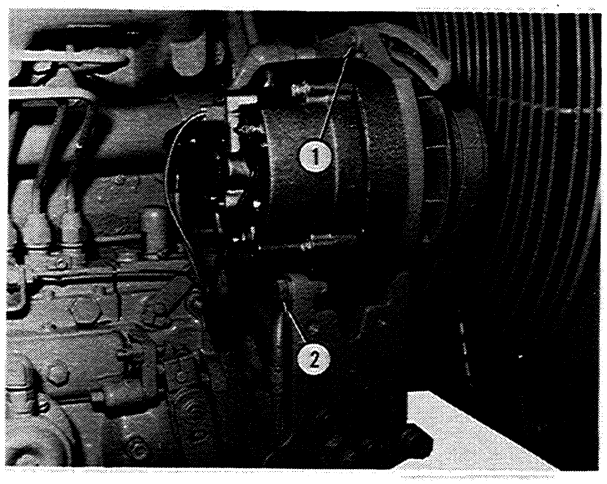

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FIG. 2a BELT ADJUSTMENT
(WHEEL LOADERS WITH ALTERNATOR)

1. Adjustment capscrew 2. Mounting capscrew

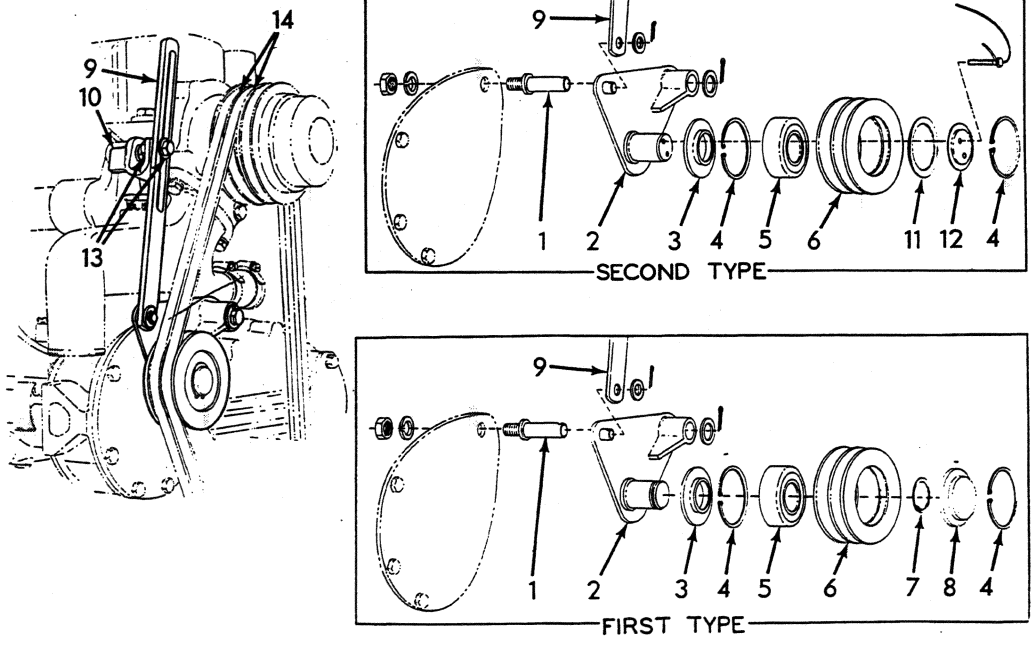

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FIG. 2b BELT TIGHTENER AND COMPONENTS
(CRAWLER LOADER PRIOR TO ENGINE S/N 15109)

1. Bracket pivot pin
2. Pivot bracket
3. Pulley bearing spacer
4. Snap ring
5. Bearing
6. Pulley
7. Snap ring
8. Cover
9. Belt tightener brace
10. Bracket
11. Spacer
12. Washer
13. Capscrew and nut
14. Fan drive belts

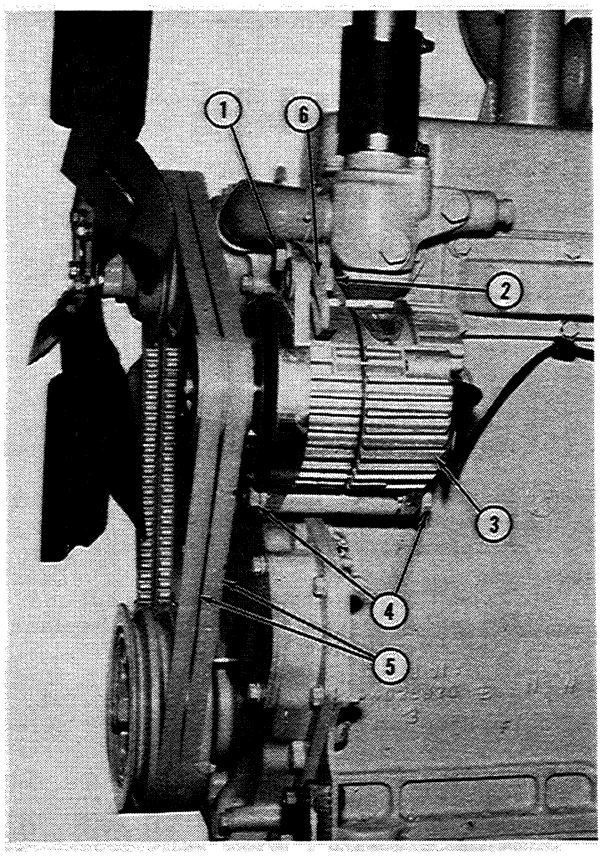

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FIG. 2c BELT ADJUSTMENT (CRAWLER LOADERS EFF. ENGINE S/N 15109)

1. Adjustment brace attaching capscrew
2. Adjustment brace capscrew
3. Alternator
4. Alternator mounting capscrews
5. Belts
6. Belt adjustment brace

4. CRAWLER LOADERS (EFF. ENGINE S/N 15109)

The belts, Fig. 2c, are properly adjusted when they can be depressed .75" (19,05mm) by hand at a point midway between crankshaft pulley and fan pulley when applying a force of 25 lbs. (11.3 kg). Correct adjustment using a belt tension gauge is 102 -- 107 lbs. (46,20 --48,46 kg). Adjust belts as follows:

a. Loosen adjustment brace capscrew (2); loosen adjustment brace attaching capscrew (1), and the two alternator mounting capscrews (4).

b. Move alternator (3) in or out to obtain correct tension. Tighten all capscrews securely.

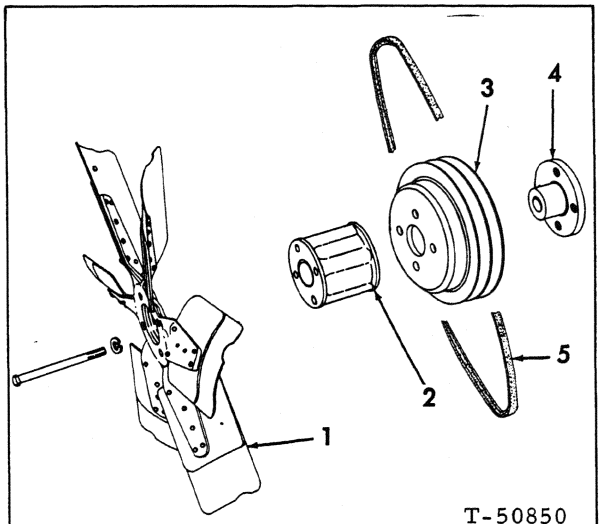


FIG. 3 FAN AND PULLEY (WHEEL LOADERS)

1. Fan
2. Fan spacer
3. Pulley
4. Pulley hub
5. Fan belts

C. FAN BELTS REMOVAL, INSPECTION AND INSTALLATION

1. Remove the fan guard.

2. Loosen tension from fan belts so that belts can be slipped from drive pulleys and over fan blades; remove belts.

3. Inspect fan belts for excessive slickness, oil-soak, wear, tears, cracks, and overstretching. The fan belts are a matched pair. If only one belt replacement is required, it is imperative that both belts be replaced to assure that satisfactory belt performance will be obtained.

4. Install the fan belts by a direct reversal of the removal procedure and adjust the belts.

D. FAN, FAN SPACER, AND FAN PULLEY REMOVAL, INSPECTION, AND INSTALLATION

Fan blades seldom require service. However, bent blades are conducive to inefficient cooling and will affect the balance of the fan. An unbalanced fan is detrimental to the water pump bearing. In case of damage, the fan should be removed and the blades restored to their original contour or replaced by a new fan. For removal of the fan, fan spacer, and fan pulley, refer to Fig. 3 or 3a and proceed as follows:

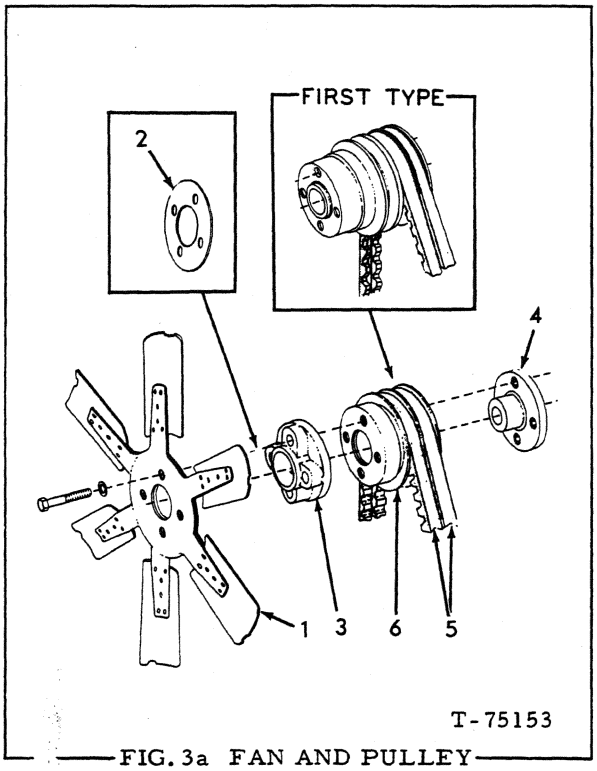


FIG. 3a FAN AND PULLEY (CRAWLER LOADERS)

1. Fan
2. Spacer (used with suction fan only)
3. Spacer
4. Pulley hub
5. Belts
6. Pulley

NOTE: On Wheel Loaders it is not necessary to drain cooling system or remove radiator to replace the fan components.

1. Remove fan guard. Drain cooling system and remove the radiator.
2. Remove capscrews and lockwashers securing fan (and fan spacer if so equipped) to pulley hub; remove fan and fan spacer.
3. Loosen the tension on the belts so that fan belts can be removed.
4. Slip fan belts off of fan pulley and remove fan pulley from the water pump hub.
5. Inspect fan for cracks, loose rivets, or bent blades. Repair or replace if necessary.
6. Inspect fan spacer (if so equipped) and fan pulley for wear or damage. Replace if necessary.
7. Position fan pulley on water pump hub; position fan belts in grooves of fan pulley.
8. Install fan spacer and fan, securing with capscrews and lockwashers. Tighten capscrews to a torque of 43 to 48 lbs. ft. (5,94 -- 6,64 kg/m).
9. Adjust fan belts to proper tension.
10. Install radiator by a direct reversal of the removal procedure. Fill cooling system.

TOPIC 4—THERMOSTAT

A. GENERAL

The thermostat is the bypass type and is located on the left side of the engine. It is so positioned in the system that when closed, coolant flow from the engine to the radiator is completely shut off. Coolant is then directed from the engine through the water bypass tube to the inlet side of the water pump, then back through the engine circulating system. When coolant temperature reaches 180°F. the thermostat starts to open allowing coolant to pass to the radiator, as well as through the engine circulating system.

Replacement of the thermostat is necessary when the thermostat becomes corroded and sticks in the open or closed position. If engine overheats or does not reach and maintain a minimum temperature of 180°F., the thermostat should be removed and tested as a possible cause of trouble.

B. THERMOSTAT REMOVAL

1. Drain cooling system.
2. Remove capscrews and lockwashers securing water outlet flange to top of thermostat housing.
3. Raise water outlet flange with hose intact and position it to one side.
4. Remove outlet flange gasket and thermostat.
5. Clean and inspect thermostat flange and housing.

C. THERMOSTAT TESTING

1. Suspend thermostat in a pan of clean water. Thermostat must be completely immersed but not touching bottom of pan.

2. Heat water gradually and stir so heat is evenly distributed.

CAUTION

Check temperature of water with a reliable thermometer. Do not overheat.

3. Observe thermostat as temperature of the water increases. If the thermostat is functioning properly, it should begin to open between 175 to 182° F. and be fully open at 202° F. The amount of travel between open and closed positions of the thermostat should be a minimum of .260".

4. The thermostat is not adjustable. If it does not operate within the above limits it must be replaced.

D. THERMOSTAT INSTALLATION

1. Install thermostat in thermostat housing, with arrow stamped on thermostat pointing up.

2. Using new outlet flange gasket; position it on top of the thermostat housing.

3. Inspect water outlet flange and clean if necessary.

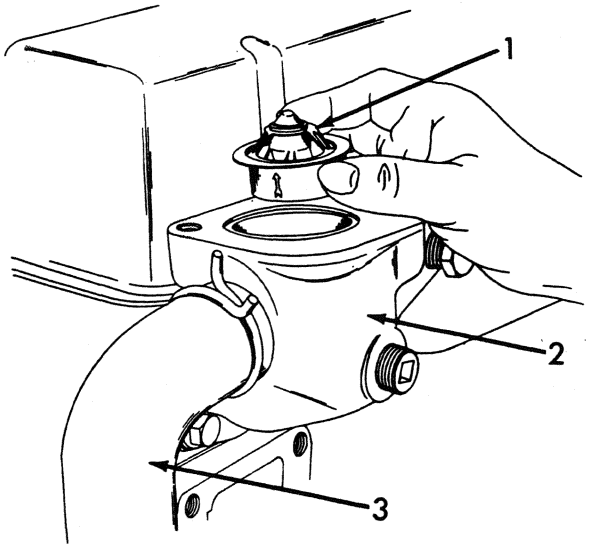


Fig. 4 -- Installing Thermostat (T-51267)

1. Thermostat
2. Thermostat Housing
3. Bypass Hose

4. Position water outlet flange on thermostat housing and secure with lockwashers and capscrews. Tighten capscrews to a torque of 44 to 49 lbs. Ft.

5. Refill cooling system.

TOPIC 5—OIL COOLER (First Type)

A. GENERAL

The oil cooler, located on the right side of the engine, consists of two corrosion resistant cores and tanks bolted to the water inlet connection and lower water connection which are bolted to the cylinder block. The smaller core and tank assembly cools the engine oil and the larger core and tank assembly cools the transmission oil. The water pump circulates coolant through the cooling core tubes and the engine and transmission oil circulates through its respective tank.

IMPORTANT

It is absolutely necessary that the oil cooler be kept clean for proper oil cooling.

B. OIL COOLER REMOVAL AND DISASSEMBLY

IMPORTANT

On engines equipped with an engine oil cooler, a plug is used in the oil gallery in the cylinder block. If for any reason, the engine is to be run with the engine oil cooler removed, this plug must be removed in order to obtain proper oil circulation in the engine.

1. Drain cooling system. Remove pipe plug from lower water connection and allow oil cooler to drain.

2. Disconnect transmission-to-oil cooler inlet and outlet lines from the oil cooler.

3. Disconnect engine throttle control rod from fuel injection pump.

4. Disconnect turbocharger oil drain line.

5. Remove lubricating oil filter closest to oil cooler.

6. Remove capscrews attaching water inlet connection and lower water connection to cylinder block.

7. Pull or tap oil cooler toward rear of engine until the water pump-to-oil cooler tube is free

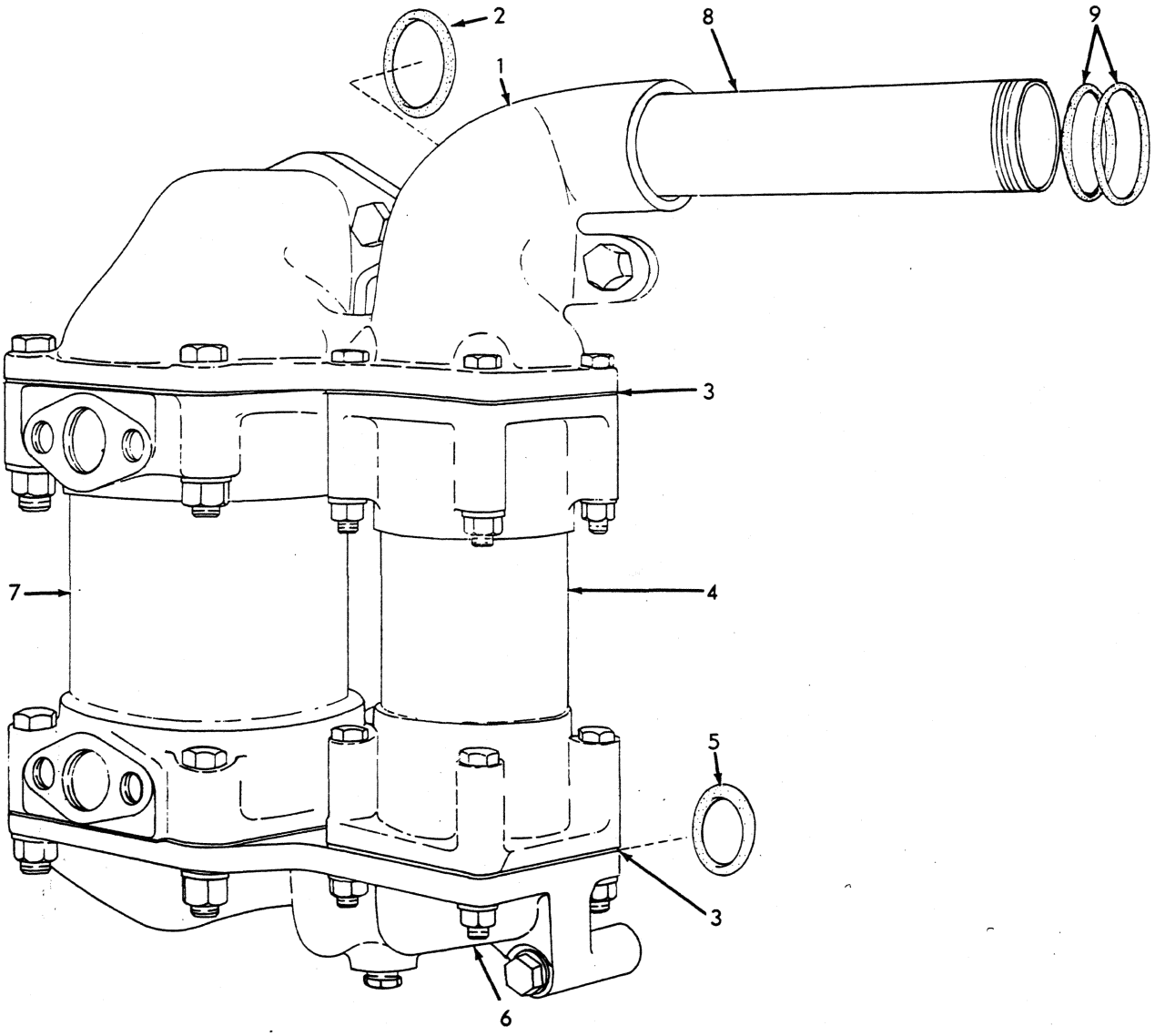


FIG. 5 OIL COOLER (First type)
(T-42365)

1. Water Inlet Connection
2. Water Outlet-to-Cylinder Block O-Ring
3. Gasket
4. Engine Oil Cooler
5. Engine Oil O-Ring
6. Lower Water Connection
7. Transmission Oil Cooler
8. Water Pump-to-Oil Cooler Tube
9. O-Rings (1 used on each end eff. engine S/N 3D-10699)

and remove oil cooler assembly from the engine.

8. Remove nuts, lockwashers, and capscrews attaching oil cooler tanks to the water inlet connection and the lower water connection and separate the oil cooler components.

C. OIL COOLER CLEANING

To function efficiently the oil cooler tank and core must be kept as clean as possible. Scale and sludge deposits reduce the cooling capacity of the oil cooler. Whenever an oil cooler is removed from the engine or if the efficiency of the cooler is impaired due to an accumulation of sludge or scale the oil cooler should be cleaned.

In many repair shops and service departments, caustic compounds are used to clean grease, dirt, paint, gasket remnants, etc., off parts. These compounds are very effective and very useful when used properly, but can cause considerable damage to certain materials.

Materials such as aluminum, rubber, fiber, sintered bronze and bonding agents are particularly sensitive to all highly concentrated caustic cleaners. There are many of these cleaning compounds on the market, under various trade names, but the majority of them are based on the same active agent - sodium hydroxide. Steam "jenny" compounds also generally contain this agent.

Some current oil coolers and radiators are being manufactured with aluminum fins. A few cleaning solutions have been found to react with aluminum to the extent of dissolving the metal.

We recommend that Trichlorethylene solvent or equivalent be used for both internal and external cleaning of oil coolers and radiators used in "Allis-Chalmers" units since there is no reaction between the aluminum and the solvent.

CAUTION

Trichlorethylene solvent is toxic and very volatile. Use only in a well ventilated room or area. Do not inhale the fumes for any length of time.

In all cleaning operations care should be taken in the selection of cleaning materials. When any doubt exists as to whether or not caustic compounds would damage the materials to be cleaned, the use of such compounds should be avoided.

After oil cooler is cleaned it should be tested. For test procedure refer to "Oil Cooler Testing" in this Section.

D. OIL COOLER TESTING

Before testing the oil cooler, it must be cleaned thoroughly and inspected. To test the oil cooler, proceed as follows:

1. Make up two suitable improvised plates, one with a drilled and tapped hole to accept an air hose fitting, and secure them with C clamps to cover the oil inlet and outlet openings in the side of the oil cooler. Use the O-rings to seal the plates.

2. Attach an air hose to the drilled and tapped plate; submerge the oil cooler in hot water for a sufficient length of time until the oil cooler is up to approximately 150° F temperature. Test for leaks with air pressure of 200 PSI or as near to that pressure as possible.

3. Air bubbles observed at either open end of the oil cooler indicates that the cooling core has a puncture or may be defective in another way. If the cooling core is faulty, the oil cooler must be replaced. If repair of the tank is necessary, the repair should be made by a reputable radiator repair shop.

E. OIL COOLER ASSEMBLY AND INSTALLATION

It is recommended that the oil cooler be assembled on a flat surface such as a surface plate. The machined surfaces, which contact the cylinder block, must be in the same plane within .005" when the oil cooler is assembled. If a surface plate is not available, use the following procedure:

1. Using new gaskets, assemble water inlet connection and lower water connection to the oil cooler tanks. Do not tighten nuts and capscrews to full torque at this time; leave them loose enough so components can shift when tapped with a soft hammer.

   The transmission oil cooler must be assembled with the identification pad to the bottom. The engine oil cooler must be assembled with the notch, cast into the cooler flange, to the bottomed aligned with the notch cast into the lower water connection.

IMPORTANT

Earlier model engines did not have the cast notches and one end of the engine oil cooler was marked TOP. This cooler must be assembled with the end marked top to the bottom when the cooler assembly is installed on the engine.

2. Clean all mounting surfaces thoroughly.

3. Position oil cooler assembly on the cylinder block; install the attaching capscrews and lockwashers and tighten securely.

4. Tap the engine oil cooler with a soft hammer until the oil inlet and outlet surfaces of the oil cooler are parallel with the machined surfaces on the cylinder block. A feeler gauge may be used to determine this.

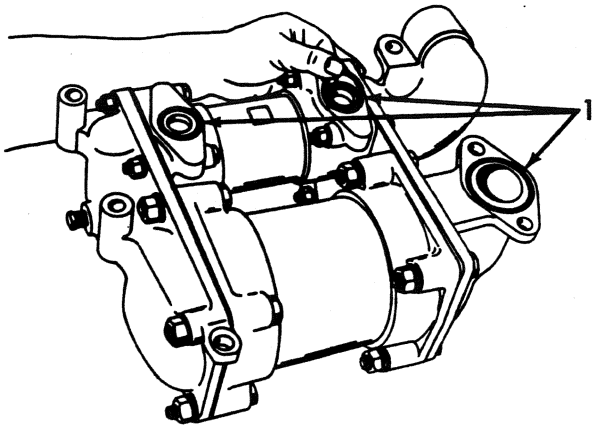


Fig. 6 -- Installing O-rings in Oil Cooler Assembly
(T-51745)

1. O-rings

5. After the oil cooler has been properly aligned, tighten the nuts and capscrews attaching the oil coolers to the water inlet connection and lower water connection.

6. Remove the oil cooler assembly from the engine and place it on a flat surface such as a piece of glass. Using a feeler gauge check to see if all machined surfaces contact the glass within the .005" maximum allowable clearance.

7. Install new O-rings on the water pump-to-oil cooler tube and install one end of the tube in the water pump.

8. Install new O-rings in the oil cooler assembly, Fig. 6, and install the oil cooler by a direct reversal of the removal procedure.

9. Fill cooling system.

10. Operate engine and check for oil and water leaks at oil cooler connections. Correct any leaks found. Stop engine and check crankcase oil level in oil pan;add oil as necessary to raise oil level to the full mark on the dipstick. Check coolant level in the radiator and add coolant if necessary.

TOPIC 5A - OIL COOLER (Second Type)

A. GENERAL

The oil cooler, Fig. 6a, located on side of engine, consists of a removable type bundle of corrosion resistant cooling tubes. The water pump circulates coolant through the engine oil cooler tubes and also through coolant tubes of the transmission oil cooler and back to cylinder block.

B. OIL COOLER REMOVAL AND DISASSEMBLY

IMPORTANT: On engine equipped with an oil cooler a plug is used in the oil gallery in the cylinder block. If for any reason, the engine is to be run with the engine oil cooler removed, this plug must be removed in order to obtain proper oil circulation in the engine.

1. Drain cooling system. Open drain cock, Fig. 6c (8) located at bottom of transmission oil cooler and allow coolers to drain.

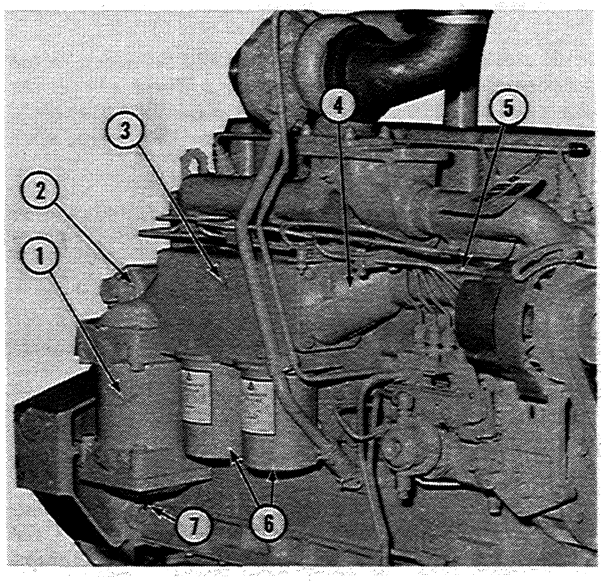
2. Disconnect transmission-to-oil cooler inlet and outlet lines from the oil cooler; identify each line for installation.

3. Disconnect engine throttle control rod from fuel injection pump. Remove capscrew attaching fuel injection lines clamp plate to cooler housing.

4. Remove turbocharger oil supply and drain lines.

5. Remove oil filter closest to fuel injection pump to reach mounting capscrews.

6. Remove capscrews attaching oil cooler housing, Fig. 6b, and transmission oil cooler, Fig. 6c, to cylinder block.



T-76992

FIG. 6a OIL COOLER

1. Transmission oil cooler
2. Cooler elbow
3. Housing assembly
4. Water inlet adapter
5. Water inlet tube from pump
6. Oil filters
7. Drain cock

7. Pry cooler assemblies loose from block and move to rear until it is free of water inlet tube or water pump volute and remove from engine.

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