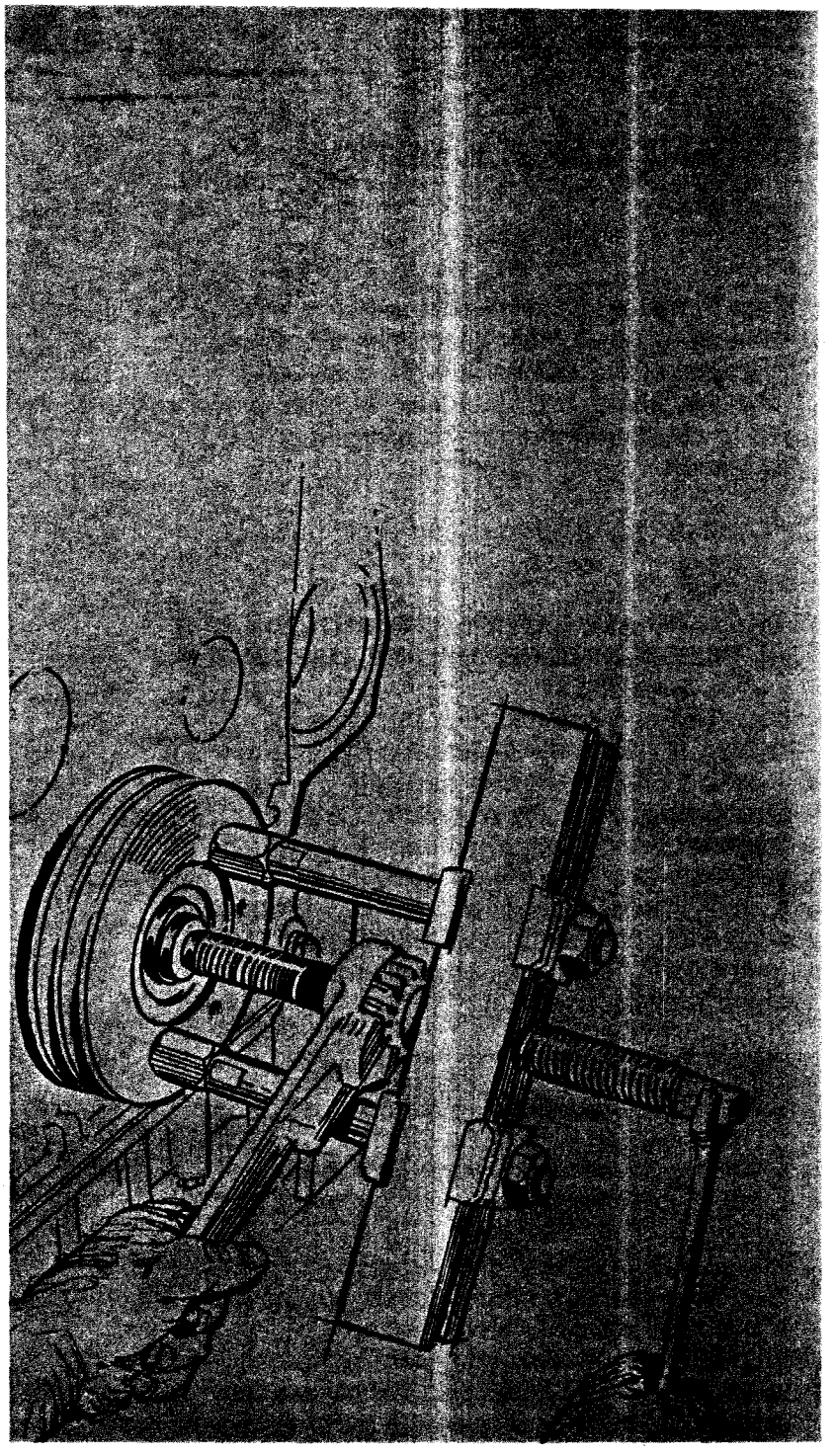
FORM NO. SENR2765
FOR USE IN SERVICE MANUAL:
613C Wheel Tractor-Scraper
FORM NO. SENR2760



DISASSEMBLY AND ASSEMBLY

3208 VEHICULAR ENGINE FOR 613C WHEEL TRACTOR

SERIAL NUMBERS:
79V

IMPORTANT SAFETY NOTICE

Proper repair is important to the safe and reliable operation of a machine. This Service Manual outlines basic recommended procedures, some of which require special tools, devices or work methods. Although not necessarily all inclusive, a list of additional skills, precautions and knowledge required to safely perform repairs is provided in the SAFETY section of this Manual.

Improper repair procedures can be dangerous and could result in injury or death.

READ AND UNDERSTAND ALL SAFETY PRECAUTIONS AND WARNINGS BEFORE PERFORMING REPAIRS ON THIS MACHINE

Basic safety precautions, skills and knowledge are listed in the SAFETY section of this Manual and in the descriptions of operations where hazards exist. Warning labels have also been put on the machine to provide instructions and identify specific hazards which if not heeded could cause bodily injury or death to you or other persons. These labels identify hazards which may not be apparent to a trained mechanic. There are many potential hazards during repair for an untrained mechanic and there is no way to label the machine against all such hazards. These warnings in the Service Manual and on the machine are identified by this symbol:

⚠ WARNING

Operations that may result only in machine damage are identified by labels on the machine and in the Service Manual by the word **NOTICE**.

Caterpillar cannot anticipate every possible circumstance that might involve a potential hazard. The warnings in this Manual are therefore not all inclusive. If a procedure, tool, device or work method not specifically recommended by Caterpillar is used, you must satisfy yourself that it is safe for you and others. You should also ensure that the machine will not be damaged or made unsafe by the procedures you choose.

IMPORTANT

The information, specifications and illustrations in this book are on the basis of information available at the time it was written. The specifications, torques, pressures of operation, measurements, adjustments, illustrations and other items can change at any time. These changes can affect the service given to the product. Get the complete and most current information before you start any job. Caterpillar Dealers have the most current information which is available. For a list of the most current modules and form numbers available for each Service Manual, see the SERVICE MANUAL CONTENTS MICROFICHE REG1139F.

⚠ WARNING

SAFETY

⚠ WARNING

The proper and safe lubrication and maintenance procedures for this machine, recommended by Caterpillar, are outlined in the LUBRICATION & MAINTENANCE GUIDE for this machine.

Improper performance of lubrication or maintenance procedures is dangerous and could result in injury or death. Read and understand the LUBRICATION & MAINTENANCE GUIDE before performing any lubrication or maintenance.

Do not operate this machine unless you have read and understand the instructions in the OPERATOR'S GUIDE. Improper machine operation is dangerous and could result in injury or death.

The serviceman or mechanic may be unfamiliar with many of the systems on this machine. This makes it important to use caution when performing service work. A knowledge of the system and/or component is important before the removal or disassembly of any component.

Because of the size of some of the machine components, the serviceman or mechanic should check the weights noted in this Manual. Use proper lifting procedures when removing any components.

Following is a list of basic precautions that should always be observed.

1. Read and understand all Warning plates and decals on the machine before operating, lubricating or repairing the machine.

2. Always wear protective glasses and protective shoes when working around machines. In particular, wear protective glasses when pounding any part of the machine or its attachments with a hammer or sledge. Use welders gloves, hood/goggles, apron and other protective clothing appropriate to the welding job being performed. Do not wear loose-fitting or torn clothing. Remove all rings from fingers when working on machinery.

3. Disconnect battery and discharge any capacitors before starting to work on machine. Hang "Do Not Operate" tag in the Operator's Compartment.

4. If possible, make all repairs with the machine parked on a level, hard surface. Block machine so it does not roll while working on or under machine.

5. Do not work on any machine that is supported only by lift jacks or a hoist. Always use blocks or jack stands to support the machine before performing any disassembly.

6. Relieve all pressure in air, oil or water systems before any lines, fittings or related items are disconnected or removed. Always make sure all raised components are blocked correctly and be alert for possible presssure when disconnecting any device from a system that utilizes pressure.

7. Lower the bucket, blade, ripper or other implements to the ground before performing any work on the machine. If this can not be done, make sure the bucket, blade, ripper or other implement is blocked correctly to prevent it from dropping unexpectedly.

8. Use steps and grab handles when mounting or dismounting a machine. Clean any mud or debris from steps, walkways or work platforms before using. Always face machine when using steps, ladders and walkways. When it is not possible to use the designed access system, provide ladders, scaffolds, or work platforms to perform safe repair operations.

⚠ WARNING

9. To avoid back injury, use a hoist when lifting components which weigh 50 lb. (23 kg) or more. Make sure all chains, hooks, slings, etc., are in good condition and are in the correct capacity. Be sure hooks are positioned correctly. Lifting eyes are not to be side loaded during a lifting operation.

10. To avoid burns, be alert for hot parts on machines which have just been stopped and hot fluids in lines, tubes and compartments.

11. Be careful when removing cover plates. Gradually back off the last two bolts or nuts located at opposite ends of the cover or device and pry cover loose to relieve any spring or other pressure, before removing them completely.

12. Be careful when removing filler caps, breathers and plugs on the machines. Hold a rag over the cap or plug to prevent being sprayed or splashed by liquids under pressure. The danger is even greater if the machine has just been stopped because fluids can be hot.

13. Use only the recommended tools which are listed for a specific procedure. Be sure the tools are in good conditon and that you fully understand how to use them before performing any service work. Failure to use the listed tools can cause damage to components or serious personal injury or death.

14. Reinstall all fasteners with same part number. Do not use a lesser quality fastener if replacements are necessary.

15. Repairs which require welding should be performed only with the benefit of the appropriate reference information and by personnel adequately trained and knowledgeable in welding procedures. Make reference to "Techniques of Structural Repair Course" form number JEG03719. Determine type of metal being welded and select correct welding procedure and electrodes, rods or wire to provide a weld metal strength equivalent at least to that of parent metal.

16. Do not damage wiring during removal operations. Reinstall the wiring so it is not damaged nor will it be damaged in operation by contacting sharp corners, or by rubbing against some object or hot surface. Do not connect wiring to a line containing fluid.

17. Be sure all protective devices including guards and shields are properly installed and functioning correctly before starting a repair. If a guard or shield must be removed to perform the repair work, use extra caution.

18. Always use lift arm supports to keep bucket arms raised and bucket tilted down when maintenance or repair work is performed which requires the bucket in the raised position.

19. Loose or damaged fuel, lubricant and hydraulic lines, tubes and hoses can cause fires. Do not bend or strike high pressure lines or install ones which have been bent or damaged. Inspect lines, tubes and hoses carefully. Do not check for leaks with your hands. Pin hole (very small) leaks can result in a high velocity oil stream that will be invisible close to the hose. This oil can penetrate the skin and cause personal injury. Use cardboard or paper to locate pin hole leaks.

20. Tighten connections to the correct torque. Make sure that all heat shields, clamps and guards are installed correctly to avoid excessive heat, vibration or rubbing against other parts during operation. Shields that protect against oil spray onto hot exhaust components in event of a line, tube or seal failure must be installed correctly.

⚠ WARNING

21. Do not operate a machine if any rotating part is damaged or contacts any other part during operation. Any high speed rotating component that has been damaged or altered should be checked for balance before reusing.

22. On track-type machines, be careful when servicing or separating tracks. Chips can fly when removing or installing a track pin. Wear safety glasses. Track can unroll very quickly when separated. Keep away from front and rear of machine. The machine can move unexpectedly when both tracks are disengaged from the sprockets. Block the machine to prevent it from moving.

23. Caution should be used to avoid breathing dust that may be generated when handling components containing asbestos fibers. If this dust is inhaled, it can be hazardous to your health. Components in Caterpillar products that contain asbestos fibers are brake pads, brake band and lining assemblies, clutch plates and some gaskets. The asbestos used in these components is usually bound in a resin or sealed in some way. Normal handling is not hazardous as long as airborne dust which contains asbestos is not generated.

If dust which may contain asbestos is present, there are several common sense guidelines that should be followed.

a. Never use compressed air for cleaning.

b. Use vacuum or wet methods for cleanup.

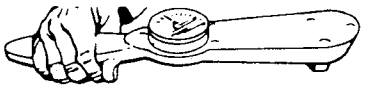
c. Use exhaust ventilation on permanent machining jobs.

d. Wear an approved respirator if there is no other way to control the dust.

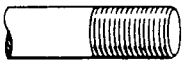
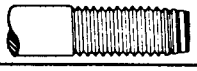
e. Follow environmental rules and regulations for disposal of asbestos.

f. Avoid areas where asbestos particles may be in the air.

GENERAL TIGHTENING TORQUE FOR BOLTS AND NUTS



The following charts give the standard torque values for bolts, nuts and taperlock studs of SAE Grade 5 or better quality. Exceptions are given in other sections of the Service Manual where needed.

THREAD DIAMETER		STANDARD TORQUE	
inches	**millimeters**	**lb. ft.**	**N·m**
Standard thread 		**Use these torques for bolts and nuts with standard threads.**	
1/4	6.35	9 ± 3	12 ± 4
5/16	7.94	18 ± 5	24 ± 7
3/8	9.53	32 ± 5	43 ± 7
7/16	11.11	50 ± 10	68 ± 14
1/2	12.70	75 ± 10	100 ± 14
9/16	14.29	110 ± 15	150 ± 20
5/8	15.88	150 ± 20	205 ± 27
3/4	19.05	265 ± 35	360 ± 47
7/8	22.23	420 ± 60	570 ± 80
1	25.40	640 ± 80	870 ± 110
1-1/8	28.58	800 ± 100	1085 ± 135
1-1/4	31.75	1000 ± 120	1355 ± 165
1-3/8	34.93	1200 ± 150	1625 ± 205
1-1/2	38.10	1500 ± 200	2035 ± 270
		Use these torques for bolts and nuts on hydraulic valve bodies with standard threads.	
5/16	7.94	13 ± 2	18 ± 3
3/8	9.53	24 ± 2	33 ± 3
7/16	11.11	39 ± 2	53 ± 3
1/2	12.70	60 ± 3	80 ± 4
5/8	15.88	118 ± 4	160 ± 5
Taperlock stud 		**Use these torques for studs with Taperlock threads.**	
1/4	6.35	5 ± 2	7 ± 3
5/16	7.94	10 ± 3	14 ± 4
3/8	9.53	20 ± 3	27 ± 4
7/16	11.11	30 ± 5	40 ± 7
1/2	12.70	40 ± 5	55 ± 7
9/16	14.29	60 ± 10	80 ± 14
5/8	15.88	75 ± 10	100 ± 14
3/4	19.05	110 ± 15	150 ± 20
7/8	22.23	170 ± 20	230 ± 27
1	25.40	260 ± 30	355 ± 40
1-1/8	28.58	320 ± 30	435 ± 40
1-1/4	31.75	400 ± 40	540 ± 55
1-3/8	34.93	480 ± 40	650 ± 55
1-1/2	38.10	550 ± 50	745 ± 68

T95416-8

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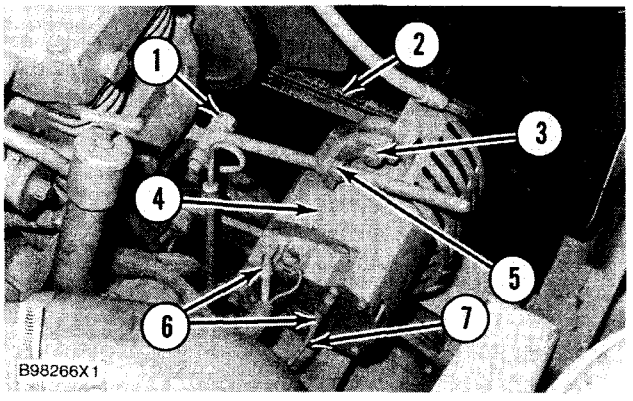
⚠ WARNING

Disconnect batteries before performance of any service work.

Alternator

Remove And Install Alternator 1405-010

1. Raise the hood.



2. Put identification marks on alternator wiring (6), and disconnect them from the alternator.

3. Loosen adjustment rod nut (5) and bolt (1). Remove V-belts (2) from the alternator pulley.

4. Remove bolts (3), (7) and alternator (4).

5. Inspect the V-belts for wear, and make necessary replacements. If a new pulley has been installed on alternator (4), tighten the nut that holds it to a torque of 100 ± 7 N•m (75 ± 5 lb.ft.).

6. See Specification, Form No. SENR2763, for alternator output specifications.

NOTE: The following steps are for the installation of the alternator.

7. Install alternator (4) on its mounting bracket.

8. Install V-belts (2) on the alternator pulley.

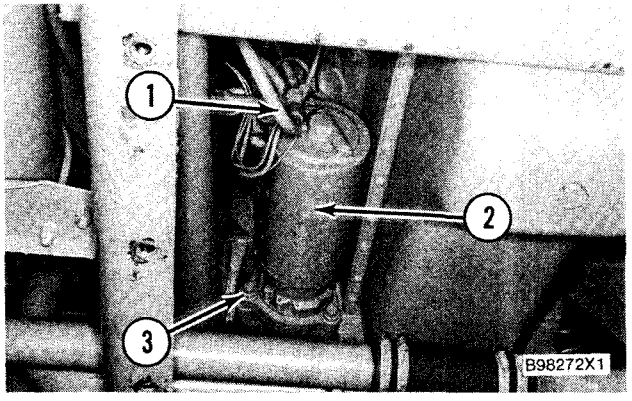
9. Tighten the nut on adjustment rod (5) to make an adjustment of belts (2). Measure the outside belt toward the radiator, with a belt tension gauge such as Borroughs Tool Company Part No. BT-33-96-4-16 or an equivalent. The correct gauge indication is 120 ± 5. For more information, see V-belt Tension Chart in Specification.

10. Install alternator wiring (6).

11. Lower the hood.

Electric Starter Motor

Remove And Install Electric Starter Motor 1453-010



1. Put identification marks on all wires (1), and disconnect the wires from the starter motor.

2. Remove three starter mounting bolts (3). Use two persons to remove starter (2). The weight of the starter is approximately 26 kg (57 lb.).

3. See Specifications, Form No. SENR2763, to check the solenoid and starter specifications.

4. Make a replacement of the starter gasket, and install starter (2).

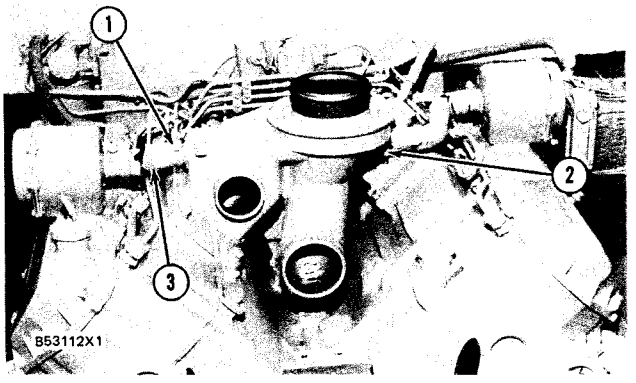
5. Connect all wires (1) to the starter motor. Tighten the terminal nuts to a torque of 25 to 35 N•m (20 to 25 lb.ft.).

Air Inlet Manifold

Remove Air Inlet Manifold 1058-011

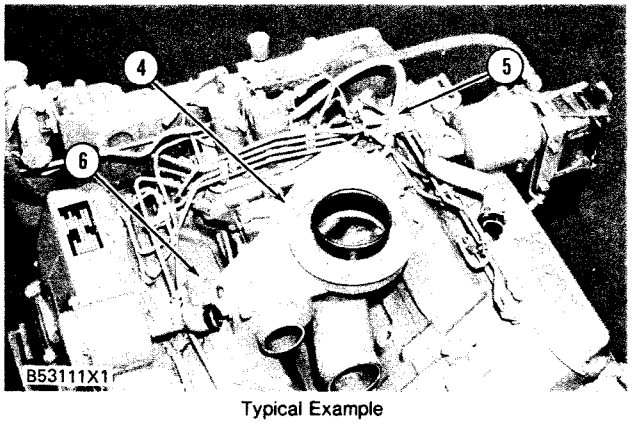
1. Remove the air cleaner assembly from the air inlet manifold.

2. Loosen the clamps that hold the air inlet manifold to the turbocharger.



Typical Example

3. Loosen clamps (1) and (2). Disconnect hoses (3) from the manifold.



Typical Example

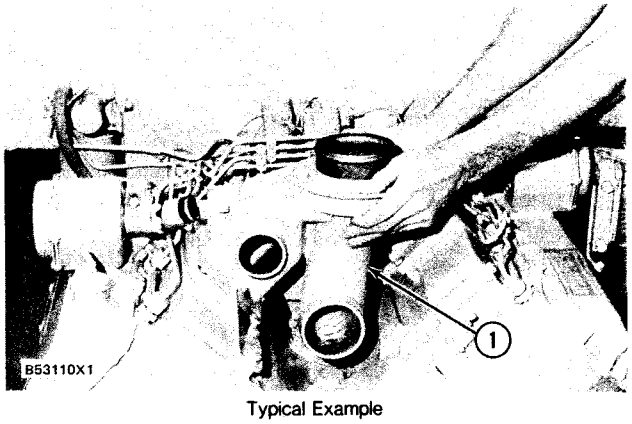
4. Remove seven bolts (6). Loosen one bolt (manifold has an opening [slot] in it for this bolt).

5. Disconnect fuel line (5).

6. Remove air inlet manifold (4) and its gaskets.

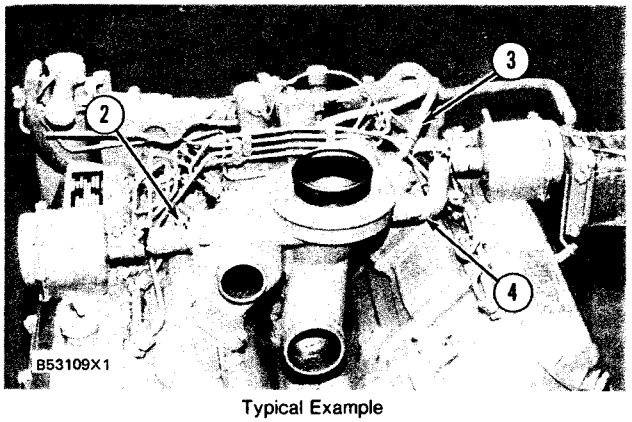
Air Inlet Manifold

Install Air Inlet Manifold 1058-012



Typical Example

1. Put air inlet manifold (1) in position on the cylinder block, and install the seven bolts that hold the manifold in place. Tighten the one bolt (one in manifold slot).



Typical Example

2. Connect fuel line (3) to the manifold.

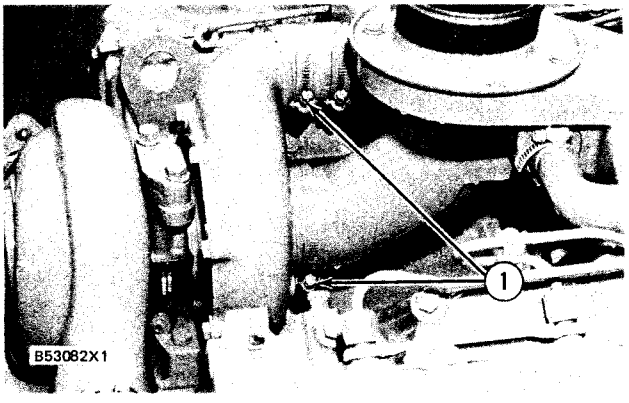
3. Connect hoses (4) to the manifold, and tighten clamps (2).

4. Tighten the clamps that hold the air inlet manifold to the turbocharger.

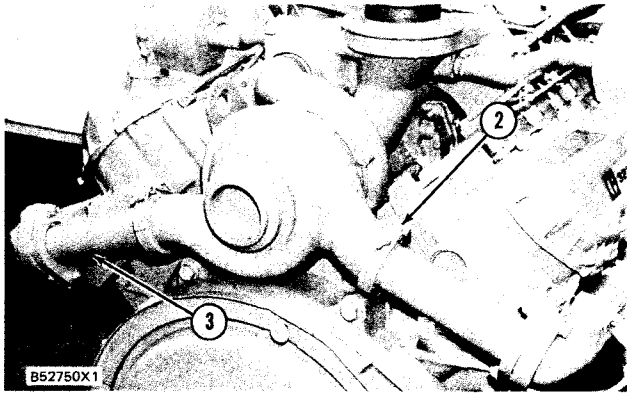
5. Install the air cleaner assembly on the air inlet manifold.

Turbocharger

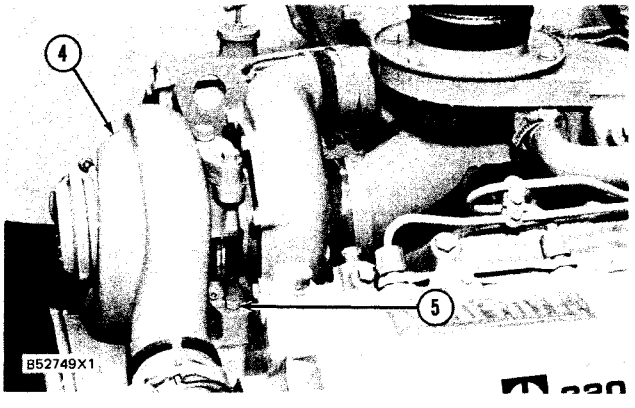
Remove Turbocharger 1052-011



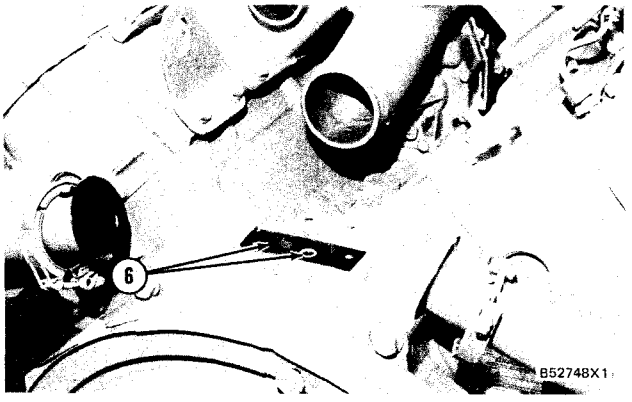
1. Loosen hose clamps (1) on the inlet manifold.



2. Loosen clamps (2), and slide them back on tubes (3).

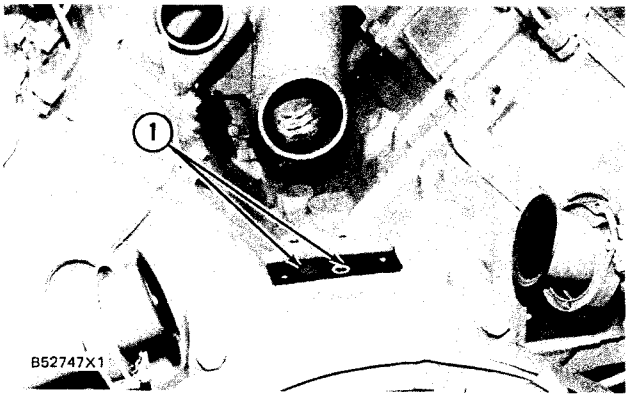


3. Remove two bolts (5); then remove turbocharger (4) from the cylinder block and inlet manifold.



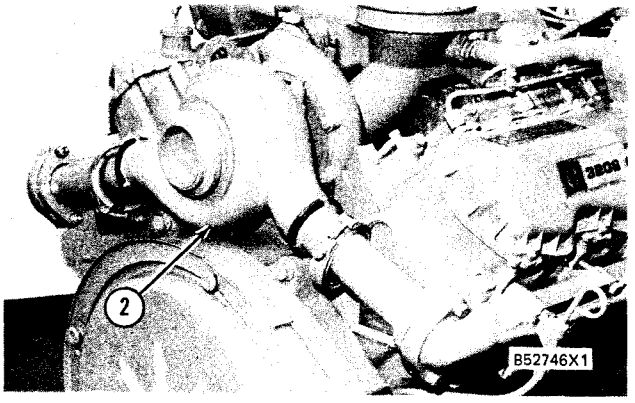
4. Remove the two O-ring seals (6) from the cylinder block.

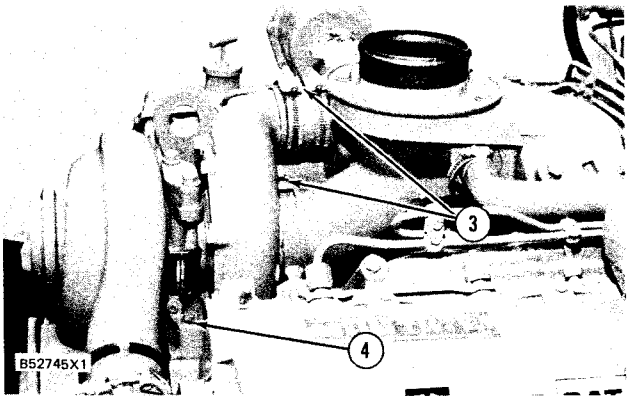
Install Turbocharger 1052-012



1. Inspect all O-ring seals for wear or damage. Put a small amount of clean engine oil on the O-ring seals.

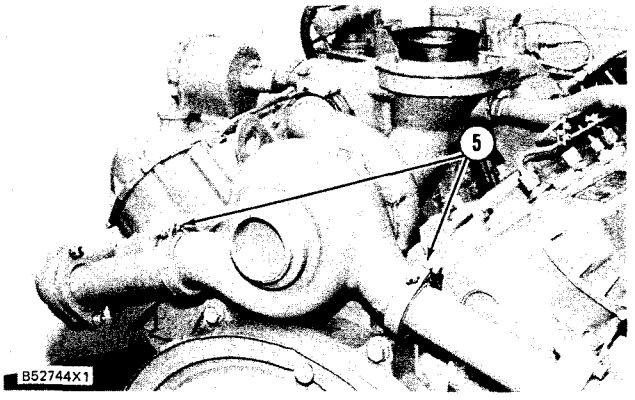
2. Put O-ring seals (1) in position in the cylinder block.





3. Put turbocharger (2) in position on the cylinder block, and install the two bolts (4) that hold it.

4. Tighten hose clamps (3) on the inlet manifold.



5. Put clamps (5) in position, and tighten them.

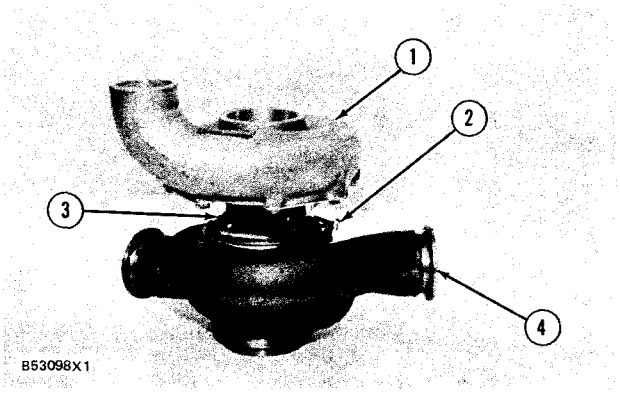
Turbocharger (AiResearch TM5101)

Disassemble Turbocharger (AiResearch TM5101) 1052-015

Tools Needed		A	B	C
9S6343	Fixture Assembly	1		
1P1863	Retaining Ring Pliers		1	
5S9566	T-Wrench			1

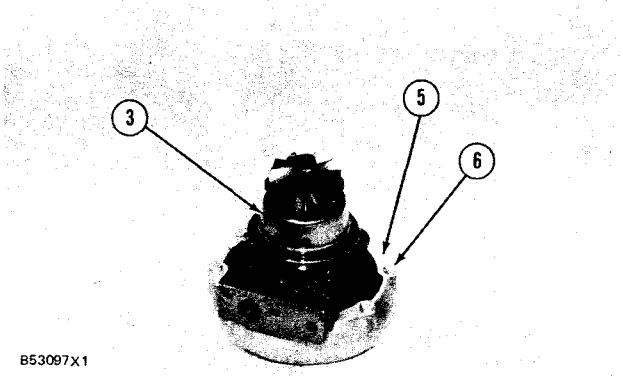
START BY:

a. remove turbocharger

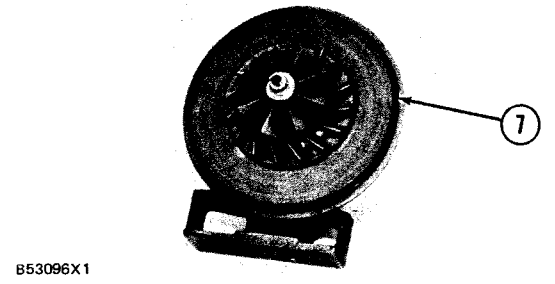


1. Make an alignment mark on compressor housing (1), cartridge assembly (3) and turbine housing (4) for correct installation.

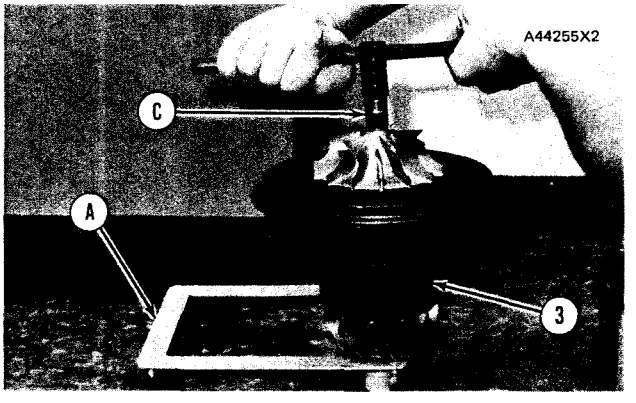
2. Loosen clamp assembly (2). Remove compressor housing (1) and cartridge assembly (3) from the turbine housing.



3. Remove bolts (6) and plates (5) that hold cartridge assembly in the compressor housing. Remove cartridge assembly (3).



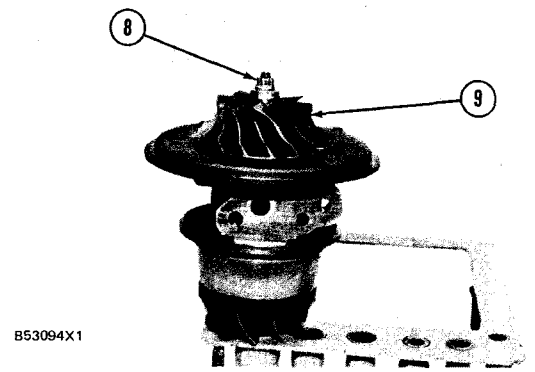
4. Remove O-ring seal (7) from the cartridge assembly.



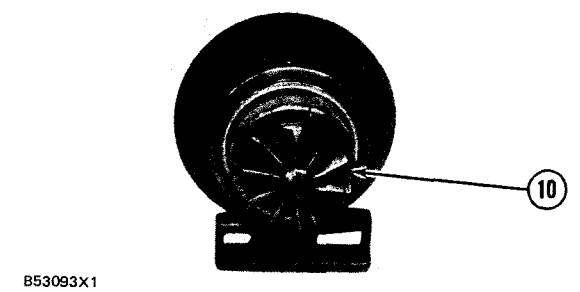
NOTICE

To prevent a bent shaft, do not put a side force on the turbine shaft when the compressor wheel nut is loosened.

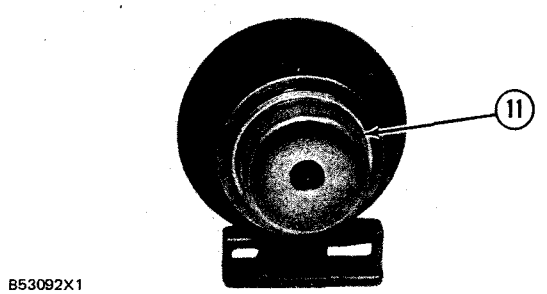
5. Put cartridge assembly (3) in position in tooling (A), and loosen the nut on the compressor wheel with tooling (C).



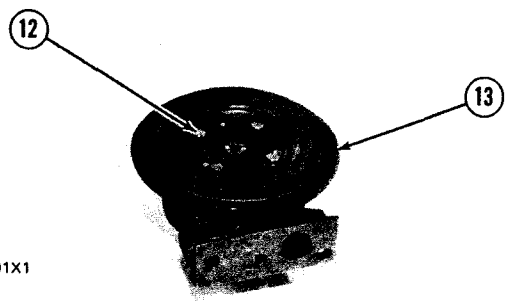
6. Remove nut (8) and compressor wheel (9).



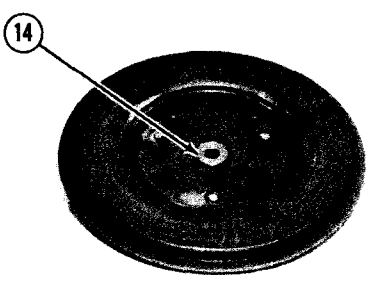
7. Remove shaft and wheel assembly (10) from the cartridge assembly.



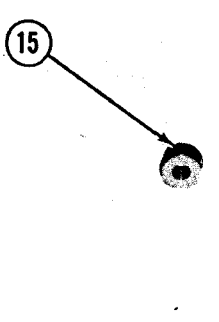
8. Remove shroud (11) from the cartridge assembly.



9. Remove four bolts (12); then remove backplate (13) from the cartridge assembly.

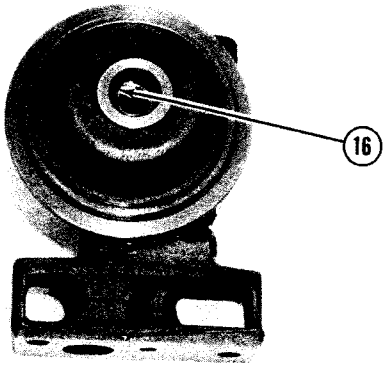


10. Remove spacer (14) from the backplate.

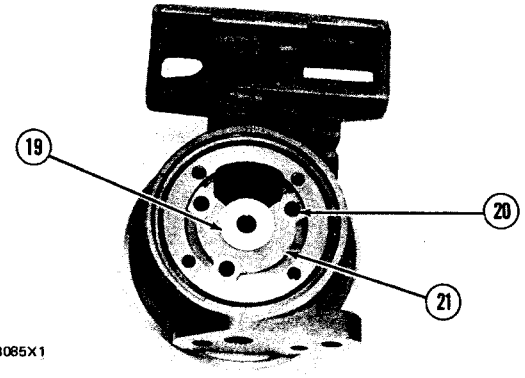


11. Remove two seal rings (15) from the spacer.

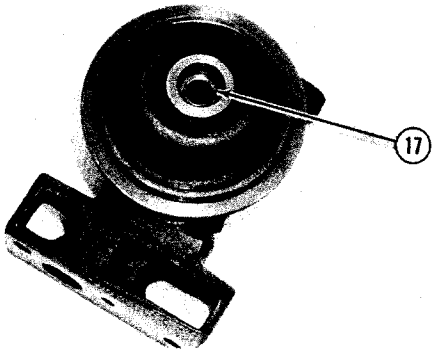
Turbocharger (AiResearch TM5101)



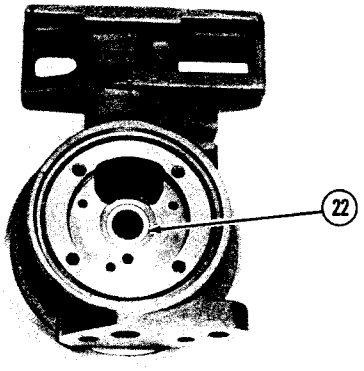
12. Remove snap ring (16) from the cartridge housing with tool (B).



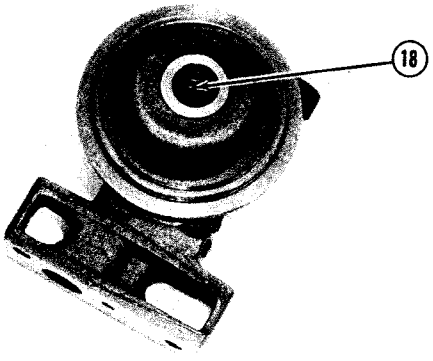
15. Turn the cartridge housing over; then remove screws (20), plate (21) and collar (19).



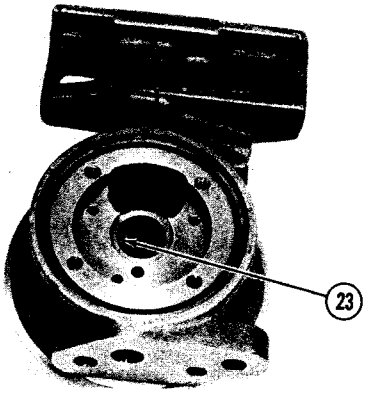
13. Remove bearing (17) and the rings from the cartridge housing.



16. Remove bearing (22) from the cartridge housing.



14. Remove snap ring (18) from the cartridge housing with tool (B).

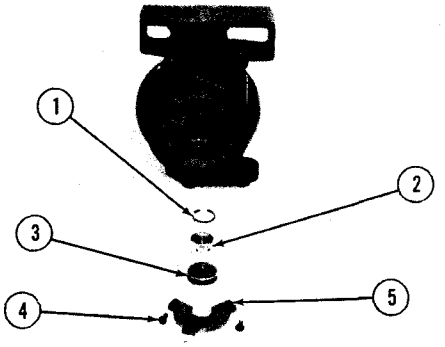


17. Remove snap ring (23) from the cartridge housing with tool (B).

Assemble Turbocharger (AiResearch TM5101) 1052-016

Tools Needed		A	B	C
1P1863	Retaining Ring Pliers	1		
9S6343	Cartridge Fixture		1	
8S2328	Dial Indicator Test Group			1

B53108X1

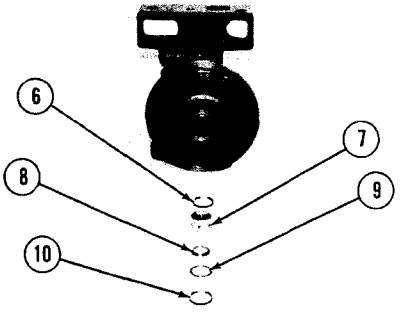


NOTE: Make sure all of the oil passages in the turbocharger cartridge housing are clean and free of dirt and foreign material. Put clean engine oil on all parts of the cartridge assembly.

1. Install snap ring (1) in the cartridge housing with tool (A).

NOTE: Make sure the oil hole in plate (5) is open and clean to prevent a bearing failure.

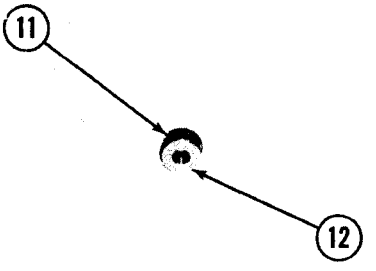
2. Install bearing (2), collars (3), plate (5) and screws (4). Tighten the screws to a torque of 2.5 ± 0.2 N•m (22 ± 2 lb.in.).



B53107X1

NOTE: Install the rings that hold the bearings in position with the round outside edges of the rings toward the bearings.

3. Turn the cartridge housing over. Install snap ring (6) in the cartridge housing with tool (A). Install bearing (7), ring (8) and ring (9) in the housing. Install snap ring (10) with tool (A).

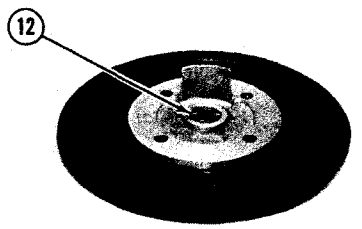


B53089X2

NOTE: Put 6V2055 High Vacuum Grease in the grooves for seal rings (11). Fill the grooves to one half or more of the depth all the way around the grooves.

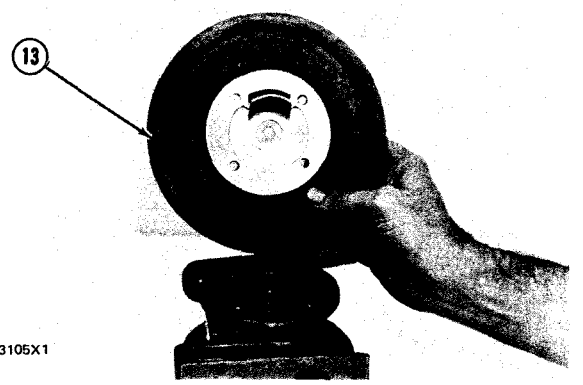
4. Install seal rings (11) on spacer (12).

Turbocharger (AiResearch TM5101)



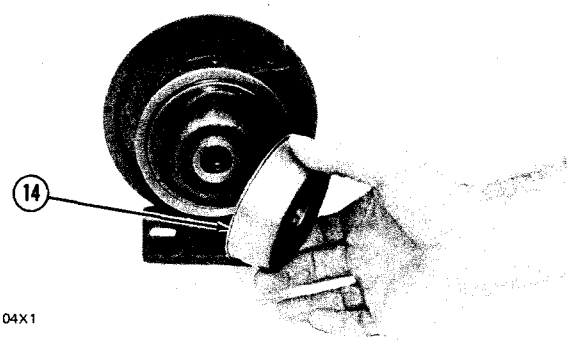
B53106X1

5. Install spacer (12) in the backplate.



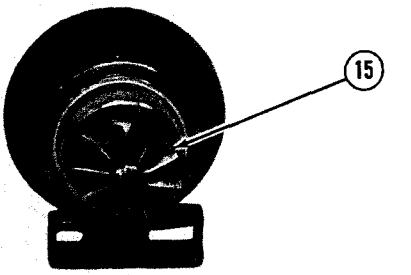
B53105X1

6. Put backplate (13) in position on the cartridge housing, and install the bolts that hold it. Tighten the bolts to a torque of 9.5 ± 1 N•m (84 ± 9 lb.in.).



B53104X1

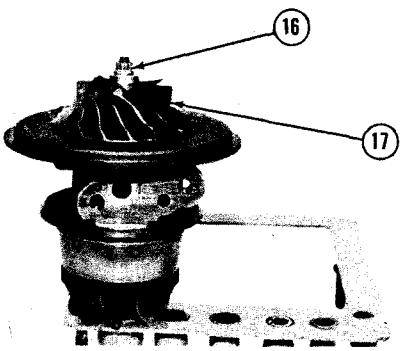
7. Put shroud (14) in position on the cartridge housing.



B53103X1

NOTE: Put 6V2055 High Vacuum Grease in the groove for the oil seal ring, on the shaft and wheel assembly (15).

8. Install shaft and wheel assembly (15) in the cartridge housing.



B53094X2

9. Put the cartridge assembly in position in tooling (B).

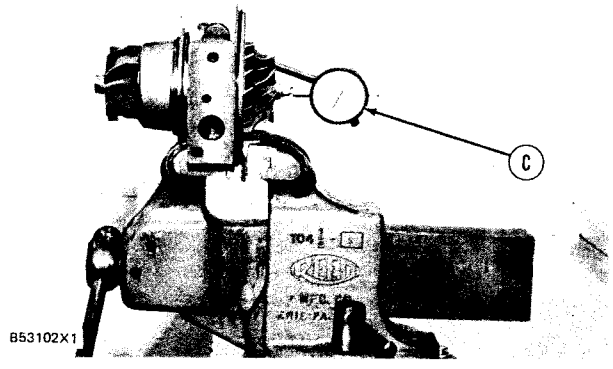
10. Put a small amount of clean engine oil on the wheel face that will be under the nut.

11. Put compressor wheel (17) in position on the shaft.

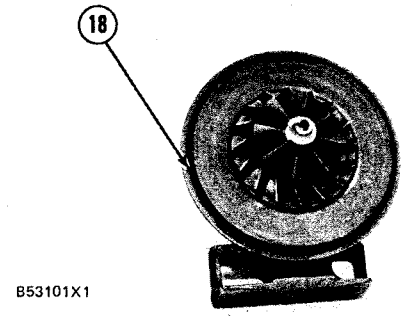
NOTICE

Do not put a side force on the shaft when the nut is tightened.

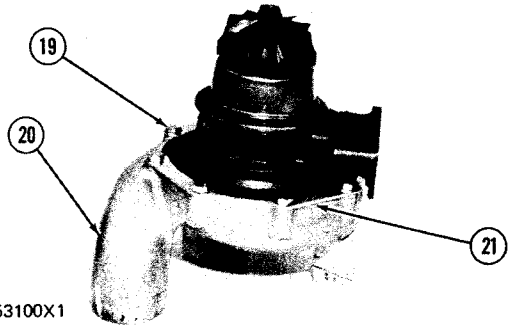
12. Install nut (16), and tighten it to a torque of 4 N•m (35 lb.in.). Tighten the nut 120° more.



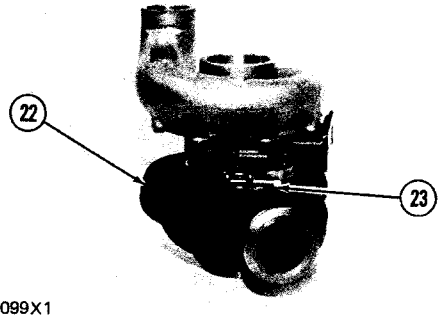
13. Put the cartridge assembly in a vise. Use tool group (C) to check end play. The end play must be 0.051 to 0.081 mm (.0020 to .0032 in.).



14. Put a small amount of clean engine oil on O-ring seal (18); then install it on the cartridge housing.



15. Put the cartridge housing on compressor housing (20), and install plates (21) and bolts (19).



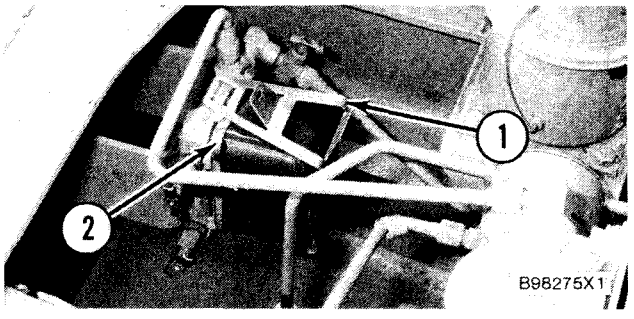
16. Put turbine housing (22) in position on the cartridge housing, and install clamp (23) that holds it. Tighten the clamp to a torque of 14 ± 1 N•m (120 ± 12 lb.in.).

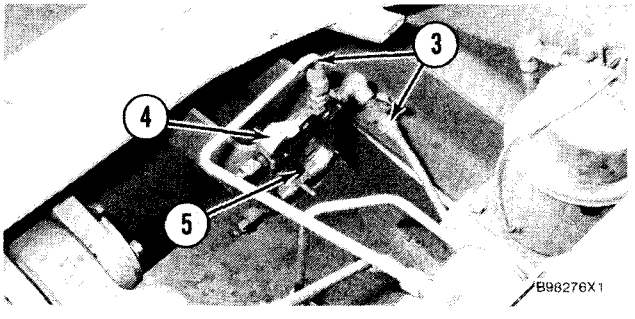
END BY:

a. install turbocharger.

Water Separator

Remove And Install Water Separator 1263-010





1. Remove the cover assembly from the rear of the scraper frame.

2. Shut off the fuel supply valve at the fuel tank. Drain the fuel from the water separator.

3. Remove clamp (1), bowl (2) and the element from the water separator base.

4. Disconnect fuel lines (3), and remove mounting bolts (5) and water separator base (4).

5. Install water separator base (4) on the scraper frame.

6. Connect fuel lines (3).

7. Install the element, bowl (2) and clamp (1).

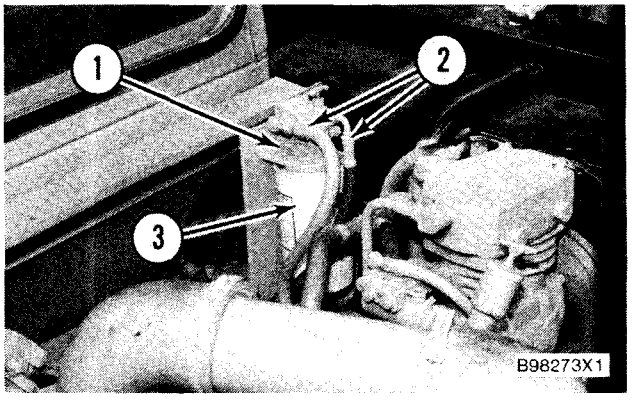
8. Turn on the fuel supply valve.

9. Install the cover assembly on the scraper frame.

Fuel Filter And Base

Remove And Install Fuel Filter And Base 1262-010

Tools Needed		A
2P8250	Strap Wrench	1



1. Use tool (A) to remove fuel filter (3) from the filter base.

2. Disconnect two fuel hose assemblies (2).

3. Remove the two bolts that fasten filter base (1) to the mounting bracket. Remove filter base (1).

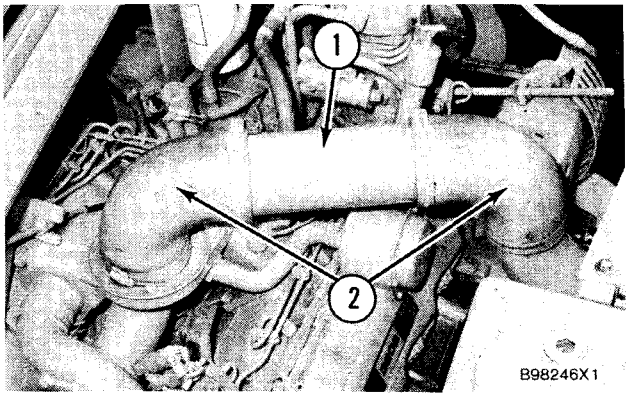
4. Install fuel filter base (1) on the mounting bracket.

5. Install hose assemblies (2). Install fuel filter (3) on the filter base per instructions on the filter.

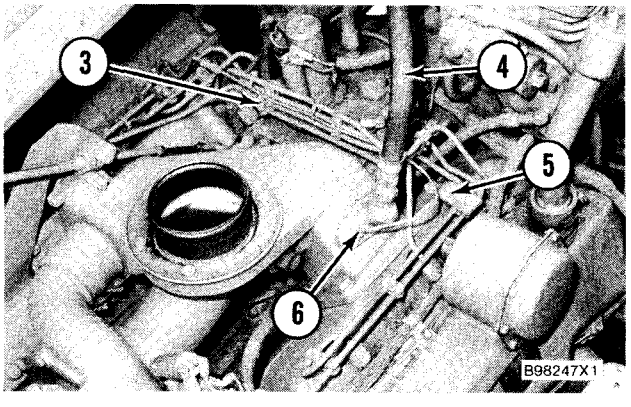
Fuel Injection Lines

Remove And Install Fuel Injection Lines 1252-010

Tools Needed		A
5P144	Socket	1



1. Loosen the hose clamps, and remove hoses (2) and tube (1) from between the air cleaner and the inlet manifold.



2. Disconnect tube assembly (6) and hose assembly (4) from the inlet manifold. Cut the nylon ties, and move tube assembly (6) from the fuel injection lines.

3. Remove the bolt that fastens bracket (5) to the inlet manifold.

4. Disconnect fuel injection lines group (3) from the fuel injection pump and adapters. Remove them as a unit.

NOTICE

Put protection caps (5F2807) and plugs (2F2990) on all lines and pumps to keep dirt and foreign material out of the fuel system.

5. Be sure the fuel injection lines are clean and dry. If a new fuel line group is used as a replacement, remove the identification tags from the lines. The tags can cause wear on the fuel injection lines.

6. Remove the plugs and caps from the fuel injection lines, pumps and adapters.

7. Put fuel injection lines (3) in position on the engine, and connect them to their pumps and adapters.

8. Make sure all fuel injection line nuts are tightened to a torque of 40 ± 7 N•m (30 ± 5 lb.ft.).

9. Install tube assembly (6) and hose assembly (4) to the inlet manifold.

10. Remove (bleed) the air from the fuel system.

11. Install hoses (2) and tube (1) between the air cleaner and inlet manifold.

Fuel Injection Pump Housing And Governor

Remove Fuel Injection Pump Housing And Governor 1286-011

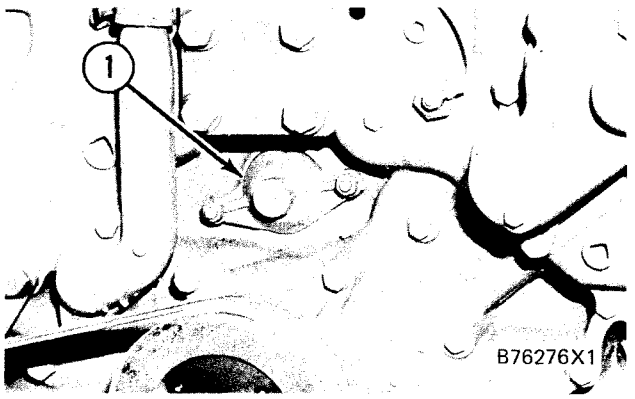
Tools Needed		A
6V4069	Body Group	1

START BY:

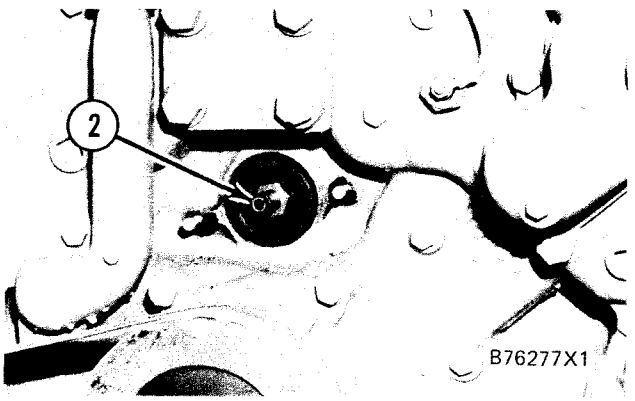
a. remove fuel injection lines

b. remove air inlet manifold

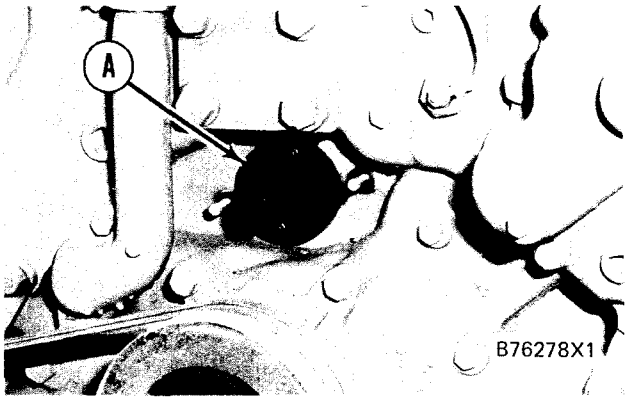
NOTE: The radiator and fan have been removed for photo purposes.



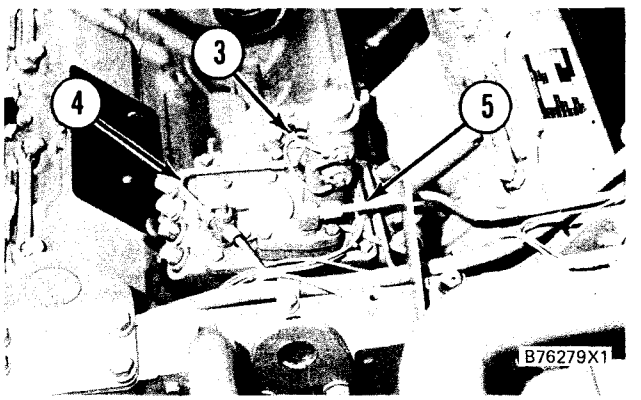
1. Remove the nuts, and remove adapter (1) from over the tachometer drive shaft.



2. Remove tachometer drive shaft (2) and the washer that hold the drive gear on the fuel injection pump camshaft.



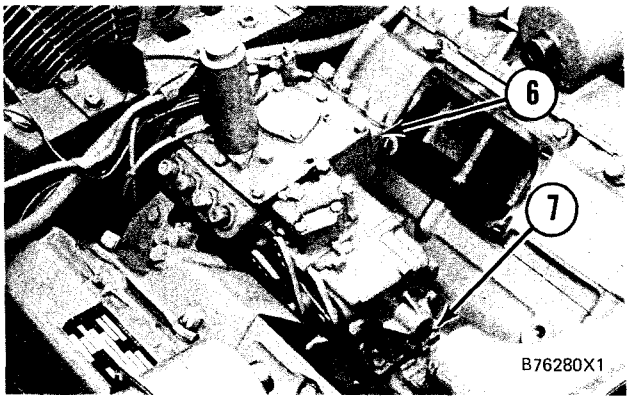
3. Install tool (A), and use it to loosen the drive gear on the fuel injection pump camshaft. Remove tool (A).



4. Disconnect wires (3) from the fuel shutoff solenoid.

5. Disconnect fuel supply tube (5) from the fuel injection pump housing.

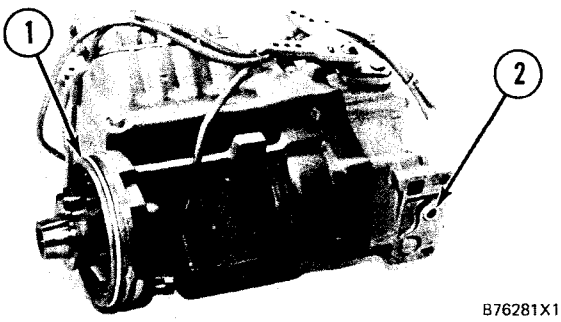
6. Remove fuel return tube (4) from the fuel injection pump housing and the engine.



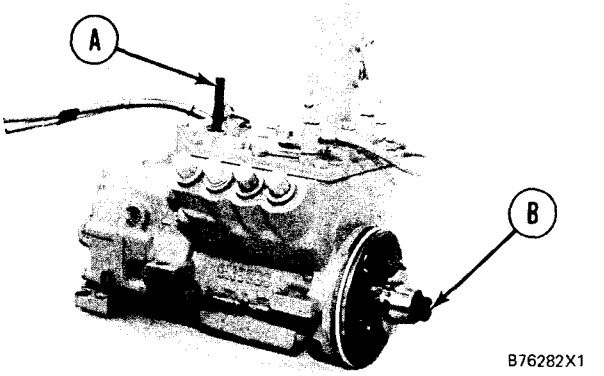
7. Remove two bolts (7), and remove fuel injection pump housing and governor (6) from the engine.

Install Fuel Injection Pump Housing And Governor 1286-012

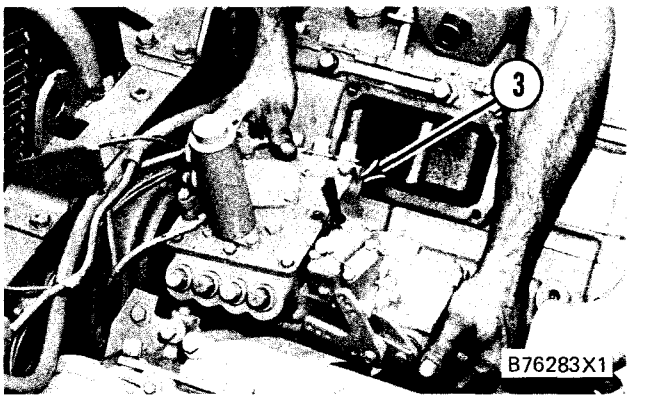
Tools Needed		A	B	C
3P1544	Pin	1		
S1603	Bolt [1/2"-20 NF x 1 1/2 in. (38 mm)]		1	
5P7307	Engine Turning Tool Group			1



1. Clean and inspect O-ring seals (1) and (2). Make a replacement of the seals if worn or damaged.

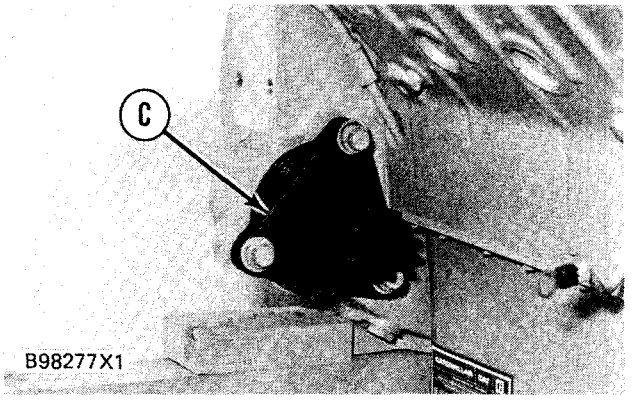


2. Install tool (B) in the fuel injection pump camshaft. Remove the plug from the cover on the fuel injection pump housing, and install tool (A). Use tool (B) to turn the camshaft until the timing pin (A) can be pushed into the groove (slot) in the fuel injection pump camshaft.

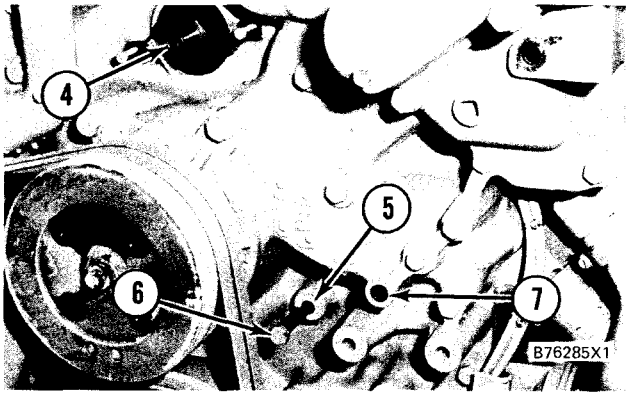


3. Put fuel injection pump housing and governor (3) in position on the engine. Install the two bolts that hold the unit in position.

Fuel Injection Pump Housing And Governor



4. Remove the starter, and install tooling (C) in the flywheel housing to turn the engine.

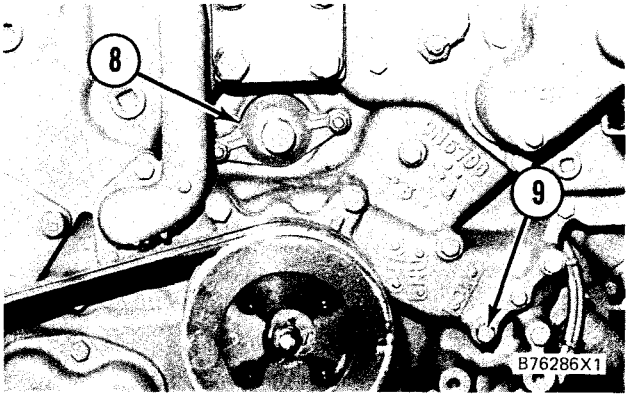


5. Install the washer and tachometer drive shaft (4), but do not tighten shaft (4).

6. Remove the cap and fitting from the front housing at location (5).

7. Install a 5/16"-18 NC bolt (6) 2 1/2 in. (64 mm) long. The cover bolt from hole (7) can be used. Use tooling (C) to turn the crankshaft clockwise (as seen from front of engine) until bolt (6) can be installed into the camshaft gear and is in the center of the timing hole. With timing pin (A) in the groove (slot) in the fuel injection pump camshaft and bolt (6) in the hole in the engine camshaft gear, the timing for the engine is correct. Tighten tachometer drive shaft (4) to a torque of 149 ± 14 N•m (110 ± 10 lb.ft.).

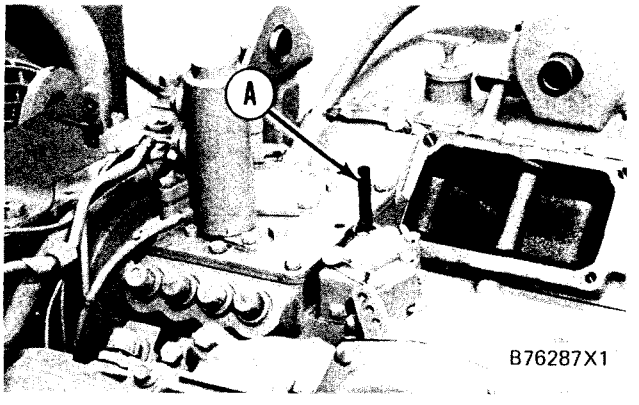
8. To check the timing, remove timing pin (A) and bolt (6). Turn the crankshaft with tool (C) clockwise (as seen from front of engine) two revolutions, and install the timing pin (A) and then bolt (6) back in place. If bolt (6) cannot be installed, the timing is not correct and the procedure must be done again. Do not turn the crankshaft counterclockwise (as seen from the front of the engine) to install bolt (6). The drive gear on the fuel injection pump camshaft must be loosened to change the timing.



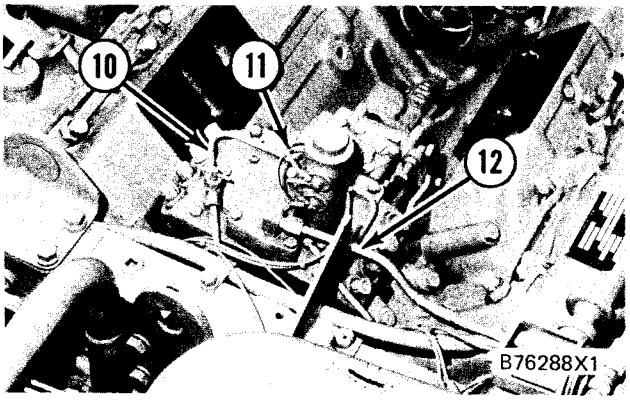
9. Install adapter (8) over the tachometer drive shaft.

10. Remove bolt (9) from the camshaft gear, and install it back in its original position in the front housing.

11. Install the fitting and cap in the front housing.



12. Remove timing pin (A), and install the plug in the cover on the fuel injection pump housing.



13. Install fuel return tube (10) on the fuel injection pump housing.

14. Connect fuel supply tube (12) to the fuel injection pump housing.

15. Connect wires (11) to the fuel shutoff solenoid.

16. Remove tooling (C), and install the starter.

END BY:

a. install fuel injection lines

b. install air inlet manifold

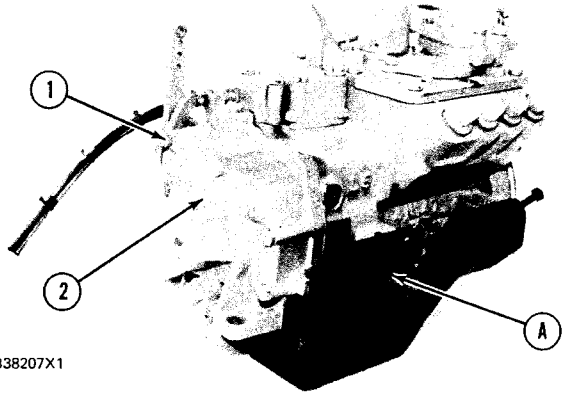
Fuel Transfer Pump

Remove Fuel Transfer Pump 1256-011

Tools Needed		A	B	C
2P8315	Bracket Assembly	1		
3P1544	Timing Pin		1	
FT1632	Bolt			1

START BY:

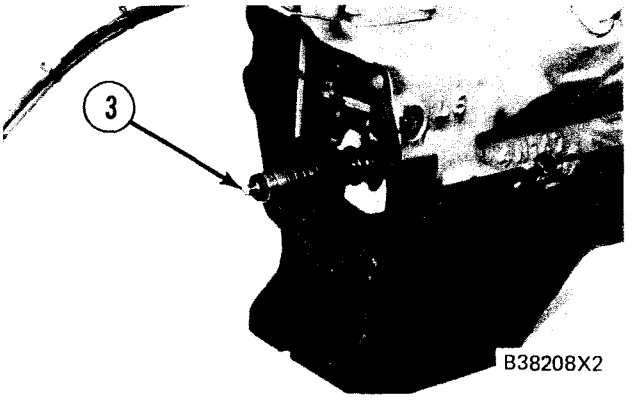
a. remove fuel injection pump housing and governor



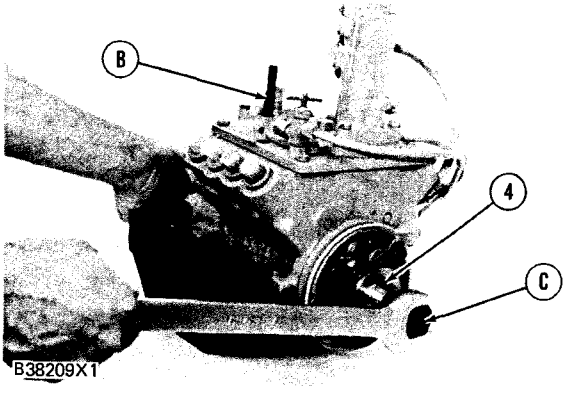
1. Install the fuel injection pump housing on tool (A).

2. Remove seven bolts (1) and governor housing (2).

Fuel Transfer Pump



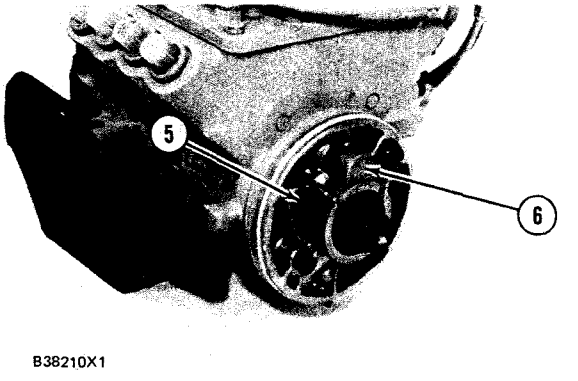
NOTE: The fuel injection pump housing has a thrust washer for the fuel injection pump camshaft. The thrust washer is behind the flange for the flyweights on the camshaft. To hold the thrust washer in place, governor shaft (3) and the camshaft must be held in toward the fuel transfer pump any time sleeve (4) is removed.



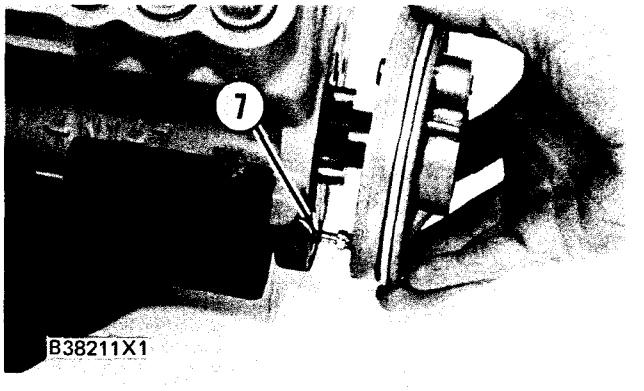
3. Remove the plug from the cover, and install tool (B) in the hole as shown. Turn the injection pump camshaft until tool (B) can be pushed into the groove (slot) in the camshaft.

NOTE: Any time the drive sleeve is removed from the camshaft a new one must be installed. The camshaft has serrations that cut grooves into the drive sleeve when it is installed to give a positive drive connection. If a formerly used drive sleeve is installed again, it can slip on the camshaft.

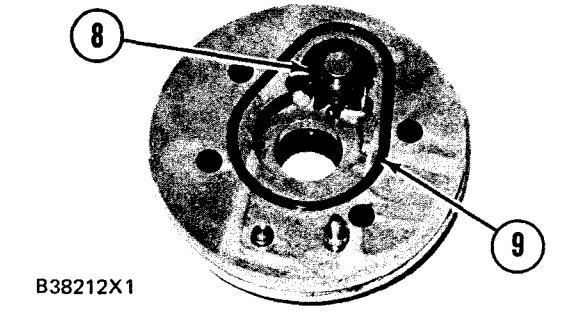
4. Install tool (C) in the threads of sleeve (4). Tighten the bolt until the sleeve can be removed.



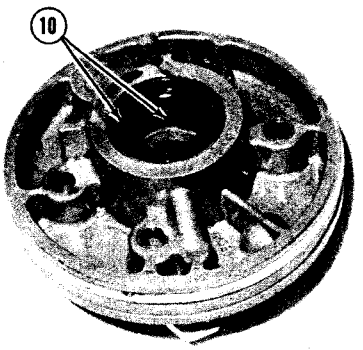
5. Remove four bolts (5) and fuel transfer pump body (6) from the housing.



6. Disconnect drain line (7) from the fitting on the back of fuel transfer pump body.

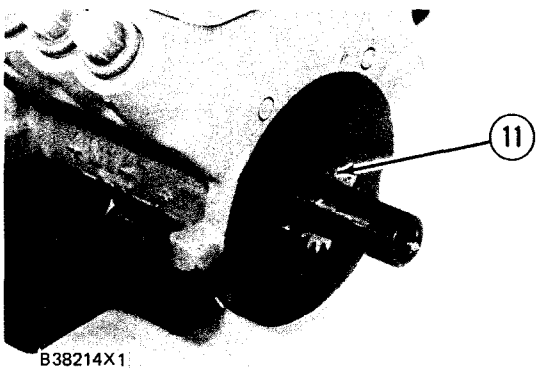


7. Remove gear (8) and O-ring seal (9) from the pump body.



B38213X1

8. Remove seals (10) from the pump body.

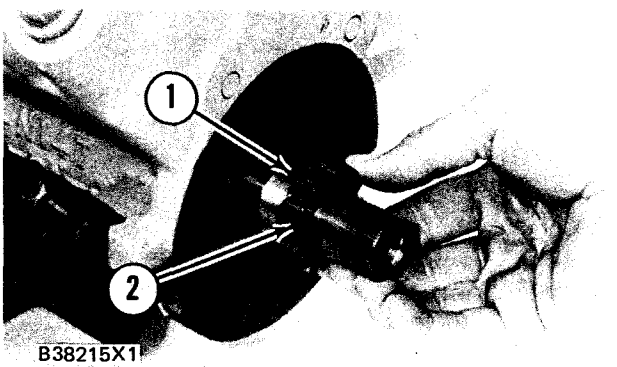


B38214X1

9. Remove drive gear (11) and the key from the camshaft.

Install Fuel Transfer Pump 1256-012

Tools Needed		A	B	C	D	E
2P8315	Bracket Assembly	1				
1P510	Driver Group		1			
6V3071	Seal Guide			1		
S1603	Bolt [1/2"-20 NV x 1 1/2 in. (38 mm)]				1	
4B4280	Washer				1	
3P1544	Timing Pin					1

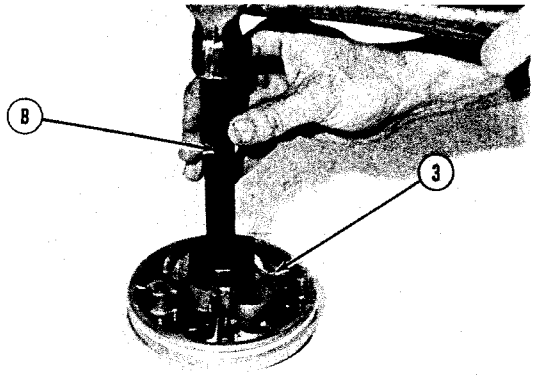


B38215X1

NOTE: The fuel injection pump camshaft must be held in toward the fuel transfer pump during installation of the fuel transfer pump parts to hold the camshaft thrust washer in its counterbore. The thrust washer will be damaged when the sleeve is installed on the camshaft if it is not in the correct position.

1. Install key (1) and drive gear (2) on the shaft.

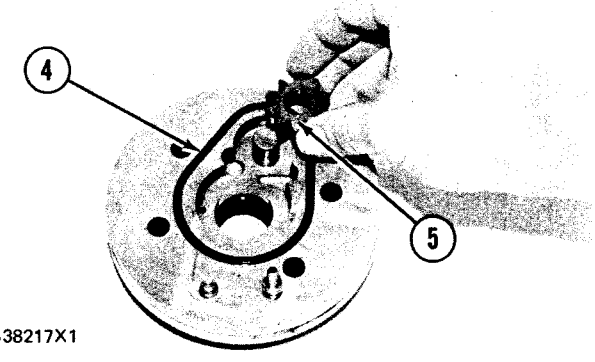
Fuel Transfer Pump



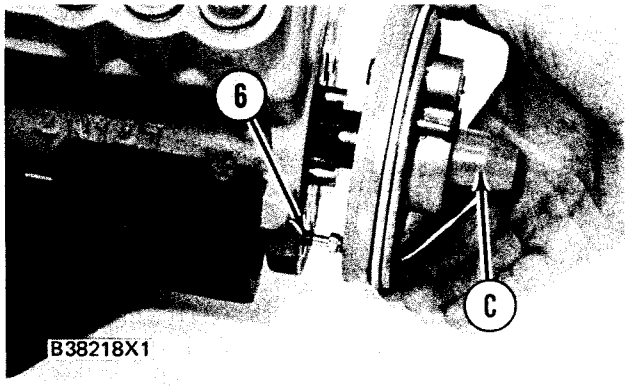
2. Put No. 3 Aviation Permatex on the outside diameter of the seals for body (3).

3. Use tooling (B) to install the first seal in the body with the lip down and the second seal with the lip up. Install the first seal to a depth of 11.51 ± 0.25 mm (.453 ± .010 in.) and the second seal to a depth of 0.76 ± 0.25 mm (.030 ± .010 in.).

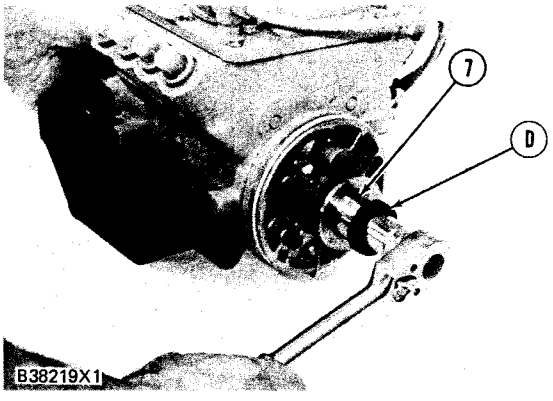
4. Remove the extra permatex from the body and seals after installation. Be sure the drain hole between the seals is open.



5. Install O-ring seal (4) and gear (5) on the body.



6. Install tool (C) in the end of the fuel injection pump camshaft. Connect drain line (6) to the fitting on the back of the body, and put the body in position on the fuel injection pump housing. Install the bolts that hold the body in place.



7. Install tool (E) in the camshaft so it will not turn.

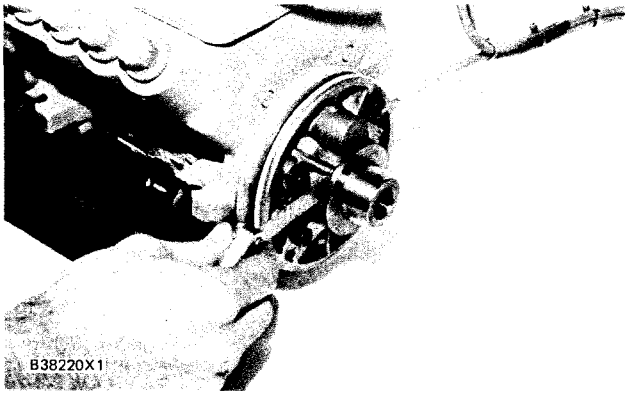
NOTICE

Do not hit the sleeve to install. Damage to the governor will be the result.

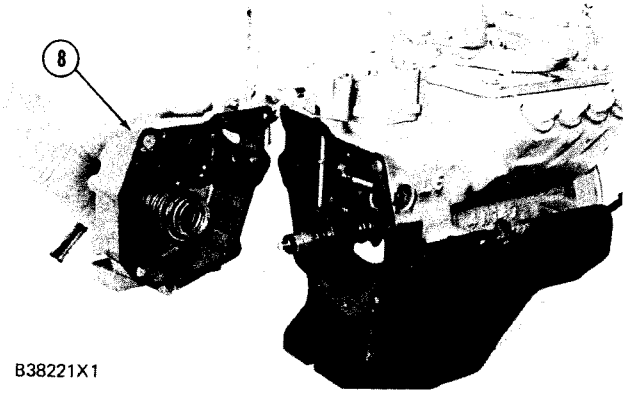
8. Put a new sleeve (7) on the camshaft.

NOTE: A new drive sleeve must be installed because a used drive sleeve can slip on the camshaft.

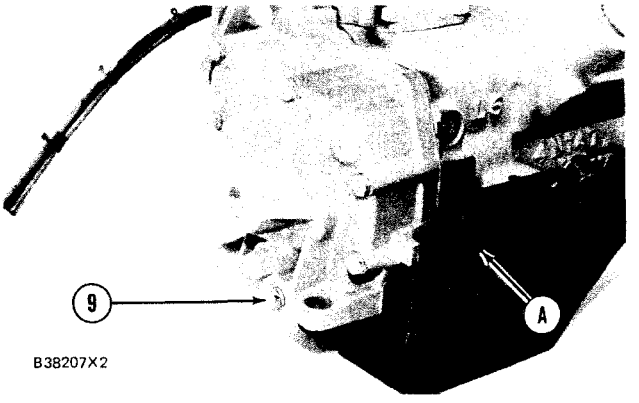
9. Tighten the sleeve into position on the shaft with the 4B4280 Washer of tooling (D) approximately 6.4 mm (.25 in.). Tighten the sleeve the remainder of the way with the 9N5022 Washer until the sleeve bottoms. This is the washer which is on the tachometer drive shaft.



10. Use a feeler gauge to check the end play of the camshaft after the sleeve is installed. The end play of the camshaft must be 0.58 ± 0.46 mm (.023 ± .018 in.).



11. Be sure the governor springs and gasket are in position on governor housing (8). Install the governor housing on the fuel injection pump housing.



12. Be sure bolt (9) has the washer and O-ring seal on it when installed.

13. Remove the fuel injection pump housing from tool (A).

END BY:

a. install fuel injection pump housing and governor

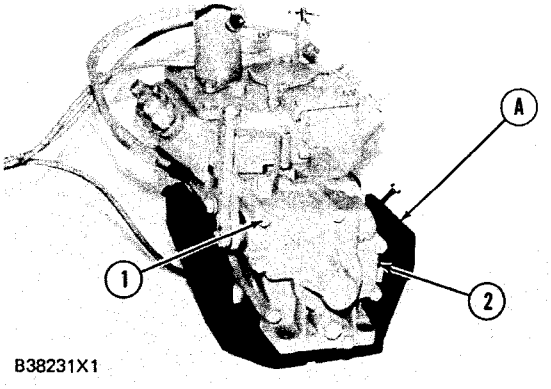
Governor

Disassemble Governor 1264-015

Tools Needed		A	B	C	D
2P8315	Bracket Assembly	1			
1P1855	Retaining Ring Pliers		1		
5P302	Bar			1	
3P1544	Timing Pin				1

START BY:

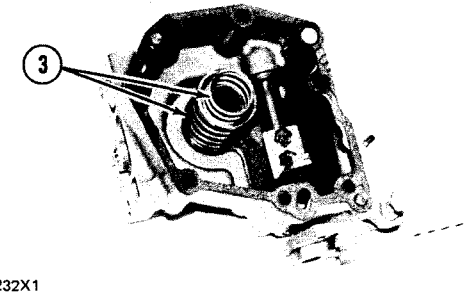
a. remove fuel injection pump housing and governor



B38231X1

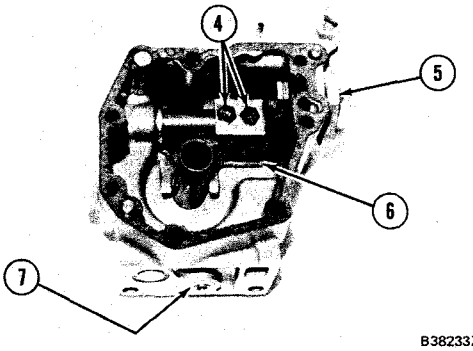
1. Install the fuel injection pump housing on tool (A) as shown.

2. Remove bolts (1) and governor housing (2) from the fuel injection pump housing.



B38232X1

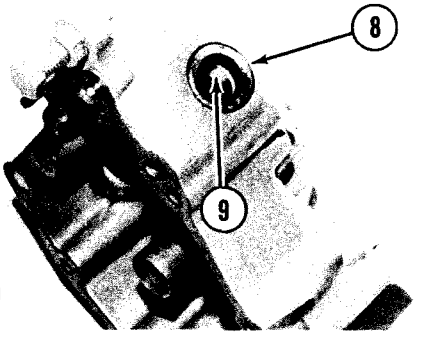
3. Remove governor springs (3) and the seat from the governor housing.



B38233X1

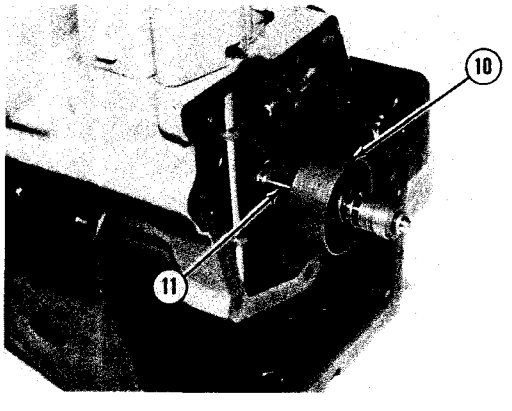
4. Remove two bolts (4) from the lever. Remove shaft assembly (5), lever (6) and the two washers from the governor housing.

5. Remove O-ring seal (7) from the governor housing.



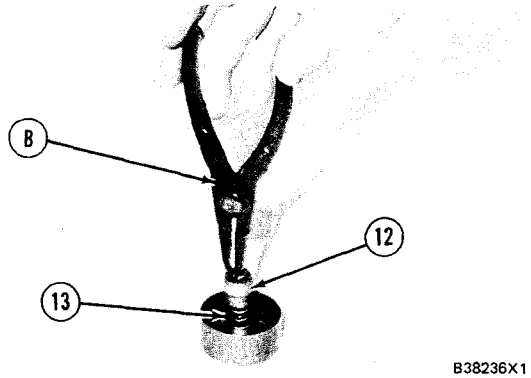
B38234X1

6. Remove seal (8) and bushing (9) from the governor housing.

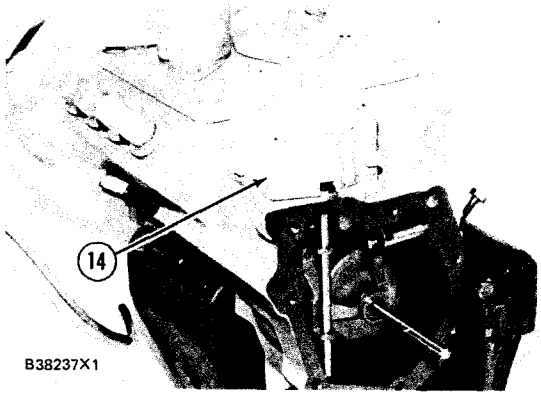


B38235X1

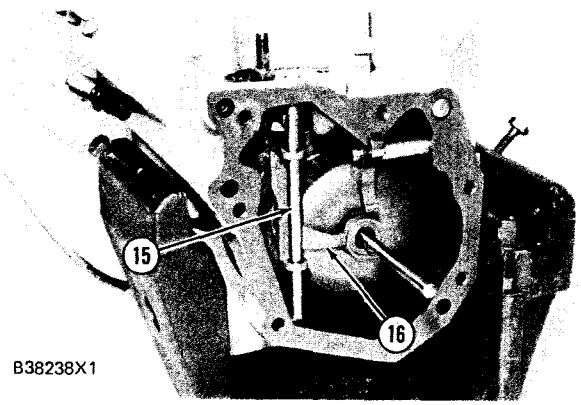
7. Remove seat assembly (10) and spring (11) from the governor shaft.



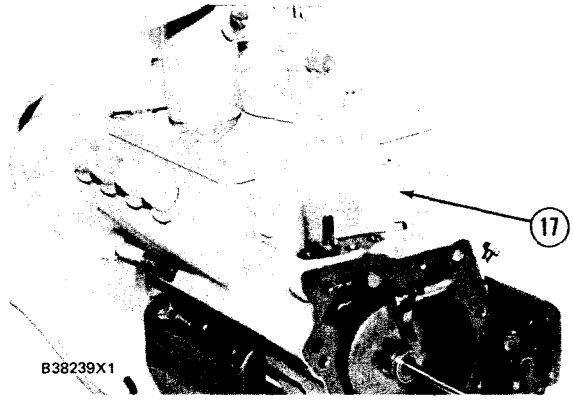
8. Use tool (B) to remove the snap ring from the spool on the seat assembly. Remove the retainer and piston (12) from the spool. Remove the spool and spring (13) from the seat.



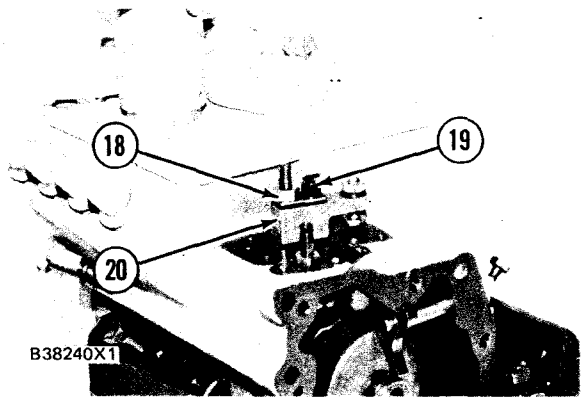
9. Remove cover (14).



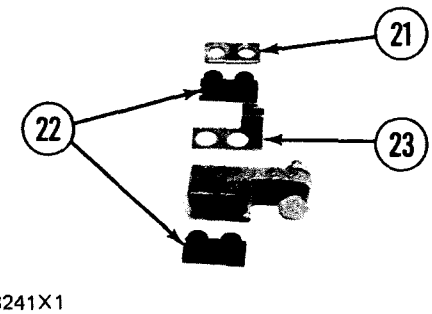
10. Remove shaft (15) and lever (16) from the housing. Remove the O-ring seal from shaft (15).



11. Remove cover (17).

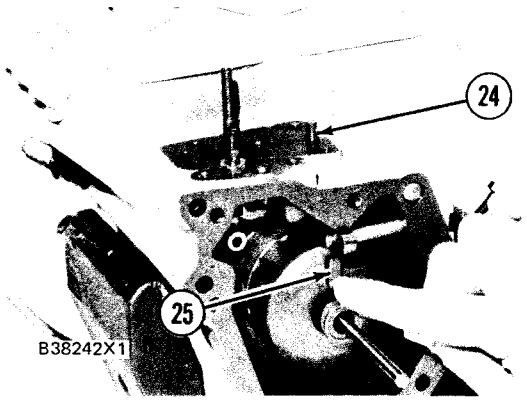


12. Remove nut (18), bolt (19) and torque control group (20).

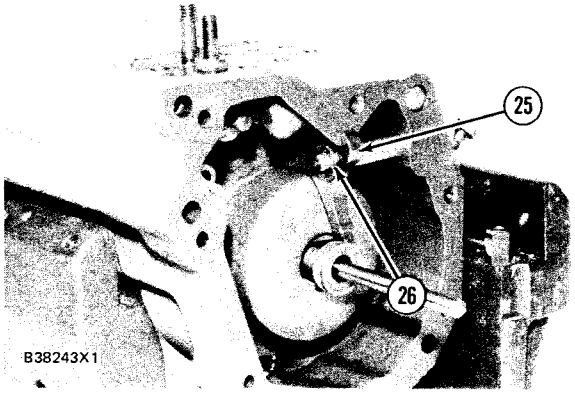


13. Remove shim (21), insulators (22) and contact (23) from the torque control bar.

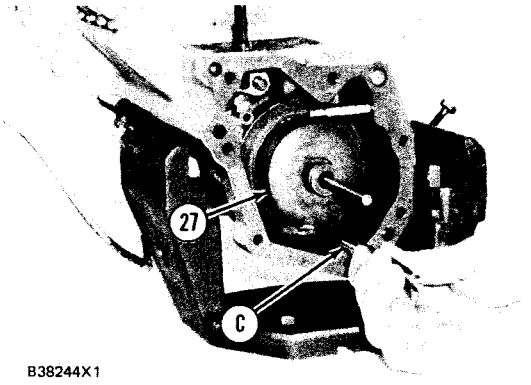
Governor



14. Push lever (25) in, and remove pin (24).



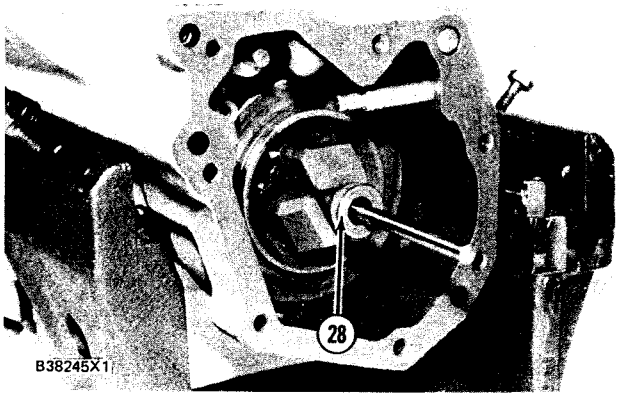
15. Remove lockring (26) and lever (25) from the dowel.



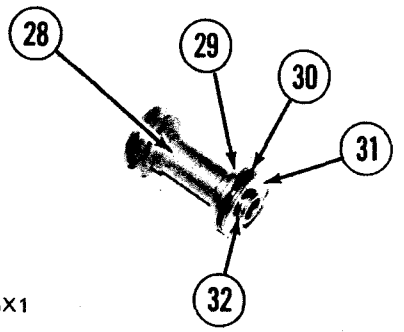
16. Use tool (C) to remove shield (27) from the camshaft.

NOTICE

Pull on the shield only a small amount in each location, so it will not have distortion or damage. The metal of the shield is staked around the camshaft and the shield can be damaged when it is removed. If the shield has damage, use a new part for replacement.

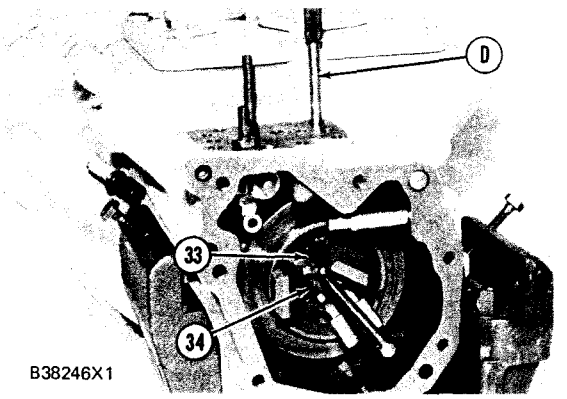


17. Remove riser assembly (28) from the governor shaft.



B38315X1

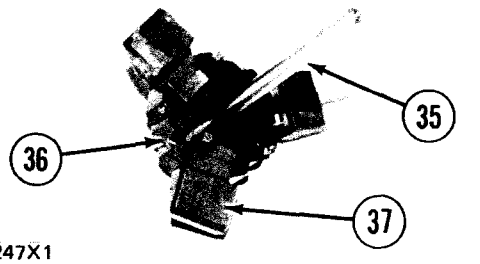
18. Remove ring (32), one race (31), bearing (30) and the other race (29) from riser (28).



B38246X1

19. Install timing pin (D) to hold the camshaft.

20. Remove bolts (33), and remove flyweight assembly (34) from the camshaft.



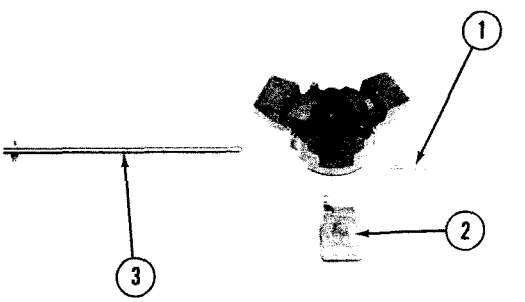
B38247X1

21. Remove shaft (35) from the flyweight carrier. Remove the dowel from the end of shaft (35).

22. Remove dowels (36) and flyweights (37) from the carrier.

Assemble Governor 1264-016

Tools Needed		A	B	C	D	E
2P8315	Bracket Assembly	1				
5P301	Driver		1			
1P1855	Retaining Ring Pliers			1		
3P1544	Timing Pin				1	
1P510	Driver Group					1



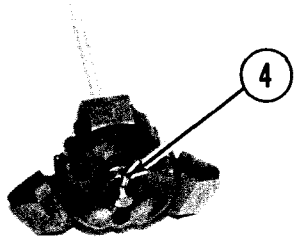
B38248X1

NOTE: Put clean fuel on governor parts during assembly.

1. Put flyweights (2) in position on the carrier, and install dowels (1) to hold them in place.

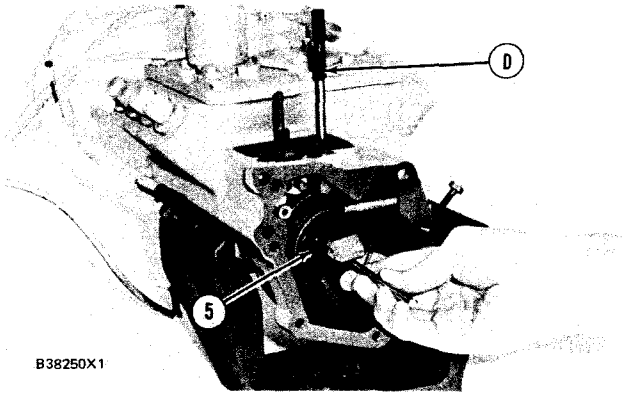
Governor

2. Install the dowel in shaft (3). Install the shaft in the carrier.



B38249X1

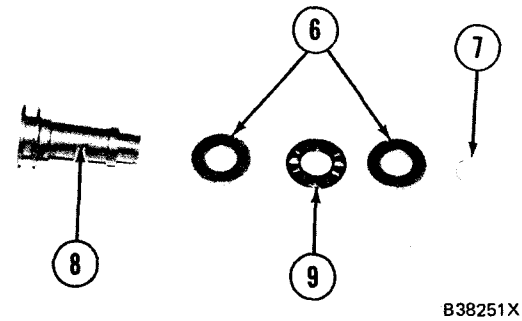
3. Be sure dowel (4) in the shaft is engaged in the groove on the back of the carrier and that the dowel is in place when the carrier is installed on the camshaft.



B38250X1

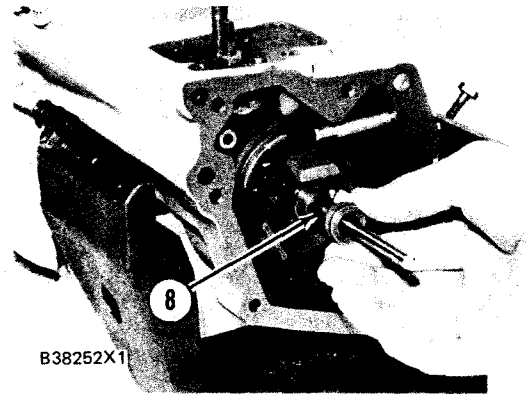
4. Install timing pin (D) to hold the camshaft.

5. Put flyweight assembly (5) in position on the camshaft, and install the bolts that hold it in place. Tighten the bolts to a torque of 10 ± 1 N•m (90 ± 9 lb.in.).



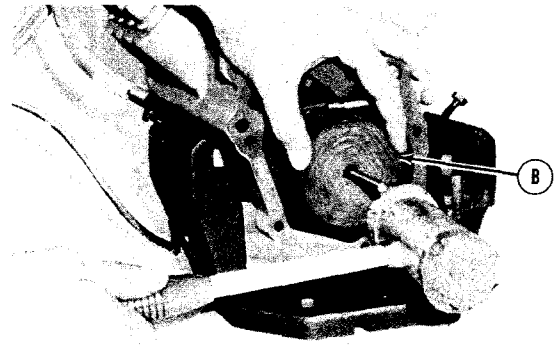
B38251X1

6. Install one race (6), bearing (9), the other race (6) and ring (7) on riser (8).



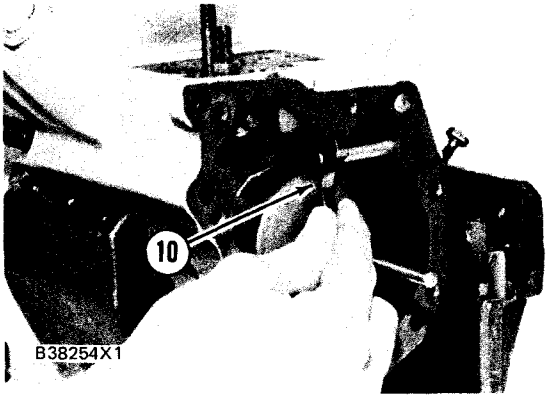
B38252X1

7. Install riser (8) between the flyweights with the bearing in.

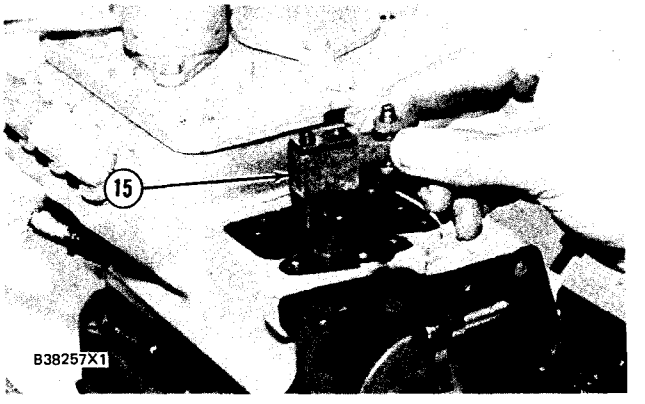


B38253X1

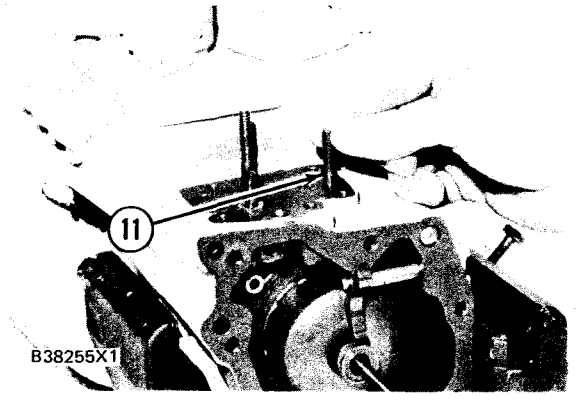
8. Put the shield in position over the flyweights. Use tool (B) to install the shield the remainder of the way on to the camshaft. Stake the metal at two places on the shield 180° ± 5° apart to hold the shield on the camshaft.



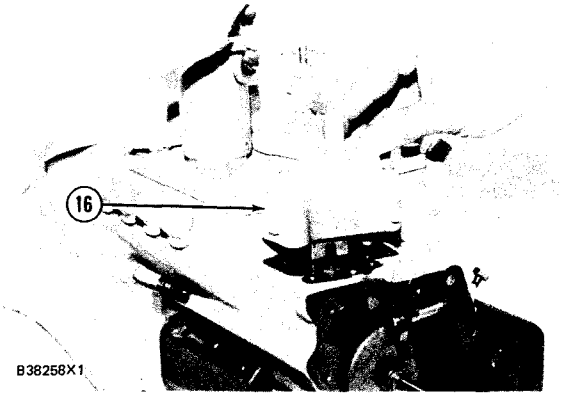
9. Put lever (10) in position on the dowel, and install the lockring to hold it in place.



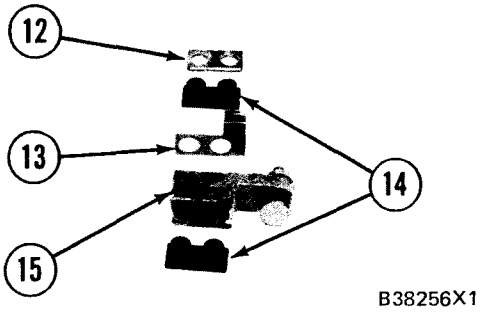
12. Put torque control group (15) in position on the stud in the fuel injection pump housing, and install the nut and bolt that hold it in place.



10. Install pin (11) as shown.

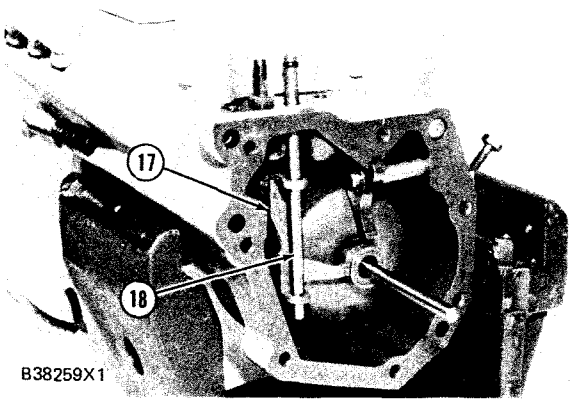


13. Install the gasket and cover (16).

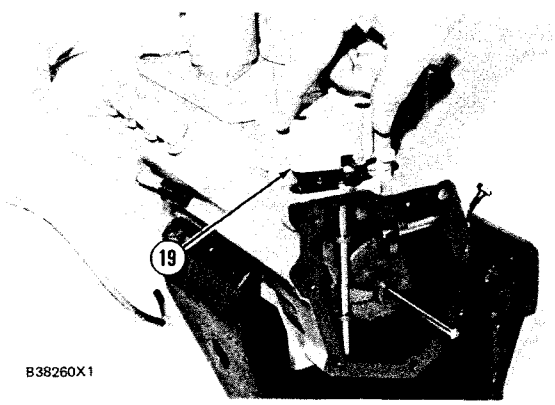


11. Install contact (13), insulators (14) and shim (12) on torque control bar (15) as shown.

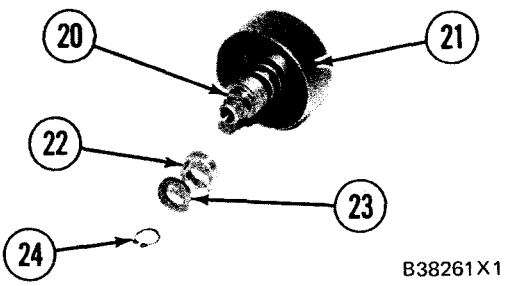
Governor



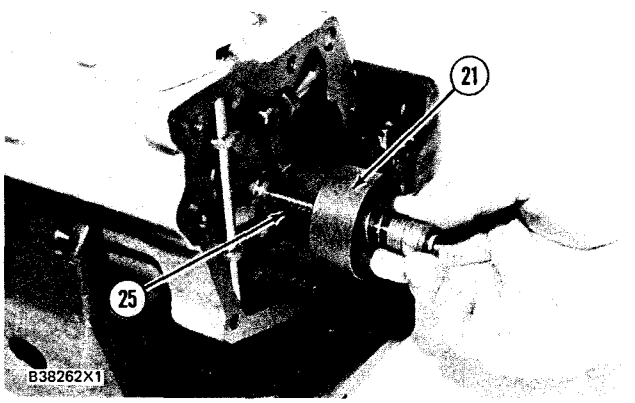
14. Install lever (17) with the ballstud on the lever engaged in the fuel shaft lever and the arm on lever (17) engaged in the groove in the riser. Install the O-ring seal on shaft (18), and put clean fuel on the O-ring seal. Install shaft (18) to hold lever (17) in place. The O-ring seal on shaft (18) must be at the top as shown.



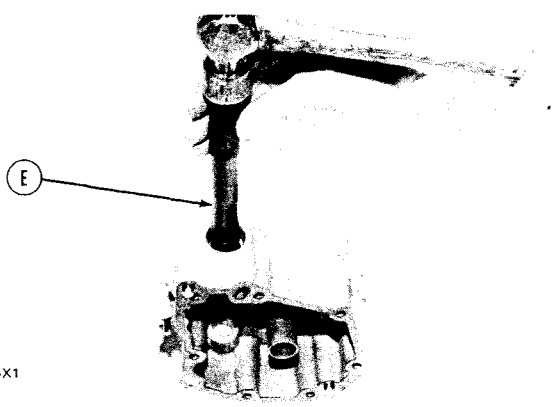
15. Install cover (19).



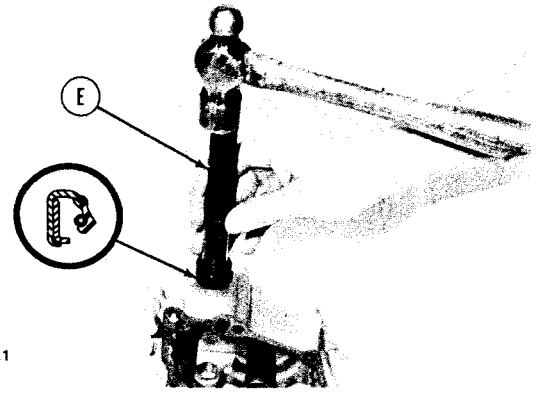
16. Install spool (20) and the spring on seat (21). Install piston (22) and retainer (23) on the spool. Use tool (C) to install snap ring (24) on the spool.



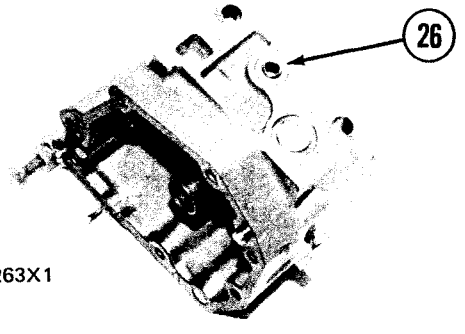
17. Install the small spring (25) and seat assembly (21) on the governor shaft.



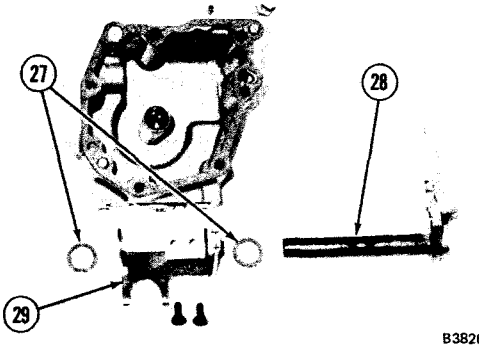
18. Use tooling (E) to install the bushing in the governor housing so the bushing is even with the counterbore in the housing.



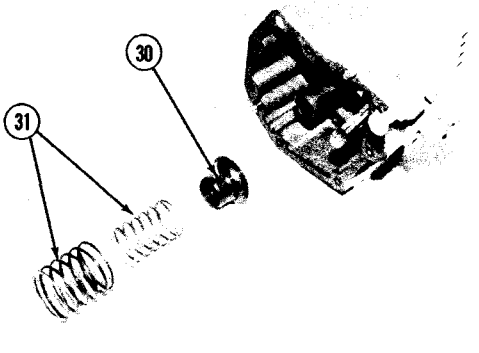
19. Put 9S3263 Thread Lock on the outside diameter of the seal for the governor housing, and use tooling (E) to install the seal with the lip in as shown. Remove all extra thread lock from the seal and housing. Be sure the drain hole between the bushing and seal is open.



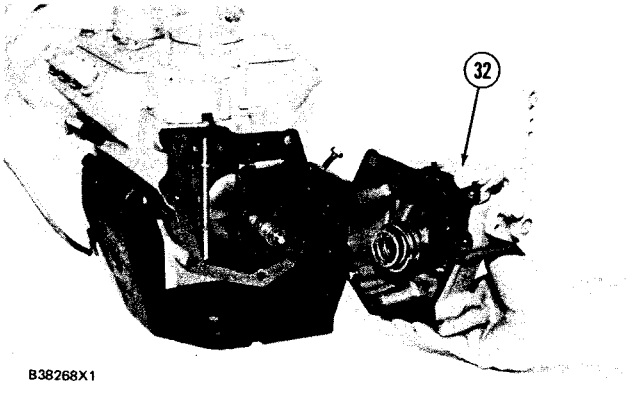
20. Use clean grease to hold O-ring seal (26) in position on the bottom of the governor housing.



21. Put lever (29) in position in the governor housing with a washer (27) on each side of the lever. Install shaft assembly (28) in the governor housing. Install the bolts that hold lever (29) to shaft (28).

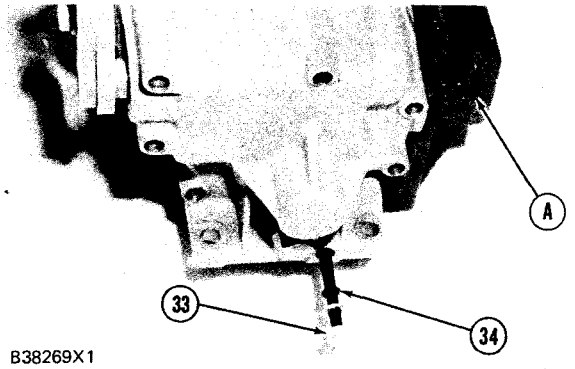


22. Install seat (30) and governor springs (31) on the spring guide in the governor housing as shown.



23. Put the gasket and governor housing (32) in position on the fuel injection pump housing.

Governor



B38269X1

24. Be sure bolt (33) at the bottom of the governor housing has a washer and O-ring seal (34) on it. Install bolt (33) in the location shown, and install the remainder of the bolts that hold the governor housing in place.

25. Remove the fuel injection pump housing from tool (A).

26. After installation of the fuel injection pump housing and governor, adjust the fuel setting and the high and low idle settings. See Testing And Adjusting for these procedures.

END BY:

a. install fuel injection pump housing and governor

Fuel Injection Pump Housing

Disassemble Fuel Injection Pump Housing 1253-015

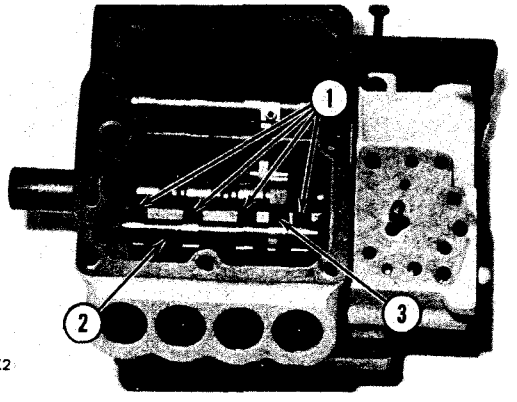
Tools Needed		A
1P510	Driver Group	1

START BY:

a. remove fuel injection pumps

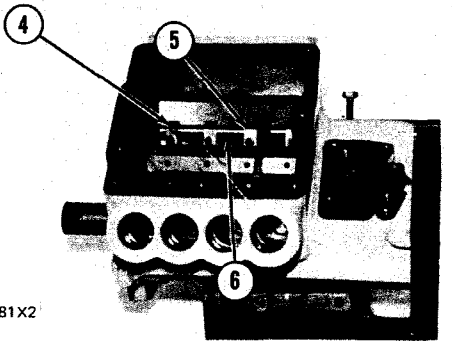
b. disassemble governor

c. remove fuel transfer pump



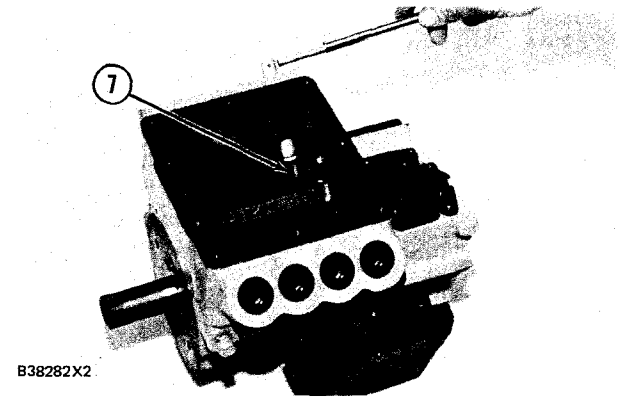
B38280X2

1. Loosen screws (1) in the levers, and remove screws (3) in the crossover lever. Slide shaft assembly (2) out of the housing.



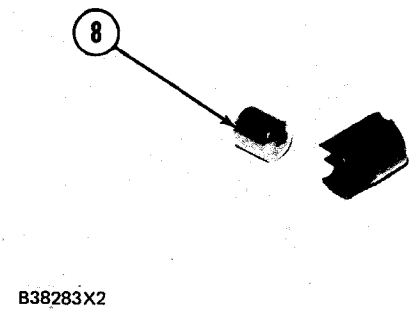
B38281X2

2. Loosen the screws in levers (4), and remove the screw in crossover lever (5). Slide shaft (6) out of the housing.

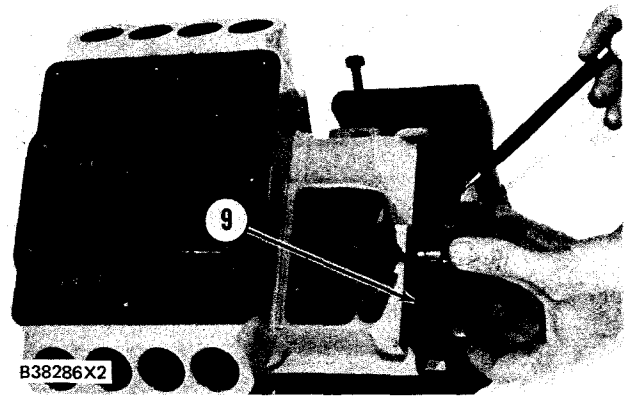


NOTE: Put identification marks on lifters (7) and rollers (8) for installation in their respective bores in the housing.

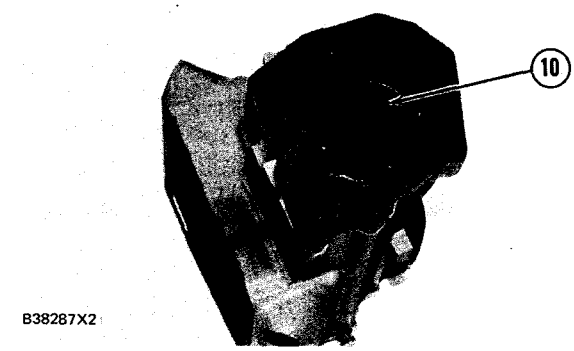
3. Use a magnet to remove eight lifter assemblies (7).



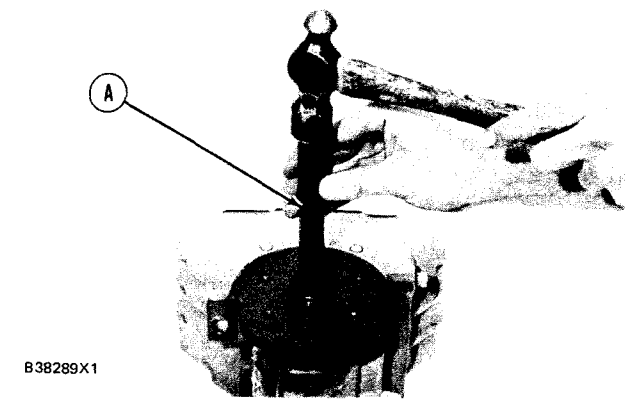
4. Remove roller (8) from each lifter assembly.



5. Turn the camshaft so the groove (slot) for the timing pin is in the position shown, and carefully remove camshaft (9). Remove the thrust washer from the housing.



6. Remove camshaft rear bearing (10) from the fuel injection pump housing. Be careful not to damage the bearing bore in the housing.

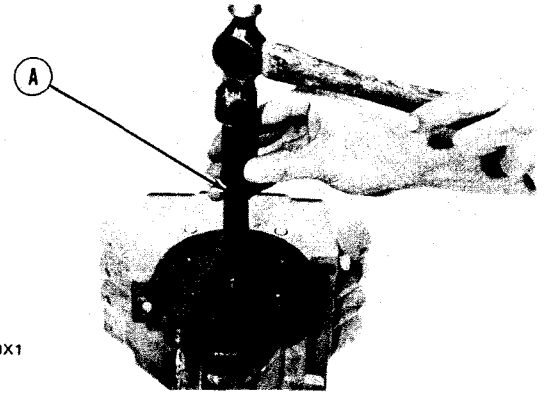


7. Use tool group (A) to remove the camshaft front bearing from the fuel injection pump housing.

Fuel Injection Pump Housing

Assemble Fuel Injection Pump Housing 1253-016

	Tools Needed	A	B
1P510	Driver Group	1	
5P3516	Reaming Tool Group		1
1P2363	Swivel Joint Universal		1
9S1744	Adapter		1
5P2169	Master Gauge		1
5P2170	Dial Bore Gauge Group		1

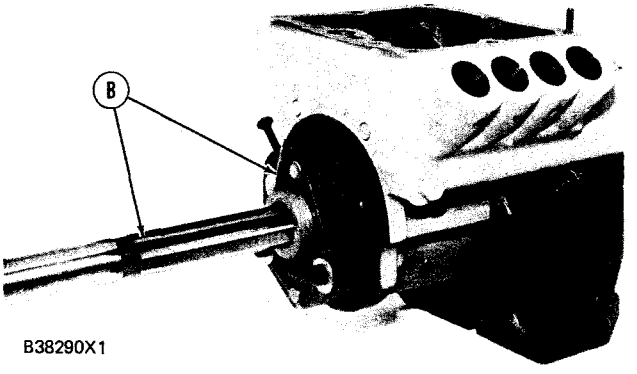


B38289X1

NOTE: Put clean fuel on all parts during assembly.

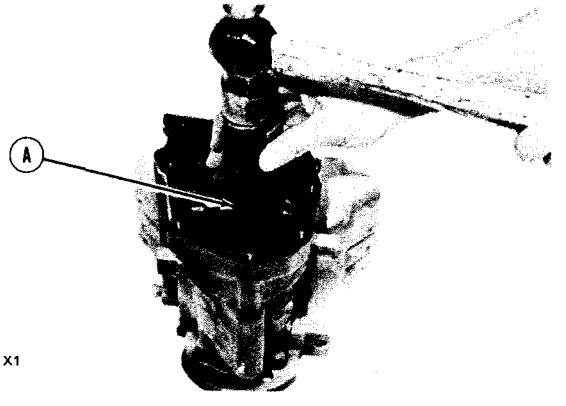
1. Use tooling (A) to install the camshaft front bearing in the housing. Install the bearing with the chamfer toward the inside of the pump housing.

2. Install the bearing so it is even with the front face of the pump housing.

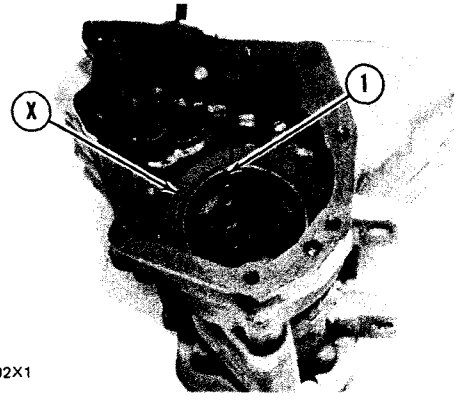


B38290X1

3. Use tooling (B) to machine the bore in the camshaft front bearing to the correct size. See Special Instruction, Form No. SMH6735 for the procedure to machine the new camshaft front bearing. The bore in the bearing must be 25.413 ± 0.013 mm (1.0005 ± .0005 in.).

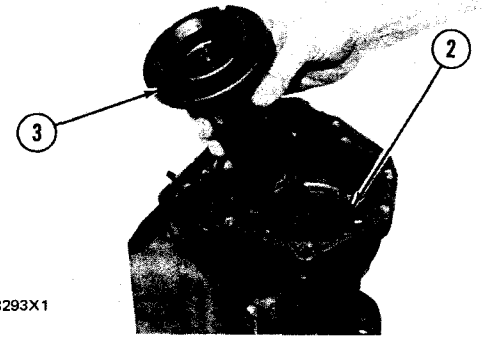


B38291X1



B38292X1

4. Use tooling (A) to install the camshaft rear bearing in the housing. Install the bearing so groove (1) in the bearing is in the position shown. On earlier pump housings without a thrust washer, install the bearing into the bore so the outer face of the bearing is 0.114 ± 0.025 mm (.0045 ± .0010 in.) below face (X) on the housing. On later pump housings with a thrust washer, install the bearing into the bore so the outer face of the bearing is 0.43 ± 0.13 mm (.017 ± .005 in.) below the counterbore for the thrust washer.



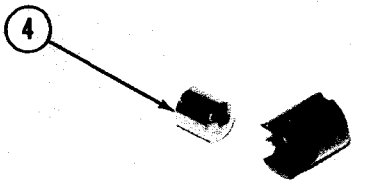
B38293X1

5. Install thrust washer (2) in the housing with the ear on the thrust washer in the hole in the pump housing so the thrust washer will not turn.

NOTICE

If the pump housing is assembled while it is in a horizontal position, the thrust washer can slide out of the counterbore and into the area between the camshaft thrust face and the housing. Then the fuel pump camshaft end play will not be correct, and it will be necessary to disassemble the fuel pump housing so the thrust washer can be installed correctly.

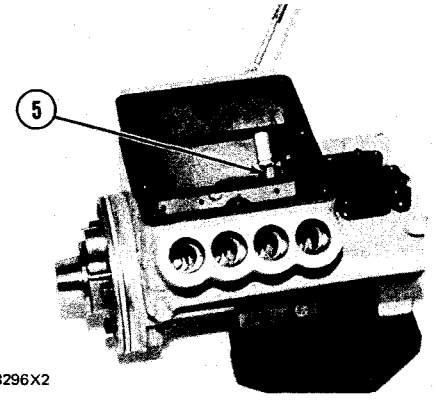
6. With the pump housing in a vertical position as shown, carefully install camshaft (3). To make sure that the thrust washer will be kept in its correct installation location, keep the pump housing in a vertical position, and install the fuel transfer pump and camshaft sleeve. See Fuel Transfer Pump Installation for the procedure to install the fuel transfer pump and camshaft sleeve.



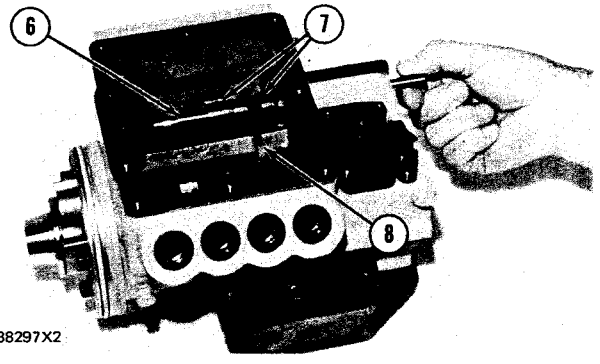
B38295X2

7. Install each roller (4) in their respective lifters.

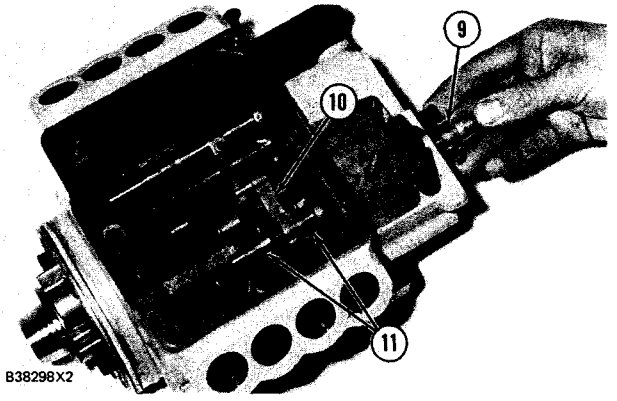
Fuel Injection Pump Housing



8. Use a magnet to install lifter assemblies (5) in their respective bores in the pump housing. Install the lifter assemblies with the groove in each lifter in alignment with the dowel in the lifter bore.



9. Install shaft (6) in the pump housing. Install the shaft through one lever (7), through crossover lever (8) and through three levers (7) as shown. Install the screw in crossover lever (8). Tighten the screw in crossover lever (8). Tighten the screw to a torque of 2.70 ± 0.25 mm (24 ± 2 lb.in.). Do not tighten any of the screws in the levers.



10. Install shaft assembly (9) in the pump housing; then through three levers (11) as shown. Install the screw in crossover lever (10). Tighten the screw to a torque of 2.8 ± 0.2 mm (24 ± 2 lb.in.). Do not tighten any of the screws in the levers.

11. After connecting the governor to the fuel injection pump housing, installing the fuel injection pumps and installing the fuel transfer pump, adjust the following:

a. Adjust the crossover levers.

b. Adjust fuel pump calibration.

c. Adjust the fuel setting.

d. Adjust high and low idle speeds.

See Testing And Adjusting for the above procedures.

END BY:

a. connection of governor to fuel injection pump housing

b. install fuel injection pumps

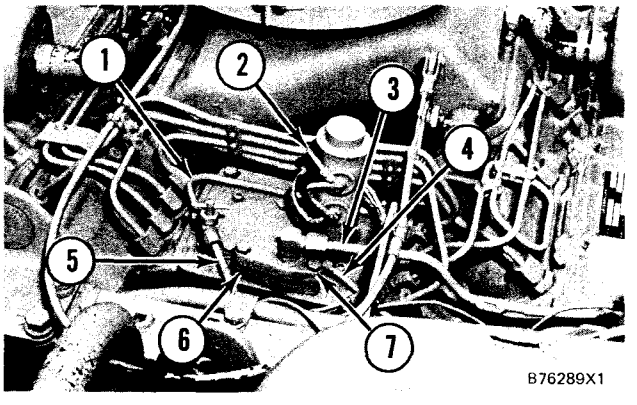
c. install fuel transfer pump

Shutoff Housing, Check Valve And Bypass Valve

Remove Shutoff Housing, Check Valve And Bypass Valve 1256 & 1259-011

NOTICE

Before any service is done on the fuel system, the outer surface of the injection pump housing must be clean.



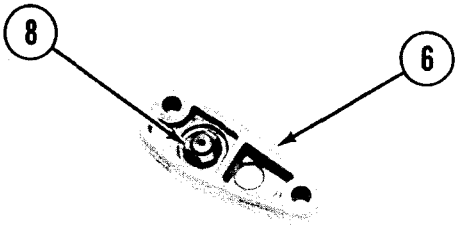
B76289X1

1. Disconnect wires (2) from the shutoff solenoid.

2. Disconnect fuel supply tube (3) and fuel return tube (1) from the fuel injection pump housing.

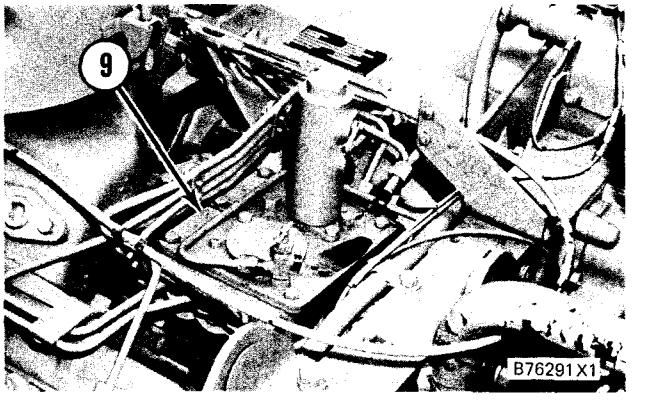
3. Disconnect air bleed tubes (4) and (5) from the fuel injection pump housing.

4. Remove the two bolts to remove flange (7), flange assembly (6) and the gaskets from the fuel injection pump housing.



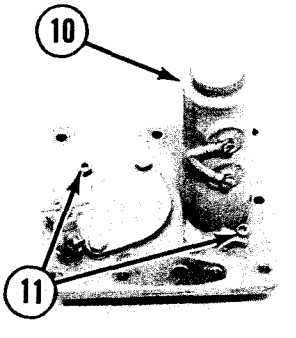
B76290X1

5. If necessary, remove check valve (8) from flange assembly (6).



B76291X1

6. Remove the bolts, and remove shutoff housing cover (9) from the fuel injection pump housing.

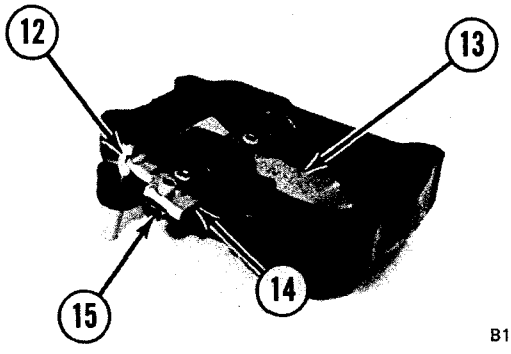


B76292X1

7. Remove shutoff solenoid (10) from the shutoff housing cover.

8. Remove bolts (11) to remove the shutoff housing cover from the shutoff housing.

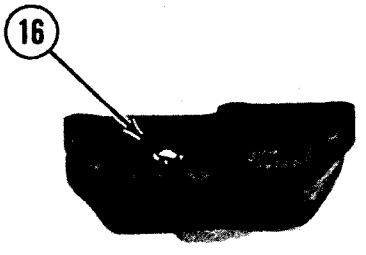
Shutoff, Check Valve And Bypass Valve



B17102X2

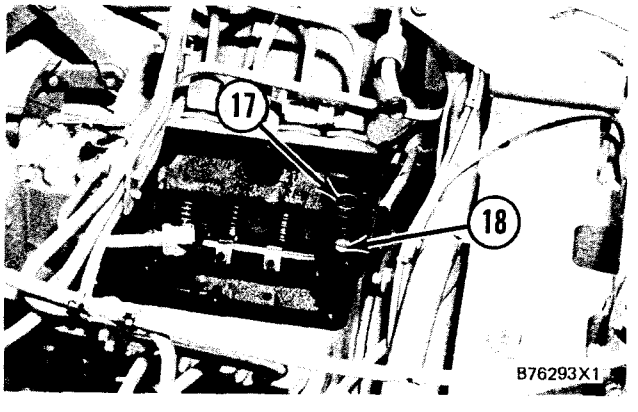
9. Remove two screws to remove lever (13) from the shutoff housing.

10. Remove lever (14) and shaft (15) as a unit and shaft (12) from the shutoff housing. Remove the screws to remove lever (14) from shaft (15).



B17103X2

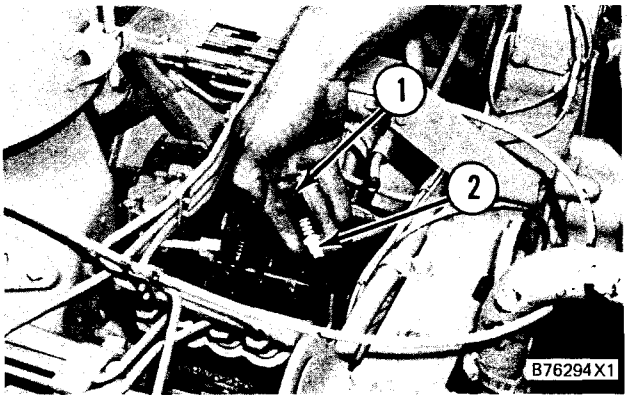
11. Remove seal (16) from the shutoff housing.



B76293X1

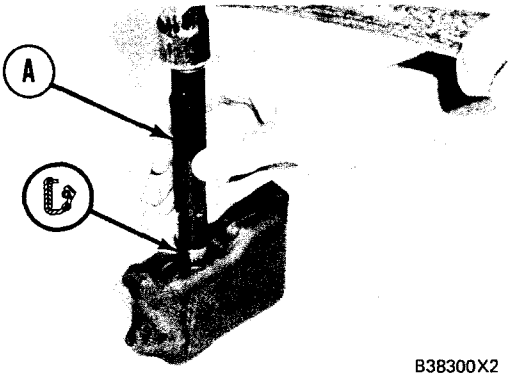
12. Remove spring (17) and bypass valve (18) from the fuel injection pump housing.

Install Shutoff Housing, Check Valve And Bypass Valve 1256 & 1259-012



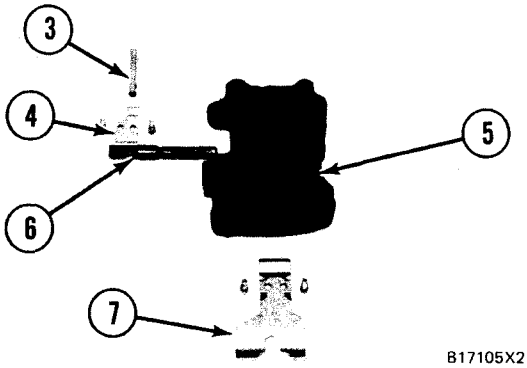
B76294X1

1. Install bypass valve (2) and spring (1) in the fuel injection pump housing.



B38300X2

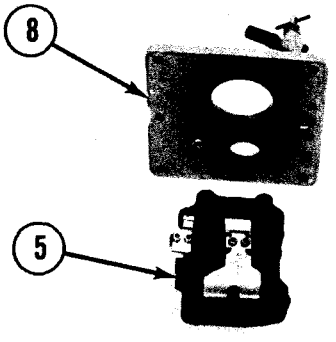
2. Put 7M7260 Liquid Gasket Material on the outside diameter of the seal, and install the seal with tooling (A) in the shutoff housing with the lip toward the outside. The outer face of the seal must be 1.00 mm (.039 in.) below the surface of the housing. Remove the extra sealing compound from the housing and the seal after installation.



B17105X2

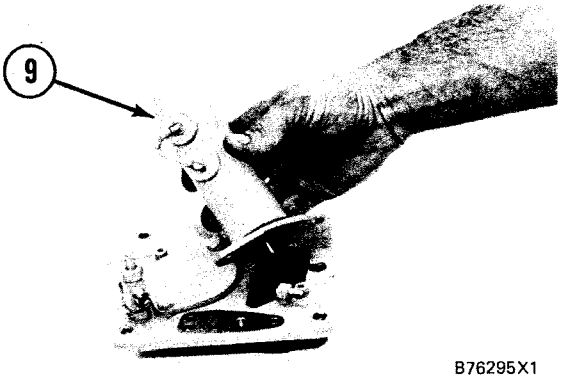
3. Install lever (4) on shaft (6) with the screws to hold these together. Put shaft (3) and shaft (6) in position in shutoff housing (5). Make sure lever (4) is correctly engaged with the groove (slot) on shaft (3).

4. Install lever (7) and the screws to hold it on shaft (6).



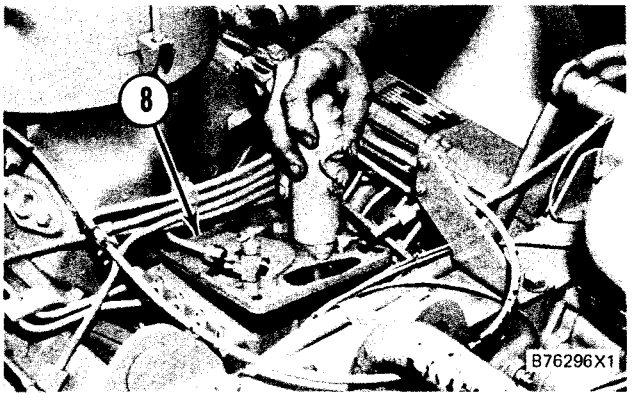
B17106X2

5. Install shutoff housing cover (5) on shutoff housing (8).

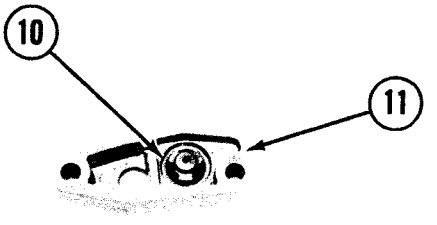


B76295X1

6. Install shutoff solenoid (9) on the shutoff housing cover.



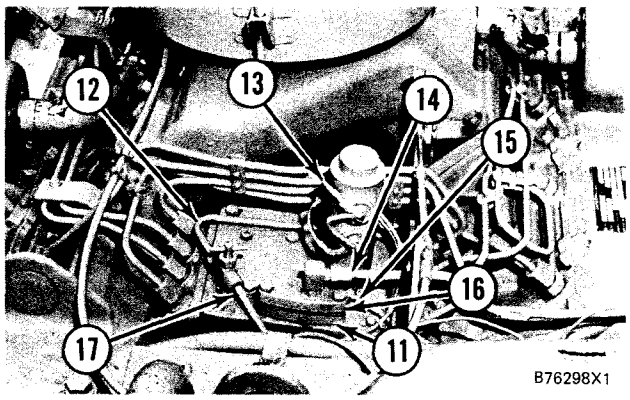
7. Install shutoff housing cover (8) on the fuel injection pump housing.



B76297X1

8. If necessary, install a new check valve (10) in flange assembly (11).

Shutoff, Check Valve And Bypass Valve



9. Install a gasket, flange assembly (11), a gasket, flange (16) and the two bolts on the fuel injection pump housing.

10. Connect air bleed tubes (17) and (15) to the fuel injection pump housing.

11. Connect fuel return tube (12) and fuel supply tube (14) to the fuel injection pump housing.

12. Connect wires (13) to the shutoff solenoid.

Fuel Injection Pumps

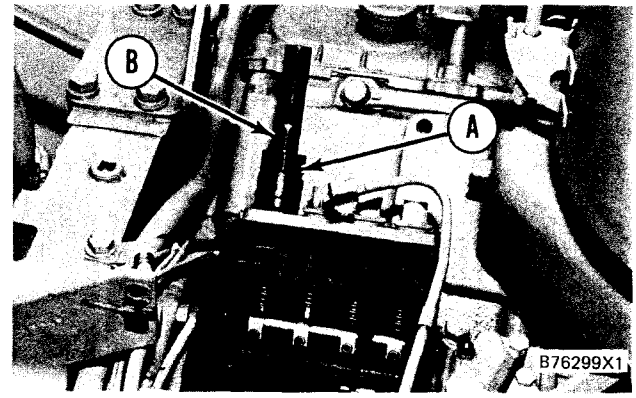
Remove Fuel Injection Pumps 1251-011

Tools Needed		A	B
8S2243	Wrench	1	
8S2244	Extractor		1

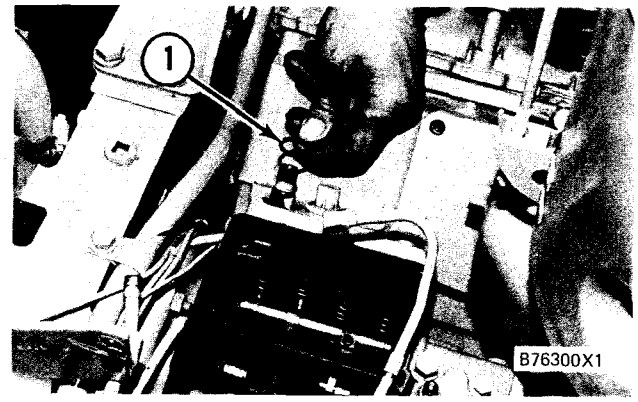
START BY:

a. remove fuel injection lines

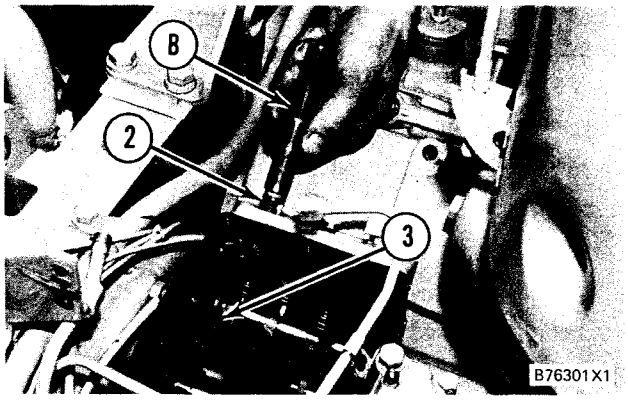
b. remove shutoff housing, check valve and bypass valve



1. Install tools (A) and (B) on the fuel injection pump. Use tool (A) to loosen the bushing. Remove tools (A) and (B).



2. Remove the bushing and O-ring seal (1) from the fuel injection pump and pump housing.



NOTE: Do not loosen screws (3) when the fuel injection pump is removed or installed. If the levers are moved, the fuel pump calibration will be changed.

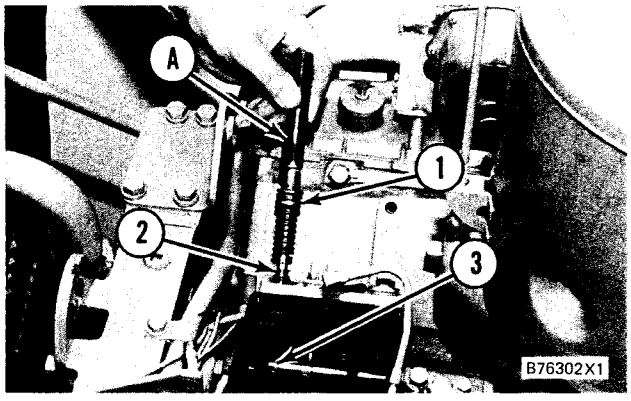
3. Install tool (B) on fuel injection pump (2). Remove fuel injection pump (2) from the fuel injection pump housing. The sleeve on the plunger will slide off on the lever as the fuel injection pump is removed.

NOTE: Keep the sleeve and plunger with their respective barrel for installation. Do not mix sleeve, plunger and barrel with other sleeves, plungers and barrels.

4. Do Step 1 through 3 again to remove the other fuel injection pumps.

Install Fuel Injection Pumps 1251-012

Tools Needed		A	B
8S2244	Extractor	1	
8S2243	Wrench		1



NOTICE

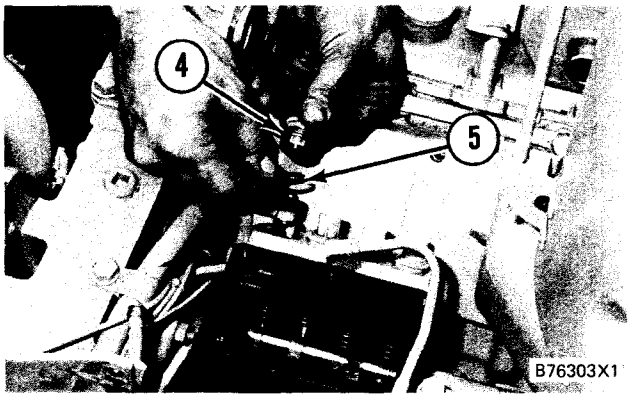
Make sure the sleeve is installed with the thin edge up.

1. Install tool (A) on fuel injection pump (1). Put pump (1) in position in the bore of the fuel injection pump housing. Make sure the groove in sleeve (2) is engaged with lever (3).

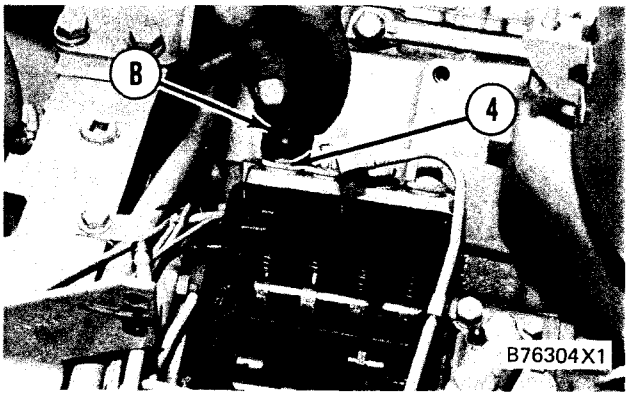
NOTICE

If lever (3) has moved on the shaft, fuel pump calibration must be made. See Testing And Adjusting.

Fuel Injection Pumps



2. Install O-ring seal (5) and bushing (4) over the fuel injection pump and in the fuel injection pump housing.



3. Use tool (B) to tighten bushing (4) to a torque of 80 ± 7 N•m (60 ± 5 lb.ft.).

4. Do Steps 1 through 3 for the other fuel injection pumps.

END BY:

a. install fuel injection lines

b. install shufoff housing, check valve and bypass valve

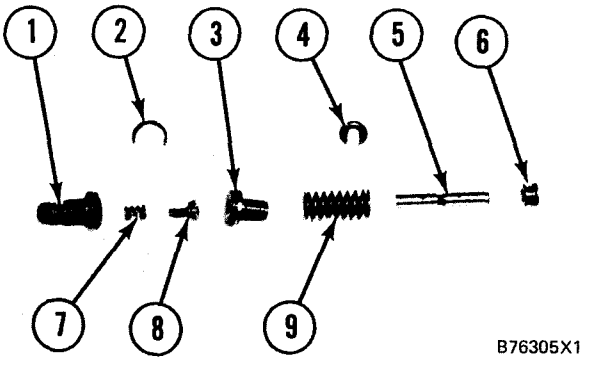
Disassemble And Assemble Fuel Injection Pumps 1251-017

START BY:

a. remove fuel injection pumps

NOTICE

Be careful when the fuel injection pumps are disassembled. Do not damage the surfaces of the plungers, barrels and bonnets. Any scratches will cause leakage inside the fuel injection pump. The plunger and barrel for each pump are made as a set. Do not put the plunger of one pump in the barrel of another pump. The check assemblies are made as a set. Do not mix the parts of the different check assemblies. If one part has wear, install a complete new pump assembly. Be careful when the plunger is put into the bore of the barrel.



1. Remove ring (2), and make a separation of bonnet (1) and barrel (3).

2. Remove spring (7) and check assembly (8) from the bonnet.

3. Remove washer (4), plunger (5) and sleeve (6) as a unit from the barrel. Remove washer (4) and sleeve (6) from plunger (5). Remove spring (9) from the barrel.

NOTICE

Install the sleeve on the plunger with the thin edge up. Make sure the sleeve and plunger are installed in their orignal barrel and the large hole in the plunger is up (toward the barrel).

NOTE: Put clean fuel oil on all parts before assembly.

4. Install spring (9) on barrel (3). Install sleeve (6) and washer (4) on plunger (5). Install sleeve (6), washer (4) and plunger (5) as a unit in the barrel.

5. Install spring (7) and check assembly (8) in bonnet (1).

NOTICE

Do not slide bonnet (1) across the face of barrel (3) when ring (2) is installed. The check assembly in the bonnet can put scratches in the face of barrel (3).

6. Put bonnet (1) in position on barrel (3), and install ring (2) to hold the bonnet and barrel together.

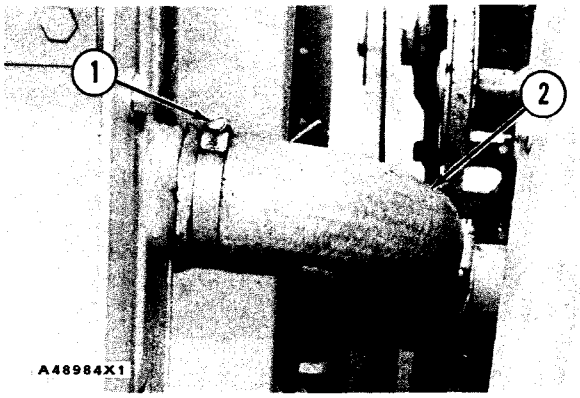
END BY:

a. install fuel injection pumps

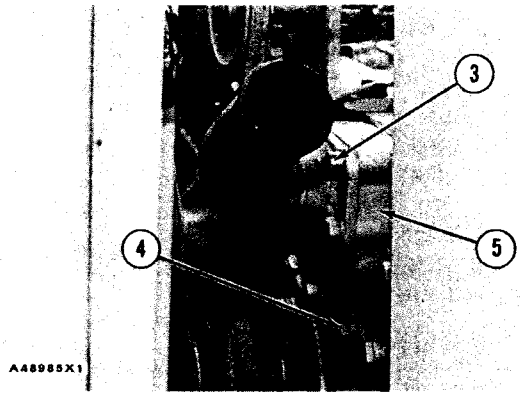
Water Temperature Regulators

Remove Water Temperature Regulators 1355-011

1. Drain the coolant from the cooling system.

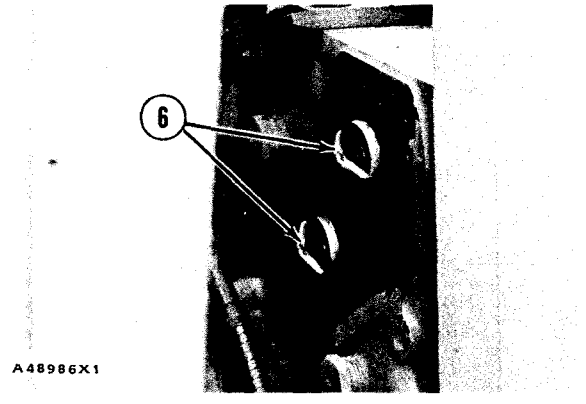


2. Loosen clamps (1), and remove hose (2) from the radiator and water temperature regulator housing.



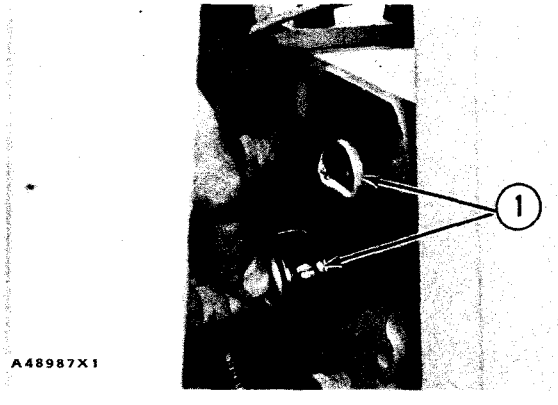
3. Remove bolts (4), the washers and nuts (3), and remove water temperature regulator housing (5) and gasket from the timing gear cover.

Water Temperature Regulators



4. Remove water temperature regulators (6).

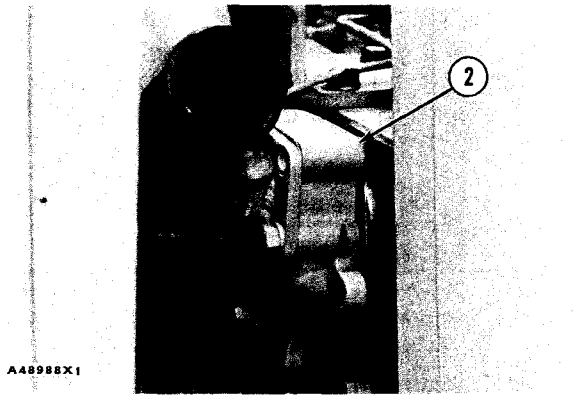
Install Water Temperature Regulators 1355-012



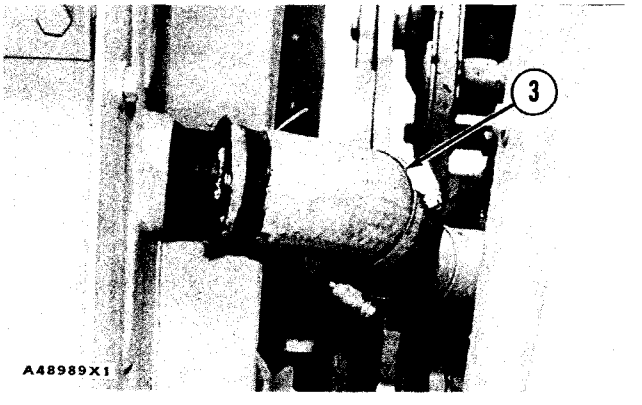
1. Install water temperature regulators (1) in the timing gear cover with the spring toward the inside as shown.

NOTICE

If the water temperature regulators are installed improperly, it will cause the engine to overheat.



2. Put housing (2) and the gasket in position, and install the bolts, washers and nuts to hold it.



3. Install hose (3), and tighten the clamps.

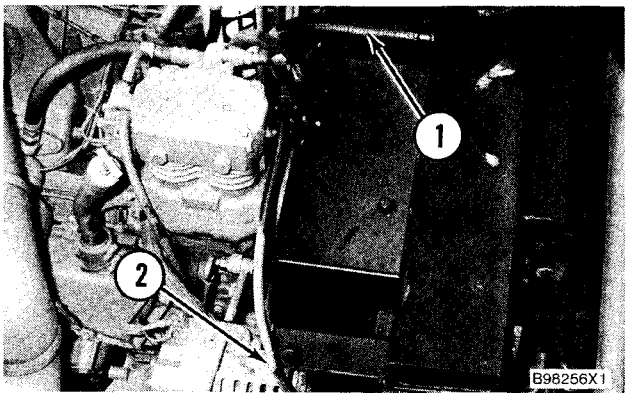
4. Fill the cooling system with coolant to the correct level. See the Maintenance Guide.

Radiator, Air Conditioner Condenser, Hydraulic Oil Cooler And Transmission Oil Cooler

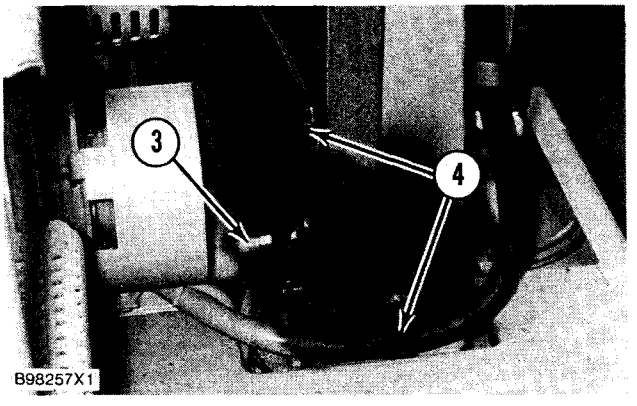
Remove Radiator, Air Conditioner Condenser, Hydraulic Oil Cooler And Transmission Oil Cooler 1353, 7320, 1374, 1375-011

Tools Needed		A
5P9736	Link Bracket	2
6V6146	Loader Leveler	1

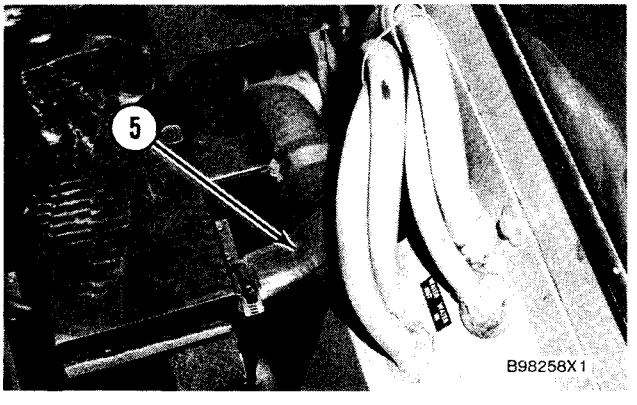
1. Open the hood for the engine compartment, and drain the cooling system.



2. Disconnect hose assembly (1) from radiator and hose clip (2) from radiator guard.

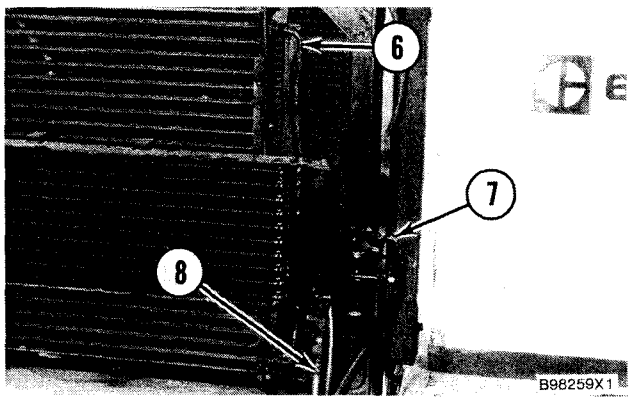


3. Disconnect lower radiator hose (3) and hose clips (4).



4. Disconnect upper radiator hoses (5).

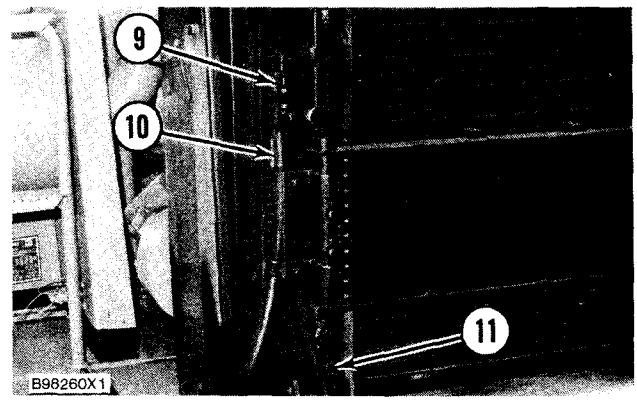
Radiator, Air Conditioner Condenser, Hydraulic Oil Cooler And Transmission Oil Cooler



⚠ WARNING

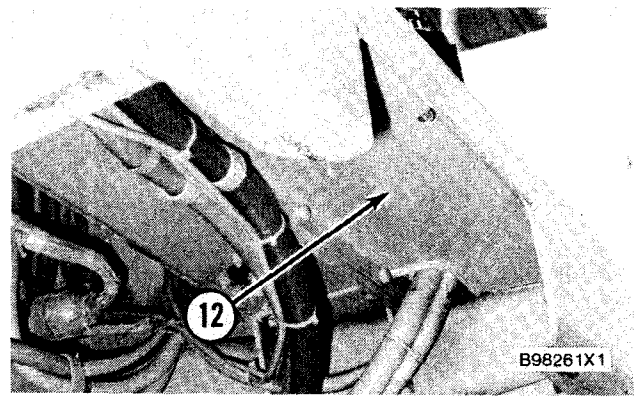
Always wear goggles when the air conditioning system is opened. This system is charged with Freon-12 (CCL2F2 Dichlorodifluoromethane) which is not toxic or flammable. But there is a reason for caution. When Freon-12 makes contact with a flame, lethal phosgene gas is made. INHALING FREON THROUGH A LIGHTED CIGARETTE CAN CAUSE VIOLENT ILLNESS. This system is under pressure at all times, engine running or not. HEAT MUST NEVER BE PUT ON A CHARGED SYSTEM. See Air Conditioning And Heating Service Manual Form No. SENR7454 for more information on procedures and safety requirements on removal and installation of lines and refrigerant from the system.

5. Disconnect hose assembly (7) from the air conditioner dryer. Disconnect hose assemblies (6) and (8) from the air conditioner condenser and transmission oil cooler.

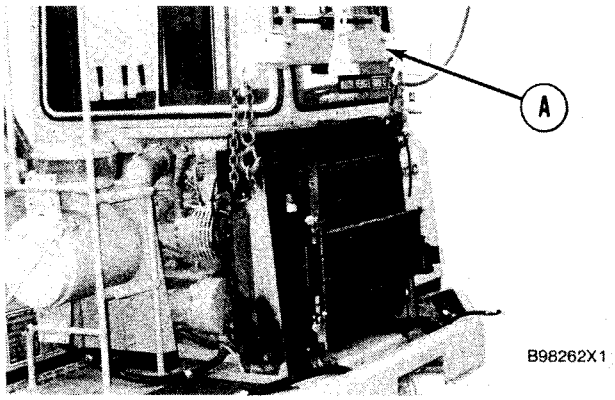


6. Disconnect hose assemblies (10) and (11) from the hydraulic oil cooler.

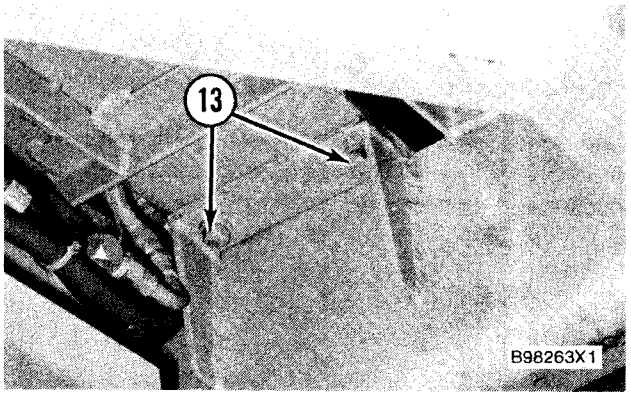
7. Remove hose assembly (9) from the transmission oil cooler.



8. Remove plate (12) from under the radiator support mounting bolts.



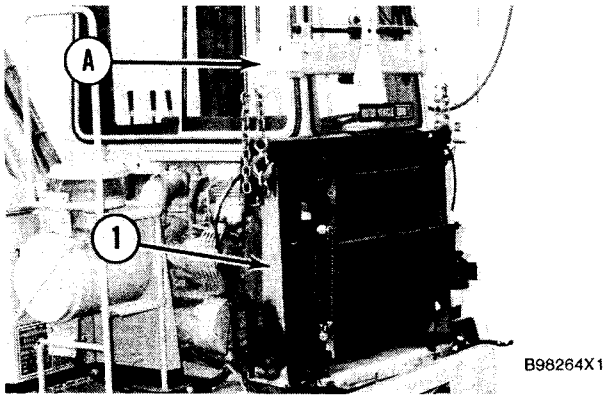
9. Install tooling (A) on the radiator assembly.



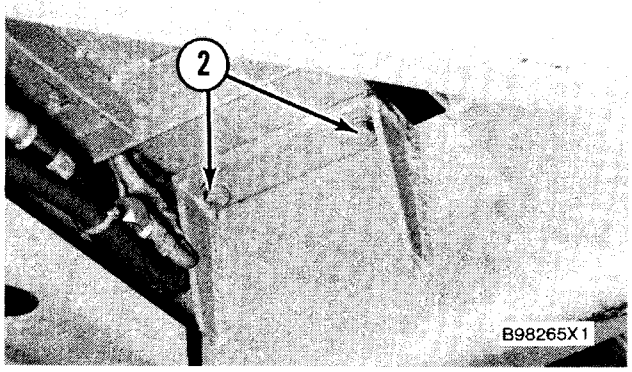
10. Remove mounting bolts (13) from each side of the radiator support. Remove the radiator assembly. The weight of the unit is approximately 200 kg (440 lb.).

Install Radiator, Air Conditioner Condenser, Hydraulic Oil Cooler And Transmission Oil Cooler 1353, 7320, 1374, 1375-012

Tools Needed		A
5P9736	Link Bracket	2
6V6146	Load Leveler	1

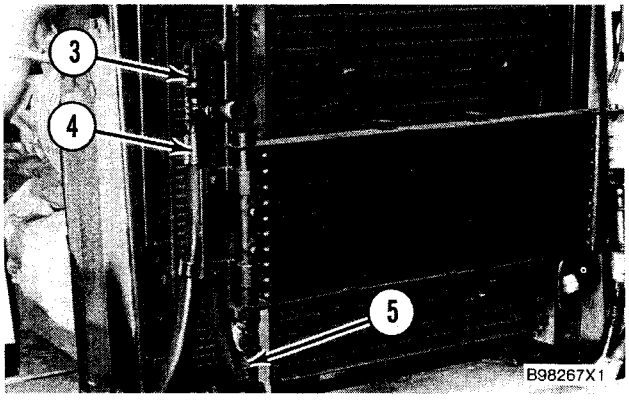


1. Attach tooling (A) to radiator assembly (1), and put radiator assembly (1) in position.

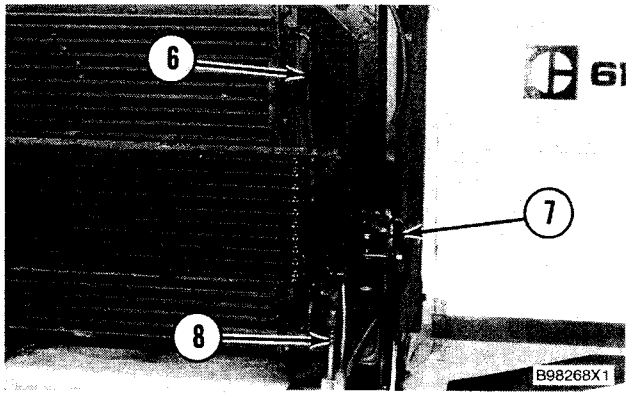


2. Install support mounting bolts (2). Install the panel.

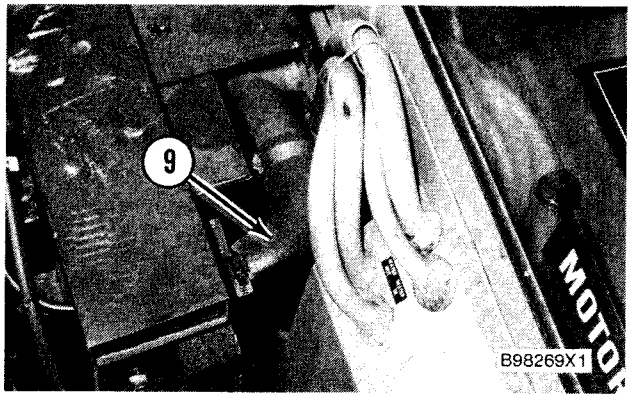
Radiator, Air Conditioner Condenser, Hydraulic Oil Cooler And Transmission Oil Cooler



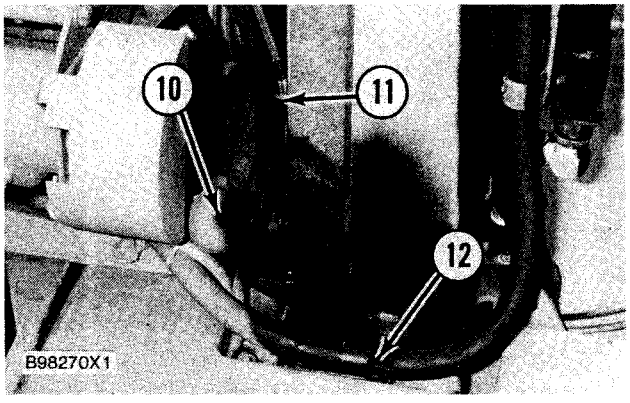
3. Connect hose assemblies (4) and (5) to the hydraulic oil cooler. Connect hose assembly (3) to the transmission oil cooler.



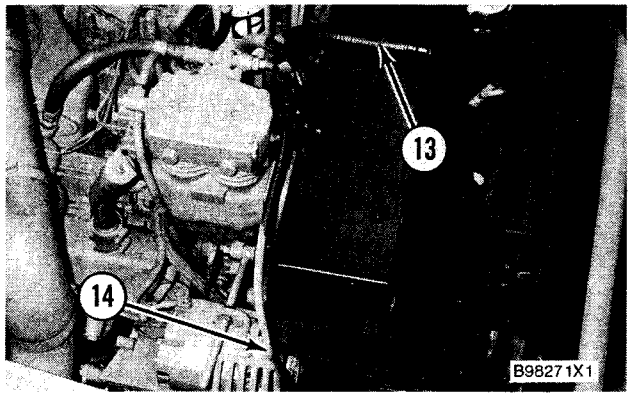
4. Connect hose assemblies (6), (8) and (7) to the condenser, transmission oil cooler and the air conditioner dryer.



5. Connect upper radiator hose (9).



6. Connect lower radiator hose (10) and hose assembly mounting clips (11) and (12).



7. Connect hose clip (14) and hose (13) to the top of the radiator.

8. See Air Conditioning And Heating Service Manual, Form No. SENR7454, for correct procedure for evacuating and charging the system.

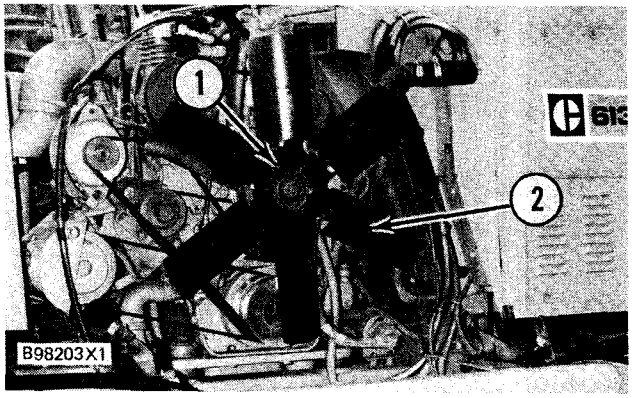
9. Fill the cooling system with coolant to the correct level. See the Maintenance Guide.

Fan And Fan Drive

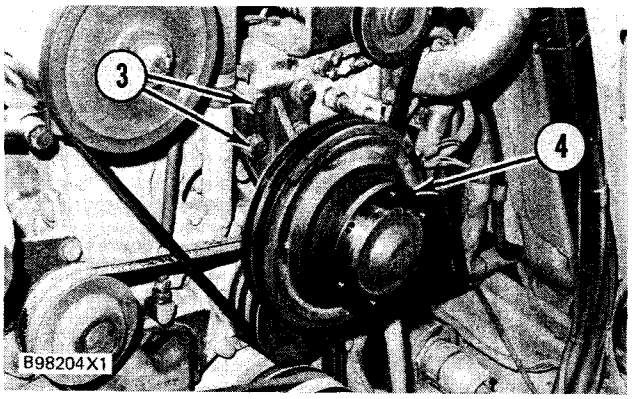
Remove And Install Fan And Fan Drive 1356 & 1359-010

START BY:

a. remove radiator, air conditioner condenser, hydraulic oil cooler and transmission oil cooler



1. Remove six bolts (1) and fan (2) from the fan drive.



2. Remove bolts (3) and fan drive (4) from the timing gear cover.

3. Install fan drive (4) on the front timing gear cover. Install fan (2) on the fan drive.

END BY:

a. install radiator, air conditioner condenser, hydraulic oil cooler and transmission oil cooler

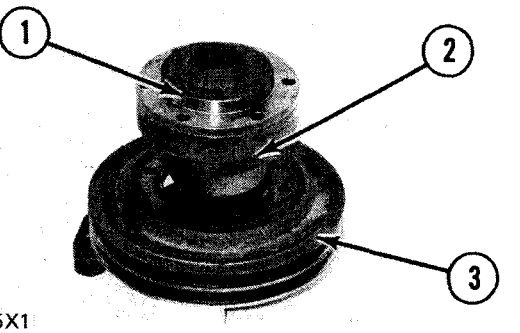
Fan Drive

Disassemble And Assemble Fan Drive 1359-017

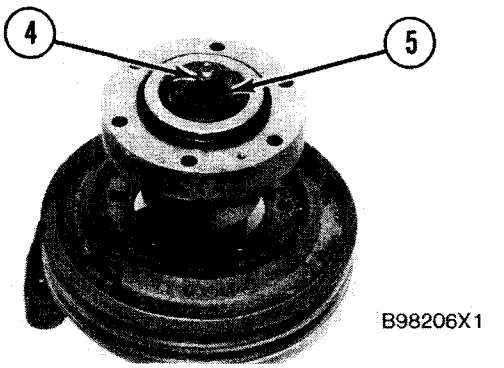
Tools Needed		A
1P510	Driver Group	1

START BY:

a. remove fan and fan drive

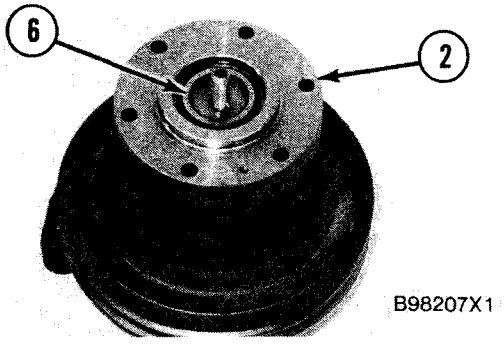


1. Slide pulley (3) from hub (2). Remove adapter (1) from hub (2).

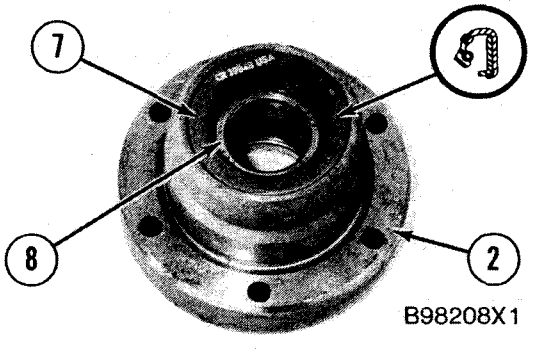


2. Remove nut (4) and washer (5).

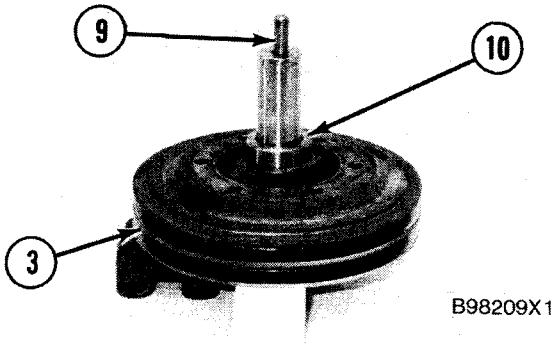
Fan Drive



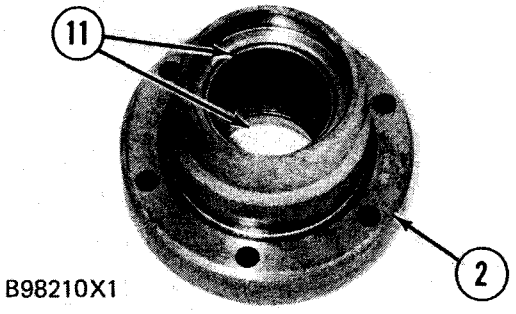
3. Remove bearing cone (6) and the spacer from the bracket assembly. Remove hub (2).



4. Remove lip-type seal (7) and bearing cone (8) from hub (2).



5. Remove bolt (9), spacer (10) and pulley (3) from the bracket assembly.



6. Remove bearing cups (11) from hub (2).

NOTE: The following steps are for the assembly of the fan drive.

7. If the bearing cups were removed, install them in hub (2) with tooling (A).

8. Install cone (8) and lip-type seal (7) in hub. The lip of the seal must be toward the inside when installed.

9. Install pulley (3), bolt (9) and spacer (10) on the bracket assembly.

10. Put hub (2) on the bracket assembly, and install the spacer and bearing cone (8).

11. Install washer (5), nut (4) and adapter (1).

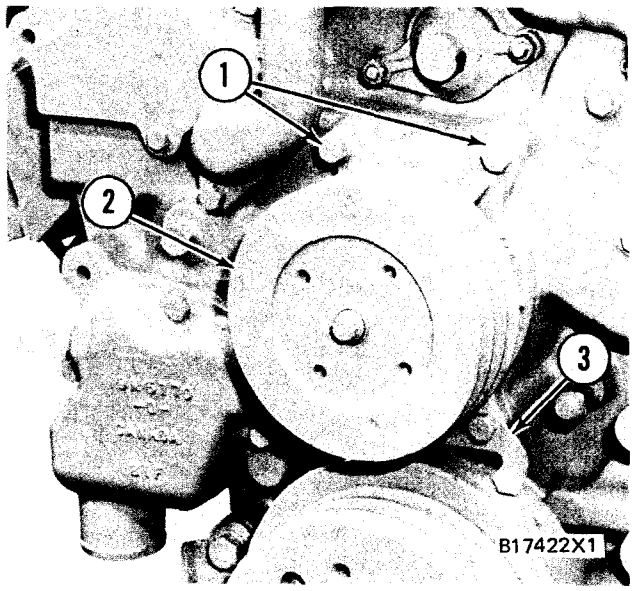
END BY:

a. install fan and fan drive

Water Pump

Remove Water Pump 1361-011

1. Remove the fan. See Remove Fan And Fan Drive.

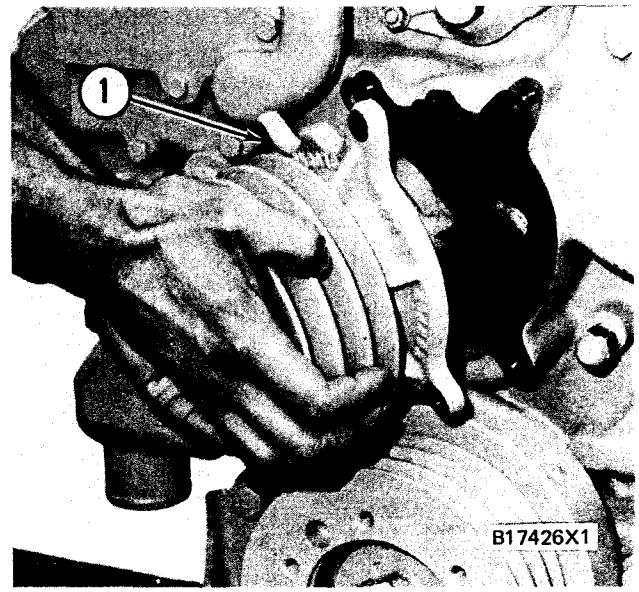


2. Drain the coolant from the cooling system.

3. Loosen the tension on the V-belts, and disconnect the V-belts from the water pump pulley.

4. Remove bolts (1) and pointer (3). Remove water pump (2) from the timing gear cover.

Install Water Pump 1361-012



1. Put the gasket and water pump (1) in position in the timing gear cover.

2. Install the pointer and bolts to hold the water pump.

3. Put the V-belts in position on the engine.

4. Make an adjustment to the belt tension with a belt tension gauge such as a Borroughs Tool Company Part No. BU-33-95 or equivalent. The correct gauge indication is 534 ± 22 N (120 ± 5 lb.ft.) for a new belt. Operate the engine at high idle for a minimum of 30 minutes; then make another adjustment to the belt tension. The correct tension for a used belt is a gauge indication of 400 ± 44 N (90 ± 10 lb.).

NOTE: Used belt tension is for a belt which has more than 30 minutes of operation at rated speed of the engine.

5. Fill the cooling system with coolant to the correct level. See the Maintenance Guide.

6. Install fan. See Install Fan And Fan Drive.

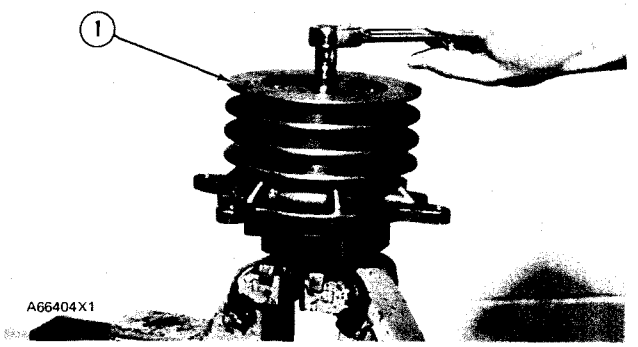
Water Pump

Disassemble Water Pump 1361-015

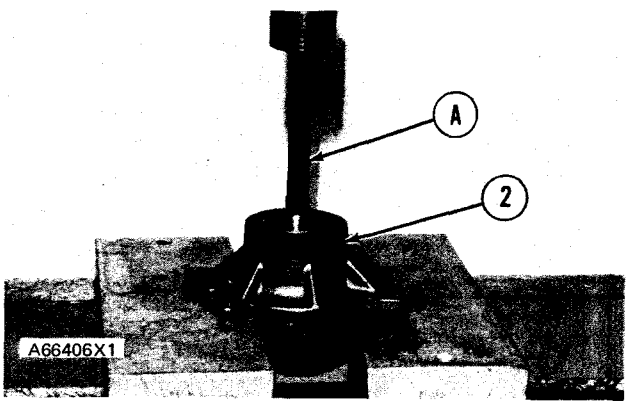
Tools Needed		A	B	C
1P529	Handle	1		
1P460	Driver Plate	1		
1P1861	Retainer Ring Pliers		1	
5P7354	Pin			1

START BY:

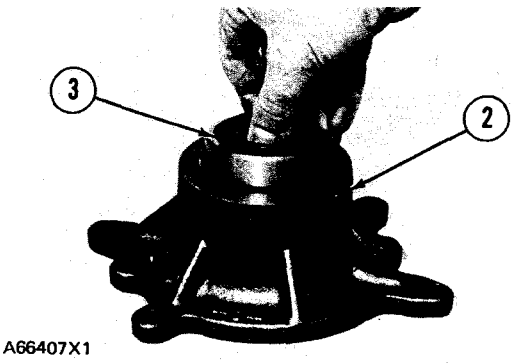
a. remove water pump



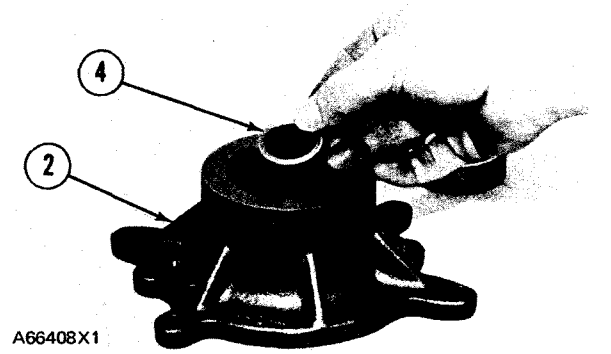
1. Hold the pump shaft in a vise as shown, and remove the bolt and pulley (1).



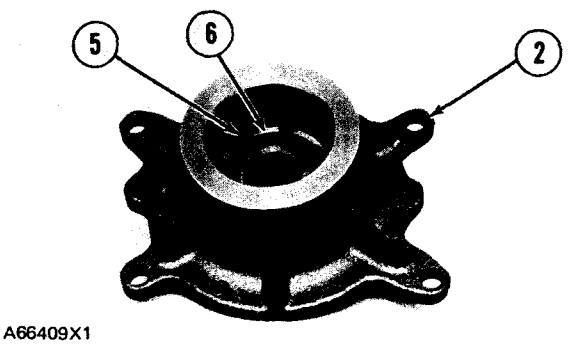
2. Use tooling (A) and a press to remove the shaft, seal and impeller from housing (2) as shown.



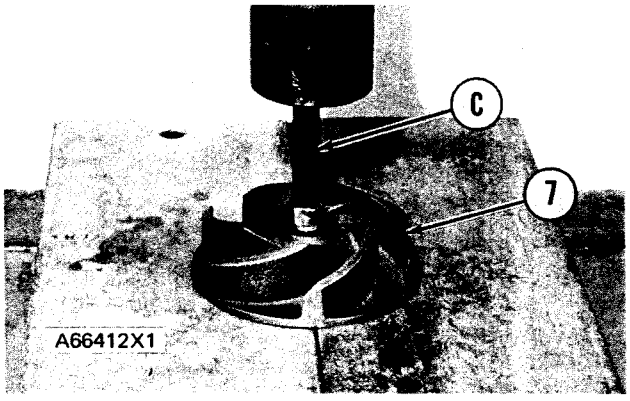
3. Remove bearing (3) from housing (2).



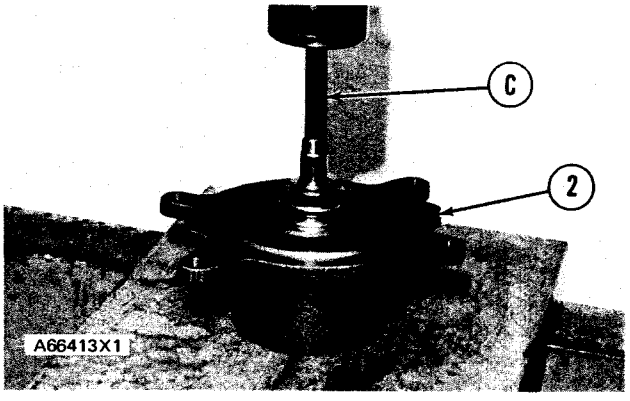
4. Remove spacer (4) from housing (2).



5. Use tool (B) to remove ring (5) from housing (2). Remove bearing (6) from housing (2).



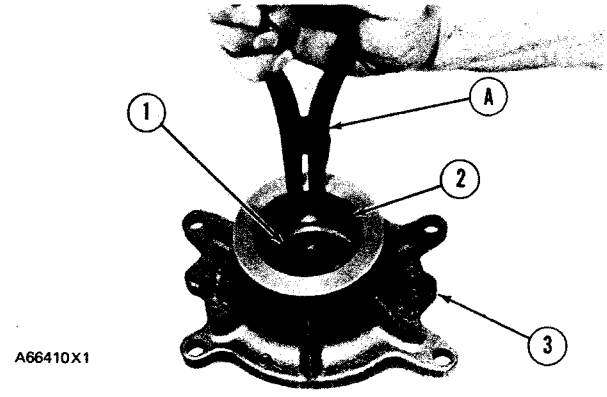
6. Use a press and tool (C) to remove the shaft and seal assembly from impeller (7) as shown.



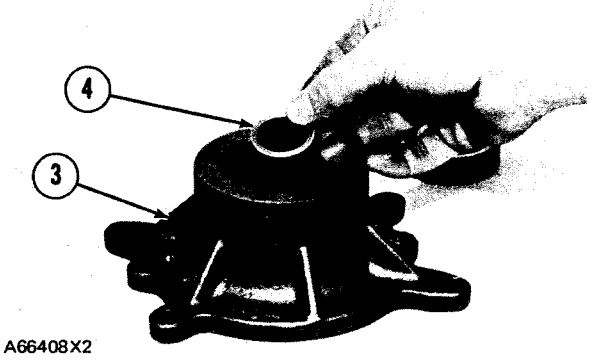
7. Install the seal assembly and shaft in housing (2) as shown. Use a press and tool (C) to remove the shaft from the seal assembly.

Assemble Water Pump 1361-016

Tools Needed		A	B	C	D	E
1P1861	Retaining Ring Pliers	1				
5P9722	Driver		1			
5P7353	Spacer			1		
5P7352	Spacer				1	
1P529	Handle					1
1P460	Driver Plate					1

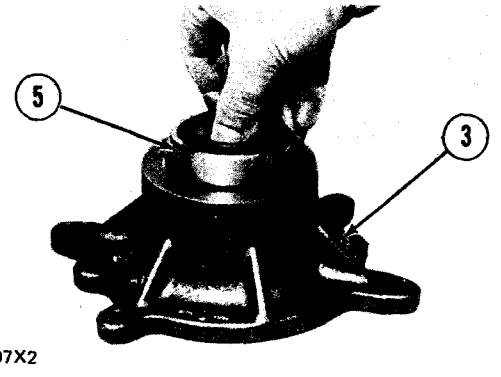


1. Install bearing (1) in housing (3). Use tool (A) to install ring (2) that holds bearing (1) in position.



2. Install spacer (4) in housing (3).

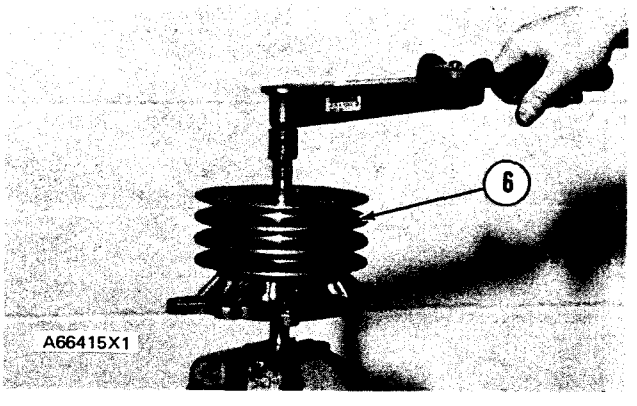
Water Pump



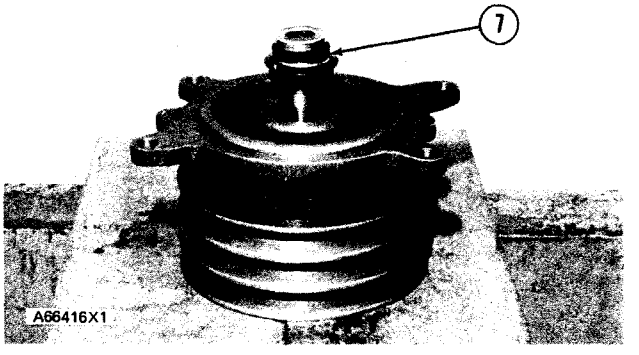
3. Make sure the outside diameter of bearing (5) and the bore in housing (3) are clean and dry. Install bearing (5) in housing (3). Fill the chamber area between the housing and outside diameter of bearing (5) with 7M7456 Bearing Mount. Remove the excess bearing mount from the housing.

4. Turn the pump housing over, and make sure that the bores in the bearings and spacer are in alignment. Install the shaft through the bearings from the impeller side of the housing.

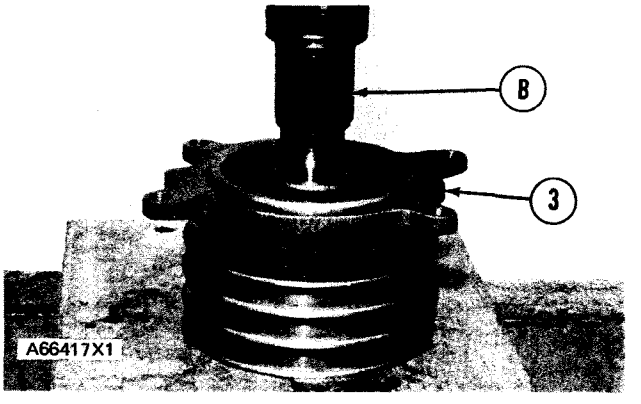
NOTE: The shaft to bearing clearance can be 0.018 mm (.0007 in.) loose to 0.008 mm (.0003 in.) tight. If it is necessary to use a press to install the shaft, make sure the inner races of the bearings have support.



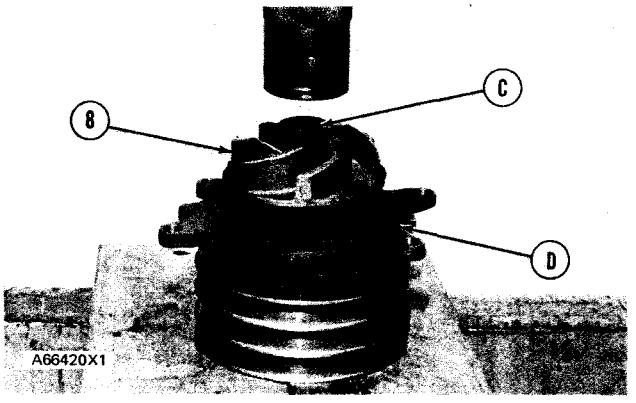
5. Install pulley (6) on the shaft, and tighten the bolt to a torque of 75 ± 7 N•m (55 ± 5 lb.ft.).



6. Put a new seal assembly (7) on the shaft as shown.



7. Use tool (B) and a press to install the seal assembly in housing (3). Do not use a hammer to install the seal.



8. Put tool (D) between impeller (8) and the pump housing.

9. Use a press and tool (C) to install impeller (8) on the shaft until tool (D) can just be moved between the housing and impeller.

10. If the impeller is installed too far and tool (D) can not be removed, turn the pump over, and remove the pulley. Use tooling (E) and press to push the shaft out of the bearings enough to remove tool (D). Install the pulley, and tighten the bolt to a torque of 75 ± 7 N•m (55 ± 5 lb.ft.).

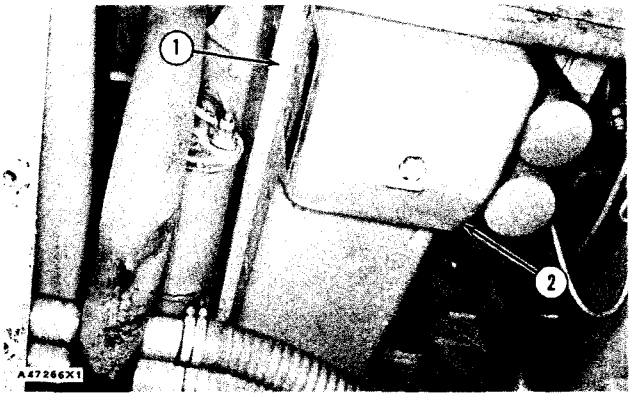
END BY:

a. install water pump

Oil Pan

Remove Oil Pan 1302-011

1. Remove the crankcase guard; then drain the oil from the oil pan.



2. Remove bolts (1) that hold oil pan (2) in position, and lower the oil pan from the machine.

3. Remove the oil pan gasket.

Install Oil Pan 1302-012

1. Put the oil pan gasket in position.

2. Lift oil pan (1) into position, and install the bolts to hold it. Tighten the bolts to a torque of 23 ± 4 N•m (17 ± 3 lb.ft.). Fill the engine with clean oil to the correct level.

3. Install the crankcase guard.

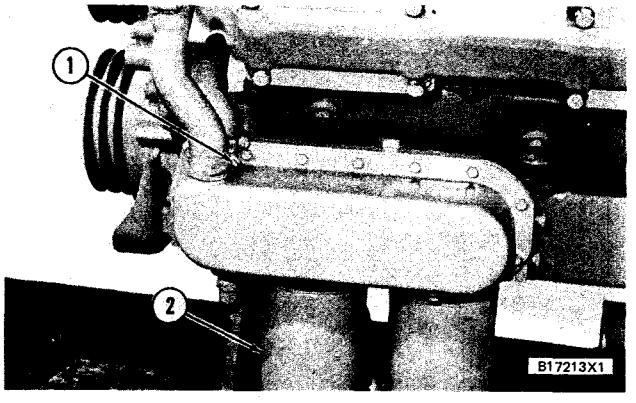
Engine Oil Cooler And Oil Filter Base

Remove Engine Oil Cooler And Oil Filter Base 1306 & 1378-011

Tools Needed		A
2P8250	Strap Wrench	1

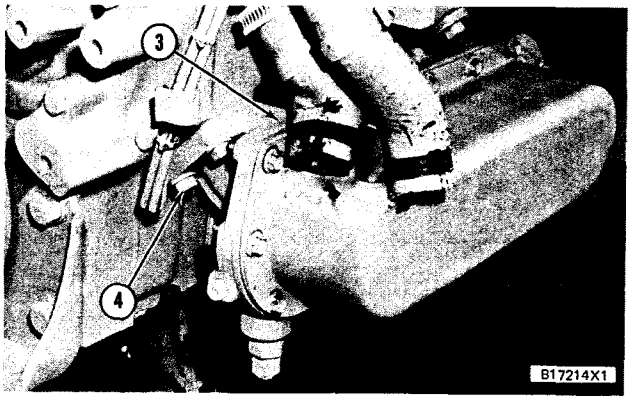
NOTE: It is not necessary to remove the oil pan.

1. Remove the coolant from the cooling system.



2. Use tooling (A), and remove oil filter (2).

3. Loosen clamps (1), and disconnect the bases.

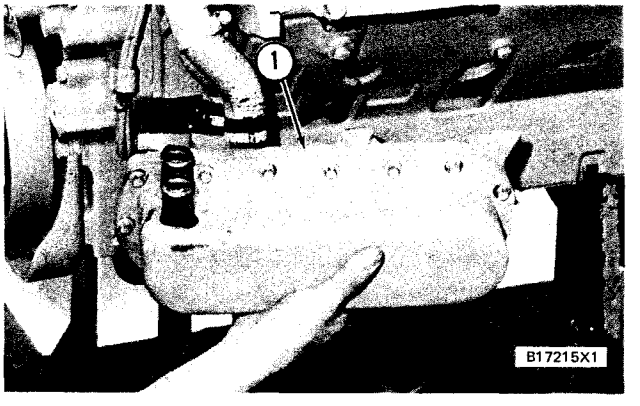


4. Remove bolt (4) and three bolts from behind the oil cooler.

5. Remove oil filter base and engine oil cooler (3) as a unit.

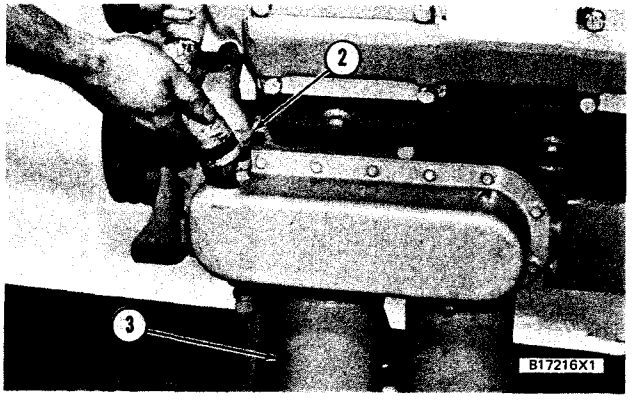
Install Engine Oil Cooler And Oil Filter Base 1306 & 1378-012

1. Inspect the O-ring seals in the oil filter base. Install new seals if needed. Put clean oil on the seals.



2. Put oil filter base and oil cooler (1) in position on the engine.

3. Install the four bolts that hold the oil cooler in place.



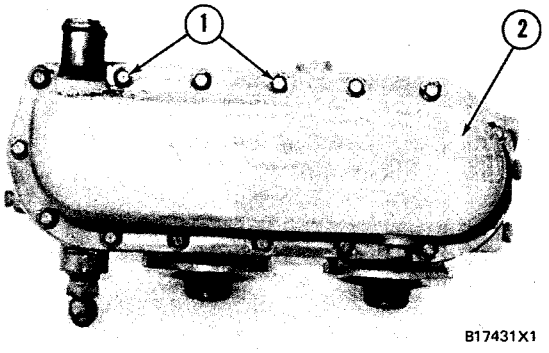
4. Connect the two hoses, and install clamps (2).

5. Install oil filters (3). See the instructions on the oil filter.

Disassemble Engine Oil Cooler And Oil Filter Base 1306 & 1378-015

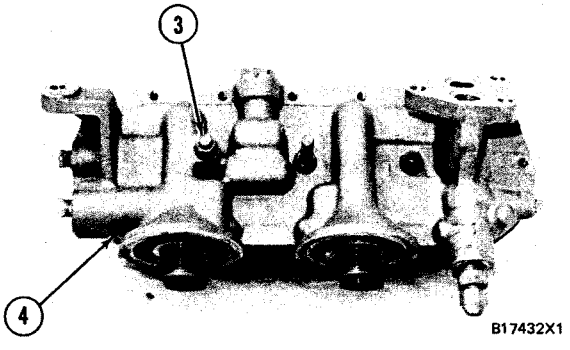
START BY:

a. remove engine oil cooler and oil filter base



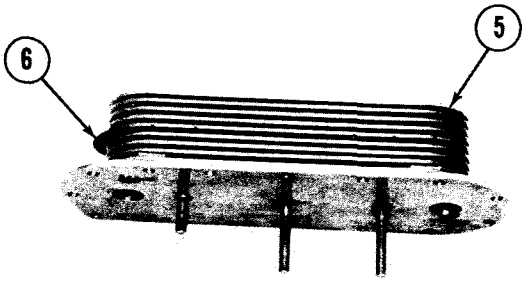
B17431X1

1. Remove bolts (1), and make a separation of cover (2) from the oil filter base.



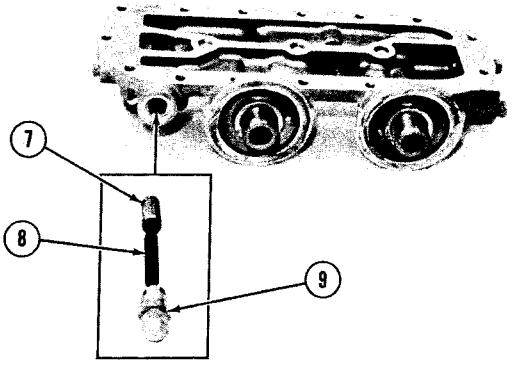
B17432X1

2. Remove nuts (3), and make a separation of the oil cooler from oil filter base (4).



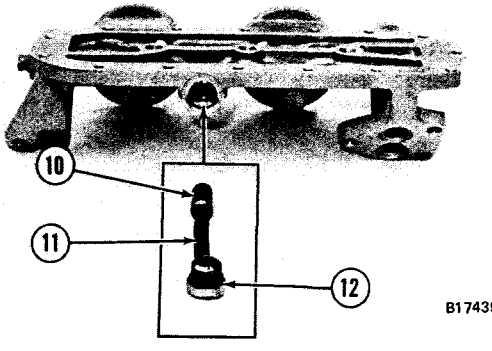
B17433X1

3. Remove divider (6) from oil cooler (5).



B17434X1

4. Remove plug (9), spring (8) and bypass valve (7).

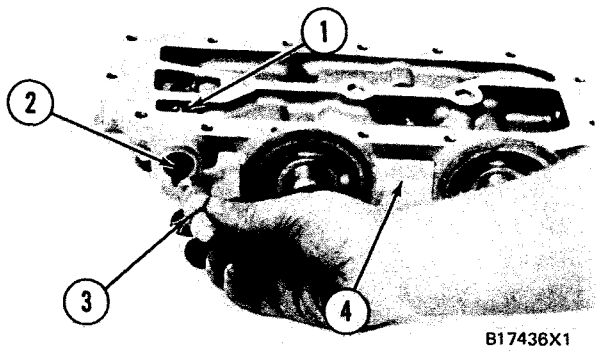


B17435X1

5. Remove plug (12), spring (11) and bypass valve (10) from the oil filter base.

Engine Oil Cooler And Oil Filter Base

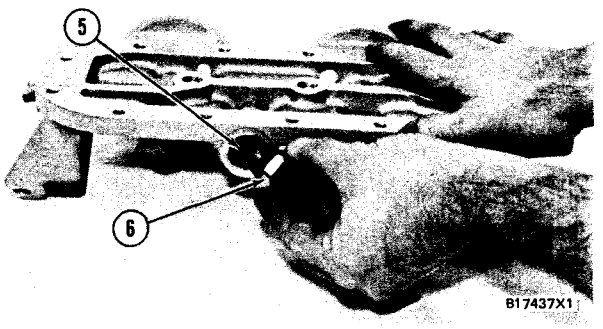
Assemble Engine Oil Cooler And Oil Filter Base 1306 & 1378-016



B17436X1

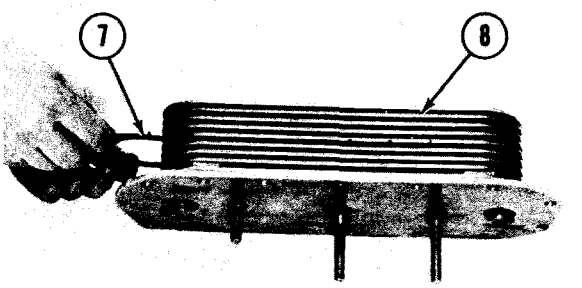
1. Put valve (1) and spring (2) in position in oil filter base (4).

2. Install plug (3).



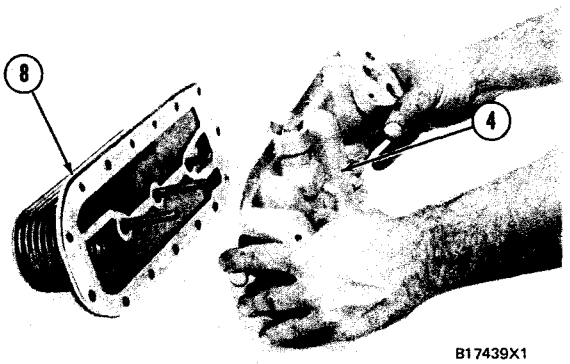
B17437X1

3. Put the valve and spring (5) in position, and install plug (6).



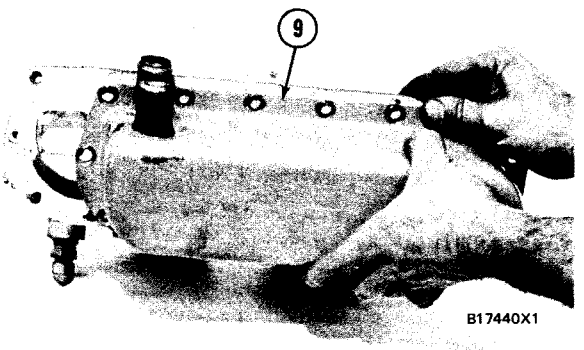
B17438X1

4. Put divider (7) in position between the fifth and sixth plates from the flange and on the same end as the short stud.



B17439X1

5. Install oil filter base (4) in position on oil cooler (8), and install the nuts. Tighten the nuts to a torque of 22 ± 3 N•m (16 ± 2 lb.ft.).



B17440X1

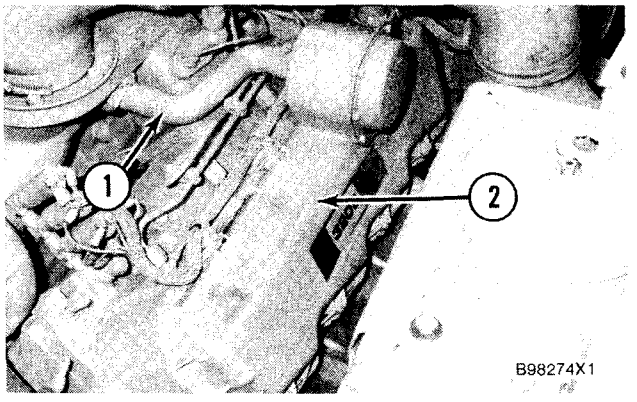
6. Install the gasket, cover (9) and the bolts.

END BY:

a. install engine oil cooler and oil filter base

Valve Covers

Remove And Install Valve Covers 1107-010



NOTE: To remove the left hand valve cover, the cab must be tilted.

1. Loosen the clamp and slide hose (1) from the crankcase ventilator valve.

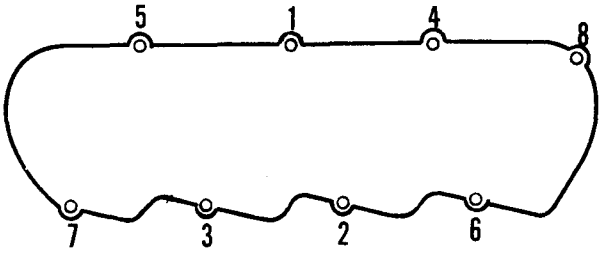
2. Remove the bolts and valve cover (2).

3. Remove the gasket from the valve cover.

NOTE: The following steps are for installation of the valve cover.

4. Put the gasket in position in the valve cover.

5. Put valve cover (2) in position, and install the bolts.



6. Tighten the bolts to a torque of 14 ± 3 N•m (10 ± 2 lb.ft.) in the sequence shown.

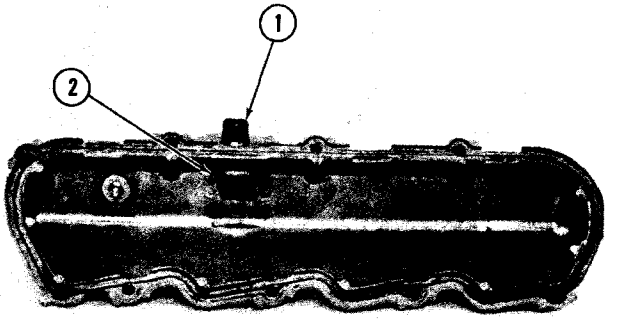
7. Connect hose (1) to the crankcase ventilator valve.

Crankcase Ventilator Valve

Remove Crankcase Ventilator Valve 1074-011

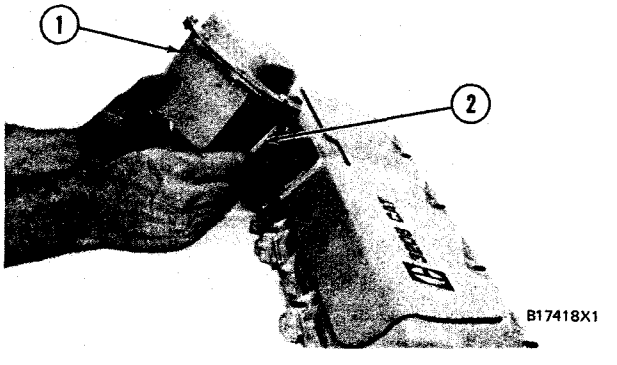
START BY:

a. remove valve covers



1. Remove four bolts (2), ventilator valve (1) and the gasket.

Install Crankcase Ventilator Valve 1074-012



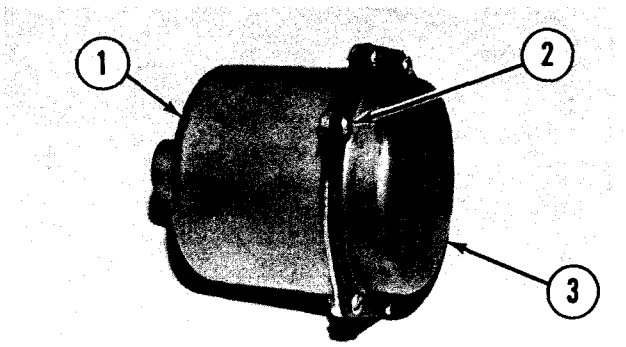
1. Put gasket (2) and ventilator valve (1) in position.

2. Install the bolts, and tighten them to a torque of 3.4 ± 0.5 N•m (30 ± 4 lb.in.).

Crankcase Ventilator Valve

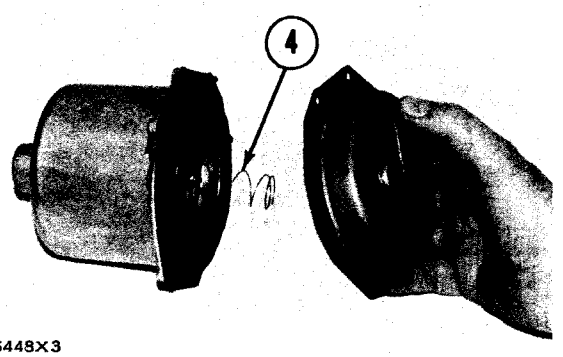
Disassemble Crankcase Ventilator Valve 1074-015

NOTE: The crankcase ventilator valve can be disassembled while installed on the engine. The valve was removed for better photo illustration.



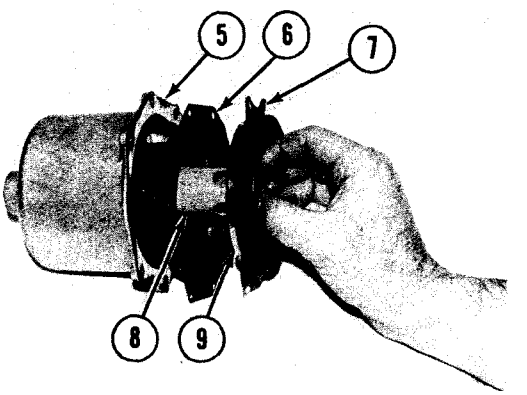
76447X2

1. Remove screws (2) that hold cover (3) on housing (1).



76448X3

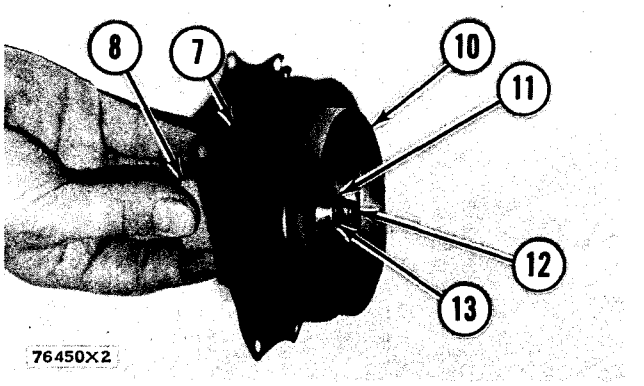
2. Remove cover (3) and spring (4) from the housing.



76449X2

3. Remove the piston, sleeve (8), retainer (9) and diaphragm (7) from the housing as a unit.

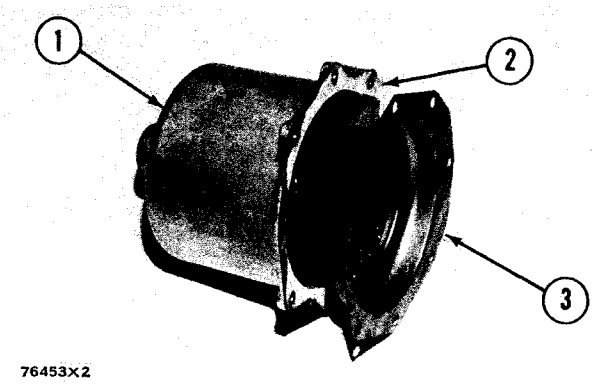
4. Remove inner sleeve (6) and gasket (5) from the housing.



76450X2

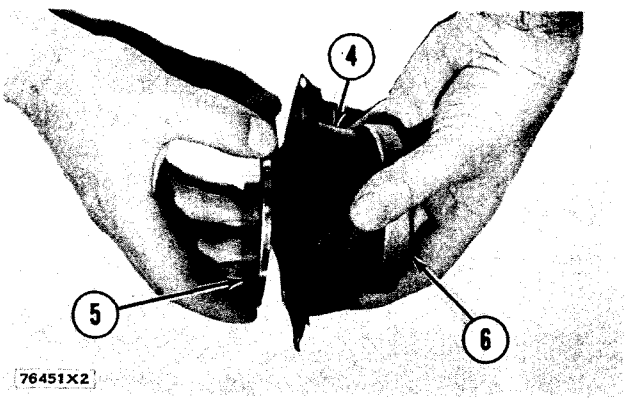
5. Remove nut (12), washer (13), spacer (11), piston (10), diaphragm (7) and the retainer from sleeve (8).

Assemble Crankcase Ventilator Valve 1074-016



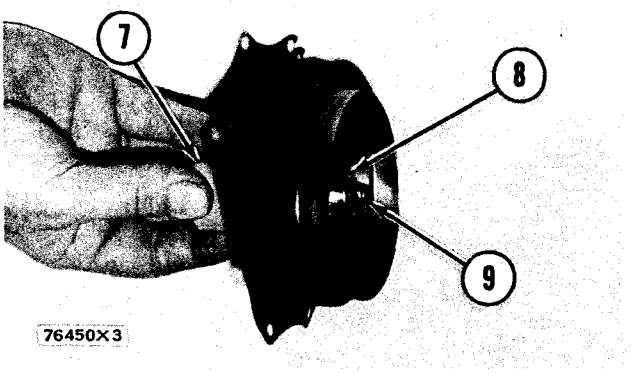
1. Put 5H2471 Gasket Cement on both sides of gasket (2). Install the gasket on housing (1).

2. Install inner sleeve (3) in the housing.



3. Put piston (6) in position next to the side of diaphragm (4) that has identification "PISTON SIDE".

4. Put retainer (5) in the diaphragm.



5. Put the screw through sleeve (7), retainer, diaphragm and the piston.

6. Install spacer (8), washer and nut (9) on the screw.

7. Put 5H2471 Gasket Cement on the contact surfaces of the diaphragm. Install the sleeve, retainer, diaphragm and piston in the inner sleeve and housing.

8. Put the spring and cover in position on the housing, and install the screws that hold the cover in place.

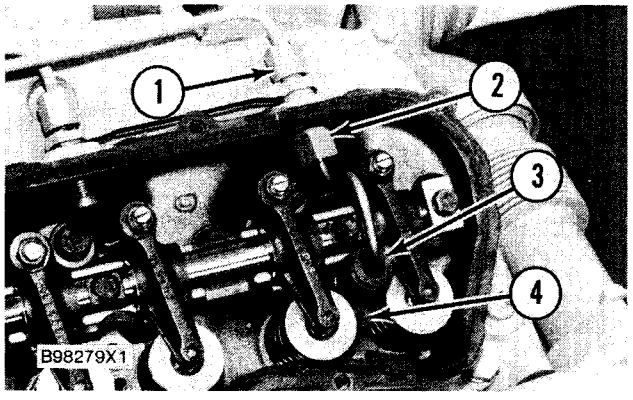
Fuel Injection Nozzles

Remove And Install Fuel Injection Nozzles 1254-010

Tools Needed		A	B
8S2242	Nozzle Test Group	1	
8S2252	Carbon Seal Installation Tool		1

START BY:

a. remove valve cover



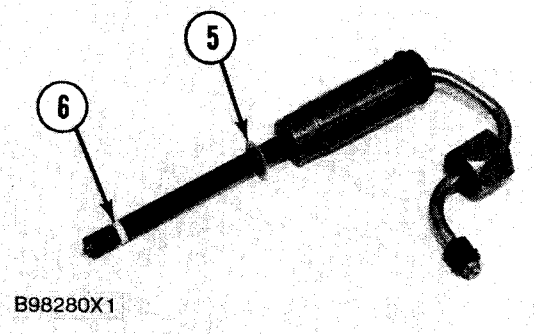
1. Thoroughly clean the area around each of the fuel line connections. Disconnect fuel line connection (1). Disconnect fuel injection nozzle fitting (2) from the adapter.

2. Remove bolt (4), the clamp and spacer that hold the fuel injection nozzle in place.

NOTICE

Never use force to remove the fuel injection nozzles. If necessary, turn and pull the fuel injection nozzles out of the cylinder head.

3. Slide the adapter from the cylinder head, and remove fuel injection nozzles (3).



4. Remove carbon seal dam (6) and compression seal (5).

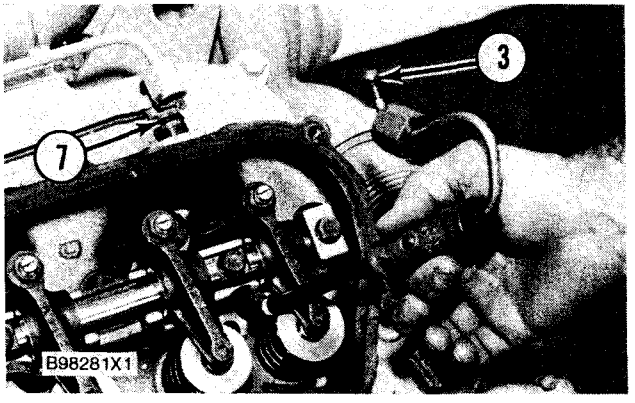
NOTE: The following steps are for installation of the fuel injection nozzles.

NOTICE

Before the fuel injection nozzles are installed, check for fuel leakage, the pressure at which the injection nozzle opens, and the amount of fuel (spray pattern) that comes out of the nozzle with tool (A). See Testing Fuel Injection Nozzles in Testing And Adjusting.

5. Install a new compression seal (5). Install a new carbon seal dam (6) with tool (B).

6. Make sure the bore in the cylinder head and the fuel inlet fittings are clean.



7. Install new O-ring seals on adapter (7) and fuel injection nozzle (3).

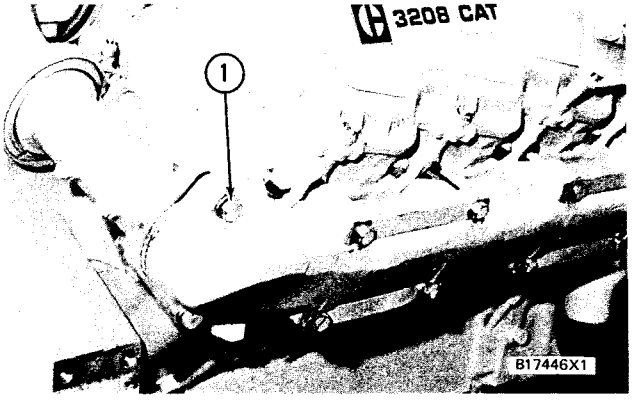
8. Install the fuel injection nozzle in the cylinder head. Never put lubricant on the nozzle or bore in the cylinder head.

9. Install the adapter in the cylinder head. Connect the nozzle and fuel injection line to the adapter. Tighten the nuts to a torque of 40 ± 7 N•m (30 ± 5 lb.ft.).

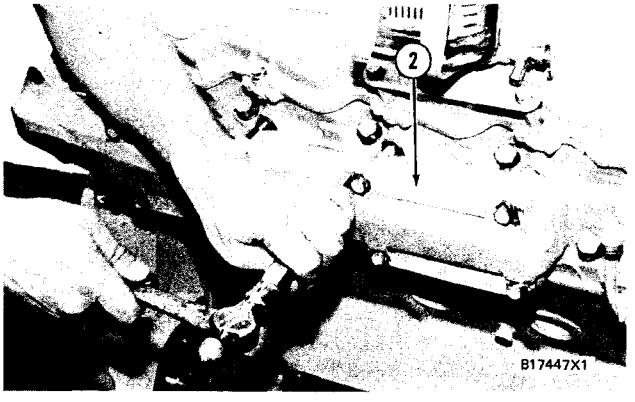
10. Install the spacer and clamp that hold the nozzles in the cylinder head.

Exhaust Manifolds

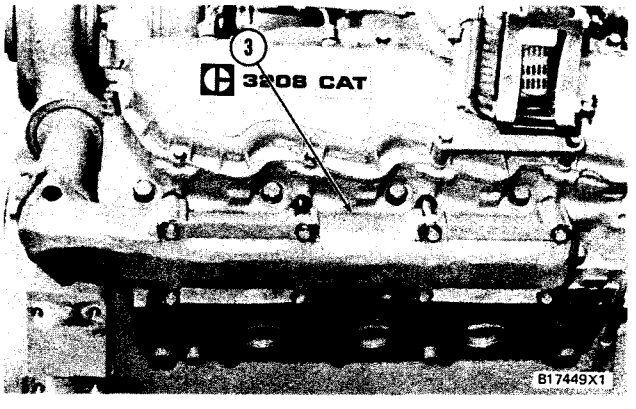
Remove Exhaust Manifolds 1059-011



1. Remove two bolts (1) from the flanges.



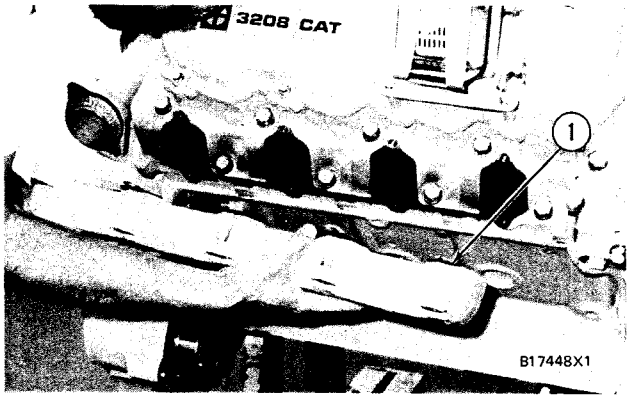
2. Bend the tabs back on locks (2).



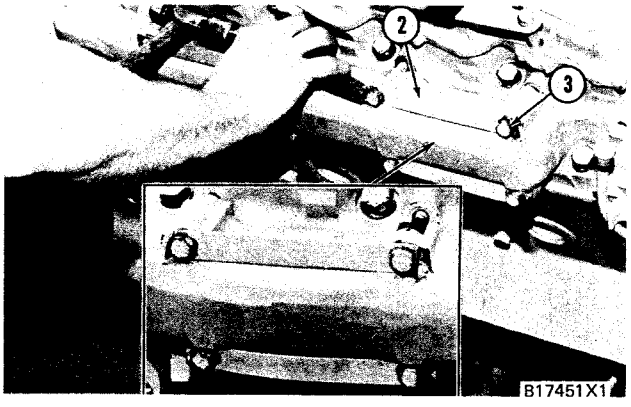
3. Remove the bolts, exhaust manifold (3) and the gasket.

Exhaust Manifolds

Install Exhaust Manifolds 1059-012



1. Put the gasket and exhaust manifold (1) in position.

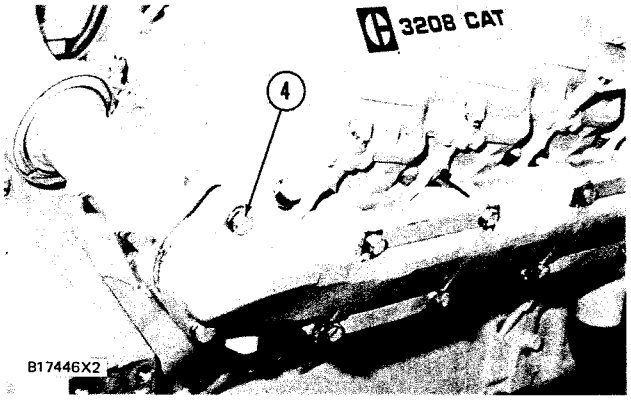


NOTE: Put 5P3931 Anti-Seize Compound on the bolt threads.

2. Install locks (2) and bolts (3).

3. Tighten the bolts to a torque of 43 ± 7 N•m (32 ± 5 lb.ft.).

NOTE: The locks must be bent on a flat side of the bolt head. Bolts must be turned no more than 30° of a turn (in the direction of increased torque only) for the alignment of the locks with a flat side of the bolt head.



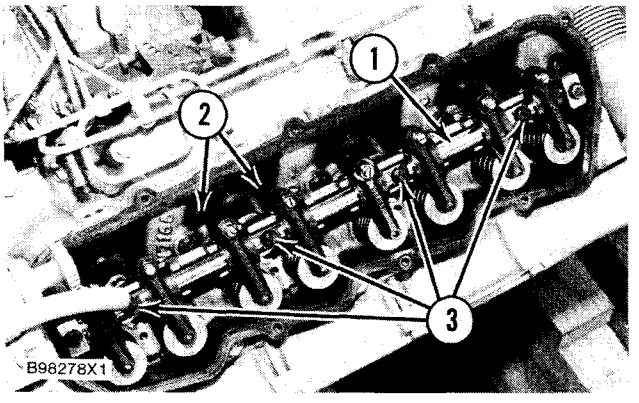
4. Put bolts (4) and the flange in position. Install the nuts.

Rocker Shafts And Push Rods

Remove And Install Rocker Shaft And Push Rods 1102 & 1208-010

START BY:

a. remove fuel injection nozzles



1. Remove four bolts (3) and the rocker shaft (1) from the cylinder head.

2. Put identification marks on the push rods as to their location in the engine. Remove push rods (2).

3. Inspect all components, and make any replacements if necessary.

NOTE: The following steps are for installation of the rocker shaft and push rods.

4. Install push rods (2) in their original locations in the engine. New push rods can be mixed. Put rocker shaft (1) in position on the engine. Tighten the bolts to a torque of 24 ± 7 N•m (18 ± 5 lb.ft.).

5. Make an adjustment until the intake valve clearance is 0.38 mm (.015 in.) and the exhaust valve clearance is 0.64 mm (.025 in.). Tighten the locknuts to a torque of 33 ± 7 N•m (24 ± 5 lb.ft.). For valve adjustment procedure see Valve Clearance Setting in Form No. SENR2764.

END BY:

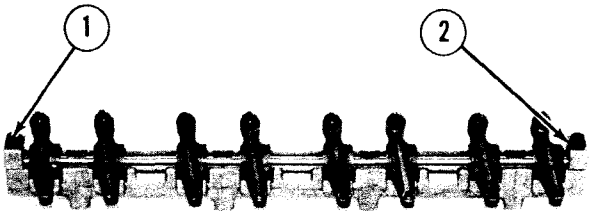
a. install fuel injection nozzles

Rocker Shafts

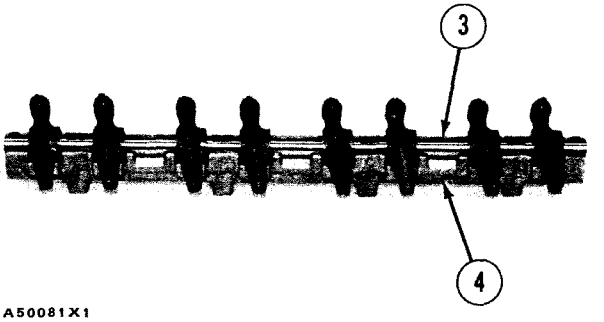
Disassemble Rocker Shafts 1102-015

START BY:

a. remove rocker shafts and push rods

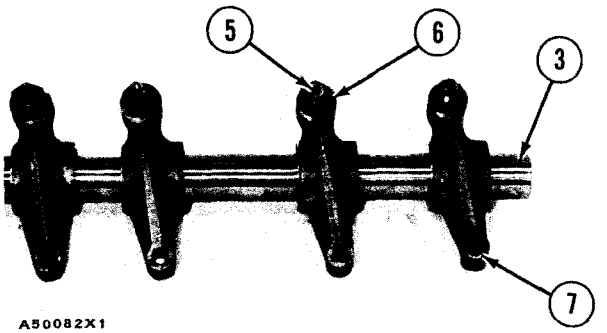


1. Remove bolts (1), locks (2) and the washers from each end of the rocker shaft.



2. Remove shaft (3) from bracket (4).

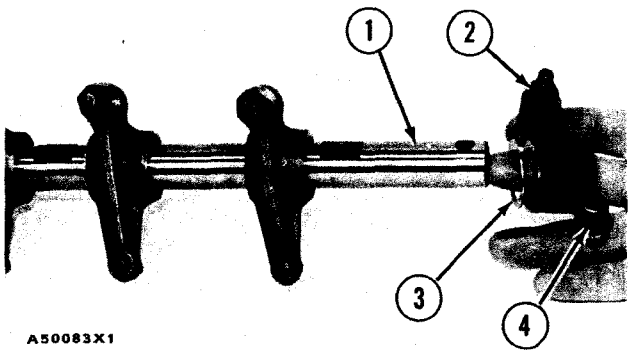
Rocker Shafts



3. Remove rocker arm assemblies (7) and the washers from shaft (3).

4. Remove screw (5) and nut (6) from rocker arm assemblies (7).

Assemble Rocker Shafts 1102-016



1. Make sure the oil holes in the rocker arm assemblies, rocker shaft and bracket are clean and free of all dirt and foreign material.

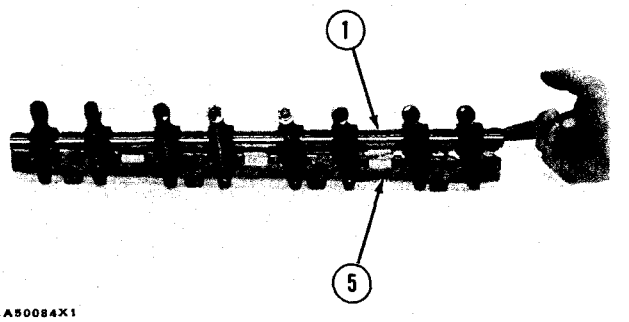
2. Measure the bore of the bushing in each of the rocker arms. The bore must be 21.852 ± 0.020 mm (.8603 ± .0008 in.). The maximum permissible bore is 21.920 mm (.8630 in.).

NOTE: Make a replacement of the arm and bushing as a unit if the bore is not correct. The arms and bushings can not be ordered separately.

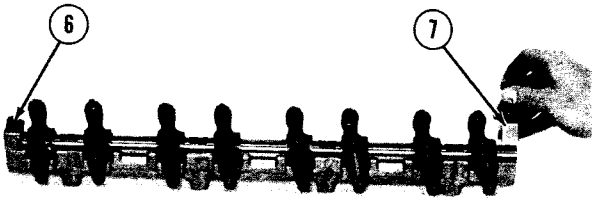
3. Measure the diameter of the shaft at each of the rocker arm locations. The diameter must be 21.793 to 21.814 mm (.8580 to .8588 in.). The minimum permissible diameter is 21.768 mm (.8570 in.).

4. Install the screws and nuts (2) into rocker arm assemblies (4). Turn the screws until they are 11.2 mm (.44 in.) below the bottom of the rocker arm assemblies.

5. Install the rocker arm assemblies and washers (3) on shaft (1) as shown.



6. Put shaft (1) and the rocker arm assemblies in position on bracket (5) with the adjustment screws on the same side as the oil hole on the bottom of the bracket.



A50085X1

7. Make sure the flat surfaces on shaft (1) are turned up. Install locks (7), the washers and bolts (6). Tighten the bolts to a torque of 24 ± 7 N•m (18 ± 5 lb.ft.).

END BY:

a. install rocker shafts and push rods

Cylinder Heads

Remove Cylinder Heads 1101-011

Tools Needed		A	B
6V116	Water Sleeve Tool	1	
5P9736	Link Bracket		2

START BY:

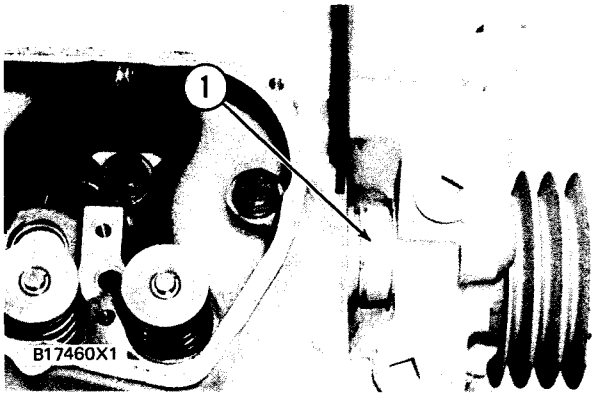
a. remove exhaust manifold

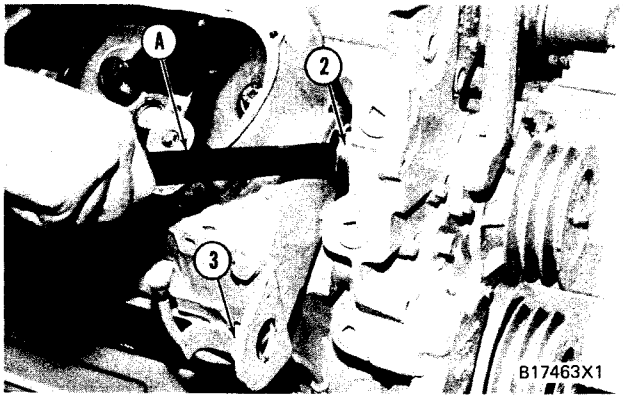
b. remove air inlet manifold

c. remove fuel injection lines

d. remove fuel injection nozzles

1. Remove the coolant from the cooling system.

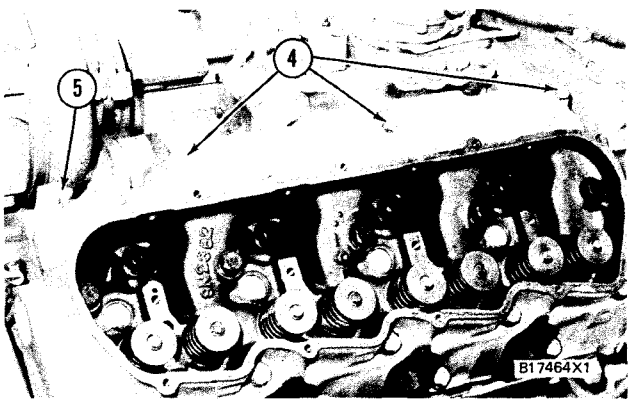




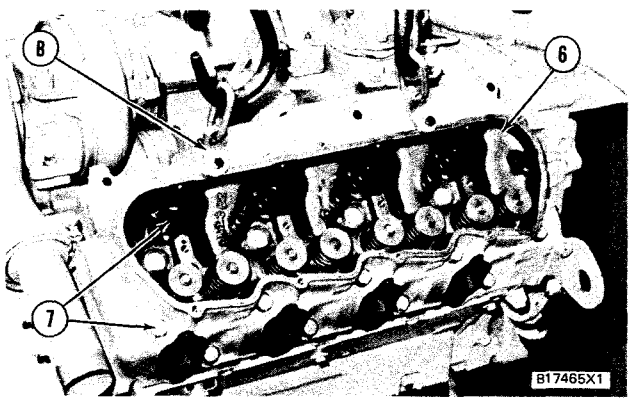
2. Remove clamp (2) from water sleeves (1) in each cylinder head. Push the water sleeves into the timing gear cover with tool (A) and a screwdriver.

3. Remove bolt (3) from the bracket on the dipstick tube.

Cylinder Heads



4. Remove bolts (4) and stud (5) from the heads.



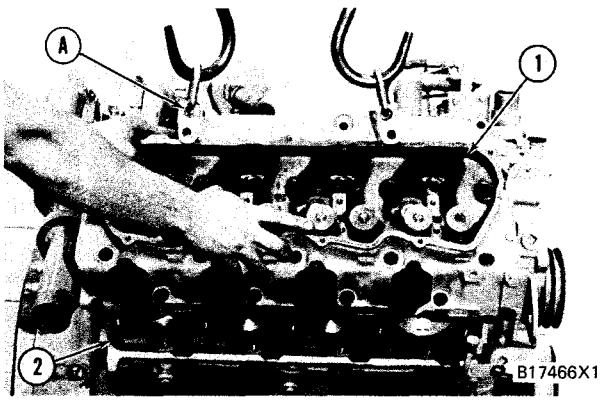
NOTICE

Make sure the fuel injection nozzles are removed before the cylinder heads are removed. The fuel injection nozzles go through the cylinder heads and the nozzle tips can be broken off if the nozzles are not removed from the heads.

5. Install tooling (B), and fasten a hoist. Remove bolts (7), cylinder head (6) and the gasket. The weight of the cylinder head is 54 kg (120 lb.).

Install Cylinder Heads 1101-012

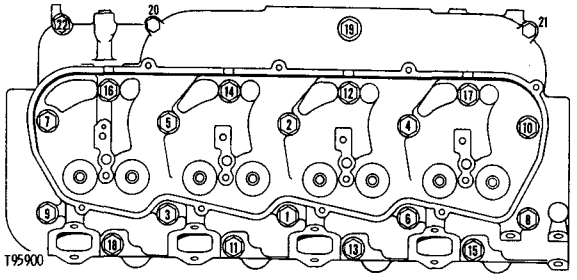
Tools Needed		A	B
5P9736	Link Bracket	2	
6V116	Sleeve Tool		1



1. Clean the contact surfaces of the cylinder head and cylinder block. Make sure the surfaces are clean and dry. Install a new cylinder head gasket.

NOTE: Clean the bore in the cylinder head for the water sleeves. Put oil on the seals on the water sleeves.

2. Install tooling (A) in the cylinder head. Fasten a hoist, and put cylinder head (1) in position on the cylinder block.



3. Put engine oil on the bolt threads, and install the bolts that hold the cylinder head in place. Tighten the bolts in the cylinder head according to the following procedure:

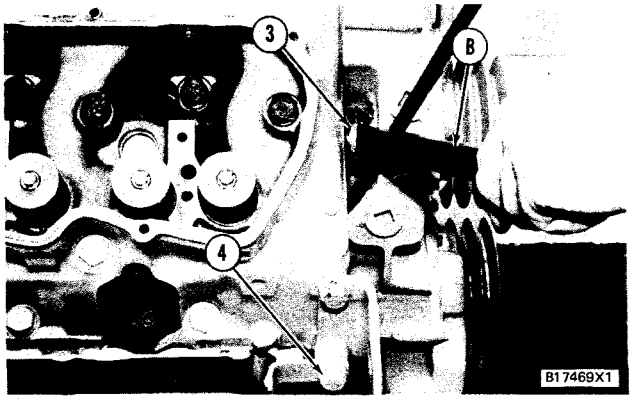
a. Tighten bolts 1 through 18 in number sequence to 80 ± 14 N•m (60 ± 10 lb.ft.).

b. Tighten bolts 1 through 18 in number sequence to 150 ± 7 N•m (110 ± 5 lb.ft.).

c. Again tighten bolts 1 through 18 in number sequence to 150 ± 7 N•m (110 ± 5 lb.ft.).

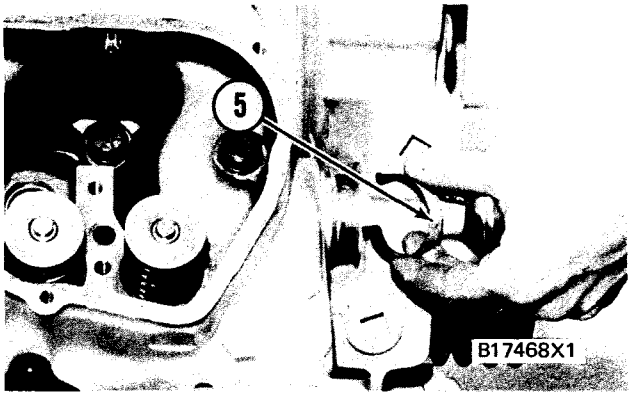
d. Torque for head bolts 19 through 22 (tighten in number sequence to) 43 ± 7 N•m (32 ± 5 lb.ft.).

Head Bolt Chart	
Location	**Length**
5, 2, 4, 10	5.25 in. (133.4 mm)
19, 20, 21	5.0 in. (127.0 mm)
16, 14, 12, 17	3.0 in. (76.2 mm)
7, 9, 3, 1, 6, 8	4.75 in. (120.6 mm)
18, 11, 13, 15	2.25 in. (57.2 mm)
22	Stud



4. Install water sleeve (3) into the cylinder head with tool (B) and a screwdriver.

5. Install bolt (4) which holds the dipstick tube to the cylinder head.



6. Install clamp (5) on the water sleeves.

7. Fill the cooling system with coolant to the correct level.

END BY:

a. install fuel injection nozzles

b. install fuel injection lines

c. install air inlet manifold

d. install exhaust manifold

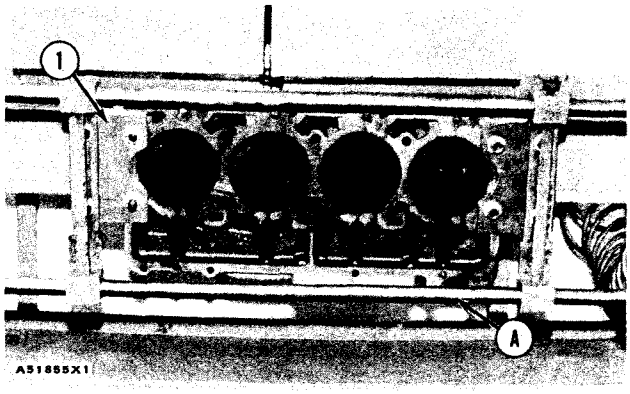
Cylinder Heads

Disassemble Cylinder Heads 1101-015

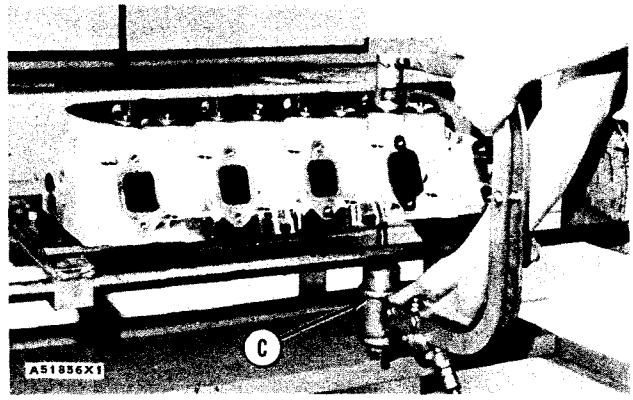
Tools Needed		A	B	C	D
FT806	Cylinder Head Stand	1			
FT967	Adapter Plate	2			
8S2263	Valve Spring Tester		1		
5S1330	Valve Spring Compressor			1	
8S7170	Valve Seat Insert Puller Group				1

START BY:

a. remove cylinder heads



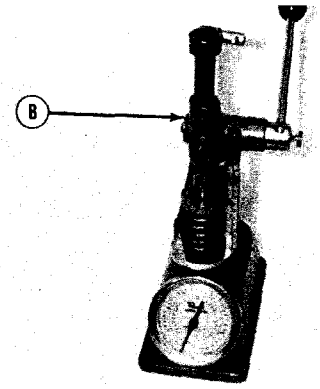
1. Fasten a hoist, and put the cylinder head in position on tool (A). Use adapter plates (1) from tooling (A) to hold the head in place.



2. Put the valve springs under compression with tool (C).

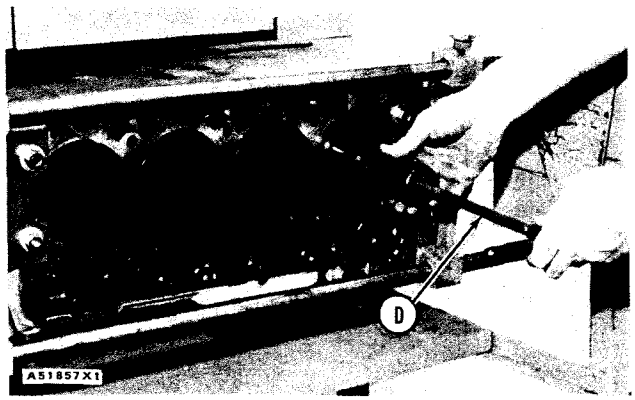
3. Remove the locks from the valves.

4. Remove tool (C), retainer, spring, washer and valve from the cylinder head. Put identification on the valve as to its location in the cylinder head.



5. Check the valve spring force with tool (B). For the correct spring force, see the subject Valves in Specifications.

6. Do Steps 2 through 5 for the remainder of the valves.

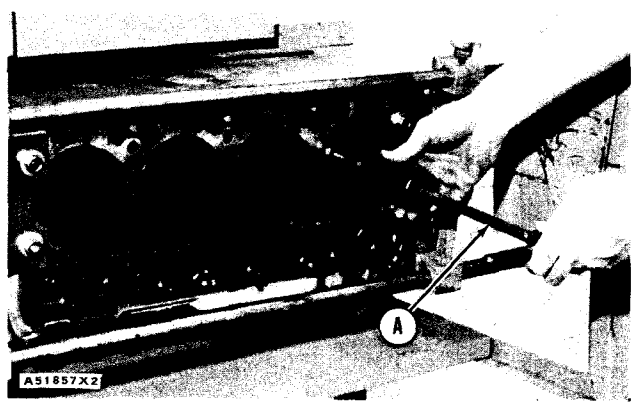


7. Remove the valve seat inserts with tooling (D).

NOTE: The valve guides are part of the cylinder head. Measure the bore in each valve guide 19.0 mm (.75 in.) from the outside edge on both ends of each valve guide. The bore must be 9.512 ± 0.013 mm (.3745 ± .0005 in.). The maximum permissible bore is 9.550 mm (.3760 in.). Valve guides worn more than the maximum specification can be made to the original size by knurling.

Assemble Cylinder Heads 1101-016

Tools Needed		A	B	C
8S7170	Valve Seat Insert Puller Group	1		
5S1322	Valve Keeper Inserter		1	
5P1330	Valve Spring Compressor			1



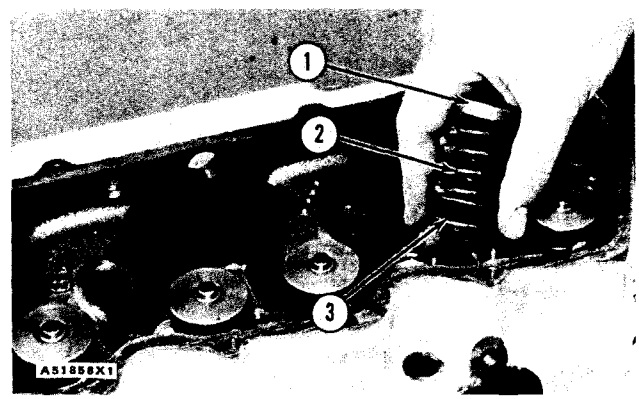
1. Clean and remove burrs and all foreign material from the valve seat bores.

NOTICE

Do not make the diameter of the extractor [part of tooling (A)] in valve seat insert larger when the insert is installed in the cylinder head.

2. Lower the temperature of the valve seat inserts, and install them with tooling (A).

3. Grind the valve inserts according to the dimensions given in Specifications.



4. Put clean engine oil on the valve stem. Install the valve, washer (3), springs (2) and retainer (1) in the cylinder head.