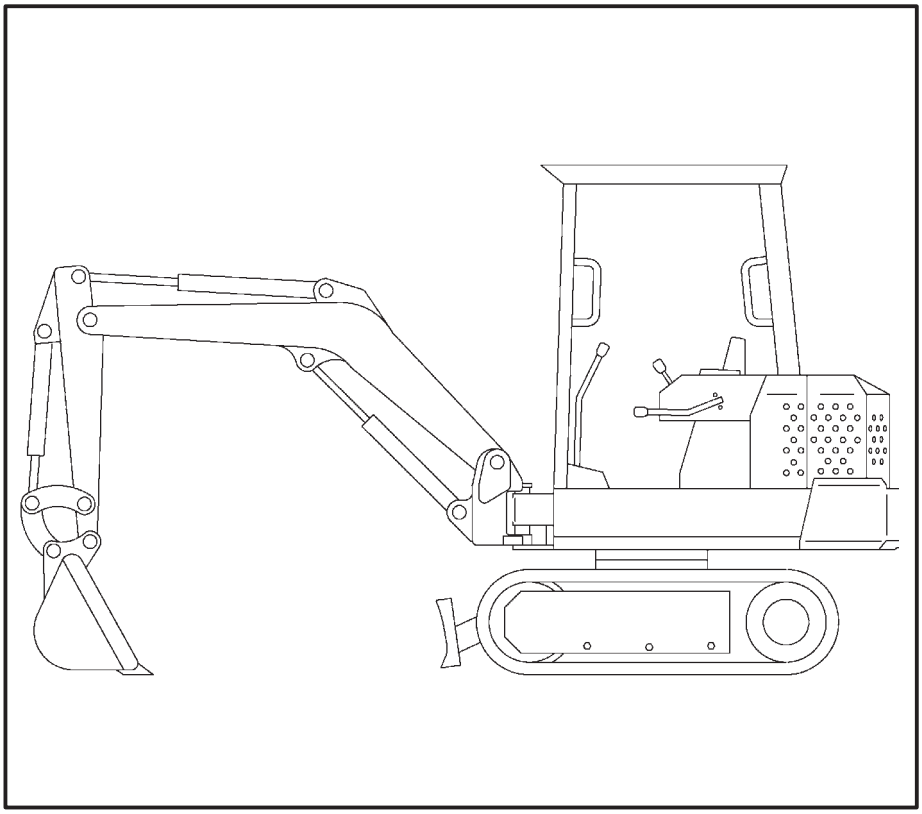
X 231

Excavator

Service Manual

(S/N 508911999 & Below)



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MELROE
INGERSOLL-RAND

6720496 (6-12)

Printed in U.S.A.

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MAINTENANCE SAFETY

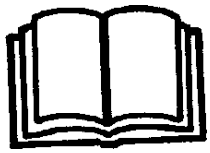
WARNING

Instructions are necessary before operating or servicing machine. Read and understand the Operation & Maintenance Manual, Operator's Handbook and signs (decals) on machine. Follow warnings and instructions in the manuals when making repairs, adjustments or servicing. Check for correct function after adjustments, repairs or service. Untrained operators and failure to follow instructions can cause injury or death.

W-2003-0903

Safety Alert Symbol: This symbol with a warning statement, means: "Warning, be alert! Your safety is involved!" Carefully read the message that follows.

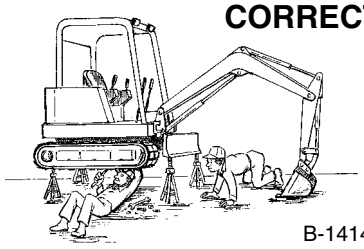
CORRECT



B-10731a

- **Never service the Bobcat Hydraulic Excavator without instructions.**

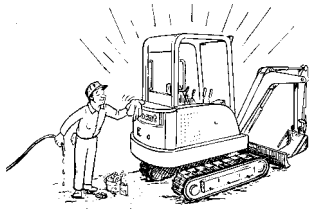
CORRECT



B-14148

- **Use the correct procedure to lif t and support the excavator.**
- **Always lift the blade fully before installing jackstands.**

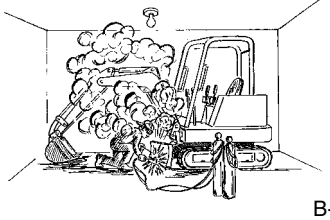
CORRECT



B-14142

- **Cleaning and maintenance are required daily.**

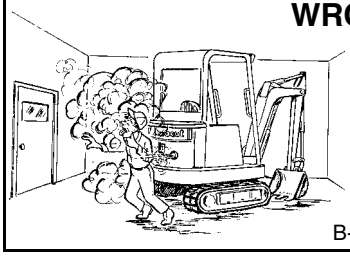
WRONG



B-14147

- **Have good ventilation when welding or grinding painted parts.**
- **Wear dust mask when grinding painted parts. Toxic dust and gas can be produced.**

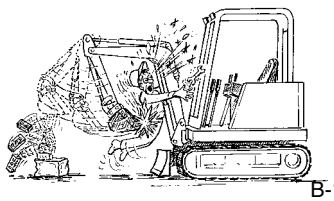
WRONG



B-14141

- **Vent exhaust to o utside when engine must be run for service.**
- **Exhaust system must be tightly sealed. Ex haust Fumes can kill without warning.**

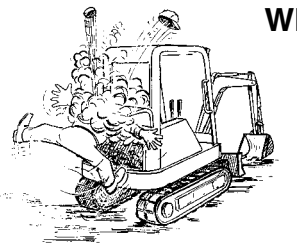
WRONG



B-14145

- **Always lower the bucket and blade to the ground before doing any maintenance.**
- **Never modify equipment or add attachments not approved by Bobcat Company.**

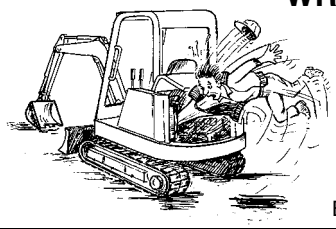
WRONG



B-14146

- **Stop, cool and clean engine of flammable materials before checking fluids.**
- **Never service or adjust machine with the engine running unless instructed to do so in the manual.**
- **Avoid contact with leaking hydraulic fluid or diesel fuel under pressure. It can penetrate the skin or eyes.**
- **Never fill fuel tank with e ngine running, while smoking or when near open flame.**

WRONG



B-14143

- **Keep body, jewelry and clothing away from moving parts, electrical contact, hot parts and exhaust.**
- **Wear eye protection to gu ard from battery acid, compressed springs, fluids under pressure and flying debris when engines are running or tools are used. Use eye protection approved for type of welding.**
- **Keep rear door closed except for service. Close and latch door before operating the excavator.**

WRONG



B-6589

- **Lead-acid batteries produce flammable and explosive gases.**
- **Keep arcs, sparks, flames and lighted tobacco away from batteries.**
- **Batteries contain acid which burns eyes or skin on contact. Wear protective clothing. If acid contacts body, flush well with water. For eye contact flush well and get immediate medical attention.**

Maintenance procedures which are given in the Operation & Maintenance Manual can be perform ed by the owner/ operator without any specific technical training. Maintenance procedures which are **not** in the Operation & Maintenance Manual must be performed **ONLY BY QUALIFIED BOBCAT SERVICE PERSONNEL. Always use genuine Bobcat replacement parts.** The Service Safety Training Course is available from your Bobcat dealer.

MSW20-0805

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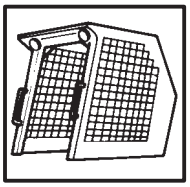
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FOREWORD

This manual is for the Bobcat hydraulic excavator mechanic. It provides necessary servicing and adjustment procedures for the hydraulic excavator and its component parts and systems. Refer to the Operation & Maintenance Manual for operating instructions, starting procedure, daily checks, etc.

A general inspection of the following items must be made after the hydraulic excavator has had service or repair:

1. Check that the ROPS/FOPS (Including sidescreens) is in good condition and is not modified.



2. Check that ROPS mounting hardware is tightened and is Melroe approved.



3. The seat belt must be correctly installed, functional and in good condition.



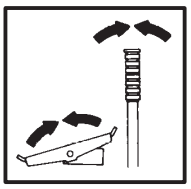
4. Inspect for loose or broken parts or connections.



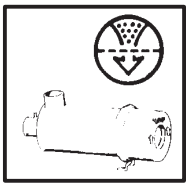
5. Machine signs must be legible and in the correct location.



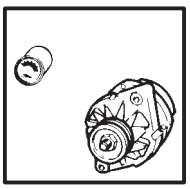
6. Steering levers, control levers and foot pedals must return to neutral. Check that foot pedals lock and control lever locks are in working condition.



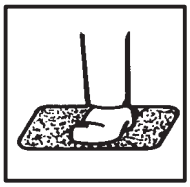
7. Inspect the air cleaner for damage or leaks. Check the condition of the element.



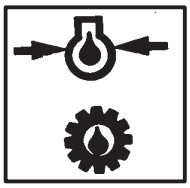
8. Check the electrical charging system.



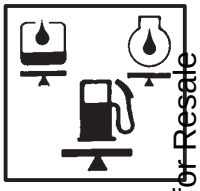
9. Safety treads must in good condition.



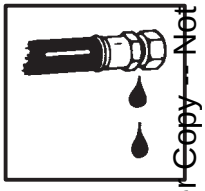
10. Check for correct function of indicator lamps (Optional on some models).



11. Check hydraulic fluid level, engine oil level and fuelsupply.



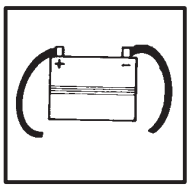
12. Inspect for fuel, oil or hydraulic fluid leaks.



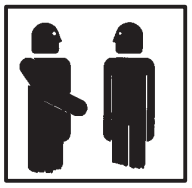
13. Lubricate the loader.



14. Check the condition of the battery and cables.



Recommend to the owner that all necessary corrections be made before the machine is returned to service.



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SAFETY INSTRUCTIONS

⚠ WARNING

Instructions are necessary before operating or servicing machine. Read Operation & Maintenance Manual, Handbook and signs (decals) on machine. Follow warnings and instructions in the manuals when making repairs, adjustments or servicing. Check for correct function after adjustments, repairs or service. Failure to follow instructions can cause injury or death.

W–2003–0797

The following publications provide information on the safe use and maintenance of the loader and attachments:

- The Delivery Report is used to assure that complete instructions have been given to the new owner and that the machine is in safe operating condition.
- The Operation & Maintenance Manual delivered with the loader gives operating information as well as routine maintenance and service procedures. It is a part of the loader and must stay with the machine when sold. Replacement Operation & Maintenance Manuals can be ordered from your Bobcat Excavator dealer.
- The excavator has machine signs (decals) which instruct on the safe operation and care. The signs and their locations are shown in the Operation & Maintenance Manual. Replacement signs are available from your Bobcat Excavator dealer.
- The CIMA Safety Manual delivered with the excavator gives information for safe operating and standard signals.
- The Service Manual and Parts Manual are available from your dealer for use by mechanics to do shop–type service and repair work.

⚠WARNING

Warnings on the machine and in the manuals are for your safety. Failure to obey warnings can cause injury or death.

W–2044–1285

IMPORTANT

This notice identifies procedures which must be followed to avoid damage to the machine.

I–2019–0284

Safety Alert Symbol: This Safety Symbol is used for important safety messages. When you see this symbol follow the safety message to avoid personal injury or death.

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SAFETY INSTRUCTIONS (Cont'd)

- Wear tight fitting clothing. Always wear safety glasses when maintaining or servicing the excavator. Safety glasses, hearing protection or excavator special application kits are required for some work. See your dealer for Melroe Safety equipment.
- Know where fire extinguishers and first aid kits are located and how to use them.
- Do not use the Bobcat excavator where exhaust, arcs, sparks or hot components can contact flammable material, explosive dust or gases.
- The engine compartment and engine cooling system must be inspected every day and cleaned if necessary to prevent a fire hazard and overheating.
- Check all electrical wiring and connections for damage. Keep the battery terminals clean and tight. Repair or replace any damaged part.
- Check fuel and hydraulic tubes, hoses and fittings for damage and leakage. Never use open flame or bare skin to check for leaks. Tighten or replace any parts that show leakage. Always clean fluid spills. Do not use gasoline or diesel fuel for cleaning parts. Use commercial nonflammable solvents.
- Follow any environmental safety regulations when disposing of used fluids such as engine oil, grease or anti–freeze.
- Do not use ether or starting fluids on an engine that has glow plugs. These starting aids can cause an explosion and injure you or bystanders.
- Always clean the excavator and disconnect the battery before doing any welding. Cover rubber hoses, battery and all other flammable parts. Keep a fire extinguisher near the excavator when welding. Have good ventilation when grinding or welding painted parts. Wear a dust mask when grinding painted parts. Toxic dust or gas can be produced.
- Stop the engine and let it cool before adding fuel. No smoking!
- Use the procedure in the Operation & Maintenance or Service Manuals for connecting the battery.

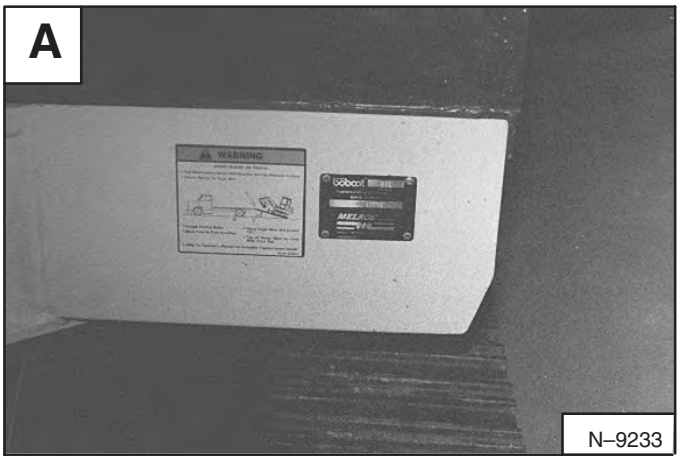
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SERIAL NUMBER LOCATIONS

Always use the serial number of the machine when requesting service information or when ordering parts. Early or later models (identification made by serial number) may use different parts, or it may be necessary to use a different procedure in doing a specific service operation.

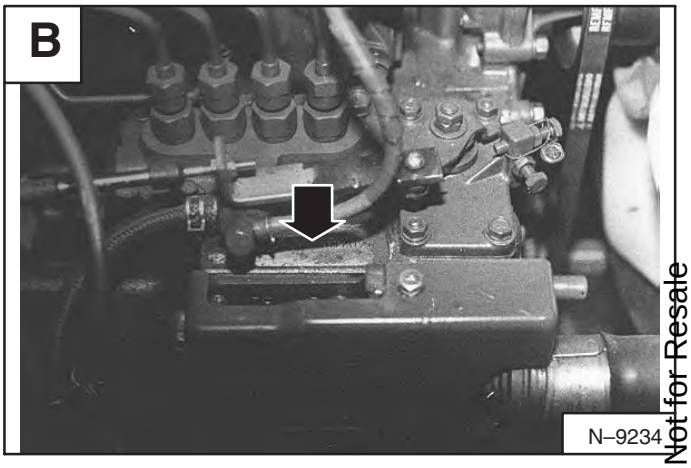
HYDRAULIC EXCAVATOR SERIAL NUMBER

The excavator serial number is on the machine frame, to the left of the boom **[A]**.



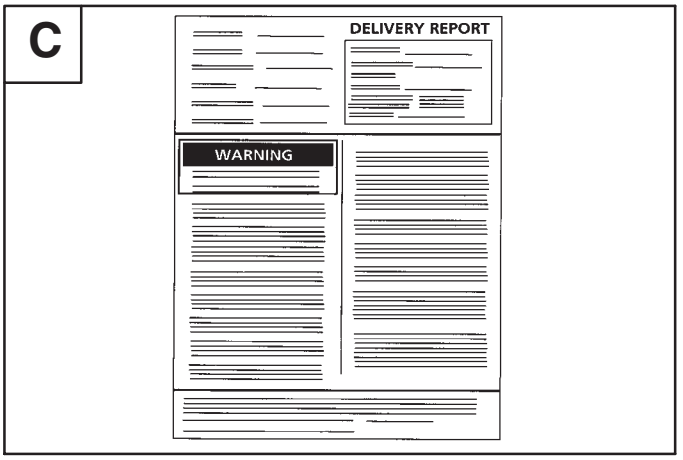
ENGINE SERIAL NUMBER

The engine serial number is located on the top surface of the fuel injection pump on the engine block **[B]**.



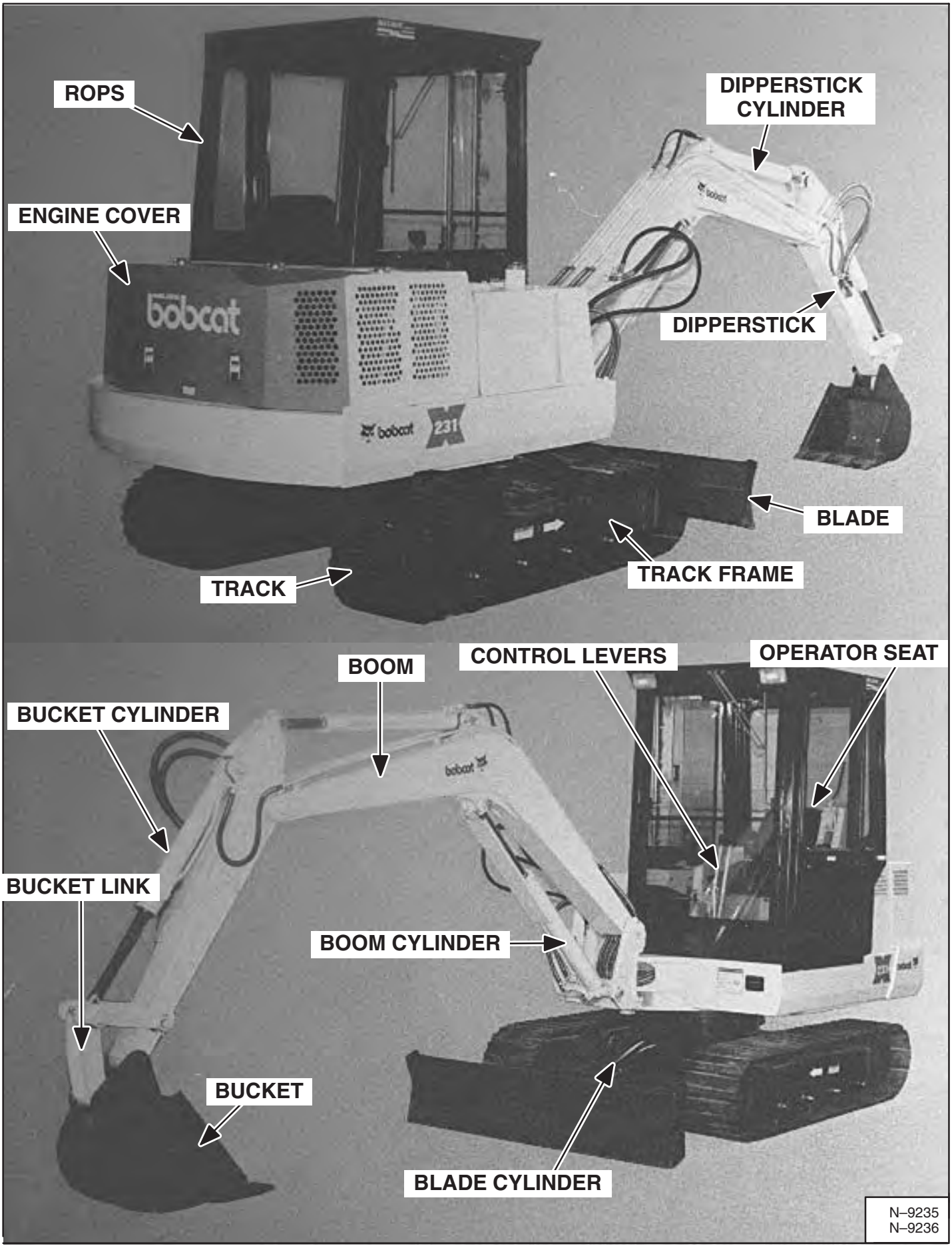
DELIVERY REPORT

The Delivery Report must be explained to the owner/operator by the dealer. The dealer is to fill out the form and the owner/operator sign the formto indicate his understanding **[C]**.



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HYDRAULIC EXCAVATOR IDENTIFICATION



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PREVENTIVE MAINTENANCE

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Chart 1–3

USING A BOOSTER BATTERY (JUMP STARTING)
Procedure 1–10

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SERVICE SCHEDULE

Maintenance work must be done at regular intervals. Failure to do so will result in excessive wear and early failures. The service schedule is a guide for correct maintenance of the Hydraulic Excavator.

⚠ WARNING

Instructions are necessary before operating or servicing machine. Read Operation & Maintenance Manual, Handbook and signs (decals) on machine. Follow warnings and instructions in the manuals when making repairs, adjustments or servicing. Check for correct function after adjustments, repairs or service. Failure to follow instructions can cause injury or death.

W–2003–0797

SERVICE SCHEDULE		HOURS					
ITEM	**SERVICE REQUIRED**	**8–10**	**50**	**100**	**250**	**500**	**■ 1000**
Engine Air Cleaner	Check & empty dust cap as requited.	■					
Engine Oil	Check the oil level & add oil as needed.	■					
Engine Coolant System	Check coolant level in recovery tank.	■					
Indicator Lights	Check for correct operation.	■					
Operator Cab	Check the fastening bolts, nuts, & condition of cab.	■					
Seat Belt	Check the condition & that fasteners are tight.	■					
Safety Signs (Decals)	Check for damaged signs (decals) replace as needed.	■					
Control Locks	Check for correct function.	■					
Tracks	Check and adjust tension.	■					
Hydraulic Reservoir	Check fluid level.	■					
All Machinery Pivot Pts.	Lubricate 20 grease fittings.	■					
Fuel Tank	Drain water & sediment from fuel tank.		■				
Swing Circle	Lubricate two grease fittings.		■				
Swing Pinion	Lubricate one grease fitting.		■				
Engine Oil & Filter	Replace oil & filter element.			■			
Alternator Belt	Check & adjust tension.			■			
Final Drive Case	Check fluid level & add oil as needed.				■		
Hydraulic Filter	Replace filter element.				■		
Fuel Filter	Replace filter element.				■		
Battery	Check & clean cable ends & check electrolyte level.				■		
Air Cleaner	Replace the filter element.				■		
Cooling System	Clean the radiator fins.					■	
Alternator & Starter	Check the condition.					■	
Engine Valve Clearance	Check & adjust valve clearance.					■	
Swing Motor Gear Red.	Check oil level.					■	
Cooling System	Drain, flush & add new coolant to the cooling system.						■
Hydraulic Tank	Change the fluid, clean fill neck strainer & suction strainer. Replace hydraulic filter.						■
Final Drive Case	Change the oil.						■

After the first 50 hours of machine operation do the following:
*** Replace the hydraulic fluid filter.**
*** Check the condition of fan belt.**

After the first 250 hours of machine operation do the following procedures:
*** Change oil in final drive case.**
■ Or Every 12 Months.

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ENGINE COVER

Procedure

WARNING

AVOID INJURY

Never service or adjust the machine when the engine is running unless instructed to do so in the manual.

W–2012–0290

WARNING

Keep the engine cover closed when operating the machine.

W–2141–0189

Open the engine cover to service the engine. Pull on the latches and lift the engine cover until it is fully raised **[A]**.

AIR CLEANER

Replacing the Filter Element

See the Service Schedule page 1–3 for the correct service interval.

Service the air cleaner as follows:

Remove the dust cup (Item 1) **[B]**.

Remove the wing nut (Item 1) **[C]**.

Remove the filter element **[D]**.

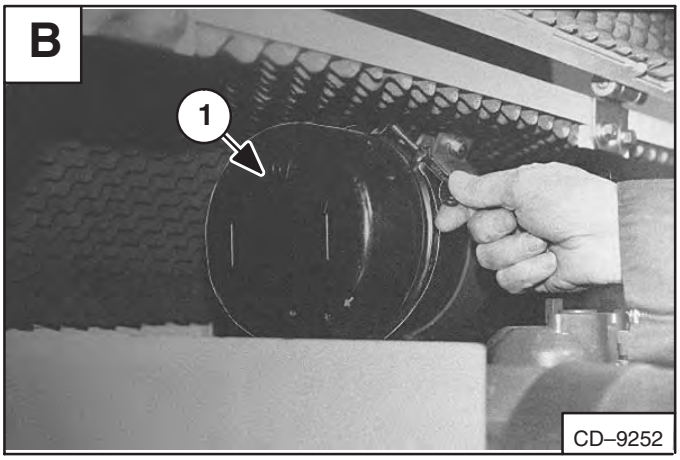
Check the air cleaner housing for damage.

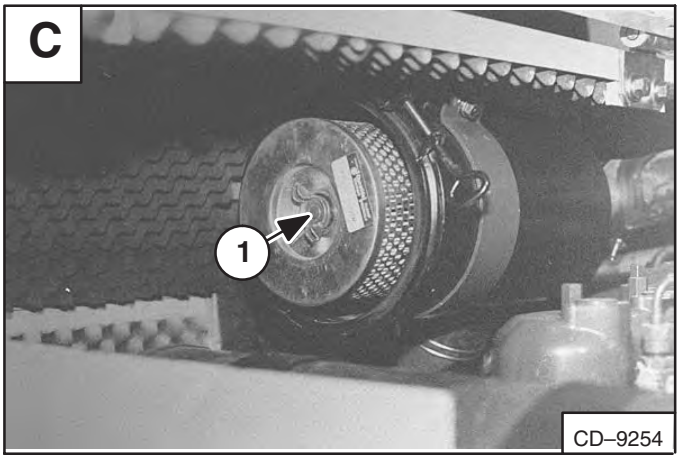
Install a new air filter element. Install and tighten the wing nut.

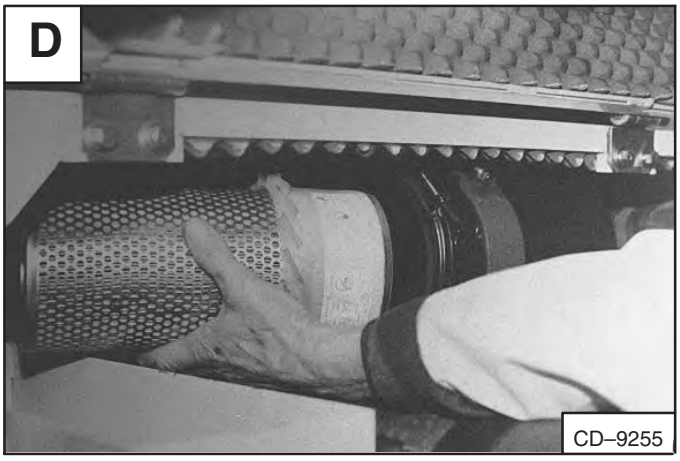
Install the dust cup so the arrow points up.

Check that the air cleaner hose clamps are tight.









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FUEL SYSTEM

Fuel Specifications

Use Number 2 diesel fuel in the engine. During very cold temperatures, Number 1 fuel can be used.

⚠ WARNING

Stop and cool the engine before adding fuel. NO SMOKING! Failure to obey warnings can cause an explosion or fire.

W–2063–0887

Fuel System Service

The fuel level in the tank is indicated by the fuel gauge or by the sight tube (Item 1) **[A]** on the side of the fuel tank.

Use the key to un–lock the fuel fill cap **[B]**.

Turn the fill cap to remove it from the fuel tank **[C]**.

Use a clean, approved safety container to add fuel to the tank.

Add fuel only in an area that has a free movement of air and no open flames or sparks. NO SMOKING!

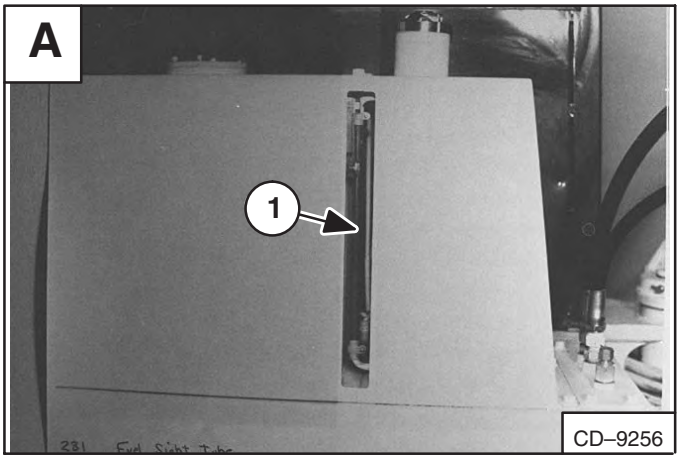
After the tank is full, install and tighten the fuel fill cap.

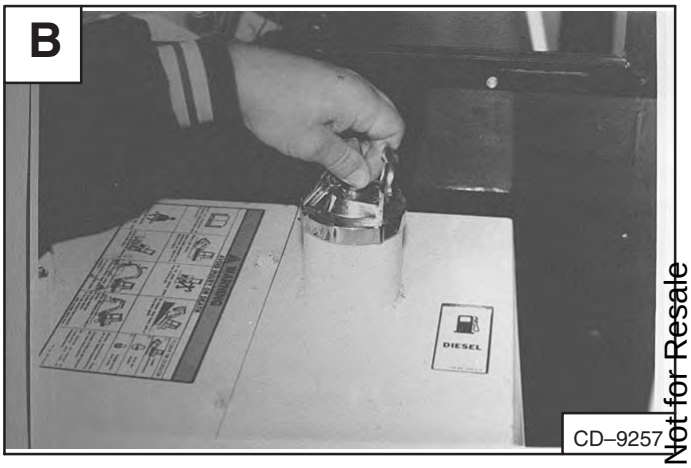
⚠ WARNING

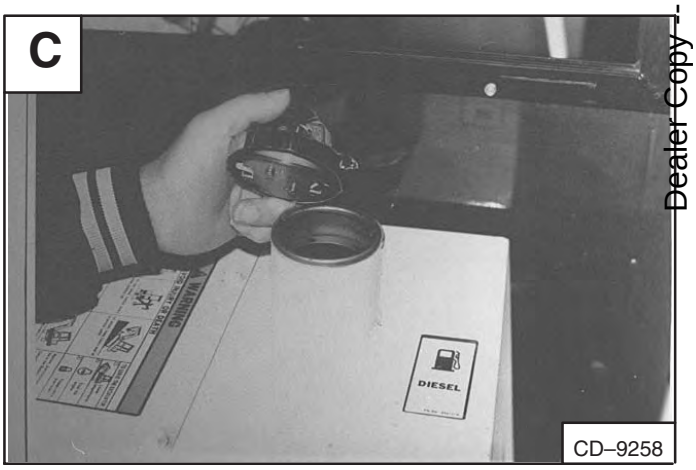
Always clean up spilled fuel or oil. Keep heat, flames, sparks or lighted tobacco away from fuel and oil. Failure to use care around combustibles can cause explosion or fire which can result in injury or death.

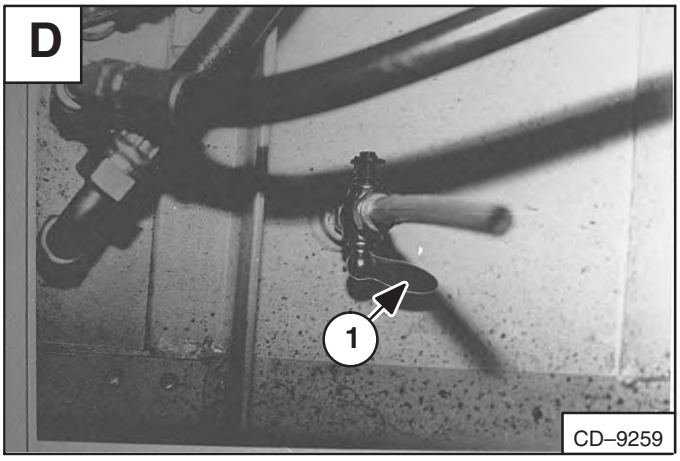
W–2103–1285

To remove the water and sediment from the fuel tank, open the drain (Item 1) **[D]** on the bottom of the tank.









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ENGINE LUBRICATION SYSTEM

Checking the Engine Oil

Check the engine oil every day.

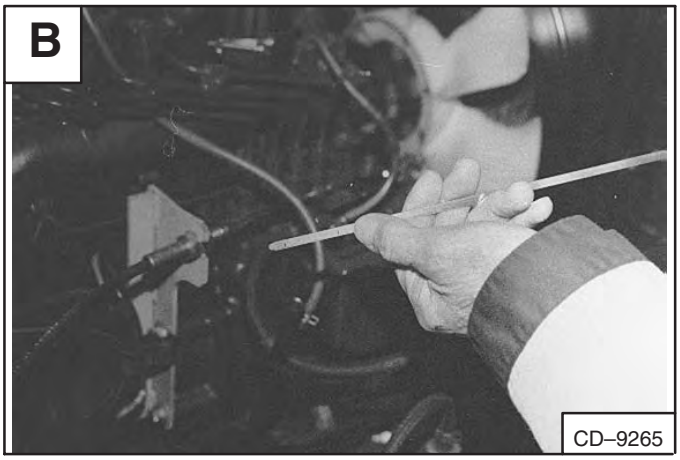
Stop the engine. Open the engine cover.

Remove the dipstick **[A]**.



Keep the oil between the marks on the dipstick **[B]**.

Use a good quality motor oil that meets API Service Classification of CC or CD. (See Fuel, Coolant and Lubricants Chart, Page 8–1.)



Engine oil and Filter Replacement

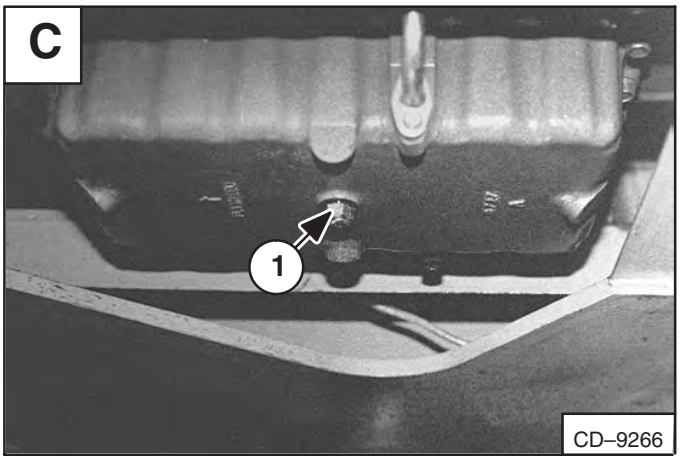
See the Service Schedule page 1–3 for the correct service interval.

Use the following procedure to change the oil and filter:

Run the engine until it is at operating temperature.

Turn the upper works so there is clearance for the engine oil drain plug. Stop the engine.

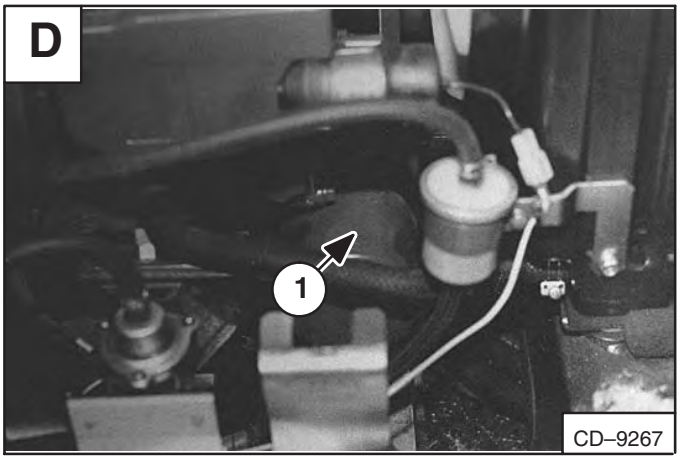
Remove the drain plug (Item 1) **[C]**. Drain the oil into a container.



Remove the oil filter (Item 1) **[D]**, using a filter wrench.

Clean the filter housing surface. Putclean oil on the filter gasket. Install the new filter and hand tighten only.

Install and tighten the oil drain plug.



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ENGINE LUBRICATION SYSTEM (Cont'd)

Remove the oil fill cap **[A]**. Put 9.0 quarts (8,5 L.) of the oil into the engine. (See Fuel, Coolant and Lubricants Chart, Page 8–1.)

Start the engine and let it run for several minutes. Stop the engine. Check for leaks at the oil filter.

Check the oil level and add oil as needed to bring it to the top mark on the dipstick.

COOLING SYSTEM

Coolant Level

When the engine is cool, the coolant level in the recovery tank (Item 1) **[B]** must be half full.

If the coolant level is low, add pre–mixed coolant (50% water and 50% ethylene glycol) to the recovery tank.

Coolant Replacement

⚠ WARNING

Do not remove radiator cap when the engine is hot. You can be seriously burned.

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Turn the upper works so there is access to the engine and radiator from underneath. Stop the engine.

Loosen and remove the radiator cap **[C]**.

Open the radiator drain valve (Item 1) **[D]**.

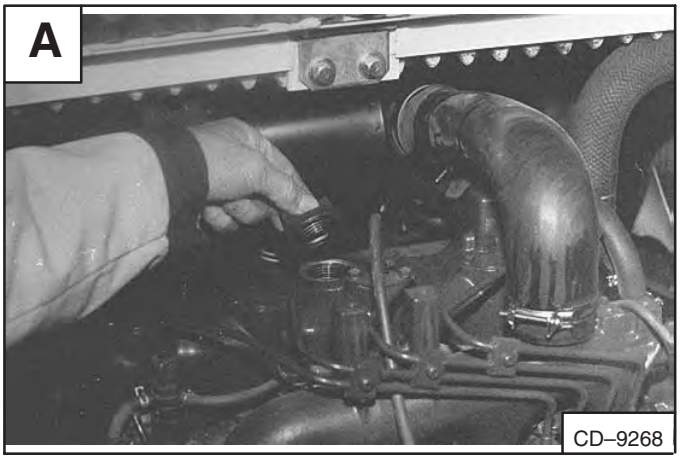
Drain all the coolant from the system.

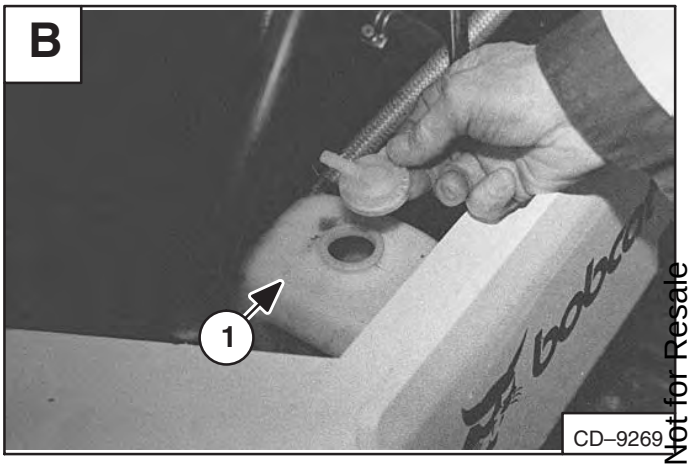
When all the coolant is removed, close the drain valve.

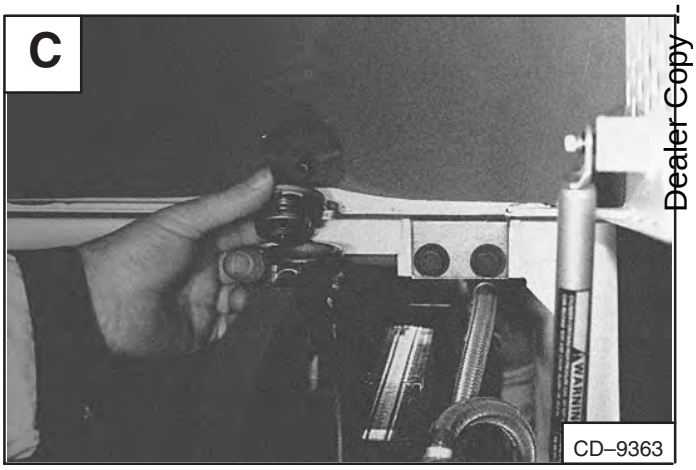
Pre–mix 50% water and 50% ethylene glycol in a separate container. Fill the radiator with pre–mixed coolant until it is full. Add coolant to the recovery tank until it is half full.

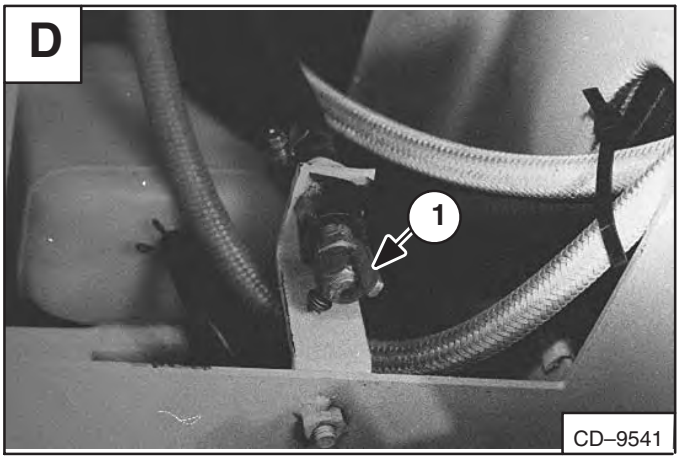
Run the engine at idle speed for about 5–10 minutes to remove the air from the cooling system (leave the radiator cap off during this operation).

Stop the engine. Check the coolant level and add as needed to bring it up to the radiator filler neck. Install the radiator cap and tighten.









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HYDRAULIC SYSTEM

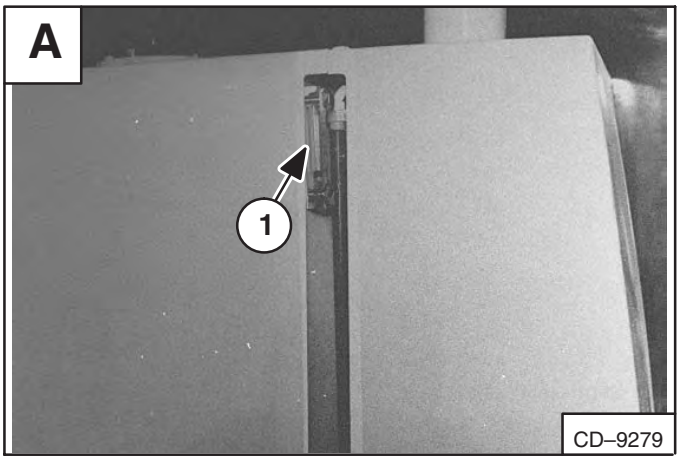
Checking and Adding Fluid

To check and add hydraulic fluid to the reservoir, use the following procedure:

Put the machine on a flat level surface.

Retract the dipperstick and bucket cylinders, put the bucket on the ground and raise the blade. Stop the engine.

Check the hydraulic fluid level, it must be visible and between the marks in the sight gauge (Item 1) **[A]**.



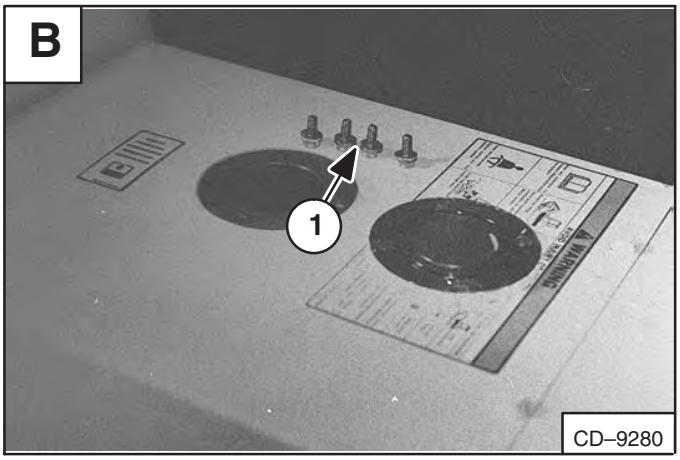
If fluid level is not correct, remove the four bolts (Item1) **[B]** from the reservoir cover.

Remove the reservoir cover.

Add the correct fluid to the reservior until it is at the top mark in the sight gauge. (See Fuel, Coolant and Lubricants Chart, Page 8–1.)

Install the reservoir cover, make sure the O–ring is in the correct position.

Install the four bolts and tighten.



Replacement of the Hydraulic Filters

See the Service Schedule page 1–3 for the correct service interval.

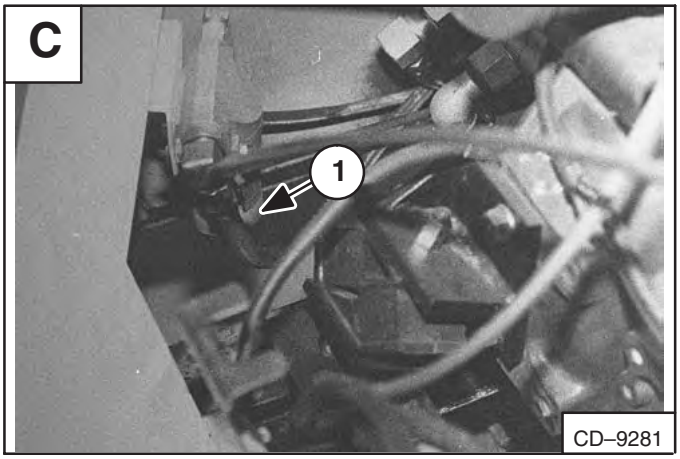
Open the engine cover.

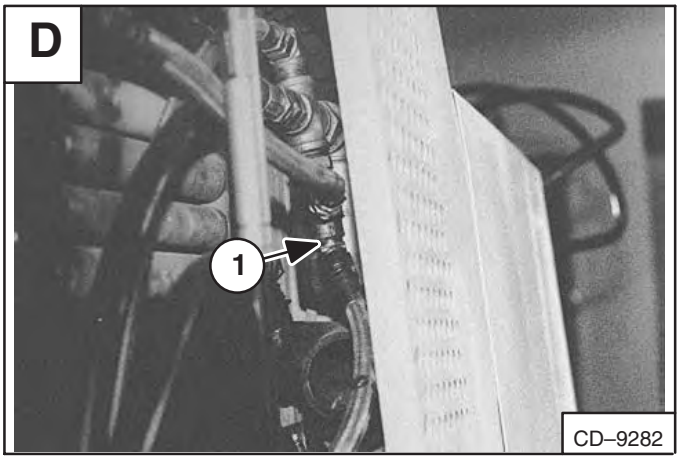
Use a filter wrench and remove the filter elements (Item 1) **[C]** & **[D]**.

Clean the housing where the filter gasket makes contact.

Put clean fluid on the gasket. Install the new filter elements and hand tighten only.

Start the engine. Run the machine through the hydraulic functions. Stop the engine. Check the fluid level at the reservoir and add as needed. Check around the filters for leaks.





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HYDRAULIC SYSTEM (Cont'd)

Hydraulic Reservoir

See the Service Schedule page 1–3 for the correct service interval.

Move the upper works so the reservoir is between the tracks at the rear of the machine.

Retract the dipperstick and bucket cylinders, lower the bucket to the ground. Stop the engine.

Remove the drain plug (Item 1) **[A]** and drain fluid into a container.

Remove the hydraulic filters. (See Page 1–8.)

Remove the hose clamp (Item 1) **[B]** and disconnect the hose. Remove the bolts (Item 2) **[B]**. Remove the flange/mesh screen assembly from the reservoir.

Clean all the parts with clean solvent and air dry them.

Replace the filters. Install the mesh screen and tighten the bolts, hose clamp and drain plug.

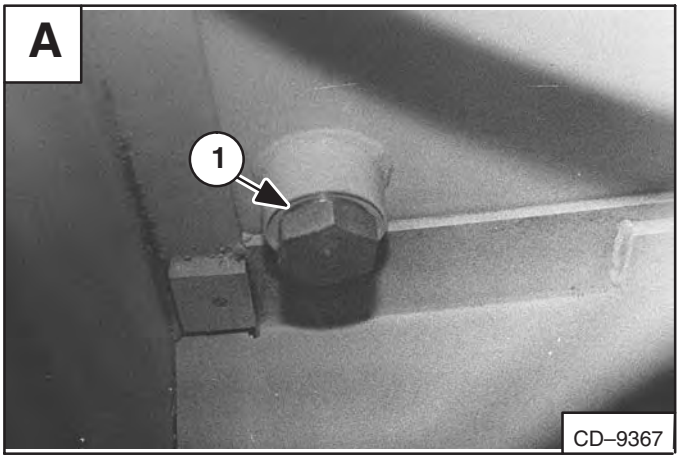
Add approximately 18.25 gals. (69 L.) of fluid to the reservoir. (See Fuel, Coolant and Lubricants Chart, Page 8–1.)

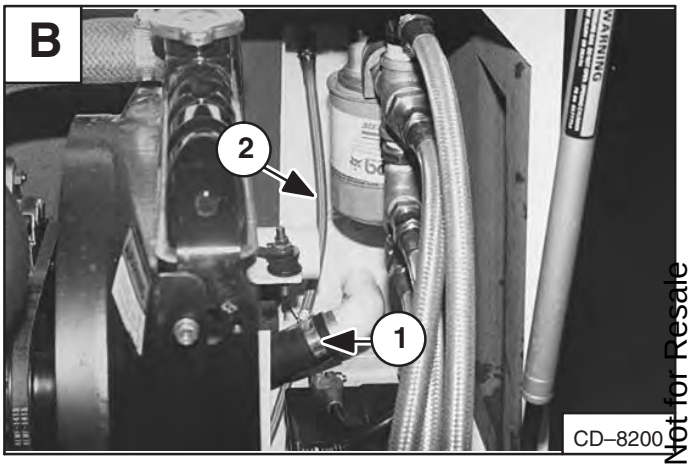
Operate all the hydraulic functions. Check the fluid level and add as needed.

⚠ WARNING

Always clean up spilled fuel or oil. Keep heat, flames, sparks or lighted tobacco away from fuel and oil. Failure to use care around combustibles can cause explosion or fire which can result in injury or death.

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ELECTRICAL SYSTEM

Using A Booster Battery (Jump Starting)

If it is necessary to use a booster battery to start the engine, BE CAREFUL! Make sure the control lock is engaged.

The key switch must be in the OFF position.

The booster battery must be 12 volt.

Open the engine cover.

Connect the end of the first cable to the positive (+) terminal of the booster battery. Connect the other end of the same cable to the positive (+) terminal (Item 1) **[A]** of the machine battery.

Connect the end of the second cable to the negative (–) terminal of the booster battery. Connect the other end of the same cable to the machine frame (Item 2) **[A]**.

NOTE: Also see Cold Starting Procedure, in Operation & Maintenance Manual.

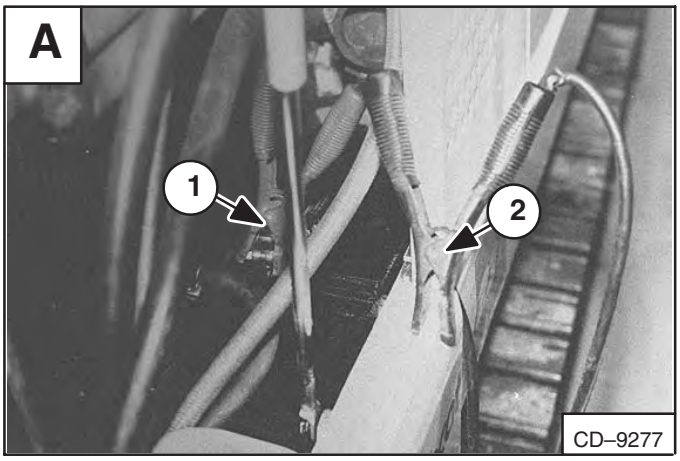
Start the engine. After the engine is running, remove the cable (Item 2) **[A]** connected to the frame first. Disconnect the cable from the machine battery (Item 1) **[A]**.

IMPORTANT

Damage to the alternator can occur if:

- **Engine is operated with battery cables disconnected.**
- **Battery cables are connected when using a fast charger or when welding on the loader (Remove both cables from the battery).**
- **Extra battery cables (booster cables) are connected wrong.**

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⚠ WARNING

Keep arcs, sparks, flames and lighted tobacco away from batteries. When *jumping* from booster battery make final connection (negative) at engine frame.

Do not jump start or charge a frozen battery. Warm battery to 60°F. (16°C.) before connecting to a charger. Unplug charger before connecting or disconnecting cables to battery.

Battery gas can explode and cause serious injury.

W–2066–0490

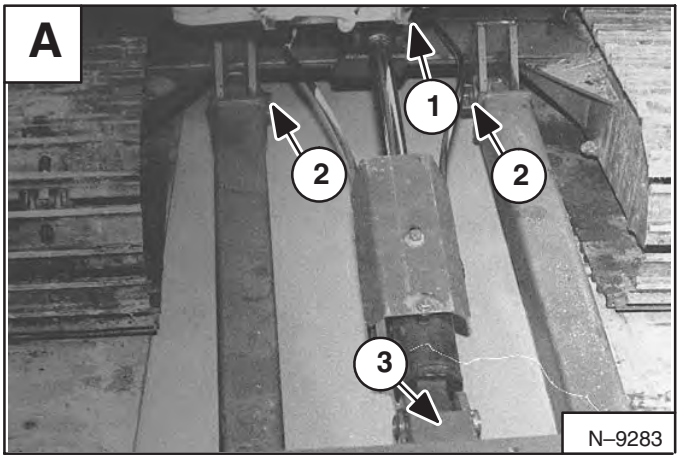
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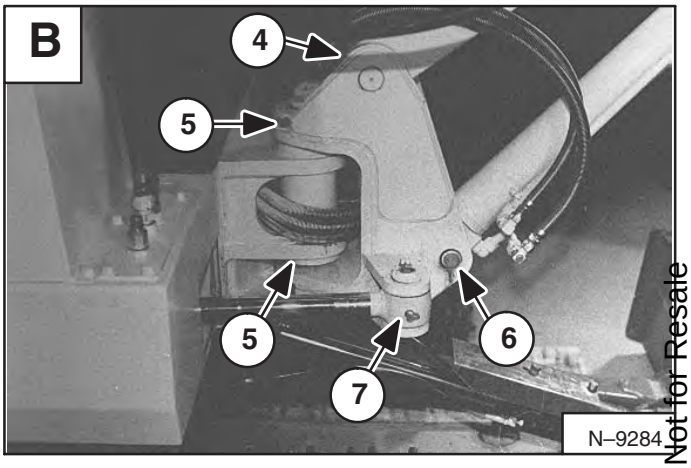
LUBRICATION OF THE HYDRAULIC EXCAVATOR

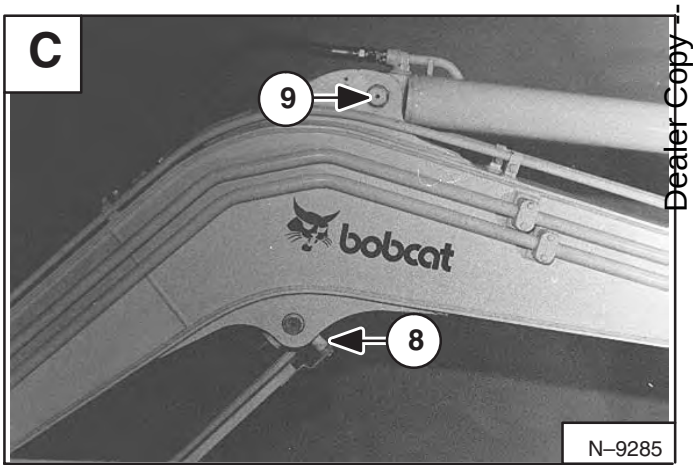
Lubricate the Hydraulic Excavator as specified in the Service Schedule page 1–3 for the best performance of the machine.

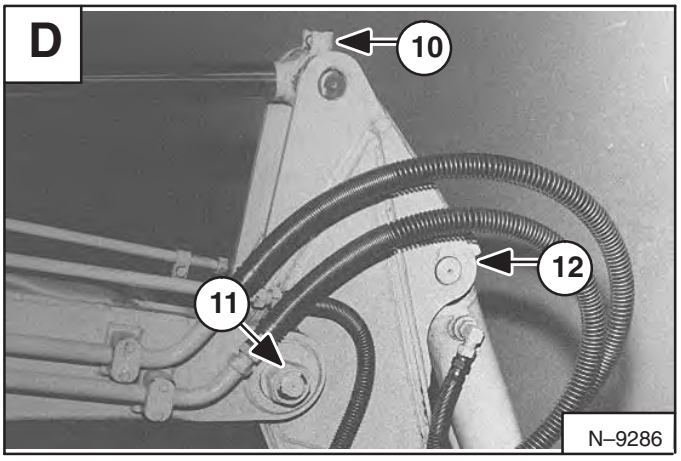
Always use a good quality lithium based multi–purpose grease when lubrication the machine. Apply the lubricant until extra grease shows.

Ref.	Description (# of Fittings)
1	Blade Cylinder Rod End (1) **[A]**.
2	Blade Pivots (2) **[A]**.
3	Blade Cylinder Base End (1) **[A]**.
4	Boom Base Pivot (1) **[B]**.
5	Boom Swing Bracket Pivot (2) **[B]**.
6	Boom Cylinder Base End (1) **[B]**.
7	Boom Swing Cylinder Rod End (1) **[B]**.
8	Boom Cylinder Rod End (1) **[C]**.
9	Dipperstick Cylinder Base End (1) **[C]**.
10	Dipperstick Cylinder Rod End **[D]**.
11	Dipperstick Base Pivot (1) **[D]**.
12	Bucket Cylinder Base End (1) **[D]**.





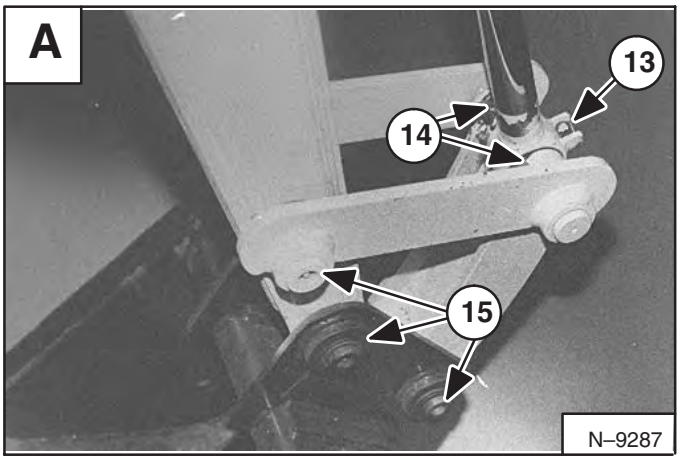




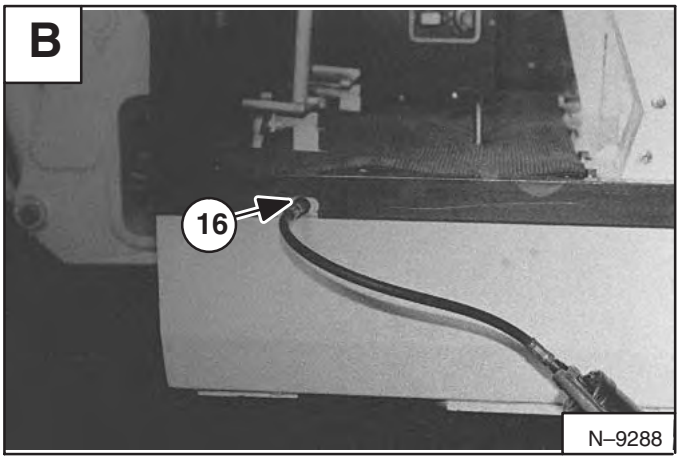
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LUBRICATION OF THE HYDRAULIC EXCA VATOR (Cont'd)

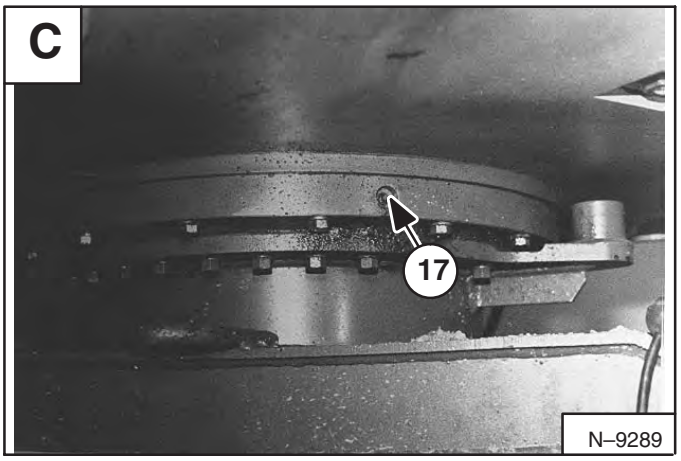
Ref.	Description (# of Fittings)
13	Bucket Cylinder Rod End (1) **[A]**.
14	Bucket Link Pivots (2) **[A]**.
15	Bucket Pivots (3) **[A]**.



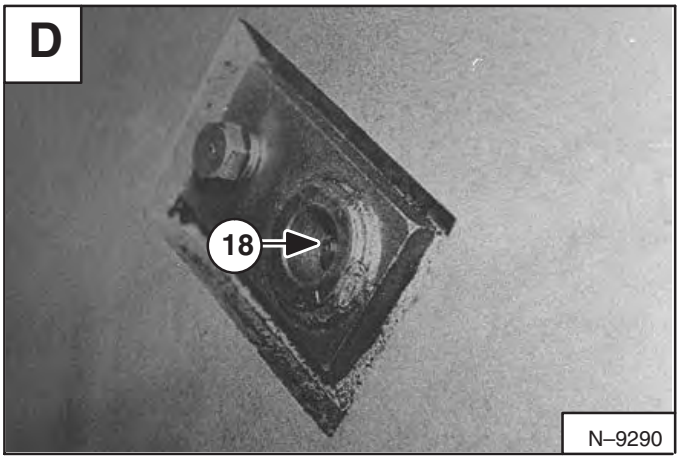
16 Swing Circle Pinion (1) **[B]**.



17 Swing Circle Ball Bearings (2) **[C]**.



18 Boom Swing Cylinder Base End (1)**[D]** (under the right front of upper frame)



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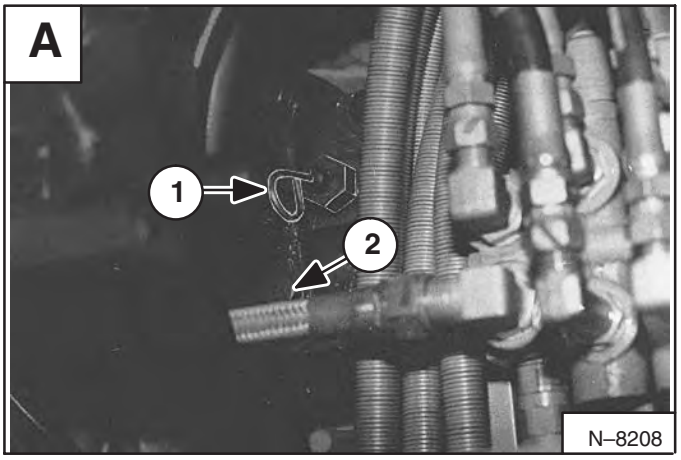
SWING MOTOR GEAR REDUCTION

See Service Schedule page 1–3 for the correct service interval.

Remove the seat and cover over the swing motor. (See Page 5–1.)

Remove the dipstick (Item 1) **[A]** and check the oil level.

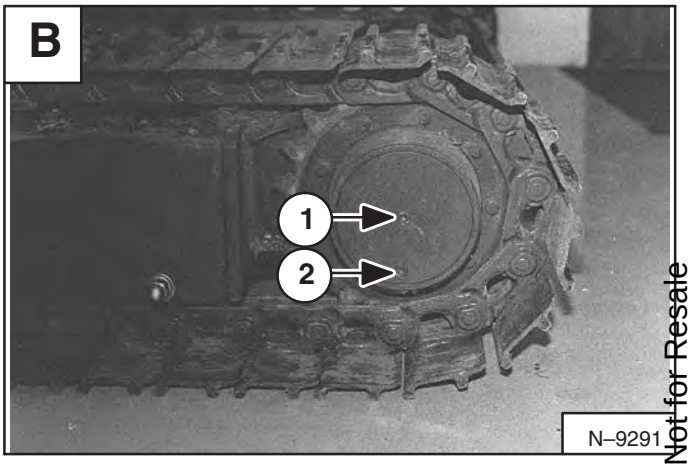
If the oil level is not at the top mark on the dipstick, remove the plug (Item 2) **[A]** and add oil as needed. (See Fuel, Cool and Lubrications Chart, Page 8–1.)



FINAL DRIVE CASE

Checking Oil Level

1. Put the machine on a flat level surface with the plugs positioned as shown in figure **[B]**.
2. Remove the top plug (Item 1) **[B]**.
3. Add oil through the hole if the oil level is below the hole. (See Fuel, Coolant and Lubricant Chart, Page 8–1.)
4. Install and tighten the plug.
5. Repeat the procedure for the other side.



Draining Final Drive Case

See the Service Schedule page 1–3 for the correct service interval.

1. Put the machine on flat level surface with the plugs positioned as shown in figure **[B]**.
2. Remove the bottom plug (Item 2) **[B]** and top plug (Item 1) **[B]**.
3. After all the oil is removed, install and tighten the bottom plug.
4. Add .63 quarts (0,6L) of oil to the top plug hole. Install the plug.
5. Repeat the procedure for the other side.

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Page Number

AUXILIARY ROUTING 2–69

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Removal and Installation 2–51

BOOM CYLINDER
Disassembly and Assembly 2–55
Removal and Installation 2–45

BOOM SWING CYLINDER
Disassembly and Assembly 2–55
Removal and Installation 2–53

BUCKET CYLINDER
Disassembly and Assembly 2–55
Removal and Installation 2–49

CONTROL VALVE
Disassembly and Assembly 2–15

DIPPERSTICK CYLINDER
Disassembly and Assembly 2–55
Removal and Installation 2–47

HYDRAULIC CONTROL VALVE
Removal and Installation 2–13

HYDRAULIC CYLINDER
Assembly 2–55
Disassembly 2–59

HYDRAULIC FILTER
Removal and Installation 2–69

HYDRAULIC PUMP
Assembly 2–9
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Removal and Installation 2–6

HYDRAULIC RESERVOIR
Removal and Installation 2–43

HYDRAULIC SERVICE INFORMATION
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Checking the Main Relief Valves 2–3
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Continued On Next Page

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SOLENOID VALVE
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Disassembly 2–35
Removal and Installation 2–33

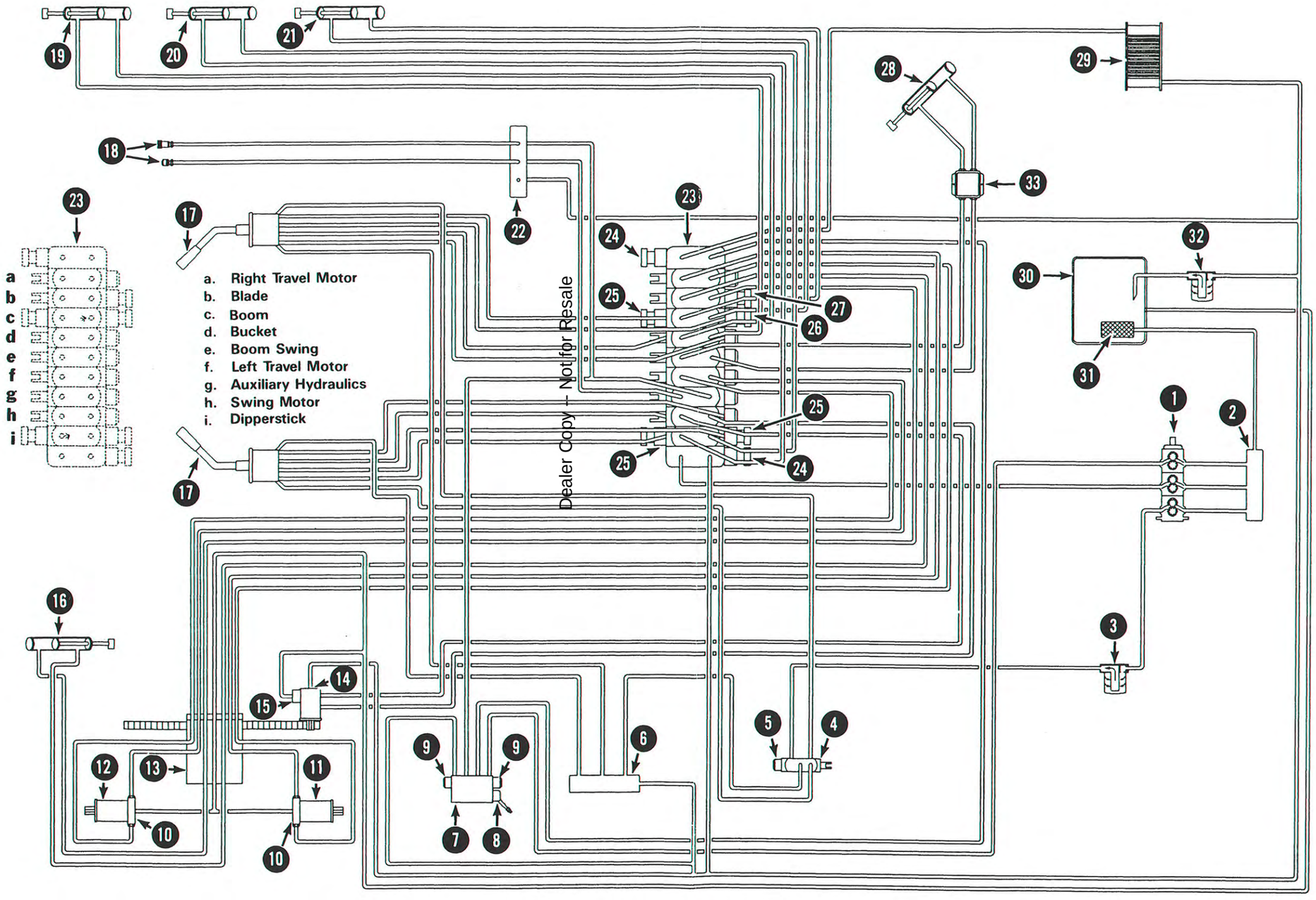
SUCTION FILTER 2–44

SWING CYLINDER LOCK VALVE
Assembly 2–67
Disassembly 2–66

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HYDRAULIC FLOW CHART
For Model
231 EXCAVATOR (I.S.O.)
Chart #6720425 (Printed July 1991)

NOTE
Chart shows oil flow in Forward Drive Position and with Hydraulic Cylinders Partially Extended. For Hydraulic/ Hydrostatic System Operation, refer to Sheet 2 of this publication.



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HYDRAULIC SYSTEM OPERATION

To Be Used With

HYDRAULIC FLOW CHART

For Model

231 EXCAVATOR (I.S.O.)

Chart # 6720425 (Printed July 1991)

CHART LEGEND

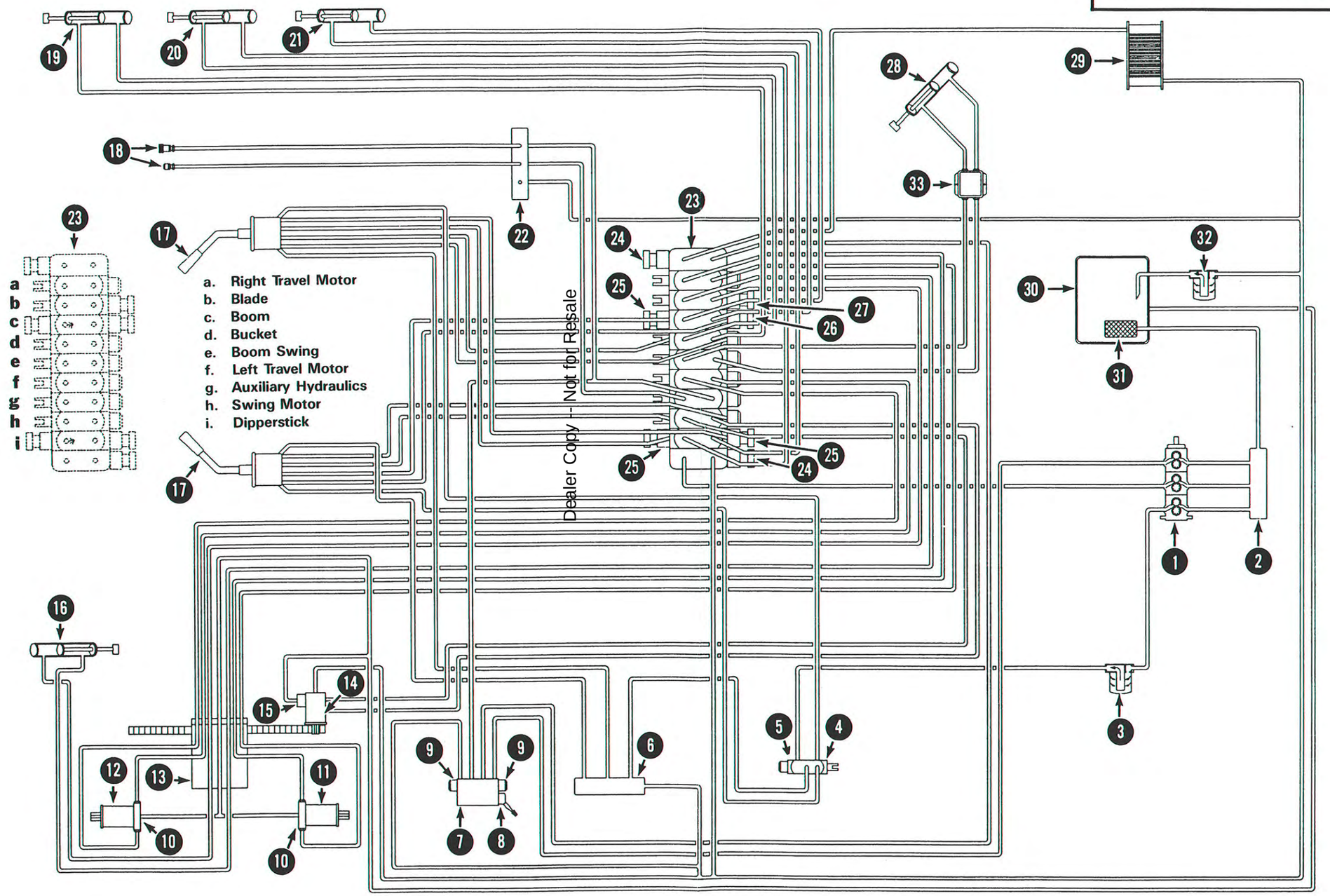
1. **HYDRAULIC PUMP** Triple Section - Gear Pump: 2 x 9.4 GPM (35,75 L/min.) Joystick Control = 4.6 GPM (17,5 L/min.)
2. **SUPPLY MANIFOLD**
3. **HYDRAULIC FILTER ELEMENT**
4. **LOCKING LEVER VALVE**
5. **LOCKING LEVER RELIEF VALVE (Console Down)** 355 PSI (2447 kPa)
6. **RETURN BLOCK**
7. **DIVERTER VALVE**
8. **ELECTRIC SOLENOID**
9. **DIVERTER RELIEF VALVES** 2500 PSI (17235 kPa)
   (2) S/N 11118 & Below
   (1) S/N 11119 & Above
10. **BRAKE VALVE**
11. **RIGHT SIDE TRAVEL MOTOR**
12. **LEFT SIDE TRAVEL MOTOR**
13. **SWIVEL JOINT**
14. **SWING MOTOR,** Port Relief Valves (2) 1885 PSI (12995 kPa)
15. **BRAKE VALVE**
16. **BLADE CYLINDER**
17. **JOYSTICK CONTROLS**
18. **FRONT AUXILIARY HYDRAULICS**
19. **BUCKET CYLINDER**
20. **DIPPERSTICK CYLINDER**
21. **BOOM CYLINDER**
22. **AUXILIARY MANIFOLD**
23. **HYDRAULIC CONTROL VALVE** 9 Sections
24. **MAIN RELIEF VALVES (2)** . . 2550 PSI (17580 kPa) + or — 75 PSI
25. **PORT RELIEF VALVES** . . . . . 2986 PSI (20585 kPa)
26. **BOOM CYLINDER RELIEF VALVE (Rod End)** . . . . 3480 PSI (23991 kPa)
27. **BLADE RELIEF VALVE** . . . . . 1422 PSI (9803 kPa)
28. **BOOM SWING CYLINDER**
29. **HYDRAULIC OIL COOLER**
30. **HYDRAULIC RESERVOIR**. 18.25 Gals. (69 L) (Tank Capacity)
31. **SUCTION SCREEN**
32. **HYDRAULIC FILTER ELEMENT** 10 Micron
33. **SWING CYLINDER LOCK VALVE**

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HYDRAULIC FLOW CHART
For Model
231 EXCAVATOR (STANDARD)
Chart #6720426 (Printed July 1991)

NOTE
Chart shows oil flow in Forward Drive Position and with Hydraulic Cylinders Partially Extended. For Hydraulic/ Hydrostatic System Operation, refer to Sheet 2 of this publication.



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HYDRAULIC SYSTEM OPERATION

To Be Used With

HYDRAULIC FLOW CHART

For Model

231 EXCAVATOR (STANDARD)

Chart # 6720426 (Printed July 1991)

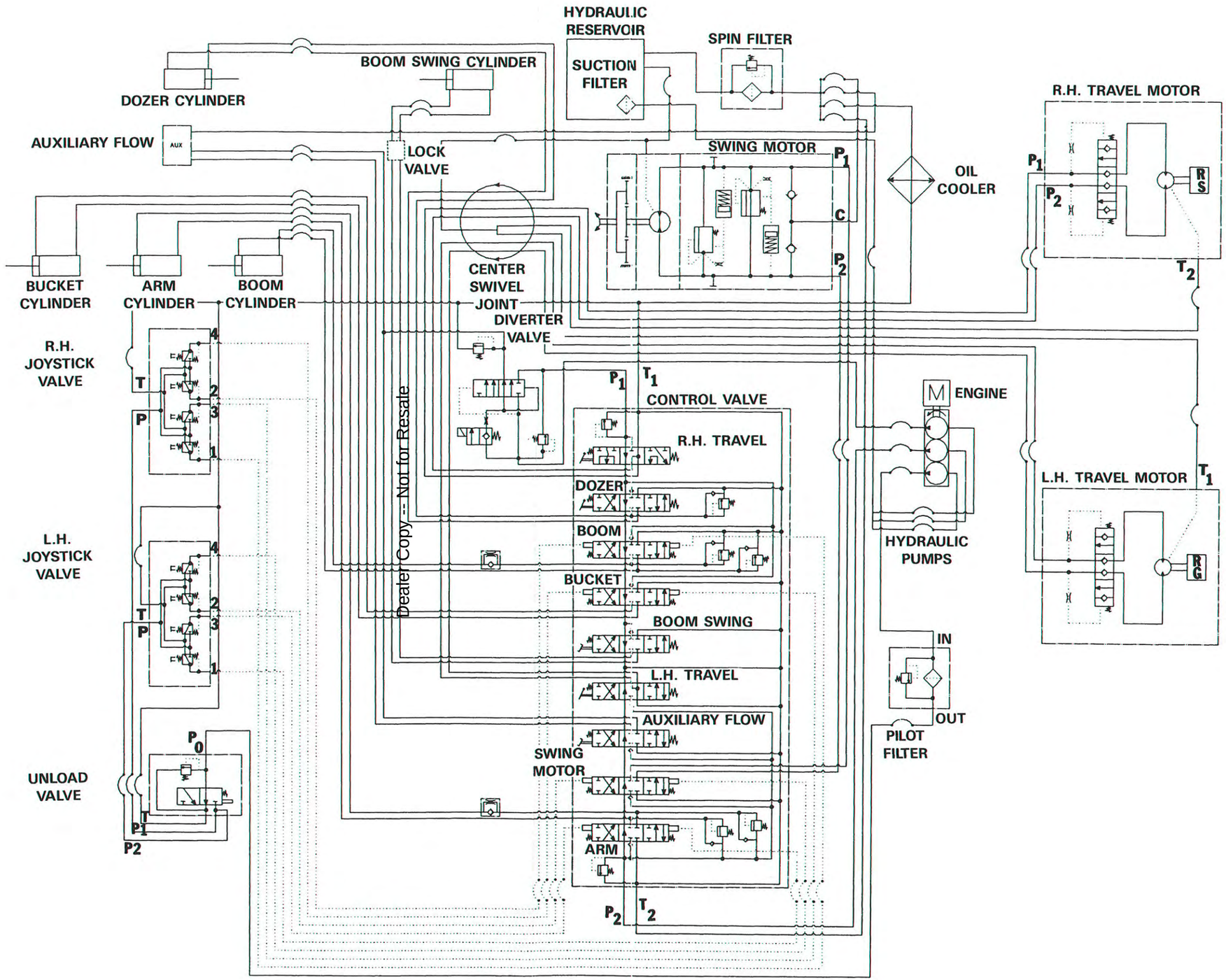
CHART LEGEND

1. **HYDRAULIC PUMP** Triple Section - Gear Pump: 2 x 9.4 GPM (35,75 L/min.) Joystick Control = 4.6 GPM (17,5 L/min.)
2. **SUPPLY MANIFOLD**
3. **HYDRAULIC FILTER ELEMENT**
4. **LOCKING LEVER VALVE**
5. **LOCKING LEVER RELIEF VALVE (Console Down)** . 355 PSI (2447 kPa)
6. **RETURN BLOCK**
7. **DIVERTER VALVE**
8. **ELECTRIC SOLENOID**
9. **DIVERTER RELIEF VALVES** 2500 PSI (17235 kPa)
   (2) S/N 11118 & Below
   (1) S/N 11119 & Above
10. **BRAKE VALVE**
11. **RIGHT SIDE TRAVEL MOTOR**
12. **LEFT SIDE TRAVEL MOTOR**
13. **SWIVEL JOINT**
14. **SWING MOTOR,** Port Relief Valves (2) 1885 PSI (12995 kPa)
15. **BRAKE VALVE**
16. **BLADE CYLINDER**
17. **JOYSTICK CONTROLS**
18. **FRONT AUXILIARY HYDRAULICS**
19. **BUCKET CYLINDER**
20. **DIPPERSTICK CYLINDER**
21. **BOOM CYLINDER**
22. **AUXILIARY MANIFOLD**
23. **HYDRAULIC CONTROL VALVE** 9 Sections
24. **MAIN RELIEF VALVES (2)** . . 2550 PSI (17580 kPa) + or — 75 PSI
25. **PORT RELIEF VALVES** . . . . . 2986 PSI (20585 kPa)
26. **BOOM CYLINDER RELIEF VALVE (Rod End) . . . . 3480 PSI (23991 kPa)**
27. **BLADE RELIEF VALVE** . . . . . 1422 PSI (9803 kPa)
28. **BOOM SWING CYLINDER**
29. **HYDRAULIC OIL COOLER**
30. **HYDRAULIC RESERVOIR**. 18.25 Gals. (69 L) (Tank Capacity)
31. **SUCTION SCREEN**
32. **HYDRAULIC FILTER ELEMENT** 10 Micron
33. **SWING CYLINDER LOCK VALVE**

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HYDRAULIC SCHEMATIC (231 Excavator) (I.S.O.)



6720427 (4-90)

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IMPORTANT

When making repairs on hydrostatic and hydraulic systems, clean the work area before disassembly and keep all parts clean. Always use caps and plugs on hoses, tubelines and ports to keep dirt out. Dirt can quickly damage the system.

I–2003–0284

Description

There are three (3) main relief valves (Item 1) **[A]** and nine (9) port relief valves (Item 2) **[A]** in the hydraulic system.

NOTE: Some machines are eqipped with only one port relief valve in the diverter valve.

Checking the Main Relief Valves

The tools listed will be needed to do the following procedure:

OEM–1238
OEM–1239 – Hydraulic Tester
6657708 – Test Fitting
6657709 – Hose Adapter

Stop the engine and raise the engine cover.

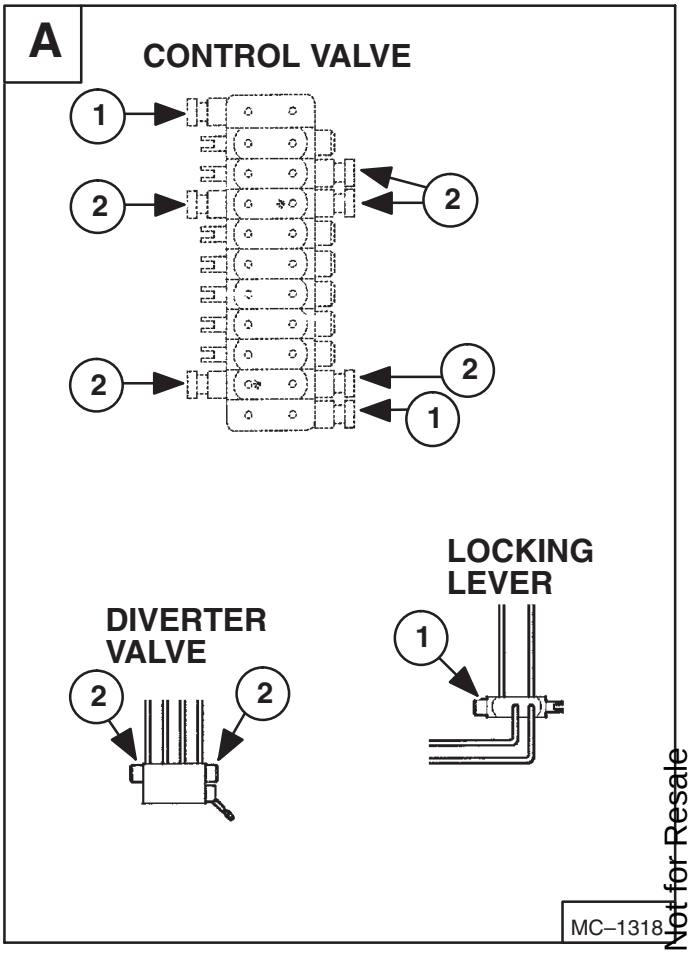
Disconnect the outlet hose from the hydraulic pump (Item 1) **[B]** and connect that hose to the outlet of the tester.

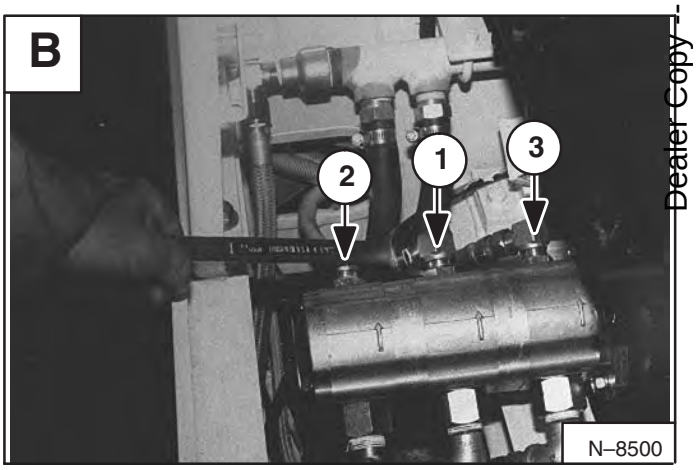
NOTE: Use hose adapter 6657709 when checking pumps (Item 1 or Item 2). Install the adapter between outlet hose of tester and outlet hose of the pump.

Remove the outlet fitting from the pump being tested and install the test fitting shown below **[B]**.

Ref.	Part No.	Description
1.	6657708	Hydraulic Pump for Control Valve
2.	6657708	Hydraulic Pump for Locking Lever

Connect the inlet of the tester to the test fitting in the pump **[B]**.





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NOTE: Open the flow control knob fully to prevent pump damage.

NOTE: Refer to the hydraulic flow chart valve section.

Start the engine and run at low RPM. Make sure the tester is connected correctly. If no flow is indicated at the tester, the hoses are connected wrong.

Increase the engine speed to full RPM. W arm the hydraulic fluid to 140° F (60° C) by turning restrictor valve until the gauge reads about 1000 PSI (6895kPa). Do not exceed system pressure.

Stroke a cylinder to it's limit, in the section being tested, to open the relief valve.

The relief valve pressure should open at 2550 PSI (17580 kPa) ± 75 PSI. The flow should be 4.6 GPM (17.5 L/min.) on a new pump.

Release the pressure on the cylinder being tested.

Close the flow control knob (Item 1) **[A]** slowly, to 100 PSI below relief valve setting, and record the free flow.

NOTE: The high pressure flow must be at lease 80% of free flow.

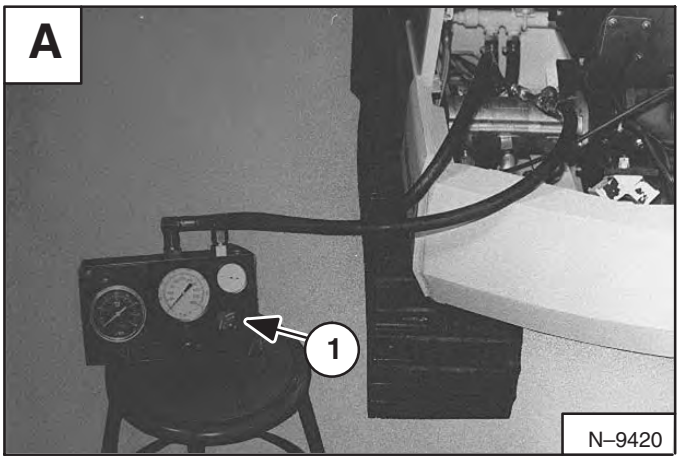
$$\% = \frac{\textbf{HIGH PRESSURE FLOW (GPM)}}{\textbf{FREE FLOW (GPM)}} \times 100$$

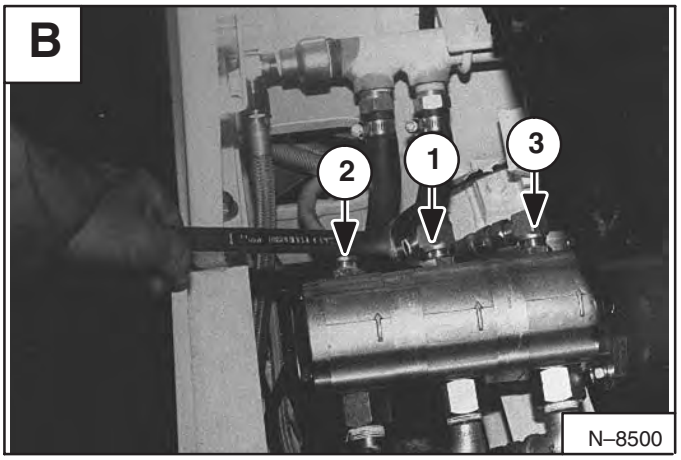
If high pressure is less than 80% of freeflow, remove the hydraulic pump for repair or replacement.

Connect the tester to the inside hydraulic pump (Item 3) **[B]**. Use the same hose routing as shown on page 2–3.

No adapter is needed for this pump outlet hose.

Repeat the testing procedure and use same readings as shown.





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Checking the Locking Lever Relief Valve

Use OEM1238 or OEM1239 HYDRAULIC TESTER and hose adapter 6657709 to do the following procedure:

Stop the engine.

Raise the engine cover.

Disconnect the outlet hose from the hydraulic pump (Item 1) **[A]** and connect that hose to the inlet of the tester.

Install hose adapter between pump outlet hose and tester output hose.

NOTE: This hose is the inlet to the filter . (See Page 2–3 for correct hose fitting.)

Connect the inlet of the tester to the outlet of the pump.

NOTE: Be sure the left control lever panel is lowered and locked in the operating position.

Start the engine and run to 2500 RPM.

With Locking Lever Down (Going Over Relief) Stroke the Bucket (Curl)

The locking lever relief valve is stamped at 355 PSI (2477 kPa). The flow should be 9.4 GPM (35.75 L/min.) on a new pump.

Checking the Auxiliary Relief Valve

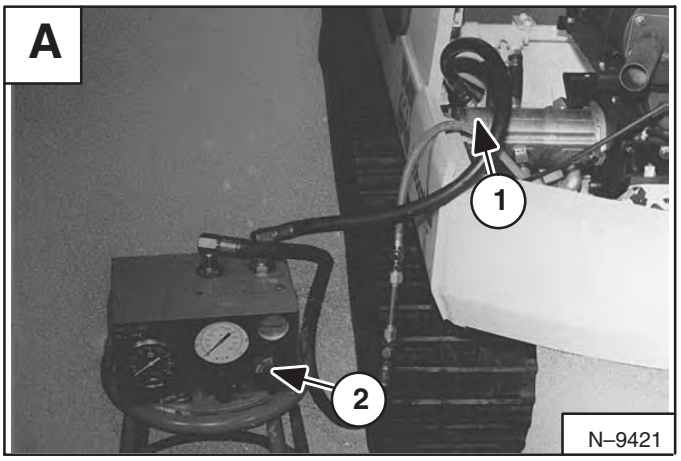
Connect the gauge to the female quick coupler **[B]**.

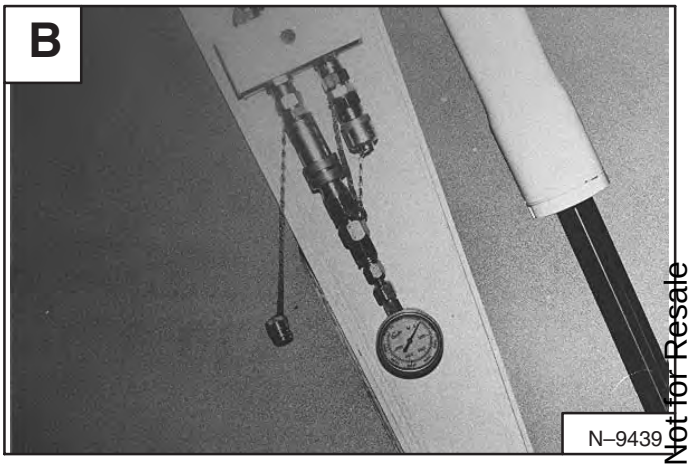
Start the engine and run at high RPM.

The pressure should be 2200 PSI (15167 kPa).

NOTE: When diverter valve has only one reliefvalve the reading should be 2500 PSI (17235 kPa)± 75 PSI.

Replace the relief valve if the pressure is not correct.





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HYDRAULIC PUMP

Removal and Installation

IMPORTANT

When making repairs on hydrostatic and hydraulic systems, clean the work area before disassembly and keep all parts clean. Always use caps and plugs on hoses, tubelines and ports to keep dirt out. Dirt can quickly damage the system.

I–2003–0284

NOTE: Mark the hoses and tubelines for correct installation.

Disconnect the three inlet hoses (Item 1) **[A]** from the hydraulic pump.

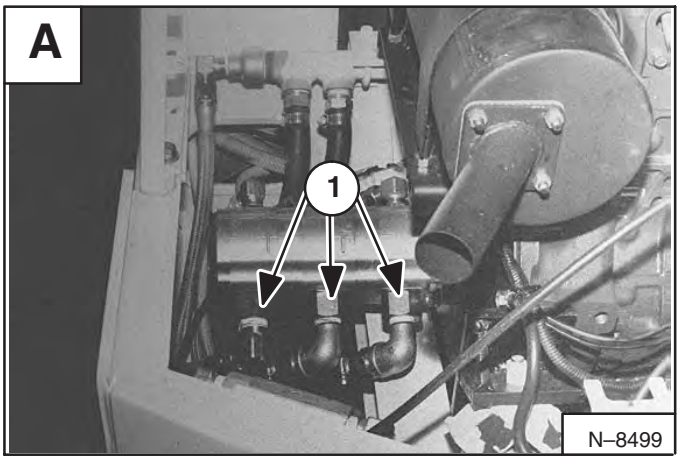
Drain the hydraulic fluid into a container.

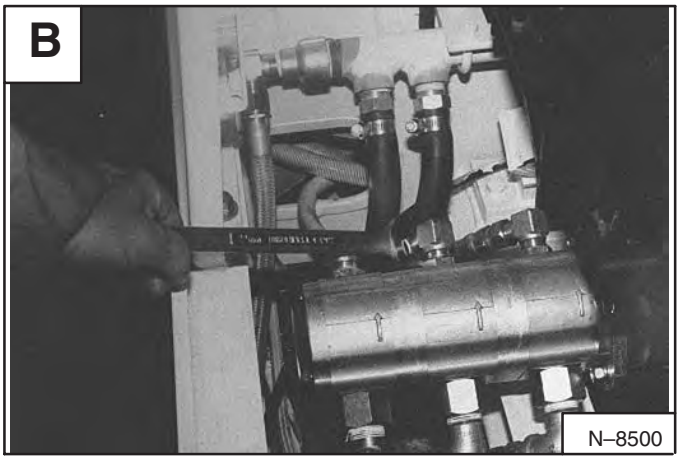
Disconnect the three pressure hoses **[B]**.

Loosen the pump mounting bolts **[C]**.

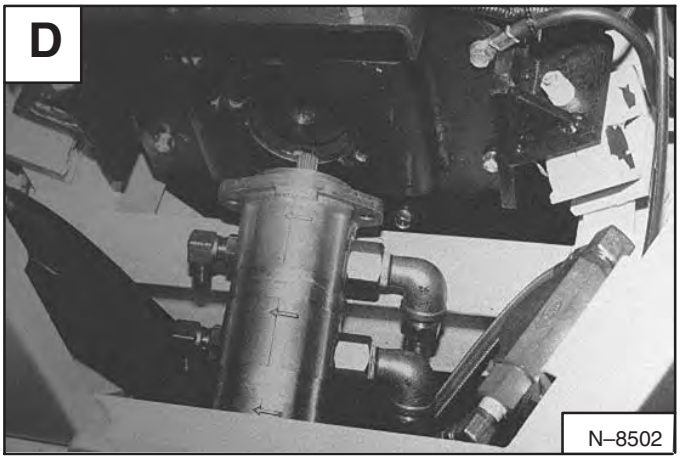
Remove the bolts.

Remove the hydraulic pump adapter from the pump plate **[D]**.









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Disassembly

IMPORTANT

Do not modify DS loader which has special parts and features necessary for the Underwriters Laboratory approval and control of certain fire hazards. Use exact replacement parts from a Melroe dealer.

I–2002–0284

Clean the outside of the pumps.

NOTE: During disassembly, place all parts on a clean paper.

Clamp the mounting flange of the pumps in a vise as shown **[A]**.

Mark the housing for assembly purposes.

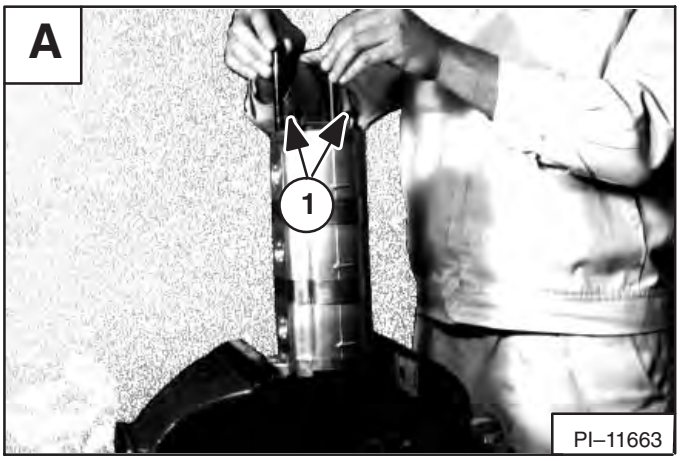
Remove the bolts (Item 1) **[A]**.

Remove the cover **[B]**.

Remove the seal **[C]**.

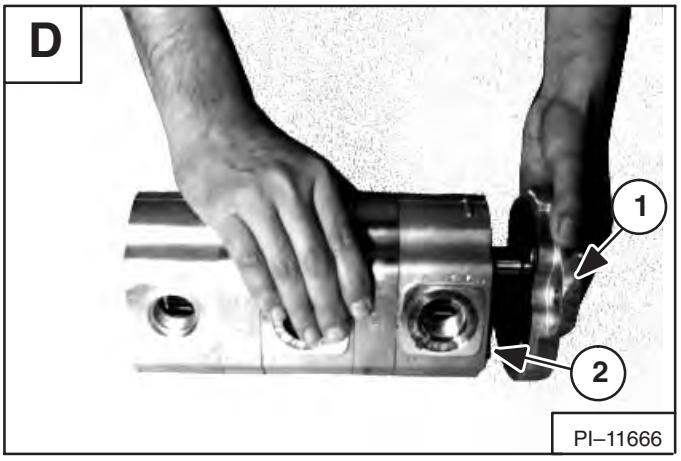
Remove the pumps from the vise.

Remove the mounting flange (Item 1) **[D]** and seal (Item 2) **[D]**.









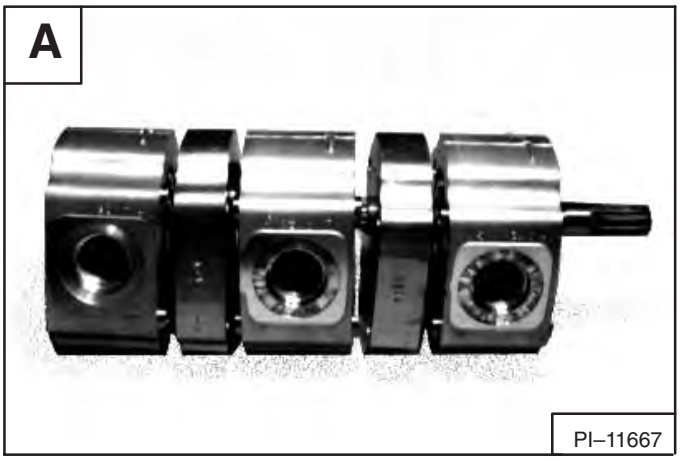
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HYDRAULIC PUMP (Cont'd)

Disassembly (Cont'd)

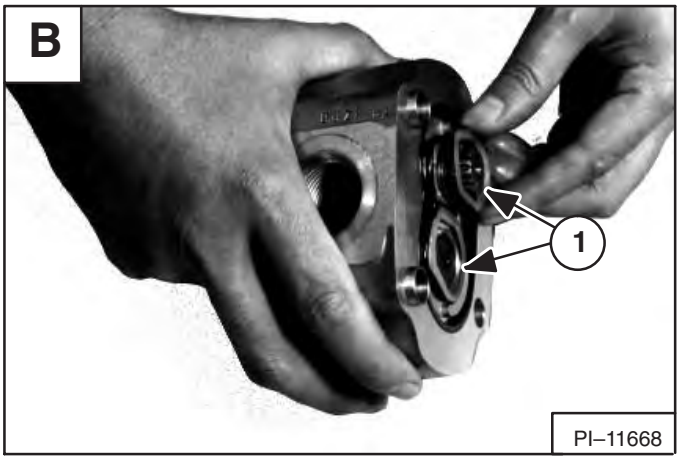
Separate the three parts **[A]**.

NOTE: Use a rubber hammer to help separate the pumps if needed.

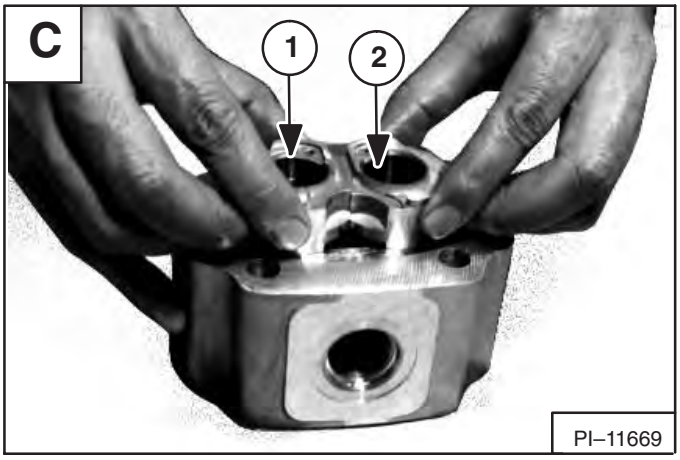


Remove the center plate from the rear pump **[B]**.

Remove the seal (Item 1) **[B]**.



Remove the bushings (Items 1 & 2) **[C]**.

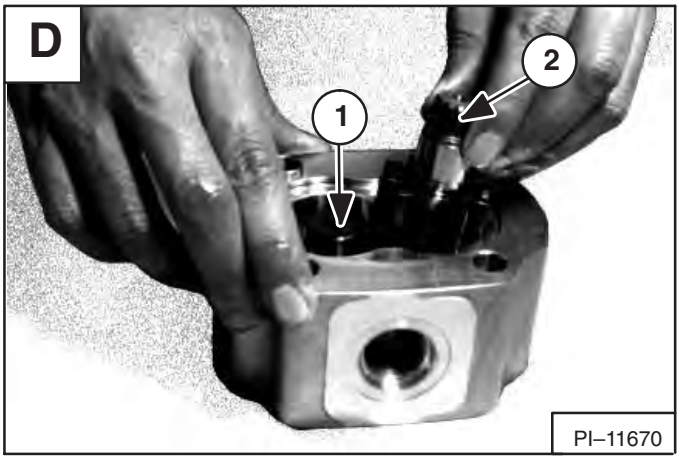


Remove the gears (Items 1 & 2) **[D]**.

NOTE: Use the gears to push out stuck bushings.

Remove the center plate from center pump and disassemble same as the rear pump.

Remove the seal from the front pump. Disassemble in the same procedure.

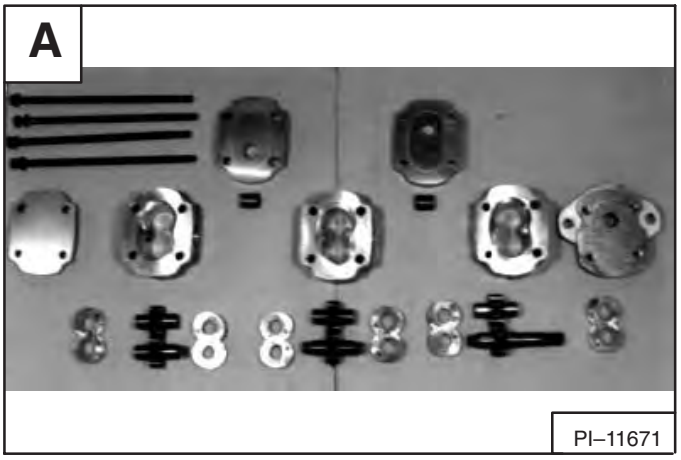


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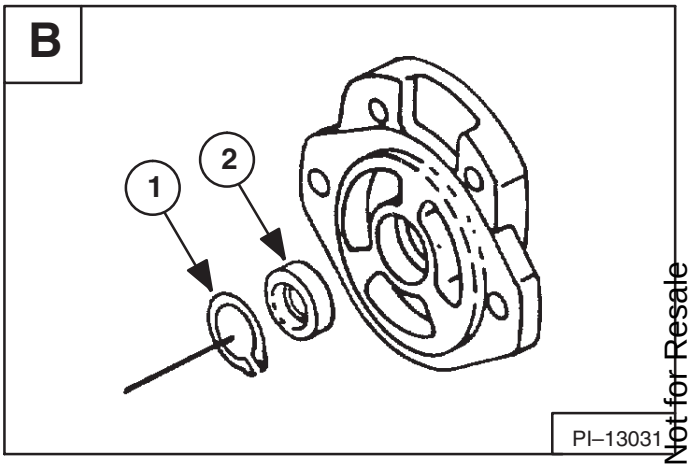
HYDRAULIC PUMP (Cont'd)

Disassembly (Cont'd)

Lay parts on paper as shown for assembly **[A]**.



Remove the snap ring (Item 1**[B]** and oil seal (Item 2**[B]** from inside the mounting flange.



Assembly

Clean all parts thoroughly.

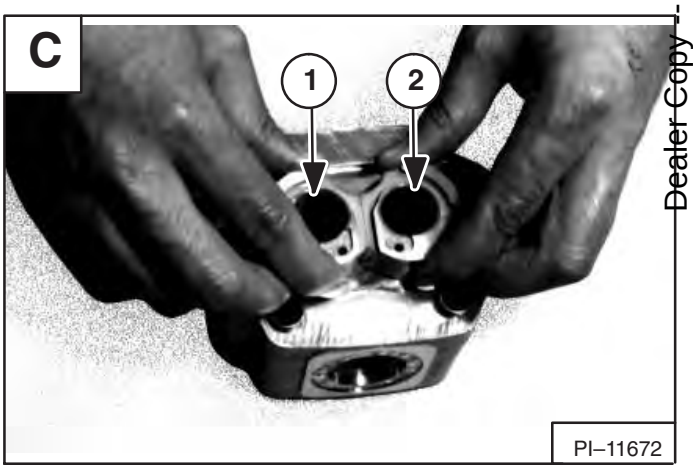
Put clean grease on all seals.

Apply a clean oil fim on inside of all pumps.

Place center pump on a table.

Install the bushings (Items 1 & 2) **[C]** at the same time in the body until they are flat with the top surface.

NOTE: DO NOT FORCE the bushings.



Turn the body over. Do not allow the bushings to drop out of the body **[D]**.

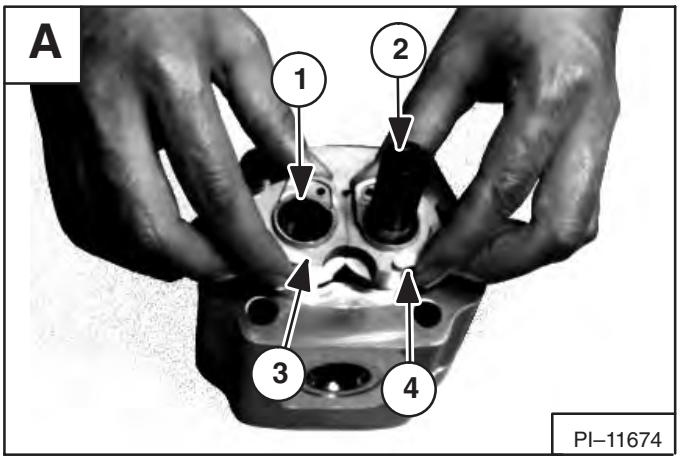


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HYDRAULIC PUMP (Cont'd)

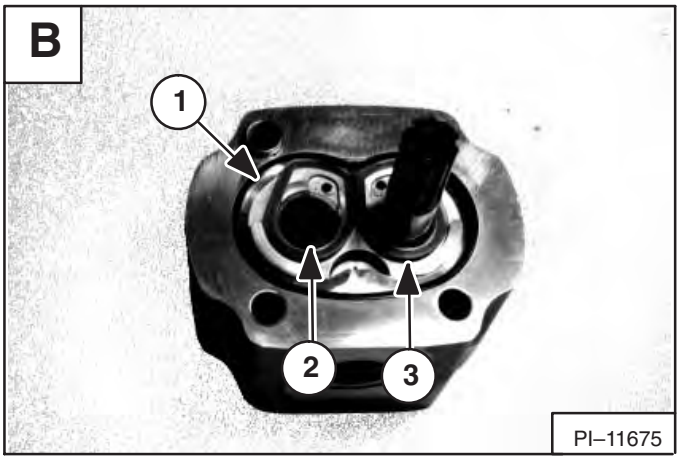
Assembly (Cont'd)

Install the gears (Items 1 & 2) **[A]** and bushings (Items 3 & 4) **[A]**.



Install the bushing seal body (Item 1)**[B]** and the packing ring (Items 2 & 3) **[B]**.

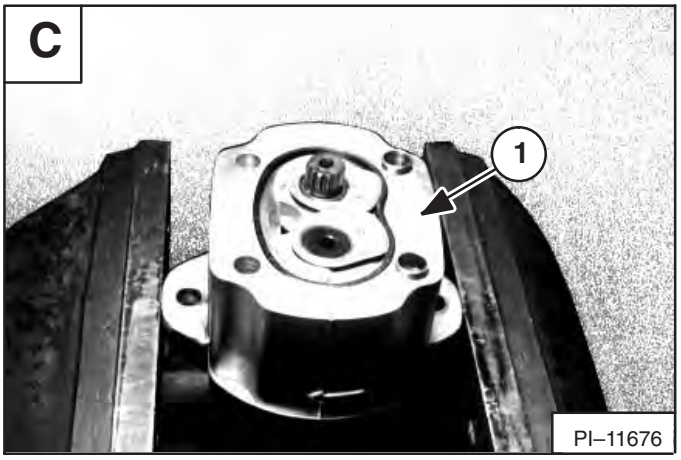
NOTE: DO NOT OVERLAP the center part of the packing rings (Items 2 & 3) [B].



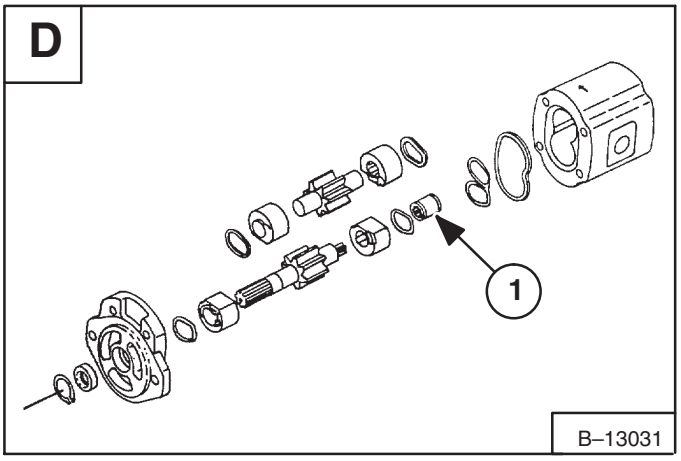
Install the rear pump (Item 1)**[C]** on the mounting flange.

Install the mounting flange in a vise **[C]**.

Assemble the center and rear pumps in the same procedure as the rear pump.



Install the splined coupler (Item 1)**[D]** on the splined gear of the rear pump.



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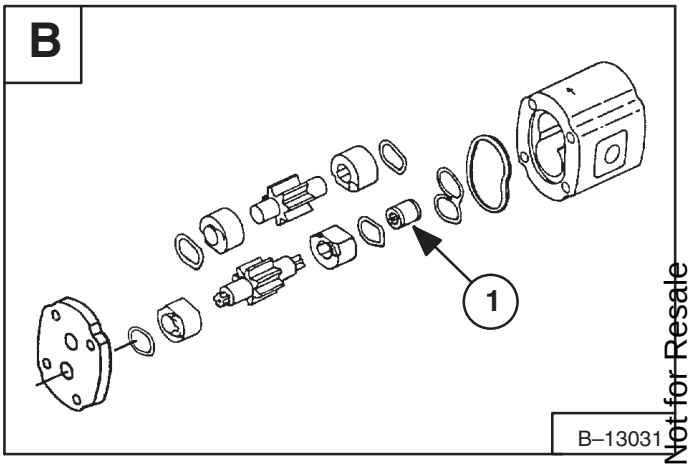
HYDRAULIC PUMP (Cont'd)

Assembly (Cont'd)

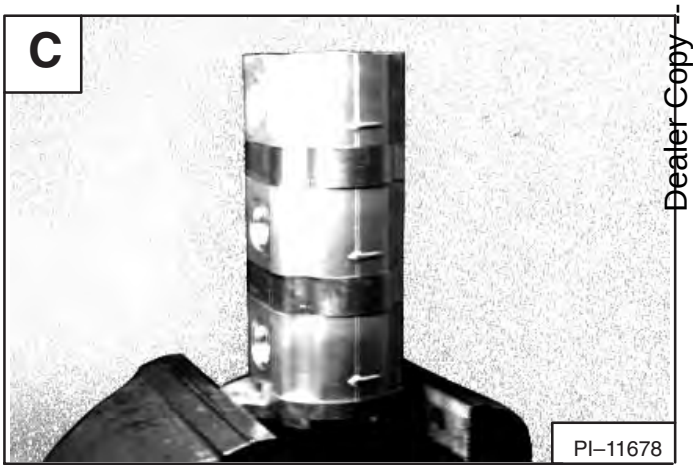
Install the center pump on the rear pump using the coupler for alignment **[A]**.



Install the splined coupler (Item 2)**[B]** on the splined gear of the center pump.



Install the front pump on the center pump using the coupler for alignment **[C]**.

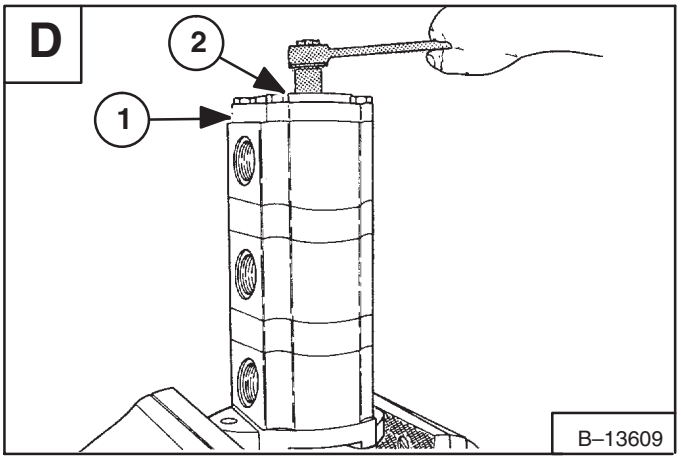


Check the alignment marks made earlieron the housing.

Install the cover (Item 1) **[D]** and the washers and bolts.

Tighten the bolts to 34 ft.–lbs. (46 Nm) torque.

Rotate the pump input shaft, it must turn freely.

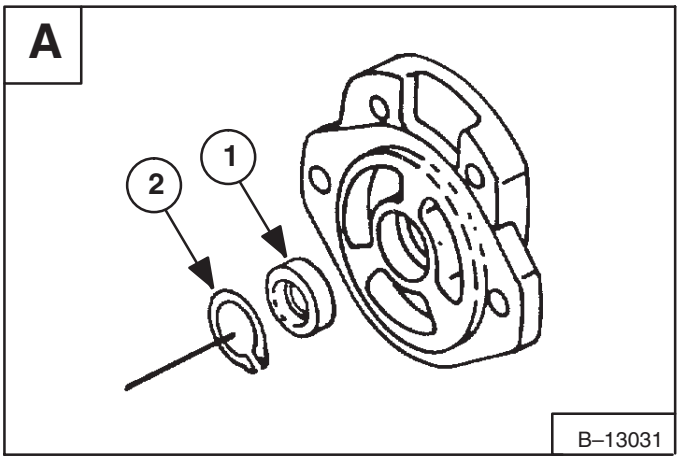


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HYDRAULIC PUMP (Cont'd)

Assembly (Cont'd)

Install the oil seal (Item 1) **[A]** and snap ring (Item 2) **[A]** in the mounting flange.



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HYDRAULIC CONTROL VALVE

Removal and Installation

IMPORTANT

When making repairs on hydrostatic and hydraulic systems, clean the work area before disassembly and keep all parts clean. Always use caps and plugs on hoses, tubelines and ports to keep dirt out. Dirt can quickly damage the system.

I–2003–0284

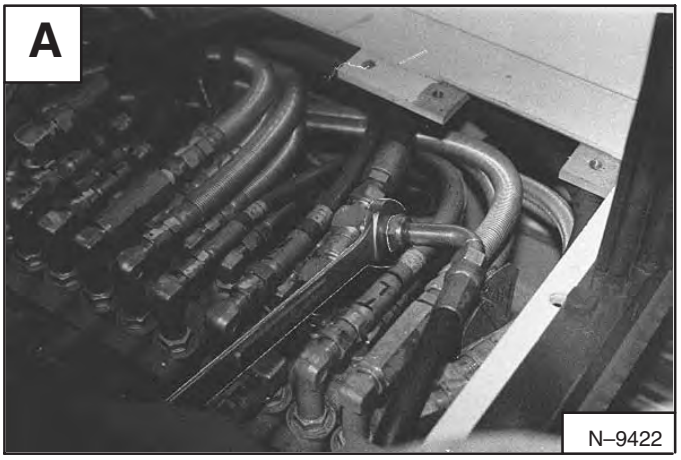
NOTE: Mark all the hoses for correct installation.

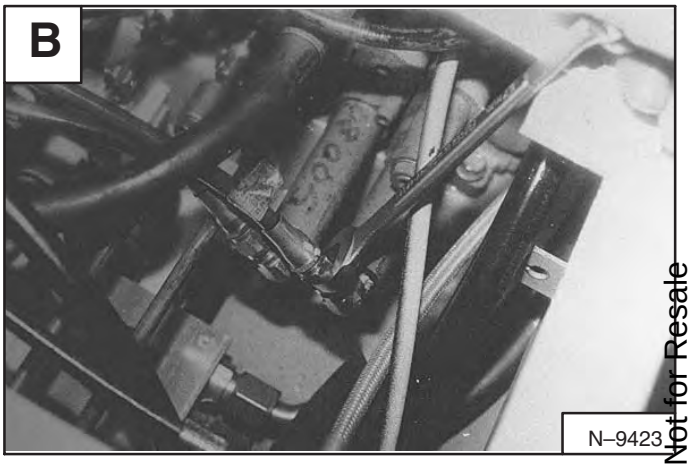
Disconnect the two auxiliary hoses **[A]**.

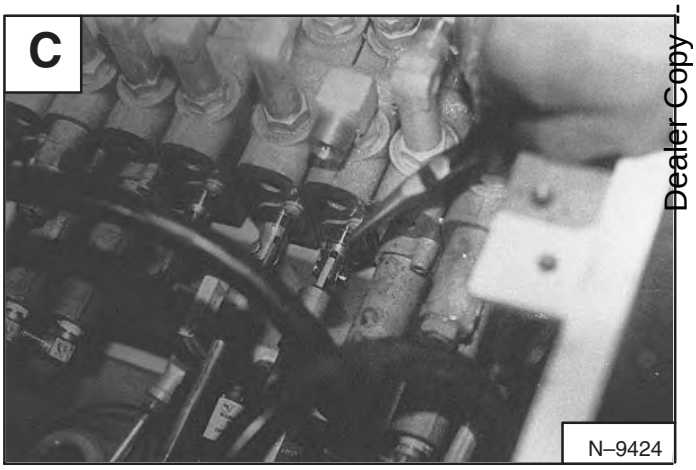
Disconnect the hand control lever hoses from the front and rear of the control valve **[B]**.

Disconnect the control linkage pins from the control valve spools **[C]**.

Disconnect the hoses from the control valve **[D]**.





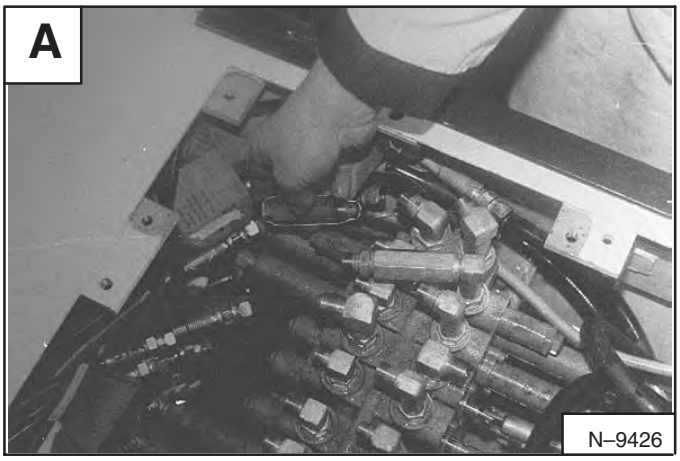




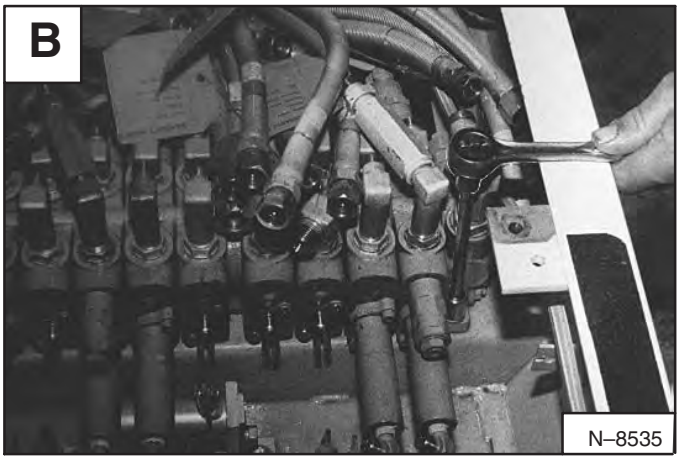
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HYDRAULIC CONTROL VALVE (Cont'd)

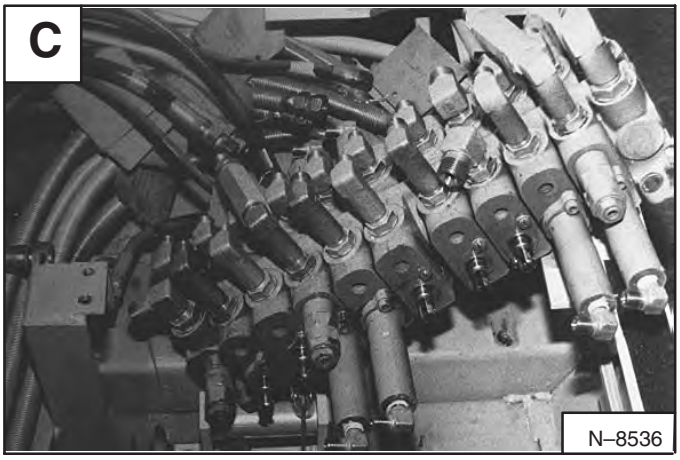
The main relief valve must be removed to remove the mounting bolts from the control valve **[A]**.



Remove the control valve mounting bolts **[B]**.



Remove the control valve **[C]**.



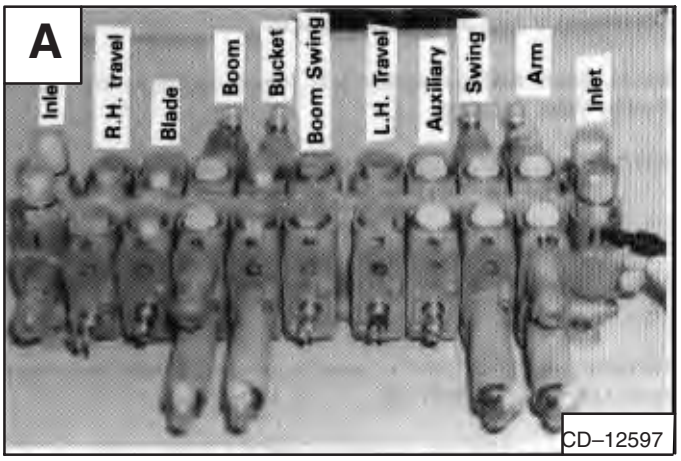
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CONTROL VALVE

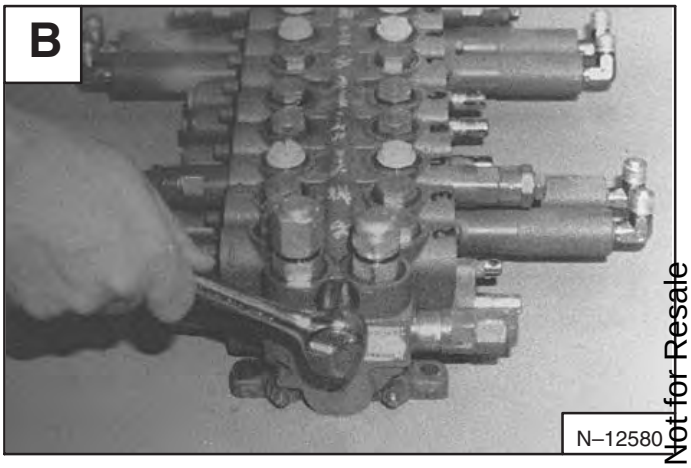
Disassembly and Assembly

Mark each section of the control valve for ease of reassembly **[A]**.

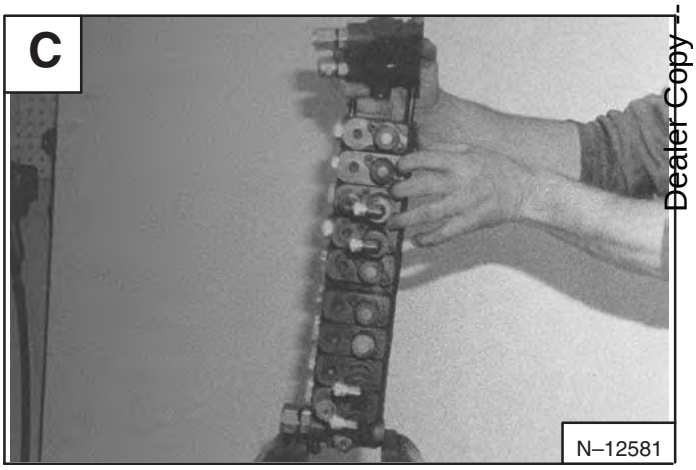
NOTE: Always use new O–rings during assembly of the control valve.



Loosen and remove the nuts from one end of the control valve through bolts **[B]**.



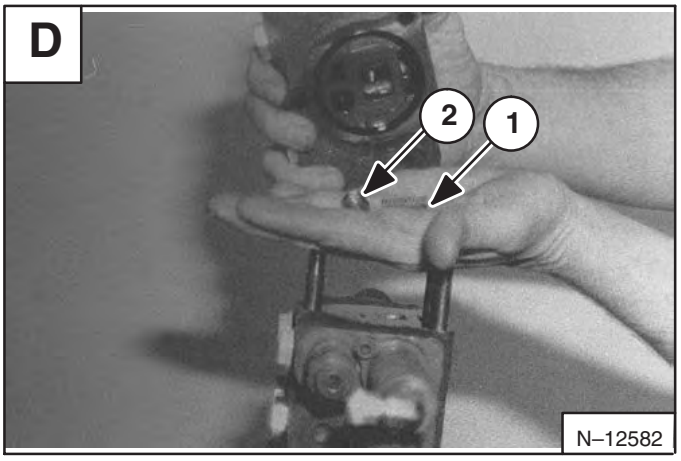
Position the valve assembly on it's end and remove the inlet section of the control valve **[C]**.



Remove each of the additional valve sections by lifting them off of the valve through bolts **[D]**

Do not scratch the side faces of the valve sections.

NOTE: With the exception of the two (2) travel sections, each section of the control valve has a spring (Item 1) [D] and load check plug (Item 2) [D] in the side face of the sections. Keep the load check plug and spring with the sections in which they were originally installed.



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CONTROL VALVE (Cont'd)

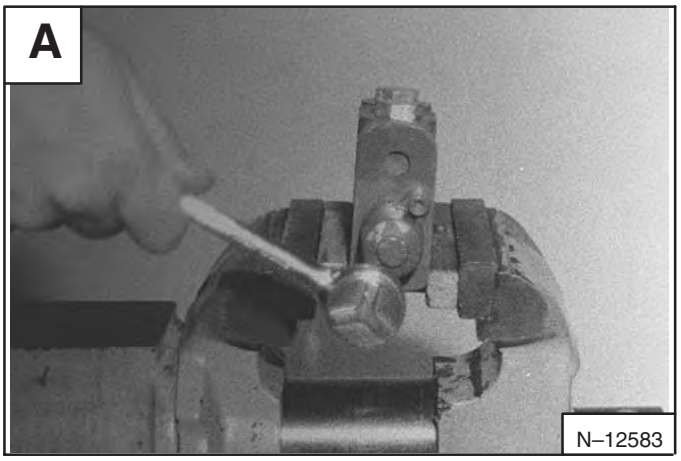
Disassembly and Assembly

Blade, Boom Swing, Bucket, L.H. T ravel, Auxiliary and House Swing Valve Sections

NOTE: The photo may not show the valve section exactly as it appears, but the procedure is correct for these sections.

Use a vise with protective jaws and clamp the valve section **[A]**.

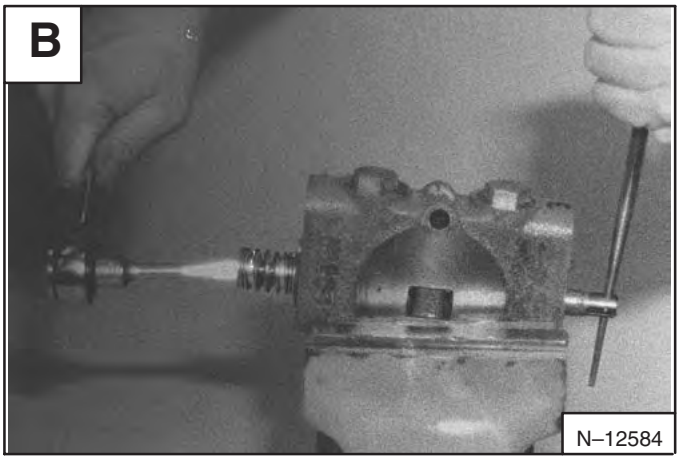
Remove the bolts from the spool cover and remove the cover from the valve section **[A]**.



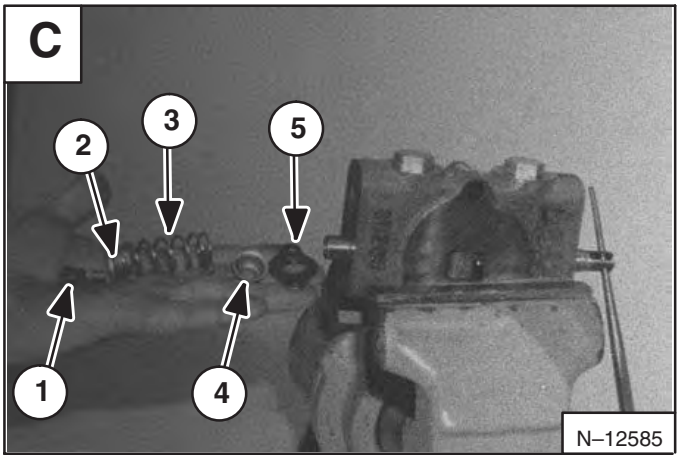
Install a rod through the clevis end of the spool. Remove the bolt from the end of the spool **[B]**.

DO NOT grip the spool with any type of tool.

NOTE: The spool spring is under pressure, use care when removing the bolt from the spool end.

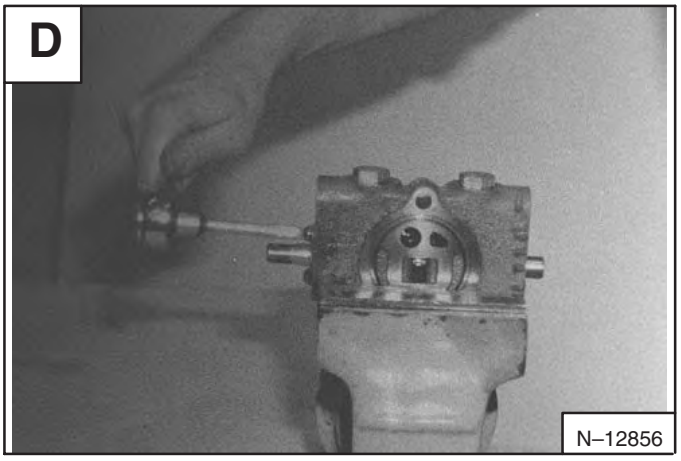


Remove the bolt (Item 1)**[C]**, spring retainer (Item 2)**[C]**, spring (Item 3) **[C]**, spring retainer (Item 4) **[C]** and the cover plate (Item 5) **[C]**.



Remove the screws and cover plate from the clevis end of the valve section **[D]**.

NOTE: The spool and valve housing are not serviceable, they are a matched set. It is not necessary to remove the spool from the housing to service the spool wipers and O–rings. If the spool isremoved, use extreme care not to scratch the spool surface and do not intermix the spools and housings.

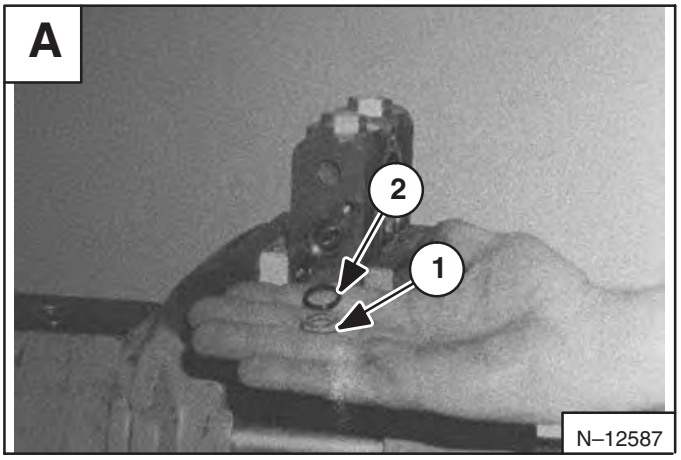


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CONTROL VALVE (Cont'd)

Disassembly and Assembly (Cont'd)

Push the spool into the valve housing far enough to remove the wiper (Item 1) **[A]** and O–ring (Item 2) **[A]** from the clevis end of the housing.

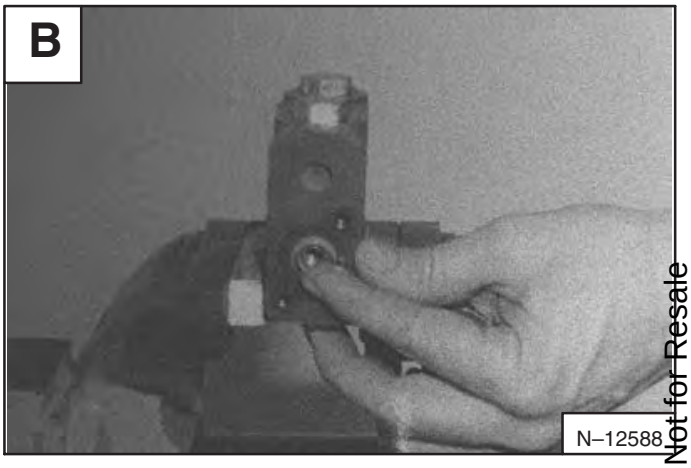


Check the O–ring groove in the housing for contaminates and clean as necessary.

Apply oil to the O–ring and wiper.

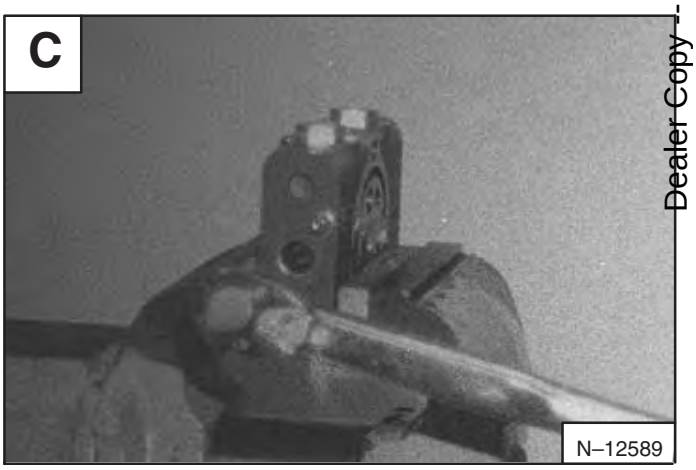
Install the O–ring and wiper into the housing **[B]**.

NOTE: The flange side of the wiper faces outwards from the housing.

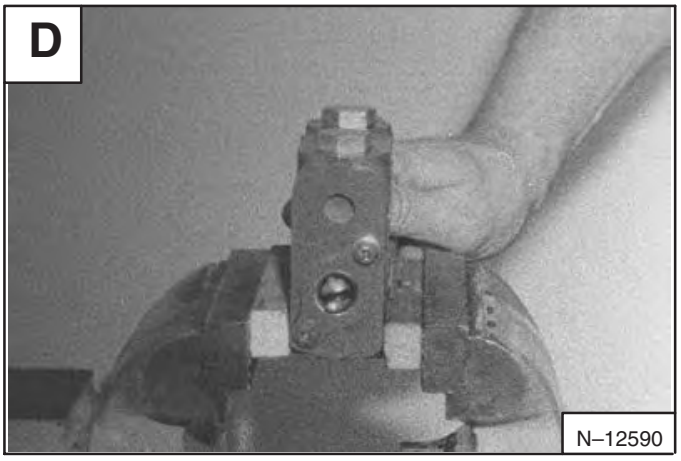


Install the cover plate onto the clevis end of the housing **[C]**.

Tighten the screws to 24 in.–lbs. (2,75 Nm) torque.



Slowly rotate the spool and push it into thevalve until the clevis end of the spool has past through the O–ring and wiper **[D]**.

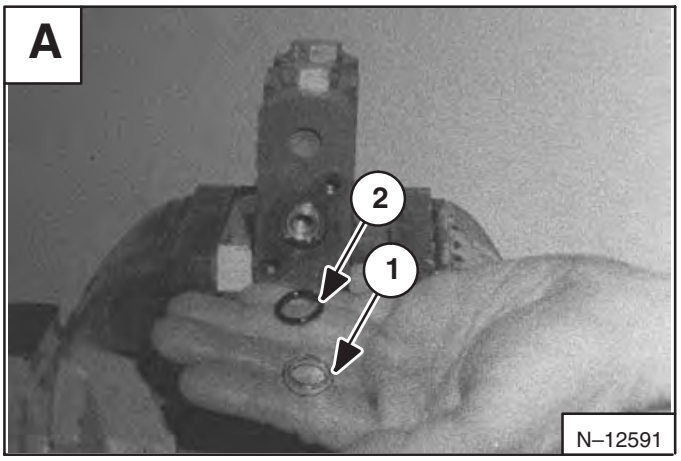


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CONTROL VALVE (Cont'd)

Disassembly and Assembly (Cont'd)

Pull the spool out of the valve far enough to remove the rear wiper (Item 1) **[A]** and O–ring (Item 2) **[A]** from the housing.

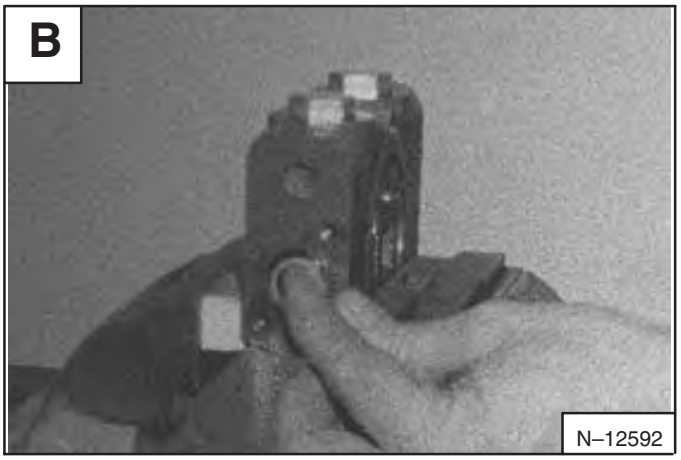


Check the O–ring groove in the housing for contamination and clean as necessary.

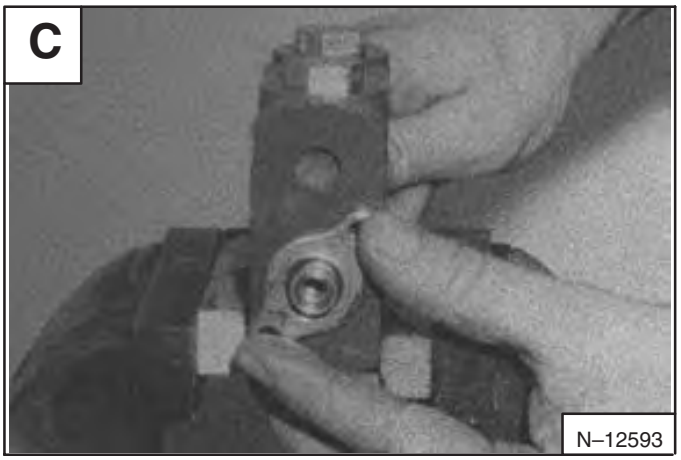
Apply oil to the O–ring and wiper.

Install the O–ring and wiper into the housing **[B]**.

NOTE: The flange side of the wiper faces outwards from the housing.

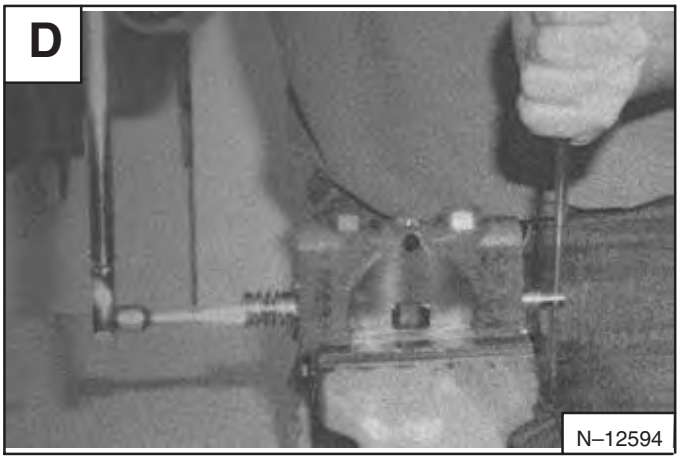


Install the cover plate onto the rear housing. Hold the cover plate in position and slowly rotate the spool and push it through the O–ring, wiper and the cover plate **[C]**.



Leave the cover plate positioned over the wiper and install the spring retainer, spring, spring retainer and the bolt **[D]**.

Install a rod through the clevis end of the spool and tighten the bolt to 55 in.–lbs. (6,27 Nm) torque.

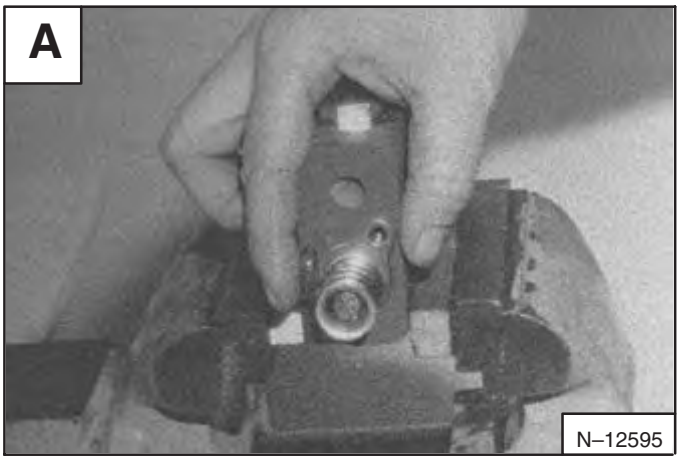


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CONTROL VALVE (Cont'd)

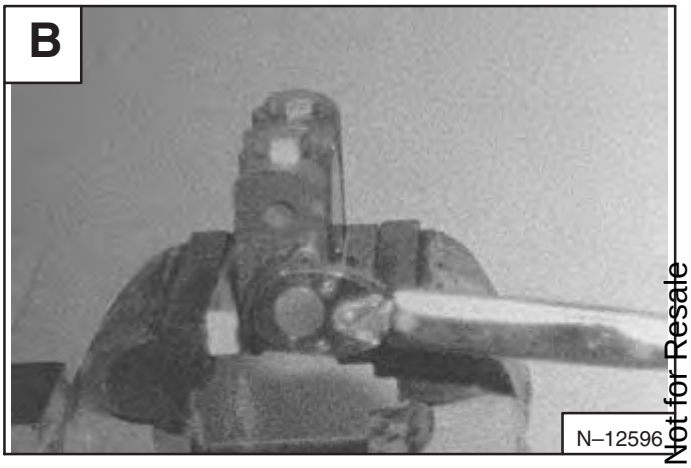
Disassembly and Assembly (Cont'd)

Apply grease to the outer diameter of the spring **[A]**.



Install the cover and the bolts **[B]**.

Tighten the bolts to 152 in.–lbs. (17,25 Nm) torgue.



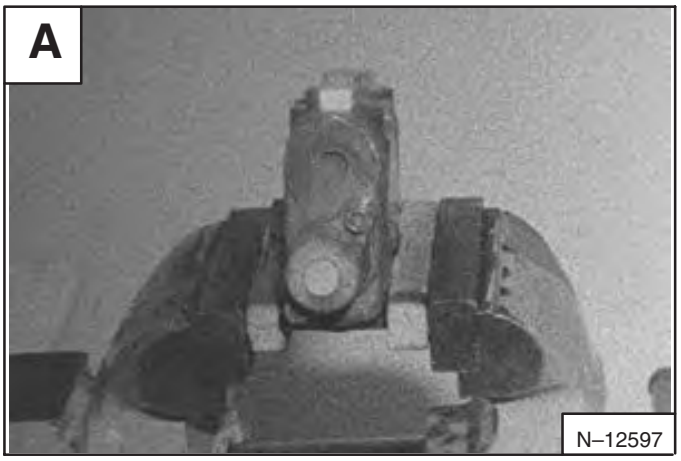
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CONTROL VALVE (Cont'd)

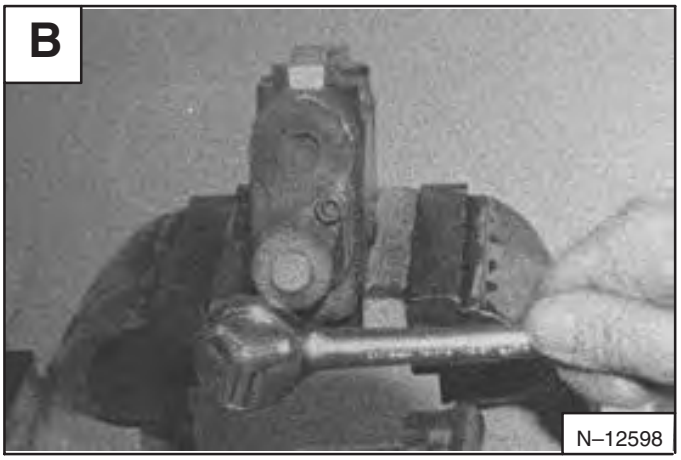
Disassembly and Assembly (Cont'd)

R.H. Travel Valve Section

Use a vise with protective jaws and clamp the valve section **[A]**.



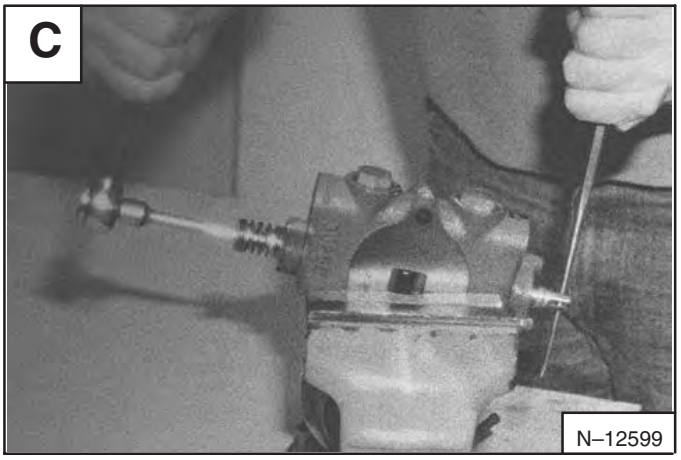
Remove the bolts from the spool cover and remove the cover from the valve section **[B]**.



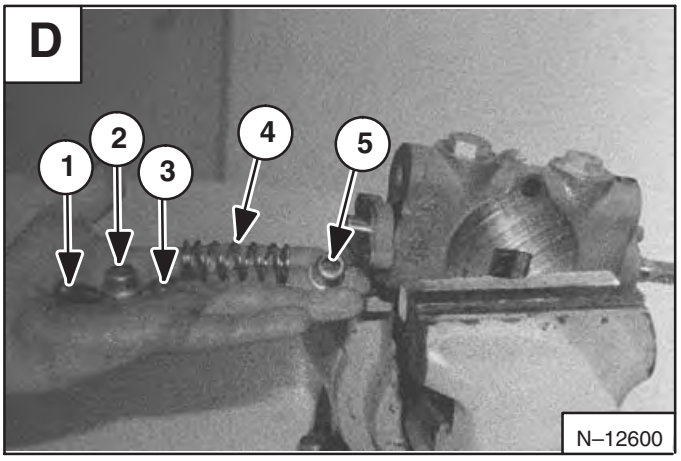
Install a rod through the clevis end of the spool. Remove the bolt from the end of the spool **[C]**.

Do not grip the spool with any type of tool.

NOTE: The spool spring is under pressure, use care when removing the bolt from the spool end.



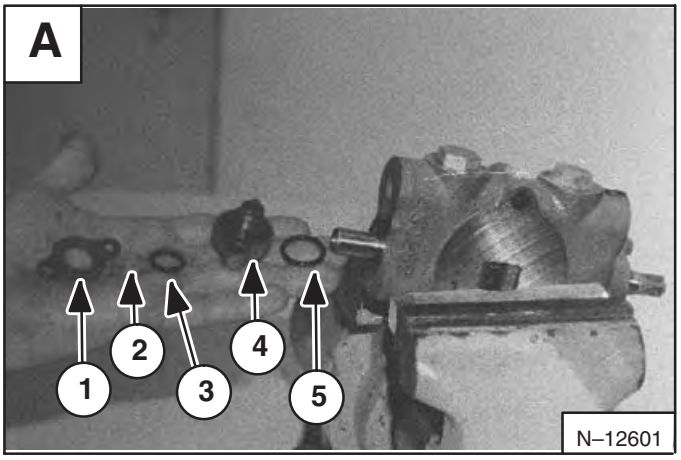
Remove the bolt with O–ring (Item 1)**[D]**, spring retainer (Item 2) **[D]**, washer (Item 3) **[D]**, spring (Item 4) **[D]** and spring retainer (Item 5) **[D]**.



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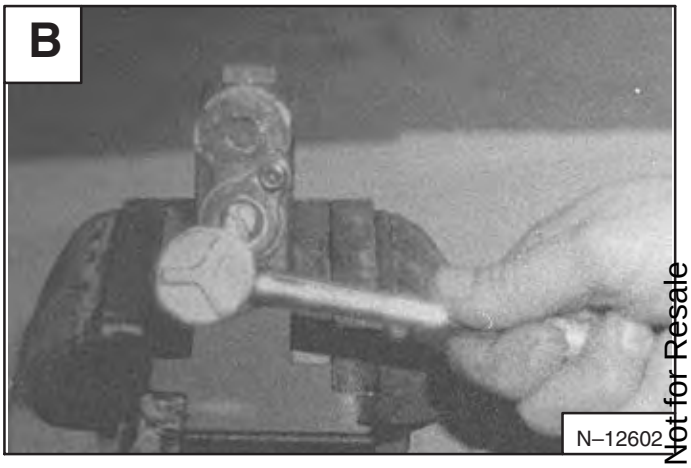
Disassembly and Assembly (Cont'd)

Remove the cover plate (Item 1) **[A]**, wiper (Item 2) **[A]**, O–ring (Item 3) **[A]**, spacer (Item 4) **[A]**, and O–ring (Item 5) **[A]**.

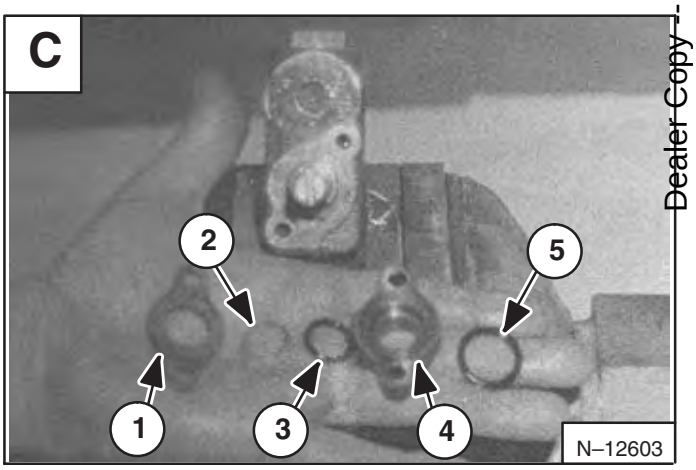


Remove the screws from the cover plate from the clevis end of the valve section **[B]**.

NOTE: The spool and the valve housing are not serviceable, they are a matched set. It is not necessary to remove the spool from the valve housing. If the spool is removed from the valve section, use extreme care not to scratch the spool surface and do not intermix spools and housings.



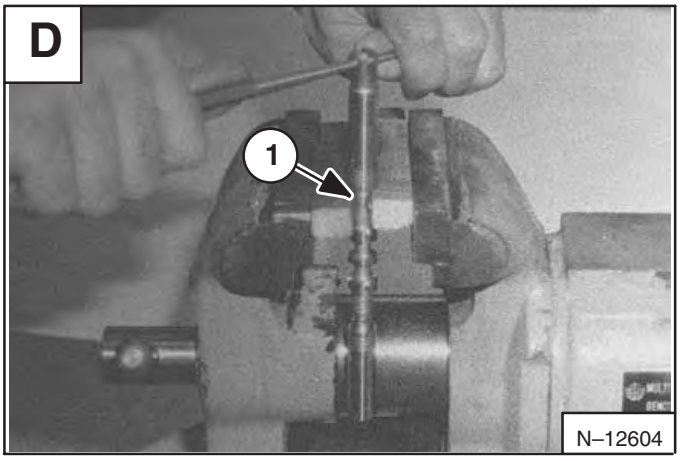
Remove the cover plate (Item 1) **[C]**, wiper (Item 2) **[C]**, O–ring (Item 3) **[C]** spacer (Item 4) **[C]** and O–ring (Item 5) **[C]**.



The clevis end of this spool is replaceable. Unless the clevis end has been damaged, or the O–ring on the threaded end of the clevis is leaking, do not remove it.

If it must be removed, carefully remove the spool from the valve section.

Install a hardened dowel pin (Item 1) **[D]** through the hole in the spool and clamp the spool in a vise with protective jaws. Install a rod through the clevis end and turn the clevis off the spool.



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CONTROL VALVE (Cont'd)

Disassembly and Assembly (Cont'd)

If the clevis end has been removed, replace the O–ring **[A]**.

To install the O–ring onto the clevis, wrap the threaded end of the clevis with 3 or 4 wraps of household wax paper. Oil the O–ring and slide it over the wax paper and into the O–ring groove.

Install the clevis end into the spool.

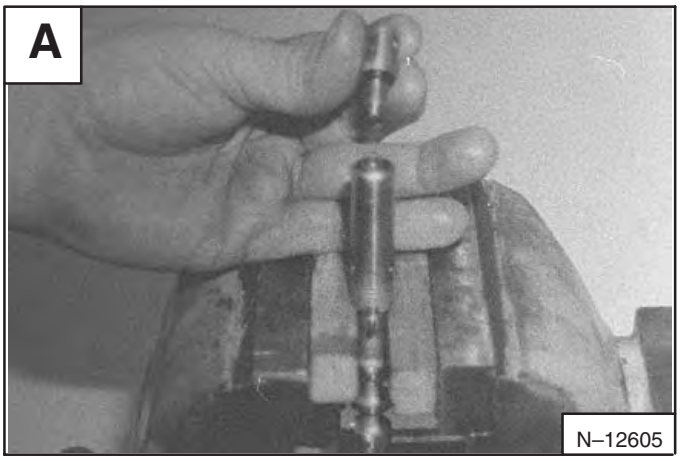
Tighten the clevis to 55 in.–lbs. (6,25 Nm) torque.

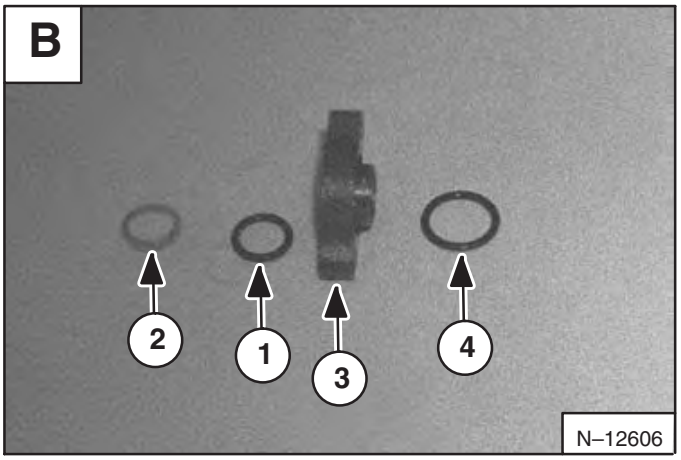
Reinstall the spool into the valve section.

Check the O–ring groove in the spacer for contaminates and clean as necessary . Apply oil to the wiper and O–rings.

Install the O–ring (Item 1) **[B]** and wiper (Item 2) **[B]** into the spacer (Item 3) **[B]**. Install the O–ring (Item 4) **[B]** to the spacers flange.

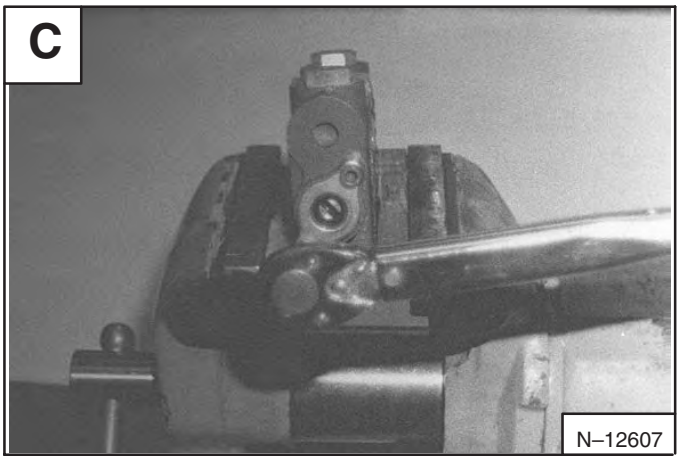
NOTE: The flanged side of the wiper faces outwards from the spacer.



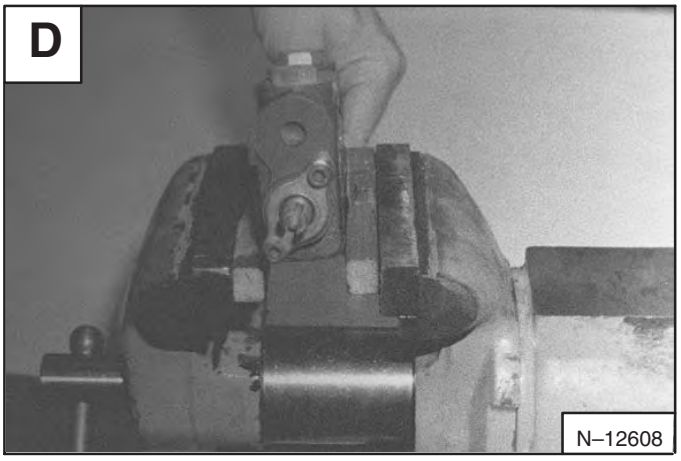


Install the spacer and the cover plate onto the clevis end of the valve section **[C]**.

Tighten the bolts to 76 in.–lbs. (8,6 Nm) torque.



Slowly rotate the spool and push it into thevalve until the clevis end of the spool has past through the O–ring and wiper **[D]**.



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CONTROL VALVE (Cont'd)

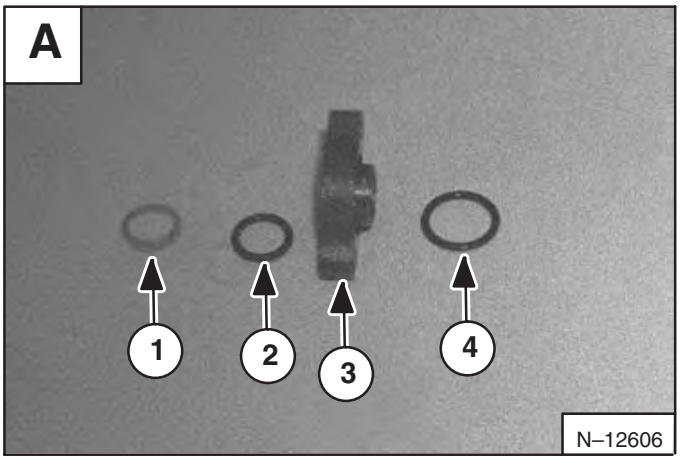
Disassembly and Assembly (Cont'd)

Check the O–ring groove in the spacer for contaminates and clean as necessary.

Apply oil to the wiper and O–rings.

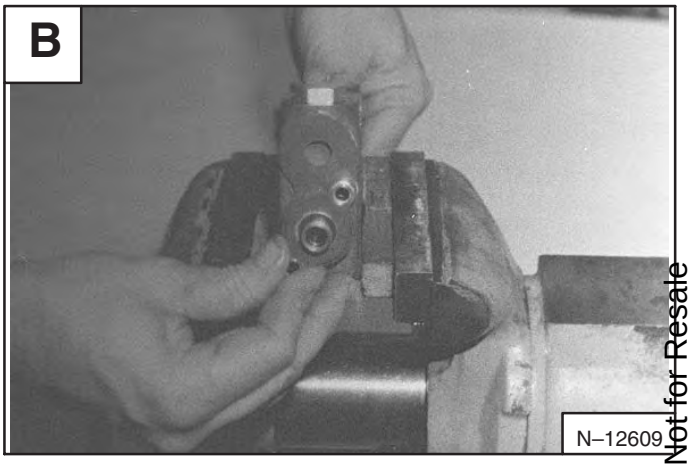
Install the O–ring (Item 1) **[A]** and wiper (Item 2) **[A]** into the spacer (Item 3) **[A]**. Install the O–ring (Item 4) **[A]** to the spacers flange.

NOTE: The flanged side of the wiper faces outwards from the spacer.



Install the spacer and cover plate onto the rear end of the valve section and hold these in place **[B]**.

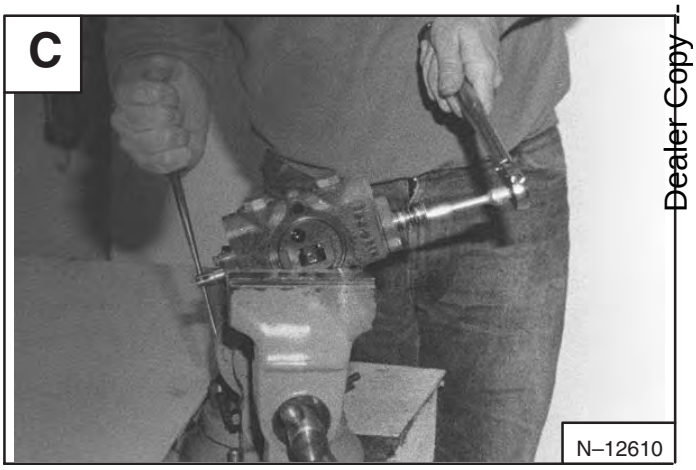
Slowly rotate the spool and push it through the O–ring and wiper in the spacer.



Install the new O–ring onto the spring retaining bolt by wrapping the threads with 3 or 4 wraps of household wax paper. Oil the O–ring and slide it over the wax paper and into the O–ring groove.

Install the spring retainer, spring washer, spring retainer onto the end of the spool **[C]**.

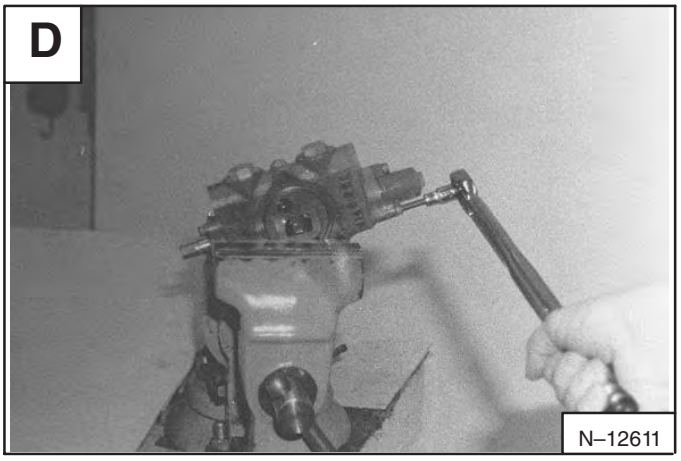
Tighten the bolt to 55 in.–lbs. (6,25 Nm) torque.



Apply grease to the outer diameter of the spring.

Install the end cover **[D]**.

Tighten the bolts to 76 in.–lbs. (8,63 Nm) torque.



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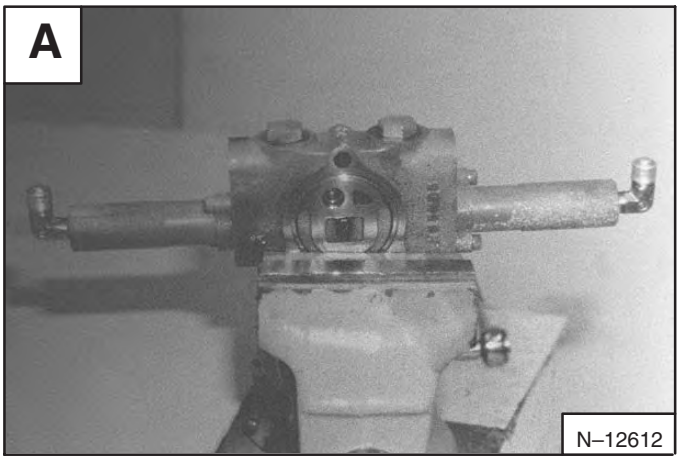
CONTROL VALVE (Cont'd)

Disassembly and Assembly (Cont'd)

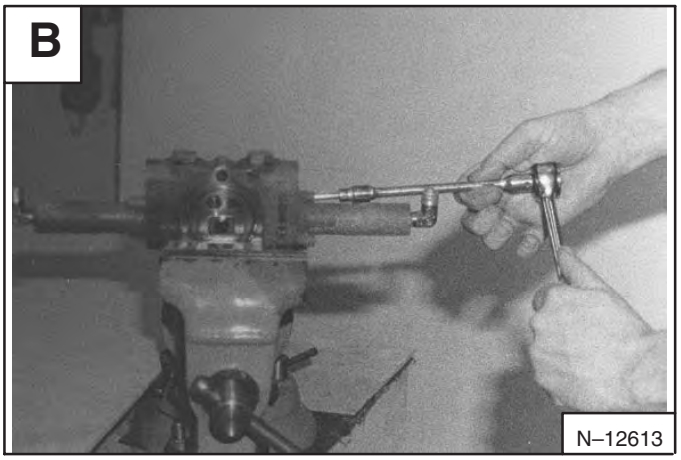
Hydraulically Activated Valve Sections

NOTE: The photos may not show the valve exactly as they appear, but the procedure is correct for these sections.

Use a vise with protective jaws and clamp the valve section **[A]**.

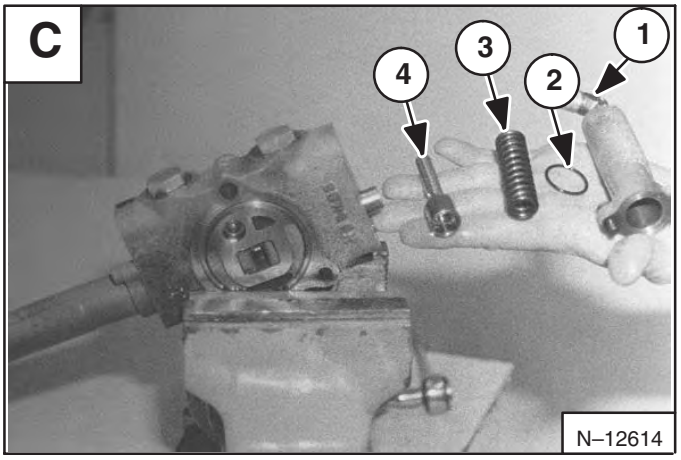


Remove the bolts from the cover **[B]**.



Remove the cover (Item 1) **[C]**, O–ring (Item 2) **[C]**, spring (Item 3) **[C]** and the spring retainer (Item 4) **[C]**.

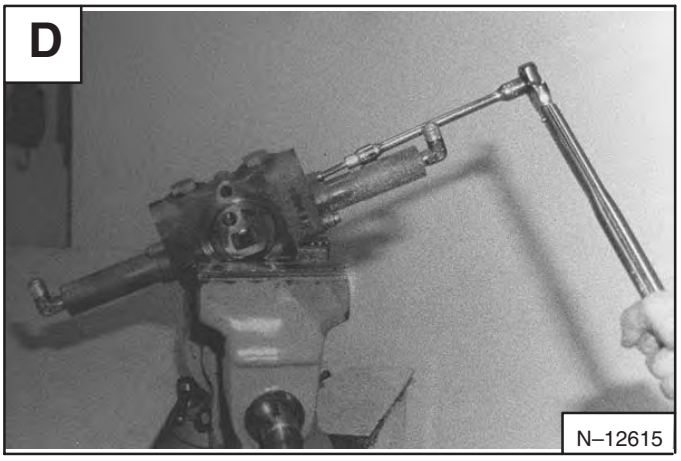
NOTE: There are no O–rings or wipers used with these spools and housings. The spool and housing are not serviceable separately, they are a matched set. It is not necessary to remove the spool from the housing. If the spool is removed, use extreme care not to scratch the spool surface and the spool must be reinstalled in the same housing and in the same orientation.



Install the spring retainer and the spring. Apply grease to the outer diameter of the spring. Install a new O–ring and attach the cover to the housing **[D]**.

Torque the bolts to 76 in.–lbs. (8,63 Nm) torque.

NOTE: Both ends of the valve section use identical parts. Repeat steps [B], [C] and [D] for the opposite end of the valve.



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CONTROL VALVE (Cont'd)

Disassembly and Assembly (Cont'd)

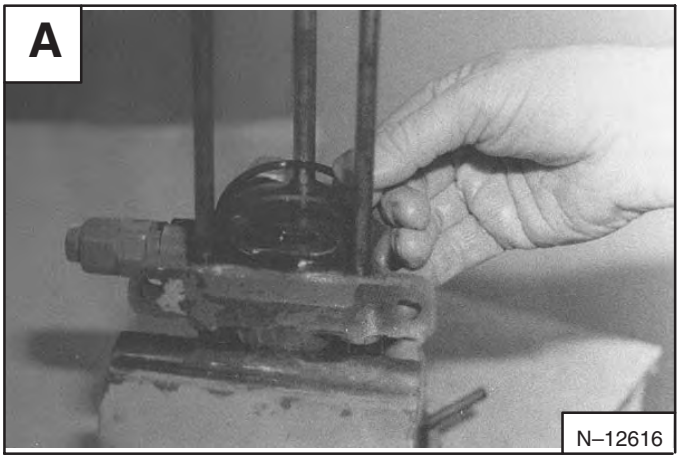
Install the three through bolts into the inlet section of the control valve.

Position the inlet section on its end.

Install a new O–ring into the inlet section O–ring groove **[A]**.

Oil the O–ring.

Check each valve section for location marks. Make sure that the valve section are installed in the correct order.

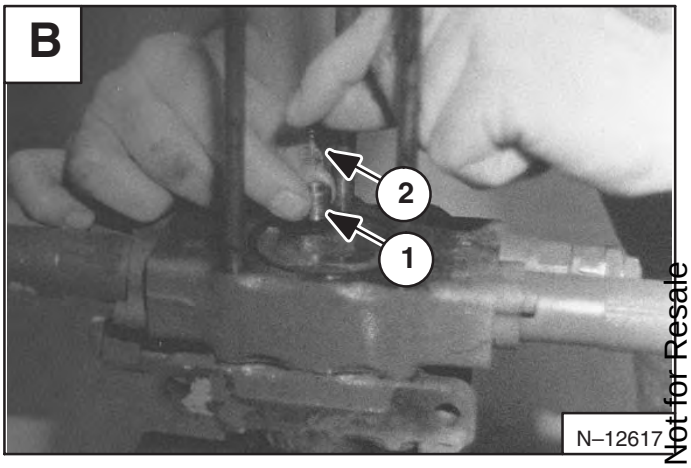


Install the next section over the three through bolts and position it flat against the previous valve section.

If the valve section had a load check plug (Item 1) **[B]** and spring (Item 2), oil the load check plug and install it in the side face of the valve and set the spring into the load check plug cavity.

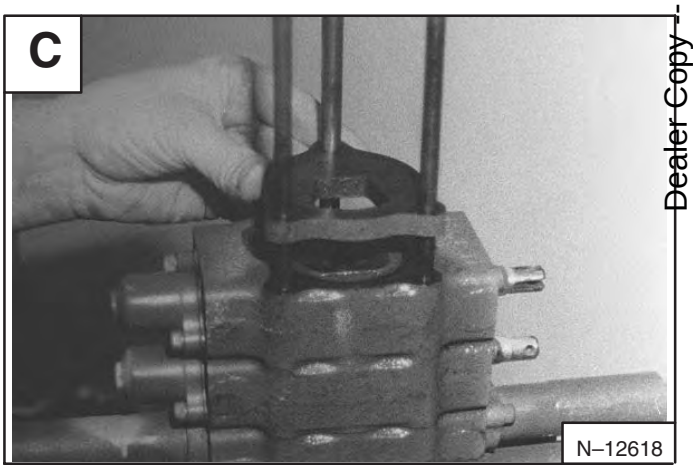
Install the O–ring into the valve section groove and oil the O–ring.

Continue the installation of each of the valve sections in their correct locations.



Install the valve plate between sections marked 6 and 7 **[C]**.

Continue the installation of the sections until all valve sections are installed

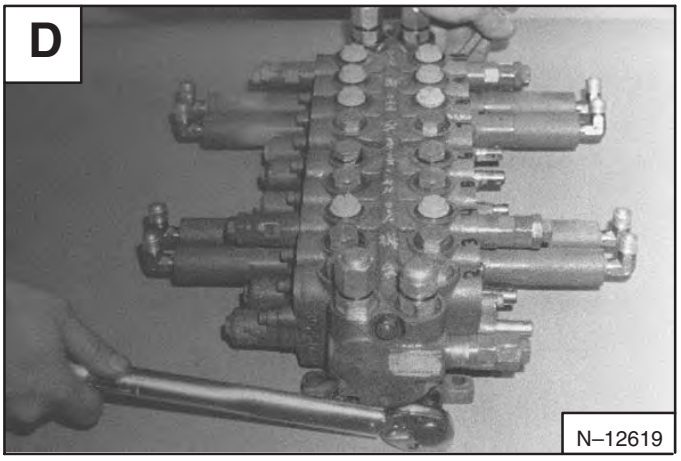


Install the nuts onto the through bolts **[D]**.

Tighten the 10mm nuts to 34 ft.–lbs. (46 Nm) torque.

Tighten the 8 mm nut to 14 ft.–lbs. (19 Nm) torque.

NOTE: Tighten the nuts evenly to avoid the spools binding in the housings. Check the operation of spools, they must move freely in and out. If any binding is felt, loosen the nuts and retorque.



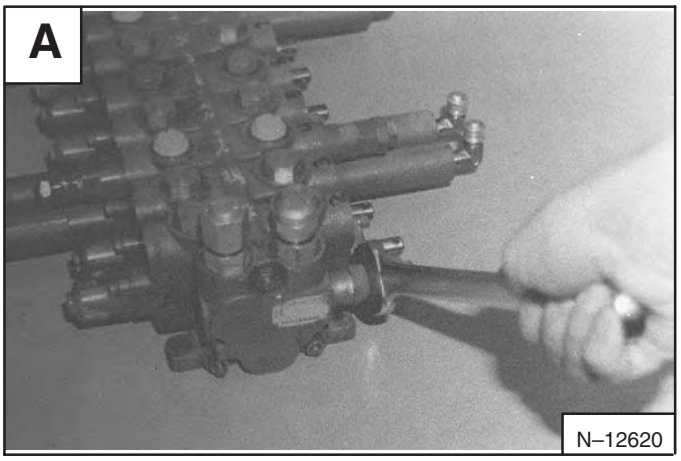
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CONTROL VALVE (Cont'd)

Disassembly and Assembly (Cont'd)

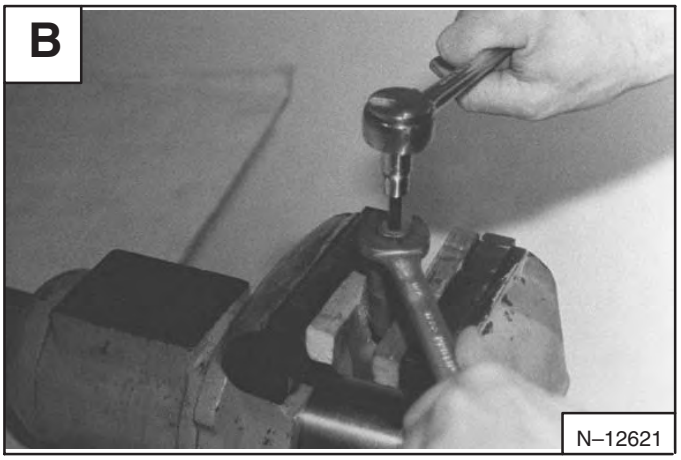
Main Relief Valves

Remove the main relief valve from the inlet section **[A]**.

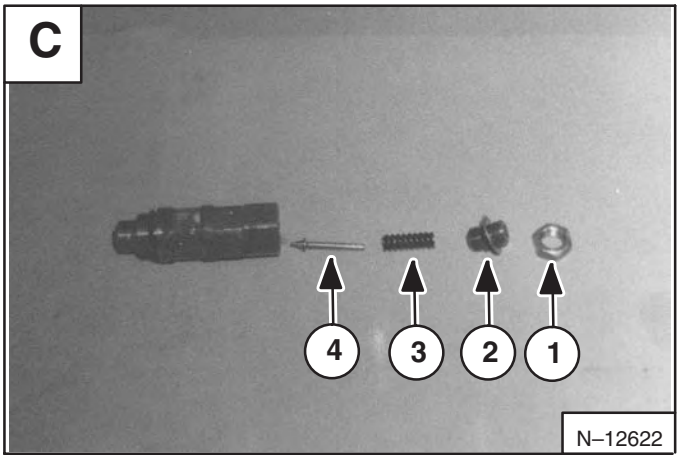


Use a vise with protective jaws and hold the relief valve.

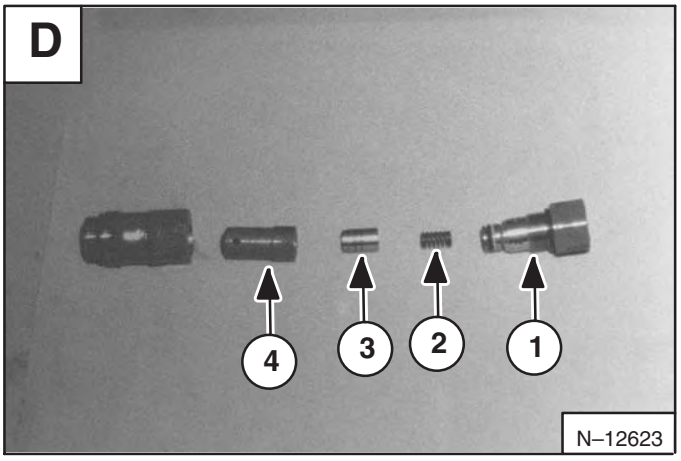
Loosen the adjusting set screws jam nut from the end of the relief valve **[B]**.



Remove the jam nut (Item 1) **[C]**, the adjusting set screw with O–ring (Item 2) **[C]**, spring (Item 3) **[C]** and the poppet (Item 4) **[C]** from the relief valve housing.



Remove the relief plug (Item 1) **[D]**, spring (Item 2) **[D]**, poppet (Item 3) **[D]** and the sleeve (Item 4) **[D]** from the relief valve housing (Item 5) **[D]**.



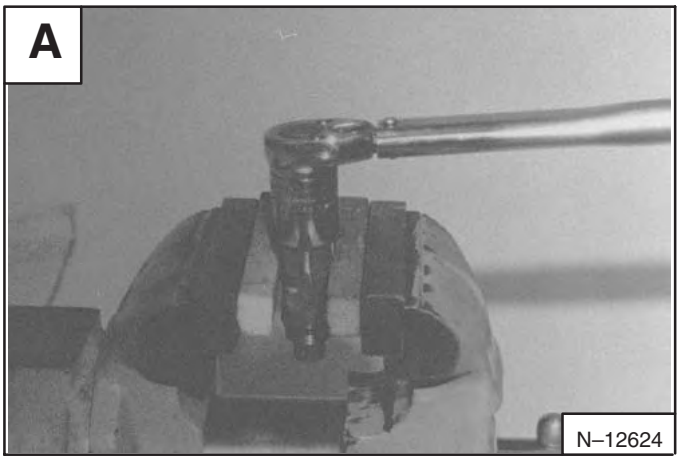
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CONTROL VALVE (Cont'd)

Disassembly and Assembly (Cont'd)

Clean and inspect all parts of the main relief valve. If any of the relief valve components are scratched or damaged, a new relief valve will need to be ordered, as internal components are not serviced separately.

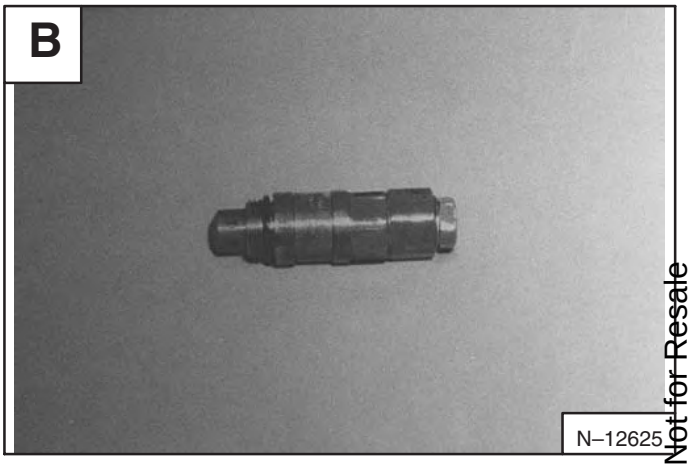
Oil all moving parts and reassemble the sleeve, poppet, spring and the relief plug to 33 ft.–lbs. (45 Nm) torque.



Install a new O–ring onto the adjusting set screw . Wrap the threads of the set screw with 3 or 4 wraps of wax paper, oil the O–ring and slide the O–ring over the threads and into the O–ring groove.

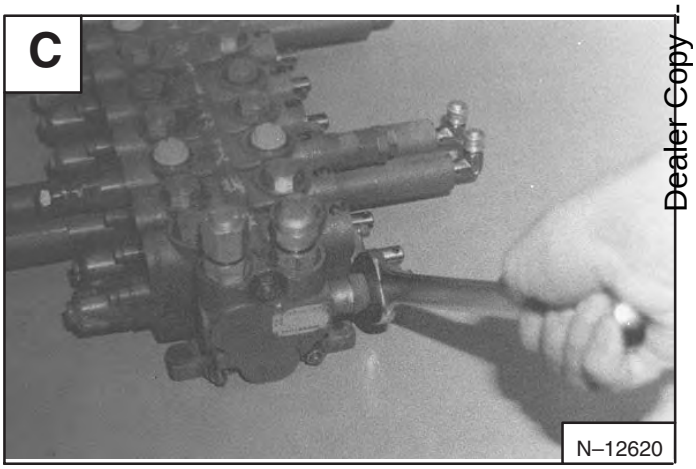
Install the poppet, spring, adjusting set screw and the jam nut into the relief valve **[B]**. Leave the jam nut loose until relief valves have been set to specified pressure settings.

See Relief Valve adjustment procedure on Page 2–30 and 2–31.



Install the main relief valve into the inlet section of the control valve **[C]**.

Tighten the relief valve to 54 ft.–lbs. (73 Nm) torque.



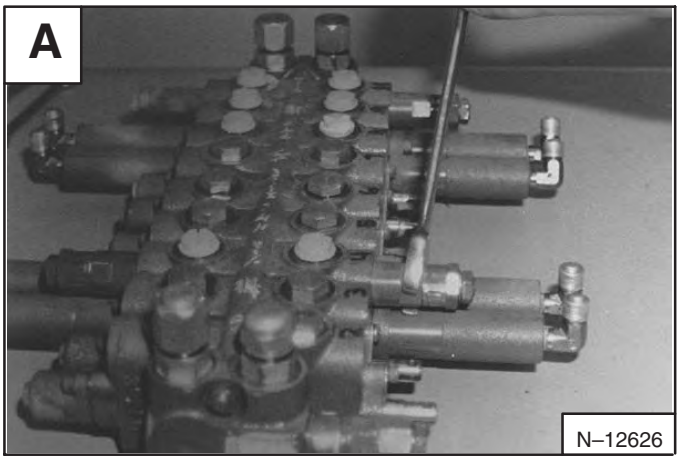
Dealer Copy -- Not for Resale

CONTROL VALVE (Cont'd)

Disassembly and Assembly (Cont'd)

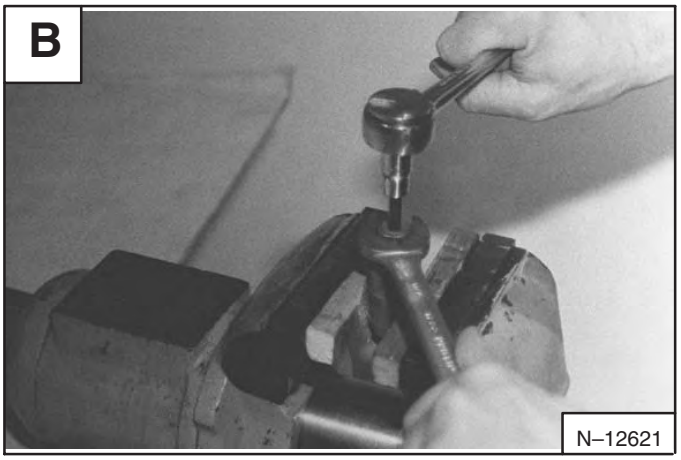
Work Port Relief Valves

Remove the relief valve from the valve section **[A]**.

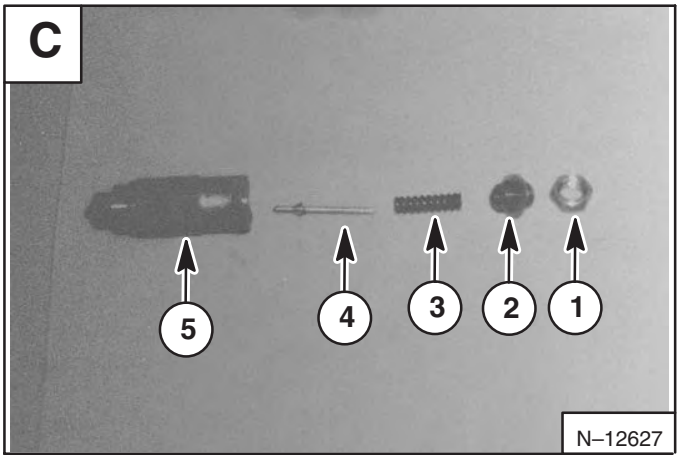


Use a vise with protective jaws and hold the relief valve.

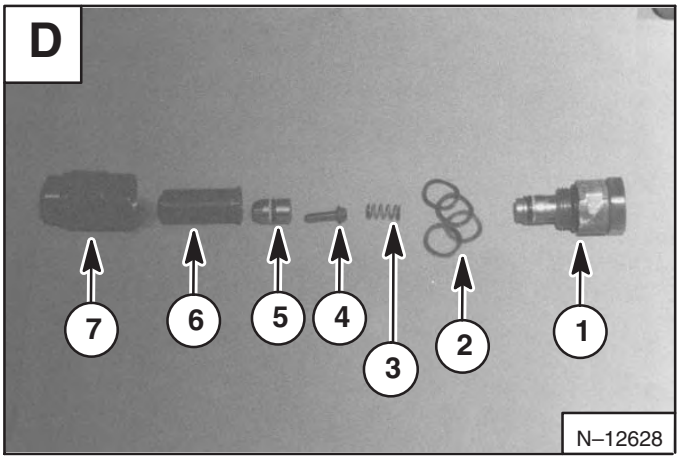
Loosen the adjusting set screws jam nut from the end of the relief valve **[B]**.



Remove the jam nut (Item 1)**[C]**, the adjusting set screw with O–ring (Item 2) **[C]**, spring (Item 3) **[C]** and poppet (Item 4) **[C]** from the relief valve housing.



Remove the relief plug (Item 1)**[D]**, spring washers (Item 2) **[D]**, spring (Item 3) **[D]**, piston (Item 4) **[D]**, poppet (Item 5) **[D]**, sleeve (Item 6) **[D]** and the relief valve housing (Item 7) **[D]**.



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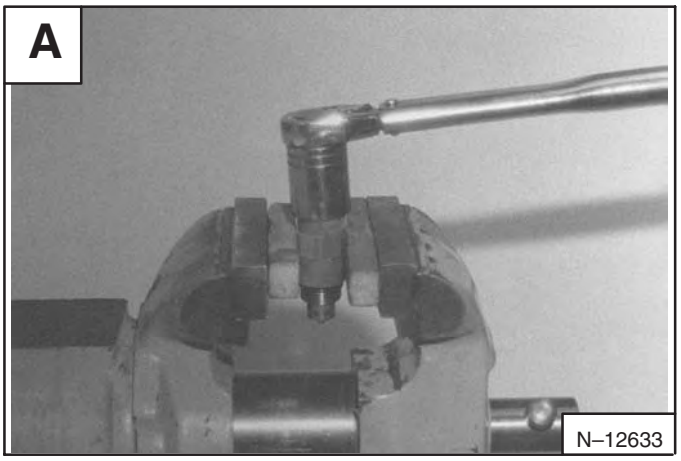
CONTROL VALVE (Cont'd)

Disassembly and Assembly (Cont'd)

Clean and inspect all parts of the work port relief valve. If any of the relief valves components are scratched or damaged, a new relief valve assembly will need to be ordered as the internal components are not sold separately.

Oil all moving parts and reassemble the sleeve, poppet, piston spring, spring washers and relief plug into the relief valve housing **[A]**.

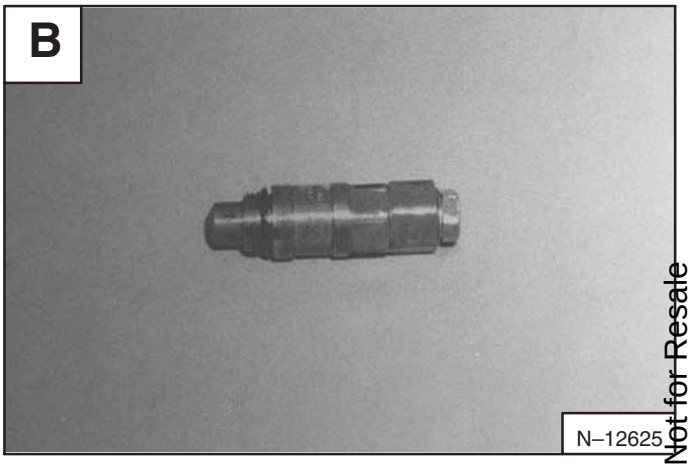
Tighten the relief plug to 33 ft.–lbs. (45 Nm) torque.



Install a new O–ring onto the adjusting set screw . Wrap the threads of the set screw with 3 or 4 wraps of wax paper, oil the O–ring and slide the O–ring over the threads and into the O–ring groove.

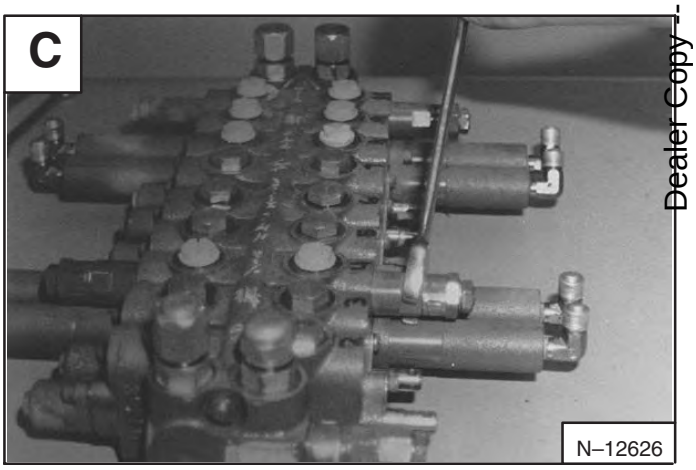
Install the poppet, spring, set screw and jam nut into the relief valve **[B]**. Leave the jam nut loose until relief valves have been set to specified pressure settings.

See Relief Valve adjustment procedure on Page 2–30 and 2–32.



Install the work port relief valve into the inlet section of the control valve **[C]**.

Tighten the relief valve to 54 ft.–lbs. (73 Nm) torque.



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CONTROL VALVE (Cont'd)

Relief Valve Pressure Setting Adjustment

Main Relief Set At . . . . . .2550 PSI (15686 kPa)
Blade Relief Set At . . . . . .1140 PSI (7860 kPa)
Arm Relief Set At:
(Rod End) Front . . . . . .2980 PSI (20544 kPa)
(Base End) Rear . . . . . .2980 PSI (20544 kPa)
Boom Reliefs Set At:
(Base End) Front . . . . . .2980 PSI (20544 kPa)
(Rod End) Rear . . . . . .3480 PSI (23991 kPa)

MAIN RELIEF VALVE

To adjust the main relief valves, the hydraulic circuit back pressure must be known.

Install OEM–1238 or OEM–1239 hydraulic tester and hose adapter 6657709 into the pump pressure circuit that is next to the engine **[A]**. (Pump outlet to tester inlet/tester outlet to hose going to the valve.) Open the flow control knob on the tester to full open.

Start the engine and run at low RPM. Make sure the tester is connected correctly. If no flow is indicated at the tester, the hoses are connected wrong.

Increase the engine speed to full RPM. Make sure the tester is connected correctly. If no flow is indicated at the tester, the hoses are connected wrong.

Increase the engine speed to full RPM. W arm the hydraulic fluid to 140° F (60° C).

Take a gauge reading of the hydraulic circuit back pressure and record this information. Back pressure is the pressure noted on the gauge with the flow restrictor fully open and all spools in neutral.

Turn the excavator engine off.

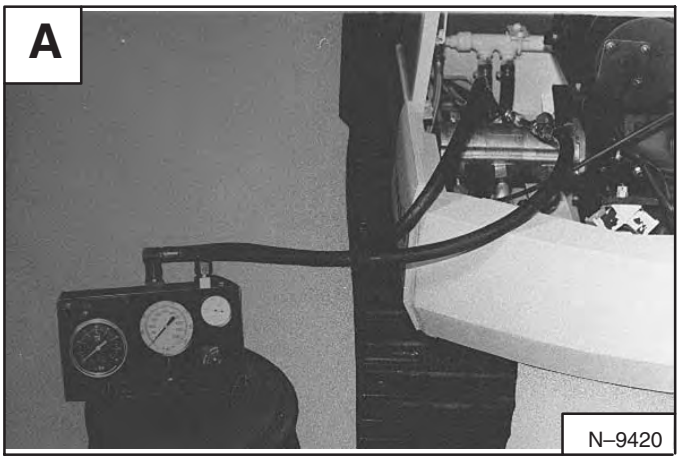
Repeat this test procedure on the center hydraulic pump circuit.

The recorded circuit back pressure will needto be added to the relief valve pressure setting that is listed in the above chart. This will assure accurate relief valve settings;

EXAMPLE: The circuit next to the engine has 150 PSI (1034 Nm) back pressure, add 150 PSI (1034 Nm) to 2550 PSI (17580 Nm) and set that relief valve to 2700 PSI (18614 Nm). The circuit in the center of the pump has 225 PSI (1551 Nm) back pressure, add225 PSI (1551 Nm) to 2550 PSI (17580 Nm) and set that relief valve to 2775 PSI (19130 Nm).

NOTE: This is only applicable to the main relief valves. Work port relief valves are to be set per the above chart.

NOTE: When testing the main relief valves, the appropriate cylinder for the relief valve being tested, will have to be extended or retracted fully to activate the relief valves. Make sure that there is adequate clearance for excavator movement and that no unauthorized personnel are in the work area. If adequate room is not available, the hydraulic work hoses can be removed from the control valve section being tested andthe control valve ports plugged.



⚠ WARNING

Wear safety glasses to prevent eye injury when any of the following conditions exist:

- **When fluids are under pressure.**
- **Flying debris or loose material is present.**
- **Engine is running.**
- **Tools are being used.**

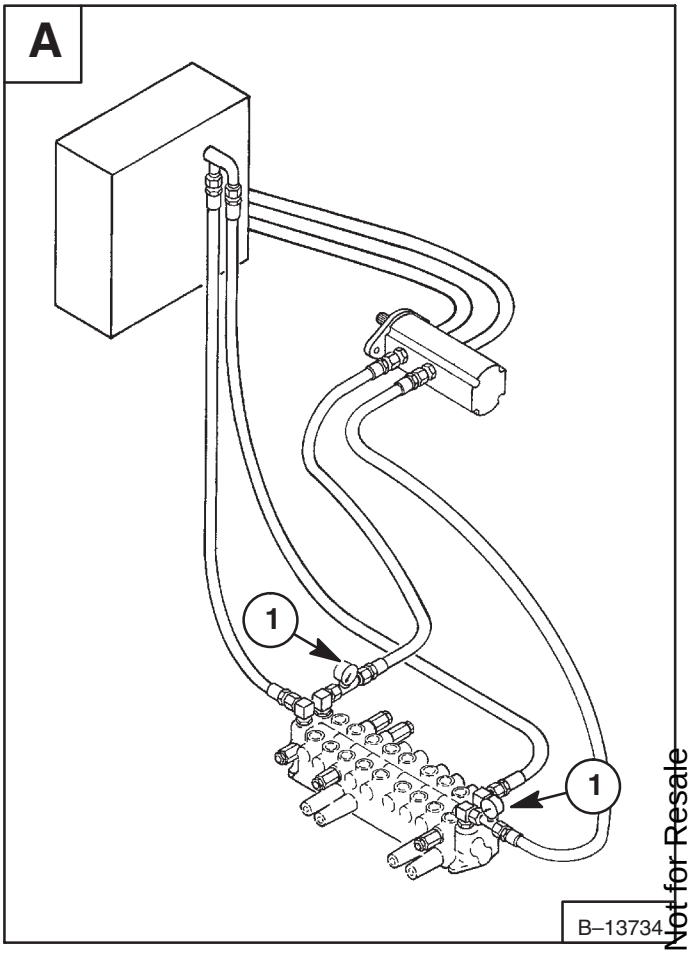
W–2019–1285

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CONTROL VALVE (Cont'd)

Install a pressure gauge (Item 1) **[A]** (minimum of 5000 PSI) into the pressure line at the inlet section of both sides of the control valve.

Run the hydraulic pump at maximum rated RPM (high idle on engine).

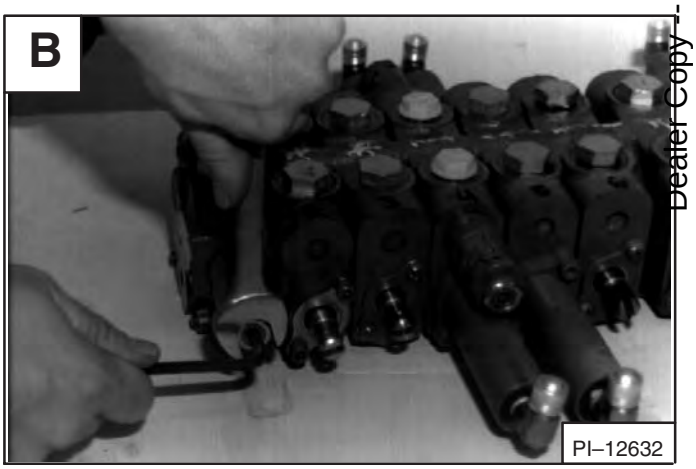


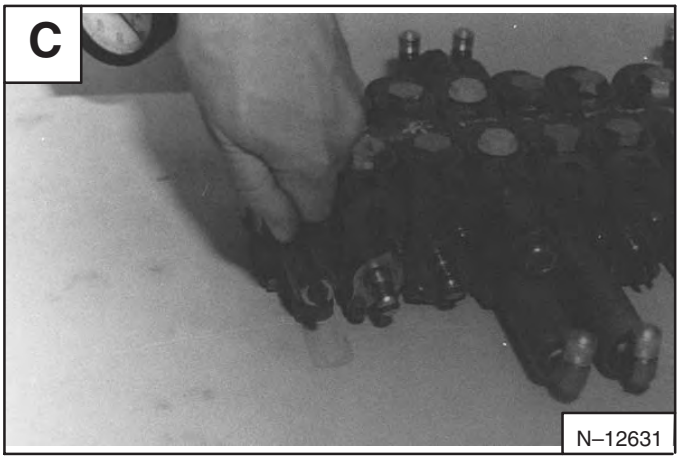
Loosen the jam nut on the relief valve adjusting set screw.

Stroke a spool and check the pressure gauge PSI reading.

Turn the set screw clockwise to increase the pressure, counterclockwise to decrease the pressure **[B]**. When the correct pressure setting is obtained, tighten the jam nut while holding the adjusting screw from turning **[C]**.

Recheck the gauge reading after tightening the jam nut to assure that the correct setting has been maintained.





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CONTROL VALVE (Cont')

Relief Valve Pressure Setting Adjustment (Cont'd)

Work Port Relief Valves

⚠ WARNING

Wear safety glasses to prevent eye injury when any of the following conditions exist:

- **When fluids are under pressure.**
- **Flying debris or loose material is present.**
- **Engine is running.**
- **Tools are being used.**

W–2019–1285

Work port relief valves will need to be tested and set with a different test method.

Use a portable hydraulic hand pump with clean fluid that is compatable with the Melroe hydraulic fluid or use SAE 10W–30 motor oil.

Lower the arm and boom to the ground. Turn off the engine. Move the control levers back and forth to relieve any hydraulic pressure. Loosen the hydraulic tank cap or cover.

Disconnect the hose from the control valve section in which the work port relief valve to be tested is located.

Install a pressure gauge (minimum of 5000 PSI) into the section being tested. Attach the hydraulic hand pump hose onto the pressure gauge **[A]**.

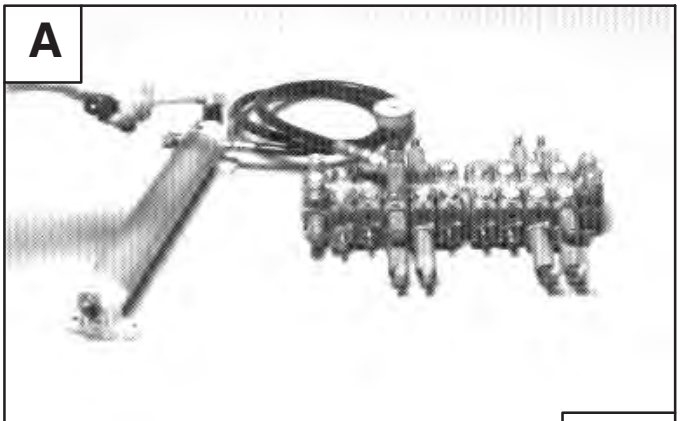
Pressurize the section with the hydraulic hand pump until the relief valve opens. Record the gauge reading at which the relief valve opens. If the relief valve needs to be reset, loosen the jam nut on the relief valve adjusting set screw. Turn the set screw clockwise to increase the pressure, counterclockwise to decrease the pressure **[B]**.

When the correct pressure setting is obtained, tighten the jam nut while holding the adjustment set screw from turning **[C]**.

Recheck the gauge reading after tightening the jam nut to assure that the correct setting has been maintained.

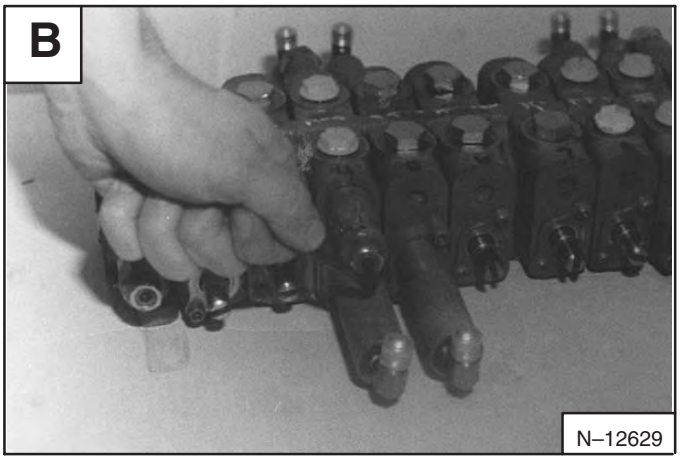
To check and reset the additional port relief valves, the hydraulic hand pump can either be relocated to the different valve sections or the port relief valves can be installed into the section that the hydraulic hand pump has been installed. Test each relief valve and then reinstall the relief valve into the correct valve section.

A



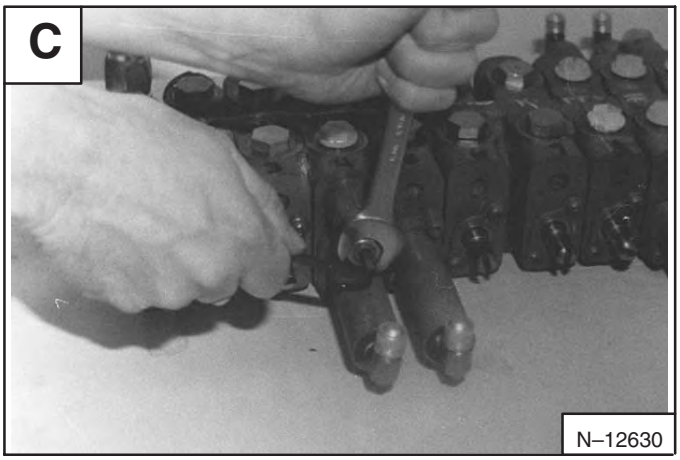
N–15859

B



N–12629

C



N–12630

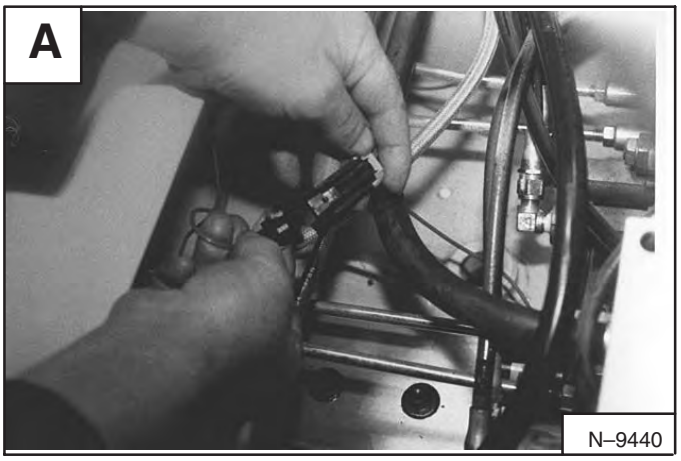
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SOLENOID VALVE

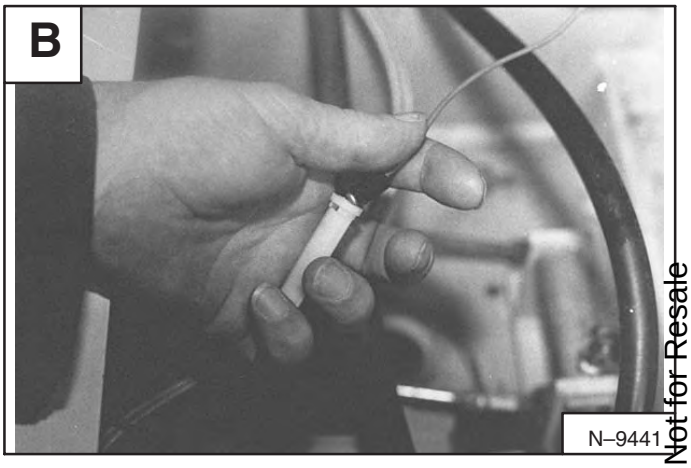
Removal and Installation

Remove the floor panel. (See Page 5–1.)

Disconnect the solenoid wires from the harness **[A]**.

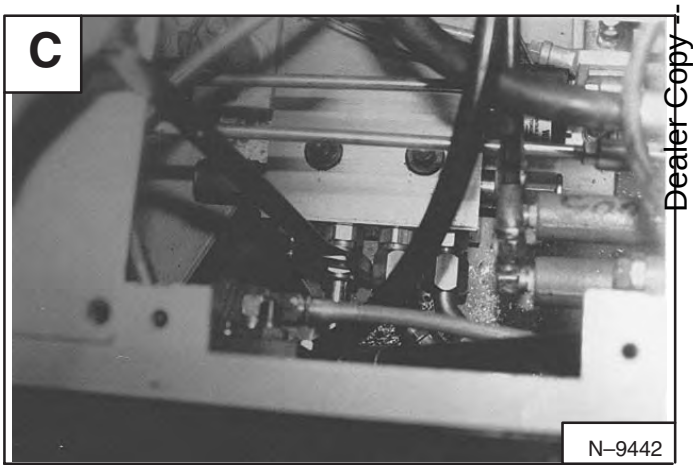


Disconnect the fuse **[B]**.



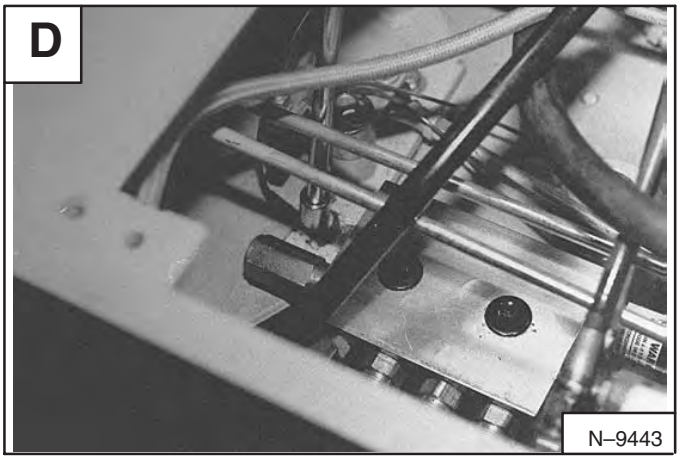
NOTE: Mark the hoses for installation.

Remove the hoses from the solenoid valve **[C]**.



Remove the solenoid valve two mounting bolts **[D]**.

Remove the solenoid valve.

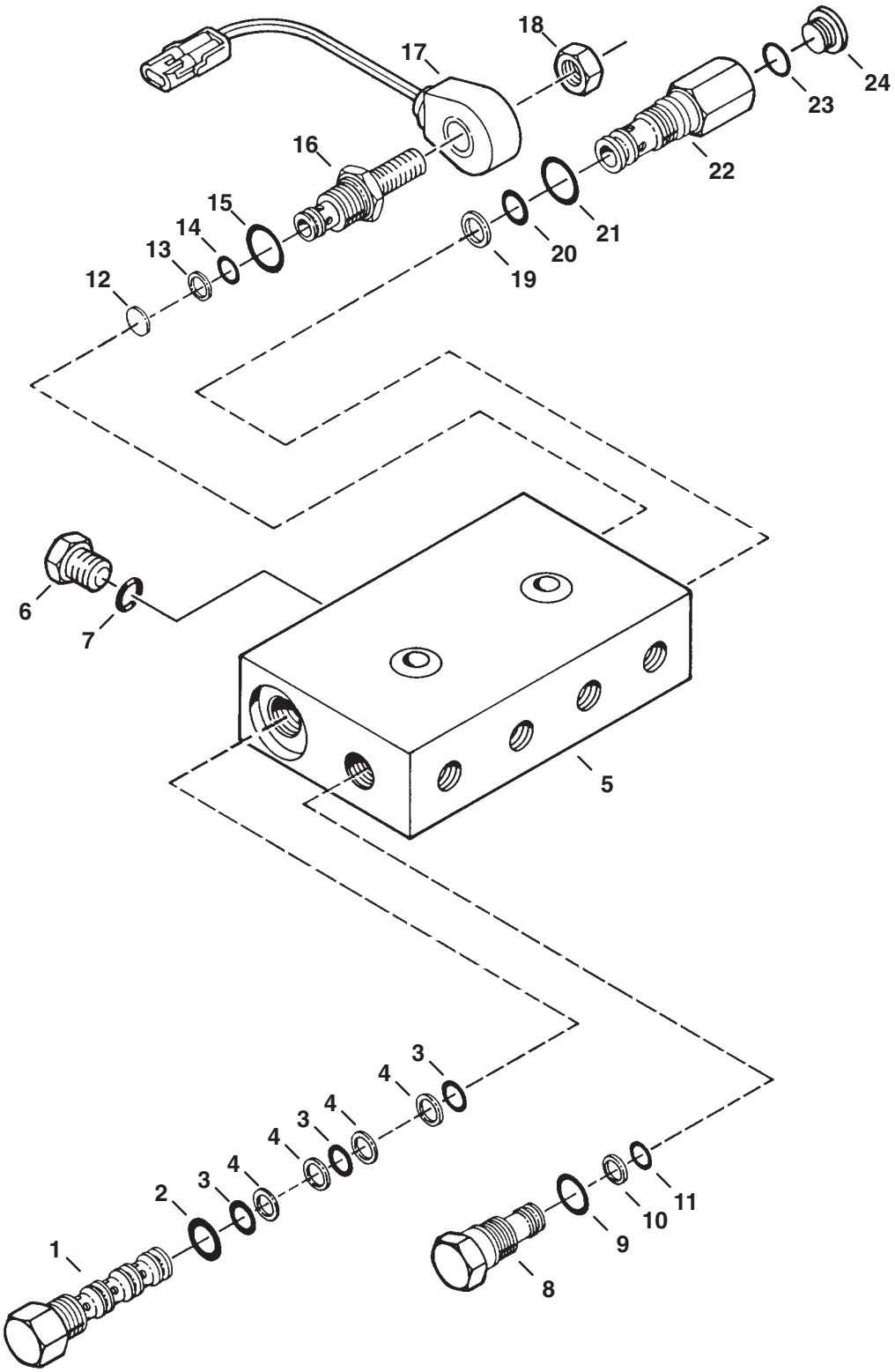


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SOLENOID VALVE

Parts Identification

1. Compensator
2. O–ring
3. O–ring
4. Back–up Ring
5. Valve Body
6. Plug
7. O–ring
8. Check Valve
9. O–ring
10. Back–up Ring
11. O–ring
12. Restrictor Plate 0.130”
13. Back–up Ring
14. O–ring
15. O–ring
16. Valve Stem
17. Coil
18. Nut
19. Back–up Ring
20. O–ring
21. O–ring
22. Relief Valve
23. O–ring
24. Plug



B–14927

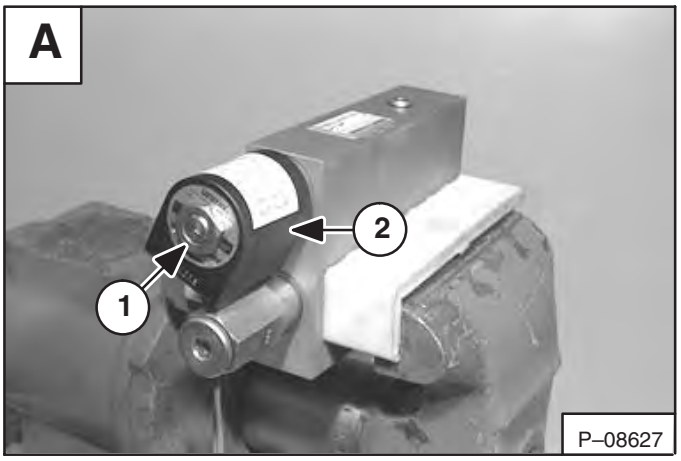
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SOLENOID VALVE (Cont'd)

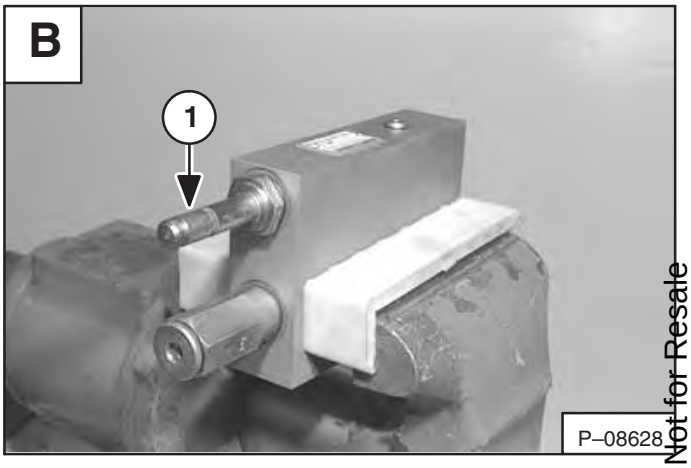
Disassembly

Clamp the valve in a vise that has padded jaws.

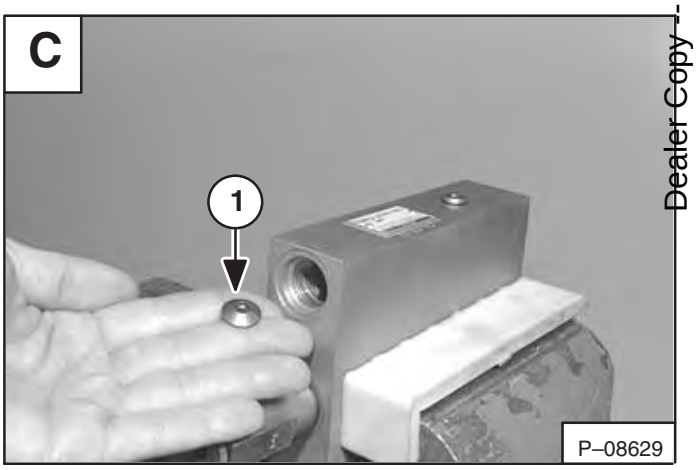
Remove the nut (Item 1) **[A]** and coil (Item 2) **[A]** from the valve stem.



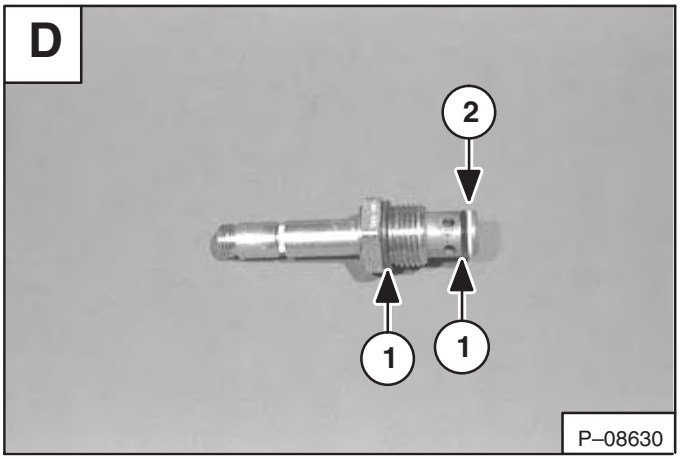
Remove the valve stem (Item 1) **[B]** from the valve body.



Remove the restrictor plate (Item 1) **[C]** from the valve body.



Remove the O–rings (Item 1) **[D]** and back–up ring (Item 2) **[D]** from the valve stem.

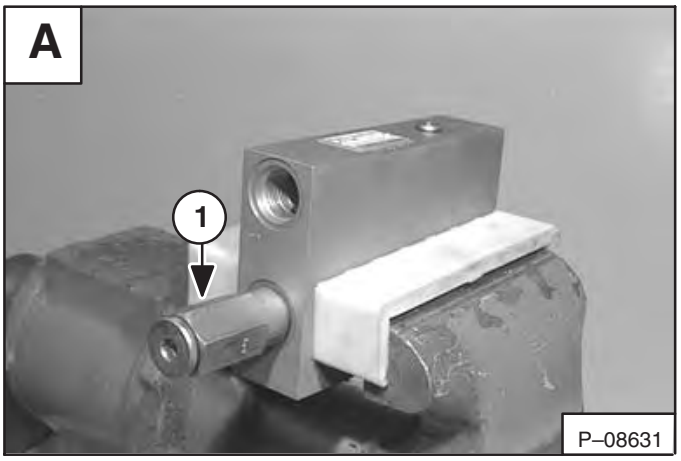


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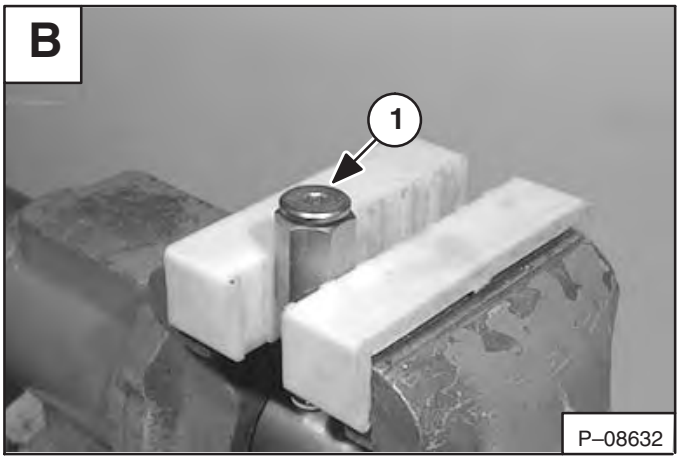
SOLENOID VALVE (Cont'd)

Disassembly (Cont'd)

Remove the relief valve (Item 1) **[A]** from the valve body.

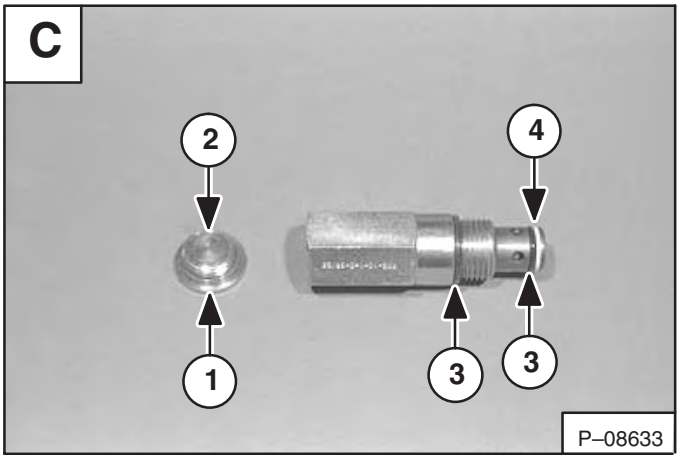


Remove the plug (Item 1) **[B]** from the end of the relief valve.

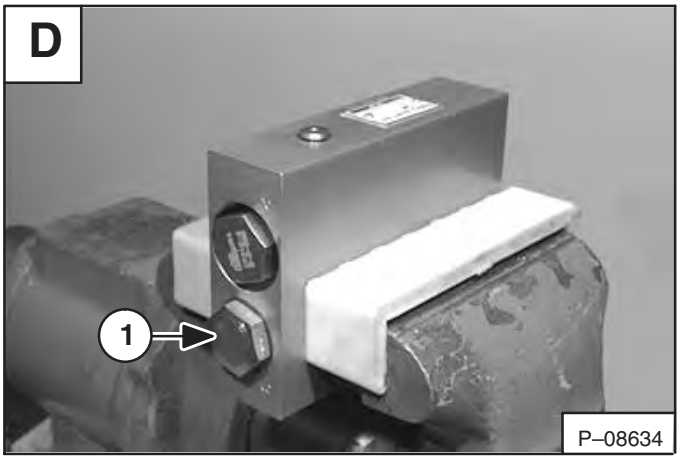


Remove the O–ring (Item 1) **[C]** from the plug (Item 2 **[C]**.

Remove the O–rings (Item 3) **[C]** and back–up ring (Item 4) **[C]** from the relief valve.



Remove the check valve (Item 1) **[D]** from the valve body

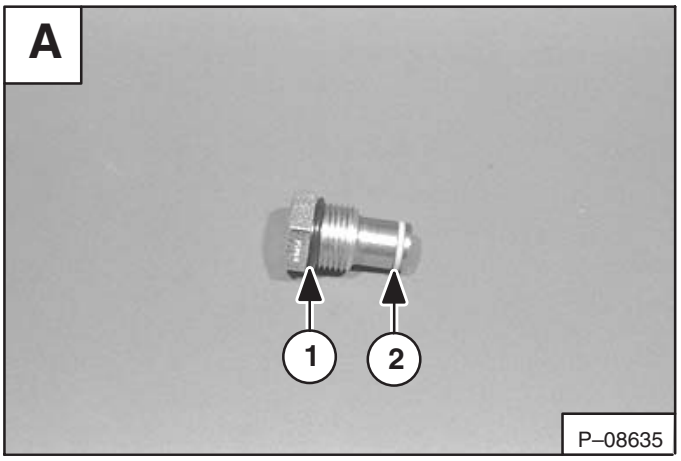


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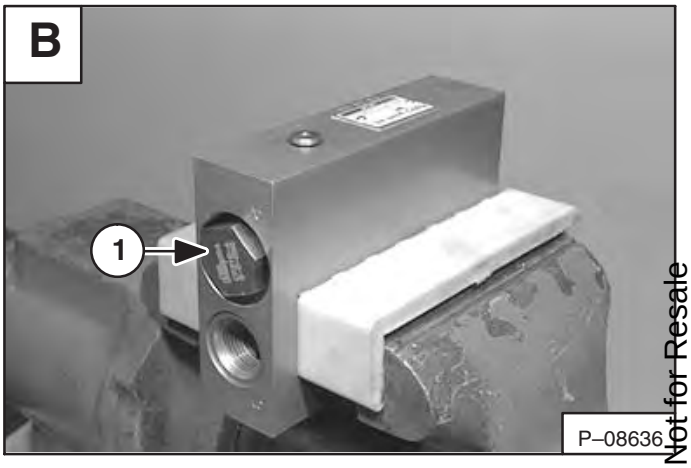
SOLENOID VALVE (Cont'd)

Disassembly (Cont'd)

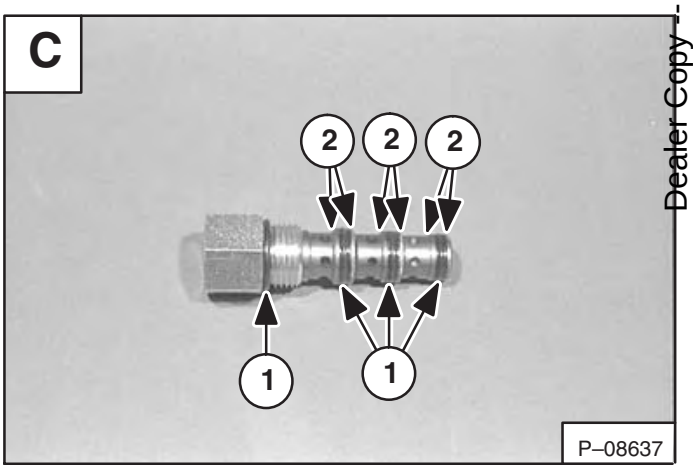
Remove the O–ring (item 1) **[A]** and the seal (Item 2) **[A]** from the check valve.



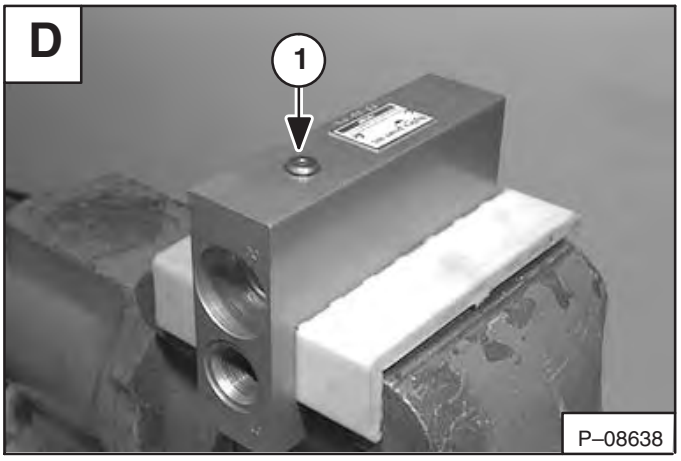
Remove the compensator valve (Item 1) **[B]** from the valve body.



Remove the O–rings (Item 1) **[C]** and back–up rings (Item 2) **[C]** from the compensator valve.



Remove the plug (Item 1) **[D]** from the valve body.

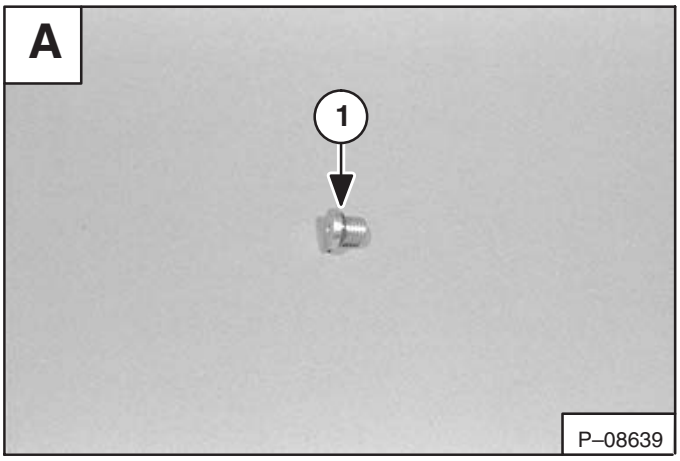


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SOLENOID VALVE (Cont'd)

Disassembly (Cont'd)

Remove the O–ring (Item 1) **[A]** from the plug.

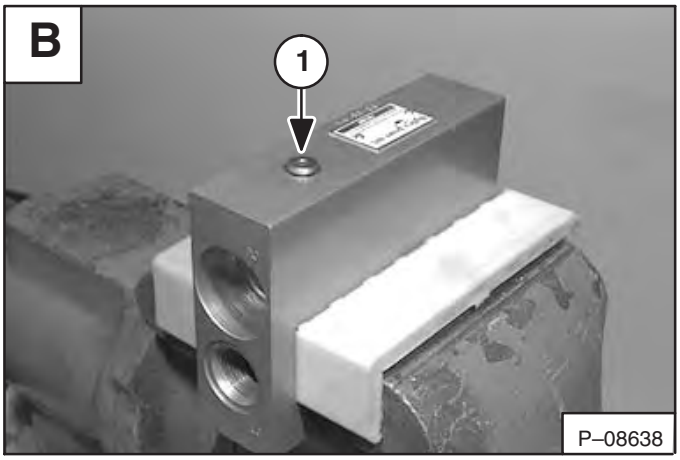


Assembly

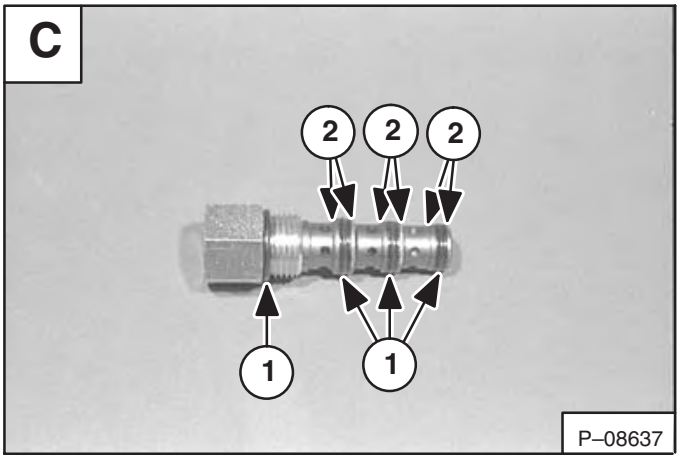
Clean all parts in solvent and dry with compressed air . The valves are not serviceable. If the valves do not operate correctly after cleaning, the relief valves must be replaced. Order new valves from Melroe Parts.

Apply oil and install a new O–ring (Item 1) **[A]** on the plug.

Install the plug (Item 1) **[B]** in the valve body.

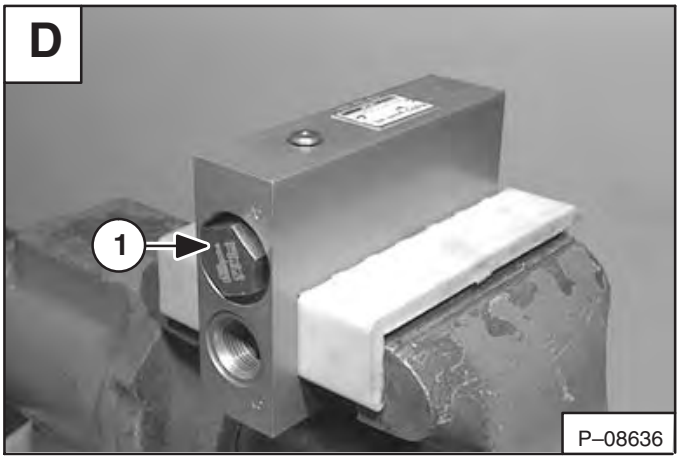


Apply oil and install new O–rings (Item 1) **[C]** and back–up rings (Item 2) **[C]** on the compensator valve.



Dip the compensator valve in clean hydraulic fluid.

Install the compensator valve (Item 1) **[D]** in the valve body.

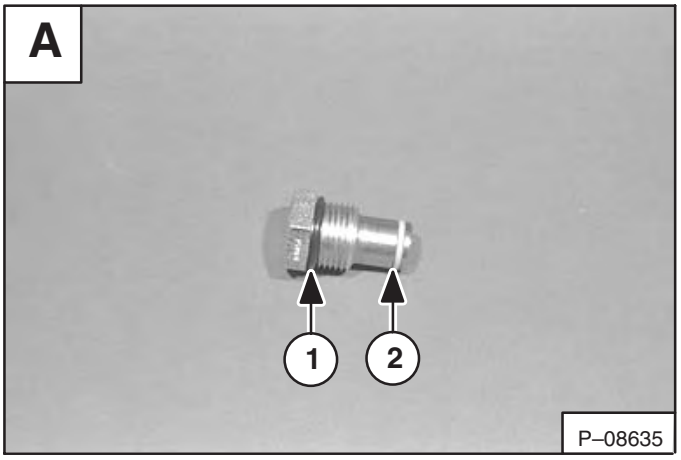


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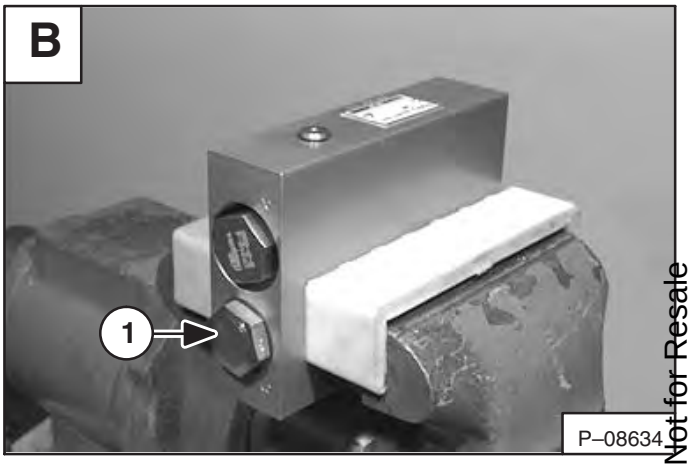
SOLENOID VALVE (Cont'd)

Assembly (Cont'd)

Apply oil and install new O–ring (Item 1) **[A]** and seal (Item 2) **[A]** on the check valve.

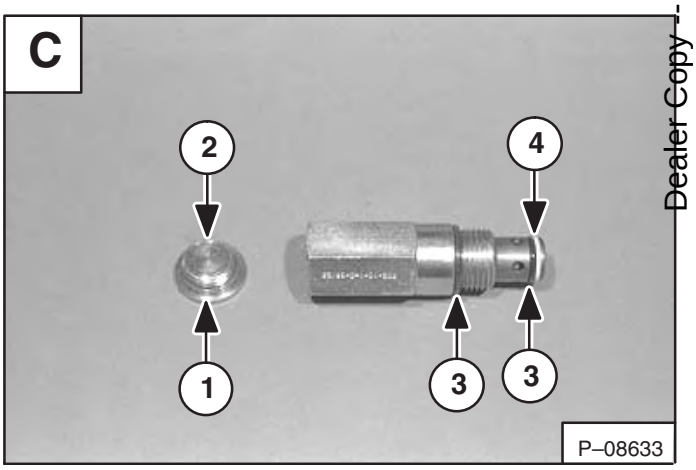


Install the check valve (Item 1) **[B]** in the valve body.

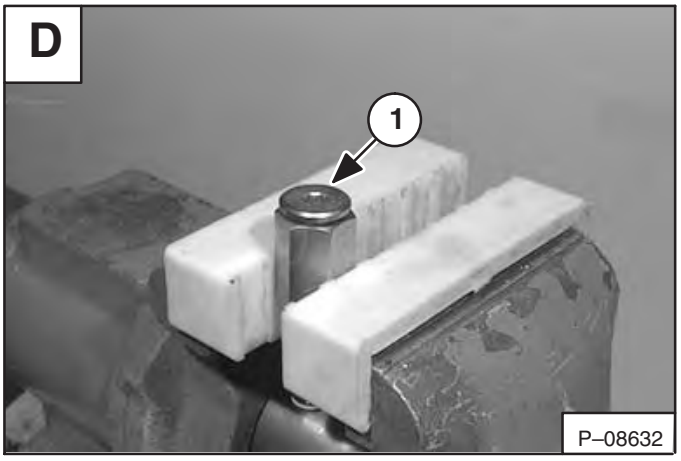


Apply oil and install a new O–ring (Item 1) **[C]** on the plug (Item 2) **[C]**.

Apply oil and install new O–rings (Item 3) **[C]** and back–up ring (Item 4) **[C]** on the relief valve.



Install the plug (Item 1) **[D]** in the end of the relief valve.

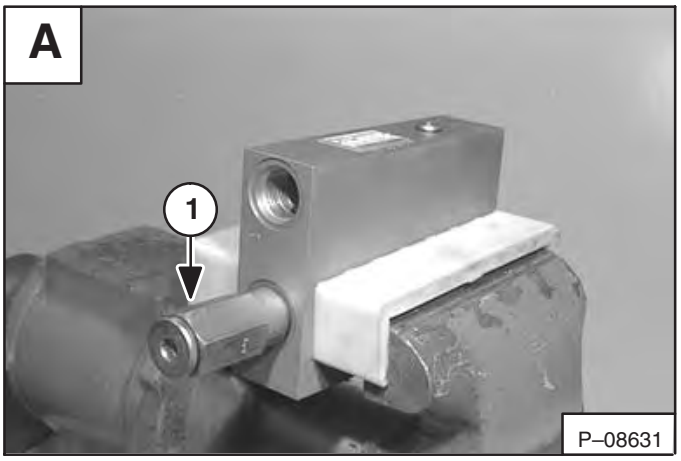


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SOLENOID VALVE (Cont'd)

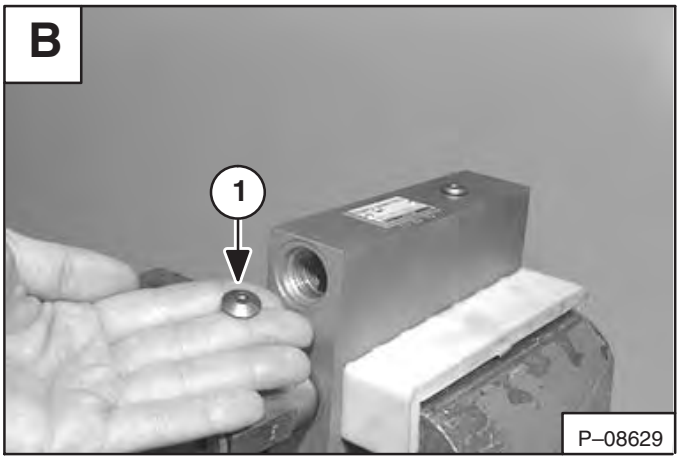
Assembly (Cont'd)

Dip the relief valve (Item 1) **[A]** in clean hydraulic fluid and install in the valve body.

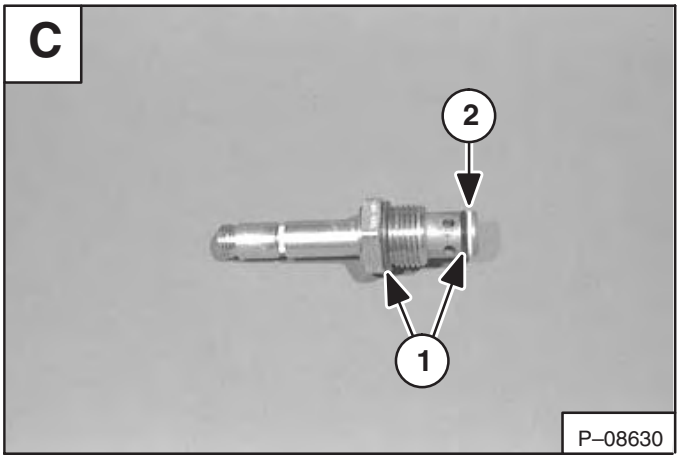


Make sure the restrictor plate (Item 1) **[B]** orifice is open.

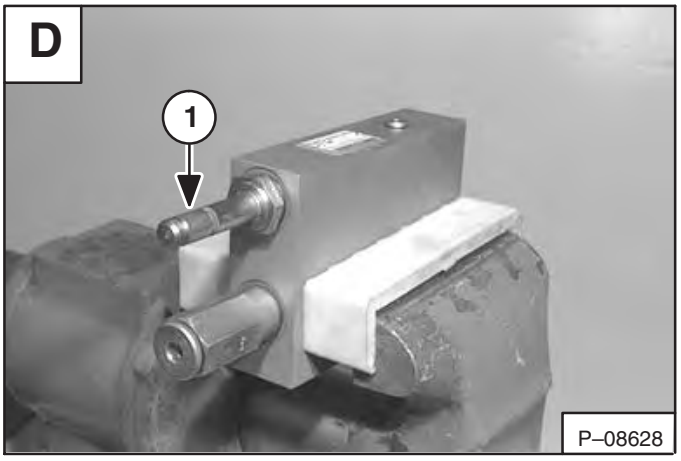
Install the restrictor plate (Item 1) **[B]** in the valve body.



Apply oil and install new O–rings (Item 1) **[C]** and back–up ring (Item 2) **[C]** on the valve stem.



Dip the valve stem (Item 1) **[D]** in clean hydraulic fluid and install in the valve body.



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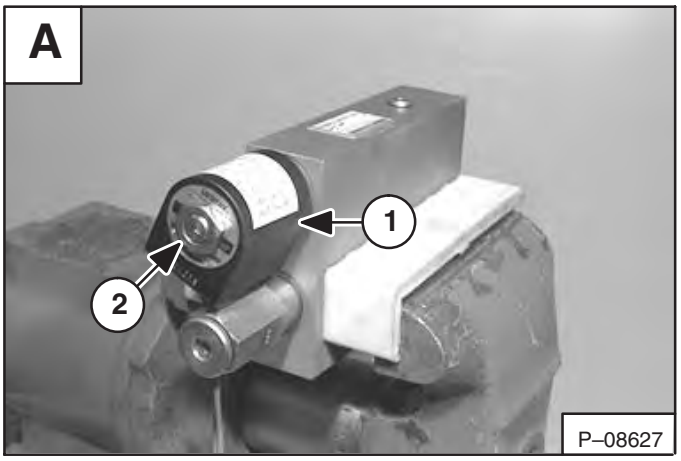
SOLENOID VALVE (Cont'd)

Assembly (Cont'd)

Install the coil (Item 1) **[A]** and nut (Item 2) **[A]** on the valve stem.

Tighten to 4–6 ft.–lbs. (5–8 Nm) torque.

NOTE: If the coil is over torqued it may cause valve failure.



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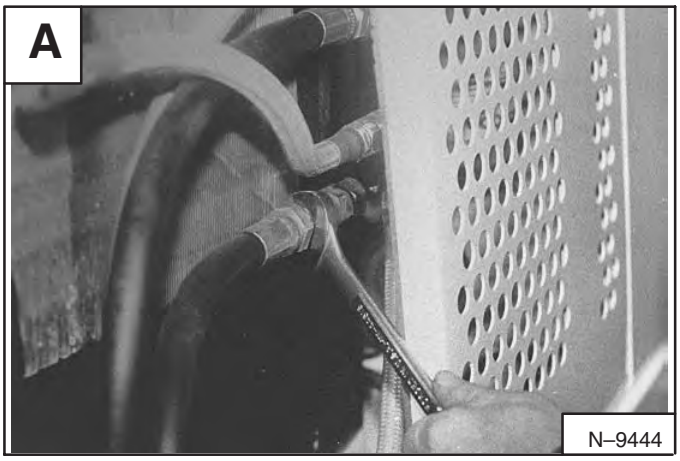
OIL COOLER

Removal and Installation

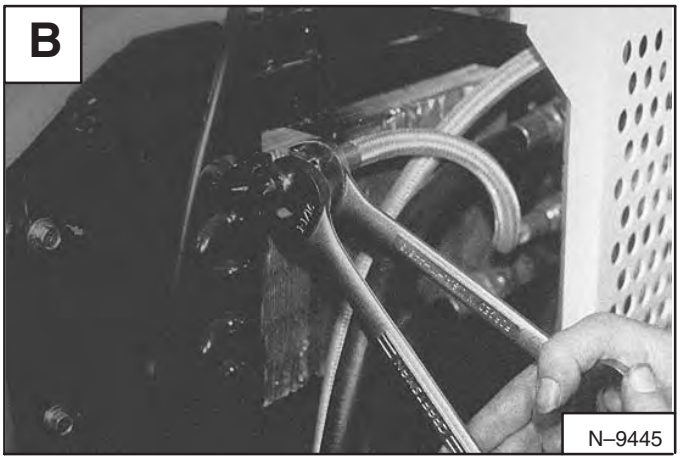
Raise the engine hood.

Drain the hydraulic fluid. (See Page 2–6.)

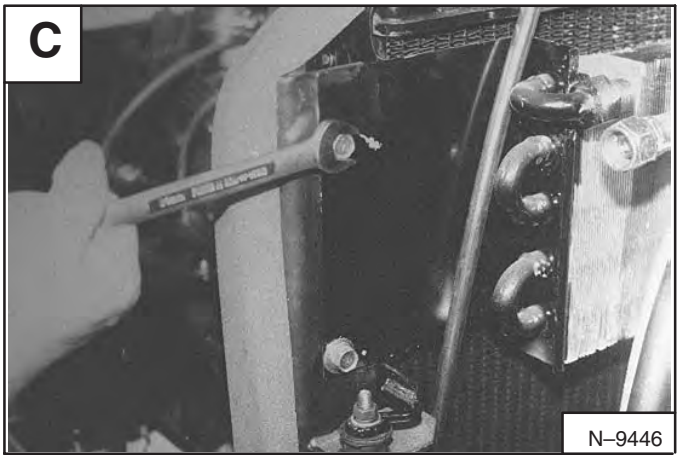
Remove the hose from the cooler inlet **[A]**.



Remove the cooler outlet hose **[B]**.

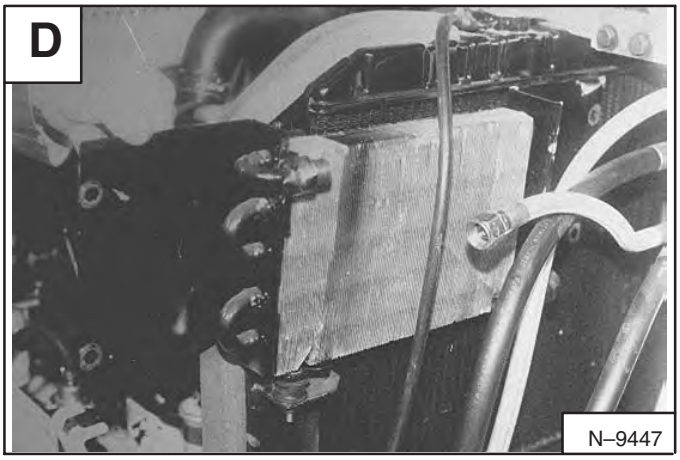


Remove the cooler mounting bolts **[C]**.



Remove the oil cooler **[D]**.

NOTE: Use care when removing the oil cooler to avoid damaging the cooling fins.



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HYDRAULIC RESERVOIR

Removal and Installation

IMPORTANT

When making repairs on hydrostatic and hydraulic systems, clean the work area before disassembly and keep all parts clean. Always use caps and plugs on hoses, tubelines and ports to keep dirt out. Dirt can quickly damage the system.

I–2003–0284

Remove the fuel tank. (See Page 5–1.)

Remove the drain plug from the bottom of the reservoir **[A]**. Drain the fluid into a container.

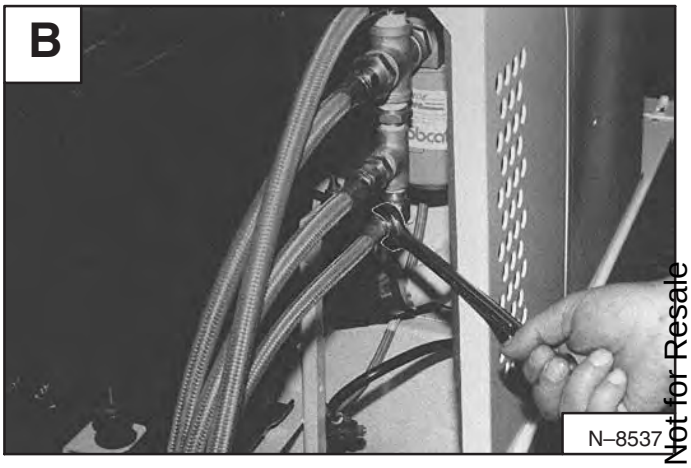
Mark all the hoses for correct installation.

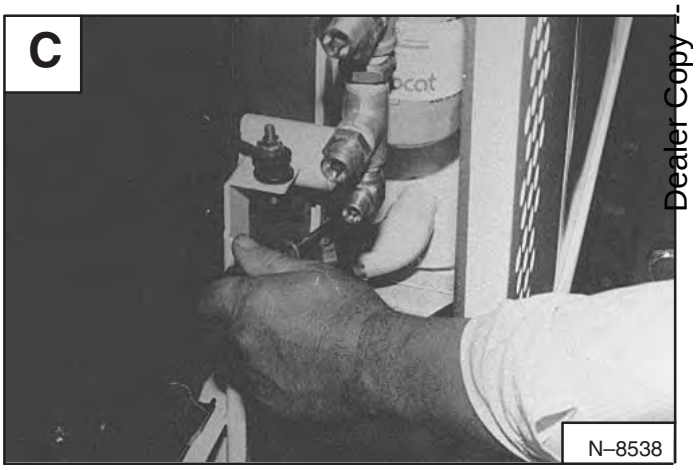
Disconnect the reservoir return lines **[B]**.

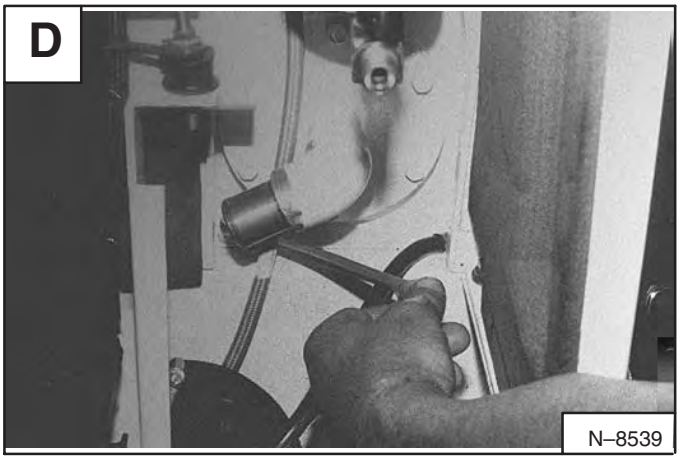
Remove the supply hose clamp anddisconnect the hose **[C]**.

Remove the bolts from the reservoir base **[D]**.





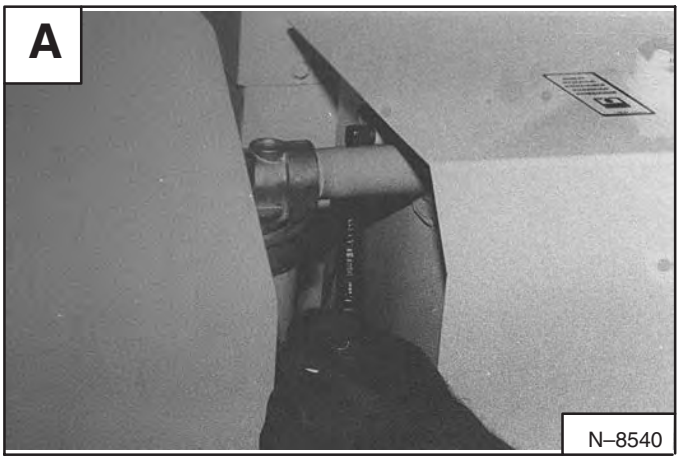




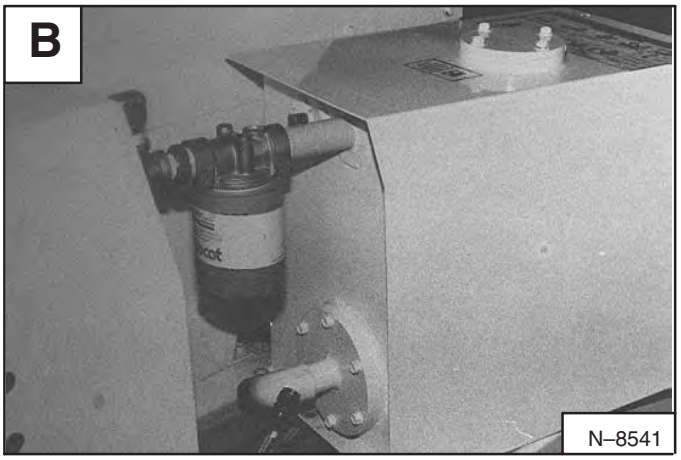
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HYDRAULIC RESERVOIR (Cont'd)

Slide the reservoir forward and remove the swing motor return hose from the reservoir **[A]**.



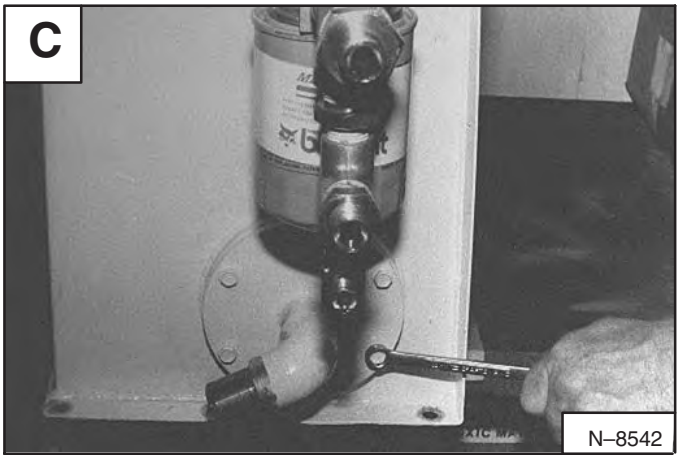
Remove the hydraulic reservoir from the machine **[B]**.



SUCTION FILTER

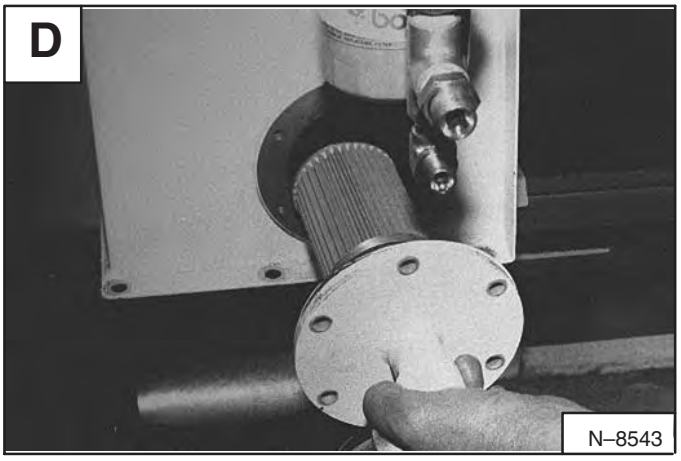
To remove and install the mesh filter use the following procedure:

Remove the bolts from the mounting flange **[C]**.



Remove the mesh screen and mounting flange assembly from the reservoir **[D]**.

Use clean solvent to clean the suction filter . Use air pressure to dry the mesh screen.



Dealer Copy -- Not for Resale

BOOM CYLINDER

Removal and Installation

Put the bucket on the floor. Stop the engine.

Move the hydraulic controls to release the hydraulic pressure.

IMPORTANT

When making repairs on hydrostatic and hydraulic systems, clean the work area before disassembly and keep all parts clean. Always use caps and plugs on hoses, tubelines and ports to keep dirt out. Dirt can quickly damage the system.

I–2003–0284

Disconnect the two hoses from the boom cylinder **[A]**.

Remove the retainer bolt and nut from the boom cylinder base end pin **[B]**.

Remove the cylinder base end pin.

Lower the base end of the boom cylinder to the floor.

Remove the bolt from the cylinder shield **[C]**.

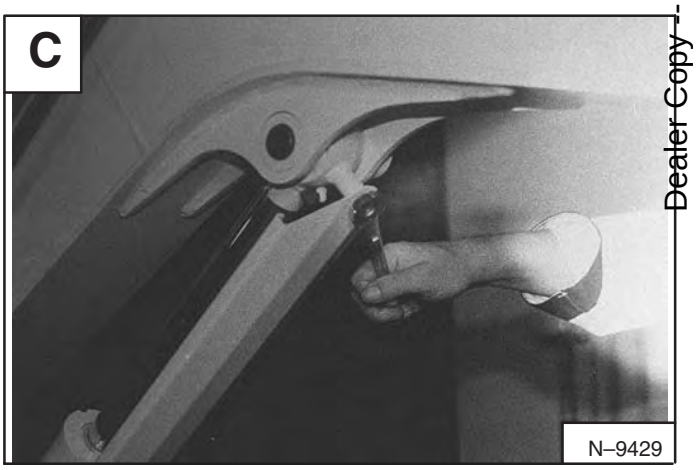
Remove the shield.

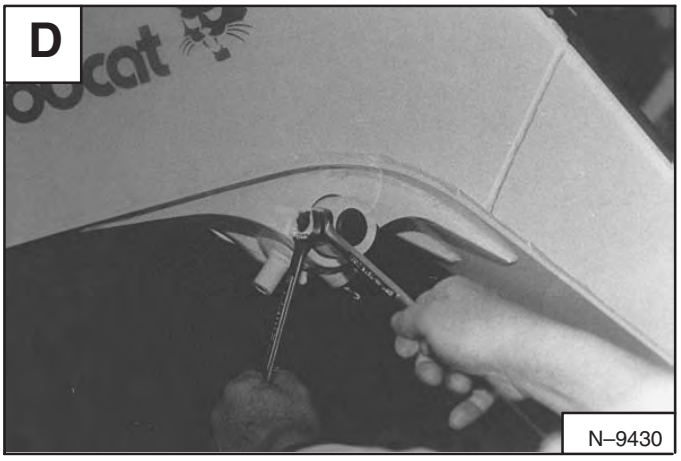
Remove the retainer bolt and nut from the cylinder rod end pin **[D]**.

Remove the cylinder rod end pin. Remove the boom cylinder from the boom.









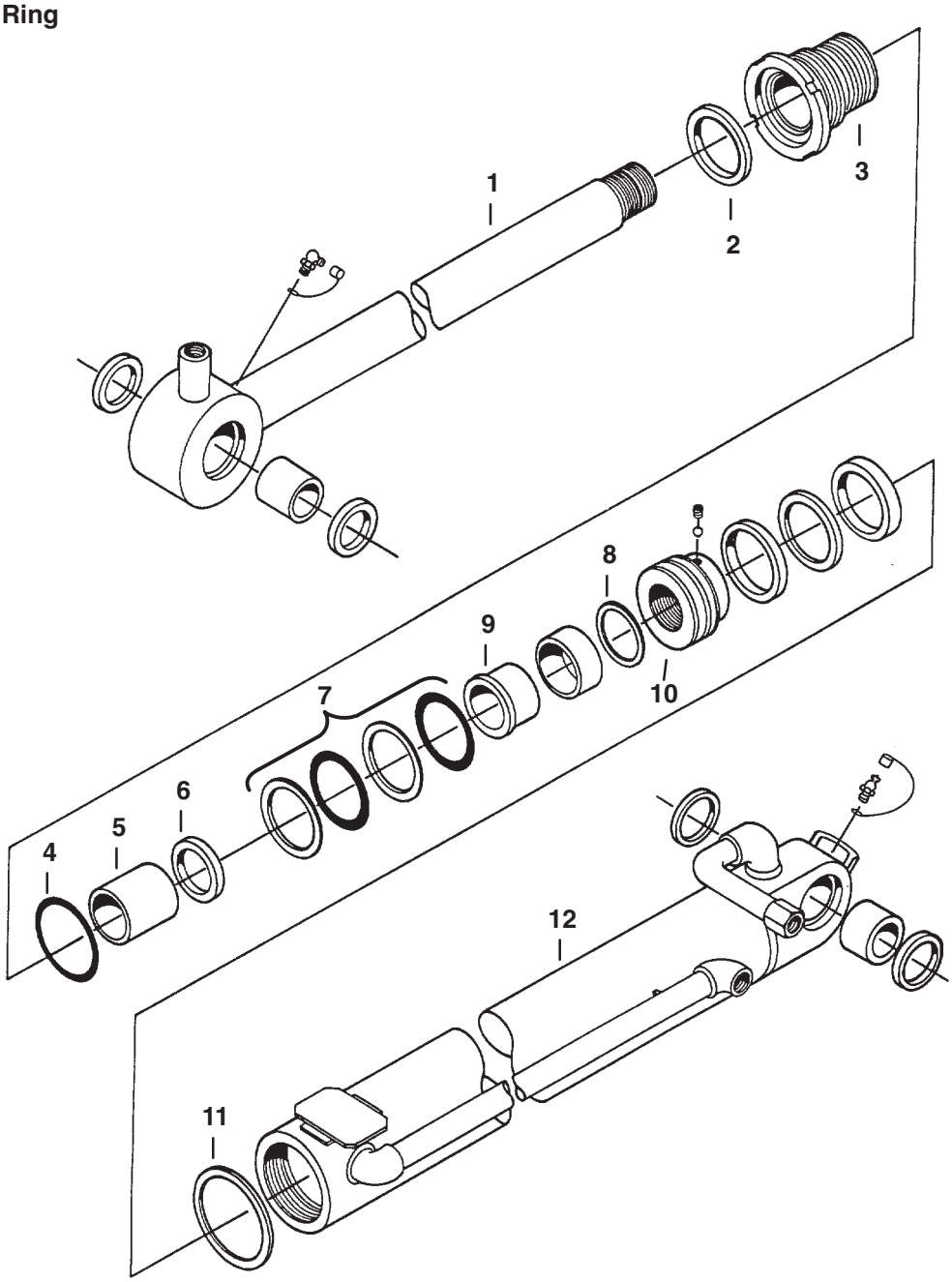
Dealer Copy -- Not for Resale

BOOM CYLINDER (Cont'd)

Parts Identification

For Cylinder Disassembly and Assembly See Page 2–55.

1. Rod
2. Ring
3. Head
4. O–ring
5. Bushing
6. U–ring
7. Seal
8. Shim
9. Cushion Ring
10. Piston
11. Washer
12. Housing



B–13197

Dealer Copy -- Not for Resale

DIPPERSTICK CYLINDER

Removal and Installation

Put the bucket on the floor. Stop the engine.

Move the hydraulic controls to release the hydraulic pressure.

IMPORTANT

When making repairs on hydrostatic and hydraulic systems, clean the work area before disassembly and keep all parts clean. Always use caps and plugs on hoses, tubelines and ports to keep dirt out. Dirt can quickly damage the system.

I–2003–0284

Disconnect the two hoses from the dipperstick cylinder **[A]**.

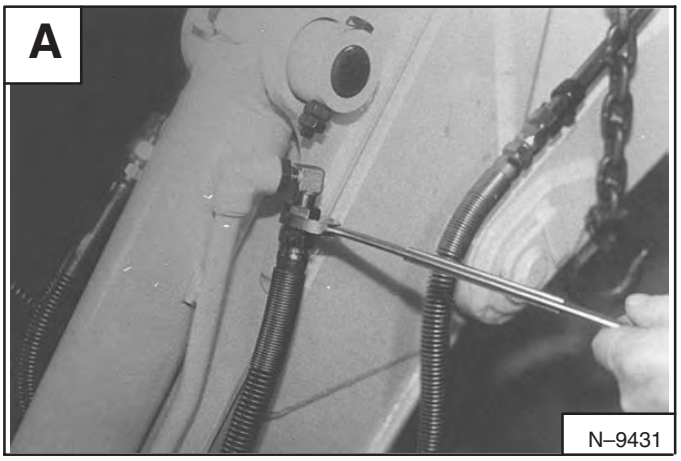
Remove the retainer bolt and nut fro the cylinder base end pin **[B]**.

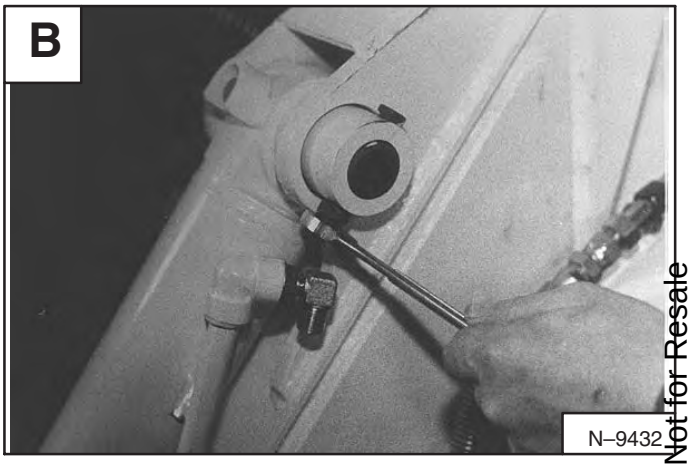
Remove the cylinder base end pin.

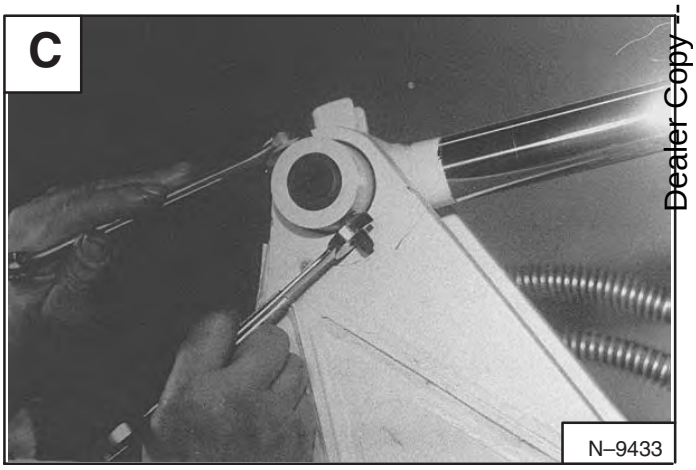
Remove the retainer bolt and nut from the cylinder rod end pin **[C]**.

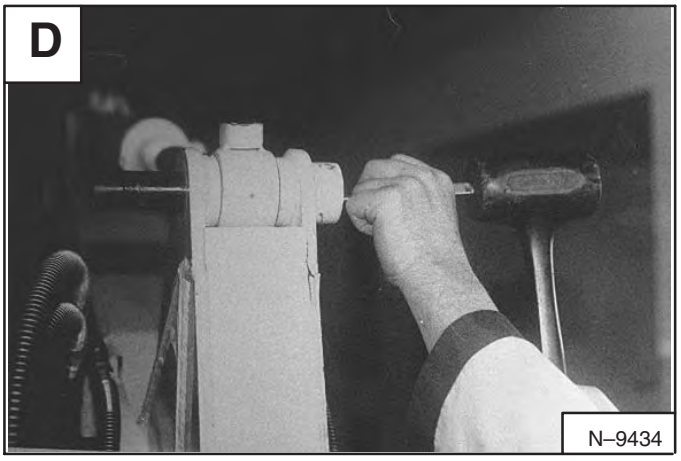
Remove the cylinder rod end pin **[D]**.

Remove the cylinder from the dipperstick.









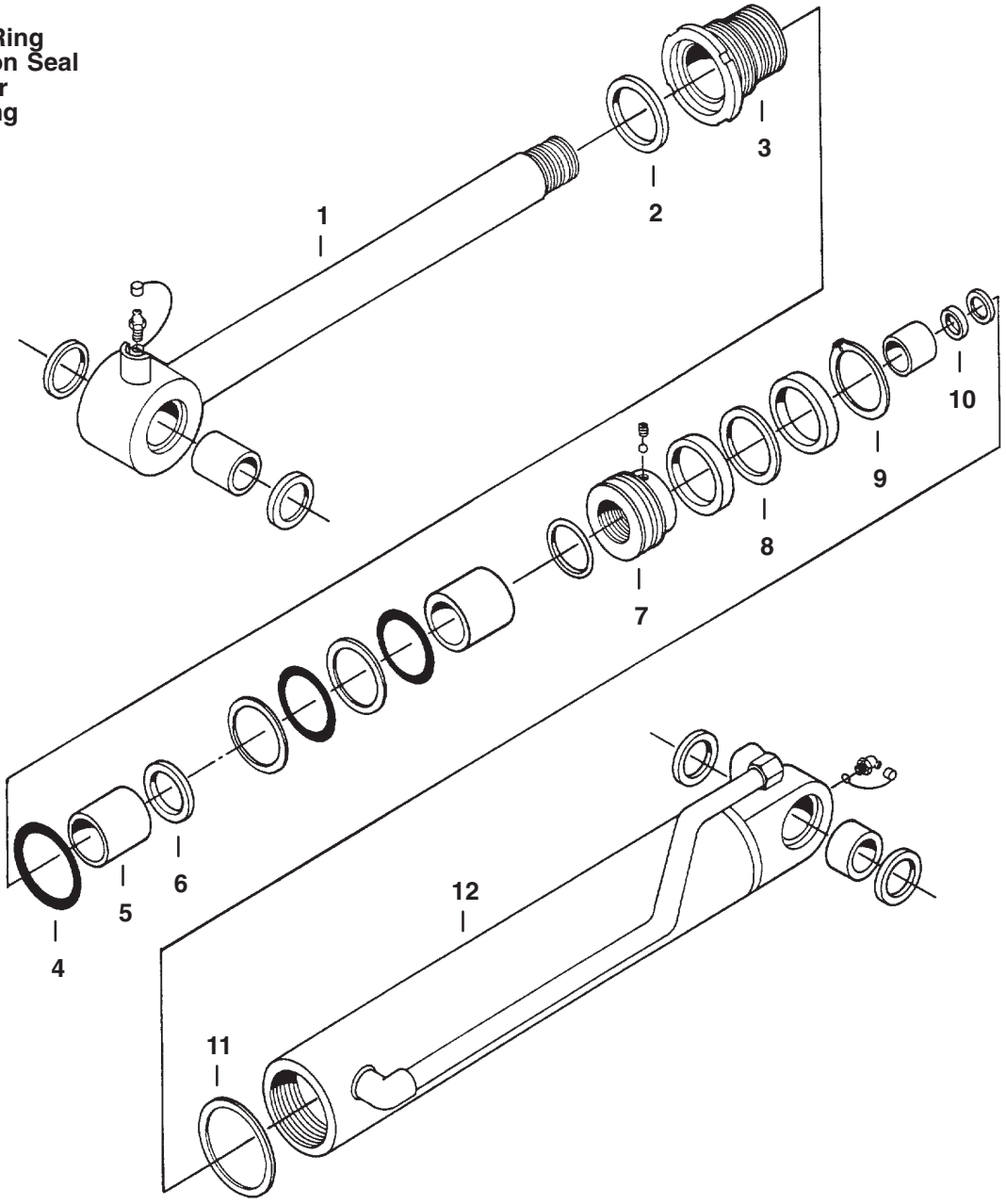
Dealer Copy -- Not for Resale

DIPPERSTICK CYLINDER (Cont'd)

Parts Identification

For Cylinder Disassembly and Assembly See Page 2–55.

1. Rod
2. Ring
3. Head
4. O–ring
5. Bushing
6. U–ring
7. Piston
8. Seal
9. Snap Ring
10. Cushion Seal
11. Washer
12. Housing



B–13198

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BUCKET CYLINDER

Removal and Installation

Put the bucket on the floor. Stop the engine.

Move the hydraulic controls to release the hydraulic pressure.

IMPORTANT

When making repairs on hydrostatic and hydraulic systems, clean the work area before disassembly and keep all parts clean. Always use caps and plugs on hoses, tubelines and ports to keep dirt out. Dirt can quickly damage the system.

I–2003–0284

Disconnect the two hoses (Item 1) **[A]** from the bucket cylinder.

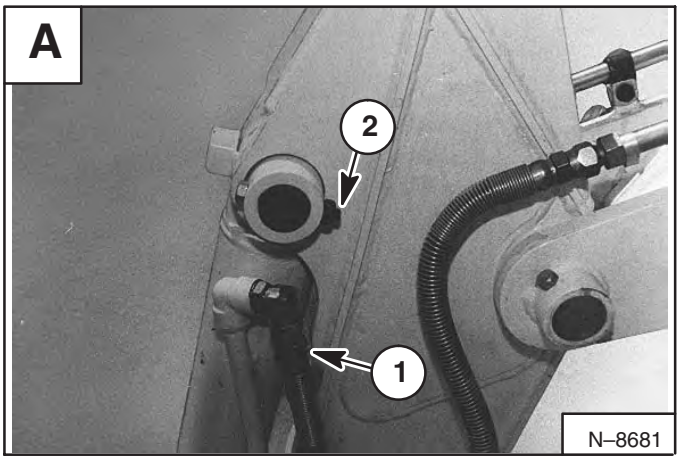
Remove the retainer bolt (Item 2) **[A]** and nut from the cylinder base end pin.

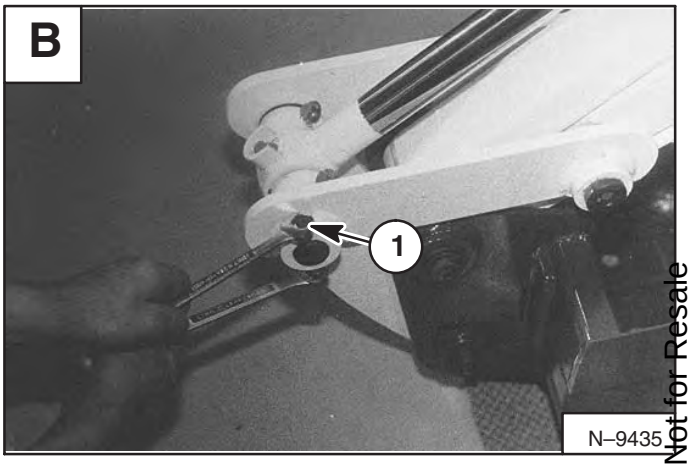
Remove the cylinder base end pin.

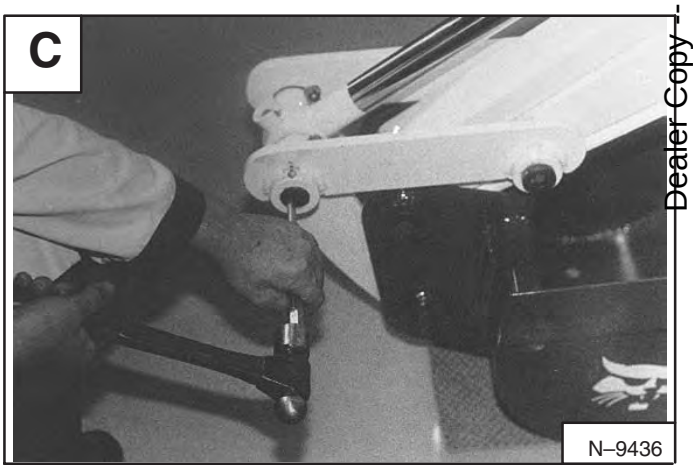
Remove the retainer bolt (Item 1) **[B]** and nut from the cylinder rod end pin.

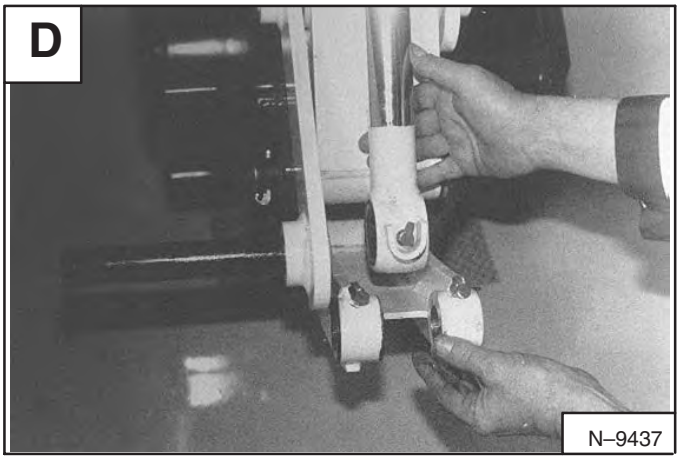
Remove the cylinder rod end pin **[C]**.

Remove the bucket cylinder **[D]**.







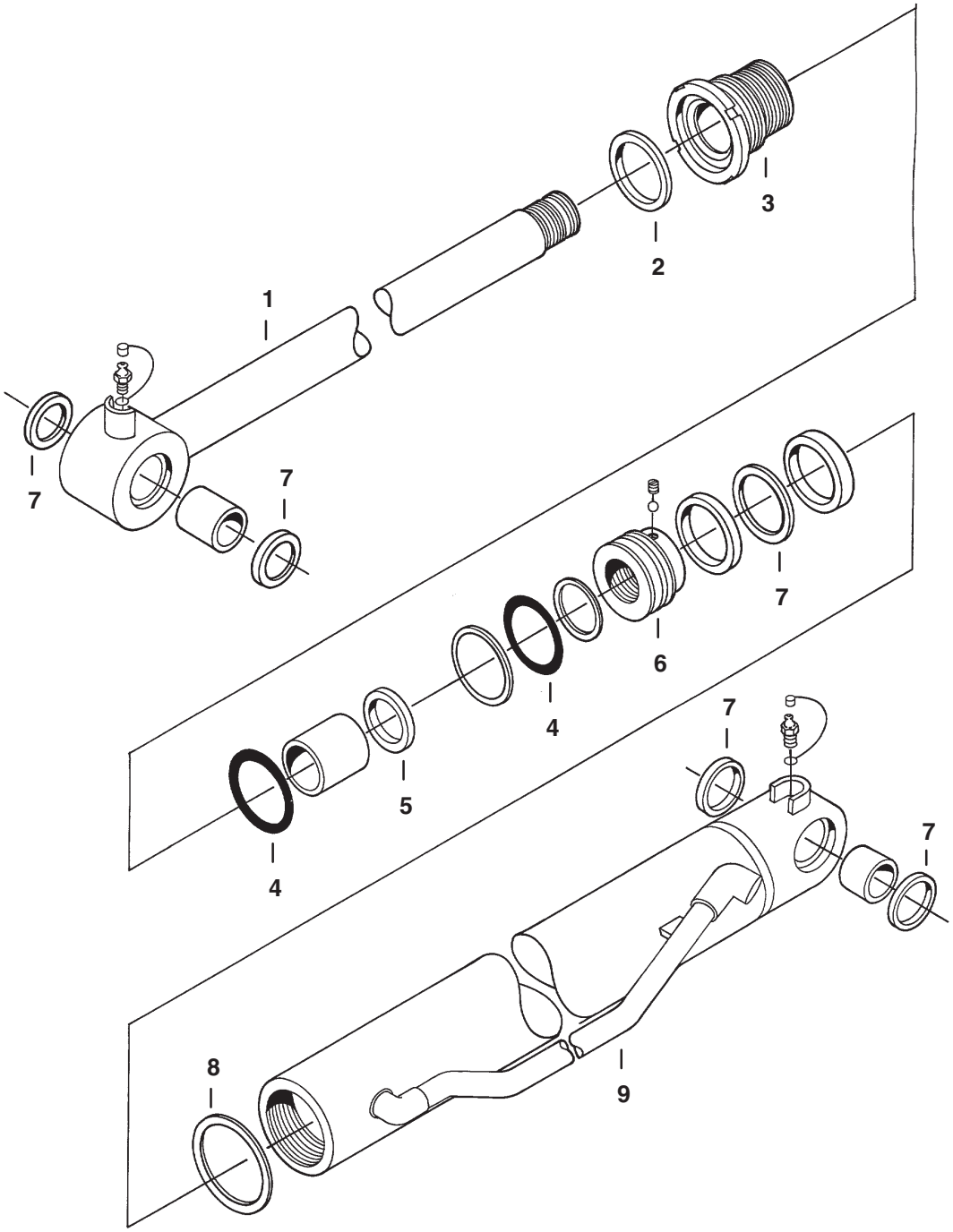


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Parts Identification

For Cylinder Disassembly and Assembly See Page 2–55.

1. **Rod**
2. **Ring**
3. **Head**
4. **O–ring**
5. **U–ring**
6. **Piston**
7. **Seal**
8. **Washer**
9. **Housing**



C–03153

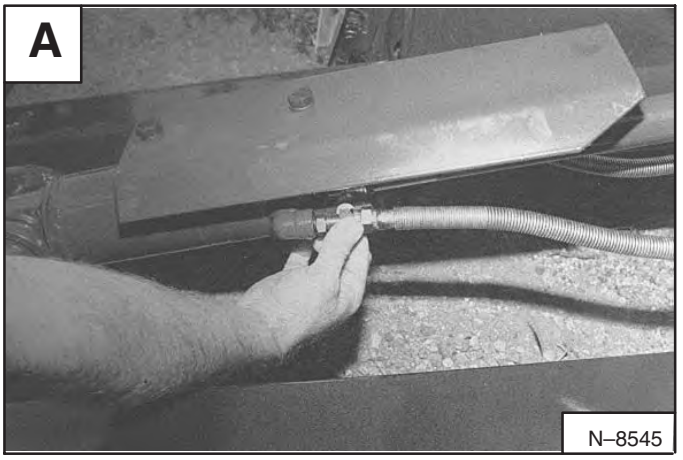
Dealer Copy -- Not for Resale

BLADE CYLINDER

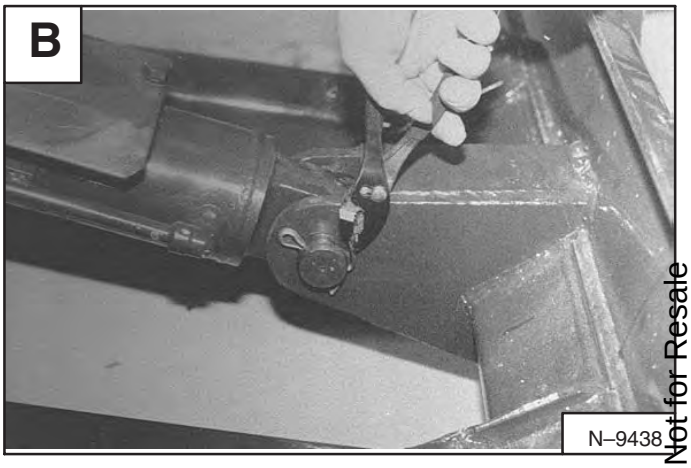
Removal and Installation

Put the blade on the floor . Stop the engine. Move the blade control lever to release the hydraulic pressure.

Disconnect the two hoses **[A]**.

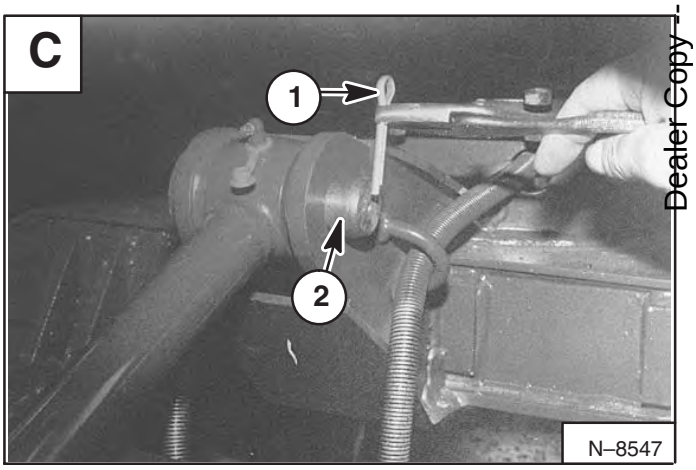


Remove the cotter pin and base end pin from the blade cylinder **[B]**.



Remove the cotter pin (Item 1) **[C]** from the cylinder rod end pin.

Remove the cylinder rod end pin (Item 2) **[C]**. Remove the blade cylinder.



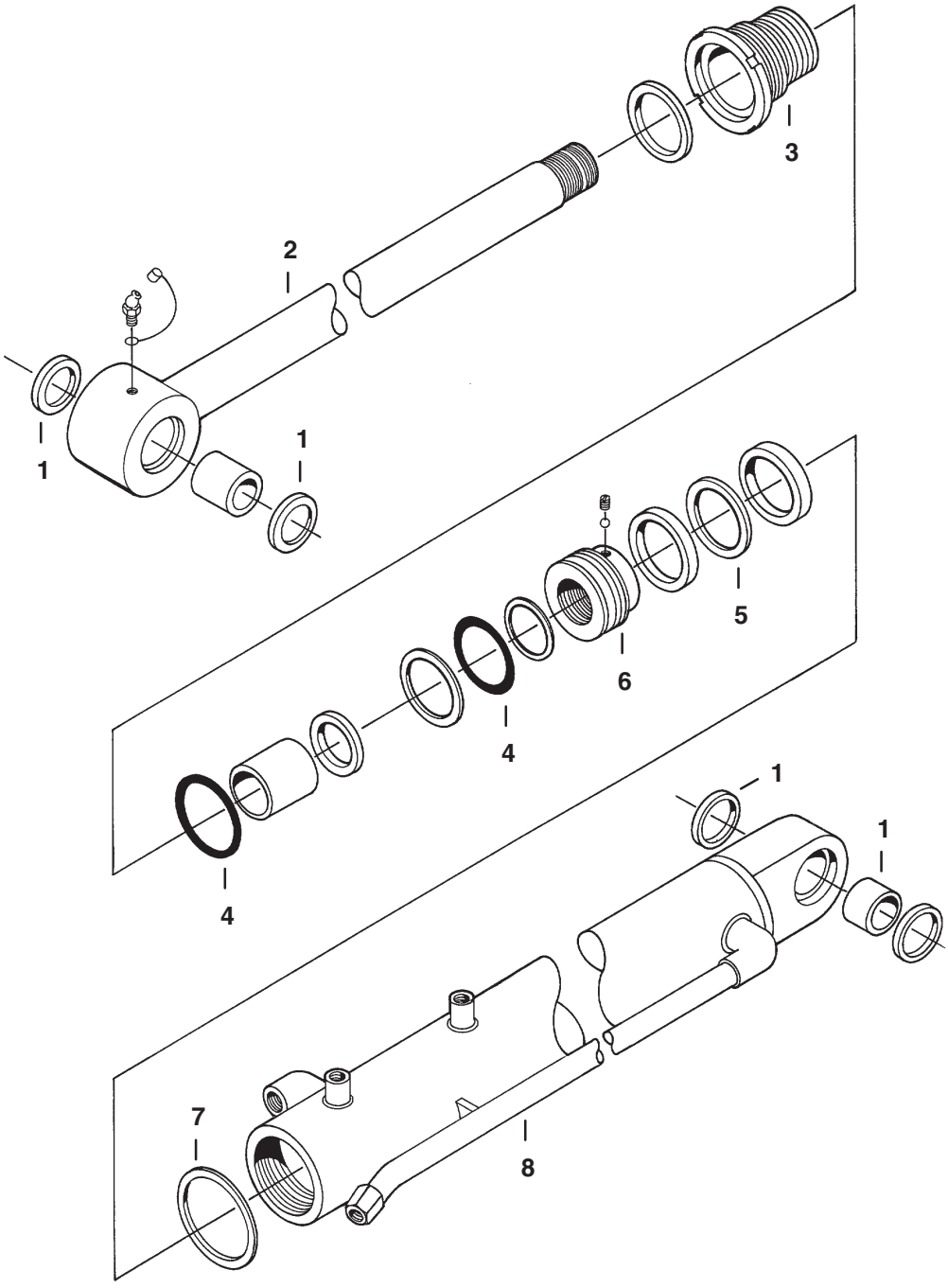
Dealer Copy -- Not for Resale

BLADE CYLINDER (Cont'd)

Parts Identification

For Cylinder Disassembly and Assembly See Page 2–55.

1. **Seal**
2. **Rod**
3. **Head**
4. **O–ring**
5. **Seal**
6. **Piston**
7. **Washer**
8. **Housing**



C–03154

Dealer Copy -- Not for Resale

BOOM SWING CYLINDER

Removal and Installation

IMPORTANT

When making repairs on hydrostatic and hydraulic systems, clean the work area before disassembly and keep all parts clean. Always use caps and plugs on hoses, tubelines and ports to keep dirt out. Dirt can quickly damage the system.

I–2003–0284

Disconnect the hoses (Item 1) **[A]** from the cylinder.

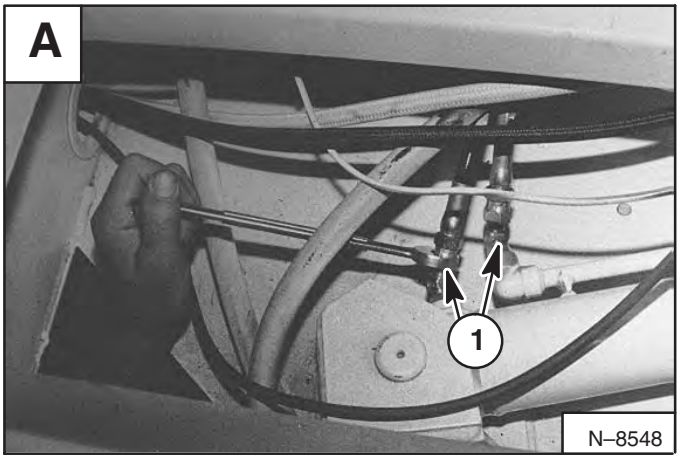
Remove the retainer bolt (Item 1) **[B]** from the cylinder base end pin.

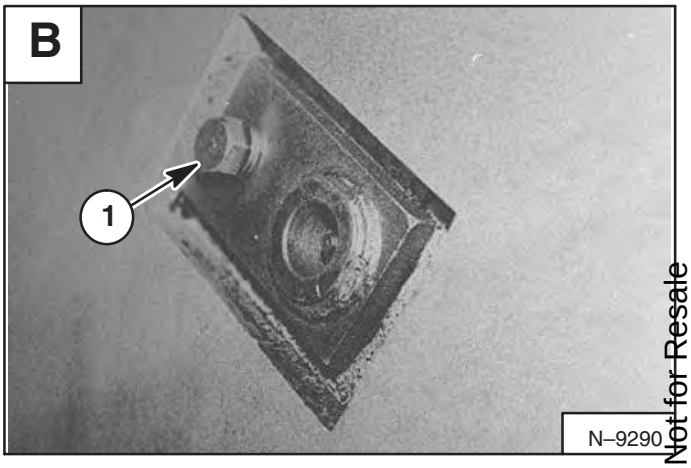
Remove the cylinder base end pin **[B]**.

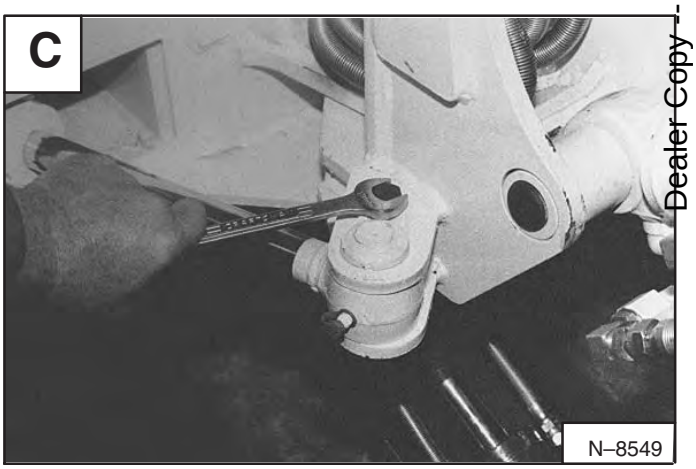
Remove the retainer bolt from the cylinder rod end pin **[C]**.

Remove the cylinder rod end pin.

Remove the boom swing cylinder.







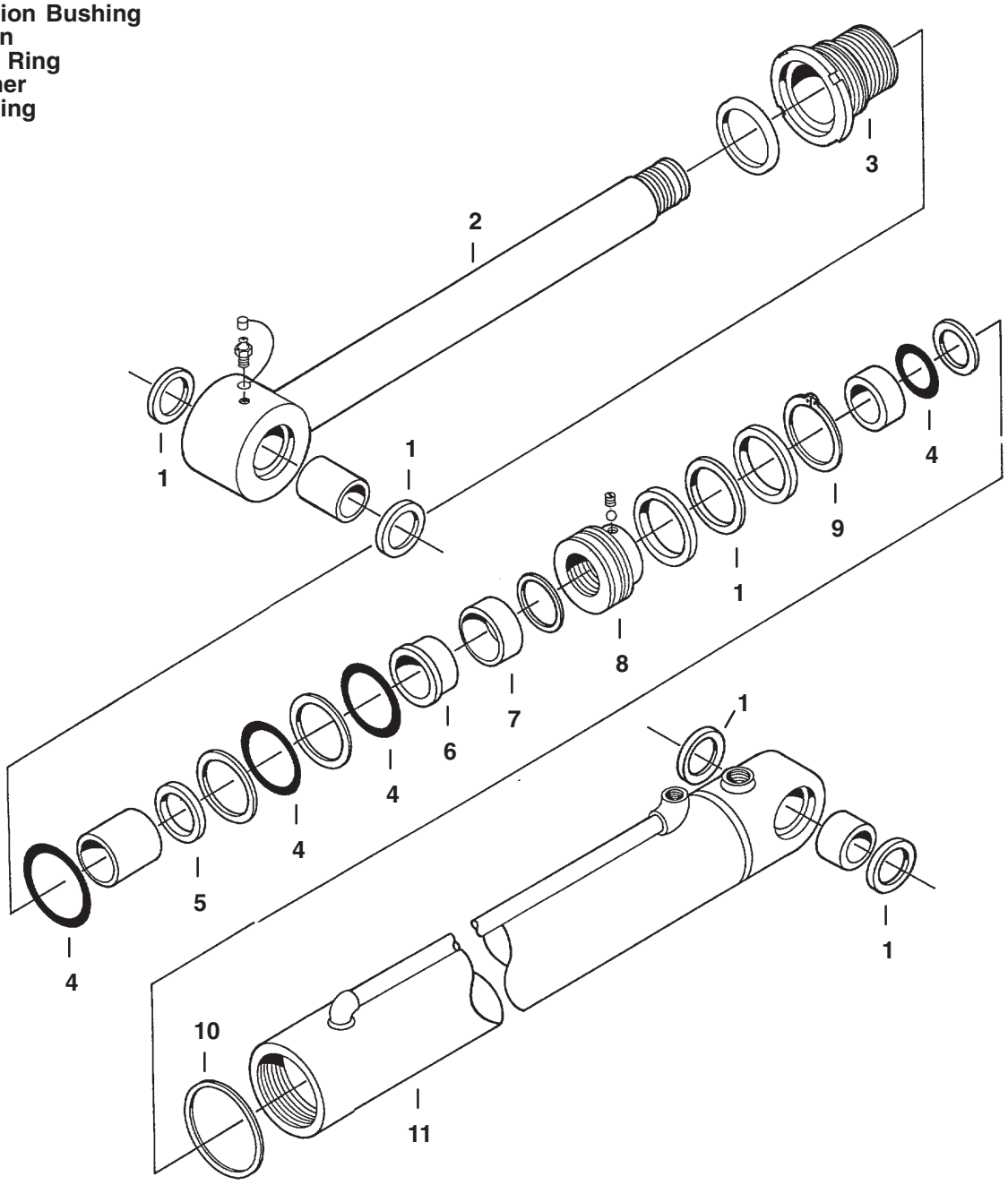
Dealer Copy -- Not for Resale

BOOM SWING CYLINDER (Cont'd)

Parts Identification

For Cylinder Disassembly and Assembly See Page 2–55.

1. Seal
2. Rod
3. Head
4. O–ring
5. U–ring
6. Shim
7. Cushion Bushing
8. Piston
9. Snap Ring
10. Washer
11. Housing



C–03156

Dealer Copy -- Not for Resale

HYDRAULIC CYLINDER

Disassembly

The following tools will be needed:

Adjustable Gland Nut Wrench MEL1075
Seal Stretcher MEL1396
Rod Seal Installation Tool MEL1033

The following hones are available. Order the appropriate size hone from OTC Service Tools.

2” Diameter Hone MEL1418
2 3/4” – 3” Diameter Hone OEM–6275
3” – 3 1/2” Diameter Hone OEM–6270
3 1/2” – 4” Diameter Hone OEM–6271

NOTE: The photos may not show the cylinder exactly as it appears, but the procedure is the same for all cylinders.

Put the base end of the hydraulic cylinder in a drain pan. Move the rod in and out to remove the fluid from the cylinder. Move the rod slowly so the fluid will go directly into the drain pan.

Put the base end of the cylinder in a vise.

Straighten the lock ring (Item 1) **[A]** in two places.

Use the adjustable gland nut wrench to loosen the head (Item 2) **[A]**.

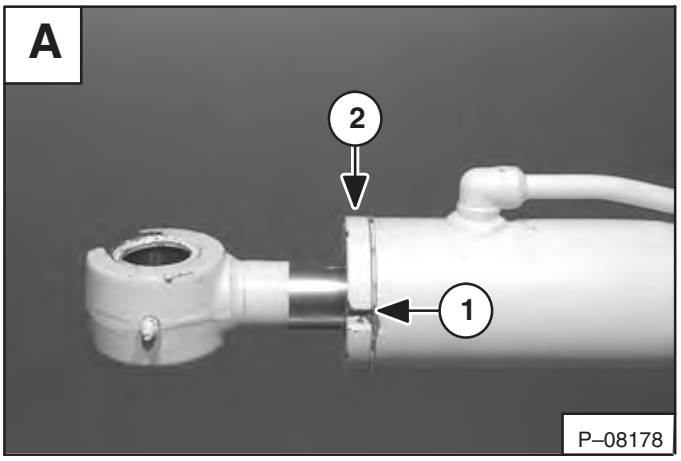
Remove the rod assembly from the cylinder case **[B]**.

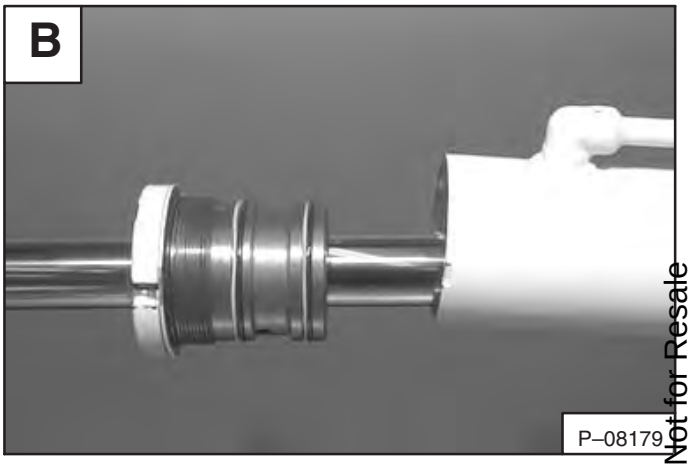
Remove the cylinder case from the vise.

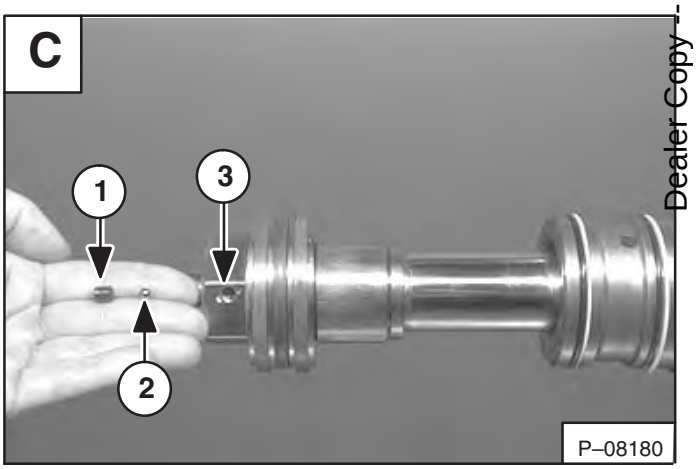
Put the rod end in the vise.

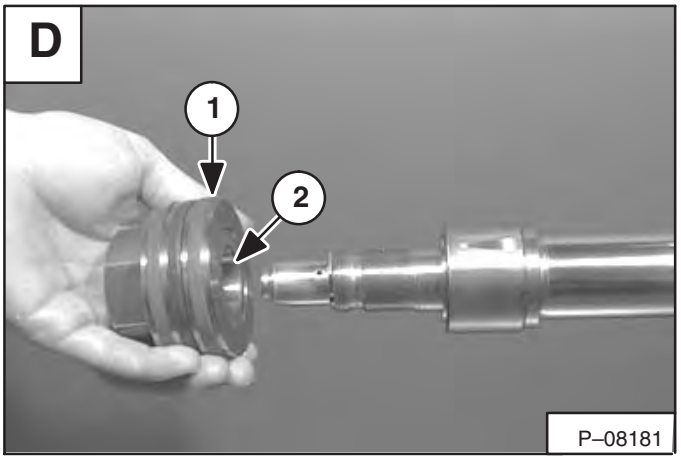
Remove the set screw (Item 1) **[C]** and steel ball (Item 2) **[C]** from the piston (Item 3) **[C]**.

Remove the piston (Item 1) **[D]** and shim (Item 2) **[D]** from the rod.









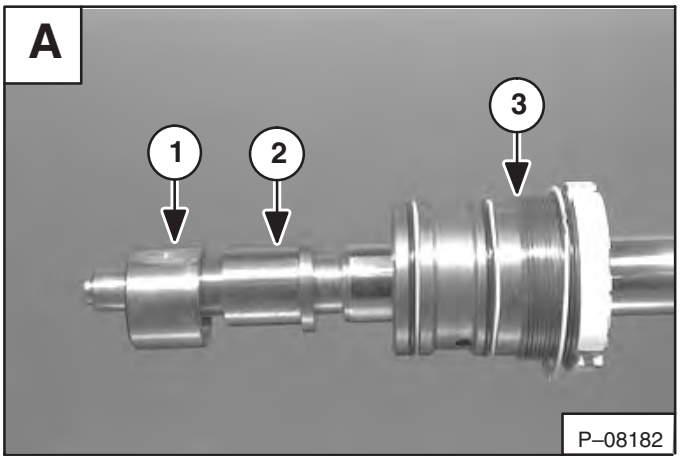
Dealer Copy -- Not for Resale

HYDRAULIC CYLINDER (Cont'd)

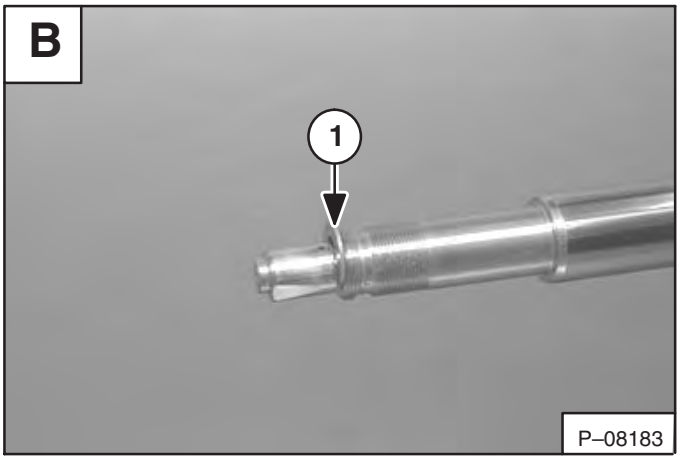
Disassembly (Cont'd)

Slide the bushing (Item 1) **[A]**, shim (Item 2) **[A]**, and head (Item 3) **[A]** off the rod.

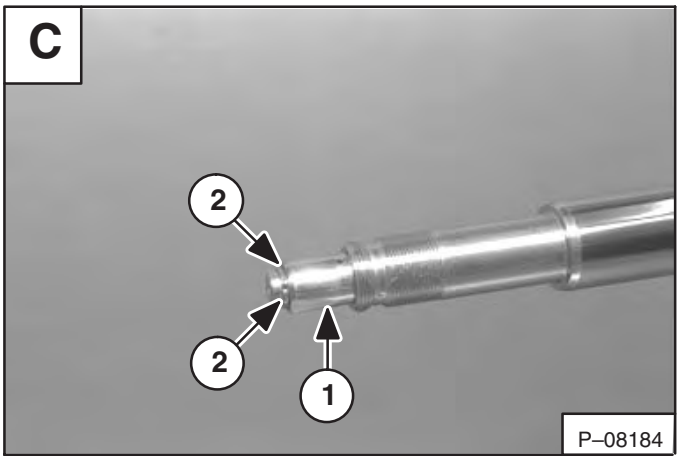
NOTE: Only the boom and blade cylinders have this type of shim (Item 2) [A].



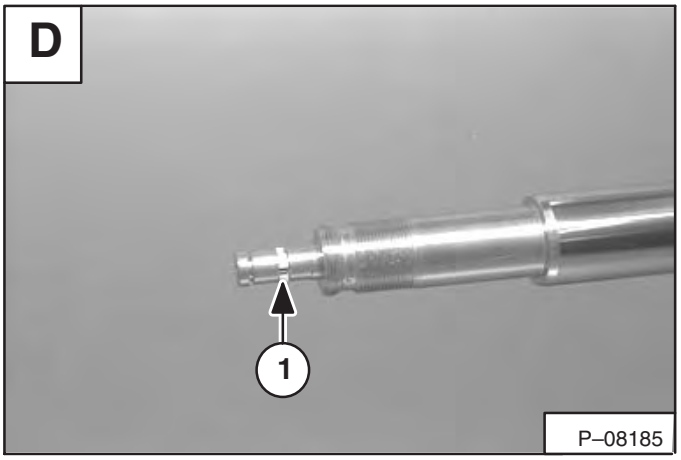
Remove the c–clip (Item 1) **[B]** from the rod.



Slide the bushing (Item 1) **[C]** back and remove the two (2) bushing stops (Item 2) **[C]**. Slide the bushing (Item 1) **[C]** off the rod.



Remove the cushion seal (Item 1) **[D]** from the rod.



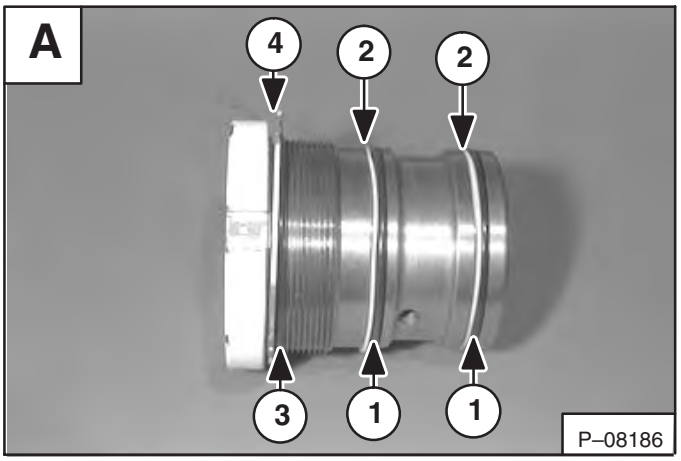
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HYDRAULIC CYLINDER (Cont'd)

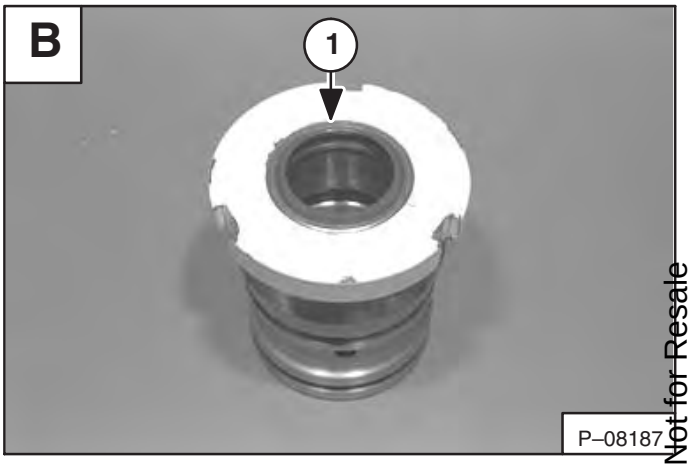
Disassembly (Cont'd)

Remove the O–rings (Item 1) **[A]** and backup rings (Item 2) **[A]** from the head.

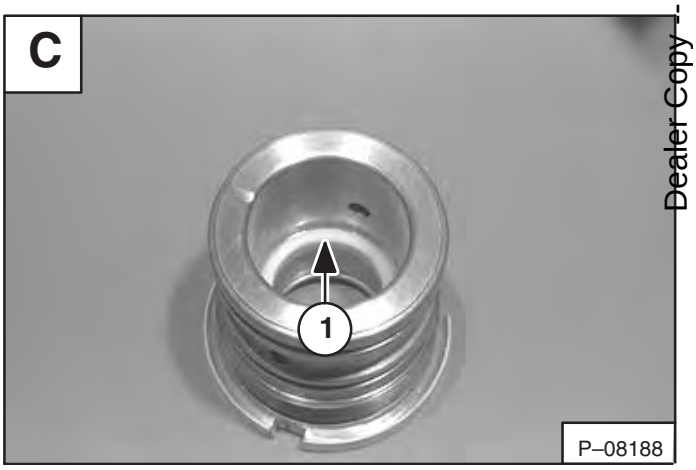
Remove the O–ring (Item 3) **[A]** and lock ring (Item 4) **[A]** from the head.



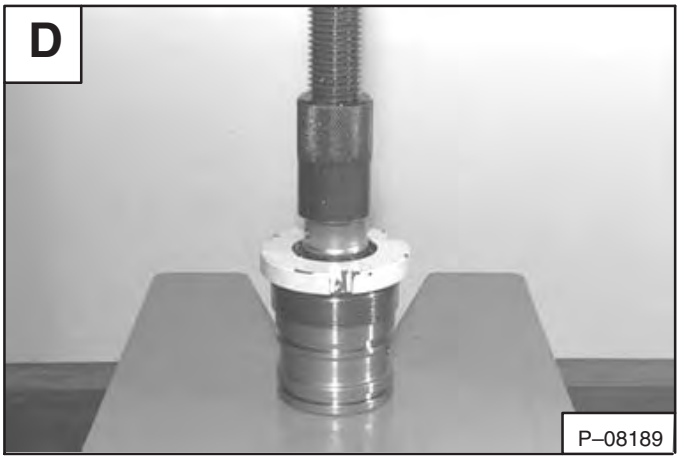
Remove the wiper seal (Item 1) **[B]** from the head. The seal will be destroyed when it is removed.



Cut and remove the U–ring (Item 1) **[C]** from inside the head.



Press the bushing out the bottom of the head **[D]**.



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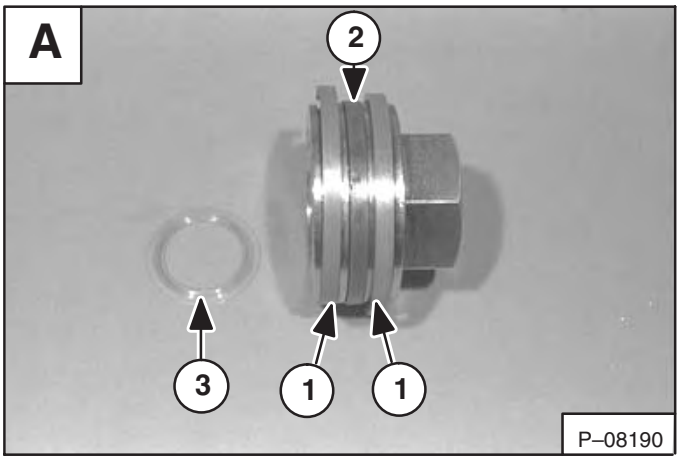
HYDRAULIC CYLINDER (Cont'd)

Disassembly (Cont'd)

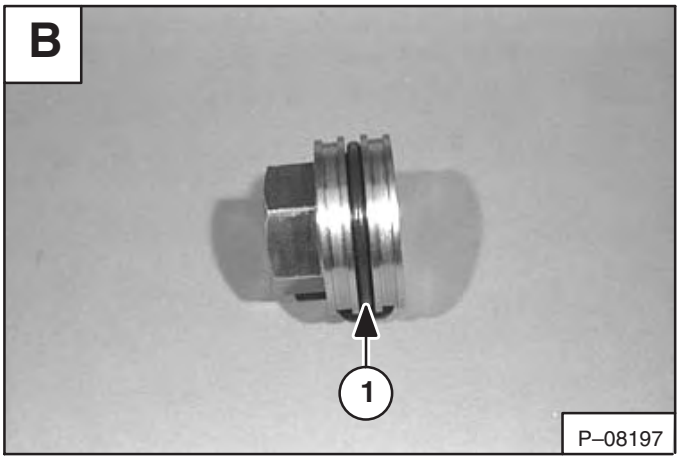
Remove the two slide rings (Item 1) **[A]** from the piston.

Cut and remove the Teflon seal (Item 2) **[A]**.

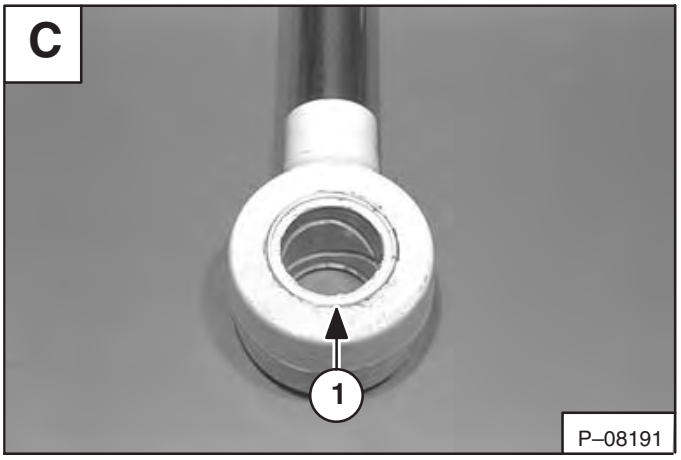
Remove the shim (Item 3) **[A]** from the piston.



Remove the O–ring (Item 1) **[B]** from the piston.

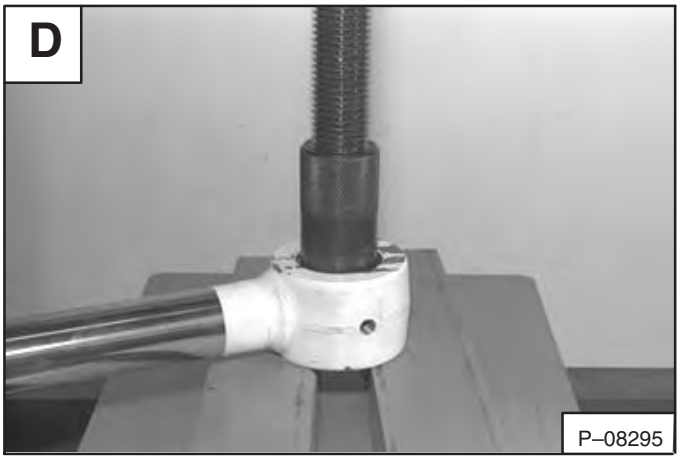


Remove the seal (Item 1) **[C]** from both sides of the rod end.



Press the bushing out of the rod end **[D]**.

Repeat the above procedure **[C]** & **[D]** to remove the seals and bushing from the cylinder base end.



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HYDRAULIC CYLINDER (Cont'd)

Disassembly (Cont'd)

Inspect the inside of the cylinder case for nicks and scratches. If the cylinder case has minor scuf fing, the cylinder case can be honed **[A]**. Use a flexible hone and lubricate with oil during the honing process.

Thoroughly wash the inside of the cylinder case after honing process.

The following hones can be ordered from OTC Service Tools:

2" Diameter Hone MEL1418
2 3/4"–3" Diameter Hone OEM–6275
3"–3 1/2" Diameter Hone OEM–6270
3 1/2"–4" Diameter Hone OEM–6271

Assembly

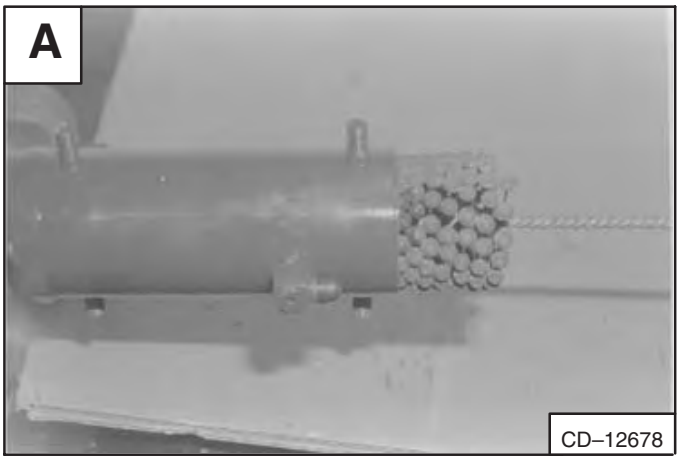
Wash the cylinder parts in solvent and dry with compressed air.

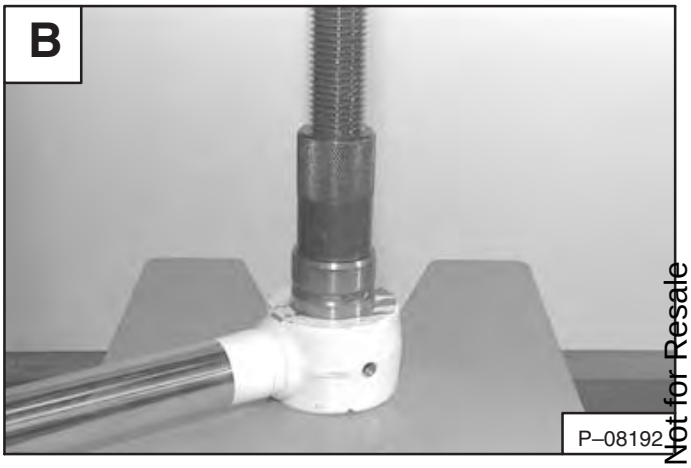
While servicing the cylinder do not damage the parts. Inspect for nicks, scratches or otherwise damaged or bent parts before assembling the cylinder. Replace parts that appear damaged in any way. The cylinder may not function correctly if there is damage to any of the parts.

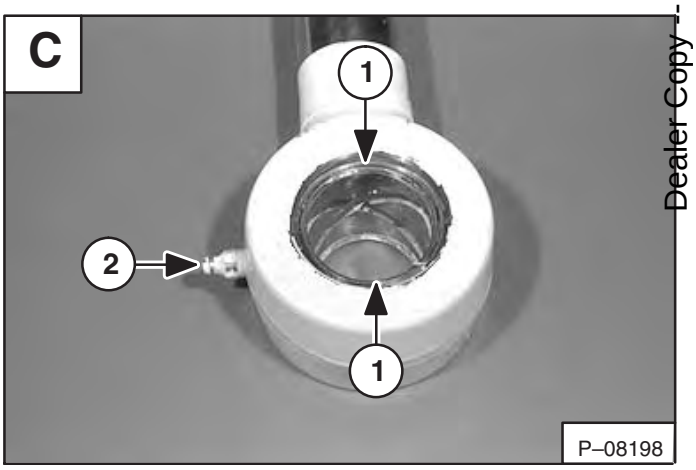
Destroy all the O–rings and seals and replace them with NEW O–rings and seals.

Press the bushing in the rod end until it is centered in the rod end **[B]**.

NOTE: When installing the bushing, the grease holes (Item 1) [C] should be 90 ° from the grease fitting (Item 2) [B].

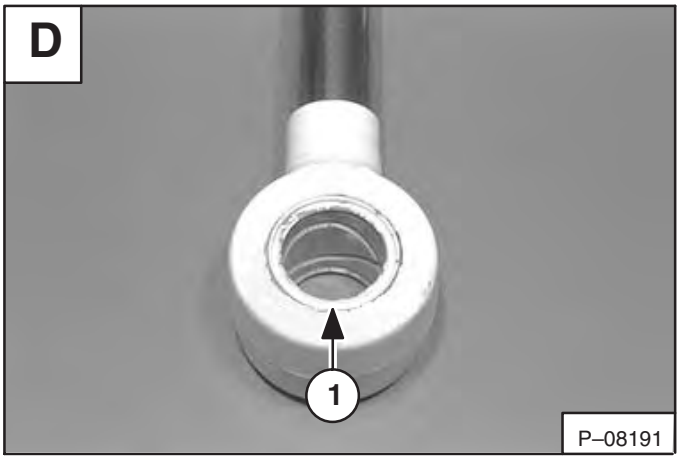






Install the seal (Item 1) **[D]** on both sides of the rod end.

Repeat the above procedure **[B]** through **[D]** to install the bushing and seals on the cylinder base end.

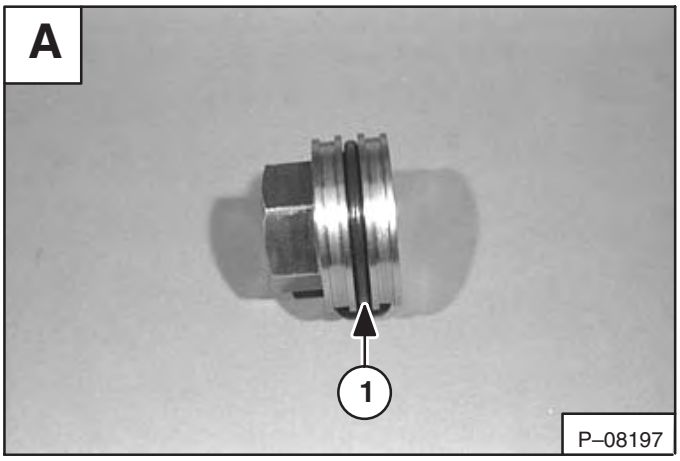


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HYDRAULIC CYLINDER (Cont'd)

Assembly (Cont'd)

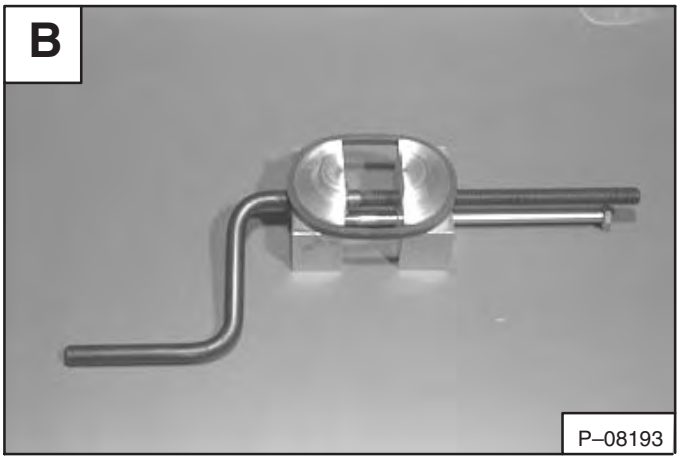
Oil and install the O–ring (Item 1) **[A]** on the piston.



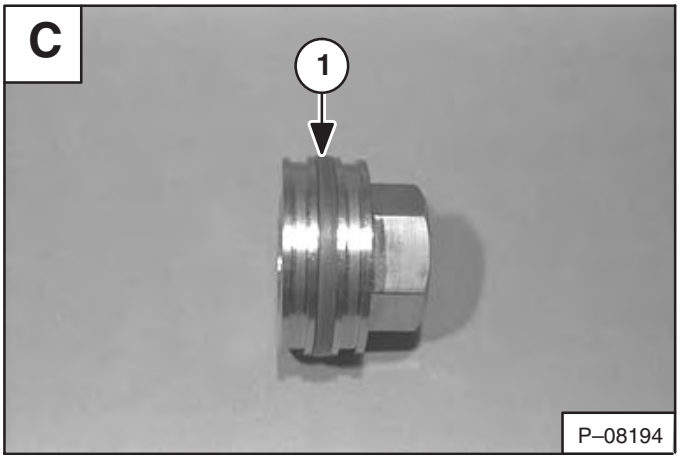
Install the Teflon seal on the tool (MEL1396) and stretch it until it fits the piston **[B]**.

Allow the seal to stretch for 30 seconds before removing it from the tool.

NOTE: Do not over stretch the seal.



Install the seal (Item 1) **[C]** on the piston.



Use a ring compressor to compress the seal to the correct size **[D]**.

Leave the piston in the ring compressor for three minutes.

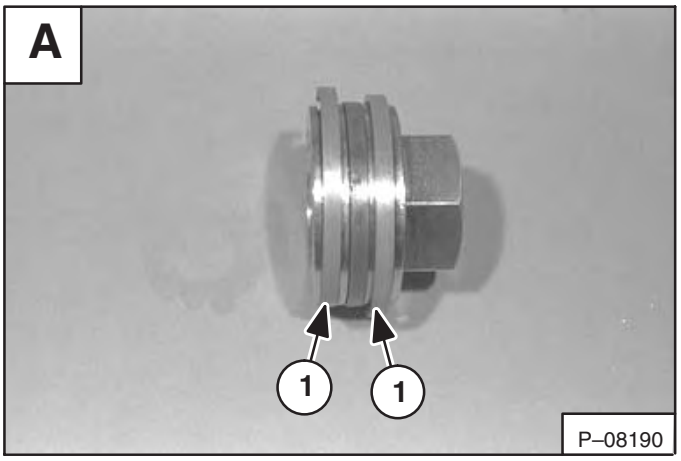


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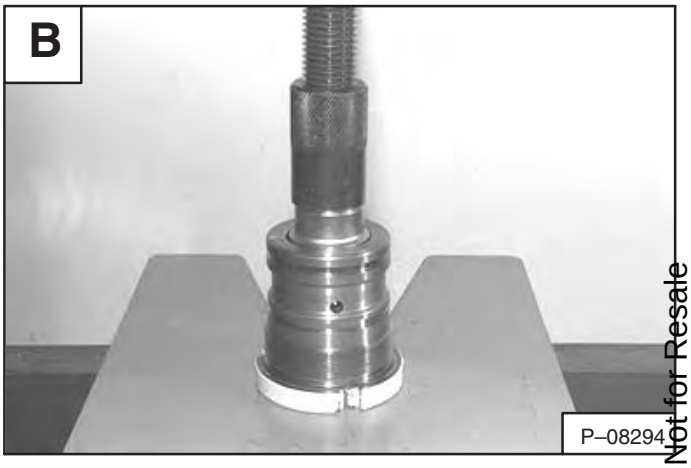
HYDRAULIC CYLINDER (Cont'd)

Assembly (Cont'd)

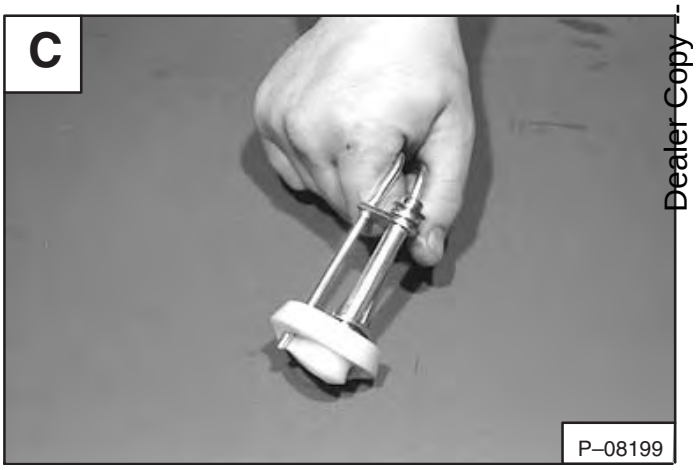
Install the two slide rings (Item 1) **[A]** on the piston.



Press the bushing in the head **[B]**.

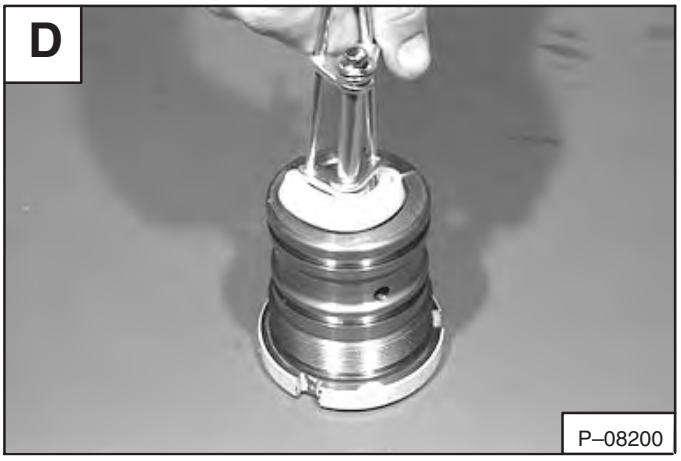


Install the U–ring on the rod seal tool (MEL1033) **[C]**.



Install the U–ring in the head **[D]**.

NOTE: The open side of the U–ring will face the bottom of the head.

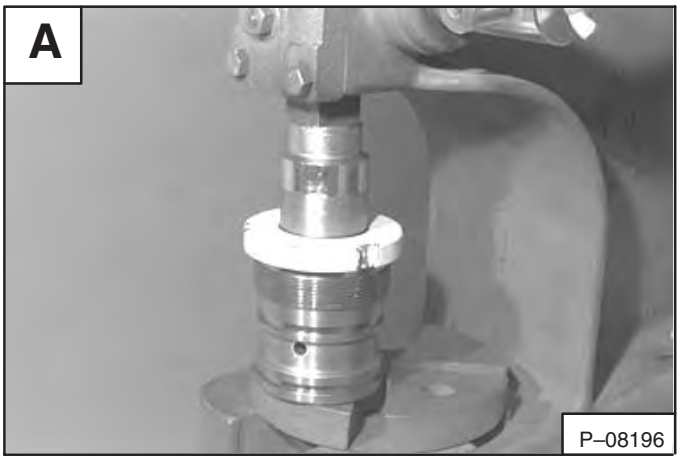


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HYDRAULIC CYLINDER (Cont'd)

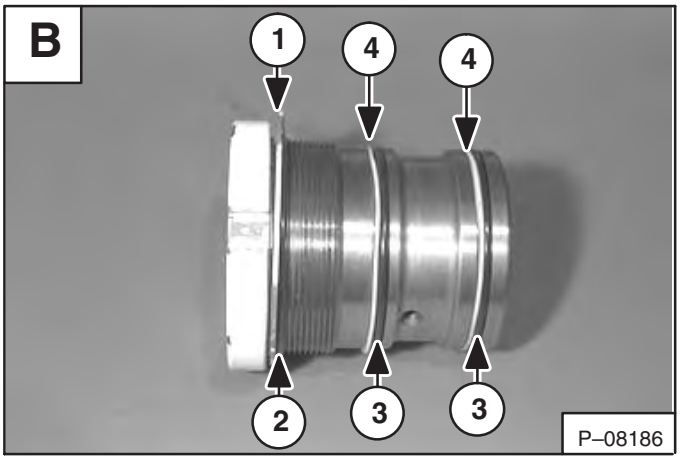
Assembly (Cont'd)

Install the wiper seal in the head **[A]**.

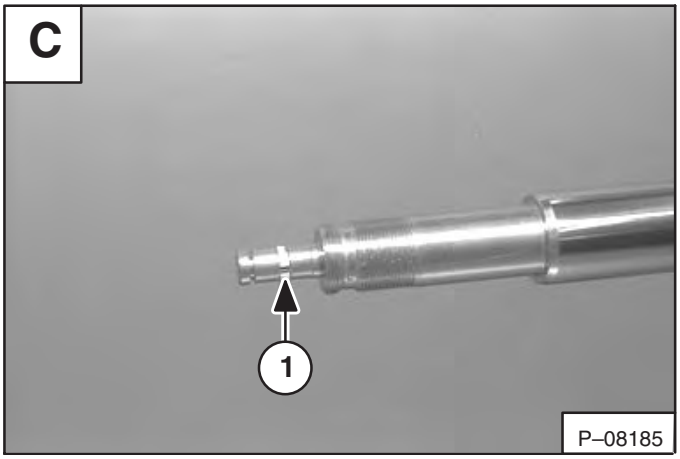


Install the lock ring (Item 1) **[B]** and O–ring (Item 2) **[B]** on the head.

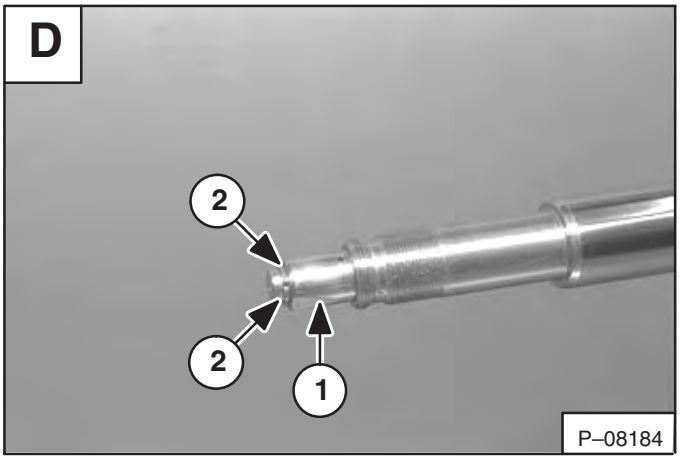
Install the O–rings (Item 3) **[B]** and back–up rings (Item 4) **[B]** on the head.



Install the cushion seal (Item 1) **[C]** on the rod.



Install the bushing (Item 1)**[D]** and the two bushing stops (Item 2) **[D]**.

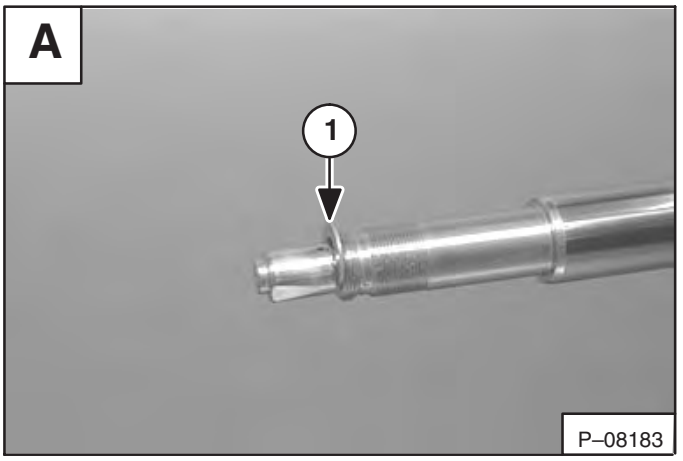


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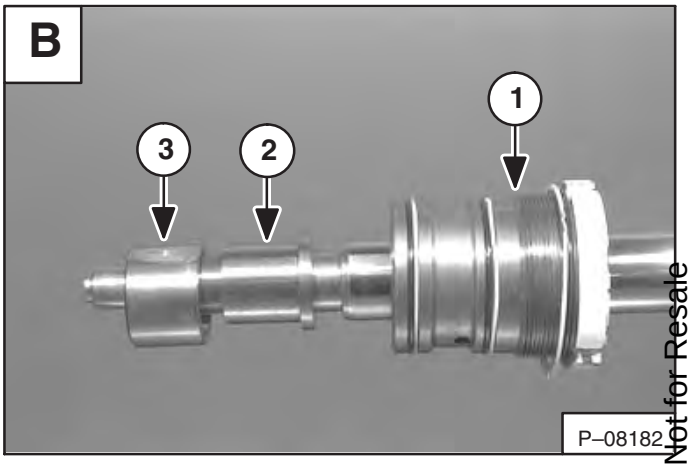
HYDRAULIC CYLINDER (Cont'd)

Assembly (Cont'd)

Slide the bushing against the bushing stops and install the c–clip (Item 1) **[A]** on the rod.

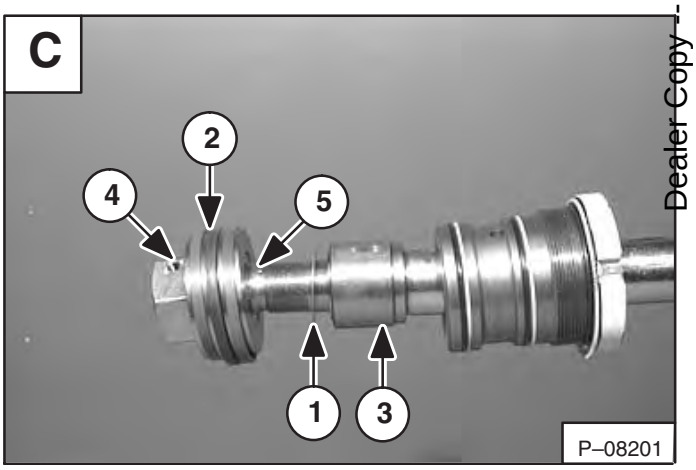


Slide the head (Item 1) **[B]**, shim (Item 2) **[B]**, and bushing (Item 3) **[B]** on the rod.



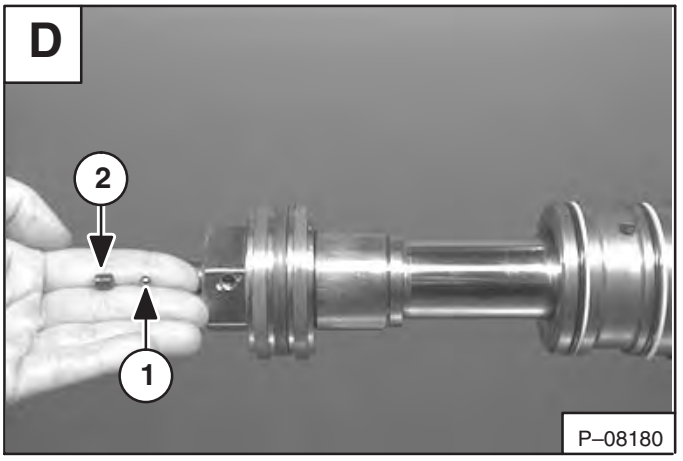
Install the shim (Item 1) **[C]** and piston (Item 2) **[C]** on the rod.

NOTE: Tighten the piston (Item 2) [C] on the rod until it is snug to the bushing (Item 3) [C]. Further tighten the piston (Item 2) [C] until the hole in the piston (Item 4) [C] lines up with the machined depression (Item 5) [C] in the rod.



Apply thread lock (LOCTITE #242) to the set screw (Item 2) **[D]**.

Install the steel ball (Item 1) **[D]** and set screw (Item 2) **[D]** in the piston.



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HYDRAULIC CYLINDER (Cont'd)

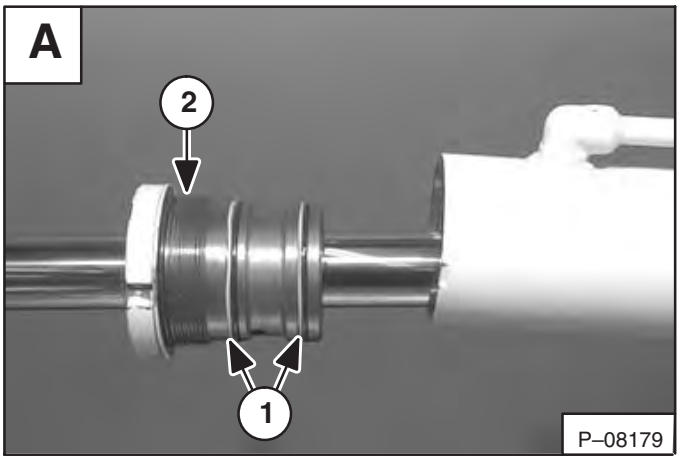
Assembly (Cont'd)

Put the base end of the cylinder in a vise.

Oil the Teflon seal and slide rings.

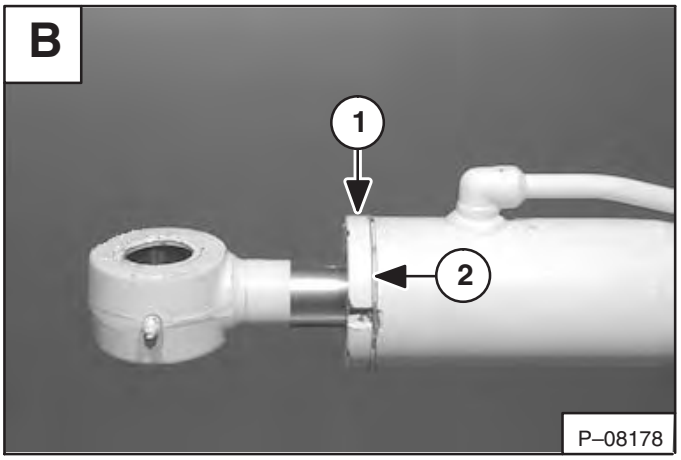
Install the rod assembly in the cylinder case **[A]**.

Oil the O–rings (Item 1)**[A]** and threads (Item 2)**[A]** of the head.



Tighten the head (Item 1) **[B]** until it is flush with the end of the cylinder case. Tap the lock ring (Item 2) **[B]** in the grooves of the cylinder and head.

Move the rod in and out of the cylinder case and make sure that it moves freely.

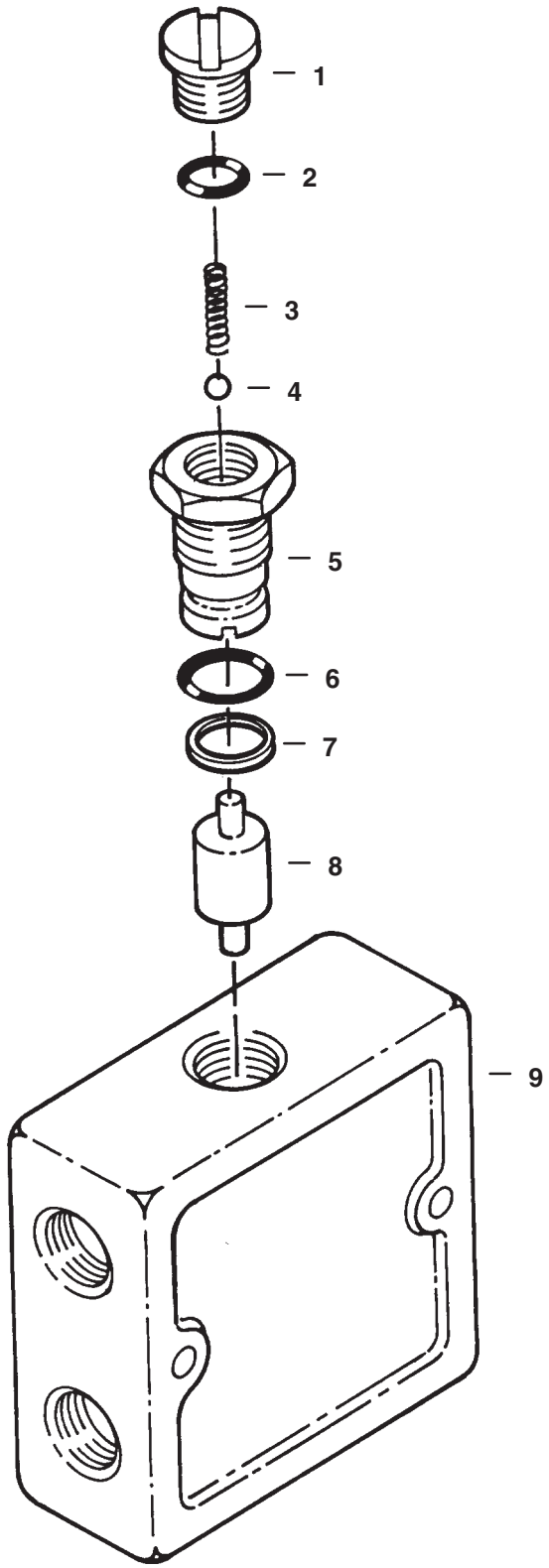


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SWING CYLINDER LOCK VALVE

Parts Identification

1. Plug
2. O–ring
3. Spring
4. Ball
5. Check Valve Body
6. O–ring
7. Back–up Ring
8. Spool
9. Valve Body



C–03458

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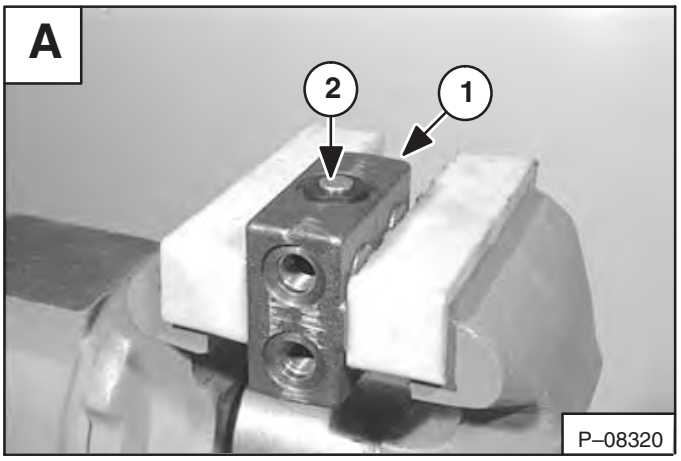
SWING CYLINDER LOCK VALVE

Disassembly

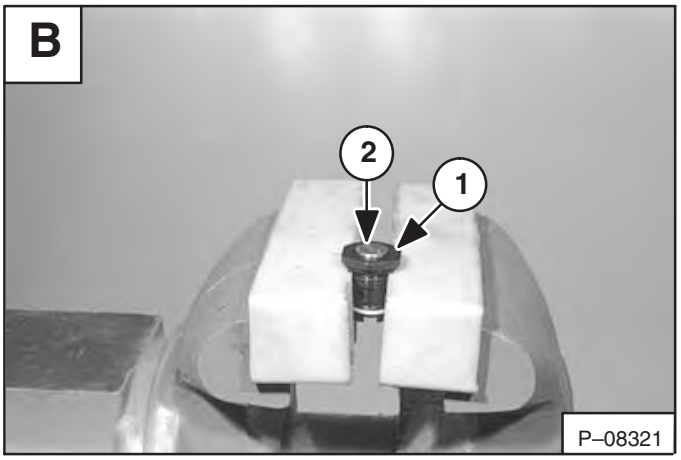
Before disassembly:

Clean the outside of the valve.
Disassemble the valve in a clean area.

Clamp the valve (Item 1) **[A]** in the vise, with padded jaws, and remove the check valve (Item 2) **[A]** (both sides).

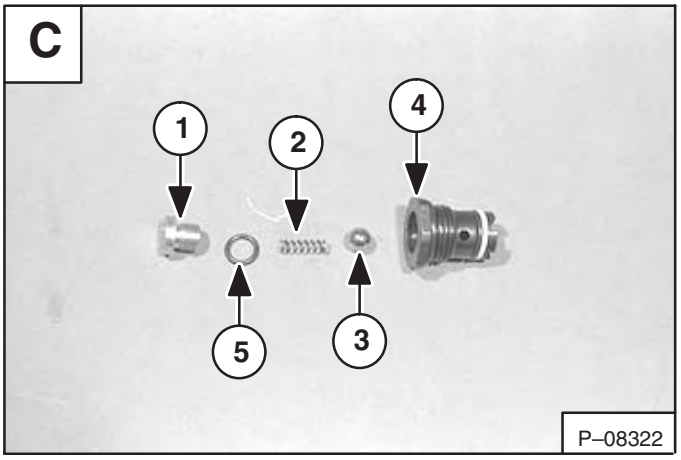


Clamp the check valve (Item 1) **[B]** in the vise, with padded jaws, and loosen the cap (Item 2) **[B]** (on both valves).

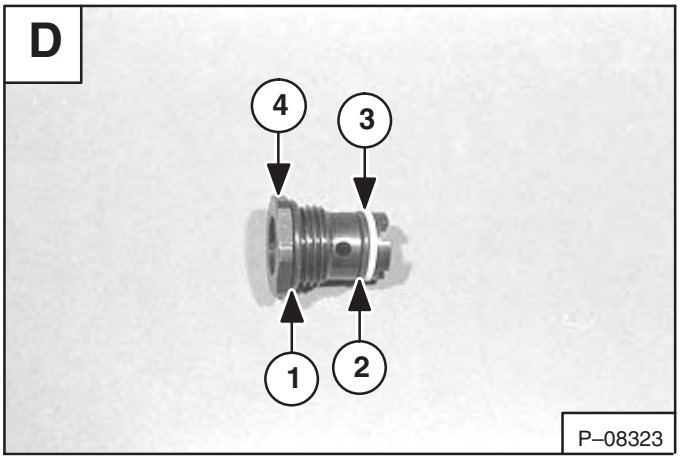


Remove the cap (Item 1) **[C]** the spring (Item 2) **[C]** and the check ball (Item 3) **[C]** from the check valve (Item 4) **[C]**.

Remove the O–ring (Item 5) **[C]** from the cap (Item 1) **[C]** (on both valves).



Remove the large O–ring (Item 1) **[D]**, the small O–ring (Item 2) **[D]** and the back–up ring (Item 3) **[D]** from the check valve (Item 4) **[D]** (on both valves).



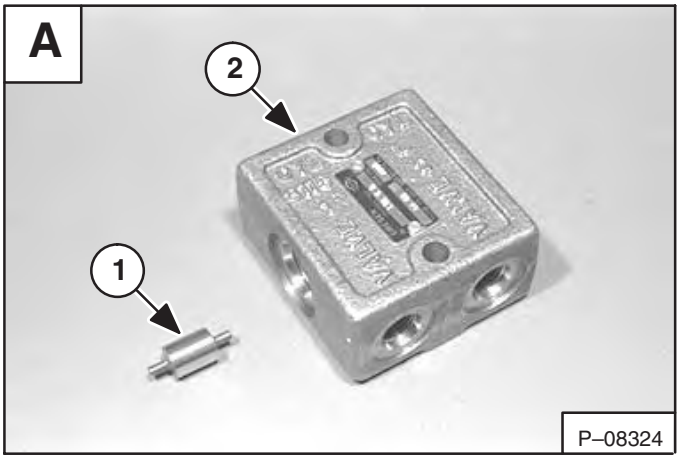
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SWING CYLINDER LOCK VALVE (Cont'd)

Disassembly (Cont'd)

Remove the spool (Item 1) **[A]** from the valve body (Item 2) **[A]**.

NOTE: Be careful not to scratch or damage the spool.



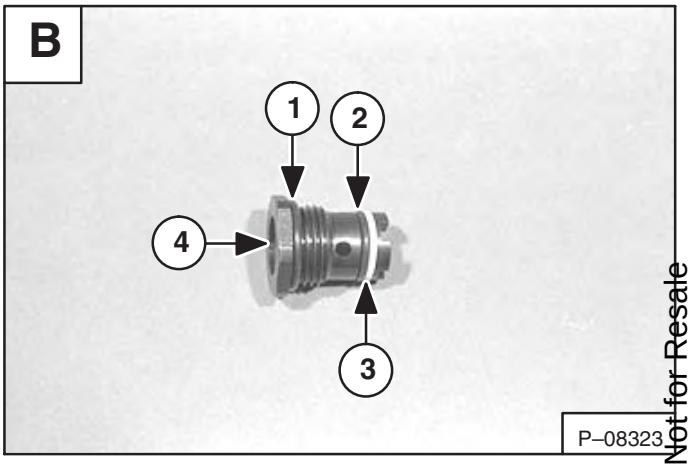
Assembly

Before assembly:

Clean all parts with solvent and dry with compressed air.
Put oil on all O–rings.

Apply oil and install the spool (Item 1) **[A]** in the valvebody (Item 2) **[A]**.

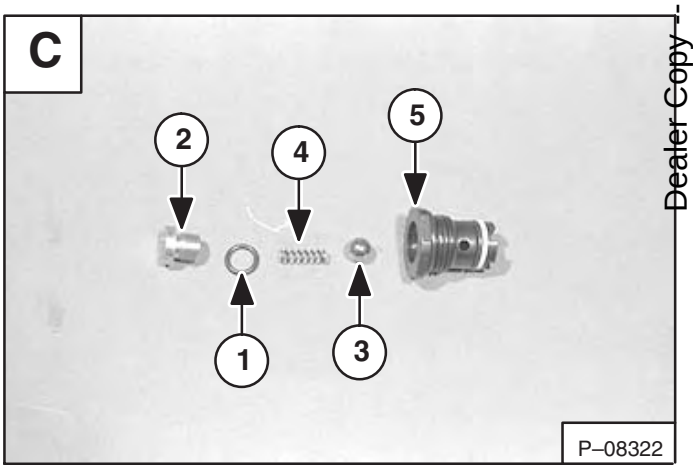
Install the large O–ring (Item 1) **[B]** the small O–ring (Item 2) **[B]** and the back–up ring (Item 3) **[B]** on the check valve (Item 4) **[B]**.



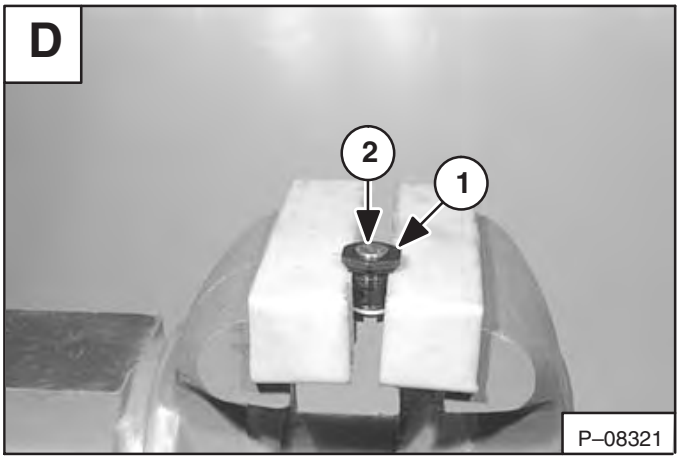
Install the O–ring (Item 1) **[C]** on the cap (Item 2) **[C]**.

Install the check ball (Item 3) **[C]** the spring (Item 4) **[C]**.

Install the cap (Item 2) **[C]** in the check valve (Item 5) **[C]** and tighten by hand.



Clamp the check valve (Item 1) **[D]** in a vise with padded jaws, and tighten the cap (Item 2) **[D]**.

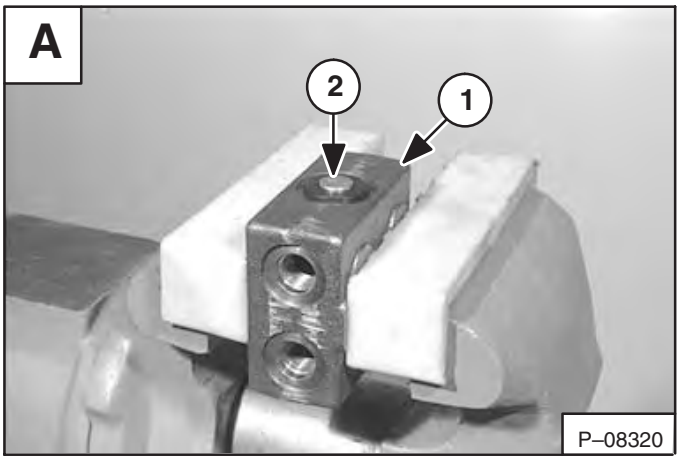


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SWING CYLINDER LOCK VALVE (Cont'd)

Assembly (Cont'd)

Clamp the valve (Item 1) **[A]** in a vise with padded jaws and tighten the check valve (Item 2) **[A]** (both sides).



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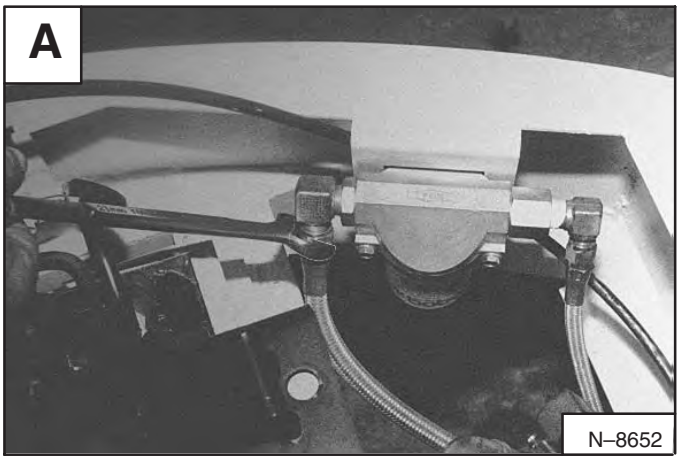
HYDRAULIC FILTER

Removal and Installation

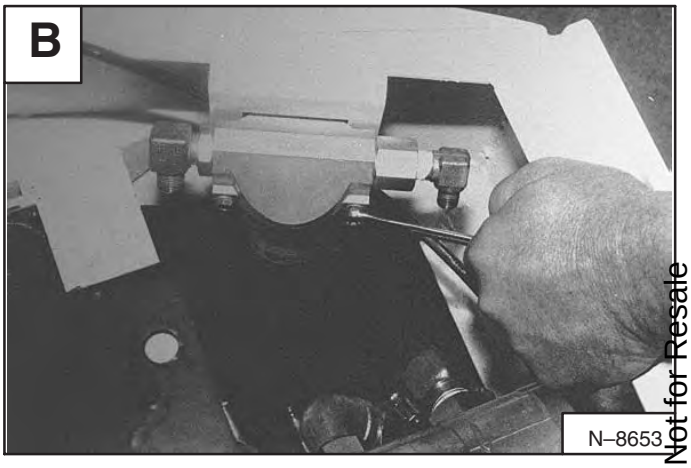
Raise the engine cover.

Remove the inlet and outlet hoses from the filter **[A]**.

Drain the fluid into a container.



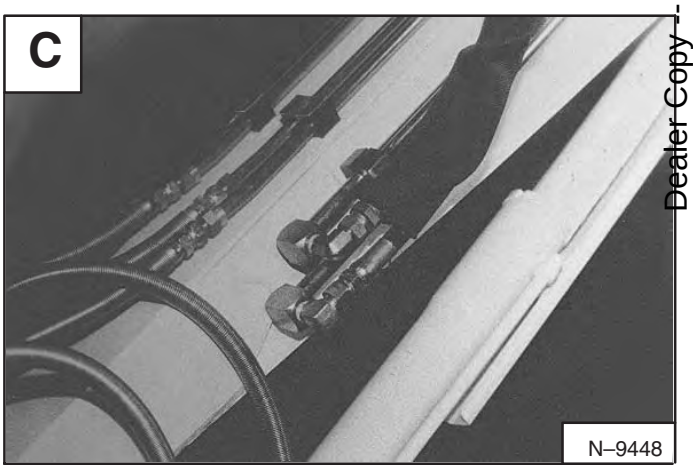
Remove the mounting bolts from the filter **[B]**.



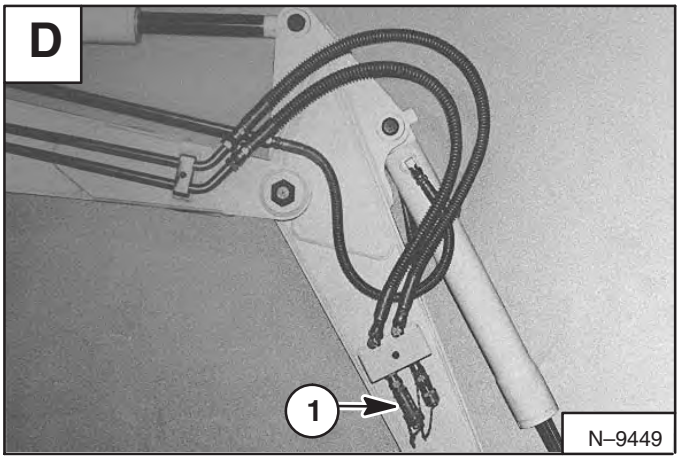
AUXILIARY ROUTING

The auxiliary tubelines run parallel with the boom.

For cab clearance the hose fittings must be installed parallel with the tubelines **[C]**.



When installing the auxiliary quick couplers the female quick coupler (pressure) is on the bottom (Item 1) **[D]**.

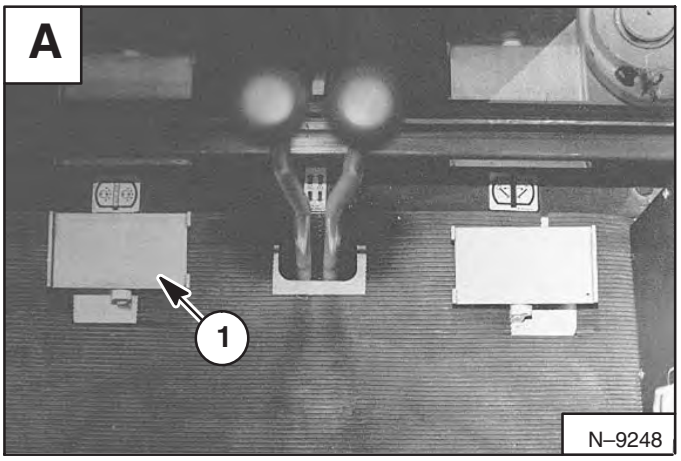


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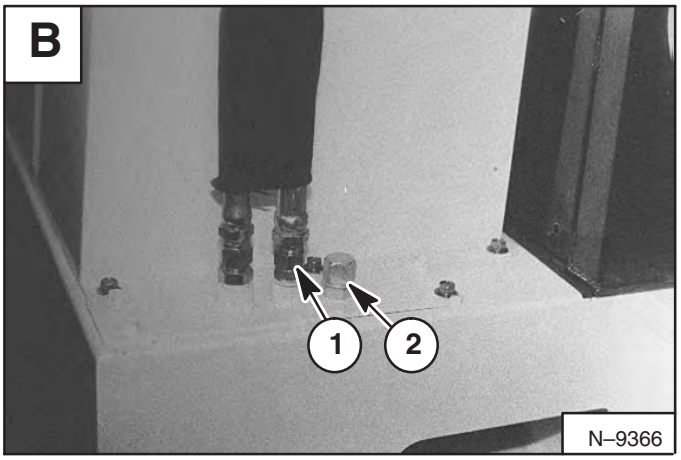
AUXILIARY ROUTING (Cont'd)

The pedal (Item 1) **[A]** controls optional equipment when mounted on the dipperstick.

The excavator is equipped with two–way flow auxiliary lines. The female coupler is pressure, the male coupler is return. Push pedal (Item 1) **[A]** on right side for high flow and left side for low flow.



To change to one–way flow (Direct to Tank) move center hose (male) (Item 1) **[B]** to inside fitting (Item 2) **[B]** and cap center fitting. Pedal will now supply fluid when pushed to one side only.



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JOYSTICK CONTROL CHANGE

To change from I.S.O. to STANDARD joystick controls do the following procedure:

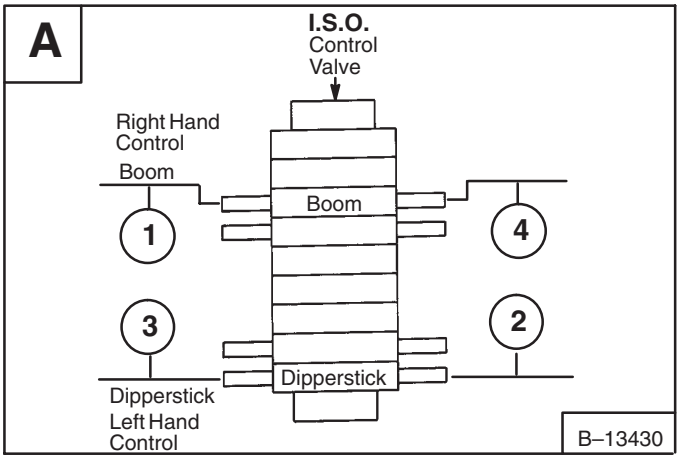
Remove the seat and swing motor cover (See Page 5–1.)

Remove the rear floor panel. (See Page 5–1.)

Remove the left control panel base. (See Page 3–1.)

Exchange the boom control hose (Item 1) **[A]** with the dipperstick control hose (Item 2) **[A]**.

Exchange the dipperstick control hose (Item 3) **[A]** with the boom control hose (Item 4) **[A]**.



After exchange of hoses the routing from the joystick to the control valve will be as shown **[B]**.

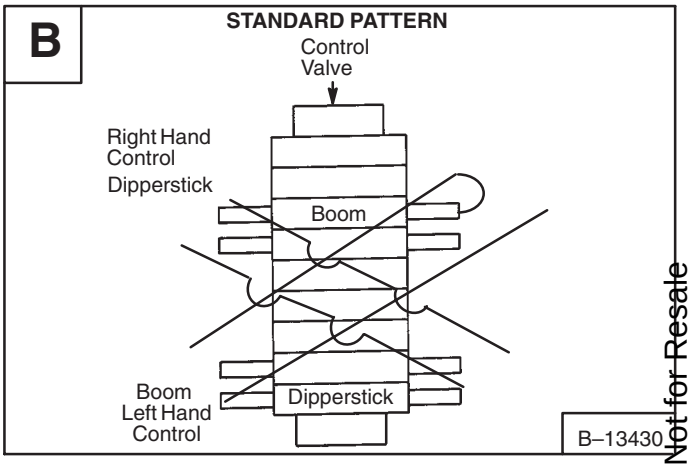
The right joystick now will control dipperstick raise and lower as well as bucket curl **[B]**.

The left joystick now will control upper works swing and boom raise and lower **[B]**.

NOTE: The piping from the control valve to the effected cylinders DOES NOT change.

NOTE: Remove the decal for I.S.O. Controls and install decals (P/N 6658049 R.H. & 6658050 L.H.) for U.S. Control.

To change from STANDARD to I.S.O. joystick controls reverse the hose routing to **[A]**.



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Page Number

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Removal and Installation 3–10

CONTROL LOCKING ARM
Removal and Installation 3–11

CONTROL PANEL BASE
Removal and Installation 3–15

FINAL DRIVE
Removal and Installation 3–18

FOOT PEDAL AND STEERING LEVER LINKAGE
Removal and Installation 3–16

GAS CYLINDER
Removal and Installation 3–12

HYDRAULIC CONTROL LEVERS
Boom/Bucket Control Lever 3–9
Swing/Dipperstick Control Lever 3–3

JOYSTICK
Disassembly 3–4
Assembly 3–31

LOCKING LEVER CABLE
Removal and Installation 3–14

LOCKING LEVER VALVE
Removal and Installation 3–13

STEERING LEVERS
Removal and Installation 3–17

THROTTLE LEVER
Removal and Installation 3–10

TRAVEL MOTOR
Disassembly 3–20
Assembly 3–31

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HYDRAULIC CONTROL LEVERS

Swing/Dipperstick Control Lever

Use the following procedure to remove and install the swing/dipperstick control lever:

Remove the control panel mounting bolts **[A]**.

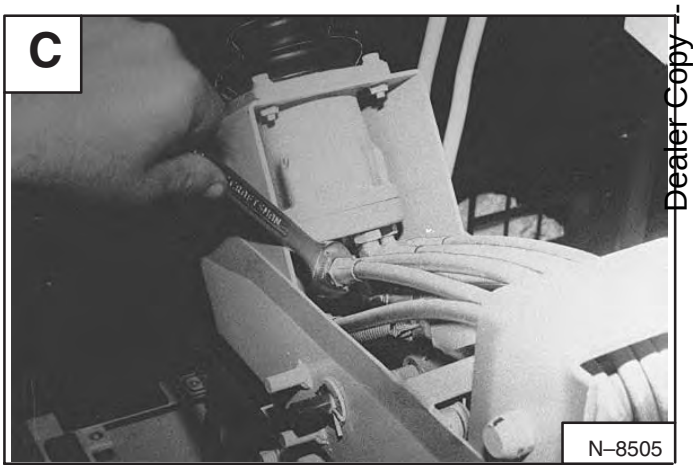


Remove the control panel **[B]**.

NOTE: Mark the hose locations for correct installation.



Remove the hoses from the control **[C]**.



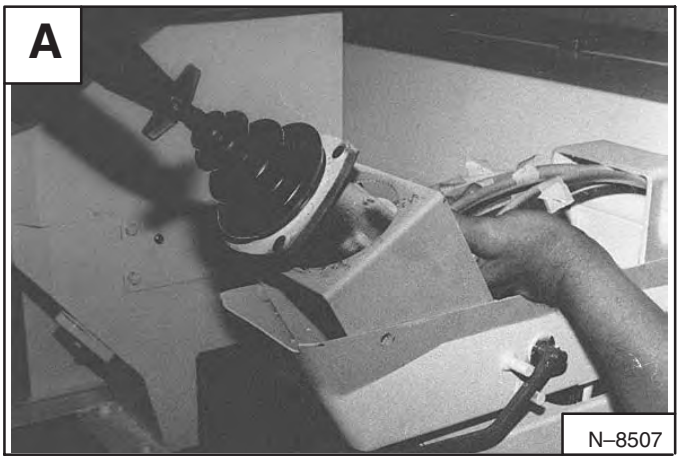
Remove the mounting bolts from the control lever flange **[D]**.



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HYDRAULIC CONTROL LEVERS (Cont'd)

Remove the control from the mount **[A]**.



JOYSTICK

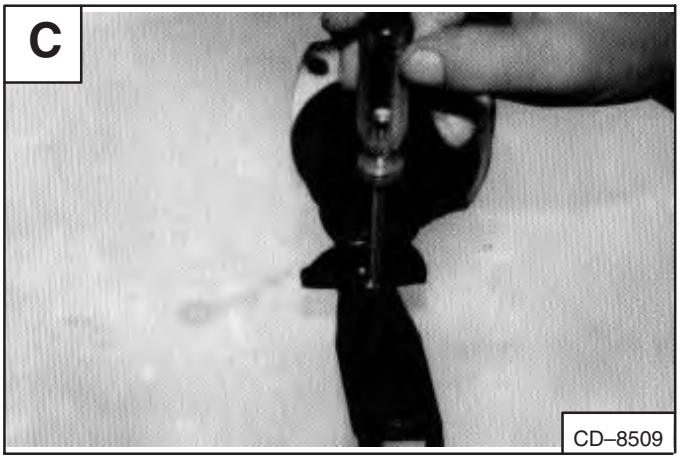
Disassembly and Assembly

NOTE: The following shows the procedure on the R.H. joystick. The procedure for the L.H. joystick is the same except it does not have the horn switch in the handle.

Remove the cap from the control lever **[B]**.



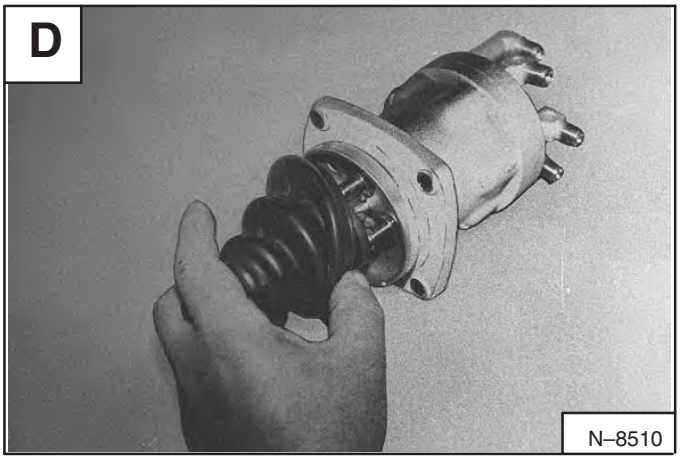
Remove the screws from the handle **[C]**.



Right Joystick Only: Remove the horn wires from the cap **[D]**.

NOTE: Mark the wires for correct installation.

Remove the rubber boot from the joystick.



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JOYSTICK (Cont'd)

Disassemble and Assembly (Cont'd)

Remove the joystick lever and the lock nut (Item 1) **[A]**.

Remove the adjustment nut (Item 2) **[A]** and the horn wires.

Remove the push rod disc (Item 3) **[A]**.

Installation: Apply grease to the disc contact surface. Tighten the disc until it touches the push rods equally , then tighten the adjustment nut to 43 in.–lbs. (5 Nm) torque.

NOTE: To test the joystick for proper rod disc adjustment. Blow air at 10 PSI into the P port of the joystick and adjust the disc downward until air starts to flow out of the 1,2,3, & 4 ports. Back off the rod disc until the air flow stops. Tighten the adjustment nut to 43 in.–lbs. (5 Nm) torque.

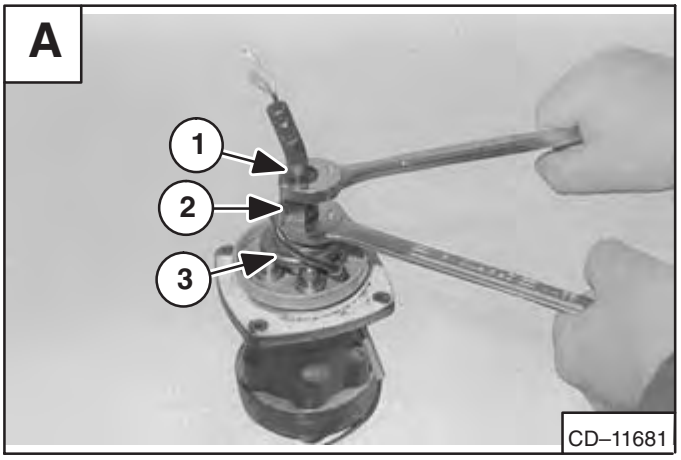
Remove the joint **[B]**.

Installation: Tighten the joint to 30 in.–lbs. (3,4 Nm) torque.

Remove the plate **[C]**.

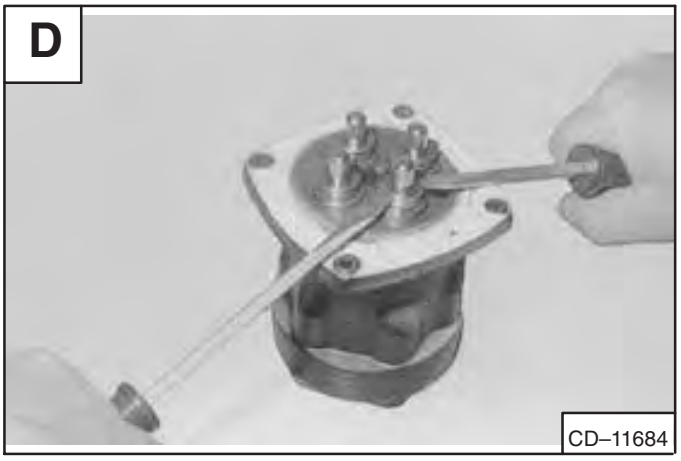
Installation: Align the hole in the plate with the valve body hole.

Use screwdrivers to remove the plugs **[D]**.









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JOYSTICK (Cont'd)

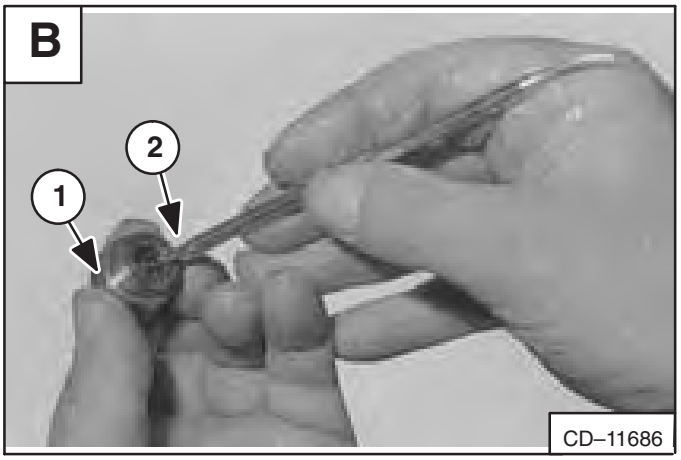
Disassembly and Assembly (Cont'd)

Remove the push rod from the plug **[A]**.

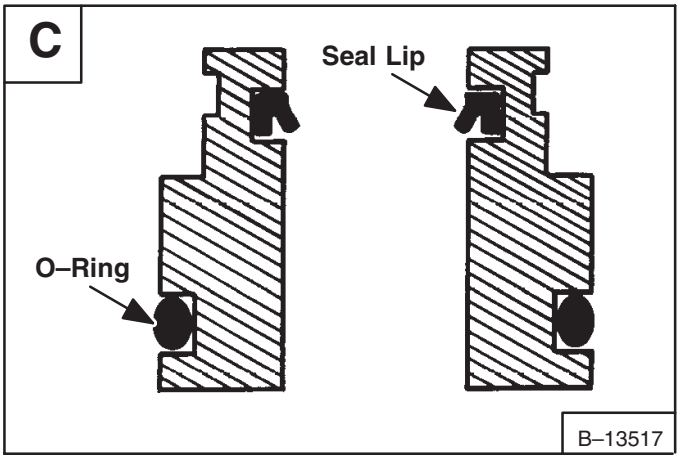
Check the push rod crown for wear.



Remove the O–ring (Item 1) **[B]** and seal (Item 2) **[B]** from the plug.

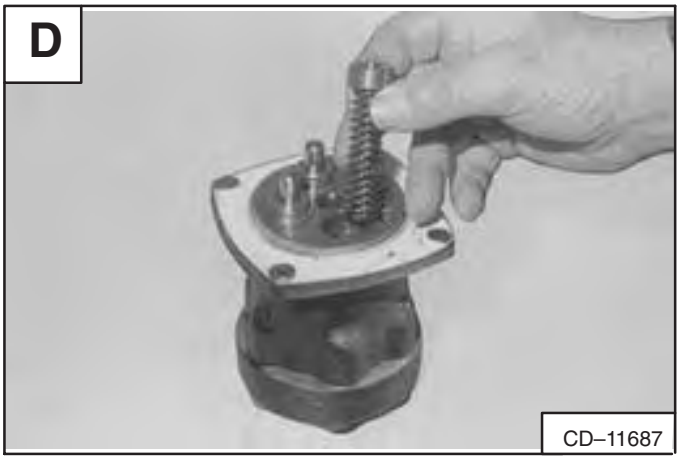


Installation: Be sure the seal lip is toward the valve body **[C]**.



Remove the spool assembly from the valve body **[D]**.

NOTE: Install the spool assemblies in the same location from which they are removed.

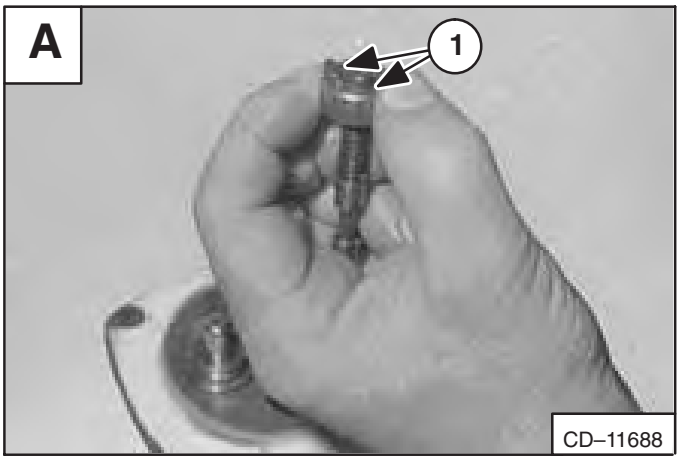


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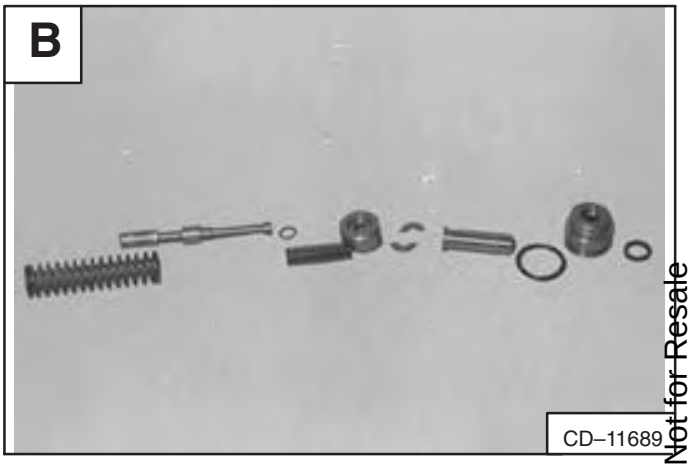
JOYSTICK (Cont'd)

Disassembly and Assembly (Cont'd)

Push the spring seat down to remove the washers (Item 1) **[A]**.

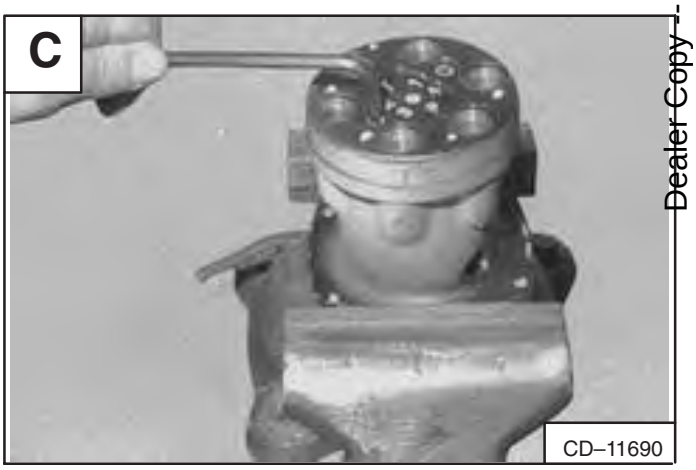


Remove spring seat, spring and washers from the spool **[B]**.



Remove the two bolts from the port plate **[C]**.

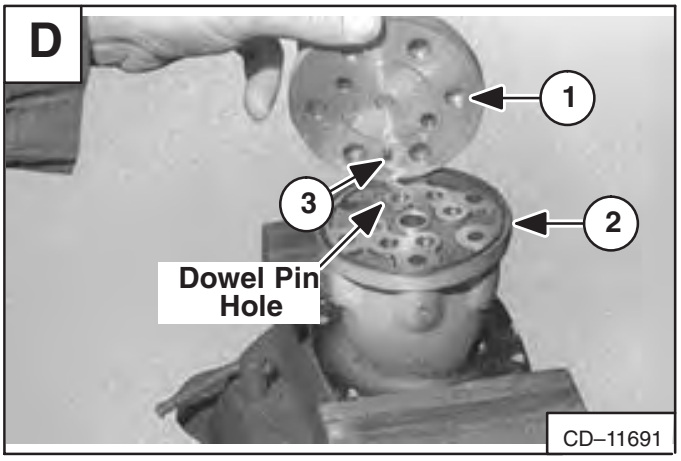
Installation: Tighten the bolts to 26 in.–lbs. (3 Nm) torque.



Remove the port plate (Item 1**[D]** and O–ring (Item 2)**[D]** from the valve body.

Use a new O–ring during assembly.

Installation: Align the dowel pin (Item 3) **[D]** with the dowel pin hole in the valve body.



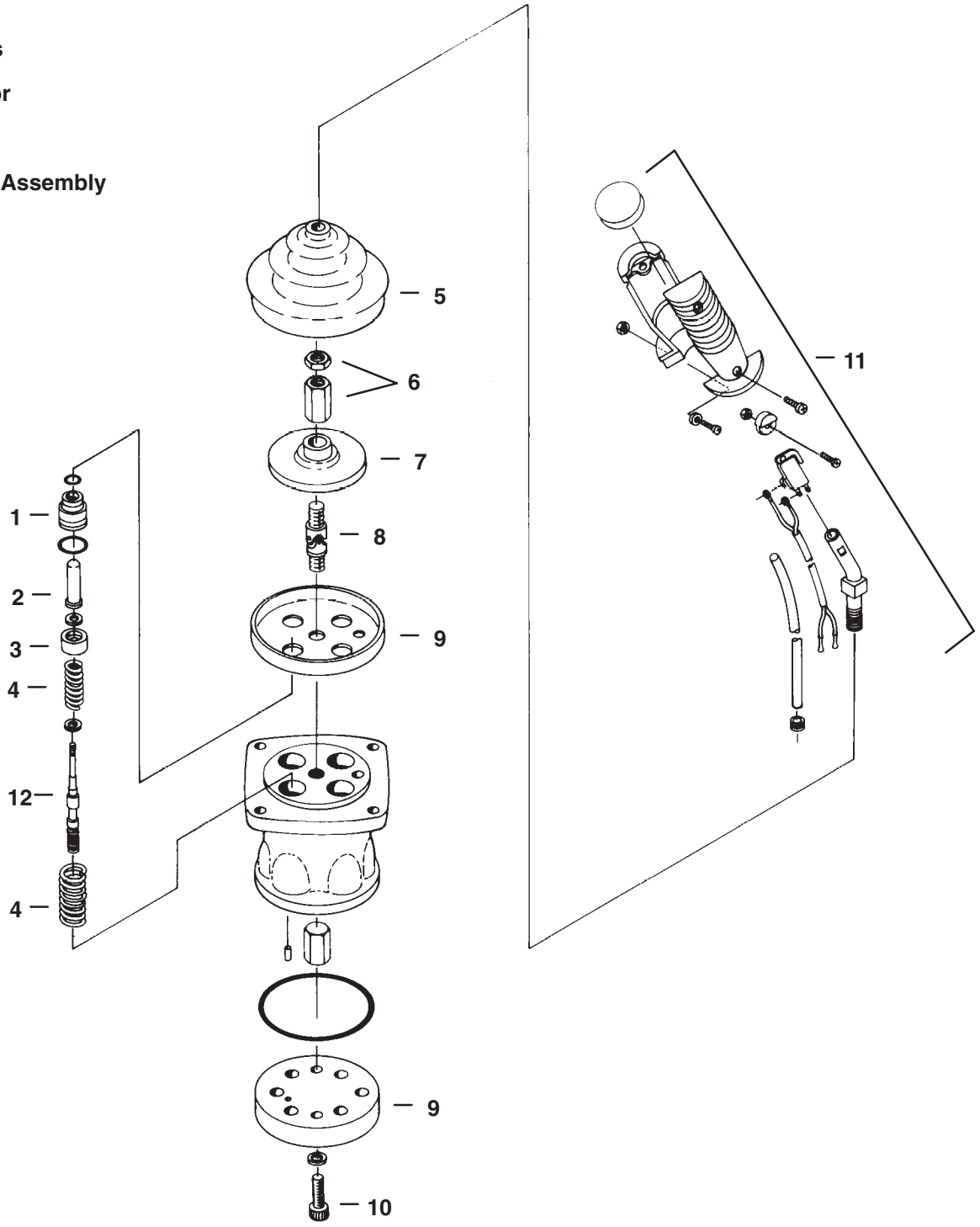
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Parts Identification

NOTE: Left Joystick parts identification and assembly is the same without horn button and wires.

RIGHT JOYSTICK SHOWN

1. Plug
2. Rod
3. Seat
4. Spring
5. Bellows
6. Nut
7. Actuator
8. Joint
9. Plate
10. Bolt
11. Handle Assembly
12. Spool



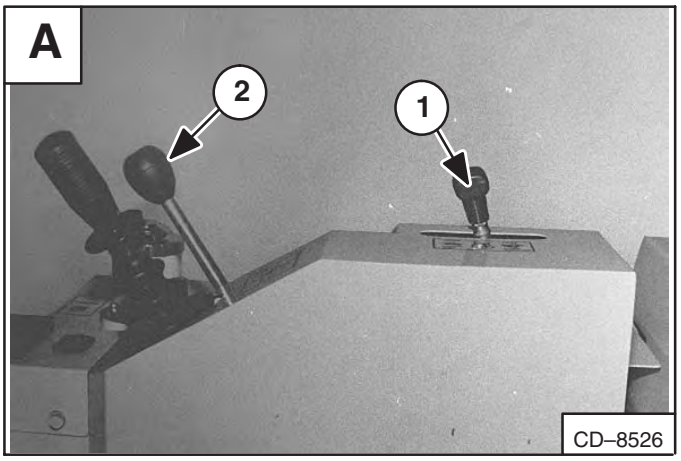
D–1972

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HYDRAULIC CONTROL LEVERS (Cont'd)

Boom/Bucket Control Lever

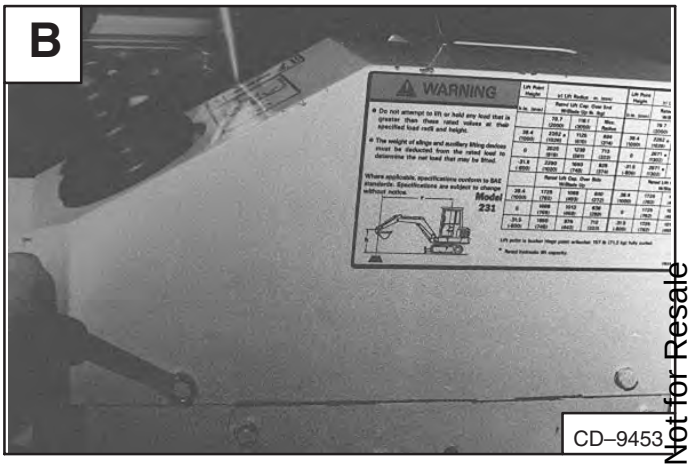
Remove the knobs from the throttle lever (Item 1**[A]** and the blade control lever (Item 2) **[A]**.



Remove the mounting bolts from the control panel **[B]**.

Remove the panel.

NOTE: Use the same procedure shown on Page 3–3 to remove the right control lever from the panel.

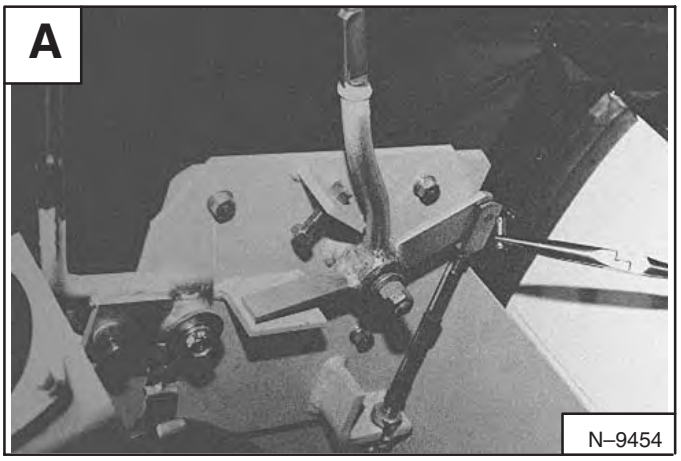


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THROTTLE LEVER

Removal and Installation

Remove the cotter pin and clevis pin from the throttle cable **[A]**.



Remove the mounting nut from the throttle lever (Item 1) **[B]**.

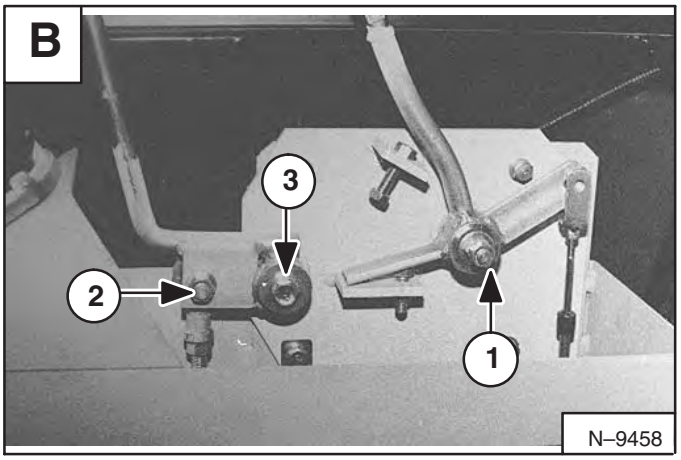
Remove the throttle lever.

(See Page 7–1) to remove the throttle cable.

BLADE CONTROL LEVER

Removal and Installation

Remove the control linkage nut (Item 2)**[B]** and the lever mounting bolt (Item 3) **[B]** to remove the lever.



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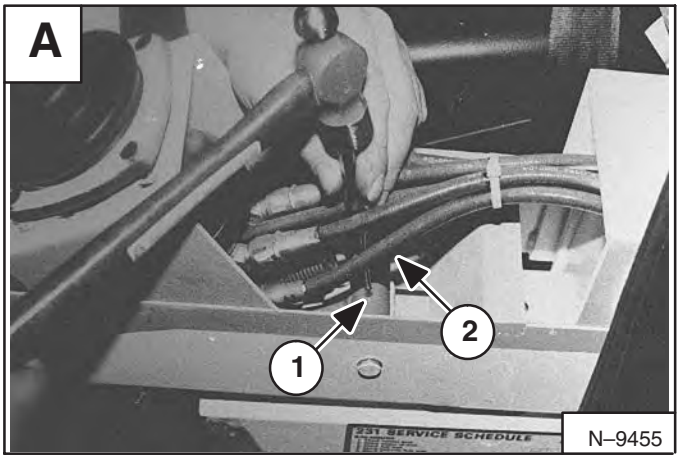
CONTROL LOCKING ARM

Removal and Installation

Use a hammer and punch to tap the outer roll pin (Item 1) **[A]** from the lever lock.

Remove the inner roll pin (Item 2)**[A]** from the lever lock.

Slide the lever lock from the bushings.

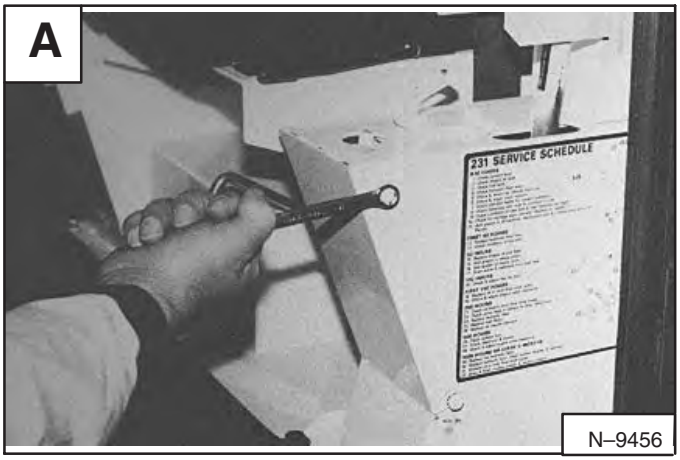


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GAS CYLINDER

Removal and Installation

Remove the front cover mounting bolts **[A]**.



Remove the cover **[B]**.



Remove the hair pin and washer from both ends of the gas cylinder **[C]**.

Remove the gas cylinder.



⚠ WARNING

Cylinder contains high pressure gas. Do not open. Opening cylinder can release rod and cause injury or death.

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LOCKING LEVER VALVE

Removal and Installation

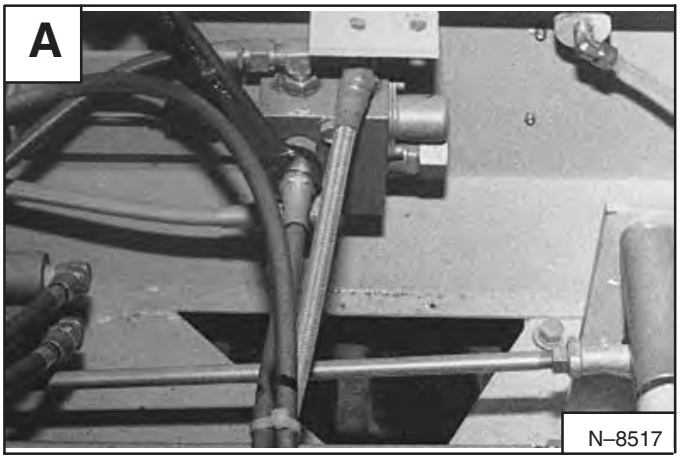
Remove the floor panel. (See Page 5–1.)

Remove the seat. (See Page 5–1.)

Remove the swing motor cover. (See Page 5–1.)

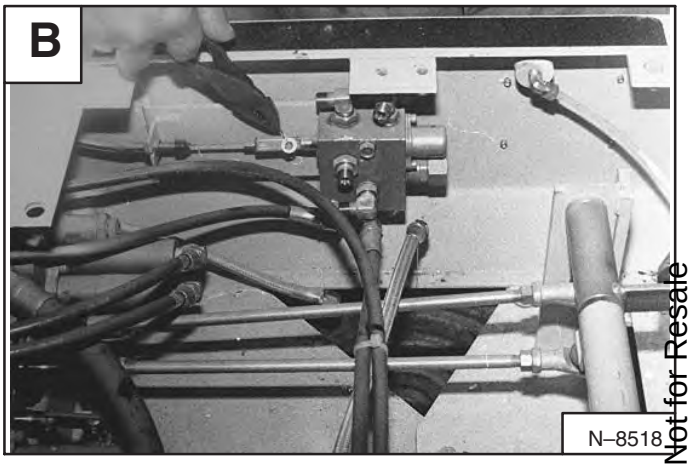
Mark the hoses for correct installation.

Remove the hoses from the valve body **[A]**.

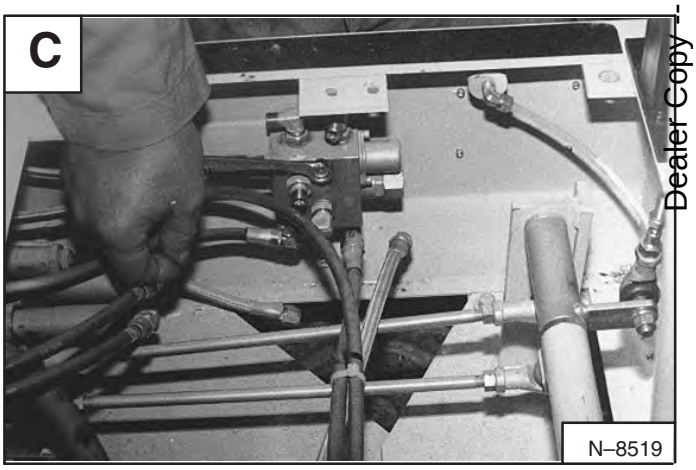


Remove the cotter pin and washer from the control cable clevis **[B]**.

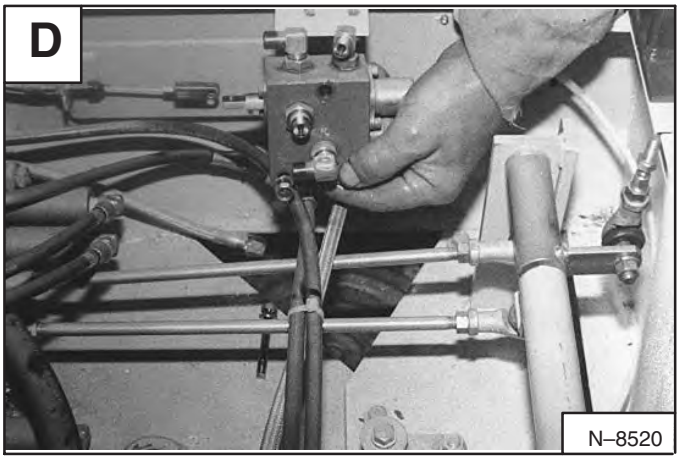
Remove the clevis pin.



Remove the mounting bolts **[C]**.



Remove the locking lever valve **[D]**.

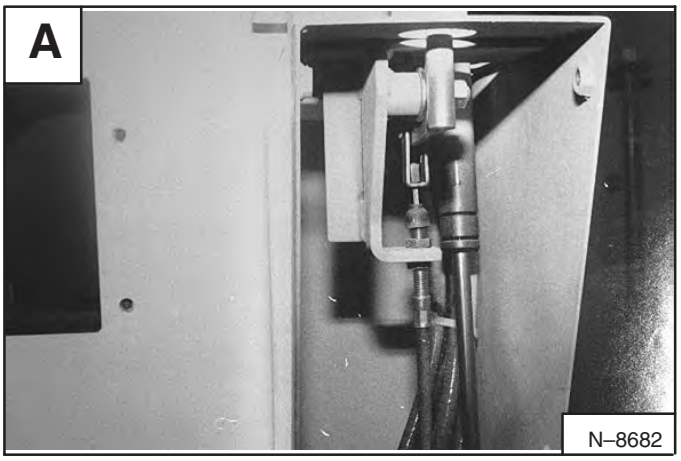


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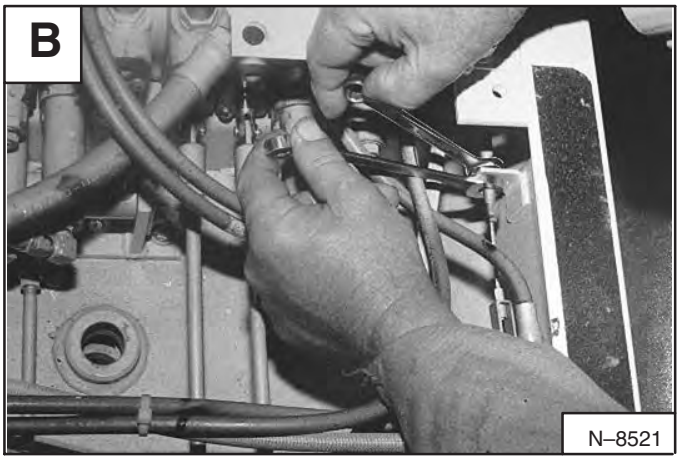
LOCKING LEVER CABLE

Removal and Installation

Remove the cotter pin and clevis pin from the control lever pivot **[A]**.



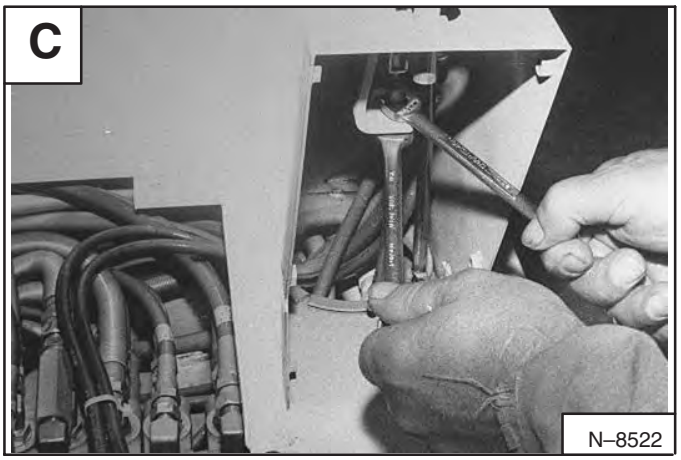
Loosen the control cable jam nuts from the lower bracket **[B]**.



Loosen the control cable jam nuts from the upper bracket **[C]**.

Remove the cotter pin and clevis pin from the control lever pivot.

Remove the cable.



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CONTROL PANEL BASE

Removal and Installation

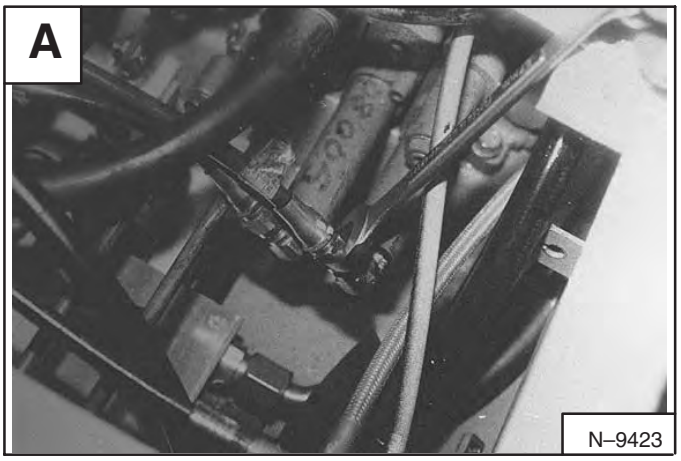
Remove the floor panel. (See Page 5–1.)

Remove the seat. (See Page 5–1.)

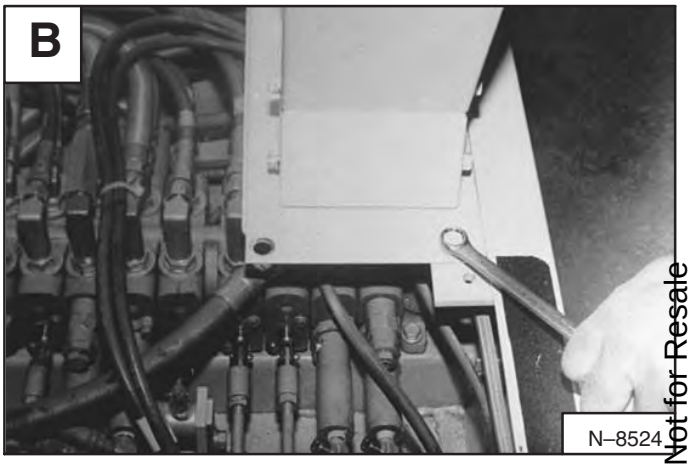
Remove the swing motor cover. (See Page 5–1.)

NOTE: Mark the hoses for correct installation.

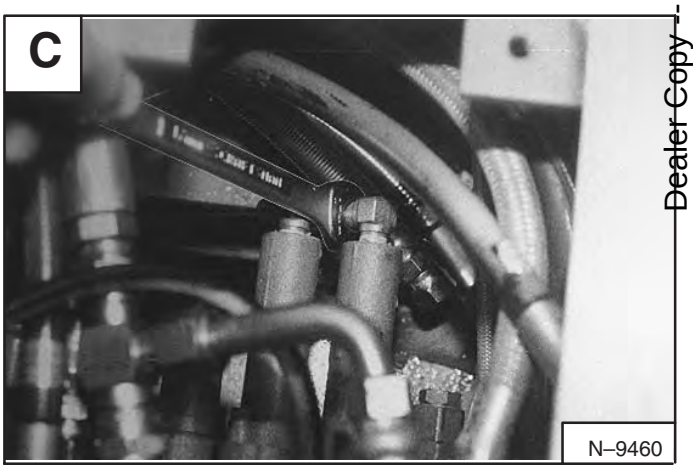
Remove the control lever hoses from the front of the control valve **[A]**.



Remove the mounting bolts from the base plate **[B]**.

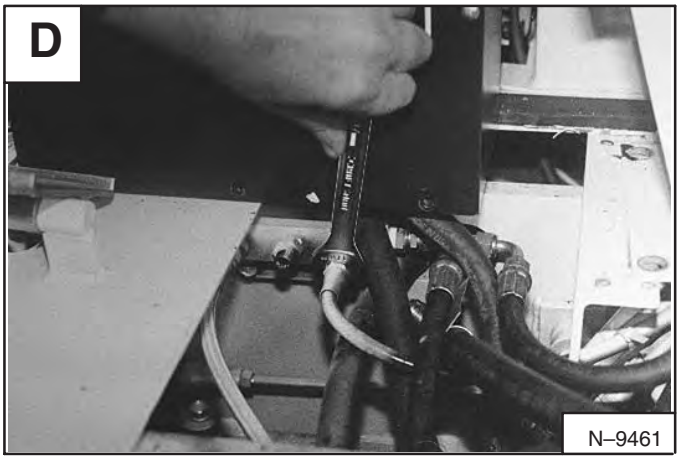


Move the control panel base to remove the hoses from the rear of the control valve **[C]**.



Remove the joystick hose from the return block **[D]**.

Remove the control panel base.



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FOOT PEDAL AND STEERING LEVER LINKAGE

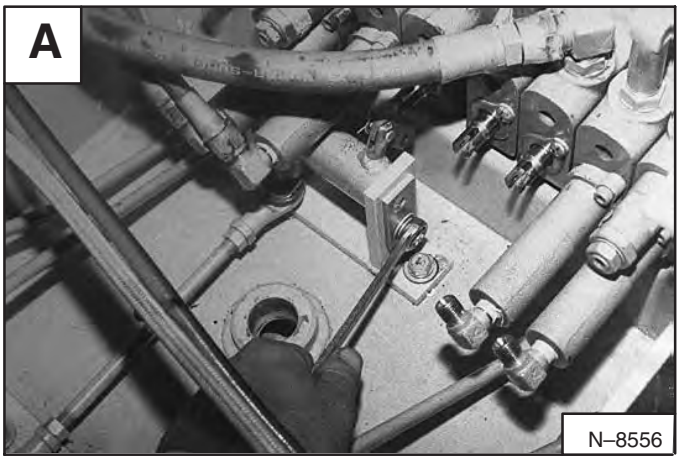
Removal and Installation

Remove the floor panels. (See Page 5–1.)

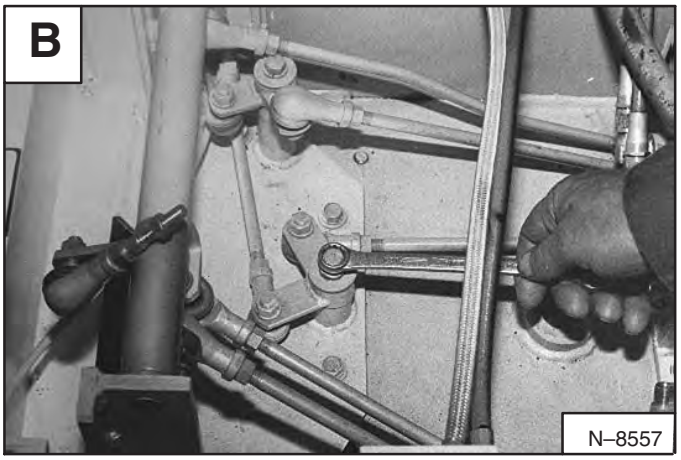
Mark the linkage for correct installation.

Disconnect the linkage rods from the spools.

Remove the bolt holding the boom swing pivot pin **[A]**.

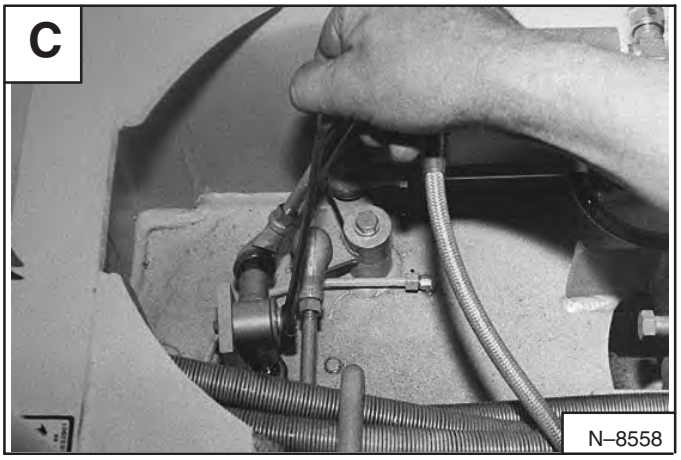


Remove the boom swing center pivot bolt **[B]**.

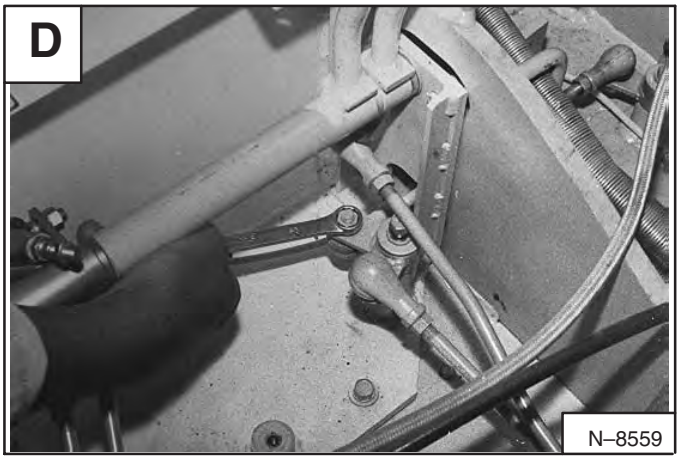


Remove the pivot bolt below the foot pedal **[C]**.

Remove the boom swing linkage assembly.



Remove the bolts from the blade linkage pivots **[D]**.



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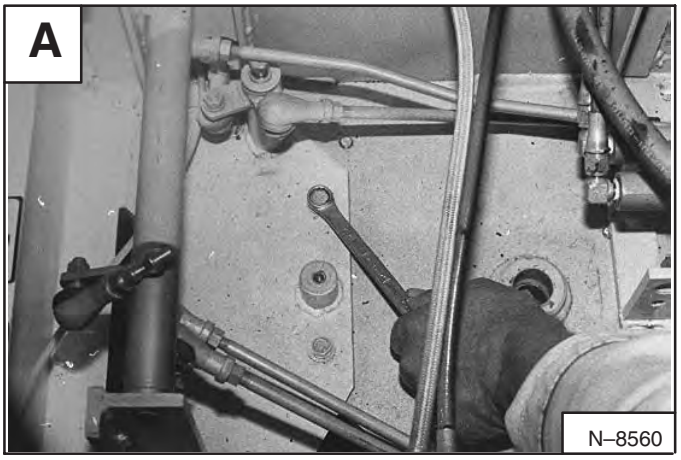
STEERING LEVERS

Removal and Installation

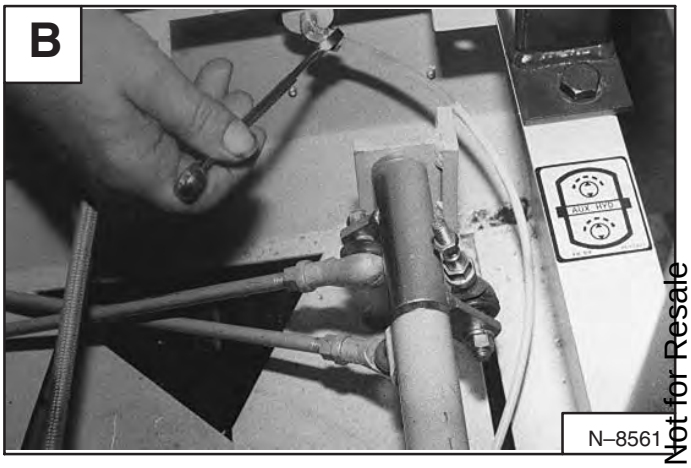
Remove the floor panels. (See Page 5–1.)

Remove the control linkage. (See Page 3–16.)

Remove the mounting bolts **[A]**.

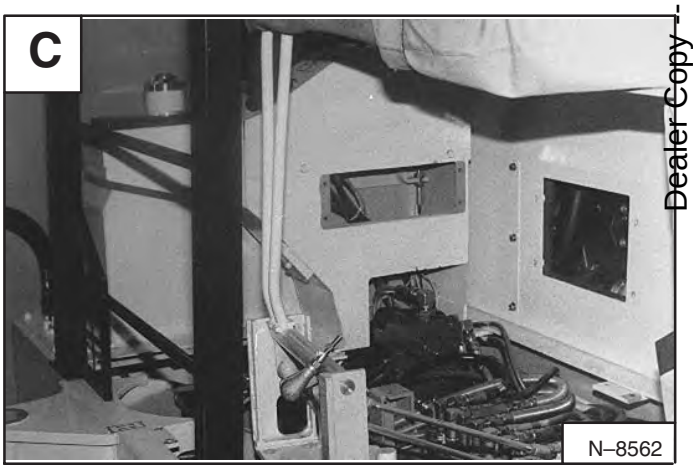


Remove the grease tubeline for the swing circle pinion gear **[B]**.



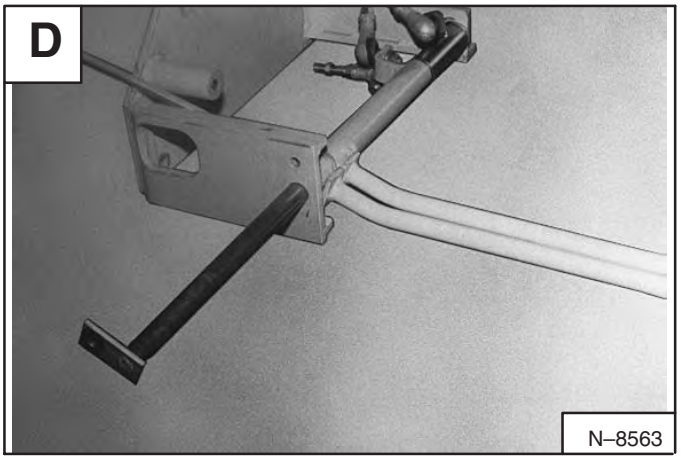
Lift the steering levers from the machine **[C]**.

Remove the bolt holding the steering levers pivot pin.



Remove the pivot pin **[D]**.

***Installation*:** Install spacers or shims in the original locations and grease the pivot shaft.



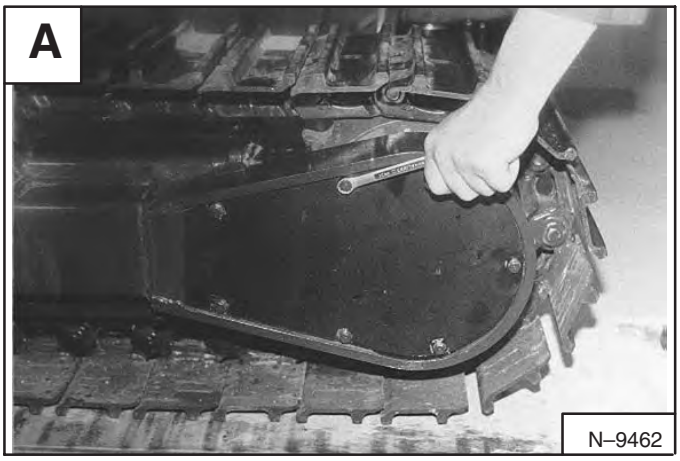
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FINAL DRIVE

Removal and Installation

Remove the bolts from the track frame cover **[A]**.

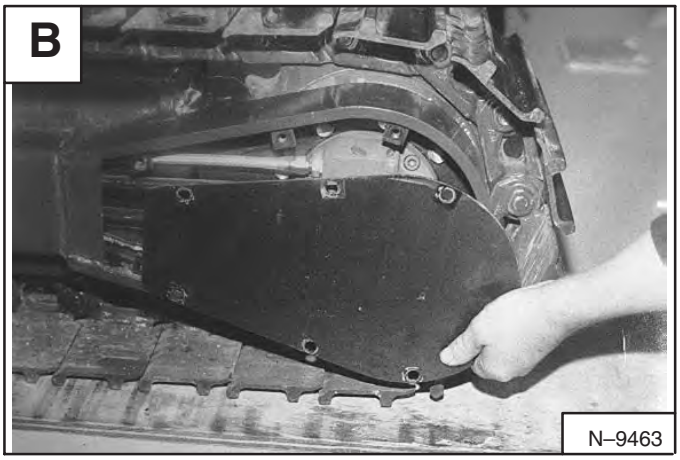
Installation: Tighten the bolts to 48 ft.–lbs. (65 Nm) torque.



Remove the cover **[B]**.

Lift and block the side of the track frame where the final drive will be removed.

Release the track tension and remove the track. (See Page 5–1.)



IMPORTANT

When making repairs on hydrostatic and hydraulic systems, clean the work area before disassembly and keep all parts clean. Always use caps and plugs on hoses, tubelines and ports to keep dirt out. Dirt can quickly damage the system.

I–2003–0284

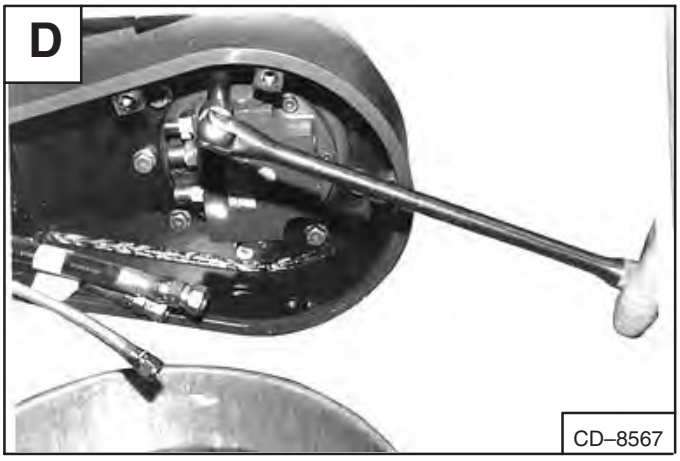
Mark the hoses for correct installation.

Disconnect the hoses from the drive motor **[C]**.



Loosen and remove the final drive mounting bolts **[D]**.

Installation: Put LOCTITE on the bolts and tighten to 80 ft.–lbs. (108 Nm) torque.



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FINAL DRIVE (Cont'd)

Remove the motor , sprocket and reduction gear assembly from the track frame **[A]**.



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TRAVEL MOTOR

Disassembly

IMPORTANT

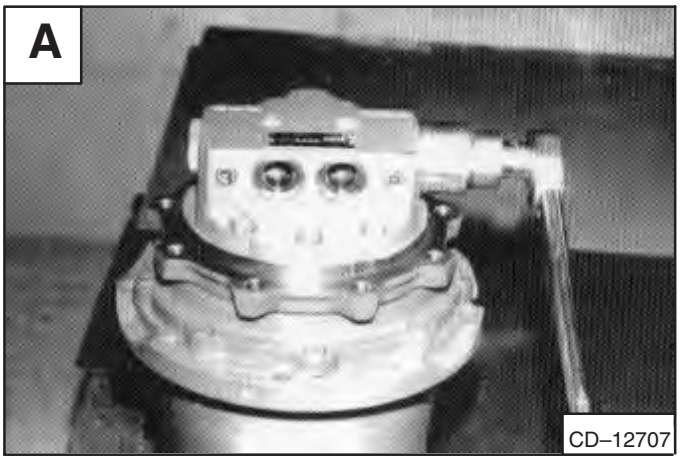
When making repairs on hydrostatic and hydraulic systems, clean the work area before disassembly and keep all parts clean. Always use caps and plugs on hoses, tubelines and ports to keep dirt out. Dirt can quickly damage the system.

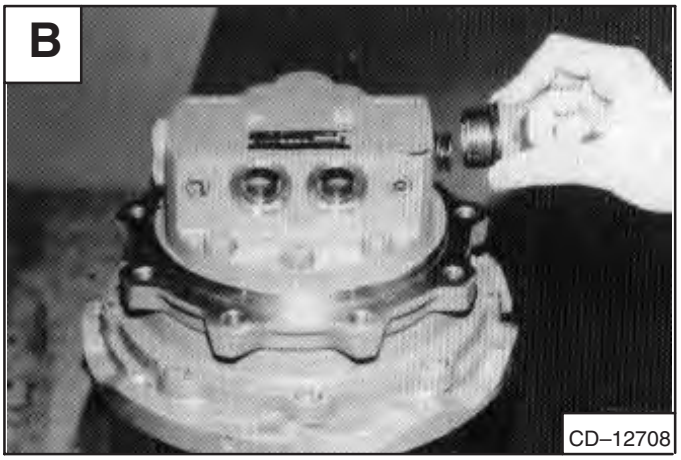
I–2003–0284

See Page 3–31 for tools that will need to be made for reassembling the travel motor.

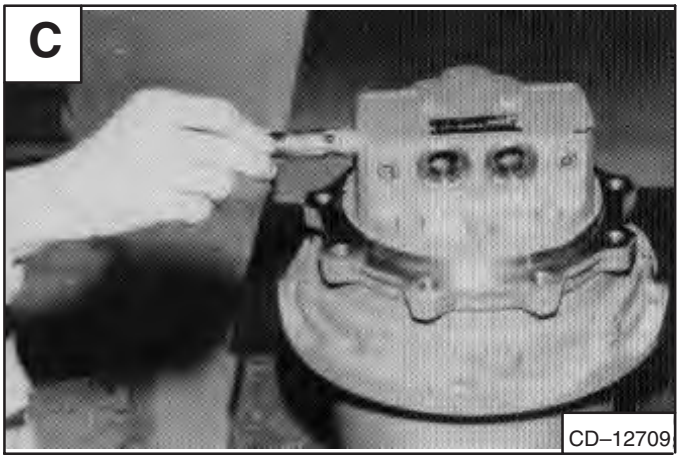
Loosen the two caps from the counter valve **[A]**.

Remove the caps, the springs and the spring seats **[B]**.



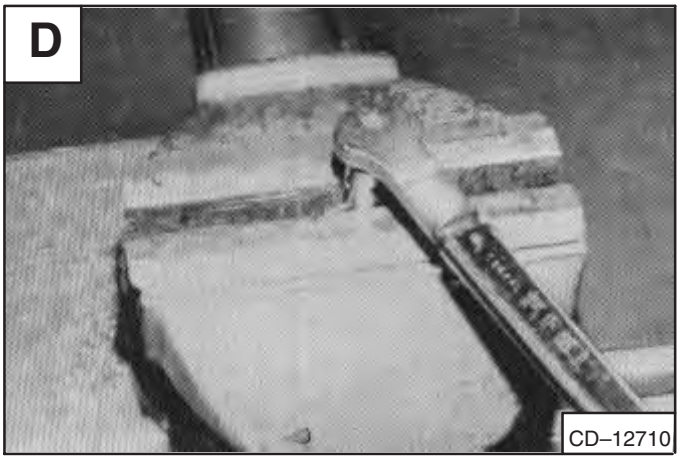


Carefully remove the counter balance valve by rotating spool slowly **[C]**.



Insert a hardened dowel pin through the top hole in the spool. Use a vise with protective jaws to hold the spool at the dowel pin. Remove the end caps **[D]**.

NOTE: Be very careful not to damage the surface of the spool.

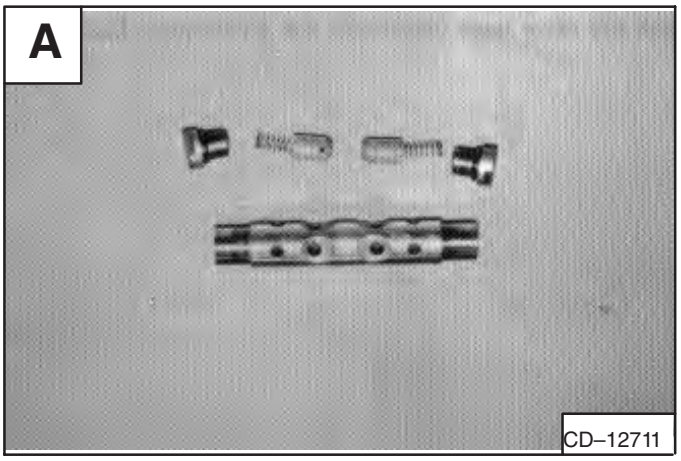


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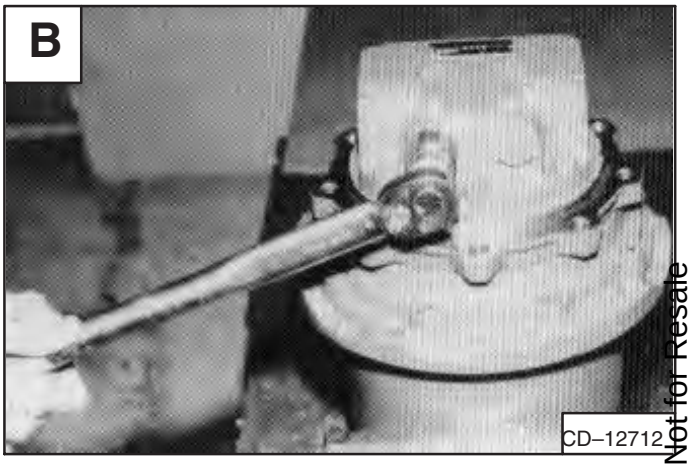
TRAVEL MOTOR (Cont'd)

Remove the springs and the check valves **[A]**.

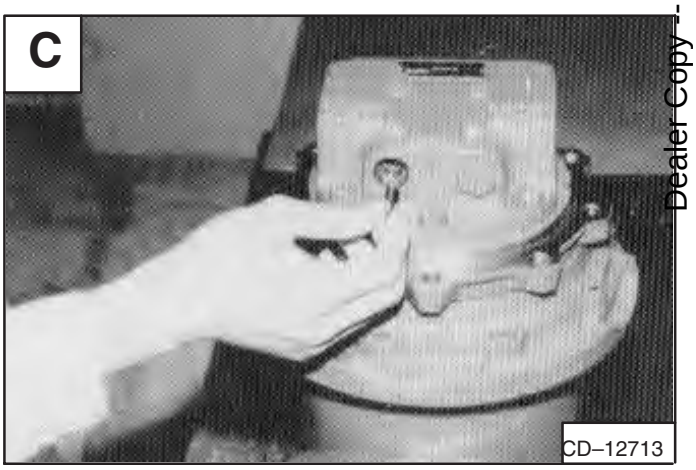
NOTE: Keep the check valves in the same order as they are removed from the spool.



Remove the relief valve caps **[B]**.

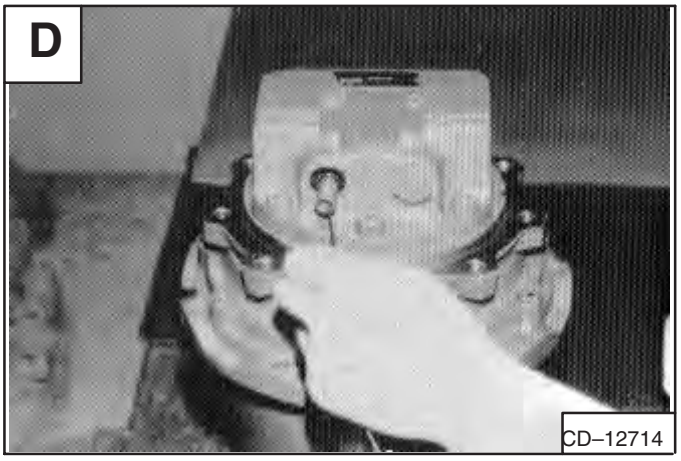


Remove the spring and the poppet **[C]**.



Remove the poppet seat by making a wire hook and inserting it into the seat hole **[D]**.

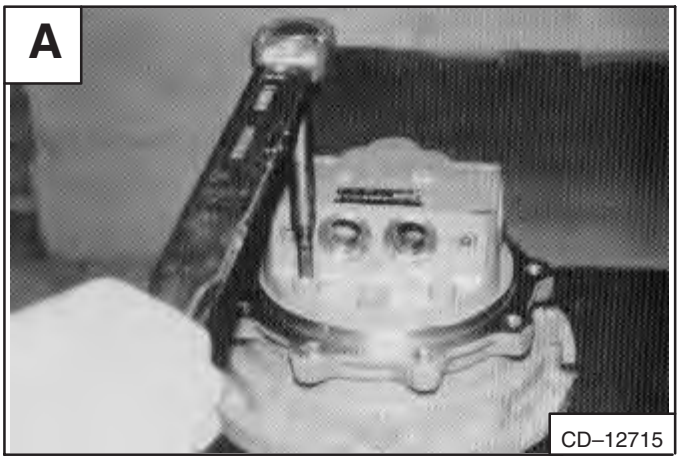
Pull the poppet seat out.



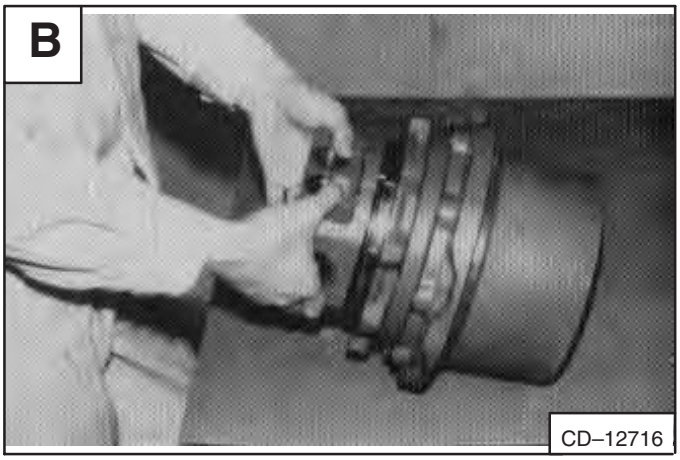
Dealer Copy -- Not for Resale

TRAVEL MOTOR (Cont'd)

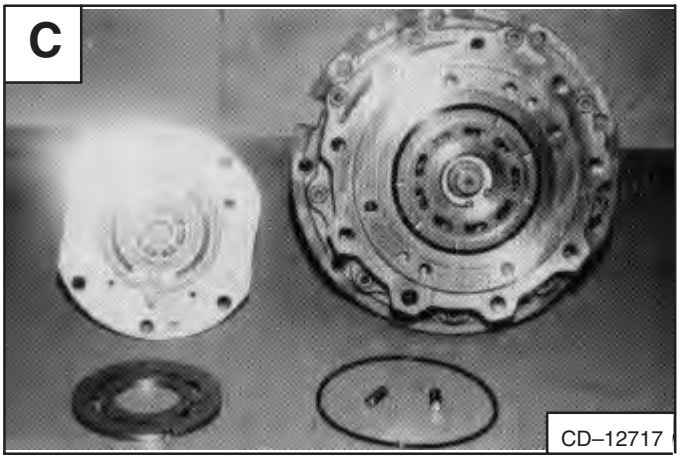
Remove the six bolts from the valve base plate **[A]**.



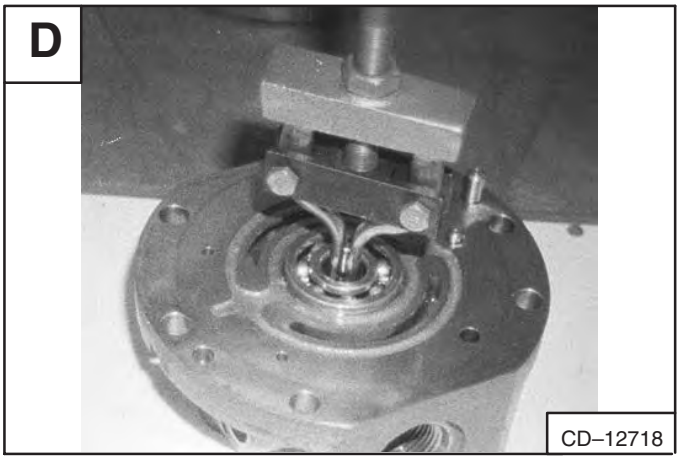
Remove the valve base plate from the gear box housing **[B]**.



Remove the valve plate, dowel pins and the O–ring **[C]**.



Remove the ball bearing from thevalve base plate with a slide hammer type puller **[D]**.



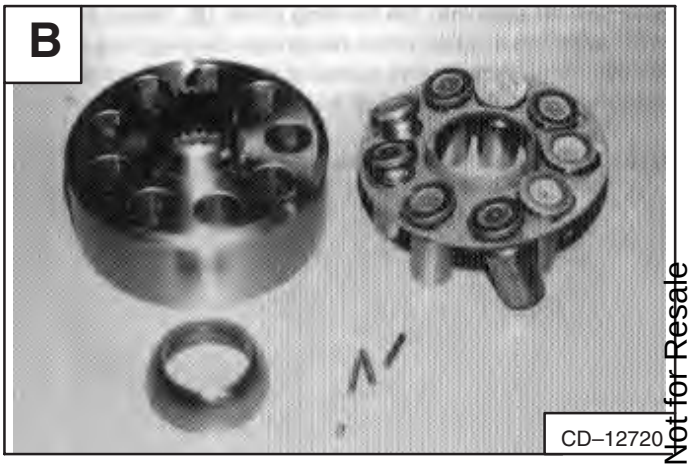
Dealer Copy -- Not for Resale

TRAVEL MOTOR (Cont'd)

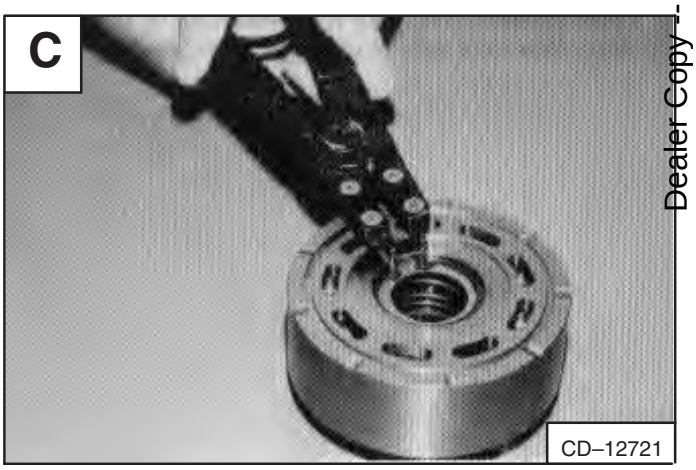
Remove the piston assembly from the housing **[A]**.



Disassemble the piston assembly by removing the pistons, piston retainer plate, pins ball, holder and the cylinder block.

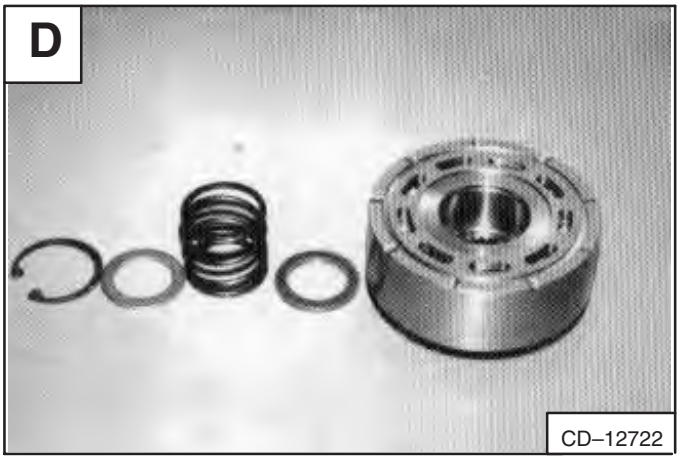


Turn the cylinder block over and remove the snap ring **[C]**.



Remove the collar, spring and the collar from the cylinder block **[D]**.

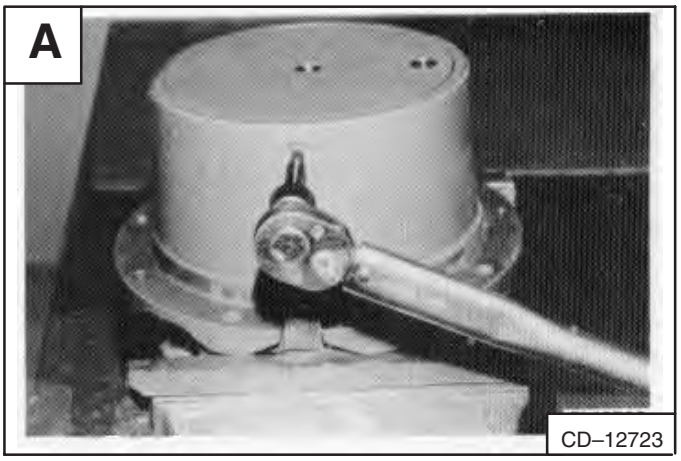
NOTE: The inside collar is thicker than the out collar



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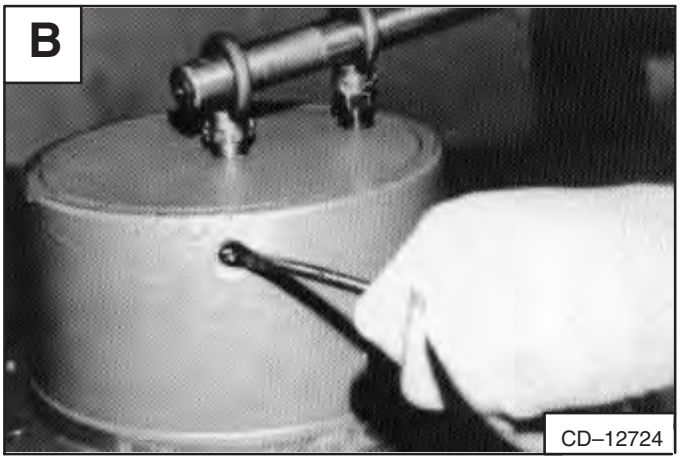
TRAVEL MOTOR (Cont'd)

Remove the plug from the housing and the plugs from the cover **[A]**.

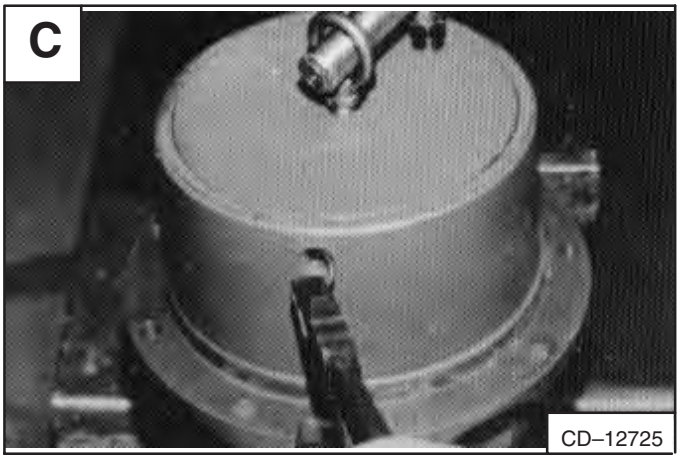


Install two lift eyes into the housing cover **[B]**. Insert a bar into the lift eyes and a screwdriver blade into the plug hole **[B]**. Turn the cover until the wire end contacts the screwdriver blade and starts coming out of the plughole.

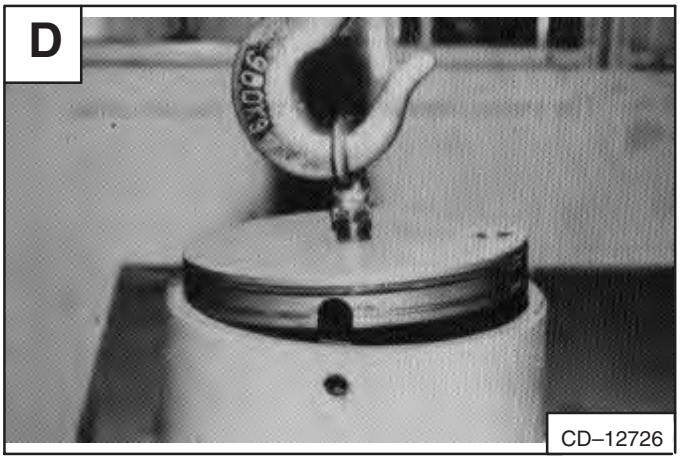
NOTE: Lift eyes threads dimensions must be PT 3/8.



Use a plier and pull out on the wire while turning the top cover **[C]**. Turn cover until wire is removed from housing.



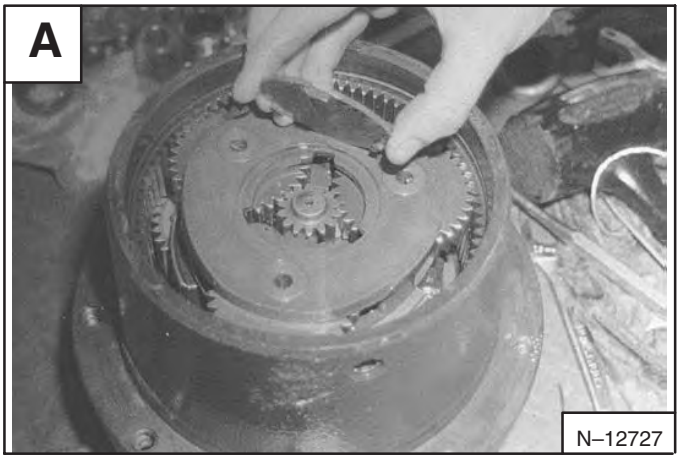
Use the center lift eye and remove the cover from the housing **[D]**.



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TRAVEL MOTOR (Cont'd)

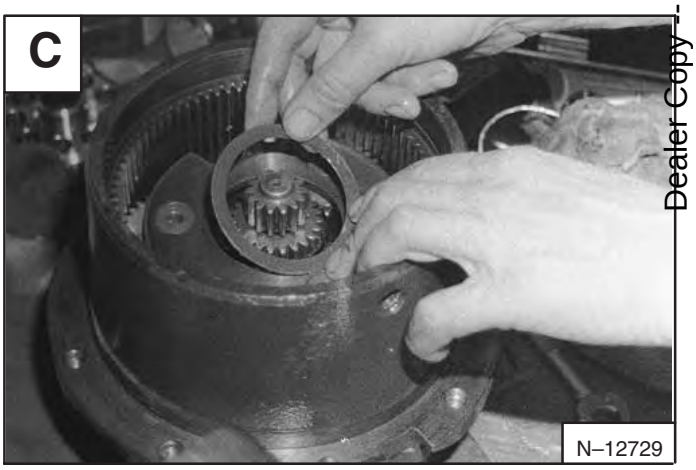
Remove the thrust plate **[A]**.



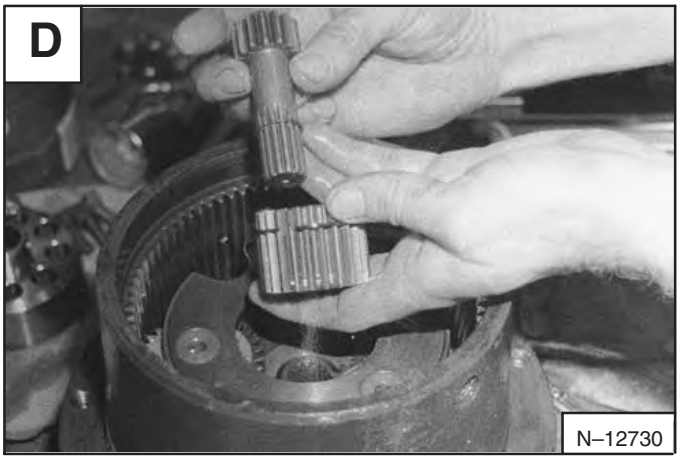
Remove the planetary gear assembly **[B]**.



Remove the thrust washer from the top of the housing **[C]**.



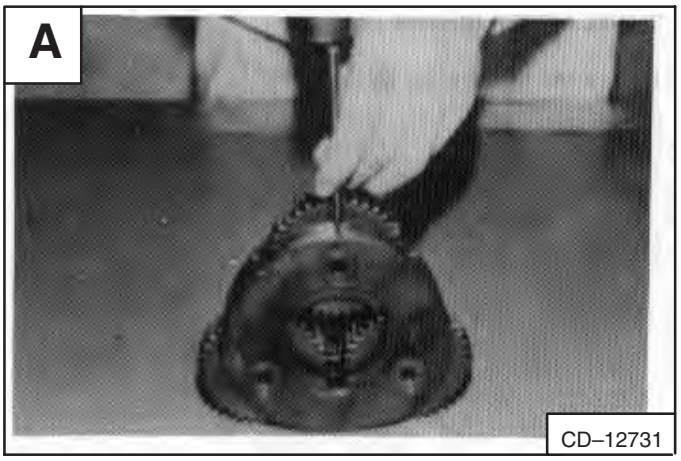
Remove the sun gear and the drive gear **[D]**.



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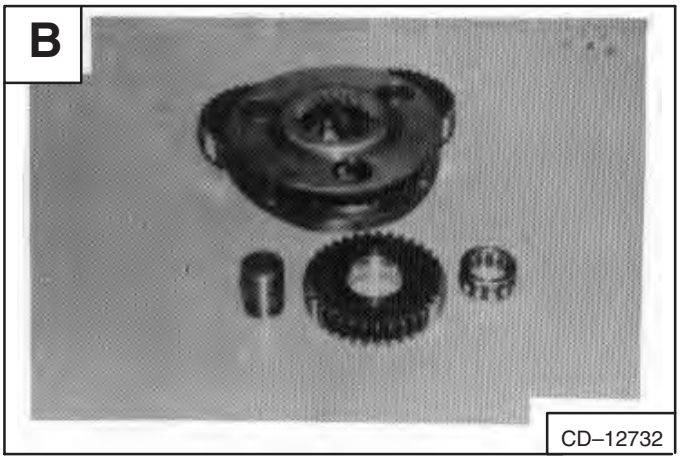
TRAVEL MOTOR (Cont'd)

Drive the spring pin into the center of the gear shaft **[A]**.

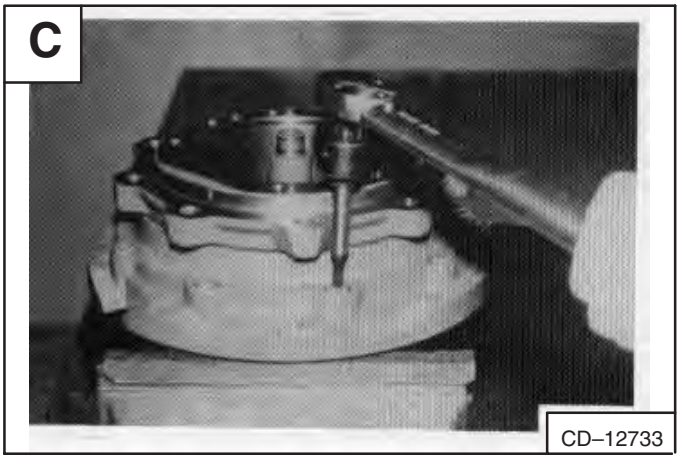


Remove the shaft from the housing and remove the planet gears and bearings **[B]**.

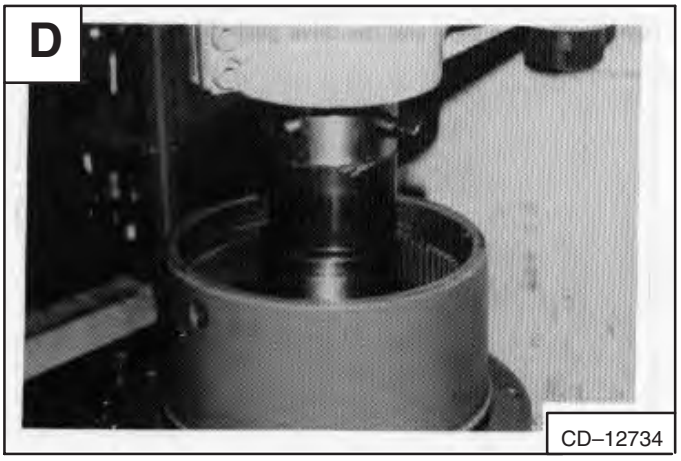
NOTE: The spring pins will now need to be driven out of the center of the shafts.



Turn the drive housing over and remove the nine bolts from the housing **[C]**.



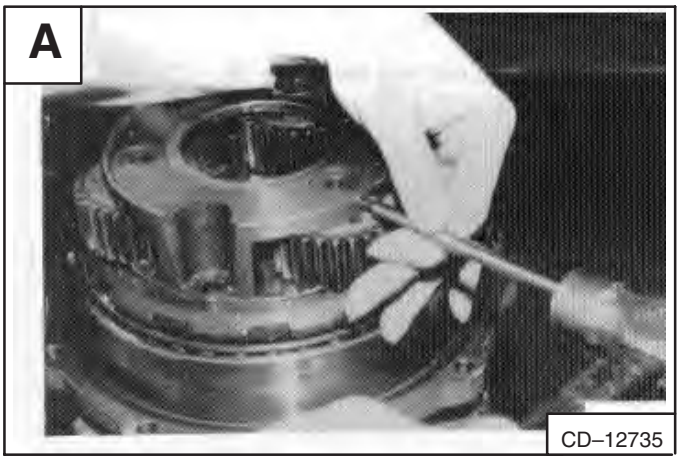
Press the flange off of the gear flange **[D]**.



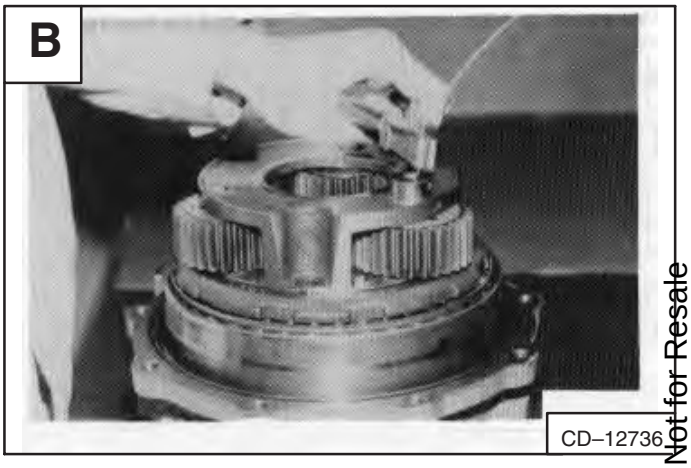
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TRAVEL MOTOR (Cont'd)

Drive the spring pin into the center of the shafts **[A]**.



Use a hooked wire to pull the shafts out of the flange **[B]**.

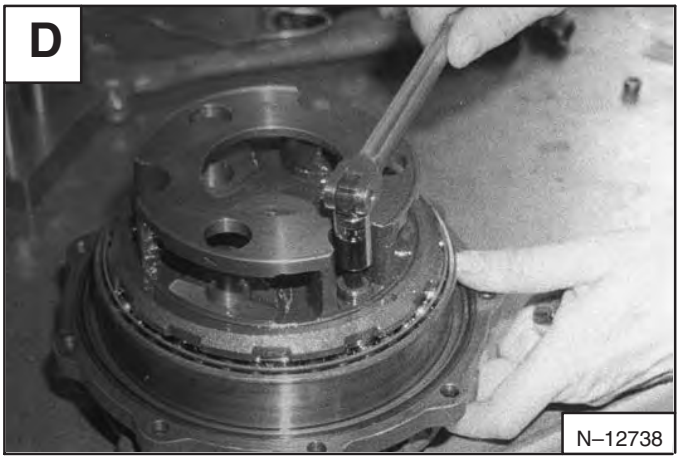


Remove the thrust washers, gear, spacer and the bearing **[C]**.

NOTE: The spring pins will now need to be driven out of the center of the shafts.



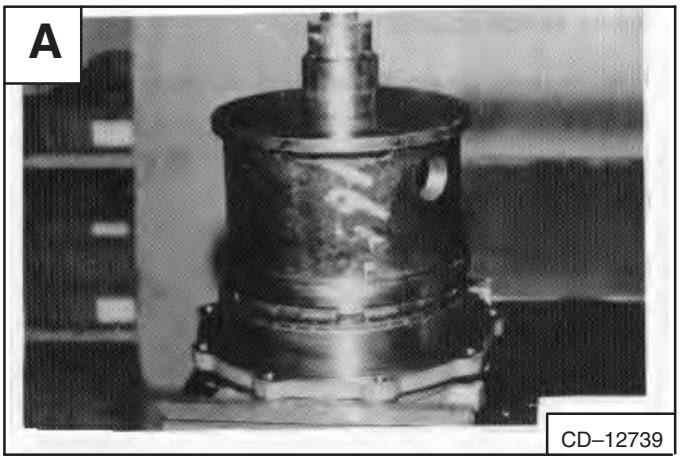
Remove the three set screws from the flange **[D]**.



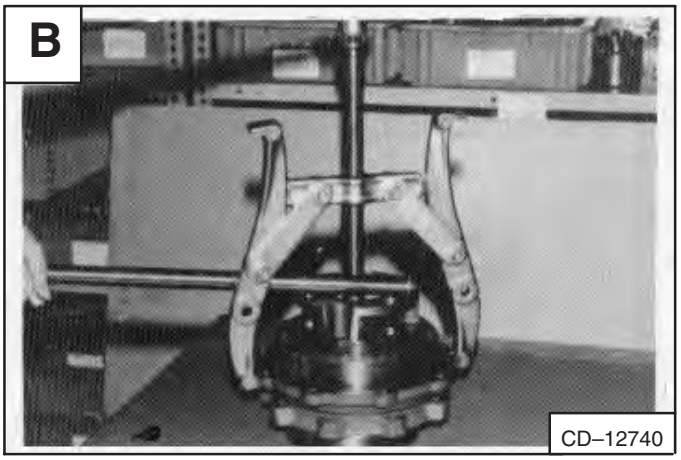
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TRAVEL MOTOR (Cont'd)

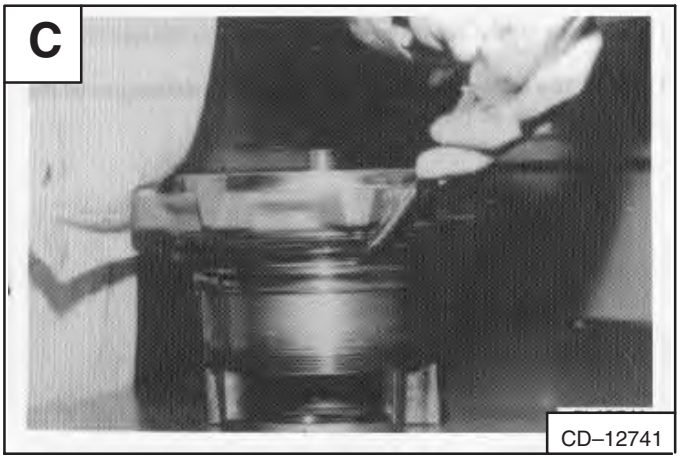
Remove the bearing nut from the flange **[A]**.



Use a bearing puller to remove the flange and the bearing from the housing **[B]**.



Remove the inner bearing race from the housing **[C]**.

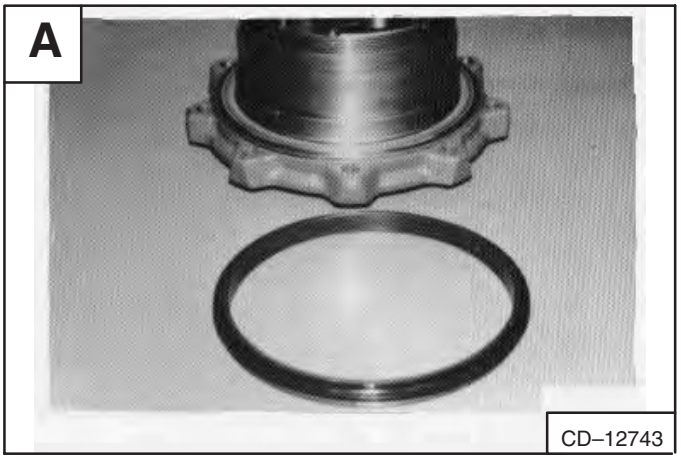


The main bearing is a double race bearing. The outer races, balls and ball bearing retainers are loose from the center race. If bearing is to be reused, use care not to loose any of the loose balls.



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Remove the floating seal from the flange **[A]**.



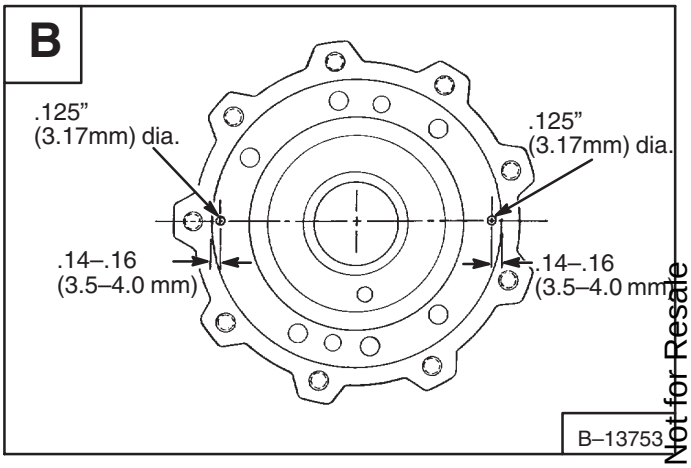
Turn the housing over and center punch 2 points onto the flange in the location shown **[B]**.

⚠ WARNING

AVOID INJURY OR DEATH

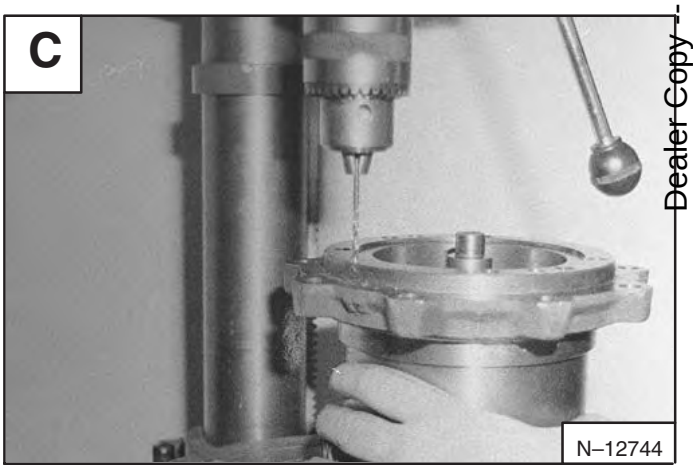
Wear safety goggles to prevent eye injury when drilling or grinding.

W–2108–1186

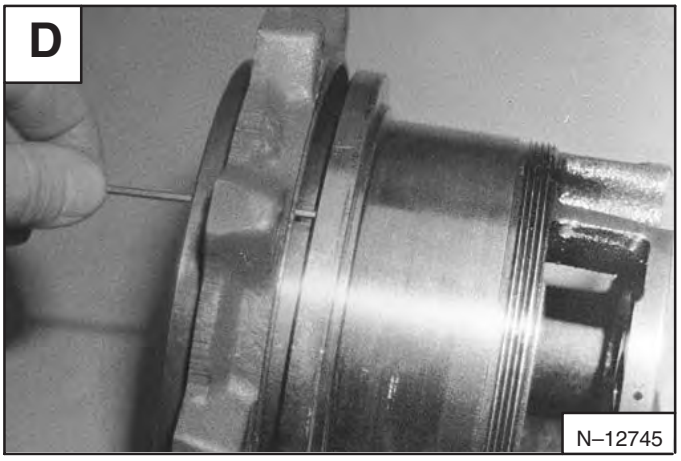


Drill two (2) holes .125 inch (3.17 mm) diameter through the housing to the back side of the floating seal wear ring (approximately .97 inch [24 mm] deep) **[C]**. Use special care to prevent metal filings from falling into the housing.

NOTE: While drilling, pay attention to the wear ring. As soon as the drill bit has penitrated through the housing, the wear ring will partially move out of the housing counter bore.



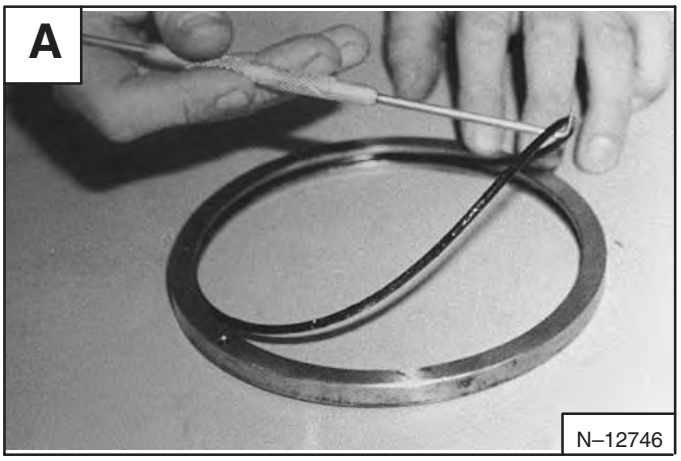
Use two (2) punches and push the wear ring out of the housing counter bore using the two (2) previously drilled holes for access **[D]**.



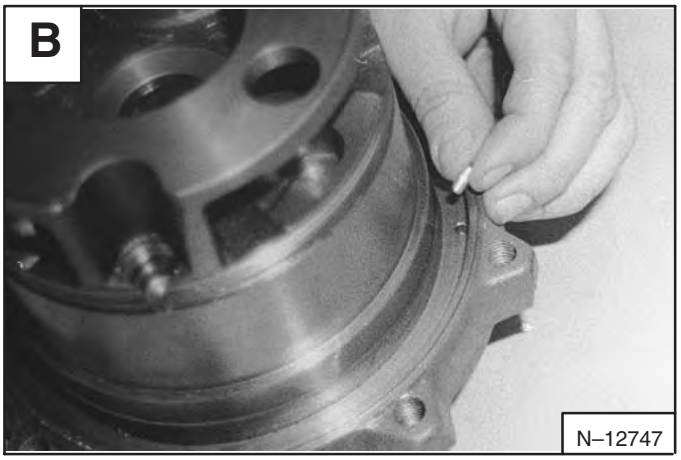
Dealer Copy -- Not for Resale

TRAVEL MOTOR (Cont'd)

Remove the O–ring from the wear ring **[A]**.

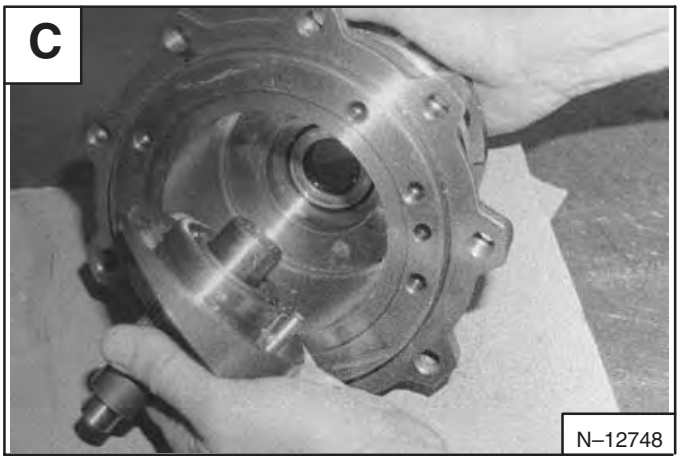


Remove the dowel pin from the housing counter bore **[B]**.



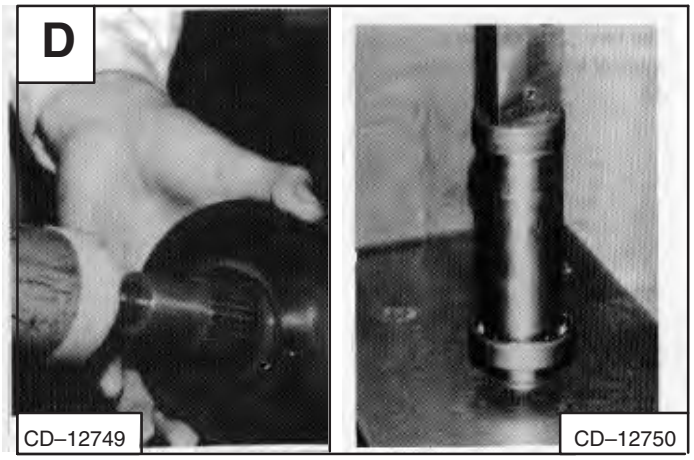
Remove the swash plate and shaft assembly from the housing **[C]**.

Remove the shaft seal from the housing **[C]**.



Use a plastic or rubber mallet and remove the shaft and bearing from the swash plate **[D]**.

Press the bearing off of the shaft **[D]**. Use a press tube that contacts only the inner race.



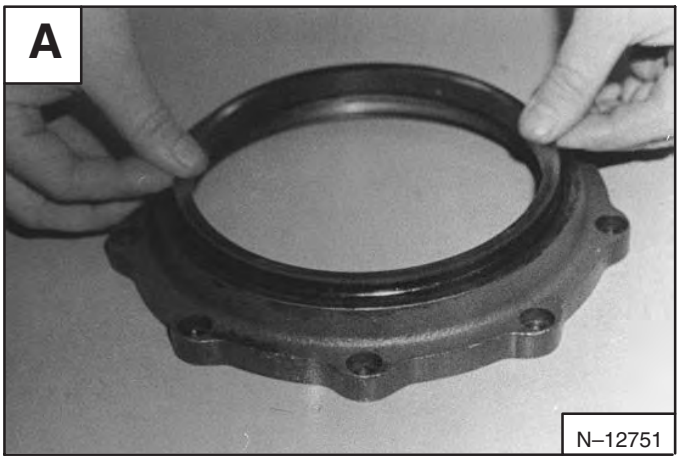
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TRAVEL MOTOR (Cont'd)

Assembly

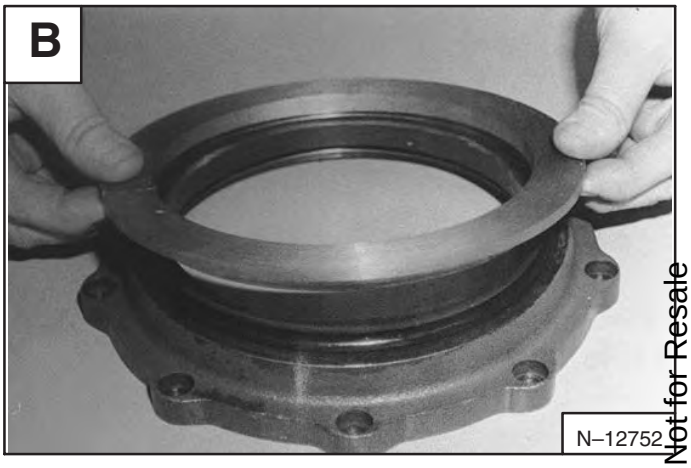
Install the O–ring onto the floating seal ring and position the floating seal onto the flange **[A]**.

NOTE: Put oil on the O–ring for ease of installation.

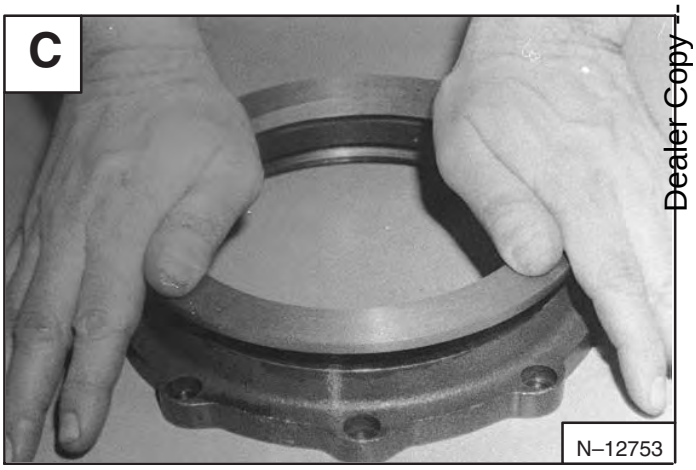


Position the floating seal installation tool over the floating seal **[B]**.

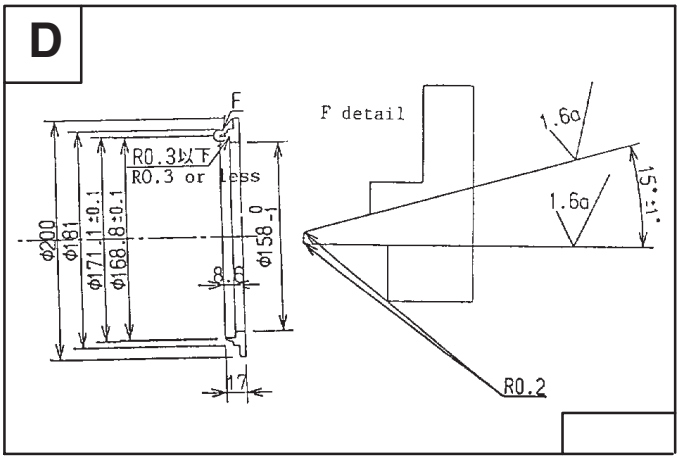
NOTE: For dimensions needed for floating seal installation tool, see [D].



Press down evenly onto the installation tool to install the floating seal into the flange bore **[C]**.



Floating seal installation tool dimensions **[D]**.

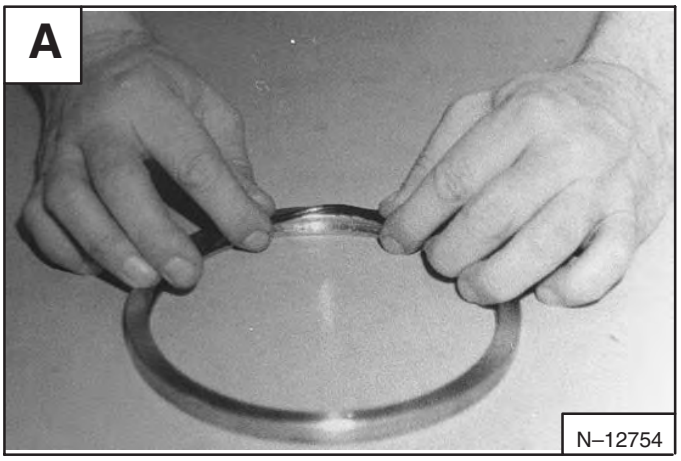


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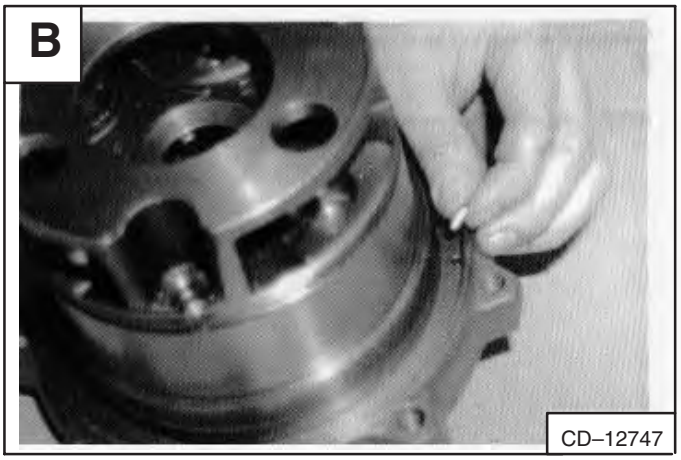
TRAVEL MOTOR (Cont'd)

Install the O–ring into the floating seal wear ring **[A]**.

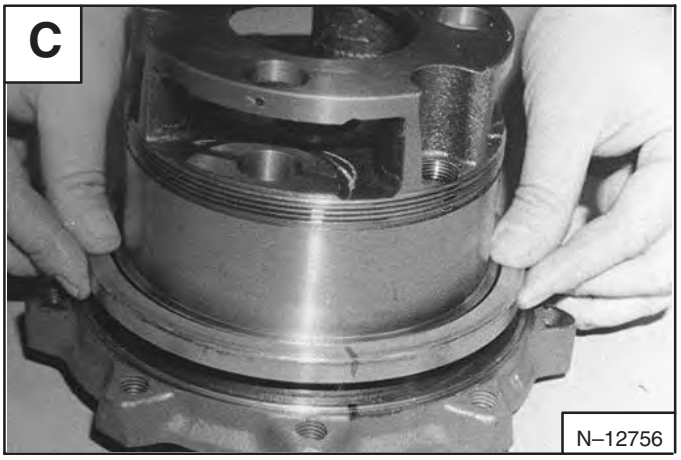
Oil the O–ring.



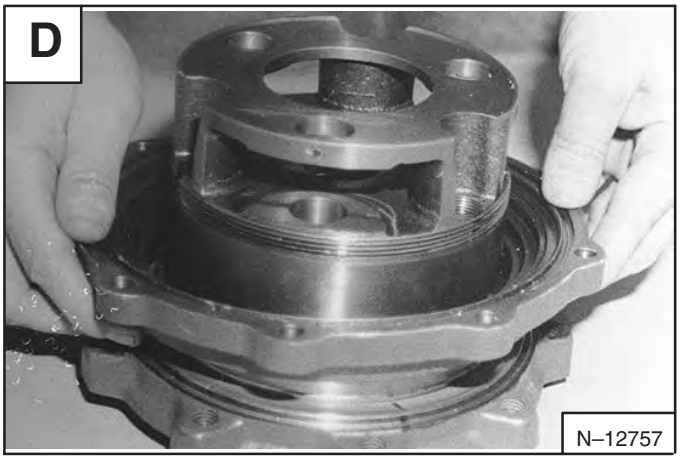
Install the dowel pin into the housing **[B]**.



Install the wear ring into the housing counter bore so that the hole in the bottom side of the wear ring fits onto the dowel pin **[C]**. Mark the edge of the wear ring at the hole and the edge of the housing at the dowel pin for ease of alignment.



Install the flange onto the housing so that the floating seal ring contracts the wear ring **[D]**.



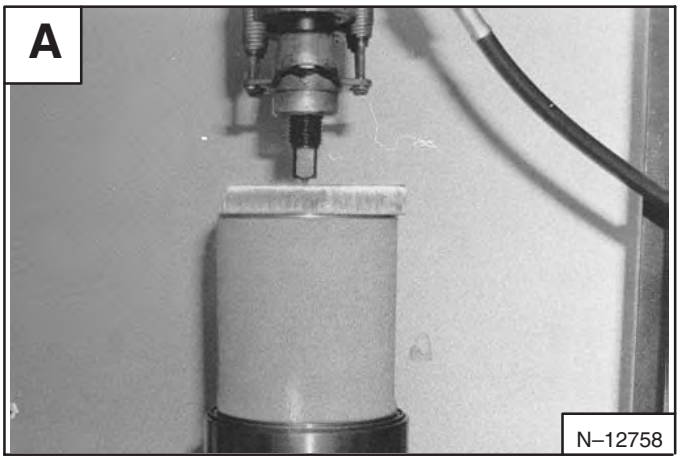
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TRAVEL MOTOR (Cont'd)

Install the bearing onto the housing with a press **[A]**.

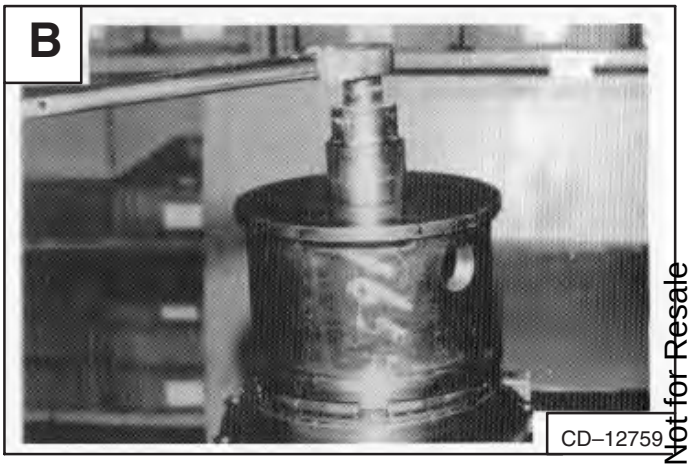
Use a press tube that contracts only the inner bearing race.

NOTE: Use care when installing the bearing so that the inner bearing race, balls and retainer do not fall out of the main bearing race.



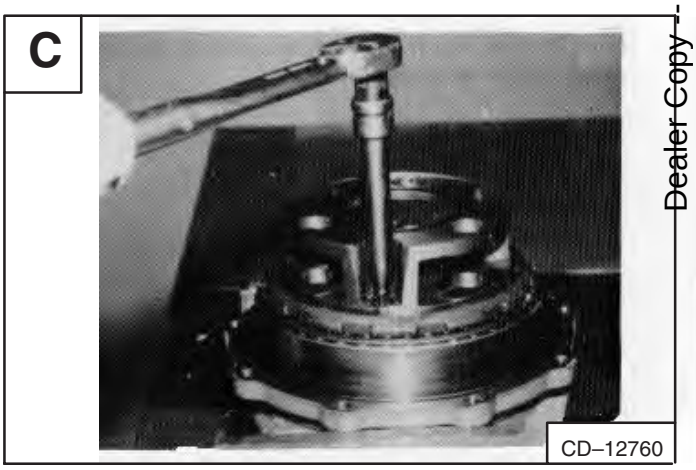
Install the bearing nut onto the housing **[B]**.

Tighten the bearing nut to 115–130 ft.–lbs. (156–176 Nm) torque.



Install the three set screws that lock the bearing nut into position **[C]**.

Tighten the set screws to 58–72 ft.–lbs. (80–97 Nm) torque.



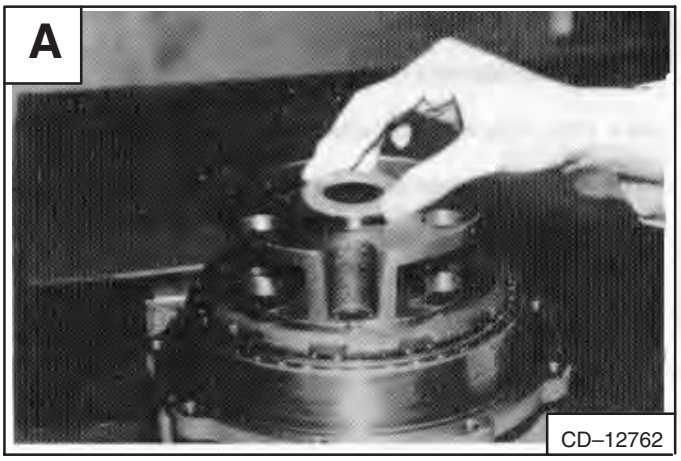
Use a center punch and stake the housing to the set screws so that they do not come loose **[D]**.



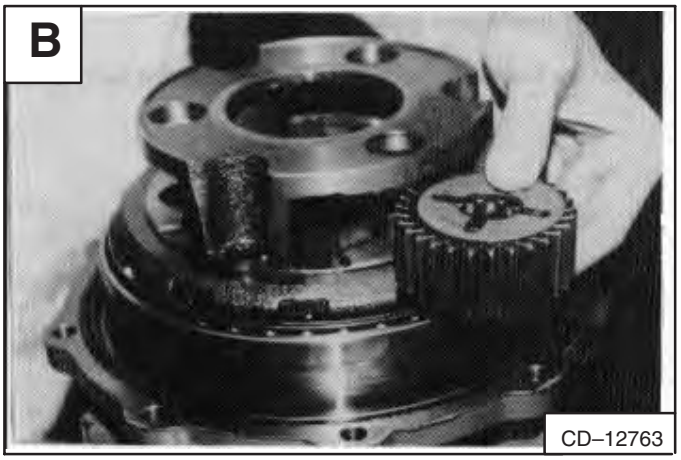
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TRAVEL MOTOR (Cont'd)

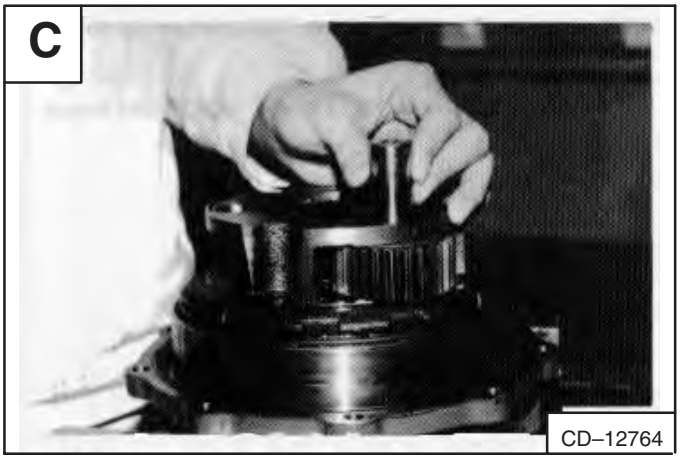
Install the thrust washer into the housing **[A]**.



Install the roller bearing and spacer into the planetary gears. Place a thrust washer onto each side of the planetary gears and install into the housing **[B]**.

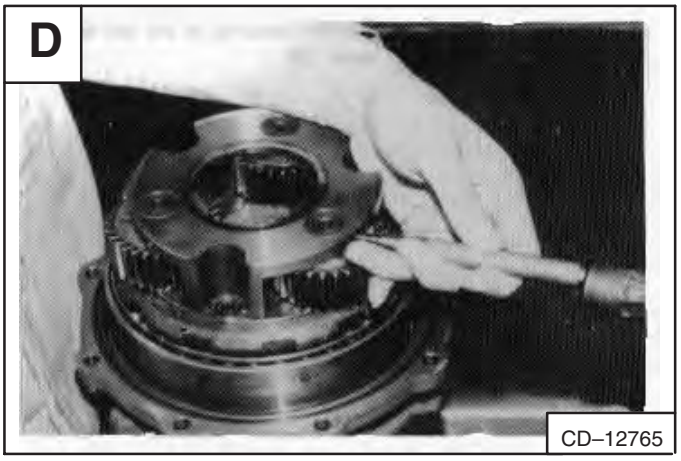


Insert the shaft into the housing and through the center of the planetary gear bearings **[C]**.



Align the hole in the pin with the hole in the housing. Drive the spring pin flush with the edge of the housing **[D]**.

Use a center punch and stake the edge of the spring pin hole so that the spring pins do not work out of the housing.

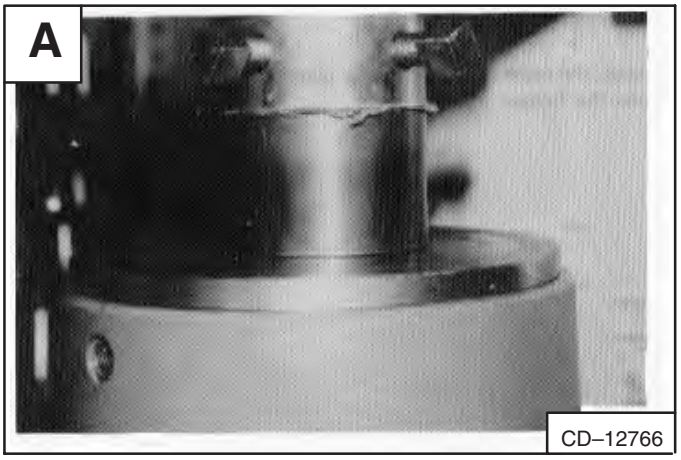


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TRAVEL MOTOR (Cont'd)

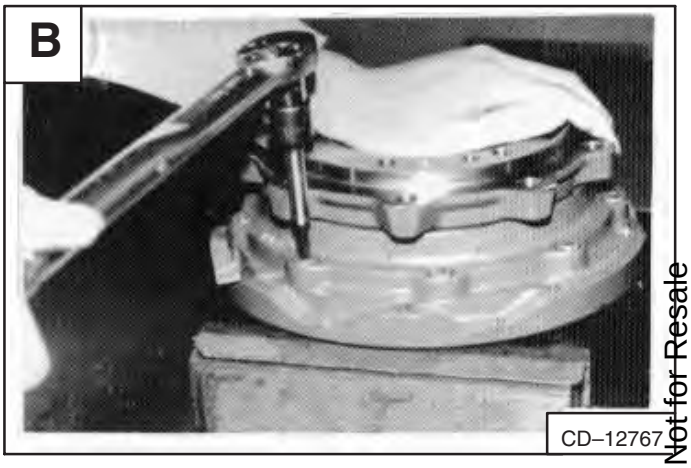
Install the hub onto the housing by aligning the hub gear to the planetary gears. Use a press and install the hub over the bearings **[A]**.

NOTE: Make sure that the hub is pressed down evenly so that the planetary gears do not gall the hub gears.



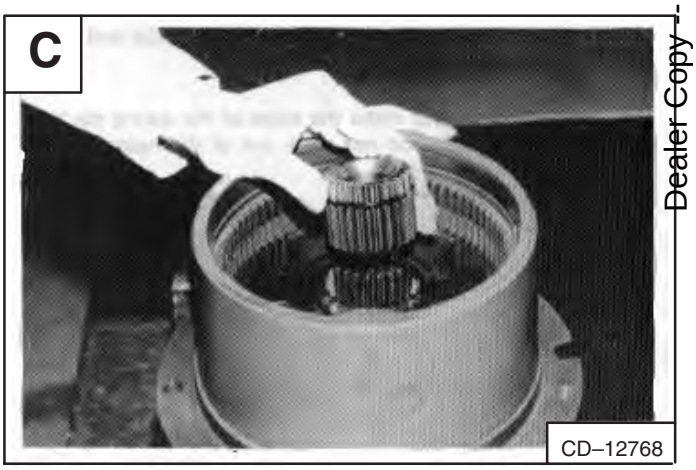
Turn the assembly over and install the nine (9) bolts that hold the housing to the hub **[B]**.

Tighten the bolts to 14–18 ft.–lbs. (189–24 Nm) torque.

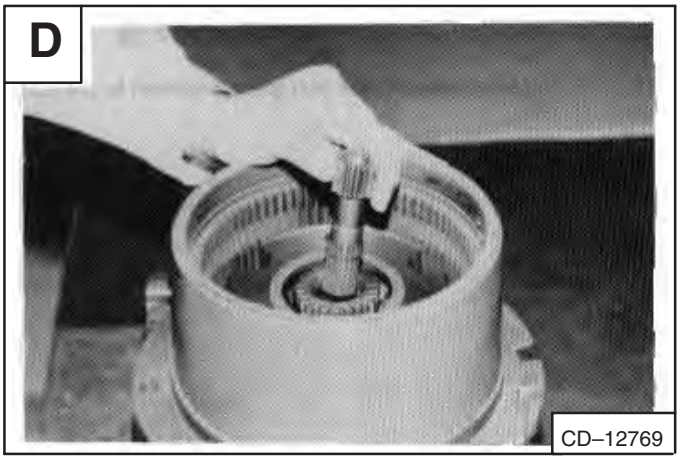


Install the snap ring onto the sun gear. Insert the sun gear into the planetary gears **[C]**.

The narrow side of the sun gear , from the snap ring groove, must face upwards.



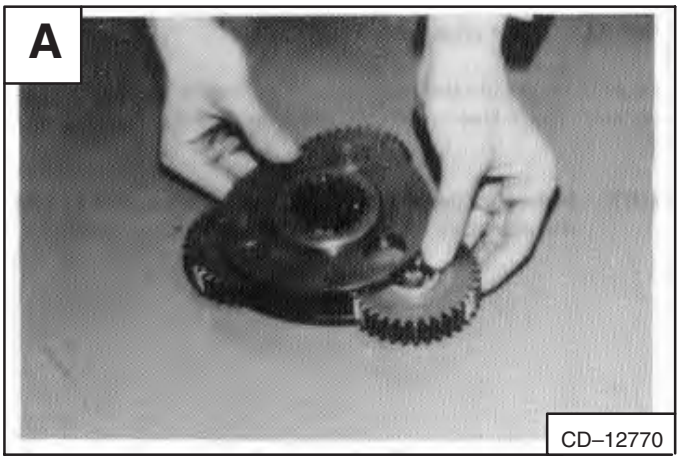
Install the snap ring onto the geared shaft. Insert the geared shaft into the sun gear **[D]**.



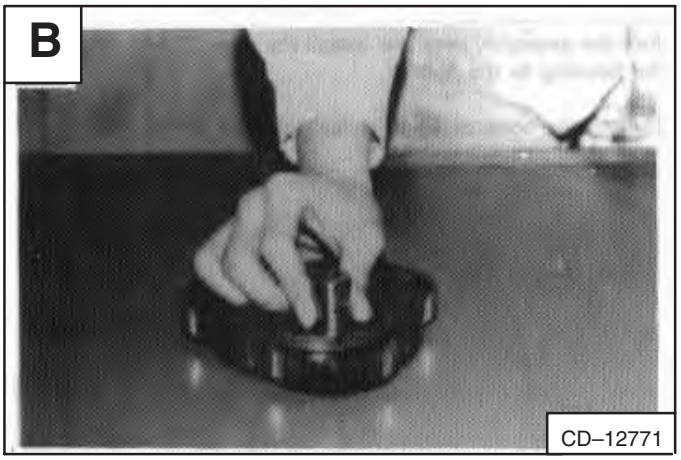
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TRAVEL MOTOR (Cont'd)

Install the roller bearing into the planetary gears and install these into the holder **[A]**.

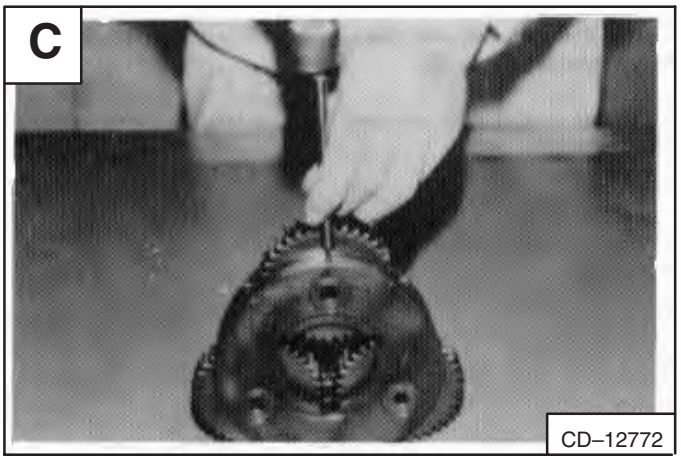


Install the shaft into the holder and through the gears **[B]**.



Align the hole in the shaft with the hole in the holder and install the spring pins **[C]**.

Use a center punch and stake the edge of the spring pin hole so that the spring pins do not work out of the holder.



Install the planetary gear assembly into the hub **[D]**.

Align the planetary gears to the hub gears and then to the sun gear.



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TRAVEL MOTOR (Cont'd)

Install the thrust plate onto the planetary flange assembly **[A]**.

Add oil to the top side of the thrust plate.

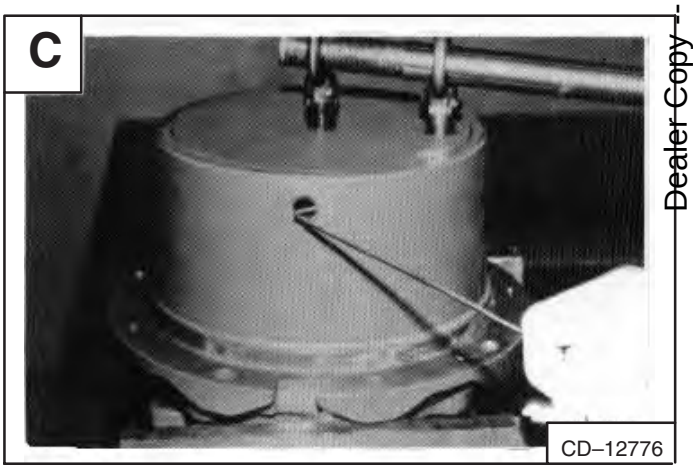


Install the O–ring onto the housing cover. Oil the O–ring and the edge of the cover.

Install the cover into the hub **[B]**.



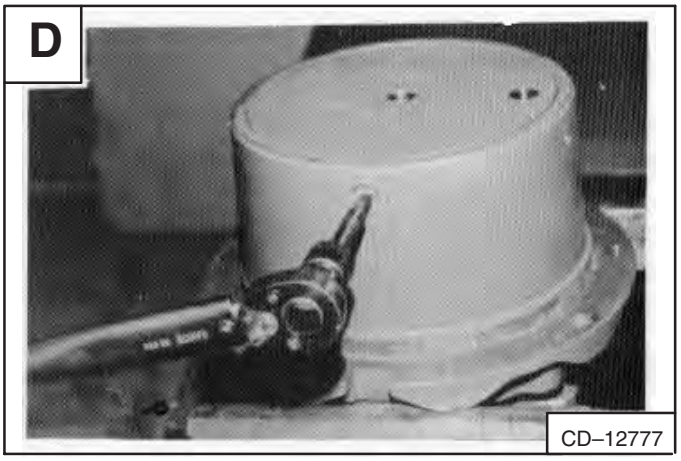
Install the eyebolts into the cover . Bend a hook approximately .25 inch (6 mm) long on the end of the lock wire. Insert the lock wire into the hub opening **[C]**. Turn the cover until the lockwire has been completely encircled in the cover.



Install the plugs into the hub and cover **[D]**.

Tighten the plug in hub to 7–11 ft.–lbs. (10–15 Nm) torque.

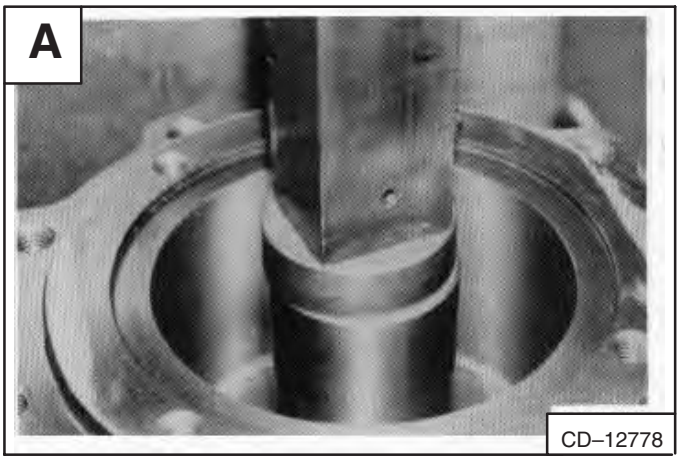
Tighten the plugs in the cover to 21–29 ft.–lbs. (28–39 Nm) torque.



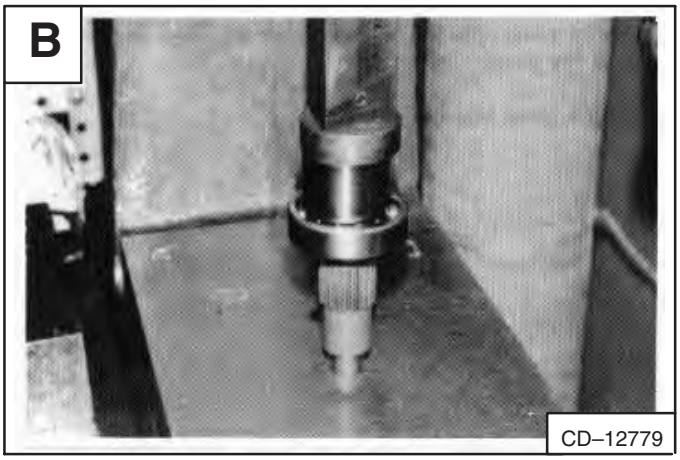
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TRAVEL MOTOR (Cont'd)

Press the seal into the flange **[A]**.

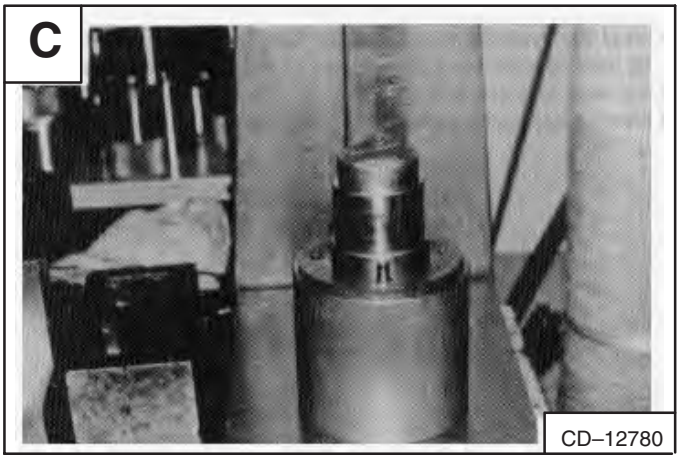


Press the ball bearing onto the shaft **[B]**.

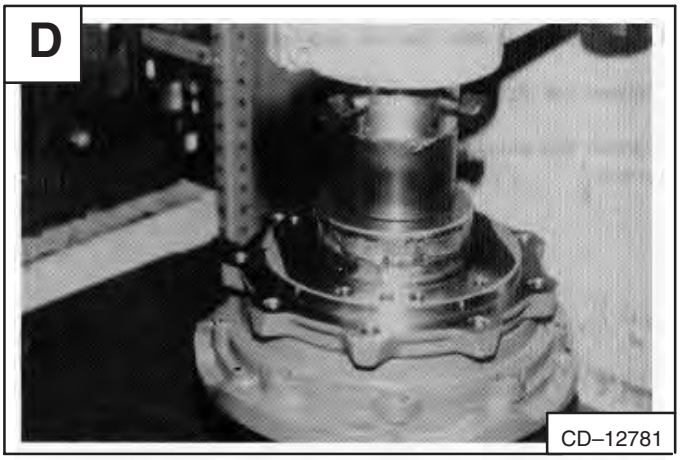


Press the shaft and bearing into the swash plate **[C]**.

Use care not to mar the swash plates angled surface.



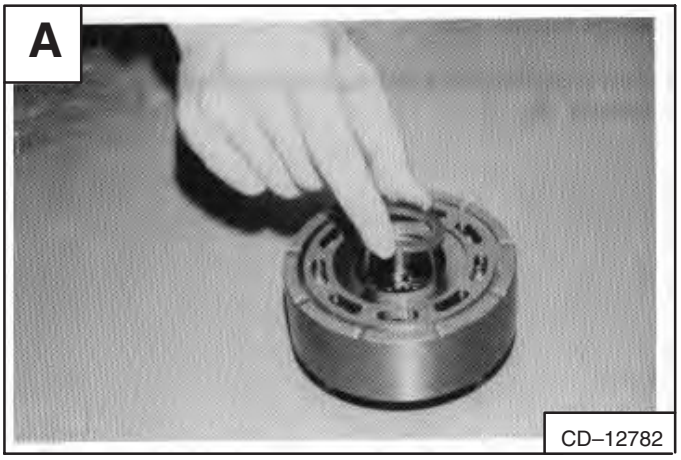
Align the pin in the swash plate with the hole in the flange. Press the swash plate into the flange **[D]**.



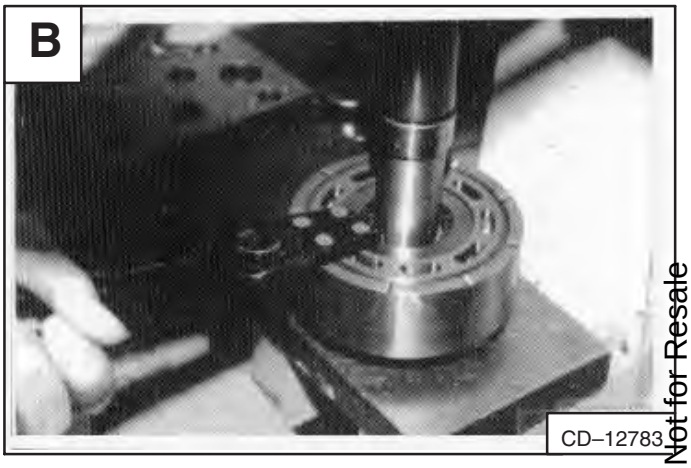
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TRAVEL MOTOR (Cont'd)

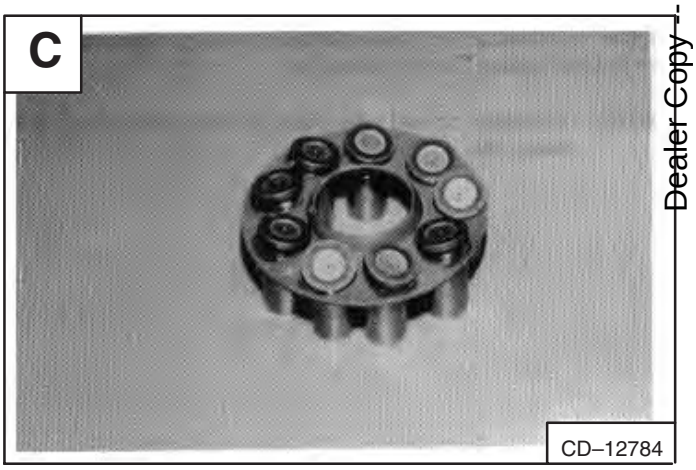
Sub–assemble the piston block by installing the thick spring collar, then the spring, with the thin spring collar on top of the spring **[A]**.



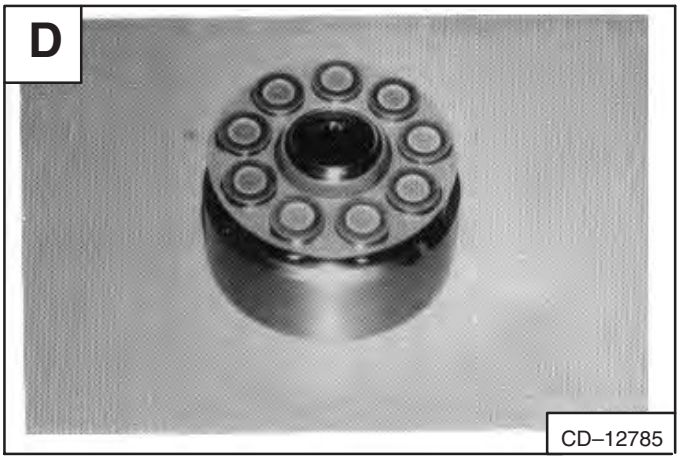
Install the snap ring by using a press to compress the collar and spring into the piston block **[B]**.



Install the pistons into the piston retainer plate **[C]**.



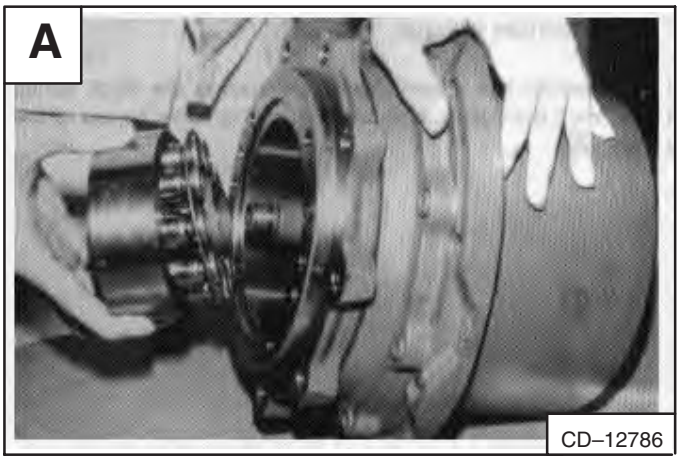
Oil the piston holes in the piston block. Install the ball, the three dowel pins, the conical holder and insert the pistons into the piston block **[D]**.



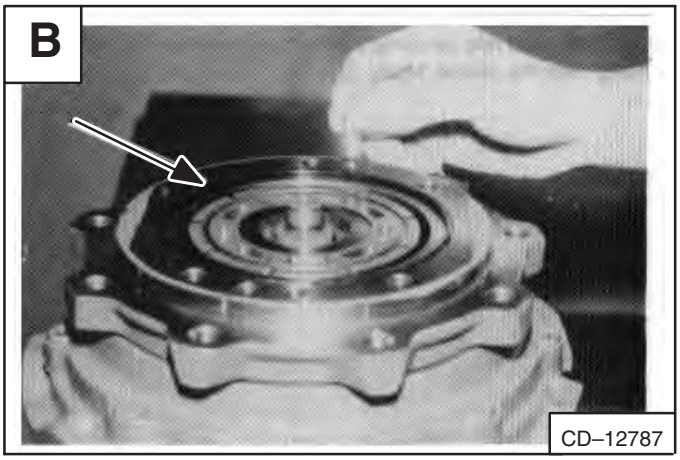
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TRAVEL MOTOR (Cont'd)

Oil the angle face of the swash plate and install the piston block assembly **[A]**.

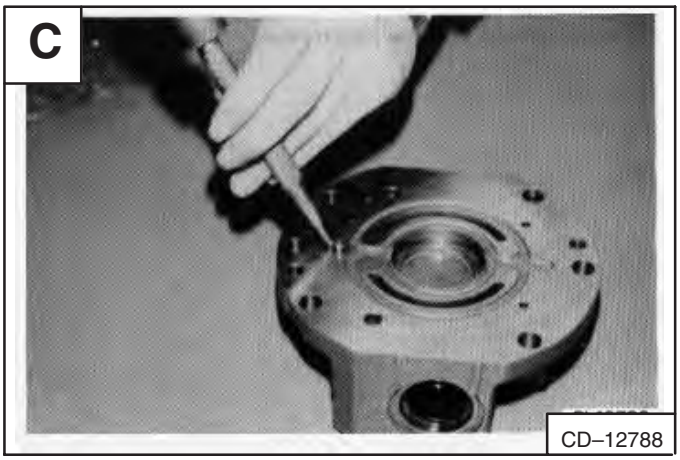


Install the two dowel pins and the O–ring into the flange **[B]**.

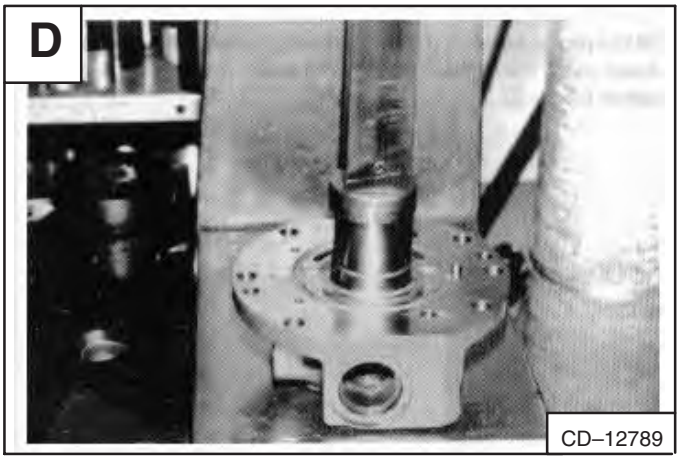


Install the dowel pin into the valve base plate **[C]**. Use a hammer and punch and stake the dowel pin.

NOTE: The stake should take place to the outer side of the dowel pin.



Press the bearing into the valve base plate **[D]**.

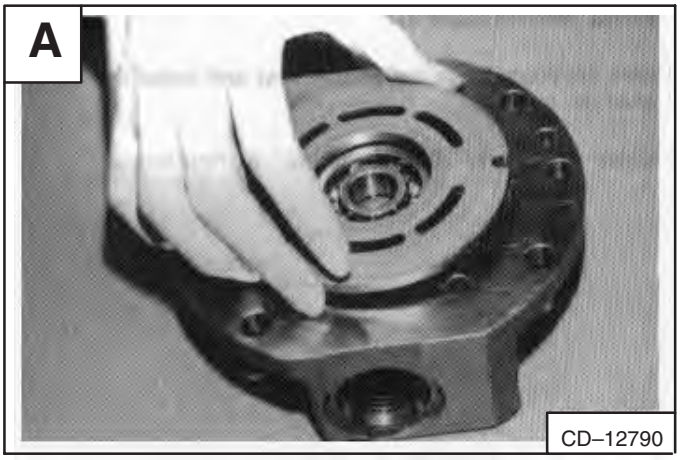


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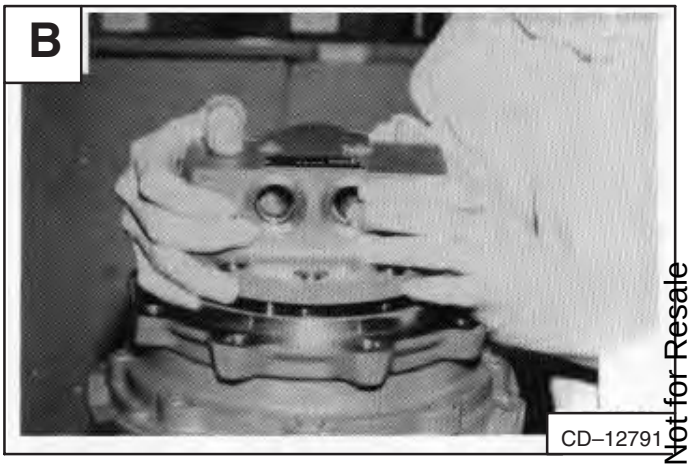
TRAVEL MOTOR (Cont'd)

Oil the bottom side of the valve plate and install over the bearing and onto the valve base plate **[A]**.

After the valve plate is installed, oil the top side of the valve plate.

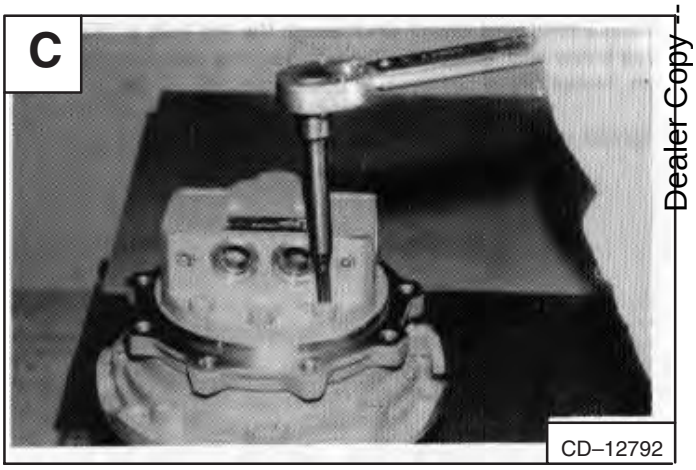


Install the valve base plate onto the drive motor flange **[B].**

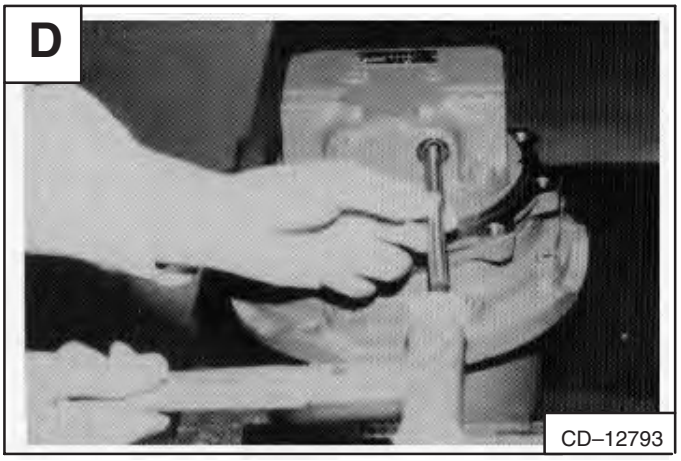


Install the six bolts **[C]**.

Tighten to 36–42 ft.–lbs. (49–57 Nm) torque.



Install the O–ring onto the poppet seat. Oil the O–ring and poppet seat and insert into the valve base plate. Use a drift pin and tap the poppet into the valve base plate **[D]**.

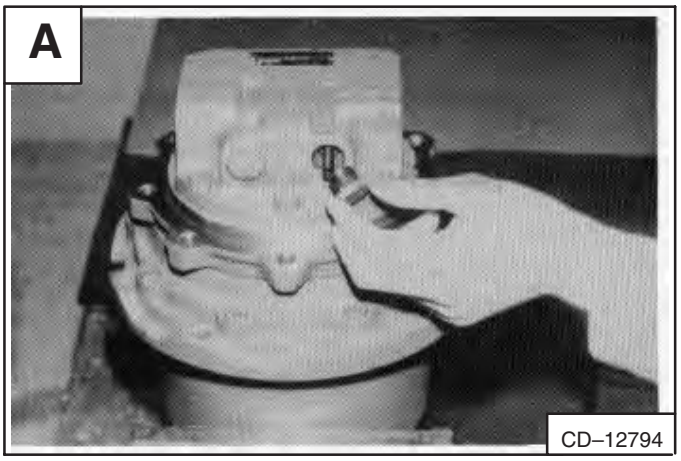


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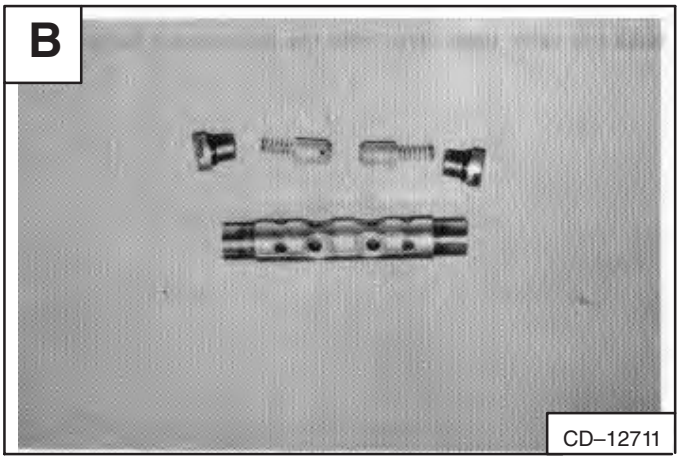
TRAVEL MOTOR (Cont'd)

Insert the poppet into the poppet seat and install the O–ring. Install the plug **[A]**.

Tighten the plug to 20–23 ft.–lbs. (27–31 Nm) torque.

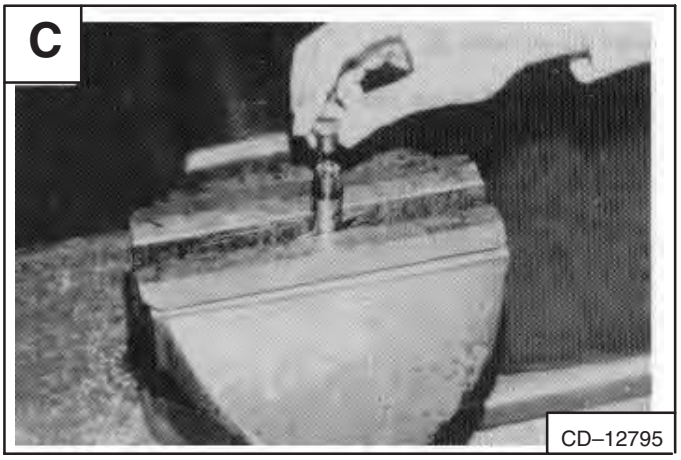


Insert the poppet and spring into the valve spool **[B]**.

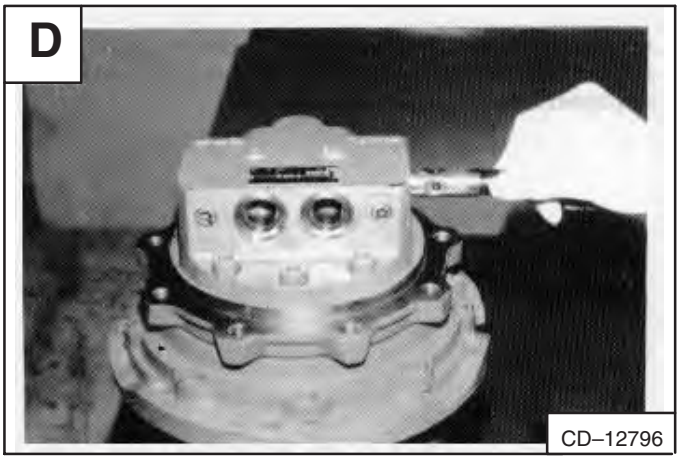


Insert a hardened dowel pin through the top hole in the spool. Use a vise with protective jaws to hold the spool at the dowel pin. Install the spool caps at both ends **[C]**.

Tighten the caps to 21–25 ft.–lbs. (29–34 Nm) torque.



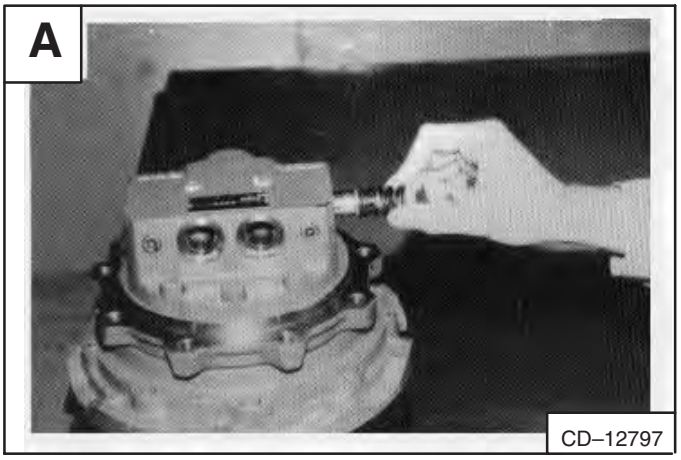
Oil the spool and insert it into the valve base plate **[D]**.



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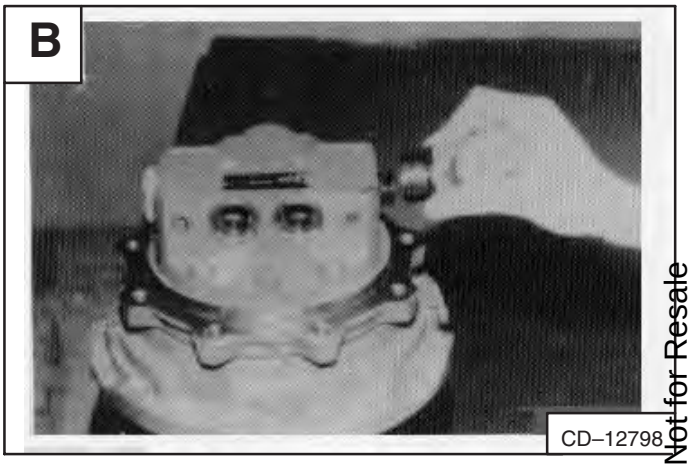
TRAVEL MOTOR (Cont'd)

Install the spring seat and spring onto the spool **[A]**.



Install the spool end plugs **[B]**.

Tighten the plugs to 108–123 ft.–lbs. (147–166 Nm) torque.



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UPPER WORKS AND SWING SECTION

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BRAKE VALVE
Disassembly 4–4
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CENTER SWIVEL JOINT
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Removal and Installation (Through Bottom Access Cover) 4–40

REDUCTION GEAR
Disassembly 4–21
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RELIEF VALVE
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UPPER WORKS & SWING CIRCLE GEAR
Removal and Installation 4–34
Reinstalling the Swing Bearing 4–37

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SWING MOTOR

Removal and Installation

Remove the seat and swing motor cover (See Page 5–1.)

IMPORTANT

When making repairs on hydrostatic and hydraulic systems, clean the work area before disassembly and keep all parts clean. Always use caps and plugs on hoses, tubelines and ports to keep dirt out. Dirt can quickly damage the system.

I–2003–0284

Mark the hoses for correct installation.

NOTE: Use caps and plugs on all hydraulic hoses and fittings.

Remove the pressure hoses from the swing motor **[A]**.

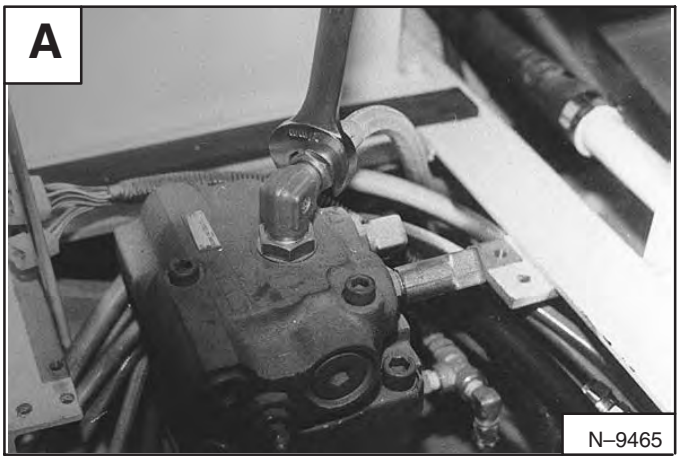
Remove the drain hose from the swing motor **[B]**.

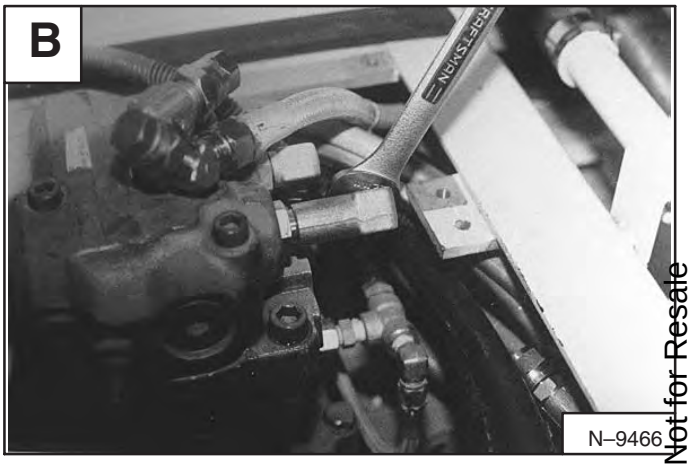
Remove the center swivel joint drain hose **[C]**.

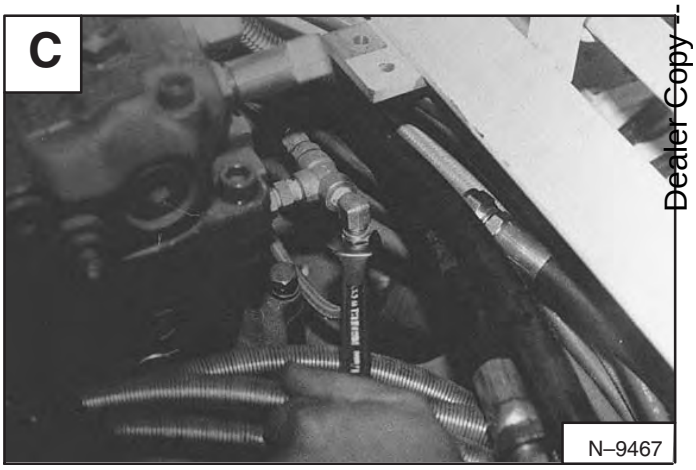
Remove the mounting bolts from the swing motor **[D]**.

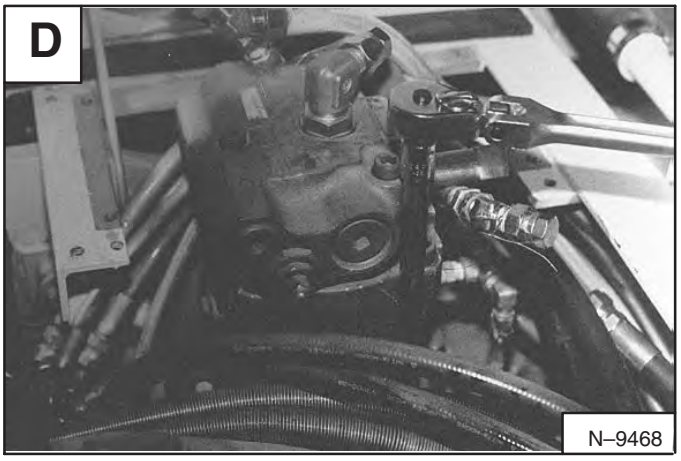
Remove the swing motor.

Installation: Tighten the bolts to 48–55 ft.–lbs. (65–75 Nm) torque.









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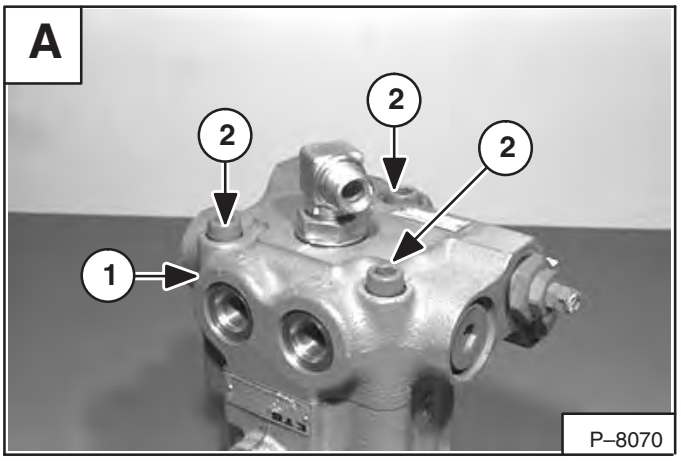
BRAKE VALVE

Disassembly

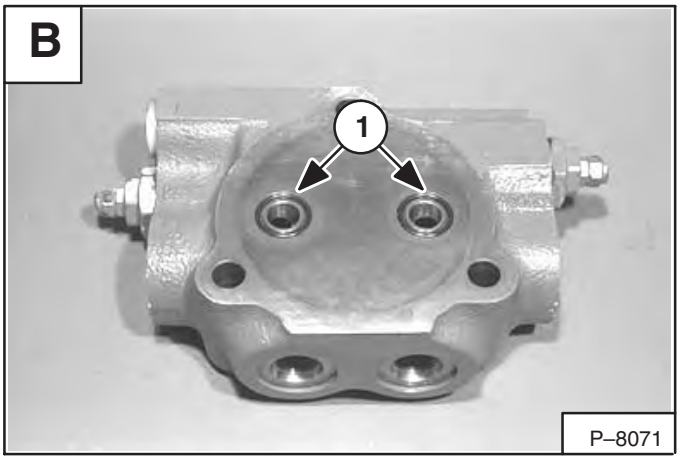
Prior to disassembly:

Clean the outside of the unit.
Drain oil from the unit.
Select a clean environment.
Handle with care.

Remove the brake valve assembly (Item 1) **[A]** from the swing motor by removing the three bolts (Item 2) **[A]**.

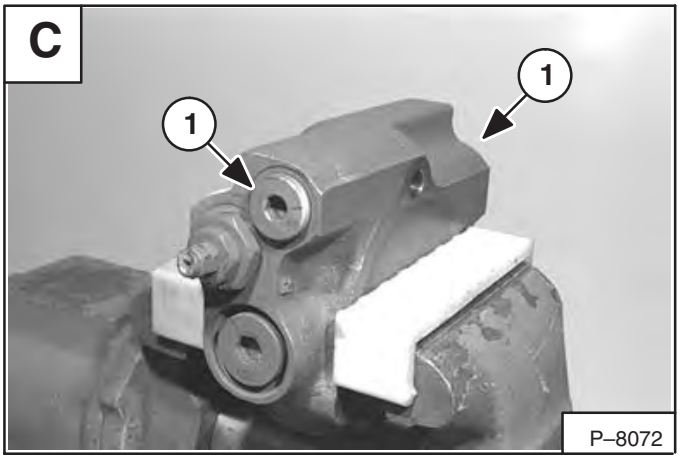


Remove the two O–rings (Item 1) **[B]** from the valve assembly.



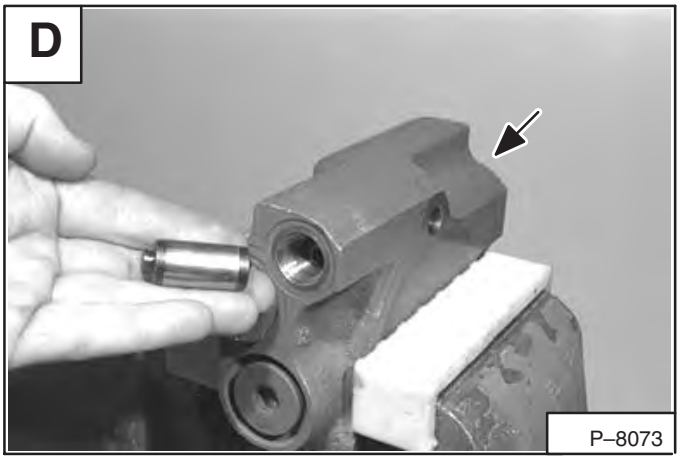
Clamp the valve assembly into a vise with padded jaws and remove the plug (Item 1) **[C]** from both sides of the valve.

NOTE: Do not use any type of tool to grip the finished surface of the piston or the piston will be damaged.



Remove the pistons from both sides of the valve **[D]**.

NOTE: Do not mix up the parts that are removed from the valve.

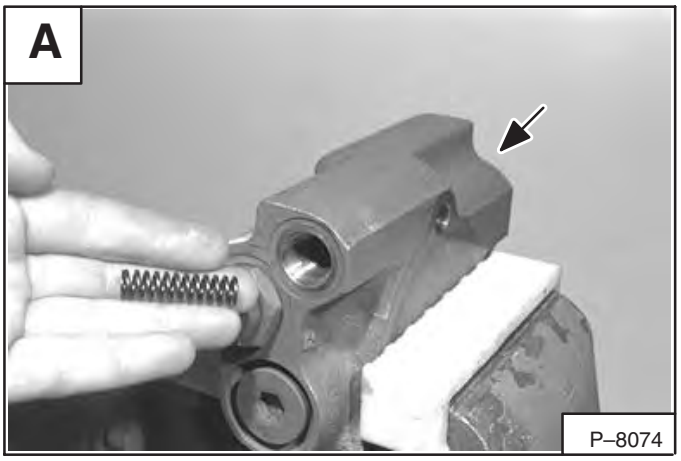


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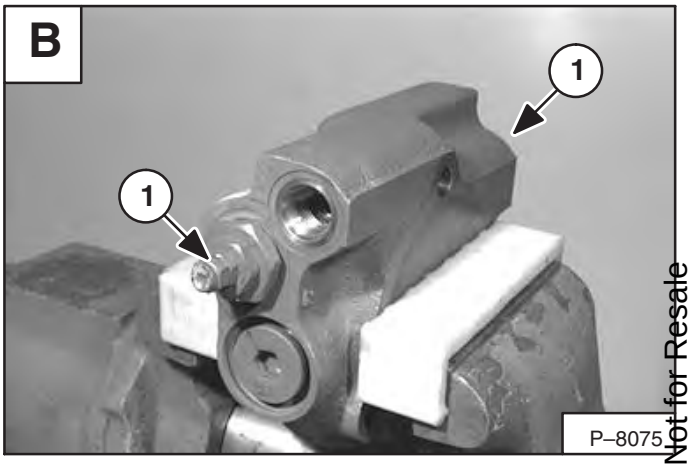
BRAKE VALVE (Cont'd)

Disassembly (Cont'd)

Remove the springs from both sides of the valve **[A]**.

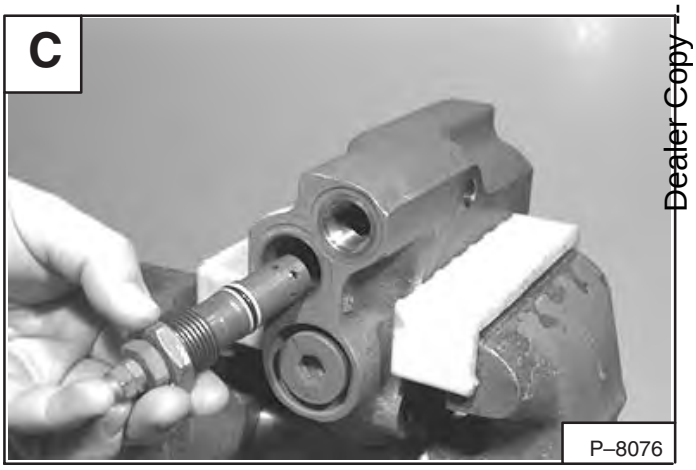


Loosen the relief valve cartridges (Item 1) **[B]** from both sides of the valve.

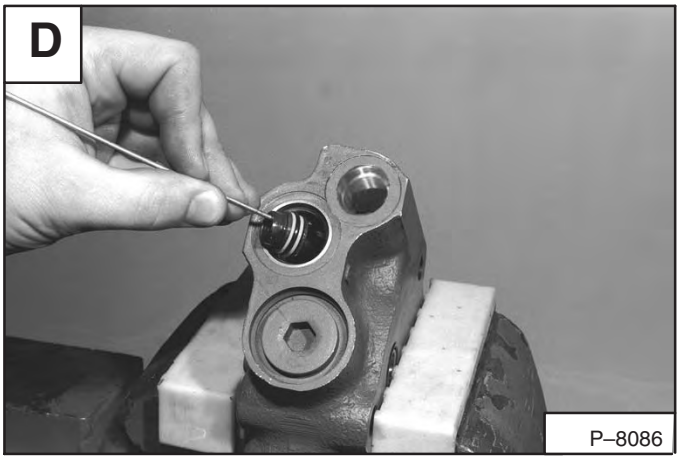


Remove the relief valve cartridges **[C]**.

NOTE: If the relief valve is disassembled, the relief pressure setting must be reset. See Page 4–29 for the valve disassembly.



Remove the poppet seat from the valve body using a piece of wire **[D]**.

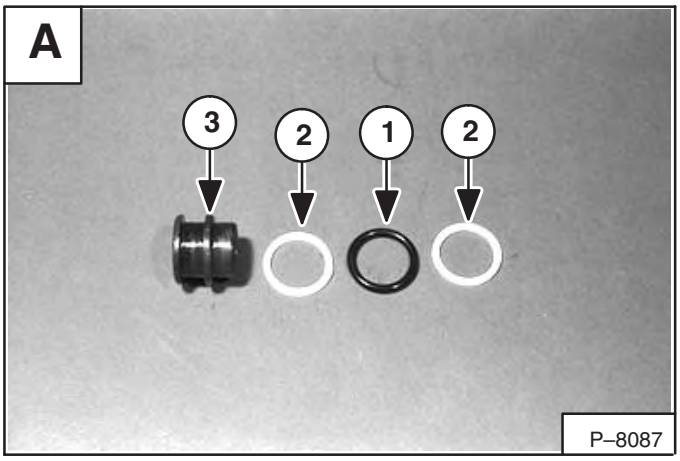


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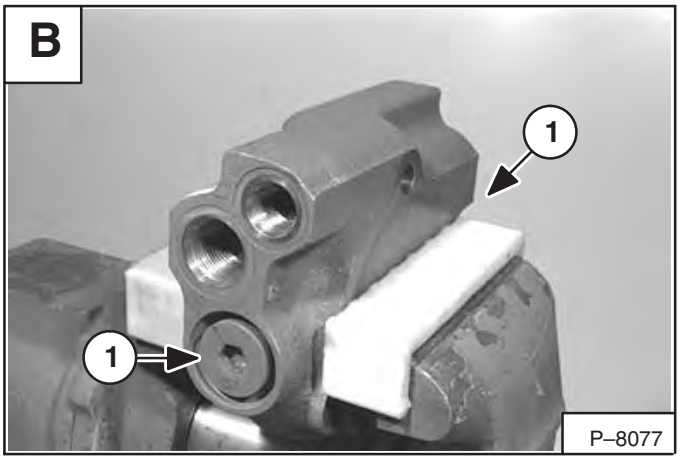
BRAKE VALVE (Cont'd)

Disassembly (Cont'd)

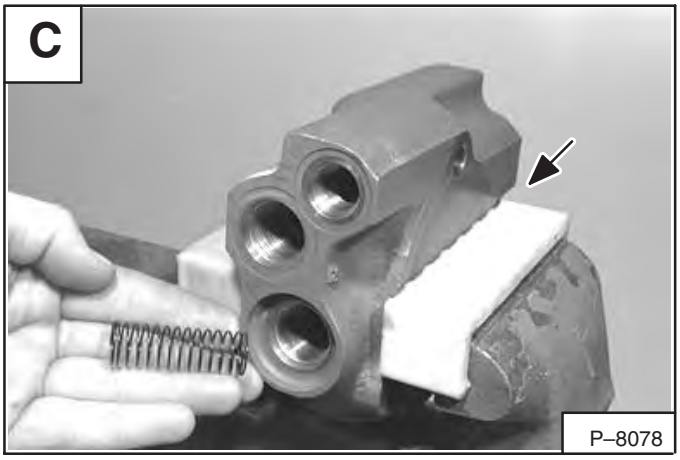
Remove the O–ring (Item 1) **[A]** and the back–up washers (Item 2) **[A]** from the poppet seat (Item 3) **[A]**.



Remove the plugs (Item 1) **[B]** from both sides of the valve.

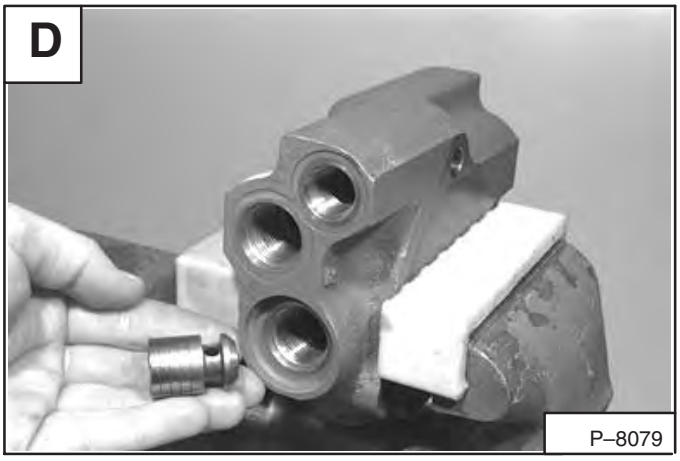


Remove the spring from both sides of the valve **[C]**.



Remove the check valves from both sides of the valve body **[D]**.

Do not use any type of tool to grip the finished surface of the check valves or the check valves will be damaged.



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BRAKE VALVE (Cont'd)

Disassembly (Cont'd)

NOTE: Do not mix up the parts that are removed from the valve.

Parts that are removed from the valve body and separated **[A]**.



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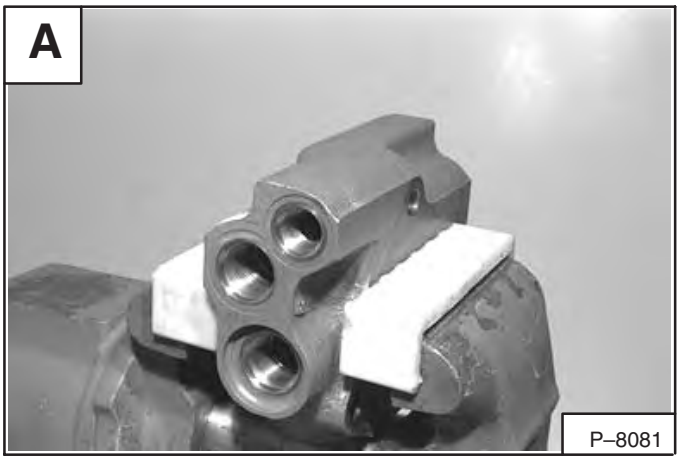
BRAKE VALVE (Cont'd)

Assembly

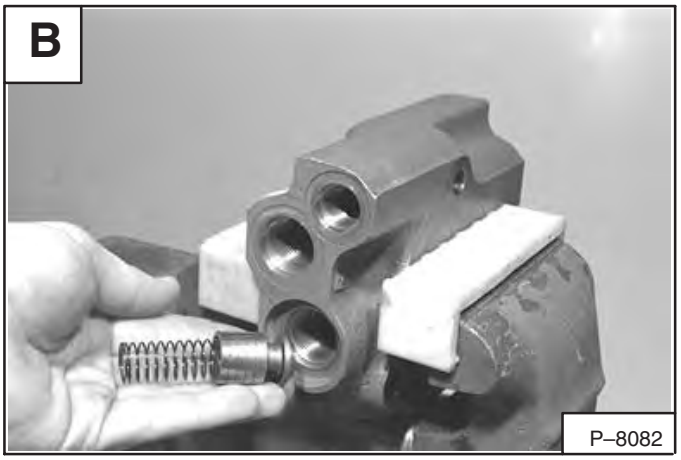
Prior to assembly:

Clean all the parts with solvent and dry with compressed air.
Handle all parts with care.
Replace all the O–rings.
Put oil on the O–rings.
Torque the parts as suggested.

Clamp the valve assembly into a vise with padded jaws **[A]**.

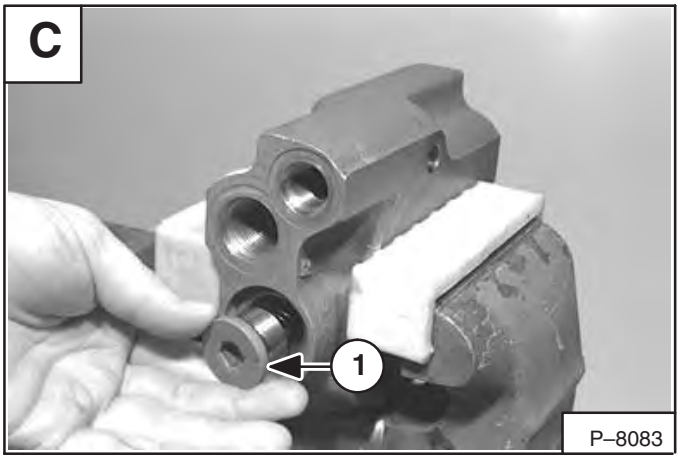


Install the check valve and spring into the valve **[B]**.

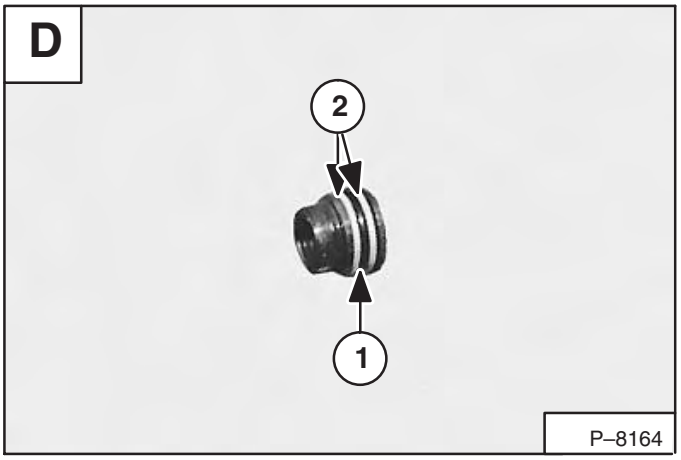


Install the O–ring on the plug (Item 1**[C]** and install in the valve.

Tighten the plug to 109–123 ft.–lbs. (147–167 Nm) torque.



Install the new O–ring (Item 1) **[D]** and the two back–up washers (Item 2) **[D]** on the poppet seat and install in the valve.



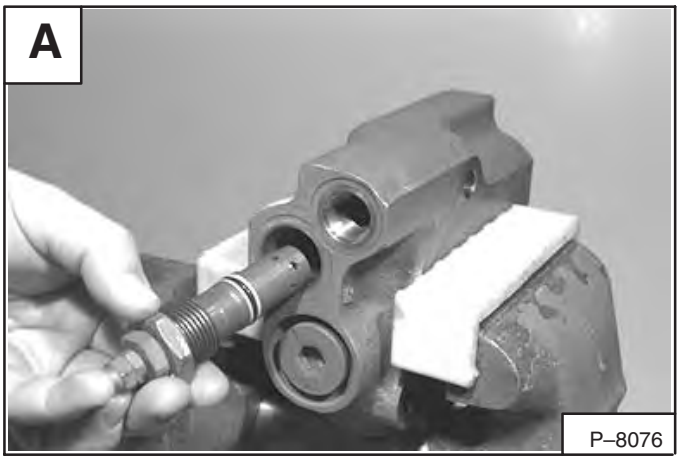
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BRAKE VALVE (Cont'd)

Assembly (Cont'd)

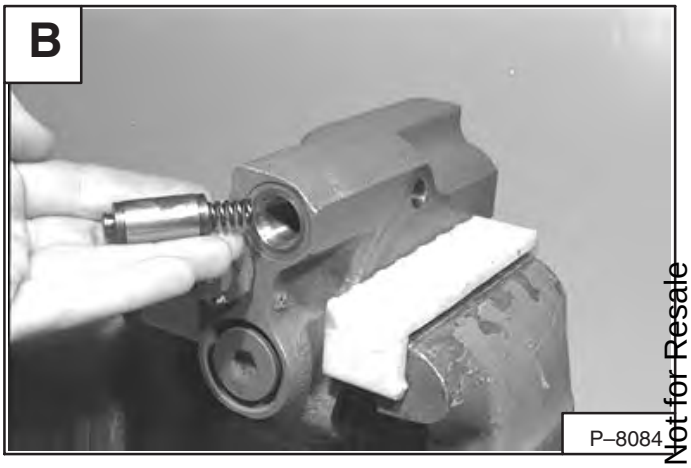
Install the relief valve assembly in the valve **[A]**.

Tighten the relief valve 58–65 ft.–lbs. (78–88 Nm) torque.



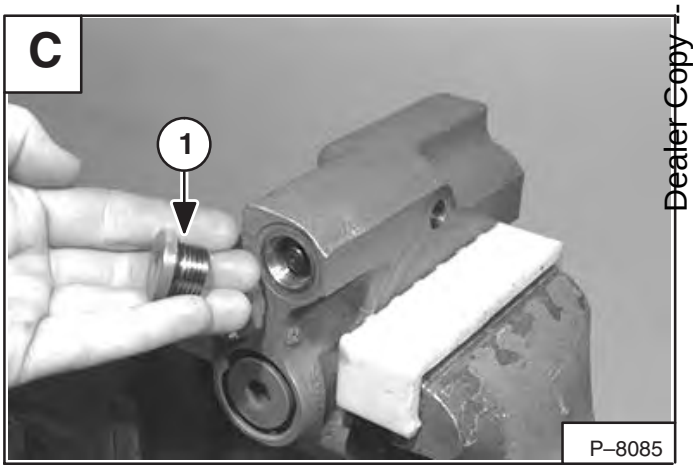
Insert the spring in the piston and install them in the valve **[B]**.

NOTE: Do not use force when installing the piston into the valve. Check for sudden movement of the piston.

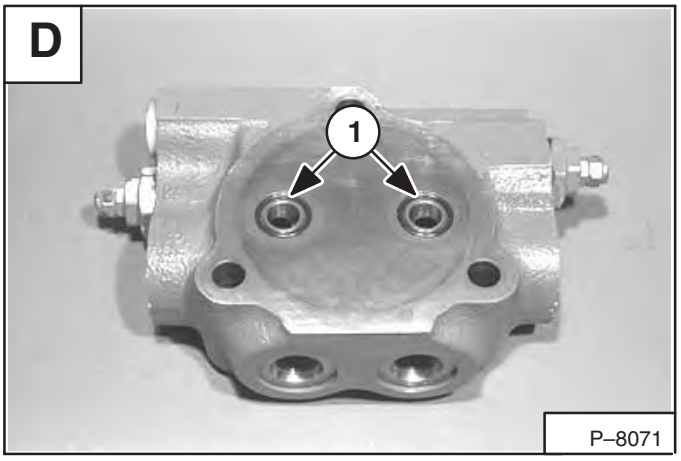


Install the O–ring on the plug (Item 1) **[C]**. Install in the valve **[C]**.

Tighten the plug to 58–65 ft.–lbs. (78–88 Nm) torque.



Install the O–rings (Item 1) **[D]**.



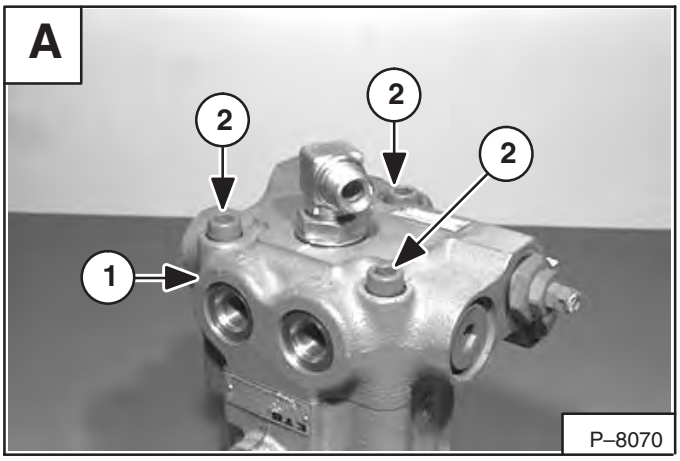
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BRAKE VALVE (Cont'd)

Assembly (Cont'd)

Install the brake valve assembly (Item 1)**[A]** to the swing motor, using the three bolts (Item 2) **[A]**.

Tighten bolts to 42.0 ft.–lbs. (57.0 Nm) torque.



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SWING MOTOR

Disassembly

Prior to disassembly:

Clean the outside of the motor.
Drain the oil from the motor casing.
Select a clean environment.
Handle with care.

Remove the three bolts (Item 1) **[A]** from the valve assembly and remove.

NOTE: Mark the swing motor case and the lower housing for ease of assembly.

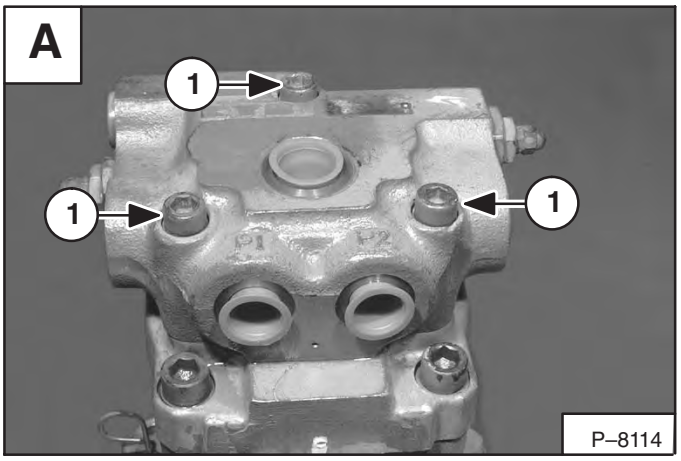
Remove the two bolts (Item 1) **[B]** and remove the reduction gearcase assembly and shaft.

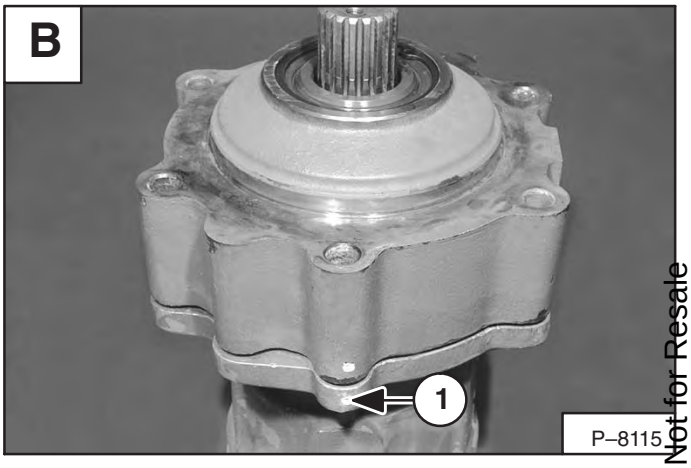
NOTE: Mark the port block (Item 1) [C] and the case (Item 2) [C] for ease of assembly.

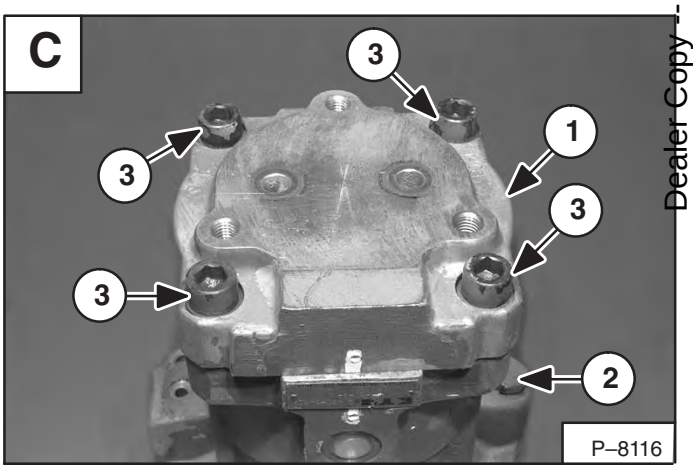
Remove the four bolts and washers (Item 3) **[C]** and remove the port block.

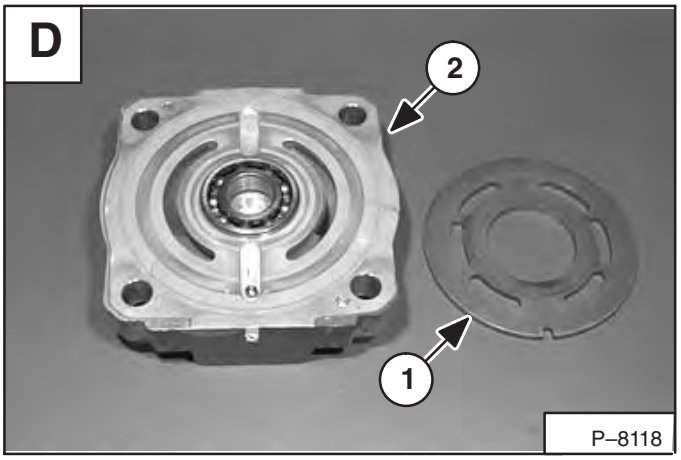
Remove the valve plate (Item 1)**[D]** from the cover (Item 2) **[D]**.

NOTE: The valve plate must be installed with the grooved or shiny side towards the cover plate.







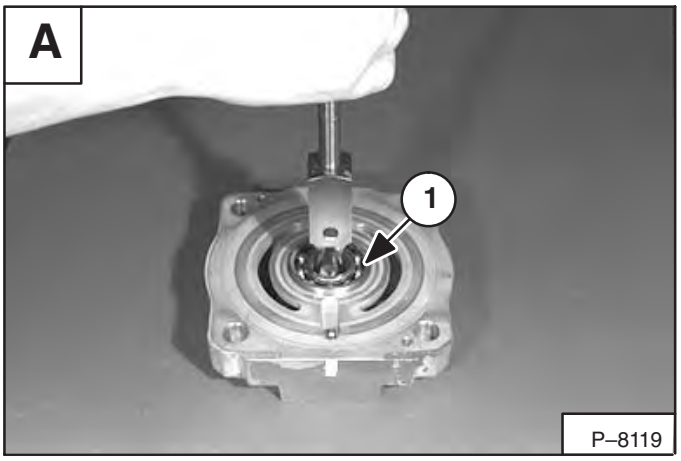


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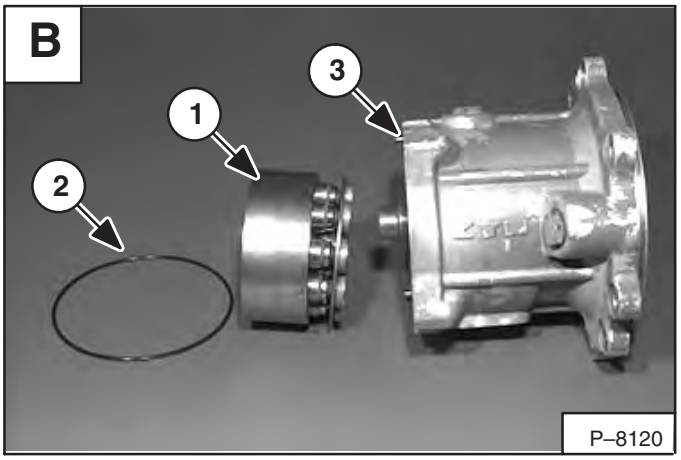
SWING MOTOR (Cont'd)

Disassembly (Cont'd)

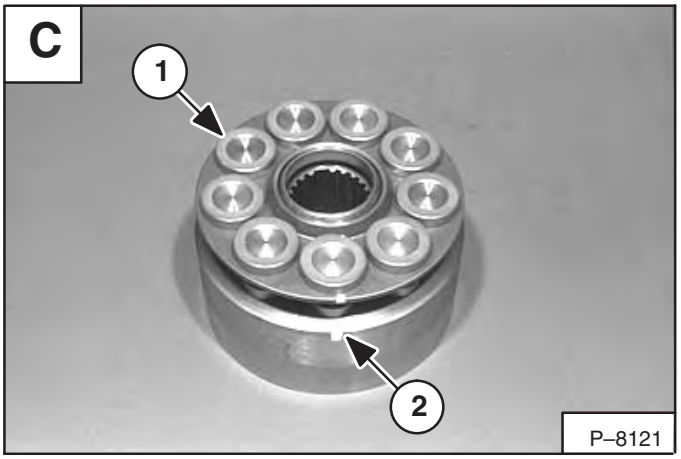
Remove the bearing (Item 1)**[A]** from the valve plate with a slide hammer type puller.



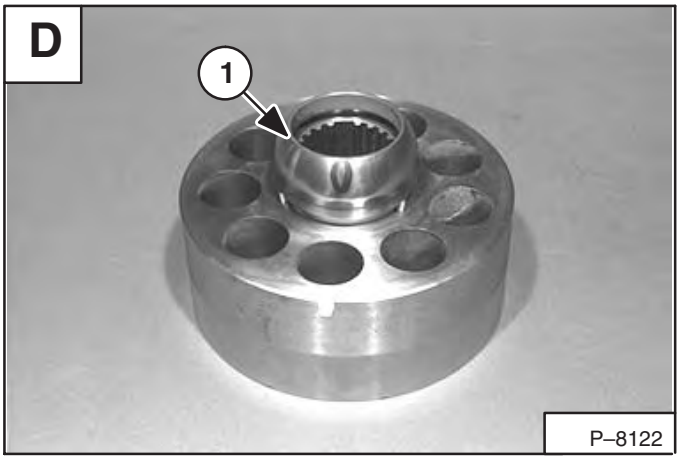
Lay the swing motor assembly on its side and remove the piston assembly (Item 1) **[B]**. Remove the O–ring (Item 2) **[B]** from the housing (Item 3) **[B]**.



NOTE: It is important that the pistons are installed in their original positions. Before the retainer plate and pistons (Item 1) [C] are removed from the cylinder block (Item 2) [C], mark the retainer and piston assembly to the cylinder block using a felt tip pen.



Remove the retainer plate holder (Item 1) **[D]** from the cylinder block taking care not to loose the ball that is installed behind the holder.

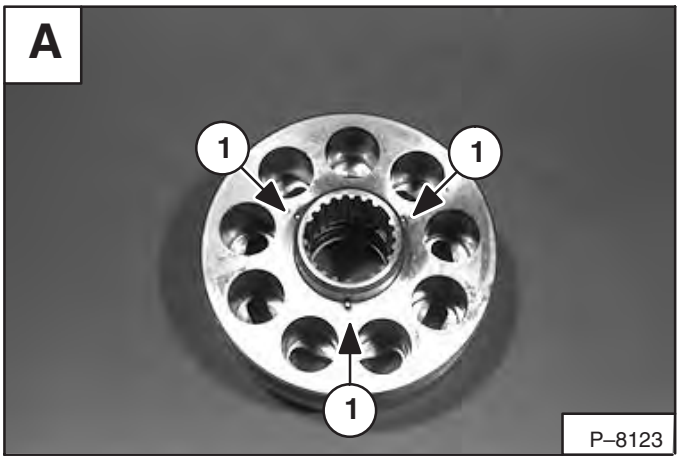


Dealer Copy -- Not for Resale

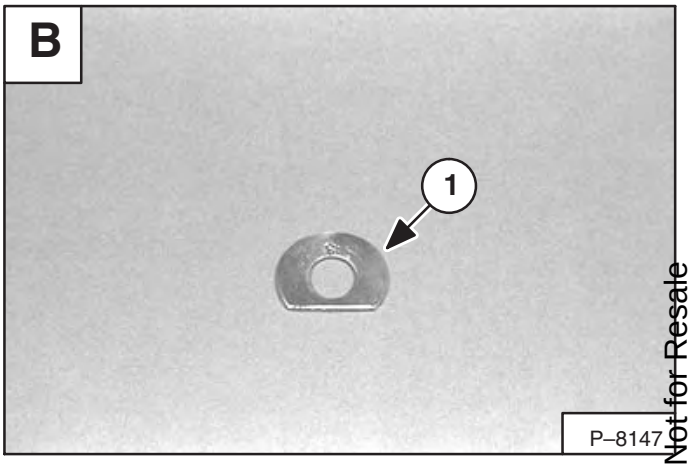
SWING MOTOR (Cont'd)

Disassembly (Cont'd)

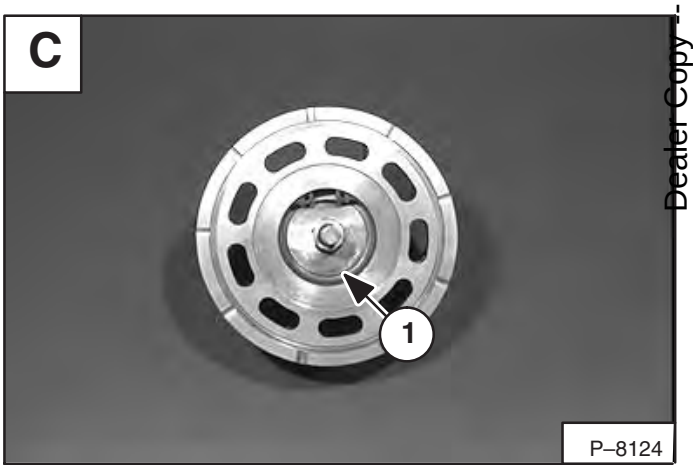
Remove the three pins (Item 1) **[A]** from the cylinder block.



NOTE: To remove the spring from inside the cylinder block, use a bolt, two washers, and a nut to compress the spring. The washers must fit over the spring but it must also fit inside the snap ring. The washer that fits inside the snap ring must be trimmed (Item 1) [B] so the snap ring can be removed.

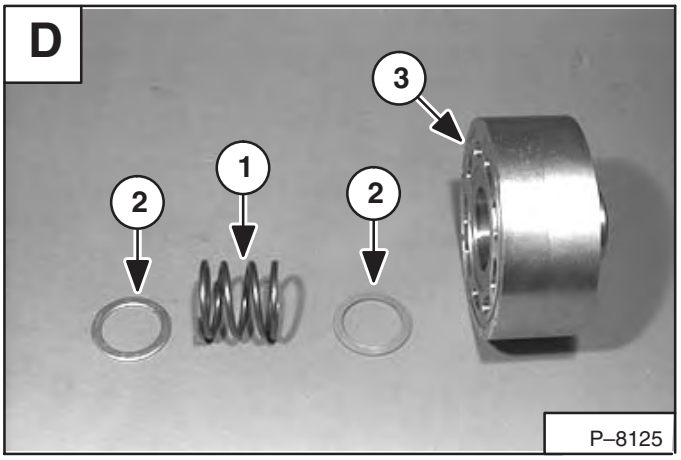


Install the non–modified washer on the bolt and insert the bolt through the spring in the cylinder block. Install the modified washer (Item 1) **[B]** & **[C]** and nut. Tighten the nut until the spring is compressed enough to remove the snap ring.



Loosen the nut to release the tension on the spring and remove the bolt. Remove the spring (Item 1) **[D]** and the two washers (Item 2) **[D]** from the cylinder block (Item 3) **[D]**.

NOTE: Check the spring to see that it is not cracked or broken.

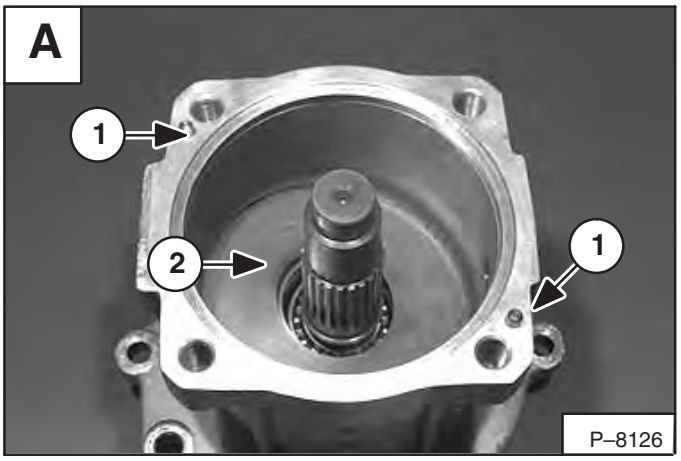


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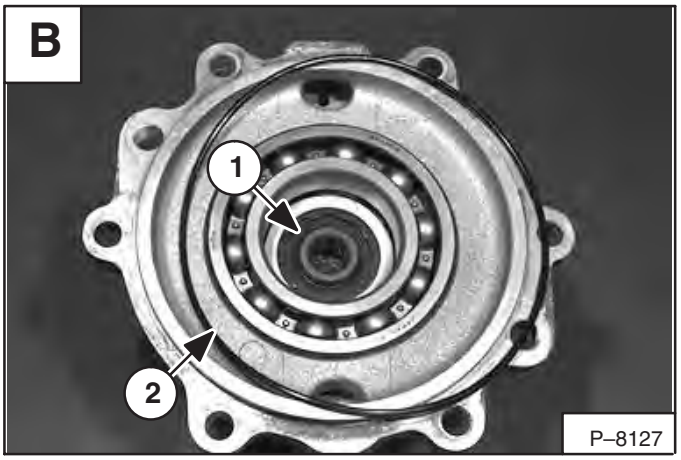
SWING MOTOR (Cont'd)

Disassembly (Cont'd)

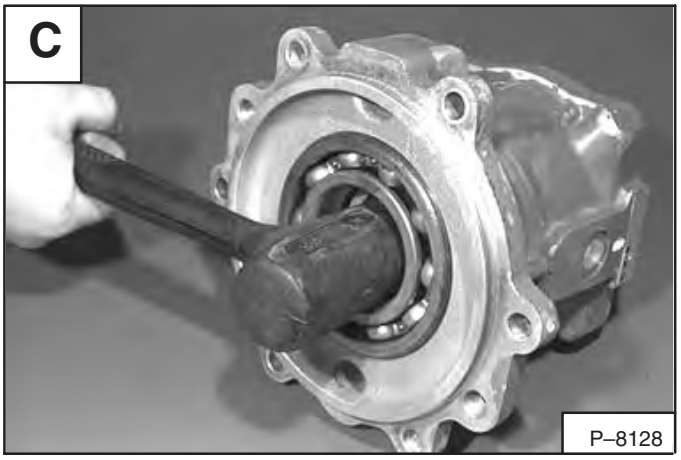
Remove the two pins (Item 1) **[A]** and the swash plate (Item 2) **[A]** from the case.



Remove the snap ring (Item 1) **[B]** and the O–ring (Item 2) **[B]** from the case.

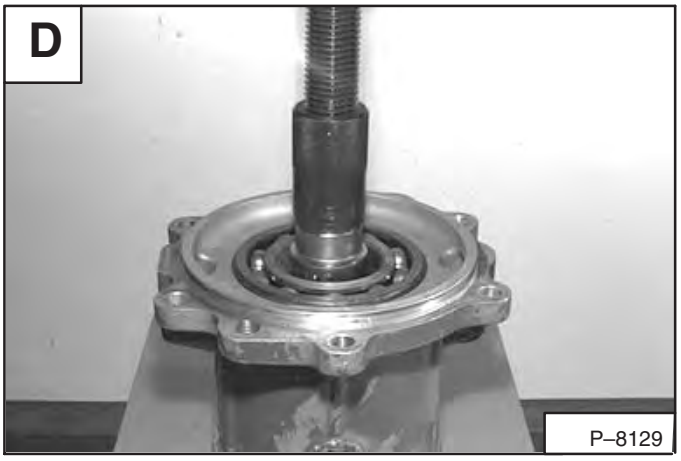


Tap the shaft from the swing motor case bearing **[C]**.



Press the seal and bearing from the case at the same time **[D]**.

NOTE: The seal will be ruined and a new seal will need to be installed.

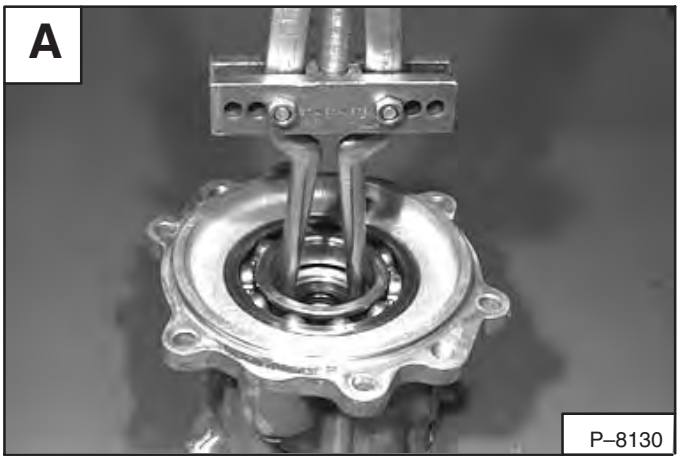


Dealer Copy -- Not for Resale

SWING MOTOR (Cont'd)

Disassembly (Cont'd)

Remove the bearing from the swing motor case **[A]**.



Dealer Copy -- Not for Resale

SWING MOTOR (Cont'd)

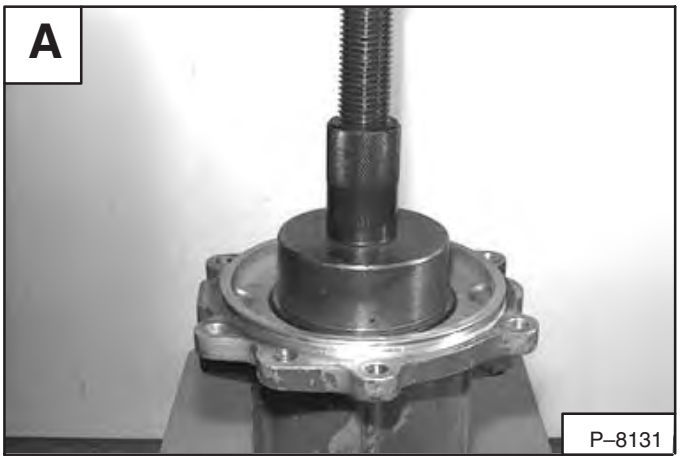
Assembly

Prior to Assembly:

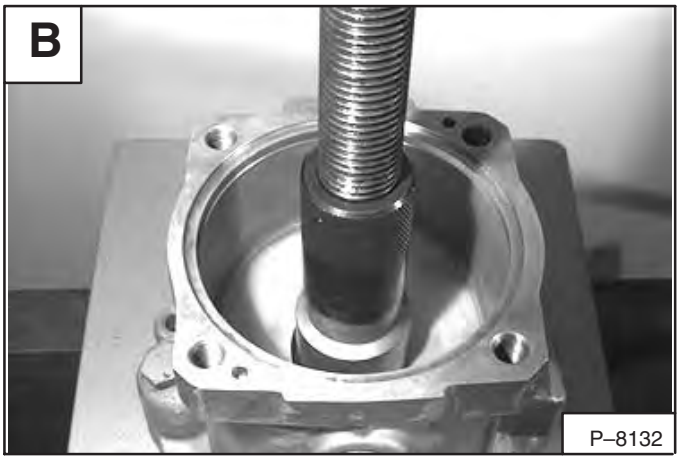
Clean all parts with oil and dry with compressed air.

Put grease on the oil seal and O–rings.

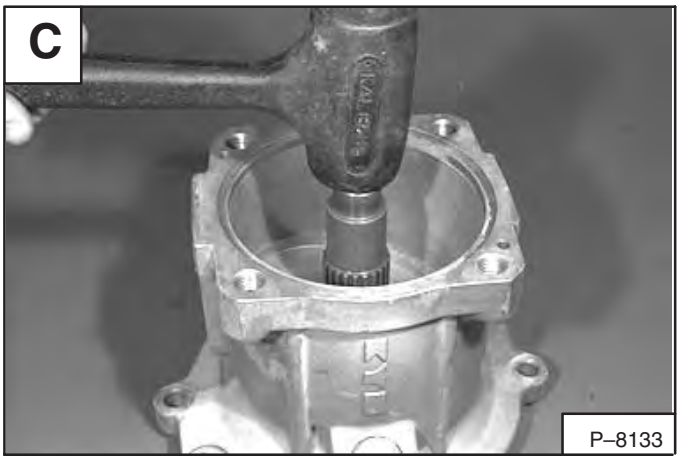
Press the large bearing in the swing motor case **[A]**.



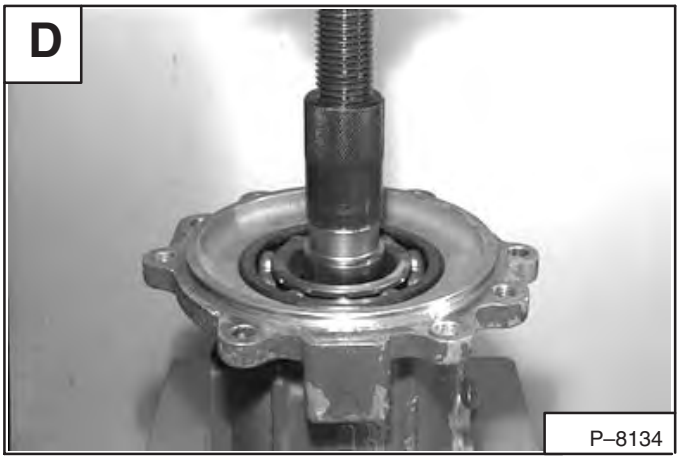
Press the small bearing in the swing motor case **[B]**.



Tap the shaft in the bearing **[C]**.



Press the seal over the shaft **[D]**.

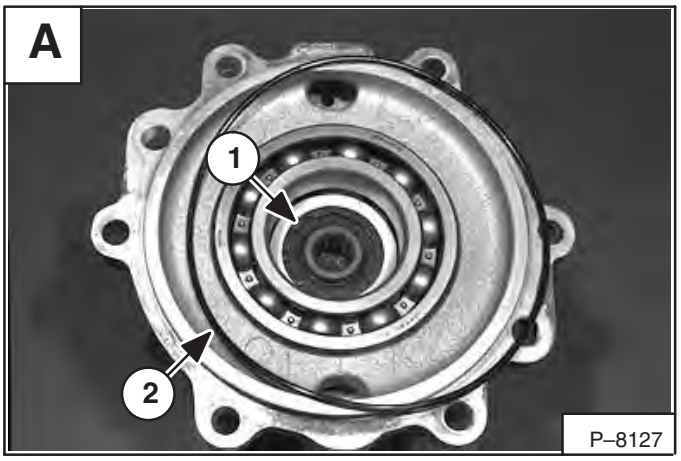


Dealer Copy -- Not for Resale

SWING MOTOR (Cont'd)

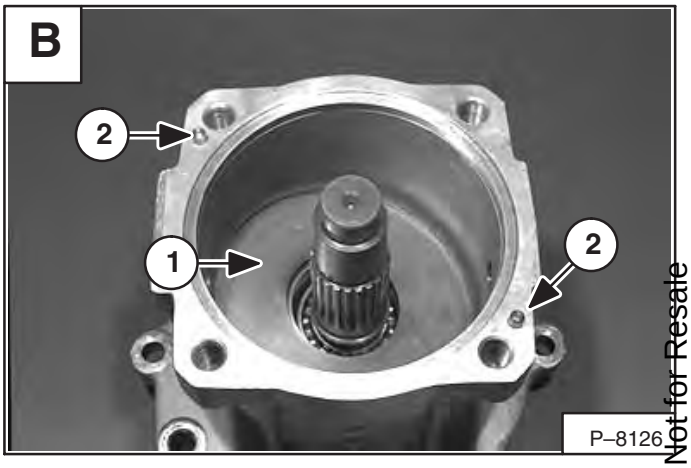
Assembly (Cont'd)

Install the snap ring (Item 1) **[A]** in the groove over the seal. Install the O–ring (Item 2) **[A]** on the case.



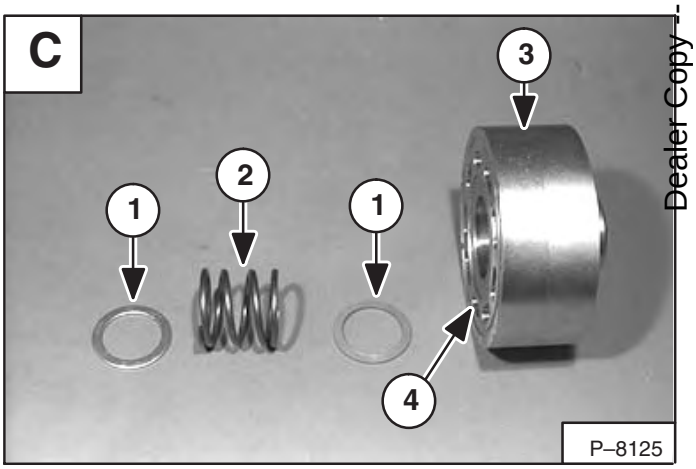
Install the swash plate (Item 1)**[B]** and the two pins(Item 2) **[B]**.

NOTE: The swash plate must be installed with the bevelled side towards the case.

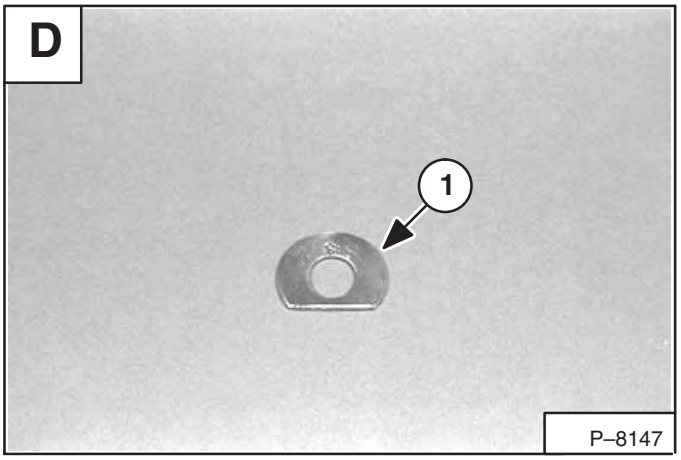


Install the washer, (Item 1) **[C]** spring, (Item 2)**[C]** and the washer (Item 1) **[C]** in the cylinder block (Item 3) **[C]**.

NOTE: Inspect the backside of the cylinder block (Item 4) [C] for wear. If the grooves can be felt with fingernails it must be replaced.



NOTE: To install the spring from inside the cylinder block, use a bolt, two washers, and a nut to compress the spring. The washers must fit over the spring but it must also fit inside the snap ring. The washer that fits inside the snap ring must be trimmed (Item 1) [B] so the snap ring can be removed.



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SWING MOTOR (Cont'd)

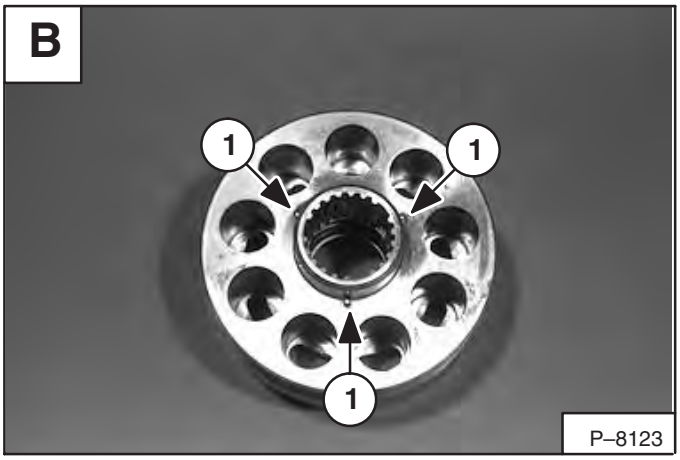
Assembly (Cont'd)

Install the non–modified washer on the bolt and insert the bolt through the spring in the cylinder block. Install the modified washer (Item 1)**[A]** and nut. Tighten the nut until the spring is compressed enough to install the snap ring **[A]**.

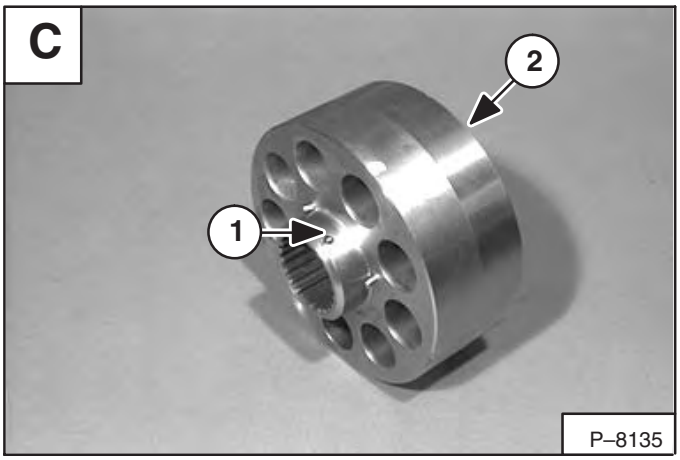
Remove the bolt used to compress spring.



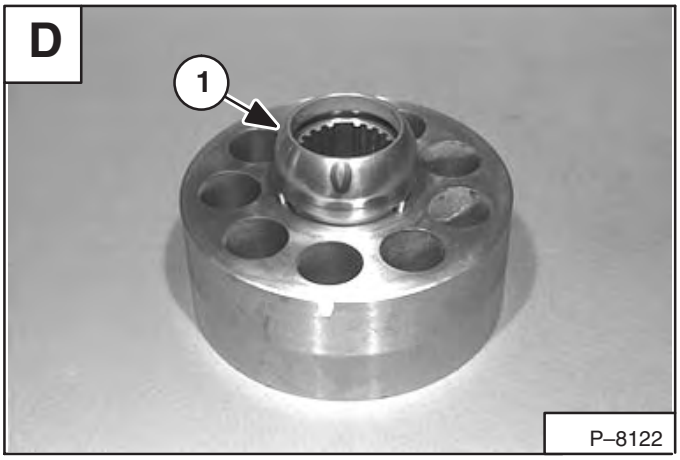
Install the three pins (Item 1) **[B]** in the cylinder block.



Install the ball (Item 1)**[C]** in the hole on the cylinder block (Item 2) **[C]**.



Align the groove in the retainer plate holder (Item 1) **[D]** with the ball on the cylinder block and install on the cylinder block until the retainer plate holder rests on the three pins.



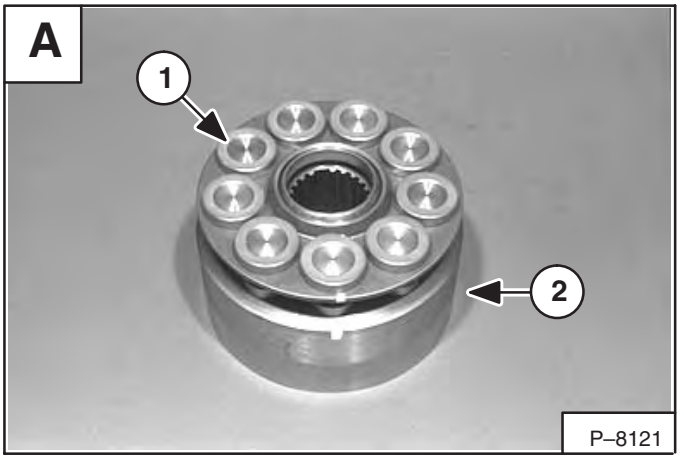
Dealer Copy -- Not for Resale

SWING MOTOR (Cont'd)

Assembly (Cont'd)

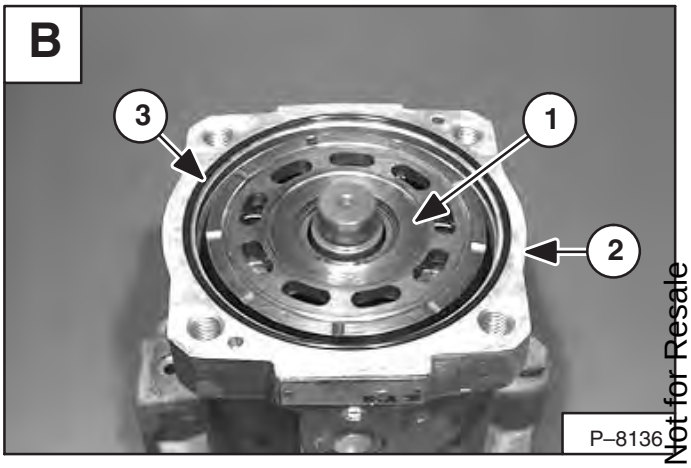
If the retainer plate and pistons (Item 1) **[A]** have been removed from the cylinder (Item 2) **[A]** align the marks and install the pistons and retainer plate (Item 1**[A]** back in the cylinder (Item 2) **[A]**.

NOTE: The pistons (Item 1) [A] must be installed in their original locations in the cylinder (Item 2) [A].

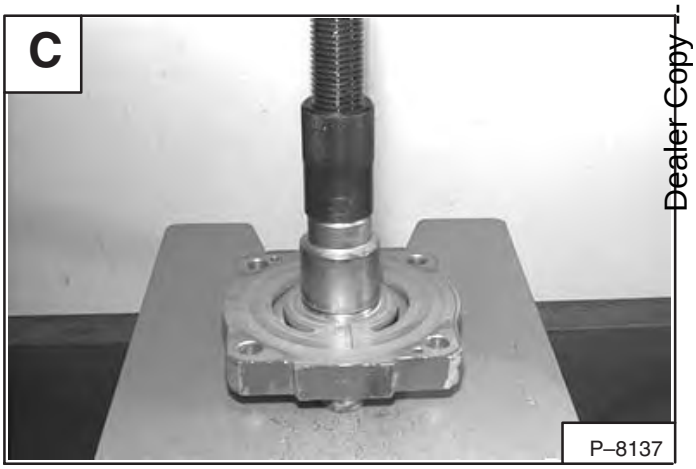


Insert the piston assembly (Item 1)**[B]** in the swing motor assembly (Item 2) **[B]**.

Install a new O–ring (Item 3) **[B]** on the swing motor assembly.



Press the bearing in the valve plate cover **[C]**.



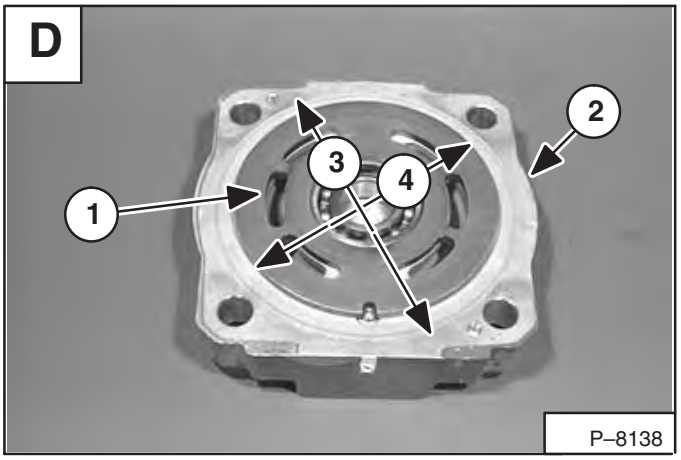
Install the valve plate (Item 1)**[D]** on the valve plate cover (Item 2) **[D]**.

NOTE: The valve plate must be installed with the grooved or shiny side towards the cover plate. Inspect the kidney ports for damage. Replace if damaged, do not surface grind.

Checking the valve plate flatness:

1. Measure the flatness of the port block with the valve removed. It must be less than 0.0005 mm (Item 3) **[D]**.

2. Measure the flatness of both surfaces of the valve plate. It must be less than 0.007 mm (Item 4) **[D]**.



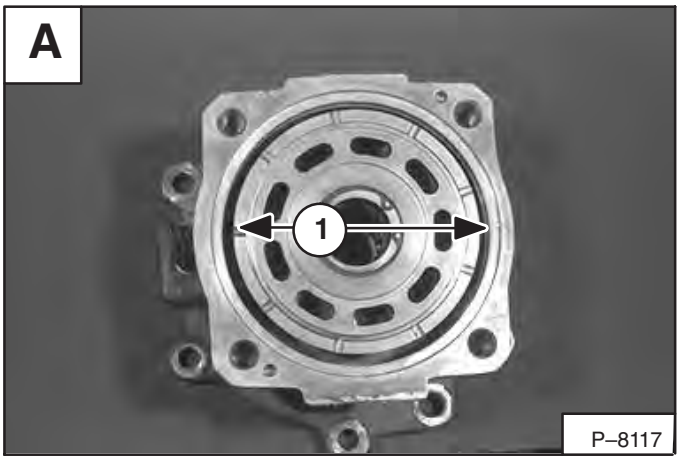
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SWING MOTOR (Cont'd)

Assembly (Cont'd)

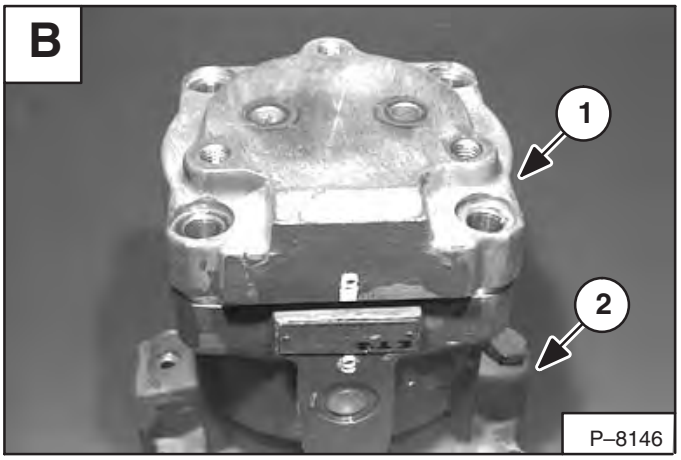
Checking the valve block flatness:

1. Measure the flatness of the cylinder block sliding surface where it contacts the valve plate **[A]**. The variance must be less than 0.005 mm.



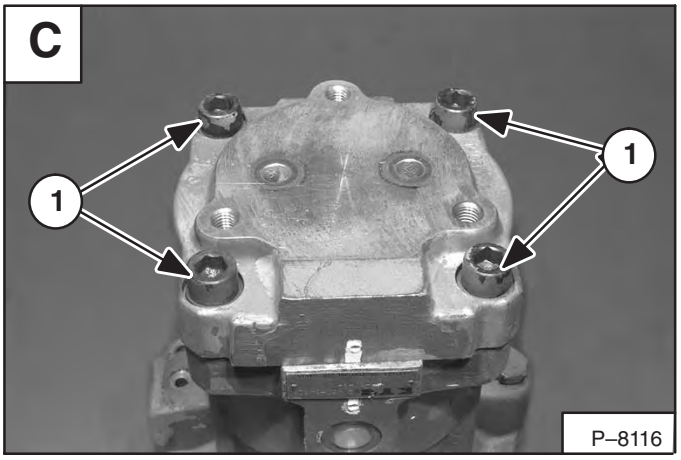
NOTE: Align the marks on the housing.

Install the valve cover plate assembly (Item 1)**[B]** on the swing motor assembly (Item 2) **[B]**.



Install the four bolts and washers (Item 1)**[C]** and tighten .

Tighten the bolts to 66.5 ft.–lbs. (90,2 Nm) torque.



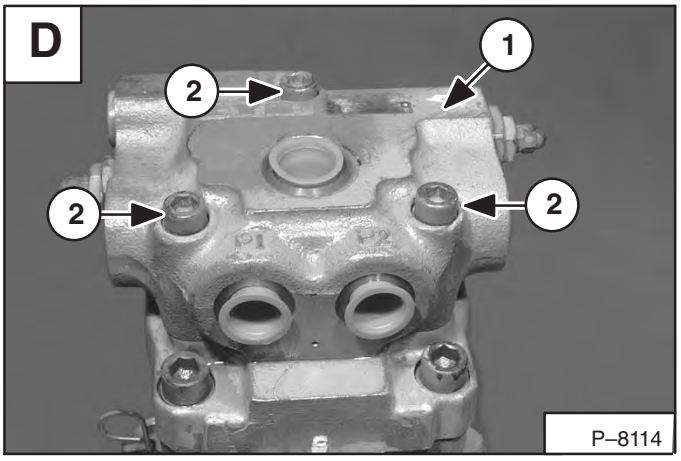
Install the valve assembly (Item 1)**[D]** and install the three bolts (Item 2) **[D]** and tighten.

Tighten the bolts to 42.0 ft.–lbs. (57,0 Nm) torque.

Uneven or improper tightening torque for the three bolts (Item 2) **[D]** on the valve block may cause the swing motor to drift. To correct the problem, loosen and re–torque the bolts to the required torque.

1. The three bolts (Item 2) **[D]** between the valve block and port block. Tighten to 42.0 ft.–lbs. (57,0 Nm) torque.

2. The four bolts (Item 1)**[C]** between the port block and the motor case. Tighten to 66.5 ft.–lbs. (90,2 Nm) torque.



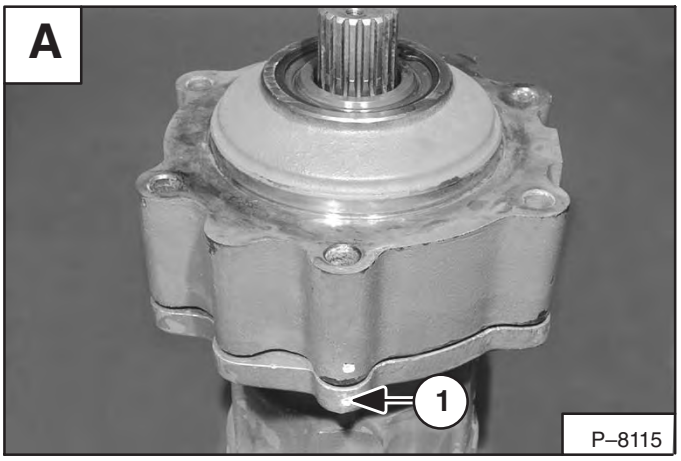
Dealer Copy -- Not for Resale

SWING MOTOR (Cont'd)

Assembly (Cont'd)

Install the two bolts (Item 1) **[A]** and fasten the reduction gearcase assembly.

Tighten the bolts to 42.0 ft.–lbs. (57.0 Nm) torque.



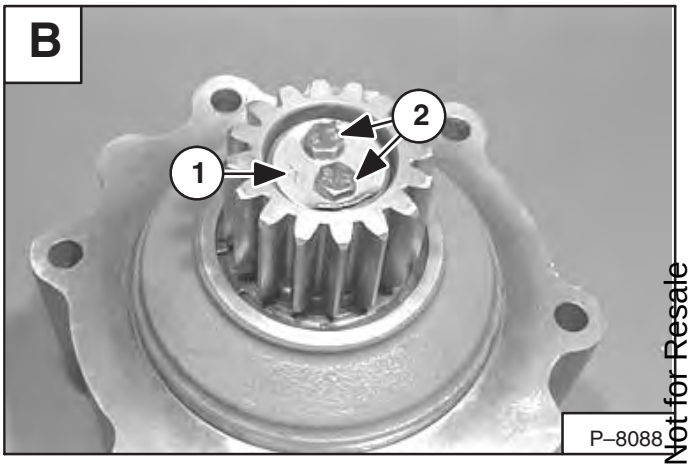
REDUCTION GEAR

Disassembly

Drain oil from the unit.

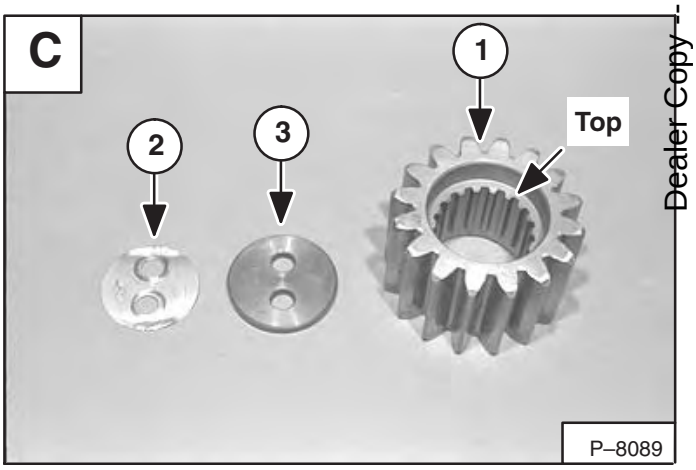
Flatten the locking plate (Item 1) **[B]**.

Remove the bolts (Item 2) **[B]**.

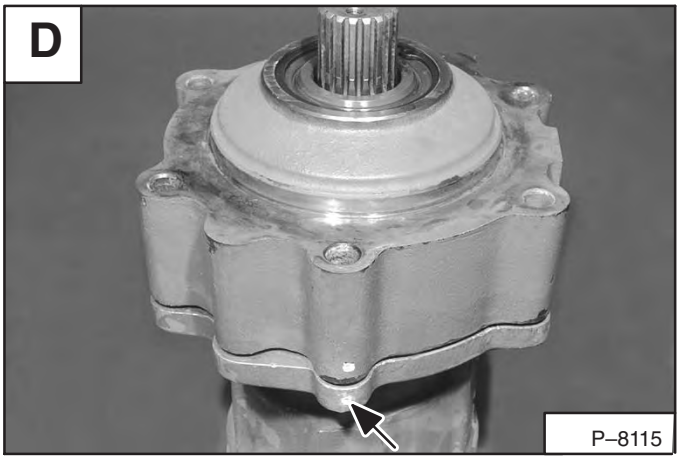


Remove the drive gear (Item 1) **[C]**, the locking plate (Item 2) **[C]** and the plate (Item 3) **[C]** from the shaft.

NOTE: The drive gear only goes on one way. Deepest groove to the top.



Mark the swing motor case and the lower housing for ease of assembly **[D]**.

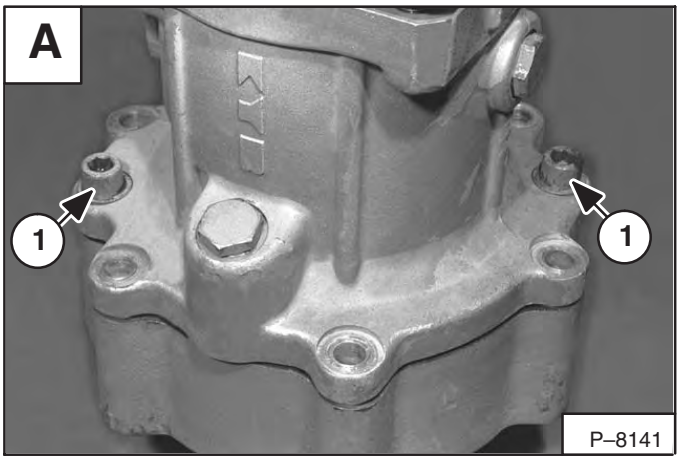


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REDUCTION GEAR (Cont'd)

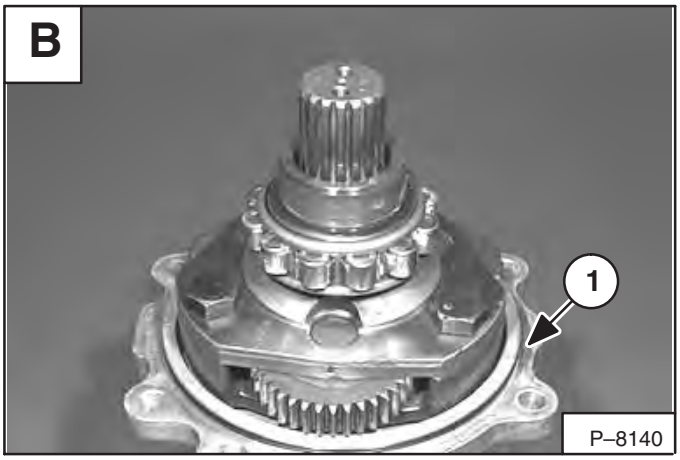
Disassembly (Cont'd)

Remove the two bolts (Item 1)**[A]** from the upper casing.

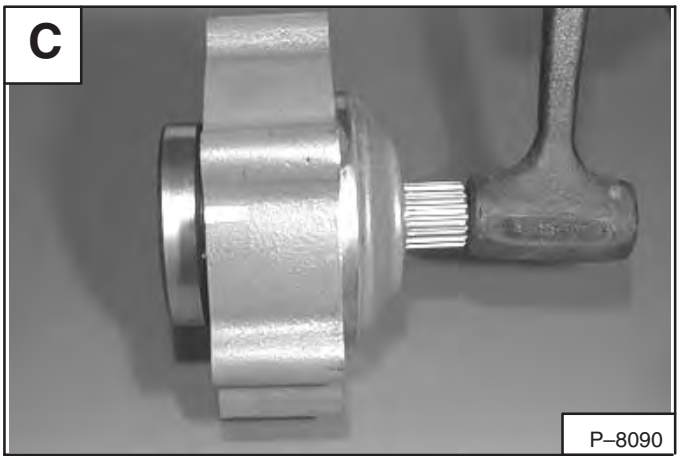


Remove the upper housing from the lower housing **[B]**.

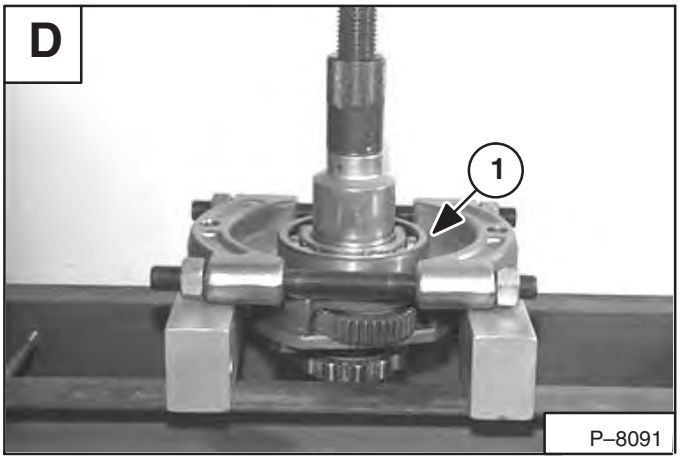
Remove the O–ring (Item 1) **[B]** from the upper housing.



Remove the shaft assembly from the lower housing by laying the housing on its side and tap with a mallet on the shaft assembly **[C]**.



Remove the bearing (Item 1)**[D]** from the shaft assembly



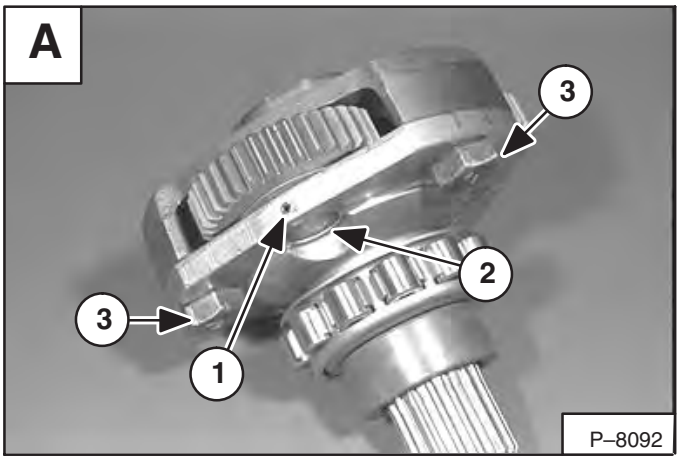
Dealer Copy -- Not for Resale

REDUCTION GEAR (Cont'd)

Disassembly (Cont'd)

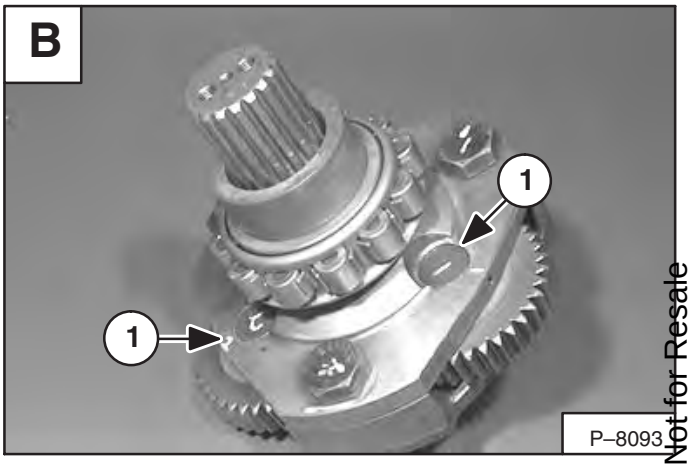
Drive the spring pins (Item 1) **[A]** so it is inside the gear pin (Item 2) **[A]**.

Do not remove the three bolts (Item 3) [A] for any reason as it is a matched assembly.

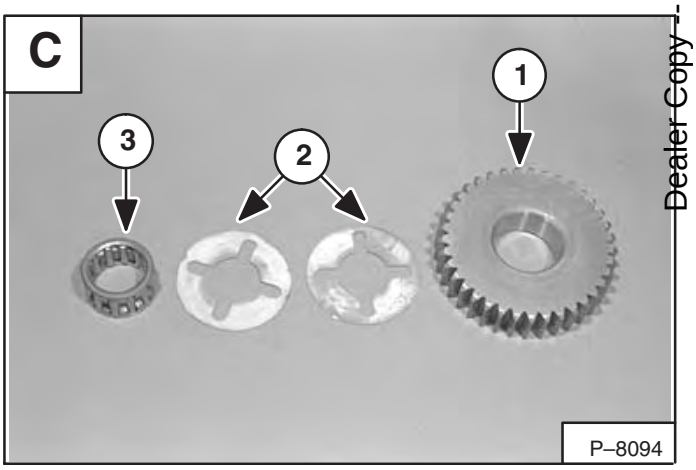


Remove the three pins (Item 1) **[B]** tapping them out from the bearing side.

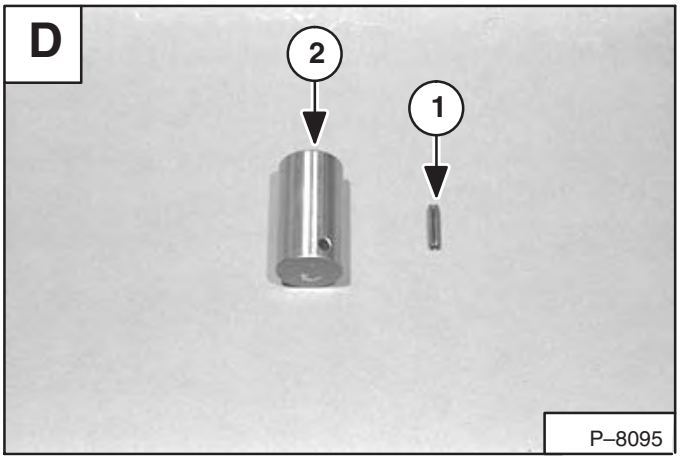
NOTE: Mark the pins and housing for ease of assembly.



Remove the gear (Item 1) **[C]** the two washers (Item 2) **[C]** and the bearing (Item 3) **[C]** as one unit from the assembly.



Remove the spring pins (Item 1) **[D]** from the shaft (Item 2) **[D]**.

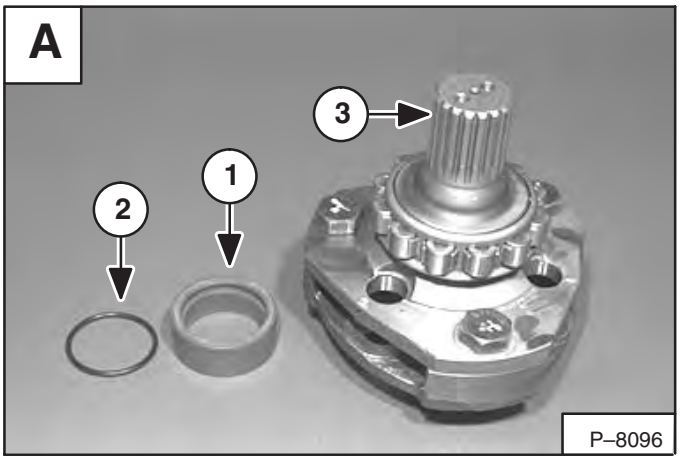


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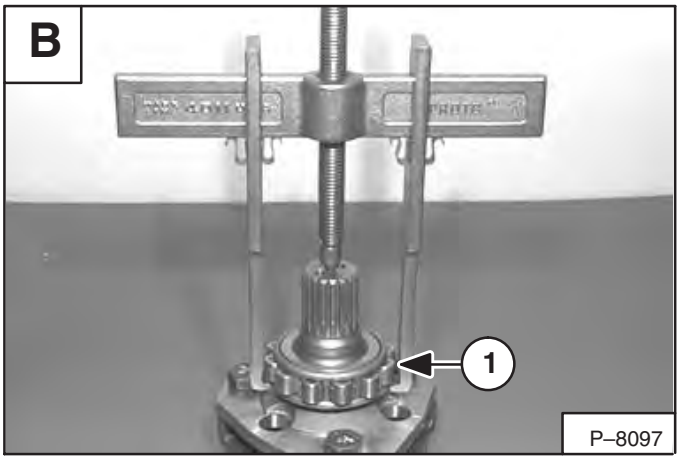
REDUCTION GEAR (Cont'd)

Disassembly (Cont'd)

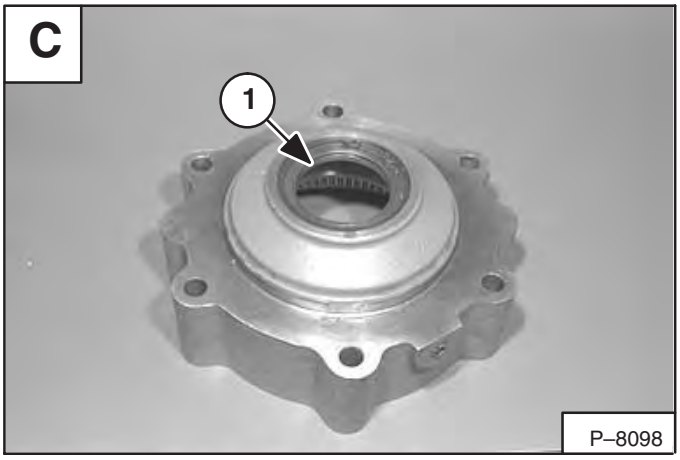
Remove the spacer (Item 1) **[A]** and O–ring (Item 2) **[A]** from the shaft assembly (Item 3) **[A]**.



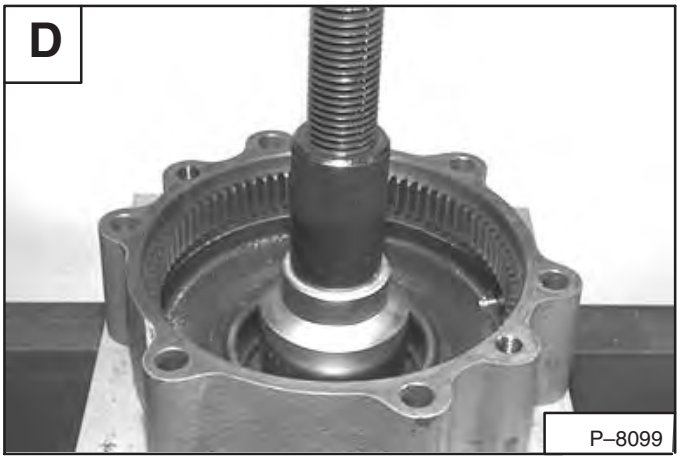
Remove the bearing (Item 1)**[B]** from the shaft assembly



Remove the snap ring (Item 1) **[C]** from the upper housing.



Remove the seal fromthe upper housing **[D]** push only on the seal not the flange.



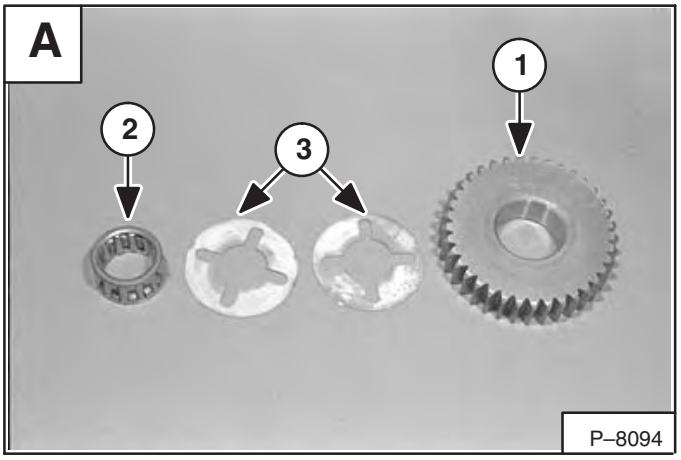
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REDUCTION GEAR (Cont'd)

Assembly

Clean all parts in solvent and dry with compressed air . Inspect all of the parts and replace any that are damaged. If any of the planetary gears are damaged replace all the planetary and sun gear. One damaged gear can cause microscopic fatigue cracks in mating gear teeth and cause premature failure after servicing. Apply oil to all O–rings, and light grease to the ball and roller bearings before installation.

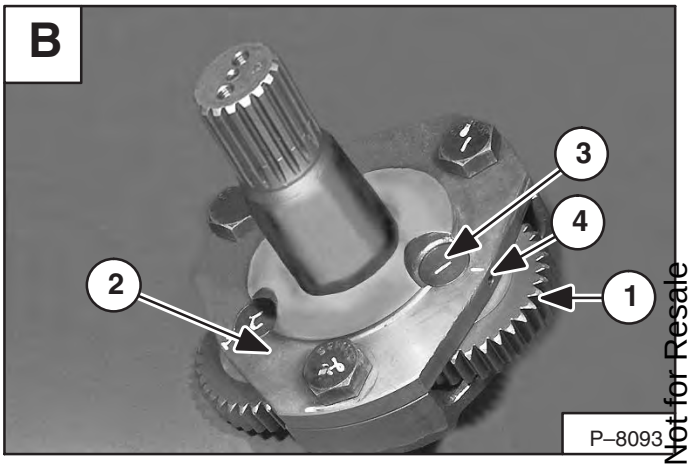
Assemble the gear (Item 1) **[A]**, the bearing (Item 2) **[A]** and the two washers (Item 3) **[A]**.



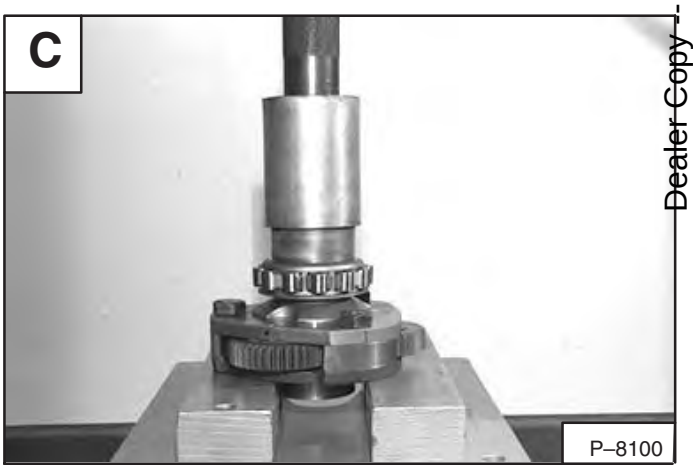
Install the gear assembly (Item 1) **[B]** in the planetary assembly (Item 2) **[B]**.

Install the three pins (Item 3) **[B]**.

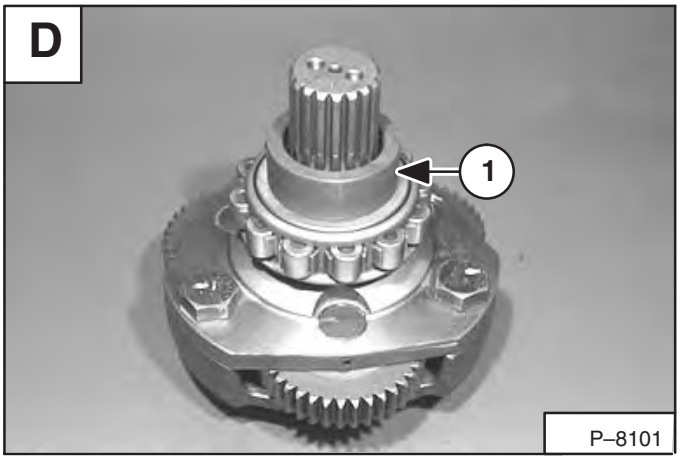
Install the roll pins (Item 4) **[B]** flush with the outer surface of the planetary assembly.



Install the bearing on the shaft assembly **[C]**.



Install a new O–ring in the spacer and install the spacer (Item 1) **[D]** on the shaft assembly.

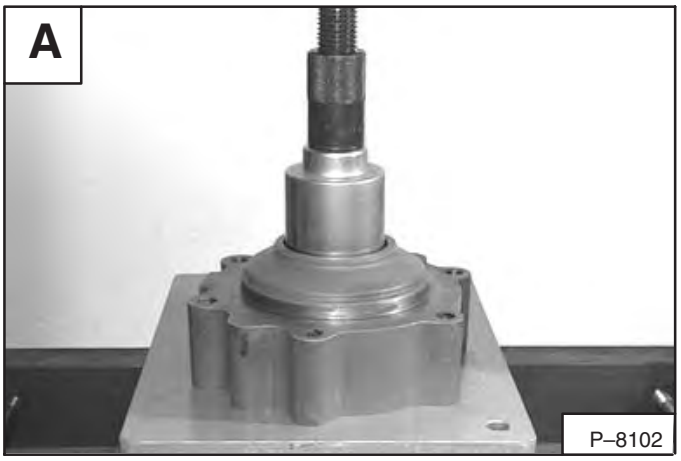


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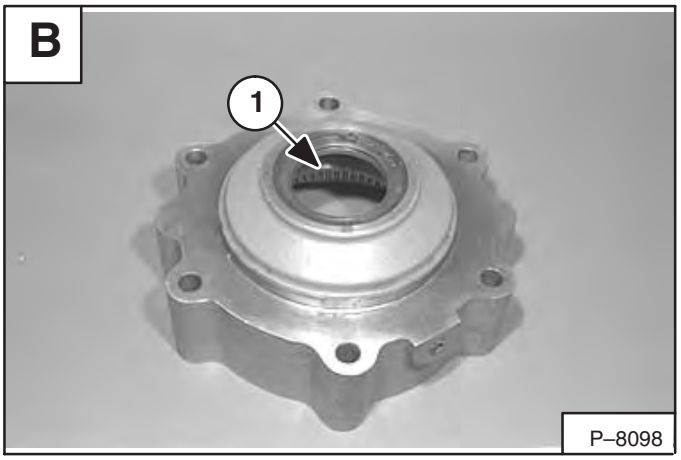
REDUCTION GEAR (Cont'd)

Assembly (Cont'd)

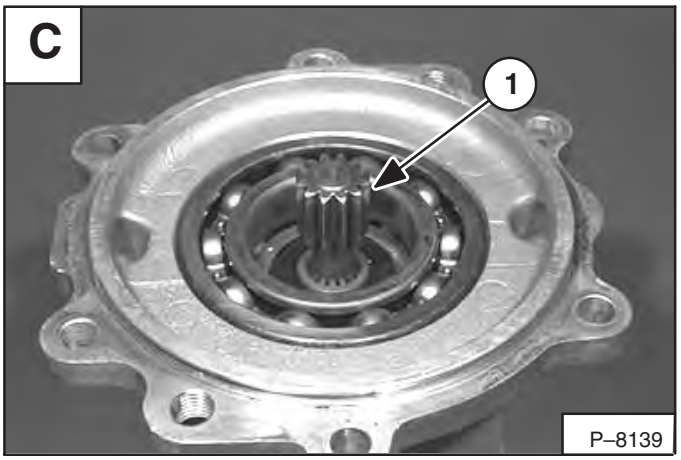
Install the new oil seal in the lower housing until the snap ring groove is seen **[A]**.



Install the snap ring (Item 1) **[B]** in the lower housing.

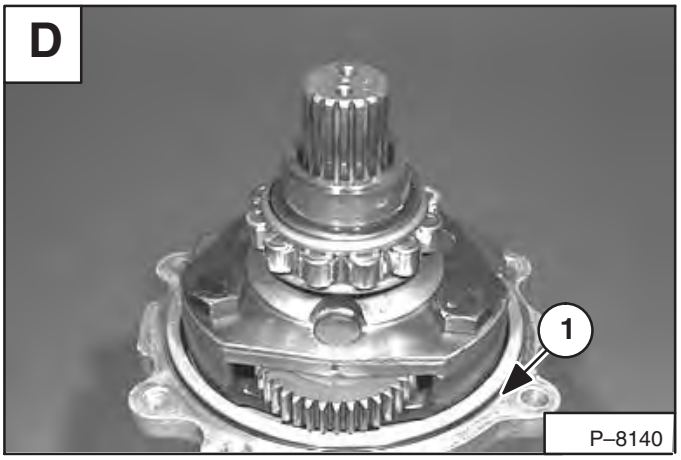


Install the shaft (Item 1) **[C]** in the swing motor.



Tap the shaft assembly in the upper housing **[D]**.

Install a new O–ring (Item 1) **[D]** on the swing motor.



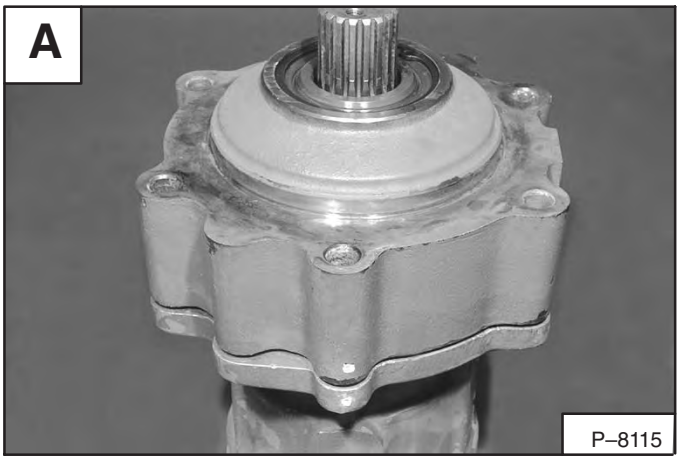
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REDUCTION GEAR (Cont'd)

Assembly (Cont'd)

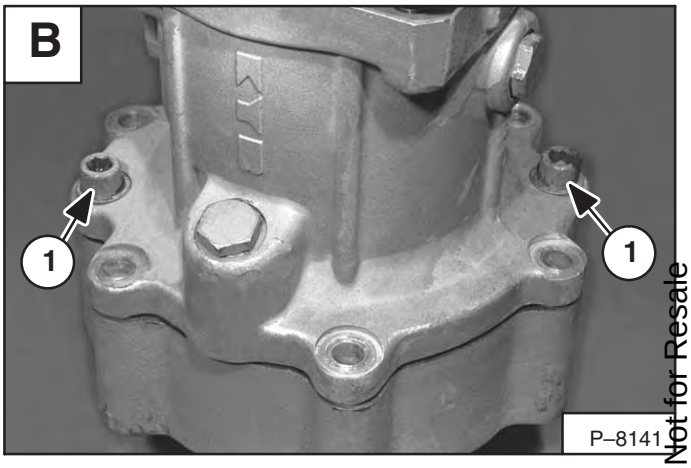
Install the lower housing on the shaft assembly by aligning the planetary gears.

NOTE: Make sure to align the marks made earlier.

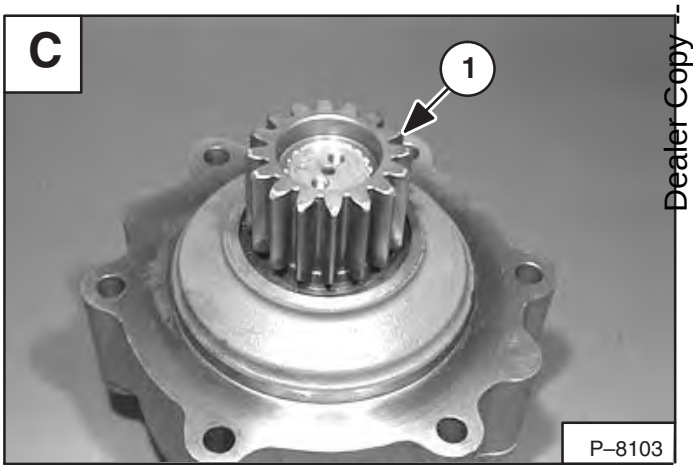


Install the two bolts (Item 1) **[B]**.

Tighten the bolts to 42.0 ft.–lbs. (57.0 Nm) **[B]**.

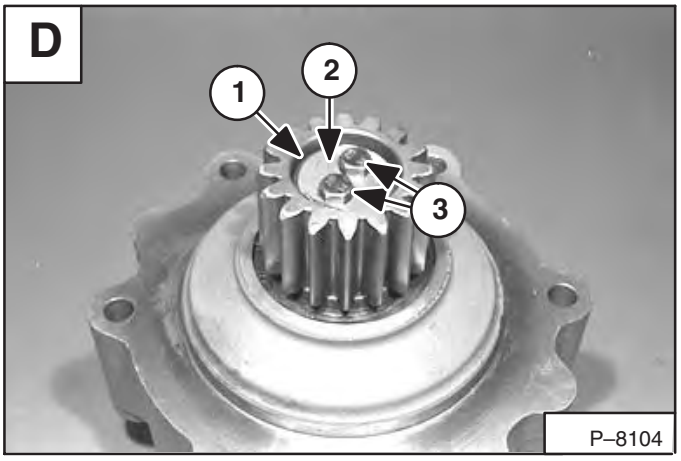


Install the pinion gear (Item 1) **[C]** on the shaft.



Install the plate (Item 1) **[D]**, the locking washer (Item 2) **[D]**, and the two bolts (Item 3) **[D]**.

Tighten the bolts to 21.0 ft.–lbs. (28.5 Nm) torque.

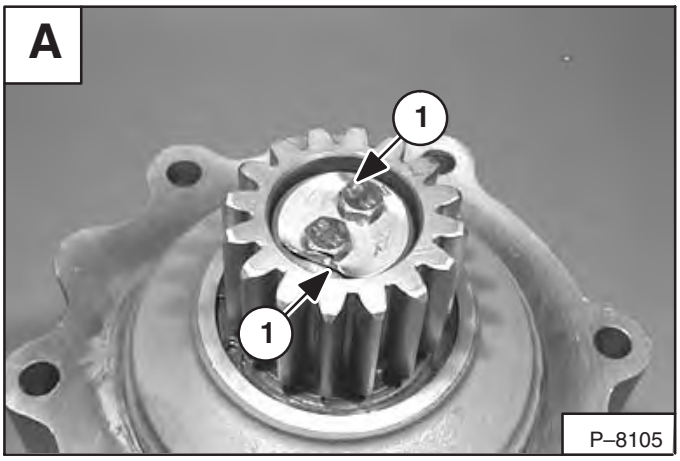


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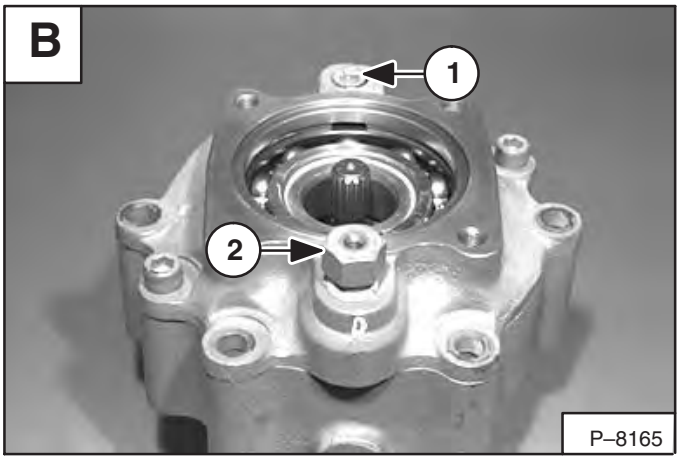
REDUCTION GEAR (Cont'd)

Assembly (Cont'd)

Bend the locking washer (Item 1) **[A]** to keep the two bolts from loosening.



Install the plug (Item 1) **[B]** and the dipstick plug (Item 2) **[B]** in the assembly.



The oil capacity and type for the reduction gearcase are as follows:

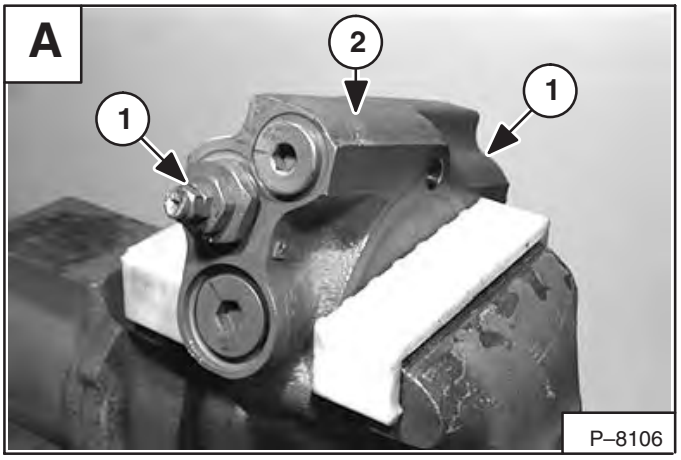
Capacity . . . . . 0.63 qts (0,6 L)
Oil Type . . . . . 90W gear oil

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RELIEF VALVE

Disassembly

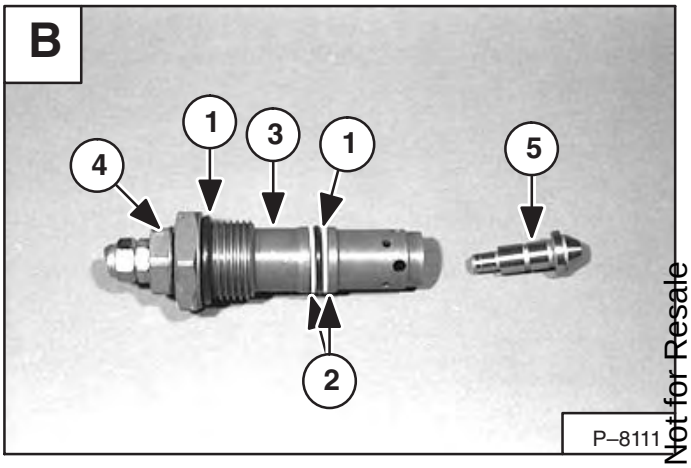
Remove the two relief valve cartridges (Item 1) **[A]** from the valve assembly (Item 2) **[A]**.



Remove the O–rings (Item 1) **[B]** and the two back–up washers (Item 2) **[B]** from the housing (Item 3) **[B]**.

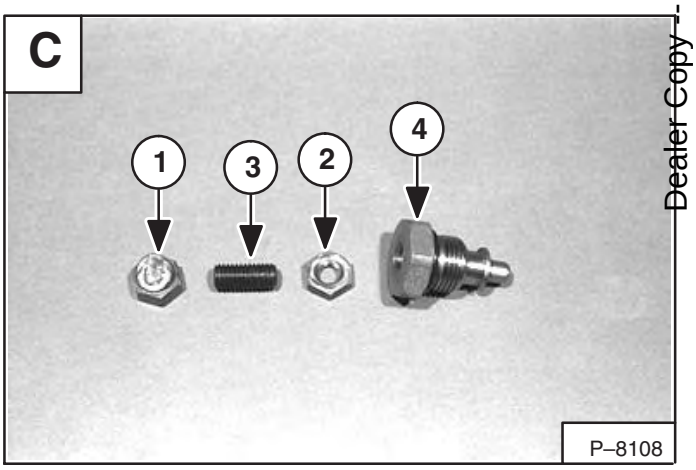
Remove the adjusting bolt assembly (Item 4**[B]** from the housing (Item 3) **[B]**.

Remove the poppet (Item 5) **[B]** from the housing (Item 3) **[B]**.

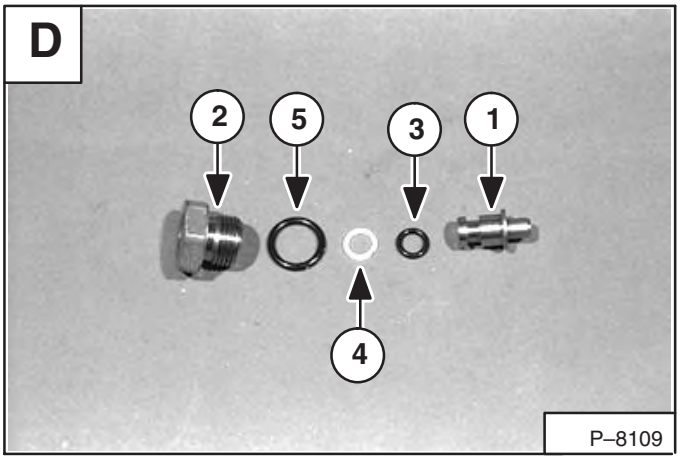


Remove the cap (Item 1)**[C]**, the jam nut (Item 2) and the set screw (Item 3) **[C]** from the plug (Item 4) **[C]**.

The jam nut (Item 2) **[C]** does not need to be removed from the set screw (Item 3) **[C]**.



Remove the guide assembly (Item 1) **[D]** from the plug (Item 2) **[D]**. Remove the O–ring (Item 3**[D]**, the back–up washer (Item 4) **[D]** and the O–ring (Item 5) **[D]** from the plug (Item 2) **[D]**.



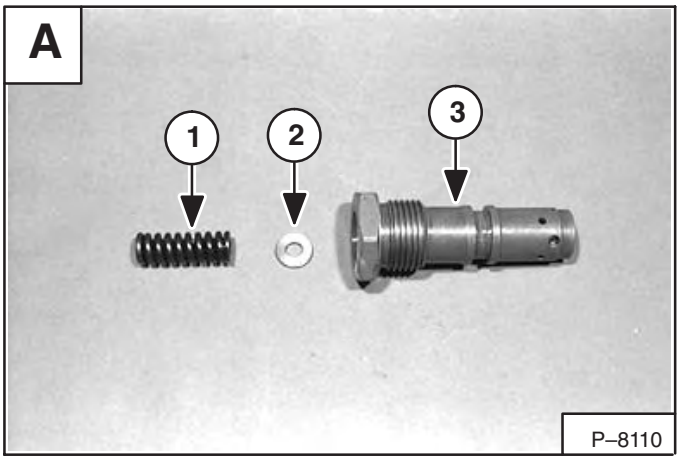
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RELIEF VALVE (Cont'd)

Disassembly (Cont'd)

Remove the spring (Item 1) **[A]** and the spring seat (Item 2) **[A]** from the housing (Item 3) **[A]**.

NOTE: The inside diameter of the spring seat is beveled on one side only , and should be installed with the spring resting on the non–beveled side.



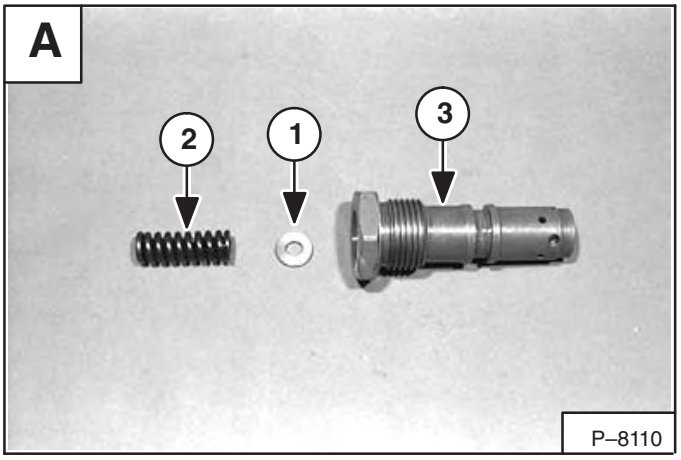
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RELIEF VALVE (Cont'd)

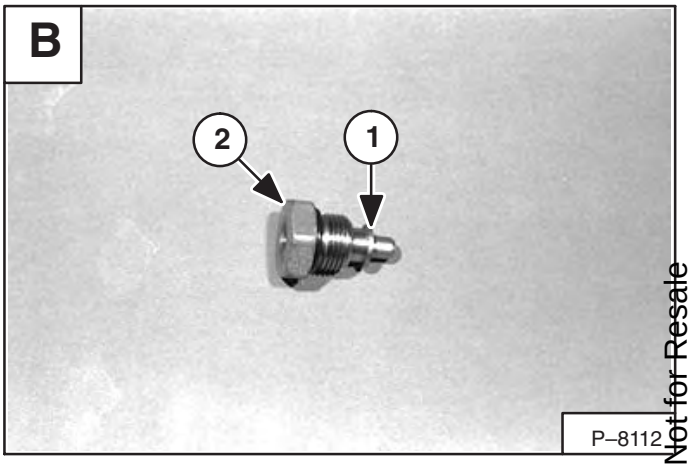
Assembly

Apply oil to the O–rings, and back–up washer and install. Be careful not to over stretch these parts during installation. Install the spring seat (Item 1)**[A]** and spring (Item 2) **[A]** in the housing (Item 3) **[A]**.

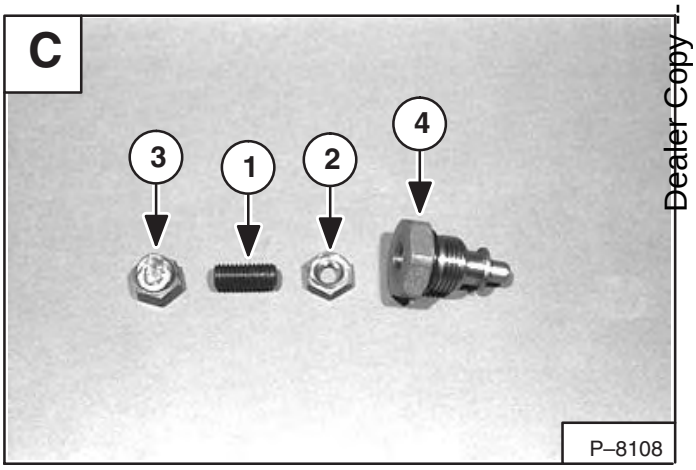
NOTE: The inside diameter of the spring seat is beveled on one side only , and should be installed with the spring resting on the non–beveled side.



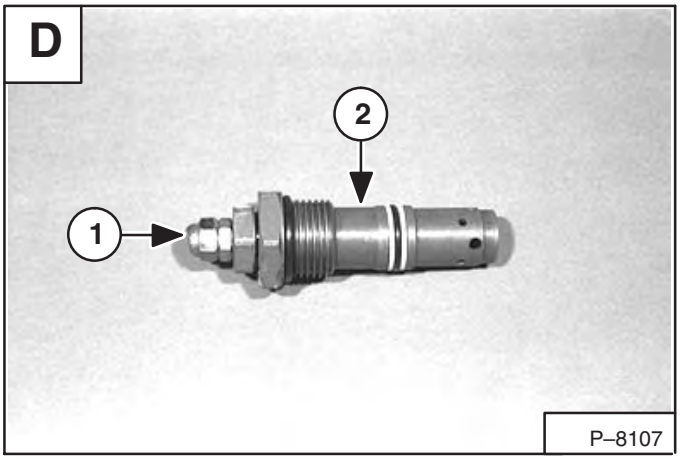
Install the guide assembly (Item 1) **[B]** in the plug (Item 2) **[B]**.



Install the set screw (Item 1) **[C]** the jam nut (Item 2) **[C]** and the cap (Item 3) **[C]** in the plug (Item 4) **[C]**.



Install the guide assembly and plug (Item 1) **[D]** in the housing (Item 2) **[D]**.

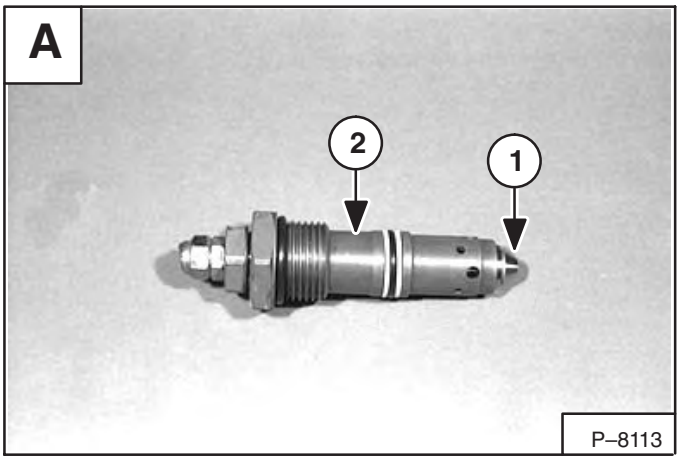


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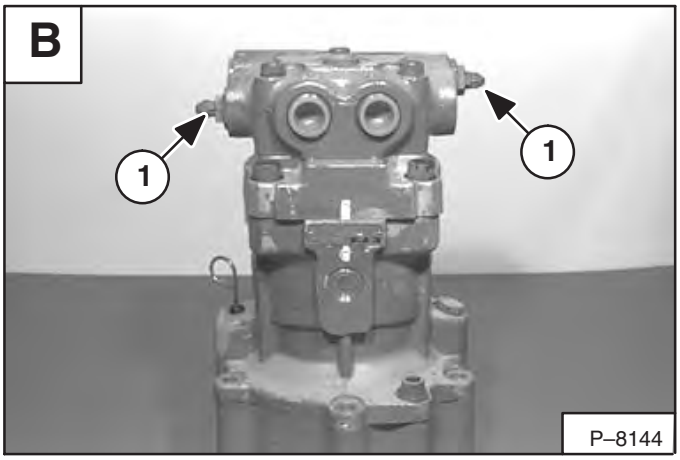
RELIEF VALVE (Cont'd)

Assembly (Cont'd)

Install the poppet (Item 1) **[A]** in the housing (Item 2)**[A]**.



Install the two relief valves (Item 1)**[B]** in the swing motor valve.



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RELIEF VALVE (Cont'd)

Adjustment

The brake valve used on the swing motor has two relief valves and two check valves mounted on either side of the valve body.

The two check valves are used to dampen the swing stop, preventing damage to the swing motor. The check valves also prevent the upper structure from independent movement, or creeping, until the swing circuit is engaged.

The relief valves prevent damage to the swing motor if the swing motor is engaged when the arm is in the ground or the swing lock is engaged.

The relief valves, control valve, and swing motor are shown removed from the excavator for photo clarity **[A]**.

Disconnect the outlet hose (Item 1) **[B]** from the middle pump sections.

Install a tee in between the middle pump section, outlet and the outlet hose.

Install a 5000 PSI gauge on the tee fitting.

Warm the excavator up to operating temperature.

With the swing lock engaged, activate the swing circuit in one direction.

Record the pressure.

Activate the swing circuit in the opposite direction. Record the pressure.

If adjustment is needed, remove the cap and loosen the lock nut (Item 1) **[C]**.

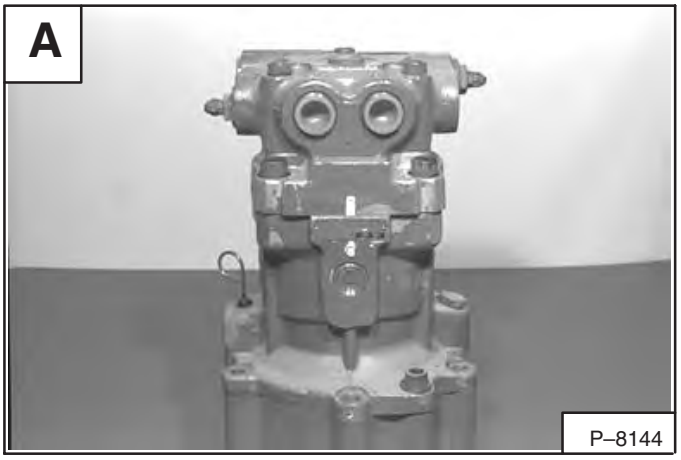
Turn the adjustment screw (Item 2) **[C]** until the correct pressure is recorded on the gauge.

NOTE: The swing motor is removed from the excavator for photo clarity.

The correct pressure setting for the relief valves is 1650 PSI (11375 kPa).

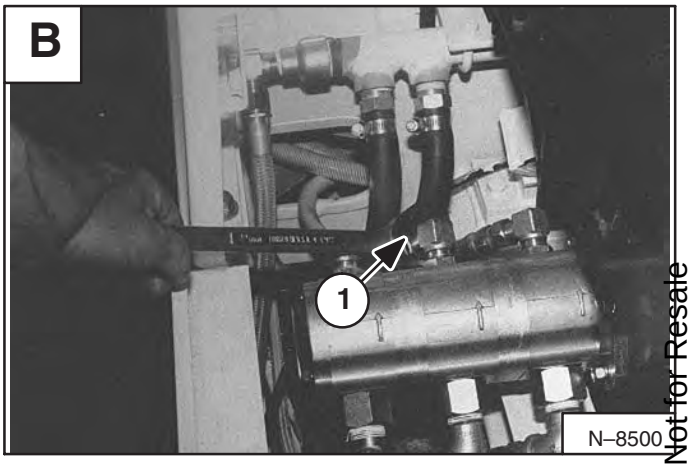
The front relief valve controls the clockwise direction of rotation while the rear relief valve controls the counterclockwise direction of rotation.

A



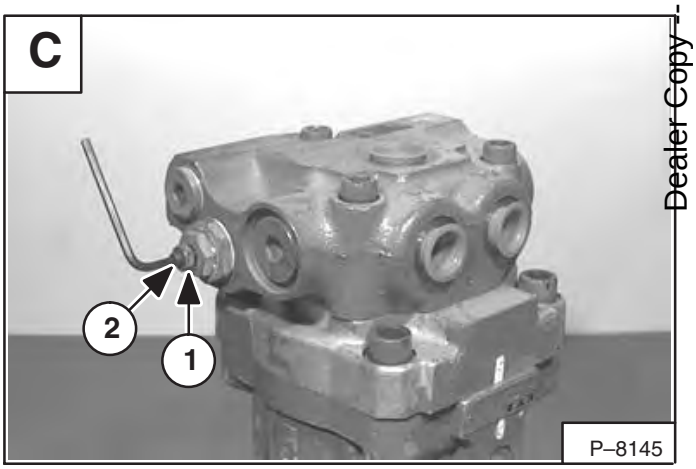
P–8144

B



N–8500

C



P–8145

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UPPER WORKS AND SWING CIRCLE GEAR

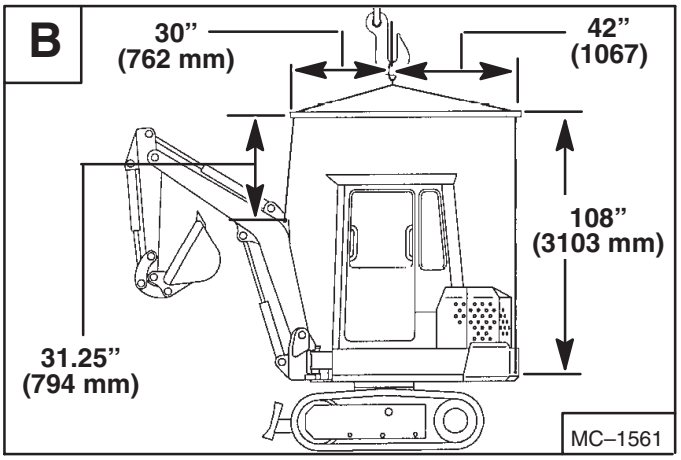
This section involves the removal and installation of the complete upperstructure. It explains how to separate the upperstructure from the track frame.

Removal and Installation

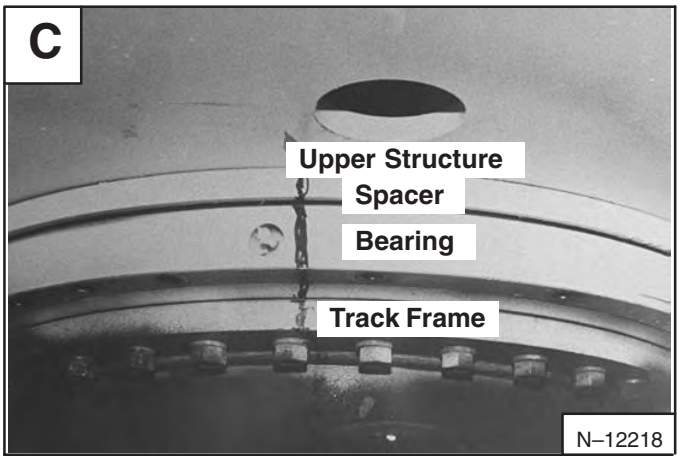
Connect a lifting sling to the excavator at the rear of the swing frame and to the lift hook holes in the boom **[A]**.



The boom must be in full raised position and centered to the front of the excavator. For approximate lifting data and dimensions, see information in**[B]**. (See Page 8–1 for the excavator weight information.)



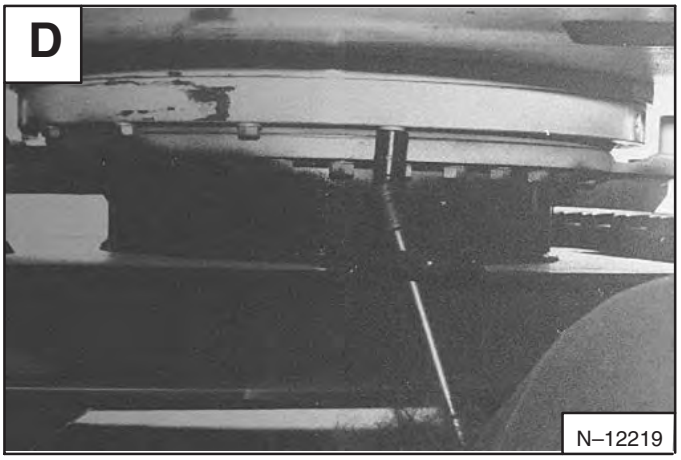
Mark the upperstructure to the swing bearing to the track frame for the ease of realignment **[C]**.



Partially disassemble the upperstructure from the swing bearing by removing all but four bolts which are spaced at 90 degrees from each other **[D]**. The upperstructure must be rotated to gain access to the bolts for removal. Start the engine and run it at idle. Remove a bolt from the swing bearing, then move out of the way of upperstructure and slowly rotate the excavator until access to the next bolt is available. Removethis bolt and continue the above procedure.

NOTE: A minimum of 4 evenly spaced bolts must be left installed at this point of time.

Remove the floormat and floor plate. (See Page 5–1 of Service Manual.)



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Remove the tee fitting with the two hoses from the rear of the drain block **[A]**. Reposition these hoses out of the way.

IMPORTANT

When repairing hydrostatic and hydraulic systems, clean the work area before disassembly and keep all parts clean. Always use caps and plugs on hoses, tubelines and ports to keep dirt out. Dirt can quickly damage the system.

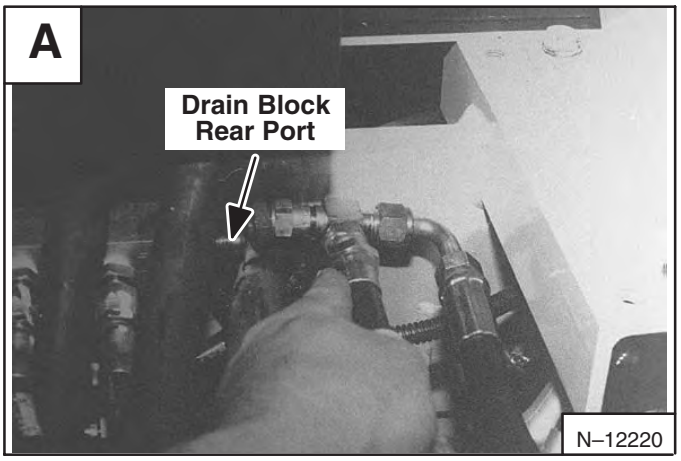
I–2003–0888

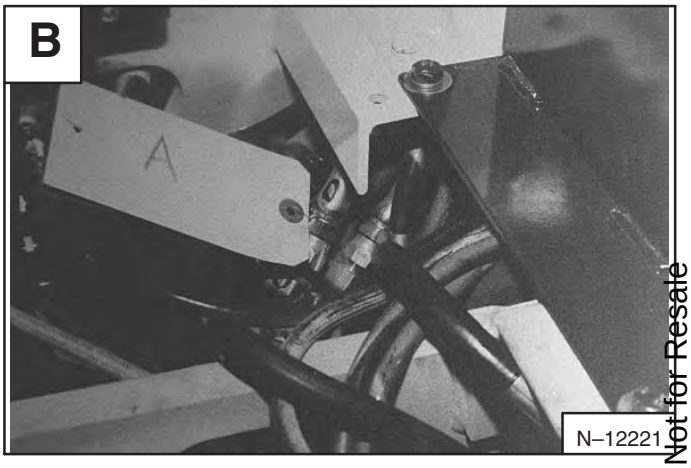
Mark the seven hoses and fittings on the top portion of the swivel for correct installation **[B]**. Remove the hoses from the swivel joint.

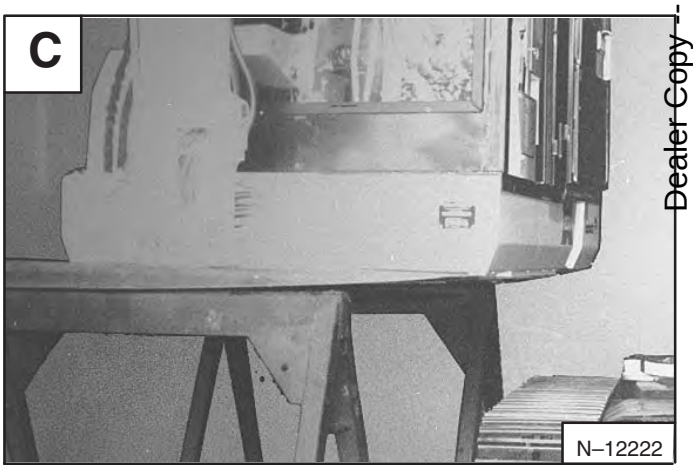
Apply a slight amount of lifting pressure to the upperstructure with the lift sling. Remove the four remaining bolts holding the upperstructure to the swing bearing.

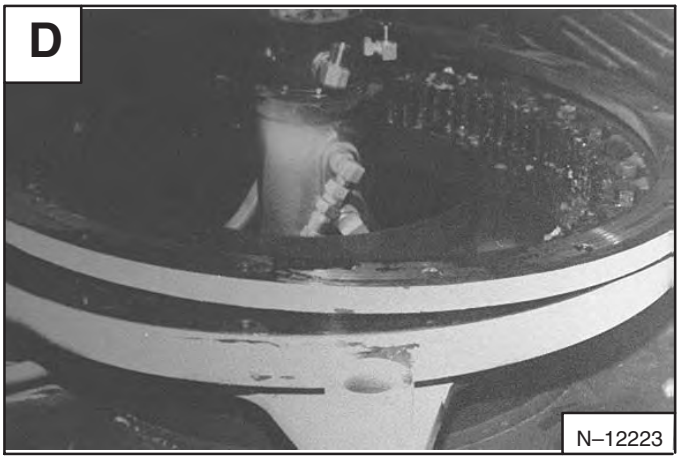
Lift the upperstructure off of the swing bearing. Position the upperstructure onto suitable supporting stands or blocks **[C]**.

Remove the spacer ring from the top of the swing bearing **[D]**.







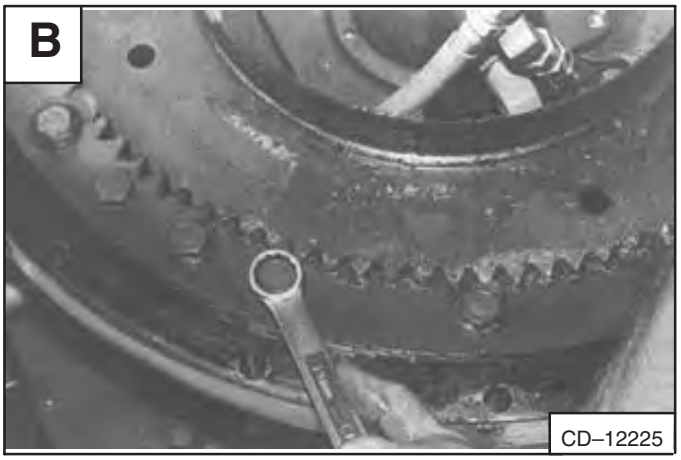


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Install a c–clamp or other suitable retainer to prevent the swing bearing from turning while being removed **[A]**.



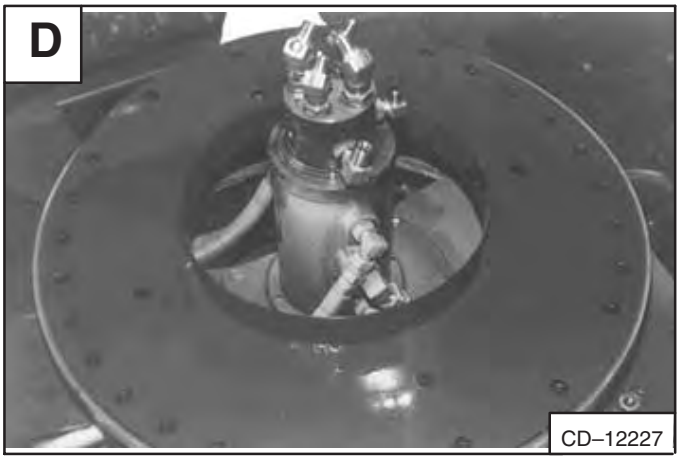
Remove the 24 bolts, lock washers and nuts that hold the swing bearing to the track frame **[B]**.



Mark the top surface of the swing bearing for ease of reassembly. Remove the swing bearing from the track frame **[C]**.



Remove the grease cover from the track frame. Clean and inspect the grease cover for damage **[D]**. Replace if necessary.



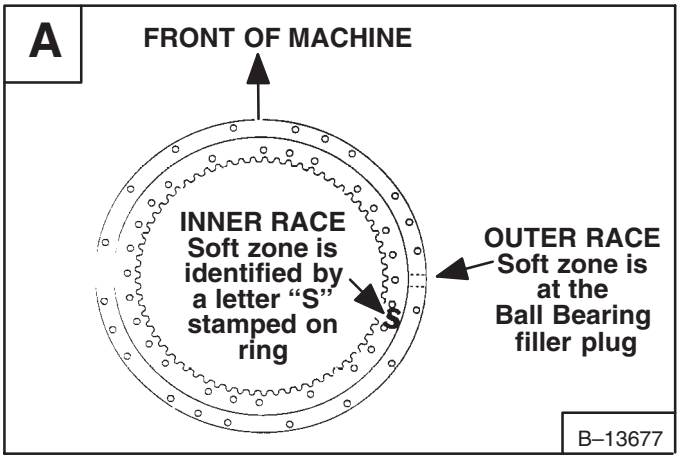
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Reinstalling the Swing Bearing

If reusing the existing swing bearing, use top side and edge aligning marks to correctly position swing bearing. If a new swing bearing isbeing installed, locate soft zone area **[A]**.

Install the swing bearing so that the soft zone is positioned to either the L.H. or R.H. side of the excavator.

NOTE: DO NOT locate the soft zone to the front or rear of excavator.



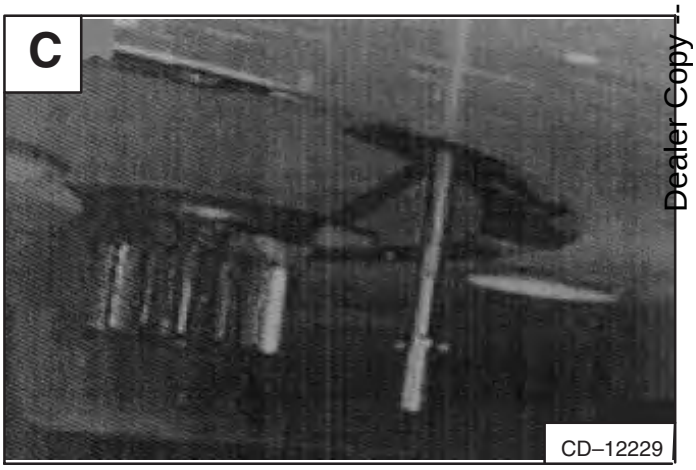
Reinstall the 24 bolts and lock nuts **[B]**.

NOTE: If excavator was originally equipped with lock washers and nuts, order new lock nut (P/N 39DM–12), quantity 24. Tighten the lock nuts to 90 ft.–lbs. (120 Nm) torque.

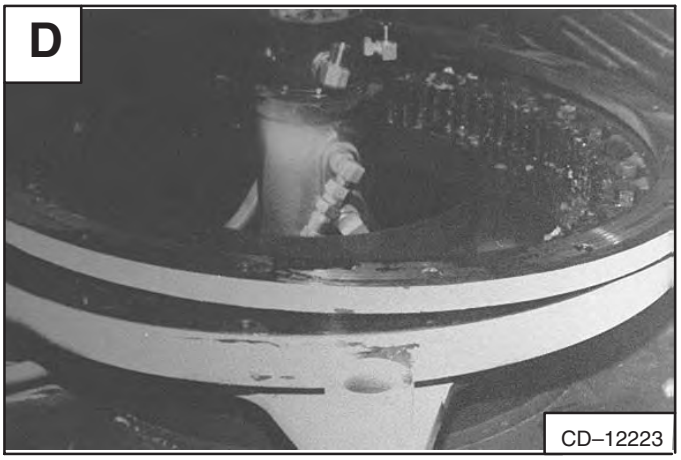


Run a tap (12 mm) into the tapped holes in the upperstructure to remove any dried LOCTITE or burrs **[C]**.

NOTE: While running the tap into these holes, you will notice that 3 holes are NOT thru holes. Mark these 3 holes so that they can be located during later assembly.



Reinstall the spacer ring onto the swing bearing **[D]**. Make note of the alignment marks, which were made earlier.

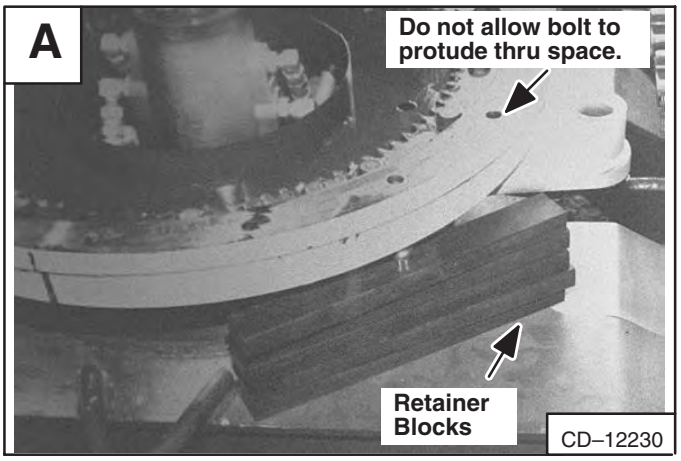


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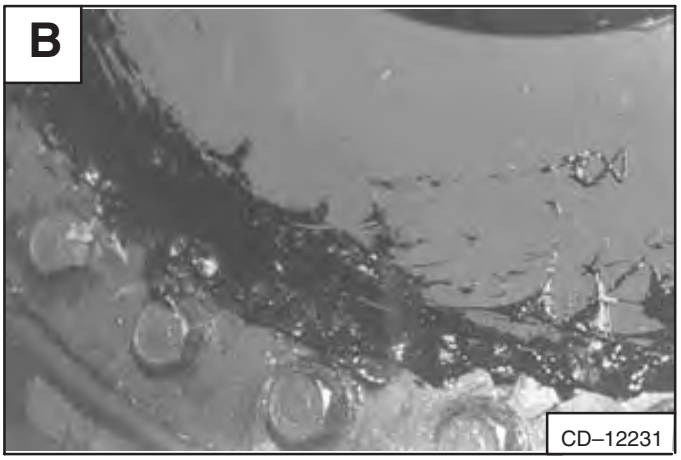
UPPER WORKS AND SWING CIRCLE GEAR (Cont'd)

Reinstalling the Swing Bearing (Cont'd)

Insert two or three bolts (from the bottom) thru the swing bearing and into the spacer ring. The bolt threads should not protrude thru the spacer ring. Use wood blocks or other types of retainers to hold these bolts in this position **[A]**. This will keep the spacer ring positioned properly to the swing bearing during the reassembly of the upperstructure.

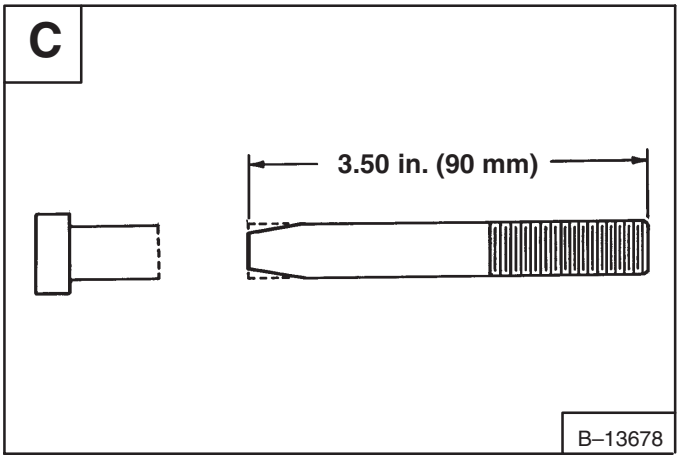


Grease the swing bearing gear with lubriplate grease or equivalent **[B]**.



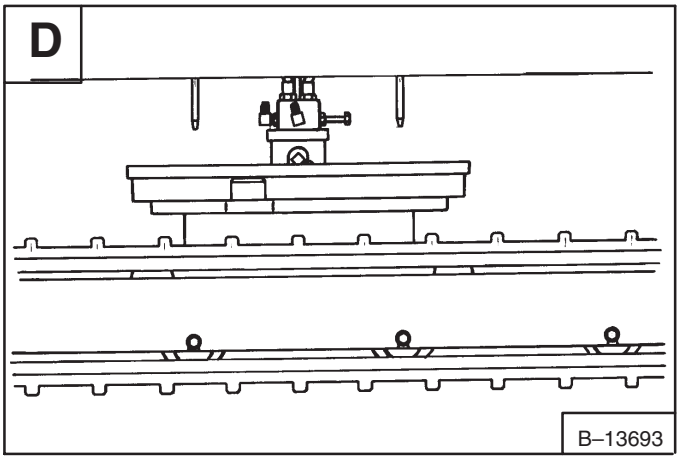
Make three alignment pins by using M12 x 110 mm (P/N 7GM–12110) long bolts. Cut the head of of these bolts at 90 mm and then taper this end of the bolt.

Install these three pins into the upperstructure at approximately 120° apart **[C]**. These will act as alignment pins while lowering the house frame onto the swing bearing.



Reposition the upperstructure onto the swing bearing using the alignment marks and the alignment pins to assist in repositioning of these components **[D]**.

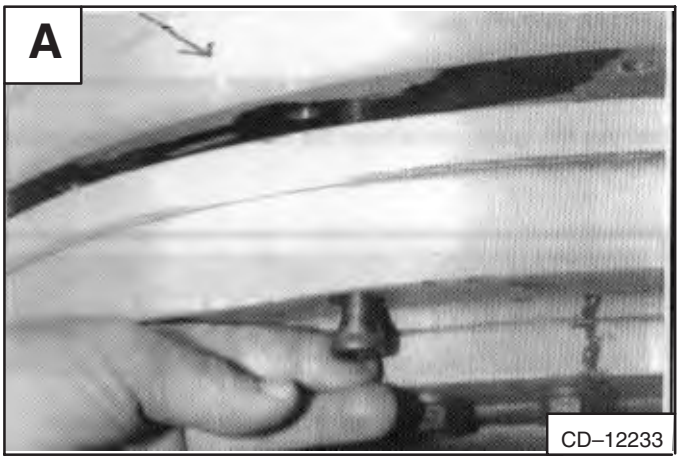
Make sure that the swing motor gear teeth mesh with the swing bearing teeth and that the swivel joint is centered into the upperstructure access hole.



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UPPER WORKS AND SWING CIRCLE GEAR (Cont'd)

Reinstalling the Swing Bearing (Cont'd)



Install the three tapered head alignment bolts (P/N 6535902) thru the swing bearing and into the upperstructure **[A]**. These bolts should be spaced at approximately 120°. This procedure will properly align the upperstructure for correct swing motor gear to the swing bearing ring gear clearance.

Tighten these three tapered bolts to 60 ft.–lbs.

Remove the three, 3.50 inch alignment pins from the upperstructure.

These headless pins can be removed from the bottom with a clamp on style plier.

Examine the length of the swing bearing to the upperstructure bolts. Three of these bolts will be 70 mm long and the remaining bolts will be 74 mm long. Also, if excavator was originally equipped with lock washers used with these bolts, discard and order hardened washers (P/N 27E–7), quantity 16.

Reinstall the hoses and fittings that were previously removed. With the hoses reconnected, the engine can be started and run at idle to rotate the upperstructure to install and tighten the bolts.

Apply LOCTITE #242 to the threads of the bolts. Install the three 70 mm long bolts into the holes that were previously marked as non–thru holes. Install the remaining bolts into all holes (except the three with the alignment bolts installed). Tighten these bolts to 80 ft.–lbs. (108 Nm) torque.

Remove the three alignment bolts (P/N 6535902). Install the three remaining 74 mm long bolts. Tighten these bolts to 80 ft.–lbs. (108 Nm) torque..

Reinstall the floor plate and floormat.

Check the hydraulic fluid level and add as necessary.

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CENTER SWIVEL JOINT

Removal and Installation (Through Upper Access Removal)

Remove the upper works from the swing gear and track frame . (See Page 4–2.)

IMPORTANT

When repairing hydrostatic and hydraulic systems, clean the work area before disassembly and keep all parts clean. Always use caps and plugs on hoses, tubelines and ports to keep dirt out. Dirt can quickly damage the system.

I–2003–0888

Mark all the hoses for correct installation.

Disconnect the hoses from the swivel joint **[A]**.

Remove the bolts from the plate (Item 1) **[A]** below the center swivel joint.

Installation: Tighten the bolts to 220–245 ft.–lbs. (300–330 Nm) torque.

Remove the center swivel joint mounting bolts (Item 2) **[A]**.

Installation: Tighten the bolts to 65–70 ft.–lbs. (88–95 Nm) torque.

Remove the center swivel joint from the track frame.

Removal and Installation (Through Bottom Access Cover)

Lower blade and boom to the ground.

Stop engine.

⚠ WARNING

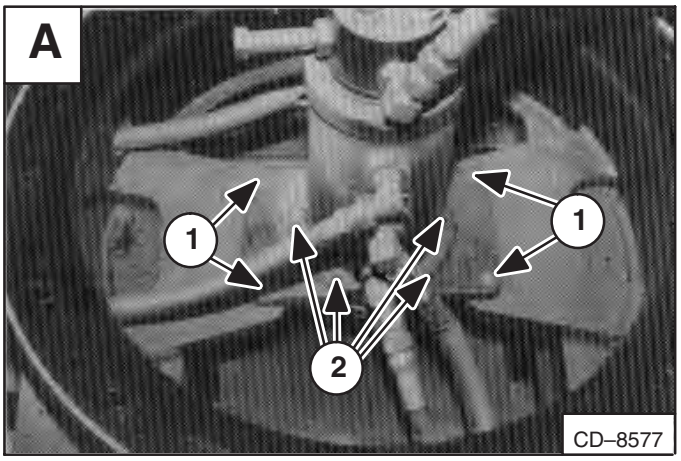
Put jackstands under the front axles and rear corners of the frame before running the engine for service. Failure to use jackstands can allow the machine to fall or move and cause injury or death.

W–2017–0286

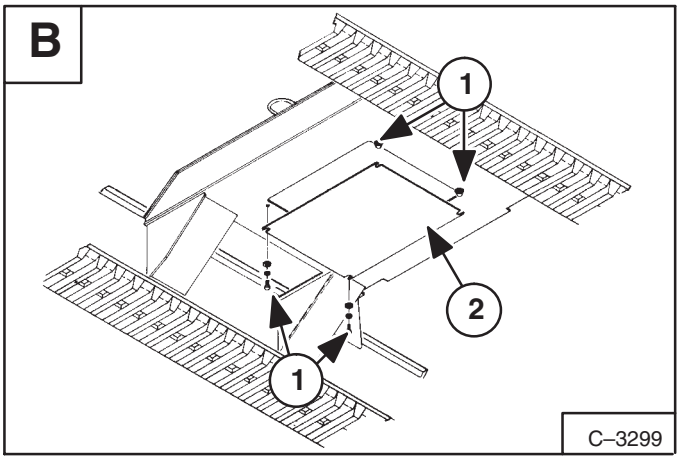
Remove the access plate (Item 1) **[B]** from the bottom of the under carriage by removing two of the bolts (Item 2) **[B]** and loosening the other two bolts (Item 2) **[B]**. The plate mounting holes are slotted so that the plate can be slid out.

Installation: Tighten the bolts to 30–37 ft.–lbs. (40–50 Nm) torque.

A



B



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CENTER SWIVEL JOINT

Removal and Installation (Through Bottom Access Cover) (Cont'd)

IMPORTANT

When repairing hydrostatic and hydraulic systems, clean the work area before disassembly and keep all parts clean. Always use caps and plugs on hoses, tubelines and ports to keep dirt out. Dirt can quickly damage the system.

I–2003–0888

Mark or tag the hoses and fittings for correct installation **[A]**.

Remove the bottom eight hoses from the swivel joint **[A]**. Remove the 6 side elbows from the side of the swivel joint.

NOTE: Mark fitting alignment angle for ease of installation.

Remove the floormat and floor panels. (Refer to Page 5–1 for the correct procedure.)

Remove the top seven hoses from the swivel joint from the top side **[B]**.

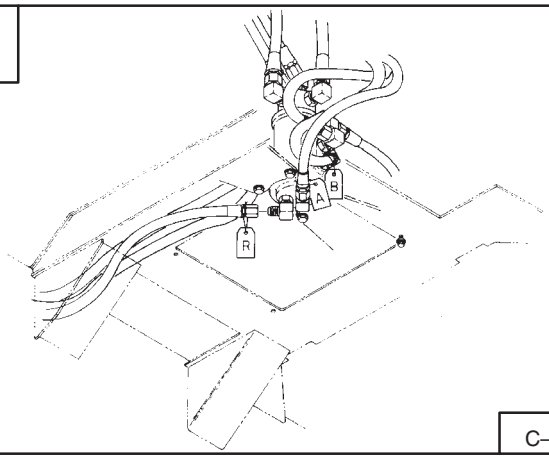
Remove the four bolts (Item 1) **[C]** holding the swivel joint to the track frame .

Installation: Tighten the bolts to 220–245 ft.–lbs. (300–330 Nm) torque. Use LOCTITE 242 on the bolt threads.

Rotate the swivel joint 90 degrees **[C]**. Lower the swivel joint out the bottom of under carriage.

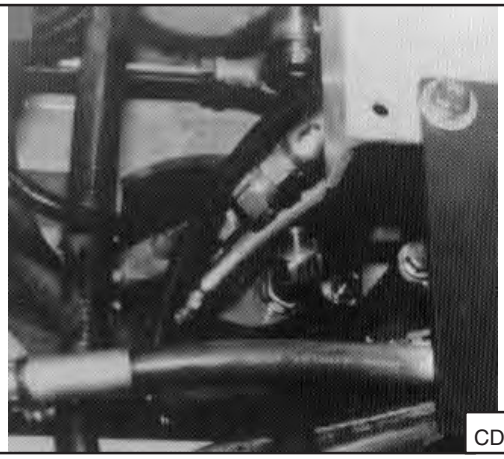
Inspect the fitting O–rings for damage and replace as necessary.

A



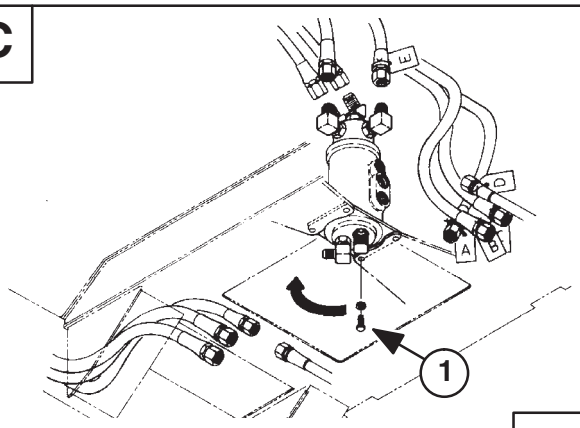
C–3300

B



CD–12248

C



C–3301

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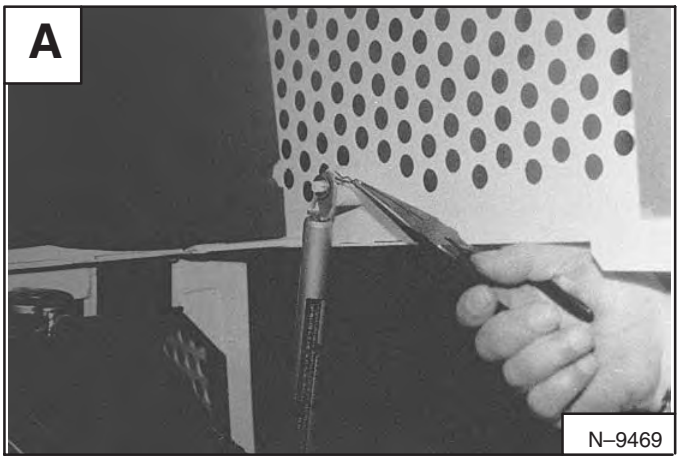
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ENGINE COVER

Removal and Installation

Open the engine cover.

Remove the retainer clip from the rod end pin of the gas cylinder **[A]**.



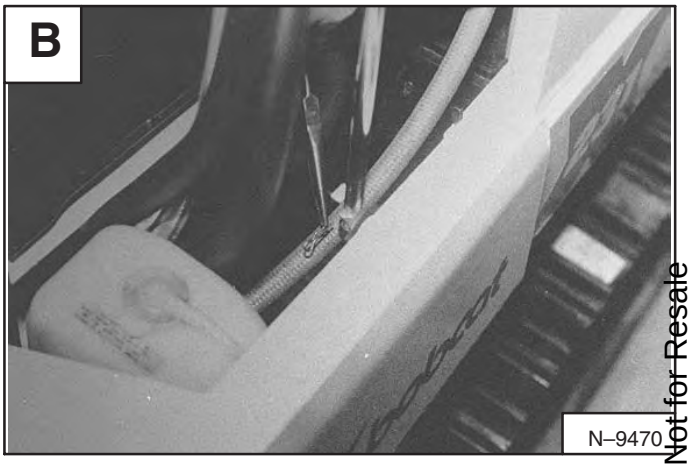
Remove the retainer clip from the base end pin of the gas cylinder **[B]**.

Hold the engine cover and remove the gas cylinder. Close the engine cover.

⚠ WARNING

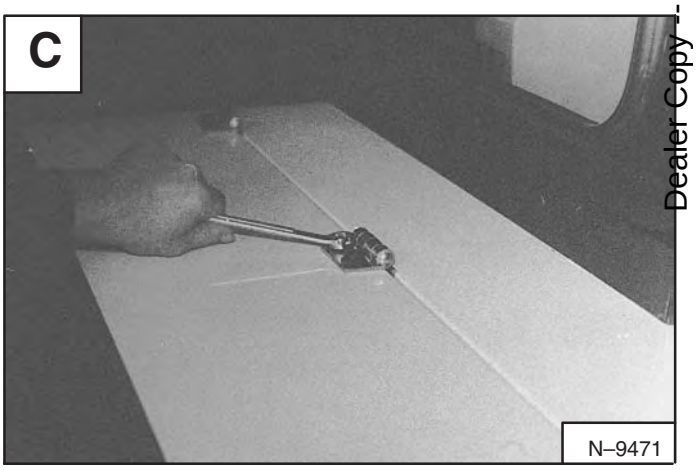
Cylinder contains high pressure gas. Do not open. Opening cylinder can release rod and cause injury or death.

W–2113–0288



Remove the bolts from the hinge **[C]**.

Remove the engine cover from the machine.



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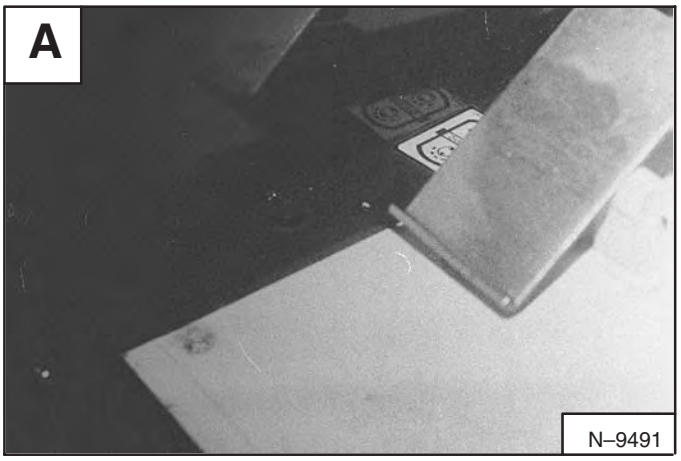
ROPS

Removal and Installation

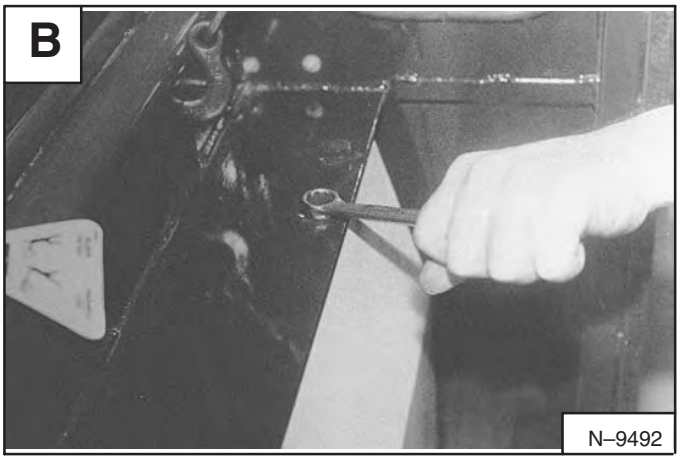
Remove the front lights and install lifting eyes through the light holes.

Connect chains to the lift eyes and to the slots inside the cab behind the operator's seat.

Remove the bolts along the front edge and the sides of the ROPS **[A]**.

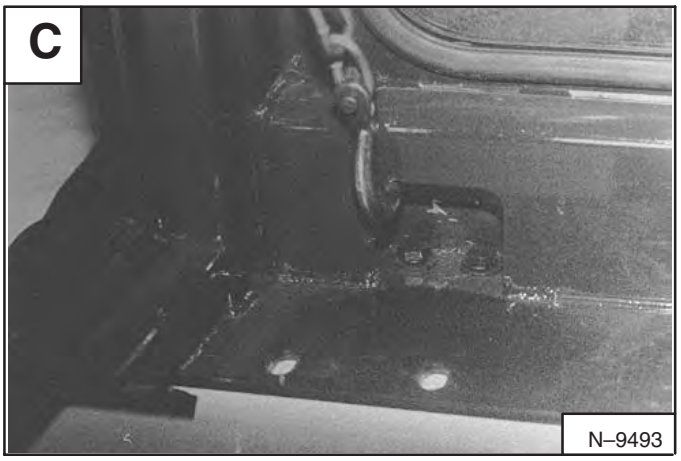


Remove the bolts from the plate behind the operator's seat **[B]**.

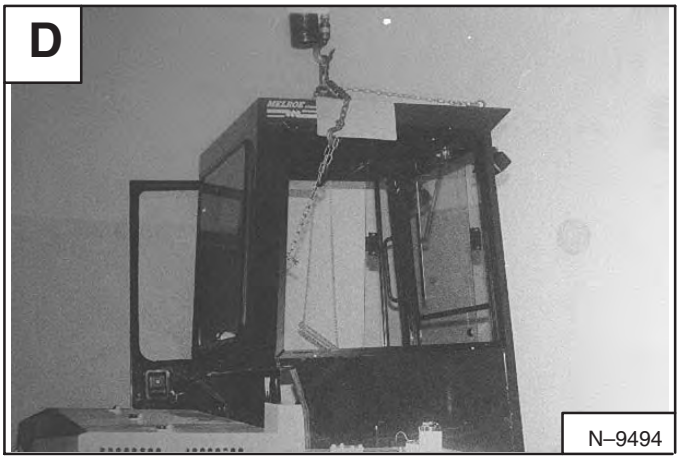


Remove the bolts from the slots at the rear inside the ROPS **[C]**.

Installation: Tighten the bolts to 40–45 ft.–lbs. (54–61 Nm) torque.



Lift the ROPS from the upper works **[D]**.



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ROPS (Cont'd)

Front Window Removal & Installation

Remove the screws (Item 1) from the window frame **[A]**.

NOTE: Cabs with S/N M8960B–1 & Above use a single bead of urethane around the window perimeter only.

NOTE: Cabs with S/N M8960A–50 & Below only, use a extra bead of urethane under the window flange.

All Cabs: Use a utility knife to cut the urethane from the window perimeter **[B]**.

Remove the window from the ROPS frame.

Cab S/N M8960A–50 & Above Only: From the inside of the cab, force a corner of the window out slightly , use wedges to hold window in position.

Cut the urethane bead from the window flange until the window is free from the ROPS frame.

Remove the two screws (Item 2) **[A]** that hold the center post in the window frame. Remove the center post.

Spread the frame and remove the glass or clean the channel of all broken glass particles, if necessary.

Installation: Install the glazing vinyl on three sides of the stationary glass. Hold the vinyl in place with tape during installation.

Apply water diluted liquid soap on channels during window installation.

Install the glass in one side of the channel, spread the frame and use a putty knife to control glazing vinyl while guiding window into position.

Push glass into bottom position.

Install the glazing vinyl and center post on top of stationary window.

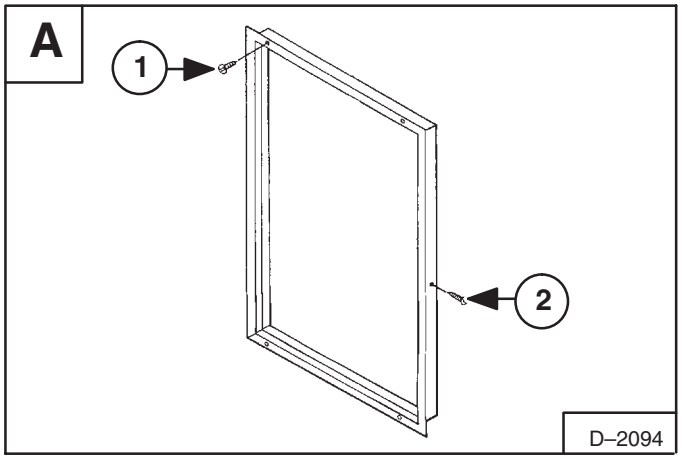
Install the screws in the center post to hold frame, DO NOT TIGHTEN.

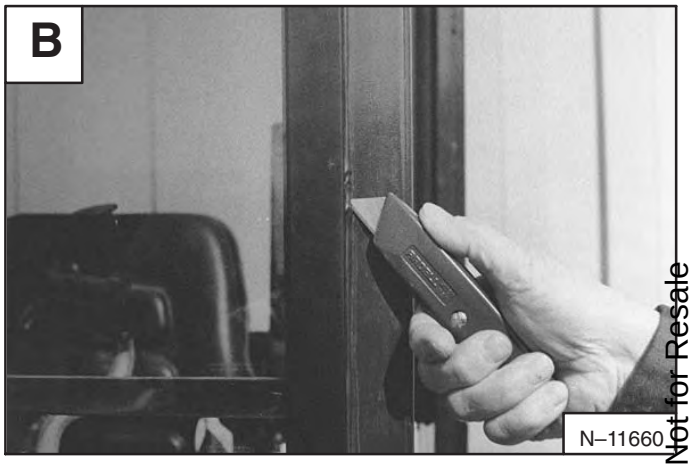
Install the sliding glass in one side of the frame, spread the frame and use a putty knife to control glazing vinyl and guide the window in position.

Tighten the screws into the center post.

Use a utility knife to cut the tape from the window.

Install the window in the opening, install the (4) screws and apply a bead of urethane on the perimeter of the window **[C]**.







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Side Window Removal & Installation

NOTE: The removal procedure for the side window is the same as the front window . (See Page 5–5.)

Installation:

Remove the glass or clean the channel of all broken glass particles, if necessary.

Install the locks on glass.

Install the sliding glass in one side of the frame, spread the frame and use a putty knife to control glazing vinyl and guide the window in position.

Install the window in the opening, install the four screws and apply a bead of urethane on the perimeter of the window **[A]**.

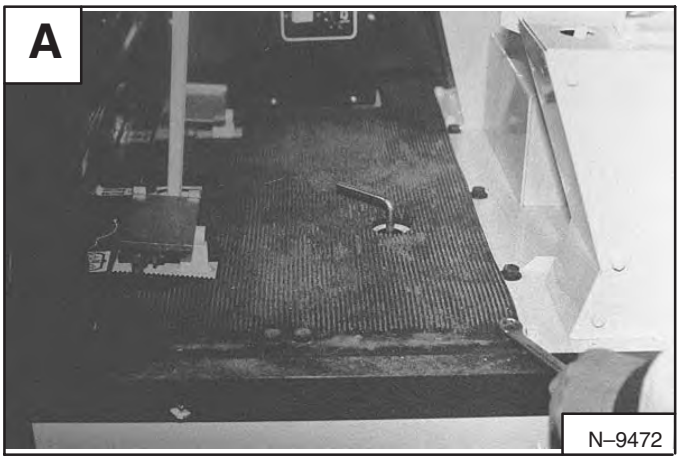


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REAR FLOOR PANEL

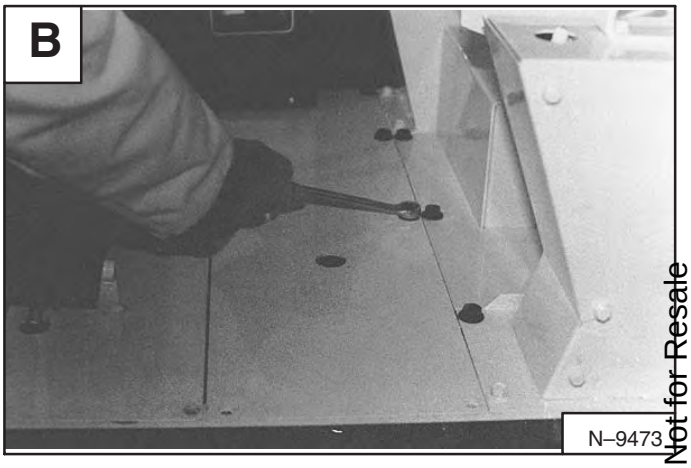
Removal and Installation

Remove the bolts from the floor mat **[A]**.



Remove the bolts from the floor panel **[B]**.

Remove the floor panel.

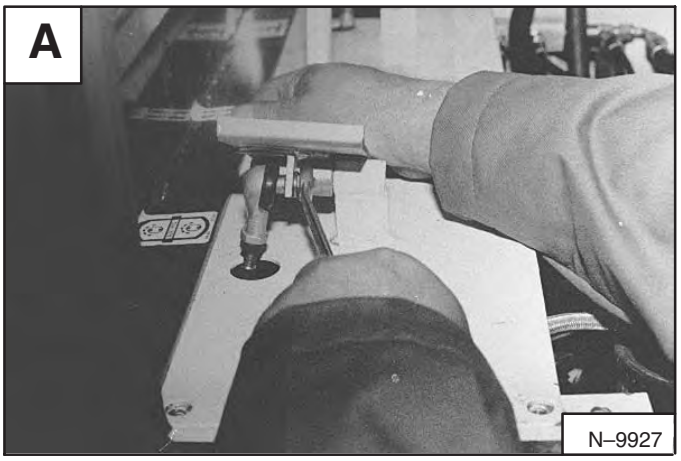


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FOOT PEDALS

Removal and Installation

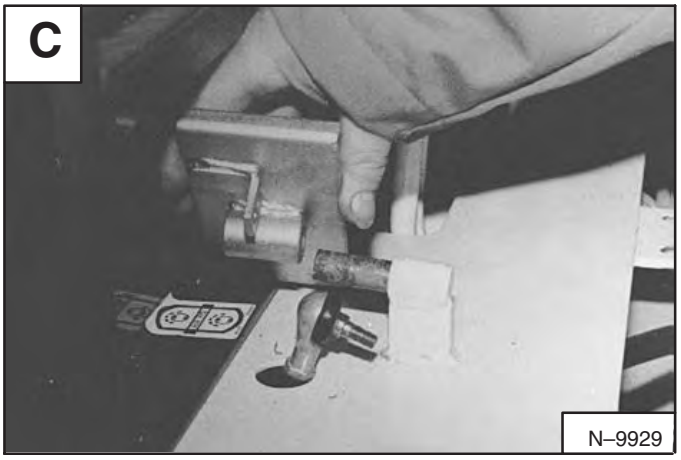
Remove the nut from the foot pedal linkage (both pedals) **[A]**.



Remove the bolt from the pedal pivot **[B]**.



Remove the foot pedal from the mount **[C]**.

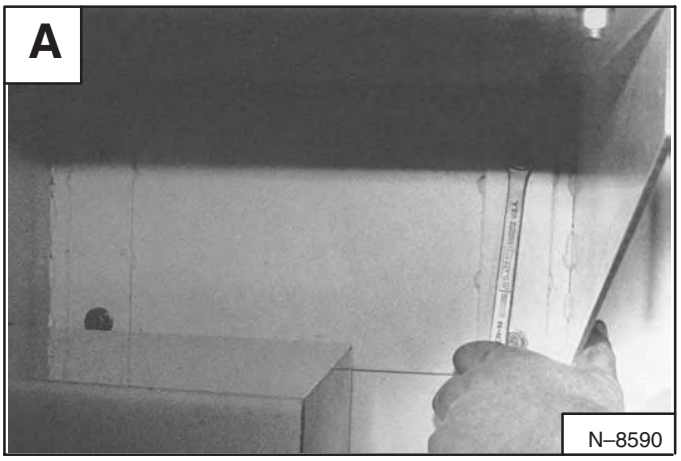


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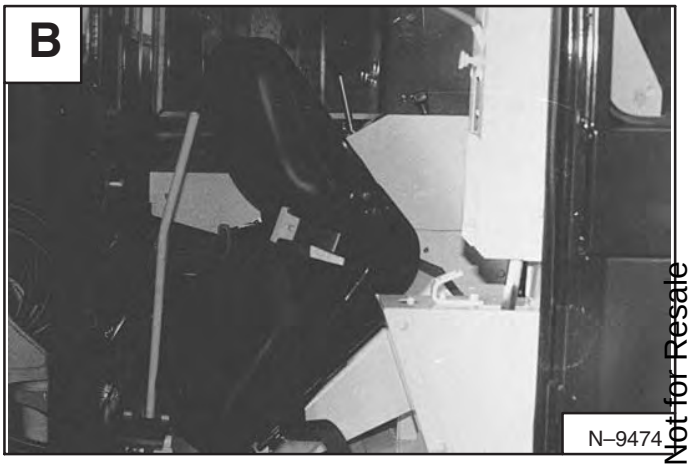
SEAT AND MOUNTING FRAME

Removal and Installation

Remove the four mounting bolts **[A]**.



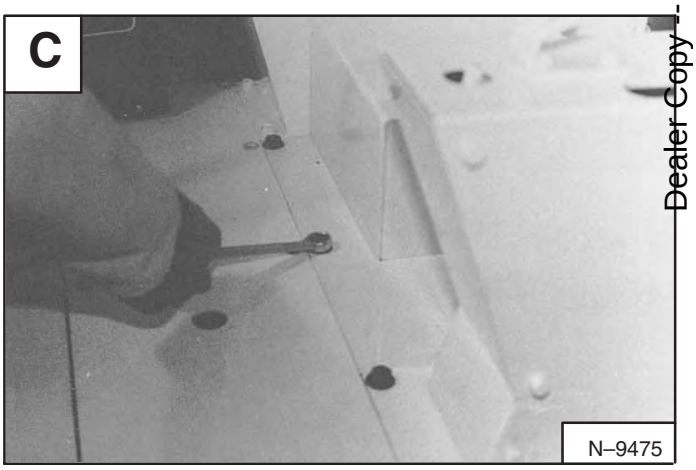
Remove the seat and the mounting frame **[B]**.



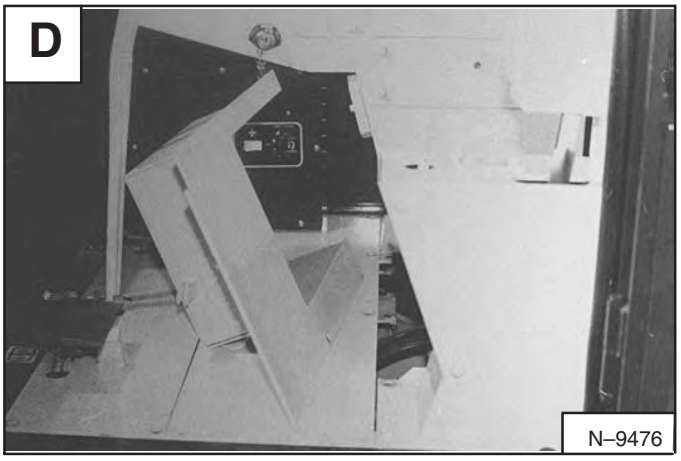
SWING MOTOR COVER

Removal and Installation

Remove the bolts from the swing motor cover **[C]**.



Remove the swing motor cover **[D]**.



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ENGINE SHROUD

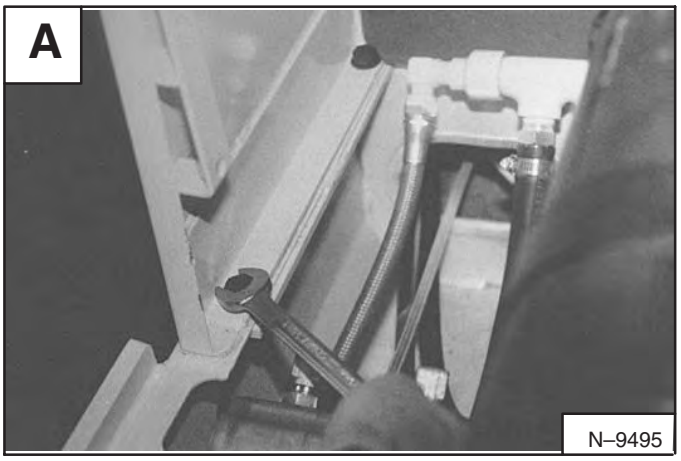
Removal and Installation

Remove the rear engine cover. (See Page 5–3.)

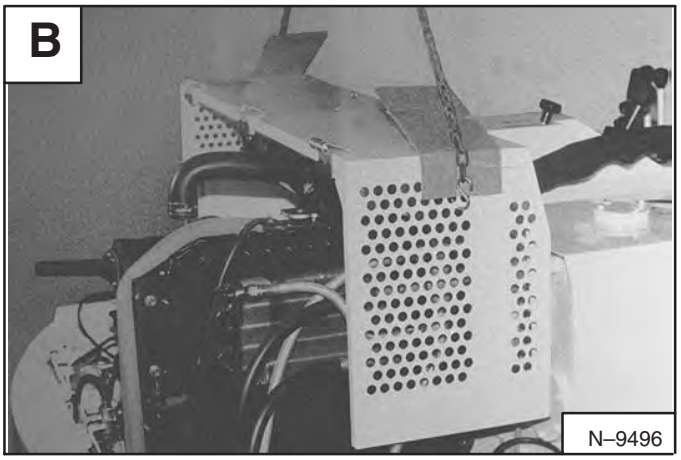
Remove the ROPS. (See Page 5–4.)

Remove the air cleaner clamp. (See Page 7–1.)

Remove the shroud mounting bolts **[A]**.



Use a chain hoist to remove the engine shroud **[B]**.



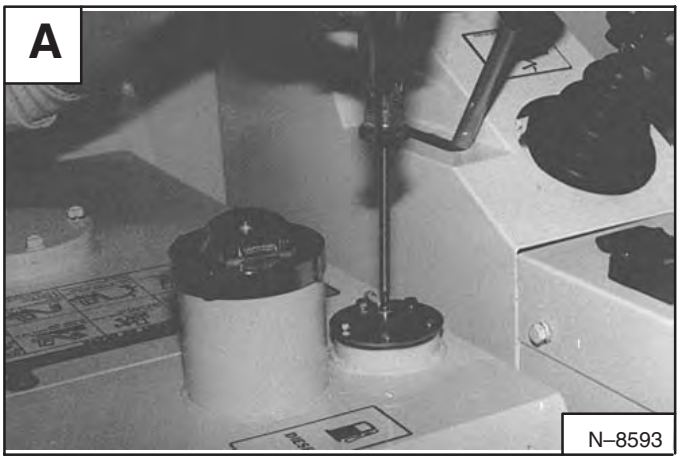
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FUEL TANK

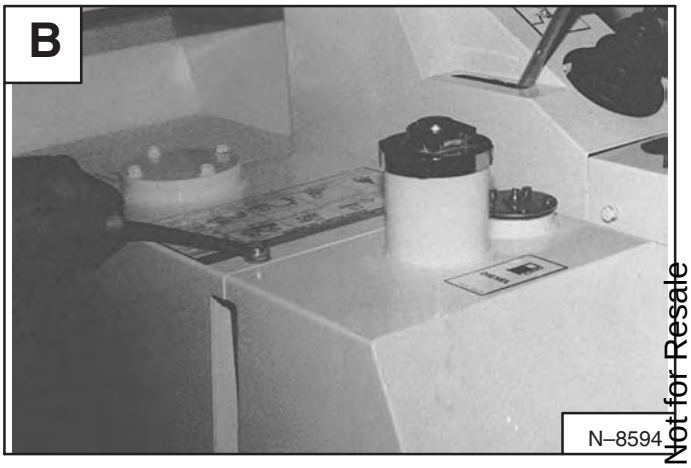
Removal and Installation

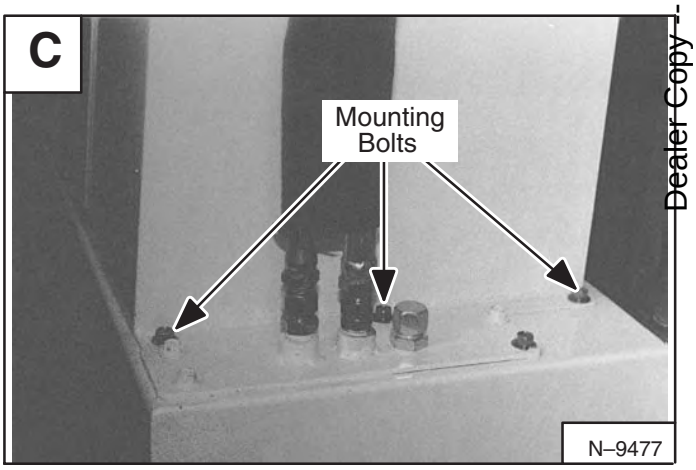
Drain the fuel from the tank into a container.

Disconnect the fuel switch wire **[A]**.



Remove the fuel tank mounting bolts **[B]** & **[C]**.





Lift and move the fuel tank forward. Disconnect the fuel hoses **[D]**.

Remove the fuel tank from the machine.



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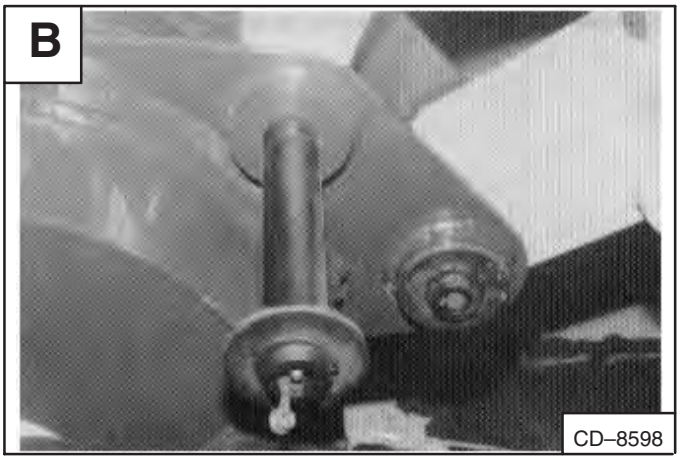
BUCKET

Removal and Installation

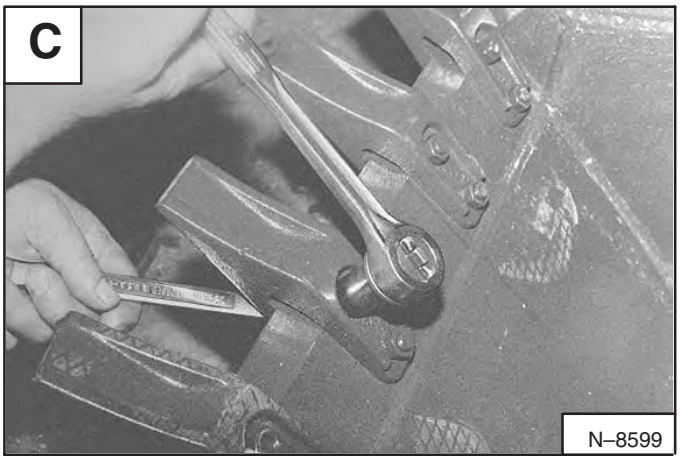
Remove the retainer clips from the bucket pins **[A]**.



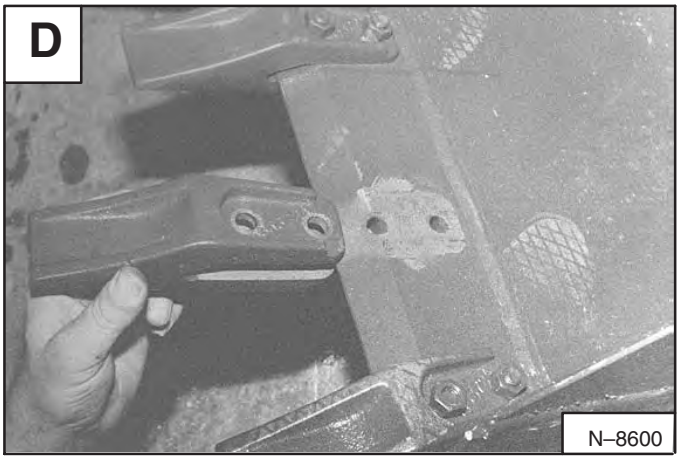
Remove the bucket pins **[B]**.



Remove the nuts and bolts from the bucket teeth **[C]**.



Remove the bucket teeth **[D]**.

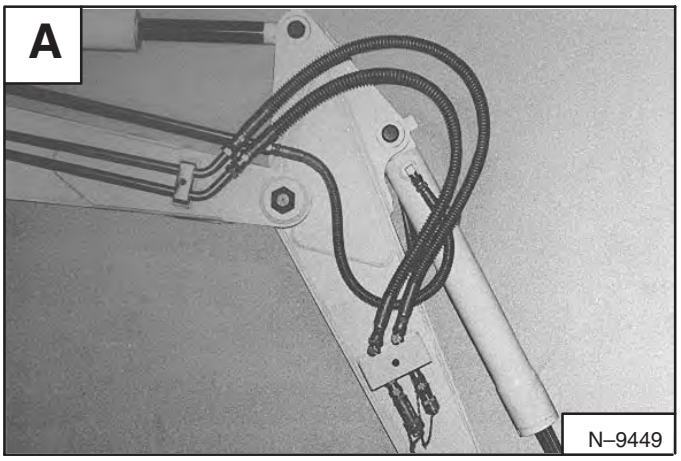


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DIPPERSTICK

Removal and Installation

Remove the auxiliary hoses from the dipperstick **[A]**.



Support the dipperstick with a chain hoist.

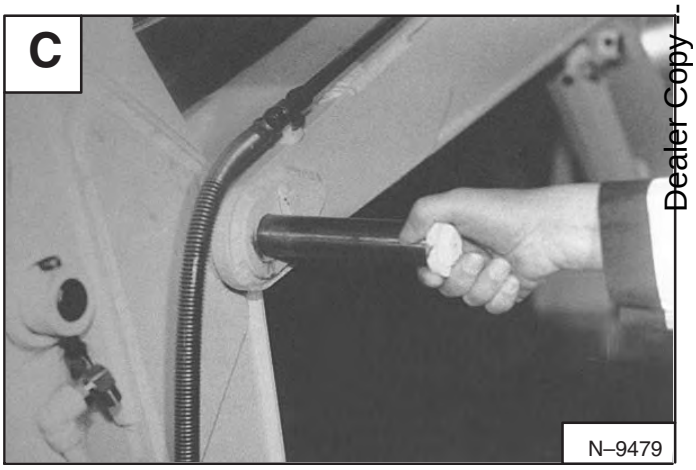
Disconnect the bucket hoses. (See Page 2–1.)

Remove the rod end of the dipperstick cylinder from the dipperstick. (See Page 2–1.)

Remove the nut from the dipperstick pivot pin **[B].**



Remove the dipperstick pivot pin **[C]**.

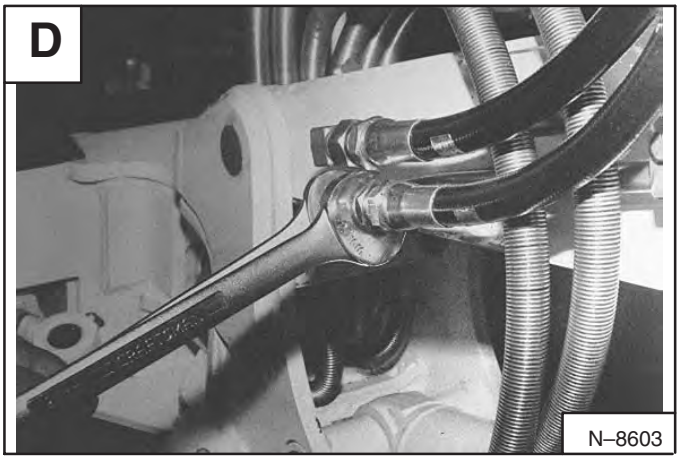


BOOM

Removal and Installation

Support the boom with a chain hoist.

Remove the auxiliary hoses from the boom **[D]**.



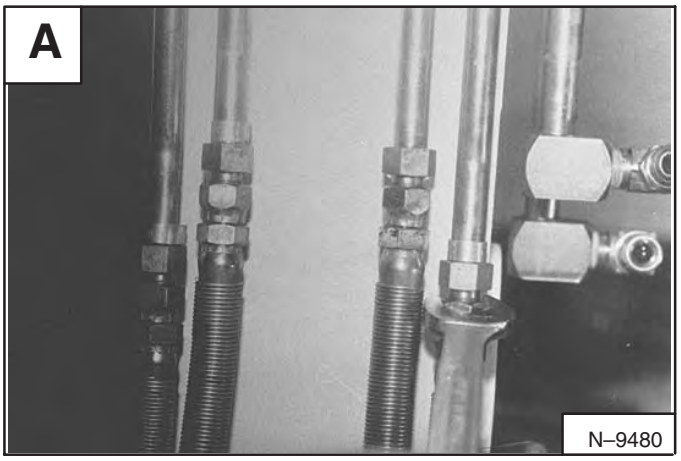
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BOOM (Cont'd)

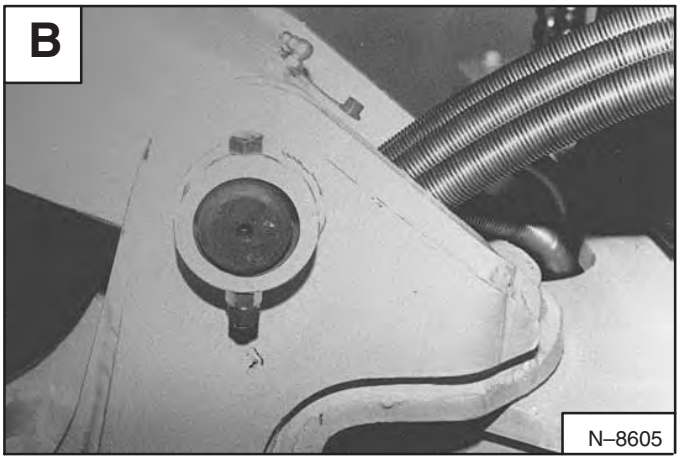
Removal & Installation (Cont'd)

Remove all the cylinder hoses from the tubelines on the boom **[A]**.

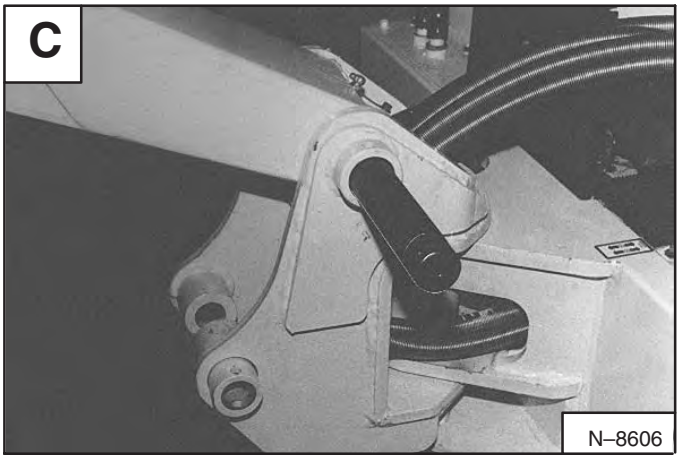
Remove the boom cylinder base end from the boom swing bracket. (See Page 2–1.)



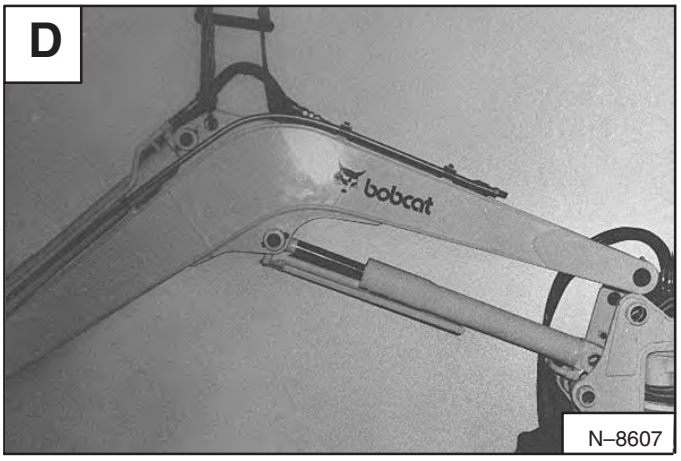
Remove the bolt from the boom pivot pin **[B]**.



Remove the boom pivot pin **[C]**.



Remove the boom **[D]**.



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BOOM SWING BRACKET

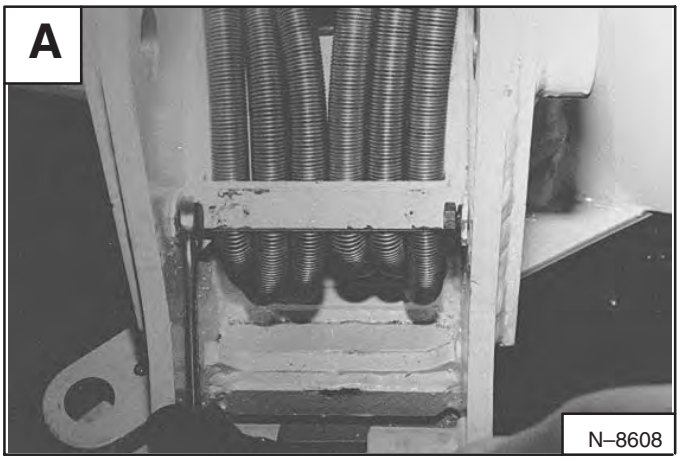
Removal and Installation

Remove the boom and dipperstick. (See Page 5–13.)

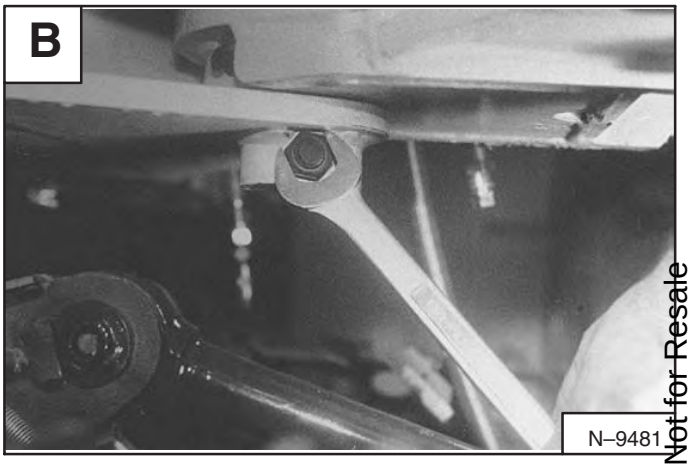
Remove the boom swing cylinder pin. (See Page 2–1.)

Remove the hose retaining bracket **[A]**.

Pull the hoses out of the boom swing bracket.



Remove the retainer bolt and nut from the boom swing bracket pivot pin **[B]**.



Remove the boom swing bracket pivot pin **[C]**.

Remove the boom swing bracket.



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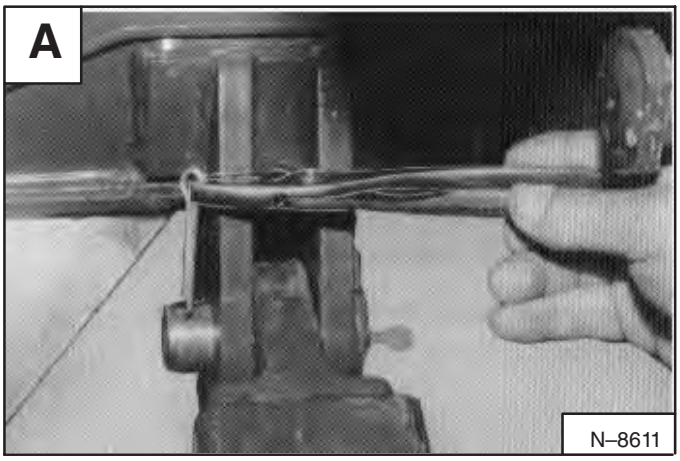
BLADE

Removal and Installation

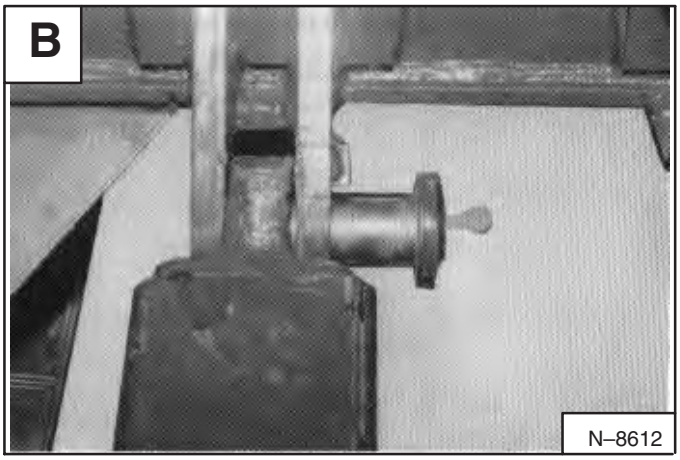
Lower the blade to the ground.

Remove the blade cylinder hoses. (See Page 2–1.)
Remove the cylinder. (See Page 2–1.)

Remove the cotter pins from the blade arm pivot pins (both sides) **[A]**.



Remove the blade arm pivot pins **[B]**.



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TRACK TENSION

NOTE: The wear of the pins and bushings on the undercarriage vary with the work conditions and different types of soil conditions. It is necessary to inspect track tension to maintain the correct tension. See Service Schedule Page 1–1 for the correct service interval.

Adjustment

Raise the machine using the boom and arm as shown in **[A]**.

Raise the blade and install jackstands under the blade and the swing frame **[B]**.

Stop the engine.

⚠ WARNING

AVOID INJURY

Keep fingers and hands out of pinch points when checking the track tension.

W–2142–0189

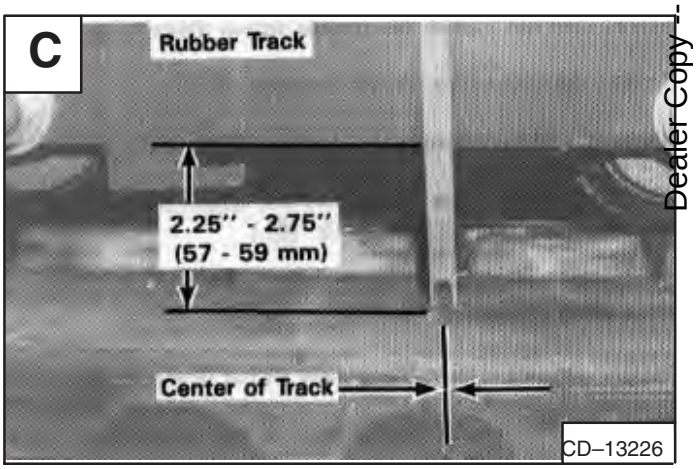
Measure the track sag at the center of the track, between the lower edge of the track frame and the top surface of the track **[C]** & **[D]**.

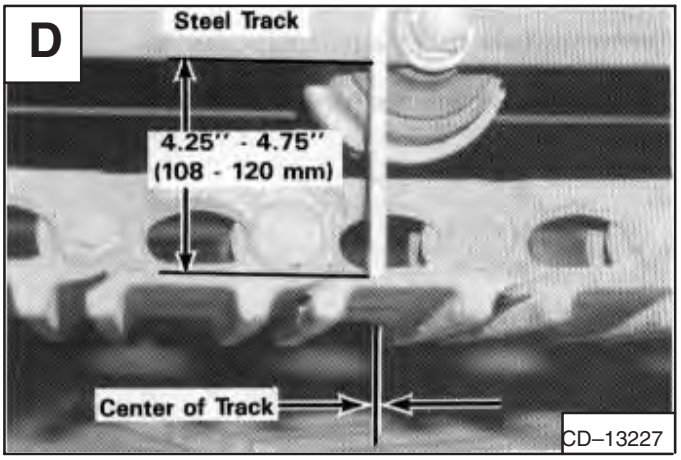
Repeat the procedure for the other side.

Rubber Track . . . . . .2.25”–2.75” (57–59 mm) **[C]**.
Steel Track . . . . . .4.25”–4.75” (108–120 mm) **[D]**.







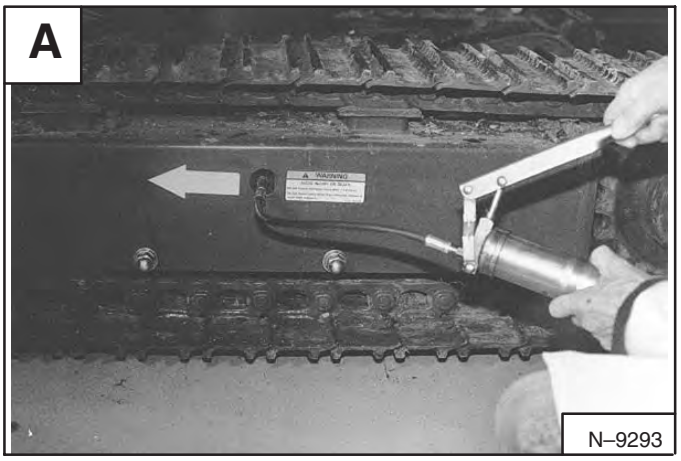


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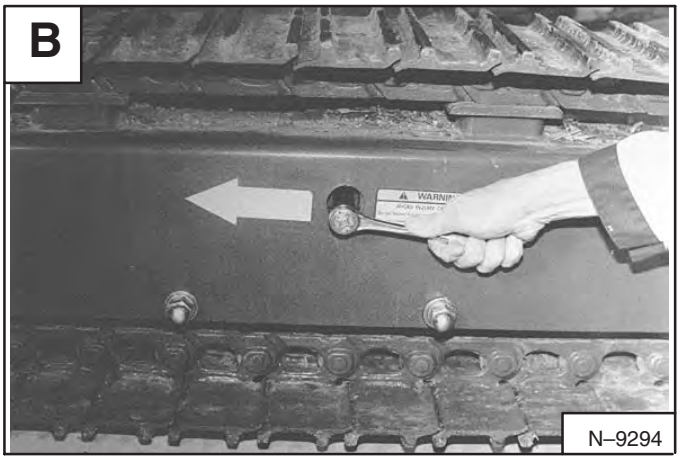
TRACK TENSION (Cont'd)

Assembly (Cont'd)

Add grease to the fitting until the track tension is correct **[A]**.



Loosen the fitting (Item 2) **[B]**. one to 1–1/2 turns to release the tension from the track **[B]** & **[C]**.



NOTE: Do not loosen the grease fitting (Item 1) [C].

Repeat the procedure for the opposite side.

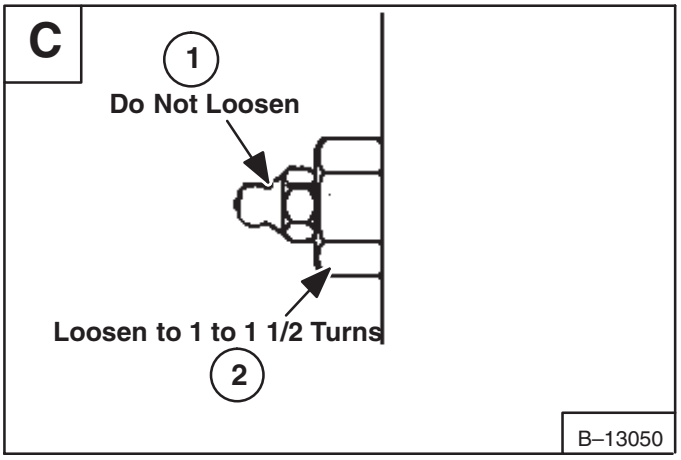
Removal and Installation

Lift and block the side of the machine where the track will be removed. (See Page 5–17 **[A]** & **[B]**.)

Loosen the large hex nut (Item 2) **[C]** from the recoil spring cylinder, 1–1/2 turns maximum.

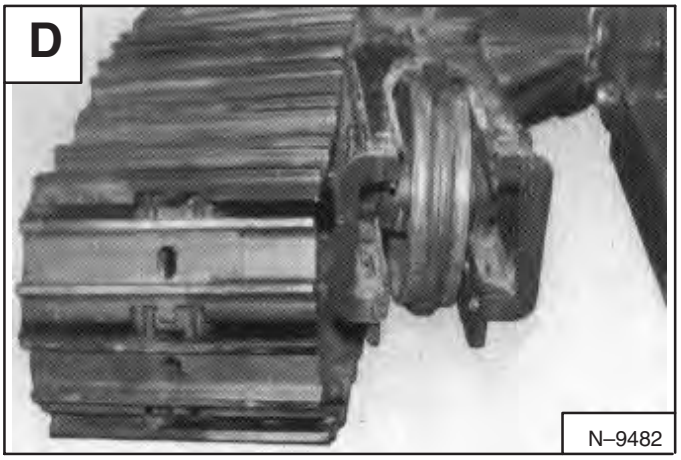
NOTE: Do not loosen the grease fitting (Item 1) [C] .

NOTE: A chain hoist can be used to pull up on the track so all the tension is released from the recoil spring cylinder for easier removal of the track.



Remove the track from the front track idler **[D]**.

Remove the track from the frame and rear drive sprocket.



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TRACK FRAME

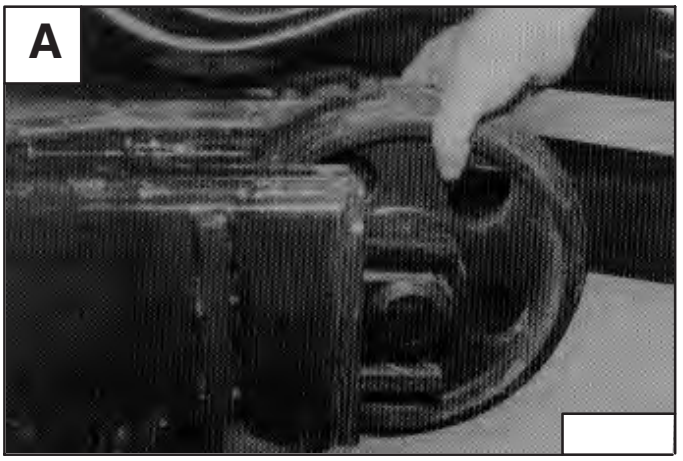
Disassembly and Assembly

Use the following procedure to remove the different parts from the track frame:

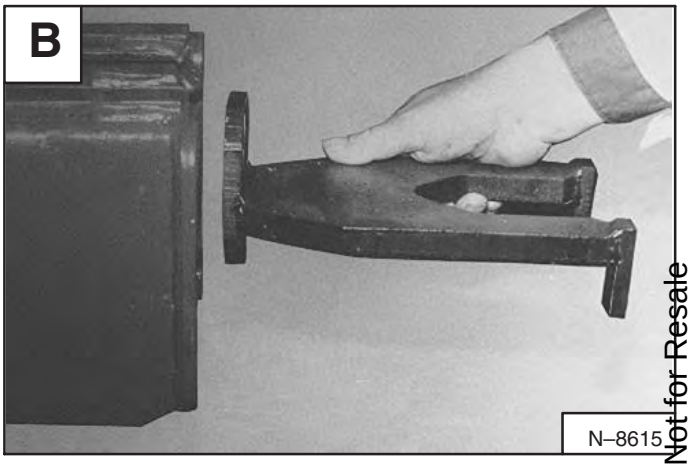
Remove the track. (See Page 5–17.)

Slide the front track idler out of the track frame to remove it **[A]**.

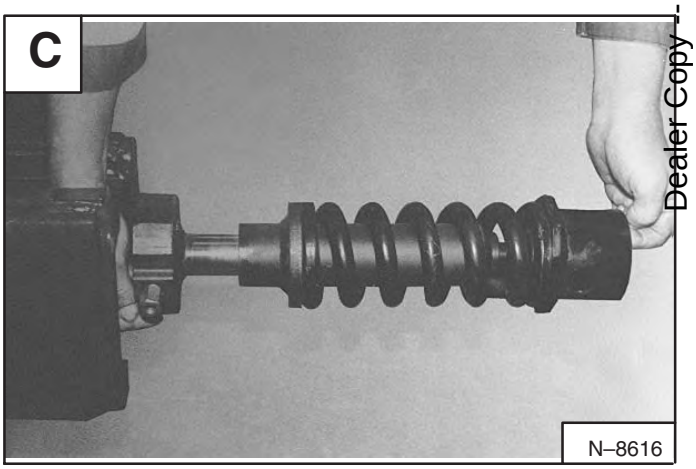
See Page 5–20 for disassembly and assembly procedure.



Remove the sliding plate **[B]**.



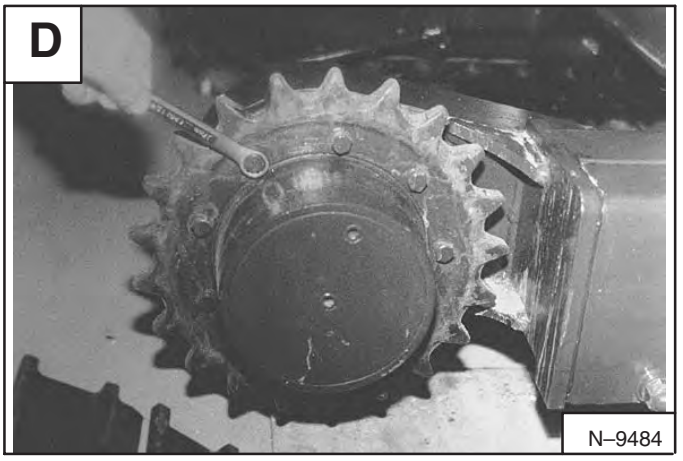
Slide the recoil spring cylinder forward and remove it from the track frame **[C]**.



Remove the drive gear bolts **[D]**.

Installation: Put LOCTITE on the bolts and tighten to 80 ft.–lbs. (108 Nm) torque.

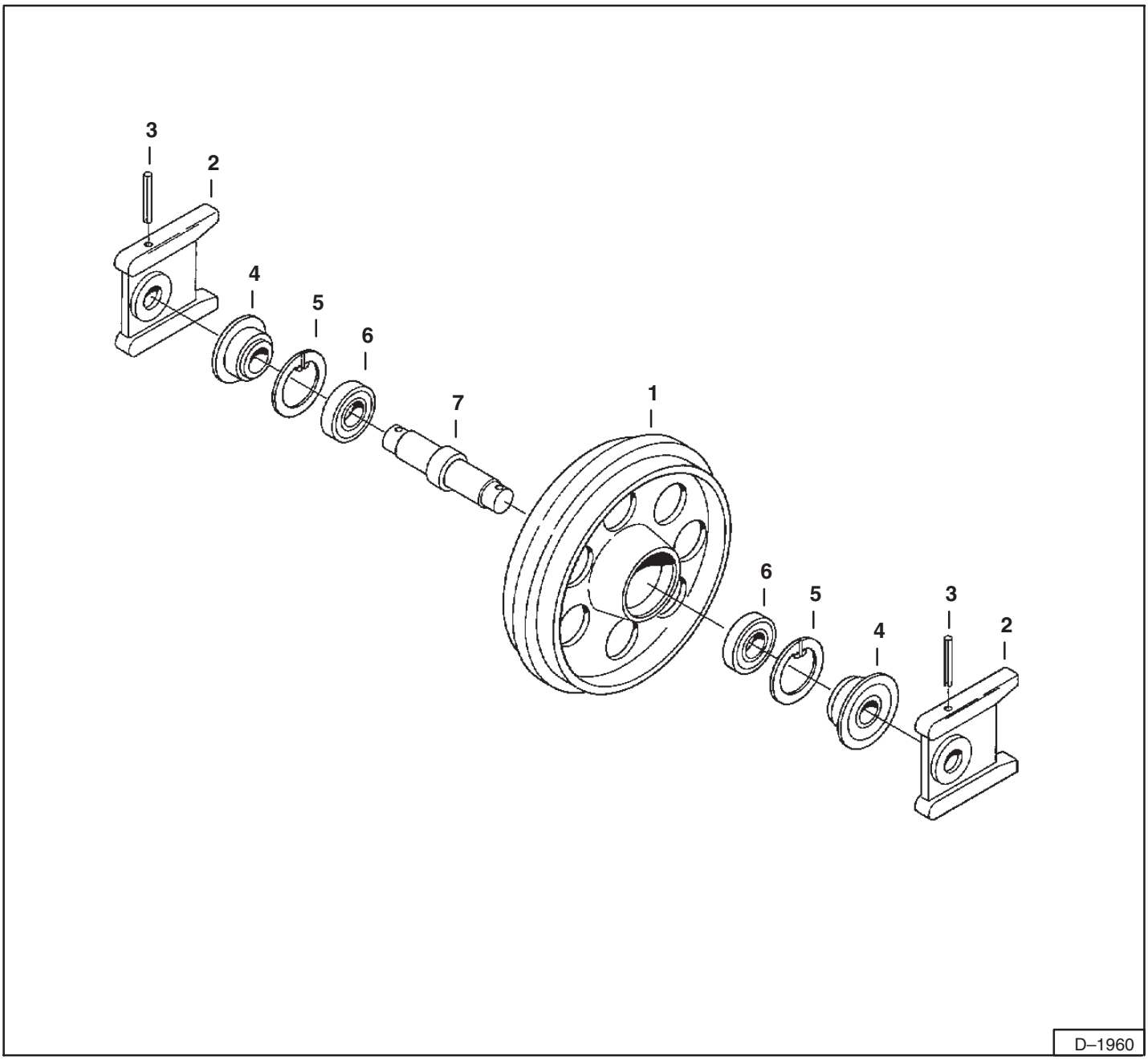
Remove the drive gear from the drive motor and planetary gear assembly.



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TRACK IDLER

Parts Identification



TRACK IDLER

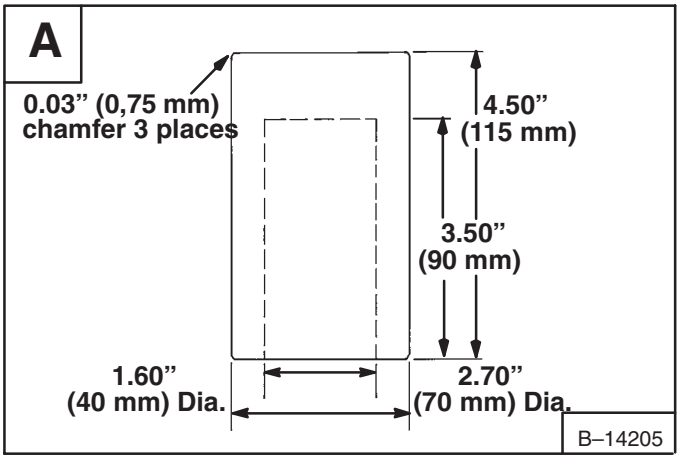
Ref.	Description
1.	Idler
2.	Block
3.	Pin
4.	Seal
5.	Snap Ring
6.	Bearing
7.	Shaft

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TRACK IDLER (Cont'd)

The following tools must be fabricated for this procedure:

1. Driver Tool – See **[A]**.
2. Support Fixture – Tube, 3" ID x 1/4" wall x 6 inches long.

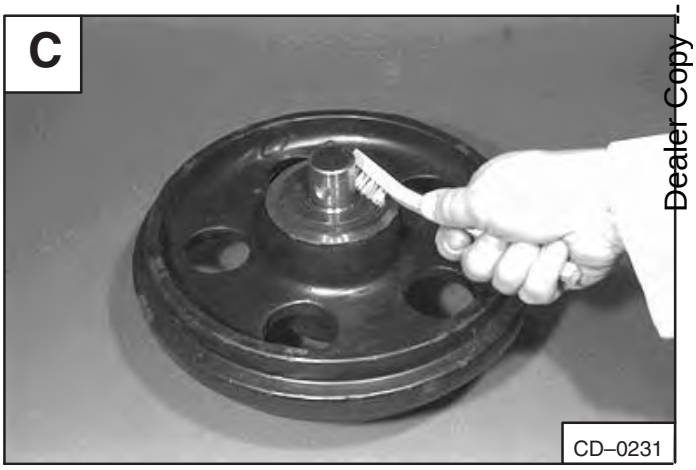


Disassembly

Remove the roll pin and block from each end of the shaft **[B]**.



Use a wire brush to remove any corrosion or paint from both ends of the exposed shaft that could affect seal removal or damage the new seal during installation **[C]**.



Apply penetrating oil to both ends of the exposed shaft to ease removal of the inner part of the seal.

Remove the inner part of the seal using two screwdrivers **[D]**.



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TRACK IDLER (Cont'd)

Disassembly (Cont'd)

Remove the outer part of the seal from the idler using two screwdrivers **[A]**.

Pour the oil out of the idler . Discard the oil in an appropriate manner.

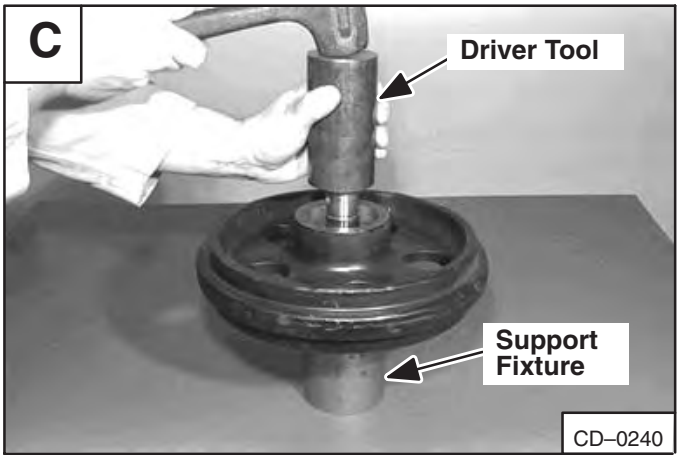
Turn the idler assembly over and remove the other seal.



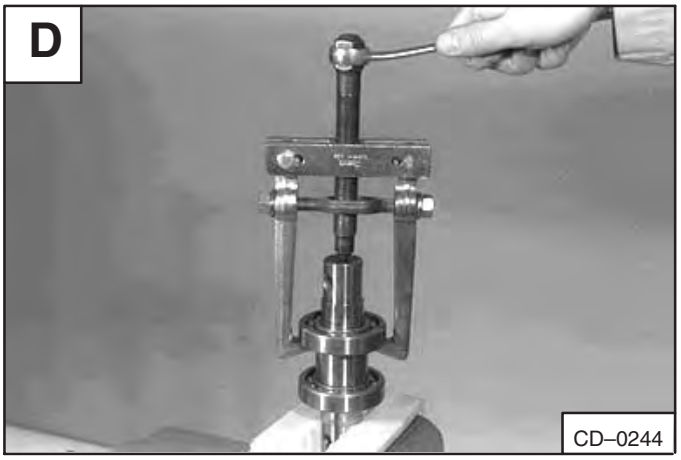
Remove the snap ring from each side of the idler **[B]**.



Using the fabricated driver tool and support fixture, press or drive the shaft and bearing assembly out of the idler **[C]**.



Inspect the bearings for rust or for rough spots. The bearings must turn freely. If any damage is found, replace the bearings. If replacement of the bearings is necessary, use a two or three jaw puller, remove the two bearings from the shaft **[D]**.



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TRACK IDLER (Cont'd)

Assembly

Remove all paint and corrosion from the seal surface on both sides of the idler **[A]**.

Be sure all parts are clean before assembly.



Using the driver tool, install a new bearing, with the numbered side upward, onto the shaft **[B]**. Press only on the inner diameter of the bearing.



Using the driver tool, install the shaft and bearing assembly into the idler **[C]**.



Install the snap ring **[D]**.



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TRACK IDLER (Cont'd)

Assembly (Cont'd)

Turn the idler assembly over.

Using the driver tool, install the other bearing, with the numbered side upward, into the idler **[A]**.



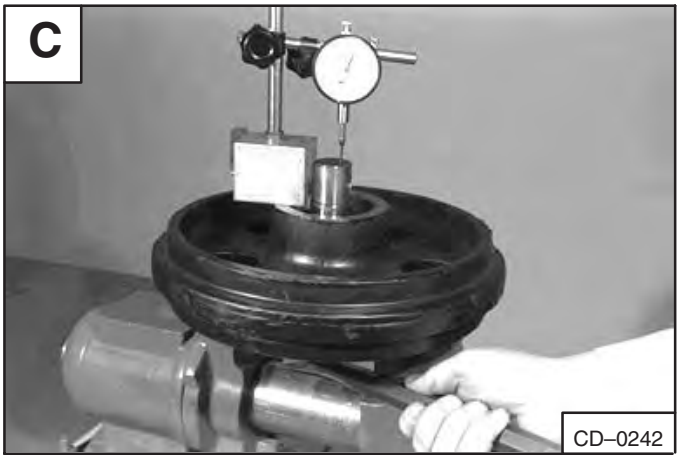
Install the snap ring **[B]**.



Using a dial indicator, check the endplay of the shaft **[C]**.

If the endplay is greater than 0.030 inch (0,76 mm) then the bearing must be shimmed.

Cut a shim from the necessary thickness shim stock an install the shim between the bearing and the shoulder on the shaft.



Separate the inner and outer halfs of the seal.

Apply grease to the grooves on the outer part of a new seal **[D]**.

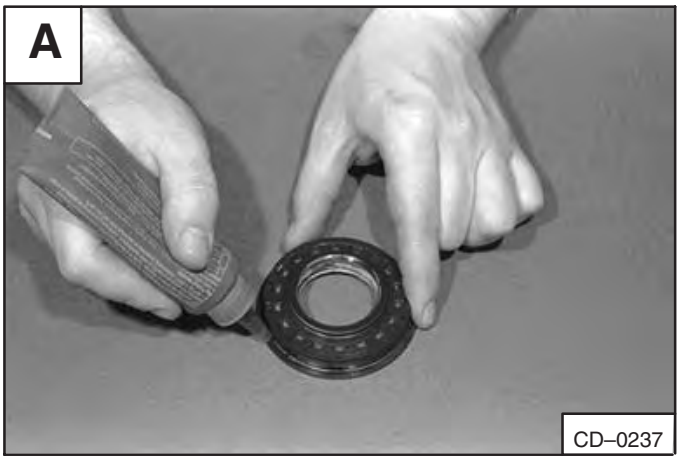


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TRACK IDLER (Cont'd)

Assembly (Cont'd)

Apply a small bead of high temperature silicone sealant around the flange surface of the seal **[A]**.



Using the driver tool, install the outer part of the new seal into the idler **[B]**.

NOTE: The inner and outer parts of the seal must be installed separately so the air will escape from under the seal.



Using the driver tool, install the inner part ofthe new seal over the shaft **[C]**.

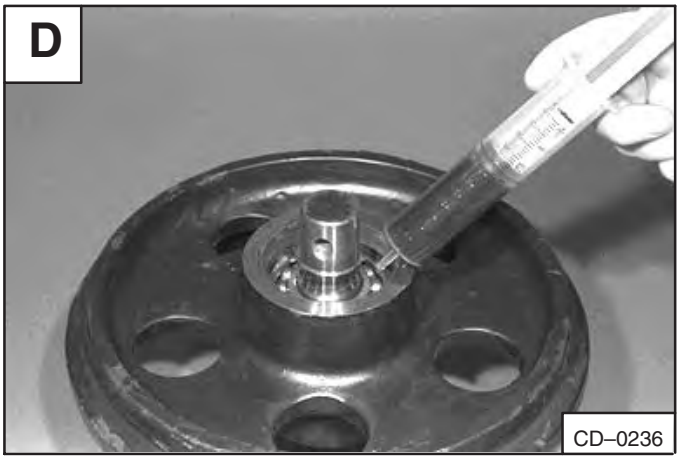
NOTE: The inner part of the seal must be pressed down level with the outer part of the seal to seal properly.



Turn the idler assembly over. Using a syringe add 80 cc of SAE 10W/30 oil to the assembly **[D]**.

Repeat Page 5–24 **[D]** thru Page 5–25 **[C]** to install the remaining seal.

Check for leaks.



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TRACK IDLER (Cont'd)

Assembly (Cont'd)

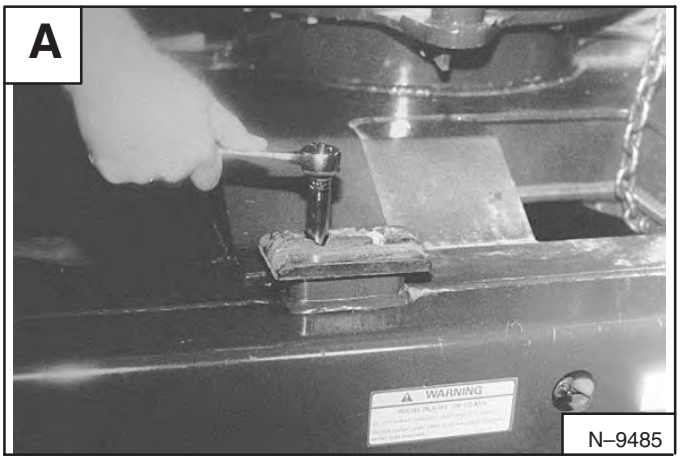
Install the roll pin and block on each end of the shaft**[A]**.



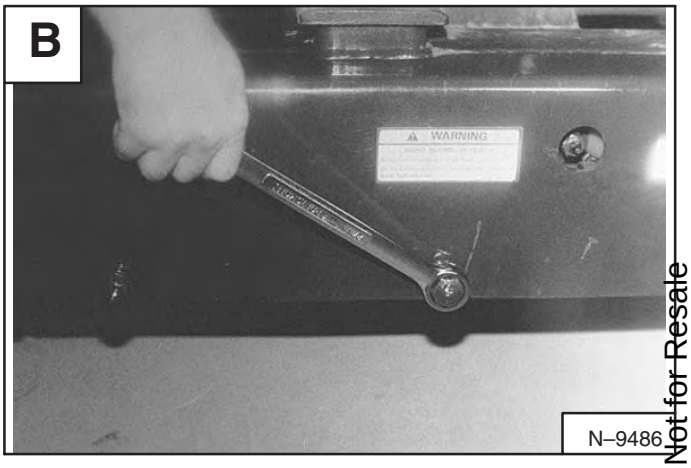
Dealer Copy -- Not for Resale

TRACK FRAME

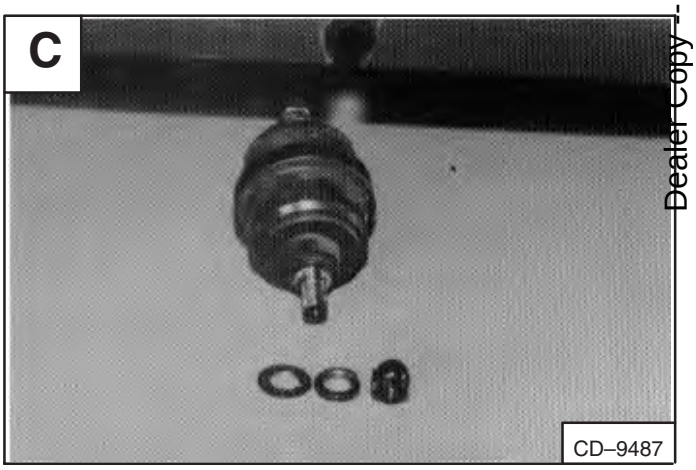
Remove the guide block bolts **[A]**.



Loosen the nuts at the track roller on both sides of the track frame **[B]**.



Remove the track roller **[C]**.



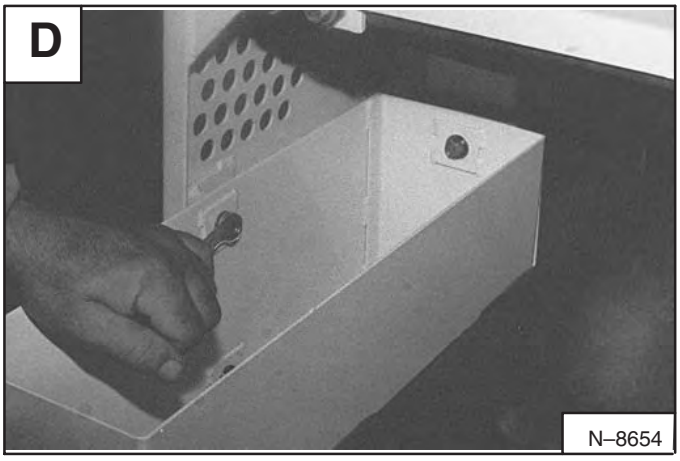
TOOL BOX

Removal and Installation

Raise the engine cover.

Remove the mounting bolts from the tool box **[D]**.

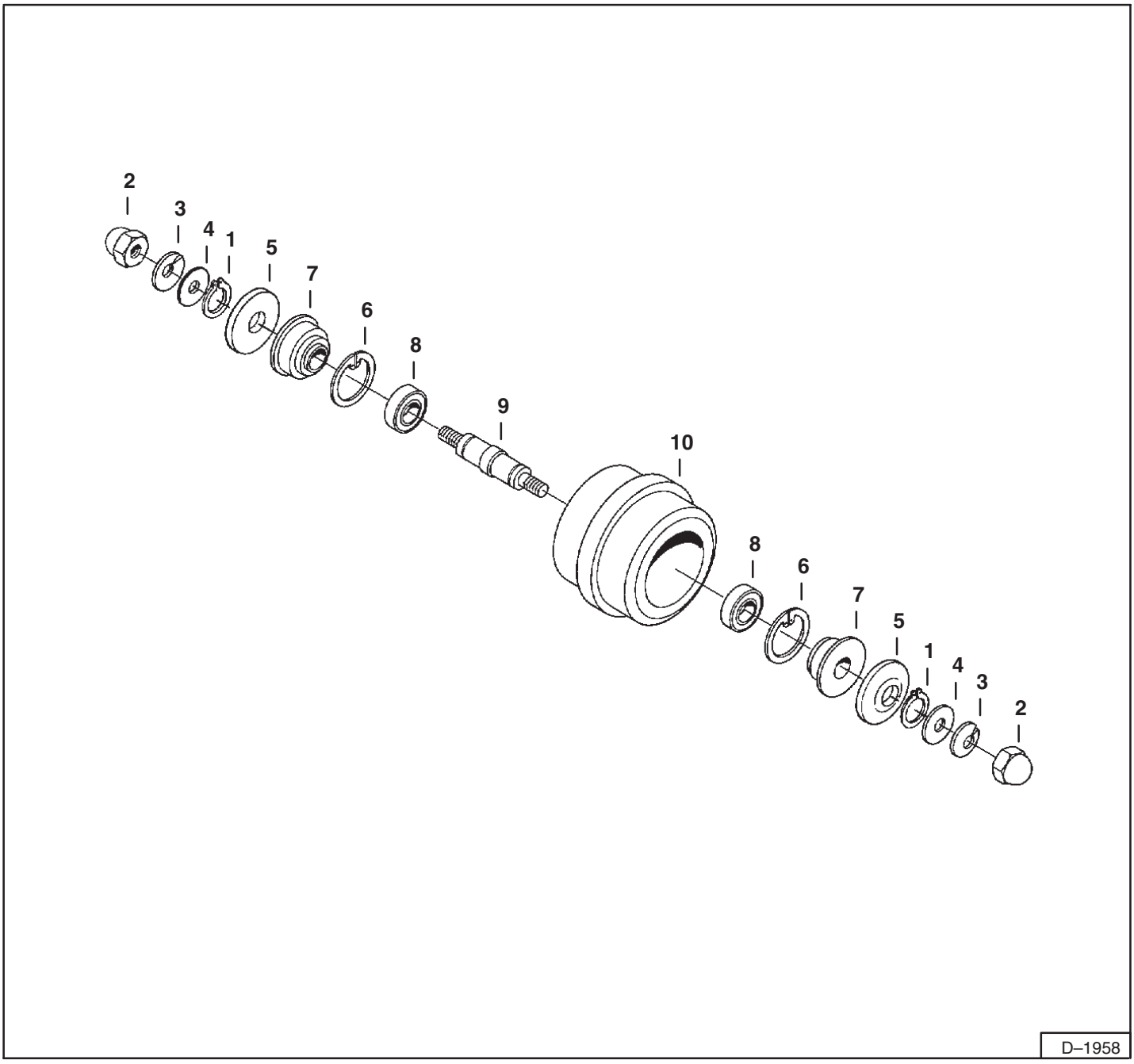
Remove the tool box.



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TRACK ROLLER

Parts Identification

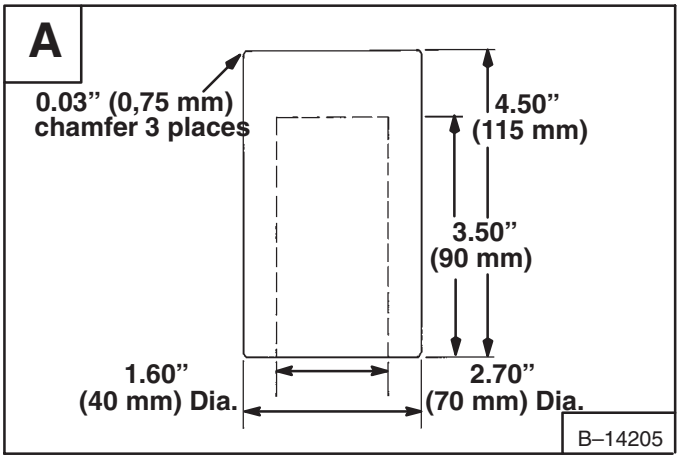


Ref.	Description	Ref.	Description
1.	Spacer	6.	Snap Ring
2.	Nut	7.	Seal
3.	Washer	8.	Bearing
4.	Washer	9.	Shaft
5.	Snap Ring	10.	Roller

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The following tools must be fabricated for this procedure:

1. Driver Tool – See **[A]**.
2. Support Fixture – Tubing, 3" ID x 1/4" wall x 6 inches long.



Disassembly

Remove the snap ring and spacer from each end of the shaft **[B]**.



Use a wire brush to remove any corrosion or paint from both ends of the exposed shaft that could affect seal removal or damage the new seal during installation **[C]**.



Apply penetrating oil to both ends of the exposed shaft to ease removal of the inner part of the seal.

Remove the inner part of the seal using two screwdrivers **[D]**.



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TRACK ROLLER (Cont'd)

Disassembly (Cont'd)

Remove the outer part of the seal from the roller using two screwdrivers **[A]**.

Pour the oil out of the roller. Discard the oil in an appropriate manner.

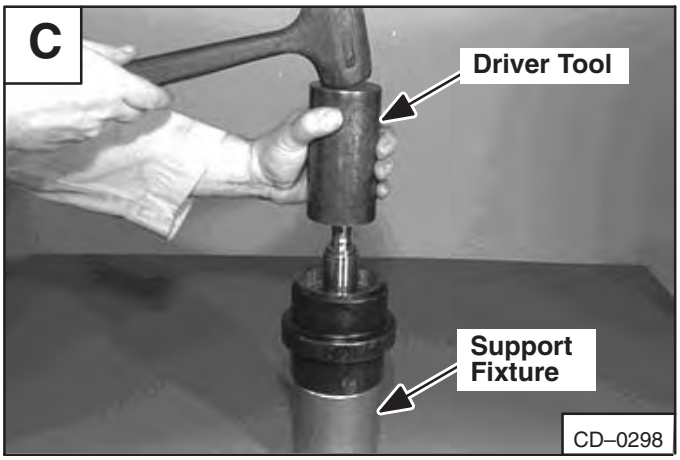
Turn the roller assembly over and removethe other seal.



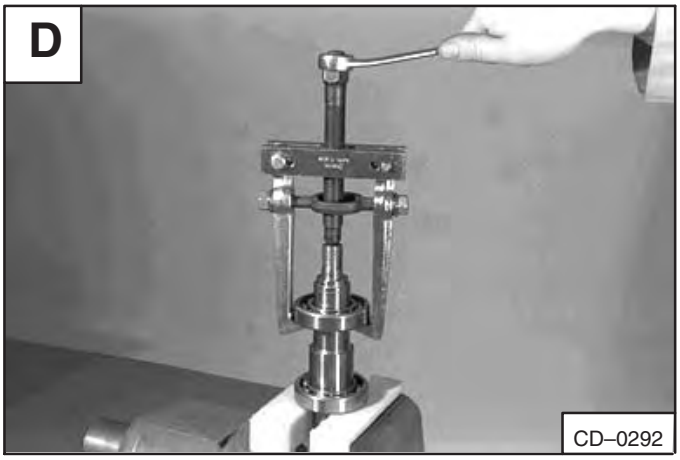
Remove the snap ring from each side of the roller **[B]**.



Using the fabricated driver tool and support fixture, press or drive the shaft and bearing assembly out of the roller **[C]**.



Inspect the bearings for rust or for rough spots. The bearings must turn freely. If any damage is found, replace the bearing. If replacement of the bearings is necessary, use a two or three jaw puller, remove the two bearings from the shaft **[D]**.



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TRACK ROLLER (Cont'd)

Assembly

Remove all paint and corrosion from the seal surface on both sides of the roller **[A]**.

Be sure all parts are clean before assembly.



Using the driver tool, install a new bearing, with the numbered side upward, onto the shaft **[B]**. Press only on the inner diameter of the bearing.



Using the driver tool, install the shaft and bearing assembly into the roller **[C]**.



Install the snap ring **[D]**.



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TRACK ROLLER (Cont'd)

Assembly (Cont'd)

Turn the roller assembly over.

Using the driver tool, install the other bearing, with the numbered side upward, into the roller **[A]**.



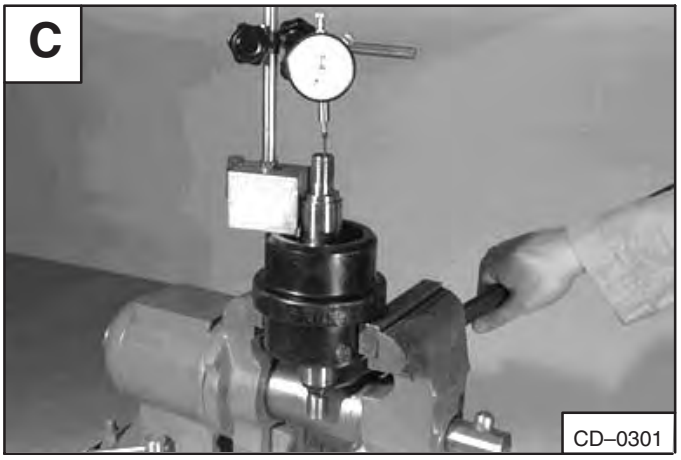
Install the snap ring **[B]**.



Using a dial indicator, check the endplay of the shaft **[C]**.

If the endplay is greater than 0.030 inch (0,76 mm) then the bearing must be shimmed.

Cut a shim from the necessary thickness shim stock and install the shim between the bearing and the shoulder on the shaft.



Separate the inner and outer halfs of the seal.

Apply grease to the grooves on the outer part of a new seal **[D]**.

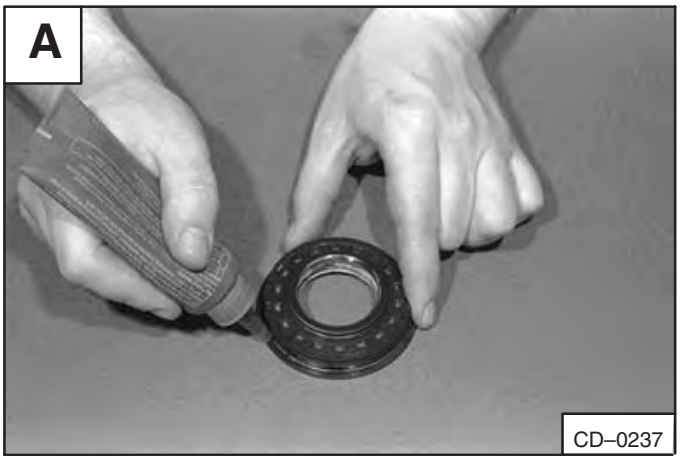


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TRACK ROLLER (Cont'd)

Assembly (Cont'd)

Apply a small bead of high temperature silicone sealant around the flange surface of the seal **[A]**.



Using the driver tool, install the outer part of the new seal into the roller **[B]**.

NOTE: The inner and outer parts of the seal must be installed separately so the air will escape from under the seal.



Using the driver tool, install the inner part ofthe new seal over the shaft **[C]**.

NOTE: The inner part of the seal must be pressed down level with the outer part of the seal to seal properly.



Turn the roller assembly over Using a syringe add 100 cc of SAE 10W/30 oil to the assembly **[D]**.

Repeat Page 5–32 **[D]** thru Page 5–33 **[C]** to install the remaining seal.

Check for leaks.



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TRACK ROLLER (Cont'd)

Assembly (Cont'd)

Install the spacer and the snap ring on each end of the shaft **[A]**.



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OVERHEAD CONSOLE

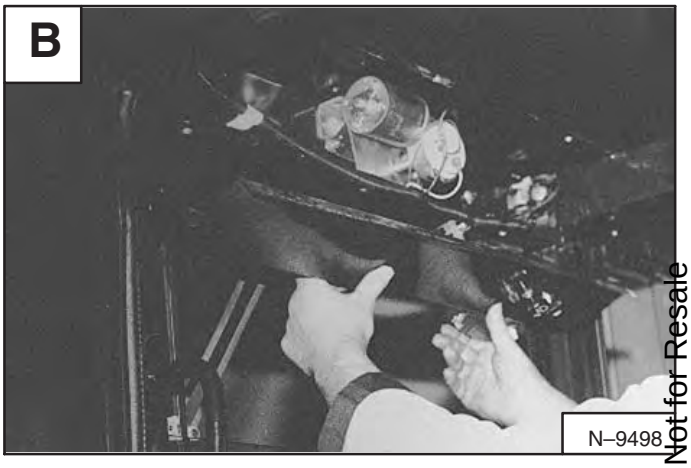
Removal and Installation

Remove the mounting screws **[A]**.



Lower the overhead console **[B]**.

Disconnect the wire harness and remove the console.



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ELECTRICAL SYSTEM

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DISPLAY MODULE
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Testing and Troubleshooting 6–11

DIVERTER VALVE SWITCH
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DOME LIGHT
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Electrical System Service 6–4
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WINDSHIELD WIPER
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TROUBLESHOOTING

Chart

The following troubleshooting chart is provided for assistance in locating and correcting problems which are most common. Many of the recommended procedures must be done by authorized Bobcat Service personnel only.

⚠ WARNING

Instructions are necessary before operating or servicing machine. Read Operation & Maintenance Manual, Handbook and signs (decals) on machine. Follow warnings and instructions in the manuals when making repairs, adjustments or servicing. Check for correct function after adjustments, repairs or service. Failure to follow instructions can cause injury or death.

W–2003–0797

PROBLEM	CAUSE
Battery will not take a charge.	1, 2, 3, 4
Alternator will not charge.	1, 2,4
Starter will not turn the engine.	2, 3, 5, 6, 7, 8

KEY TO CORRECT THE CAUSE

1. Alternator belt is loose or damaged.
2. Battery connections are dirty or loose.
3. Battery is damaged.
4. The alternator is damaged.
5. The engine is locked.
6. The starter is damaged.
7. The wiring or the solenoid is damaged.
8. Check the fuses

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ELECTRICAL SYSTEM

Description

The excavator has a 12 volt, negative ground electrical system. There are two main circuits.

1. The charging circuit has an alternator, regulator and a battery.
2. The starting circuit has a starter motor, solenoid and ignition switch for starting the engine.

The electrical system is protected by fuses, installed in the instrument panel. Fuses protect the electrical system from an overload. The reason for the overload must be found before starting the engine.

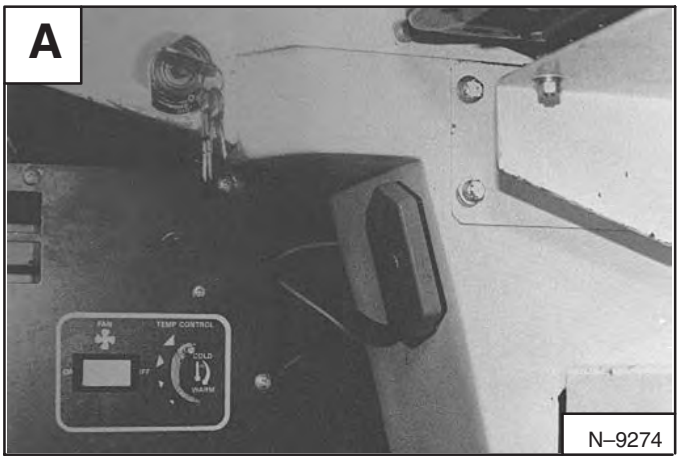
ELECTRICAL SYSTEM (Cont'd)

Fuses

The fuses protect the electrical system from damage. To replace the fuse (s), loosen the screw and remove the cover **[A]**.

Replace the fuse (s) with the same type and capacity.

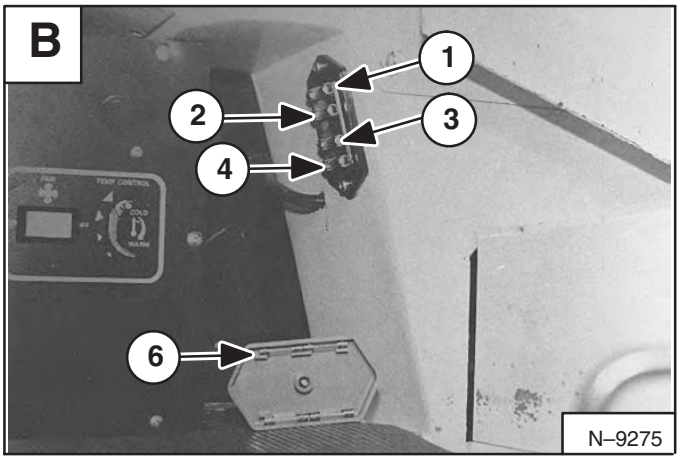
NOTE: Before replacing any fuse(s), make sure the key switch is in the OFF position.



Fuse Arrangement [B] & [C].

Ref.	Fuse Capacity
1.	10 Amp **[B]**
2.	10 Amp **[B]**
3.	10 Amp **[B]**
4.	10 Amp **[B]**
5.	10 Amp **[C]**

Store spare fuses in the cover (Item 6) **[B]**.

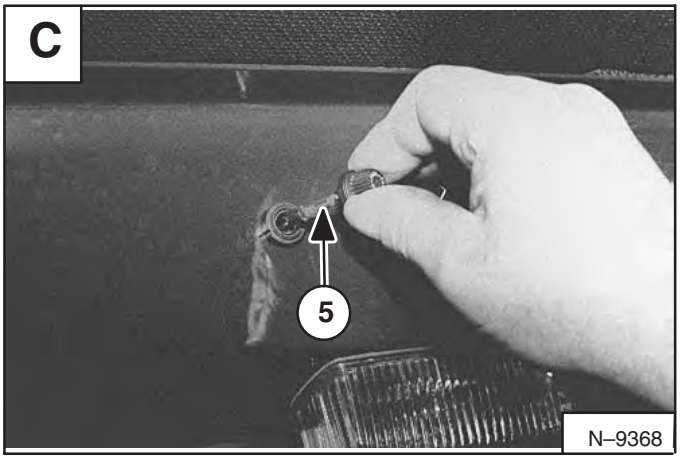


Electrical System Service

The battery cables must be clean and tight. Remove any acid or corrosion from the battery and cables using a sodium bicarbonate and water solution. Cover the battery terminals and cable ends with battery saver grease.

Check the electrolyte in the battery **[D]**.

If it is lower than 1/2 inch (13 mm) above the plates, add distilled water only.

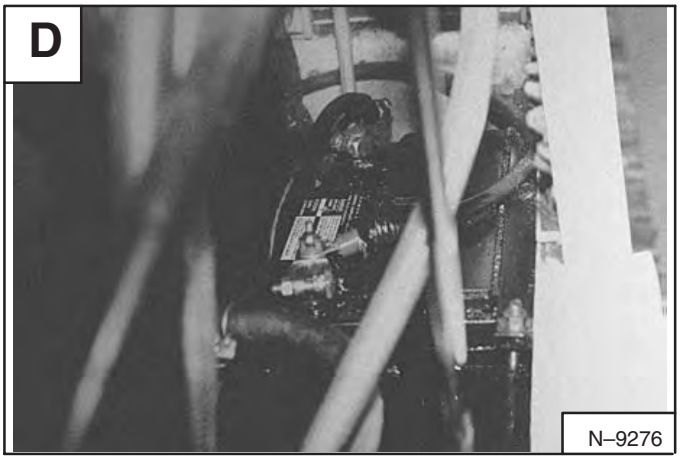


⚠ WARNING

Batteries contain acid which burns eyes and skin on contact. Wear goggles, protective clothing and rubber gloves to keep acid off body.

In case of acid contact, wash immediately with water for several minutes and get medical attention in case of eye contact.

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BATTERY

Checking the Battery

The tool listed will be needed to do the following procedure:

MEL10004A–Battery Tester

To make a safe and complete check of the battery, see the Melroe Battery Manual (P/N 6566047). The battery manual has all the information needed for checking and servicing the battery.

Removal and Installation

Rotate the upper works until the battery can be lowered between the tracks in the rear of the machine.

Raise the engine cover **[A]**.

⚠ WARNING

Batteries contain acid which burns eyes and skin on contact. Wear goggles, protective clothing and rubber gloves to keep acid off body.

In case of acid contact, wash immediately with water for several minutes and get medical attention in case of eye contact.

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Disconnect the negative (–) cable first **[B]**.

Disconnect the positive (+) cable.

Remove the battery holddown clamp **[C]**.

Lower the hinged cover (Item 1) **[D]** under the frame below the battery.

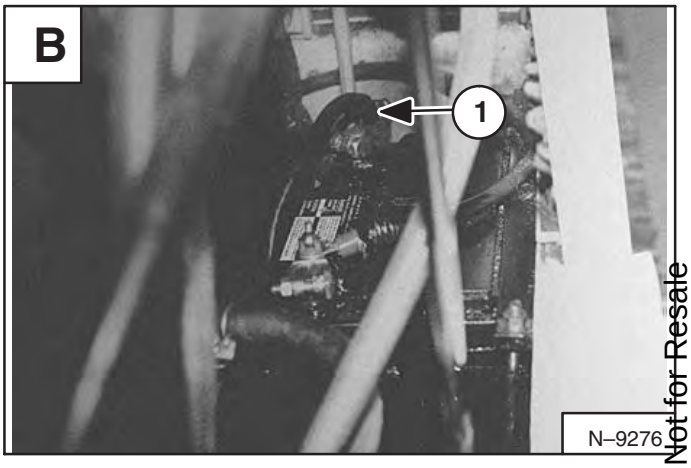
Lower the battery from the compartment.

Always clean the terminals and cable ends, even when installing a new battery.

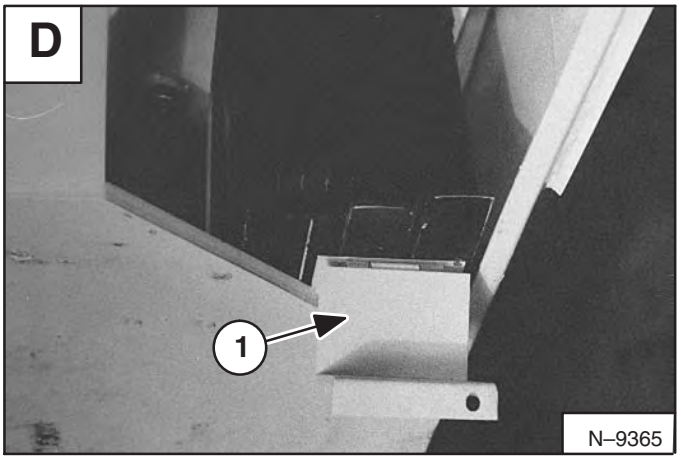
Install the battery. Install the holddown clamp and tighten the wing nuts.

Connect the battery cables. Connect the negative (–) cable (Item 1) **[D]** last to prevent sparks at the terminal **[B]**.









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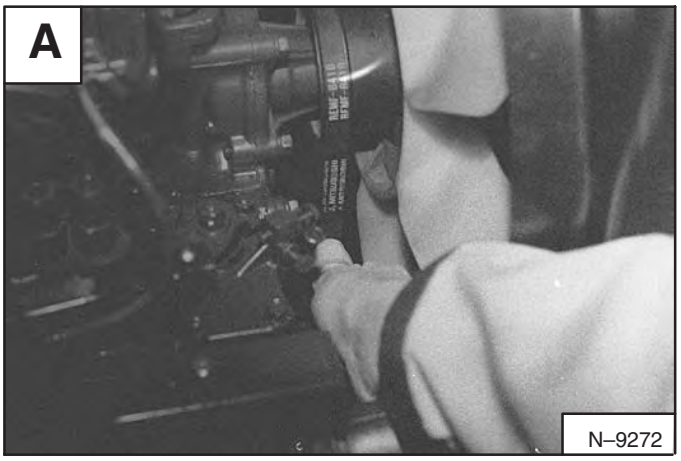
ALTERNATOR

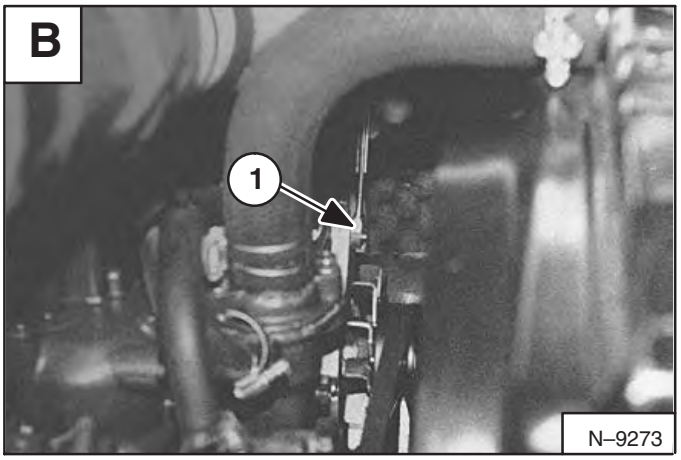
Belt Adjustment

To adjust the belt tension, use the following procedure:

1. Stop the engine. Open the engine cover.
2. The belt should deflect about 1/2” (13mm) when pressed between the water pump pulley and crankshaft pulley with approximately 13 lbs. (58 N) force **[A]**.
3. If the tension is not correct, loosen the alternator mounting bolt.
4. Loosen the adjustment bolt (Item 1) **[B]**.
5. Move the alternator until the belt tension is correct.
6. Tighten the adjustment bolt and mounting bolt.

Replace the belt if it has stretched or there are cracks in the belt. Check the pulley grooves, make sure the belt is not in contact with the bottom of the grooves in the pulleys.





Removal and Installation

Disconnect the negative (–) cable from the battery.

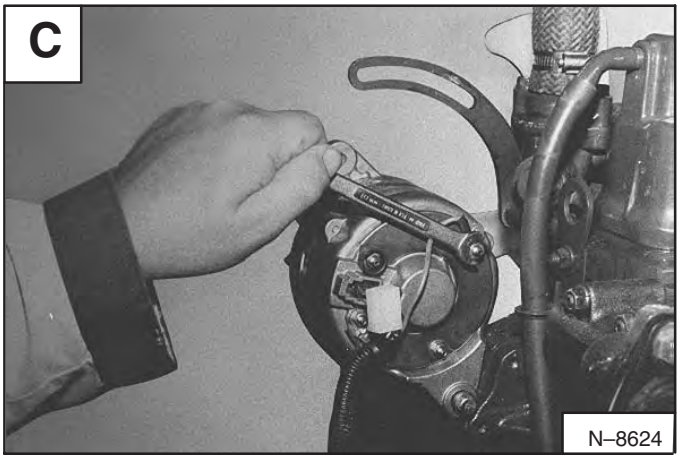
Disconnect the alternator wires **[C]**.

Remove the adjustment bolt **[B]**.

Remove the alternator belt.

Remove the mounting bolt.

Remove the alternator from the bracket.



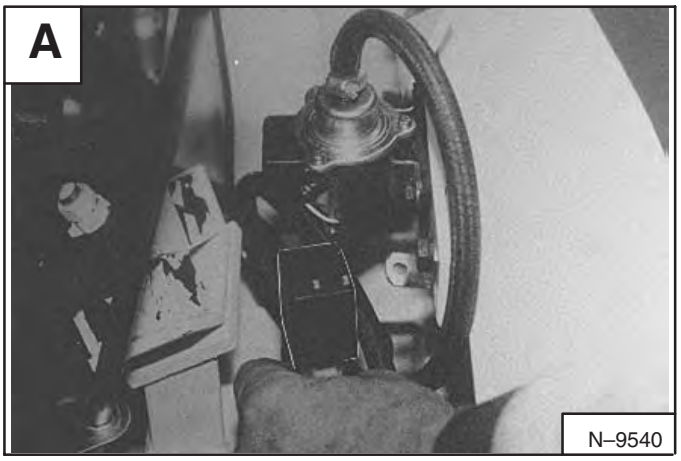
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FUEL SHUT–DOWN RELAY

Removal and Installation

Disconnect the wires from the fuel shut–down relay.

Remove the relay **[A]**.



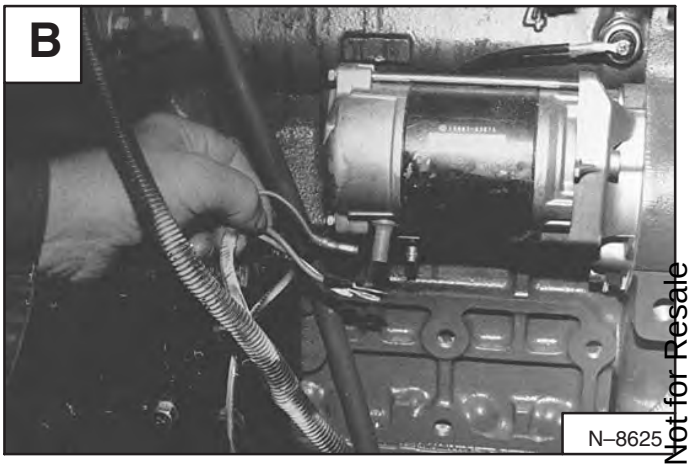
STARTER

Removal and Installation

Remove the operator seat and seat mount to gain access to the starter.

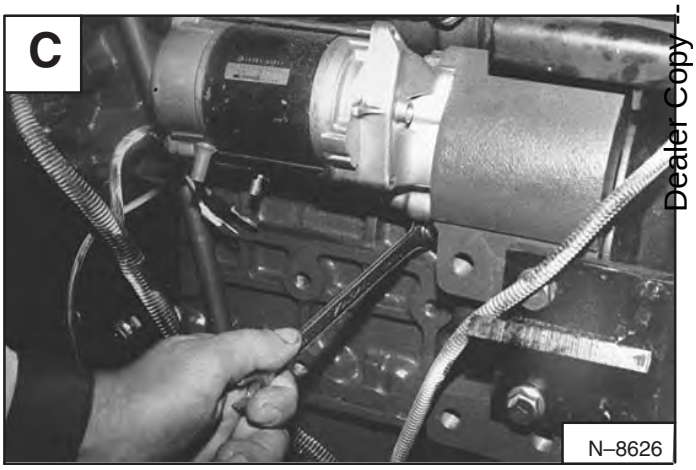
Disconnect the negative (–) cable from the battery.

Disconnect the wires from the starter **[B]**.



Remove the mounting bolts from the starter **[C]**.

Remove the starter from the bell housing.



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STARTER (Cont'd)

Disassembly and Assembly

Disassemble the starter as shown in figure **[A]**.

Cleaning and Inspection

⚠ WARNING

Wear safety glasses to prevent eye injury when any of the following conditions exist:

- **When fluids are under pressure.**
- **Flying debris or loose material is present.**
- **Engine is running.**
- **Tools are being used.**

W–2019–1285

Use a brush and air pressure to clean the drive, field coils, armature and starter housing.

NOTE: Do not use solvent to clean the drive assembly. The solvent will remove the lubricant and the drive will slip.

Check the following items:

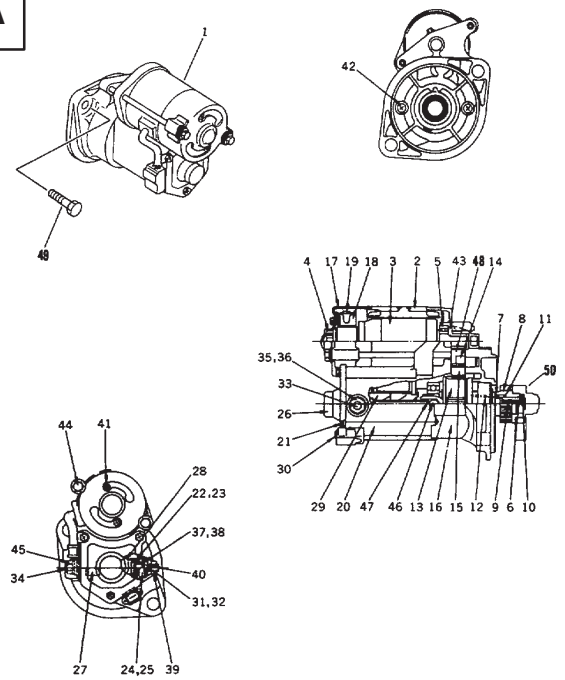
Armature
—Broken or burned insulation
—Loose connections at commutator
—Open or grounded circuits
—Worn shaft or bearings
—Rough commutator

Field Coils
—Broken or burned insulation
—Electrical continuity
—Brush connections

Drive Gear
—Worn Teeth
—Tooth engagement (drive gear must engage ring gear by 1/2 the depth of the ring gear tooth).

Brush Holders
—Broken springs
—Broken insulation
—Spring tension

A



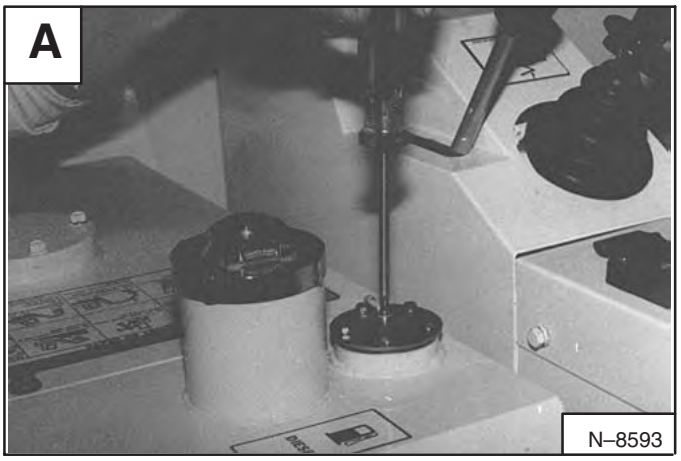
1.	Starter	26.	Cover
2.	Yoke Assy.	27.	Plate
3.	Armature	28.	Plate
4.	Bearing	29.	Plunger
5.	Bearing	30.	Bolt
6.	Nut	31.	Washer
7.	Retainer	32.	Washer
8.	Pinion	33.	Bolt
9.	Shaft	34.	Bolt
10.	Snap Ring	35.	Nut
11.	Spring	36.	Nut
12.	Spring	37.	O–ring
13.	Clutch	38.	O–ring
14.	Roller	39.	Nut
15.	Pinion	40.	Washer
16.	Housing	41.	Screw
17.	Frame	42.	Screw
18.	Holder Assy.	43.	Washer
19.	Spring	44.	Bolt
20.	Solenoid	45.	Nut
21.	Gasket	46.	Ball
22.	Bushing	47.	Spring
23.	Bushing	48.	Retainer
24.	Bushing	49.	Bolt
25.	Bushing	50.	Clutch Assy.

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FUEL LEVEL SENDER

Removal and Installation

Remove the wire from the fuel sender screw **[A]**.



Remove the sender mounting bolts **[B]**.

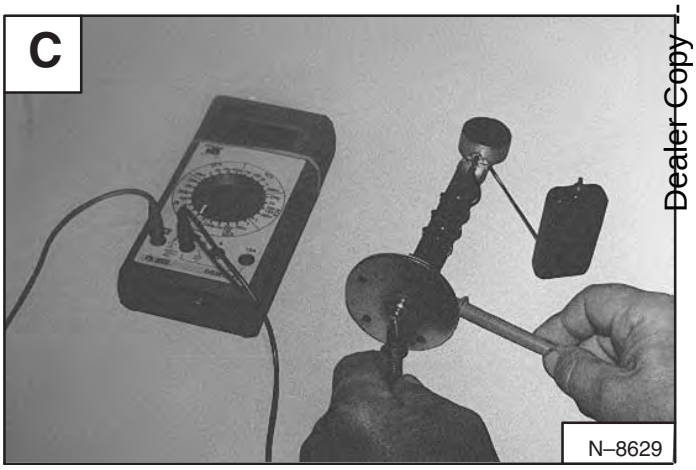
Remove the sender from the tank.



Checking

Use a ohmmeter to check the resistance of the fuel sender **[C]**.

See additional test information on Page 6–16.



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DISPLAY MODULE

Removal and Installation

Use the following procedure to remove or install the gauge cover:

Disconnect the negative (–) cable from the battery.

Remove the screws from the display module **[A]**.

Lift the cover.

Remove the defective part and install the new part.

See Pages 6–11 thru 6–19 for display module testing and trouble shooting with the display module installed in the excavator.

If the display module has been removed from the excavator and has been brought into the service shop for diagnosis. (See Pages 6–20 thru 6–24 for test procedures.)

INSTRUMENT PANEL

Removal and Installation

Disconnect the negative (–) cable from the battery.

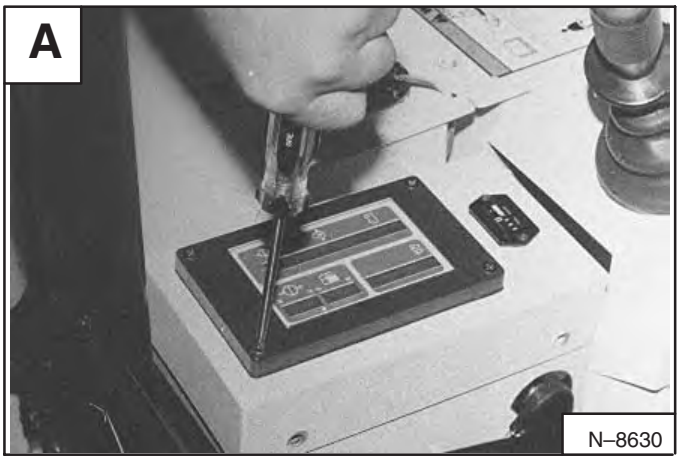
Remove the bolts on both sides of the instrument panel housing **[B]**.

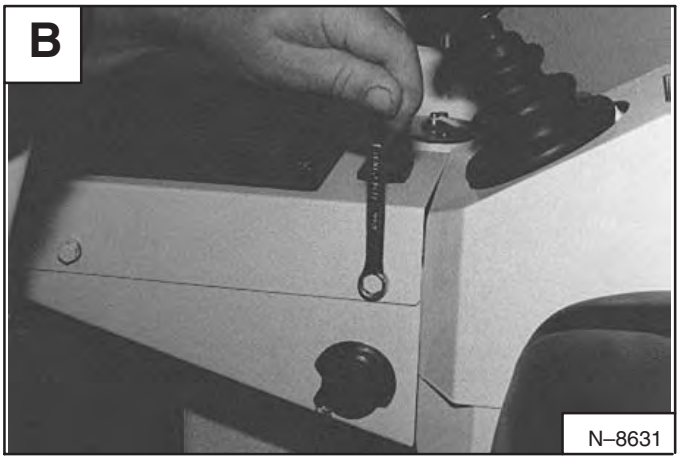
Lift the cover.

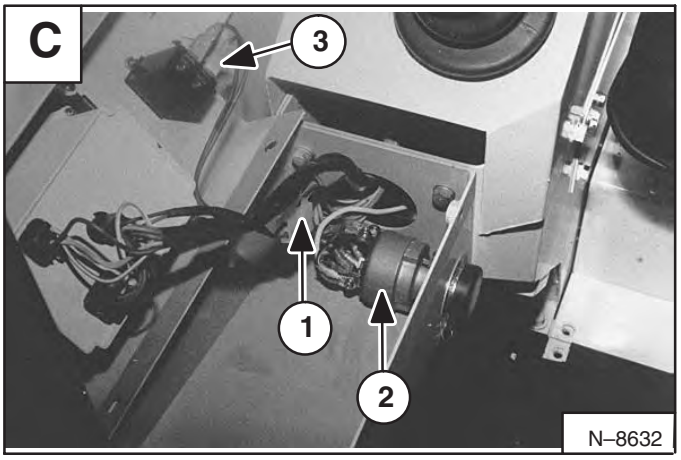
Remove the wiring harness connectors (Item 1) **[C]**.

Mark the wires on the ignition switch (Item 2) **[C]** for correct installation.

Mark the wires on the hourmeter (Item 3) **[C]** for the correct installation.







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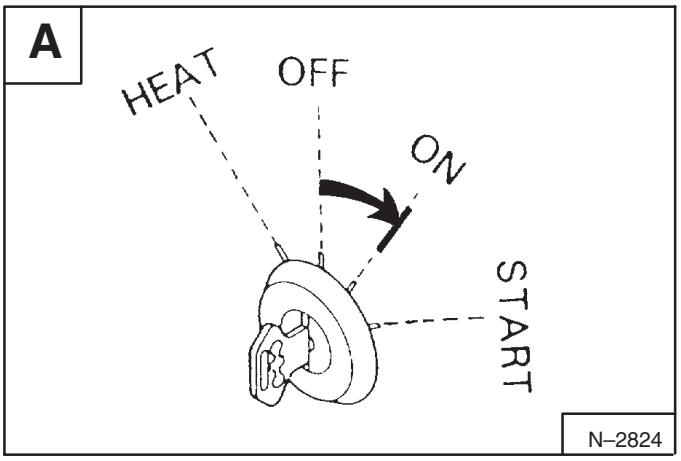
DISPLAY MODULE

Testing and Trouble Shooting

Initial test (with Display Module installed in the Excavator.)

NOTE: If the display module has been removed from the excavator. (See the gauge test information on Pages 6–20 thru 6–24.)

Turn the ignition key to the ON position (do not start the engine) **[A]**. The following display module conditions will exist.



Engine temperature bar graph will illuminate at the current engine temperature. If the engine temperature is below the minimum normal operating temperature warning light will blink on and off **[B]**.

Fuel level bar graph will illuminate at the full **F** setting. At ten second intervals, the fuel level bar graph will drop one bar at a time until the actual fuel level in the tank is reached. If the fuel level is in the empty **E** range on the bar graph the low fuel warning light will blink on and off **[B]**.

Engine oil pressure warning light will blink on and off continuously **[B]**.

Voltage charging light will blink on and off continuously **[B]**.

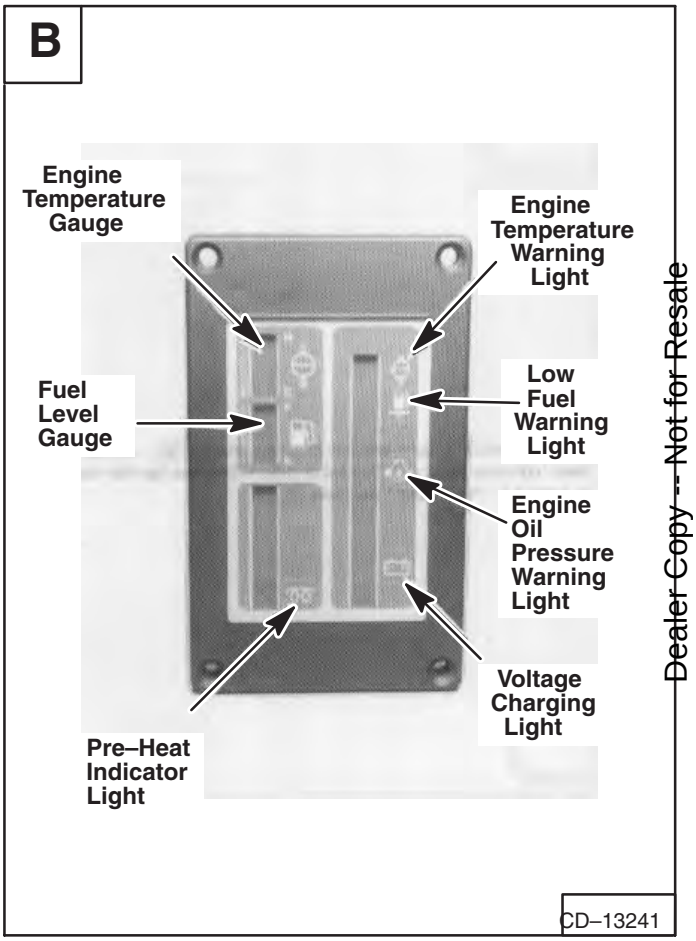
Pre heat indicator light will not be illuminated. The pre–heat indicator light will illuminate only when the ignition key is turned to the heat position **[A]**.

Start the excavator **[A]**.

With the excavator started, the display module will perform an internal module check. This will last for three seconds and the following display module conditions will exist.

Engine temperature bar graph will illuminate at the current engine temperature. The engine temperature warning light will blink on and off for three seconds. After the three second check, if the engine temperature is below the minimum normal operating temperature (122°F–50°C), the engine warning light will continue to blink on and off until the engine reaches the normal operating temperature and the second bar graph illuminates.

If the engine temperature at start up is above the minimum operating temperature, the warning light will not blink on and off.



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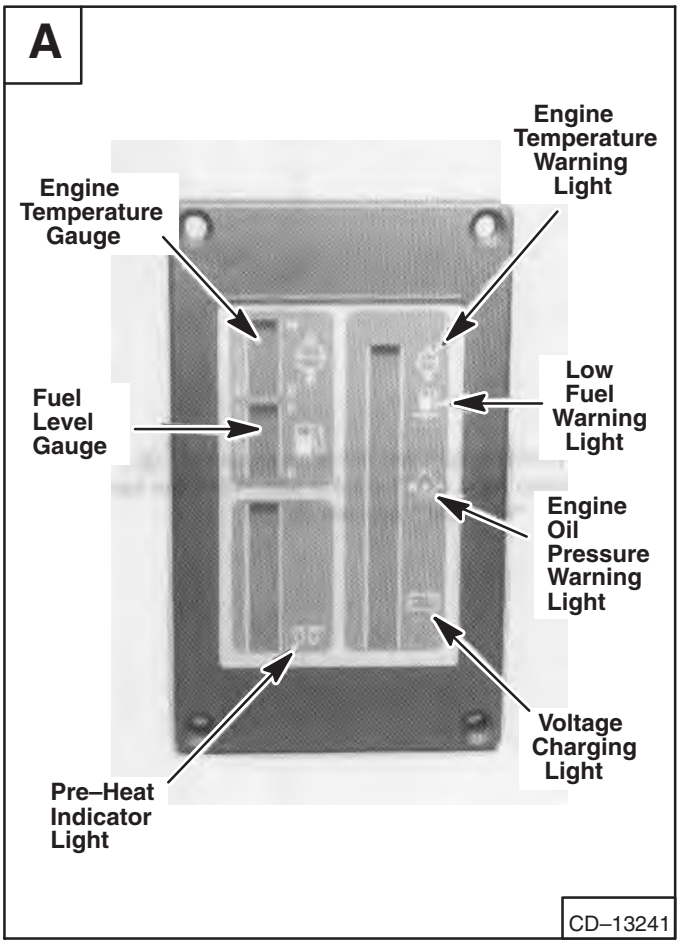
DISPLAY MODULE (Cont'd)

Testing and Trouble Shooting (Cont'd)

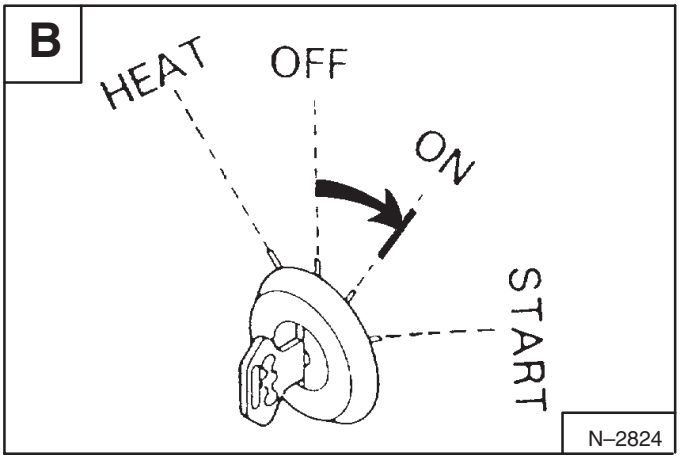
Fuel level bar graph will illuminate at the full **F** setting. At ten second intervals, the fuel level bar graph will drop one bar at a time until the actual fuel level in the tank is reached. The low fuel warning light does not blink on and off during the three second check. Only if the fuel level bar graph drops to the empty **E** level will the low fuelwarning light blink on and off **[A]**.

Engine oil pressure warning light will blink on and off for three seconds, then the warning light will turn off. If the warning light continues to blink after the three second check, STOP the engine.

Voltage charging light will blink on and of f for three seconds, then the charging light will turn off **[A]**.



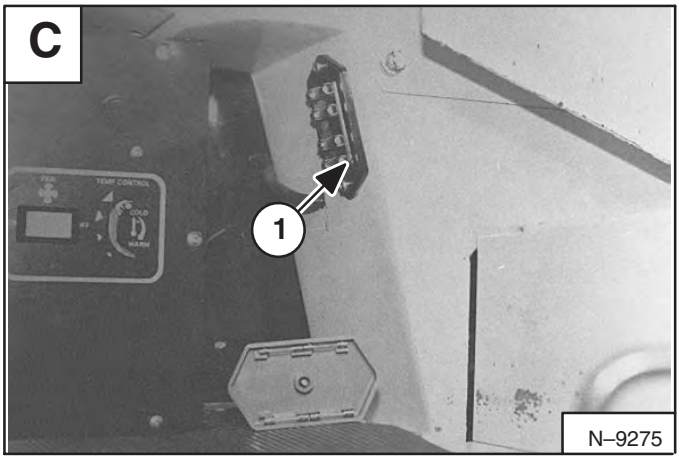
Pre–heat indicator light will not blink on and off **[A]**. The pre–heat indicator light will illuminate only when the ignition key is turned to the heat position **[B]**.



If the display module does not illuminate at all, check the fuse (Item 1) **[C].** If the fuse is blown, check the wire harness for damage, then, replace the fuse (10 amp).

If the fuse is in good working condition, check the voltage at the fuse block, (10–14 volts). If no voltage is recorded, check the wire harness for damage and repair or replace the harness **[C]**.

If the voltage is correct, see the following pages for additional display module testing information.



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DISPLAY MODULE (Cont'd)

Engine Temperature Circuit Test
(with display module installed in the excavator .)

The engine temperature gauge bar graph (Item 1) **[A]** & **[B]** will illuminate per the engine temperature shown.

After engine start–up, the engine temperature warning light (Item 2) **[A]** will blink on and of f until the engine reaches the operating temperature of approximately 122°F (50°C). The temperature warning light will then turn off. If the engine operating temperature rises to an overheat temperature of 212 °F (110°C) or above, the engine temperature warning light (Item 2)**[A]** will blink on and off until either the operating temperature drops below 212°F (110°C) or the engine is shut off.

Testing the Display Panel

The following tools will be needed:

A potentiometer with a range of 0–100 ohms and and ohm meter.

Connect the ohm meter (Item 1) **[C]** to the potentiometer (Item 2) **[C]** and set the potentiometer to 22 ohms.

Disconnect the engine harness at the water temperature sender **[D]**.

Connect the potentiometer to the engine harness water temperature sender wire and ground the opposite potentiometer terminal to the excavator frame.

Turn the ignition key to the ON position, but do not start the excavator.

The water temperature warning light will blink for approximately two seconds and then the second temperature bar graph light will illuminate and the warning light will turn off.

NOTE: The display module has a two second delay built into the water temperature circuit to eliminate eratic lighting of the gauge bar graph as the engine temperature changes.

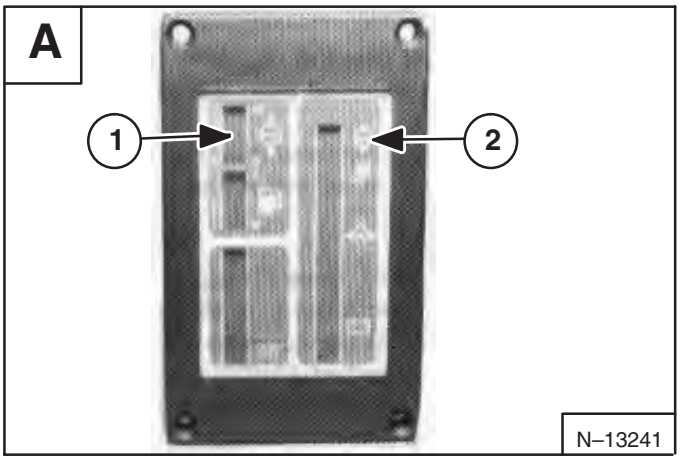
After approximately ten seconds, the fifth bar graph light should be illuminated. If further checks are desired, adjust the potentiometer settings per the chart **[B]** and check for the corresponding bar graph light changes.

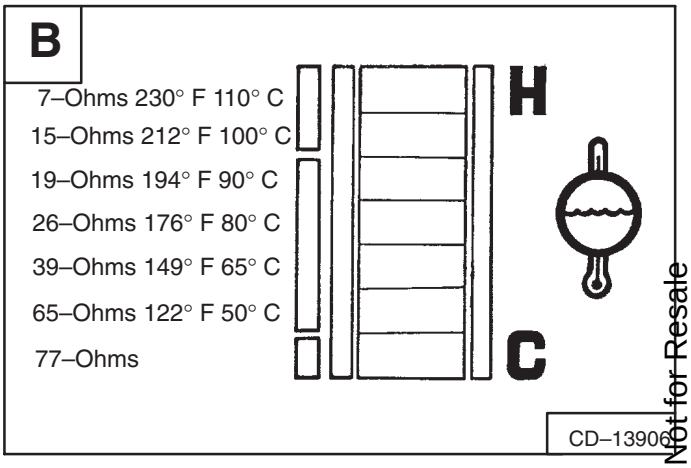
If the display module test shows the dash is working correctly, the water temperature sending unit may be defective.

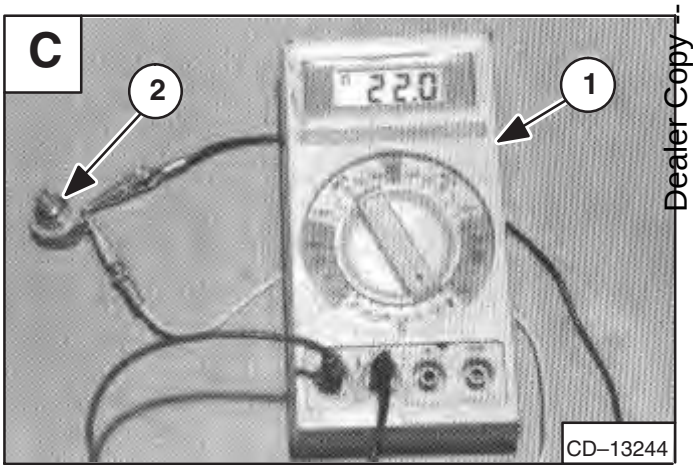
To test the sending unit, use an ohm meter . Disconnect the wire from the sending unit **[D]**. Connect one end of the ohm meter leads to the sending units wire connection terminal and ground the other lead to the base of the sending unit. With the engine temperature (and the sending unit) at ambient temperature (engine cool to the touch), the ohm meter should read approximately 180 ohms.

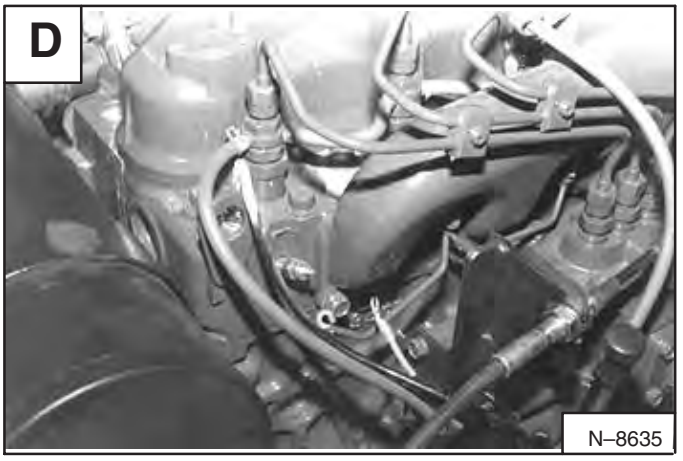
Start the engine.

As the engine temperature rises, the ohm meter reading should continually decrease. If the ohm meter reading did not show the correct (approximately 180 ohms) initial test or as the engine temperature increase the meter reading does not decrease, or if the ohm meter shows an open circuit, replace the sending unit.









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DISPLAY MODULE (Cont'd)

Engine Temperature Circuit Test (Cont'd)
(with display module installed in the excavator.)

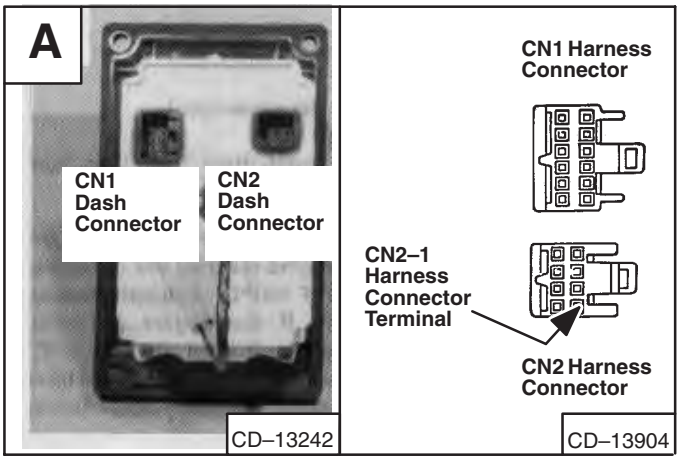
If the display module test does not illuminate the engine temperature bar graph lights per the ohm test, check the engine harness wire that attaches to the temperature sending unit and to the CN2–1 pin **[A]** in the display module harness to make sure this wire is not broken or shorted out.

NOTE: If the engine harness wire is shorted out, the engine temperature bar graph will show the overheat level setting continuously and the warning light will blink on and off. If the wire is broken, the bar graph will show the cold C level setting continuously and the warning light will blink on and off.

To check the wire, use the ohm meter and connect the ohm meter leads to each end of the harness wire. If the wire is in good working condition, the ohm meter will show approximately 0.4 ohms.

If the wire is found defective, repair or replace the harness.

If the wire is in good working order and the sending unit is in good working order, but the display module bar graph will not illuminate per the previous tests, replace the display module.



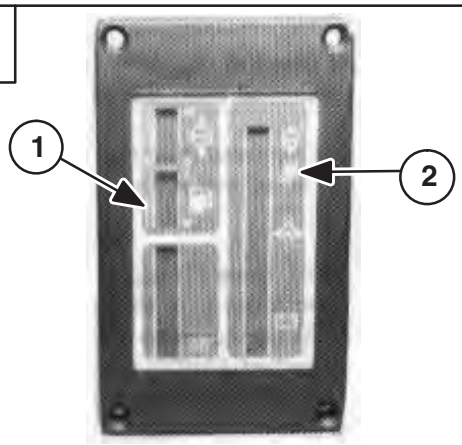
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DISPLAY MODULE (Cont'd)

Fuel Level Circuit Test
(with display module installed in the excavator)

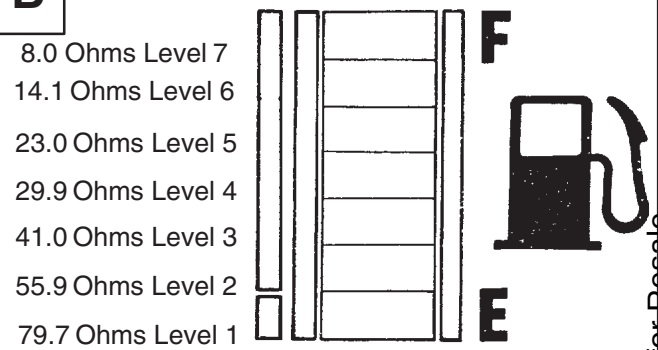
The fuel level gauge bar graph (Item 1) **[A]** & **[B]** will illuminate per the fuel level shown. When the fuel level drops to the E level on the bar graph, the low fuel warning light (Item 2) **[A]** & **[B]** will blink on and off.

A



N–13241

B



B–13907

Testing the Display Panel

The following tools will be needed:

A potentiometer with a range of 0–100 ohms and an ohm meter. Connect the ohm meter (Item 1) **[C]** to the potentiometer (Item 2) **[C]** and set the potentiometer to 41 ohms.

Disconnect the engine harness at the fuellevel sender in the fuel tank **[D]**.

Connect the potentiometer to the fuel level sender wire and ground the opposite potentiometer terminal to the excavator frame.

Turn the ignition key to the ON position, but do not start the engine.

The fuel level bar graph will be illuminated at all seven levels **[B]**. After approximately ten seconds, the seventh bar graph light will turn off.

NOTE: The display module has a ten (10) second delay built into the fuel level circuit to eliminate eratic lighting of the bar graphs as fuel sloshes in the fuel tank.

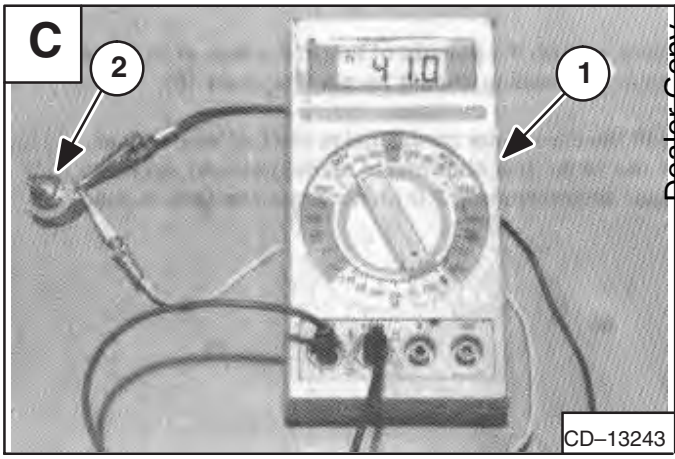
After approximately forty seconds, the bar graph will be illuminated through the third level **[B]**.

To do additional tests, adjust the potentiometer per the chart **[B]**.

Adjust the potentiometer so the bar graph drops to level one, empty E, the low fuel warning light will blink on and off.

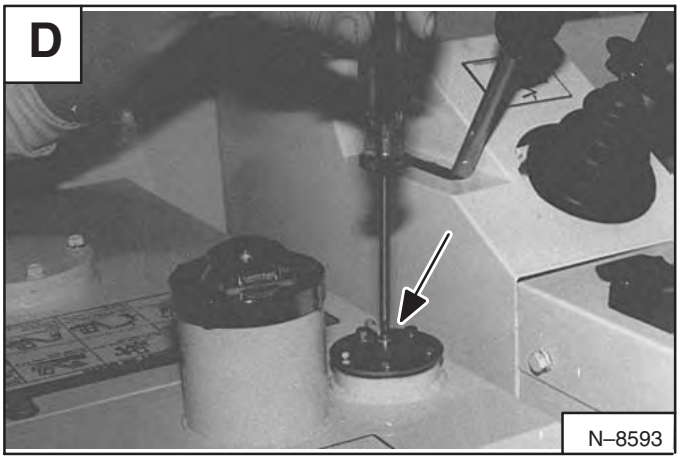
If the display module test shows that the fuel level bar graph is working properly, then the fuel level sender may be defective, test the sender (see information on next page).

C



CD–13243

D



N–8593

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DISPLAY MODULE (Cont'd)

Fuel Level Circuit Test (Cont'd)
(with display module installed in the excavator.)

If the display module test does not illuminate the fuel level bar graph lights, check the wire harness that attaches to the fuel level sender and to the CN2–3 termina **[A]** on the display harness, to make sure that this wire is not broken or shorted.

NOTE: If the fuel level sender wire is shorted, the fuel level bar graph should show a full F level setting at all times. If the wire is broken, the fuel level bar graph will show an empty E level setting at all times and the low fuel light will blink on and off.

To check the wire, use the ohm meter. Connect one ohm meter lead to each end of the fuel wire. The ohm meter should read approximately 0.4 ohms.

If the wire is found defective, repair or replace the harness. If the wire is in good condition, check the fuel sender.

Fuel Level Sender

To check the fuel level sender (in the tank test), connect the ohm meter to the sender at the wire connection screw and ground the other lead to the fuel level sender mounting flange **[B]**.

NOTE: Ignition key must be in the off position when doing this check.

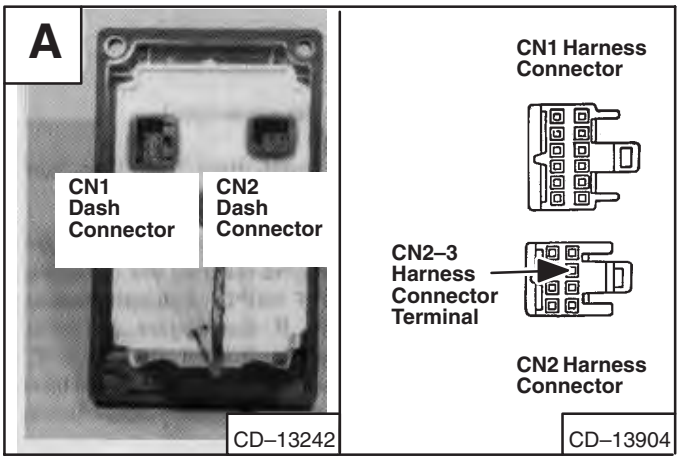
Depending on the amount of fuel in the tank at the time of test, the meter reading should be per the chart **[C]**.

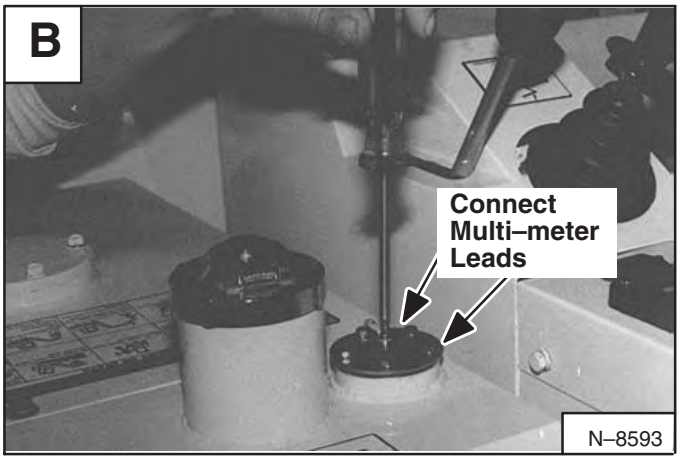
With the ohm meter connected to the fuel level sender, add fuel to the tank. The ohm meter reading should decrease until it reads approximately 2.0 ohms when the tank is full.

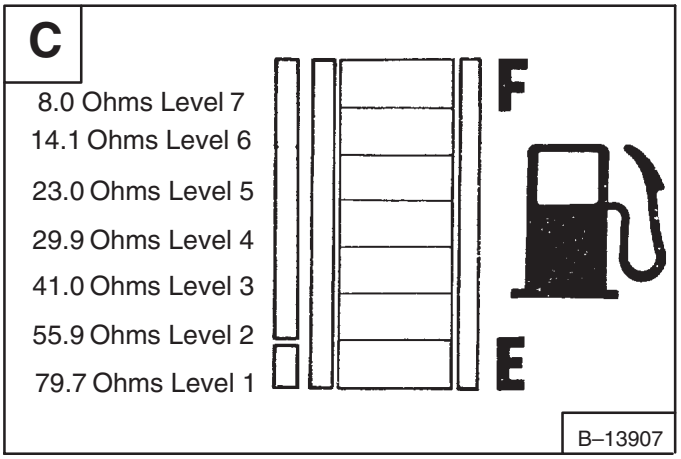
To check the fuel level sender (out of the tank test), connect the ohm meter to the sender at the wire connection screw and ground the other lead to the fuel level sender mounting flange **[D]**.

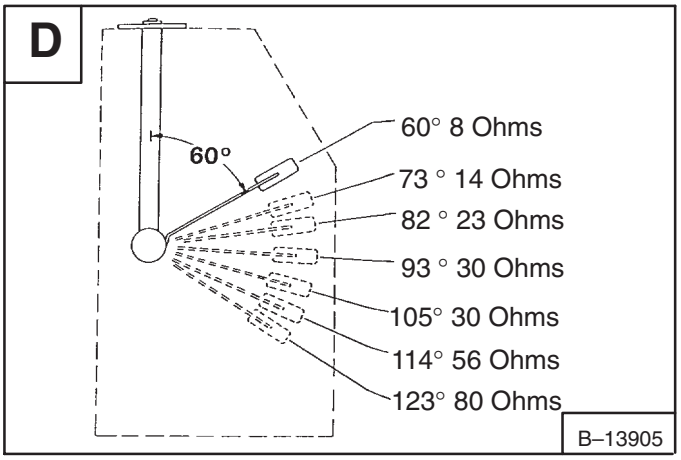
Hold the mounting flange horizontally and move the fuel level arm to the angles shown in the chart **[D]** and read the corresponding ohms per the arm angle.

If the wire is in good working order, the sending unit is in good working order, but the display module bar graph will not illuminate, replace the display module.









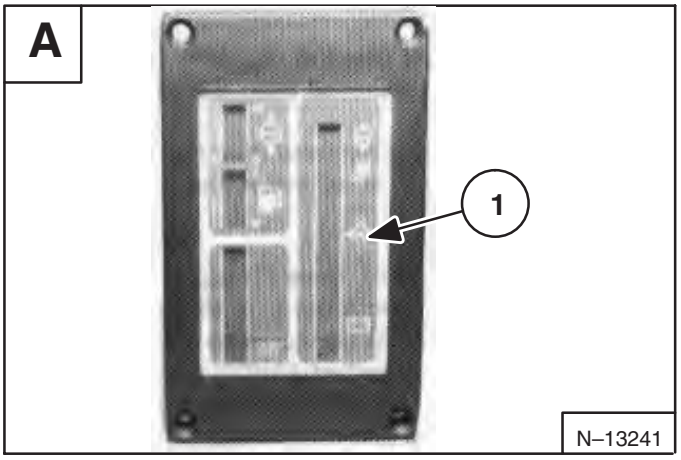
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DISPLAY MODULE (Cont'd)

Engine Oil Pressure Circuit Test (with display module installed in the excavator)

The low oil pressure warning light (Item 1) **[A]** will start to blink when the engine oil pressure drops below 7 PSI (50 kPa).

STOP engine immediately.



Testing the Display Module

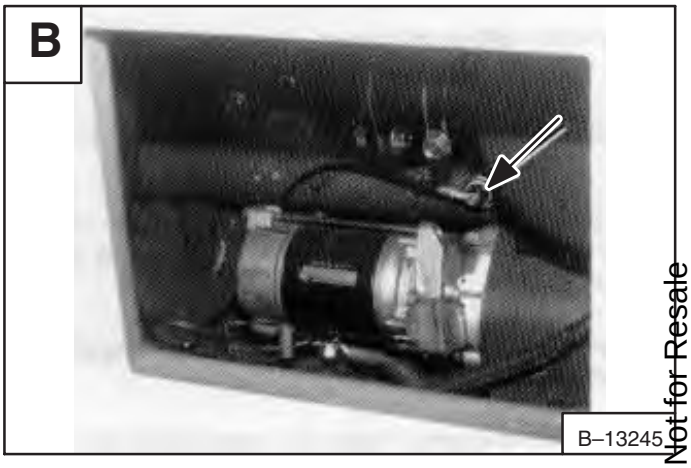
Turn the ignition switch to the ON position but do not start the engine.

The engine oil pressure warning light should continuously blink on and off. Disconnect the engine harness at the oil pressure sending unit on the engine **[B]**.

Wait four seconds and if the warning light goes off, the sending unit is defective.

Replace the sending unit.

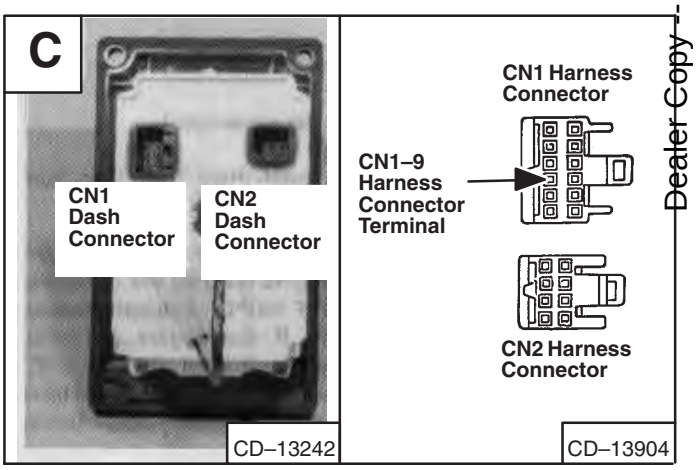
NOTE: Grounding the sending unit wire to the engine will cause the light to blink on and off in four (4) seconds.



If the light continues to blink on and off with the wire disconnected from the sending unit, check the wire harness. Disconnect the harness wire at the oil pressure sending unit. Use an ohm meter and connect one of the leads to this wire and connect the other lead to the display module harness, terminal CN1–9 **[C]**. The ohm meter should read approximately 0.4 Ohms.

If the wire is defective, repair or replace the harness.

NOTE: If this wire has a bare spot and is grounded to the excavator frame or to the engine, the oil pressure warning light will continually blink on and off. If the wire is broken, the low oil pressure light will not blink, repair or replace the wire harness.



If the harness is in good working order but the display module does not work properly, remove the sending unit from the engine and install a mechanical oil pressure gauge to the engine. Start the engine, the oil pressure should be 42–64 PSI (294–441 kPa).

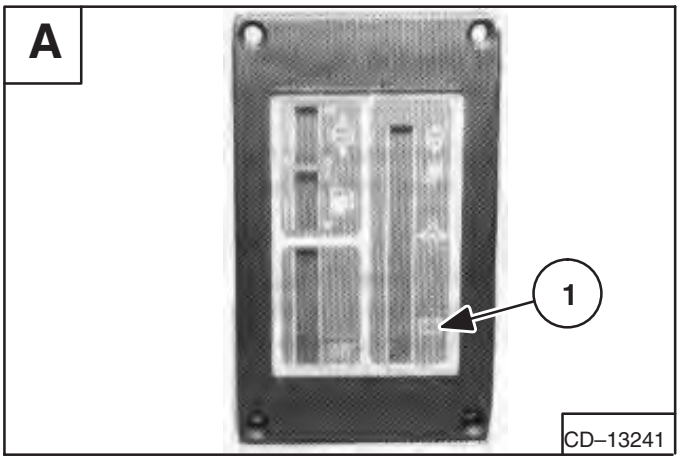
If the oil pressure is correct, the display module is defective, replace the display module.

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DISPLAY MODULE (Cont'd)

Battery Charge Circuit Test
(with display module installed in the excavator.)

If the battery light (Item 1 **[A]**) continually blinks on and off with the engine running, this indicates a low voltage condition (less than 9 volts).



Install a DC voltmeter between the alternator battery B terminal and the engine ground **[B]**.

Start the engine.

The voltage at engine idle should be approximately 14 volts. Stop the engine. If the voltage is incorrect, repair or replace the alternator.

If the alternator voltage is correct, check the engine harness to display harness.

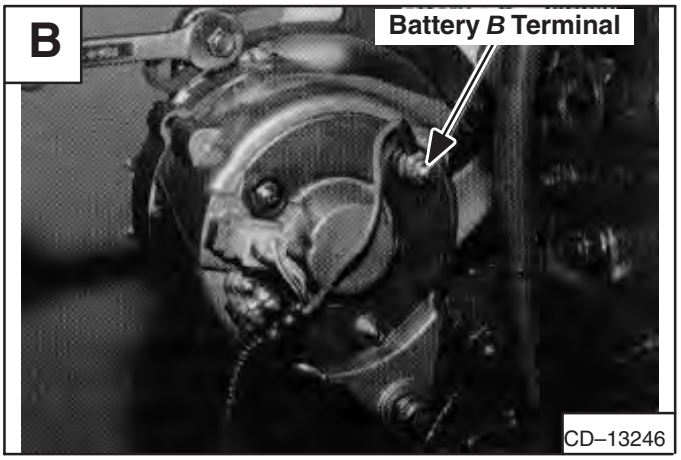
Disconnect the CN1 connector from the back of the display module.

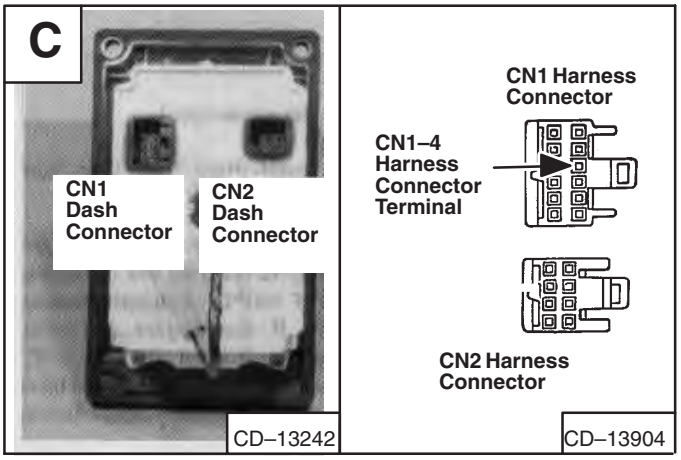
Connect a DC voltmeter to the display module harness connector pin CN1–4 **[C]**. Connect the other lead to ground. Start the excavator.

The voltage should be approximately 14 volts at engine idle. Stop the engine.

If no voltage is measured, check the wire harness for broken or damaged wires. Repair or replace the harness.

If voltage at the display module harness (connector pin CN1–4) is correct, the display module is defective. Replace the display module.



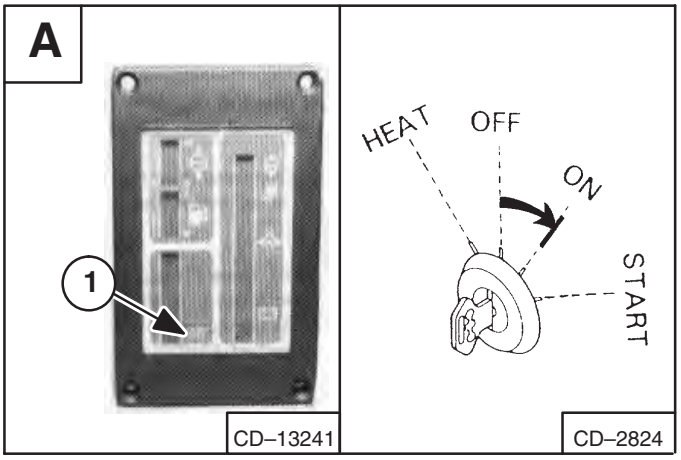


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DISPLAY MODULE (Cont'd)

Glow Plug Circuit Test
(with display module installed in the excavator)

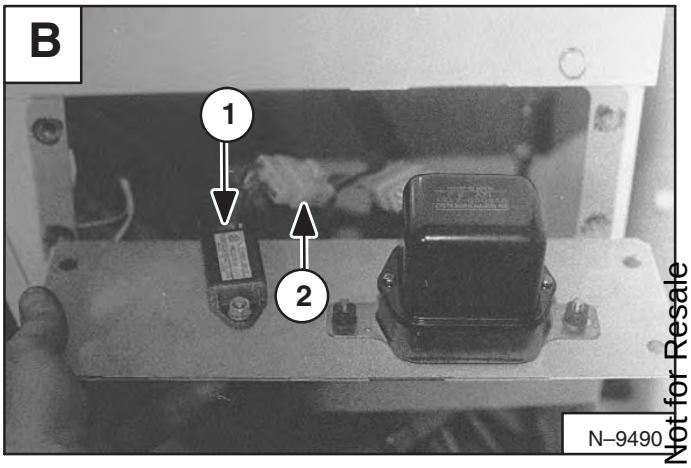
The glow plug light (Item 1) **[A]** will illuminate when the glow plugs are activated by turning the ignition key to the *heat* position.



The glow plug light is activated by a glow plug timer (Item 1) **[B]**.

When the ignition key is held in the *heat* position the timer will turn the glow plug light off after fifteen (15) seconds **[B]**. This indicates that the engine is ready to start.

NOTE: The ignition timer only turns off the display light. If the ignition key is held in the heat position after the display light turns off, the glow plugs will still be heating.

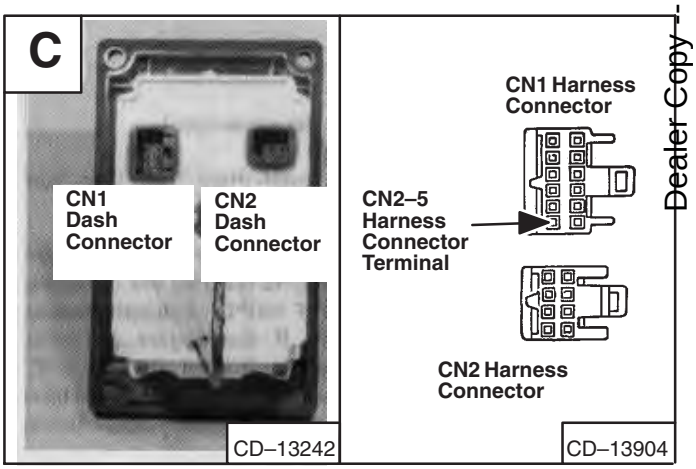


If the glow plug light (Item 1) **[A]** does not illuminate when the ignition key is turned to the *heat* position, check the voltage at the glow plugs. Connect a DC volt–meter leads to a glow plug wire and to ground **[C]**. Turn the key to the heat position, the voltage at the glow plug should be approximately 10.6 volts.

If no voltage is recorded at the glow plugs, check the engine harness for broken or damaged wires. Check the ignition switch harness connections. Repair or replace the engine harness.

If voltage is correct, the glow plug timer (Item 1) **[B]** may be defective.

Disconnect the CN1 and CN2 connectors from the back of the display module. Connect a DC voltmeter to the display harness terminal CN2–5 **[C]**. Connect the other lead to ground. Turn the ignition key to *heat*, the voltage should be 10–14 volts. If no voltage is recorded, disconnect the timer module harness (Item 2) **[B]** from the engine harness. Use a jumper wire and connect the two (2) yellow wire terminals together. Turn the ignition key to *heat* and check for voltage at the CN2–5 terminal **[C]**. If voltage is now recorded, the glow plug timer is defective, replace the glow plug timer. With the jumper wire still in place, connect the dash harness (CN1) to the dash module. Turn the key to *heat* position and check to see that the glow plug light is on. If glow plug light is not on, the display module is defective, replace the display module.



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DISPLAY MODULE (Cont'd)

Engine Temperature Circuit Test (with display module removed from the excavator.)

The following tools will be needed:

A potentiometer with a range of 0–100 ohms and an ohm meter.

With the display module removed from the excavator, the only test that can be made is to see if the engine temperature bar graph and warning light will illuminate.

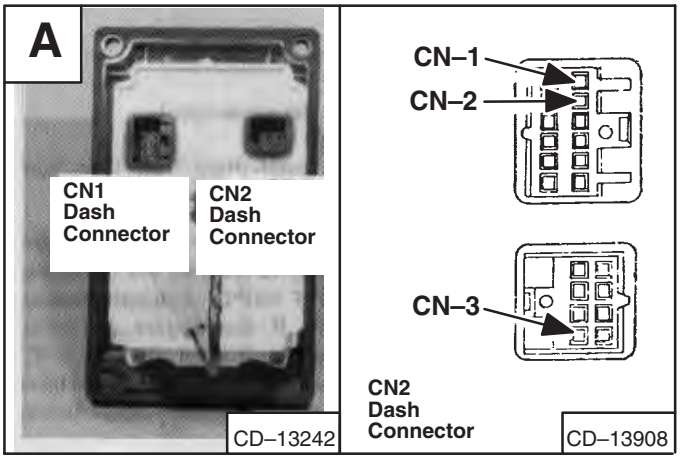
To test the display module, three test leads will need to be connected to the connector pins on the back of the module **[A]**. These leads must be protected so that the test wires will only contact the pins specified. Expose approximately 3/8 inch (10 mm) of the end of the test lead. Wrap the exposed end of the wire with electrical tape so only a small opening is exposed at the end of the lead. Connect one (1) of the test leads to the CN1–1 connector pin **[A]**. Connect this lead to a 12 volt battery positive (+) terminal. Connect a test lead to the CN1–2 connector pin **[A]**. Connect this lead to the battery negative (–) terminal. The display should now be illuminated. Connect the third test lead to the CN2–1 connector pin **[A]**. Connect the opposite end of this lead to the potentiometer (preset to 22 ohms, see instructions below) and ground the other potentiometer terminal to the negative (–) battery terminal.

The engine temperature bar graph should illuminate the fifth bar in approximately ten (10) seconds. Change the potentiometer setting per chart **[B]** to further test the bar graph. When the bar graph is tested, and the first (cold *C*) bar is illuminated or the six or seven (Hot *H*) bars are illuminated, then the engine temperature warning light will blink on and off.

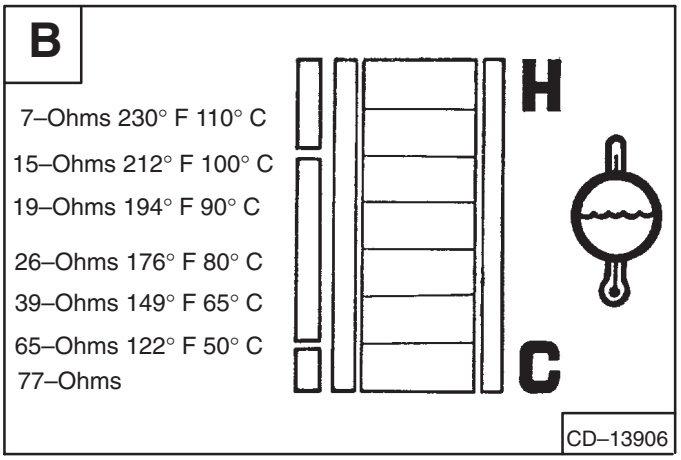
To set the potentiometer, connect the ohm meter to the potentiometer and turn the potentiometer until a reading of 22 ohms is recorded **[C]**. Disconnect the multi–meter.

If the display module will not illuminate, replace the display module.

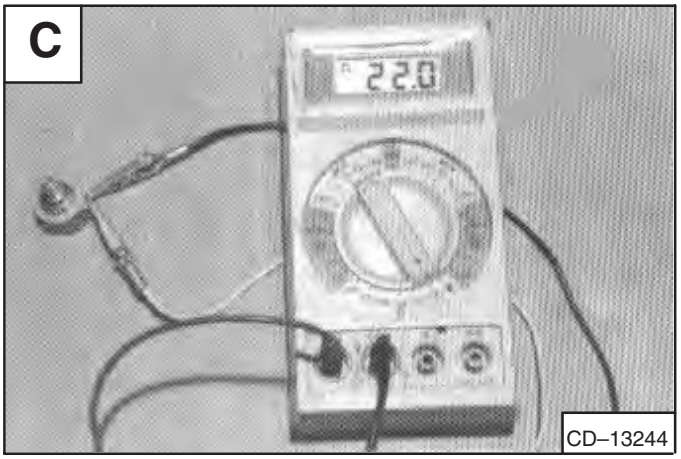
A



B



C



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DISPLAY MODULE (Cont'd)
Fuel Level Circuit Test
(with display module removed from the excavator.)

The following tools will be needed:

A potentiometer with a range of 0–100 ohms and an ohm meter.

With the display module removed from the excavator, the only test that can be made is to see if the fuel level bar graph and the warning light will illuminate.

To test the display module, three test leads will need to be connected to the connector pins on the back of the module **[A]**. These leads must be protected so that the test wires will only contact the pins specified. Expose approximately 3/8 inch (10 mm) of the end of the test lead. Wrap the exposed end of the wire with electrical tape so only a small opening is exposed at the end of the lead. Connect one (1) of the test leads to the CN1–1 connector pin **[A]**. Connect the opposite end of this lead to a 12 volt battery positive (+) terminal. Connect a test lead to the CN1–2 connector pin **[A]**. Connect the opposite end of this lead to the battery negative (–) terminal. The dash should now be illuminated.

Connect the third test lead to the CN2–3 connector pin **[A]**. Connect the opposite end of this lead to the potentiometer (preset to 41 ohms, see instructions below), and ground the other potentiometer terminal to the negative (–) battery terminal.

The fuel level bar graph should be illuminated in the level *E* area **[B]** and the low fuel warning light should be blinking on and off.

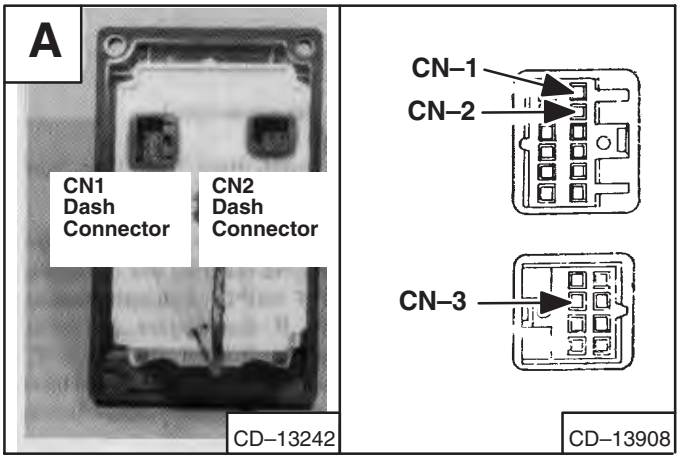
After approximately ten seconds the second bar graph (level 2) should illuminate and the low fuel warning light will turn off.

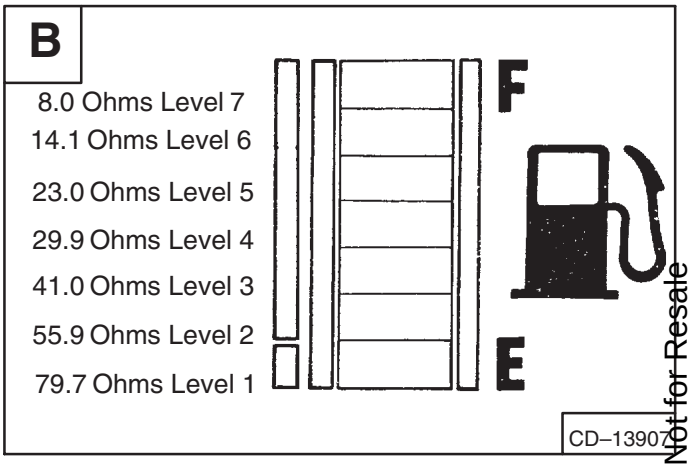
NOTE: The display module fuel circuit has a ten second delay built in to eliminate eratic lighting of the bar graphs as the fuel sloshes in the tank, After approximately thirty seconds the bar graph will be illuminated through the third level [B].

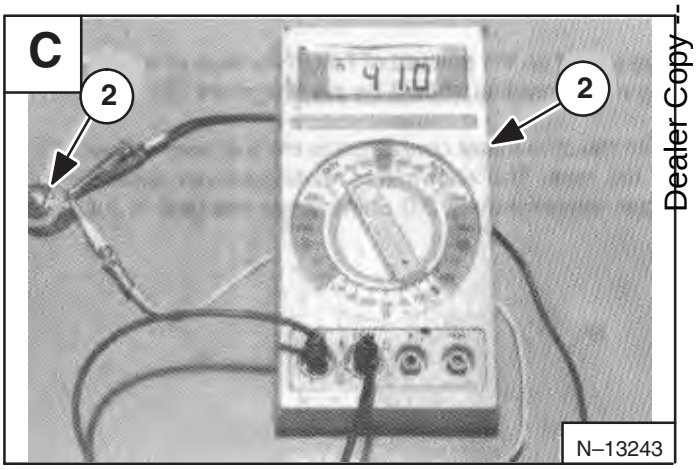
Change the potentiometer setting per chart **[B]** to further test the bar graph. When the bar graph is tested so only the level one bar is illuminated, the low fuel warning light will blink on and off.

To set the potentiometer, connect the ohm meter (Item1) **[C]** to the potentiometer and turn the potentiometer (Item 2) **[C]** until a reading of 41 ohms is recorded. Disconnect the ohm meter.

If the display module will not illuminate, replace the display module.







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DISPLAY MODULE (Cont'd)

Engine Oil Pressure Circuit Test
(with display module removed from the excavator.)

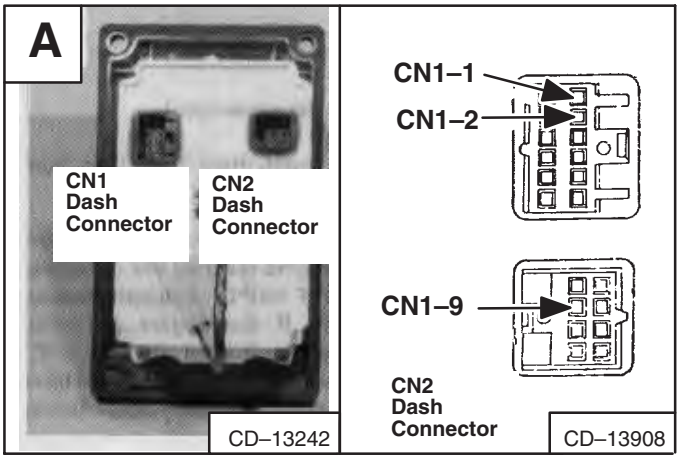
With the display module removed from the excavator, the only test that can be made is to see if the low oil pressure warning light will illuminate.

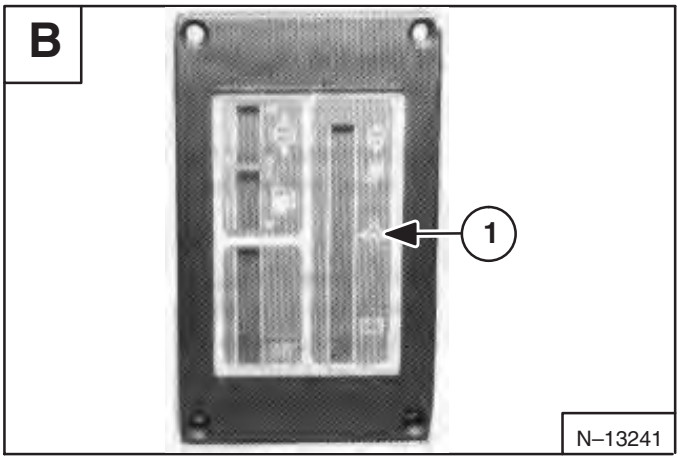
To test the display module, three test leads will need to be connected to the connector pins on the back of the module **[A]**. These leads must be protected so that the test wires will only contact the pins specified. Expose approximately 3/8 inch (10 mm) of the end of the test lead. Wrap the exposed end of the wire with electrical tape so only a small opening is exposed at the end of the lead. Connect one of the test leads to the CN1–1 connector pin **[A]**. Connect the opposite end of this lead to a 12 volt battery positive (+) terminal. Connect a test lead to the CN1–2 connector pin **[A]**. Connect the opposite end of this lead to the battery negative (–) terminal. The display should now be illuminated.

Connect the third test lead to the CN1–9 connector pin **[A]**. Ground the other end of this test lead to the battery negative (–) terminal. In approximately four seconds the low pressure warning light (Item 1) **[B]** will start to blink on and off.

Remove the third test lead from the negative (–) battery terminal and the low oil pressure warning light (Item 1) **[B]** will turn off.

If the display light will not illuminate, replace the display module.





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DISPLAY MODULE (Cont'd)

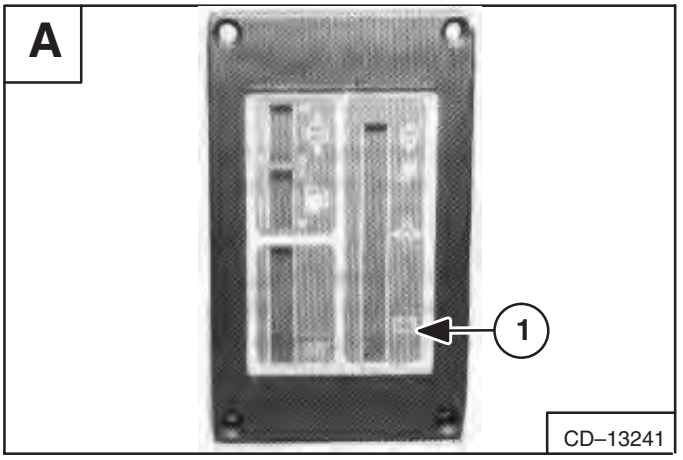
Battery Charge Circuit Test
(with display module removed from the excavator.)

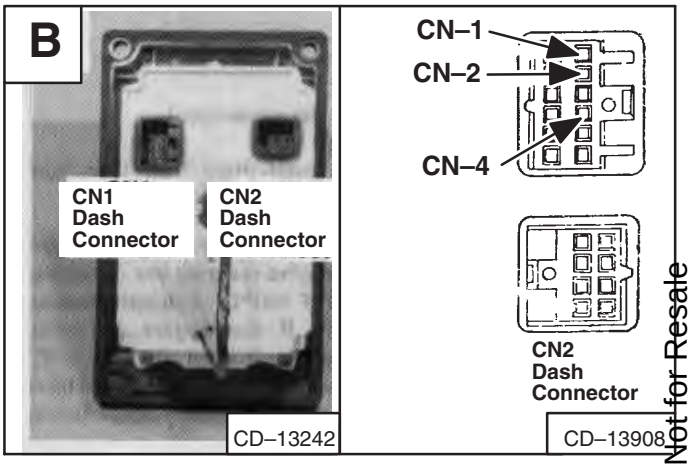
With the display module removed from the excavator, the only test that can be made is to see if the charge light (Item 1) **[A]** will illuminate.

To test the display module, three test leads will need to be connected to the connector pins on the back of the module **[B]**. These leads must be protected so that the test wires will only contact the pins specified. Expose approximately 3/8 inch (10 mm) of the end of the test lead. Wrap the exposed end of the wire with electrical tape so only a small opening is exposed at the end of the lead. Connect one (1) of the test leads to the CN1–1 connector pin **[B]**. Connect the opposite end of this lead to a 12 volt battery positive (+) terminal. Connect a test lead to the CN1–2 connector pin **[B]**. Connect the opposite end of this lead to the battery negative (–) terminal. The display should now be illuminated.

Connect the third test lead to the CN1–4 connector pin **[B]**. Connect the other end of the lead to the positive (+) battery terminal. The battery charge light (Item 1) **[A]** should stop blinking in approximately four seconds.

If the display module does not illuminate per above information, replace the display module.





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DISPLAY MODULE (Cont'd)

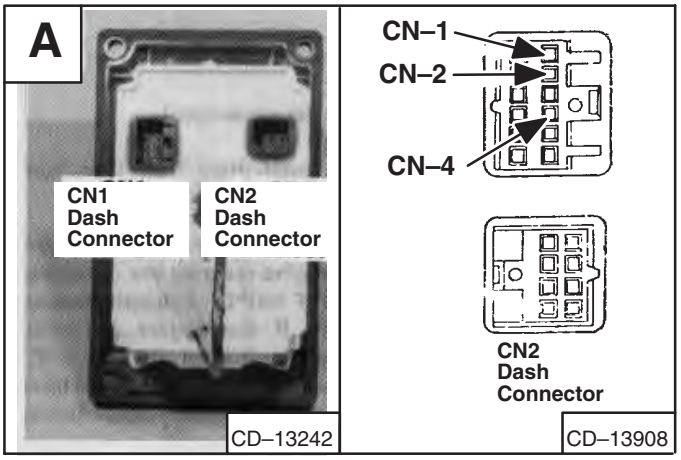
Glow Plug Circuit Test (Cont'd)
(with display module removed from the excavator.)

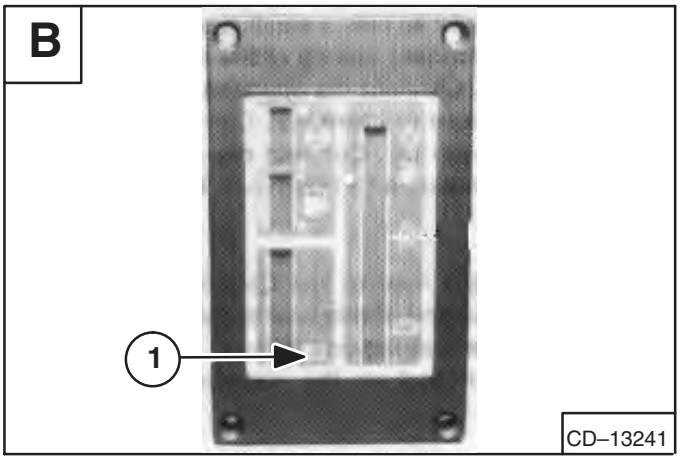
With the display module removed from the excavator, the only test that can be made is to see if the glow plug light will illuminate.

To test the display module, three test leads will need to be connected to the connector pins on the back of the module **[A]**. These leads must be protected so that the test wires will only contact the pins specified. Expose approximately 3/8 inch (10 mm) of the end of the test lead. Wrap the exposed end of the wire with electrical tape so only a small opening is exposed at the end of the lead. Connect one of the test leads to the CN1–1 connector pin **[A]**. Connect the opposite end of this lead to a 12 volt battery positive (+) terminal. Connect a test lead to the CN1–2 connector pin **[A]**. Connect the opposite end of this lead to the battery negative (–) terminal. The display should now be illuminated.

Connect the third test lead to the CN2–5 connector pin **[A]**. Connect the opposite end of the lead to the battery positive (+) terminal. The glow plug light (Item 2) **[B]** should be illuminated. Remove this wire from the battery positive (+) terminal and the light will turn off.

If the glow plug light does not illuminate, the display module is defective. Replace the display module.



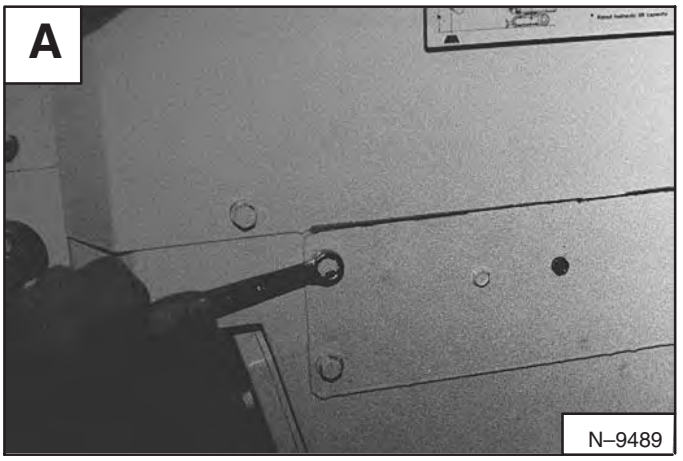


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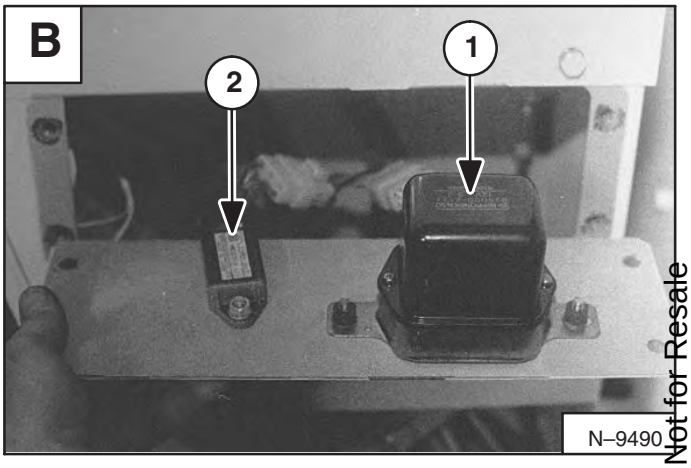
VOLTAGE REGULATOR/GLOW PLUG TIMER

Removal and Installation

Remove the mounting bolts from the panel **[A]**.



Remove the voltage regulator (Item 1) **[B]** and the glow plug timer (Item 2) **[B]**.



DIVERTER VALVE SWITCH

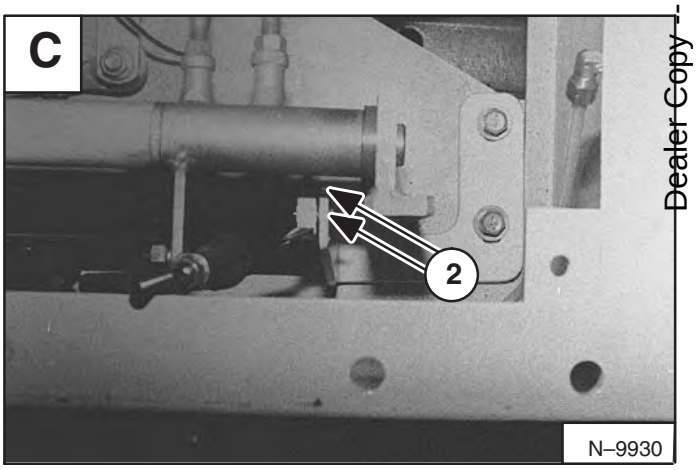
Removal and Installation

Remove the rear floor panel. (See Page 5–1.)

Disconnect the switch harness connector.

Remove the two nuts (Item 1) **[C]** from the switch mounting bolts.

Remove the switch from the mounting bracket.



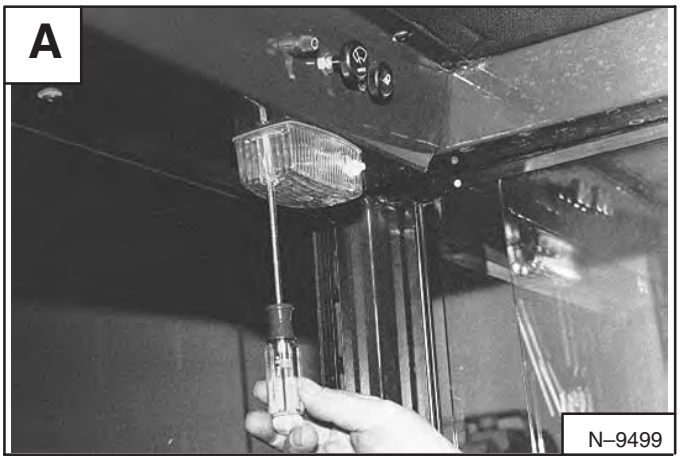
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DOME LIGHT

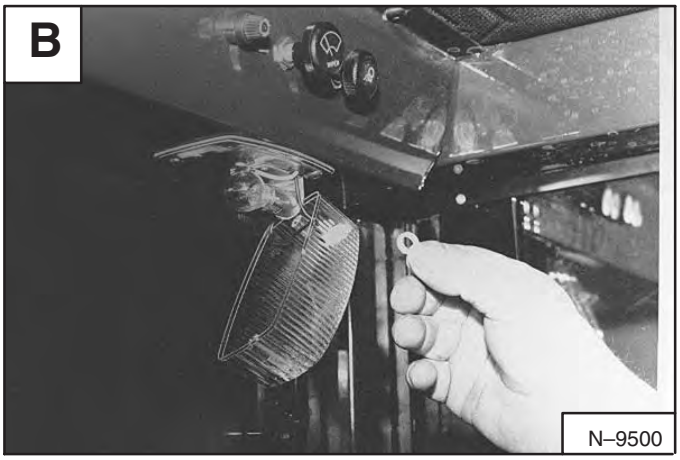
Removal and Installation

Remove the screws from the light cover **[A]**.

Remove the cover.



Remove the switch nut from the cover **[B]**.



Remove the dome light **[C]**.



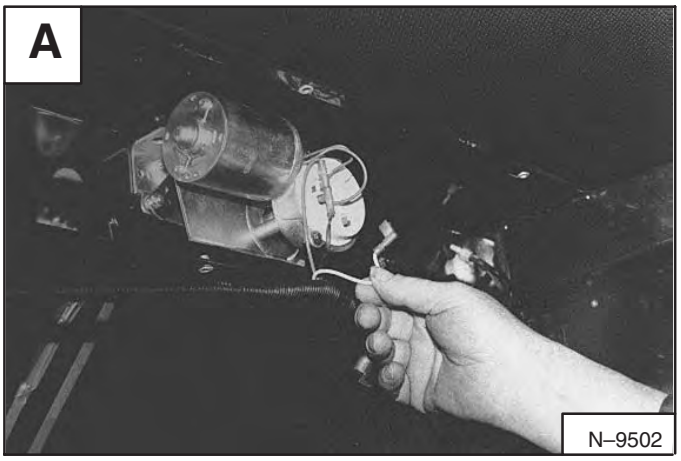
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WINDSHIELD WIPER

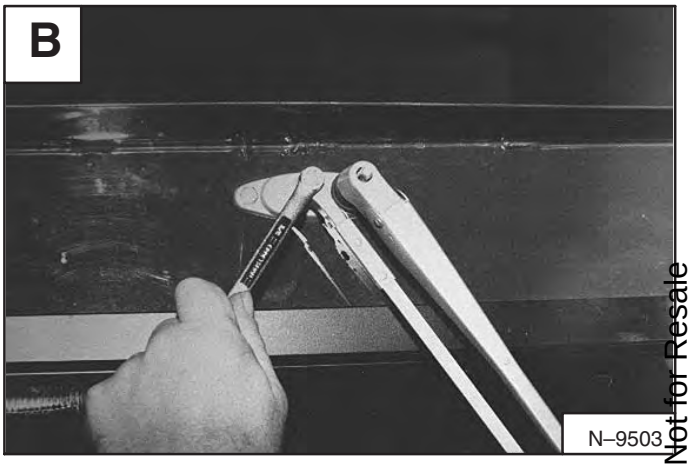
Removal and Installation

Remove the wires from the wiper motor **[A]**.

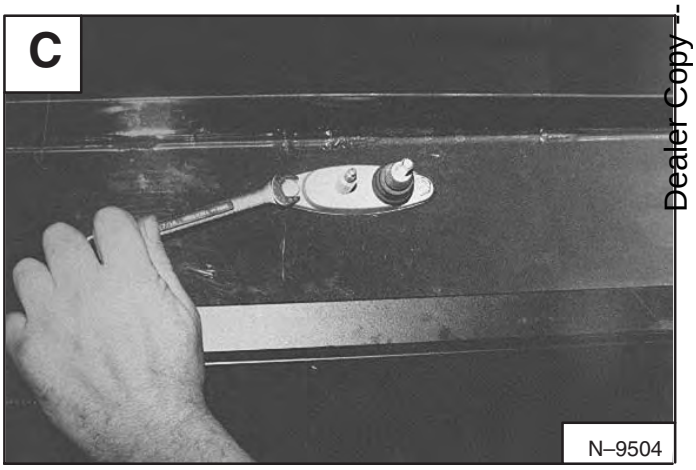
Mark the wires for installation.



Remove the nuts from the wiper arms **[B]**.



Remove the nuts and bolts from the wiper mount **[C]**.

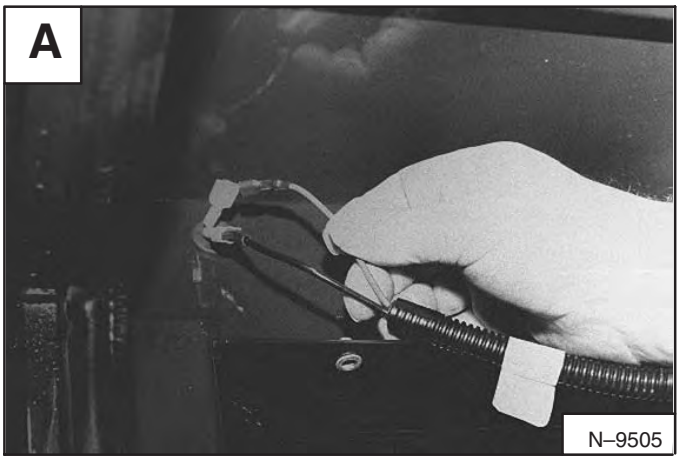


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FRONT LIGHTS

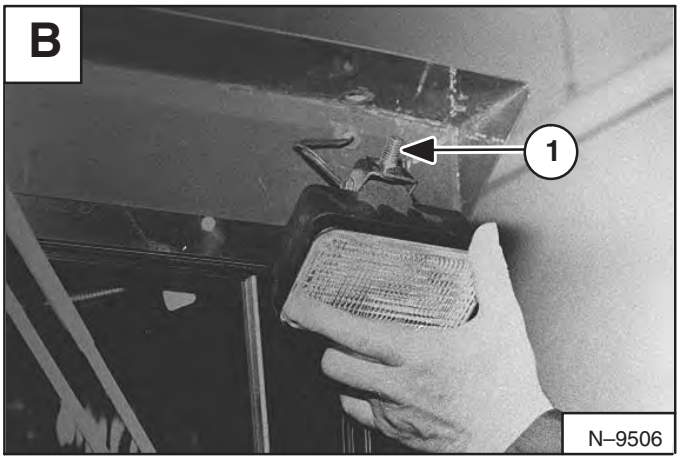
Removal and Installation

Remove the harness wires from the lights **[A]**.



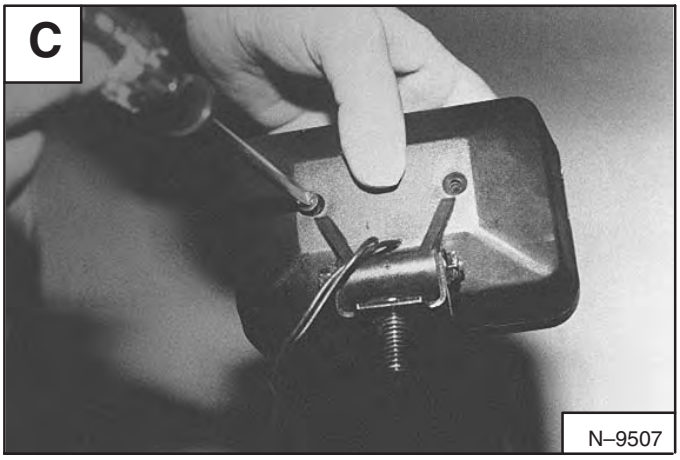
Remove the nut from the light mounting stud (Item 1) **[B]**.

Remove the light **[B]**.

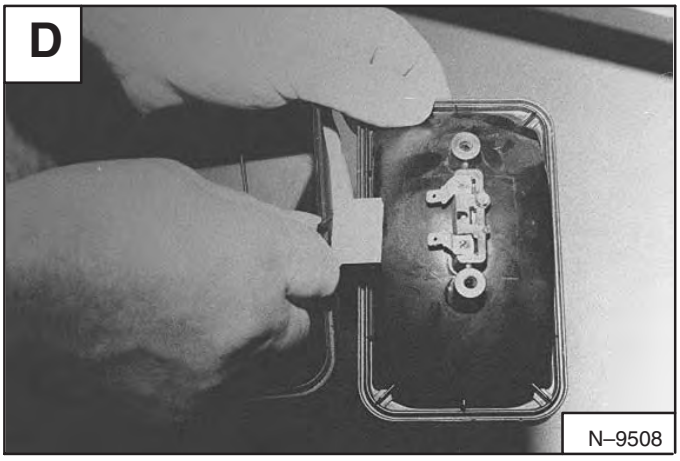


Lamp Replacement

Remove the screws from the back of the light housing **[C]**.



Remove the wire connector from the light **[D]**.



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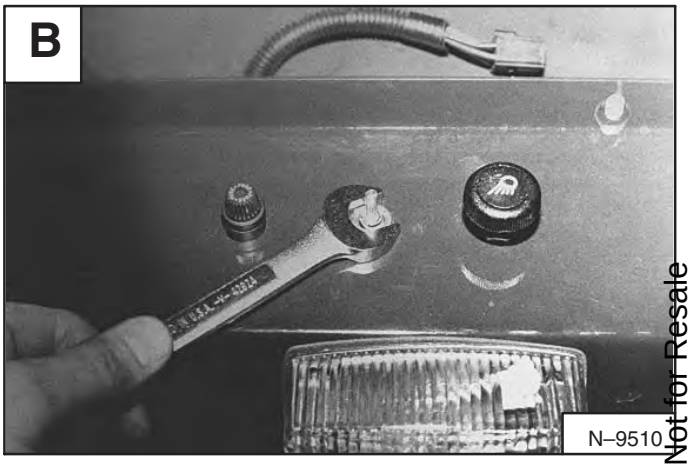
CONSOLE SWITCHES

Removal and Installation

NOTE: Remove the wires from the switches and fuse.

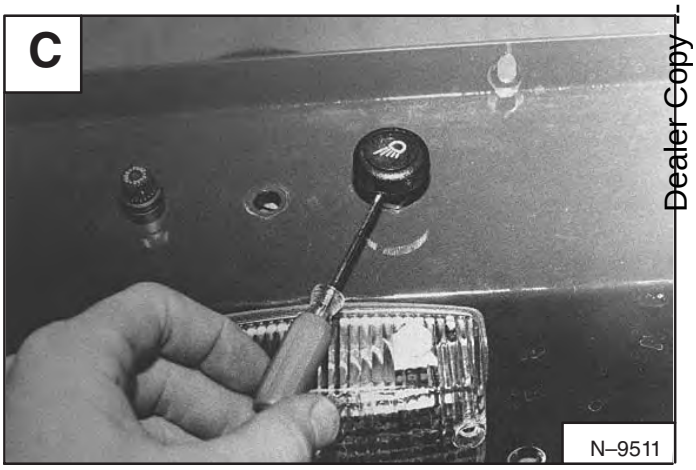


Remove the nut from the wiper switch **[B]**.

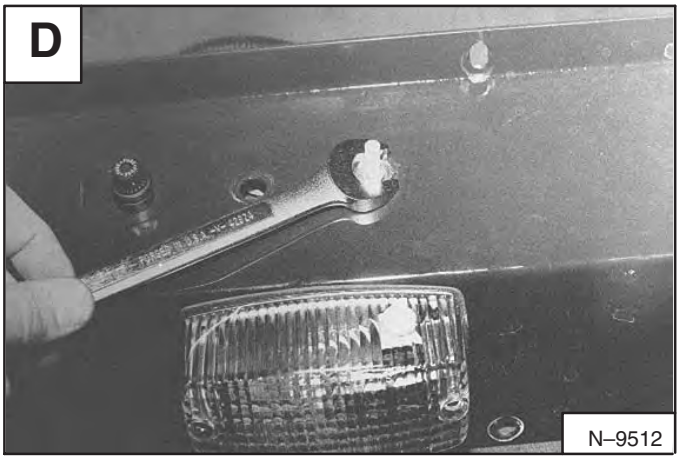


Use a small screwdriver to loosen the screw from the light knob **[C]**.

Remove the light switch knob.



Remove the nut from the light switch **[D]**.

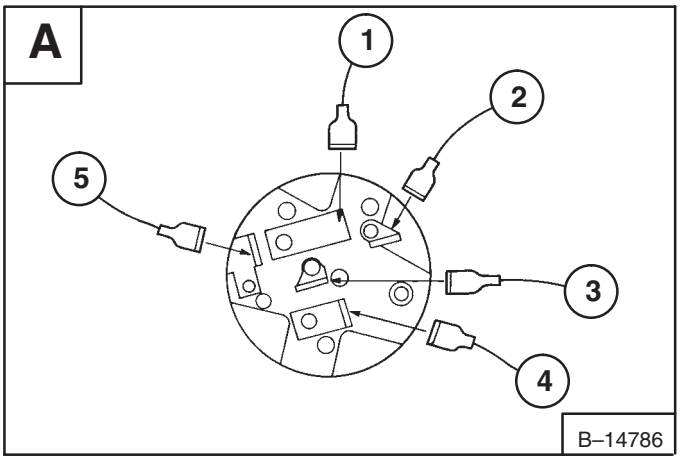


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WIPER MOTOR AND SWITCH

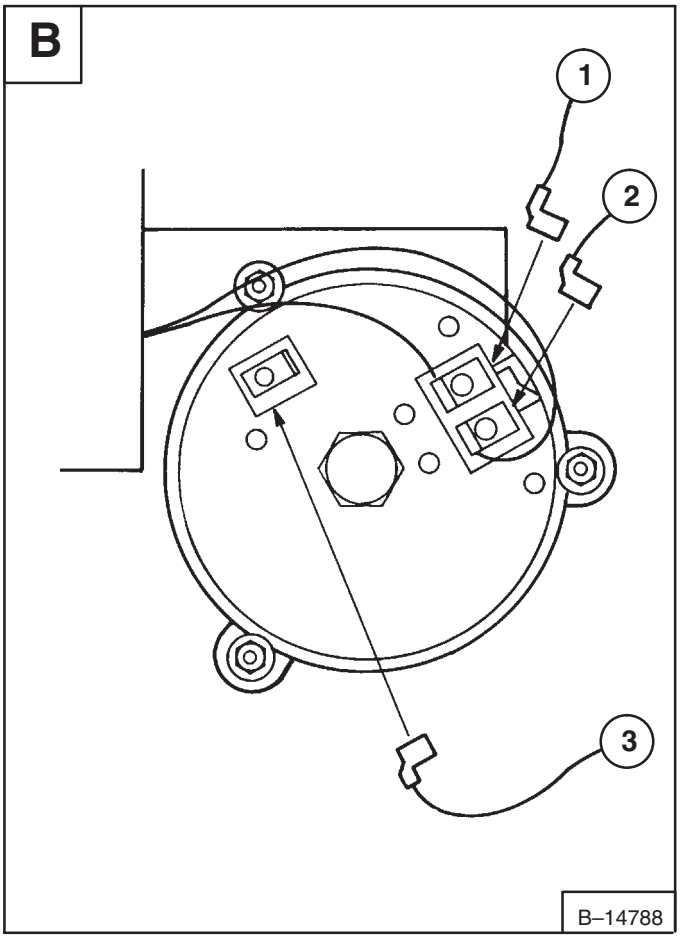
The wiper switch wiring connections are as shown in **[A]**:

1.) Red Wire . . . . . .Wiper High Speed
2.) Yellow Wire . . . . . .Wiper Park Position
3.) Red/White Wire . . . . Power from the Fuse Panel
4.) Green Wire . . . . . .Wiper Low Speed
5.) Purple Wire . . . . . .Washer (if equipped)



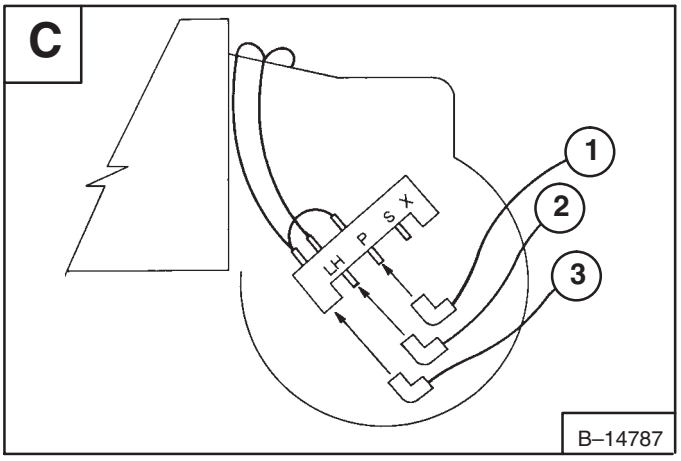
On Excavators with the early style wiper motor (P/N 6654163) the wiring connections are as shown in **[B]**:

1.) Green Wire . . . . . .Wiper Low Speed
2.) Red Wire . . . . . .Wiper High Speed
3.) Yellow Wire . . . . . .Wiper Park Position



On Excavators with the new wiper motor (P/N 6664094) the wiring connections are as shown in **[C]**:

1.) Yellow Wire . . . . . .Wiper Park Position
2.) Red Wire . . . . . .Wiper High Speed
3.) Green Wire . . . . . .Wiper Low Speed



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TROUBLESHOOTING

The following troubleshooting chart is provided for assistance in locating and correcting problems which are most common. Many of the recommended procedures must be done by authorized Bobcat Service personnel only.

PROBLEM	CAUSE
Slow cranking speed.	1, 2, 3, 4
Engine will not start.	2, 5, 6, 7, 8, 9, 11, 12, 13, 14, 15, 16, 17, 19, 27, 28, 29
Difficult to start.	5, 7, 8, 9, 10, 11, 12, 13, 15, 16, 17, 18, 19, 20, 25, 27, 28, 29
No power from engine.	8, 9, 10, 11, 12, 13, 15, 16, 17,18, 20, 21, 22, 23, 27, 28, 29
Engine is mis–firing.	8, 9, 11, 12, 13, 15, 16, 17, 21, 22, 24, 25, 26, 28
Too much fuel consumption.	10, 12, 13, 15, 16, 17, 19, 20, 21, 23, 24, 25, 27, 28, 29
Black exhaust.	10, 12, 13, 15, 16, 17, 19, 20, 21, 23, 24, 25, 27, 28, 29
Blue/white exhaust.	4, 10, 15, 16, 17, 21, 23, 27, 29, 30, 50
Low oil pressure.	4, 31, 32, 33, 34, 35, 37, 38, 39, 52
Engine knocking.	13, 15, 16, 19, 22, 24, 25, 27, 29, 31, 40, 41, 53
Engine running rough.	7, 8, 9, 10, 11, 12, 13, 17, 18, 22, 24, 25, 26, 29, 40, 53
Vibration.	12, 13, 17, 21, 22, 25, 26, 29, 40, 42, 43
High oil pressure.	4, 33, 36
Overheating.	10, 12, 13, 15, 16, 20, 21, 40, 44, 45, 46, 47, 48, 51
Too much crankcase pressure.	22, 27, 29, 30, 40, 49
Poor compression.	10, 16, 21, 24, 25, 27, 28, 29, 30, 41, 53
Start and stop	9, 10, 11

KEY TO CORRECT THE CAUSE

1. Battery capacity low.
2. Bad electrical connections.
3. Faulty starter motor.
4. Incorrect grade of oil.
5. Low cranking speed.
6. Fuel tank empty.
7. Faulty stop control operation.
8. Plugged fuel line.
9. Plugged fuel filter.
10. Restriction in the air cleaner.
11. Air in the fuel system.
12. Faulty fuel injection pump.
13. Faulty fuel injectors.
14. Broken injection pump drive.
15. Incorrect injection pump timing.
16. Incorrect valve timing.
17. Poor compression.
18. Plugged fuel tank vent.
19. Incorrect grade of fuel.
20. Exhaust pipe restriction.
21. Cylinder head gasket leaking.
22. Overheating.
23. Cold running.
24. Incorrect tappet adjustment.
25. Sticking valves.
26. Incorrect high pressure fuel lines.
27. Worn cylinder bores.
28. Worn valves and seat.
29. Broken or worn piston rings.
30. Worn valve stems or guides.
31. Worn or damaged bearings.
32. Not enough oil in the oil pan.
33. Switch is defective.
34. Oil pump worn.
35. Relief valve is stuck open.
36. Relief valve is stuck closed.
37. Broken relief valve spring.
38. Faulty suction pipe.
39. Plugged oil filter.
40. Piston seizure.
41. Incorrect piston height.
42. Faulty engine mounting.
43. Incorrect alignment of flywheel.
44. Faulty thermostat.
45. Restriction in water jacket.
46. Loose alternator belt.
47. Plugged radiator.
48. Faulty water pump.
49. Plugged breather pipe.
50. Damaged valve stem oil deflectors.
51. Coolant level too low.
52. Plugged oil pump pipe strainer.
53. Broken valve spring.

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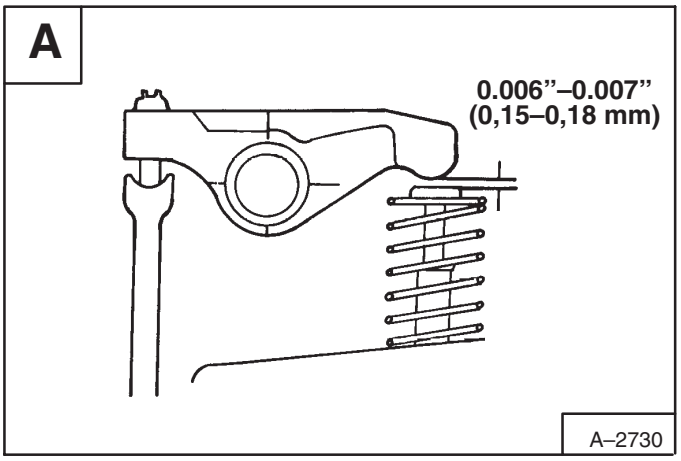
VALVE CLEARANCE

Adjustment

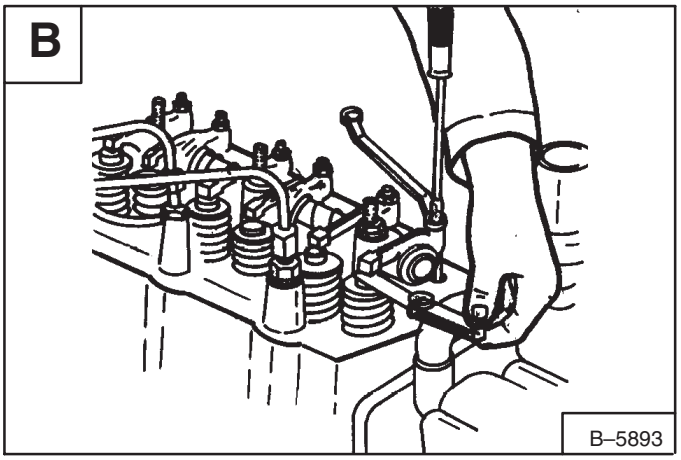
Adjust the valve clearance with the engine stopped and cold.

The correct valve clearance is 0.006–0.007 inch (0,15–0,18 mm) **[A]**.

Make sure the piston is at T .D.C. when making the adjustment for the valves of the particular cylinder.



Put the correct size feeler gauge between the rocker arm and valve stem. Turn the adjustment bolt until the clearance is correct **[B]**.



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ENGINE COMPRESSION

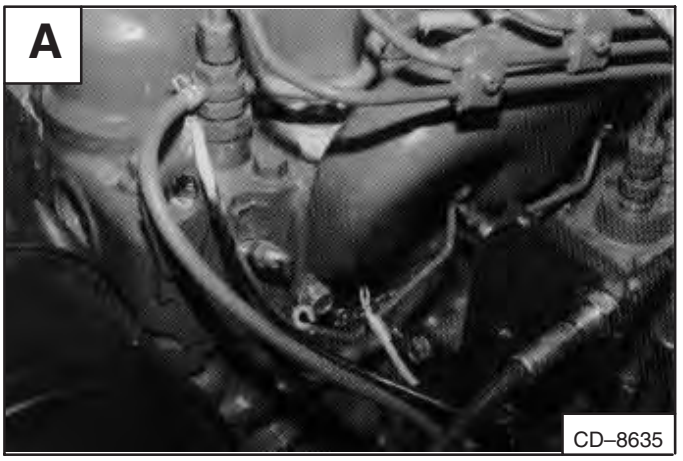
Checking

Use MEL1063 – Engine Compression Kit to do the following procedure.

The engine must be a operating temperature.

The compression must be at least 75% of 337–448 PSI (2324–3089 kPa) with no more than 50 PSI (345 kPa) difference between the cylinders.

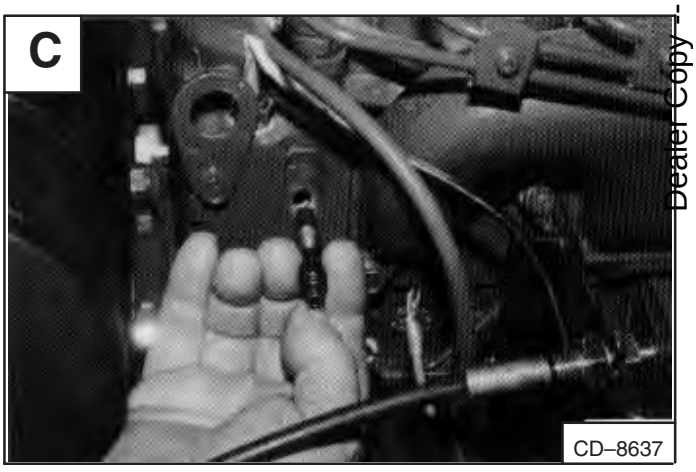
Remove the nut and the glow plug wire **[A]**.



Remove the glow plug **[B]**.

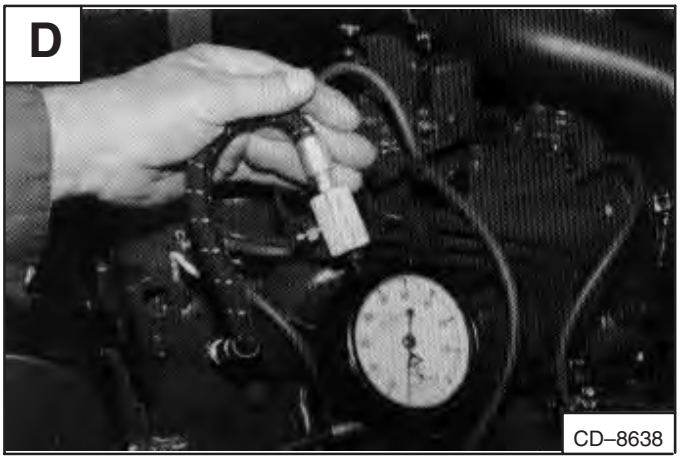


Install the compression adapter in the glow plug hole **[C]**.



Connect the compression gauge to the adapter **[D]**.

Turn the engine with the starter and check the gauge pressure.



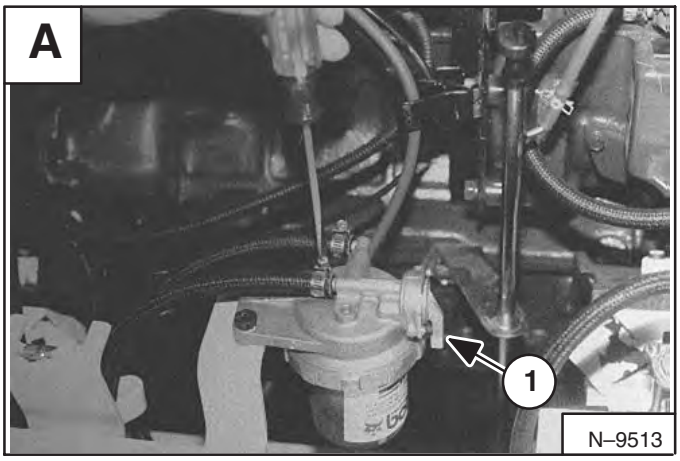
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FUEL FILTER

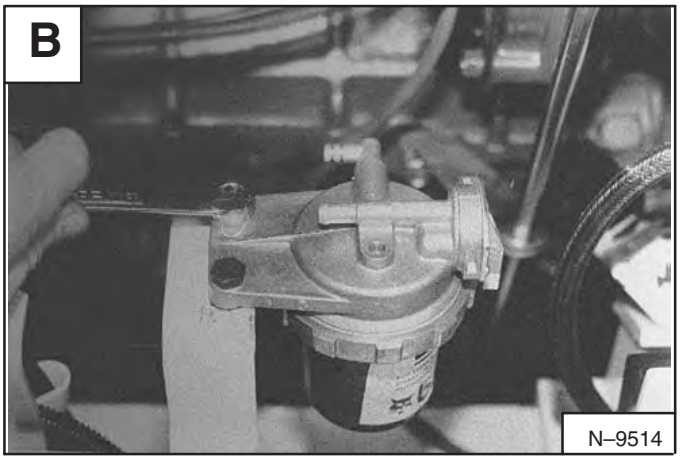
Final Filter

See the Service Schedule Page 1–1 for the correct service interval to service the fuel filters.

Close the valve (Item 1) **[A]** when removing the fuel lines from the filter.



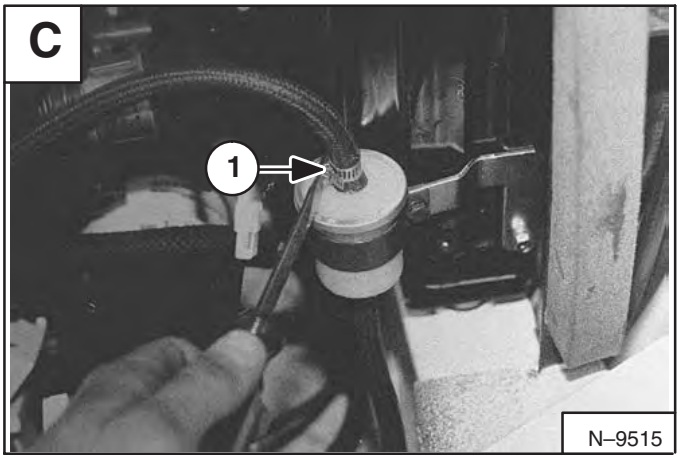
Remove the mounting bolts from the filter **[B]**.



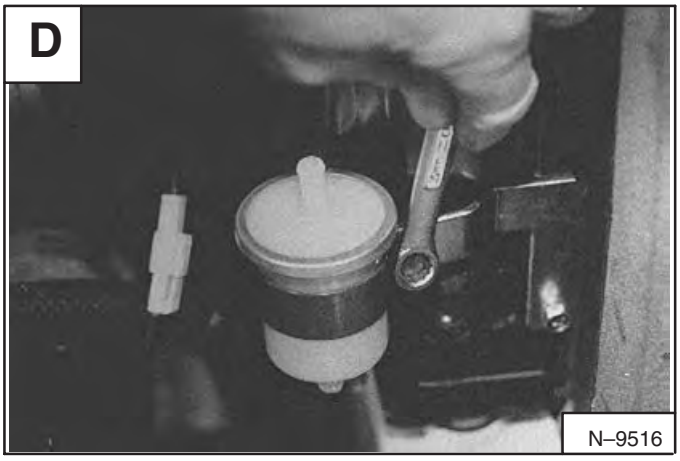
In–Line Filter

Remove the hose clamp (Item 1) **[C]** from the in–line fuel filter.

Remove the fuel hose.



Remove the nut from the filter clamp and remove the filter **[D]**.



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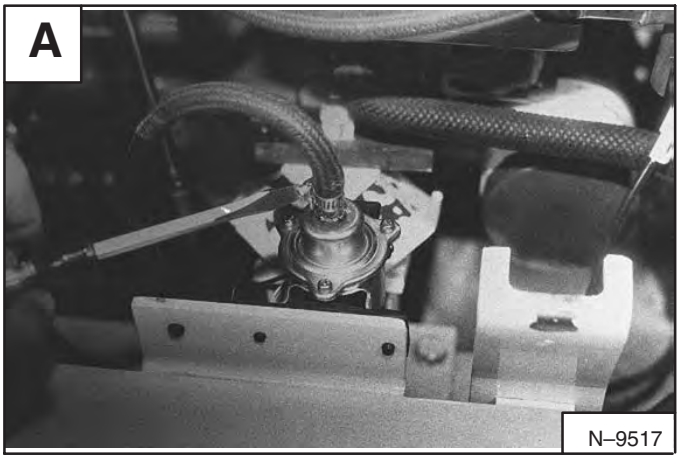
ELECTRIC FUEL PUMP

Air removal from the fuel system is not necessary when filters are changed or the machine runs out of fuel.

The electric fuel pump will self bleed the system by turning the ignition key to the *ON* position.

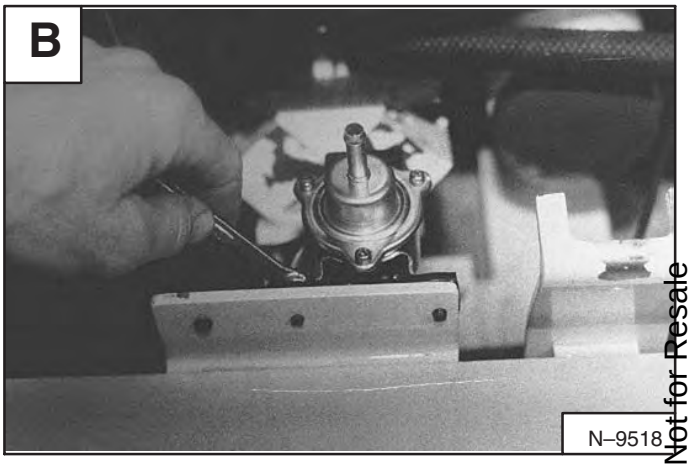
Removal and Installation

Remove the hose clamp from the fuel pump **[A]**.



Remove the mounting bolts from the fuel pump bracket **[B]**.

Remove the electric pump.



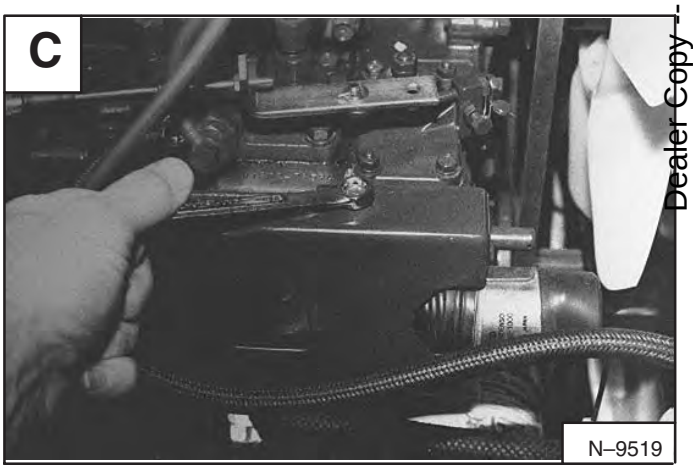
FUEL SHUT–DOWN SOLENOID

Removal and Installation

Disconnect the wire from the solenoid.

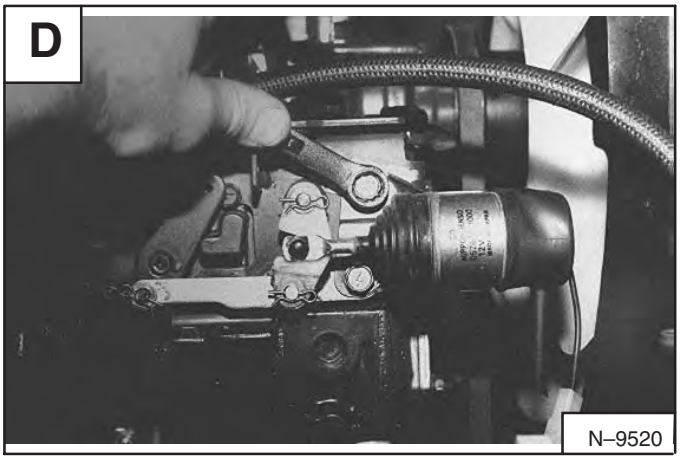
Remove the bolts from the fuel solenoid shroud **[C]**.

Remove the shroud.



Remove the shut–down mounting bolts **[D]**.

Remove the shut–down.



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FUEL INJECTION PUMP

Checking the Injection Pump

The injection pump contains parts which have a very close tolerance and its operation has a direct effect on the performance of the engine.

IMPORTANT

Do not attempt to maintain or adjust unless you are trained and have the correct equipment.

I–2028–0289

The tools listed will be needed to do the following procedure:

MEL1237 – Adapter Fuel Line
MEL1173–1 – Pressure Gauge

To check the discharge pressure at the fuel injection pump, use the following procedure:

Disconnect the clamp from the fuel line **[A]**.

Disconnect the other end of the same high pressure line **[B]**.

Disconnect the high pressure fuel line at the pump **[C]**.

Connect the adapter fuel line (Item 1) **[D]** to the fitting.

Connect the pressure gauge (Item 2) **[D]**.

Crank the engine, with the starter , to increase the pressure to 2133 PSI (14707 kPa). Align the plunger at T.D.C.

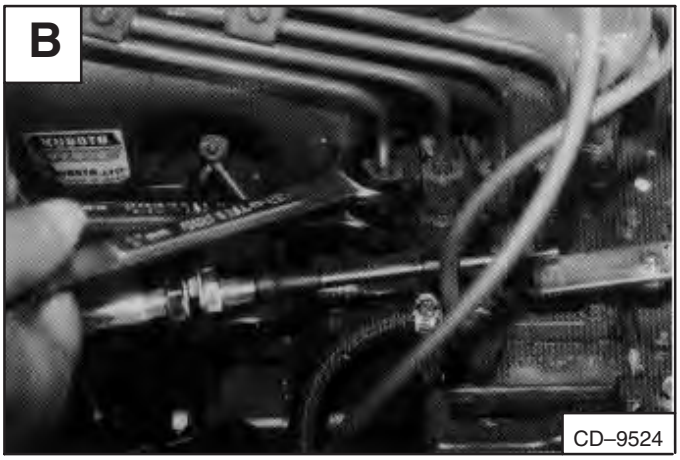
The pressure should hold at 2133 PSI (14707 kPa), at least 5 seconds. If not, repair or replace the injection pump.

A



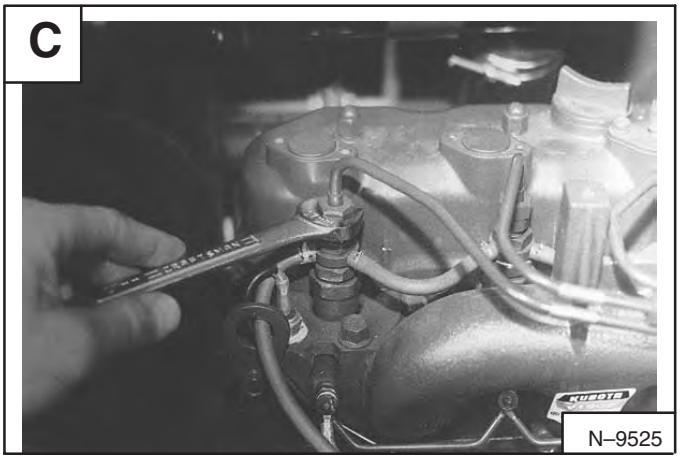
CD–9523

B



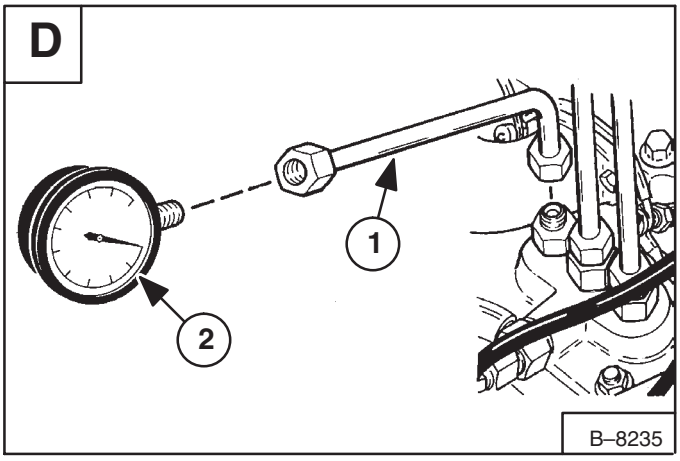
CD–9524

C



N–9525

D



B–8235

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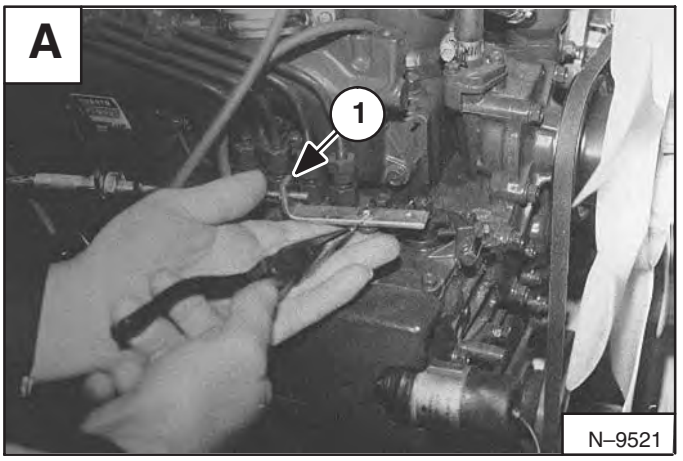
FUEL INJECTION PUMP (Cont'd)

Removal and Installation

Clean the area around the fuel injection pump. Remove the high pressure fuel lines.

Disconnect the throttle linkage cable from the injection pump **[A]**.

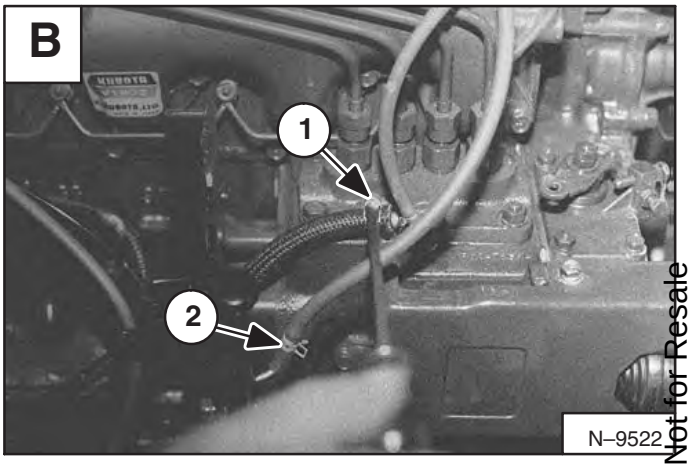
Loosen the nuts (Item 1) **[A]** from the bracket to remove the throttle cable.



Disconnect the fuel inlet hose (Item 1) **[B]** and return hose (Item 2) **[B]**.

Remove the four injection pump mounting nuts (Item 3) **[B]**.

Installation: Tighten the nuts to 17–20 ft.–lbs. (23–27 Nm) torque.

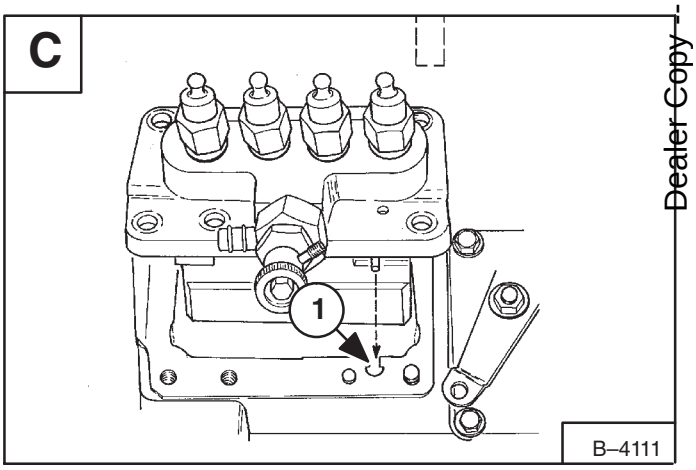


Align the pin (Item 1) **[C]** in the control rack with the slot in the engine block.

Remove the injection pump.

Installation: When the injection pump is installed, make sure the pin (Item 1) **[C]** on the control rack is correctly installed on the fork lever . If the slot is not installed correctly, the engine will run over maximum speed and serious damage can result.

NOTE: Make sure the same number shims are installed under the injection pump. The shims are used for engine timing.

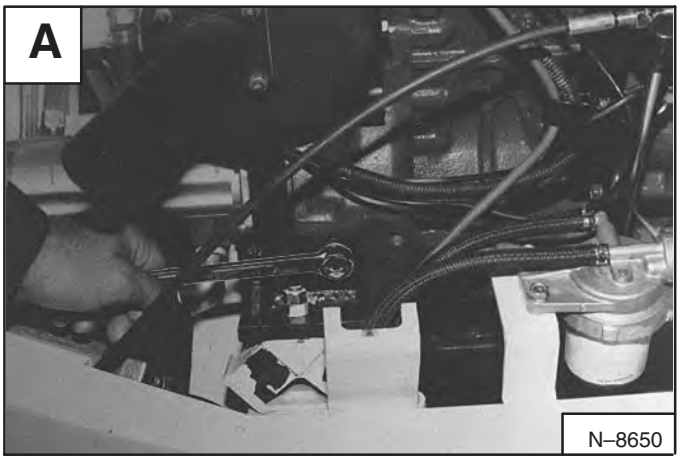


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FUEL INJECTION PUMP (Cont'd)

Timing the Injection Pump

NOTE: The engine timing marks are located on the engine flywheel. Remove the left rear motor mount [A].



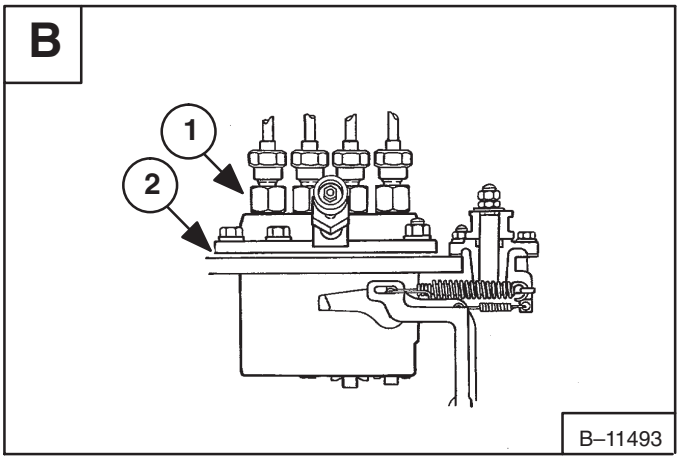
NOTE: Check the delivery valve nuts (Item 1) [B]. Tighten to 29–30 ft.–lbs. (40–41 Nm) torque.

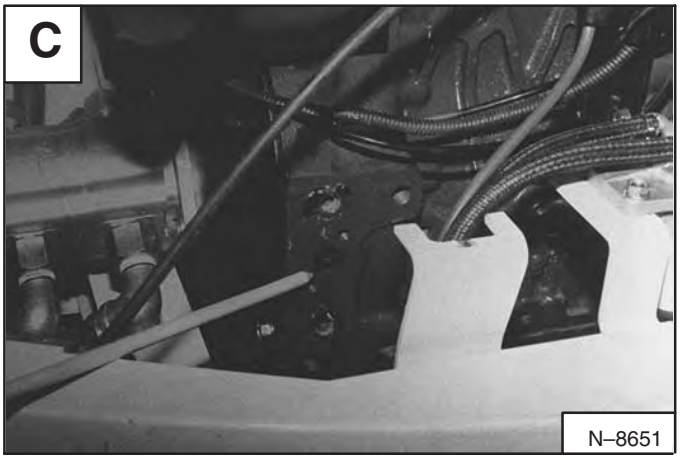
Timing the fuel injection pump is done by changing the number of shims (Item 2) **[B]** between the injection pump and engine block.

Each shim will change the timing 1.5 degrees. The timing of the pump will be later when a shim is added, and earlier when a shim is removed.

Use the following procedure to time the injection pump:

1. Remove the number 1 cylinder high pressure line from the injection pump.
2. Install a short pipe in the number 1 outlet of the pump. Point the pipe up (vertical).
3. With fuel supply to the injection pump, rotate the engine counterclockwise direction (viewed from the flywheel end of the engine). Fuel must flow from the pipe as the mark on the flywheel and the pointer are in alignment **[C]**.
4. The correct timing for the engine is 23–25 degrees B.T.D.C..Add or subtract shim(s) as needed to adjust the delivery time of the fuel injection pump.
5. Repeat Step 3 several times forcorrect timing mark alignment before adding or removing shim(s).





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FUEL INJECTOR NOZZLES

⚠ WARNING

Diesel fuel or hydraulic fluid under pressure can penetrate skin or eyes causing serious injury. Fluid leaks under pressure may not be visible. Use a piece of cardboard or wood to find leaks. Do not use your bare hand. W ear safety goggles. If fluid enters skin or eyes, get immediate medical attention.

W–2074–1285

Some problems caused by faulty injector nozzles:

1. The engine is hard to start or will not start.
2. Rough engine operation at idle.
3. The engine will not have full power.
4. The engine exhaust smoke is black, white or blue.

Removal and Installation

IMPORTANT

Do not bend the high pressure fuel injection tubes when removing or installing them.

I–2029–0289

The tool listed will be needed to do the following procedure:

MEL1181 – Nozzle Socket

Disconnect the high pressure fuel lines from the fuel injectors and the injection pump. Remove the high pressure fuel lines **[A]**.

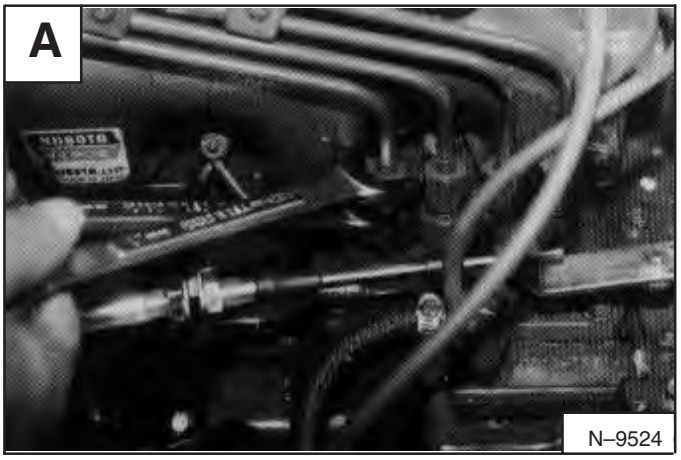
Disconnect the return fuel hoses **[B]**.

Remove the banjo fitting from the fuel injector **[C]**.

Use the special socket and loosen the injector nozzle.

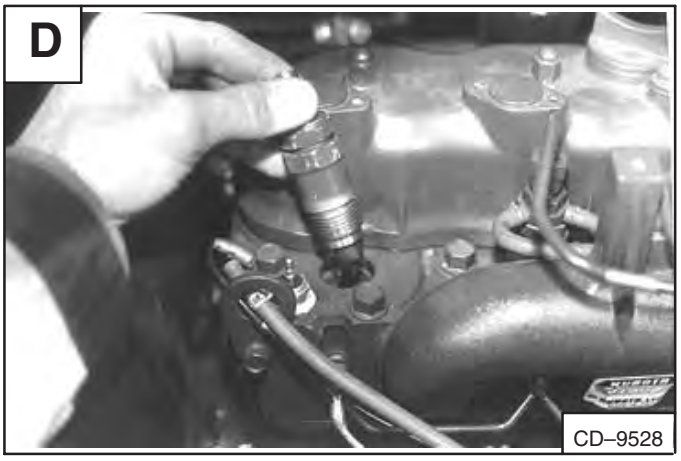
Installation: Tighten the injector nozzle to 29–36 ft.–lbs. (39–49 Nm) torque.

Remove the injector nozzle from the cylinder head **[D]**.









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FUEL INJECTOR NOZZLES (Cont'd)

Checking the Injector Nozzle

IMPORTANT

Do not disassemble or test the fuel injector nozzles unless you have the correct service and testing tools.

I–2027–0284

The tool listed will be needed to do the following procedure:

MEL10018 – Injector Nozzle Tester

You can adjust the release pressure of the injector nozzle by adding or removing spacer (s) (Item 1) **[A]** from the top of the nozzle spring (Item 2) **[A]**.

Each spacer is 0.004" (0,10 mm) thick and will change the release pressure by about 142 PSI (980 kPa). The release pressure should be 1920–2133 PSI (13238–14707 kPa).

Connect the injector nozzle to the tester with the nozzle down **[B]**.

Operate the hand lever slowly and note the opening pressure. If the pressure is not correct, disassemble the injector nozzle and add or remove spacer (s) (Item 1) **[A]**.

Assemble the nozzle and check the pressure again. Tighten the nozzle body (Item 3) **[A]** to 43–58 ft.–lbs. (59–79 Nm) torque.

NOTE: Do not over–tighten, or slow action of the valve will occur.

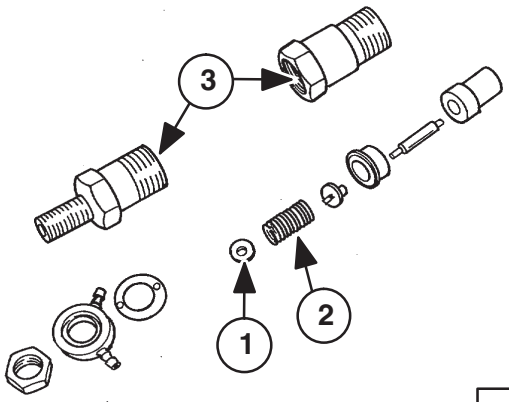
Check for internal leakage. Operate the hand lever until the pressure is almost enough to open the injector valve.

Record the pressure. Release the hand lever. check the pressure drop for 10 seconds. If the pressure drop is more than 740 PSI (5102 kPa), the nozzle is damaged.

Check that the spray pattern is correct **[C]**:

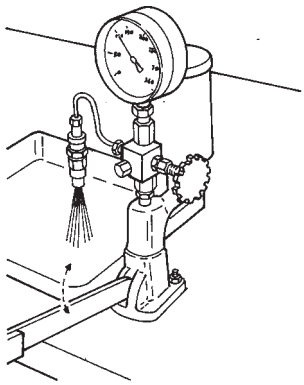
1. Fuel does not come out the side of the nozzle.
2. Drops of fuel are not present at the nozzle.
3. The nozzle has an even flow coming from the nozzle.

A



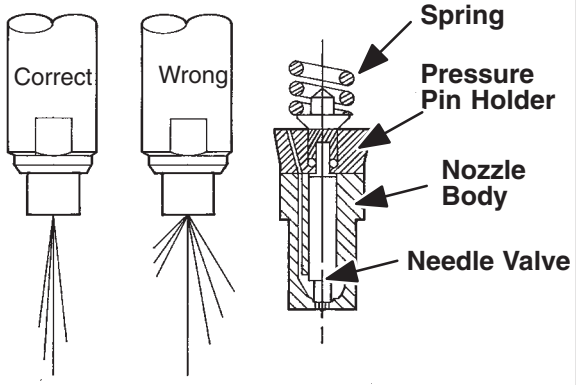
B–4103

B



A–2513

C



A–2621

WARNING

Diesel fuel or hydraulic fluid under pressure can penetrate skin or eyes causing serious injury. Fluid leaks under pressure may not be visible. Use a piece of cardboard or wood to find leaks. Do not use your bare hand. W ear safety goggles. If fluid enters skin or eyes, get immediate medical attention.

W–2074–1285

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GLOW PLUGS

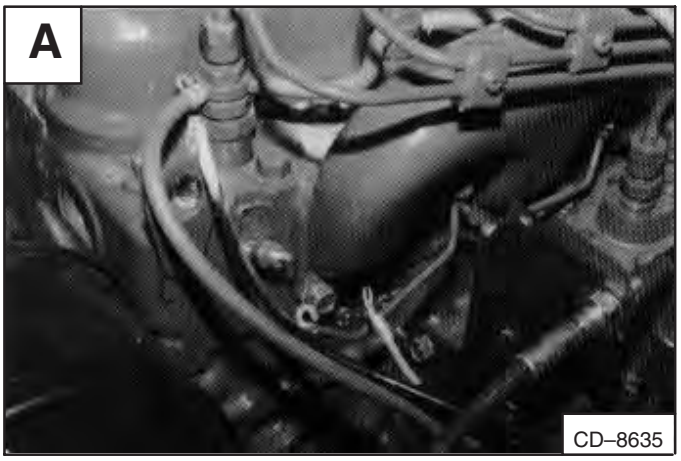
Removal and Installation

Remove the high pressure fuel lines from the injector nozzles and injection pump.

IMPORTANT

Do not bend the high pressure fuel injection tubes when removing or installing them.

I–2029–0289



Disconnect the glow plug wires **[A]**.

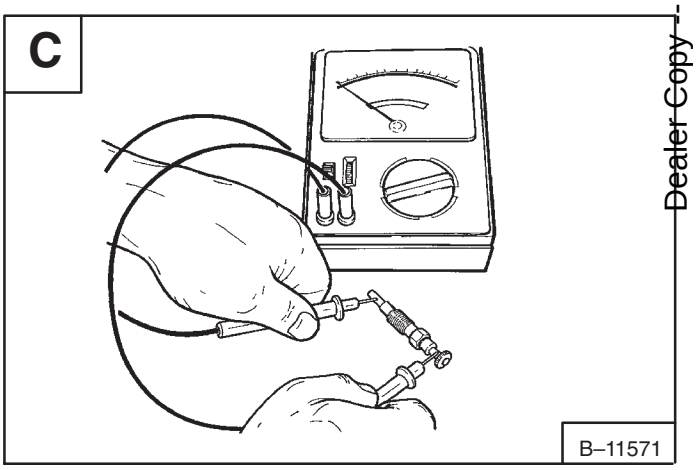
Remove the glow plugs from the cylinder head **[B]**.



Checking the Glow Plug

Connect a voltmeter to the terminal end of the glow plug, touch the other lead from the voltmeter to the heating end of the glow plug **[C]**.

The reading must be approximately 1.5 ohms. If the resistance is zero ohms, the glow plug has a short circuit. If the resistance is infinite, the coil of the glow plug is broken.



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RADIATOR

Removal and Installation

Drain the cooling system.

Disconnect the top radiator hose **[A]**.

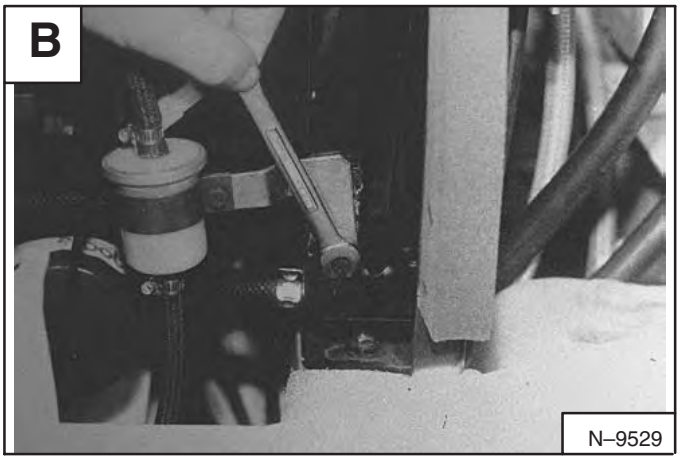
Disconnect the lower radiator hose and engine block drain hose.



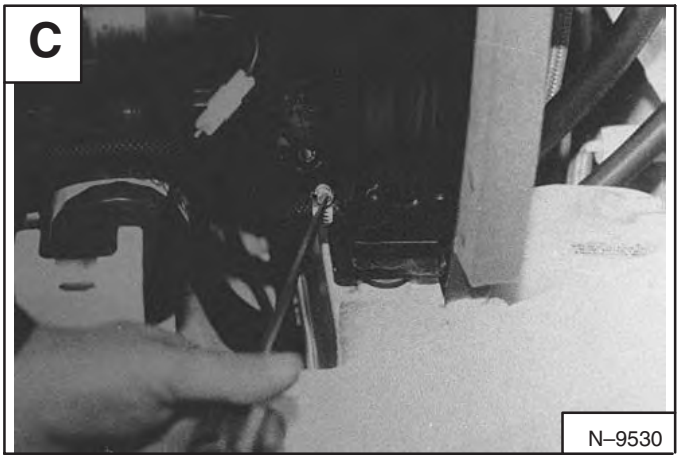
Remove the bolt from the inline filter mounting bracket **[B]**.

Remove the shroud mounting bolts.

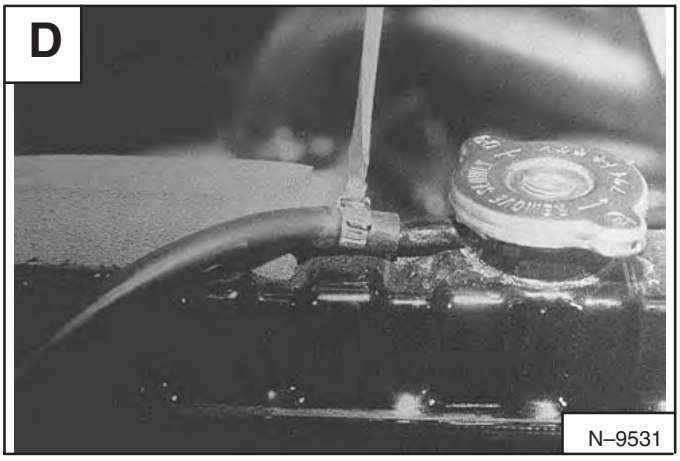
Move the shroud away from the radiator.



Remove the lower radiator hose **[C]**.



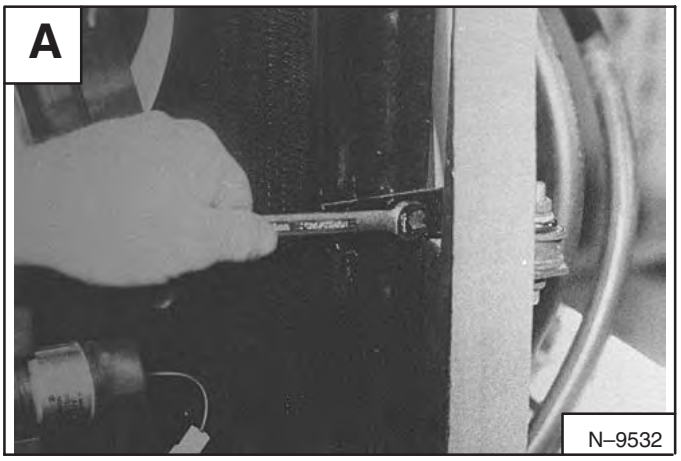
Remove the overflow hose **[D]**.



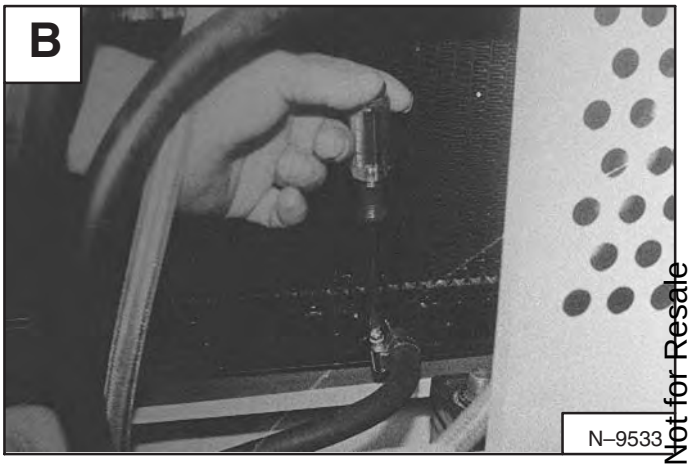
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RADIATOR (Cont'd)

Remove the radiator side brackets **[A]**.



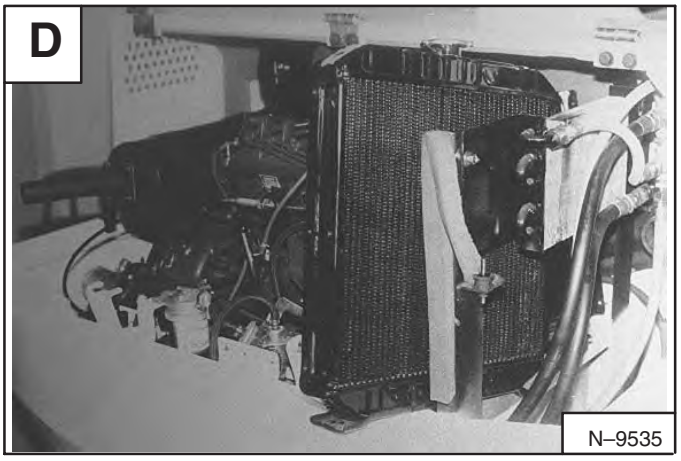
Remove the radiator drain valve hose **[B]**.



Remove the radiator mounting bolts and nuts **[C]**.



Remove the radiator **[D]**.



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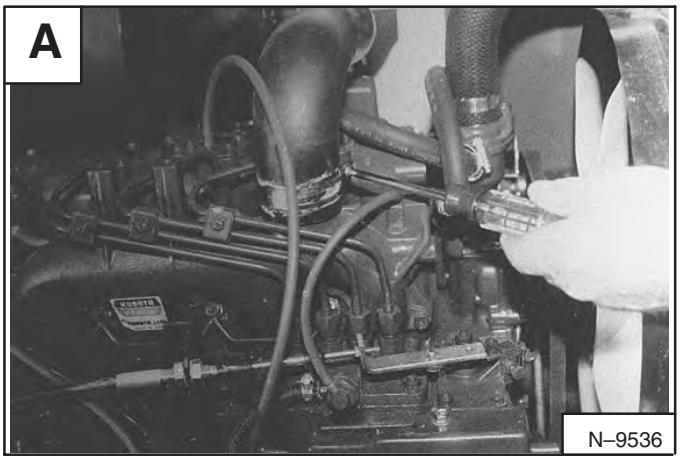
AIR CLEANER

Removal an Installation

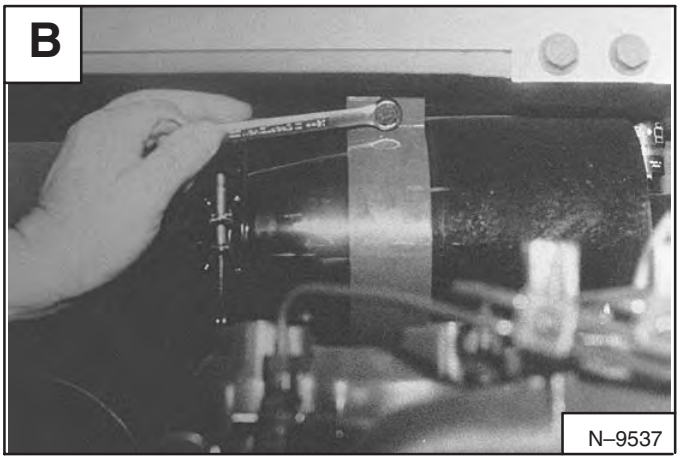
Raise the engine cover.

Loosen the hose clamps on the air intake hose **[A]**.

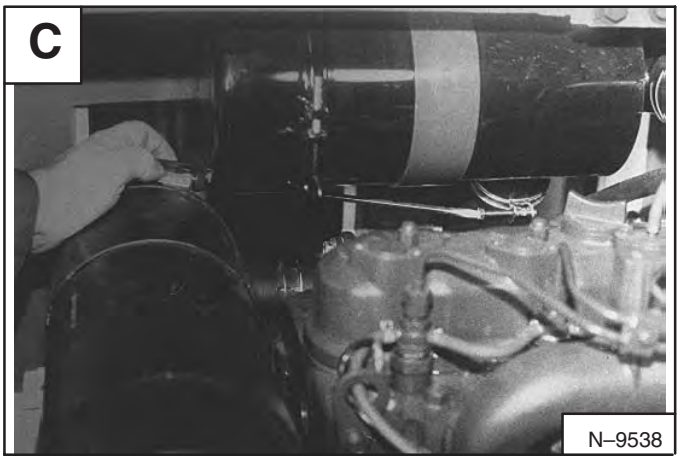
Remove the hose.



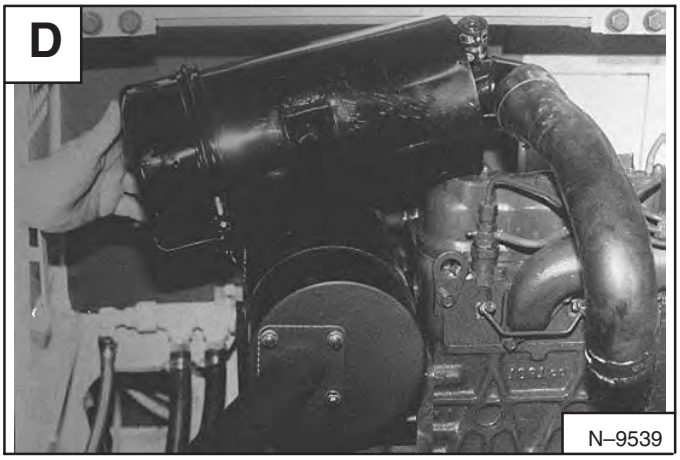
Remove the bolt from the air cleaner clamp **[B]**.



Remove the clamp from the air cleaner intake hose **[C]**.



Remove the air cleaner **[D]**.



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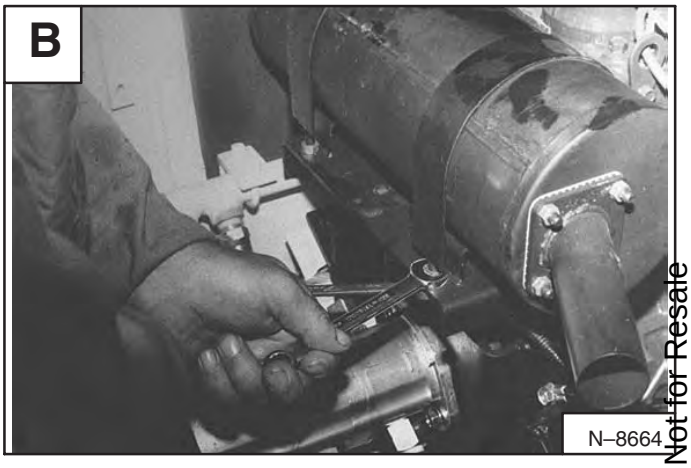
MUFFLER

Removal and Installation

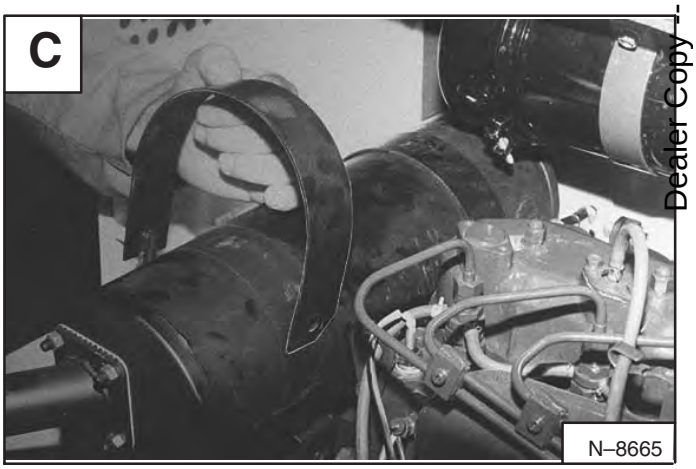
Remove the bolt from the exhaust pipe clamp **[A]**.



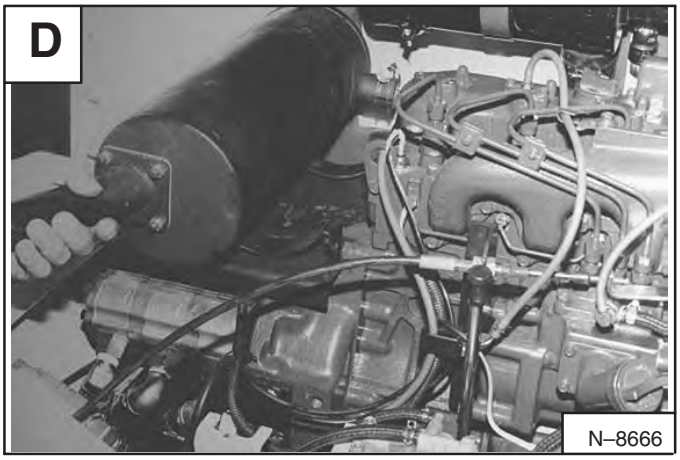
Remove the bolt from the muffler clamp **[B]**.



Remove the muffler clamp **[C]**.



Remove the muffler **[D]**.



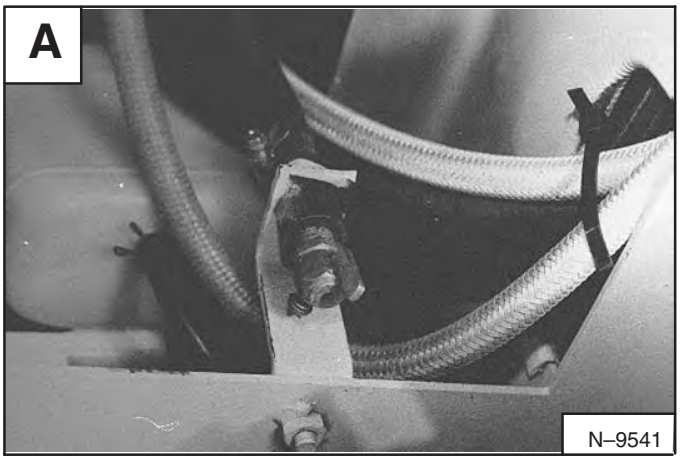
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HEATER

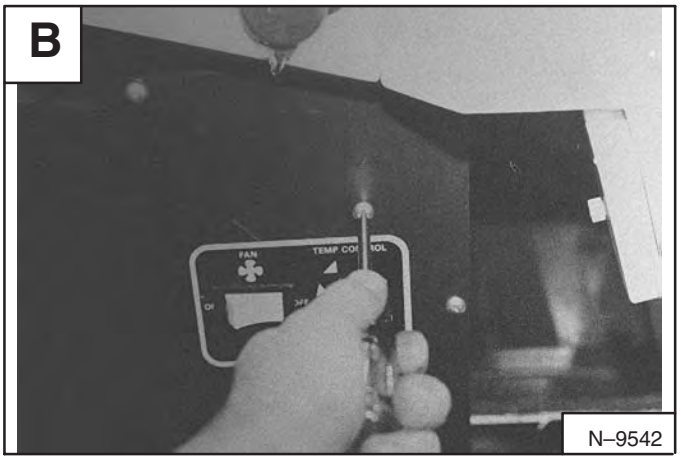
Removal and Installation

Open the drain valve (Item 1) **[A]** and drain the coolant into a container.

Remove the rear floor panel. (See Page 5–1.)



Remove the screws from the heater cover **[B]**.



Disconnect the wire (Item 1) **[C]** from the power source.

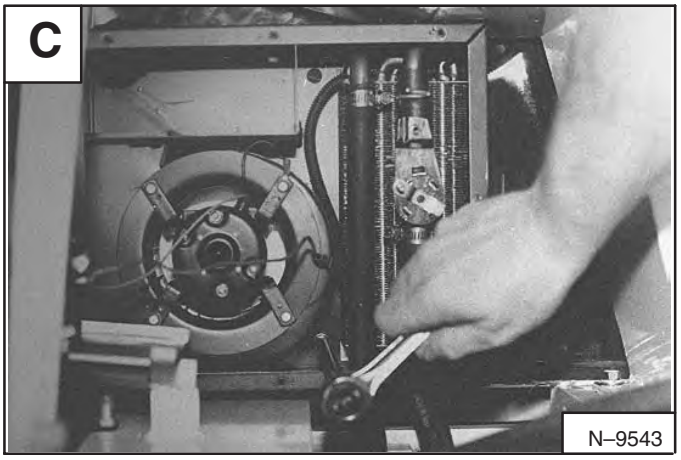
Pull the wire harness from the heater housing.

Mark the heater hoses (Item 2) **[C]** for installation.

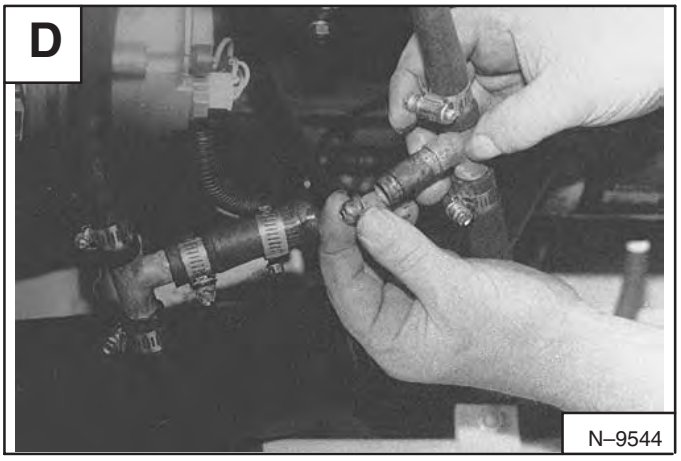
Remove the heater hoses.

Remove the four heater housing mounting bolts (Item 3) **[C]**.

Remove the heater.



NOTE: There is an orifice (Item 1) [D] in the heater hose by–pass line. Be sure to install the orifice before assembly.



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ENGINE

Removal and Installation

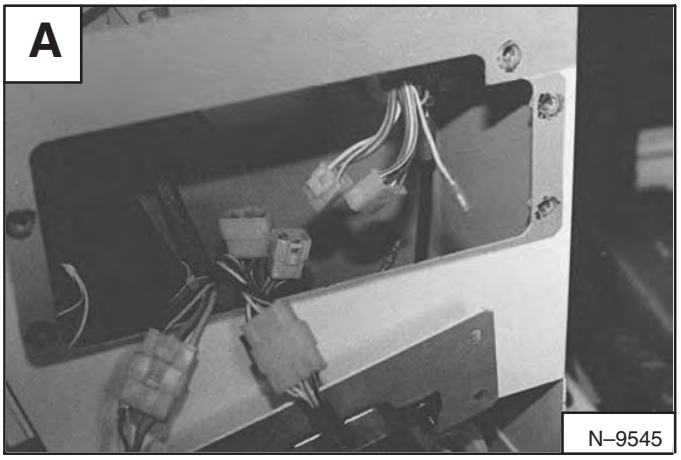
Remove the engine cover. (See Page 5–1.)

Remove the radiator. (See Page 7–14.)

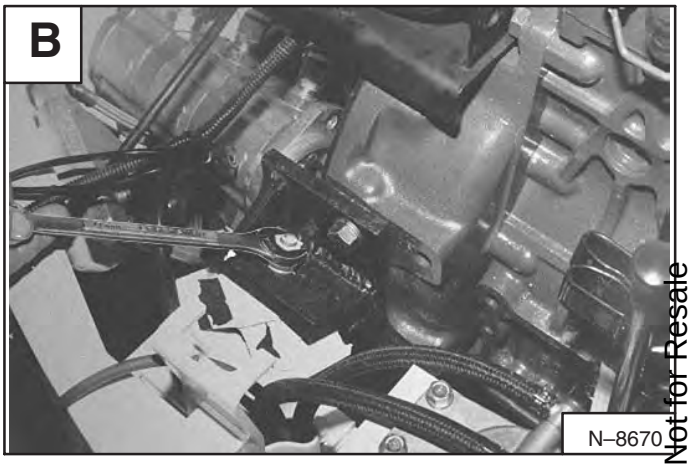
Remove the seat and swing motor cover (See Page 5–1.)

Disconnect the battery cables from the battery.

Disconnect the engine harness **[A]**.



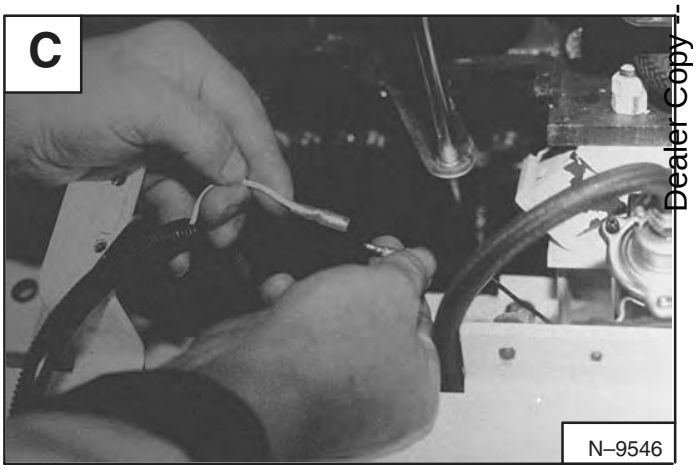
Remove the motor mount bolts **[B]**.



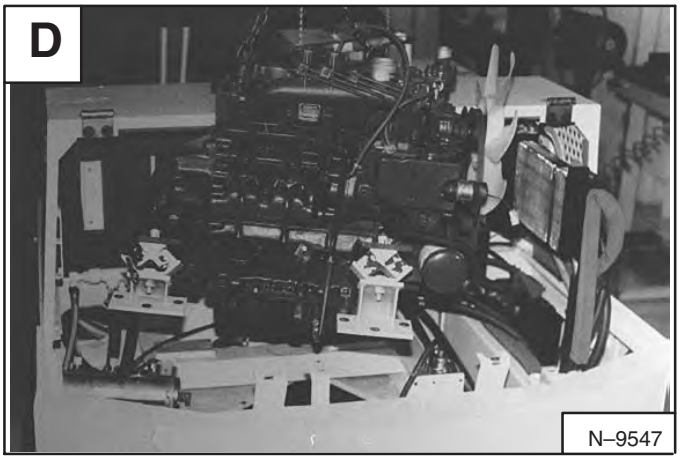
Disconnect the electric fuel pump wire **[C]**.

Remove the fuel hose from the injection pump.

Remove the hydraulic pump mounting bolts. (See Page 2–1.)



Connect a chain to the lift eyes on the engine and remove the engine using a chain hoist **[D]**.



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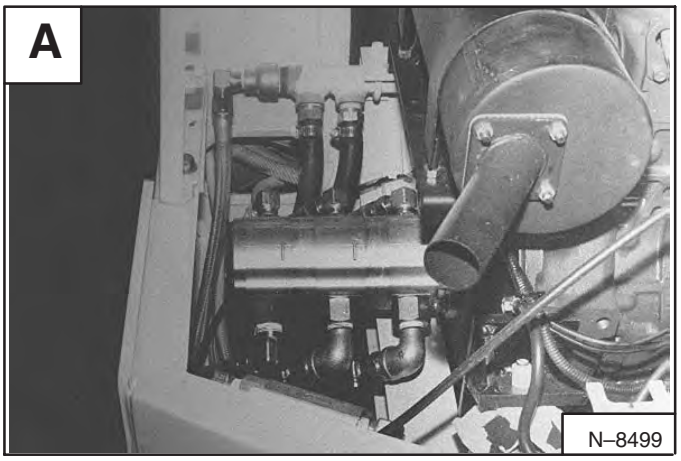
ENGINE FLYWHEEL

Removal and Installation

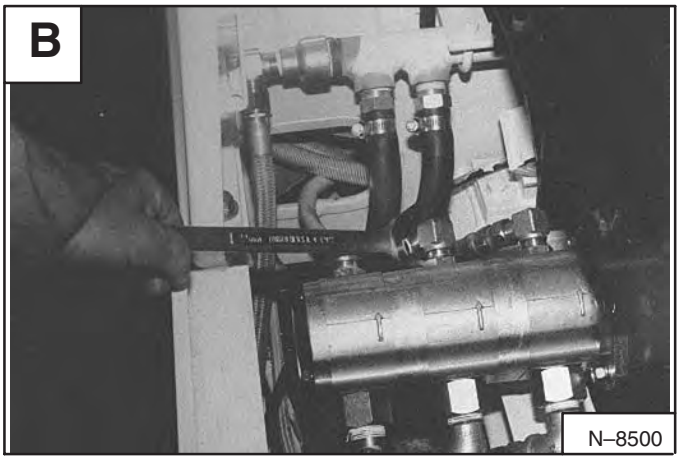
NOTE: The flywheel can be removed with the engine installed in the machine. The following photo's show the engine removed from the machine for photo clarity.

If the engine is not removed; disconnect the three inlet hoses from the hydraulic pump **[A]**.

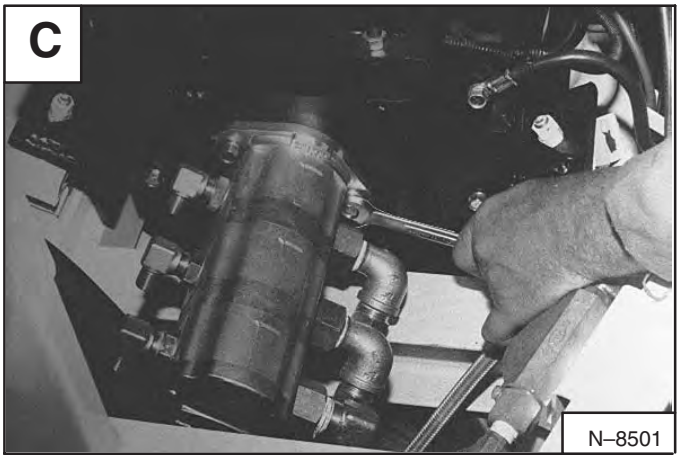
Drain the hydraulic fluid into a container.



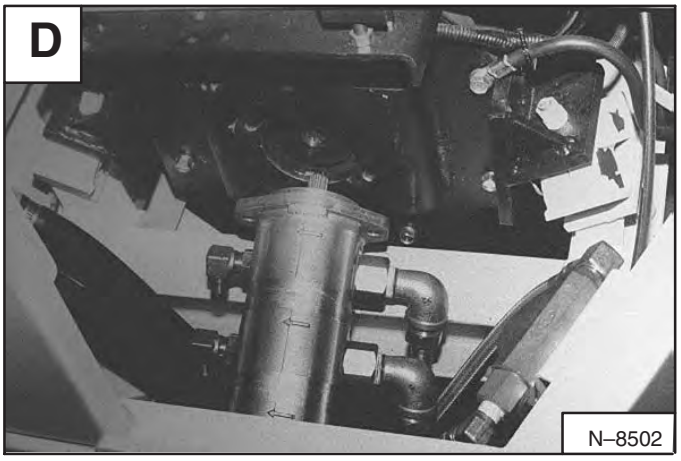
If the engine is not removed, disconnect the two high pressure hoses from the hydraulic pump **[B]**.



Remove the two mounting bolts from the hydraulicpump **[C]**.



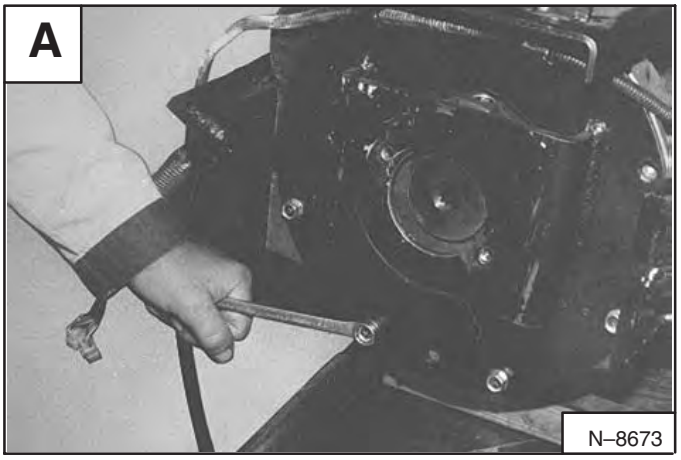
Remove the hydraulic pump from the flywheel bell housing **[D]**.



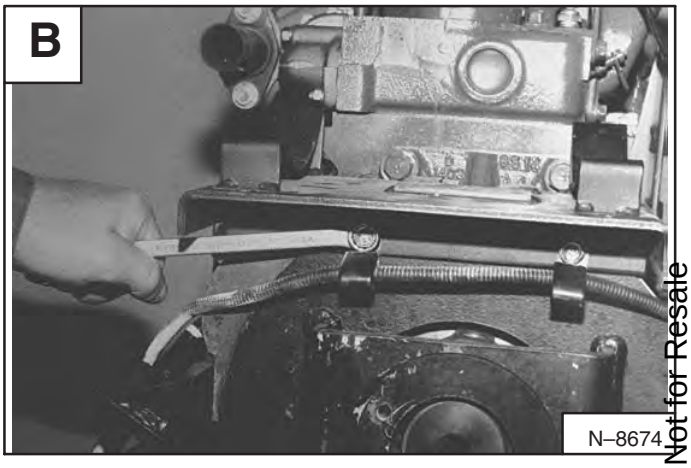
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ENGINE FLYWHEEL (Cont'd)

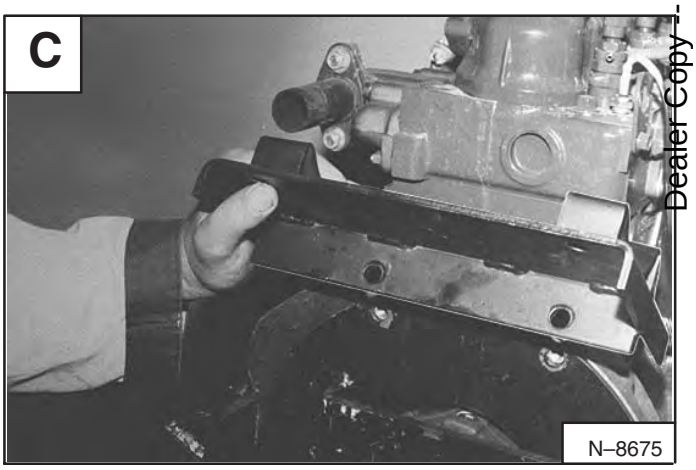
Remove the bolts from the flywheel housing **[A]**.



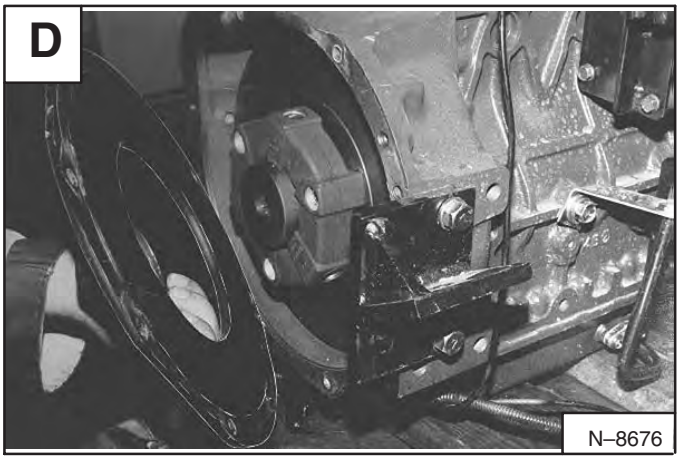
Remove the two top bolts from the muffler bracket **[B]**.



Remove the muffler bracket **[C]**.

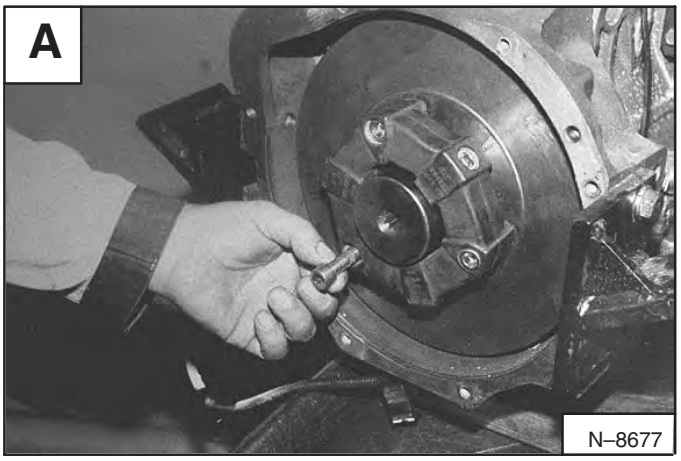


Remove the cover from the flywheel housing **[D]**.

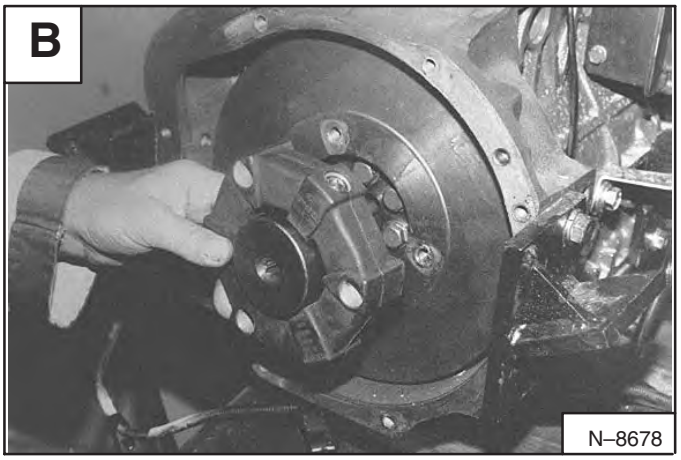


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Remove the bolts from the hydraulic pump coupler **[A]**.



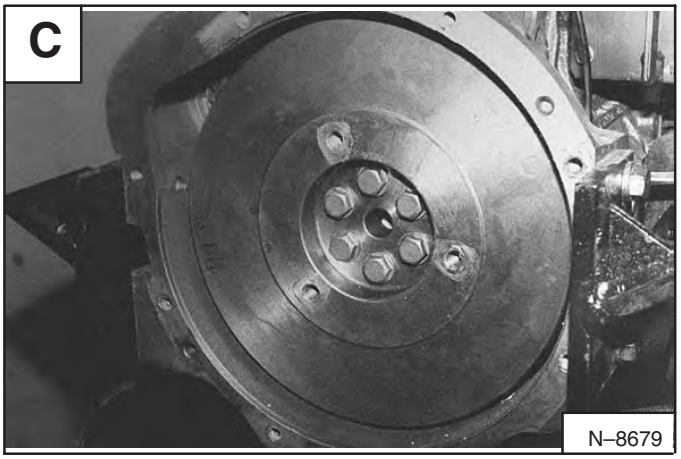
Remove the hydraulic pump coupler **[B]**.



Remove the bolts from the flywheel **[C]**.

Installation: tighten the bolts to 40–43 ft.–lbs. (54–59 Nm) torque.

Remove the flywheel.



Flywheel Ring Gear

⚠ WARNING

Wear safety glasses to prevent eye injury when any of the following conditions exist:

- **When fluids are under pressure.**
- **Flying debris or loose material is present.**
- **Engine is running.**
- **Tools are being used.**

W–2019–1285

The ring gear on the flywheel is an interference fit. Heat the ring gear enough to expand it and hit it with a hammer, evenly to remove it.

Clean the outer surface of the flywheel to give a smooth fit.

Clean the new ring gear and heat it to a temperature of 450–500° F (232–260° C).

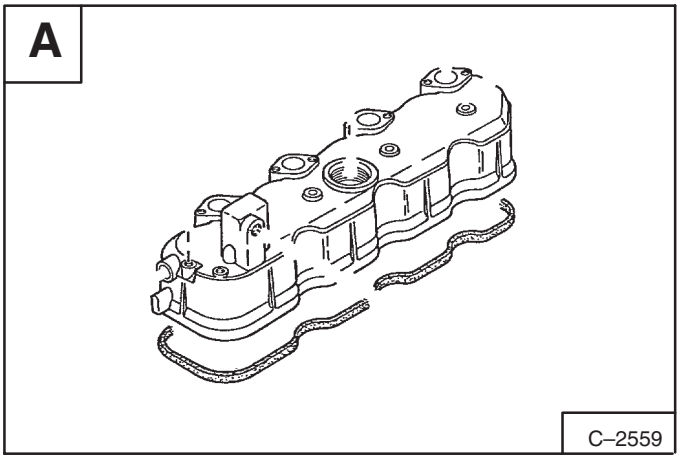
Fit the ring gear over the flywheel. Make sure the gear is seated correctly.

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CYLINDER HEAD

Removal

Remove the nuts from the valve cover and remove the valve cover **[A]**.

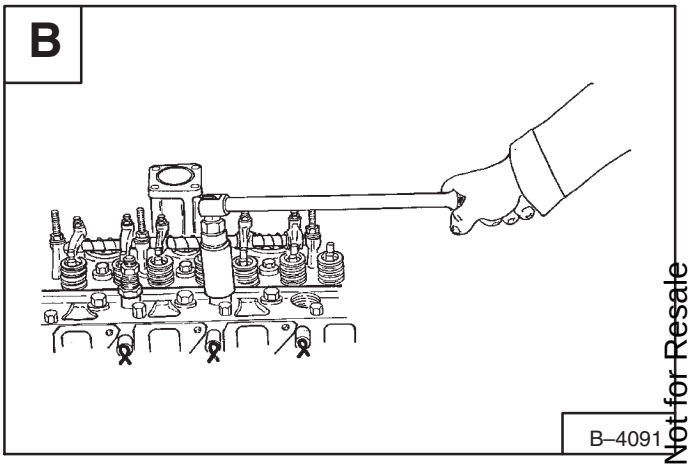


Disconnect the injector tubelines and bleed–off banjo fittings.

Remove the injector nozzles and the copper gasket **[B]**.

Remove the intake manifold.

Remove the belt shield and remove the alternator.

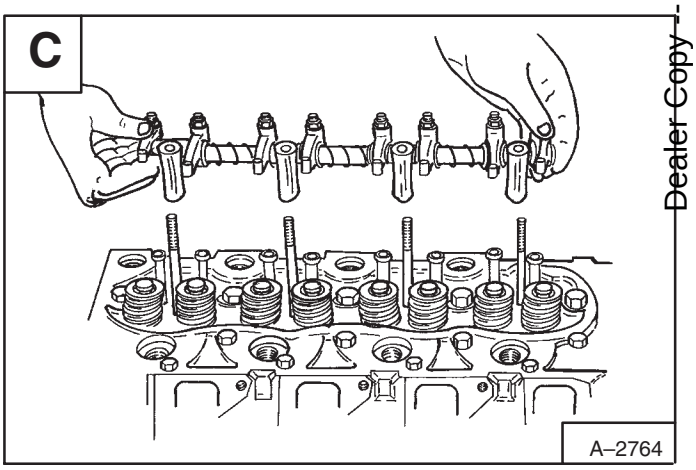


Remove the rocker arms **[C]**.

Remove the push rods.

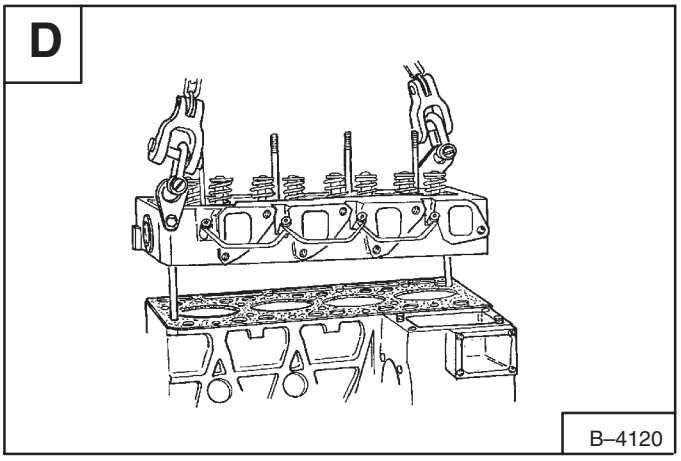
Remove the water return pipe.

Remove the cylinder head bolts.



Remove the cylinder head **[D]**.

Remove the cylinder head gasket and the O–rings.



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CYLINDER HEAD (Cont'd)

Disassembly

NOTE: There may be a shim under the head gasket. Use the shim over again or replace it with the same size shim.

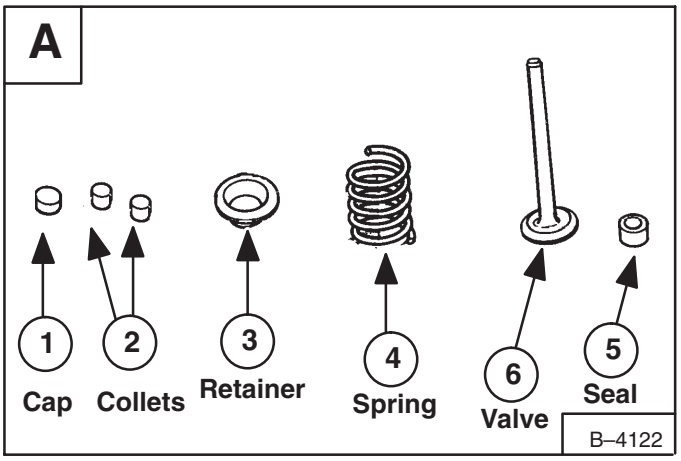
Remove the valve cap (Item 1) **[A]** and the valve spring collet (Item 2) **[A]**.

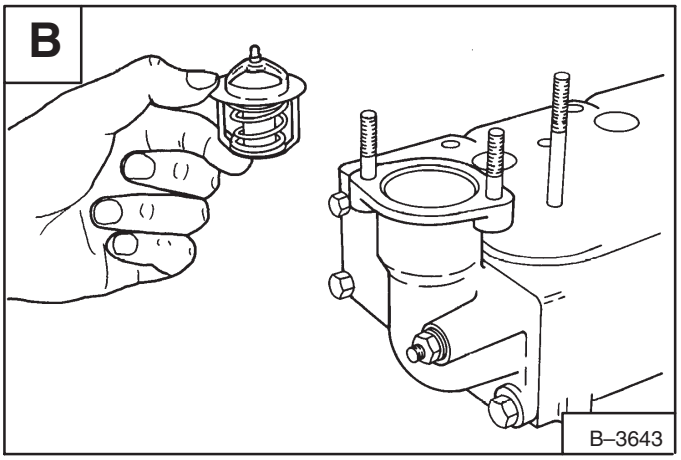
Remove the valve spring retainer (Item 3) **[A]**.

Remove the spring (Item 4) **[A]**.

Remove the seal (Item 5) **[A]** and the valve (Item 6) **[A]**.

Remove the thermostat **[B]**.





Servicing the Cylinder Head

Use the tool listed for the following procedure:

MEL1098 – Valve Lapper

Clean the surface of the cylinder head.

Put a straight edge (Item 1) **[C]** on the cylinder head.

NOTE: Do not put the straight edge across the combustion chamber.

Put a feeler gauge (Item 2)**[C]** between the straight edge and the surface of the cylinder head.

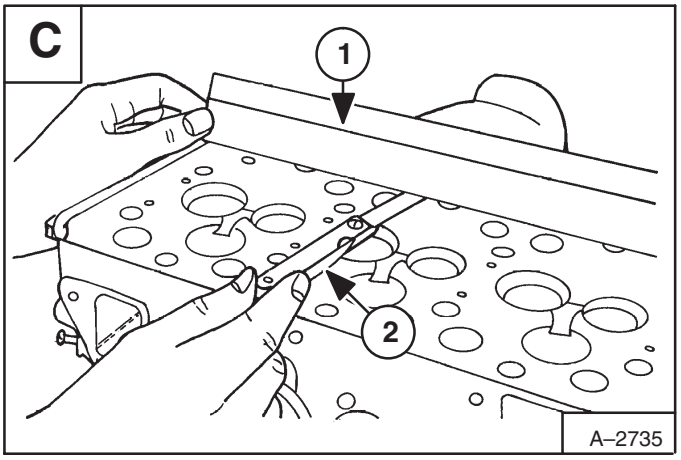
The maximum distortion of the cylinder head surface is ± 0.002" (± 0,05 mm).

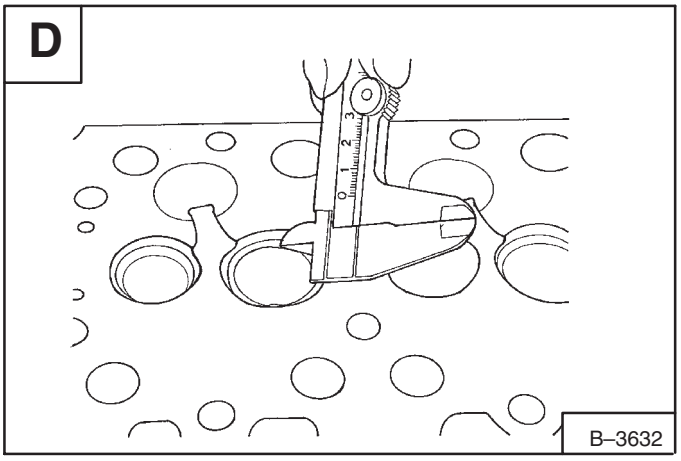
If the measurement is more than the specifications, the cylinder head must be planed.

NOTE: Place a soft brass rod through the injector hole and tap the combustion chamber out before planing the head. Plane the same amount from the bottom side of the combustion chamber before installing it back in the head.

Clean the valve surface.

Measure the width of the valve seat **[D]**.





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CYLINDER HEAD (Cont'd)

The correct width of the valve seat is 0.0827 (2,1 mm) and the seat angle is 45 degrees.

Grind the valve seats as follows:

1. Use a 45° cutter to grind the surface of the valve seat **[A]**.
2. Use a 15° cutter to grind the front surface of the valve seat **[A]**.
3. Use a 65° or 75° cutter to grind the rear surface of the valve seat to finish the seat to a 0.0827" (2,1mm) width **[A].**
4. Grind the valve surface to a 45° angle.

Install the valve in the seat and check the depth **[B]**.

The specifications for the depth of the valve is 0.0433–0.0512 (1,1–1,3 mm).

If the measurement is more than the specification, add the correct thickness of the washer under the valve spring to keep the correct tension on the spring.

Clean the valve guide.

Install the valve in the cylinder head.

Install the dial indicator.

Measure the clearance of the valve guide and the valve **[C]**.

The measurement must be 0.0016–0.0023 (0,040–0,06 mm).

If the measurement exceeds the limit, replace the valve guide.

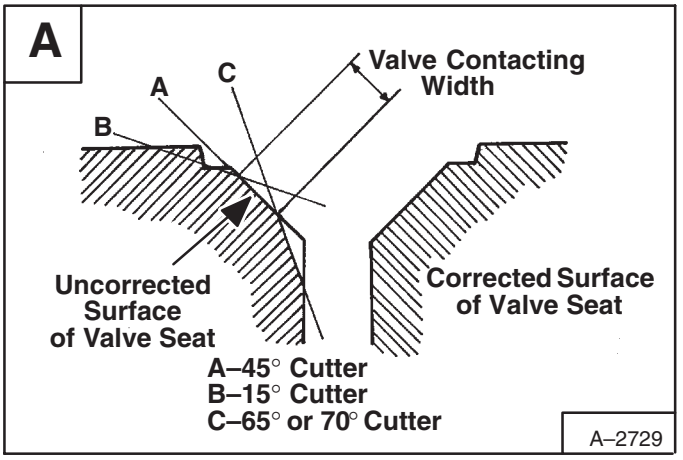
Ream the new guide to the correct dimensions.

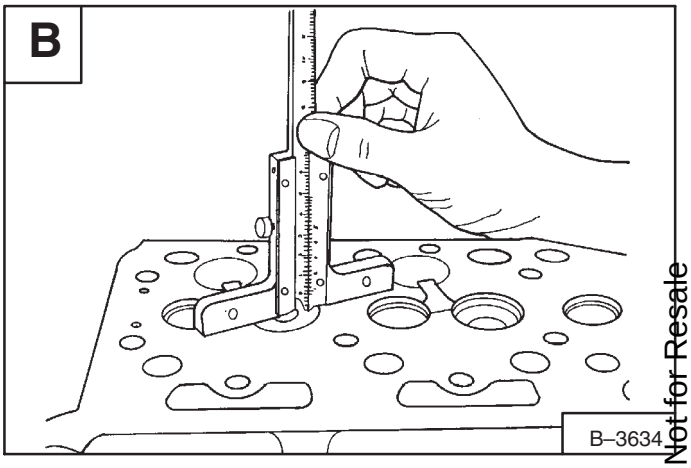
Measure the valve spring. the length of the spring must be 1.6417–1.6614 (41,7–42,2 mm).

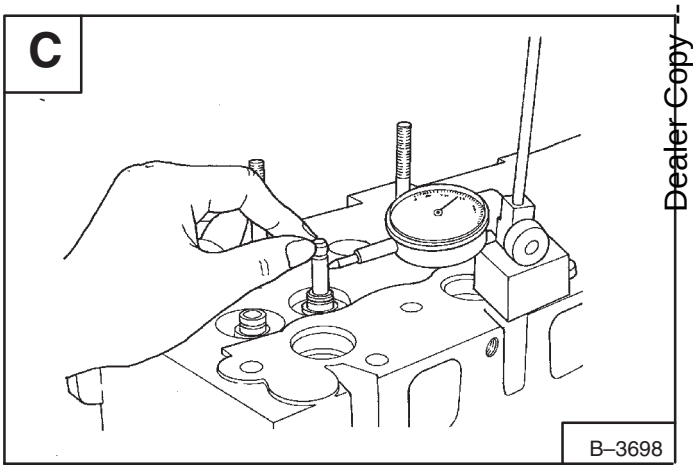
Replace the valve spring if it does not meet these specifications.

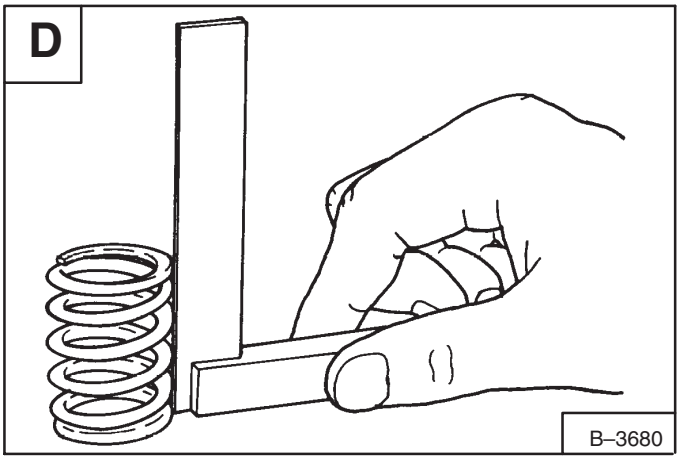
Check the valve spring with a combination square to make sure it stands straight.

Replace it if it is not straight **[D]**.









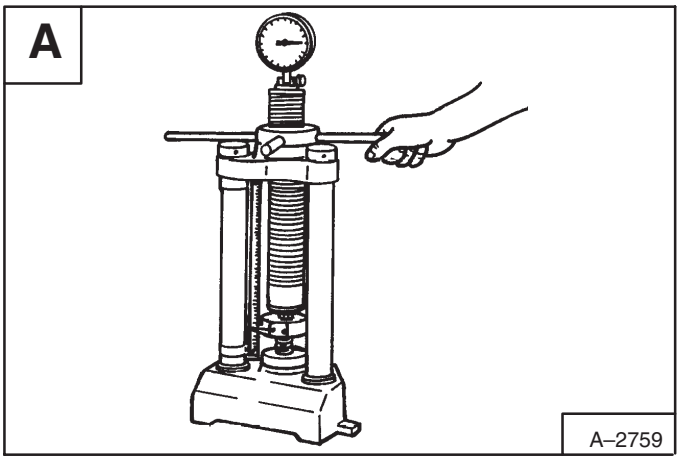
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CYLINDER HEAD (Cont'd)

Put the valve spring in a tester **[A]**.

Push down on the spring 1.3839 (35,15 mm). The compression load must be 22.5–26.5 lbs. (10,21–12,03 kg).

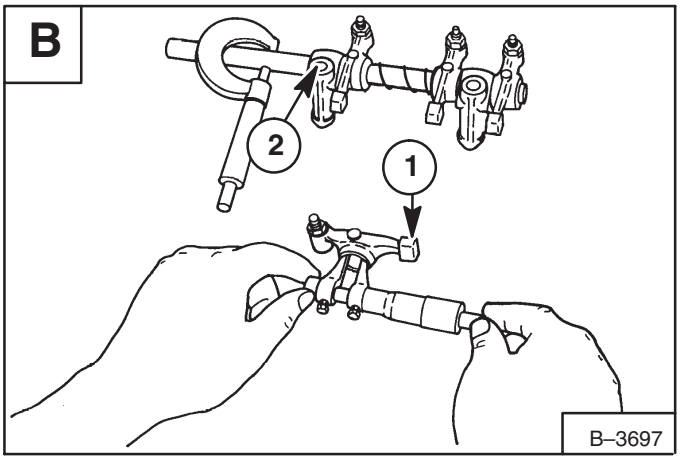
Replace the valve spring if it does not meet these specifications.



Measure the inside diameter of the rocker arm bushing (Item 1) **[B]** and the shaft diameter (Item 2) **[B]**.

The inside of the rocker bushing is 0.5513–0.5529 (14,002–14,043mm).

If the measurements are not within the specifications replace the needed parts.



Assembly

Install the valves.

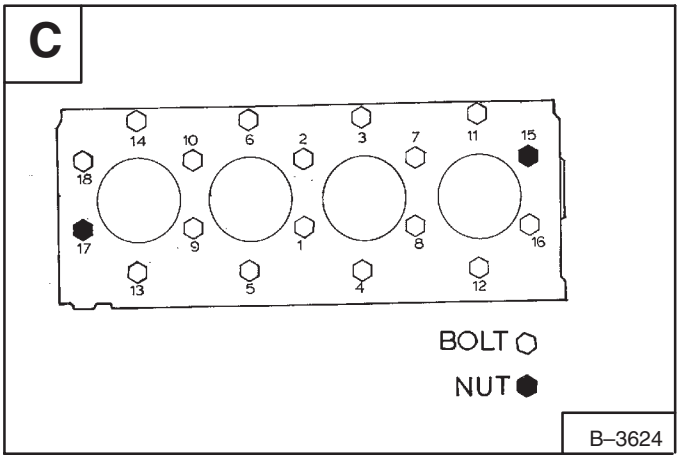
Put oil in the valve seal and install the seal on the valve.

Install the valve spring and the retainer.

Install the spring collet and the valve cap.

Install the thermostat.

NOTE: If a new cylinder head is installed be sure to install the screw plugs which are shipped with the new cylinder head.



Installation

Install a new gasket and O–ring. Install a shim if there was one removed.

Install the cylinder head on the engine block.

Put oil on the bolts and nuts and tighten to correct torque, as follows:

Bolts with washers 58–61 ft.–lbs. (78–82 Nm).

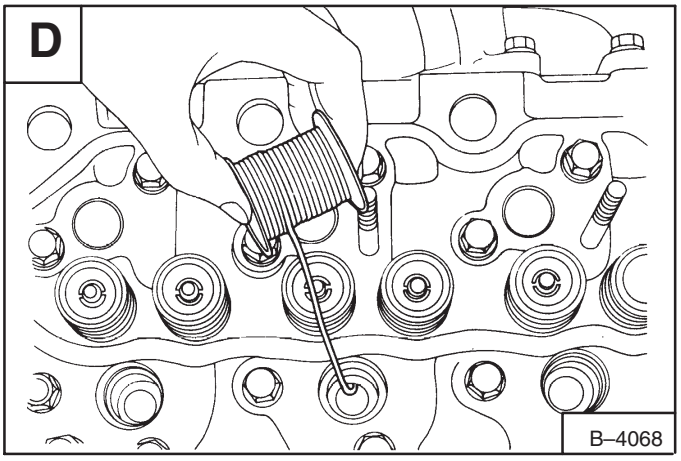
Flange head bolts 65–68 ft.–lbs. (88–92 Nm).

Use the tightening sequence as shown **[C]**.

Lower the piston which is to be measured for the clearance, between the cylinder head and the piston.

Put a piece of solder in the injector port.

Make sure the solder does not touch the valves **[D]**.



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CYLINDER HEAD (Cont'd)

Turn the engine manually.

Remove the solder and measure it. the thickness must be .0276–.0354 (0,7–0,9 mm).

If the measurement is not in the specifications, remove the cylinder head and add the correct shim between the cylinder head and the engine block.

Install the cylinder head and tighten the bolts and nuts. (See Page 7–26.)

NOTE: Be sure to torque the bolts and nuts again after the engine has been operated for 30 minutes.

Install the push rods.

Install the water return pipe.

Install the rocker arms.

Install the alternator, belt and shield.

Install the intake manifold.

Install the injector nozzle with a new copper gasket. Tighten to 22–36 ft.–lbs. (30–49 mm) torque.

Install the injector tubelines.

Adjust the valve clearance. Make sure the piston is at T.D.C. when making the adjustment **[A]**.

ENGINE REPAIR

Remove the cylinder head. (See Page 7–23.)

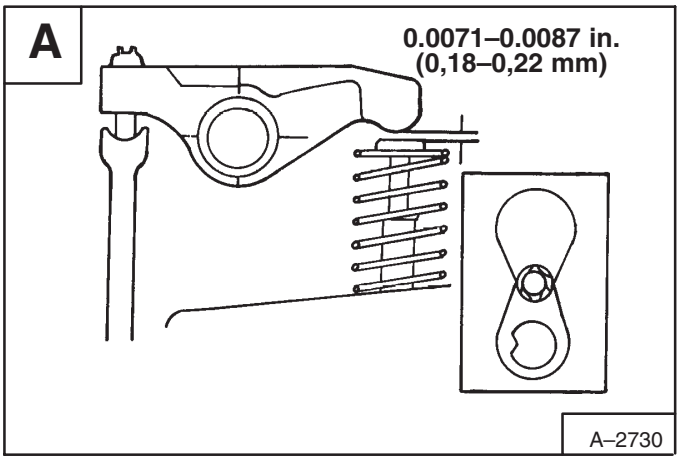
Remove the push rods.

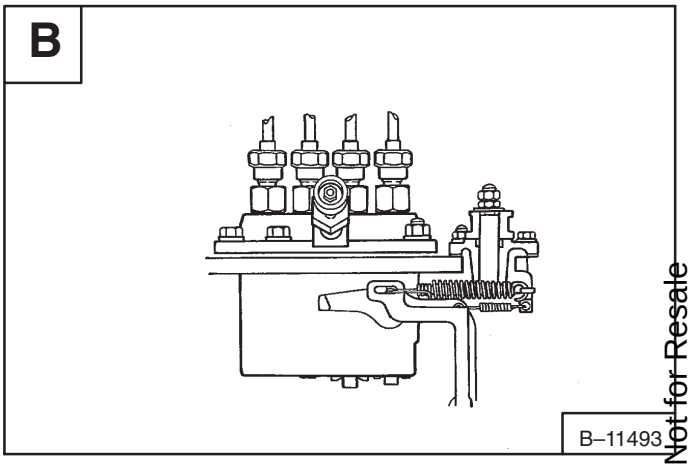
Remove the starter.

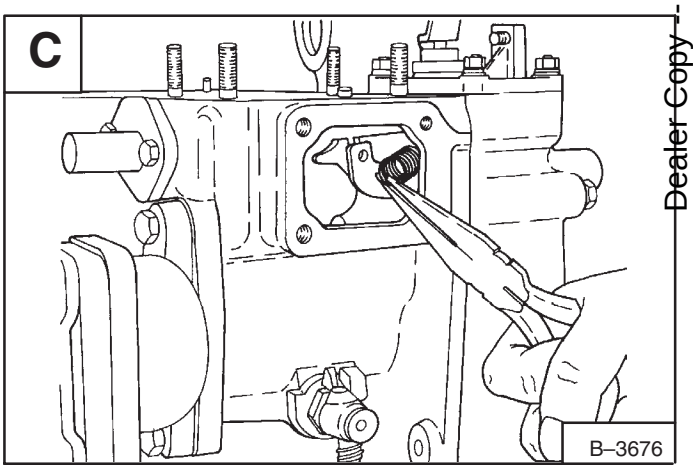
Remove the injector pump. (See Page 7–9.)

Removing the Gearcase

Remove the governor spring from the governor fork **[B]** & **[C]**.

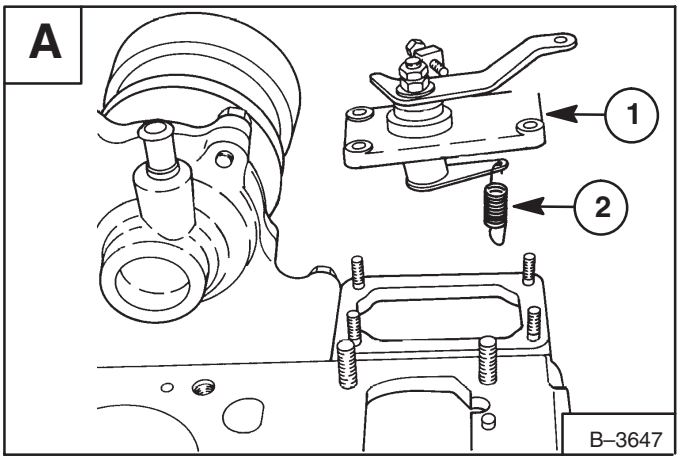






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Remove the plate (Item 1) **[A]** for speed control and the governor spring (Item 2) **[A]**.



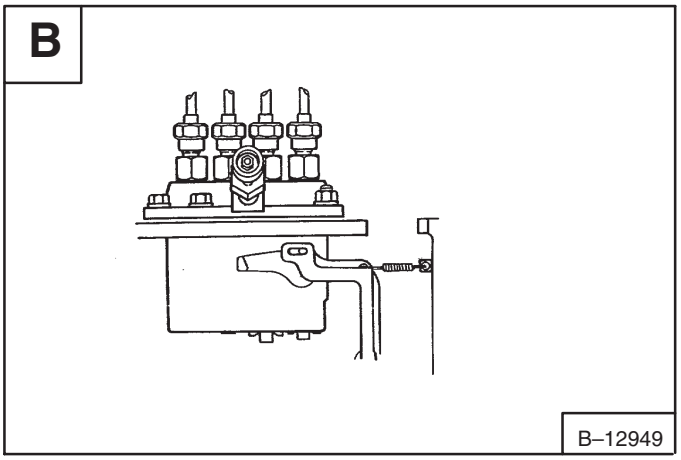
Remove the start spring from the gearcase **[B]** & **[C]**.

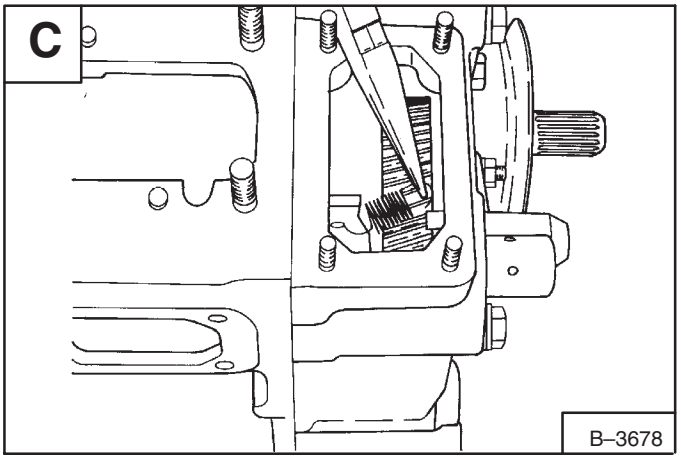
Straighten the washer on the crankshaft sheave. Remove the nut and washer.

Installation:

Tighten the nut to 101–110 ft.–lbs. (137–149 Nm) torque.

After installation, bend the washer on the sheave.





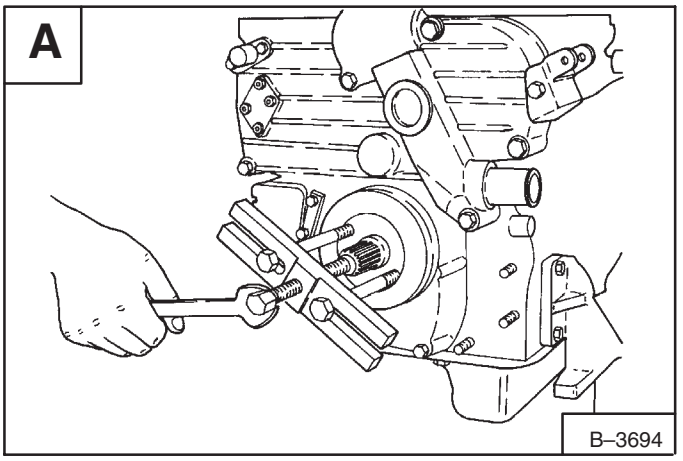
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ENGINE REPAIR (Cont'd)

The tool listed will be needed for the following procedure:

MEL1234 – Crankshaft Nut Socket.

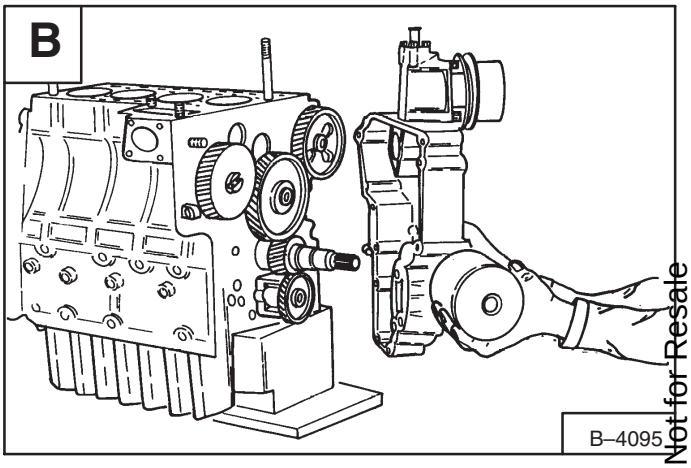
Use a puller and remove the engine crankshaft sheave **[A]**.



Remove the key.

Remove the bolts from the gearcase.

Remove the gearcase **[B]**.

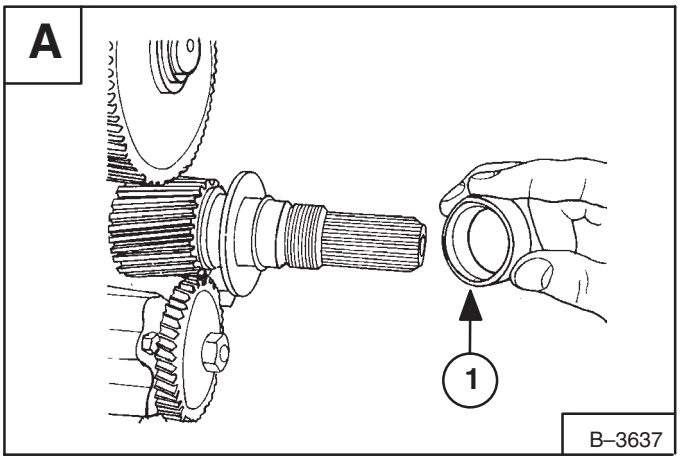


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Removing the Timing Gear, Camshaft and Oil Pump

Remove the crankshaft collar (Item 1) **[A]**, O–ring oil slinger and the gear collar.

Remove the snap ring on the idler gear.

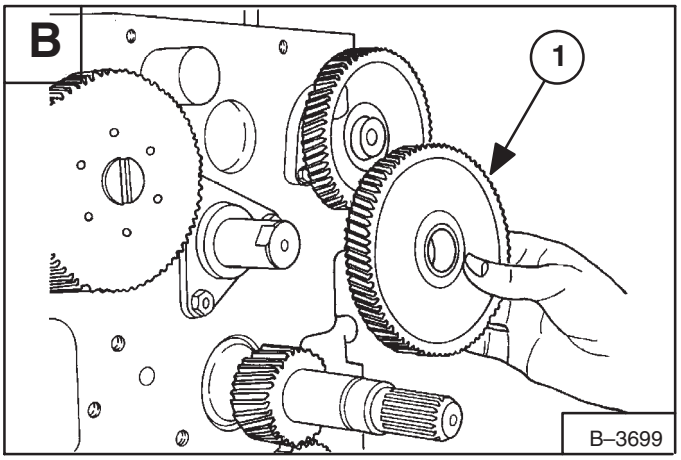


Remove the idler gear (Item 1) **[B]**.

Remove the idler gear collar from the shaft **[B]**.

Straighten the washer on the bolt for the camshaft stop.

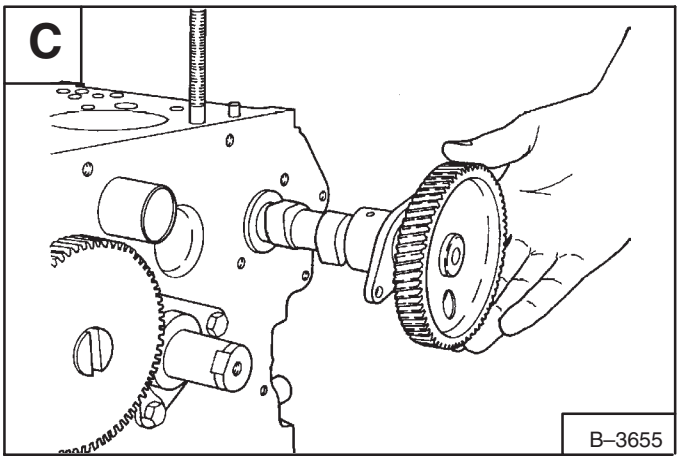
Remove the bolt for the camshaft stop.



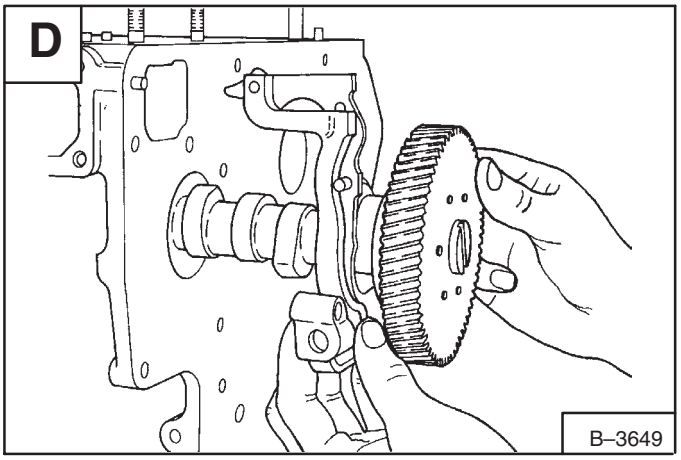
Remove the camshaft **[C]**.

Remove the three bolts that hold the fork lever on the fuel camshaft.

Remove the stop for the fuel camshaft.



Remove the fuel camshaft and the fork lever at the same time **[D]**.



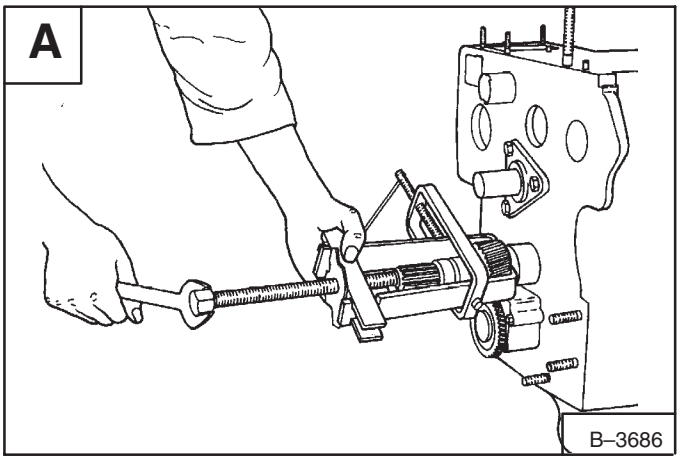
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Remove the crankshaft gear with a puller **[A]**.

Remove the key.

Straighten the washer on the gear of the oil pump.

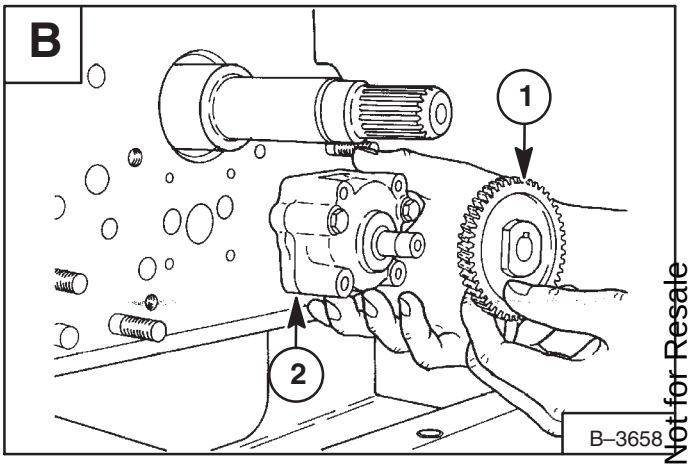
Remove the bolt on the gear of the oil pump.



Remove the gear pump (Item 1) **[B]**.

Remove the oil pump bolt.

Remove the oil pump (Item 2) **[B]**.



Removing the Pistons and Crankshaft

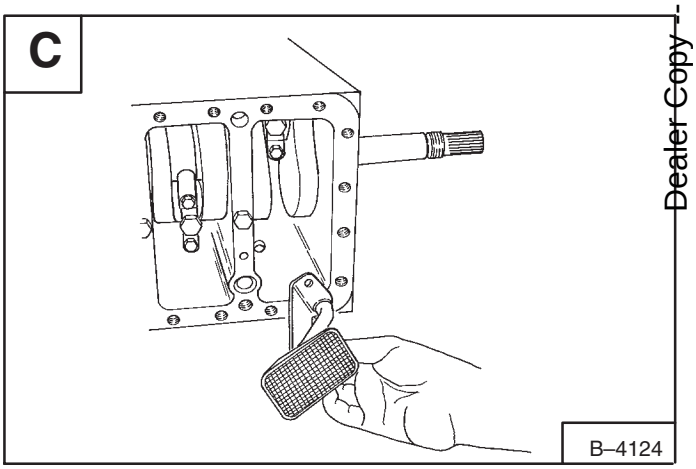
Remove the oil pan.

Remove the screen **[C]**.

NOTE: Do not damage the O–ring.

Straighten the washer on the connecting rod bolts.

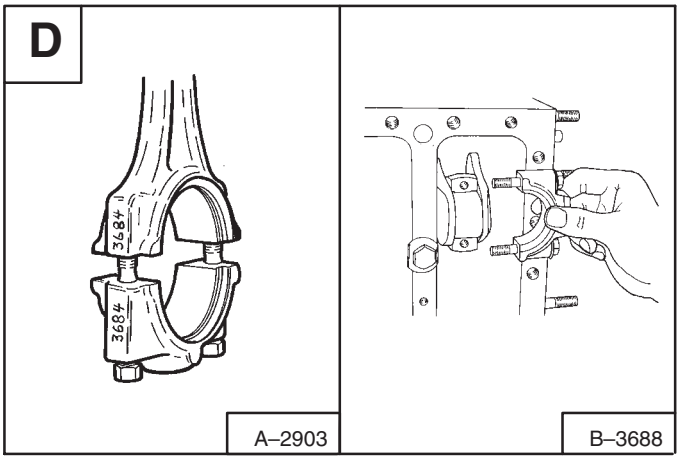
Remove the connecting rod bolts.



Remove the cap and the bearing from the connecting rods **[D]**.

NOTE: Be sure to mark the piston and the connecting rod so they will be assembled correctly [D].

NOTE: Face the marks toward the injection pump side of the block.

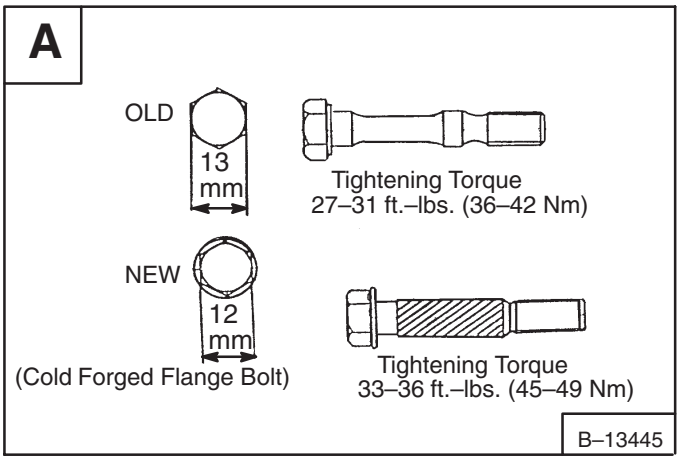


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Installation:

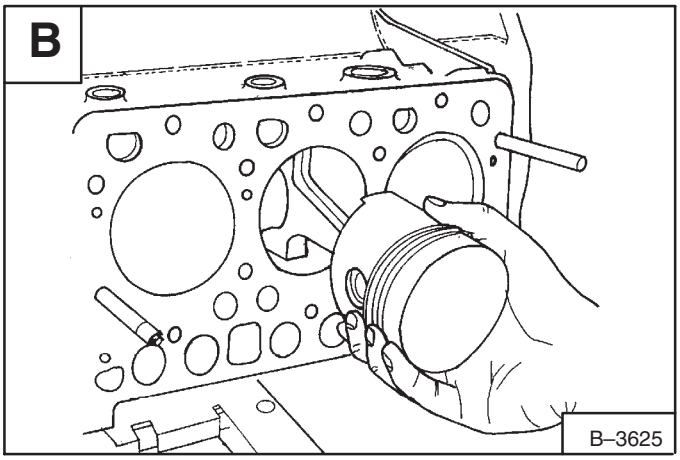
Tighten the rod cap bolts to torque as follows:

Machine Bolt (13 mm Size Head) 27–31 ft.–lbs. (36–42 Nm)
Forged Bolt (12 mm Size Head) 33–36 ft.–lbs. (45–49 Nm)



Remove the piston from the engine block **[B]**.

NOTE: Be sure the pistons are marked so they will be returned to the same cylinder.



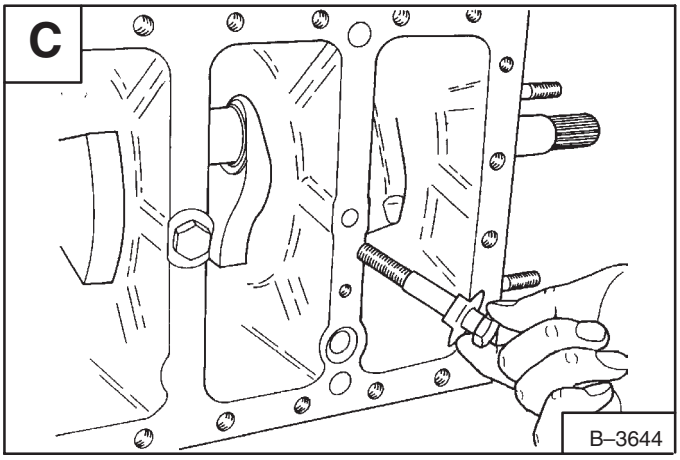
Straighten the washer on the flywheel bolts.

Remove the bolts from the flywheel.

Use a puller to remove the flywheel.

Straighten the washer on the bolts that hold the main bearing in position.

Remove the main bearing case bolts from the engine block **[C]**.



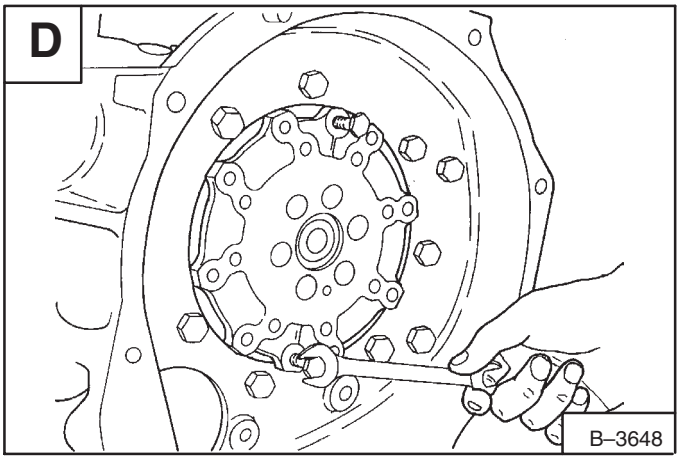
Installation:

Tighten the bolts to 47–50 ft.–lbs. (64–68 Nm) torque.

Straighten the washer on the bolts that hold the main bearings in position.

Remove the bolts.

Install two bolts in the rear cover and pull the cover out **[D]**.

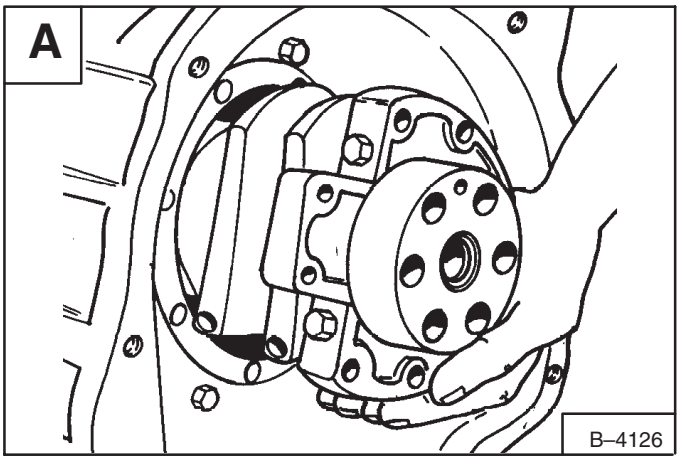


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Remove the crankshaft from the rear of the engine **[A]**.

NOTE: Do not damage the crankshaft when removing it from the engine block.

Straighten the washer on the bolts of the main bearings.



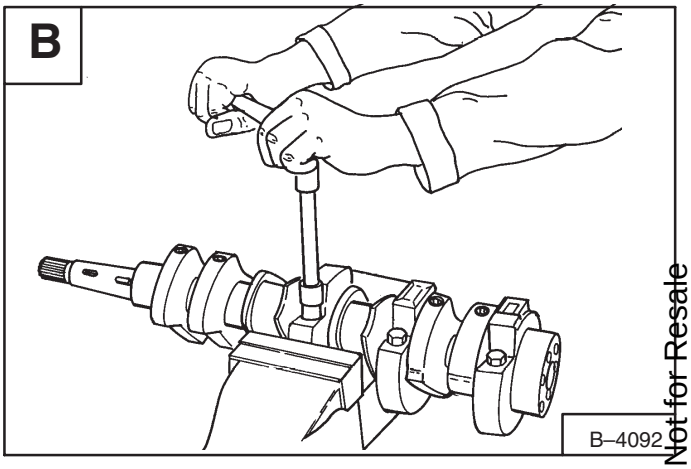
Remove the bolts from the bearing cap halves **[B]**.

Remove the halves of the main bearings.

NOTE: When installing the bearing cap halves, make sure the holes in the bearing caps align with the holes in the engine block. Thrust washers must be installed with oil grooves facing outward.

Installation:

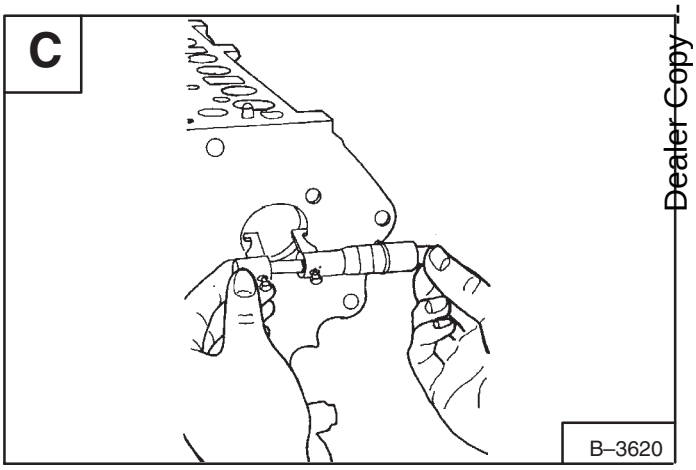
Tighten the bolts to 21–25 ft.–lbs. (28–34 Nm) torque.



Servicing the Timing Gear and Camshaft

Measure the camshaft bearing in the engine block **[C]**.

The specification is 1.5748–1.5758 (40–40,041 mm). The wear limit is .002–.0036 (0,05–0,09 mm).



Measure the camshaft journal **[D]**.

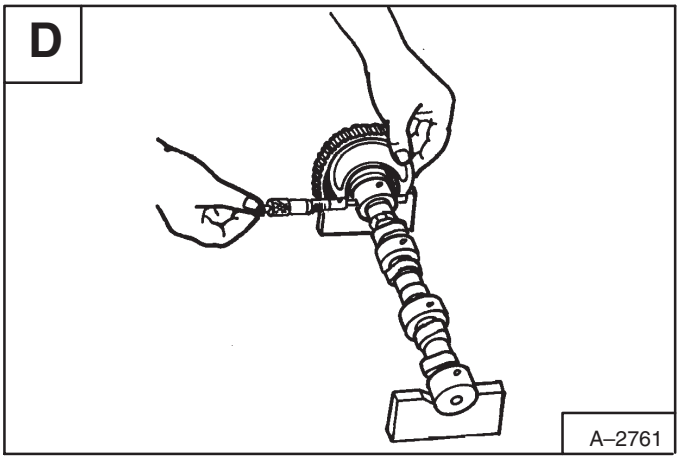
The specification is 1.5722–1.5728 (39,934–39,950 mm).

If the measurements are not within the specifications replace the needed parts.

Put the camshaft on v–blocks.

Put a dial indicator on the journals.

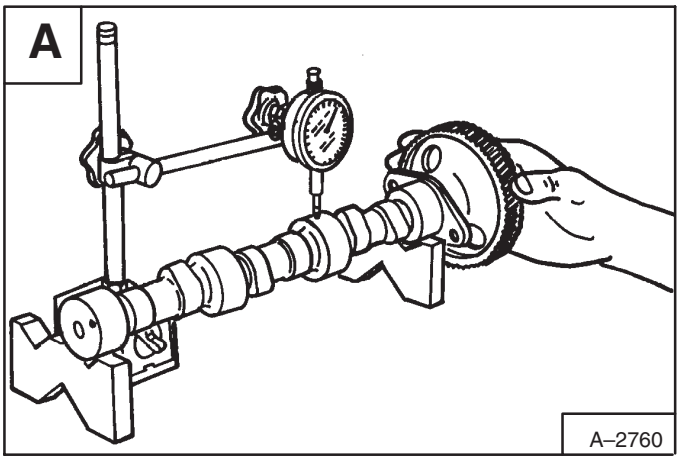
Turn the camshaft at a slow rate.



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The wear limit is 0.0008 (0,02 mm) **[A]**.

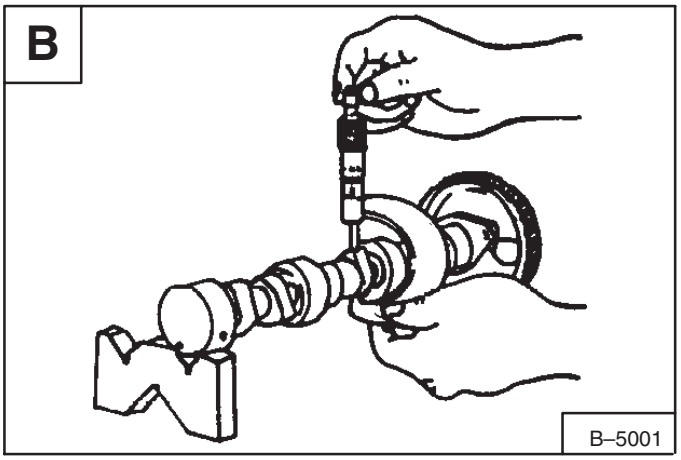
If the camshaft measurements are not withing the specifications replace the needed parts.



Measure the highest point on each camshaft lobe **[B]**.

The specification is 1.3134 (33,36 mm).

The wear limit is 1.3115 (33,31 mm).

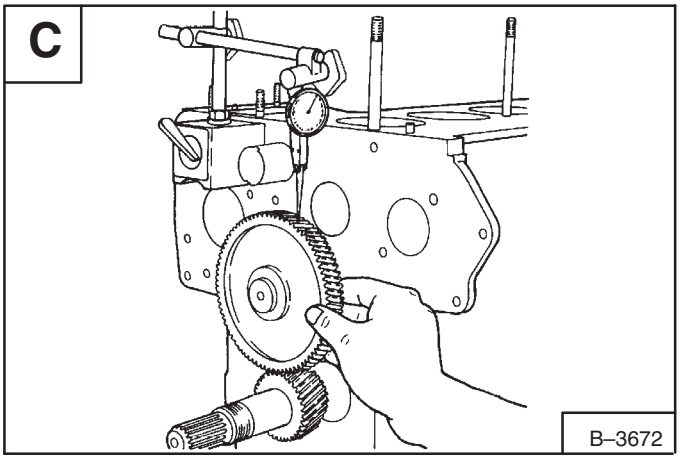


NOTE: After the crankshaft is installed, check the clearance for the camshaft gear.

Install a dial gauge.

Hold one gear while turning other gear **[C]**.

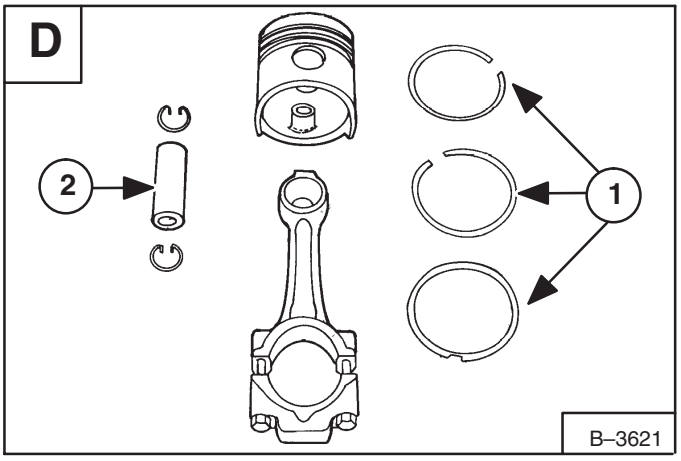
The specification is 0.006–0.0045 (152–1 14 mm). The wear limit is 0.0118 (0,3 mm).



Servicing the Connecting Rods and Pistons

Remove the piston rings (Item 1) **[D]**.

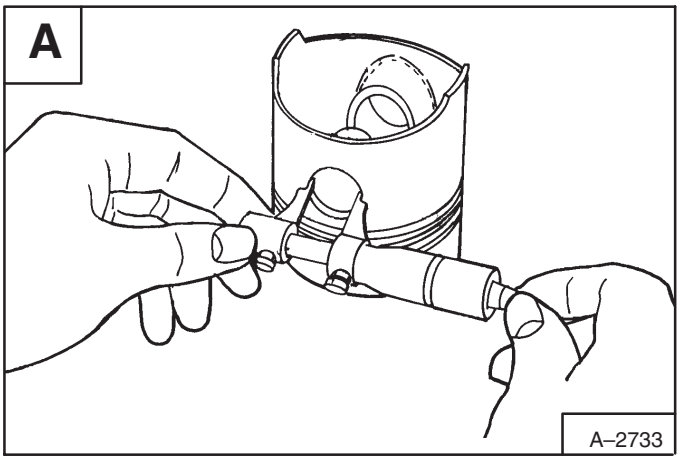
Remove the piston pin (Item 2) **[D]**.



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Measure the piston pin hole **[A]**.

The specifications are 0.9055–0.9060 (23–23,013mm). The wear limit is 0.9076 (23,053 mm).



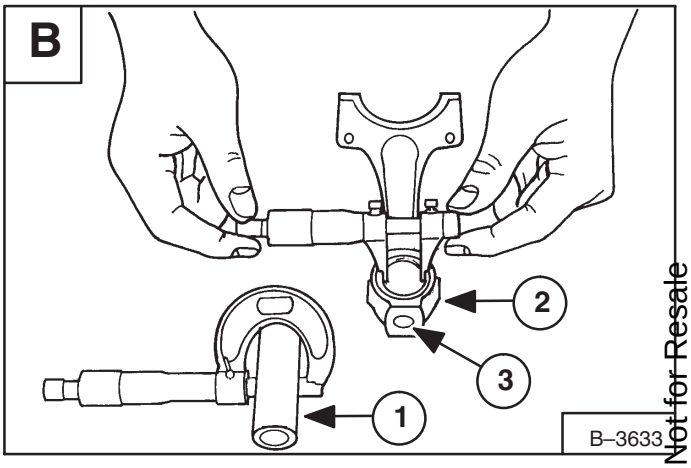
Measure the piston pin (Item 1) **[B]**.

Measure the connecting rod bushing (Item 2) **[B]**.

The specifications are 0.0006–0.0015 (0,152–0,038 mm). The wear limit is 0.0059 (0,015 mm).

NOTE: Replacement bushing specifications are .0006–.0026 (0,015–0,066 mm).

When replacing bushings use the connecting rod hole (Item 3) **[B]** as a guide, drill a hole through the replacement bushing and deburr the hole.

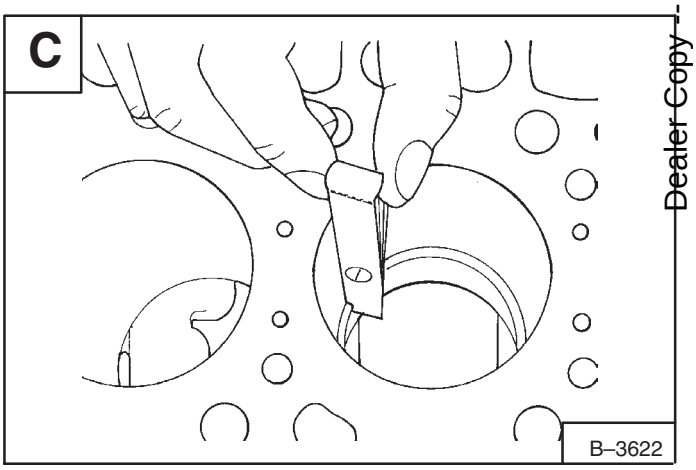


Put the piston ring on the bottom of the cylinder.

Check the clearance of the ring gap **[C]**.

The specifications is 0.018–0.0177 (0,046–0,45 mm) for the 1st and 2nd rings. The wear limit is 0.0492 (0,249–0,450 mm).

Install the connecting rod on the tool for checking connecting rod alignment.

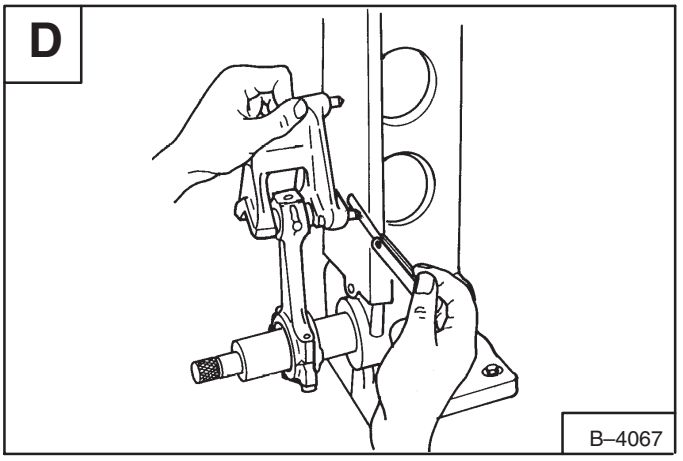


Check the clearance at the piston pin area **[D]**.

The specification is 0.0008 (0,02 mm).

The wear limit is 0.0020 (0,05 mm).

NOTE: Be sure the bushing diameter of the connecting rod is within specification.



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Servicing the Crankshaft

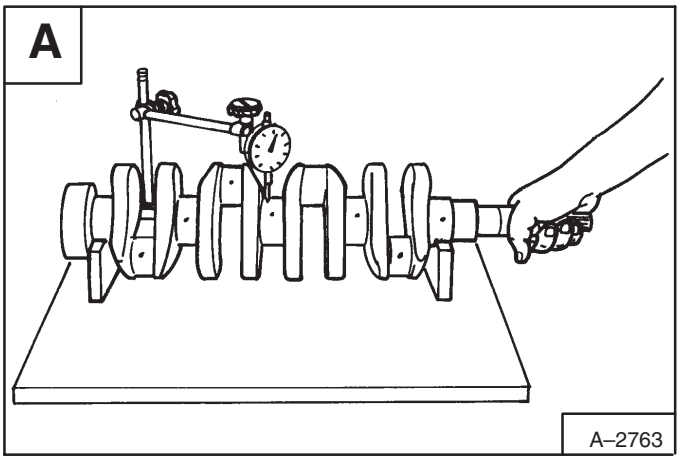
NOTE: If a new crankshaft is used, besure the plugs that come with the crankshaft are installed in the crankshaft or engine damage will occur.

Put the crankshaft on v–blocks.

Put a dial indicator on the center journal and turn the crankshaft slowly **[A]**.

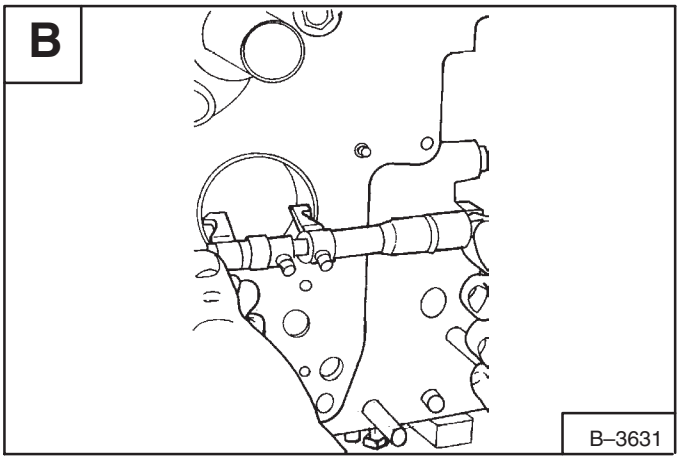
The specifications are 0.0008 (0,02 mm).

The wear limit is 0.0031 (0,08 mm).



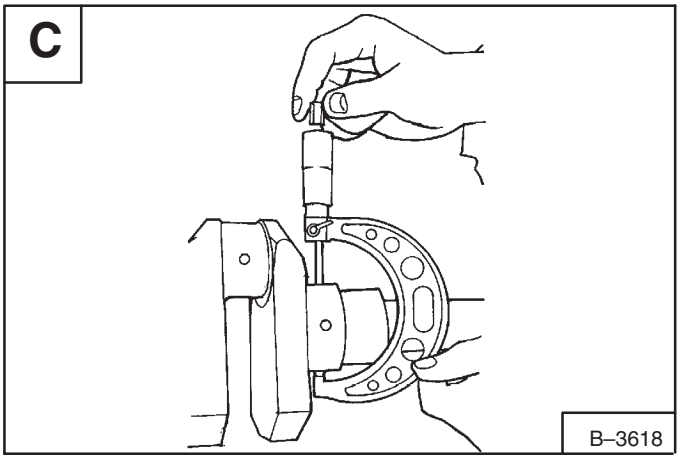
Check the inside diameter of the crankshaft bearing in the engine block **[B]**.

The specification is 2.0465–2.0488 (51,980–52,039 mm). The wear limit is 0.0079 (0,2 mm).



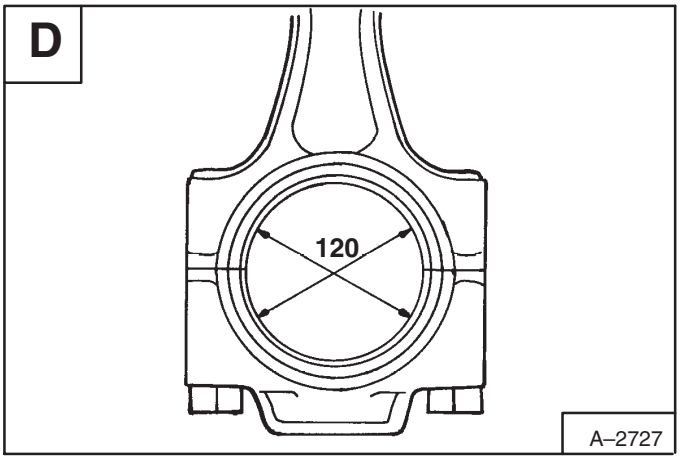
Check the outside diameter of the #1 crankshaft journal **[C]**.

The specification is 2.0441–2.0449 (51,921–51,940 mm). The wear limit is 0.0079 (0,2 mm).



Check the connecting rod bearings **[D]**.

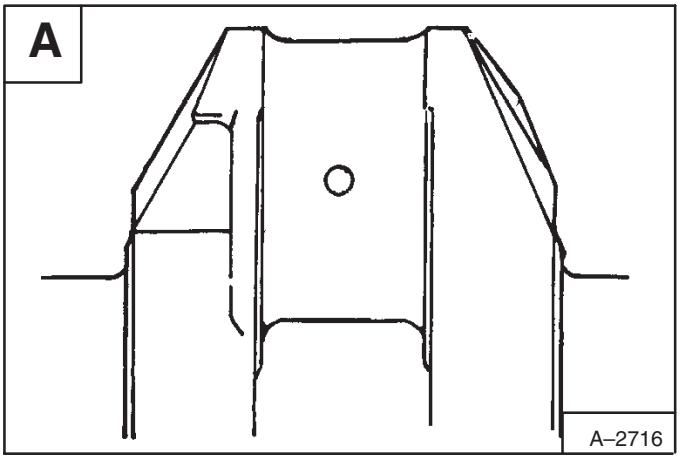
The specifications are 1.7327–1.7343 (44,010–44,052 mm). The wear limit is 0.0079 (0,2 mm).



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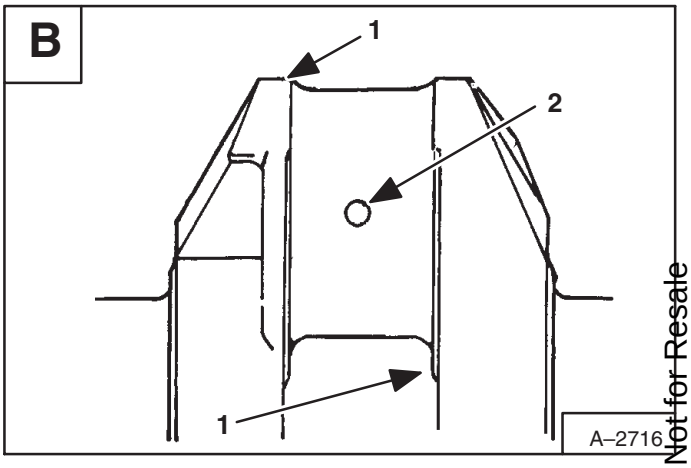
Check the connecting rod journals **[A]**.

The specifications are 1.7307–1.7313 (43,959–43,975 mm). The wear limit is 0.0079 (0.2 mm).



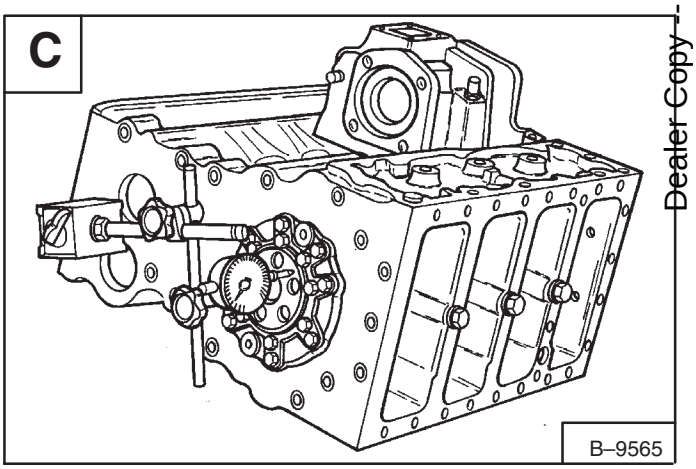
If the connecting rod journals are not within specifications grind the journals as follows **[B]**:

1. Crankshaft corner radius must be 0.1378± 0.0079 (3,5R±0,2mm) R.
2. The oil hole must be champhered to 0.0394–0.0591R (1–1,5mm) R.



Install the crankshaft and check the endplay **[C]**.

Normal end play is 0.0059–0.0122 (0,15–0,31 mm). Replace the thrust bearings on the main bearing if end play exceeds .020 (0,5mm).



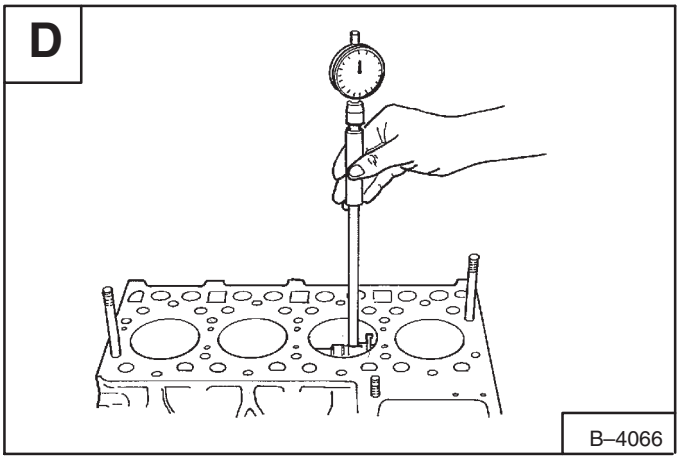
Servicing the Cylinder Liners

Check the inside diameter of the cylinder liner **[D]**.

The tools listed will be used for the following procedure:

MEL1060 – Ridge Reamer

MEL1180 – Dry Liner Puller



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To find the maximum wear check the inside diameter in three different locations **[A]**.

The specifications are 3.2283–3.2292 (82–82,021mm). The wear limit is + 0.0059 (+ 0,15mm).

NOTE: Make sure you use the correct oversize pistons and rings.

If the cylinder liner is not within the specifications, replace the cylinder liner. These are dry liners.

Remove the cylinder liners.

Clean and rub oil in the bores of the engine block.

Clean and put oil on the outside of the cylinder liners.

Install the cylinder liners into the engine block with the inside and outside diameter champhered end down.

The top of the liner must be even with the top of the engine block machined surface.

After installation, bore and hone the cylinder liner to 3.2283–3.2291 (82–82,091 mm).

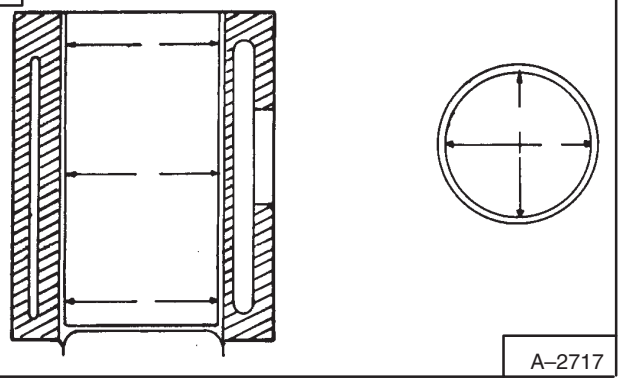
Lubrication System

The lubrication system consists of a trochoide rotor–type driven oil pump, oil filter cartridge, oil pressure regulating valve, oil switch and oil filter **[B]**.

Oil is drawn by the oil pump (b) from the oil pan (o) through the oil screen (a), where the oil is kept at 42–64 PSI (294–441 kPa) by an oil pressure regulating valve (c) installed in the gear case. Then oil flows towards the filter cartridge where it will be further filtered. To insure the supply of lubricating oil, a by–pass valve (d) is provided, the valve opens when the filter element (e) is restricted from the filter cartridge, the pressurized oil is then distributed into two areas; some will be fed through crankshaft passage to the crank pin bearing and the rest to the rocker arm shaft (i) through the frame. Oil then returns to the oil pan by gravity.

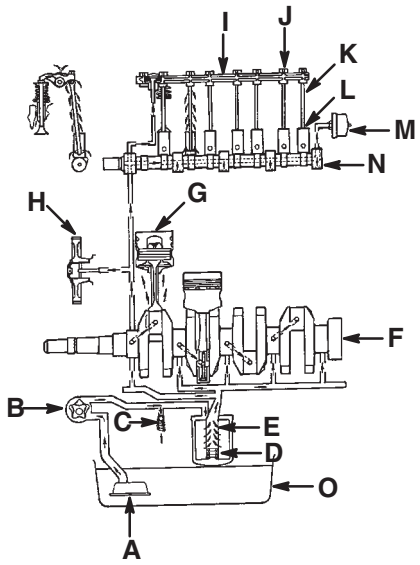
The oil pressure switch (m) will indicate when oil pressure drops below 7 PSI (50 kPa). The oil pressure switch is connected to the oil pressure gauge in the dash panel. If the pressure reads low or zero while the engine is in normal operation, stop the engine immediately and check the oil level (Refer to Operation & Maintenance Manual).

A



A–2717

B



(a) Oil Screen . . . . . (i) Rocker Arm Shaft
(b) Oil Pump . . . . . (j) Rocker Arm
(c) Pressure Regulating Valve (k) Push Rod
(d) By–Pass Valve . . . . . (l) Tappet
(e) Filter Element . . . . . (m) Oil Pressure Switch
(f) Crankshaft . . . . . (n) Camshaft
(g) Piston . . . . . (o) Oil Pan
(h) Idle Gear

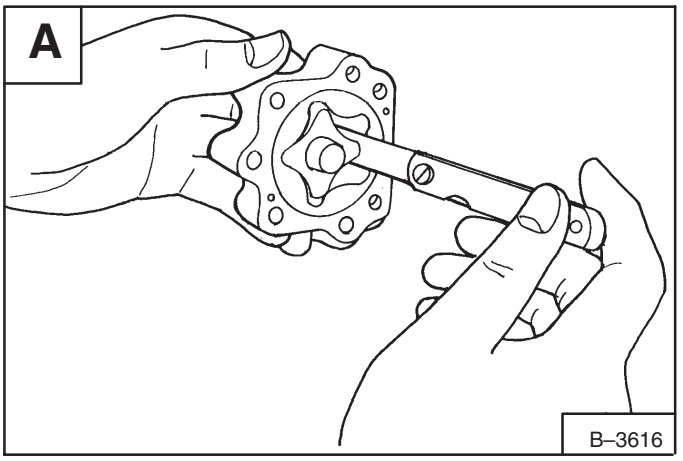
B–9194

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Oil Pump Service

Check the clearance between the inner and outer rotor **[A]**.

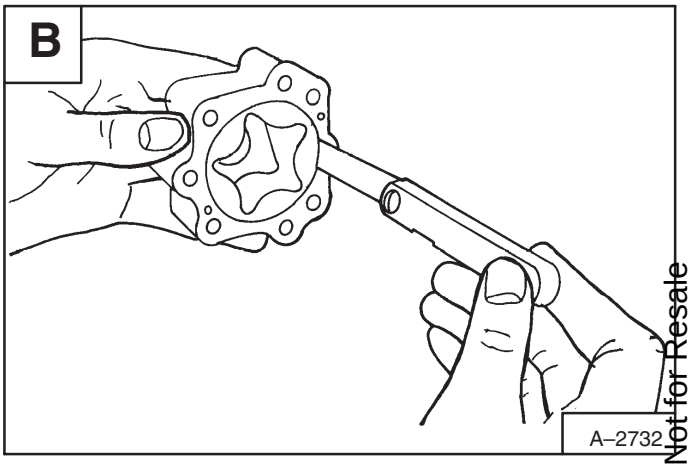
The clearance for the inner rotor is 0.0039–0.0063 (0,099–0,0160 mm). The wear limit is 0.0079 (0,2 mm).



Check the clearance between the outer rotor and the body of the oil pump **[B]**.

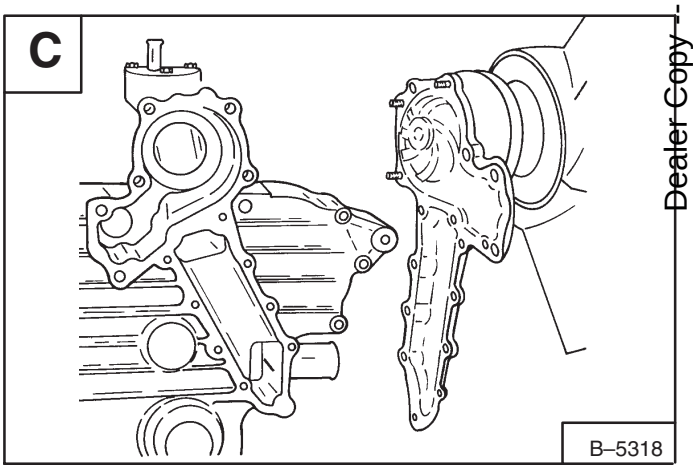
The clearance for the outer rotor is 0.0043–0.0075 (0,11–0,19 mm).

At rated engine speed, the normal oil pressure is 42–56 PSI (289,5–386,1 kPa) and minimum of 35 PSI (241,3 kPa).



Water Pump Service

Remove the water pump from the gearcase **[C]**.

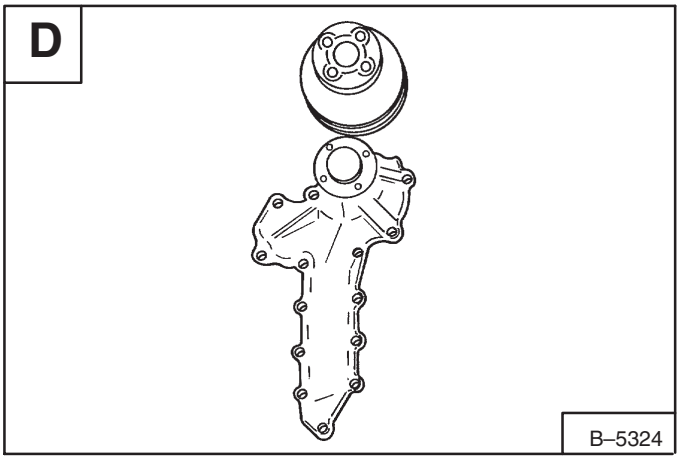


Put the water pump in a vise and remove the nut **[D]**.

Remove the pulley using a puller.

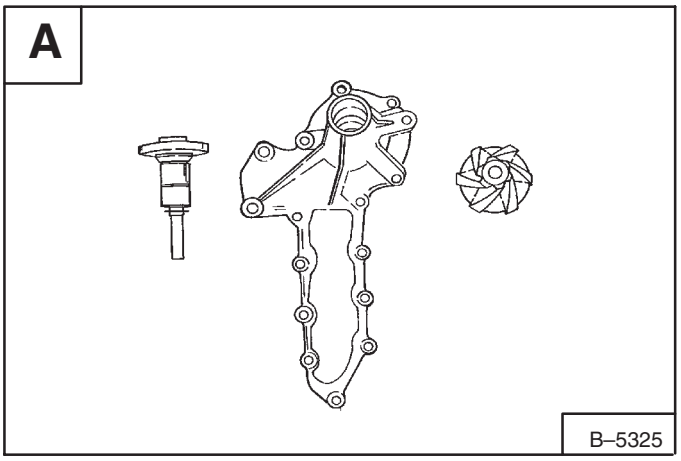
Remove the key.

Remove the snap ring.



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Drive the shaft out of the impeller side **[A]**.

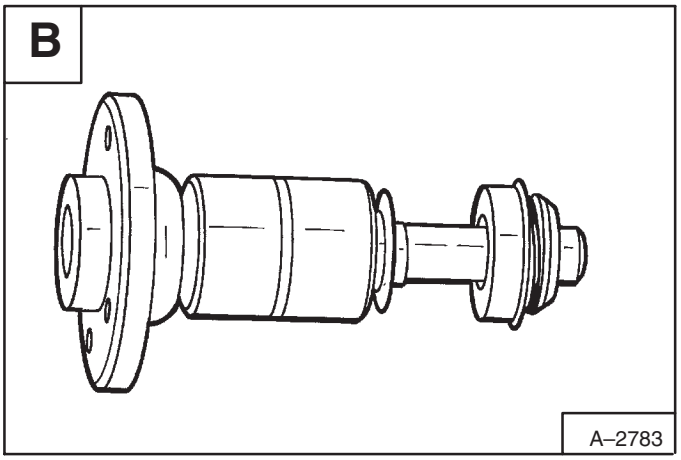


Install the new seals **[B]**.

Install the shaft.

Put the water pump in a vise and tighten the nut to 50–57 ft.–lbs. (68,8–78,4 Nm) torque.

Install the water pump assembly on the gearcase with a new gasket.



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ENGINE ASSEMBLY

Installing the Crankshaft

Install the main bearing case on the crankshaft journals.

Tighten the bolts to 21–25 ft.–lbs. (29,4–34,3 Nm) torque.

Install the thrust bearing with the oil grooves to the outside.

Install the crankshaft in the engine block.

Each main bearing is numbered for correct location.

Be sure the holes in the main bearings align with the holes in the engine block **[A]**.

Install the main bearing case bolts and tighten to 47–50 ft.–lbs. (63,7–68,6 Nm) torque

Installing the Pistons

The tools listed will be needed for the following procedure.

MEL1063 – Ring Compressor
MEL1064 – Piston Ring Expander

Assemble the connecting rod to the piston.

NOTE: Be sure the marks on the piston and the connedting rod are in the same direction.

Install the rings on the piston **[B]**.

Position the top ring so the gap is not lined up with the piston pin. Position the other rings so there is a gap every 90°.

Using a ring compressor to install the pistons in the engine block with the marks away from the camshaft.

Align the bearing cap on the connecting rod **[C]**.

Put oil on the bolts, install them in the bearing caps and tighten the bolts with 13 mm heads to 26–30 ft.–lbs. (36,3–41,2 Nm) torque.

Tighten the bolts with 12 mm heads to 32–36 ft.–lbs. (43–49 mm) torque.

Install the oil pump tube and screen.

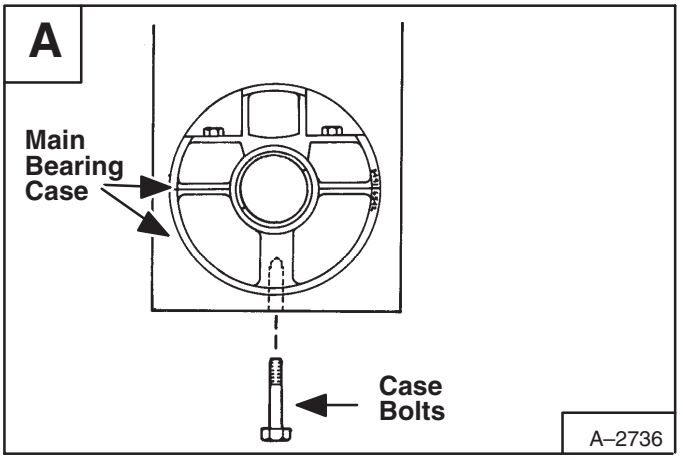
Install a new oil pan gasket and install the oil pan.

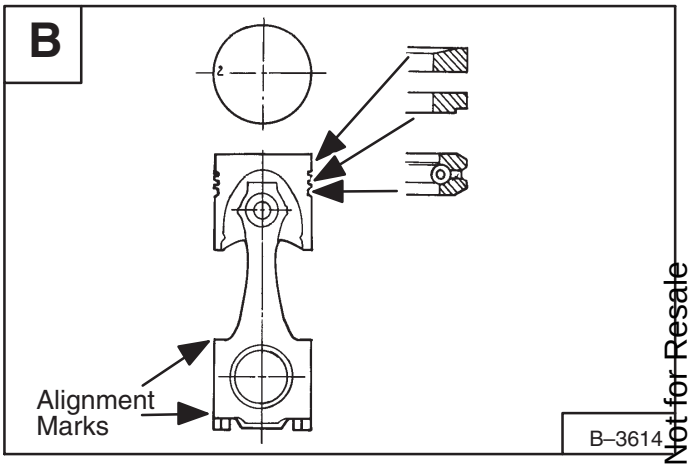
Installing the Camshaft and Timing Gears

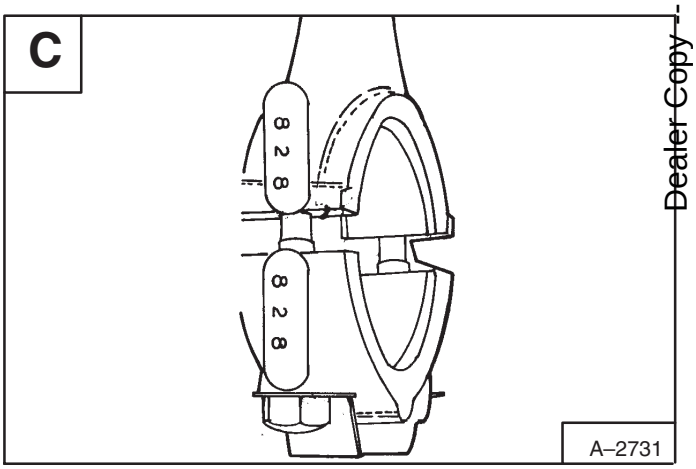
Install the oil pump and tighten the bolts to 60–72 in.–lbs. (6,78–8,13 Nm) torque **[D]**.

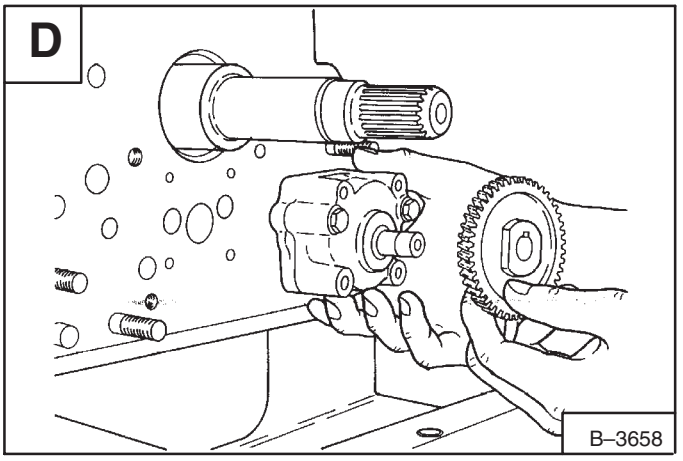
Install the gear and tighten the nut.

Install the key and the gear on the crankshaft.









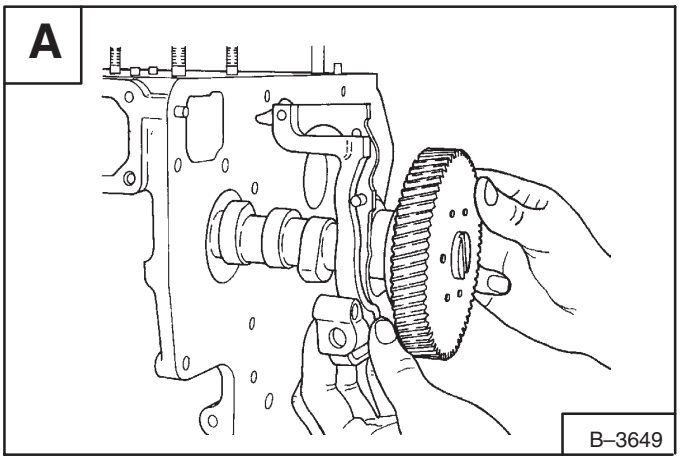
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ENGINE ASSEMBLY (Cont'd)

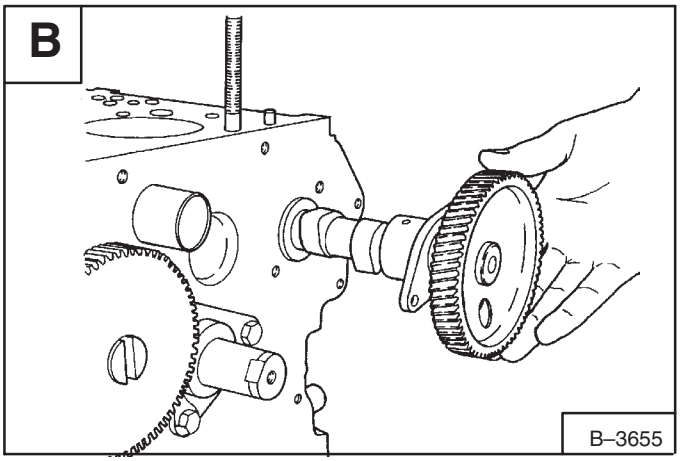
Install the fuel camshaft and the lever at the same time **[A]**.

Install the stop bolt on the fork lever . Tighten the bolt to 60–72 in.–lbs. (678–813 Nm) torque.

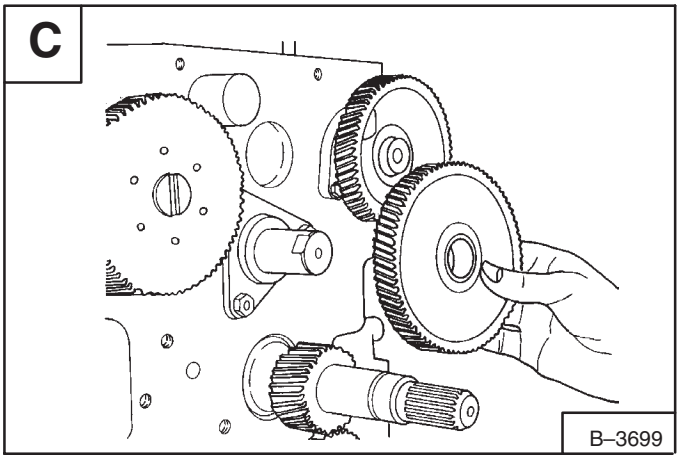
Install the bolts and tighten to 13–15 ft.–lbs. (17,7–20,6 Nm) torque.



Install the camshaft and tighten the bolts to 13–15 ft.–lbs. (17,7–20,6 Nm) torque **[B]**.

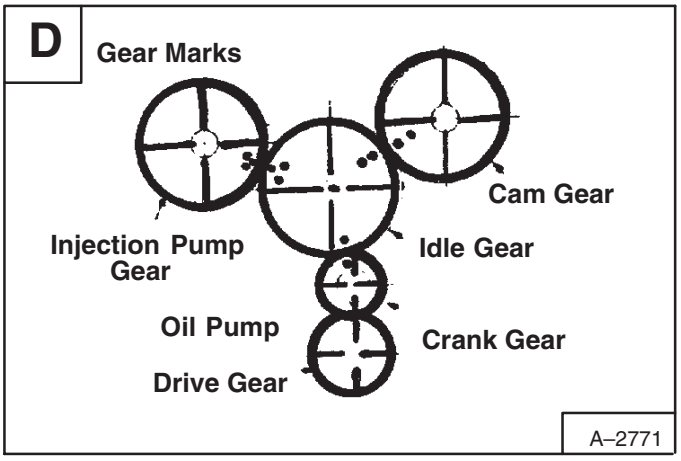


Install the idler gear **[C]**.



Be sure the timing marks are in correct alignment **[D]**.

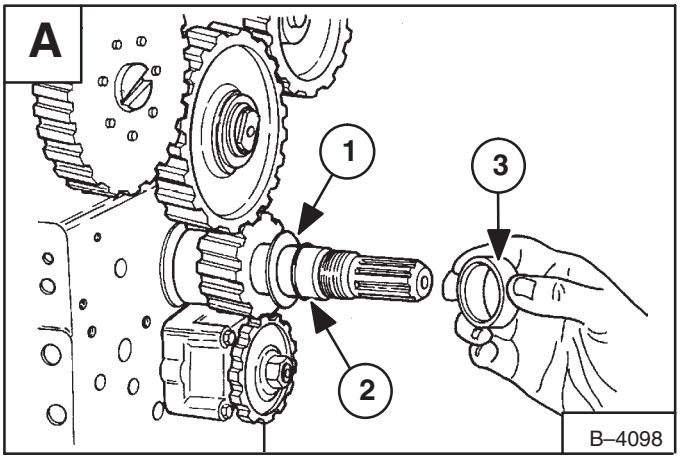
Install the snap ring on the idler gear shaft.



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ENGINE ASSEMBLY (Cont'd)

Install the oil slinger (Item 1) **[A]**. Put oil on the O–ring and install the O–ring (Item 2) **[A]** and the collar (Item 3) **[A]**.



Installing the Gearcase

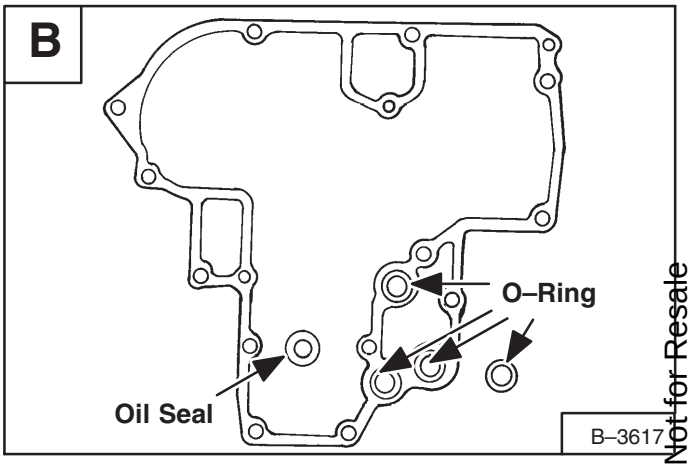
Install the O–ring and the oil seal in the gearcase cover **[B]**.

NOTE: Put oil on the oil seal.

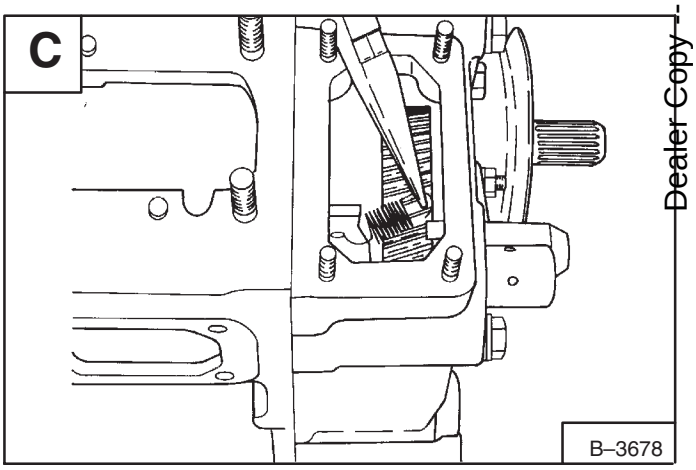
Install the gearcase cover and bolts.

Tighten the bolts to 13–15 ft.–lbs. (17,7–20,6 Nm) torque.

Install the crankshaft sheave and tighten the nut to 101–116 ft.–lbs. (137–157 Nm) torque.

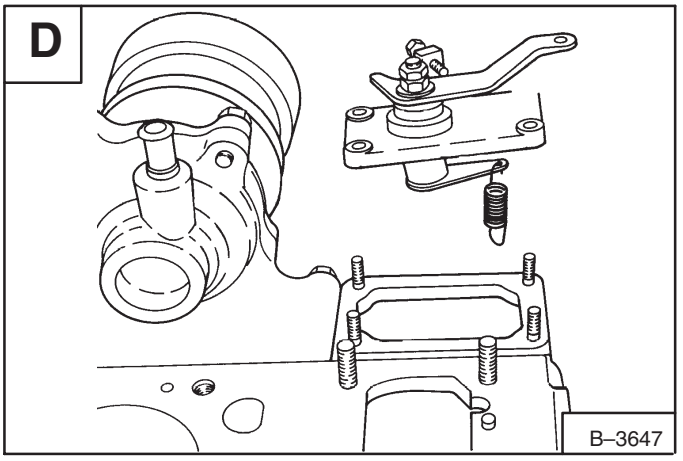


Install the start spring **[C]**.



Install the speed control plate and governor spring **[D]**.

NOTE: Do not drop the governor spring into the gearcase.



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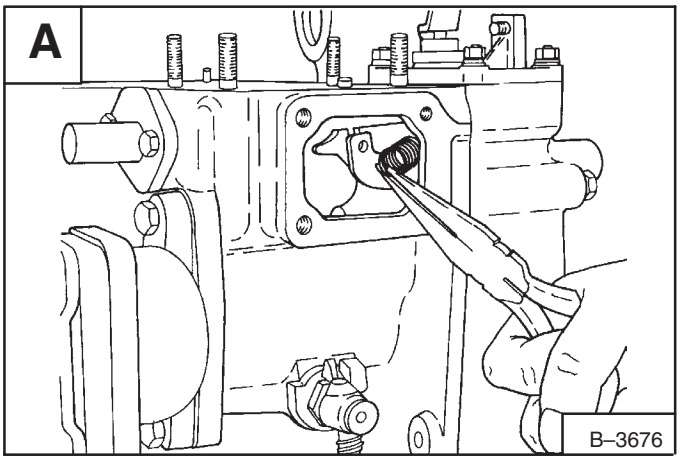
ENGINE ASSEMBLY (Cont'd)

Connect the governor spring **[A]**.

Install the injector pump. (See Page 7–9.)

Install the cylinder head. (See Page 7–23.)

Install the engine. (See Page 7–19.)



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TECHNICAL DATA

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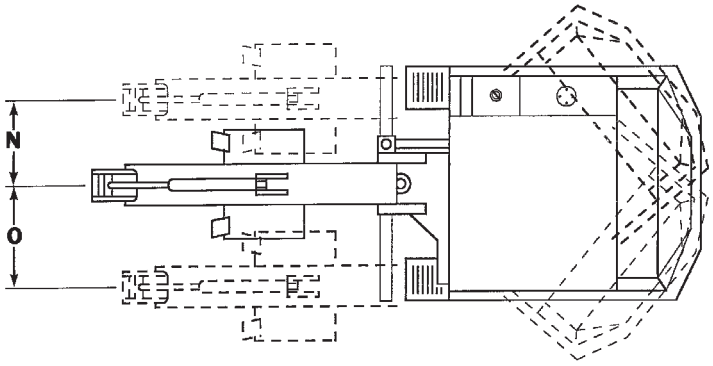


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EXCAVATOR SPECIFICATIONS

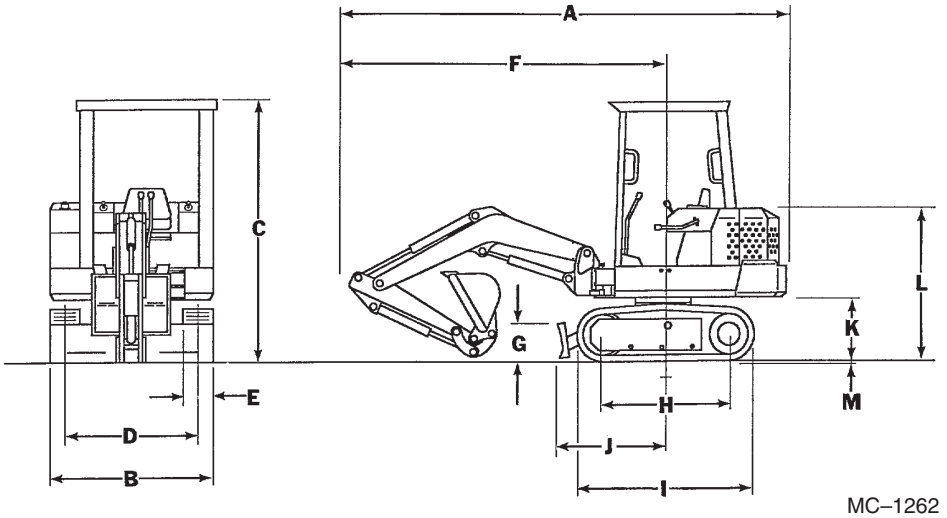
Machine Dimensions

- All dimensions are shown in inches. Respective metric dimensions are given in millimeters enclosed by parentheses.
- Where applicable, specifications conform to SAE standards. Specifications are subject to change without notice.



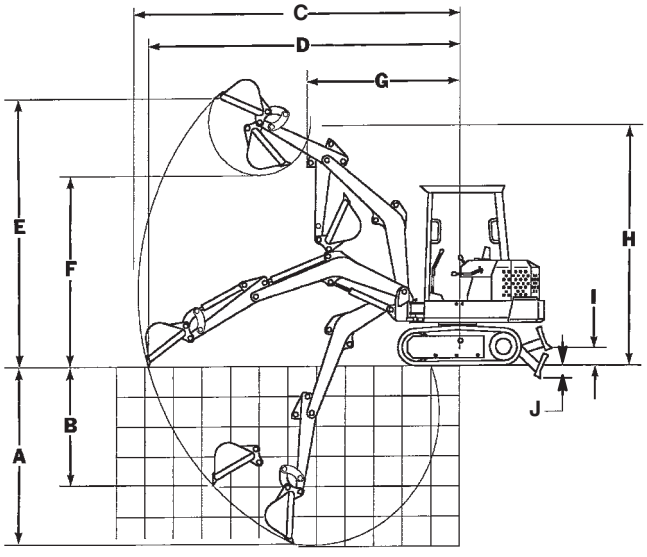
MC–1261

A – 190.9 (4850)
B – 59.8 (1520)
C – 94 (2390)
D – 47.2 (1200)
E – 12.5 (320)
F – 135.8 (3450)
G – 14.2 (360)
H – 60.8 (1545)
I – 77.7 (1975)
J – 61 (1550)
K – 22.8 (580)
L – 53.9 (1370)
M – 3.35 (85)
N – 18.1 (460)
O – 23.8 (605)



MC–1262

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MC–1263

		With 32.2 (820) Dipperstick
A	Max. digging depth	121.2 (3080)
B	Max.vertical wall depth	84.0 (2135)
C	Max. digging reach	194.6 (4945)
D	Max. digging reach at ground level	190.5 (4840)
E	Max. digging height	196.2 (4298)
F	Max. dumping height	115.1 (2925)
G	Min. swing radius (when using boom swing)	88.3 (2245)
H	Max. height of Min. swing radius	134.5 (3416)
I	Max. lift above ground (blade)	14.9 (380)
J	Max. drop below ground blade	10.2 (260)

HYDRAULIC EXCAVATOR SPECIFICATIONS (Cont'd)

All dimensions are given in inches. Respective metric dimensions are given in millimeters enclosed by parenthesis.

PERFORMANCE & OPERATION

Operating Weight	7275 lbs. (3300 kg)
Travel Speed	1.64 MPH (2,63 km/hr.)
Controls:	
Vehicle	Two Hand Levers
Functions	Two joystick levers control boom, crowd bucket, dipperstick and swing. One foot pedal controls boom swing. One foot pedal controls auxiliary hydraulics .Blade controlled by separate lever. Two separate levers control boom swing and blade.

Engine

Make	Kubota
Model	V–1902–B
Fuel	Diesel
Horsepower	34 HP (25.4 kW) @ 2500 RPM
Displacement	116 cu. in. (1902 cu. cm.)
Maximum Torque	82.5 ft.–lbs. (111.8 Nm) @ 1800 RPM
Governed RPM – Full Load	2500 RPM
No Load	2600 RPM
Low Idle Speed	1000 RPM
Number of Cylinders	Four
Bore/Stroke	3.35/3.23 (85/82)
Cooling System	Liquid
Lubrication System	Pressure System with Filter
Filter	Cartridge Type – Full Flow
Starter	12 Volt, (1.4 kW)
Alternator	12 Volt, 25 Amp.
Battery	12 Volt, 425 Cold Crank Amps.

Hydraulic System

Pump Numbers	Three
Type	Triple Section Gear Pumps
Capacity (Implement)	(2) 9.4 GPM (35,75 L/min.)
Servo Pump	(1) 4.6 GPM (17.5 L/min.)
System Relief Setting	2489.PSI (17159 kPa)
Control Valve	9 Spool
Drive Motor	Two Axial Piston
Swing Motor	Axial Piston

Swing System

Swing Drive	Axial Piston Motor Planetary Drive
Swing Circle	Single Row Shear Type Ball Bearings with Internal Gears
Swing Speed	10.8 RPM
Boom Swing (Left)	50 degrees
Boom Swing (Right)	85 degrees

Hydraulic Cylinders

	Bore Dia.	Rod Dia.	Stroke
Boom	3.15 (80)	1.77 (45)	11.6 (295)
Dipperstick	2.95 (75)	1.77 (45)	11.6 (295)
Bucket	2.95 (75)	1.77 (45)	11.6 (295)
Boom Swing	2.95 (75)	1.57 (40)	19.7 (500)
Blade	3.54 (90)	1.77 (45)	4.92 (125)

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ENGINE SPECIFICATIONS (Cont'd)

All dimensions are given in inches. Respective metric dimensions are given in millimeters enclosed by parentheses.

DRIVE SYSTEM

Final Drive	Each track is driven by an Axial Piston Motor
Type of Reduction	Planetary Gear Reduction
Maximum Drawbar Pull	5290 lbs. (2400 kg)
Gradeability	30 degrees

BRAKES

Travel	Hydraulic Lock on Motor
Swing	Hydraulic Lock on Motor & Hold Pin Lock

UNDERCARRIAGE

Type	Crawler–Tractor Design Undercarriage. Sealed Track With Reinforced Box–Section Grease Type Track Adjusters W/Shock Absorbing Recoil System

TRACK SHOES

Type	Steel
Width	12.6 (320)
Number of Shoes	41
Number of Track Rollers	8
Ground Pressure	4.2 PSI (4,26 kPa)

CAPACITIES

Fuel Tank	10.17 Gals. (38,5 L)
Cooling System	10 Qts. (9,4 L)
Engine Oil and FIlter	9.0 Qts. (8,5 L)
Hydraulic Reservoir	18.25 Gals. (69 L)
Final Drive Case (Each)	0.63 Qts. (0,6 L)

MISCELLANEOUS

Dipperstick Digging Force	3527 lbs. (1600 kg)
Bucket Digging Force	4189 lbs. (1900 kg)
Maximum Loading Height	115 (2925)

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ENGINE SPECIFICATIONS

All dimensions are given in inches. Respective metric dimensions are given in millimeters enclosed by parentheses.

Fuel Injection Nozzles

Opening Pressure . . . . . 1990–2130 PSI (1372,1–1468,63 kPa)
Fuel Tightness Nozzle Seat . . . . . Dry Nozzle at 1848–1990 PSI (12741,9–1372,1 kPa)

Fuel Injection Pump

Fuel Tightness of Plunger . . . . . 8 sec: initial pressure 2133 PSI (147071 kPa)
Limit Permitted . . . . . 4 seconds or less
Fuel Tightness of Delivery Valve . . . . . 10 sec.: initial pressure from 1422–71 PSI (9804,7–489,5 kPa)
Limit Permitted . . . . . 5 Seconds or less
Injection Timing . . . . . 25–26 degrees before T.D.C.

Cylinder Head

Cylinder Head Surface Distortion . . . . . 0.0002 in. (0,05mm)
Thickness of Gasket . . . . . 0.0512–0.0630 in. (1,300–1,600mm)
Thickness of Gasket Shims . . . . . 0.0078 in. (0,20mm)
Top Clearance (Piston to Head) . . . . . 0.0276–0.0354 in. (0,7–0,9)
Head Bolt Torque . . . . . 65–68 ft.–lbs. (88–92 Nm)
Maximum Milling Allowed . . . . . 0.004 in. (0,1mm)

Valves

Valve Seat Width . . . . . 0.0827 in. (2,1mm)
Valve Seat Angle . . . . . 45 degrees
O.D. of Valve Stems
(Intake and Exhaust) . . . . . 0.3134–0.3140 in. (7,960–7,975mm)
I.D. of Valve Guides
(Intake and Exhaust) . . . . . 0.3156–0.3161 in. (8,015–8,030mm)
Clearance Between Valve Stem & Guide . . . . . 0.0016 to 0.0028 in. (0,04–0,07mm)
Limit Permitted 0.0039 (0,1mm)
Depth of Valve . . . . . 0.0433–0.0512 in. (1,1–1,3mm)
Valve Clearance (Old)
(Intake and Exhaust) . . . . . 0.0071–0.0087 in. (0,18–0,22mm)

Valve Springs

Free Length 1.6417–1.6614 (41,7–42,2)
Fitted Length 1.378 (35,0)
Load to Compress to Fitted Length . . . . . 26.5 lbs. (12,03 kg)
Limit Permitted . . . . . 22.5 lbs. (10,22 kg))

Rocker Arms

O.D. of Rocker Arm Shaft . . . . . 0.5501–0.5506 in. (13,973–13,984mm)
I.D. of Rocker Arm Bushings . . . . . 0.5513–0.5529 in. (14,002–14,043mm)
Clearance Between Rocker Arm & Bushing . . . . . 0.0004–0.0028 in. (0,01–0,07mm)
Limit Permitted 0.0059 (0,15mm)

Camshaft

O.D of Camshaft Bearing Journal . . . . . 1.5722–1.5728 in. (39,934–39,950 mm)
I.D. of Camshaft Bearing . . . . . 1.5748–1.5758 in. (40–40,025 mm)
Clearance Between Camshaft Journal and Bearing . . . . . 0.002–0.0036 in.(0,50–0,091 mm)
Limit Permitted . . . . . 0.0059 in. (0,15 mm)
Alignment of Camshaft . . . . . 0.0008 in. (0,02 mm)
Cam Lobe Height (Intake and Exhaust) . . . . . 1.3134 in.(33,36 mm)
Limit Permitted . . . . . 1.3114 in. (33,31 mm)
Gear Clearance (Backlash) . . . . . 0.0016–0.0045 in. (0,0415–0,1154 mm)
Limit Permitted . . . . . 0.0118 in. (0,3 mm)

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All dimensions are given in inches. Respective metric dimensions are given in millimeters enclosed by parentheses.

Cylinder

I.D. of Cylinder Liner	3.3465–3.3473 in. (85–85,022 mm)
Limit Permitted	+0.0059 in. (+0,150 mm)
Oversize	3.366–3.3670 in. (85,5–85,5522 mm)

Piston Rings

Ring Gap (Top and 2nd Ring)	0.0118–0.0177 in. (0,30–0,45 mm)
Limit Permitted	0.0492 in. (1,25 mm)
Ring Gap (Oil Ring	0.0098–0.0177 in. (0,25–0,45 m)
Limiter Permitted	0.0492 in. (1,25 mm)
Side Clearance of Ring Groove	
Top Ring	0 Clearance
Second Ring	0.0037–0.0047 in. (0,093–0,120 mm)
Oil Ring	0.0008–0.0020 in. (0,020–0,052 mm)

Pistons

O.D. of Piston (Standard)	3.342 (84,88 mm)
O.D. of Piston (Oversized)	3.362 (85,39 mm)
I.D. of Piston Bosses	0.9055–0.9060 in. (23–23,013)
Limit Permitted	0.9076 in. (23,053 mm)
O.D. of Piston Pin	0.9056–0.9059 in. (23,002–23,011 mm)
I.D. of Connect Rod Bushing (Small End, Fitted)	0.9065–0.9071 in. (23,025–23,030 mm)
Clearance Between Piston Pin And Bushing (New)	0.0006–0.0015 in. (0,014–0,028 mm)
(Service Replacement Part)	0.0006–0.0026 in. (0,015–0,066 mm)
Limit Permitted	0.0059 in. (0,15 mm)
Connecting Rod Alignment	0.0008 in. (0,02 mm)
Limit Permitted	0.002 in. (0,05 mm)

Crankshaft

I.D. of Crankshaft Main Bearing (No. 1)	2.0465–2.0488 in. (51,98–52,039 mm)
I.D. of Crankshaft Main Bearing	2.0465–2.0482 in. (51,98–52,025 mm)
Clearance Between Crankshaft And Journal and Bearing	0.0016–0.0046 in. (0,04–0,118 mm)
Limit Permitted	0.0079 in. (0,2 mm)
O.D. of Connecting Rod Journals	1.7307–1.7313 in. (43,959–43,975 mm)
I.D. of Connecting Rod Bearings (Std.)	1.7327–1.7343 in. (44,010–44,052 mm)
I.D. of Connecting Rod	1.7228–1.7234 (43,759–43,775 mm)
(Undersizes)	1.7149–1.7156 (43,559–43,575 mm)
Clearance Between Connecting Rod Journal and Bearing	0.0014–0.0037 in. (0,035–0,93 mm)
Limit Permitted	0.0079 in. (0,2 mm)
End Play of Crankshaft	0.0059–0.0122 in. (0,15–0,21 mm)

Oil Pump

Oil Pressure @ rated RPM	42–64 PSI (289,6–441,3 kPa)
Limit Permitted	36 PSI (248,2 kPa)
Rotor Lobe Clearance	0.0016–0.0051 in. (0,04–0,013 mm)
Limit Permitted	0.0079 in. (0,20 mm)
Clearance Between Outer Rotor And Pump Body	0.0043–0.0075 in. (0,11–0,19 mm)
Limit Permitted	0.0098 in. (0,25 mm)

Engine Oil Specifications

Check oil level every 8 hours of operation (Check oil every 4 hours on new engine during the first 50 hours of operation).

Oil level must be between the *add* and *full* marks on the dipstick. Use a good quality detergent motor oil that meets the correct API service classification. (See Chart on Page 8–1.)

Use oil of the correct SAE viscosity for expected temperature conditions.

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All dimensions are given in inches. Respective metric dimensions are given in millimeters enclosed by parentheses

ENGINE BOLT TORQUE

	Ft.–Lbs.	Nm
*Cylinder Head Bolts & Nuts	65–68	73–78
*Main Bearing Bolts	21–25	29–34
*Main Bearing Case Bolts	47–50	63–68
*Flywheel bolts	72–79	91–108
*Connecting Rod Bolts (12 mm)	33–36	45–50
(13 mm)	26–30	36–41
*Rocker Arm Bracket Studs	12–15	17–21
*Idler Gear Shaft Bolts	7–8	9–11
Glow Plugs	15–18	20–25
Drain Plug	30–36	39–49
Nozzle Holder	21–36	29–49
Oil Switch	11–15	15–20
Fuel Injection Tubeline Fittings	11–19	13–26
Crankshaft Nut	101–116	137–157
Injection Pump Vent Screw	10–13	14–18

*Lightly Oiled Threads

PUNCHED NUMBER	BOLT MATERIAL GRADE	
None	Standard Bolts	SS41, S20C
7	Special Bolts	S43C, 248C (Refined)
9	Special Bolts	SCM3, SCR3 (Refined)

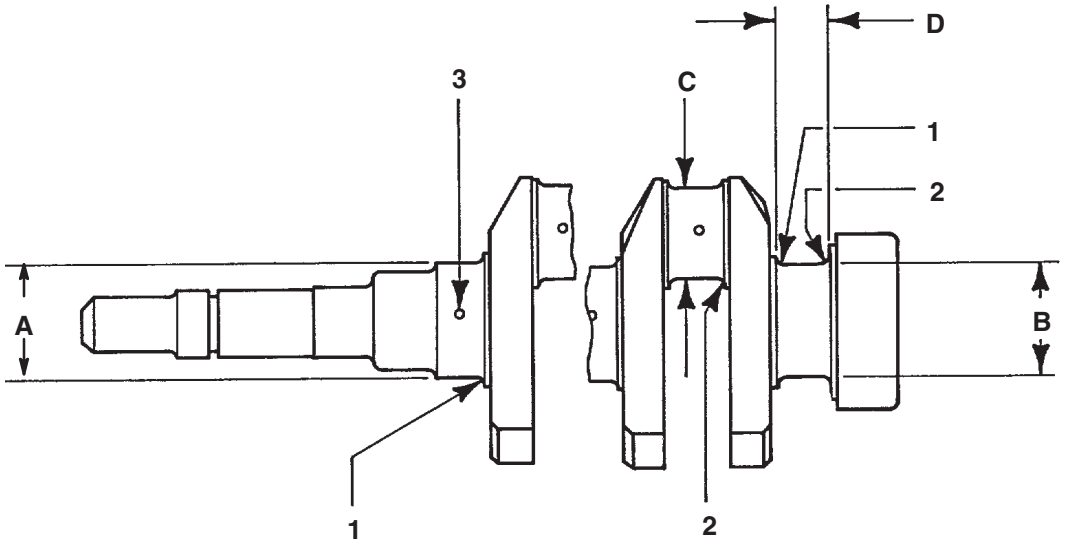
BOLT TORQUES			
MATERIAL GRADE	**STANDARD BOLT**	**SPECIAL BOLT**	**SPECIAL BOLT**
NOMINAL DIAMETER	**SS42, S20C**	**S43C, S48C (Refined)**	**SCR3, SCM3 (Refined)**
M 6	6 to 7 ft. lbs. (8 to 9 Nm)	7 to 8 ft. – lbs. (9 to 11 Nm)	9 to 11 ft.–lbs. (12 to 15 Nm)
M 8	13 to 15 ft.–lbs. (18 to 20 Nm)	17 to 20 ft.–lbs. (23 to 27 Nm)	22 to 25 ft.–lbs. (30 to 34 Nm)
M 10	29 to 33 ft.–lbs. (39 to 45 Nm)	35 to 41 ft.–lbs. (47 to 56 Nm)	45 to 52 ft.–lbs. (61 to 71 Nm)
M 12	46 to 54 ft.–lbs. (62 to 73 Nm)	57 to 67 ft.–lbs. (77 to 91 Nm)	76 to 87 ft.–lbs. (103 to 118 Nm)
M 14	80 to 93 ft.–lbs. (108 to 126 Nm)	91 to 109 ft.–lbs. (123 to 148 Nm)	123 to 145 ft.–lbs. (167 to 197 Nm)
M 16	123 to 141 ft.–lbs. (167 to 191 Nm)	145 to 166 ft.–lbs. (197 to 225 Nm)	192 to 224 ft.–lbs. (260 to 304 Nm)
M 18	181 to 210 ft.–lbs. (245 to 285 Nm)	203 to 235 ft.–lbs. (275 to 319 Nm)	253 to 297 ft.–lbs. (343 to 403 Nm)
M 20	246 to289 ft.–lbs. (334 to 392 Nm)	271 to 318 ft.–lbs. (367 to 431 Nm)	362 to 420 ft.–lbs. (491 to 578 Nm)

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All dimensions are given in inches. Respective metric dimensions are given in millimeters enclosed by parentheses

Re–Grinding The Crankshaft

If the standard size bearing cannot be used due to excessive wear of the crank pin and crankshaft journals, use undersize or oversize bearings.



REF.	SIZE	CODE NO.	DESCRIPTION	DIMENSION	MARK
A	0.008 in. (0,2 mm) U/S	15221–2391–1	Crankshaft Bearing #1	2.0363–2.0370 in. (51,721–51,740 mm)	020US
	0.016 in. (0,4 mm) U/S	15221–2392–1	Crankshaft Bearing #1	2.0284–2.0291 in. (51,521–51,540 mm)	040US
B	0.008 in. (0,2 mm) U/S	15221–2393–1	Crankshaft Bearing #2	2.0363–2.0370 in. (51,721–51,740 mm)	020US
	0.016 in. (0,4 mm) U/S	15221–2394–1	Crankshaft Bearing #2	2.0284–2.0291 in. (51,521–51,540 mm)	040US
C	0.008 in. (0,2 mm) U/S	15471–2297–1	Crankpin Bearing	1.7228–1.7234 in. (43,759–43,775 mm)	020US
	0.016 in. (0,4 mm) U/S	15471–2298–1	Crankpin Bearing	1.7149–1.7156 in. (43,559–43,575 mm)	040US
D	0.008 in. (0,2 mm) O/S	15221–2397–1 15221–2395–1	Crankshaft Thrust Bearing	0.0315–0.0335 in. (26,20–26,25 mm)	0.20 OS
	0.016 in. (0,4 mm) O/S	15221–2398–1 15221–2396–1	Crankshaft Thrust Bearing	1.0394–1.0413 in. (26,40–26,45 mm)	0.40 OS
1	Radius – 0.0079–0.1181 in. (0,2–3,0 mm)				
2	Radius – 0.0076–0.1378 in. (0,2–3,5 mm)				
3	**IMPORTANT: Oil holes must have a 0.0394–0.0591 in. (1–1,5 mm) chamfer. Use on oil stone to chamfer the oil hole.**				

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FUEL, COOLANT AND LUBRICANTS

Use this chart for correct selection of Fuel, Coolant and Lubricants.

RESERVOIR	KIND OF FLUID	AMBIENT TEMPERATURE	CAPACITY Refill
		F° –30 –20 –10 0 +10 +20 +30 +40 +50 +60 +70 +80 +90 +100 C° –34 –29 –23 –18 –13 –7 –1 +4 +10 +15 +21 +27 +32 +38	
Engine oil pan	Use SAE Viscosity Number as Listed With API Classification CC, CD or CE	SAE 10W–30 SAE 15W–40 SAE 5W–30 SAE 30 SAE 20W/20 SAE 10W	9.0 qts. (8,5 L)
Fuel Tank	Diesel Fuel	No. 1 No. 2	10.2 gals (38,5 L)
Cooling System	50/50 Water & Anti–Freeze	50/50 Water & Anti–Freeze	10 qts. (9,4 L)
Hydraulic Tank	6563328*		18.25 gals. (69 L)
Swing Motor Gear Reduction	90W Gear		0.63 qts. (0,6 L)
Final Drive Case (each)			0.55 qts. (0,5 L)

* If Bobcat fluid (P/N 6563328) is not available. Use Engine Oil SAE 10W–30/10W–40, Class SE

OIL SPECIFICATIONS

Description

When fuel sulphur content is less than 0.5% change the engine oil and filter as shown in the Service Schedule. (See Page 1–1.)

Change engine oil and filter according to the following chart if fuel sulphur content is above 0.5%.

Fuel Sulphur Content	Change Interval Of Engine Oil & Filter
0.5 to 1.0%	1/2 of Regular Interval
Above 1.0%	1/4 of Regular Interval

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231–1
Revision Number

15 July 1991
Date

SERVICE MANUAL REVISION

ROUTE TO ATTENTION

PARTS MANAGER	☐
SERVICE MANAGER	☒
SALES MANAGER	☐

AFFECTING:

Product EXCAVATOR

Model 231 (11000 – 11999)

Manual No. 6720496 (4–90)

NOTICE **Insert This Sheet With The Appropriate Manual For Future Reference.**

The attached pages are a revision to the 231 Excavator Service Manual P/N 6720496 (4–90).

Please take out and put in the pages shown below:

TAKE OUT	PUT IN
Hydraulic Flow Chart #6720425 (Printed July 1990) Chart Legend	Hydraulic Flow Chart #6720425 (Printed July 1991) Chart Legend (Revised July 1991)
Hydraulic Flow Chart #6720426 (Printed July 1990) Chart Legend	Hydraulic Flow Chart #6720426 (Printed July 1991) Chart Legend (Revised July 1991)
2–3, 2–4 2–23	2–3 (Revised July 91), 2–4 2–23 (Revised July 91)
SECTION 5	5–1 thru 5–16 (Revised July 91) 5–17 (Added July 91), 5–18 (Added July 91)
7–23, 7–24 7–29, 7–30 7–31, 7–32	7–23, 7–24 (Revised July 91) 7–29 (Revised July 91), 7–30 (Revised July 91) 7–31 (Revised July 91), 7–32 (Revised July 91)

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Revision Number

15 November 1991
Date

SERVICE MANUAL REVISION

ROUTE TO ATTENTION

PARTS MANAGER	☐
SERVICE MANAGER	☒
SALES MANAGER	☐

AFFECTING:

Product EXCAVATOR

Model 231 (11000 – 11999)

Manual No. 6720496 (4–90)

NOTICE **Insert This Sheet With The Appropriate Manual For Future Reference.**

The attached pages are a revision to the 231 Excavator Service Manual P/N 6720496 (4–90).

Please take out and put in the pages shown below:

TAKE OUT	PUT IN
Upper Works and Swing Section Tab Page	Upper Works and Swing Section Tab Page (Rev. Nov. 91)
4–1, 4–2	4–1 (Revised Nov. 91), 4–2 (Revised Nov. 91)
4–3, 4–4	4–3 (Revised Nov. 91), 4–2 (Revised Nov. 91)
	4–5 (Added Nov. 91), 4–6 (Added Nov. 91)
	4–7, (Added Nov. 91), 4–8 (Added Nov. 91)
	4–9 (Added Nov. 91)

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231–3
Revision Number

5 August 1992
Date

SERVICE MANUAL REVISION

ROUTE TO ATTENTION

PARTS MANAGER	☐
SERVICE MANAGER	☒
SALES MANAGER	☐

AFFECTING:

Product EXCAVATOR

Model 231 (11000 – 11999)

Manual No. 6720496 (4–90)

NOTICE **Insert This Sheet With The Appropriate Manual For Future Reference.**

The attached pages are a revision to the 231 Excavator Service Manual P/N 6720496 (4–90).

Please take out and put in the pages shown below:

TAKE OUT	PUT IN
SECTION 2, Content Page	SECTION 2 Contents Page (Revised Aug. 92) 2–6a thru 2–6r (Added Aug, 92)
3–1, 3–2	3–1, 3–2 (Revised Aug. 92) 3–2a thru 3–2d (Added Aug. 92)
3–13	3–13, 3–14 (Added Aug. 92) 3–15 thru 3–27 (Added Aug. 92)

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Revision Number
26 May 1993
Date

SERVICE MANUAL REVISION

ROUTE TO ATTENTION	
PARTS MANAGER	☐
SERVICE MANAGER	☒
SALES MANAGER	☐

AFFECTING:

Product EXCAVATOR

Model 231 (11000 – 11999)

Manual No. 6720496 (4–90)

NOTICE **Insert This Sheet With The Appropriate Manual For Future Reference.**

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Please take out and put in the pages shown below:

TAKE OUT	PUT IN
FOREWORD	FOREWORD (Revised May 93)
1–1, 1–2 1–5, 1–6	1–1, 1–2 (Revised May 93) 1–5, 1–6 (Revised May 93)
5–15 thru 5–18 (Added July 91)	5–15, 5–19 (Revised May 93)
8–1, 8–2 8–3, 8–4 8–7, 8–8	8–1, 8–2 (Revised May 93) 8–3 Revised May 93), 8–4 8–7, 8–8 (Revised May 93)

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231–5
Revision Number

10 September 1993
Date

SERVICE MANUAL REVISION

ROUTE TO ATTENTION

PARTS MANAGER	☐
SERVICE MANAGER	☒
SALES MANAGER	☐

AFFECTING:

Product EXCAVATOR

Model 231 (11000 – 11999)

Manual No. 6720496 (4–90)

NOTICE **Insert This Sheet With The Appropriate Manual For Future Reference.**

The attached pages are a revision to the 231 Excavator Service Manual P/N 6720496 (4–90).

Please take out and put in the pages shown below:

TAKE OUT	PUT IN
6–7 thru 6–13	6–7 thru 6–13 (Revised Sept. 93) 6–14 thru 6–27 (Added Sept. 93)

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231–6
Revision Number

11 February 1995
Date

SERVICE MANUAL REVISION

ROUTE TO ATTENTION

PARTS MANAGER	☐
SERVICE MANAGER	☒
SALES MANAGER	☐

AFFECTING:

Product EXCAVATOR

Model 231 (11000 – 11999)

Manual No. 6720496 (4–90)

NOTICE **Insert This Sheet With The Appropriate Manual For Future Reference.**

The attached pages are a revision to the 231 Excavator Service Manual P/N 6720496 (4–90).

Please take out and put in the pages shown below:

TAKE OUT	PUT IN
Content Page 5–17	Content Page (Revised Feb. 95) 5–17 thru 5–17g (Added Feb. 95) 5–18a thru 5–18g (Added Feb. 95)

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231–7
Revision Number
7 March 1995
Date

SERVICE MANUAL REVISION

ROUTE TO ATTENTION	
PARTS MANAGER	☐
SERVICE MANAGER	☒
SALES MANAGER	☐

AFFECTING:

Product EXCAVATOR

Model 231 (11000 – 11999)

Manual No. 6720496 (4–90)

NOTICE **Insert This Sheet With The Appropriate Manual For Future Reference.**

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231–8
Revision Number

15 August 1996
Date

SERVICE MANUAL REVISION

ROUTE TO ATTENTION

PARTS MANAGER	☐
SERVICE MANAGER	☒
SALES MANAGER	☐

AFFECTING:

Product EXCAVATOR

Model 231 (11000 – 11999)

Manual No. 6720496 (4–90)

NOTICE **Insert This Sheet With The Appropriate Manual For Future Reference.**

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SECTION 4	SECTION 4 (Revised August 96)

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231–9
Revision Number

4 September 1997
Date

SERVICE MANUAL REVISION

ROUTE TO ATTENTION

PARTS MANAGER	☐
SERVICE MANAGER	☒
SALES MANAGER	☐

AFFECTING:

Product EXCAVATOR

Model 231 (S/N 508911999 & Below)

Manual No. 6720496 (4–90)

NOTICE **Insert This Sheet With The Appropriate Manual For Future Reference.**

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Please take out and put in the pages shown below:

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231 Excavator Cover	231 Excavator Cover
SECTION 2	SECTION 2 (Revised Sept. 97)
SECTION 5	SECTION 5 (Revised Sept. 97)
SECTION 6	SECTION 6 (Revised Sept. 97)
SECTION 8	SECTION 8 (Revised Sept. 97)

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SERVICE MANUAL REVISION

ROUTE TO ATTENTION	
PARTS MANAGER	
SERVICE MANAGER	X
SALES MANAGER	

NOTICE **Insert This Sheet With The Below Listed Manual For Future Reference.**

Revision No: **231-10**
Date: **15 June 2012**
Product: **Bobcat Excavator**
Model: **231**
Manual No: **6720496 (4-90)**

The following Sections are a revision to the above Service Manual.

COVER	

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